SHOP MANUAL

KOMATSU

D85EX-15
D85PX-15

MACHINE MODEL	SERIAL NUMBER
D85EX-15	**10001 and up**
D85PX-15	**1001 and up**

- This shop manual may contain attachiments and optional equipment that are not available in your area. Please consult your local Komatsu distributor for those items you may require.
  Materials and specifications are subject to change without notice.
- D85EX, PX-15 mount the SA6D125E-3 engine.
  For details of the engine, see the 125-3 Series Engine Shop Manual.

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	90-3	
	90-5	(3)
	90-5-2	(3)
	90-7	(3)
	90-9	
	90-11	
	90-13	
	90-15	
	90-17	
	90-19	
	90-21	

SAFETY
SAFETY NOTICE

IMPORTANT SAFETY NOTICE

Proper service and repair is 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.

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 precautions given on the decals which are fixed to the machine.
2. 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.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, hand shield, cap and other clothes suited for welding work.
4. When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.
5. Keep all tools in good condition and learn the correct way to use them.
6. 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 or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

PREPARATIONS FOR WORK

7. Before adding oil or making any repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.
8. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground. If this is not possible, insert the safety 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.
9. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
10. 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.

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out.
    Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.
12. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned.
    Wait for the oil and water to cool before carrying out any work on the oil or water circuits.
13. Before starting work, remove the leads from the battery. Always remove the lead from the negative (–) terminal first.
14. When raising heavy components, use a hoist or crane.
    Check that the wire rope, chains and hooks are free from damage.
    Always use lifting equipment which has ample capacity.
    Install the lifting equipment at the correct places.
    Use a hoist or crane and operate slowly to prevent the component from hitting any other part.
    Do not work with any part still raised by the hoist or crane.
15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.
16. When removing components, be careful not to break or damage the wiring. Damaged wiring may cause electrical fires.
17. 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, or can even start fires.
18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.
19. Be sure to assemble all parts again in their original places.
    Replace any damaged parts 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 being operated.
20. 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. Also, check that connecting parts are correctly installed.
21. When assembling or installing parts, always use the specified tightening 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.
22. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.
23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.
24. 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.

FOREWORD
GENERAL

This shop manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgements. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This shop manual mainly contains the necessary technical information for operations performed in a service workshop. For ease of understanding, the manual is divided into the following chapters; these chapters are further divided into the each main group of components.

STRUCTURE AND FUNCTION

This 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.
In addition, this section may contain hydraulic circuit diagrams, electric circuit diagrams, and maintenance standards.

TESTING AND ADJUSTING

This section explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.
Troubleshooting charts correlating "Problems" with "Causes" are also included in this section.

DISASSEMBLY AND ASSEMBLY

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

MAINTENANCE STANDARD

This section gives the judgment standards for inspection of disassembled parts.
The contents of this section may be described in STRUCTURE AND FUNCTION.

OTHERS

This section mainly gives hydraulic circuit diagrams and electric circuit diagrams.
In addition, this section may give the specifications of attachments and options together.

NOTICE

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Use the specifications given in the book with the latest date.

HOW TO READ THE SHOP MANUAL

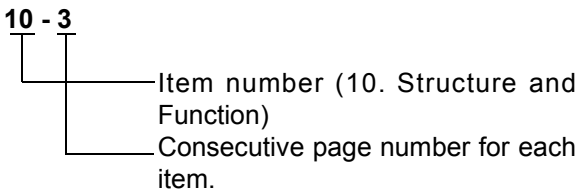
VOLUMES
Shop manuals are issued as a guide to carrying out repairs. They are divided as follows:

Chassis volume: Issued for every machine model
Engine volume: Issued for each engine series
Electrical volume:
Attachments volume:
} Each issued as one volume to cover all models

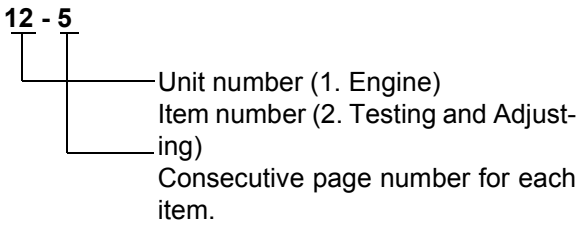
These various volumes are designed to avoid duplicating the same information. Therefore, to deal with all repairs for any model , it is necessary that chassis, engine, electrical and attachment volumes be available.

DISTRIBUTION AND UPDATING
Any additions, amendments or other changes will be sent to KOMATSU distributors. Get the most up-to-date information before you start any work.

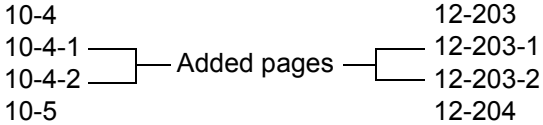
FILING METHOD
1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number.
   Example 1 (Chassis volume):



   Example 2 (Engine volume):



3. Additional pages: Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.
   Example:



REVISED EDITION MARK
When a manual is revised, an edition mark ((1)(2)(3)....) is recorded on the bottom of the pages.

REVISIONS
Revised pages are shown in the LIST OF REVISED PAGES next to the CONTENTS page.

SYMBOLS
So that the shop manual can be of ample practical use, important safety and quality portions are marked with the following symbols.

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

HOISTING INSTRUCTIONS

HOISTING

⚠ Heavy parts (25 kg or more) must be lifted with a hoist, etc. In the **DISASSEMBLY AND ASSEMBLY** section, every part weighing 25 kg or more is indicated clearly with the symbol

- If a part cannot be smoothly removed from the machine by hoisting, the following checks should be made:
  1) Check for removal of all bolts fastening the part to the relative parts.
  2) Check for existence of another part causing interference with the part to be removed.

WIRE ROPES

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

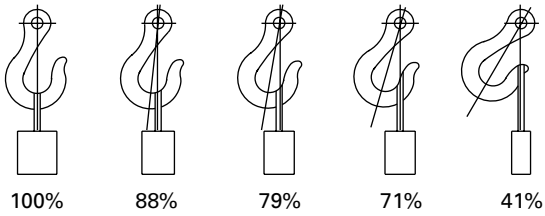
Wire ropes
(Standard "Z" or "S" twist ropes
without galvanizing)

Rope diameter	Allowable load	
mm	kN	tons
10	9.8	1.0
11.5	13.7	1.4
12.5	15.7	1.6
14	21.6	2.2
16	27.5	2.8
18	35.3	3.6
20	43.1	4.4
22.4	54.9	5.6
30	98.1	10.0
40	176.5	18.0
50	274.6	28.0
60	392.2	40.0

★ The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.

2) Sling wire ropes from the middle portion of the hook.

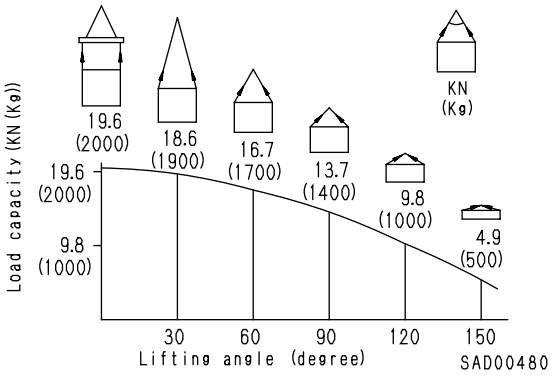
Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result. Hooks have maximum strength at the middle portion.



3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound onto the load.

⚠ 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.

4) Do not sling a heavy load with ropes forming a wide hanging angle from the hook.
When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles. The table below shows the variation of allowable load kN {kg} when hoisting is made with two ropes, each of which is allowed to sling up to 9.8 kN {1000 kg} vertically, at various hanging angles.
When two ropes sling a load vertically, up to 19.6 kN {2000 kg} of total weight can be suspended. This weight becomes 9.8 kN {1000 kg} when two ropes make a 120° hanging angle. On the other hand, two ropes are subjected to an excessive force as large as 39.2 kN {4000 kg} if they sling a 19.6 kN {2000 kg} load at a lifting angle of 150°.



METHOD OF DISASSEMBLING, CONNECTING PUSH-PULL TYPE COUPLER

⚠ Before carrying out the following work, release the residual pressure from the hydraulic tank. For details, see TESTING AND ADJUSTING, Releasing residual pressure from 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.

Disconnection

1) Release the residual pressure from the hydraulic tank. For details, see TESTING AND ADJUSTING, Releasing residual pressure from hydraulic tank.

2) Hold adapter (1) and push hose joint (2) into mating adapter (3). (See Fig. 1)
   - ★ The adapter can be pushed in about 3.5 mm.
   - ★ Do not hold rubber cap portion (4).

3) After hose joint (2) is pushed into adapter (3), press rubber cap portion (4) against (3) until it clicks. (See Fig. 2)

4) Hold hose adapter (1) or hose (5) and pull it out. (See Fig. 3)
   - ★ Since some hydraulic oil flows out, prepare an oil receiving container.

Connection

1) Hold hose adapter (1) or hose (5) and insert it in mating adapter (3), aligning them with each other. (See 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. (See 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.

Type 1

Fig. 1

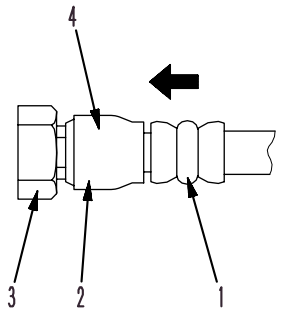


Fig. 2

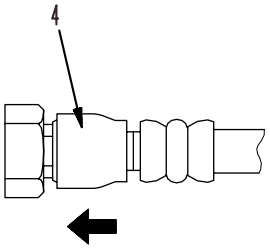


Fig. 3

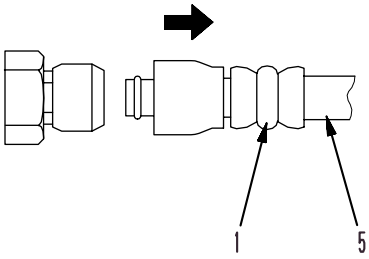


Fig. 4

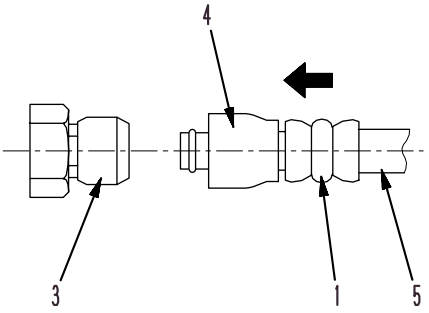
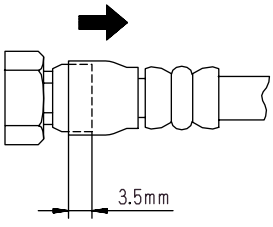
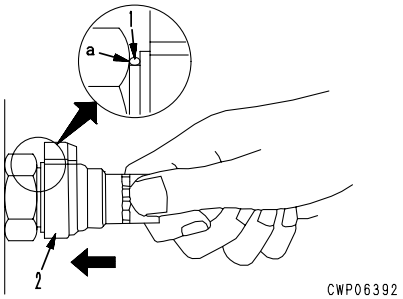
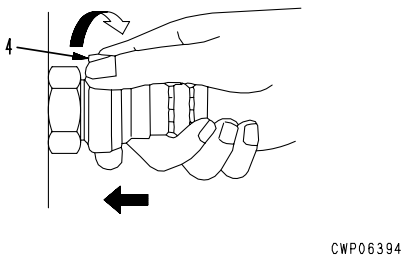


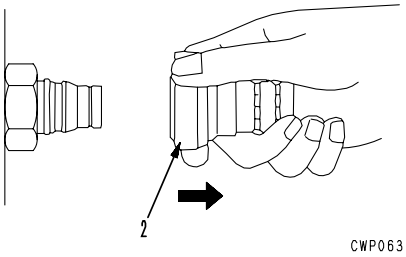
Fig. 5

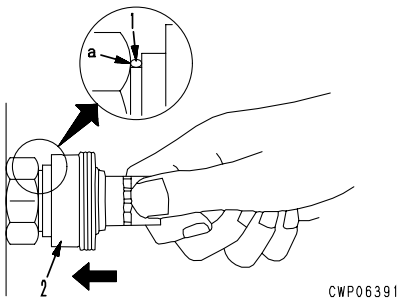


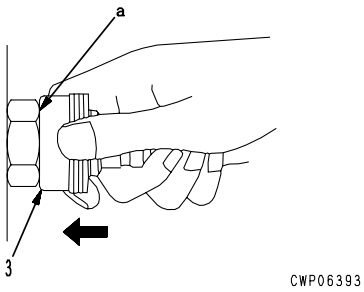
CWP10701

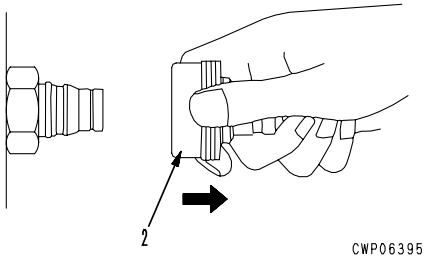
<table>
<tr><th></th><th>Type 2</th><th>Type 3</th></tr>
<tr><td>Disassembly</td><td>
1) Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface a of the hexagonal portion at the male end.


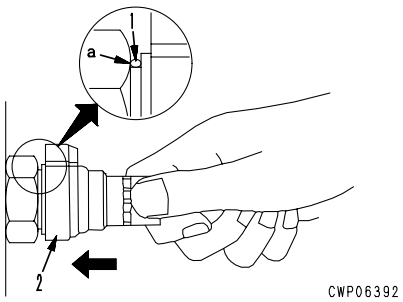
2) Hold in the condition in Step 1), and turn lever (4) to the right (clockwise).


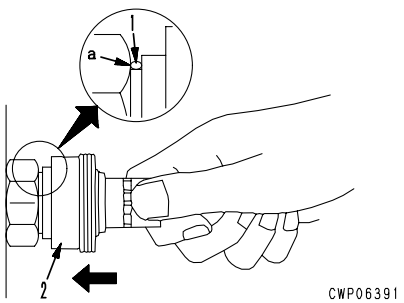
3) Hold in the condition in Steps 1) and 2), and pull out whole body (2) to disconnect it.


</td><td>
1) Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface a of the hexagonal portion at the male end.


2) Hold in the condition in Step 1), and push until cover (3) contacts contact surface a of the hexagonal portion at the male end.


3) Hold in the condition in Steps 1) and 2), and pull out whole body (2) to disconnect it.


</td></tr>
<tr><td>Connection</td><td>
• Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface a of the hexagonal portion at the male end to connect it.


</td><td>
• Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface a of the hexagonal portion at the male end to connect it.


</td></tr>
</table>

COATING MATERIALS

★ 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 list.

Category	Komatsu code	Part No.	Q'ty	Container	Main applications, featuresr
Adhesives	LT-1A	790-129-9030	150 g	Tube	• Used to prevent rubber gaskets, rubber cushions, and cock plug from coming out.
	LT-1B	790-129-9050	20 g (2 pcs.)	Polyethylene container	• Used in places requiring an immediately effective, strong adhesive. Used for plastics (except polyethylene, polyprophylene, tetrafluoroethlene and vinyl chloride), rubber, metal and non-metal.
	LT-2	09940-00030	50 g	Polyethylene container	• Features: Resistance to heat and chemicals • Used for anti-loosening and sealant purpose for bolts and plugs.
	LT-3	790-129-9060 (Set of adhesive and hardening agent)	Adhesive: 1 kg Hardening agent: 500 g	Can	• Used as adhesive or sealant for metal, glass and plastic.
	LT-4	790-129-9040	250 g	Polyethylene container	• Used as sealant for machined holes.
	Holtz MH 705	790-126-9120	75 g	Tube	• Used as heat-resisting sealant for repairing engine.
	Three bond 1735	790-129-9140	50 g	Polyethylene container	• Quick hardening type adhesive • Cure time: within 5 sec. to 3 min. • Used mainly for adhesion of metals, rubbers, plastics and woods.
	Aron-alpha 201	790-129-9130	2 g	Polyethylene container	• Quick hardening type adhesive • Quick cure type (max. strength after 30 minutes) • Used mainly for adhesion of rubbers, plastics and metals.
	Loctite 648-50	79A-129-9110	50 cc	Polyethylene container	• Resistance to heat, chemicals • Used at joint portions subject to high temperatures.
Gasket sealant	LG-1	790-129-9010	200 g	Tube	• Used as adhesive or sealant for gaskets and packing of power train case, etc.
	LG-5	790-129-9080	1 kg	Can	• Used as sealant for various threads, pipe joints, flanges. • Used as sealant for tapered plugs, elbows, nipples of hydraulic piping.
	LG-6	790-129-9020	200 g	Tube	• Features: Silicon based, resistance to heat, cold • Used as sealant for flange surface, tread. • Used as sealant for oil pan, final drive case, etc.
	LG-7	790-129-9070	1 g	Tube	• Features: Silicon based, quick hardening type • Used as sealant for flywheel housing, intake manifold, oil an, thermostat housing, etc.
	Three bond 1211	790-129-9090	100 g	Tube	• Used as heat-resisting sealant for repairing engine.
	Three bond 1207B	419-15-18131	100 g	Tube	• Features: Silicone type, heat resistant, vibration resistant, and impact resistant sealing material • Used as sealing material for transfer case

Category	Komatsu code	Part No.	Q'ty	Container	Main applications, featuresr	
Molybdenum disulphide lubricant	LM-G	09940-00051	60 g	Can	• Used as lubricant for sliding portion (to prevent from squeaking).	
	LM-P	09940-00040	200 g	Tube	• Used to prevent seizure or scuffling of the thread when press fitting or shrink fitting. • Used as lubricant for linkage, 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 normal temperature, light load bearing at places in contact with water or steam.	
	Molybdenum disulphide grease LM-G (G2-M)	SYG2-400M SYG2-400M-A SYGA-16CNM	400 g × 10 400 g × 20 16 kg	Bellows type Bellows type Can	• Used for heavy load portion	
	Hyper White Grease G2-T G0-T (*) *: For use in cold district	SYG2-400T-A SYG2-16CNT SYG0-400T-A (*) SYG0-16CNT (*)	400 g 16 kg	Bellows type Can	• Seizure resistance and heat resistance higher than molybdenum disulfide grease • Since this grease is white, it does not stand out against machine body.	
	Biogrease G2B G2-BT (*) *: For high temperature and large load	SYG2-400B SYGA-16CNB SYG2-400BT (*) SYGA-16CNBT (*)	400 g 16 kg	Bellows type Can	• Since this grease is decomposed by bacteria in short period, it has less effects on microorganisms, 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)
	SUNSTAR GLASS PRIMER 580 SUPER		20 ml	Glass container		• Used as primer for glass side (Using limit: 4 months)
Adhesive	SUNSTAR PENGUINE SEAL 580 SUPER "S" or "W"		320 ml	Polyethylene container		• "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)
	Sika Japan, Sikaflex 256HV	20Y-54-39850	310 ml	Polyethylene container		• Used as adhesive for glass. (Using limit: 6 months)
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)
	SEKISUI SILICONE SEALANT	20Y-54-55130	333 ml	Polyethylene container		• Used to seal front window. (Using limit: 6 months)

STANDARD TIGHTENING TORQUE

STANDARD TIGHTENING TORQUE TABLE (WHEN USING TORQUE WRENCH)

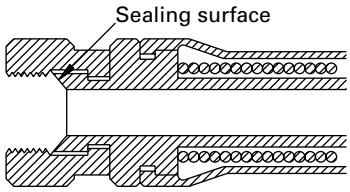
★ In the case of metric nuts and bolts for which there is no special instruction, tighten to the torque given in the table below.

Thread diameter of bolt	Width across flats	Tightening torque	
		 CDL00372	
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	1150 – 1440	118 – 147
30	46	1520 – 1910	155 – 195
33	50	1960 – 2450	200 – 250
36	55	2450 – 3040	250 – 310
39	60	2890 – 3630	295 – 370

Thread diameter of bolt	Width across flats	Tightening torque	
		 CDL00373	
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

TABLE OF TIGHTENING TORQUES FOR FLARED NUTS

★ In the case of flared nuts for which there is no special instruction, tighten to the torque given in the table below.



SAD00483

Thread diameter	Width across flat	Tightening torque	
mm	mm	Nm	kgm
14	19	24.5 ± 4.9	2.5 ± 0.5
18	24	49 ± 19.6	5 ± 2
22	27	78.5 ± 19.6	8 ± 2
24	32	137.3 ± 29.4	14 ± 3
30	36	176.5 ± 29.4	18 ± 3
33	41	196.1 ± 49	20 ± 5
36	46	245.2 ± 49	25 ± 5
42	55	294.2 ± 49	30 ± 5

TABLE OF TIGHTENING TORQUES FOR SPLIT FLANGE BOLTS

★ In the case of split flange bolts for which there is no special instruction, tighten to the torque given in the table below.

Thread diameter	Width across flat	Tightening torque	
mm	mm	Nm	kgm
10 12 16	14 17 22	59 – 74 98 – 123 235 – 285	6 – 7.5 10 – 12.5 23.5 – 29.5

TABLE OF TIGHTENING TORQUES FOR O-RING BOSS PIPING JOINTS

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

Norminal No.	Thread diameter	Width across flat	Tightening torque (Nm {kgm})	
	mm	mm	Range	Target
02 03, 04 05, 06 10, 12 14	14 20 24 33 42	Varies depending on type of connector.	35 – 63 {3.5 – 6.5} 84 – 132 {8.5 – 13.5} 128 – 186 {13.0 – 19.0} 363 – 480 {37.0 – 49.0} 746 – 1010 {76.0 – 103}	44 {4.5} 103 {10.5} 157 {16.0} 422 {43.0} 883 {90.0}

TABLE OF TIGHTENING TORQUES FOR O-RING BOSS PLUGS

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

Norminal No.	Thread diameter	Width across flat	Tightening torque (Nm {kgm})	
	mm	mm	Range	Target
08	08	14	5.88 – 8.82 {0.6 – 0.9}	7.35 {0.75}
10	10	17	9.8 – 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}	124.4 {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}

TIGHTENING TORQUE FOR 102 ENGINE SERIES

1) BOLT AND NUTS

Use these torques for bolts and nuts (unit: mm) of Cummins Engine.

Thread diameter	Tightening torque	
mm	Nm	kgm
6	10 ± 2	1.02 ± 0.20
8	24 ± 4	2.45 ± 0.41
10	43 ± 6	4.38 ± 0.61
12	77 ± 12	7.85 ± 1.22

2) EYE JOINTS

Use these torques for eye joints (unit: mm) of Cummins Engine.

Thread diameter	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

3) TAPERED SCREWS

Use these torques for tapered screws (unit: inch) of Cummins Engine.

Thread diameter	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 ± 0.41
1 / 2	24 ± 4	2.45 ± 0.41
3 / 4	36 ± 5	3.67 ± 0.51
1	60 ± 9	6.12 ± 0.92

TIGHTENING TORQUE TABLE FOR HOSES (TAPER SEAL TYPE AND FACE SEAL TYPE)

★ Tighten the hoses (taper seal type and face seal type) to the following torque, unless otherwise specified.

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

Nominal size of hose	Width across flats	Tightening torque (Nm {kgm})		Taper seal type	Face seal type	
		Range	Target	Thread size (mm)	Nominal thread size - Threads per inch, Thread series	Root diameter (mm) (Reference)
02	19	34 - 63 {3.5 - 6.5}	44 {4.5}	14	$\frac{9}{16}$ - 18UNF	14.3
03	22	54 - 93 {5.5 - 9.5}	74 {4.5}	–	$\frac{11}{16}$ - 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	$\frac{13}{16}$ - 16UN	20.7
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	$1\frac{3}{16}$ - 12UNF	30.3
(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	–	–

ELECTRIC WIRE CODE

In the wiring diagrams, various colors and symbols are employed to indicate the thickness of wires.
This wire code table will help you understand WIRING DIAGRAMS.
Example: 5WB indicates a cable having a nominal number 5 and white coating with black stripe.

CLASSIFICATION BY THICKNESS

Norminal number	Copper wire			Cable O.D. (mm)	Current rating (A)	Applicable circuit
	Number of strands	Dia. of strands (mm^2)	Cross section (mm^2)			
0.85	11	0.32	0.88	2.4	12	Starting, lighting, signal etc.
2	26	0.32	2.09	3.1	20	Lighting, signal etc.
5	65	0.32	5.23	4.6	37	Charging and signal
15	84	0.45	13.36	7.0	59	Starting (Glow plug)
40	85	0.80	42.73	11.4	135	Starting
60	127	0.80	63.84	13.6	178	Starting
100	217	0.80	109.1	17.6	230	Starting

CLASSIFICATION BY COLOR AND CODE

Priority	Classification \ Circuits		Charging	Ground	Starting	Lighting	Instrument	Signal	Other
1	Primary	Code	W	B	B	R	Y	G	L
		Color	White	Black	Black	Red	Yellow	Green	Blue
2	Auxiliary	Code	WR	—	BW	RW	YR	GW	LW
		Color	White & Red	—	White & Black	Red & White	Rellow & Red	Green & White	Blue & White
3		Code	WB	—	BY	RB	YB	GR	LR
		Color	White & Black	—	Black & Yellow	Red & Black	Yellow & Black	Green & Red	Blue & Yellow
4		Code	WL	—	BR	RY	YG	GY	LY
		Color	White & Blue	—	Black & Red	Red & Yellow	Yellow & Green	Green & Yellow	Blue & Yellow
5		Code	WG	—	—	RG	YL	GB	LB
		Color	White & Green	—	—	Red & Green	Yellow & Blue	Green & Black	Blue & Black
6		Code	—	—	—	RL	YW	GL	—
		Color	—	—	—	Red & Blue	Yellow & White	Green & Blue	—

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 Ⓐ, then draw a horizontal line from Ⓐ.
   (2) Locate the number 5 in the row across the top, take this as Ⓑ, then draw a perpendicular line down from Ⓑ.
   (3) Take the point where the two lines cross as Ⓒ. This point Ⓒ 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 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

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

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

Liter to U.S. Gallon

1ℓ = 0.2642 U.S. Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.113	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

Liter to U.K. Gallon

1ℓ = 0.21997 U.K. Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	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	7.969	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/cm² to lb/in²

1kg/cm² = 14.2233 lb/in²

	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	1010	1024	1038	1053	1067	1081	1095	1109	1124
80	1138	1152	1166	1181	1195	1209	1223	1237	1252	1266
90	1280	1294	1309	1323	1337	1351	1365	1380	1394	1408
100	1422	1437	1451	1465	1479	1493	1508	1522	1536	1550
110	1565	1579	1593	1607	1621	1636	1650	1664	1678	1693
120	1707	1721	1735	1749	1764	1778	1792	1806	1821	1835
130	1849	1863	1877	1892	1906	1920	1934	1949	1963	1977
140	1991	2005	2020	2034	2048	2062	2077	2091	2105	2119
150	2134	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2389	2404
170	2418	2432	2446	2460	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	2603	2617	2631	2646	2660	2674	2688
190	2702	2717	2731	2745	2759	2773	2788	2802	2816	2830
200	2845	2859	2873	2887	2901	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3343	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

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 or 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 as 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 as 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**	117.8
–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	**0**	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

UNITS

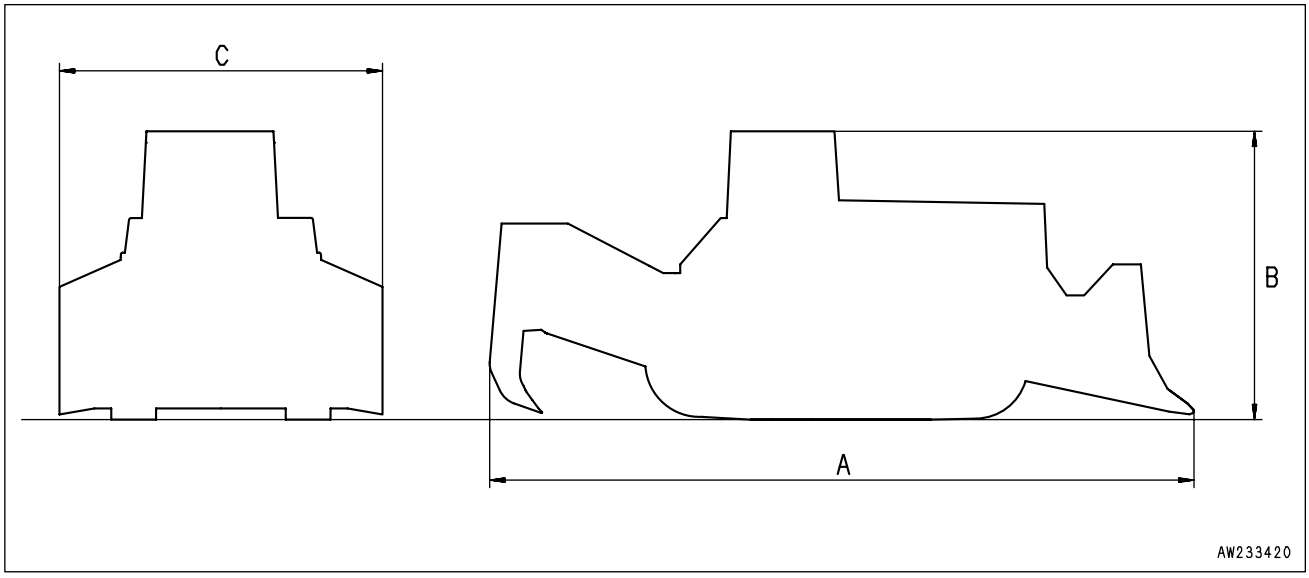
In this manual, the measuring units are indicated with Internatinal System of units (SI).
As for reference, conventionally used Gravitational System of units are indicated in parentheses { }.

Example:

N {kg}
Nm {kgm}
MPa {kg/cm^2}
kPa {mmH_2O}
kPa {mmHg}
kW/rpm {HP/rpm}
g/kWh {g/HPh}

01 GENERAL

SPECIFICATION DRAWING



D85EX-15

	Item	Unit	Straight-tilt dozer + Fixed multiple shank ripper	Semi U-tilt dozer + Fixed multiple shank ripper	Straight-tilt dozer + Variable multiple shank ripper	Semi U-tilt dozer + Variable multiple shank ripper
A	Overall length	mm	7,100	7,255	7,155	7,310
B	Overall height (with ROPS)	mm	3,330 (3,324)	3,330 (3,324)	3,330 (3,324)	3,330 (3,324)
C	Overall width	mm	3,715	3,635	3,715	3,635

D85PX-15

	Item	Unit	Straight-tilt dozer + Drawber
A	Overall length	mm	6,065
B	Overall height (with ROPS)	mm	3,367 (3,361)
C	Overall width	mm	4,365

SPECIFICATIONS

D85EX-15

Machine model				D85EX-15
Serial number				10001 and up
Weight	Machine weight • Bare tractor		kg	21,040
	• Above with semi U-tilt dozer + Fixed multiple shank ripper + ROPS + cab + air conditioner + side cover			28,000
	• Above with semi U-tilt dozer + Variable multiple shank ripper + ROPS + cab + air conditioner + side cover			28,120
Performance	Min. turning radius		m	2.0 (F1)
	Gradeability		deg.	30
	Stability (front, rear, left, right)		deg.	35
	Transmission speed ranges	Forward 1st speed 2nd speed 3rd speed	km/h	 3.6 6.1 10.1
		Reverse 1st speed 2nd speed 3rd speed	km/h	 4.7 8.0 13.0
	Ground pressure	• Bare tractor	kPa {kg/cm^2}	60.80 {0.62}
		• With straight-tilt dozer + Fixed multiple shank ripper + ROPS + cab + air conditioner + side cover		79.44 {0.81}
		• With semi U-tilt dozer + Fixed multiple shank ripper + ROPS + cab + air conditioner + side cover		80.42 {0.82}
		• With straight-tilt dozer + Variable multiple shank ripper + ROPS + cab + air conditioner + side cover		79.95 {0.82}
		• With semi U-tilt dozer + Variable multiple shank ripper + ROPS + cab + air conditioner + side cover		80.73 {0.82}
Dimensions	Overall length	Bare tractor (To top of lift cylinder)	mm	5,012
		With straight-tilt dozer + Fixed multiple shank ripper		7,100
		With straight-tilt dozer + Variable multiple shank ripper		7,155
		With semi U-tilt dozer + Fixed multiple shank ripper		7,255
		With semi U-tilt dozer + Variable multiple shank ripper		7,310
	Overall width	Bare tractor	mm	2,560
		With straight-tilt dozer + Fixed/Variable multiple shank ripper		3,715
		With semi U-tilt dozer + Fixed/Variable multiple shank ripper		3,635

Machine model				D85EX-15
Serial number				10001 and up
Dimensions	Overall height	To top of exhaust pipe (Incl. grouser) To top of air intake duct (Incl. grouser) (To top of control lever)	mm	3,330 2,592
		With cab (Incl. grouser) (not incl. exhaust pipe) With ROPS canopy (Incl. grouser) (not incl. exhaust pipe)	mm	3,163 3,324
		Track gauge Length of track on ground Track shoe width (Standard) Minimum ground clearance (To the bottom of under cover)	mm	2,000 3,050 560 450
Engine		Name		SA6D125E-3
		Type of engine		4-cycle, water-cooled, in-line vertical type, direct injection type with turbocharger and aftercooler
		Number of cylinders = Bore x Stroke Piston displacement	mm ℓ {cc}	6 – 125 x 150 11.04 {11,039}
	Performance	Flywheel horsepower Max. torque Max. speed at no load Min. speed at no load Min. fuel consumption ratio	kw{HP}/rpm Nm{kgm}/rpm rpm rpm g/kw•h {g/HP•h}	179 {239}/1,900 1,265 {129}/1,400 2,100 750 213 {159}
		Starting motor Alternator Battery		24V, 7.5kW 24V, 50A 12V, 150Ah x 2
		Radiator core type		D-7
Power train system		Torque converter		3-element, 1-stage, 1-phase
		Transmission		Planetary gear type, multiple disc clutch type, hydraulically actuated type (electric), force-feed lubrication gear pump type, forward 3-speed, reverse 3-speed, electrically operated type

Machine model				D85EX-15
Serial number				10001 and up
Power train system	HSS pump		MPa {kg/cm^2} ℓ/min/rpm	Variable swash plate type (HPV160) Max. discharge pressure: 40.2 {410} Logical discharge pressure: 341/2,133
	HSS motor		MPa {kg/cm^2}	Fixed swash plate type (HMF112) Max. allowable working pressure: 40.2 {410}
	Bevel gear shaft			Spiral bevel gear type, force-feed lubrication gear pump type
	HSS	HSS steering system		Differential planetary gear type, hydraulic motor actuated type, electric motorized type, hydraulically actuated type
		Master brake		Wet type, multiple disc clutch type, spring-boosted type, hydraulically actuated type, pedal operated type
	Final drive			Spur gear 1-stage, planetary gear 1-stage type, splash type lubrication
Undercarriage	Suspension			Rigid, balancing beam type
	Carrier roller			2 on each side
	Track roller			7 on each side
	Track shoe (560 mm)			Assembly type, single grouser, 41 each side Pitch: 260.6 mm
Power train + lubrication pump (tandem)				Gear type (SAL(3)63+(2)50)
Scavenging pump				Gear type (SAR(3)80)
Work equipment hydraulic system	Work equipment pump		MPa {kg/cm^2} ℓ/min/rpm	Variable swash plate type (HPV160) with HSS common use Max. discharge pressure: 27.4 {280} Work equipment relief pressure: 22.5 {230} Logical discharge pressure: 341/2,133
Variable in-line pump type	Fan pump		MPa {kg/cm^2} ℓ/min/rpm	Variable swash plate type: (LPV30) Max. discharge pressure: 19.1 {195} Logical discharge pressure: 64/2,133
	Fan motor		MPa {kg/cm^2} ℓ/min/rpm	Fixed swash plate type (LMF28) Max. allowable working pressure: 19.1 {195}

Machine model				D85EX-15
Serial number				10001 and up
Work equipment hydraulic system	Main control valve	(1) For fixed multiple shank ripper Type • For blade lift • For blade tilt • For ripper lift • For steering		3 + 1 spool, spool type, hydraulic assisted type + ripper lift + blade lift + blade tilt + steering
		(2) For variable multiple shank ripper Type • For blade lift • For blade tilt • For steering • For ripper lift • For blade tilt		3 + 1 + 1 spool, spool type, hydraulic assisted type + blade lift + blade tilt + steering + ripper lift + ripper tilt
	Hydraulic cylinder	Type		Double acting piston type
		Dimension of blade lift cylinder	Cylinder bore Piston rod outside diameter Piston stroke (Max.) Max. distance between pins Min. distance between pins	mm mm mm mm mm	100 65 1,350 2,040 690
		Dimension of blade tilt cylinder	Cylinder bore Piston rod outside diameter Piston stroke (Max.) Max. distance between pins Min. distance between pins	mm mm mm mm mm	150 75 130 1,351 1,221
		Dimension of ripper lift cylinder	(1) For fixed multiple shank ripper Cylinder bore Piston rod outside diameter Piston stroke (Max.) Max. distance between pins Min. distance between pins	 mm mm mm mm mm	 130 70 410 1,320 910
			(2) For variable multiple shank ripper Cylinder bore Piston rod outside diameter Piston stroke (Max.) Max. distance between pins Min. distance between pins	 mm mm mm mm mm	 130 70 410 1,350 940
		Dimension of ripper tilt cylinder	• For variable multiple shank ripper Cylinder bore Piston rod outside diameter Piston stroke (Max.) Max. distance between pins Min. distance between pins	 mm mm mm mm mm	 130 70 285 1,225 940
	Hydraulic tank				Box type(Control valve externally installed type)

Machine model					D85EX-15
Serial number					10001 and up
Work equipment	Type				Hydraulic straight-tilt dozer,Hydraulic semi U-tilt dozer
	Blade support method				Brace type (Right-side tilt cylinder)
	Straight-tilt dozer	Performance	Max. lifting blade height (from ground level)	mm	1,207
			Max. lowering blade depth (from ground level)	mm	540
			Max. tilt	mm	740
			Blade capacity (SAE)	m^3	5.2
		Dimensions	Blade width	mm	3,725
			Blade height	mm	1,450
			Blade cutting angle	deg.	52
	Semi U-tilt dozer	Performance	Max. lifting blade height (from ground level)	mm	1,207
			Max. lowering blade depth (from ground level)	mm	540
			Max. tilt	mm	735
			Blade capacity (SAE)	m^3	7.0
		Dimensions	Blade width	mm	3,640
			Blade height	mm	1,580
			Blade cutting angle	deg.	52
	Fixed multiple shank ripper	Type			Parallelogram type
		Weight		kg	2,500
		Beam length		mm	2,246
		Number of shanks		unit	3
		Performance	Digging angle	deg.	54
			Digging depth		Two Switch-Selectable
			Max. digging depth	mm	653
			Max. lifting height	mm	564
	Variable multiple shank ripper	Type			Parallelogram type
		Weight		kg	2,570
		Beam length		mm	2,246
		Number of shanks		unit	3
		Performance	Digging angle (Standard)	deg.	42.4 – 63.6 (54)
			Digging depth		Two Switch-Selectable
			Max. digging depth	mm	736
			Max. lifting height	mm	720

D85PX-15

Machine model				D85PX-15
Serial number				1001 and up
Weight	Machine weight • Bare tractor • Straight-tilt dozer + drawber + ROPS + cab + air conditioner + side cover		kg	23,320 27,550
Performance	Min. turning radius		m	2.7 (F1)
	Gradeability		deg.	30
	Stability (front, rear, left, right)		deg.	35
	Transmission speed ranges	Forward 1st speed 2nd speed 3rd speed	km/h	3.6 6.0 10.0
		Reverse 1st speed 2nd speed 3rd speed	km/h	4.7 7.9 12.7
	Ground pressure	Bare tractor With straight-tilt dozer + drawber+ ROPS + cab + air conditioner + side cover	kPa {kg/cm^2}	36.28 {0.37} 42.17 {0.43}
Dimensions	Overall length	Bare tractor (To top of lift cylinder) With straight-tilt dozer + drawber	mm	4,720 6,065
	Overall width	Bare tractor (To top of lift cylinder) With straight-tilt dozer + drawber	mm	3,160 4,365
	Overall height	To top of exhaust pipe (Incl. grouser) To top of air intake duct (Incl. grouser) (To top of control lever)	mm	3,367 2,629
		With cab (Incl. grouser) (not incl. exhaust pipe) With ROPS canopy (Incl. grouser) (not incl. exhaust pipe)	mm	3,200 3,361
	Track gauge Length of track on ground Track shoe width (Standard) Minimum ground clearance (To the bottom of under cover)		mm	2,250 3,480 910 560

Machine model				D85PX-15
Serial number				1001 and up
Engine	Name			SA6D125E-3
	Type of engine			4-cycle, water-cooled, in-line vertical type, direct injection type with turbocharger and aftercooler
	Number of cylinders = Bore x Stroke		mm	6 – 125 x 150
	Piston displacement		ℓ {cc}	11.04 {11,039}
	Performance	Flywheel horsepower	kw{HP}/rpm	179 {239}/1,900
		Max. torque	Nm{kgm}/rpm	1,265 {129}/1,400
		Max. speed at no load	rpm	2,100
		Min. speed at no load	rpm	750
		Min. fuel consumption ratio	g/kw•h {g/HP•h}	213 {159}
	Starting motor Alternator Battery			24V, 7.5kW 24V, 50A 12V, 150Ah x 2
	Radiator core type			D-7
Power train system	Torque converter			3-element, 1-stage, 1-phase
	Transmission			Planetary gear type, multiple disc clutch type, hydraulically actuated type (electric), force-feed lubrication gear pump type, forward 3-speed, reverse 3-speed, electrically operated type

Machine model				D85PX-15
Serial number				1001 and up
Power train system	HSS pump		MPa {kg/cm^2} ℓ/min/rpm	Variable swash plate type (HPV160) Max. discharge pressure: 40.2 {410} Logical discharge pressure: 341/2,133
	HSS motor		MPa {kg/cm^2}	Fixed swash plate type (HMF112) Max. allowable working pressure: 40.2 {410}
	Bevel gear shaft			Spiral bevel gear type, force-feed lubrication gear pump type
	HSS	HSS steering system		Differential planetary gear type, hydraulic motor actuated type, electric motorized type, hydraulically actuated type
	HSS	Master brake		Wet type, multiple disc clutch type, spring-boosted type, hydraulically actuated type, pedal operated type
	Final drive			Spur gear 1-stage, planetary gear 1-stage type, splash type lubrication
Undercarriage	Suspension			Rigid, balancing beam type
	Carrier roller			2 on each side
	Track roller			8 on each side
	Track shoe (910 mm)			Assembly type, single grouser, 45 each side Pitch: 260.6 mm
Power train + lubrication pump (tandem)				Gear type (SAL(3)63+(2)50)
Scavenging pump				Gear type (SAR(3)80)
Work equipment hydraulic system	Work equipment pump		MPa {kg/cm^2} ℓ/min/rpm	Variable swash plate type (HPV160) with HSS common use Max. discharge pressure: 27.4 {280} Work equipment relief pressure: 22.5 {230} Logical discharge pressure: 341/2,133
Variable in-line pump type	Fan pump		MPa {kg/cm^2} ℓ/min/rpm	Variable swash plate type: (LPV30) Max. discharge pressure: 19.1 {195} Logical discharge pressure: 64/2,133
	Fan motor		MPa {kg/cm^2} ℓ/min/rpm	Fixed swash plate type (LMF28) Max. allowable working pressure: 19.1 {195}

Machine model					D85PX-15
Serial number					1001 and up
Work equipment hydraulic system	Main control valve	Type • For blade lift • For blade tilt			3 spool, spool type, hydraulic assisted type + blade lift + blade tilt + steering
	Hydraulic cylinder	Type			Double acting piston type
		Dimension of blade lift cylinder	Cylinder bore Piston rod outside diameter Piston stroke (Max.) Max. distance between pins Min. distance between pins	mm mm mm mm mm	100 65 1,225 2,153 928
		Dimension of blade tilt cylinder	Cylinder bore Piston rod outside diameter Piston stroke (Max.) Max. distance between pins Min. distance between pins	mm mm mm mm mm	150 75 130 1,351 1,221
	Hydraulic tank				Box type(Control valve externally installed type)

Machine model					D85PX-15
Serial number					1001 and up
Work equipment	Type				Hydraulic straight-tilt dozer
	Blade support method				Brace type (Right-side tilt cylinder)
	Straight-tilt dozer	Performance	Max. lifting blade height (from ground level)	mm	1,222
			Max. lowering blade depth (from ground level)	mm	568
			Max. tilt	mm	500
			Blade capacity (SAE)	m^3	5.9
		Dimensions	Blade width	mm	4,365
			Blade height	mm	1,370
			Blade cutting angle	deg.	55

WEIGHT TABLE

⚠ This weight table is for reference in handling or transporting components.

Unit: kg

Machine model	D85EX-15	D85PX-15
Serial number	10001 and up	1001 and up
Engine		
• Dumper assembly	1,403	1,403
• Engine assembly	1,250	1,250
• Dumper assembly	131	131
• Universal joint	17	17
• Engine mounting parts (Wiring)	5	5
Main radiator assembly (Including built-in oil cooler)	256	256
Hydraulic cooler	26	26
Fuel tank assembly (When empty)	215	215
Fuel tank assembly (When full)	618	618
Power train unit assembly (Including HSS pump, motor)	1,800	1,800
• Torque converter, PTO assembly	322	322
• Transmission assembly	443	443
• HSS assembly	748	748
• Brake valve assembly	5	5
• HSS cooler bypass valve assembly	11	11
• Power train filter assembly	17	17
• Scavenging pump	12	12
• Power train, lubricating pump	25	25
• Work equipment & HSS pump	106	106
• HSS motor	41	41
• Fan pump	25	25
• Fan motor	13	13
Final drive assembly	1,010 x 2	1,063 x 2
Sprocket teeth	(10 x 9) x 2	(10 x 9) x 2
Hull frame assembly	3,262	3,262
Track group assembly (each side)	2,168	2,278
• Track frame	800	860
• Idler assembly	290	290
• Recoil spring assembly	350	350
• Track roller assembly (Single flange x 1)	72 x 5	72 x 6
• Track roller assembly (Double flange x 1)	80 x 2	80 x 2
• Carrier roller assembly	39 x 2	39 x 2
• Roller guard etc.	130	108

Unit: kg

Machine model	D85EX-15	D85PX-15
Serial number	10001 and up	1001 and up
Track shoe assembly (560mm width, wet type)	1,945 x 2	2,795 x 2
Pivot shaft assembly	82 x 2	106 x 2
Equalizer bar	158	204
Hydraulic tank assembly	95	95
Main control valve (Blade lift + blade tilt + ripper lift + steering)	95	84
Engine underguard (Front)	80	80
Engine underguard (Rear)	89	89
Transmission underguard	160	160
Operator seat (Excluding tilt and front-rear sliding device)	55	55
Straight-tilt dozer assembly	3,305	3,343
• Blade (Incl. cutting edge)	1,674	1,779
• Straight frame (Left)	371	371
• Straight frame (Right)	389	389
• Tilt brace	66 x 1	66 x 1
• Center brace	81 x 2	81 x 2
• Tilt cylinder assembly	130	130
Semi U-tilt dozer assembly	3,575	—
• Blade	1,860	—
• Straight frame (Left)	371	—
• Straight frame (Right)	389	—
• Center brace	66 x 1	—
• Tilt cylinder assembly	130	—
Radiator mask assembly	117	117
Blade lift cylinder assembly	115 x 2	110 x 2
Fixed multiple shank ripper assembly	2,500	—
• Mount bracket	124 x 2	162 x 2
• Ripper arm	368	468
• Ripper beam	1,038	898
• Upper link	54 x 2	—
• Shank (Incl. protector)	168 x 3	—
• Lift cylinder assembly	81 x 2	—
Variable multiple shank ripper assembly	2,570	—
• Mount bracket	162 x 2	—
• Ripper arm	464	—
• Ripper beam	898	—
• Shank (Incl. protector)	168 x 3	—
• Lift cylinder assembly	78 x 2	—
• Tilt cylinder assembly	74 x 2	—
ROPS assembly	371	371
Cab assembly	410	410
ROPS canopy	437	437
Dash board (With cab and air conditioner)	76	76
Floor frame assembly	350	350
Air conditioner assembly (Incl. air conditioner unit assembly)	76	76
Operator seat assembly	68	68

TABLE OF FUEL, COOLANT AND LUBRICANT

Refilling position	Kind of oil	Ambient temperature -20 -10 0 10 20 30 40 C°	Specified oil amount (ℓ)	Refilled oil amount (ℓ)
Engine oil pan	Engine oil	SAE 30 / SAE 10 / SAE 10W-30 / SAE 15W-40	44	38
Power train oil pan (including torque converter, transmission and bevel gear case)	Engine oil	SAE 30 / SAE 10	90	60
Final drive case (each side)	Engine oil	SAE 30 / SAE 10	D85EX-15: 26 D85PX-15: 36	D85EX-15: 26 D85PX-15: 36
Damper case	Engine oil	SAE 30	1.5	1.5
Pivot shaft case (each side)	Engine oil	SAE 30	7	7
Hydraulic oil	Engine oil	SAE 10 / SAE 10W-30 / SAE 15W-40	D85EX-15:120 D85PX-15:106	67
Idler (each)	Gear oil	GO 140	0.35	0.35
Track roller (each)	Gear oil	GO 140	0.28	0.28
Carrier roller (each)	Gear oil	GO 140	0.5	0.5
Fuel tank	Diesel fuel	ASTM D975 No.2 / *1	490	—
Cooling system (Incl. reservoir tank)	Coolant	Add antifreeze	82	—

*1 ASTM D975 No.1

NOTE

(1) When fuel sulphur content is less than 0.5%, change oil in the oil pan every periodic maintenance hours described in this manual.
Change oil according to the following table if fuel sulphur content is above 0.5%.

Fuel sulphur content	Change interval of oil in engine oil pan
0.5 to 1.0%	1/2 of regular interval
Above 1.0%	1/4 of regular interval

(2) When staring the engine in an atmospheric temperature of lower than 0°C, be sure to use engine oil of SAE10W, SAE10W-30 and SAE15W-40, even though an atmospheric temperature goes up to 10°C more or less in the day time.
(3) Use API classification CD as engine oil and if API classification CC, reduce the engine oil change interval to half.
(4) There is no problem if single grade oil is mixed with multigrade oil (SAE10W-30, 15W-40), but be sure to add single grade oil that matches the temperature in the table on the left.
(5) We recommend Komatsu genuine oil which has been specifically formulated and approved for use in engine and hydraulic work equipment applications.

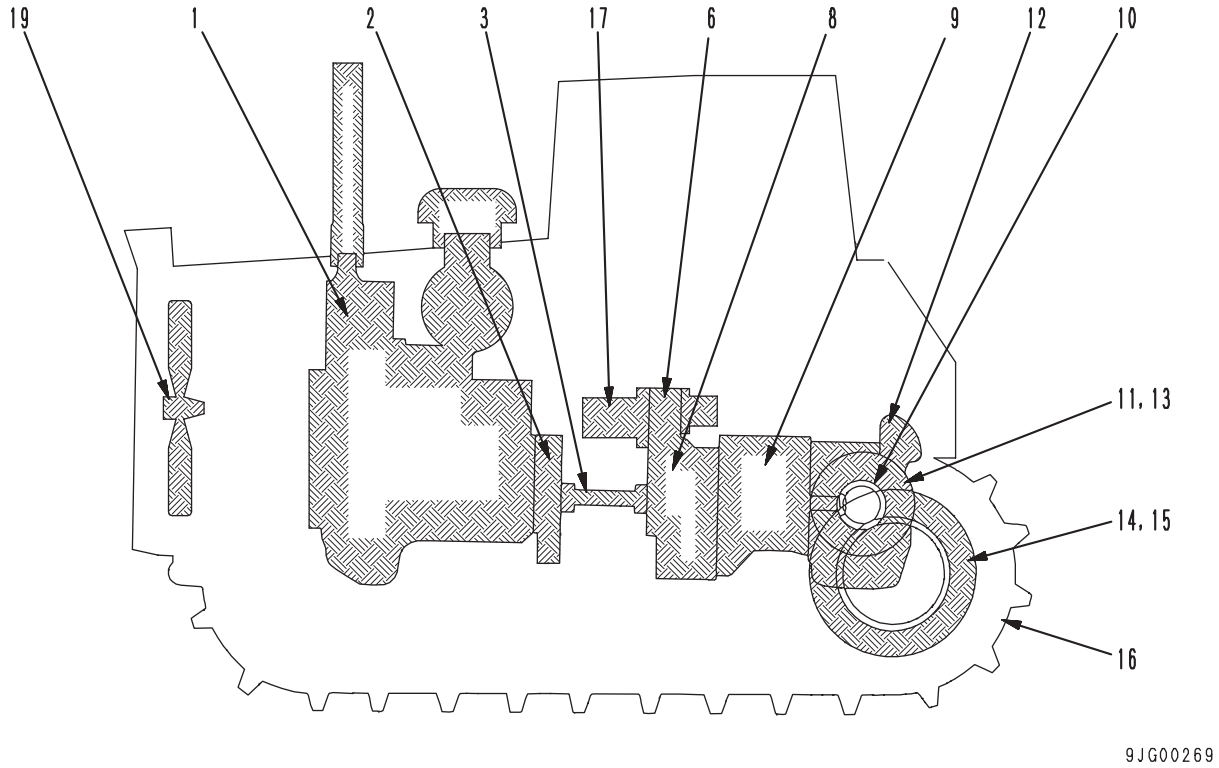
★ Use API classification CD, CE or CF-4 as engine oil.

ASTM: American Society of Testing and Material
SAE: Society of Automotive Engineers
API: American Petroleum Institute

Specified capacity: Total amount of oil including oil for components and oil for components and oil in piping.
Refill capacity: Amount of oil needed refill system during normal inspection and maintenance.

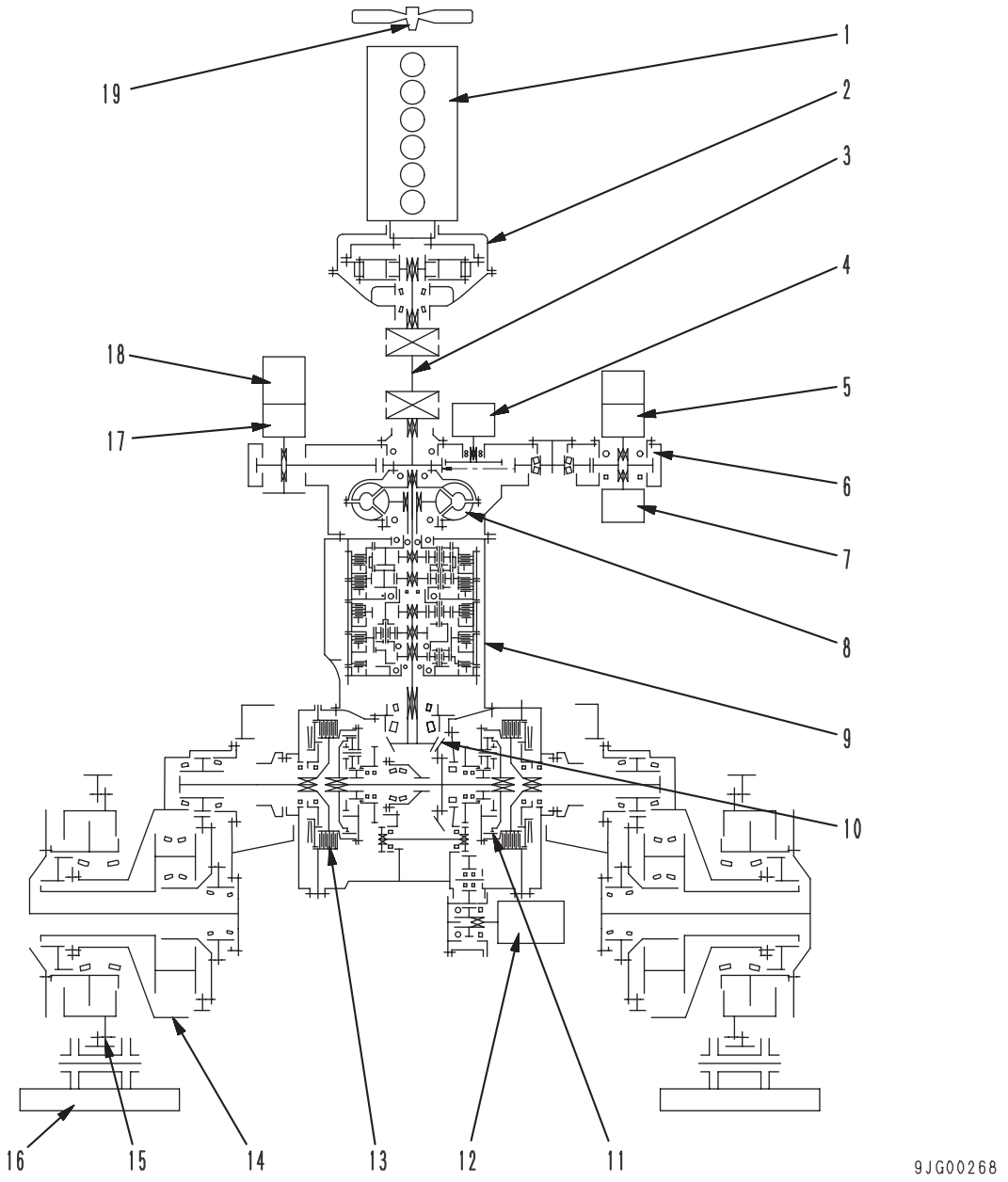
10 STRUCTURE, FUNCTION AND MAINTENANCE STANDARD

POWER TRAIN



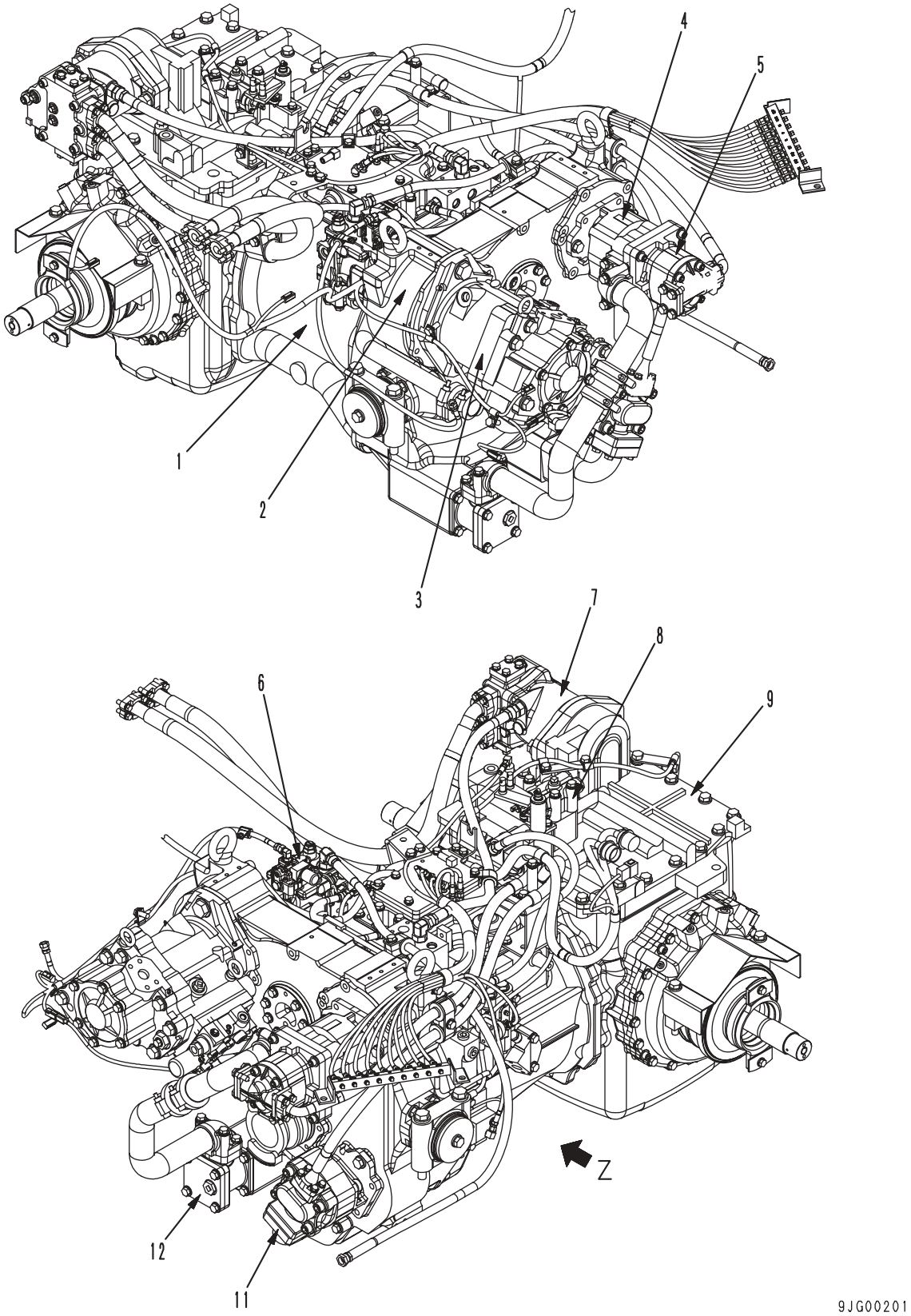
Outline

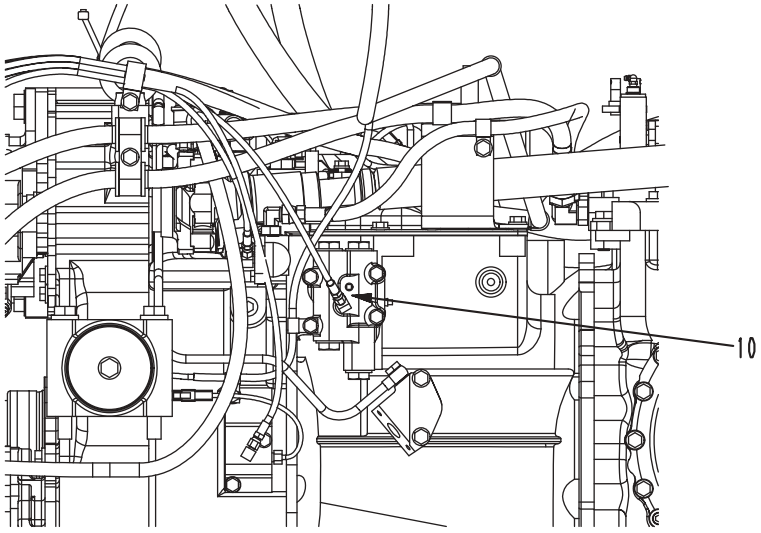
- The power generated by engine (1) has its torsional vibration dampened by damper (2), and then passes through universal joint (3), and is transmitted to torque converter (8).
- The power from the engine is transmitted through the oil by torque converter (8) to the transmission input shaft (turbine shaft) in accordance with the change in load.
- Transmission (9) uses a combination of a planetary gear system and hydraulic clutches to reduce the speed and shift the gears (3 forward gears and 3 reverse gears). It connects 2 sets of clutches selected according to the change in load, and transmits the power to bevel gear (10) from the bevel pinion at the rear end of the transmission.
- The power transmitted to the bevel gear shaft is transmitted to HSS (Hydrostatic Steering System) (11). Hydraulic, HSS pump (5) is driven by PTO (6), and output oil of the hydraulic, HSS pump (5) drives HSS motor (12). The rotation of the pair of the HSS gears on the right and left is controlled by HSS motor (12). The steering is carried out 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 pivot turns.
- Brake (13) of the HSS is used for braking the machine. Brake (13) is a wet, multiple disc clutch, spring boosted type.
  The power sent from brake (13) is transmitted to final drive (14).
- Final drive (14) consists of a single-stage spur gear and a single-stage planetary gear system. It reduces the speed and rotates sprocket (15) to drive track shoe (16) and move the machine. It also rotates fan motor (19) with the oil discharged from fan pump (7) driven with PTO (6).



1. Engine (SA6D125E-3)
2. Damper
3. Universal joint
4. Scavenging pump [BAR(3)-80]
5. Hydraulic, HSS pump (HPV160)
6. PTO
7. Fan pump (LPV30)
8. Torque converter (TCS46-4Z)
9. Transmission
10. Bevel gear
11. HSS unit
12. HSS motor (HMF112)
13. Brake
14. Final drive
15. Sprocket
16. Track shoe
17. Power train pump [SAL(3)-63]
18. Steering lubricating oil pump [SAL(2)-50]
19. Fan motor (LMF28)

OVERALL DRAWING OF POWER TRAIN UNIT



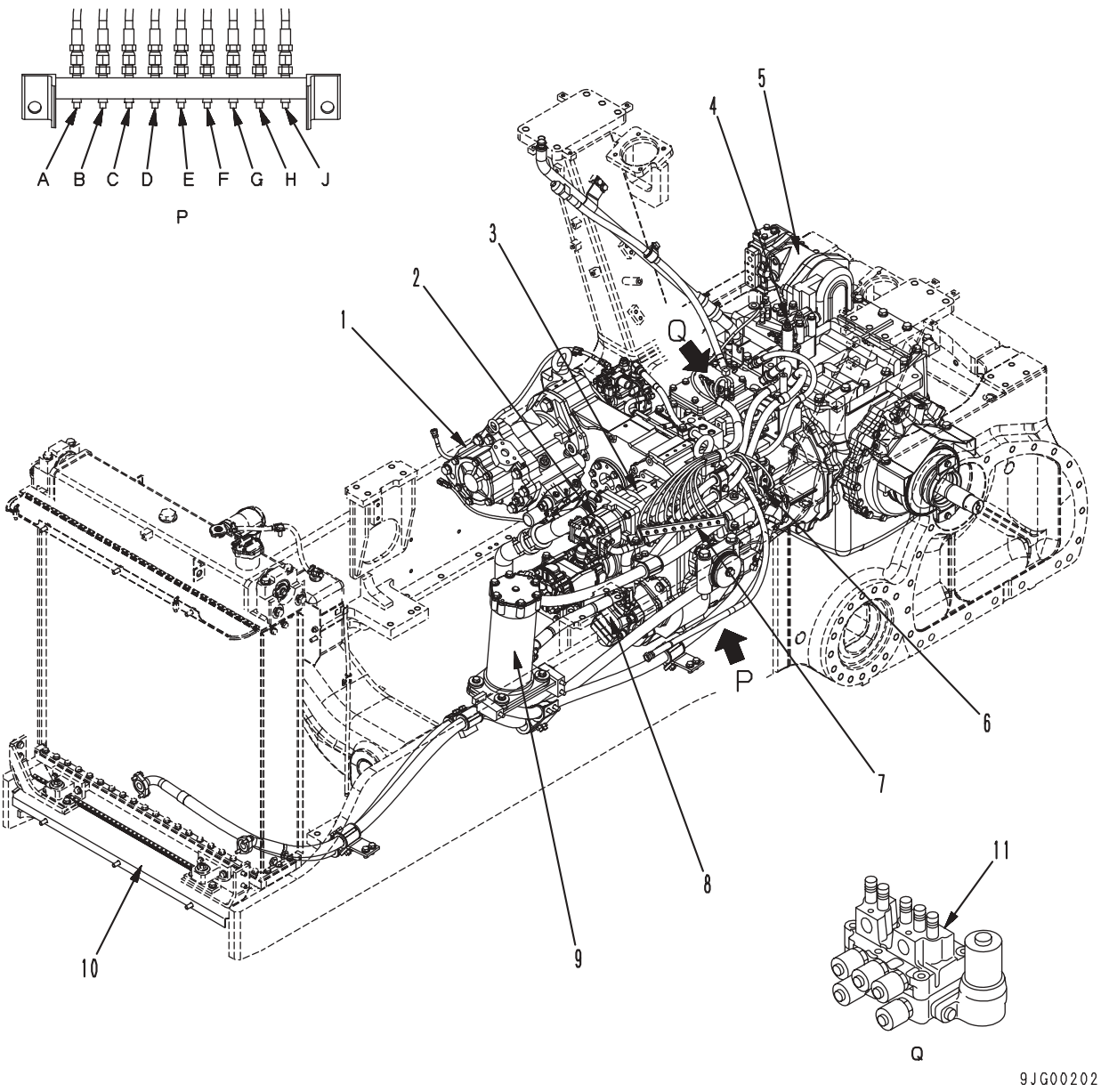


1. Transmission
2. Torque converter, PTO
3. Hydraulic, HSS pump (HPV160)
4. Power train pump [SAL(3)63]
5. Steering lubricating oil pump [SAL(2)50]
6. Fan pump (LPV30)
7. HSS motor (HMF112)
8. Parking brake valve
9. HSS unit
10. Main relief valve
11. Scavenging pump [SAR(3)80]
12. Power train oil strainer

Outline

- The power train unit consists of the main components of torque converter (2), transmission (6), and HSS unit (9). Accordingly, after the power train unit is removed, it can be divided into the torque converter, transmission unit, and HSS unit.
- The HSS unit consists of the bevel pinion unit, bevel gear shaft, HSS motor, planetary gear system, and brake.

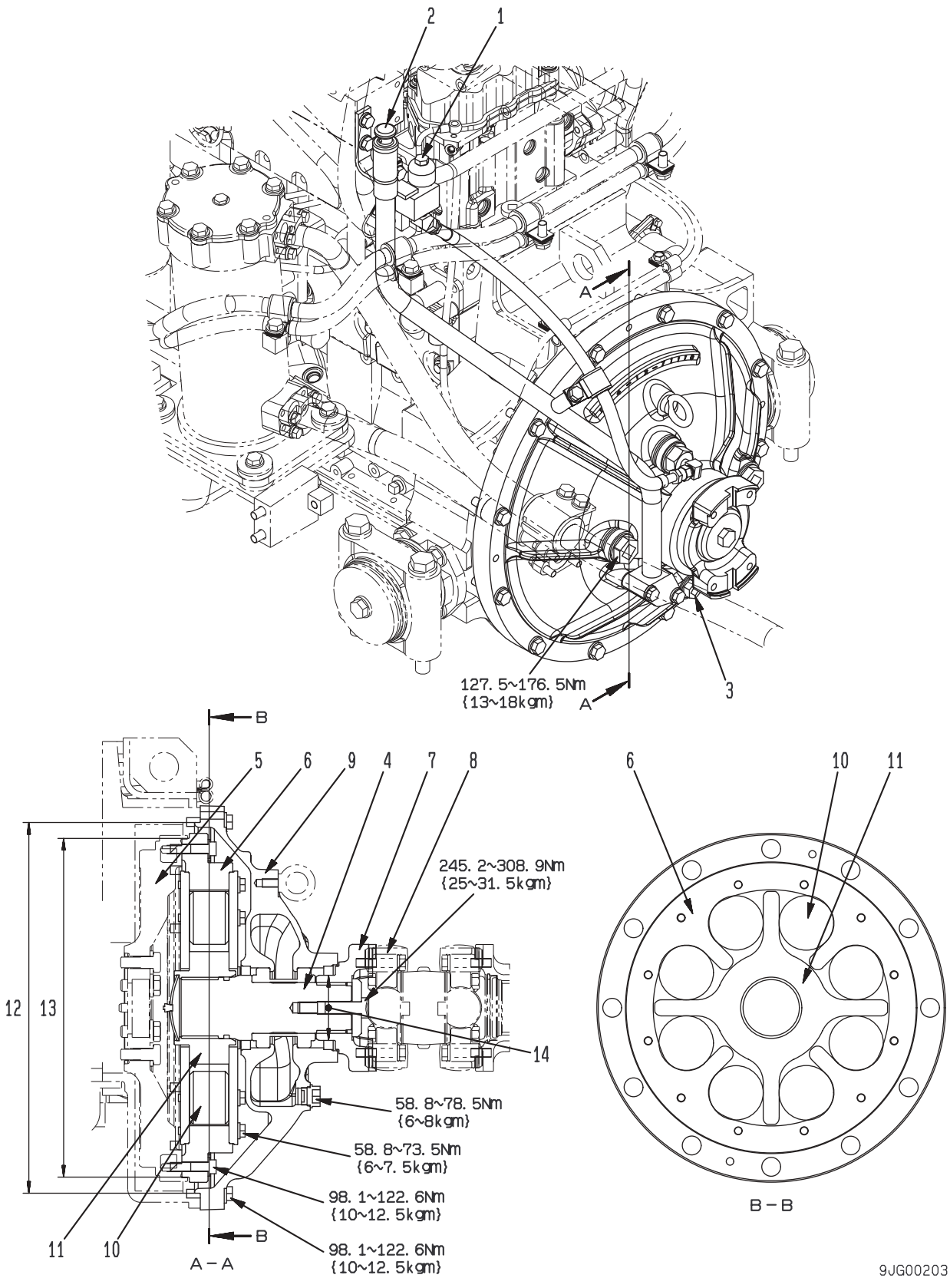
HYDRAULIC PIPING OF POWER TRAIN



1. Hydraulic, HSS pump (HPV160)
2. Steering lubricating oil pump [SAL(2)50]
3. Power train pump [SAL(3)63]
4. Brake control valve
5. HSS motor (HMF112)
6. Main relief valve
7. Centralized pressure pick-up ports
8. Scavenging pump [SAR(3)80]
9. Power train oil filter
10. Power train oil cooler
    (built in radiator lower tank)

A. Brake oil pressure pick-up port
B. Transmission 3rd clutch oil pressure pick-up port (3RD)
C. Transmission 2nd clutch oil pressure pick-up port (2ND)
D. Transmission 1st clutch oil pressure pick-up port (F1)
E. Transmission R clutch oil pressure pick-up port (R)
F. Transmission F clutch oil pressure pick-up port (FWD)
G. Torque converter inlet pressure pick-up port (IN)
H. Transmission main relief pressure pick-up port (TM)
J. Torque converter outlet pressure pick-up port (OUT)

DAMPER, UNIVERSAL JOINT



1. Breather
2. Oil level gauge
3. Drain plug
4. Output shaft
5. Flywheel
6. Outer body
7. Coupling
8. Universal joint
9. Cover
10. Rubber coupling
11. Inner body

Outline

- The damper dampens the torsional vibration caused by the change in engine torque and the impact torque generated when accelerating suddenly or when carrying out heavy-duty digging. In this way it acts to protect the torque converter, transmission, and other parts of the power train.
- This damper has few component parts: it uses a rubber coupling, so the vibration is absorbed by the damping effect of the rubber material.

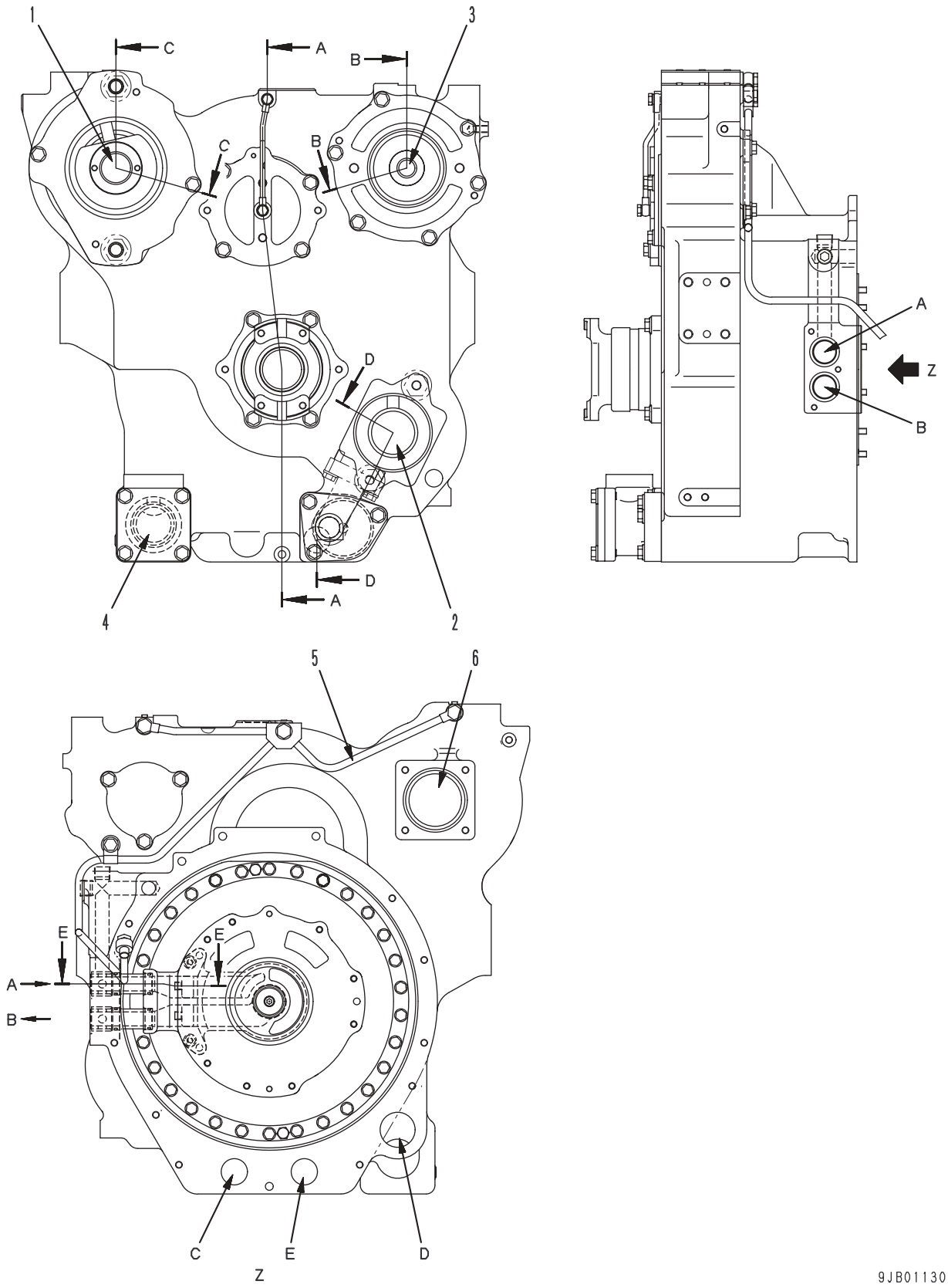
Operation

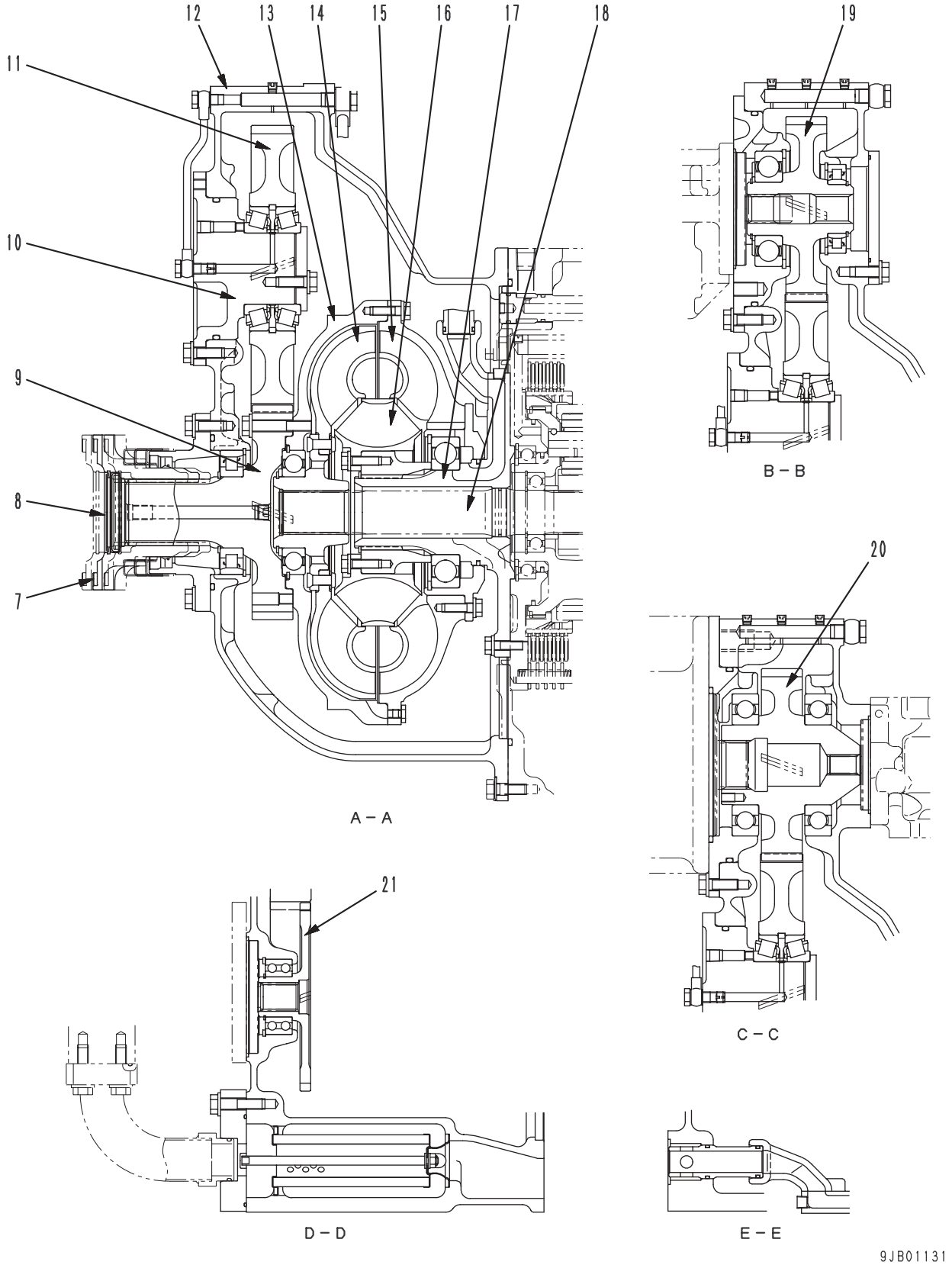
- This motive force from the engine passes through flywheel (5) and it transmitted to outer body (6).
- The torsional vibration of the engine is absorbed by rubber coupling (10), and the power is transmitted to inner body (11). It passes through universal joint (8), and is then transmitted to the torque converter and transmission.

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">12</td><td rowspan="2">Clearance between flywheel housing and cover</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>511.18</td><td>– 0.022
– 0.092</td><td>+ 0.070
0</td><td>0.022–
0.162</td><td>0.2</td></tr>
<tr><td>13</td><td>Clearance between flywheel and damper</td><td>466.72</td><td>– 0.020
– 0.083</td><td>+ 0.063
0</td><td>0.020–
0.146</td><td>0.2</td></tr>
<tr><td rowspan="2">14</td><td rowspan="2">Outer circumference of coupling oil seal contact surface</td><td colspan="2">Standard size</td><td colspan="2">Tolerance</td><td colspan="2">Repair limit</td></tr>
<tr><td colspan="2">90</td><td colspan="2">0
– 0.087</td><td colspan="2">89.8</td></tr>
</table>

TORQUE CONVERTER, PTO



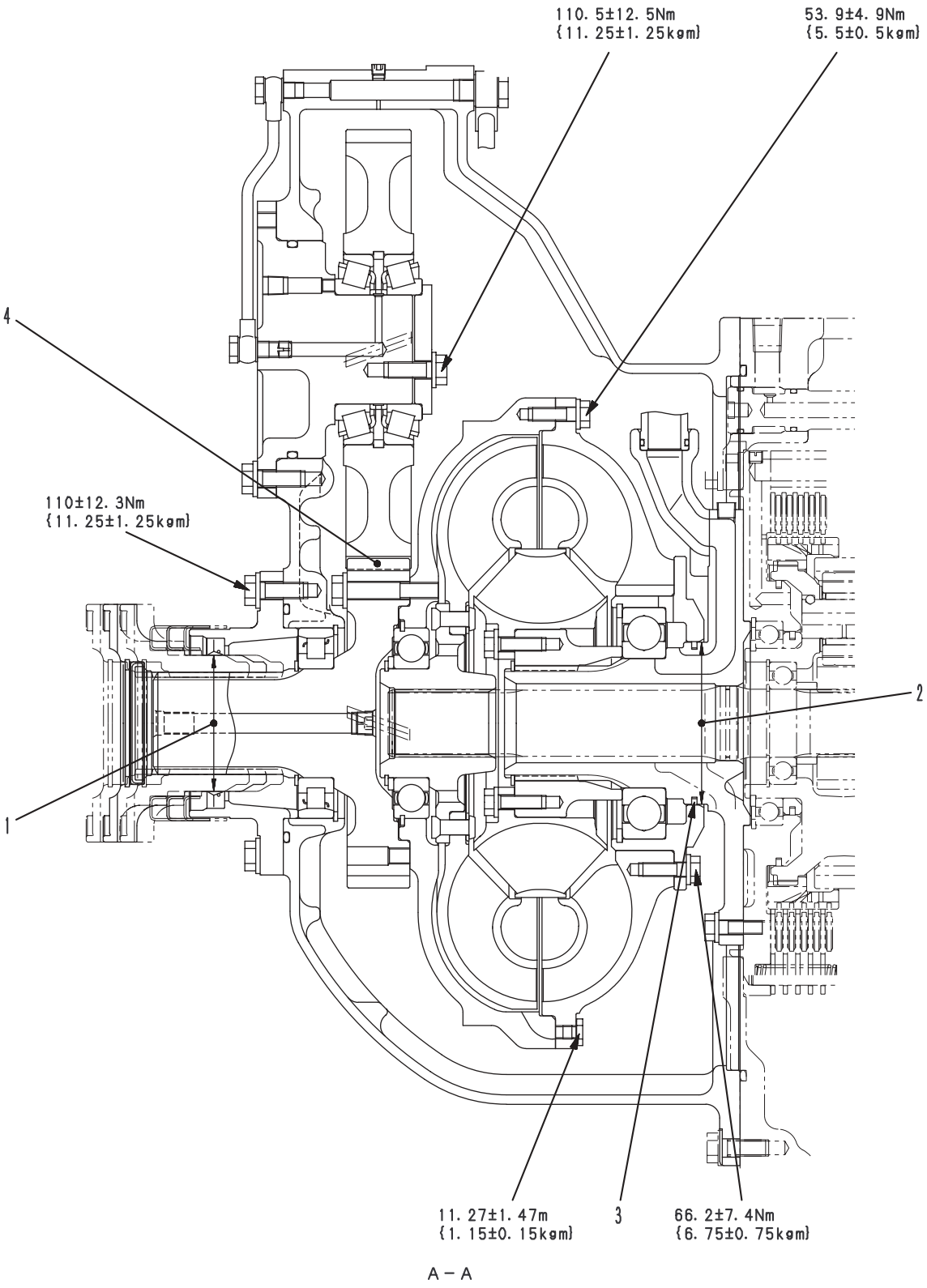

12
13
14
15
16
17
18
11
10
9
8
7
A – A
19
B – B
20
C – C
21
D – D
E – E
9JB01131

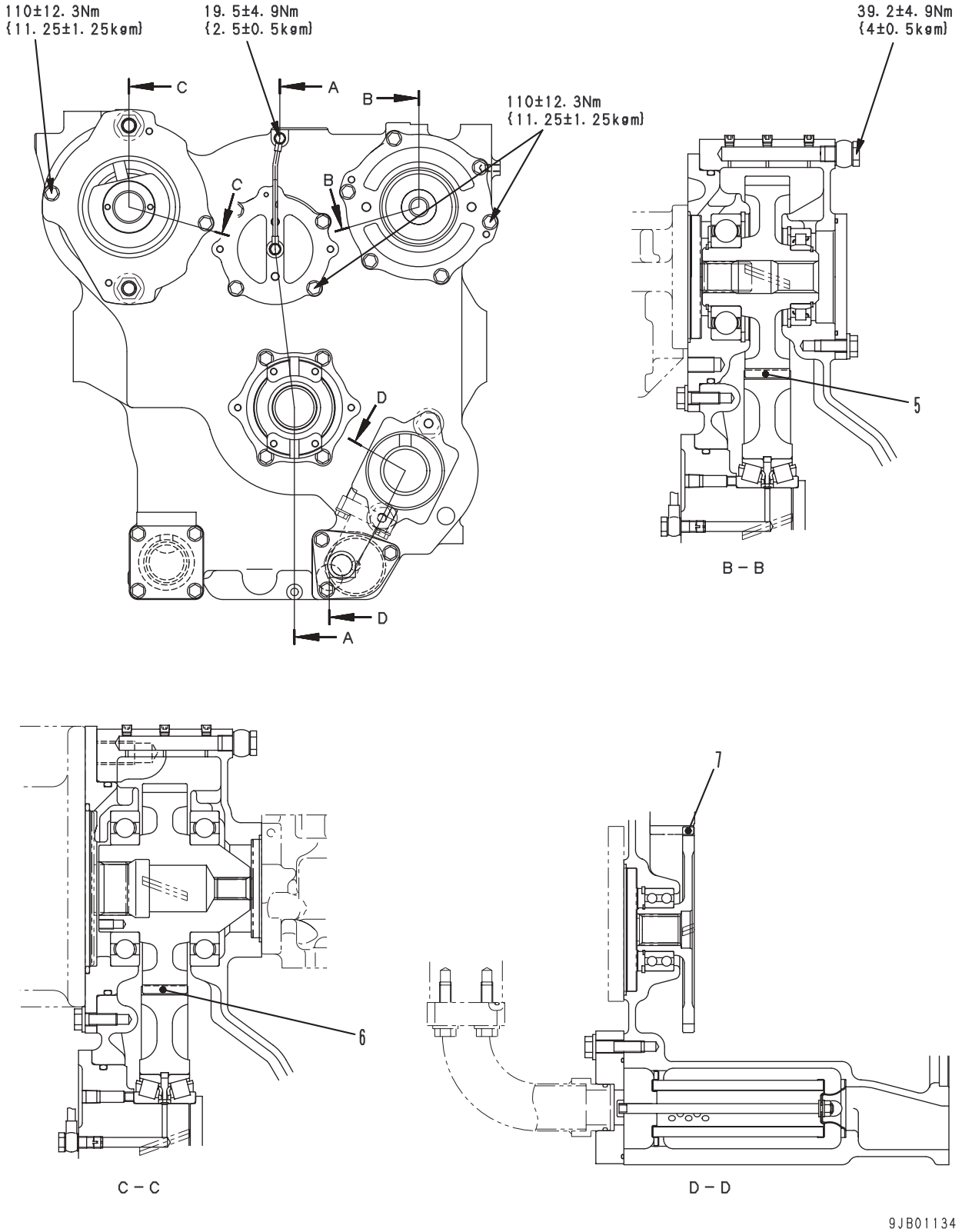
A. Torque converter oil inlet port
B. To oil cooler
C. From transmission case (to scavenging pump)
D. From transmission case (to power train pump)
E. To transmission case (passage)

1. Mounting of hydraulic, HSS pump
2. Scavenging pump mount
3. Power train pump mount
4. Power train oil strainer
5. PTO lubrication tube
6. Mounting of fan pump
7. Input coupling
8. Input shaft
9. PTO drive gear (No. of teeth: 55)
10. Idler gear shaft
11. Idler gear (No. of teeth: 74)
12. PTO case
13. Drive case
14. Turbine
15. Pump
16. Stator
17. Stator shaft
18. Transmission input shaft
19. Power train pump drive gear (Number of teeth: 47)
20. Pump drive gear (Number of teeth: 49) (Hydraulic/HSS pump, fan pump)
21. Scavenging pump drive gear (No. of teeth: 48)

Outline

- The torque converter is a 3-element, 1-stage, 1-phase type and forms one unit with the transmisssion.
- Pump (15) forms one unit with coupling (7) input shaft (8) and drive case (13), and is rotated by the power from the engine.
- Turbine (14) forms one unit with transmission input shaft (18), and is rotated by the oil from the pump.
- Stater (16) forms one unit with stator shaft (17), and is fixed to PTO case (12).
- The scavenging pump is driven with PTO drive gear (9) and returns the oil accumulated in the transmission case to the steering case


110.5±12.5Nm
{11.25±1.25kgm}
53.9±4.9Nm
{5.5±0.5kgm}
4
110±12.3Nm
{11.25±1.25kgm}
2
1
11.27±1.47m
{1.15±0.15kgm}
3
66.2±7.4Nm
{6.75±0.75kgm}
A – A
9JB01133

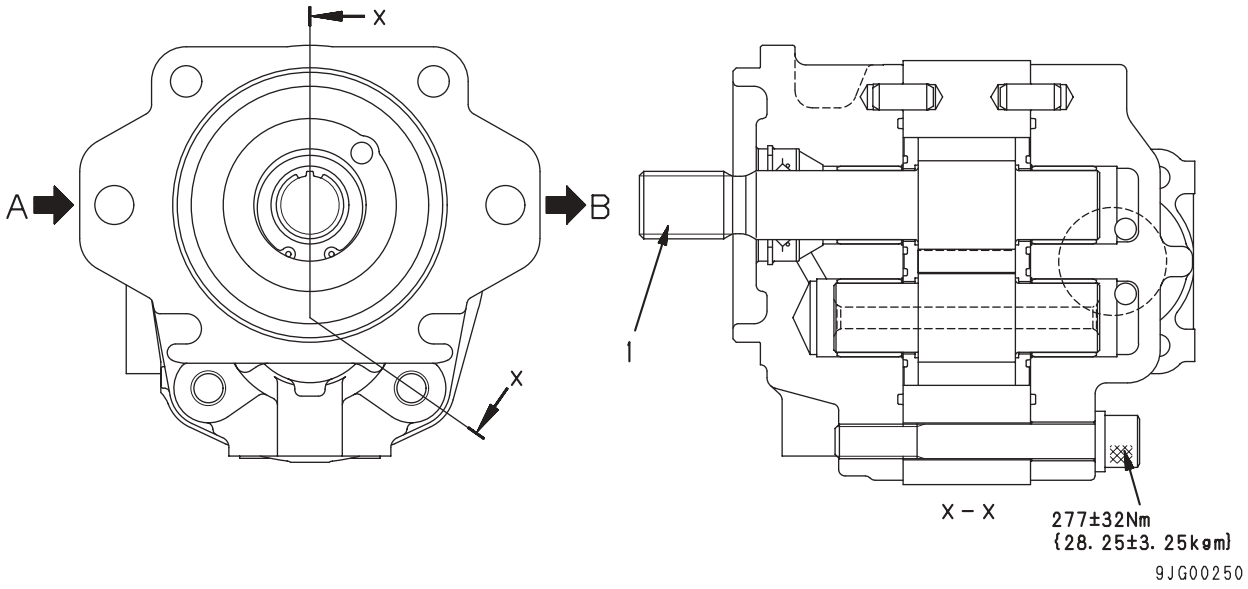

110±12. 3Nm
{11. 25±1. 25kgm}
19. 5±4. 9Nm
{2. 5±0. 5kgm}
39. 2±4. 9Nm
{4±0. 5kgm}
110±12. 3Nm
{11. 25±1. 25kgm}
C
A
B
C
B
D
D
A
5
B – B
6
C – C
7
D – D
9JB01134

Unit: mm

No.	Check item		Criteria			Remedy
1	Outer diameter of input coupling oilseal contact surface		Standard size	Tolerance	Repair limit	Hard chrome plating or replace
			ø100	0 –0.054	ø99.8	
2	Inner diameter of retainer seal ring contact surface		ø120	+0.040 0	ø120.3	
3	Wear of stator shaft seal ring	Width	3.95	0 –0.1	3.5	
		Thickness	4.6	± 0.1	4.1	
4	Backlash between PTO drive gear and PTO idler gear		0.192 – 0.485			Replace
5	Backlash between PTO idler gear and power train pump drive gear		0.192 – 0.485			
6	Backlash between PTO idler gear and hydraulic, HSS pump drive gear		0.192 – 0.485			
7	Backlash between PTO idler gear and scavenging pump drive gear		0.192 – 0.485			

SCAVENGING PUMP

SAR (3) 80



A. Suction port
B. Discharge port

Specifications
Model: SAR 80
Theoretical discharge capacity: 80.0 cc/rev
Max. discharge pressure: 20.6 MPa {210 kg/cm^2}
Max. revolving speed: 2,500 rpm

Outline
- The scavenging pump is installed under the torque converter and PTO case and driven with the power from the engine.
- The scavenging pump sucks the oil accumulated in the bottom of the transmission case and returns it through the strainer to the steering case.

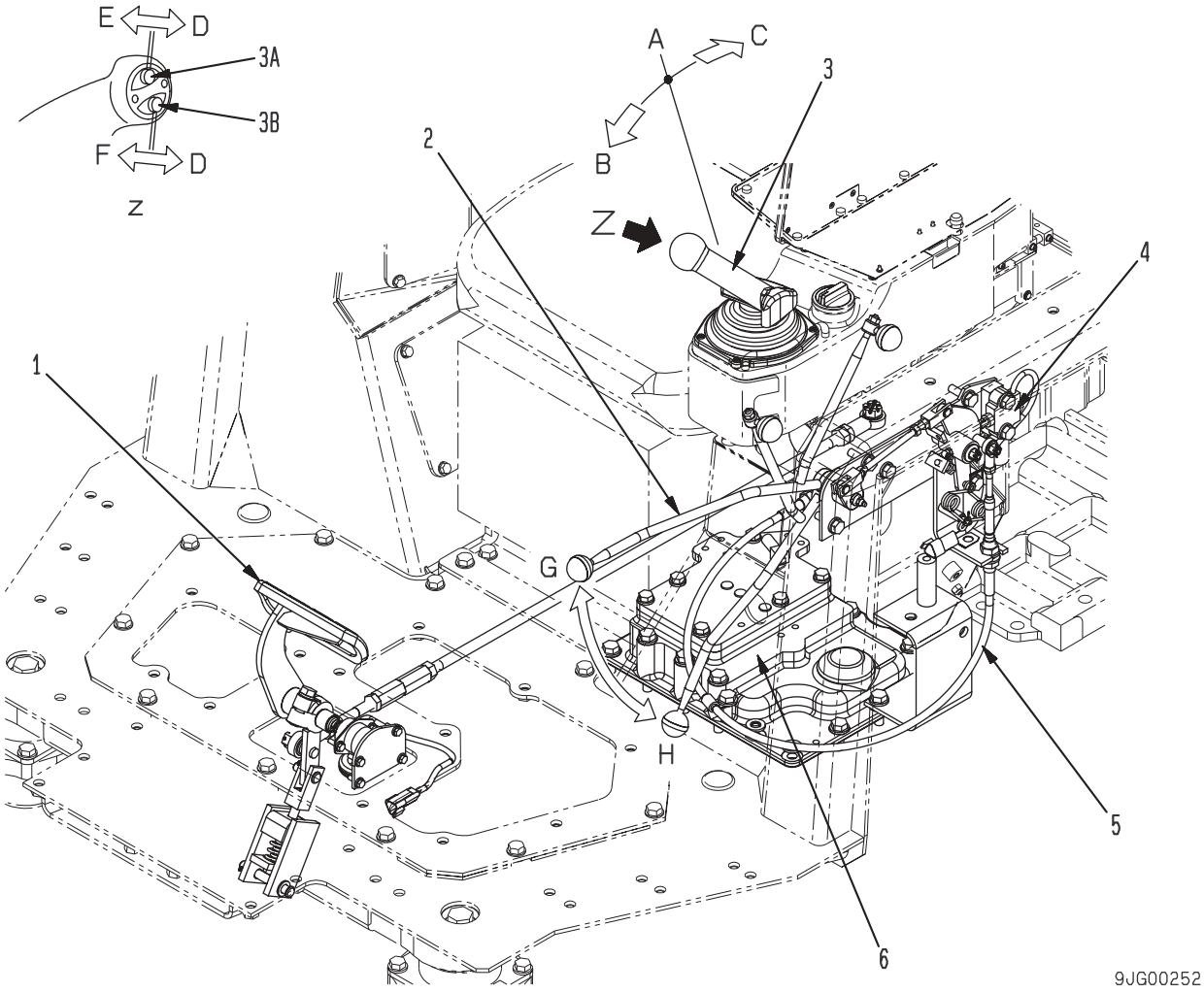
Unit: mm

No.	Check item	Criteria					Remedy
1	Spline shaft rotation torque	–					
–	Delivery (Oil: E010-CD Oil temperature: 45 – 55 x °C)	Type	Rotating speed (rpm)	Discharge pressure (MPa {kg/cm^2})	Standard discharge amount (ℓ/min)	Permissible discharge amount (ℓ/min)	–
		SAR(3)-80	2,500	0.29 {3.0}	–	–	

TRANSMISSION CONTROL

★ For steering operation concerned to operation of the Palm Command Steering Control lever (PCCS lever), see STEERING, BRAKE CONTROL.

★ PCCS: Abbreviation for Palm Command Control System



1. Brake pedal
2. Safety lever
3. PCCS lever
   (Forward-Reverse, Gear shift)
   3A. UP switch
   (Gear is shifted up each time this switch is pressed.)
   3B. DOWN switch
   (Gear is shifted down each time this switch is pressed.)
4. Transmission neutral safety switch
5. Cable
6. Transmission control valve

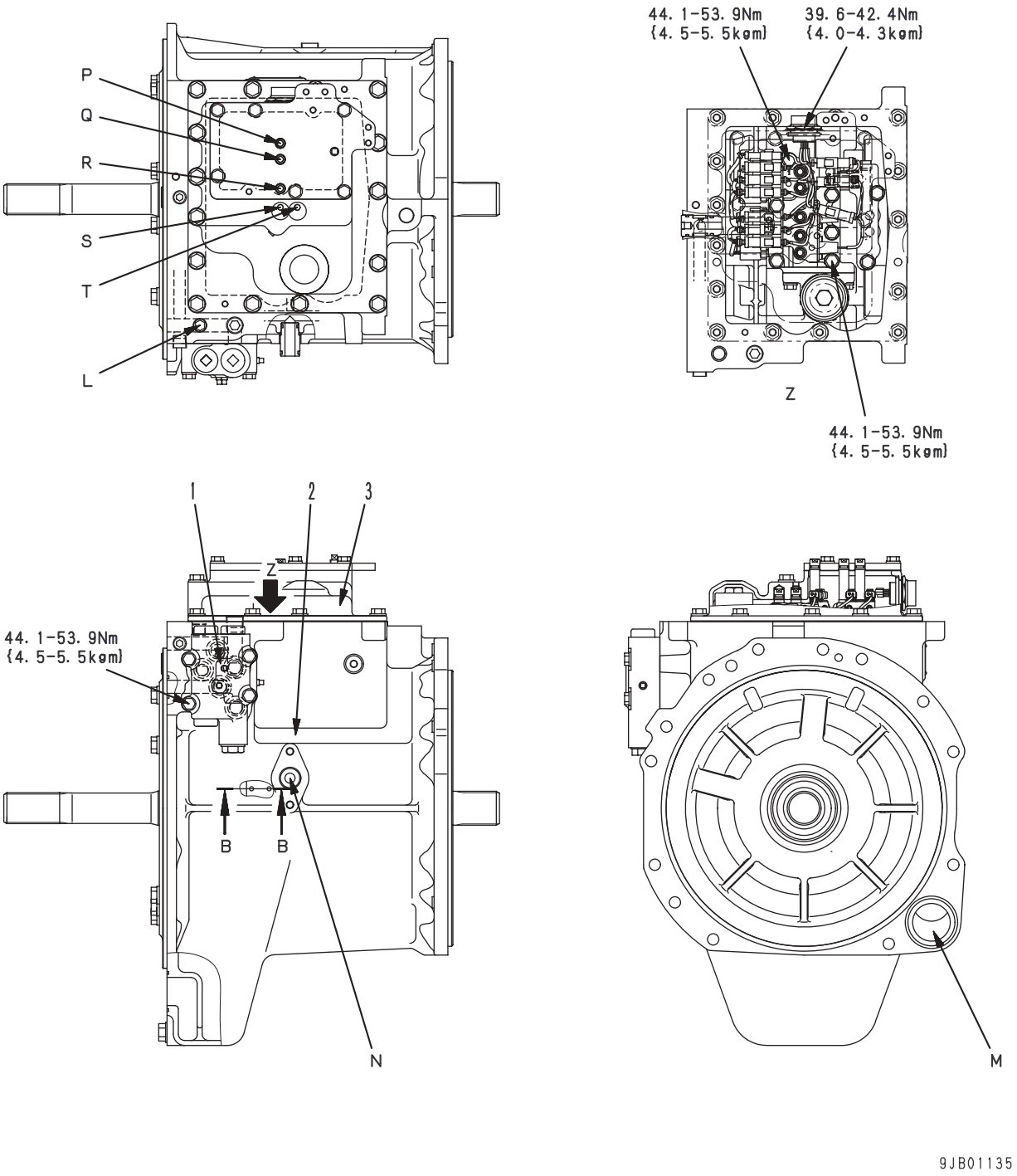
Lever positions

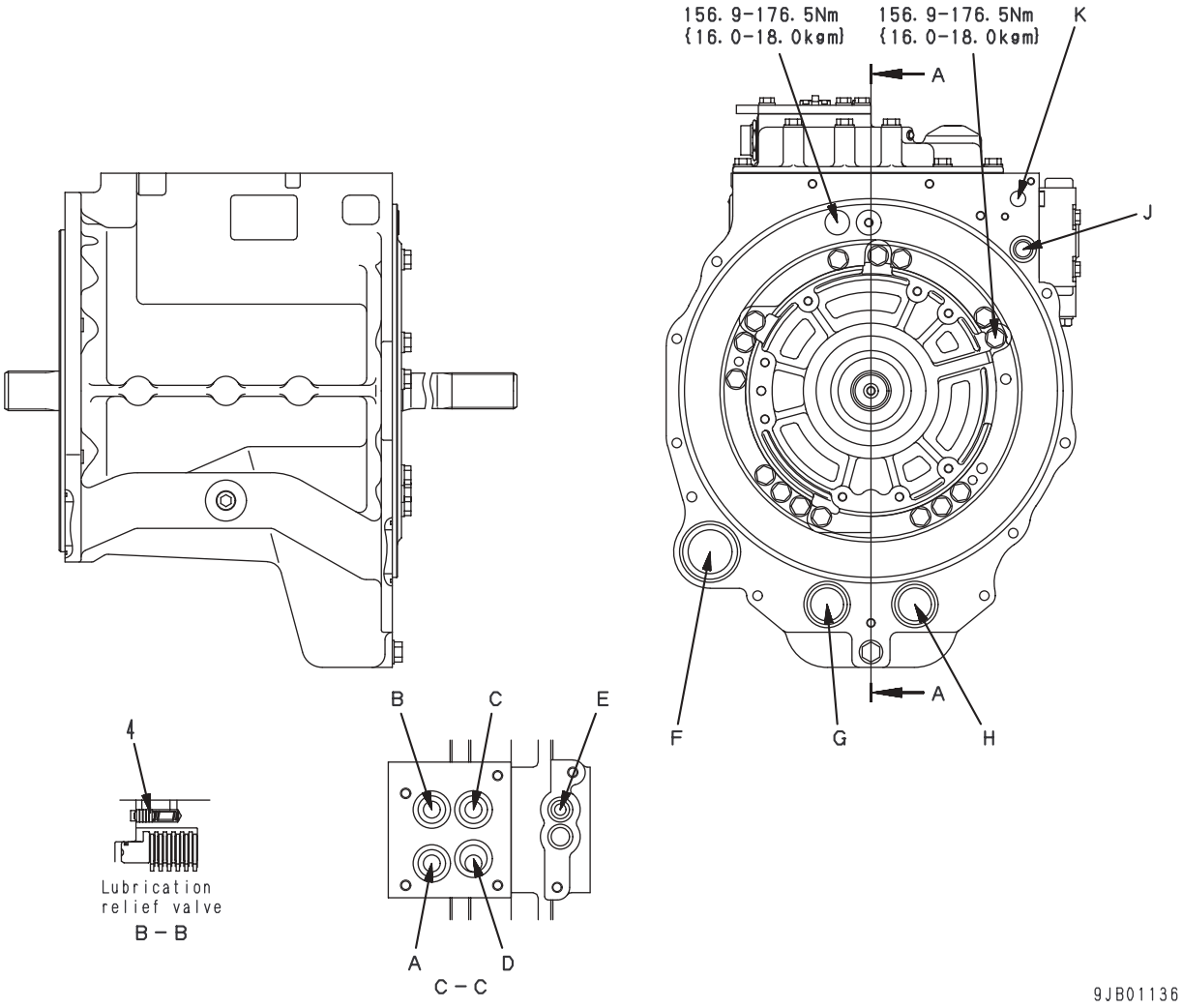
A: Neutral
B: Forward
C: Reverse
D: OFF
E: Shift UP
F: Shift DOWN
G: Free
H: Lock

Outline

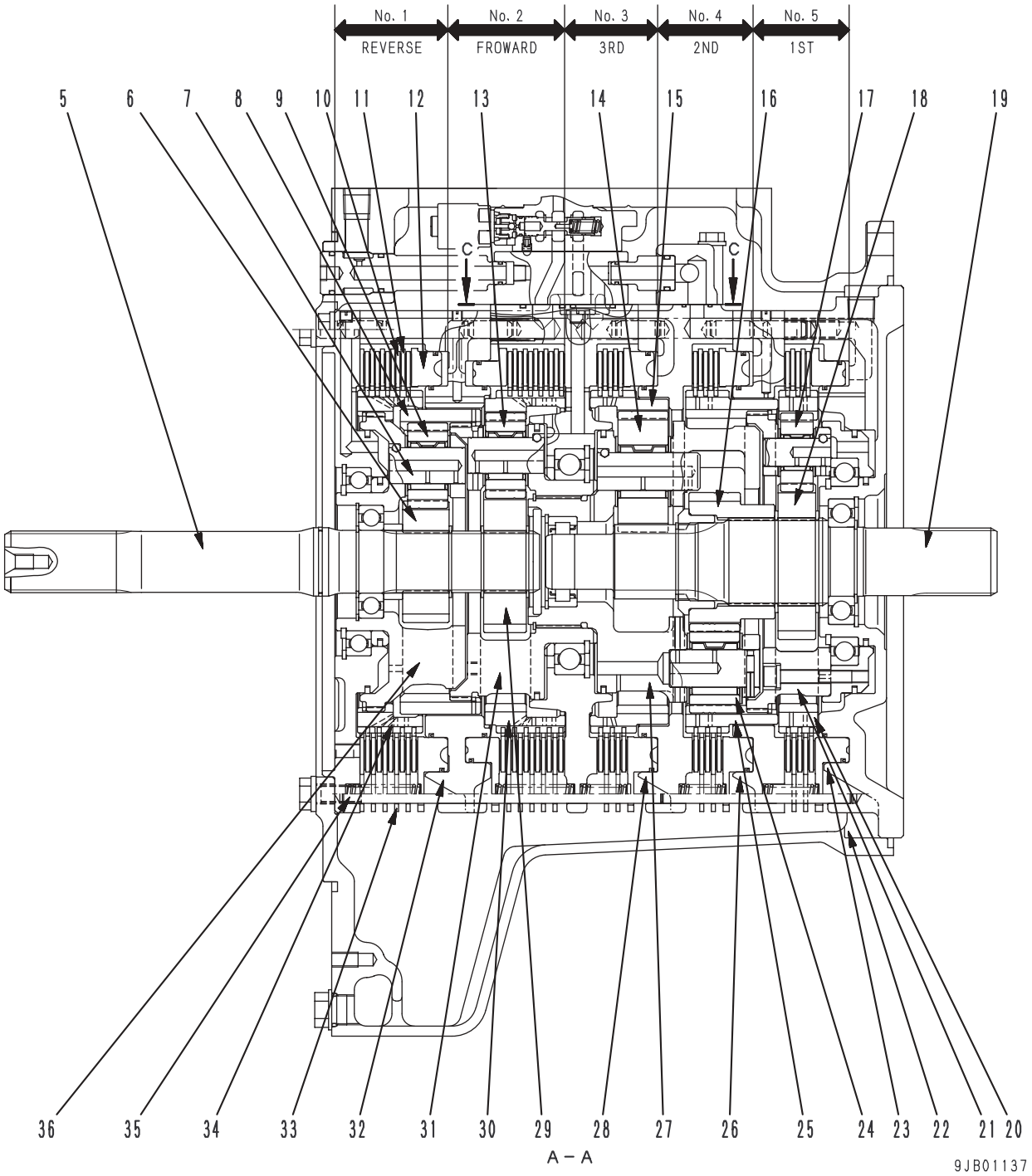
- The transmission is controlled with PCCS lever (3).
  The PCCS lever is used to select the travel direction and shift the gear.
- Since the safety mechanism is employed, transmission neutral safety switch (4) does not work and the engine does not start unless safety lever (2) is in the LOCK position.

TRANSMISSION





A: To forward clutch
B: To reverse clutch
C: To 3rd clutch
D: To 2nd clutch
E: To 1st clutch
F: To torque converter case
(To power train pump)
G: From torque converter case
H: To scavenging pump
J: To torque converter case
K. From power train pump
L. To steering valve
M. From steering case
N. Transmission lubrication oil inlet
P. Transmission 1st clutch pressure pick-up port
Q. Transmission 3rd clutch pressure pick-up port
R. Transmission R clutch pressure pick-up port
S. Transmission 2nd clutch pressure pick-up port
T. Transmission F clutch pressure pick-up port


No. 1
REVERSE
No. 2
FROWARD
No. 3
3RD
No. 4
2ND
No. 5
1ST
5 6 7 8 9 10 11 12 13 14 15 16 17 18 19
C
C
36 35 34 33 32 31 30 29 28 27 26 25 24 23 22 21 20
A – A
9JB01137

1. Main relief valve
2. Transmission case
3. Transmission control valve and valve cover
4. Lubricating oil relief valve
5. Input shaft
6. Sun gear for reverse (30 teeth)
7. Pinion shaft
8. Ring gear of reverse travel (70 teeth)
9. Planetary pinion for reverse travel (20 teeth)
10. Disc
11. Plate
12. Piston
13. Planetary pinion for forward travel (20 teeth)
14. Planetary pinion for 3rd gear speed (30 teeth)
15. Ring gear for 3rd gear speed (Number of internal teeth: 76, Number of external teeth: 90)
16. Sun gear for 2nd gear speed (33 teeth)
17. Planetary pinion for 1st gear speed (18 teeth)
18. Sun gear for 1st gear speed (39 teeth)
19. Output shaft (Number of teeth of sun gear for 3rd gear speed: 17)
20. Ring gear for 1st gear speed (Number of internal teeth: 75, Number of external teeth: 90)
21. Carrier for 1st gear speed (75 teeth)
22. Clutch housing for 1st gear speed
23. Clutch housing for 2nd gear speed
24. Planetary pinion for 2nd gear speed (21 teeth)
25. Ring gear for 2nd gear speed (Number of internal teeth: 75, Number of external teeth: 90)
26. Clutch housing for 3rd gear speed
27. Carrier for 2nd and 3rd gear speeds
28. Clutch housing for forward travel
29. Sun gear for forward travel (35 teeth)
30. Ring gear for forward travel (Number of internal teeth: 75, Number of external teeth: 90)
31. Carrier for forward (70 teeth)
32. Clutch housing for reverse
33. Return spring
34. Ring gear (hub) for reverse (Number of internal teeth: 75, Number of external teeth: 90)
35. Pin
36. Carrier for reverse travel (75 teeth)

Outline

- The transmission consists of planetary gear systems and disc clutches and has "3 forward gear speeds and 3 reverse gear speeds".
- Among the 5 sets of planetary gear system and disc clutch of the transmission, 2 clutches are fixed hydraulically with control valves to select 1 rotating direction and rotating speed.
- Clutches No. 1, No. 2, No. 3, No. 4, and No. 5 are fixed respectively when the reverse, forward, 3rd, 2nd, and 1st gears are selected.

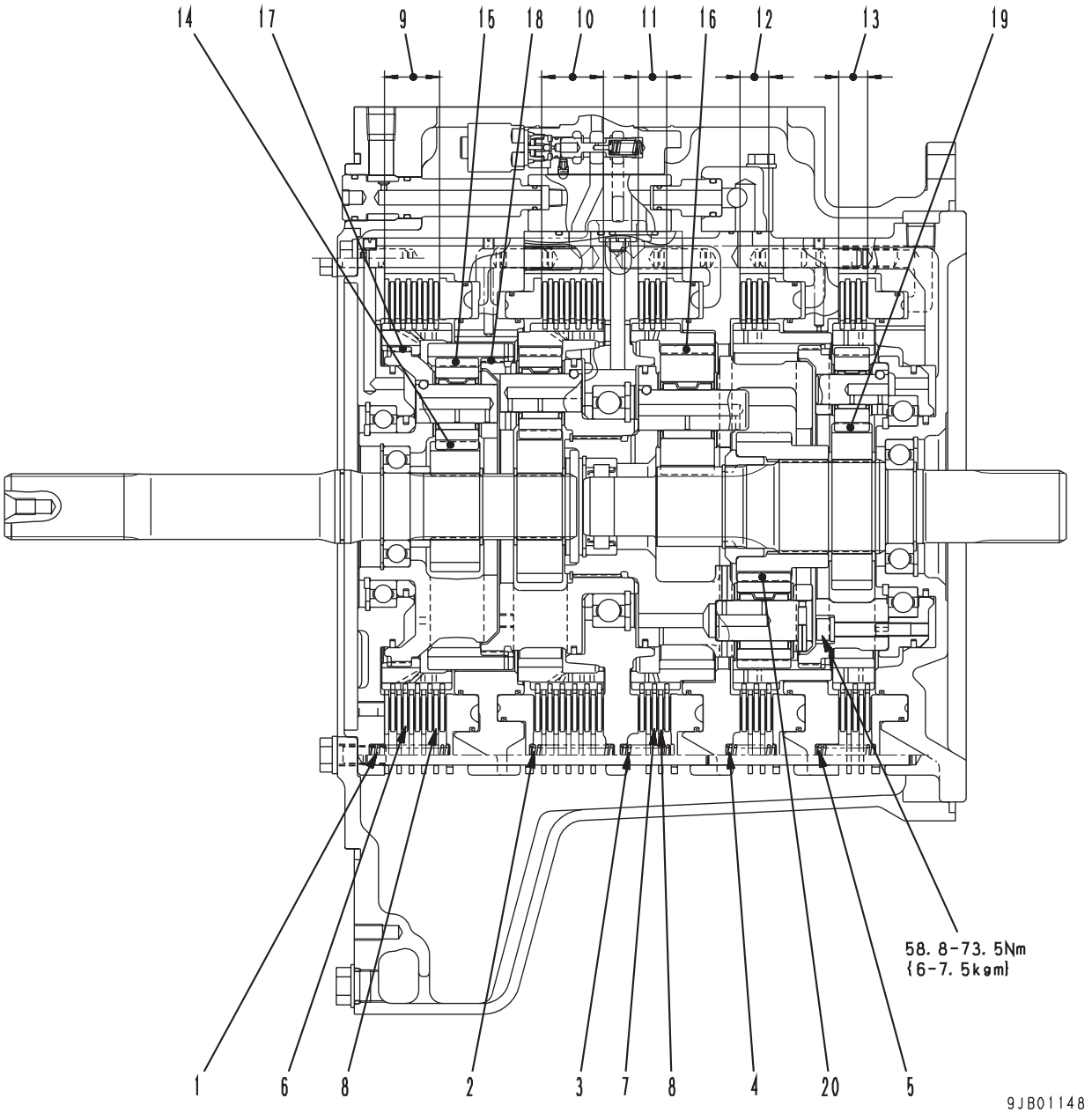
Number of plates and discs

Clutch No.	Number of discs	Number of plates
No.1	5	5
No.2	6	5
No.3	3	2
No.4	3	2
No.5	3	2

Gear speeds and operated clutches

Gear speed	Operated clutches (Turned ON)
Forward 1st	No.2・No.5
Forward 2nd	No.2・No.4
Forward 3rd	No.2・No.3
Neutral	* 1. No.5
Reverse 1st	No.1・No.5
Reverse 2nd	No.1・No.4
Reverse 3rd	No.1・No.3

* 1: Speed clutch No. 5, No. 4, or No. 3 is simply filled with low-pressure oil.


14
17
9
15
18
10
11
16
12
13
19
58.8-73.5Nm
{6-7.5kgm}
1
6
8
2
3
7
8
4
20
5
9JB01148

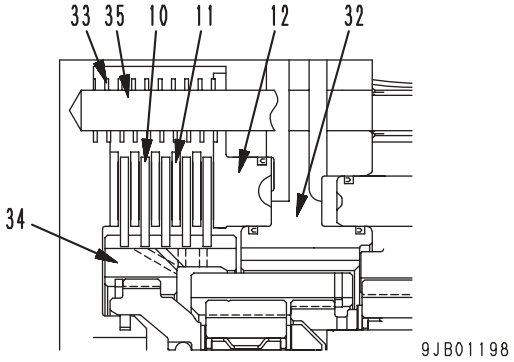
Unit: mm

No.	Check item	Criteria					Remedy
1	No. 1 clutch spring (10 pcs.)	Standard size			Repair limit		Replace
		Free length	Installed length	Installed load	Free length	Installed load	
		77	60	120.6N {12.3 kg}	74.7	114.5N {11.6 kg}	
2	No. 2 clutch spring (10 pcs.)	77	63	99.5N {10.2 kg}	74.7	94.5N {9.6 kg}	
3	No. 3 clutch spring (10 pcs.)	59	37.5	206.8N {21.1 kg}	57.2	196.4N {20.0 kg}	
4	No. 4 clutch spring (10 pcs.)	59	37.5	206.8N {21.1 kg}	57.2	196.4N {20.0 kg}	
5	No. 5 clutch spring (10 pcs.)	59	45	137.3N {14.0 kg}	57.2	130.4N {13.3 kg}	
6	Thickness of clutch disc (No. 1, 2 clutches)	Standard size		Tolerance		Repair limit	
		5.0		± 0.1		4.4	
7	Thickness of clutch disc (No. 3 – 5 clutches)	5.0		± 0.1		4.3	
8	Thickness of clutch plate (No. 1 – 5 clutches)	3.2		± 0.1		2.9	
9	Total thickness of No. 1 clutch (5 discs and 5 plates)	41.0		± 0.3		38.9	
10	Total thickness of No. 2 clutch (5 discs and 5 plates)	46.0		± 0.4		43.7	
11	Total thickness of No. 3 clutch (3 discs and 2 plates)	21.4		± 0.3		20.2	
12	Total thickness of No. 4 clutch (3 discs and 2 plates)	21.4		± 0.3		20.2	
13	Total thickness of No. 5 clutch (3 discs and 2 plates)	21.4		± 0.3		20.2	
14	Backlash between each sun gear and planetary pinion (Forward, reverse, 2nd – 3rd gear speeds)	Standard clearance					
		0.13 – 0.32					
15	Backlash between planetary gear and internal teeth of ring gear (Reverse gear speed)	0.13 – 0.37					
16	Backlash between planetary pinion and internal teeth of ring gear (Forward, 1st and 3rd gear speeds)	0.14 – 0.37					
17	Backlash between each carrier and internal teeth of ring gear (Reverse and 1st gear speeds)	0.18 – 0.54					
18	Backlash between carrier and internal teeth of ring gear (Forward gear speed)	0.18 – 0.54					
19	Backlash between sun gear and planetary pinion (1st gear speed)	0.14 – 0.35					
20	Backlash between planetary gear and internal teeeth of ring gear (2nd gear speed)	0.13 – 0.32					

Operation

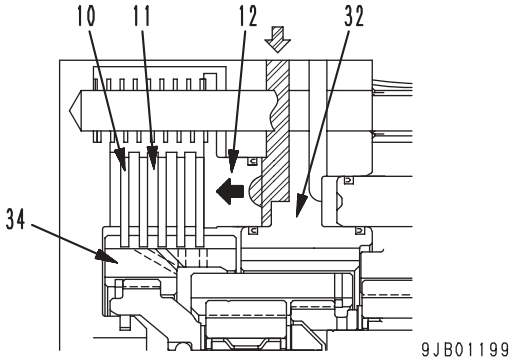
Operation of disc clutch

- To lock ring gear (hub) (34) a disc clutch is used. The clutch consists of piston (12), plates (11), discs (10), pin (35) and piston return springs (33).
- The internal teeth of the disc engage with the external teeth of the ring gear.
- The teeth on the outside diameter of the plate engage with pins (35) secured by housing (32).



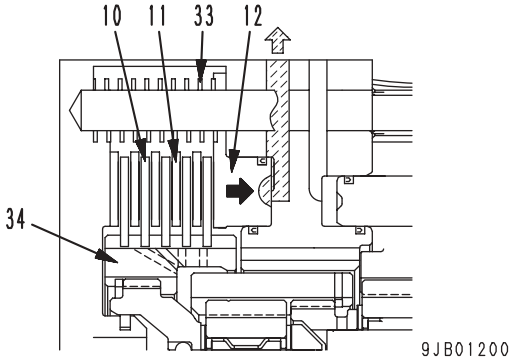
Clutch engaged (locked)

- Oil from the control valve flows under pressure through the port in housing (32) to the back of piston (12).
- The piston presses plates (11) and discs (10) together, and the resulting frictional force stops the rotation of discs so ring gear (hub) (34) meshing with the internal teeth of the disc is locked.



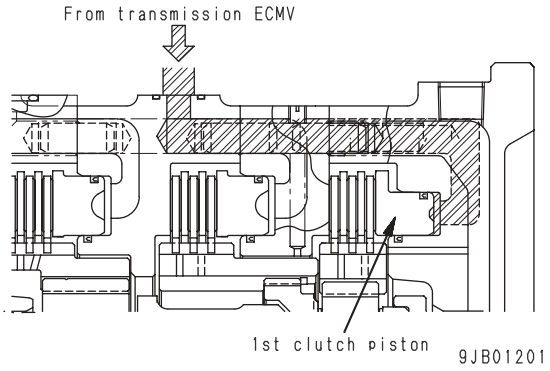
Clutch disengaged (free)

- When the supply of pressure oil from the control valve is shut off, piston (12) is returned to its original position by the force of piston return spring (33). This relieves the frictional force between plates (11) and discs (10), making the ring gear (hub) (34) free.

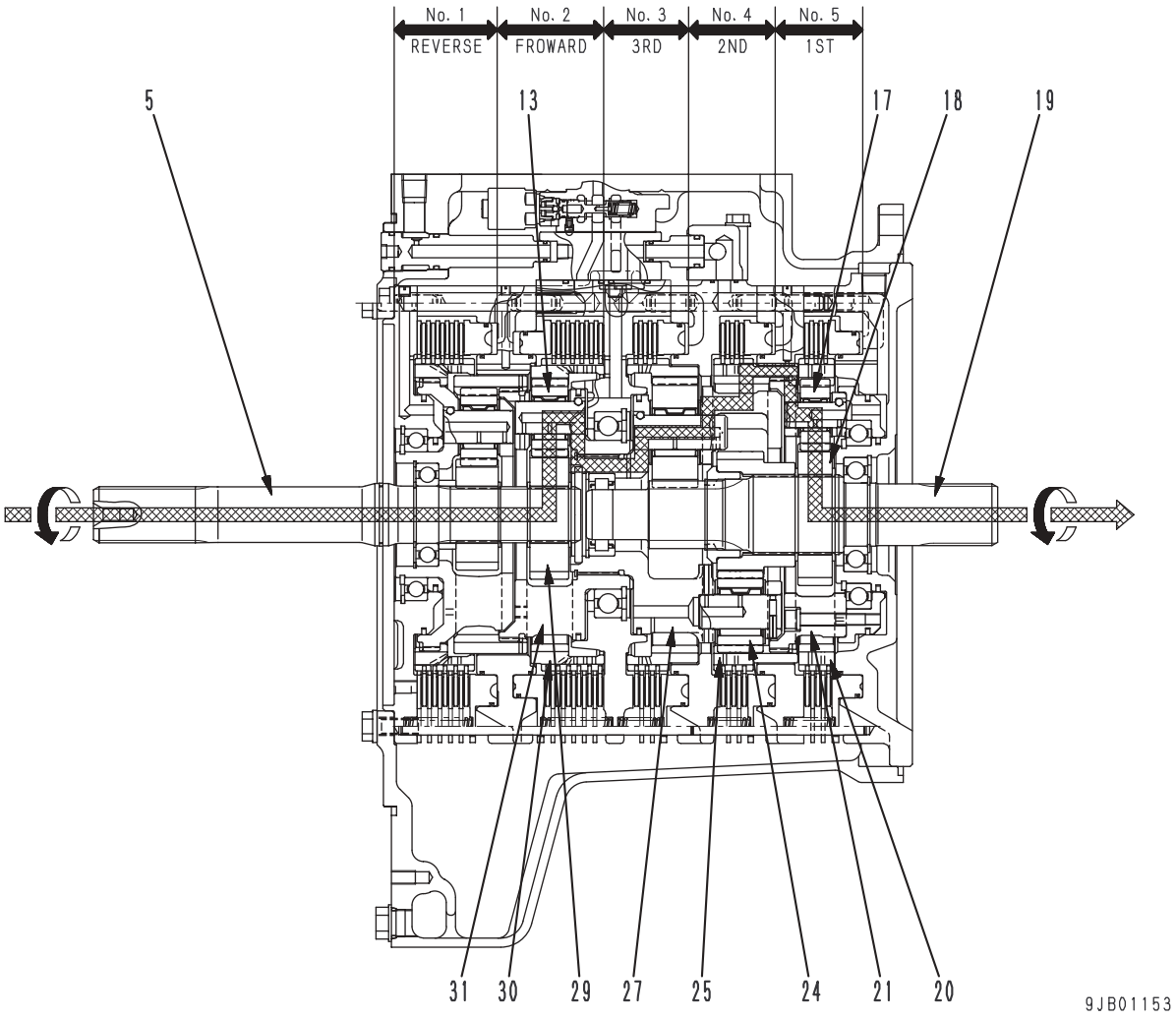


Oil circuit of 1st clutch

- The 1st, 2nd, or 3rd gear speed is set, even if the forward-reverse lever is in the NEUTRAL position. The oil circuit is so controlled electronically that the piston chamber of the speed clutch corresponding to the set gear speed will be kept filled with the oil.
- Accordingly, when the forward-reverse lever is shifted from the NEUTRAL position to the FORWARD or REVERSE position, the pump is required to supply oil of only quantity to fill the piston chamber of the forward or reverse clutch.
- When the gear shift switch is changed from the F1 to F2, the pump is required to supply fill of only quantity to fill the 2nd clutch since the forward clutch has been filled with the oil.
- The time lag in the gear shifting operation is reduced by using the oil as explained above.

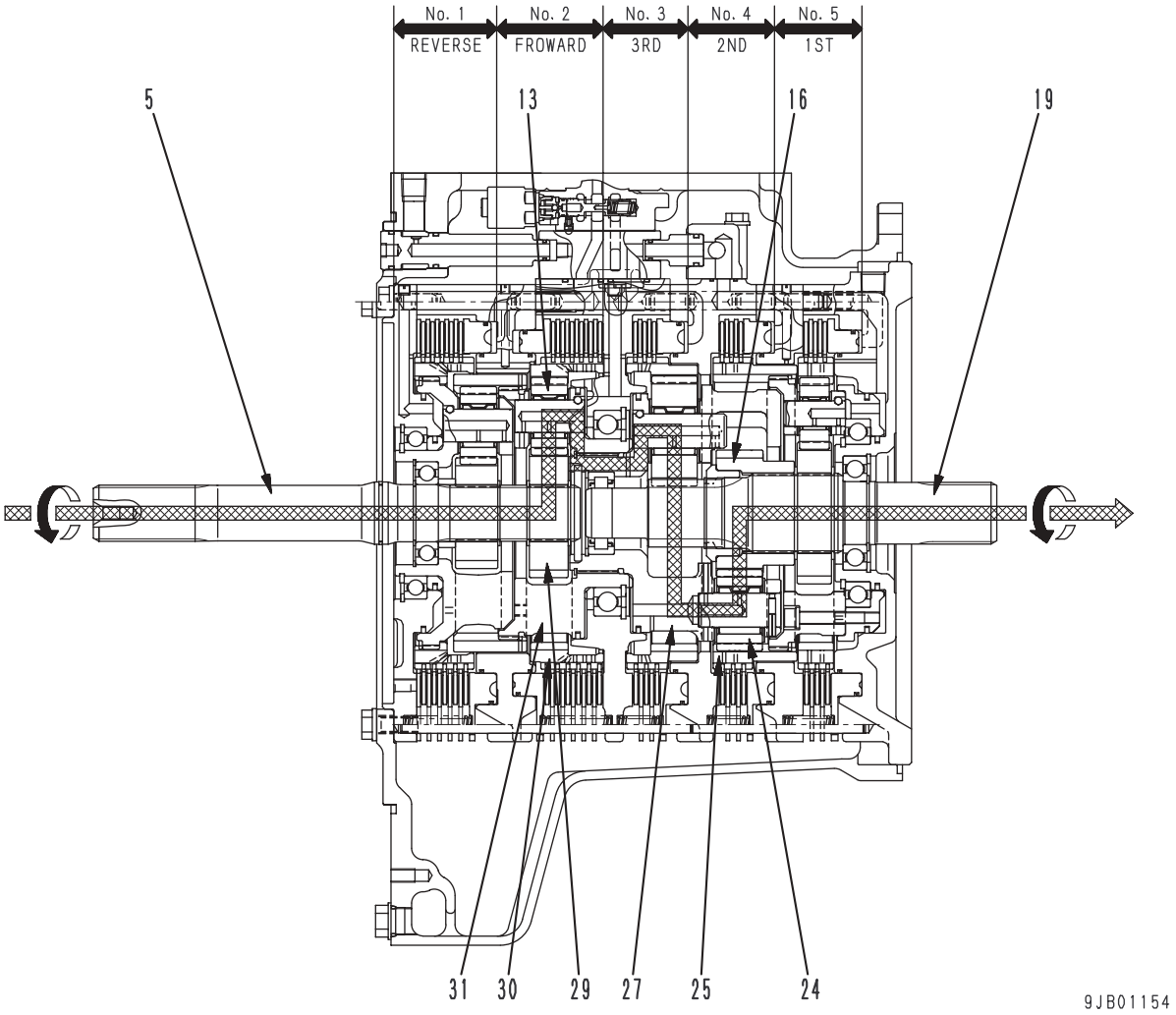


Forward 1st



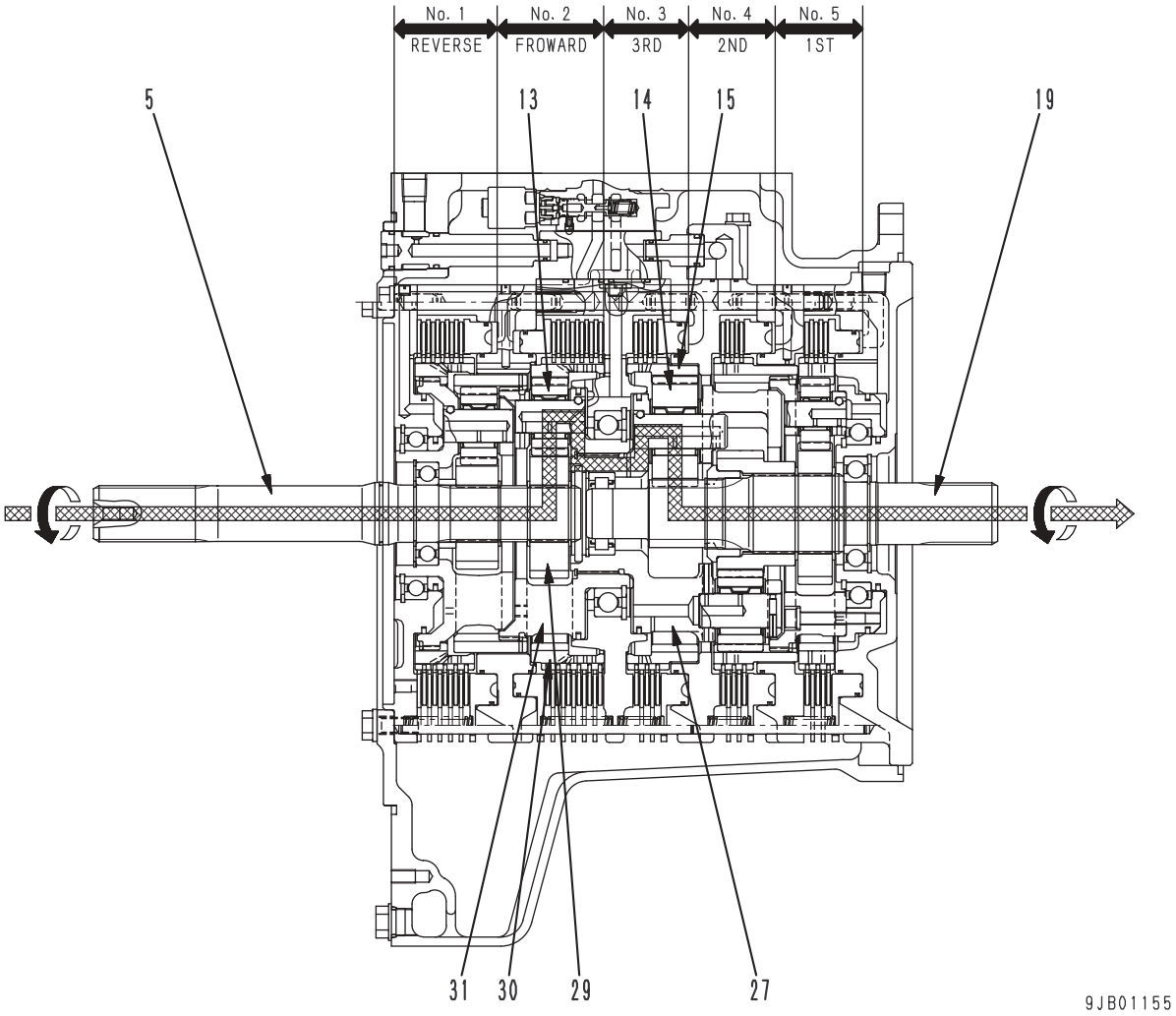
- When the transmission is set to FORWARD 1st, the No. 2 clutch and No. 5 clutch are engaged. The motive force from the torque converter transmitted to input shaft (5) is then transmitted to output shaft (19).
- No. 2 clutch is actuated by the hydraulic pressure applied to the clutch piston, and holds ring gear (30) in position. No. 5 clutch is actuated by the hydraulic pressure applied to the clutch piston, and engages ring gear (20).
- The motive force from the torque converter is transmitted to input shaft (5), and the rotation of the input shaft passes through sun gear (29) and is transmitted to planet pinion (13).
- Ring gear (30) is held in position by No. 2 clutch, so the rotation of planet pinion (13) rotates carrier (31), which is on the inside of ring gear (30).
- Carrier (31) and carrier (27) are joined by a spline, and rotate as one unit, so the rotation of carrier (31) passes through planet pinion (24) and is transmitted to ring gear (25).
- Carrier (21) is meshed with ring gear (25), and rotates as one unit, so the rotation is transmitted to planet pinion (17).
- Ring gear (20) is being held in position by No. 5 clutch, so the rotation of planet pinion (17) rotates sun gear (18), and this rotates output shaft (19).

Forward 2nd



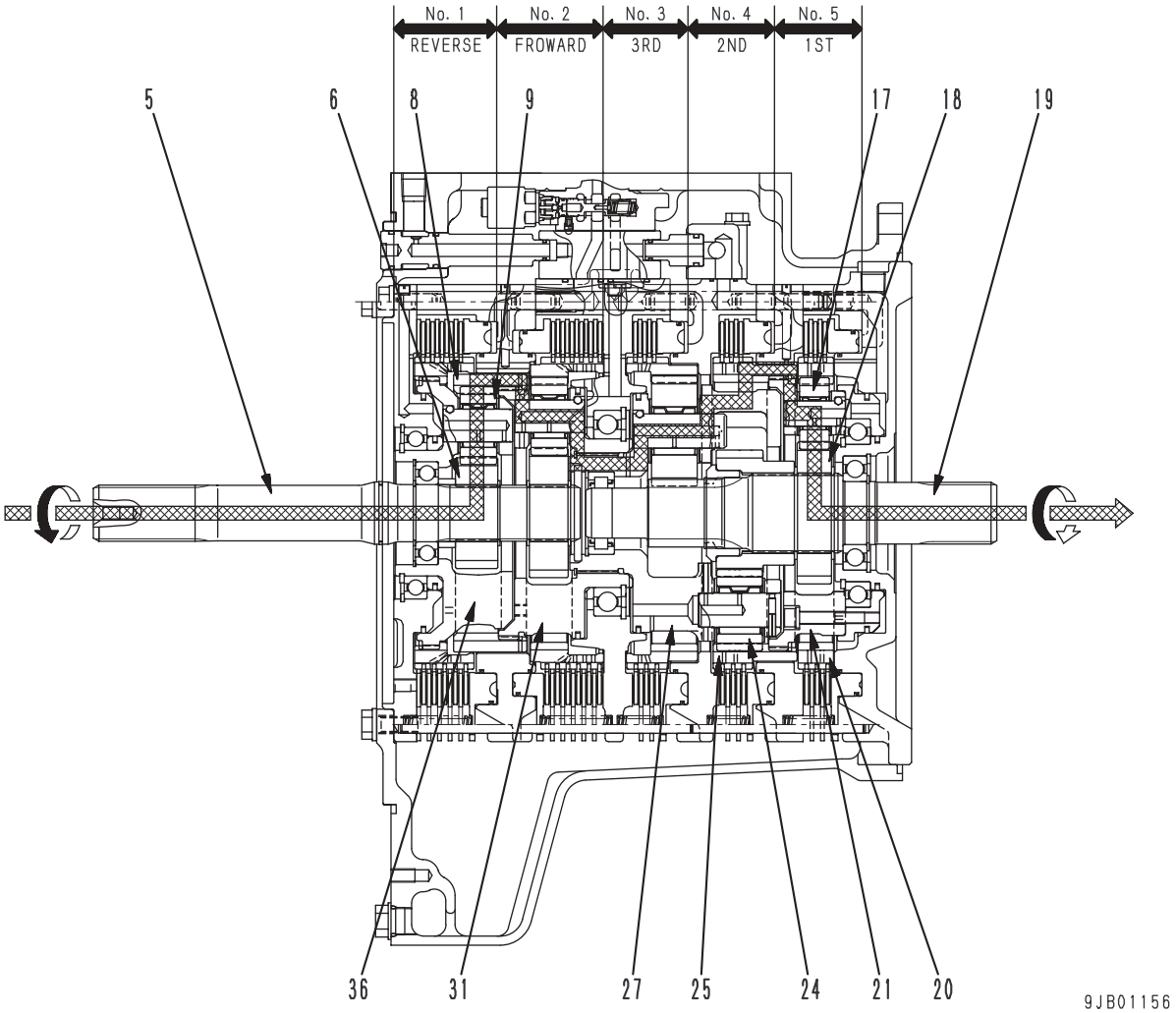
- When the transmission is set to FORWARD 2nd the No. 2 clutch and No. 4 clutch are engaged. The motive force from the torque converter transmitted to input shaft (5) is then transmitted to output shaft (19).
- No. 2 clutch is actuated by the hydraulic pressure applied to the clutch piston, and holds ring gear (30) in position. No. 4 clutch is actuated by the hydraulic pressure applied to the clutch piston, and engages ring gear (25).
- The motive force from the torque converter is transmitted to input shaft (5), and the rotation of the input shaft passes through sun gear (29) and is transmitted to planet pinion (13).
- Ring gear (30) is held in position by No. 2 clutch, so the rotation of planet pinion (13) rotates carrier (31), which is on the inside of ring gear (30).
- Carrier (31) and carrier (27) are joined by a spline, and rotate as one unit, so the rotation is transmitted to planet pinion (24).
- Ring gear (25) is being held in position by No. 4 clutch, so the rotation of planet pinion (24) rotates sun gear (16), and this rotates output shaft (19).

Forward 3rd



- When the transmission is set to FORWARD 3rd the No. 2 clutch and No. 3 clutch are engaged. The motive force from the torque converter transmitted to input shaft (5) is then transmitted to output shaft (19).
- No. 2 clutch is actuated by the hydraulic pressure applied to the clutch piston, and holds ring gear (30) in position. No. 5 clutch is actuated by the hydraulic pressure applied to the clutch piston, and engages ring gear (15).
- The motive force from the torque converter is transmitted to input shaft (5), and the rotation of the input shaft passes through sun gear (29) and is transmitted to planet pinion (13).
- Ring gear (30) is held in position by No. 2 clutch, so the rotation of planet pinion (13) rotates carrier (31), which is on the inside of ring gear (30).
- Carrier (31) and carrier (27) are joined by a spline, and rotate as one unit, so the rotation is transmitted to planet pinion (14).
- Ring gear (15) is being held in position by No. 3 clutch, so the rotation of planet pinion (14) rotates output shaft (19).

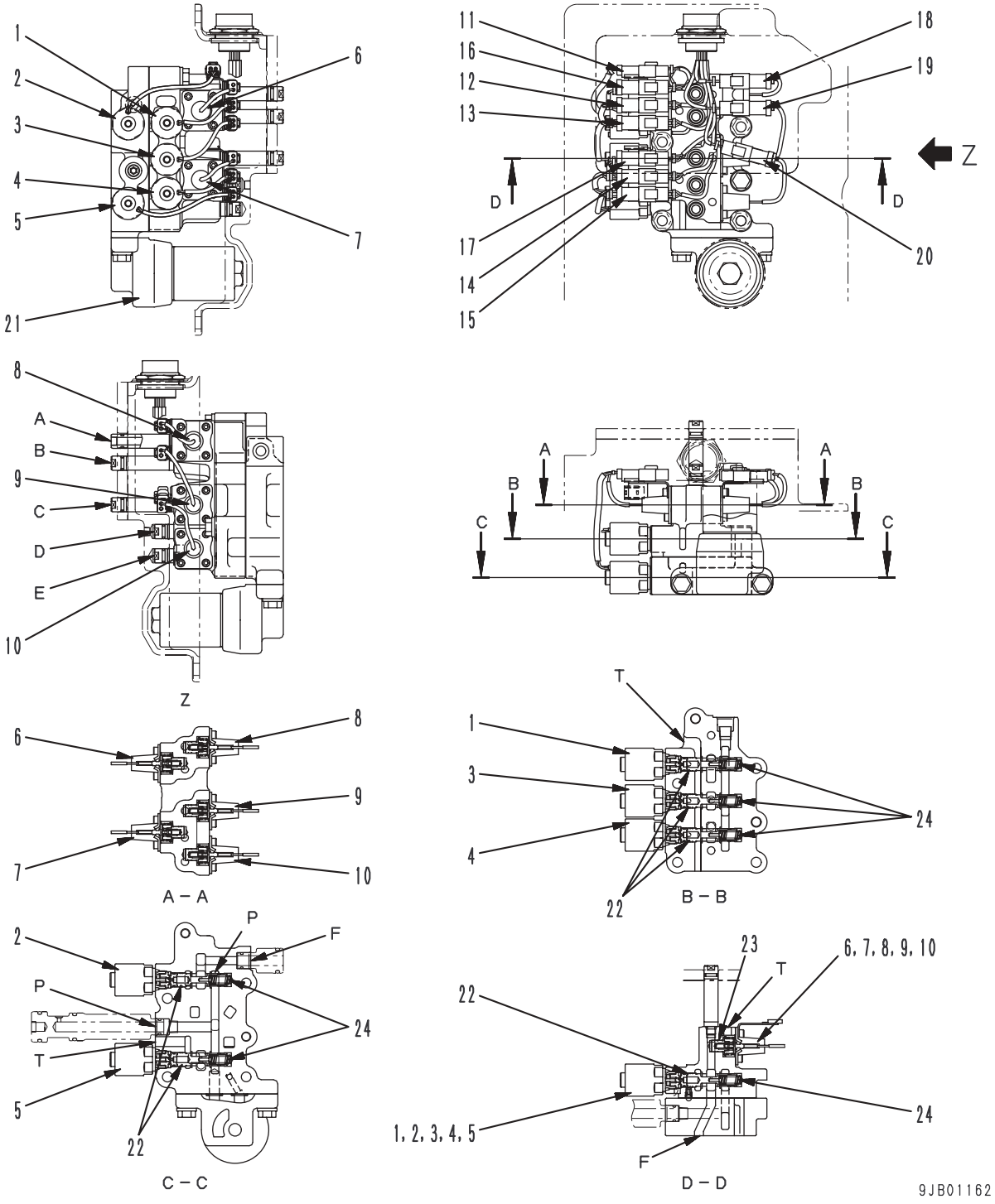
Reverse 1st



- When the transmission is set to REVERSE 1st, the No. 1 clutch and No. 5 clutch are engaged. The motive force from the torque converter transmitted to input shaft (5) is then transmitted to output shaft (19).
- No. 1 clutch is actuated by the hydraulic pressure applied to the clutch piston, and holds carrier (36) in position. No. 5 clutch is actuated by the hydraulic pressure applied to the clutch piston, and engages ring gear (20).
- The motive force from the torque converter is transmitted to input shaft (5), and the rotation of the input shaft passes through sun gear (6) and is transmitted to planet pinion (9).
- Carrier (36) is held in position by No. 1 clutch, so the rotation of planet pinion (9) rotates ring gear (8).
  Ring gear (8) rotates in the opposite direction from the input shaft, and rotates carrier (31).
- Carrier (31) and carrier (27) are joined by a spline, and rotate as one unit, so the rotation of carrier (31) passes through planet pinion (24) and is transmitted to ring gear (25).
- Carrier (21) is meshed with ring gear (25), and rotates as one unit, so the rotation is transmitted to planet pinion (17).
- Ring gear (20) is being held in position by No. 5 clutch, so the rotation of planet pinion (17) rotates sun gear (18), and this rotates output shaft (19).

TRANMISSION ECMV

(Electronic control modulation valve)

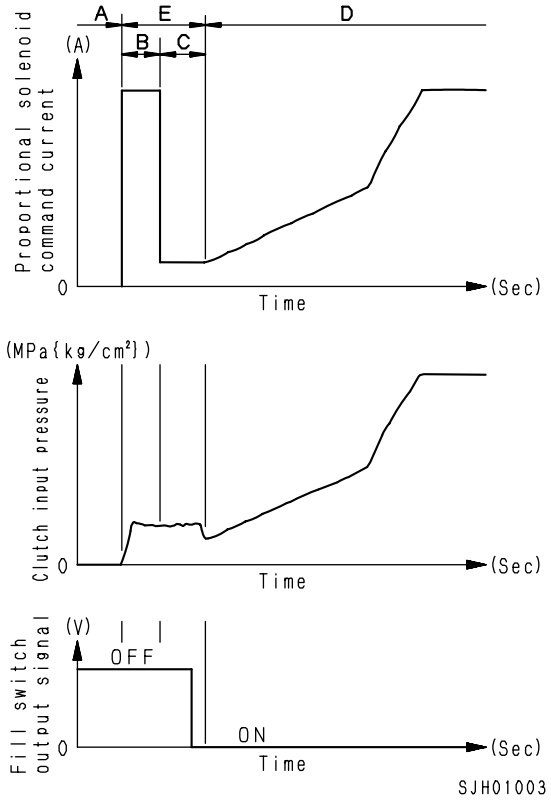


A: 1st clutch operating pressure pick-up port
B: 3rd clutch operating pressure pick-up port
C: R clutch operating pressure pick-up port
D: 2nd clutch operating pressure pick-up port
E: F clutch operating pressure pick-up port
F: To clutch
P: From pump
T. Drain

1. Proportional solenoid valve for 3rd clutch ECMV
2. Proportional solenoid valve for 1st clutch ECMV
3. Proportional solenoid valve for R clutch ECMV
4. Proportional solenoid valve for 2nd clutch ECMV
5. Proportional solenoid valve for F clutch ECMV
6. Fill switch for 3rd clutch
7. Fill switch for 2nd clutch
8. Fill switch for 1st clutch
9. Fill switch for R clutch
10. Fill switch for F clutch
11. Connector for 1st proportional solenoid valve
12. Connector for 3rd proportional solenoid valve
13. Connector for R proportional solenoid valve
14. Connector for 2nd proportional solenoid valve
15. Connector for F proportional solenoid valve
16. Connector for 3rd fill switch
17. Connector for 2nd fill switch
18. Connector for 1st fill switch
19. Connector for R fill switch
20. Connector for F fill switch
21. Filter
22. Pressure control valve
23. Oil pressure detection valve
24. Pressure control valve spring

Outline of ECMV

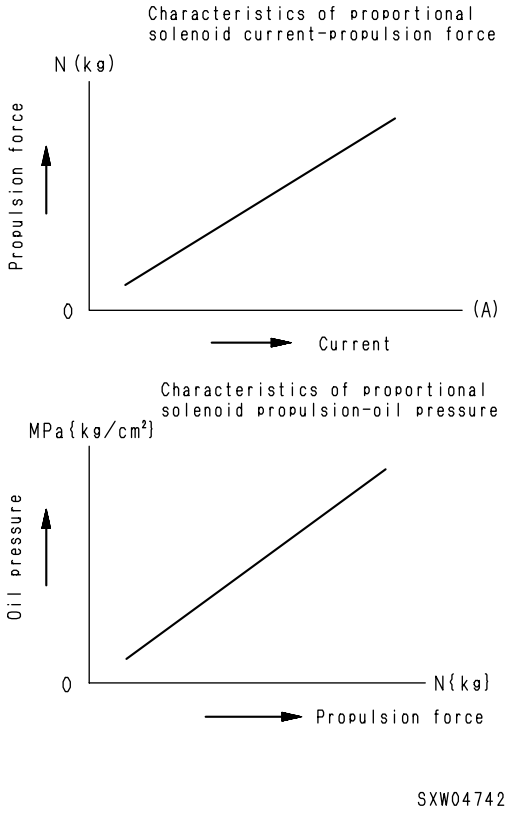
- The ECMV (Electronic Control Modulation Valve) consists of the following two units, a pressure control valve and fill switch.
- **Pressure control valve**
  Converts a current sent from the transmission controller to the proportional solenoid valve, to an oil pressure.
- **Fill switch**
  Detects that the clutch is filled with oil. It has the functions below.
  1) It outputs a signal (fill signal) to the controller as soon as the clutch is filled with oil to report the completion of filling.
  2) It outputs a signal (fill signal) to the controller while an oil pressure is applied to the clutch to report the presence/absence of oil pressure.
     A region: Before gear shift (When draining)
     B region: Filling starts (During trigger)
     C region: Filling finishes
     D region: Voltage regulation
     E region: During filling



ECMV and proportional solenoid

- One proportional solenoid is attached to one ECMV. After receiving the command current from the controller, it produces thrust in the figure below.

  By making the proportional solenoid-produced thrust act on the pressure control valve spool, it produces an oil pressure shown in the figure below. By controlling the amount of command current, the thrust is changed to operate the pressure control valve, controlling the oil flow and oil pressure.



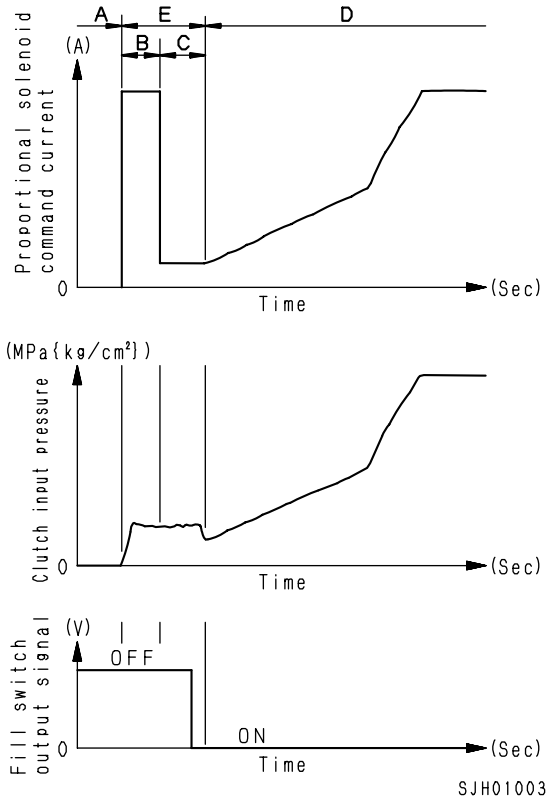
ECMV and fill switch

- One fill switch is attached to one ECMV.
  When the clutch completes filling, the pressure of the clutch turns "ON" the fill switch. By this signal, the oil pressure starts build-up.

Operation of ECMV

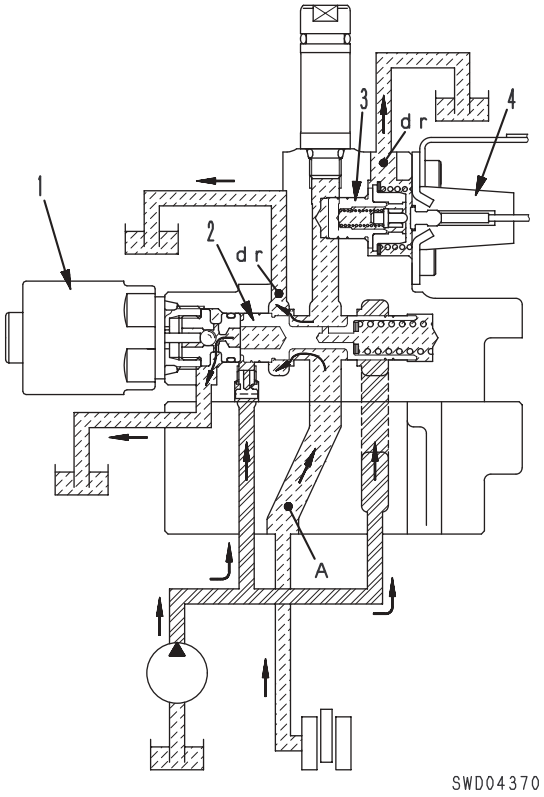
- The ECMV is controlled by the command current sent from the controller to the proportional solenoid and the fill switch output signal.
  The relation among the proportional solenoid command current of the ECMV, the clutch input pressure, and fill switch output signal is as shown in the figure to the right.

A region: Before gear shift (When draining)
B region: Filling starts (During trigger)
C region: Filling finishes
D region: Voltage regulation
E region: During filling



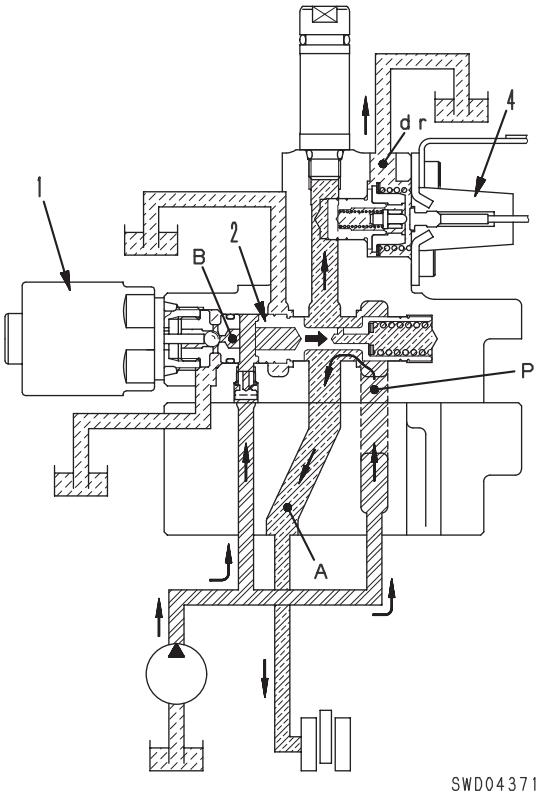
- The clutch is crimped by the piston when shifting the gear with the gear shift switch. If a high oil pressure is applied suddenly, however, the piston connects to the clutch suddenly, causing the machine to make a sudden start and give an excessive shock to the machine.
  To prevent them, it is designed so that if you connect the ECMV to shift gears with the gear shift switch, the oil pressure to the clutch may be gradually increased up to the specified level. By this design, the clutch is excited smoothly to eliminate the shock at the start, improve the durability of the power transfer system, and also provide operator comfort.

1. **Before gear shift (Region A in the diagram)**
   When a current is not carried to the proportional solenoid (1), the pressure control valve (2) is draining the oil at the clutch port **A** through the drain port **dr**.
   Since, at that time, no oil pressure acts on the oil pressure detection valve (3), the fill switch (4) is OFF.



2. When filling (When inputting the trigger command to the pressure control valve) (B and C regions in the diagram)

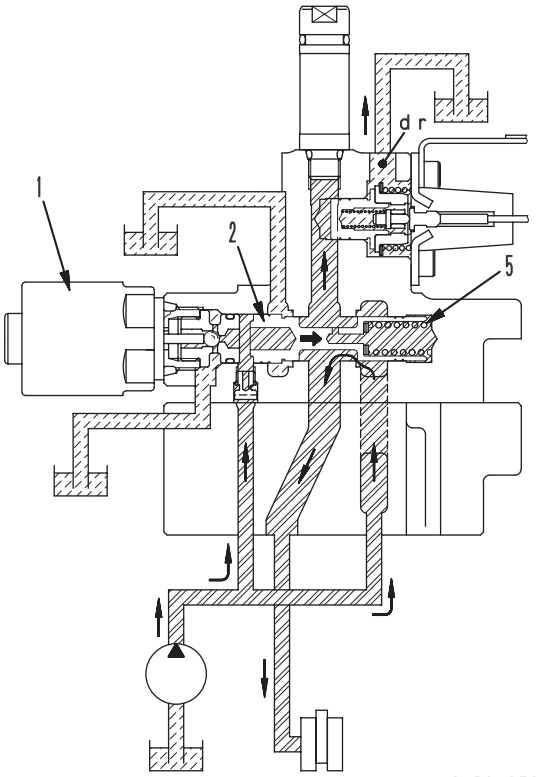
If you supply a current to the proportional solenoid (1) with no oil in the clutch, an oil pressure proportional to the solenoid force acts on the chamber **B**, pushing the pressure control valve (2) rightward. This operation opens the pump port **P** and clutch port **A** to start filling the clutch with oil. When the clutch is filled with oil, the fill switch (4) is turned ON.



SWD04371

3. Pressure regulation (D region in the diagram)

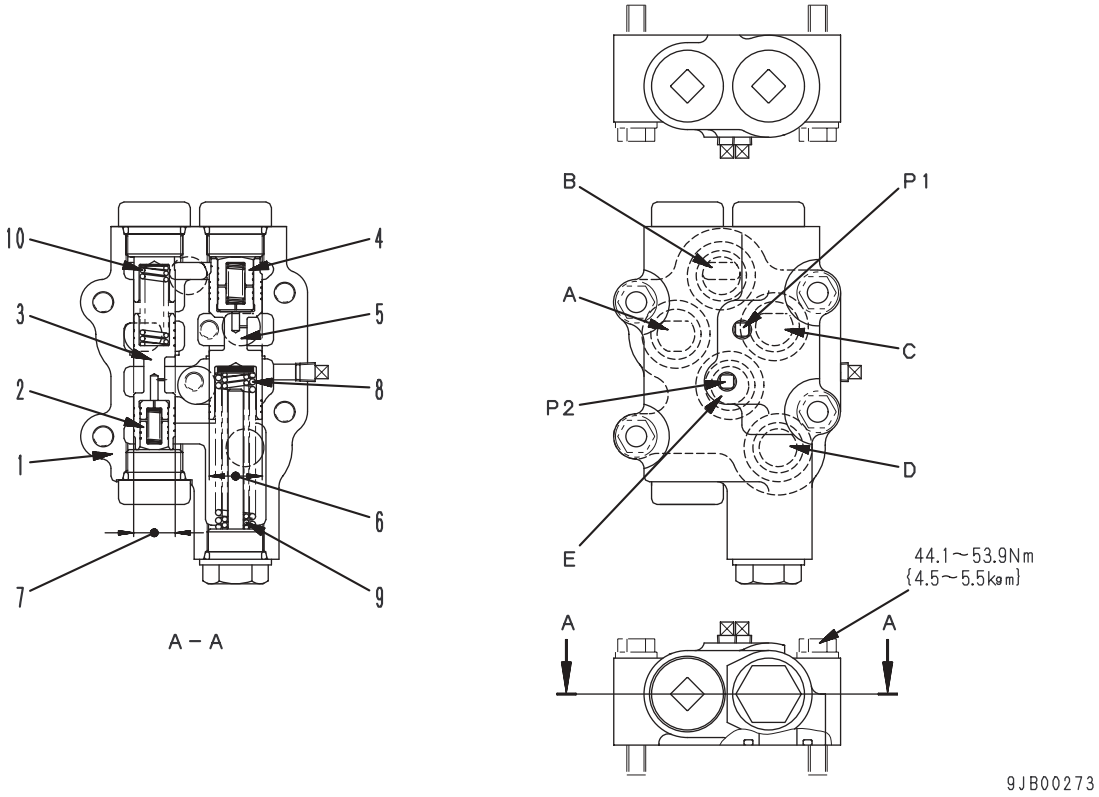
If you flow a current to the proportional solenoid (1), the solenoid produces thrust proportional to the current. Pressure is regulated by striking a balance among the thrust of the solenoid, the thrust of the oil pressure of the clutch port, and reaction force of the pressure control spring (5).



SWD04372

MAIN RELIEF VALVE

Main relief, torque converter relief valve



A: Drain port (for torque converter relief)
B: Drain port
C: From pump
D: Drain port
E: To torque converter
P1: Main relief oil pressure detection port
P2: Torque converter relief oil pressure detection 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 main relief valve and valve body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		ø28	– 0.035 – 0.045	+0.013 0	0.035 – 0.058	0.078	
7	Clearance between torque converter relief valve and valve body	ø22	– 0.035 – 0.045	+0.013 0	0.035 – 0.058	0.078	
8	Main relief valve spring (outer)	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		128	75.3	508.6 N {51.9 kg}	124.2	483.2 N {49.3 kg}	
9	Main relief valve spring (inner)	108	78.0	401.8 N {41.0 kg}	104.8	381.7 N {39.0 kg}	
10	Torque converter relief valve spring	50	40.5	182.1 N {18.6 kg}	48.5	173 N {17.7 kg}	

Outline

Torque converter relief valve

The torque converter relief valve protects the torque converter from abnormally high pressure. It is installed in the torque converter inlet port circuit to hold the oil pressure in the torque converter inlet port circuit below the set pressure.

Set pressure: 1.00 MPa {10.2 kg/cm²}
(Cracking pressure)

Main relief valve

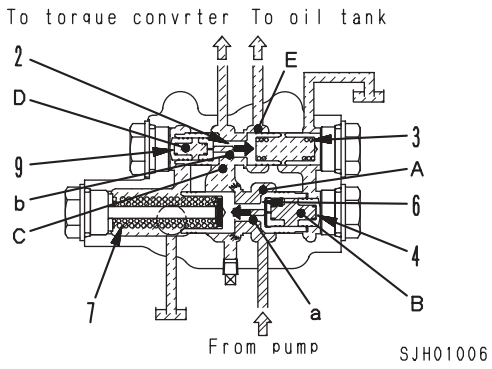
The main relief valve holds the oil pressure in the transmission and brake at the set pressure.

Set pressure: 3.40 MPa {34.7 kg/cm²}
(Engine at rated speed)

Operation

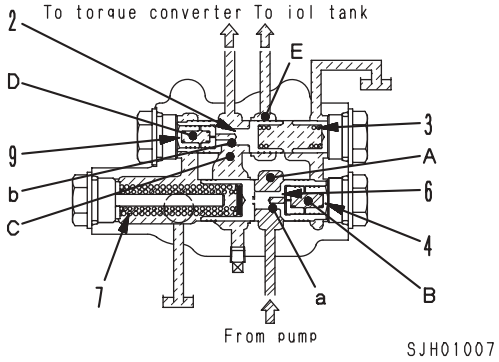
Operation of torque converter relief valve

- 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 compresses valve spring (3) and 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 1.00 MPa {10.2 kg/cm²} (cracking pressure)



Operation of main relief valve

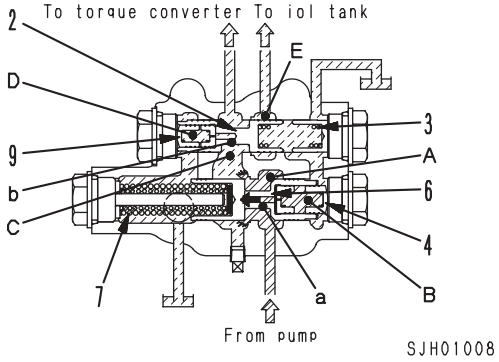
- The oil from the hydraulic pump passes through the filter and enters port **A** of the relief valve. It then passes through orifice **a** of spool (6) and enters chamber **B**.
  When the oil from the pump fills the circuit, the oil pressure starts to rise.



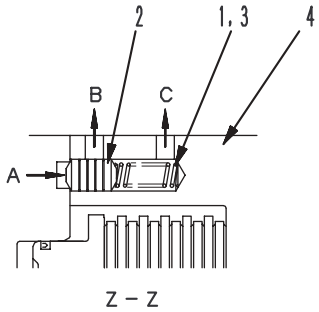
As the oil pressure in the circuit rises, the oil entering chamber **B** pushes piston (4). The reaction force compresses valve spring (7) and moves spool (6) to the left to open the circuit between port **A** and port **C**.

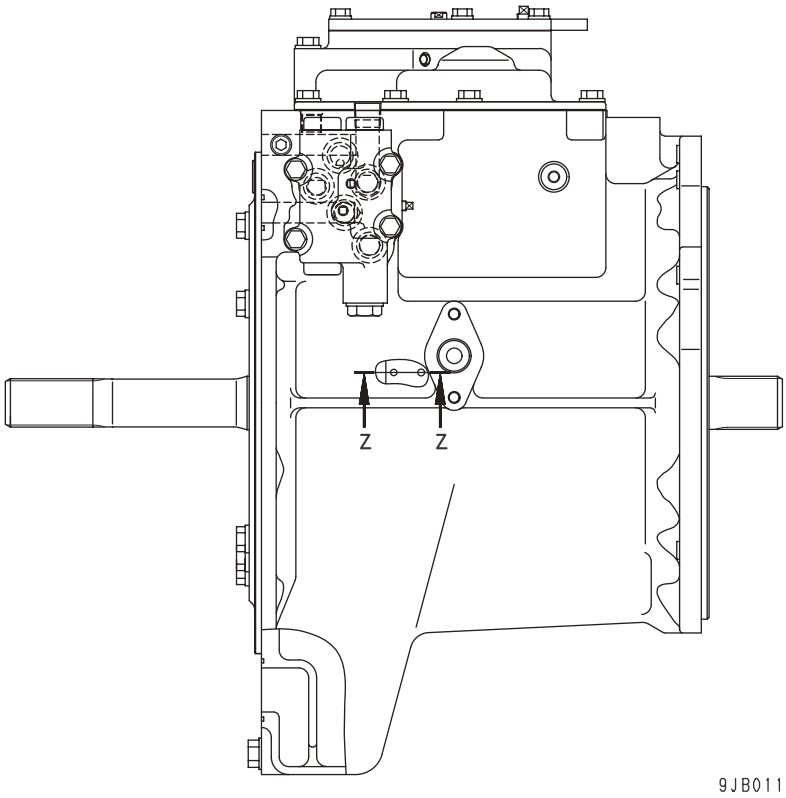
When this happens, the oil at port **A** is relieved to port **C** and flows from port **C** to the torque converter.

The oil pressure at port **A** at this point is 3.40 MPa {34.7 kg/cm²} (engine at rated speed)



LUBRICATION RELIEF VALVE





2. Piston
3. Spring
4. Forward clutch housing

A: From oil cooler
B: Drain
C: Drain

Outline

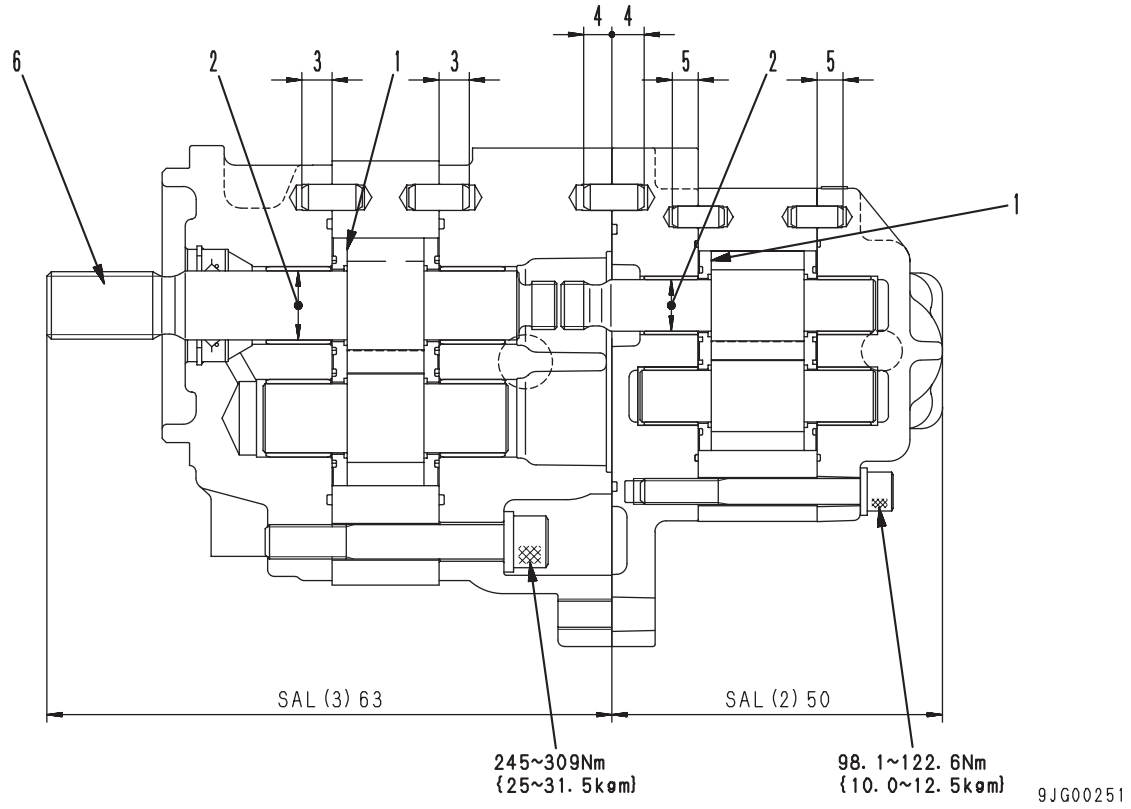
- The oil leaving the torque converter passes through the oil cooler built in the radiator lower tank. It then goes through the lubrication relief valve and lubricates the transmission and PTO.
- The lubrication relief valve is installed to the right side face of the forward clutch housing. And prevents any abnormal pressure in the lubrication oil.
- At this time, the oil pressure (cracking pressure) is 0.34 MPa {3.5 kg/cm^2}.
  The normal oil pressure is 0.08 – 0.20 MPa {0.8 – 2.0 kg/cm^2}

Unit: mm

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

POWER TRAIN PUMP, LUBRICATION PUMP

SAL (3) 63 + (2) 50

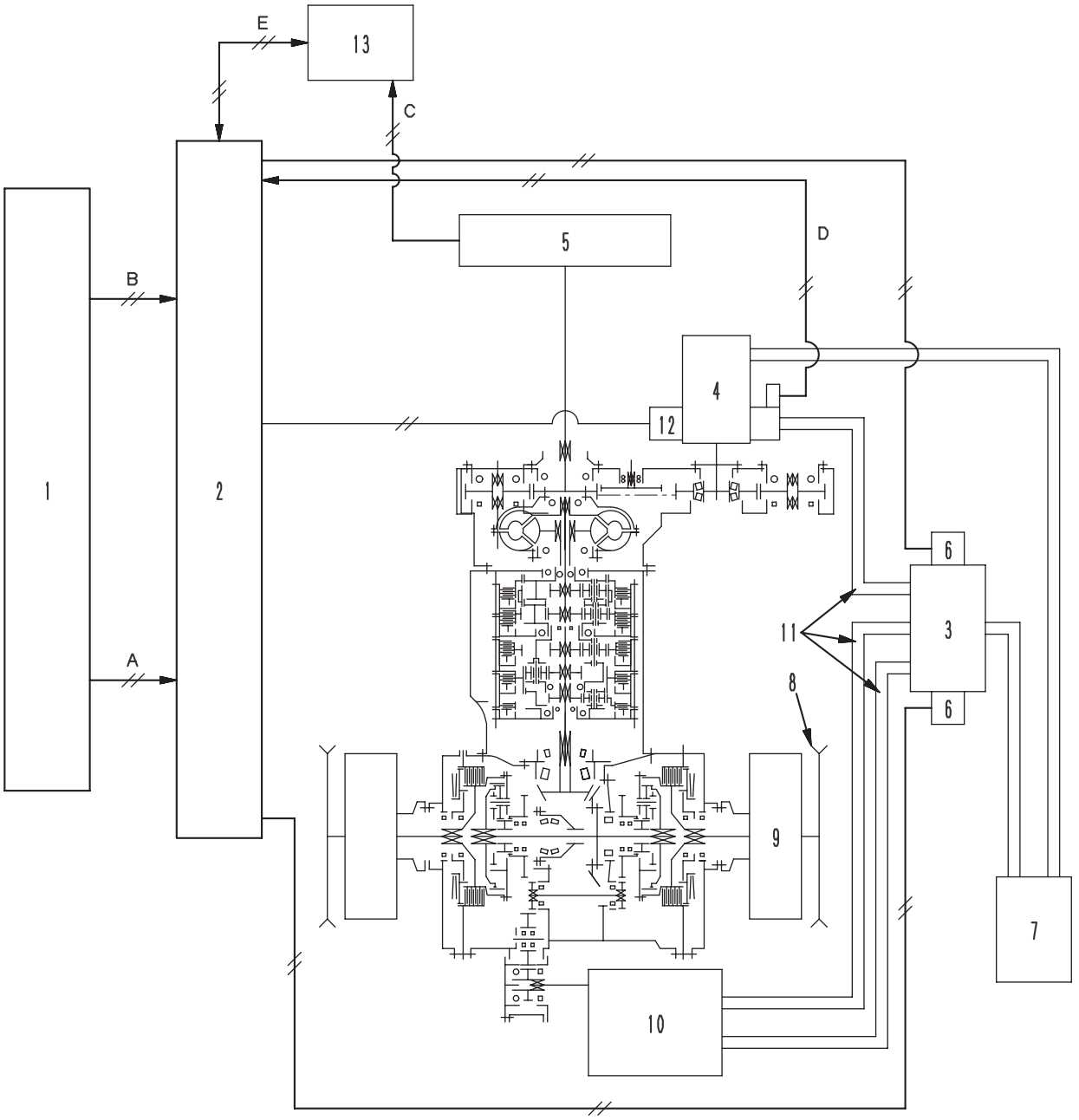


Unit: mm

No.	Check item	Criteria			Remedy
1	Side clearance	Type	Standard clearance	Clearance limit	Replace
		SAL (3) 63	0.10 – 0.15	–	
		SAL (2) 50			
2	Clearance between plain bearing inner diameter and gear shaft outer diameter	SAL (3) 63	0.060 – 0.149	–	
		SAL (2) 50			
3	Pin driving depth	Standard size	Tolerance		
		14	0 – 0.5		
4	Pin driving depth	13	0 – 0.5		
5	Pin driving depth	12	0 – 0.5		
6	Spline shaft rotation torque	9.8 – 18.6 Nm {1.0 – 1.9 kgm}			

No.	Check item	Type	Speed (rpm)	Delivery pressure MPa {kg/cm^2}	Standard delivery (ℓ/min)	Delivery limit (ℓ/min)	Remedy
–	Delivery (Oil: EO10-CD Oil temperature: 45 – 50°C)	SAL (3) 63	2,300	3.3 {34}	63.1	–	–
		SAL (2) 50		0.29 {3.0}	50.1	–	

HSS SYSTEM



1. PCCS lever
2. Transmission, steering controller
3. Hydraulic, HSS valve
4. Hydraulic, HSS pump
5. Engine
6. EPC valve
7. Hydraulic tank
8. Sprocket
9. Final drive
10. HSS motor
11. HSS opening circuit
12. Servo valve
13. Engine controller

A. Forward, reverse signal
B. Steering signal
C. Engine control information
D. Hydraulic oil pressure signal
E. CAN communication network

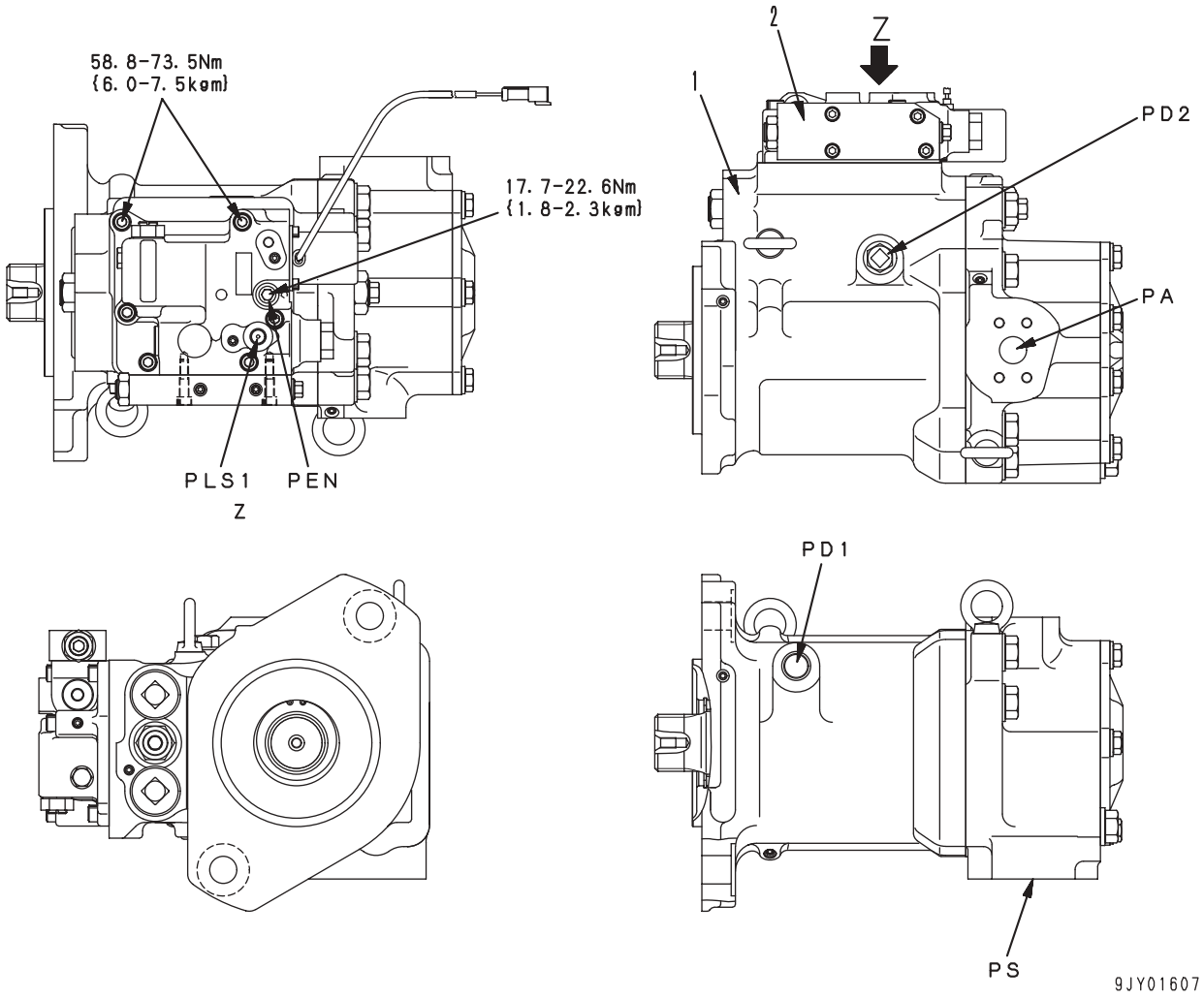
Outline

- HSS system is an abbreviation for the Hydrostatic Steering System.
- The HSS system consists of a set of hydraulic-HSS valve, piston pump, and piston motor. It turns the machine continuously without lowering the travel speed by making a difference in speed between both tracks.
- The transmission, steering controller controls the EPC valve of the hydraulic-HSS valve to control the revolving direction and revolving speed of the HSS motor according to the tilting direction and angle of the PCCS lever. The HSS motor acts on the planetary gear mechanism of the bevel gear shaft to make a difference in speed between both sprockets. As a result, the machine turns.
- The steering-transmission controller senses the engine speed and oil pressure at each part and controls the hydraulic, HSS pump and hydraulic, HSS valve to drive the HSS pump so that the engine will not stall.
- The engine speed signal and other engine control information items are send and received through the CAN communication network which connects the engine controller and transmission, steering controller.

HYDRAULIC, HSS PUMP

HPV160

Outline
This pump consists of a variable displacement swash plate type piston pump and LS valve.

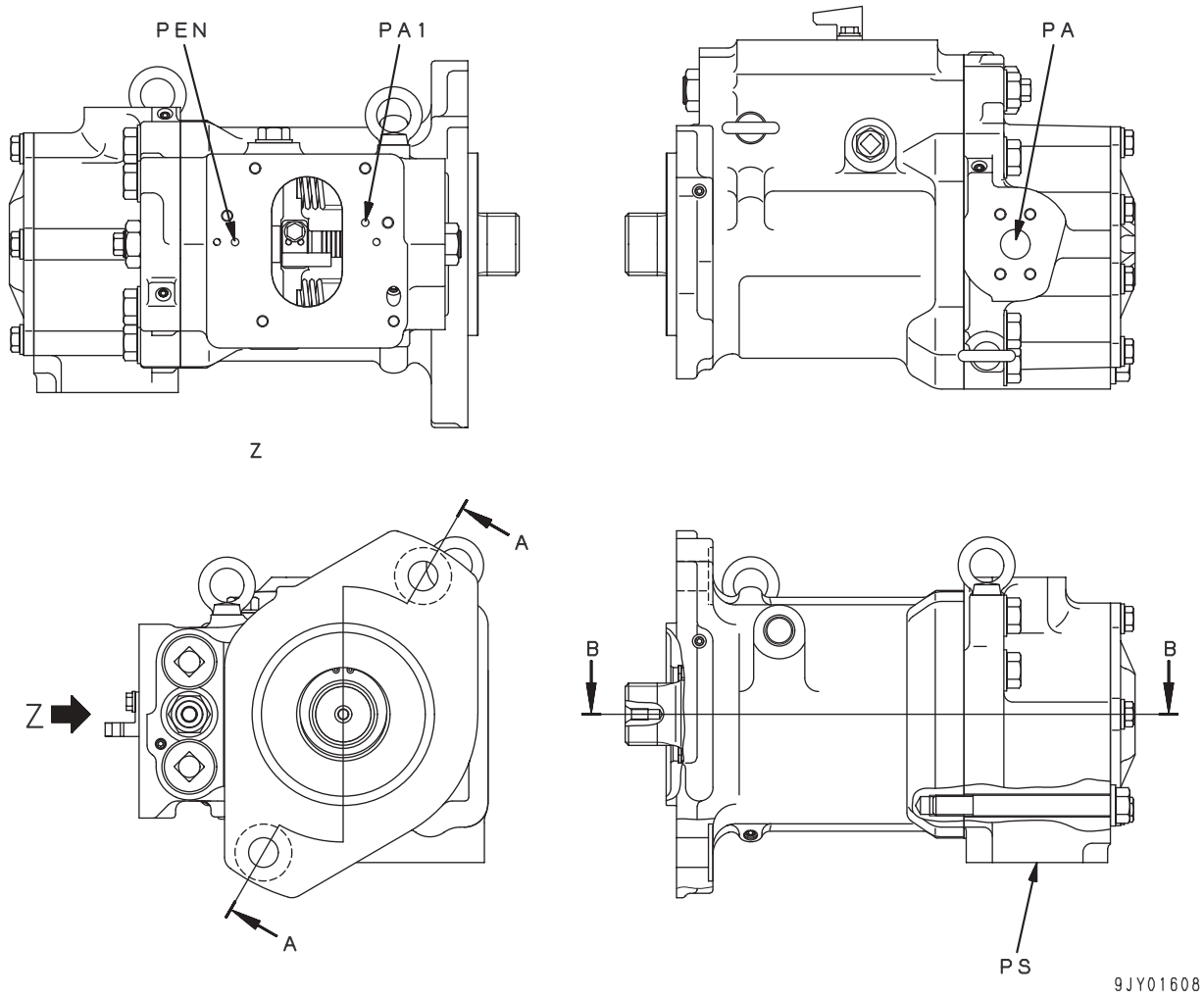


PA: Pump discharge port
PS: Pump suction port
PD1: Pump drain port
PD2: Pump drain plug
PEN: Control pressure detection plug
PLS1: Load pressure inlet port

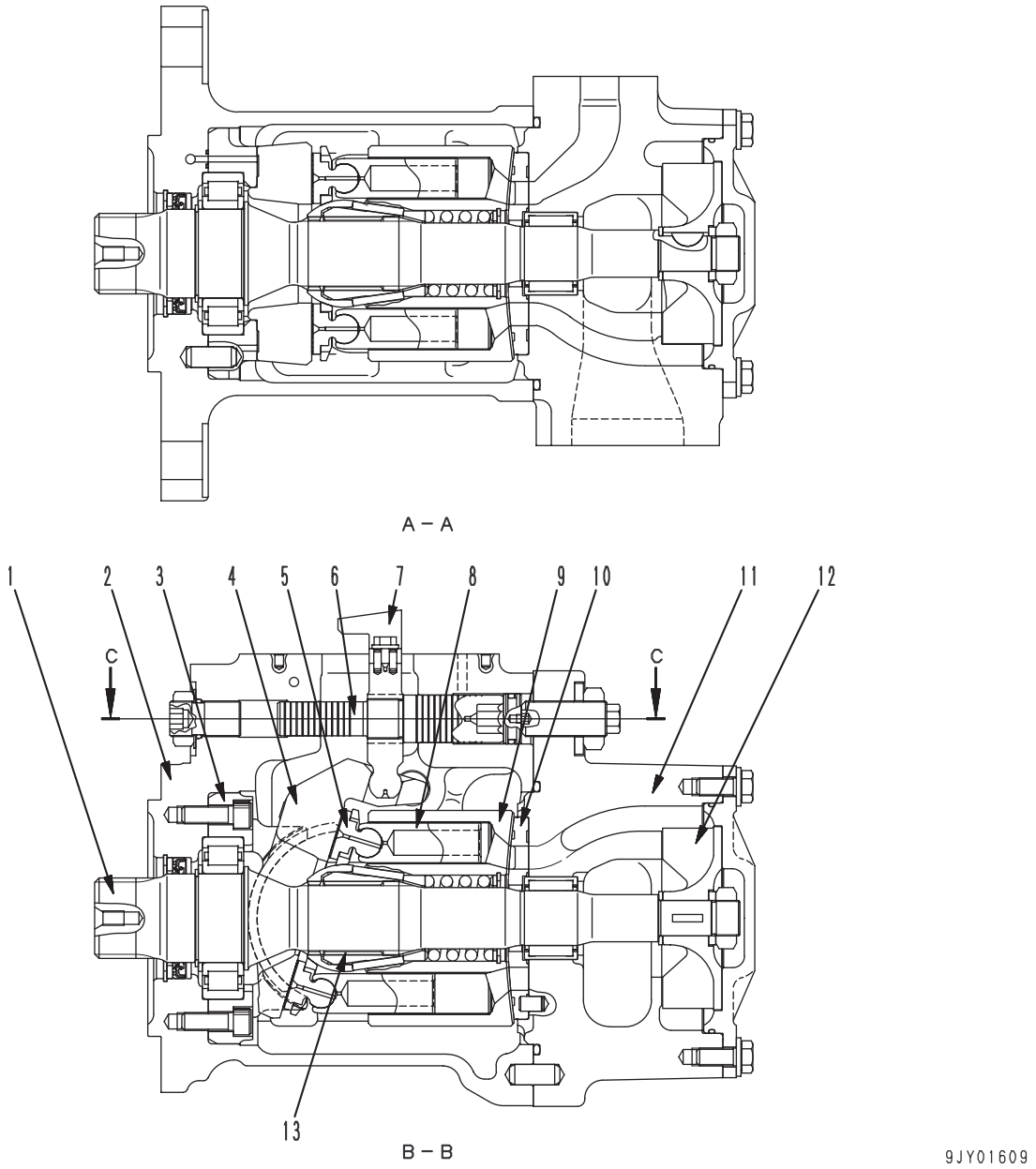
1. Piston pump
2. Servo valve

Specification
Model: HPV160 (160 cm^3/rev)
Theoretical displacement capacity: 160±1 cm^3/rev
Rated speed: 2,133 rpm
Max. cut off pressure: 38.2 MPa {390 kg/cm^2}

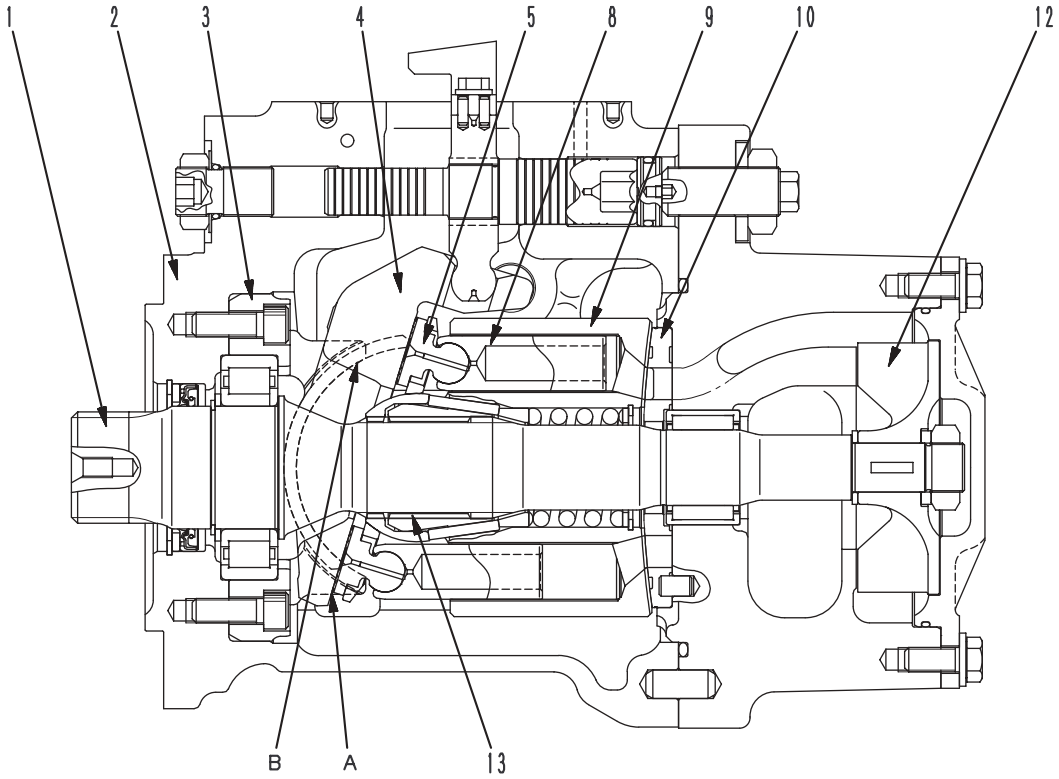
PISTON PUMP



PA: Pump discharge port
PS: Pump suction port
PA1: Pump pressure signal port
PEN: Control pressure port



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



Outline

- The engine rotation and torque transmitted to the pump shaft is converted to hydraulic energy and pressurized oil is discharged according to the load.
- It is possible to change the discharge amount by changing the swash plate angle.

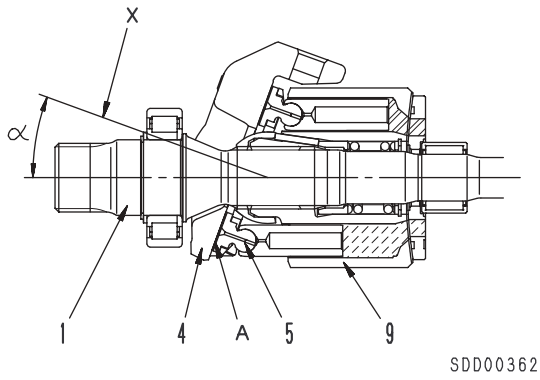
Structure

- Cylinder block (9) is supported to shaft (1) by a 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 calked to it to form one unit.
- Piston (8) and shoe (5) from a spherical bearing.
- Rocker cam (4) holds plane **A**, and shoe (5) is always pressed against this surface as it slides in a circle.
- Rocker cam (4) forms a static beaing sending high pressure oil at cylindrical surface **B** of cradle (3), which is fixed to the case, and carries out a sliding movement.
- Piston (8) carries out motion relative to the axial direction inside each cylinder chamber of cylinder block (9).
- The 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 clinder block (9) is sucked in and dischaged through valve plate (10).
- Impeller (12) is fixed to shaft (1), and rotates together with the shaft, it makes it easier for the oil sucked in from the suction port to be sucked in and sends it into the cylinder chamber by centrifugal force.

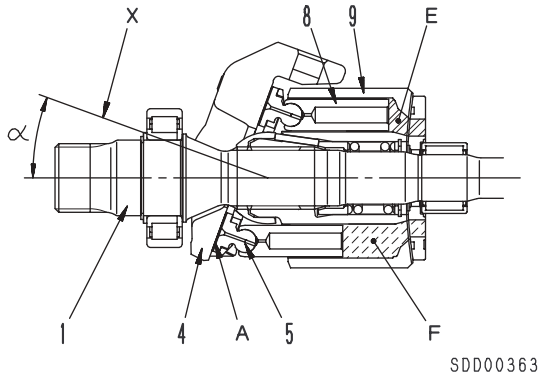
Operation

1. Operation of pump

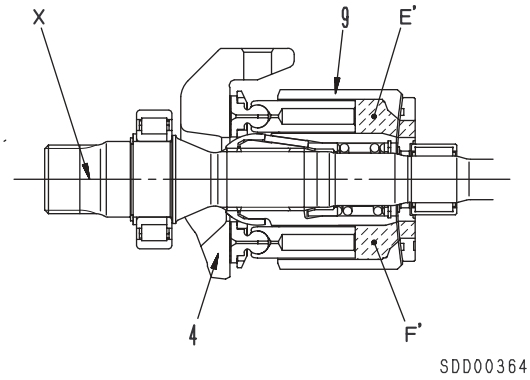
- Cylinder block (9) rotates toghther with shaft (1), and shoe (5) slides on plane **A**.
  When this happens, rocker cam (4) moves along cylindrical surface **B**, so angle α of center line **X** of arocker cam (4) to the axial direction of cylinder block (9) changes.
  This angle α is called the swash plate angle.



- With swash plate angle α formed by the angle between center line **X** of rocker cam (4) to the axial direction of cylinder block (9), plane **A** acts as a cam for 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 the cylinder block. The amount of suction and discharge is equal to difference **F** – **E**.
- In other words, cylinder block (9) rotates, and the volume of chamber **E** becomes smaller, so oil is discharged during this process. At the same time, the volume of chamber **F** becomes larger and oil is sucked in this process.

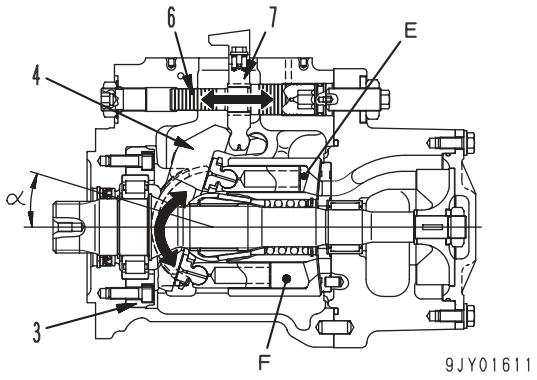


- When center line **X** of rocker cam (4) is the same as the axial direction of cylinder block (9) (swash plate angle = 0), the difference between volumes **E'** and **F'** indside cylinder block (9) is 0, so pump does not suction and discharge, and no pumping's carried out.
  Actually swash plate angle does not become 0.)
- The swash plate angle α is proportional to pump discharge volume.

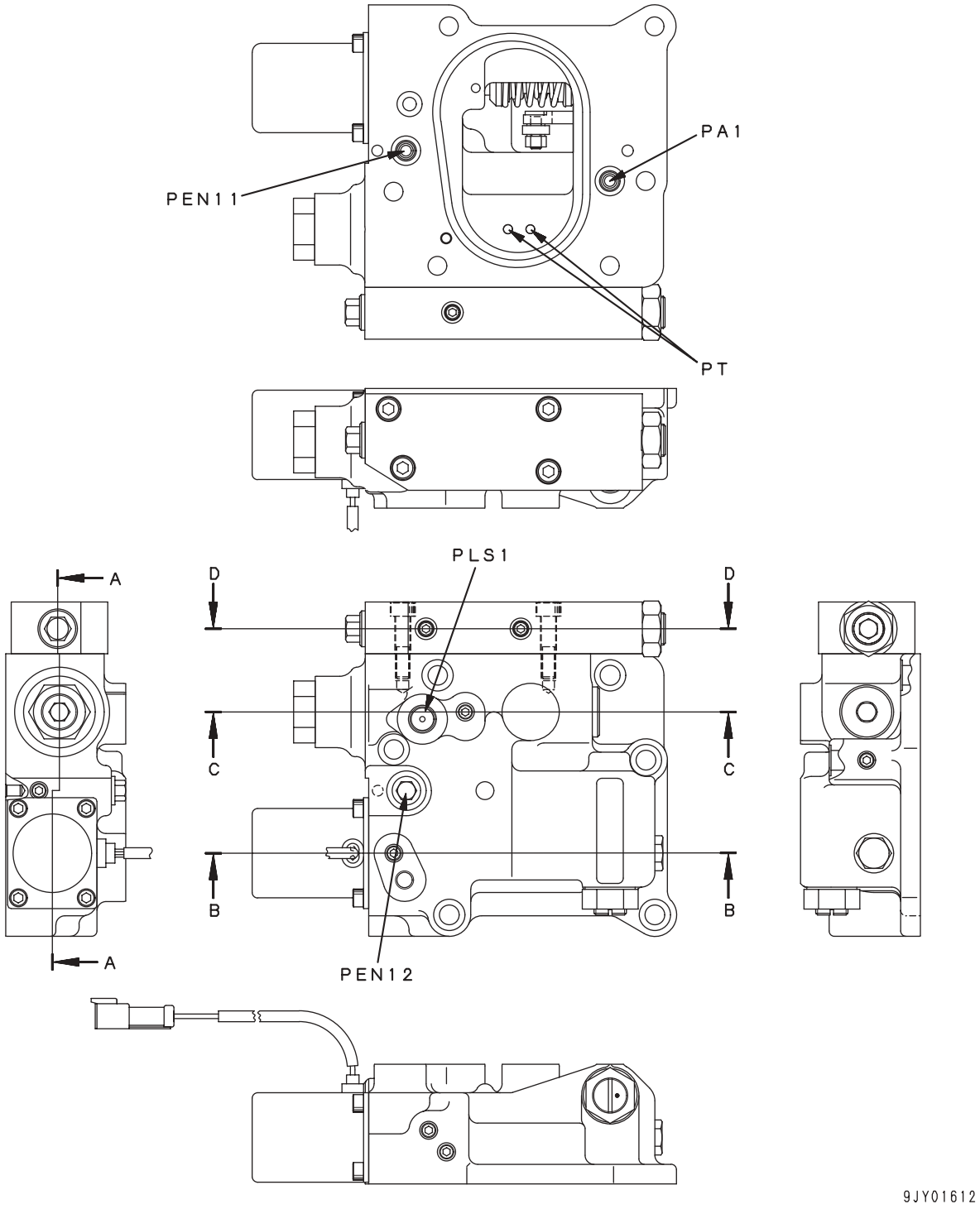


2. Control of discharge amount

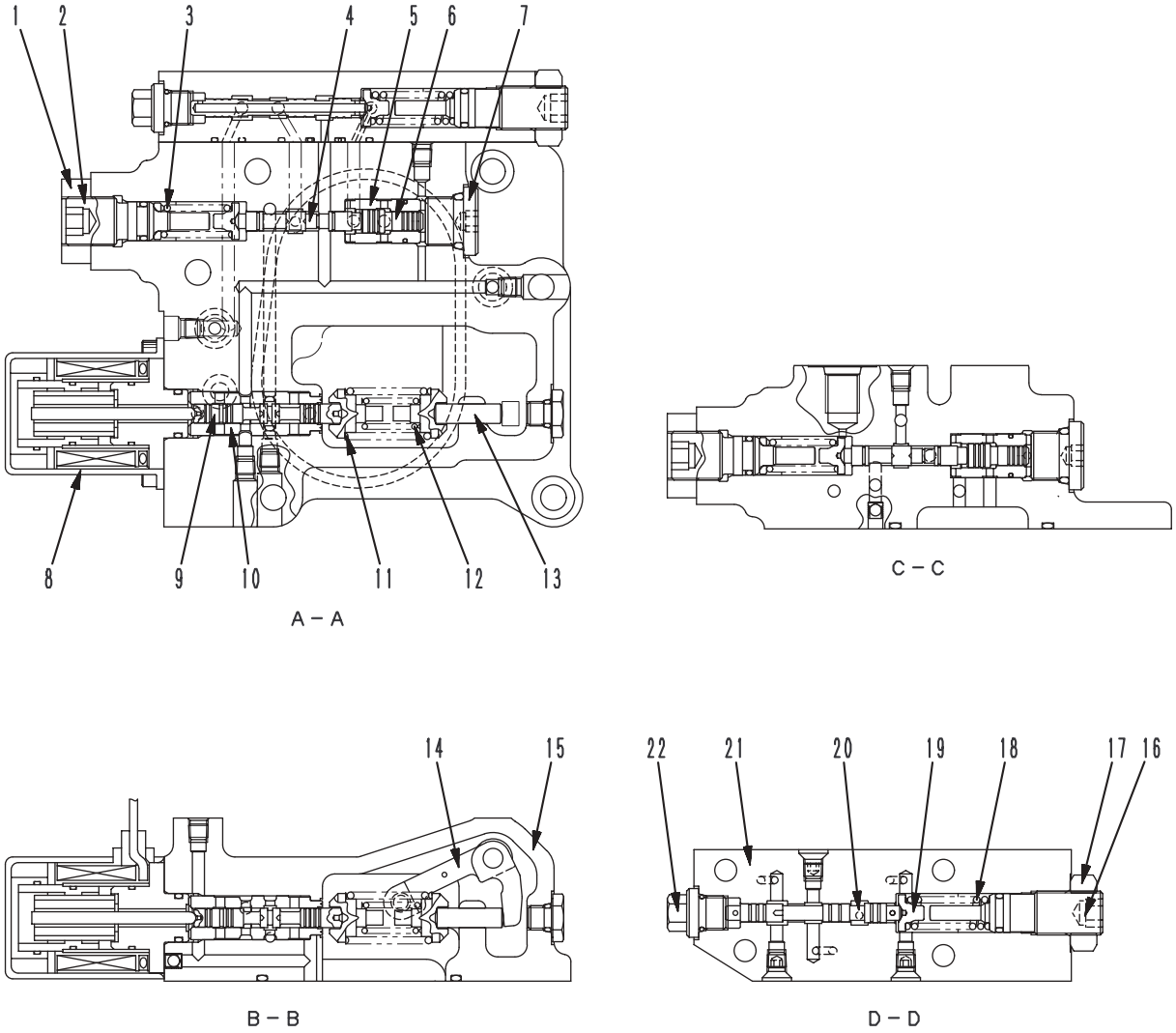
- If swash plate angle α becomes larger, the difference between volumes **E** and **F** becomes larger, and oil discharge **Q** is incleased. Swash plate angle α is changed by servo piston (6)
- Servo piston (6) carrise out reciprocal movement in a straight line (↔) according to the command from the servo valve single pressure. This straight line movement is trasmitted to rocker cam (4) through rod (7), and rocker cam (4), which is supported on the cylindrical surface by creadle (3) rotates on the cylindrical surface.
- 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 main pump discharge pressure (self pressure) **PP**.
- Output pressure **PNC** of the servo valve is applied to the chamber receiving the pressure at the large diameter piston end (which receives pressure of the pump).
- The movement of servo piston (6) is controlled by the relationship of the size of pump pressure **PP** and the pressure at the large diameter piston end, and the comparative size of the ratio of area receiving the pressure at the large diameter piston end and small diameter piston end.



SERVO VALVE



PT: Drain port
PA1: Pump self pressure port
PLS1: Load pressure input port
PEN11: Control pressure port
PEN12: Control pressure detection port



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

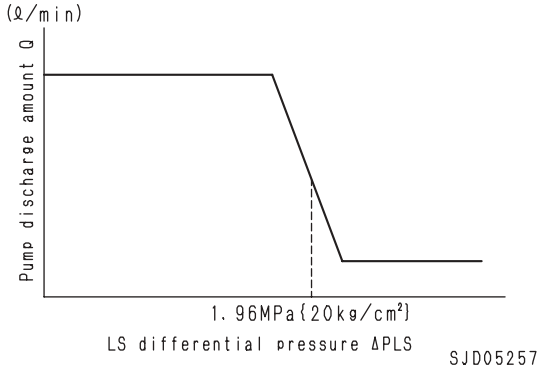
TVC VALVE
8. Solenoid
9. Piston
10. Sleeve
11. Spring
12. Spring
13. Piston
14. Lever
15. Valve body

VARIABLE THROTTLE VALVE
16. Screw
17. Locknut
18. Spring
19. Seat
20. Spool
21. Block
22. Plug

Function

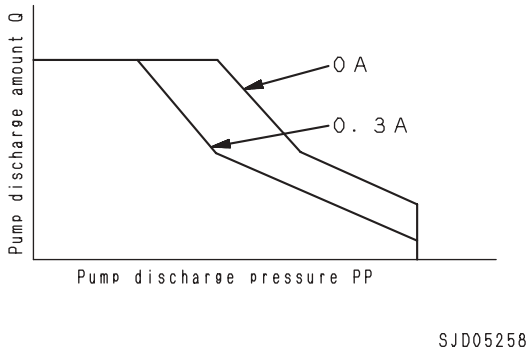
1. LS valve

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



2. TVC valve

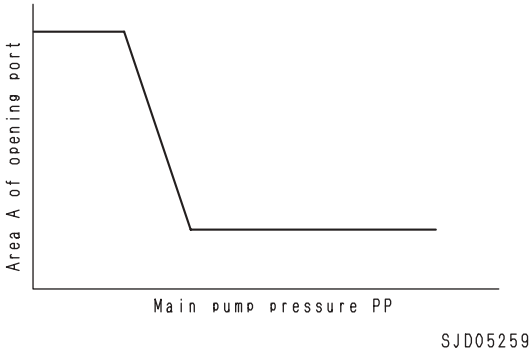
- When the pump discharge pressure **PP** is high, the TVC valve controls the pump so that no more oil than the constant flow (in accordance with the discharge pressure) flows even if the stroke of the control valve becomes larger.
- In this way, it carries out equal horsepower control so that the horsepower absorbed by the pump does not exceed the engine horsepower.
- In other words, 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** when this happens is shown in the diagram with the current given to the TVC valve solenoid shown as a parameter.



- When the working load is heavy or the engine speed lowers, a current flows in the TVC solenoid according to the command from the controller.
- As a result, the pump discharge (pump absorption torque) is reduced to reduce the load on the engine.

3. Variable throttle valve

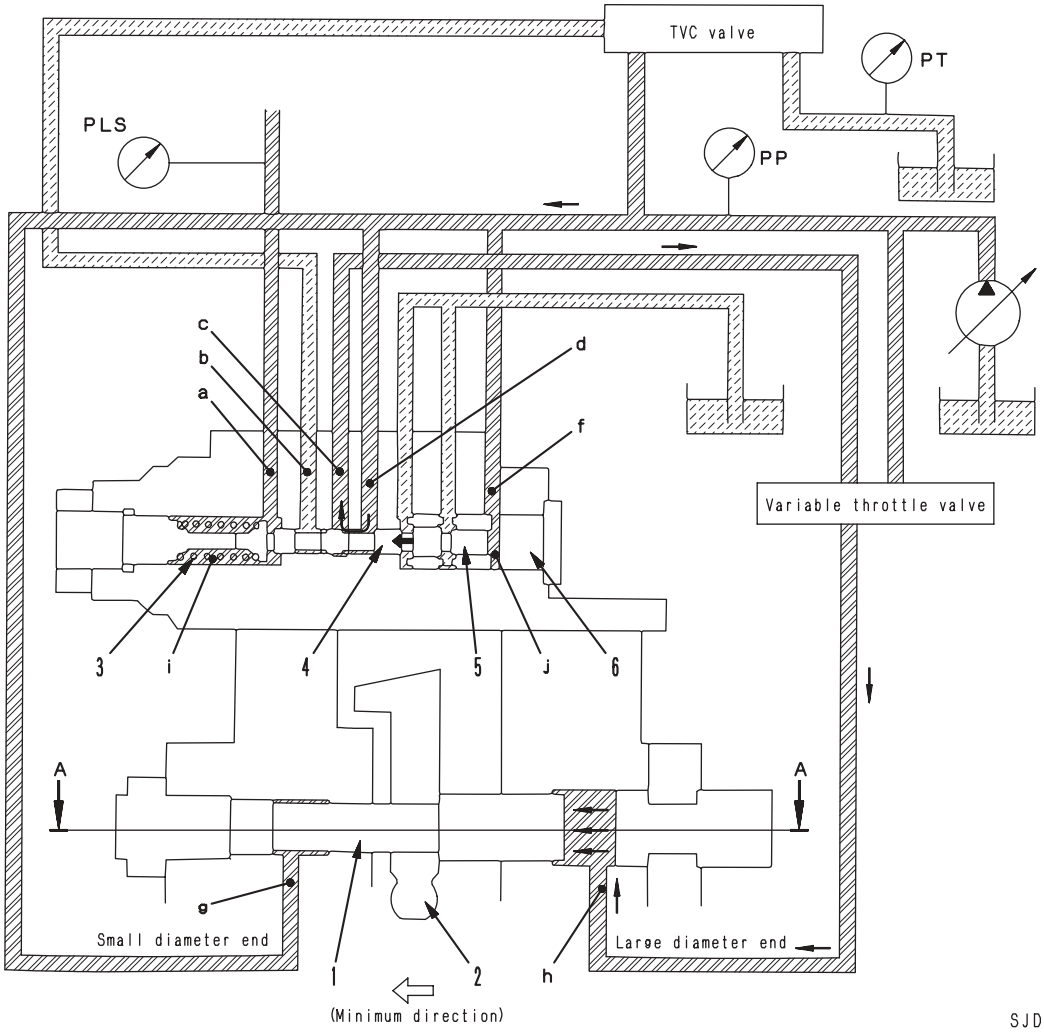
- Because the main pump controls its own prssure, there is a tendency for the response speed of the swash plate to be quick at high pressure and slow at low pressure.
- The variable throttle valve has been installed for the following reasons.
  (1) To reduce the swash plate speed between MIN and MAX 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 MIN to MAX.
- 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.



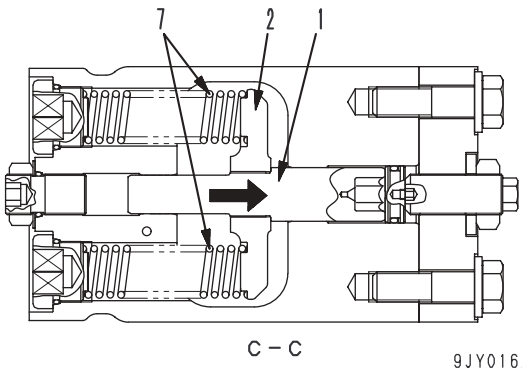
Operation

1. LS valve

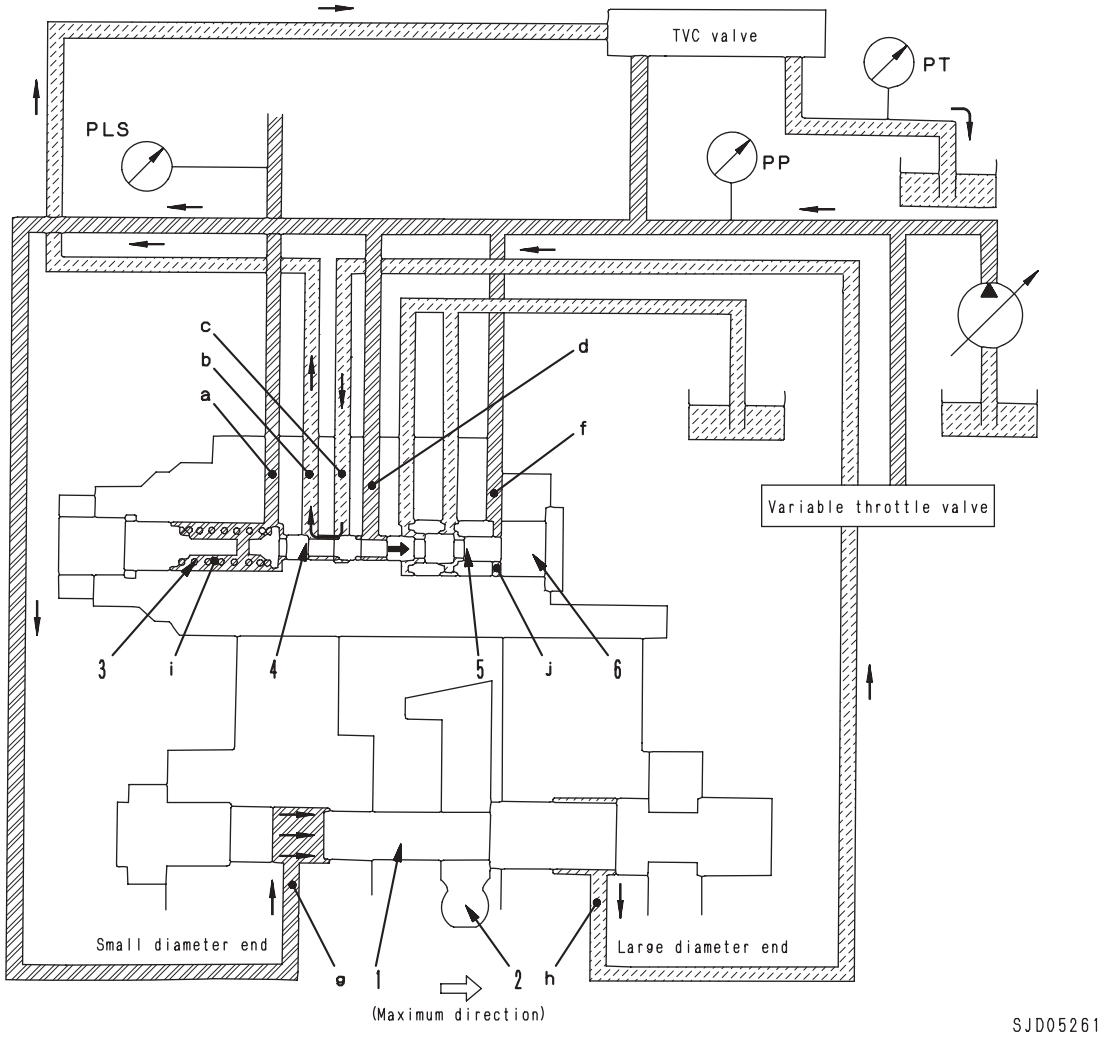
(1) When control valve is at "neutral" position



- The LS valve is a three-way selector valve, with pressure **PLS** (LS pressure) 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 the 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 the diagram on the right)
- When the engine is started and the control lever is at the "NEUTRAL" position, LS pressure **PLS** is 0 MPa {0 kg/cm^2}. (It is interconnected with the drain circuit through the control valve spool.) At this point, 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).

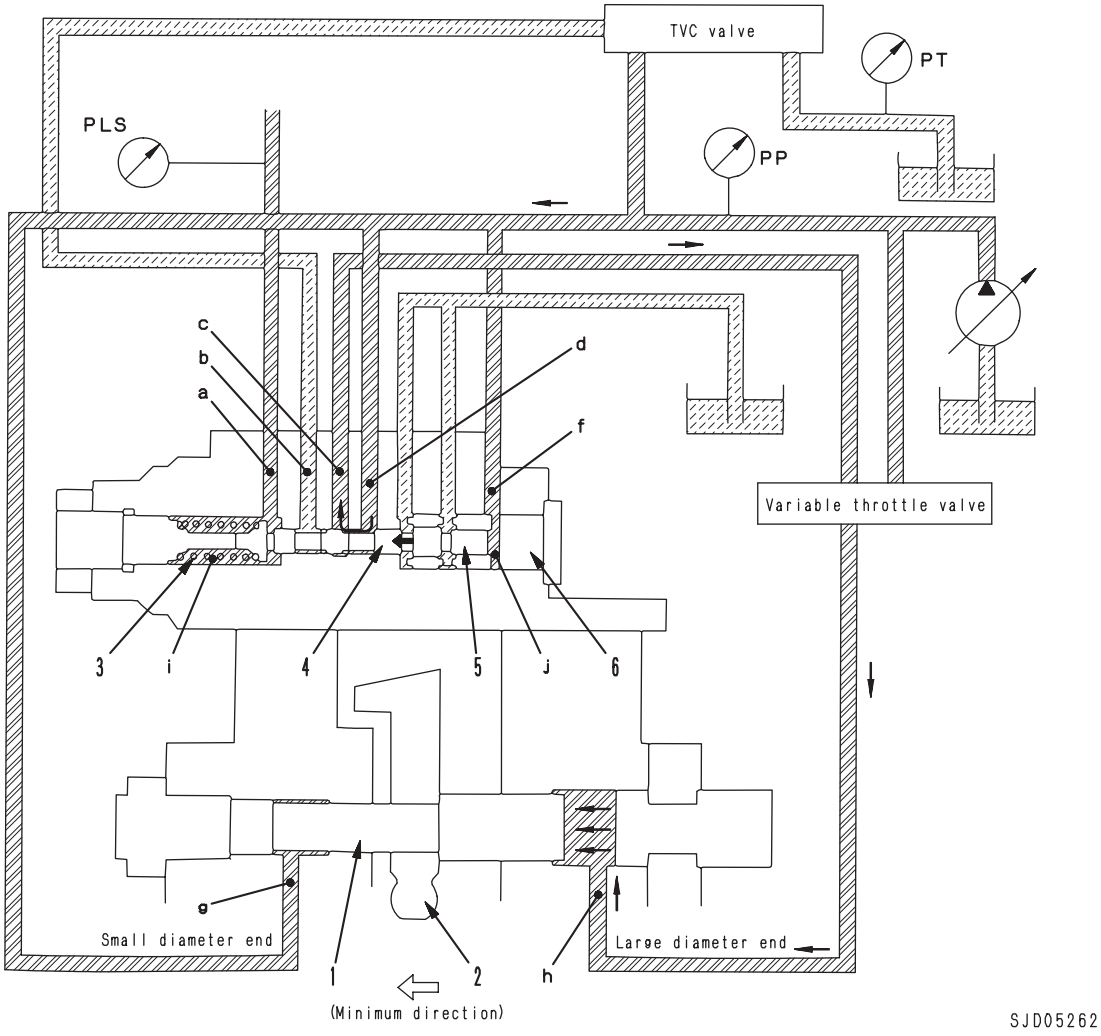


(2) Operation in maximum direction for pump discharge amount



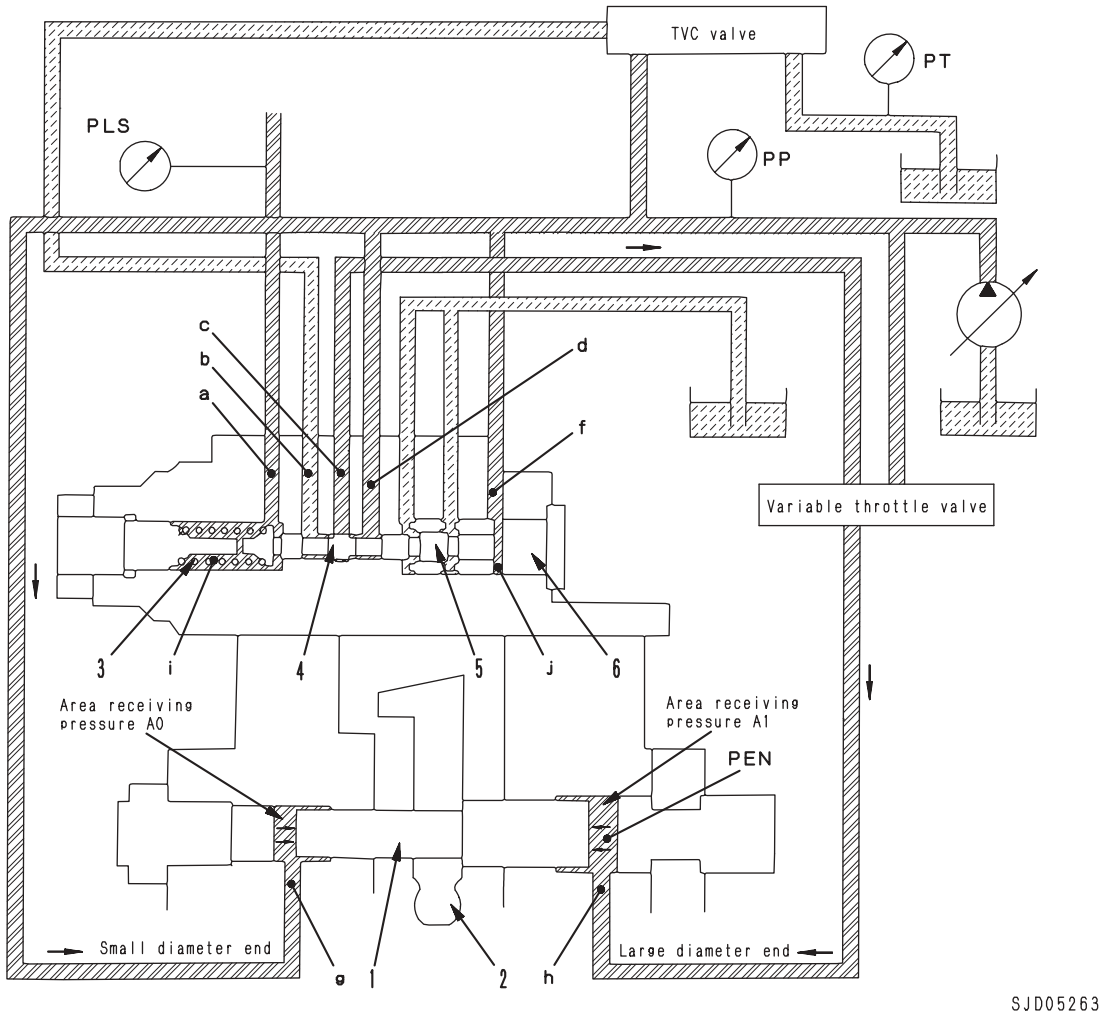
- When the difference between main pump pressure **PP** and LS pressure PLS, in other words, LS differential pressure ∆**PLS** becomes smaller (for example, when the area of opening of the control valve becomes larger and pump pressure **PP** drops), spool (4) is pushed to the right by the combined force 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. When this happens, the TVC valve is connected to the drain port, so circuit **c** – **h** becomes drain pressure **PT**. (The operation of the TVC valve is explained later.)
- For this reason, 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.
- Therefore, rod (2) moves to the right and moves the swash plate in the direction to make the discharge amount larger.

(3) Operation in minimum direction for pump discharge amount



- The following explains the situation if servo piston (1) moves to the left (the discharge amount becomes smaller).
- When LS pressure ∆**PLS** 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 piston diameter end of servo piston (1) and the small piston diameter end, servo piston (1) is pushed to the left.
- As a result, rod (2) moves in the direction to make the swash plate angle smaller.

(4) When servo piston is balanced

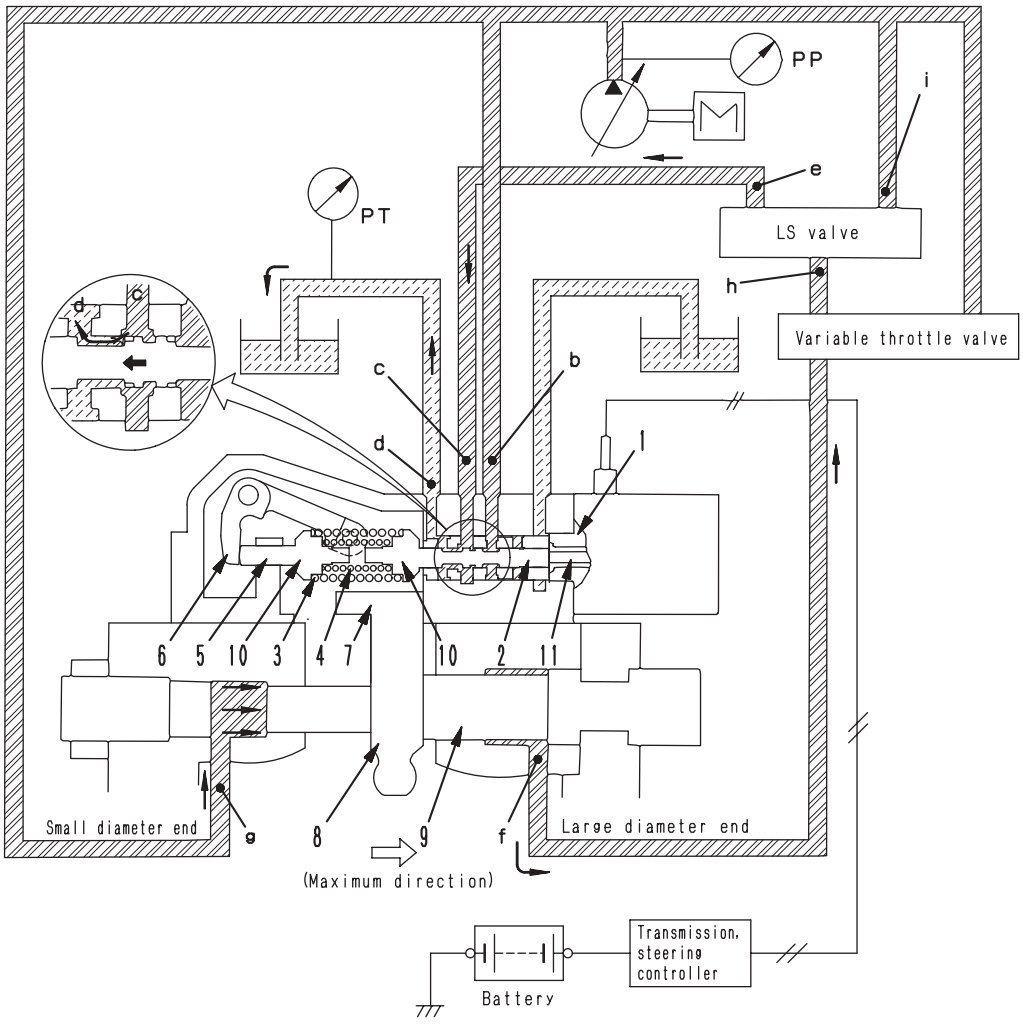


- Let us take the area receiving the pressure at the large piston diameter end as **A1**, the area receiving the pressure at the small diameter end as **A0**, and the pressure flowing into the large piston diameter end as **Pen**.
- If the main pump pressure **PP** of the LS valve and the combined force of force **F** of spring (3) and LS pressure **PLS** are balanced, and the relationship is **A0** x **PP** = **A1** x **Pen**.
- The servo piston (1) will stop in that position, and the swash plate will be kept at an intermediate position. (It will stop at a position where the opening from port **b** to port **c** and from port **d** to port **c** of spool (4) is approximately the same.)
- At this point, 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** ≒ **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 transmission, steering controller is normal

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

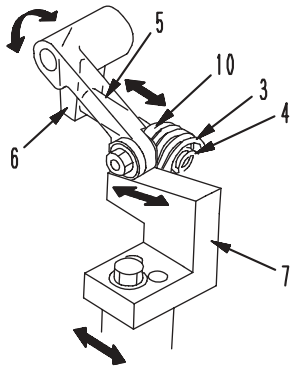


a. Movement of solenoid (1)

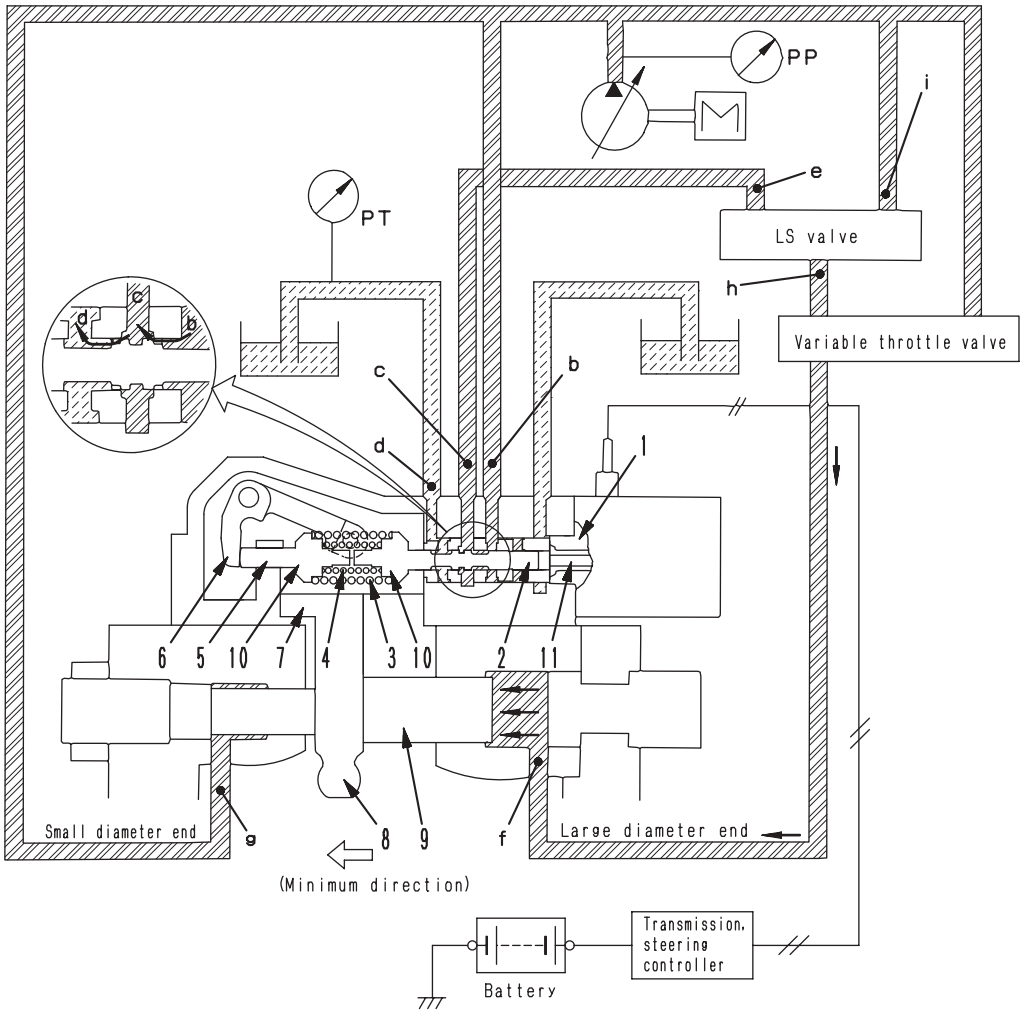
- The command current from the transmission, steering controller flows to solenoid (1). This command current changes the internal force pushing solenoid push pin (11).
- On the opposite side to the force pushing this solenoid push pin (11) is the spring set pressure of springs (3) and (4) and pump pressure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

b. Movement 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 position (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 spring (3) and spring (4) function.
- In other words, the spring load is changed by piston (5) extending or contacting springs (3) and (4).
- If the command current input to solenoid (1) changes further, the force pushing solenoid push pin (11) changes, and the spring load of springs (3) and (4) also changes according to the value of the solenoid command current.
- 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.
- At this point, 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 the 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.
- In this way, the pump discharge amount moves in the direction of increase.
- 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 weaker.
- When the spring force becomes weaker, piston (2) moves to the left, so the connection between port **c** and port **d** is cut, and the pump discharge pressure is connected to port **b**.
- As a result, 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.
- In other words, 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 from the solenoid and the pushing force created by pressure **PP** acting on piston (2) are in balance.

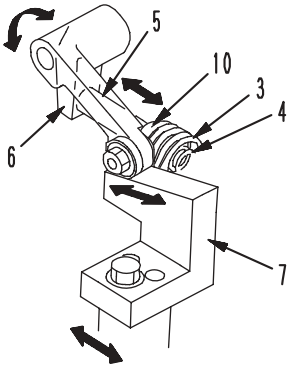


(2) When load on actuator is small and pump discharge pressure is high



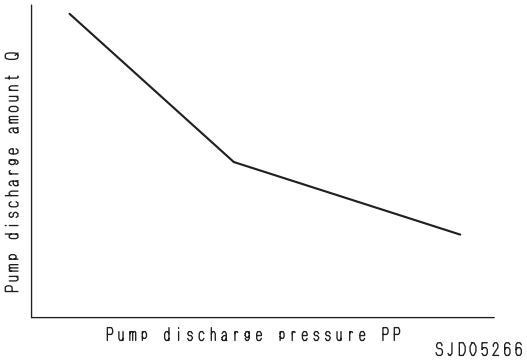
SJD05265

- 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.
- When this happens, 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 the 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).
- For this reason, 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.

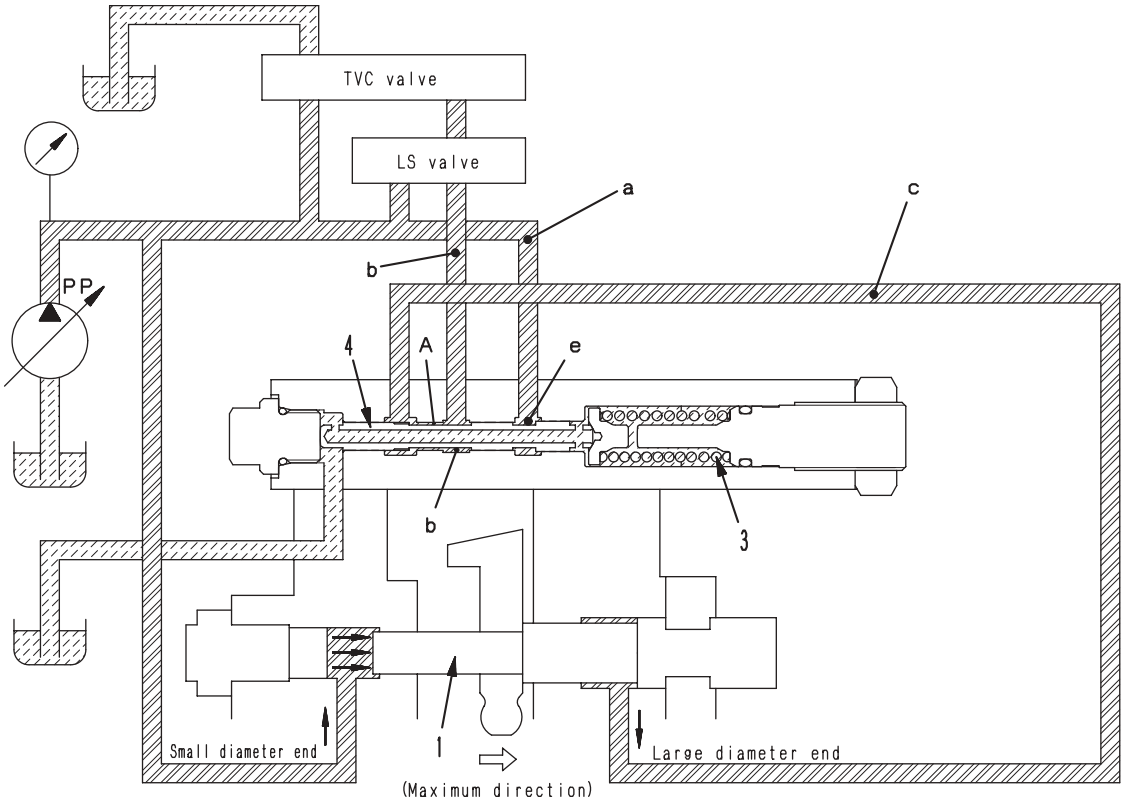


9JY01625

- 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



SJD05267

(1) Operation in maximum direction for pump discharge amount

- Main pump 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.
- At this point, 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 to reduce pump discharge

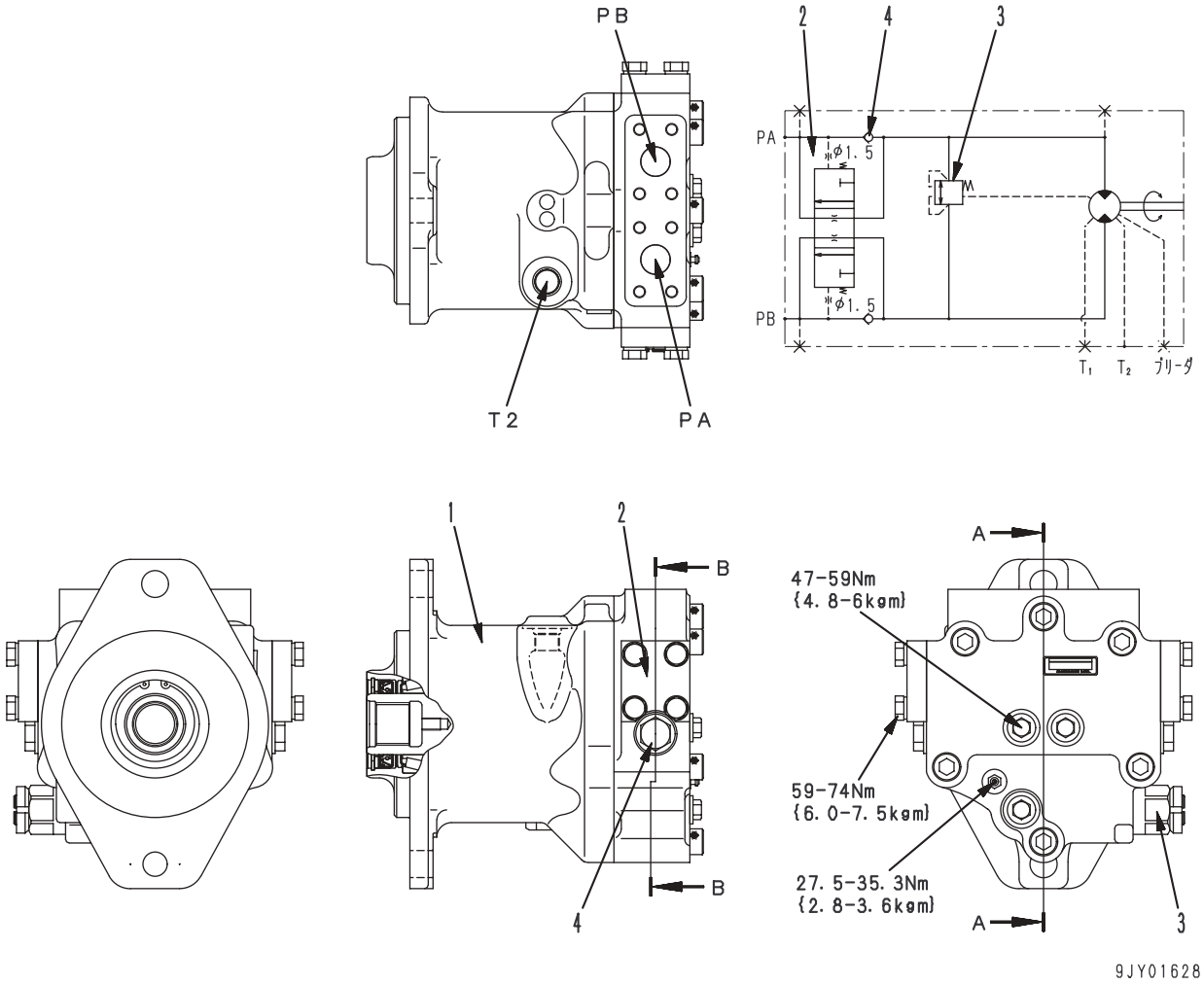
- The hydraulic oil flows from port **b** through port **c** to the large diameter side of servo piston (1).
- Spool (4) operates according to main pump pressure **PP** as explained in the above section.

HSS MOTOR

HMF112

Outline

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

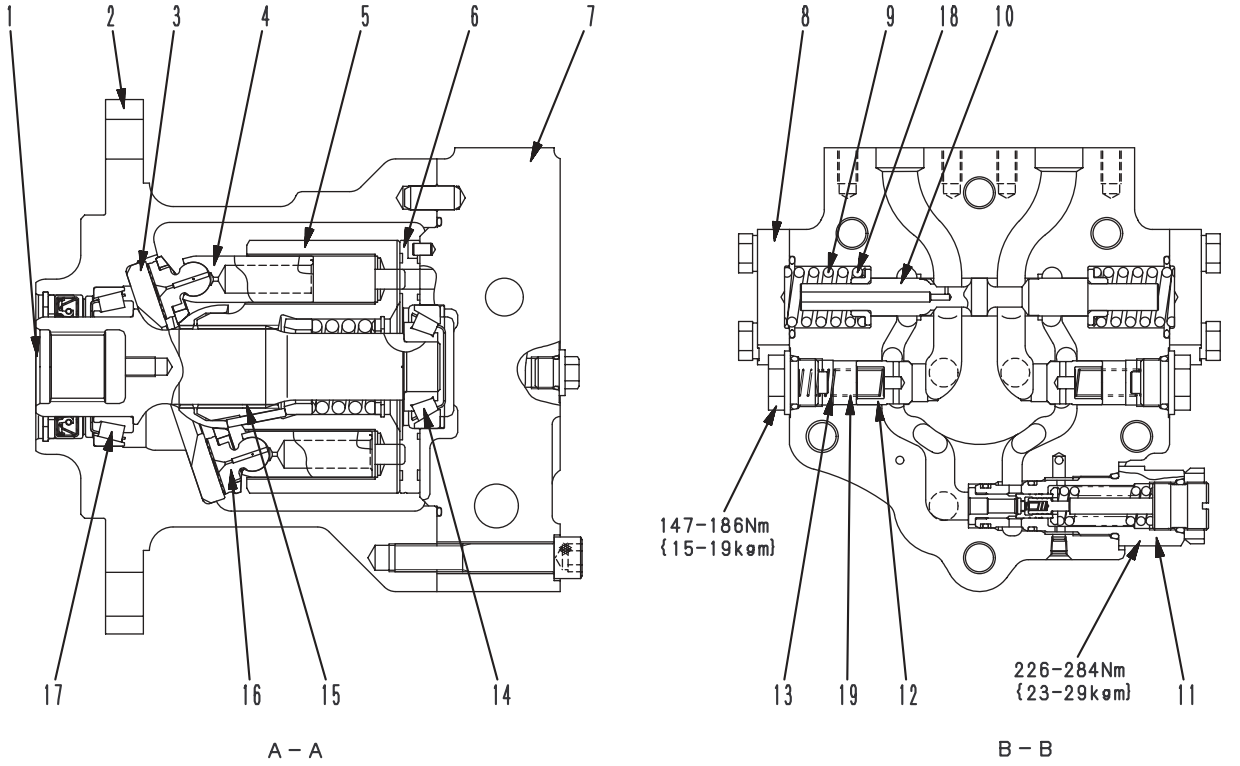


1. HSS motor assembly
2. Counterbalance valve
3. Safety valve
4. Check valve

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

Specifications

Model: HMF112
Theoretical displacement: 112.7 cc/rev
Rated output pressure : 38.2 MPa{390 kg/cm^2}
Rated speed : 2,241 rpm



1. Output shaft
2. Motor case
3. Swash plate
4. Piston
5. Cylinde
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		
18	Spool return spring	Free length x OD	Installed length	Installed load	Free length	Installed load	Replace spring if damaged or deformed
		42.7 x 30.0	40.5	192 N {19.6 kg}	–	154 N {15.7 kg}	
19	Check valve spring	43 x 13.8	32.9	1.27 N {0.13 kg}	–	0.98N {0.10 kg}	

Outline

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

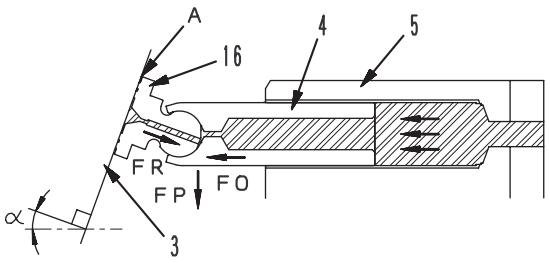
Structure

- Cylinder block (5) is supported to shaft (1) by a spline (15), and 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 (15) 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, and this surface ensures that the hydraulic balance is maintained correctly.
- The oil inside each cylinder chamber of cylinder block (5) is sucked in and discharged through valve plate (6).

Operation

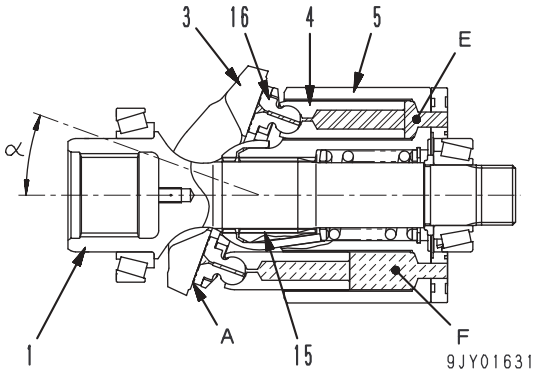
1. Operation of motor

- 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 a to the axial direction of cylinder block (5).
- As a result, if we take the example of one of pistons (4), oil pressure is applied to the back face of the right, and 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 plane **A** is generated. The combined force of **FO** and **FR** is **FP**, and this becomes the force to rotate cylinder block (5).



9JY01630

- Shaft (1), which is meshed to cylinder block (5) by spline (15) transmits this rotation 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.



9JY01631

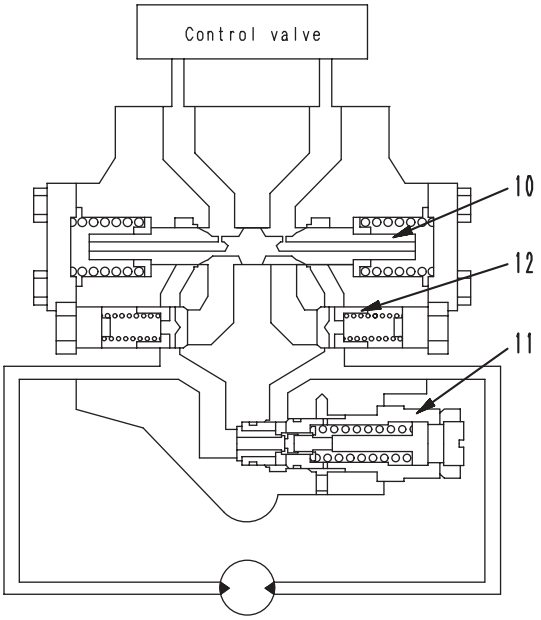
2. Rotation speed and torque control

- 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), torque **T** is proportional to pressure **P**.
- Swash plate angle α is approx. 19°.

Q = qN **Q: Total flow**
(q = E – F) **q: Flow per 1 turn**
N: Rotation speed
$T = \frac{Pq}{2\pi}$ **P: Pressure**
T: Rotating torque

OPERATION OF BRAKE VALVE

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



9JY01632

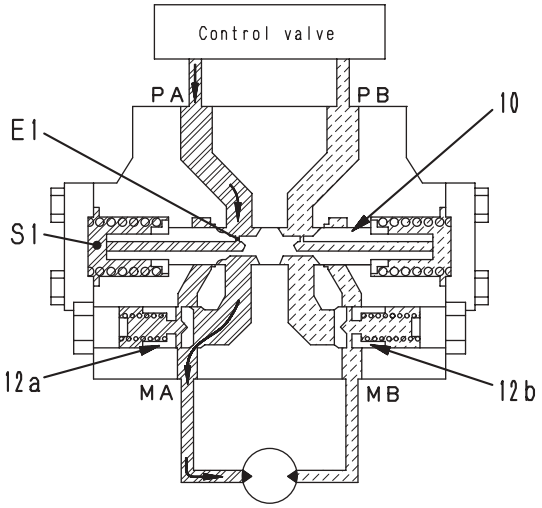
1. Counterbalance valve, check valve

Function

- When operation the steering on 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 steeting in accordance with the engine speed (pump discharge volume).

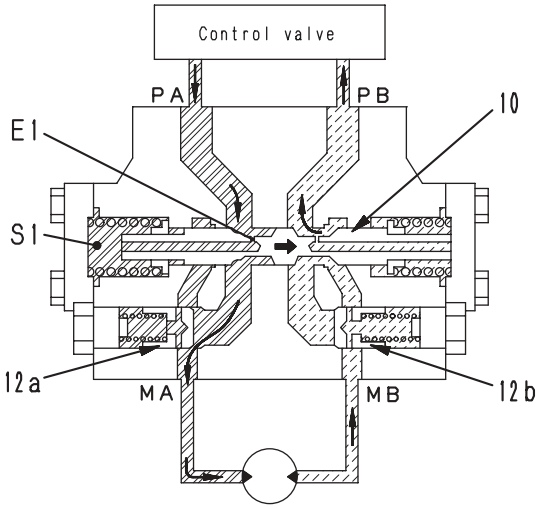
Operation when oil is supplied

- 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 inet 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.



9JY01633

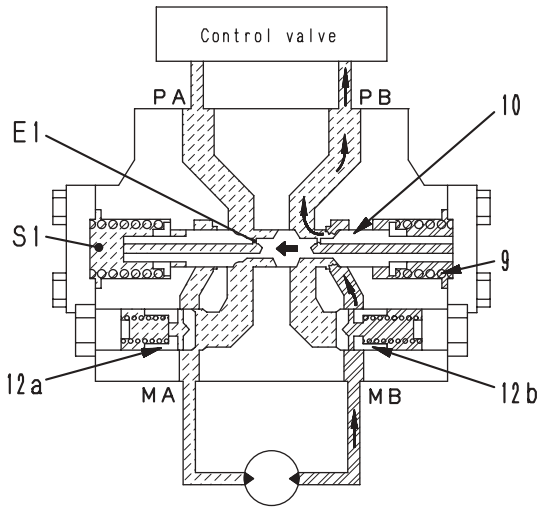
- The pressurized oil at the side where the oil is being supplied flows from orifice **E1** of spool (10) into chamber **S1**. And when the pressure in chamber **S1** bcomes greater than the spool switching pressure, spool (10) is pushed to the right.
- In this way, port **MB** and port **PB** are connected,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



9JY01634

Action of brakes when oprating steering on downhill slopes

- When the steering is operated on a down hill 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 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.



9JY01635

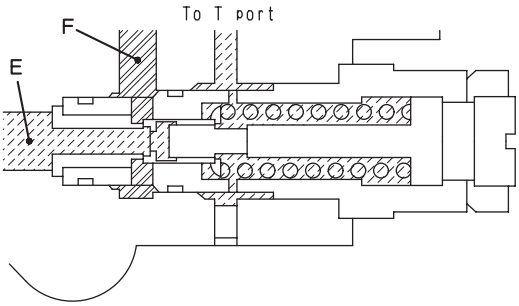
2. Safety valve

Function

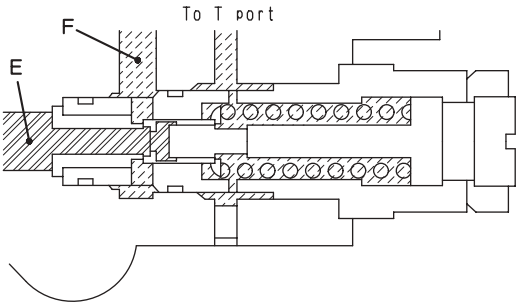
- When the operation of the steering stops, counterbalance valve (10) closes the circuit at the inlet and outlet ports of the HSS motor.
- But the HSS motor continues to turn because of inertia. As a result, the pressure at the outlet port of the HSS motor becomes extremely high, and this will damage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

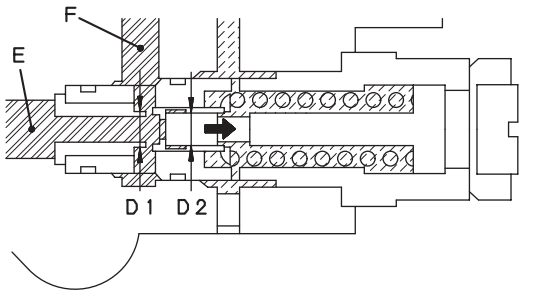


9JY01636

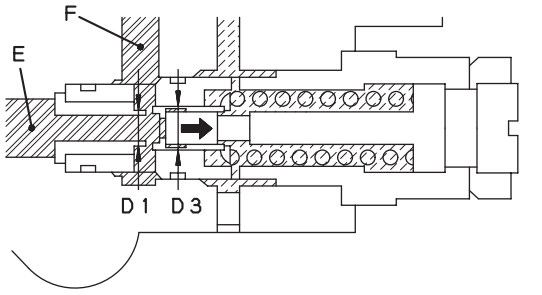


9JY01637

- If the pressure in chamber **E** (or chamber **F**) goes above the set pressure, the force of $\pi/4$ ($D1^2 - D2^2$) x pressure resulting from the difference in area of **D1** and **D2** (or the force of $\pi/4$ ($D3^2 - D1^2$) x 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.

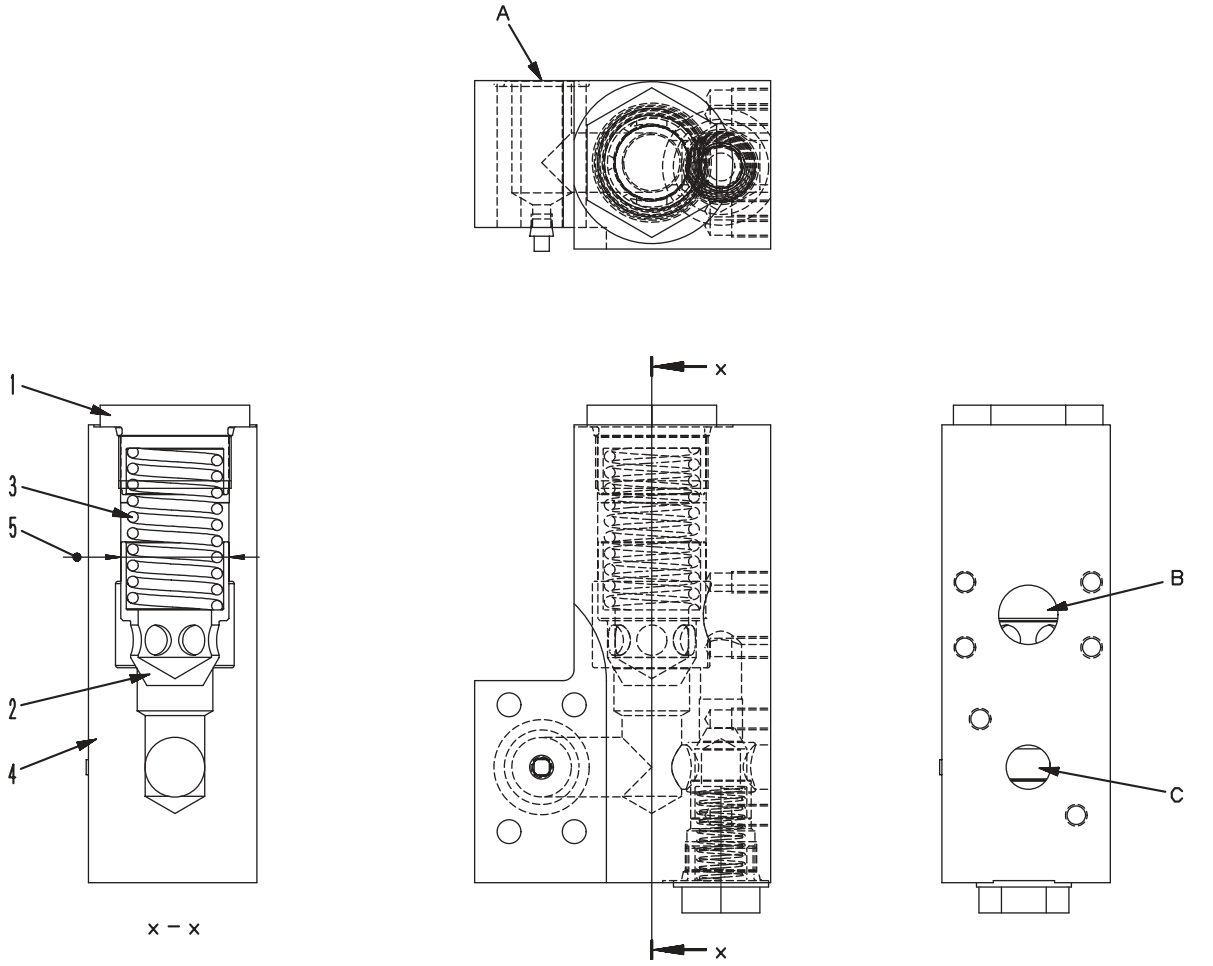


9JY01638



9JY01639

HSS OIL COOLER BYPASS VALVE



1. Plug
2. Poppet
3. Spring
4. Body

A: From CLSS valve
B: To hydraulic tank
C: To oil cooler

Outline

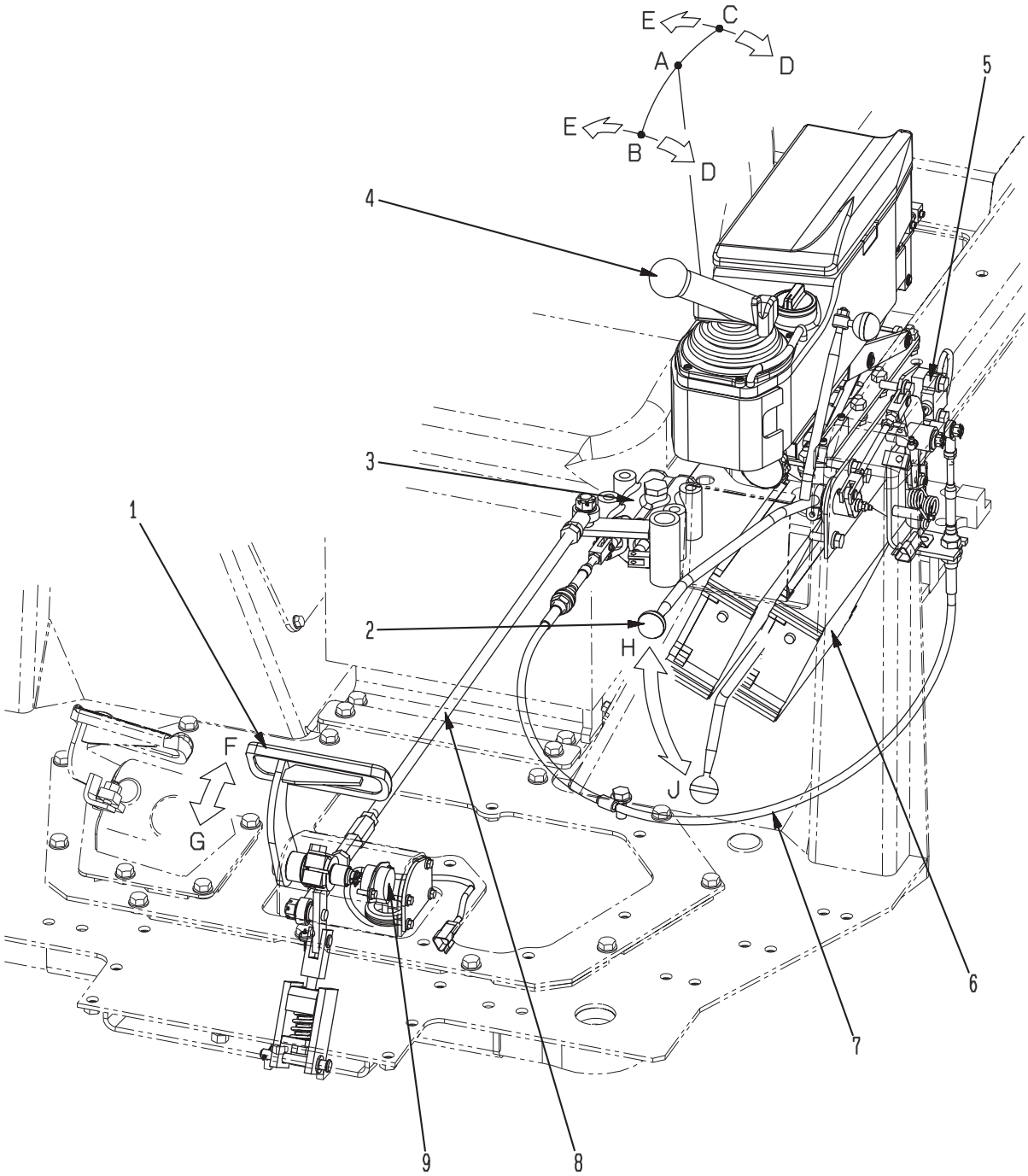
- This valve is installed in the circuit between the HSS pump oil return circuit and the oil cooler. If any abnormal pressure is generated in the oil flowing to the oil cooler, this valve acts to return the oil directly to the hydraulic tank.
  Cracking pressure: 0.304 MPa {3.10 kg/cm^2}

Unit: mm

No.	Check item	Criteria					Remedy
3	Spring	Standard size			Repair limit		Replace
		Free length	Installed length	Installed load	Free length	Installed load	
		94.8	74.8	296N {30kg}	88	279N {28.5kg}	
5	Clearance between oil cooler by-pass valve and valve body	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		50	– 0.050 – 0.089	+ 0.20 + 0.10	0.150– 0.289	0.30	

STEERING, BRAKE CONTROL

- Regarding the transmission-related description of the operation of the PCCS lever, see TRANSMISSION CONTROL.
- PCCS: Palm Command Control System



9JG00218

1. Brake pedal
2. Safety lever
3. Brake valve
4. PCCS lever (Steering)
5. Limit switch
6. Transmission, steering controller
7. Cable
8. Rod (From brake pedal)
9. Potentiometer

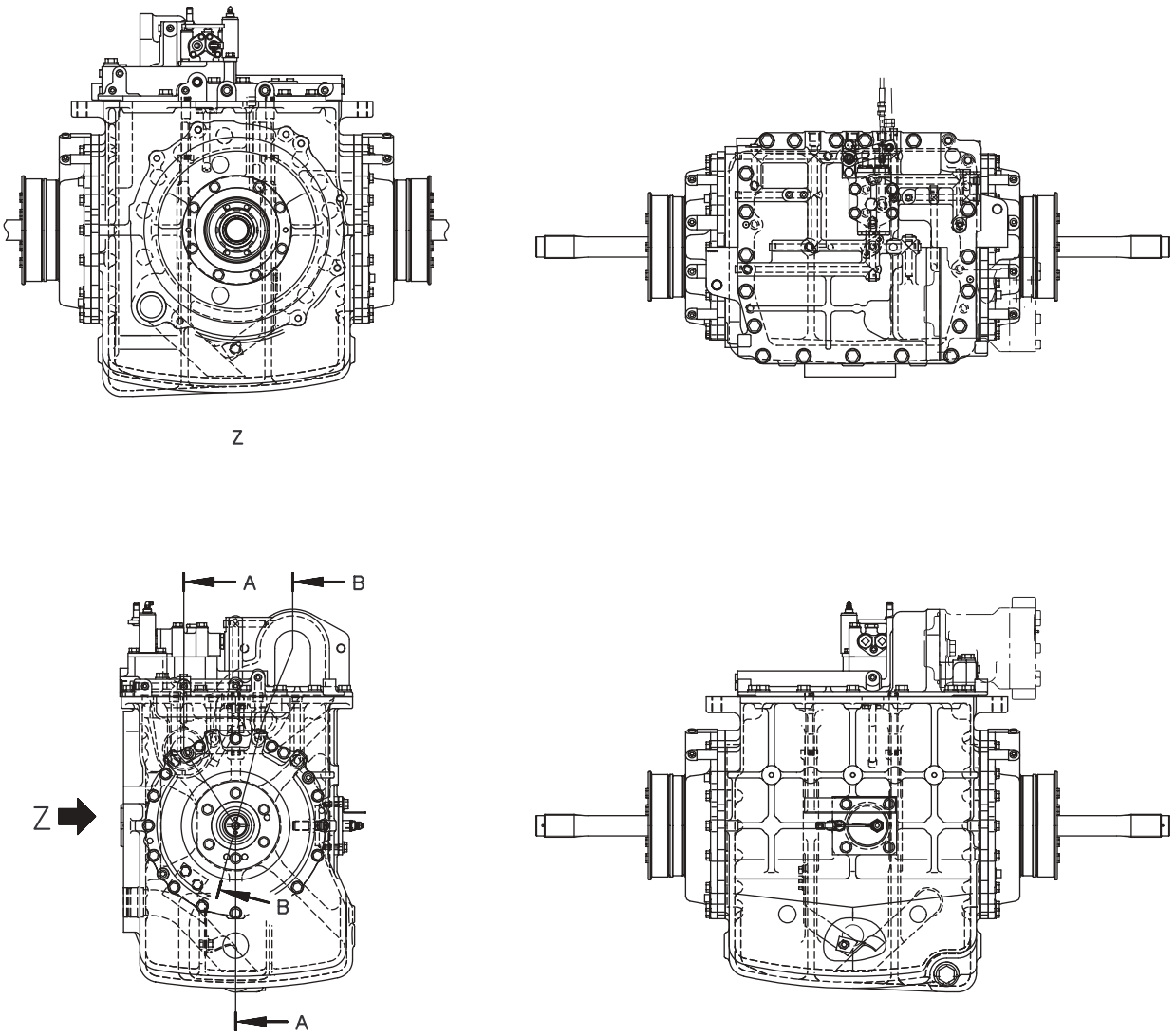
Positions of levers and pedals

A: Neutral
B: Forward straight
C: Reverse straight
D: Left turn
E: Right turn
F: Brake OFF
G: Brake ON
H: Free
J: Lock

Outline

- PCCS lever (4) sends electric signals to transmission, steering controller (6). Upon receiving those signals, transmission, steering controller (6) sends signals to EPC valve of hydraulic control valve to changes the discharge of the pump to operate the steering motor.
- Brake pedal (1) operates the brake through rod (8) and brake valve (3).
- Safety lever (2) is connected to brake valve (3) and used as the parking brake, too.

BEVEL GEAR SHAFT, HSS, BRAKE



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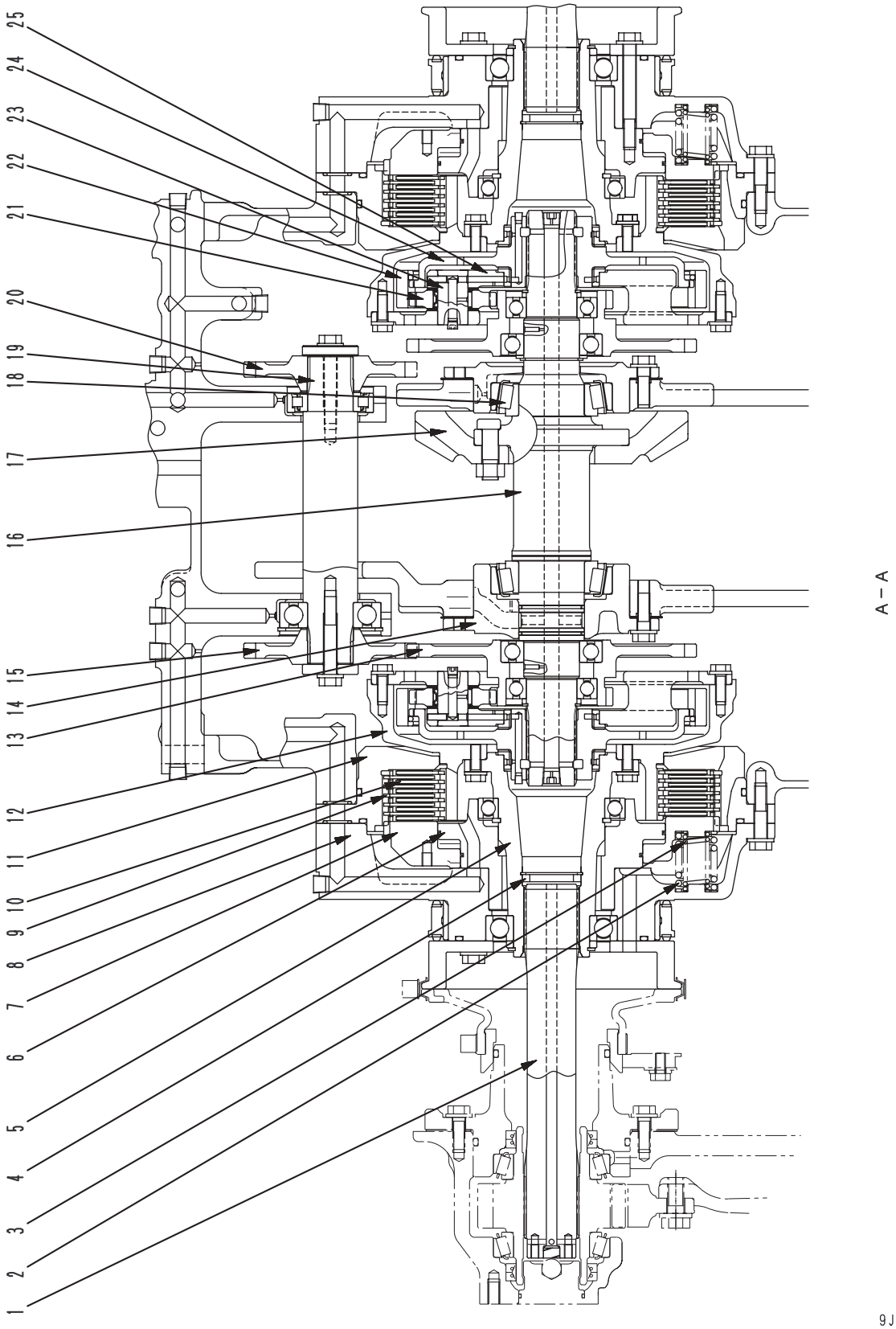
1
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22
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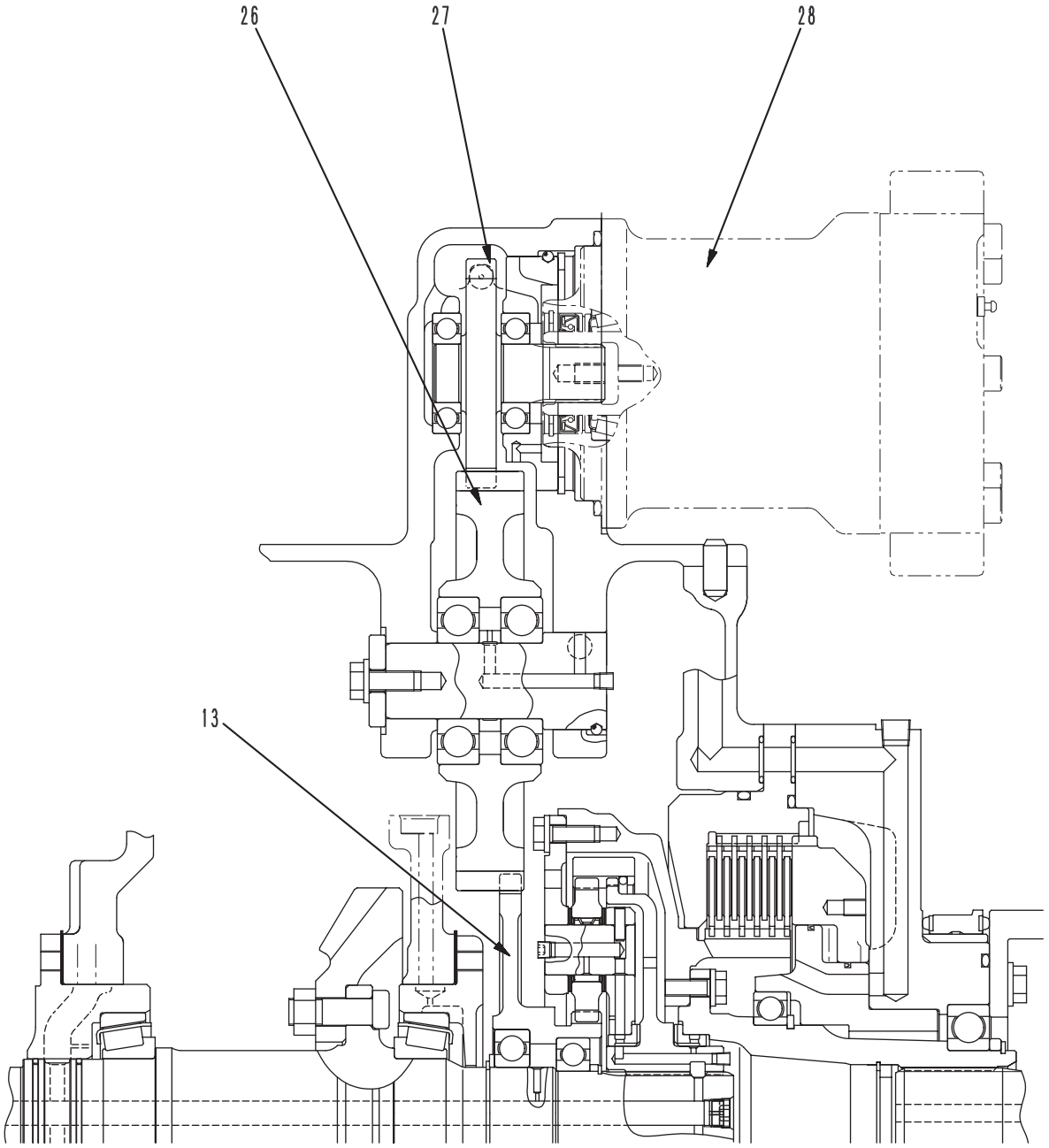
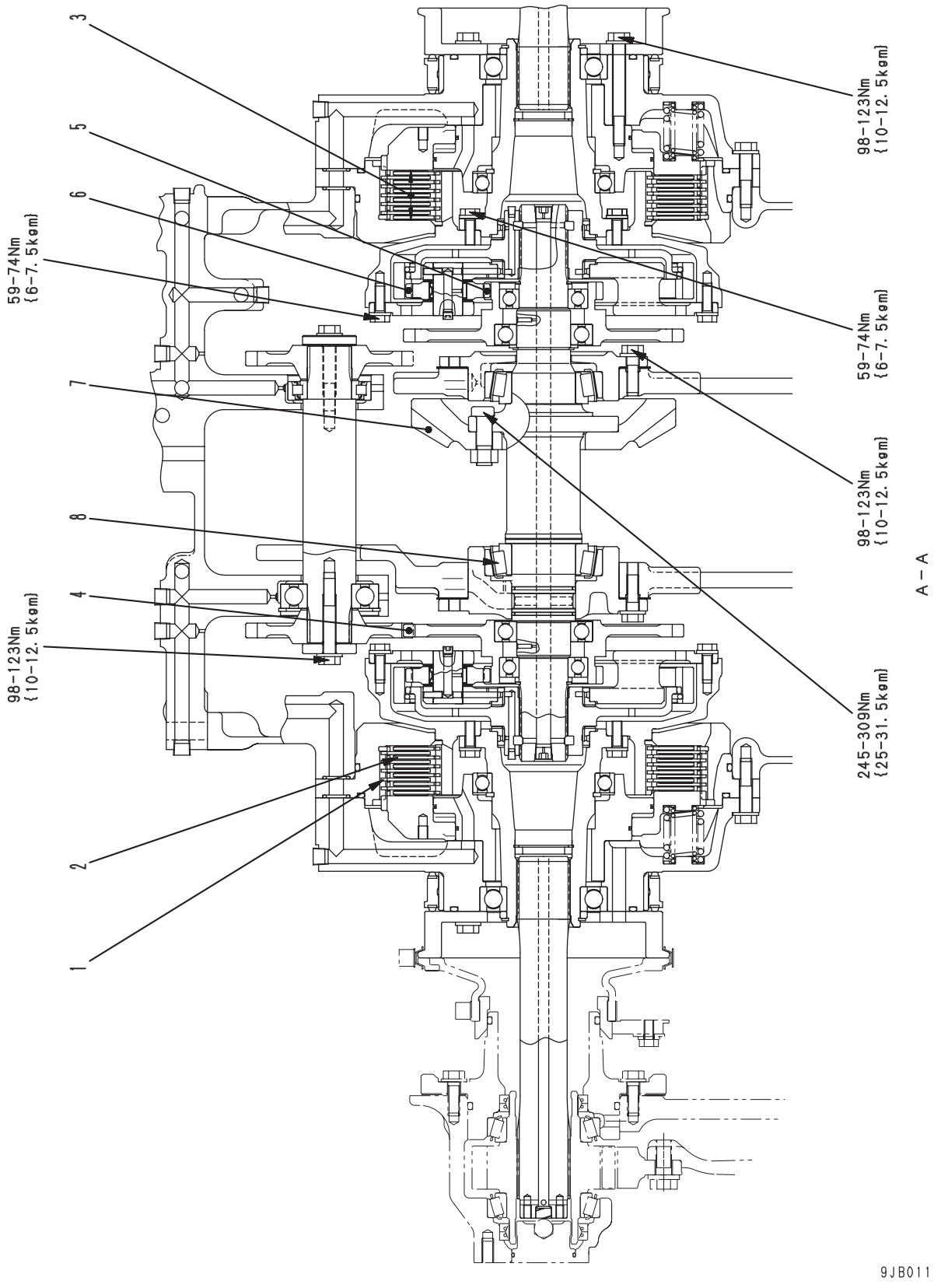
25
A – A
9JB01166



B – B

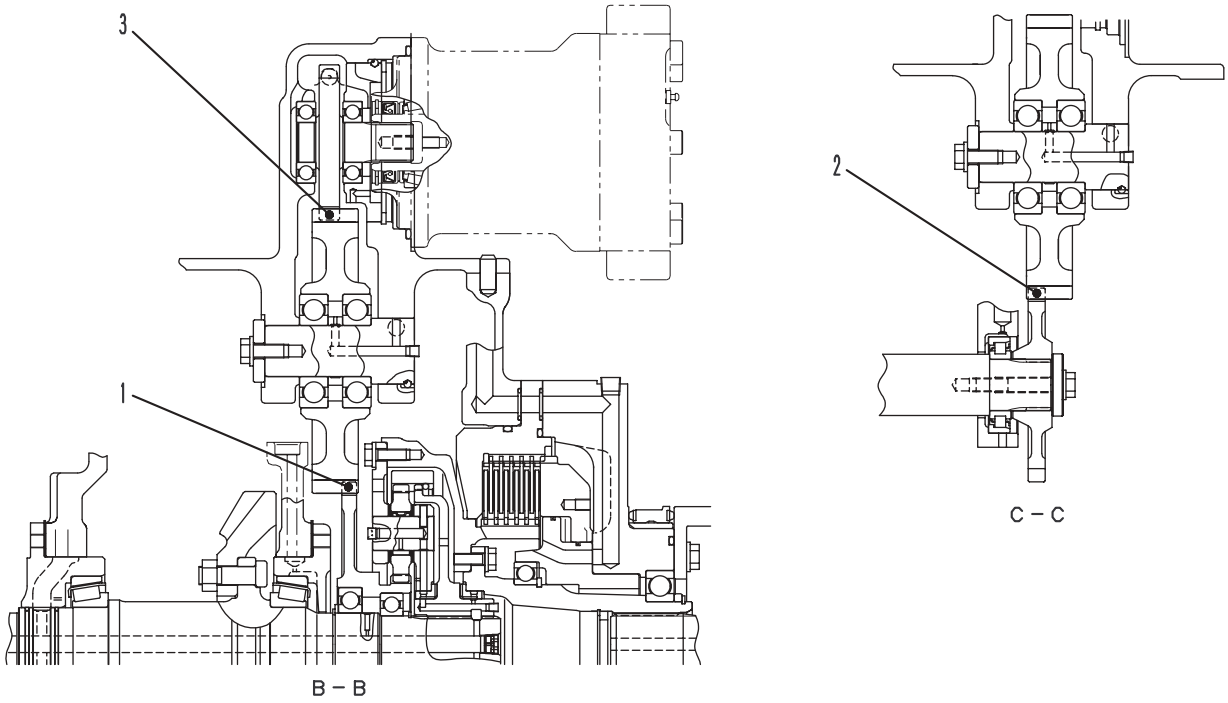
9JB01167

1. Output shaft
2. Brake spring (large)
3. Brake spring (small)
4. Stopper
5. Brake hub
6. Brake cage
7. Brake piston (100 teeth)
8. Brake cover
9. Brake plate (each side: 5)
10. Brake disc (each side: 6)
11. Brake drum (109 teeth)
12. Brake inner drun (72 teeth)
13. Gear A (55 teeth)
14. Bevel gear shaft case
15. Gear B (32 teeth)
16. Bevel gear shaft
17. Bevel gear (35 teeth)
18. Bevel gear shaft bearing
19. Shaft
20. Gear C (32 teeth)
21. Planetary pinion gear (26 teeth)
22. Ring gear (91 teeth)
23. Planetary shaft
24. Hub (91 teeth)
25. Carrier
26. Gear D (48 teeth)
27. Pinion
28. HSS motor


3
5
6
7
8
4
2
1
59–74Nm
{6–7.5kgm}
98–123Nm
{10–12.5kgm}
98–123Nm
{10–12.5kgm}
59–74Nm
{6–7.5kgm}
98–123Nm
{10–12.5kgm}
245–309Nm
{25–31.5kgm}
A – A
9JB01168

Unit: mm

No.	Check item	Criteria		Remedy
1	Thickness of brake plate	Standard size	Repair limit	Replace
		3.0	2.7	
	Distortion of brake plate	Tolerance	Repair limit	Correct or replace
		Max. 0.15	0.3	
2	Thickness of brake disc	Standard size	Repair limit	Replace
		5.2	4.9	
	Distortion of brake disc	Tolerance	Repair limit	Correct or replace
		Max. 0.25	0.4	
3	Total assembled thickness of brake plates and discs	Standard size	Repair limit	Replace
		46.2	43.3	
4	Backlash between gear A and gear B	Standard clearance	Clearance limit	
		0.06 – 0.65	–	
5	Backlash between sun gear and planetary pinion	0.14 – 0.35	–	
6	Backlash between planetary pinion and ring gear	0.15 – 0.38	–	
7	Backlash between bevel gear and pinion	0.20 – 0.28	0.45	
8	Preload of taper roller bearing for bevel gear shaft	Starting torque: 10.3 – 14.7 Nm {1.05 – 1.50 kgm}		Adjust



9JB01173

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 pinion	0.10 – 0.40	–	

Outline

Bevel gear shaft

- The engine power is transmitted through the torque converter to the transmission. Then, the bevel gear shaft device engages the bevel pinion with the bevel gear to turn the engine power at right angles into the lateral direction and reduce the revolving speed.
- The bevel pinion and bevel gear of the bevel gear shaft device are spiral bevel gears, which are lubricated with oil splashed by the lubricating oil pump and scavenging pump.
- The bevel gear shaft device consists of bevel gear (17) meshed with the bevel pinion, bevel gear shaft (16), bevel gear shaft bearing (18) to support the bevel gear shaft, and bevel gear shaft cage (14).

HSS

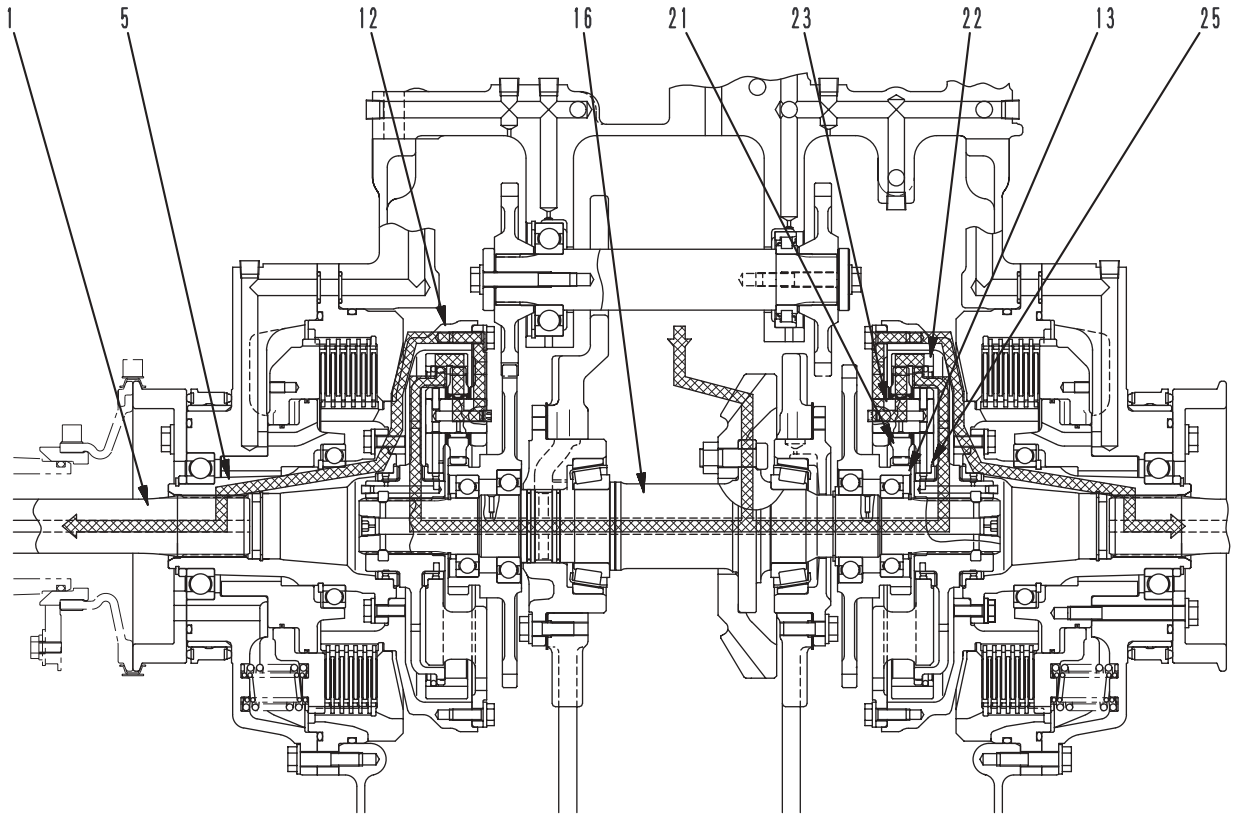
- The HSS (hydrostatic steering systems) consists of the transfer unit to reverse the revolution direction of the HSS motor and transmit it to gear A (13) and the planetary gear unit to increase or decrease the input for ring gear (22) and gear A (13) and output it to carrier (25). The turning direction of the machine is changed by stopping or reversing the revolution of the HSS motor.
- The transfer unit employs a spur gear speed reduction mechanism and is lubricated with oil splashed by the scavenging pump and lubricating oil pump.
- The planetary gear unit is lubricated forcedly with oil supplied by the scavenging pump and lubricating oil pump.
- The transfer unit consists of pinion (27) connected to the HSS motor by spline, gear D (26) meshed with the pinion, gear C (22) meshed with gear D, gear B (15) connected to shaft (19), gear A (13) supported by the bearing on the bevel gear shaft and meshed with gears B (15) and D (26), and cover to support these parts.
- The planetary gear unit consists of gear A (13), planet pinion (21), planet shaft (23), hub (24) connected to the bevel gear shaft and ring gear (22) by spline, and carrier (25) connected to brake inner drum (12).

Brake

- The brake is installed specially to brake the machine and connected to the brake inner drum (12).
- The brake is a wet-type, multiple disc clutch-type, spring force brake. It is driven hydraulically by the brake valve operated with brake pedal.
  The brake is lubricated forcedly with oil supplied by the power train lubricating oil pump and scavenging pump. The lubricating oil flows through the paths in the steering case, housing, cage, disc, and plate.
- While the engine is stopped, even if the brake pedal is not pressed, the back pressure of the brake piston lowers and the brake is "applied". After the engine is started again, however, as the hydraulic pressure in the circuit rises, the brake is "released". Accordingly, the parking brake must be kept locked.
- The brake consists of carrier gear (25), inner drum (12) connected to brake hub (5), disc (10) meshed with the inner drum, plate (9), the periphery of which is connected to the brake drum (11) by spline, brake drum (11), piston (7) to press the disc and plate against each other, springs (2) and (3), and cage (6), brake cover (8), and output shaft (1) to support these parts.
- Brake drum (11) and brake cover (8) are fixed to the steering case.
  Output shaft (1) are connected to the brake hub by spline and fixed by stopper (4) in the axial direction.

Operation of HSS

1. Steering lever at neutral



9JB01178

Traveling in the straight line

When the steering lever is at the neutral position, HSS motor is stopped, and the rotation of the transfer gear and left and right gears A (13) in the planetary system is also stopped.

In this condition, the power from bevel gear shaft (16) is input to ring gear (22), and is transmitted to through planet any pinion (21), planetary pinion shaft (23) and carrier (25). It is then transmitted to output shaft (1) through brake inner drum (12), and brake hub (5).

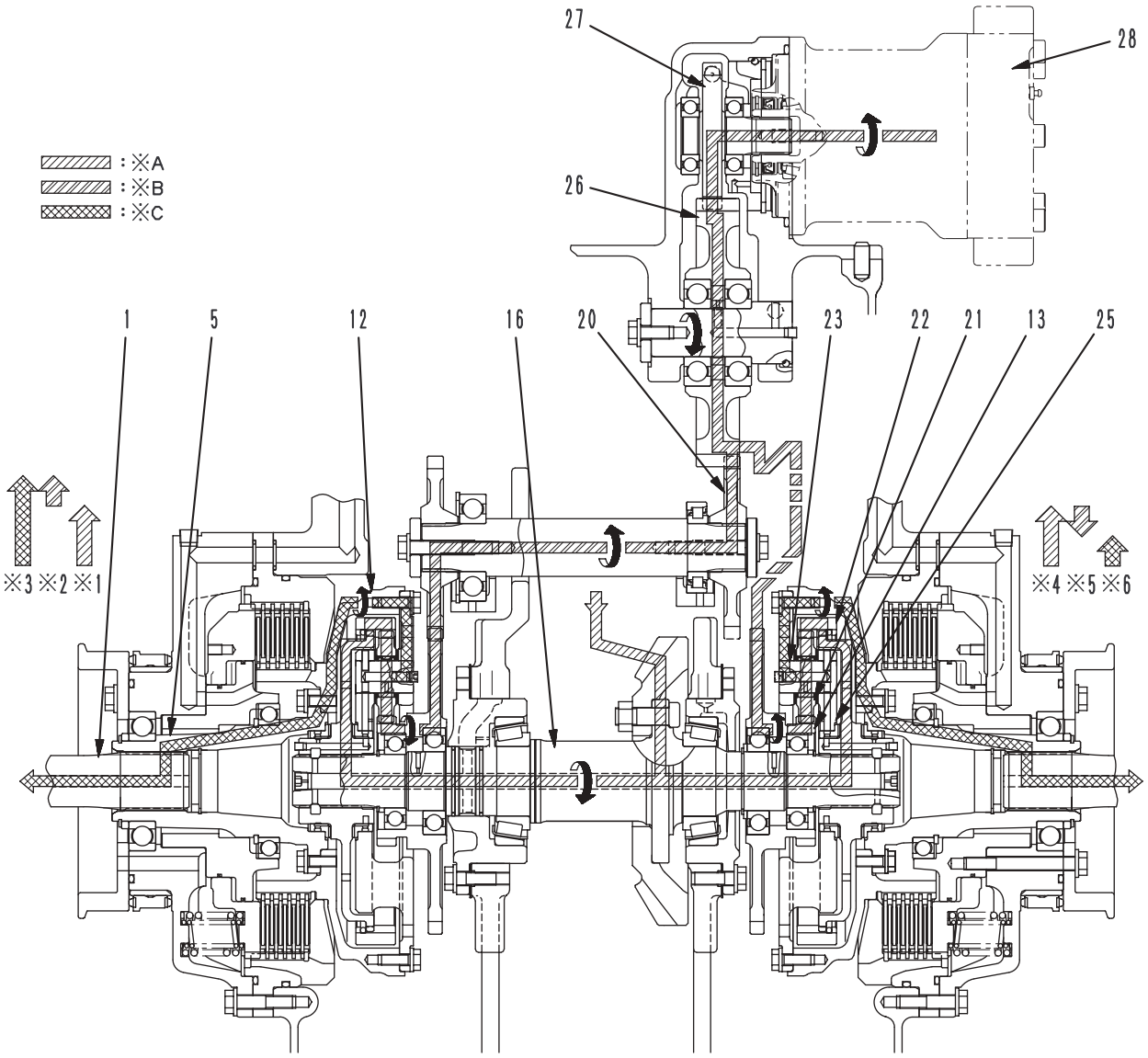
Therefore, the output speed on the left and right sides in the same, and the machine travles in a straight line.

Direction of rotation of HSS motor

Steering lever position	Left steering			Right steering			Neutral
Directional lever position	*1. Neutral	Forward	Reverse	*1. Neutral	Forward	Reverse	Any position
Direction of rotation of HSS motor as seen from left of machine	Clockwise	Clockwise	Counter-clockwise	Counter-clockwise	Counter-clockwise	Clockwise	Does not rotate

*1. Pivot turn

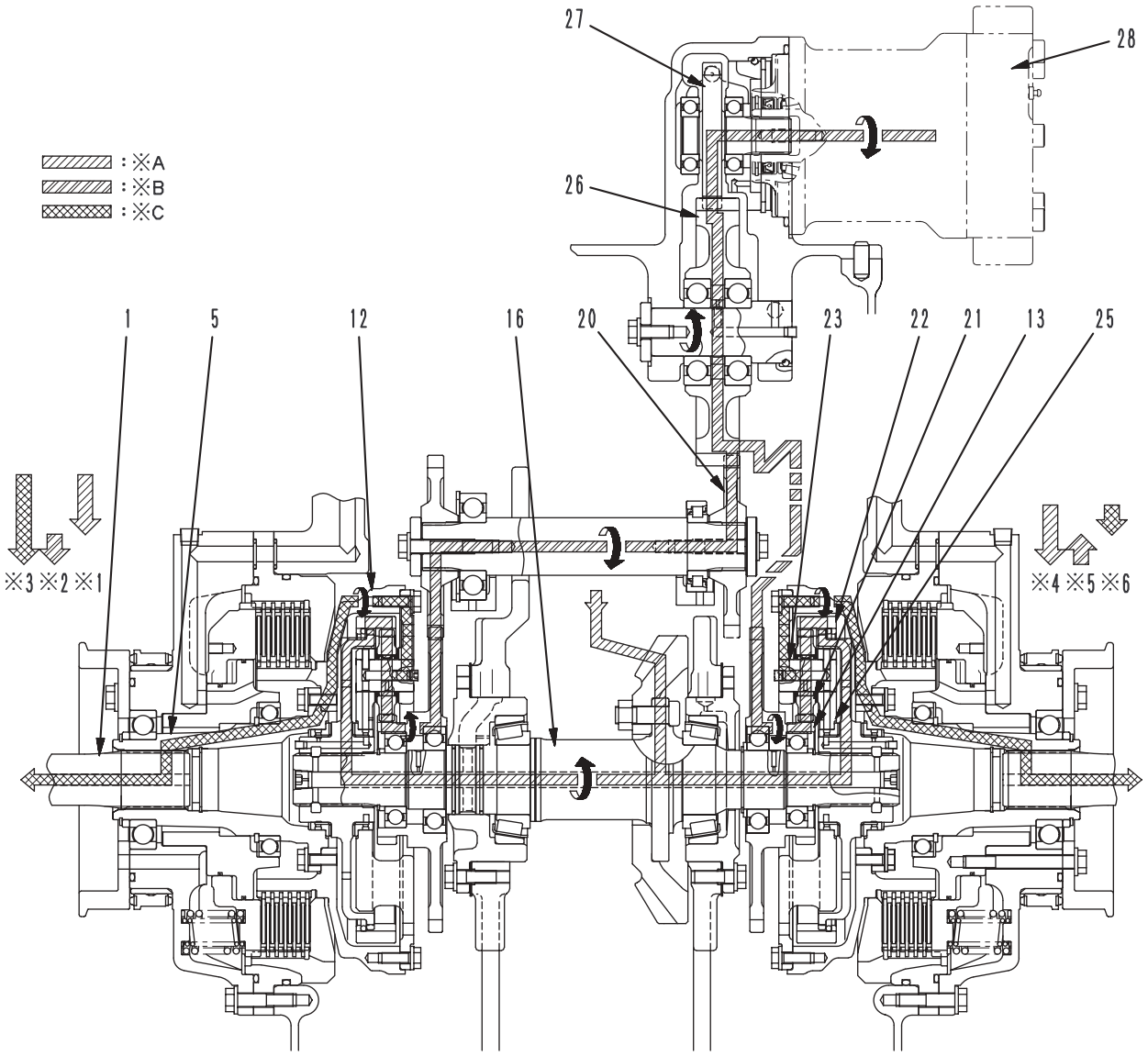
2. When steering lever is operated to right



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

※ 1. Transmission output speed
※ 2. Increase in speed from HSS motor
※ 3. Left bevel gear shaft output speed
(※ 1. + ※ 2.)
※ 4. Transmission output speed
※ 5. Decrease in speed from HSS motor
※ 6. Right bevel gear shaft output speed
(※ 4. – ※ 5.)

Forward
If the steering lever is operated to the right when the machine is traveling forward, HSS motor (28) rotates counterclockwise as seen from the left side of the machine. At the same time, gear A (13) on the left side of the machine rotates clockwise as seen from the left side of the machine, while gear A (13) on the right side of the machine rotates counterclockwise as seen from the left side of the machine.
When the machine is traveling forward, bevel gear shaft (16) and ring gear (22), which is interconnected with the bevel gear shaft, rotate clockwise as seen from the left side of the machine.
Therefore, considering the relationship of the rotating speed of the elements in the pairs of planetary gears, the rotating speed of carrier (25) on the left side is faster than when traveling in a straight line by the amount of the power of HSS motor; on the other hand, the rotating speed of carrier (25) on the right side is slower than when traveling in a straight line, so the machine turns in forward to the right, where the output speed is slower.



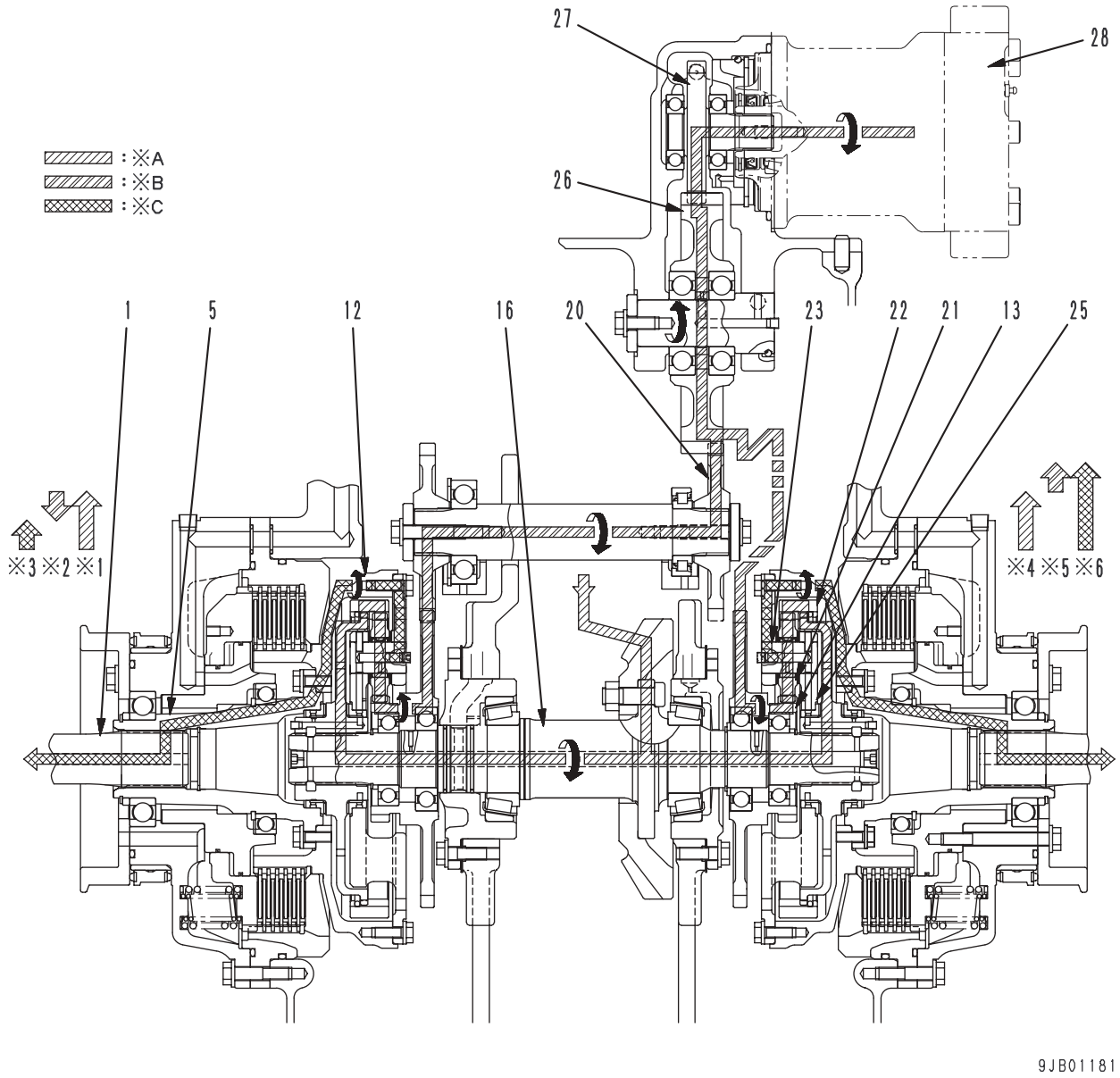
※ A: Transmission power
※ B: HSS motor power
※ C: Combined power

※ 1. Transmission output speed
※ 2. Increase in speed from HSS motor
※ 3. Left bevel gear shaft output speed (※ 1. + ※ 2.)
※ 4. Transmission output speed
※ 5. Decrease in speed from HSS motor
※ 6. Right bevel gear shaft output speed (※ 4. – ※ 5.)

Reverse
If the steering lever is operated to the right when the machine is traveling in reverse, the action of the selector valve makes HSS motor (28) rotate in the opposite direction when traveling forward.

That is, the HSS motor rotates clockwise as seen from the left side of the machine.
At the same time, gear A (13) on the left side of the machine rotates counterclockwise as seen from the left side of the machine while gear A (13) on the right side of the machine rotates clockwise as seen from the left side of the machine.
When the machine is traveling in reverse, bevel gear shaft (16) and ring gear (22), which is interconnected with the bevel gear shaft, rotate counterclockwise as seen from the left side of the machine.
Therefore, considering the relationship of the rotating speed of the elements in the pairs of planetary gears, the rotating speed of carrier (25) on the left side is faster (in the reverse direction) than when traveling in a straight line by the amount of the power of HSS motor; on the other hand, the rotating speed of carrier (25) on the right side is slower than when traveling in a straight line, so the machine turns in reverse to the right, where the output speed is slower.

3. When steering lever is operated to left

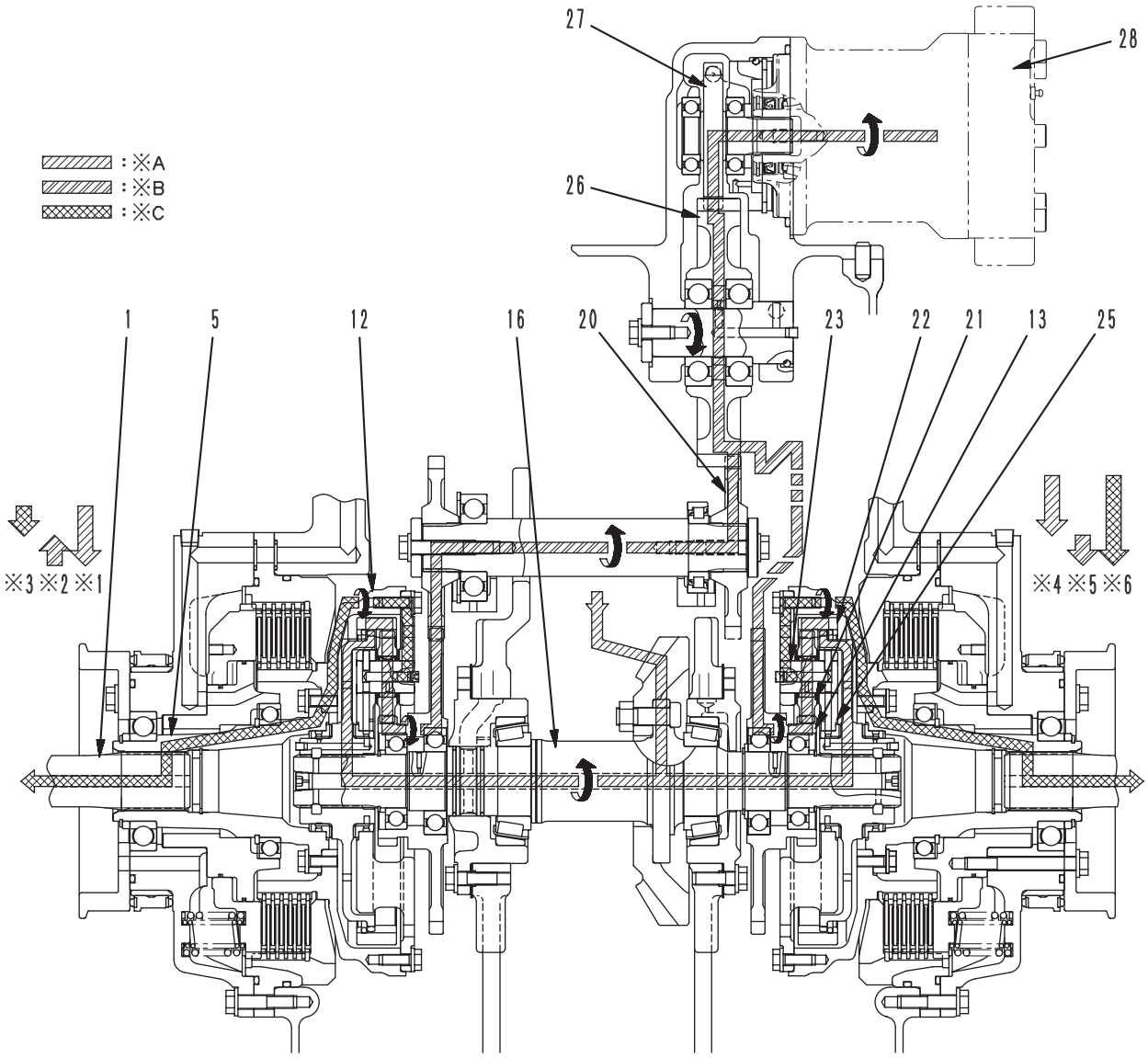


※ A: Transmission power
※ B: HSS motor power
※ C: Combined power

※ 1. Transmission output speed
※ 2. Decrease in speed from HSS motor
※ 3. Left bevel gear shaft output speed
(※ 1. – ※ 2.)
※ 4. Transmission output speed
※ 5. Increase in speed from HSS motor
※ 6. Right bevel gear shaft output speed
(※ 4. + ※ 5.)

Forward
If the steering lever is operated to the left when the machine is traveling forward, HSS motor (28) rotates clockwise as seen from the left side of the machine.

At the same time, gear A (13) on the left side of the machine rotates counterclockwise as seen from the left side of the machine, while gear A (13) on the right side of the machine rotates clockwise as seen from the left side of the machine.
When the machine is traveling forward, bevel gear shaft (16) and ring gear (22), which is interconnected with the bevel gear shaft, rotate clockwise as seen from the left side of the machine.
Therefore, considering the relationship of the rotating speed of the elements in the pairs of planetary gears, the rotating speed of carrier (25) on the right side is faster than when traveling in a straight line by the amount of the power of HSS motor; on the other hand, the rotating speed of carrier (25) on the left side is slower than when traveling in a straight line, so the machine turns in forward to the left, where the output speed is slower.



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

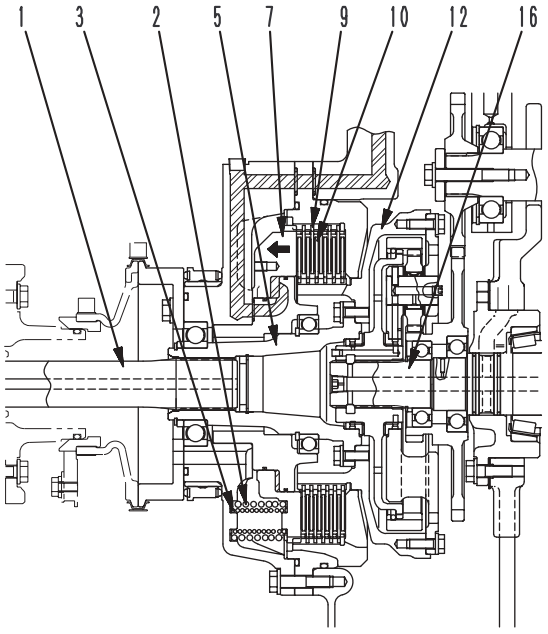
※ 1. Transmission output speed
※ 2. Decrease in speed from HSS motor
※ 3. Left bevel gear shaft output speed
(※ 1. – ※ 2.)
※ 4. Transmission output speed
※ 5. Increase in speed from HSS motor
※ 6. Right bevel gear shaft output speed
(※ 4. + ※ 5.)

Reverse
If the steering lever is operated to the left when the machine is traveling in reverse, the action of the selector valve makes HSS motor (28) rotate in the opposite direction from the traveling forward.
That is, the HSS motor rotates counterclockwise as seen from the left side of the machine.
At the same time, gear A (13) on the left side of the machine rotates clockwise as seen from the left side of the machine, while gear A (13) on the right side of the machine rotates counterclockwise as seen from the left side of the machine.
When the machine is traveling in reverse, bevel gear shaft (16) and ring gear (22), which is interconnected with the bevel gear shaft rotate counterclockwise as seen from the left side of the machine.
Therefore, considering the relationship of the rotating speed of the elements in the pairs of planetary gears, the rotating speed of carrier (25) on the right side is faster (in the reverse direction) than when traveling in a straight line by the amount of the power of HSS motor; on the other hand, the rotating speed of carrier (25) on the left side is slower than when traveling in a straight line, so the machine turns in reverse to the left, where the output speed is slower.

Operation of brakes

1. Brake released

When the brake is in the neutral position, the brake valve is also in the neutral position and oil enters the back-pressure port of brake piston (7). When the oil pressure rises, the oil pushes the piston to the left in the direction of the arrow, compresses springs (2) and (3), and releases the pressure pushing discs (10) and plates (9) together. When this happens, the power transmitted from bevel gear shaft (16) through the HSS steering to brake inner drum (12) is transmitted from hub (5) to output shaft (1), and goes to the final drive.



9JB01183

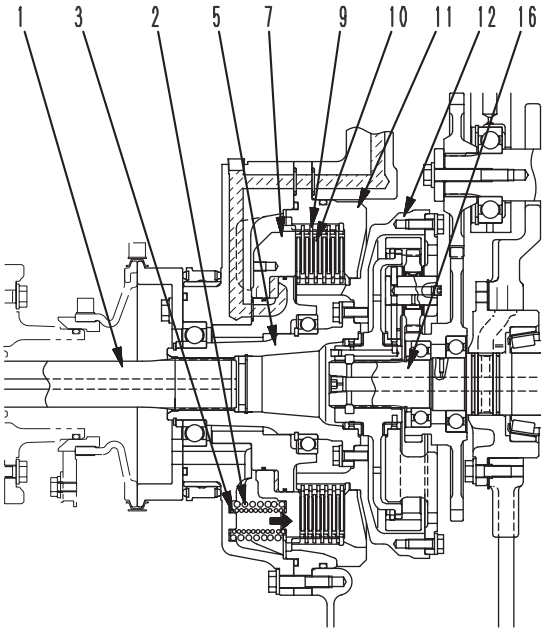
2. Brake applied (brake pedal depressed)

If the brake pedal is depressed, the brake valve switches and the oil applying back pressure to piston (7) is connected to the drain circuit.

In this condition, piston (7) is pushed out to the right in the direction of the arrow by the tension of springs (2) and (3), so discs (10) and plates (9) are pressed against the stopper portion of brake outer drum (11). The brake outer drum is joined to the steering case and is fixed in position.

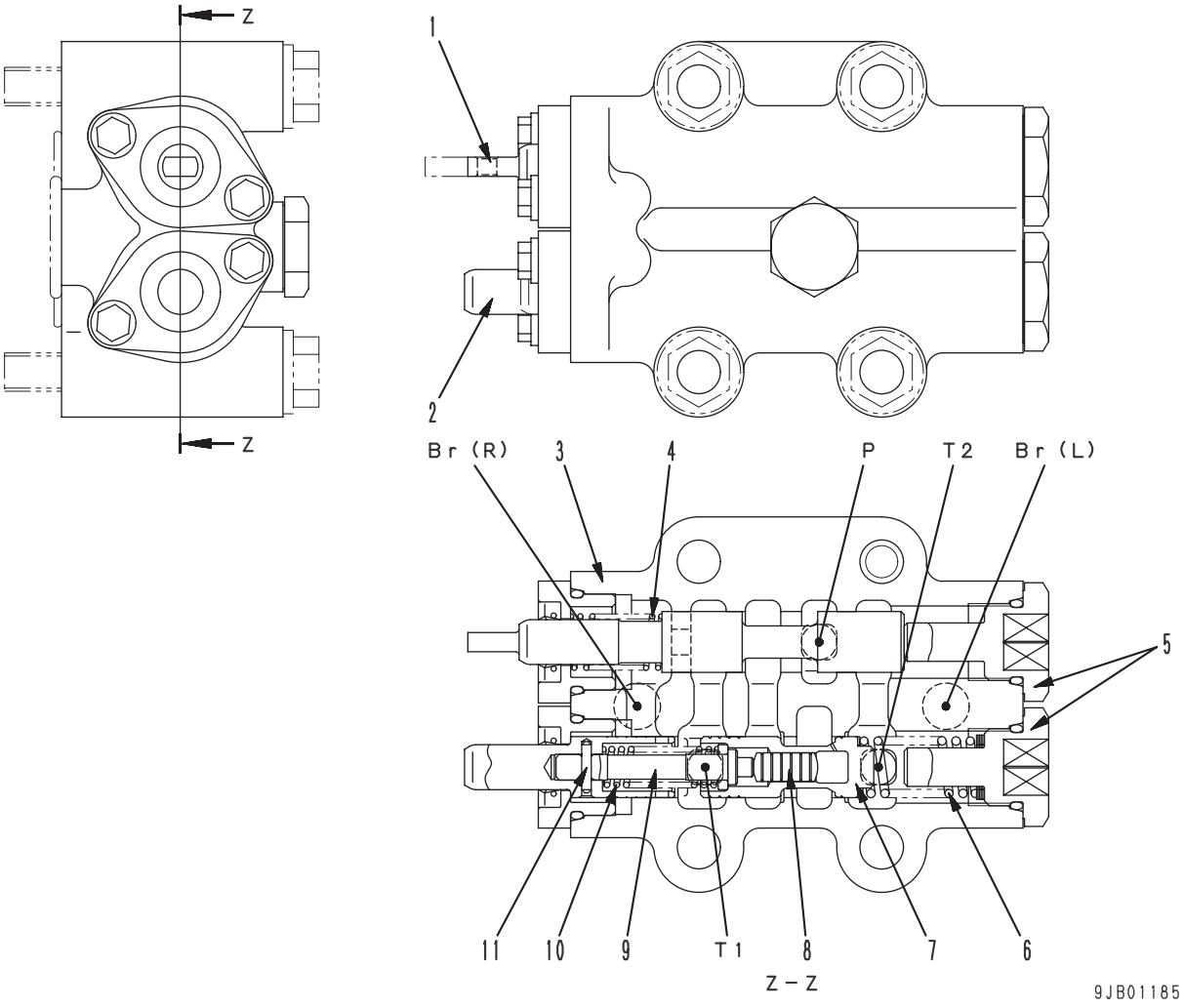
Therefore, the rotation of brake inner drum (12), that is the rotation of output shaft (1), is stopped because the discs and plates are pushed into contact together.

The hydraulic force applied to piston (7) cab be controlled by the amount that the brake pedal is depressed, and the braking force can be adjusted.



9JB01184

BRAKE VALVE

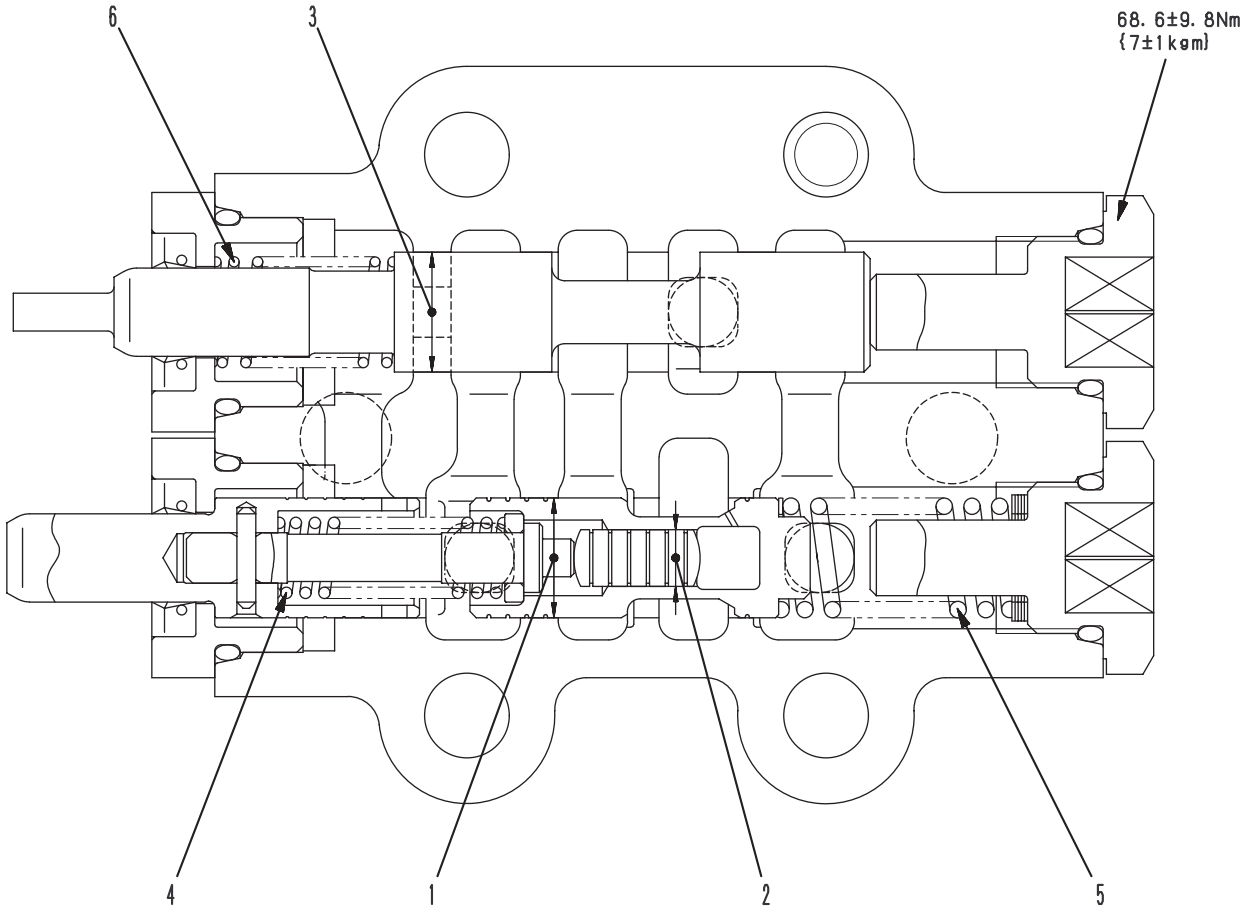


P: From power train pump
T1: To steering case
T2: To steering case
Br (R): To right brake
Br (L) : To left brake

1. Parking brake valve
2. Main brake valve
3. Body
4. Return spring
5. Plug
6. Return spring
7. Valve
8. Piston
9. Shaft
10. Modulating spring
11. Guide

Outline

- The brake valve is in the circuit between the power train pump through the main relief valve and the piston of the brake inside the HSS unit. It consists of the main brake valve and parking brake valve.
- When the brake pedal is depressed, the flow of oil to the brake piston is shut off, the brake piston pushes the disc and plate together under the force of the spring, and the brake is applied.
- In the case of the HSS, the brakes are used only for braking (the brakes have no connection with the steering control), so the left and right brakes are both applied at the same time.



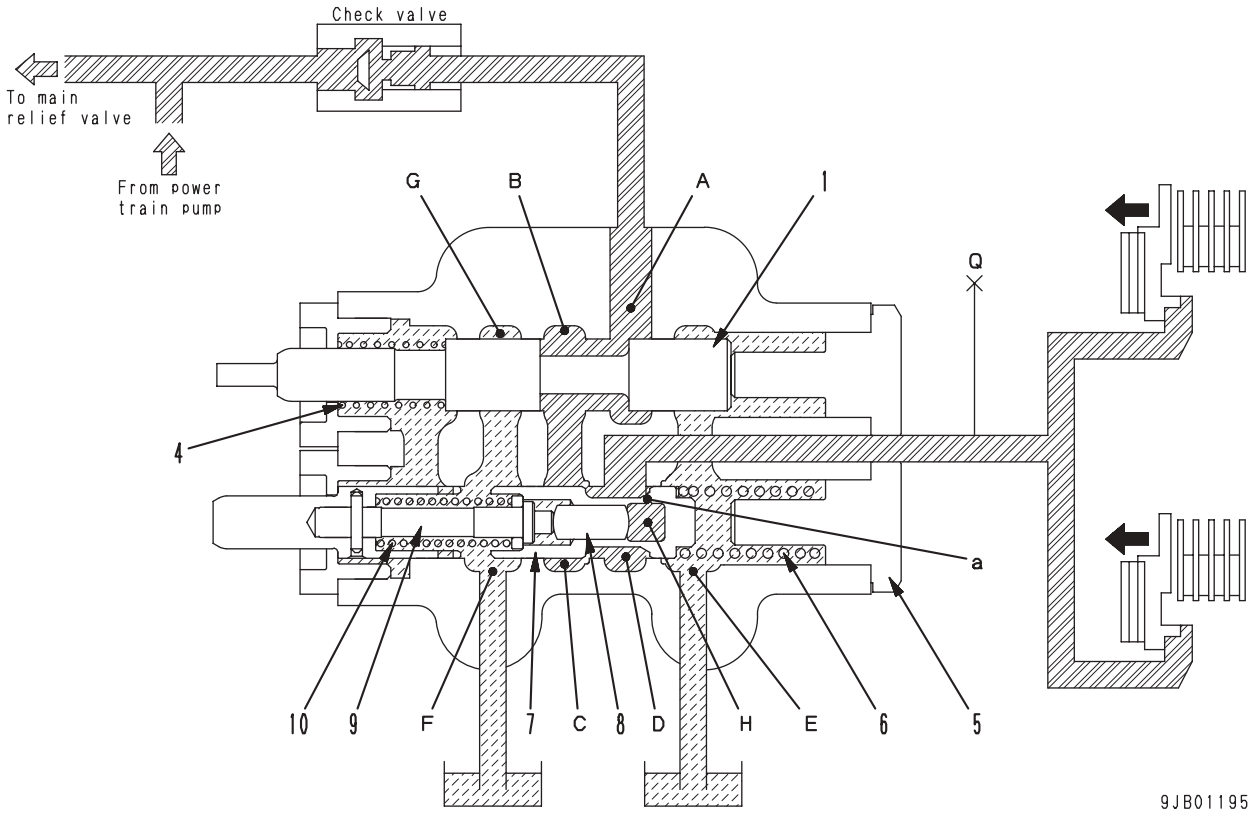
9JB01186

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between brake valve and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		ø19	– 0.020 – 0.030	+ 0.013 0	0.020– 0.043	0.07	
2	Clearance between brake valve and piston	ø9	– 0.030 – 0.040	+ 0.015 0	0.03– 0.055	0.08	
3	Clearance between parking brake valve and body	ø19	– 0.034 – 0.043	+ 0.013 0	0.034– 0.056	0.08	
4	Brake modulating spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		48	36	75.3 N {7.68 kg}	46.6	71.6 N {7.3 kg}	
5	Brake valve return spring	52	37	169 N {17.3 kg}	50.4	162 N {16.5}	
6	Parking brake valve return spring	36.5	28.5	16.7 N {1.7 kg}	35.4	15.7 N {1.6 kg}	

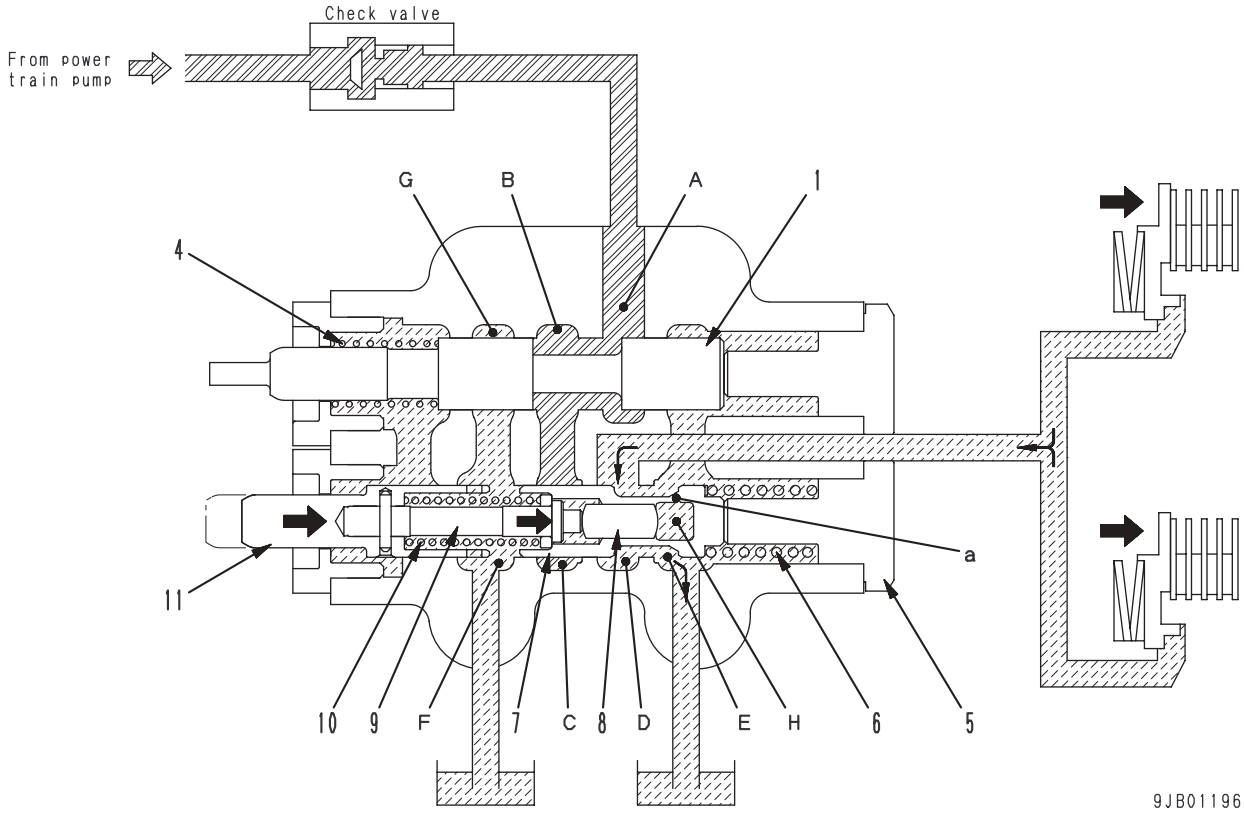
Operation

1. When brake is released (parking brake OFF, brake pedal released)



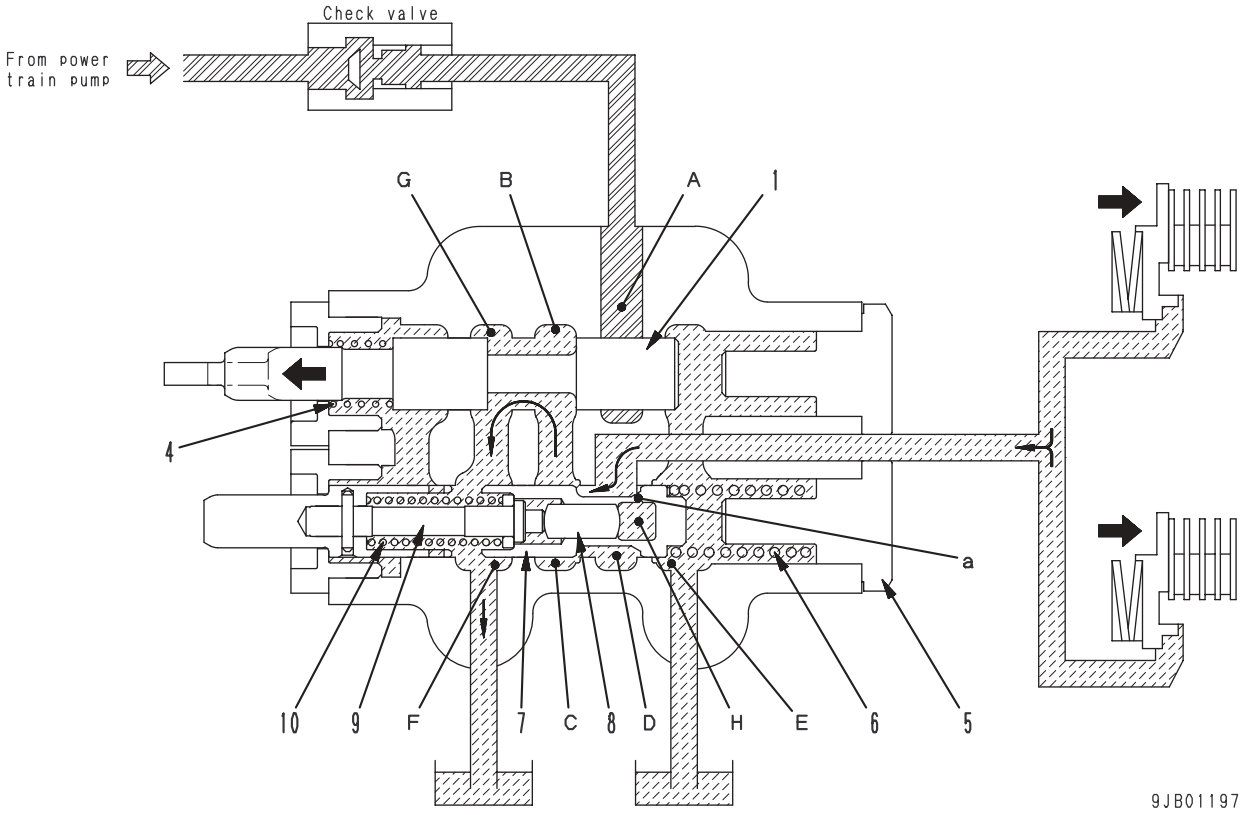
- When the brake pedal is at the released position (not depressed), the oil ports of each valve are opened or closed by the tension of the spring.
  The oil from the power train pump passes through the main relief valve, enters port **A**, then passes through ports **B**, **C**, and **D**, and flows to the back pressure port of the brake piston. It moves the piston to the left in the direction of the arrow, and compresses the brake spring to release the brake. The pressure at this point is balanced at 3.02 MPa {30.8 kg/cm2}, and it can be measured at pressure detection port **Q**.

2. When brake is applied (parking brake OFF, brake pedal depressed)



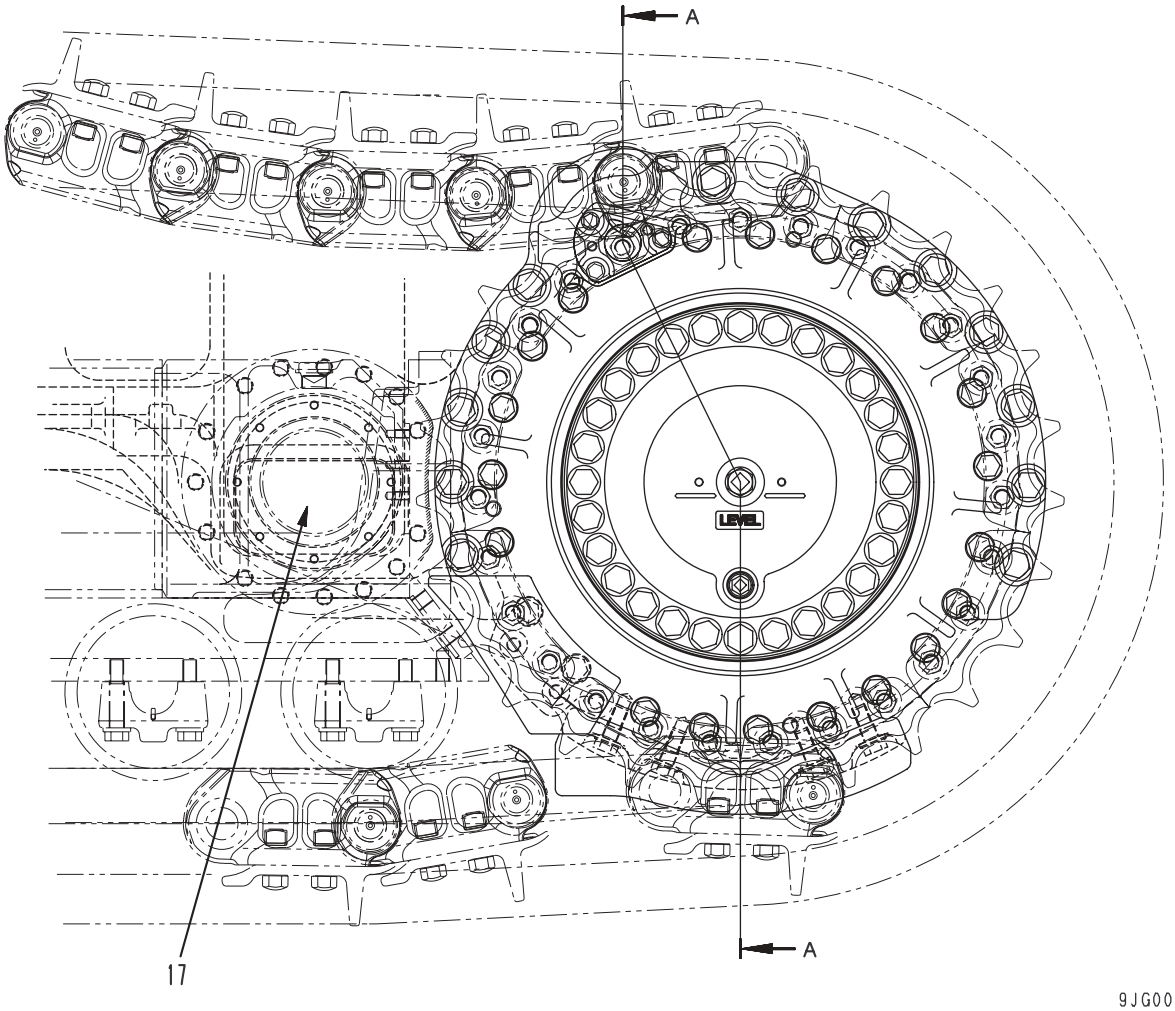
- When the brake pedal is depressed, guide (11) and shaft (9) are pushed to the right in the direction of the arrow, and modulating spring (10) is compressed. The reaction force moves brake valve (7) to the right in the direction of the arrow. When this happens, ports **C** and **D** are closed, and port **D** and drain port **E** are opened, so the oil from the power train pump enters port **A** and stops at port **C**. Some of the oil flowing into the brake piston port and forming the back pressure is drained from port **D** to port **E**, and the rest of the oil passes from port **D** through orifice **a** and enters port **H**. However, the oil beyond port **D** is drained to port **E**, so the oil pressure drops. the oil entering port **H** pushes piston (8) and the reaction force pushing brake valve (7) to the right in the direction of the arrow becomes smaller, so brake valve (7) is moved to the left in the direction of the arrrow by the tension of return spring (6). This closes ports **D** and **E**, so the oil pressure beyond port **D** does not drop any further and is maintained at the same level.
- If the brake pedal is depressd further, the above operation is repeated, and when the valve reaches the end of its stroke, the brake is completely applied.
- The oil pressure beyond port **D** is determined by the tension of return spring (6), which changes the load according to the amount that the brake pedal is operated.
  Therefore, if the brake pedal is depressed only a short distance, the oil pressure beyond port **D** is set at a high level, and the brake is partially applied. If the brake pedal is depressed a large amount, the oil pressure is set at a low level and the brake is applied.

3. When parking brake is ON (brake pedal is released, brake lock lever at LOCK)



- If the brake lock lever (safety lever) is placed at the LOCK position, parking brake valve (1) is pulled to the left in the direction of the arrow. When this happens, port **A** and port **B** are closed, and port **B** and port **G** are opened. The oil from the power train pump enters port **A** and stops.
- The oil flowing to the brake piston port and forming the back pressure passed from port **D** to ports **C**, **B**, **G**, and **F**, and is drained. Parking brake valve (1) remains pulled to the left in the direction of the arrow and is fixed in position, so the back pressure of the brake piston port continues to drop. The brake is completely applied, and this condition is maintained.
  This condition is maintained even when the engine is started agein.

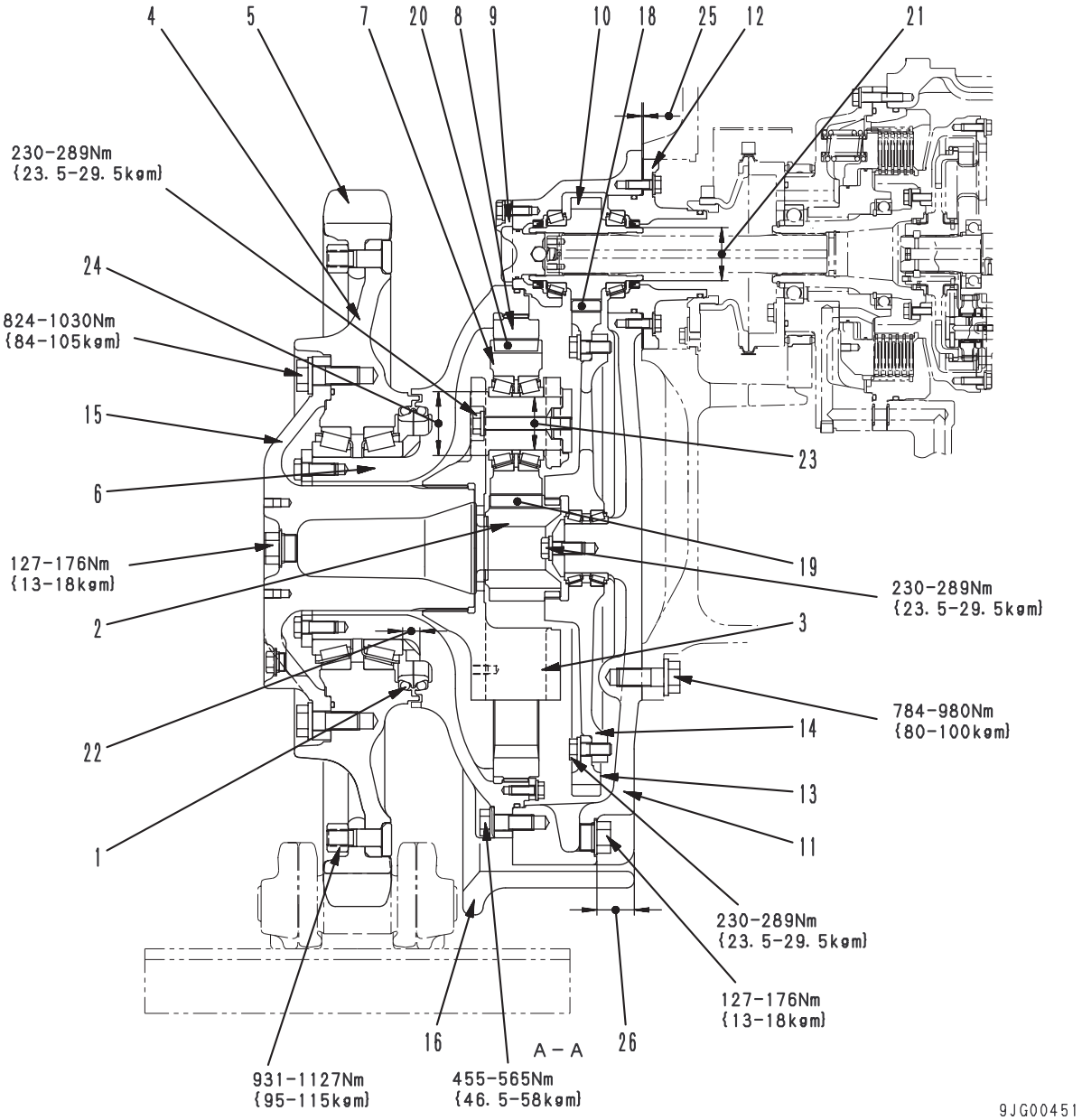
FINAL DRIVE



Outline

- The final drive is a single stage spur gear, single stage planetary gear reduction type. The lubrication is of splash type using the rotation of the gears. The final drive can be removed and installed as a single unit.
- Floating seal (1) is installed to the rotating sliding portion of the sprocket to prevent the entry of dirt or sand and to prevent leakage of lubricating oil.

D85EX-15

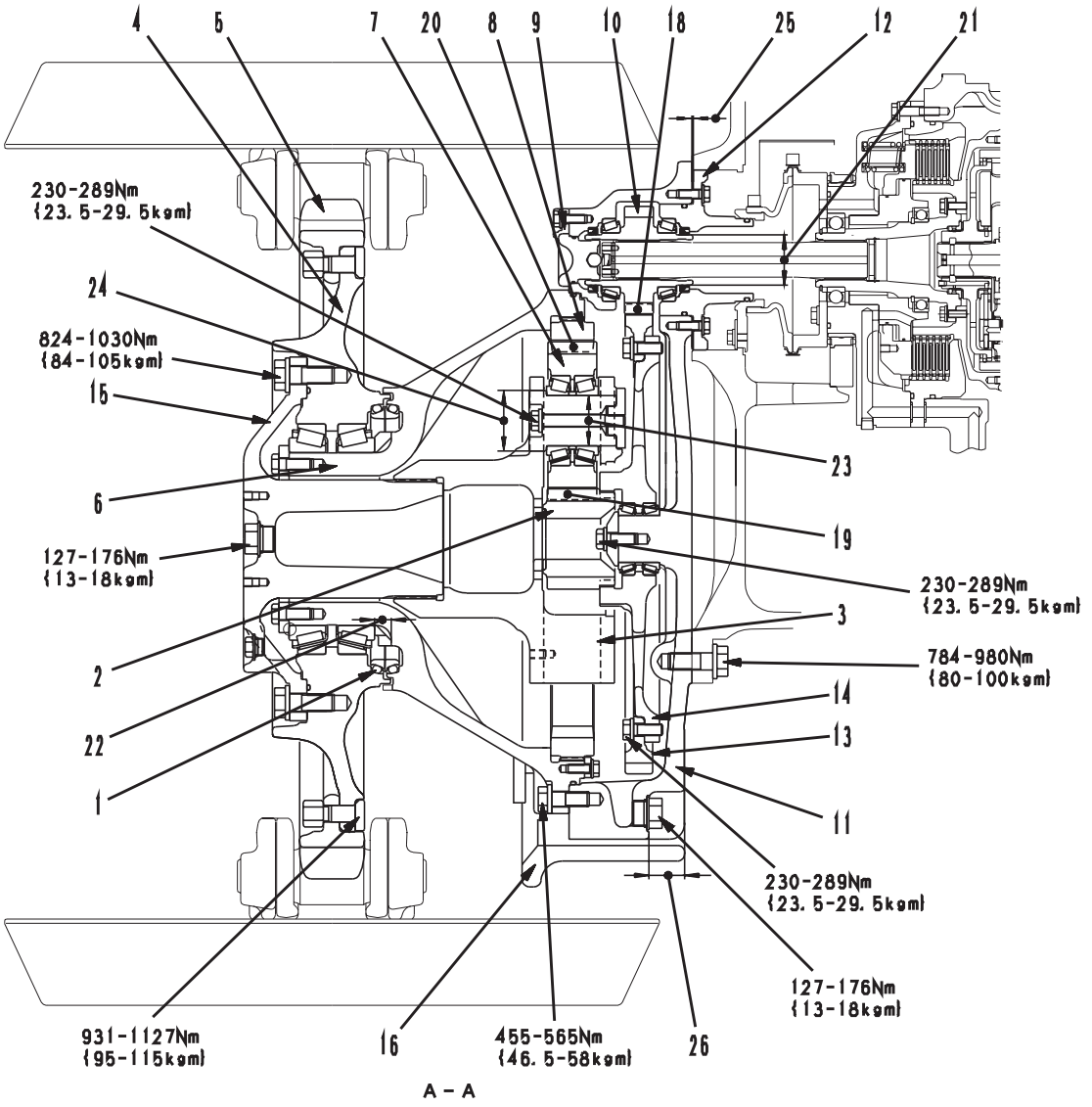

4
5
7
20
8
9
10
18
25
12
21
230-289Nm
{23. 5-29. 5kgm}
24
824-1030Nm
{84-105kgm}
15
6
127-176Nm
{13-18kgm}
2
22
1
23
19
230-289Nm
{23. 5-29. 5kgm}
3
784-980Nm
{80-100kgm}
14
13
11
230-289Nm
{23. 5-29. 5kgm}
127-176Nm
{13-18kgm}
26
16
A-A
931-1127Nm
{95-115kgm}
455-565Nm
{46. 5-58kgm}
9JG00451

1. Floating seal
2. Sun gear
3. Carrier
4. Sprocket boss
5. Sprocket teeth
6. Cover
7. Planetary gear
8. Ring gear
9. Cover
10. No.1 pinion
11. Final drive case
12. Bearing cage
13. No.1 gear
14. No.1 gear hub
15. Shaft
16. Wear guard
18. Pivot shaft

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">18</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="3">Replace</td></tr>
<tr><td colspan="3">0.23 – 0.79</td><td colspan="2">0.79</td></tr>
<tr><td>19</td><td>Backlash between sun gear and planetary gear</td><td colspan="3">0.20 – 0.74</td><td colspan="2">0.74</td></tr>
<tr><td>20</td><td>Backlash between planetary gear and ring gear</td><td colspan="3">0.24 – 0.83</td><td colspan="2">0.83</td></tr>
<tr><td rowspan="2">21</td><td rowspan="2">Outside diameter of No.1 pinion oil seal contact surface</td><td colspan="2">Standard size</td><td colspan="2">Tolerance</td><td>Repair limit</td><td rowspan="2">Repair or replace</td></tr>
<tr><td colspan="2">70</td><td colspan="2">0
– 0.074</td><td>69.926</td></tr>
<tr><td>22</td><td>Thickness of thrust collar of inner body roller bearing</td><td colspan="3">23</td><td colspan="2">22.95</td><td rowspan="3">Replace</td></tr>
<tr><td rowspan="2">23</td><td rowspan="2">Clearance between outer diameter of planet gear shaft and inner diameter of carrier hole.
(Small diameter)</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>70</td><td>+ 0.021
+ 0.002</td><td>0
– 0.03</td><td>– 0.051-
– 0.002</td><td>0.002</td></tr>
<tr><td>24</td><td>Clearance between outer diameter of planet gear shaft and inner diameter of carrier hole.
(Large diameter)</td><td>84</td><td>+ 0.059
+ 0.037</td><td>+ 0.035
0</td><td>– 0.059-
– 0.002</td><td>– 0.002</td></tr>
<tr><td>25</td><td>Standard shim thickness for No.1 pinion bearing cage</td><td colspan="5">2</td><td>Adjust</td></tr>
<tr><td rowspan="2">26</td><td rowspan="2">Wear of wear guard</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="2">Repair or replace</td></tr>
<tr><td colspan="3">52</td><td colspan="2">21</td></tr>
</table>

D85PX-15



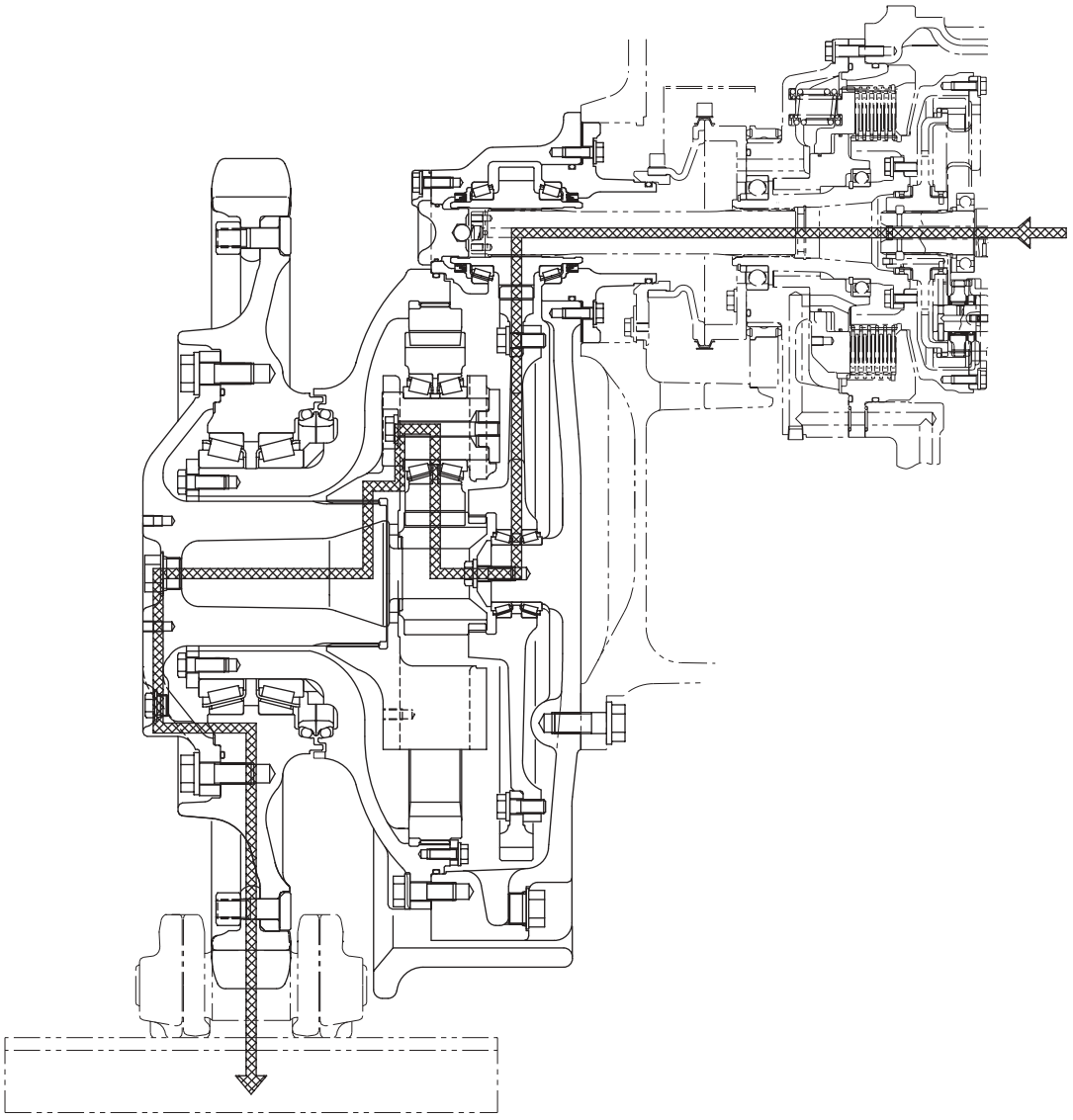
9JG00400

1. Floating seal
2. Sun gear
3. Carrier
4. Sprocket boss
5. Sprocket teeth
6. Cover
7. Planetary gear
8. Ring gear
9. Cover
10. No.1 pinion
11. Final drive case
12. Bearing cage
13. No.1 gear
14. No.1 gear hub
15. Shaft
16. Wear guard
18. Pivot shaft

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">18</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="3">Replace</td></tr>
<tr><td colspan="3">0.23 – 0.79</td><td colspan="2">0.79</td></tr>
<tr><td>19</td><td>Backlash between sun gear and planetary gear</td><td colspan="3">0.20 – 0.74</td><td colspan="2">0.74</td></tr>
<tr><td>20</td><td>Backlash between planetary gear and ring gear</td><td colspan="3">0.24 – 0.83</td><td colspan="2">0.83</td></tr>
<tr><td rowspan="2">21</td><td rowspan="2">Outside diameter of No.1 pinion oil seal contact surface</td><td colspan="2">Standard size</td><td colspan="2">Tolerance</td><td>Repair limit</td><td rowspan="2">Repair or replace</td></tr>
<tr><td colspan="2">70</td><td colspan="2">0
– 0.074</td><td>69.926</td></tr>
<tr><td>22</td><td>Thickness of thrust collar of inner body roller bearing</td><td colspan="3">23</td><td colspan="2">22.95</td><td rowspan="3">Replace</td></tr>
<tr><td rowspan="2">23</td><td rowspan="2">Clearance between outer diameter of planet gear shaft and inner diameter of carrier hole.
(Small diameter)</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>70</td><td>+ 0.021
+ 0.002</td><td>0
– 0.03</td><td>– 0.051-
– 0.002</td><td>0.002</td></tr>
<tr><td>24</td><td>Clearance between outer diameter of planet gear shaft and inner diameter of carrier hole.
(Large diameter)</td><td>84</td><td>+ 0.059
+ 0.037</td><td>+ 0.035
0</td><td>– 0.059-
– 0.002</td><td>– 0.002</td></tr>
<tr><td>25</td><td>Standard shim thickness for No.1 pinion bearing cage</td><td colspan="5">2</td><td>Adjust</td></tr>
<tr><td rowspan="2">26</td><td rowspan="2">Wear of wear guard</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="2">Repair or replace</td></tr>
<tr><td colspan="3">52</td><td colspan="2">21</td></tr>
</table>

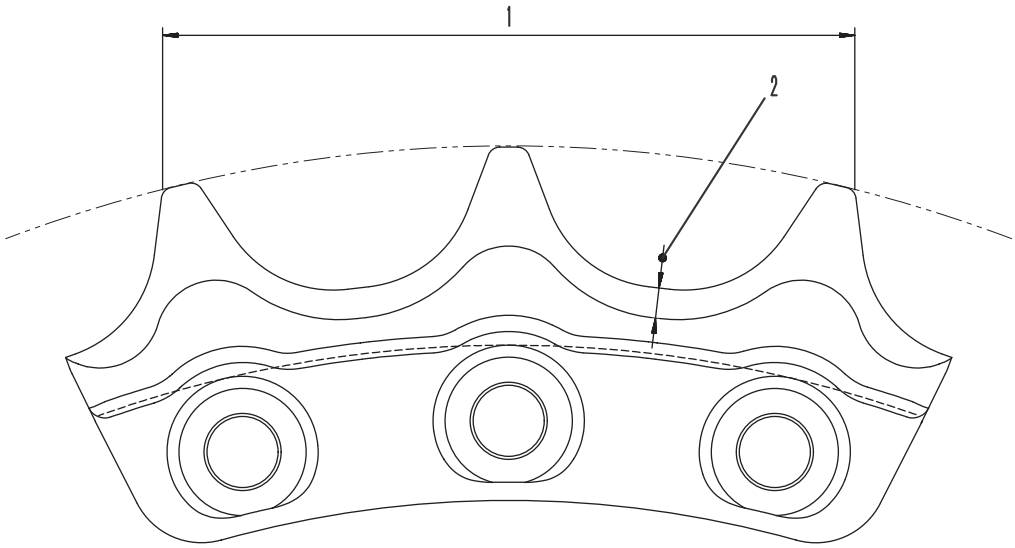
PATH OF POWER TRANSMISSION



9JG00207

- The power from the bevel gear shaft and steering clutch is transmitted to 1st pinion (10) to rotate 1st gear (13) meshed with the 1st pinion and sun gear (2) meshed with the 1st gear.
  The rotation of sun gear (2) is transmitted to planetary gear (10). Since ring gear (8) meshed with the planetary gear is fixed to cover (6), the planetary gear rotates along the ring gear (8) and revolves around the sun gear (2).
  Then, the rotating force of sun gear (2) forms the rotating force of carrier (3), which supports the planetary gear (10), via shaft (15), and is transmitted to sprocket hub (4).
  The rotating direction of carrier (3) is the same with sun gear (2).
  The rotational force transmitted to sprocket boss (4) is further transmitted to sprocket teeth (5).

SPROCKET

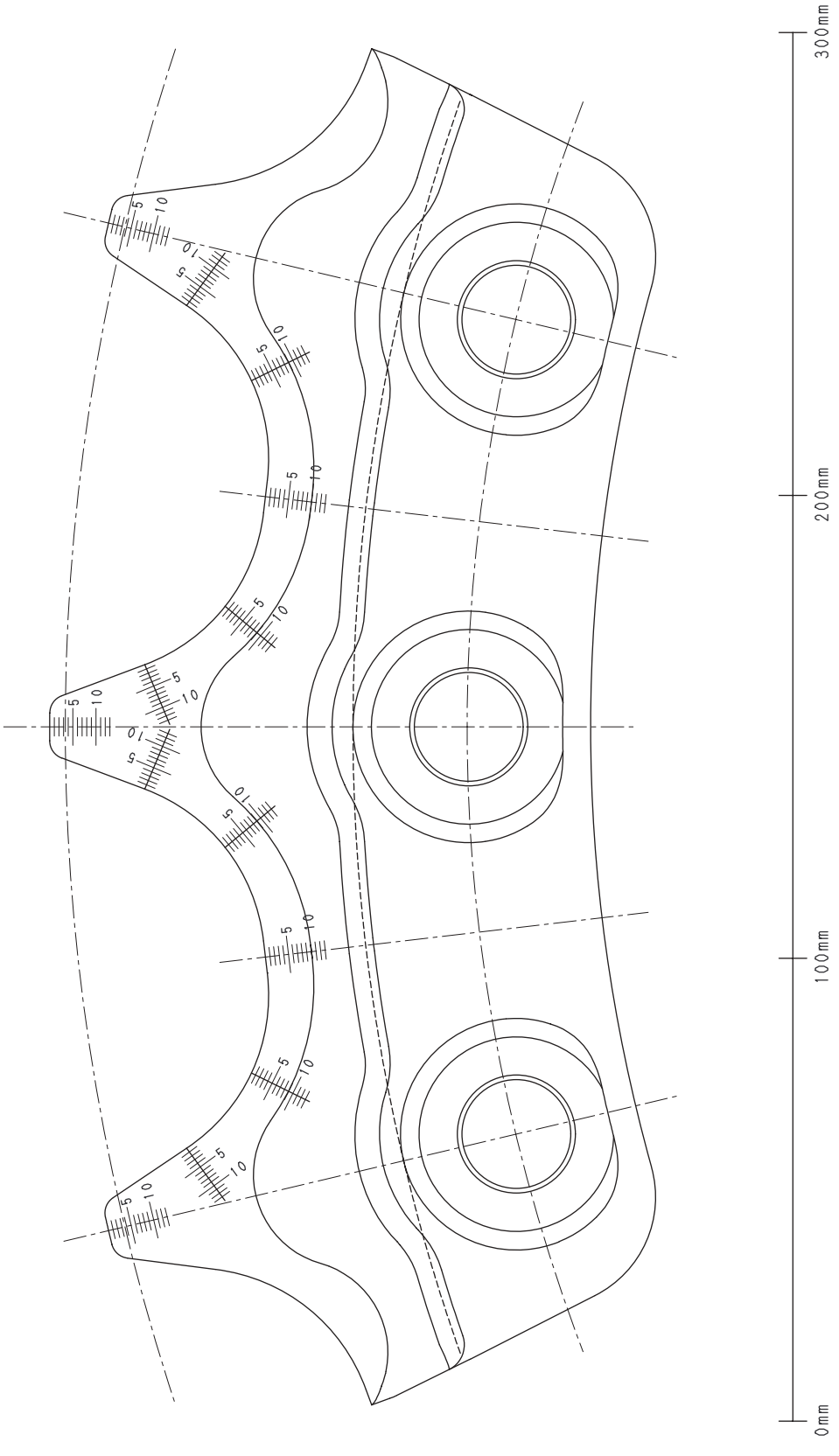


9JG00253

Unit: mm

No.	Check item	Criteria		Remedy
1	Wear of tooth tip	Standard size	Repair limit	Repair or replace
		229	217	
2	Thickness of tooth root	23	17	

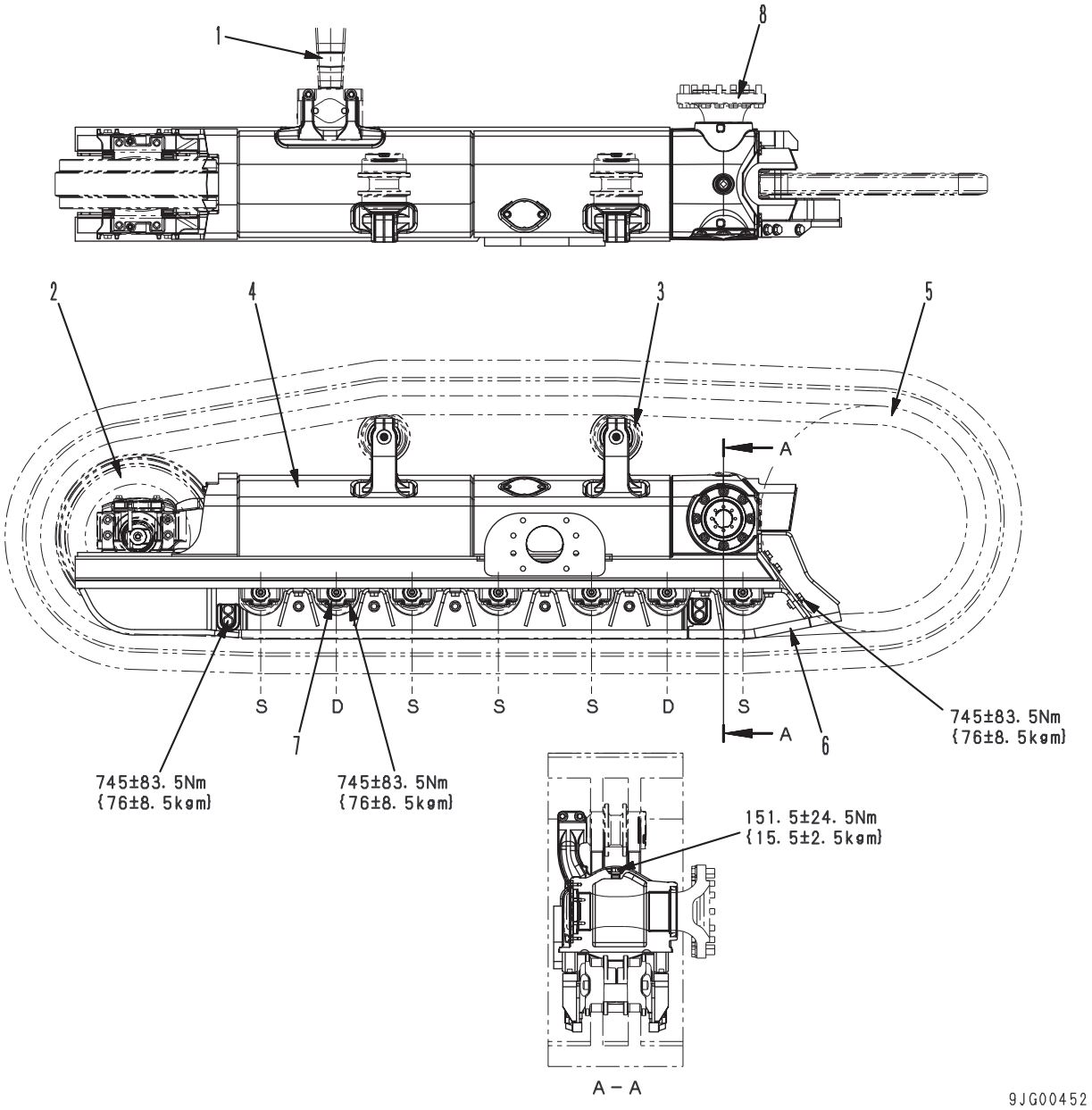
SPROCKET TOOTH SHAPE OF REAL DIMENSION



★ The above drawing is reduced to 67%. Enlarge it to 150% to return it to the full scale and make a copy on an OHP sheet.

TRACK FRAME

★ The figures indicate the D85EX-15.



1. Equalizer bar
2. Idler
3. Carrier roller
4. Track frame
5. Sprocket
6. Track roller guard
7. Track roller
8. Pivot shaft

Track roller

D85EX-15

Track roller flange type and arrangement						
1st	2nd	3rd	4th	5th	6th	7th
S	D	S	S	S	D	S

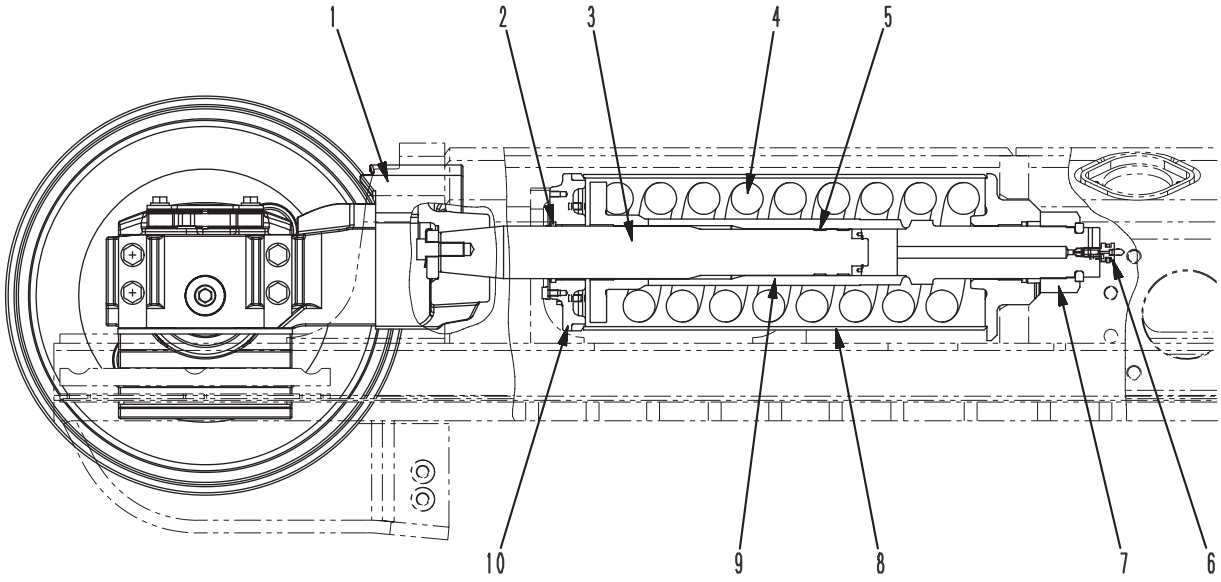
D85PX-15

Track roller flange type and arrangement							
1st	2nd	3rd	4th	5th	6th	7th	8th
S	S	D	S	S	S	D	S

Unit: mm

No.	Check item	Criteria		Remedy
4	Deformation of track frame outer pipe	Item	Repair limit	Repair or replace
		Curvature	7 (for length of 3,000)	
		Twisting	3 (for level length of 300)	
		Dents (pipe portion)	12	

RECOIL SPRING



9JG00221

1. Yoke
2. Dust seal
3. Rod
4. Recoil spring
5. Wear ring
6. Lubricator (for pumping in and releasing grease)
7. Nut
8. Housing
9. Cylinder
10. Holder

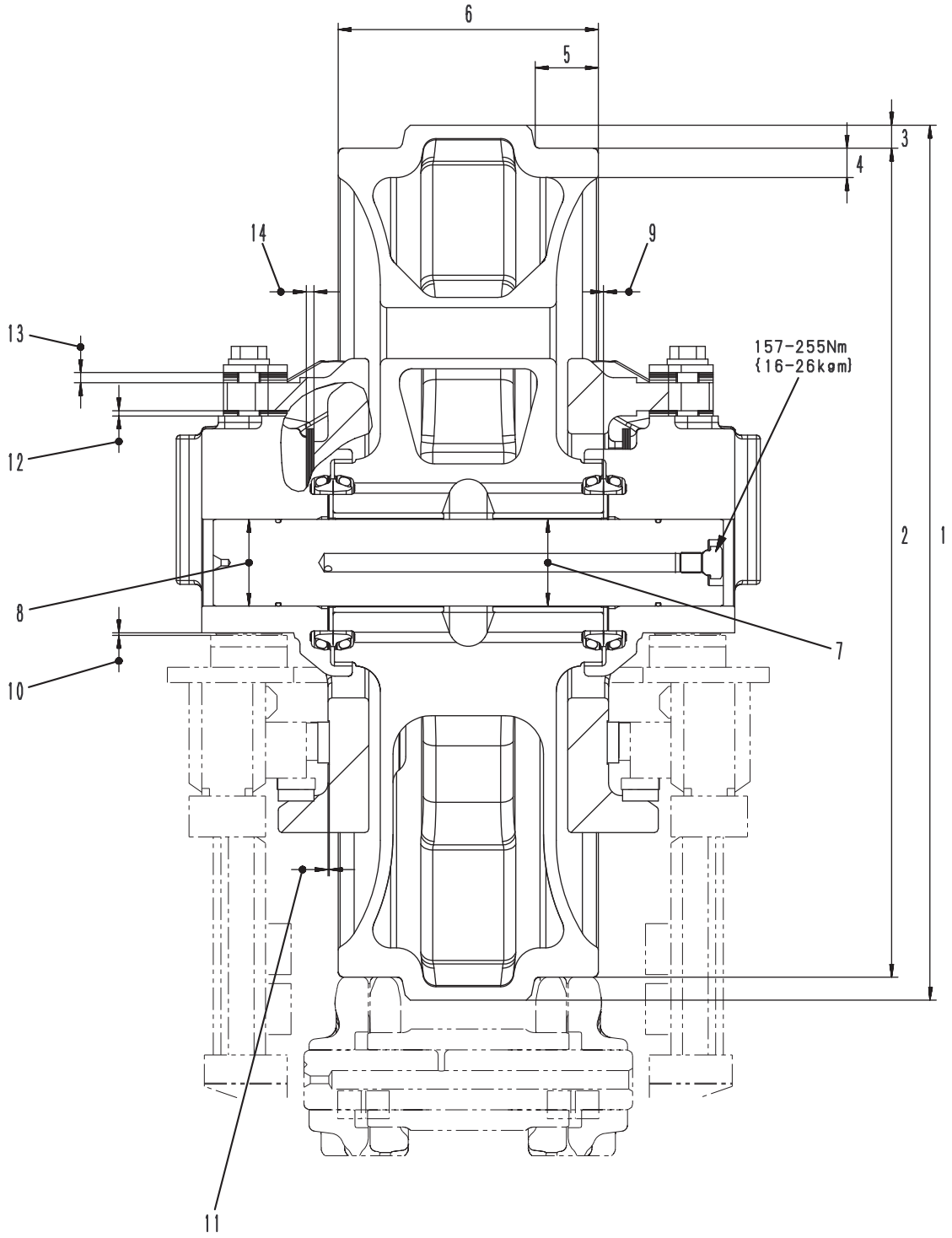
Outline

- Recoil spring (4) is used to adjust the track tension by pumping in or releasing grease from lubricator (6) to move rod (3) forward or backward. The recoil spring (4) also acts to dampen any sudden shock brought to bear on the idler.

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td>1</td><td>Press-fitting force for idler york</td><td colspan="5">392 kN {40 ton}</td><td>Adjust</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Clearance between rod 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="5">Replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>90</td><td>– 0.120
– 0.207</td><td>+ 0.270
+ 0.061</td><td>0.181–
0.477</td><td>1.0</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td></tr>
<tr><td>Free length</td><td>Installed length</td><td>Installed load</td><td>Free length</td><td>Installed load</td></tr>
<tr><td>787.4</td><td>651</td><td>227.5 kN
{23,200 kg}</td><td>855</td><td>208.9 kN
{21,300 kg}</td></tr>
</table>

IDLER

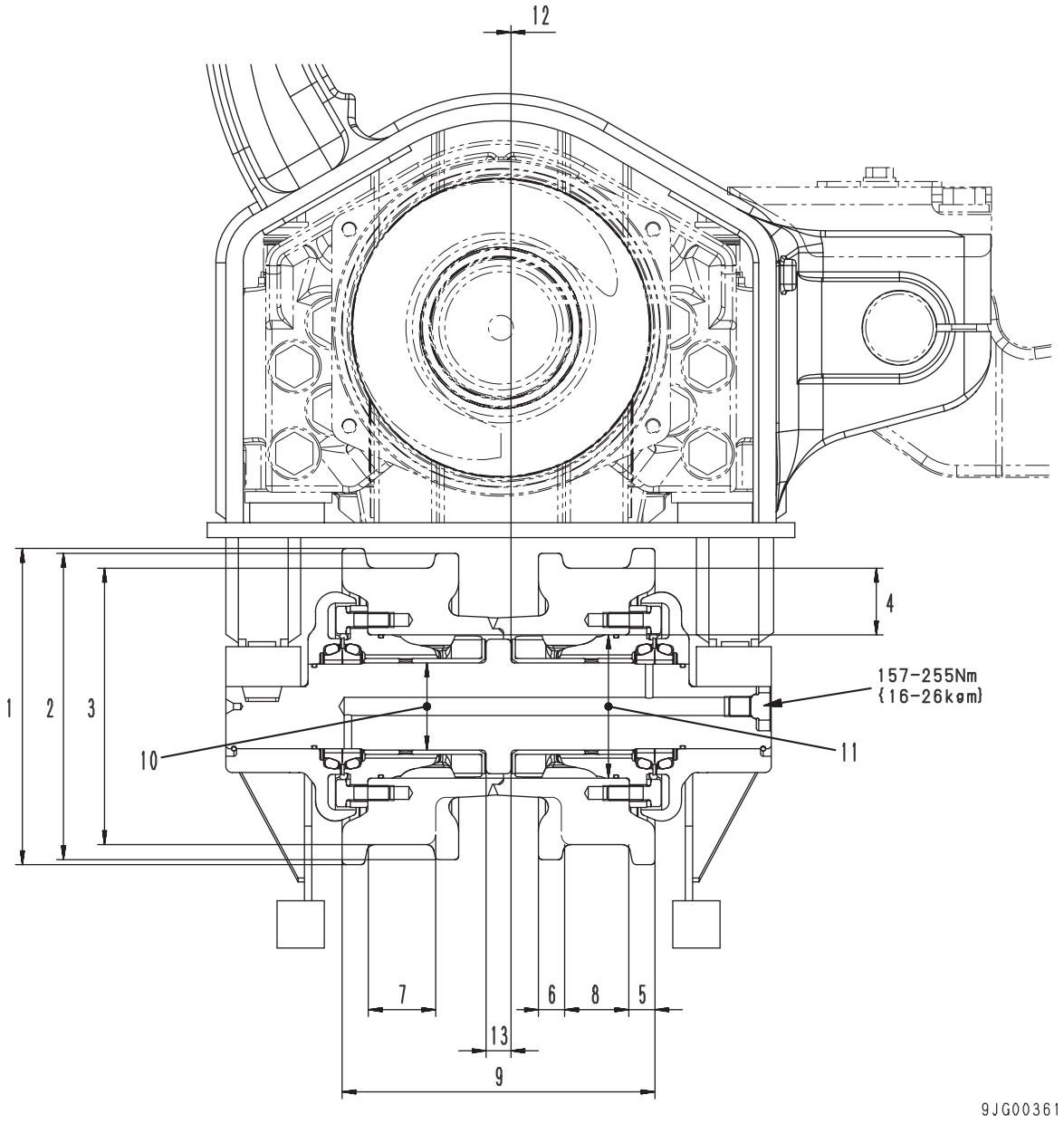


9JG00360

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of protruded section on idler</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="7">Build-up welding of replace</td></tr>
<tr><td colspan="3">686</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of idler tread</td><td colspan="3">650</td><td colspan="2">625</td></tr>
<tr><td>3</td><td>Step difference of protruded section of idler</td><td colspan="3">18</td><td colspan="2">30.5</td></tr>
<tr><td>4</td><td>Thickness of idler tread</td><td colspan="3">23</td><td colspan="2">10.5</td></tr>
<tr><td>5</td><td>With of tread section</td><td colspan="3">49.5</td><td colspan="2">–</td></tr>
<tr><td>6</td><td>Overall width of idler</td><td colspan="3">204.0</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="4">Replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>68</td><td>– 0.250
– 0.350</td><td>+ 0.188
– 0.024</td><td>0.226–
0.538</td></tr>
<tr><td>8</td><td>Clearance between shaft and support</td><td>68</td><td>– 0.250
– 0.290</td><td>– 0.110
– 0.220</td><td>0.030–
0.180</td></tr>
<tr><td>9</td><td>Free play of shaft in the axial derection</td><td colspan="4">0.26 – 0.66</td></tr>
<tr><td>10</td><td>Clarance between guide plate and support</td><td colspan="4">2.0</td><td>Build-up welding or replace</td></tr>
<tr><td>11</td><td>Clarance between guide plate and side plate</td><td colspan="4">0.5 – 1.0</td><td>Shim adjust or plate replacement</td></tr>
<tr><td>12</td><td>Thickness of shims for guide plate</td><td colspan="4">4</td><td rowspan="3">Adjustment</td></tr>
<tr><td>13</td><td>Thickness of shims for guide plate</td><td colspan="4">8</td></tr>
<tr><td>14</td><td>Thickness of shims for guide plate</td><td colspan="4">6</td></tr>
</table>

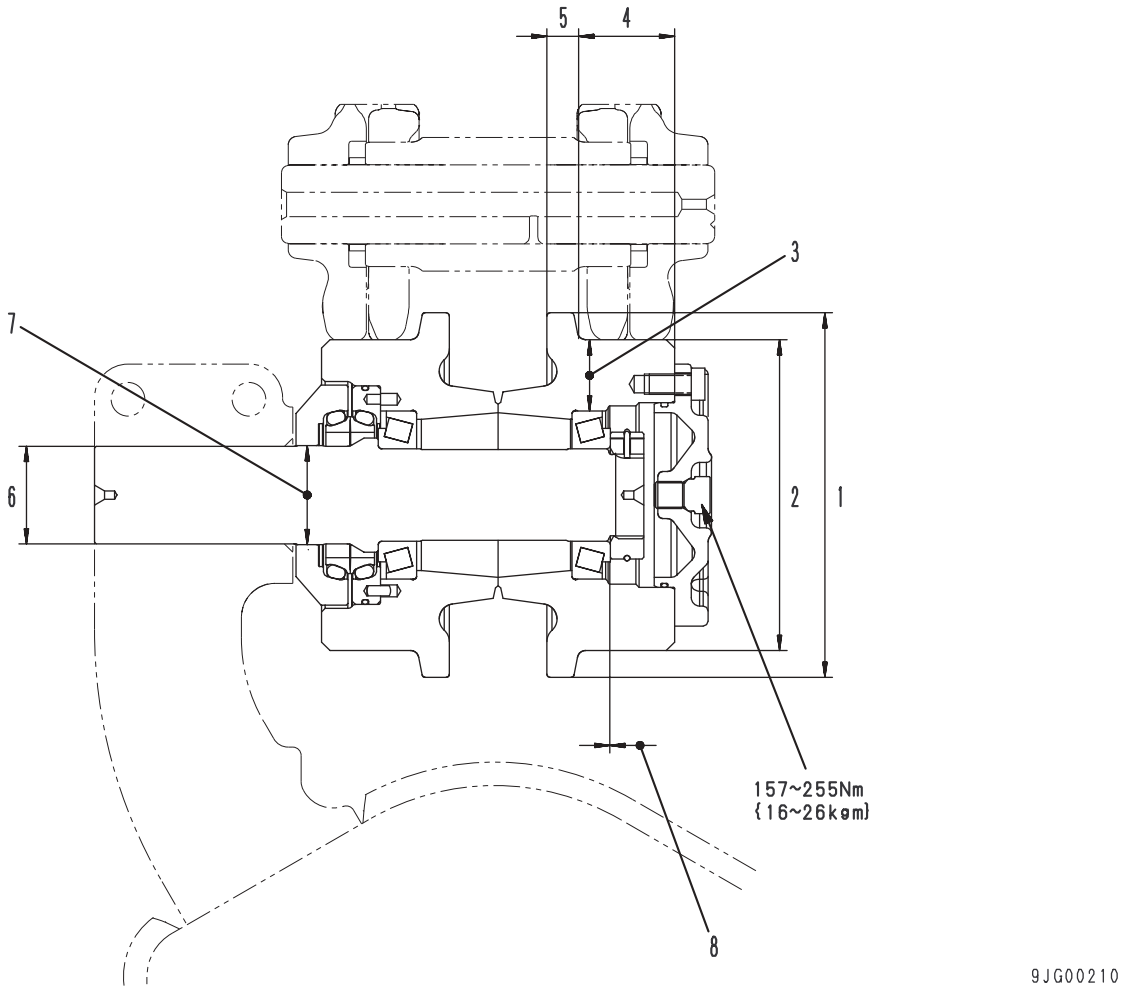
TRACK ROLLER



Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of fiange (outside)</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="10">Build-up welding of replace</td></tr>
<tr><td colspan="2">254</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of ifiange (intside) (for double flange)</td><td colspan="2">246</td><td colspan="2">–</td></tr>
<tr><td>3</td><td>Outside diameter of track roller tread</td><td colspan="2">222</td><td colspan="2">182</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Thickness of tread</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td></tr>
<tr><td colspan="2">53.5</td><td colspan="2">33.5</td></tr>
<tr><td>5</td><td>Width of flange (outside)</td><td colspan="2">21</td><td colspan="2">–</td></tr>
<tr><td>6</td><td>Width of flange (for double flange, inside)</td><td colspan="2">21</td><td colspan="2">–</td></tr>
<tr><td>7</td><td>Width of track roller tread (single flange)</td><td colspan="2">55.6</td><td colspan="2">–</td></tr>
<tr><td>8</td><td>Width of track roller tread (double flange)</td><td colspan="2">51.6</td><td colspan="2">–</td></tr>
<tr><td>9</td><td>Overall width of track roller</td><td colspan="2">251.2</td><td colspan="2">–</td></tr>
<tr><td rowspan="2">10</td><td rowspan="2">Clearance between shaft and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="6">Replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>70</td><td>– 0.210
– 0.260</td><td>+ 0.134
+ 0.060</td><td>0.344–
0.394</td></tr>
<tr><td rowspan="2">11</td><td rowspan="2">Interference between outside bushing and track roller</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>115</td><td>+ 0.094
+ 0.040</td><td>+ 0.027
– 0.047</td><td>0.013–
0.141</td></tr>
<tr><td rowspan="2">12</td><td rowspan="2">Free play of shaft in the axial derection</td><td colspan="4">Standard clearance</td></tr>
<tr><td colspan="4">0.50 – 0.75</td></tr>
<tr><td>13</td><td>Width of collar on shaft</td><td colspan="2">20</td><td colspan="2">–</td></tr>
</table>

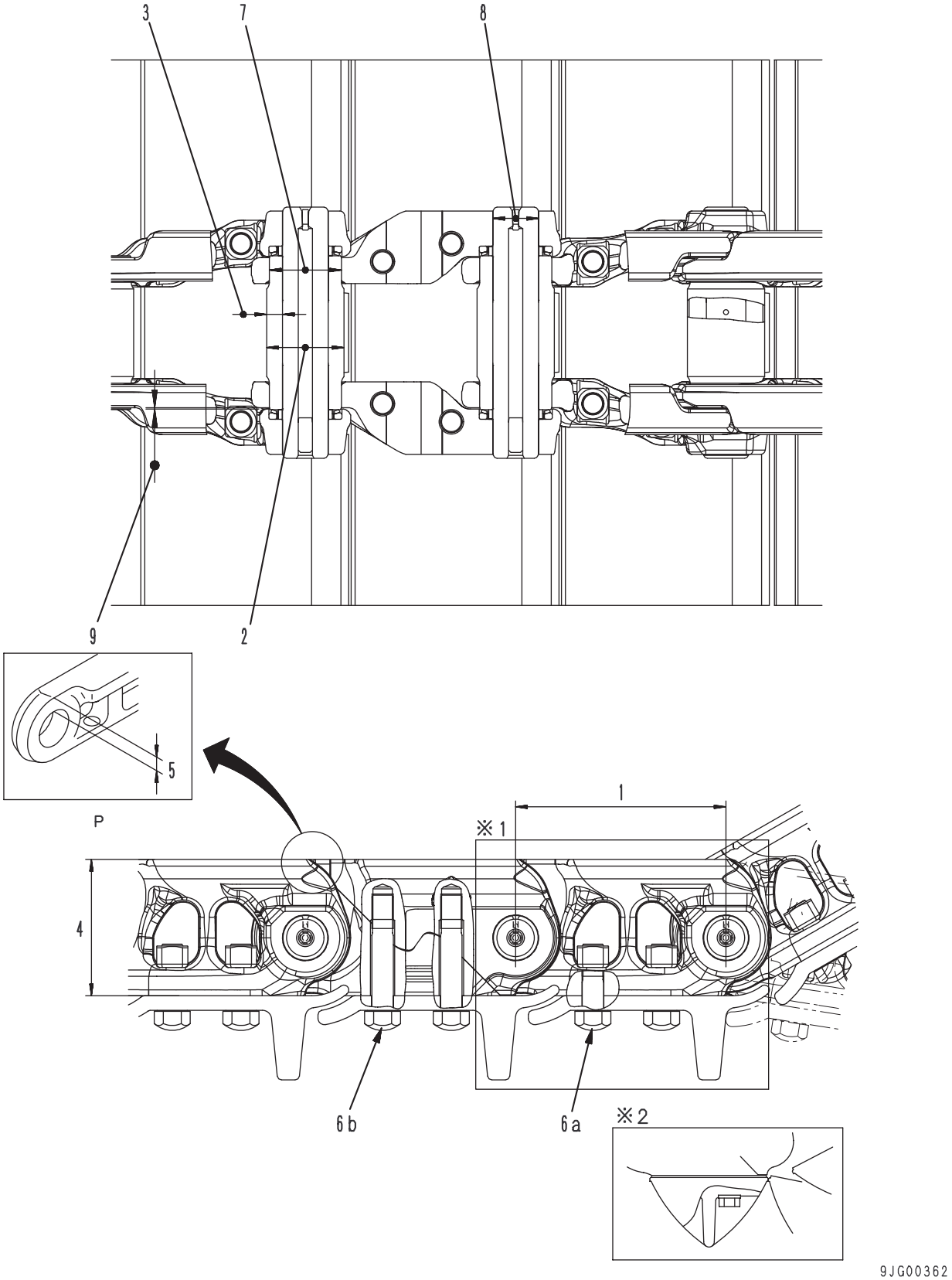
CARRIER ROLLER



Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="6">Rebuild or replace</td></tr>
<tr><td colspan="3">217</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of carrier roller tread</td><td colspan="3">185</td><td colspan="2">162</td></tr>
<tr><td>3</td><td>Thickness of tread</td><td colspan="3">42.5</td><td colspan="2">31</td></tr>
<tr><td>4</td><td>Width of carrier roller tread</td><td colspan="3">57</td><td colspan="2">–</td></tr>
<tr><td>5</td><td>Width of flange</td><td colspan="3">19</td><td colspan="2">–</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Clearance between shaft and support</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>58</td><td>0
– 0.2</td><td>+ 0.300
0</td><td>0 – 0.5</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Interference between shaft and seal guard</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td><td rowspan="3">Replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>59</td><td>+0.046
0</td><td>– 0.12
– 0.17</td><td>0.120–
0.216</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Play in axial direction of shaft</td><td colspan="4">Standard clearance</td></tr>
<tr><td colspan="4">0 – 0.22</td></tr>
</table>

TRACK SHOE



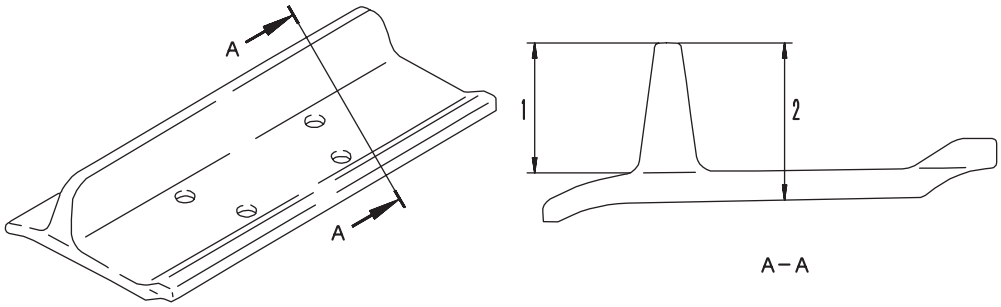
※ 1. Single shoe
※ 2. Swamp shoe

★ Portion P shows the link on the side where the bushing is pressed fitted.

Unit: mm

<table>
<tr><th>No.</th><th colspan="3">Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td colspan="3" rowspan="2">Link pitch</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="2">Turn or replace</td></tr>
<tr><td colspan="2">216.3</td><td colspan="2">219.3</td></tr>
<tr><td rowspan="3">2</td><td colspan="3" rowspan="3">Outside diameter of bushing</td><td rowspan="2">Standard size</td><td colspan="3">Reverse</td><td rowspan="3">Reverse or replace</td></tr>
<tr><td colspan="2">Light load</td><td>Heavy load</td></tr>
<tr><td>79.5</td><td colspan="2">69.3</td><td>71.9</td></tr>
<tr><td>3</td><td colspan="3">Thickness of bushing</td><td>15.9</td><td colspan="2">5.7</td><td>8.3</td></tr>
<tr><td rowspan="2">4</td><td colspan="3" rowspan="2">Height of link</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Rebuild or replace</td></tr>
<tr><td colspan="2">140</td><td colspan="2">127.5</td></tr>
<tr><td>5</td><td colspan="3">Thiuckness of link
(Fitting portion of bushing)</td><td colspan="2">43.5</td><td colspan="2">31</td></tr>
<tr><td rowspan="4">6</td><td rowspan="2">Shoe bolt
(Single and heavy duty shoe)</td><td>a.</td><td>Regular link</td><td colspan="2">Tighten torque
(Nm {kgm})</td><td colspan="2">Retightening angle
(Angle)</td><td rowspan="4">Retightening or replace</td></tr>
<tr><td colspan="2">343 ± 39 {35 ± 4}</td><td colspan="2">120 ± 10</td></tr>
<tr><td>b.</td><td>Master link</td><td colspan="2">343 ± 39 {35 ± 4}</td><td colspan="2">180 (+0/ –20)</td></tr>
<tr><td rowspan="2">Shoe bolt
(Swanp shoe)</td><td>a.</td><td>Regular link</td><td colspan="2">539 ± 49 {55 ± 5}</td><td colspan="2">120 ± 10</td></tr>
<tr><td>b.</td><td>Master link</td><td colspan="2">343 ± 39 {35 ± 4}</td><td colspan="2">180 (+0/ –20)</td></tr>
<tr><td rowspan="2">7</td><td colspan="3" rowspan="2">Interference between bushing and link</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td><td rowspan="3">Adjusting or replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>8</td><td colspan="3">Interference between regular pin and link</td><td>74</td><td>+ 0.344
+ 0.304</td><td>+ 0.074
0</td><td>0.230 –
0.344</td></tr>
<tr><td>9</td><td colspan="3">Clearance between link and link</td><td>47</td><td>+ 0.190
+ 0.130</td><td>+ 0.138
+ 0.200</td><td>0.268 –
0.390</td></tr>
<tr><td rowspan="3">9</td><td colspan="3" rowspan="3">Clearance between link and link</td><td colspan="4">Standard clearance</td><td rowspan="3"></td></tr>
<tr><td colspan="2">Each size</td><td colspan="2">Both limit</td></tr>
<tr><td colspan="2">1.4</td><td colspan="2">2.8</td></tr>
</table>

Single shoe, heavy duty shoe

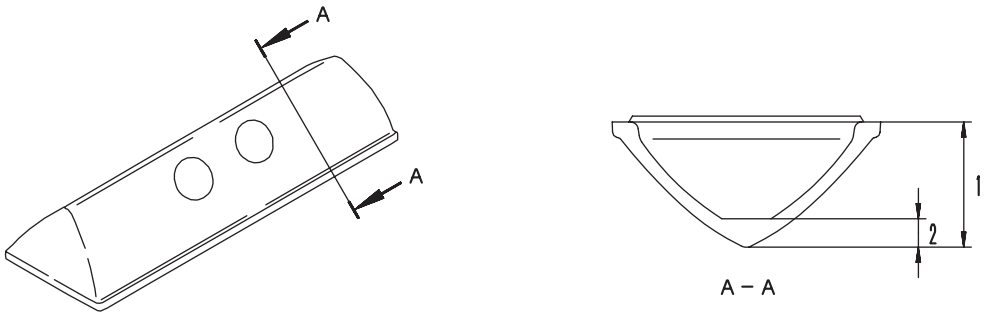


9JB00825

Unit: mm

No.	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Height of grouser	Single shoe	71.4	25	
		Heavy duty shoe	71.4	25	Build-up welding of replace
2	Thickness of groser	Single shoe	86.4	40	
		Heavy duty shoe	88	41.6	

Swamp shoe

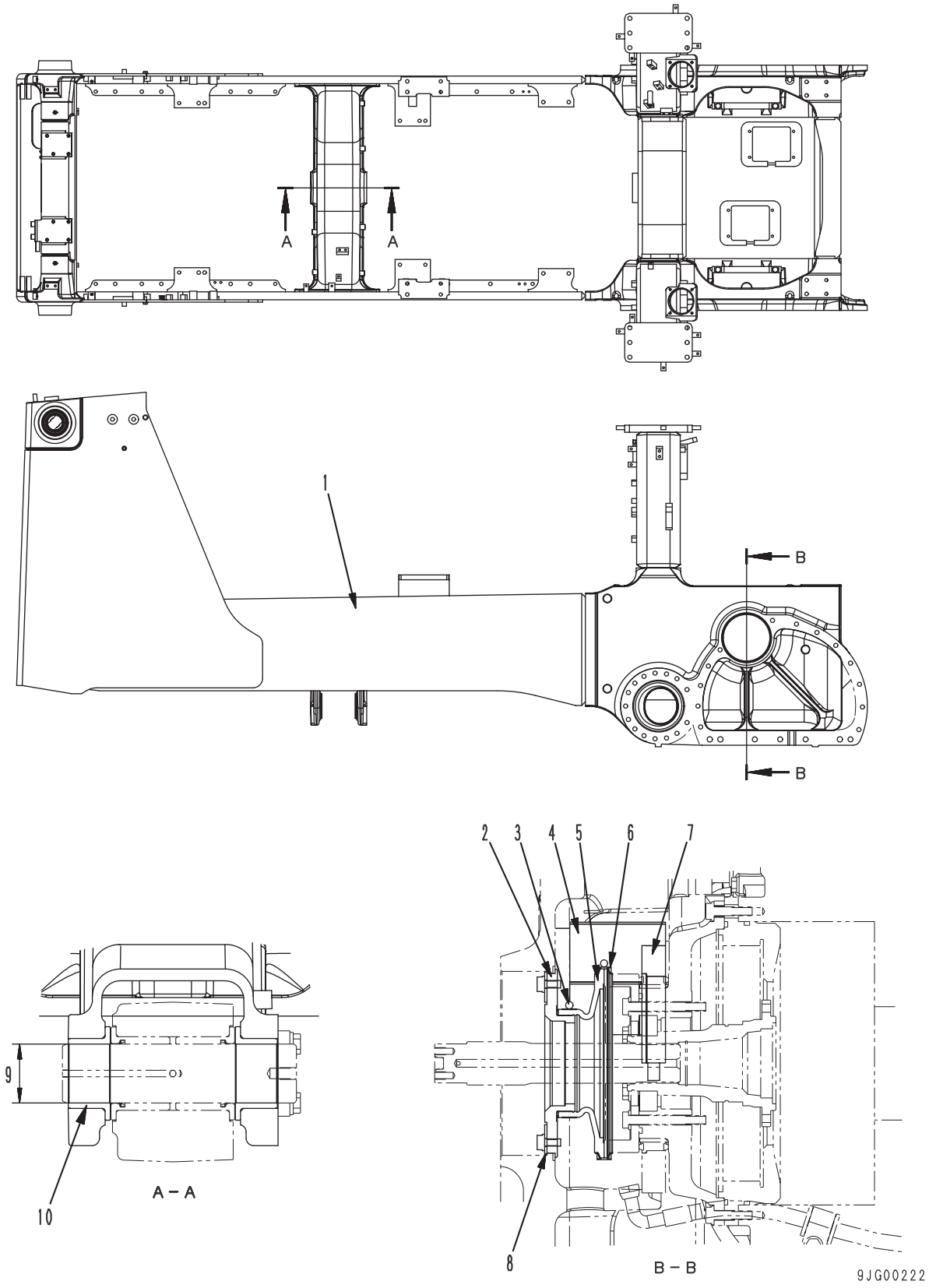


SED01630

Unit: mm

No.	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Height of grouser	120	98	Build-up welding of replace
2	Thickness of groser	27	5	

MAIN FRAME

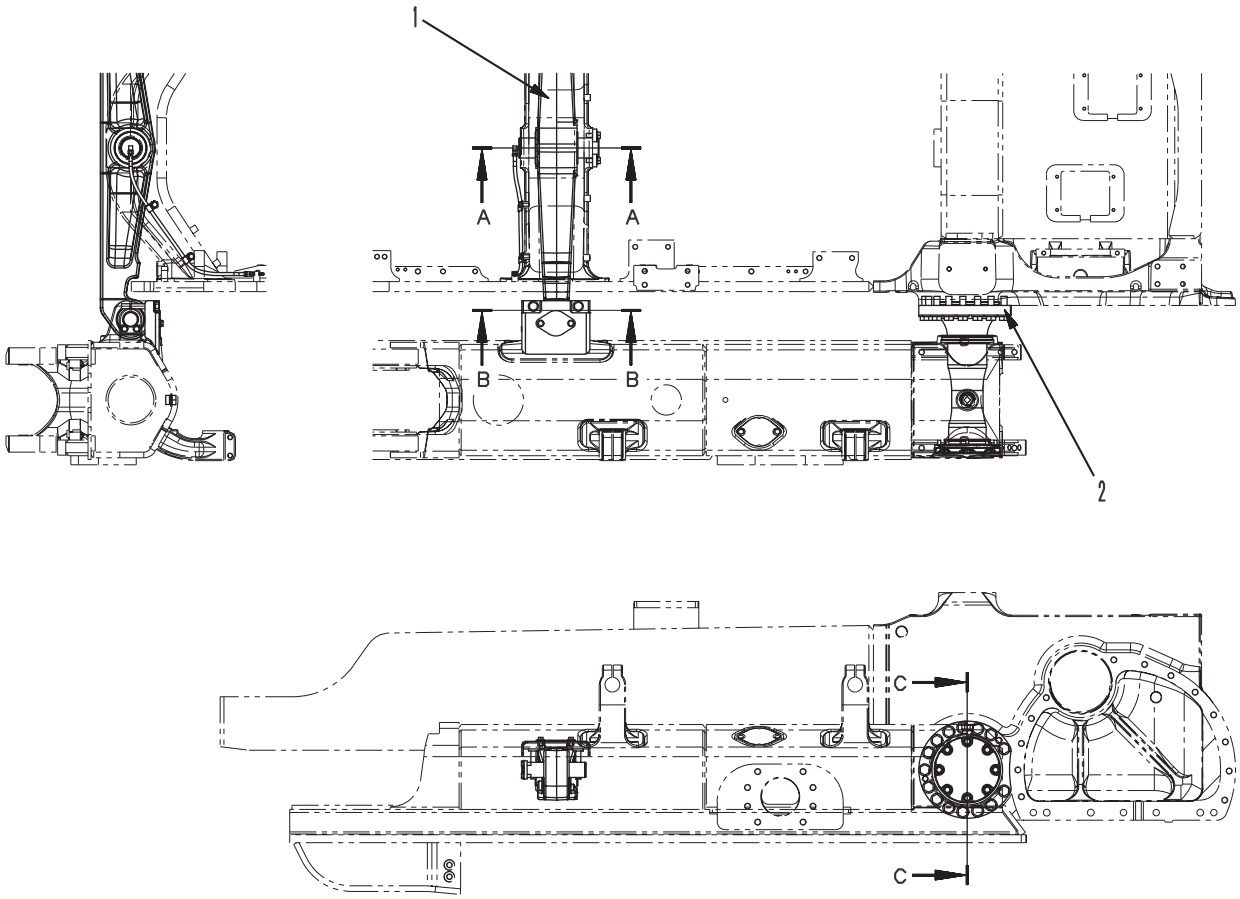


1. Main frame
2. Cage
3. Clamp
4. Cover
5. Seal
6. Clamp
7. Cap
8. Plate

Unit: mm

<table>
<tr><th rowspan="2">No.</th><th rowspan="2">Check item</th><th colspan="5">Criteria</th><th rowspan="2">Remedy</th></tr>
<tr><th rowspan="2">Standard size</th><th colspan="2">Tolerance</th><th rowspan="2">Standard clearance</th><th rowspan="2">Clearance limit</th></tr>
<tr><th rowspan="2">9</th><th rowspan="2">Clearance between equalizer bar shaft and bushing</th><th>Shaft</th><th>Hole</th><th rowspan="2">Replace</th></tr>
<tr><td>80</td><td>– 0.030
– 0.076</td><td>+ 0.179
+ 0.100</td><td>0.103–
0.255</td><td>1.5</td></tr>
<tr><td>10</td><td>Press fit force of equalizer bar shaft mounting bushing</td><td colspan="5">21.6 – 71.6 kN {2.2 – 7.3 ton}</td><td>Adjust</td></tr>
</table>

SUSPENSION

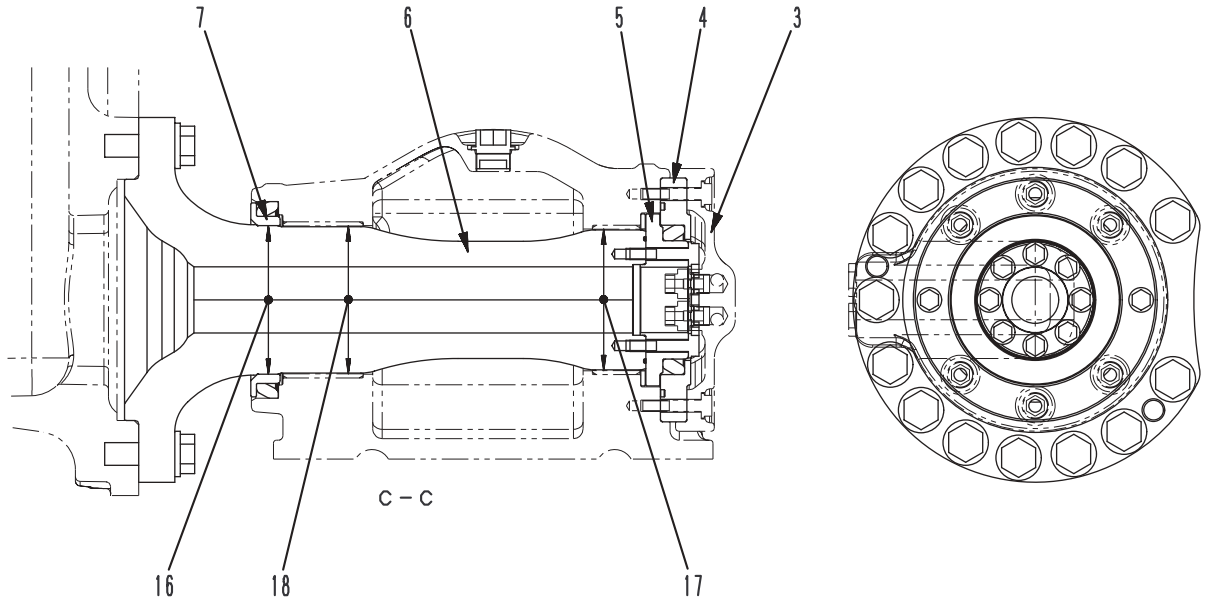


9JG00223

1. Equalizer bar
2. Pivot shaft assembly
3. Cover
4. Thrust plate
5. Thrust plate
6. Pivot shaft
7. Seal cage

Outline

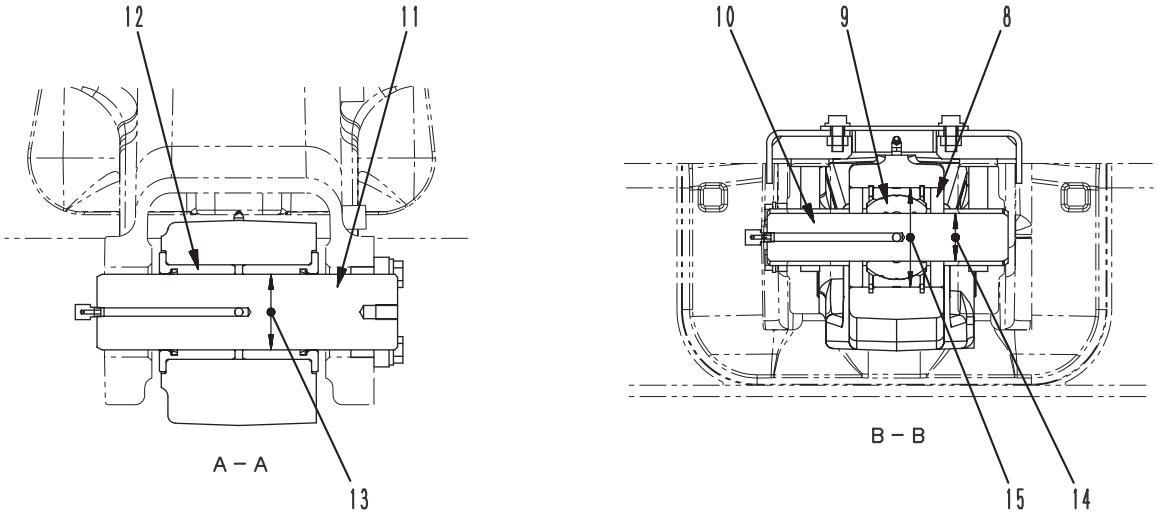
- The front of the track frame rocks up and down using the rear pivot shafts (6) as a fulcrum.
  Equalizer bar (1) rocks using center pin (11) as a fulcrum. The left and right track frames are connected by side pin (10).



9JG00225

Unit: mm

No.	Check item	Criteria					Remedy
18	Interference between thrust washer and seal	Standard size	Tolerance		Standard interference	Interference limit	Replace
			Shaft	Hole			
		210	+ 0.213 + 0.098	– 0.180 – 0.226	0.278– 0.439	–	
19	Interference between thrust washer and seal	140	+ 0.140 + 0.100	– 0.061 – 0.124	0.161– 0.264	–	
20	Interference between pivot shaft and seal stopper ring	157	+ 0.083 + 0.043	– 0.050 – 0.090	0.093– 0.173	–	
21	Clearance between pivot shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replacing bushing
			Shaft	Hole			
		148	– 0.145 – 0.208	+ 0.099 + 0.035	0.180– 0.307	1.0	
22	Clearance between pivot shaft and bushing	155	– 0.145 – 0.208	+ 0.132 + 0.059	0.204– 0.340	1.0	



9JG00224

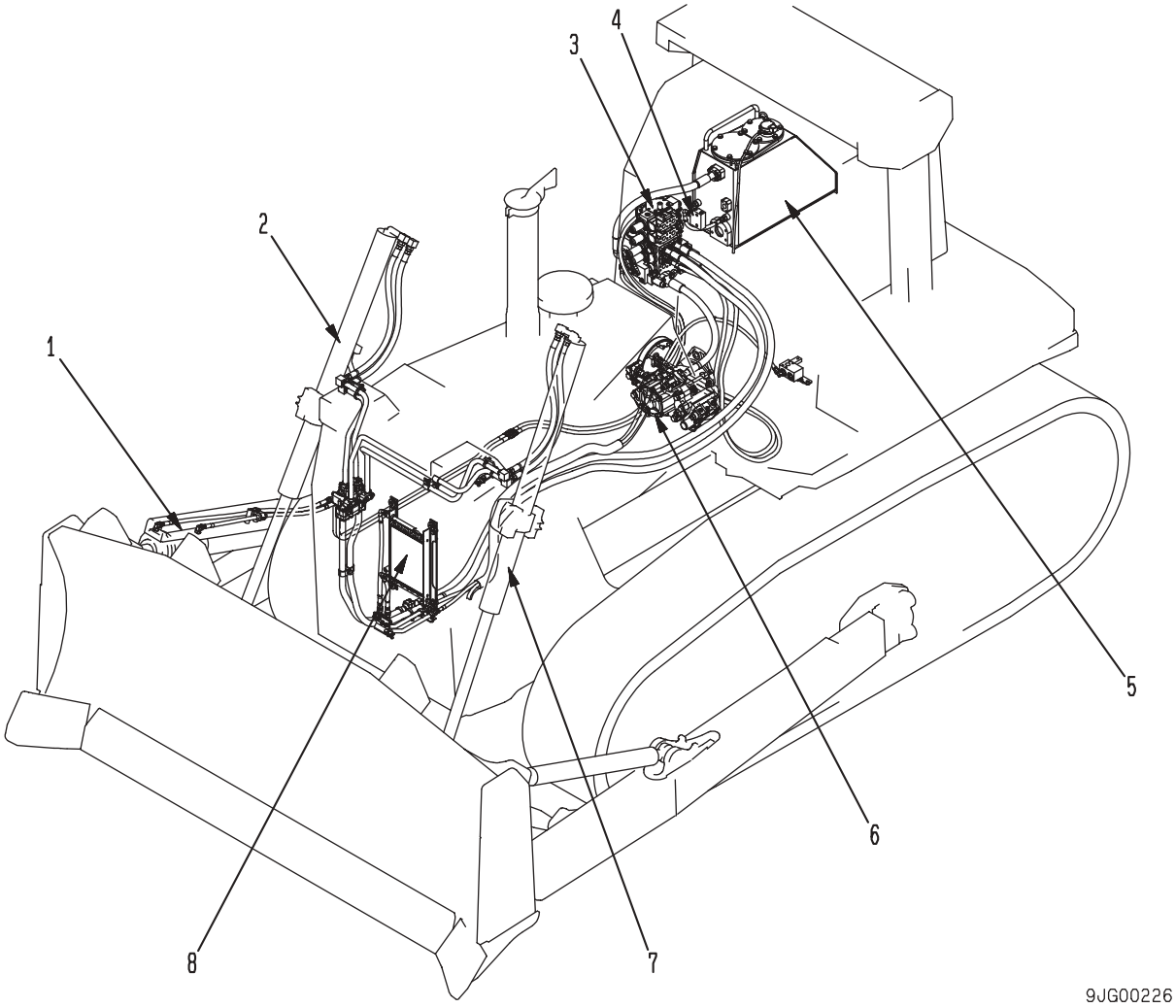
8. Seal
9. Bushing
10. Side pin
11. Center pin
12. Bushing

Unit: mm

No.	Check item	Criteria					Remedy
9	Press-fitting force for side pin bushing	15.7 – 35.3 kN {1.6 – 3.6ton}					–
12	Press-fitting force for center pin bushing	57.9 – 161.8 kN {5.9 – 16.5 ton}					
13	Clearance between center pin and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		80	– 0.030 – 0.076	+ 0.234 – 0.169	0.199– 0.310	1.0	
14	Clearance between side pin and bushing	60	– 0.030 – 0.060	+ 0.046 0	0.030– 0.106	1.0	
15	Interference between side pin boss and bushing	Standard size	Tolerance		Standard interfer-ence	Interfer-ence limit	
			Shaft	Hole			
		110	+ 0.035 + 0.017	– 0.024 – 0.059	0.041– 0.094	–	

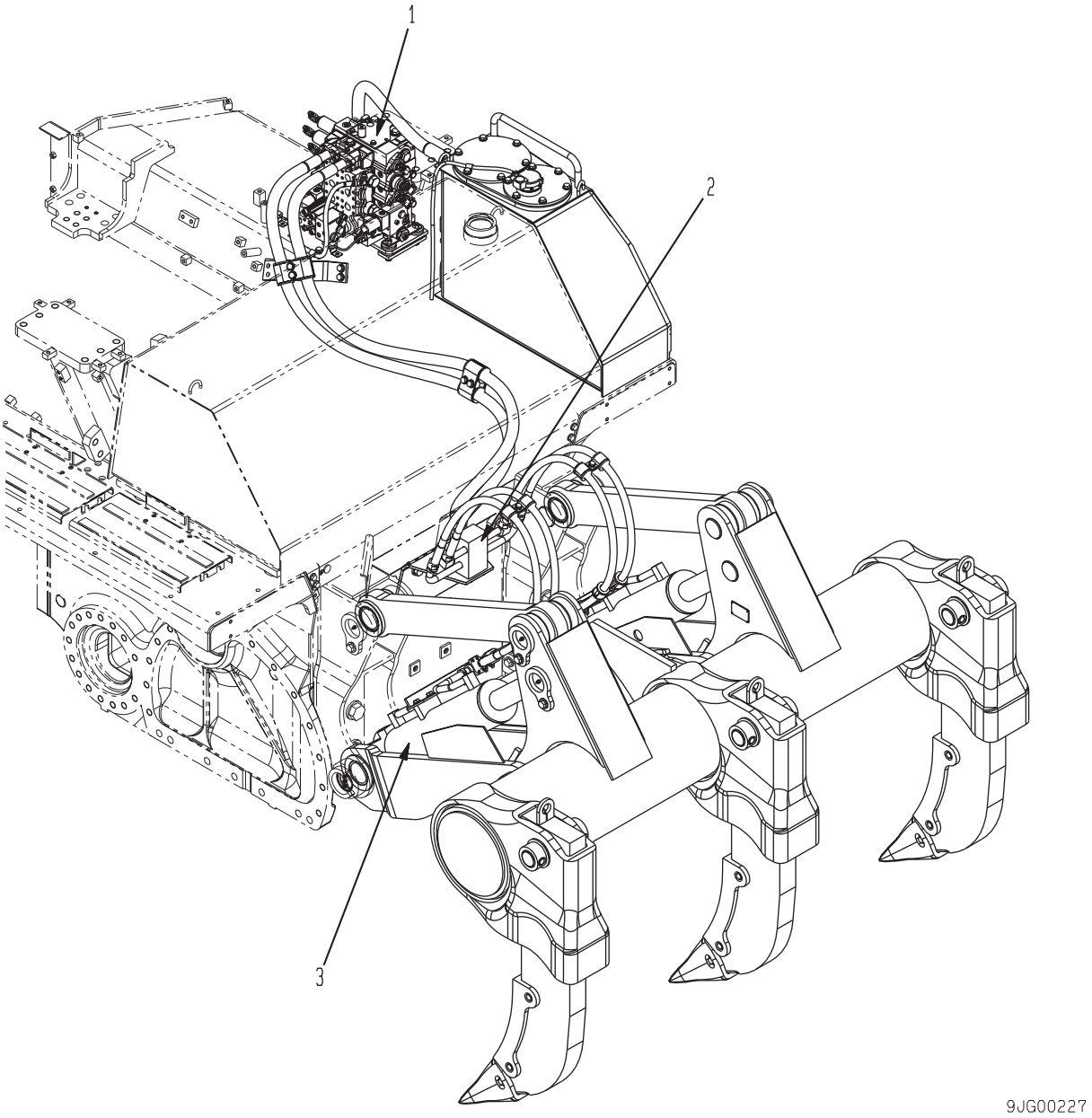
WORK EQUIPMENT HYDRAULIC PIPING DIAGRAM

SEMI U-DOZER



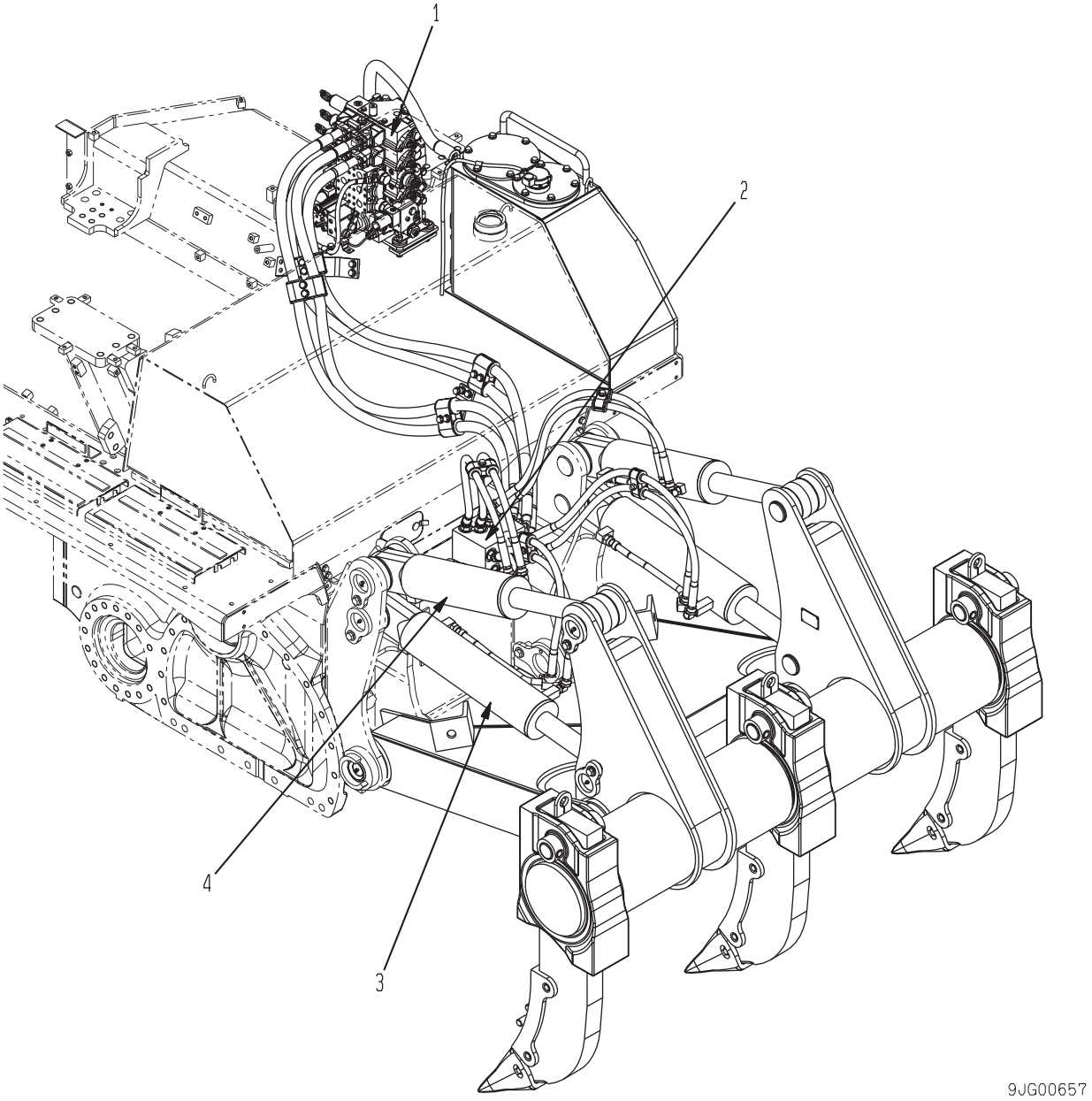
1. Blade tilt cylinder
2. R.H. blade lift cylinder
3. Main control valve
4. Accumulator
5. Hydraulic tank
6. Hydraulic pump
7. L.H. blade lift cylinder
8. Oil cooler

FIXED MULTIPLE SHANK RIPPER



1. Main control valve
2. Divider block
3. Ripper lift cylinder

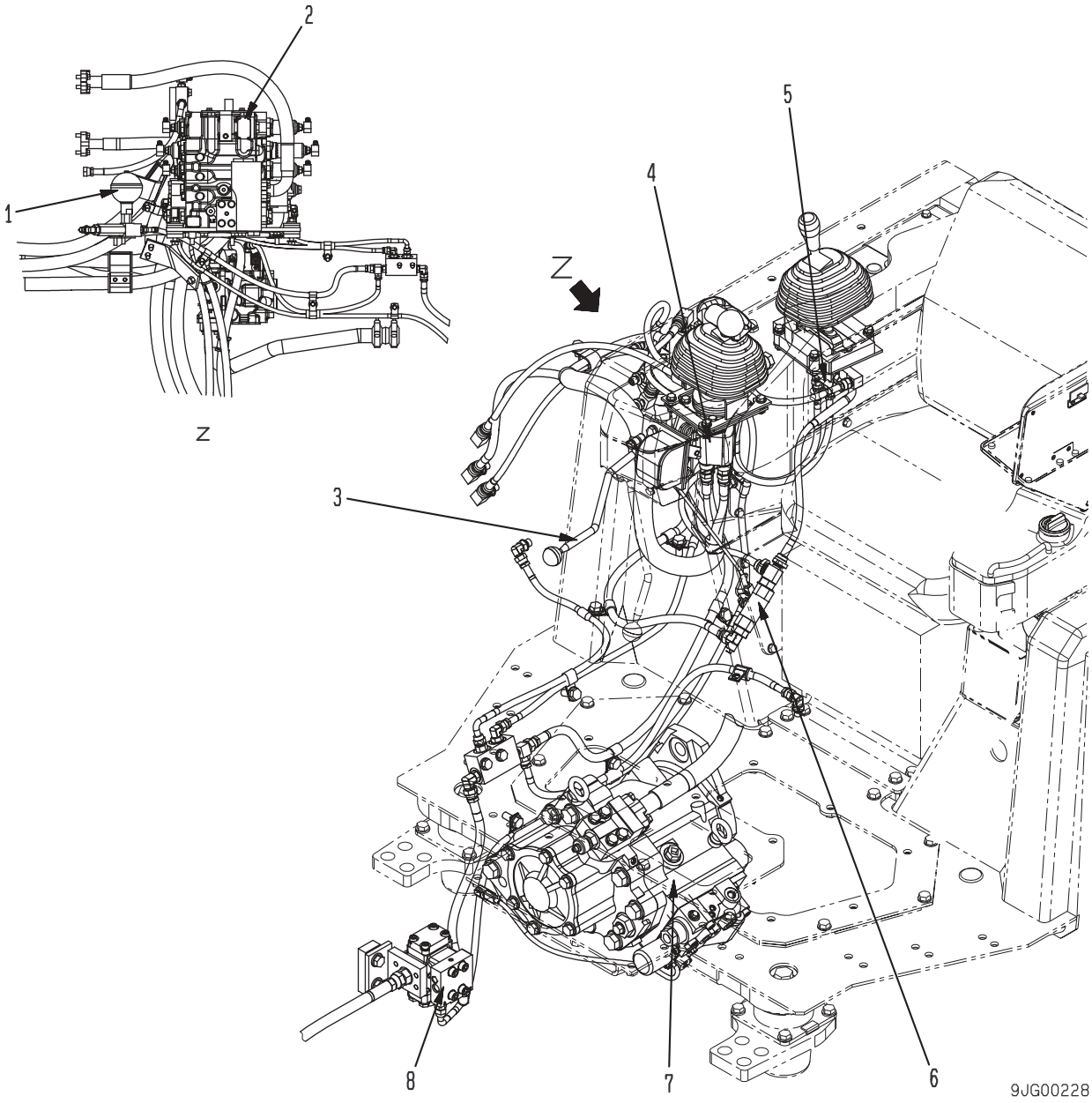
VARIABLE MULTIPLE SHANK RIPPER



1. Main control valve
2. Divider block
3. Ripper lift cylinder
4. Ripper tilt cylinder

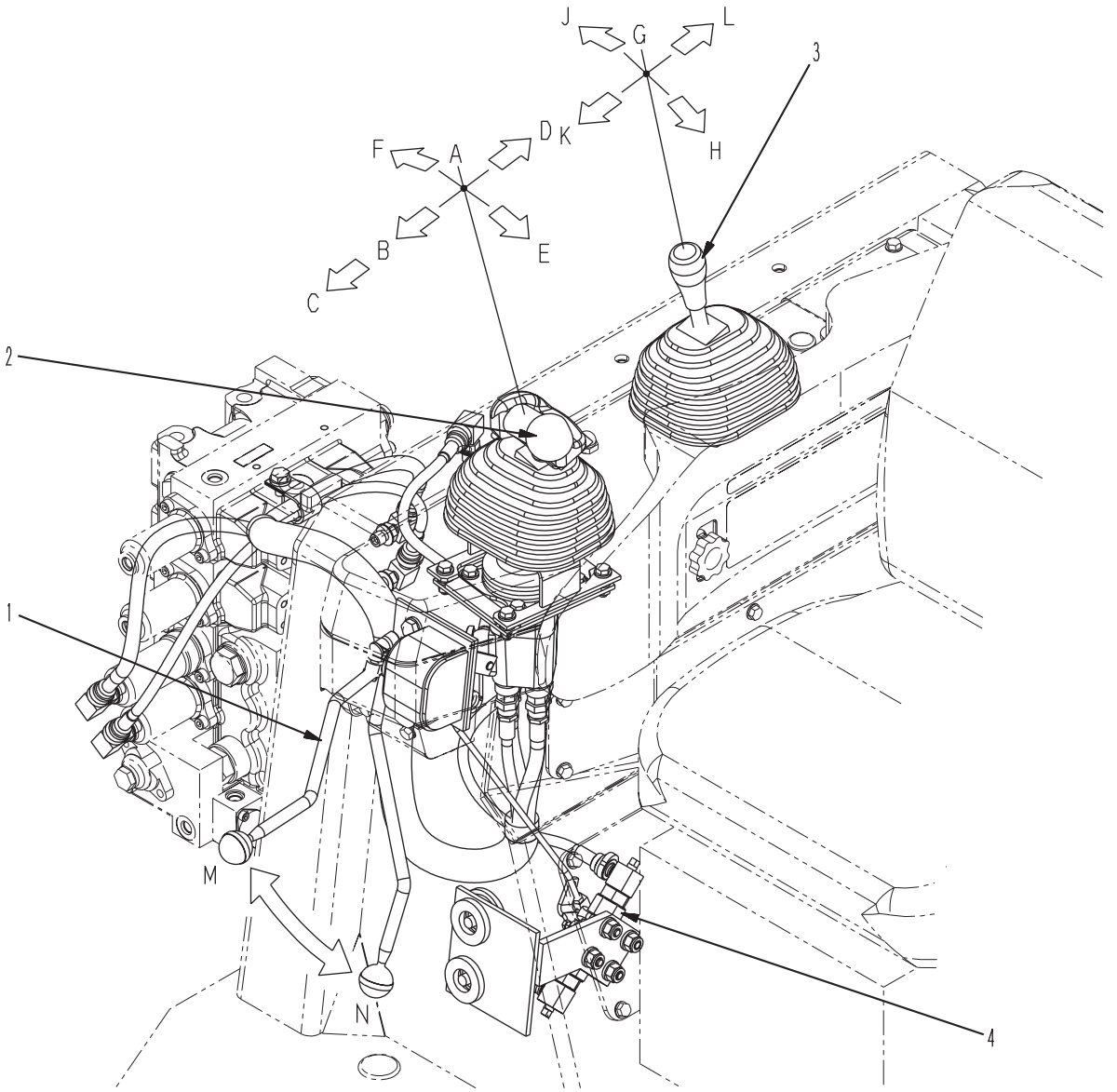
PPC CONTROL PIPING DIAGRAM

BLADE, RIPPER CONTROL



1. Accumulator
2. Main control valve
3. Work equipment safety lever
4. Blade control PPC valve
5. Ripper control PPC valve
6. PPC lock valve
7. Hydraulic, HSS pump
8. Self-reducing pressure valve

WORK EQUIPMENT CONTROL



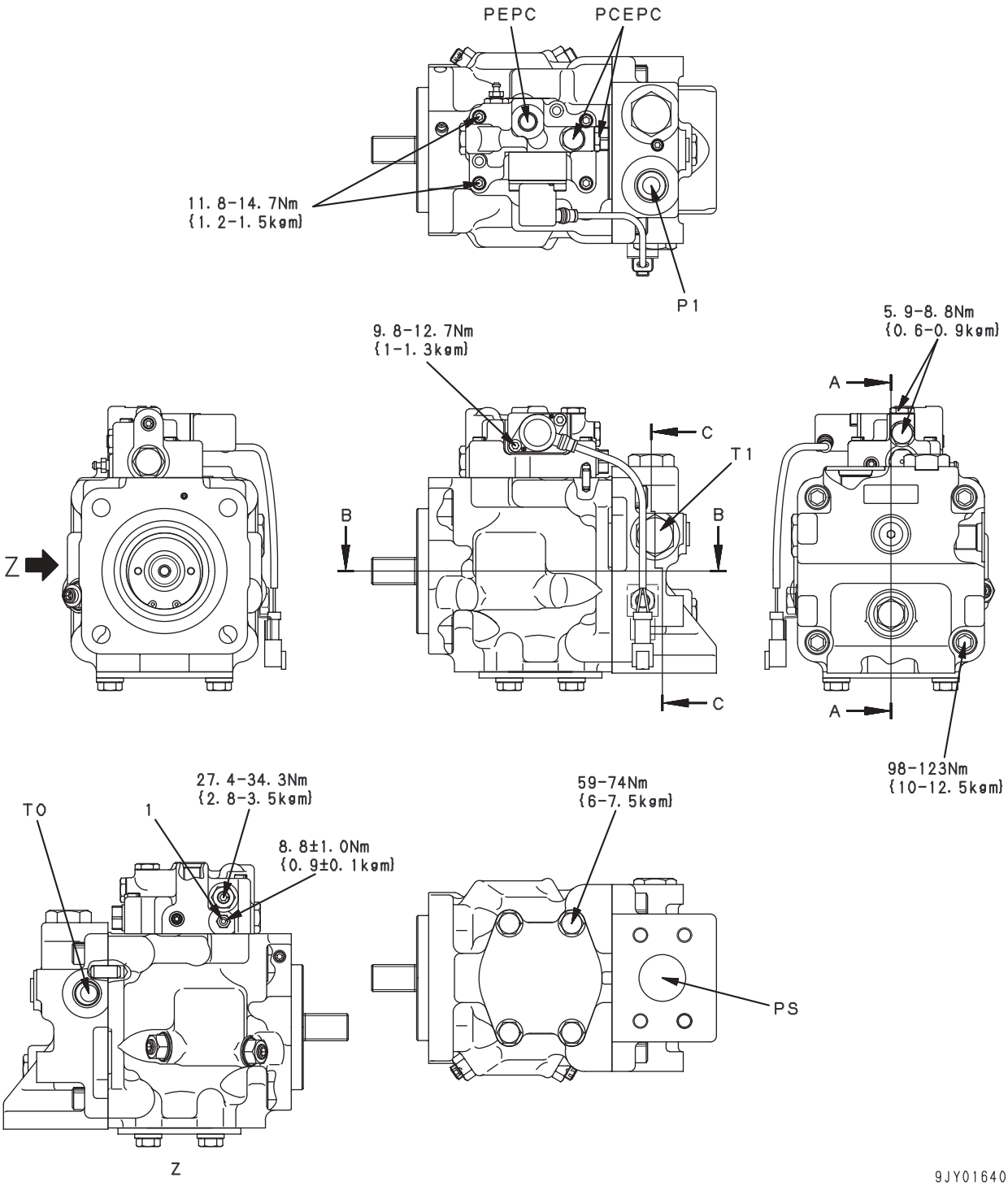
1. Work equipment safety lever
2. Blade control valve
3. Ripper control lever
4. PPC lock valve

Lever positions
A : Blade HOLD
B : Blade LOWER
C : Blade FLOAT
D : Blade RAISE
E : Blade LEFT TILT
F : Blade RIGHT TILT
G : Ripper HOLD
H : Ripper RAISE
J : Ripper LOWER
K : Ripper TILT IN
(For variable multiple shank ripper)
L : Ripper TILT BACK
(For variable multiple shank ripper)
M : FREE
N : LOCK

Outline
- The work equipment control employs a PPC method which uses a PPC valve to move each control valve spool.
- Work equipmentc safety lever (1) is interconnected with PPC lock valve (4), and at the LOCK position, the oil in the PPC circuit is stopped.

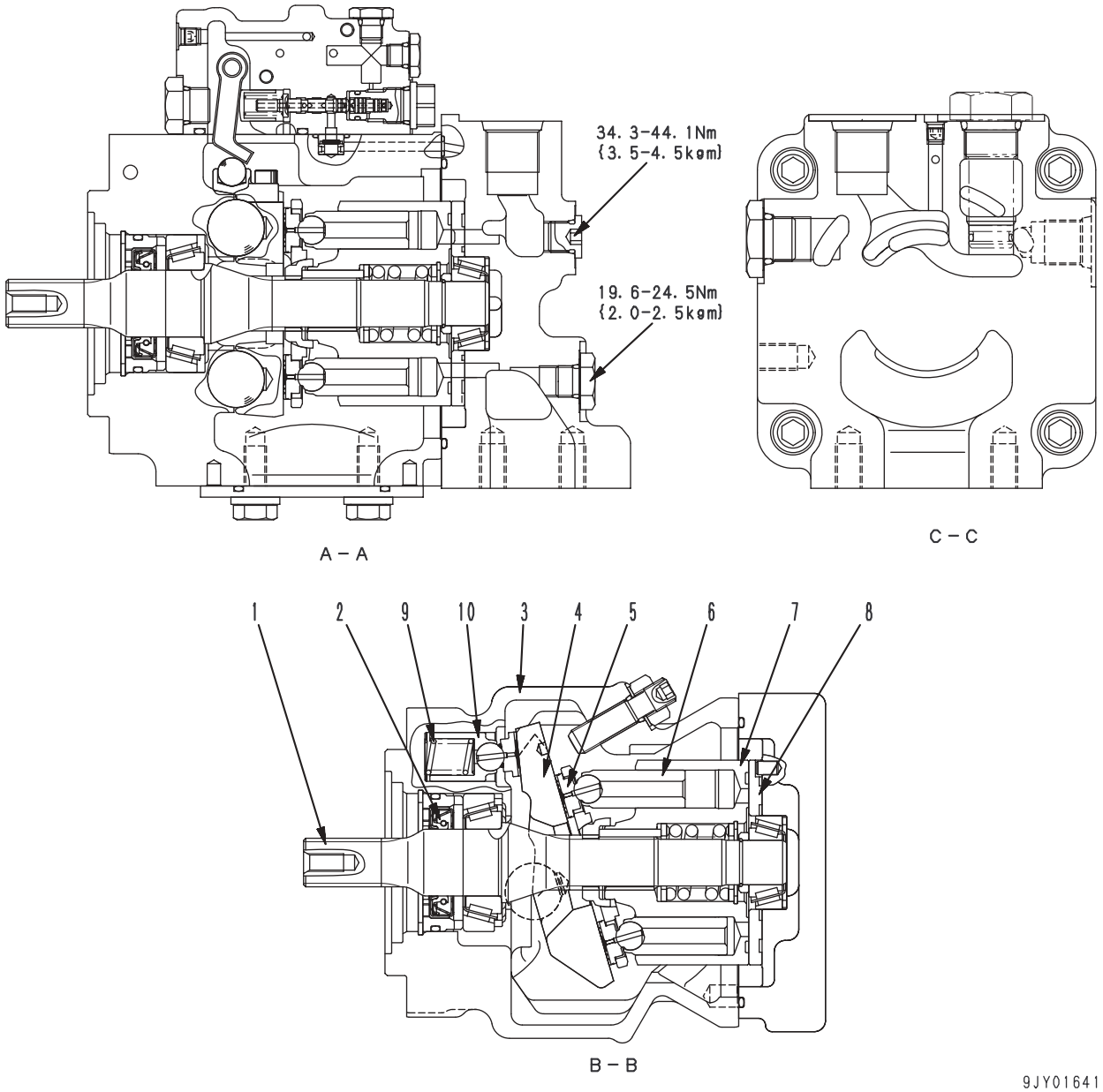
COOLING FAN PUMP

LPV30

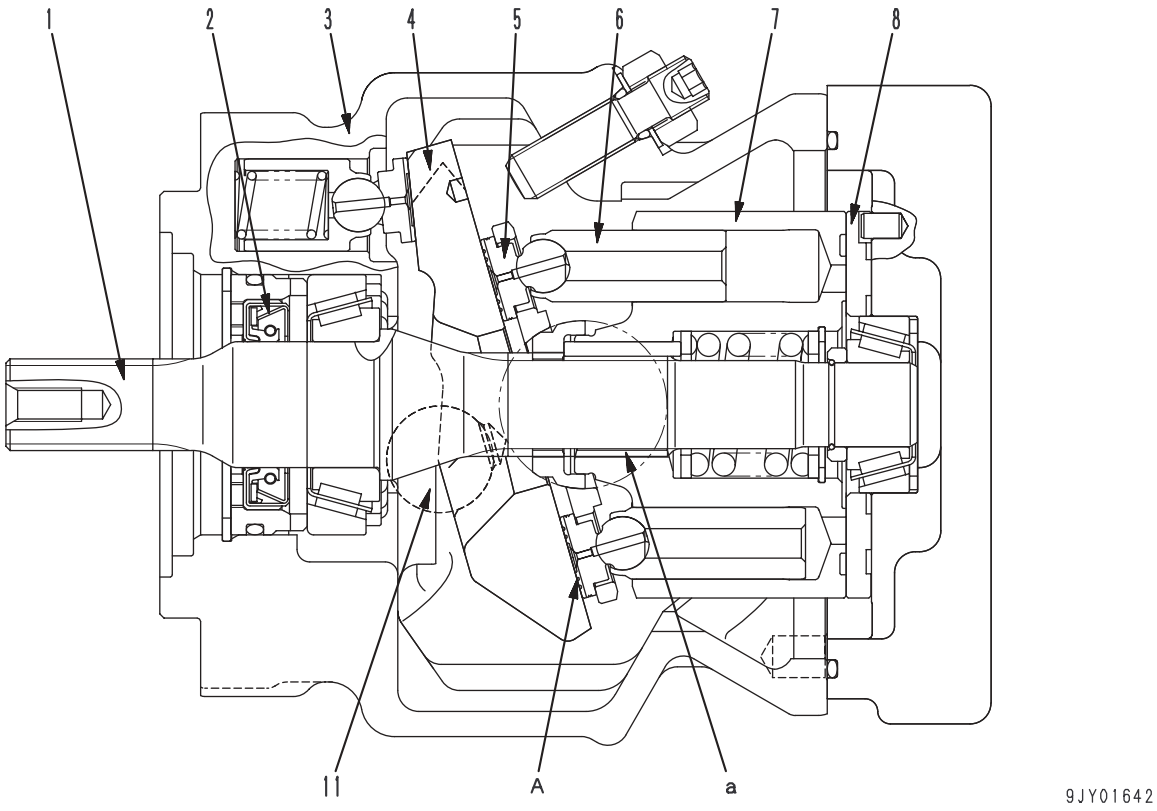


P1: Pump discharge pressure
PS: Pump suction
TO: Drain

T1: Drain plug
PEPC :EPC valve main pressure
PCEPC:EPC valve 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 rotation and torque of the engine are transmitted to the shaft of this pump and converted into hydraulic energy in this pump. This pump discharges the pressurized oil according to the load.
- The discharge of this pump can be changed by changing the swash plate angle in it.

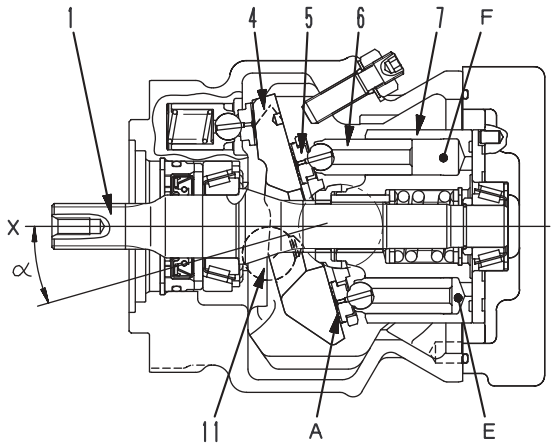
Structure

- Cylinder block (7) is supported on shaft (1) through spline **a**. Shaft (1) is supported by the front and rear bearings.
- The end of piston (6) has a spherical hollow which is combined with shoe (5). Piston (6) and shoe (5) form a spherical bearing.
- Rocker cam (4) has plane **A**. Shoe (5) is kept pressed against plane **A** and slid circularly. Rocker cam (4) slides around ball (11).
- Piston (6) in each cylinder of cylinder block (7) moves relatively in the axial direction.
- Cylinder block (7) rotates relatively against valve plate (8), sealing the pressurized oil, and the hydraulic balance is maintained properly.
- The oil in each cylinder of cylinder block (7) can be sucked and discharged through valve plate (8).

Operation

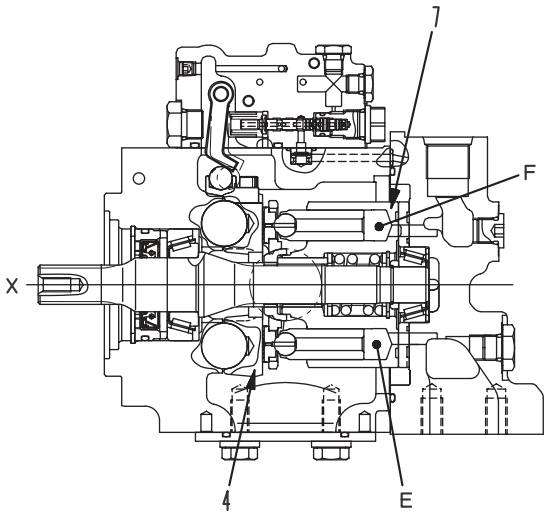
1. Operation of pump

- Cylinder block (7) rotates together with shaft (1) and shoe (5) slides on plane **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. Angle α is called the swash plate angle.
- If angle α is made between center line **X** of rocker cam (7) and the axis of cylinder block (7), plane **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, if cylinder block (7) rotates and the volume of chamber **E** is decreased, the oil is discharged from chamber **E**. On the other hand, the volume of chamber **F** is increased and the oil is sucked in chamber **F**. (In the figure, chamber **F** is at the end of the suction stroke and chamber **E** is at the end of the discharge stroke.)



9JY01643

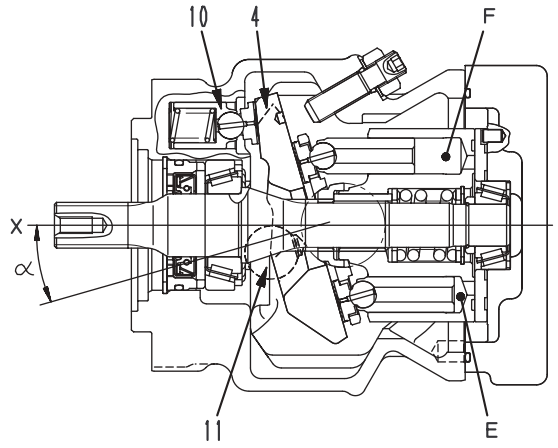
- If center line **X** of rocker cam (4) is equal to the axial of cylinder block (7) (the swash plate angle is 0), there is not a difference between volumes **E** and **F** in cylinder block (7) and oil is not sucked or discharged. (The swash plate angle is not set to 0 actually, however.)
- In short, swash plate angle α is in proportion to the pump discharge.



9JY01644

2. Control of discharge

- If swash plate angle α is increased, the difference between volumes **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 motion is transmitted to rocker cam (4). Then, rocker cam (4) supported on ball (11) slides around ball (11).



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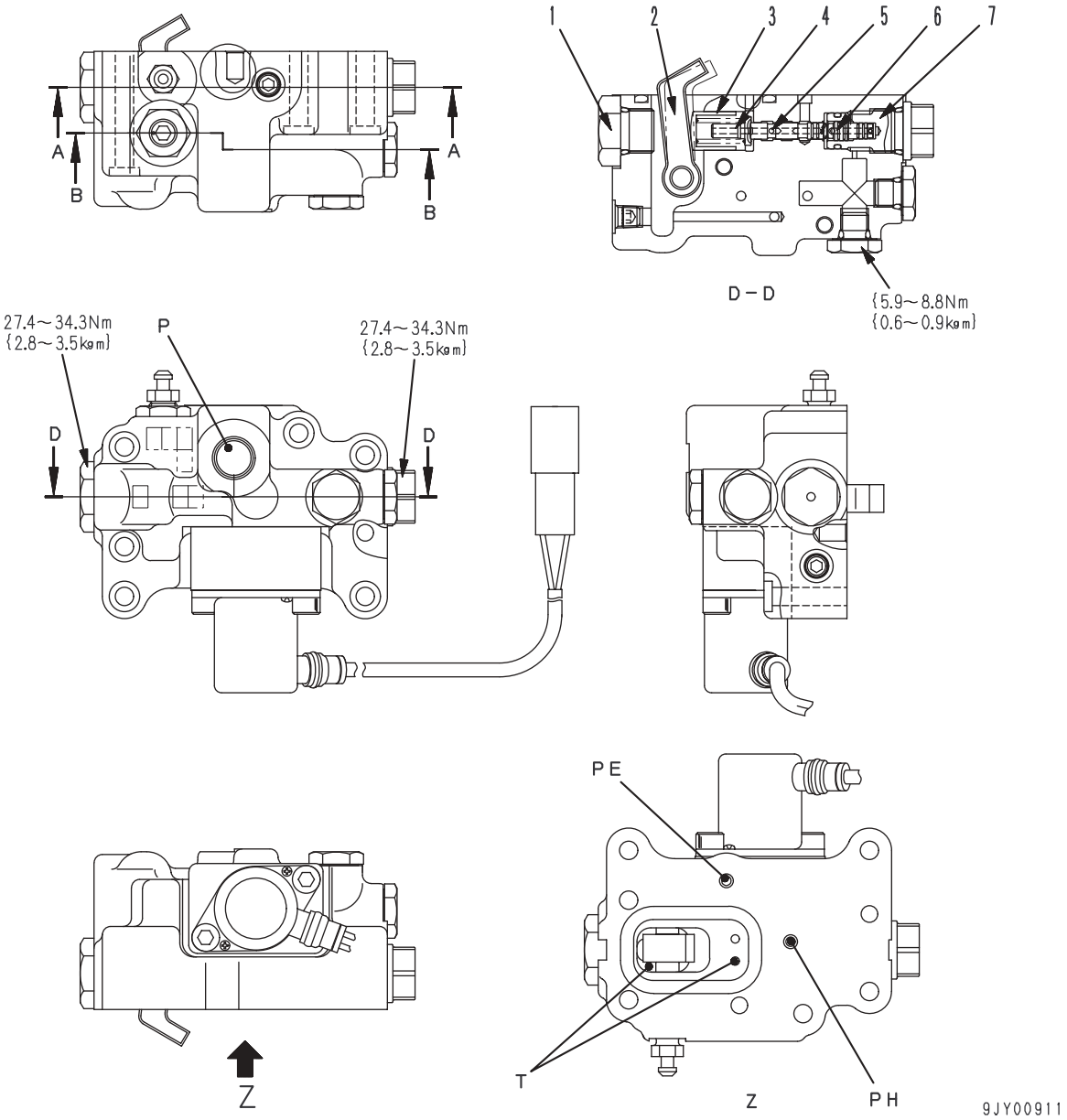
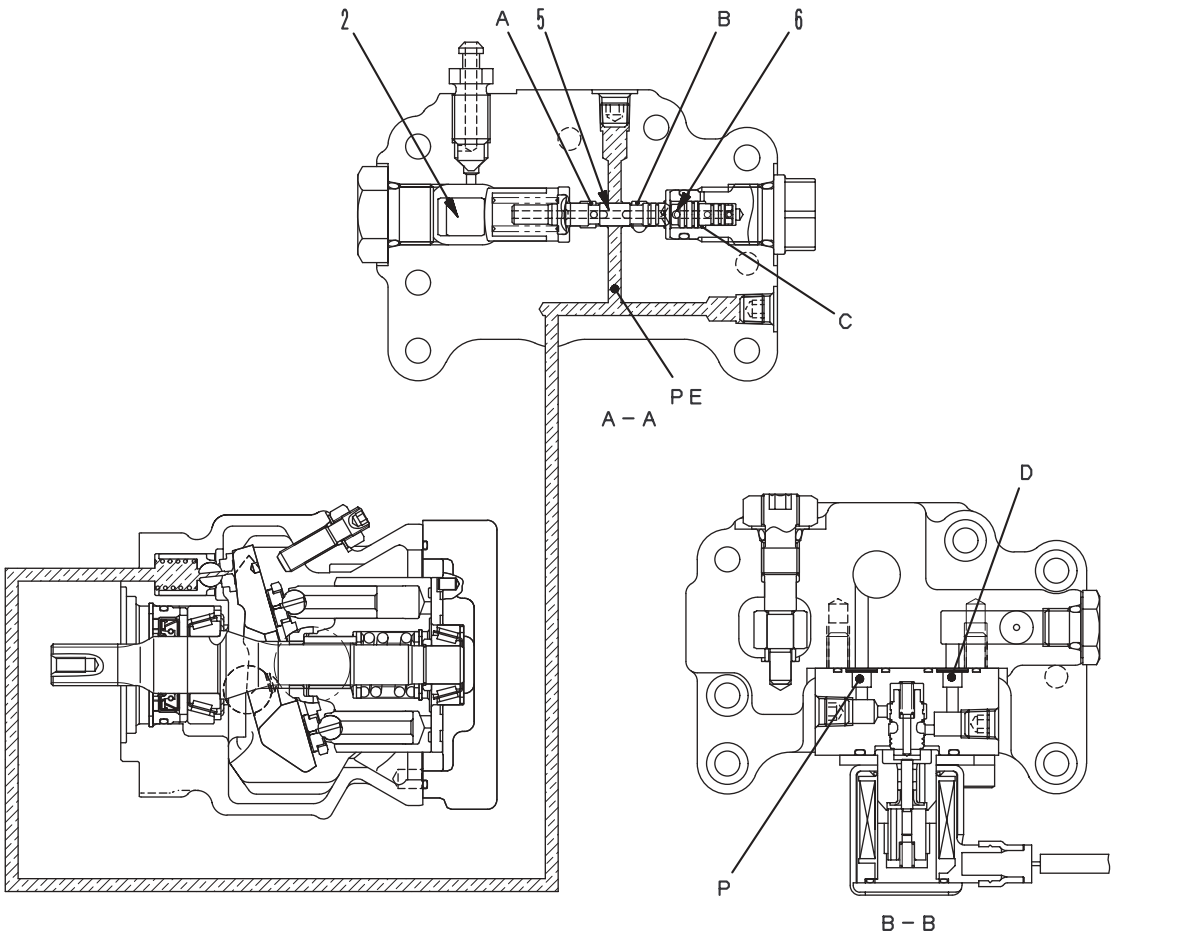
SERBO VALVE



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

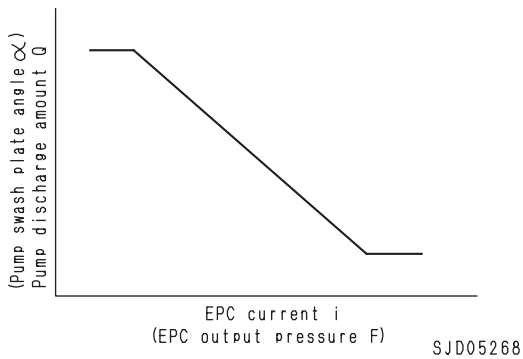
1. Plug
2. Lever
3. Retainer
4. Seat
5. Spool
6. Piston
7. Sleeve



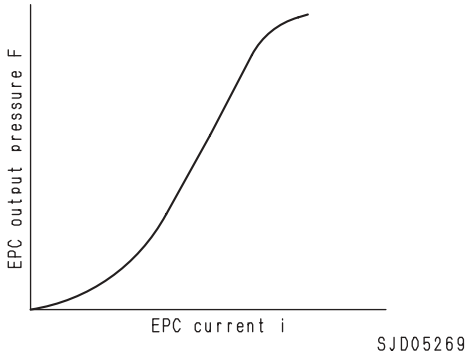
A: Drain side
B: Pump discharge pressure input side
C: EPC output pressure received
D: EPC output pressure

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 figure.



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

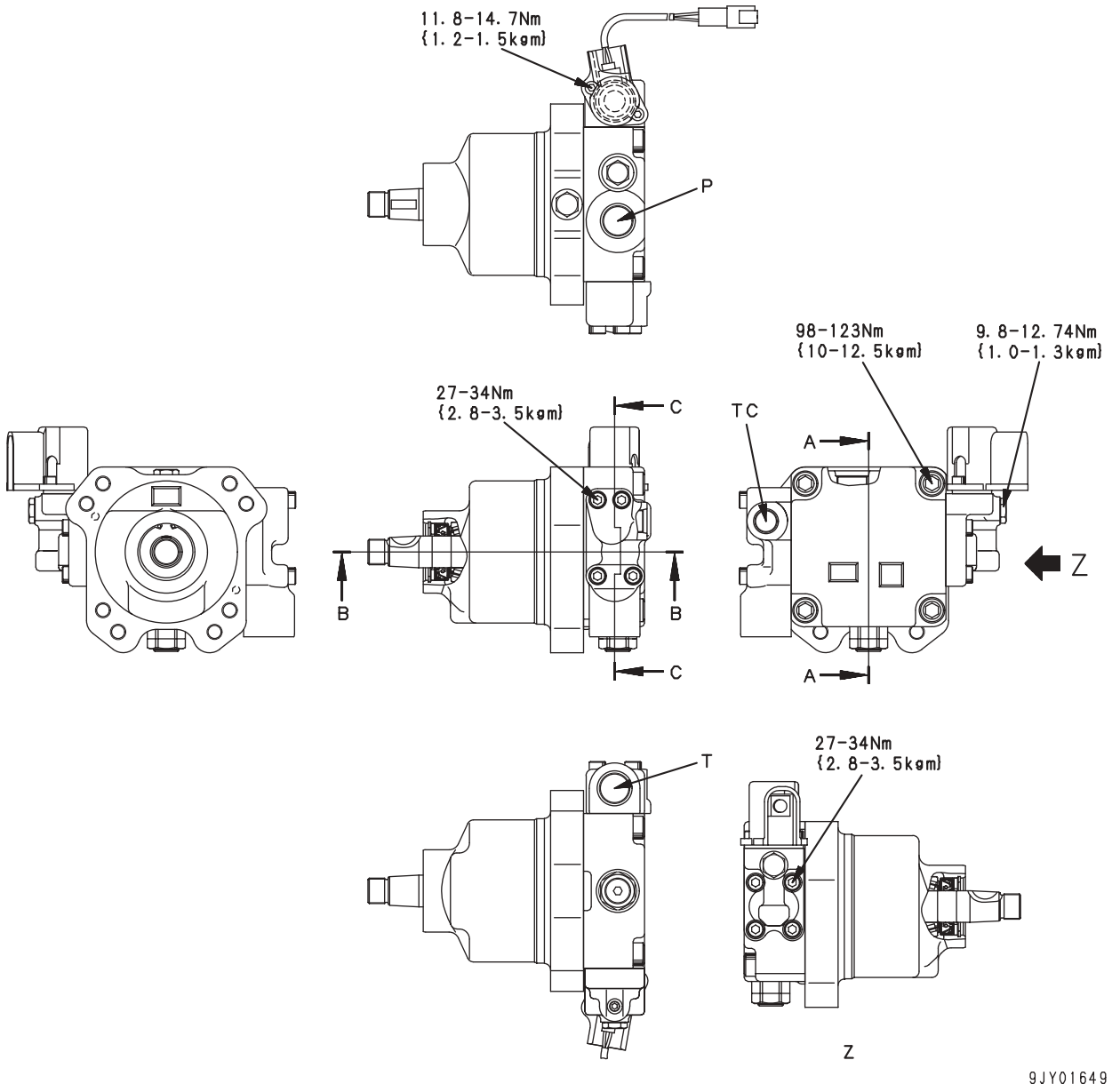


Operation

- The output pressure of the EPC valve is applied to the piston chamber to push the piston. Piston (6) pushes spool (5) until it is balanced with the spring.
- Then, the land of the servo piston pressure passage is connected to the pump discharge passages by the cut of spool (5) and the discharge pressure is led to the servo piston.
- The servo piston is raised by the rocker cam. 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.

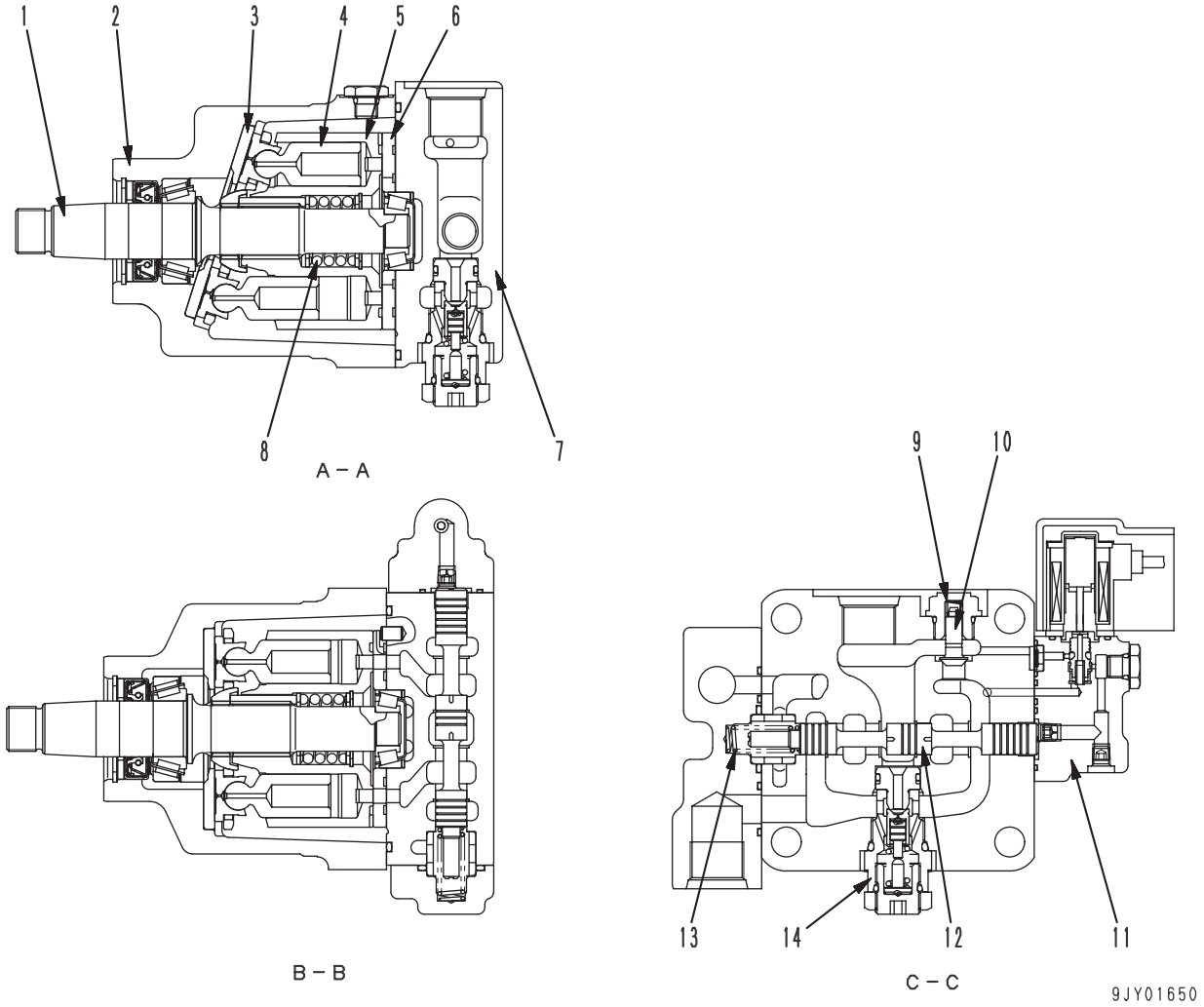
COOLING FAN MOTOR

LMF28



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

Specifications
Model: LMF28
Capacity: 28 cc/rev
Rated speed: 1,500 rpm
Rated flow rate: 40 ℓ/min
Cracking pressure of check valve:
44.1 kPa {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. Reversible valve spool
13. Reversible valve spring
14. Safety valve

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
9	Check valve spring	Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	If damaged or deformed, replace spring
		13.0 x 6.5	7.0	3.43 N {0.35 kg}	–	2.55 N {0.26 kg}	

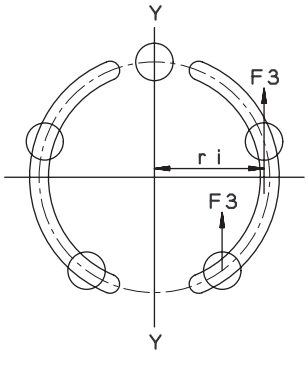
1. Hydraulic motor unit

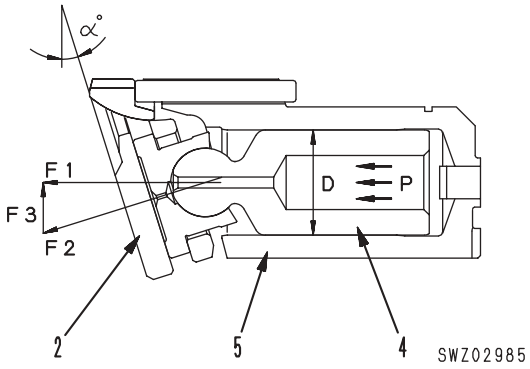
Function

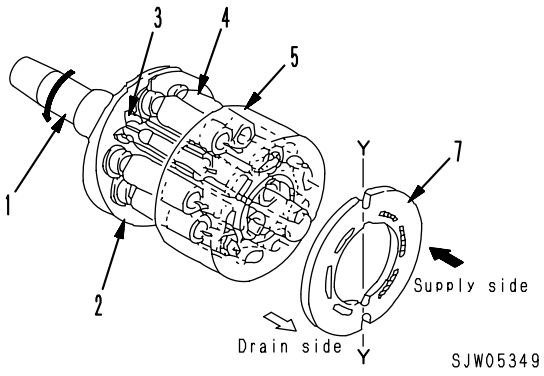
- This hydraulic motor is called a swash plate-type axial piston motor. It converts the energy of the pressurized oil sent from the hydraulic pump into rotary motion.

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 1 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 1 side of cylinder block (5) presses pistons (4) (4 or 5 pieces) and generates force **F1** (**F1 kg = P** kg/cm^2 x π/4D^2 cm^2).
- This force is applied to thrust plate (2). Since thrust plate (2) is fixed to the angle of α degrees to the output shaft (1), the force is divided into components **F2** and **F3**.
- The radial component **F3** generates torque against the **Y-Y** line connecting the top dead center and bottom dead center (**T = F3 x ri**).
- The resultant of this torque [**T = $\sum$(F3 x ri)**] rotates the cylinder block (5) through the piston.
- Since the cylinder block (5) is coupled with the output shaft by means of spline, the output shaft revolves to transmit the torque.







2. Suction valve

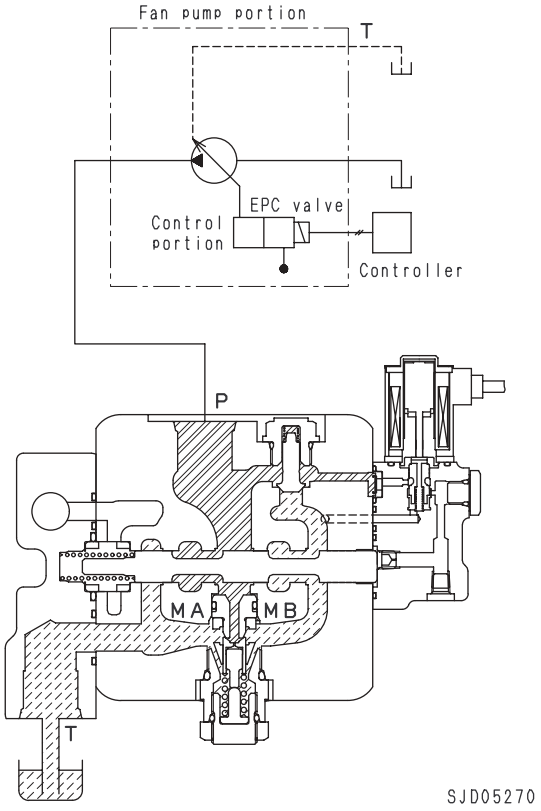
Function

- If the fan pump stops, the hydraulic 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 the port **MA** where there is not sufficient oil to prevent cavitation.

Operation

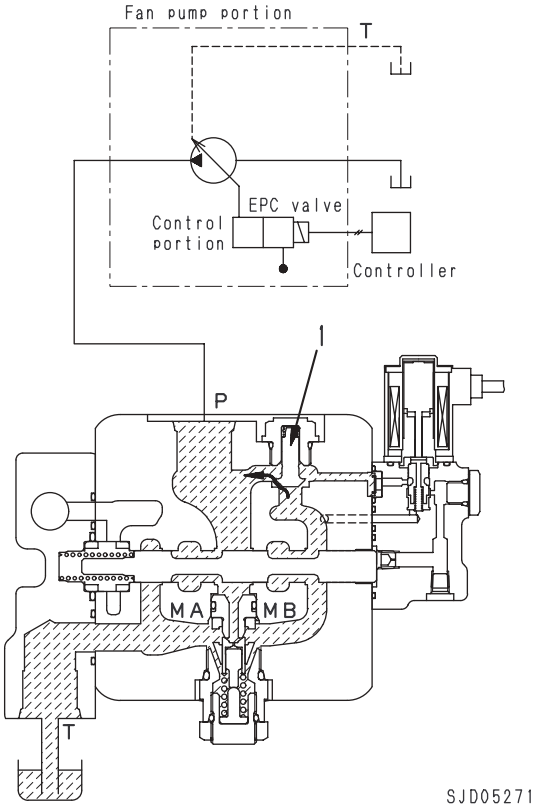
(1) When pump is started

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



(2) When pump is stopped

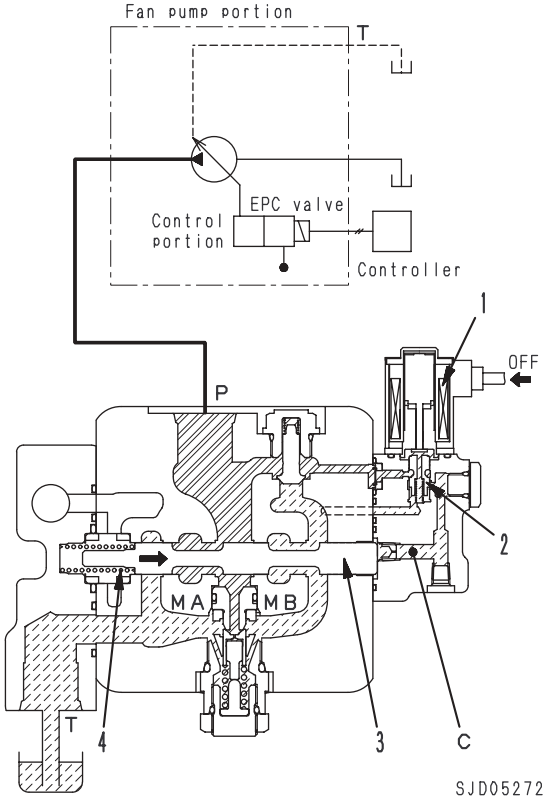
- If the engine is stopped and the input revolution of the fan pump lowers to 0 rpm, the hydraulic oil from the pump is not supplied to port **P** any more. As the hydraulic oil is not supplied to the **MA** side of the motor, the motor speed lowers gradually to stop.
- If the motor shaft is revolved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



3. OPERATION OF REVERSIBLE VALVE

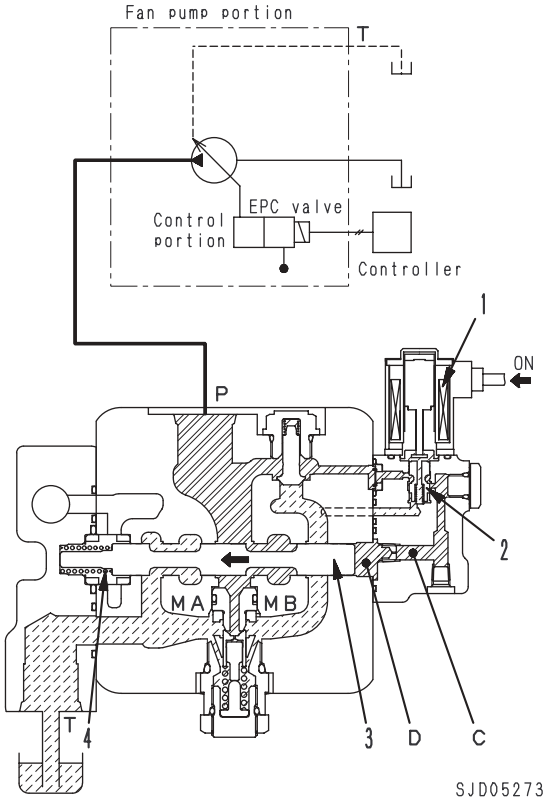
(1) When ON-OFF solenoid for reversible valve is turned OFF

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

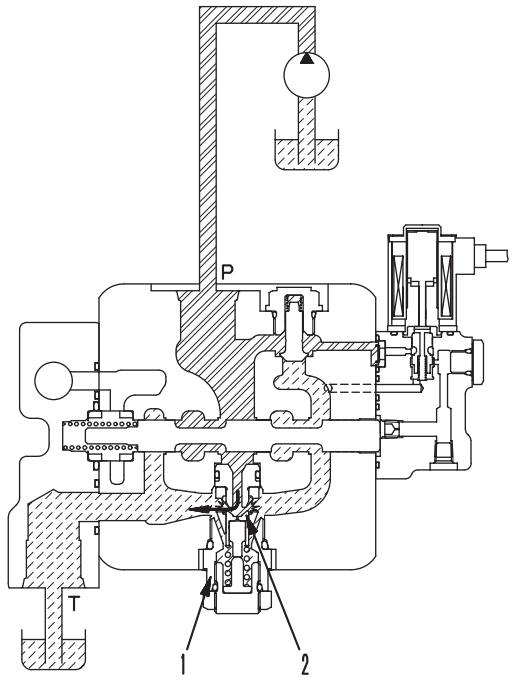


(2) When ON-OFF solenoid for reversible valve is turned ON

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



4. Safety valve



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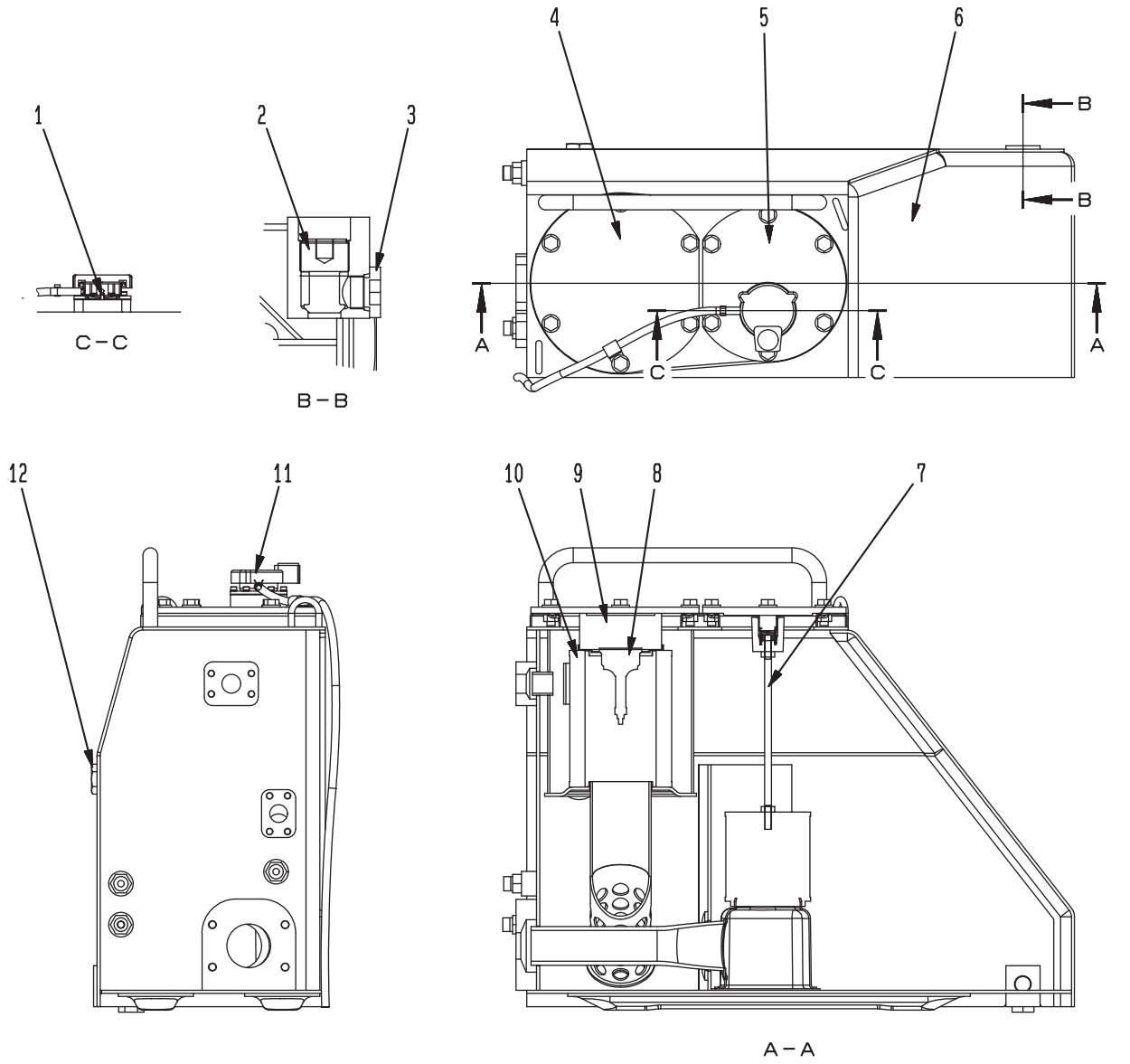
Function

- 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 hydraulic oil into port **T**.
  By this operation, generation of abnormal pressure in port **P** is prevented.

HYDRAULIC TANK



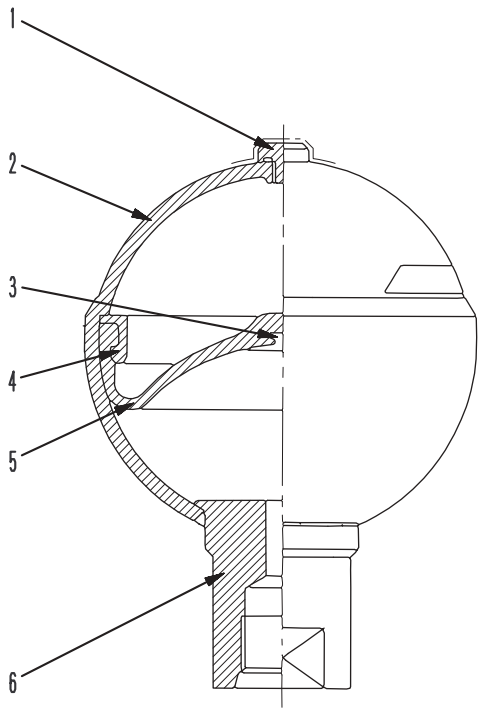
1. Pressure valve
2. Drain valve
3. Drain plug
4. Cover
5. Cover
6. Hydraulic tank
7. Strainer
8. Suction valve
9. Spring
10. Hydraulic filter element
11. Oil filler cap
12. Sight gauge

Specification

Item			Specified value
Hydraulic tank	Tank capacity (ℓ)		95
	Oil level	Hi (ℓ)	74
		Middle (ℓ)	67
		Low (ℓ)	64
Breather cap	Cracking pressure (KPa {kg/cm2})		16.7 ± 6.9 {0.17 ± 0.07}
	Vacuum valve actuating pressure (KPa {kg/cm2})		0 – 0.49 {0 – 0.005 }
Hydraulic filter	Cracking pressure (KPa {kg/cm2})		147 ± 29.4 {1.5 ± 0.3}
	Mesh size (μm)		20/10/5
	Filtering area (cm2)		13,600
	Filtering oil flow (ℓ/min)		195
Strainer	Mesh size (μm)		105
	Filtering area (cm2)		1,850

ACCUMULATOR

For PPC valve



SWD04477

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

Specifications

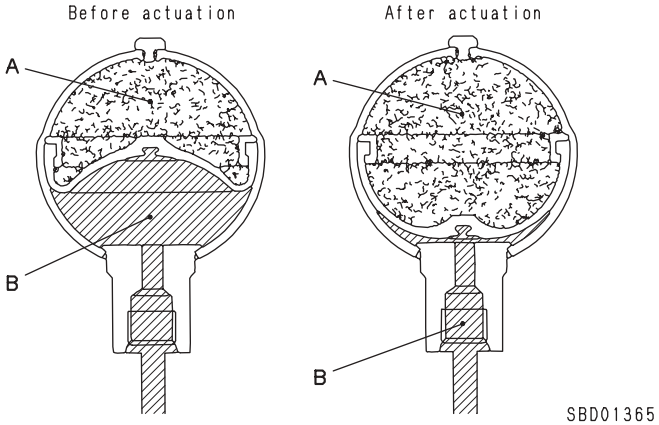
Type of gas: Nitrogen
Gas volume: 300 cc
Max. actuation pressure: 3.1MPa {32kg/cm^2}
Max. actuation pressure: 1.2MPa {12kg/cm^2}

Function

- The accumulator is installed between the reducing valve and the PPC valve. Even if the engine is stopped with the hydraulic still raised, the pressure of the nitrogen gas compressed inside the accumulator sends the pilot pressure to the main control valve to actuate it and enable the hydraulic to move down under its own weight.

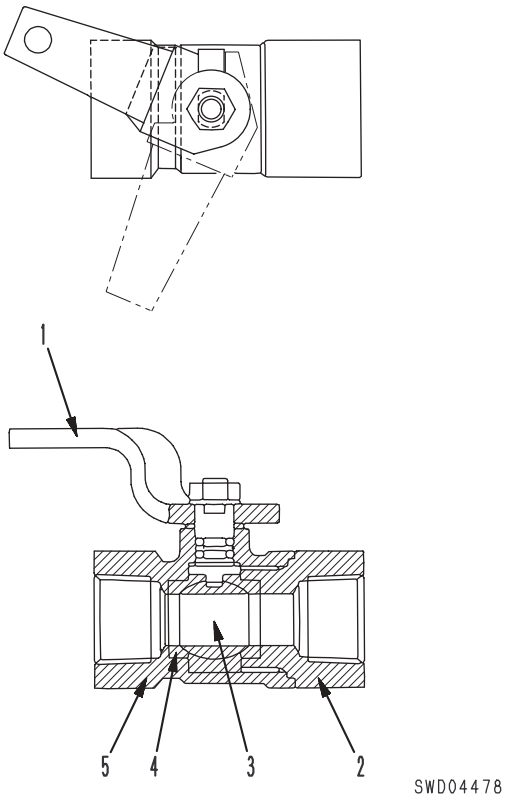
Operation

- After the engine is stopped, when the PPC valve is at neutral, chamber **A** inside the bladder is compressed by the oil pressure in chamber **B**.
- When the PPC valve is operated, the oil pressure in chamber **B** goes below 2.9 MPa {30 kg/cm^2}, and the pressure of the nitrogen gas in chamber **A** expands the bladder, so the oil in chamber **B** acts as the pilot pressure and actuates the main control valve.
-



SBD01365

PPC LOCK VALVE



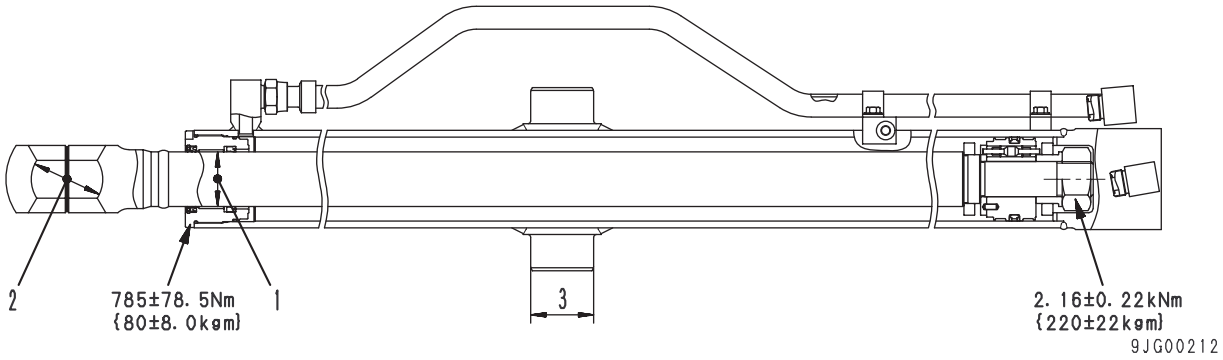
1. Lever
2. End cap
3. Ball
4. Seat
5. Body

Outline

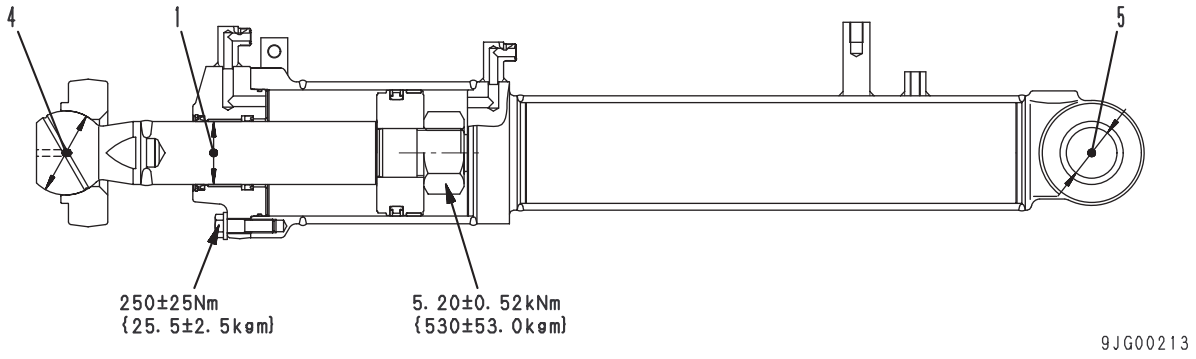
- The PPC lock valve is installed in the PPC circuit between the PPC, HSS charge valve and PPC valve. If the work equipment safety lever is placed at the LOCK position, the PPC lock valve is actuated together with the work equipment safety lever. This stops the oil in the PPC circuit and makes it impossible to operate the hydraulic.

HYDRAULIC CYLINDER

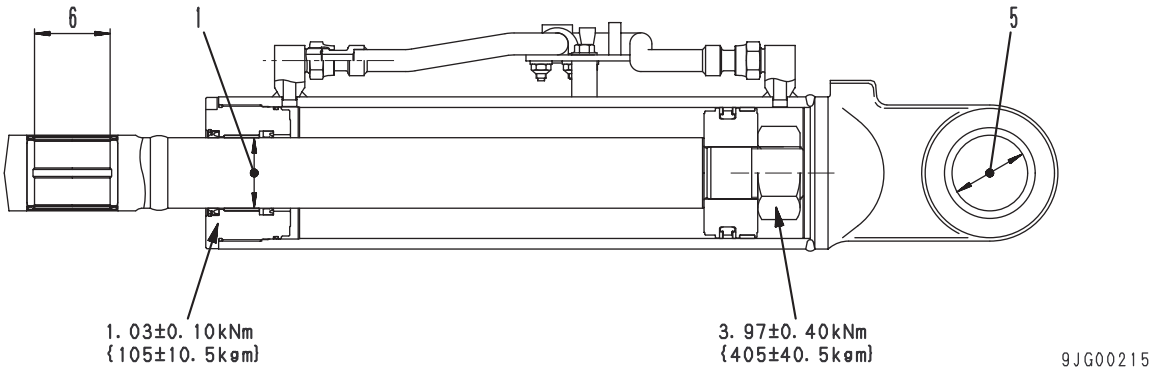
BLADE LIFT CYLINDER



BLADE TILT CYLINDER



RIPPER LIFT CYLINDER
RIPPER TILT CYLINDER (For variable multiple shank ripper)



★ Illustration shows for lift cylinder for fixed multiple shank ripper.
Lift cylinder and tilt cylinder for variable multiple shank ripper are different from piping.

Unit: mm

No.	Check item		Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Blade lift	65	– 0.030 – 0.104	+ 0.262 + 0.067	0.097– 0.366	0.666	Replace
		Blade tilt	75	– 0.030 – 0.104	+ 0.291 + 0.077	0.107– 0.395	0.695	
		Ripper lift/ tilt	70	– 0.030 – 0.104	+ 0.271 + 0.075	0.105– 0.375	0.675	
2	Clearance between piston rod spherical surface and blade ball portion	Blade lift	85 (Ball)	–	+ 0.3 0	–	1.0	
3	Clearance between cylinder support shaft bushing and yoke	Blade lift	75	– 0.100 – 0.174	–	–	0.5	
4	Clearance between piston rod spherical shaft and cap	Blade tilt	100	– 0.200 – 0.300	–	–	–	
5	Clearance between cylinder bottom support shaft and bushing	Blade tilt	60	–	+ 0.174 + 0.100	–	1.0	
		Ripper lift/ tilt	75	–	+ 0.286 + 0.184	–	1.0	
6	Clearance between piston rod support shaft and bushing	Ripper lift/ tilt	75	–	+ 0.286 + 0.184	–	1.0	

PISTON VALVE

FOR BLADE LIFT CYLINDER

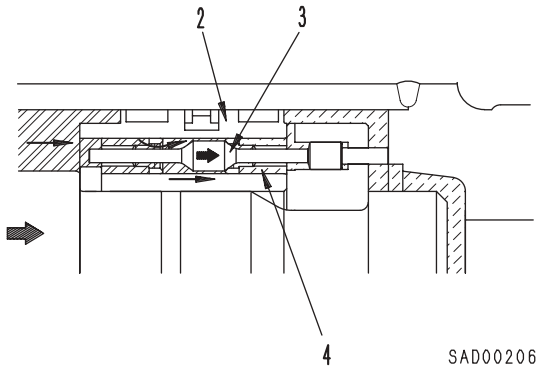
Outline

- The piston valve is installed on the piston in the blade lift cylinder. When the piston reaches its stroke end, the valve releases the oil from the hydraulic pump to reduce the oil pressure being exerted on the piston.
  When the blade is tilted, the blade is subject to a tortional force owing to the uneven position of the pistons in the two cylinders; that is the piston one side is still moving while the piston on the other side has reached its stroke end.
  The piston valves are installed to prevent the tortional force from occurring. When one of the pistons reaches its stroke end, its piston valve opens to relieve the oil pressure.
  In addition the piston valve relieves the shock which occurs when the piston comes into contact with the cylinder head or the bottom and serves to redure the subsequent surge pressure in the cylinder by letting the oil escape from the cylinder before the piston reaches its stroke end.

Operation

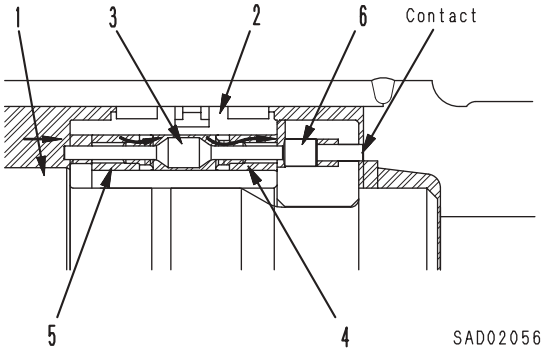
1. Piston valve CLOSED

Pressurized oil from the hydraulic pump acts on piston (2) and piston valve (3).
The piston valve (3) is pushed in the direction of the arrow until piston valve seat (4) comes into snug contact with the tapered section, thereby, this causing the pressure in the cylinder to rise and moving piston (2) in the direction of the arrow.



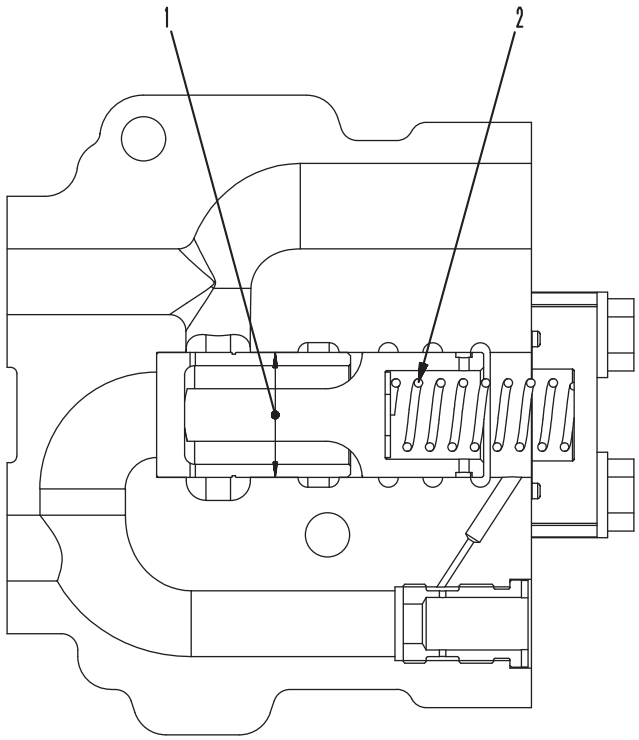
2. Piston valve OPEN

Just before piston rod (1) reaches the end of its stroke, the tip of valve (6) contacts the cylinder bottom, so valve (6) and piston valve (3) stop at that position and do not move further. Only piston (2) moves further.
When this happens, the oil at the cylinder head, which was sealed by piston valve (3), escapes from piston valve seats (4) and (5), and the pressure inside the cylinder stops rising.



QUICK DROP VALVE

FOR BLADE LIFT CYLINDER



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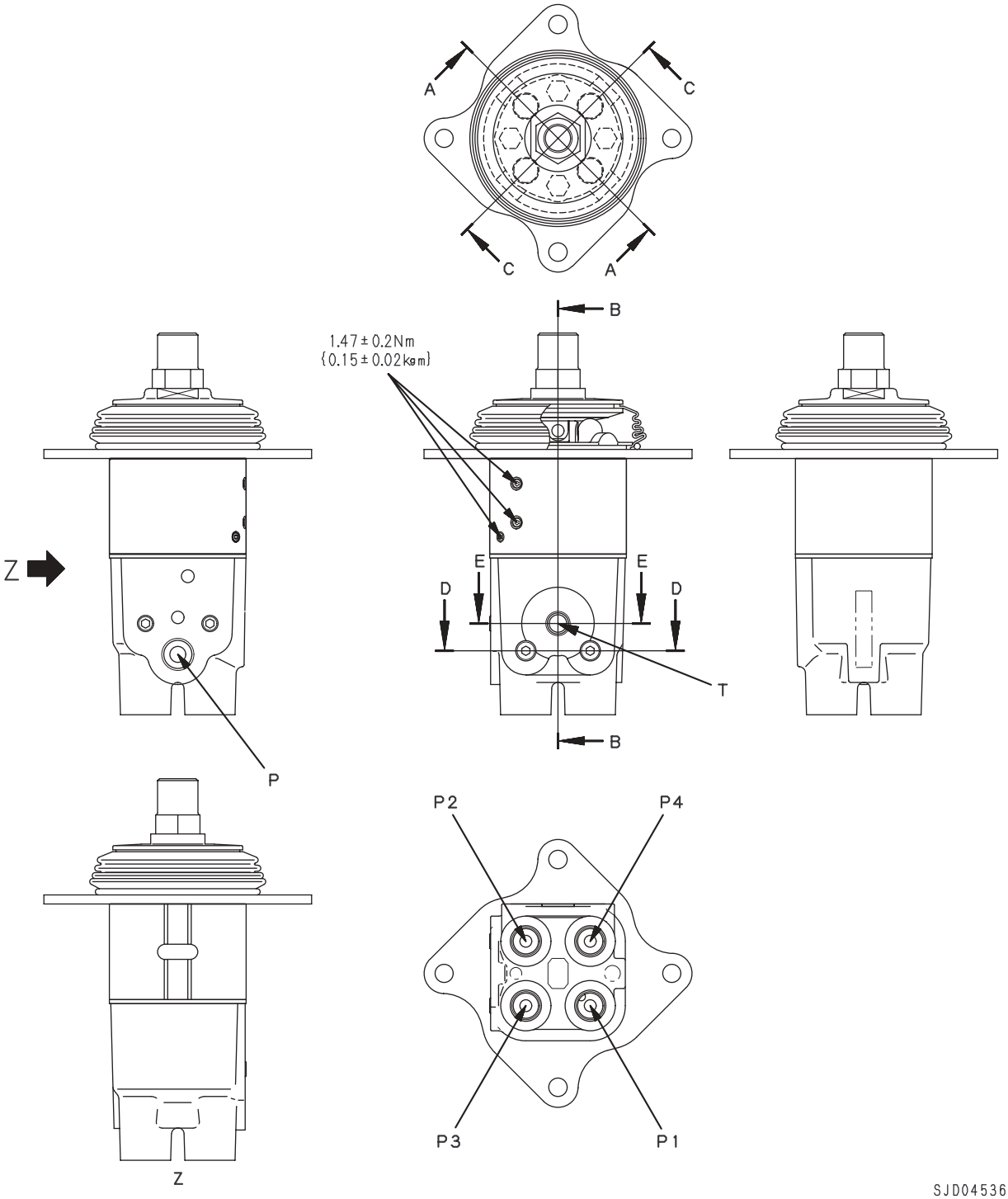
Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between spool and valve body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		38.0	– 0.011 – 0.016	+ 0.010 0	0.011– 0.026	0.03	
2	Valve spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		75.2	55.9	136.3 N {13.9 kg}	67.7	122.6 N {12.5 kg}	

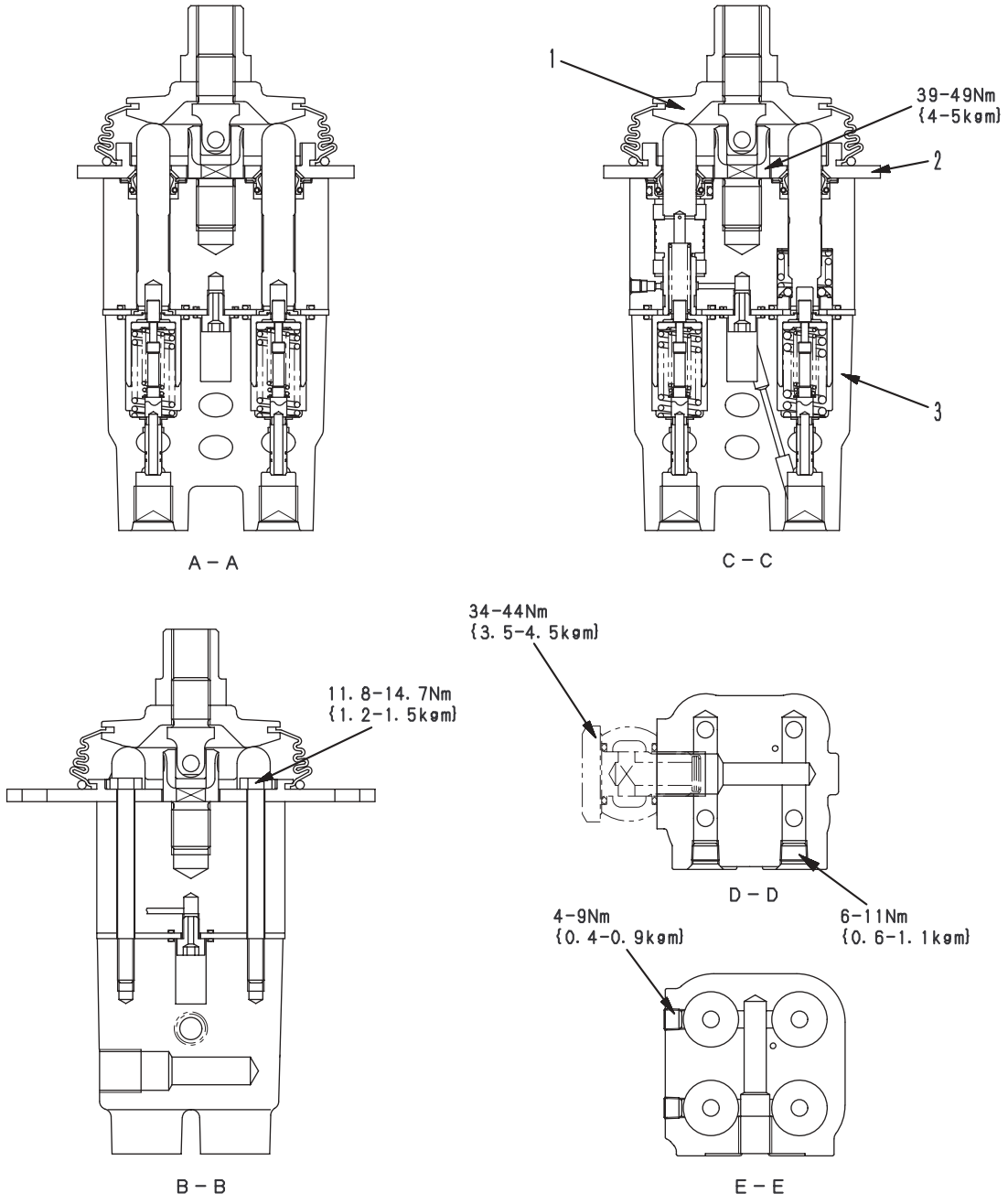
PPC VALVE

FOR BLADE LIFT, BLADE TILT



P. From PPC charge valve port P
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



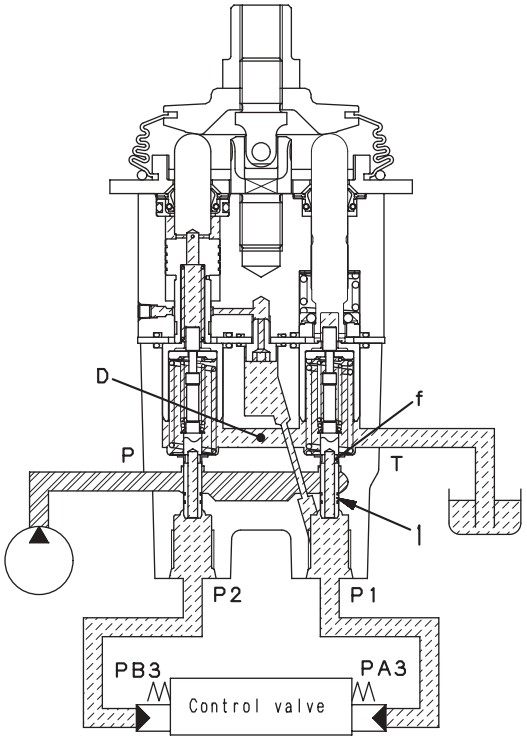
1. Disc
2. Plate
3. Body

OPERATION

1. At Neutral

1) For blade lift

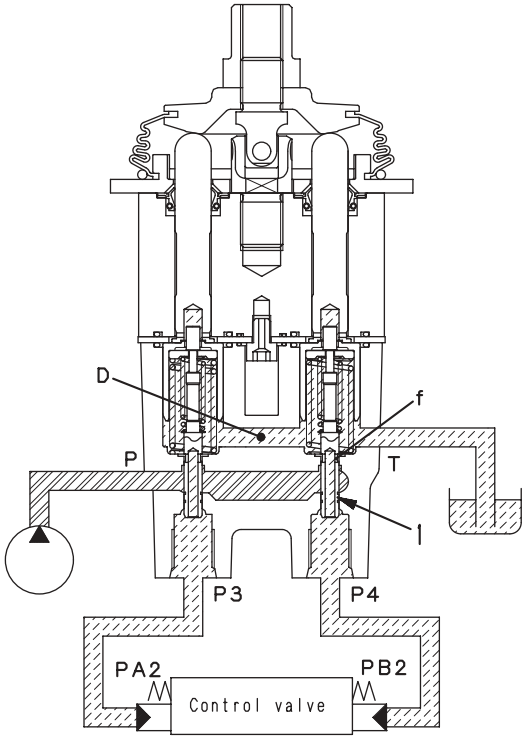
- Ports **PA3** and **PB3** of the blade lift control valve and ports **P1** and **P2** of the PPC valve are connected to drain chamber **D** through fine control hole **f** spool (1).



9JY01657

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).



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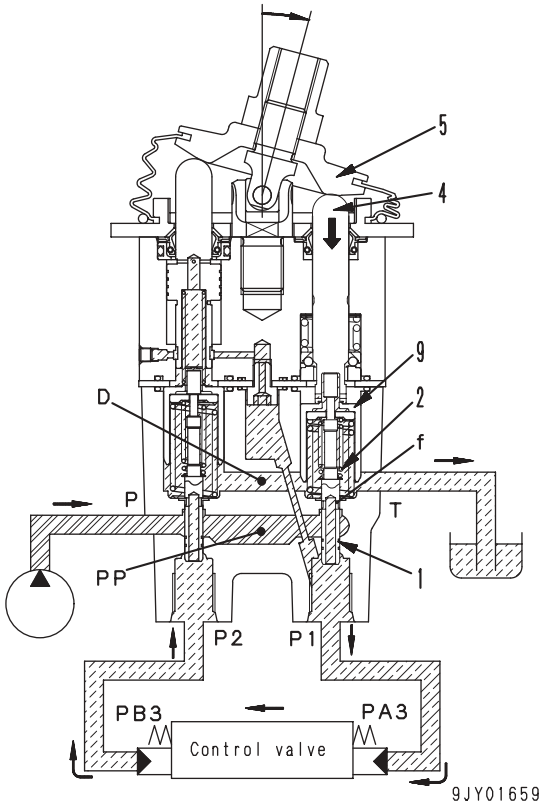
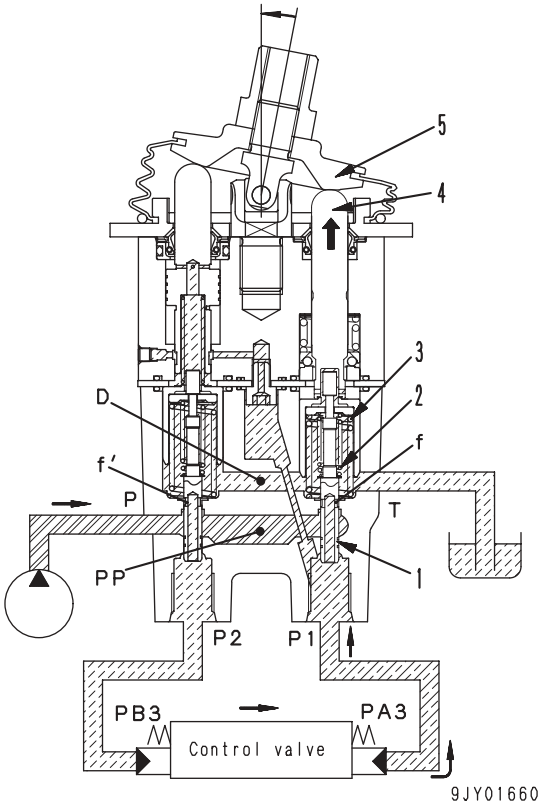
2. During fine control (Neutral → fine control)

- When piston (4) is pushed by disc (5), retainer (9) is pushed, and spool (1) is also pushed through metering spring (2), and moves down.
- As a result, if fine control hole **f** is shut off from drain chamber **D**, at almost the same time, it is connected with pump pressure chamber **PP**, and the pilot pressure oil passes through fine control hole **f** and flows from port **P1** to port **PA3**.
- When the pressure at port **P1** becomes high, if 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 with drain chamber **D** and released 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 an amount proportional to the movement of the control lever, so the pressure at port **P1** also rises in proportion to the movement 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.



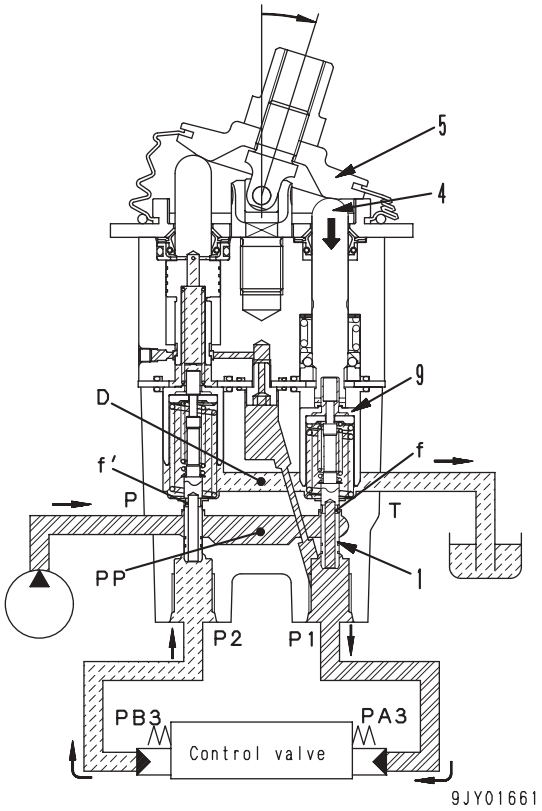
3. During fine control
(when control lever is returned)

- When disc (5) starts to be returned, spool (1) is pushed up by the pressure at port **P1** and the force of centering spring (3).
- As a result, fine control hole **f** is connected to drain chamber **D**, so the pressure oil at port **P1** is relieved.
- If the pressure at port **P1** goes down to far, spool (1) is pushed down by metering spring (2).
  Fine control hole **f** is shut off from drain chamber **D**, and at almost the same time, 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. It passes through port **P2** , is taken to chamber **PB3**, and the oil fills the chamber.



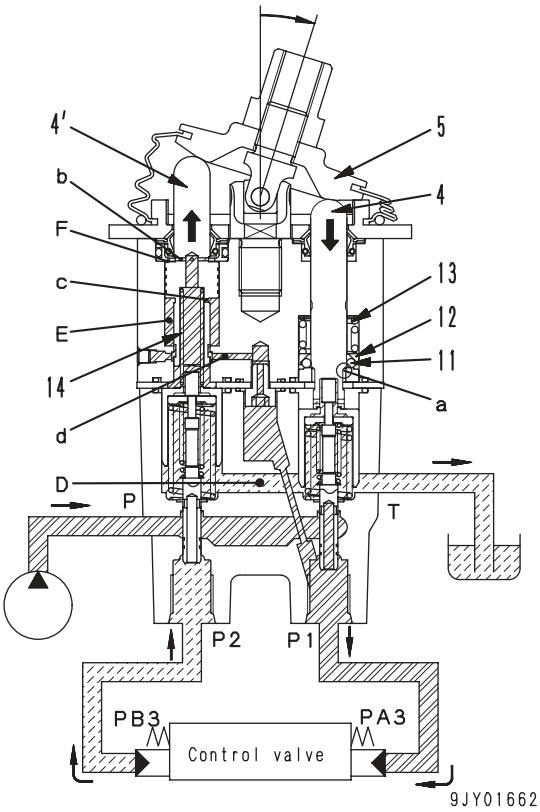
4. When lever is operated fully

- 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

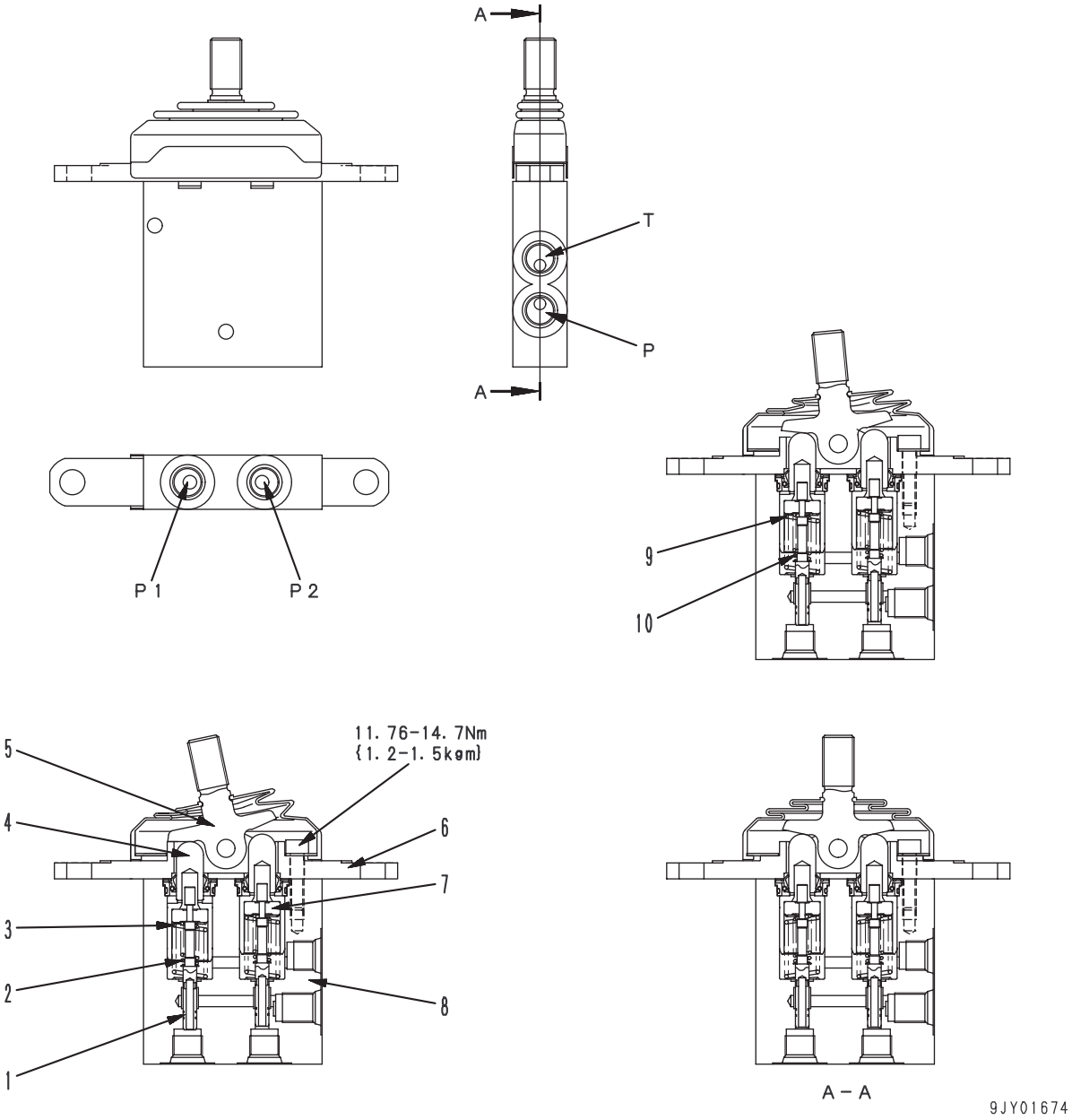
- When piston (4) at the port **P1** LOWER side is pushed by disc (5) and moves down, ball (11) contacts protrusion **a** of the piston during the stroke. (Detent starts to act.)
- When piston (4) pushed in further, ball (11) pushes up collar (12), which is being held by detent spring (13). While pushing 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 the 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 FLOATposition is canceled.

FOR FIXED MULTIPLE SHANK RIPPER



T : To hydraulic tank
P : From main pump
P1 : To ripper spool (To control valve port PB4)
P2 : To ripper spool (To control valve port PA4)

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

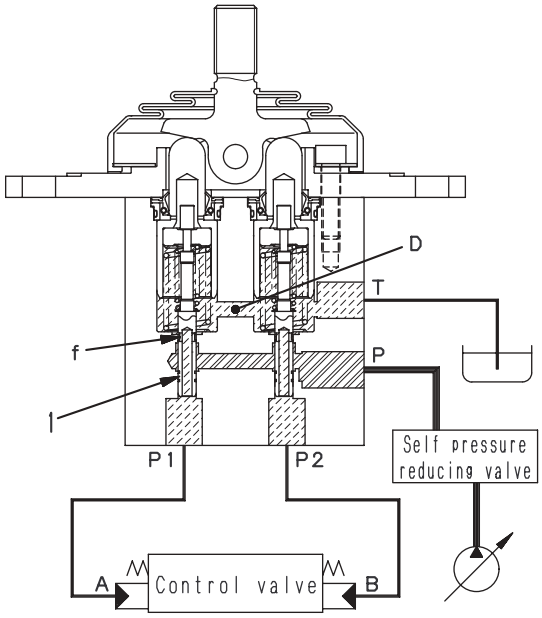
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
9	Centering spring	Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	If damaged or deformed, replace spring.
		33.9 x 15.3	28.4	125 N {12.7 kg}	–	100 N {10.2 kg}	
10	Metering spring	22.7 x 8.10	22.0	16.7 N {1.70 kg}	–	13.3 N {1.36 kg}	

Operation

1. At neutral

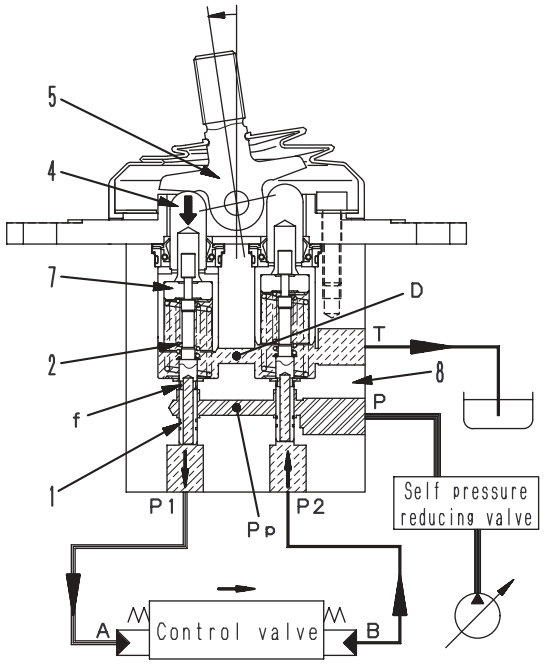
- **P1** and **P2** ports of the operation valves **A**, **B** and PPC valve are connected to drain room **D** via the fine control hole **f** on the spool (1).



SJP07646

2. During fine control
(Neutral → fine control)

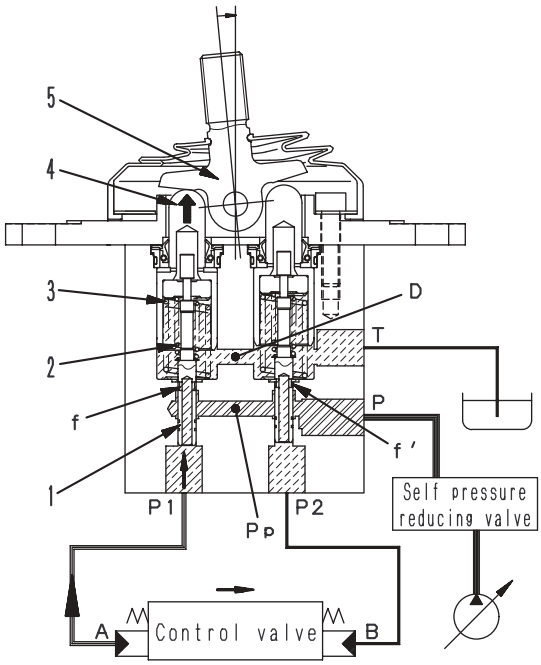
- As the piston (4) is pushed by disk (5), the retainer (7) is pushed too. At the same time, the spool (1) is also pushed down via the metering spring (2).
- By this move, connection of the fine control hole **f** is switched from the drain room **D** to the pump pressure room **PP**, and pilot pressure oil is conducted from **P1** port to **A** port.
- As **P1** port pressure increases, the spool (1) is pushed back. By this move, connection of the fine control hole **f** is switched from the pump pressure room **PP** to the drain room **D**, thereby relieving **P1** port pressure.
- As the result, the spool (1) moves up and down so that force of the metering spring (2) and **P1** port pressure may be balanced.
- Positional relationship between the spool (1) and body (8) (fine control hole **f** is situated at mid point between the drain room **D** and pump pressure room **PP**) remains unchanged until the retainer (7) is contacted against the spool (1).
- The metering spring (2) is, therefore, compressed in proportion to strokes of the operation lever. Thus, the **P1** port pressure too, increases in proportion to strokes of the operation lever.
- As the result, the operation valve spool moves to the position where the pressure of **A** room (the same as **P1** port pressure) is balanced against force of the operation valve spool return spring.



SJP07647

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

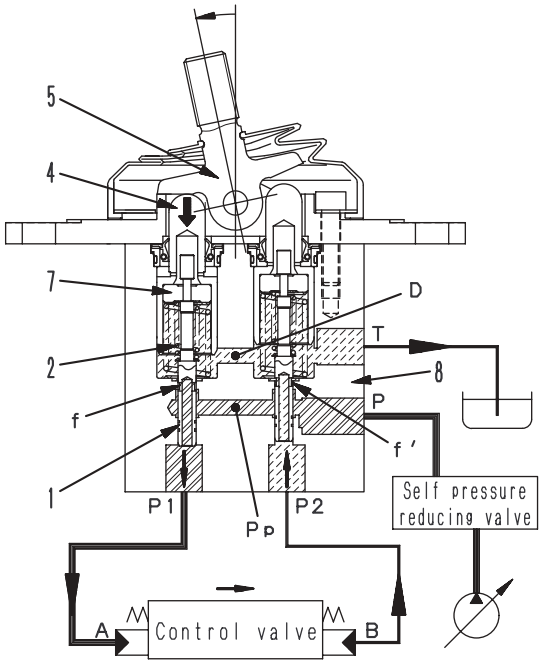
- As the lever (5) starts returning, the spool (1) is pushed up by force of the centering spring (3) and **P1** port pressure. By this move, the fine control hole **f** is connected to the drain room **D** and relieves pressurized oil of **P1** port to it.
- If **P1** port pressure goes excessively low, the spool (1) is pushed down by the metering spring (2), and passage between fine control hole **f** and drain room **D** is shut down. And, almost at the same time, the hole is connected to the pump pressure room **PP** and starts supplying pump the pressure. This supply continues until the **P1** port pressure is recovered to the level equivalent to the lever position.
- When the operation valve spool returns, oil in the drain room **D** flows in through the fine control hole **f'** on the not moving side valve. Oil is then conducted via **P2** port to the room **B** to fill it up.



SJP07648

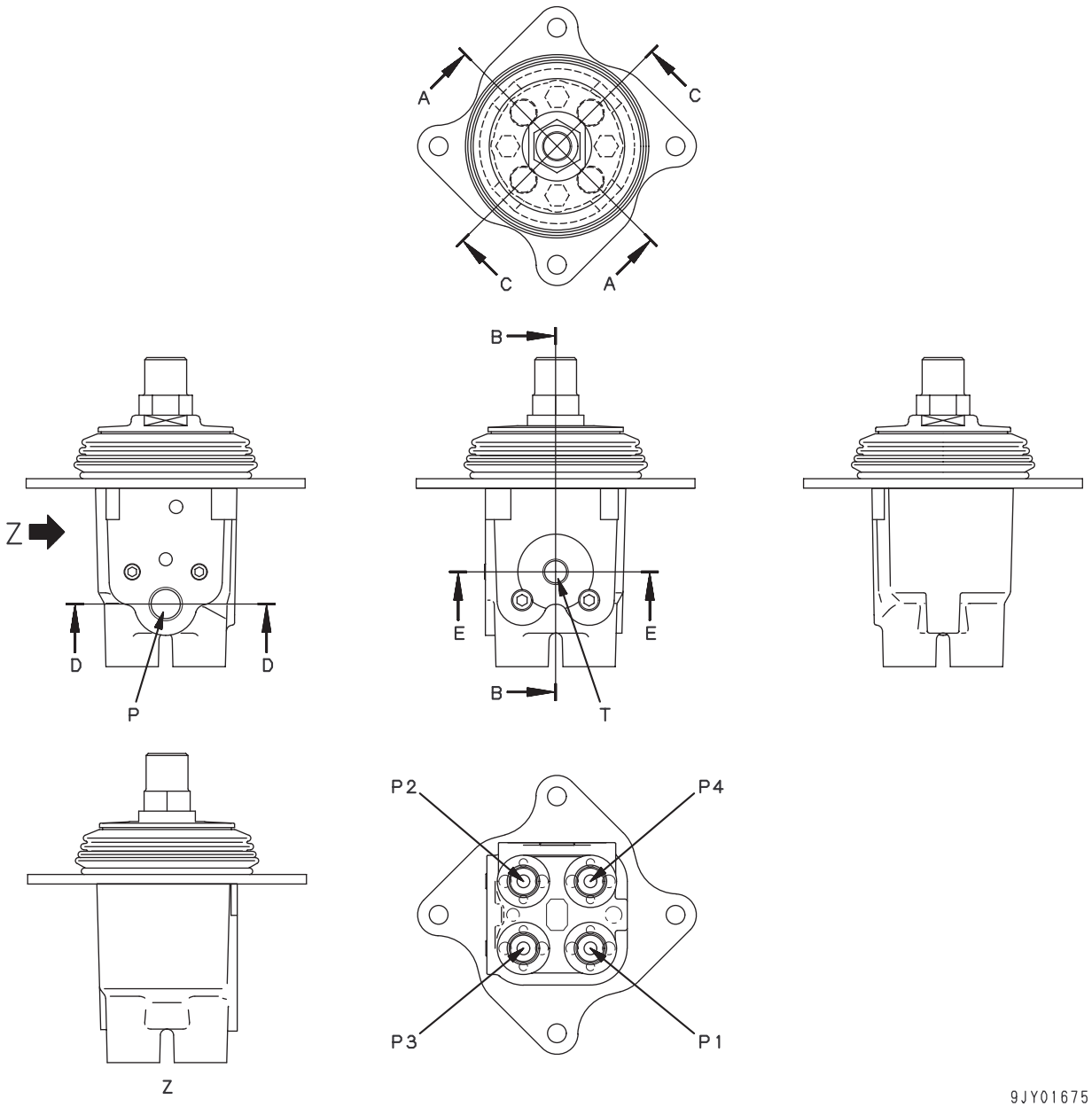
4. At full stroke

- When the disk (5) pushes down piston (4) and the retainer (7) pushes down the spool (1), connection of the fine control hole **f** is switched from the drain room **D**, to the pump pressure room **PP**.
- Thus, pilot pressurized oil from the control pump passes through fine control hole **f** and conducted to **A** room via **P1** port to push the operation valve spool.
- Return oil from **B** room is conducted from **P2** port to the drain room **D** via the fine control hole **f'**.

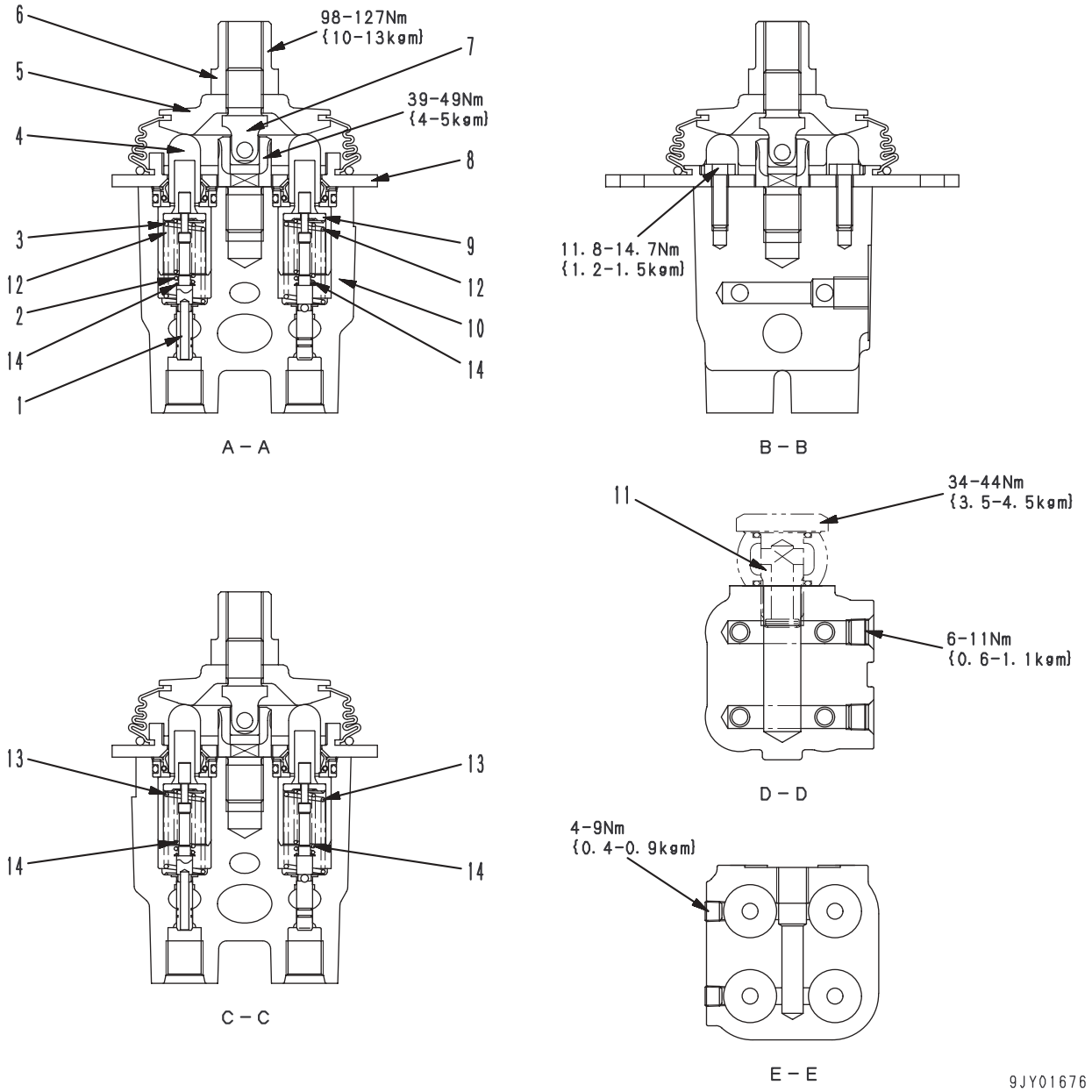


SJP07649

FOR SCRAPER, FIXED MULTIPLE SHANK RIPPER



P: From PPC lock valve
T: To hydraulic tank
P1: To ball or ripper tilt spool (To control valve port PA5)
P2: To ball or ripper tilt spool (To control valve port PB5)
P3: To apron or ripper lift spool (To control valve port PA4)
P4: To apron or ripper lift spool (To control valve port PB4)



1. Spool
2. Metering spring
3. Centering spring
4. Piston
5. Disc
6. Nut (for lever connection)
7. Joint
8. Plate
9. Retainer
10. Body
11. Filter

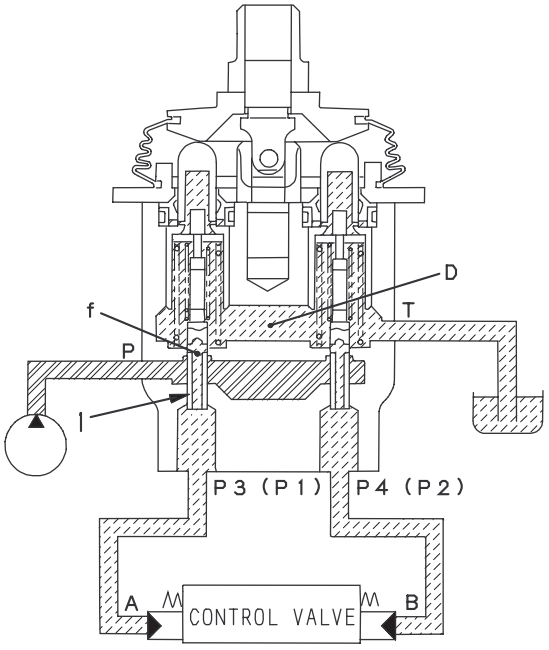
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
12	Centering spring (for P3, P4)	Free length	Installed length	Installed load	Free length	Installed load	Replace spring if damaged or deformed
		50.4 × 15.5	34	55.9 N {5.7 kg}	–	44.7 {4.56 kg}	
13	Centering spring (for P1, P2)	50.1 × 15.5	34	71.4 N {7.28 kg}	–	56.9 N {5.8 kg}	
14	Metering spring	26.5 × 8.20	24.9	16.7 N {1.7 kg}	–	13.3 N {1.36 kg}	

OPERATION

1. At neutral

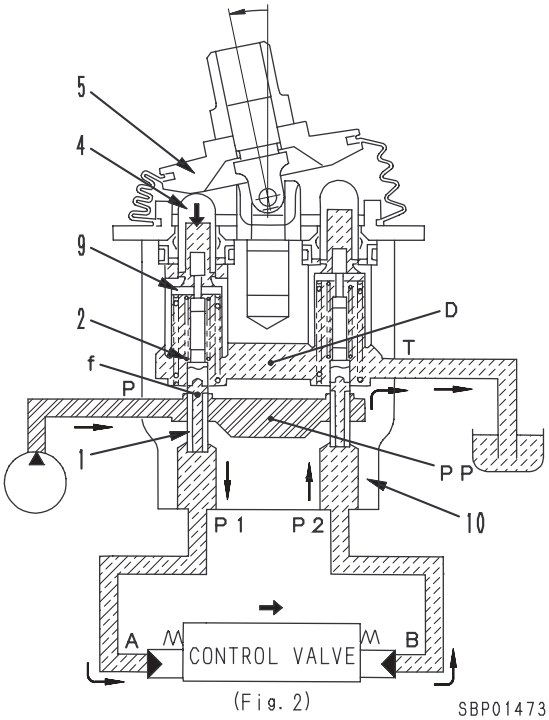
- Ports **A** and **B** of the control valve and ports **P1**, **P2**, **P3**, and **P4** of the PPC valve are connected to drain chamber **D** through fine control hole **f** of spool (1). (Fig. 1)



(Fig. 1) SBP01472

2. Fine control (neutral → fine control)

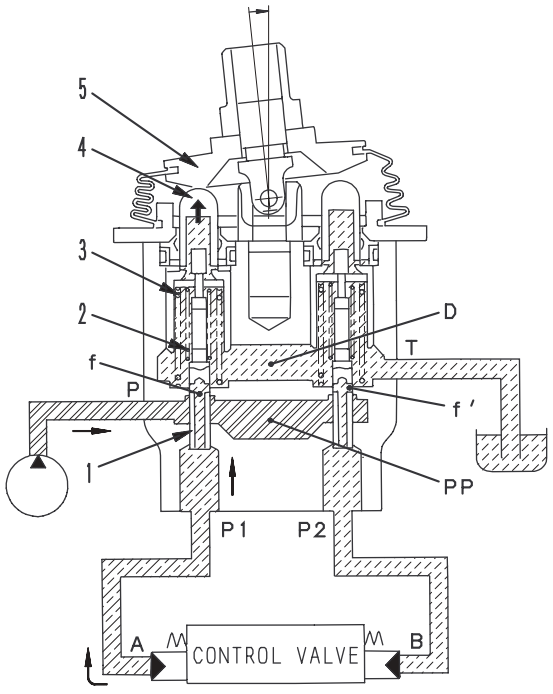
- When piston (4) starts to be pushed by disc (5), retainer (9) is pushed. Spool (1) is also pushed by metering spring (2) and moves down.
- When this happens, fine control hole **f** is shut off from drain chamber **D**. At almost the same time, it is connected to pump pressure chamber **PP**, and the pilot pressure is sent through fine control hole **f** from port **P1** to port **A**.
- When the pressure at port **P1** rises, spool (1) is pushed back. Fine control hole **f** is shut off from pump pressure chamber **PP**. At almost the same time, it is connected to drain chamber **D**, so the pressure at port **P1** escapes.
- As a result, spool (1) moves up and down until the force of metering spool (2) is balanced with the pressure of port **P1**.
  The relationship of the positions of spool (1) and body (10) (fine control hole **f** is in the middle between drain hole **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 travel of the control lever, so the pressure at port **P1** also rises in proportion to the travel of the control lever.
- In this way, the spool of the control valve moves to a position where the pressure of chamber **A** (same as pressure at port **P1**) and the force of the return spring of the control valve spool are balanced. (Fig. 2)



(Fig. 2) SBP01473

3. Fine control (control lever returned)

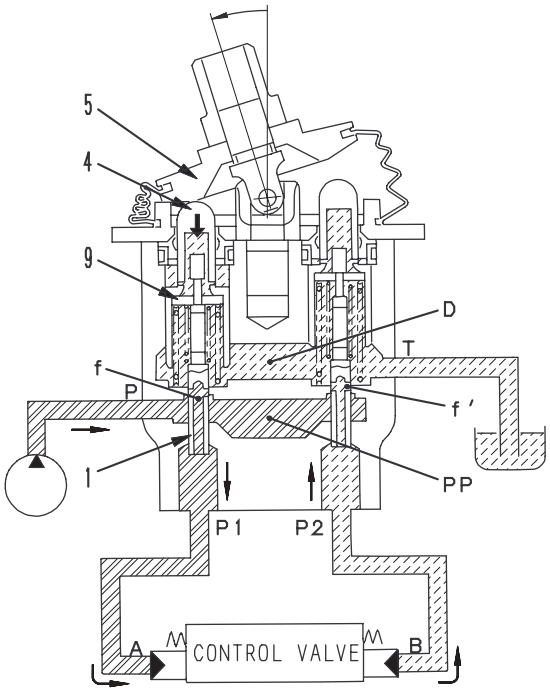
- When disc (5) starts to be returned, spool (1) is pushed up by the force of centering spring (3) and the pressure at port **P1**.
- Because of this, fine control hole **f** is connected to drain chamber **D**, and the pressurized oil at port **P1** is released.
- If the pressure at port **P1** drops too much, spool (1) is pushed down by metering spring (2), so fine control hole **f** is shut off from drain chamber **D**. At almost the same time, it is connected to pump pressure chamber **PP**, so the pressure at port **P1** supplies the pump pressure until the pressure recovers to a pressure equivalent to the position of the lever.
- When the control valve spool returns, oil in drain chamber **D** flows in from fine control hole **f'** of the valve on the side that is not moving. It passes through port **P2** and goes to chamber **B** to charge the oil. (Fig. 3)



(Fig. 3) SBP01474

4. At full stroke

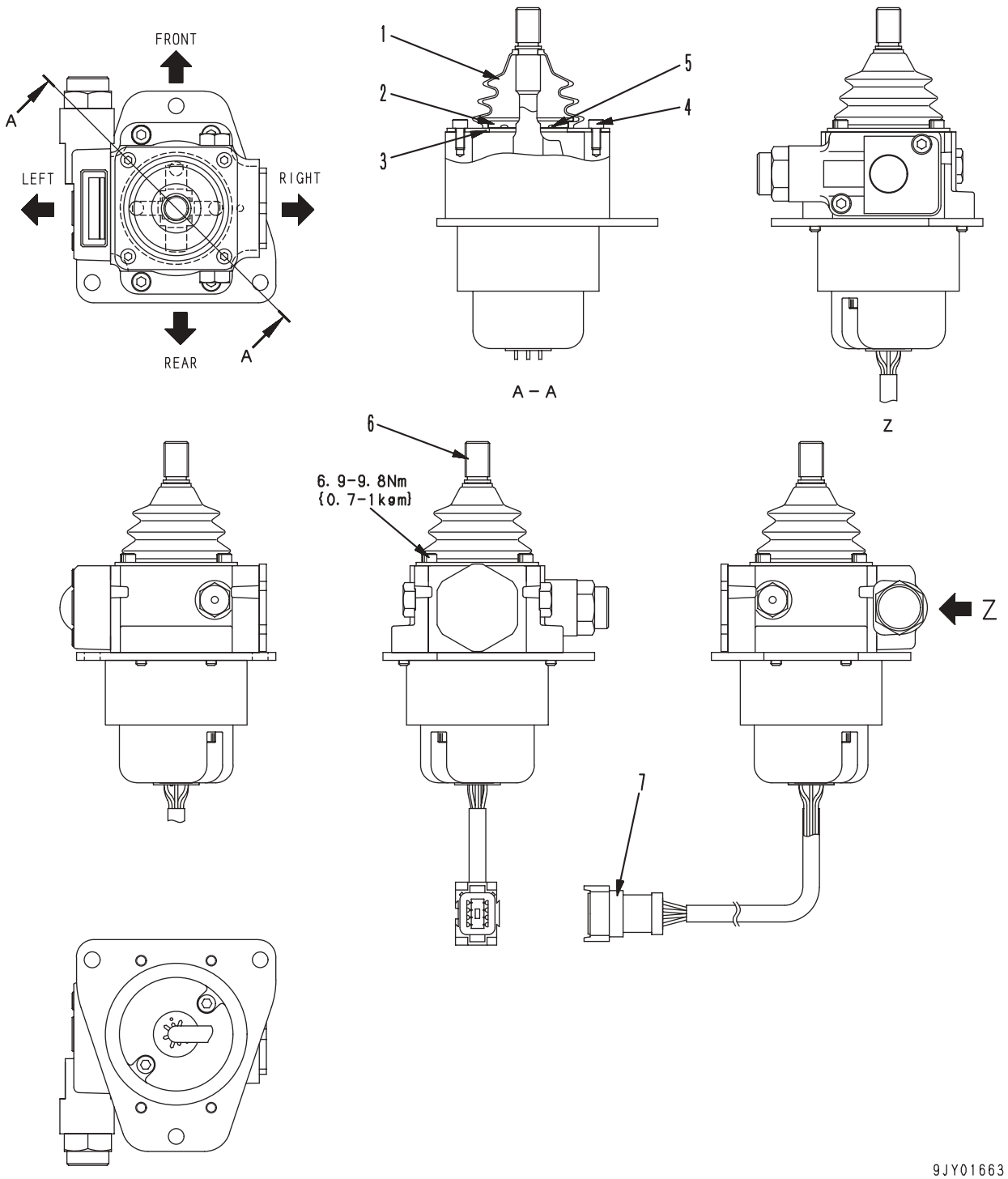
- When disc (5) pushes down piston (4), and retainer (9) pushes down spool (1), fine control hole **f** is shut off from drain chamber **D**, and is connected to pump pressure chamber **PP**.
- Therefore, the pilot pressure oil is sent from port **P1** through fine control hole f to port **A** to push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



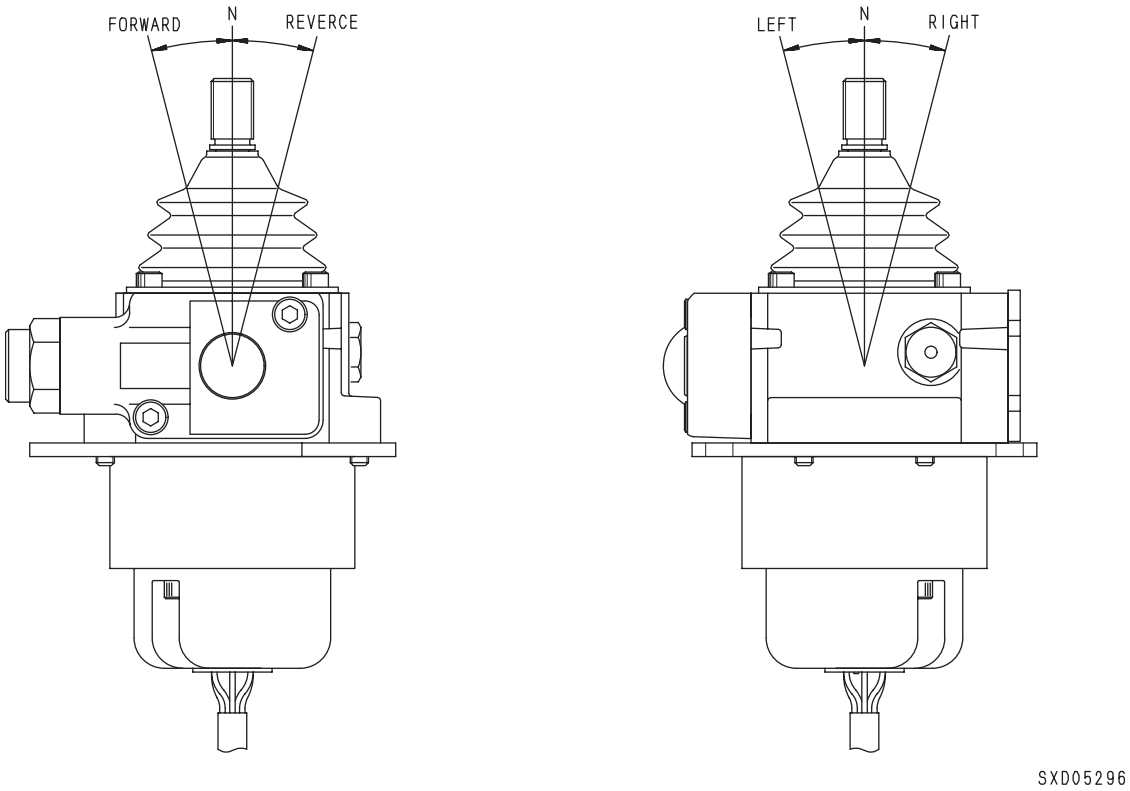
(Fig. 4) SBP01475

PCCS LEVER

FOR STEERING



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

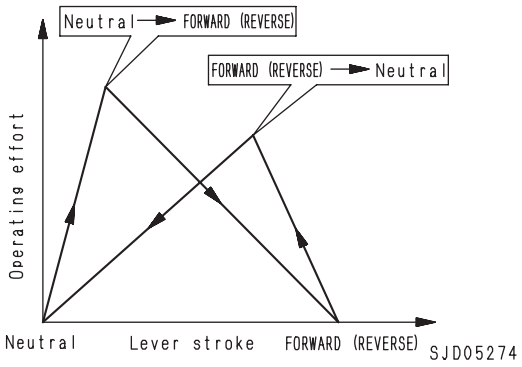


FUNCTION

1. Operating effort characteristics

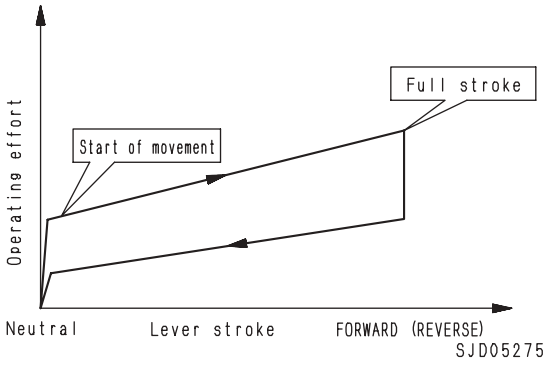
(1) Operation for forward and reverse travel

- The control lever is held at 3 positions of Forward, Neutral, and Reverse (Operating effort characteristics chart A).



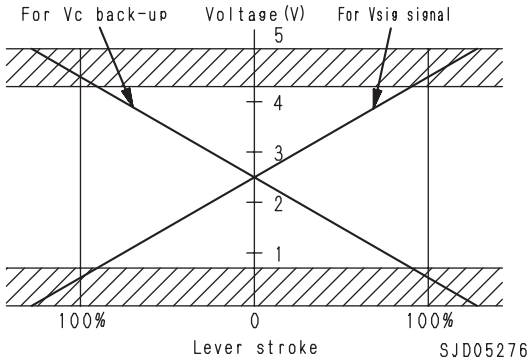
(2) Operation for steering

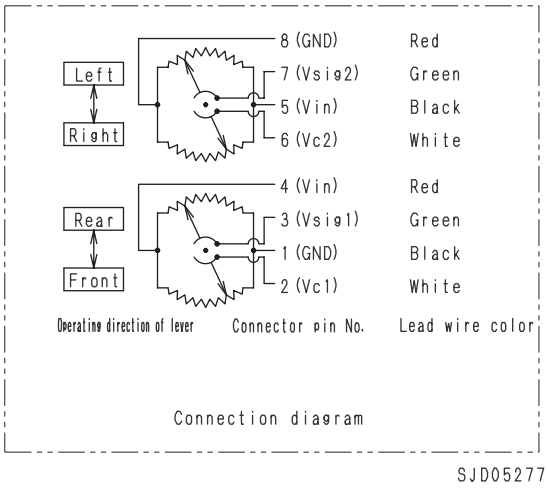
- Free return (Operating effort characteristics chart B).



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 lever is 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.





CONTROL VALVE

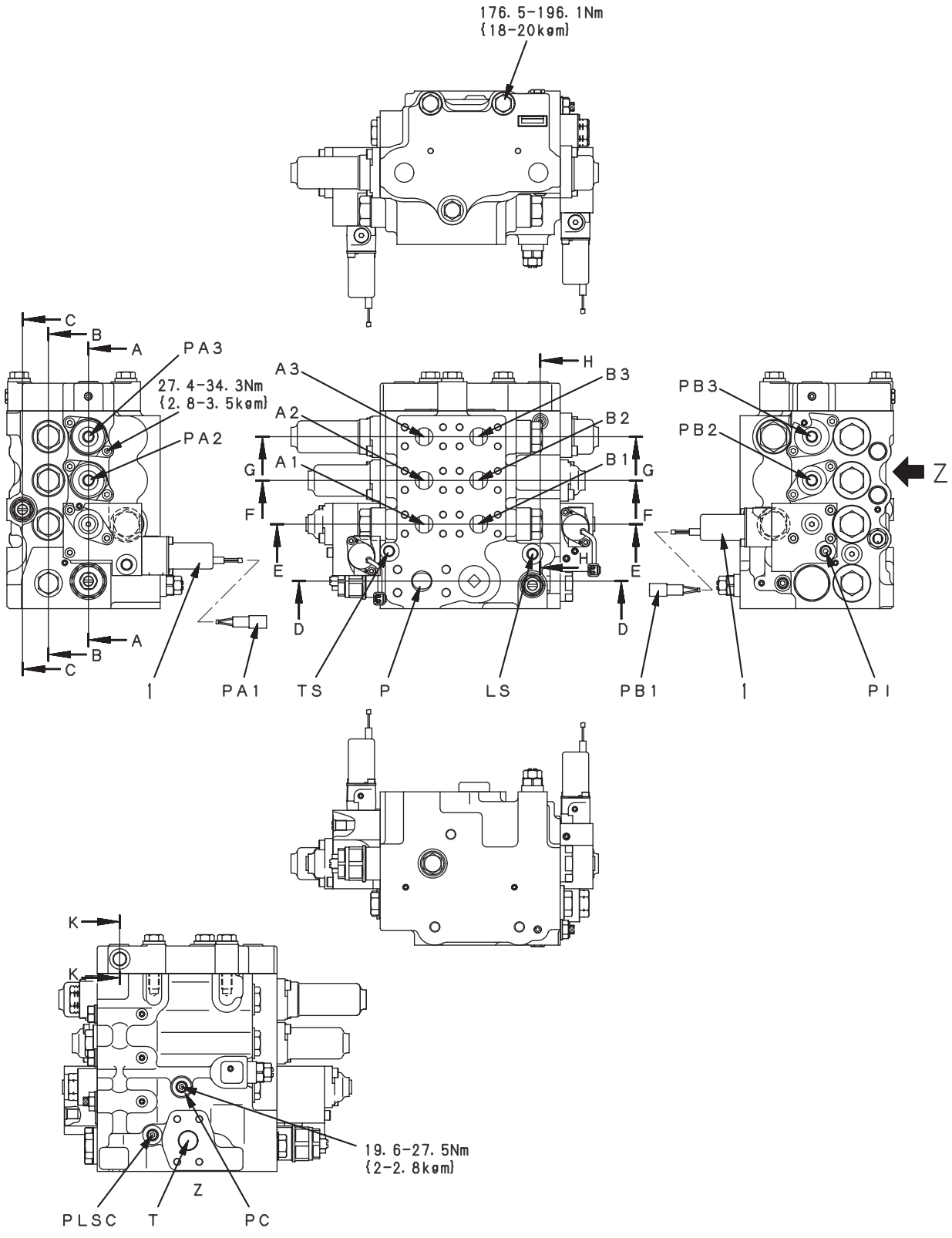
Outline

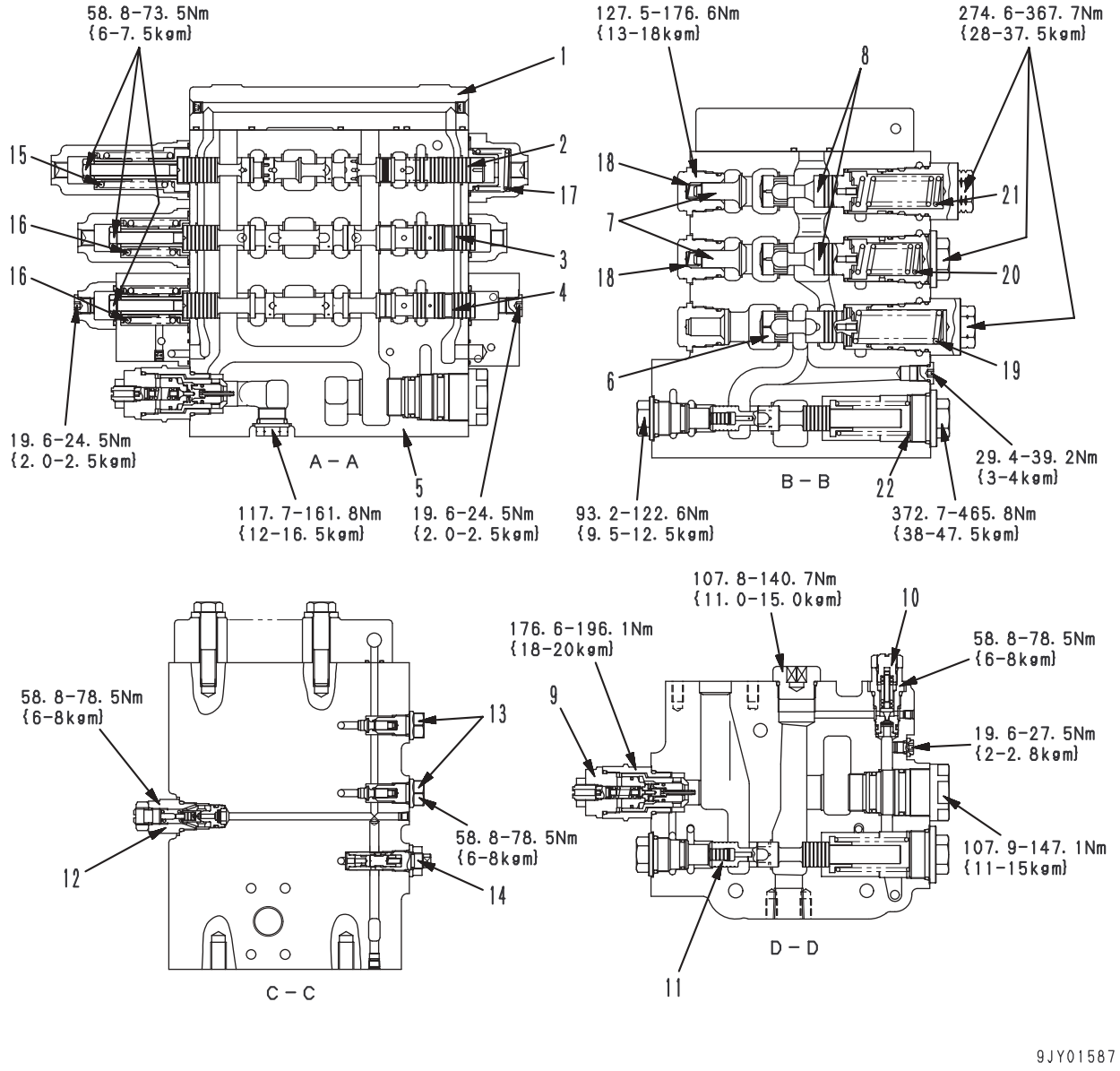
- This manual explains the 3-spool valve (Blade lift + Tilt + Steering) and 4-spool valve (Ripper + Blade lift + Tilt + Steering).

1. 3-spool valve

P: From pump
T: To hydraulic 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 hydraulic 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

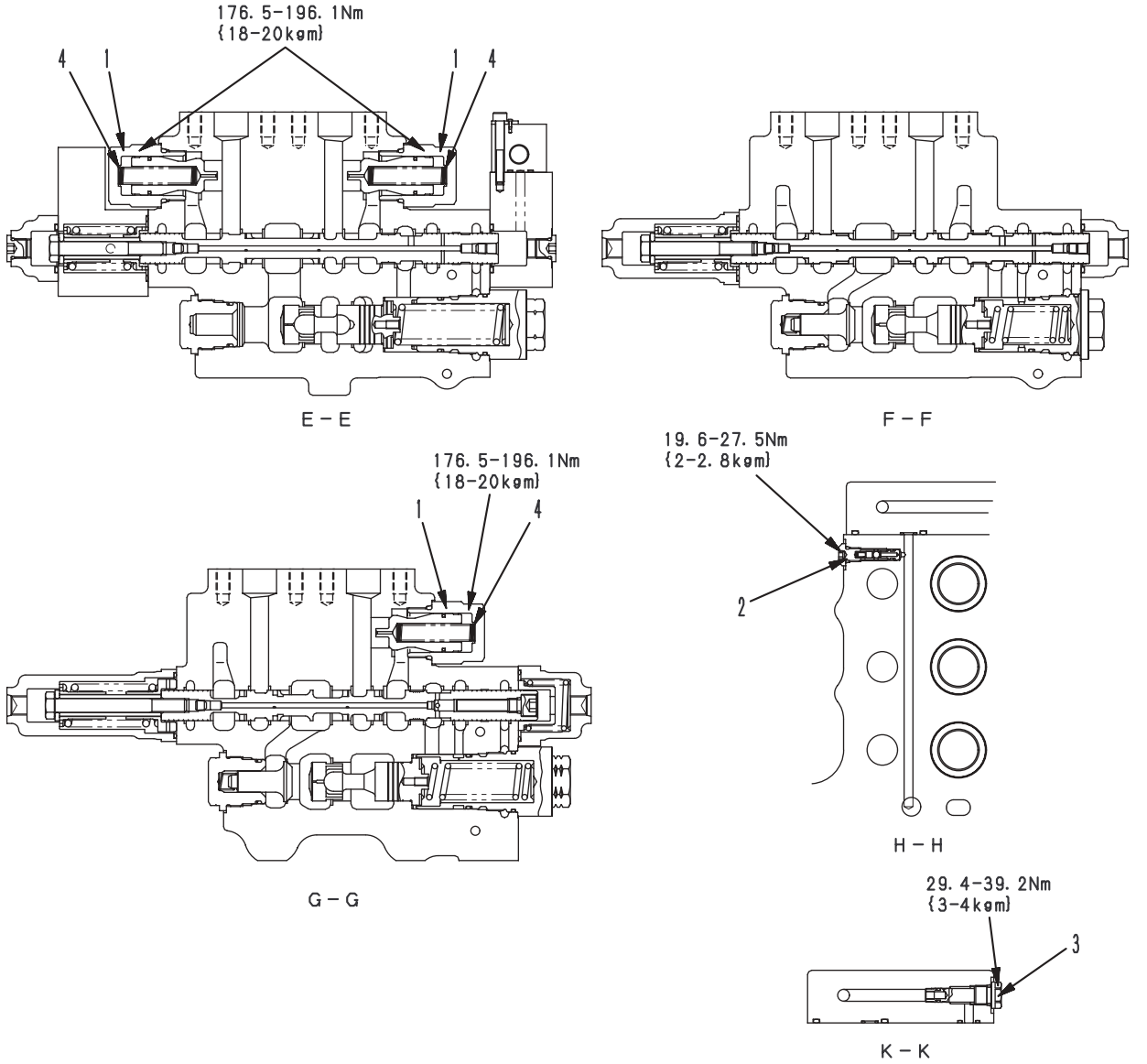

176.5-196.1Nm
{18-20kgm}
C
B
A
PA3
27.4-34.3Nm
{2.8-3.5kgm}
PA2
A3
A2
A1
H
B3
B2
B1
G
F
E
D
PB3
PB2
Z
PA1
TS
P
LS
PB1
PI
K
19.6-27.5Nm
{2-2.8kgm}
PLSC
T
PC
9JY01586



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
		Basic dimension			Allowable limit		
15	Spool return spring (for lift)	Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	If damaged or deformed, replace spring.
		73.4 x 31	68.5	224 N {22.8 kg}	–	178 N {18.2 kg}	
16	Spool return spring (tilt, steering)	51.7 x 31.3	50	140 N {14.3 kg}	–	112 N {11.4 kg}	
17	Spool return spring (for lift FLOAT)	65.3 x 36.5	33.5	335 N {34.2 kg}	–	269 N {27.4 kg}	
18	Road check valve spring	20.8 x 10.2	13.5	12.7 N {1.3 kg}	–	9.81 N {1.0 kg}	
19	Pressure compensation valve spring (steering valve)	109.4 x 29.5	81	563 N {57.4 kg}	–	450 N {45.7 kg}	
20	Pressure compensation valve spring (tilt valve)	70 x 26.5	62.5	197 N {20.1 kg}	–	158 N {16.1 kg}	
21	Pressure compensation valve spring (lift valve)	97.7 x 29.5	81	453 N {46.2 kg}	–	363 N {37.0 kg}	
22	Unload valve spring	86.7 x 30	66	192 N {19.6 kg}	–	154 N {15.7 kg}	



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

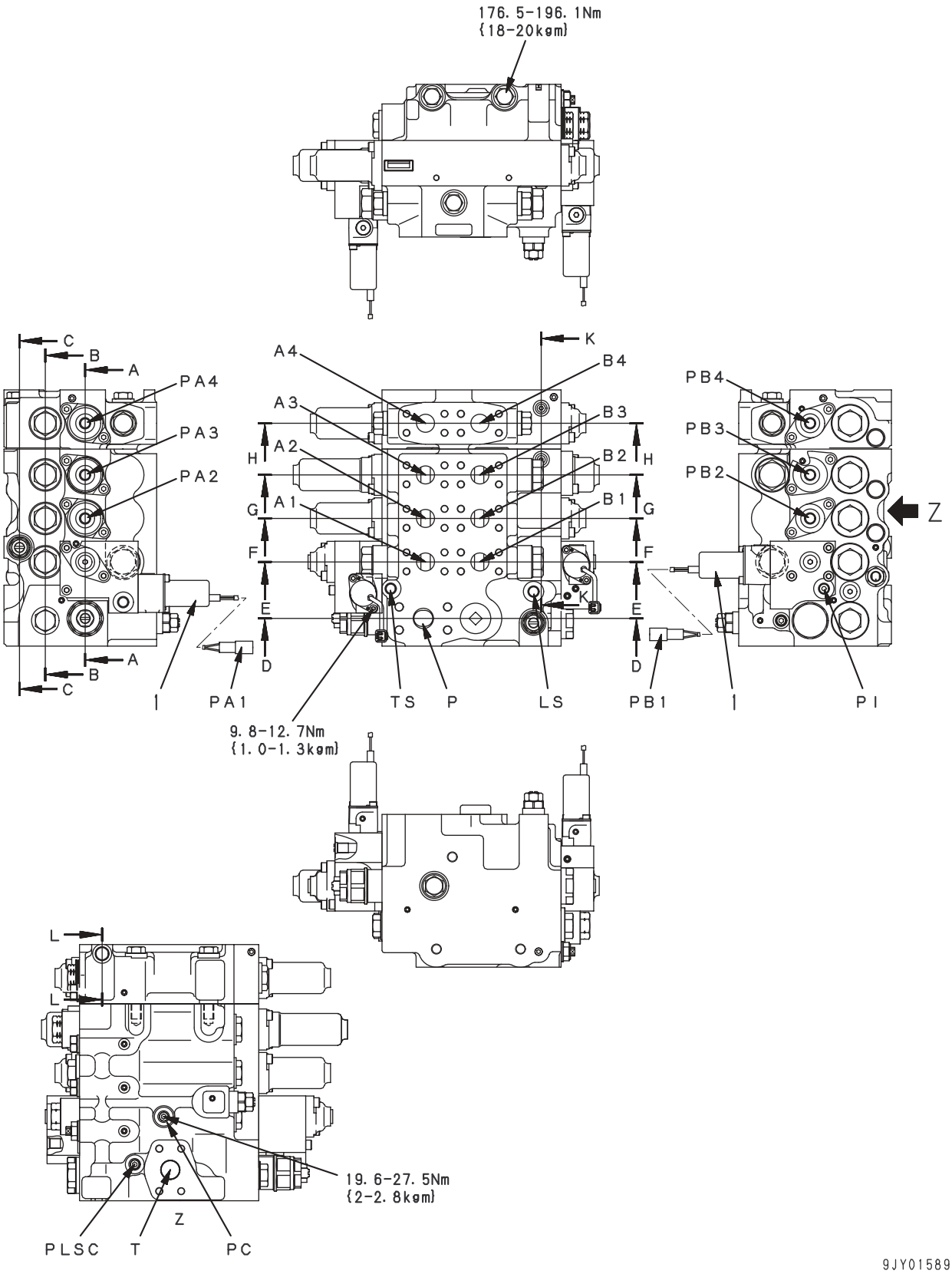
Unit: mm

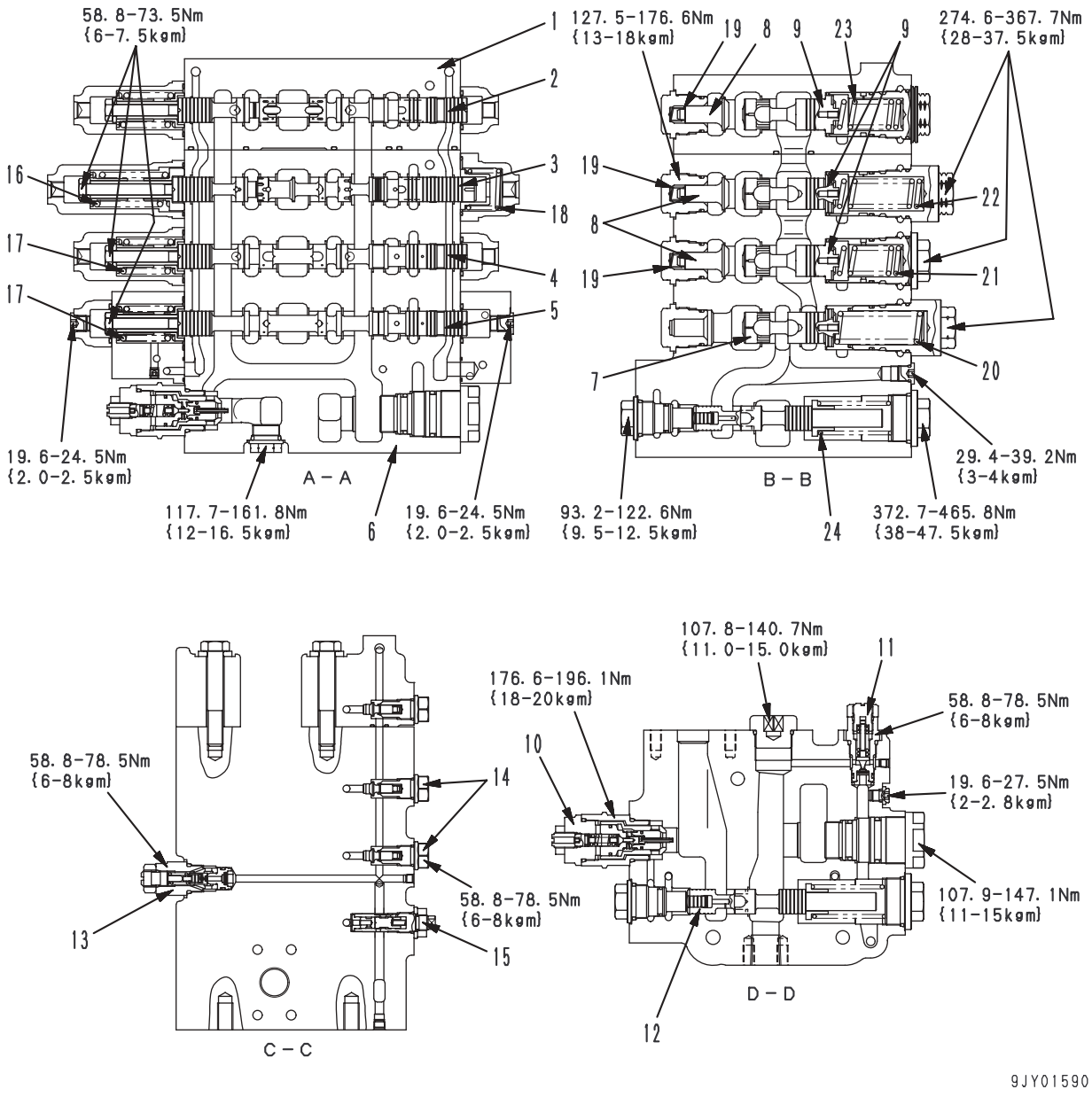
No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
4	Suction valve spring	Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	If damaged or deformed, replace spring.
		64.9 x 12.5	56	6.4 N {0.65 kg}	–	5.1 N {0.52 kg}	

2. 4-spool valve

P: From pump
T: To hydraulic 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 hydraulic tank
PA1: 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

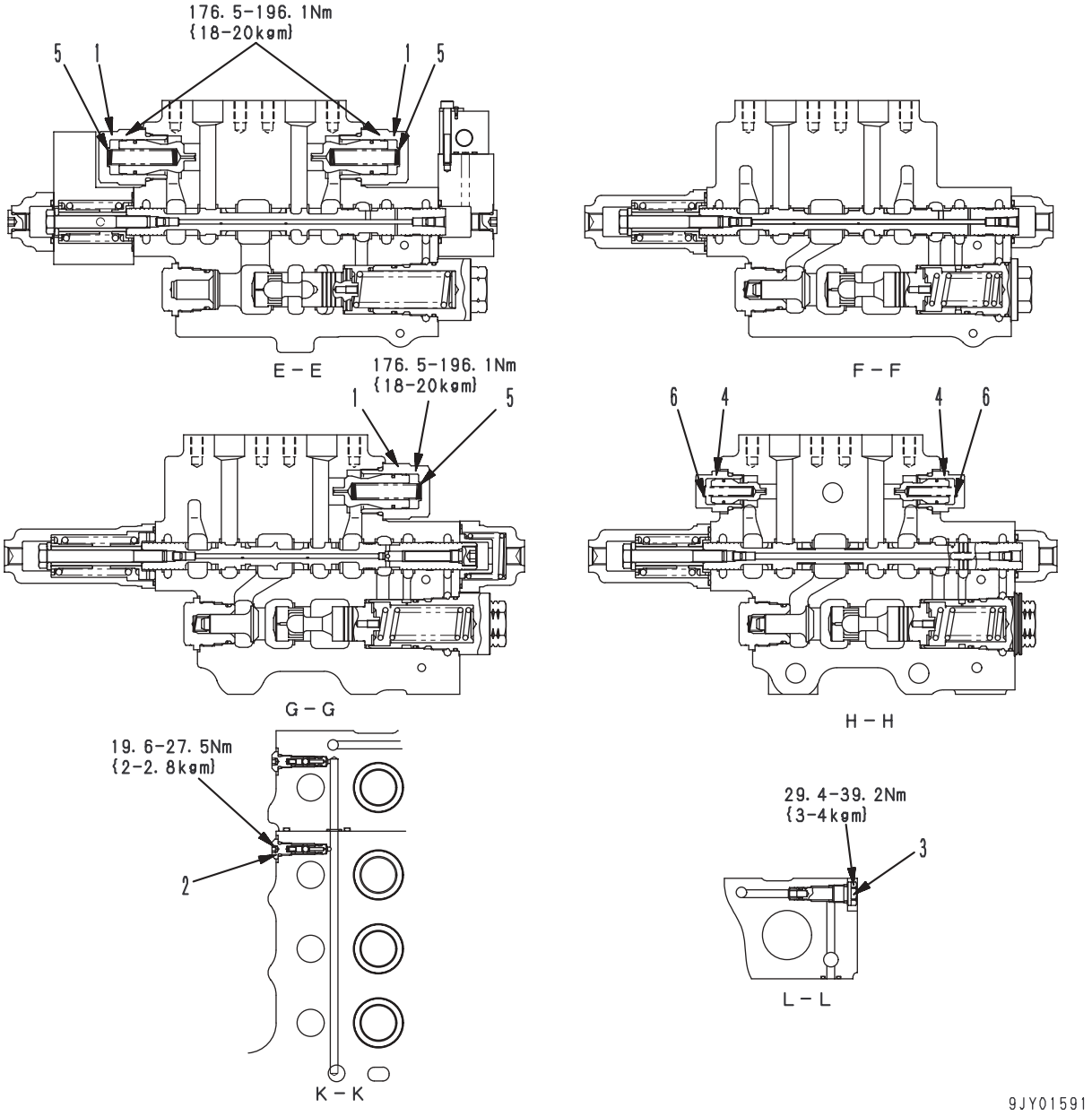

176.5-196.1Nm
{18-20kgm}
C
B
A
PA4
PA3
PA2
A4
A3
A2
A1
H
G
F
E
D
K
B4
B3
B2
B1
PB4
PB3
PB2
Z
PA1
TS
P
LS
PB1
PI
9.8-12.7Nm
{1.0-1.3kgm}
L
19.6-27.5Nm
{2-2.8kgm}
PLSC
T
PC
9JY01589



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		
16	Spool return spring (For lift)	Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	
		73.4 x 31	68.5	224 N {22.8 kg}	–	178 N {18.2 kg}	
17	Spool return spring (For tilt and steering)	51.7 x 31.3	50	140 N {14.3 kg}	–	112 N {11.4 kg}	
18	Spool return spring (For lift "FLOAT")	65.3 x 36.5	33.5	335 N {34.2 kg}	–	269 N {27.4 kg}	
19	Load check valve spring	20.8 x 10.2	13.5	12.7 N {1.3 kg}	–	9.81 N {1.0 kg}	If damaged or deformed, replace spring.
20	Pressure compensation valve spring (Steering valve)	109.4 x 29.5	81	563 N {59.4 kg}	–	450 N {45.9 kg}	
21	Pressure compensation valve spring (Tilt valve)	70 x 26.5	62.5	197 N {20.1 kg}	–	158 N {16.1 kg}	
22	Pressure compensation valve spring (Lift valve)	97.7 x 29.5	81	453 N {46.2 kg}	–	363 N {37.0 kg}	
23	Pressure compensation valve spring (Ripper valve)	64.5 x 26.5	62.5	51.3 N {5.28 kg}	–	41 N {4.18 kg}	
24	Unload spring	86.7 x 30	66	192 N {19.6 kg}	–	154 N {15.7 kg}	



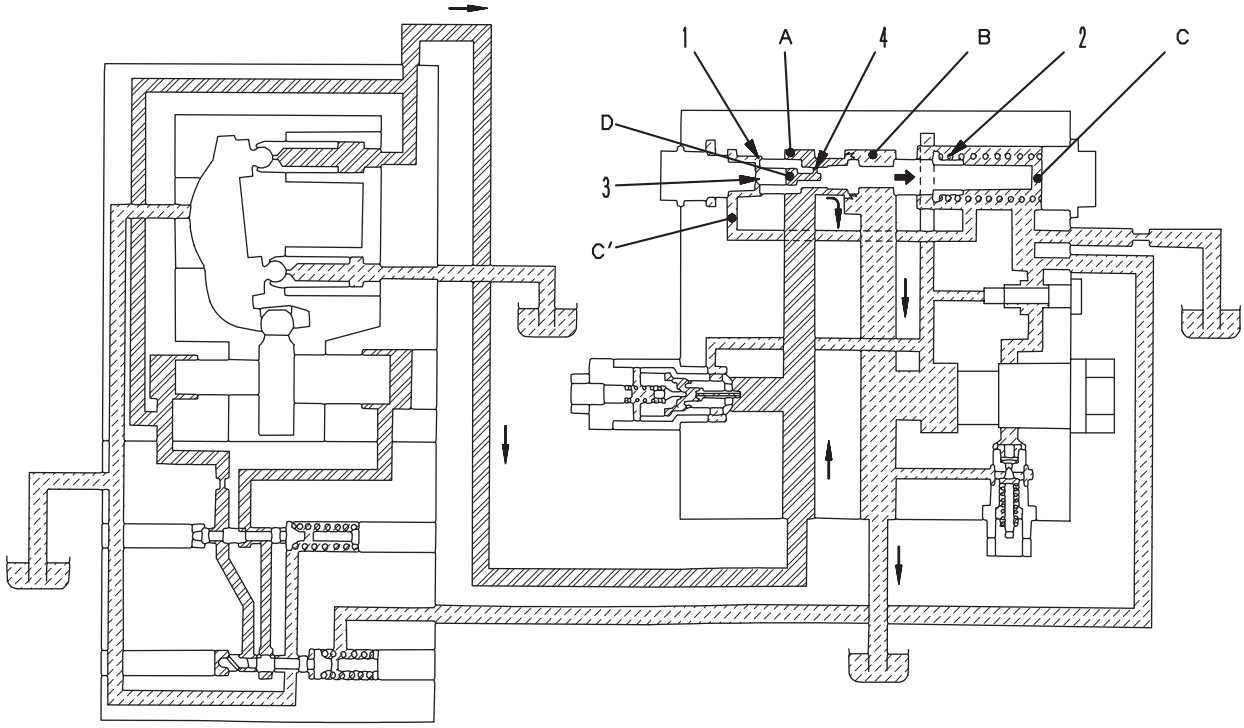
1. Suction valve
2. Preset check valve
3. LS bypass valve
4. Suction valve

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
5	Suction valve spring	Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	If damaged or deformed, replace spring.
		64.9 x 12.5	56	6.4 N {0.65 kg}	–	5.1 N {0.52 kg}	
6	Suction valve spring	46.8 x 7.5	40.6	5.49 N {0.56 kg}	–	4.41 N {0.45 kg}	

OPERATION OF MAIN CONTROL VALVE

1. AT HOLD (OPERATION OF UNLOAD VALVE)



9JY01592

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 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 **FO** becomes larger than set load **FS** 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).

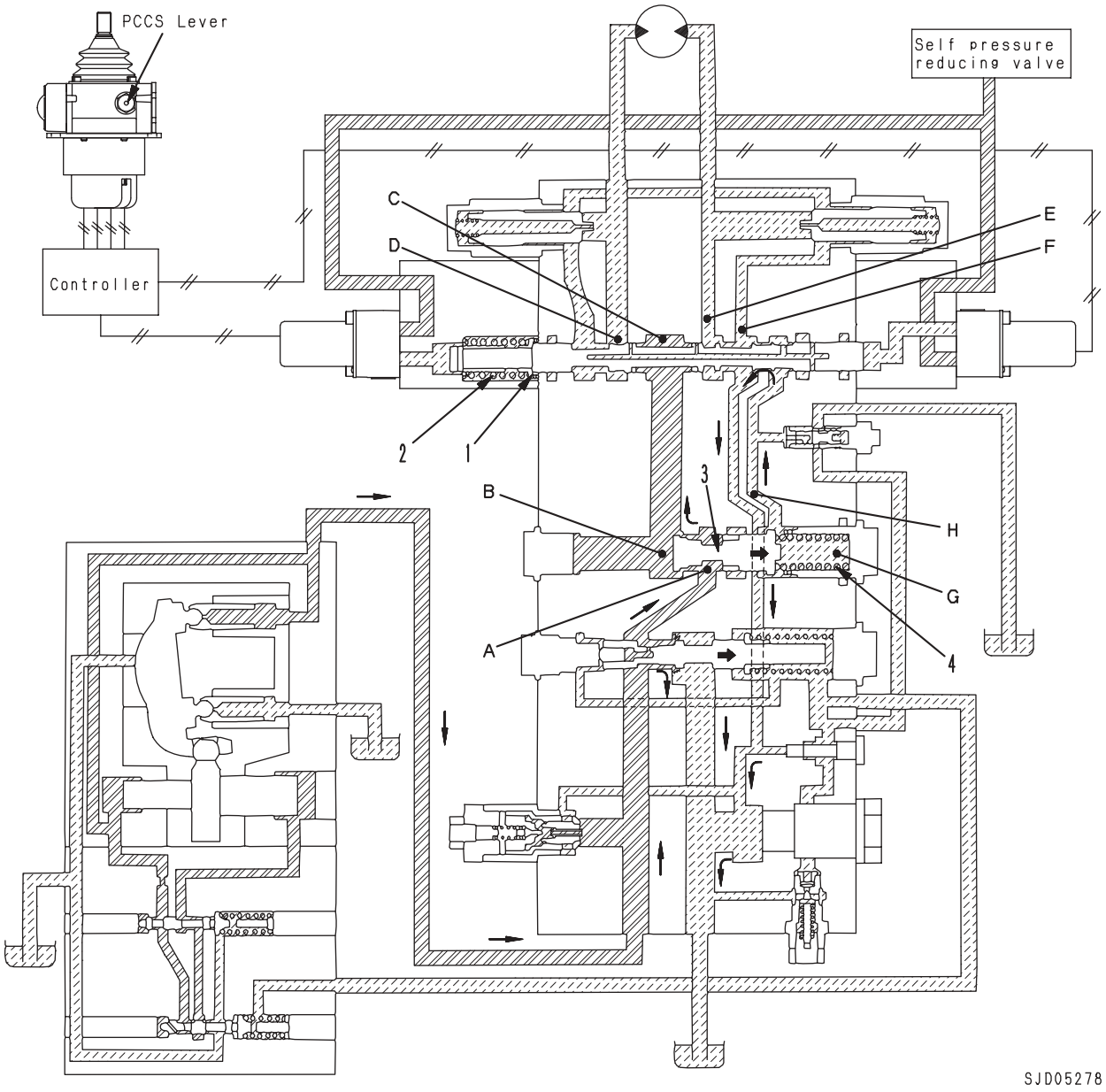
2. CONTROL OF OIL FLOW

(1) Steering valve

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.

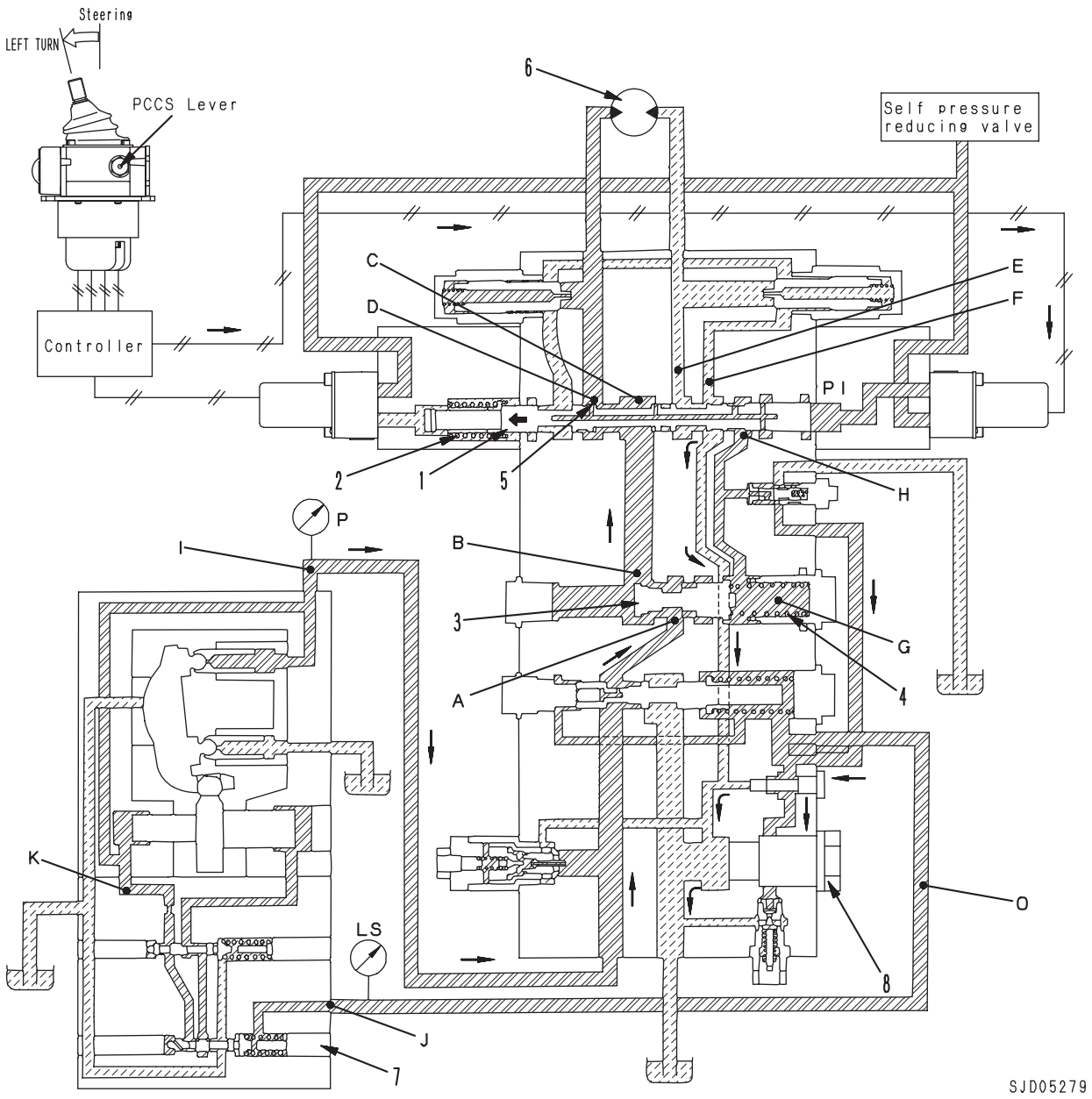
1) At HOLD



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 left

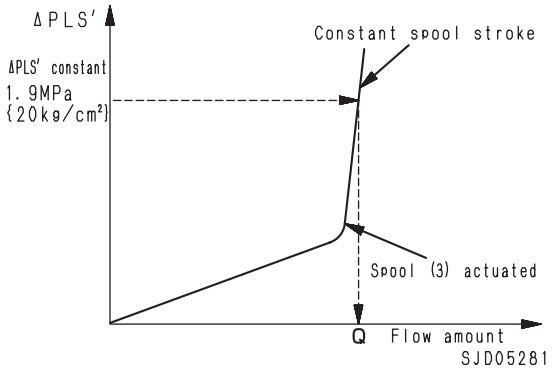


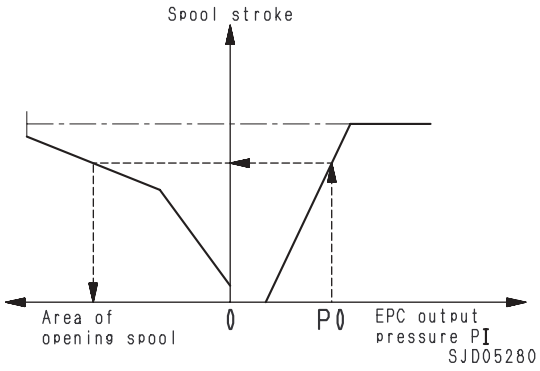
- $\triangle$**PLS** = Differential pressure between ports **K** and **J** = 2.0 MPa (20 kg/cm^2)
- $\triangle$**PLS'** = Differential pressure between ports **I** and **D**
- $\triangle$**PLS** $\fallingdotseq$ $\triangle$**PLS'**

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 PPC valve.
- When the pressure becomes greater than the set load of spring (2), the spool to move to the left. It becomes balanced at a position that matches PPC output pressure **PI**.

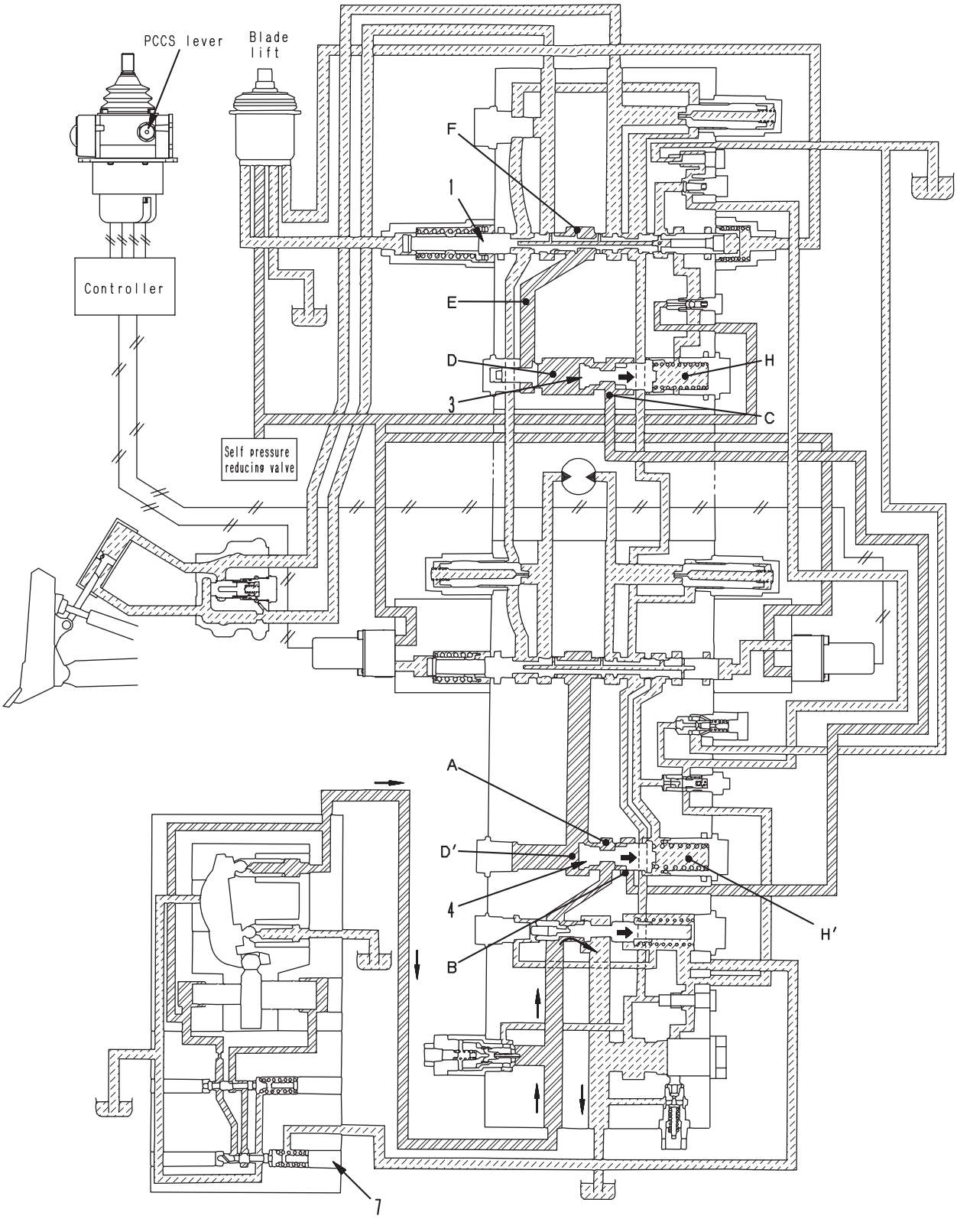
- Chamber **C** and chamber **D** are connected, and the oil from the pump flows through ports **A**, **B**, **C** and **D** to HSS motor (6).
- At the same time, the load pressure in chamber **D** passes through **LS** ofifice (5) and chamber **H**, and is sent to chamber **G**. It is also sent from the **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: ∆**PLS**) remains constant, so a suitable amount of oil flows to ensure that the loss of pressure at the control valve (∆ **PLS'**) is equal to ∆ **PLS**.
- 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 the HSS motor (6) passes through chamber **E** and chamber **F**, and is drained.





(2) Work equipment valve
(tilt valve, lift valve, ripper valve)

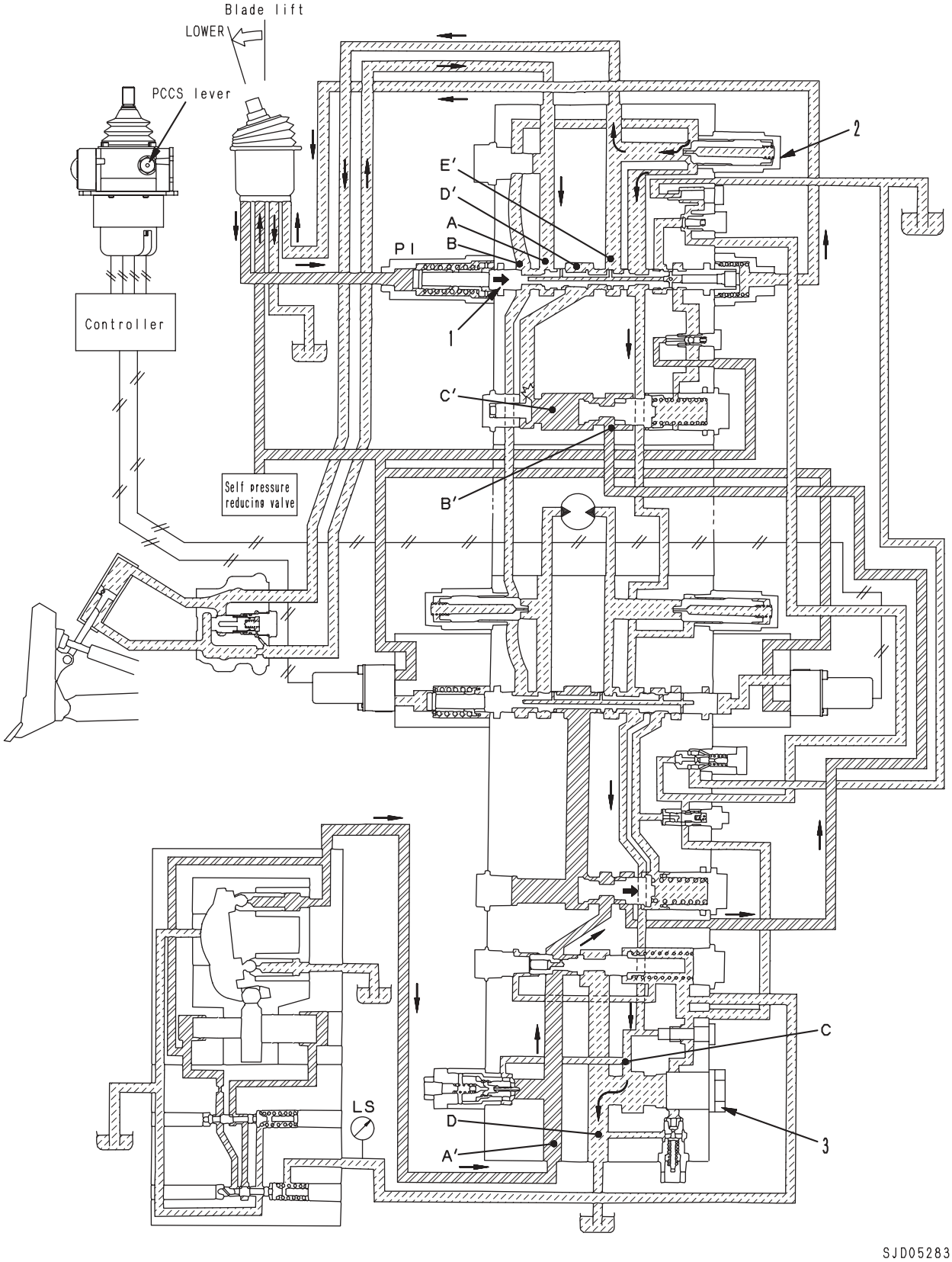
★ The diagram shows the blade lift valve.



Operation

- When spool (1) of the hydraulic 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 compensation 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 main control valve. From here it goes through chamber **D** and chamber **E** to chamber **F**.
- In the same way as for Item **(1) Steering valve**, the position of pressure compensation valve spool (3) is determined to match the opening of spool (1) of the work equipment valve, and the oil flow is determined so that the pressure loss of the control valve becomes equal to the differential pressure Δ **LS** of **LS** valve (7).

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



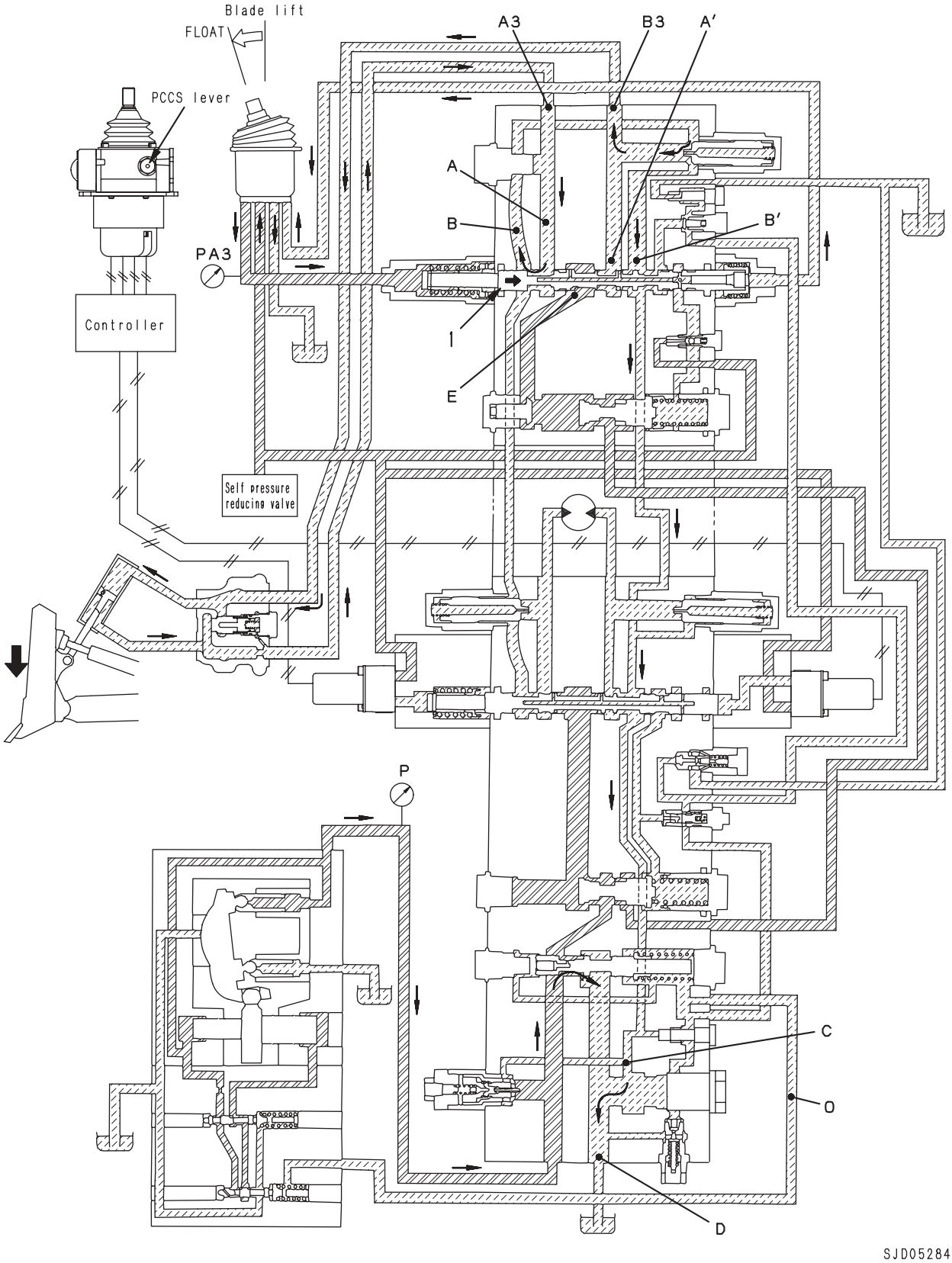
Function

- 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 at the cylinder head 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.

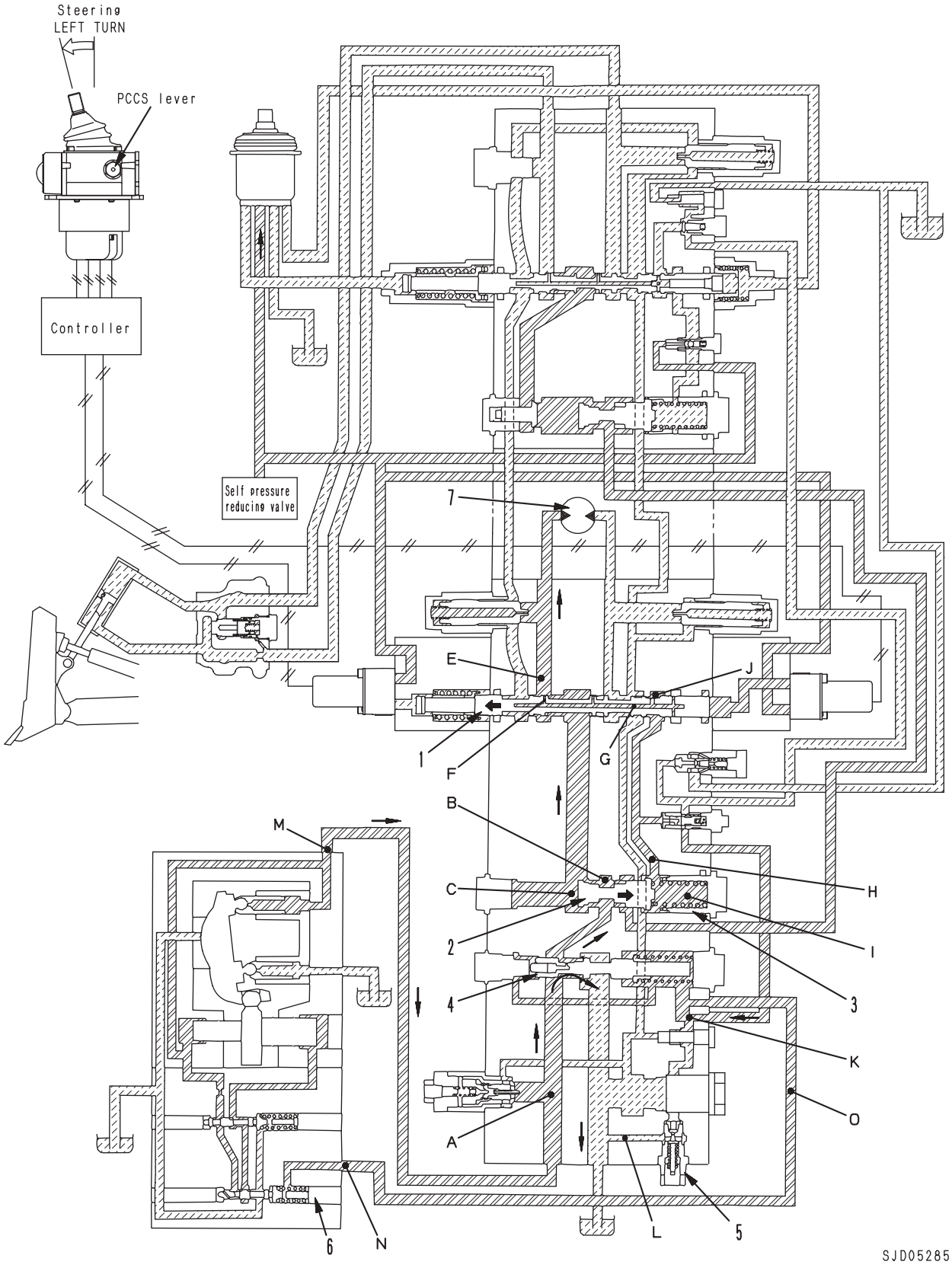
Operation

- When the work equipmentc 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** and **B3** and the **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 oil flows through ports **C** and **D**, and is drained.
- When this happens, the oil flows 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.

3. AT RELIEF

(1) Steering valve

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



- Δ **P1** = Δ **P3** + Δ **P4** = Differential pressure between ports **M** and **E**
- Δ **P2** = Differential pressure between ports **E** and **N**
- Δ **P3** = Differential pressure between ports **M** and **B**
- Δ **P4** = Differential pressure between ports **B** and **E**
- Δ **LS** = Δ **P1** + Δ **P2** = Differential pressure between ports **M** and **N** = 2.0 MPa (20 kg/cm^2)

Function

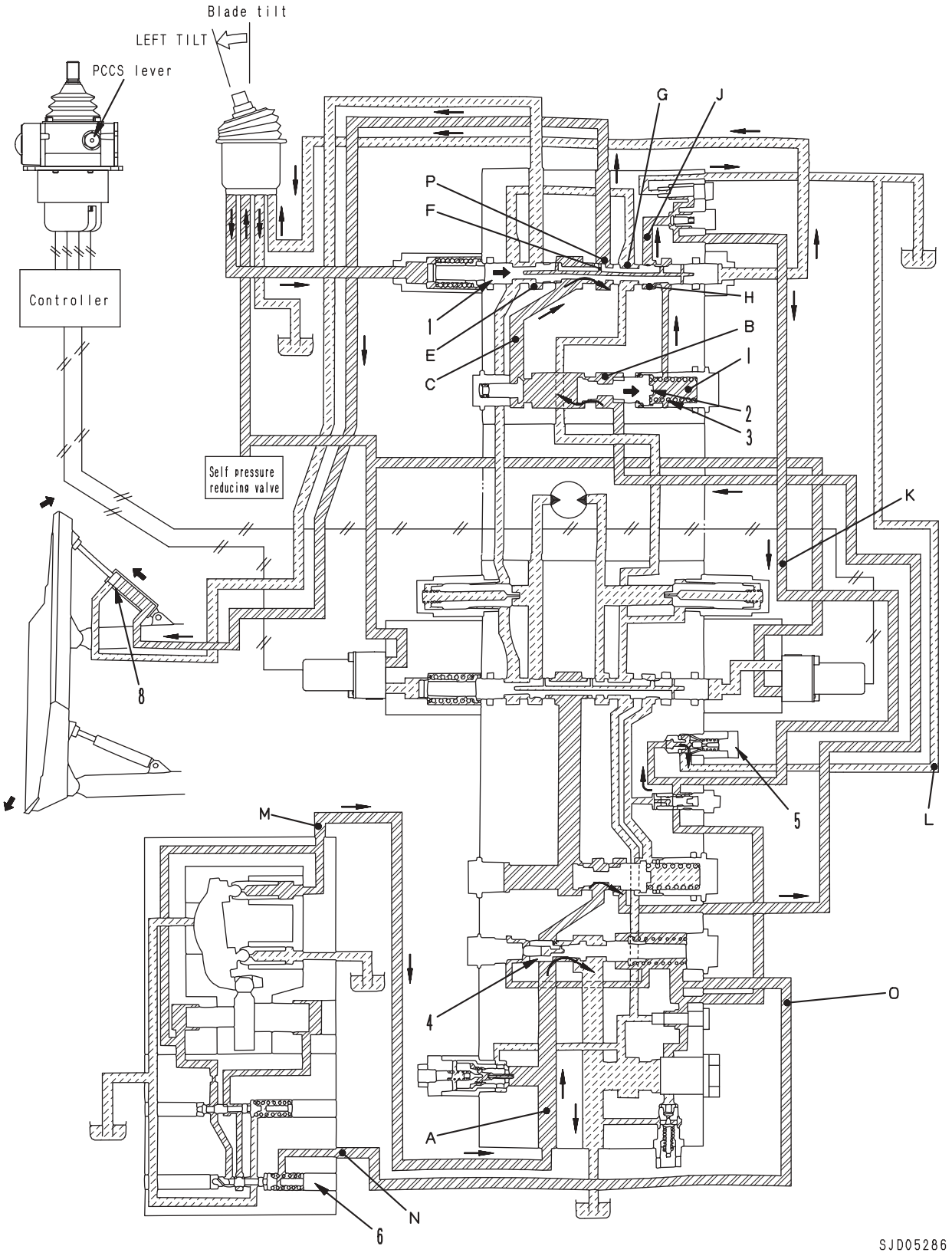
- If specifies the maximum pressure when the HSS is operated.

Operation

- If 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 Δ **P2** 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 Δ **P4** 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). Δ **P1** + Δ **P2** equal to **LS** differential pressure (Δ **LS**).
- When this happens, pump **LS** valve (6) detects the differential pressure generated by **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 releive 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.



- ∆ **P1** = ∆ **P3** + ∆ **P4** = Differential pressure between ports **M** and **P**
- ∆ **P2** = Differential pressure between ports **P** and **N**
- ∆ **P3** = Differential pressure between ports **M** and **B**
- ∆ **P4** = Differential pressure between ports **B** and **P**
- ∆ **LS** = ∆ **P1** + ∆ **P2** = Differential pressure between ports **M** and **N** = 2.0 MPa (20 kg/cm^2)

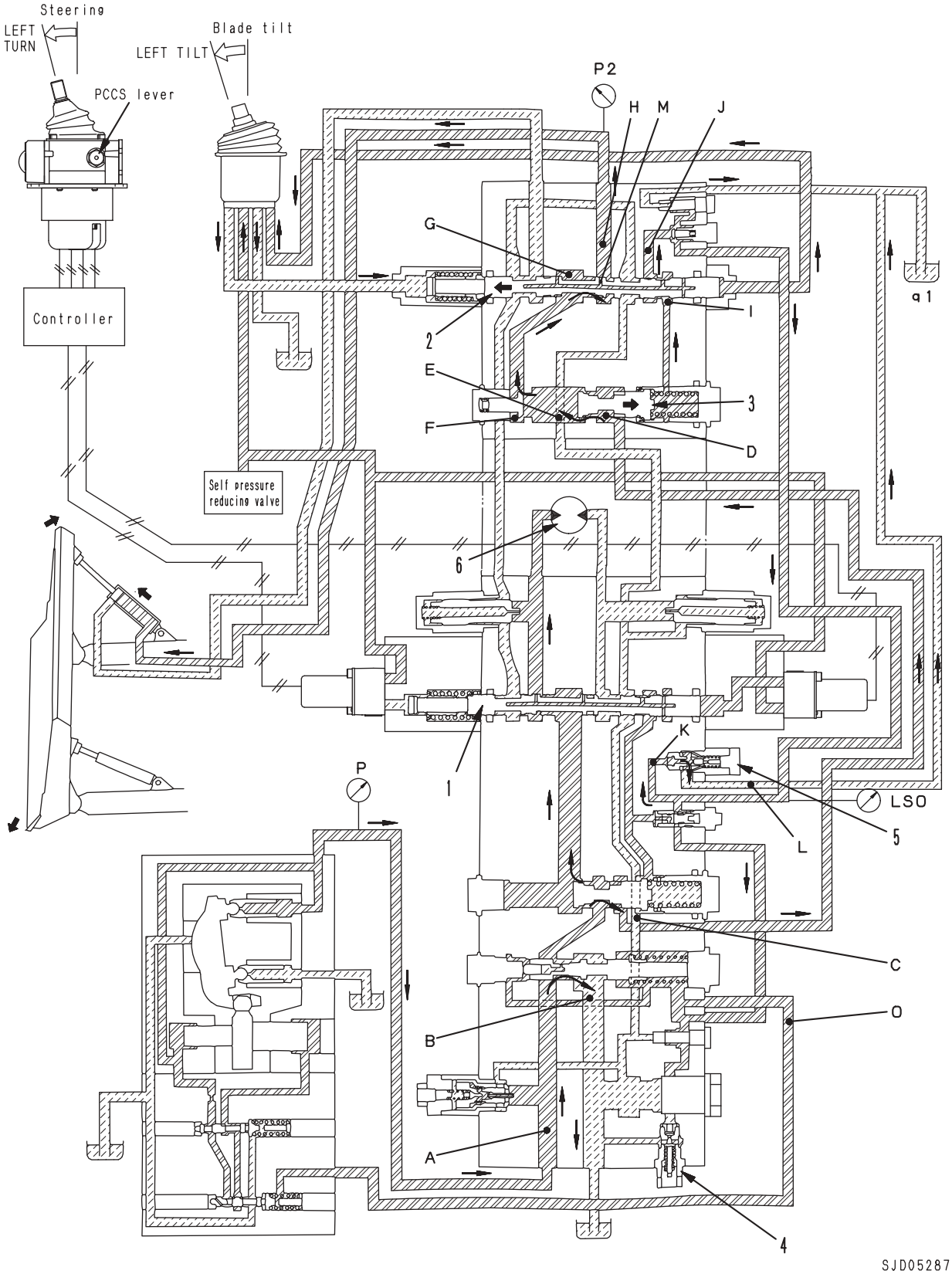
Operation

- If blade tilt valve (1) is moved, and the pressure of tilt cylinder (8) becomes higher, 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 ∆**P2** 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 between chambers **B** and **C** will be throttled and ∆**P4** 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 hydraulic **LS** relief valve (5) ∆**P1** + ∆**P2** equal to **LS** differential pressure (∆**LS**).
- When this happens, pump **LS** valve (6) detects the differential pressure generated by **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 releive the excess oil flow and balance the circuit.

(3) Steering + work equipment valve (compound operations)

★ 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**
- Δ **PO** = Differential pressure between ports **H** and **K**
- Pressure **P2** = **LSO** + Δ**PO**



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.

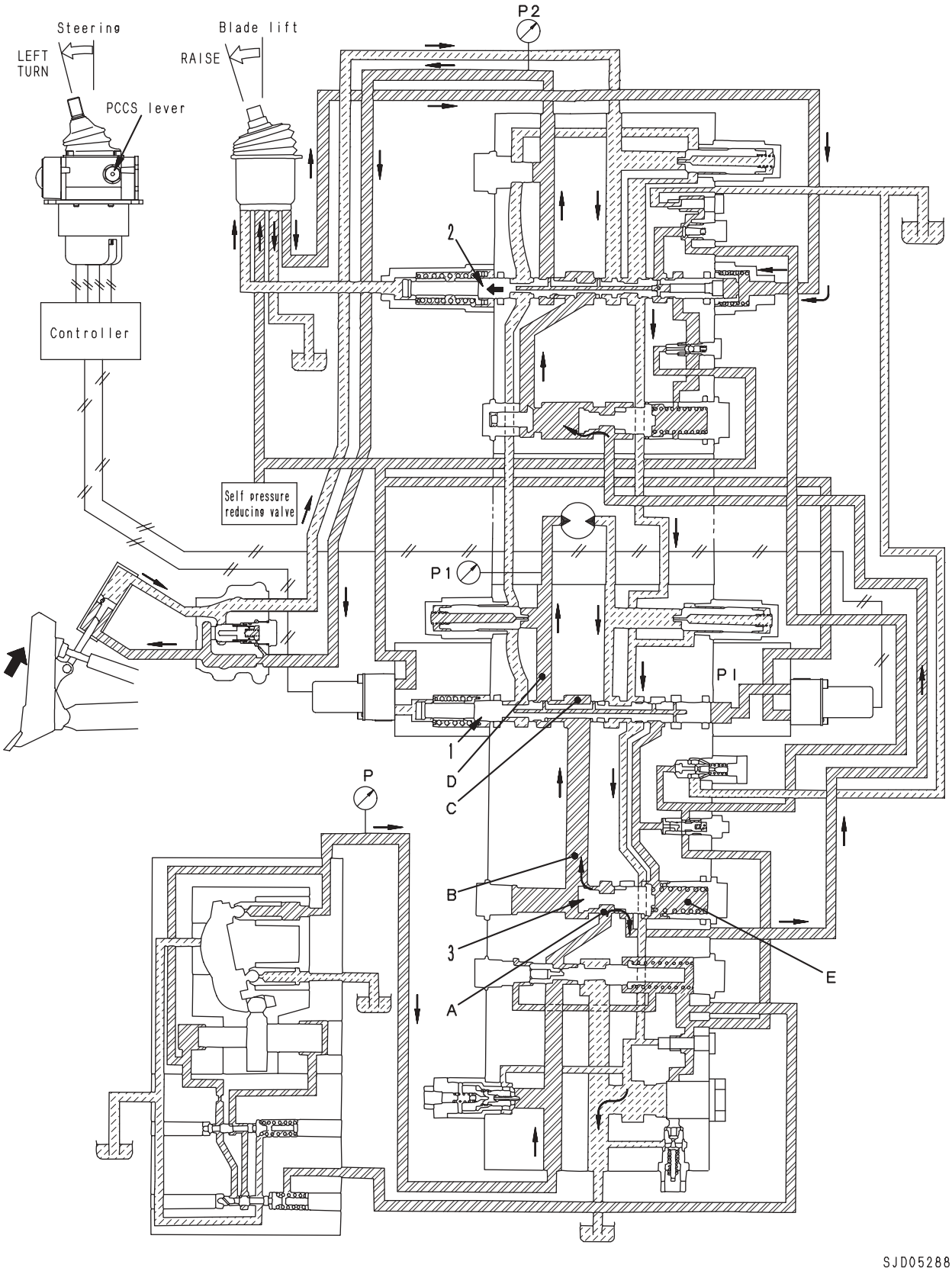
Operation

- 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 Item **(1) Steering valve**).
- When this happens, the pump pressure is maintained at 38.2 MPa (390 kg/cm2), and this is sent to chamber **G** of the work equipment valve.
- When work equipment valve (2) is ooperated 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 (4) 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** + Δ**PO**) of the circuit pressure loss of ports **H**, **I**, **J** and **K**, and the set pressure of work equipment **LS** relief valve (5).

4. COMPOUND OPERATIONS

(1) Steering valve + work equipment valve

★ The diagram shows the condition when the steering and blade lift valve are operated at the same time.



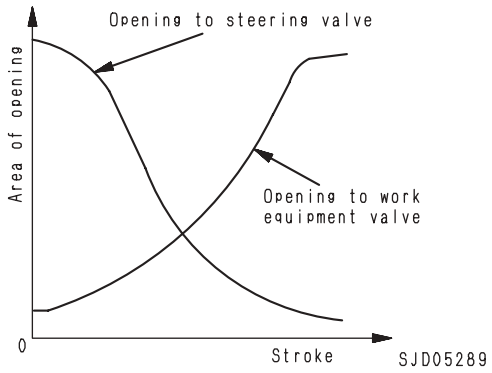
SJD05288

Function

- The steering valve is equipped with a 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 Δ**PLS** = 2.0 MPa (20 kg/cm^2), and the flow of oil to the steering valve is fixed.
- See Item **2 – (1) Steering valve**.
- In this condition, if downstream blade lift valve (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 hydraulic valve.
- At the same time, Δ**PLS** 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 drops.



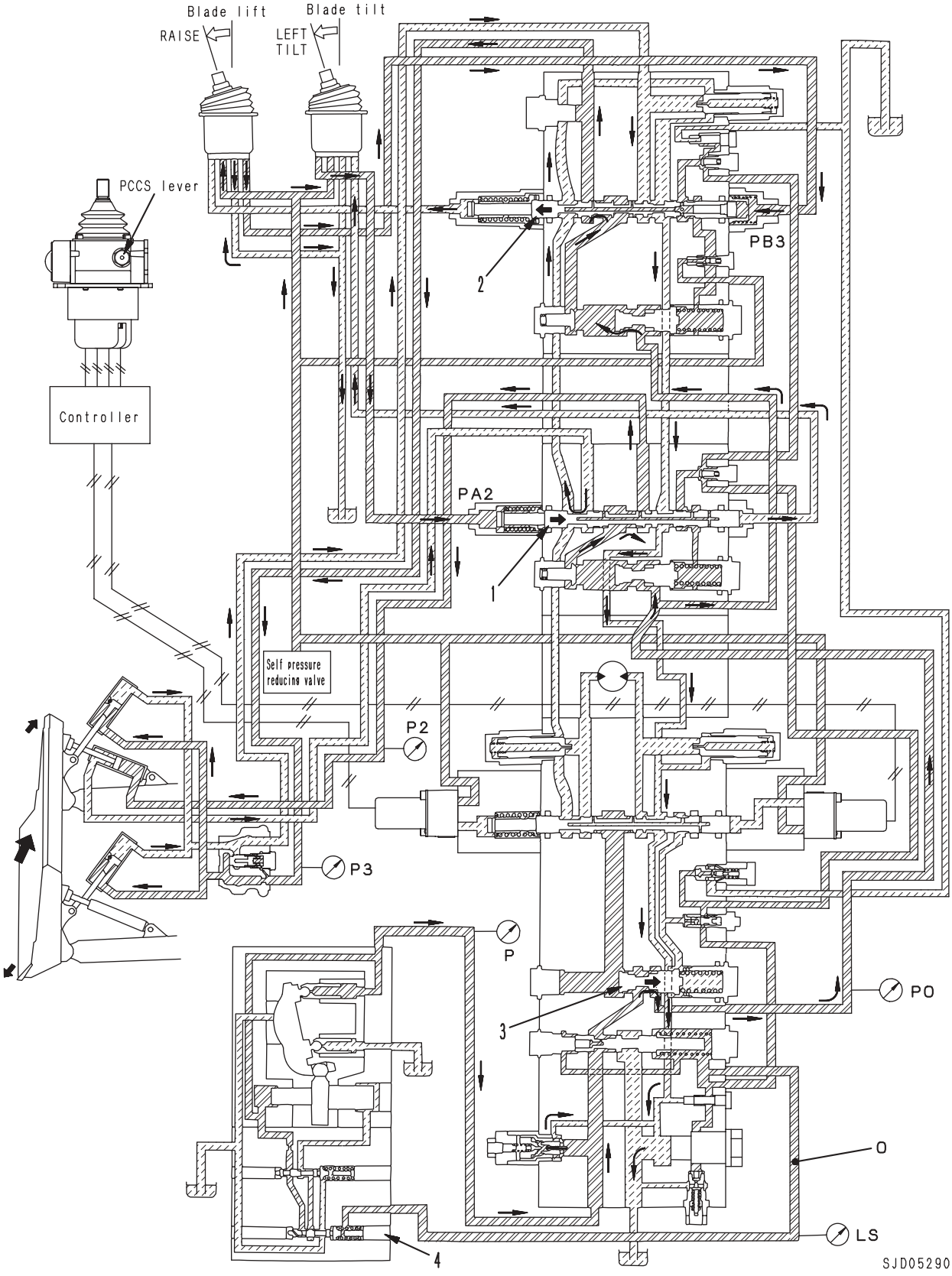
1. When pump swash plate does not reach maximum angle
   - When the maximum oil flow from the pump is greater than the sum of the flow demanded by the steering valve and work equipment valve, an amount of oil that matches the opening of steering spool (1) flows to the steering valve;
   - An amount of oil decided by the pump pressure and load pressure and area of opening of the spool flows to the work equipment valve.
2. 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 $\leqq$ 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.

1. When pressure **P2** $\leqq$ **P3**
   - Lift valve load pressure **P3** is sent to pump **LS** valve (4) through **LS** passage **O**.

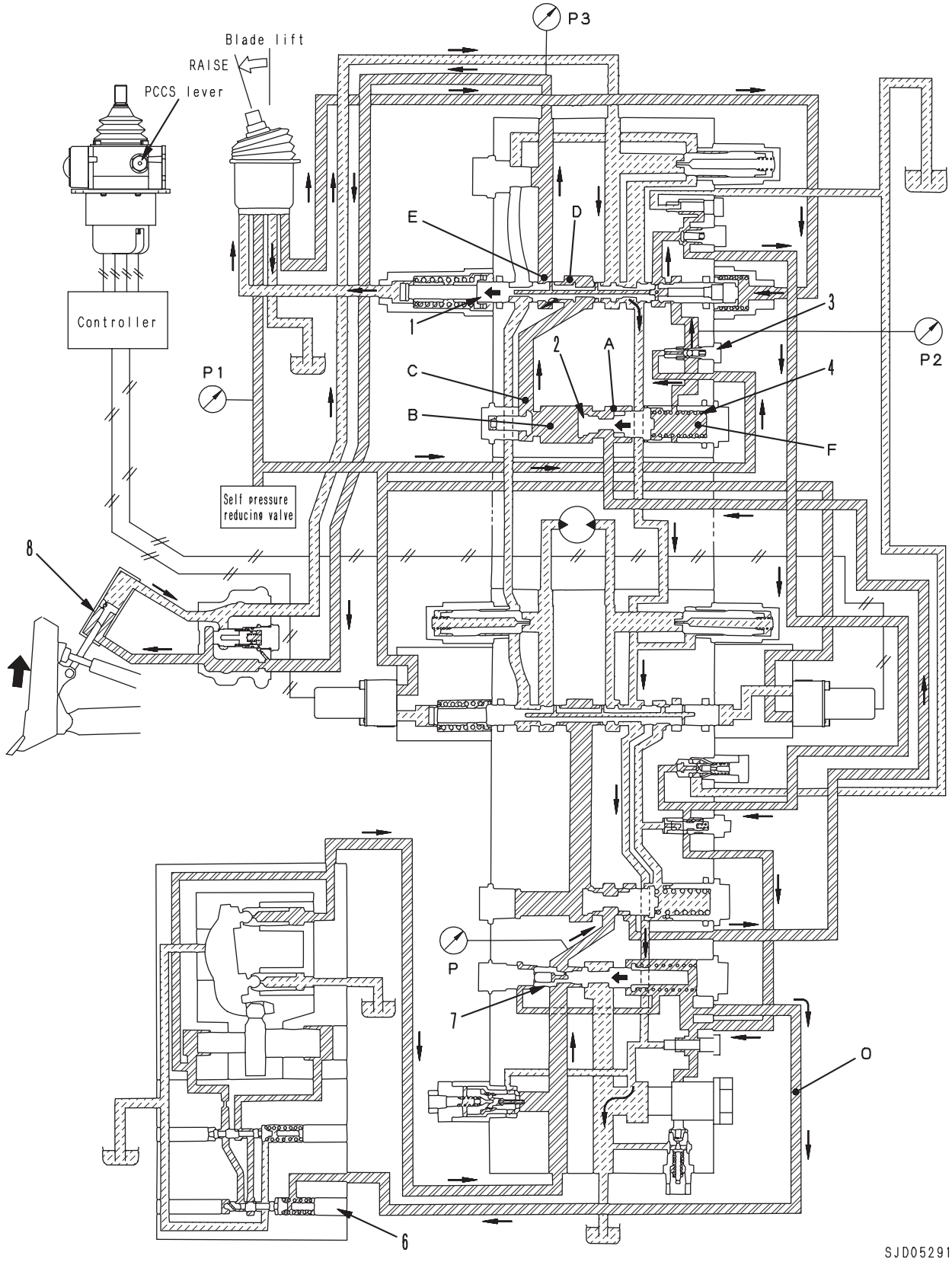
   (1) When pump swash plate does not reach maximum angle
   - When the maximum flow of oil from the pump is greater than the total of the oil flow demanded by the tilt valve and lift valve, an oil flow that matches the opening of the spool flows to both the tilt valve and lift valve.

   (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 pressurse **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 in the air 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.

2. When pressure **P2** = pressure **P3**
   - **P** – **P2** $\fallingdotseq$ **P** – **P3**, so an oil flow proportional to the size of the spool opening is distributed to each spool.

5. UNLOAD VALVE PRESET SYSTEM

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



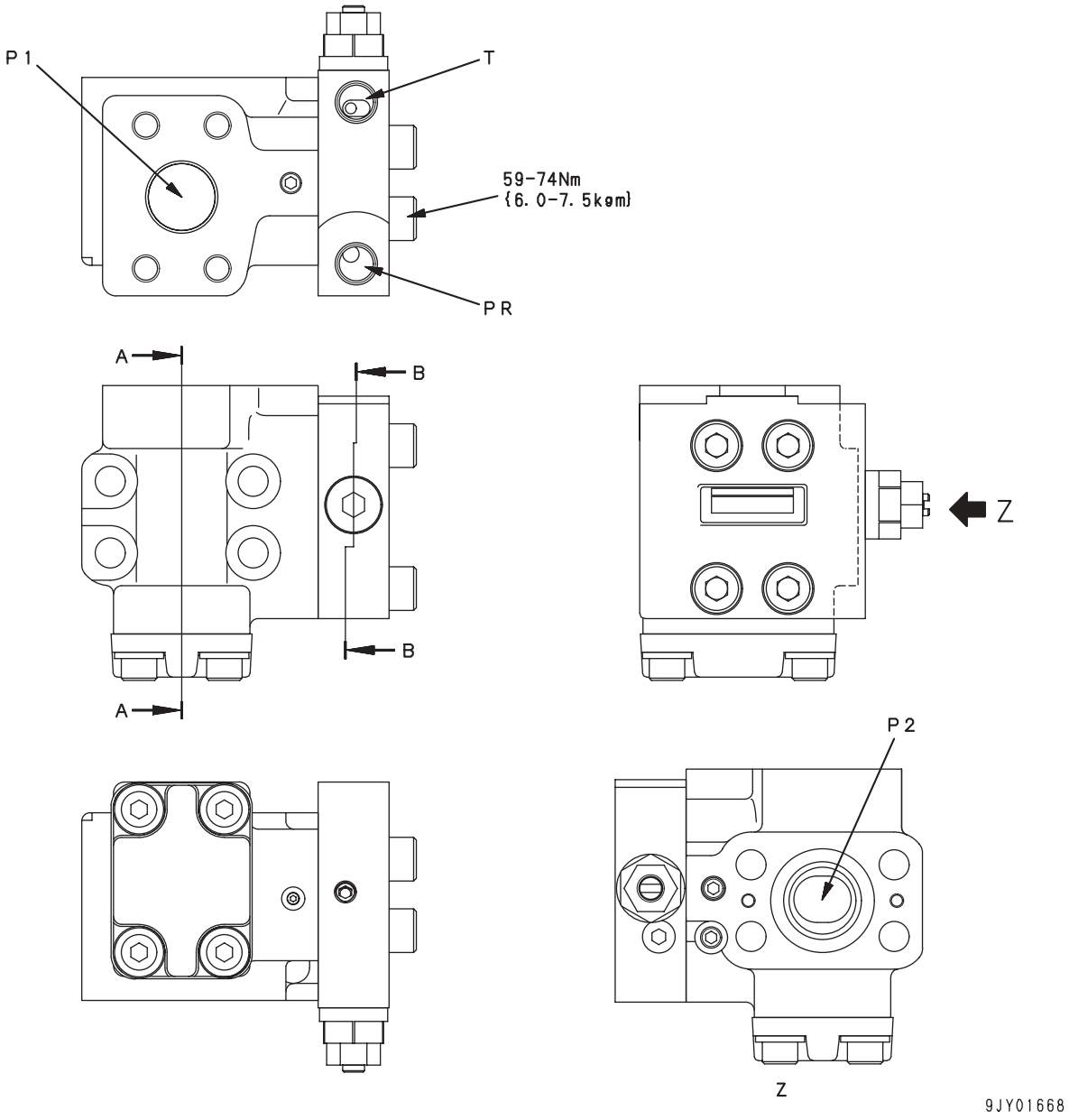
Function

- This improves the response of the systsem 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.

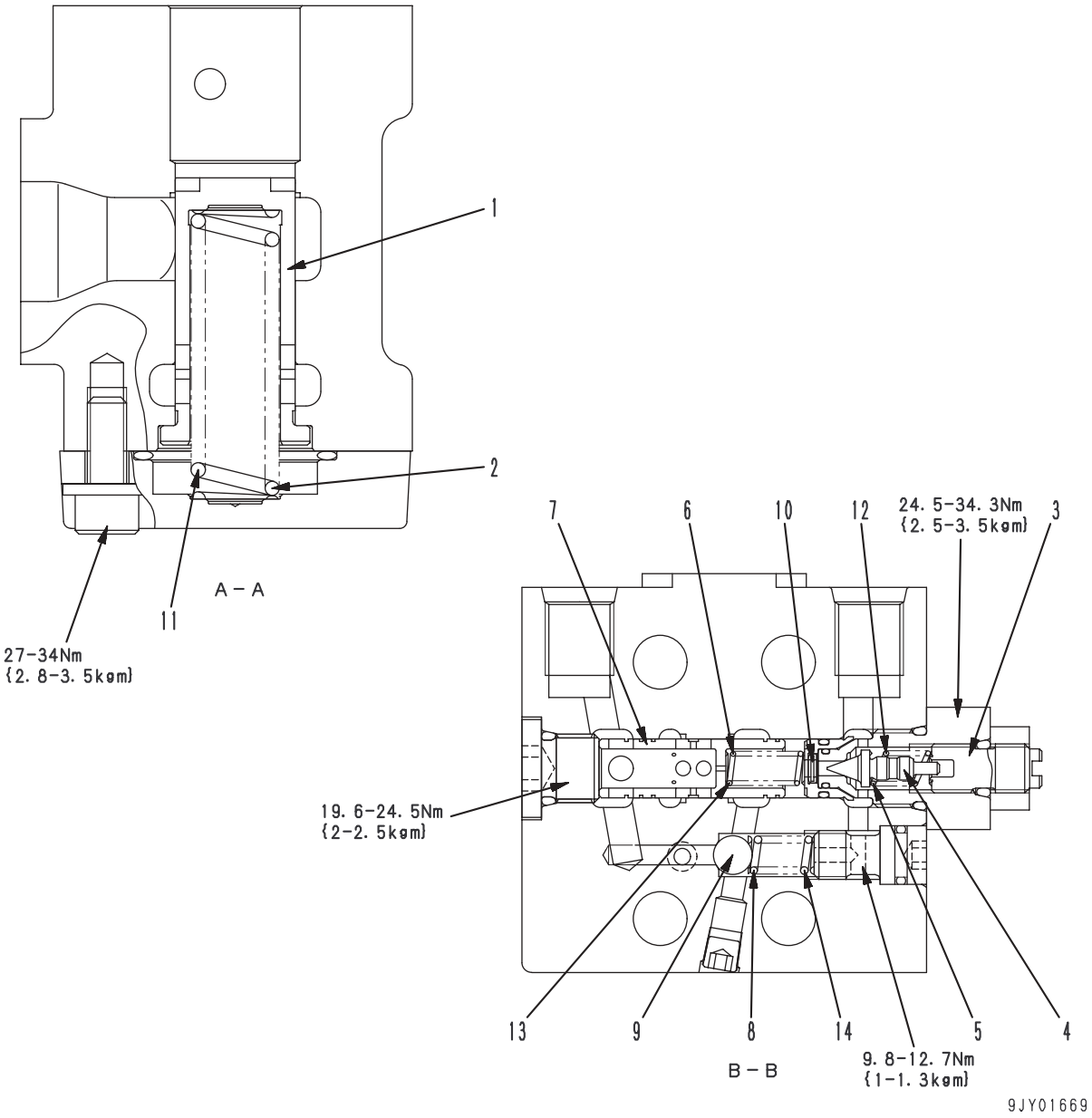
Operation

- When lift spool (1) is at the HOLD position, pilot pressure **P1** (basic pressure of PPC valve) is sent through preset check valve (3) to the 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** + **FO** > **P** (**FO**: load of spring (4)), so pressure compensation spool (2) moves to the left and the size of the opening between **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.

SELF PRESSURE REDUCING VALVE



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



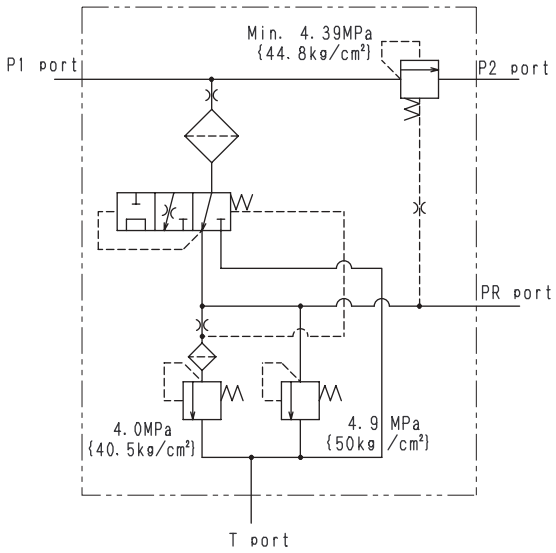
1. Valve (sequence valve)
2. Spring
3. Screw
4. Poppet
5. Spring (pressure reducing valve pilot)
6. Spring (pressure reducing valve main)
7. Valve (pressure reducing valve)
8. Spring (safety valve)
9. Ball
10. Filter

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
11	Spring (pressure reduction main)	Free length x O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found
		19.2 x 7.20	16.1	19.6 {2.0 kg}	–	17.7 N {1.80 kg}	
12	Spring (pressure reduction valve pilot)	17.8 x 7.20	12.7	28 N {2.90 kg}	–	25.6 N {2.60 kg}	
13	Spring	71.0 x 18.0	59.0	200 N {20.4 kg}	–	186 N {19.0 kg}	
14	Spring (safety valve)	16.1 x 7.80	13.4	61.7 N {6.30 kg}	–	58.8 N {6.0 kg}	

Function

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

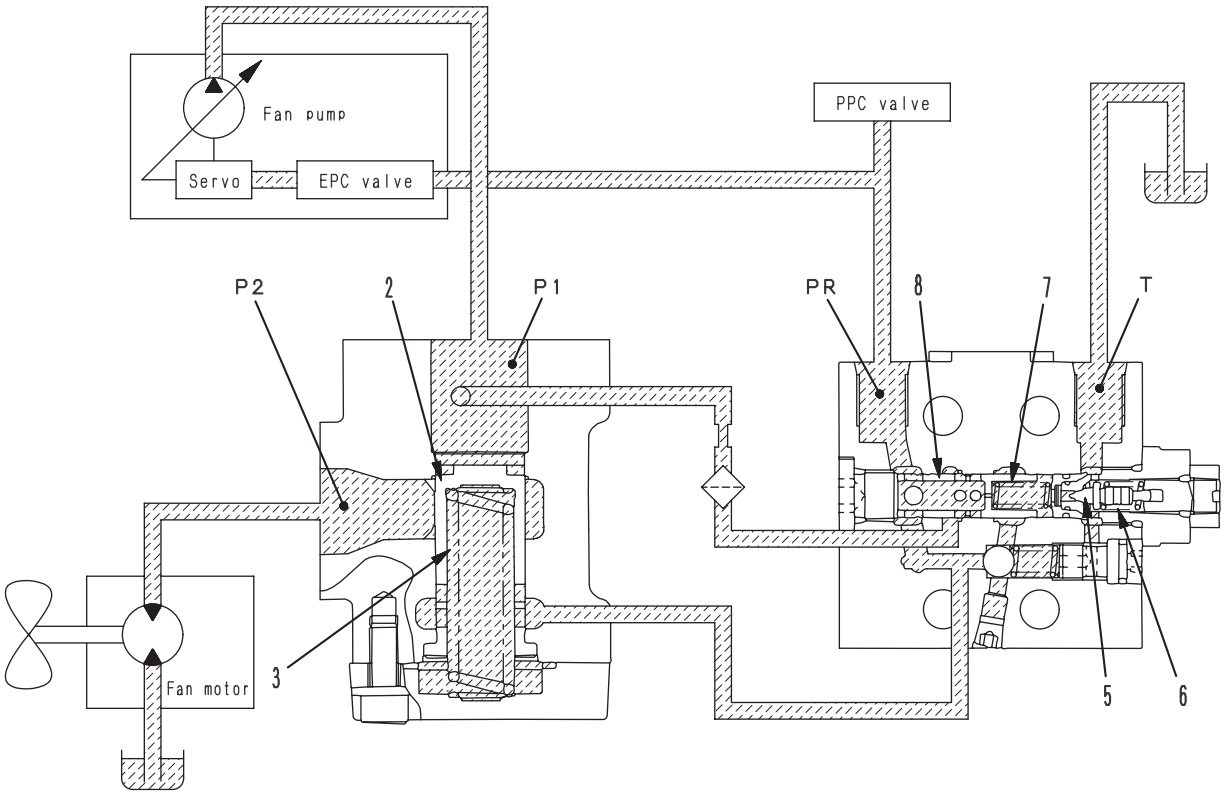


Hydraulic circuit

SJD05292

Operation

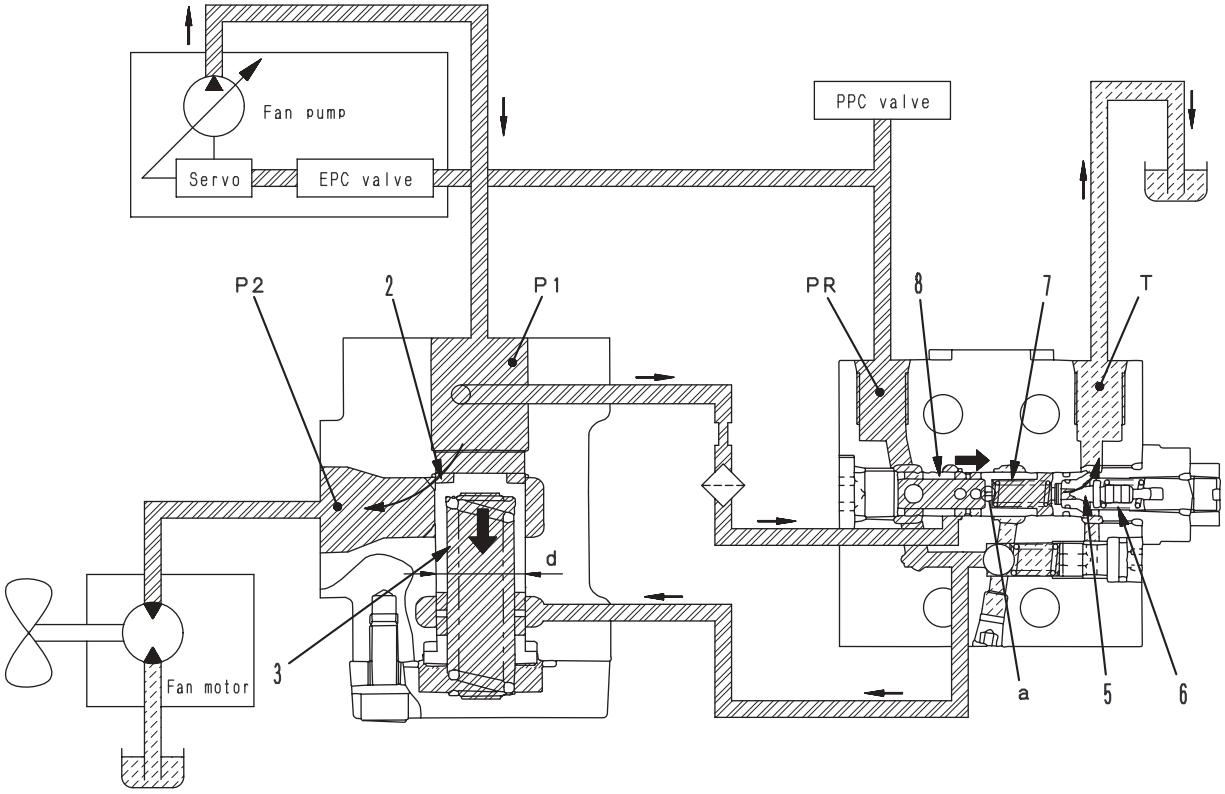
1. At engine stop (total low pressure)



SJD05293

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

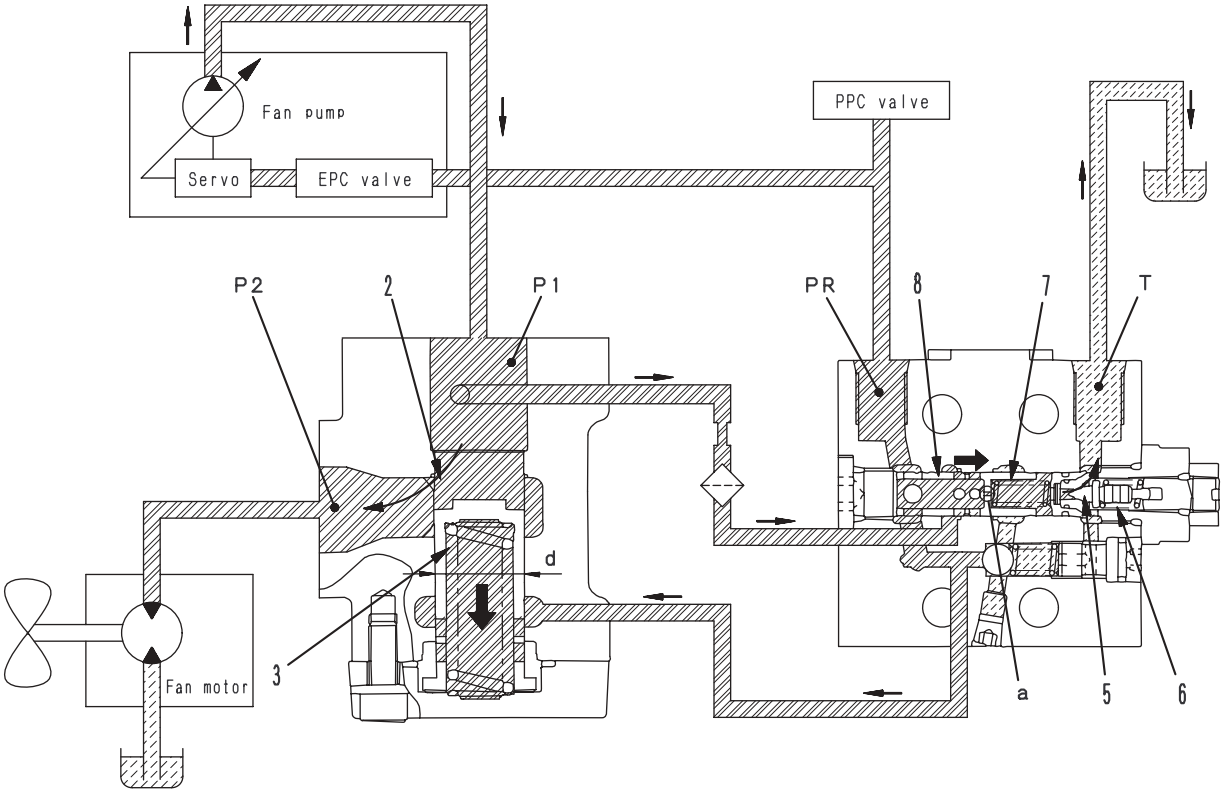
2. When the load pressure P2 is lower than the output pressure PR of the self pressure reducing valve.



SJD05294

- The spring (3) and the **PR** pressure (0 MPa {0 kg/cm2} at the time of engine stop) pushes the valve (2) in the direction to close the circuit between the ports **P1** and **P2**. When the hydraulic oil enters the **P1** port, the expression (**P1** pressure ≒ Spring (7) force + (ø**d** area x **PR** pressure)) holds, and the self pressure reducing valve will adjust the openings of the ports **P1** and **P2** so that the **P1** pressure can be maintained higher than the **PR** pressure.
- When the **PR** pressure rises above the set pressure, the poppet (5) will open and the hydraulic oil flows through the route from the **PR** port, the hole a in the spool (8), the poppet (5) opening to the tank port **T**.
- Therefore, there will occur a differential pressure around the hold **a** in the spool (8) and the spool will move in the direction to close the port **P1** and the **PR** opening. Then, the **P1** pressure is reduced and adjusted to a certain pressure (set pressure) with the opening and is supplied as the **PR** pressure.

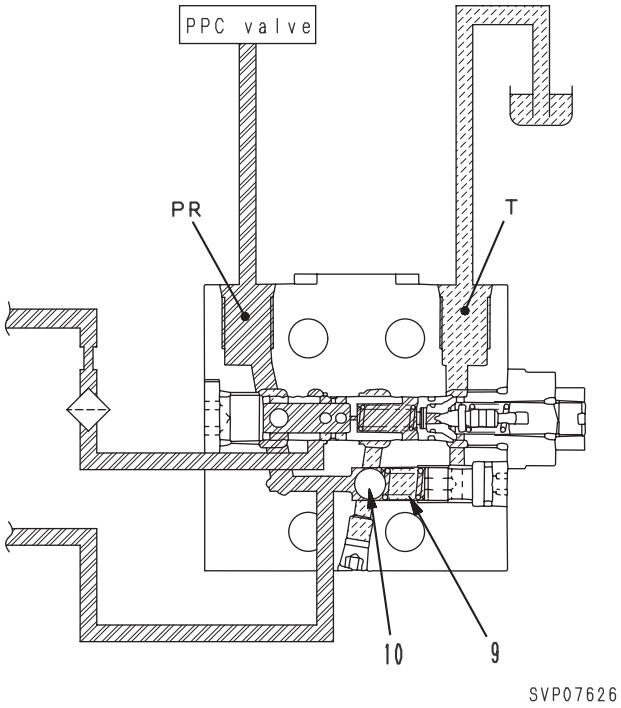
3. At raise of load pressure P2



SJD05295

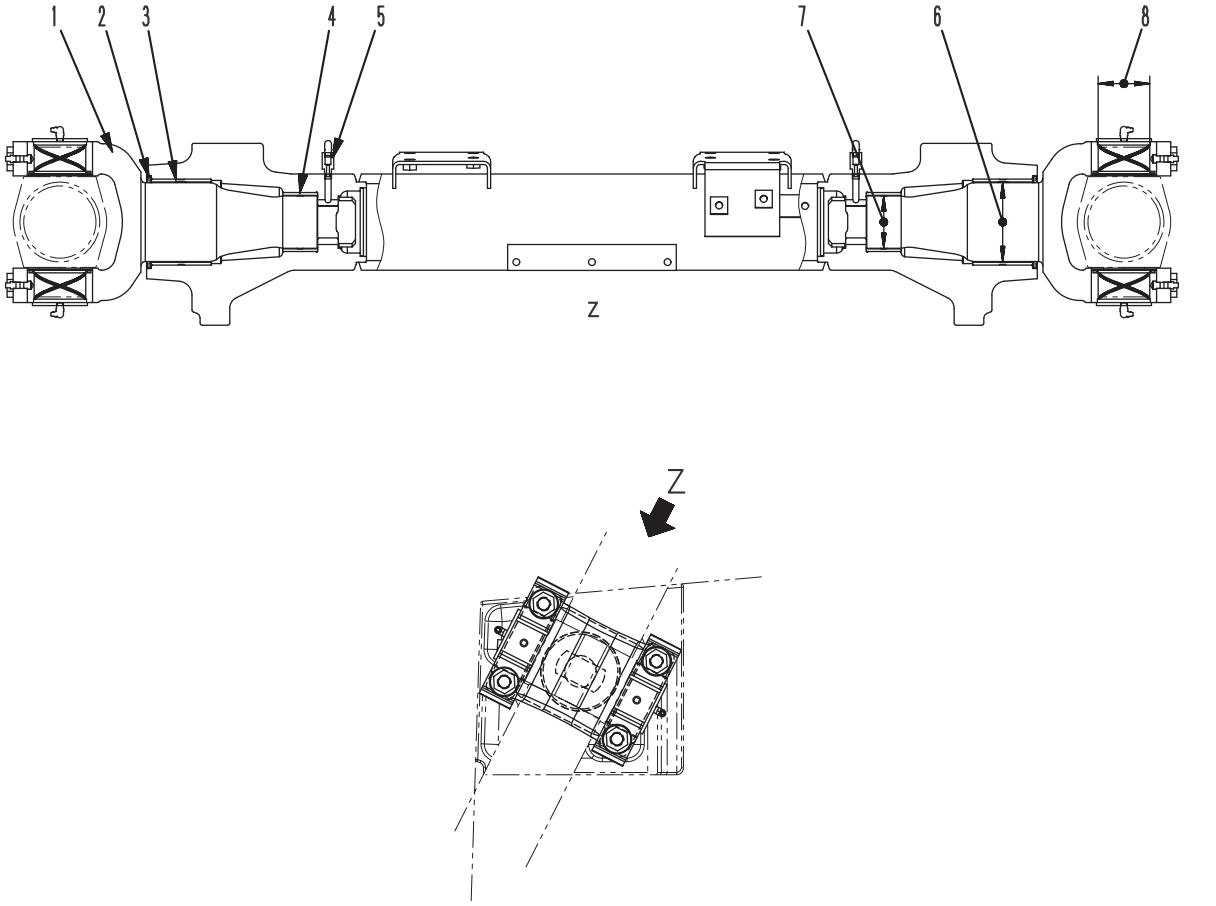
- When the load pressure **P2** rises due to digging or other operations, the pump delivery will increase and the **P1** pressure will rise. Then, the expression (**P1** pressure > Spring (7) force + (ø**d** area x **PR** pressure)) will hold, and the valve (2) will move to the right side till the stroke end. As a result, the opening between the ports **P1** and **P2** will increase, the passage resistance will become smaller to reduce engine loss horsepower.
- When the **PR** pressure rises above the set pressure, the poppet (5) will open and the hydraulic oil will flow through the route from the **PR** port, the hole **a** in the spool (8), the poppet (5) opening to the tank port **T**.
- Therefore, there will occur a differential pressure around the hold **a** in the spool (8) and the spool will move in the direction to close the port **P1** and the **PR** opening. Then, the **P1** pressure is reduced and adjusted to a certain pressure (set pressure) with the opening and is supplied as the **PR** pressure.

4. At occurrence of abnormal high pressure



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

CYLINDER STAY



9JG00232

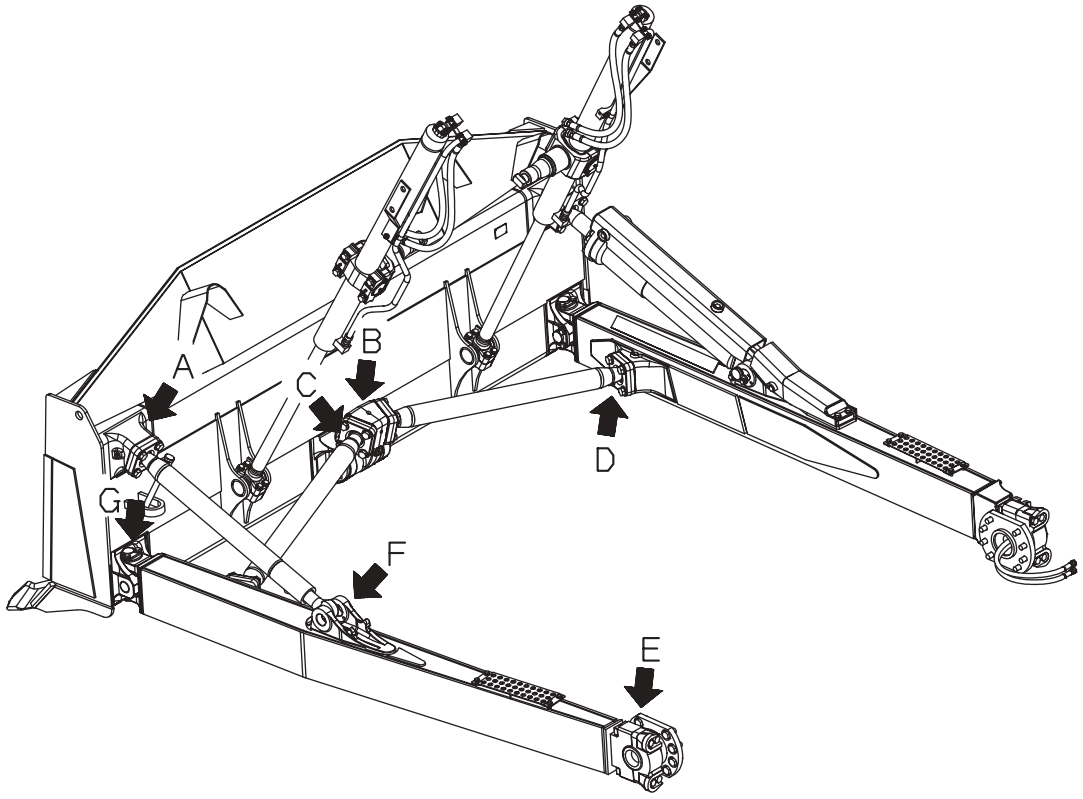
1. Yoke
2. Oil seal
3. Bushing
4. Bushing
5. Air breather plug

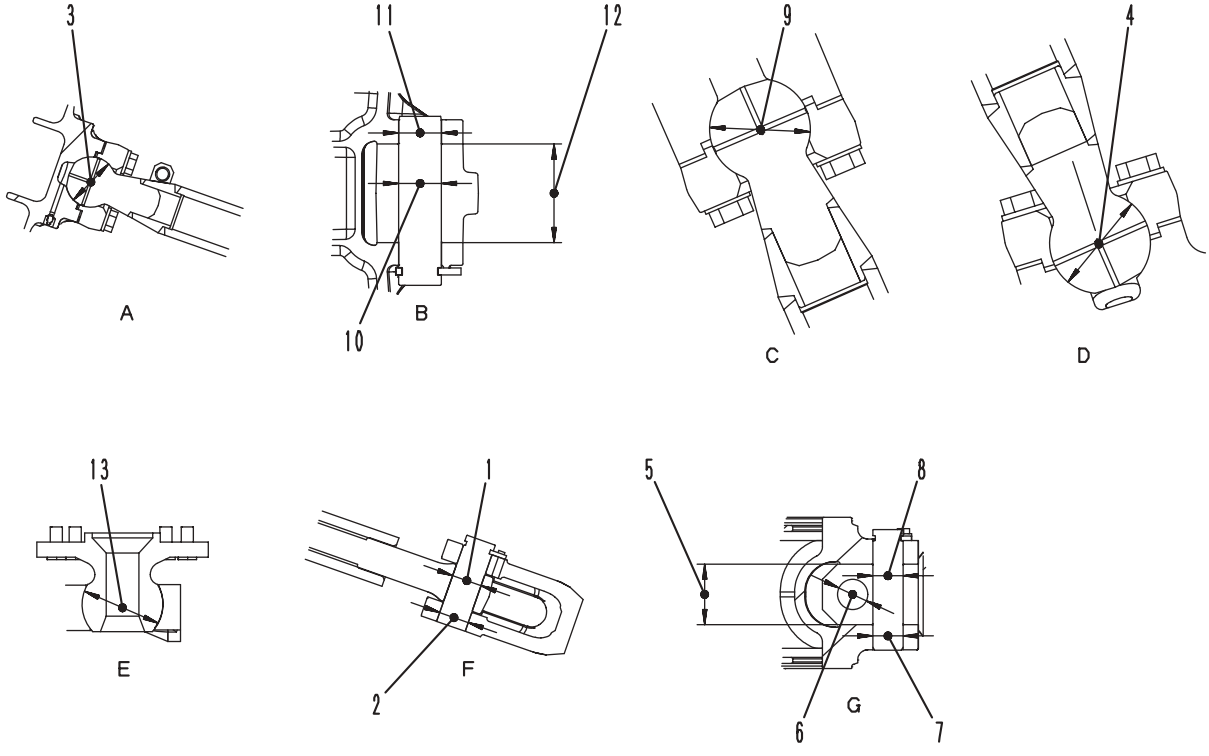
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
6	Clearance between cylinder yoke and bushing	115	– 0.144 – 0.198	+ 0.054 0	0.144– 0.252	–	Replace
7	Clearance between cylinder yoke and bushing	76	– 0.147 – 0.193	+ 0.046 0	0.147– 0.239	–	
8	Clearance between lift cylinder support shaft and bushing	75	– 0.100 – 0.174	+ 0.075 0	0.100– 0.249	0.5	

BLADE

SEMI U-DOZER

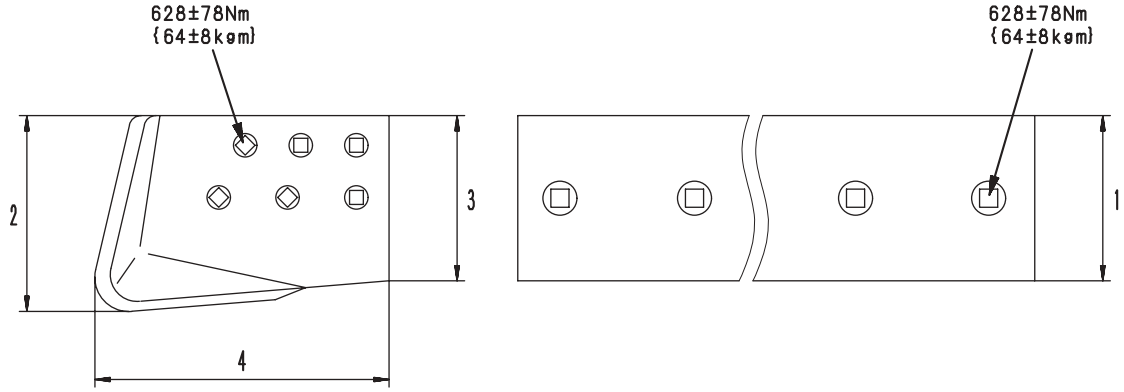




Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between brace and pin	60	– 0.3 – 0.5	+ 0.5 + 0.3	0.6–1.0	2	Replace
2	Clearance between brace pin and bracket	60	– 0.3 – 0.5	+ 0.5 + 0.2	0.5–1.0	2	
3	Clearance between brace spherical surface and cap	100	0 – 0.1	+ 0.5 + 0.2	0.2–0.6	1	Adjust shim or replace
4	Clearance between center brace spherical surface and cap	100	0 – 0.1	+ 0.5 + 0.2	0.2–0.6	1	
5	Clearance between joint and blade bracket	120	– 0.2 – 0.7	+ 0.5 + 0.3	0.5–1.2	2	Replace
6	Clearance between frame pin and joint	60	– 0.3 – 0.5	+ 0.3 0	0.3–0.8	3	
7	Clearance between blade bracket pin and bracket	60	– 0.3 – 0.5	+ 0.3 0	0.3–0.8	3	
8	Clearance between blade bracket pin and joint	60	– 0.3 – 0.5	+ 0.3 0	0.3–0.8	3	
9	Clearance between center brace spherical surface and cap	100	0 – 0.1	+ 0.5 + 0.2	0.2–0.6	1	Adjust shim or replace
10	Clearance between center link pin and center link	85	– 0.3 – 0.5	+ 0.1 – 0.1	0.2–0.6	2	Replace
11	Clearance between center link pin and blade bracket	85	– 0.3 – 0.5	+ 0.3 0	0.3–0.8	2	
12	Clearance between center link and blade bracket	196	0 – 0.1	+ 0.5 + 0.3	0.3–0.6	2	
13	Clearance between trunnion and cap spherical surface	160	– 0.5 – 1.0	+ 0.5 0	0.5–1.5	8	

CUTTING EDGE, END BIT



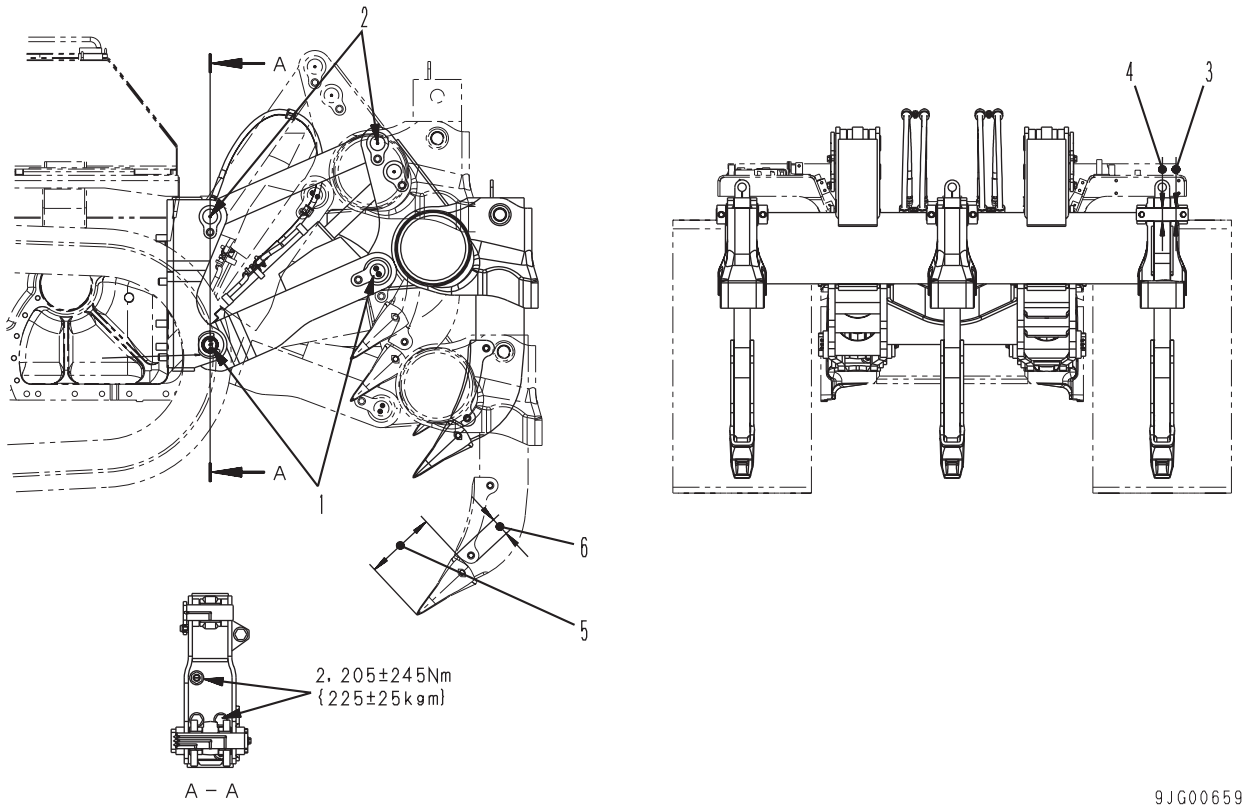
9JG00234

Unit: mm

No.	Check item	Criteria		Remedy
1	Heighr of cutting edge	Standard size	Repair limit	Replace or turning (after turning max. 172 mm)
		254	213	
2	Height of end bit (outside)	302	211	Replace
3	Height of end bit (inside)	254	211	
4	Width of end bit	447	360	

RIPPER

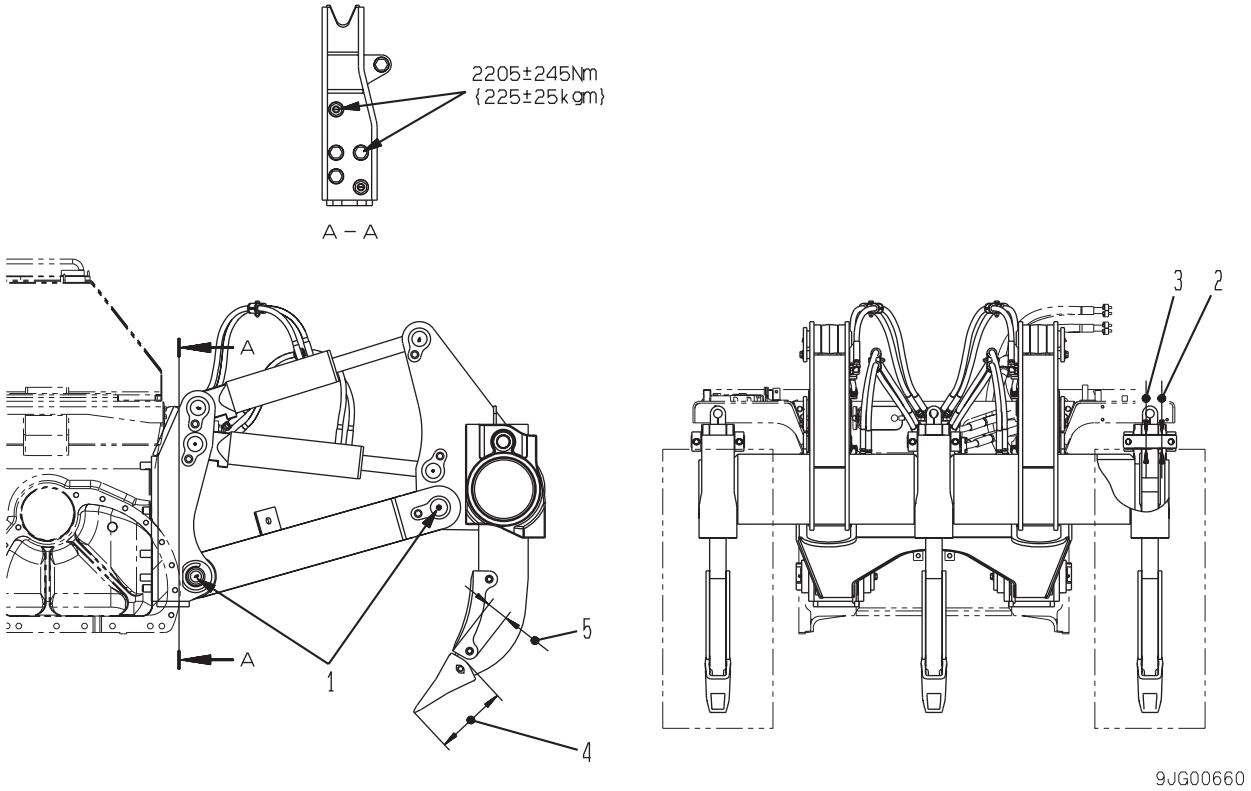
FIXED MALTIPLE SHANK RIPPER



Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between link pin and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		75	– 0.030 – 0.076	+ 0.396 + 0.199	0.229 – 0.472	1.5	
2	Clearance between link pin and bushing	75	– 0.030 – 0.076	+ 0.165 + 0.115	0.145 – 0.241	1.5	
3	Clearance between shank mounting pin and shank holder	Shaft: 60 Hole: 62	+ 0.300 – 0.300	+ 0.300 – 0.300	1.4 –`2.6	10.0	
4	Clearance between shank mounting pin and shank hole	Shaft: 60 Hole: 65	+ 0.300 – 0.300	+ 0.100 – 0.100	4.6 –`5.	15.0	
5	Wear of point	Standard size			Repair limit		
		335			225		
6	Wear of protector	113			93		

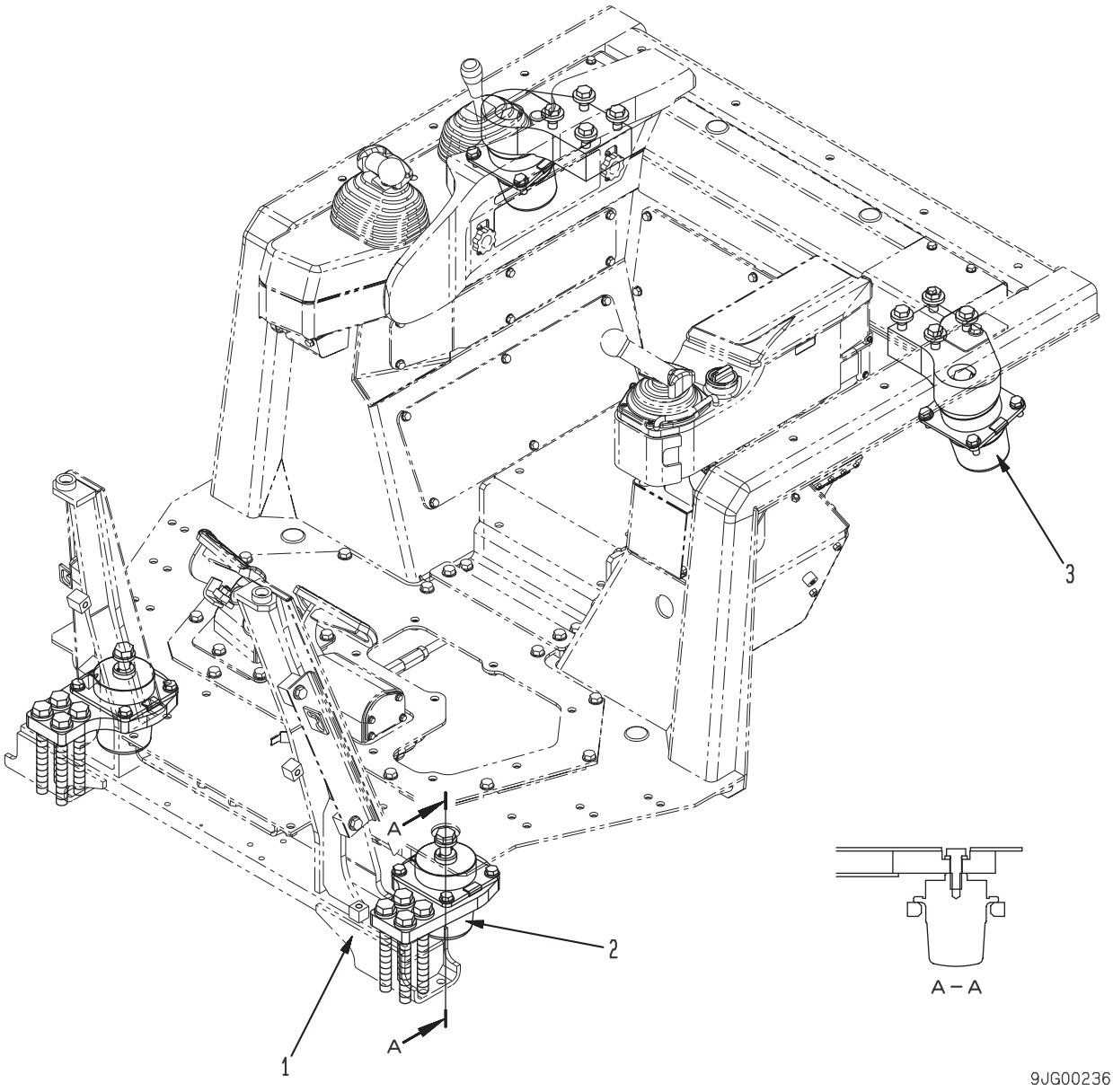
VARIABLE MALTIPLE SHANK RIPPER



Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between link pin and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		85	– 0.036 – 0.090	+ 0.207 + 0.120	0.156 – 0.297	1.5	
2	Clearance between shank mounting pin and shank holder	Shaft: 60 Hole: 62	+ 0.300 – 0.300	+ 0.300 – 0.300	1.4 –`2.6	10.0	
3	Clearance between shank mounting pin and shank hole	Shaft: 60 Hole: 65	+ 0.300 – 0.300	+ 0.100 – 0.100	4.6 –`5.	15.0	
4	Wear of point	Standard size		Repair limit			
		335		225			
5	Wear of protector	113		93			

CAB MOUNT



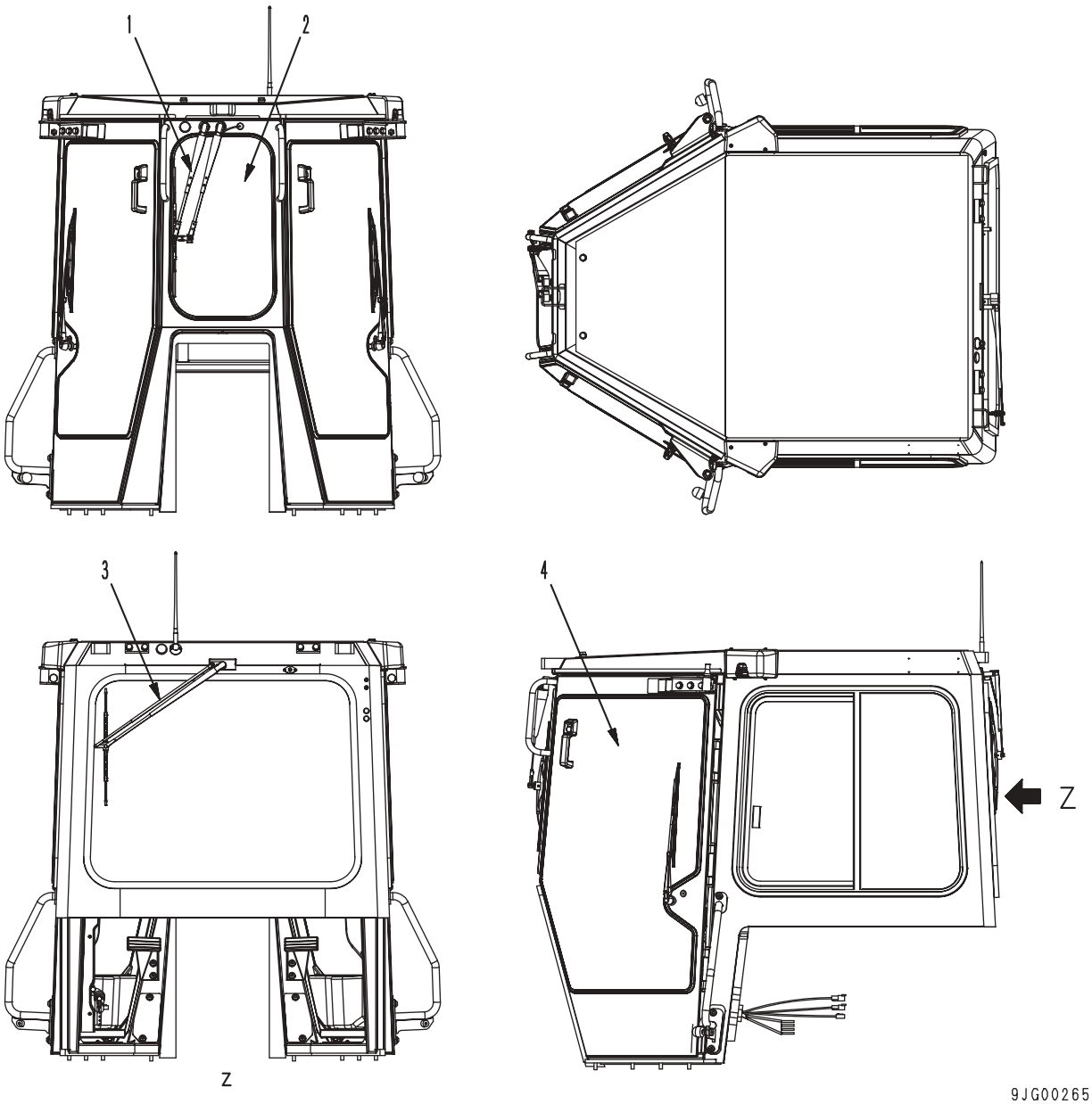
1. Support
2. Damper mount (front)
3. Damper mount (rear)

Outline

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

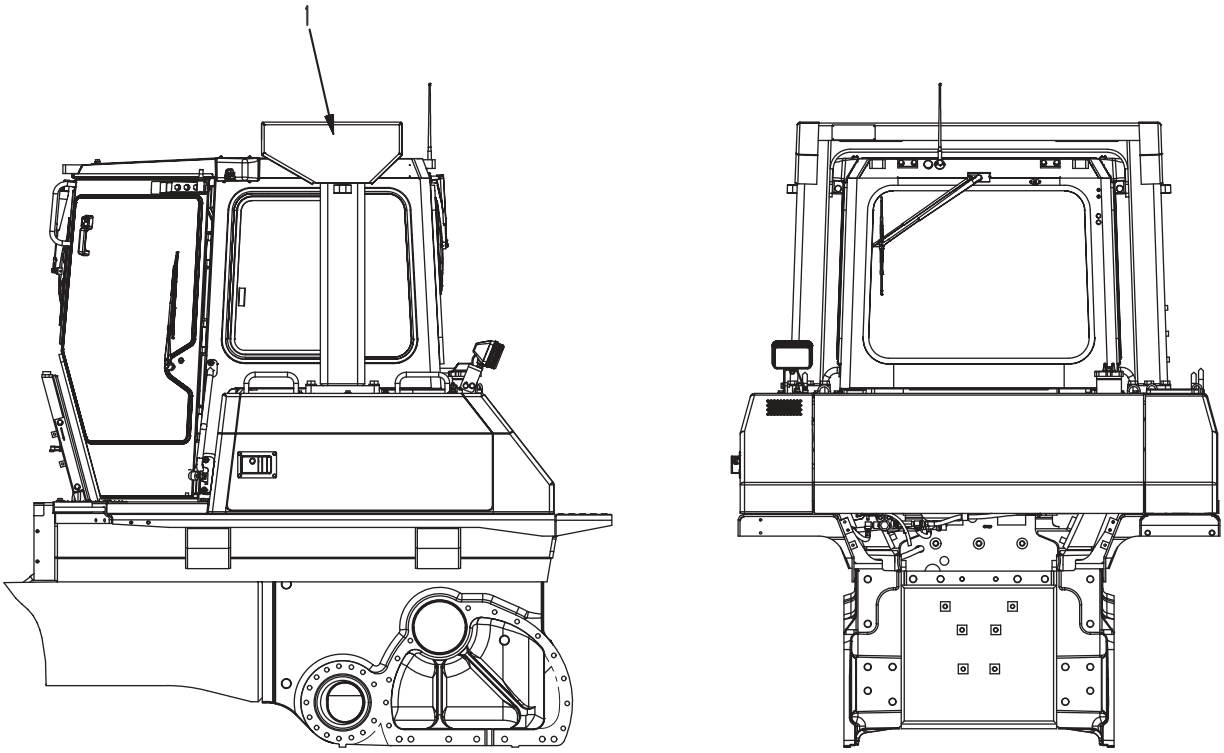
CAB

CAB ASSEMBLY



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

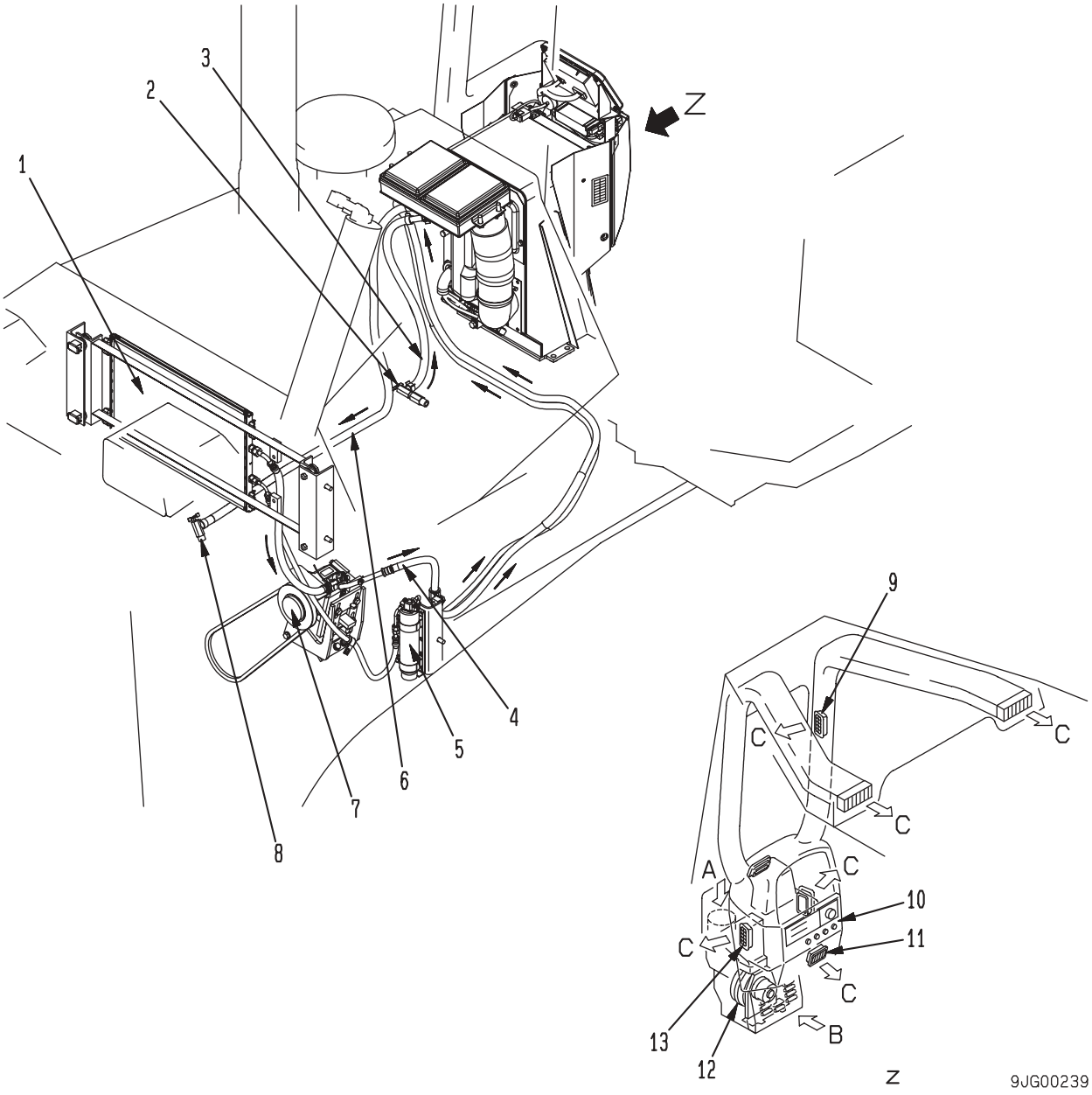
ROPS GUARD



1. ROPS guard

AIR CONDITIONER

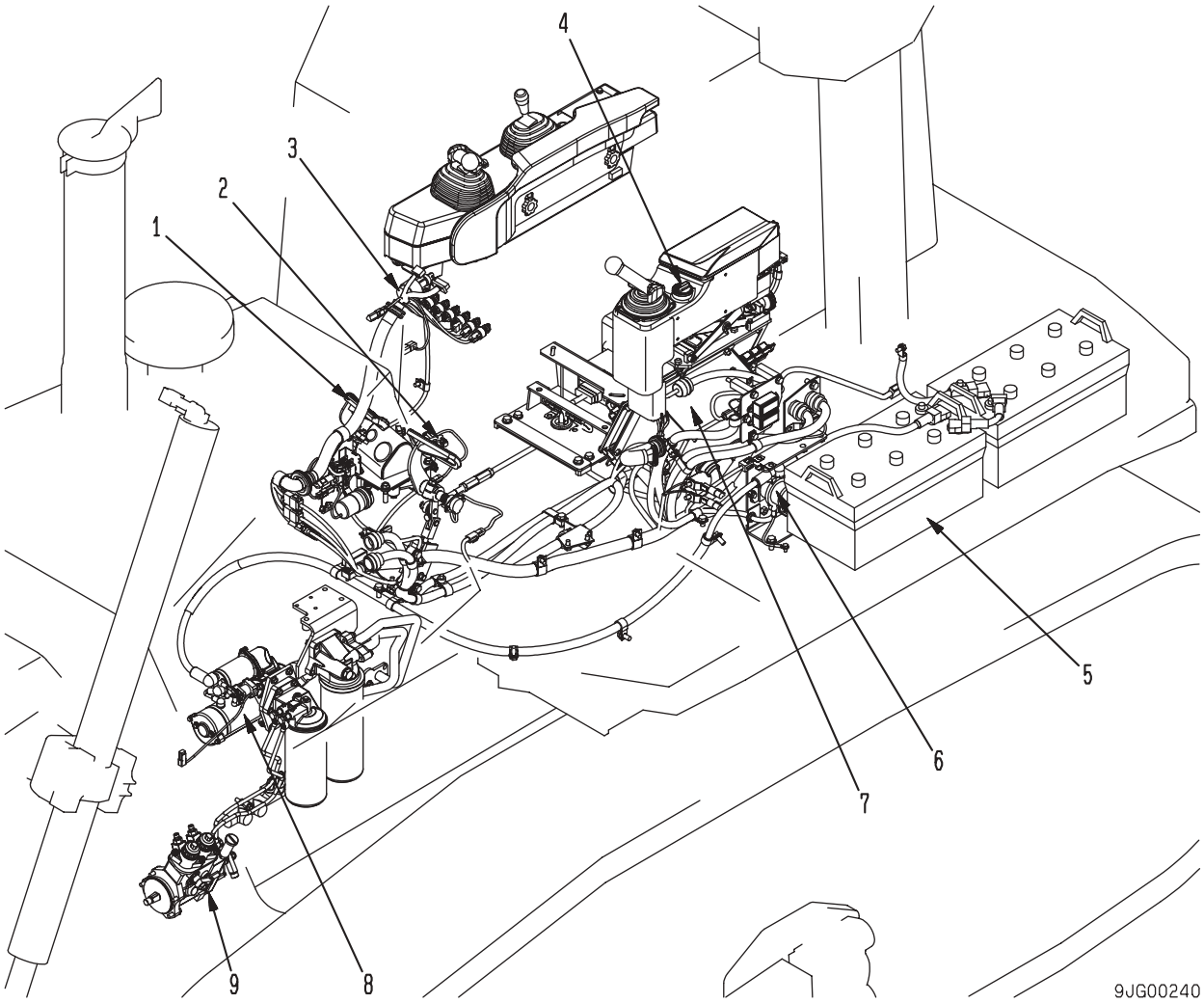
AIR CONDITIONER PIPING



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

A. Fresh air
B. Recirculated air
C. Hot air/cold air

ENGINE CONTROL

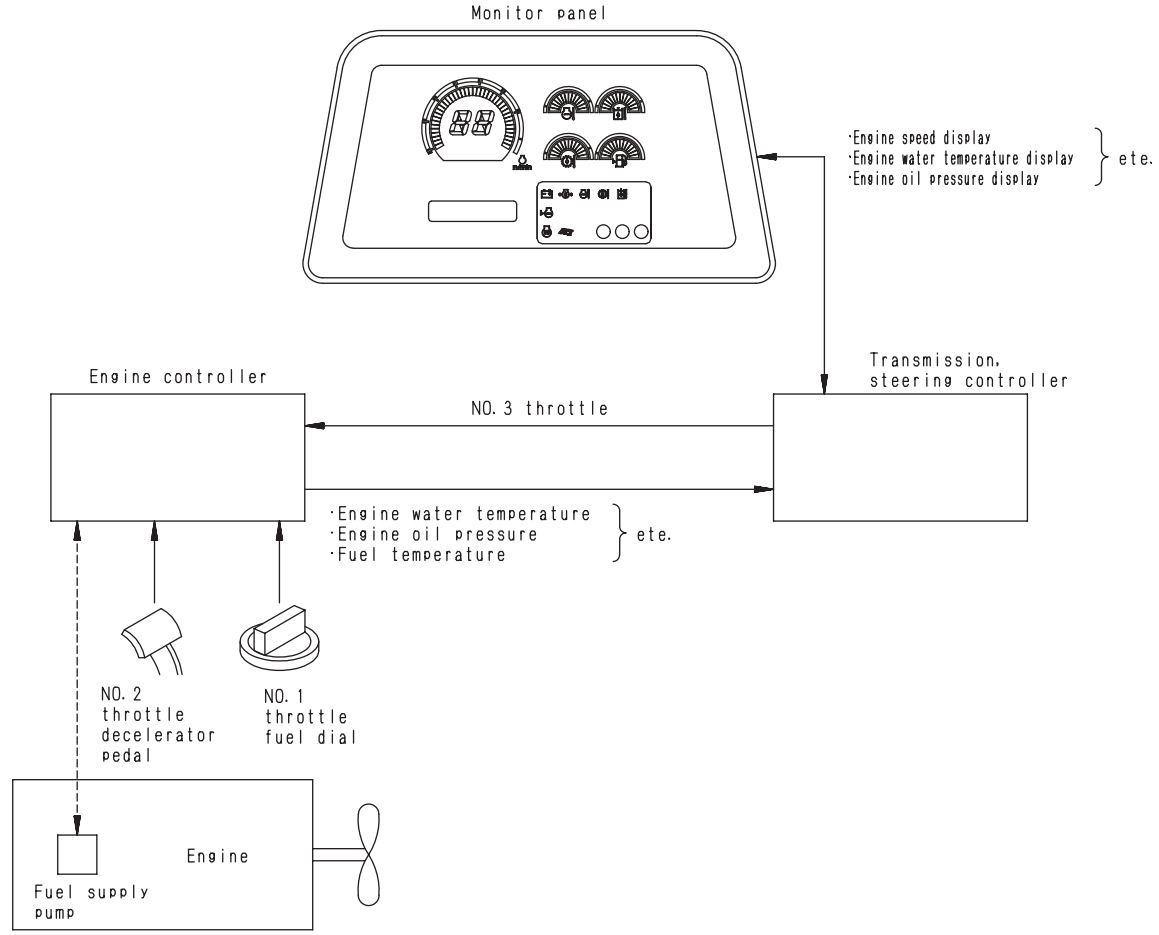


1. Decelerator pedal
2. Decelerator potentiometer
3. Starter switch
4. Fuel dial
5. Battery
6. Battery relay
7. Transmission, steering controller
8. Starter
9. Fuel supply pump

Outline

- The throttle signals of fuel dial (4) and decelerator pedal (1) are input to transmission, steering controller (7) and processed there together with the 3rd throttle signal, and then sent as throttle commands to the engine controller. The engine controller controls the engine according to the commands.

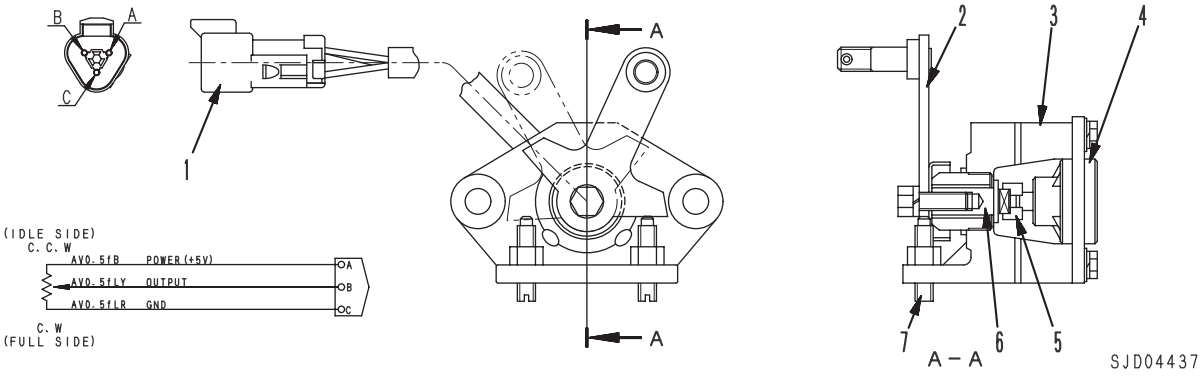
ENGINE CONTROL SYSTEM



Outline

- The engine controller receives the fuel control dial signal of the 1st throttle, decelerator pedal signal of the 2nd throttle, and 3td throttle signal which is the control signal from the steering controller, and then controls the fuel supply pump according to the command signal having the lowest engine speed.
  The control signals of the 3rd throttle are as follows.
  (1) Auto deceleration (F3, R3, F2, R2)
  (2) Neutral deceleration
- The steering controller calculates a proper engine speed from information items (1), (2), etc. and sends it as the 3rd throttle signal to the engine controller.
- The information of the engine controller is possessed jointly by the other controllers through the network and used for the optimum control of the engine and machine body.
- The auto deceleration is a function of setting the engine speed low temporarily when the travel direction is changed from F3, R3, F2, and R2 (to protect the transmission clutch).
- The neutral deceleration is a function of limiting the high idling speed when the transmission is set in neutral.

DECELERATION POTENTIOMETER



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

Outline

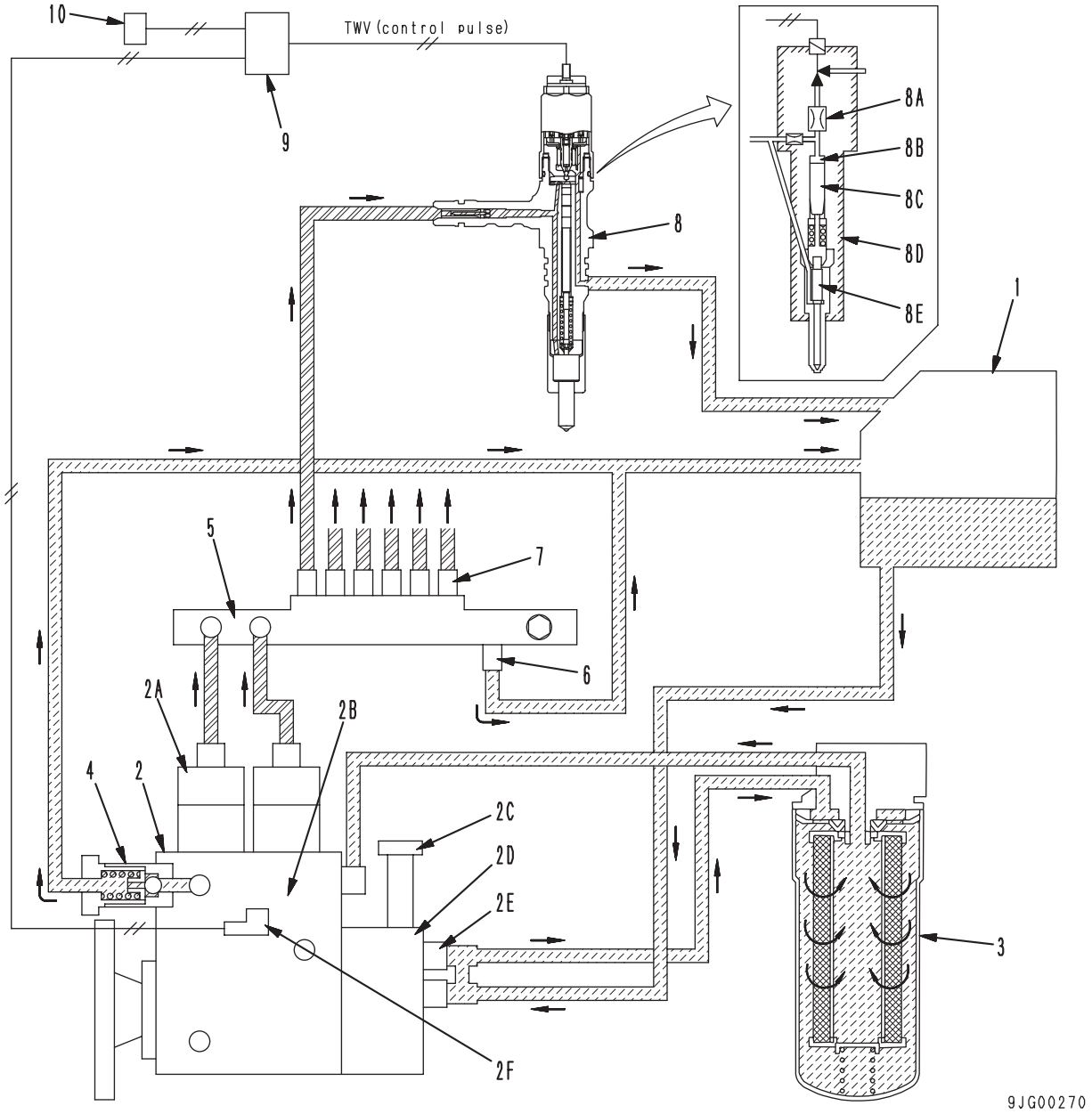
- The deceleration potentiometer is installed to the front lower part of the operator's cab and connected to the decelerator pedal by linkage.

- If the decelerator pedal is pressed, the throttle potentiometer shaft rotates by the linkage and the potentiometer resistance changes.
  Constant voltage is applied between pins **A** and **C** of the potentiometer and an electric signal is sent through pin **B** to the engine controller according to the position of the decelerator pedal.

CRI ENGINE CONTROL SYSTEM

★ "CRI" is an abbreviation for Common Rail Injection.

SYSTEM DIAGRAM



Outline

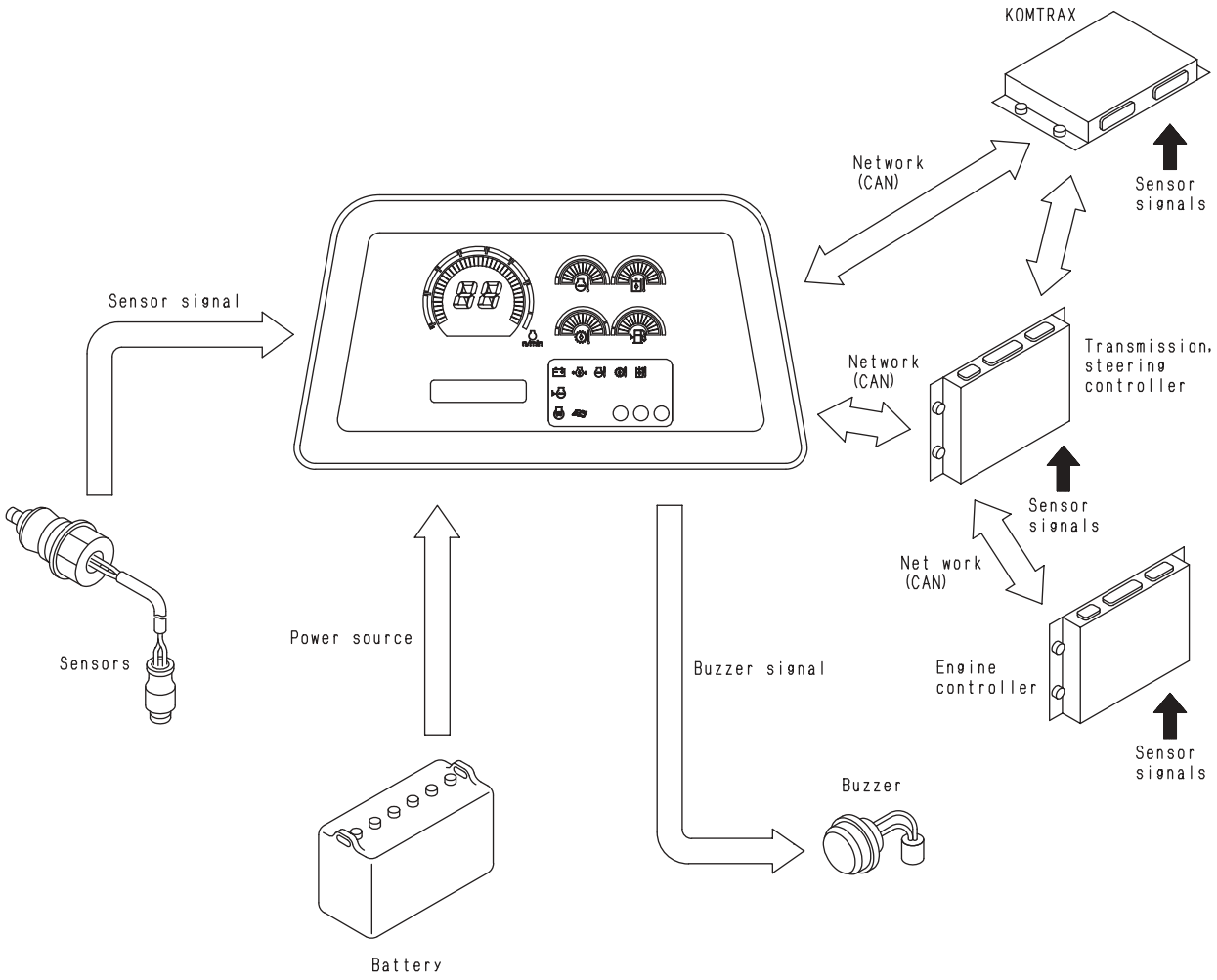
- The signals detected by various sensors are input to the engine controller.
- The input signals are processed by the controller and output to each actuator to control the fuel injection rate and fuel injection timing.

1. Fuel tank
2. Fuel supply pump assembly
   2A. PCV
   2B. High pressure pump
   2C. Priming pump
   2D. Feed pump
   2E. Bypass valve
   2F. G speed sensor
3. Fuel filter
4. Overflow valve
5. Common rail
6. Pressure limiter
7. Flow damper
8. Injector assembly
   8A. Orifice
   8B. Control chamber
   8C. Hydraulic piston
   8D. Injector
   8E. Nozzle
9. Engine controller
10. NE speed sensor

System configuration

- The CRI system consists of fuel supply pump (2), common rail (5), injector (8), engine controller (9) to control them, and sensors.
- The fuel supply pump generates fuel pressure in the common rail. The fuel pressure is controlled by the fuel discharge rate of the supply pump. The discharge rate is controlled by turning on and off PCV (discharge control valve) (2A) of the fuel supply pump according to the electric signals from the engine controller.
  The common rail receives the pressurized fuel from the fuel supply pump and distributes it to the cylinders.
  The fuel pressure is sensed by the common rail fuel pressure sensor installed to the common rail and controlled by the feedback method so that the actual fuel pressure will match to the command pressure set according to the engine speed and the load on the engine.
  The fuel pressure in the common rail is applied to the nozzle (8E) side of the injector and control chamber (8B) through the fuel injection pipe of each cylinder.
- The injector controls the fuel injection rate and fuel injection timing by turning on and off the TWV (2-way solenoid valve). If the TWV is turned on, the fuel circuit is so changed that the high-pressure fuel in the control chamber will flow through orifice (8A). The needle valve is raised to start fuel injection by the nozzle cracking pressure applied as the high-pressure fuel on the nozzle side. If the TWV is turned off, the fuel circuit is so change that the high-pressure fuel will be applied to the control chamber through the orifice. As a result, the needle valve lowers and finishes fuel injection. Accordingly, the fuel injection timing and fuel injection rate are controlled respectively by the timing to turn on the TWV and the length of the turn-on time of the TWV.

MONITOR SYSTEM



- The monitor system monitors the machine condition with the sensors installed to various parts of the machine and processes and displays the obtained information on the panel quickly to notify the operator of the machine condition.
  The main display sections and functions of the panel are as follows.
  1) Monitor unit which turns on the alarm when the machine has a trouble.
  2) Gauge unit which constantly displays the machine condition (coolant temperature, torque converter oil temperature, fuel level, etc.)
  3) Function of displaying error codes.
  4) Function of monitoring the current and voltage of the sensors and solenoids.
- The CPU (Central Processing Unit) in the monitor panel displays and outputs various information items processed by the transmission, steering controller. The display unit is LCD (Liquid Crystal Display)

Processing in monitor panel (Common to all specifications)

Display of monitor panel

(1) Contents and conditions of processing	(2) Method	(3) Flow of signals
1) Display of travel direction and gear speed. F1, R3, etc. are notified by CAN according to information of transmission and steering controller.		
2) Display of gauges of engine speed, engine water temperature, etc. Controller converts the sensor signals into gauge numbers and sends them to the monitor panel by CAN.	CAN	
3) Display of trouble When the machine has a trouble, the corresponding failure code is notified to the monitor panel by CAN. Which one should be turned on, the buzzer or the caution lamp, is notified, too. (a) In normal state User code (b) In trouble history display mode The service code (6-digit code) and the following items are displayed 1. Time after first occurrence 2. Time after latest occurrence 3. Number of past occurrences The monitor panel displays the code on the multi insformation section.	CAN	Each sensor/solenoid–controller–monitor panel

Display of monitoring condition

(1) Contents and conditions of processing	(2) Method	(3) Flow of signals
1) The communication conditions of each sensor, each solenoid, and CAN are displayed. The item Nos. and device conditions are notified to the monitor panel by CAN. The monitor panel displays the items and each value on its multi-information section.	CAN	Each sensor–controller–monitor panel
2) Each items is selected by using the cursor switches, selector switches, buzzer cancel switch, and shift UP/DOWN switches.		

Other items

(1) Contents and conditions of processing	(2) Method	(3) Flow of signals
1) Function selection mode (Displayed each time cancel switch is turned to left) (a) Replacement periods of oil filter and oil are displayed. (b) Engine speed, oil pressure in work equipment circuit, etc. are displayed. (c) Failure codes related to electronic control are displayed. (d) Brightness of display, etc. are adjusted. 2) Mode to change replacement periods of maintenance mode 3) Mode to display failure codes related to machine body such as overheating, abnormal water temperature, etc. 4) Mode to display service meter and information related to load on machine	—	—

★ See TESTING AND ADJUSTING, Special functions of monitor panel (EMMS).

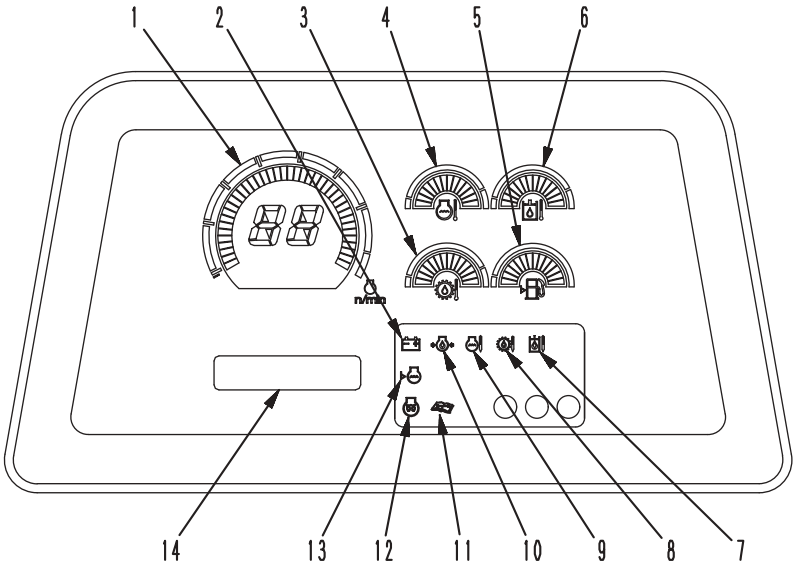
Other items

(1) Contents and conditions of processing	(2) Method	(3) Flow of signals
1) Maintenance mode 2) Pm clinic auxiliary mode 3) Adjustment mode 4) Failure code display mode 5) Maintenance interval change mode 6) Electric system failure code display mode 7) Mechanical system failure code display mode 8) Adjustment mode 9) Load saving display mode 10) Real time monitoring mode 11) Dual display monitoring mode	—	—

★ See TESTING AND ADJUSTING, Special functions of monitor panel (EMMS).

MONITOR PANEL

MONITOR PORTION



1. Display portion A
   (Speed range display and engine speed)
2. Charge caution lamp
3. Power train oil temperature gauge
4. Engine water temperature gauge
5. Fuel gauge
6. Hydraulic oil temperature gauge
7. Hydraulic oil temperature caution lamp
8. Power train oil temperature caution lamp
9. Engine water temperature caution lamp
10. Engine oil pressure caution lamp
11. Maintenance caution lamp
12. Preheat pilot lamp
13. Radiator water level caution lamp
14. Display portion B (Multi information)

Outline

- The monitor panel consists of a monitor that issues an alarm when an error occurred in a vehicle, a gauge that always displays the state of the vehicle, and the service meter display portion etc.
  The monitor panel installs a microcomputer and processes and displays signals from each sensor and controller.
  Besides, the items displayed on the monitor portion and gauge portion are listed in the table on the next page.

Operation

1. When the power turns on (When the starter switch is ON)

1) All items of the gauge and monitor portions come on for three seconds.
2) The alarm lamp comes on for two seconds.

2. Check before starting

1) After all lighting of Section 1 is terminated, if there is an error in a check-before-starting item, the item may flash and the contents of the error may be displayed on display portion **B** (14).
2) If the engine is started, the check-before-starting items go off. (Whether the engine is running is judged by the signal (CAN) from the engine controller.)

3. Cautions

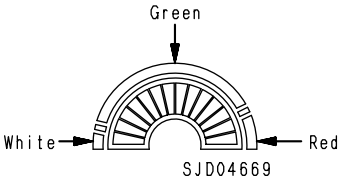
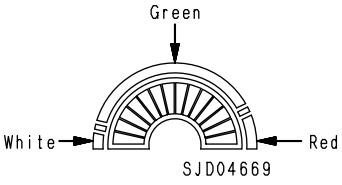
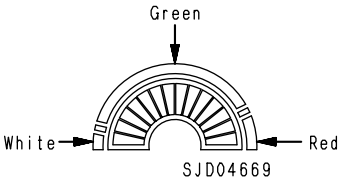
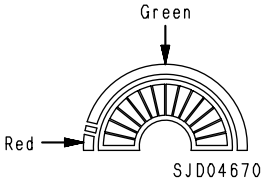
Caution items are checked until the engine stops after the engine starts.
If an error occurs, the error is displayed by flashing and the alarm lamp synchronously flashes.

★ Further, if an emergency item flashes, the alarm buzzer also sounds at the same time.
Flashing of the monitor and alarm lamp is repeated. They come on and off for about 0.8 second.

★ The flashing period of the monitor slightly changes when atmospheric temperature is low (below about - 10°C), but this case in not abnormal.

Monitor panel display

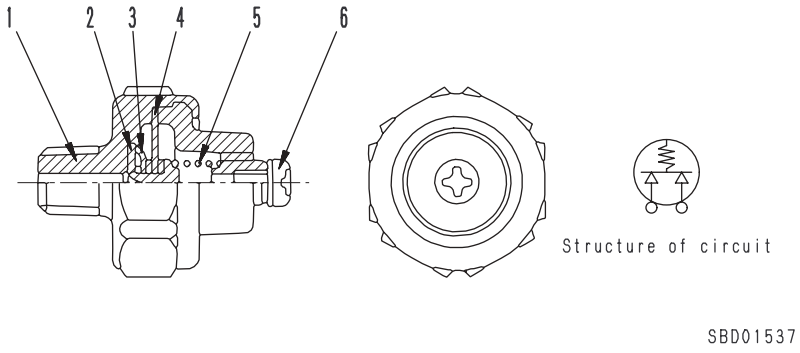
Display category	Symbol	Display item	Display range	Display method
Check	 SAD01479	Radiator water level	Below low level	Displays when engine is stopped and starting switch is ON Display when normal: OFF Display when abnormal: Flashes
	 SAD01481	Engine oil pressure	When sensor is abnormal or when wiring harness is disconnected	Display when normal: OFF Display when abnormal: ON
Caution 1	 SAP00522	Battery charge	When charge is defective	Displays when starting switch is ON and engine is running Display when normal: OFF Display when abnormal: Flashes CAUTION lamp flashes
Caution 2	 SAD01481	Engine oil pressure	Below 49.0kPa {0.5kg/cm^2}	Displays when starting switch is ON and engine is running Display when normal: OFF Display when abnormal: Flashes CAUTION lamp flashes Alarm buzzer sounds
	 SAD01479	Radiator water level	Below low level	
	 SAD01482	Engine water temperature	When at highest level (108°C or above) on engine water temperature gauge	
	 SAD01483	Torque converter oil temperature	When at highest level (130°C or above) on engine water temperature gauge	
	 SAD01484	Hydraulic oil temperature	105±3°C or above	
	 SJD04665	Maintenance	When replacement time of filter or oil has been passed	
Pilot	 SJD04666	Preheating	When preheating	Lights according to required time determined by engine controller based. It also lights at the time of manual preheat by setting starting switch at preheat position (turning it counterclockwise).

Display category	Symbol	Display item	Display range	Display method
Gauges	 SAD01482	Engine water temperature	 SJD04669	One place lights up to show applicable level
	 SAD01483	Torque converter oil temperature	 SJD04669	
	 SAD01484	Hydraulic oil temperature	 SJD04669	
	 SAD01486	Fuel level	 SJD04670	All lamps light up below applicable level
Multi information	 SJD04668	Service meter (Hours meter)	From 0 to 99999	Actuated when the engine is rotating

SENSORS

Type of sensor	Sensor method	When normal	When abnormal
Engine oil pressure	Contact	OFF	ON
Engine water temperature	Resistance	–	–
Torque converter oil temperature	Resistance	–	–
Hydraulic oil temperature	Resistance	–	–
Radiator water level	Contact	ON	OFF
Fuel level	Resistance	–	–

ENGINE OIL PRESSURE SENSOR

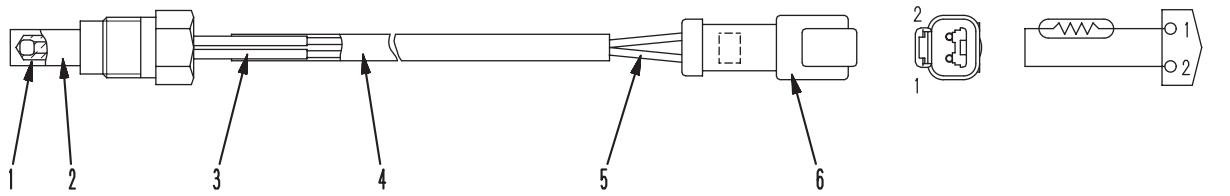


1. Plug
2. Contact ring
3. Contact
4. Diaphragm
5. Spring
6. Terminal

ENGINE COOLING WATER TEMPERATURE SENSOR

TORQUE CONVERTER OIL TEMPERATURE SENSOR

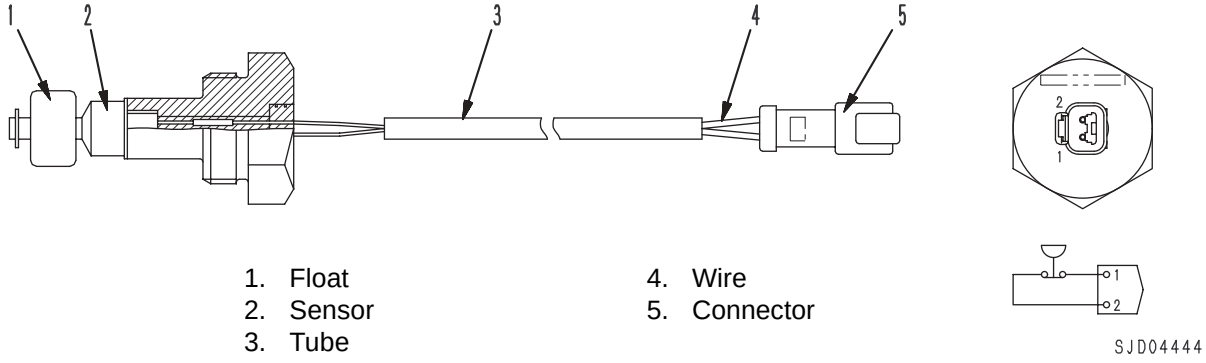
HYDRAULIC OIL TEMPERATURE SENSOR



1. Thermistor
2. Body
3. Tube
4. Tube
5. Wire
6. Connector

SJP08350

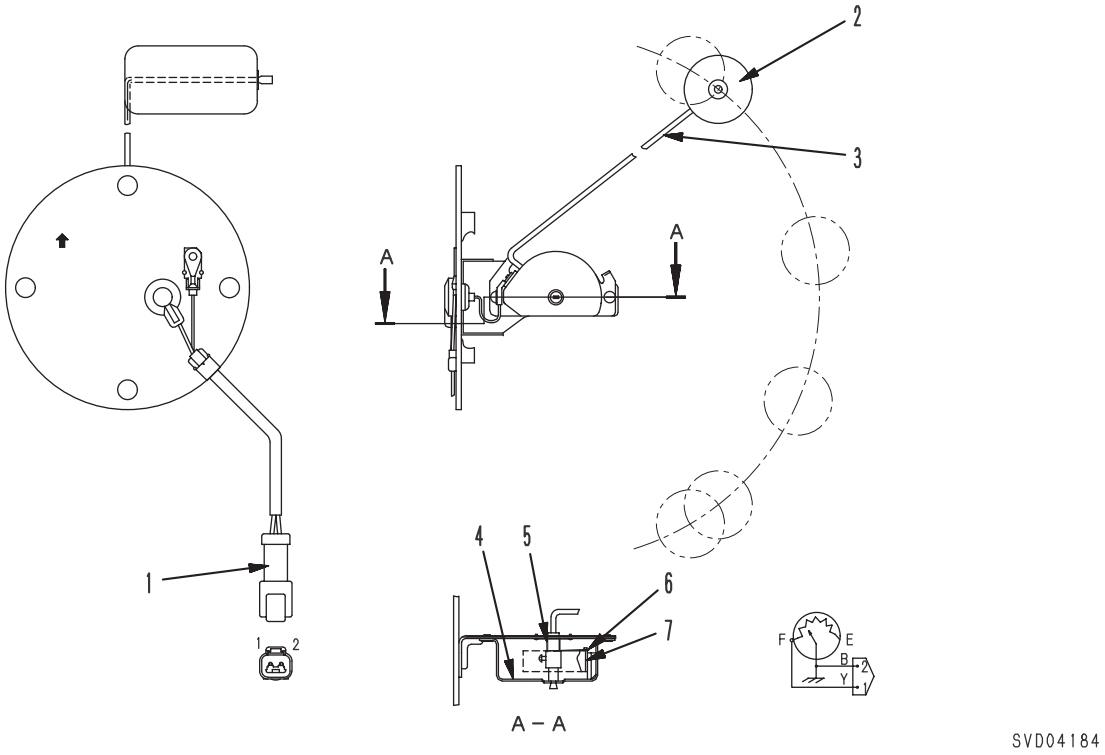
RADIATOR WATER LEVEL SENSOR



1. Float
2. Sensor
3. Tube
4. Wire
5. Connector

SJD04444

FUEL LEVEL SENSOR



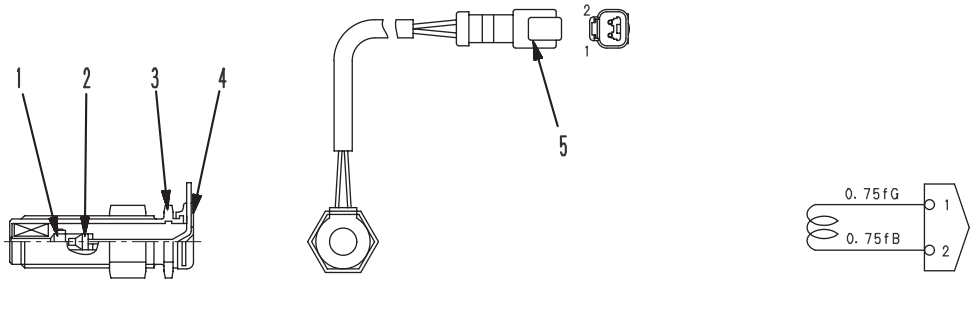
1. Connector
2. Float
3. Arm
4. Body
5. Spring
6. Contact
7. Spacer

Function

- The fuel sensor is installed to the side face of the fuel tank. The float moves up and down according go to the fuel level. This movement of the float is transmitted by the arm and actuates a variable resistance. This sends a signal to the monitor panel to indicate the remaining fuel level. When the display on the monitor panel reaches a certain level, a warning lamp flashes.

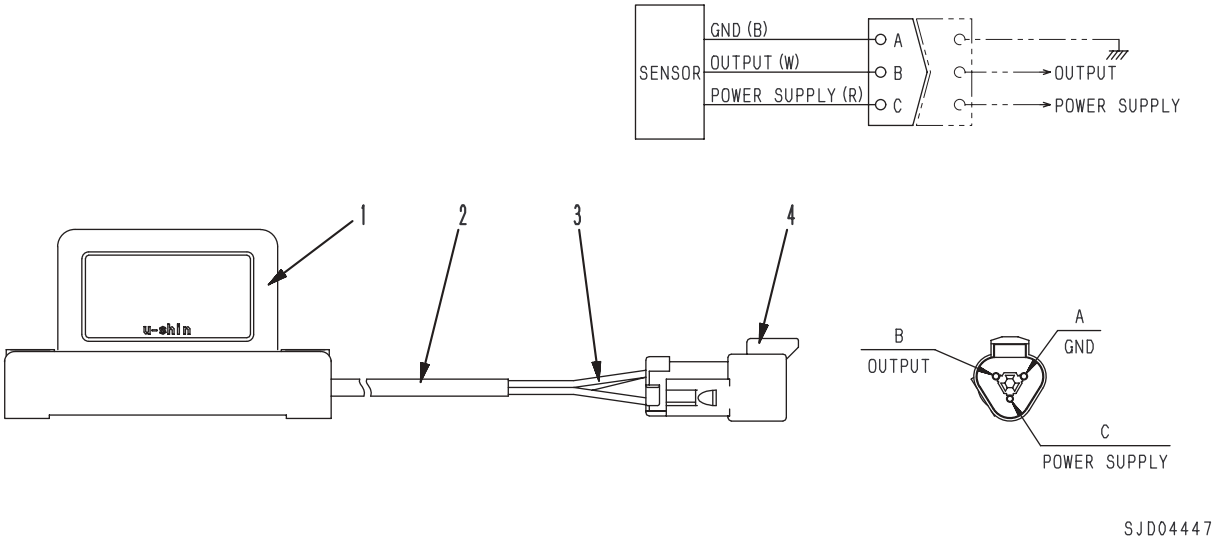
ENGINE SPEED SENSOR

BEVEL GEAR SPEED SENSOR



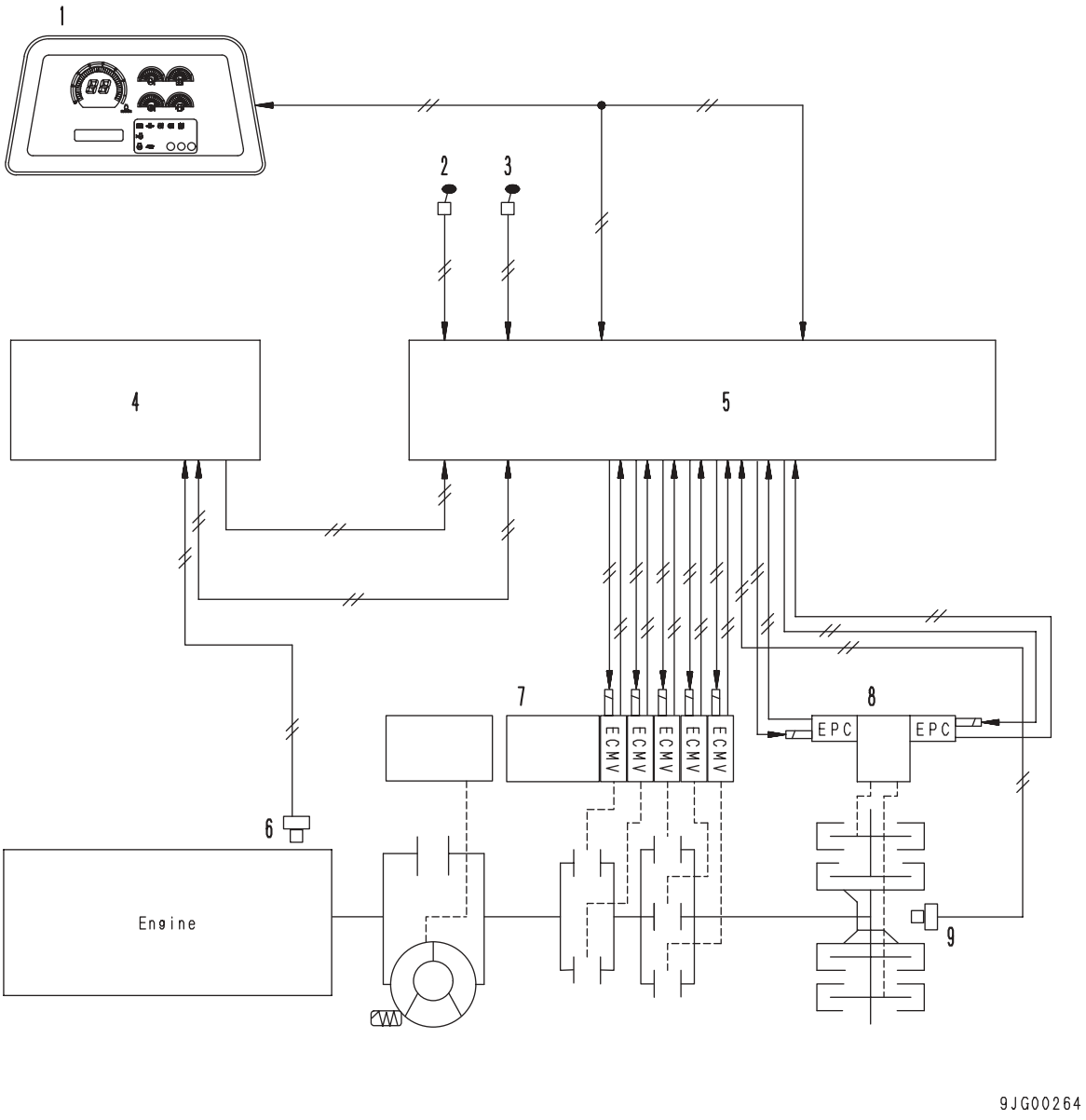
1. Magnet
2. Terminal
3. Case
4. Boots
5. Connector

PITCH ANGLE SENSOR



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

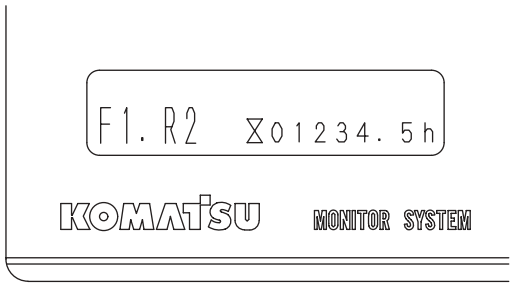
PALM COMMAND CONTROL SYSTEM



1. Monitor panel (Multi-information)
2. Preset mode switch
3. Auto shift-down switch
4. Engine controller
5. Transmission, steering controller
6. Engine speed sensor
7. Transmission control valve
8. Steering control valve
9. Transmission output shaft speed sensor

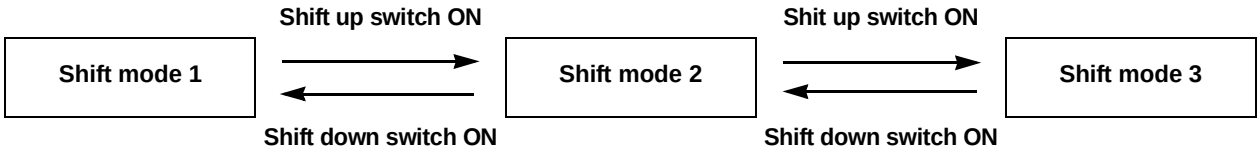
- **Shift mode function**

1. Function
   If you shift the PCCS lever to the forward or reverse, the gear speed selected from the shift mode is turned on.
   - Shift mode 1: F1/R1
   - Shift mode 2: F1/R2
   - Shift mode 3: F2/R2
2. Type of modes
   (1) F1-R1
   (2) F1-R2
   (3) F2-R2



SWD04689

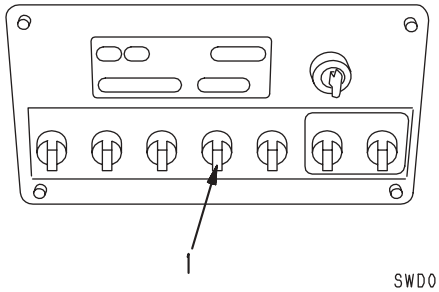
3. Selecting method
   Turn the preset mode switch "ON".
   Shift the PCCS lever to “N”.
   Select a mode with the shift up switch and shift down switch.



4. Displaying method
   The selected mode is displayed on the monitor panel.

- **Auto Shift-down Function**

1. Function
   This function automatically shifts the gear speed down if load is increased while the machine is travelling at 2nd or 3rd speed or while the machine is in operation.
   1) This function turns on the shift-down automatically by calculating the drawbar pull (load to the machine body) based the engine speed, transmission speed and throttle information from the steering controller.
   2) Once the machine is automatically shifted down, it is not automatically shifted up again to the former gear speed (it can be shifted up with the shift switch, however).
   3) This function is available for both the forward and reverse travel.
2. Selecting method
   Turn the auto shift-down switch (1) “ON”.



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20 TESTING AND ADJUSTING

★ Note the following when making judgements using the standard value tables for testing, adjusting, or troubleshooting.

1. The standard value for a new machine given in the table is the value used when shipping the machine from the factory and is given for reference. It is used as a guideline for judging the progress of wear after the machine has been operated, and as a reference value when carrying out repairs.
2. The service limit value given in the tables is the estimated value for the shipped machine based on the results of various tests. It is used for reference together with the state of repair and the history of operation to judge if there is a failure.
3. These standard values are not the standards used in dealing with claims.

STANDARD VALUE TABLE FOR ENGINE

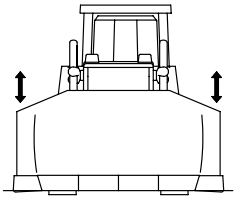
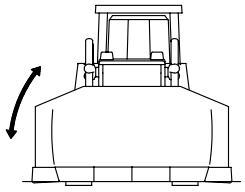
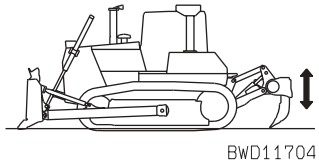
Machine model				D85EX, PX-15	
Engine				SA6D125E-3	
Item	Measurement conditions		Unit	Standard value for new machine	Service limit value
Engine speed	High idling		rpm	2,050 $^{+50}_{0}$	2,050 $^{+50}_{0}$
	Low idling			750 $^{+50}_{0}$	750 $^{+50}_{0}$
	Rated speed			1,900	—
Air supply	At rated output		kPa {mmHg}	Min. 79.8 {Min 600}	60 {450}
Exhaust gas color	At sudden acceleration At high idling		Bosch index	Max. 4.5 Max. 1.0	6.5
Exhaust temperature (Torbocharger inlet temperature)	Whole speed range (Ambinent temperature 20°C)		°C	Max. 680	700
Valve clearance	Intake valve Exhaust valve		mm	0.33 0.71	— —
Compression pressure (SAE30 or SAE15W-40)	Oil temperature: 40 – 60°C (Engine speed)		MPa {kg/cm^2} (rpm)	Min. 2.9 {Min 30} (150 – 250)	—
Blow-by pressure (SAE30 or SAE15W-40)	(Water temperature: Operating range) At rated output		kPa {mmH_2O}	Max. 0.98 {Max. 100}	1.96 {200}
Oil pressure	(Water temperature: Operating range)		kPa {kg/cm^2}		
	At high idling (SAE30 or SAE15W-30)			392 – 690 {4.0 – 7.0}	206 {2.1}
	At high idling (SAE10W)			343 – 640 {3.5 – 6.5}	176 {1.8}
	At low idling (SAE30 or SAE15W-30)			Min. 147 {Min 1.5}	69 {0.7}
	At low idling (SAE10W)			Min. 98 {Min. 1.0}	69 {0.7}
Oil temperature	Whole speed range (Inside oil pan)		°C	90 – 120	MIn. 120
Belt tension	Deflection when pressed with a finger force of approx. 58.8 N {approx. 6 kg}	Altermator-crankshaft pulley	mm	13	—
	Deflection when pressed with a finger force of approx. 98 N {approx. 10 kg}	Air conditioner-crankshaft pulley		16 – 20	16 – 20

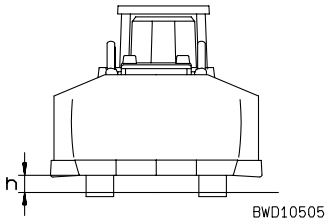
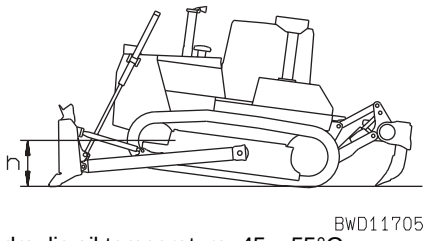
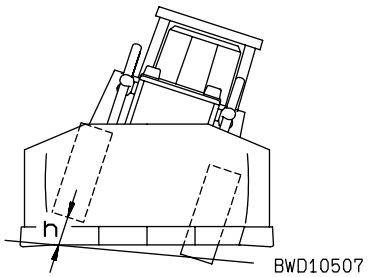
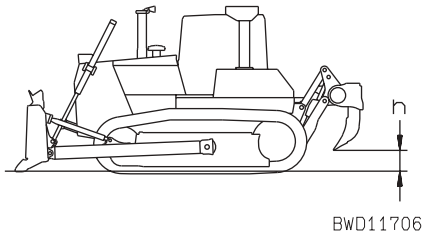
STANDARD VALUE TABLE FOR CHASSIS

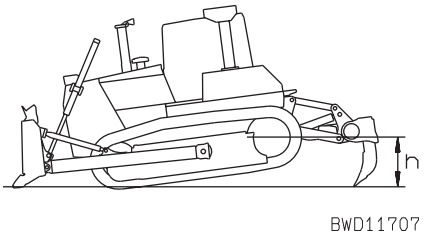
Machine model						D85EX, PX-15	
Category	Item		Measurement conditions		Unit	Standard value for new machine	Service limit value
Engine speed	Decelerator pedal speed		• Engine water temperature: Within operating range • Torque converter oil temperature: Within operating range • Hydraulic oil temperature: Within operating range • Decelerator pedal speed: Press pedal. • Auto deceleration speed: Set all equipment in neutral. • Torque converter stall speed: F3 • Torque converter stall + Work equipment relief speed: F3 + Ripper RAISE		rpm	1,025 ± 25	1,025 ± 25
	Auto deceleration speed					1,875 ± 25	1,875 ± 25
	Torque converter stall speed					1,760 ± 50	1,760 ± 50
	Torque converter stall + Work equipment relief speed					1,710 ± 50	1,710
Stroke of control lever/pedal	PCCS lever	Forward and reverse	• Stop engine. • Set lever knob to center.	Neutral → Forward	mm	30 ± 10	30 ± 10
				Neutral → Reverse		30 ± 10	30 ± 10
		Steering		Neutral → Left		40 ± 10 (Play: Max. 3)	40 ± 10 (Play: Max. 3)
				Neutral → Right		40 ± 10 (Play: Max. 3)	40 ± 10 (Play: Max. 3)
	Decelerator pedal		• Stop engine. • Set pedal to center.		mm	45 ± 15	47 ± 5
	Brake pedal		• Engine: Low idling • Set pedal to center.	All stroke	mm	77 ± 8	75 ± 8
				Stroke to 0 of oil pressure		64 ± 10	61 ± 10
	Blade lever		• Engine: Low idling • Hydraulic oil temperature: Within operating range • Set lever knob to center.	Neutral – Raise/Float	mm	72 ± 10	72 ± 10
				Neutral – Right/Left tilt		53 ± 10	53 ± 10
	Ripper lever (for EX) Forward → Neutral Reverse → Neutral		• Engine: Low idling • Hydraulic oil temperature: Within operating range • Set lever knob to center.	Neutral – Raise/Lower	mm	55 ± 10	85 ± 10
Operating effort of control lever/pedal	PCCS lever	Forward and reverse	• Stop engine. • Set lever knob to center.	Neutral → Forward Neutral → Reverse	N {kg}	56.9 ± 6.9 {5.8 ± 0.7}	56.9 ± 6.9 {5.8 ± 0.7}
				Forward → Neutral Reverse → Neutral		51 ± 6.9 {5.2 ± 0.7}	51 ± 6.9 {5.2 ± 0.7}
		Steering		Neutral → Left		24.5 ± 4.9 {2.5 ± 0.5}	24.5 ± 4.9 {2.5 ± 0.5}
				Neutral → Right		27.4 ± 4.9 {2.8 ± 0.5}	27.4 ± 4.9 {2.8 ± 0.5}
	Decelerator pedal		• Stop engine. • Set pedal to center.		N {kg}	49.0 ± 9.8 {5.0 ± 1.0}	49.0 ± 9.8 {5.0 ± 1.0}
	Brake pedal		• Engine: Low idling • Set pedal to center.		N {kg}	460.6 ± 49.0 {47.0 ± 5.0}	490.0 ± 49.0 {50.0 ± 5.0}

Machine model					D85EX, PX-15	
Category	Item	Measurement conditions		Unit	Standard value for new machine	Service limit value
Operating effort of control lever/pedal	Blade lever	• Engine: Low idling • Hydraulic oil temperature: Within operating range • Set lever knob to center.	Neutral → Raise	N {kg}	39.2 ± 9.8 {4.0 ± 1.0}	39.2 ± 9.8 {4.0 ± 1.0}
			Neutral → Float		82.3 ± 9.8 {8.4 ± 1.0}	82.3 ± 9.8 {8.4 ± 1.0}
			Neutral – Right/Left tilt		28.4 ± 9.8 {2.9 ± 1.0}	28.4 ± 9.8 {2.9 ± 1.0}
	Ripper lever (for EX)	• Engine: Low idling • Hydraulic oil temperature: Within operating range • Set lever knob to center.	Neutral – Raise/Lower	N {kg}	25.5 ± 9.8 {2.6 ± 1.0}	25.5 ± 9.8 {2.6 ± 1.0}
			Neutral – Tilt in/out		25.5 ± 9.8 {2.6 ± 1.0}	25.5 ± 9.8 {2.6 ± 1.0}
Power train oil pressure	Torque converter inlet pressure	• Torque converter oil temperature: Within operating range	Engine: Low idling	MPa {kg/cm²}	0.1 – 0.5 {1 – 5}	Max. 0.2 {Max. 2}
			Engine: High idling		Max. 1.02 {Max. 10}	0.49 – 1.0 {5 – 10}
	Torque converter outlet pressure		Engine: Low idling		0.1 – 0.31 {1 – 3}	Max. 0.2 {Max. 2}
			Engine: High idling		0.61 – 0.81 {6 – 8}	0.49 ± 0.1 {5 ± 1}
	Transmission main relief pressure	• Torque converter oil temperature: Within operating range	Engine: Low idling	MPa {kg/cm²}	2.82 – 3.02 {28.8 – 30.8}	Min. 2.65 {Min. 26.8}
			Engine: High idling		3.24 – 3.53 {23 – 36}	Min. 3.04 {Min. 31}
	Transmission F clutch pressure		Engine: Low idling		2.16 – 2.45 {22 – 25}	Min. 1.96 {Min. 20}
			Engine: High idling		2.16 – 2.45 {22 – 25}	Min. 1.96 {Min. 20}
	Transmission R clutch pressure		Engine: Low idling		2.75 – 3.02 {28 – 30.8}	Min. 2.55 {Min. 26}
			Engine: High idling		2.75 – 3.04 {28 – 31}	Min. 2.55 {Min. 26}
	Transmission 1st clutch pressure		Engine: Low idling		2.35 – 2.65 {24 – 27}	Min. 2.16 {Min. 22}
			Engine: High idling		2.35 – 2.65 {24 – 27}	Min. 2.16 {Min. 22}
	Transmission 2nd clutch pressure		Engine: Low idling		2.55 – 2.84 {26 – 29}	Min. 2.35 {Min. 24}
			Engine: High idling		2.55 – 28.4 {26 – 29}	Min. 2.35 {Min. 24}
	Transmission 3rd clutch pressure		Engine: Low idling		2.75 – 3.02 {28 – 30.8}	Min. 2.55 {Min. 26}
			Engine: High idling		2.75 – 3.04 {28 – 31}	Min. 2.55 {Min. 26}
	Transmission lubricating oil pressure (For reference)		Engine: High idling		0.1 – 0.25 {1.0 – 2.5}	0.1 – 0.25 {1.0 – 2.5}
	Steering brake pressure		Engine: Low idling		2.75 – 2.94 {28 – 30}	Min. 2.26 {Min. 23}
			Engine: High idling		2.75 – 2.94 {28 – 30}	Min. 2.45 {Min. 25}

Machine model						D85EX, PX-15	
Category	Item	Measurement conditions			Unit	Standard value for new machine	Service limit value
HSS pressure	Relief pressure	• Hydraulic oil temperature: Within operating range • Engine: High idling			MPa {kg/cm²}	38.2 – 41.7 {390 – 425}	38.2 – 41.7 {390 – 425}
	LS pressure (Lood sensing pressure)					36.2 – 38.1 {369 – 389}	36.2 – 38.1 {369 – 389}
Performance of power train	Travel speed	• Flat road • Engine water temperature: Within operating range • Torque converter oil temperature: Within operating range • Engine: High idling • Run up distance: 10 – 30m • Measuring distance: 20m	EX	F1	km/h	3.6 ± 0.2	3.6 ± 0.2
				F2		6.1 ± 0.3	6.1 ± 0.3
				F3		10.1 ± 0.5	10.1 ± 0.5
				R1		4.7 ± 0.2	4.7 ± 0.2
				R2		8.0 ± 0.4	8.0 ± 0.4
				R3		13.0 ± 0.7	13.0 ± 0.7
			PX	F1	km/h	3.8 ± 0.2	3.8 ± 0.2
				F2		6.7 ± 0.3	6.7 ± 0.3
				F3		11.2 ± 0.6	11.2 ± 0.6
				R1		4.9 ± 0.2	4.9 ± 0.2
				R2		8.7 ± 0.4	8.7 ± 0.4
				R3		14.9 ± 0.7	14.9 ± 0.7
Work equipment oil pressure	Unload pressure	• Hydraulic oil temperature: Within operating range • Unload pressure: Set all equipment in neutral. • Relief pressure: Set cylinder to stroke end. • LS pressure: Set cylinder to stroke end.	Engine: Low idling		MPa {kg/cm²}	—	—
			Engine: High idling			$2.45\ ^{+1.37}_{0}$ $\{25\ ^{+14}_{0}\}$	$2.45\ ^{+1.37}_{0}$ $\{25\ ^{+14}_{0}\}$
	Blade lift relief pressure		Engine: Low idling			21.6 ± 1.18 {220 ± 12}	22.54 ± 1.18 {230 ± 12}
			Engine: High idling			22.54 ± 1.18 {230 ± 12}	22.54 ± 1.18 {230 ± 12}
	Blade tilt relief pressure		Engine: Low idling			21.6 ± 1.18 {220 ± 12}	22.54 ± 1.18 {230 ± 12}
			Engine: High idling			22.54 ± 1.18 {230 ± 12}	22.54 ± 1.18 {230 ± 12}
	Ripper lift relief pressure (for EX)		Engine: Low idling			22.54 ± 1.18 {230 ± 12}	22.54 ± 1.18 {230 ± 12}
			Engine: High idling			22.54 ± 1.18 {230 ± 12}	22.54 ± 1.18 {230 ± 12}
	LS pressure (Load sensing pressure)		Engine: Low idling			20.2 ± 0.98 {206 ± 10}	20.2 ± 0.98 {206 ± 10}
			Engine: High idling			20.2 ± 0.98 {206 ± 10}	20.2 ± 0.98 {206 ± 10}
	Control circuit main pressure (HSS, PPC, fan)	• Hydraulic oil temperature: Within operating range • Engine: High idling			MPa {kg/cm²}	$3.97\ ^{+0.49}_{0}$ $\{40.5\ ^{+5}_{0}\}$	$3.97\ ^{+0.49}_{-0.20}$ $\{40.5\ ^{+5}_{-2}\}$
	PPC valve output pressure					3.82 – 4.12 {39 – 42}	3.82 – 4.12 {39 – 42}

Machine model							D85EX, PX-15	
Category	Item		Measurement conditions			Unit	Standard value for new machine	Service limit value
Work equipment	Work equipment speed	Blade lift	 BWD10501 • Hydraulic oil temperature: 45 – 55°C • Apply no load to blade. • Between ground level and rising end of blade	Raise	Low idling	sec	8 – 15	20
					High idling		EX: 2.5 – 4.5 PX: 2.2 – 4.2	5.5 5.2
				Lower	Low idling		1.0 – 1.7	2.2
					High idling		1.0 – 1.7	2.2
		Blade tilt	 BWD10502 • Hydraulic oil temperature: 45 – 55°C • Apply no load to blade. • Between left tilt end and right tilt end	Left tilt	Low idling	sec	3 – 5	7
					High idling		2.7 ± 0.5	3.5
				Right tilt	Low idling		3 – 5	7
					High idling		2.2 ± 0.5	3.5
		Ripper lift (for EX)	 BWD11704 • Hydraulic oil temperature: 45 – 55°C • Apply no load to ripper. • Between ground level and rising end of blade	Raise	Low idling	sec	7 – 10	13
					High idling		2.5 ± 0.5	4.0
				Lower	Low idling		2 – 3	4.0
					High idling		1.5 ± 0.5	4.0
	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.		Low idling	sec	Max. 8	11
					High idling		Max. 1.8	2.5
		Ripper (for EX)	• Hydraulic oil temperature: 45 – 55°C • Move lever to stroke end. • Lower ripper from max. rising position and measure time after ripper comes in contact with ground until sprocket is lifted.		Low idling		Max. 6	8
					High idling		Max. 1.5	2.5

Machine model					D85EX, PX-15	
Category	Item		Measurement conditions	Unit	Standard value for new machine	Service limit value
Work equipment	Hydraulic drift	Hydraulic drift of lifted blade	 • Hydraulic oil temperature: 45 – 55°C • Engine: Stopped • Measure reduction of blade bottom height h (for 15 minutes).	mm	Max. 200/15 minutes	300/15 minutes
		Hydraulic drift of machine lifted by blade	 • Hydraulic oil temperature: 45 – 55°C • Engine: Stopped • Measure reduction of idler center height h (for 5 minutes).		Max. 50/5 minutes	100/15 minutes
		Hydraulic drift of machine tilted by blade	 • Hydraulic oil temperature: 45 – 55°C • Engine: Stopped • Measure reduction of idler center height h (for 5 minutes).		Max. 50/5 minutes	100/15 minutes
	Hydraulic drift	Hydraulic drift of lifted ripper (for EX)	 • Hydraulic oil temperature: 45 – 55°C • Engine: Stopped • Measure reduction of shank bottom height h (for 15 minutes).	mm	Max. 80/15 minutes	160/15 minutes

Machine model						D85EX, PX-15	
Category	Item		Measurement conditions		Unit	Standard value for new machine	Service limit value
Work equipment	Hydraulic drift	Hydraulic drift of machine lifted by ripper (for EX)	 BWD11707 • Hydraulic oil temperature: 45 – 55°C • Engine: Stopped • Measure reduction of sprocket center height h (for 5 minutes).		mm	Max. 50/5 minutes	100/5 minutes
	Leakage from cylinder	Blade tilt cylinder	• Engine: High idling • Hydraulic oil temperature: 45 – 55°C • Relieve cylinder and measure leakage for 1 minute.		cc/min	4	16
		Ripper lift cylinder (for EX)				4	16
		Ripper tilt cylinder (for EX)				4	16
Cooling fan	Fan speed		• Fan 100% speed mode • Engine: Low idling	Min. speed	rpm	800 ± 50	400
			• Fan 100% speed mode • Engine: High idling	Max. speed		1,500 ± 50	1,400
	Fan pump pressure		• Fan 100% speed mode • Engine: High idling		MPa {kg/cm^2}	11.8 – 14.7 {120 – 150}	16.17 – 19.11 {165 – 195}

TESTING AND ADJUSTING

⚠ When carrying out testing, adjusting, or troubleshooting, park the machine on level ground and use the safety pins and blocks to prevent the machine from moving.

⚠ When carrying out work together with other workers, always use signals and do not let unauthorized people near the machine.

⚠ When checking the water level, always wait for the water to cool down. If the radiator cap is removed when the water is still hot, the water will spurt out and cause burns.

⚠ Be careful not to get caught in the fan, fan belt, or other rotating parts.

TOOLS FOR TESTING, ADJUSTING, AND TROUBLESHOOTING

Check or measurement item	Symbol		Part No.	Part name	Remarks
Boost pressure	A		799-201-2202	Boost gauge kit	-101 – 200kPa {-760 – 1,500mmHg}
Water temperature, Oil temperature, exhaust temperature	B		799-101-1502	Digital temperature gauge	-99.9 – 1,299°C
Exhaust color	C	1	799-201-9000	handy smoke checker	Discoloration 0 – 70% (with standard color) (Discoloration x 1/10 ≒ Boost index)
		2	Commercially available	Smoke meter	
Valve clearance	D		Commercially available	Feeler gauge	Intake valve : 0.33mm, Exhaust valve : 0.71mm
Compression pressure	N	1	795-502-1590	Compression gauge	0 – 6.9MPa {0 – 70kg/cm^2} Kit part No. : 795-502-1205
		2	795-471-1410	Adapter	
Blow-by pressure	E	1	799-201-1504	Blow-by checker	
		2	799-201-1590	Gauge	0 – 9.81kPa {0 – 1,000mmH_2O}
Engine oil pressure, Fuel pressure, Power train pressure	F	1	799-101-5002	Hydraulic tester	Pressure gauge : 2.5, 5.9, 39.2, 58.8 MPa {25, 60, 400, 600kg/cm^2}
			790-261-1203	Digital hydraulic tester	Pressure gauge : 58.8MPa {600kg/cm^2}
		2	799-401-2320	Hydraulic gauge	Pressure gauge : 0.98MPa {10kg/cm^2}
HST pressure, Work equipment pressure	G	1	799-101-5002	Hydraulic tester	Pressure gauge : 2.5, 5.9, 39.2, 58.8 MPa {25, 60, 400, 600kg/cm^2}
			790-261-1203	Digital hydraulic tester	Pressure gauge : 58.8MPa {600kg/cm^2}
		2	799-101-5220	Nipple	10 x 1.25mm
			07002-11023	O-ring	
Emergency escape when power train has trouble	H	1	19M-06-32820	Switch assembly	
			17M-06-41530	Wiring harness	
		2	790-190-1600	Pump assembly	
		3	07235-10314	Elbow	
			07002-11823	O-ring	
Control circuit main pressure Outlet pressure of ripper pin pulled solenoid valve	J	1	799-101-5002	Hydraulic tester	Pressure gauge : 2.5, 5.9, 39.2, 58.8 MPa {25, 60, 400, 600kg/cm^2}
			790-261-1203	Digital hydraulic tester	Pressure gauge : 58.8MPa {600kg/cm^2}
		2	799-401-3200	Adapter	Face seal type (#03)
			02896-11009	O-ring	

Check or measurement item	Symbol		Part No.	Part name	Remarks
PPC valve outlet pressure	K	1	799-101-5002	Hydraulic tester	Pressure gauge : 2.5, 5.9, 39.2, 58.8 MPa {25, 60, 400, 600kg/cm^2}
			790-261-1203	Digital hydraulic tester	Pressure gauge : 58.8MPa {600kg/cm^2}
		2	799-401-3100	Adapter	Face seal type (#02)
			02896-11008	O-ring	
		3	799-401-3200	Adapter	Face seal type (#03)
			02896-11009	O-ring	
Oil leakage of Work equipment cylinder	L		Commercially available	Mess cylinder	100cc
Fan motor speed	M		799-203-8001	Multi-tachometer	Digital display L : 60 – 2,000rpm H : 60 – 19,999rpm
Fan pump circuit oil pressure	P	1	799-101-5002	Hydraulic tester	Pressure gauge : 2.5, 5.9, 39.2, 58.8 MPa {25, 60, 400, 600kg/cm^2}
			790-261-1203	Digital hydraulic terter	Pressure gauge : 58.8MPa {600kg/cm^2}
		2	799-401-3300	Adapter	Face seal type (#04)
			02896-11012	O-ring	
Operating effort	Q		79A-264-0021	Push-pull scale	0 – 294N {0 – 30kg}
			79A-264-0091	Push-pull scale	0 – 490N {0 – 50kg}
Stroke, hydraulic drift	R		Commercially available	Scale	
Work equipment speed	S		Commercially available	Stopwatch	
Measuring voltage, resistance value	T		Commercially available	Tester	
Troubleshooting of wiring harness, sensor	U	1	799-601-7400	T-ADAPTER KITS	
			799-601-7360	Adapter	For relay (5-pin)
		2	799-601-9000	T-adapter kits	For DT connector
		3	799-601-9300	T-adapter kits	For DT connector (24-pin, 40-pin)
		4	799-601-9410	Socket	For NE sensor, G sensor
			799-601-9420	Adapter	For boost pressure sensor, Fuel pressure sensor
			799-601-9430	Socket	For PCV solenoid

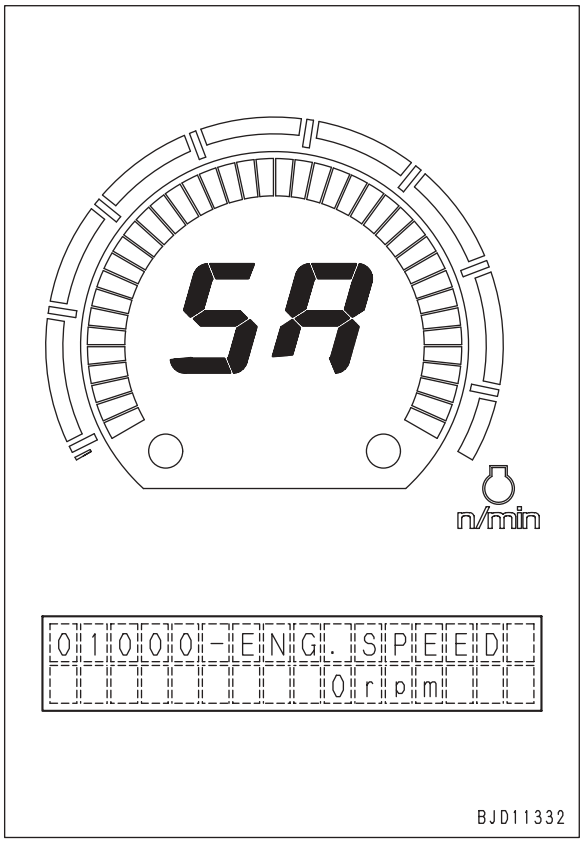
MEASURING ENGINE SPEED

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

1. Preparation 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 idling speed

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

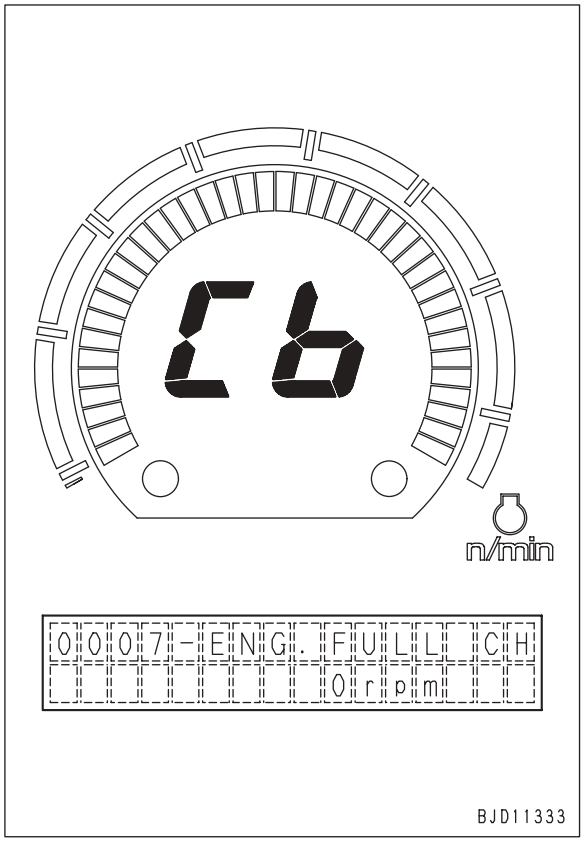
3. Measuring high idling speed

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

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

★ When measuring the high idling speed of the engine, use the “Adjustment mode”.

Adjustment code: **0007** (Engine decelerator cut mode)



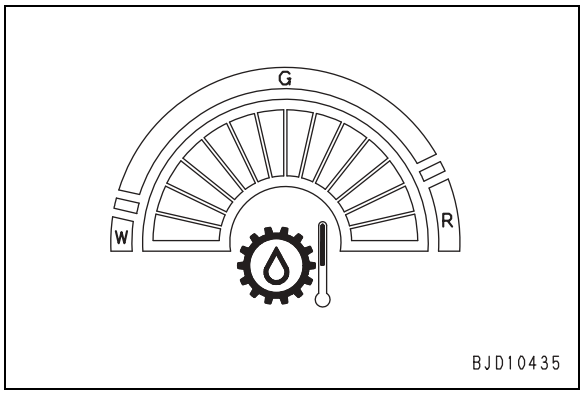
4. Measuring decelerator pedal speed

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

5. Measuring torque converter stall speed

1) Start the engine and set the fuel control dial in the low idling position.
2) Press the brake pedal securely and set the parking brake lever in the FREE position and 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 idling position.
4) Return the decelerator pedal slowly to stall the torque converter with the engine at high idling.

   ⚠ 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.

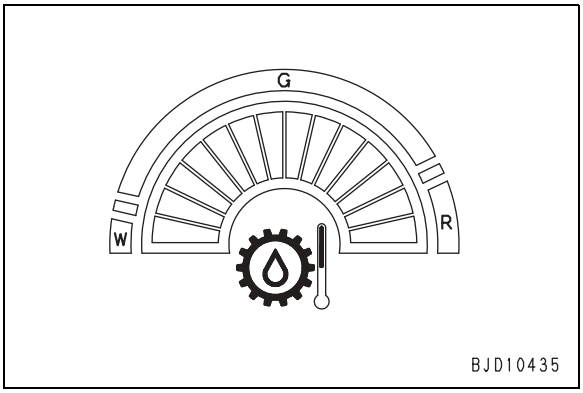


6) Repeat above steps 2) – 5) 3 times.
7) Perform steps 2) – 4) again and measure the engine speed about 5 seconds after the power train oil temperature gauge reads the top line of the green range.
   - ★ After finishing measurement, return the direction of the PCCS lever into neutral and lower the power train oil temperature with the engine at high idling.

6. Torque converter stall + Work equipment relief speed (Full stall speed)

1) Start the engine and set the fuel control dial in the low idling position and raise the ripper to the stroke end.
2) Keep pressing the brake pedal securely and set the parking brake lever in the FREE position and 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**].
   - ★ Set the steering unit in neutral.
3) Press the decelerator pedal and set the fuel control dial in the high idling position.
4) Return the decelerator pedal slowly to stall the torque converter with the engine at high idling.

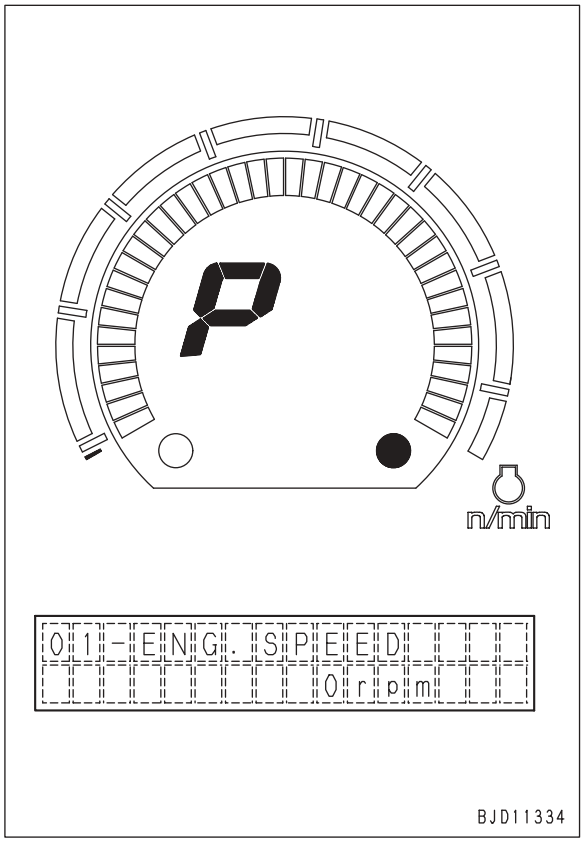
   ⚠ Keep pressing the brake pedal securely and keep your right foot on the decelerator pedal for safety until the work is finished.
5) Just after the power train oil temperature gauge reads the top line of the green range, return the direction of the PCCS lever into neutral.



6) Repeat above steps 2) – 5) 3 times.

7) Perform steps 2) – 4) again and relieve the ripper in the raising direction 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 idling.

★ The engine speed can be measured in the “Pm Clinic auxiliary mode” of the monitor panel (Measure the high idling speed of the engine in the “Adjustment mode”, however).



MEASURING INTAKE AIR PRESSURE (BOOST PRESSURE)

★ Measuring instruments for intake air pressure (boost pressure)

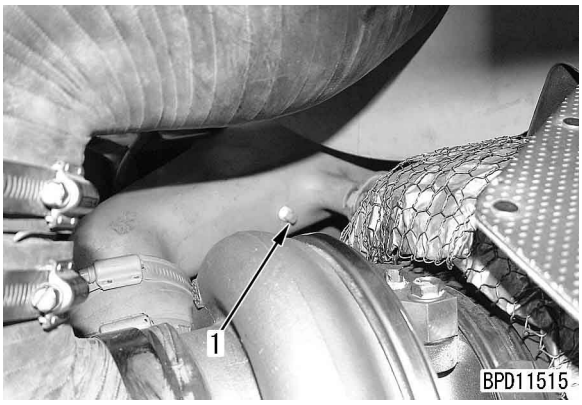
Symbol	Part No.	Name
A	799-201-2202	Boost gauge kit

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

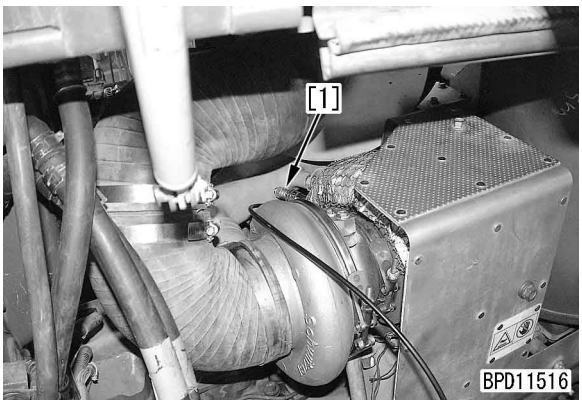
★ Measure the intake air pressure (boost pressure) under the following condition.
- Engine water temperature: Within operating range
- Power train oil temperature: Within operating range
- Hydraulic oil temperature: Within operating range

1. Open the right side cover of the engine.

2. Remove air intake connector boost pressure pick-up plug (1).

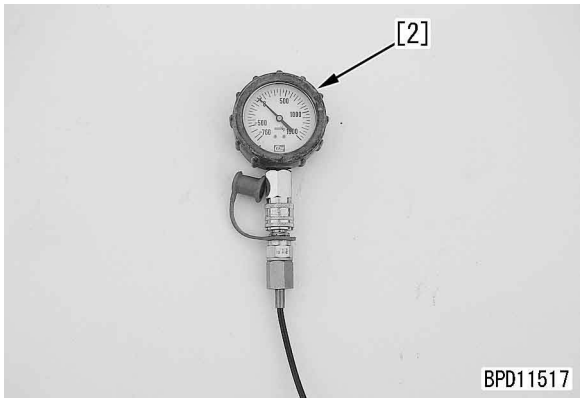


3. Install nipple [1] of boost gauge kit **A** and connect gauge [2].



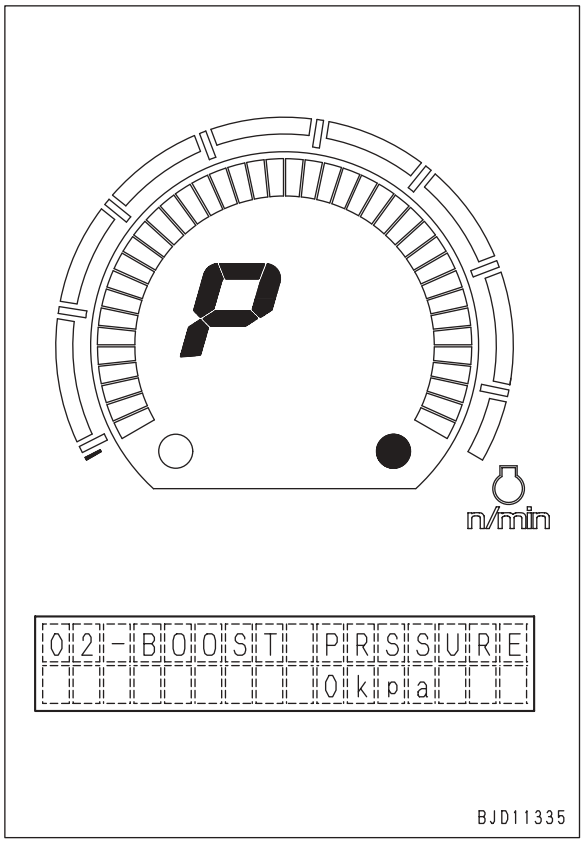
4. Run the engine at medium or higher speed and drain the oil from the hose.
   ★ Insert the joint of the gauge and hose halfway and open the self-seal on the hose side repeatedly, and the oil is drained.
   ★ If Pm kit (A) is available, the air bleeding coupling (790-261-1130) in it may be used.
  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

5. Run the engine at high idling and stall the torque converter and measure the intake air pressure (boost pressure) at this time.
   ★ 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 operated 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 return the removed parts.

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



MEASURING EXHAUST TEMPERATURE

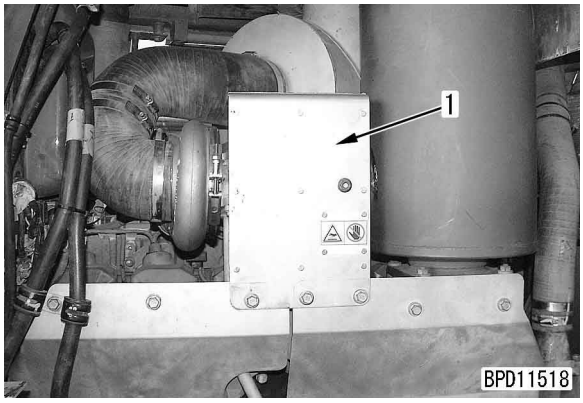
★ Measuring instrument for exhaust temperature

Symbol	Part No.	Name
B	799-101-1502	Digital thermometer

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

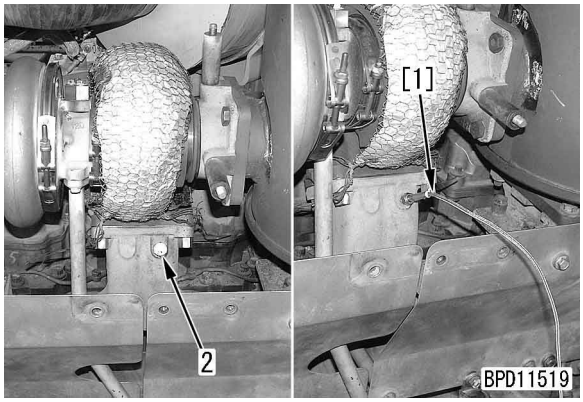
★ Measure the exhaust temperature under the following condition.
- Engine water temperature: Within operating range
- Power train oil temperature: Within operating range
- Hydraulic oil temperature: Within operating range

1. Open the right side cover of the engine and remove turbocharger heat insulation cover (1).

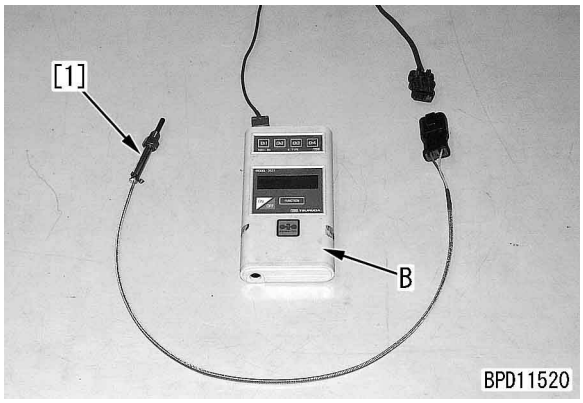


2. Remove exhaust temperature pick-up plug (2).

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



4. Procedure for measuring maximum exhaust temperature 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 outside air temperature (intake air temperature of the engine). Accordingly, if any abnormal value is obtained, correct it by the following calculation.
   - Corrected value [°C] = Measured value + 2 x (20 – Outside air temperature)

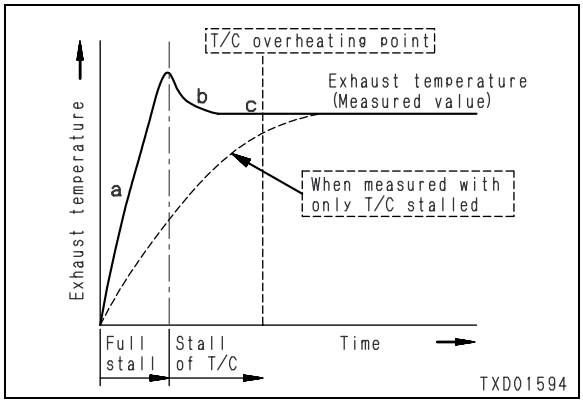


5. Procedure for measuring exhaust temperature periodically for preventive maintenance
   ★ If the torque converter is stalled simply, the torque converter oil temperature is overheated before the exhaust temperature is stabilized. Accordingly, measure according to the following procedure.
   1) Stall the torque converter fully to raise the exhaust temperature to about 650×C according to the following procedure (Condition **a** in the figure).
      i) Start the engine and set the fuel control dial to the low idling position. Raise the ripper lift cylinder to the stroke end with the ripper lever.
      ii) Press the brake pedal securely and set the PCCS lever in the FORWARD 3rd gear speed position.
      iii) Press the decelerator pedal and set the fuel control dial to the high idling position.
      iv) Return the decelerator pedal slowly to stall the torque converter and relieve the ripper in raising direction with the engine at high idling.

⚠ Press 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 ripper and lower the exhaust temperature by only stalling the torque converter (Condition **b** in the figure).
   ★ If the temperature does not lower but rises, set the 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.



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

MEASURING EXHAUST GAS COLOR

★ Measuring instrument for exhaust gas color

Symbol		Part No.	Name
C	1	799-201-9000	Handy smoke checker
	2	Purchased	Smoke meter

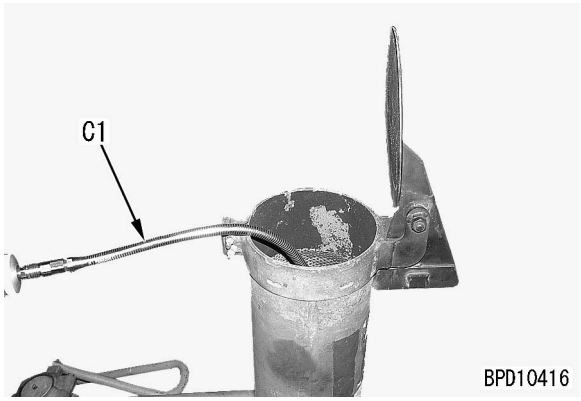
⚠ When installing and removing the measuring instrument, take care not to touch a hot part.

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

★ Measure the exhaust gas color under the following condition.
   • Engine water temperature:
     Within operating range

1. Measuring with handy smoke checker C1

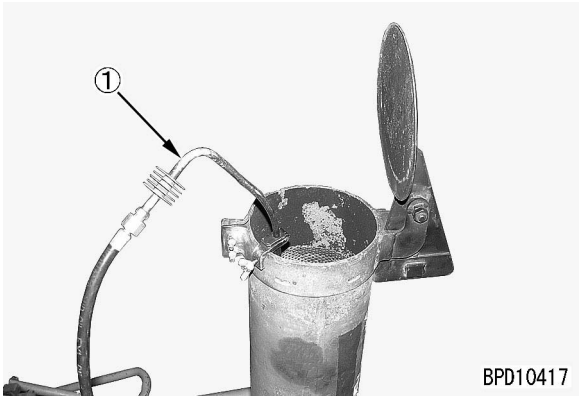
1) Stock a sheet of filter paper to **C1**.
2) Insert the exhaust gas intake pipe in the exhaust pipe.
3) Start the engine.
4) Accelerate the engine suddenly or run it at high idling and operate the handle of smoke checker **C1** so that the filter paper will absorb the exhaust gas.



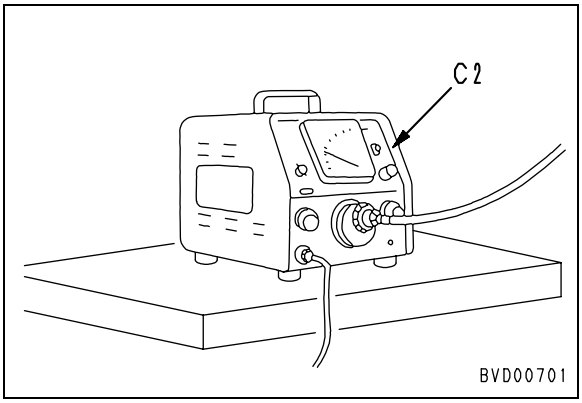
5) Remove the filter paper and compare it with the attached scale.
6) After finishing measurement, remove the measuring instrument and return the removed parts.

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**.
   ★ Limit the supplied air pressure to 1.5MPa {15kg/cm^2}.
3) Connect the power cable to a receptacle of AC power supply.
   ★ 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**.



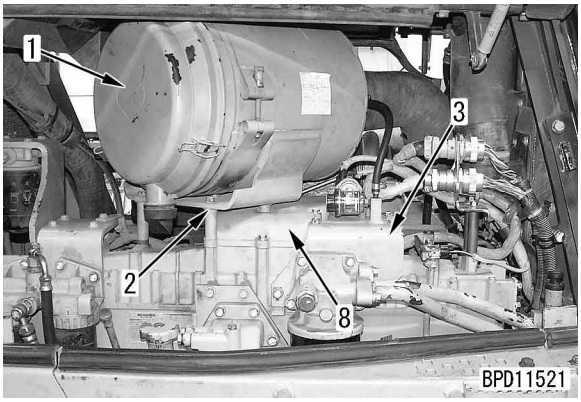
6) Start the engine.
7) Accelerate the engine suddenly or run it at high idling and press the accelerator pedal of smoke meter **C2** and collect the exhaust gas into the filter paper.
8) Place the contaminated filter paper on the clean filter paper (at least 10 sheets) in the filter paper holder and read the indicated value.
9) After finishing measurement, remove the measuring instrument and return the removed parts.

ADJUSTING VALVE CLEARANCE

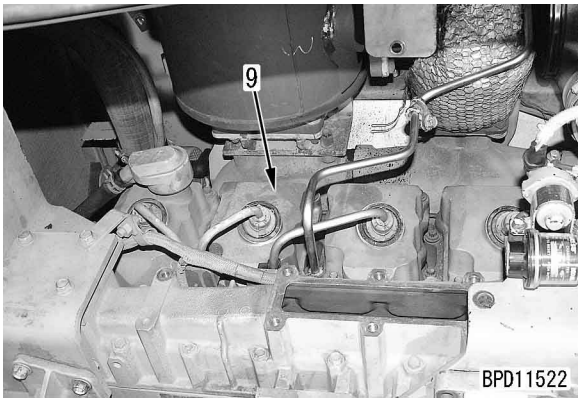
★ Adjusting instrument for valve clearance

Symbol	Part No.	Name
D	Purchased	Filler gauge

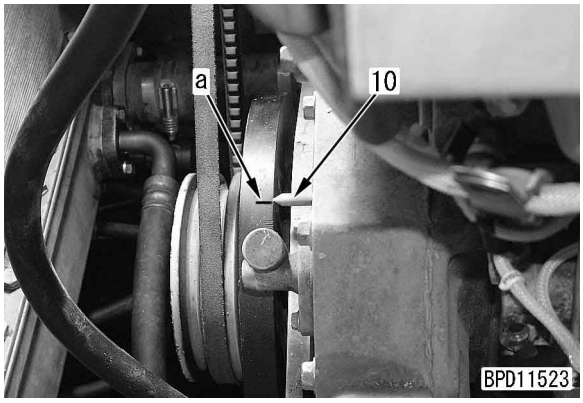
1. Open the engine left side cover.
2. Remove air cleaner (1) and bracket (2).
3. Move bracket (3) back and remove air intake connector (8).



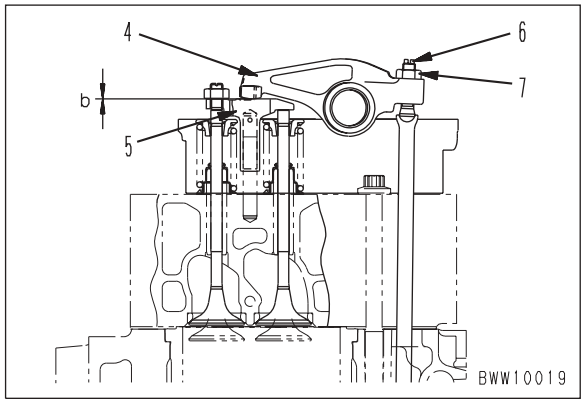
4. Remove all cylinder head covers (9).
   ★ The cylinder head covers cannot be removed completely because of the fuel high-pressure tube. Move them toward the air intake manifold without removing them from the tube.



5. Rotate the crankshaft forward to bring the stamped 1.6TOP line **a** to pointer (10) and set the No. 1 cylinder to the top dead center.
   ★ Use the damper mounting bolt to rotate the crankshaft.
   ★ When the No. 1 cylinder is at the compression top dead center, the rocker arms on both intake side and exhaust side can be moved by the valve clearance with the hand. If the rocker arms cannot be moved, rotate the crankshaft one more turn.



6. Insert filler gauge **D** in clearance "b" between rocker arm (4) and crosshead (5) and adjust the valve clearance with adjustment screw (6).
   ★ With the filler gauge inserted, turn the adjustment screw so that you can move the filler gauge lightly.
7. Fixing adjustment screw (6), tighten locknut (7).
   Locknut: **53.0 – 64.7 Nm {5.4 – 6.6 kgm}**
   ★ After tightening the locknut, check the valve clearance again.



8. Turn the crankshaft forward by 120 degrees each time and adjust the clearances of the air intake valve and exhaust valve of each cylinder according the firing order.
   ★ Firing order: 1 – 5 – 3 – 6 – 2 – 4

9. After finishing adjustment, return the removed parts.
   - Cylinder head cover mounting bolt:
     9.8 ± 1.0 Nm {1.0 ± 0.1 kgm}
   - Air intake connector hose clamp bolt:
     6.8 ± 0.49 Nm {69 ± 5 kgcm}
   - Air cleaner air intake hose clamp bolt:
     8.8 ± 0.5 Nm {0.9 ± 0.05 kgm}
   - Air cleaner band bolt:
     9.8 – 11.76 Nm {1.0 – 1.2 kgm}

MEASURING COMPRESSION PRESSURE

★ Measuring instruments for compression pressure

Symbol		Part No.	Name	Q'ty	Remarks
N	1	795-502-1590	Compression gauge	1	0 – 0.9MPa {0 – 70kg/cm^2} Kit No.: 795-502-1205
	2	795-471-1410	Adapter	1	

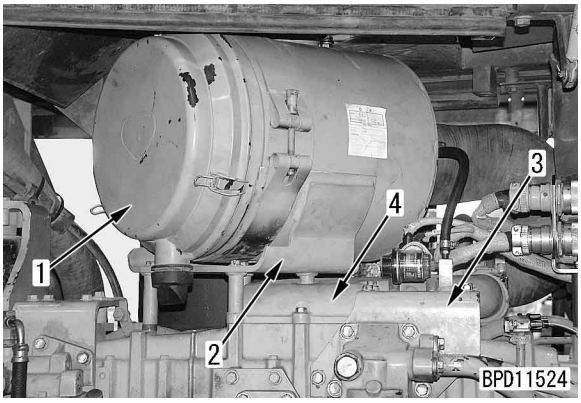
⚠ When measuring the compression pressure, take care not to burn yourself on the exhaust manifold, muffler, etc. or get caught in a rotating part.

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

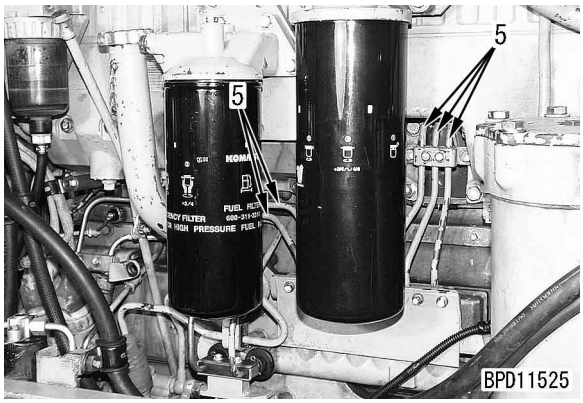
1. Open the engine left upper side cover and remove the lower side cover.

2. Remove air cleaner (1) and bracket (2).

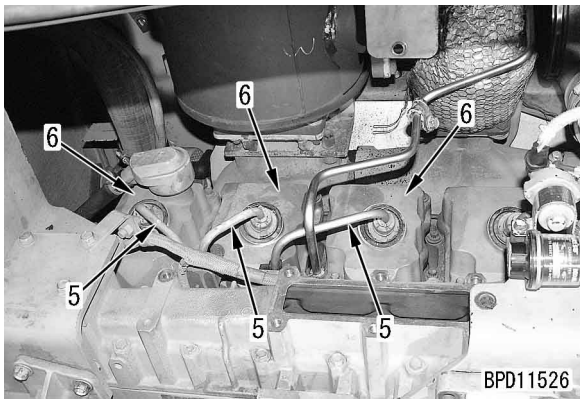
3. Move bracket (3) back and remove air intake connector (4).



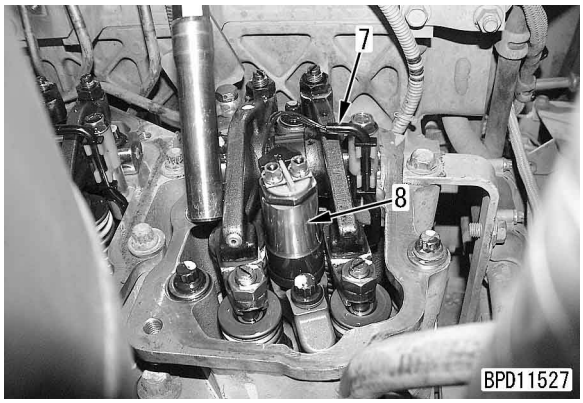
4. Remove all of 6 fuel high-pressure tubes (5), and then remove the all clamps so that the tubes can be moved.
   - Common rail side



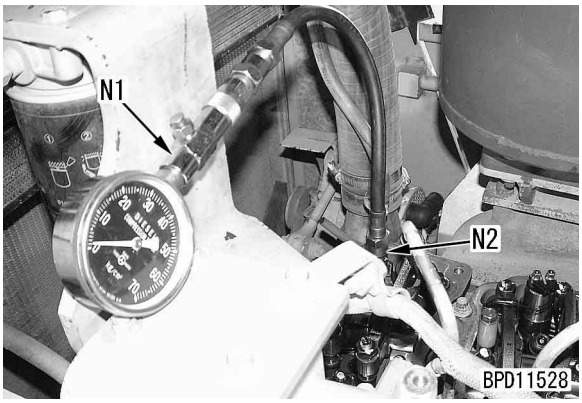
5. Remove 6 cylinder head covers (6).
   - Head side



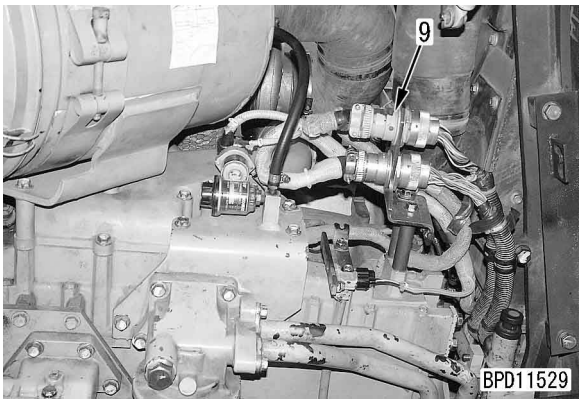
6. Remove wiring harness (7) and injector assembly (8).



7. Install adapter **N2** and connect it to compression gauge **N1**.
   ★ Leakage can be prevented by applying a little amount of engine oil to the fitting faces of the adapter and gauge.
   ★ Secure the adapter with the injector holder.



8. Disconnect concentrated connector (9) (E21) for the engine.
   ⚠ Disconnect the concentrated connector for safety, although the fuel high-pressure tube is disconnected.
   ⚠ Cover the connector on the controller side with a vinyl sheet, etc. to prevent electric leakage and grounding fault.



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

10. After finishing measurement, return the removed parts.

Injector assembly mounting bolt:
58.8 – 73.5 Nm {6.0 – 7.5 kgm}

Fuel high-pressure tube sleeve nut:
39.2 – 49.0 Nm {4.0 – 5.0 kgm}

Cylinder head cover mounting bolt:
9.8 ± 1.0 Nm {1.0 ± 0.1 kgm}

Air intake connector hose clamp bolt:
6.8 ± 0.49 Nm {69 ± 5 kgcm}

Air cleaner air intake hose clamp bolt:
8.8 ± 0.5 Nm {0.9 ± 0.05 kgm}

Air cleaner band bolt:
9.8 – 11.76 Nm {1.0 – 1.2 kgm}

MEASURING BLOW-BY PRESSURE

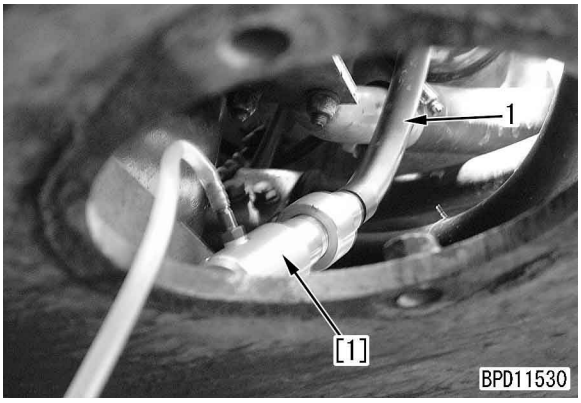
★ Measuring instrument for blow-by pressure

Symbol	Part No.	Name
E	799-201-1504	Blow-by kit

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

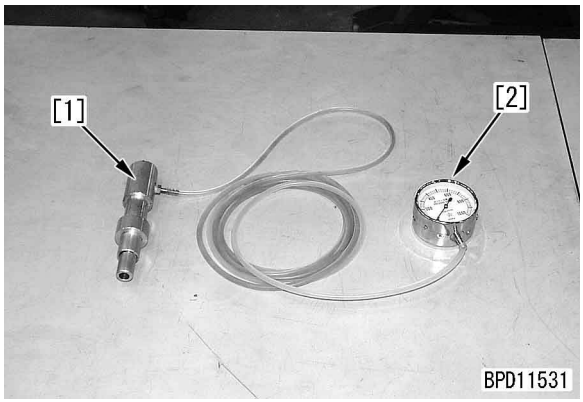
1. Remove the radiator drain cock cover.

2. Install nozzle [1] of blow-by checker **E** to blow-by hose (1) and connect them to gauge [2].



3. Run the engine at high idling, stall the torque converter, and measure the blow-by pressure.
   ★ 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 idling.
   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, deterioration of oil, high deterioration speed of oil, etc. which are related to the abnormal blow-by pressure.



4. After finishing measurement, remove the measuring instrument and return the removed parts.

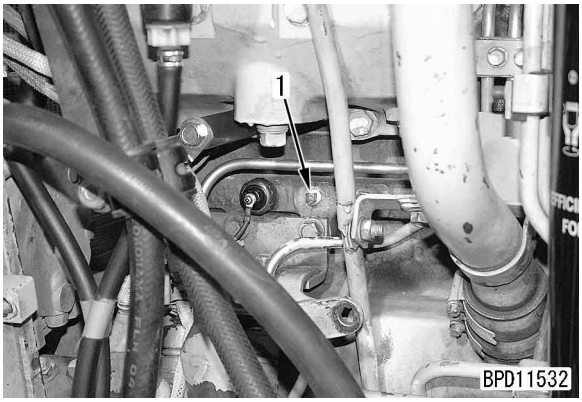
MEASURING ENGINE OIL PRESSURE

★ Measuring instruments for engine oil pressure

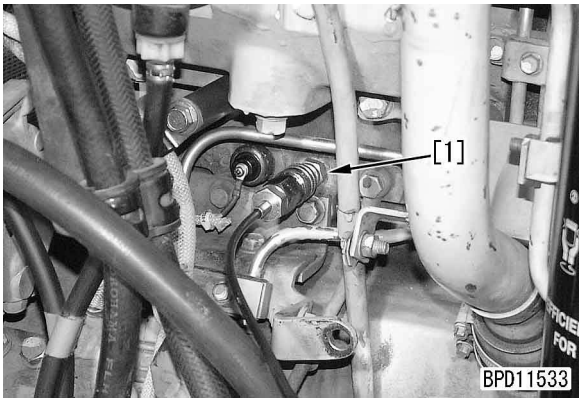
Symbol		Part No.	Name
F	1	799-101-5002	Hydraulic tester
		790-261-1203	Digital hydraulic tester
	2	799-401-2320	Hydraulic tester (1.0MPa {10kg/cm^2})

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

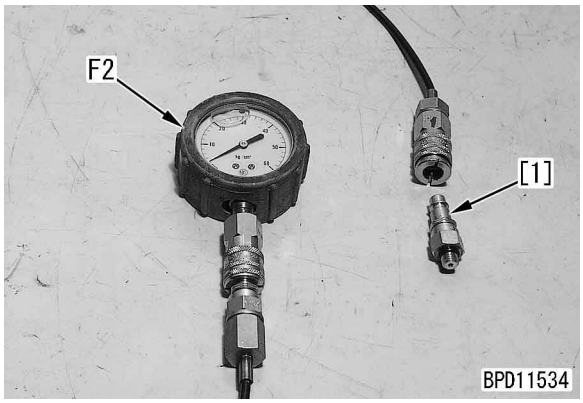
1. Open the left side cover of the engine and remove plug (1) RC 1/8.



2. Install nipple [1] of hydraulic tester **F1** and connect them to hydraulic tester **F2**.



3. Run the engine at low idling and high idling and measure the engine oil pressure in each speed.



4. After finishing measurement, remove the measuring instruments and return the removed parts.

HANDLING OF FUEL SYSTEM DEVICES

★ Precautions for testing and adjusting 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 adjusting 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 cartrige
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:
Feed pump – Fuel 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.)

MEASURING FUEL PRESSURE

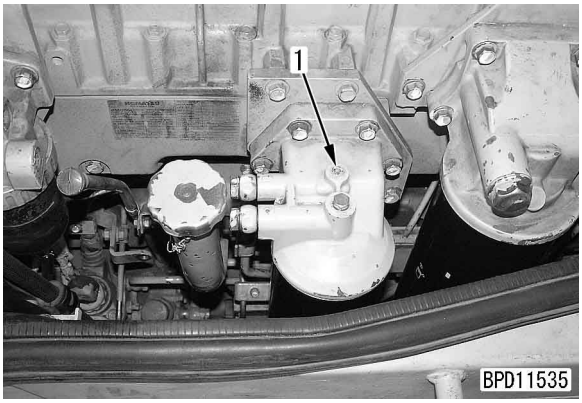
★ Measuring instrument for fuel pressure

Symbol		Part No.	Name
F	1	799-101-5002	Hydraulic tester
		790-261-1203	Digital hydraulic tester
	2	799-401-2320	Hydraulic tester (1.0MPa {10kg/cm^2})

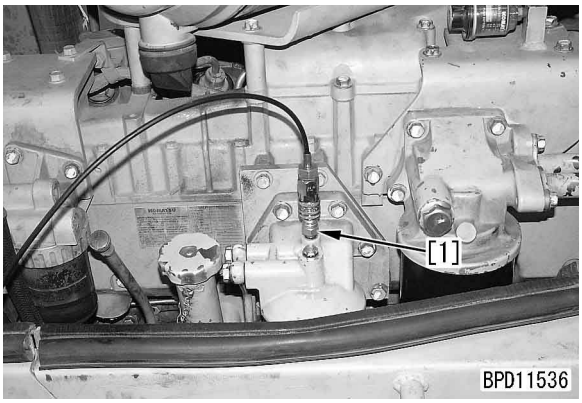
★ Measure only the fuel pressure in the low-pressure circuit from the feed pump to the fuel filter and fuel supply pump.

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

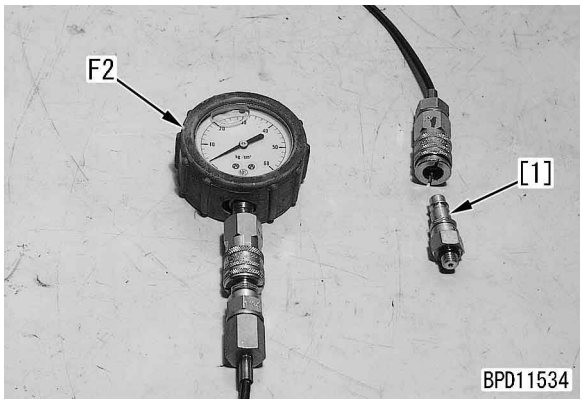
1. Open the left side cover of the engine and remove fuel pressure pick-up plug (1).



2. Install nipple [1] of hydraulic tester **F1** and connect them to hydraulic tester **F2**.

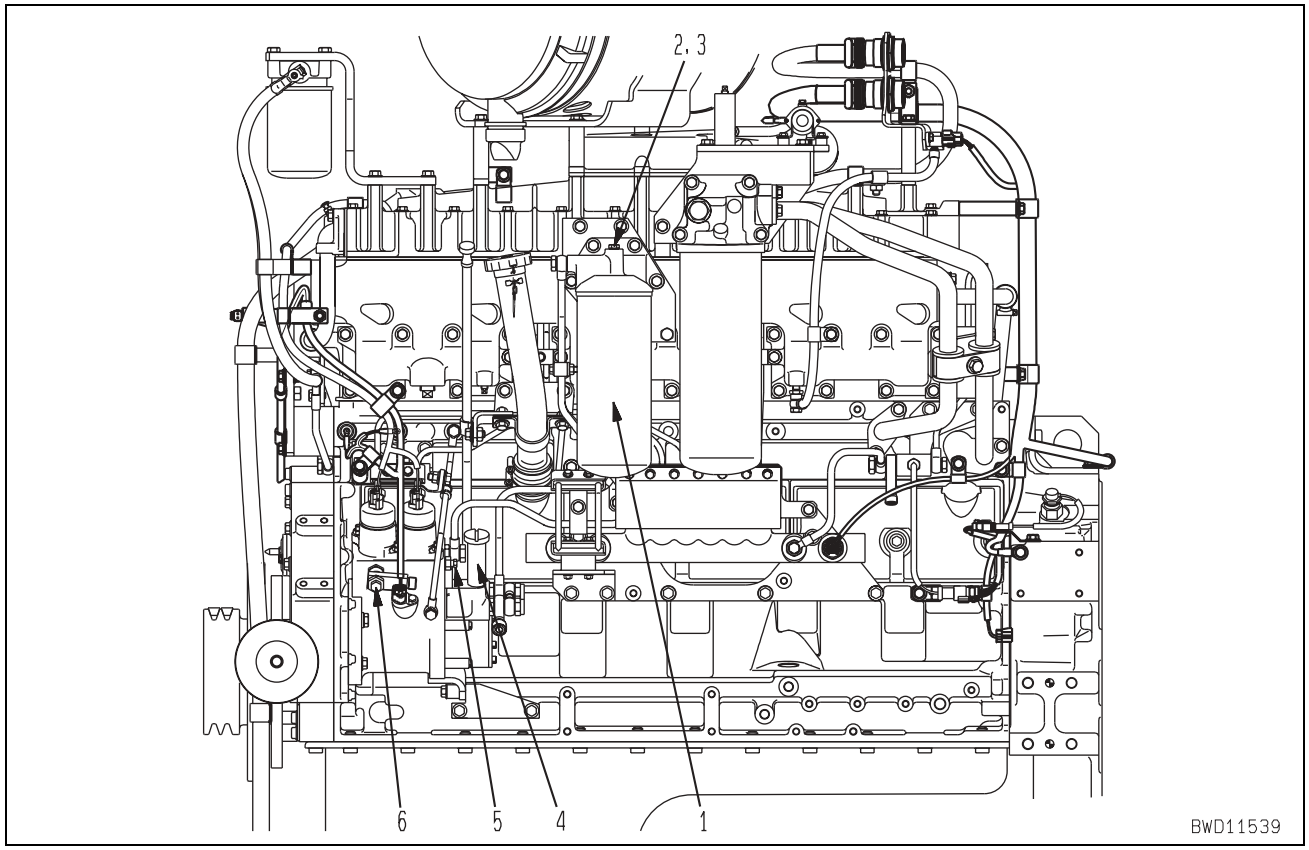


3. Run the engine at high idling and measure the fuel pressure.
   ★ For the standard value, see Troubleshooting when error code is displayed (Error code AD10L3).



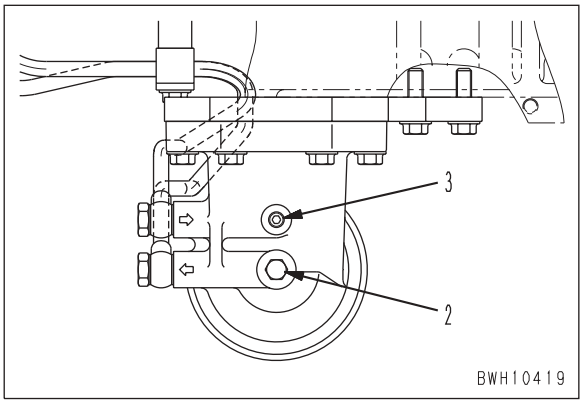
4. After finishing measurement, remove the measuring instruments and return the removed parts.

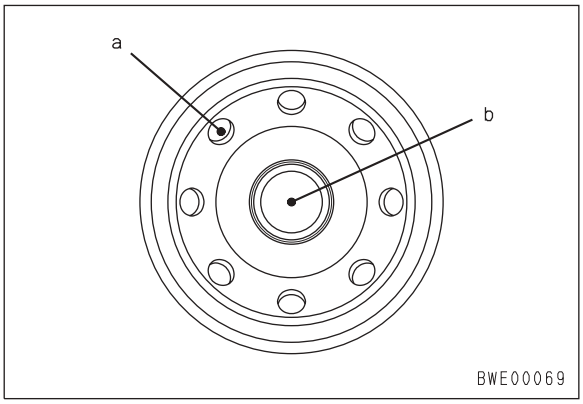
BLEEDING AIR FROM FUEL CIRCUIT



★ Bleeding the air as follows if the engine has run out of fuel or the fuel circut equipment has been removed and installed.

1. Remove fuel filter (1), fill with fuel, then install again.
   ★ When filling, use clean fuel and be careful not to let dirt get in.
   ★ Add fuel through inlet port portion **a** (8 places) of the filter. Portion **b** is the outlet port (clean side) after the fuel has been filtered, so never add fuel from hear.
   ★ If clean fuel is not available, do not remove the filter. Operate the priming pump to fill the filter with fuel.

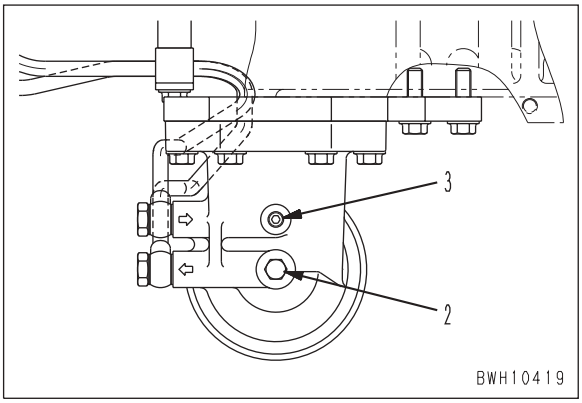




2. Remove air bleed plug (2) of the fuel filter and operate priming pump (4).
   ★ Continue operating the priming pump until flow out from the plug hole. When fuel comes out, install the plug.

   Air bleed plug:
   7.8 – 9.8 Nm {0.8 – 1.0Nm}

3. There are the following two cases that the engine does not start up easily after bleeding air from CRI, (Common Rail Injection System), i.e. even after carrying out the Items 1 and 2 above.
   ★ If air has not been removed completely, leaving some in the system, cranking up the engine with the engine starting motor cannot get rid of the remaining air in a short span of time. Thus the engine start-up becomes difficult.
   1) In the cases that the fuel has run out, that the fuel filter has been replaced or that some fuel device has been removed and installed.
      • Most of the fuel is left in the fuel circuit, so the engine may be started after bleeding air with the air bleeding methods introduced in the Item 1 and 2 above.
   2) In the case that a number of fuel devices have been removed and installed in course of engine overhauling.
      • Little fuel is left in the fuel circuit, so air cannot be get rid of completely with the air bleeding methods introduced in the Item 1 and 2 above (i.e. ordinary method). In that case, bleed air in the following manner.



Air bleeding steps

i) Remove air bleeding plug (2) of fuel filter (1) and operate priming pump (4).
   • Continue to operate the priming pump until fuel is confirmed to flow out of the air bleeding plug hole and then tighten it.

   Air bleeding plug:
   7.8 – 9.8 Nm {0.8 – 1.0 kgm}

ii) Remove fuel pressure measuring plug (3) for the fuel filter and operate priming pump (4).
   • Continue to operate the priming pump until fuel is confirmed to flow out of the air bleeding plug hole and then tighten it.

   Fuel pressure measuring plug:
   3.9 – 6.9 Nm {0.4 – 0.7 kgm}

iii) Loosen air bleeder (5) of the fuel supply pump (only after loosening the lock nut) and operate priming (4) 90 to 100 times.
   • Continue to operate the priming pump until fuel is confirmed to flow out of air bleeder (5) and then tighten it.

   Air bleeder:
   4.9 – 6.9 Nm {0.5 – 0.7 kgm}
   • Still continue to operate the priming pump until it becomes harder to operate and a relief sound of overflow valve (6) in the fuel supply pump is heard. (A high pitch sound) it requires approx. 50 times of operation to reach that stage.

iv) Push in the knob of priming pump (4) to tighten it.

v) Crank up the engine with the engine starting motor for start-up.
   ★ Do not keep the engine starting motor running idly for more than 20 seconds. Moreover try to start up the engine only after two minute pause.
   ★ If the engine does not start up even after repeating to crank for 20 seconds 4 times, insufficient air bleeding is suspected of. In that case, start the air bleeding steps once again from the beginning.

4. Loosen air bleeder (5) of the fuel supply pump and operate priming pump (4) 90 to 100 times.
   ★ Continue operating the priming pump until fuel flow out from the bleeder.
   When fuel comes out, tighten the bleeder, then operate several times until the priming pump becomes stiff.

   Air bleeder:
   4.9 – 6.9 Nm {0.5 – 0.7 kgm}

5. Crank the engine with the starting motor and start the engine.
   ★ When the engine is cranked, the air in the high-pressure circuit is automatically bled.
   ★ If the engine does not start, the air has probably been not properly bled from the low-pressure circuit, so repeat the procedure from Step 2.

REDUCED CYLINDER MODE OPERATION FOR ENGINE

★ Reduced cylinder mode operation for the engine means setting the fuel injectors of a single cylinder or multiple cylinders electronically to the NO injection condition to run the engine on a reduced number of cylinders.
The reduced cylinder mode operation is used when it is though that one of the engine cylinders is not giving normal output (combustion). It is a method to determine which cylinder is not operating normally.

★ The reduced cylinder mode operation is carried out by using the reduced cylinder mode operation setting function on the monitor panel.

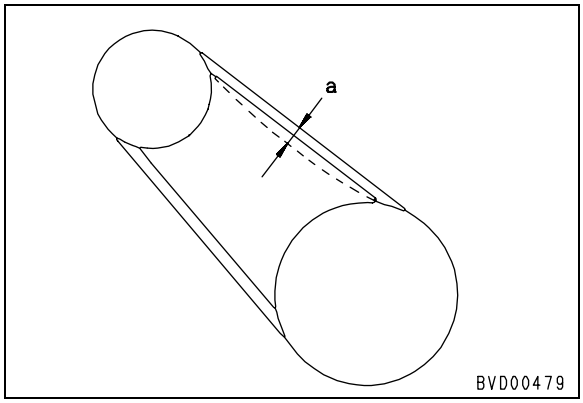
★ For details of the method of operation, see the TROUBLESHOOTING of chassis volume, Monitor panel display and special functions.

TESTING AND ADJUSTING ALTERNATOR BELT TENSION

Testing

- Press the intermediate point between alternator pulley and drive pulley with a finger and measure deflection **a** of the belt.

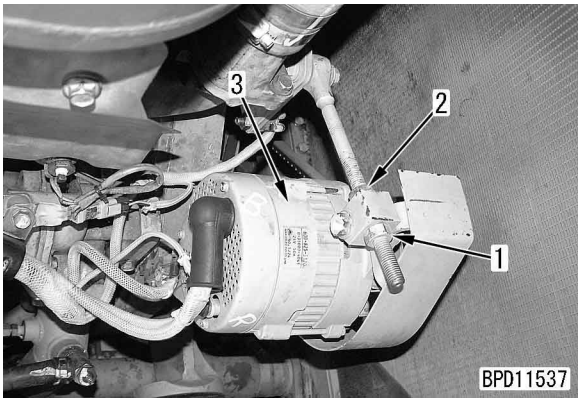
★ Pressing force: Approx. 58.8 N {Approx. 6 kg}



Adjusting

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

1. Loosen the 2 alternator mounting bolts and the 1 adjustment rod set bolt.
2. Loosen locknut (1) and turn adjustment nut (2) to move alternator (3) and adjust the belt tension.
3. Tighten the 2 alternator mounting bolts and the 1 adjustment rod set bolt.

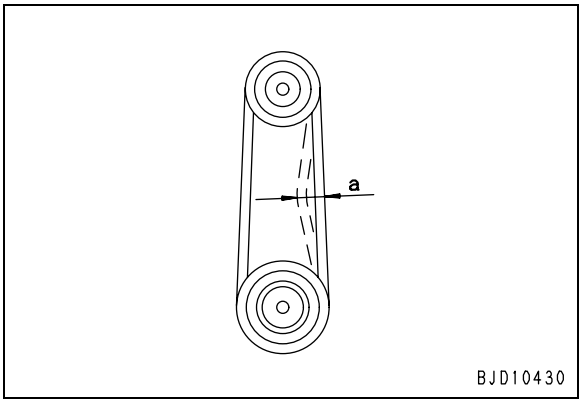


TESTING AND ADJUSTING AIR CONDITIONER COMPRESSOR BELT TENSION

Testing

- Press the intermediate point between air conditioner compressor pulley and drive pulley with a finger and measure deflection **a** of the belt.

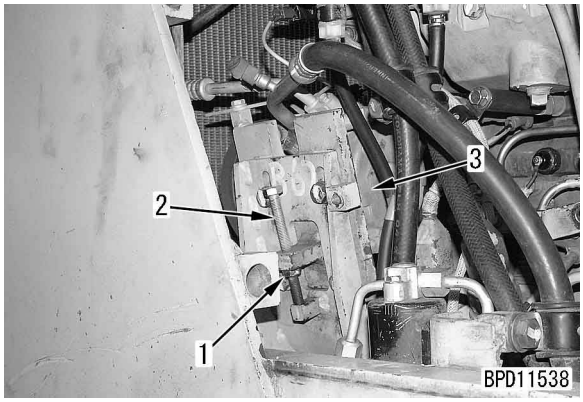
★ Pressing force: Approx. 98N {Approx. 10kg}



Adjusting

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

1. Loosen the 2 compressor bracket mounting bolts.
2. Loosen locknut (1) and turn adjustment nut (2) to move compressor (3) and adjust the belt tension.
3. Tighten the 2 compressor bracket mounting bolts.

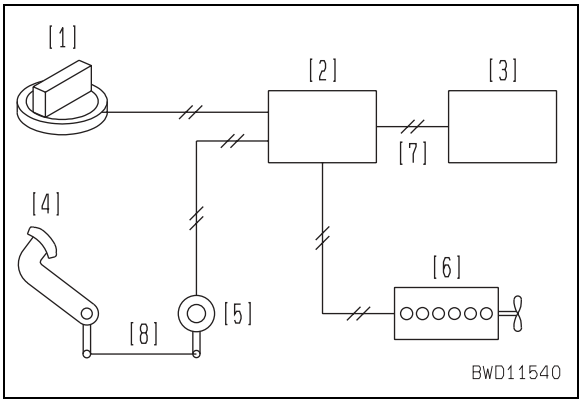


ADJUSTING FUEL CONTROL DIAL AND DECELERATOR PEDAL

1. Outline of fuel control system

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

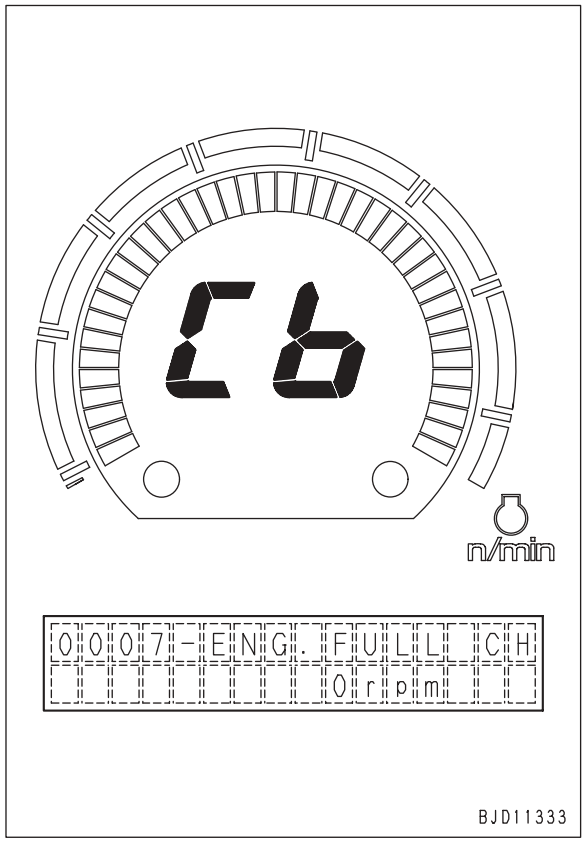
  The engine controller controls the fuel control system of the engine (CRI system) according to the one of the above input signals having the lowest engine speed.
- Adjust the deceleration slow rotation by adjusting the decelerator pedal linkage.



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

2. Preparation work

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



3. Adjusting decelerator pedal engine speed

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

- Decelerator pedal engine speed: 1,000 – 1,050 rpm

★ If the decelerator pedal engine speed is abnormal, adjust installed dimension **a** of stopper bolt (2).

- Standard installed dimension **a** of stopper bolt: 19 mm

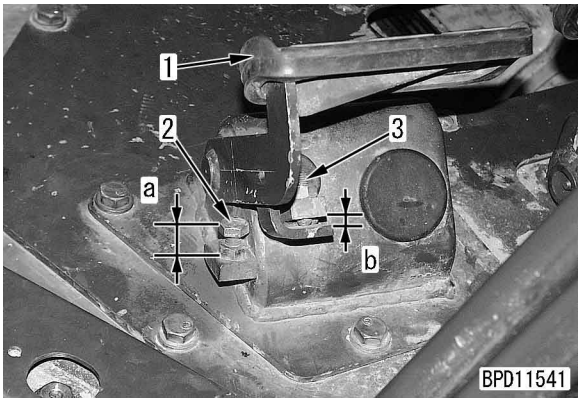
4. High idling engine speed

Set the fuel control dial in the high idling position and check that the high idling engine speed is normal.

- High idling engine speed: 2,050 – 2,100 rpm
- Standard installed dimension **b** of stopper bolt: 6 mm

★ If the engine speed is abnormal, perform the following.

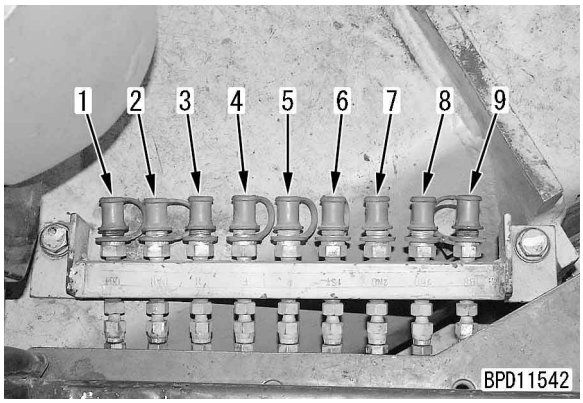
- When the engine speed is above 1,950 rpm: Lower the engine speed below 1,900 rpm temporarily with stopper bolt (3) to eliminate the play of the decelerator pedal, and then adjust the engine speed to the high idling speed.
- When the engine speed is below 1,950 rpm: Adjust the engine speed to the high idling speed with stopper bolt (3).



MEASURING POWER TRAIN OIL PRESSURE

★ Measuring instrument for power train pressure

Symbol		Part No.	Name
F	1	799-101-5002	Hydraulic tester
		790-261-1203	Digital hydraulic tester
	2	799-401-2320	Hydraulic tester (1.0MPa {10kg/cm^2})



⚠ Stop the machine on a level place, lower the work equipment to the ground, and set the parking brake lever and safety lock lever in the LOCK position.

★ Measure the power train oil pressure under the following condition.
  - Power train oil temperature: Within operating range

★ The centralized power train pressure pick-up ports are installed inside the inspection cover on the left outside of the operator's cab.

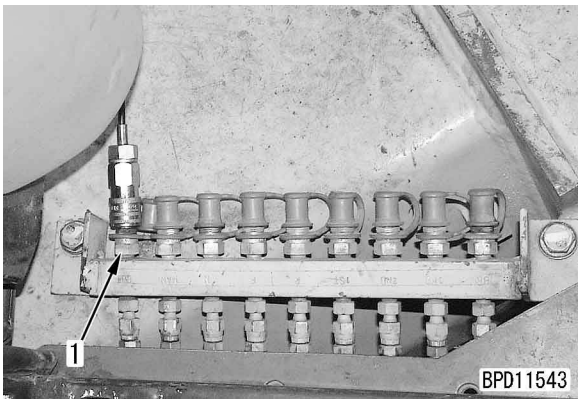
★ A nipple for measuring oil pressure is not installed as standard.

★ List of oil pressure measuring points and gauges to be used

No.	Mark	Measured oil pressure	Gauge (MPa {kg/cm^2})
1	OUT	Torque converter outlet pressure	0.98 {10}
2	TM	Transmission main relief pressure	5.9 {60}
3	IN	Torque converter inlet pressure	2.5 {25}
4	FWD	Transmission forward clutch pressure	5.9 {60}
5	R	Transmission reverse clutch pressure	5.9 {60}
6	1ST	Transmission 1st clutch pressure	5.9 {60}
7	2ND	Transmission 2nd clutch pressure	5.9 {60}
8	3RD	Transmission 3rd clutch pressure	5.9 {60}
9	BR	Steering left brake pressure	5.9 {60}

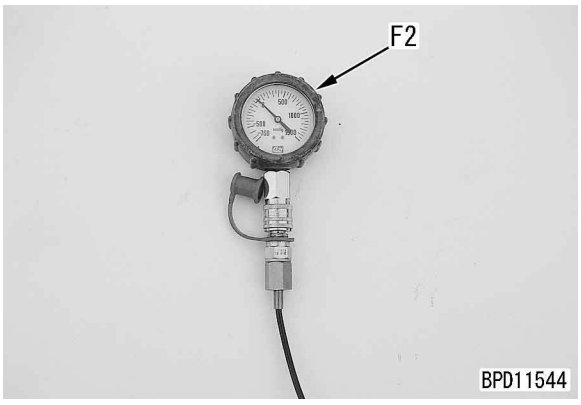
1. Measuring torque converter outlet pressure (OUT)

1) Connect hydraulic tester **F2** to oil pressure pick-up nipple (1).
   ★ Use an oil pressure gauge of 0.98MPa {10kg/cm^2}.



2) Start the engine and set the PCCS lever in the full neutral position.

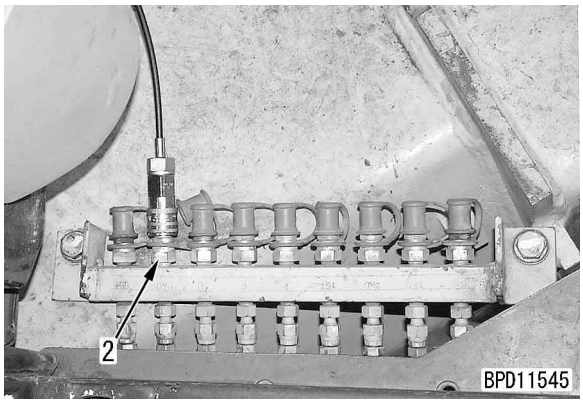
3) Measure the oil pressure while the engine is running at low idling and high idling.



4) After finishing measurement, remove the measuring instrument and return the removed parts.

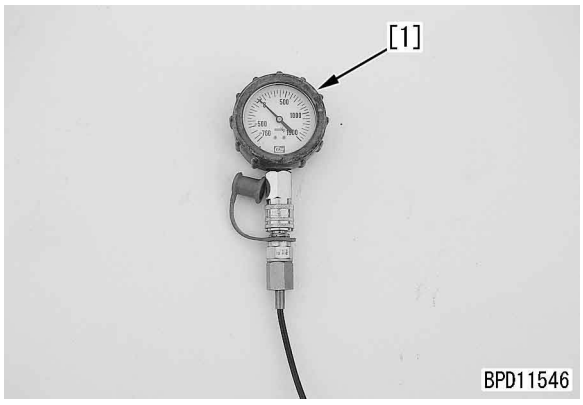
2. Measuring transmission main relief pressure (TM)

1) Connect oil pressure gauge [1] of hydraulic tester **F1** to oil pressure pick-up nipple (2).
   ★ Use an oil pressure gauge of 5.9MPa {60kg/cm^2}.



2) Run the engine and set the PCCS lever in the full neutral position.

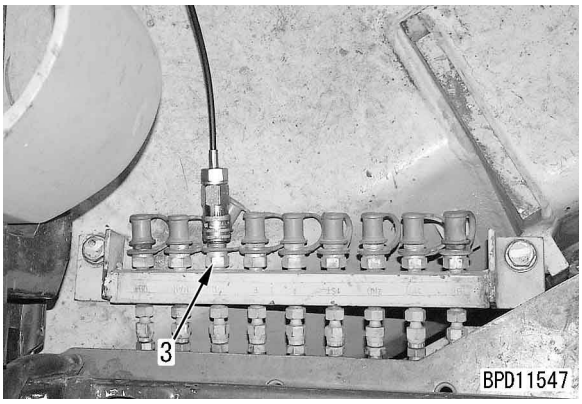
3) Measure the oil pressure while the engine is running at low idling and high idling.



4) After finishing measurement, remove the measuring instrument and return the removed parts.

3. Measuring torque converter inlet pressure (IN)

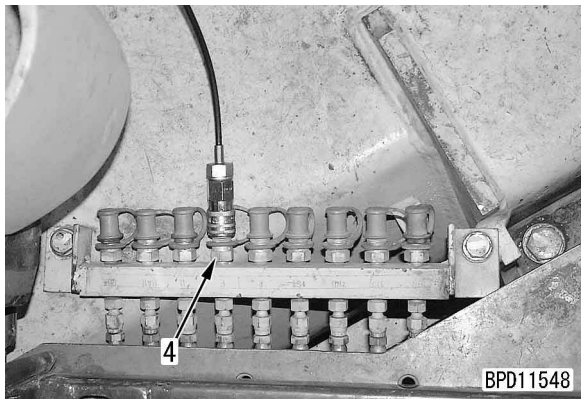
1) Connect oil pressure gauge [1] of hydraulic tester **F1** to oil pressure pick-up nipple (3).
   ★ Use an oil pressure gauge of 2.5MPa {25kg/cm2}.



2) Start the engine and set the PCCS lever in the full neutral position.
3) Measure the oil pressure while the engine is running at low idling and high idling.
4) After finishing measurement, remove the measuring instrument and return the removed parts.
   ★ For the oil pressure gauge, see BPD11546.

4. Measuring transmission forward clutch pressure (FWD)

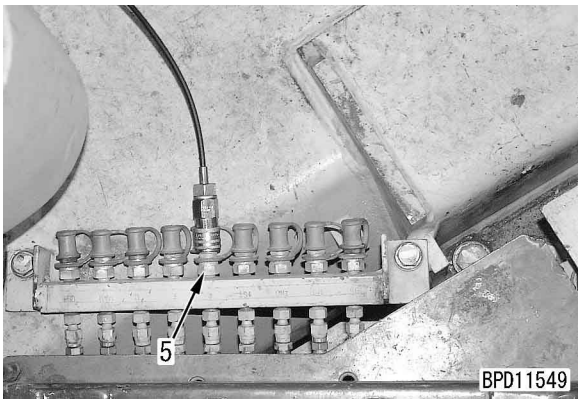
1) Connect oil pressure gauge [1] of hydraulic tester **F1** to oil pressure pick-up nipple (4).
   ★ Use an oil pressure gauge of 5.9MPa {60kg/cm2}.



2) Run the engine and set the parking brake lever in the FREE position.
3) Press the brake pedal and set the PCCS lever in the FORWARD and 3rd gear speed position.
4) Measure the oil pressure while the engine is running at high idling.
   ⚠ Since the torque converter will be stalled, press the brake pedal securely and keep your right foot on the decelerator pedal for safety until the work is finished.
   ★ For the oil pressure gauge, see BPD11546.
5) After finishing measurement, remove the measuring instrument and return the removed parts.

5. Measuring transmission reverse clutch pressure (R)

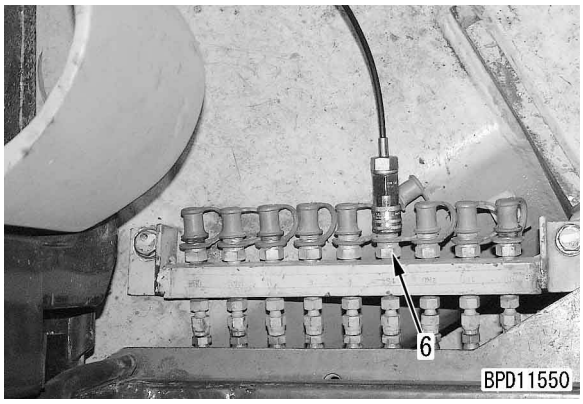
1) Connect oil pressure gauge [1] of hydraulic tester **F1** to oil pressure pick-up nipple (5).
   ★ Use an oil pressure gauge of 5.9MPa {60kg/cm^2}.



2) Run the engine and set the parking brake lever in the FREE position.
3) Press the brake pedal and set the PCCS lever in the REVERSE 3rd gear speed position.
4) Measure the oil pressure while the engine is running at high idling.
   ⚠ Since the torque converter will be stalled, press the brake pedal securely and keep your right foot on the decelerator pedal for safety until the work is finished.
   ★ For the oil pressure gauge, see BPD11546.
5) After finishing measurement, remove the measuring instrument and return the removed parts.

6. Measuring transmission 1st clutch pressure (1ST)

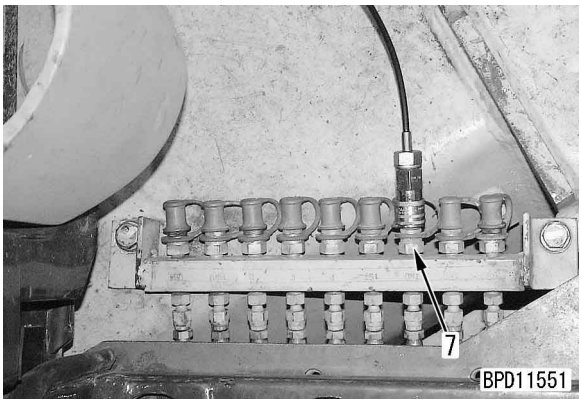
1) Connect oil pressure gauge [1] of hydraulic tester **F1** to oil pressure pick-up nipple (6).
   ★ Use an oil pressure gauge of 5.9MPa {60kg/cm^2}.



2) Run the engine and set the parking brake lever in the FREE position.
3) Press the brake pedal and set the PCCS lever in the FORWARD and 1st gear speed position.
4) Measure the oil pressure while the engine is running at low idling.
   ⚠ Since the torque converter will be stalled, keep pressing the brake pedal securely.
   ⚠ Do not raise the engine speed to high idling during measurement.
   ★ For the oil pressure gauge, see BPD11546.
5) After finishing measurement, remove the measuring instrument and return the removed parts.

7. Measuring transmission 2nd clutch pressure (2ND)

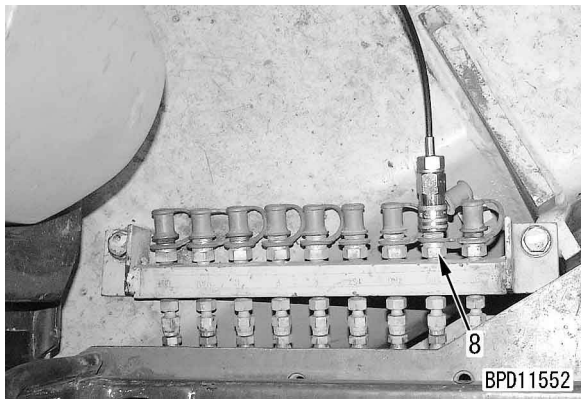
1) Connect oil pressure gauge [1] of hydraulic tester **F1** to oil pressure pick-up nipple (7).
   ★ Use an oil pressure gauge of 5.9MPa {60kg/cm²}.



2) Run the engine and set the parking brake lever in the FREE position.
3) Press the brake pedal and set the PCCS lever in the FORWARD and 2nd gear speed position.
4) Measure the oil pressure while the engine is running at low idling.
   ⚠ Since the torque converter will be stalled, keep pressing the brake pedal securely.
   ⚠ Do not raise the engine speed to high idling during measurement.
   ★ For the oil pressure gauge, see BPD11546.
5) After finishing measurement, remove the measuring instrument and return the removed parts.

8. Measuring transmission 3rd clutch pressure (3RD)

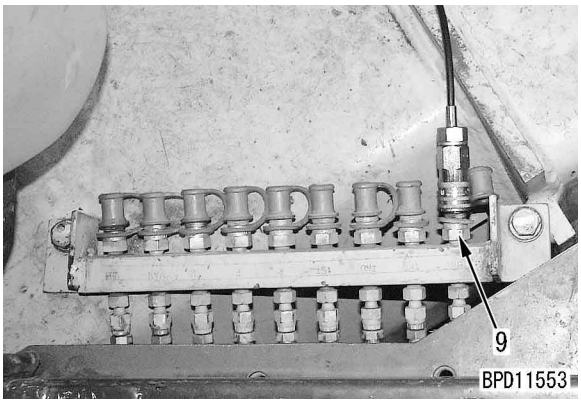
1) Connect oil pressure gauge [1] of hydraulic tester **F1** to oil pressure pick-up nipple (8).
   ★ Use an oil pressure gauge of 5.9MPa {60kg/cm²}.



2) Run the engine and set the parking brake lever in the FREE position.
3) Press the brake pedal and set the PCCS lever in the FORWARD and 3rd gear speed position.
4) Measure the oil pressure while the engine is running at low idling.
   ⚠ Since the torque converter will be stalled, keep pressing the brake pedal securely.
   ⚠ Do not raise the engine speed to high idling during measurement.
   ★ For the oil pressure gauge, see BPD11546.
5) After finishing measurement, remove the measuring instrument and return the removed parts.

9. Measuring steering left brake pressure (LB)

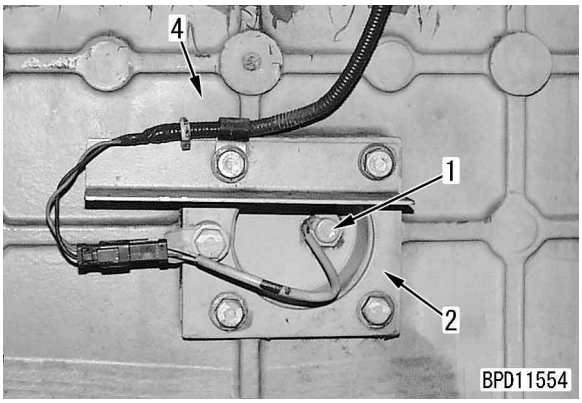
1) Connect oil pressure gauge [1] of hydraulic tester **F1** to oil pressure pick-up nipple (9).
   ★ Use an oil pressure gauge of 5.9MPa {60kg/cm^2}.



2) Run the engine and set the parking brake lever in the FREE position.
3) Measure the oil pressure while the engine is running at low idling and high idling.
   ★ Check that the oil pressure lowers to 0 when the brake pedal is pressed or the parking brake lever is set in the LOCK position.
   ★ For the oil pressure gauge, see BPD11546.
4) After finishing measurement, remove the measuring instrument and return the removed parts.

ADJUSTING TRANSMISSION SPEED SENSOR

1. Remove the fuel tank undercover, and then remove transmission speed sensor (1) and cover (2) together.
   ★ Before adjusting transmission speed sensor (1), remove it temporarily and check that its tip is free from a steel chip and a flaw.
   ★ Before installing the transmission speed sensor, separate sensor (1), cover (2), and locknut (3).



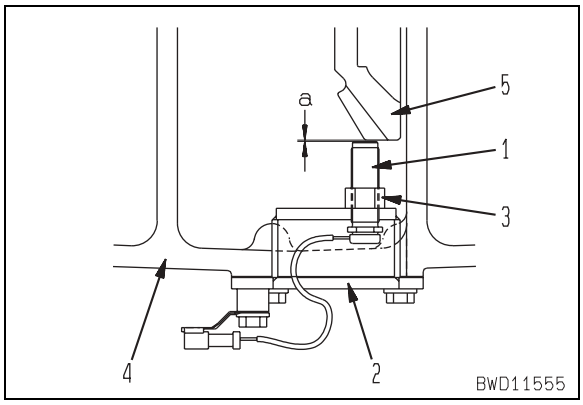
2. Install cover (2) to HSS case (4) temporarily.
   ★ Take care of direction of cover (2).

3. Tighten sensor (1) until its tip touches the tooth tip of gear (5).
   Threads of sensor:
   Gasket sealant (LG-5)

4. Return sensor (1) from the above position by the specified angle.
   ★ Returning angle of sensor: 1/2 – 1 turn
   ★ Adjust clearance **a** between the sensor tip and gear tooth tip to 0.75 – 1.50 mm.

5. Remove sensor (1) and cover (2) together and secure them with locknut (3).
   ★ Take care that the adjustment angle of the sensor will not change.
   Nut: **49.0 – 68.6 Nm {5 – 7 kgm}**

6. Taking care of the direction of cover (2), install it and sensor (2) together again to HSS case (4).
   Surfaces of cover and case:
   Gasket sealant (LG-5)

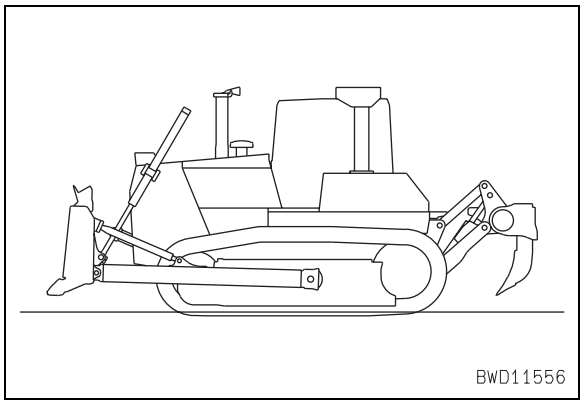


7. After finishing adjustment, set the monitor panel in the "Monitoring display mode" and check that the transmission speed is displayed normally.
   ★ For the method of operation, see "Special functions of monitor panel (EMMS)".
   ★ Model code: 31400 (Transmission speed)

SIMPLE METHOD OF TESTING BRAKE PERFORMANCE

★ Carry out the simple test of brake performance under the following condition.
- Power train oil temperature:
  Within operating range

1. Set the blade and ripper in the travel position on a level place.



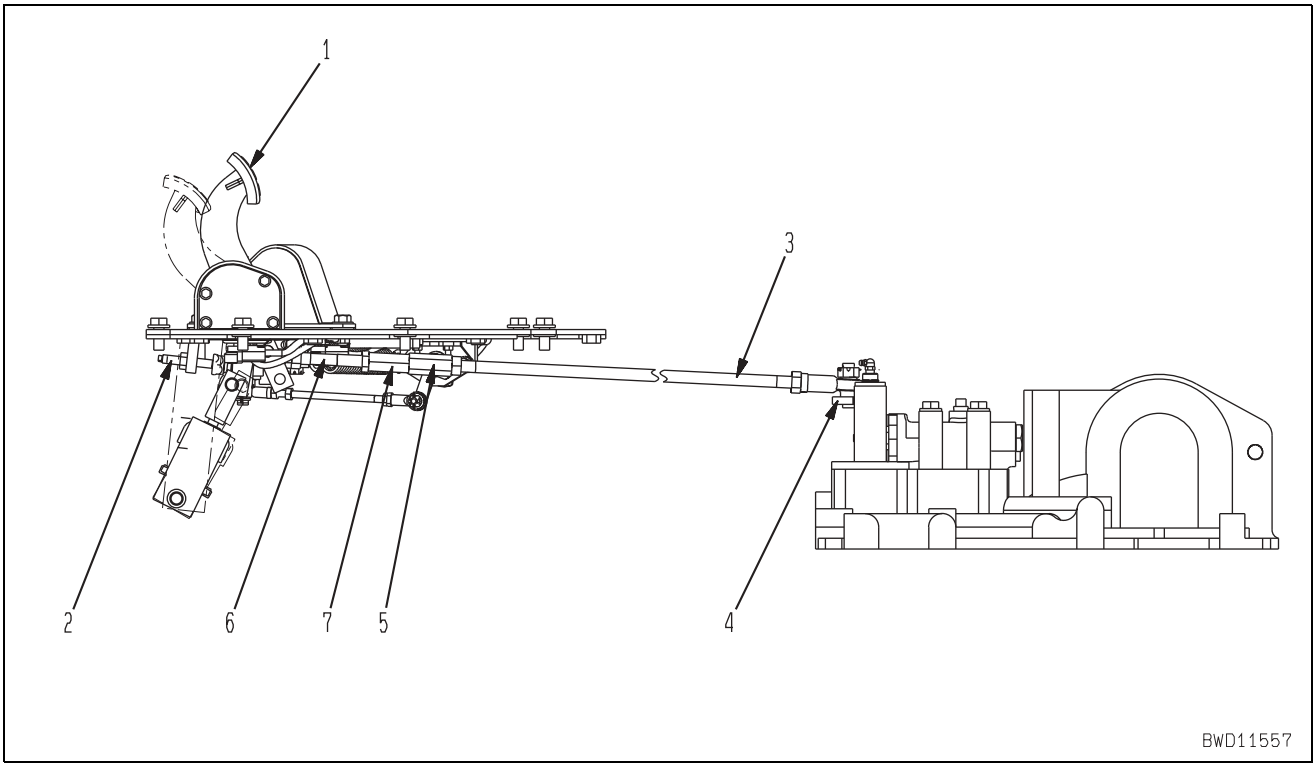
2. Run the engine and set the parking brake lever in the FREE position.

3. Run the engine at low idling and press the brake pedal and set the PCCS lever in the FORWARD and 2nd gear speed position.
   ⚠ If this test is carried out in the 1st gear position, the brake will be overloaded. Accordingly, be sure to carry out in the 2nd gear speed.
   ★ Set the steering unit in neutral.

4. Press the decelerator pedal and set the fuel control dial in the high idling position.

5. Return the decelerator pedal slowly and check that the machine does not start when the engine speed reaches the high idling level.
   ⚠ Since the torque converter will be 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.

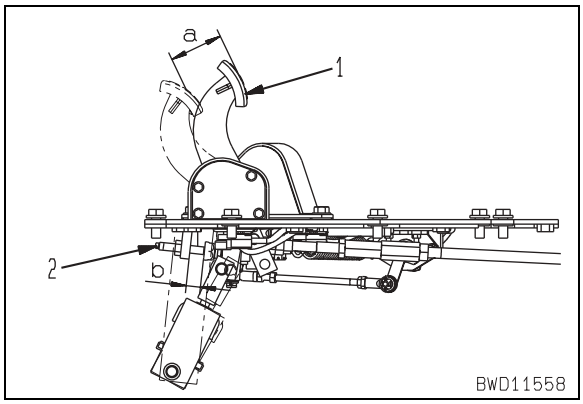
1. Adjust fitting dimension **b** of damper (2) so that the soroke of brake pedal (1) will be dimension **a**.
   - Pedal stroke **a**: 77 mm
   - Fitting dimension **b** of damper: 39 mm

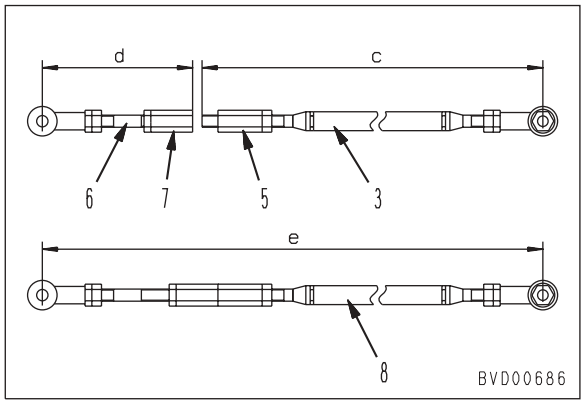
2. Adjust fitting dimension **c** of rod (3) on the valve side, then connect to brake valve lever (4).
   - Fitting dimension **c** of rod: 954 mm
   - ★ Fully screw joint (5) into the valve side.

3. Adjust fitting dimension **d** of rod (6) on the pedal side, then connect to brake pedal (1).
   - Fitting dimension **d** of rod: 195 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. When brake pedal (1) released, adijust its play with dimension **e** between the poins of rod assembly (8).
   - Play of pedal: 1 – 5 mm (Center of pedal)
   - Dimension **e** between pins of rod assembly: 1,125 mm
   - ★ Adjust by turning joints (5) and (7) in the same direction.

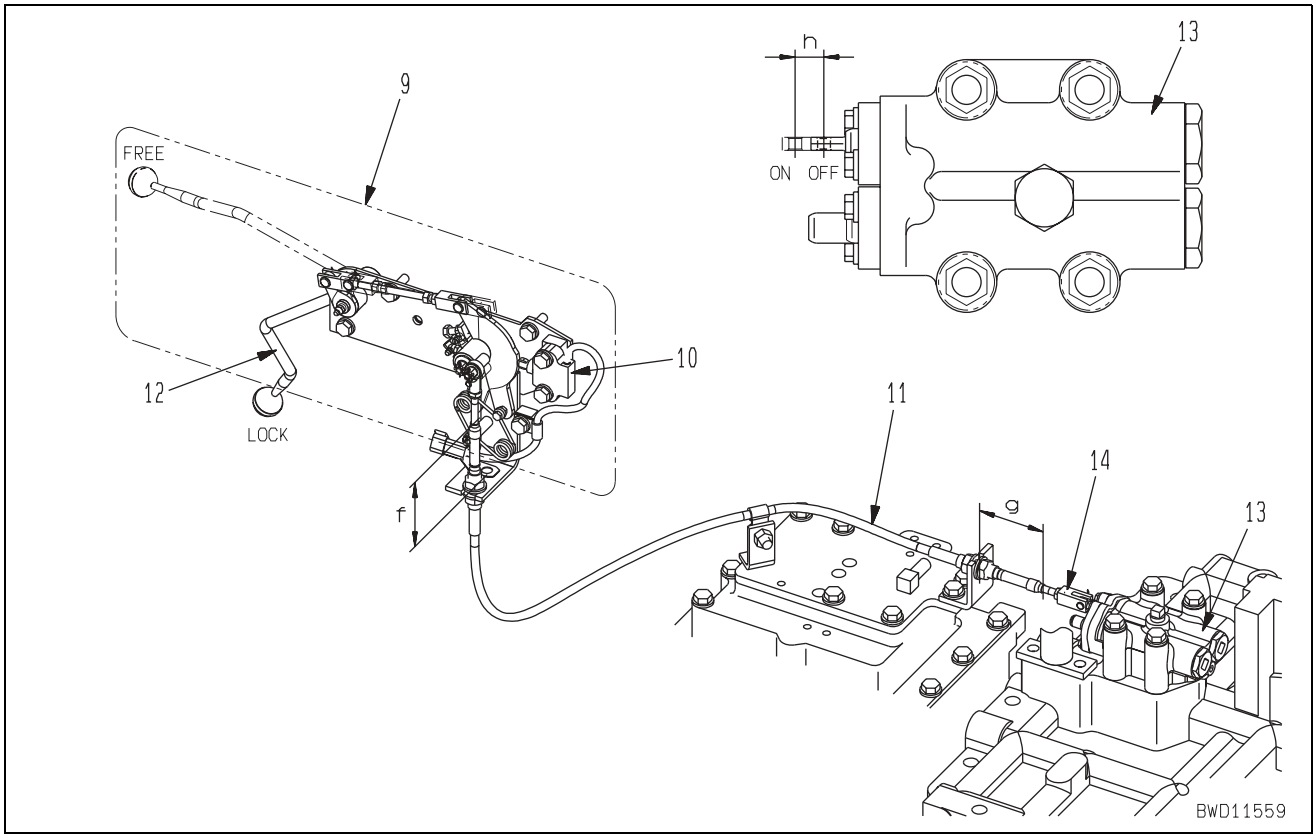
6. With brake pedal (1) released, check that brake pedal (1) is in contact with damper (2).

7. Checking brake oil pressure

	Oil pressure MPa {kg/cm^2}	Remarks
Brake OFF	2.84±0.10 {29±1}	Engine at full throttle
Brake ON	0	

8. After adjusting the pedal, adjust the zero point of the brake potentiometer (Adjustment mode: 0005).
   - ★ For the method of operation, see "Special functions of monitor panel (EMMS)".

Adjusting at parking brake lever



1. Assembling and installing lever assembly

1) Assemble lever assembly (9) and adjust the operation of limit switch (10).
   - ★ When assembling the lever assembly, disconnect the parking brake cable from the lever.
   - • When lever is raised: OFF, lowered: ON
   - • Operation stroke of limit switch: 3mm
2) Install lever assembly (9).

2. Adjusting length of parking brake cable

1) Connect parking brake cable (11) to the lever and valve and adjust dimensions **f** and **g**.
   - • Dimension **f** of cable: 88mm
   - • Dimension **g** of cable: 90mm
2) Operate parking brake lever (12) between the FREE and LOCK positions and adjust rod end (14) so that spool stroke **h** of brake valve (13) will be normal.
   - • Spool stroke **h**: 13.0mm

3. Checking brake oil pressure

Check that the brake oil pressure is as follows when the parking brake lever is set in the FREE and ROCK 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 the FREE and ROCK positions. Check that the limit switch signal is normal at this time.

- ★ For the operating method of the monitoring display mode, see “SPECIAL FUNCTIONS OF MONITOR PANEL (EMMS)”.
- • Monitoring code:
  40910 (Steering controller related switch input 1)

EMERGENCY ESCAPE METHOD WHEN POWER TRAIN HAS TROUBLE

★ Devices used for emergency escape

Symbol		Part No.	Part name
H	1	19M-06-32820	Switch assembly
		17M-06-41530	Wiring harness
	2	790-190-1600	Pump assembly
	3	07235-10314	Elbow
		07002-11823	O-ring

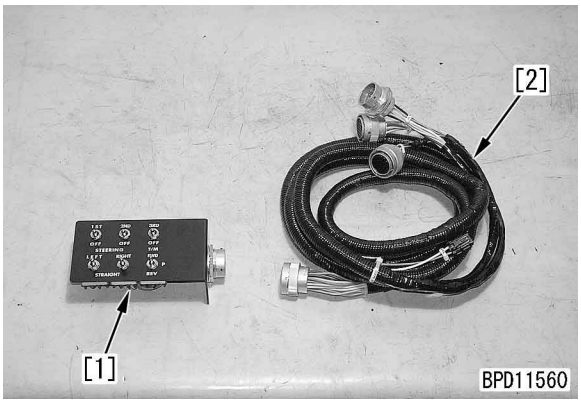
1. Escape with switch box (Use H1)

★ 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), escape according to the following procedure.

★ The engine must be startable for the following procedure. If the engine cannot be started, see EMERGENCY ESCAPE WITH BRAKE RELEASING DEVICE.

1) Connect switch assembly [1] to wiring harness [2] of emergency escape device **H1**.

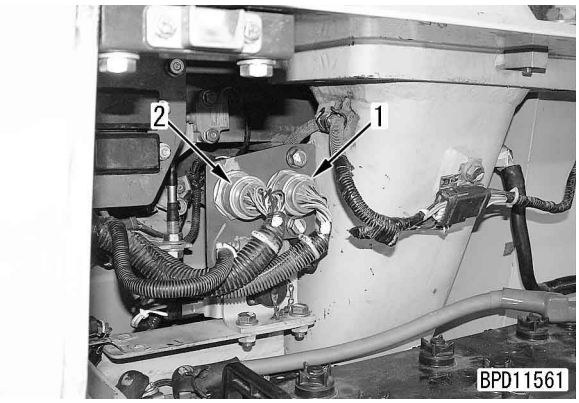
⚠ Set the all gear speed switches of switch assembly [1] in the OFF position and the direction switch in the P position to prevent the machine from starting suddenly.



2) Open the left fender inspection cover and connect wiring harness [2] to connectors **PL1** (1) and **PL2** (2).
   - Connector **PL1** (1):
     Connect to male side and female side.
   - Connector **PL2** (2):
     Connect to female side.

★ Since the male side of connector **PL2** is kept disconnected, mask it with a vinyl sheet, etc.

★ Put switch assembly [1] in the cab through the cab window.

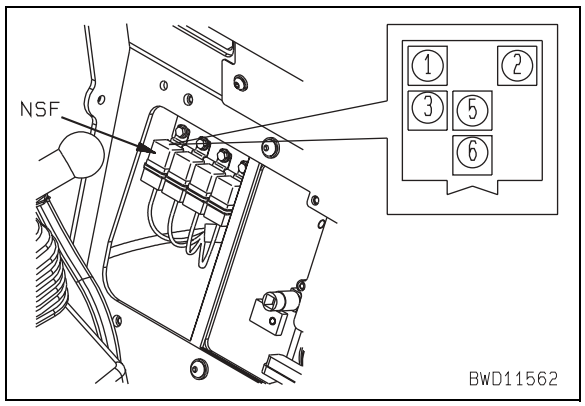


3) Disconnect neutral safety relay (**NSF**) in the rear control box and connect pins [3] and [5] of the connector on the wiring harness side.

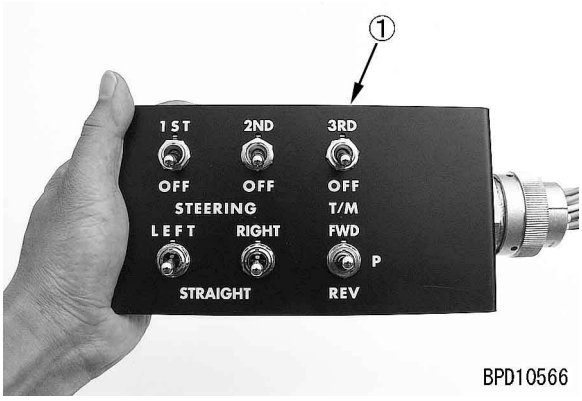
★ If the connector (**PL2**) is disconnected, an model selection error is made and the neutral safety relay is not driven because of that error. The above work must be performed to avoid this problem.

⚠ 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 the LOCK position and set the PCCS lever in the full neutral position.

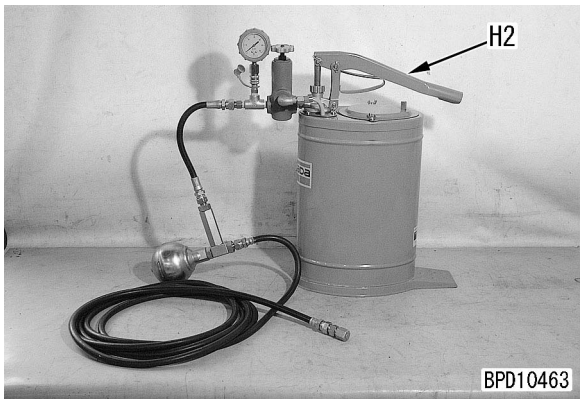
⚠ Start the engine by this method only in an emergency. If the engine does not start in another case, be sure to carry out troubleshooting and repair the trouble.



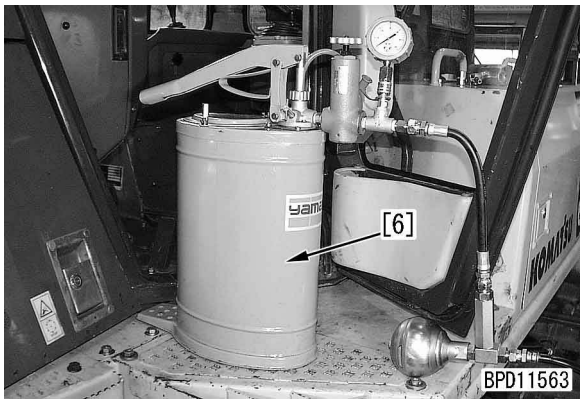
4) Start the engine and set the parking brake lever in the FREE position.
5) Operate switch assembly [1] and move the machine to a safe place.
   ★ The gear speed switch is so made that the switch on the lower gear speed will be operated first.



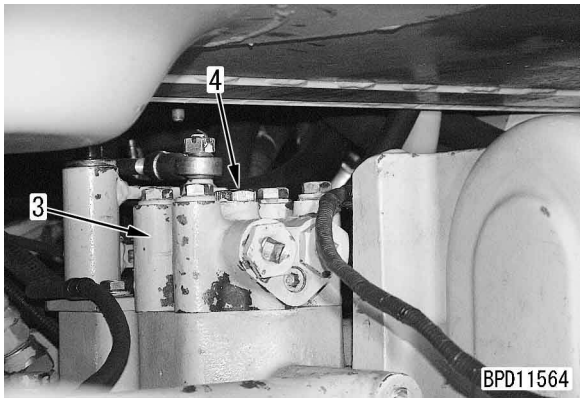
2. Escape with brake releasing device (Use H2)
★ If the engine cannot be started and the parking brake cannot be released, escape according to the following procedure.
1) Assemble pump assembly **H2**.



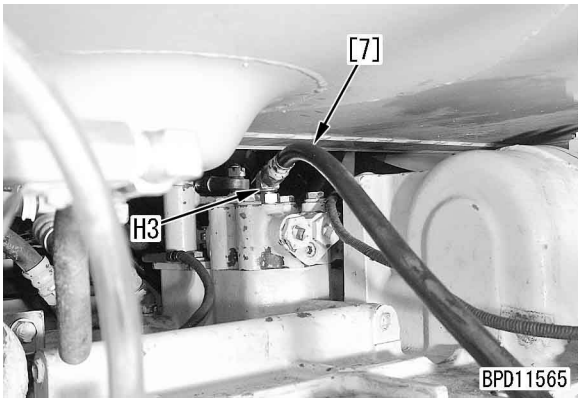
2) Install volume pump [6] of pump assembly **H2** to the outside of the operator's cab.



3) Remove the fuel tank undercover and plug (4) (M18 x 1.5) of the brake release pressure supply port of brake valve (3).

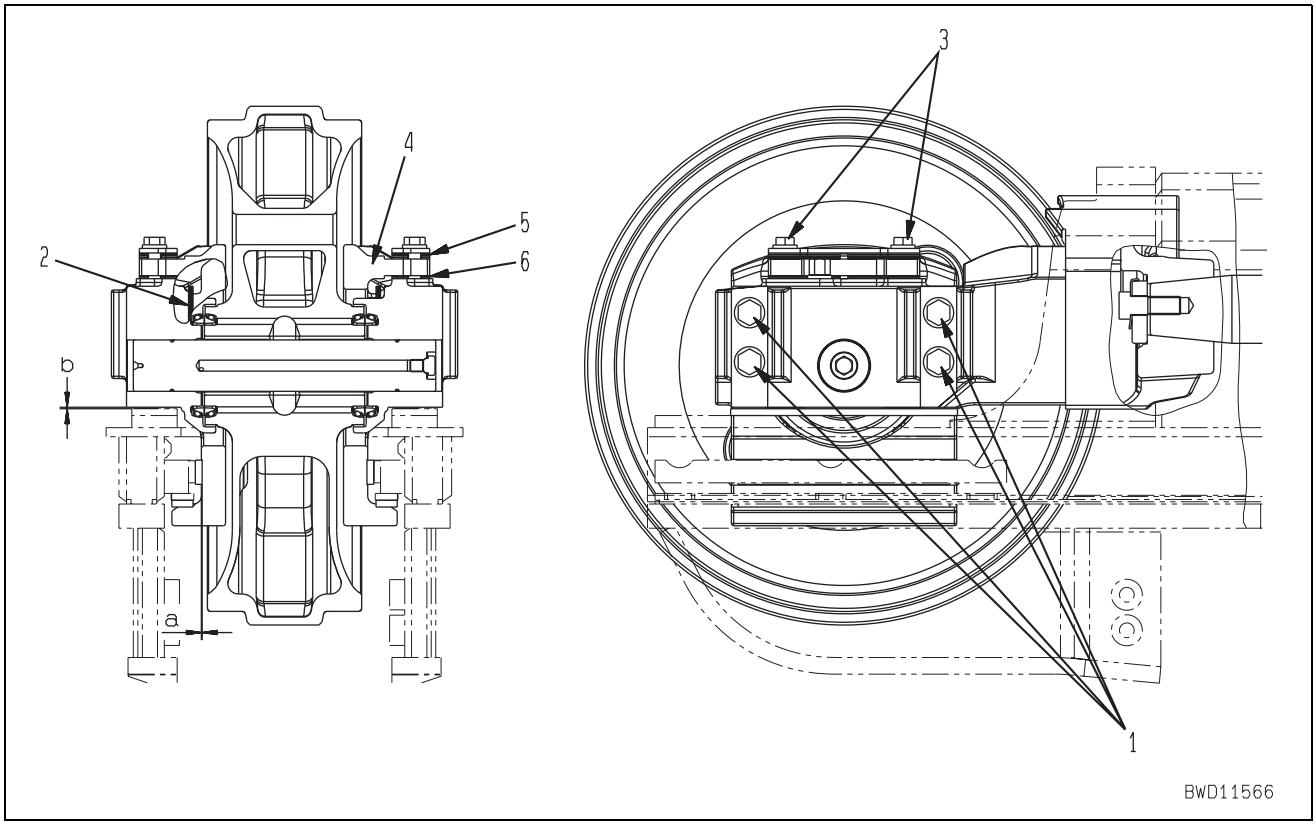


4) Install elbow **H3** and connect end hose [7] of pump assembly **H2**.



5) Turn the starting switch ON and set the parking brake lever in the FREE position.
6) Operate the vacuum pump to raise the brake releasing oil pressure to the initial pressure.
   - Initial pressure:
     Approx. 2.74MPa {28kg/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 minutes after. Accordingly, work quickly.
   ★ If the brake releasing pressure lowers to about 1.5MPa {16kg/cm^2}, the brake is applied. In this case, operate the volume pump again to raise the brake releasing pressure to the intial 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 and vertical guide of the idler are so worn that the idler runs out or slants, adjust the clearance of the idler according to the following procedure.

1. Lateral adjustment

1) Drive the machine 1 – 2 m on flat ground, and then measure clearance **a** between the track frame and guide plate (at 4 places on both sides, inside, and outside).
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
   - Sorts of shim thickness: 0.5 mm, 1.0 mm

2. Vertical adjustment

1) Measure clearance **b**, subtract 2 mm from it, and record the result (quantity of adjustment).
   - Example: When clearance **b** is 5 mm
     The quantity of adjustment is 5 – 2 = 3 mm.
2) Loosen bolts (3) (4 pieces on inside and outside) until the reaction force of the spring is lost.
3) Loosen bolt (1). Do not loosen it more than 3 turns, however.
4) Pull up vertical guide (4) with a bar, etc. and pull out shim (5) by the quantity of adjustment obtained in 1) above.
5) Add shim (5) pulled out onto shim (6). (8 places in total on both sides, inside, and outside)
   ★ The total number of shims (5) and (6) before adjustment must be the same as that after adjustment.
   - Sorts of shim thickness: 1 mm, 2 mm

INSPECTING WEAR OF SPROCKET

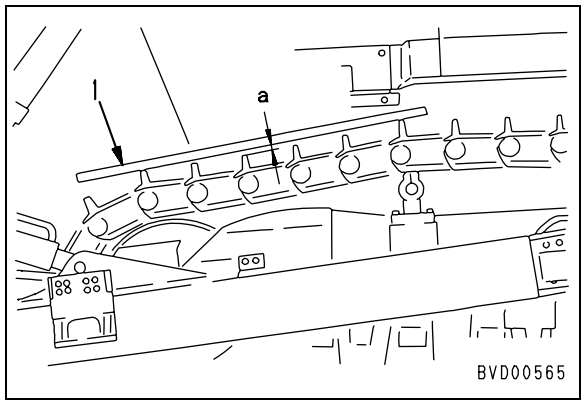
★ Make a copy of the “Full-scale drawing of sprocket tooth profile” on a transparent sheet and apply it to the sprocket directly to see if the sprocket is serviceable.

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 (1) 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 – 30mm



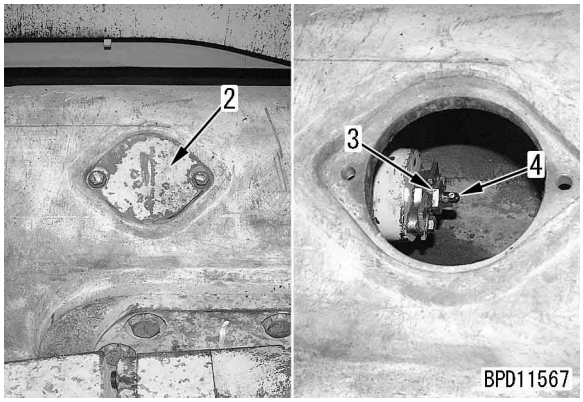
Adjusting

★ If the track shoe tension is abnormal, adjust it according to the following procedure.

1. Remove cover (2).

2. When the tension is too high
   Loosen plug (3) to discharge the grease.
   ⚠ Since the high-pressure grease may spout out, do not loosen the plug more than 1 turn.
   Plug: **59 – 88Nm {6 – 9kgm}**

3. When tension is low
   Add grease through grease fitting (1).
   ★ 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.	Name
G	1	799-101-5002	Hydraulic tester
		790-261-1203	Digital hydraulic tester
	2	799-101-5220	Nipple (10 x 1.25mm)
		07002-11023	O-ring

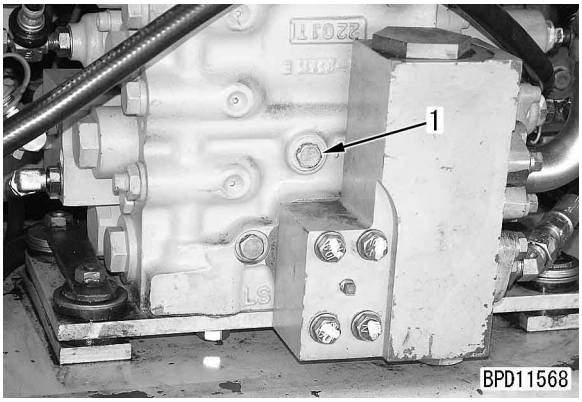
Measuring

⚠ Stop the machine on a level place, lower the work equipment to the ground, and set the parking brake lever and safety lock lever in the LOCK position.

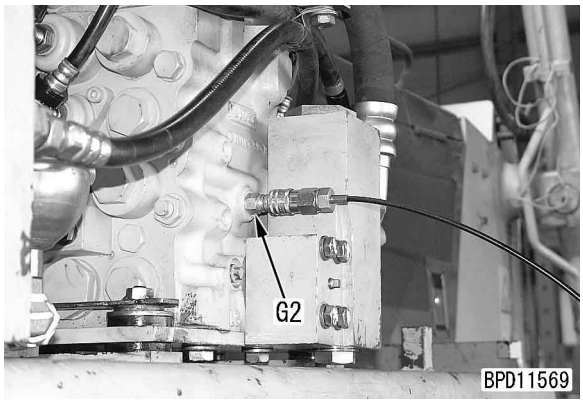
★ Measure the work equipment and HSS oil pressure under the following condition.
- Hydraulic oil temperature:
  Within operating range

1. Measuring unload pressure

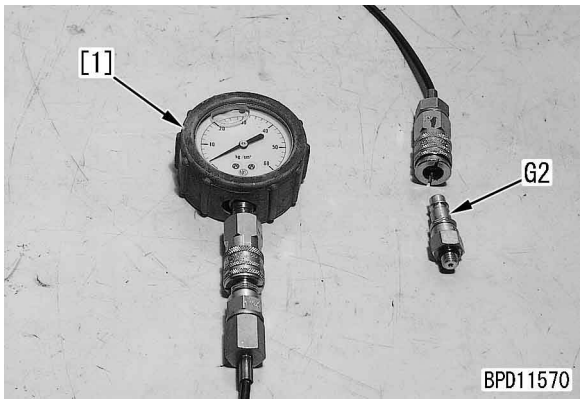
1) Remove the main control valve cover.
2) Remove the oil pressure pickup plug.



3) Install nipple **G2** and connect oil pressure gauge [1] of hydraulic tester **G1**.
   ★ Use an oil pressure gauge of 39.2MPa {400kg/cm^2}.



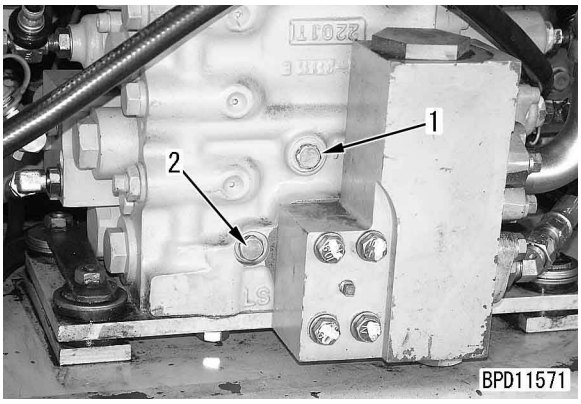
4) Run the engine at high idling and set the blade lever and ripper lever in neutral and measure the oil pressure.



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

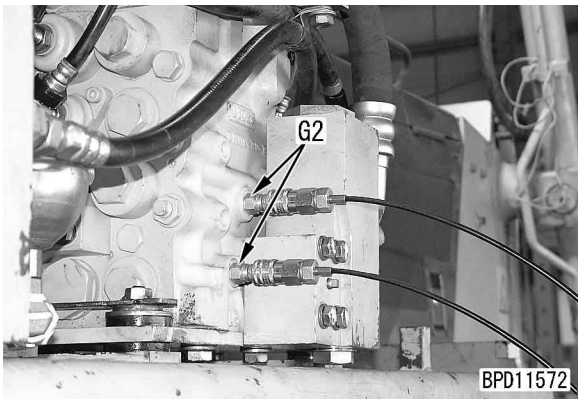
2. Measuring work equipment oil pressure and HSS oil pressure

1) Remove the main control valve cover.
2) Remove pump discharge oil pressure pickup plug (1) and LS oil pressure (load sensing pressure) pickup plug (2).



3) Install nipple **G2** and connect it to oil pressure gauge [1] of hydraulic tester **G1**.

★ Use an oil pressure gauge which can measure the following pressure.
Work equipment oil pressure:
39.2 MPa {400 kg/cm^2}
HSS oil pressure: 58.8 MPa {600 kg/cm^2}

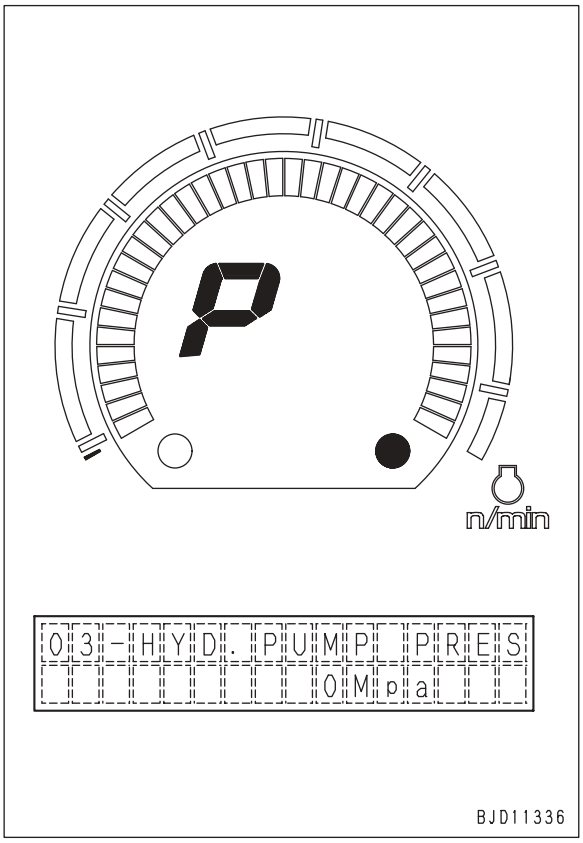


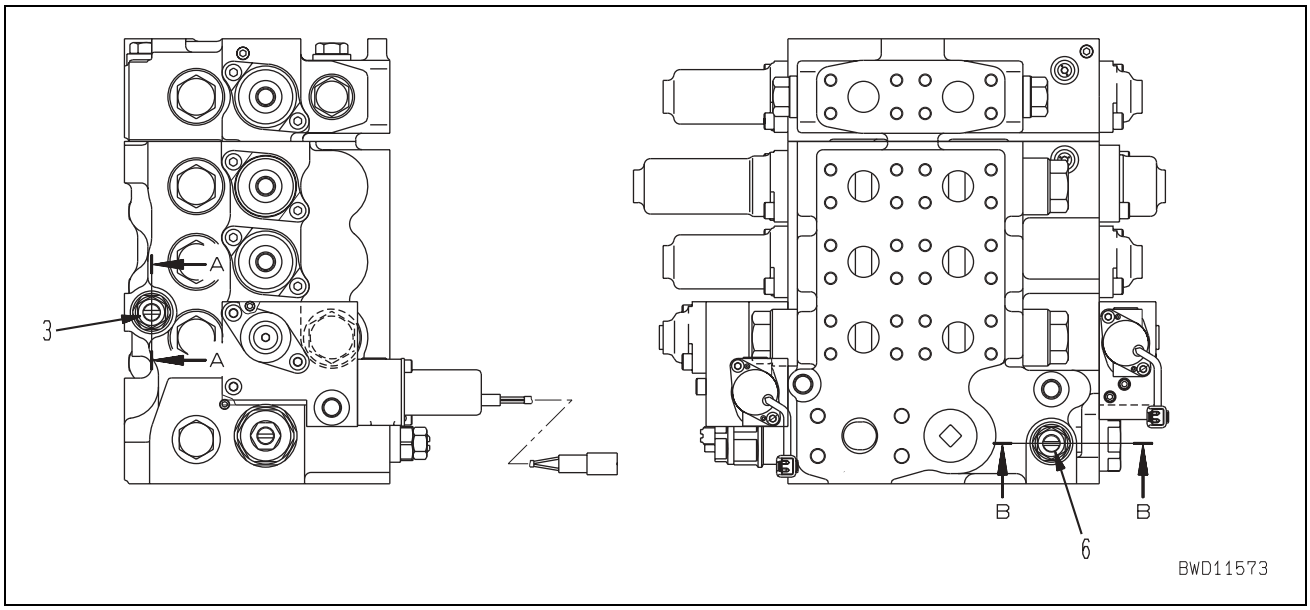
Work equipment oil pressure

i) Start the engine and set the safety lock lever in the free position.
ii) Run the engine at high idling and operate the blade lever and ripper lever. When each cylinder is relieved at the stroke end and measure the oil pressure.
★ When measuring the relief pressure of the blade lift cylinder, block the return oil hose.
iii) After finishing measurement, remove the measuring instruments and return the removed parts.

HSS oil pressure

i) Start the engine, set the parking brake lever in the free position, and press the brake pedal.
⚠ Since the steering circuit will be relieved, keep pressing the brake pedal securely and keep your right foot on the decelerator pedal for safety until the work is finished.
ii) Run the engine at high idling and steer to the right or left with the PCCS lever. When the steering circuit is relieved, measure the oil pressure.
iii) After finishing measurement, remove the measuring instrument and return the removed parts.
★ The unload pressure and relief pressure can be measured in the "Pm clinic auxiliary mode" of the monitor panel.



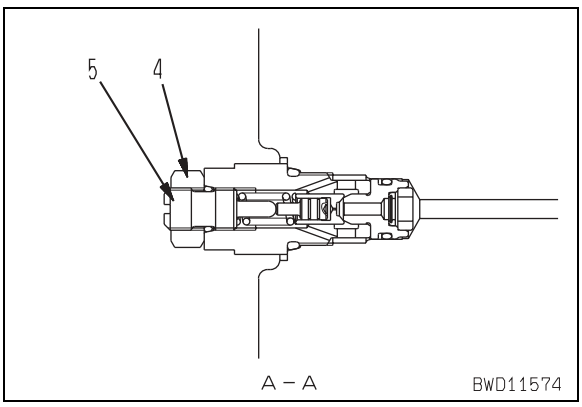


3. Adjusting

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}

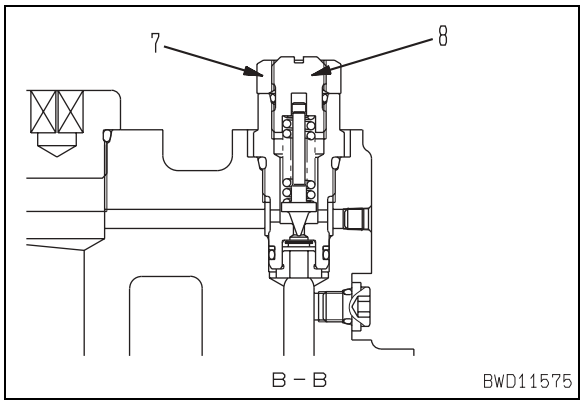
• After adjusting, check the relief pressure and LS pressure of work equipment again.



2) LS pressure (Load sensing pressure) of HSS
Loosen locknut (7) of HSS LS valve (6) 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 MAIN PRESSURE

★ Testing and adjusting instruments for control circuit main pressure

Symbol		Part No.	Name
J	1	799-101-5002	Hydraulic tester
		790-261-1203	Digital hydraulic tester
	2	799-401-3200	Oil pressure pickup adapter (Size 03)
		12896-11009	O-ring

★ The control circuit main pressure is the pressure lowered by the self-pressure reducing valve. It is used commonly for ripper PPC, blade PPC, fan pump control and steering EPC.

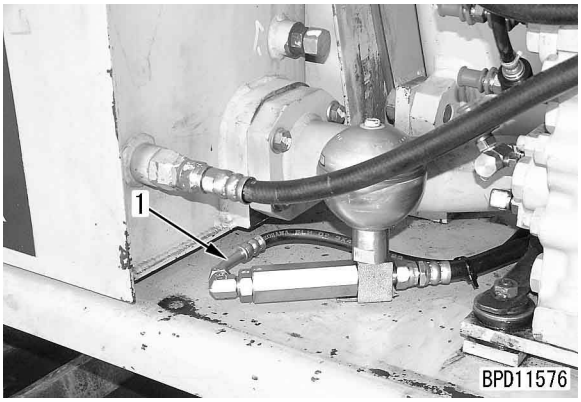
Measuring

⚠ Stop the machine on a level place, lower the work equipment to the ground, and set the parking brake lever and safety lock lever in the LOCK position.

★ Measure the control circuit main pressure under the following condition.
- Hydraulic oil temperature:
  Within operating range

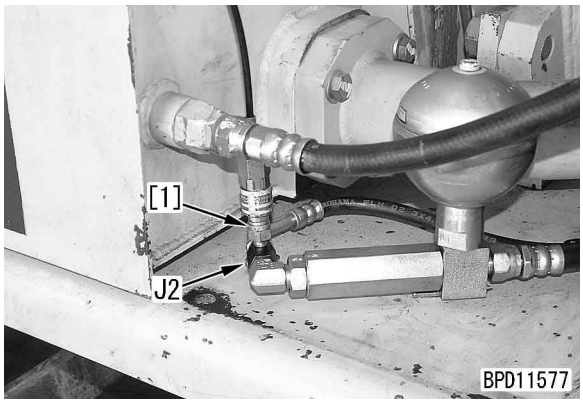
1. Remove the main control valve cover.

2. Disconnect hose (1).

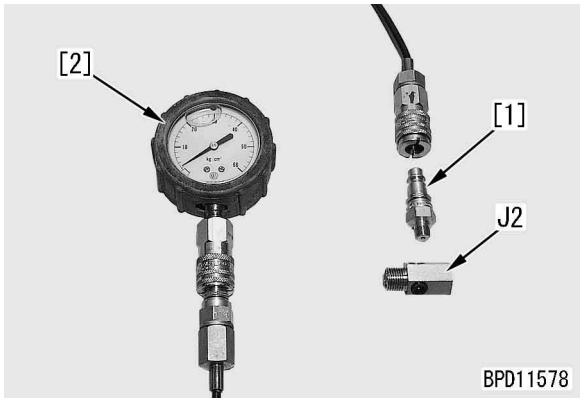


3. Install oil pressure pickup adapter **J2** and connect the disconnected hose again.

4. Install nipple [1] of hydraulic tester **J1** 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 idling and set the blade lever and ripper lever in neutral and measure the oil pressure.



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

Adjusting

★ The self-pressure reducing valve cannot be adjusted.

MEASURING PPC VALVE OUTPUT PRESSURE

★ Measuring instruments for PPC valve output pressure

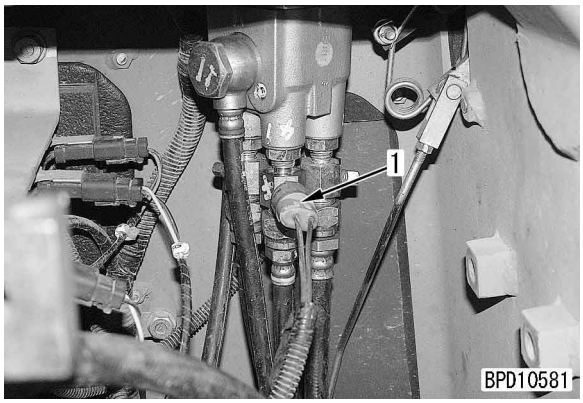
Symbol		Part No.	Name
K	1	799-101-5002	Hydraulic tester
		790-261-1203	Digital hydraulic tester
	2	799-401-3100	Oil pressure pickup adapter (Size 02)
		02896-11008	O-ring
	3	799-401-3200	Oil pressure pickup adapter (Size 03)
		02896-11009	O-ring

⚠ Stop the machine on a level place, lower the work equipment to the ground, and set the parking brake lever and safety lock lever in the LOCK position.

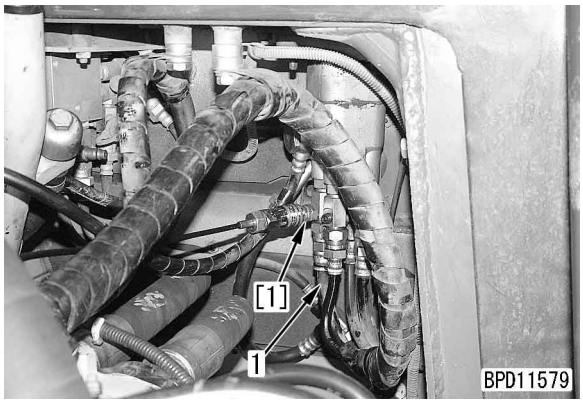
★ Before measuring the PPC valve output pressure, check that the control circuit main pressure is normal.

★ Measure the PPC valve output pressure under the following condition.
- Hydraulic oil temperature: Within operating range

1. Remove the main control valve cover.
2. Disconnect PPC valve output pressure hose (1) and install oil pressure pickup adapters (**K2** and **K3**).
   ★ For the circuits to be measured, see the drawing on the next page.

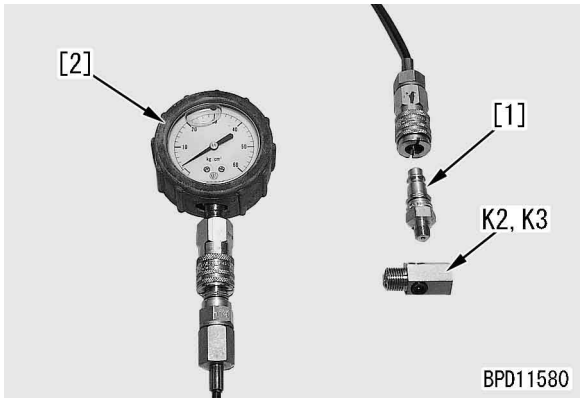


3. Install nipple [1] of hydraulic tester **K1** and connect oil pressure gauge [2].

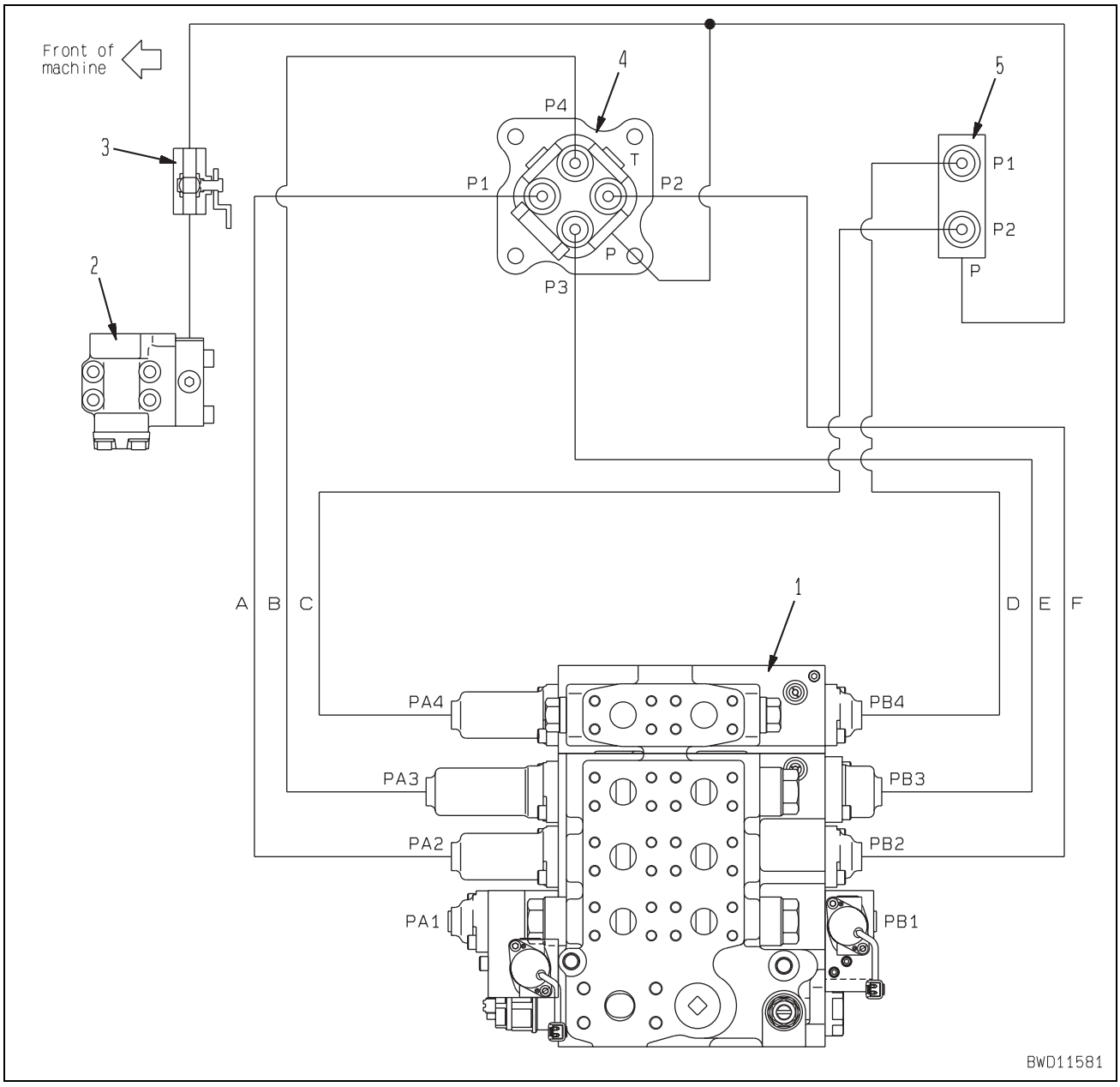


4. Start the engine and set the safety lock lever in the FREE position.

5. Run the engine at high idling 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.



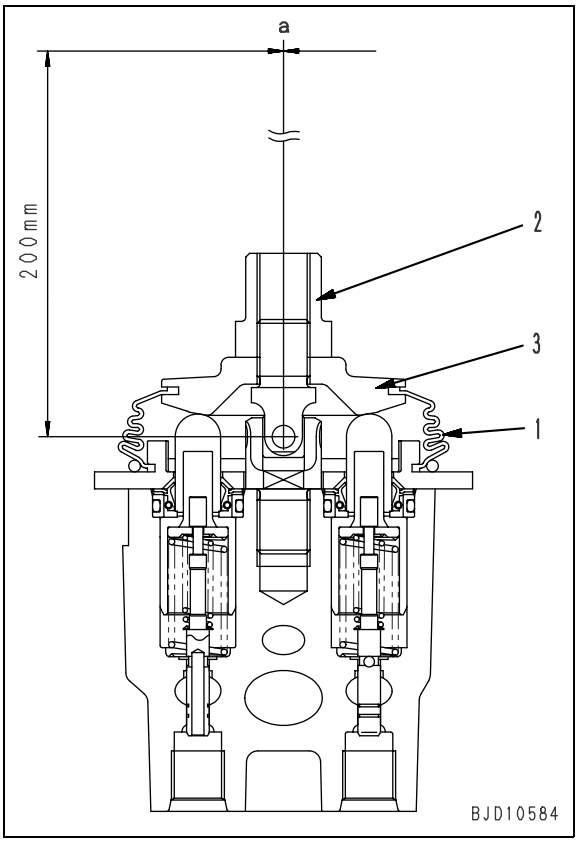
6. After finishing measurement, remove the measuring instrument and return the removed parts.



1. Main valve
2. Self-pressure reducing valve
3. PPC lock valve
4. Blade PPC valve
5. Ripper PPC valve

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 – 3.0mm at 200mm 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.

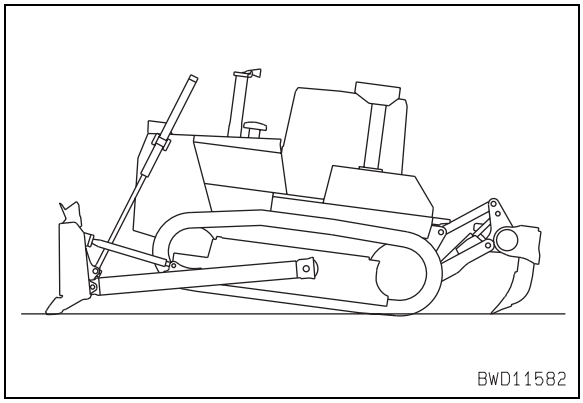
3. Fix disc (3) and tighten locknut (2).
   Locknut: **98 – 127 Nm {10 – 13 kgm}**

4. Install boot (1).

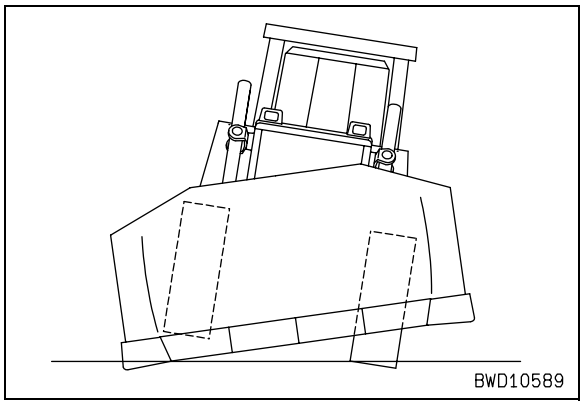
TESTING PARTS WHICH CAUSE HYDRAULIC DRIFT OF BLADE AND RIPPER

★ If the blade or ripper drifts hydraulically, check to see if the cause is on the cylinder packing side or control valve side according to the following procedure.

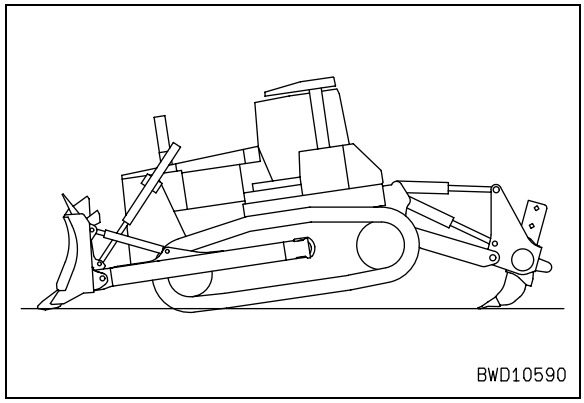
1. Set the cylinders to be tested in the following positions and stop the engine.
   1) Blade lift cylinder
      Brace the blade to raise the front side of the machine body.
      ★ Since the blade lift cylinder is equipped with a piston valve, do not extend it to the stroke end.



   2) Blade tilt cylinder
      Retract the tilt cylinder to the stroke end and brace the blade to push up the right side of the machine body.



   3) Ripper lift cylinder
      Brace the ripper to push up the rear side of the machine body.



2. Extend the cylinder to be tested with the corresponding lever and check its movement.
   - If the lowering speed is increased, the cylinder packing is defective.
   - If the lowering speed does not change, the control valve is defective.

   ★ If the pressure in the accumulator is lost, run the engine for about 10 seconds to heighten the pressure in the accumulator.

[Reference]

Reason why the lowering speed is increased when the cylinder packing is the cause of the hydraulic drift:

1) If the machine is set in the above position (where the holding pressure is applied to the bottom side), the oil leaks from the bottom side to the head side. Since the volume on the head side is less than that on the bottom side by the volume of the rod, the pressure in the head side is increased by the oil flowing in from the bottom side.
2) As the pressure in the head side is increased, it is balanced at a certain level (which depends on the leakage), then the lowering speed is lowered.
3) If the circuit on the head side is opened to the drain circuit by the above operation of the lever (the bottom side is closed by the check valve at this time), the oil on the head side flows in the drain circuit. As a result, the pressure is unbalanced and the lowering speed is increased.

MEASURING INTERNAL LEAKAGE OF WORK EQUIPMENT CYLINDER

★ Measuring instruments for internal leakage of work equipment cylinder

Symbol	Part No.	Name
L	Purchased	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. Retract the cylinder to be measured to the stroke end and set the machine in the measuring position.
   1) Blade tilt cylinder
      Tilt the blade to the right end.
   2) Ripper lift cylinder
      Pull out the shank pin and lower the ripper to the end.

2. Disconnect hose on the cylinder bottom 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 head side.

3. Run the engine at high idling and apply the relief pressure to the cylinder head side.
   - Blade tilt cylinder:
     Operate to tilt blade to right.
   - Ripper lift cylinder:
     Operate to lower ripper.

4. After 30 second, measure leakage in 1 minute.

5. After finishing measurement, return the removed parts.

BLEEDING AIR FROM WORK EQUIPMENT CYLINDER

★ If the work equipment cylinder is removed and installed or its piping is disconnected and connected, bleed air from its circuit according to the following procedure.

1. Run the engine at low idling for about 5 minutes.

2. Running the engine at low idling, extend and retract the cylinder to be bled 4 – 5 times.
   ★ Move the piston rod to about 100mm before the stroke end and never relieve the oil.

3. Running the engine at high idling and carry out the operation in 2.

4. Running the engine at low idling, move the cylinder to the stroke end to relieve the oil.

RELEASING RESIDUAL PRESSURE IN WORK EQUIPMENT CYLINDER

(If PPC accumulator is installed)

★ 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 safety 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 idling for about 5 seconds, and then stop it.

4. Repeat steps 2 and 3 by 2 – 3 times.

RELEASING RESIDUAL PRESSURE IN WORK EQUIPMENT CYLINDER

(If PPC accumulator is not installed)

★ 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. Run the engine at low idling and lower the blade and ripper to the ground without relieving each hydraulic cylinder.
   ★ Lower the blade gradually to the ground. Just after the blade reaches the ground, set the blade lever in the FLOAT position.

2. Turn the starting switch OFF and quickly operate the blade lever and ripper lever forward, backward, to the right, and to the left.
   ★ After turning the starting switch OFF, operate the levers quickly until the engine stops complately.

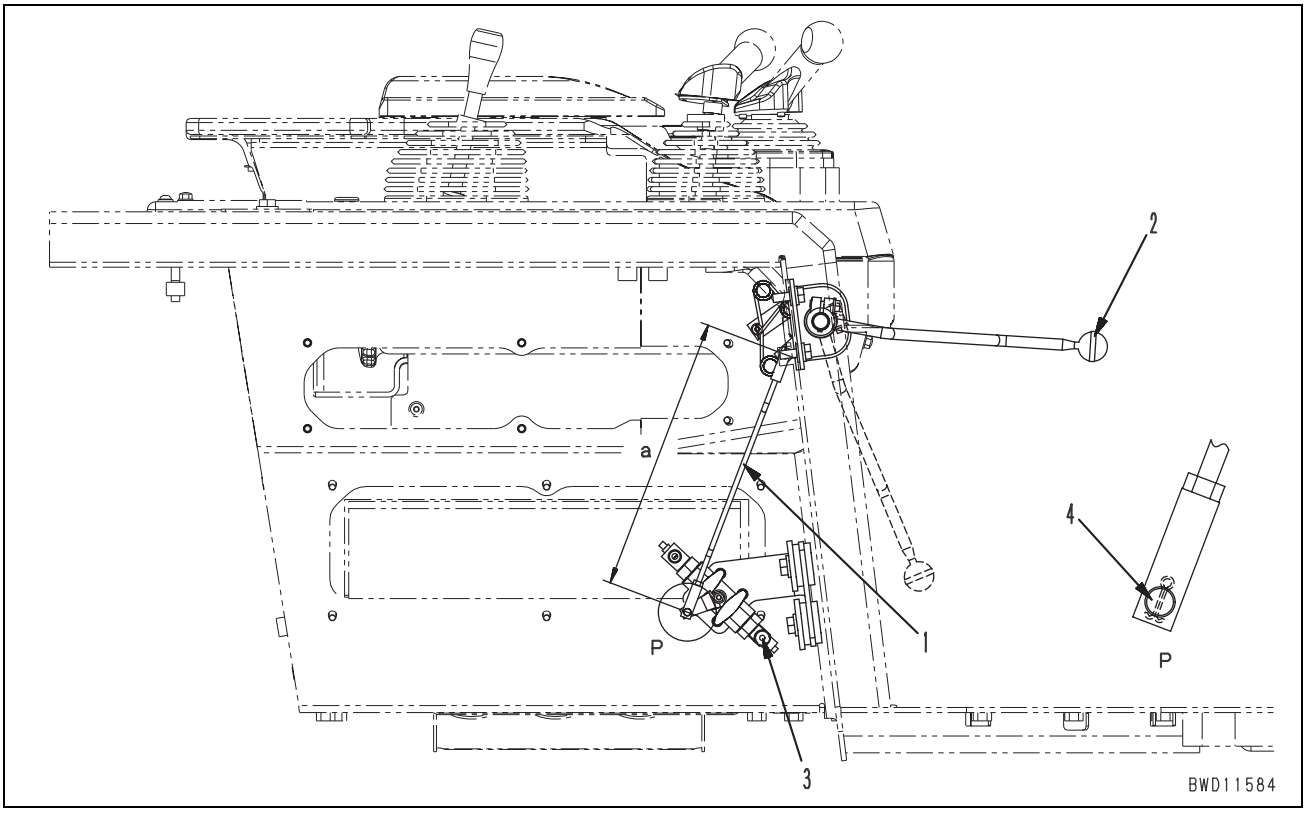
<If the engine was stopped while a hydraulic cylinder was relieved at the stroke end, perform either of the following operations.>

- Start the engine again and perform steps 1 and 2 (This operation is recommended).
- Wait for 5 – 10 minutes after stopping the engine, and then perform following steps 3 and 4.

3. Loosen the hydraulic tank cap gradually to release the residual pressure in the tank.

4. Apply cloths to the joint of the cylinder piping and loosen the sleeve nut gradually to release the residual pressure, while shaking the hose slowly.
   ★ Check that the residual pressure is released and oil does not spout out any more, and then disconnect the piping.

ADJUSTING SAFETY LOCK LEVER



1. Adjust dimension **a** between pins of rod (1).
   - Dimension **a** between pins: 329 mm

2. Connect rod (1) to safety lock lever (2) and PPC lock valve (3).
   ★ Install connecting pin (4) on the safety lock lever side with the cotter pin on the outside of the machine.

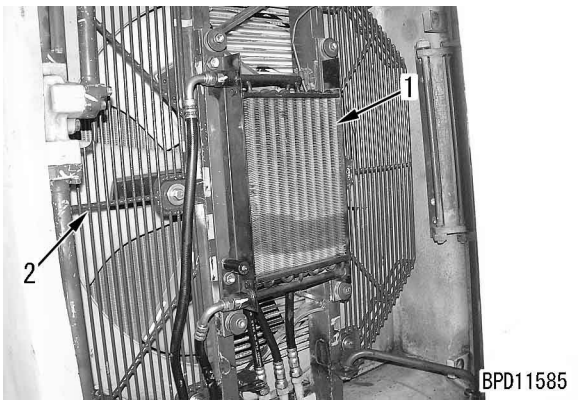
MEASURING FAN MOTOR SPEED

★ Measuring instruments for fan motor speed

Symbol	Part No.	Name
M	799-203-8001	Multitachometer

1. Open the radiator mask.

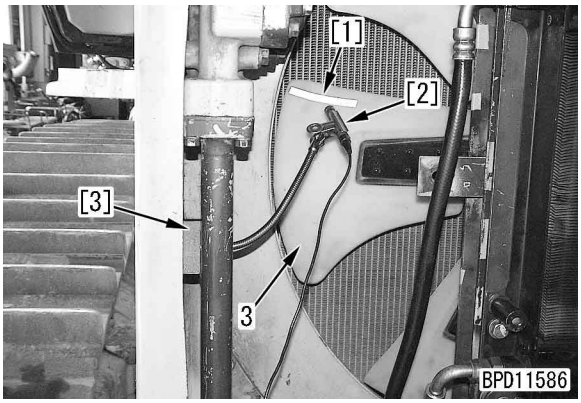
2. Remove hydraulic oil cooler (1) and fan guard (2), and then return the hydraulic oil cooler.



3. Stick 1 sheet of reflecting tape [1] to fan (3).

4. Set probe [2] of multitachometer [4] to stand [3], matching it to reflecting tape [1], then connect it to multitachometer [4].

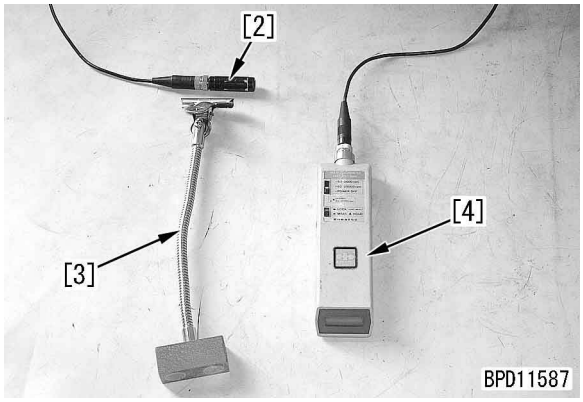
⚠ Take care that the probe will not interfere with the fan.



5. Close the radiator mask, run the engine, and set the monitor panel in the adjustment mode.
   - ★ For the method of operation in the adjustment mode, see "Special functions of monitor panel (EMMS)".
   - ★ Adjustment code: 1005 (Fan 100% speed mode)

6. Run the engine at high idling and low idling and measure the fan motor speed.

⚠ 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 return the removed parts.

MEASURING FAN PUMP CIRCUIT PRESSURE

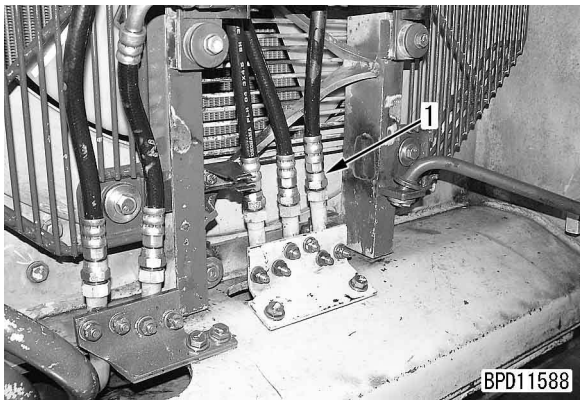
★ Measuring instruments for fan pump circuit pressure

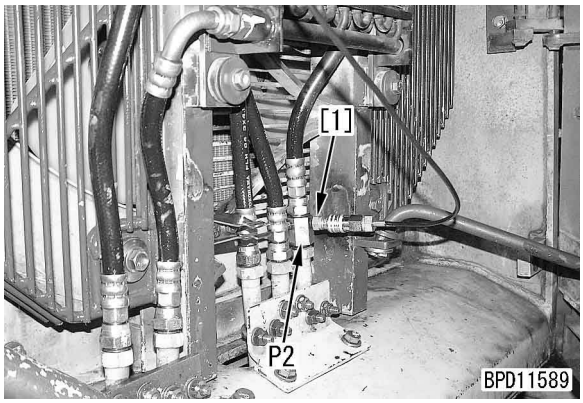
Symbol		Part No.	Name
P	1	799-101-5002	Hydraulic tester
		790-261-1203	Digital hydraulic tester
	2	799-401-3300	Oil pressure pickup adapter (Size: 04)
		02896-11012	O-ring

1. Open the radiator mask.

2. Disconnect fan motor drive circuit hose (1), install oil pressure pickup adapter P2, and connect hose (1) again.

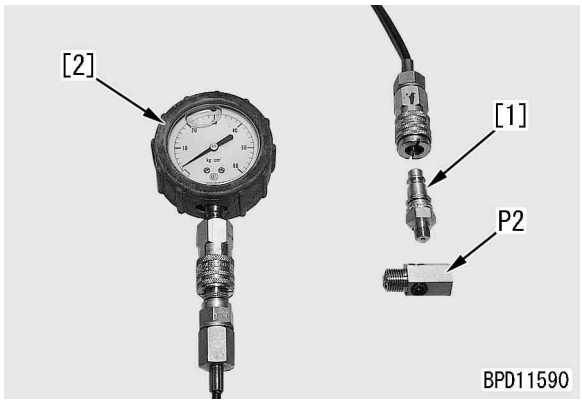
3. Install nipple [1] of hydraulic tester P1 and connect oil pressure gauge [2].
   ★ Use an oil pressure gauge which can measure 39.2 MPa {400 kg/cm^2}.





4. Run the engine and set the monitor panel in the adjustment mode.
   ★ For the method of operation in the adjustment mode, see "Special functions of monitor panel (EMMS)".
   ★ Adjustment code: 1005 (Fan 100% speed mode)

5. Run the engine at high idling and measure the fan circuit pressure.



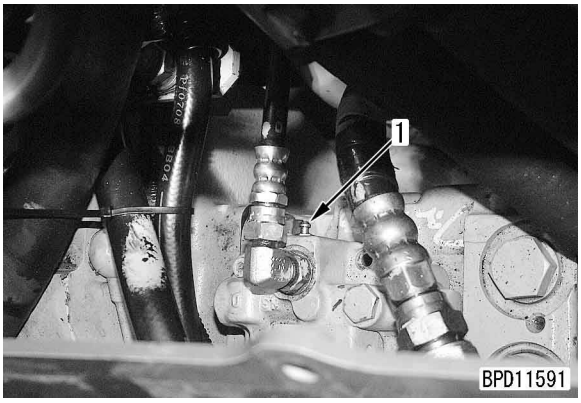
6. After finishing measurement, remove the measuring instruments and return the removed parts.

BLEEDING AIR FROM FAN PUMP

★ If the fan pump is removed and installed or its piping is disconnected and connected, bleed air from the pump case according to the following procedure.
★ Before bleeding air, check that the hydraulic oil level is proper.

1. Remove the floor inspection cover (R.H).

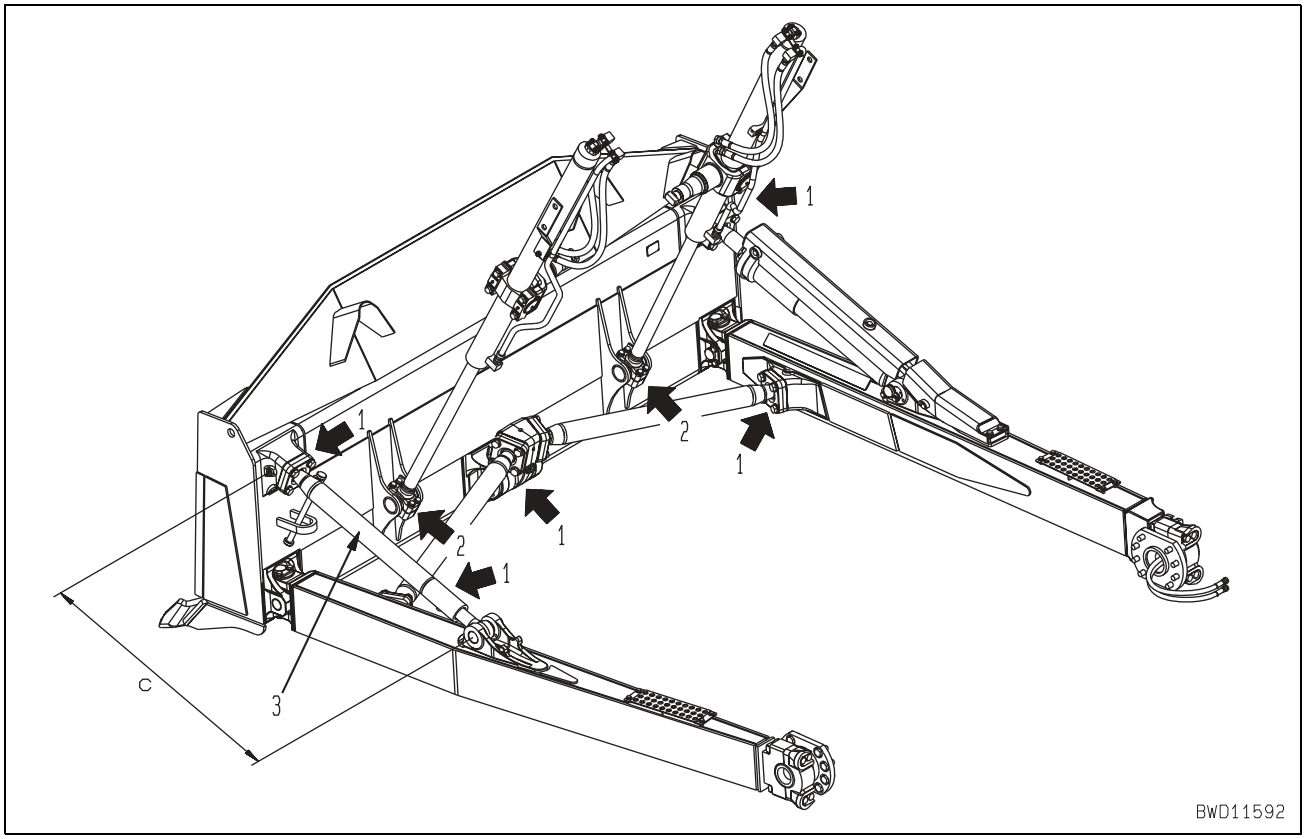
2. Loosen air bleeder (1) and leave it for 15 minutes.



3. After 15 minutes, run the engine at low idling.

4. After oil flows out of air bleeder (1), tighten air bleeder (1).

ADJUSTING BLADE



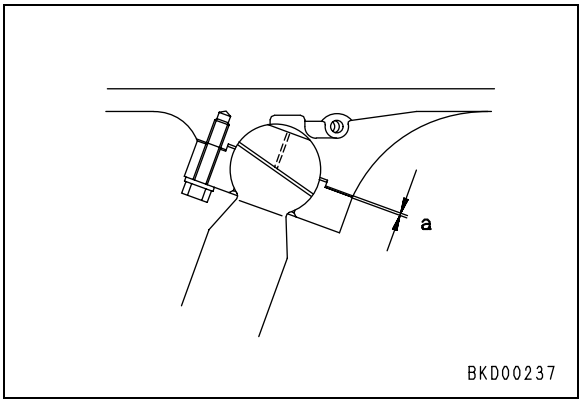
★ If the blade is removed and installed or disassembled and reassemble, adjust it according to the following procedure.

1. Adjusting shims for assembly

1) Adjust the shim of center (1). (6 pieces)

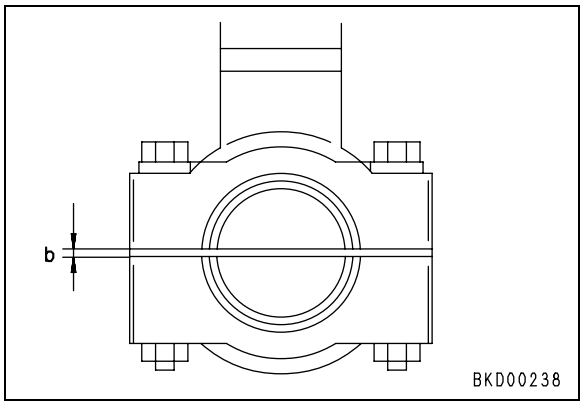
Adjusted point	Adjusted clearance	Standard clearance	Standard shim thickness
1	**a**	See note.	4 mm

Note: Adjust the shim so that the play of the ball in the axial direction will be less than 1mm and the ball can rotate smoothly.



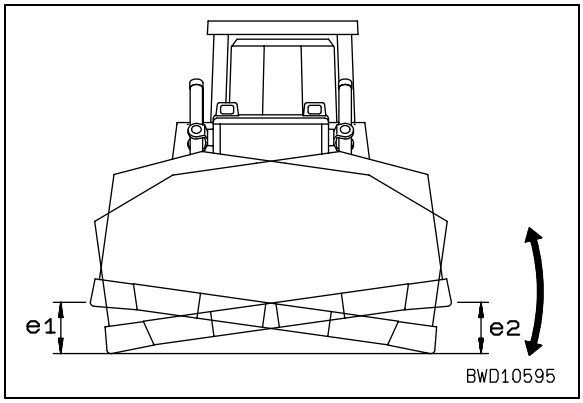
Adjust the shim of lift (2). (2 pieces)

Adjusted point	Adjusted clearance	Standard clearance	Standard shim thickness
2	**b**	Max. 1mm	4 mm



2. Adjusting blade tilt distance

1) Adjust dimension **c** of brace (3) with the handle.
   - Dimension **d** of brace: 1,287 mm
2) Measure right and left tilt distances **e1** and **e2**.
   - Right tilt distance **e1**: Approx. 400 mm
   - Left tilt distance **e2**: Approx. 400 mm
3) If both tilt distances are not the same, adjust dimension **c** of brace (3) according to the following procedure.
   - e1 > e2:Increase dimension **c** finely.
   - e1 < e2:Decrease dimension **c** finely.



TESTING AND ADJUSTING OF OPERATOR'S CAB

Check after installing cab assembly

1. Measuring pressure in cab

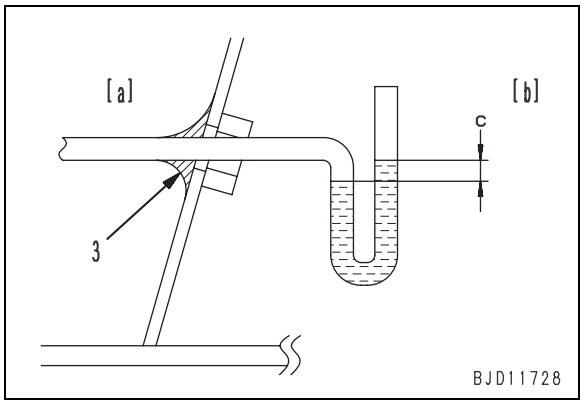
- Criterion:
  Measured value ≧ 78.5 Pa {8 mmH_2O}
- Engine speed: High idling
- Fan speed: 100% mode
- (Refer to user adjustment mode on monitor panel)
- Air conditioner fan switch: High
- Air conditioner Fresh/Recirculation switch: Fresh air position

★ 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.
   i) Prepare a transparent vinyl hose.
      - Inside diameter: 6 mm, Length: 3,000 mm
   ii) Secure the inside end of the hose to the top of the back seat with a tape.
   iii) 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.

   iv) Seal the hole of bolt (1) with tape (3).
   v) Pour water in the hose up to about half, then bent the hose to **U**-shape.
   vi) Set the water level in the vinyl hose out of the cab to that in the cab.
   vii) Run the engine at high idling and measure water level difference "**c**".
   (Value "**c**": Pa {mmH_2O})

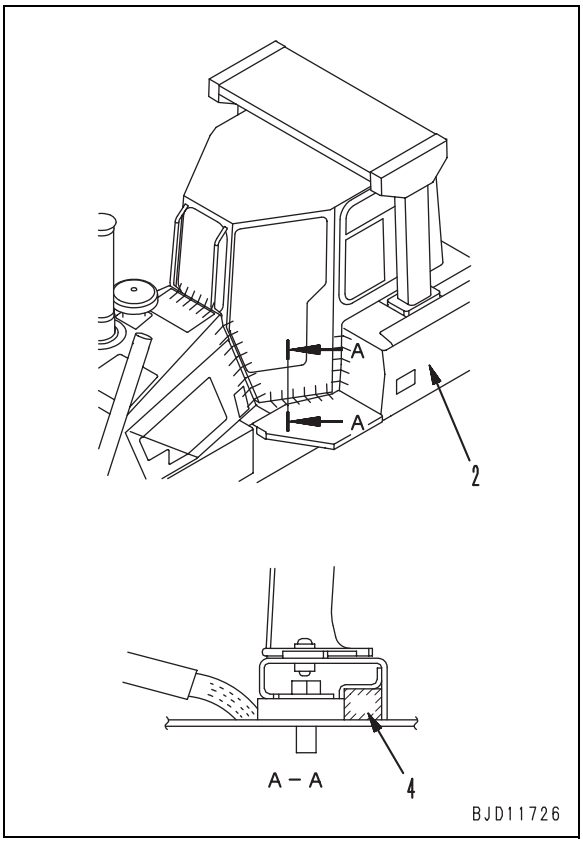
★ **[a]** side: Inside of cab [Pressurized]
[b] side: Out of cab [Atmospheric pressure]



2. Check of searing 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's cab and door. If there is any fault, repair it.

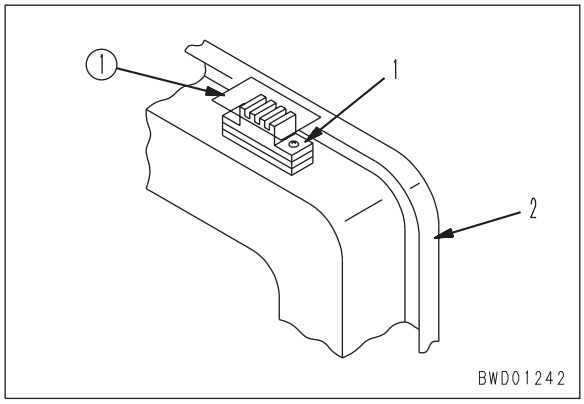
1) Check of condition

i) Check the installed height to damper rubber (1). (Check both sides, 2 pieces on each.)

- Stick adhesive tape ①, etc. to the contact face of damper rubber (1) and open and close the door 2 – 3 times. Then, check the contact face of adhesive tape ① against the operator's cab.

Normal: When the door is closed, the damper rubber comes in contact lightly.

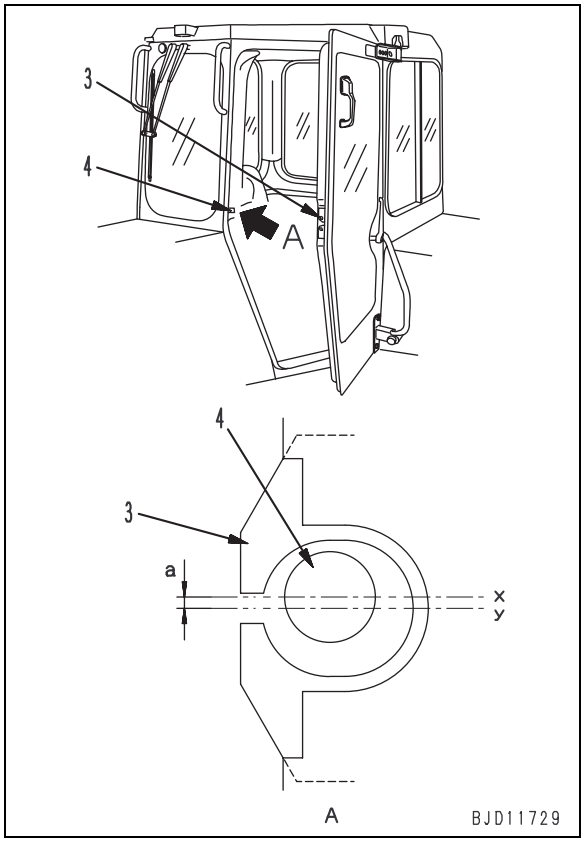
Abnormal: When the door is closed, the damper rubber does not come in contact or comes in contact so strongly that adhesive tape is removed.



ii) Check the relationship between the door notch 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**.



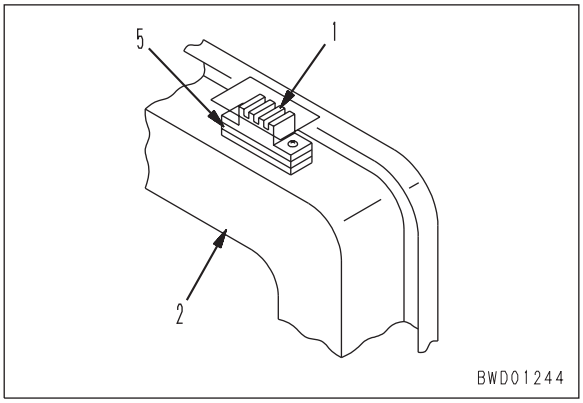
2) Adjusting

i) Adjusting height of damper rubber

- Loosen the mounting bolts of dumper rubber (1).

★ You can remove or 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.

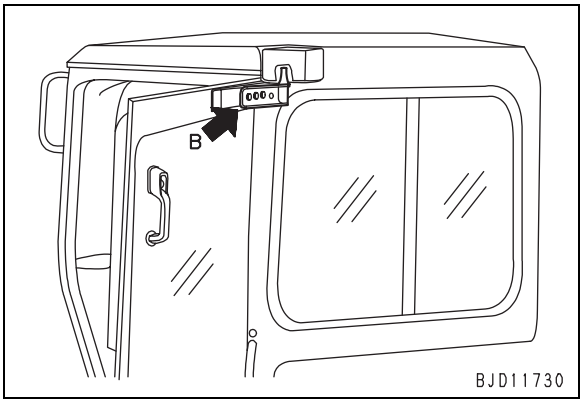


ii) Adjusting height of latch and striker
(1) Tighten the mounting bolt of striker (4) temporarily bolt and close the door 2 – 3 times to align latch (3) and striker (4) with each other.
(2) Check the engaging condition of latch (3) and striker (4).
(3) Tighten the mounting bolt of striker (4) securely.
(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}

iii) Apply grease (G2-LI) to latch (3).
★ If latch (3) is not greased, the knob becomes heavy. Accordingly, apply grease sufficiently.

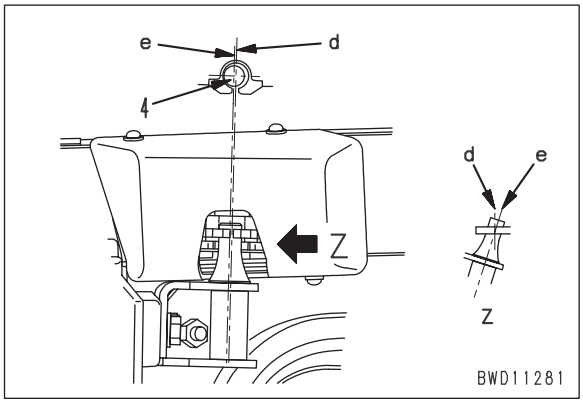
4. Testing open lock
• Lock the door open and check the relationship between the operator's cab and door. If there is any fault, repair it.

1) Check of condition
i) Check the relationship between open lock latch (3) and striker (4) from the direction of **B**.

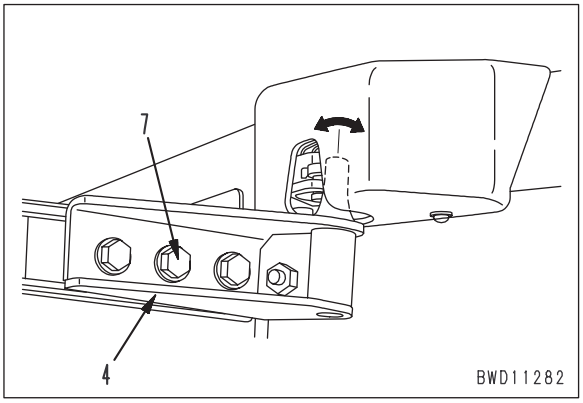


★ Move the door in the opening direction to check the engagement of the latch and striker.

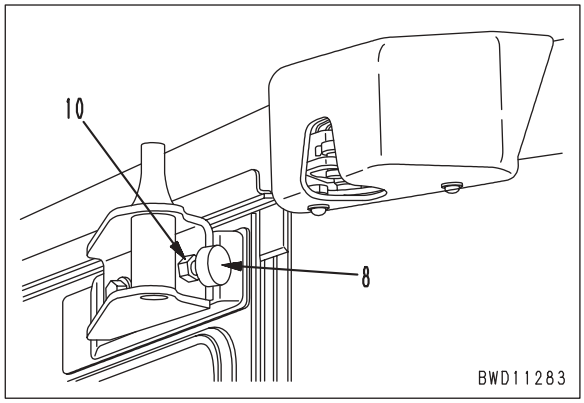
ii) Check the installed height of stopper rubber. (Check both sides, 2 pieces on each.)
(1) Lock the door open and shake it in the forward and reverse directions to see if it has any play.
(2) Check that the operating effort of unlock lever is not heavy.
(3) Check that striker (4) does not slant from center (d) of the latch.
(4) Check that the latch is not shifted from center (e) of the striker.
• Normal: Error of "**a**" must be 0.5 mm or less.

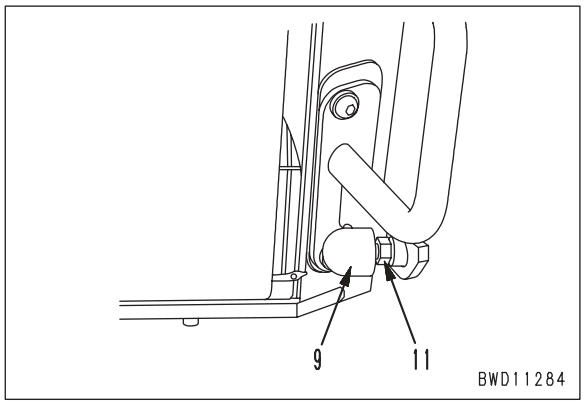


2) Adjusting
i) Adjusting latch and striker
• Loosen mounting bolt (7) of striker (4), adjust striker (4) upright, and tighten mounting bolt (7).



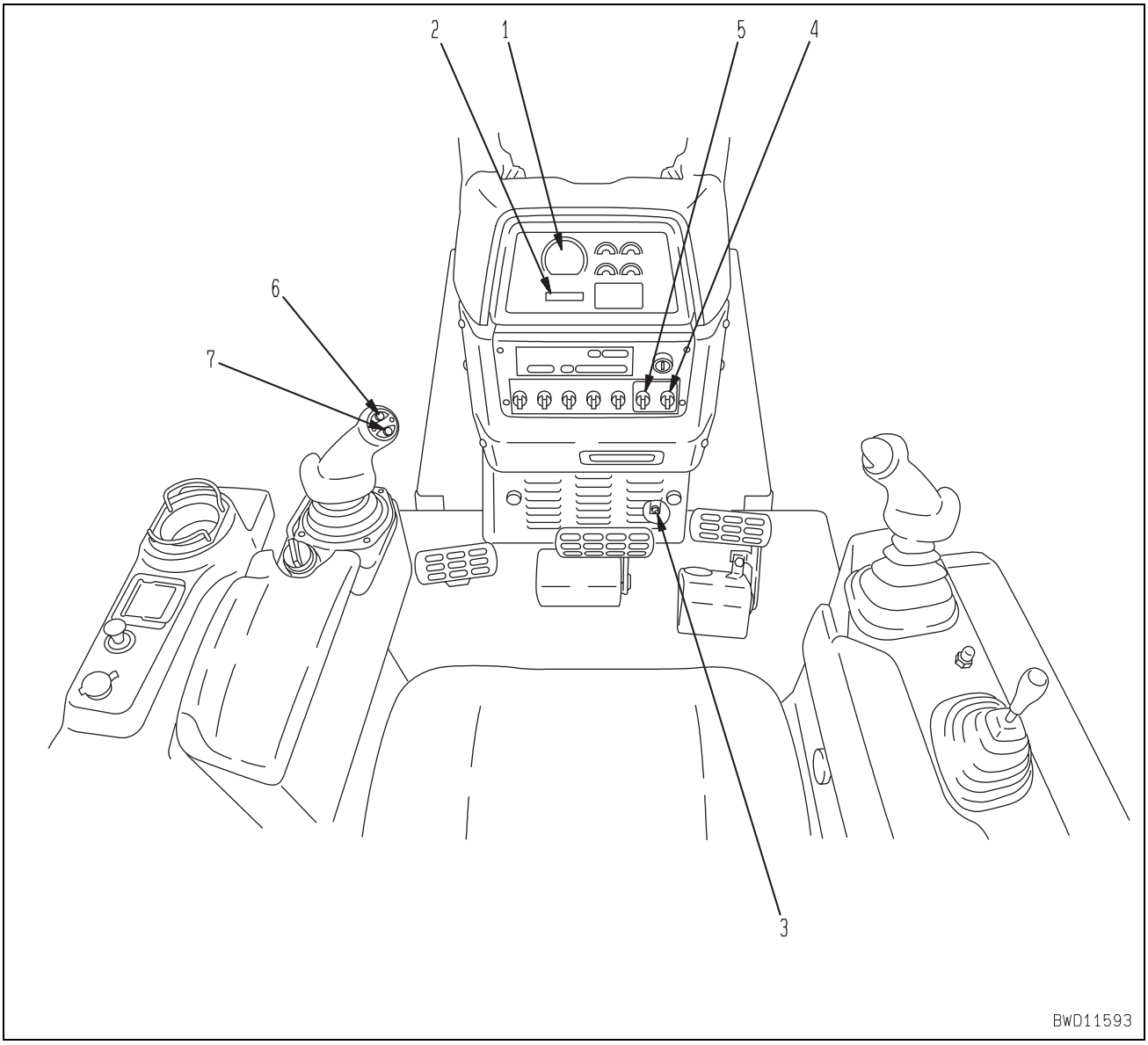
ii) Adjusting installed height of stopper rubber
(1) Loosen the locknut (10), (11) of the stopper rubber upper side (8), lower side (9).





(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 hevy any play.
(3) Tighten the locknut.

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)

Operation section 1 of special functions (Basic operation)

3. Service switch

Operation section 2 of special functions (Changeover operation)

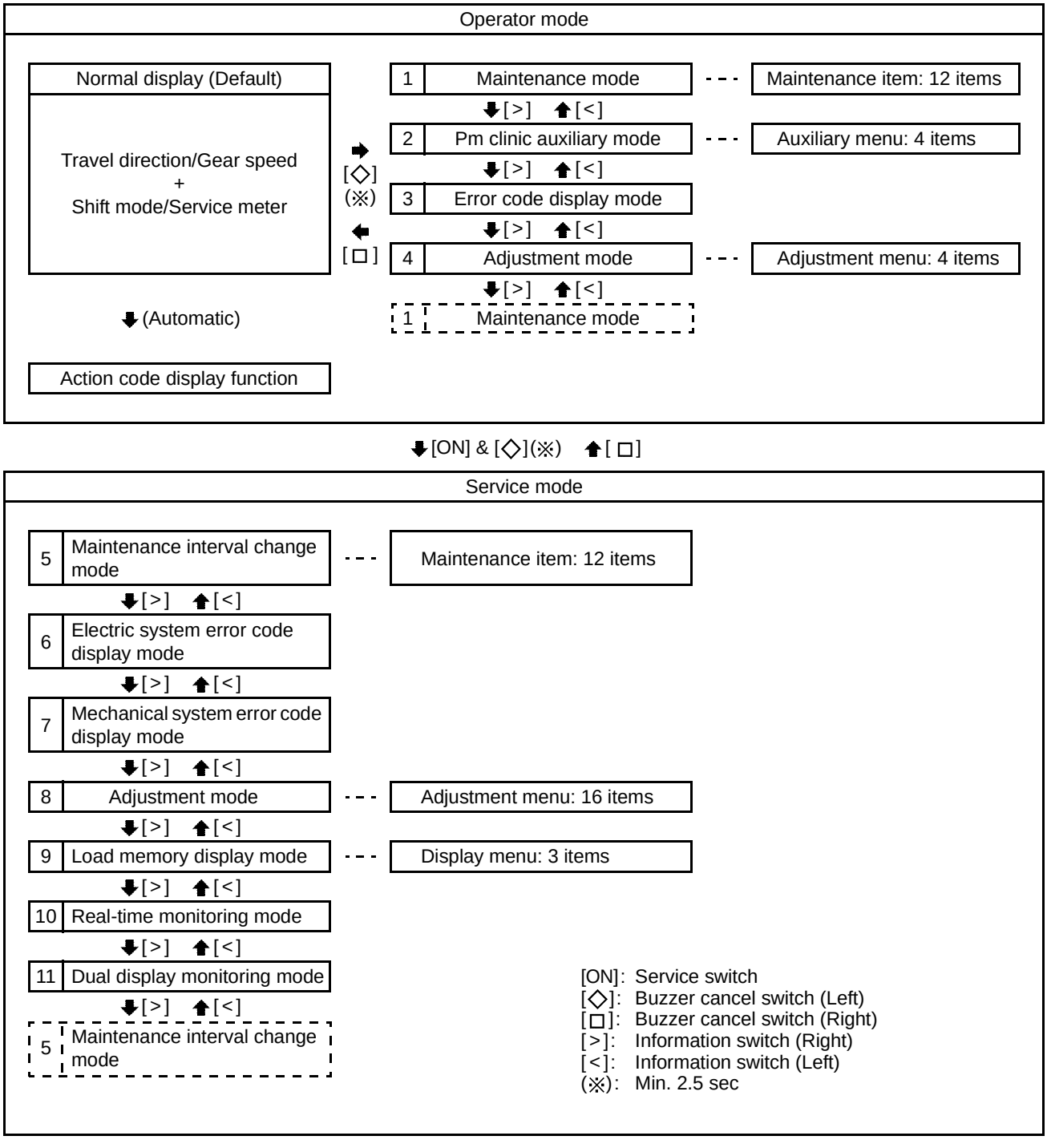
4. Buzzer cancel switch
5. Information switch
6. Shift-up switch
7. Shift-down switch

★ **EMMS**: Equipment Management Monitoring System

Normal function and special functions of monitor panel (EMMS)
The monitor panel (EMMS) has the normal function and special functions and displays information of various types at the gear speed display section at its center 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: Operation mode
   With this function, the operator can display and change the items displayed normally.
2. Special function 1: Service mode
   With this function, a serviceman can display and change the displayed items with special switches for testing, adjusting, and troubleshooting.

Flow of modes and functions

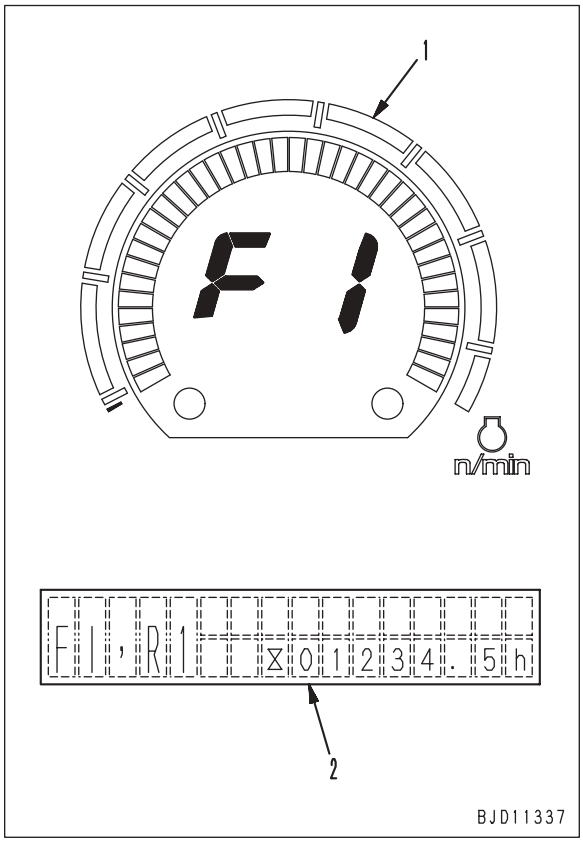


Operation and display in operator mode (Outline)

★ In this section, only the outline of the operation mode is described. For the details of the contents and operation method of each function and mode, see Operation Manual.

Normal display mode (Default)
The monitor panel displays the following information normally.
Gear speed display section (1):
- Front side: Travel direction (P·N·F·R)
- Rear side: Gear speed (1·2·3)
- Graphics: Engine speed

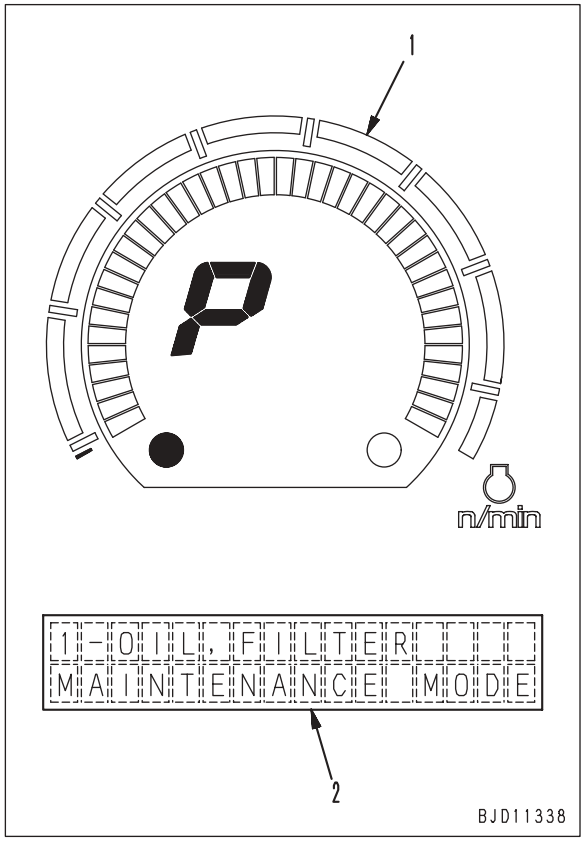
Multi-information section (2):
★ Information is displayed in 2 lines of 16 characters each.
- Front side:
  Gear shift mode (F1-R1·F1-R2·F2-R2)
  (Displayed when preset mode is set)
- Rear side:
  Service meter (Unit: 0.1h)
- Each time the information switch is set to the right or left, the service meter and 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 the multi-information section (2) and reset after the replacement.
★ Gear speed display section (1) keeps displaying normally.

No.	Maintenance item
01	Engine oil
02	Engine oil filter
03	Fuel filter
04	Hydraulic oil filter
05	Corrosion resistor
06	Bypass filter★
07	Damper oil
08	Final drive oil
09	Hydraulic oil
10	Power train oil
11	Power train oil filter
12	HSS charge filter (HSS specification)★

The items marked with ★ are displayed but not used for this machine.

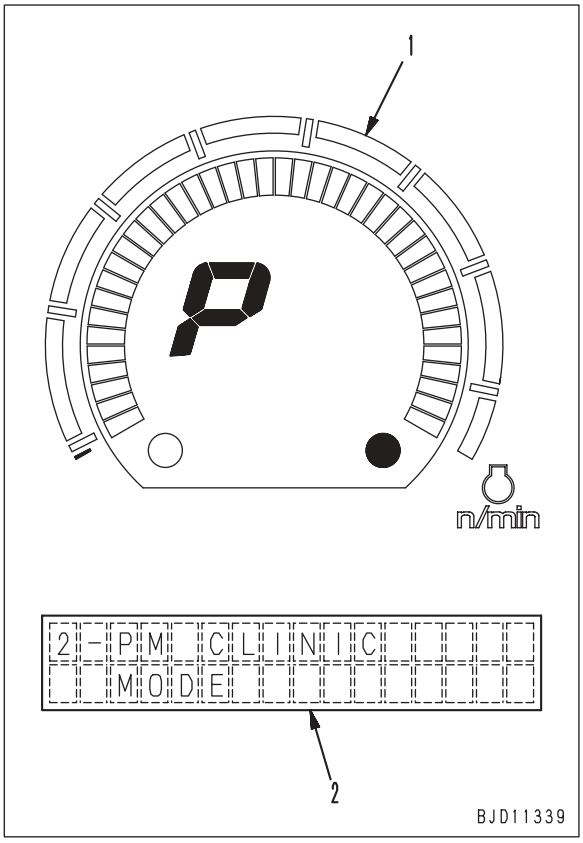


2. Pm clinic auxiliary mode
(2-PM CLINIC MODE)

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) keeps displaying normally.

No.	Pm clinic auxiliary item
01	Engine speed
02	Boost pressure
03	Work equipment pressure
04	Battery voltage



3. Error code display mode
(3-ERROR CODE DISPLAY MODE)

In this mode, the contents of each fault in the machine are displayed by a 6-character error code on the multi-information section (2).

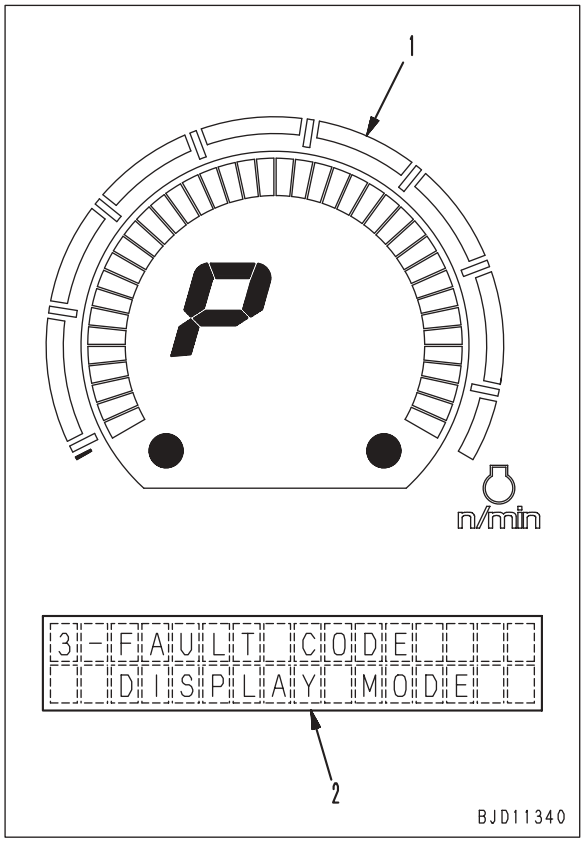
When the user or the operator needs to be notified of the error code of each fault, this mode is applied.

★ Gear speed display section (1) keeps displaying normally.

★ When a serviceman needs to check the error codes for troubleshooting, the Electric system error code display mode and the Mechanical system error code display mode should be used for more detailed information.

★ Method of checking error code:
Turn buzzer cancel switch (4) to the [◇] position on the screen shown at right, and the all error 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 error codes list, see TROUBLESHOOTING.



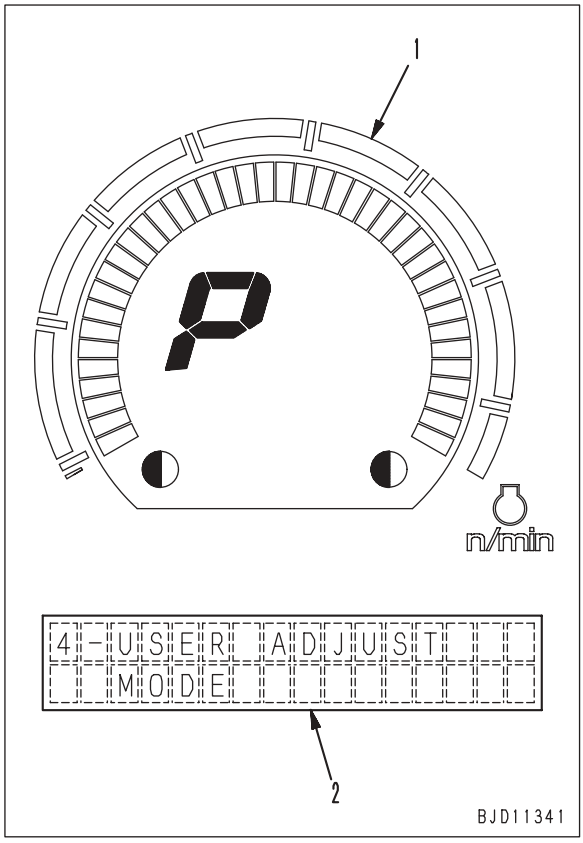
4. Adjustment mode (4-USER ADJUST MODE)

In this mode, the display condition of the monitor panel can be adjusted and the fan 100% mode can be changed on the multi-information section (2).

★ Gear speed display section (1) keeps displaying normally.

No.	Adjustment item
01	Brightness of LCD
02	Brightness of display
03	Contrast of display
04	Fan 100% mode

★ Use the fan 100% mode for cleaning the radiator.



Action code display function

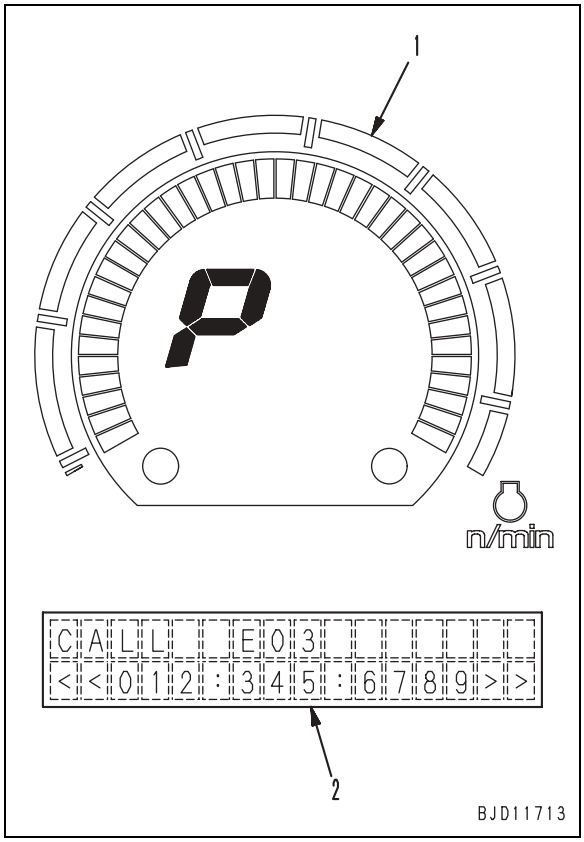
If a fault to be notified to the operator occurs during work, an action code and a phone No. are displayed on the multi-information section (2).

★ Gear speed display section (1) keeps displaying normally.
★ The phone No. is displayed for only important action codes. The display shown at right is an example. (The form of the displayed phone No. depends on the form of the input No.)
★ If an important action code is displayed, the caution lamp flashes and the caution buzzer sounds.

<Reference>

An action code is displayed only when a serious fault occurs.

Even if an action code is not displayed, a fault may have occurred. If you feel any abnormality, be sure to check for a error code in the “Electric system error code display mode” and “Mechanical system error code display mode” of the service mode.



Action codes table

Action code	Indication method of fault	Contents of fault	Remedy
E01	• Only action code is displayed.	• Backup alarm does not sound. • Fan speed is kept at maximum.	• Automatic function stops or normal function stops partially but machine can work. • Call your Komatsu distributor for repair.
E02	• Action code is displayed. • Caution lamp flashes. • Caution buzzer sounds.	• Gear is not shifted up or down. • Engine boost pressure is abnormal. • Exhaust gas color is bad when temperature is low.	• Stop engine and start it again, and you can operate machine without limiting function. You must take care, however. • Call your Komatsu distributor for repair.
CALL E03	• Action code is displayed. • Caution lamp flashes. • Caution buzzer sounds.	• Engine water temperature is defective. • Usable gear speeds are limited. • Engine speed does not rise fully. • Gear shifting shocks become large. • Steering performance lowers. • Brake shocks become large.	• Move machine to safe place. • Call your Komatsu distributor for repair.
CALL E04	• Action code is displayed. • Caution lamp flashes. • Caution buzzer sounds.	• Engine cannot be controlled. • Machine cannot travel. • Machine stops.	• Stop machine immediately. • Call your Komatsu distributor for repair.

Operation and display in service mode

Method of changing to service mode

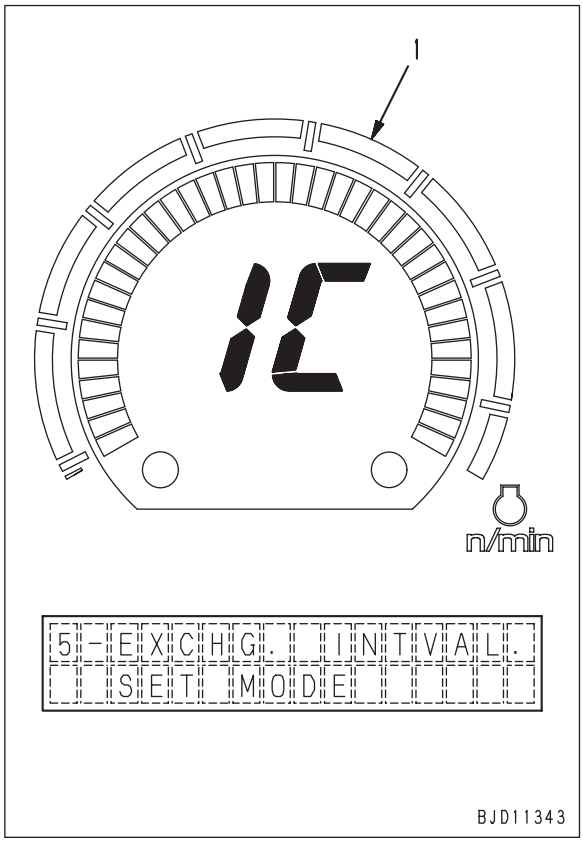
★ When using the service mode, change the screen by the following special operation.

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 the ON position, hold the buzzer cancel switch in the [◇] position for 2.5 seconds.
   - ★ If the monitor panel is set in the service mode, [1C] is displayed on the gear speed display section (1).
   - ★ Each time the monitor panel is set in the service mode, the “Maintenance interval change mode” is displayed first.

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 the 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 the all operation:
   Turn off the starting switch.

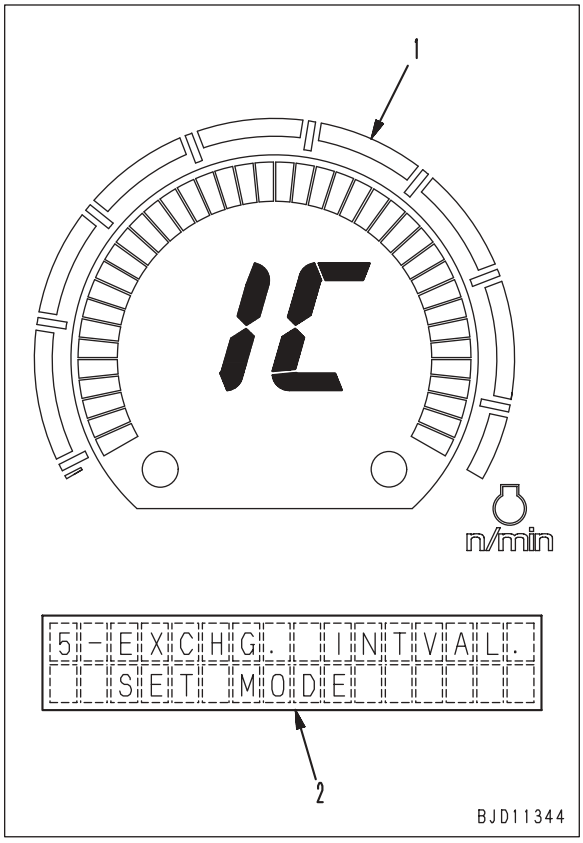


No.	Gear speed display section	Service mode item
5	1C	Maintenance interval change mode
6	EE	Electric system error code display mode
7	bE	Mechanical system error code display mode
8	Cb	Adjustment mode
9	Ld	Load memory display mode
10	5R	Real-time monitoring mode
11	dR	Dual display monitoring mode

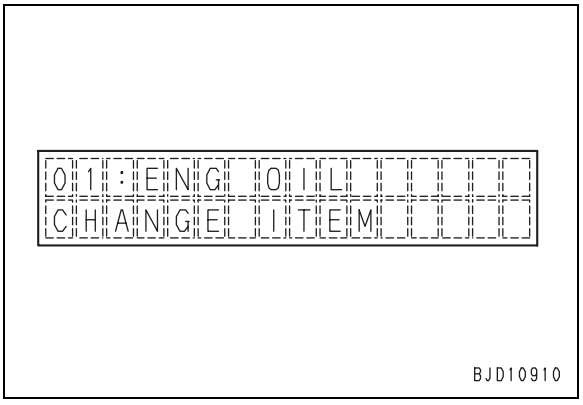
5. Maintenance interval change mode (5-EXCHG. INTVAL. SET MODE)

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.

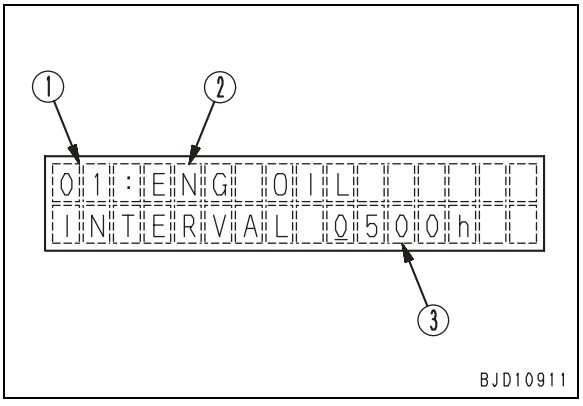
1) Selecting and executing mode
   i) Select “Maintenance interval change mode” on the mode selection screen.
      ★ If the mode is selected, code (1C) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).
   ii) Display the maintenance item selection screen by operating buzzer cancel switch (4).
      • [◇]: Execute mode.



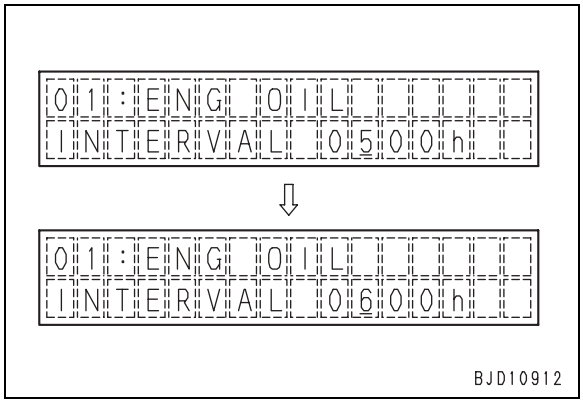
2) Selecting and displaying maintenance item
   i) Operate information switch (5) on the maintenance item selection screen to select a maintenance item.
      • [>]: Next code
      • [<]: Previous code
   ii) Display the maintenance item selection screen by operating buzzer cancel switch (4).
      • [◇]: Execute item.



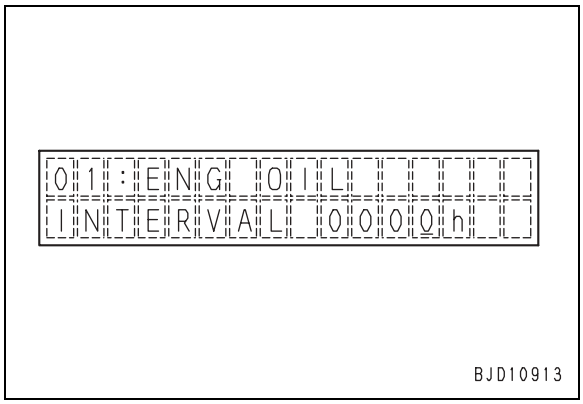
3) Contents of information section
   The following items are displayed on the information section.
   ①: Code
   ②: Maintenance item
   ③: Replacement interval time (Set time)
   ★ The items shown at right are examples.
   ★ If the replacement interval does not need to be changed, finish the operation on this screen.
   ★ If the replacement interval needs to be changed, go to step 4).



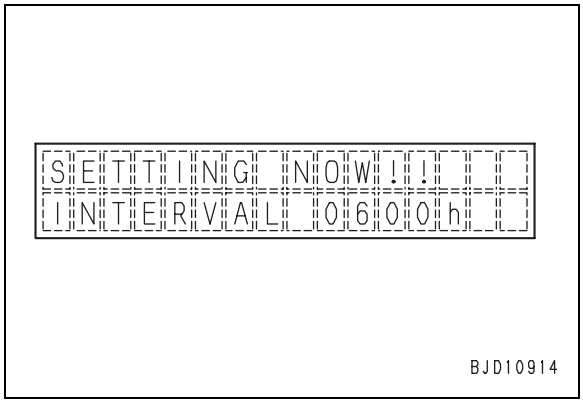
4) Changing replacement interval time
   i) Change the set time by operating information switch (5), shift-up switch (6), and shift-down switch (7).
      - [>]: Move cursor to right.
      - [<]: Move cursor to left.
      - [UP]: Increase number.
      - [DOWN]: Decrease number.



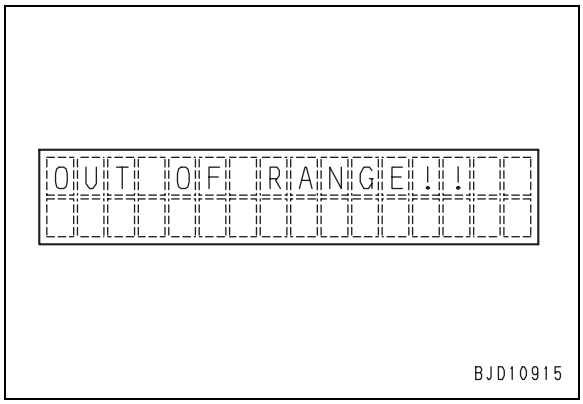
   ★ If you do not use the maintenance function, set the all times to 0.



   ii) 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 at right.



      - ★ If the change is not finished normally, the information display screen before the change appears after the screen shown at right. In this case, execute the above operation again.



Maintenance items table

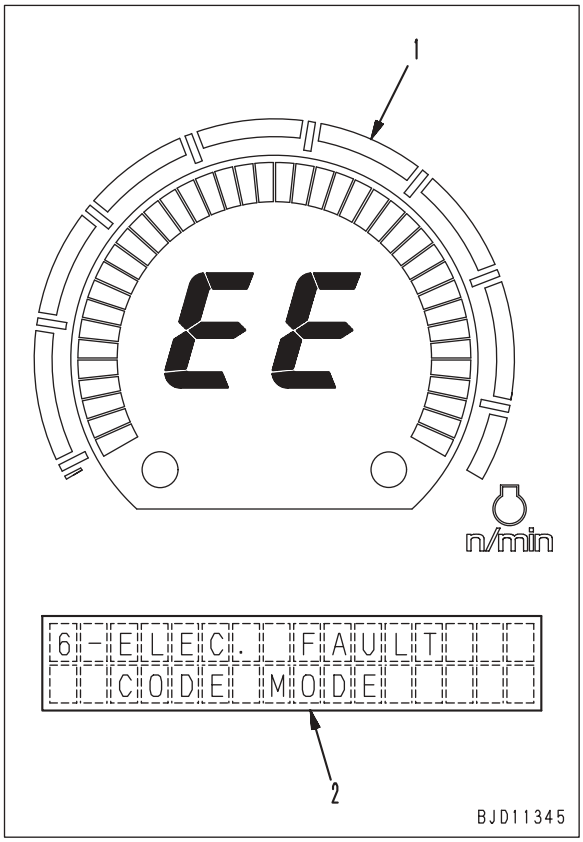
Code	Maintenance item		Replacement interval time	
			1st time (Cannot be changed)	2nd time and after (Can be changed)
01	ENG OIL	Engine oil	0500h	0500h
02	ENG FILT	Engine oil filter	0500h	0500h
03	FUEL FILT	Fuel filter	0500h	0500h
04	HYD FILT	Hydraulic oil filter	0500h	2000h
05	CORR RES	Corrosion resistor	1000h	1000h
06	BYPS FILT	Bypass filter	—	—
07	DAMP OIL	Damper oil	2000h	2000h
08	FNL OIL	Final drive oil	0500h	1000h
09	HYD OIL	Hydraulic oil	0500h	2000h
10	POWL OIL	Power train oil	0500h	1000h
11	POWL FILT	Power train oil filter	0500h	0500h
12	HSS FILT	HSS charge filter (HSS specification)	0500h	—

★ The first interval time cannot be changed. If it needs to be changed for a particular reason, assume that the first maintenance has been finished in the maintenance mode of the operator mode, then change the 2nd and after interval times.

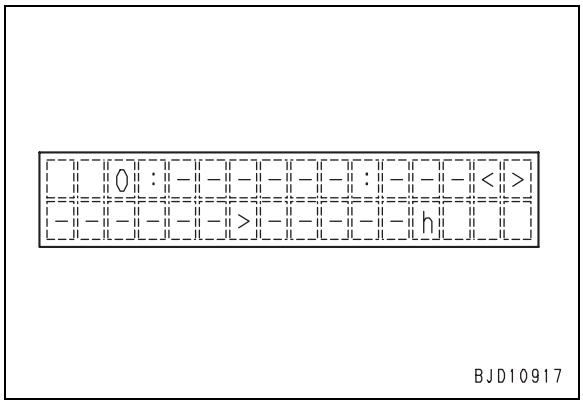
6. Electric system error code display mode (6-ELEC. ERROR CODE MODE)

In this mode, you can check the electric system error codes.

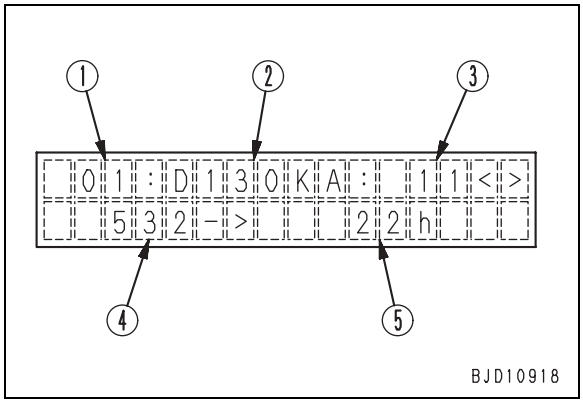
1) Selecting and executing mode
   i) Select “Electric system error code display mode” on the mode selection screen.
      ★ If the mode is selected, code (EE) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).
   ii) Display the error code display screen by operating buzzer cancel switch (4).
      • [◇]: Execute mode.



2) Display in the case where no codes are recorded
   If no error codes have been output up to now, the information section displays as shown at right.



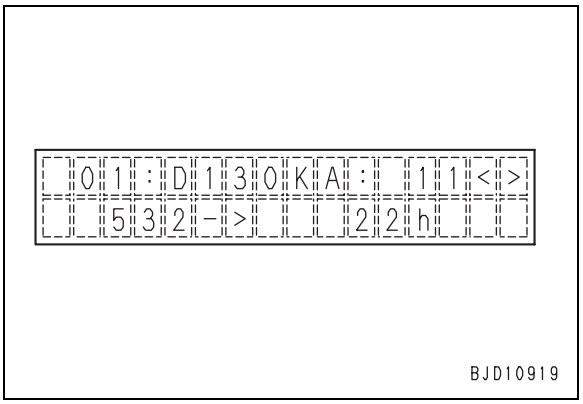
3) Display in the case where 1 or more codes are recorded
   If any error code has been output up to now, the information section displays as shown at right.
   ①: Record No. (Up to 20)
   ②: Error code (Code being output currently is flashing)
   ③: Number of past occurrences
   ④: Time measured by service meter after first occurrence
   ⑤: Time measured by service meter after last occurrence
   ★ The items shown at right are examples.
   ★ For the error codes list, see TROUBLE-SHOOTING.



★ Flashing and lighting of error code
Flashing: Code is being output currently.
Lighting: Code is not being output currently.
★ Condition for detecting and keeping error code
If a error code of any item other than communication is output, it keeps flashing until the starting switch is turned off. After the starting switch is turn on or the engine is started again, the error code keeps lighting until the same fault is detected.
A error code of communication starts lighting when the fault is solved, even if the starting switch is turned off.

4) Operation to take when multiple codes are recorded.
When multiple codes are recorded, they can be displayed one by one by operating information switch (5).
• [>]: Next code
• [<]: Previous code
★ The error codes are displayed from the oldest one in order of length of time after they were output.

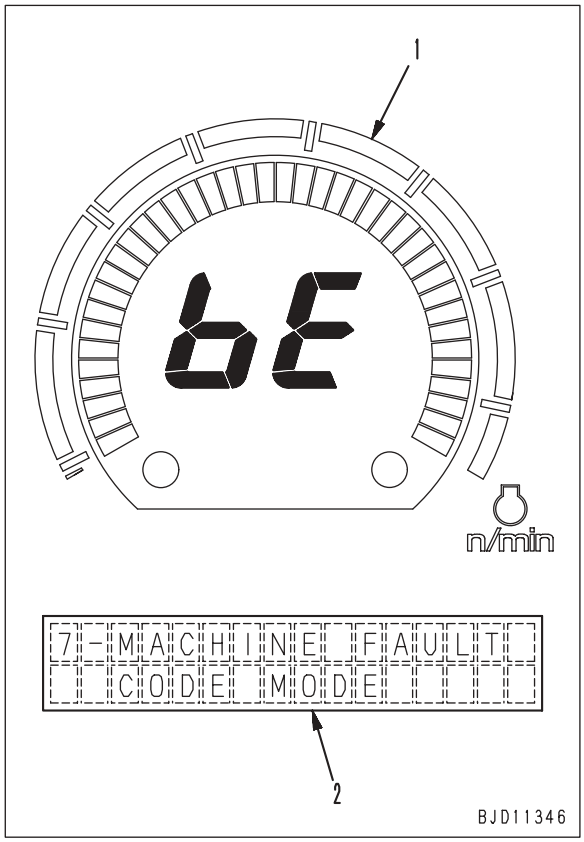
5) Method of deleting error code
While a error code to be deleted, operate shift-up switch (6) or shift-down switch (7).
• [UP] or [DOWN]: Delete error code.
★ A error code which is being output currently (which is flashing) cannot be deleted.



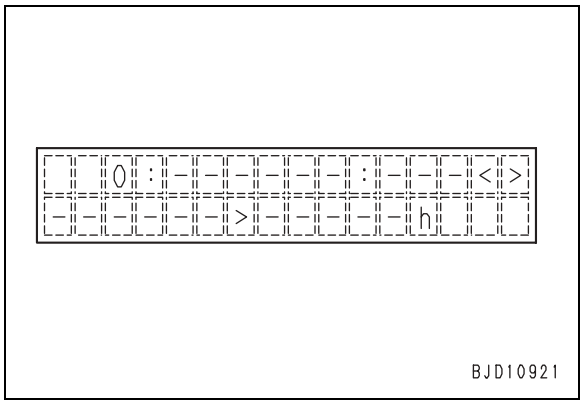
7. Mechanical system error code display mode (7-MACHINE ERROR CODE MODE)

In this mode, you can check the mechanical system error codes.

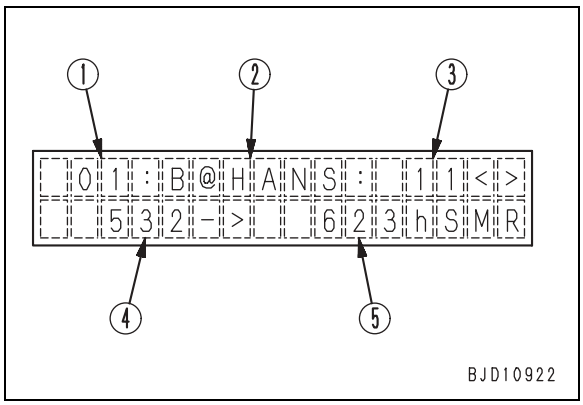
1) Selecting and executing mode
   i) Select “Mechanical system error code display mode” on the mode selection screen.
      ★ If the mode is selected, code (bE) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).
   ii) Display the error code display screen by operating buzzer cancel switch (4).
      • [◇]: Execute mode.



2) Display in the case where no codes are recorded
   If no error codes have been output up to now, the information section displays as shown at right.



3) Display in the case where 1 or more codes are recorded
   If any error code has been output up to now, the information section displays as shown at right.
   ①: No.
   ②: Error code (Code being output currently is flashing)
   ③: Number of past occurrences
   ④: Time measured by service meter after first occurrence
   ⑤: Time measured by service meter after last occurrence
   ★ The items shown at right are examples.
   ★ For the error codes list, see TROUBLESHOOTING.



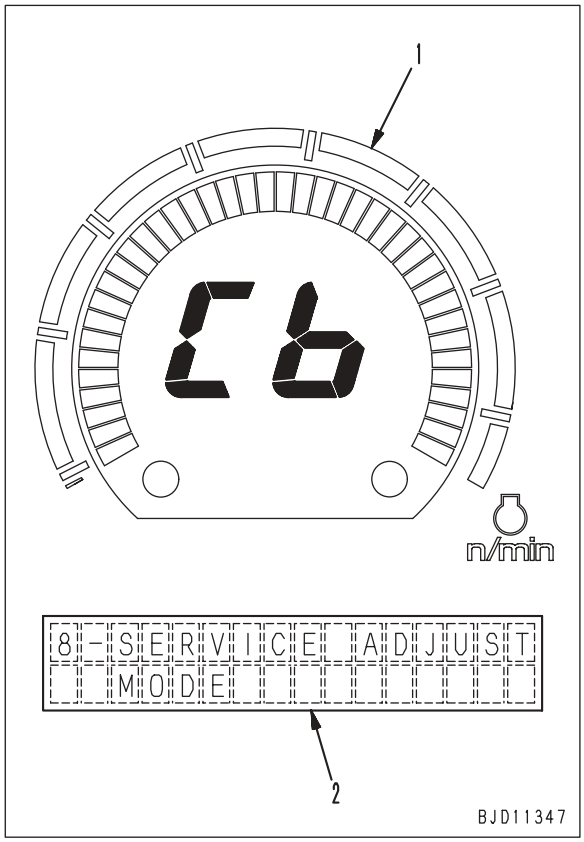
★ Flashing and lighting of error code
Flashing: Code is being output currently.
Lighting: Code is not being output currently.
★ Condition for detecting and keeping error code
If a error code of any item other than communication is output, it keeps flashing until the starting switch is turned off. After the starting switch is turn on or the engine is started again, the error code keeps lighting until the same fault is detected.
A error code of communication starts lighting when the fault is solved, even if the starting switch is turned off.

4) Operation to take when multiple codes are recorded.
When multiple codes are recorded, they can be displayed one by one by operating information switch (5).
• [>]: Next code
[<]: Previous code
★ The error codes are displayed from the oldest one in order of length of time after they were output.

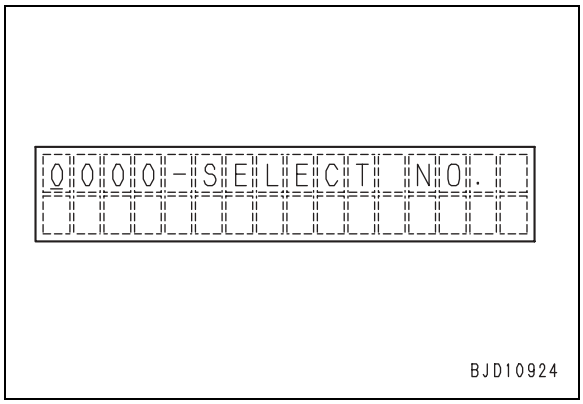
5) Method of deleting error code
The mechanical system error codes cannot be deleted.

8. Adjustment mode
(8-SERVICE ADJUST MODE)
In this mode, you can adjust the control system and various devices of the machine.

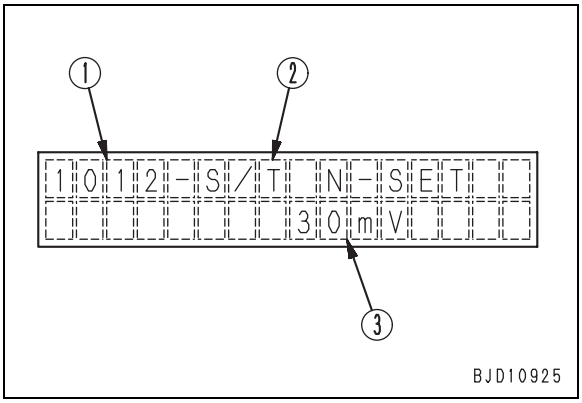
1) Selecting and executing mode
   i) Select “Adjustment mode” on the mode selection screen.
      ★ If the mode is selected, code (Cb) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).
   ii) Display the adjustment code input screen by operating buzzer cancel switch (4).
      • [◇]: Execute mode.



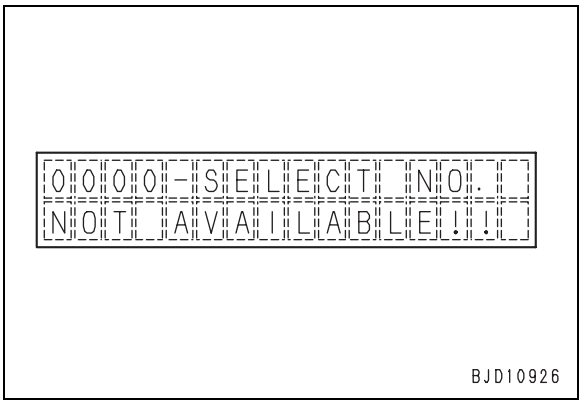
2) Selecting adjustment items
   i) On the adjustment code input screen, input the 4-digit code of the item to be adjusted by operating information switch (5), shift-up switch (6), and shift-down switch (7).
      • [>]: Move cursor to right.
      • [<]: Move cursor to left.
      • [UP]: Increase number.
      • [DOWN]: Decrease number.
   ii) After inputting the code, operate buzzer cancel switch (4) to display the monitoring screen.
      • [◇]: Enter input code.



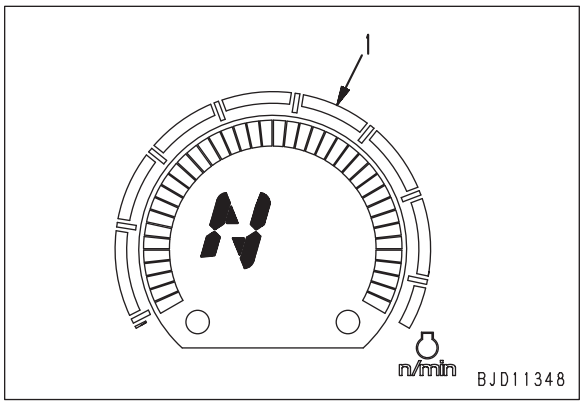
3) Contents of display on adjustment screen
   ①: Code
   ②: Adjustment item
   ③: Related information
   ★ For the detailed information and adjustment procedure, see “ADJUSTMENT MODE TABLE AND ADJUSTMENT PROCEDURE”.



   ★ If an incorrect code is input, the adjustment code input screen appears again after the screen shown at right. In this case, execute the above operation again.



4) When operating machine in adjustment mode
   If the parking brake lever is set in the FREE position, gear speed display section (1) displays normally and the machine can be operated normally.
   ★ To select another screen, return the parking brake lever to the LOCK position and perform the necessary procedure.



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".
   ★ This operation is not accepted while the parking brake lever is in the FREE position. Take care.
   ★ An adjustment item can be selected by returning to the input screen and inputting the code for that item.

Adjustment mode table and adjustment procedure

No.	Code	Adjustment item		Related information	Disassembly/ 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	
★ [7]	0009	PITCH SENS.	Pitch angle sensor initial set	Voltage	
★ [8]	0010	FAN 70%MODE	Fan 70% speed mode	Adjustment data	
★[10]	1005	FAN100%MODE	Fan 100% speed mode	Adjustment data	
[11]	1012	S/T N-SET	Steering lever neutral set	Voltage	
[12]	1013	S/T M.L-SET	Steering lever left set	Voltage	
[13]	1014	S/T M.R-SET	Steering lever right set	Voltage	
[14]	2222	HSS ADJUST	HSS lever initial current set (HSS specification)	Current	
[15]	9997	HI IDLE SET	High idling limit mode	Speed	
[16]	9998	SFT INHIBIT	Gear speed limit mode	Symbol	

⚠ Items marked with ● in the Disassembly/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.

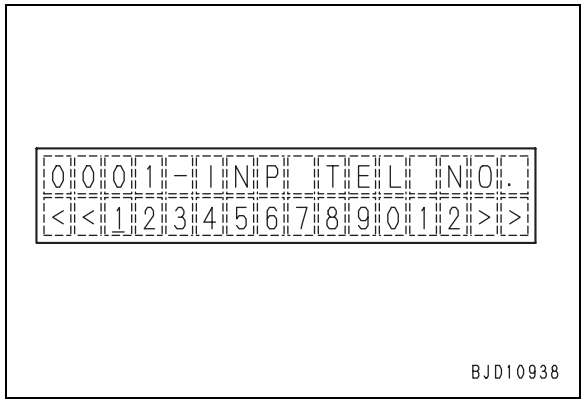
[1] 0001: Phone number input mode

- 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 : ; < > ?
- Instructions for use:
  By operating the information switch (5), shift up switch (6), and shift down switch (7), input a phone number and symbols.
  - [>]: Moves the cursor rightward.
  - [<]: Moves the cursor leftward.
  - [UP]: Advance the numeric character or character (in the order of available characters).
  - [DOWN]: Reverse the numeric character or character (in the reverse order of available characters).

  ★ 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.)

  ★ The setting is enabled even after ending this code.



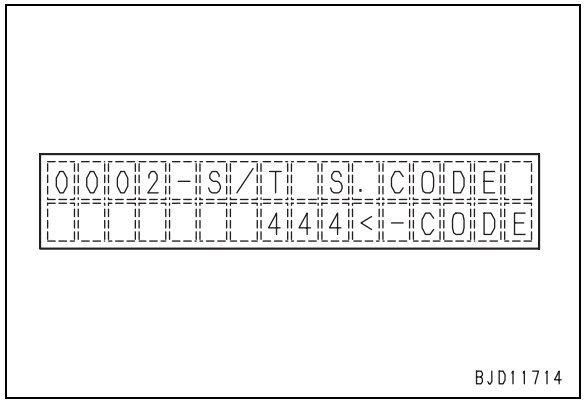
BJD10938

[2] 0002: Steering and transmission controller specification set

- This code is used to initialize the specification codes recognized by the steering 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 caution 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.

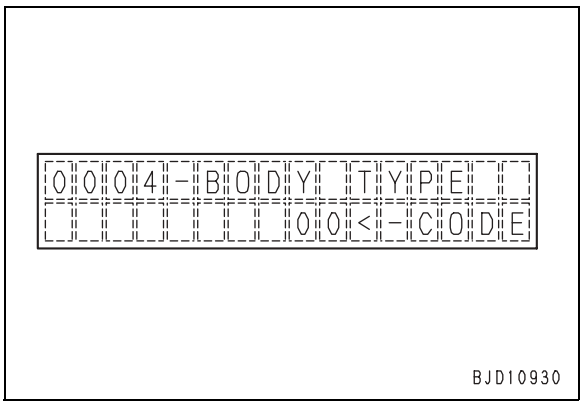


BJD11714

[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 (5) in the [>] position.
  2) Set buzzer cancel switch (4) in the [◇] position and check that the caution buzzer sounds.

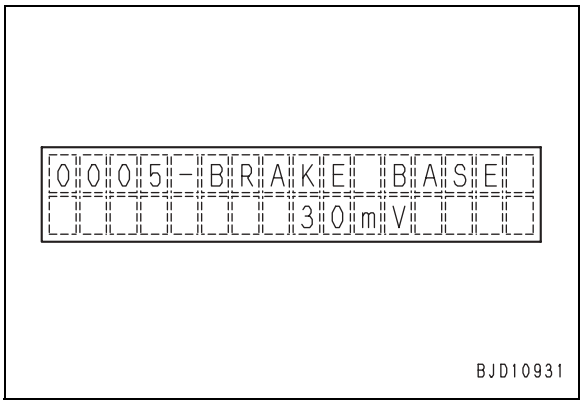
  ⚠ If the machine specification is different from the setting in the controller, the machine may move abnormally or an error may be made. Accordingly, be sure to match the setting to the machine specification.
  - ★ Even if this code is turned off, the setting is effective.



No.	Specification
00	Standard specification
08	–
80	Standard cold district specification
88	–

[4] 0005: Brake potentiometer zero point adjustment

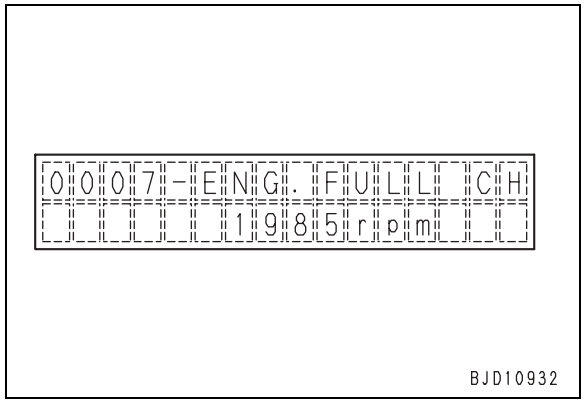
- This code is used to adjust the zero point of the potentiometer of the brake pedal.
- The deviation from the standard is displayed by voltage on the lower line (Display range: –2500 – 2500).
- Adjustment method:
  With the brake pedal released, set buzzer cancel switch (4) in the [◇] position and check that the caution buzzer sounds.
  - ★ Even if the neutral position of the brake pedal is adjusted, 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 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 idling speed of the engine singly.
- The engine speed is displayed on the lower line (Display range: 0 – 3000).
- Using method:
  While this code is displayed, its function is turned on and the auto-deceleration function is turned off.

★ If this code is turned off, its function is turned off.



[6] 0008: Common rail reduced cylinder mode

★ When the engine common rail system seems to be faulty, 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 faulty cylinder from the change of the engine speed.

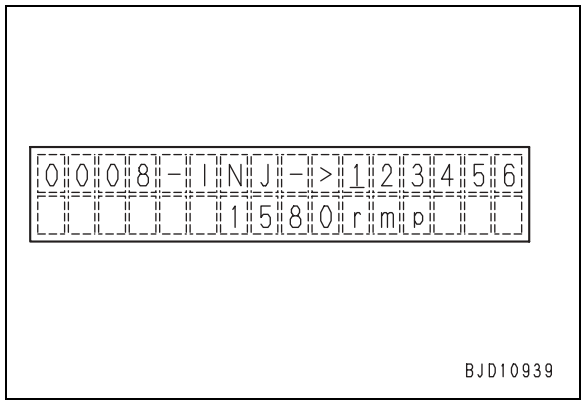
★ Since a fault is detected by the difference of the engine speed in the reduced cylinder mode operation from that in the normal mode operation, use this function while the engine is running.

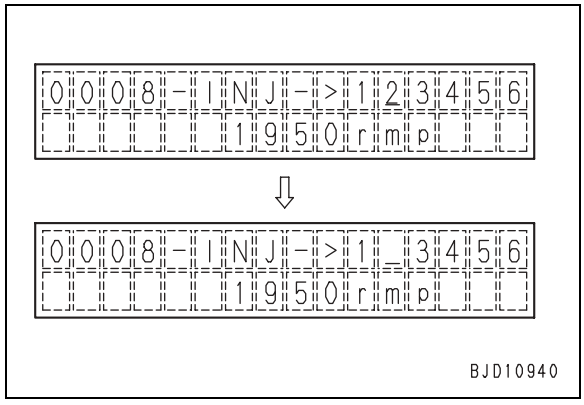
- The engine speed is displayed on the lower line (Display range: 0 – 3000).
- Using method:
  Select the cylinders to be turned off for the reduced cylinder mode operation by operating information switch (5) and buzzer cancel switch (4).
  Use this method to turn on the selected cylinders again, too.
  - [>]: Move cursor to right.
  - [<]: Move cursor to left.
  - [◇]: Execute or stop reduced cylinder mode operation.

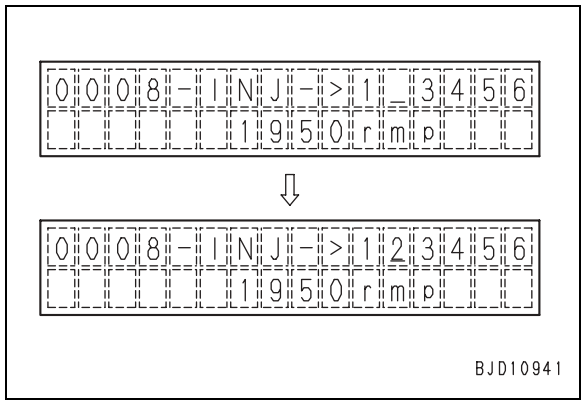
  ★ The figure at right is an example that No. 2 cylinder is turned off for reduced cylinder mode operation and turned on again (The cylinder No. lamp is turned off in the reduced cylinder mode operation and on in the normal mode operation).

  ★ Only one or more cylinders can be turned off for the reduced cylinder mode operation.

  ★ If this code is turned off, its function is turned off.

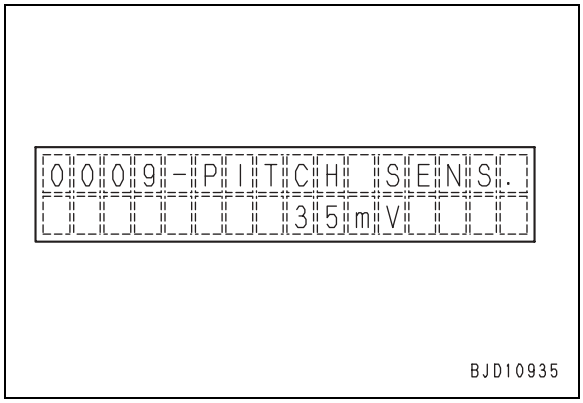






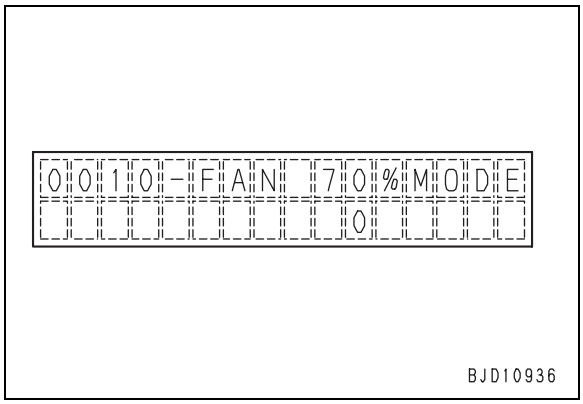
[7] 0009: Pitch angle sensor initial set

- This code is used to adjust the zero point and installation error of the pitch angle sensor.
- 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 caution buzzer sounds.
  - ★ Even after adjustment, the display of the lower line does not change.
  - ★ Even if this code is turned off, the setting is effective.



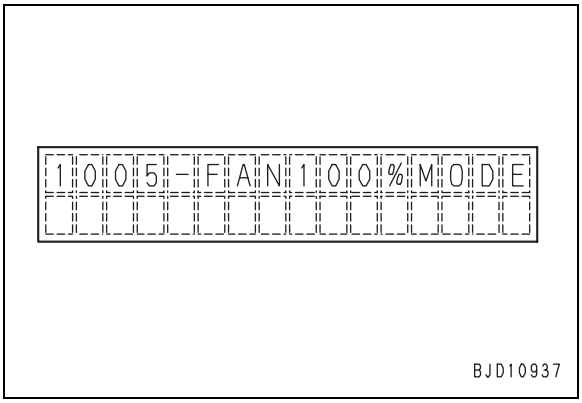
[8] 0010: Fan 70% speed mode

- This code forcedly sets the rpm of cooling fan at approximately 70% of the maximum speed.
- The lower part displays data for adjustment.
- Instructions for use:
  The function is enabled with this code displayed to control the rpm of cooling fan to approximately 70% of the maximum speed.
  - ★ Ending this code disables the function.



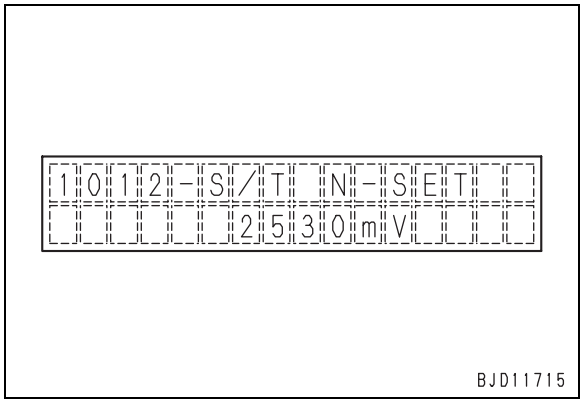
[10] 1005: Fan 100% speed mode

- This code forcedly sets the rpm of cooling fan at approximately 100% of the maximum speed.
- The lower part displays data for adjustment.
- Instructions for use:
  The function is enabled with this code displayed to control the rpm of cooling fan to approximately 100% of the maximum speed.
  ★ Ending this code disables the function.



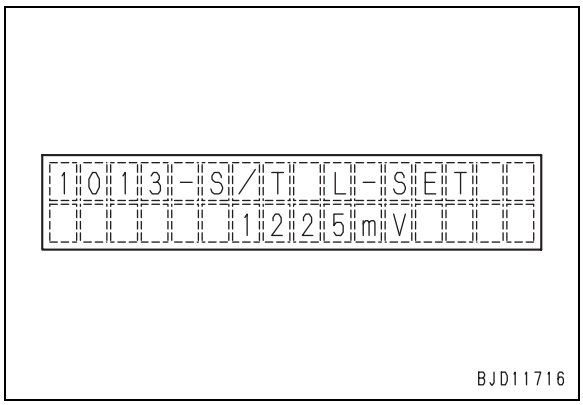
[11] 1012: Steering lever neutral set

- This code is used to adjust the steering potentiometer neutral position of the PCCS lever.
- The output signal of steering potentiometer from 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 caution buzzer sounds.
     - ★ Even if this code is turned off, the setting is effective.
     - ★ This code is not for adjustment of the steering performance, etc.
     - ★ Even after adjustment, the display of the lower line does not change.



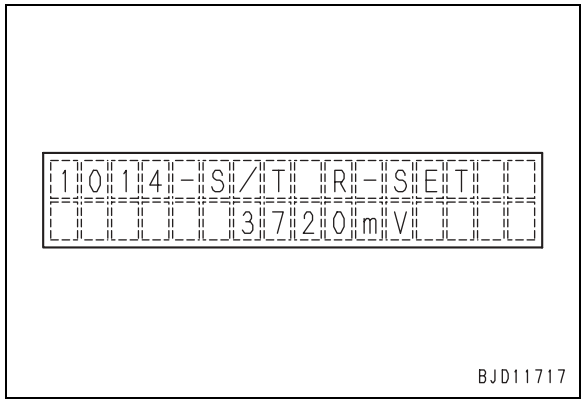
[12] 1013: Steering lever left set

- This code is used to adjust the maximum left steering potentiometer position of the PCCS lever.
- The output signal of the steering potentiometer from displayed by voltage on the lower line (Display range: 0 – 5000).
- Adjustment method:
  1) Set the PCCS lever to the left steering stroke end.
  2) Set buzzer cancel switch (4) in the [◇] position and check that the caution buzzer sounds.
  - ★ Even if this code is turned off, the setting is effective.
  - ★ This code is not for adjustment of the steering performance, etc.
  - ★ Even after adjustment, the display of the lower line does not change.



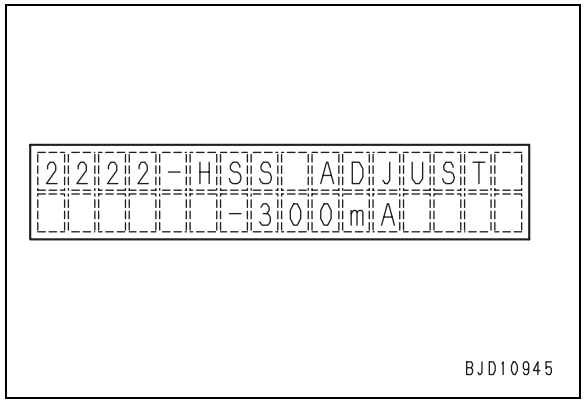
[13] 1014: Steering lever right set

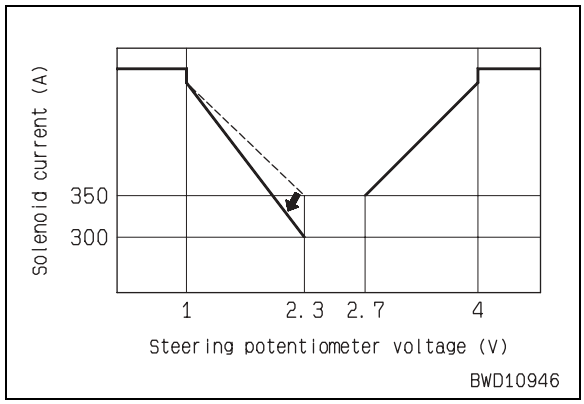
- This code is used to adjust the maximum right steering potentiometer position of the PCCS lever.
- The output signal of steering potentiometer from displayed by voltage on the lower line (Display range: 0 – 5000).
- Adjustment method:
  1) Set the PCCS lever to the right steering stroke end.
  2) Set buzzer cancel switch (4) in the [◇] position and check that the caution buzzer sounds.
  ★ Even if this code is turned off, the setting is effective.
  ★ This code is not for adjustment of the steering performance, etc.
  ★ Even after adjustment, the display of the lower line does not change.



[14] 2222:HSS lever initial current set

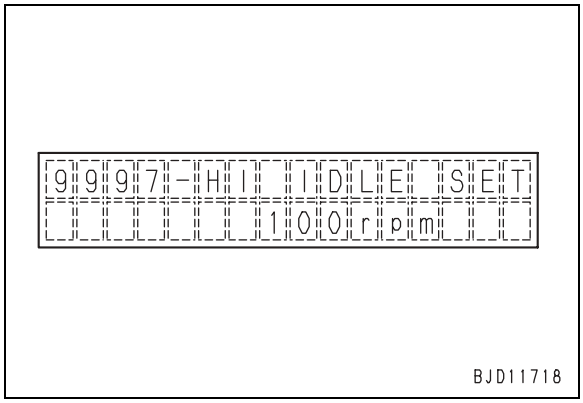
- When the steering start feeling is different by the steering direction, this code is used to adjust the turning radius at the start of steering.
- The current to drive the HSS EPC solenoid is displayed on the lower line [Display range: –350 (Left end) – 0 – 350 (Right end)].
- Adjustment method:
  1) Gradually turning the PPC lever to the left or right, display and keep the current to be set.
     - If the lever is turned to the left, the current becomes negative.
     - If the lever is turned to the right, the current becomes positive.
  2) Set buzzer cancel switch (4) in the [◇] position and check that the caution 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 figure at right 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.





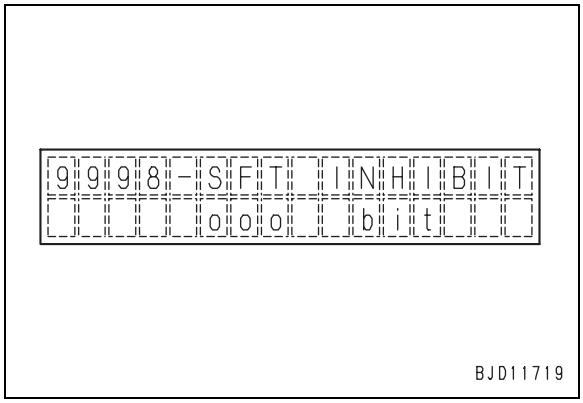
[15] 9997: High idling limit mode

- This code is used to limit the use high idling speed.
- The limited speed (0 – 400) is displayed on the lower line.
- Limit range: High idling speed – –400rpm
- Using method:
  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 caution buzzer sounds.
  - ★ If the high idling speed is limited, the engine speed is not raised to the normal high idling level even if the fuel control dial is controlled so.
  - ★ Even if this code is turned off, the setting is effective.



[16] 9998: Gear speed limit mode

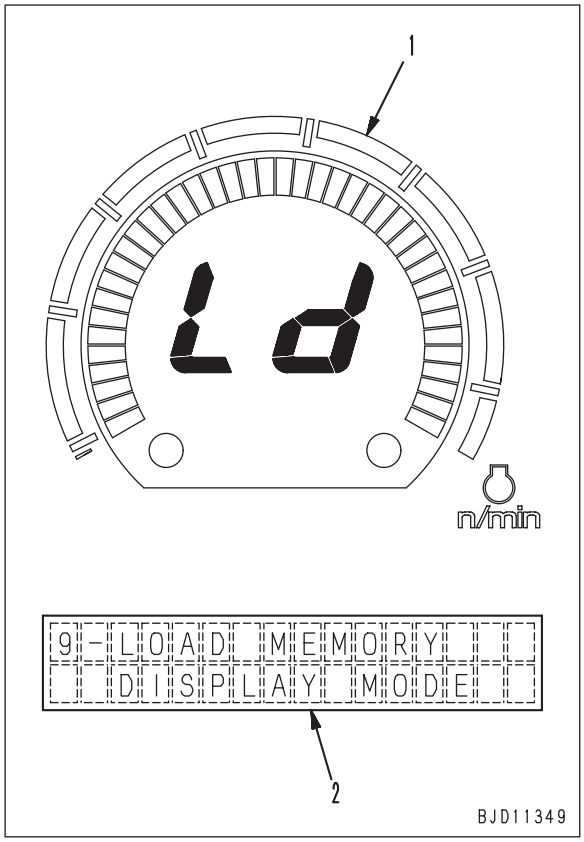
- This code is used to limit the use of the 3 gear speeds.
- The usable gear speeds are displayed by bits on the lower line (in the order of the 3rd, 2nd, and 1st from the left).
- Using method:
  Limit or allow the use of the maximum gear speed by operating information switch (5) and buzzer cancel switch (4).
  - [>]: Do not prohibit shifting to 3rd gear speed.
  - [<]: Prohibit shifting to 3rd gear speed.
  - [◇]: Enter the selection.
  - Display on lower line [o]:
    Gear speed is effective.
  - Display on lower line [ ]:
    Gear speed is not effective.
  - ★ If the use of a gear speed is limited, 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, you can check the load on the machine, forward odometer, and reverse odometer.

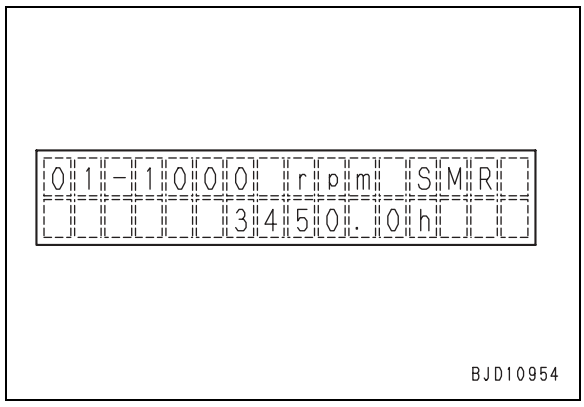
1) Selecting and executing mode
   i) Select “Load memory display mode” on the mode selection screen.
      ★ If the mode is selected, code (Ld) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).
   ii) Display the adjustment code input screen by operating buzzer cancel switch (4).
   [◇]: Execute mode.



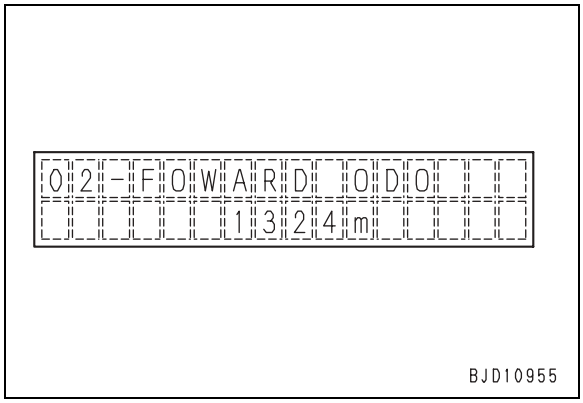
2) Changing information screen
   Change the information screen by operating information switch (5).
   • [>]: Next screen.
   • [<]: Previous screen.

No.	Displayed information
01	1,000rpm service meter
02	Forward odometer
03	Reverse odometer

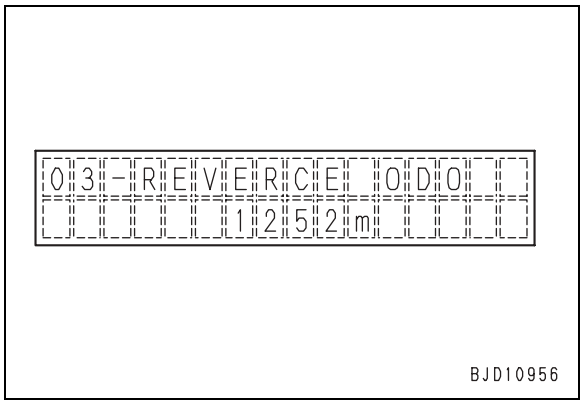
3) Display of 1,000rpm service meter (01)
   This code is used to display the service meter which integrates the operation hours only while the engine speed is higher than 1,000rpm.
   ★ The data cannot be reset.



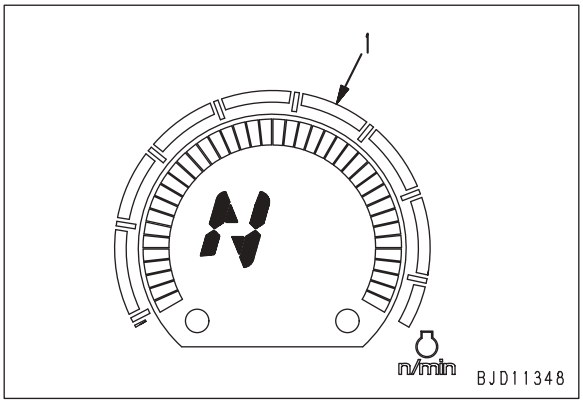
4) Display of forward odometer (02)
On this screen, the integrated forward travel distance is displayed.
★ The data cannot be reset.



5) Display of reverse odometer (02)
On this screen, the integrated reverse travel distance is displayed.
★ The data cannot be reset.



6) When operating machine in load memory display mode
If the parking brake lever is set in the FREE position, gear speed display section (1) displays normally and the machine can be operated normally.
★ To select another screen, return the parking brake lever to the LOCK position and perform the necessary procedure.

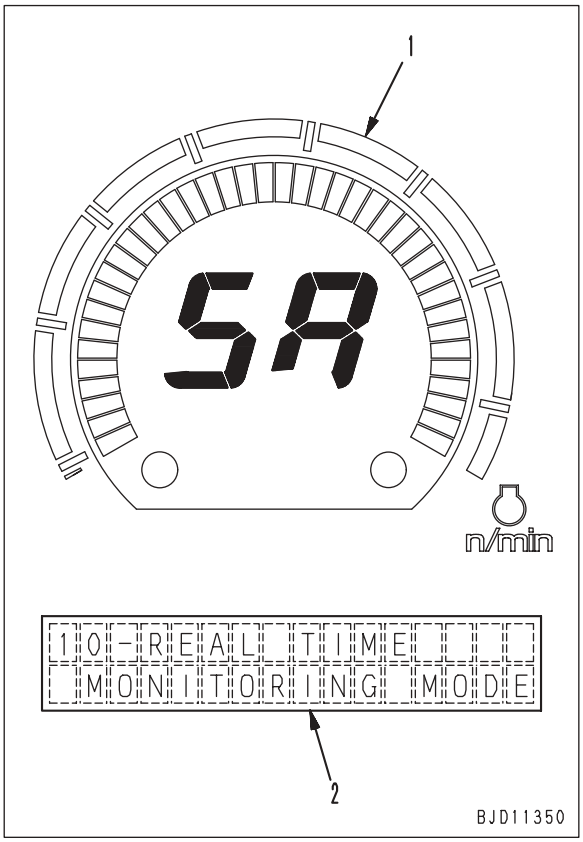


10. Real-time monitoring mode
(10-REAL TIME MONITORING MODE)

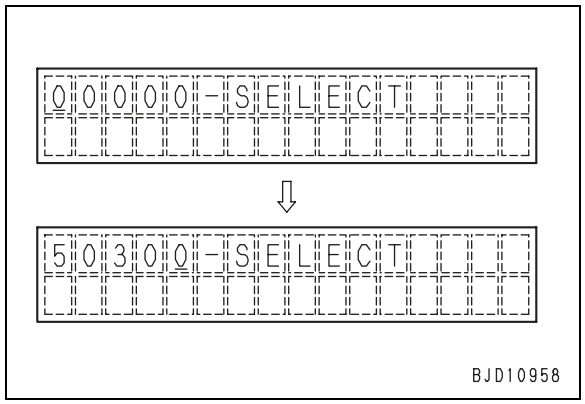
In this mode, the speeds, oil pressures, oil temperatures, currents, voltages, etc. can be monitored by using the signals from sensors, switches, and solenoids installed various parts of the machine.

★ This mode is used to monitor 1 item. When monitoring 2 items simultaneously, use the "Dual display monitoring mode".

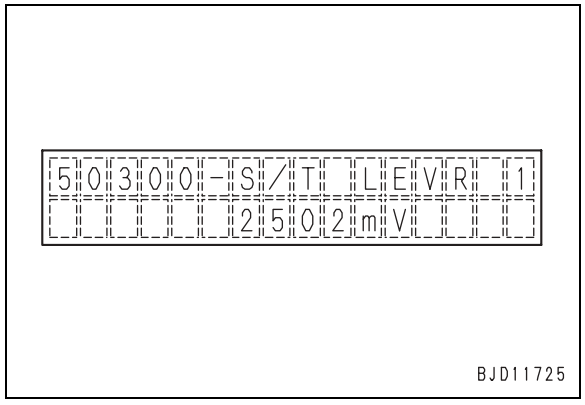
1) Selecting and executing mode
   i) Select "Real-time monitoring mode" on the mode selection screen.
      ★ If the mode is selected, code (5R) is displayed on gear speed display section (1) and the title is displayed on multi-information section (2).
   ii) Display the monitoring code input screen by operating buzzer cancel switch (4).
      • [◇]: Decide selection.



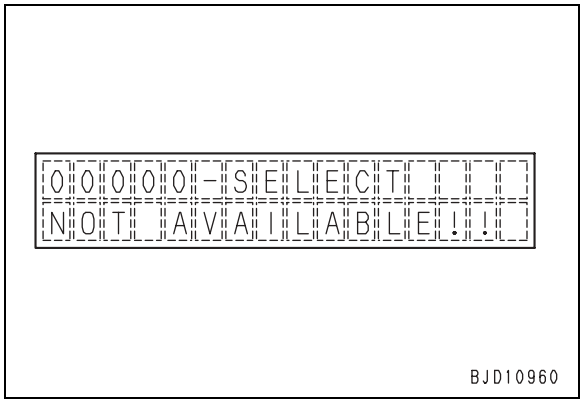
2) Selecting and entering monitored items
   i) On the code input screen, input the 5-digit code of the item to be monitored by operating information switch (5), shift-up switch (6), and shift-down switch (7).
      • [>]: Move cursor to right.
      • [<]: Move cursor to left.
      • [UP]: Increase number.
      • [DOWN]: Decrease number.



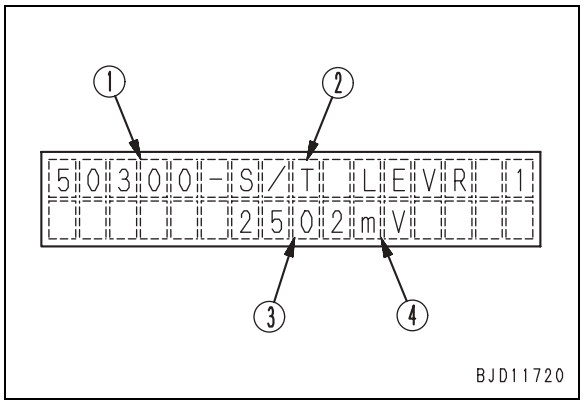
iii) After inputting the code, display the monitoring screen by operating buzzer cancel switch (4).
   • [◇]: Enter input code.
   ★ If the input code is correct, the monitoring screen shown at right appears.



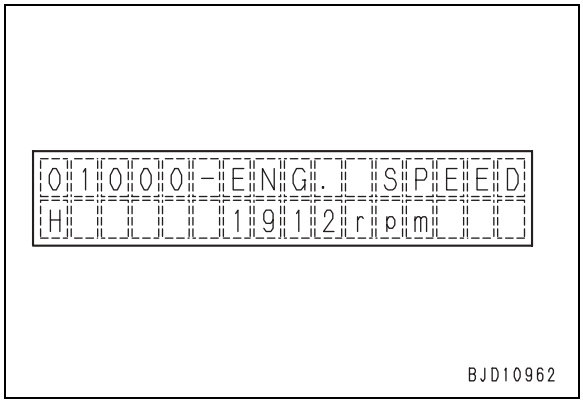
★ If the input code is not correct, the code input screen appears again after the screen shown at right.



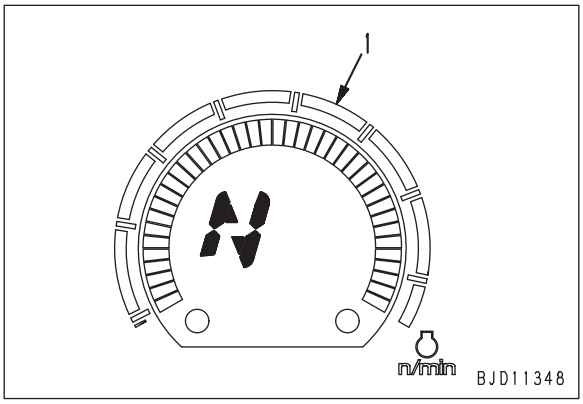
3) Contents of display on monitoring screen (Right figure shows examples)
   ①: Code
   ②: Monitoring item
   ③: Information
   ④: Unit (Not displayed for some items)
   ★ For the details, see the “MONITORING MODE TABLE”.



4) Function of holding monitoring information
   If an information item 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.



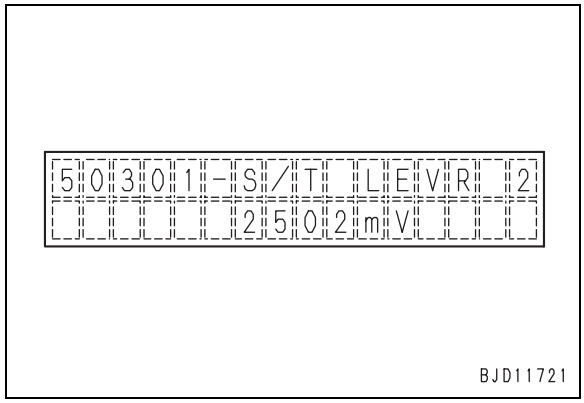
5) When operating machine in monitoring mode
   If the parking brake lever is set in the FREE position, gear speed display section displays normally and the machine can be operated normally.
   ★ To select another screen, return the parking brake lever to the FREE position and perform the necessary procedure.



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 applicable to only the numbers marked with *.

   ★ This operation is not accepted while the parking brake lever is in the FREE position. Take care.



Monitoring mode table

No.	Code	Monitored item		Unit	Display range
*1	01000	ENG. SPEED	Engine speed	rpm	0 – 3000
2	01300	TVC SOL F/B	TVC solenoid output FB current	mA	0 – 1000
3	01301	TVC SOL OUT	TVC solenoid output command current	mA	0 – 1000
4	03000	FUEL DIAL	Voltage of fuel control dial	mV	0 – 5000
*5	03001	FUEL DIAL	Acceleration ratio	%	0 – 100
*6	03200	BATTERY	Battery voltage	mV	0 – 30000
*7	04102	WATER HIGH	Engine water temperature (High temperature side)	°C	0 – 150
*8	04104	WATER LOW	Engine water temperature (Low temperature side)	°C	–30 – 100
*9	04200	FUEL SENS	Fuel level sensor voltage	mV	0 – 5000
10	04204	FUEL TEMP.	Fuel temperature	°C	0 – 150
11	04401	HYD. TEMP.	Hydraulic oil temperature	°C	0 – 150
12	04402	HYD. TEMP.	Hydraulic oil temperature voltage	mV	0 – 5000
13	10000	FAN REVO.	Command speed of cooling fan	rpm	0 – 2000
14	20000	ENG-MACHIN	Engine controller program No.	Character	
15	20200	MON. PROGRM	Monitor panel (Tachometer module) program No.	Character	
16	20202	S/T. PROGRM	Steering controller program No.	Character	
17	20203	ENG-PROGRM	Engine controller program No.	Character	
18	20300	KOMTRAX	KOMTRAX LED display	—	
*19	30100	T/C TEMP.	Torque converter oil temperature	°C	0 – 150
*20	31400	T/M OUT	Transmission speed	rpm	0 – 5000
21	31520	T/M-FILL	Input state of transmission-related fill switch	Bit	(See detailed information)
22	31602	1st CLUTCH	Output command current of 1st clutch ECMV	mA	0 – 1000
23	31603	2nd CLUTCH	Output command current of 2nd clutch ECMV	mA	0 – 1000
24	31604	3rd CLUTCH	Output command current of 3rd clutch ECMV	mA	0 – 1000
25	31606	Rev CLUTCH	Output command current of reverse clutch ECMV	mA	0 – 1000
26	31608	Frd CLUTCH	Output command current of forward clutch ECMV	mA	0 – 1000
*26	31612	1 CLUTCH F	Output FB current of 1st clutch ECMV	mA	0 – 1000
*27	31613	2 CLUTCH F	Output FB current of 2nd clutch ECMV	mA	0 – 1000
*28	31614	3 CLUTCH F	Output FB current of 3rd clutch ECMV	mA	0 – 1000
*29	31616	R CLUTCH F	Output FB current of reverse clutch ECMV	mA	0 – 1000
*30	31622	F CLUTCH F	Output FB current of forward clutch ECMV	mA	0 – 1000
32	31623	FAN PUMP.O	Output command current of cooling fan pump solenoid	mA	0 – 1000
33	31624	FAN PUMP.F	Output FB current of cooling fan pump solenoid	mA	0 – 1000
*34	32900	BODY ANGLE	Machine pitch angle	°	–30 – 30
35	36100	Q-INJECTOR	Command value of fuel injection rate	mm3/st	–30 – 600
36	36200	CRI. PRESS	Command pressure of common rail	MPa	0 – 150
37	36300	CRI-TIMING	Fuel injection timing	CA	–30.0 – 30.0
*38	36400	CRI. PRESS	Common rail pressure	MPa	0 – 200
*39	36500	BOOST. PRES	Boost pressure	KPa	0 – 300
40	36600	CRI. CONTRL	Engine control mode	Character	
41	36700	CRI-TORQUE	Converted torque of engine	%	0 – 100
42	36800	CRI-Q-MOD1	Fuel injection amount adjustment command value 1	Character	0123456789abcdef
43	36801	CRI-Q-MOD2	Fuel injection amount adjustment command value 2	Character	0123456789abcdef
*44	40001	VEHICLE SP	Travel speed (Theoretical value)	km/h	0 – 100
45	40900	ENG-SW 1	Engine controller input signal 1	Bit	(See detailed information)
46	40901	ENG-SW 2	Engine controller input signal 2	Bit	(See detailed information)

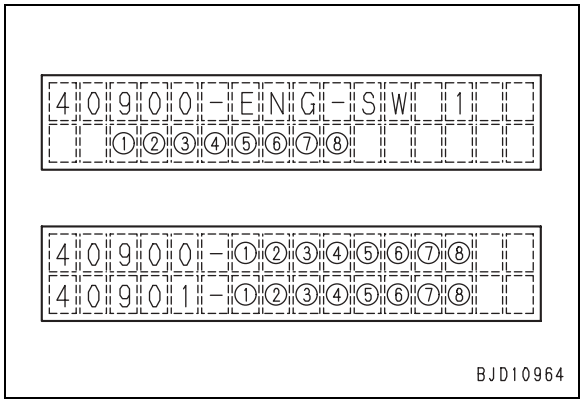
No.	Code	Monitored item		Unit	Display range
47	**40905**	**T/M-SW1**	Transmission-related controller input signal 1	Bit	(See detailed information)
48	**40906**	**T/M-SW2**	Transmission-related controller input signal 2	Bit	(See detailed information)
49	**40909**	**T/M SOL.2**	Transmission-related controller output signal	Bit	(See detailed information)
50	**40910**	**S/T-SW1**	Steering-related controller input signal 1	Bit	(See detailed information)
51	**40911**	**S/T-SW2**	Steering-related controller input signal 2	Bit	(See detailed information)
52	**40913**	**S/T-SW5**	Steering-related controller input signal 5	Bit	(See detailed information)
53	**40914**	**S/T SOL.1**	Output signal of steering controller	Bit	(See detailed information)
*54	**50000**	**DESEL PEDAL**	Deceleration ratio	%	0 – 100
*55	**50100**	**SSC**	3rd throttle	%	0 – 100
56	**50101**	**SSC ORDER**	3rd throttle command voltage	mV	0 – 5000
*57	**50200**	**T/M LEVER 1**	Voltage of forward-reverse potentiometer 1	mV	0 – 5000
*58	**50201**	**T/M LEVER 2**	Voltage of forward-reverse potentiometer 2	mV	0 – 5000
*59	**50300**	**S/T LEVER 1**	Voltage of steering potentiometer 1	mV	0 – 5000
*60	**50301**	**S/T LEVER 2**	Voltage of steering potentiometer 2	mV	0 – 5000
*61	**50400**	**BRAKE PEDL**	Voltage of brake potentiometer	mV	0 – 5000
*62	**50600**	**HSS L.H.F**	Output FB current of left HSS solenoid	mA	0 – 1000
*63	**50601**	**HSS R.H.F**	Output FB current of right HSS solenoid	mA	0 – 1000
64	**50602**	**HSS L.H.O**	Output command current of left HSS solenoid	mA	0 – 1000
65	**50603**	**HSS R.H.O**	Output command current of right HSS solenoid	mA	0 – 1000
*66	**50900**	**N-SAFETY**	Drive current of neutral safety relay	mV	0 – 30000
67	**51000**	**SSC ORDER**	3rd throttle command speed	rpm	0 – 3000
*68	**60000**	**TRACTION**	Traction force (Theoretical value)	W	0 – 0
69	**60100**	**BODY ANGLE**	Machine pitch angle sensor voltage	mV	0 – 5000
70	**60600**	**BR HOLD**	Drive voltage of battery relay	mV	0 – 30000
71	**60700**	**S/T MODE**	Steering state code	Character	
72	**60800**	**FILL MODE**	Variable for setting fill condition	Character	
73	**60909**	**MOD. MODE**	Setting of modulation condition	Character	
74	**70000**	**CHG. P. MODE**	Variable for setting condition of gear shift point	Character	
75	**70400**	**BACK ALARM**	Drive voltage of back-up alarm relay	mV	0 – 30000
76	**70500**	**Regulation**	Reguration speed	rpm	0 – 2200
77	**70700**	**HYD. PUMP 1**	Work equipment oil pressure	MPa	0 – 50
78	**70701**	**HYD. PUMP 1**	Voltage of work equipment oil pressure sensor	mV	0 – 5000

The numbers marked with ★ can be displayed in order by setting the information switch in the ">" or "<" position.

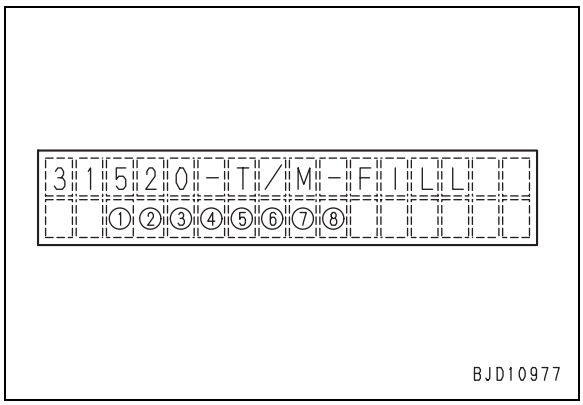
Detailed information on bit display codes

Examples of display of bit information

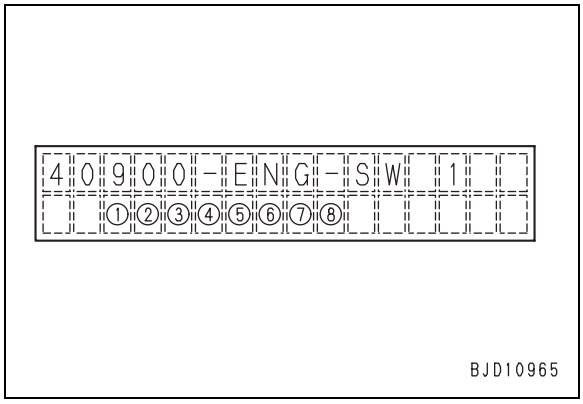
★ The display position of the bit information in the "Real-time monitoring mode (Display of only 1 item)" is different from that in the "Dual display monitoring mode (Simultaneous display of 2 items)".
★ The bit information is displayed by [ ] for OFF and [o] for ON in the places ① – ⑧.
★ The state of each item shown below is the condition for turning on the bit.



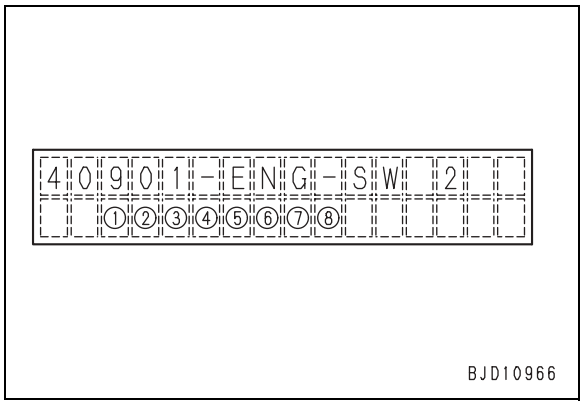
31520: Input state of transmission related fill switch
①: Forward clutch fill switch: ON
②: Reverse clutch fill switch: ON
③: 1st clutch fill switch: ON
④: 2nd clutch fill switch: ON
⑤: 3rd clutch fill switch: ON
⑥: (Unused)
⑦: (Unused)
⑧: (Unused)



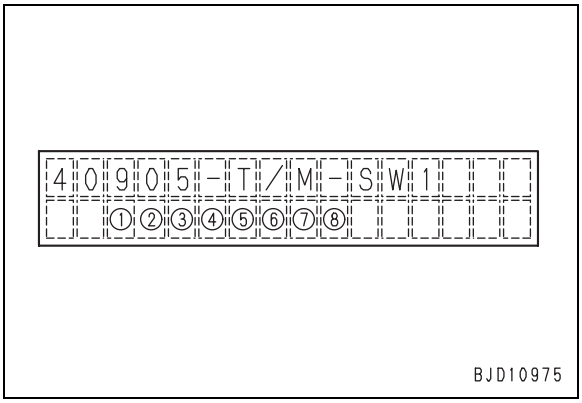
40900: Engine controller input signal 1
①: Starting switch signal C: Input
②: (Unused)
③: (Unused)
④: Low engine oil pressure switch: ON
⑤: High engine oil pressure switch: ON
⑥: (Unused)
⑦: (Unused)
⑧: Model selection signal 1: ON



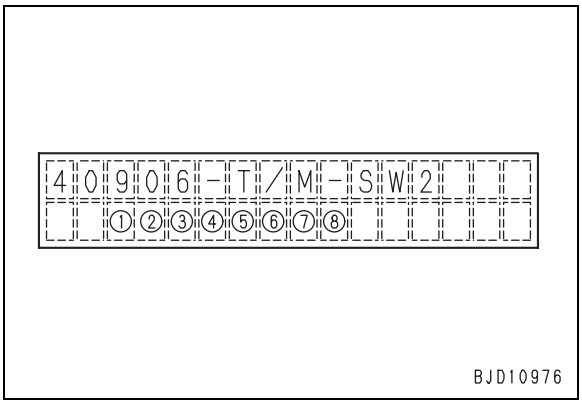
40901: Engine controller input signal 2
①: Model selection signal 2: ON
②: Model selection signal 3: ON
③: (Unused)
④: (Unused)
⑤: N-signal 1: ON
⑥: N-signal 2: ON
⑦: (Unused)
⑧: (Unused)



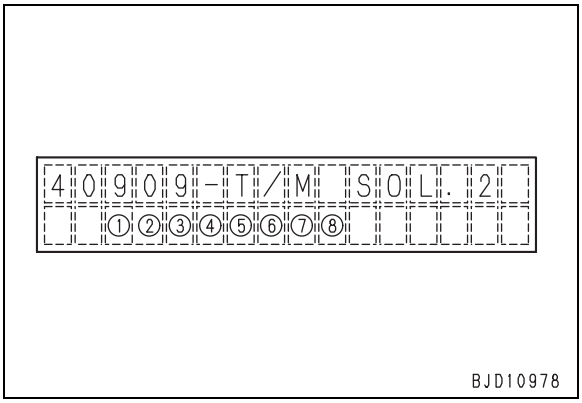
40905: Transmission related controller input signal 1
①: Gear shift-up switch: OFF
②: Gear shift-up switch: ON
③: Gear shift-down switch: OFF
④: Gear shift-down switch: ON
⑤: (Unused)
⑥: (Unused)
⑦: (Unused)
⑧: (Unused)



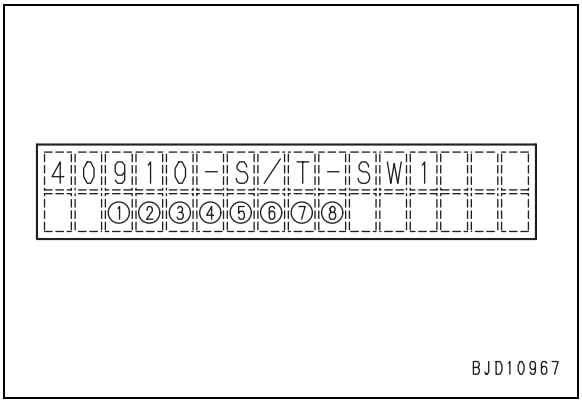
40906: Transmission-related controller input signal 2
①: Automatic gear shift-down switch: ON
②: Fan reverse mode: ON
③: Fan reverse 100% mode: ON
④: (Unused)
⑤: (Unused)
⑥: (Unused)
⑦: (Unused)
⑧: (Unused)



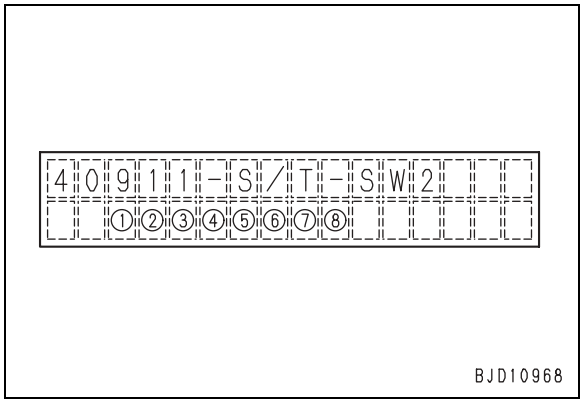
40909: Transmission related controller output signal
①: Transmission N-signal: ON
②: N-signal 2: ON
③: (Unused)
④: Back-up alarm relay: ON
⑤: Neutral safety relay: ON
⑥: (Unused)
⑦: (Unused)
⑧: (Unused)



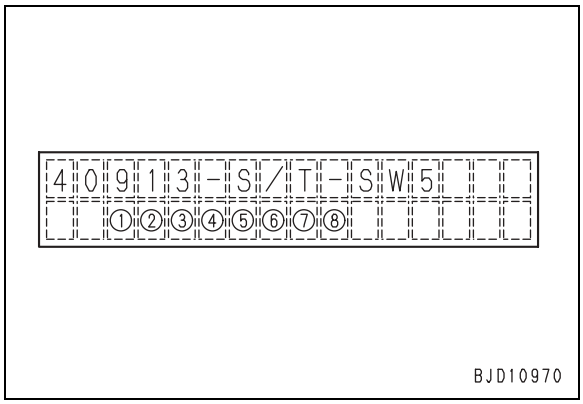
40910: Steering related controller input signal 1
①: (Unused)
②: (Unused)
③: (Unused)
④: (Unused)
⑤: Parking brake lever switch: FREE
⑥: Parking brake lever switch: LOCK
⑦: (Unused)
⑧: (Unused)



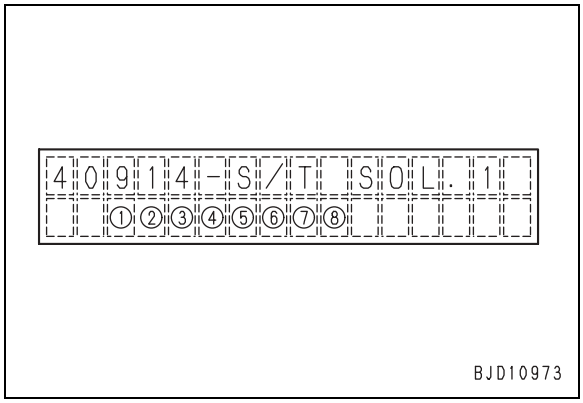
40911: Steering related controller input signal 2
①: Buzzer cancel switch: At ◇
②: Buzzer cancel switch: At □
③: Information switch: At <
④: Information switch: At >
⑤: Service switch: ON
⑥: (Unused)
⑦: (Unused)
⑧: (Unused)



40913: Steering related controller input signal 5
①: ACC signal: ON
②: (Unused)
③: (Unused)
④: Motoring signal: ON
⑤: (Unused)
⑥: (Unused)
⑦: (Unused)
⑧: (Unused)



40914: Output signal of steering related controller
①: (Unused)
②: (Unused)
③: Fan reverse solenoid: ON
④: (Unused)
⑤: Battery relay drive: ON
⑥: (Unused)
⑦: (Unused)
⑧: (Unused)

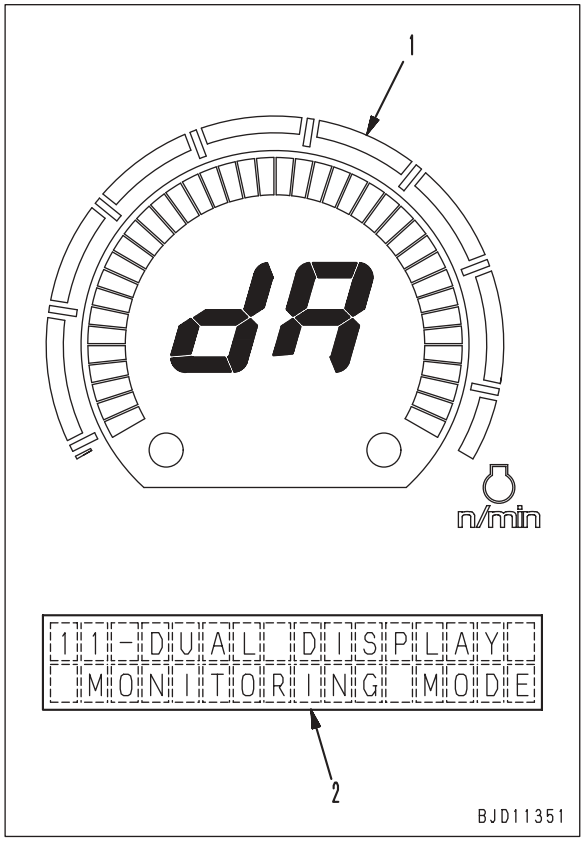


11. Dual display monitoring mode (11-DUAL DISPLAY MONITORING MODE)

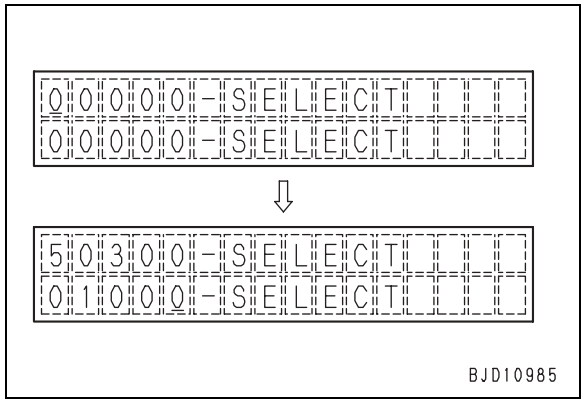
In this mode, 2 monitored items can be displayed simultaneously.

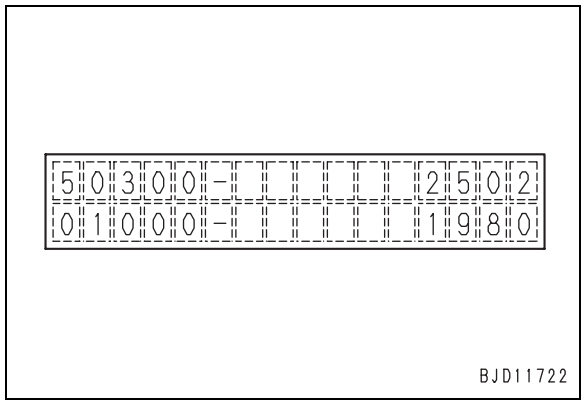
★ Note that only codes and monitoring information are displayed in this mode since the usable display columns are limited. (Item names and units cannot be displayed.)

1) Selecting and executing mode
   i) Select “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).
   ii) Display the monitoring code input screen by operating buzzer cancel switch (4).
      • [◇]: Execute mode.

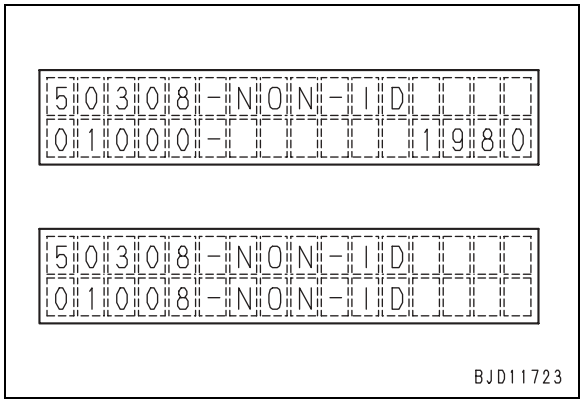


2) Selecting and entering monitored items
   i) On the code input screen, input the 5-digit codes of the items to be monitored to the upper and lower lines by operating information switch (5), shift-up switch (6), and shift-down switch (7).
      • [>]: Move cursor to right.
      • [<]: Move cursor to left.
      • [UP]: Increase number.
      • [DOWN]: Decrease number.
   ii) After inputting the codes, display the monitoring screen by operating buzzer cancel switch (4).
      • [◇]: Enter input code.
      ★ If the input codes are normal, the monitoring screen shown at right appears.

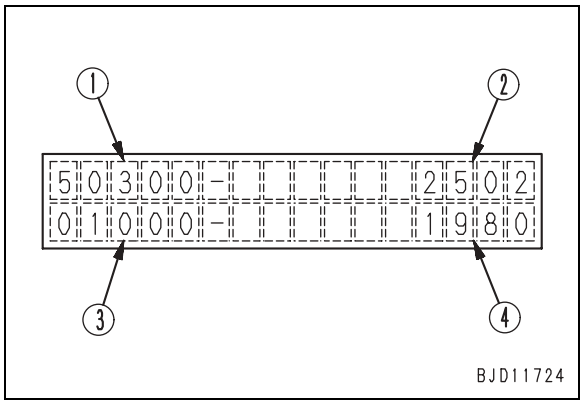




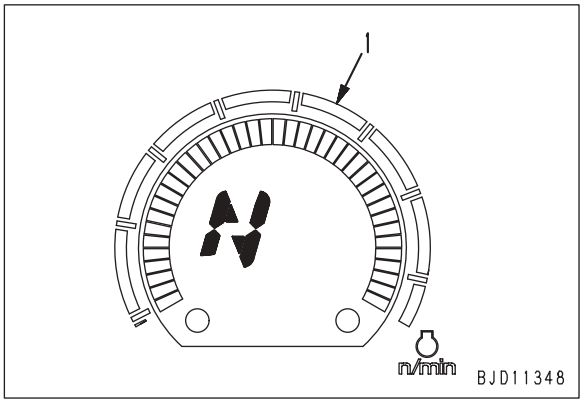
★ If the input codes are abnormal, the code input screen appears again after the screen shown at right.



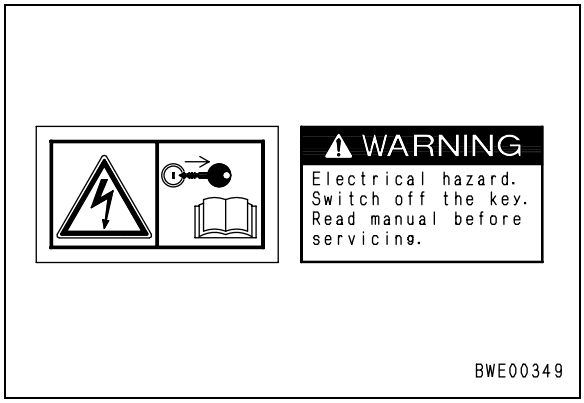
3) Contents of display on monitoring screen
(Right figure shows examples)
①: Code 1
②: Information 1
③: Code 2
④: Information 2
★ For the details, see the “MONITORING MODE TABLE”.



4) When operating machine in monitoring mode
If the parking brake lever is set in the FREE position, gear speed display section (1) displays normally and the machine can be operated normally.
★ To select another screen, return the parking brake lever to the FREE position and perform the necessary procedure.



HANDLING OF HIGH-VOLTAGE CIRCUIT OF ENGINE CONTROLLER



The engine controller has a high-voltage circuit (110 – 130V) to drive the fuel injector. This circuit is connected to the wiring harness and connectors between the engine controller and fuel injector.

★ Normally, the engine controller outputs the high voltage to the fuel injector only while the engine is running and stops outputting if the engine stops.

If you touch the high-voltage circuit directly, you may get an electric shock. To avoid this, observe the following precautions.

1. The following connectors are used in the high-voltage circuit.
   - Engine controller connector: EGC3
   - Junction connector: E21
   - Injector connectors:
     CN1, CN2, CN3, CN4, CN5, CN6
   - Injector head terminal (in head cover)

2. When disconnecting or connecting a connector related to the high-voltage circuit, be sure to turn off the starting switch.

3. If a T-adapter is inserted in or connected to a connector related to the high-voltage circuit for troubleshooting, do not start the engine.
   ★ You may turn the starting switch to the OFF or ON position but must not turn it to the START position.

ADJUSTMENT METHOD OF REPLACED CONTROLLER

★ After the machine is assembled or steering and transmission controller is replaced, adjust the system according to the following procedure.

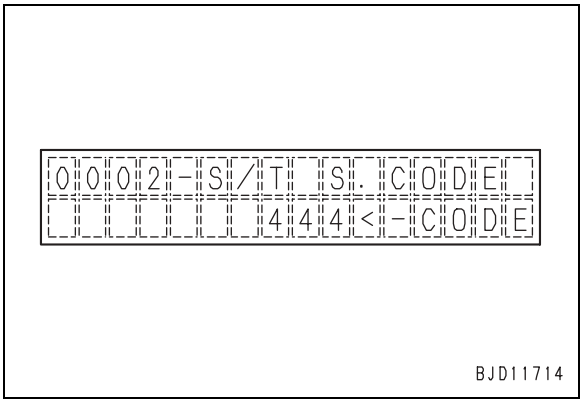
If the system is not adjusted, the machine may not operate normally and may move suddenly. Accordingly, be sure to adjust it.

★ 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.

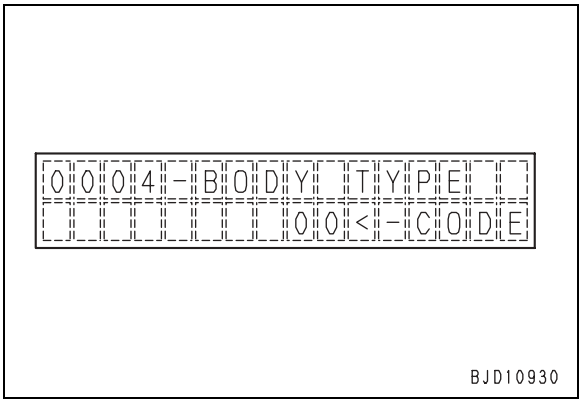
1. Setting system in service mode
Turn the starting switch on and set the monitor panel in the “Adjustment mode” of the service mode.

2. Adjusting steering and transmission controller
Select steering and transmission controller specification set (0002) and adjust the steering and transmission controller.

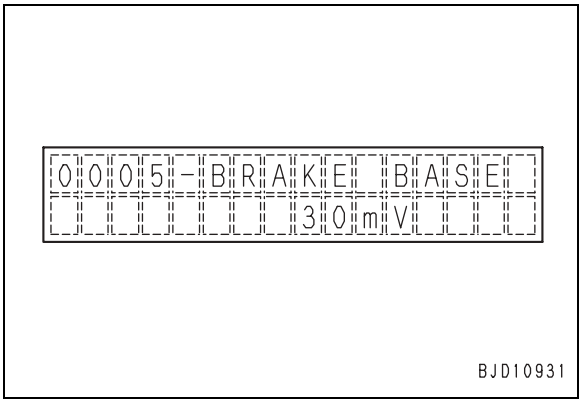


3. Turning power on again
Turn the starting switch off and on, then set the monitor panel in the “Adjustment mode” of the service mode again.

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. Turning power on again
Turn the starting switch off and on.

7. Checking error codes
1) Set the monitor panel in the “Electric system error code display mode” of the service mode.
2) See if any error code is being output currently. If any error code is not being output, delete the all error codes.

★ If any error code is being output, remove its cause by troubleshooting and execute steps 6 and 7 again.

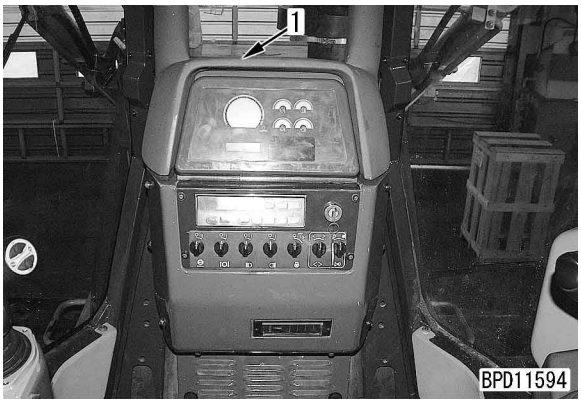
★ Precautions after replacing controller:
If any controller is replaced, the service meter in the oil and filter maintenance mode is reset to 0. As a result, the replacement period displayed on the monitor panel may be different from the actual operating hours. To solve this problem, determine the first 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

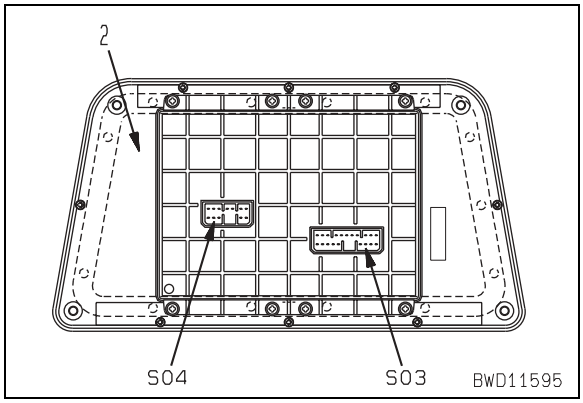
★ When carrying out troubleshooting for an electric circuit related to the monitor panel, engine controller or steering and transmission controller, expose the related connectors according to the following procedure.

1. Monitor panel

1) Remove cover (1) above the dashboard.

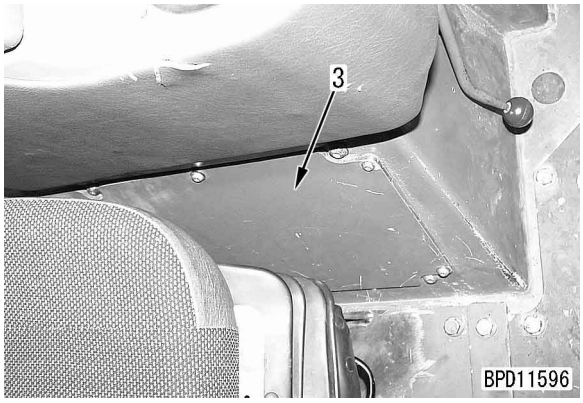


2) Insert or connect T-adapters in or to connectors S03 and S04 on the back side of monitor panel (2).



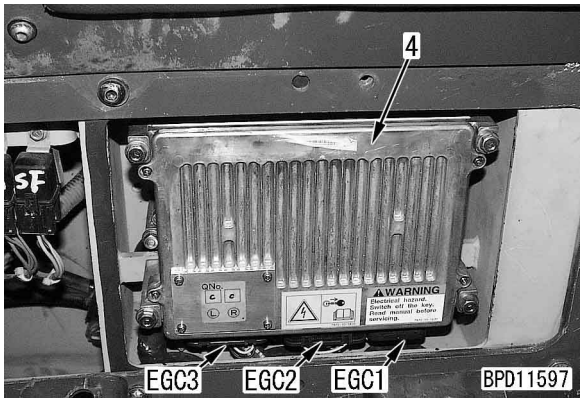
2. Engine controller

1) Remove left console box inspection cover (3).

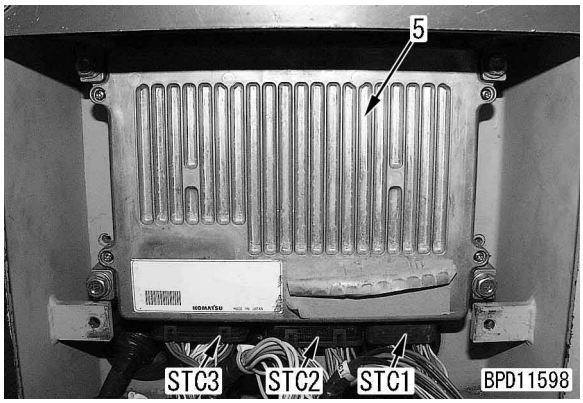


2. Insert or connect T-adapters in or to connectors EGC1, EGC2, and EGC3 of engine controller (4).
   - ★ If the connectors cannot be disconnected and connected easily, remove the controller from the floor frame.
   - ★ Since the connectors are secured with screws, loosen those screws before disconnecting.
   - ★ When connecting the connectors again, tighten their screws to the specified torque.

   Screw: **2.82 Nm {0.288 kgm}**



3. Steering and transmission controller



1) Remove engine controller
   ★ Disconnect connectors (EGC1, EGC2, EGC3) of the engine controller.
2) Insert or connect T-adapters in or to connectors STC1, STC2, and STC3 of steering and transmission controller (5).
   ★ If the connectors cannot be disconnected and connected easily, remove the controller from the floor frame.
   ★ Since the connectors are secured with screws, loosen those screws before disconnecting.
   ★ When connecting the connectors again, tighten their screws to the specified torque.

   Screw: 2.82Nm {0.288kgm}

Pm CLINIC SERVICE

Model	Serial No.	Service meter
D85EX, PX-15		h

User name	Date of clinic	Serviceman
	/ /	

Specifications		
Blade	Rear attachment	Shoe width
☐ Semi-U blade (EX) ☐ U-blade (EX) ☐ Straight tilt blade (EX, PX) ☐	☐ Multi-shank ripper (EX) ☐ Counterweight (kg) ☐ ☐	☐ 560 mm (EX) ☐ 610 mm (EX) ☐ 660 mm (EX) ☐ 910 mm (PX)

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 % ☐ Side cutting % ☐ Ripping % ☐ Travel %

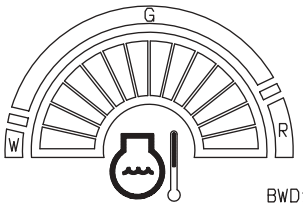
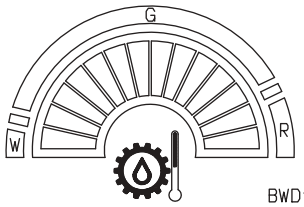
Existence of abnormalities

Oil, water level check

☐ Engine coolant level
☐ Engine oil level
☐ Hydraulic oil level

When necessary
☐ Power train
☐ Final drive

☐ Damper case
☐ ( )

Engine coolant temperature Max. range	Power train oil temperature Max. range	Ambient temperature
		Max. ℃ Min. ℃ **Height above sea level** m

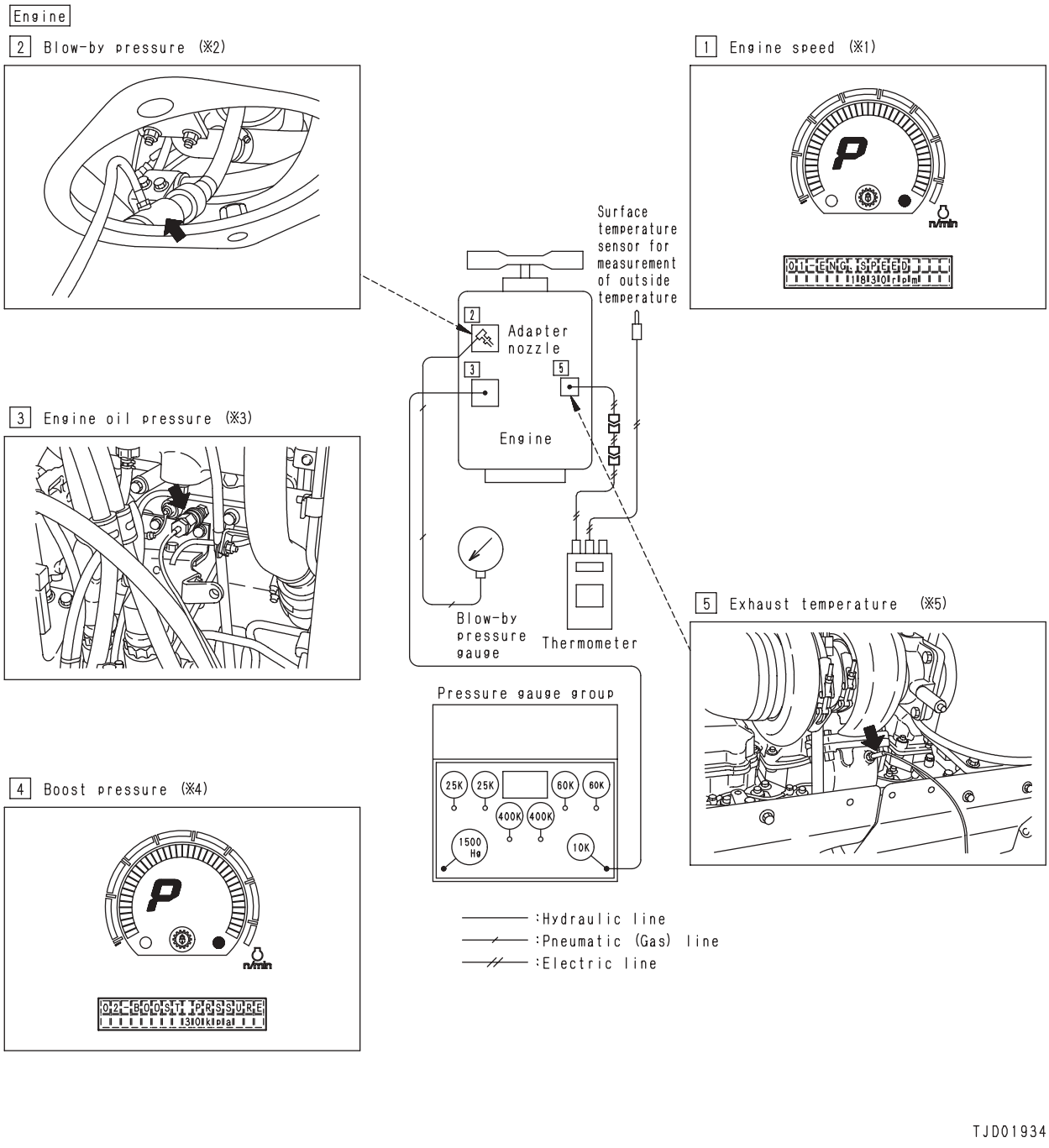
Operator's opinion

Visual check results

Service code history

E h		E h	
Content:		Content:	
E h		E h	
Content:		Content:	

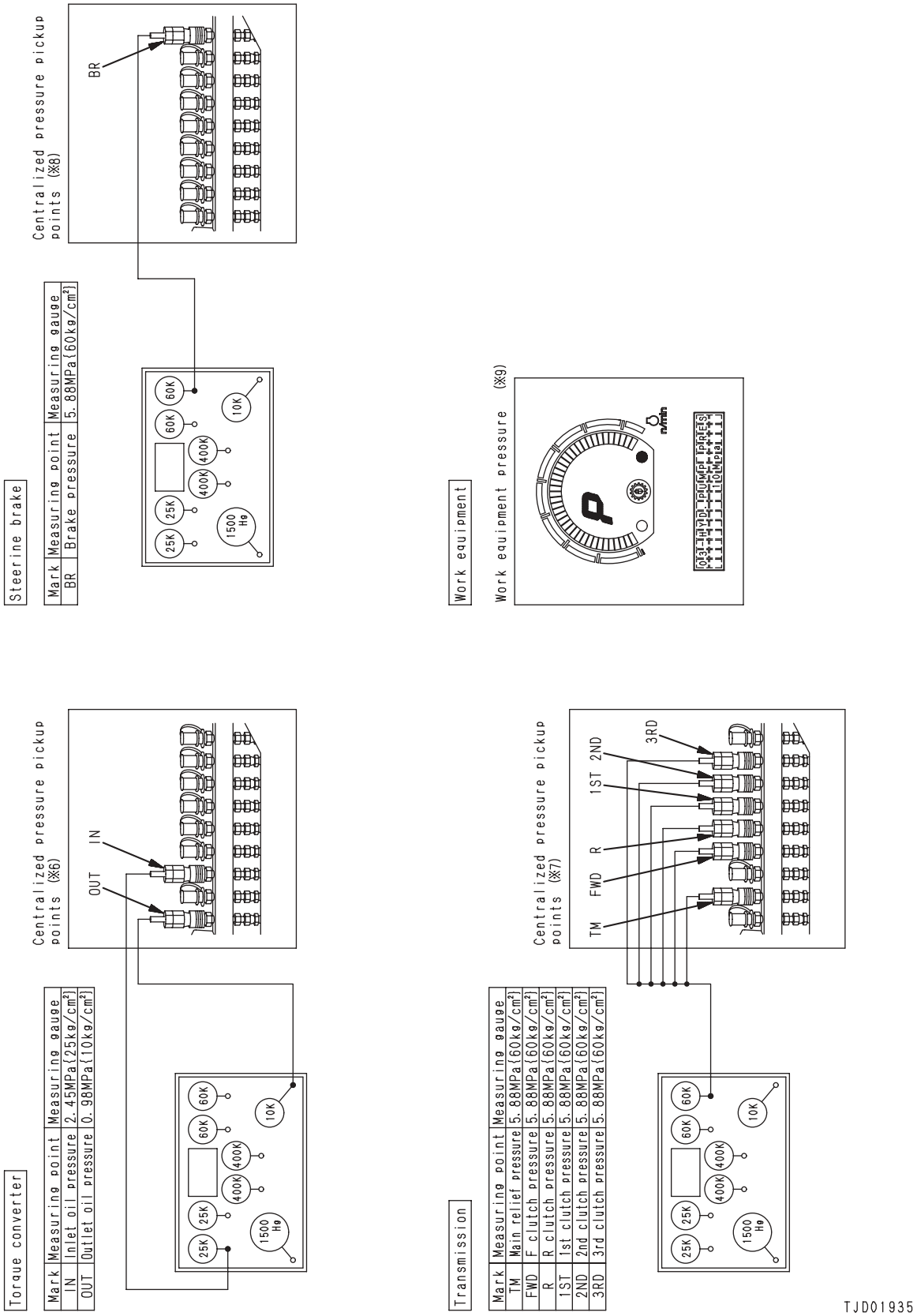
Pm-clinic measuring points for D85EX, PX-15 (1/2)



“Reference Page for Measurement Procedure” designated.

※ 1. Engine speed: 20-105 – 107 page
※ 2. Blow-by pressure: 20-117 page
※ 3. Engine oil pressure: 20-118 page
※ 4. Boost pressure: 20-108 – 109 page
※ 5. Exhaust temprature: 20-110 – 111 page

Pm-clinic measuring points for D85EX, PX-15 (2/2)



“Reference Page for Measurement Procedure” designated.

※ 6. Phenomenon related to torque converter: 20-128 – 133 page

※ 7. Phenomenon related to transmission: 20-128 – 133 page

※ 8. Phenomenon related to steering brake: 20-128 – 133 page

※ 9. Phenomenon related to work equipment: 20-144 – 146 page

Pm CLINIC CHECK SHEET

D85EX, PX-15	Serial No

Work order No.	Date	Service meter	Serviceman
	/ /	h	

Item		Measurement conditions		Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Engine	Engine speed	Low idling		rpm	750 – 800	750 – 800			
		High idling	Deceleration pedal depressed		1000 – 1050	1000 – 1050			
		High idling			2050 – 2100	2050 – 2100			
		Torque converter stall			1710 – 1810	1710 – 1810			
		Torque converter stall + work equipment relief			1660 – 1760	1660 – 1760			
	Blow-by pressure	Torque converter stall		kPa <mmAq>	Max. 0.98 <Max. 100>	Max. 1.96 <Max. 200>			
	Engine oil pressure	Engine at low idling	SAE10W	MPa <kg/cm^2>	Min. 0.10 <Min. 1.0>	0.07 <0.7>			
		Engine at high idling	SAE10W		0.34 – 0.64 <3.5 – 6.5>	0.18 <1.8>			
		Engine at low idling	SAE15W-40 SAE30		Min. 0.15 <Min. 1.5>	0.07 <0.7>			
		Engine at high idling	SAE15W-40 SAE30		0.39 – 0.69 <4.0 – 7.0>	0.21 <2.1>			
	Boost pressure	Torque converter stall		kPa <mmHg>	Min. 116.0 <Min. 870>	60 <450>			
	Exhaust temperature	Torque converter stall		°C	Max. 680	700			

※ When measuring the oil pressure of the torque converter and transmission, use the adjustment mode of the monitor and set to "Both steering clutches release mode (Co mode)". (Check that the left and right steering clutches are released.) When measuring the pressure of each transmission clutch, check only with the engine at low idling to ensure safety.

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 idling	MPa <kg/cm^2>	0.1 – 0.5 <1 – 5>	0.1 – 0.5 <1 – 5>			
	Outlet oil pressure		Engine at low idling		0.1 – 0.31 <1 – 3>	0.1 – 0.31 <1 – 3>			
	Inlet oil pressure		Engine at high idling		Max. 1.02 <Max. 10>	Max. 1.02 <Max. 10>			
	Outlet oil pressure		Engine at high idling		0.61 – 0.81 <6 – 8>	0.61 – 0.81 <6 – 8>			

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 idling	MPa <kg/cm^2>	2.82 – 3.02 <28.8 – 30.8>	Min. 2.65 <Min. 26.8>			
			Engine at high idling		3.24 – 3.53 <33.0 – 36.0>	Min. 3.04 <Min. 31.0>			
	Lubricating oil pressure		Engine at low idling		— —	— —			
			Engine at high idling		0.1 – 0.25 <1.0 – 2.5>	0.1 – 0.25 <1.0 – 2.5>			
	F clutch pressure	Transmission: F	Engine at low idling		2.16 – 2.45 <22.0 – 25.0>	1.96 <20>			
	R clutch pressure	Transmission: R	Engine at low idling		2.75 – 3.02 <28.0 – 30.8>	2.55 <26.0>			
	1st clutch pressure	Transmission: F1	Engine at low idling		2.35 – 2.65 <24.0 – 27.0>	2.16 <22.0>			
	2nd clutch pressure	Transmission: F2	Engine at low idling		2.55 – 2.84 <26.0 – 29.0>	2.35 <24.0>			
	3rd clutch pressure	Transmission: F3	Engine at low idling		2.75 – 3.02 <28.0 – 30.8>	2.55 <26.0>			
Cooling fan	Fan speed	• Fan 100% speed mode • Engine at low idling	Min. speed	rpm	800 ± 50	400			
		• Fan 100% speed mode • Engine at high idling	Max. speed		1,500 ± 50	1,400			
	Fan pump oil pressure	• Fan 100% speed mode • Engine at high idling		MPa <kg/cm^2>	11.8 – 14.7 <120 – 150>	16.17 – 19.11 <165 – 195>			

Pm CLINIC CHECK SHEET

D85EX, PX-15	Serial No

Work order No.	Date	Service meter	Serviceman
	/ /	h	

Item		Measurement conditions		Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Steering brake	Brake pressure	Transmission: Neutral	Engine at low idling	MPa <kg/cm²>	2.75 – 2.94 <28.0 – 30.0>	Min. 2.26 <Min. 23.0>			
			Engine at high idling		2.75 – 2.94 <28.0 – 30.0>	Min. 2.45 <Min. 25.0>			
	Brake performance	Engine at high idling, F2, brake actuated			Machine must not move				
HSS oil pressure	HSS main relief pressure	PCCS lever (for travel) right FULL	Engine at high idling	MPa <kg/cm²>	38.2 – 41.7 <390 – 425>	38.2 – 41.7 <390 – 425>			
		PCCS lever (for travel) left FULL			38.2 – 41.7 <390 – 425>	38.2 – 41.7 <390 – 425>			

Item		Measurement conditions		Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Hydraulic components	HSS and work equipment pump	Ripper lift relief (EX)	Engine at low idling	MPa <kg/cm²>	20.4 – 22.8 <208 – 232>	21.3 – 23.7 <218 – 242>			
		Blade tilt relief (single tilt only)			20.4 – 22.8 <208 – 232>	21.3 – 23.7 <218 – 242>			
		Ripper lift relief (EX)	Engine at high idling		21.3 – 23.7 <218 – 242>	21.3 – 23.7 <218 – 242>			
		Blade tilt relief (single tilt only)			21.3 – 23.7 <218 – 242>	21.3 – 23.7 <218 – 242>			
	PPC valve output pressure	Blade tilt relief			3.82 – 4.12 <39.0 – 42.0>	3.82 – 4.12 <39.0 – 42.0>			

Item		Measurement conditions	Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Work equipment speed	Blade RAISE	Engine at low idling	Sec.	8 - 15	Max. 20			
		Engine at high idling		EX: 2.5 – 4.5 PX: 2.2 – 4.2	Max. 5.5 Max. 5.2			
	Tilt (left → right)	Engine at low idling		3 – 5	Max. 7			
		Engine at high idling		1.7 – 2.7	Max. 3.5			
	Ripper RAISE (EX)	Engine at low idling		7 – 10	Max. 13			
		Engine at high idling		2.0 – 3.0	Max. 4.0			

Item		Measurement conditions	Unit	Standard value for new machine	Service limit value	Measurement results	Pass	Fail
Hydraulic drift	Hydraulic oil temperature	Engine stopped	°C	—	—			
	Blade lift cylinder		mm/15 min.	Max. 200	Max. 300			
	Ripper lift cylinder (EX)			Max. 80	Max. 160			

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

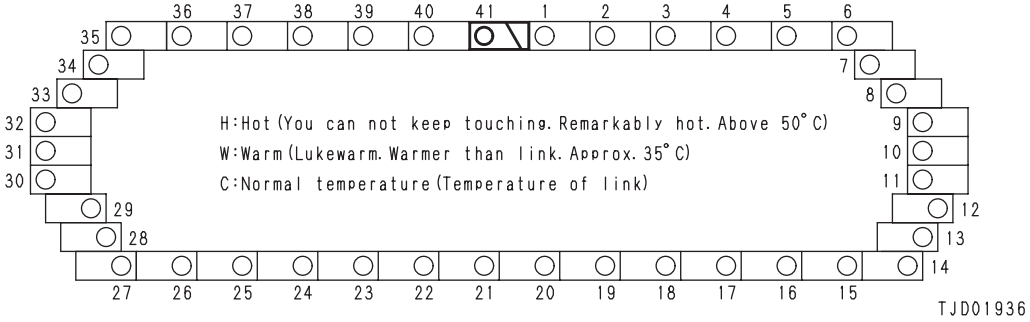
Pm CLINIC UNDERCARRIAGE CHECK SHEET

D85EX-15	Serial No

Work order No.	Date	Service meter	Serviceman
	/ /	h	

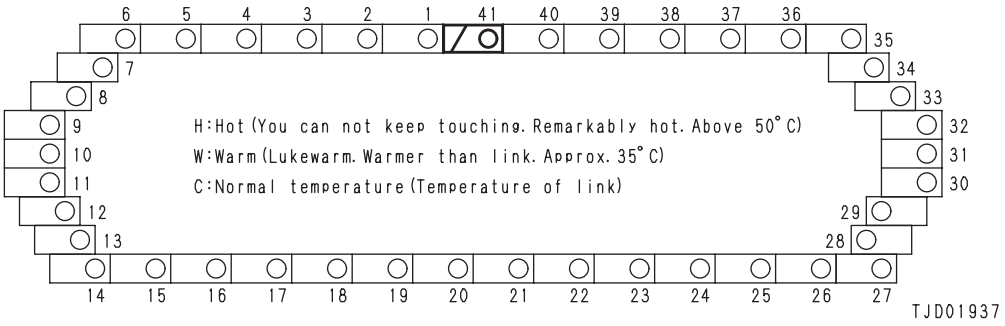
- **Measure the bushing temperature immediately after operations**

Left side of machine



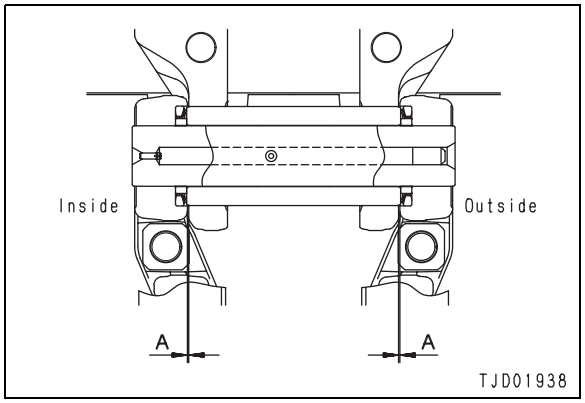
Measurement results	Pass	Fail

Right side of machine



Measurement results	Pass	Fail

- **Opening of track link**



Left track	A: Clearance between links
Pin No.	1.4

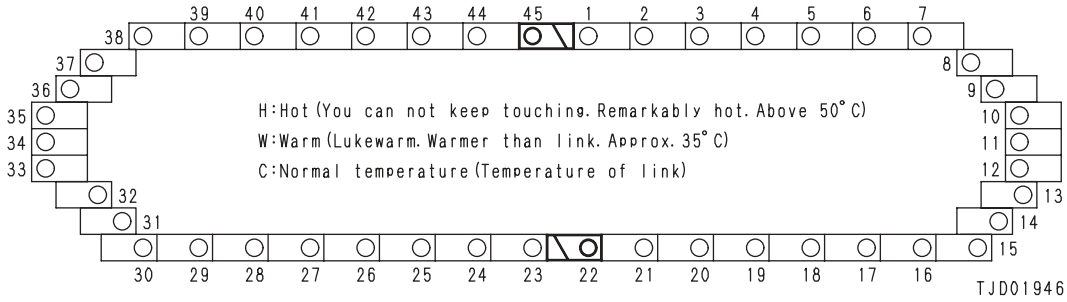
Right track	A: Clearance between links
Pin No.	1.4

Pm CLINIC UNDERCARRIAGE CHECK SHEET

D85PX-15	Serial No

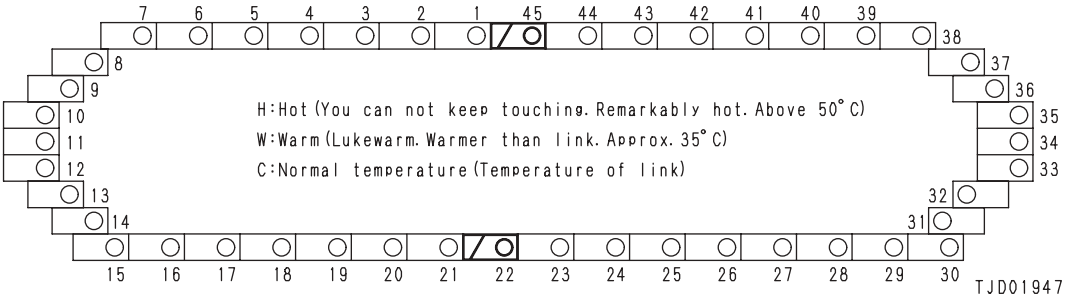
Work order No.	Date	Service meter	Serviceman
	/ /	h	

- **Measure the bushing temperature immediately after operations**
  Left side of machine



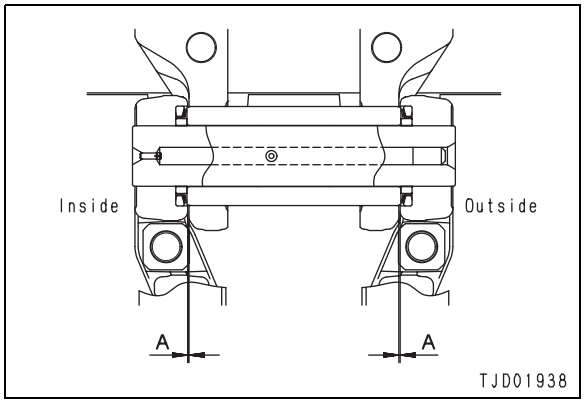
Measurement results	Pass	Fail

Right side of machine



Measurement results	Pass	Fail

- **Opening of track link**



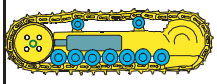
Left track	A: Clearance between links
Pin No.	1.4

Right track	A: Clearance between links
Pin No.	1.4

UNDERCARRIAGE TROUBLESHOOTING REPORT (NORMAL)

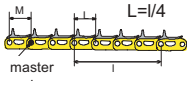
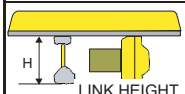
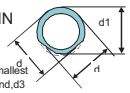
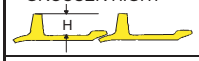
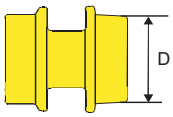
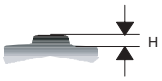
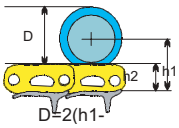
(Program form No.: SELA195001)

KUC



Komatsu
Undercarriage Inspection

Customer name:					
Address:					
Model	D85EX, PX-15	Serial#		Equip#	
Location		SMR			
Soil condition		Dealer			
Working condition		Inspector			
		Insp.Date(yy/mm/dd)		(yyyy/m/d)	
Work Order No					
Wet,AR,HD or Dry	Wet				
Shoe width (mm)					
Shoe type	SINGLE				
Wear type	NORMAL				

			New	100% Wear	Measured mm	Wear %	SMR New	SMR Rebuilt	Hours on Parts:	Comments/Observation
LINK PITCH 	R	LH	865.2	877.2						
		RH	865.2	877.2						
	M	LH	216.3	219.3						
		RH	216.3	219.3						
		LH	140.0	127.5						
		RH	140.0	127.5						
BUSHING 		LH	79.5	69.3			New	Turned		
		RH	79.5	69.3			New	Turned		
GROUSER HIGHT 		LH	71.4	25.0						
		RH	71.4	25.0						
CARRIER 	Front	LH	185.0	162.0						
		RH	185.0	162.0						
	Rear	LH	185.0	162.0						
		RH	185.0	162.0						
IDLER 	Front	LH	18.0	30.5						
		RH	18.0	30.5						
	Rear	LH	18.0	30.5						
		RH	18.0	30.5						
TRACK ROLLER 	1	LH	222.0	182.0						
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	3	LH	222.0	182.0						
	4	LH	222.0	182.0						
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	6	LH	222.0	182.0						
	7	LH	222.0	182.0						
	8	LH	222.0	182.0						
	9	LH	222.0	182.0						
	10	LH	222.0	182.0						
	1	RH	222.0	182.0						
	2	RH	222.0	182.0						
	3	RH	222.0	182.0						
	4	RH	222.0	182.0						
	5	RH	222.0	182.0						
	6	RH	222.0	182.0						
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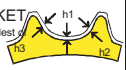
	10	RH	222.0	182.0						
SPROCKET 		LH	0.0	6.0						
		RH	0.0	6.0						

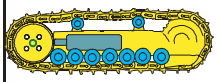
Remarks:

UNDERCARRIAGE TROUBLESHOOTING REPORT (IMPACT)

(Program form No.: SELA195001)

KUC

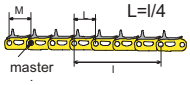
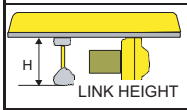
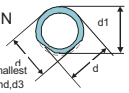
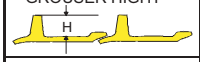
Komatsu
Undercarriage Inspection



Customer name:

Address:

Model	D85EX, PX-15	Serial#		Equip#		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	865.2	877.2						
		RH	865.2	877.2						
	M	LH	216.3	219.3						
		RH	216.3	219.3						
		LH	140.0	127.5						
		RH	140.0	127.5						
BUSHING 		LH	79.5	71.9			New	Turned		
		RH	79.5	71.9			New	Turned		
GROUSER HIGHT 		LH	71.4	25.0						
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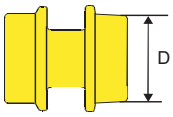
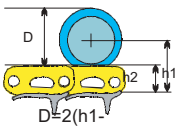
CARRIER 	Front	LH	185.0	162.0						
		RH	185.0	162.0						
	Rear	LH	185.0	162.0						
		RH	185.0	162.0						
IDLER 	Front	LH	18.0	30.5						
		RH	18.0	30.5						
	Rear	LH	18.0	30.5						
		RH	18.0	30.5						
TRACK ROLLER 	1	LH	222.0	182.0						
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	4	LH	222.0	182.0						
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	10	LH	222.0	182.0						
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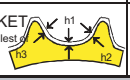
SPROCKET 		LH	0.0	6.0						
		RH	0.0	6.0						

Remarks:

TROUBLESHOOTING

POINTS TO REMEMBER WHEN TROUBLESHOOTING

⚠ Stop the machine in a level place, and check that the safety pin, blocks, and parking brake are securely fitted.

⚠ When carrying out the operation with two or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.

⚠ If the radiator cap is removed when the engine is hot, hot water 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 immediately any failure occurs:
- Parts that have no connection with the failure or other unnecessary parts will be disassembled.
- It will become impossible to find the cause of the failure.

It will also cause a waste of 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 the oil level
2) Check for any external leakage of oil from the piping or hydraulic equipment.
3) Check the travel of the control levers.
4) Check the stroke of the control valve spool.
5) Other maintenance items can be checked externally, so check any item that is considered to be necessary.

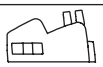
4. Confirming failure
- Confirm the extent of the failure yourself, and judge whether to handle it as a real failure or as a problem with the method of operation, etc.
  - ★ When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.

5. Troubleshooting
- Use the results of the investigation and inspection in Items 2 – 4 to narrow down the causes of failure, then use the troubleshooting flowchart to locate the position of the failure exactly.
  - ★ The basic procedure for troubleshooting is as follows.
    1) Start from the simple points.
    2) Start from the most likely points.
    3) Investigate other related parts or information.

6. Measures to remove root cause of failure
- Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occur again.
To prevent this, always investigate why the problem occurred. Then, remove the root cause.

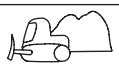
SEQUENCE OF EVENTS IN TROUBLESHOOTING

Office, shop



TEW00180

Jobsite

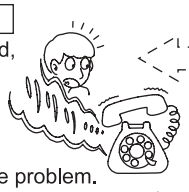


TEW00181

Step 1

Examination, confirmation of symptoms

1) When a request for repairs is received, first ask the following points.
   - Name of customer
   - Type, serial number of machine
   - Details of jobsite, etc.
2) Ask questions to gain an outline of the problem.
   - Condition of failure
   - Work being carried out at the time of the failure
   - Operating environment
   - Past history, details of maintenance, etc.



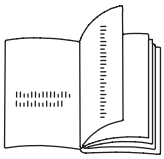
TEW00182

TEP01348

Step 2

Determining probable location of cause

1) Look at the troubleshooting section of the shop manual to find locations of possible causes.



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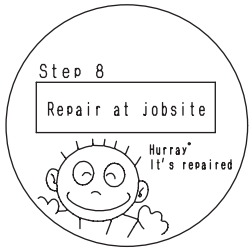
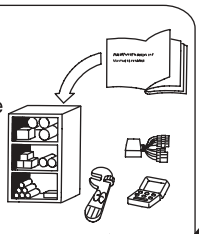


TEP01349

Step 3

Preparation of troubleshooting tools

1) Look at the table of troubleshooting tools in the shop manual and prepare the necessary tools.
   - T-adapter
   - Hydraulic pressure gauge kit, etc.
2) Look in the parts book and prepare the necessary replacement parts.

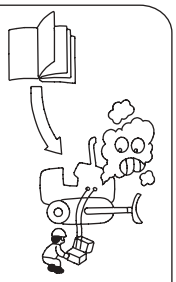


TEW00186

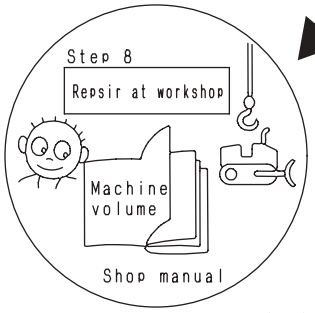
Step 7

- Pinpoint locations of failure (carry out troubleshooting)
- Decide action to take

1) Before starting troubleshooting, locate and repair simple failures.
   - Check before starting items
   - Other check items
2) See the Troubleshooting Section of the shop manual, select a troubleshooting flowchart that matches the symptoms, and carry out troubleshooting.



TEW00187



TEP01351

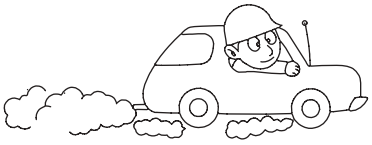
Step 6

Re-enacting failure

- Drive and operate the machine to confirm the condition and judge if there is really a failure.

Step 4

Go to jobsite

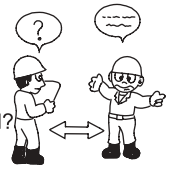


TEW00189

Step 5

Ask operator questions to confirm details of failure.

- Was there anything strange about the machine before the failure occurred?
- Did the failure occur suddenly?
- Had any repairs been carried out before the failure?



TEW00190

POINTS TO REMEMBER WHEN CARRYING OUT MAINTENANCE

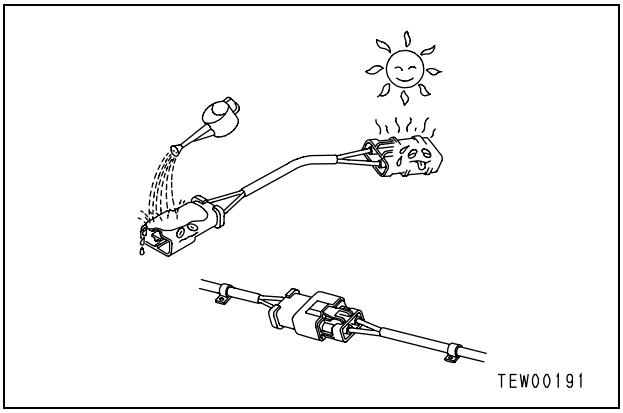
To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct operation, maintenance and inspection, troubleshooting, and repairs must be carried out. This section deals particularly with correct repair procedures for mechatronics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

1. 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.

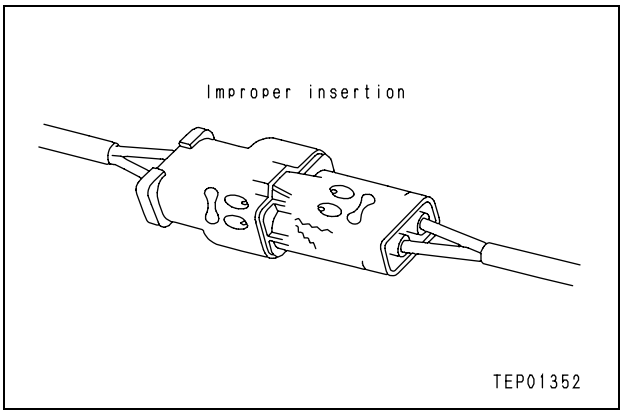
Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations, they are frequently removed and installed again, so they are likely to suffer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


TEW00191

Main failures occurring in wiring harness

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

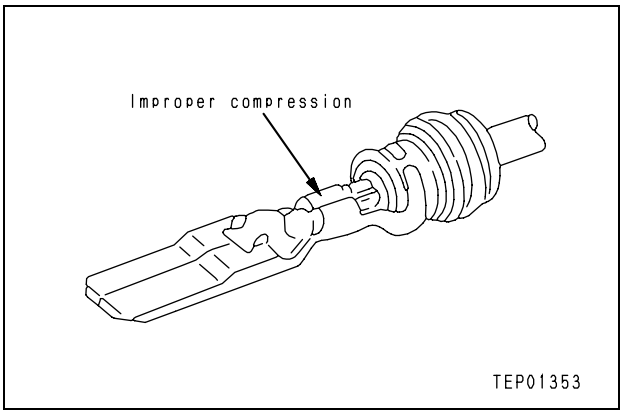
Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned, or because there is corrosion or oxidization of the contact surfaces.



TEP01352

(2) Defective crimping or soldering of connectors

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



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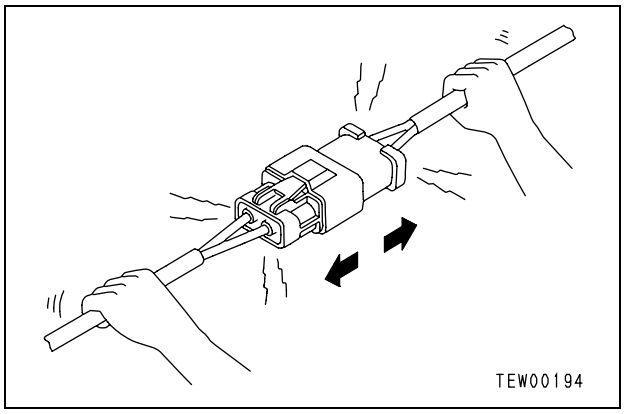
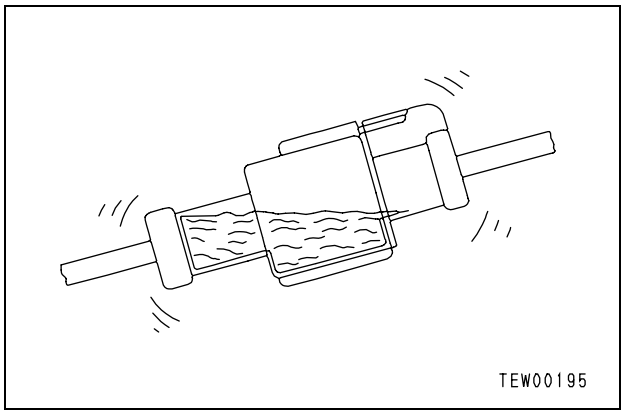
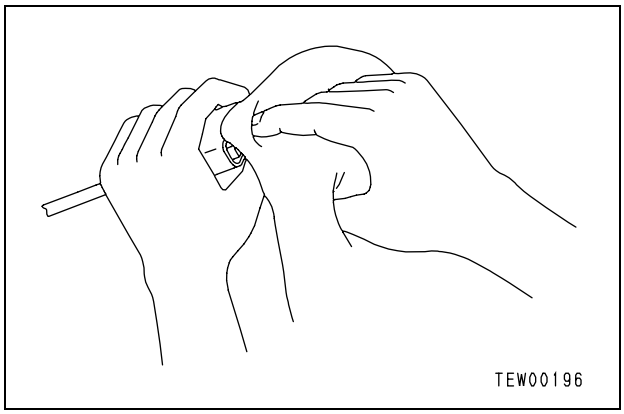
(3) Disconnections in wiring
If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping of the connector may separate, or the soldering may be damaged, or the wiring may be broken.



(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.
As already said, 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.



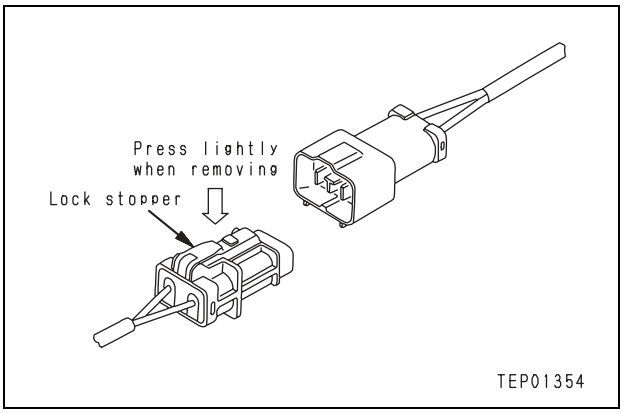
(5) Oil or dirt stuck to connector
If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact.
If there is oil or grease stuck to the connector, wipe it off 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.



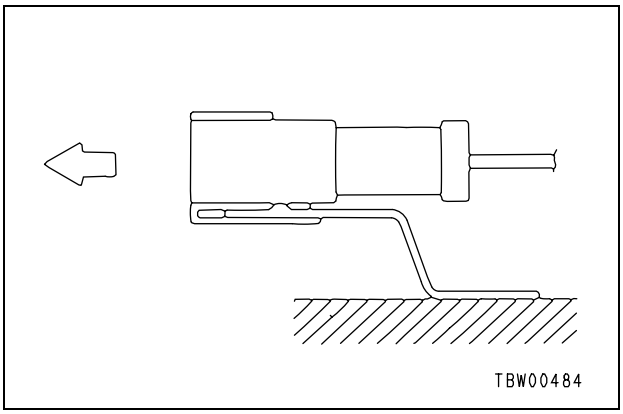
2) Removing, installing, and drying connectors and wiring harnesses

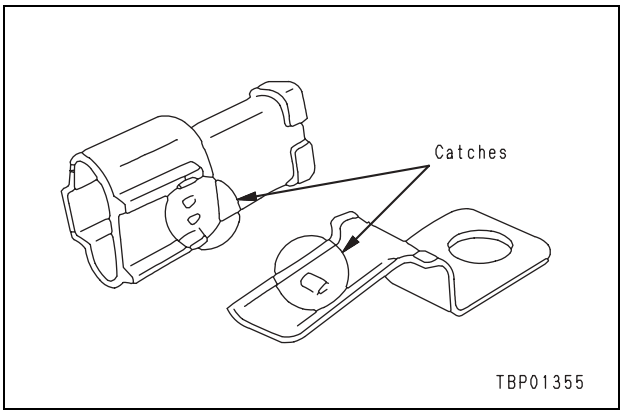
(1) Disconnecting connectors

- Hold the connectors when disconnecting. When disconnecting the connectors, hold the connectors and not the wires. 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.

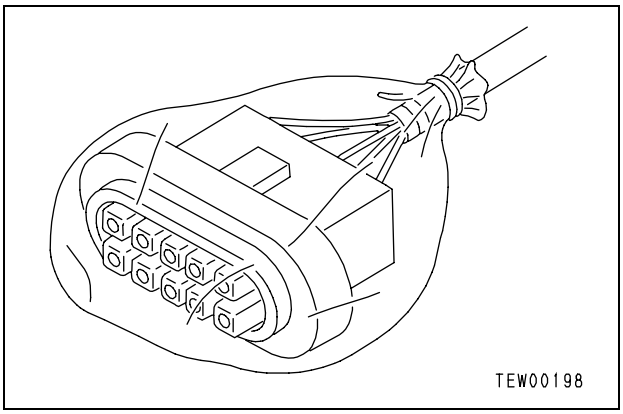


- When removing from clips
  When removing a connector from a clip, pull the connector in a parallel direction to the clip.
  ★ If the connector is twisted up and down or to the left or right, the housing may break.



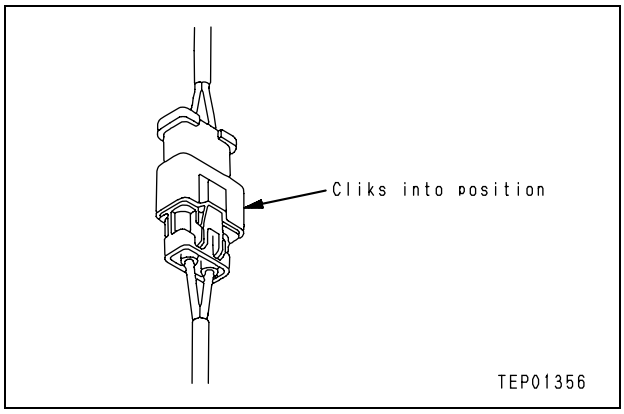


- Action to take after removing connectors
  After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.
  ★ If the machine is left disassembled for a long time, it is particularly easy for improper contact to occur, so always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

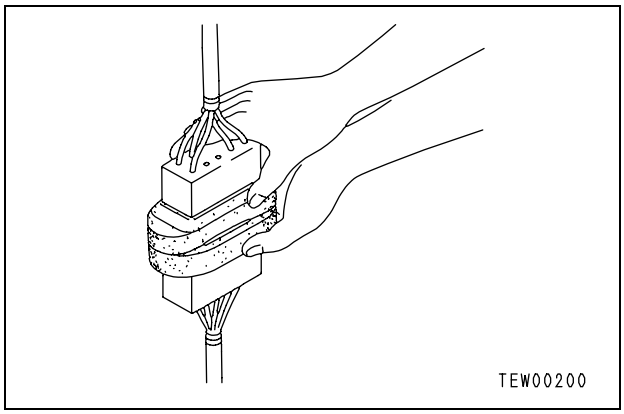


(2) Connecting connectors

- 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.

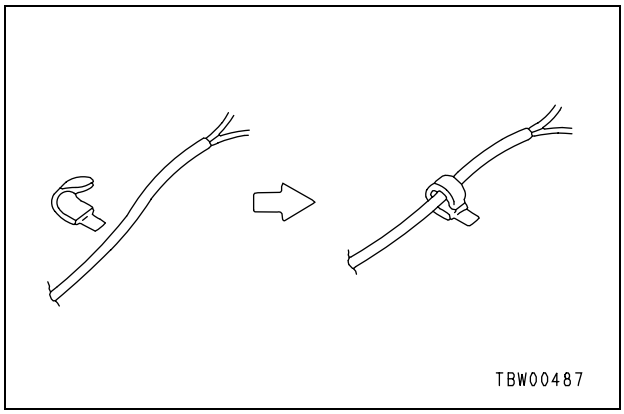


- Fix the connector securely.
  Align the position of the connector correctly, then insert it securely.
  For connectors with lock stopper, push in the connector until the stopper clicks into position.



- 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.

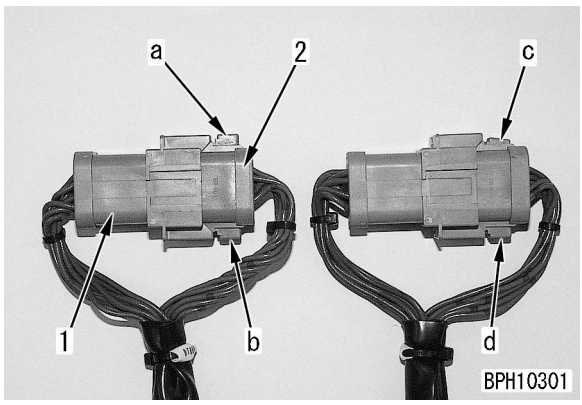


(3) Connecting connectors (DT type connector)

Since the DT 8-pole and 12-pole DT type 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**

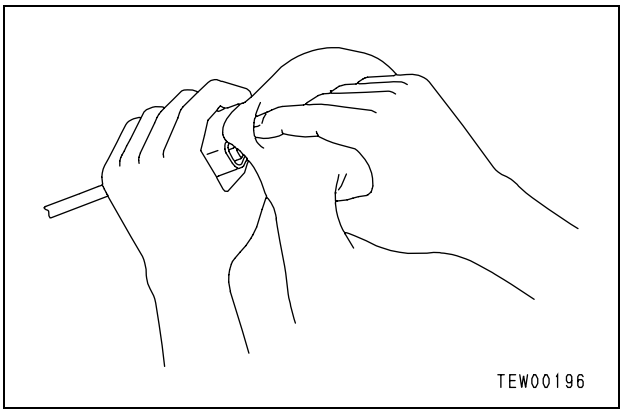


(4) Drying wiring harness

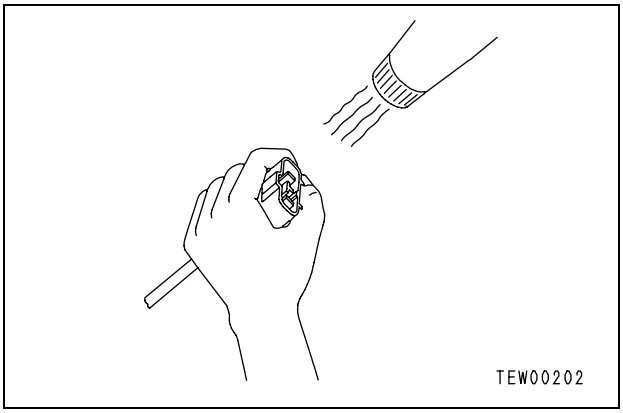
If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high-pressure water or steam directly on the wiring harness.

If water gets directly on the connector, do as follows.

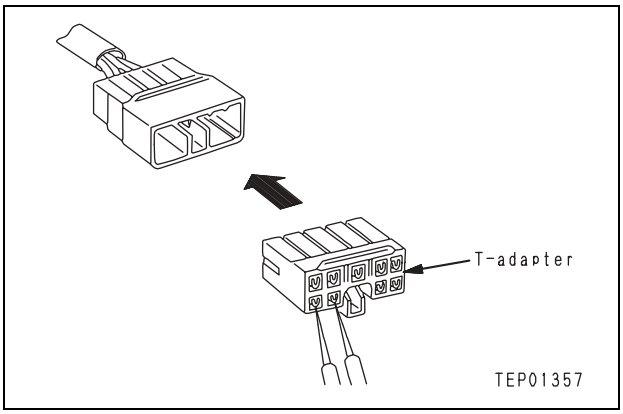
- Disconnect the connector and wipe off the water with a dry cloth.
  - ★ If the connector is blown dry with compressed air, there is the risk that oil in the air may cause defective contact, so remove all oil and water from the compressed air before blowing with air.



- 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.



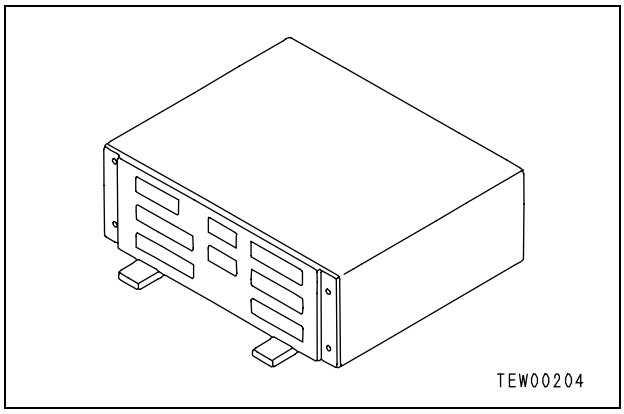
- Carry out a continuity test on the connector. After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.
  - ★ After completely drying the connector, blow it with contact restorer and reassemble.



3) Handling control box

(1) The control box contains a microcomputer and electronic control circuits. These control all of the electronic circuits on the machine, so be extremely careful when handling the control box.

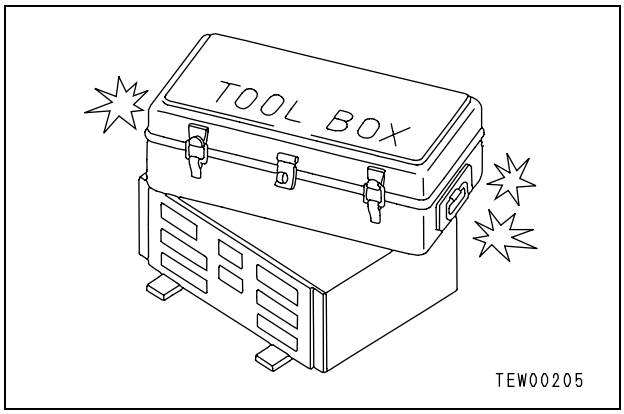
(2) Do not open the cover of the control box unless necessary.



(3) Do not place objects on top of the control box.

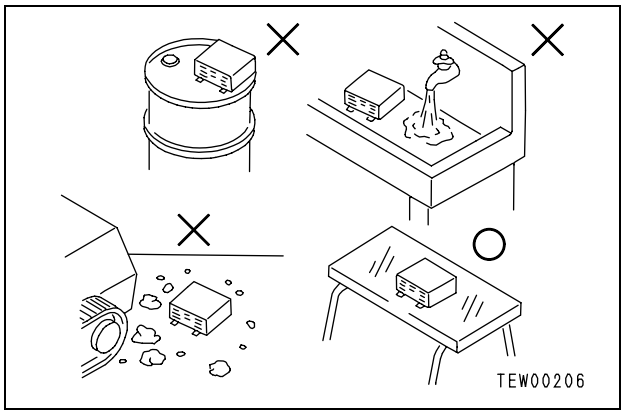
(4) Cover the control connectors with tape or a vinyl bag.
Never touch the connector contacts with your hand.

(5) During rainy weather, do not leave the control box in a place where it is exposed to rain.



(6) Do not place the control box on oil, water, or soil, or in any hot place, even for a short time. (Place it on a suitable dry stand).

(7) Precautions when carrying out arc welding
When carrying out arc welding on the body, disconnect all wiring harness connectors connected to the control box. Fit an arc welding ground close to the welding point.



2. Points to remember when troubleshooting electric circuits

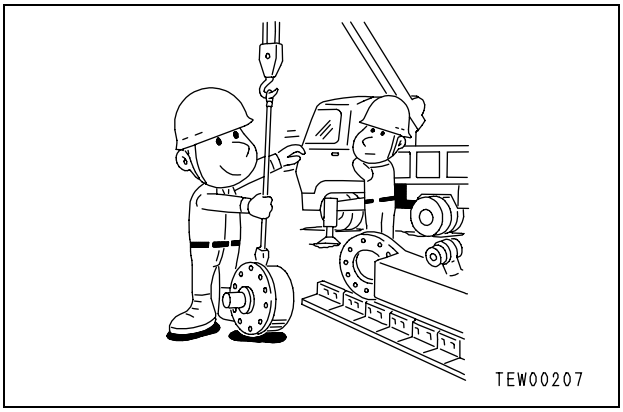
1) Always turn the power OFF before disconnecting or connect connectors.
2) Before carrying out troubleshooting, check that all the related connectors are properly inserted.
   ★ Disconnect and connect the related connectors several times to check.
3) Always connect any disconnected connectors before 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.

3. Points to remember when handling hydraulic equipment

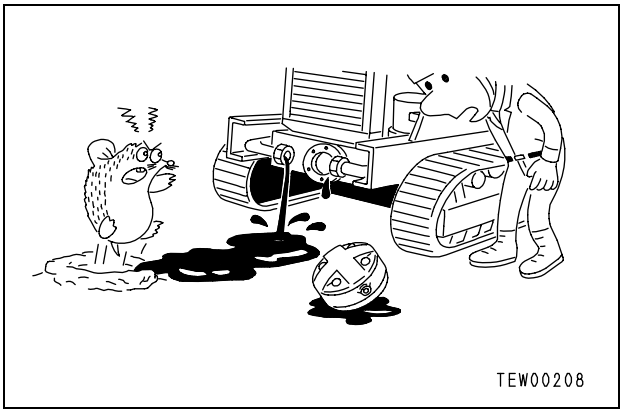
With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

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.

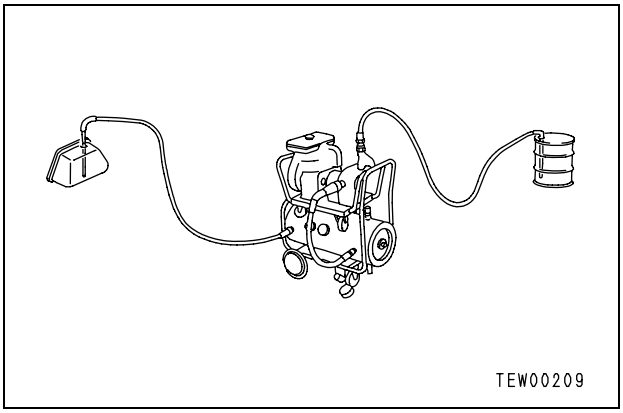
2) Disassembly and maintenance work in the field
If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to confirm the performance after repairs, so it is desirable to use unit exchange. Disassembly and main-tenance of hydraulic equipment should be carried out in a specially prepared dustproof workshop, and the performance should be confirmed 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 on to the ground, 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.



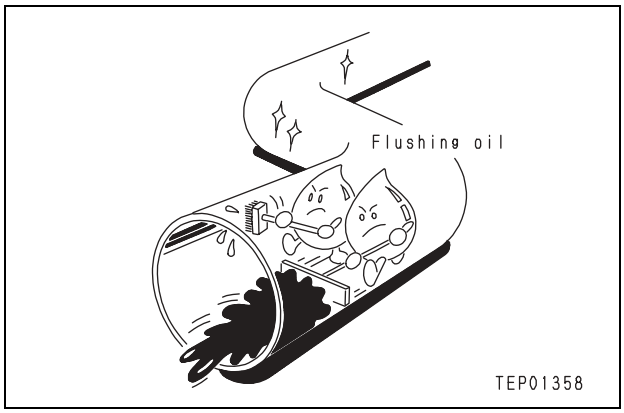
5) Change hydraulic oil when the temperature is high.

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.

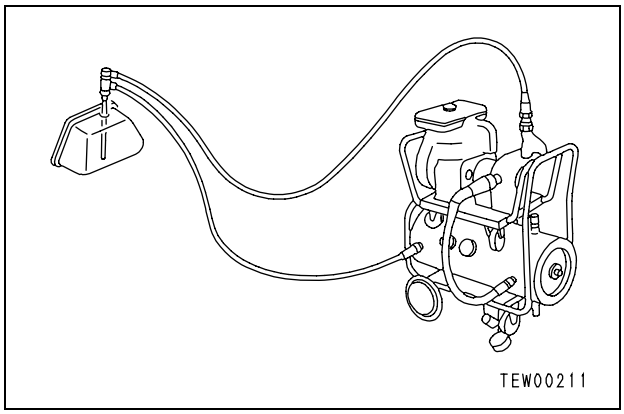
Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.



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 ultrafine (about 3µ) particles that the filter built into the hydraulic equipment cannot remove, so it is an extremely effective device.



CHECKS BEFORE TROUBLESHOOTING

		Item	Judgement Value	Action
Checks before starting	Lubricating oil, coolant	1. Check fuel level	—	Add fuel
		2. Check for impurities in fuel	—	Clean, drain
		3. Check hydraulic oil level	—	Add oil
		4. Check oil level in damper case	—	Add oil
		5. Check power train oil level	—	Add oil
		6. Check engine oil level (engine oil pan level)	—	Add oil
		7. Check coolant level	—	Add water
		8. Check dust indicator for clogging	—	Clean or replace
		9. Check travel of brake pedal	—	Adjust
	Electrical equipment	10. Check for looseness, corrosion of battery terminal, wiring	—	Tighten or replace
		11. Check for looseness, corrosion of alternator terminal, wiring	—	Tighten or replace
		12. Check for looseness, corrosion of starting motor terminal, wiring	—	Tighten or replace
Other check items	Hydraulic, mechanical equipment	13. Check for abnormal noise, smell	—	Repair
		14. Check for oil leakage	—	Repair
		15. Carry out air bleeding	—	Bleed air
	Electrical equipment	16. Check battery voltage (engine stopped)	20 - 30 V	Replace
		17. Check battery electrolyte level	—	Add or replace
		18. Check for discolored, burnt, exposed wiring	—	Replace
		19. Check for missing wiring clamps, hanging wire	—	Repair
		20. Check for water leaking on wiring (pay particularly careful attention to water leaking on connectors or terminals)	—	Disconnect connector and dry
		21. Check for water on wiring	—	Replace
		22. Check alternator voltage (engine running at 1/2 throttle or above)	After running for several minutes: 27.5 - 29.5 V	Replace
		23. Check operating sound of battery relay (starting switch ON, OFF)	—	Replace

CLASSIFICATION AND PROCEDURES OF TROUBLESHOOTING

Classification of Troubleshooting

Mode	Explanation
Error code	Troubleshooting when a service code is displayed
E Mode	Troubleshooting of the electrical system
H Mode	Troubleshooting of the hydraulic and mechanical systems
S Mode	Troubleshooting of the engine body

Troubleshooting Procedures

When any phenomenon 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 error code in the error code display mode (electrical system, mechanical system) on the monitor display (EMMS).
   Execute a troubleshooting of the relevant **[Error Code]** in accordance with the displayed error code.
   - ★ Since a error code flashes when a problem was detected, the failure has not always been corrected even if it lights when the starting switch is set to ON. (For some codes, problems can be detected only when the starting switch is set to ON.)
   - ★ When a error code has been recorded, be sure to reproduce the code and check if the problem of the code has still remained or has already been corrected. (For the reproducing method, refer to the troubleshooting of the error code.)

2. **Troubleshooting Procedures when error codes have been recorded:**
   When no action code is displayed on the monitor panel, check a error code in the error code display mode (electrical system, mechanical system) on the monitor panel (EMMS).
   When error codes have been recorded, execute a troubleshooting of the relevant **[Error Code]** in accordance with the error code.
   - ★ Since a error code flashes when a problem was detected, the failure has not always been corrected even if it lights when the starting switch is set to ON. (For some codes, problems can be detected only when the starting switch is set to ON.)
   - ★ When a error code has been recorded, be sure to reproduce the code and check if the problem of the code has still remained or has already been corrected. (For the reproducing method, refer to the troubleshooting of the error code.)

3. **Troubleshooting Procedures when no action code is displayed and error codes have not been recorded:**
   When error codes have 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/mechanical system. In this case, check again a phenomenon supposed to be a failure and select the relevant phenomenon out of the table of “Phenomena supposed to be Failures and Troubleshooting No.” Then, execute the troubleshooting in the **[E Mode]**, **[H Mode]** or **[S Mode]** related to the phenomenon.

Phenomena supposed to be Failures and Troubleshooting No.

No.	Phenomenon suppose to be Failure		Troubleshooting			
			Error Code	E Mode	H Mode	S Mode
Phenomenon related to action code/error code						
1	An action code is displayed on the monitor panel.		Check the error code.			
2	A error code is displayed in the error code display mode.		●			
Phenomenon related to engine						
3	The engine does not start smoothly. (Engine starting takes a time all the time.)					S-1
4	The engine does not start.	The engine does not rotate.		E-1		S-2a)
5		The engine rotates but does not exhaust gas.				S-2b)
6		The engine exhausts gas but does not rotate.				S-2c)
7	The engine does not pick-up smoothly. (Poor follow-up performance)					S-3
8	The engine stops during operation.					S-4
9	The engine rotates abnormally. (Hunting)					S-5
10	Insufficient output or no power					S-6
11	Black exhaust (Imperfect combustion)					S-7
12	Large oil consumption or blue exhaust					S-8
13	Oil is contaminated fast.					S-9
14	Large fuel consumption					S-10
15	Oil mixes in coolant, spurts or water reduces.					S-11
16	Engine oil pressure drops.					S-12
17	Oil increases.					S-13
18	Water temperature rises too high. (Overheat)					S-14
19	An abnormal noise occurs.					S-15
20	Large vibration					S-16
21	The preheater does not work.			E-2		
Phenomenon related to power train						
22	The power train has no power (no drawbar pull).				H-1	S-6
23	The power train does not travel (in case of 2-spool or 3-spool).				H-2	
24	The power train does not start at all gear speeds.				H-3	
25	The power train travel forward or in reverse only				H-4	
26	Large time lag at any gear speed or at forward-reverse shifting				H-5	
27	Steering is not possible. (Left turn or right turn is impossible.)				H-6	
28	The steering speed is slow or the steering system has no power.				H-7	
29	The brake does not work.				H-8	
30	The power train oil is overheated.				H-9	
31	Abnormal noise around the HSS and work equipment pump or the HSS motor				H-10	
Phenomenon related to work equipment						
32	All the work equipment operates slowly.				H-11	
33	All the work equipment does not operate.				H-12	
34	The blade lift moves slowly or has no power.				H-13	
35	The blade tilt moves slowly or has no power.				H-14	
36	The ripper lift moves slowly or has no power.				H-15	
37	Large hydraulic drift of the blade lift				H-16	
38	Large hydraulic drift of the blade tilt				H-17	
39	Large hydraulic drift of the ripper lift				H-18	

No.	Phenomenon suppose to be Failure	Troubleshooting			
		Error Code	E Mode	H Mode	S Mode
Phenomenon related to monitor panel (Operator mode: Normal screen)					
40	When the starting switch is set to ON, no light on the monitor panel comes on.		E-3		
41	When the starting switch is set to ON, all the lights on the monitor panel do not go out.		E-4		
42	When the starting switch is set to ON, the radiator water level caution flashes.		E-5		
43	While the engine is operating, the caution items flash.		E-6		
44	While the engine is operating, the emergency warning items flash.		E-7		
45	While the preheater is operating, the preheating pilot lamp does not come on.		E-8		
46	Indication of the engine water temperature gauge is abnormal.		E-9		
47	Indication of the power train oil temperature gauge is abnormal.		E-10		
48	Indication of the hydraulic oil temperature gauge is abnormal.		E-11		
49	Indication of the fuel gauge is abnormal.		E-12		
50	Indications of gear speed and engine speed are abnormal.		E-13		
51	Indication of the preset mode service meter is abnormal.		E-14		
52	The warning lamp does not flash or does not go out.		E-15		
53	The alarm buzzer does not sound or does not stop.		E-16		
54	Auto shift down is not possible or is not released.		E-17		
55	The buzzer cancel switch does not work.		E-18		
56	The information switch does not work.		E-19		
57	The manual mode does not be operated or cancelled.		E-20		
Phenomenon related to monitor panel (Service mode: Special function screen)					
58	The monitor panel cannot be set in the service mode.		E-21		
Others					
59	The back-up alarm does not sound.		E-22		
60	The head lamp, rear lamp, and ripper point lamp on the panel do not come on.		E-23		
61	The wiper malfunctions.		E-24		
62	Washing water does not come out.		E-25		
63	The air conditioner does not operate.		E-26		

TYPES AND LOCATIONS OF CONNECTORS

★ The addresses in the following table are the addresses used in the connector arrangement drawing (3-dimensional drawing) and electric circuit diagram.

Connector No.	Type	Number of pins	Location	Address			
				Arrangement drawing	Engine system diagram	ST•TM system diagram	MON system diagram
1	DT	4	Intermediate connector [Cab specification]	I-9			
2	KES	2	Rear speaker (Left) [Cab specification]	I-8			
4	KES	2	Rear speaker (Right) [Cab specification]	H-9			
6	One-pin connector	1	Heater wire glass [Cab specification]	H-9			
7	YAZAKI	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			
10	M	2	Additional light switch [Cab specification]	B-8			
11	M	2	Wiper intermittent switch [Cab specification]	B-9			
12	KES	6	Rear wiper switch [Cab specification]	B-9			
13	KES	6	Right door wiper switch [Cab specification]	A-9			
14	KES	6	Front wiper switch [Cab specification]	A-9			
15	KES	6	Left door wiper switch [Cab specification]	A-9			
16	KES	2	Room lamp [Cab specification]	B-7			
17	DT	4	Right door wiper [Cab specification]	B-7			
18	DT	4	Intermediate connector [Cab specification]	E-8			
19	DT	4	Windshield washer motor [Cab specification]	C-5,H-1			
20	DT	1	Cab power supply [Cab specification]	C-6			
21	DT	1	Cab power supply (Battery direct) [Cab specification]	C-6			
23	DT	6	Front wiper [Cab specification]	E-8			
24	DT	4	Left door wiper [Cab specification]	C-5			
25	Relay	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]	C-7			
32	Relay(YAZAKI)	6	Rear wiper intermittent relay [Cab specification]	C-8			
33	Relay	5	Rear wiper intermittent selector relay [Cab specification]	D-7			
34	Relay	4	Heater wire glass relay [Cab specification]	C-8			
35	M	4	Converter [Cab specification]	D-8			
36	One-pin connector	1	Heater wire glass [Cab specification]	I-8			
37	KES	4	Rear wiper [Cab specification]	H-9			

Connector No.	Type	Number of pins	Location	Address			
				Arrangement drawing	Engine system diagram	ST•TM system diagram	MON system diagram
101	DT (Gr)	8	Intermediate connector	H-1		B-2	I-7
203	DT	2	Right head lamp	A-4			I-8
204	DT	2	Left head lamp	A-3			J-8
205	One-pin connector	1	Horn	A-3			
214	DT (B)	12	Intermediate connector [Dashboard]	O-3		B-8	A-6
215	DT (G)	12	Intermediate connector [Dashboard]	O-1		C-8	E-6
217	DT	2	Caution buzzer	O-4			C-8
218	DT (Br)	12	Intermediate connector [Dashboard]	P-1			
224	DT	2	Left rear lamp	J-8			I-8
226	DT	2	Ripper point lamp	K-7			I-8
244	DT	2	Intermediate connector	J-8		A-1	
248	DT	2	Intermediate connector	J-7			
250	Terminal	1	Starting switch (Terminal B)	P-9	I-9	C-9	D-9
255	Terminal	1	Starting switch (Terminal R1)	P-8	J-9		D-9
260	Terminal	1	Starting switch (Terminal BR)	P-8	J-9	C-9	D-9
262	DT	2	Horn switch	S-9			
265	Terminal	1	Horn switch	S-9			
266	Terminal	1	Horn switch	S-9			
270	Terminal	1	Starting switch (Terminal ACC)	P-9	J-9	D-9	D-9
280	Terminal	1	Starting switch (Terminal C)	P-9	J-9	C-9	D-9
361	M	2	Left door washer motor	H-1			
362	M	2	Front window washer motor	I-1			
363	M	2	Right door washer motor	I-2			
364	M	2	Rear window washer motor	J-2			
423	DT	2	Fuel level sensor	I-8			A-2
453	DT	2	Torque converter oil temperature sensor	AH-2		J-6	H-8
800	One-pin connector	1	Service power supply	T-1			
A/C	DT	2	Air conditioner compressor	Y-2			
AC1	MIC	17	Air conditioner unit	P-6			
AC2	AMP	16	Auto air conditioner controller	Q-8			
AC3	AMP	12	Auto air conditioner controller	Q-8			
ACC	YAZAKI	2	Accessory socket [Cab specification]	C-5			
ALTB	Terminal	1	Alternator (Terminal B)	Y-6		K-2	G-2
ALTR	DT	2	Alternator (Terminal R)	Y-6		K-2	H-3
AL/R	Terminal	1	Intermediate connector (Alternator)	Z-9		J-2	H-3
ASD	KES	4	Auto shift-down switch	O-6		E-9	
BKA	Relay	5	Backup alarm relay	W-7		E-9	

Connector No.	Type	Number of pins	Location	Address			
				Arrangement drawing	Engine system diagram	ST•TM system diagram	MON system diagram
BRB	Terminal	1	Battery relay power supply inlet	V-2	I-1	E-1	D-1
BRC	Terminal	1	Battery relay power supply outlet	V-2	I-1	E-1	D-1
BRE	Terminal	1	Battery relay ground	V-2	J-2	E-1	D-1
BRK	DT	3	Brake pedal potentiometer	R-1		A-2	
BUZ	KES	3	Buzzer cancel switch	P-7		F-9	E-8
CA1	DT	3	CAN terminating resistor	V-1	E-8		L-2
CA2	DT	3	CAN terminating resistor	Q-6	I-9	A-8	C-9
CAN	DT (Gr)	12	Intermediate connector [KOMTRAX]	T-1		I-1	
CB1	—	—	Circuit breaker	M-7	J-8		M-7
CB2		2	Circuit breaker	M-6			
CN1	DT	2	Engine No. 1 injector	AC-2	A-3		
CN2	DT	2	Engine No. 2 injector	AC-2	A-2		
CN3	DT	2	Engine No. 3 injector	AC-3	A-2		
CN4	DT	2	Engine No. 4 injector	AD-5	A-1		
CN5	DT	2	Engine No. 5 injector	AD-6	A-2		
CN6	DT	2	Engine No. 6 injector	AD-6	A-2		
CN-R1		4	Air conditioner relay	O-5			
CN-R2		4	Air conditioner relay	O-4			
CN-R3		4	Air conditioner relay	O-4			
CN-R4		4	Air conditioner relay	O-4			
CIG	YAZAKI	2	Cigarette lighter	C-6			
CUR	KES	3	Information switch	P-7		E-9	E-8
DCL	DT	3	Decelerator pedal potentiometer	Q-1	J-8		
DIAL	M	3	Fuel control dial potentiometer	V-8	J-8		
E21	HD-24	31	Intermediate connector (injector)	D-7	C-3		
E22	HD-24	31	Intermediate connector (sensor)	D-7	C-7	I-2	K-6
EG1	HD-24	31	Intermediate connector	T-1	G-3	G-2	G-5
EGC1	DRC-26	24	Engine controller	X-3	B-7		K-1
EGC2	DRC-26	40	Engine controller	W-3	B-6	H-1	K-1
EGC3	DRC-26	40	Engine controller	W-2	B-4	H-1	
FAC	DT	2	Fan pump solenoid	AF-6		J-7	
F1T	DT	2	1st clutch ECMV (Fill switch)	AH-7		K-3	
F2T	DT	2	2nd clutch ECMV (Fill switch)	AI-2		K-3	
F3T	DT	2	3rd clutch ECMV (Fill switch)	AG-6		K-2	
FAM	KES	4	Fan reverse mode switch	O-7		D-9	
FAR2	DT	2	Fan reverse solenoid	A-2		A-2	
FFC	DT (Gr)	12	Intermediate connector	J-2		B-1	I-7

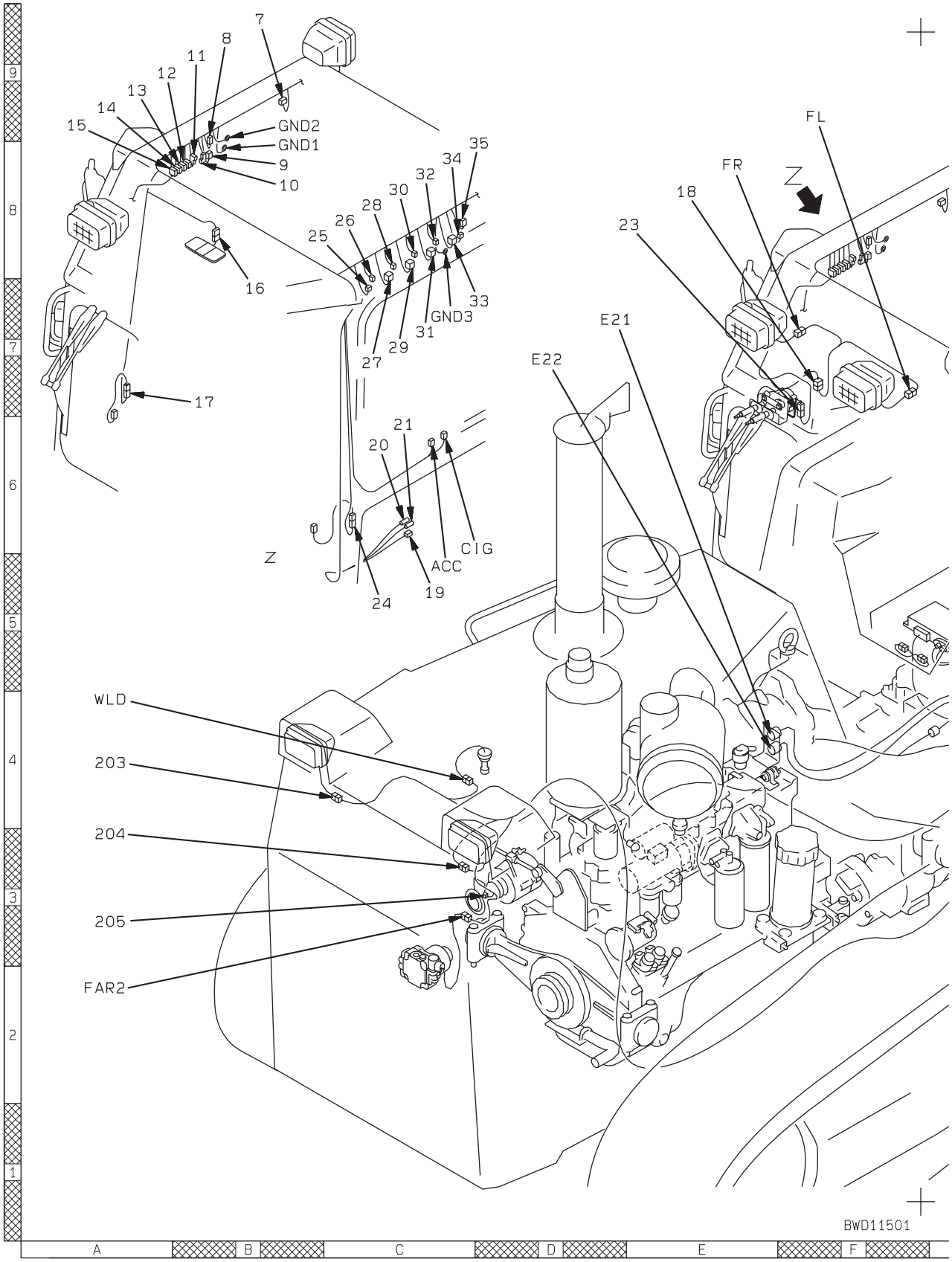
Connector No.	Type	Number of pins	Location	Address			
				Arrangement drawing	Engine system diagram	ST•TM system diagram	MON system diagram
FFT	DT	2	Forward clutch ECMV (Fill switch)	AI-7		K-4	
FL	DT	2	Front additional light (Left)	F-9			
FLS	X	4	Software writing connector (Engine controller)	V-2	B-3		
FR	DT	2	Front additional light (Right)	E-8			
FRT	DT	2	Reverse clutch ECMV (Fill switch)	AI-7		K-4	
FS1	—	—	Fuse box	W-5	H-2	C-2	A-1
FS2	—	—	Fuse box	W-4	H-1	C-1	A-1
FWL	KES	4	Head lamp switch	O-6			D-8
G	YAZAKI	2	Engine speed G sensor	AB-2	E-8		L-8
GND	Terminal	1	GND (heater relay)	AA-9			
GND1	Terminal	1	Ground [Cab specification]	B-8			
GND2	Terminal	1	Ground [Cab specification]	B-9			
GND3	Terminal	1	Ground [Cab specification]	C-7			
GND4	Terminal	1	Ground [Cab specification]	H-9			
GND02	Terminal	1	Ground [ROPS]	U-1	K-1	F-1	F-1
GND03	Terminal	1	Ground [ROPS]	U-1	K-1	F-1	E-1
GND05	Terminal	1		U-1		F-1	F-1
GND06	Terminal	1	Ground [ROPS]	U-1			
HHP	DT	3	Hydraulic oil pressure sensor	AE-5		J-5	
HSA	DT	2	HSS-EPC (Left swing)	AF-8		J-7	
HSB	DT	2	HSS-EPC (Right swing)	AE-6		J-7	
HT/A	Terminal	1	Intake air heater relay (Terminal A)	AC-8	B-8		I-1
HT/B	Terminal	1	Intake air heater relay (Terminal B)	AD-7	A-8		I-1
HT/S	Terminal	1	Intake air heater relay (Terminal C)	AD-8	B-8		I-1
JE2	DT	6	Joint connector	AA-9	B-8		J-1
KOM1	DRC-26	40	KOMTRAX controller	T-9			
KOM2			KOMTRAX controller	T-9			
KOM3			KOMTRAX controller	U-9			
KOM4			KOMTRAX controller (Antenna)	G-9			
KOM5			KOMTRAX controller (Antenna)	G-9			
M26	M	6	Air conditioner unit	P-6			
MAM	KES	4	Manual mode switch	P-7		E-9	
NE	YAZAKI	2	Engine speed NE sensor	AD-3	E-9		L-8
NSF	Relay	5	Neutral safety relay	X-7	L-7	F-9	F-6
NSW	DT	3	Parking lever switch	W-3		A-2	A-2
PCV1	DT	2	Fuel supply pump (PCV1)	AB-2	A-1		
PCV2	DT	2	Fuel supply pump (PCV2)	AB-2	A-1		

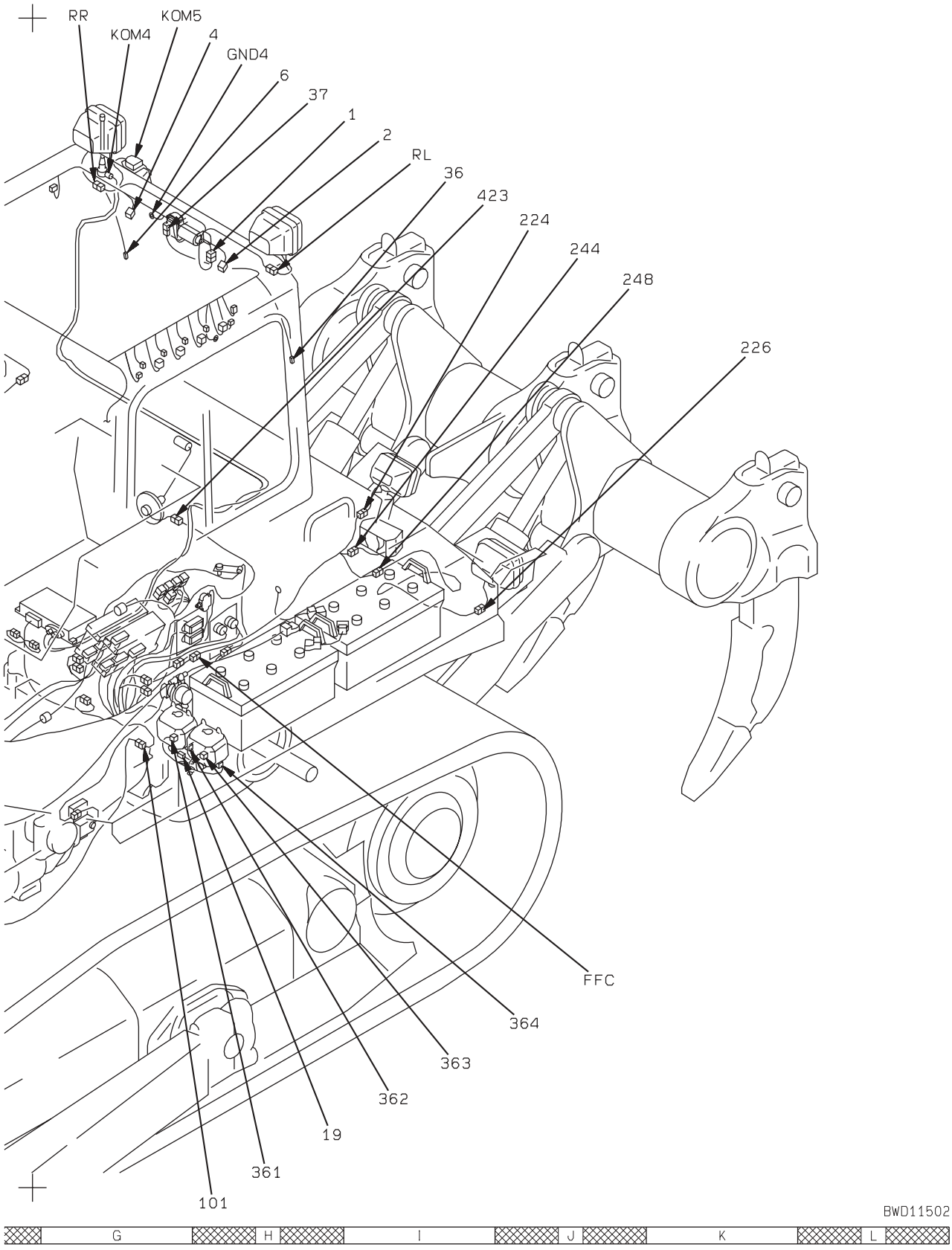
Connector No.	Type	Number of pins	Location	Address			
				Arrangement drawing	Engine system diagram	ST•TM system diagram	MON system diagram
PFUEL	AMP070	3	Common rail fuel pressure switch	AD-3	A-8		
PIM	AMP090	3	Boost pressure sensor	AD-7	A-9		
PL1	HD-24	23	Intermediate connector [Power train]	W-5		I-4	
PL2	HD-24	31	Intermediate connector [Power train]	W-4		I-7	H-7
PL5	DT (Gr)	12	Intermediate connector	W-4		I-5	
PPR	Relay	5	Supply pump power relay	W-7	K-7		
PSH	Terminal	1	Engine oil pressure sensor (High pressure)	Z-1	E-9		L-8
PSL	Terminal	1	Engine oil pressure sensor (Low pressure)	Z-1	E-9		K-8
PT1	DT	3	Intermediate connector [Pitch angle sensor]	Q-1		B-1	
PT2	DT	3	Pitch angle sensor	P-1		A-1	
RPL	DT	2	Rear additional light (Left) [Cab specification]	I-8			
RR	DT	2	Rear additional light (Right) [Cab specification]	G-9			
RHR	Relay	5	Pre-heater relay	W-8	K-7		E-6
RWL	KES	4	Rear lamp switch	O-6			E-8
S03	AMP070	20	Monitor panel	N-9		A-9	A-8
S04	AMP070	12	Monitor panel	N-9	H-8	A-9	B-8
S13	DT (Gr)	12	Intermediate connector	O-3	I-7	C-8	C-6
S24			Service switch	M-6		D-9	C-9
S1T	DT	2	1st clutch ECMV (Solenoid)	AF-6		K-3	
S2T	DT	2	2nd clutch ECMV (Solenoid)	AI-3		K-3	
S3T	DT	2	3rd clutch ECMV (Solenoid)	AG-6		K-2	
SDS	DT	2	Hydraulic oil temperature sensor	AE-5		J-5	I-8
SFT	DT	2	Forward clutch ECMV (Solenoid)	AI-3		K-4	
SFTD		3	Shift-down switch	U-9		K-8	
SFTU		3	Shift-up switch	U-9		K-8	
SRT	DT	2	Reverse clutch ECMV (Solenoid)	AG-7		K-4	
ST	DT	2	Starting motor	Y-8		J-1	H-2
ST/B	Terminal	1	Starting motor (Terminal B)	Z-8		K-1	G-2
STC1	DRC-26	24	Steering and transmission controller	X-1		A-7	A-4
STC2	DRC-26	40	Steering and transmission controller	X-1	L-2	A-6	A-3
STC3	DRC-26	40	Steering and transmission controller	X-1		A-4	A-3
STF	X	4	Software writing connector (Steering and transmission controller)	X-7		B-8	
SW	Terminal	1	Battery relay terminal BR	V-2	J-1	E-1	D-1
T0F	DT	2	KOMTRAX station opening inspection connector (Female)	S-1			
T0M	DT	2	KOMTRAX station opening inspection connector (Male)	S-1			
T1F	DT	2	KOMTRAX station opening inspection connector (Male)	S-1			
T1M	DT	2	KOMTRAX station opening inspection connector (Male)	S-1			

Connector No.	Type	Number of pins	Location	Address			
				Arrangement drawing	Engine system diagram	ST•TM system diagram	MON system diagram
THL	DT	3	Fuel temperature sensor	AD-3	E-8		
TL1	HD-24	23	Intermediate connector [Console]	W-8	J-1	I-9	
TL2	DT (Gr)	8	Travel lever	V-8		J-9	
TL3	DT	6	Intermediate connector [Shift switch]	V-8		J-8	
TM1	DT	2	Transmission bevel speed sensor	AJ-6		J-6	
TMV	HD-24	23	Intermediate connector [Transmission ECMV]	AG-6		K-4	
TVC	DT	2	HSS • hydraulic pump	AE-3		J-5	
TWH	DT	2	Engine water temperature sensor (High temperature)	Y-6	B-9		K-8
TWL	DT	2	Engine water temperature sensor (Low temperature)	AB-9	B-9		K-8
WLD	DT	2	Radiator water level sensor	A-4			J-8

* The color symbols of the bodies of the heavy duty wire connectors (DT-8 poles) and (DT-12 poles) are as follows.
(Gr) = Gray, (B) = Black, (G) = Green, (Br) = Brown

CONNECTOR ARRANGEMENT DRAWING

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KOM4
KOM5
4
GND4
6
37
1
2
RL
36
423
224
244
248
226
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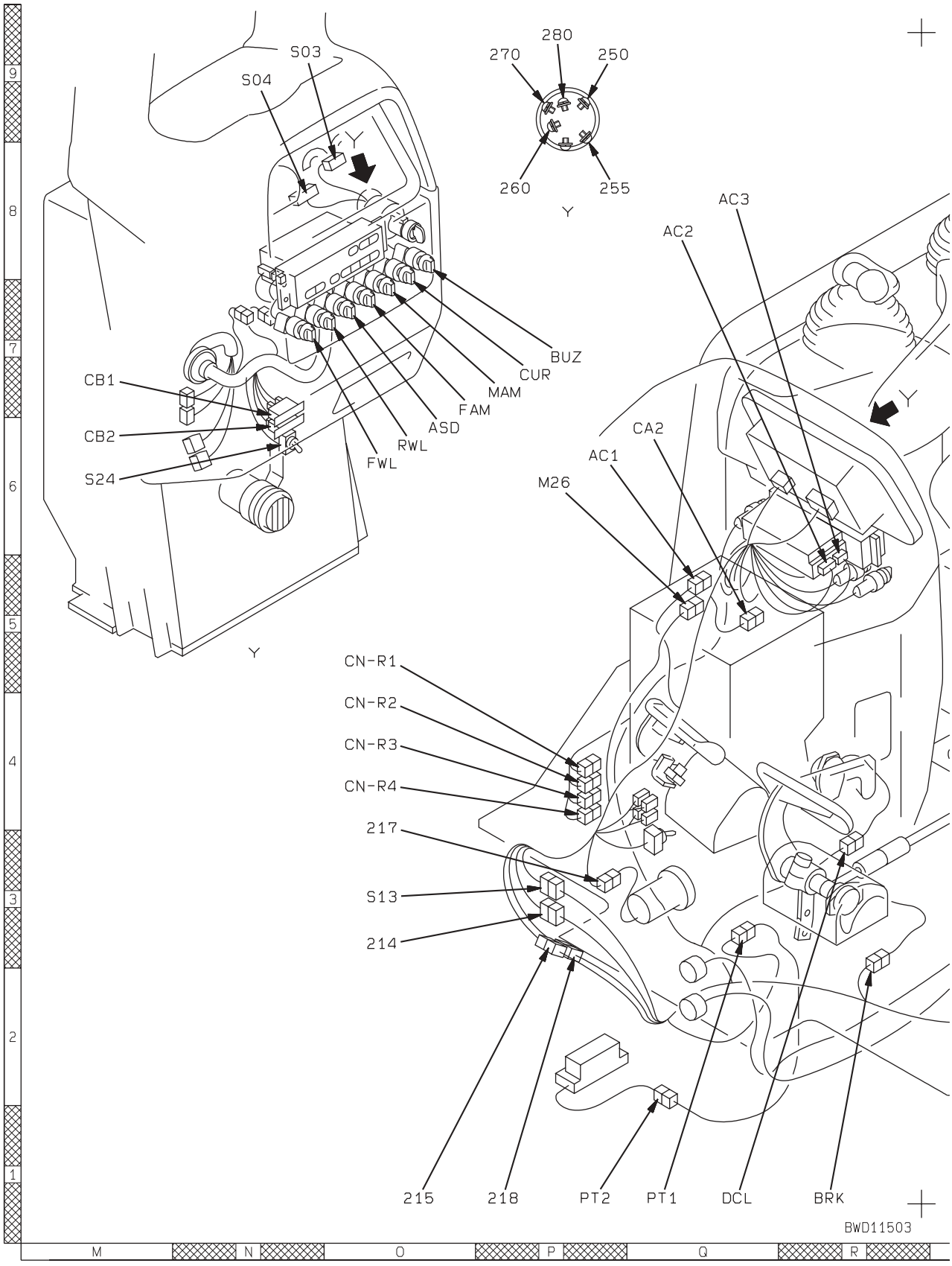
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RWL
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CB2
S24
AC3
AC2
CA2
AC1
M26
CN-R1
CN-R2
CN-R3
CN-R4
217
S13
214
215
218
PT2
PT1
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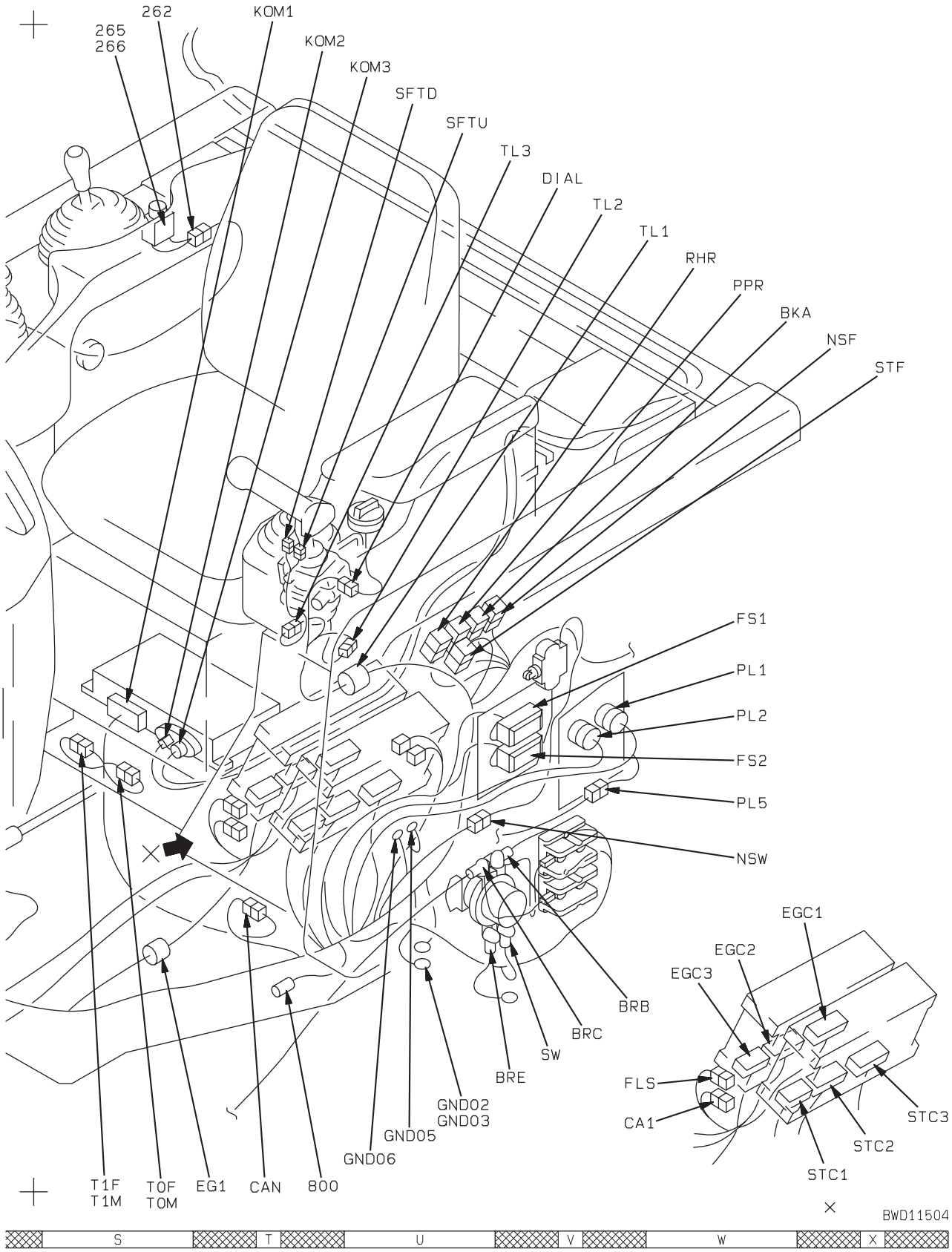
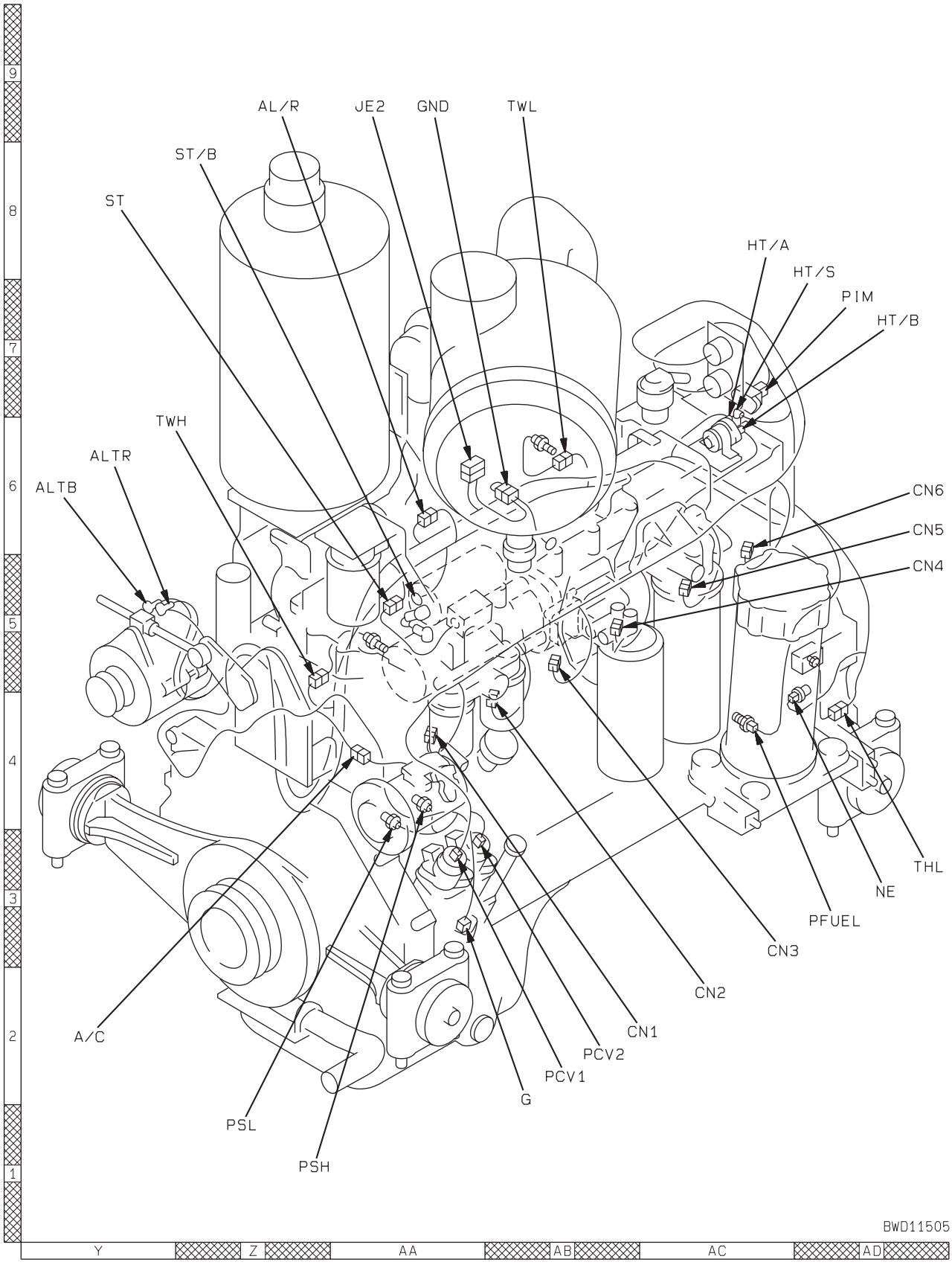
Q
R


262
265
266
KOM1
KOM2
KOM3
SFTD
SFTU
TL3
DIAL
TL2
TL1
RHR
PPR
BKA
NSF
STF
FS1
PL1
PL2
FS2
PL5
NSW
EGC1
EGC2
EGC3
BRB
BRC
SW
BRE
FLS
CA1
STC3
STC2
STC1
GND02
GND03
GND05
GND06
T1F
T1M
TOF
TOM
EG1
CAN
800
BWD11504
S
T
U
V
W
X


AL/R
JE2
GND
TWL
ST/B
ST
HT/A
HT/S
PIM
HT/B
TWH
ALTR
ALTB
CN6
CN5
CN4
THL
NE
PFUEL
CN3
CN2
CN1
PCV2
PCV1
G
A/C
PSL
PSH
BWD11505
9
8
7
6
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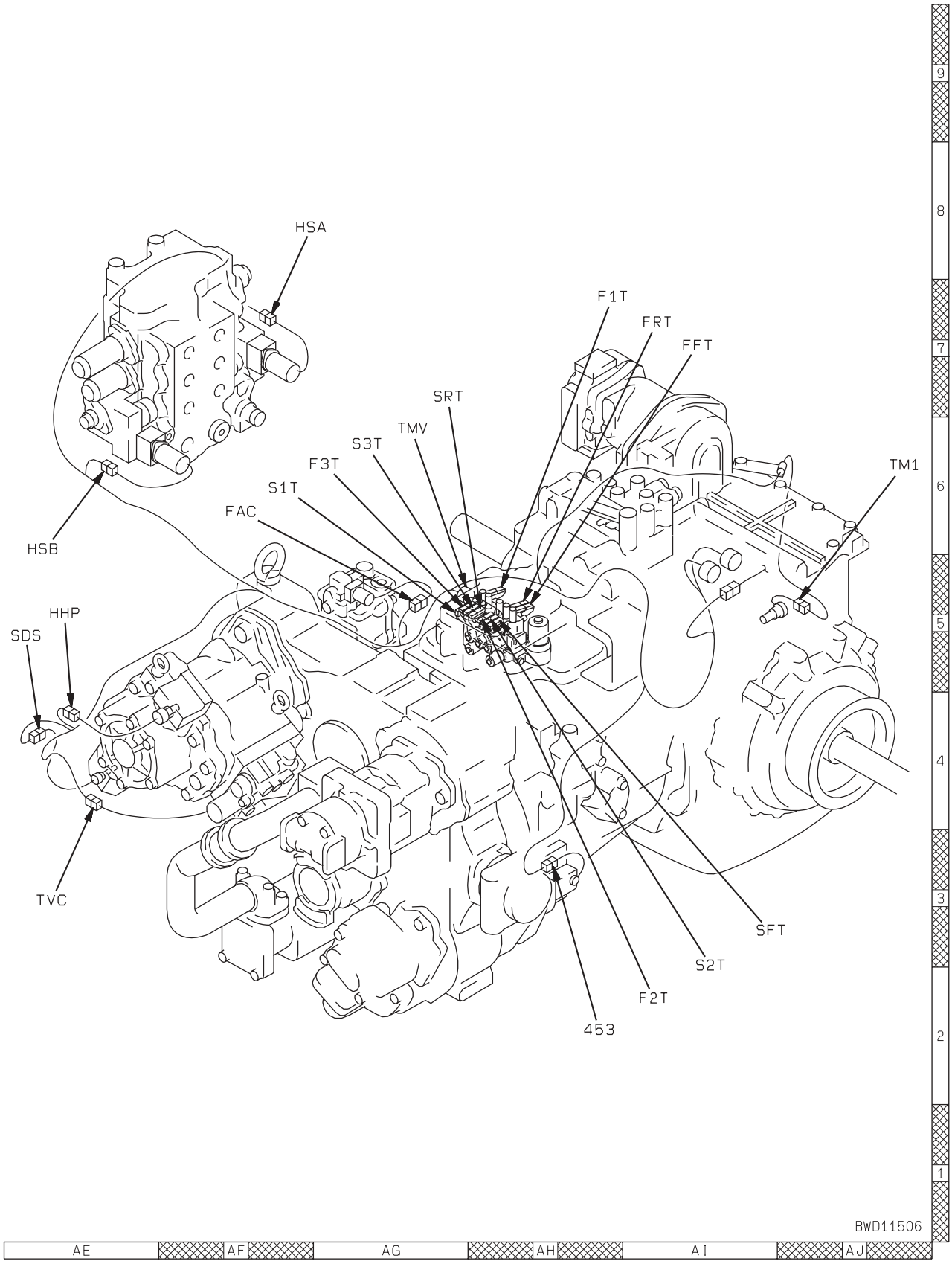
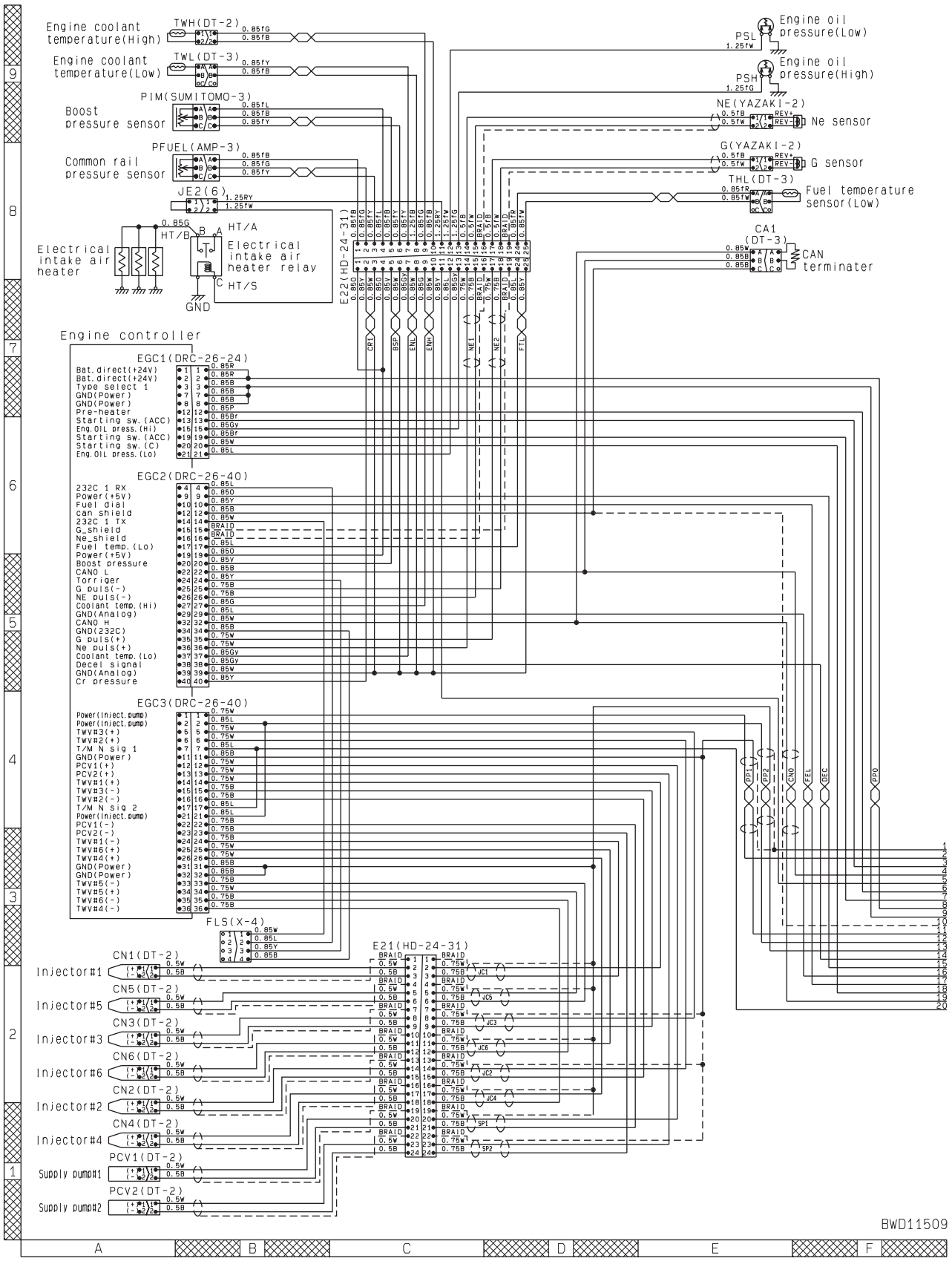
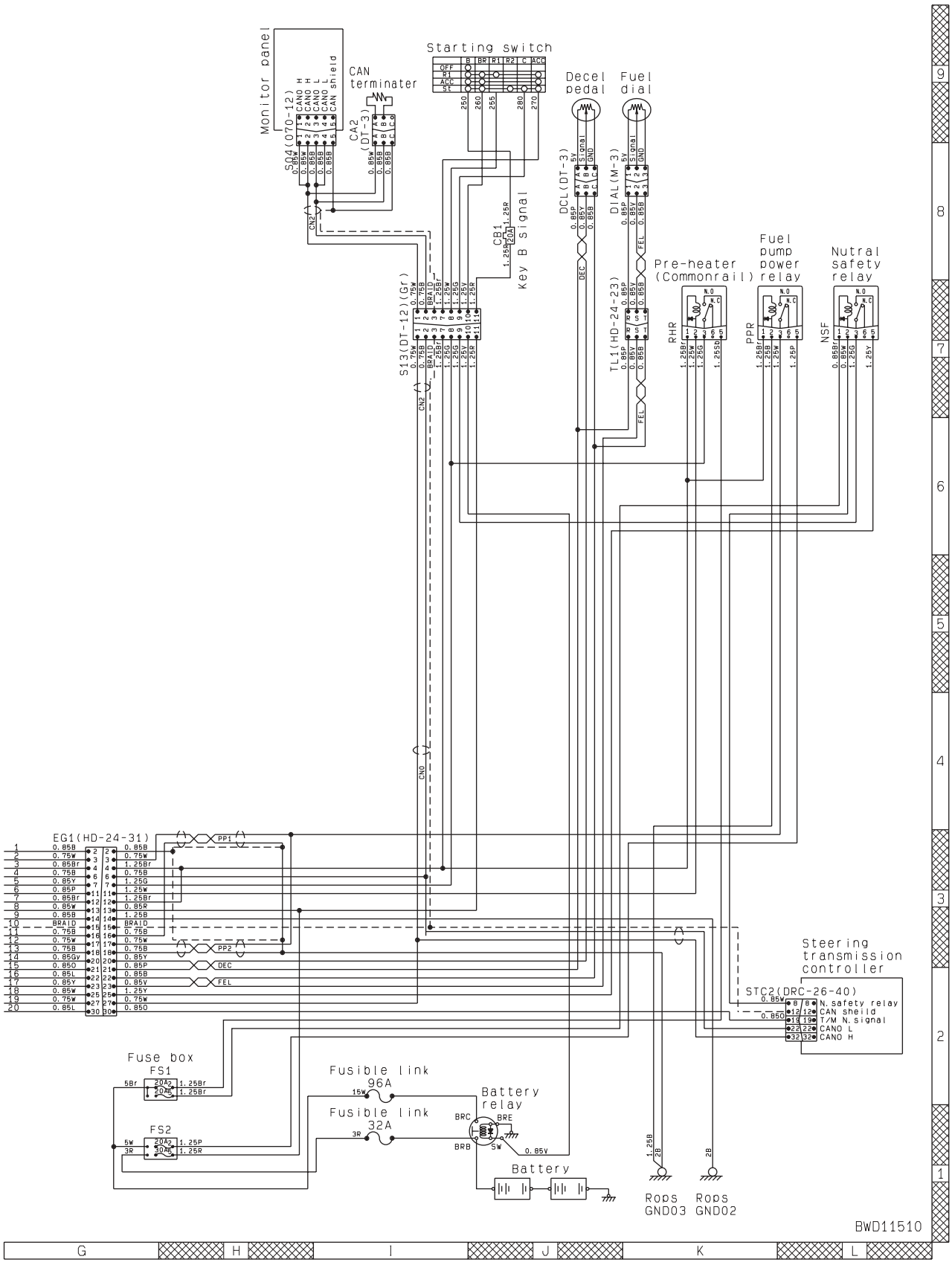
Y
Z
AA
AB
AC
AD


HSA
F1T
FRT
FFT
SRT
TMV
S3T
F3T
S1T
FAC
TM1
HSB
HHP
SDS
TVC
SFT
S2T
F2T
453
BWD11506
9
8
7
6
5
4
3
2
1
AE
AF
AG
AH
AI
AJ

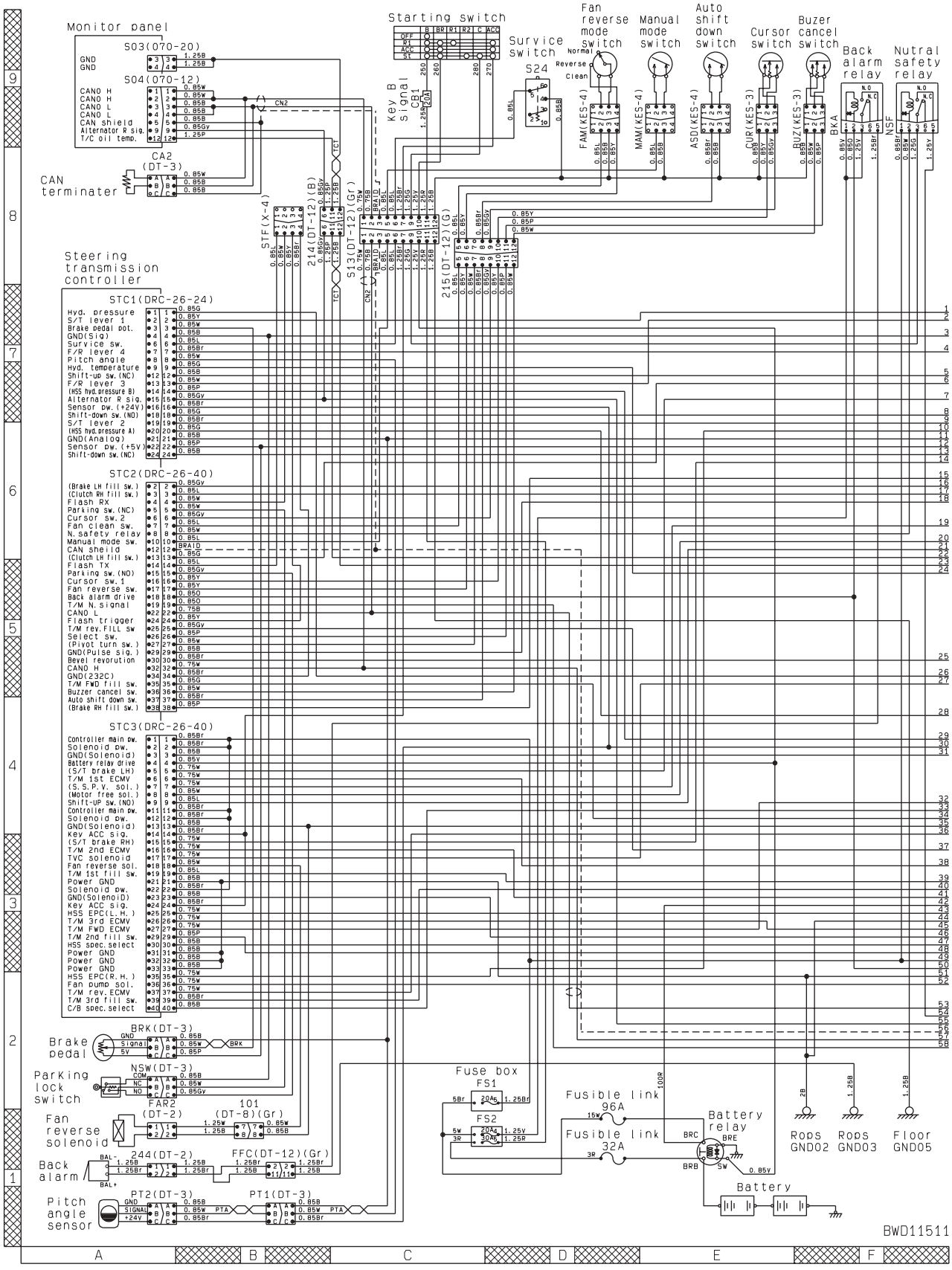
CIRCUIT DRAWING FOR ENGINE CONTROLLER SYSTEM (E CIRCUIT)



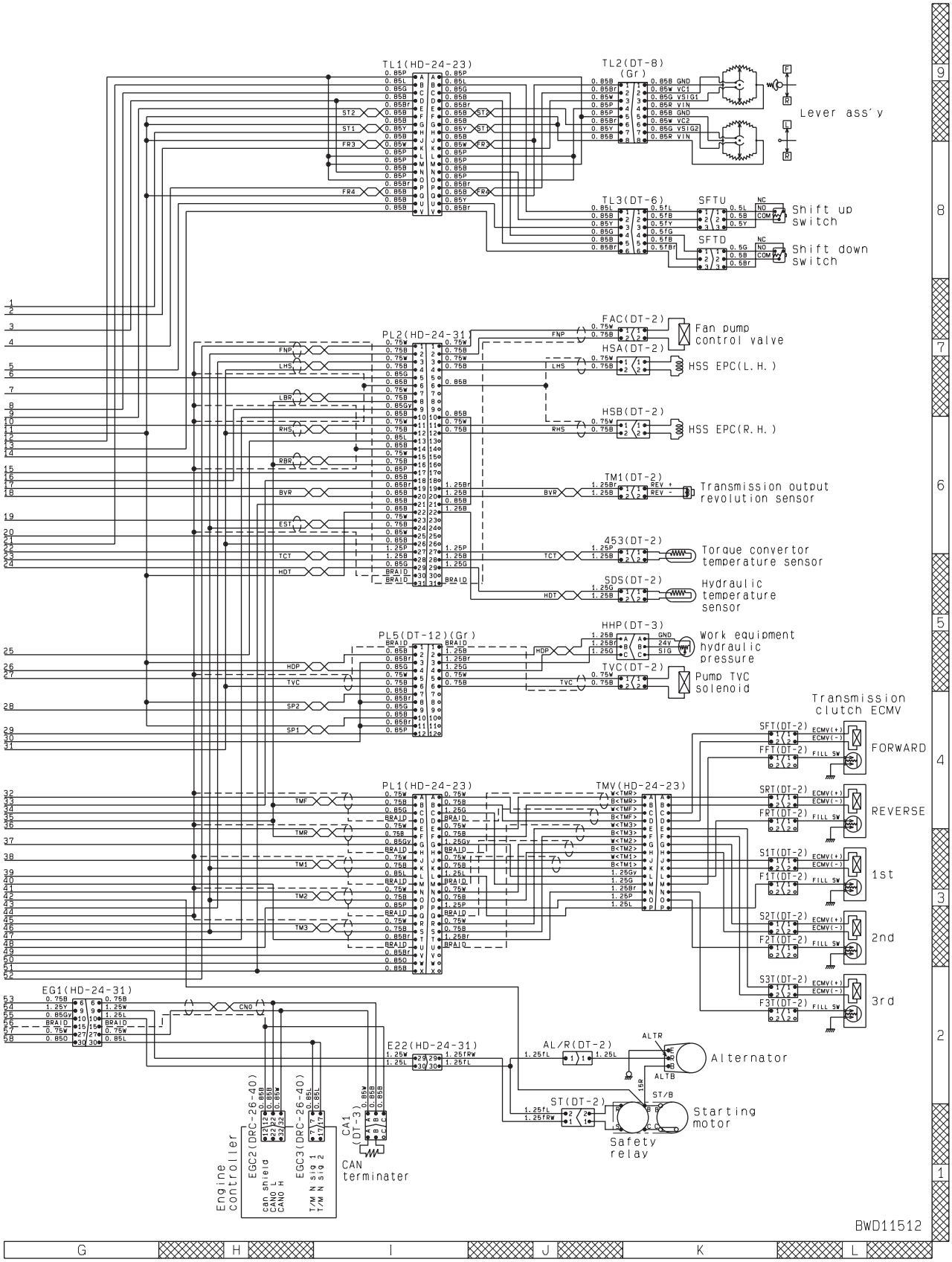
★ This circuit diagram was drawn by extracting the engine controller system from the general electrical circuit diagram.



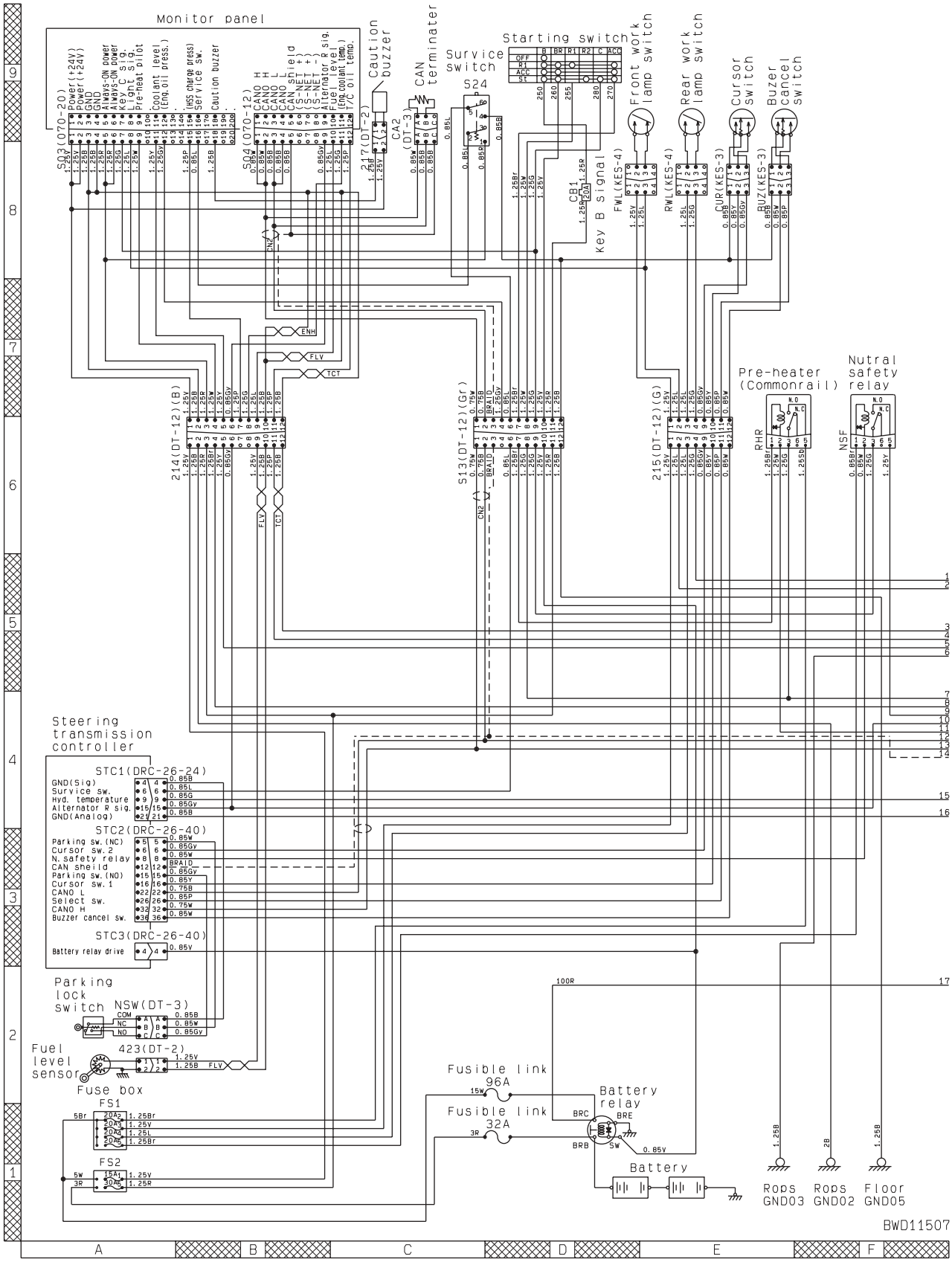
CIRCUIT DRAWING FOR STEERING AND TRANSMISSION CONTROLLER SYSTEM (ST • TM CIRCUIT)



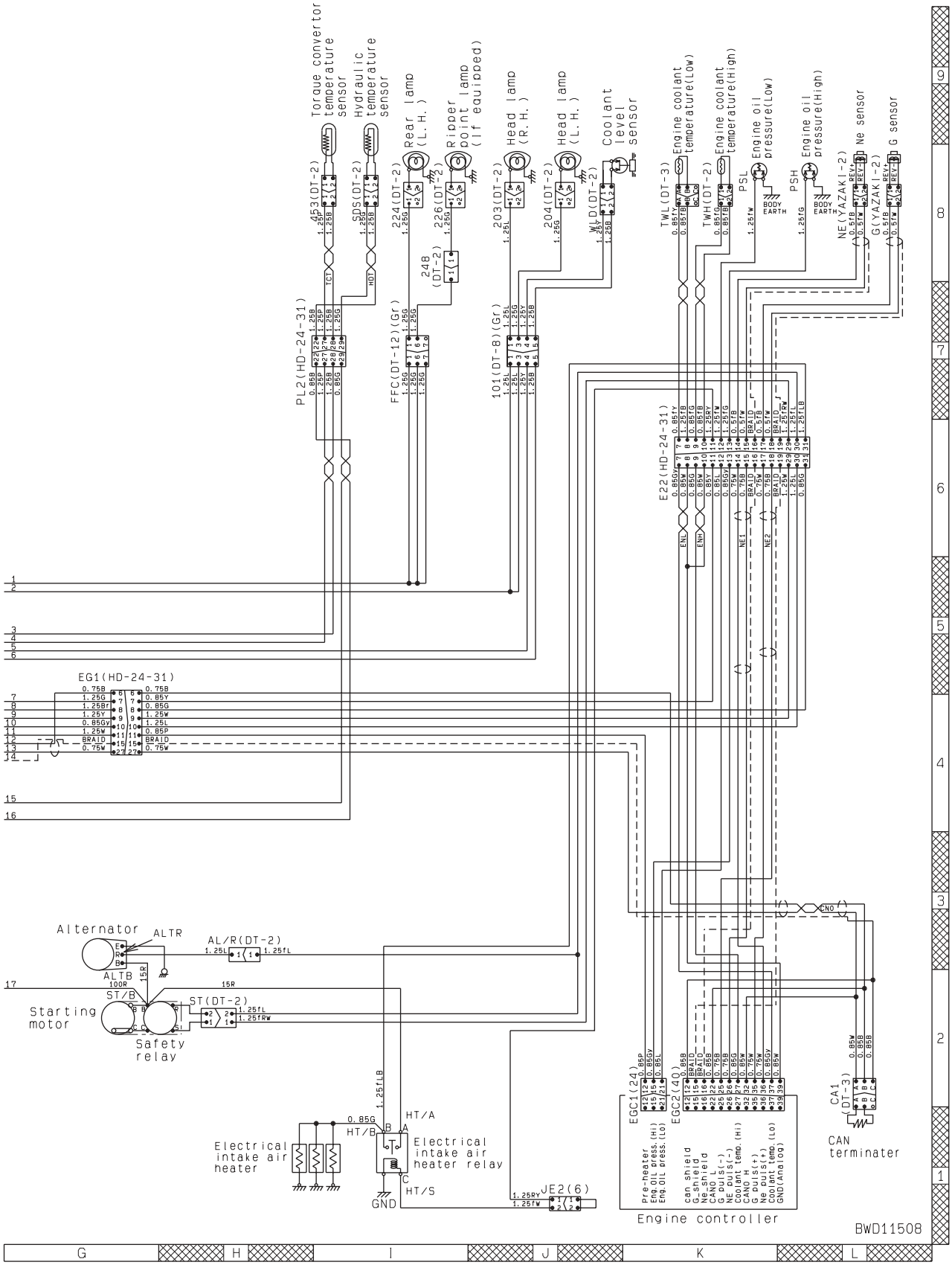
★ This circuit diagram was drawn by extracting the steering and transmission controller system from the general electrical circuit diagram.



CIRCUIT DRAWING FOR MONITOR PANEL SYSTEM (M CIRCUIT)

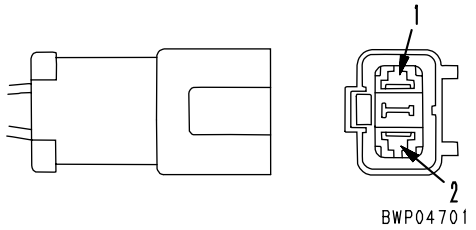
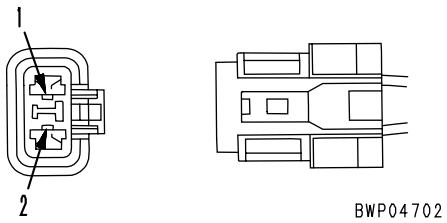
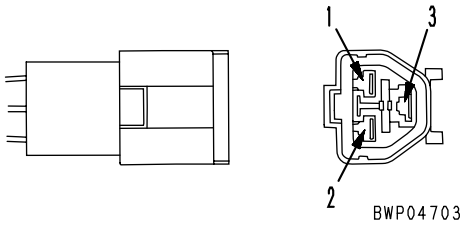
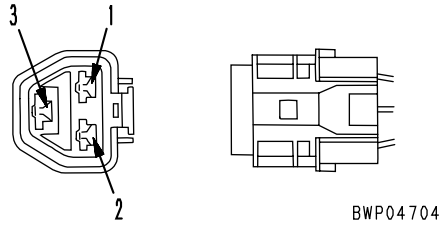


★ This circuit diagram was drawn by extracting the monitor panel system, starting and filling systems, the lighting system and the communication network system from the general electrical circuit diagram.



CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

★ The terms male and female refer to the pins, while the terms male housing and female housing refer to the mating portion of the housing.

<table>
<tr><td rowspan="2">No.of pins</td><td colspan="2">X type connector</td><td rowspan="2">T-adapter Part No.</td></tr>
<tr><td>Male (female housing)</td><td>Female (male housing)</td></tr>
<tr><td>1</td><td>Part No.: 08055-00181</td><td>Part No.: 08055-00191</td><td>799-601-7010</td></tr>
<tr><td rowspan="2">2</td><td> 
</td><td> 
</td><td rowspan="2">799-601-7020</td></tr>
<tr><td>Part No.: 08055-00282</td><td>Part No.: 08055-00292</td></tr>
<tr><td rowspan="2">3</td><td> 
</td><td> 
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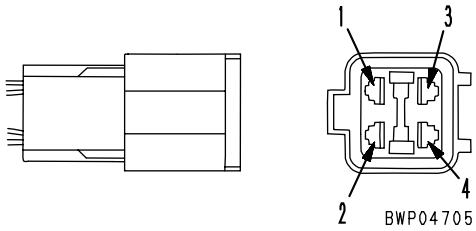
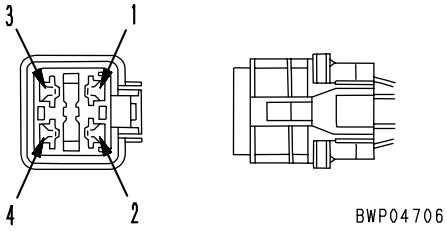
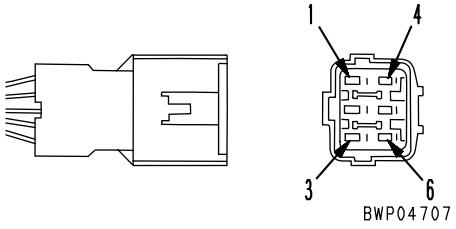
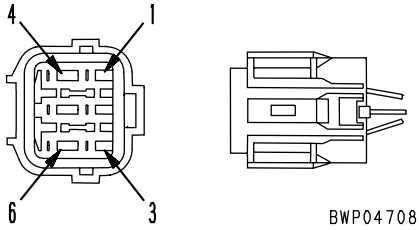
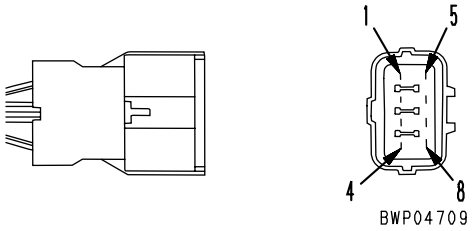
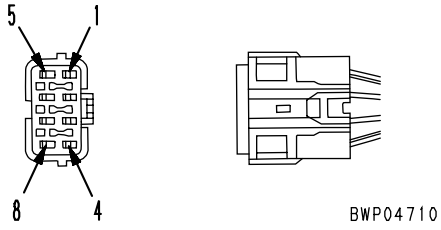
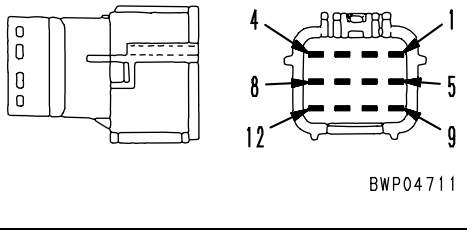
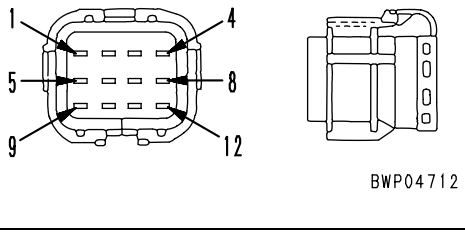
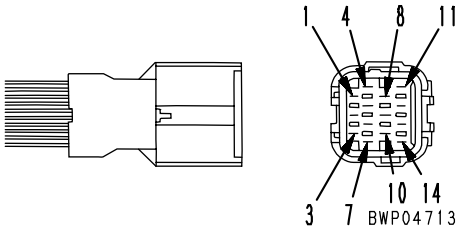
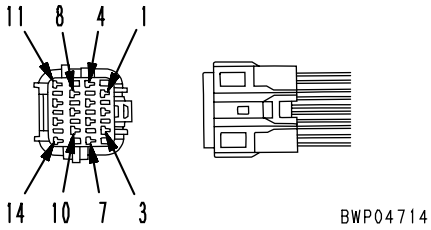
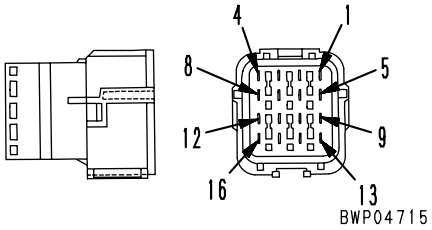
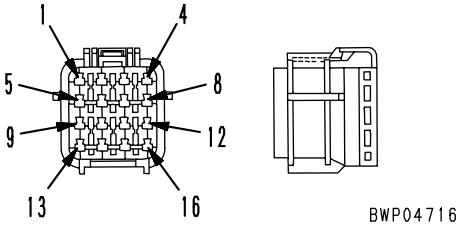
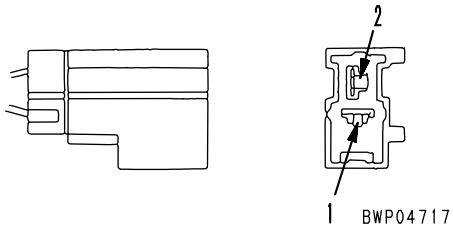
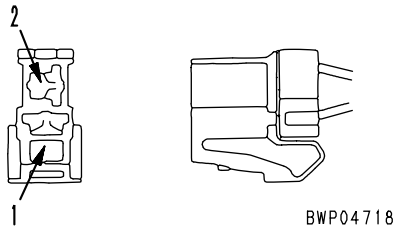
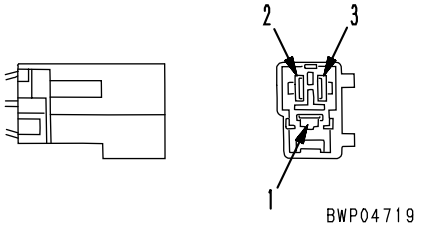
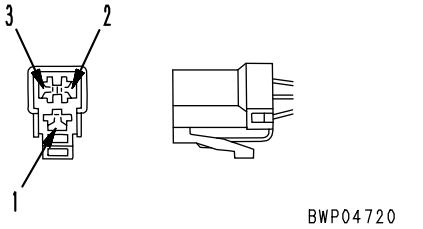
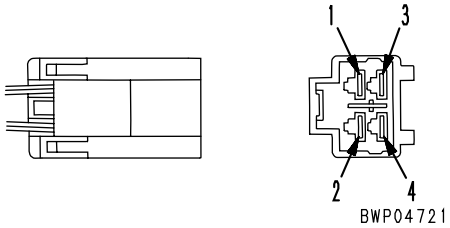
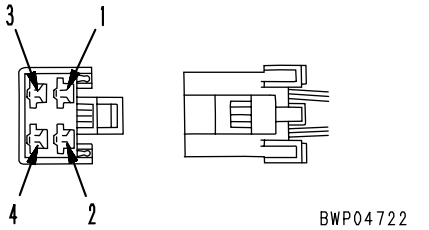
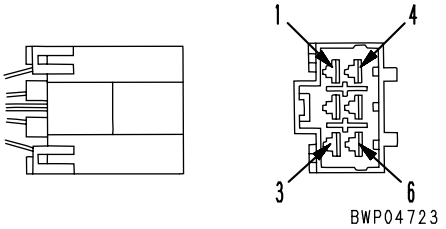
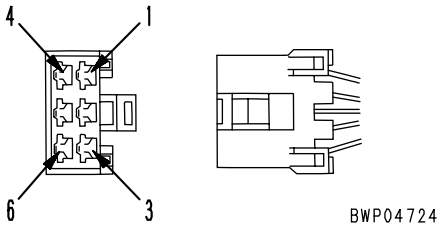
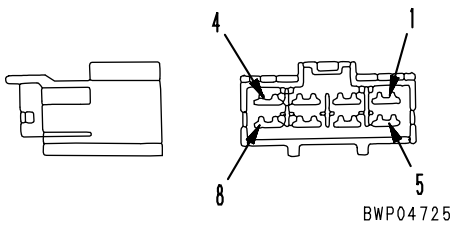
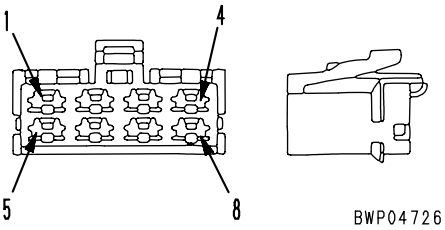
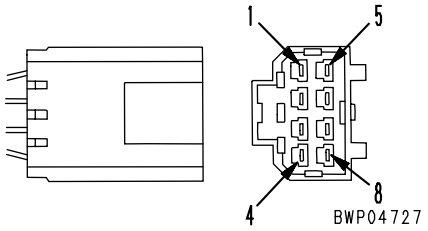
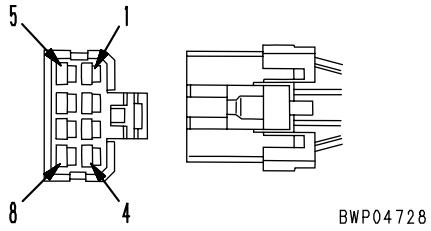
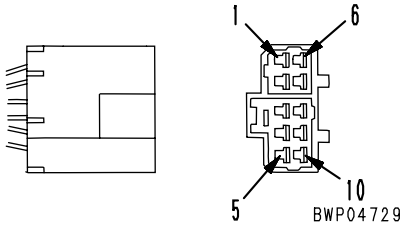
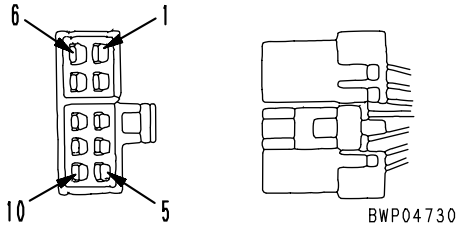
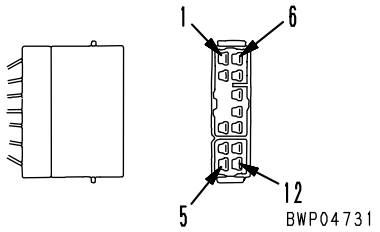
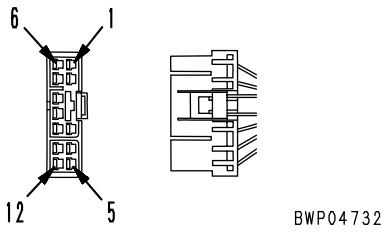
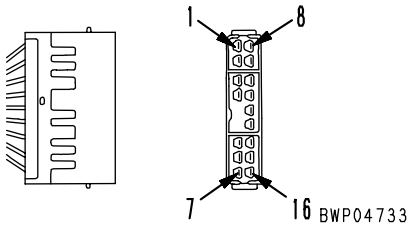
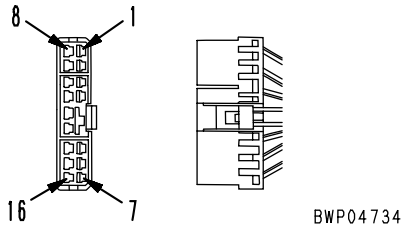
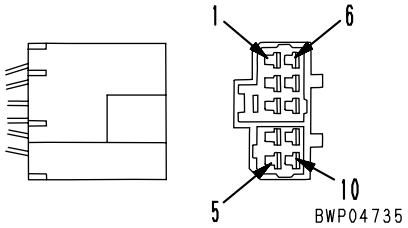
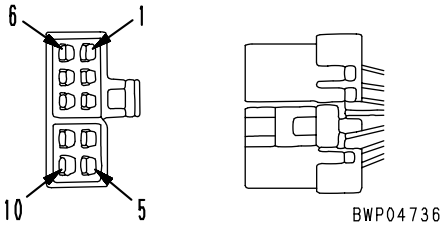
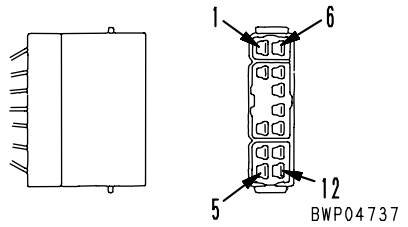
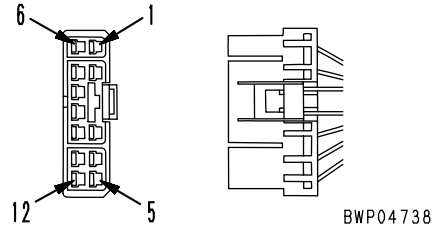
<tr><td>Part No.: 08055-00381</td><td>Part No.: 08055-00391</td></tr>
<tr><td rowspan="2">4</td><td> 
</td><td> 
</td><td rowspan="2">799-601-7040</td></tr>
<tr><td>Part No.: 08055-00481</td><td>Part No.: 08055-00491</td></tr>
<tr><td>—</td><td>Terminal part No.: 79A-222-3370
• Electric wire size: 0.85
• Grommet: Black
• Q’ty: 20</td><td>Terminal part No.: 79A-222-3390
• Electric wire size: 0.85
• Grommet: Black
• Q’ty : 20</td><td>—</td></tr>
<tr><td>—</td><td>Terminal part No.: 79A-222-3380
• Electric wire size: 2.0
• Grommet: Red
• Q’ty: 20</td><td>Terminal part No.: 79A-222-3410
• Electric wire size: 2.0
• Grommet: Red
• Q’ty: 20</td><td>—</td></tr>
</table>

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	

No. of pins	SWP type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
16			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	—

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			799-601-7090
	Part No.: 08056-00271	Part No.: 08056-00281	
3			799-601-7110
	Part No.: 08056-00371	Part No.: 08056-00381	
4			799-601-7120
	Part No.: 08056-00471	Part No.: 08056-00481	
6			799-601-7130
	Part No.: 08056-00671	Part No.: 08056-00681	
8			799-601-7340
	Part No.: 08056-00871	Part No.: 08056-00881	

No.of pins	S type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8			799-601-7140
	Part No.: 08056-10871	Part No.: 08056-10881	
10 (White)			799-601-7150
	Part No.: 08056-11071	Part No.: 08056-11081	
12 (White)			799-601-7350
	Part No.: 08056-11271	Part No.: 08056-11281	
16 (White)			799-601-7330
	Part No.: 08056-11671	Part No.: 08056-11681	

<table>
<tr><td rowspan="3">No.of pins</td><td colspan="2">S type connector</td><td rowspan="2">T-adapter Part No.</td></tr>
<tr><td>Male (female housing)</td><td>Female (male housing)</td></tr>
<tr><td>10 (Blue)</td><td> 
</td><td> 
</td><td>—</td></tr>
<tr><td>—</td><td>—</td></tr>
<tr><td rowspan="2">12 (Blue)</td><td> 
</td><td> 
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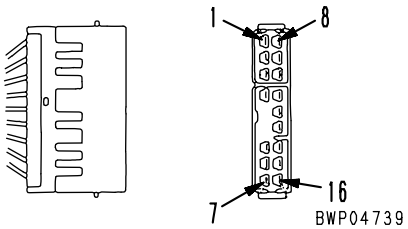
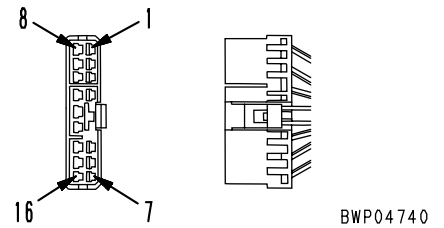
<tr><td rowspan="2">16 (Blue)</td><td> 
</td><td> 
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<tr><td>Part No.: 08056-11672</td><td>Part No.: 08056-11682</td></tr>
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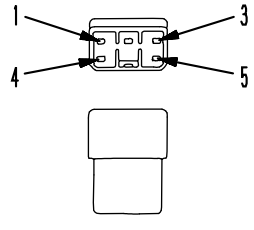
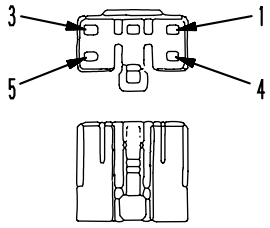
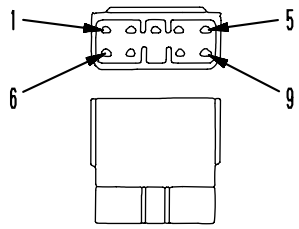
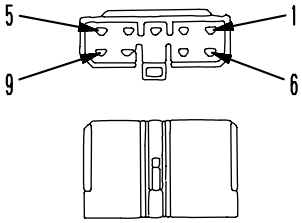
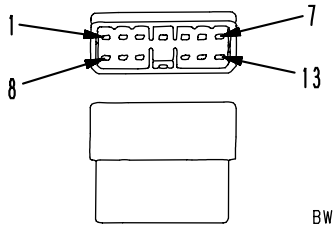
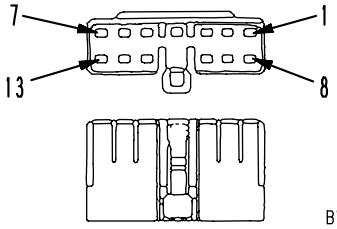
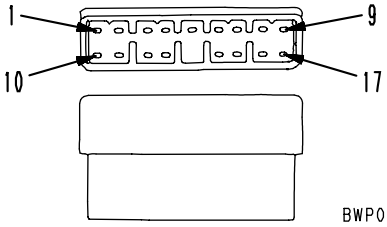
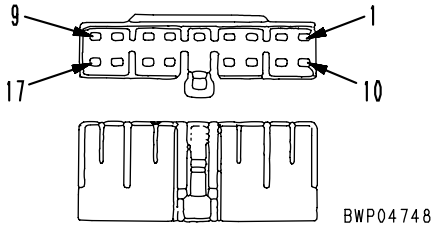
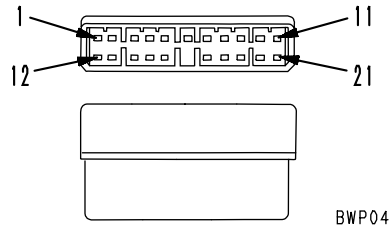
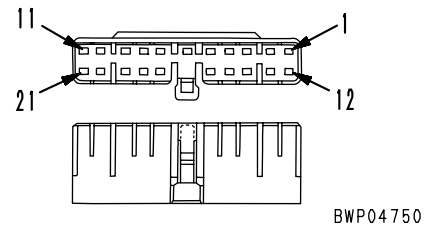
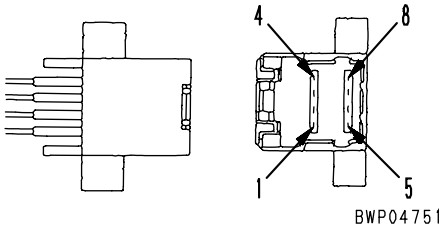
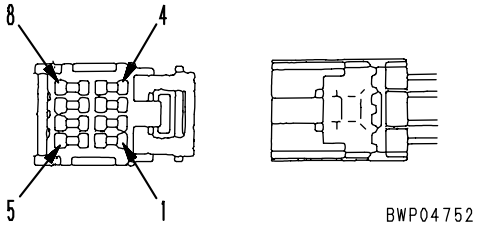
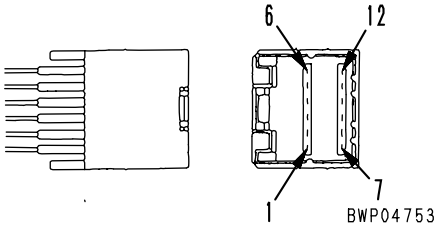
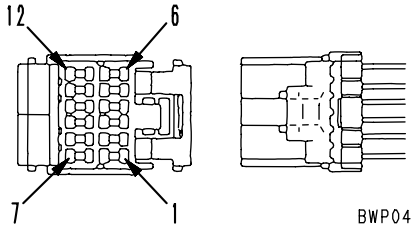
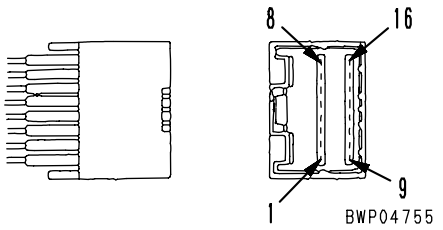
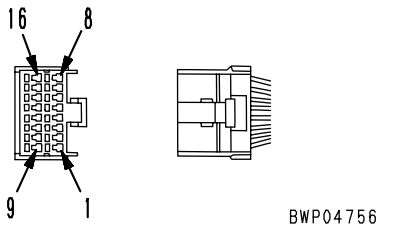
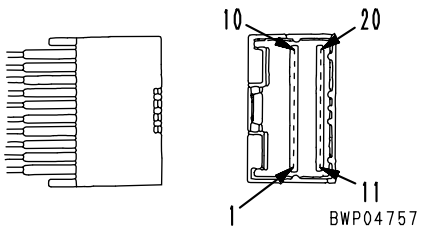
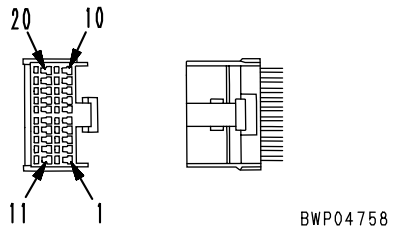
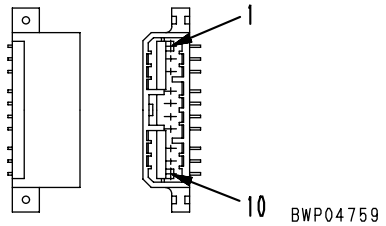
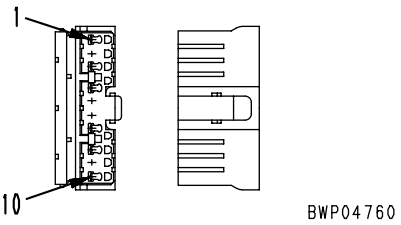
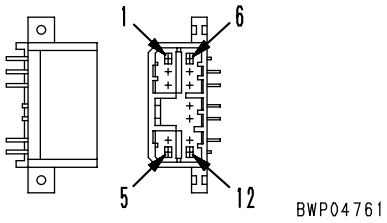
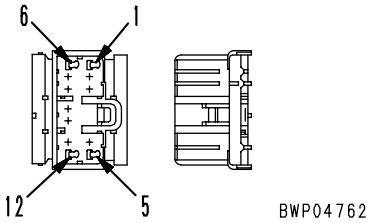
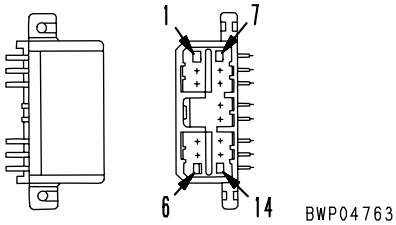
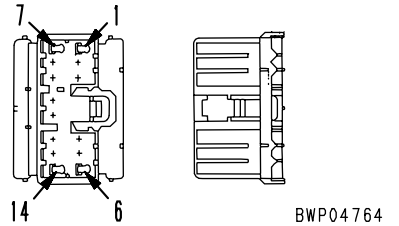
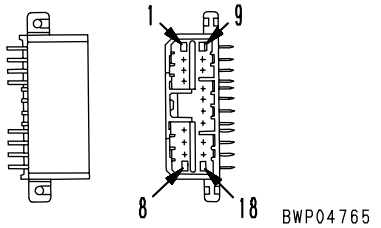
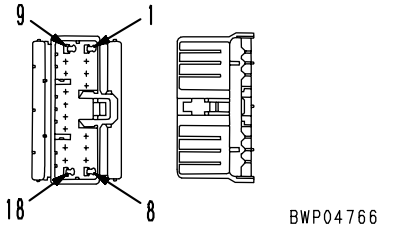
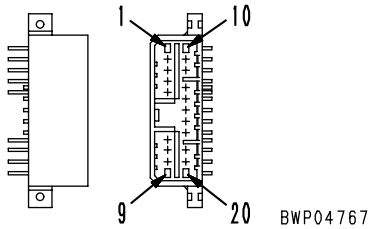
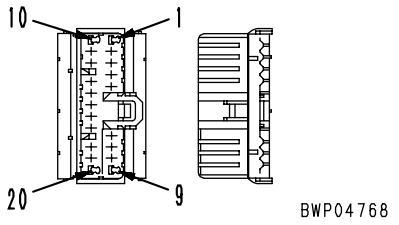
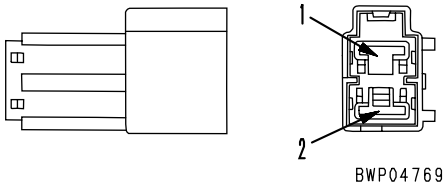
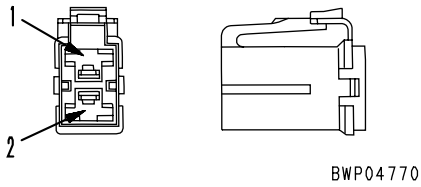
No.of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
7	Body part No.: 79A-222-2640 (Q'ty: 5)	Body part No.: 79A-222-2630 (Q'ty: 5)	—
11	Body part No.: 79A-222-2680 (Q'ty: 5)	Body part No.: 79A-222-2670 (Q'ty: 5)	—
5	 BWP04741	 BWP04742	799-601-2710
	Body part 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)	

No.of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
17			799-601-2730
	Body part No.: 79A-222-2730 (Q'ty: 2)	Body part No.: 79A-222-2720 (Q'ty: 2)	
21			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)	—

No.of pins	AMP040 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8			799-601-7180
	—	Housing part No.: 79A-222-3430 (Q'ty: 5)	
12			799-601-7190
	—	Housing part No.: 79A-222-3440 (Q'ty: 5)	
16			799-601-7210
	—	Housing part No.: 79A-222-3450 (Q'ty: 5)	
20			799-601-7220
	—	Housing part No.: 79A-222-3460 (Q'ty: 5)	

★ Terminal part No.: 79A-222-3470 (No relation with number of pins)

No.of pins	AMP070 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10			799-601-7510
	—	Part No.: 08195-10210	
12			799-601-7520
	—	Part No.: 08195-12210	
14			799-601-7530
	—	Part No.: 08195-14210	
18			799-601-7540
	—	Part No.: 08195-18210	
20			799-601-7550
	—	Part No.: 08195-20210	

No.of pins	L type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2	 BWP04769	 BWP04770	—
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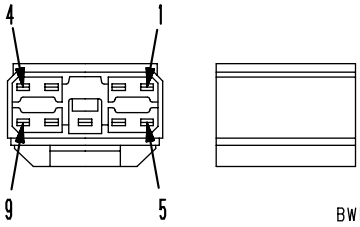
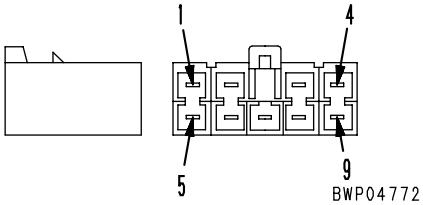
No.of pins	Connector for PA		
	Male (female housing)	Female (male housing)	T-adapter Part No.
9	 BWP04771	 BWP04772	—
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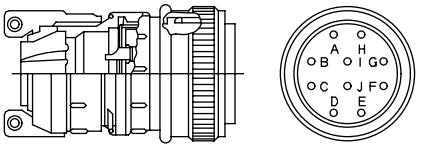
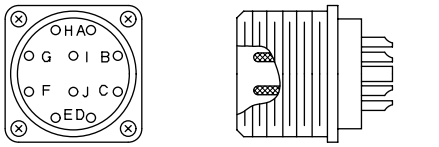
No.of pins	Bendix MS connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10	 BWP04773	 BWP04774	799-601-3460
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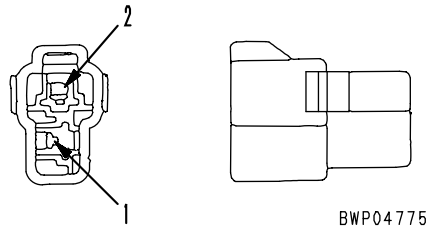
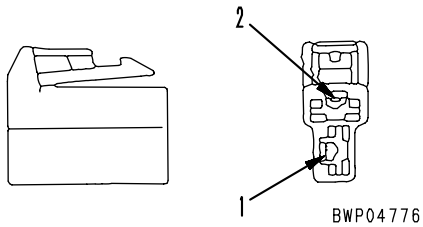
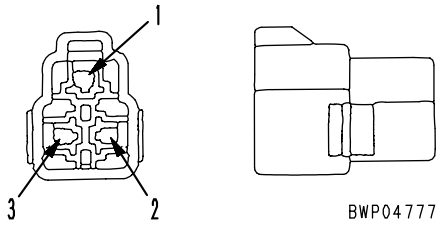
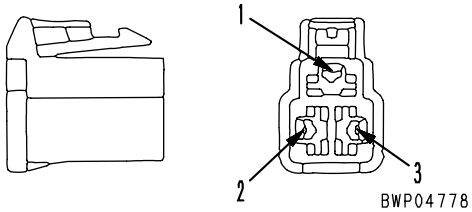
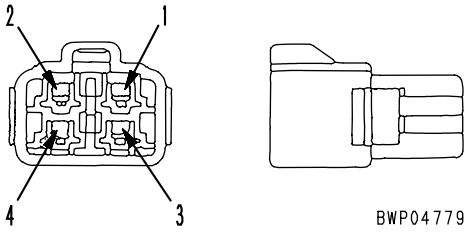
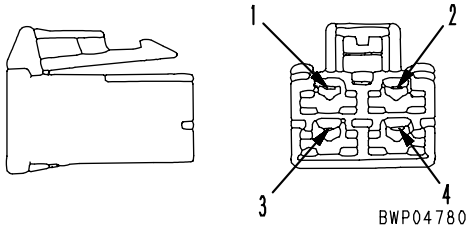
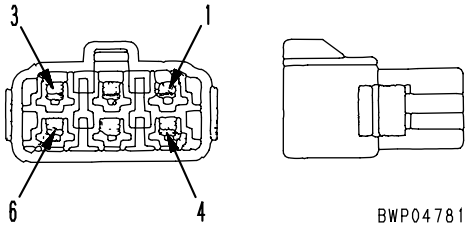
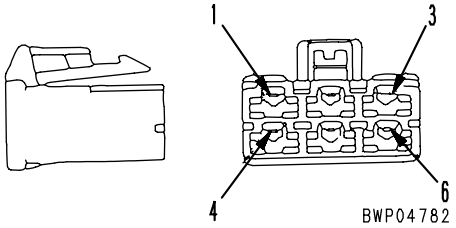
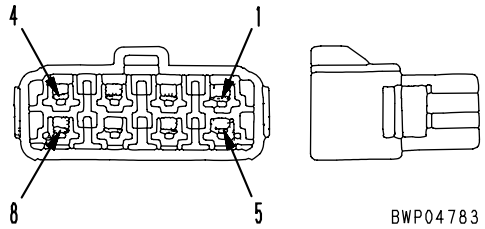
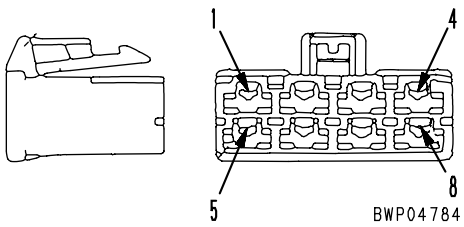
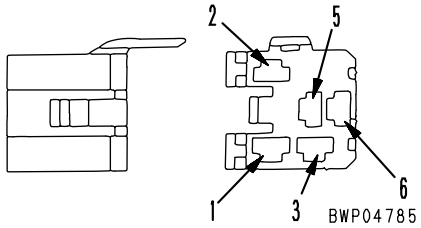
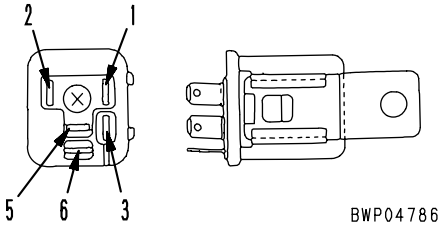
No.of pins	KES 1 (Automobile) connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2			—
	Part No.: 08027-10210 (Natural color) 08027-10220 (Black)	Part No.: 08027-10260 (Natural color) 08027-10270 (Black)	
3			—
	Part No.:08027-10310	Part No.:08027-10360	
4			—
	Part No.: 08027-10410 (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)	

No.of pins	KES 1 (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
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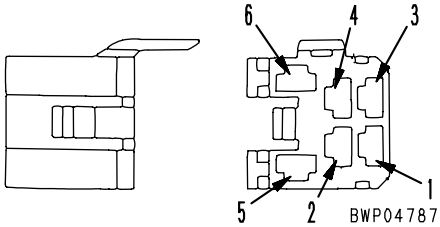
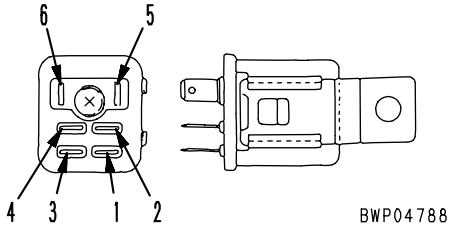
6			799-601-7370
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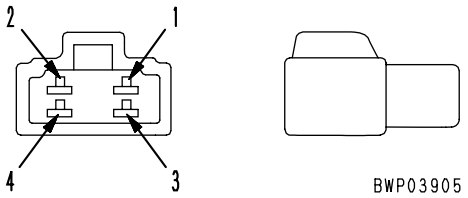
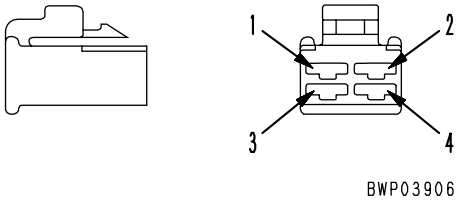
No.of pins	F type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
4	 BWP03905	 BWP03906	—
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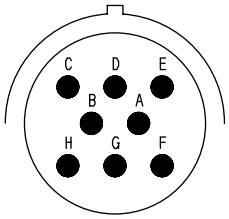
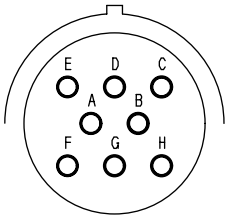
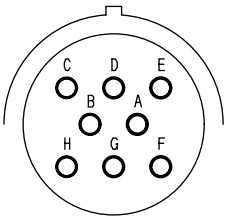
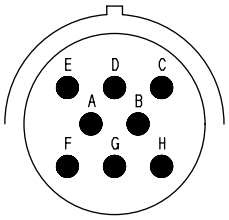
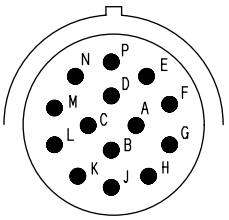
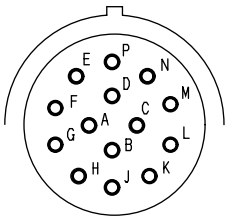
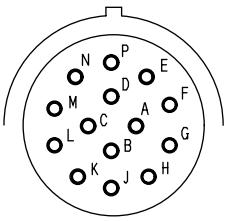
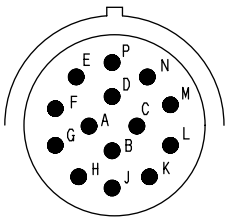
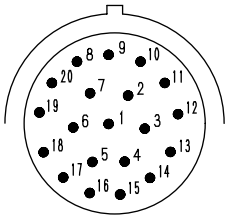
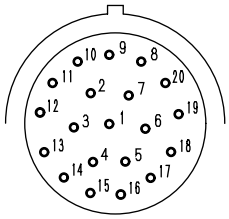
[The pin No. is also marked on the connector (electric wire insertion end)]

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	

[The pin No. is also marked on the connector (electric wire insertion end)]

<table>
<tr><td rowspan="2">Type (shell size code)</td><td colspan="3">HD30 Series connector</td></tr>
<tr><td>Body (plug)</td><td>Body (receptacle)</td><td>T-adapter Part No.</td></tr>
<tr><td rowspan="4">18-20 (3)</td><td>Pin (male terminal)</td><td>Pin (female termial)</td><td rowspan="2">799-601-9230</td></tr>
<tr><td> 
BWP05009</td><td> 
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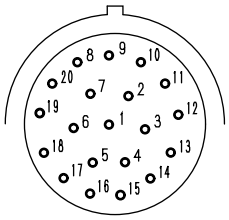
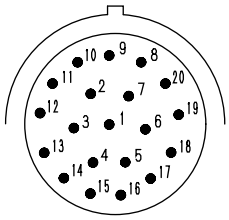
<tr><td>Part No.:08191-31201, 08191-31202</td><td>Part No.:08191-34101, 08191-34102</td><td rowspan="3">799-601-9230</td></tr>
<tr><td>Pin (female terminal)</td><td>Pin (male termial)</td></tr>
<tr><td> 
BWP05011</td><td> 
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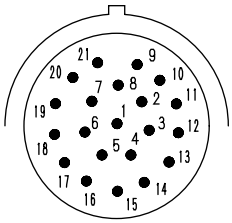
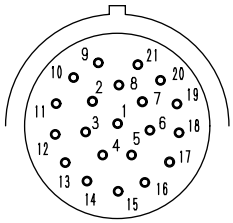
<tr><td>Part No.:08191-32201, 08191-32202</td><td>Part No.:08191-33101, 08191-33102</td></tr>
<tr><td rowspan="4">18-21 (4)</td><td>Pin (male terminal)</td><td>Pin (female termial)</td><td rowspan="2">799-601-9240</td></tr>
<tr><td> 
BWP05013</td><td> 
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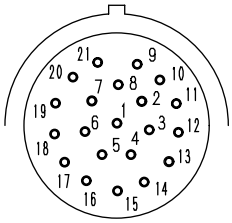
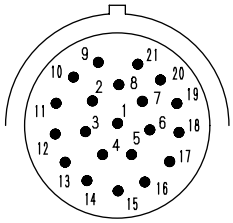
<tr><td>Pin (female terminal)</td><td>Pin (male termial)</td></tr>
<tr><td> 
BWP05015</td><td> 
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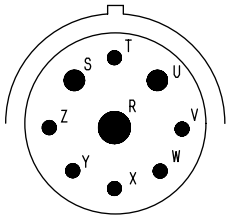
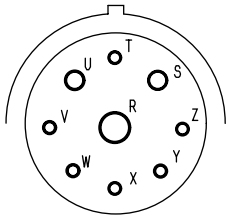
[The pin No. is also marked on the connector (electric wire insertion end)]

<table>
<tr><td rowspan="2">Type (shell size code)</td><td colspan="3">HD30 Series connector</td></tr>
<tr><td>Body (plug)</td><td>Body (receptacle)</td><td>T-adapter Part No.</td></tr>
<tr><td rowspan="4">24-9 (5)</td><td>Pin (male terminal)</td><td>Pin (female termial)</td><td rowspan="2">799-601-9250</td></tr>
<tr><td> 

BWP05017</td><td> 

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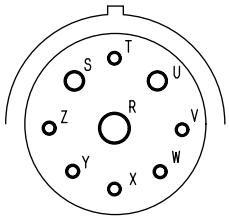
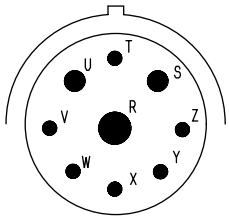
<tr><td>Pin (female terminal)</td><td>Pin (male termial)</td><td rowspan="2">799-601-9250</td></tr>
<tr><td> 

BWP05019</td><td> 

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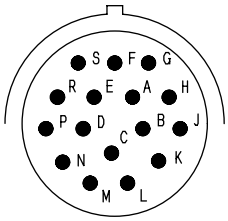
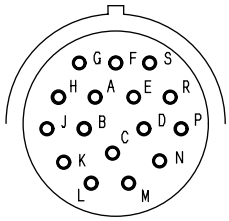
<tr><td> 

BWP05021</td><td> 

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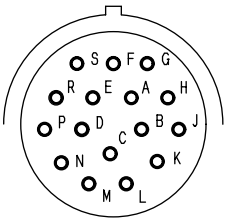
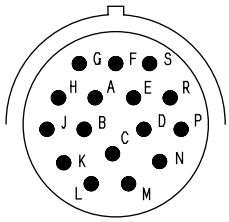
<tr><td> 

BWP05023</td><td> 

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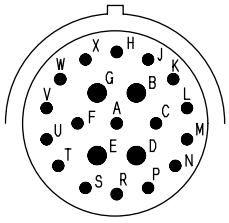
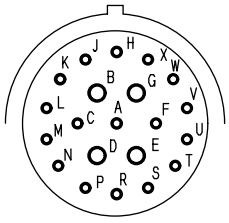
[The pin No. is also marked on the connector (electric wire insertion end)]

<table>
<tr><td rowspan="2">Type (shell size code)</td><td colspan="3">HD30 Series connector</td></tr>
<tr><td>Body (plug)</td><td>Body (receptacle)</td><td>T-adapter Part No.</td></tr>
<tr><td rowspan="6">24-21 (7)</td><td>Pin (male terminal)</td><td>Pin (female termial)</td><td rowspan="2">799-601-9270</td></tr>
<tr><td> 
BWP05025</td><td> 
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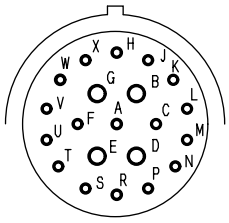
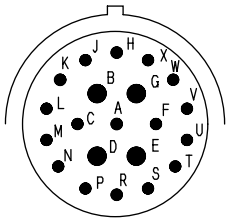
08191-74105, 08191-74106</td></tr>
<tr><td>Pin (female terminal)</td><td>Pin (male termial)</td><td rowspan="2">799-601-9270</td></tr>
<tr><td> 
BWP05027</td><td> 
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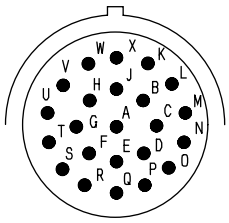
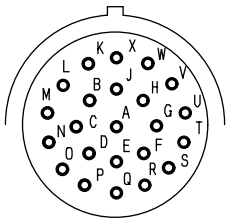
08191-73105, 08191-73106</td></tr>
<tr><td rowspan="6">24-23 (8)</td><td>Pin (male terminal)</td><td>Pin (female termial)</td><td rowspan="2">799-601-9280</td></tr>
<tr><td> 
BWP05029</td><td> 
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<tr><td>Part No.: 08191-81201, 08191-81202
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08191-84105, 08191-84106</td></tr>
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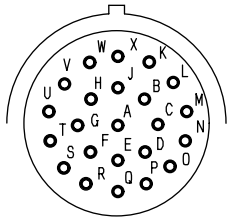
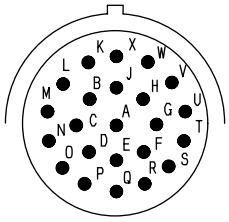
<tr><td> 
BWP05031</td><td> 
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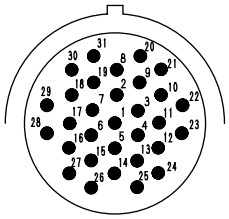
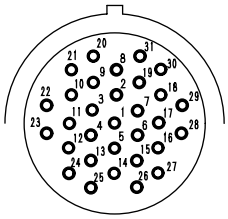
08191-82205, 08191-82206</td><td>Part No.: 08191-83101, 08191-83102
08191-83103, 08191-83104
08191-83105, 08191-83106</td></tr>
</table>

[The pin No. is also marked on the connector (electric wire insertion end)]

<table>
<tr><td rowspan="2">Type (shell size code)</td><td colspan="3">HD30 Series connector</td></tr>
<tr><td>Body (plug)</td><td>Body (receptacle)</td><td>T-adapter Part No.</td></tr>
<tr><td rowspan="4">24-31 (9)</td><td>Pin (male termial)</td><td>Pin (female terminal)</td><td rowspan="2">799-601-9290</td></tr>
<tr><td> 
BWP05033</td><td> 
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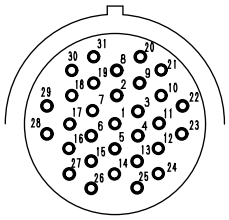
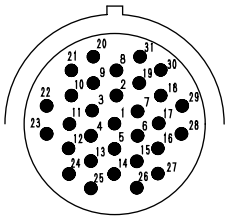
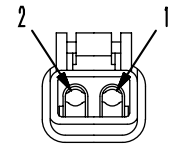
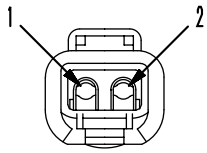
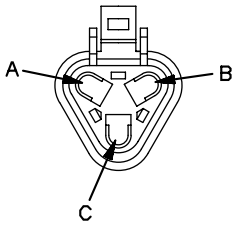
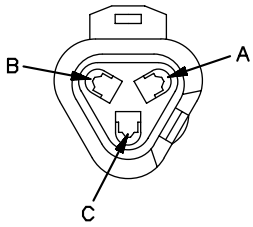
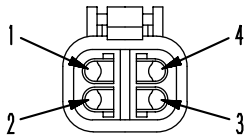
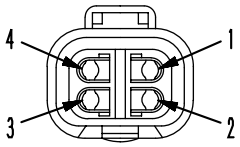
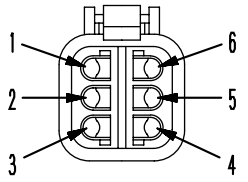
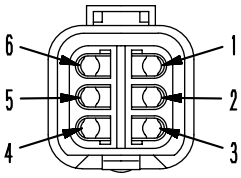
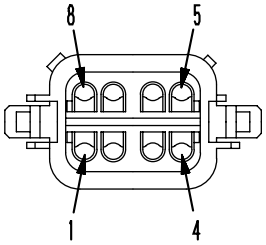
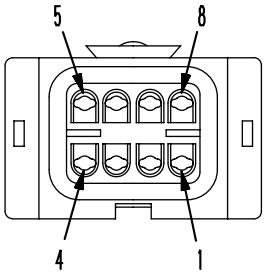
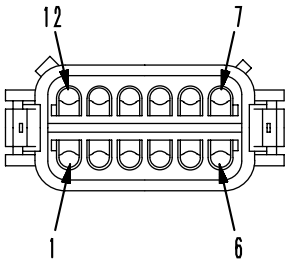
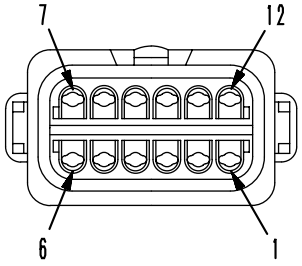
<tr><td>Pin (female terminal)</td><td>Pin (male termial)</td></tr>
<tr><td> 
BWP05035</td><td> 
BWP05036</td><td></td></tr>
<tr><td>Part No.: 08191-92203, 08191-92204, 08191-92205, 08191-92206</td><td>Part No.: 08191-93103, 08191-93104, 08191-93105, 08191-93106</td><td></td></tr>
</table>

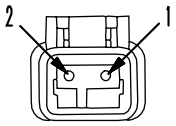
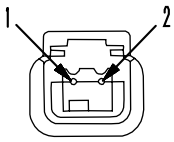
[The pin No. is also marked on the connector (electric wire insertion end)]

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)	

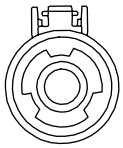
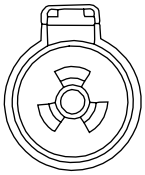
[The pin No. is also marked on the connector (electric wire insertion end)]

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)	

[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	

[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.
1	 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)	

T-BRANCH BOX AND T-BRANCH TABLE

★ The vertical column shows part number of T-Branch Box or T-Branch, and horizontal column shows part number of Harness Checker Ass'y.

Part No.	Connector type or part name	No. of pins	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	Measurement box	Econo-21P	○		○	○						○	○		○					
799-601-3100	Measurement box	MS-37P					○													
799-601-3200	Measurement box	MS-37P					○													
799-601-3300	Measurement box	Econo-24P							○											
799-601-3360	Plate	For MS box																		
799-601-3370	Plate	For MS box																		
799-601-3380	Plate	For MS box																		
799-601-3410	BENDIX (MS)	24P							○	○										
799-601-3420	BENDIX (MS)	24P							○	○										
799-601-3430	BENDIX (MS)	17P							○	○										
799-601-3440	BENDIX (MS)	17P							○	○										
799-601-3450	BENDIX (MS)	5P						○	○											
799-601-3460	BENDIX (MS)	10P							○	○										
799-601-3510	BENDIX (MS)	5P						○	○											
799-601-3520	BENDIX (MS)	14P						○	○											
799-601-3530	BENDIX (MS)	19P							○	○										
799-601-2910	BENDIX (MS)	14P						○	○											
799-601-3470	Case								○											
799-601-2710	MIC	5P	○	○		○							○							
799-601-2720	MIC	13P	○	○		○							○							
799-601-2730	MIC	17P	○	○	○	○						○	○		○					
799-601-2740	MIC	21P	○	○	○	○						○	○		○					
799-601-2950	MIC	9P									○	○	○		○					
799-601-2750	ECONO	2P	○	○																
799-601-2760	ECONO	3P	○	○																
799-601-2770	ECONO	4P	○	○																
799-601-2780	ECONO	8P	○	○																
799-601-2790	ECONO	12P	○	○																
799-601-2810	DLI	8P	○	○																
799-601-2820	DLI	12P	○	○																
799-601-2830	DLI	16P	○	○																
799-601-2840	Additional cable		○	○									○							
799-601-2850	Case		○																	
799-601-7010	X	1P											○		○					
799-601-7020	X	2P									○	○	○		○					
799-601-7030	X	3P									○	○	○		○					
799-601-7040	X	4P									○	○	○		○					
799-601-7050	SWP	6P									○	○	○							
799-601-7060	SWP	8P									○	○	○							
799-601-7310	SWP	12P																		○
799-601-7070	SWP	14P											○		○					
799-601-7320	SWP	16P																		○
799-601-7080	M	1P											○		○					
799-601-7090	M	2P									○	○	○		○					
799-601-7110	M	3P									○	○	○		○					
799-601-7120	M	4P									○	○	○		○					
799-601-7130	M	6P									○	○	○		○					
799-601-7340	M	8P																		

Part No.	Connector type or part name	No. of pins	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	—
799-601-7140	S	8P									○	○	○		○					
799-601-7150	S	10P-White									○	○	○		○					
799-601-7160	S	12P-Blue									○	○	○							
799-601-7170	S	16P-Blue									○	○	○		○					
799-601-7330	S	16P-White													○					
799-601-7350	S	12P-White																		○
799-601-7180	AMP040	8P											○							
799-601-7190	AMP040	12P											○		○					
799-601-7210	AMP040	16P									○	○	○		○					
799-601-7220	AMP040	20P									○	○	○		○					
799-601-7230	Short connector	X-2									○	○	○		○					
799-601-7240	Case										○	○								
799-601-7270	Case												○							
799-601-7510	070	10P												○						
799-601-7520	070	12P												○						
799-601-7530	070	14P												○						
799-601-7540	070	18P												○						
799-601-7550	070	20P												○						
799-601-7360	Relay connector	5P																		○
799-601-7370	Relay connector	6P																		○
799-601-7380	JFC connector	2P																		○
799-601-9010	DTM	2P														○		○		
799-601-9020	DT	2P														○		○		
799-601-9030	DT	3P														○		○		
799-601-9040	DT	4P														○		○		
799-601-9050	DT	6P														○		○		
799-601-9060	DT	8P-Gray														○		○		
799-601-9070	DT	8P-Black														○		○		
799-601-9080	DT	8P-Green														○		○		
799-601-9090	DT	8P-Brown														○		○		
799-601-9110	DT	12P-Gray														○		○		
799-601-9120	DT	12P-Black														○		○		
799-601-9130	DT	12P-Green														○		○		
799-601-9140	DT	12P-Brown														○		○		
799-601-9210	HD30	18-8														○	○			
799-601-9220	HD30	18-14														○	○			
799-601-9230	HD30	18-20														○	○			
799-601-9240	HD30	18-21														○	○			
799-601-9250	HD24	24-9														○	○			
799-601-9260	HD30	24-16														○	○			
799-601-9270	HD30	24-21														○	○			
799-601-9280	HD30	24-23														○	○			
799-601-9290	HD30	24-31														○	○			
799-601-9310	Plate	For HD30														○	○		○	
799-601-9320	Measurement box	For DT, HD														○	○		○	
799-601-9330	Case															○				
799-601-9340	Case																○			
799-601-9350	DEUTSCH	40P																	○	
799-601-9360	DEUTSCH	24P																	○	
799-601-9410	For NE, G sensor	2P																		○
799-601-9420	For fuel, boost press.	3P																		○
799-601-9430	PVC for solenoid	2P																		○

TROUBLESHOOTING WHEN ERROR CODE IS DISPLAYED (ERROR CODE)

INFORMATION DESCRIBED IN TROUBLESHOOTING LIST

★ The troubleshooting list and related circuit diagram summarize the following information. Understand their contents well to advance troubleshooting.

Action code	Error code	Controller code	Trouble	Trouble that appeared on machine
Panel display	Panel display	Steering and transmission		
Contents of trouble	State where the monitor panel or controller detects the trouble			
Action of monitor panel or controller	Action to be taken to protect the system and equipment when the monitor panel or controller detects a trouble			
Problem 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)			
Related information	Information related to a detected trouble or troubleshooting			

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	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 in normal state required to judge the assumed cause (good or not) • Remarks required to judge whether the cause is good <Phenomenon of defective harness> • Disconnection in wiring The connector connection is defective or the wiring harness is disconnected. • Grounding fault A harness not connected to the ground (earth) circuit comes into contact with the ground (earth) circuit. • Defective hot short A harness not connected to the power (24V) circuit comes into contact with the power (24V) circuit. • Defective short A harness of an independent circuit abnormally comes into contact with one of another circuit. <Notes on troubleshooting> (1) Method of indicating connector numbers and handling T-junction For troubleshooting, insert or connect the T-junction adapter as shown below unless especially specified. • When “male” or “female” is not indicated for a connector number, disconnect the connector, and insert the T-junction adapter in both the male and female. • When “male” or “female” is indicated for a connector number, disconnect the connector, and insert the T-junction 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 as shown below unless especially specified. • Connect the plus (+) lead to a pin or harness indicated in the front. • Connect the minus (–) lead to a pin or harness indicated in the rear.
	2		
	3		
	4		
	5		

Related circuit diagram

This is the excerpted circuit diagram related to trouble
- Connector No.: Indicates (Model-No. of pins) (Color).
- Arrow (⇔): Roughly indicates mounting place on machine.

TROUBLE CODE TABLE

★ Regarding trouble code provided with instruction “Refer to table”, check it against table below.

Trouble code	Contents of trouble	Trouble code	Contents of trouble
KA	Disconnection in wiring	L0	Fill signals at two or more channels which are not set as combination are turned ON at the same time.
KB	Short circuit	L1	Fill signal is ON when command current to ECMV is OFF.
KK	Source voltage reduction/ input	L2	Fuel pressure is above maxim specified value.
KQ	Type select signal inconsis-tency	L3	Object part is uncontrollable.
KR	Defective communication	L4	ON and OFF signals at two systems are inconsistent.
KT	Abnormality in controller	L6	Engine rotation signal, terminal C signal, oil pressure switch sig-nal, water temperature sensor signal, etc. are inconsistent with operation state or stop state.
KX	Outside input signal range	L8	Analog signals in two systems are inconsistent.
KZ	Disconnection or short cir-cuit	LC	rpm signals in two systems are inconsistent.
MA	Malfunction	LD	Switch is pressed for usually unthinkable long time.
MB	Performance reduction	LH	Fill signal is OFF when command current to ECMV is ON.
MW	Sliding		
NS	Overheat		
ZG	Oil pressure reduction		
ZK	Coolant level reduction		

ERROR CODE 1500LO (TRANSMISSION CLUTCH: SEE THE LIST. (L1))

Action code	Error code	Controller code	Trouble	Transmission clutch: See the list. (LO) (Steering and transmission controller system)
CALL E03	1500L0	Steering and transmission		
Contents of trouble	• Of the error codes related to the transmission clutch, the following codes were displayed at the same time. (Connection error) (1)Either [DXH4KA] or [DXH4KB] and either [DXH5KA] or [DXH5KB] • Of the error codes related to the transmission clutch, the following codes were displayed at the same time. (Disconnection error) (2)Either [DXH8KA] or [DXH8KB] and either [DXH7KA] or [DXH7KB] (3)[DXH6KA] and [DXH6KB] (4)[15SFL1] and [15SGL1] (5)[15SFLH] and [15SGLH] (6)[15SAL1], [15SBL1], and [15SEL1] (7)[15SALH] and [15SBLH] (8)[15SALH] and [15SELH] (9)[15SBLH] and [15SELH]			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem that appears on machine	• The auto shift down function does not start. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to specific gear speeds.			
Related information	• Method of reproducing error code: Engine start + Run			

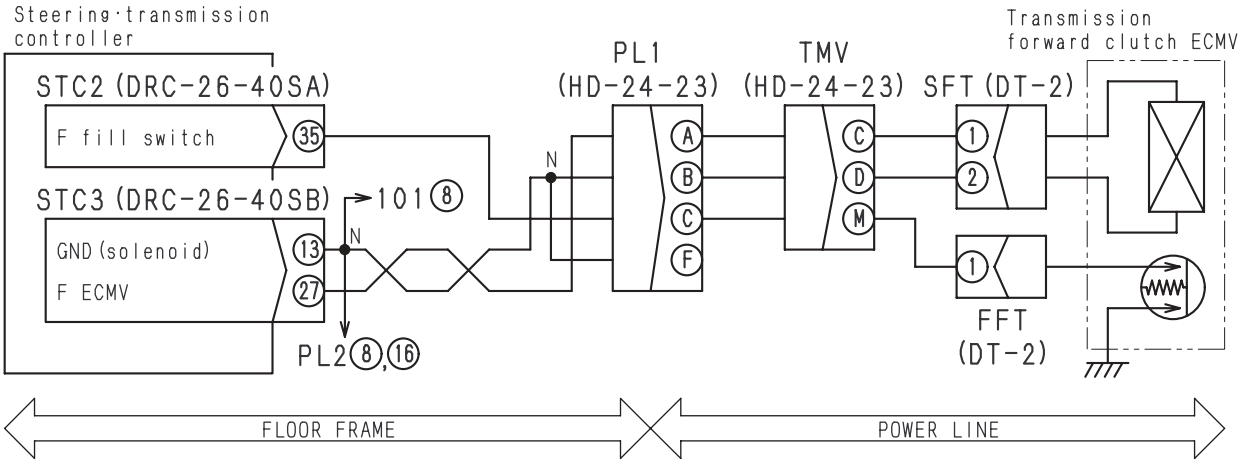
	Cause	Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	Confirm the error codes displayed at the same time, then carry out troubleshooting for the codes. [15SAL1], [15SALH], [15SBL1], [15SBLH], [15SEL1], [15SELH], [15SFL1], [15SFLH], [15SGL1], [15SGLH] [DXH4KA], [DXH4KB], [DXH5KA], [DXH5KB], [DXH6KA], [DXH6KB], [DXH7KA], [DXH7KB], [DXH8KA], [DXH8KB]	

ERROR CODE 15SAL1 (FORWARD CLUTCH: SEE THE LIST. (L1))

Action code	Error code	Controller code	Trouble	Forward clutch: See the list. (L1) (Steering and transmission controller system)
CALL E03	15SAL1	Steering and transmission		
Contents of trouble	• The fill switch signal is not set off at output stop of the transmission forward clutch solenoid circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Decides that engine speed is neutral (N) at reverse operation. • Limits operation of engine and transmission.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F1.			
Related 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) • Method of reproducing error code: Engine start + Neutral running			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective forward clutch fill switch (Internal short)	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			FFT (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	N	Min. 1MΩ	
				F (Forward)	Max. 1Ω	
	2	Defective harness grounding (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC2 (female) (35) – FFT (female) (1) with chassis ground		Resistance	Max. 1MΩ
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			STC2	PCCS lever	Voltage	
			Between (35) – chassis ground	N	20 – 30V	
				F (Forward)	Max. 1V	
	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



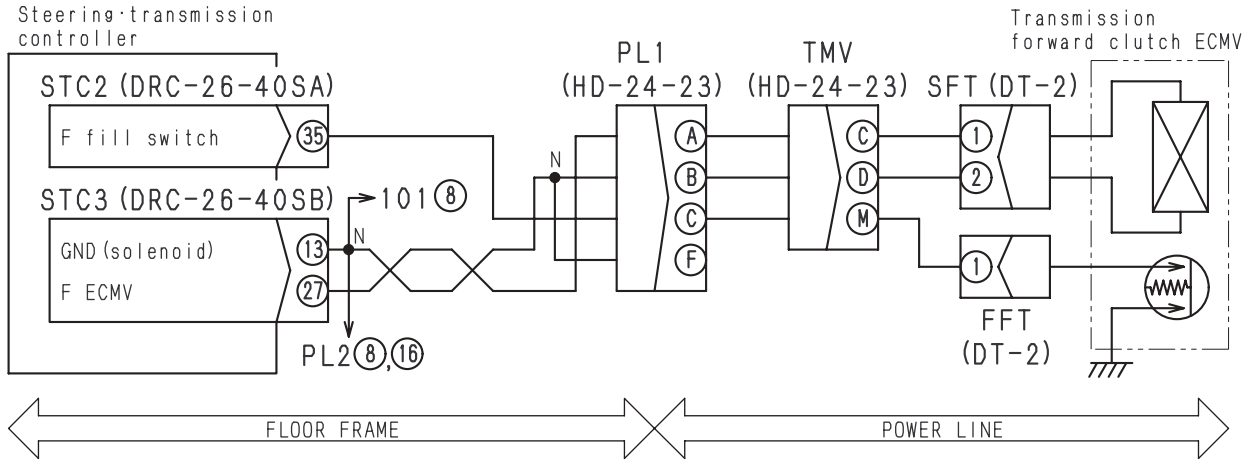
BJD11601

ERROR CODE 15SALH (FORWARD CLUTCH: SEE THE LIST. (LH))

Action code	Error code	Controller code	Trouble	Forward clutch: See the list. (LH) (Steering and transmission controller system)
CALL E03	15SALH	Steering and transmission		
Contents of trouble	• The fill switch signal is not set off at output to the transmission forward clutch solenoid circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Decides that engine speed is neutral (N) at forward operation. • Limits operation of engine and transmission.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to R1.			
Related 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) • Method of reproducing error code: Engine start + Forward running			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective forward clutch fill switch (Internal short)	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			FFT (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	N	Min. 1MΩ	
				F (Forward)	Max. 1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC2 (female) (35) – FFT (female) (1)		Resistance	Max. 1Ω
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			STC2	PCCS lever	Voltage	
			Between (35) – chassis ground	N	20 – 30V	
				F (Forward)	Max. 1V	
	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 ECM



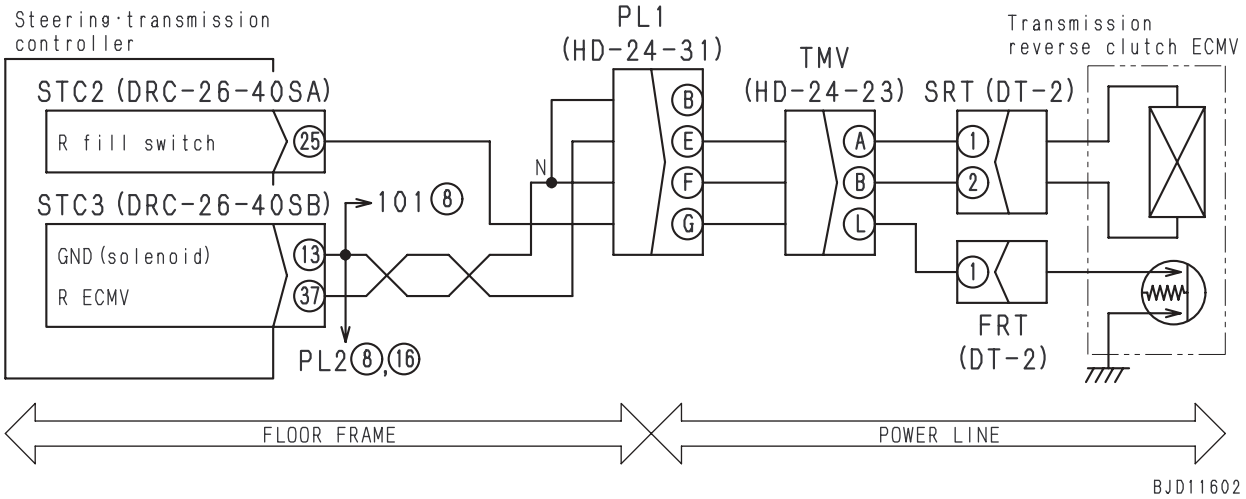
BJD11601

ERROR CODE 15SBL1 (REVERSE CLUTCH: SEE THE LIST. (L1))

Action code	Error code	Controller code	Trouble	Reverse clutch: See the list. (L1) (Steering and transmission controller system)
CALL E03	15SBL1	Steering and transmission		
Contents of trouble	• The fill switch signal is not set off at output stop of the transmission reverse clutch solenoid circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Decides that engine speed is neutral (N) at forward operation. • Limits operation of engine and transmission.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to R1.			
Related 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) • Method of reproducing error code: Engine start + Forward running			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective reverse clutch fill switch (Internal short)	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			FRT (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	N	Min. 1MΩ	
				R (Reverse)	Max. 1Ω	
	2	Defective harness grounding (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC2 (female) (25) – FFT (female) (1) with chassis ground		Resistance	Max. 1MΩ
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			STC2	PCCS lever	Voltage	
			Between (24) and (25) – chassis ground	N	20 – 30V	
				R (Reverse)	Max. 1V	
	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 ECM

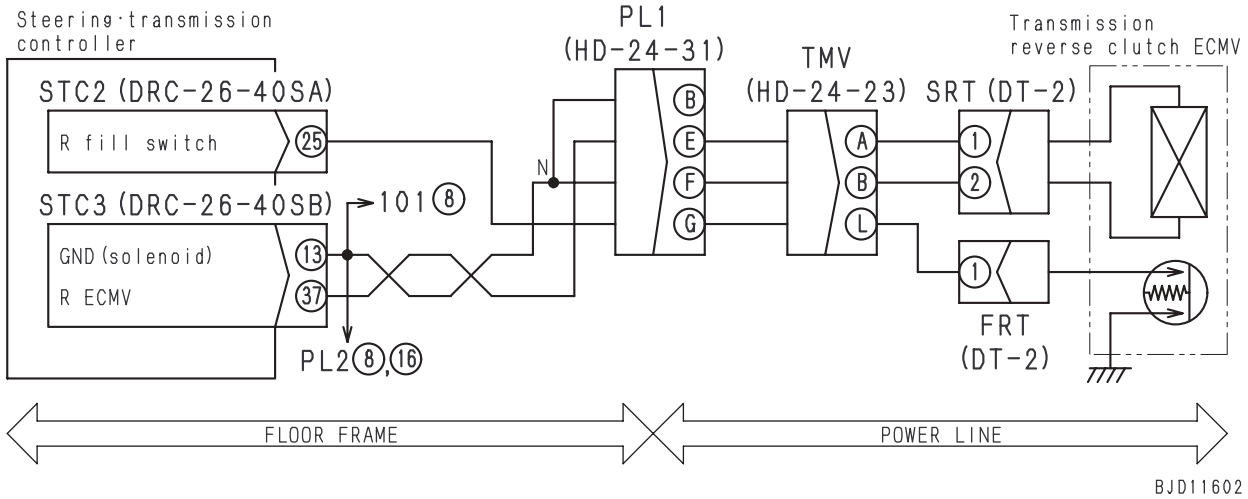


ERROR CODE 15SBLH (REVERSE CLUTCH: SEE THE LIST. (LH))

Action code	Error code	Controller code	Trouble	Reverse clutch: See the list. (LH) (Steering and transmission controller system)
CALL E03	15SBLH	Steering and transmission		
Contents of trouble	• The fill switch signal is not set on at output to the transmission reverse clutch solenoid circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Decides that engine speed is neutral (N) at reverse operation. • Limits operation of engine and transmission.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F1.			
Related 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) • Method of reproducing error code: Engine start + Forward running			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective reverse clutch fill switch (Internal short)	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			FRT (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	N	Min. 1MΩ	
				R (Reverse)	Max. 1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC2 (female) (25) – FRT (female) (1)		Resistance	Max. 1MΩ
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			STC2	PCCS lever	Voltage	
			Between (25) – chassis ground	N	20 – 30V	
				R (Reverse)	Max. 1V	
	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 ECM

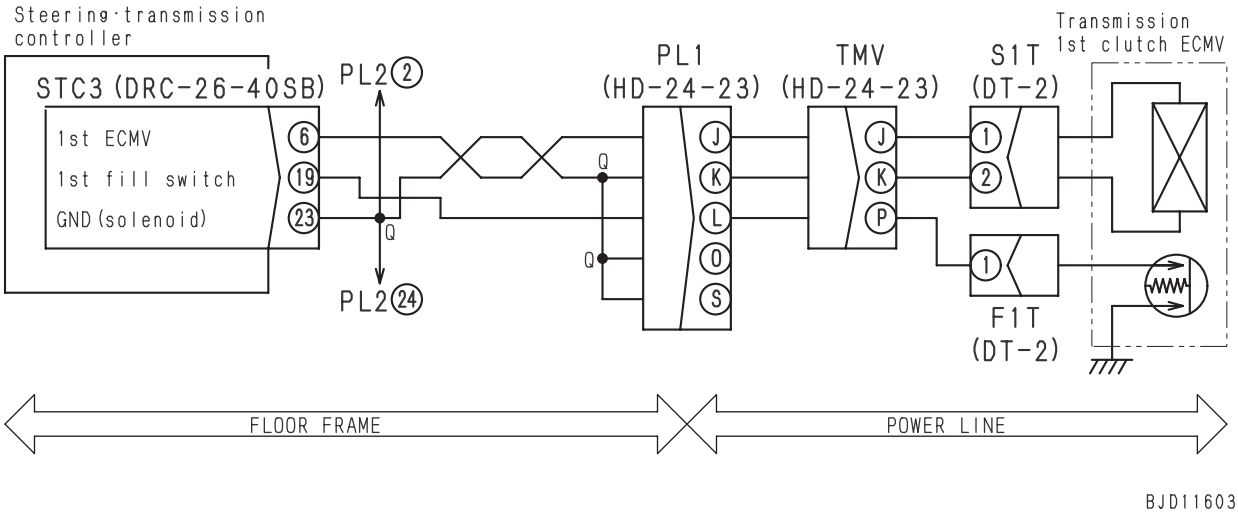


ERROR CODE 15SEL1 (1ST CLUTCH: SEE THE LIST. (L1))

Action code	Error code	Controller code	Trouble	1st clutch: See the list. (L1) (Steering and transmission controller system)
CALL E03	15SEL1	Steering and transmission		
Contents of trouble	• The fill switch signal is not set off at output stop of the transmission level 1 clutch solenoid circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F1 and R1.			
Related information	• The input state (ON/OFF) from the level 1 clutch fill switch can be checked in monitoring mode. (Code 31520: Transmission fill switch input state) • Method of reproducing error code: Engine start + Forward running			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective 1st clutch fill switch (Internal short)	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			F1T (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	Other than F1/R1	Min. 1MΩ	
				F1·R1	Max. 1Ω	
	2	Defective harness grounding (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC3 (female) (19) – F1T (female) (1) with chassis ground		Resistance	Max. 1MΩ
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			STC3	PCCS lever	Voltage	
			Between (19) – chassis ground	Other than F1/R1	20 – 30V	
				F1·R1	Max. 1V	
	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 level 1 clutch ECMV

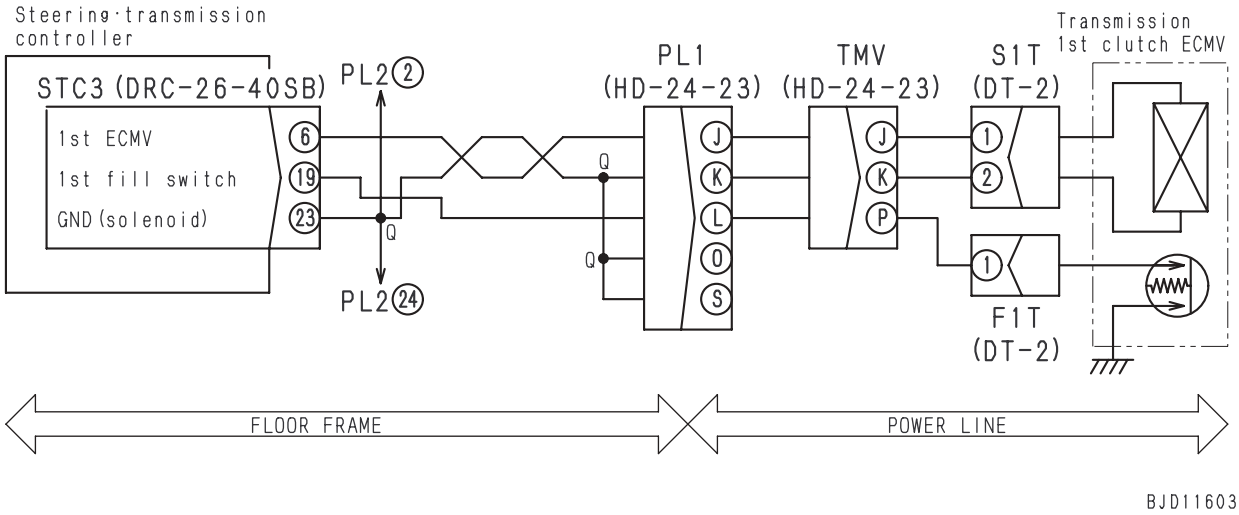


ERROR CODE 15SELH (1ST CLUTCH: SEE THE LIST. (LH))

Action code	Error code	Controller code	Trouble	Level 1 clutch: See the list. (LH) (Steering and transmission controller system)
CALL E03	15SELH	Steering and transmission		
Contents of trouble	• The fill switch signal is not set off at output to the transmission 1st clutch solenoid circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem that appears on machine	• The auto shift down function does not start. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F2 and R2.			
Related 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) • Method of reproducing error code: Engine start + F1 or R1 running			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective 1st clutch fill switch (Internal short)	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			F1T (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	Other than F1/R1	Min. 1MΩ	
				F1·R1	Max. 1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC3 (female) (19) – F1T (female) (1)		Resistance	Max. 1MΩ
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			STC3	PCCS lever	Voltage	
			Between (19) – chassis ground	Other than F1/R1	20 – 30V	
				F1·R1	Max. 1V	
	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 ECM



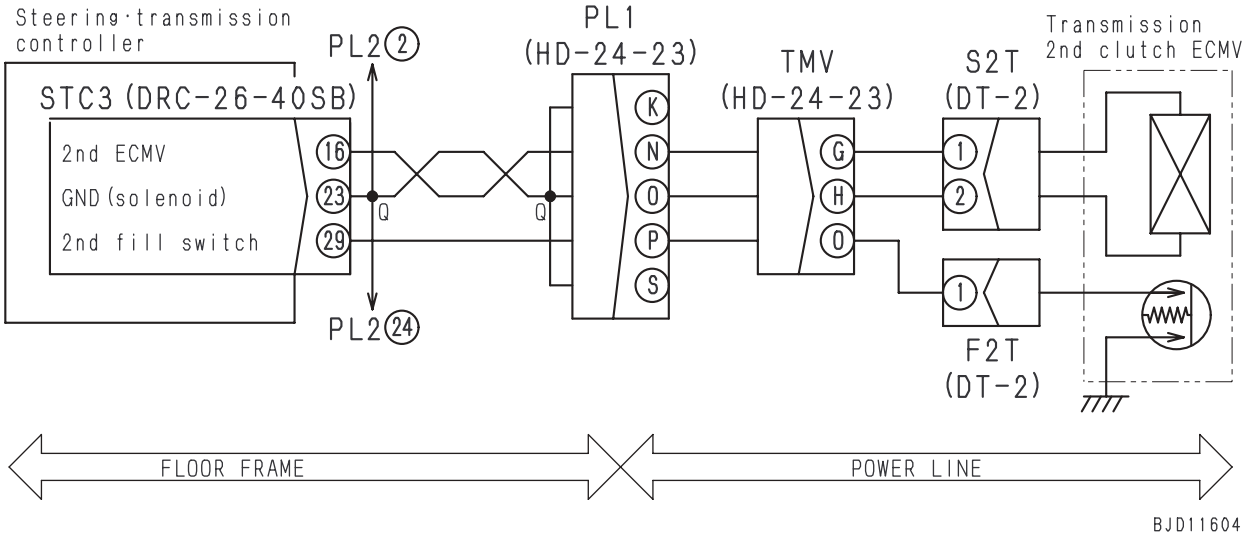
BJD11603

ERROR CODE 15SFL1 (2ND CLUTCH: SEE THE LIST. (L1))

Action code	Error code	Controller code	Trouble	2nd clutch: See the list. (L1) (Steering and transmission controller system)
CALL E03	15SFL1	Steering and transmission		
Contents of trouble	• The fill switch signal is not set off at stop of output of the transmission 2nd clutch solenoid circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem that appears on machine	• The auto shift down function does not operate. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F2 and R2.			
Related 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) • Method of reproducing error code: Engine start + Neutral running			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective 2nd clutch fill switch (Internal short)	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			F2T (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	Other than F2/R2	Min. 1MΩ	
				F2･R2	Max. 1Ω	
	2	Defective harness grounding (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC3 (female) (29) – F2T (female) (1) with chassis ground		Resistance	Max. 1MΩ
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			STC3	PCCS lever	Voltage	
			Between (29) – chassis ground	Other than F2/R2	20 – 30V	
				F2･R2	Max. 1V	
	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

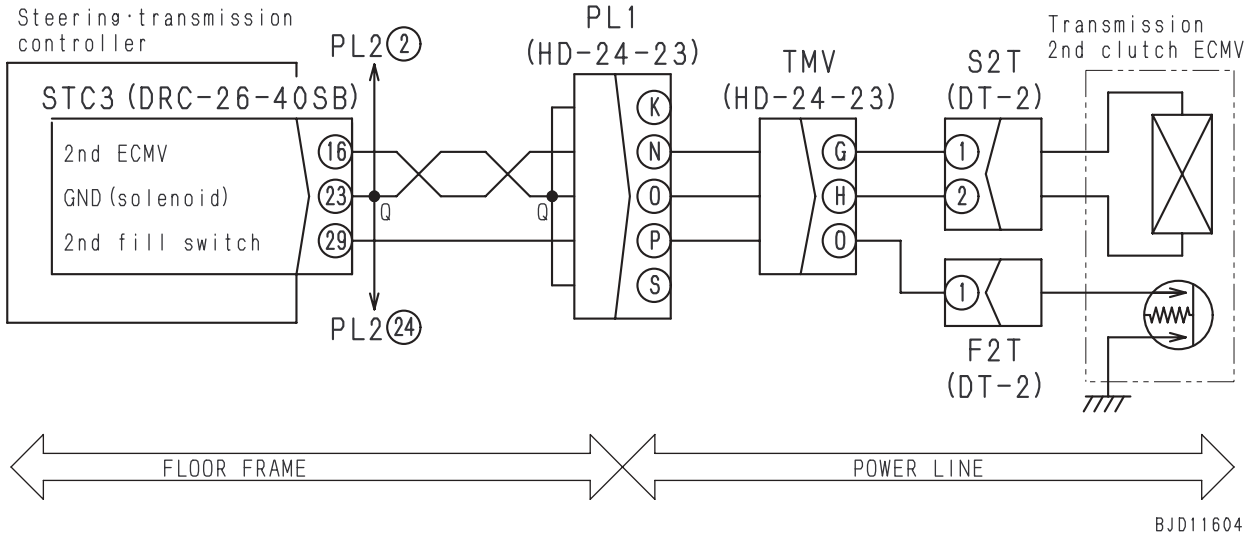


ERROR CODE 15SFLH (2ND CLUTCH: SEE THE LIST. (LH))

Action code	Error code	Controller code	Trouble	2nd clutch: See the list. (LH) (Steering and transmission controller system)
CALL E03	15SFLH	Steering and transmission		
Contents of trouble	• The fill switch signal is not set on at output to the transmission level 2 clutch solenoid circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F1 and R1.			
Related 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) • Method of reproducing error code: Engine start + F2 or R2 running			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective 2nd clutch fill switch (Internal short)	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			F2T (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	Other than F2/R2	Min. 1MΩ	
				F2･R2	Max. 1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC3 (female) (29) – F2T (female) (1)		Resistance	Max. 1MΩ
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			STC3	PCCS lever	Voltage	
			Between (29) – chassis ground	Other than F2/R2	20 – 30V	
				F2･R2	Max. 1V	
	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

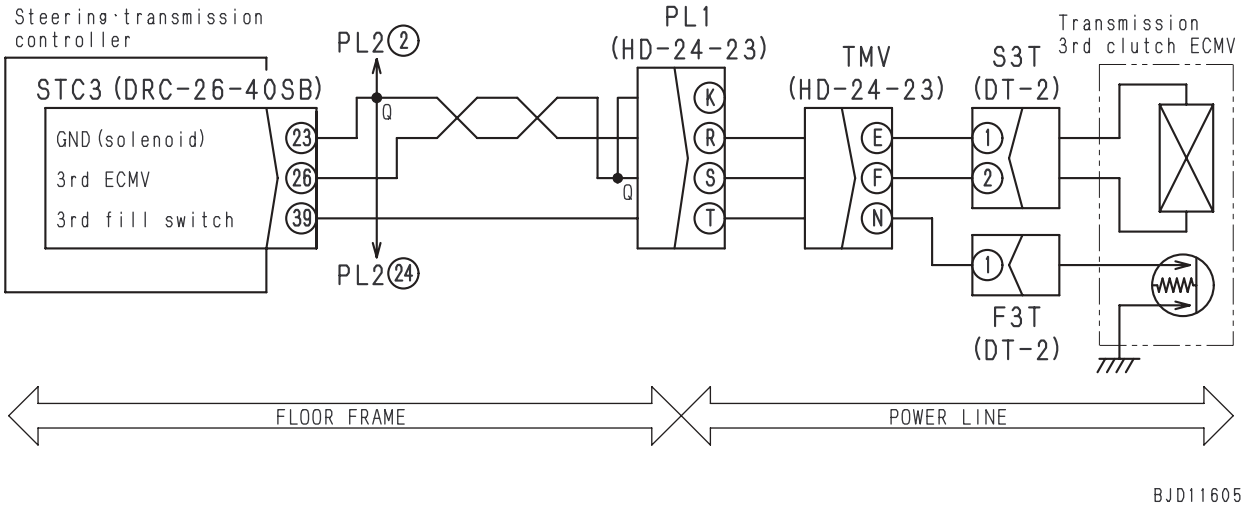


ERROR CODE 15SGL1 (3RD CLUTCH: SEE THE LIST. (L1))

Action code	Error code	Controller code	Trouble	3rd clutch: See the list. (L1) (Steering and transmission controller system)
CALL E03	15SGL1	Steering and transmission		
Contents of trouble	• The fill switch signal is not set off at output stop of the transmission 3rd clutch solenoid circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem that appears on machine	• The auto shift down function does not operate. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F3 and R3.			
Related 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) • Method of reproducing error code: Engine start + Neutral running			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective 3rd clutch fill switch (Internal short)	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			F3T (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	Other than F3/R3	Min. 1MΩ	
				F3·R3	Max. 1Ω	
	2	Defective harness grounding (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC3 (female) (39) – F3T (female) (1) with chassis ground		Resistance	Max. 1MΩ
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			STC3	PCCS lever	Voltage	
			Between (39) – chassis ground	Other than F3/R3	20 – 30V	
				F3·R3	Max. 1V	
	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

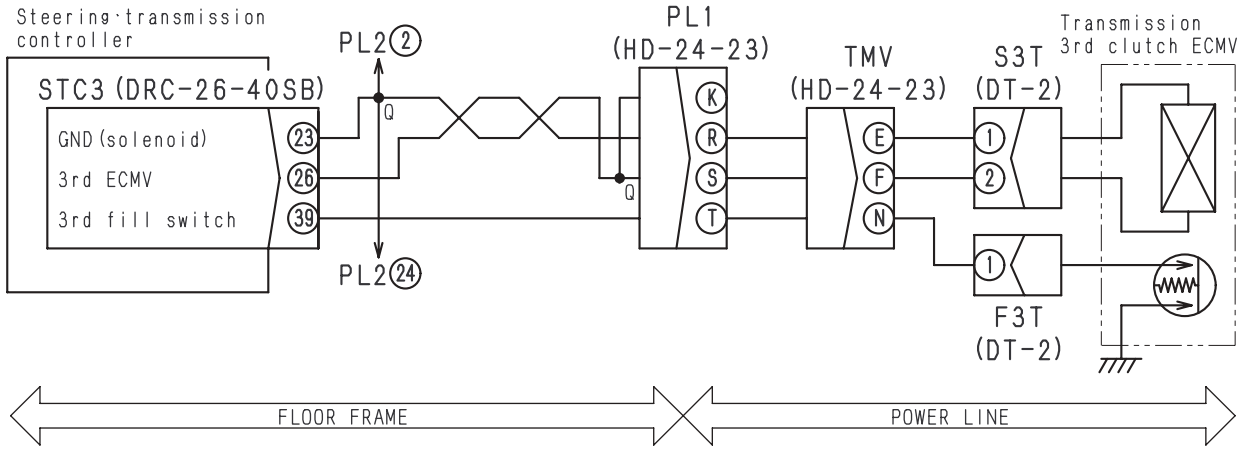


ERROR CODE 15SGLH (3RD CLUTCH: SEE THE LIST. (LH))

Action code	Error code	Controller code	Trouble	3rd clutch: See the list. (LH) (Steering and transmission controller system)
CALL E03	15SGLH	Steering and transmission		
Contents of trouble	• The fill switch signal is not set off at output to the transmission 3rd clutch solenoid circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F1 and R1.			
Related 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) • Method of reproducing error code: Engine start + F3 or R3 running			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective 3rd clutch fill switch (Internal short)	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			F3T (male)	PCCS lever	Resistance	
			Between (1) – chassis ground	Other than F3/R3	Min. 1MΩ	
				F3·R3	Max. 1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC3 (female) (39) – F3T (female) (1)		Resistance	Max. 1Ω
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then start the engine for troubleshooting.			
			STC3	PCCS lever	Voltage	
			Between (39) – chassis ground	Other than F3/R3	20 – 30V	
				F3·R3	Max. 1V	
	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



BJD11605

ERROR CODE A000N1 (ENGINE: OVERRUN (N1))

Action code	Error code	Controller code	Trouble	Engine: Overrun (N1) (Engine controller system)
—	A000N1	ENG		
Contents of trouble	• The engine speed exceeded the specified speed.			
Action of controller	• Saves the trouble but does not make any alarm. • Stops fuel injection until the engine speed lowers below the specified speed.			
Problem that appears on machine	• None in particular.			
Related information	• Method of reproducing error code: Turn starting switch ON. • Engine speed can be checked in monitoring mode (Monitoring mode: 01000).			

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	If any other error code is displayed and recorded at the same time, carry out troubleshooting for that error code first.	
	2	Improper use	Instruct the using procedure again.
	3	Defective engine controller	Check that engine speed is displayed normally.

ERROR CODE AB00MA (ALTERNATOR: MALFUNCTION (MA))

Action code	Error code	Controller code	Trouble	Alternator: Malfunction (MA) (Mechanical system)
—	AB00MA	—		
Contents of trouble	• During rotation of engine, charge level caution lamp flashes.			
Action of controller				
Problem that appears on machine	• If machine is operated as it is, battery may be discharged.			
Related information	• Method of reproducing error code: Start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Defective battery charge (When system is in normal state)	It is suspected that problem causing defective battery charge is occurring at present or occurred in past. Investigate 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 “During running of engine, emergency caution item flashes” in E mode.

ERROR CODE AD00L2 (COMMON RAIL: SEE THE LIST. (L2))

Action code	Error code	Controller code	Trouble	Common rail: See the list. (L2) (Engine controller system)
E02	AD00L2	ENG		
Contents of trouble	• The fuel pressure of common rail became high (level 1).			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits output for operation.			
Problem that appears on machine	• Engine output reduces.			
Related information	• The fuel state (fuel pressure) of common rail can be checked in monitoring mode. (Code 36400: Common rail pressure) • Method of reproducing error code: Engine start			

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Defective related system	Check the displayed error code. If another code is displayed, first carry out troubleshooting for the code.
	2	Inappropriate fuel	The fuel used may be inappropriate; directly check it.
	3	Defective electric system of common rail pressure sensor	Carry out troubleshooting for error code [DH40KX].
	4	Defective mechanical system of common rail pressure sensor	The common rail pressure sensor is assumed to be defective mechanically; directly check it.
	5	Defective overflow valve	The overflow valve may cause spring damage, sheet abrasion, or ball fixing; directly check it.
	6	Clogged overflow pipe	The overflow pipe is assumed to be clogged; directly check it.
	7	Defective pressure limiter	The pressure limiter is assumed to be defective mechanically; directly check it.

ERROR CODE AD00MA (COMMON RAIL: DEFECTIVE FUNCTION (MA))

Action code	Error code	Controller code	Trouble	Common rail: See the list. (MA) (Engine controller system)
E02	AD00MA	ENG		
Contents of trouble	• The fuel pressure of common rail became high (level 2).			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits output and engine speed for operation.			
Problem that appears on machine	• Engine output and speed reduces.			
Related information	• The fuel state (fuel pressure) of common rail can be checked in monitoring mode. (Code 36400: Common rail pressure) • Method of reproducing error code: Engine start			

Possible causes and standard value in normal state	Cause	Standard value in normal state/Remarks on troubleshooting
	Carry out troubleshooting for error code [AD00L2].	

ERROR CODE AD10L3 (FUEL SUPPLY PUMP: SEE THE LIST. (L3))

Action code	Error code	Controller code	Trouble	Fuel supply pump: See the list. (L3) (Engine controller system)
CALL E03	AD10L3	ENG		
Contents of trouble	• Non-pressure transmission (level 1) occurred in fuel supply pump.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits output for operation.			
Problem that appears on machine	• Engine output reduces.			
Related information	• The pressure transmission state (fuel pressure) of fuel supply pump can be checked in monitoring mode. (Code 36400: Common rail pressure) • Method of reproducing error code: Engine start			

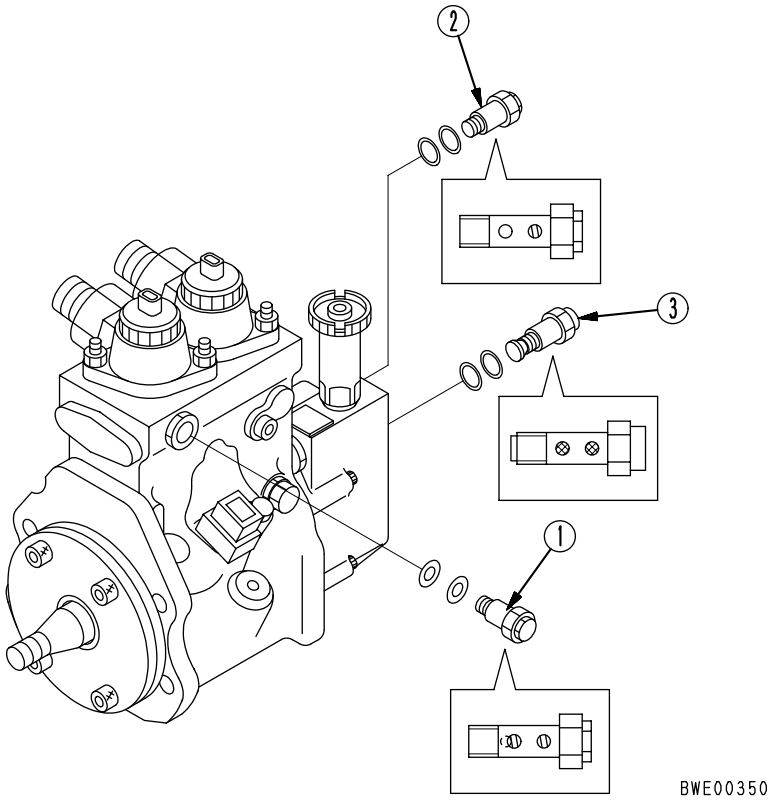
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defective related system	Check the displayed error code. If another code is displayed, first carry out troubleshooting for the code.
	2	Inappropriate fuel	The fuel used may be inappropriate; directly check it.
	3	Defective low-pressure circuit equipment	The low-pressure circuit equipment is assumed to be defective; see Note 2 for troubleshooting.
	4	Clogged filter strainer	The filter strainer is assumed to be clogged; see Note 1 for troubleshooting.
	5	Defective electric system of fuel supply pump PCV	Carry out troubleshooting for error codes [AD11KA], [AD11KB], [AD51KA], and [AD51KB].
	6	Defective fuel supply pump	of fuel supply pump
	7	Defective common rail pressure sensor	The common rail pressure sensor is assumed to be defective; directly check it.
	8	Defective pressure limiter	The pressure limiter is assumed to be defective mechanically; directly check it.
	9	Defective fuel injector	The fuel injector is assumed to be defective; see Note 3 for troubleshooting.

Note 1: Follow the procedure below to check, clean, and replace the filter and strainer.
1) Gauze filter: Disassemble and check. If the filter is clogged, clean it.
2) Gauze filter upstream strainer: If the gauze filter is clogged, also clean the upstream strainer.
3) Fuel filter: If abnormality is not yet recovered after steps 1) and 2), replace the fuel filter.

Note 2: When the low-pressure equipment is defective, check the following points:
1) Remaining fuel quantity
2) Feed pump fixing, abrasion, and filter clogging
3) Leak and clogging of low-pressure fuel pipe
4) Defective bypass valve function or other parts assembled erroneously (See the figure below.)
5) Clogged fuel filter
6) Fuel mix in oil pan (Fuel leak in head cover)

- Fuel low-pressure circuit pressure: 0.15 – 0.3MPa {1.5 – 3.0kg/cm^2}

Figure: Overflow valve (1), bypass valve (2), and fuel inlet joint (3) mounting positions
- Overflow valve (1): Spring viewed from both holes
- Bypass valve (2): Spring viewed from nut hole side
- Fuel inlet joint (3): Gauze filter viewed from both holes



Note 3: When the fuel injector is defective, measure the fuel spill charge for decision.

⚠ The temperature of spill fuel rises extremely (max. 90°C). Take care not to get burnt.

1) Disconnect the hose connected to the spill tube return set (in the rear of the engine).
2) Connect another hose to the end of the spill tube so that spill fuel can be poured in the container.
3) Start the engine and measure the spill fuel quantity per minute at stall for each engine speed.

★ Limit of fuel spill charge (6 cylinders in all)

Engine stall speed (rpm)	Spill limit (cc/min.)
1,600	960
1,700	1,020
1,800	1,080
1,900	1,140
2,000	1,200

ERROR CODE AD10MA (FUEL SUPPLY PUMP: DEFECTIVE FUNCTION (MA))

Action code	Error code	Controller code	Trouble	Fuel supply pump: Defective function (MA) (Engine controller system)
CALL E03	AD10MA	ENG		
Contents of trouble	• An abnormal pressure occurred in the common rail fuel pressure.			
Action of controller	• Runs in normal control state.			
Problem that appears on machine	• Engine output and speed reduces.			
Related information	• The fuel state (fuel pressure) of common rail can be checked in monitoring mode. (Code 36400: Common rail pressure) • Method of reproducing error code: Engine start			

Possible causes and standard value in normal state	Cause	Standard value in normal state/Remarks on troubleshooting
	Carry out troubleshooting for error code [AD10L3].	

ERROR CODE AD10MB (FUEL SUPPLY PUMP: FUNCTION REDUCTION (MB))

Action code	Error code	Controller code	Trouble	Fuel supply pump: Function reduction (MB) (Engine controller system)
E02	AD10MB	ENG		
Contents of trouble	• Non-pressure transmission (level 2) occurred in the fuel supply pump.			
Action of controller	• Limits output and engine speed for operation.			
Problem that appears on machine	• Engine output reduces.			
Related information	• The pressure transmission state (fuel pressure) of fuel supply pump can be checked in monitoring mode. (Code 36400: Common rail pressure) • Method of reproducing error code: Engine start			

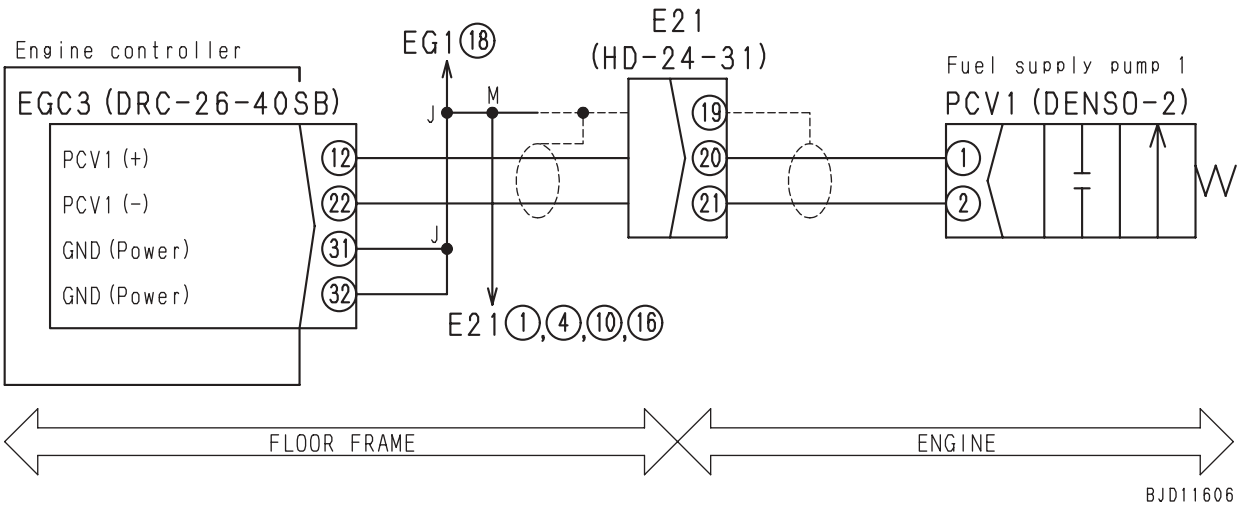
Possible causes and standard value in normal state	Cause	Standard value in normal state/Remarks on troubleshooting
	Carry out troubleshooting for error code [AD10L3].	

ERROR CODE AD11KA (FUEL SUPPLY PUMP SOLENOID 1: DISCONNECTION IN WIRING (KA))

Action code	Error code	Controller code	Trouble	Fuel supply pump solenoid 1: Disconnection in wiring (KA) (Engine controller system)
CALL E03	AD11KA	ENG		
Contents of trouble	• Disconnection in wiring occurred in fuel supply pump solenoid 1 (PCV1).			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits engine and transmission operation. • Stops output to fuel supply pump solenoid 1 circuit.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F1 and R1. • If codes [AD51KA] and [AD51KB] are displayed at the same time, engine stops.			
Related information	• The special adapter (799-601-9430) is necessary for troubleshooting of fuel supply pump solenoid 1. • Method of reproducing error code: Engine start			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fuel supply pump solenoid 1 (Internal disconnection in wiring)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			PCV1 (male)	Resistance	
			Between (1) – (2)	2.3 – 5.3Ω	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (12) – PCV1 (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC3 (female) (22) – PCV1 (female) (2)	Resistance	Max. 1Ω
	3	Defective harness grounding (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (22) – PCV1 (female) (2) with chassis ground	Resistance	Min. 1MΩ
	4	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC3 (male)	Resistance	
			Between (12) – (22)	2.3 – 5.3Ω	
			Between (12) (22) – chassis ground	Min. 1MΩ	

Circuit diagram related to fuel supply pump solenoid 1

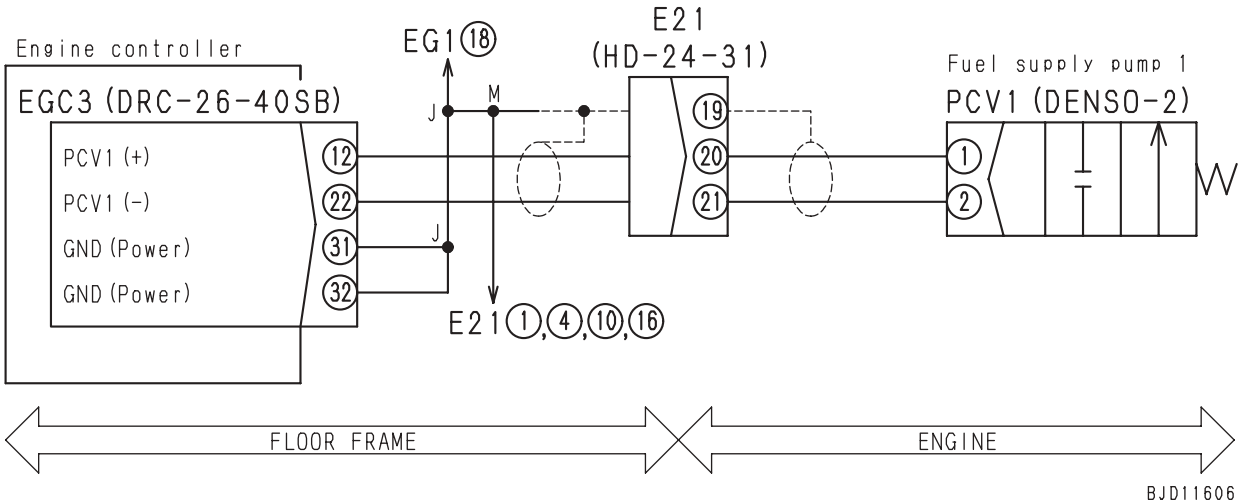


ERROR CODE AD11KB (FUEL SUPPLY PUMP SOLENOID 1: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Fuel supply pump solenoid 1: Short circuit (KB) (Engine controller system)
CALL E03	AD11KB	ENG		
Contents of trouble	• Overcurrent flowed in fuel supply pump solenoid 1 (PCV1) circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission. • Stops output to fuel supply pump solenoid 1 circuit.			
Problem 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. • When code [AD51KA] and [AD51KB] appear at the same time, engine stops.			
Related information	• For troubleshooting of fuel supply pump solenoid 1, special adaptor (799-601-9430) is required. • Method of reproducing error code: Start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fuel supply pump solenoid 1 (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			PCV1 (male)	Resistance	
			Between (1) – (2)	2.3 – 5.3Ω	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (12) – PCV1 (female) (1) with chassis ground	Resistance	Max. 1MΩ
	3	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between EGC3 (female) (12) – PCV1 (female) (1) with chassis ground	Voltage	Max. 1V
			Short circuit of wiring harness between EGC3 (female) (22) – PCV1 (female) (2) with chassis ground	Voltage	Max. 1V
	4	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC3 (male)	Resistance	
			Between (12) – (22)	2.3 – 5.3Ω	
			Between (12) (22) – chassis ground	Min. 1MΩ	

Circuit diagram related to fuel supply pump solenoid 1

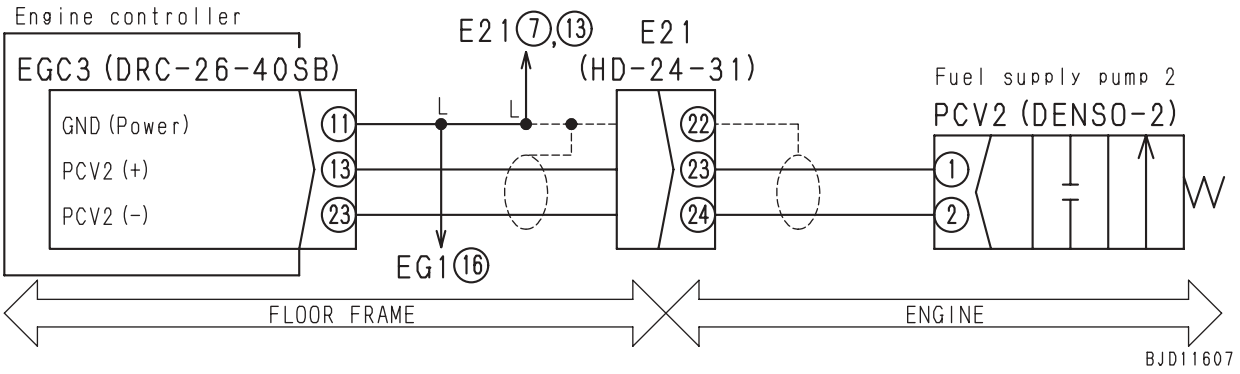


ERROR CODE AD51KA (FUEL SUPPLY PUMP SOLENOID 2: DISCONNECTION IN WIRING (KA))

Action code	Error code	Controller code	Trouble	Fuel supply pump solenoid 2: Disconnection in wiring (KA) (Engine controller system)
CALL E03	AD51KA	ENG		
Contents of trouble	• Disconnection in wiring occurred in fuel supply pump solenoid 2 (PCV2).			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits engine and transmission operation. • Stops output to fuel supply pump solenoid 2 circuit.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F1 and R1. • If codes [AD11KA] and [AD11KB] are displayed at the same time, engine stops.			
Related information	• The special adapter (799-601-9430) is necessary for troubleshooting of fuel supply pump solenoid 2. • Method of reproducing error code: Engine start			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fuel supply pump solenoid 2 (Internal disconnection in wiring)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			PCV2 (male)	Resistance	
			Between (1) – (2)	2.3 – 5.3Ω	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (13) – PCV2 (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC3 (female) (23) – PCV2 (female) (2)	Resistance	Max. 1Ω
	3	Defective harness grounding (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (23) – PCV2 (female) (2) with chassis ground	Resistance	Min. 1MΩ
	4	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC3 (male)	Resistance	
			Between (13) – (23)	2.3 – 5.3Ω	
			Between (13) (23) – chassis ground	Min. 1MΩ	

Circuit diagram related to fuel supply pump solenoid 2

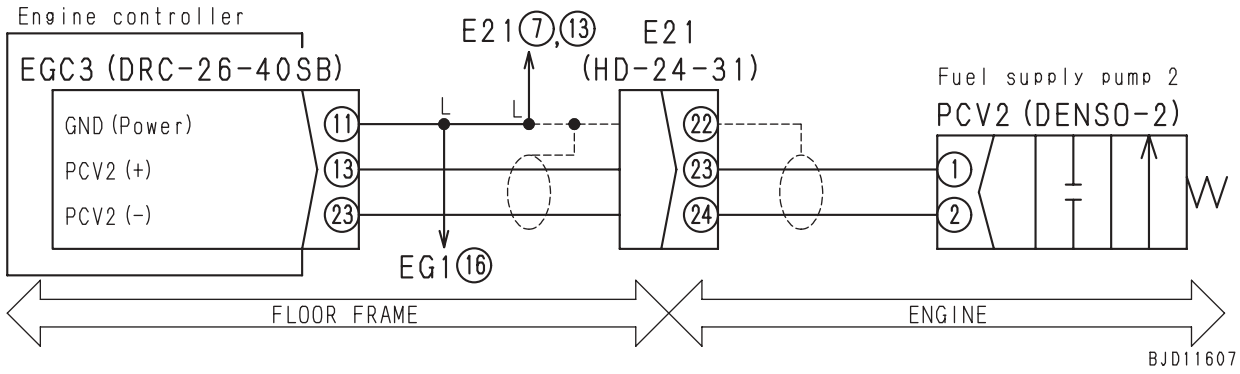


ERROR CODE AD51KB (FUEL SUPPLY PUMP SOLENOID 2: DISCONNECTION IN SHORT (KB))

Action code	Error code	Controller code	Trouble	Fuel supply pump solenoid 2: Short (KB) (Engine controller system)
CALL E03	AD51KB	ENG		
Contents of trouble	• Overcurrent occurred in fuel supply pump solenoid 2 (PCV2).			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits engine and transmission operation. • Stops output to fuel supply pump solenoid 2 circuit.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F1 and R1. • If codes [AD11KA] and [AD11KB] are displayed at the same time, engine stops.			
Related information	• The special adapter (799-601-9430) is necessary for troubleshooting of fuel supply pump solenoid 2. • Method of reproducing error code: Engine start			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective fuel supply pump solenoid 2 (Internal disconnection in wiring)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			PCV2 (male)	Resistance		
			Between (1) – (2)	2.3 – 5.3Ω		
			Between (1) – chassis ground	Min. 1MΩ		
	2	Defective harness grounding (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between EGC3 (female) (13) – PCV2 (female) (1)	Resistance	Max. 1MΩ	
	3	Defective harness hot short (Contact with 24V circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between EGC3 (female) (13) – PCV2 (female) (1) with chassis ground	Voltage	Max. 1V	
			Wiring harness between EGC3 (female) (23) – PCV2 (female) (2) with chassis ground	Voltage	Max. 1V	
	4	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			EGC3 (male)	Resistance		
			Between (13) – (23)	2.3 – 5.3Ω		
			Between (13) (23) – chassis ground	Min. 1MΩ		

Circuit diagram related to fuel supply pump solenoid 2

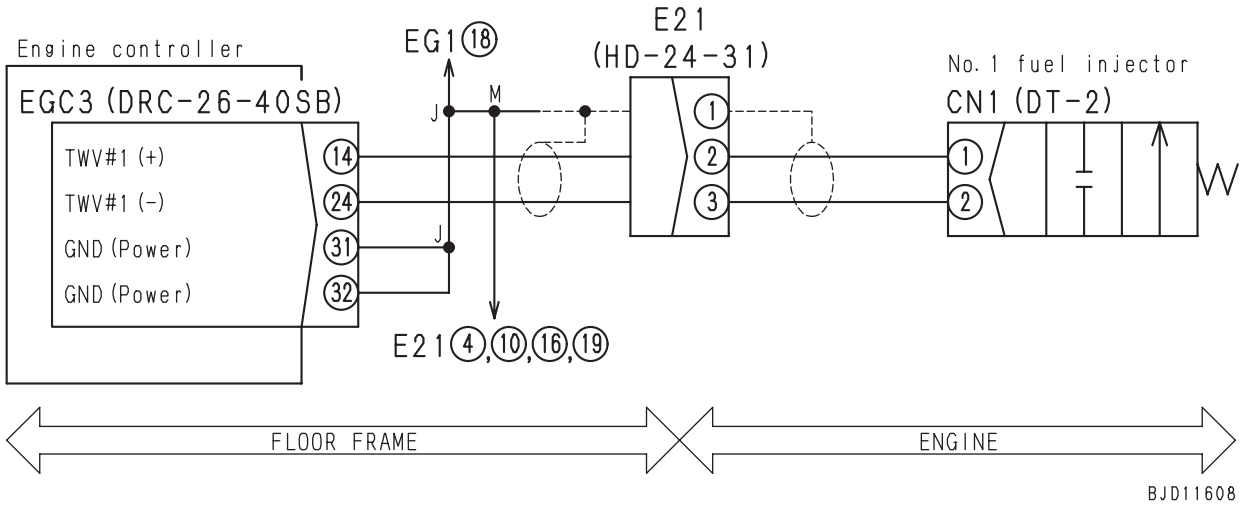


ERROR CODE ADA1KA (NO.1 INJECTOR SOLENOID: DISCONNECTION IN WIRING (KA))

Action code	Error code	Controller code	Trouble	No.1 injector solenoid: Disconnection in wiring (KA) (Engine controller system)
E02	ADA1KA	ENG		
Contents of trouble	• Disconnection in wiring occurred in the No.1 injector solenoid (TWV#1) circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops output to the No.1 injector solenoid circuit.			
Problem that appears on machine	• Engine output reduces.			
Related information	• Method of reproducing error code: Engine start			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective No.1 injector solenoid (Internal disconnection in wiring)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN1 (male)	Resistance	
			Between (1) and (2)	0.4 – 1.1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (14) – CN1 (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC3 (female) (24) – CN1 (female) (2)	Resistance	Max. 1Ω
	3	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC3 (male)	Resistance	
			Between (14) and (24)	0.4 – 1.1Ω	

Circuit diagram related to No.1 injector solenoid



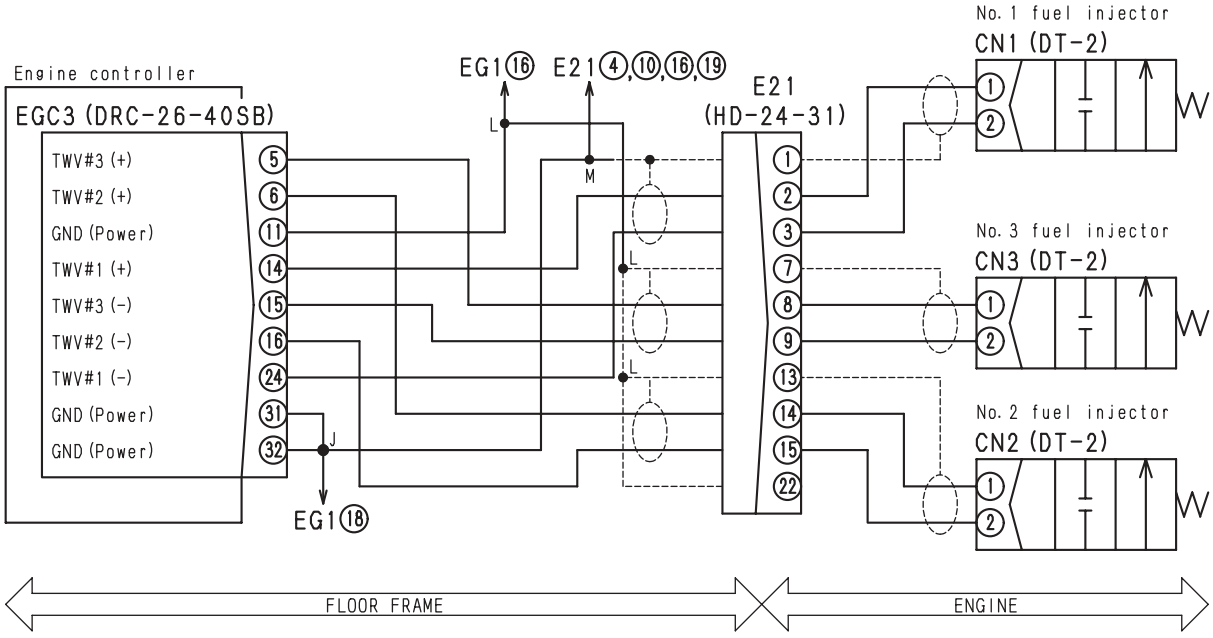
ERROR CODE ADAZKB (NO.1, 2, AND 3 INJECTOR SOLENOIDS: SHORT (KB))

Action code	Error code	Controller code	Trouble	No.1, 2, and 3 injector solenoids: Short (KB) (Engine controller system)
CALL E03	ADAZKB	ENG		
Contents of trouble	• Overcurrent occurred in the No.1 injector solenoid (TWV#1), No.2 injector solenoid (TWV#2), or No.3 injector solenoid (TWV#3).			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits engine and transmission operations. • Stops output to the No.1, 2, and 3 injector solenoid circuits.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F1 and R1. • Engine output reduces extremely.			
Related information	• Method of reproducing error code: Engine start			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective No.1 injector solenoid (Internal short)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN1 (male)	Resistance	
			Between (1) – (2)	0.4 – 1.1Ω	
			Between (1) (2) – chassis ground	Min. 1MΩ	
	2	Defective No.2 injector solenoid (Internal short)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN2 (male)	Resistance	
			Between (1) – (2)	0.4 – 1.1Ω	
			Between (1) (2) – chassis ground	Min. 1MΩ	
	3	Defective No.3 injector solenoid (Internal short)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN3 (male)	Resistance	
			Between (1) – (2)	0.4 – 1.1Ω	
			Between (1) (2) – chassis ground	Min. 1MΩ	
	4	Defective harness grounding (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (14) – CN1 (female) 1) with chassis ground	Resistance	Min. 1MΩ
			Wiring harness between EGC3 (female) (24) – CN1 (female) (2) with chassis ground	Resistance	Min. 1MΩ
			Wiring harness between EGC3 (female) (6) – CN2 (female) 1) with chassis ground	Resistance	Min. 1MΩ
			Wiring harness between EGC3 (female) (16) – CN2 (female) (2) with chassis ground	Resistance	Min. 1MΩ
			Wiring harness between EGC3 (female) (5) – CN3 (female) 1) with chassis ground	Resistance	Min. 1MΩ
			Wiring harness between EGC3 (female) (15) – CN3 (female) (2) with chassis ground	Resistance	Min. 1MΩ

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	5	Defective harness hot short (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON for troubleshooting.		
			Wiring harness between EGC3 (female) (14) – CN1 (female) (1) with chassis ground	Voltage	Max. 1V
			Wiring harness between EGC3 (female) (24) – CN1 (female) (2) with chassis ground	Voltage	Max. 1V
			Wiring harness between EGC3 (female) (6) – CN2 (female) (1) with chassis ground	Voltage	Max. 1V
			Wiring harness between EGC3 (female) (16) – CN2 (female) (2) with chassis ground	Voltage	Max. 1V
			Wiring harness between EGC3 (female) (5) – CN3 (female) (1) with chassis ground	Voltage	Max. 1V
			Wiring harness between EGC3 (female) (15) – CN3 (female) (2) with chassis ground	Voltage	Max. 1V

Circuit diagram related to No.1, 2, and 3 injector solenoids



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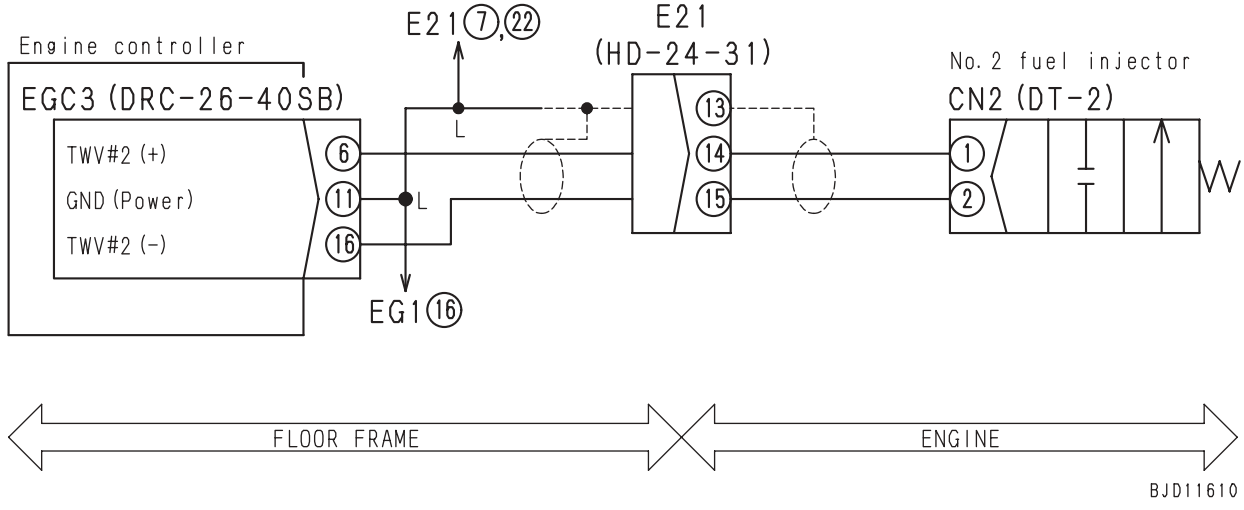
ERROR CODE ADB1KA (NO.2 INJECTOR SOLENOID: DISCONNECTION IN WIRING (KA))

Action code	Error code	Controller code	Trouble	No.2 injector solenoid: Disconnection in wiring (KA) (Engine controller system)
E02	ADB1KA	ENG		
Contents of trouble	• Disconnection in wiring occurred in the No.2 injector solenoid (TWV#2) circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops output to the No.2 injector solenoid circuit.			
Problem that appears on machine	• Engine output reduces.			
Related information	• Method of reproducing error code: Engine start			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective No.2 injector solenoid (Internal disconnection in wiring)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN2 (male)	Resistance	
			Between (1) and (2)	0.4 – 1.1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (6) – CN2 (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC3 (female) (16) – CN2 (female) (2)	Resistance	Max. 1Ω
	3	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC3 (male)	Resistance	
			Between (6) and (16)	0.4 – 1.1Ω	

Circuit diagram related to No.2 injector solenoid

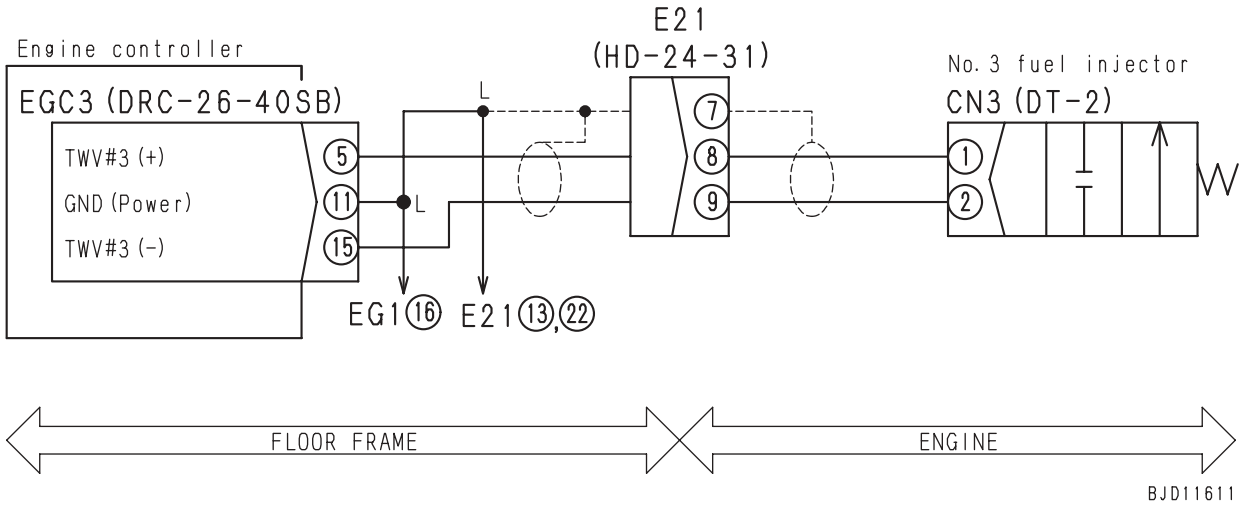


ERROR CODE ADC1KA (NO.3 INJECTOR SOLENOID: DISCONNECTION IN WIRING (KA))

Action code	Error code	Controller code	Trouble	No.3 injector solenoid: Disconnection in wiring (KA) (Engine controller system)
E02	ADC1KA	ENG		
Contents of trouble	• Disconnection in wiring occurred in the No.3 injector solenoid (TWV#3) circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops output to the No.3 injector solenoid circuit.			
Problem that appears on machine	• Engine output reduces.			
Related information	• Method of reproducing error code: Engine start			

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Defective No.3 injector solenoid (Internal disconnection in wiring)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN3 (male)	Resistance	
			Between (1) and (2)	0.4 – 1.1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (5) – CN3 (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC3 (female) (15) – CN3 (female) (2)	Resistance	Max. 1Ω
	3	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC3 (male)	Resistance	
			Between (5) and (15)	0.4 – 1.1Ω	

Circuit diagram related to No.3 injector solenoid

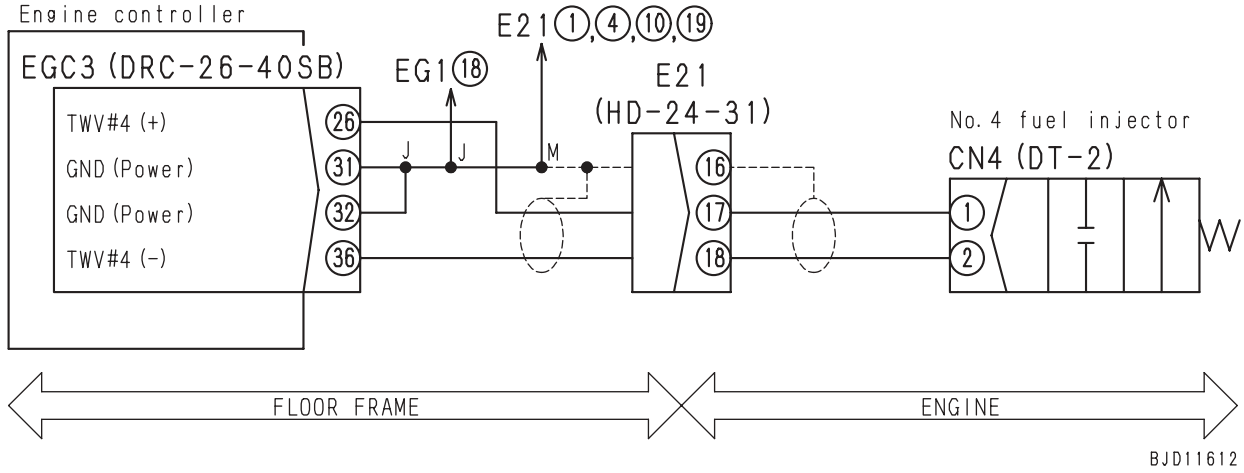


ERROR CODE ADD1KA (NO.4 INJECTOR SOLENOID: DISCONNECTION IN WIRING (KA))

Action code	Error code	Controller code	Trouble	No.4 injector solenoid: Disconnection in wiring (KA) (Engine controller system)
E02	ADD1KA	ENG		
Contents of trouble	• Disconnection in wiring occurred in the No.4 injector solenoid (TWV#4) circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops output to the No.4 injector solenoid circuit.			
Problem that appears on machine	• Engine output reduces.			
Related information	• Method of reproducing error code: Engine start			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective No.4 injector solenoid (Internal disconnection in wiring)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN4 (male)	Resistance	
			Between (1) and (2)	0.4 – 1.1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (26) – CN4 (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC3 (female) (36) – CN4 (female) (2)	Resistance	Max. 1Ω
	3	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC3 (male)	Resistance	
			Between (26) and (36)	0.4 – 1.1Ω	

Circuit diagram related to No.4 injector solenoid



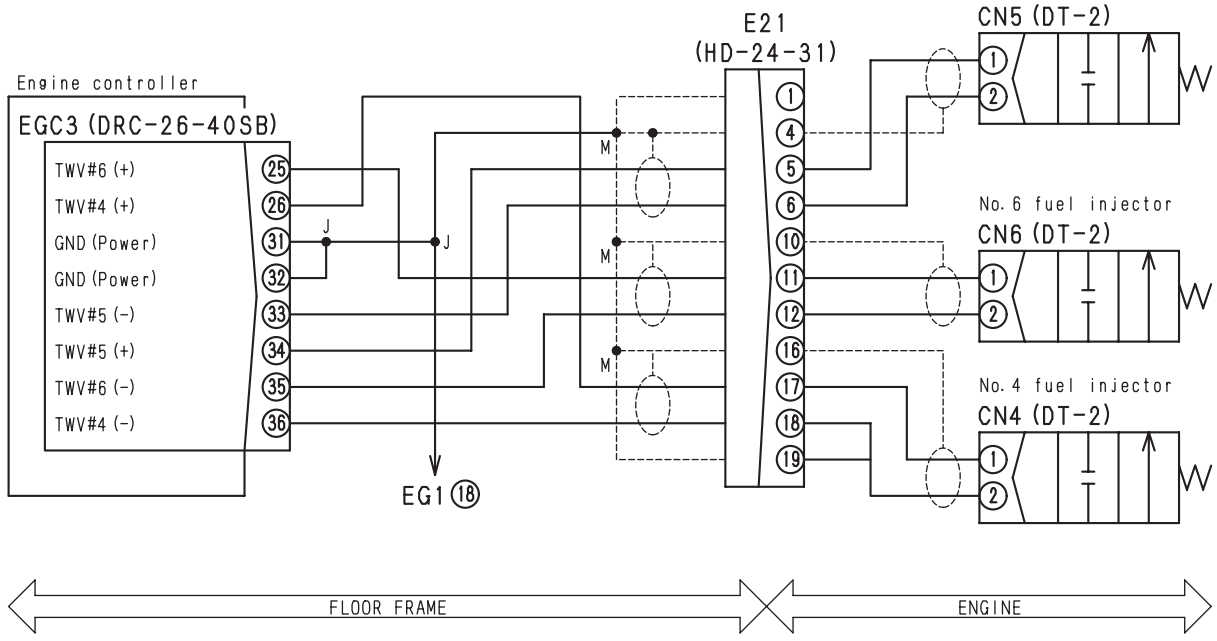
ERROR CODE ADDZKB (NO.4, 5, AND 6 INJECTOR SOLENOIDS: SHORT (KB))

Action code	Error code	Controller code	Trouble	No.4, 5, and 6 injector solenoids: Short (KB) (Engine controller system)
CALL E03	ADDZKB	ENG		
Contents of trouble	• Overcurrent occurred in the No.4 injector solenoid (TWV#4), No.5 injector solenoid (TWV#5), or No.6 injector solenoid (TWV#6).			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits engine and transmission operations. • Stops output to the No.4, 5, and 6 injector solenoid circuits.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, running is limited to F1 and R1. • Engine output reduces extremely.			
Related information	• Method of reproducing error code: Engine start			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective No.4 injector solenoid (Internal short)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN4 (male)	Resistance	
			Between (1) – (2)	0.4 – 1.1Ω	
			Between (1) (2) – chassis ground	Min. 1MΩ	
	2	Defective No.5 injector solenoid (Internal short)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN5 (male)	Resistance	
			Between (1) – (2)	0.4 – 1.1Ω	
			Between (1) (2) – chassis ground	Min. 1MΩ	
	3	Defective No.6 injector solenoid (Internal short)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN6 (male)	Resistance	
			Between (1) – (2)	0.4 – 1.1Ω	
			Between (1) (2) – chassis ground	Min. 1MΩ	
	4	Defective harness grounding (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (26) – CN4 (female) (1) with chassis ground	Resistance	Min. 1MΩ
			Wiring harness between EGC3 (female) (36) – CN4 (female) (2) with chassis ground	Resistance	Min. 1MΩ
			Wiring harness between EGC3 (female) (34) – CN5 (female) (1) with chassis ground	Resistance	Min. 1MΩ
			Wiring harness between EGC3 (female) (33) – CN5 (female) (2) with chassis ground	Resistance	Min. 1MΩ
			Wiring harness between EGC3 (female) (25) – CN6 (female) (1) with chassis ground	Resistance	Min. 1MΩ
			Wiring harness between EGC3 (female) (35) – CN6 (female) (2) with chassis ground	Resistance	Min. 1MΩ

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	5	Defective harness hot short (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON for troubleshooting.		
			Wiring harness between EGC3 (female) (26) – CN4 (female) (1) with chassis ground	Voltage	Max. 1V
			Wiring harness between EGC3 (female) (36) – CN4 (female) (2) with chassis ground	Voltage	Max. 1V
			Wiring harness between EGC3 (female) (34) – CN5 (female) (1) with chassis ground	Voltage	Max. 1V
			Wiring harness between EGC3 (female) (33) – CN5 (female) (2) with chassis ground	Voltage	Max. 1V
			Wiring harness between EGC3 (female) (25) – CN6 (female) (1) with chassis ground	Voltage	Max. 1V
			Wiring harness between EGC3 (female) (35) – CN6 (female) (2) with chassis ground	Voltage	Max. 1V

Circuit diagram related to No.4, 5, and 6 injector solenoid



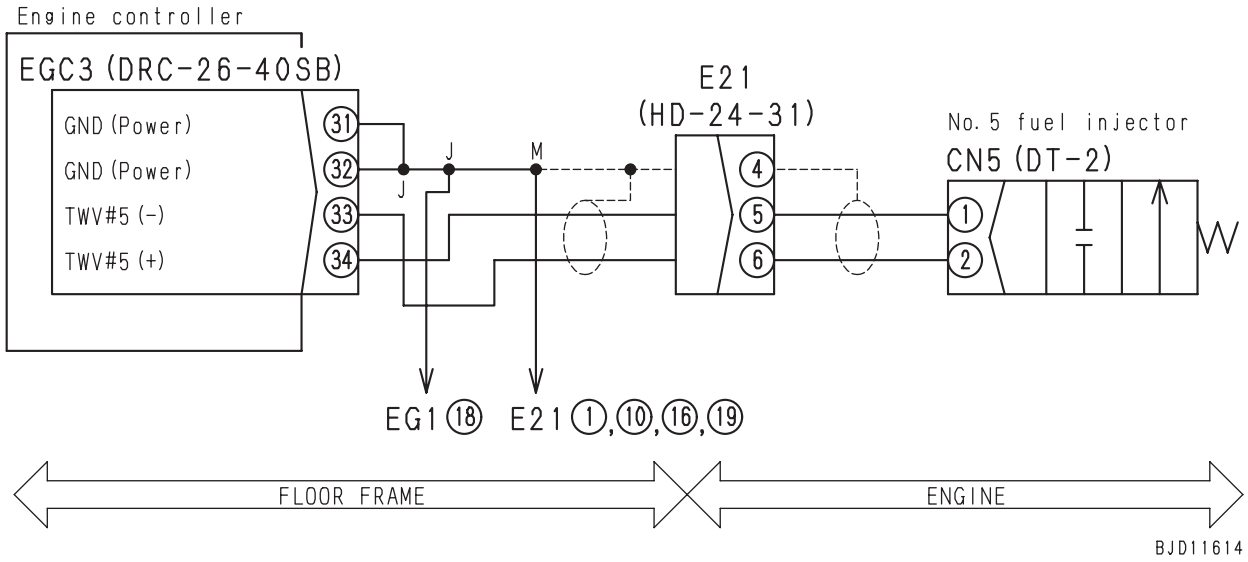
BJD11613

ERROR CODE ADE1KA (NO. 5 FUEL INJECTOR SOLENOID: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	No. 5 fuel injector solenoid: Disconnection (KA) (Engine controller system)
E02	ADE1KA	ENG		
Contents of trouble	• Disconnection occurred in No. 5 fuel injector solenoid (TWV#5) circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops output to No. 5 fuel injector solenoid circuit.			
Problem that appears on machine	• Engine output lowers.			
Related information	• Method of reproducing error code: Start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective No. 5 fuel injector solenoid (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN5 (male)	Resistance	
			Between (1) – (2)	0.4 – 1.1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (34) – CN5 (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC3 (female) (33) – CN5 (female) (2)	Resistance	Max. 1Ω
	3	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC3 (male)	Resistance	
			Between (34) – (33)	0.4 – 1.1Ω	

Circuit diagram related to No. 5 fuel injector solenoid

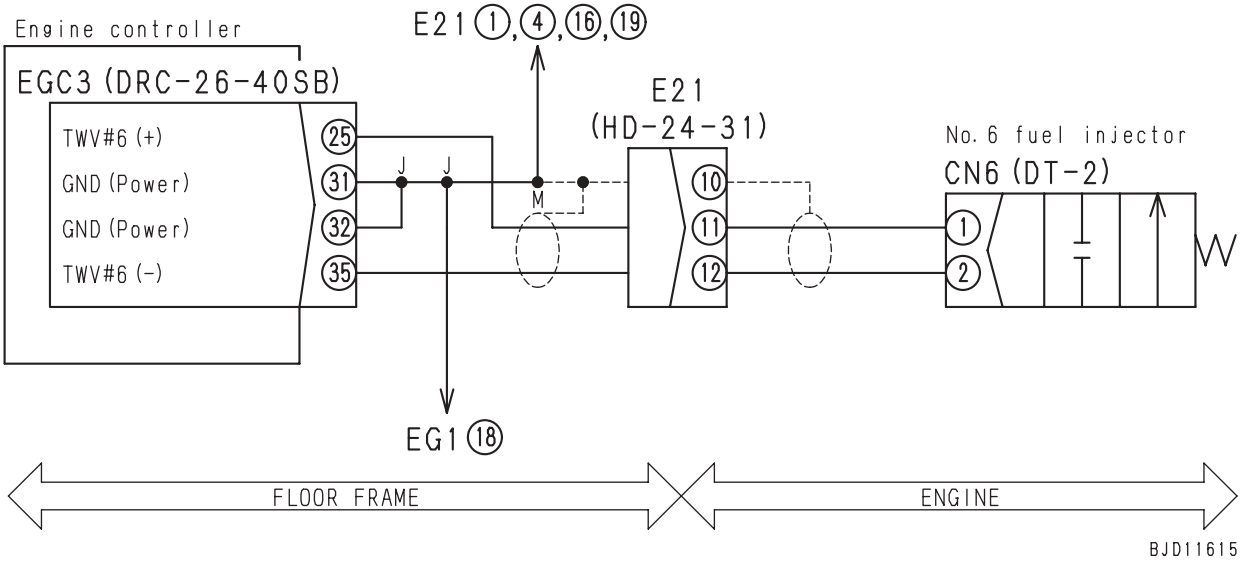


ERROR CODE ADF1KA (NO. 6 FUEL INJECTOR SOLENOID: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	No. 6 fuel injector solenoid: Disconnection (KA) (Engine controller system)
E02	ADF1KA	ENG		
Contents of trouble	• Disconnection occurred in No. 6 fuel injector solenoid (TWV#6) circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops output to No. 6 fuel injector solenoid circuit.			
Problem that appears on machine	• Engine output lowers.			
Related information	• Method of reproducing error code: Start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective No. 6 fuel injector solenoid (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN6 (male)	Resistance	
			Between (1) – (2)	0.4 – 1.1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (25) – CN6 (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC3 (female) (35) – CN6 (female) (2)	Resistance	Max. 1Ω
	3	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC3 (male)	Resistance	
			Between (25) – (35)	0.4 – 1.1Ω	

Circuit diagram related to No. 6 fuel injector solenoid



ERROR CODE B@BAZG (ENGINE OIL: OIL PRESSURE REDUCTION (ZG))

Action code	Error code	Controller code	Trouble	Engine oil: Oil pressure reduction (ZG) (Mechanical system)
—	B@BAZG	ENG		
Contents of trouble	• During rotation of engine, engine oil pressure caution lamp flashes.			
Action of controller	• Turns on caution buzzer. (Function of monitor panel)			
Problem that appears on machine	• If machine is operated as it is, engine may be damaged.			
Related information	• Method of reproducing error code: Start engine.			

		Cause	Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Engine oil pressure reduction (When system is in normal state)	It is suspected that problem causing engine oil pressure reduction is occurring at present or occurred in past. Investigate 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 “During running of engine, emergency caution item flashes” in E mode.

ERROR CODE B@BCNS (RADIATOR COOLANT: OVERHEAT (NS))

Action code	Error code	Controller code	Trouble	Radiator coolant: Overheat (NS) (Mechanical system)
—	B@BCNS	ENG		
Contents of trouble	• During rotation of engine, engine water temperature caution lamp flashes.			
Action of controller	• Turns on caution buzzer. (Function of monitor panel)			
Problem that appears on machine	• If machine is operated as it is, engine may be damaged.			
Related information	• Method of reproducing error code: Start engine.			

		Cause	Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Engine water temperature overheat (When system is in normal state)	It is suspected that problem causing engine water temperature overheat is occurring at present or occurred in past. Investigate cause and damage condition, and correct it.
	2	Defective engine water temperature caution lamp system	Carry out troubleshooting of engine water temperature caution lamp system in accordance with “During running of engine, emergency caution item flashes” in E mode.

ERROR CODE B@BCZK (RADIATOR COOLANT: LEVEL REDUCTION (ZK))

Action code	Error code	Controller code	Trouble	Radiator coolant: Level reduction (ZK) (Mechanical system)
—	B@BCZK	Steering and transmission		
Contents of trouble	• When turning starting switch ON, radiator coolant caution lamp flashes.			
Action of controller				
Problem that appears on machine	• If machine is operated as it is, engine may be damaged.			
Related information	• Method of reproducing error code: Turn starting switch ON.			

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Radiator coolant level reduction (When system is in normal state)	It is suspected that problem causing radiator coolant level reduction is occurring at present or occurred in past. Investigate cause and damage condition, and correct it.
	2	Defective radiator coolant level caution lamp system	Carry out troubleshooting of radiator coolant level caution lamp system in accordance with “When turning starting switch ON, basic check item flashes” in E mode.

ERROR CODE B@CENS (POWER TRAN OIL: OVERHEAT (NS))

Action code	Error code	Controller code	Trouble	Power train oil: Overheat (NS) (Mechanical system)
—	B@CENS	Steering and transmission		
Contents of trouble	• During rotation of engine, power train oil temperature caution lamp flashes.			
Action of controller	• Turns on caution buzzer. (Function of monitor panel)			
Problem that appears on machine	• If machine is operated as it is, power train may be damaged.			
Related information	• Method of reproducing error code: Start engine.			

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Power train oil temperature overheat (When system is in normal state)	It is suspected that problem causing power train oil temperature overheat is occurring at present or occurred in past. Investigate cause and damage condition, and correct it.
	2	Defective power train oil temperature overheat caution lamp system	Carry out troubleshooting of power train oil temperature caution lamp system in accordance with “During running of engine, emergency caution item flashes” in E mode.

ERROR CODE B@HANS (HYDRAULIC OIL: OVERHEAT (NS))

Action code	Error code	Controller code	Trouble	Hydraulic oil: Overheat (NS) (Mechanical system)
—	B@HANS	Steering and transmission		
Contents of trouble	• During rotation of engine, hydraulic oil temperature caution lamp flashes.			
Action of controller	• Turns on caution buzzer. (Function of monitor panel)			
Problem that appears on machine	• If machine is operated as it is, work equipment circuit units may be damaged.			
Related information	• Method of reproducing error code: Start engine.			

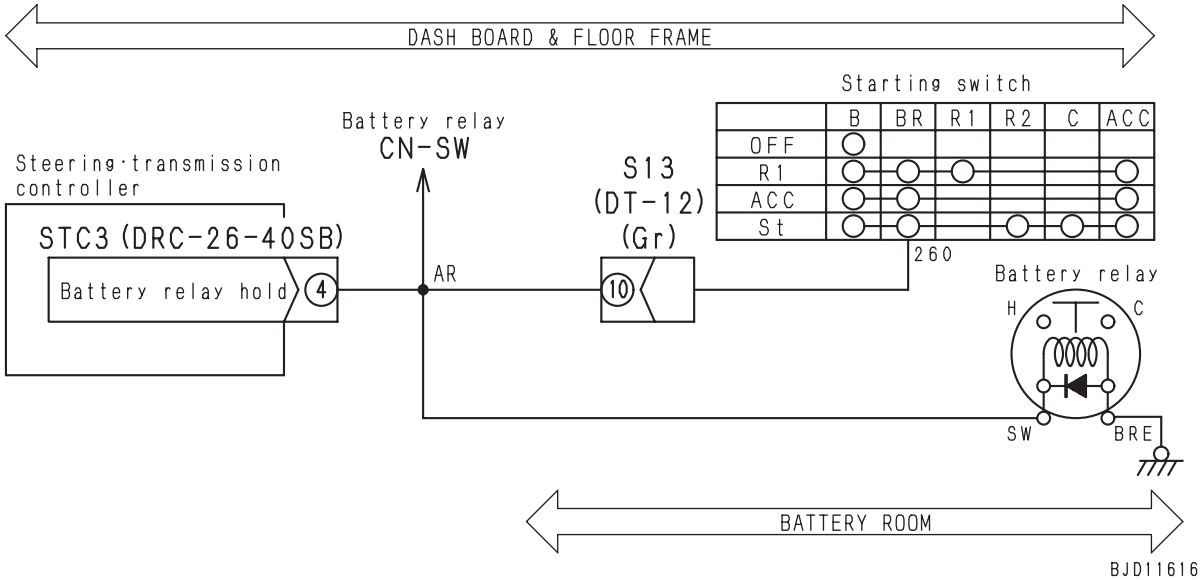
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Hydraulic oil temperature overheat (When system is in normal state)	It is suspected that problem causing hydraulic oil temperature overheat is occurring at present or occurred in past. Investigate cause and damage condition, and correct it.
	2	Defective hydraulic oil temperature caution lamp system	Carry out troubleshooting of hydraulic oil temperature caution lamp system in accordance with “During running of engine, emergency caution item flashes” in E mode.

ERROR CODE D110KA (BATTERY RELAY: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Battery relay: Disconnection (KA) (Steering and transmission controller system)
—	D110KA	Steering and transmission		
Contents of trouble	• Current does not flow when outputting it to battery relay circuit.			
Action of controller	• Stops output to battery relay circuit.			
Problem that appears on machine	• Problem may occur in data writing to ROM (nonvolatile storage) of each controller.			
Related information	• Output state (voltage) to battery relay can be checked in monitoring mode. (Code 60600: Battery relay drive voltage) • Method of reproducing error code: Switch starting switch from ON to OFF.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective battery relay (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Battery relay	Continuity	
			Between terminals SW – ground terminal	Continue	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC3 (female) (4) – battery relay SW terminal	Resistance	Max. 1Ω
			Wiring harness between battery relay ground terminal – chassis ground	Resistance	Max. 1Ω
	3	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC3 (female) (4) – battery relay terminal SW – S13 (female) (10) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3 (female)	Continuity	
			Between (4) – chassis ground	Continue	

Circuit diagram related to battery relay

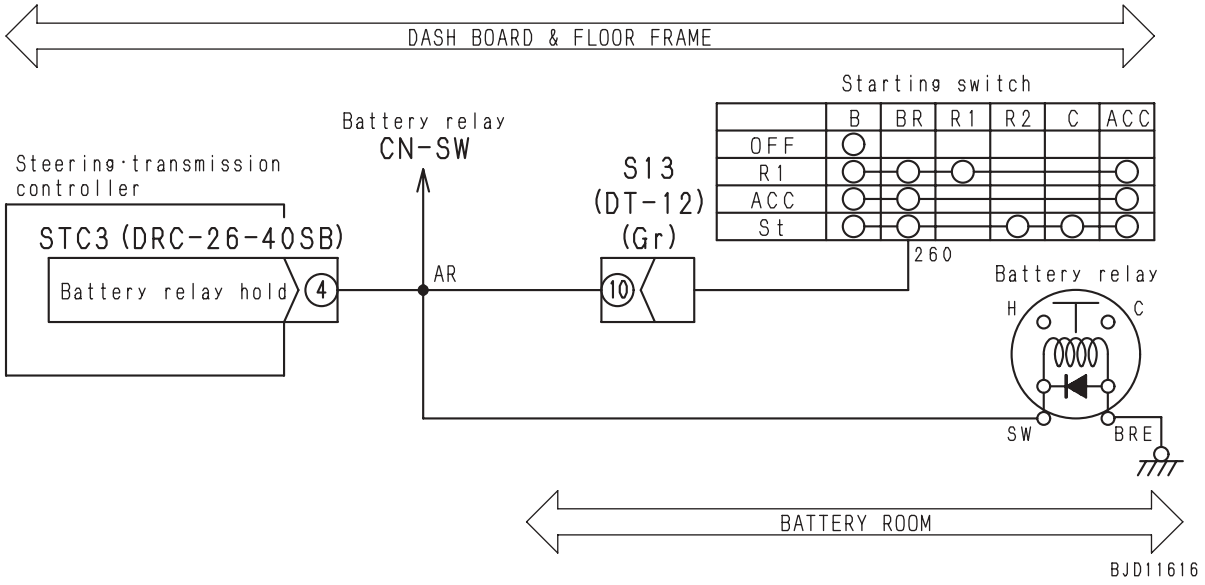


ERROR CODE D110KB (BATTERY RELAY: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Battery relay: Short circuit (KB) (Steering and transmission controller system)
—	D110KB	Steering and transmission		
Contents of trouble	• Abnormal current flowed to battery relay circuit when outputting it.			
Action of controller	• Stops output to battery relay circuit.			
Problem that appears on machine	• Problem may occur in data writing to ROM (nonvolatile storage) of each controller.			
Related information	• Output state (voltage) to battery relay can be checked in monitoring mode. (Code 60600: Battery relay drive voltage) • Method of reproducing error code: Switch starting switch from ON to OFF.			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective battery relay (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Battery relay	Continuity/resistance		
			Between terminals SW – ground terminal	Continue		
			Between terminal SW – chassis ground	Min. 1MΩ		
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between STC3 (female) (4) – battery relay terminal SW – S13 (female) (10) with chassis ground	Resistance	Min. 1MΩ	
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			STC3	Starting switch	Voltage	
			Between (4) – chassis ground	ON	20 – 30V	

Circuit diagram related to battery relay

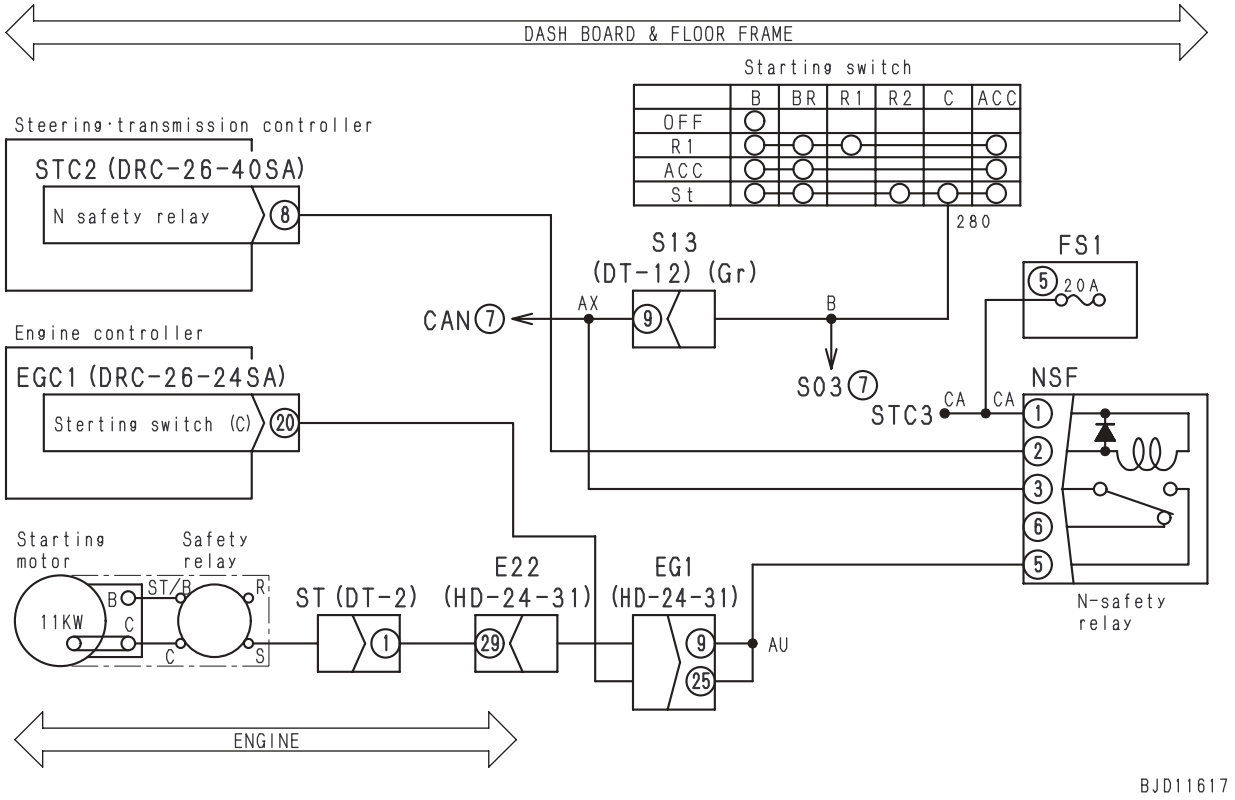


ERROR CODE D130KA (NEUTRAL SAFETY RELAY: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Neutral safety relay: Disconnection (KA) (Steering and transmission controller system)
E02	D130KA	Steering and transmission		
Contents of trouble	• 24V is not generated when ground of neutral safety relay circuit is interrupted.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops ground output to neutral safety relay circuit.			
Problem that appears on machine	• Engine does not start.			
Related information	• Output state (voltage) to neutral safety relay can be checked in monitoring mode. (Code 50900: Neutral safety relay drive voltage) • Method of reproducing error code: Turn starting switch ON and operate parking lever (Lock position). ★This error code detects abnormality in primary side (coil side) of neutral safety relay, but not in secondary side (contact side)			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective fuse FS1-5	If circuit breaker is tripped, circuit probably has short circuit with ground.			
	2	Defective neutral safety relay (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			NSF (male)	Resistance		
			Between (1) – (2)	200 – 400Ω		
	3	Defective disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between TMC2 (female) (8) – NSF (female) (2)	Resistance	Max. 1Ω	
			Wiring harness between NSF (female) (1) – FS1-5	Resistance	Max. 1Ω	
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between TMC2 (female) (8) – NSF (female) (2) with chassis ground	Resistance	Min. 1MΩ	
			Short circuit of wiring harness between NSF (female) (1) – FS1-5 with chassis ground	Resistance	Min. 1MΩ	
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			TMC2	Parking lever	Voltage	
			Between (8) – chassis ground	Free position	20 – 30V	
				Lock position	Max. 1V	

Circuit diagram related to neutral safety relay

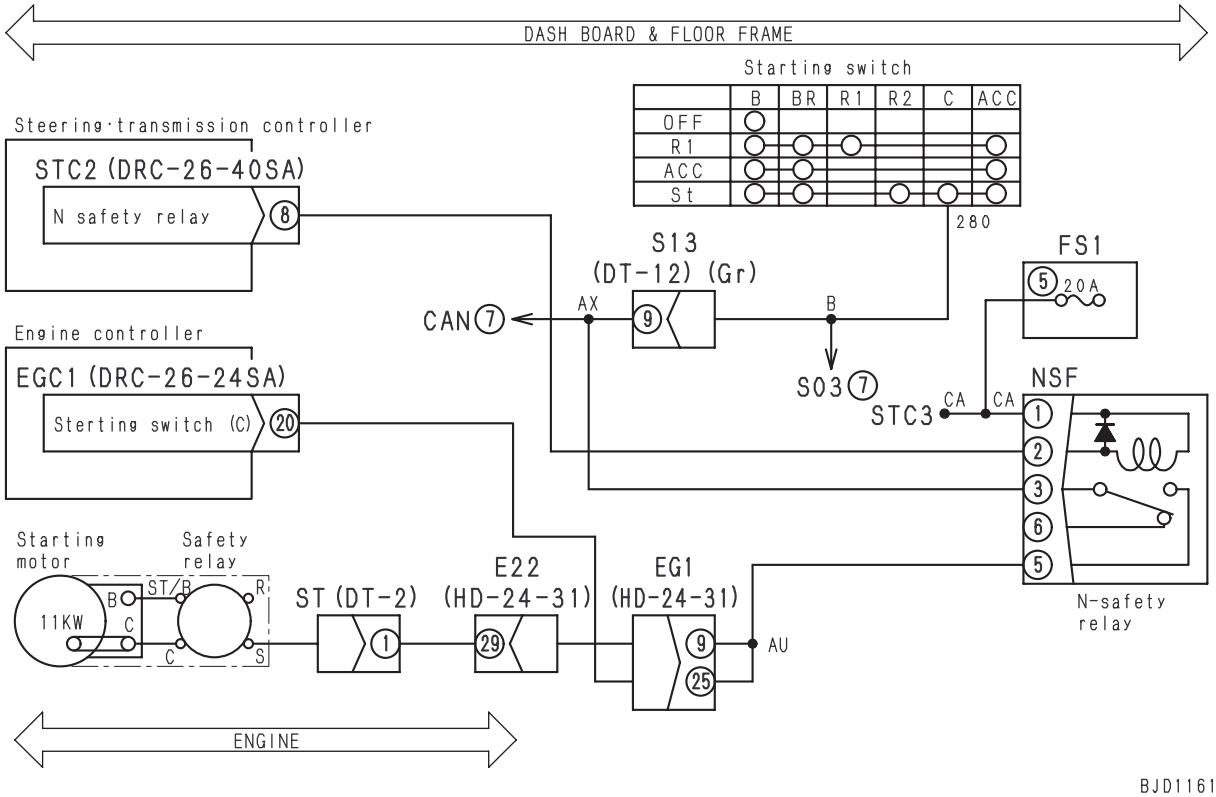


ERROR CODE D130KB (NEUTRAL SAFETY RELAY: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Neutral safety relay: Short circuit (KB) (Steering and transmission controller system)
E02	D130KB	Steering and transmission		
Contents of trouble	• Abnormal current flowed in neutral safety relay circuit at the time of ground output.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops ground output to neutral safety relay circuit.			
Problem that appears on machine	• Engine does not start.			
Related information	• Output state (voltage) to neutral safety relay can be checked in monitoring mode. (Code 50900: Neutral safety relay drive voltage) • Method of reproducing error code: Turn starting switch ON and operate parking lever (Free position). ★This error code detects abnormality in primary side (coil side) of neutral safety relay, but not in secondary side (contact side)			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective neutral safety relay (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			NSF (male)	Resistance	
			Between (1) – (2)	200 – 400Ω	
	2	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC2 (female) (8) – NSF (female) (2) with chassis ground	Voltage	Max. 1V
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC2	Parking lever	Voltage
			Between (8) – chassis ground	Free position	20 – 30V
				Lock position	Max. 1V

Circuit diagram related to neutral safety relay



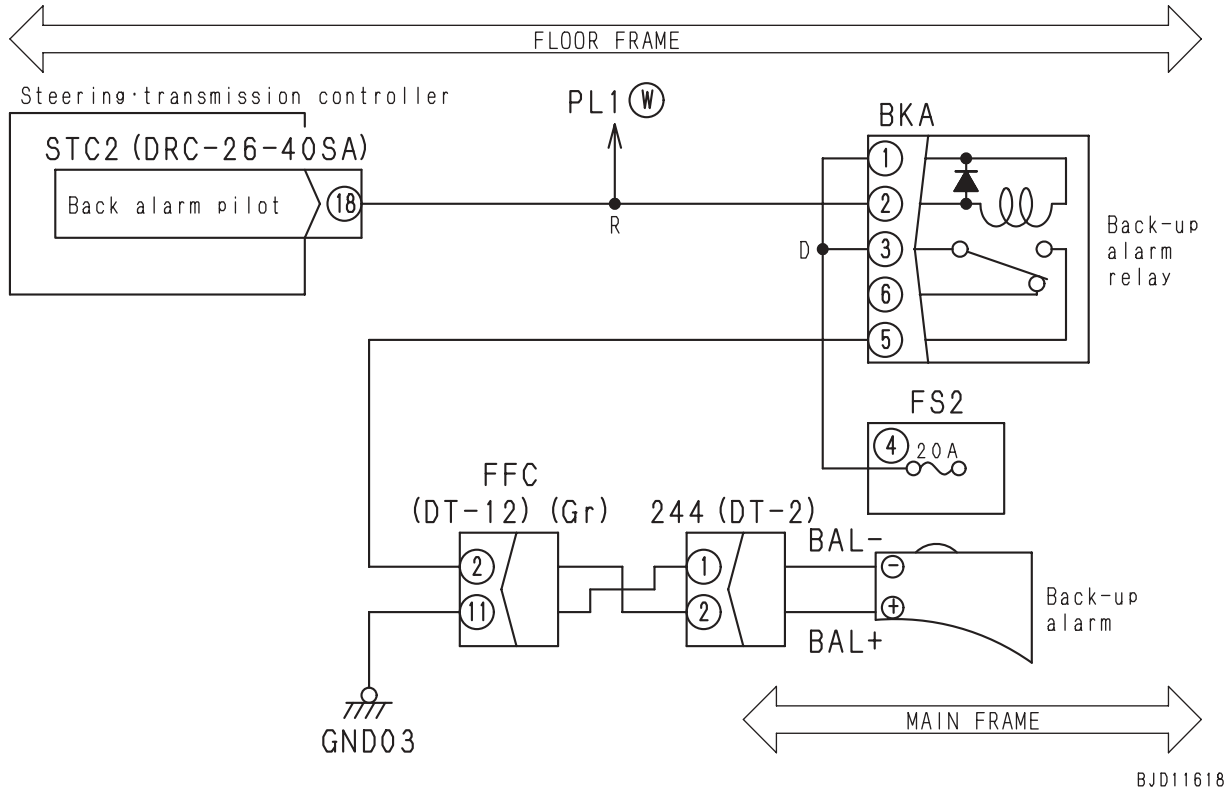
BJD11617

ERROR CODE D161KA (BACK-UP ALARM RELAY: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Back-up alarm relay: Disconnection (Steering and transmission controller system)
E01	D161KA	Steering and transmission		
Contents of trouble	• 24V is not generated when ground output of neutral safety relay circuit is interrupted.			
Action of controller	• Stops output to back-up alarm relay circuit.			
Problem that appears on machine	• Back-up alarm is not turned on.			
Related information	• Output state (voltage) to back-up alarm relay can be checked in monitoring mode. (Code 70900: Back-up alarm relay drive voltage) • Method of reproducing error code: Turn starting switch ON and operate parking lever (Neutral position). ★This error code detects abnormality in primary side (coil side) of back-up alarm relay, but not in secondary side (contact side)			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective fuse FS2-4	If fuse is burnout, circuit probably has short circuit with chassis ground.			
	2	Defective back-up alarm relay (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			BKA (male)	Resistance		
			Between (1) – (2)	200 – 400Ω		
	3	Defective disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC2 (female) (18) – BKA (female) (2)	Resistance	Max. 1Ω	
			Wiring harness between BKA (female) (1) – FS2-4 outlet port	Resistance	Max. 1Ω	
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between STC2 (female) (18) – BKA (female) (2) with chassis ground	Resistance	Min. 1MΩ	
			Short circuit of wiring harness between BKA (female) (1) – FS2-4 outlet port with chassis ground	Resistance	Min. 1MΩ	
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			STC2	PCCS lever	Voltage	
			Between (18) – chassis ground	Neutral position	20 – 30V	
				Reverse position	Max. 1V	

Circuit diagram related to back-up alarm relay

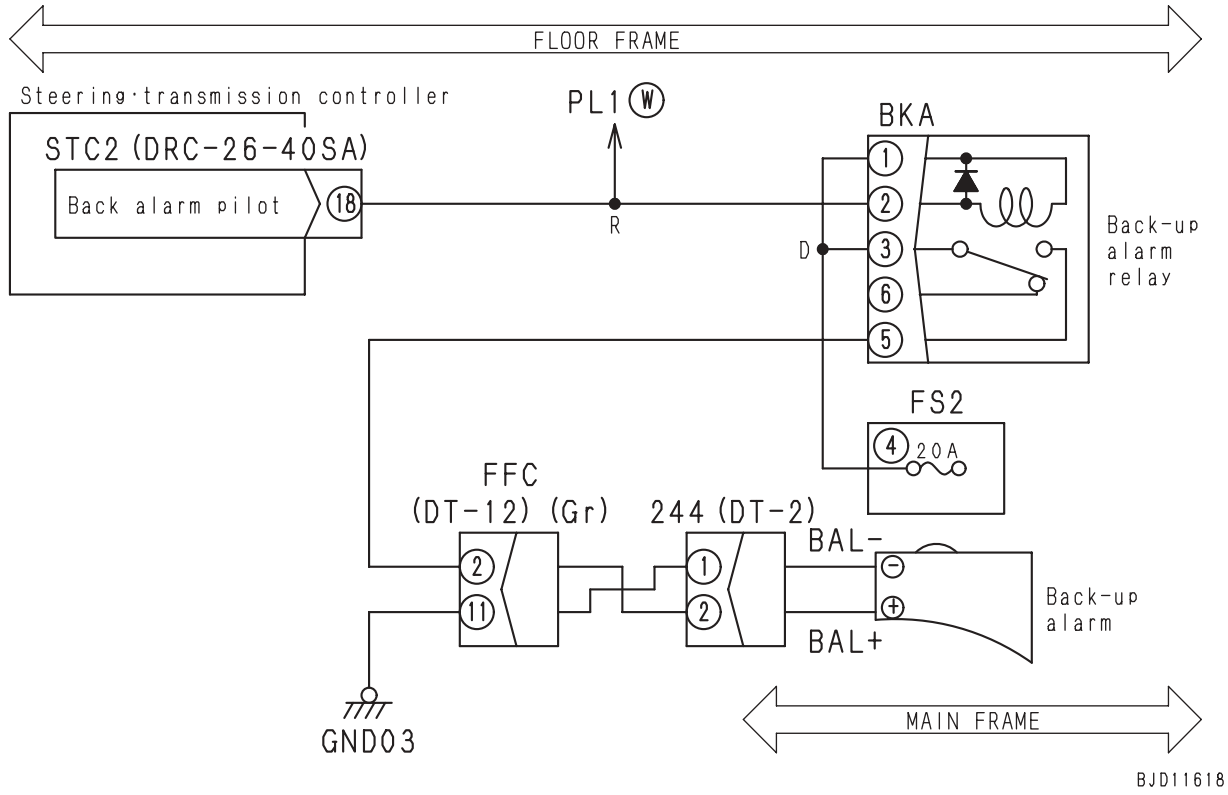


ERROR CODE D161KB (BACK-UP ALARM RELAY: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Back-up alarm relay: Short circuit (KB) (Steering and transmission controller system)
E01	D161KB	Steering and transmission		
Contents of trouble	• Abnormal current flowed in back-up alarm relay circuit at the time of ground output.			
Action of controller	• Stops output to back-up alarm relay circuit.			
Problem that appears on machine	• Back-up alarm is not turned on.			
Related information	• Output state (voltage) to back-up alarm relay can be checked in monitoring mode. (Code 70400: Back-up alarm relay drive voltage) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (Reverse position). ★This error code detects abnormality in primary side (coil side) of back-up alarm relay, but not in secondary side (contact side)			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective back-up alarm relay (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			BKA (male)	Resistance	
			Between (1) – (2)	200 – 400Ω	
	2	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC2 (female) (18) – BKA (female) (2) with chassis ground	Voltage	Max. 1V
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC2	Parking lever	Voltage
			Between (18) – chassis ground	Neutral position	20 – 30V
				Reverse position	Max. 1V

Circuit diagram related to back-up alarm relay

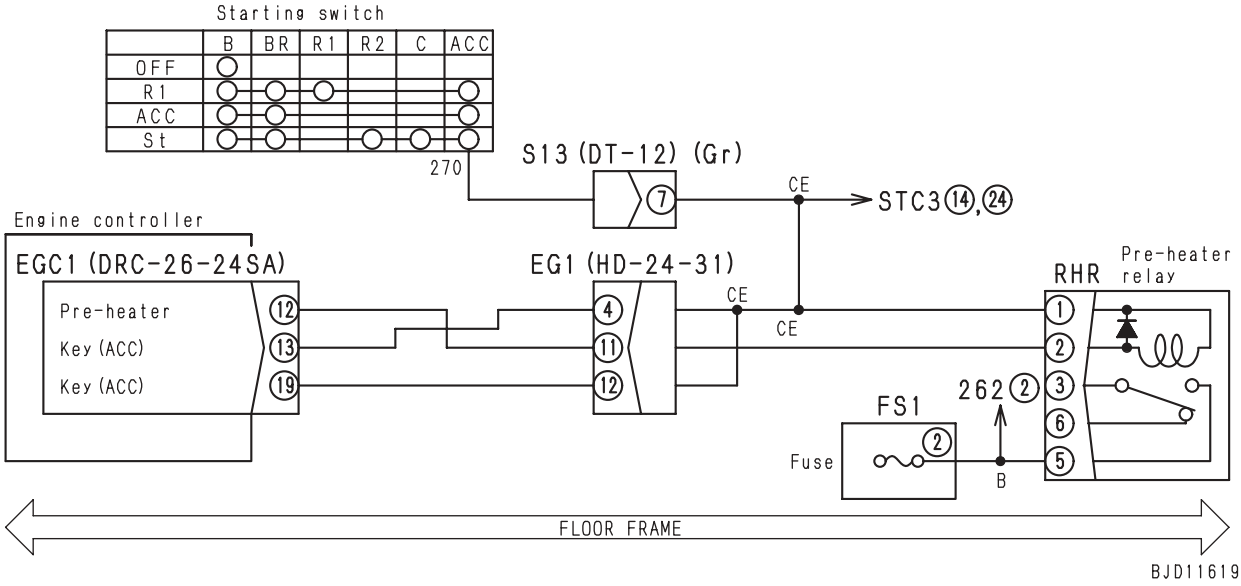


ERROR CODE D182KZ (PREHEATER RELAY COIL: DISCONNECTION OR SHORT CIRCUIT) (KZ)

Action code	Error code	Controller code	Trouble	Preheater relay coil: Disconnection or short circuit (KZ) (Steering and transmission controller system)
CALL E03	D182KZ	ENG		
Contents of trouble	• The drive circuit of the preheater relay has a trouble of disconnection or short circuit.			
Action of controller	• Cannot drive the preheater relay.			
Problem that appears on machine	• The engine does not start easily at low temperature.			
Related information				

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective preheater relay (RHR) (Internal disconnection or grounding fault)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Between RHR (female) (1) – (2)	Resistance	280 ± Ω
			Between RHR (female) (1) – ground	Resistance	Min. 1MΩ
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between RHR (female) (2) – EGC1 (female) (12)	Resistance	Max. 1Ω
			Wiring harness between RHR (female) (1) – 270	Resistance	Max. 1Ω
			Wiring harness between RHR (female) (1) – EGC1 (female) (13), (19)	Resistance	Max. 1Ω
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between RHR (female) (2) – EGC1 (female) (12) with chassis ground	Resistance	Min. 1MΩ
			Between wiring harness between RHR (female) (1) – EGC1 (female) (13), (19) and ground	Resistance	Min. 1MΩ
	4	Defective controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between EGC1 (female) (13) – ground		Voltage
				When relay is driven	Max. 1V
				When relay is not driven	20 – 30V

Circuit diagram related to preheater relay coil

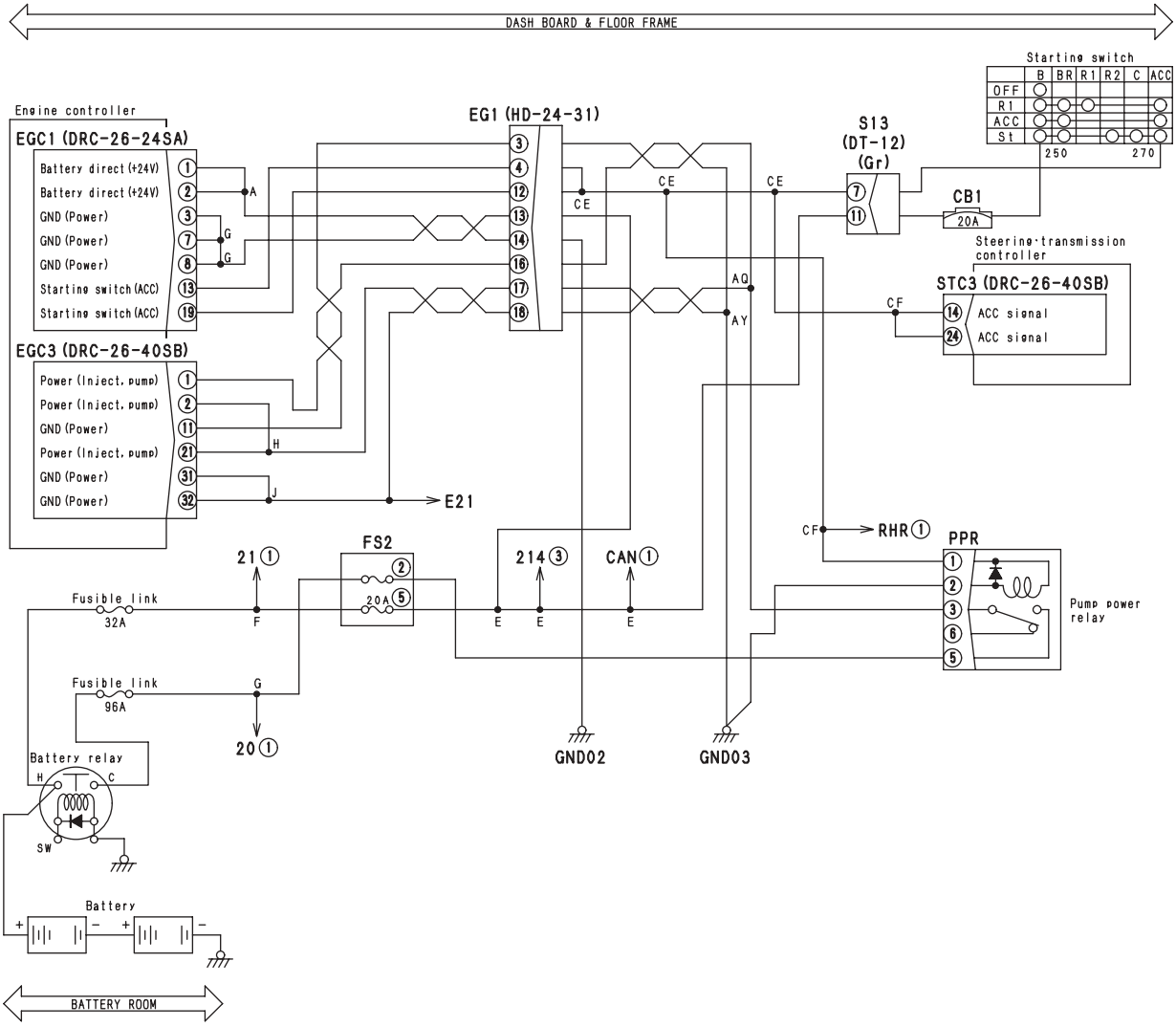


ERROR CODE D1D0KB (ENGINE CONTROLLER LOAD POWER SUPPLY RELAY: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Engine controller load power supply relay: Short circuit (KB) (Engine controller system)
CALL 04	D1D0KB	ENG		
Contents of trouble	• Voltage is generated in controller load power supply circuit when starting switch is turned OFF.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine, transmission, and brake.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it cannot travel any more.			
Related information	• Method of reproducing error code: Turn starting switch OFF. ★This error code detects abnormality in secondary side (contact side) of engine controller load power supply relay, but not in primary side (coil side)			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective engine controller load power supply relay (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			PPR (male)		Resistance	
			Between (3) – (5)		Min. 1Mz	
	2	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Short circuit of wiring harness between EGC3 (female) (1), (2), (21) – PPR (female) (3) with chassis ground		Voltage	Max. 1V
	3	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting with starting switch OFF or ON.			
			EGC3	Starting switch	Voltage	
			Between (1), (2), (21) – chassis ground	OFF position	Max. 1V	
				ON position	Max. 8V	

Circuit diagram related to engine controller



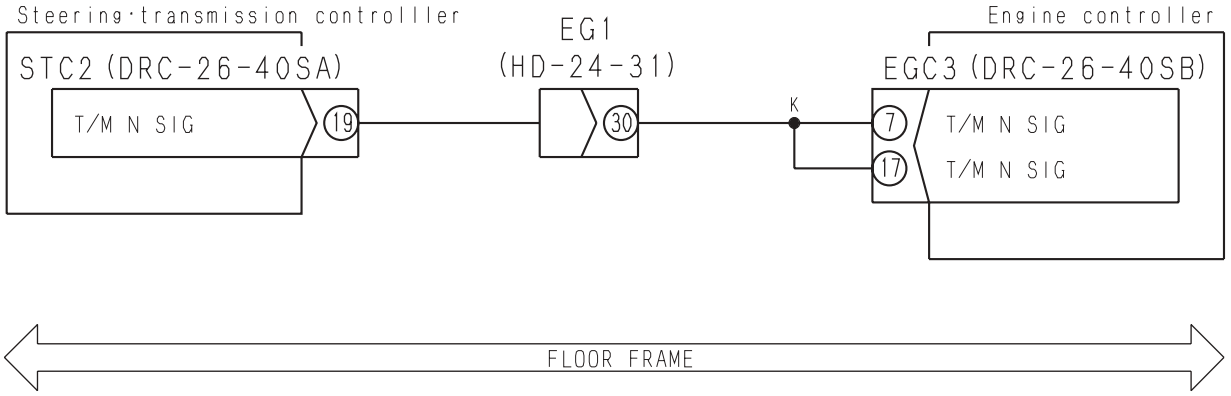
BJD11620

ERROR CODE D5ZFKA (TRANSMISSION NEUTRAL SIGNAL: DISCONNECTION) (KA)

Action code	Error code	Controller code	Trouble	Transmission neutral signal: Disconnection (KA) (Steering and transmission controller system)
E01	D5ZFKA	Steering and transmission		
Contents of trouble	• The transmission neutral signal output line is disconnected.			
Action of controller	• This signal line is for backing up (The main signal is transmitted through the CAN communication network). • Stops outputting the transmission neutral signal.			
Problem that appears on machine	• None in particular.			
Related information	• The state of the transmission neutral signal can be checked in monitoring mode (Code: 40909 input signal) (Code: 40901 input signal). • Method of reproducing error code: Turn starting switch ON and shift transmission in N position.			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC2 (female) (19) – EGC3 (female) (7), (17)		Resistance	Max. 1Ω
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between STC2 (female) (19) – EGC3 (female) (7), (17) with chassis ground		Resistance	Min. 1 MΩ
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between STC2 (female) (19) – ground	Lever in N	Voltage	Max. 1V
				Lever in F or R	Voltage	20 – 30V
	4	Defective engine controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between EGC3 (7), (17) – ground		Voltage	Approx. 7 V

Circuit diagram related to transmission neutral signal



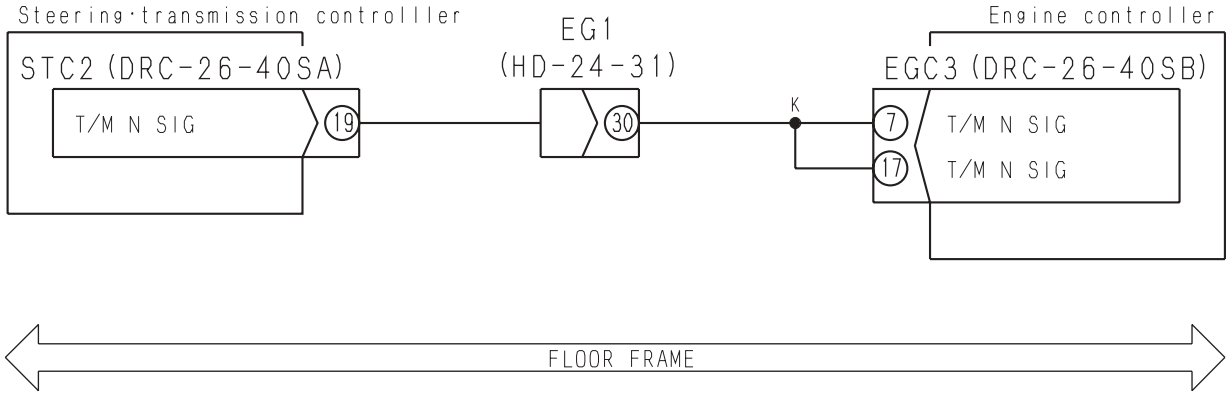
BJD11621

ERROR CODE D5ZFKB (TRANSMISSION NEUTRAL SIGNAL: SHORT CIRCUIT) (KB)

Action code	Error code	Controller code	Trouble	Transmission neutral signal: Short circuit (KB) (Steering and transmission controller system)
E01	D5ZFKB	Steering and transmission		
Contents of trouble	• The transmission neutral signal output line has a short circuit.			
Action of controller	• This signal line is for backing up (The main signal is transmitted through the CAN communication network). • Stops outputting the transmission neutral signal.			
Problem that appears on machine	• None in particular.			
Related information	• The state of the transmission neutral signal can be checked in monitoring mode (Code: 40909 input signal) (Code: 40901 input signal). • Method of reproducing error code: Turn starting switch ON and shift transmission in N position.			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC2 (female) (19) – EGC3 (female) (7), (17)		Resistance	Max. 1Ω
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between STC2 (female) (19) – EGC3 (female) (7), (17) with chassis ground		Resistance	Min. 1 MΩ
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between STC2 (female) (19) – ground	Lever in N	Voltage	Max. 1V
				Lever in F or R	Voltage	20 – 30V
	4	Defective engine controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between EGC3 (7), (17) – ground		Voltage	Approx. 7 V

Circuit diagram related to transmission neutral signal



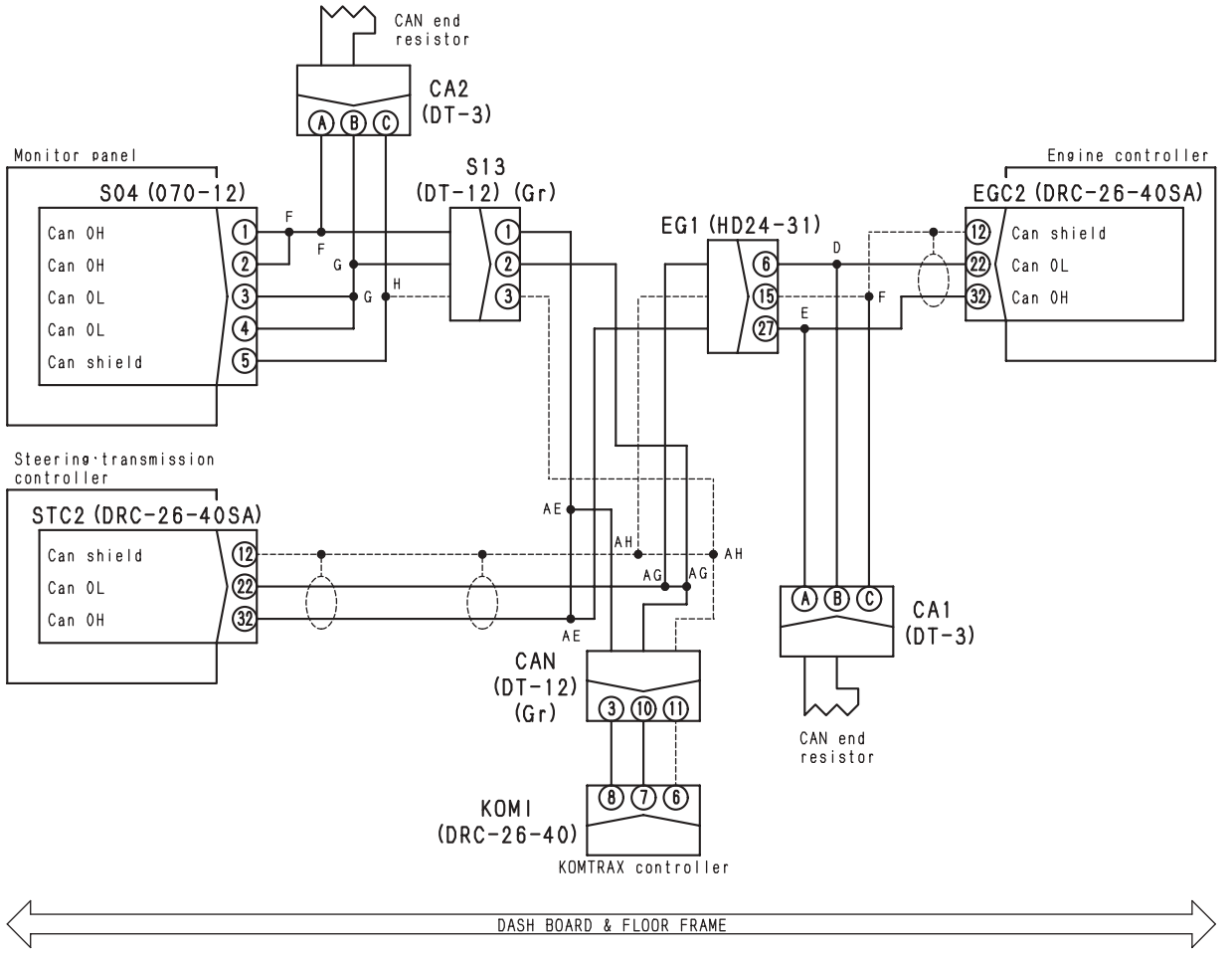
BJD11621

ERROR CODE DAFRKR (MONITOR PANEL CAN COMMUNICATION: DEFECTIVE COMMUNICATION (KR))

Action code	Error code	Controller code	Trouble	Monitor panel CAN communication: Defective communication (KR) (Monitor panel system)
CALL E03	DAFRKR	MON		
Contents of trouble	• Monitor panel cannot recognize steering and transmission controller with CAN communication circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A)	Resistance	Max. 1Ω
			Wiring harness between S04 (female) (3) (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B)	Resistance	Max. 1Ω
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A) with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between S04 (female) (3), (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B) with chassis ground	Resistance	Min. 1MΩ
	3	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A) with chassis ground	Voltage	Max. 1V
			hort circuit of wiring harness between S04 (female) (3), (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B) with chassis ground	Voltage	Max. 1V
	4	Defective CAN terminal resistance	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CA1 (male), CA2 (male)	Resistance	
			Between (A) – (B)	40 – 80Ω	
	5	Defective monitor panel or defective steering and transmission controller	If no problem is found in causes 1 to 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

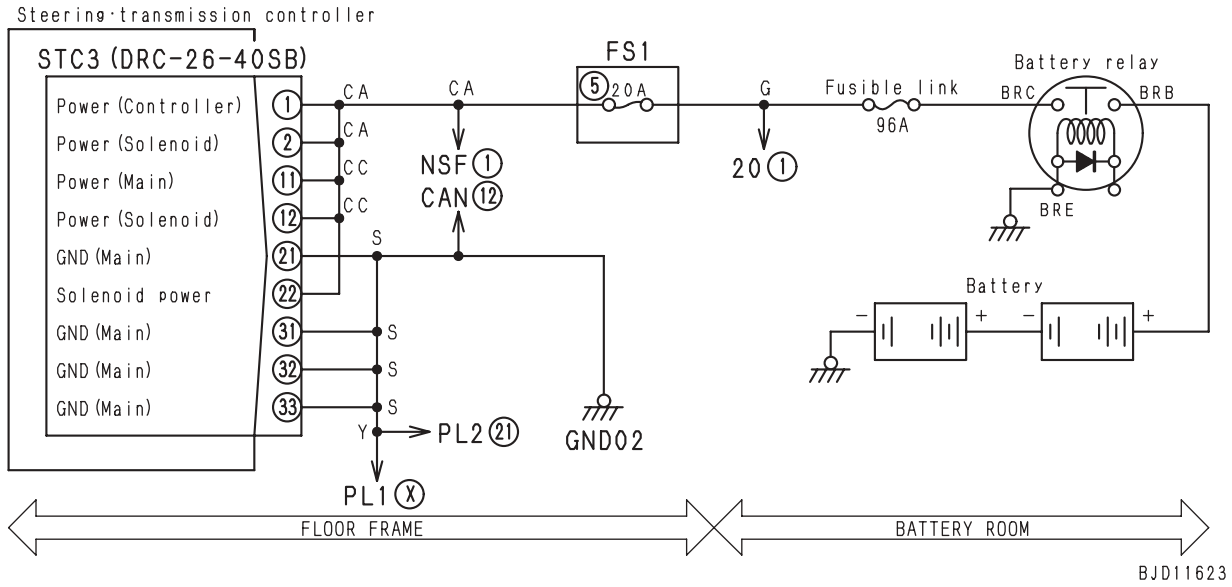


ERROR CODE DAQ0KK DB30KK (STEERING AND TRANSMISSION CONTROLLER: SOURCE VOLTAGE REDUCTION/INPUT (KK))

Action code	Error code	Controller code	Trouble	Steering and transmission controller: Source voltage reduction/ input (KK) (Steering and transmission controller system)
CALL E04	DAQ0KK DB30KK	Steering and transmission		
Contents of trouble	• Source voltage of steering and transmission controller is below 17V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine, transmission, and brake.			
Problem that appears on machine	• Monitor panel may not display normally. • Relays and solenoids cannot operate, not allowing system operate normally. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it cannot travel any more.			
Related information	• Both of DAQ0KK and DB30KK are displayed. • Charge level (voltage) of battery can be checked in monitoring mode. (Code 03200: Battery voltage) • Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fuse FS1-5	If circuit breaker is tripped, circuit probably has short circuit with chassis ground.		
	2	Defective fusible link (96A)	If fusible link is burnout, circuit probably has short circuit with chassis ground.		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC3 (female) (1), (11) – FS1-5	Resistance	Max. 1Ω
			Wiring harness between inlet FS1 – fusible link – battery relay terminal C	Resistance	Max. 1Ω
			Wiring harness between STC3 (female) (21) (31) (32) (33) – chassis ground	Resistance	Max. 1Ω
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC3 (female) (1), (11) – FS1-5 with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between inlet FS1 – fusible link – battery relay terminal C with chassis ground	Resistance	Min. 1MΩ
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC3	Voltage	
			Between (1), (11) – (21), (31), (32), (33)	20 – 30V	

Circuit diagram related to Steering and transmission controller power supply



ERROR CODE DAQ0KT DB30KT (STEERING AND TRANSMISSION CONTROLLER: ABNORMALITY IN CONTROLLER (KT))

Action code	Error code	Controller code	Trouble	Steering and transmission controller: abnormality in controller (KT) (Steering and transmission controller system)
E02	DAQ0KT DB30KT	Steering and transmission		
Contents of trouble	• Information of ROM (nonvolatile storage) of steering and transmission controller is not normal.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Sets default internal adjustment value.			
Problem that appears on machine	• Gear shift feeling of transmission may become worse.			
Related information	• Both of DAQ0KT and DB30KT are displayed. • Method of reproducing error code: Turn starting switch ON.			

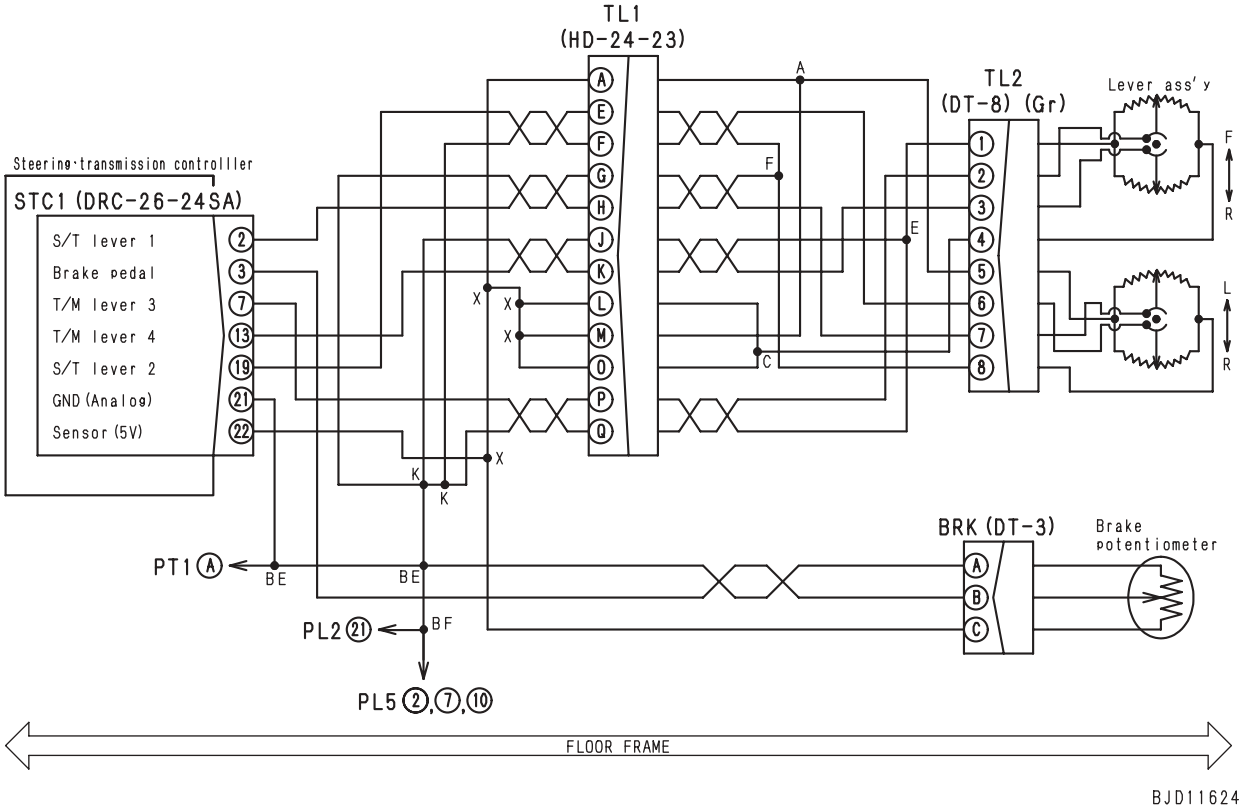
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defective steering and transmission controller	Troubleshooting cannot be carried out since it is internal defect. • Adjust once in the adjustment mode (Code: 0002). (It is no problem even if you use controller unless no visible problem appears on machine.)

ERROR CODE DAQ5KK DB35KK (STEERING AND TRANSMISSION CONTROLLER SENSOR 5V POWER SUPPLY: SOURCE VOLTAGE REDUCTION/INPUT (KK))

Action code	Error code	Controller code	Trouble	Steering and transmission controller potentiometer power supply: Source voltage reduction/input (KK) (Steering and transmission controller system)
CALL 03	DAQ5KK DB35KK	Steering and transmission		
Contents of trouble	• Voltage of 5V power supply circuit of steering and transmission controller sensor is below 4.5V or above 5.5V. • Abnormal current flowed in 5V power supply circuit of steering and transmission controller sensor.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops output to 5V power supply circuit if abnormal voltage flows • Limits operation of engine and transmission.			
Problem 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 an R1.			
Related information	• Both of DAQ5KK and DB35KK are displayed. • Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective brake potentiometer (Internal short circuit)	When the connector shown at right is disconnected, if the service code is lighted up (to indicate returning to normal), the cause is an internal trouble. ★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			BRK connector
	2	Defective forward-reverse potentiometer (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			TL2 (male)		Resistance	
			Sensor 1 (FR3)	Between (4) – (1)	2kΩ ± 20%	
				Between (4) – chassis ground	Min. 1MΩ	
	3	Defective steering potentiometer (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			TL1 (male)		Resistance	
			Sensor 1 (ST1) Sensor 2 (ST2)	Between (A) – (G)	3.2kΩ ± 20%	
				Between (A) – chassis ground	Min. 1MΩ	
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between STC1 (female) (22) – TL2 (female) (5), – TL2 (female) (4), – BRK (female) (C) with chassis ground		Resistance	Min. 1MΩ
	5	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Short circuit of wiring harness between STC1 (female) (22) – TL2 (female) (5), – TL2 (female) (4), – BRK (female) (C) with chassis ground		Voltage	Max. 1V
	6	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			STC1		Voltage	
			Between (22) – (21)		4.5 – 5.5V	

Circuit diagram related to steering and transmission controller 5V power supply

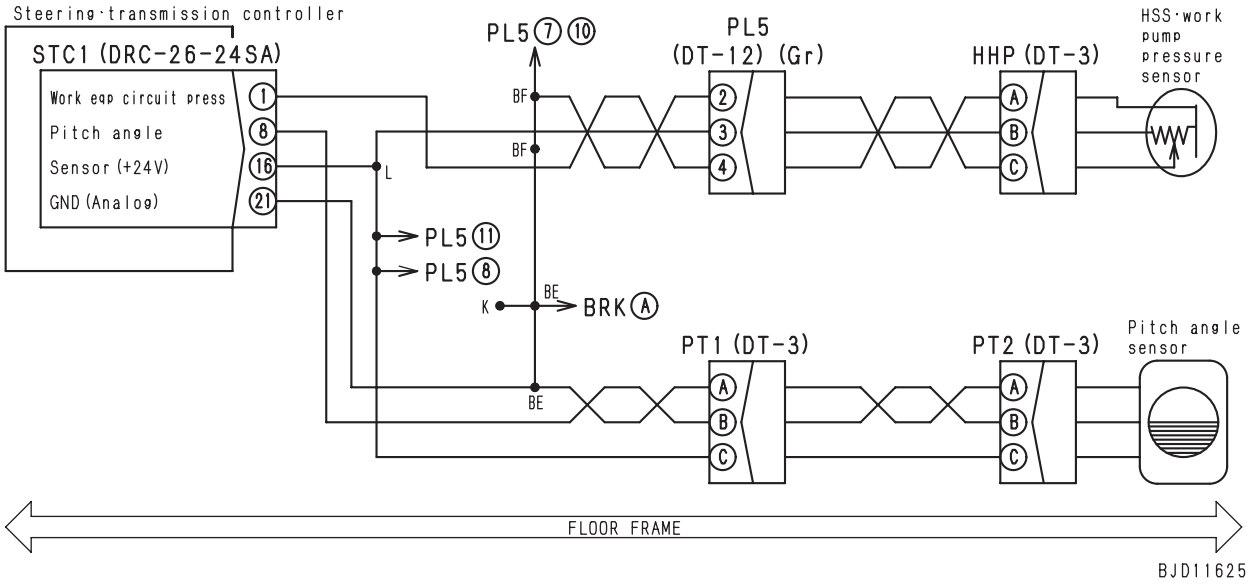


ERROR CODE DAQ6KK DB36KK (STEERING AND TRANSMISSION CONTROLLER SENSOR POWER SUPPLY: SOURCE VOLTAGE REDUCTION/INPUT (KK))

Action code	Error code	Controller code	Trouble	Steering and transmission controller sensor power supply: Source voltage reduction/input (KK) (Steering and transmission controller system)
E01	DAQ6KK DB36KK	Steering and transmission		
Contents of trouble	• Voltage of 24V power supply circuit of steering and transmission controller sensor is below 17V or above 30V. • Abnormal current flowed in 24V power supply circuit of steering and transmission controller sensor.			
Action of controller	• Stops output to 24V power supply circuit if abnormal voltage flows			
Problem that appears on machine	• Oil pressure of work equipment cannot be monitored in service mode.			
Related information	• Both of DAQ6KK and DB36KK are displayed. • Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective HSS and work equipment pump oil pressure sensor (Internal short circuit)	It is internal defect if error code lights on (reset display) when disconnecting right connector. ★Disconnect connector with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		HHP connector
	2	Defective angle of inclination sensor (Internal short circuit)	It is internal defect if service code lights on (reset display) when disconnecting right connector. ★Disconnect connector with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		PT2 connector
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC1 (female) (16) – HHP (female) (B) – PT2 (female) (C) with chassis ground	Resistance	Min. 1MΩ
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC1	Voltage	
			(16) – (21)	20 – 30V	

Circuit diagram related to steering and transmission controller 24V power supply

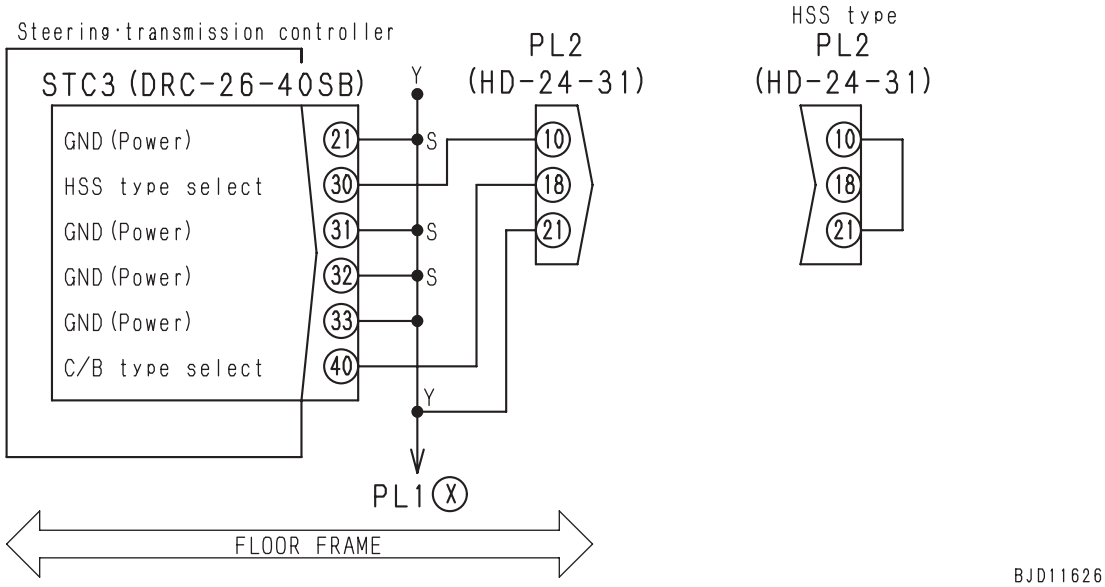


ERROR CODE DAQ9KQ DB39KQ (STEERING AND TRANSMISSION CONTROLLER TYPE COLLATION: TYPE SELECT SIGNAL INCONSISTENCY (KQ))

Action code	Error code	Controller code	Trouble	Steering and transmission controller type collation: type select signal inconsistency (KQ) (Steering and transmission controller system)
CALL E04	DAQ9KQ DB39KQ	Steering and transmission		
Contents of trouble	• Internal spec. setting of steering and transmission controller is inconsistent with spec. set signal.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops all outputs to steering and transmission controller. • Limits operation of engine, transmission, and brake.			
Problem 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 cannot travel any more.			
Related information	• Both of DAQ9KQ and DB39KQ are displayed. • Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective steering and transmission controller adjustment	It is normal if error code lights on (reset display) after carrying out adjustment mode. • Adjustment code: 0002: Steering and transmission controller spec.		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC3 (female) (30) with chassis ground	Resistance	Max. 1Ω
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC3	Voltage	
			Between (30) – chassis ground	Max. 1V	

Circuit diagram related to transmission controller type selec

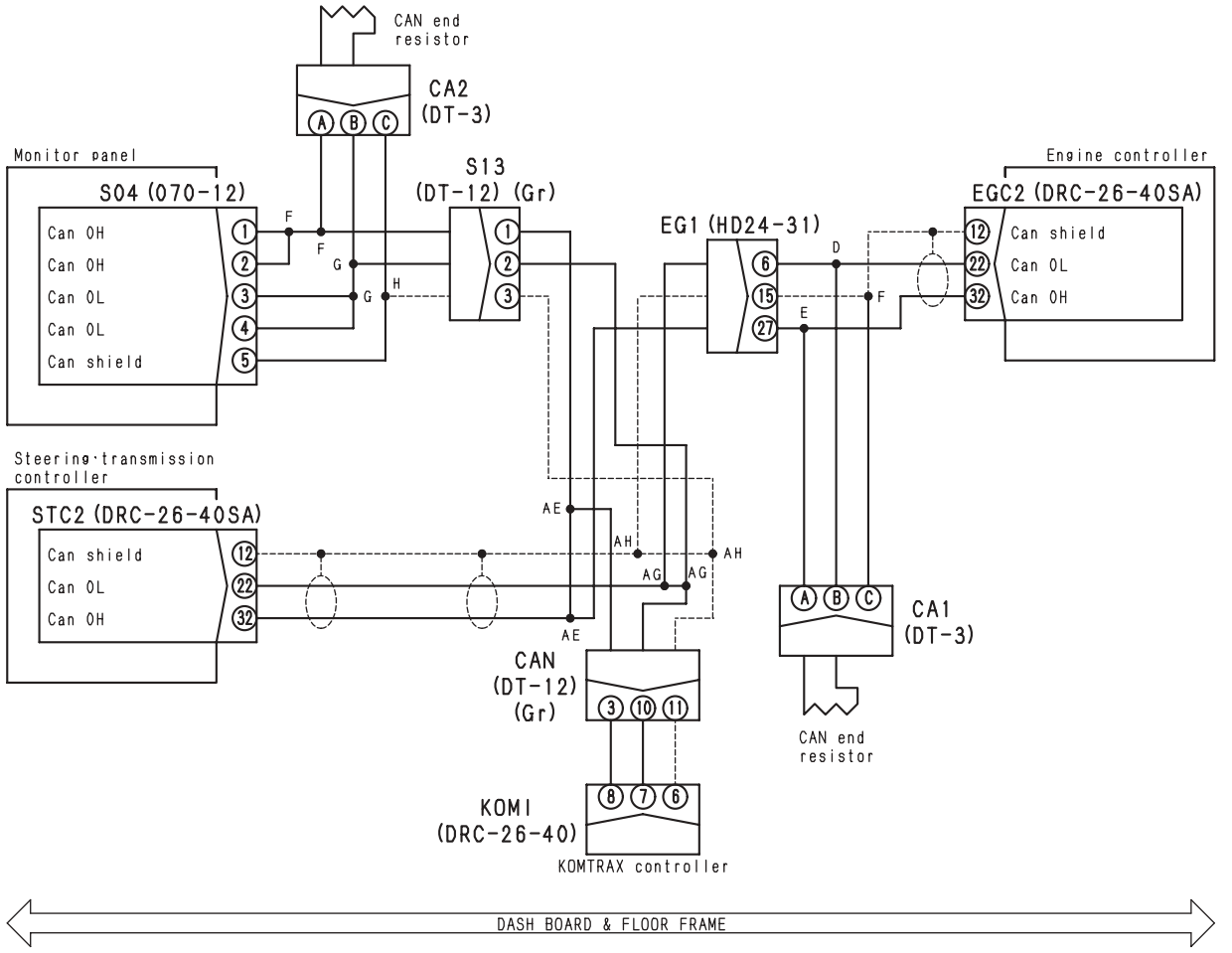


ERROR CODE DAQRKR DB3RKR (STEERING AND TRANSMISSION CONTROLLER CAN COMMUNICATION: DEFECTIVE COMMUNICATION (KR))

Action code	Error code	Controller code	Trouble	Steering and transmission controller CAN communication: Defective communication (KR) (Steering and transmission controller system)
CALL E03	DAQRKR DB3RKR	Steering and transmission		
Contents of trouble	• Steering and transmission controller cannot recognize monitor panel, or engine controller with CAN communication circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Both of DAQRKR and DB3RKR are displayed. • Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A)	Resistance	Max. 1Ω
			Wiring harness between S04 (female) (3) (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B)	Resistance	Max. 1Ω
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A) with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between S04 (female) (3), (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B) with chassis ground	Resistance	Min. 1MΩ
	3	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A) with chassis ground	Voltage	Max. 1V
			Short circuit of wiring harness between S04 (female) (3), (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B) with chassis ground	Voltage	Max. 1V
	4	Defective CAN terminal resistance	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CA1 (male), CA2 (male)	Resistance	
			Between (A) – (B)	40 – 80Ω	
	5	Defective monitor panel, defective engine controller, defective steering and transmission controller	If no problem is found in causes 1 to 4, it is suspected that monitor panel, engine controller, or steering and transmission controller. (Troubleshooting cannot be carried out since it is internal defect.)		

Circuit diagram related to CAN communication

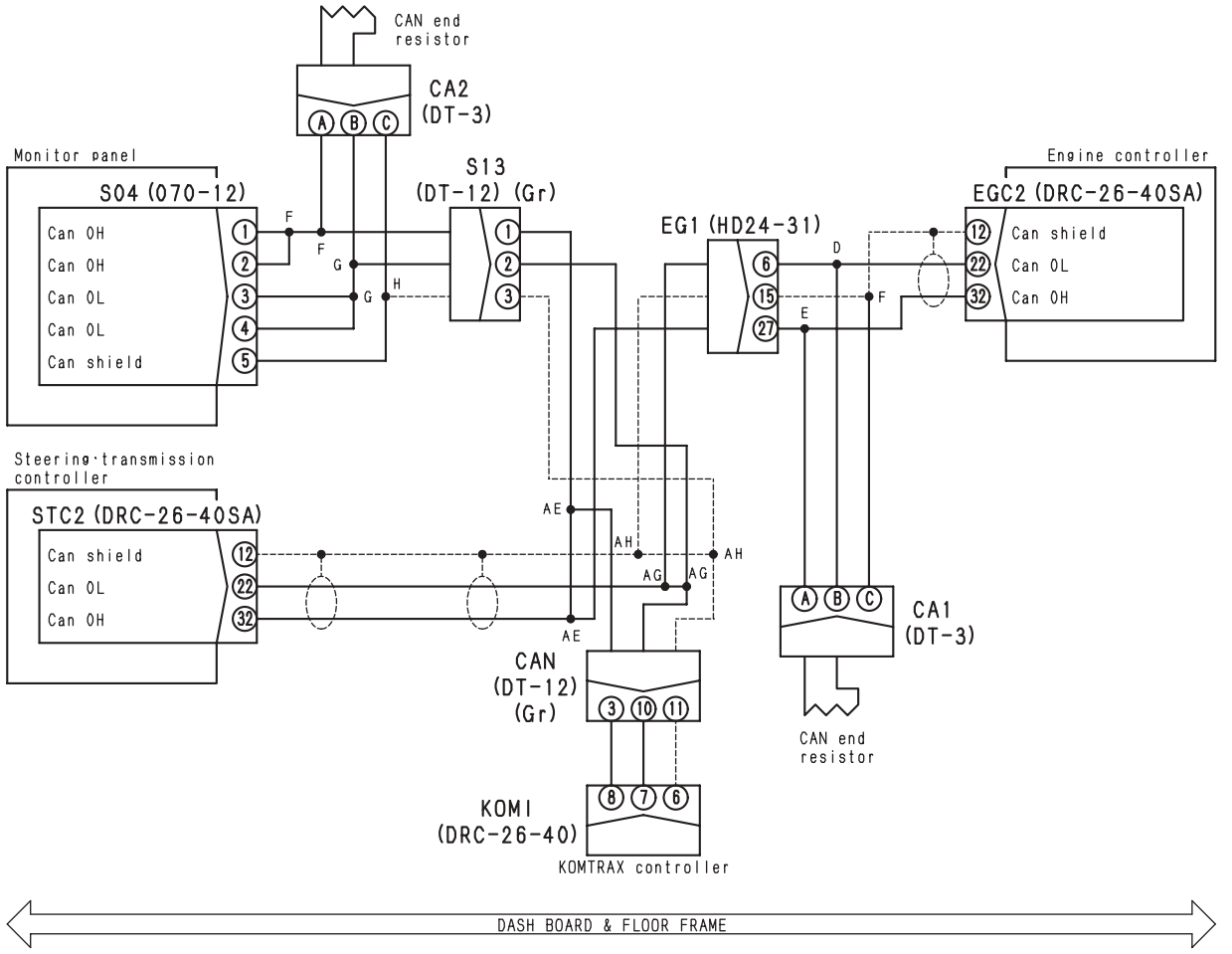


ERROR CODE DB20KQ (ENGINE CONTROLLER TYPE COLLATION: TYPE SELECT CODE INCONSISTENCY (KQ))

Action code	Error code	Controller code	Trouble	Engine controller type collation: Type select code inconsistency (KQ) (Engine controller system)
CALL E03	DB29KQ	ENG		
Contents of trouble	• Type collation code directly acquired by engine controller is inconsistent with type collation code acquired via communication.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Controls it as default-set type. • Limits operation of engine.			
Problem that appears on machine	• Machine does not provide normal output. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.			
Related information	• Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Installation of wrong engine controller	Check part No. of engine controller.		
			If part No. is correct, controller may have trouble in it.		
	2	Installation of wrong steering and transmission controller	Check part No. of steering and transmission controller.		
			If part No. is correct, controller may have trouble in it.		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A)	Resistance	Max. 1Ω
			Wiring harness between S04 (female) (3) (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B)	Resistance	Max. 1Ω
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A) with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between S04 (female) (3), (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B) with chassis ground	Resistance	Min. 1MΩ
	5	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A) with chassis ground	Voltage	Max. 1V
			Short circuit of wiring harness between S04 (female) (3), (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B) with chassis ground	Voltage	Max. 1V
	6	Defective CAN terminal resistance	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CA1 (male), CA2 (male)	Resistance	
			Between (A) – (B)	40 – 80Ω	
	7	Defective monitor panel or defective steering and transmission controller	If no problem is found in causes 1 to 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 engine controller type select

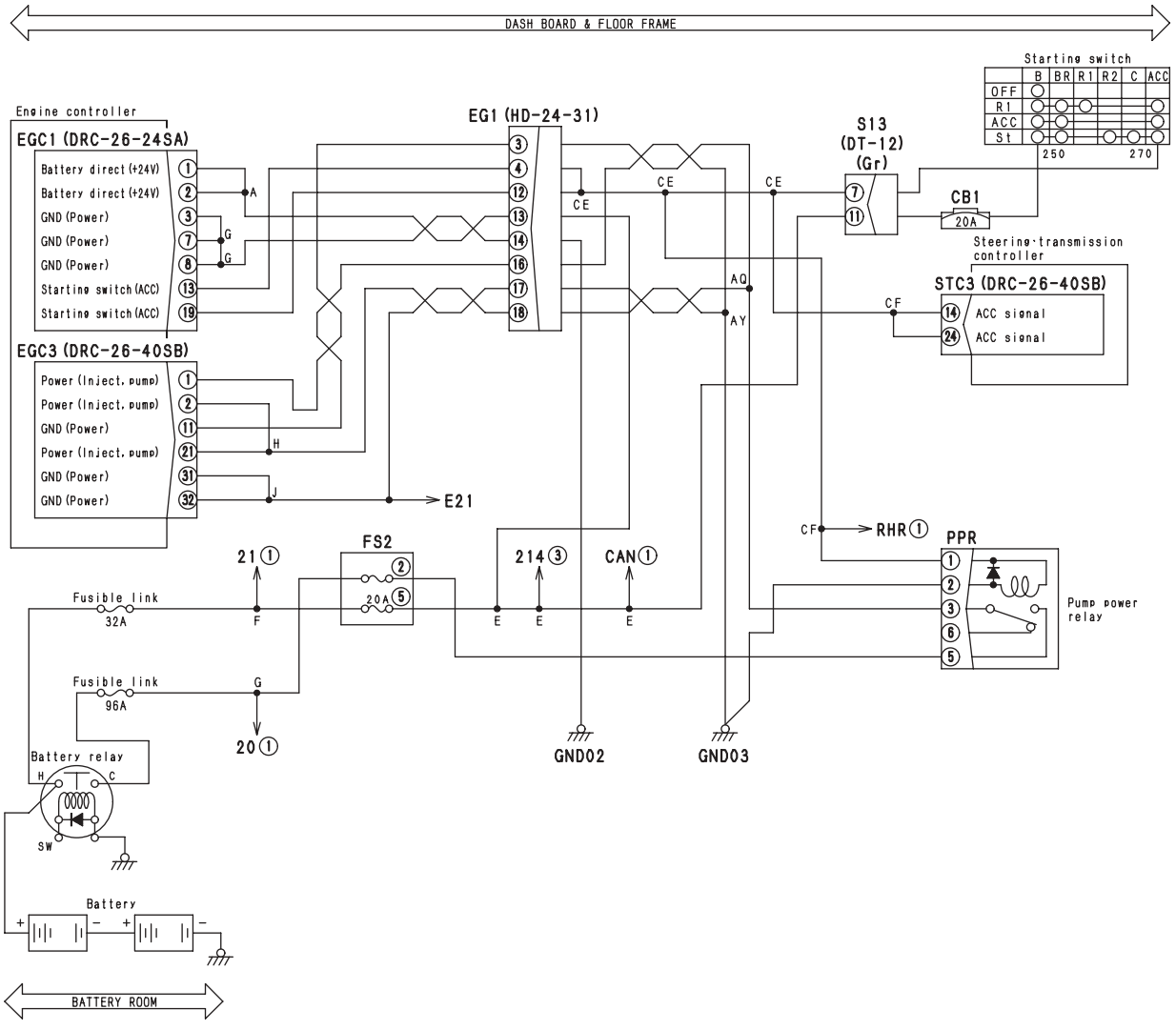


ERROR CODE DB20KT (ENGINE CONTROLLER: ABNORMALITY IN CONTROLLER (KT))

Action code	Error code	Controller code	Trouble	Engine controller: Abnormality in controller (KT) (Engine controller system)
CALL E03	DB20KT	ENG		
Contents of trouble	• Problem occurred in engine controller.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Cannot operate fuel injector solenoid well or stops output. • Limits operation of engine and transmission.			
Problem that appears on machine	• Engine may stop during operation or engine may not start. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.			
Related information	• Method of reproducing error code: Turn starting switch ON.			

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between EGC3 (female) (11), (31), (32) with chassis ground	Resistance	Max. 1Ω
	2	Defective engine controller	Troubleshooting cannot be carried out since it is internal defect.		

Circuit diagram related to engine controller power supply



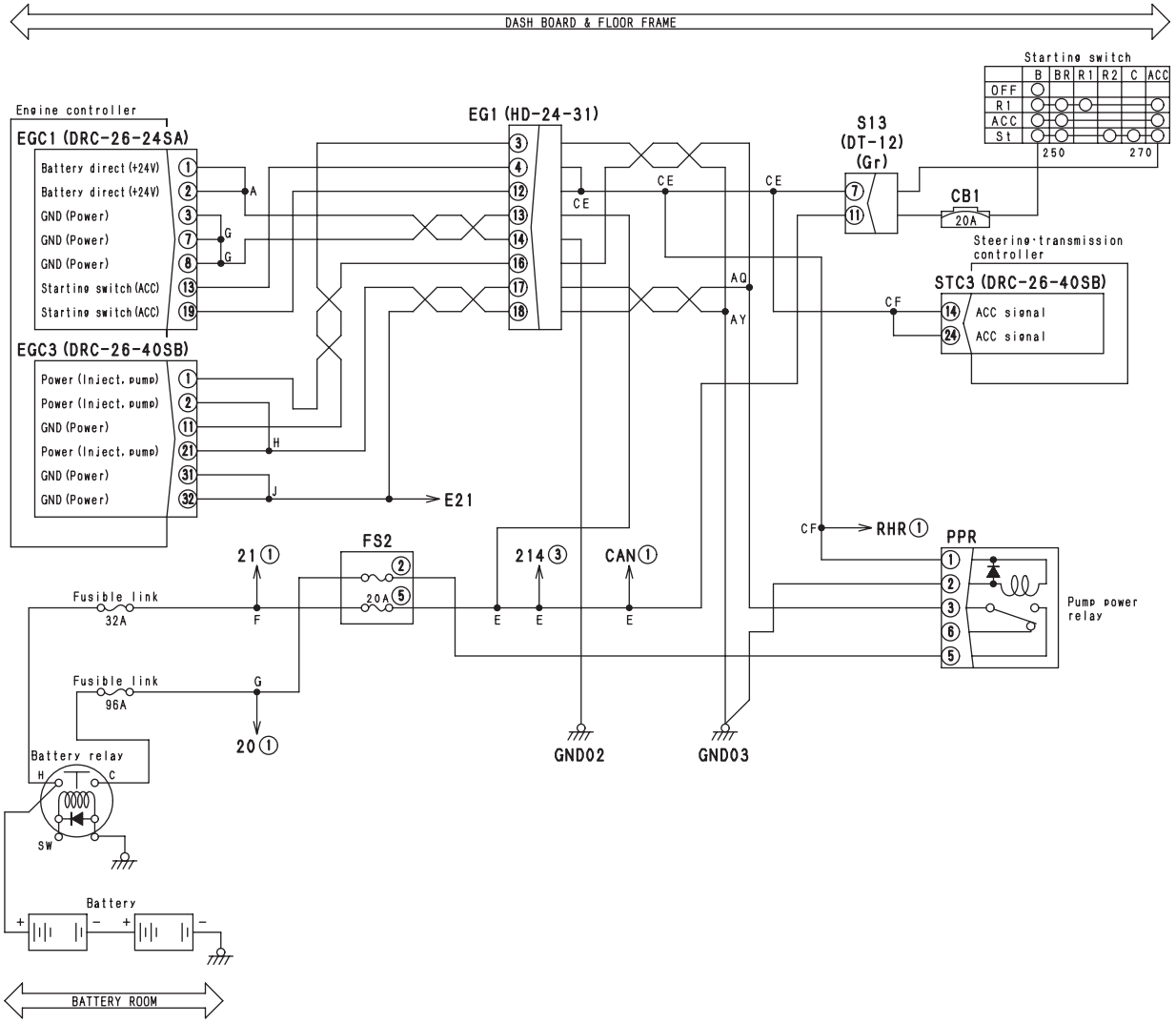
BJD11620

ERROR CODE DB22KK (ENGINE CONTROLLER LOAD POWER SUPPLY: SOURCE VOLTAGE REDUCTION/INPUT (KK))

Action code	Error code	Controller code	Trouble	Engine controller load power supply: Source voltage reduction/ input (KK) (Engine controller system)
CALL E04	DB22KK	ENG		
Contents of trouble	• Load source voltage of engine controller is below 17V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine, transmission, and brake.			
Problem that appears on machine	• Engine may stop during operation or engine may not start. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it cannot travel any more.			
Related information	• Charge level (voltage) of battery can be checked in monitoring mode. (Code 03200: Battery voltage) • Method of reproducing error code: Turn starting switch ON. ★This error code detects abnormality in engine controller load power supply.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fuse (FS1-2)	If fuse is burnout, circuit probably has short circuit with chassis ground.		
	2	Defective fusible link (96A)	If fusible link is burnout, circuit probably has short circuit with chassis ground.		
	3	Defective engine controller load power supply relay (Internal disconnection)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			If error code lights on (reset display) by replacing right connector with other relay, engine controller load power supply relay is defective.		PPR
	4	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC3 (female) (1), (2), (21) – PPR (female) (3)	Resistance	Max. 1Ω
			Wiring harness between PPR (female) (5) – FS1-2 outlet port	Resistance	Max. 1Ω
			Wiring harness between FS1-2 inlet port – fusible link – battery relay terminal C	Resistance	Max. 1Ω
	5	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between EGC1 (female) (13), (19) – starting switch 270 with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between starting switch 250 – CB1 – FS2 (5) with chassis ground	Resistance	Min. 1MΩ
			Wiring harness between FS2 (5) – fusible link – battery relay terminal H	Resistance	Min. 1MΩ
	6	Defective engine controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			EGC3	Voltage	
			Between (1), (2), (21) – (11), (31), (32)	20 – 30V	

Circuit diagram related to engine controller power supply



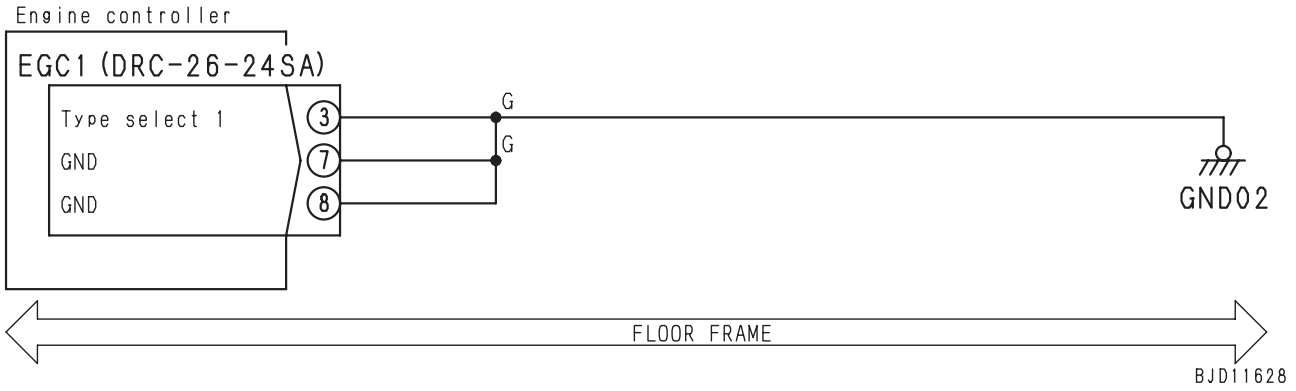
BJD11620

ERROR CODE DB29KQ (ENGINE CONTROLLER TYPE SELECT: TYPE SELECT SIGNAL INCONSISTENCY (KQ))

Action code	Error code	Controller code	Trouble	Engine controller type select: Type select signal inconsistency (KQ) (Engine controller system)
CALL E03	DB29KQ	ENG		
Contents of trouble	• Type select signal directly acquired by engine controller is inconsistent with type select signal acquired via communication.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Controls it as default-set type. • Limits operation of engine and transmission.			
Problem that appears on machine	• Machine does not provide normal output. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.			
Related information	• Method of reproducing error code: Turn starting switch ON.			

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC1 (female) (3) – chassis ground	Resistance	Max. 1Ω
	2	Defective engine controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			EGC1	Resistance	
			Between (3) – chassis ground	Max. 1Ω	
			Between (7), (8) – chassis ground	Max. 1Ω	

Circuit diagram related to engine controller type select



ERROR code DB2AMA (FUEL INJECTION AMOUNT ADJUSTMENT SWITCH SIGNAL: MALFUNCTION (MA))

Action code	Error code	Controller code	Trouble	Fuel injection amount adjustment switch signal: Malfunction (MA) (Engine controller system)
CALL E03	DB2AMA	ENG		
Contents of trouble	• Fuel injection amount adjustment switch is not set at correct position.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem that appears on machine	• Fuel injection amount adjustment setting cannot be changed. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.			
Related information	• Method of reproducing error code: Turn starting switch ON.			

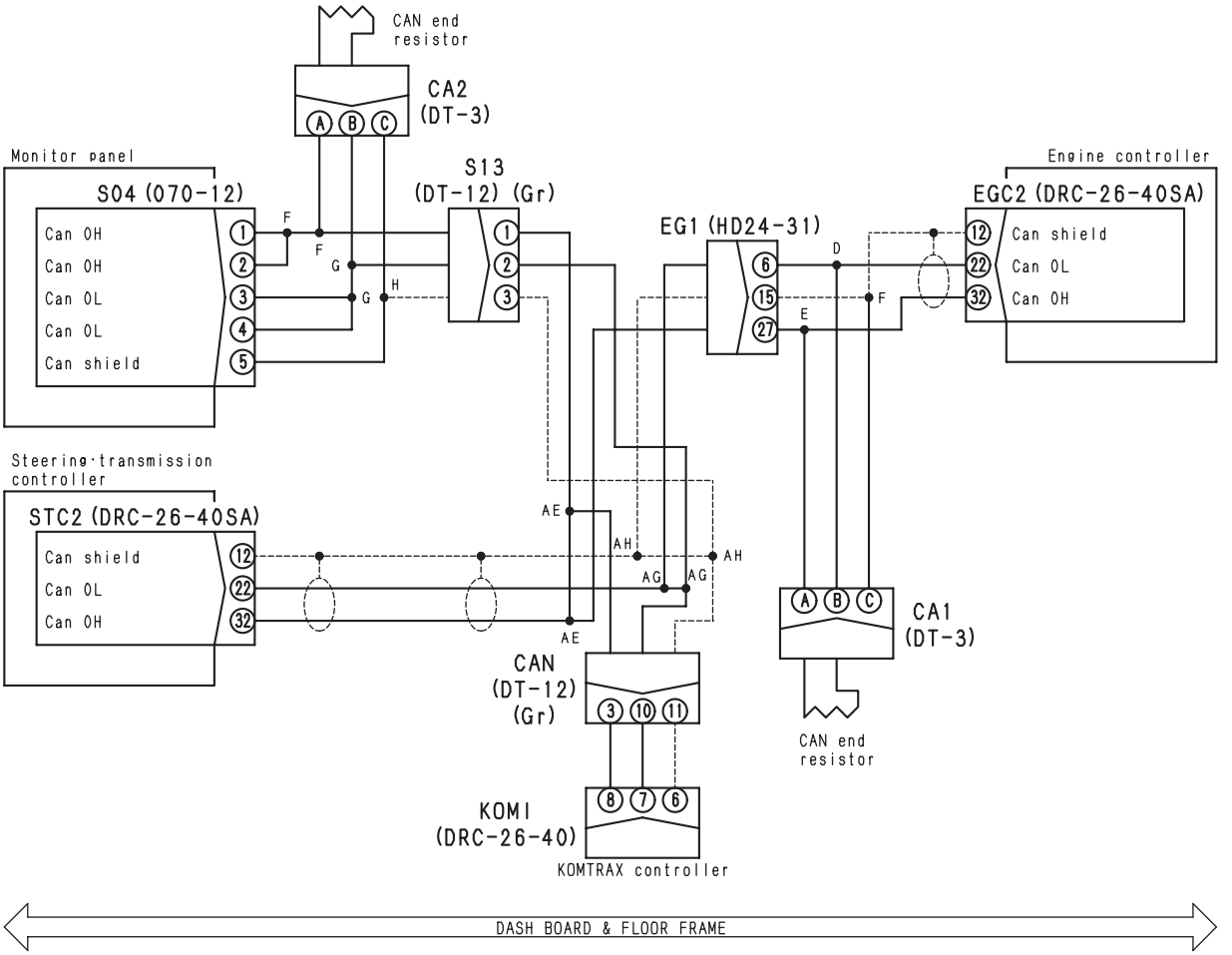
	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Defective fuel injection amount adjustment switch setting	If both fuel injection amount adjustment switches 1 and 2 are set at [F], fuel injection amount adjustment switch setting is defective.
	2	Defective engine controller	If no problem is found in above cause, it is suspected that engine controller is defective.

ERROR CODE DB2RKR (ENGINE CONTROLLER CAN COMMUNICATION: DEFECTIVE COMMUNICATION (KR))

Action code	Error code	Controller code	Trouble	Engine controller CAN communication: Defective communication (KR) (Engine controller system)
CALL E03	DB2RKR	ENG		
Contents of trouble	• Engine controller cannot recognize steering and transmission controller with CAN communication circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A)	Resistance	Max. 1Ω
			Wiring harness between S04 (female) (3), (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B)	Resistance	Max. 1Ω
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A) with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between S04 (female) (3), (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B) with chassis ground	Resistance	Min. 1MΩ
	3	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A) with chassis ground	Voltage	Max. 1V
			Short circuit of wiring harness between S04 (female) (3), (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B) with chassis ground	Voltage	Max. 1V
	4	Defective CAN terminal resistance	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CA1 (male), CA2 (male)	Resistance	
			Between (A) – (B)	40 – 80Ω	
	5	Defective engine controller, defective steering and transmission controller	If no problem is found in causes 1 to 4, it is suspected that engine controller, steering and transmission controller is defective. (Troubleshooting cannot be carried out since it is internal defect.)		

Circuit diagram related to CAN communication

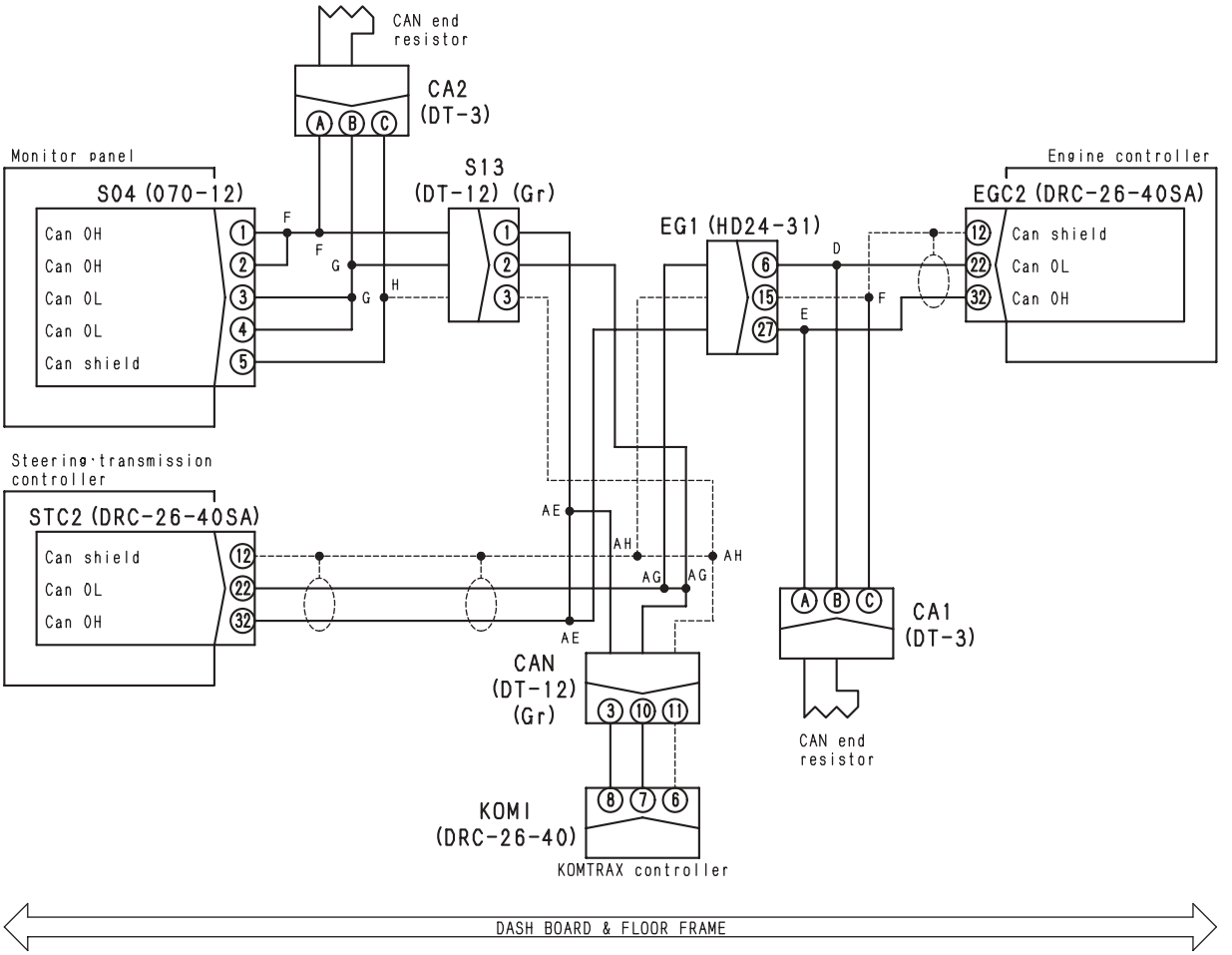


ERROR CODE DB2RMC (STEERING AND TRANSMISSION CONTROLLER CAN COMMUNICATION: DEFECTIVE COMMUNICATION (MC))

Action code	Error code	Controller code	Trouble	Steering and transmission controller CAN communication: Defective communication (MC) (Steering and transmission controller system)
CALL E03	DB2RMC	ENG		
Contents of trouble	• Steering and transmission controller cannot recognize engine controller with CAN communication circuit.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A)	Resistance	Max. 1Ω
			Wiring harness between S04 (female) (3), (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B)	Resistance	Max. 1Ω
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A) with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between S04 (female) (3), (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B) with chassis ground	Resistance	Min. 1MΩ
	3	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between S04 (female) (1), (2) – STC2 (female) (32) – EGC2 (female) (32) – CA1 (female) (A) – CA2 (female) (A) with chassis ground	Voltage	Max. 1V
			Short circuit of wiring harness between S04 (female) (3), (4) – STC2 (female) (22) – EGC2 (female) (22) – CA1 (female) (B) – CA2 (female) (B) with chassis ground	Voltage	Max. 1V
	4	Defective CAN terminal resistance	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CA1 (male), CA2 (male)	Resistance	
			Between (A) – (B)	40 – 80Ω	
	5	Defective steering and transmission controller, defective engine controller	If no problem is found in causes 1 to 4, it is suspected that steering and transmission controller, engine controller is defective. (Troubleshooting cannot be carried out since it is internal defect.)		

Circuit diagram related to CAN communication



ERROR CODE DB30KK DAQ0KK (STEERING AND TRANSMISSION CONTROLLER: SOURCE VOLTAGE REDUCTION/INPUT (KK))

★ See DAQ0KK.

ERROR CODE DB30KT DAQ0KT (STEERING AND TRANSMISSION CONTROLLER: ABNORMALITY IN CONTROLLER (KT))

★ See DAQ0KT.

ERROR CODE DB35KK DAQ5KK (STEERING AND TRANSMISSION CONTROLLER ENSOR 5V POWER SUPPLY: SOURCE VOLTAGE REDUCTION/INPUT (KK))

★ See DAQ5KK.

ERROR CODE DB36KK DAQ6KK (STEERING AND TRANSMISSION CONTROLLER SENSOR 24V POWER SUPPLY: SOURCE VOLTAGE REDUCTION/INPUT (KK))

★ See DAQ6KK.

ERROR CODE DB39KQ DAQ9KQ (STEERING AND TRANSMISSION CONTROLLER TYPE COLLATION: TYPE SELECT SIGNAL INCONSISTENCY (KQ))

★ See DAQ9KQ.

ERROR CODE DB3RKR DAQRKR (STEERING AND TRANSMISSION CONTROLLER CAN COMMUNICATION: DEFECTIVE COMMUNICATION (KR))

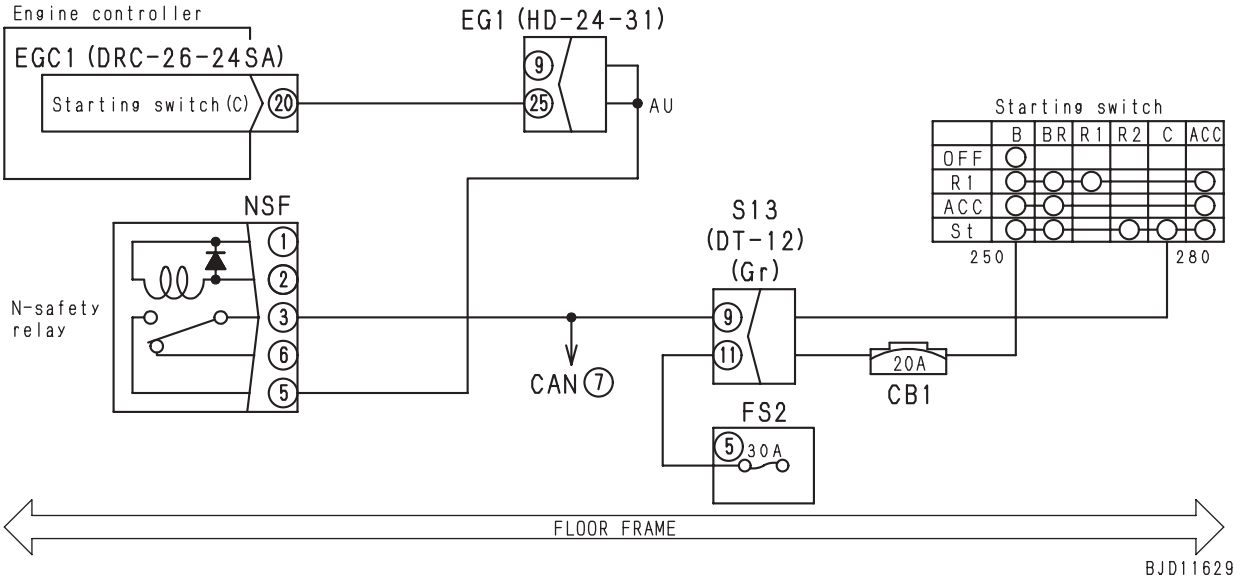
★ See DAQRKR.

ERROR CODE DD11KB (STARTING SWITCH: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Starting switch: Short circuit (KB) (Engine controller system)
CALL E04	DD11KB	ENG		
Contents of trouble	• Signal C of starting switch is input during running of engine.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine, transmission, and brake.			
Problem 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 cannot travel any more.			
Related information	• Method of reproducing error code: Start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective adjustment of starting engine (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting with starting switch OFF or ON.		
			Starting switch	Starting switch	Resistance
			Between 250 (B) – 280 (C)	When OFF/ON	Min. 1MΩ
	2	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between EGC1 (female) (20) – NSF (female) (5) with chassis ground	Voltage	Max. 1V
			Short circuit of wiring harness between NSF (female) (3) – starting switch 280 with chassis ground	Voltage	Max. 1V
	3	Defective engine controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			EGC1	Voltage	
			Between (20) – chassis ground	Max. 1V	

Circuit diagram related to starting switch signal C

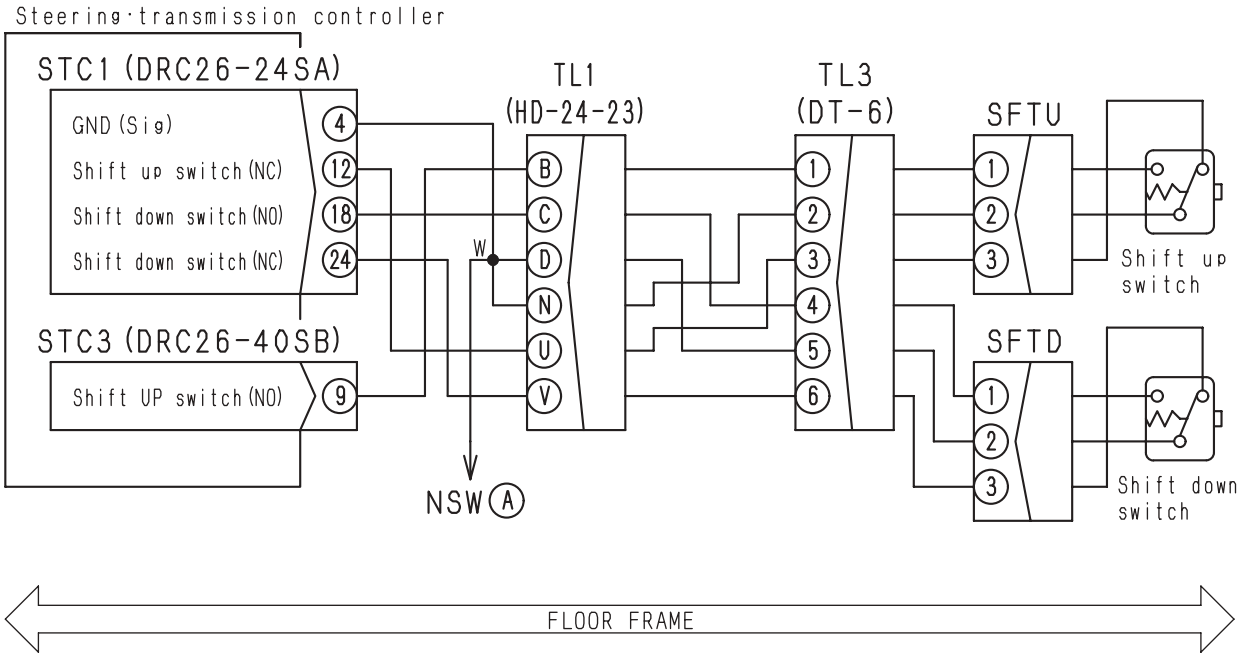


ERROR CODE DD12KA (SHIFT UP SWITCH: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Shift up switch: Disconnection (KA) (Steering and transmission controller system)
E02	DD12KA	Steering and transmission		
Contents of trouble	• Signals of two systems of shift up switch circuit were turned OFF (OPEN) at the same time.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Recognizes that switch is not pressed.			
Problem that appears on machine	• Shift up is not possible. • Auto shift down does not function.			
Related information	• Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input state (ON/OFF) from shift up switch can be checked in monitoring mode. (Code 40905: Steering and transmission controller input signal 1) • Method of reproducing error code: Turn starting switch ON and operate shift up switch.			

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting			
	1	Defective shift up switch (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			SFTU (male)	Shift up switch		
				OFF (Release)	ON (Press)	
			Resistance between (2) – (3)	Max. 1Ω	Min. 1MΩ	
			Resistance between (2) – (1)	Min. 1MΩ	Max. 1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between TMCN1 (female) (12) – SFTU (female) (3)	Resistance	Max. 1Ω	
			Wiring harness between TMCN2 (female) (9) – SFTU (female) (1)	Resistance	Max. 1Ω	
			Wiring harness between TMCN1 (female) (4) – SFTU (female) (2)	Resistance	Max. 1Ω	
	3	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.			
			Short circuit of wiring harness between STC1 (female) (12) – TL1 (female) (3) with chassis ground	Voltage	Max. 1V	
			Short circuit of wiring harness between STC1 (female) (9) – TL1 (female) (1) with chassis ground	Voltage	Max. 1V	
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.			
			STC1, STC3	Shift up switch		
				OFF (Release)	ON (Press)	
			Voltage between STC1 (12) – STC1 (4)	Max. 1V	5 – 11V	
			Voltage between STC3 (9) – STC1 (4)	5 – 11V	Max. 1V	

Circuit diagram related to shift up switch and shift down switch



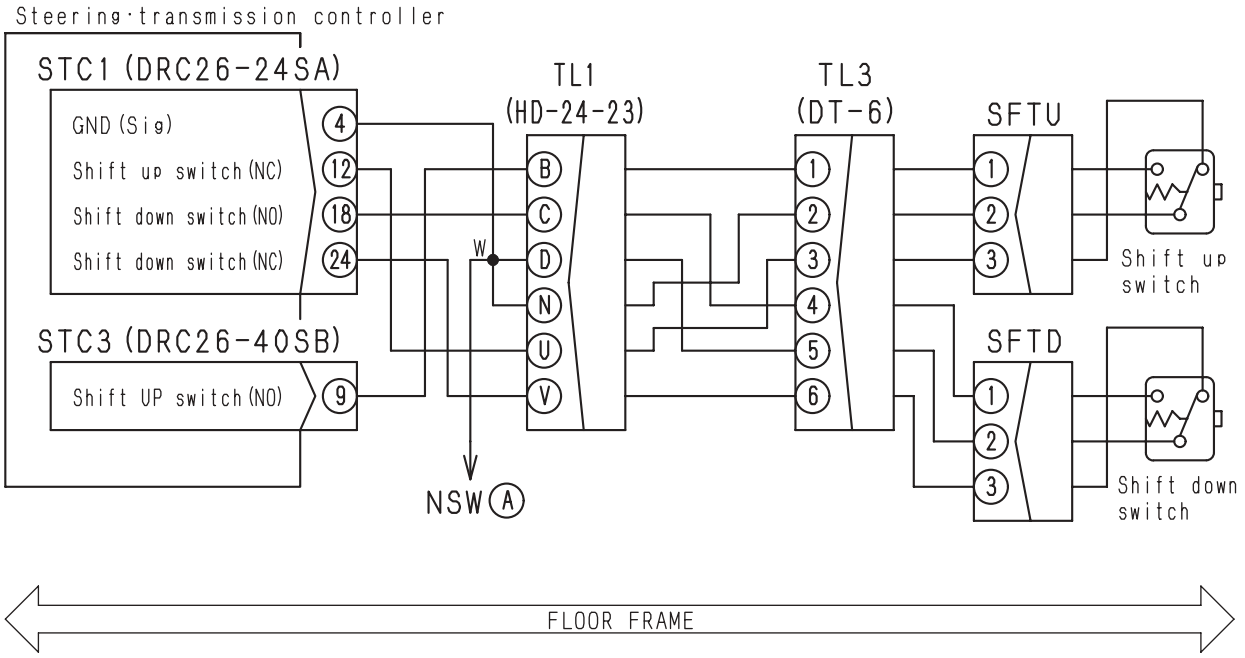
BJD11630

ERROR CODE DD12KB (SHIFT UP SWITCH: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Shift up switch: Short circuit (KB) (Steering and transmission controller system)
E02	DD12KB	Steering and transmission		
Contents of trouble	• Signals of two systems of shift up switch circuit were turned ON (CLOSE) at the same time.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Recognizes that switch is not pressed.			
Problem that appears on machine	• Shift up is not possible. • Auto shift down does not function.			
Related information	• Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input state (ON/OFF) from shift up switch can be checked in monitoring mode. (Code 40905: Steering and transmission controller input signal 1) • Method of reproducing error code: Turn starting switch ON and operate shift up switch.			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective shift up switch (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			SFTU (male)	Shift up switch		
				OFF (Release)	ON (Press)	
			Resistance between (2) – (3)	Max. 1Ω	Min. 1MΩ	
			Resistance between (2) – (1)	Min. 1MΩ	Max. 1Ω	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between STC1 (female) (12) – SFTU (female) (3) with chassis ground	Resistance	Min. 1MΩ	
			Short circuit of wiring harness between STC3 (female) (9) – SFTU (female) (1) with chassis ground	Resistance	Min. 1MΩ	
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.			
			STC1, STC3	Shift up switch		
				OFF (Release)	ON (Press)	
			Voltage between STC1 (12) – STC1(4)	Max. 1V	5 – 11V	
			Voltage between STC3 (9) – STC1(4)	5 – 11V	Max. 1V	

Circuit diagram related to shift up switch and shift down switch



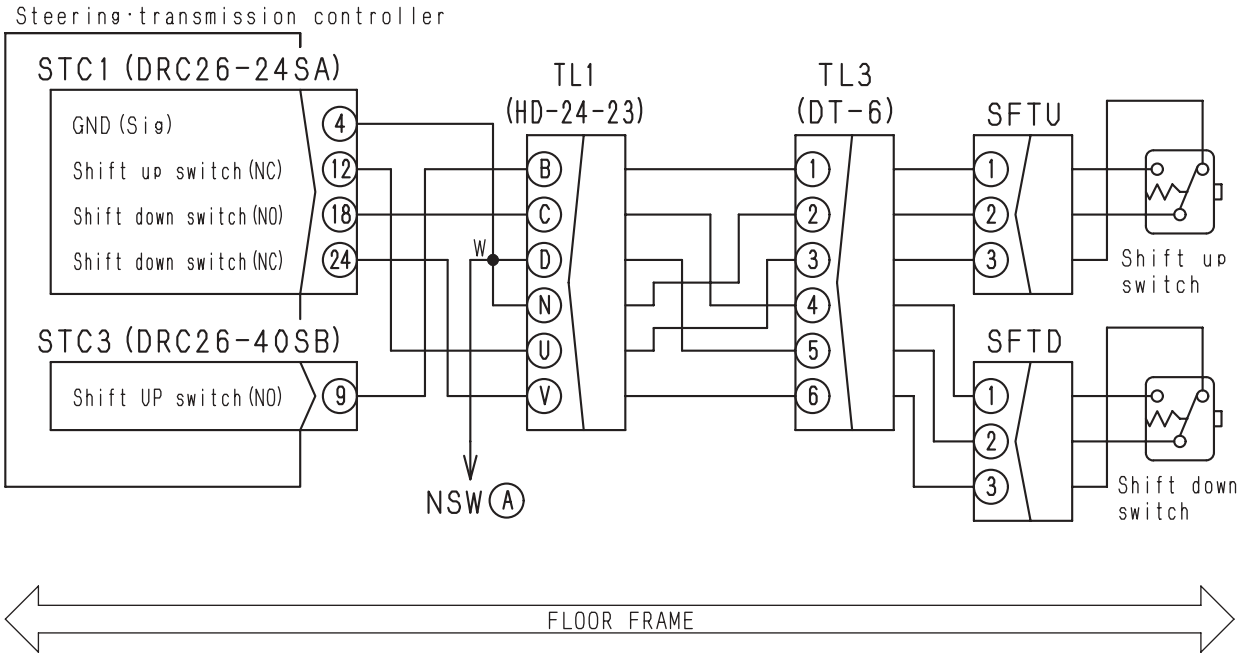
BJD11630

ERROR CODE DD13KA (SHIFT DOWN SWITCH: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Shift down switch: Disconnection (KA) (Steering and transmission controller system)
E02	DD13KA	Steering and transmission		
Contents of trouble	• Signals of two systems of shift down switch circuit were turned OFF (OPEN) at the same time.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Recognizes that switch is not pressed.			
Problem that appears on machine	• Shift down is not possible. • Auto shift down does not function.			
Related information	• Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input state (ON/OFF) from shift down switch can be checked in monitoring mode. (Code 40905: Steering and transmission controller input signal 1) • Method of reproducing error code: Turn starting switch ON and operate shift down switch.			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective shift down switch (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			SFTD (male)	Shift down switch		
				OFF (Release)	ON (Press)	
			Resistance between (2) – (3)	Max. 1Ω	Min. 1MΩ	
			Resistance between (2) – (1)	Min. 1MΩ	Max. 1Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC1 (female) (24) – SFTD (female) (3)		Resistance	Max. 1Ω
			Wiring harness between STC1 (female) (18) – SFTD (female) (1)		Resistance	Max. 1Ω
			Wiring harness between STC1 (female) (4) – SFTD (female) (4)		Resistance	Max. 1Ω
	3	Hot short circuit in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.			
			Short circuit of wiring harness between STC1 (female) (24) – SFTD (female) (3) with chassis ground		Voltage	Max. 1V
			Short circuit of wiring harness between STC1 (female) (29) – SFTD (female) (1) with chassis ground		Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.			
			STC1	Shift down switch		
				OFF (Release)	ON (Press)	
			Voltage between STC1 (24) – STC1 (4)	Max. 1V	5 – 11V	
			Voltage between STC1 (18) – STC1 (4)	5 – 11V	Max. 1V	

Circuit diagram related to shift up switch and shift down switch



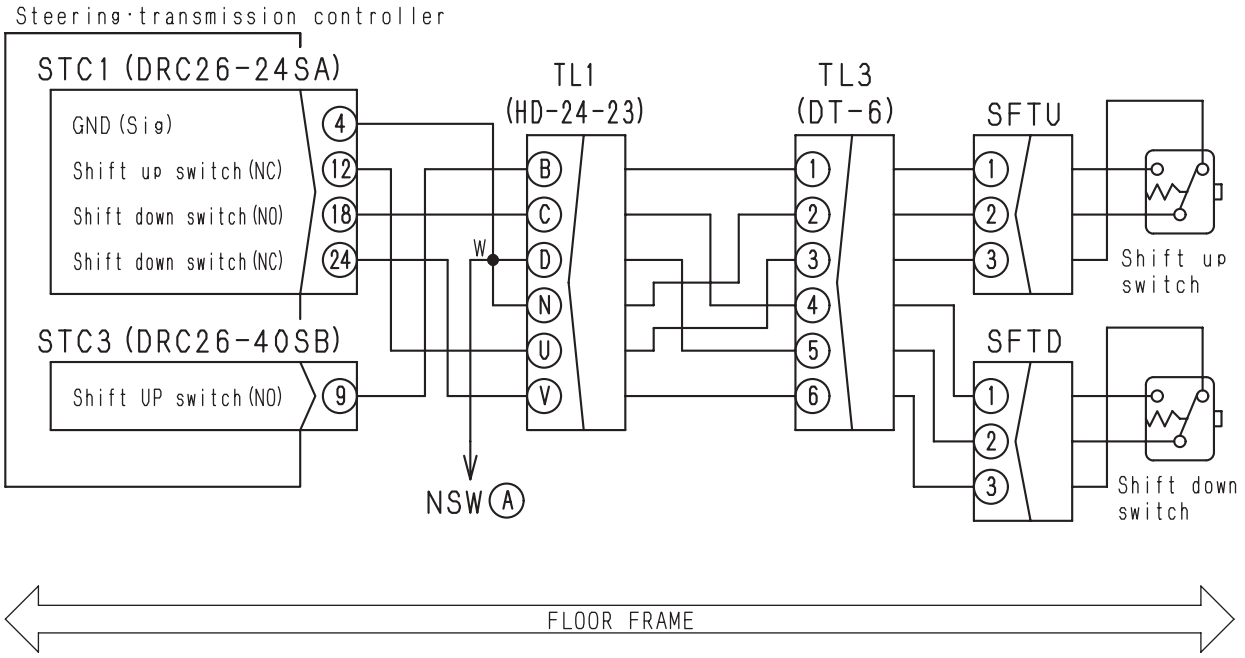
BJD11630

ERROR CODE DD13KB (SHIFT DOWN SWITCH: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Shift down switch: Short circuit (KB) (Steering and transmission controller system)
E02	DD13KB	Steering and transmission		
Contents of trouble	• Signals of two systems of shift down switch circuit were turned ON (CLOSE) or OFF at the same time.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Recognizes that switch is not pressed.			
Problem that appears on machine	• Shift down is not possible. • Auto shift down does not function.			
Related information	• Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input state (ON/OFF) from shift down switch can be checked in monitoring mode. (Code 40905: Steering and transmission controller input signal 1) • Method of reproducing error code: Turn starting switch ON and operate shift up switch.			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective shift down switch (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			SFTD (male)	Shift down switch		
				OFF (Release)	ON (Press)	
			Resistance between (2) – (3)	Max. 1Ω	Min. 1MΩ	
			Resistance between (2) – (1)	Min. 1MΩ	Max. 1Ω	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between STC1 (female) (24) – SFTD (female) (3) with chassis ground	Resistance	Min. 1MΩ	
			Short circuit of wiring harness between STC1 (female) (18) – SFTD (female) (1) with chassis ground	Resistance	Min. 1MΩ	
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.			
			STC1	Shift down switch		
				OFF (Release)	ON (Press)	
			Voltage between STC1 (24) – STC1 (4)	Max. 1V	5 – 11V	
			Voltage between STC1 (18) – STC1 (4)	5 – 11V	Max. 1V	

Circuit diagram related to shift up switch and shift down switch



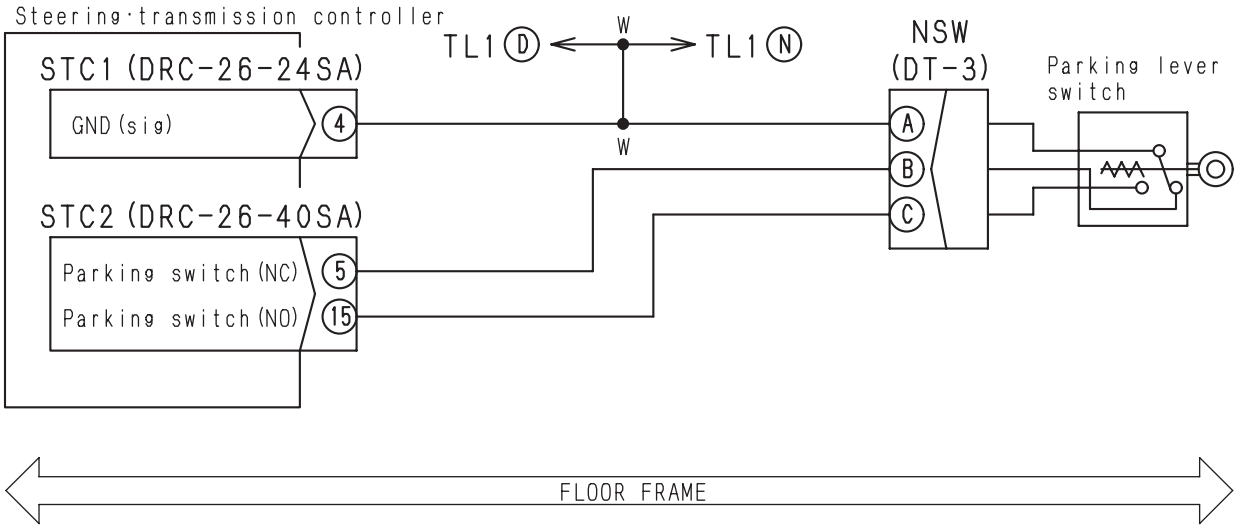
BJD11630

ERROR CODE DD14KA DDQ2KA (PARKING LEVER SWITCH: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Parking lever switch: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DD14KA DDQ2KA	Steering and transmission		
Contents of trouble	• Signals of two systems of parking lever switch circuit were turned OFF (OPEN) at the same time.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Recognizes parking lever is in Free position. • Limits operation of engine, transmission, and brake.			
Problem 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.			
Related information	• Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input state (ON/OFF) from parking brake switch can be checked in monitoring mode. (Code 40905: Steering and transmission controller input signal 1) • Method of reproducing error code: Turn starting switch ON and operate parking lever.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC2 (female) (15) – NSW (female) (C)	Resistance	Max. 1Ω
			Wiring harness between STC2 (female) (5) – NSW (female) (B)	Resistance	Max. 1Ω
	2	Defective steering and transmission controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			STC2	Parking lever	
				Free position	Lock position
			Between (18) – chassis ground	Max. 1V	5 – 11V
			Between (12) – chassis ground	5 – 11V	Max. 1V

Circuit diagram related to parking brake switch



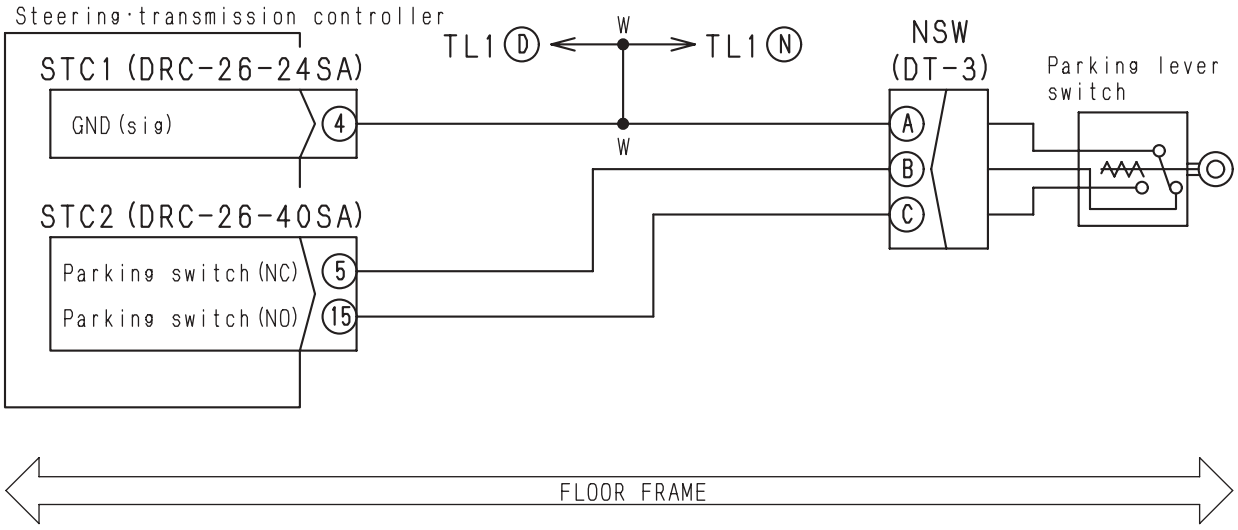
BJD11631

ERROR CODE DD14KB DDQ2KB (PARKING LEVER SWITCH: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Parking lever switch: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DD14KB DDQ2KB	Steering and transmission		
Contents of trouble	• Signals of two systems of parking lever switch circuit were turned ON (CLOSE) at the same time.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Recognizes parking lever is in Free position. • Limits operation of engine, transmission, and brake.			
Problem 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.			
Related information	• Of signals of two systems of switch, NO is for operation detection and NC is for error detection. • Input state (ON/OFF) from parking brake switch can be checked in monitoring mode. (Code 40905: Steering and transmission controller input signal 1) • Method of reproducing error code: Turn starting switch ON and operate parking lever.			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Parking lever switch (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			NSW	Parking lever		
				Free position	Lock position	
			Between (A) – (B)	Max. 1Ω	Min. 1MΩ	
			Between (A) – (C)	Min. 1MΩ	Max. 1Ω	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.			
			Wiring harness between NSW (female) (B) – STC2 (female) (15) with chassis ground		Resistance	Min. 1MΩ
			Wiring harness between NSW (female) (C) – STC2 (female) (5) with chassis ground		Resistance	Min. 1MΩ
	3	Defective steering and transmission controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.			
			STC2	Parking lever		
				Free position	Lock position	
			Between (15) – chassis ground	Max. 1V	5 – 11V	
			Between (5) – chassis ground	5 – 11V	Max. 1V	

Circuit diagram related to parking brake switch



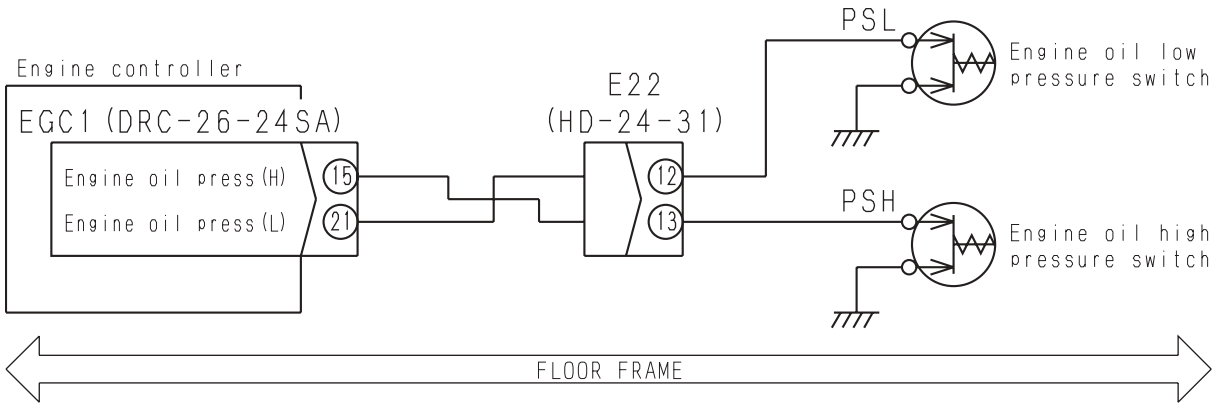
BJD11631

ERROR CODE DDE2L6 (ENGINE OIL PRESSURE SWITCH: REFER TO TABLE (L6)

Action code	Error code	Controller code	Trouble	Engine oil pressure switch: Refer to table (L6) (Engine controller system)
CALL E03	DDE2L6	ENG		
Contents of trouble	• Signals of engine oil pressure switch are inconsistent with engine state.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Input state (ON/OFF) from engine oil pressure switch can be checked in monitoring mode. (Code 40900: Engine controller input signal 1) • Method of reproducing error code: Turn starting switch ON or start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective low engine oil pressure switch (Internal disconnection/short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON or by starting engine.			
			PSL	Engine	Resistance	
			Between terminal – chassis ground	Stop	Max. 1Ω	
				Min. 600rpm	Min. 1MΩ	
	2	Defective high engine oil pressure switch (Internal disconnection/short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON or by starting engine.			
			PSH	Engine	Resistance	
			Between terminal – chassis ground	Stop	Max. 1Ω	
				Min. 1,300rpm	Min. 1MΩ	
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between EGC1 (female) (21) – PSL		Resistance	Max. 1Ω
			Wiring harness between EGC1 (female) (15) – PSH		Resistance	Max. 1Ω
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between EGC1 (female) (21) – PSH with chassis ground		Resistance	Min. 1MΩ
	5	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON or by starting engine.			
			EGC1	Engine	Voltage	
			Between (21) – chassis ground	Stop	Max. 1V	
				Min. 600rpm	20 – 30V	
			Between (15) – chassis ground	Stop	Max. 1V	
				Min. 1,300rpm	20 – 30V	

Circuit diagram related to low engine oil pressure switch & high engine oil pressure switch



BJD11632

ERROR CODE DDQ2KA DD14KA (PARKING LEVER SWITCH: DISCONNECTION (KA))

★ See DA14KA.

ERROR CODE DDQ2KB DD14KB (PARKING LEVER SWITCH: SHORT CIRCUIT (KB))

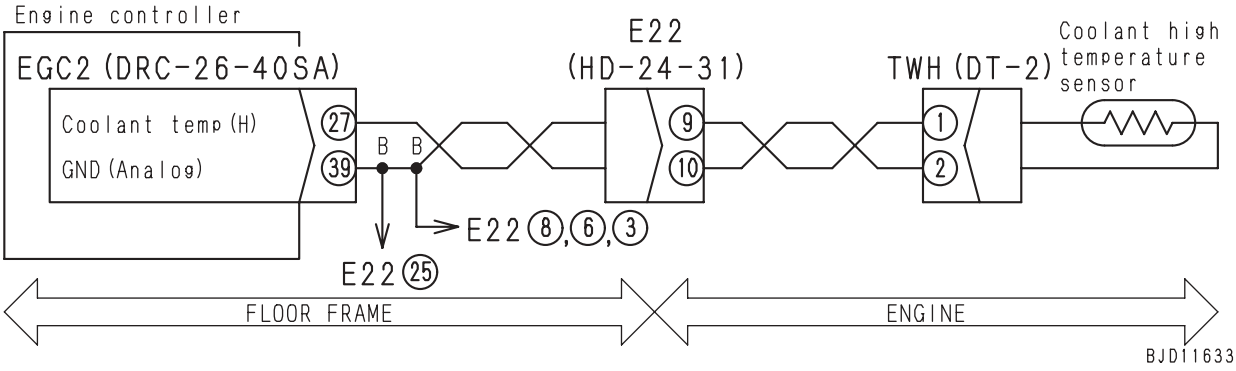
★ See DA14KB.

ERROR CODE DGE2KX (ENGINE WATER TEMPERATURE SENSOR (FOR HIGH TEMPERATURE): INPUT SIGNAL IS OUT OF NORMAL RANGE (KX))

Action code	Error code	Controller code	Trouble	Engine water temperature sensor (for high temperature): Input signal is out of normal range (KX) (Engine controller system)
CALL E03	DGE2KX	ENG		
Contents of trouble	• High engine water temperature sensor signal is out of normal range.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Fixes water temperature signal output for monitor panel at 90%. • Limits operation of engine and transmission.			
Problem that appears on machine	• Monitor panel does not display engine water temperature normally. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.			
Related information	• Engine water temperature (temperature) can be checked in monitoring mode. (Code 04102: Engine water temperature (High temperature side)) • Method of reproducing error code: Start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective high engine water temperature sensor (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			TWH	Resistance	
			Between (1) – (2)	3.5k – 90kΩ	
			Between (1), (2) – chassis ground	Min. 1MΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC2 (female) (27) – TWH (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (39) – TWH (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between EGC2 (female) (27) – TWH (female) (1) with chassis ground	Resistance	Min. 1MΩ
	4	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC2 (female)	Resistance	
			Between (27) –(39)	3.5k – 90kΩ	
			Between (27), (39) – chassis ground	Min. 1MΩ	

Circuit diagram related to high engine water temperature sensor

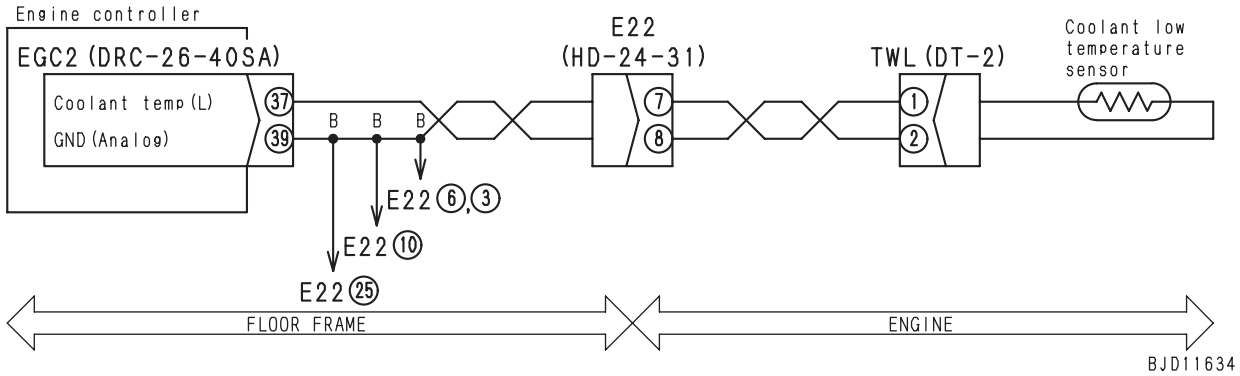


ERROR CODE DGE3L6 (ENGINE WATER TEMPERATURE SENSOR (FOR LOW TEMPERATURE): SEE TABLE (L6))

Action code	Error code	Controller code	Trouble	Engine water temperature sensor (for low temperature): See table (L6) (Engine controller system)
E02	DGE3L6	ENG		
Contents of trouble	• Low engine water temperature sensor signal is not input.			
Action of controller	• Flashes caution lamp and turns on caution buzzer.			
Problem that appears on machine	• Exhaust gas color is bad at low temperature. • Engine does not start easily at low temperature.			
Related information	• Engine water temperature (temperature) can be checked in monitoring mode. (Code 04104: Engine water temperature (Low temperature side)) • Method of reproducing error code: Start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective low engine water temperature sensor (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			TWL (male)	Resistance		
			Between (1) – (2)	0.3k – 9kΩ		
			Between (1), (2) – chassis ground	Min. 1MΩ		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between EGC2 (female) (37) – TWL (female) (1)	Resistance	Max. 1Ω	
			Wiring harness between EGC2 (female) (39) – TWL (female) (2)	Resistance	Max. 1Ω	
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between EGC2 (female) (37) – TWL (female) (1) with chassis ground	Resistance	Min. 1MΩ	
	4	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			EGC2 (female)	Resistance		
			Between (37) – (39)	0.3k – 9kΩ		
			Between (37), (39) – chassis ground	Min. 1MΩ		

Circuit diagram related to low engine water temperature sensor

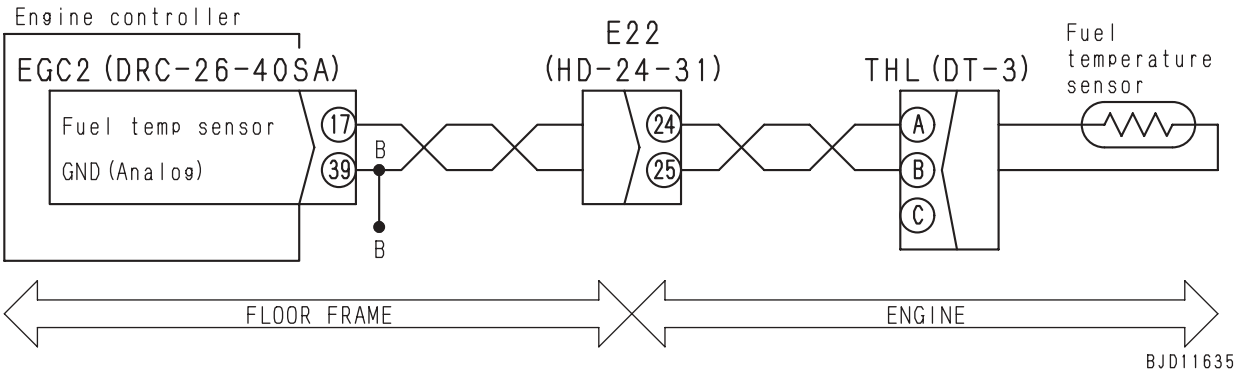


ERROR CODE DGE4KX (FUEL TEMPERATURE SENSOR: INPUT SIGNAL IS OUT OF NORMAL RANGE (KX))

Action code	Error code	Controller code	Trouble	Fuel temperature sensor: Input signal is out of normal range (KX) (Engine controller system)
E01	DGE4KX	ENG		
Contents of trouble	• Fuel temperature sensor signal is out of normal range.			
Action of controller	• Operates with normal control.			
Problem that appears on machine	• Engine output lowers a little at low temperature.			
Related information	• Fuel temperature (temperature) can be checked in monitoring mode. (Code 04204: Fuel temperature) • Method of reproducing error code: Turn starting switch ON or start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fuel temperature sensor (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			THL (male)	Resistance	
			Between (1) – (2)	0.3k – 9kΩ	
			Between (1), (2) – chassis ground	Min. 1MΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC2 (female) (17) – THL (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (39) – THL (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between EGC2 (female) (17) – THL (female) (1) with chassis ground	Resistance	Min. 1MΩ
	4	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC2 (female)	Resistance	
			Between (17) – (39)	0.3k – 9kΩ	
			Between (17), (39) – chassis ground	Min. 1MΩ	

Circuit diagram related to fuel temperature sensor

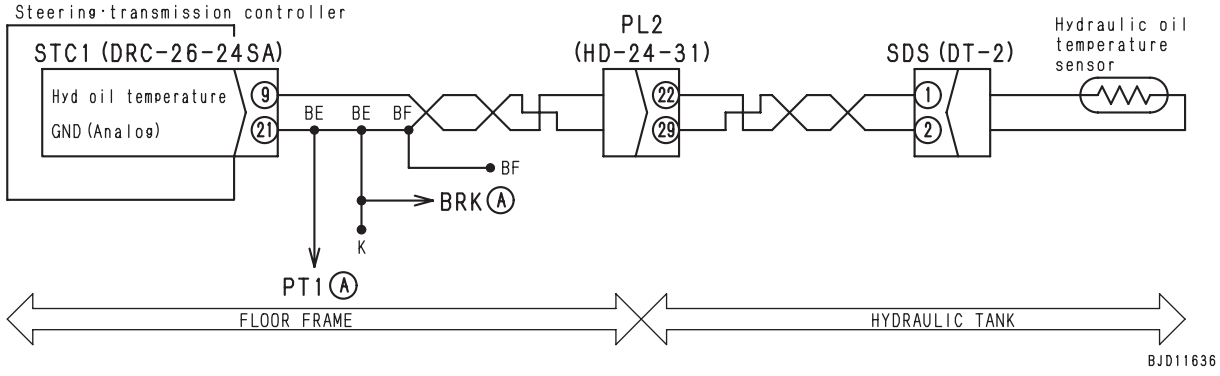


ERROR CODE DGS1KX (HYDRAULIC OIL TEMPERATURE SENSOR: INPUT SIGNAL IS OUT OF NORMAL RANGE (KX))

Action code	Error code	Controller code	Trouble	Hydraulic oil temperature sensor: Input signal is out of normal range (KX) (Steering and transmission controller system)
—	DGS1KX	Steering and transmission		
Contents of trouble	• Hydraulic oil temperature sensor signal is out of normal range.			
Action of controller	• Does not take any particular action.			
Problem that appears on machine	• Hydraulic oil temperature gauge of monitor panel may not display normally.			
Related information	• Hydraulic oil temperature (temperature) can be checked in monitoring mode. (Code 04401: Hydraulic oil temperature) • Method of reproducing error code: Turn starting switch ON or start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective hydraulic oil temperature sensor (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			SDS (male)	Resistance	
			Between (1) – (2)	1k – 50kΩ	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC1 (female) (14) – SDS (female) (1)	Resistance	Max. 1Ω
			Wiring harness between STC1 (female) (21) – SDS (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC1 (female) (14) – SDS (female) (1) with chassis ground	Resistance	Min. 1MΩ
	4	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC1 (female) (14) – SDS (female) (1) with chassis ground	Voltage	Max. 1V
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC1 (female)	Resistance	
			Between (14) – (21)	1k – 50kΩ	
			Between (14) – chassis ground	Min. 1MΩ	

Circuit diagram related to hydraulic oil temperature sensor

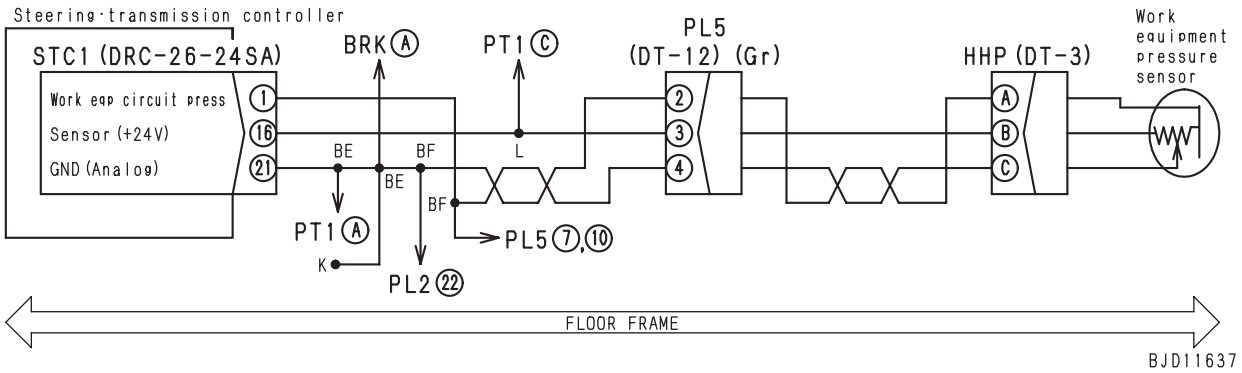


ERROR CODE DH21KA (HSS AND WORK EQUIPMENT PUMP OIL PRESSURE SENSOR: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	HSS and work equipment pump oil pressure sensor: Disconnection (KA) (Steering and transmission controller system)
E01	DH21KA	Steering and transmission		
Contents of trouble	• Signal voltage of work equipment pump oil pressure sensor circuit is below 0.5V.			
Action of controller	• Does not take any particular action.			
Problem that appears on machine	• Work equipment pump oil pressure cannot be monitored.			
Related information	• Input (Voltage) from work equipment pump oil pressure sensor can be checked in monitoring mode. (Code 70701: Voltage of work equipment pump oil sensor) • Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective 24V power source system	See if error code [DAQ6KK] is displayed. If it is displayed, carry out troubleshooting for it first.		
	2	Defective work equipment pump oil pressure sensor (Internal trouble)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			HHP	Voltage	
			Between (C) – (A)	0.5 – 6.0V	
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC1 (female) (16) – HHP (female) (B)	Resistance	Max. 1Ω
			Wiring harness between STC1 (female) (1) – HHP (female) (C)	Resistance	Max. 1Ω
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC1 (female) (1)– HHP (female) (C) with chassis ground	Resistance	Min. 1MΩ
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			STC1 (female)	Voltage	
			Between (1) – (21)	0.5 – 6.0V	

Circuit diagram related to work equipment pump oil pressure sensor

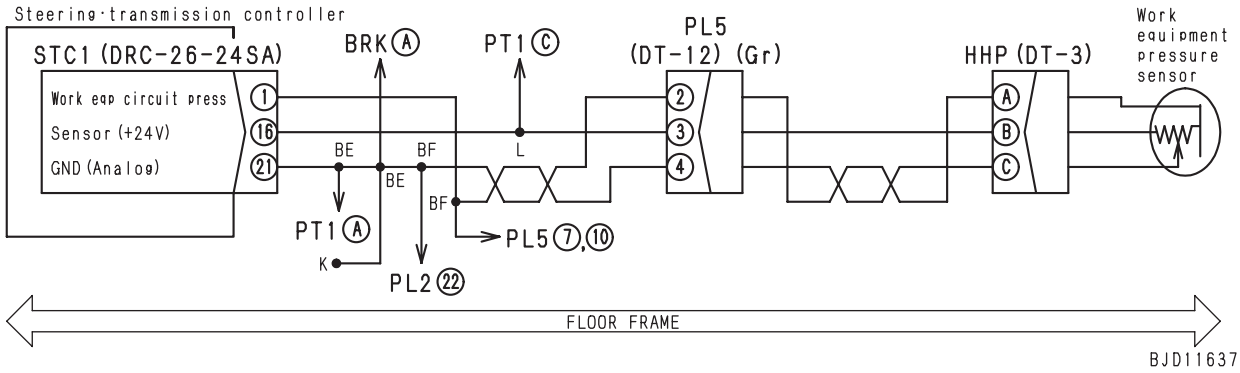


ERROR CODE DH21KB (HSS AND WORK EQUIPMENT PUMP OIL PRESSURE SENSOR: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	HSS and work equipment pump oil pressure sensor: Short circuit (KB) (Steering and transmission controller system)
E01	DH21KB	Steering and transmission		
Contents of trouble	• Signal voltage of work equipment pump oil pressure sensor circuit is above 6.0V			
Action of controller	• Does not take any particular action.			
Problem that appears on machine	• Work equipment pump oil pressure cannot be monitored.			
Related information	• Input (Voltage) from work equipment pump oil pressure sensor can be checked in monitoring mode. (Code 70701: Voltage of work equipment pump oil pressure sensor) • Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective 24V power source system	See if error code [DAQ6KK] is displayed. If it is displayed, carry out troubleshooting for it first.		
	2	Defective work equipment pump oil pressure sensor (Internal trouble)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			HHP	Voltage	
			Between (C) – (A)	0.5 – 6.0V	
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC1 (female) (1) – HHP (female) (C) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			STC1 (female)	Voltage	
			Between (1) – (21)	0.5 – 6.0V	

Circuit diagram related to work equipment pump oil pressure sensor

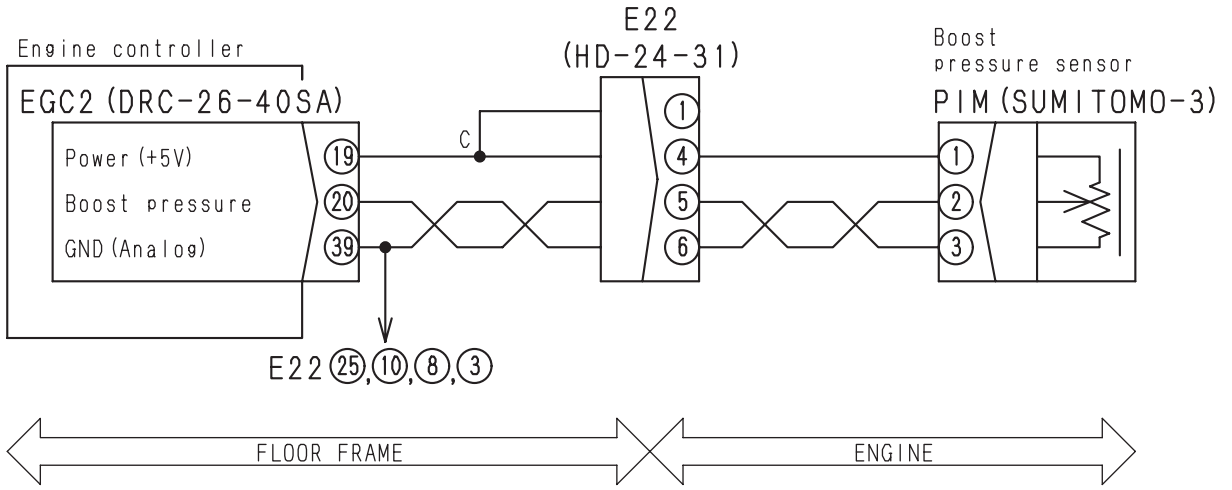


ERROR CODE DH30KX (BOOST PRESSURE SENSOR: INPUT IS OUT OF NORMAL RANGE (KX))

Action code	Error code	Controller code	Trouble	Boost pressure sensor: Input is out of normal range (KX) (Engine controller system)
E02	DH30KX	ENG		
Contents of trouble	• Boost pressure sensor signal is out of normal range.			
Action of controller	• Flashes caution lamp and turns on caution buzzer.			
Problem that appears on machine	• Machine is not affected seriously.			
Related information	• Special adapter (799-601-9420) is necessary for troubleshooting for boost pressure sensor. • Boost pressure (pressure) can be checked in monitoring mode. (Code 36500: Boost pressure) • Method of reproducing error code: Turn starting switch ON or start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective boost pressure sensor (Internal trouble)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			PIM	Voltage	
			Between (1) – (3)	4.6 – 5.4V	
			Between (2) – (3)	0.3 – 4.7V	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC2 (female) (19) – PIM (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (20) – PIM (female) (2)	Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (39) – PIM (female) (3)	Resistance	Max. 1Ω
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between EGC2 (female) (19) – PIM (female) (1) with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between EGC2 (female) (20) – PIM (female) (2) with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between EGC2 (female) (39) – PIM (female) (3) with chassis ground	Resistance	Min. 1MΩ
	4	Defective engine controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			EGC2	Voltage	
			Between (19) – (39)	4.6 – 5.4V	
			Between (20) – (39)	0.3 – 5.7V	

Circuit diagram related to boost presure sensor



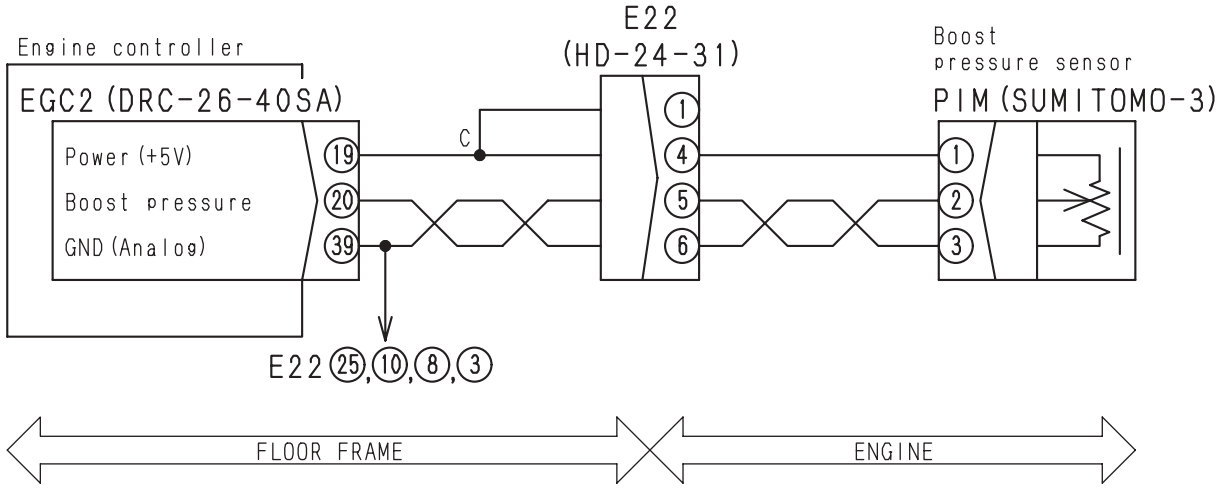
BJD11638

ERROR CODE DH40KX (COMMON RAIL PRESSURE SENSOR: INPUT IS OUT OF NORMAL RANGE (KX))

Action code	Error code	Controller code	Trouble	Common rail pressure sensor: Input is out of normal range (KX) (Engine controller system)
CALL E03	DH40KX	ENG		
Contents of trouble	• Common rail pressure sensor signal is out of normal range.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Special adapter (799-601-9420) is necessary for troubleshooting for common rail pressure sensor. • Common rail pressure (pressure) can be checked in monitoring mode. (Code 36400: Common rail pressure) • Method of reproducing error code: Turn starting switch ON or start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective common rail pressure sensor (Internal trouble)	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			PFUEL	Voltage	
			Between (1) – (3)	4.6 – 5.4V	
			Between (2) – (3)	0.7 – 4.5V	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC2 (female) (19) – PFUEL (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (40) – PFUEL (female) (2)	Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (39) – PFUEL (female) (3)	Resistance	Max. 1Ω
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between EGC2 (female) (19) – PFUEL (female) (1) with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between EGC2 (female) (40) – PFUEL (female) (2) with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between EGC2 (female) (39) – PFUEL (female) (3) with chassis ground	Resistance	Min. 1MΩ
	4	Defective engine controller	★Prepare with starting switch OFF, turn starting switch ON and carry out troubleshooting.		
			EGC2	Voltage	
			Between (19) – (39)	4.6 – 5.4V	
			Between (40) – (39)	0.3 – 5.7V	

Circuit diagram related to common rail presure sensor



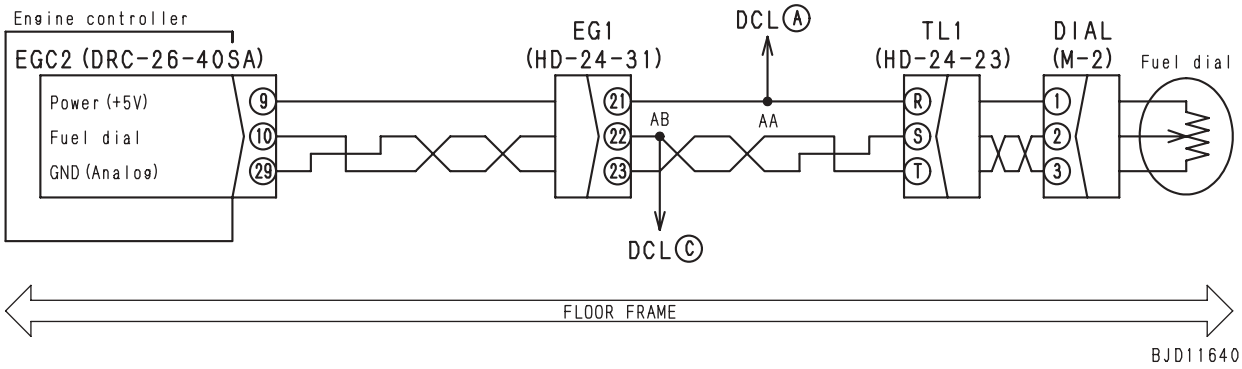
BJD11638

ERROR CODE DK10KX (FUEL CONTROL DIAL: INPUT IS OUT OF NORMAL RANGE (KX))

Action code	Error code	Controller code	Trouble	Fuel control dial: Input is out of normal range (KX) (Engine controller system)
CALL E03	DK10KX	ENG		
Contents of trouble	• Signal voltage of fuel control dial circuit is below 0.5V or above 4.5V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Continues controlling with signal of decelerator pedal potentiometer. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Inputting from fuel control dial (Voltage) can be checked in monitoring mode. (Code 03000: Voltage of fuel control dial) • Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fuel control dial (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			DIAL (male)	Resistance	
			Between (1) – (3)	4.0 – 6.0kΩ	
			Between (1) – (2)	0.25 – 7.0kΩ	
			Between (2) – (3)	0.25 – 7.0kΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC2 (female) (9) – DIAL (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (10) – DIAL (female) (2)	Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (29) – DIAL (female) (3)	Resistance	Max. 1Ω
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between EGC2 (female) (9) – DIAL (female) (1) with chassis ground	Resistance Resistance	Min. 1MΩ
			Short circuit of wiring harness between EGC2 (female) (10) – DIAL (female) (2) with chassis ground	Resistance	Min. 1MΩ
	4	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between EGC2 (female) (9) – DIAL (female) (1) with chassis ground	Voltage	Max. 1V
			Short circuit of wiring harness between EGC2 (female) (10) – DIAL (female) (2) with chassis ground	Voltage	Max. 1V
	5	Defective engine controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			EGC2	Voltage	
			Between (9) – (29)	4.6 – 5.4V	
			Between (10) – (29)	0.5 – 4.5V	

Circuit diagram related to fuel control dial

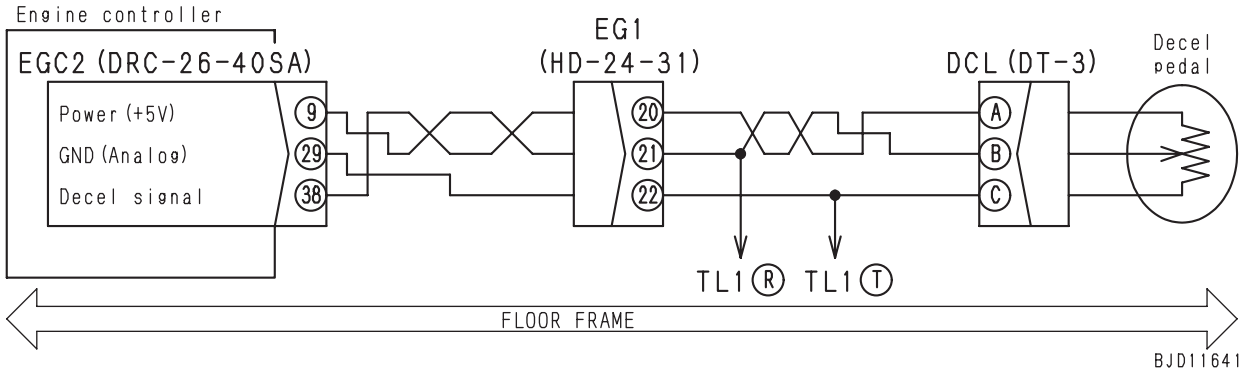


ERROR CODE DK12KX (DECELERATION POTENTIOMETER: INPUT IS OUT OF NORMAL RANGE (KX))

Action code	Error code	Controller code	Trouble	Fuel control dial: Input is out of normal range (KX) (Engine controller system)
CALL E03	DK12KX	ENG		
Contents of trouble	• Signal voltage of deceleration potentiometer circuit is below 0.3V or above 4.5V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Continues controlling with signal of fuel control dial. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Inputting from deceleration potentiometer (Voltage) can be checked in monitoring mode. (Code 50101: Voltage of deceleration potentiometer) • Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective deceleration potentiometer (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			DCL (male)	Resistance	
			Between (A) – (C)	4.0 – 6.0kΩ	
			Between (A) – (B)	0.25 – 7.0kΩ	
			Between (B) – (C)	0.25 – 7.0kΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC2 (female) (9) – DCL (female) (A)	Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (38) – DCL (female) (B)	Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (29) – DCL (female) (C)	Resistance	Max. 1Ω
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between EGC2 (female) (9) – DCL (female) (A) with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between EGC2 (female) (36) – DCL (female) (B) with chassis ground	Resistance	Min. 1MΩ
	4	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between EGC2 (female) (9) – DCL (female) (A) with chassis ground	Voltage	Max. 1V
			Short circuit of wiring harness between EGC2 (female) (36) – DCL (female) (B) with chassis ground	Voltage	Max. 1V
	4	Defective engine controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			EGC2	Voltage	
			Between (9) – (29)	4.6 – 5.4V	
			Between (38) – (29)	0.3 – 4.5V	

Circuit diagram related to decel potentiometer

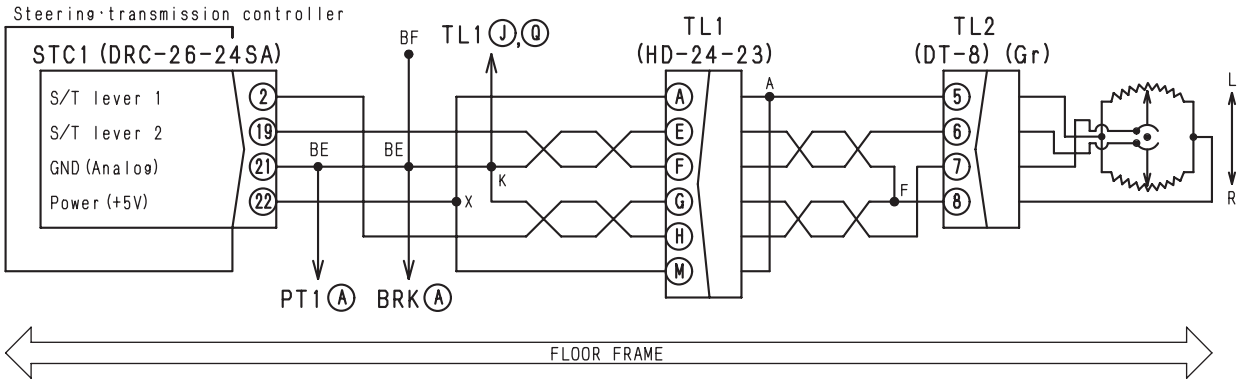


ERROR CODE DK30KA (STEERING POTENTIOMETER 1: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Steering potentiometer 1: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DK30KA	Steering and transmission		
Contents of trouble	• Signal voltage of steering potentiometer 1 system is below 0.5V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Continues controlling with signal of steering potentiometer 2 system. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Input (Voltage) from steering potentiometer 1 can be checked in monitoring mode. (Code 50300: Voltage of steering potentiometer 1) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for steering).			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective 5V sensor power source system	See if error code [DAQ5KK] [DB35KK] is displayed. If it is displayed, carry out troubleshooting for it first.			
	2	Defective steering potentiometer 1 (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			TL2 (male)	Resistance		
			Between (5) – (8)	3.2kΩ ± 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 in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC1 (female) (22) – TL2 (female) (5)	Resistance	Max. 1Ω	
			Wiring harness between STC1 (female) (2) – TL2 (female) (7)	Resistance	Max. 1Ω	
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between STC1 (female) (2) – TL2 (female) (7)H with chassis ground	Resistance	Min. 1MΩ	
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			STC1	Voltage		
			Between (2) – (21)	0.5 – 4.5V		

Circuit diagram related to steering potentiometer



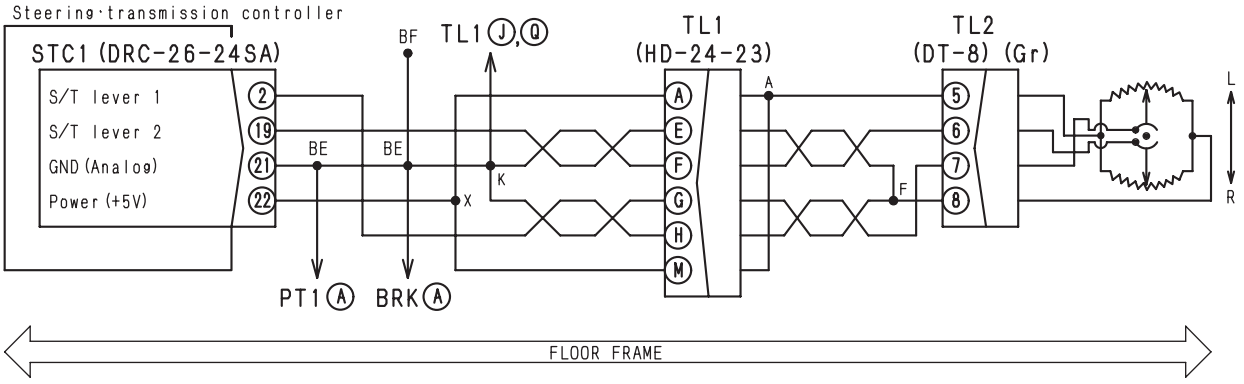
BJD11642

ERROR CODE DK30KB (STEERING POTENTIOMETER 1: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Steering potentiometer 1: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DK30KB	Steering and transmission		
Contents of trouble	• Signal voltage of steering potentiometer 1 system is above 4.5V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Continues controlling with signal of steering potentiometer 2 system. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Input (Voltage) from steering potentiometer 1 can be checked in monitoring mode. (Code 50300: Voltage of steering potentiometer 1) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for steering).			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective 5V sensor power source system	See if error code [DAQ5KK] [DB35KK] is displayed. If it is displayed, carry out troubleshooting for it first.		
	2	Defective steering potentiometer 1 (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			TL2 (male)	Resistance	
			Between (5) – (8)	3.2kΩ ± 20%	
			Between (7) – (5)	1 – 6 kΩ (Right – Left steering)	
			Between (7) – (8)	6 – 1 kΩ (Right – Left steering)	
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC1 (female) (2) – TL2 (female) (7) with chassis ground	Voltage	Max. 1V
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC1	Voltage	
			Between (2) – (21)	0.5 – 4.5V	

Circuit diagram related to steering potentiometer



BJD11642

ERROR CODE DK30KX (STEERING POTENTIOMETER: INPUT SIGNAL IS OUT OF NORMAL RANGE (KX))

Action code	Error code	Controller code	Trouble	Steering potentiometer: Input signal is out of normal range (KX) (Steering and transmission controller system)
CALL E04	DK30KX	Steering and transmission		
Contents of trouble	• Either of error codes [DK30KA] and [DK30KB] of steering potentiometer systems 1 and 2 and error codes [DK31KA] and [DK31KB] are displayed simultaneously.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine, transmission, and brake.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it cannot travel any more.			
Related information	• Input (Voltage) from steering potentiometers can be checked in monitoring mode. (Code 50300: Voltage of steering potentiometer 1) (Code 50301: Voltage of steering potentiometer 2) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for steering).			

Possible causes and standard value in normal state	Cause	Standard value in normal state/Remarks on troubleshooting
	Carry out troubleshooting for error codes [DK30KA], [DK30KB], [DK31KA], and [DK31KB].	

ERROR CODE DK30KZ (STEERING POTENTIOMETER: DISCONNECTION OR SHORT CIRCUIT (Double trouble) (KZ))

Action code	Error code	Controller code	Trouble	Steering potentiometer: Disconnection or short circuit (KZ)) (Steering and transmission controller system)
CALL E04	DK30KZ	Steering and transmission		
Contents of trouble	• When starting switch is turned ON, either of steering potentiometer systems 1 and 2 is abnormal, then either of error codes [DK30KA] and [DK30KB] and error codes [DK31KA] and [DK31KB] are displayed simultaneously.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine, transmission, and brake.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it cannot travel any more.			
Related information	• Input (Voltage) from steering potentiometers can be checked in monitoring mode. (Code 50300: Voltage of steering potentiometer 1) (Code 50301: Voltage of steering potentiometer 2) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for steering).			

Possible causes and standard value in normal state	Cause	Standard value in normal state/Remarks on troubleshooting
	Carry out troubleshooting for error codes [DK30KA], [DK30KB], [DK31KA], and [DK31KB].	

ERROR CODE DK30L8 (STEERING POTENTIOMETER 1: SEE TABLE (L8))

Action code	Error code	Controller code	Trouble	Steering potentiometer 1: See table (L8) (Steering and transmission controller system)
CALL E03	DK30L8	Steering and transmission		
Contents of trouble	• Total signal voltage of each of steering potentiometer 1 system and 2 system is below 4.41V or above 5.59V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Continues controlling with signal of normal one of steering potentiometer 1 system and 2. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Input (Voltage) from steering potentiometers can be checked in monitoring mode. (Code 50300: Voltage of steering potentiometer 1) (Code 50301: Voltage of steering potentiometer 2) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for steering).			

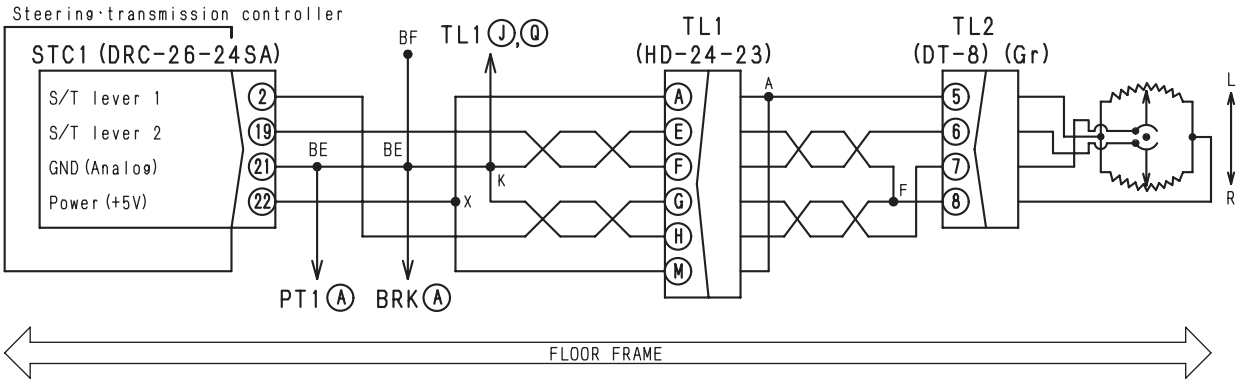
Possible causes and standard value in normal state	Cause	Standard value in normal state/Remarks on troubleshooting
	Carry out troubleshooting for error codes [DK30KA], [DK30KB], [DK31KA], and [DK31KB].	

ERROR CODE DK31KA (STEERING POTENTIOMETER 2: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Steering potentiometer 2: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DK31KA	Steering and transmission		
Contents of trouble	• Signal voltage of steering potentiometer 2 system is below 0.5V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Continues controlling with signal of steering potentiometer 1 system. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Input (Voltage) from steering potentiometer 2 can be checked in monitoring mode. (Code 50301: Voltage of steering potentiometer 2) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for steering).			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power source system	See if error code [DAQ5KK] [DB35KK] is displayed. If it is displayed, carry out troubleshooting for it first.		
	2	Defective steering potentiometer 2 (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			TL2 (male)	Resistance	
			Between (5) – (8)	3.2kΩ ± 20%	
			Between (6) – (5)	6 – 1 kΩ (Right – Left steering)	
			Between (6) – (8)	1 – 6 kΩ (Right – Left steering)	
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC1 (female) (22) – TL2 (female) (5)	Resistance	Max. 1Ω
			Wiring harness between STC1 (female) (19) – TL2 (female) (6)	Resistance	Max. 1Ω
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC1 (female) (19) – TL2 (female) (6) with chassis ground	Resistance	Min. 1MΩ
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC1	Voltage	
			Between (19) – (21)	0.5 – 4.5V	

Circuit diagram related to steering potentiometer



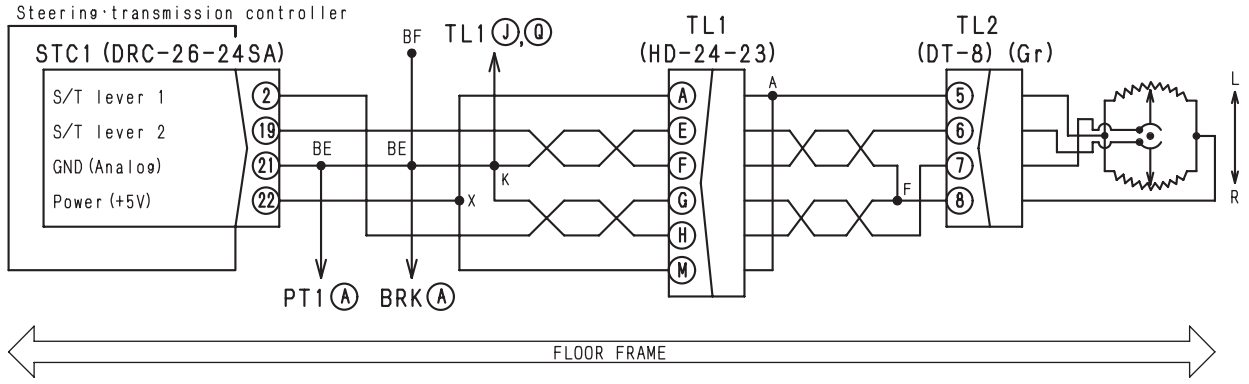
BJD11642

ERROR CODE DK31KB (STEERING POTENTIOMETER 2: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Steering potentiometer 2: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DK31KB	Steering and transmission		
Contents of trouble	• Signal voltage of steering potentiometer 2 system is above 4.5V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Continues controlling with signal of steering potentiometer 1 system. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Input (Voltage) from steering potentiometer 2 can be checked in monitoring mode. (Code 50301: Voltage of steering potentiometer 2) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for steering).			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power source system	See if error code [DAQ5KK] [DB35KK] is displayed. If it is displayed, carry out troubleshooting for it first.		
	2	Defective steering potentiometer 2 (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			TL2 (male)	Voltage	
			Between (5) – (8)	3.2kΩ ± 20%	
			Between (6) – (5)	6 – 1 kΩ (Right – Left steering)	
			Between (6) – (8)	1 – 6 kΩ (Right – Left steering)	
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC1 (female) (19) – TL2 (female) (6) with chassis ground	Resistance	Max. 1V
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC1	Voltage	
			Between (19) – (21)	0.5 – 4.5V	

Circuit diagram related to steering potentiometer



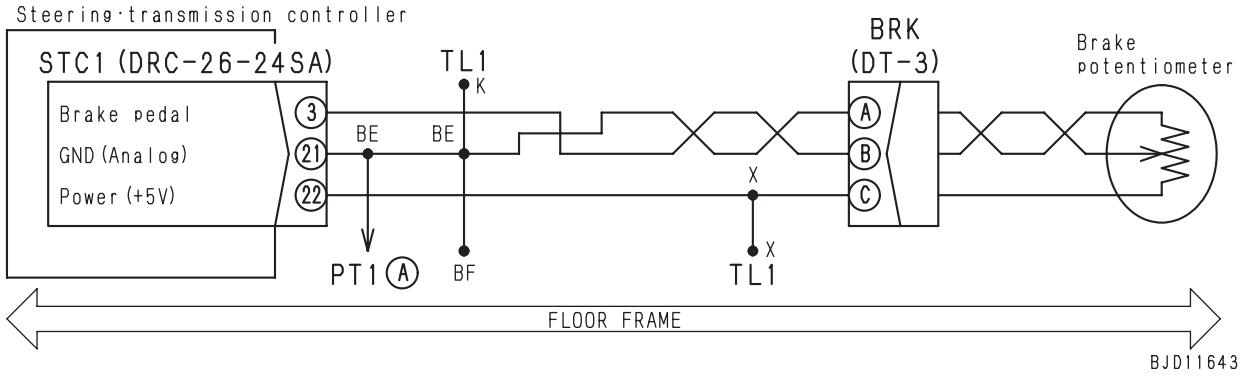
BJD11642

ERROR CODE DK40KA (BRAKE POTENTIOMETER: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Brake potentiometer: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DK40KA	Steering and transmission		
Contents of trouble	• Signal voltage of brake potentiometer circuit is below 0.5V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Does not control with signal of brake potentiometer (Brake can be operated with pedal). • Limits operation of engine and transmission.			
Problem that appears on machine	• Brake control performance of brake pedal lowers. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.			
Related information	• Input (Voltage) from brake potentiometer can be checked in monitoring mode. (Code 50400: Voltage of brake potentiometer) • Method of reproducing error code: Turn starting switch ON and operate brake pedal.			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective 5V sensor power source system	See if error code [DAQ5KK] [DB35KK] is displayed. If it is displayed, carry out troubleshooting for it first.			
	2	Defective brake potentiometer (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			BRK (male)	Resistance		
			Between (A) – (C)	4.0 – 6.0kΩ		
			Between (A) – (B)	0.25 – 7.0kΩ		
			Between (B) – (C)	0.25 – 7.0kΩ		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC1 (female) (22) – BRK (female) (C)	Resistance	Max. 1Ω	
			Wiring harness between STC1 (female) (3) – BRK (female) (B)	Resistance	Max. 1Ω	
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between STC1 (female) (3) – BRK (female) (B) with chassis ground	Resistance	Min. 1MΩ	
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			STC1	Voltage		
			Between (3) – (B)	0.5 – 4.5V		

Circuit diagram related to brake potentiometer

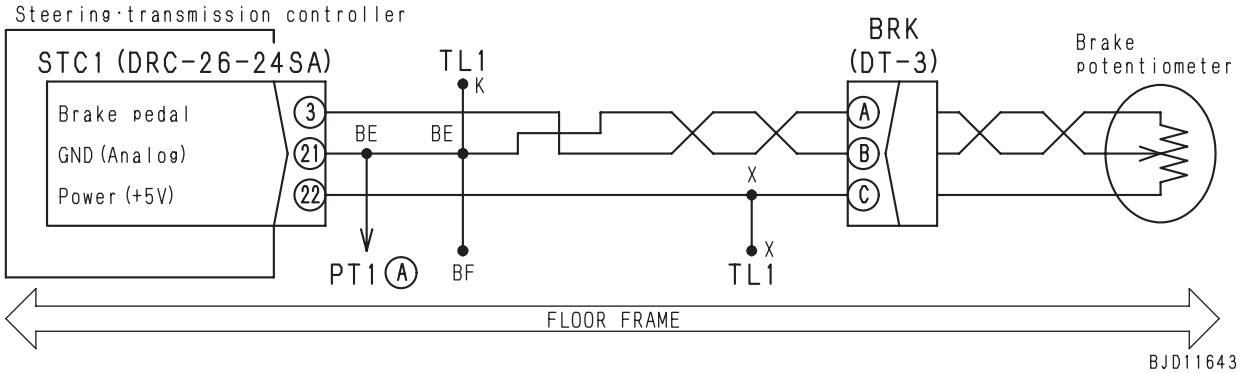


ERROR CODE DK40KB (BRAKE POTENTIOMETER: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Brake potentiometer: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DK40KB	Steering and transmission		
Contents of trouble	• Signal voltage of brake potentiometer circuit is below 0.5V or above 4.5V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Does not control with signal of brake potentiometer (Brake can be operated with pedal). • Limits operation of engine and transmission.			
Problem that appears on machine	• Brake control performance of brake pedal lowers. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.			
Related information	• Input (Voltage) from brake potentiometer can be checked in monitoring mode. (Code 50400: Voltage of brake potentiometer) • Method of reproducing error code: Turn starting switch ON and operate brake pedal.			

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Defective 5V sensor power source system	See if error code [DAQ5KK] [DB35KK] is displayed. If it is displayed, carry out troubleshooting for it first.		
	2	Defective brake potentiometer (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			BRK (male)	Resistance	
			(A) – (C)	4.0 – 6.0kΩ	
			(A) – (B)	0.25 – 7.0kΩ	
			(B) – (C)	0.25 – 7.0kΩ	
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC1 (female) (3) – BRK (female) (B) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC1	Voltage	
			Between (3) – (B)	0.5 – 4.5V	

Circuit diagram related to brake potentiometer



ERROR CODE DK55KX (FORWARD-REVERSE POTENTIOMETER: INPUT SIGNAL IS OUT OF NORMAL RANGE (KX))

Action code	Error code	Controller code	Trouble	Forward-reverse potentiometer: Input signal is out of normal range (KX) (Steering and transmission controller system)
CALL E04	DK55KX	Steering and transmission		
Contents of trouble	• Either of error codes [DK56KA] and [DK56KB] of forward-reverse potentiometer systems 1 and 2 and either of error codes [DK57KA] and [DK57KB] are displayed simultaneously.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine, transmission, and brake.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, it cannot travel any more.			
Related information	• Input (Voltage) from forward-reverse potentiometers can be checked in monitoring mode. (Code 50200: Voltage of forward-reverse potentiometer 1) (Code 50201: Voltage of forward-reverse potentiometer 2) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for forward/reverse travel).			

Possible causes and standard value in normal state	Cause	Standard value in normal state/Remarks on troubleshooting
	Carry out troubleshooting for error codes [DK56KA], [DK56KB], [DK57KA], and [DK57KB].	

ERROR CODE DK55KZ (FORWARD-REVERSE POTENTIOMETER: DISCONNECTION OR SHORT CIRCUIT (KZ))

Action code	Error code	Controller code	Trouble	Forward-reverse potentiometer: Disconnection or short circuit (KZ)) (Steering and transmission controller system)
CALL E04	DK55KZ	Steering and transmission		
Contents of trouble	• When starting switch is turned ON, either of forward-reverse potentiometer systems 1 and 2 is abnormal, then either of error codes [DK56KA] and [DK56KB] and either of error codes [DK57KA] and [DK57KB] are displayed simultaneously.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine, transmission, and brake.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Input (Voltage) from forward-reverse potentiometers can be checked in monitoring mode. (Code 50200: Voltage of forward-reverse potentiometer 1) (Code 50201: Voltage of forward-reverse potentiometer 2)			
Related information	• Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for forward/reverse travel).			

Possible causes and standard value in normal state	Cause	Standard value in normal state/Remarks on troubleshooting
	Carry out troubleshooting for error codes [DK56KA], [DK56KB], [DK57KA], and [DK57KB].	

ERROR CODE DK55L8 (FORWARD-REVERSE POTENTIOMETER: SEE TABLE (L8))

Action code	Error code	Controller code	Trouble	Forward-reverse potentiometer: See table (L8) (Steering and transmission controller system)
CALL E03	DK55L8	Steering and transmission		
Contents of trouble	• Total signal voltage of each of forward-reverse potentiometer 1 system and 2 system is below 4.41V or above 5.59V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Continues controlling with signal of normal one of forward-reverse potentiometer 1 system and 2. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Input (Voltage) from forward-reverse potentiometers can be checked in monitoring mode. (Code 50200: Voltage of forward-reverse potentiometer 1) (Code 50201: Voltage of forward-reverse potentiometer 2) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for forward/reverse travel).			

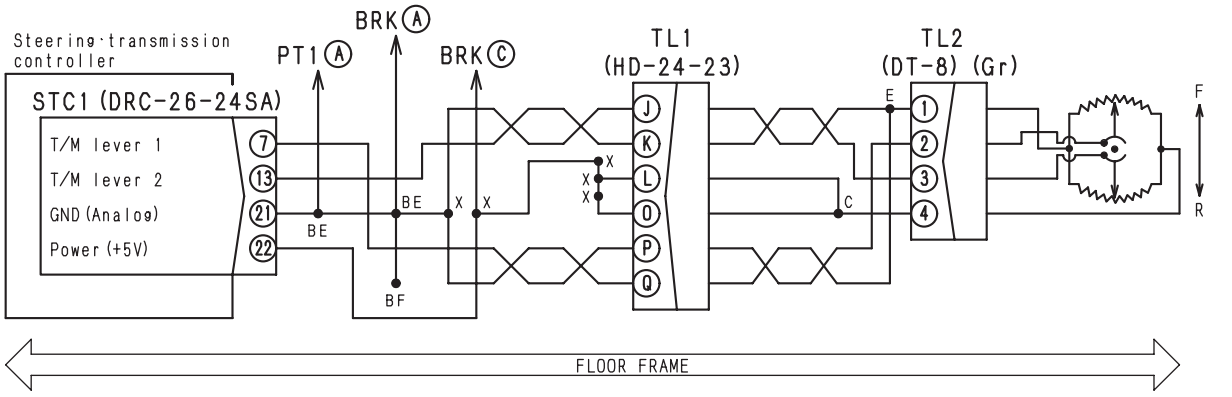
Possible causes and standard value in normal state	Cause	Standard value in normal state/Remarks on troubleshooting
	Carry out troubleshooting for error codes [DK56KA], [DK56KB], [DK57KA], and [DK57KB].	

ERROR CODE DK56KA (FORWARD-REVERSE POTENTIOMETER 1: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Forward-reverse potentiometer 1: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DK56KA	Steering and transmission		
Contents of trouble	• Signal voltage of forward-reverse potentiometer 1 system is below 0.5V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Continues controlling with signal of forward-reverse potentiometer 2 system. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Input (Voltage) from forward-reverse potentiometer 1 can be checked in monitoring mode. (Code 50200: Voltage of forward-reverse potentiometer 1) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for forward/reverse travel).			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective 5V sensor power source system	See if error code [DAQ5KK] is displayed. If it is displayed, carry out troubleshooting for it first.			
	2	Defective forward-reverse potentiometer 1 (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			TL2 (male)	Resistance		
			Between (4) – (1)	3.2kΩ ± 20%		
			Between (2) – (4)	5.5 – 1.5 kΩ (Forward – Reverse)		
			Between (2) – (1)	1.5 – 5.5 kΩ (Forward – Reverse)		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC1 (female) (22) – TL2 (female) (4)	Resistance	Max. 1Ω	
			Wiring harness between STC1 (female) (7) – TL2 (female) (2)	Resistance	Max. 1Ω	
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between STC1 (female) (2) – TL2 (female) (2) with chassis ground	Resistance	Min. 1MΩ	
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			STC1	Voltage		
			Between (2) – (21)	0.5 – 4.5V		

Circuit diagram related to forward-reverse potentiometer



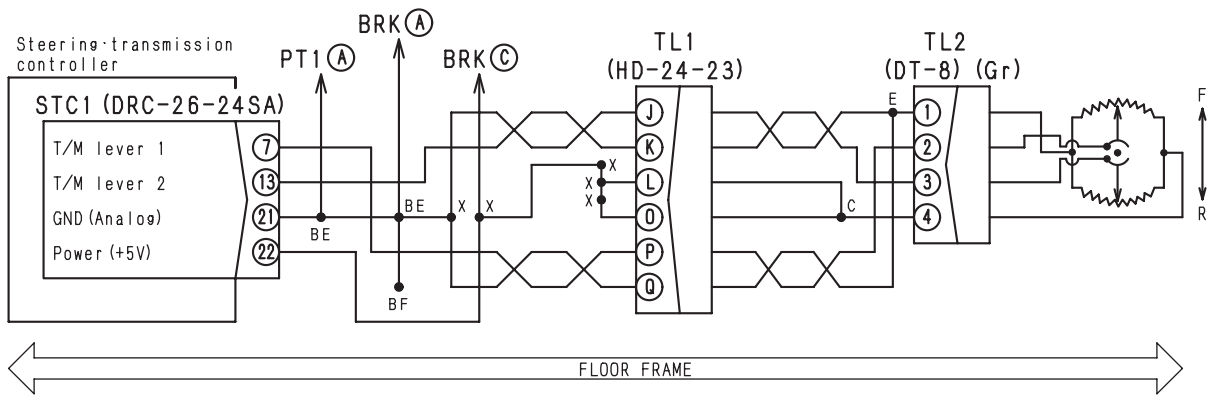
BJD11644

ERROR CODE DK56KB (FORWARD-REVERSE POTENTIOMETER 1: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Forward-reverse potentiometer 1: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DK56KB	Steering and transmission		
Contents of trouble	• Signal voltage of forward-reverse potentiometer 1 system is above 4.5V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Continues controlling with signal of forward-reverse potentiometer 2 system. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Input (Voltage) from forward-reverse potentiometer 1 can be checked in monitoring mode. (Code 50200: Voltage of forward-reverse potentiometer 1) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for forward/reverse travel).			

Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting		
	1	Defective 5V sensor power source system	See if error code [DB35KK] [DAQ5KK] is displayed. If it is displayed, carry out troubleshooting for it first.		
	2	Defective forward-reverse potentiometer 1 (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			TL2 (male)	Resistance	
			Between (4) – (1)	3.2kΩ ± 20%	
			Between (2) – (4)	5.5 – 1.5 kΩ (Forward – Reverse)	
			Between (2) – (1)	1.5 – 5.5 kΩ (Forward – Reverse)	
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC1 (female) (2) – TL2 (female) (2) with chassis ground	Resistance	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC1	Voltage	
			Between (7) – (21)	0.5 – 4.5V	

Circuit diagram related to forward-reverse potentiometer



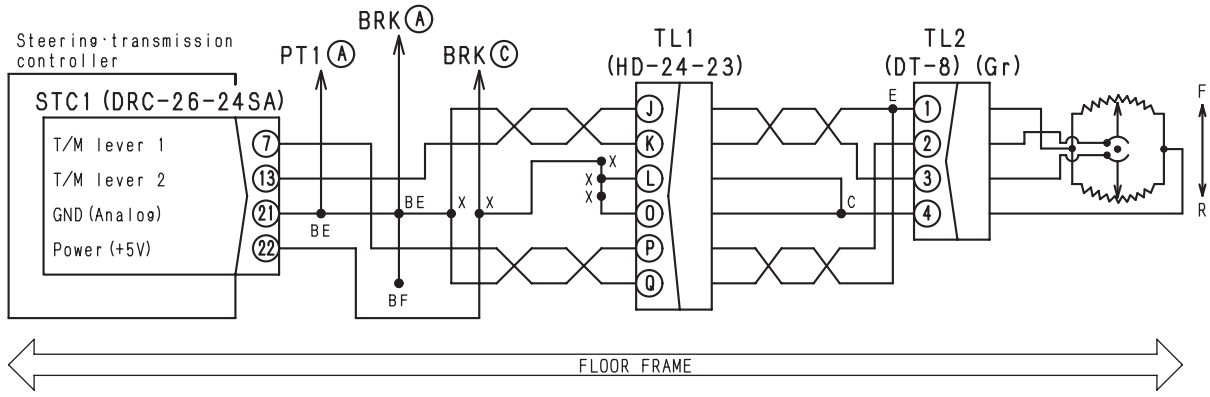
BJD11644

ERROR CODE DK57KA (FORWARD-REVERSE POTENTIOMETER 2: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Forward-reverse potentiometer 2: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DK57KA	Steering and transmission		
Contents of trouble	• Signal voltage of forward-reverse potentiometer 2 system is below 0.5V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Continues controlling with signal of forward-reverse potentiometer 1 system. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Input (Voltage) from forward-reverse potentiometer 2 can be checked in monitoring mode. (Code 50201: Voltage of forward-reverse potentiometer 2) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for forward/reverse travel).			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective 5V sensor power source system	★See if error code [DB35KK] [DAQ5KK] is displayed. If it is displayed, carry out troubleshooting for it first.			
	2	Defective forward-reverse potentiometer 2 (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			TL2 (male)	Resistance		
			Between (4) – (1)	3.2kΩ ± 20%		
			Between (3) – (4)	1.5 – 5.5 kΩ (Forward – Reverse)		
			Between (3) – (1)	5.5 – 1.5 kΩ (Forward – Reverse)		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC1 (female) (22) – TL2 (female) (4)	Resistance	Max. 1Ω	
			Wiring harness between STC1 (female) (19) – TL2 (female) (3)	Resistance	Max. 1Ω	
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between STC1 (female) (19) – TL2 (female) (3) with chassis ground	Resistance	Min. 1MΩ	
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			STC1	Voltage		
			Between (19) – (21)	0.5 – 4.5V		

Circuit diagram related to forward-reverse potentiometer



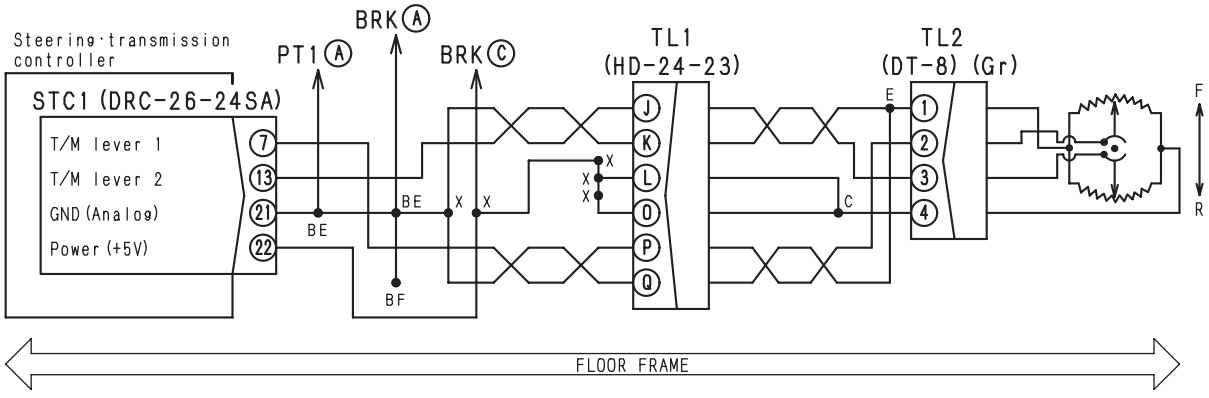
BJD11644

ERROR CODE DK57KB (FORWARD-REVERSE POTENTIOMETER 2: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Forward-reverse potentiometer 2: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DK57KB	Steering and transmission		
Contents of trouble	• Signal voltage of forward-reverse potentiometer 2 system is above 4.5V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Continues controlling with signal of forward-reverse potentiometer 1 system. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Input (Voltage) from forward-reverse potentiometer 2 can be checked in monitoring mode. (Code 50201: Voltage of forward-reverse potentiometer 2) • Method of reproducing error code: Turn starting switch ON and operate PCCS lever (for forward/reverse travel).			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	See if error code [DB35KK] [DAQ5KK] is displayed. If it is displayed, carry out troubleshooting for it first.		
	2	Defective forward-reverse potentiometer 2 (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			TL2 (male)	Resistance	
			Between (4) – (1)	3.2kΩ ± 20%	
			Between (3) – (4)	1.5 – 5.5 kΩ (Forward – Reverse)	
			Between (3) – (1)	5.5 – 1.5 kΩ (Forward – Reverse)	
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC1 (female) (13) – TL2 (female) (3) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC1	Voltage	
			Between (13) – (21)	0.5 – 4.5V	

Circuit diagram related to forward-reverse potentiometer



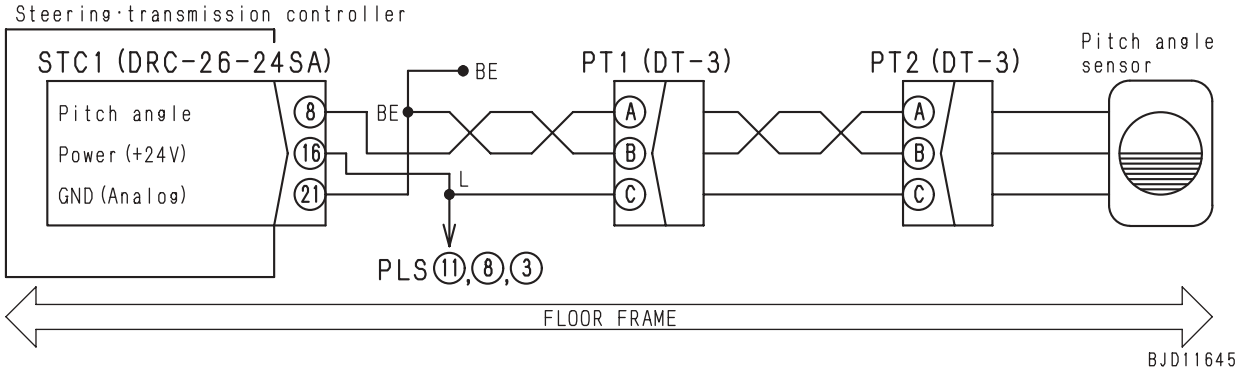
BJD11644

ERROR CODE DKH1KA (PITCH ANGLE SENSOR: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Pitch angle sensor: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DKH1KA	Steering and transmission		
Contents of trouble	• Signal voltage of pitch angle sensor is below 0.15V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Cannot recognize pitch angle. • Limits operation of engine and transmission.			
Problem that appears on machine	• Shocks are made when gear is shifted on slope and when machine is steered on level place. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.			
Related information	• Input (Voltage) from pitch angle sensor can be checked in monitoring mode. (Code 60100: Voltage of pitch angle sensor) • Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective 24V power source system	See if error code [DAQ6KK] [DB36KK] is displayed. If it is displayed, carry out troubleshooting for it first.		
	2	Defective pitch angle sensor (Internal trouble)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			PT2	Voltage	
			Between (B) – (A)	0.15 – 4.85V	
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC1 (female) (16) – PT2 (female) (C)	Resistance	Max. 1Ω
			Wiring harness between STC1 (female) (13) – PT2 (female) (B)	Resistance	Max. 1Ω
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC1 (female) (8) – PT2 (female) (B) with chassis ground	Resistance	Min. 1MΩ
	5	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC1	Voltage	
			Between (8) – (21)	0.15 – 4.85V	

Circuit diagram related to pitch angle sensor

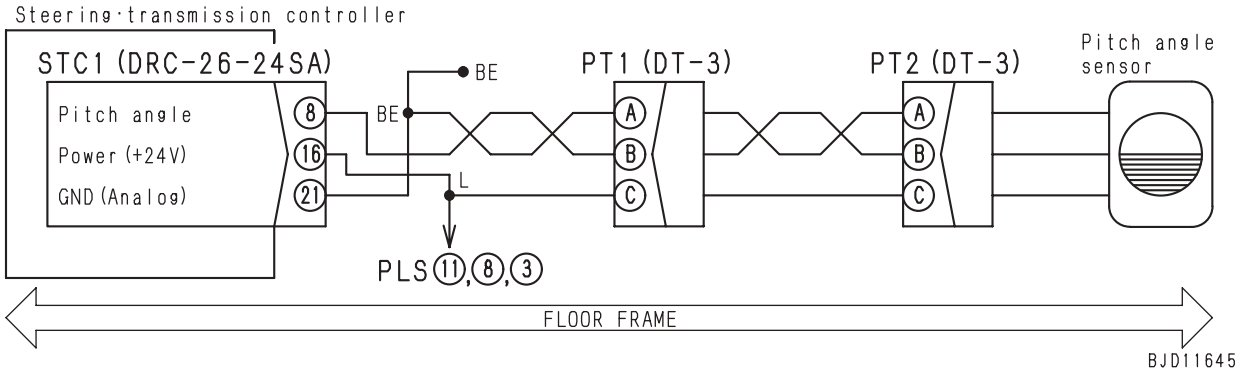


ERROR CODE DKH1KB (PITCH ANGLE SENSOR: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Pitch angle sensor: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DKH1KB	Steering and transmission		
Contents of trouble	• Signal voltage of pitch angle sensor is above 4.85V.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Cannot recognize pitch angle. • Limits operation of engine and transmission.			
Problem that appears on machine	• Shocks are made when gear is shifted on slope and when machine is steered on level place. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.			
Related information	• Input (Voltage) from pitch angle sensor can be checked in monitoring mode. (Code 60100: Voltage of pitch angle sensor) • Method of reproducing error code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective 24V power source system	See if error code [DAQ6KK] [DB36KK] is displayed. If it is displayed, carry out troubleshooting for it first.		
	2	Defective pitch angle sensor (Internal trouble)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			PT2	Voltage	
			Between (B) – (A)	0.15 – 4.85V	
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC1 (female) (8) – PT2 (female) (B) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC1	Voltage	
			Between (8) – (21)	0.15 – 4.85V	

Circuit diagram related to pitch angle sensor

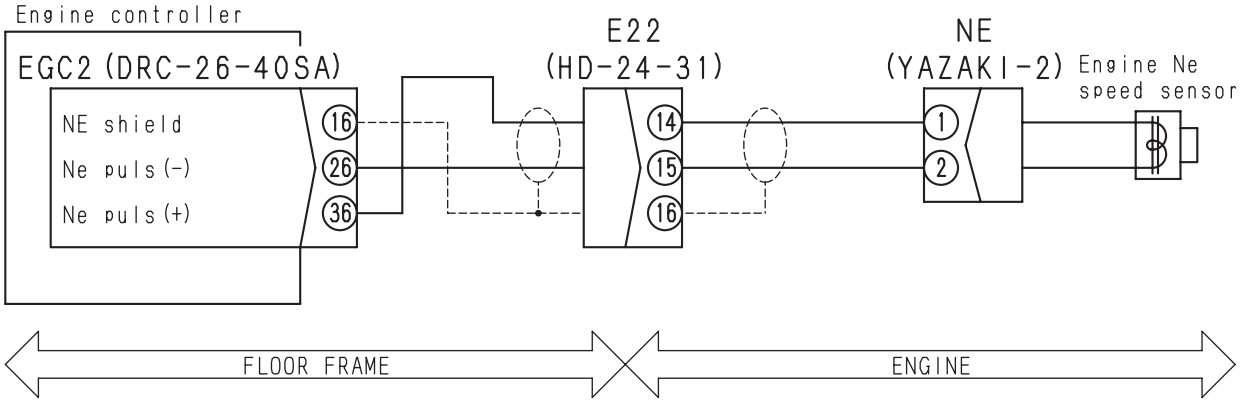


ERROR CODE DLE3LC (ENGINE NE SPEED SENSOR: SEE TABLE (LC))

Action code	Error code	Controller code	Trouble	Engine Ne speed sensor: See table (LC) (Engine controller system)
CALL E03	DEL3LC	ENG		
Contents of trouble	• Cylinders cannot be identified by signal of engine NE speed sensor.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem that appears on machine	• Engine speed may become unstable or engine may stop. • Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1 and R1.			
Related information	• Special adapter (799-601-9410) is necessary for troubleshooting for engine Ne speed sensor. • Method of reproducing error code: Start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective engine Ne speed sensor (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			NE (male)	Resistance	
			Between (1) – (2)	85 – 210Ω	
			Between (1), (2) – chassis ground	Min. 1MΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC2 (female) (36) – NE (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (26) – NE (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between EGC2 (female) (36) – NE (female) (1) with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between EGC2 (female) (26) – NE (female) (2) with chassis ground	Resistance	Min. 1MΩ
	4	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC2 (female)	Resistance	
			Between (36) – (26)	85 – 210Ω	
			Between (36), (26) – chassis ground	Min. 1MΩ	

Circuit diagram related to engine Ne speed sensor



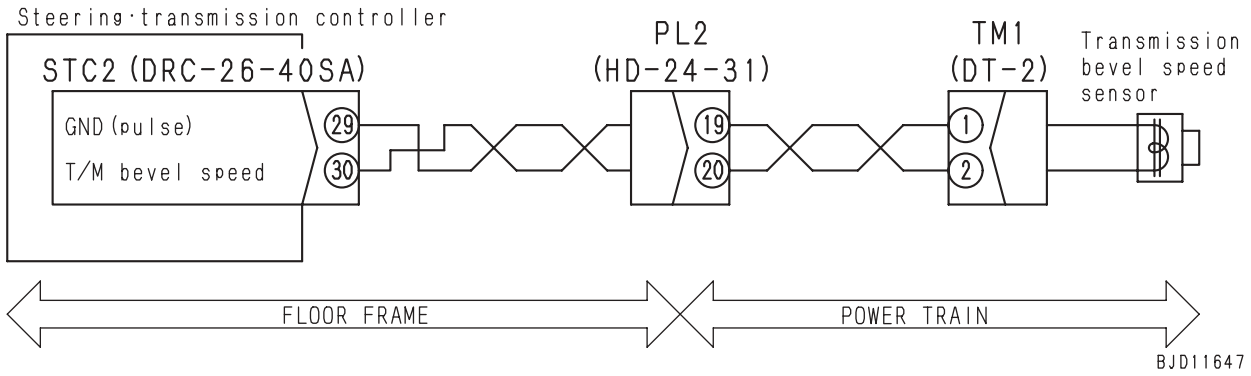
BJD11646

ERROR CODE DLF1KA (TRANSMISSION BEVEL SPEED SENSOR: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Transmission bevel speed sensor: Disconnection (KA) (Steering and transmission controller system)
E01	DLF1KA	Steering and transmission		
Contents of trouble	• Signal is not input from transmission bevel speed sensor.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Assumes that transmission bevel speed is 0rpm.			
Problem that appears on machine	• Transmission speed cannot be monitored. • Traction force cannot be calculated.			
Related information	• Input (rpm) from transmission output speed sensor can be checked in monitoring mode. (Code 31400: Transmission speed) • Method of reproducing error code: Start engine and travel machine actually.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective transmission output speed sensor (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			TM1 (male)	Resistance	
			Between (1) – (2)	500 – 1,000Ω	
			Between (1), (2) – chassis ground	Min. 1MΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC2 (female) (30) – TM1 (female) (1)	Resistance	Max. 1Ω
			Wiring harness between STC2 (female) (29) – TM1 (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC2 (female) (30) – TM1 (female) (1) with chassis ground	Resistance	Min. 1MΩ
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC2 (female)	Resistance	
			Between (30) – (29)	500 – 1,000Ω	
			Between (30) – chassis ground	Min. 1Ω	

Circuit diagram related to transmission output speed sensor

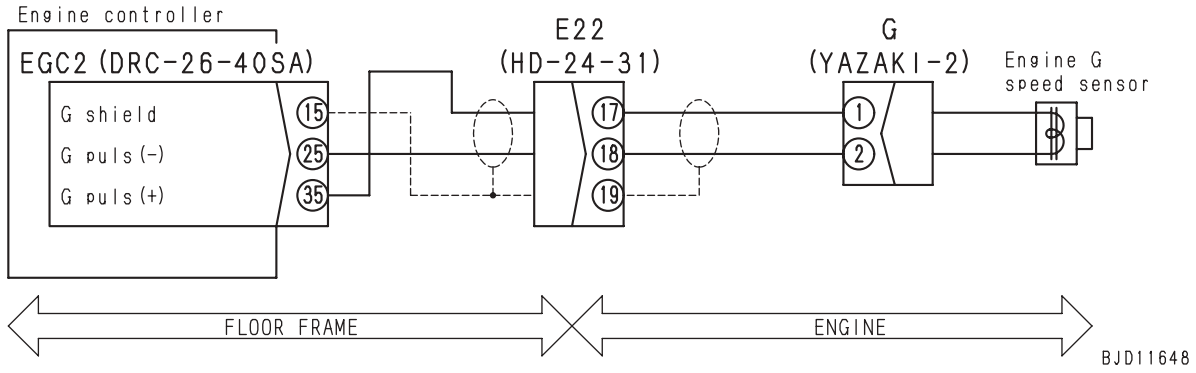


ERROR CODE DLH1LC (ENGINE G SPEED SENSOR: SEE TABLE (LC))

Action code	Error code	Controller code	Trouble	Engine G speed sensor: See table (LC) (Engine controller system)
CALL E03	DLH1LC	ENG		
Contents of trouble	• Signal of engine G speed sensor does not match to signal of engine Ne speed sensor.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Special adapter (799-601-9410) is necessary for troubleshooting for engine G speed sensor. • Method of reproducing error code: Start engine.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective engine G speed sensor (Internal disconnection or short circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			G (male)	Resistance	
			Between (1) – (2)	1.4k – 3.5kΩ	
			Between (1), (2) – chassis ground	Min. 1MΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between EGC2 (female) (35) – G (female) (1)	Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (25) – G (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between EGC2 (female) (35) – G (female) (1) with chassis ground	Resistance	Min. 1MΩ
			Short circuit of wiring harness between EGC2 (female) (25) – G (female) (2) with chassis ground	Resistance	Min. 1MΩ
	4	Defective engine controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			EGC2 (female)	Resistance	
			Between (35) – (25)	1.4k – 3.5kΩ	
			Between (35), (25) – chassis ground	Min. 1MΩ	

Circuit diagram related to engine G speed sensor

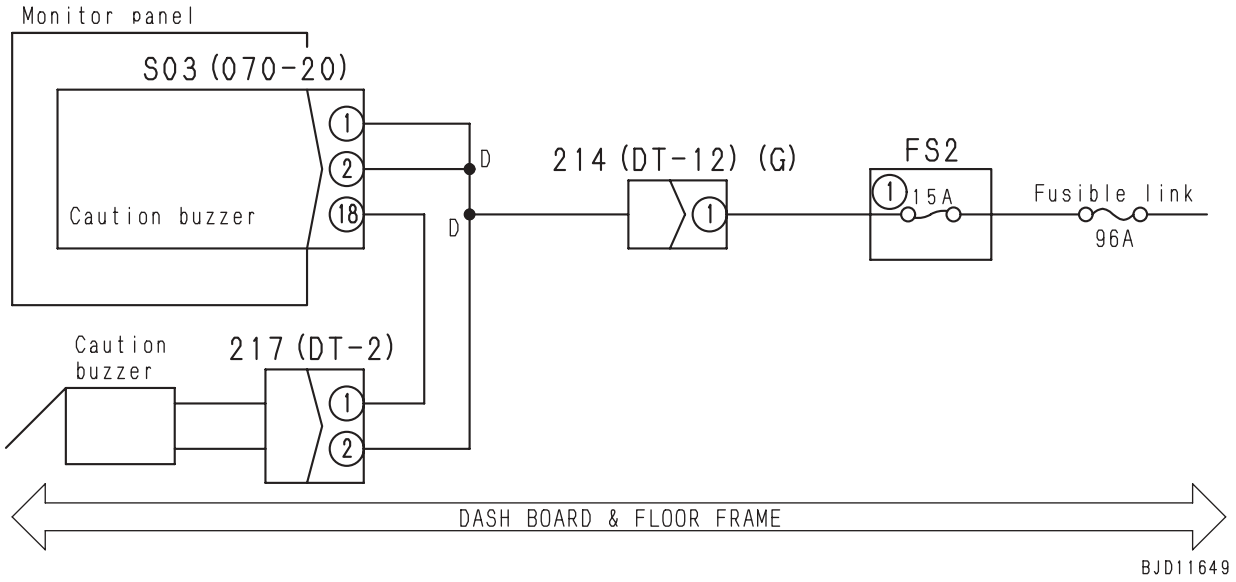


ERROR CODE DV00KB (CAUTION BUZZER: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Caution buzzer: Short circuit (KB) (Monitor panel system)
E01	DV00KB	MON		
Contents of trouble	• Abnormal current flowed when caution buzzer circuit output ground signal.			
Action of controller	• Flashes caution lamp. • Stops caution buzzer circuit from outputting ground signal.			
Problem that appears on machine	• Caution buzzer does not sound.			
Related information	• Method of reproducing error code: Turn starting switch ON (When it is turned ON, buzzer sounds for 1 second).			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective caution buzzer (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			217 (male)	Resistance	
			Between (1) – (2)	200Ω	
	2	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between 217 (female) (1) – S03 (female) (18) with chassis ground	Voltage	Max. 1V
	3	Defective monitor panel	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			S03	Caution buzzer	Voltage
			Between (18) – chassis ground	When turned OFF	20 – 30V
				When turned ON (sounding)	Max. 3V

Circuit diagram related to caution buzze

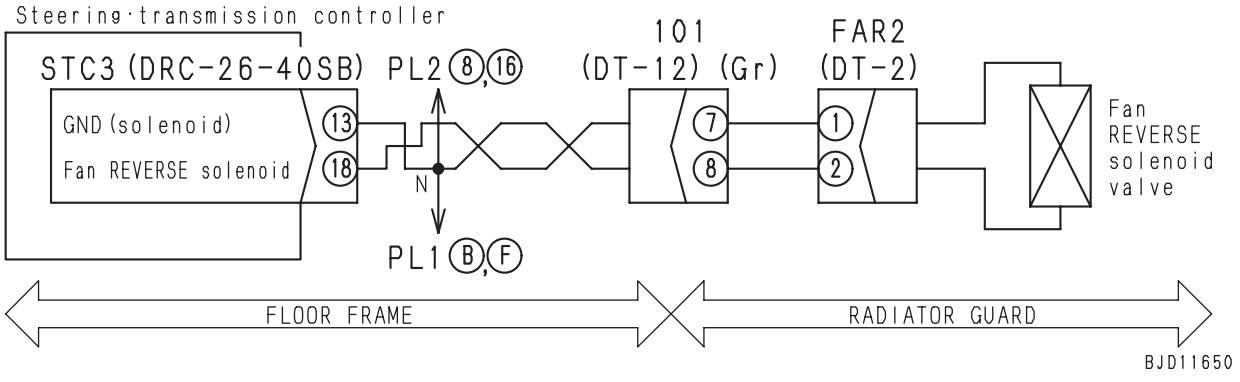


ERROR CODE DW7BKA (FAN REVERSE SOLENOID: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Fan reverse solenoid: Disconnection (KA) (Steering and transmission controller system)
—	DW7BKA	Steering and transmission		
Contents of trouble	• When signal is output to fan reverse solenoid circuit, any current does not flow.			
Action of controller	• Stops outputting to fan reverse solenoid circuit.			
Problem that appears on machine	• The fan reversing function cannot be used.			
Related information	• Output (Current) to fan reverse solenoid can be checked in monitoring mode. (Code 40909: Cooling fan reverse solenoid output current) • Method of reproducing service code: Turn starting switch ON and operate fan in reverse.			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective fan reverse solenoid (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			FARC (male)	Resistance		
			Between (1) – (2)	34 – 44Ω		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between STC3 (female) (18) – FAR2 (female) (1)	Resistance	Max. 1Ω	
			Wiring harness between STC3 (female) (13) – FAR2 (female) (2)	Resistance	Max. 1Ω	
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Short circuit of wiring harness between STC3 (female) (18) – FAR2 (female) (1) with chassis ground	Voltage	Max. 1V	
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			STC3 (female)	Resistance		
			Between (18) – (13)	15 – 25Ω		

Circuit diagram related to fan reverse solenoid

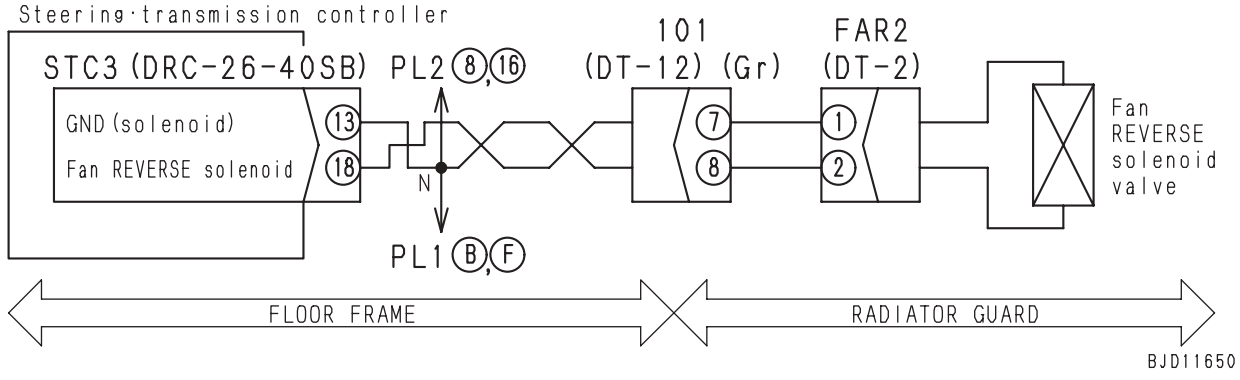


ERROR CODE DW7BKB (FAN REVERSE SOLENOID: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Fan reverse solenoid: Short circuit (KB) (Steering and transmission controller system)
E01	DW7BKB	Steering and transmission		
Contents of trouble	• When signal was output to fan reverse solenoid circuit, abnormal current flowed.			
Action of controller	• Stops outputting to fan reverse solenoid circuit.			
Problem that appears on machine	• The fan reversing function cannot be used.			
Related information	• Output (Current) to fan reverse solenoid can be checked in monitoring mode. (Code 40909: Cooling fan reverse solenoid output current) • Method of reproducing service code: Turn starting switch ON and operate fan in reverse.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fan reverse solenoid (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			FARC (male)	Resistance	
			Between (1) – (2)	34 – 44Ω	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC3 (female) (18) – FAR2 (female) (1) with chassis ground	Resistance	Min. 1MΩ
	3	Short circuit in wiring harness (with another wiring harness)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit in wiring harness between STC3 (female) (18) – FAR2 (female) (1) with wiring harness between STC3 (female) (13) – FAR2 (female) (2)	Resistance	Min. 1MΩ
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC3	Resistance	
			Between (18) – (13)	34 – 44Ω	
			Between (18) – chassis ground	Min. 1MΩ	

Circuit diagram related to fan reverse solenoid

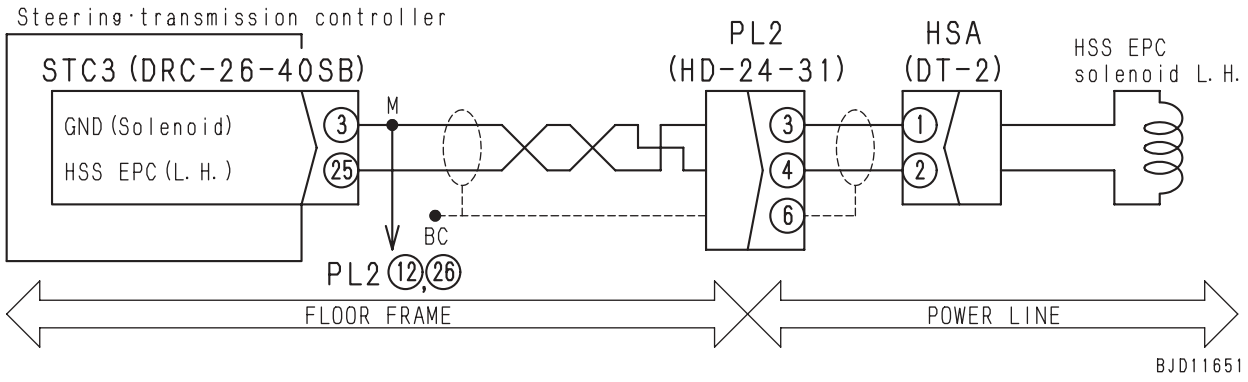


ERROR CODE DWN1KA (HSS EPC SOLENOID LEFT: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	HSS EPC solenoid left: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DWN1KA	Steering and transmission		
Contents of trouble	• When signal is output to HSS EPC solenoid left circuit, any current does not flow.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to HSS EPC solenoid left circuit. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Output (Current) to HSS EPC solenoid left can be checked in monitoring mode. (Code 50600: Left HSS solenoid output current) • Method of reproducing service code: Turn starting switch ON and operate PCCS lever (for steering to left).			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective HSS pump solenoid left (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			HSA (male)	Resistance	
			Between (1) – (2)	5 – 15Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC3 (female) (25) – HSA (female) (1)	Resistance	Max. 1Ω
			Wiring harness between STC3 (female) (3) – HSA (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC3 (female) (25) – HSA (female) (1) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3	Resistance	
			Between (25) – (3)	5 – 15Ω	

Circuit diagram related to HSS EPC solenoid left

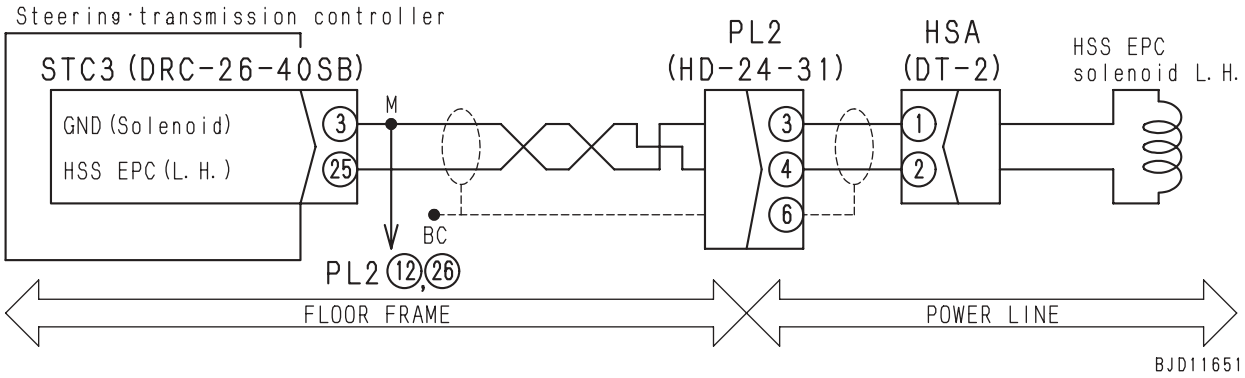


ERROR CODE DWN1KB (HSS EPC SOLENOID LEFT: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	HSS EPC solenoid left: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DWN1KB	Steering and transmission		
Contents of trouble	• When signal was output to HSS EPC solenoid left circuit, abnormal current flowed.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to HSS EPC solenoid left circuit. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Output (Current) to HSS EPC solenoid left can be checked in monitoring mode. (Code 50600: Left HSS solenoid output current) • Method of reproducing service code: Turn starting switch ON and operate PCCS lever (for steering to left).			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective HSS EPC solenoid left (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			HSA (male)	Resistance	
			Between (1) – (2)	5 – 15Ω	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC3 (female) (25) – HSA (female) (1) with chassis ground	Resistance	Min. 1MΩ
	3	Short circuit in wiring harness (with another wiring harness)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit in wiring harness between STC3 (female) (25) – HSA (female) (1) with wiring harness between STC3 (female) (3) – HSA (female) (2)	Resistance	Min. 1MΩ
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3	Resistance	
			Between (25) – (3)	5 – 15Ω	
			Between (25) – chassis ground	Min. 1MΩ	

Circuit diagram related to HSS EPC solenoid left

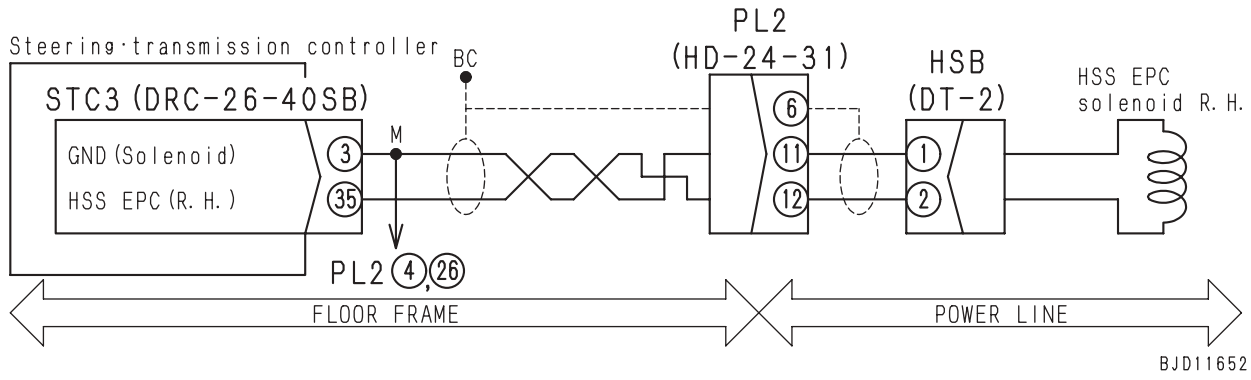


ERROR CODE DWN2KA (HSS EPC SOLENOID RIGHT: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	HSS EPC solenoid right: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DWN2KA	Steering and transmission		
Contents of trouble	• When signal is output to HSS EPC solenoid right circuit, any current does not flow.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to HSS EPC solenoid right circuit. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Output (Current) to HSS EPC solenoid right can be checked in monitoring mode. (Code 50601: Right HSS solenoid output current) • Method of reproducing service code: Turn starting switch ON and operate PCCS lever (for steering to right).			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective HSS EPC solenoid right (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			HSB (male)	Resistance	
			Between (1) – (2)	10 – 20Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC3 (female) (35) – HSB (female) (1)	Resistance	Max. 1Ω
			Wiring harness between STC3 (female) (3) – HSB (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC3 (female) (35) – HSB (female) (1) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3	Resistance	
			Between (35) – (3)	10 – 20Ω	

Circuit diagram related to HSS EPC solenoid right

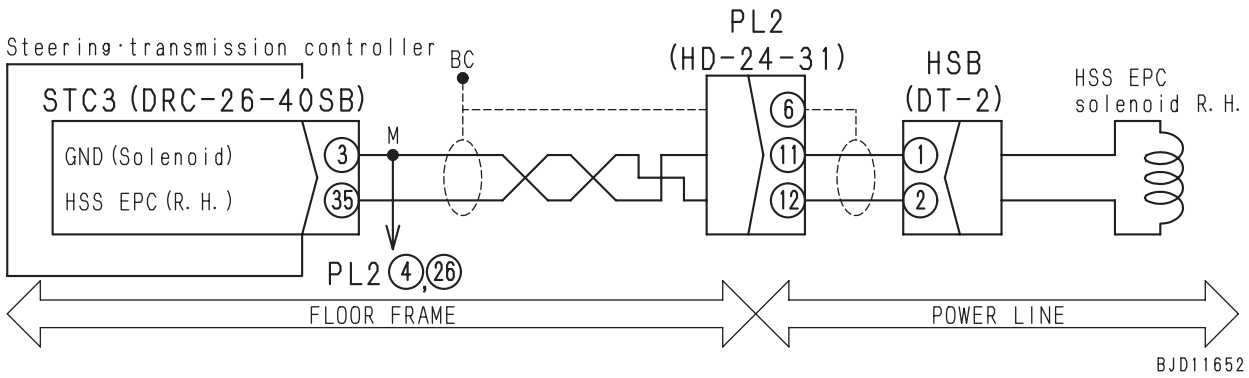


ERROR CODE DWN2KB (HSS EPC SOLENOID RIGHT: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	HSS EPC solenoid right: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DWN2KB	Steering and transmission		
Contents of trouble	• When signal was output to HSS EPC solenoid right circuit, abnormal current flowed.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to HSS EPC solenoid right circuit. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Output (Current) to HSS EPC solenoid right can be checked in monitoring mode. (Code 50601: Right HSS solenoid output current) • Method of reproducing service code: Turn starting switch ON and operate PCCS lever (for steering to right).			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective HSS EPC solenoid right (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			HSB (male)	Resistance		
			Between (1) – (2)	10 – 20Ω		
			Between (1) – chassis ground	Min. 1MΩ		
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit of wiring harness between STC3 (female) (35) – HSB (female) (1) with chassis ground	Resistance	Min. 1MΩ	
	3	Short circuit in wiring harness (with another wiring harness)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Short circuit in wiring harness between STC3 (female) (35) – HSB (female) (1) with wiring harness between STC3 (female) (3) – HSB (female) (2)	Resistance	Min. 1MΩ	
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			STC3	Resistance		
			Between (35) – (3)	10 – 20Ω		
			Between (35) – chassis ground	Min. 1MΩ		

Circuit diagram related to HSS EPC solenoid right

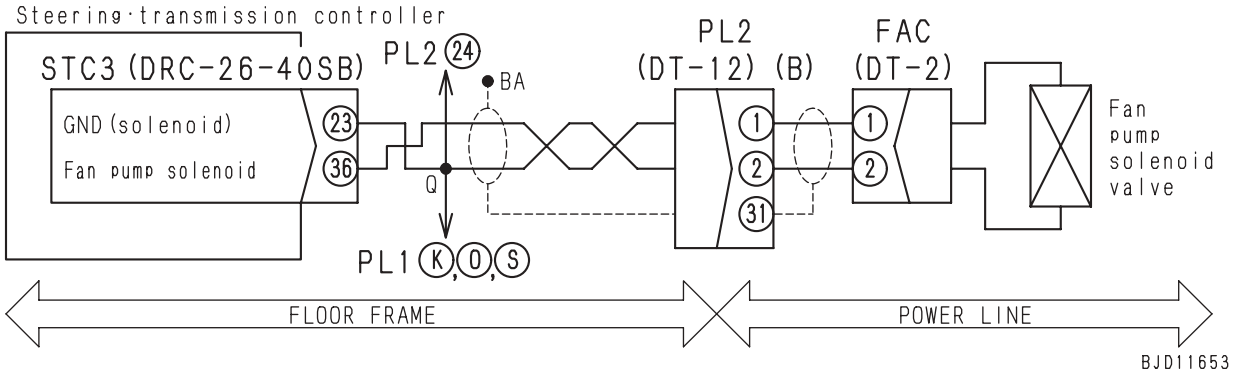


ERROR CODE DWN5KA (FAN PUMP SOLENOID: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Fan pump solenoid: Disconnection (KA) (Steering and transmission controller system)
E01	DWN5KA	Steering and transmission		
Contents of trouble	• When signal is output to fan pump solenoid circuit, any current does not flow.			
Action of controller	• Stops outputting to fan pump solenoid circuit.			
Problem that appears on machine	• Fan speed is kept at maximum level.			
Related information	• Output (Current) to fan pump solenoid can be checked in monitoring mode. (Code 31623, 31624: Cooling fan solenoid output current) • Method of reproducing service code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fan pump solenoid (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			FAC (male)	Resistance	
			Between (1) – (2)	15 – 25Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC3 (female) (36) – FAC (female) (1)	Resistance	Max. 1Ω
			Wiring harness between STC3 (female) (23) – FAC (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC3 (female) (36) – FAC (female) (1) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC3 (female)	Resistance	
			Between (36) – (23)	15 – 25Ω	

Circuit diagram related to fan pump solenoid

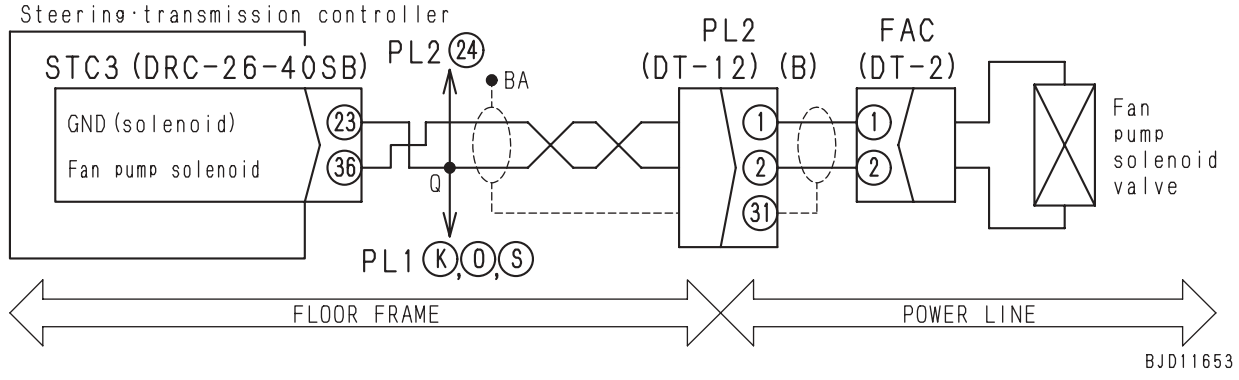


ERROR CODE DWN5KB (FAN PUMP SOLENOID: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Fan pump solenoid: Short circuit (KB) (Steering and transmission controller system)
E01	DWN5KB	Steering and transmission		
Contents of trouble	• When signal was output to fan pump solenoid circuit, abnormal current flowed.			
Action of controller	• Stops outputting to fan pump solenoid circuit.			
Problem that appears on machine	• Fan speed is kept at maximum level.			
Related information	• Output (Current) to fan pump solenoid can be checked in monitoring mode. (Code 31623, 31624: Cooling fan solenoid output current) • Method of reproducing service code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fan pump solenoid (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			FAC (male)	Resistance	
			Between (1) – (2)	15 – 25Ω	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between TMC3 (female) (36) – FAC (female) (1) with chassis ground	Resistance	Min. 1MΩ
	3	Short circuit in wiring harness (with another wiring harness)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit in wiring harness between TMC3 (female) (36) – FAC (female) (1) with wiring harness between TMC3 (female) (23) – FAC (female) (2)	Resistance	Min. 1MΩ
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			TMC3	Resistance	
			Between (36) – (23)	15 – 25Ω	
			Between (36) – chassis ground	Min. 1MΩ	

Circuit diagram related to fan pump solenoid

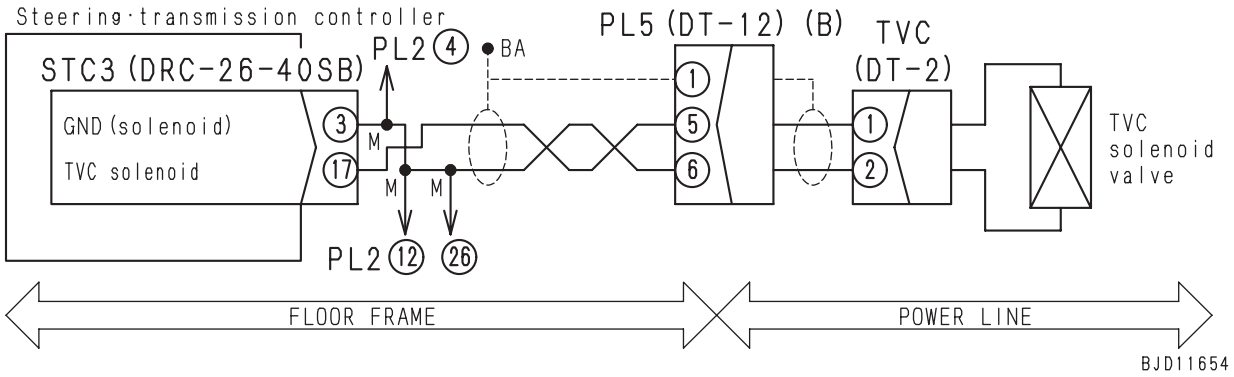


ERROR CODE DXA0KA (HSS • HYDRAULIC PUMP TVC SOLENOID: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	HSS • Hydraulic pump TVC solenoid: Disconnection (KA) (Steering and transmission controller system)
E01	DXA0KA	Steering and transmission		
Contents of trouble	• When signal is output to TVC solenoid circuit, any current does not flow.			
Action of controller	• Stops outputting to TVC solenoid circuit.			
Problem that appears on machine	• If the engine is loaded while its speed is low, it stalls.			
Related information	• Output (Current) to TVC solenoid can be checked in monitoring mode. (Code 01300, 01301: TVC solenoid output current) • Method of reproducing service code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective TVC solenoid (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			TVC (male)	Resistance	
			Between (1) – (2)	9 – 19Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC3 (female) (17) – TVC (female) (1)	Resistance	Max. 1Ω
			Wiring harness between STC3 (female) (23) – TVC (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC3 (female) (17) – TVC (female) (1) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC3 (female)	Resistance	
			Between (17) – (3)	9 – 19Ω	

Circuit diagram related to TVC solenoid

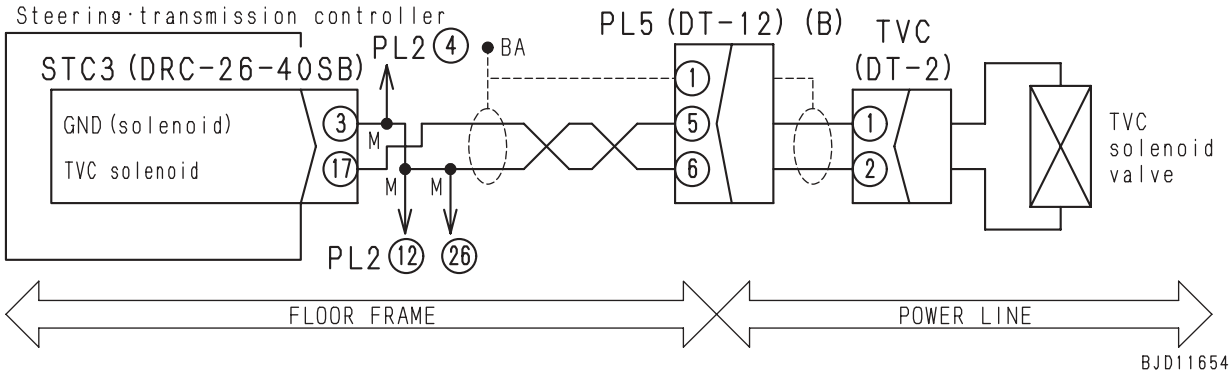


ERROR CODE DXA0KB (HSS • HYDRAULIC PUMP TVC SOLENOID: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	HSS • Hydraulic pump TVC solenoid: Short circuit (KB) (Steering and transmission controller system)
E01	DXA0KB	Steering and transmission		
Contents of trouble	• When signal was output to TVC solenoid circuit, abnormal current flowed.			
Action of controller	• Stops outputting to TVC solenoid circuit.			
Problem that appears on machine	• If the engine is loaded while its speed is low, it stalls.			
Related information	• Output (Current) to TVC solenoid can be checked in monitoring mode. (Code 31623, 31624: Cooling fan solenoid output current) • Method of reproducing service code: Turn starting switch ON.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective TVC solenoid (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			TVC (male)	Resistance	
			Between (1) – (2)	9 – 19Ω	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC3 (female) (17) – TVC (female) (1) with chassis ground	Resistance	Min. 1MΩ
	3	Short circuit in wiring harness (with another wiring harness)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit in wiring harness between STC3 (female) (17) – TVC (female) (1) with wiring harness between STC3 (female) (3) – TVC (female) (2)	Resistance	Min. 1MΩ
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			STC3	Resistance	
			Between (17) – (3)	9 – 19Ω	
			Between (17) – chassis ground	Min. 1MΩ	

Circuit diagram related to TVC solenoid

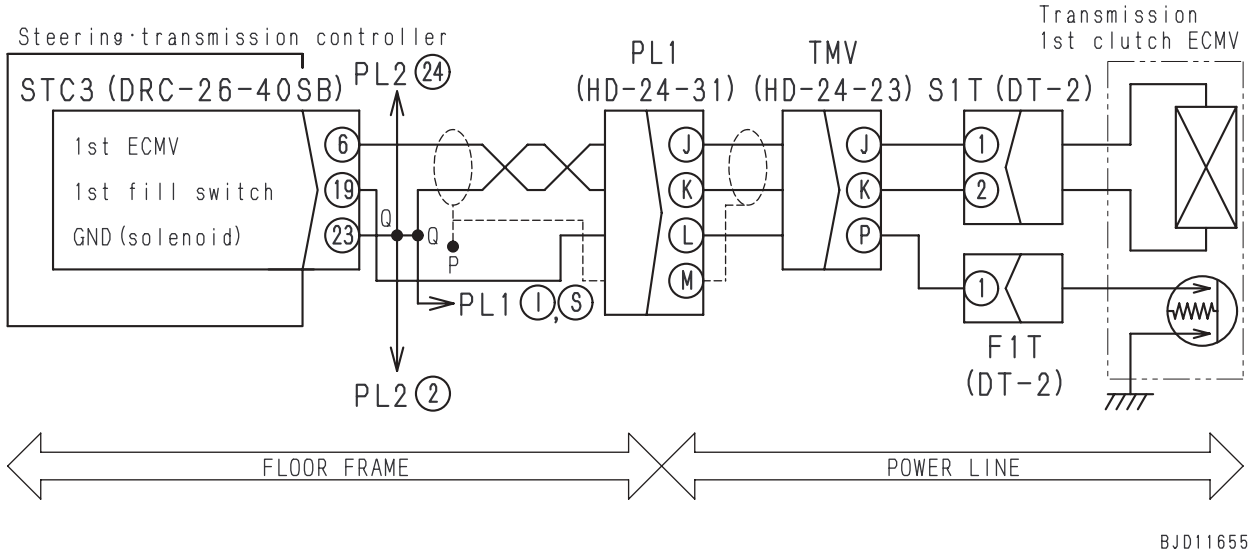


ERROR CODE DXH4KA (1ST CLUTCH ECMV: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	1st clutch ECMV: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DXH4KA	Steering and transmission		
Contents of trouble	• When signal is output to 1st clutch solenoid circuit, any current does not flow.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to transmission 1st clutch solenoid circuit. • Limits operation of engine and transmission.			
Problem that appears on machine	• Automatic 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.			
Related information	• Output (Current) to 1st clutch solenoid can be checked in monitoring mode. (Code 31602, 31612: Output current of 1st clutch ECMV) • Method of reproducing service code: Start engine and drive machine in F1 or R1.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective 1st clutch ECMV (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			S1T (male)	Resistance	
			Between (1) – (2)	5 – 25Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC3 (female) (6) – S1T (female) (1)	Resistance	Max. 1Ω
			Wiring harness between STC3 (female) (23) – S1T (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC3 (female) (6) – S1T (female) (1) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3 (female)	Resistance	
			Between (6) – (23)	5 – 25Ω	

Circuit diagram related to transmission 1st clutch ECMV

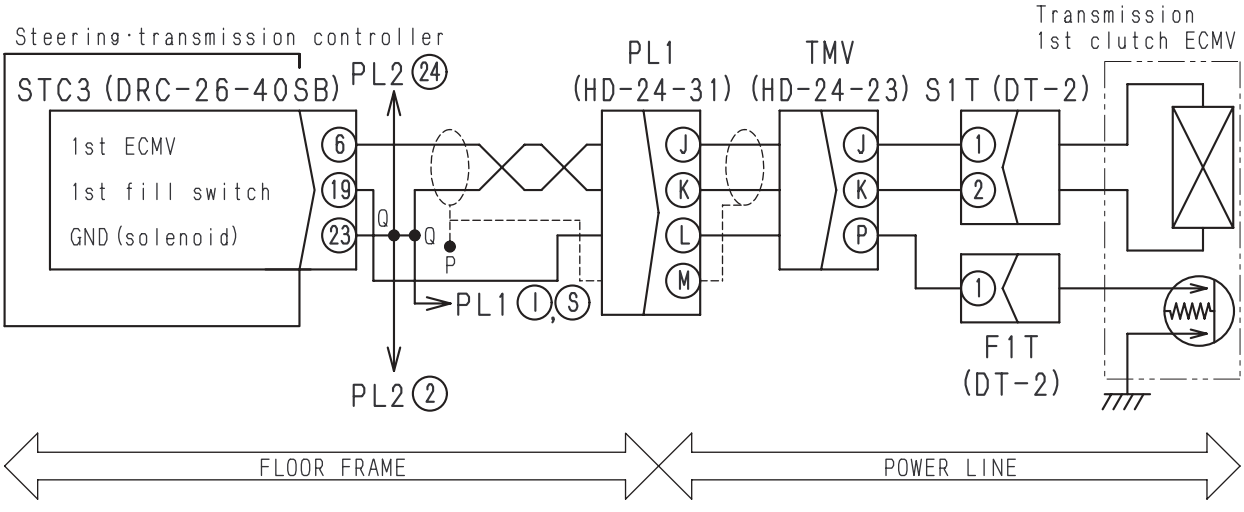


ERROR CODE DXH4KB (1ST CLUTCH ECMV: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	1st clutch ECMV: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DXH4KB	Steering and transmission		
Contents of trouble	• When signal was output to transmission 1st clutch solenoid circuit, abnormal current flowed.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to transmission 1st clutch solenoid circuit. • Limits operation of engine and transmission.			
Problem that appears on machine	• Automatic 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.			
Related information	• Output (Current) to 1st clutch solenoid can be checked in monitoring mode. (Code 31602, 31612: Output current of 1st clutch ECMV) • Method of reproducing service code: Start engine and drive machine in F1 or R1.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective 1st clutch ECMV (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			S1T (male)	Resistance	
			Between (1) – (2)	5 – 25Ω	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC3 (female) (6) – S1T (female) (1) with chassis ground	Resistance	Min. 1MΩ
	3	Short circuit in wiring harness (with another wiring harness)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit in wiring harness between STC3 (female) (6) – S1T (female) (1) with wiring harness between STC3 (female) (23) – S1T (female) (2)	Resistance	Min. 1MΩ
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3	Resistance	
			Between (6) – (23)	5 – 25Ω	
			Between (6) – chassis ground	Min. 1MΩ	

Circuit diagram related to transmission 1st clutch ECMV



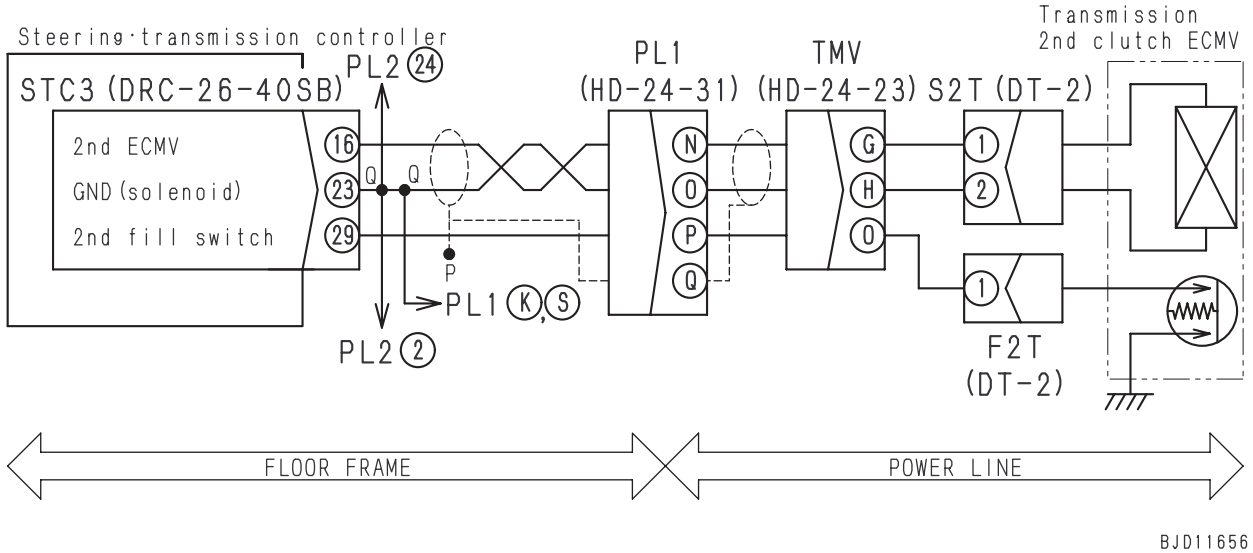
BJD11655

ERROR CODE DXH5KA (2ND CLUTCH ECMV: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	2nd clutch ECMV: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DXH5KA	Steering and transmission		
Contents of trouble	• When signal is output to 2nd clutch solenoid circuit, any current does not flow.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to transmission 2nd clutch solenoid circuit. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Output (Current) to 2nd clutch solenoid can be checked in monitoring mode. (Code 31603, 31613: Output current of 2nd clutch ECMV) • Method of reproducing service code: Start engine and drive machine in F2 or R2.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective 2nd clutch ECMV (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			S2T (male)	Resistance	
			Between (1) – (2)	5 – 25Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC3 (female) (16) – S2T (female) (1)	Resistance	Max. 1Ω
			Wiring harness between STC3 (female) (23) – S2T (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC3 (female) (16) – S2T (female) (1) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3 (female)	Resistance	
			Between (16) – (23)	5 – 25Ω	

Circuit diagram related to transmission 2nd clutch ECMV

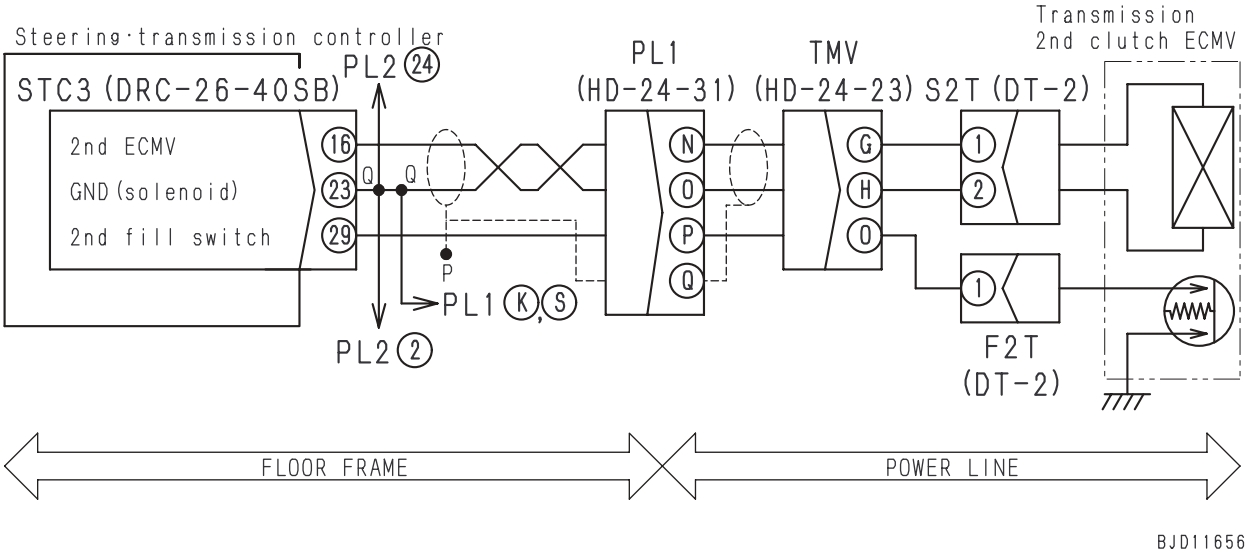


ERROR CODE DXH5KB (2ND CLUTCH ECMV: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	2nd clutch ECMV: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DXH5KB	Steering and transmission		
Contents of trouble	• When signal was output to transmission 2nd clutch solenoid circuit, abnormal current flowed.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to transmission 2nd clutch solenoid circuit. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Output (Current) to 2nd clutch solenoid can be checked in monitoring mode. (Code 31603, 31613: Output current of 2nd clutch ECMV) • Method of reproducing service code: Start engine and drive machine in F2 or R2.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective 2nd clutch ECMV (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			S2T (male)	Resistance	
			Between (1) – (2)	5 – 25Ω	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC3 (female) (16) – S2T (female) (1) with chassis ground	Resistance	Min. 1MΩ
	3	Short circuit in wiring harness (with another wiring harness)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit in wiring harness between STC3 (female) (16) – S2T (female) (1) with wiring harness between STC3 (female) (23) – S2T (female) (2)	Resistance	Min. 1MΩ
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3	Resistance	
			Between (16) – (23)	5 – 25Ω	
			Between (16) – chassis ground	Min. 1MΩ	

Circuit diagram related to transmission 2nd clutch ECMV

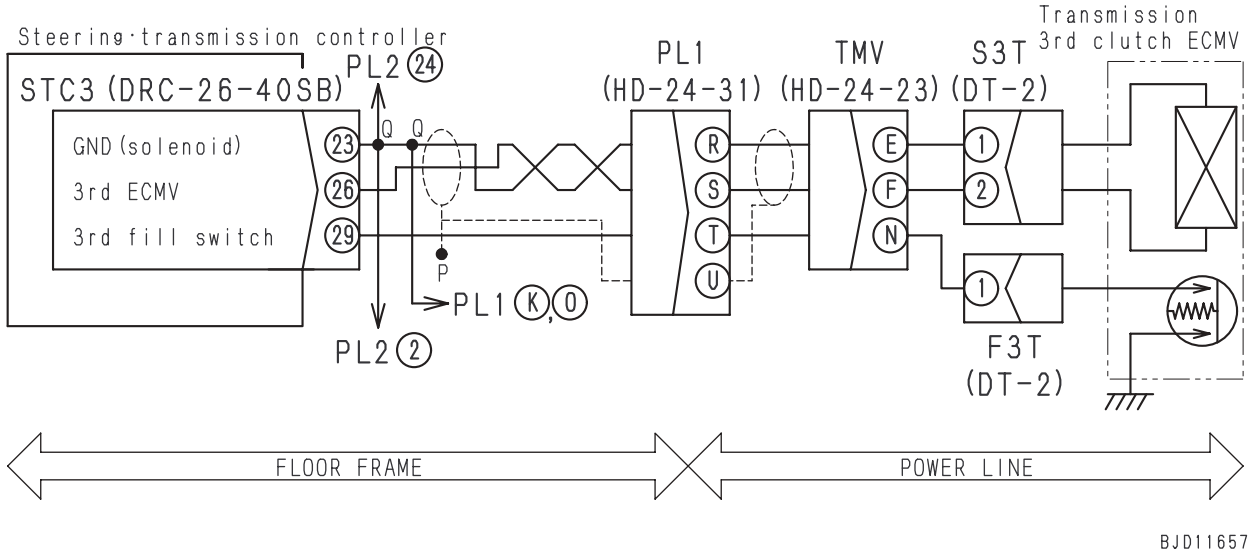


ERROR CODE DXH6KA (3RD CLUTCH ECMV: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	3rd clutch ECMV: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DXH6KA	Steering and transmission		
Contents of trouble	• When signal is output to 3rd clutch solenoid circuit, any current does not flow.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to transmission 3rd clutch solenoid circuit. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Output (Current) to 3rd clutch solenoid can be checked in monitoring mode. (Code 31604, 31614: Output current of 3rd clutch ECMV) • Method of reproducing service code: Start engine and drive machine in F3 or R3.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective 3rd clutch ECMV (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			S3T (male)	Resistance	
			Between (1) – (2)	5 – 25Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC3 (female) (26) – S3T (female) (1)	Resistance	Max. 1Ω
			Wiring harness between STC3 (female) (23) – S3T (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC3 (female) (26) – S3T (female) (1) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3 (female)	Resistance	
			Between (26) – (23)	5 – 25Ω	

Circuit diagram related to transmission 3rd clutch ECMV



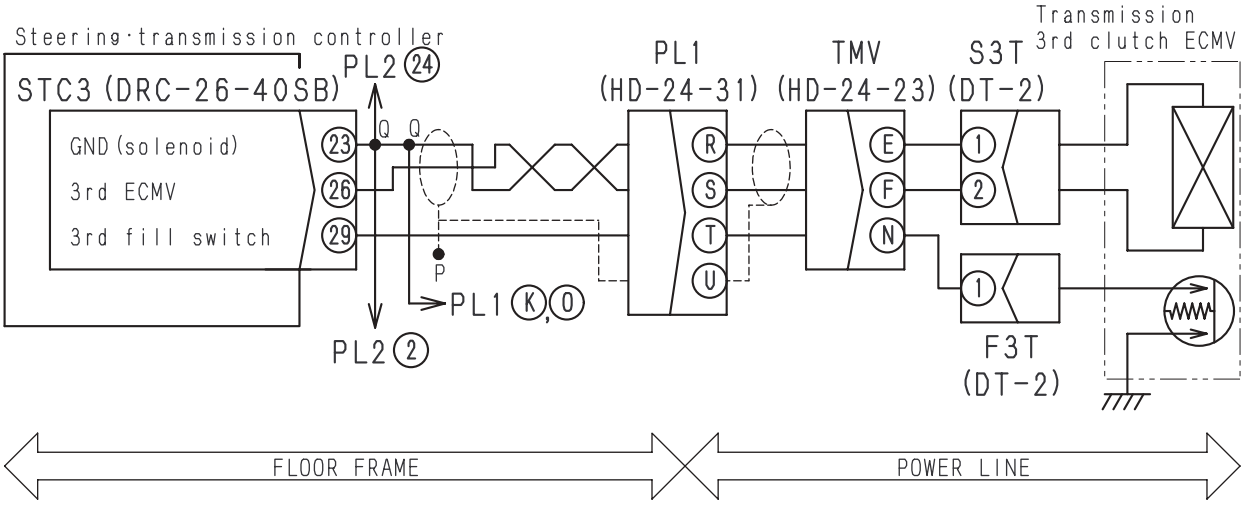
BJD11657

ERROR CODE DXH6KB (3RD CLUTCH ECMV: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	3rd clutch ECMV: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DXH6KB	Steering and transmission		
Contents of trouble	• When signal was output to transmission 3rd clutch solenoid circuit, abnormal current flowed.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to transmission 3rd clutch solenoid circuit. • Limits operation of engine and transmission.			
Problem 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.			
Related information	• Output (Current) to 3rd clutch solenoid can be checked in monitoring mode. (Code 31604, 31614: Output current of 3rd clutch ECMV) • Method of reproducing service code: Start engine and drive machine in F3 or R3.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective 3rd clutch ECMV (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			S3T (male)	Resistance	
			Between (1) – (2)	5 – 25Ω	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC3 (female) (26) – S3T (female) (1) with chassis ground	Resistance	Min. 1MΩ
	3	Short circuit in wiring harness (with another wiring harness)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit in wiring harness between STC3 (female) (26) – S3T (female) (1) with wiring harness between STC3 (female) (23) – S3T (female) (2)	Resistance	Min. 1MΩ
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3	Resistance	
			Between (26) – (23)	5 – 25Ω	
			Between (26) – chassis ground	Min. 1MΩ	

Circuit diagram related to transmission 3rd clutch ECMV



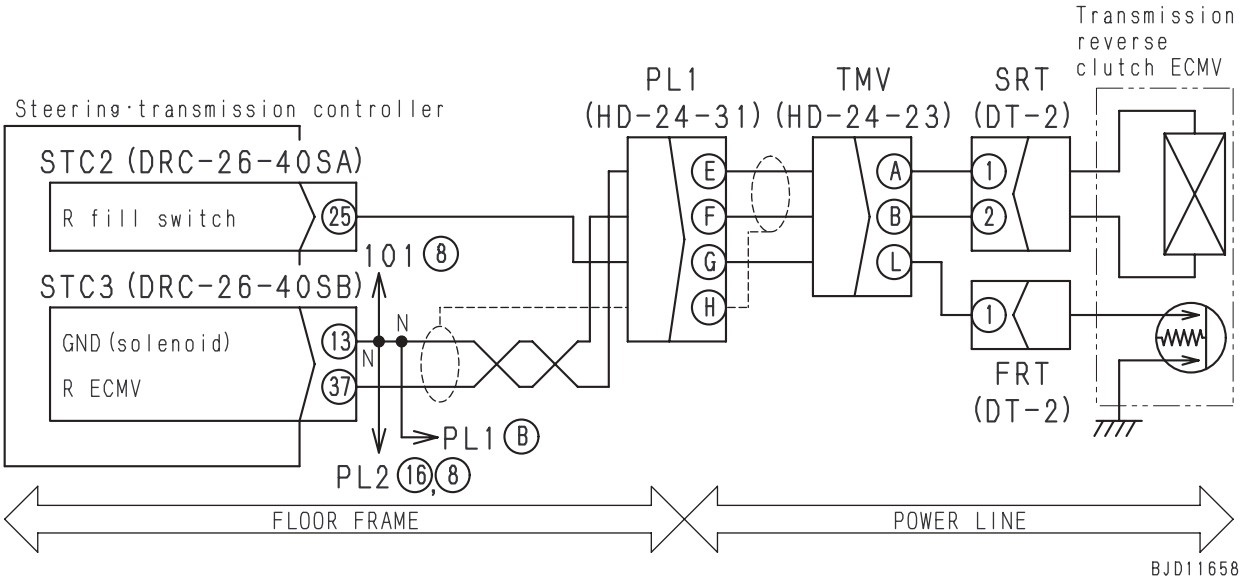
BJD11657

ERROR CODE DXH7KA (REVERSE CLUTCH ECMV: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Reverse clutch ECMV: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DXH7KA	Steering and transmission		
Contents of trouble	• When signal is output to reverse clutch solenoid circuit, any current does not flow.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to transmission reverse clutch solenoid circuit. • Limits operation of engine and transmission.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1.			
Related information	• Output (Current) to reverse clutch solenoid can be checked in monitoring mode. (Code 31606, 31616: Output current of reverse clutch ECMV) • Method of reproducing service code: Start engine and drive machine in reverse.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective reverse clutch ECMV (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			SRT (male)	Resistance	
			Between (1) – (2)	5 – 25Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC3 (female) (37) – SRT (female) (1)	Resistance	Max. 1Ω
			Wiring harness between STC3 (female) (13) – SRT (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC3 (female) (37) – SRT (female) (1) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3 (female)	Resistance	
			Between (37) – (13)	5 – 25Ω	

Circuit diagram related to transmission reverse clutch ECMV

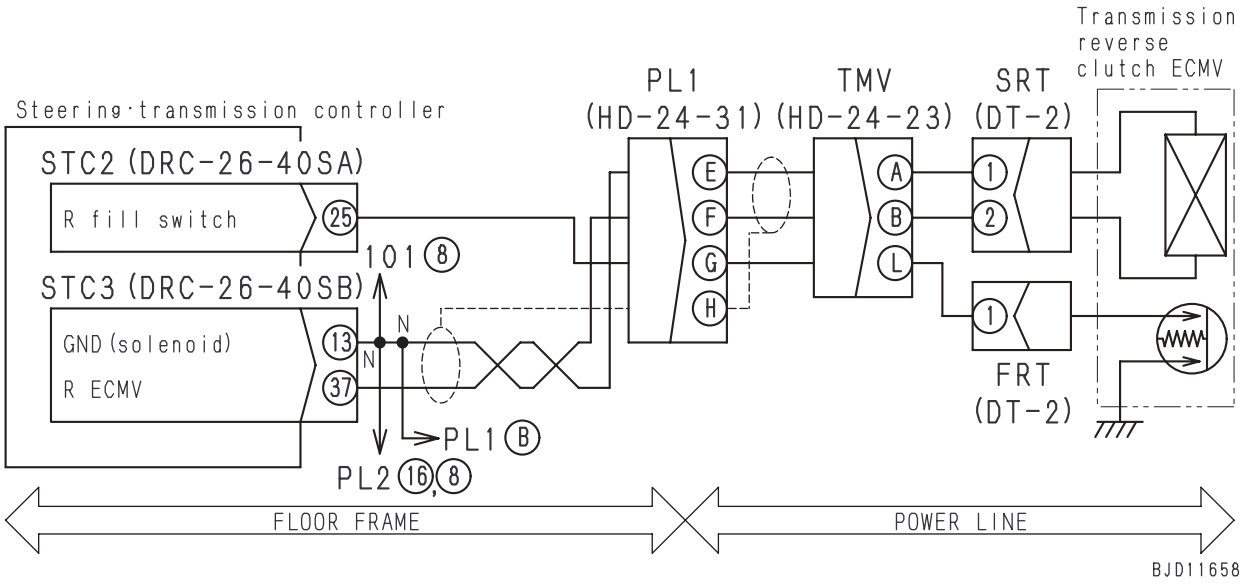


ERROR CODE DXH7KB (REVERSE CLUTCH ECMV: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Reverse clutch ECMV: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DXH7KB	Steering and transmission		
Contents of trouble	• When signal was output to transmission reverse clutch solenoid circuit, abnormal current flowed.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to transmission reverse clutch solenoid circuit. • Limits operation of engine and transmission.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to F1.			
Related information	• Output (Current) to reverse clutch solenoid can be checked in monitoring mode. (Code 31606, 31616: Output current of reverse clutch ECMV) • Method of reproducing service code: Start engine and drive machine in reverse.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective reverse clutch ECMV (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			SRT (male)	Resistance	
			Between (1) – (2)	5 – 25Ω	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC3 (female) (37) – SRT (female) (1) with chassis ground	Resistance	Min. 1MΩ
	3	Short circuit in wiring harness (with another wiring harness)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit in wiring harness between STC3 (female) (37) – SRT (female) (1) with wiring harness between STC3 (female) (13) – SRT (female) (2)	Resistance	Min. 1MΩ
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3	Resistance	
			Between (37) – (13)	5 – 25Ω	
			Between (37) – chassis ground	Min. 1MΩ	

Circuit diagram related to transmission reverse clutch ECMV

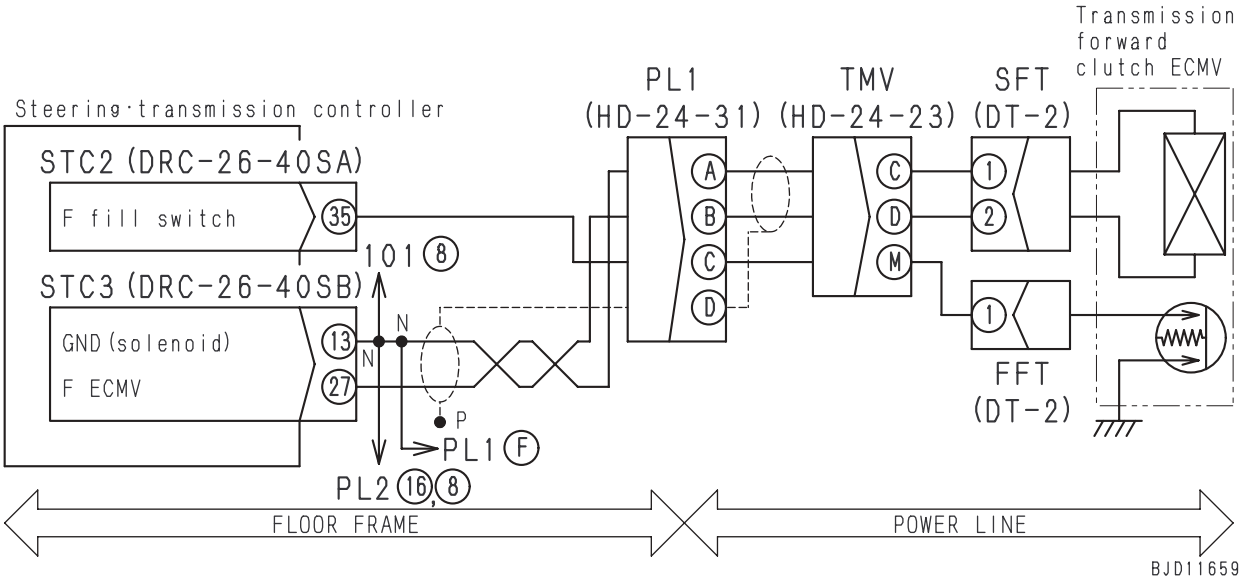


ERROR CODE DXH8KA (FORWARD CLUTCH ECMV: DISCONNECTION (KA))

Action code	Error code	Controller code	Trouble	Forward clutch ECMV: Disconnection (KA) (Steering and transmission controller system)
CALL E03	DXH8KA	Steering and transmission		
Contents of trouble	• When signal is output to forward clutch solenoid circuit, any current does not flow.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to transmission forward clutch solenoid circuit. • Limits operation of engine and transmission.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to R1.			
Related information	• Output (Current) to forward clutch solenoid can be checked in monitoring mode. (Code 31608, 31622: Output current of forward clutch ECMV) • Method of reproducing service code: Start engine and drive machine forward.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective forward clutch ECMV (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			SFT (male)	Resistance	
			Between (1) – (2)	5 – 25Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between STC3 (female) (27) – SFT (female) (1)	Resistance	Max. 1Ω
			Wiring harness between STC3 (female) (13) – SFT (female) (2)	Resistance	Max. 1Ω
	3	Short circuit with power source in wiring harness (Contact with 24V circuit)	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Short circuit of wiring harness between STC3 (female) (27) – SFT (female) (1) with chassis ground	Voltage	Max. 1V
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3 (female)	Resistance	
			Between (27) – (13)	5 – 25Ω	

Circuit diagram related to transmission forward clutch ECMV

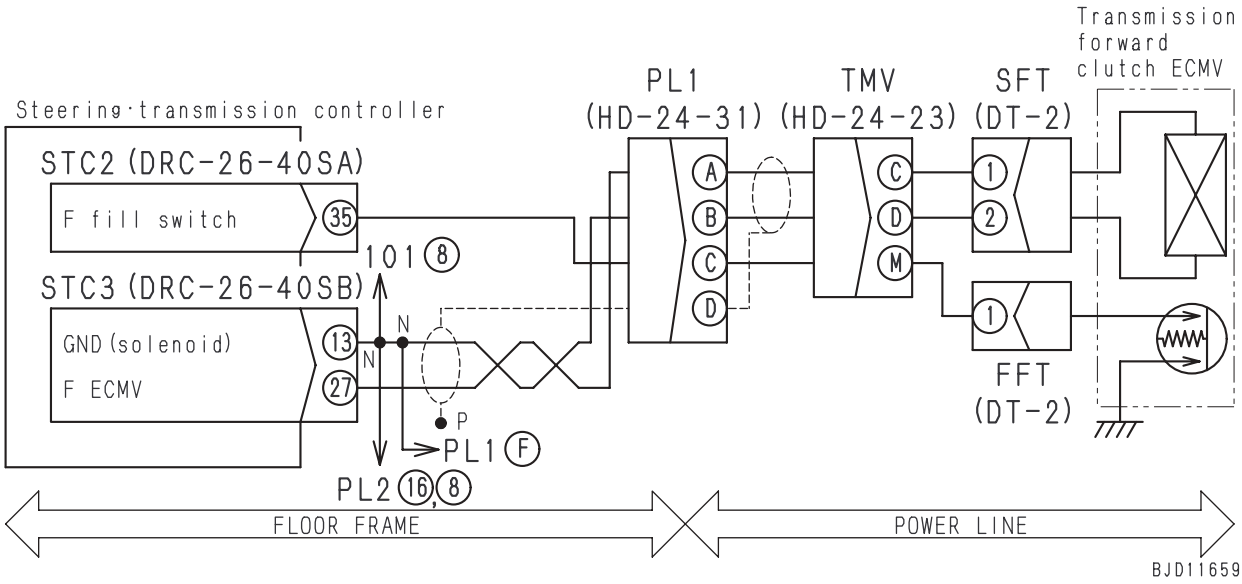


ERROR CODE DXH8KB (FORWARD CLUTCH ECMV: SHORT CIRCUIT (KB))

Action code	Error code	Controller code	Trouble	Forward clutch ECMV: Short circuit (KB) (Steering and transmission controller system)
CALL E03	DXH8KB	Steering and transmission		
Contents of trouble	• When signal was output to transmission forward clutch solenoid circuit, abnormal current flowed.			
Action of controller	• Flashes caution lamp and turns on caution buzzer. • Stops outputting to transmission forward clutch solenoid circuit. • Limits operation of engine and transmission.			
Problem that appears on machine	• Once machine is stopped, engine speed is limited to medium (half). • Once machine is stopped, travel is limited to R1.			
Related information	• Output (Current) to forward clutch solenoid can be checked in monitoring mode. (Code 31608, 31622: Output current of forward clutch ECMV) • Method of reproducing service code: Start engine and drive machine forward.			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective forward clutch ECMV (Internal short circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			SFT (male)	Resistance	
			Between (1) – (2)	5 – 25Ω	
			Between (1) – chassis ground	Min. 1MΩ	
	2	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit of wiring harness between STC3 (female) (27) – SFT (female) (1) with chassis ground	Resistance	Min. 1MΩ
	3	Short circuit in wiring harness (with another wiring harness)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Short circuit in wiring harness between STC3 (female) (27) – SFT (female) (1) with wiring harness between STC3 (female) (13) – SFT (female) (2)	Resistance	Min. 1MΩ
	4	Defective steering and transmission controller	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			STC3	Resistance	
			Between (27) – (13)	5 – 25Ω	
			Between (27) – chassis ground	Min. 1MΩ	

Circuit diagram related to transmission forward clutch ECMV



TROUBLESHOOTING OF ELECTRICAL SYSTEM (E-MODE)

INFORMATION DESCRIBED IN TROUBLESHOOTING LIST

★ Troubleshooting lists and related circuit diagrams contain the following information all together. Understand the contents carefully and troubleshoot the machine.

Trouble	Problem that appears on the machine.
Related information	Information related to problems occurred or troubleshooting

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1 2 3 4	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 in normal state required to judge the assumed cause (good or not) • Remarks required to judge whether the cause is good <Phenomenon of defective harness> • Disconnection in wiring The connector connection is defective or the wiring harness is disconnected. • Grounding fault A harness not connected to the ground (earth) circuit comes into contact with the ground (earth) circuit. • Defective hot short A harness not connected to the power (24V) circuit comes into contact with the power (24V) circuit. • Defective short A harness of an independent circuit abnormally comes into contact with one of another circuit. <Notes on troubleshooting> (1) Method of indicating connector numbers and handling T-junction For troubleshooting, insert or connect the T-junction adapter as shown below unless especially specified. • When “male” or “female” is not indicated for a connector number, disconnect the connector, and insert the T-junction adapter in both the male and female. • When “male” or “female” is indicated for a connector number, disconnect the connector, and insert the T-junction 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 as shown below unless especially specified. • Connect the plus (+) lead to a pin or harness indicated in the front. • Connect the minus (–) lead to a pin or harness indicated in the rear.

Related circuit diagram

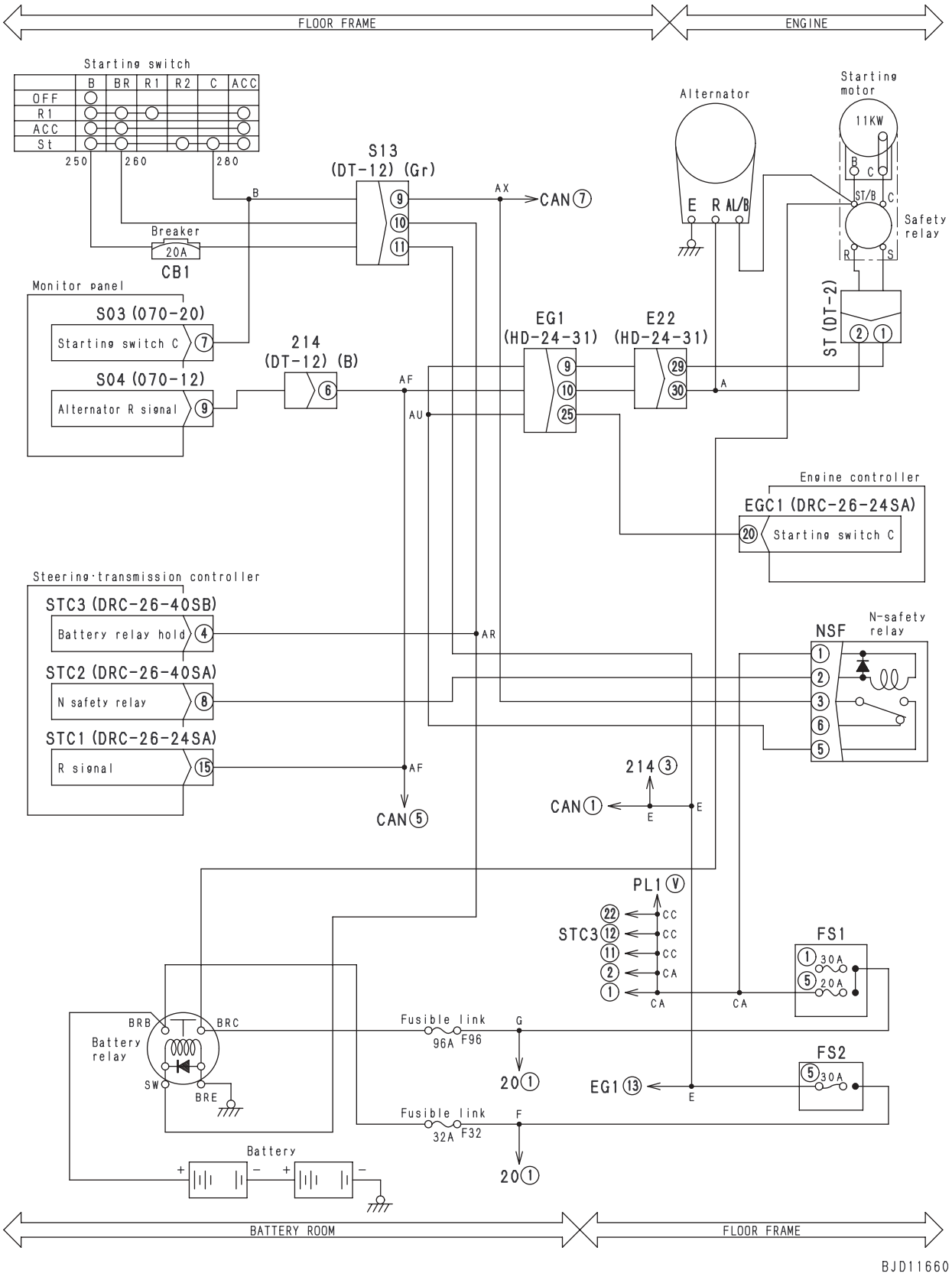
This is the excerpted circuit diagram related to trouble
- Connector No.: Indicates (Model-No. of pins) (Color).
- Arrow (⇔): Roughly indicates mounting place on machine.

E-1 THE ENGINE DOES NOT START

Trouble	• The engine does not start.
Related information	• The engine start circuit has the neutral safety function, and the engine does not start unless the parking lever is set to the lock position. • If “the monitor panel does not come on” or “the battery relay does not cause operating sound” when the starting switch is set to ON, the main electric power supply system is supposed to be out of order. So, inspect the main electric power supply system.

<table>
<tr><td rowspan="20">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>1</td><td>Insufficient battery capacity</td><td colspan="2">Battery voltage</td><td colspan="2">Battery specific gravity</td></tr>
<tr><td colspan="2"></td><td colspan="2">Min. 24V</td><td colspan="2">Min. 1.26</td></tr>
<tr><td rowspan="4">2</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 250 (B) and 280 (C)</td><td>OFF</td><td colspan="2">Min. 1MΩ</td></tr>
<tr><td>START</td><td colspan="2">Max. 1Ω</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Defective neutral safety relay (internal disconnection)</td><td colspan="4">★Prepare with the starting switch OFF, then start the engine and carry out troubleshooting.</td></tr>
<tr><td colspan="4">If the engine starts in accordance with the engine starting arrangement after the neutral safety relay (NSF) is replaced with another one while the starting switch is set to OFF, the relay is defective.</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Defective alternator (internal short-circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.</td></tr>
<tr><td colspan="2">Alternator</td><td colspan="2">Voltage</td></tr>
<tr><td colspan="2">Between Terminal R and ground</td><td colspan="2">Max. 1V</td></tr>
<tr><td rowspan="6">5</td><td rowspan="6">Detective starting motor (internal defect)</td><td colspan="4">★Prepare with the starting switch OFF, then start the engine and carry out troubleshooting.</td></tr>
<tr><td colspan="2">Starting motor</td><td colspan="2">Voltage</td></tr>
<tr><td colspan="2">Electric power supply : between Terminal ST/B and ground</td><td colspan="2">20 – 30V</td></tr>
<tr><td colspan="2">Charge : between ST (2) and ground</td><td colspan="2">Max. 1V</td></tr>
<tr><td colspan="2">Starting : between ST (1) and ground</td><td colspan="2">20 – 30V</td></tr>
<tr><td colspan="4">When the voltages of electric power supply, for charging and starting are normal but the starting motor does not rotate, the starting motor is defective.</td></tr>
<tr><td rowspan="4">6</td><td rowspan="4">Disconnection in wiring harness (disconnection in wiring or defective contact in connector)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between 280 (C) and NFS (female) (3)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td colspan="2">Wiring harness between NSF (female) (5) and ST (female) (1)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td colspan="2">Wiring harness between NSF (female) (5) and EGC1 (female) (20)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Hot short circuit of wiring harness (Contact with 24V circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.</td></tr>
<tr><td colspan="2">Hot short circuit of wiring harness between alternator R terminal and ST (female) (2) or STC1 (female) (15) or S04 (female) (9) with ground (Note : While a hot short circuit occurs, the battery charge level lamp comes on when the starting switch is turned ON.)</td><td>Voltage</td><td>Max. 1V</td></tr>
</table>

Engine start/charge-related circuit diagram

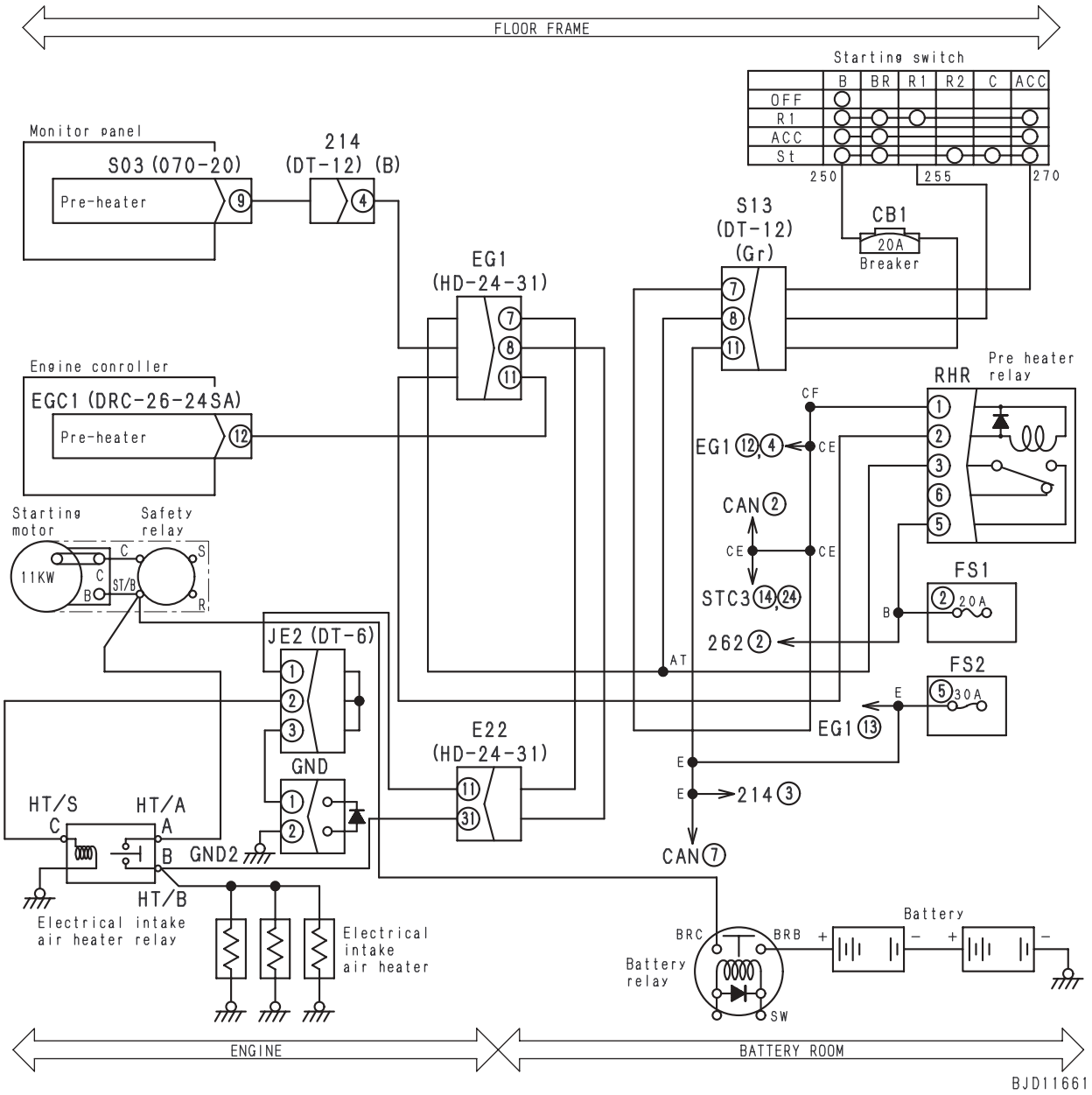


E-2 THE PREHEATER DOES NOT OPERATE. (MANUAL PREHEATING FUNCTION)

Trouble	• The preheater does not operate. (Manual preheating function)
Related information	★This troubleshooting describes the procedures to be followed when the manual preheating function cannot heat the electrical intake air heater mounting section. (When the preheating lamp only does not come on, carry out the troubleshooting of “The preheating lamp does not come on.”) • For preheating, both the “Automatic Preheating Function” and the “Manual Preheating Function” are available. When either function is performed, the preheating lamp comes on. • If “the monitor panel does not come on” or “the battery relay does not cause operating sound” hen the starting switch is turned ON, the main electric power supply system supposed to be out of order. So, inspect the main electric power supply system.

<table>
<tr><td rowspan="15">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="5">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective starting switch (Internal disconnection)</td><td colspan="5">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td>Starting switch</td><td colspan="2">Switch position</td><td colspan="2">Resistance</td></tr>
<tr><td>Between 250 (B) and 280 (C)</td><td colspan="2">OFF</td><td colspan="2">Min. 1M Ω</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Defective heater relay (internal defect)</td><td colspan="2">HEAT</td><td colspan="2">Max. 1 Ω</td></tr>
<tr><td colspan="5">★Prepare with the starting switch OFF, then set the starting switch to HEAT and carry out troubleshooting.</td></tr>
<tr><td colspan="3">Heater relay</td><td colspan="2">Voltage</td></tr>
<tr><td colspan="3">Electric power supply : between Terminal HT/A (A) and ground</td><td colspan="2">20 – 30V</td></tr>
<tr><td colspan="3">Signal : between Terminal HT/S (C) and ground</td><td colspan="2">20 – 30V</td></tr>
<tr><td colspan="5">When the both voltages of electric power supply and signal are normal and no operating sound is caused, the heater relay is defective.</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Defective electrical intake air heater (internal defect)</td><td colspan="5">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="3">Electrical intake air heater</td><td colspan="2">Continuity</td></tr>
<tr><td colspan="3">Between terminals</td><td colspan="2">Continue</td></tr>
<tr><td rowspan="4">4</td><td rowspan="4">Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)</td><td colspan="5">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="3">Wiring harness between starting switch 255 (R1) and HT/S (C)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td colspan="3">Wiring harness between battery relay c terminal and starting motor, or heater relay A terminal</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td colspan="3">Wiring harness between heater relay HT/B (B) terminal and electrical intake air heater</td><td>Resistance</td><td>Max. 1Ω</td></tr>
</table>

Engine preheat-related circuit diagram

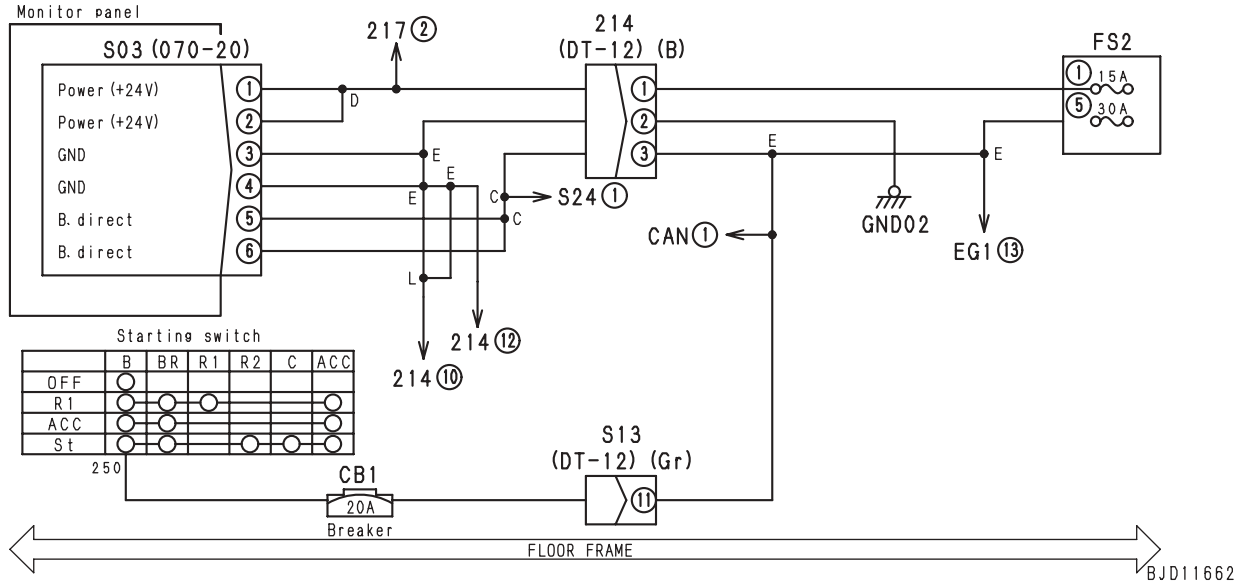


E-3 THE MONITOR PANEL DOES NOT COME ON AT ALL WHEN THE STARTING SWITCH IS TURNED ON.

Trouble	• The monitor panel does not come on at all when the starting switch is turned ON.
Related information	• When the starting switch is turned ON, the gear speed indicator, the multi information section, the gauge section and the lamp section come on for approximately 2 sec. and go out.

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fuse FS2-(1)	When the fuse FS-2(1) is cut off, the circuit may have possibly been short-circuited with ground.		
	2	Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.		
			Wiring harness between S03 (female) (1) (2) and fuse FS-2(1) outlet	Resistance	Max. 1Ω
			Wiring harness between S03 (female) (3) (4) and ground	Resistance	Max. 1Ω
	3	Ground fault of wiring harness (Contact with ground circuit)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.		
			Contact of wiring harness between S03 (female) (1), (2) – fuse FS2-(1) with ground	Resistance	Min. 1MΩ
	4	Defective monitor panel	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.		
			S03	Voltage	
			Between (1) (2) and (3) (4)	20 – 30V	

Circuit diagram related to ripper pin puller solenoid



E-4 WHEN THE STARTING SWITCH IS TURNED ON, THE MONITOR PANEL COMPLETELY REMAINS LIGHTED AND DOES NOT GO OUT.

Trouble	• When the starting switch is turned ON, the monitor panel completely remains lighted and does not go out.
Related information	• When the starting switch is turned ON, the gear speed indicator, the multi information section, the gauge section and the lamp section come on for approximately 2 sec. and go out.

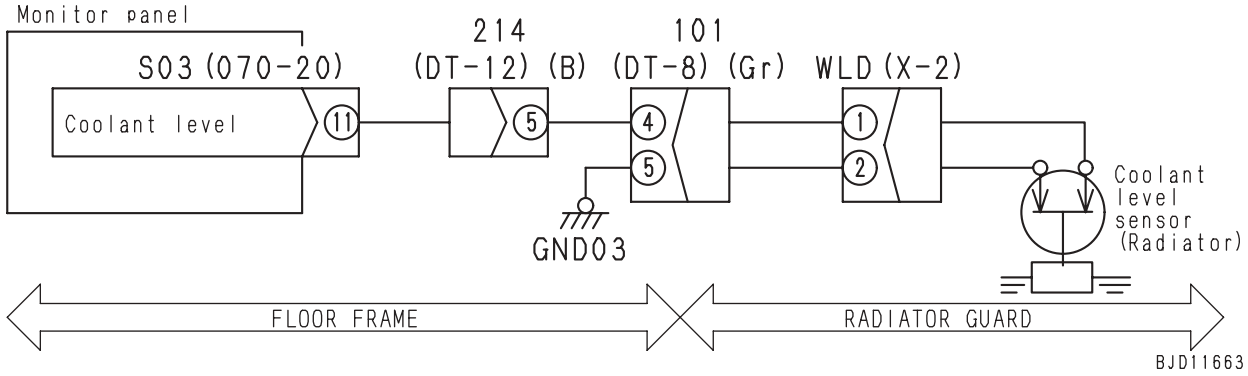
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defective monitor panel	This internal defect cannot be diagnosed.

E-5 WHEN THE STARTING SWITCH IS TURNED ON, THE RADIATOR WATER LEVEL CAUTION LAMP FLASHES.

Trouble	• The radiator water level caution lamp flashes.
Related information	• When any basic check items are detected to be abnormal before the engine starts, they will flash.

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>1</td><td>Drop of radiator water level (when the system is normal)</td><td colspan="4">A drop of radiator water level was detected, inspect the radiator water levels. (The lamp flashes when the level is below the specified level.)</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">The main radiator water level sensor is defective. (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>WLD (male)</td><td>Radiator water level</td><td colspan="2">Resistance</td></tr>
<tr><td rowspan="2">Between (1) and (2)</td><td>Normal level</td><td colspan="2">Max. 1Ω</td></tr>
<tr><td>Lower level</td><td colspan="2">Min. 1MΩ</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between S03 (female) (11) and WLD (female) (1)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td colspan="2">Wiring harness between WLD (female) (2) and ground</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td rowspan="4">4</td><td rowspan="4">Defective monitor panel</td><td colspan="4">★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.</td></tr>
<tr><td>S03</td><td>Radiator water level</td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="2">Between (11) and ground</td><td>Normal level</td><td colspan="2">Max. 1V</td></tr>
<tr><td>Lower level</td><td colspan="2">Min. approximately 7V</td></tr>
</table>

Circuit diagram related to monitor panel electric power supply

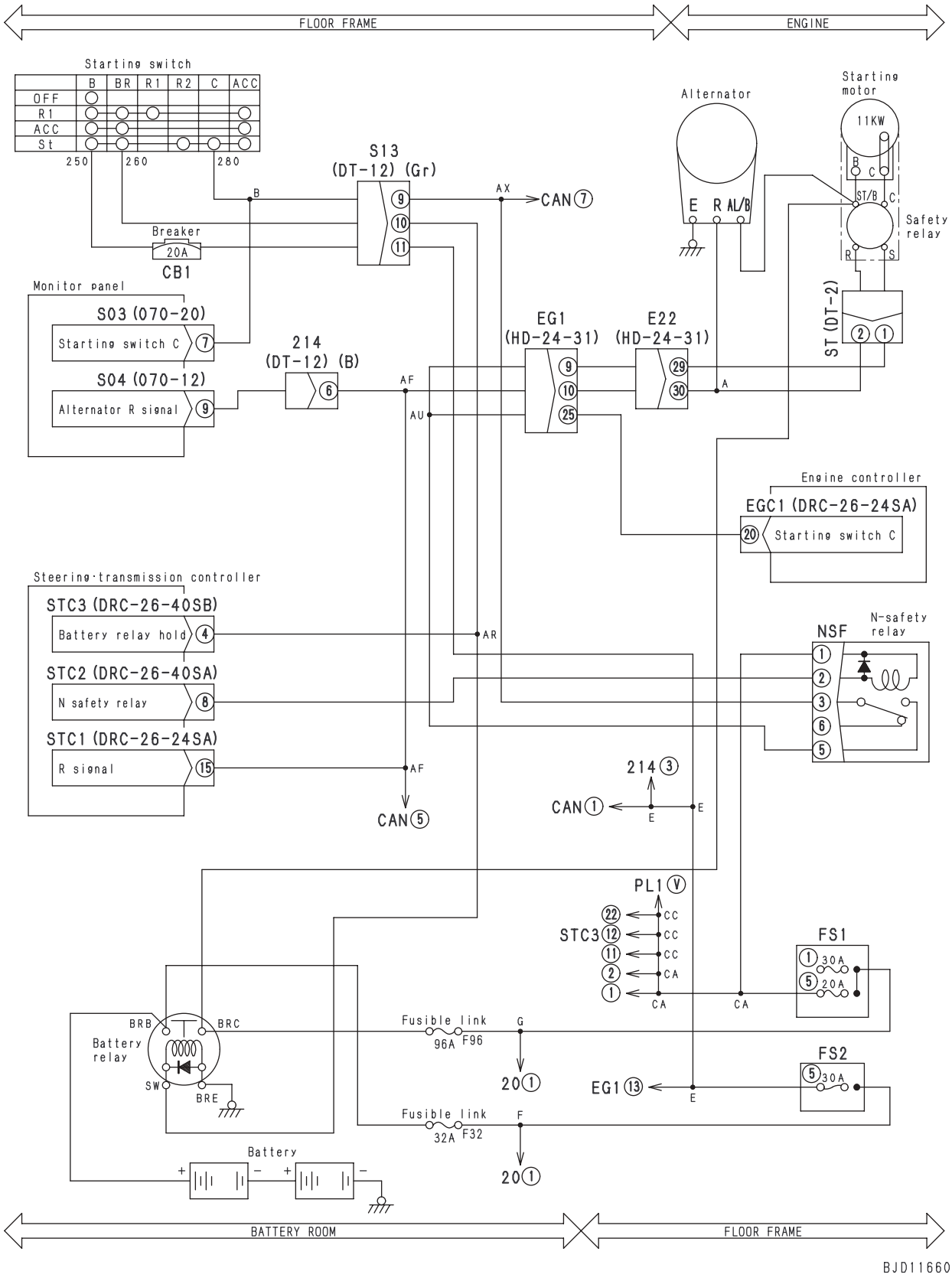


E-6 WHILE THE ENGINE IS OPERATING, THE BATTERY CHARGE LEVEL CAUTION LAMP FLASHES.

Trouble	• The battery charge level caution lamp flashes.
Related information	• When any abnormality is detected during engine operation, the battery charge level caution lamp will flash.

<table>
<tr><td rowspan="12">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective alternator (insufficient power generation)</td><td colspan="4">★Prepare with the starting switch OFF, then start the engine and carry out troubleshooting.</td></tr>
<tr><td>Alternator</td><td>Engine speed</td><td colspan="2">Voltage</td></tr>
<tr><td>Between Terminal R and ground</td><td>Min. medium speed (half)</td><td colspan="2">20 – 30V</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between S04 (female) (9) and alternator R terminal</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Ground fault of wiring harness (Contact with ground circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Between wiring harness (between S04 (female) (9) and alternator R terminal, or STC1 (1) (female) (15)) and ground</td><td>Resistance</td><td>Min. 1MΩ</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Defective monitor panel</td><td colspan="4">★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.</td></tr>
<tr><td>S04</td><td></td><td colspan="2">Voltage</td></tr>
<tr><td>Between (9) and ground</td><td>Min. medium speed (half)</td><td colspan="2">20 – 30V</td></tr>
</table>

Engine start/charge-related circuit diagram

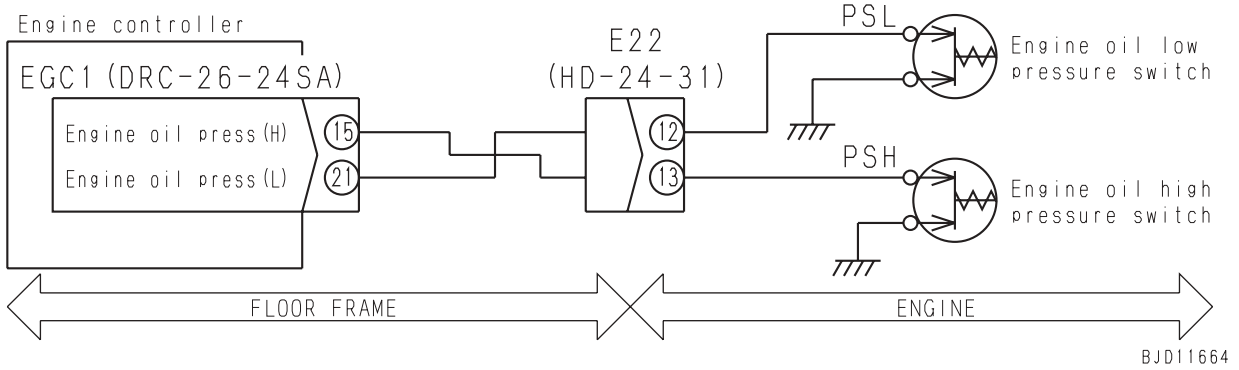


E-7 WHILE THE ENGINE IS OPERATING, THE EMERGENCY WARNING ITEM FLASHES.

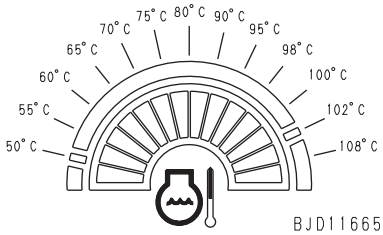
Trouble (1)	• The engine oil pressure caution lamp flashes.
Related information	• When any abnormality is detected during engine operation, the engine oil pressure caution lamp will flash and sound the alarm buzzer. • The engine oil pressure switch signal is sent and received from the engine controller through communication.

<table>
<tr><td rowspan="16">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>1</td><td>Drop of engine oil pressure (when the system is normal)</td><td colspan="4">Check the engine oil pressure as the drop of engine oil pressure is detected.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">The engine oil low pressure switch is defective.
(Internal short circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the switch ON or after starting the engine.</td></tr>
<tr><td>PSL</td><td>Engine</td><td colspan="2">Resistance</td></tr>
<tr><td rowspan="2">Between terminal and ground</td><td>Stop</td><td colspan="2">Max. 1Ω</td></tr>
<tr><td>Min. 600rpm</td><td colspan="2">Min. 1MΩ</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">The engine oil high pressure switch is defective.
(Internal short circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the switch ON or after starting the engine.</td></tr>
<tr><td>PSH</td><td>Engine</td><td colspan="2">Resistance</td></tr>
<tr><td rowspan="2">Between terminal and ground</td><td>Stop</td><td colspan="2">Max. 1Ω</td></tr>
<tr><td>Min. 1,300rpm</td><td colspan="2">Min. 1MΩ</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Ground fault of wiring harness (Contact with ground circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Between wiring harness (between EGC1 (female) (21) and PSL) and ground</td><td>Resistance</td><td>Min. 1MΩ</td></tr>
<tr><td colspan="2">etween wiring harness (between EGC1 (female) (15) and PSH) and ground</td><td>Resistance</td><td>Min. 1MΩ</td></tr>
<tr><td rowspan="5">5</td><td rowspan="5">Defective engine controller</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the switch ON or after starting the engine.</td></tr>
<tr><td>EGC1</td><td>Engine</td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="2">Between (21) and ground</td><td>Stop</td><td colspan="2">Max. 1V</td></tr>
<tr><td>Min. 600rpm</td><td colspan="2">20 – 30V</td></tr>
<tr><td rowspan="2">Between (15) and ground</td><td>Stop</td><td colspan="2">Max. 1V</td></tr>
<tr><td>Min. 1,300rpm</td><td colspan="2">20 – 30V</td></tr>
<tr><td>6</td><td>Defective monitor panel</td><td colspan="4">This is an internal defect, which cannot be troubleshot.</td></tr>
</table>

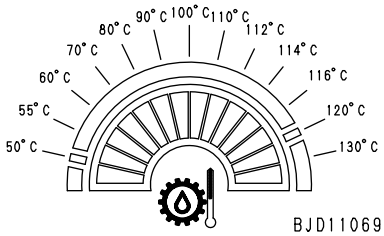
Circuit diagram related to engine oil low pressure switch and engine oil high pressure switch



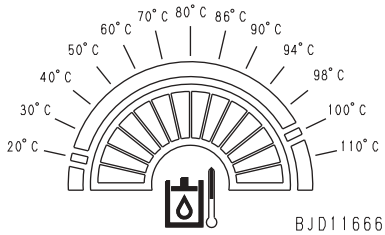
Trouble (2)	• The engine water temperature caution lamp flashes.
Related information	• When any abnormality is detected during engine operation, the engine water temperature caution lamp will flash and sound the alarm buzzer. • The engine water temperature caution lamp flashes or goes out as it links with indication on the engine water temperature gauge.

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Overheated engine water temperature (when the system is normal)	As overheated engine water was detected, check the engine water temperature. (When the water temperature is over 108°C, the lamp flashes.)		
	2	The engine water temperature sensor system is defective. (Engine controller system)	Check the indication on the engine water temperature gauge. If the indication is abnormal, carry out the troubleshooting of “Indication on the engine water temperature gauge is abnormal.”		
			Water temperature gauge	★Water temperatures are guides for selecting indications. 	
			Water temperature lamp	White range/ Green range	Red range
				Goes out.	Flashes.
	3	Defective monitor panel	When Causes 1 and 2 are not applicable, the monitor panel is supposed to be defective. (This is an internal defect, which cannot be troubleshot.)		

Trouble (3)	• The power train oil temperature caution lamp flashes.
Related information	• When any abnormality is detected during engine operation, the power tlain oil temperature caution lamp will flash and sound the alarm buzzer. • The power train oil temperature caution lamp flashes or goes out as it links with indication on the power train oil temperature gauge.

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Overheated oil temperature of power train (when the system is normal)	As an overheated power train oil temperature was detected, check the power train oil temperature. (When the oil temperature is over 130°C, the lamp flashes.)		
	2	The power train oil temperature sensor system is defective. (Monitor panel system)	Check the indication on the power train oil temperature gauge. If the indication is abnormal, carry out the troubleshooting of “Indication on the power train oil temperature gauge is abnormal.”		
			Oil temperature gauge	★Oil temperatures are guides for selecting indications. 	
			Oil temperature lamp	White range/ Green range	Red range
				Goes out.	Flashes.
	3	Defective monitor panel	When Causes 1 and 2 are not applicable, the monitor panel is supposed to be defective. (This is an internal defect, which cannot be troubleshot.)		

Trouble (4)	• The hydraulic oil temperature caution lamp flashes.
Related information	• When any abnormality is detected during engine operation, the hydraulic oil temperature caution lamp will flash and sound the alarm buzzer. • The hydraulic oil temperature caution lamp flashes or goes out as it links with indication on the hydraulic oil temperature gauge.

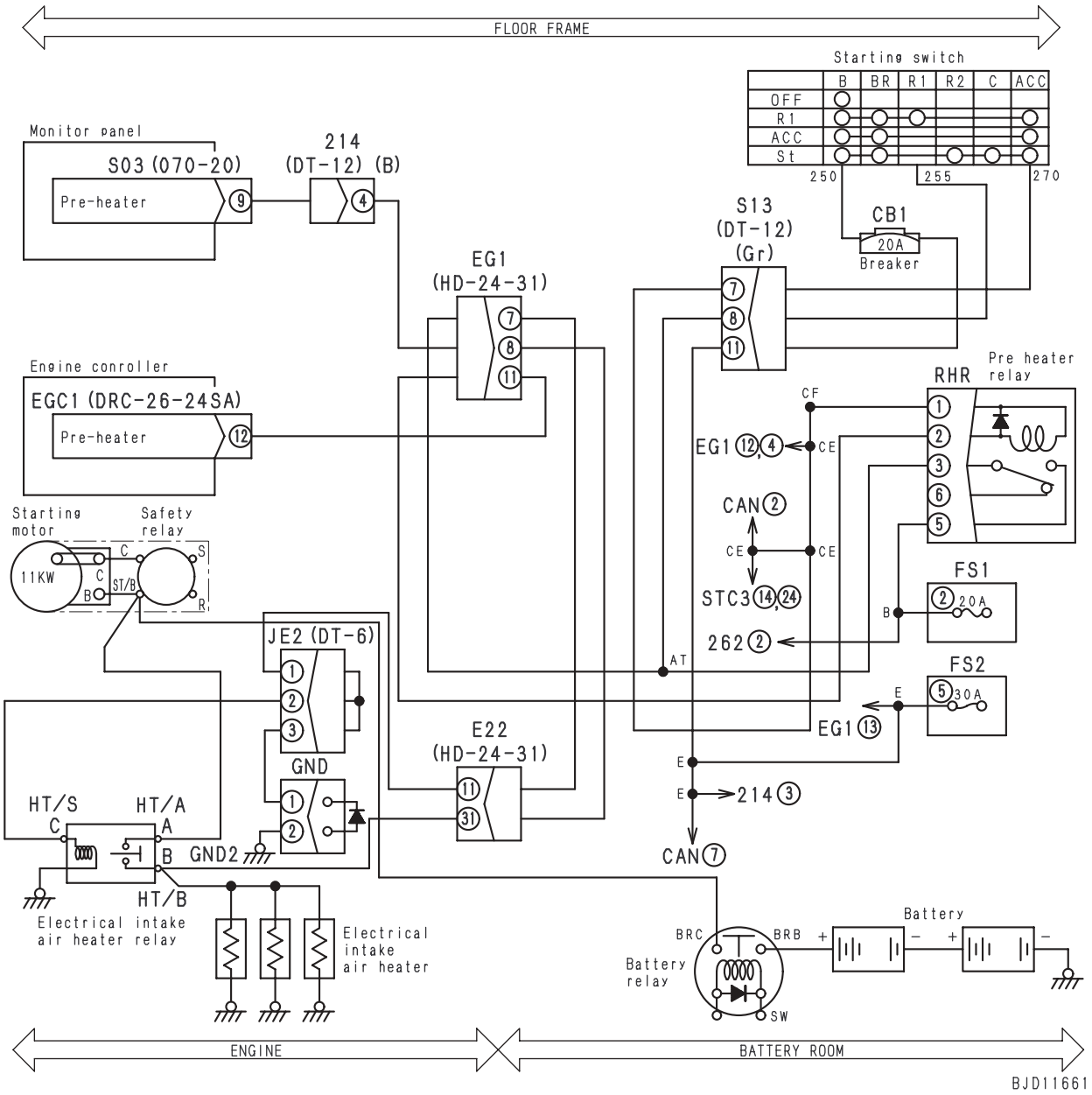
<table>
<tr><td rowspan="6">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="3">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>1</td><td>Overheated hydraulic oil temperature (when the system is normal)</td><td colspan="3">As an overheated hydraulic oil temperature was detected, check the hydraulic oil temperature. (When the oil temperature is over 130°C, the lamp flashes.)</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">The hydraulic oil temperature sensor system is defective. (Monitor panel system)</td><td colspan="3">Check the indication on the engine water temperature gauge. If the indication is abnormal, carry out the troubleshooting of “Indication on the hydraulic oil temperature gauge is abnormal.”</td></tr>
<tr><td>Oil temperature gauge</td><td colspan="2">★Oil temperatures are guides for selecting indications.
 
</td></tr>
<tr><td rowspan="2">Oil temperature lamp</td><td>White range/ Green range</td><td>Red range</td></tr>
<tr><td>Goes out.</td><td>Flashes.</td></tr>
<tr><td>3</td><td>Defective monitor panel</td><td colspan="3">When Causes 1 and 2 are not applicable, the monitor panel is supposed to be defective. (This is an internal defect, which cannot be troubleshot.)</td></tr>
</table>

E-8 WHILE THE PREHEATER IS OPERATING, THE PREHEATING PILOT LAMP DOES NOT COME ON.

Trouble	• While the preheater is operating, the preheating pilot lamp does not come on.
Related information	★This troubleshooting describes the procedures to be followed when the preheating lamp doe not come on. (When the preheater mounting section is not heated, carry out the troubleshooting of “The preheater does not work.”) • For preheating, both the “Automatic Preheating Function” and the “Manual Preheating Function” are available. Even when either function is performed, the preheating lamp comes on.

<table>
<tr><td rowspan="8">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between S03 (female) (9) and heater relay HT/B (B) terminal</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Ground fault of wiring harness (Contact with ground circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Between wiring harness between S03 (female) (9) and heater relay HT/B (B) terminal and ground</td><td>Resistance</td><td>Min. 1MΩ</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">Defective monitor panel</td><td colspan="4">★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.</td></tr>
<tr><td>S03</td><td></td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="2">Between (9) and ground</td><td>ON</td><td colspan="2">Max. 1V</td></tr>
<tr><td>HEAT</td><td colspan="2">Min. approximately 7V</td></tr>
</table>

Engine preheat-related circuit diagram

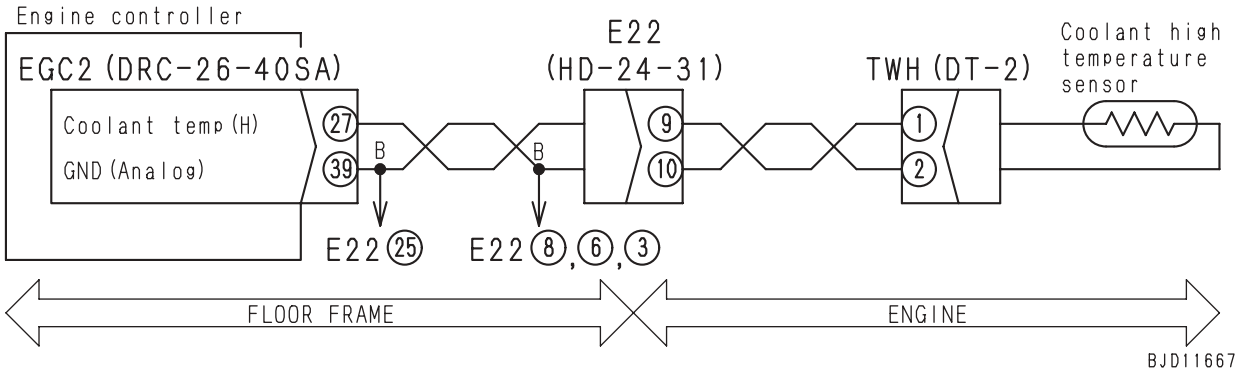


E-9 THE ENGINE WATER TEMPERATURE GAUGE DOES NOT INDICATE NORMALLY.

Trouble (1)	• The engine water temperature gauge does not indicate normally.
Related information	• Signals of the engine water high temperature sensor are sent and received from the engine controller through communication. • When any abnormality occurred in the engine hot water temperature sensor system, the failure code [DGE2KX] is displayed sometimes.

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	The engine water high temperature sensor is defective. (Internal disconnection or short circuit)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			TWH (male)	Resistance		
			Between (1) and (2)	3.5k – 90kΩ		
			Between (1) (2) and ground	Min. 1MΩ		
	2	Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			Wiring harness between EGC2 (female) (27) and TWH (female) (1)		Resistance	Max. 1Ω
			Wiring harness between EGC2 (female) (39) and TWH (female) (2)		Resistance	Max. 1Ω
	3	Ground fault of wiring harness (Contact with ground circuit)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			Between wiring harness (between EGC2 (female) (27) and TWH (female) (1)) and ground		Resistance	Min. 1MΩ
	4	Hot short circuit of wiring harness (Contact with 24V circuit)	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.			
			Between wiring harness (between EGC2 (female) (27) and TWH (female) (1)) and ground		Voltage	Max. 1V
	5	Defective engine controller	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			EGC2 (female)	Resistance		
			Between (27) and (39)	3.5k – 90kΩ		
			Between (27) (39) and ground	Min. 1MΩ		
	6	Defective monitor panel	This is an internal defect, which cannot be troubleshot.			

Circuit diagram related to engine water high temperature sensor

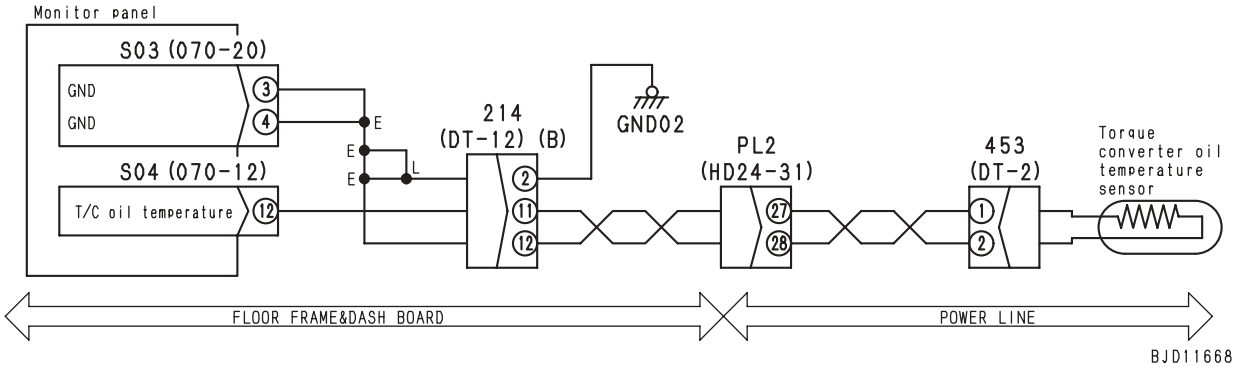


E-10 INDICATION OF THE POWER TRAIN TEMPERATURE GAUGE IS ABNORMAL.

Trouble	• Indication of the power train temperature gauge is abnormal.
Related information	• Signals of the power train oil temperature sensor are sent and received through communication by the monitor panel.

<table>
<tr><th rowspan="2">Possible causes and standard value in normal state</th><th colspan="2">Cause</th><th colspan="4">Standard value in normal state/Remarks on troubleshooting</th></tr>
<tr><td rowspan="4">1</td><td rowspan="4">The power train oil temperature sensor is defective. (Internal disconnection or short circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td>453 (male)</td><td>Torque converter oil temperature</td><td colspan="2">Resistance</td></tr>
<tr><td>Between (1) and (2)</td><td rowspan="2">10 – 100°C</td><td colspan="2">About 3.8k – about 80kΩ</td></tr>
<tr><td>Between (1) and ground</td><td colspan="2">Min. 1MΩ</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between S04 (female) (12) and 453 (female) (1)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td colspan="2">Wiring harness between 453 (female) (2) and S03 (female) (3)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Ground fault of wiring harness (Contact with ground circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Between wiring harness (between S04 (female) (12) and 453 (female) (1)) and ground</td><td>Resistance</td><td>Min. 1MΩ</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Hot short circuit of wiring harness (Contact with 24V circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.</td></tr>
<tr><td colspan="2">Between wiring harness (between S04 (female) (12) and 453 (female) (1)) and ground</td><td>Voltage</td><td>Max. 1V</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Defective monitor panel</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td>S04 (female)</td><td>Torque converter oil temperature</td><td colspan="2">Resistance</td></tr>
<tr><td>Between (12) and ground</td><td>10 – 100°C</td><td colspan="2">About 3.8k – about 80kΩ</td></tr>
</table>

Circuit diagram related to power train oil temperature sensor

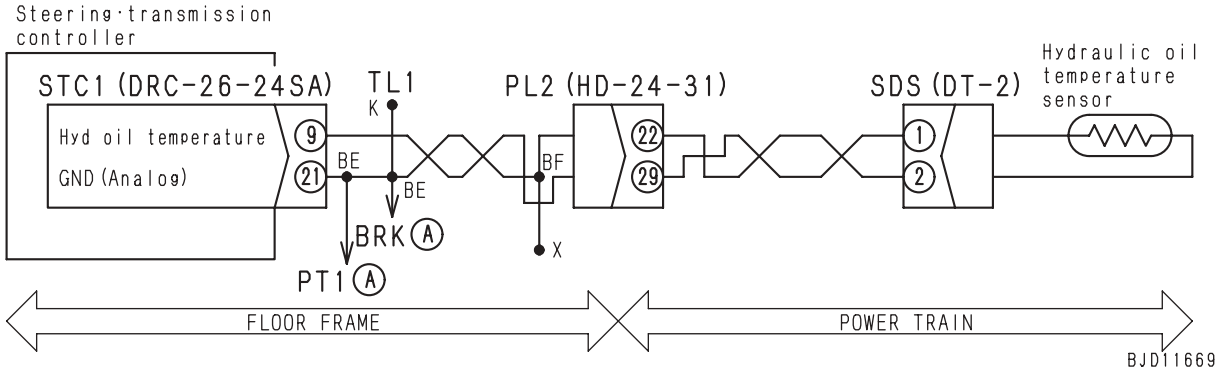


E-11 THE HYDRAULIC OIL TEMPERATURE GAUGE DOES NOT INDICATE NORMALLY.

Trouble	• The hydraulic oil temperature gauge does not indicate normally.
Related information	• Signals of the hydraulic oil temperature sensor are received from the steering and transmission controller through communication. • When any abnormality occurred in the hydraulic oil temperature sensor system, the failure code [DGS1KX] is displayed sometimes.

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	The hydraulic oil temperature sensor is defective. (Internal disconnection or short circuit)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			SDS (male)	Resistance		
			Between (1) and (2)	3.5k – 90kΩ		
			Between (1) and ground	Min. 1MΩ		
	2	Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			Wiring harness between STC1 (female) (14) and SDS (female) (1)	Resistance	Max. 1Ω	
			Wiring harness between STC1 (female) (21) and SDS (female) (2)	Resistance	Max. 1Ω	
	3	Ground fault of wiring harness (Contact with ground circuit)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			Between wiring harness (between STC1 (female) (14) and SDS (female) (1)) and ground	Resistance	Min. 1MΩ	
	4	Hot short circuit of wiring harness (Contact with 24V circuit)	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.			
			Between wiring harness (between STC1 (female) (14) and SDS (female) (1)) and ground	Voltage	Max. 5V	
	5	Defective transmission controller	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			STC1 (female)	Resistance		
			Between (9) and (21)	3.5k – 90kΩ		
			Between (9) and ground	Min. 1MΩ		
	6	Defective monitor panel	This is an internal defect, which cannot be troubleshot.			

Circuit diagram related to hydraulic oil temperature sensor

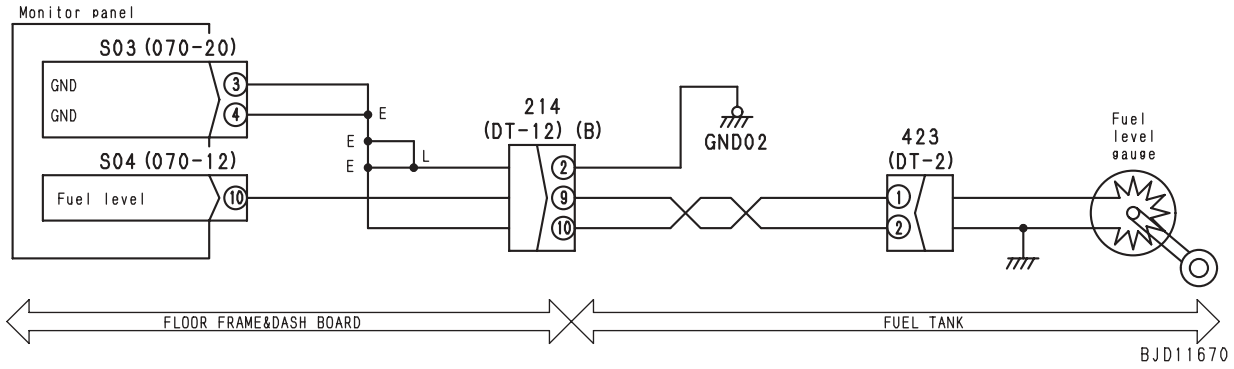


E-12 INDICATION OF THE FUEL GAUGE IS ABNORMAL.

Trouble	• Indication of the fuel gauge is abnormal.
Related information	• Signals of the fuel level sensor are sent and received through communication by the monitor panel.

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Defective fuel level sensor. (Internal disconnection or short circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td>423 (male)</td><td>Remained fuel level</td><td colspan="2">Resistance</td></tr>
<tr><td rowspan="2">Between (1) and (2) (ground)</td><td>Full</td><td colspan="2">About 4Ω</td></tr>
<tr><td>Empty</td><td colspan="2">About 85Ω</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between S04 (female) (10) and 423 (female) (1)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td colspan="2">Contact of wiring harness between 423 (female) (2) – S03 (female) (3), (4) with ground.</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Ground fault of wiring harness (Contact with ground circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Between wiring harness (between S04 (female) (10) and 423 (female) (1)) and ground</td><td>Resistance</td><td>Min. 1MΩ</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Hot short circuit of wiring harness (Contact with 24V circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.</td></tr>
<tr><td colspan="2">Between wiring harness (between S04 (female) (10) and 423 (female) (1)) and ground</td><td>Voltage</td><td>Max. 5V</td></tr>
<tr><td>5</td><td>Defective monitor panel</td><td colspan="4">★This is an internal defect, which cannot be trobleshot.</td></tr>
</table>

Circuit diagram related to fuel level sensor



E-13 INDICATIONS OF GEAR SPEED AND ENGINE SPEED ARE ABNORMAL.

Trouble	• Indications of gear speed and engine speed are abnormal.
Related information	• Signals of gear speed and engine speed are sent and received through communication by the monitor panel.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defective monitor panel	This is an internal defect, which cannot be troubleshot.

E-14 INDICATION OF THE PRESET MODE SERVICE METER IS ABNORMAL.

Trouble (1)	• During engine operation, the service meter does not advance.
Related 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 standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defective alternator signals system	When the battery charge level caution lamp flashes during engine operation, carry out the troubleshooting of “While the engine is operating, caution items flash.”
	2	Defective monitor panel	This is an internal defect, which cannot be troubleshot.

Trouble (2)	• Shift mode and service meter are not displayed at all.
Related information	• The display data are sent and received through communication by the steering and transmission controller.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defective monitor panel	This is an internal defect, which cannot be troubleshot.

E-15 THE WARNING LAMP DOES NOT FLASH OR DOES NOT GO OUT.

Trouble	• The warning lamp does not flash or does not go out.
Related information	

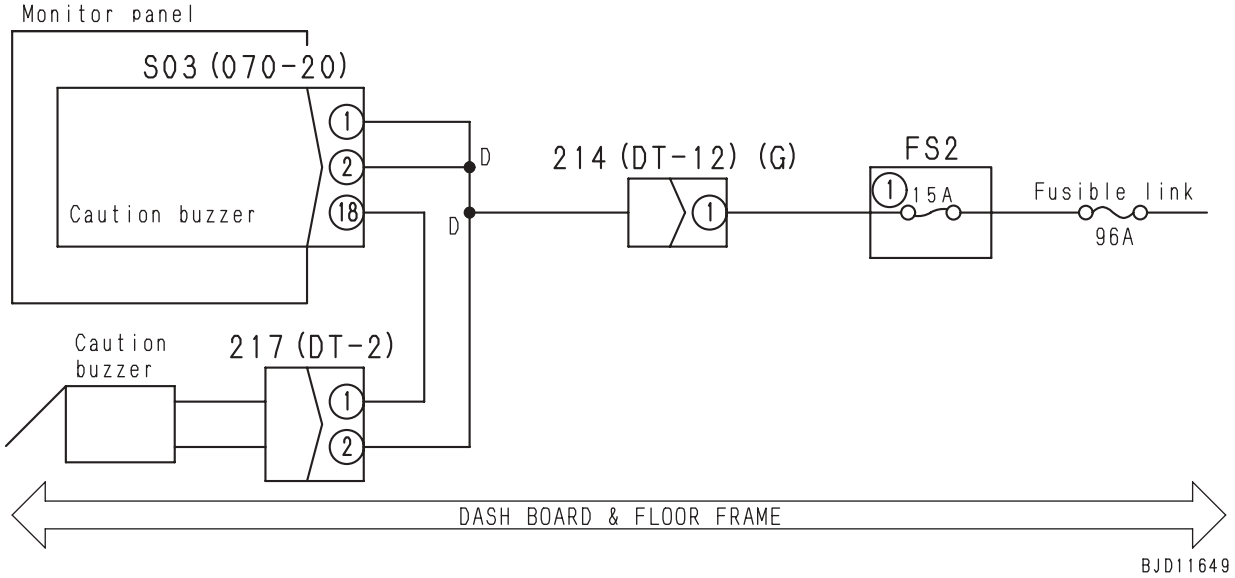
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defective monitor panel	This is an internal defect, which cannot be troubleshot.

E-16 THE ALARM BUZZER DOES NOT SOUND OR DOES NOT STOP.

Trouble	• The alarm buzzer does not sound or does not stop.
Related information	• When a short circuit occurs in the alarm buzzer system, the failure code is displayed but no other failure codes are displayed.

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>1</td><td>Defective circuit breaker fuse FS2-(1)</td><td colspan="4">When the fuse FS2-(1) is cut off, a ground fault may have possibly occurred in the circuit.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Defective alarm buzzer (Internal disconnection or short circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">217 (male)</td><td colspan="2">Resistance</td></tr>
<tr><td colspan="2">Between (1) and (2)</td><td colspan="2">200Ω</td></tr>
<tr><td colspan="2">Between (1), (2) and ground</td><td colspan="2">Min. 1MΩ</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between S03 (female) (18) and 217 (female) (1)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td colspan="2">Wiring harness between 217 (female) (2) and FS2 (1)</td><td>Resistance</td><td>Max. 1v</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Ground fault of wiring harness (Contact with ground circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Contact of wiring harness between FS2 (1) – 217 (female) (2) with ground.</td><td>Resistance</td><td>Min. 1MΩ</td></tr>
<tr><td></td></tr>
<tr><td rowspan="4">5</td><td rowspan="4">Defective monitor panel (Gauge/lamp module)</td><td colspan="4">★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.</td></tr>
<tr><td>S03</td><td>Alarm buzzer</td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="2">Between (18) and ground</td><td>At stop</td><td colspan="2">20 – 30V</td></tr>
<tr><td>At operation (sounding)</td><td colspan="2">Max. 3V</td></tr>
</table>

Circuit diagram related to alarm buzzer

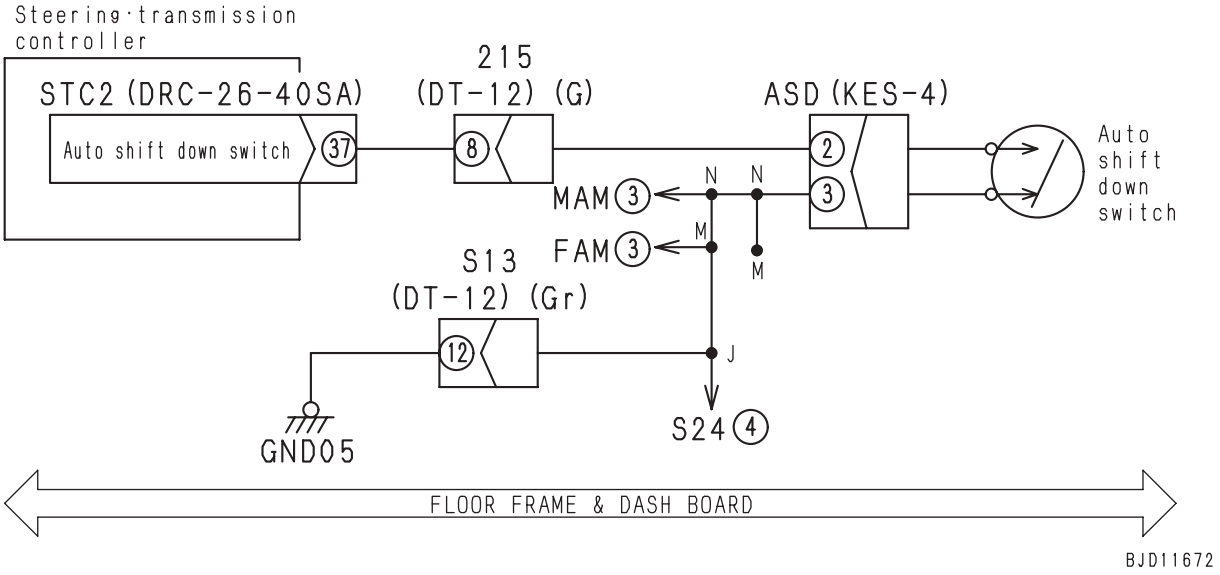


E-17 AUTO SHIFT DOWN IS NOT POSSIBLE OR IS NOT RELEASED.

Trouble	• Auto shift down is not possible or is not released.
Related information	• Defective auto shift down switch (Internal disconnection or short circuit)

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Defective auto shift down switch (Internal disconnection or short circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</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) and (3)</td><td>OFF (0)</td><td colspan="2">Min. 1MΩ</td></tr>
<tr><td>ON (1)</td><td colspan="2">Max. 1Ω</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between STC2 (female) (37) and ADS (female) (2)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td colspan="2">Wiring harness between ADS (female) (3) and ground</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Ground steering and fault of wiring harness (Contact with ground circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Between wiring harness (between STC2 (female) (37) and ASD (female) (2)) and ground</td><td>Resistance</td><td>Min. 1MΩ</td></tr>
<tr><td rowspan="4">4</td><td rowspan="4">Defective steering and transmission controller</td><td colspan="4">★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.</td></tr>
<tr><td rowspan="3">Between STC2 (37) and (21), (31), (32), (33)</td><td>Auto shift down switch</td><td colspan="2">Voltage</td></tr>
<tr><td>OFF (0)</td><td colspan="2">Approximately 7V</td></tr>
<tr><td>ON (1)</td><td colspan="2">Max. 3V</td></tr>
<tr><td>5</td><td>Restriction 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

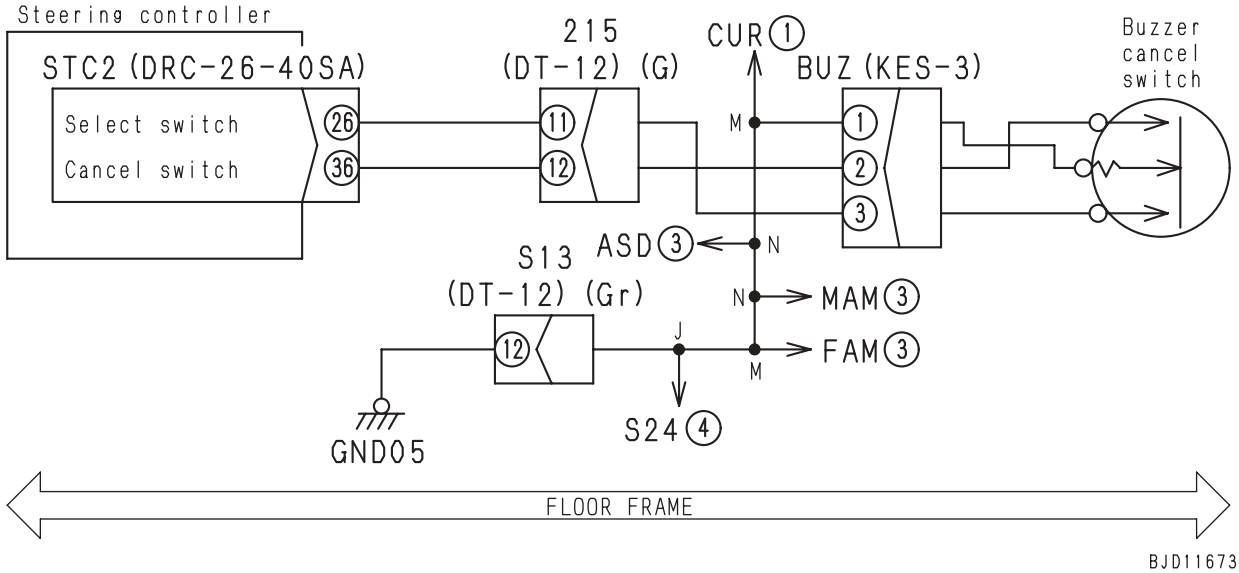


E-18 THE BUZZER CANCEL SWITCH DOES NOT WORK.

Trouble	• The buzzer cancel switch does not work.
Related information	

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective buzzer cancel switch (Internal disconnection or short circuit)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			BUZ (male)	Buzzer cancel switch	Resistance	
			Between (1) and (2)	OFF (0)	Min. 1MΩ	
				◇	Max. 1Ω	
			Between (1) and (3)	OFF (0)	Min. 1MΩ	
				□	Max. 1Ω	
	2	Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			Wiring harness between STC2 (36) and BUZ (female) (2)		Resistance	Max. 1Ω
			Wiring harness between STC2 (26) and BUZ (female) (3)		Resistance	Max. 1Ω
			Wiring harness between BUZ (female) (1) and GND05		Resistance	Max. 1Ω
	3	Ground fault of wiring harness (Contact with ground circuit)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			Between wiring harness (between STC2 (36) and BUZ (female) (2)) and ground		Resistance	Min. 1MΩ
			Between wiring harness (between STC2 (26) and BUZ (female) (3)) and ground		Resistance	Min. 1MΩ
	4	Defective steering controller	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out the troubleshooting.			
			Steering and transmission controller	Buzzer cancel switch	Voltage	
			Between STC2 (female) (36) and STC3 (female) (21), (31), (32), (33)	OFF (0)	Approximately 7V	
				◇	Max. 1V	
			Between STC2 (female) (26) and STC3 (female) (21), (31), (32), (33)	OFF (0)	Approximately 7V	
				□	Max. 1V	

Circuit diagram related to buzzer cancel switch

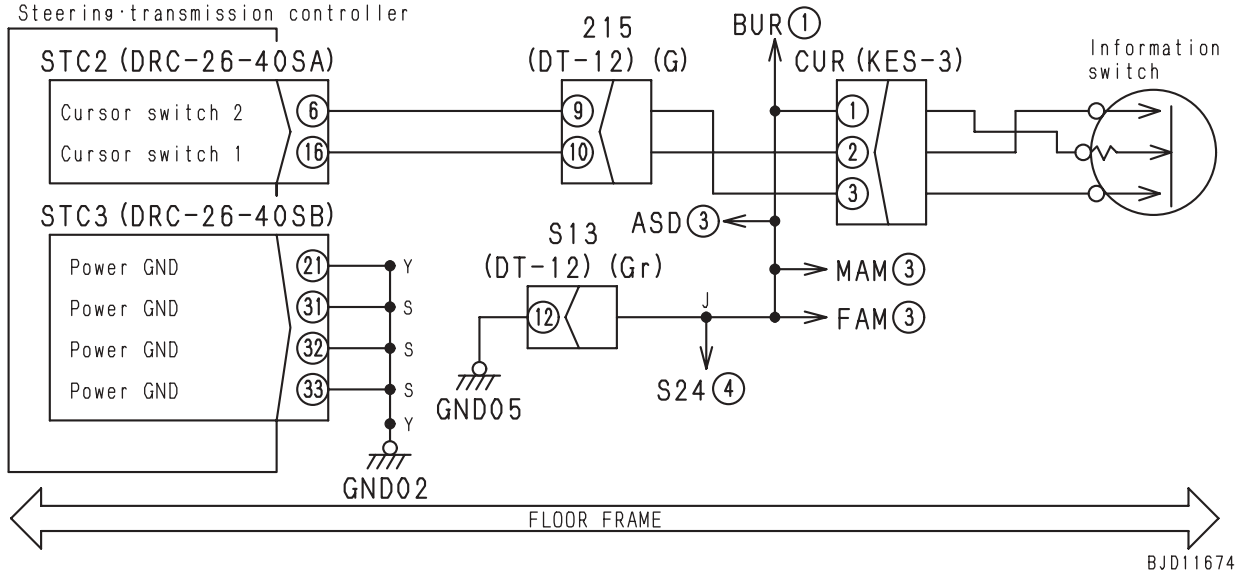


E-19 THE INFORMATION SWITCH DOES NOT WORK.

Trouble	• The information switch does not work.
Related information	

<table>
<tr><td rowspan="20">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="5">1</td><td rowspan="5">Defective information switch (Internal short circuit or 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>CUR (male)</td><td>Information switch</td><td colspan="2">Resistance</td></tr>
<tr><td rowspan="2">Between (1) and (2)</td><td>OFF (0)</td><td colspan="2">Min. 1MΩ</td></tr>
<tr><td>></td><td colspan="2">Max. 1Ω</td></tr>
<tr><td rowspan="2">Between (1) and (3)</td><td>OFF (0)</td><td colspan="2">Min. 1MΩ</td></tr>
<tr><td><</td><td colspan="2">Max. 1Ω</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between STC2 (16) and CUR (female)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td colspan="2">Wiring harness between STC2 (6) and CUR (female) (3)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td colspan="2">Wiring harness between CUR (female) (1) and ground</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Ground fault of wiring harness (Contact with ground circuit)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Between wiring harness (between STC2 (16) and CUR (female) (2)) and ground</td><td>Resistance</td><td>Min. 1MΩ</td></tr>
<tr><td colspan="2">Between wiring harness (between STC2 (6) and CUR (female) (3)) and ground</td><td>Resistance</td><td>Min. 1MΩ</td></tr>
<tr><td rowspan="5">4</td><td rowspan="5">Defective steering controller</td><td colspan="4">★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.</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 STC2 (16) and STC3 (21), (31), (32), (33)</td><td>OFF (0)</td><td colspan="2">20 – 30V</td></tr>
<tr><td><</td><td colspan="2">Max. 1Ω</td></tr>
<tr><td rowspan="2">Between (6) and ground</td><td>OFF (0)</td><td colspan="2">20 – 30V</td></tr>
<tr><td>></td><td colspan="2">Max. 1V</td></tr>
</table>

Circuit diagram related to information switch

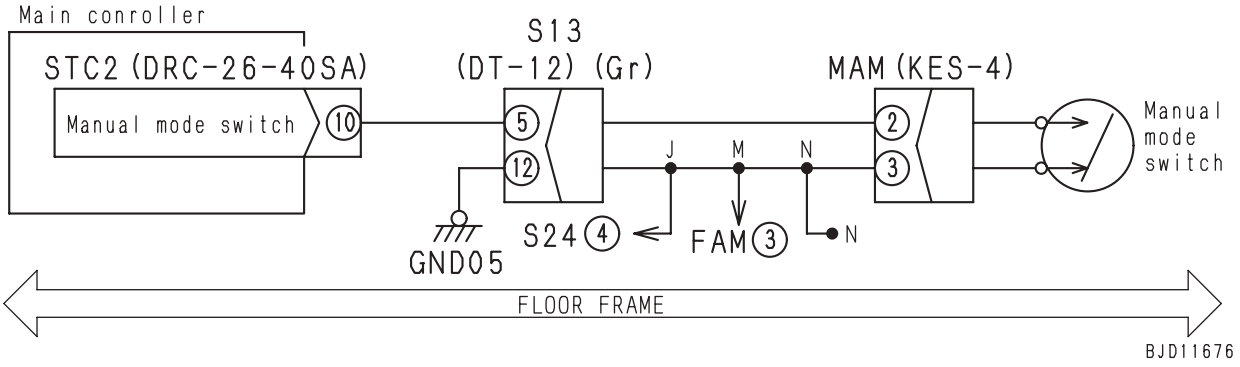


E-20 THE MANUAL MODE DOES NOT OPERATE OR CANNOT BE RESET.

Trouble	• The manual mode does not operate or cannot be reset.
Related information	

<table>
<tr><td rowspan="14">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective manual mode switch (Internal disconnection)</td><td colspan="4">★Preare with the starting OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td>MAM (male)</td><td>Manual 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. 1MΩ</td></tr>
<tr><td>ON (1)</td><td colspan="2">Max. 1Ω</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)</td><td colspan="4">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between STC2 (female) (10) – MAM (female) (2)</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td colspan="2">Wiring harness between MAM (female) (3) – ground</td><td>Resistance</td><td>Max. 1Ω</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Ground fault of wiring harness (Contact with ground circuit)</td><td colspan="4">★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Contact of wiring harness between STC2 (female) (10) – MAM (female) (2) with ground</td><td>Resistance</td><td>Min. 1Ω</td></tr>
<tr><td rowspan="5">4</td><td rowspan="5">Defective steering and transmission controller</td><td colspan="4">★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.</td></tr>
<tr><td>STC2</td><td>Manual mode switch</td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="3">Between (10) and ground</td><td>OFF (0)</td><td colspan="2">20 – 30V</td></tr>
<tr><td>ON (1)</td><td colspan="2">Max. 3V</td></tr>
<tr><td>Manual mode switch</td><td colspan="2">Resistance</td></tr>
<tr><td>5</td><td>Defective steering and transmissioncontroller</td><td colspan="4">★When Causes 1 to 4 are not applicable, the steering and transmission controller may be defective. (Since the system is defective, the control system cannot be troubleshot.)</td></tr>
</table>

Circuit diagram related to manual mode

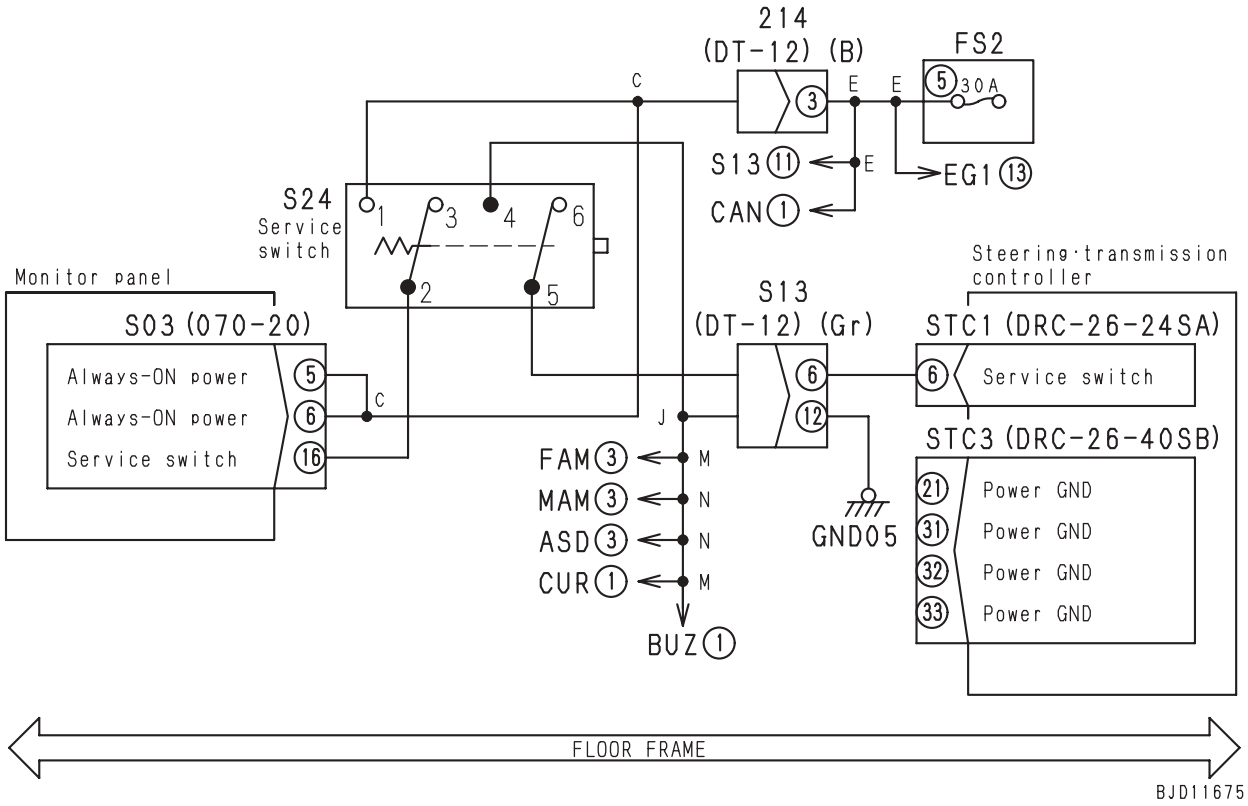


E-21 THE MONITOR PANEL CANNOT BE SET IN THE SERVICE MODE.

Trouble	• The monitor panel cannot be set in the service mode.
Related information	

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective buzzer cancel switch system	Since the buzzer cancel switch system is supposed to be out of order, carry out the troubleshooting of “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 “The information switch does not work.”			
	3	Defective fuse FS2 (5)	When the fuse FS2 (5) is cut off, a ground fault may have possibly occurred in the circuit.			
	4	Defective service switch (Internal short circuit or disconnection)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			S24	Service switch	Resistance	
			Between (1) and (2), Between (5) and (4)	OFF	Min. 1MΩ	
				ON	Max. 1Ω	
	5	Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			Wiring harness between FS2 (5)outlet and S24 (1)	Resistance	Max. 1Ω	
			Wiring harness between S24 (6) and ground	Resistance	Max. 1Ω	
			Wiring harness between S03 (female) (16) and S24 (2)	Resistance	Max. 1Ω	
			Wiring harness between STC1 (female) (6) and S24 (5)	Resistance	Max. 1Ω	
	6	Ground fault of wiring harness (Contact with ground circuit)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			Contact of wiring harness between FS2 (5) – S24 (1) – S03 (female) (5), (6) with ground.	Resistance	Min. 1Ω	
	7	Defective monitor panel (Gauge/lamp module)	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.			
			S03	Service switch	Voltage	
			Between (16) and ground	OFF	Max. 1V	
				ON	20 – 30V	
	8	Defective steering and transmission controller	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.			
			STC1	Service switch	Voltage	
			Between (6) and ground	OFF	20 – 30V	
				ON	Max. 1V	

Circuit diagram related to monitor panel

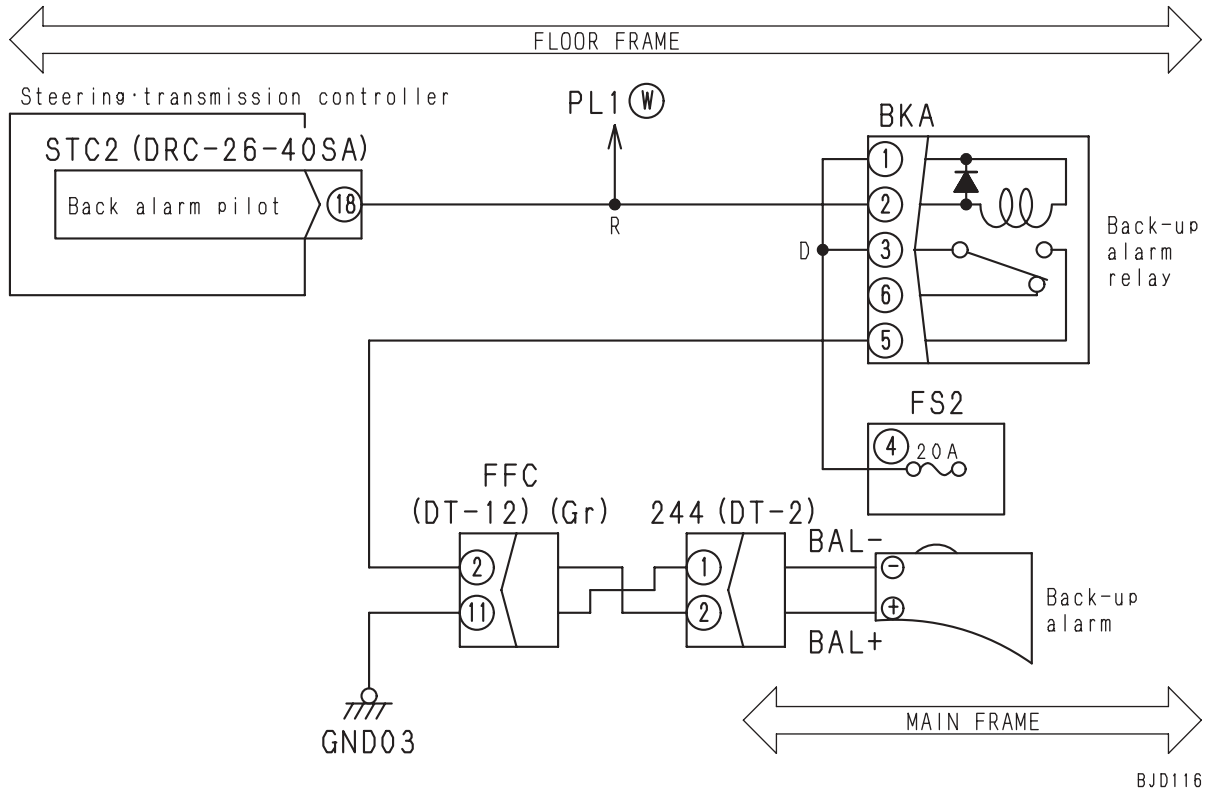


E-22 THE BACK-UP ALARM DOES NOT SOUND.

Trouble	• The back-up alarm does not sound.
Related information	• When a failure occurs on the primary side (coil side) of the back-up alarm relay, a relevant failure code is displayed, but in case of failure on the secondary side (contact side), no failure code is displayed.

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fuse (FS2-(4))	When the fuse is blown, a ground fault may have probably occurred in the circuit.		
	2	Defective back-up relay (internal disconnection)	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.		
			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 of wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.		
			Wiring harness between FS2-(4) outlet and BKA (female) (1), (3)	Resistance	Max. 1Ω
			Wiring harness between BKA (female) (2) – STC2 (female) (18)	Resistance	Max. 1MΩ
			Wiring harness between BKA (female) (5) and BAL+	Resistance	Max. 1Ω
			Wiring harness between BAL – and GND 03	Resistance	Max. 1Ω
	4	Ground fault of wiring harness (Contact with ground circuit)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.		
			Between wiring harness related to FS2-(4) (outlet side) and ground	Resistance	Min. 1MΩ
			Between wiring harness (between BKA (female) (5) and BAL+ (2)) and ground	Resistance	Min. 1MΩ
	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, REAR LAMP, AND RIPPER POINT LAMP DO NOT LIGHT UP.

Trouble (1)	• The head lamp does not light up.
Related information	

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective fuse (FS1-(3))	If the fuse is broken, the circuit probably has a grounding fault, etc.			
	2	Defective head lamp switch (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			FWL (male)	Switch	Resistance	
			Between (2) – (3)	OFF	Min. 1 MΩ	
				ON	Max. 1Ω	
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between FWL (female) (2) – FS1-(3) outlet		Resistance	Max. 1Ω
			Wiring harness between FWL (female) (3) – 203 (female) (1)		Resistance	Max. 1Ω
			Wiring harness between FWL (female) (3) – 204 (female) (1)		Resistance	Max. 1Ω
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Contact of wiring harness between FWL (female) (2) – FS1-(3) outlet with ground		Resistance	Min. 1 MΩ

Trouble (2)	• The rear lamp and ripper point lamp do not light up.
Related information	

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective fuse (FS1-(4))	If the fuse is broken, the circuit probably has a grounding fault, etc.			
	2	Defective rear lamp switch (Internal disconnection)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			RWL (male)	Switch	Resistance	
			Between (2) – (3)	OFF	Min. 1 MΩ	
				ON	Max. 1Ω	
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between RWL (female) (2) – FS1-(4) outlet		Resistance	Max. 1Ω
			Wiring harness between RWL (female) (3) – 224 (female) (1)		Resistance	Max. 1Ω
			Wiring harness between RWL (female) (3) – 226 (female) (1)		Resistance	Max. 1Ω
	4	Short circuit with chassis ground in wiring harness (Contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Contact of wiring harness between RWL (female) (2) - FS1-(4) outlet with ground		Resistance	Min. 1 MΩ

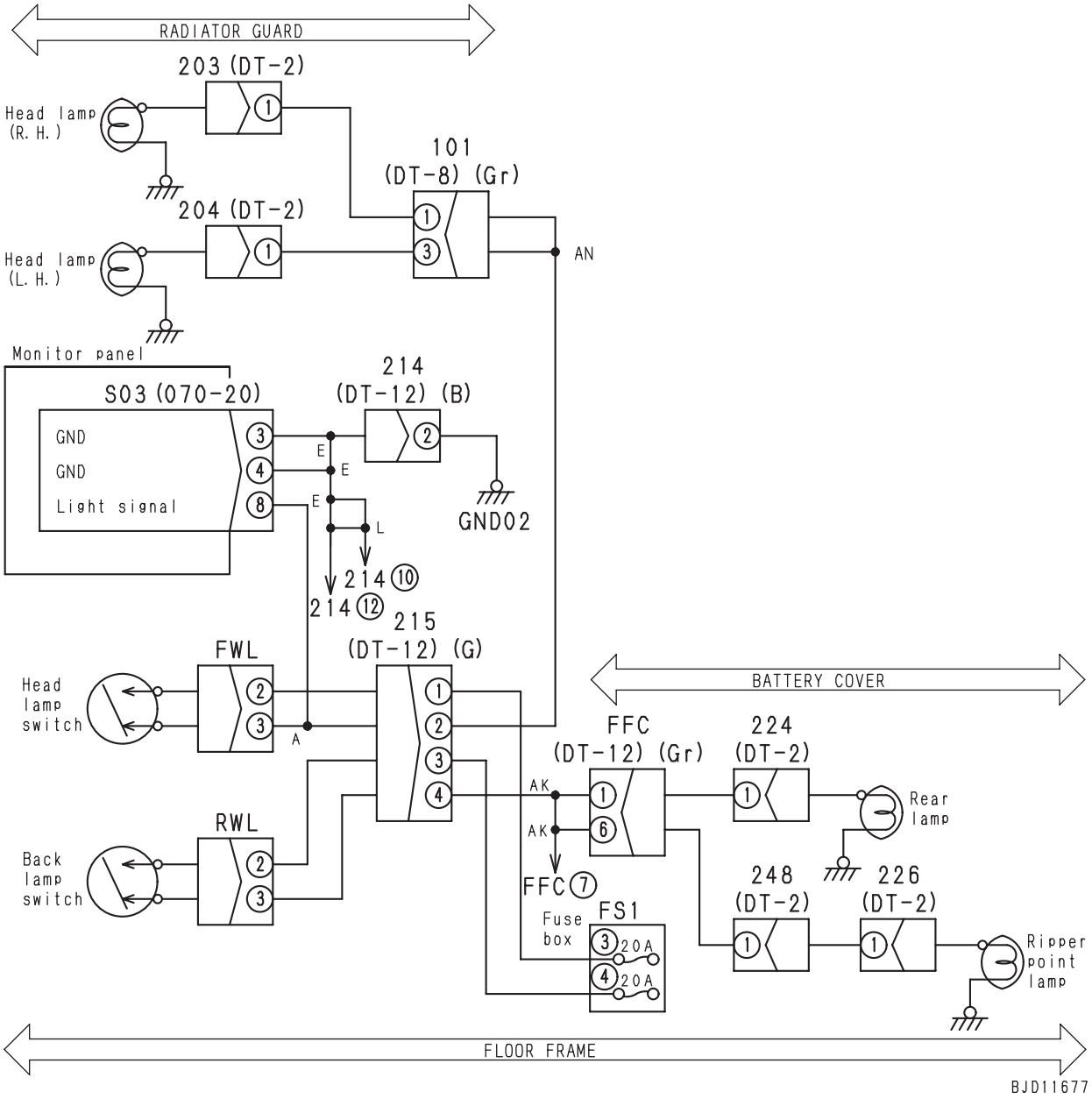
Trouble (3)	• Only the rear lamp does not light up.
Related information	—

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Defective rear lamp (Breakage of bulb)	The rear lamp may be defective. Check the bulb directly for breakage.		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between RWL (female) (3) – 224 (female) (1)	Resistance	Max. 1Ω

Trouble (4)	• Only the ripper point lamp does not light up.
Related information	—

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
	1	Defective ripper point lamp (Breakage of bulb)	The ripper point lamp may be defective. Check the bulb directly for breakage.		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between RWL (female) (3) - 226 (female) (1)	Resistance	Max. 1Ω

Circuit diagram related to panel lamp, head lamp, rear lamp, and ripper point lamp



E-24 MALFUNCTION OF WIPERS

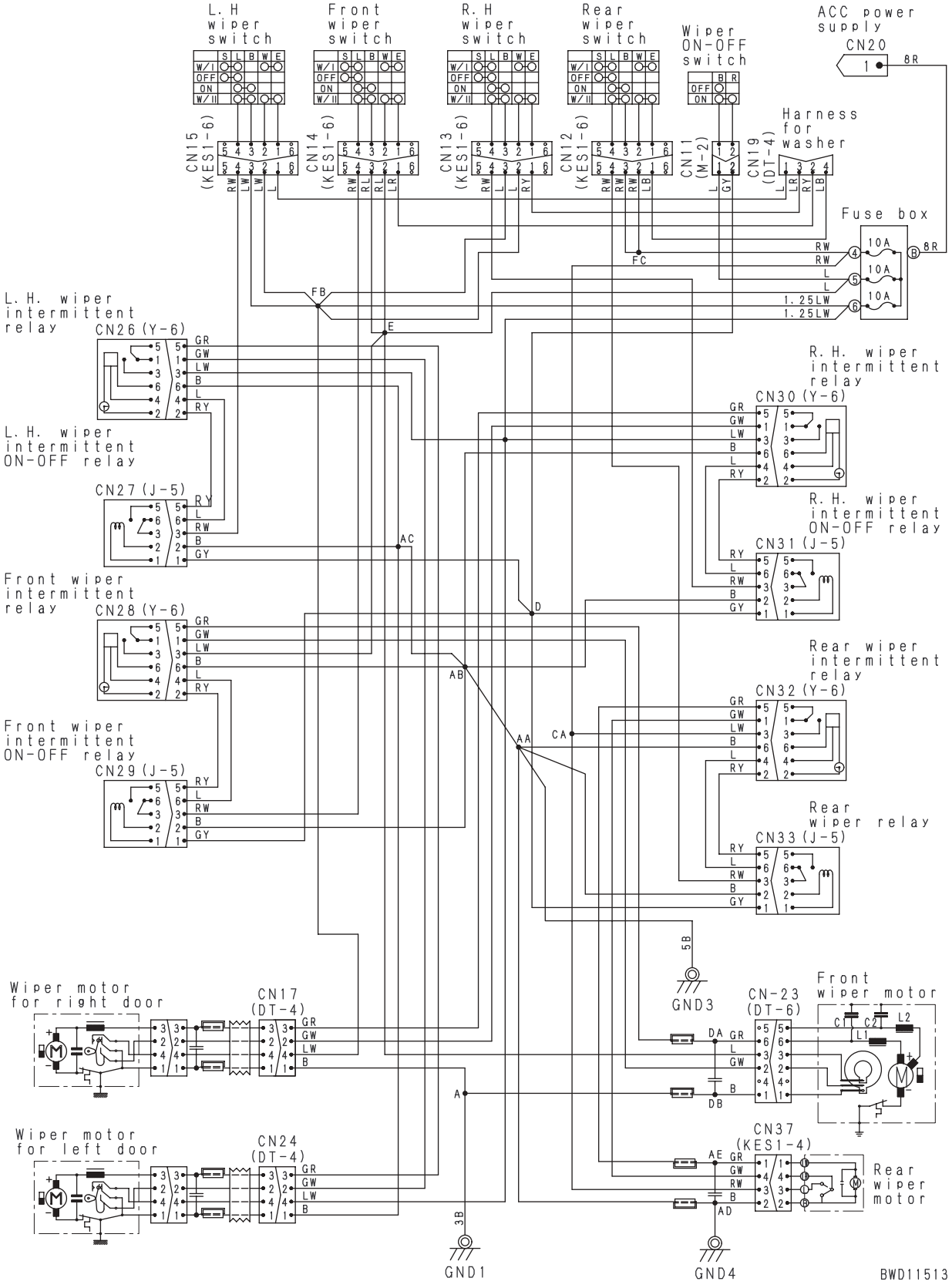
Trouble (1)	• The front wiper does not operate (Continuous operation is defective).
Related information	• Carry out the following troubleshooting when only the front wiper is defective. • If fuse (5) in the cab is broken, intermittent operation of the all wipers becomes defective. • If any wiper does not operate, check the fusible link (96A). • When carrying out the troubleshooting, turn the intermittent switch OFF and turn the wiper switch ON.

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective circuit breaker (96A)	If the circuit breaker is turned OFF, 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 system and intermittent switch system, those systems probably have a grounding fault, etc.			
	3	Defective front wiper motor	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between CN23 (6) – ground		Voltage	20 – 30V
			★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CN23 (female) (1) – ground		Resistance	Max. 1Ω
	4	Defective front wiper switch	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CN14 (male)	Position of switch	Resistance	
			Between (3) – (4)	ON	Max. 1Ω	
				OFF	Min. 1 MΩ	
	5	Defective front wiper intermittent selector relay	• If the trouble is repaired by replacing the relay with relay CN27, CN31, or CN33, the relay is defective.			
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between CN29 (3) – ground		Voltage	20 – 30V
			Between CN29 (6) – ground		Voltage	20 – 30V
			Between CN29 (1) – ground		Voltage	20 – 30V
	6	Defective front wiper intermittent relay	• If the trouble is repaired by replacing the relay with relay CN26, CN30, or CN32, the relay is defective.			
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between CN28 (4) – ground		Voltage	20 – 30V
			Between CN28 (3) – ground		Voltage	20 – 30V
			Between CN28 (5) – ground		Voltage	20 – 30V
	7	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CN14 (female) (4) – CN29 (female) (3)		Resistance	Max. 1Ω
			Contact of wiring harness between CN14 (female) (4) – CN29 (female) (3) with ground		Resistance	Min. 1 MΩ
			Wiring harness between CN29 (female) (6) - CN28 (female) (4)		Resistance	Max. 1Ω
			Contact of wiring harness between CN29 (female) (6) – CN28 (female) (4) with ground		Resistance	Min. 1 MΩ

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	7	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	Wiring harness between fuse (5) – CN14 (female) (2), (3) and between CN23 (female) (3) – CN28 (female) (3)	Resistance	Max. 1Ω
			Contact of wiring harness between fuse (5) – CN14 (female) (2), (3) and between CN23 (female) (3) – CN28 (female) (3) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN28 (female) (5) – CN23 (female) (6)	Resistance	Max. 1Ω
			Contact of wiring harness between CN28 (female) (5) – CN23 (female) (6) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN28 (female) (6) – ground	Resistance	Max. 1Ω
			Wiring harness between CN23 (female) (1) – ground	Resistance	Max. 1Ω

Trouble (2)	• The front wiper does not operate intermittently.
Related information	• Carry out the following troubleshooting when the ordinary operation is normal. • When carrying out the troubleshooting, turn the wiper switch and intermittent switch ON. • Stop about 5 seconds after the wiper goes and returns once.

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective intermittent switch	• If the ordinary operation is normal and the other wiper do not operate intermittently either, the intermittent switch is probably defective.		
			★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN11 (female)	Position of switch	Voltage
			Between (1) – (2)	ON	Max. 1Ω
				OFF	Min. 1 MΩ
	2	Defective front wiper intermittent selector relay	• If the trouble is repaired by replacing the relay with relay CN27, CN31, or CN33, the relay is defective.		
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between CN29 (1) – ground	Voltage	20 – 30V
			Between CN29 (5) – ground	Voltage	20 – 30V
	3	Defective front wiper intermittent relay	• If the trouble is repaired by replacing the relay with relay CN26, CN30, or CN32, the relay is defective.		
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between CN28 (2) – ground	Voltage	20 – 30V
	4	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CN11 (female) (2) – CN29 (female) (1)	Resistance	Max. 1Ω
			Contact of wiring harness between CN11 (female) (2) – CN29 (female) (1) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN29 (female) (5) – CN28 (female) (2)	Resistance	Max. 1Ω
			Contact of wiring harness between CN29 (female) (5) – CN28 (female) (2) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN29 (female) (2) – ground	Resistance	Max. 1Ω


L.H wiper switch
Front wiper switch
R.H wiper switch
Rear wiper switch
Wiper ON-OFF switch
ACC power supply
CN20
Harness for washer
CN15 (KES1-6)
CN14 (KES1-6)
CN13 (KES1-6)
CN12 (KES1-6)
CN11 (M-2)
CN19 (DT-4)
Fuse box
10A
10A
10A
L.H. wiper intermittent relay
CN26 (Y-6)
L.H. wiper intermittent ON-OFF relay
CN27 (J-5)
Front wiper intermittent relay
CN28 (Y-6)
Front wiper intermittent ON-OFF relay
CN29 (J-5)
R.H. wiper intermittent relay
CN30 (Y-6)
R.H. wiper intermittent ON-OFF relay
CN31 (J-5)
Rear wiper intermittent relay
CN32 (Y-6)
Rear wiper relay
CN33 (J-5)
Wiper motor for right door
CN17 (DT-4)
Wiper motor for left door
CN24 (DT-4)
GND1
GND3
CN-23 (DT-6)
Front wiper motor
CN37 (KES1-4)
Rear wiper motor
GND4
BWD11513

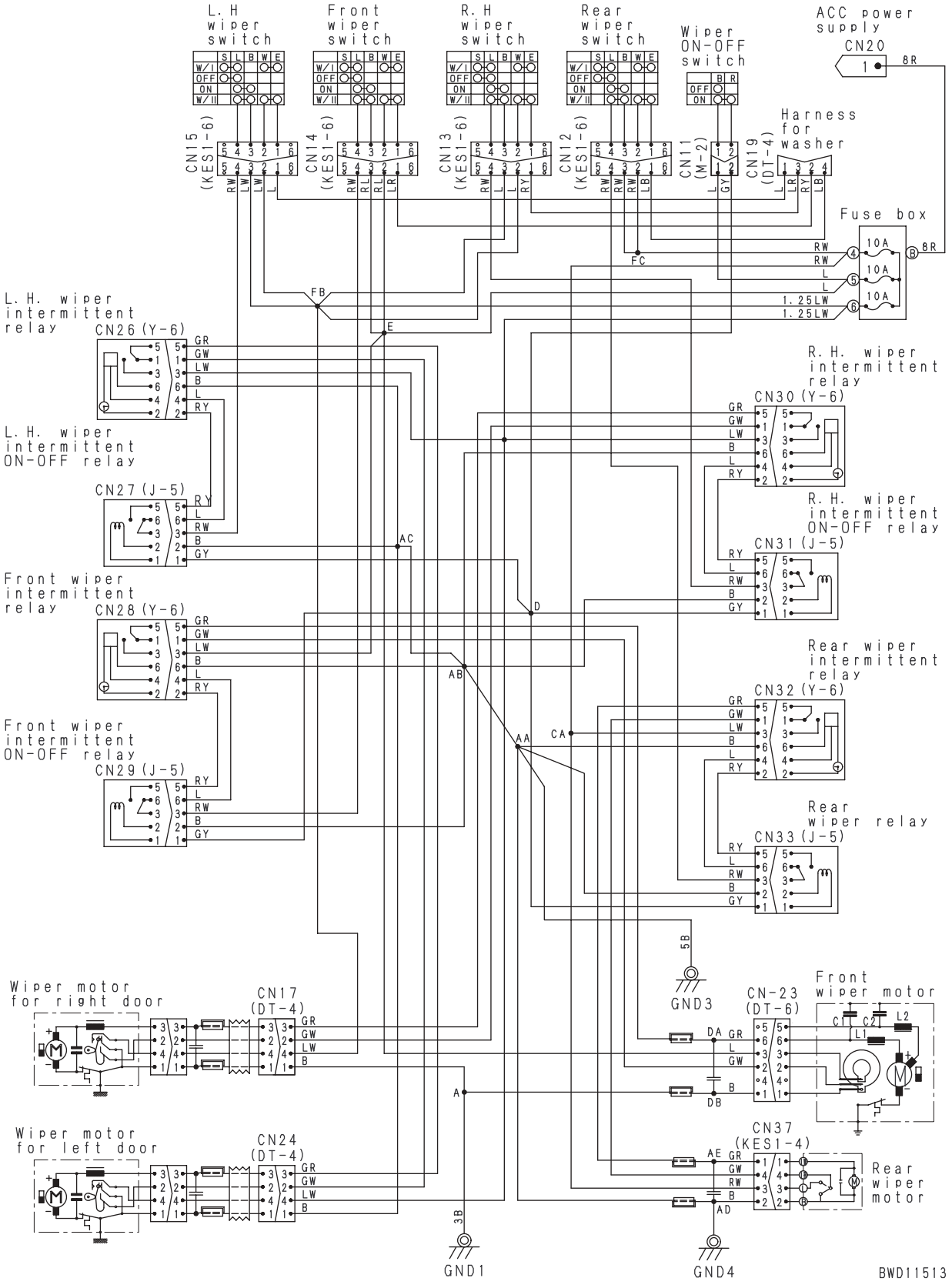
Trouble (3)	• The rear wiper does not operate (Continuous operation is defective).
Related information	• Carry out the following troubleshooting when only the rear wiper is defective. • If any wiper does not operate, check the fusible link (96A). • When carrying out the troubleshooting, turn the intermittent switch OFF and turn the wiper switch ON.

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective circuit breaker (96A)	If the circuit breaker is turned OFF, the circuit probably has a grounding fault, etc.			
	2	Defective fuse (4) in cab	Since fuse (4) in the cab is used for only the rear wiper system, this system probably has a grounding fault, etc.			
	3	Defective rear wiper motor	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between CN37 (1) – ground		Voltage	20 – 30V
			★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CN37 (female) (2) – ground		Resistance	Max. 1Ω
	4	Defective rear wiper switch	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CN12 (male)	Position of switch	Resistance	
			Between (3) – (4)	ON	Max. 1Ω	
				OFF	Min. 1 MΩ	
	5	Defective rear wiper intermittent selector relay	• If the trouble is repaired by replacing the relay with relay CN27, CN29, or CN31, the relay is defective.			
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between CN33 (3) – ground		Voltage	20 – 30V
			Between CN33 (6) – ground		Voltage	20 – 30V
			Between CN33 (1) – ground		Voltage	20 – 30V
	6	Defective rear wiper intermittent relay	• If the trouble is repaired by replacing the relay with relay CN26, CN28, or CN30, the relay is defective.			
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between CN32 (4) – ground		Voltage	20 – 30V
			Between CN32 (3) – ground		Voltage	20 – 30V
			Between CN32 (5) – ground		Voltage	20 – 30V
	7	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CN12 (female) (4) – CN33 (female) (3)		Resistance	Max. 1Ω
			Contact of wiring harness between CN12 (female) (4) – CN33 (female) (3) with ground		Resistance	Min. 1 MΩ
			Wiring harness between CN33 (female) (6) – CN32 (female) (4)		Resistance	Max. 1Ω
			Contact of wiring harness between CN33 (female) (6) – CN32 (female) (4) with ground		Resistance	Min. 1 MΩ

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	7	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	Wiring harness between fuse (4) – CN12 (female) (2), (3)	Resistance	Max. 1Ω
			Contact of wiring harness between fuse (4) – CN12 (female) (2), (3) with ground	Resistance	Min. 1 MΩ
			Wiring harness between fuse (4) – CN32 (female) (3) – CN37 (female) (3)	Resistance	Max. 1Ω
			Contact of wiring harness between fuse (4) – CN32 (female) (3) – CN37 (female) (3) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN32 (female) (5) – CN37 (female) (1)	Resistance	Max. 1Ω
			Contact of wiring harness between CN32 (female) (5) – CN37 (female) (1) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN32 (female) (6) – ground	Resistance	Max. 1Ω
			Wiring harness between CN37 (female) (2) – ground	Resistance	Max. 1Ω

Trouble (4)	• The rear wiper does not operate intermittently.
Related information	• Carry out the following troubleshooting when the ordinary operation is normal. • When carrying out the troubleshooting, turn the wiper switch and intermittent switch ON. • Stop about 5 seconds after the wiper goes and returns once.

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective intermittent switch	• If the ordinary operation is normal and the other wiper do not operate intermittently either, the intermittent switch is probably defective.		
			★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN11 (female)	Position of switch	Voltage
			Between (1) – (2)	ON	Max. 1Ω
				OFF	Min. 1 MΩ
	2	Defective rear wiper intermittent selector relay	• If the trouble is repaired by replacing the relay with relay CN27, CN29, or CN31, the relay is defective.		
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between CN33 (1) – ground	Voltage	20 – 30V
			Between CN33 (5) – ground	Voltage	20 – 30V
	3	Defective rear wiper intermittent relay	• If the trouble is repaired by replacing the relay with relay CN26, CN28, or CN30, the relay is defective.		
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between CN32 (2) – ground	Voltage	20 – 30V
	4	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CN11 (female) (2) – CN33 (female) (1)	Resistance	Max. 1Ω
			Contact of wiring harness between CN11 (female) (2) – CN33 (female) (1) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN33 (female) (5) – CN32 (female) (2)	Resistance	Max. 1Ω
			Contact of wiring harness between CN33 (female) (5) – CN32 (female) (2) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN33 (female) (2) – ground	Resistance	Max. 1Ω


L.H wiper switch
Front wiper switch
R.H wiper switch
Rear wiper switch
Wiper ON-OFF switch
ACC power supply
CN20
Harness for washer
CN15 (KES1-6)
CN14 (KES1-6)
CN13 (KES1-6)
CN12 (KES1-6)
CN11 (M-2)
CN19 (DT-4)
Fuse box
10A
10A
10A
L.H. wiper intermittent relay
CN26 (Y-6)
L.H. wiper intermittent ON-OFF relay
CN27 (J-5)
Front wiper intermittent relay
CN28 (Y-6)
Front wiper intermittent ON-OFF relay
CN29 (J-5)
R.H. wiper intermittent relay
CN30 (Y-6)
R.H. wiper intermittent ON-OFF relay
CN31 (J-5)
Rear wiper intermittent relay
CN32 (Y-6)
Rear wiper relay
CN33 (J-5)
Wiper motor for right door
CN17 (DT-4)
Wiper motor for left door
CN24 (DT-4)
GND3
CN-23 (DT-6)
Front wiper motor
CN37 (KES1-4)
Rear wiper motor
GND1
GND4
BWD11513

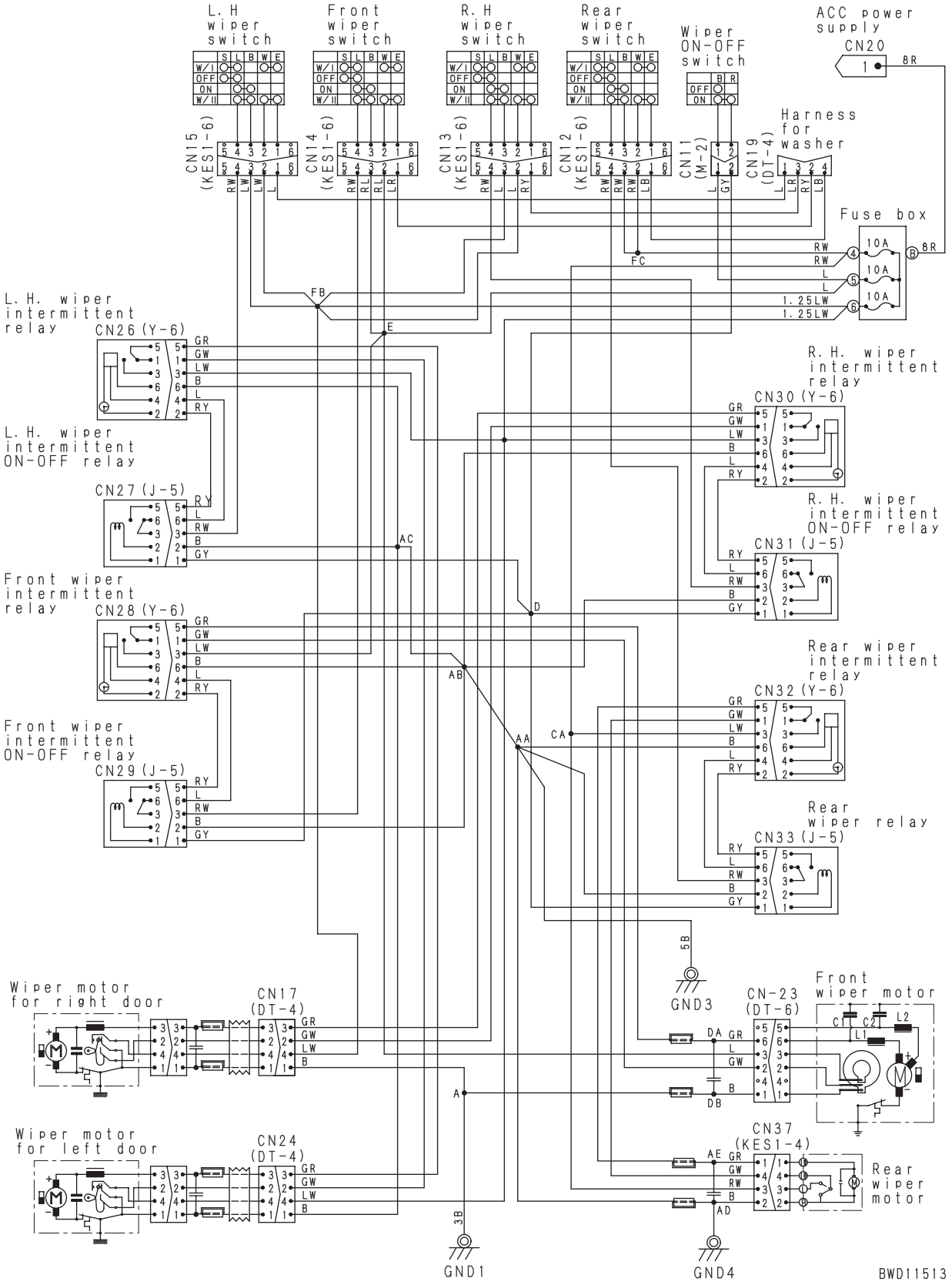
Trouble (5)	• The right door wiper does not operate (Continuous operation is defective).
Related information	• Carry out the following troubleshooting when only the right door wiper is defective. (If fuse (6) in the cab is broken, the left door wiper does not operate either.) • If any wiper does not operate, check the fusible link (96A). • When carrying out the troubleshooting, turn the intermittent switch OFF and turn the wiper switch ON.

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective circuit breaker (96A)	If the circuit breaker is turned OFF, 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 door wiper system and left door wiper system, either of those systems probably has a grounding fault, etc.		
	3	Defective right door wiper motor	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between connector (3) just before motor - ground	Voltage	20 – 30V
			★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between connector (1) just before motor – ground	Resistance	Max. 1Ω
	4	Defective right door wiper switch	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN13 (male)	Position of switch	Resistance
			Between (3) – (4)	ON	Max. 1Ω
				OFF	Min. 1 MΩ
	5	Defective right door wiper intermittent selector relay	• If the trouble is repaired by replacing the relay with relay CN27, CN29, or CN33, the relay is defective.		
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between CN31 (3) – ground	Voltage	20 – 30V
			Between CN31 (6) – ground	Voltage	20 – 30V
			Between CN31 (1) – ground	Voltage	20 – 30V
	6	Defective right door wiper intermittent relay	• If the trouble is repaired by replacing the relay with relay CN26, CN28, or CN32, the relay is defective.		
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between CN30 (4) – ground	Voltage	20 – 30V
			Between CN30 (3) – ground	Voltage	20 – 30V
			Between CN30 (5) – ground	Voltage	20 – 30V
	7	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CN13 (female) (4) – CN31 (female) (3)	Resistance	Max. 1Ω
			Contact of wiring harness between CN13 (female) (4) – CN31 (female) (3) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN31 (female) (6) – CN30 (female) (4)	Resistance	Max. 1Ω
			Contact of wiring harness between CN31 (female) (6) – CN30 (female) (4) with ground	Resistance	Min. 1 MΩ

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	7	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	Wiring harness between fuse (6) - CN13 (female) (2), (3) – CN17 (4) – connector (female) (4) just before motor – CN13 (female) (2), (3)	Resistance	Max. 1Ω
			Contact of wiring harness between fuse (6) - CN13 (female) (2), (3) – CN17 (4) – connector (female) (4) just before motor – CN13 (female) (2), (3) with ground	Resistance	Min. 1 MΩ
			Wiring harness between fuse (6) – CN30 (female) (3)	Resistance	Max. 1Ω
			Contact of wiring harness between fuse (6) – CN30 (female) (3) with ground	Resistance	Min. 1 MΩ
			Wiring harness between connector (female) (3) just before motor – CN17 (3) – CN30 (female) (5)	Resistance	Max. 1Ω
			Contact of wiring harness between connector (female) (3) just before motor – CN17 (3) – CN30 (female) (5) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN30 (female) (6) – ground	Resistance	Max. 1Ω
			Wiring harness between connector (female) (1) just before motor – CN17 (1) – ground	Resistance	Max. 1Ω

Trouble (6)	• The right door wiper does not operate intermittently.
Related information	• Carry out the following troubleshooting when the ordinary operation is normal. • When carrying out the troubleshooting, turn the wiper switch and intermittent switch ON. • Stop about 5 seconds after the wiper goes and returns once.

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective intermittent switch	• If the ordinary operation is normal and the other wiper do not operate intermittently either, the intermittent switch is probably defective.		
			★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN11 (female)	Position of switch	Voltage
			Between (1) – (2)	ON	Max. 1Ω
				OFF	Min. 1 MΩ
	2	Defective right door wiper intermittent selector relay	• If the trouble is repaired by replacing the relay with relay CN27, CN29, or CN33, the relay is defective.		
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between CN31 (1) – ground	Voltage	20 – 30V
			Between CN31 (5) – ground	Voltage	20 – 30V
	3	Defective right door wiper intermittent relay	• If the trouble is repaired by replacing the relay with relay CN26, CN28, or CN32, the relay is defective.		
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between CN30 (2) – ground	Voltage	20 – 30V
	4	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CN11 (female) (2) – CN31 (female) (1)	Resistance	Max. 1Ω
			Contact of wiring harness between CN11 (female) (2) – CN31 (female) (1) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN31 (female) (5) – CN30 (female) (2)	Resistance	Max. 1Ω
			Contact of wiring harness between CN31 (female) (5) – CN30 (female) (2) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN31 (female) (2) – ground	Resistance	Max. 1Ω


L.H wiper switch
Front wiper switch
R.H wiper switch
Rear wiper switch
Wiper ON-OFF switch
ACC power supply
CN20
Harness for washer
CN15 (KES1-6)
CN14 (KES1-6)
CN13 (KES1-6)
CN12 (KES1-6)
CN11 (M-2)
CN19 (DT-4)
Fuse box
10A
10A
10A
L.H. wiper intermittent relay
CN26 (Y-6)
L.H. wiper intermittent ON-OFF relay
CN27 (J-5)
Front wiper intermittent relay
CN28 (Y-6)
Front wiper intermittent ON-OFF relay
CN29 (J-5)
R.H. wiper intermittent relay
CN30 (Y-6)
R.H. wiper intermittent ON-OFF relay
CN31 (J-5)
Rear wiper intermittent relay
CN32 (Y-6)
Rear wiper relay
CN33 (J-5)
Wiper motor for right door
CN17 (DT-4)
Wiper motor for left door
CN24 (DT-4)
GND3
CN-23 (DT-6)
Front wiper motor
CN37 (KES1-4)
Rear wiper motor
GND1
GND4
BWD11513

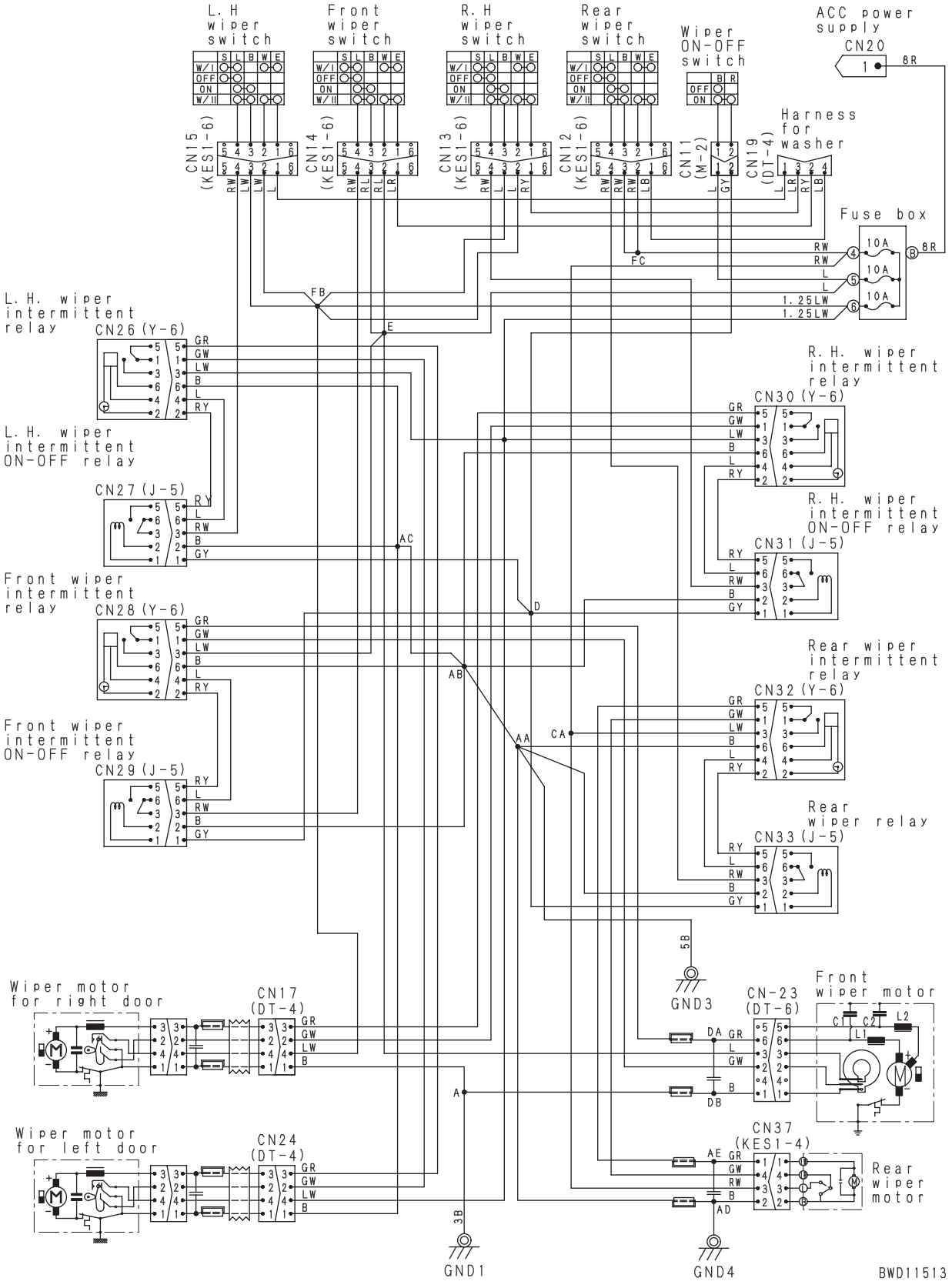
Trouble (7)	• The left door wiper does not operate (Continuous operation is defective).
Related information	• Carry out the following troubleshooting when only the left door wiper is defective. (If fuse (6) in the cab is broken, the right door wiper does not operate either.) • If any wiper does not operate, check the fusible link (96A). • When carrying out the troubleshooting, turn the intermittent switch OFF and turn the wiper switch ON.

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective circuit breaker (96A)	If the circuit breaker is turned OFF, the circuit probably has a grounding fault, etc.		
	2	Defective fuse (6) in cab	Since fuse (6) in the cab is used for the left door wiper system and left door wiper system, either of those systems probably has a grounding fault, etc.		
	3	Defective left door wiper motor	★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between connector (3) just before motor – ground	Voltage	20 – 30V
			★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between connector (1) just before motor – ground	Resistance	Max. 1Ω
	4	Defective left door wiper switch	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN15 (male)	Position of switch	Resistance
			Between (3) – (4)	ON	Max. 1Ω
				OFF	Min. 1 MΩ
	5	Defective left door wiper intermittent selector relay	• If the trouble is repaired by replacing the relay with relay CN29, CN31, or CN33, the relay is defective.		
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between CN31 (3) – ground	Voltage	20 – 30V
			Between CN31 (6) – ground	Voltage	20 – 30V
			Between CN31 (1) – ground	Voltage	20 – 30V
	6	Defective left door wiper intermittent relay	• If the trouble is repaired by replacing the relay with relay CN28, CN30, or CN32, the relay is defective.		
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between CN26 (4) – ground	Voltage	20 – 30V
			Between CN26 (3) – ground	Voltage	20 – 30V
			Between CN26 (5) – ground	Voltage	20 – 30V
	7	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CN15 (female) (4) – CN27 (female) (3)	Resistance	Max. 1Ω
			Contact of wiring harness between CN15 (female) (4) – CN27 (female) (3) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN27 (female) (6) – CN26 (female) (4)	Resistance	Max. 1Ω
			Contact of wiring harness between CN27 (female) (6) – CN26 (female) (4) with ground	Resistance	Min. 1 MΩ

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	7	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	Wiring harness between fuse (6) – CN26 (female) (3) – CN24 (4) – connector (female) (4) just before motor	Resistance	Max. 1Ω
			Contact of wiring harness between fuse (6) – CN26 (female) (3) – CN24 (4) – connector (female) (4) just before motor with ground	Resistance	Min. 1 MΩ
			Wiring harness between fuse (6) – CN15 (female) (2), (3)	Resistance	Max. 1Ω
			Contact of wiring harness between fuse (6) – CN15 (female) (2), (3)	Resistance	Min. 1 MΩ
			Wiring harness between connector (female) (3) just before motor – CN24 (3) – CN26 (female) (5)	Resistance	Max. 1Ω
			Wiring harness between connector (female) (3) just before motor – CN24 (3) – CN26 (female) (5)	Resistance	Min. 1 MΩ
			Wiring harness between CN26 (female) (6) – ground	Resistance	Max. 1Ω
			Wiring harness between connector (female) (1) just before motor – CN24 (1) – ground	Resistance	Max. 1Ω

Trouble (8)	• The left door wiper does not operate intermittently.
Related information	• Carry out the following troubleshooting when the ordinary operation is normal. • When carrying out the troubleshooting, turn the wiper switch and intermittent switch ON. • Stop about 5 seconds after the wiper goes and returns once.

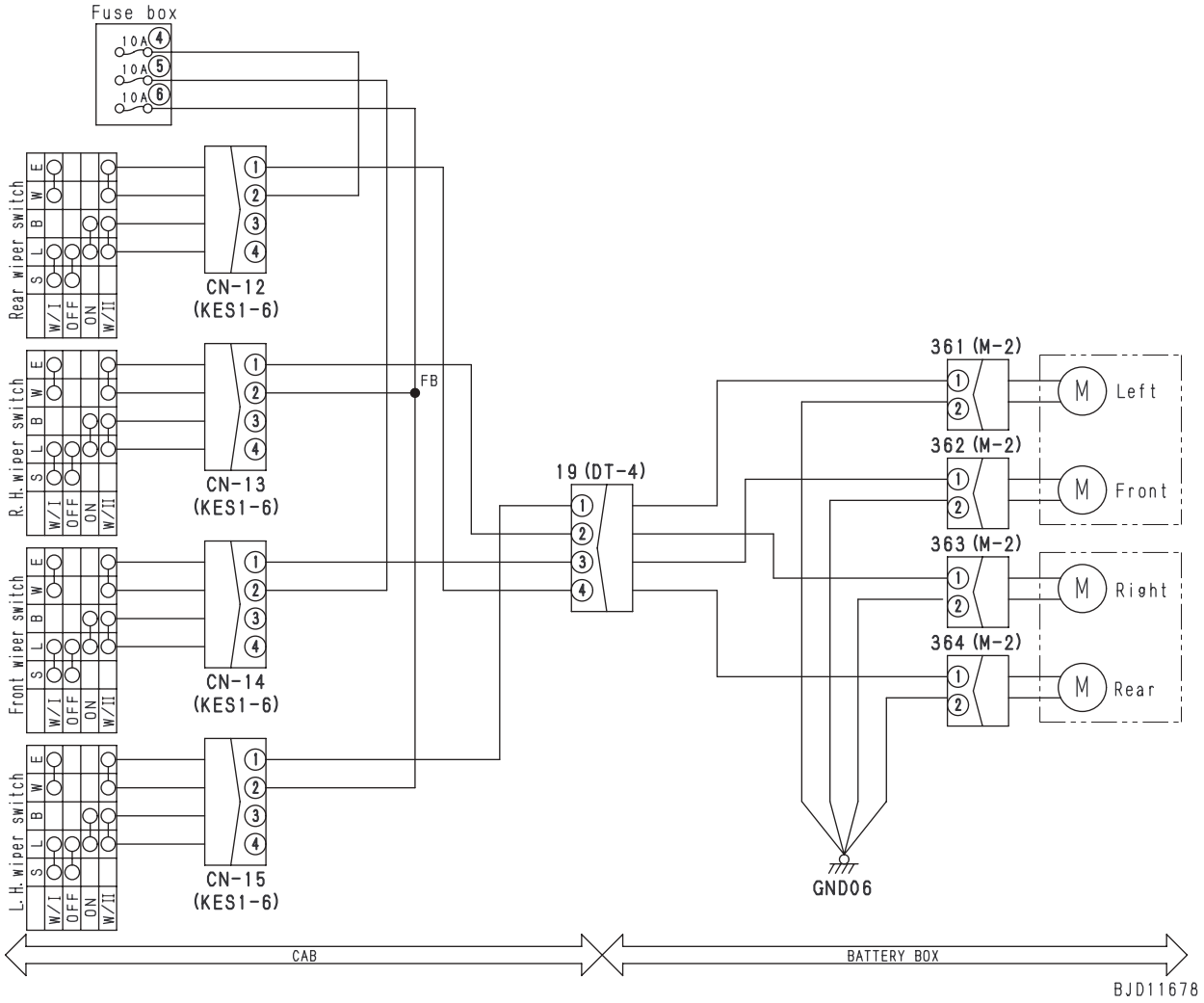
	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective intermittent switch	• If the ordinary operation is normal and the other wiper do not operate intermittently either, the intermittent switch is probably defective.		
			★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CN11 (female)	Position of switch	Voltage
			Between (1) – (2)	ON	Max. 1Ω
				OFF	Min. 1 MΩ
	2	Defective left door wiper intermittent selector relay	• If the trouble is repaired by replacing the relay with relay CN29, CN31, or CN33, the relay is defective.		
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between CN27 (1) – ground	Voltage	20 – 30V
			Between CN27 (5) – ground	Voltage	20 – 30V
	3	Defective left door wiper intermittent relay	• If the trouble is repaired by replacing the relay with relay CN28, CN30, or CN32, the relay is defective.		
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Between CN26 (2) – ground	Voltage	20 – 30V
	4	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CN11 (female) (2) – CN27 (female) (1)	Resistance	Max. 1Ω
			Wiring harness between CN11 (female) (2) – CN27 (female) (1) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN27 (female) (5) – CN26 (female) (2)	Resistance	Max. 1Ω
			Wiring harness between CN27 (female) (5) – CN26 (female) (2) with ground	Resistance	Min. 1 MΩ
			Wiring harness between CN27 (female) (2) – ground	Resistance	Max. 1Ω


L.H wiper switch
Front wiper switch
R.H wiper switch
Rear wiper switch
Wiper ON-OFF switch
ACC power supply
CN20
Harness for washer
CN15 (KES1-6)
CN14 (KES1-6)
CN13 (KES1-6)
CN12 (KES1-6)
CN11 (M-2)
CN19 (DT-4)
Fuse box
10A
10A
10A
L.H. wiper intermittent relay
CN26 (Y-6)
L.H. wiper intermittent ON-OFF relay
CN27 (J-5)
Front wiper intermittent relay
CN28 (Y-6)
Front wiper intermittent ON-OFF relay
CN29 (J-5)
R.H. wiper intermittent relay
CN30 (Y-6)
R.H. wiper intermittent ON-OFF relay
CN31 (J-5)
Rear wiper intermittent relay
CN32 (Y-6)
Rear wiper relay
CN33 (J-5)
Wiper motor for right door
CN17 (DT-4)
Wiper motor for left door
CN24 (DT-4)
GND3
GND1
GND4
CN-23 (DT-6)
Front wiper motor
CN37 (KES1-4)
Rear wiper motor
BWD11513

E-25 WASHING WATER DOES NOT COME OUT.

Trouble (1)	• Washing water of the front washer does not come out.
Related information	• Carry out the following troubleshooting when the front wiper operates normally. (If the wiper does not operate either, carry out troubleshooting in E-24 THE WIPER DOES NOT OPERATE first.

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective front washer motor	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between 362 (male) (2) – ground		Resistance	Max. 1Ω
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between 362 (2) – ground		Voltage	20 – 30V
	2	Defective front wiper switch	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CN14 (female)	Position of switch	Resistance	
			Between (2) – (1)	W/Ⅰ or W/Ⅱ	Max. 1Ω	
				OFF	Min. 1 MΩ	
	3	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)			
			Wiring harness between fuse (5) – CN14 (female) (2)		Resistance	Max. 1Ω
			Contact of wiring harness between fuse (5) – CN14 (female) (2) with ground		Resistance	Min. 1 MΩ
			Wiring harness between CN14 (female) (1) – 19 (3) – 362 (female) (1)		Resistance	Max. 1Ω
			Contact of wiring harness between CN14 (female) (6) – 19 (3) – 362 (female) (1) with ground		Resistance	Min. 1 MΩ
			Wiring harness between 362 (female) (2) – ground		Resistance	Max. 1Ω


Fuse box
10A 4
10A 5
10A 6
Rear wiper switch
R.H.wiper switch
Front wiper switch
L.H.wiper switch
S L B W E
W/I OFF ON W/II
CN-12
(KES1-6)
CN-13
(KES1-6)
CN-14
(KES1-6)
CN-15
(KES1-6)
FB
19 (DT-4)
361 (M-2)
362 (M-2)
363 (M-2)
364 (M-2)
M Left
M Front
M Right
M Rear
GND06
CAB
BATTERY BOX
BJD11678

Trouble (2)	• Washing water of the rear washer does not come out.
Related information	• Carry out the following troubleshooting when the rear wiper operates normally. (If the wiper does not operate either, carry out troubleshooting in E-24 THE WIPER DOES NOT OPERATE first.

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective rear washer motor	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between 364 (male) (2) – ground		Resistance	Max. 1Ω
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between 364 (2) – ground		Voltage	20 – 30V
	2	Defective rear wiper switch	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CN12 (female)	Position of switch	Resistance	
			Between (2) – (1)	W/Ⅰ or W/Ⅱ	Max. 1Ω	
				OFF	Min. 1 MΩ	
	3	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between fuse (4) – CN12 (female) (2)		Resistance	Max. 1Ω
			Contact of wiring harness between fuse (4) – CN12 (female) (2) with ground		Resistance	Min. 1 MΩ
			Wiring harness between CN12 (female) (1) – 19 (4) – 364 (female) (1)		Resistance	Max. 1Ω
			Contact of wiring harness between CN12 (female) (6) – 19 (4) – 364 (female) (1) with ground		Resistance	Min. 1 MΩ
			Wiring harness between 364 (female) (2) – ground		Resistance	Max. 1Ω

* For the electric circuit diagram of each system, see Trouble (1).

Trouble (3)	• Washing water of the left door washer does not come out.
Related information	• Carry out the following troubleshooting when the left door wiper operates normally. (If the wiper does not operate either, carry out troubleshooting in E-24 THE WIPER DOES NOT OPERATE first. • Since the left door wiper switch and right door wiper switch use fuse (6) jointly, if fuse (6) is broken, both wipers do not operate.

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective left door washer motor	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between 361 (male) (2) – ground		Resistance	Max. 1Ω
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between 361 (2) – ground		Voltage	20 – 30V
	2	Defective left door wiper switch	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CN15 (female)	Position of switch	Resistance	
			Between (2) – (1)	W/Ⅰ or W/Ⅱ	Max. 1Ω	
				OFF	Min. 1 MΩ	
	3	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between fuse (6) – CN15 (female) (2)		Resistance	Max. 1Ω
			Contact of wiring harness between fuse (6) – CN15 (female) (2) with ground		Resistance	Min. 1 MΩ
			Wiring harness between CN15 (female) (1) – 19 (1) – 361 (female) (1)		Resistance	Max. 1Ω
			Contact of wiring harness between CN15 (female) (6) – 19 (1) – 361 (female) (1) with ground		Resistance	Min. 1 MΩ
			Wiring harness between 361 (female) (2) – ground		Resistance	Max. 1Ω

* For the electric circuit diagram of each system, see Trouble (1).

Trouble (4)	• Washing water of the right door washer does not come out.
Related information	• Carry out the following troubleshooting when the right door wiper operates normally. (If the wiper does not operate either, carry out troubleshooting in E-24 THE WIPER DOES NOT OPERATE first. • Since the right door wiper switch and left door wiper switch use fuse (6) jointly, if fuse (6) is broken, both wipers do not operate.

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective right door washer motor	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between 363 (male) (2) – ground		Resistance	Max. 1Ω
			★Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Between 363 (2) – ground		Voltage	20 – 30V
	2	Defective right door wiper switch	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CN13 (female)	Position of switch		Resistance
			Between (2) – (1)	W/Ⅰ or W/Ⅱ		Max. 1Ω
				OFF		Min. 1 MΩ
	3	Disconnection or short circuit with chassis ground in wiring harness (Disconnection in wiring or defective contact in connector or contact with ground circuit)	★Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between fuse (6) – CN13 (female) (2)		Resistance	Max. 1Ω
			Contact of wiring harness between fuse (6) – CN13 (female) (2) with ground		Resistance	Min. 1 MΩ
			Wiring harness between CN13 (female) (1) – 19 (2) – 363 (female) (1)		Resistance	Max. 1Ω
			Contact of wiring harness between CN13 (female) (6) – 19 (2) – 363 (female) (1) with ground		Resistance	Min. 1 MΩ
			Wiring harness between 363 (female) (2) – ground		Resistance	Max. 1Ω

* For the electric circuit diagram of each system, see Trouble (1).

E-26 THE AIR CONDITIONER DOES NOT OPERATE.

Trouble (1)	• No air flow
Related information	

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	1	Defective circuit breaker (CB2)	When the circuit breaker is cut off, a ground fault may have possibly occurred in the circuit.	
	2	Defective blower main relay (coil side)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.	
			CN-R1 (male)	Resistance
			Between (1) and (2)	240 ± 40Ω
	3	Defective blower main relay (contact side)	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.	
			CN-R1	Voltage
			Between (8C) and ground	20 – 30V
	4	Defective blower Hi relay (coil side)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.	
			CN-R2 (male)	Resistance
			Between (1) and (2)	240 ± 40Ω
	5	Defective blower Hi relay (contact side)	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.	
			The relay is in order when the motor rotates after the starting switch is turned ON and the blower Hi switch is turned on.	
	6	Defective blower Mi1 relay (coil side)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.	
			CN-R3 (male)	Resistance
			Between (1) and (2)	240 ± 40Ω
	7	Defective blower Mi1 relay (contact side)	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.	
			The relay is in order when the motor rotates after the starting switch is turned ON and the blower Mi switch is turned on.	
	6	Defective blower Mi2 relay (coil side)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.	
			CN-R4 (male)	Resistance
			Between (1) and (2)	240 ± 40Ω
	7	Defective blower Mi2 relay (contact side)	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.	
			The relay is in order when the motor rotates after the starting switch is turned ON and the blower Mi switch is turned on.	
	8	Defective blower motor	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.	
			The motor is in order when it rotates after the starting switch is turned ON and the blower Lo switch is turned on.	
	8	Defective blower motor	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.	
			The motor is in order when it rotates after the starting switch is turned ON and the blower Lo switch is turned on.	

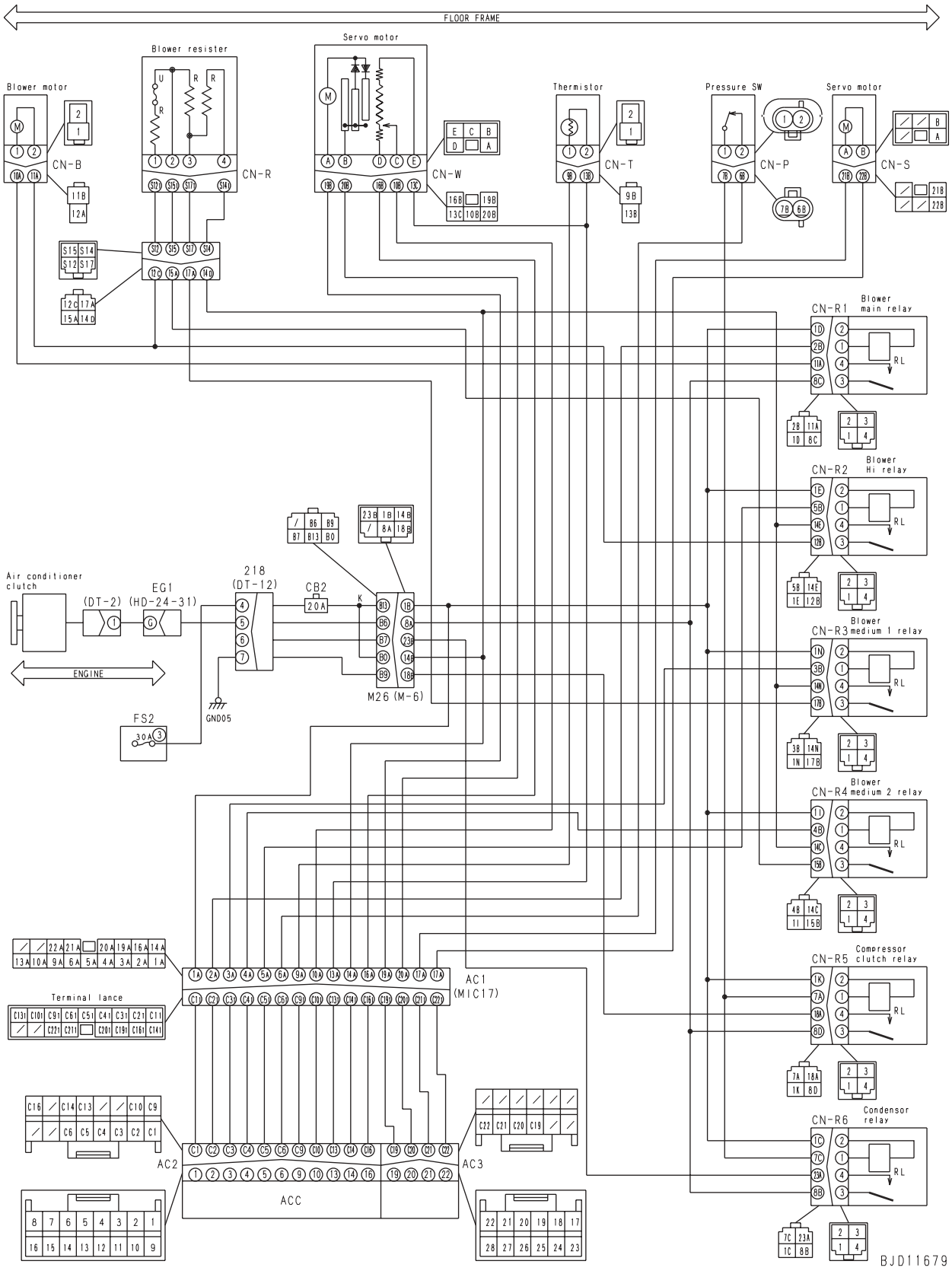
	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	9	Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.		
			Wiring harness between CN-R4 (female) (14C), AC1 (female) (14A), CN-R (female) (0D) or CN-R2 (female) (14E) or CN-R3 (female) (14N) and ground	Resistance	Max. 1Ω
			Wiring harness between CN-B(female) (11B) and CN-R1 (female) (11A)	Resistance	Max. 1Ω
			Wiring harness between CN-B (female) (12A) and CN-R2 (female) (12B) or CN-R (female) (11C)	Resistance	Max. 1Ω
			Wiring harness between CB2 outlet and AC1 (female) (1A), CN-R1 (female) (1D), CN-R2 (female) (1E) or CN-R4 (female) (11H)	Resistance	Max. 1Ω
			Wiring harness between CN-R1 (female) (2B) and AC1 (female) (2A)	Resistance	Max. 1Ω
			★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.		
			Wiring harness between CN-R3 (female) (3B) and AC1 (female) (3B)	Resistance	Max. 1Ω
			Wiring harness between CN-R2 (female) (5B) and AC1 (female) (5A)	Resistance	Max. 1Ω
			Wiring harness between CN-R4 (female) (4B) and AC1 (female) (4A)	Resistance	Max. 1Ω
	10	Defective control panel	When Causes 1 to 9 are not applicable, the control panel is supposed to be defective.		
	11	Different failure phenomenon	When any cause cannot be specified, failure phenomenon may have been mistaken. Carry out the troubleshooting of “Cooling is not possible.”		

Trouble (2)	• Cooling is not possible.
Related information	

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective pressure switch	H Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.			
			CN-P	Blower switch	Voltage	
			Between (6B) and ground	ON	20 – 30V	
	2	Defective compressor clutch relay (coil side)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			CN-R5 (male)		Resistance	
			Between (1) and (2)		240 ± 40Ω	
	3	Defective compressor clutch relay (contact side)	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.			
			CN-R5		Voltage	
			Between (18A) and ground		20 – 30V	
	4	Defective condenser relay (contact side)	★Prepare with the starting switch OFF, then turn the starting switch ON and carry out troubleshooting.			
			CN-R6		Voltage	
			Between (23A) and ground		20 – 30V	
	5	Defective thermistor	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			AC1 (male)		Resistance	
			Between (9A) and (13A)		Max. 3,500Ω	
	6	Defective condenser blower resistor	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			Condenser blower resistor		Resistance	
			Between terminals		2.8Ω ± 5%	
	7	Defective condenser motor	★Turn the starting switch on and carry out the troubleshooting.			
			The motor is in order if it is rotating when the air conditioner is switched ON.			
	8	Defective compressor magnet clutch	★Start the engine and carry out the troubleshooting.			
			The compressor magnet clutch is supposed to be out of order, so inspect it directly.			
	9	Defective compressor	★Start the engine and carry out the troubleshooting.			
			The compressor is supposed to be out of order, so inspect it directly.			
	10	Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.			
			Wiring harness between CB2 outlet and CN-R6 (female) (8B) or CN-R5 (female) (8D) or CN-R1 (female) (8C)		Resistance	Max. 1Ω
			Wiring harness between CN-R5 (female) (18A) and A/C (female) (1)		Resistance	Max. 1Ω
			Wiring harness between CB2 outlet and CN-R5 (female) (1K)		Resistance	Max. 1Ω
			Wiring harness between CN-T (female) (9B) and AC1 (female) (9A)		Resistance	Max. 1Ω

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	10	Disconnection of wiring harness (Disconnection in wiring or defective contact in connector)	★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.		
			Wiring harness between CN-P (female) (7B) and CN-R5 (female) (7A)	Resistance	Max. 1Ω
			Wiring harness between CN-P (female) (6B) and AC1 (female) (6A)	Resistance	Max. 1Ω
	11	Defective control panel	When Causes 1 to 10 are not applicable, the control panel is supposed to be defective.		

Circuit diagram related to air conditioner



TROUBLESHOOTING OF HYDRAULIC AND MECHANICAL SYSTEM (H-MODE)

INFORMATION DESCRIBED IN TROUBLESHOOTING LIST

★ Troubleshooting lists contain the following information all together. Understand the contents carefully and troubleshoot the machine.

Trouble	Problem that appears on the machine.
Related information	Information related to problems occurred or troubleshooting

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Cause supposed to have caused failure (The sequence shows reference numbers and does not mean priority.)	<Contents> • Standard values in normal state for judging possible causes • Remarks for making judgment
	2		
	3		
	4		

H-1 NO TRAVEL POWER (NO DRAWBAR PULL)

Trouble	• There is no travel power. (No drawbar pull).
Related information	• Confirm that the oil quantity on the power train is normal before troubleshooting.

<table>
<tr><td rowspan="20">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="3">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Defective engine</td><td colspan="3">★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.</td></tr>
<tr><td colspan="2">Measurement conditions</td><td>Number of engine rotations</td></tr>
<tr><td colspan="2">F3 stall</td><td>1,760rpm</td></tr>
<tr><td>2</td><td>Defective power train pump</td><td colspan="3">The power train pump is assumed to be defective; directly check it.</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Internally defective torque converter</td><td colspan="3">★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>Original pressure of torque converter</td><td>Torque converter delivery pressure</td></tr>
<tr><td>Full neutral</td><td>Max. 1.02MPa {Max. 10kg/cm^2}</td><td>0.61 – 0.81MPa {6 – 8kg/cm^2}</td></tr>
<tr><td rowspan="4">4</td><td rowspan="4">Defective set pressure of transmission main relief valve and internal defect</td><td colspan="3">★Prepare with starting switch OFF, then drive the engine in high idling mode 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. 2.84MPa {Min. 29kg/cm^2}</td></tr>
<tr><td colspan="3">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.
Directly check that the spring length and the number of shims are normal and also that the spool rotates smoothly.
• Free length of large spring: 128mm
• Free length of small spring: 108mm
• Number of shims: 6</td></tr>
<tr><td rowspan="6">5</td><td rowspan="6">Defective transmission valve (ECMV) function</td><td colspan="3">★Prepare with starting switch OFF, then drive the engine in low idling mode for troubleshooting.</td></tr>
<tr><td colspan="2">Transmission clutch</td><td>Clutch pressure</td></tr>
<tr><td colspan="2">FWD</td><td>Min. 1.96MPa {Min. 20kg/cm^2}</td></tr>
<tr><td colspan="2">REV</td><td>Min. 2.55MPa {Min. 26kg/cm^2}</td></tr>
<tr><td colspan="2">1ST</td><td>Min. 2.16MPa {Min. 22kg/cm^2}</td></tr>
<tr><td colspan="2">2ND</td><td>Min. 2.35MPa {Min. 24kg/cm^2}</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Defective brake valve</td><td colspan="3">★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.</td></tr>
<tr><td colspan="2">Parking lever</td><td>Brake pressure</td></tr>
<tr><td colspan="2">Free</td><td>Min. 2.45MPa {Min. 25kg/cm^2}</td></tr>
<tr><td>7</td><td>Defective parking lever or brake pedal linkage</td><td colspan="3">If the result of the troubleshooting in cause 6 is abnormal, the parking lever or brake pedal linkage is not assumed to be adjusted normally. Directly check it.</td></tr>
<tr><td>8</td><td>Internally defective transmission</td><td colspan="3">The transmission is assumed to be defective internally; directly check it.</td></tr>
</table>

H-2 MACHINE DOES NOT MOVE (AT 2ND OR 3RD SPEED)

Trouble	• Machine does not move. (At 2nd or 3rd speed)
Related information	• Confirm that the oil quantity on the power train is normal before troubleshooting. • Confirm that the transmission main relief pressure is normal before troubleshooting. (See H-1.)

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="3">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Internally defective torque converter</td><td colspan="3">★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>Original pressure of torque converter</td><td>Torque converter delivery pressure</td></tr>
<tr><td>Full neutral</td><td>Max. 1.02MPa {Max. 10kg/cm^2}</td><td>0.61 – 0.81MPa {6 – 8kg/cm^2}</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Defective transmission valve (ECMV) function</td><td colspan="3">★Prepare with starting switch OFF, then drive the engine in low idling mode for troubleshooting.</td></tr>
<tr><td colspan="2">Transmission clutch</td><td>Clutch pressure</td></tr>
<tr><td colspan="2">2ND</td><td>Min. 2.35MPa {Min. 24kg/cm^2}</td></tr>
<tr><td colspan="2">3RD</td><td>Min. 2.55MPa {Min. 26kg/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; directly check it.</td></tr>
<tr><td>4</td><td>Defective parking brake function (Drag)</td><td colspan="3">The parking brake function is assumed to be defective (dragged); check the linkage valves.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Defective brake function (Drag)</td><td colspan="3">★Move to a flat place, and start the engine for troubleshooting.</td></tr>
<tr><td colspan="3">If the machine does not run by low idling + F2 operation, brake drag occurs. (Carry out troubleshooting “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; directly check it.</td></tr>
</table>

H-3 MACHINE DOES NOT MOVE IN ANY SPEED RANGE

Trouble	• Machine does not move in any speed range.
Related information	• Confirm that the oil quantity on the power train is normal before troubleshooting.

<table>
<tr><td rowspan="15">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="2">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>1</td><td>Defective power train pump</td><td colspan="2">The power train pump is assumed to be defective; directly check it.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Defective and Internally defective set pressure of transmission main relief valve</td><td colspan="2">★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>Transmission main relief pressure</td></tr>
<tr><td>Full neutral</td><td>Min. 2.84MPa {Min. 29kg/cm^2}</td></tr>
<tr><td colspan="2">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td rowspan="7">3</td><td rowspan="7">Defective transmission valve (ECMV) function</td><td colspan="2">Directly check that the spring length and the number of shims are normal and also that the spool rotates smoothly.
• Free length of large spring: 128mm
• Free length of small spring: 108mm
• Number of shims: 6</td></tr>
<tr><td colspan="2">★Prepare with starting switch OFF, then drive the engine in low idling mode for troubleshooting. (Before this, confirm 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. 1.96MPa {Min. 20kg/cm^2}</td></tr>
<tr><td>REV</td><td>Min. 2.55MPa {Min. 26kg/cm^2}</td></tr>
<tr><td>1ST</td><td>Min. 2.16MPa {Min. 22kg/cm^2}</td></tr>
<tr><td>2ND</td><td>Min. 2.35MPa {Min. 24kg/cm^2}</td></tr>
<tr><td>3RD</td><td>Min. 2.55MPa {Min. 26kg/cm^2}</td></tr>
<tr><td>4</td><td>Internally defective transmission clutch</td><td colspan="2">The transmission clutch is assumed to be defective internally; directly check it.</td></tr>
<tr><td rowspan="5">5</td><td rowspan="5">Defective brake function</td><td colspan="2">★Move to a flat place, and drive the engine in high idling mode for troubleshooting. (Before this, confirm that the transmission main relief pressure is normal.)</td></tr>
<tr><td>Brake pedal</td><td>Brake hydraulic pressure (left/right)</td></tr>
<tr><td>Release</td><td>Min. 2.45MPa {Min. 25kg/cm^2}</td></tr>
<tr><td>Pedal</td><td>0 {0}</td></tr>
<tr><td colspan="2">When the hydraulic pressure is abnormal, carry out troubleshooting “Brake does not work.”</td></tr>
</table>

H-4 MACHINE TRAVELS ONLY IN ONE DIRECTION FORWARD OR IN REVERSE

Trouble	• Machine travels only in one direction Forward or in reverse.
Related information	• Confirm that the oil quantity on the power train is normal before troubleshooting.

<table>
<tr><td rowspan="11">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="2">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>1</td><td>Defective power train pump</td><td colspan="2">The power train pump is assumed to be defective; directly check it.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Defective set pressure of transmission main relief valve or internal defect</td><td colspan="2">★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.</td></tr>
<tr><td>PCCS lever</td><td>Transmission main relief pressure</td></tr>
<tr><td>Full neutral</td><td>Min. 2.84MPa {Min. 29kg/cm^2}</td></tr>
<tr><td colspan="2">★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.</td></tr>
<tr><td colspan="3">Directly check that the spring length and the number of shims are normal and also that the spool rotates smoothly.
• Free length of large spring: 128mm
• Free length of small spring: 108mm
• Number of shims: 6</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">Defective transmission valve (ECMV) function</td><td colspan="2">★Prepare with starting switch OFF, then drive the engine in low idling mode for troubleshooting. (Before this, confirm that the transmission main relief pressures is normal.)</td></tr>
<tr><td>Transmission clutch</td><td>Clutch pressure</td></tr>
<tr><td>FWD</td><td>Min. 1.96MPa {Min. 20kg/cm^2}</td></tr>
<tr><td>REV</td><td>Min. 2.55MPa {Min. 26kg/cm^2}</td></tr>
<tr><td>4</td><td>Defective transmission clutch seal</td><td colspan="2">When the troubleshooting in cause 3 is abnormal, the clutch seal is assume to be defective; directly check it.</td></tr>
<tr><td>5</td><td>Internally defective transmission clutch</td><td colspan="2">The transmission clutch (forward or backward) is assumed to be defective internally; directly check it.</td></tr>
</table>

H-5 WHEN GEAR IS SHIFTED OR TRAVEL DIRECTION IS CHANGED, LARGE TIME LAG IS MADE

Trouble	• Time lag is excessive when shifting gear or changing direction.
Related information	• Confirm that the oil quantity on the power train is normal before troubleshooting.

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	1	Defective power train pump	The power train pump is assumed to be defective; directly check it.	
	2	Defective set pressure of transmission main relief valve or internal defect	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.	
			PCCS lever	Transmission main relief pressure
			Full neutral	Min. 2.84MPa{Min. 29kg/cm^2}
			★Prepare with the starting switch OFF, then carry out troubleshooting without turning the starting switch ON.	
			Directly check that the spring length and the number of shims are normal and also that the spool rotates smoothly. • Free length of large spring: 128mm • Free length of small spring: 108mm • Number of shims: 6	
	3	Defective transmission valve (ECMV) function	★Prepare with starting switch OFF, then drive the engine in low idling mode for troubleshooting. (Before this, confirm that the transmission main relief pressure is normal.)	
			Transmission clutch	Clutch pressure
			FWD	Min. 1.96MPa {Min. 20kg/cm^2}
			REV	Min. 2.55MPa {Min. 26kg/cm^2}
			1ST	Min. 2.16MPa {Min. 22kg/cm^2}
			2ND	Min. 2.35MPa {Min. 24kg/cm^2}
			3RD	Min. 2.55MPa {Min. 26kg/cm^2}
	4	Defective transmission clutch seal	When the troubleshooting in cause 3 is abnormal, the clutch seal is assume to be defective; directly check it.	
	5	Internally defective transmission clutch	The transmission clutch is assumed to be defective internally; directly check it.	
	6	Defective brake function (Drag)	★Move to a flat place, then start the engine for troubleshooting.	
			If the machine does not run by low idling + F2 operation, brake drag occurs. (Carry out troubleshooting “Brake does not work.”)	

H-6 MACHINE DOES NOT TURN (NOT TURNED RIGHTWARD OR LEFTWARD)

Trouble	• Machine does not turn. (The machine does not turn leftward or rightward.)
Related information	• Confirm that the oil quantity for function is normal before troubleshooting.

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	1	Defective set pressure or defective function of self-pressure reducing valve (PPC source pressure)	★Prepare with starting the engine, then drive the engine in high idling mode for troubleshooting.	
			PCCS lever	Original pressure of control circuit
			Neutral	3.78 – 4.46MPa {38.5 – 45.5kg/cm^2}
	2	Abnormal sound from HSS peripheral equipment	If an abnormal sound occurs in the HSS peripheral equipment, carry out troubleshooting “Abnormal Sound around HSS Pump or HSS Motor.”	

H-7 STEERING SPEED OR POWER IS LOW

Trouble	• Steering speed or power is insufficient.
Related information	• Confirm that the oil quantity on the power train is normal before troubleshooting.

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	1	Defective set pressure or defective function of HSS main relief valve	★Prepare with starting the engine, then drive the engine in high idling mode for troubleshooting.	
			PCCS lever	HSS relief pressure
			Left or right stroke end	38.2 – 41.7MPa {390 – 425kg/cm^2}
	2	Defective set pressure or defective function of self-pressure reducing valve (PPC source pressure)	★Prepare with starting the engine, then drive the engine in high idling mode for troubleshooting.	
			PCCS lever	Original pressure of control circuit
			Neutral	3.78 – 4.46MPa {38.5 – 45.5kg/cm^2}
	3	Abnormal sound from HSS peripheral equipment	If an abnormal sound occurs in the HSS peripheral equipment, carry out troubleshooting “Abnormal Sound in HSS Pump or HSS Motor Periphery.”	

H-8 BRAKE DOES NOT WORK

Trouble	• Brake does not work.
Related information	• Confirm that the oil quantity on the power train is normal before troubleshooting. • Confirm that the main relief pressure for transmission is normal before troubleshooting. (See H-1.)

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	1	Defective brake valve function	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.	
			Brake pedal	Brake hydraulic pressure
			At release	Min. 2.45MPa {Min. 25kg/cm^2}
			At pedaling	0 {0}
	2	Defective adjustment of brake pedal linkage	If the troubleshooting in cause 1 is abnormal, the adjustment of the brake pedal linkage is assumed to be abnormal; directly check it.	
	3	Defective brake seal	If the troubleshooting in cause 1 is abnormal, the brake seal is assumed to be defective; directly check it.	
	4	Slipped or abrasive brake disk plate	The brake disk plate is assumed to be slipped or abrasive; directly check it.	

H-9 OVERHEAT OF POWER TRAIN OIL TEMPERATURE

Trouble	• The oil temperature of the power train overheats.
Related information	• Confirm that the oil quantity on the power train is normal before troubleshooting. • Confirm that the value of the oil temperature of the power train matches the actual oil temperature before troubleshooting. (If they do not match, carry out troubleshooting “Abnormal Power Train Oil temperature.”) • Confirm that the main relief pressure for transmission is normal before troubleshooting. (See H-1.)

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective engine system	The engine cooling system is assumed to be defective or the engine output is assumed to be increased; see the Shop Manual: Engine.		
	2	Defective power train pump or air from suction circuit	★The power train pump is assumed to be defective or aired from the suction circuit; directly check it.		
	3	Internally defective torque converter	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.		
			PCCS lever	Original pressure of torque converter	Torque converter delivery pressure
			Full neutral	Max. 1.02MPa {Max. 10kg/cm^2}	0.61 – 0.81MPa {6 – 8kg/cm^2}
	4	Defective transmission clutch function (Slip)	The transmission clutch is assumed to be defective internally (slipped); directly check it.		
	5	Defective brake function (Drag)	★Prepare with starting the engine for troubleshooting.		
			1. Use the blades and ripper to float the machine from the ground. 2. Convert the drive position while low-idling. 3. If the track shoe does not rotate, brake drag occurs. (Carry out troubleshooting "Brake does not work.")		
	6	Defective brake function (Slip)	★Prepare with starting the engine for troubleshooting.		
			Carry out F3 stall. If the machine does not stop completely, brake slip occurs.		

H-10 ABNORMAL SOUND COMES OUT FROM AROUND HSS AND WORK EQUIPMENT PUMP OR HSS MOTOR

Trouble	• Abnormal noise from around HSS and work equipment pump.
Related information	• Confirm that the oil quantity of the hydraulic oil tank is normal before troubleshooting.

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Inappropriate oil	The oil used is assumed to be inappropriate; directly check it.
	2	Clogged hydraulic oil tank strainer	The strainer of the hydraulic oil tank is assumed to be clogged; directly 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; directly check the pipes.
	4	Internally defective HSS pump	The HSS and work equipment pump is assumed to be defective internally; directly check it.
	5	Internally defective HSS motor	The HSS motor is assumed to be defective internally; directly check it.

H-11 ALL WORK EQUIPMENT SPEEDS ARE SLOW

Trouble	• All work equipment speeds are slow.
Related information	• Confirm that the oil quantity of the hydraulic oil tank is normal before troubleshooting.

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	1	Defective PTO (pump drive unit of HSS and work equipment)	The PTO pump drive unit of the work equipment is assumed to be defective; directly check it.	
	2	Defective HSS and work equipment pump	The pump of the HSS and work equipment is assumed to be defective; directly check it.	
	3	Defective unload valve function	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.	
			Work equipment lever	Unload pressure
			Full neutral	2.45 – 3.82MPa {25 – 39kg/cm^2}
	4	Defective set pressure or defective function of main relief valve	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.	
			Work equipment lever	Main relief pressure
			Stroke end	22.54 ± 1.18MPa {230 ± 12kg/cm^2}
	5	Defective function of self-pressure reducing valve (PPC original pressure)	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.	
			Work equipment lever	Original pressure of control circuit
			Full neutral	3.77 – 4.46MPa {38.5 – 45.5kg/cm^2}
	6	Internally defective PPC valve	When the troubleshooting in cause 5 is abnormal, the PPC valve is assumed to be defective internally; directly check it.	

H-12 WORK EQUIPMENT DOES NOT MOVE

Trouble	• Work equipment does not move.
Related information	• Confirm that the oil quantity of the hydraulic oil tank is normal before troubleshooting.

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	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; directly check it.	
	2	Defective HSS and work equipment pump	The HSS and work equipment pump is assumed to be defective; directly check it.	
	3	Defective unload valve function	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.	
			Work equipment lever	Unload pressure
			Full neutral	2.45 – 3.82MPa {25 – 39kg/cm^2}
	4	Defective set pressure or defective function of main relief valve	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.	
			Work equipment lever	Main relief pressure
			Stroke end	22.54 ± 1.18MPa {230 ± 12kg/cm^2}
	5	Defective function of self-pressure reducing valve (PPC original pressure)	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.	
			Work equipment lever	Original pressure of control circuit
			Full neutral	3.77 – 4.46MPa {38.5 – 45.5kg/cm^2}

H-13 BLADE LIFT SPEED IS SLOW OR LACKS POWER

Trouble	• Blade lift speed is slow or lacks power.
Related information	• Confirm that the oil quantity of the hydraulic oil tank is normal before troubleshooting. • Confirm whether the blade is remodeled. • When the hydraulic drift rate of the blade lift is also high, carry out troubleshooting “High Hydraulic Drift Rate of Blade Lift.”

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	1	Defective PPC valve function	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.	
			Blade lever	PPC valve output pressure
			Lift stroke end	3.82 – 4.12MPa {39 – 42kg/cm^2}
	2	Defective function of blade lift operation valve (Spool)	The spool function of the blade lift operation valve is assumed to be defective; directly check it.	
	3	Aired blade lift cylinder	The blade lift cylinder is assumed to be aired; carry out the air bleed and observe how the phenomenon changes.	

H-14 BLADE TILT SPEED IS SLOW OR LACKS POWER

Trouble	• Blade tilt speed is slow or lacks power.
Related information	• Confirm that the oil quantity of the hydraulic oil tank is normal before troubleshooting. • Confirm whether the blade is remodeled. • When the hydraulic drift rate of the blade tilt is also high, carry out troubleshooting “High Hydraulic Drift Rate of Blade Tilt.”

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	1	Defective PPC valve function	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.	
			Blade lever	PPC valve output pressure
			Lift stroke end	3.82 – 4.12MPa {39 – 42kg/cm^2}
	2	Defective function of blade tilt operation valve (Spool)	The spool function of the blade tilt operation valve is assumed to be defective; directly check it.	
	3	Aired blade tilt cylinder	The blade tilt cylinder is assumed to be aired; carry out the air bleed and observe how the phenomenon changes.	

H-15 RIPPER LIFT SPEED IS SLOW OR LACKS POWER

Trouble	• Ripper lift speed is slow or lacks power.
Related information	• Confirm that the oil quantity of the hydraulic oil tank is normal before troubleshooting. • Confirm whether the ripper is remodeled. • When the hydraulic drift rate of the ripper lift is also high, carry out troubleshooting “High Hydraulic Drift Rate of Ripper Lift.”

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	1	Defective PPC valve function	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.	
			Ripper lever	PPC valve output pressure
			Lift stroke end	3.82 – 4.12MPa {39 – 42kg/cm^2}
	2	Defective function of ripper lift operation valve (Spool)	The spool function of the ripper lift operation valve is assumed to be defective; directly check it.	
	3	Defective function of ripper lift operation valve (suction valve)	The suction valve of the ripper lift operation valve is assumed to be defective; directly check it. ★Replace the suction valve in the head with one at the bottom, and observe how the phenomenon changes.	
	4	Aired ripper lift cylinder	The ripper lift cylinder is assumed to be aired; carry out the air bleed and observe how the phenomenon changes.	

H-16 EXCESSIVE HYDRAULIC DRIFT OF BLADE LIFT

Trouble	• Excessive hydraulic drift of blade lift.
Related information	• Confirm whether the blade is remodeled. • Confirm that no oil leaks the circuits in the work equipment before troubleshooting.

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Defective seal of blade lift operation valve (Spool)	Prepare with starting the engine, then stop the engine for troubleshooting.
			Follow the procedure below for troubleshooting. If the hydraulic drift speed becomes high, the spool seal of the blade lift operation valve is assumed to be defective. 1. Prop up the machine using the blade lift, and lift the front of the machine. 2. Stop the engine, and release the safety lock lever. 3. Set the blade lever to the lift lowering side, and confirm how the phenomenon changes.
	2	Defective seal of blade lift cylinder	The seal of the blade lift cylinder is assumed to be defective; directly check it.
	3	Defective fitting performance of quick drop valve	Raise the blade about 1,000 mm and check lowering of the tip of the blade cutting edge. • 300 mm/15 min

E-17 EXCESSIVE HYDRAULIC DRIFT OF BLADE TILT

Trouble	• Excessive hydraulic drift of blade tilt.
Related information	• Confirm whether the blade is remodeled. • Confirm that no oil leaks the circuits in the work equipment before troubleshooting.

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	1	Defective seal of blade tilt operation valve (Spool)	★Prepare with starting the engine, then stop the engine for troubleshooting.	
			Follow the procedure below for troubleshooting. If the hydraulic drift speed becomes high, the spool seal of the blade tilt operation valve is assumed to be defective. 1. Prop up the machine using the blade tilt, and lift the right of the machine. 2. Stop the engine, and release the safety lock lever. 3. Set the blade lever to the right tilt side, and confirm how the phenomenon changes.	
	2	Defective seal of blade tilt cylinder	★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.	
			Blade tilt cylinder	Cylinder leak quantity
			Right tilt stroke end	16cc/min

H-18 EXCESSIVE HYDRAULIC DRIFT OF RIPPER LIFT

Trouble	• Excessive hydraulic drift of ripper lift.
Related information	• Confirm whether the ripper is remodeled. • Confirm that no oil leaks the circuits in the work equipment before troubleshooting.

<table>
<tr><td rowspan="4">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="2">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Defective seal of ripper lift operation valve (Spool)</td><td colspan="2">★Prepare with starting the engine, then stop the engine for trouble-shooting.</td></tr>
<tr><td colspan="2">Follow the procedure below for troubleshooting. If the hydraulic drift speed becomes high, the spool seal of the ripper lift operation valve (Hi) is assumed to be defective.
1. Prop up the machine using the blade tilt, and lift the rear of the machine.
2. Stop the engine, and release the safety lock lever.
3. Set the blade lever to the lift lowering side, and confirm how the phenomenon changes.</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Defective seal of ripper lift cylinder</td><td colspan="2">★Prepare with starting switch OFF, then drive the engine in high idling mode for troubleshooting.</td></tr>
<tr><td>Ripper lift cylinder</td><td>Cylinder leak quantity</td></tr>
<tr><td>Lowering stroke end</td><td>16cc/min</td></tr>
</table>

TROUBLESHOOTING OF ENGINE SYSTEM (S MODE)

METHOD OF USING TROUBLESHOOTING CHARTS

This troubleshooting chart is divided into three sections: **questions, check items, and troubleshooting**. The questions and check items are used to pinpoint high probability causes that can be located from the failure symptoms or simple inspeciton without using troubleshooting tools.
Next, troubleshooting tools or direct inspection are used to check the high probability causes to make final confirmation.

[Questions]

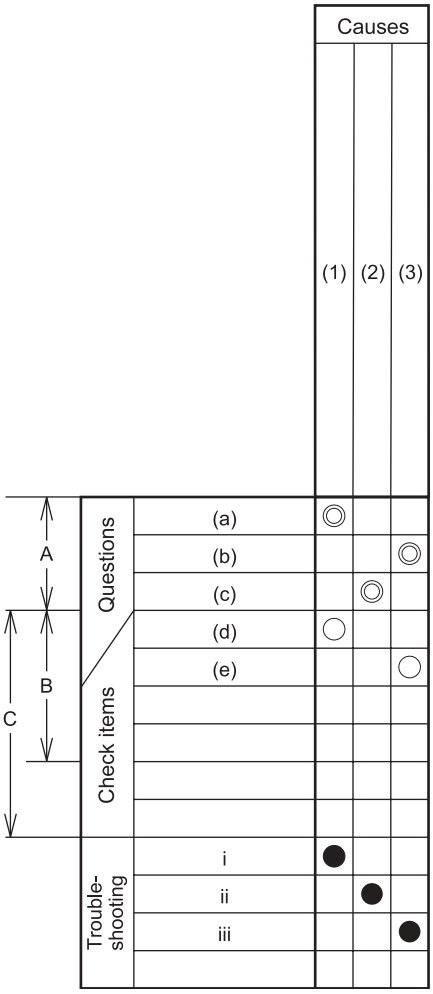
Sections (A) + (B) in the chart on the right corresponds to the items where answers can be obtained from the user. The items in (B) are items that can be obtained from the user, depending on the user's level.

[Check items]

The serviceman carries out simple inspection to narrow down the causes. The items under (C) in the chart on the right correspond to this.
The serviceman narrows down the causes from information (A) that he has obtained from the user and the results of (C) that he has obtained from his own inspection.

[Troubleshooting]

Troubleshooting is carried out in the order of probability, starting with the causes that have been marked as having the highest probability from information gained from **[Questions]** and **[Check items]**.



The basic method of using the troubleshooting chart is as follows.
Items listed for **[Questions]** and **[Check items]** that have a relationship with the Cause items are marked with ○, and of these, causes that have a high probability are marked with ◎.
Check each of the **[Questions]** and **[Check items]** in turn, taking note of the ○ or ◎ marks in the chart for the horizontal lines of symptoms applicable to the machine. The vertical column (Causes) that has the highest number of applicable ○ or ◎ marks is the most probable cause, so start troubleshooting for that item to make final confirmation of the cause.

*1. For (Confirm recent repair history) in the **[Questions]** Section, ask the user, and mark the Cause column with △ to use as reference for locating the cause of the fairure. However, do not use this when marking caluculations to narrow down causes.

*2. Use the △ in the Cause column as reference for [Degree of use (Operated for long period)] in the [Questions] section as reference.
As a rule, do not use it when calculating the points for locating the cause, but it can be included if necessary to determine the order for troubleshooting.

			Causes						
			Seized turbocherger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)	
*1	Confirm recent repair history								
*2	Degree of use	Operated for long period		△	△	△			
			◎						

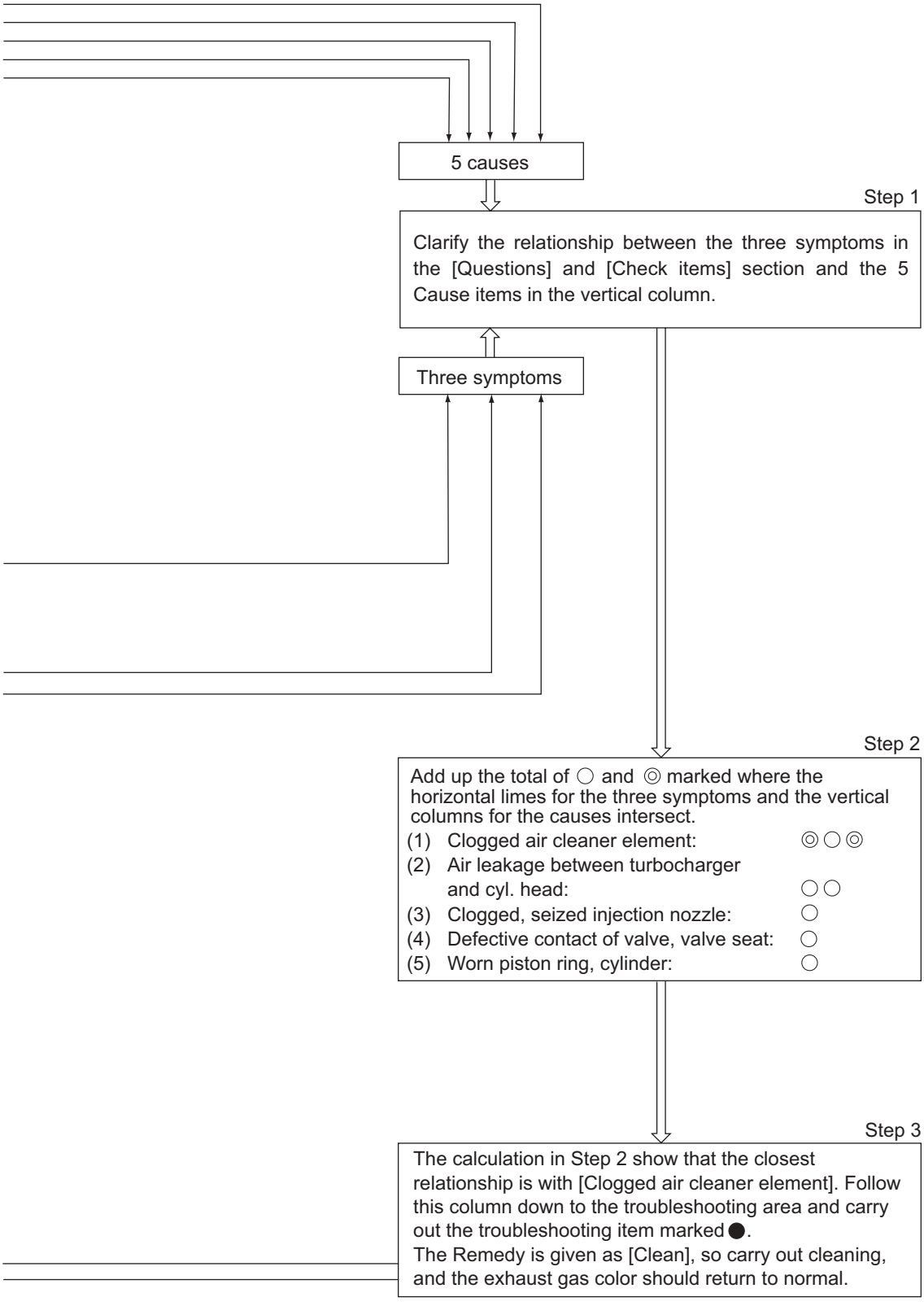
- Example of troubleshooting when exhaust gas is black
  Let us assume that [Clogged air cleaner] is taken to be the cause of black exhaust gas. Three symptoms have a causal relationship with this problem: [Exhaust gas gradually became black], [Power gradually became weaker], and [Dust indicator is red].
  If we look from these three symptoms to find the causes, we find that there is a relationship with five causes. Let us explain here the method of using this causal relationship to pinpoint the most probable cause.

S-7 Exhaust smoke is black (incomplete combustion)

General causes why exhaust smoke is black
- Insufficient intake of air
- There is excessive fuel.
- Abnormal fuel injection condition
- Improper selection of fuel
- Engine overheating
  ★ See troubleshooting for [Overheat].
- Controller controlled by delayed mode
  (The injection amount (output) is limited because an error has occurred in the electrical system.)

Legend
◯ : Possible causes (judging from Questions and Check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes														
			Clogged air cleaner element	Seized turbocharger, interference	Defective contact of valve and 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	Clogged fuel spill piping	Defective fuel injection timing	Defective fuel injection pressure	Defective water temperature sensor
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	○		○		○		○								
	Dust indicator lamp is red		◎														
Check items	Muffler is crushed							◎									
	Leakage of air between turbocharger and cylinder head, loose clamp						◎										
	Operates in low-temperature mode even at normal temperatures													○	○	○	
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low									○	◎						
	Noise of interference is heard from around turbocharger when engine is run			◎													
	Abnormal noise is heard from around cylinder head when engine is run					◎											
	Stall speed is too high (excessive injection of fuel)											○	○				
	Exhaust noise is abnormal			○				◎			○						
	Engine pickup is poor and combustion is irregular			○		○	○	○		○	◎						
	Blow-by gas is excessive								◎								
	When hose from the injector to spill collection portion is disconnected, spill flow is found to be abnormally high (See error code "AD10L3")											◎					
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 error code "AD10L3 : Fuel supply pump non-force feed"									●							
	Engine speed does not change when operation of certain cylinders is stopped in reduced cylinder mode										●						
	Check fuel spill piping directly												●				
	Carry out troubleshooting for error code "DGE3L6: Abnormality in watet temperature sensor"																●
		Remedy	Clean	Replace	Replace	Adjust	Correct	Replace	Replace	Replace	Replace	Replace	Correct	Adjust	Adjust	Replace	


5 causes
Step 1
Clarify the relationship between the three symptoms in the [Questions] and [Check items] section and the 5 Cause items in the vertical column.
Three symptoms
Step 2
Add up the total of ○ and ◎ marked where the horizontal limes for the three symptoms and the vertical columns for the causes intersect.
(1) Clogged air cleaner element: ◎○◎
(2) Air leakage between turbocharger and cyl. head: ○○
(3) Clogged, seized injection nozzle: ○
(4) Defective contact of valve, valve seat: ○
(5) Worn piston ring, cylinder: ○
Step 3
The calculation in Step 2 show that the closest relationship is with [Clogged air cleaner element]. Follow this column down to the troubleshooting area and carry out the troubleshooting item marked ●.
The Remedy is given as [Clean], so carry out cleaning, and the exhaust gas color should return to normal.

S-1 Starting performance is poor (starting always takes time)

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, 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.

			Causes													
			Clogged air cleaner element	Defective contact of valve, valve seat	Worn piston ring, cylinder liner	Clogged air breather hole in fuel tank cap	Leakage, clogging, air in fuel piping	Clogged fuel filter, element	Clogged fuel feed pump strainer	Stuck, seized fuel supply pump plunger	Defective fuel injector	Defective intake air heater system	Defective regulator	Defective alternator	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 Manual		◎					◎	◎	○	○				
	Engine oil must be added more frequently				◎										
	Preheating indicator lamp does not light up during preheating or in low temperatures											◎			
	Charging caution lamp lights up while engine is running												◎	◎	
Check items	Dust indicator lamp is red		◎												
	Air breather hole in fuel tank cap is clogged					◎									
	Leakage of fuel from fuel piping						◎			○					
	When fuel priming pump is operated, there is no response, or operation is too heavy						◎	○	○						
	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 (See error code "AD10L3")								◎					
	When exhaust manifold is touched 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			●	●										
	When air is bled from fuel line, air comes out						●								
	Check fuel filter, strainer directly							●							
	Check fuel feed pump strainer directly								●						
	Carry out troubleshooting for error code "AD10L3 : Fuel supply pump non-force feed"									●					
	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 voltage 26 – 30V between alternator terminal B and terminal E with engine at low idling?	Yes											●		
		No												●	
	When specific gravity of electrolyte or voltage of battery is measured, it is found to be low														●
		Remedy	Clean	Correct	Replace	Clean	Correct	Clean	Clean	Replace	Replace	Replace	Replace	Replace	Replace

S-2 Engine does not start

a) Engine does not turn

General causes why engine does not turn

- Internal parts of engine seized
  - ★ See "Engine stops during operations".
- Defective electrical system
- Failure in power train
  - ★ Carry out troubleshooting of the machine.

			Causes							
			Broken flywheel ring gear	Defective or deteriorated battery	Defective battery terminal connection	Defective battery relay	Defective starting switch	Defective starting motor	Defective safety relay or safety switch	Defective wiring of starting circuit
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 items	When battery is checked, battery electrolyte is found to be low			◎						
	Battery terminal is loose				◎					
	When starting switch is turned to ON, there is no actuation sound from battery relay			○		◎				
	When starting switch is turned to START, pinion does not move out			○			○			◎
	When starting switch is turned to START, pinion moves out, but	Speed of rotation is low		◎						
		Makes grating noise	◎					◎		
		Soon disengages again							◎	
		Makes rattling noise and does not turn		○				○	○	
Troubleshooting	Check flywheel ring gear directly		●							See E-1
	When specific gravity of electrolyte or voltage of battery is measured, it is found to be low			●						
	Turn the starting switch OFF, connect the cord, and carry out troubleshooting at ON	There is no 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 of starting motor are connected, engine starts						●		
		When terminal B and terminal C of safety relay are connected, engine starts							●	
		When terminal of safety switch and terminal B of 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)

			Causes: Improper fuel used	Insufficient fuel in tank	Clogged air breather hole in fuel tank	Leakage, clogging, air in fuel piping	Clogged fuel filter, element	Clogged fuel feed pump gauze filter	Seized, abnormally worn fuel feed pump	Broken fuel supply pump shaft, key	Stuck, seized fuel supply pump plunger	Defective fuel supply pump PCV	Mistaken connection of fuel supply pump PCV	Defective actuation of fuel overflow valve (does not close)	Defective actuation of fuel flow damper	Defective fuel injector (excessive spill amount)
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 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 leakage from fuel piping					◎										
	When fuel priming pump is operated, there is no response, or operation is too heavy					◎	○	○								
	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 (See error code "AD10L3")				○				◎	◎	◎	◎			○
Troubleshooting	When air is bled from fuel line, air comes out					●										
	Check fuel filter directly						●									
	Check fuel feed pump gauze filter directly							●								
	Check fuel feed pump directly								●							
	Carry out troubleshooting for error code "AD10L3 : Fuel supply pump non-force feed"									●	●		●			
	Carry out troubleshooting "Abnormality in fuel supply pump solenoid" in troubleshooting for monitor panel											●				
	Check fuel overflow valve directly													●		
	Possible to start in reduced cylinder mode														●	●
		Remedy	Replace	Add	Correct	Correct	Replace	Clean	Replace	Replace	Replace	Replace	Correct	Replace	Replace	Replace

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

			Causes												
			Clogged air cleaner element	Defective, broken 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, strainer	Clogged fuel feed pump strainer	Stuck, seized fuel supply pump plunger	Clogged injector, defective spray	Defective or deteriorated battery	Defective low-temperature water temperature sensor, disconnection	Defective intake air heater system
Questions / Check items	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 Manual		◎						◎	◎					
	Engine oil must be added more frequently				◎										
	Preheating indicator lamp does not light up during preheating or in low temperatures														◎
	Dust indicator lamp is red		◎												
	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 leakage from fuel piping							◎							
	When fuel priming pump is operated, there is no response, or operation is too heavy							◎	○	○					
	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 (See error code "AD10L3")									◎				
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											◎			
Troubleshooting	Check air cleaner element directly		●												
	Remove head cover and check 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, strainer directly								●						
	Check fuel feed pump strainer directly									●					
	Carry out troubleshooting for error code "AD10L3 : Fuel supply pump non-force feed"										●				
	Spray condition is poor when fuel injector is tested as individual part											●			
	When specific gravity of electrolyte or voltage of battery is measured, it is found to be low												●		
	Defective water temperature gauge display on machine													●	
	Intake air heater mount does not become warm during preheating														●
		Remedy	Clean	Replace	Replace	Replace	Clean	Correct	Clean	Clean	Replace	Clean	Replace	Replace	Replace

S-3 Engine does not pick up smoothly (follow-up is poor)

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 delayed mode
  (The injection amount (output) is limited because an error has occurred in the electrical system.)

			Causes												
			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, strainer	Clogged fuel feed pump strainer	Stuck, seized fuel supply pump plunger	Defective actuation of fuel flow damper (excessive leak from injector)	Clogged fuel injector, defective spray (dirt caught)
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period	△	△			△			△	△			
	Engine pick-up suddenly became poor					◎		○	○					○
	Non-specified fuel is being used									◎	◎	◎		◎
	Replacement of filters has not been carried out according to Operation Manual		◎							◎	◎			
	Engine oil must be added more frequently						◎							
Check items	Dust indicator lamp is red		◎											
	Air breather hole in fuel tank cap is clogged							◎						
	Rust and water are found when fuel is drained									◎	◎			
	There is leakage from fuel piping								◎					
	When fuel priming pump is operated, there is no response, or operation is too heavy								◎	○	○			
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											○		◎
	Color of exhaust gas	Blue under light load					◎							
		Black	◎	○		◎								◎
	Abnormal noise is heard from around cylinder head when engine is run				◎									
	Noise of interference is heard from around turbocharger					◎								
	High idling 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 element 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									●				
	Check fuel feed pump strainer directly										●			
	Carry out troubleshooting for error code "AD10L3 : Fuel supply pump non-force feed"											●		
	Engine speed does not change when operation of certain cylinders is stopped in reduced cylinder mode												●	●
		Remedy	Clean	Replace	Adjust	Replace	Replace	Clean	Correct	Clean	Clean	Replace	Replace	Correct

S-4 Engine stops during operations

General causes why engine stops
- Internal part of engine seized
- Insufficient supply of fuel
- Engine overheating
  ★ See troubleshooting for [Overheat].
- Failure in power train
  ★ Carry out troubleshooting of the machine.

			Causes														
			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	Clogged, leaking fuel piping	Clogged fuel filter, strainer	Clogged fuel feed pump strainer	Broken, seized fuel feed pump	Broken fuel supply pump drive shaft, key	Stuck, seized fuel supply pump plunger	Broken auxiliary equipment (pump, compressor, etc.)	Failure in power train mounted on machine
Questions / Check items	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 Manual									◎	◎					
	Fuel level caution lamp lights up						◎									
	Fuel tank is found to be empty						◎									
	Air breather hole in fuel tank cap is clogged							◎								
	There is leakage from fuel piping								◎							
	When priming pump is operated, there is no response, or operation is too heavy								◎	○	○					
	Rust and water are found when fuel tank is drained								◎	◎						
	Metal particles are found when oil is drained			◎	◎						○	○				
	When it is attempted to turn engine by hand	Does not turn at all		◎	◎											
		Turns in opposite direction	◎													
		Moves amount of backlash				◎									◎	
		Fuel supply pump shaft does not turn											◎			
	Engine rotates, but stops when load is applied to machine															◎
Troubleshooting	Check dynamic valve system directly		●													Troubleshooting of machine
	Check piston and connecting rod directly			●												
	Check crankshaft directly				●											
	Check gear train directly					●										
	Check fuel filter, strainer directly									●						
	Check fuel feed pump strainer directly										●					
	Check fuel feed pump directly											●				
	Carry out troubleshooting for error code "AD10L3 : Fuel supply pump non-force feed"												●	●		
	When auxiliary equipment (Hyd. pump, air compressor) is removed, engine turns														●	
		Remedy	Replace	Replace	Replace	Replace	Add	Clean	Correct	Clean	Clean	Replace	Replace	Replace	Replace	—

S-5 Engine does not rotate smoothly (hunting)

General causes why engine does not rotate smoothly
- Air in fuel system
- Speed sensor is not normal
  (abnormality not big enough to generate error display)

			Causes: Low idling speed is too low	Insufficient fuel in tank	Clogged air breather hole in fuel tank	Leakage, clogging, air in fuel piping	Clogged fuel feed pump strainer	Clogged fuel filter, strainer	Defective actuation of fuel flow damper (excessive leak from injector)	Clogged fuel injector, defective spray (dirt caught)	Defective Ne revolution sensor, defective wiring harness	Defective G revolution sensor, defective wiring harness
Questions / Check items	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 idling	◎			○	○	○	○	○	○	○
		Occurs even when speed is raised			○						○	○
		Occurs on slopes		◎							○	○
	Replacement of filters has not been carried out according to Operation Manual						◎	◎				
	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						○	○				
	There is leakage from fuel piping					◎						
	When fuel priming pump is operated, there is no response, or operation is too heavy					◎	○	○				
Troubleshooting	When air is bled from fuel line, air comes out					●						
	Check fuel feed pump strainer directly						●					
	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 error code "DLH1LC: Abnormality in Ne revolution sensor"										●	
	Carry out troubleshooting for error code "DLE3LC: Abnormality in G revolution sensor"											●
		Remedy	Correct	Add	Clean	Replace	Replace	Replace	Replace	Correct	Correct	Correct

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 troubleshooting for [Overheat].
- Controller controlled by delayed mode
  (The injection amount (output) is limited because an error has occurred in the electrical system.)

			Causes																
			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, strainer	Clogged fuel feed pump gauze filter	Stuck, seized fuel supply pump plunger	Clogged fuel injector, defective spray (dirt caught)	Defective drive of fuel injector (signal, solenoid)	Defective mount of boost pressure sensor (air leakage)	Defective boost pressure sensor	Defective fuel temperature sensor
Questions	Confirm recent repair history																		
	Degree of use of machine	Operated for long period	△			△		△			△	△							
	Power was lost	Suddenly		○											○	○	○		
		Gradually	○			○		○			○	○		○		○			
	Replacement of filters has not been carried out according to Operation Manual										○	○							
	Non-specified fuel is being used		◎																
	Engine oil must be added more frequently					○	○	○											
	Dust indicator lamp is red		◎																
	Air breather hole in fuel tank cap is clogged								◎										
	There is leakage from fuel piping									◎									
	Power is lacking after short stop in operations																		◎
Check items	Color of exhaust gas	Black	◎	◎															
		Blue under light load			◎														
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low													◎					
	Noise of interference is heard from around turbocharger when engine is run			◎															
	Abnormal noise is heard from around cylinder head when engine is run						◎												
	High idling speed of engine is low														○				
	High idling speed is normal, but speed suddenly drops when load is applied										◎	◎	○						
	Engine pickup is poor and combustion is irregular			◎					○	○				◎					
	There is hunting from engine (rotation is irregular)								○	○	○	○							
	Blow-by gas is excessive				◎														
Troubleshooting	When air cleaner element is inspected directly, it is found to be clogged		●																
	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 filter, strainer directly										●								
	Check fuel feed pump gauze filter directly											●							
	Carry out troubleshooting for error code "AD10L3 : Fuel supply pump non-force feed"												●						
	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 error code"DH30KX: Abnormality in boost pressure sensor"																●		
	Carry out troubleshooting for error code"DGE4KX: Abnormality in fuel temperature sensor"																		●
		Remedy	Clean	Correct	Replace	Replace	Adjust	Replace	Clean	Correct	Replace	Clean	Replace	Replace	Replace	Correct	Replace	Replace	

S-7 Exhaust smoke is black (incomplete combustion)

General causes why exhaust smoke is black
- Insufficient intake of air
- There is excessive fuel.
- Abnormal fuel injection condition
- Improper selection of fuel
- Engine overheating
  ★ See troubleshooting for [Overheat].
- Controller controlled by delayed mode
  (The injection amount (output) is limited because an error has occurred in the electrical system.)

			Causes														
			Clogged air cleaner element	Seized turbocharger, interference	Defective contact of valve and 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	Clogged fuel spill piping	Defective fuel injection timing	Defective fuel injection pressure	Defective water temperature sensor
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		◎													
	Muffler is crushed							◎								
	Leakage of air between turbocharger and cylinder head, loose clamp						◎									
	Operates in low-temperature mode even at normal temperatures													○	○	○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low									○	◎					
	Noise of interference is heard from around turbocharger when engine is run			◎												
	Abnormal noise is heard from around cylinder head when engine is run					◎										
	Stall speed is too high (excessive injection of fuel)											○	○			
	Exhaust noise is abnormal			○				◎			○					
	Engine pickup is poor and combustion is irregular			○		○	○	○		○	◎					
	Blow-by gas is excessive								◎							
	When hose from the injector to spill collection portion is disconnected, spill flow is found to be abnormally high (See error code "AD10L3")											◎				
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 error code "AD10L3 : Fuel supply pump non-force feed"									●						
	Engine speed does not change when operation of certain cylinders is stopped in reduced cylinder mode										●					
	Check fuel spill piping directly												●			
	Carry out troubleshooting for error code "DGE3L6: Abnormality in watet temperature sensor"															●
		Remedy	Clean	Replace	Replace	Adjust	Correct	Replace	Replace	Replace	Replace	Replace	Correct	Adjust	Adjust	Replace

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 idling for a long time continuously (more than 20 minutes continuous operation is not allowed).
- External leakage of oil
- Wear of lubrication system

			Causes														
					Turbocharger												
			Dust sucked in from intake system	Worn, broken valve (stem, guide, seal)	Worn seal at turbine end	Worn seal at blower end	Clogged breather or breather hose	Broken piston ring	Worn piston ring, cylinder liner	Worn, broken rear 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 or cylinder head
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								◎		○						
	Engine oil becomes 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 exhaust pipe is dirty with oil			○	◎												
	There is oil in engine cooling water										◎						
	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 element 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												●	●	●	●	
		Remedy	Correct	Correct	Replace	Replace	Clean	Replace	Replace	Correct	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

			Causes								
			Defective seal at turbocharger turbine end	Worn valve, valve guide	Worn piston ring, cylinder liner	Clogged breather, breather tube	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				◎						
	Even when oil temperature rises, oil filter caution lamp lights up					◎			○		
	When oil filter is inspected, metal particles are found			○	○			◎			
	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 tube directly					●					
	Check oil cooler is inspected directly						●				
	Check oil filter directly							●			
	Spring of oil filter safety valve catching or broken								●		
	Check turbocharger drain tube directly									●	
	Remedy		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

			Causes								
			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 water temperature low-temperature sensor
Questions	Confirm recent repair history										
	Degree of use of machine	Operated for long period			△	△		△			
	Condition of fuel consumption	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 idling speed is high										
	Engine stall speed is high								○		
	Exhaust gas color	Black					○	○		○	○
		White	○								
Troubleshooting	Remove head cover and check directly		●								
	Check fuel feed pump oil seal directly				●						
	Carry out toroubleshooting for error code "DGE3L6: Fuel supply pump non-force feed"					●					
	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 error code "AD10L3: Abnormality in water low-temperature sensor"										●
	Check with monitoring function on machine						●			●	
		Remedy	Correct	Correct	Replace	Replace	—	Replace	Replace	—	—

S-11 Oil is in cooling water (or water spurts back, or water level goes down)

General causes why oil is in cooling water
- Internal leakage in lubrication system
- Internal leakage in cooling system

			Causes					
			Broken cylinder head, head gasket	Internal cracks in cylinder block	Damaged cylinder liner O-ring, holes caused by pitting	Insufficient protrusion of cylinder liner	Broken oil cooler core, O-ring	Broken hydraulic cooler or transmission oil cooler
Questions	Confirm recent repair history							
	Degree of use of machine	Operated for long period			△		△	
	Oil level	Suddenly increased	○				○	○
		Gradually increased		○	○			
	Hard water is being used as cooling water				○		○	
Check items	Engine oil level has risen, oil is cloudy white			○	○		◎	
	Excessive air bubbles inside radiator, spurts back		◎			◎		
	Hydraulic oil, transmission oil is cloudy white							◎
	When hydraulic oil, transmission oil is drained, water is found							◎
Troubleshooting	Pressure-tightness test of cylinder head shows there is leakage		●					Carry out trouble-shooting of machine
	Check cylinder block, liner directly			●	●			
	Check cylinder liner directly					●		
	Pressure-tightness test of oil cooler shows there is leakage						●	
		Remedy	Replace	Replace	Replace	Replace	Replace	—

S-12 Oil pressure caution lamp lights up (drop in oil pressure)

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

			Causes: Worn bearing, journal	Lack of oil in oil pan	Water, fuel in oil	Clogged strainer inside oil pan	Clogged, broken pipe inside oil pan	Defective oil pump	Defective oil pump relief valve	Clogged oil filter	Leaking, crushed, clogged hydraulic piping	Defective oil pressure sensor	Defective oil level sensor
Questions	Confirm recent repair history												
	Degree of use of machine	Operated for long period	△					△		△			
	Oil pressure caution lamp lights up								○	◎			
	Non-specified oil is being used		○							○			
	Replacement of filters has not been carried out according to Operation Manual									◎			
Check items	Condition when oil pressure lamp lights up	Lights up at low idling	◎						○				
		Lights up at low idling and high idling		○		◎	◎	◎	○				
		Lights up on slopes		◎									
		Sometimes lights up							◎			○	○
	Oil temperature caution lamp lights up (machines equipped with lamp)			◎									◎
	Oil level in oil pan is low			◎									
	There is crushing, external leakage from hydraulic piping										◎		
	Oil is cloudy white or smells of diesel oil				◎								
	Metal particles are found when oil 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 pipe directly					●	●						
	Oil pump rotation is heavy, there is play							●					
	Deterioration, damage of valve, spring in oil pump relief valve								●				
	Check oil filter directly									●			
	Carry out troubleshooting for error code "DDE2L6: Abnormality in oil pressure sensor"											●	
	When oil level sensor is replaced, oil pressure caution lamp goes out												●
		Remedy	Clean	Add	—	Clean	Clean	Replace	Adjust	Clean	Correct	Replace	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 cooling water, carry out troubleshooting for "Oil is in cooling water".

		Causes									
		Broken cylinder head, head gasket	Leakage of fuel inside head cover	Cracks inside cylinder block	Damaged cylinder liner O-ring, holes made by pitting	Worn, damaged rear oil seal	Broken oil cooler core, O-ring	Clogged water pump drain (breather hole), defective seal	Defective thermostat seat	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		◎							◎	
	Water must be added more frequently	○							◎		
Check items	There is oil in engine cooling water	○		○	○		◎				
	Oil smells of diesel fuel		◎							◎	
	Oil is cloudy white	○							◎		
	When engine is started, drops of water come from muffler	○									
	When radiator cap is left open and engine is run at idling, an abnormal number of bubbles appear, or water spurts back	◎			○						
	Exhaust smoke is white		○						○		
	Water pump drain hole (breather hole) is clogged							◎			
	When water pump drain hole (breather hole) is cleaned, water comes out							◎			
	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 head cover and check directly		●								
	Check cylinder block, liner directly			●	●						
	Check rear oil seal directly					●					
	Pressure-tightness test of oil cooler shows there is leakage						●				
	Remove water pump and check directly							●			
	Remove thermostat cover and check directly								●		
	Remove fuel supply pump and check directly									●	
	Check auxiliary equipment seal directly										●
	Remedy	Replace	Correct	Replace	Replace	Correct	Replace	Replace	Correct	Replace	Replace

S-14 Water temperature becomes too high (overheating)

General causes why water 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 for machine.

			Causes												
			Broken cylinder head, head gasket	Damaged cylinder liner O-ring, holes made by pitting	Clogged, broken oil cooler	Lack of cooling water	Broken water pump	Defective actuation of thermostat (does not open)	Clogged, crushed radiator fins	Clogged radiator core	Defective radiator cap (pressure valve)	Fan belt slipping, worn fan pulley	Defective water 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						○	◎	◎		○		
	Water temperature gauge	Rises quickly				○		◎						
		Does not go down from red range											◎	
Check items	Radiator water level caution lamp lights up					◎								
	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 cooling water				◎									
	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					◎								
	Cooling water flows out from radiator overflow hose										◎			
	Fan belt whines under sudden acceleration											◎		
	Power train oil temperature enters red range faster than engine water temperature													◎
Troubleshooting	When compression pressure is measured, it is found to be low		●											See H-9
	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 water temperature is measured, it is found to be normal												●	
		Remedy	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 noise or an external noise.
★ 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 higher for 3 seconds, but this is not an abnormality.

			Causes												
			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 water temperature low temperature sensor)
Questions / Check items	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 in oil drained from oil filter							◎		◎				
	Leakage of air between turbocharger and cylinder head		◎											
	Noise of interference is heard from around turbocharger when engine is run			◎										
	Abnormal noise is heard from around cylinder head when engine is run				◎		◎							
	Vibrating noise is heard from around muffler when engine is run					◎								
	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 pickup is poor and combustion is abnormal											◎		
	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							●						
	Remove timing gear cover and check 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												●	
	Check with monitoring function on machine													●
	Remedy		Replace	Replace	Correct	Replace	Replace	Replace	Replace	Correct	Replace	Correct	Replace	Correct

S-16 Vibration is excessive

General causes why vibration is excessive
- Defective parts (abnormal wear, breakage)
- Improper alignment with machine
- Abnormal combustion

★ If there is abnormal noise together with the vibration, carry out troubleshooting also for "Abnormal noise is made".

			Causes									
			Defective dynamic valve system (valve, rocker lever, etc. stuck)	Worn main bearing, connecting rod	Improper gear train backlash	Worn cam bushing	Defective fuel injection timing	Loose engine mounting bolts, broken cushion	Misalignment between engine and equipment on machine	Worn front support spigot joint portion	Broken part inside output shaft (damper)
Questions / Check items	Confirm recent repair history										
	Degree of use of machine	Operated for long period		△		△		△		△	
	Condition of vibration	Suddenly increased	○								○
		Gradually increased		○		○		○		○	
	Non-specified fuel is being used			○		○					
	Metal particles are found in oil drained from oil filter			◎		◎					
	Metal particles are found when oil pan is drained			◎		◎					
	Oil pressure is low at low idling			○		○					
	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 cam bushing directly					●					
	Check with monitoring function on machine						●				
	Check engine mounting bolts directly							●			
	When face runout and radial runout are inspected, they are found to be incorrect								●		
	Check support spigot joint portion directly									●	
	Check inside of output shaft (damper) directly										●
		Remedy	Replace	Replace	Replace	Replace	Adjust	Replace	Adjust	Replace	Replace

30 DISASSEMBLY AND ASSEMBLY

HOW TO READ THIS MANUAL

REMOVAL AND INSTALLATION OF ASSEMBLIES

SPECIAL TOOLS

- Special tools that are deemed necessary for removal or installation of parts are listed.
- List of the special tools contains the following kind of information
  1) Necessity
     ■: Special tools which cannot be substituted, should always be used.
     ●: Speciall tools which are very useful if available, can be substituted with commercially available tools.
  2) Distinction of new and existing special tools.
     N: Tools with new part numbers, newly developed for this model.
     R: Tools with upgraded part numbers, remodeled from already available tools for other models.
     Blank: Tools already available for other models, used without any modification.
  3) Circle mark (○) in sketch column.
     A circle mark means that a sketch of the special tool is presented in the section of Sketches for Special Tools.

★ Part No. of special tools starting with 79*T means that they are locally made parts and as such not interchangeable with those made by Komatsu in Japan e.g. 79*T---×××---××××.

REMOVAL OF PARTS

- The REMOVAL Section contains procedures, precautions and the amount of oil or water to be drained.
- Various symbols used in the REMOVAL Section are explained and listed below.

⚠ This mark indicates safety-related precautions, which must be followed when doing the work.

★ This mark gives guidance or precautions when doing the procedure.

[*1] This mark shows that there are instructions or precautions for installing parts.

 This mark shows oil or water be drained.

 This mark shows the weight of a part or a device.

INSTALLATION OF PARTS

- Except where otherwise instructed, install parts is the reverse order of removal.
- Instructions and precautions for installing part 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.

⚠ This mark indicates safety-related precautions, which must be followed when doing the work.

★ This marks gives guidance or precautions when doing the procedure.

 This mark stands for a specific coating agent to be used.

 This mark indicates the specified torque.

 This mark indicates an amount of oil or water to be added.

SKETCHES OF SPECIAL TOOLS

- Various special tools are illustrated for the convenience of local manufacture.

DISASSEMBLY AND ASSEMBLY OF ASSEMBLIES

SPECIAL TOOLS

- Special tools which are deemed necessary for disassembly and assembly are listed in this section.
- List of the special tools contains the following kind of information.
  1) Necessity
     ■: Special tools which cannot be substituted, should always be used.
     ●: Speciall tools which are very useful if available, can be substituted with commercially available tools.
  2) Distinction of new and existing special tools.
     N: Tools with new part numbers, newly developed for this model.
     R: Tools with upgraded part numbers, remodeled from already available tools for other models.
     Blank: Tools already available for other models, used without any modification.
  3) Circle mark (○) in sketch column.
     A circle mark means that a sketch of the special tool is presented in the section of Sketches for Special Tools.
  4) Part No. of special tools starting with 79*T means that they are locally made parts and as such not interchangeable with those made by Komatsu in Japan e.g. 79*T---×××---××××.

DISASSEMBLY

- The DISASSEMBLY Section contains procedures, precautions and the amount of oil or water to be drained.
- Various symbols used in the DISASSEMBLY Section are explained and listed below.

  ⚠ This mark indicates safety-related precautions which must be followed when doing the work.

  ★ This mark gives guidance or precautions when doing the procedure.

   This mark shows oil or water to be drained.

ASSEMBLY

- Section titled ASSEMBLY contain procedures, precautions and the know-how for the work, as well as the amount of oil or water to be added.
- Various symbols used in the ASSEMBLY Section are explained and listed below.

  ⚠ This mark indicates safety-related precautions, which must be followed when doing the work.

  ★ This marks gives guidance or precautions when doing the procedure.

   This mark stands for a specific coating agent to be used.

   This mark indicates the specified torque.

   This mark indicates an amount of oil or water to be added.

SKETCHES OF SPECIAL TOOLS

1) Vartious special tools are illustrated for the convenience of local manufacture.

PRECAUTIONS WHEN PERFORMING OPERATION

Be sure to follow the general precautions given below when performing removal or installation (disassmbly or assembly) of units.

1. Precautions when performing removal work

- If the engine coolant water contains antifreeze, dispose of it correctly.
- After disconnecting hoses or tubes, cover them or install blind plugs to prevent dirt or dust from entering.
- When draining oil, prepare a container of adequate size to catch the oil.
- Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
- To avoid loosening any wire contacts, do not pull on the wires. In-order to prevent excessive force to the wiring, hold onto the connectors when disconnecting them.
- Fasten tags to wires and hoses to identify and show their installation position and help to prevent any mistakes when re-installing.
- Count and check the number and thickness of the shims, and keep them in a safe place.
- When raising or lifting components, be sure to use proper lifting equipment of ample strength and safety.
- When using forcing screws to remove any components, tighten the forcing screws uniformly in turn.
- Before removing any unit, clean the surrounding area and install a cover to prevent any dust or dirt from entering after removal.

★ **Precautions when handling piping during disassembling**

Fit the following blind plugs into the piping after disconnecting it during disassembly operations.

A. Face seal type hoses and tubes

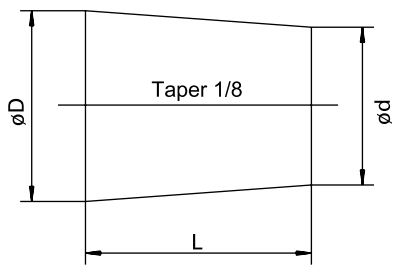
Nominal number	Plug (nut end)	Nut (elbow end)
02	07376-70210	02789-00210
03	07376-70315	02789-00315
04	07376-70422	02789-00422
05	07376-70522	02789-00522
06	07376-70628	02789-00628

B. Split flange type hoses and tubes

Nominal number	Flange (hose end)	Sleeve head (tube end)	Split flange
04	07379-00400	07378-10400	07371-30400
05	07379-00500	07378-10500	07371-30500

C. If the part is not under hydraulic pressure, the following corks can be used.

Nominal number	Part Number	Dimensions		
		D	d	L
06	07049-00608	6	5	8
08	07049-00811	8	6.5	11
10	07049-01012	10	8.5	12
12	07049-01215	12	10	15
14	07049-01418	14	11.5	18
16	07049-01620	16	13.5	20
18	07049-01822	18	15	22
20	07049-02025	20	17	25
22	07049-02228	22	18.5	28
24	07049-02430	24	20	30
27	07049-02734	27	22.5	34



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2. Precautions when carrying out installation work

- Tighten all bolts and nuts (sleeve nuts) to the specified (KES) torque.
- Install the hoses without twisting or interference.
- Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
- Bend the cotter pins or lock plate securely.
- When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with tow or three drops of adhesive.
- When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
- Clean all parts, and correct any damage, dents, burrs, or rust.
- Coat rotating parts and sliding parts with engine oil.
- When press fitting parts, coat the surface with anti-friction compound (LM-P).
- After installing snap rings, check that the snap ring is installed securely in the ring groove.
- When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
- When using eyebolts, check that there is no deformation or deterioration, screw them in fully, and align the direction of the hook.
- When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.

★ When operating the hydraulic cylinders for the first time after reassembling cylinders, pumps and other hydraulic equipment removed for repair, always bleed the air as follows:

1. Start the engine and run it at low idle.
2. Operate the work equipment control lever to operate the hydraulic cylinders, 4 – 5 times, stopping the cylinder 100 mm from the end of their stroke.
3. Next, operate the hydraulic cylinder 3 – 4 times to the end of its stroke.
4. After doing this, run the engine at normal speed.

★ When using the machine for the first time after repair or long storage, follow the same procedure.

3. Precautions when completing the operations

- If the engine coolant water has been drained, tighten the drain valve, and add coolant water to the specified level. Run the engine to circulate the coolant water through the system. Then check the coolant water level again.
- If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- If the piping or hydraulic equipment have been removed for repair, Bleed the air from the system after reassembling the parts.

★ For details, see TESTING AND ADJUSTING, Bleeding air.

- Add the specified amount of grease (molybdenum disulphide grease) to the work equipment parts.

SPECIAL TOOL LIST

★ Tools with part number 79○T-○○○-○○○○ can not be supplied (they must 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 the sketches of the special tools (See SKETCHES OF SPECIAL TOOLS).

Component	Symbol		Part No.	Part Name	Necessity	Q'ty	New/ Remodel	Sketch	Nature of work, remarks
Engine assembly	A1		795-471-1800	Remover	■	1	N		Removal of fuel supply pump
		1	• 795-471-1810	• Plate		1	N		
		2	• 795-471-1820	• Bolt		1	N		
		3	• 795-471-1830	• Bracket		1	N		
		4	• 01435-01035	• Bolt		3			
		5	• 01435-01025	• Bolt		1			
	A2		795T-521-1140	Push tool	■	1		○	Installation of engine front seal
			790-101-5221	Grip	■	1			
			• 01010-81225	• Bolt	■	1			
			• 01050-31640	• Bolt	■	3			
	A3	1	795-931-1210	Push tool	■	1			Installation of engine rear seal
			• 01050-31625	• Bolt	■	3			
			• 01050-31645	• Bolt	■	3			
		2	795-931-1220	Push tool	■	1			
			• 01050-31645	• Bolt	■	3			
	A4		790-331-1110	Wrench	■	1			Tightening of cylinder head bolt
	A5		795T-471-1550	Wrench	■	1		○	Removal, installation of nozzle tip
Damper assembly	B		791-612-1100	Installer	■	1			Press fitting of bearing
			790-101-4200	Puller (294kN {30ton})	■	1			
			790-101-1102	Hydraulic pump	■	1			
TORQFLOW transmission assembly	D1		791-415-1300	Puller assembly	■	1			Removal, installation of snap ring of carrier
	D2		799-301-1600	Oil leak tester	■	1			Operation check of piston
HSS case assembly	E1		791T-422-1320	Hanger	■	1		○	Removal, installation of brake assembly
	E2		790-302-1500	Wrench set	●	1			Removal, installation of bearing nut

Component	Symbol	Part No.	Part Name	Necessity	Q'ty	New/ Remodel	Sketch	Nature of work, remarks
HSS case assembly	E3	796-730-2300	Wrench assembly	■	1			Check of bevel gear rotating torque
	E4	795-630-1810 or purchased tool	Torque wrench	●	1			
Final drive assembly	J1	790-337-1032	Lifting tool	■	1			Slinging of final drive assembly
		791T-627-2110	Plate	■	1	N	○	
		01643-32060	Washer	■	6			
	J2	790-431-1031	Block	■	1			Removal of sprocket hub bearing
		791-520-4140	Screw	■	2			
		790-101-2360	Plate	■	2			
		791-112-1180	Nut	■	2			
		791-546-1110	Adapter	■	2			
		790-201-2690	Plate	■	1			
		790-101-2102	Puller	■	1			
		790-101-1102	Hydraulic pump	■	1			
	J3	790-431-1031	Block	■	1			Press fitting of sprocket hub bearing inner race
		791-520-4140	Screw	■	1			
		791-112-1180	Nut	■	2			
		01643-32460	Washer	■	2			
		791T-627-2130	Plate	■	1	N	○	
		791T-627-2120	Push tool	■	1	N	○	
		790-101-2102	Puller	■	1			
		790-101-1102	Hydraulic pump	■	1			
	J4	791-580-1510	Installer	■	1			Press fitting of floating seal
	J5	790-101-5201	Push tool KIT	■	1			Press fitting of oil seal
		• 790-101-5281	• Plate	■	1			
		• 790-101-5221	• Grip	■	1			
		• 01010-51225	• Bolt	■	1			
Idler assembly	L1	791-530-1510	Installer	■	1			Press fitting of floating seal of idler assembly
	L2	791-601-1000	Oil pump	■	1			Adding oil
Recoil spring assembly	M1	791-685-8006	Compressor	■	1			Disassembly, assembly of recoil spring assembly
		791-635-3160	Extension	■	1			
		791T-630-2610	Spacer	■	1	N	○	

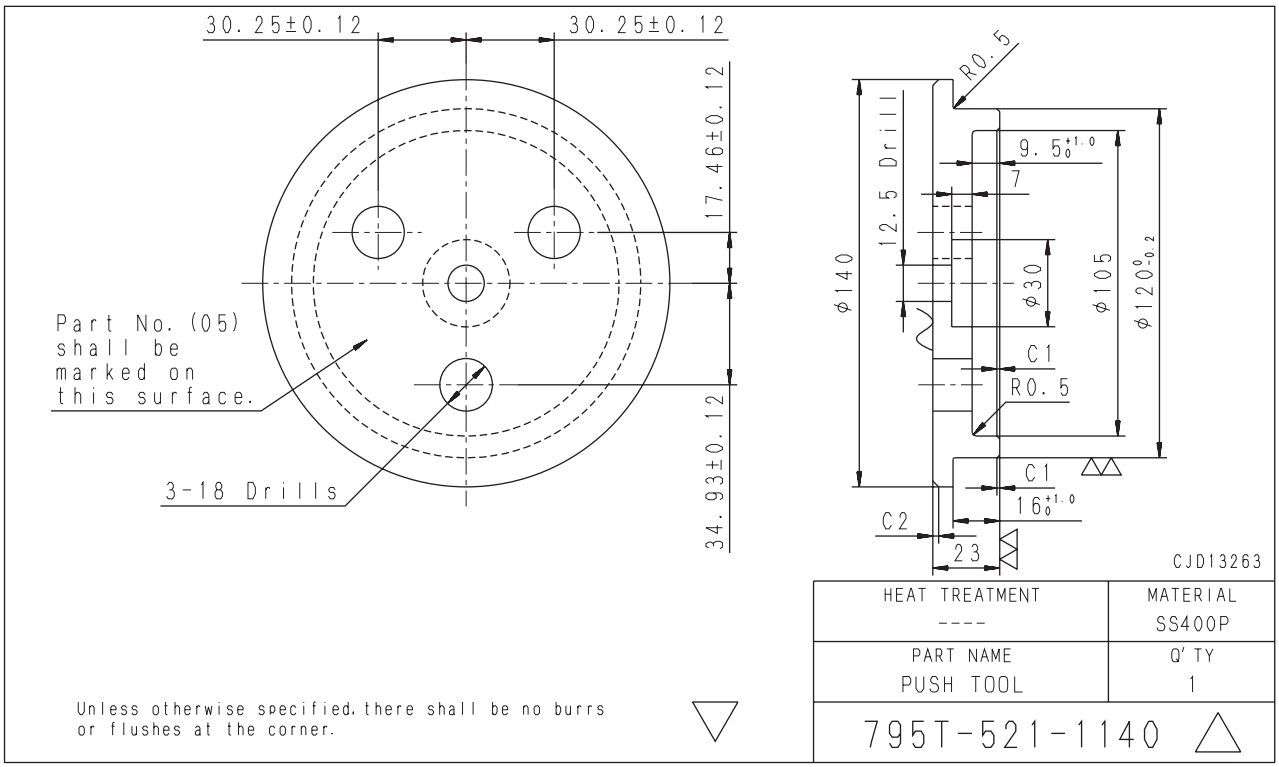
Component	Symbol	Part No.	Part Name	Necessity	Q'ty	New/ Remodel	Sketch	Nature of work, remarks
Recoil spring assembly	M1	790-101-1300	Cylinder	■	1			Disassembly, assembly of recoil spring assembly
		790-101-1102	Hydraulic pump	■	1			
Track roller and carrier roller assemblies	N1	791-651-1510	Installer	■	1			Press fitting of floating seals of track roller and carrier roller
	N2	791-601-1000	Oil pump	■	1			Adding oil
Track shoe assembly	R1	794-650-3000	Remover and installer	■	1			Disassembly, assembly of track (Master link type)
		790-101-1300	Cylinder assembly	■	1			
		790-105-2300	Jack assembly	■	1			
		790-101-1102	Hydraulic pump	■	1			
	R2	791-650-3500	Remover and installer	■	1			Disassembly, assembly of track (Lubricated type)
		791-675-5542	Adapter	■	1			
		791-675-5571	Adapter	■	1			
		790-101-1300	Cylinder assembly	■	1			
		790-105-2300	Jack assembly	■	1			
		790-101-1102	Hydraulic pump assembly	■	1			
	R3	791-646-7531	Push tool	■	1			Removal of track pin plug
	R4	791-660-7460	Pin brush	■	1			Cleaning of track pin plug
	R5	791-646-7900	Plug push tool	■	1			Installation of track pin plug
		• 790-434-1210	• Bar		1			
		• 790-434-1220	• Guide		1			
		791-932-1110	Plug push tool	■	1			
		• 791-646-7523	• Bar		1			
		• 791-646-7590	• Guide		1			
	R6	791-632-1060	Installer	■	1			Installation of track link seal
	R7	790-701-3000	Seal checker	■	1			Check of sealing of track link
	R8	791-601-1000	Oil pump	■	1			Adding track link oil
Hydraulic cylinder assembly	U1	790-502-1003	Cylinder repair stand	■	1			Disassembly, assembly of hydraulic cylinder
		790-101-1102	Hydraulic pump	■	1			
	U2	790-102-3802	Wrench	■	1			Removal, installation of hydraulic cylinder head
	U3	790-302-1310	Socket	■	1			Removal, installation of nut (Blade lift) (Blade tilt) (Ripper lift)
		790-302-1350	Socket	■	1			

Component	Symbol	Part No.	Part Name	Necessity	Q'ty	New/ Remodel	Sketch	Nature of work, remarks
Hydraulic cylinder assembly	U3	790-302-1340	Socket	■	1			Removal, installation of nut (Blade lift) (Blade tilt) (Ripper lift)
	U4	790-201-1702	Push tool KIT	■	1			Press fitting of cylinder head bushing (Blade lift) (Blade tilt) (Ripper lift) (Ripper tilt)
		• 790-101-5021	• Grip		1			
		• 01010-50816	• Bolt		1			
		• 790-201-1791	• Push tool		1			
		• 790-201-1821	• Push tool		1			
		• 790-201-1811	• Push tool		1			
	U5	790-201-1500	Push tool KIT	■	1			Press fitting of cylinder head dust seal (Blade lift) (Blade tilt) (Ripper lift) (Ripper tilt)
		• 790-101-5021	• Grip		1			
		• 01010-50816	• Bolt		1			
		• 790-201-1610	• Plate		1			
		• 790-201-1630	• Plate		1			
		• 790-201-1620	• Plate		1			
	U6	790-720-1000	Expander	■	1			Installation of piston ring
	U7	796-720-1660	Ring	■	1			Installation of piston ring (Blade lift) (Blade tilt) (Ripper lift) (Ripper tilt)
		07281-01159	Clamp	■	1			
		796-720-1680	Ring	■	1			
		07281-01589	Clamp	■	1			
		796-720-1670	Ring	■	1			
		07281-01279	Clamp	■	1			
Operator's cab assembly	X1	793-498-1210	Lifter (Suction cup)	■	1			Removal, installation of operator's cab glass (stuck glass)
Air compressor	X2	799-703-1200	Service tool KIT	■	1			Adding air conditioner refrigerant (R134a)
		799-703-1100	Vacuum pump	■	1			
		799-703-1110	Vacuum pump	■	1			
		799-703-1120	Vacuum pump	■	1			
		799-703-1401	Gas leak detector	■	1			

SKETCH OF SPECIAL TOOL

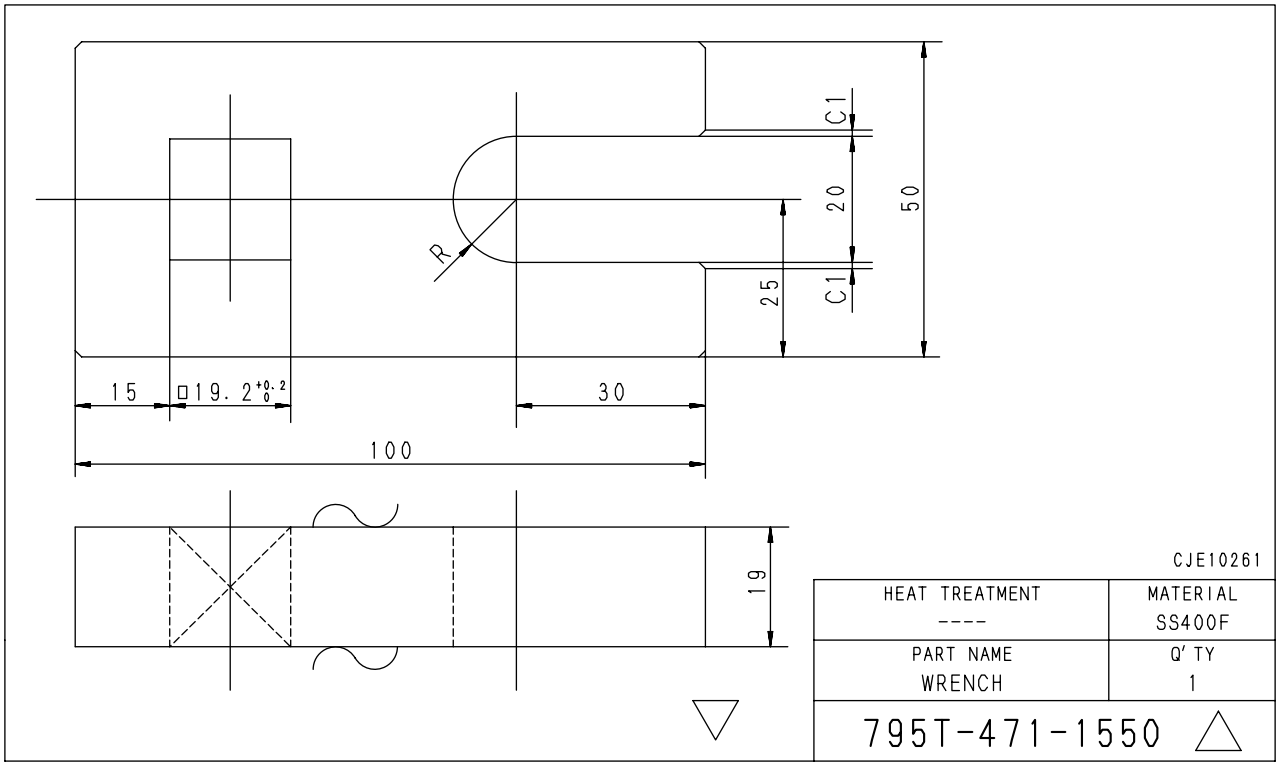
Note: Komatsu cannot accept any responsibility for special tools manufactured according to these drawings.

A2: Push tool



HEAT TREATMENT	MATERIAL
----	SS400P
PART NAME	Q'TY
PUSH TOOL	1
795T-521-1140 △	

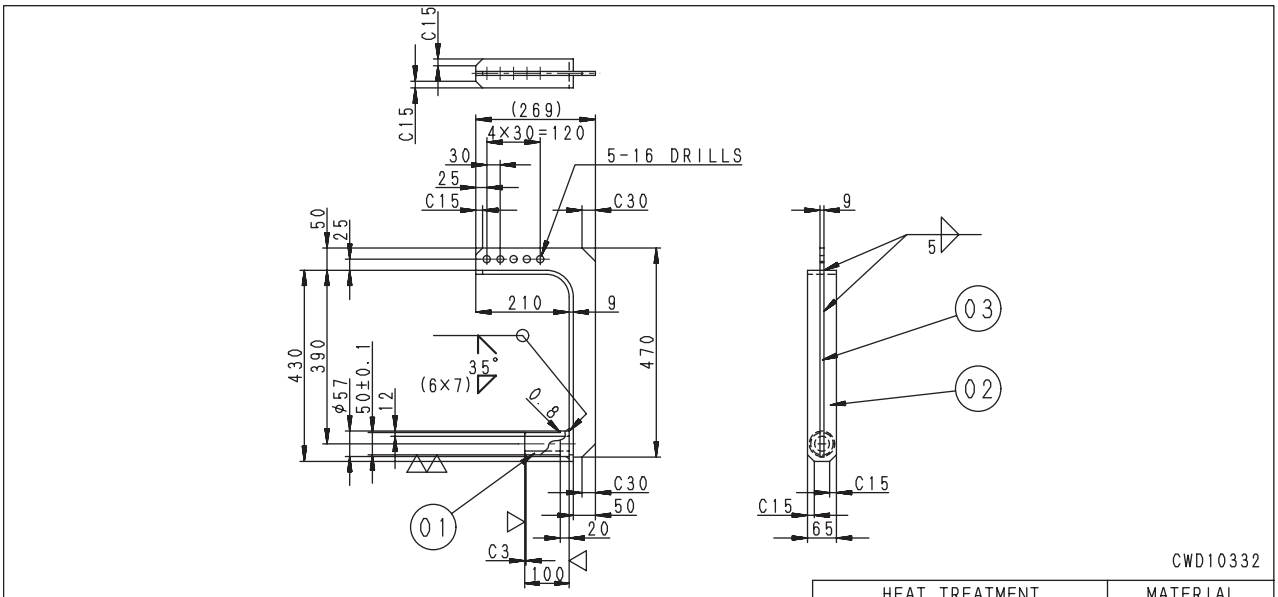
A5: Wrench



HEAT TREATMENT	MATERIAL
----	SS400F
PART NAME	Q'TY
WRENCH	1
795T-471-1550 △	

Note: Komatsu cannot accept any responsibility for special tools manufactured according to these drawings.

E1: Hanger

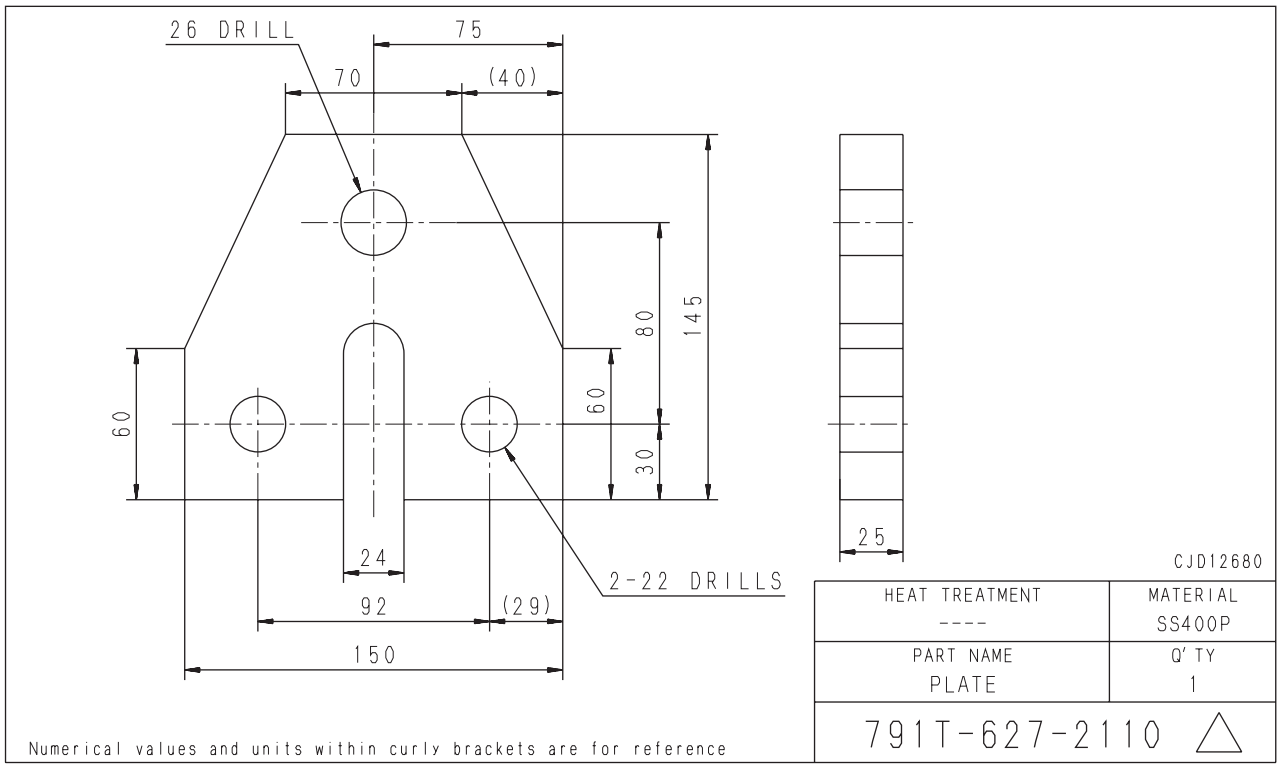


SYM.	PART NAME	MATERIAL	QTY/SET	MASS (kg)	REMARKS
03	PLATE	SS400P	1	2.32	t9
02	PLATE	SS400F	1	2.8	65×t9
01	BOSS	STKM13A	1	0.96	ϕ57×t12

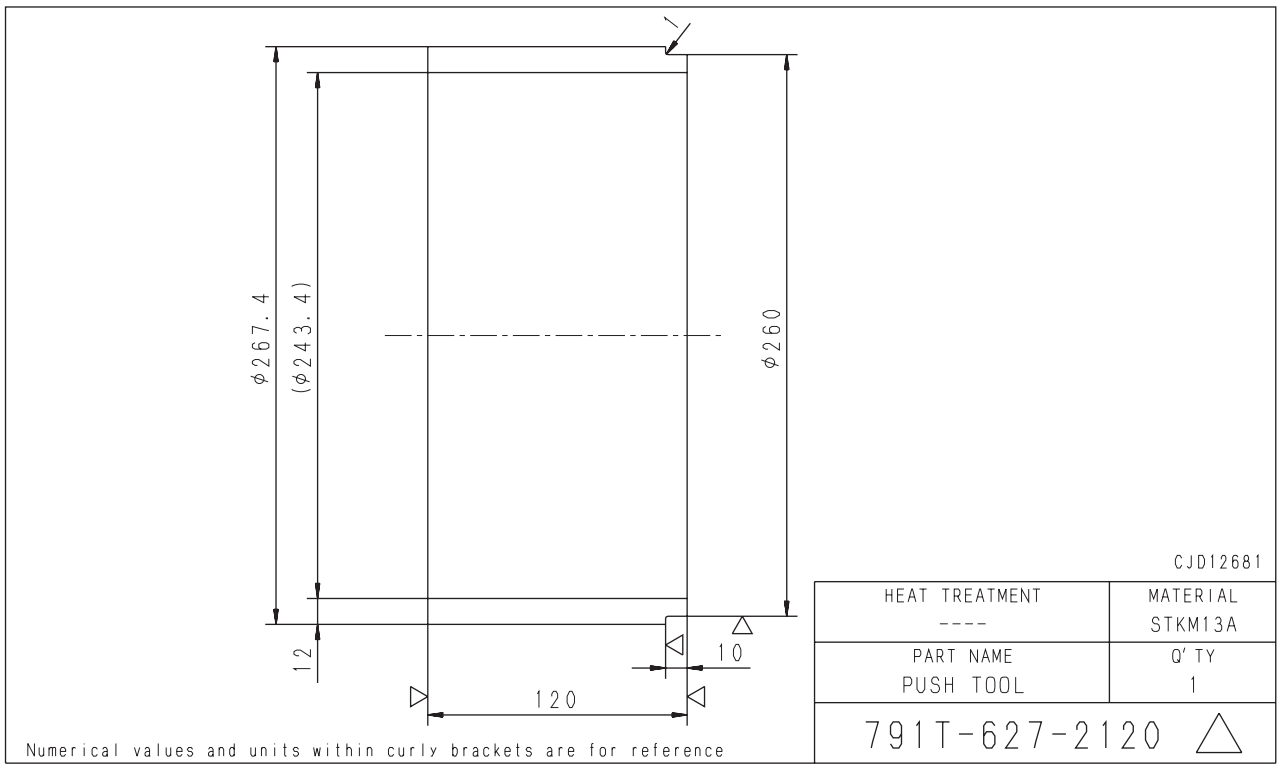
HEAT TREATMENT	MATERIAL
----	WELD
PART NAME	Q'TY
HANGER	1
791T-422-1320 △	

Note: Komatsu cannot accept any responsibility for special tools manufactured according to these drawings.

J1: Plate

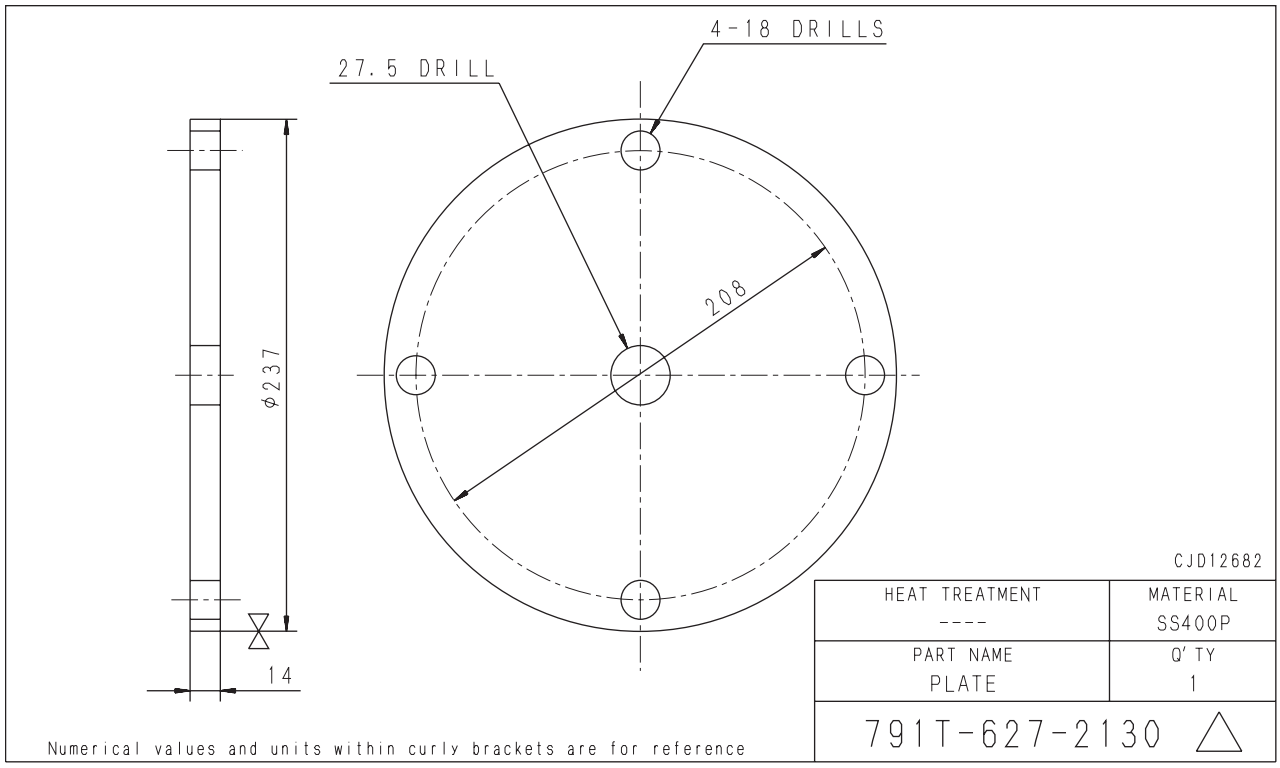


J3: Push tool

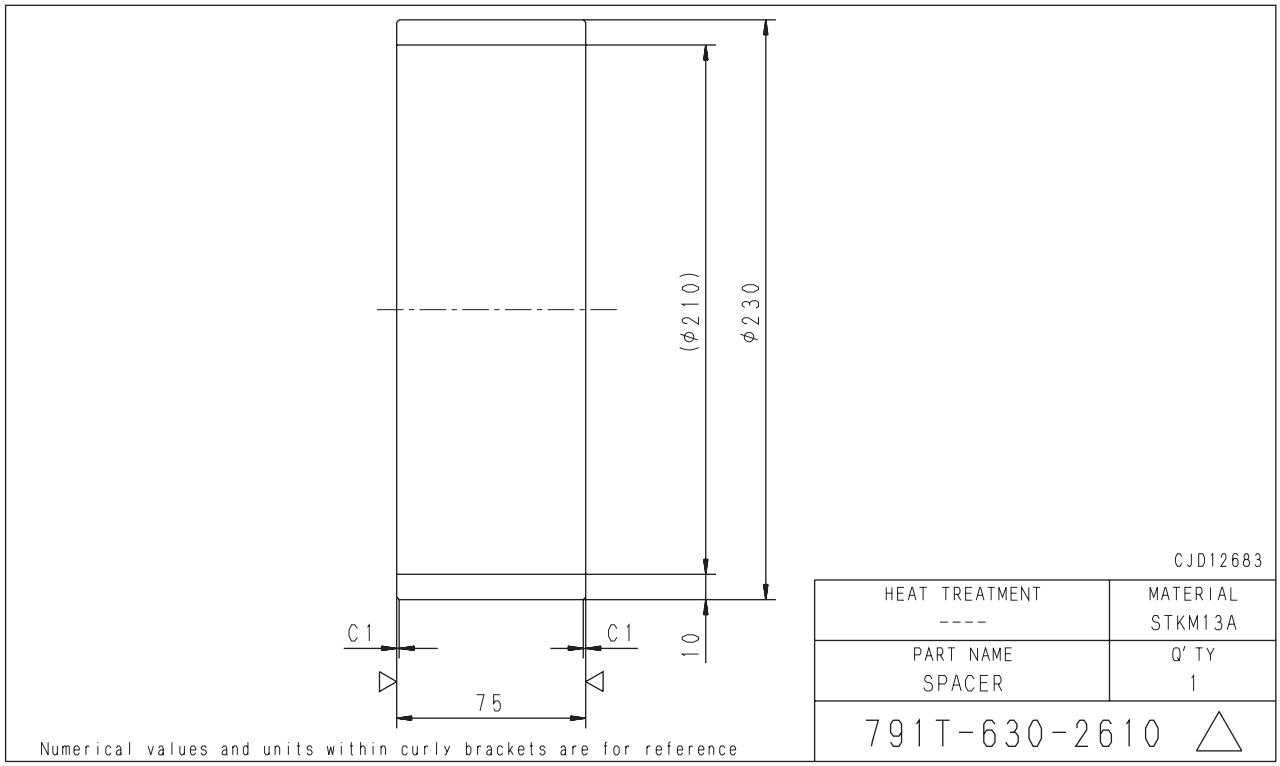


Note: Komatsu cannot accept any responsibility for special tools manufactured according to these drawings.

J3: Plate



M1: Spacer



REMOVAL AND INSTALLATION OF FUEL SUPPLY PUMP ASSEMBLY

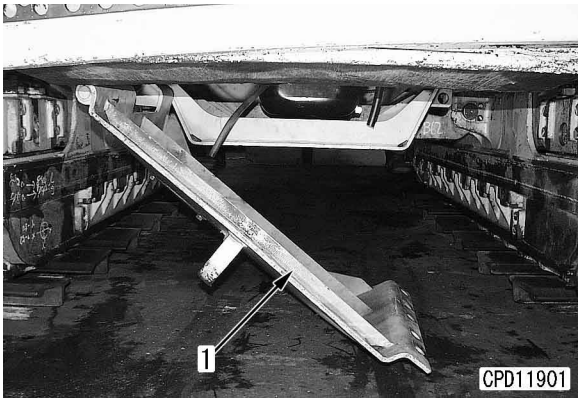
SPECIAL TOOLS

Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
A1		795-471-1800	Remover	■	1	N	
	1	• 795-471-1810	• Plate		1	N	
	2	• 795-471-1820	• Bolt		1	N	
	3	• 795-471-1830	• Bracket		1	N	
	4	• 01435-01035	• Bolt		3		
	5	• 01435-01025	• Bolt		1		

REMOVAL

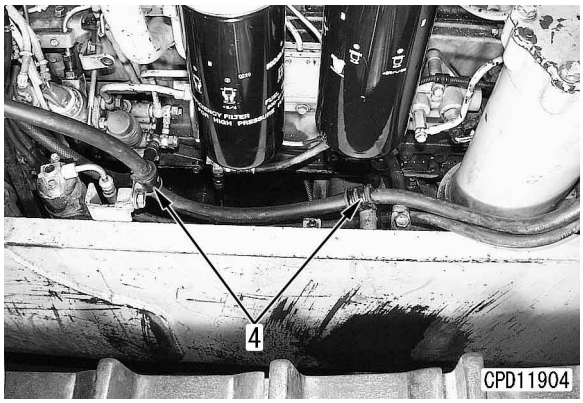
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Release the residual pressure from the fuel system. For details, see TESTING AND ADJUSTING, Releasing residual pressure from fuel system.
2. Close the fuel supply valve of the fuel tank.
3. Open engine undercover (1).

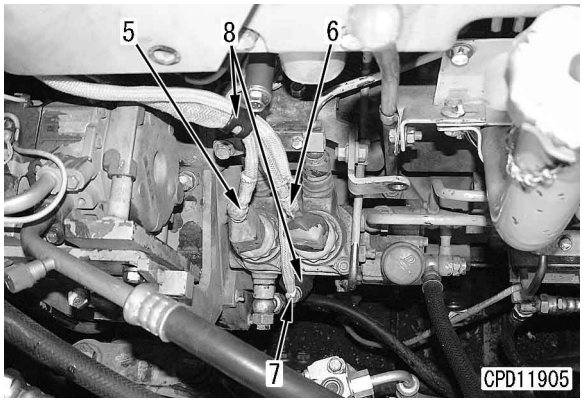


4. Open engine left side cover (2).
5. Remove side cover (3).

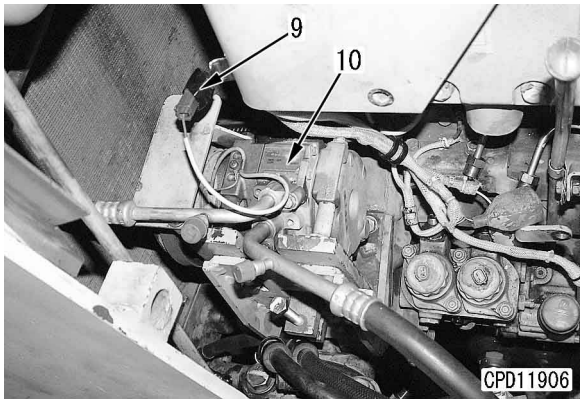
6. Remove the 2 clamps of air conditioner hose (4).



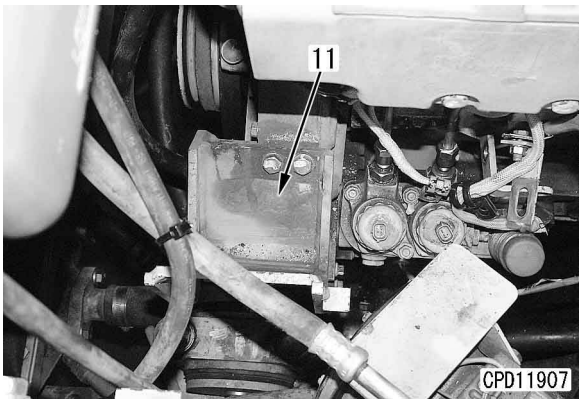
7. Disconnect 3 fuel supply pump wiring connectors PCV1 (5), PCV2 (6), and G (7), and then remove 2 clamps (8).



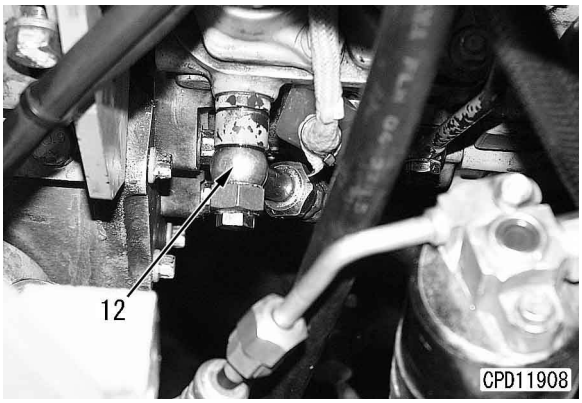
8. Disconnect 1 air conditioner wiring connector (9) and remove the compressor mounting bolts, and then remove the belt and compressor (10).
   ★ Move the compressor aside.



9. Remove compressor bracket (11).



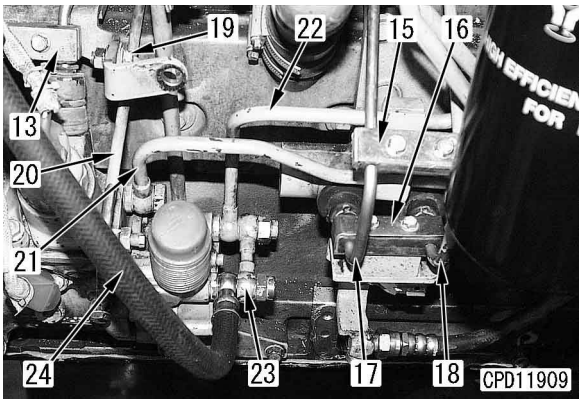
10. Disconnect fuel return hose (12) from the pump. [*1]



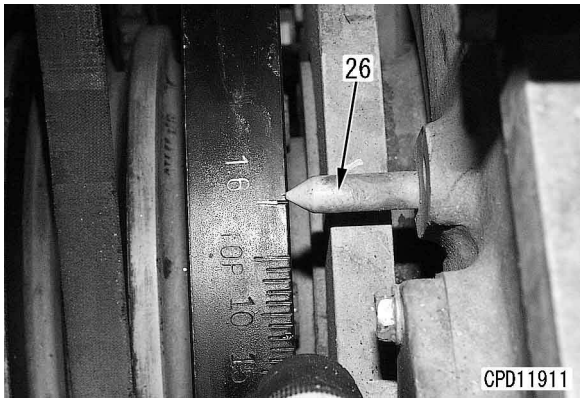
11. Remove 4 high-pressure pipe clamps, (13), (14), (15), and (16) and 2 high-pressure pipes (17) and (18). [*2]
    ★ Clamp (14) is on the back side of the oil supply pipe.

12. Remove clamp (19) and disconnect lubrication tube (20). [*3]

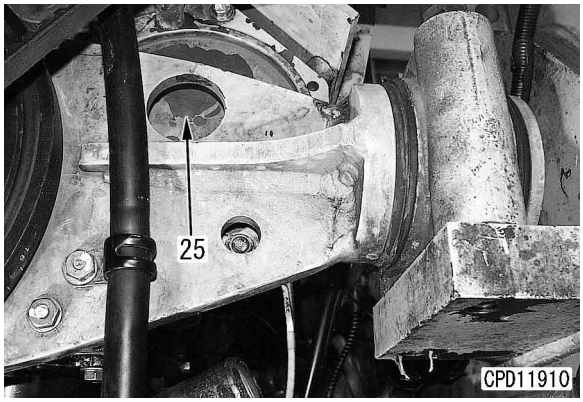
13. Disconnect fuel filter tubes (21), (22), and (23) and fuel hose (24). [*4]



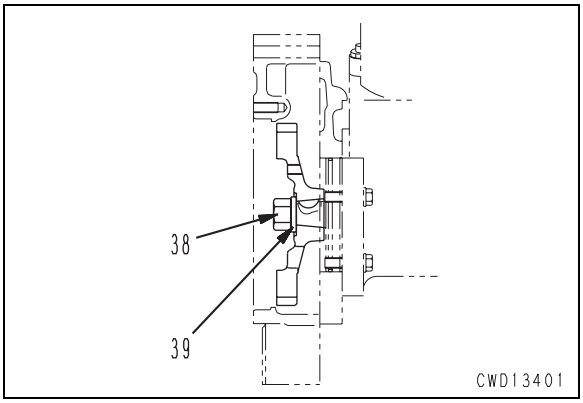
14. Removal of fuel supply pump.
    1) Remove the No. 1 head cover.
    2) Rotate the crankshaft forward to bring the stamped "1.6TOP" line to pointer (26) and set the No. 1 cylinder to the compression top dead center.
       ★ Rotate the crankshaft with the damper mounting bolt.
       ★ When the No. 1 cylinder is at the compression top dead center, the rocker arms on both intake side and exhaust side of the No. 1 cylinder can be moved by the valve clearance with the hand. If the rocker arms cannot be moved, rotate the crankshaft one more turn.



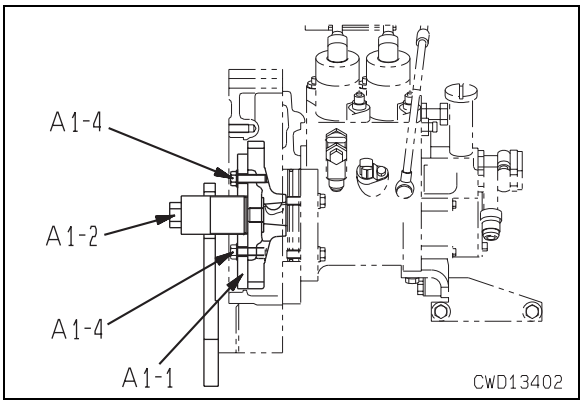
    3) Remove cover (25).
       ★ Remove the lower mounting bolt (1 piece) through the engine front support.



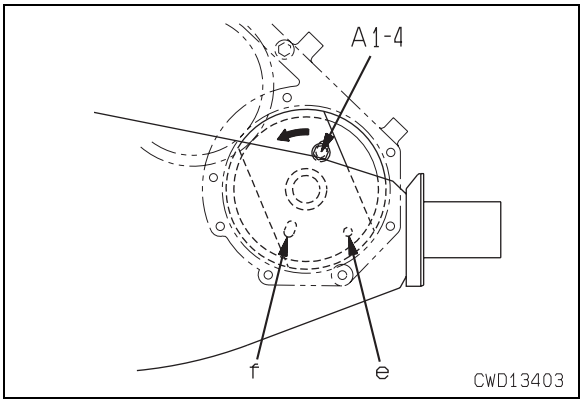
4) Remove gear mounting nut (38) and washer (39).
   ★ Take great care not to drop the nut and washer in the case.



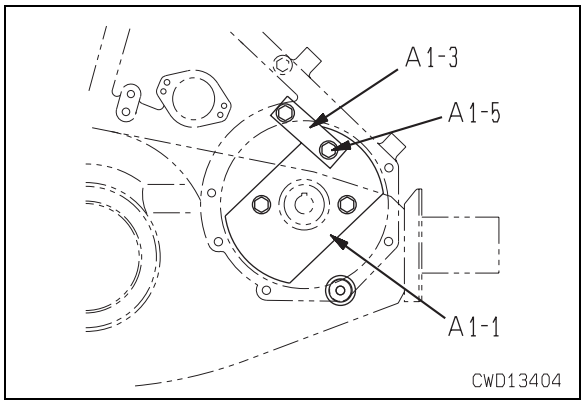
5) Insert plate **A1-1** with its shouldered side toward the gear and tighten bolt **A1-2** with your fingers (about 5 turns).



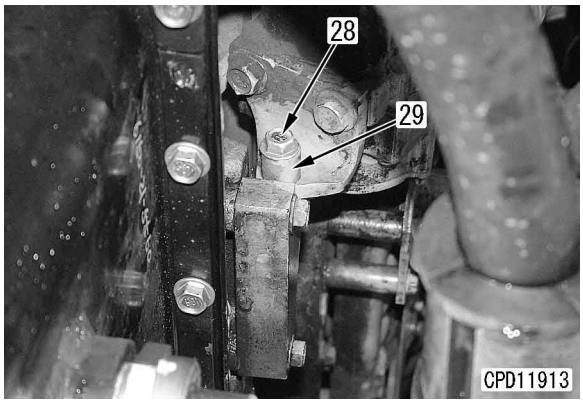
6) Tighten gear fixing bolt **A1-4** with your fingers.
   ★ Set tap hole **e** of plate **A1-1** down.
7) Rotate the crankshaft 1 turn again (forward) to set lower gear fixing bolt hole **f** up, and then tighten bolt **A1-4** with your fingers.



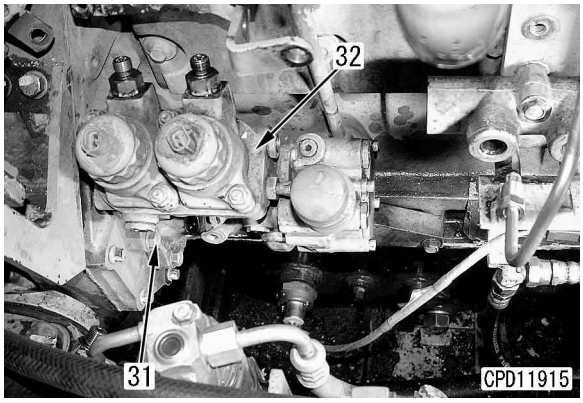
8) Install bracket **A1-3** to the case.
9) Rotate the crankshaft to match tap hole **e** of plate **A1-1** and secure bracket **A1-3** with bolt **A1-5**.
   • At this time, the key of the supply pump must be at the upper position.



10) Remove fuel supply pump lower bracket mounting bolt (28) and spacer (29).

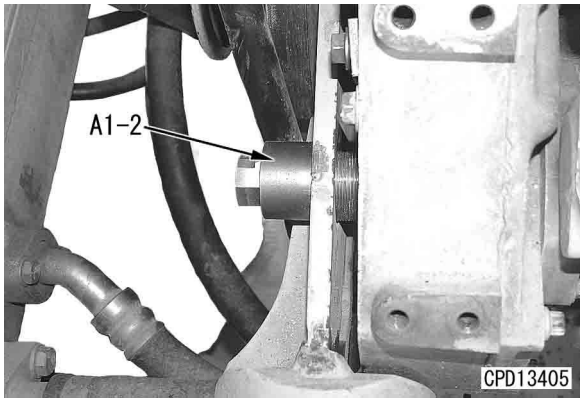


11) Remove 4 mounting bolts (31).
   • Tighten 1 mounting bolt on the upper side temporarily as a guide bolt.



12) Tighten bolt **A1-2** and remove the gear and fuel supply pump (32).

Removing torque of gear:
Approx. 196 – 294 Nm
{Approx. 20 – 30 kgm}



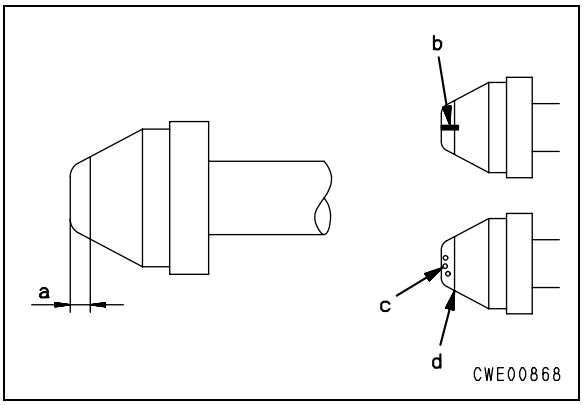
★ Take care not to drop the woodruff key of the supply pump shaft.
★ Do not remove bracket **A1-3** until you will install the supply pump assembly again.

INSTALLATION

• Carry out installation in the reverse order to removal.

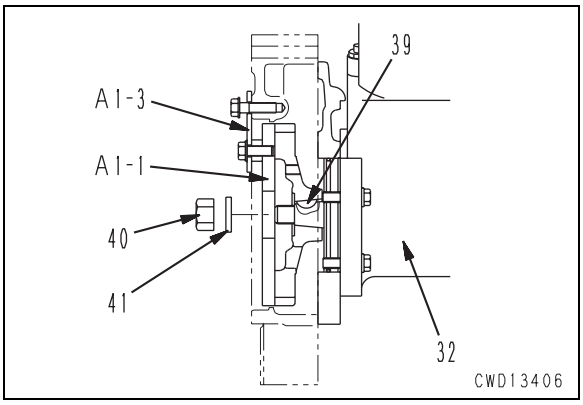
[*1]
Fuel return hose:
54 – 93 Nm {5.5 – 9.5 kgm}

[*2]
⚠ Do not correct the high-pressure pipe by bending before installing it.
⚠ Be sure to use the genuine high-pressure pipe clamp and observe the tightening torque.
⚠ Install the 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 of 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.

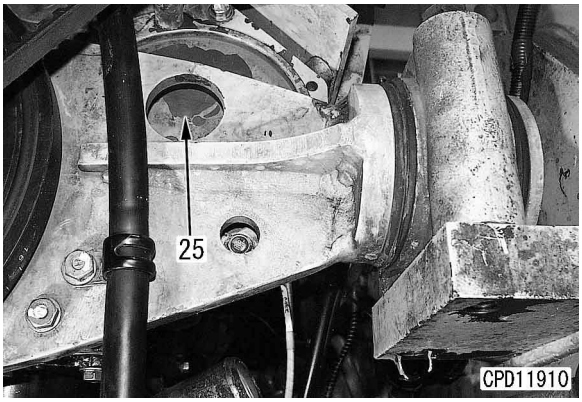


★ Install the fuel supply pump and the high-pressure pipe between it and common rail according to the following procedure.

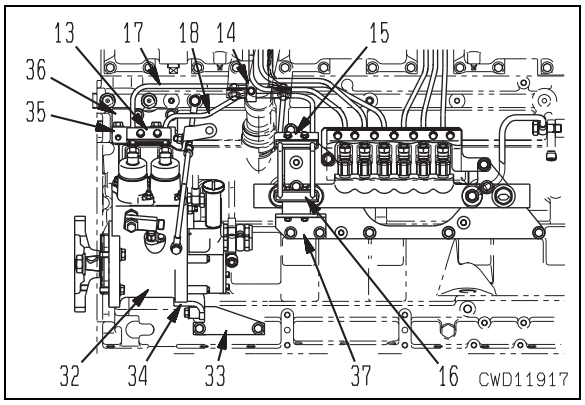
1) Installation of fuel supply pump assembly
   i) Remove bolt **A1-2** from plate **A1-1**.
   ii) Insert supply pump (32) with key (39) up and matched to the key way of the gear, and then secure it temporarily.
   iii) Tighten supply pump drive gear mounting nut (40) and washer (41) temporarily.
   iv) Remove bracket **A1-3** and plate **A1-1**.
   v) Tighten supply pump drive gear mounting nut (40).
   Mounting nut:
   127 – 147 Nm {13 – 15 kgm}



   vi) Install gear cover (25).
   Mounting bolt:
   14.7 – 17.6 Nm {1.5 – 1.8 kgm}



2) Installation of high-pressure pipe



   i) Tighten brackets (33) and (34) and high-pressure pipes (17) and (18) with your fingers.
   ii) Tighten high-pressure pipes (17) and (18) permanently.
   Sleeve nut on common rail side:
   39.2 – 58.8 Nm {4 – 6 kgm}
   Sleeve nut on supply pump side:
   39.2 – 49 Nm {4 – 5 kgm}
   iii) Tighten supply pump (32) permanently.
   4 supply pump mounting bolts:
   Adhesive (LT-2)
   ★ When tightening 1 lower mounting bolt, install spacer (29).
   iv) Tighten bracket (33) and (34) permanently.
   v) Install high-pressure pipe clamp (13) and brackets (35) and (36) with your fingers.
   vi) Tighten high-pressure clamp (13) permanently.
   Clamping bolt:
   11.8 – 14.7 Nm {1.2 – 1.5 kgm}
   vii) Tighten bracket (36) permanently, and then tighten bracket (35) permanently.
   Clamping bolt:
   11.8 – 14.7 Nm {1.2 – 1.5 kgm}
   viii) Install clamps (15) and (16) and bracket (37) with your fingers.
   ix) Tighten clamps (15) and (16) permanently.
   x) Tighten bracket (37) permanently.
   xi) Install clamp (14).

[*3]
- Joint bolt on supply pump side:
  7.9 – 12.7 Nm {0.8 – 1.3 kgm}
- Joint bolt on engine side:
  9.8 – 12.7 Nm {1.0 – 1.3 kgm}

[*4]
- Fuel hose (24):
  14.8 – 19.6 Nm {1.5 – 2.0 kgm}
- Eyebolts (21), (22), and (23):
  24.5 – 34.3 Nm {2.5 – 3.5 kgm}

- **Checking for fuel leakage**
  Check for fuel leakage. For details, see TESTING AND ADJUSTING, Checking fuel system for leakage.

- **Bleeding air**
  Bleed air from the fuel circuit. For details, see TESTING AND ADJUSTING, Bleeding air from fuel circuit.

REMOVAL AND INSTALLATION OF FUEL INJECTOR ASSEMBLY

REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

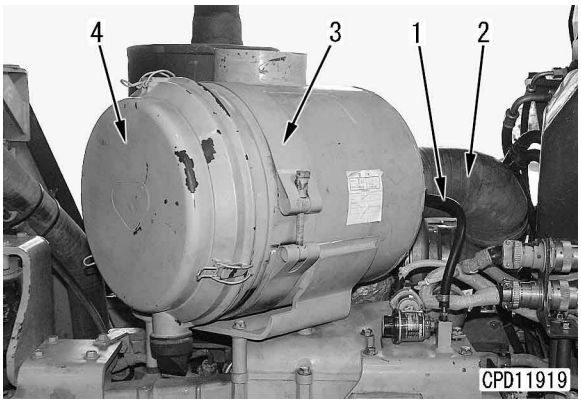
1. Remove the engine hood. For details, see REMOVAL OF ENGINE HOOD ASSEMBLY.

2. Remove the engine left side cover.

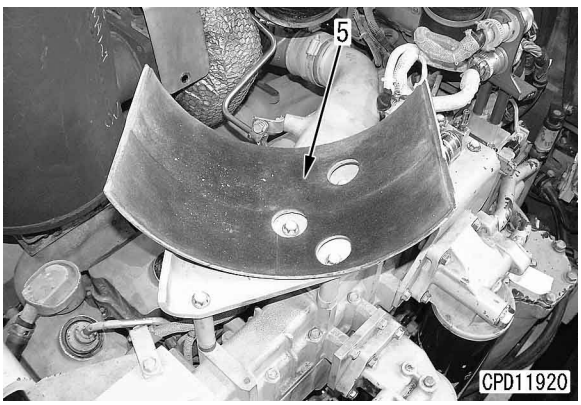
3. Disconnect dust indicator hose (1) from the dust indicator.

4. Loosen the hose clamp and disconnect hose (2). [*1]

5. Remove band (3) and air cleaner assembly (4). [*2]

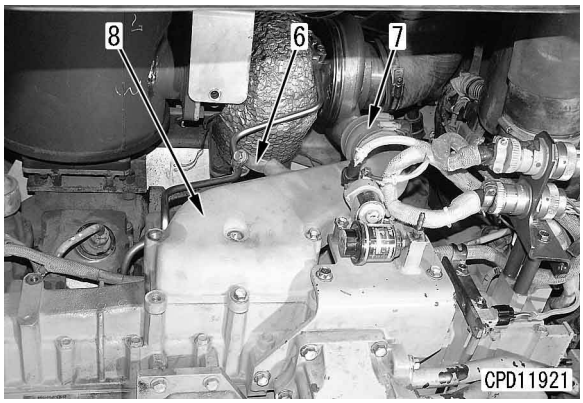


6. Remove the 4 mounting bolts and bracket (5).

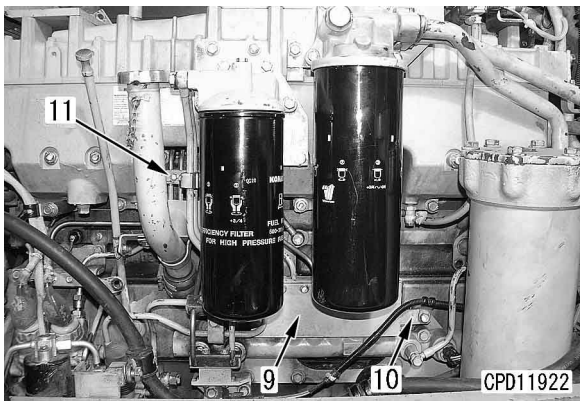


7. Remove turbocharger lubrication tube clamp plate (6).

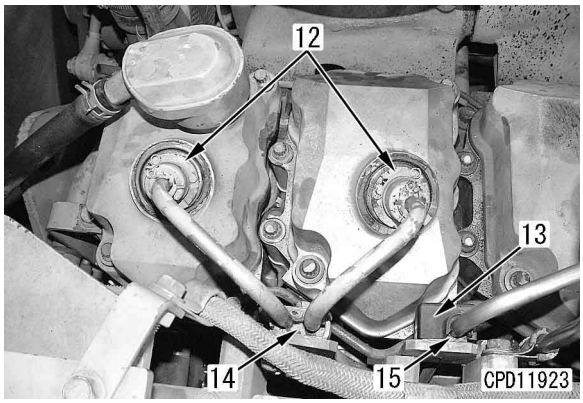
8. Loosen the hose clamp, disconnect hose (7), and remove air intake connector (8). [*3]



9. Remove common rail cover (9), and then remove gate-type frame (10) and 2 engine-side clamps (11). [*4]

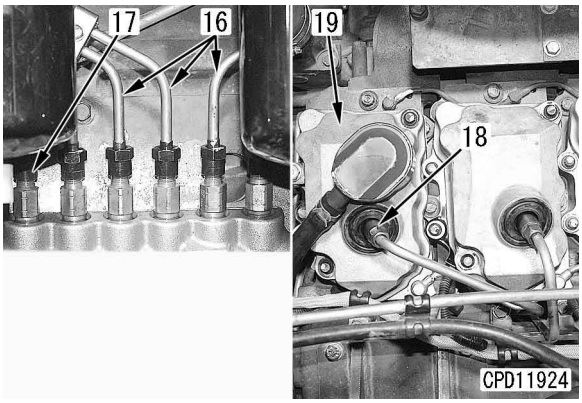


10. Remove fuel injector-side cover (12) and common rail-side cover, depending on the fuel injector to be removed, and then remove clamp cover (13) and clamp (14) or (15). [*5]



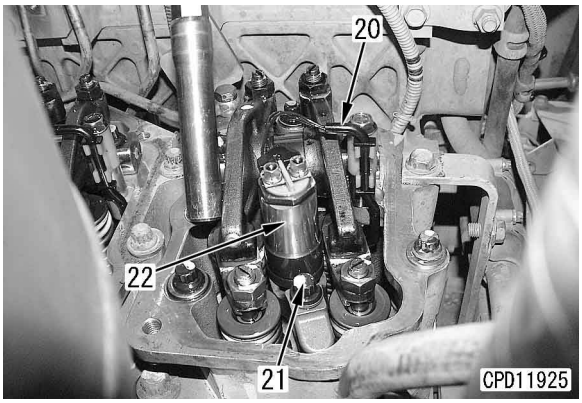
11. Remove common rail-side sleeve nuts (17) and fuel injector-side sleeve nuts (18) of high-pressure pipes (16). [*6]

12. Remove head cover (19). [*7]



13. Remove wiring harness (20) from the fuel injector. [*8]

14. Remove holder mounting bolts (21), and then remove the holder and fuel injector assembly (22) together. [*9]



INSTALLATION

- Carry out installation in the reverse order to removal.

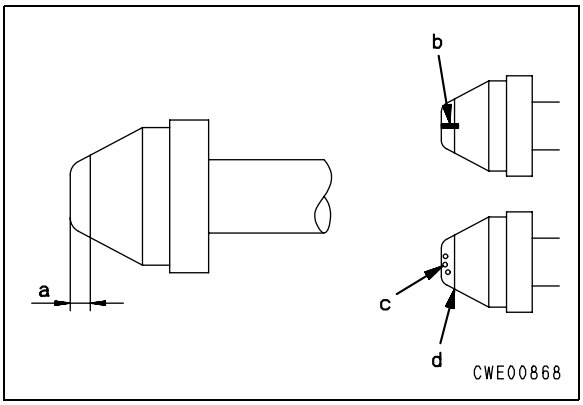
[*4] [*5] [*6]

⚠ Do not bend the high-pressure pipes before using them.

⚠ Be sure to use the genuine high-pressure pipe clamps and tighten them to the specified torque.

⚠ Install the high-pressure pipes and wiring harness at least 10 mm apart.

★ 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 of 2 mm from the end) for stepped-type wear (fatigue) which your nail can feel. If any of those defects may cause fuel leakage, replace the high-pressure pipe.



[*1]
Hose clamp:
8.8 ± 0.5 Nm {0.9 ± 0.5 kgm}

[*2]
Band clamp:
9.8 – 11.76 Nm {1.0 – 1.2 kgm}

[*3]
Air intake hose clamp:
6.8 ± 0.49 Nm {69 ± 5 kgcm}

[*4] [*5] [*6]

★ Install high-pressure pipes (16) between the fuel injector and common rail according to the following procedure.

1) Tighten 6 high-pressure pipes securely.

Fuel injector-side sleeve nut:
39.2 – 49 Nm {4 – 5 kgm}

Common rail-side sleeve nut:
39.2 – 49 Nm {4 – 5 kgm}

2) Tighten high-pressure pipe clamps (14) and (15), high-pressure pipe clamp plates (23) and (24), and high-pressure pipe clamp (11) temporarily with the fingers.
3) Tighten high-pressure clamps (11), (14), and (15) permanently.

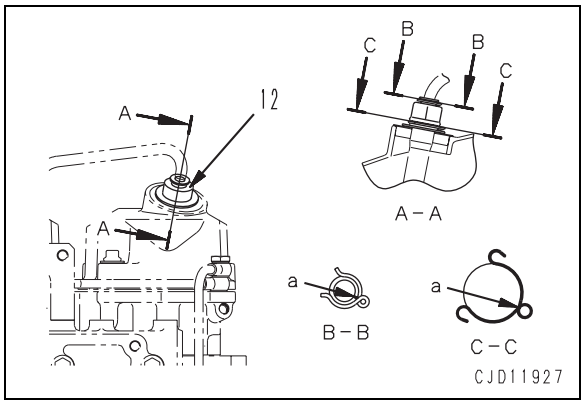
Clamp bolt:
11.8 – 14.7 Nm {1.2 – 1.5 kgm}

4) Set high-pressure clamp plates (23) and (24) horizontally and tighten them permanently.
5) Install high-pressure pipe clamp (9) and gate-type frame (10) temporarily.
6) Tighten high-pressure pipe clamp (9) permanently first, then tighten gate-type frame (10) permanently.

Clamp bolt:
11.8 – 14.7 Nm {1.2 – 1.5 kgm}

[*5]

★ Direct the slit of the common rail-side cover toward the cylinder block.
★ Direct the slit of fuel injector-side cover (12) toward position **a** shown in the figure.

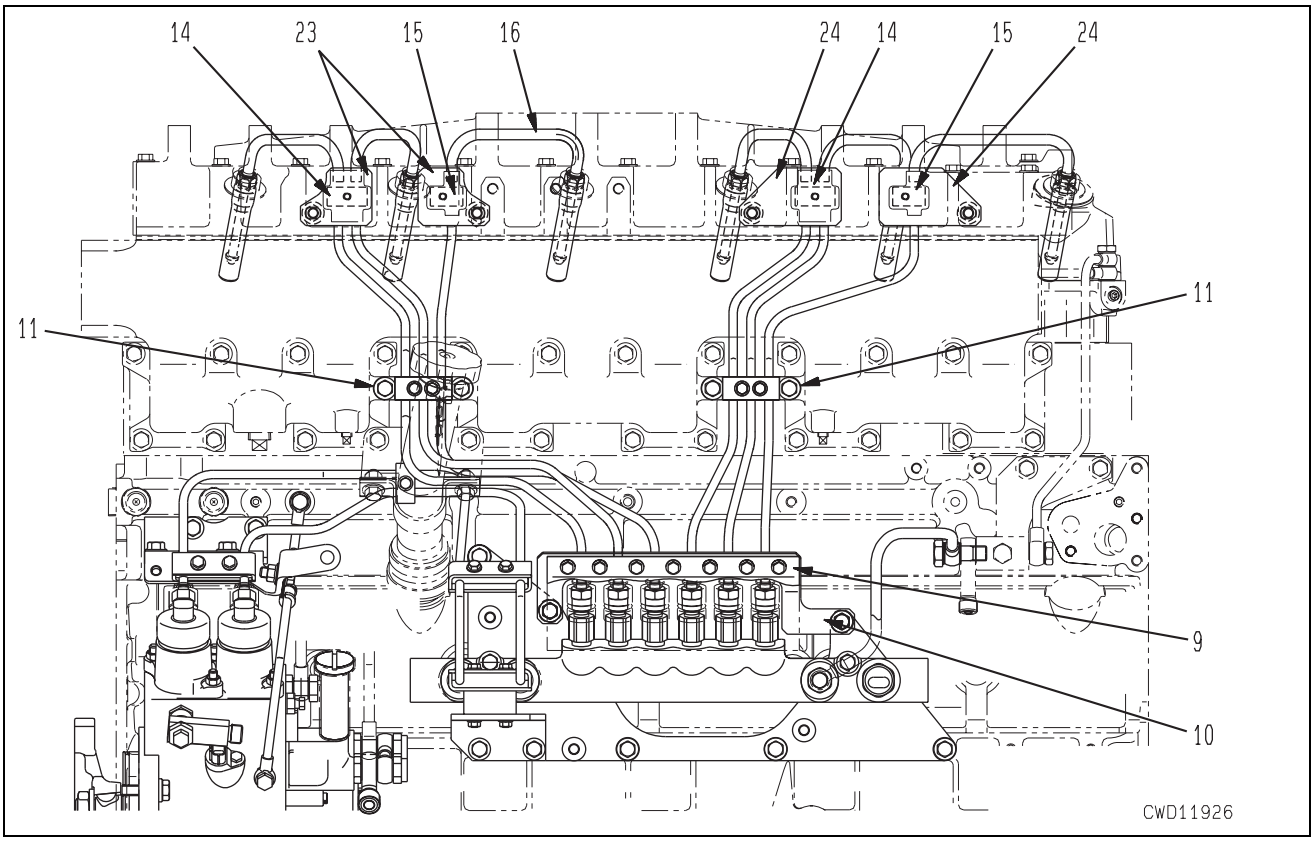


[*7]

Head cover mounting bolt:
9.8 ± 1 Nm {1.0 ± 0.1 kgm}

[*8]

Wiring harness capture nut:
2.0 – 2.4 Nm {0.2 – 0.24 kgm}

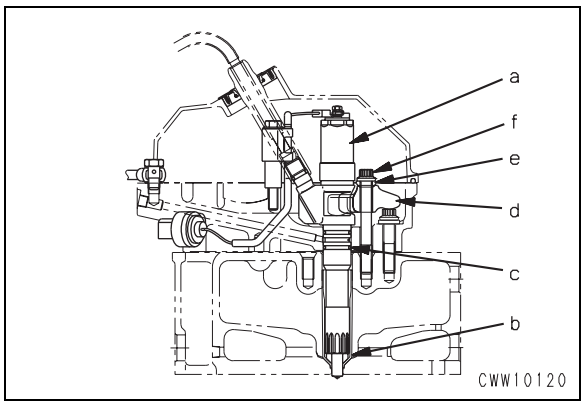


[*9]

★ Install fuel injector assembly (22) according to the following procedure.

1) Insert gasket (b) and O-ring in fuel injector (a).
2) Insert holder (d) in fuel injector (a) and install them to the rocker housing temporarily.
   ★ Matching the injector key to the key way of the rocker housing, insert the injector securely until its sealing face touches the sealing face of the cylinder head.
3) Apply engine oil to the spherical part of the spherical washer (e).
4) Tighten holder mounting bolt (f).

   Holder mounting bolt:
   58.5 – 73.5 {6 – 7.5 kgm}



- **Checking for fuel leakage**
  Check for fuel leakage. For details, see TESTING AND ADJUSTING, Releasing residual pressure from fuel system.

- **Bleeding air**
  Bleed air from the fuel circuit. For details, see TESTING AND ADJUSTING, Bleeding air from fuel circuit.

REMOVAL AND INSTALLATION OF NOZZLE TIP

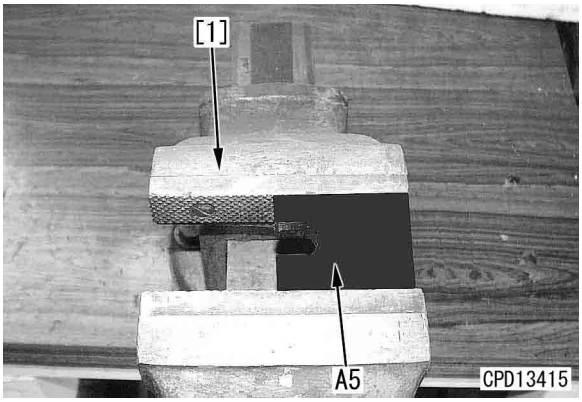
★ [EPA Regulation]
In a country where EPA Regulation is applied, replace the nozzle of the common rail engine by the assembly. In a country where EPA Regulation is not applied, however, only the nozzle tip can be replaced according to the following procedure.
(EPA: Environ mental Protection Agency)

SPECIAL TOOL

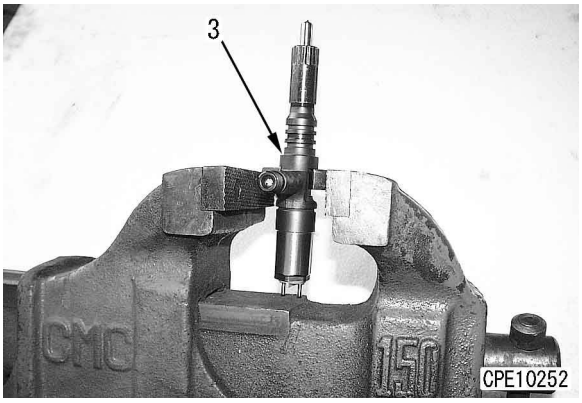
Symbol	Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
A5	795T-471-1550	Wrench	■	1		○

REMOVAL

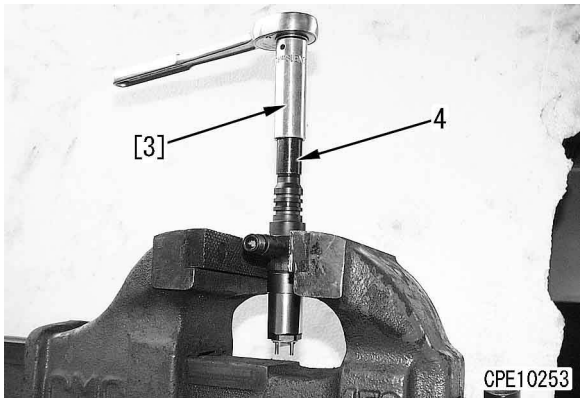
1. Grip tool **A5** with vise [1].
   ★ Do not grip the injector directly with the vise.



2. Set injector assembly (3) to tool **A5**.

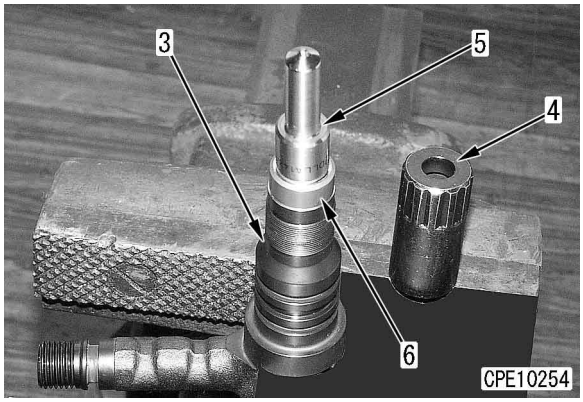


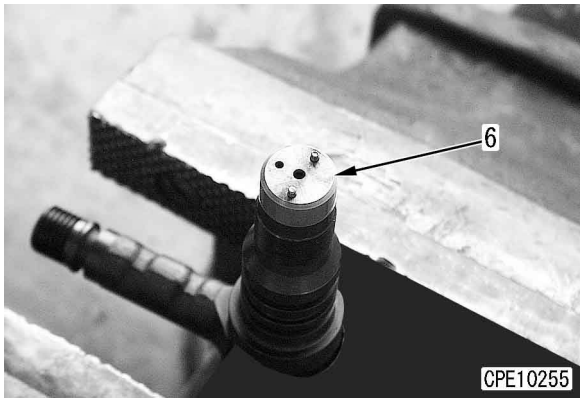
3. Using 19-mm deep socket [3], loosen retaining nut (4).



4. Remove retaining nut (4) from injector assembly (3).

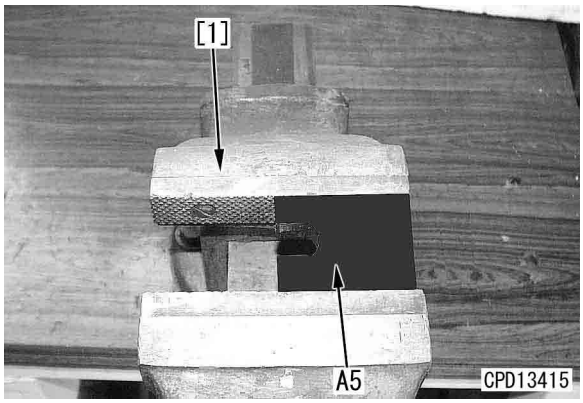
5. Lift up and remove nozzle assembly (5) vertically.
   ★ Do not remove tip guide (6). (The tip guide cannot be disassembled.)
   ★ Take care that dirt will not stick to the parts.





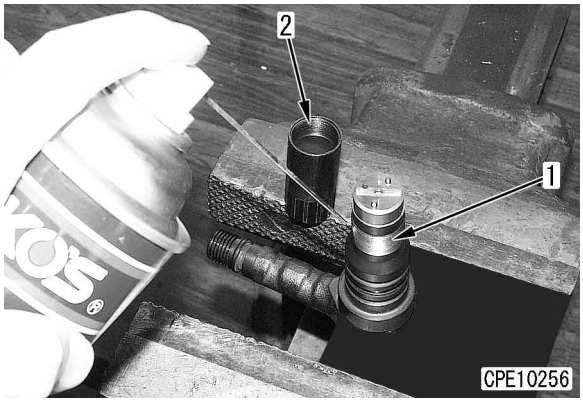
INSTALLATION

1. Grip tool **A5** with vise [1].
   ★ Do not hold the injector directly with the vise.

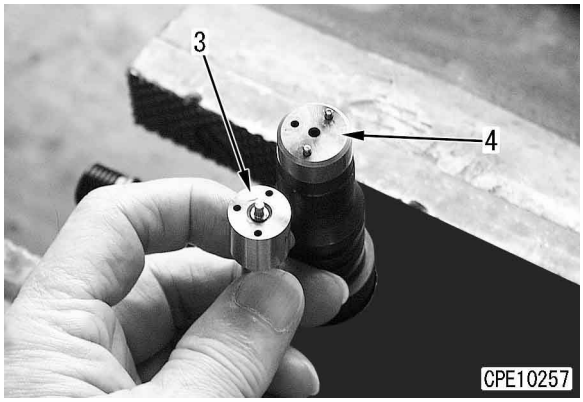


2. Set injector assembly (1) to tool **A5**.

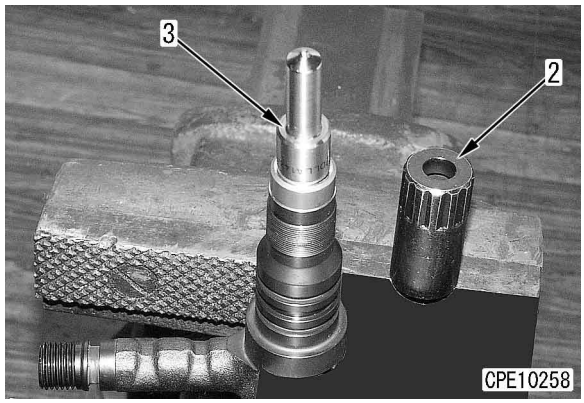
3. Clean the lower body and the threads of retaining nut (2) thoroughly with parts cleaner and blow air against them.



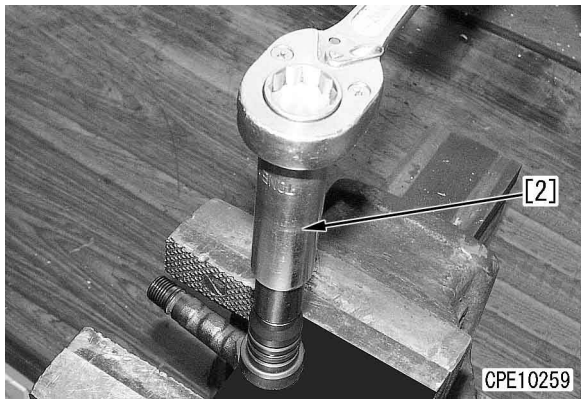
4. Install new nozzle assembly (3), matching it to the dowel pin of tip guide (4).
   ★ Take care not to drop the tip.

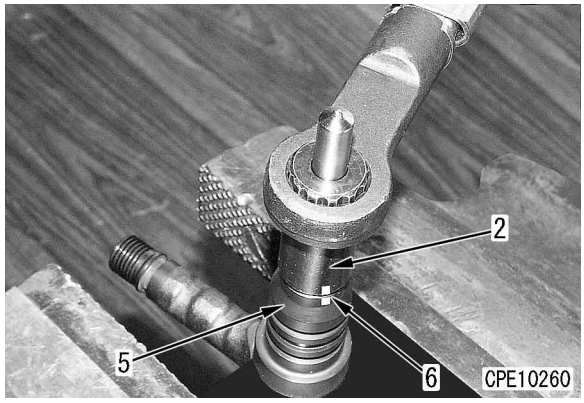


5. Install nozzle assembly (3) and tighten retaining nut (2) with the fingers.



6. Set 19-mm deep socket [2] to a torque wrench and tighten the retaining nut according to the following procedure.
   ★ Apply rust-preventive oil to the nozzle body.
   1) Tighten the retaining nut to 88.3 Nm {9.0 kgm}.
   2) Make match marks (6) on retaining nut (2) and lower body (5).
   3) Tighten the retaining nut by 45 degrees (Angle tightening).





REMOVAL AND INSTALLATION OF ENGINE FRONT SEAL

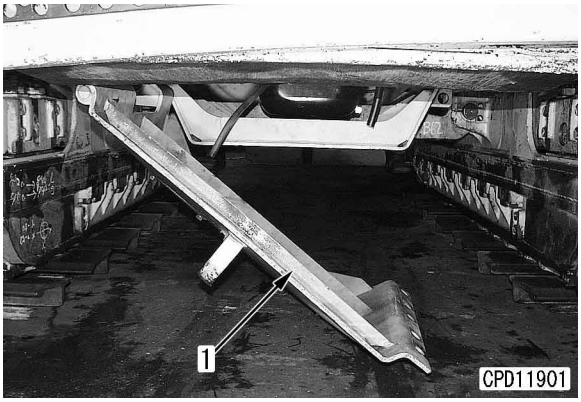
SPECIAL TOOLS

Symbol	Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
A2	795T-521-1140	Push tool	■	1		
	790-101-5221	Grip	■	1		○
	• 01010-81225	• Bolt	■	1		
	• 01050-31640	• Bolt	■	3		

REMOVAL

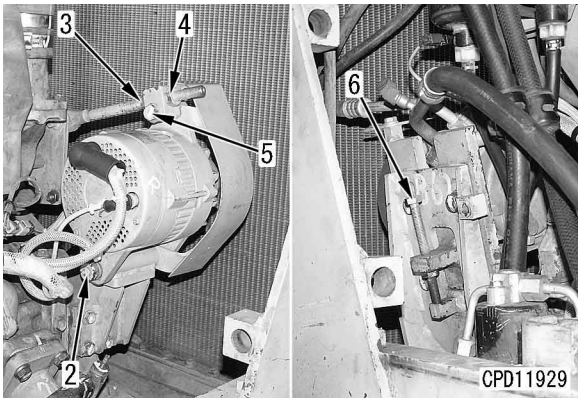
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Open undercover (1).

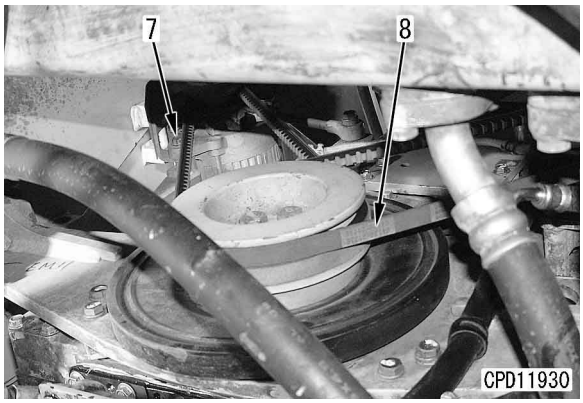


2. Loosen alternator assembly mounting bolts (2), nuts (3) and (4) of the adjustment bolts, and bolt (5) of the adjustment bolt guide. [*1]

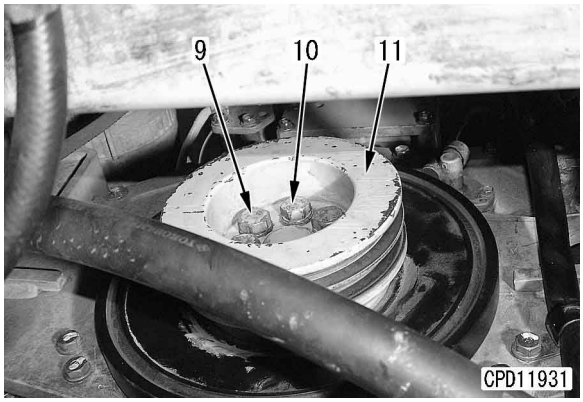
3. Loosen the 4 mounting bolts of the air compressor assembly and adjustment bolt (6). [*2]



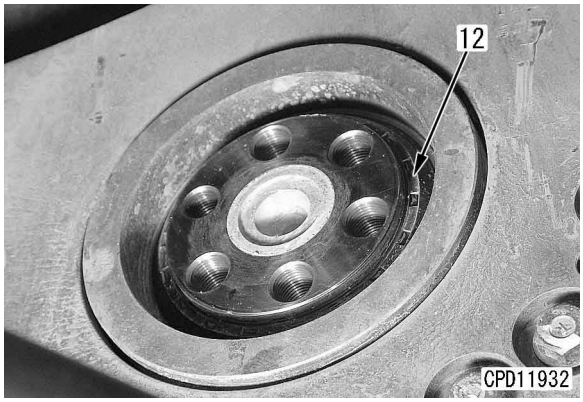
4. Remove alternator belt (7) and air compressor belt (8).



5. Remove 6 pulley mounting bolts (9) and (10) and pulley (11).
   ★ One of mounting bolts (10) has a different diameter. [*3]



6. Remove front seal (12). [*4]



INSTALLATION

[*1]

- Strain the belt according to the following procedure.

1) Loosen mounting bolt (2), nut (3), and bolt (4).
2) Strain the belt with nut (3).
3) Tighten mounting bolt (2), nut (3), and bolt (4).
   ★ Tension of belt: 13 mm (When pressed with finger to about 58.8 N {6 kg})

[*2]

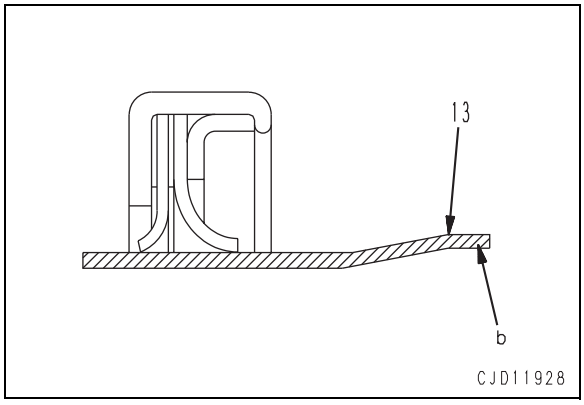
★ Tension of belt: 16 – 20 mm (When pressed with finger to about 98 N {10 kg})

[*3]

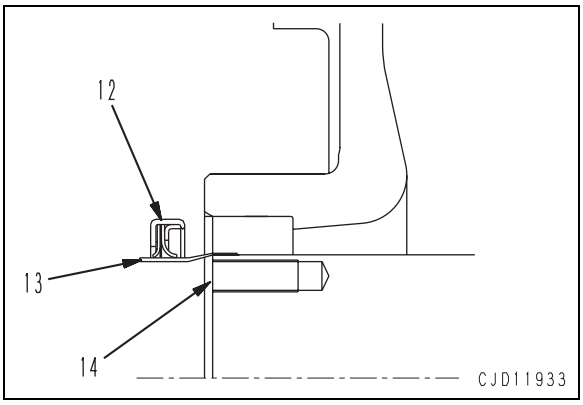
Mounting bolt (9):
245 – 308.7 Nm {25 – 31.5 kgm}
Mounting bolt (10):
56.8 – 196 Nm {16 – 20 kgm}

[*4]

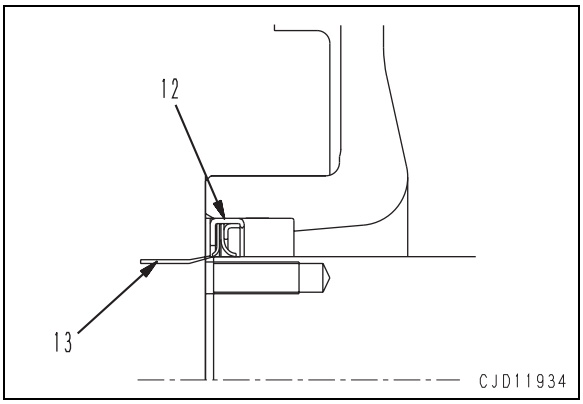
4) Procedure for installing front seal (12)
   ★ Before installing the seal, check the rims of the crankshaft end, sliding faces of the lip, and housing for flaw, burr, sharp fin, rust, etc.
   ★ When installing the seal, do not apply oil, grease, etc. to the shaft. Wipe oil thoroughly from the shaft.
   ★ Never remove the internal plastic cylinder of the spare seal before installing the seal.



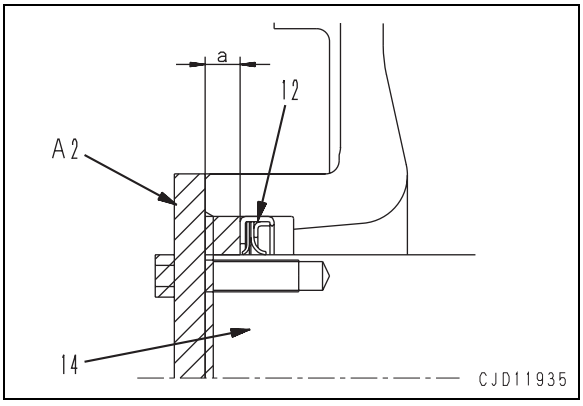
i) Put the large inside diameter side **b** of internal plastic cylinder (13) to the end of crankshaft (14).
   ★ Take care not to mistake the direction of the plastic internal cylinder.
   Lip: **Lithium grease (G2-LI)**



ii) Evenly push in the metallic ring of seal (12) with both hands, getting over the large diameter side of the internal plastic cylinder.
iii) After pushing in seal (12), remove internal plastic cylinder (13).
   ★ When removing, take care not to damage the seal lip.



iv) Tighten the bolt of tool **A2** evenly until the end of tool **A2** touches the end of crankshaft (14) to press fit seal (12).
   ★ When press fitting the seal, take care not to damage the lip on the PTO side with the tool, etc.
   ★ After press fitting the seal, remove the red sealant layer on its periphery.
   ★ Seal driving dimension **a**: $16\ ^{+1}_{0}$ mm



REMOVAL AND INSTALLATION OF ENGINE REAR SEAL

SPECIAL TOOLS

Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
A3	1	795-931-1210	Push tool	■	1		
		• 01050-31625	• Bolt	■	3		
		• 01050-31645	• Bolt	■	3		
	2	795-931-1220	Push tool	■	1		
		• 01050-31645	• Bolt	■	3		

REMOVAL

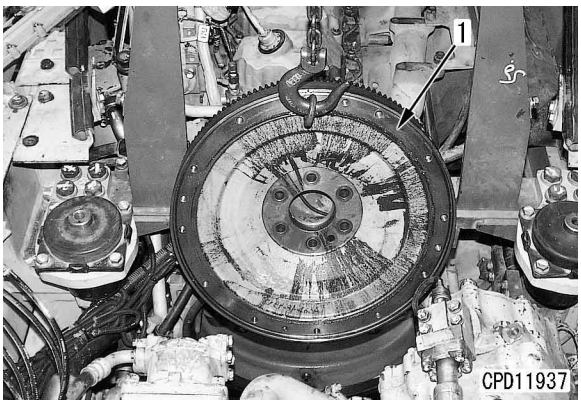
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove the damper assembly. For details, see REMOVAL OF DAMPER ASSEMBLY.

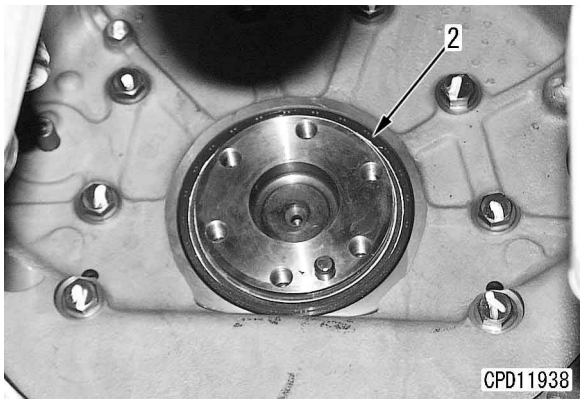
2. Using eyebolt [1], sling the flywheel assembly temporarily and remove the 6 mounting bolts. [*1]

3. Lift off flywheel assembly (1).

Flywheel assembly: **58 kg**



4. Remove rear seal (2). [*2]



INSTALLATION

- Carry out installation in the reverse order to removal.

[*1]

★ Apply clean lubricating oil (E030-CD) all over the threads, seats, and washers of the bolts.

★ Tighten the 6 flywheel mounting bolts in the order of 1 – 6 as shown in the following figure.

★ Tighten each mounting bolt twice.

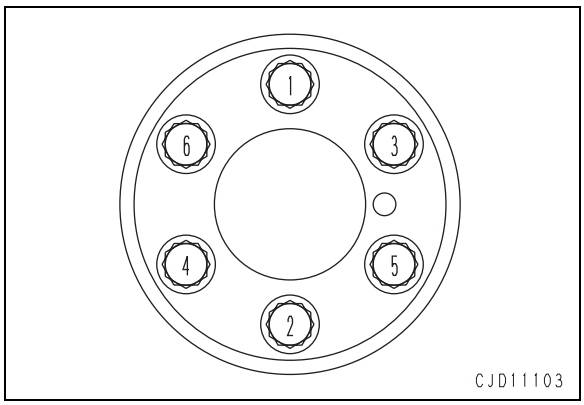
Mounting bolt:

1st tightening torque:

147 ± 19.6 Nm {15 ± 2.0 kgm}

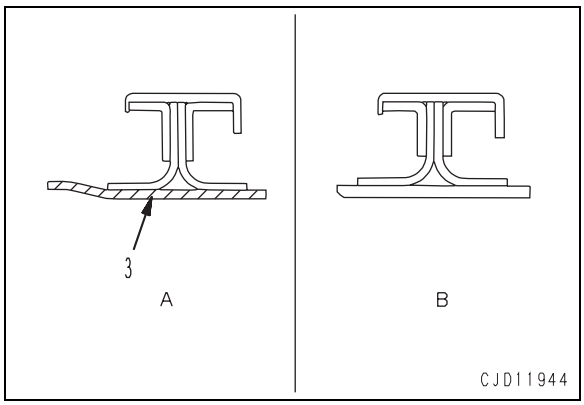
2nd tightening torque:

289.1 ± 19.6 Nm {29.5 ± 2.0 kgm}

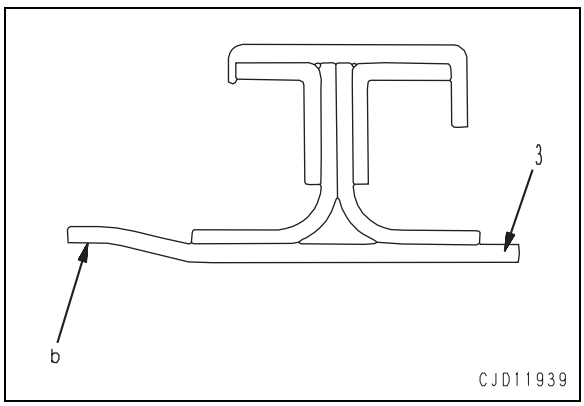


[*2]

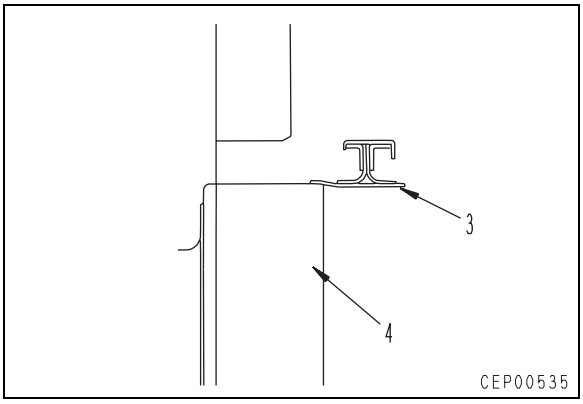
- Procedure for installing rear seal (2)
  - ★ Before installing the Teflon seal (lay-down lip seal), check the shaft for wear. Then, install the "standard seal **A**" or the "seal with sleeve **B**" according to the check result.
    If the shaft is still glossy (If the wear depth felt with a finger cushion is 10 μm or less) and it does not have a flaw, install the "standard seal **A**". In other cases, install the "seal with sleeve **B**".



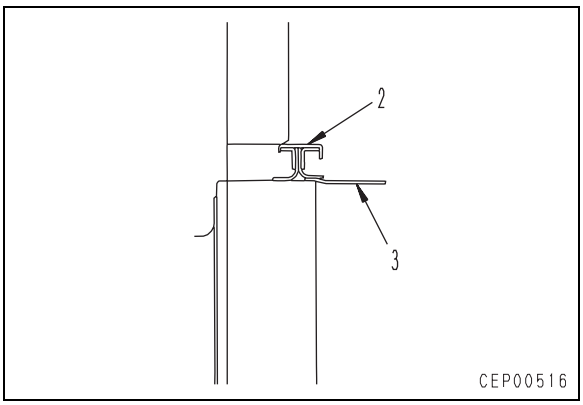
- Procedure for installing standard seal **A**
  - ★ Before installing the seal, check the rims of the crankshaft end, sliding faces of the lip, and housing for flaw, burr, sharp fin, rust, etc.
  - ★ When installing the seal, do not apply oil, grease, etc. to the shaft. Wipe oil thoroughly from the shaft.
  - ★ Never remove the internal plastic cylinder (3) of the spare seal before installing the seal.



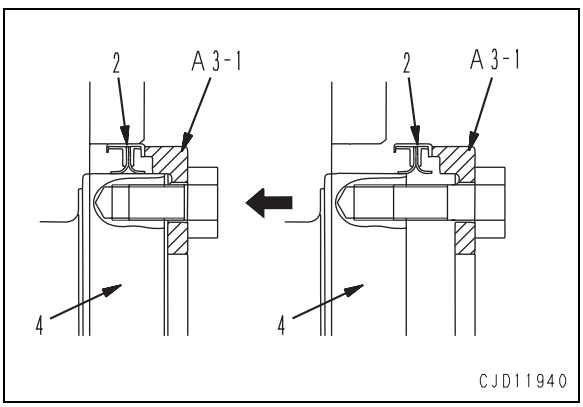
1) Put the large inside diameter side **b** of internal plastic cylinder (3) to the end of crankshaft (4).
   - ★ Take care not to mistake the direction of the plastic internal cylinder.



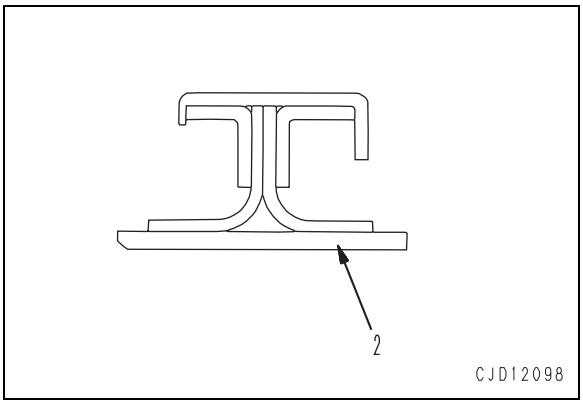
2) Evenly push in the metallic ring of seal (2) with both hands, getting over the large diameter side of the internal plastic cylinder.
3) After pushing in seal (2), remove internal plastic cylinder (3).
   - ★ When removing, take care not to damage the seal lip.



4) Tighten the bolt of tool **A3-1** evenly until the end of tool **A3-1** touches the end of crankshaft (4) to press fit seal (2).
   - ★ When press fitting the seal, take care not to damage the lip on the damper side with the tool, etc.
   - ★ After press fitting the seal, remove the red sealant layer on its periphery.

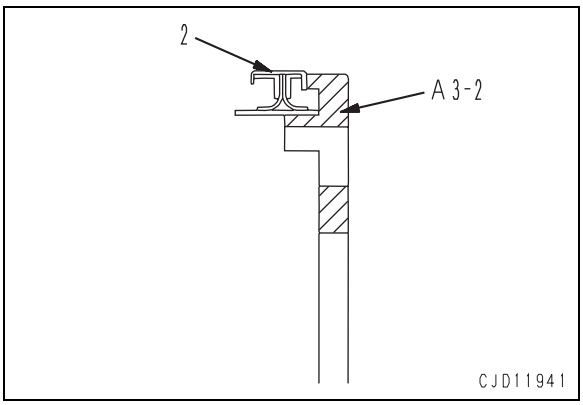


- Procedure for installing seal with sleeve **B**
  - ★ Before installing the seal, check the rims of the crankshaft end, sliding faces of the lip, and housing for flaw, burr, sharp fin, rust, etc.
  - ★ When installing the seal, do not apply oil, grease, etc. to the shaft. Wipe oil thoroughly from the shaft.
  - ★ Handle the seal and sleeve as an assembly. Never separate them from each other.

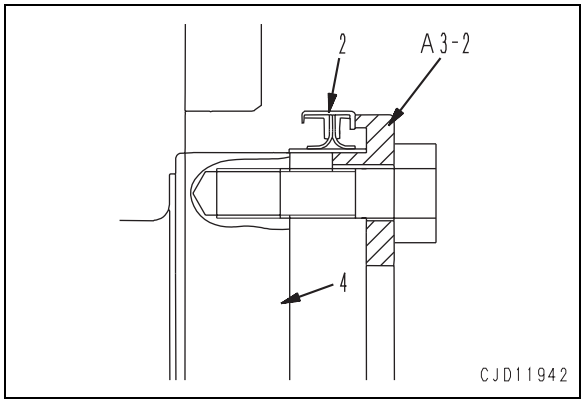


1) Set seal with sleeve (2) to tool **A3-2**.
   - ★ Take care not to mistake the direction of the seal.

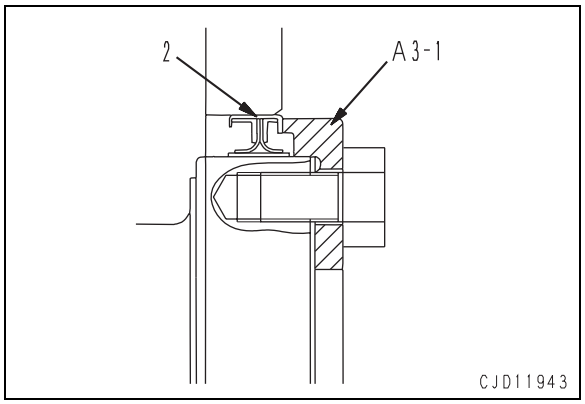
   Internal cylinder of sleeve:
   Gasket sealant (LG-7)



2) Put the sleeve of the seal to the end of the crankshaft and tighten the bolt of tool **A3-2** evenly until the end of tool **A3-2** touches the end of crankshaft (4) to press fit seal with sleeve (2).



3) Remove tool **A3-2** and install tool **A3-1**.
4) Tighten the bolt of tool **A3-1** evenly until the end of tool **A3-1** touches the end of crankshaft (4) to press fit seal with sleeve (2).
   - ★ After press fitting the seal, remove the red sealant layer on its periphery.



REMOVAL AND INSTALLATION OF ENGINE CYLINDER HEAD ASSEMBLY

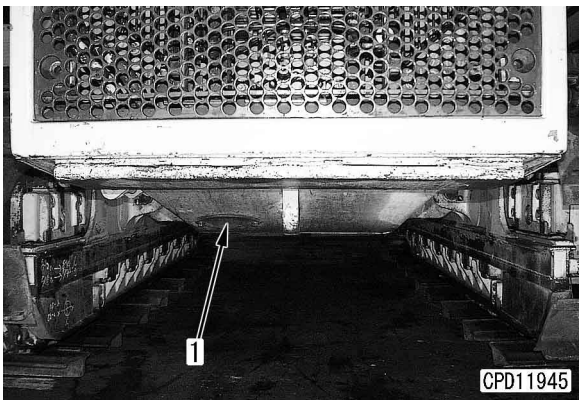
SPECIAL TOOLS

Symbol	Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
A4	790-331-1110	Wrench	■	1		

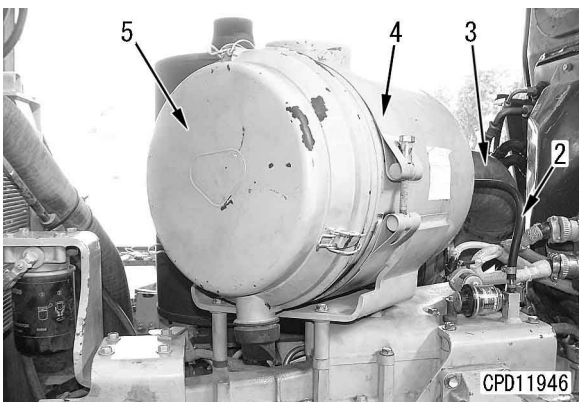
REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

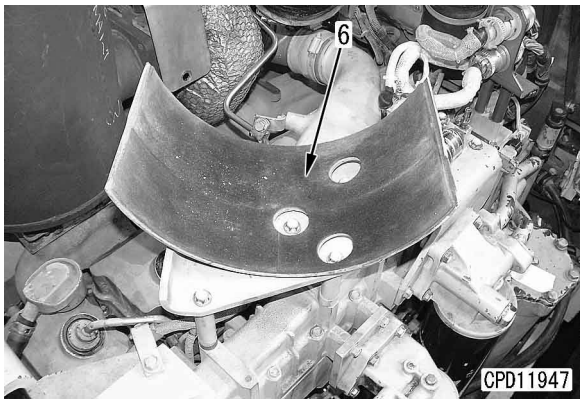
1. Remove the engine hood assembly. For details, see REMOVAL OF ENGINE HOOD ASSEMBLY.
2. Close the fuel supply valve of the fuel tank.
3. Remove drain cover (1) of the engine undercover and drain the cooling water.
   Cooling water: **Approx. 80** ℓ



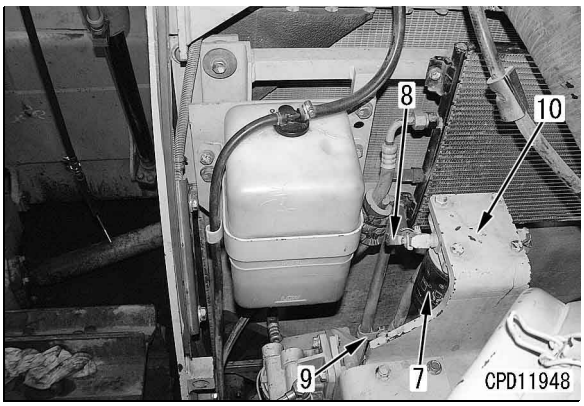
4. Remove the both engine side covers.
5. Disconnect dust indicator hose (2) from the dust indicator.
6. Loosen the clamp and disconnect hose (3). [*1]
7. Remove band (4) and air cleaner assembly (5). [*2]



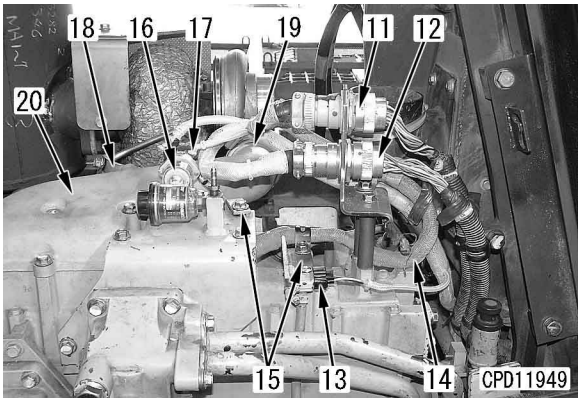
8. Remove the 4 mounting bolts and bracket (6).



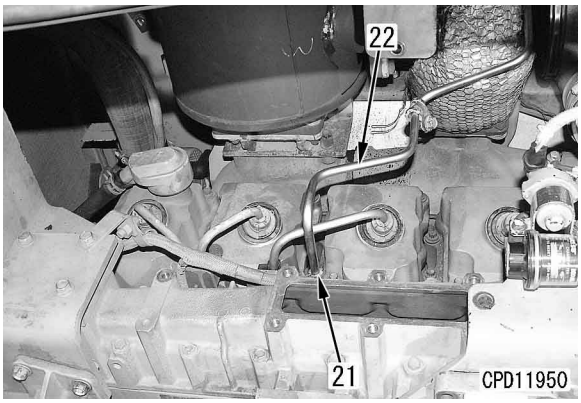
9. Close hose valve (8) of corrosion resistor (7), remove hose clamp (9), and remove the corrosion resistor and bracket (10) together.
   ★ Move the corrosion resistor aside.



10. Disconnect centralized connectors E21 (11) and E22 (12).
11. Disconnect boost pressure sensor connector PIM (13).
12. Remove 2 clamps (15) of wiring harness (14) of centralized connector E21 (11).
13. Disconnect wiring harness (17) on the ribbon heater side of ribbon heater relay (16) and remove ribbon heater relay (16). [*3]
14. Remove turbocharger lubrication tube clamp plate (18).
15. Loosen the hose clamp, disconnect hose (19), and remove air intake connector (20). [*4]



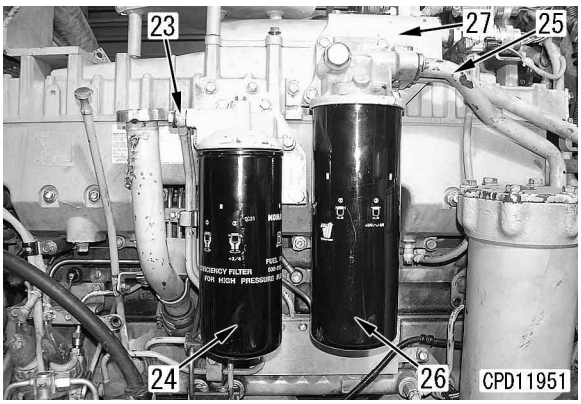
16. Remove clamp (21) and turbocharger lubrication inlet tube (22). [*5]



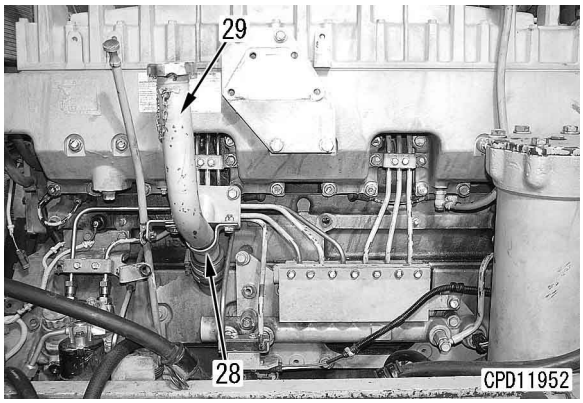
17. Disconnect 2 fuel filter tubes (23) and remove fuel filter (24).

18. Disconnect 2 oil filter tubes (25) and remove oil filter (26).

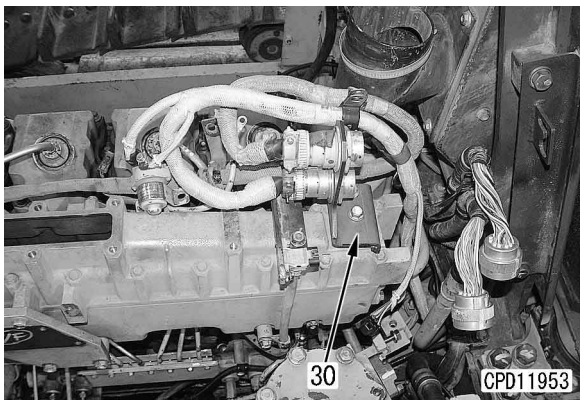
19. Remove oil filter bracket (27).



20. Remove oil supply pipe clamp (28) and oil supply clamp (29). [*6]

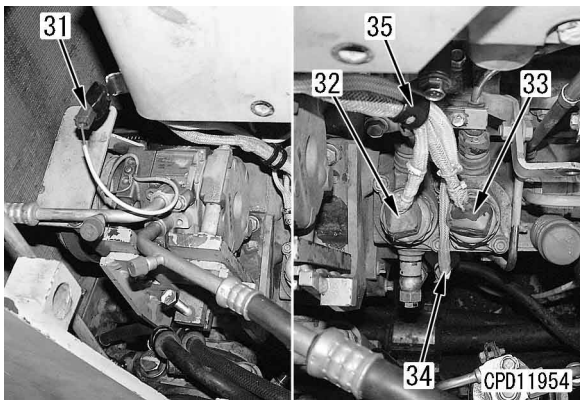


21. Remove centralized connector bracket (30). [*7]
★ Take care of the spacer.

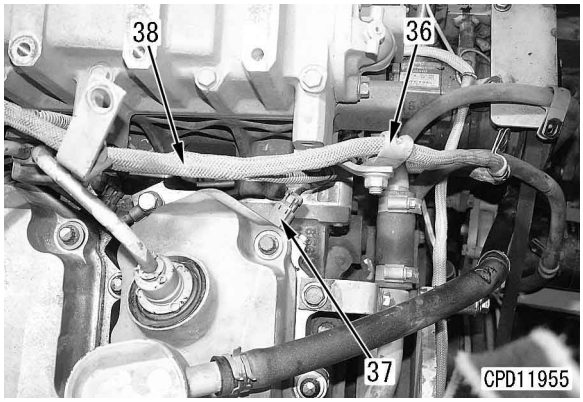


22. Disconnect air conditioner wiring harness A/C (31) and remove the connector from the clamp.

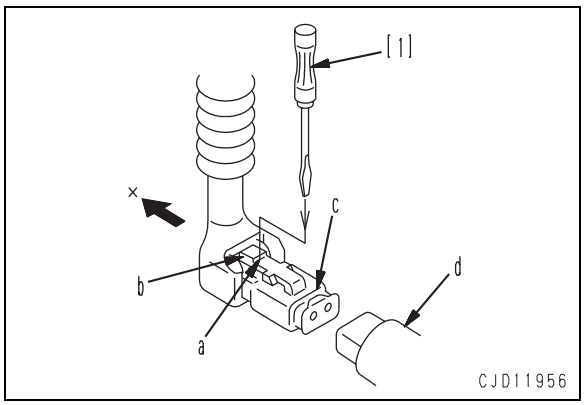
23. Disconnect 3 fuel supply pump wiring connectors PCV1 (32), PCV2 (33), and G (34) and remove 2 clamps (35).



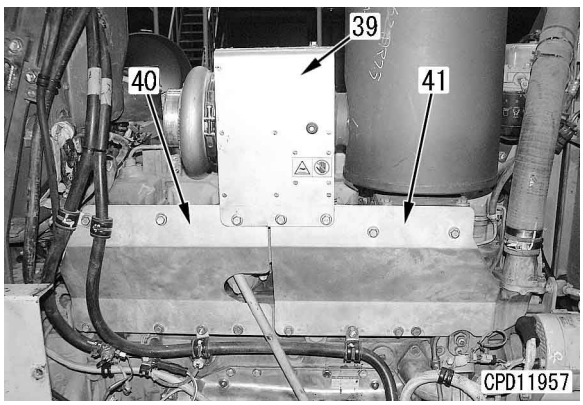
24. Remove wiring harness clamp (36) and disconnect 6 fuel injector connectors (37).
    ★ Place disconnected wiring harness assembly (38) on the dashboard side.



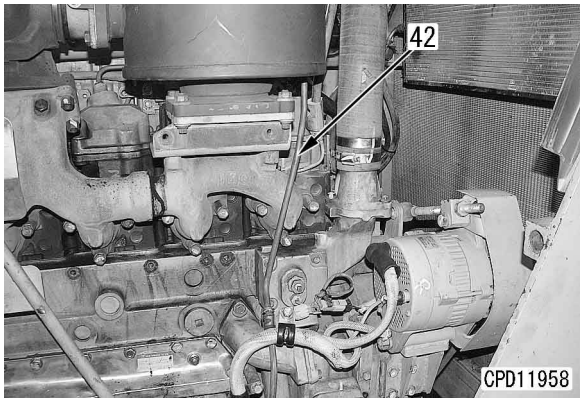
    ★ Insert a flat-head screwdriver [1] in shoulder **a**. Pressing stopper **b**, move the screwdriver in direction **X**, and connector **c** is disconnected.



25. Remove heat insulation covers (39), (40) and (41).
    ★ Take care of the spacer. [*8]



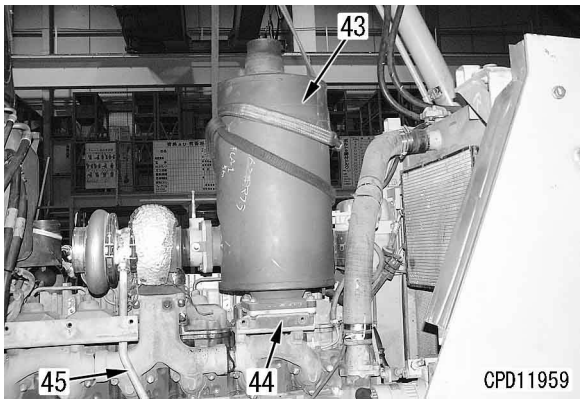
26. Remove the clamp and muffler drain tube (42).



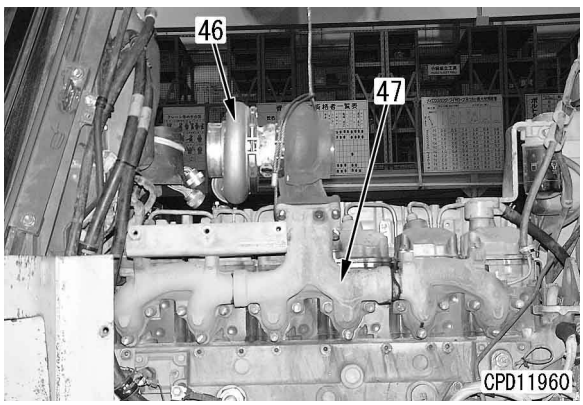
27. Sling muffler (43) temporarily and remove the mounting bolt on the turbocharger side and muffler bracket mounting bolts to remove the muffler.
    Muffler: **33 kg**

28. Remove muffler bracket (44).
    ★ Take care of the spacer. [*9]

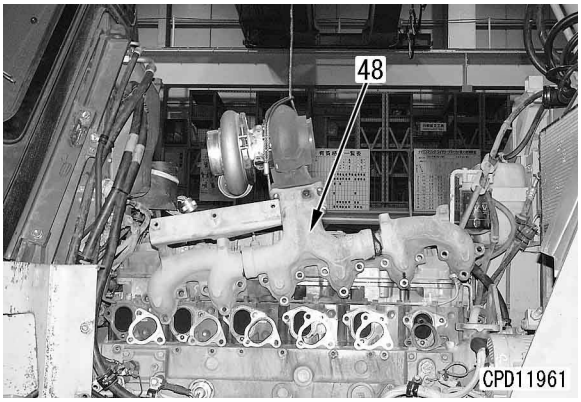
29. Remove turbocharger lubrication drain tube (45).



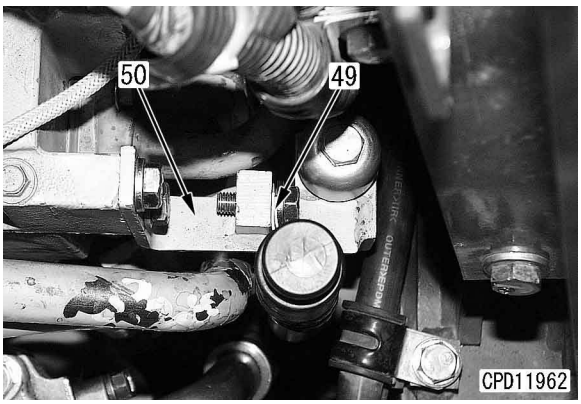
30. Sling turbocharger assembly (46) and remove the mounting bolts of exhaust manifold (47). [*10]
    ★ Take care of the spacer.



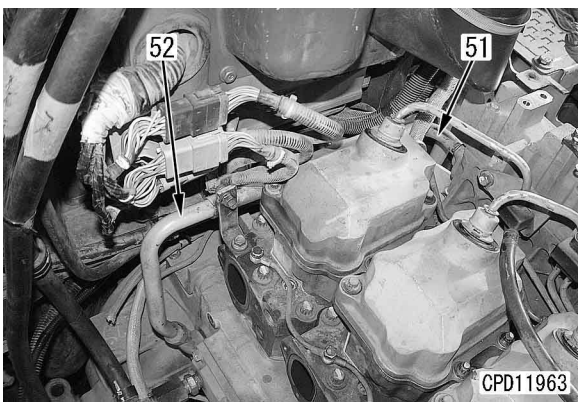
31. Lift off turbocharger and exhaust manifold assembly (48).
    Turbocharger and exhaust manifold assembly: **44 kg**



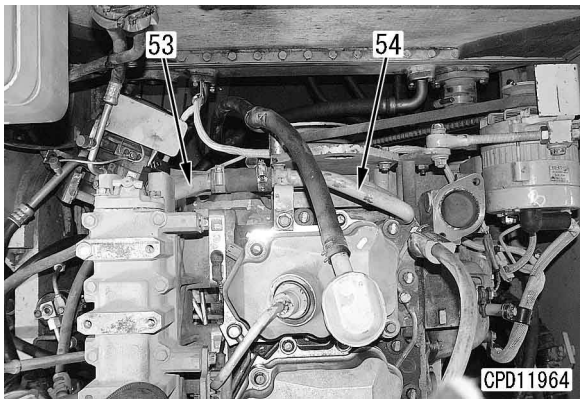
32. Remove clamp (49) of the damper oil level detection pipe and oil level detection pipe bracket (50).



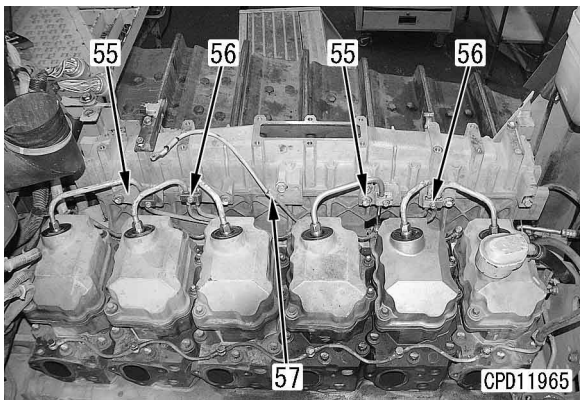
33. Remove aftercooler cooling inlet tube (51).
    ★ Since tube (51) is fitted deeply on the air intake manifold side, remove the clamp of tube (52) on the cylinder block side, too. [*11]



34. Remove aftercooler cooling outlet tube (53).
    ★ Since tube (53) is fitted deeply on the air intake manifold side, remove the clamp of tube (54) on the cylinder block side, too. [*12]

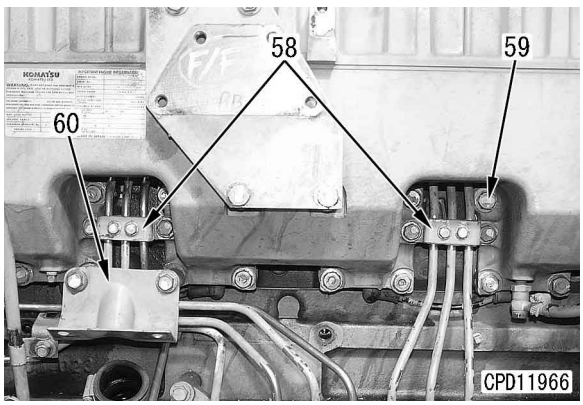


35. Remove 2 couples of high-pressure pipe clamps (55) and (56) and ribbon heater wiring harness clamp (57). [*13]



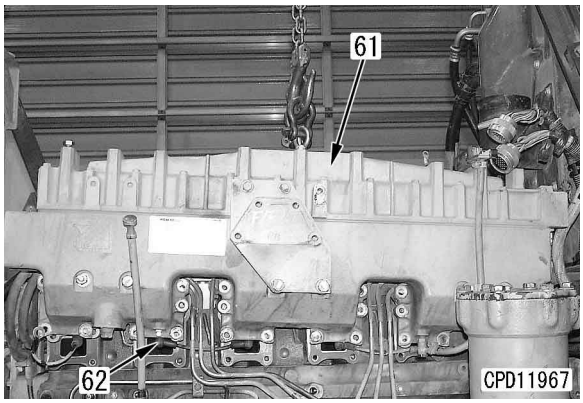
36. Remove 2 high-pressure pipe clamps (58). [*14]

37. Sling the air intake manifold temporarily and remove air intake manifold mounting bolts (59). [*15]
    ★ When removing oil supply pipe bracket (60), take care of the spacer. [*16]

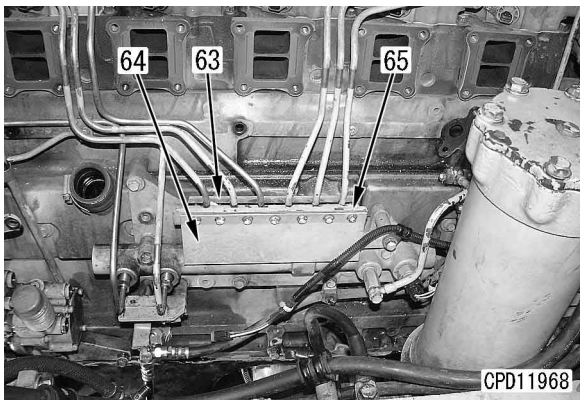


38. Lift off air intake manifold assembly (61).

39. Remove ribbon heater assembly (62).
★ When slinging the air intake manifold assembly, take care of the ribbon heater assembly which comes off the assembly.



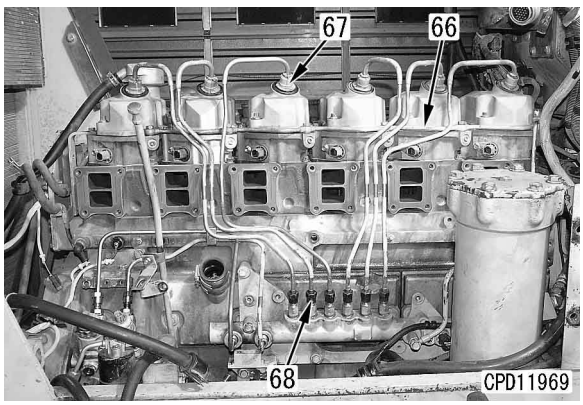
40. Remove high-pressure pipe clamp (63) on the common rail side and cover (64), and then remove gate-type bracket (65). [*17]



41. Remove cooling water tube (66).

42. Remove each high-pressure pipe cap (67). [*18]

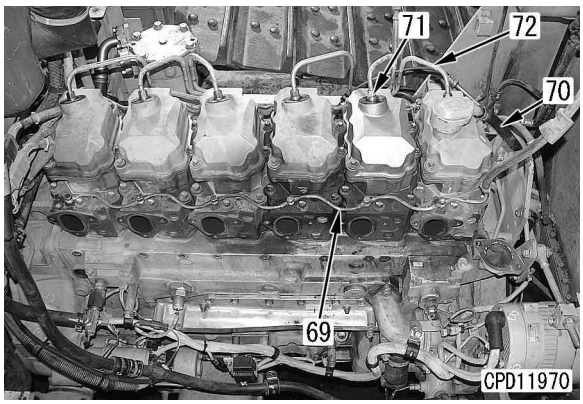
43. Remove 6 high-pressure pipe joint bolts (68) on the common rail side. [*19]



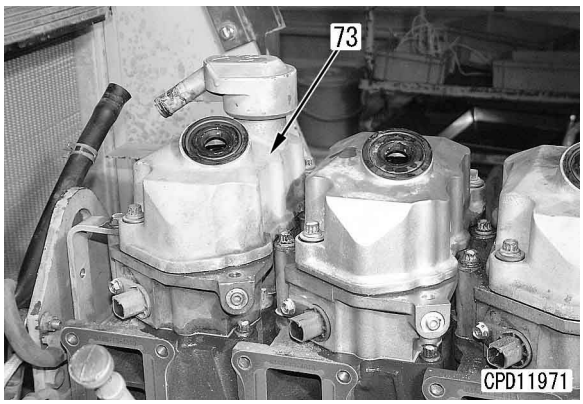
44. Remove spill tube (69). [*20]

45. Remove breather hose (70) of No. 1 head cover.

46. Loosen 6 high-pressure pipe joint bolts (71) on the head side and remove 6 high-pressure pipes (72). [*21]

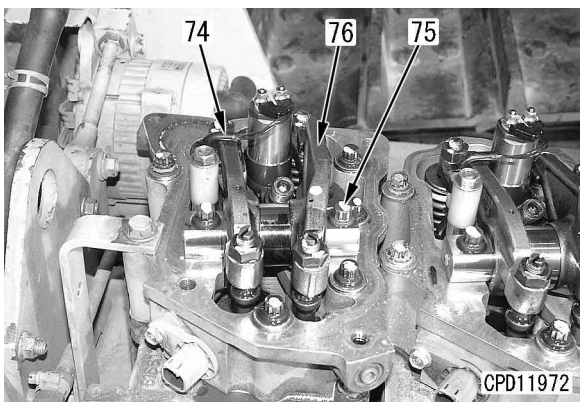


47. Remove 6 head covers (73). [*22]



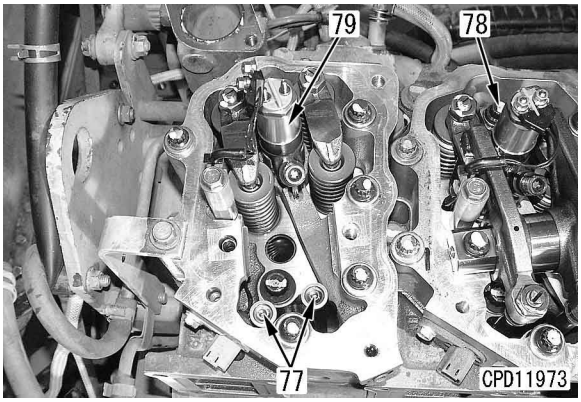
48. Disconnect wiring harness (74) from the injector. [*23]

49. Remove rocker shaft mounting bolt (75) and rocker arm and rocker shaft assembly (76). [*24]



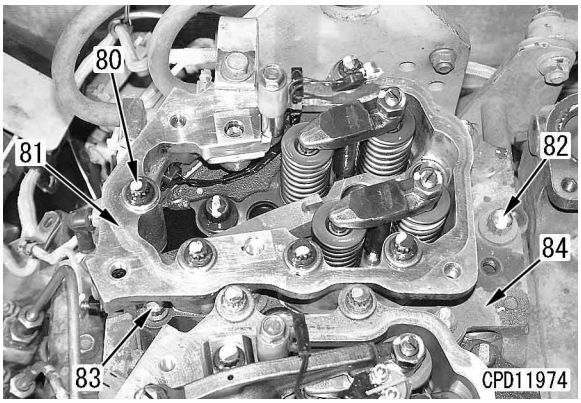
50. Remove 2 push rods (77).

51. Remove injector mounting bolt (78) and injector assembly (79). [*25]



52. Remove 6 mounting bolts (80) and rocker housing (81). [*26]

53. Remove 6 cylinder head mounting bolts (82), 1 auxiliary bolt (83), and cylinder head assembly (84). [*27]



INSTALLATION

- Carry out installation in the reverse order to removal.

[*1]
Hose clamp:
8.8 ± 0.5 Nm {0.9 ± 0.5 kgm}

[*2]
Band clamp:
9.8 – 11.76 Nm {1.0 – 1.2 kgm}

[*3]
Wiring harness mounting nut:
2.5 – 2.9 Nm {0.25 – 0.3 kgm}

[*4]
Hose clamp:
6.8 ± 0.49 Nm {69 ± 5 kgcm}

[*5]
Joint bolt on engine block side:
24.5 – 34.3 Nm {2.5 – 3.5 kgm}

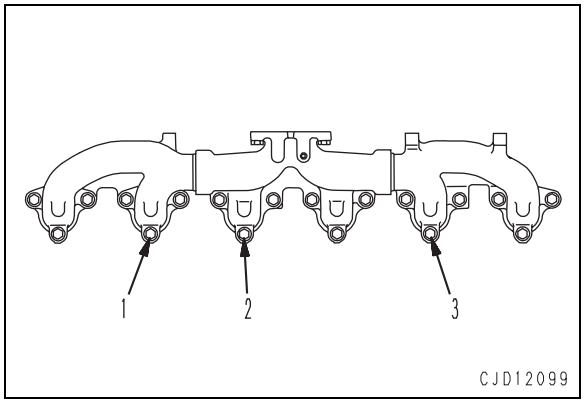
[*6]
Hose clamp:
5.9 ± 0.49 Nm {0.6 ± 0.05 kgm}

[*7]
Length of spacer: **L** = 84 mm (2 pieces)

[*8]
Length of spacer: **L** = 60.5 mm (2 pieces)
L = 108.5 mm (8 pieces)

[*9]
Length of spacer: **L** = 18 mm (4 pieces)

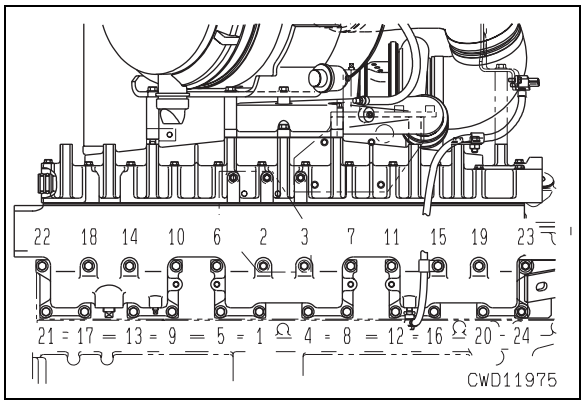
[*10]
Tighten the exhaust manifold assembly mounting bolts in the order shown below, and then tighten the other bolts.
Exhaust manifold assembly mounting bolt:
58.8 – 73.5 Nm {6 – 7.5 kgm}



[*11] [*12]
Cooling tube connecting hose clamp:
4.4 ± 0.49 Nm {0.45 ± 0.5 kgm}

[*13] [*14] [*17] [*18] [*19] [*21]
★ For the procedure for tightening the high-pressure pipe, see REMOVAL, INSTALLATION OF NOZZLE HOLDER ASSEMBLY.

[*15]
Tighten the air intake manifold assembly mounting bolts in the order shown below.



[*16]
Length of spacer: **L** = 45.8 mm (2 pieces)

[*20]
Spill tube: **9.8 – 12.7 Nm {1.0 – 1.3 kgm}**

[*22]
Head cover mounting bolt:
1.0 ± 0.1 Nm {15 ± 1 kgm}

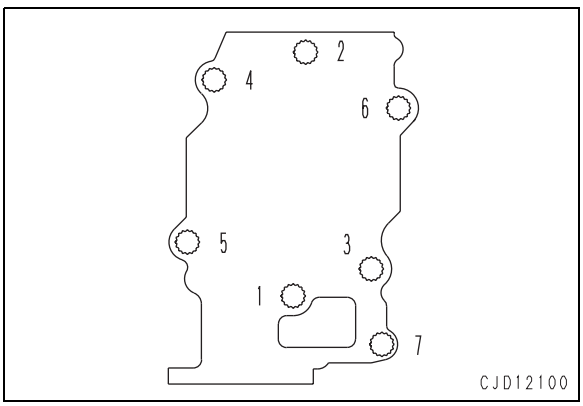
[*23]
Wiring harness capture nut:
2.0 – 2.4 Nm {0.2 – 0.24 kgm}

[*24]
Rocker shaft mounting bolt:
58.8 – 73.5 Nm {6 – 7.5 kgm}
★ For the procedure for adjusting the valve clearance, see TESTING AND ADJUSTING, Adjusting valve clearance.

[*25]
★ For the procedure for installing the injector and nozzle holder, see REMOVAL, INSTALLATION OF NOZZLE HOLDER ASSEMBLY.

[*26]
Rocker housing mounting bolt:
58.8 – 73.5 Nm {6 – 7.5 kgm}

[*27]
★ Clean the underside of the head, top of the block, and liners with dry cloth or cloth soaked with solvent.
★ Tighten each bolt into the block with the fingers at least 2 turns.
Threads of bolt and underside of bolt head: **LM-P or engine oil (E030-CD)**
★ Tighten the cylinder head mounting bolts in the order shown below.
Cylinder head mounting bolts 1 – 6:
1st time: **88.3 – 108 Nm {9 – 11 kgm}**
2nd time: **157 – 167 Nm {16 – 17 kgm}**
3rd time:
1) When using tool **A4**
Using tool **A4**, retighten each bolt by $90° {}^{+30°}_{0}$ in the order of 1 – 6.



2) When not using tool **A4**
Make marks on the all bolts and cylinder head with a marker, then retighten each bolt by 90° $^{+30^\circ}_{0}$ in the order of 1 – 6.

★ After tightening bolts 1 – 6, tighten auxiliary bolt 7.

Cylinder head auxiliary mounting bolt 7: **66.2 ± 7.4 Nm {6.8 ± 0.8 kgm}**

- **Refilling with water**
Add water through the water filler to the specified level. Run the engine to circulate the water through the system. Then, check the water level again.

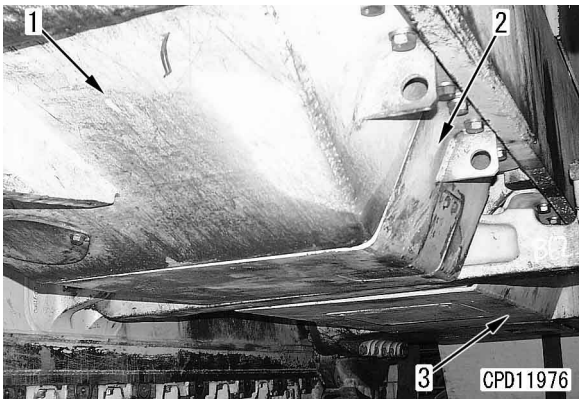
Cooling water: **Approx. 80** ℓ

REMOVAL AND INSTALLATION OF ENGINE OIL PAN

REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Open undercovers (1) and (2) and remove undercover (3).

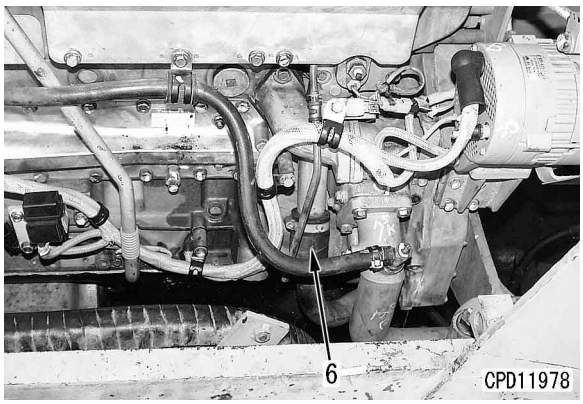


2. Drain the engine oil. [*1]
   Engine oil: **Approx. 47** ℓ
   ★ Remove the engine oil level gauge.

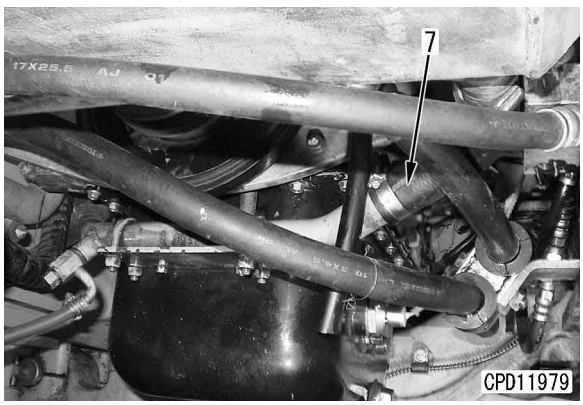
3. Drain the cooling water from the radiator.
   Cooling water: **Approx. 80** ℓ

4. Open both engine side covers (4) and remove both side covers (5).

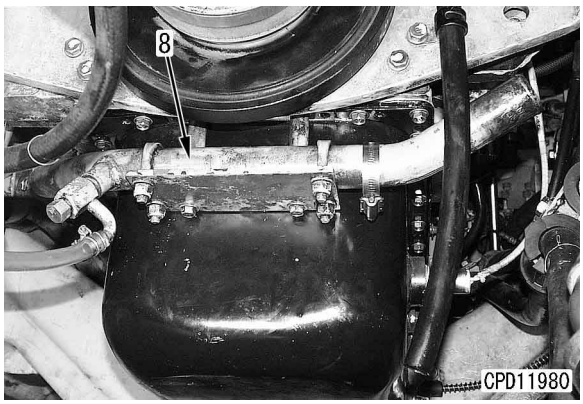
5. Loosen the clamp and disconnect radiator tube hose (6) on the cylinder block side.



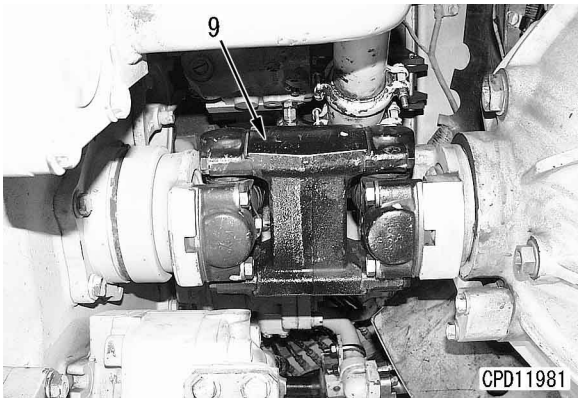
6. Loosen the clamp and disconnect tube hose (7) on the upper side of the radiator.



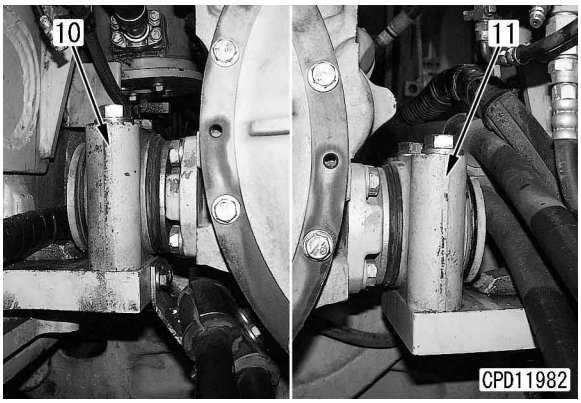
7. Remove tube assembly (8) on the upper side of the radiator.
   ★ Take care of the spacer. [*2]



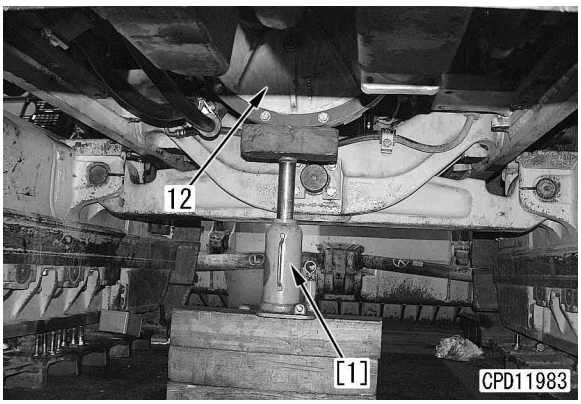
8. Disconnect universal joint assembly (9). [*3]



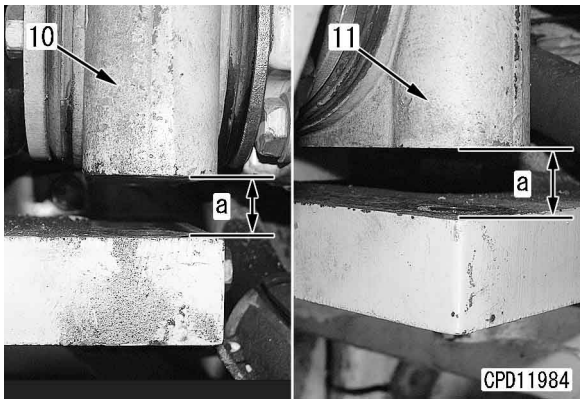
9. Remove the mounting bolts of both rear engine mounts (10) and (11).



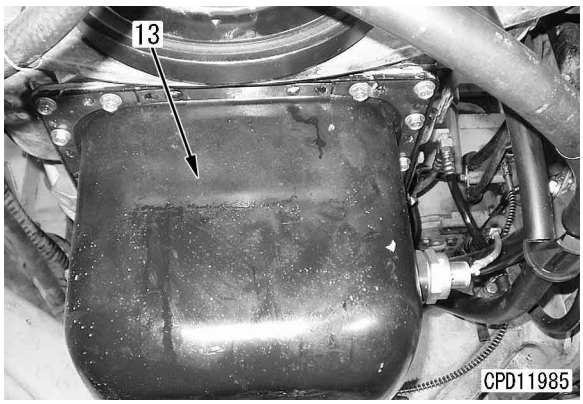
10. Set jack [1] under damper (12) to push up the damper.



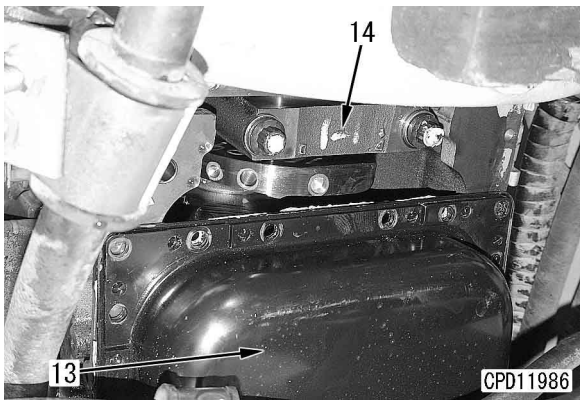
11. Push up the damper until clearance **a** of both rear engine mounts (10) and (11) is 25 mm.
    ★ This work must be performed to prevent the main cap of No. 6 engine cylinder from interfering with the oil pan when the oil pan is pulled out.



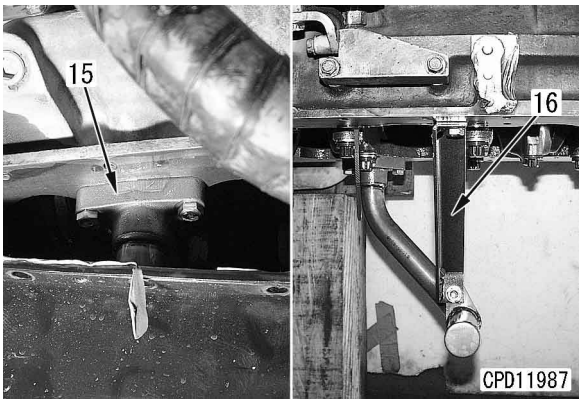
12. Remove the mounting bolts of engine oil pan (13). [*4]



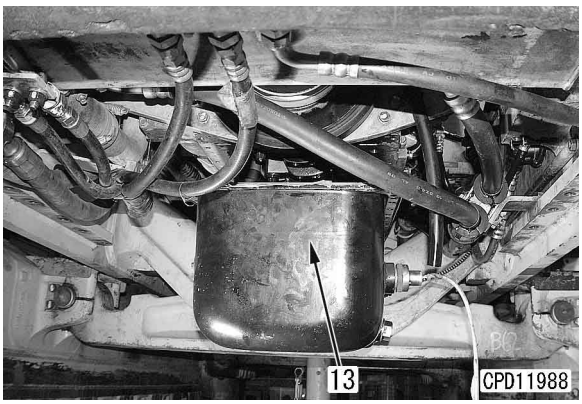
13. Pull oil pan (13) forward until it can pass main cap (14) of No. 6 engine cylinder.



14. Remove oil suction pipe (15) and pipe bracket (16) together.



15. Pull oil pan (13) forward to remove it.
    Oil pan: **26 kg**



INSTALLATION

- Carry out installation in the reverse order to removal.

[*1]
Drain plug:
127.4 – 176.4 Nm {13 – 18 kgm}

[*2]
Length of spacer: **L** = 98.5 mm (2 pieces)

[*3]
Mounting bolt:
98.1 – 122.6 Nm {10 – 12.5 kgm}

[*4]
Mating face of oil pan:
Gasket sealant (LG-7)

- **Refilling with water**
  Add water through the water filler to the specified level. Run the engine to circulate the water through the system. Then, check the water level again.
  Cooling water: **Approx. 80** ℓ

- **Refilling with oil**
  Tighten the drain plug and add oil through the engine oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.
  Oil pan: **Approx. 47** ℓ

REMOVAL AND INSTALLATION OF FUEL TANK ASSEMBLY

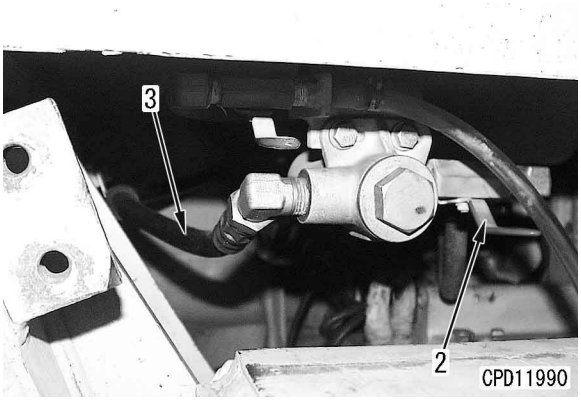
REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove rear cover (1).

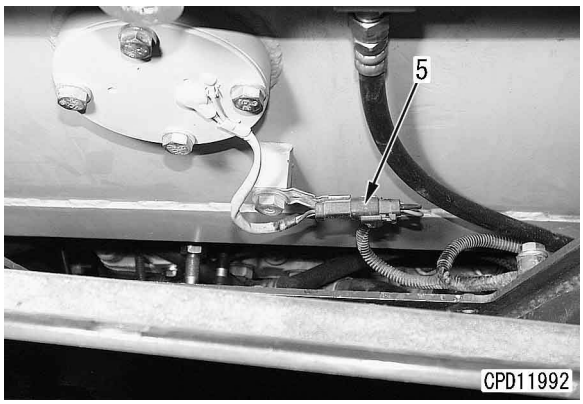
2. Close fuel supply valve (2).

3. Disconnect fuel supply hose (3).

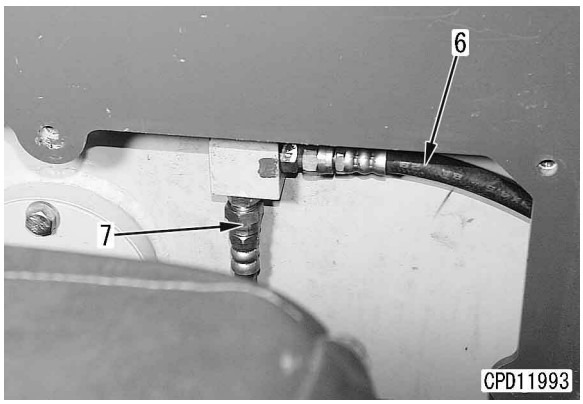


4. Remove sear rear cover (4).

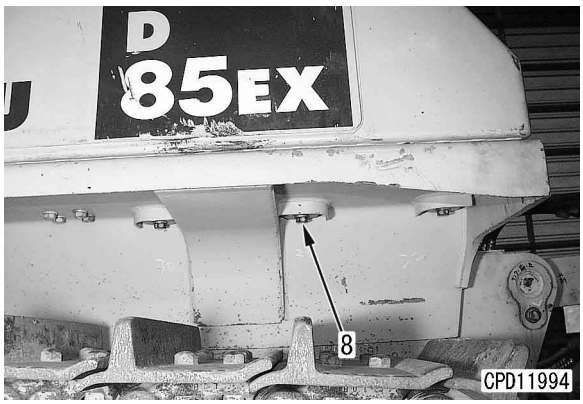
5. Disconnect fuel level sensor wiring connector 423 (5).



6. Disconnect 2 fuel return hoses (6) and (7).



7. Remove 6 fuel tank mounting bolts (8).



8. Lift off fuel tank assembly (9).
   Fuel tank assembly: **215 kg (When empty)**
   618 kg (When full)

INSTALLATION

- Carry out installation in the reverse order to removal.

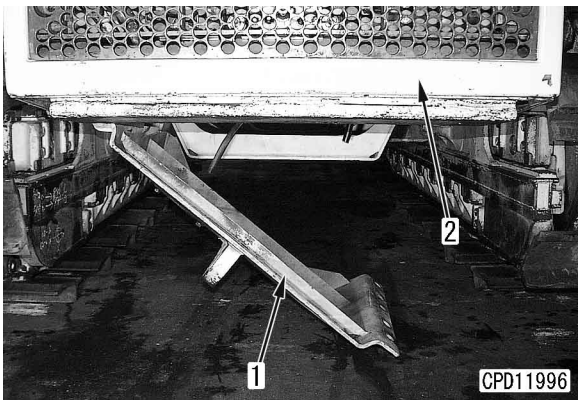
REMOVAL AND INSTALLATION OF RADIATOR ASSEMBLY

REMOVAL

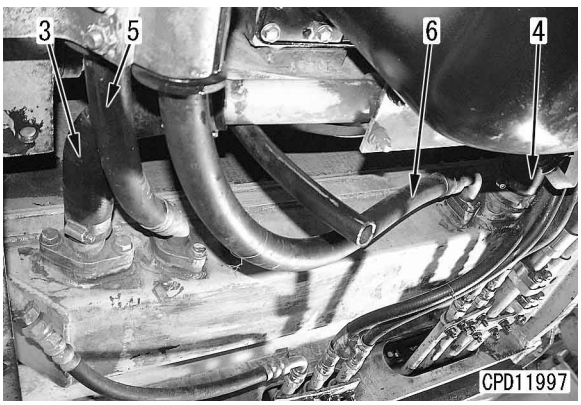
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Drain the cooling water from the radiator.
   Cooling water: **Approx. 80** ℓ

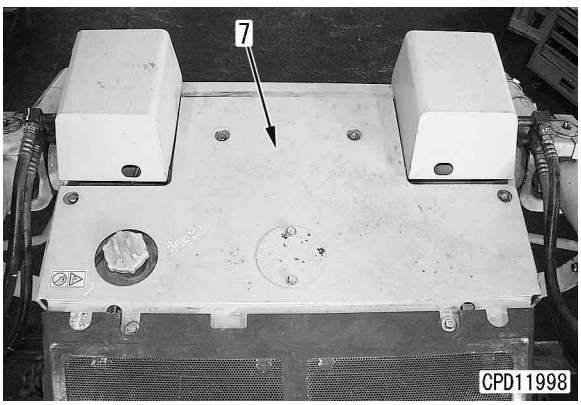
2. Open undercover (1) and guard (2).



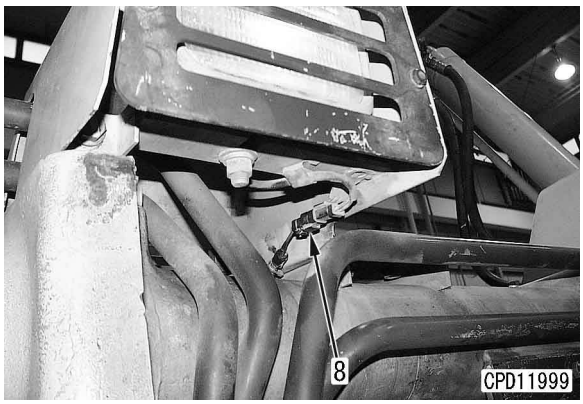
3. Disconnect radiator bypass inlet hose (3), radiator outlet hose (4), power train oil cooler inlet hose (5), and outlet hose (6). [*1]



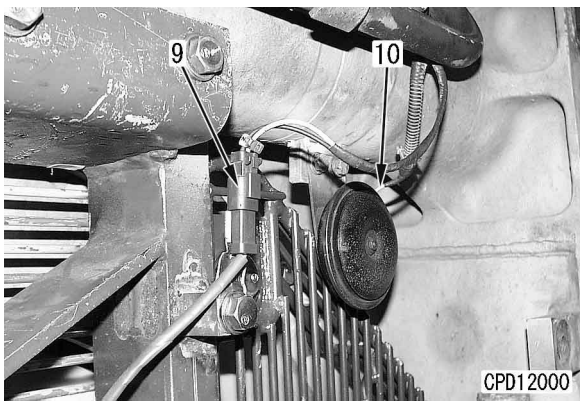
4. Remove radiator upper cover (7).



5. Disconnect right and left head lamp wiring connectors 203 and 204 (8).



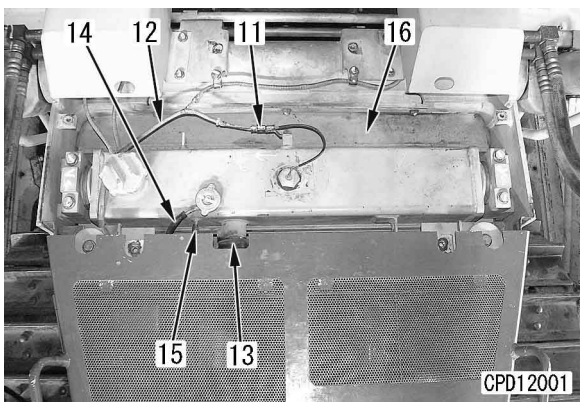
6. Disconnect fan motor solenoid wiring connector FAR2 (9) and horn wiring connector 205 (10).



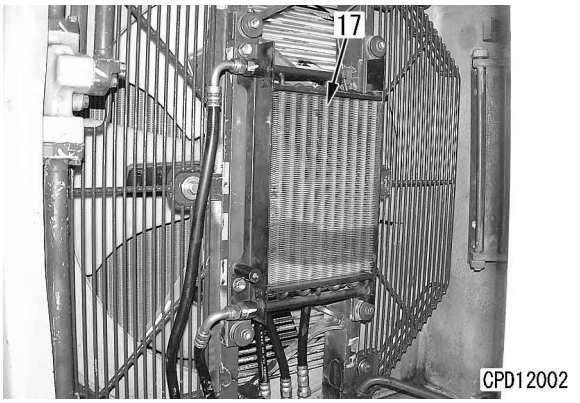
7. Disconnect radiator water level sensor wiring connector WLD (11) and remove the 2 clamps of wiring harness assembly (12).
   ★ Pull out the wiring harness assembly and place it on the hood.

8. Disconnect radiator inlet hose (13), reservoir hose (14), and aeration hose (15).

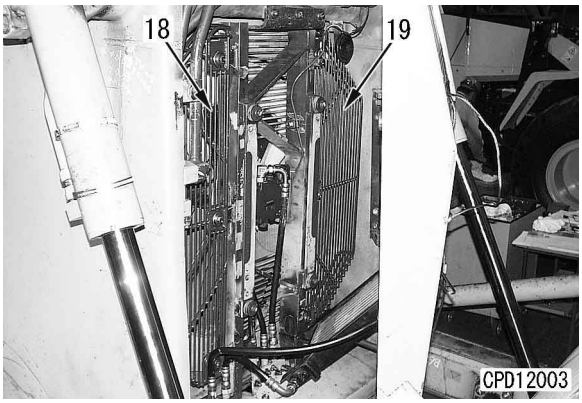
9. Remove windbreak plate (16). [*2]



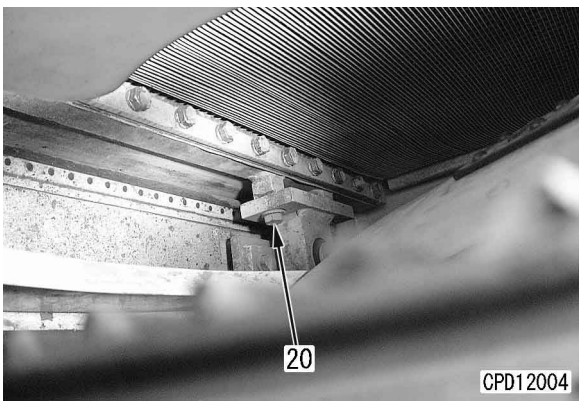
10. Remove hydraulic oil cooler assembly (17).
    ★ Move the oil cooler assembly aside.



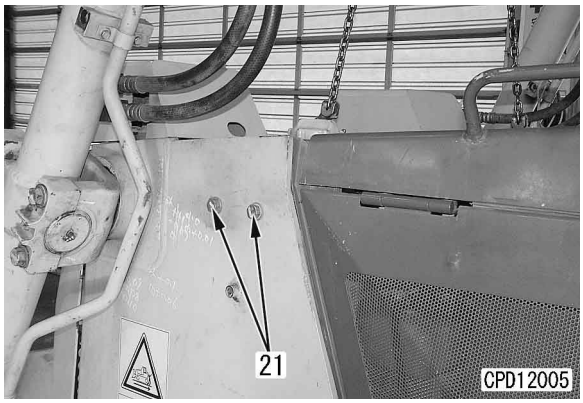
11. Remove both fan guards (18) and (19).



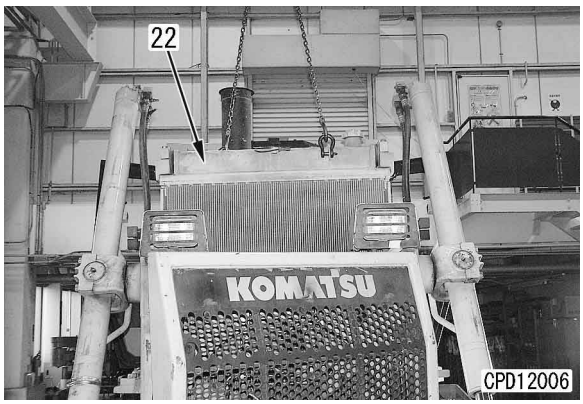
12. Remove 2 mounting bolts (20) of radiator lower bracket.
    ★ The lower bracket is between the fan and radiator.



13. Sling the radiator assembly temporarily and remove 2 mounting bolts (21) on each side.



14. Lift off the radiator assembly (22).
    Radiator assembly: **286 kg**



INSTALLATION

- Carry out installation in the reverse order to removal.

[*1]
Radiator bypass inlet hose (3):
8.8 ± 0.5 Nm {90 ± 5 kgcm}
Radiator outlet hose (3):
8.8 ± 0.5 Nm {90 ± 5 kgcm}

[*2]
★ Fit the rubber windbreak plate to the radiator tank securely.

- **Refilling with water**
  Add water through the water filler to the specified level. Run the engine to circulate the water through the system. Then, check the water level again.
  Cooling water: **Approx. 80 ℓ**

REMOVAL AND INSTALLATION OF ENGINE 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 (100V)	■	1		
	799-703-1110	Vacuum pump (220V)	■	1		
	799-703-1120	Vacuum pump (240V)	■	1		
	799-703-1401	Gas leak detector	■	1		

REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

★ For the method of changing the fuel injection amount adjustment after the engine assembly or engine controller is replaced, ask your Komatsu distributor.

1. Drain the cooling water.

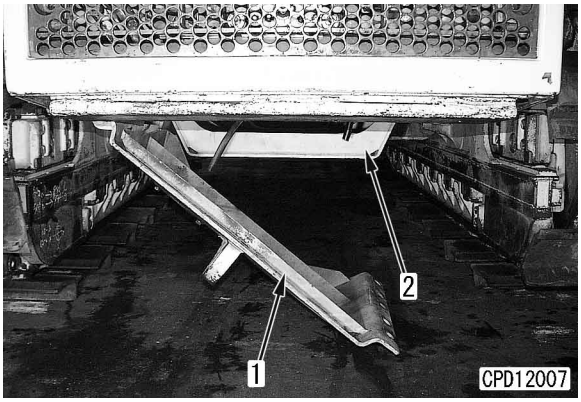
   Cooling water: **Approx. 80** ℓ

2. Remove the engine hood assembly. For details, see REMOVAL OF ENGINE HOOD ASSEMBLY.

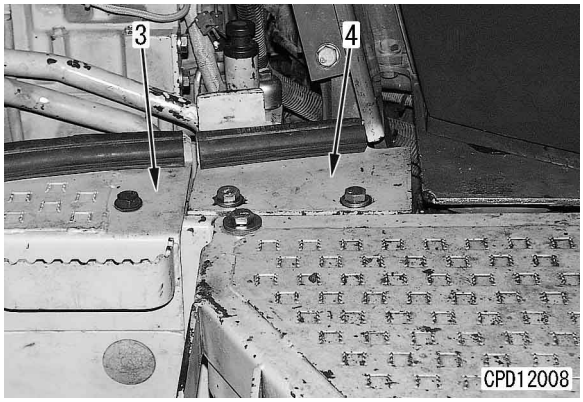
3. Remove the radiator assembly. For details, see REMOVAL OF RADIATOR ASSEMBLY.

4. Close the fuel supply valve of the fuel tank.

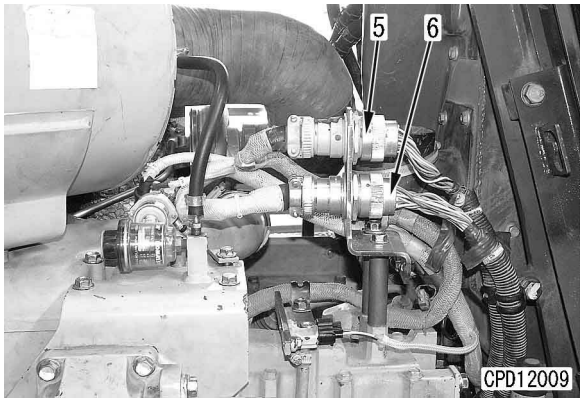
5. Open undercovers (1) and (2).



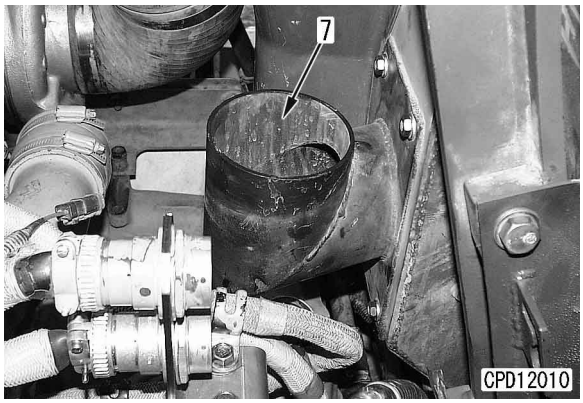
6. Remove engine side covers (3) and plates (4) on both sides.



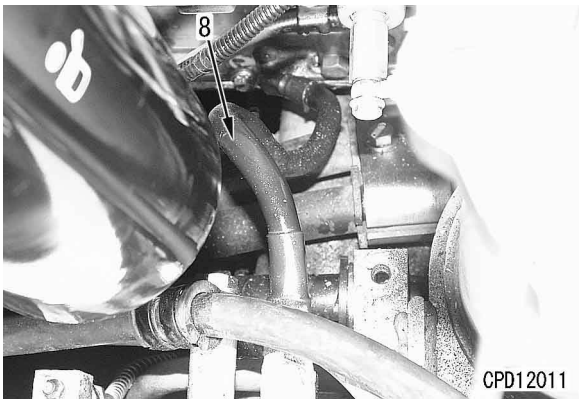
7. Disconnect centralized connectors E21 (5) and E22 (6).



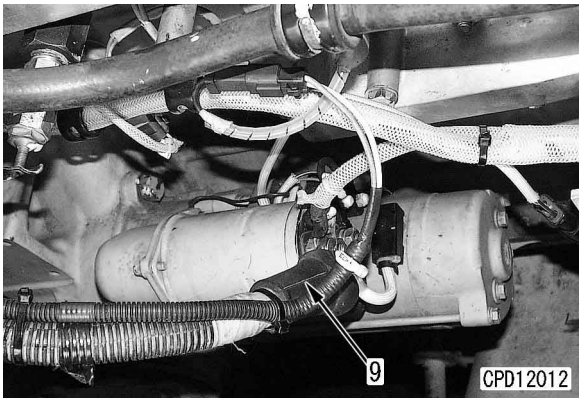
8. Remove fresh air suction tube (7).



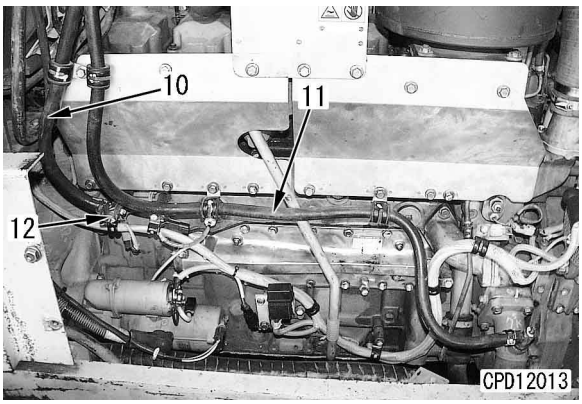
9. Disconnect ground wire (8).



10. Disconnect starting motor wire (9).

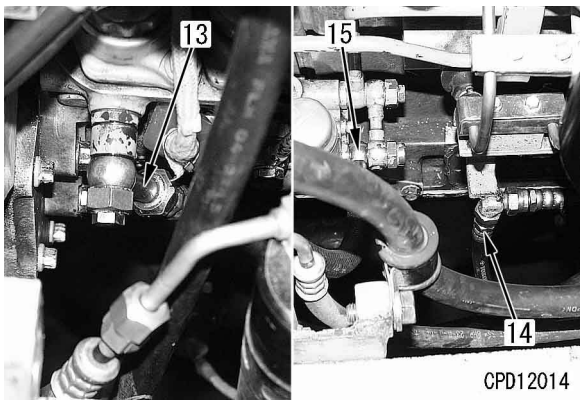


11. Remove the 3 hose clamps and disconnect heater hoses (10) and (11). [*1]
    ★ Close heater valve (12) on the engine side.
    ★ Take care of the spacers of the 2 hose clamps.

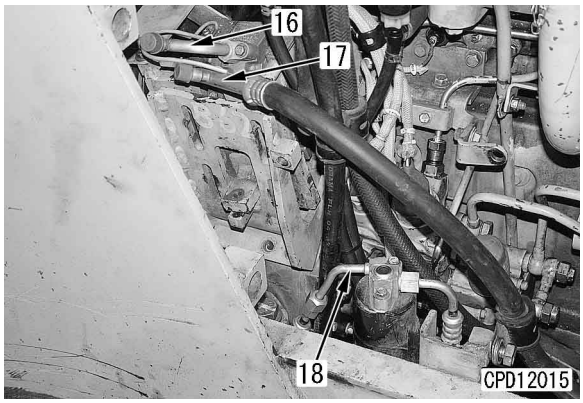


12. Disconnect fuel return hoses (13) and (14).

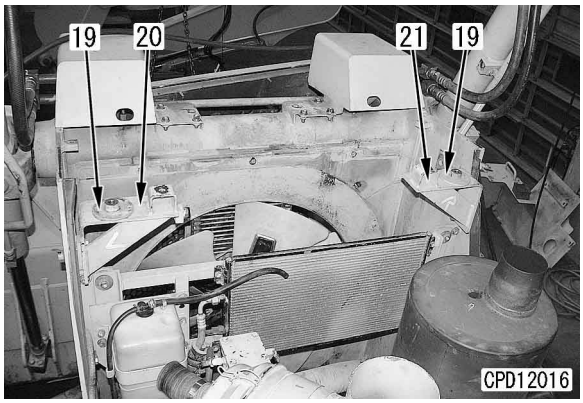
13. Disconnect fuel supply hose (15).



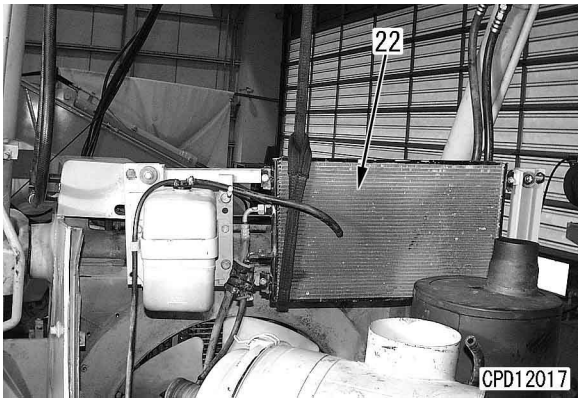
14. Disconnect 2 tubes (16) and (17) on the air compressor side and 1 tube (18) on the receiver tank.
    ★ Before disconnecting the air compressor tubes, collect new Freon gas (R134a).



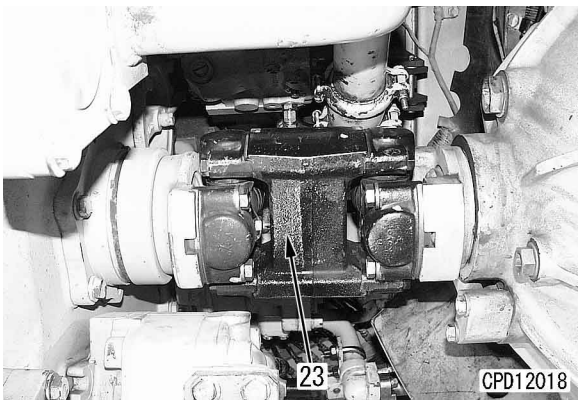
15. Remove spacer (19) and both hood brackets (20) and (21).



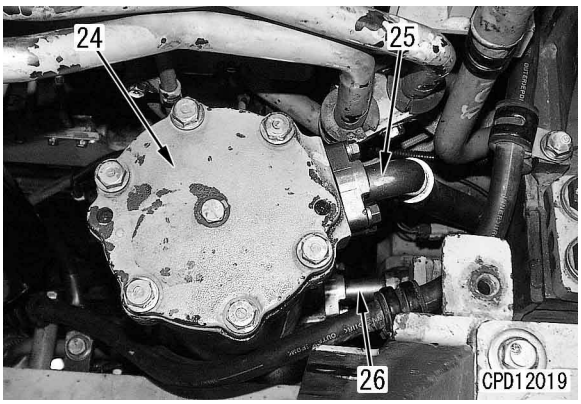
16. Sling condenser assembly (22) and remove the mounting bolts and condenser assembly.
    ★ Remove the condenser assembly and reservoir tank together.



17. Remove universal joint assembly (23). [*2]

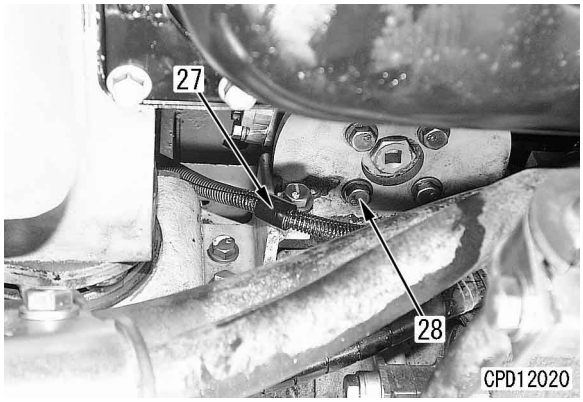


18. Disconnect 2 pipes (25) and (26) of power train line filter assembly (24).
    ★ Cover the disconnected flanges to prevent foreign matter from entering them.

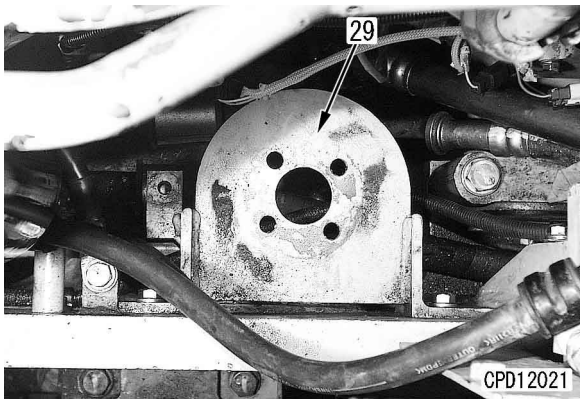


19. Remove wiring harness clamp (27) under the power train line filter assembly bracket, and then remove the wiring harness.

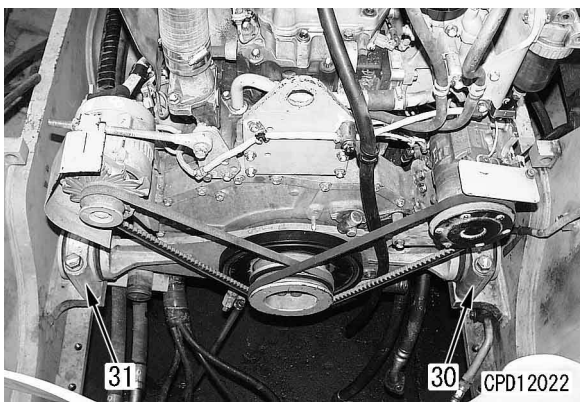
20. Remove 4 mounting bolts (28) of the power train line filter assembly, and then remove the power train line filter assembly.
    Power train line filter assembly: **23 kg**



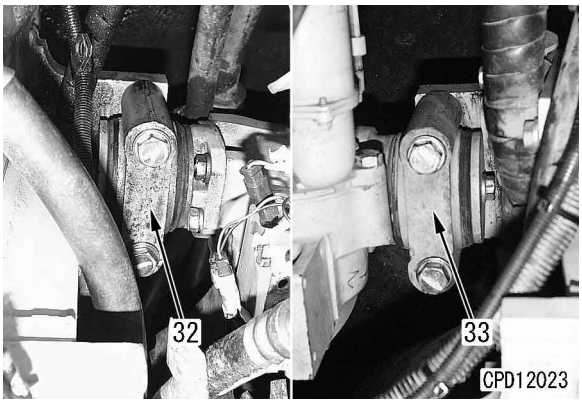
21. Remove power train line filter assembly bracket (29).



22. Remove the 2 mounting bolts of front engine mounts (30) and (31).

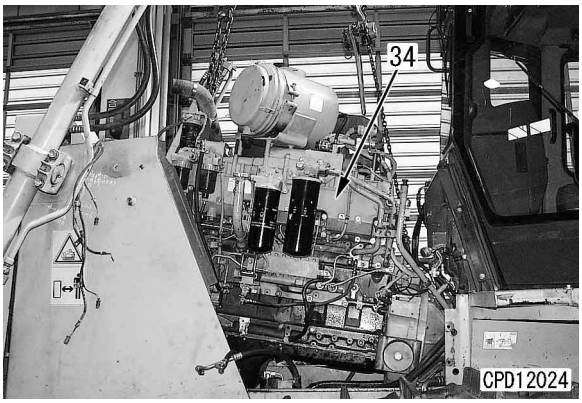


23. Remove the 2 mounting bolts of rear engine mounts (32) and (33).



24. Lift off engine assembly (34).
    ★ Before lifting off the engine assembly, check that all the wires and pipes are disconnected.

    Engine assembly: **1,390 kg**



INSTALLATION

- Carry out installation in the reverse order to removal.
  ★ For the method of changing the fuel injection amount adjustment after the engine assembly or engine controller is replaced, ask your Komatsu distributor.

[*1]
Length of spacer: **L** = 108.5 mm (2 pieces)

[*2]
Mounting bolt:
98.1 – 122.6 Nm {10 – 12.5 kgm}

- **Refilling with water**
  Add water through the water filler to the specified level. Run the engine to circulate the water through the system. Then, check the water level again.

  Cooling water: **Approx. 80 ℓ**

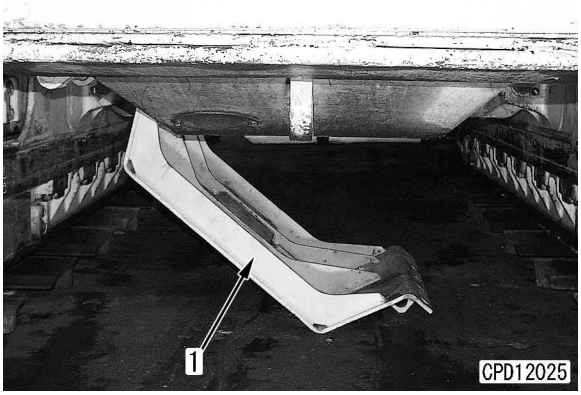
- **Charging air conditioner with refrigerant gas**
  Using tool **X2**, charge the air conditioner circuit with new Freon gas (R134a).

REMOVAL AND INSTALLATION OF DAMPER ASSEMBLY

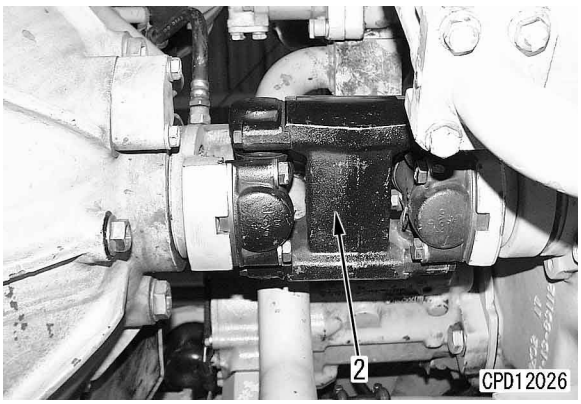
REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

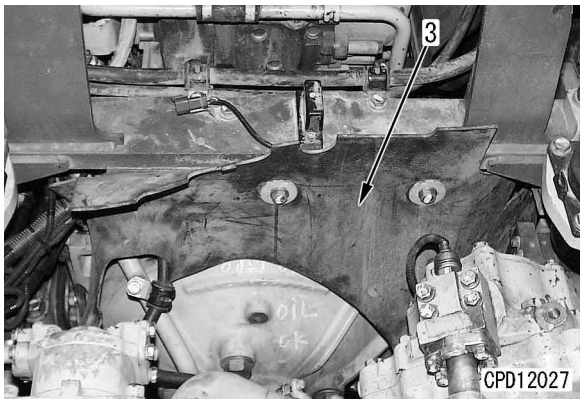
1. Remove the engine hood assembly. For details, see REMOVAL OF ENGINE HOOD ASSEMBLY.
2. Remove the operator's cab assembly. For details, see REMOVAL OF OPERATOR'S CAB ASSEMBLY.
3. Remove the floor frame assembly. For details, see REMOVAL OF FLOOR FRAME ASSEMBLY.
4. Open undercover (1).



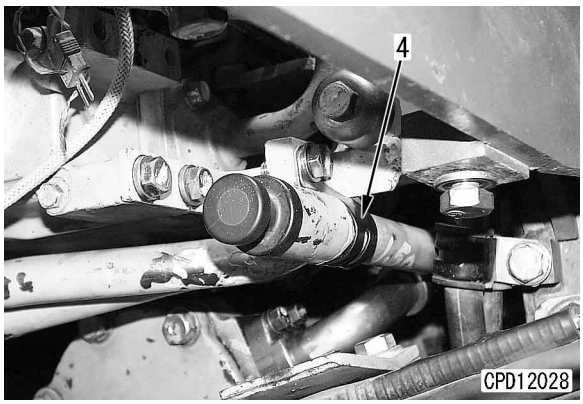
5. Drain the oil from the damper chamber.
   Oil in damper chamber: **Approx. 1.5 ℓ**
6. Remove universal joint assembly (2). [*1]



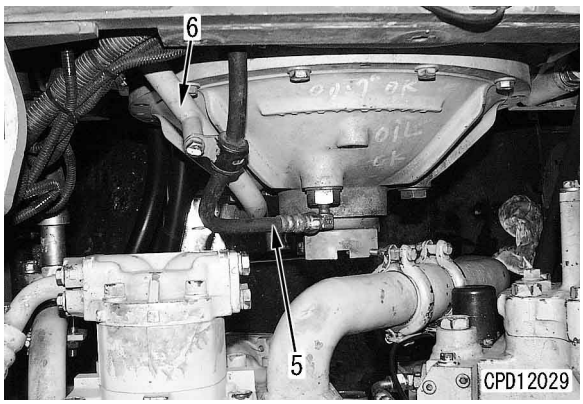
7. Remove rubber cover (3).



8. Loosen clamp (4) of damper oil level detection pipe.

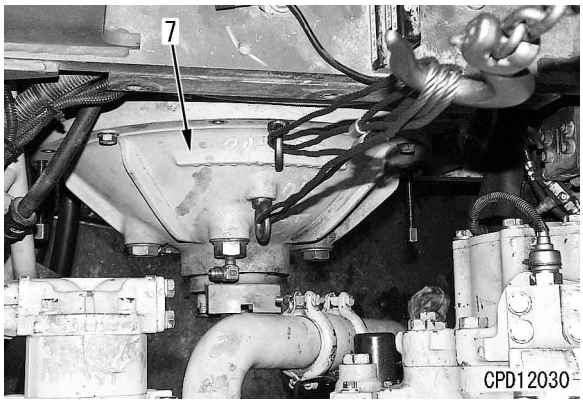


9. Disconnect breather hose (5) and remove oil level detection pipe (6) and breather hose together.
   ★ Move the oil level detection pipe aside.



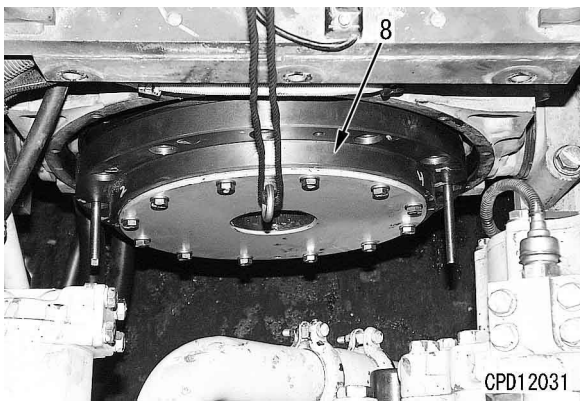
10. Using a eyebolt, sling damper cover assembly (7) temporarily and remove the mounting bolts. [*2]

11. Using 2 forcing screws, lift off damper cover assembly (7). [*3]
    ★ Lower the damper cover assembly to the floor.
    Damper cover assembly: **57 kg**



12. Using a eyebolt, sling damper assembly (8) temporarily and remove the mounting bolts. [*4]

13. Using 2 guide bolts, lift off damper assembly (8).
    ★ Lift up the damper assembly, and then lower it to the floor.
    Damper assembly: **74 kg**



INSTALLATION

- Carry out installation in the reverse order to removal.

[*1]
Mounting bolt:
98.1 – 122.6 Nm {10 – 12.5 kgm}

[*2]
Damper cover assembly mounting bolt:
98.1 – 122.6 Nm {10 – 12.5 kgm}

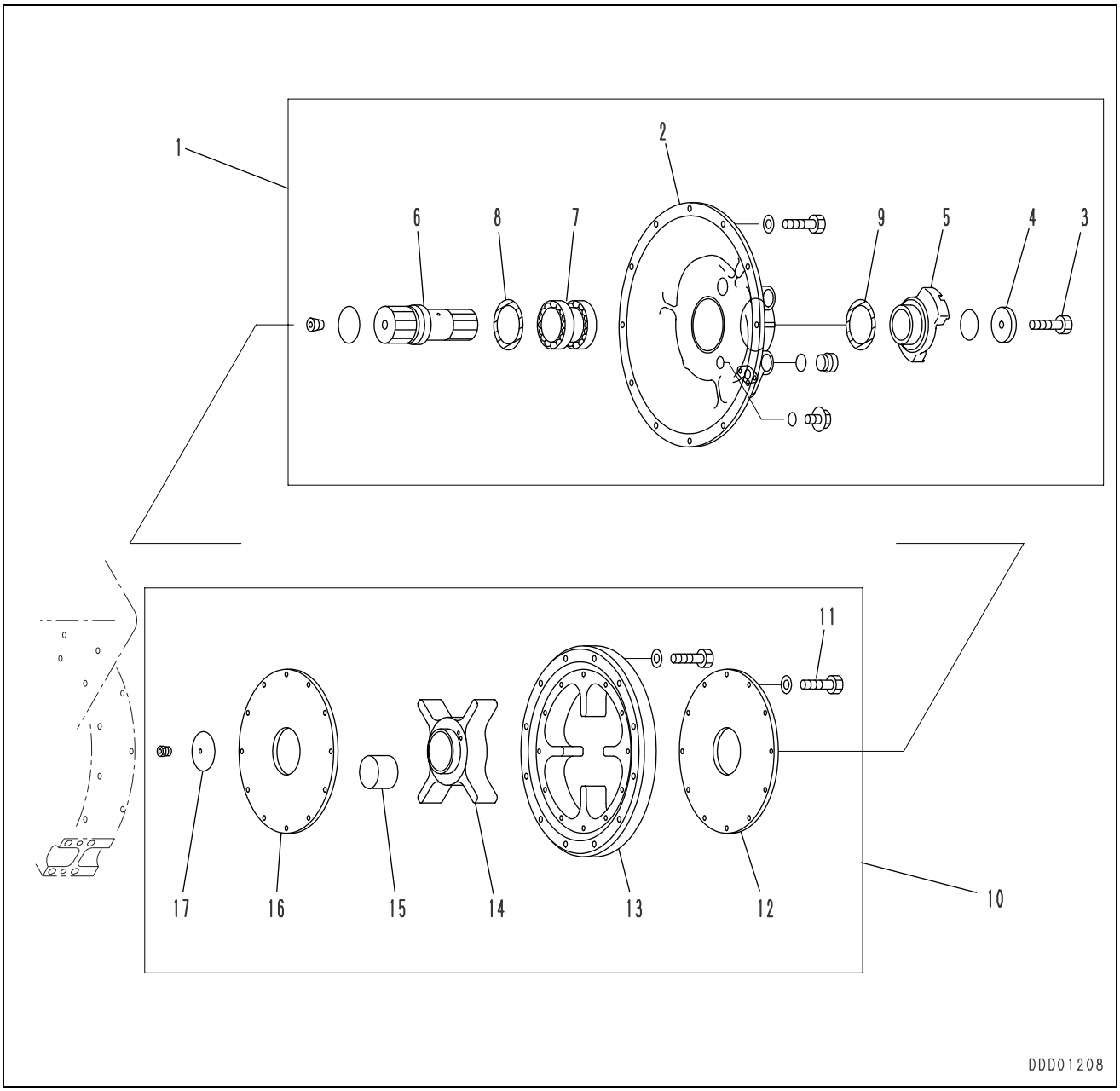
[*3]
★ When installing the damper assembly, degrease the shaft spline and apply dry lubricant A and leave it as it is for 2 - 3 minutes. Then, apply extreme pressure lithium grease containing molybdenum B to the shaft spline.

A	Molybdenum disulfide dry lubricant	• Sumiko lubricant: Rocol Dry Splay or equivalent
B	Extreme pressure lithium grease containing molybdenum	• Kyodo Yushi: Morilex No. 2 • Showa-Shell: Letinax AM • Nippon oil: Moritex

[*4]
Damper assembly mounting bolt:
98.10 – 122.6 Nm {10 – 12.5 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.
  Oil in damper chamber: **Approx. 1.5 ℓ**
  Drain plug: **58.8 – 78.5 Nm {6 – 8 kgm}**

DISASSEMBLY AND ASSEMBLY OF DAMPER ASSEMBLY



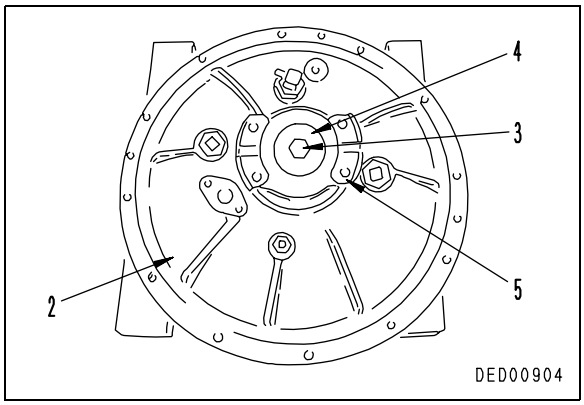
SPECIAL TOOLS

Symbol	Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
B	791-612-1100	Installer	■	1		
	790-101-4200	Puller (294 kN {30 ton})	■	1		
	790-101-1102	Hydraulic pump	■	1		

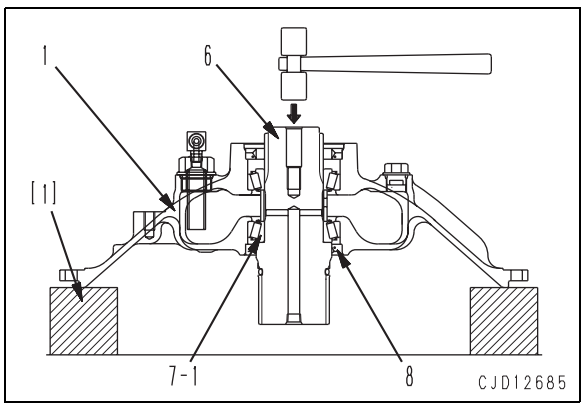
DISASSEMBLY

1. Disassembly of damper cover assembly (1)

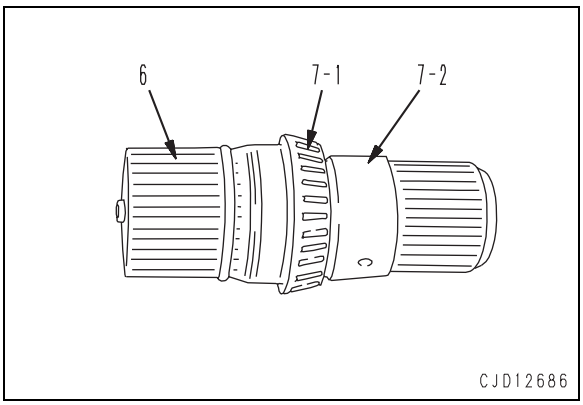
1) Coupling
Remove bolt (3) from cover (2), then remove holder (4) and coupling (5).



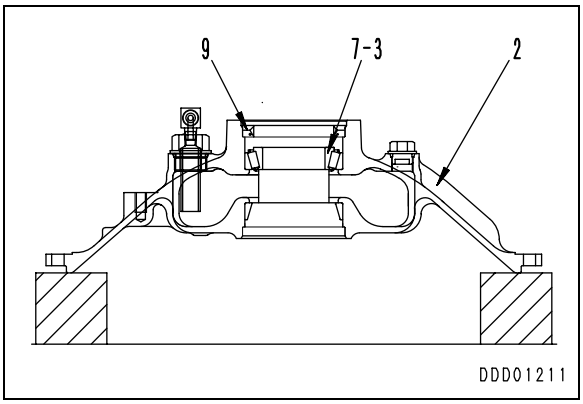
2) Shaft
   i) Set damper cover assembly (1) on block [1].
   ii) Push out shaft (6) by hitting it with a plastic hammer from the output side.
   ★ Shaft (6) comes out together with inner race (7-1) and oil seal (8) of bearing (7).



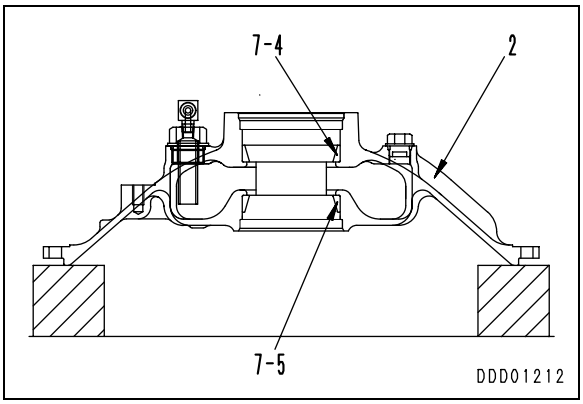
iii) Remove the O-ring from shaft (6), then remove collar (7-2) and inner race (7-1) of bearing (7).



3) Bearing and oil seal
   i) Remove oil seal (9) from cover (2), then remove inner race (7-3) of bearing (7).

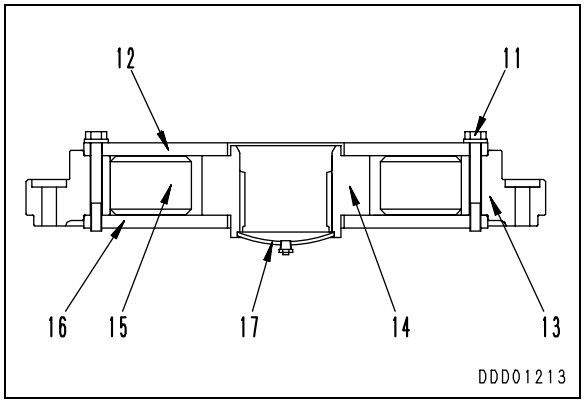


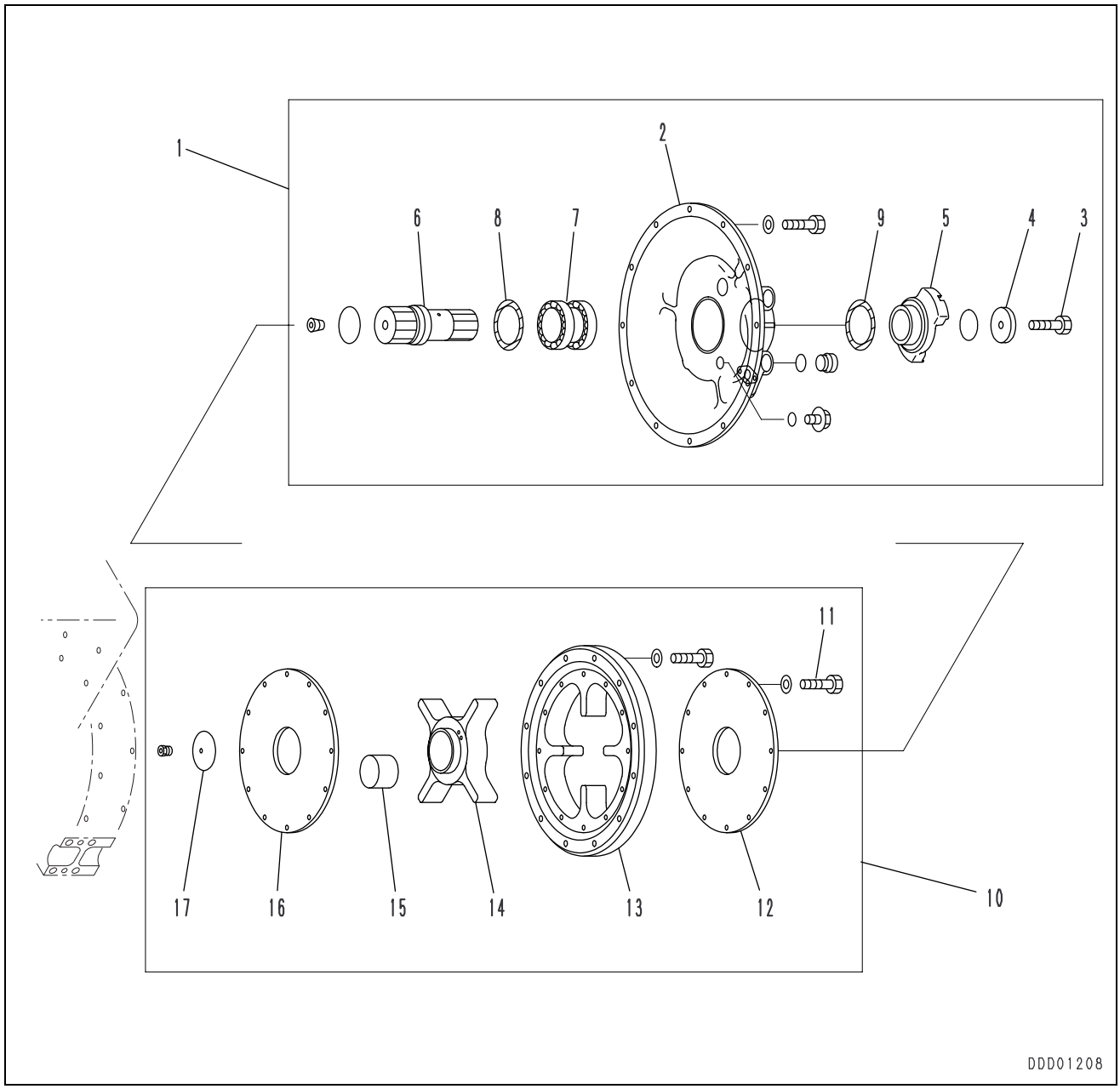
   ii) Remove inner races (7-4) and (7-5) of bearing (7) from cover (2).



2. Disassembly of damper assembly (2)

1) Remove bolts (11) and flange (12).
2) Remove outer body (13), inner body (14), and cushion (15).
3) Pull plug (17) out of flange (16).
   ★ Perform this procedure only when the plug needs to be replaced.





ASSEMBLY

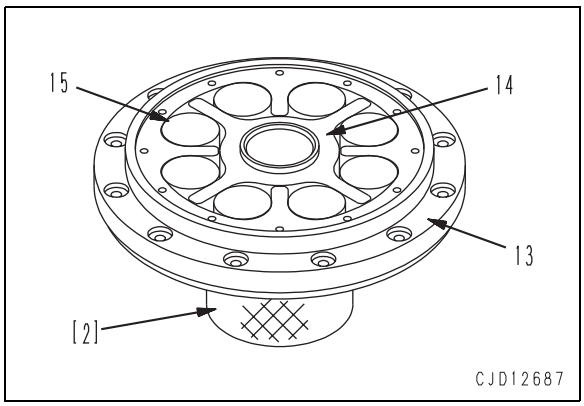
1. Assembly of damper assembly (10)

1) Set flange (16) and outer body (13) to cylinder [2], matching their bolt holes, and install inner body (14).

Mating faces of flange and outer body: **Gasket sealant (LG-6)**

Inside of outer body: **Grease (G2-LI)**

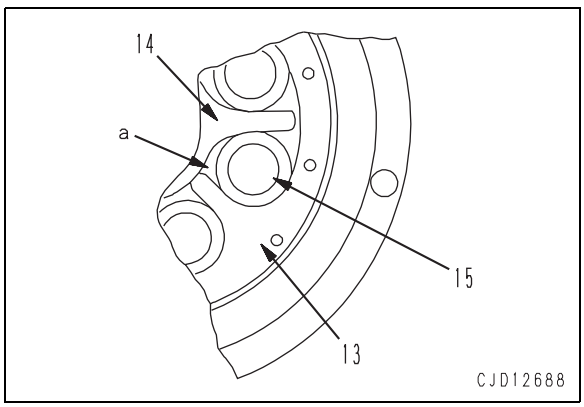
Cushion contact surface of inner body: **Grease (G2-LI)**



2) Install cushion (15).

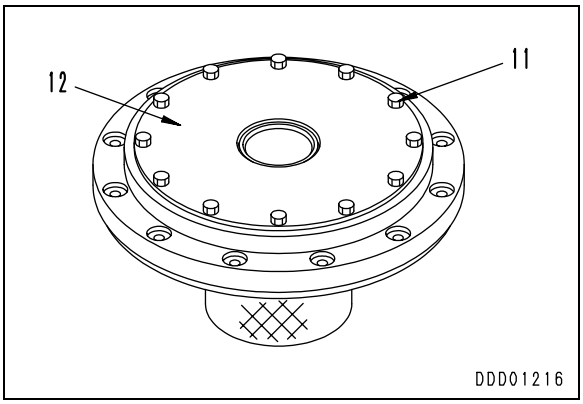
★ Apply grease (G2-LI) all over the cushion.

★ After installing the cushion, fill the clearance **a** between the inner body (14) and outer body (13) (16 places) with grease of 30%.



3) Install flange (12) and secure it with bolts (11).

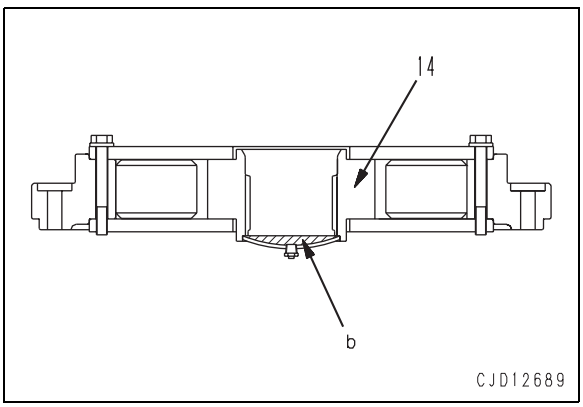
Flange mounting bolt:
58.8 – 73.5 Nm {6 – 7.5 kgm}



4) Fill with grease.
Fill part **b** of the inner body with 80 g of grease.

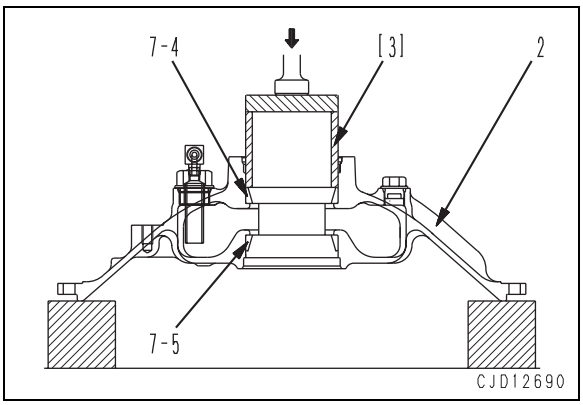
Grease:

A	Molybdenum disulfide dry lubricant	• Sumiko lubricant: Rocol Dry Splay or equivalent
B	Extreme pressure lithium grease containing molybdenum	• Kyodo Yushi: Morilex No. 2
		• Showa-Shell: Letinax AM
		• Nippon oil: Moritex

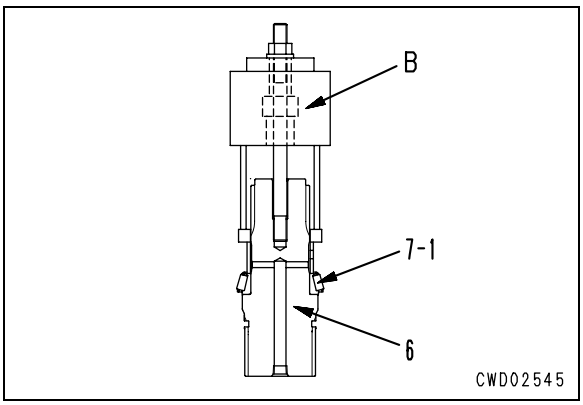


2. Assembly of damper cover assembly (1)

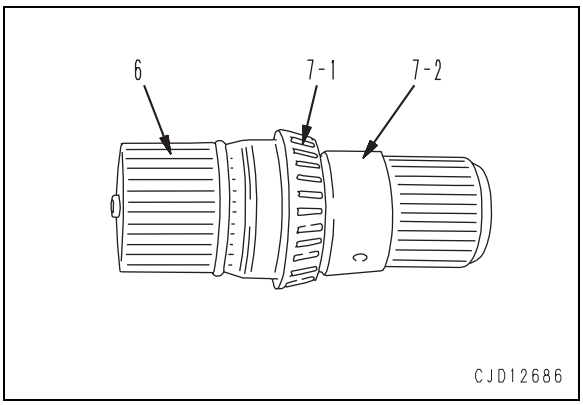
1) Using push tool [3], press fit outer races (7-4) and (7-5) of bearing (7) to cover (2).



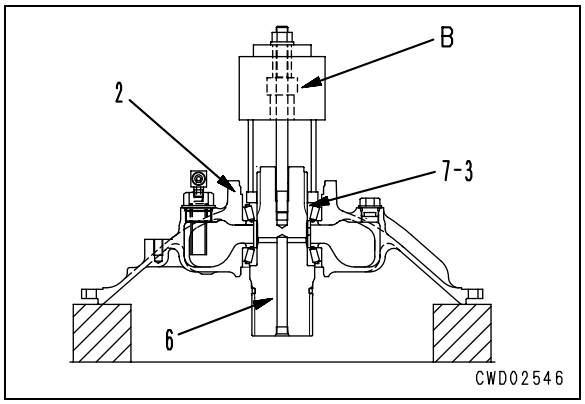
2) Press fit inner race (7-1) of bearing (7) to shaft (6) with tool **B**.



3) Install collar (7-2) and O-ring to shaft (6).



4) Set cover (2) to shaft (6). Using tool **B**, press fit bearing inner race (7-3).

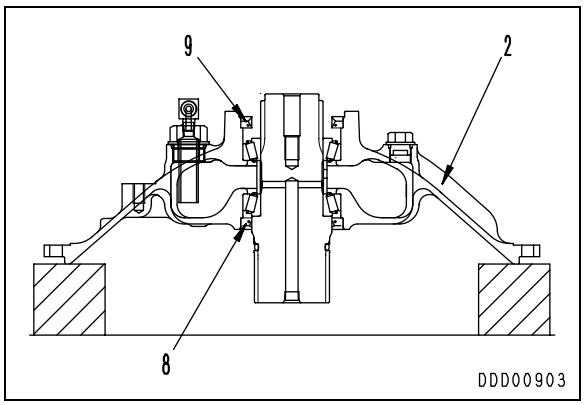


5) Fit oil seals (8) and (9) to cover assembly (2).

Press fitting face of oil seal: **Gasket sealant (LG-6)**

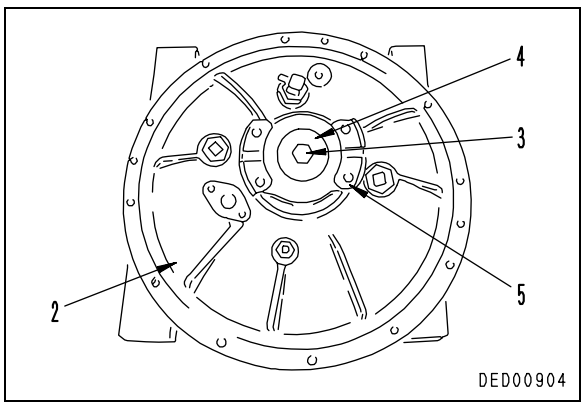
Oil seal lip: **Grease (G2-LI)**

★ Apply the gasket sealant thinly to the oil seal surface and wipe off projected part.



6) Install coupling (5) and holder (4) and secure them with bolts (3).

Coupling mounting bolt: **245 – 309 Nm {25 – 31.5 kgm}**

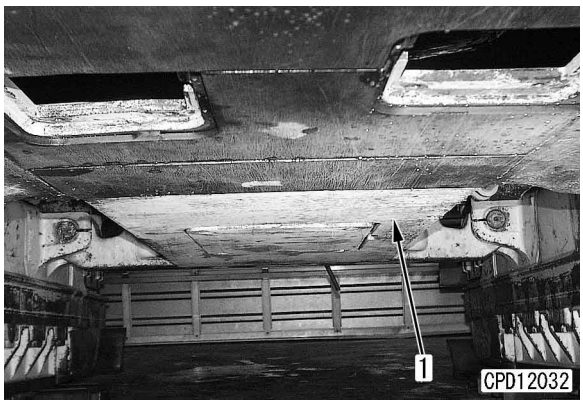


REMOVAL AND INSTALLATION OF POWER TRAIN UNIT ASSEMBLY

REMOVAL

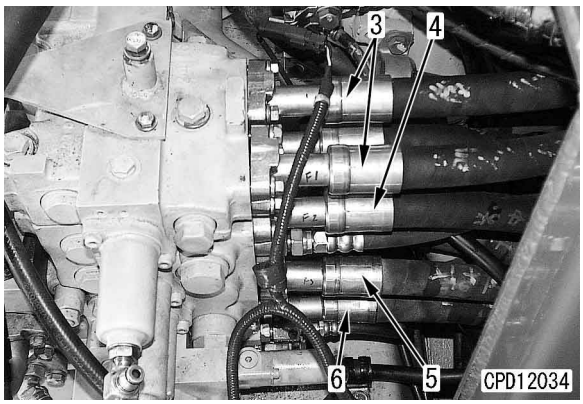
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Drain the oil.
   - Power train case: **Approx. 100 ℓ**
   - Hydraulic tank: **D85EX-15; Approx. 150 ℓ**
     D85PX-15; Approx. 140 ℓ
2. Remove the engine hood assembly. For details, see REMOVAL OF ENGINE HOOD ASSEMBLY.
3. Remove the operator's cab assembly. For details, see REMOVAL OF OPERATOR'S CAB ASSEMBLY.
4. Remove the floor frame assembly. For details, see REMOVAL OF FLOOR FRAME ASSEMBLY.
5. Remove the fuel tank assembly. For details, see REMOVAL OF FUEL TANK ASSEMBLY.
6. Remove power train undercover (1).

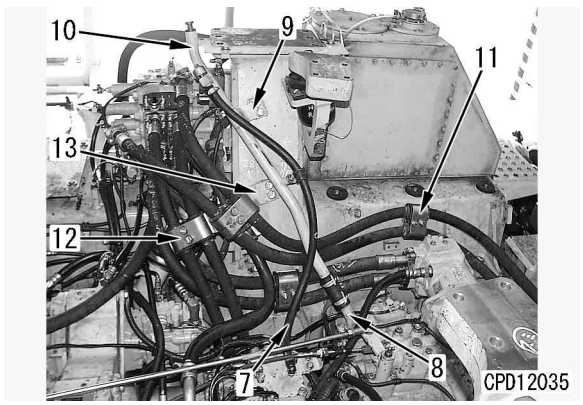


7. Remove work equipment valve cover (2).

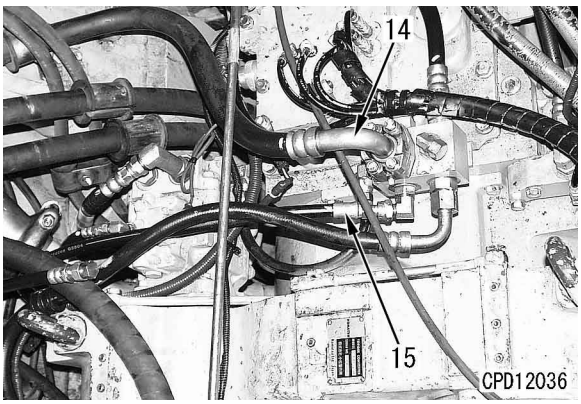
8. Disconnect 2 ripper hoses (3).
   ★ Secure the ripper assembly.
9. Disconnect 2 blade tilt hoses (4).
10. Disconnect 2 HSS motor hoses (5).
    ★ Disconnect these hoses from the HSS motor, too.
11. Disconnect main hoses (6) of the HSS and work equipment pump.



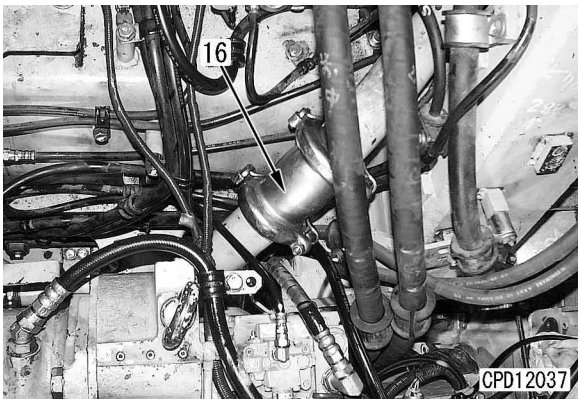
12. Disconnect breather hose (7) and oil level detection pipe lower tube (8) from the steering case.
13. Remove clamp (9) and oil level detection pipe assembly (10).
14. Remove ripper hose clamp (11) and move the hose toward the ripper.
15. Remove blade lift hose clamp (12) and clamp bracket (13).



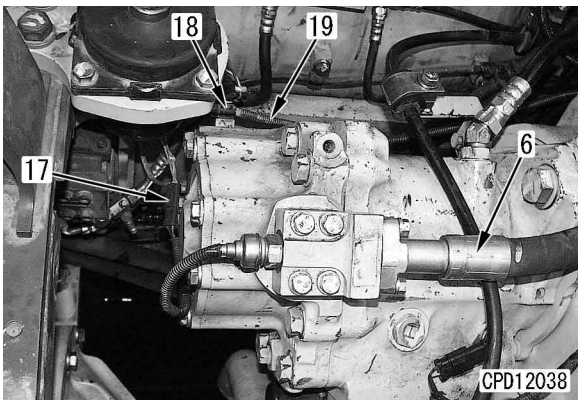
16. Disconnect tank return hose (14) of the drain merge block and pressure reducing valve return hose (15).



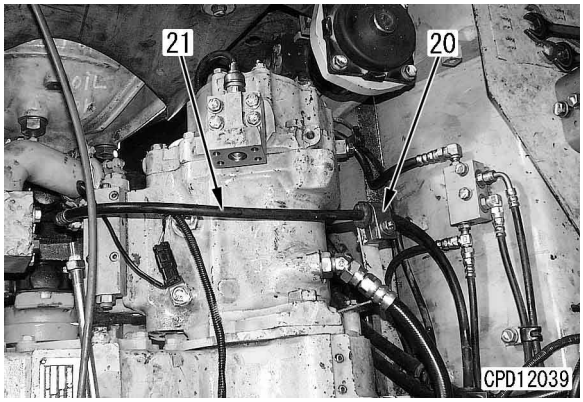
17. Remove pump suction tube clamp (16).



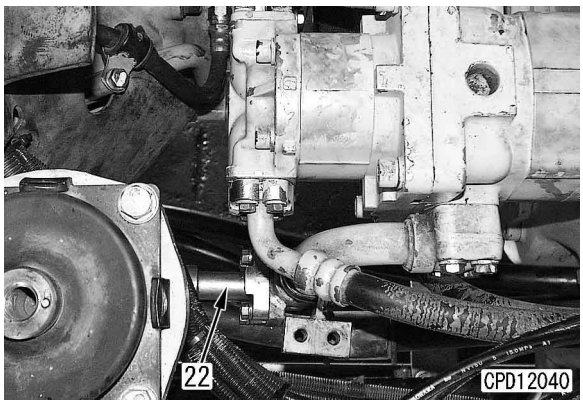
18. Disconnect pump pressure sensor connector HHP (17).
19. Remove wiring harness clamp (18) and wiring harness assembly (19).
20. Disconnect main hoses (6) of HSS and work equipment pump.



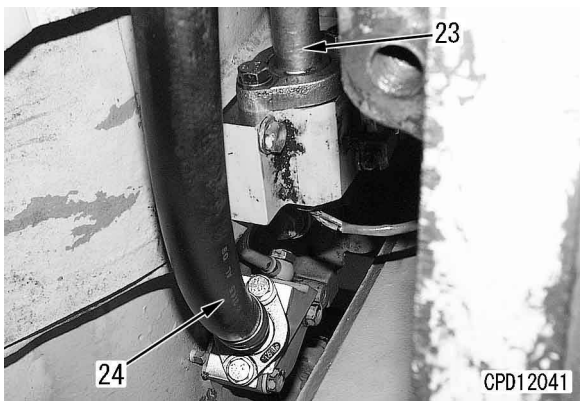
21. Remove hose clamp bracket (20) and disconnect LS pressure hose (21) of the HSS and work equipment pump.



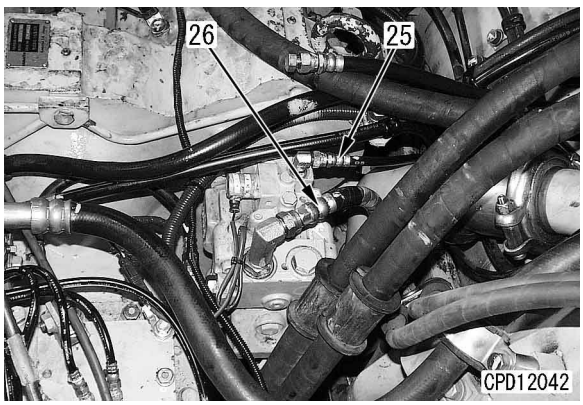
22. Disconnect power train pump discharge hose (22).



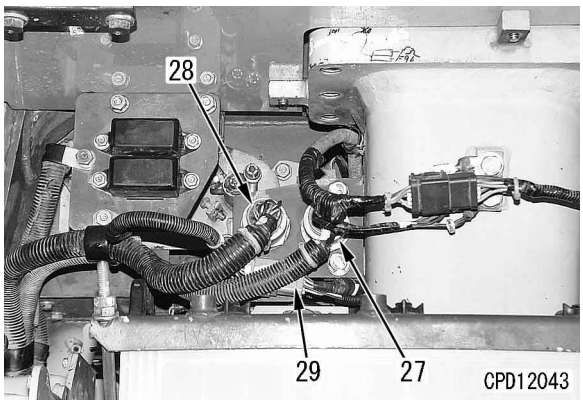
23. Disconnect torque converter outlet hose (23) and transmission lubrication inlet hose (24).



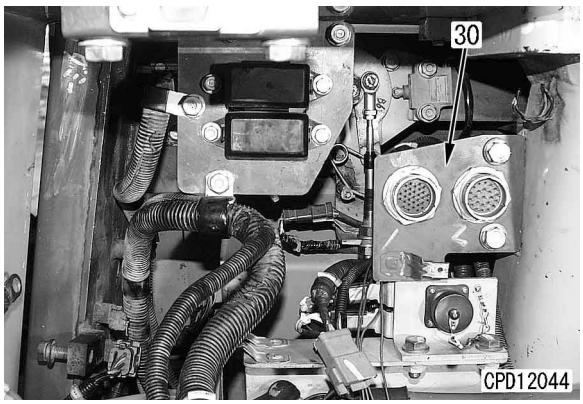
24. Disconnect fan pump discharge hose (25) and EPC valve basic pressure input hose (26).



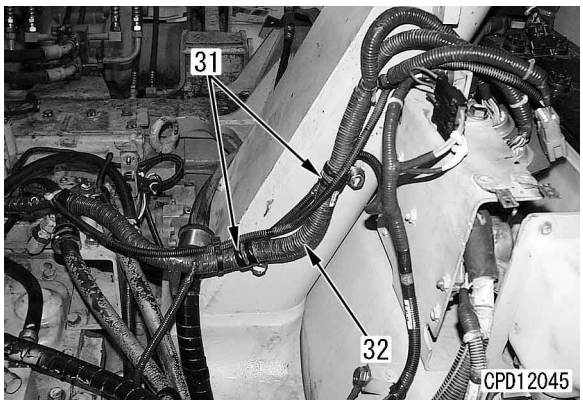
25. Open the battery case cover.
26. Disconnect centralized connectors PL1 (27), PL2 (28), and PL5 (29).



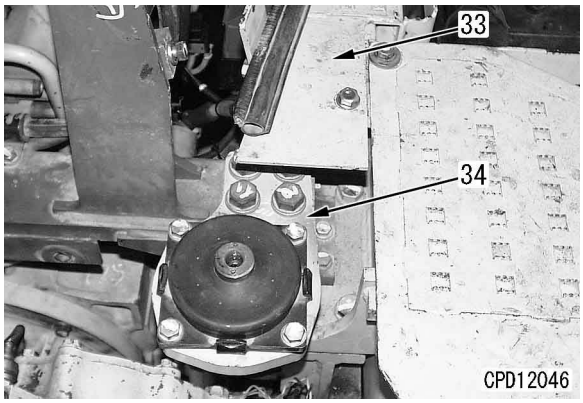
27. Remove centralized connector bracket (30).



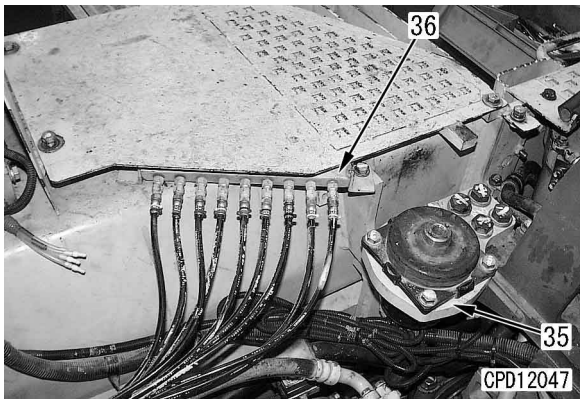
28. Remove 2 wiring harness clamps (31) and wiring harness assembly (32).



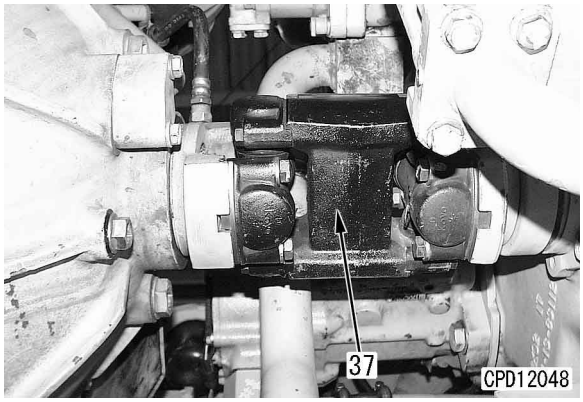
29. Remove cover (33).
30. Remove right floor frame mount (34).



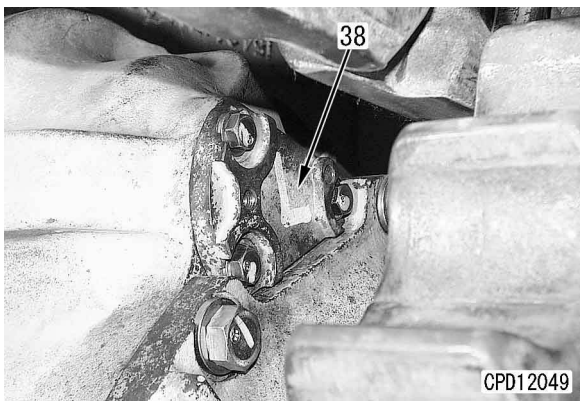
31. Remove left floor frame mount (35).
32. Remove centralized oil pressure pickup pipe block (36).



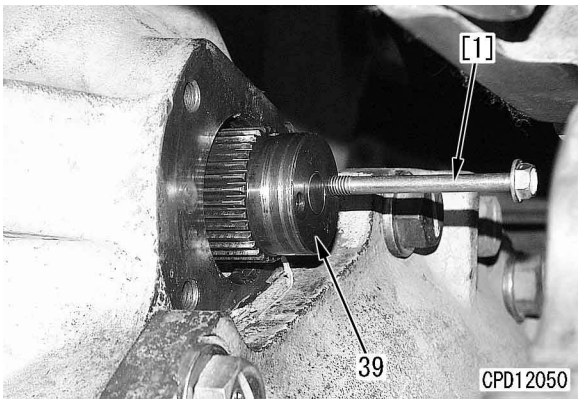
33. Remove universal joint assembly (37). [*1]



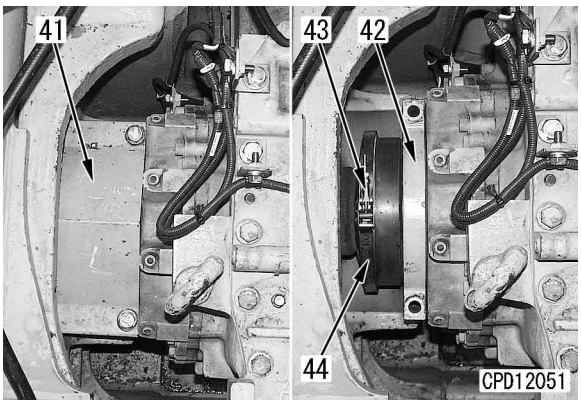
34. Remove the mounting bolts and the left and right covers (38) of the final drive shaft.



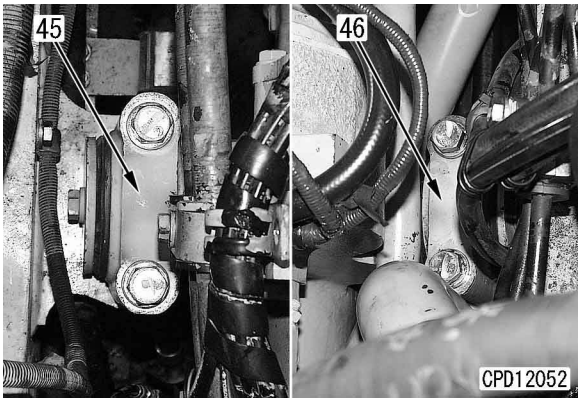
35. Pull out drive shaft (39) according to the following procedure.
    Using forcing screw [1], pull out the drive shaft until the spline on the steering case side comes off.
    ★ If the shaft is difficult to pull out, raise the shoe grouser with a jack and find out a position where the shaft is pulled out easily.
    ★ Pull out the drive shaft on the opposite side similarly.



36. Remove cover (41) of the steering case bevel gear shaft.
37. Remove cap (42) and loosen coupling clamp (43) and move seal (44) outward. [*2]
    ★ Work on the opposite side similarly.



38. Remove left mount mounting bolts (45) and right mount mounting bolts (46) on the front side.



39. Lift off the power train unit assembly (47). [*3]
    ★ Before lifting off the power train unit assembly, check that all the wires and pipes are disconnected.

    Power train unit assembly: **1,850 kg**

INSTALLATION

- Carry out installation in the reverse order to removal.

[*1]
Mounting bolt:
98.1 – 122.6 Nm {10 – 12.5 kgm}

[*2]
★ Clamp the peak of the coupling seal securely and set the clamp threads in parallel with the cap mounting seat.

[*3]
★ When installing the power train unit assembly, take care extremely not to damage seal (44).

- **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: **Approx. 100 ℓ**

  Hydraulic tank: **D85EX-15; Approx. 150 ℓ**
  D85PX-15; Approx. 140 ℓ

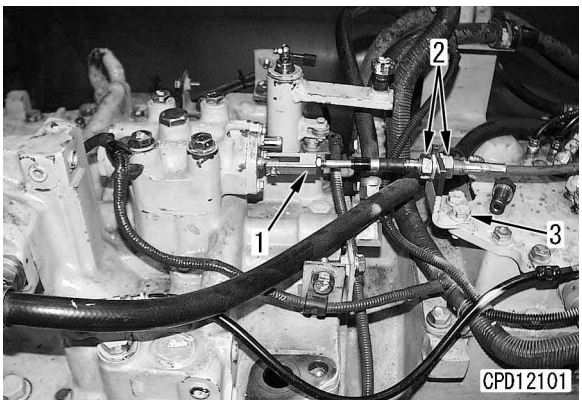
  Hydraulic tank drain plug:
  58.8 – 78.5 Nm {6 – 8 kgm}

DISCONNECTION AND CONNECTION OF POWER TRAIN UNIT ASSEMBLY

DISCONNECTION

1. Remove the drain plugs of the steering case and transmission case to drain the oil from the cases.

2. Remove parking brake rod (1).
   ★ Do not loosen nut (2) but remove bracket (3). [*1]

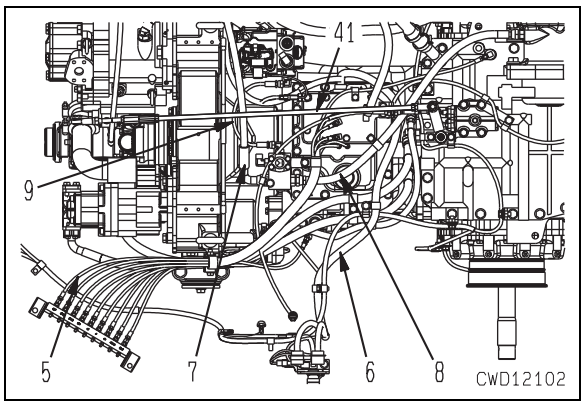


3. Remove brake rod (4). [*2]

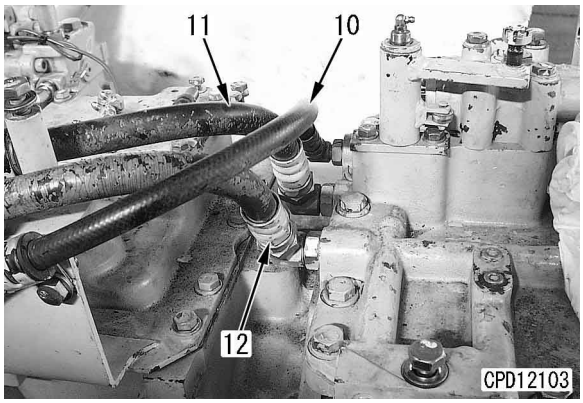
4. Remove 9 oil pressure pickup hoses (5).

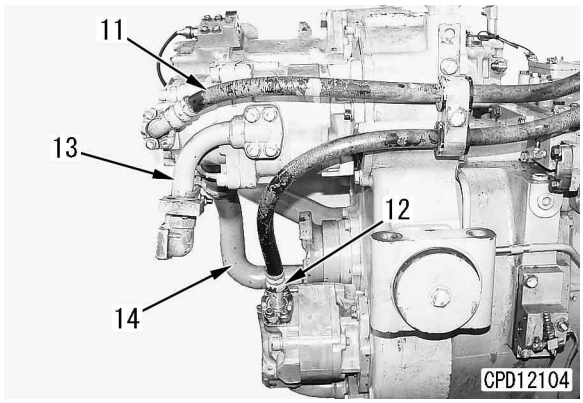
5. Remove wires (6).
   ★ The wiring connectors are TMV, TVC, HHP, 453, TMI, and FAC.

6. Disconnect hoses (7), (8), and (9).

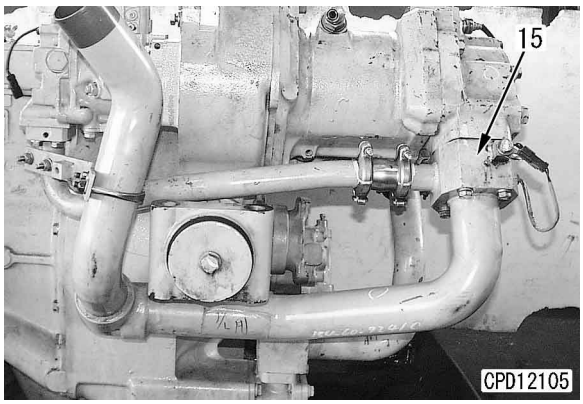


7. Remove hoses (10), (11), and (12) and suction tubes (13) and (14).

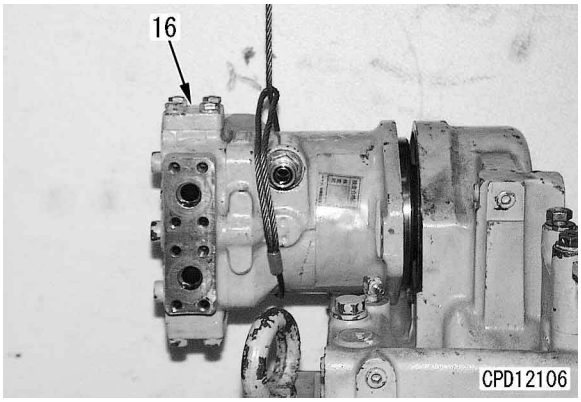




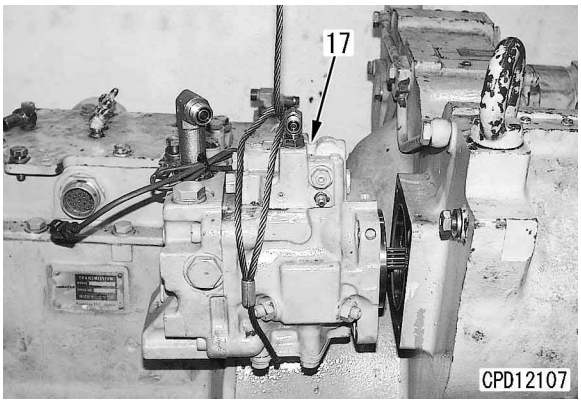
8. Remove suction tube (15).



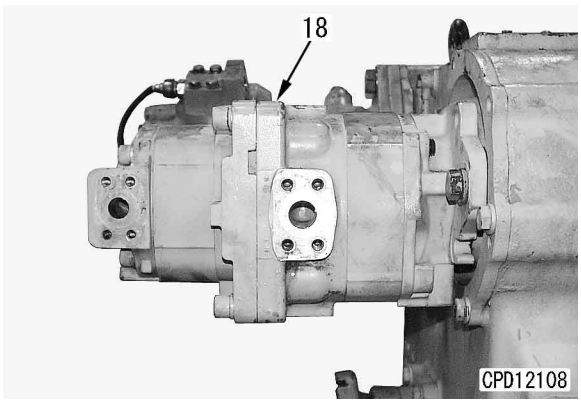
9. Lift off HSS motor assembly (16).



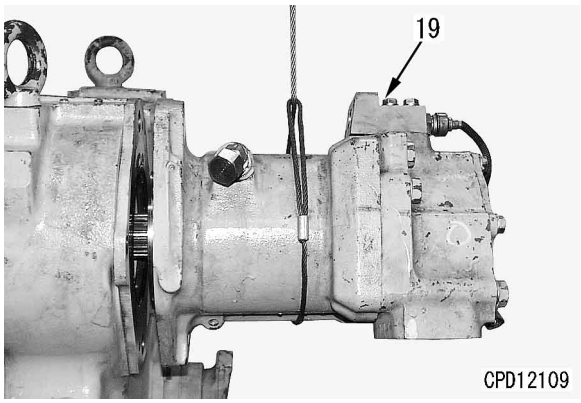
10. Lift off fan drive pump assembly (17).



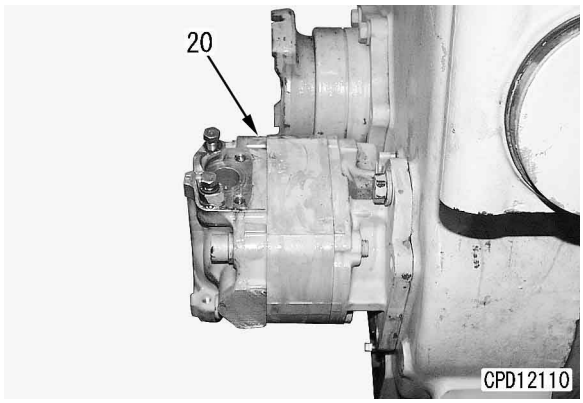
11. Remove tandem pump assembly (18).



12. Lift off HSS and work equipment pump assembly (19).



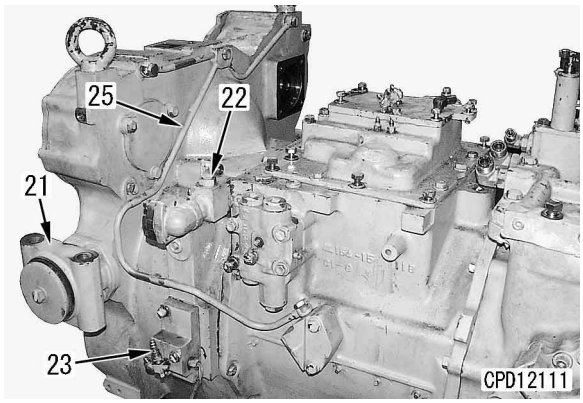
13. Remove scavenging pump assembly (20).



14. Remove the left and right mount assemblies (21).

15. Remove blocks (22) and (23).

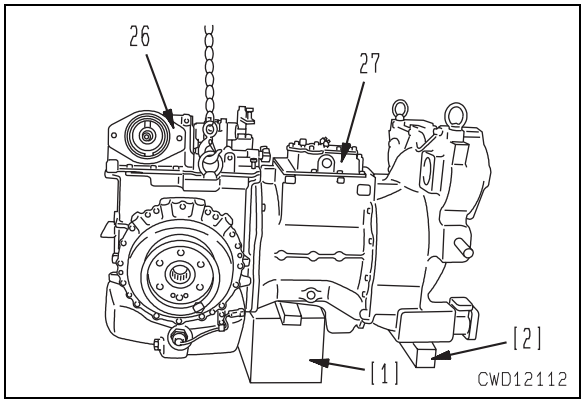
16. Remove lubrication tube (25).



17. HSS assembly

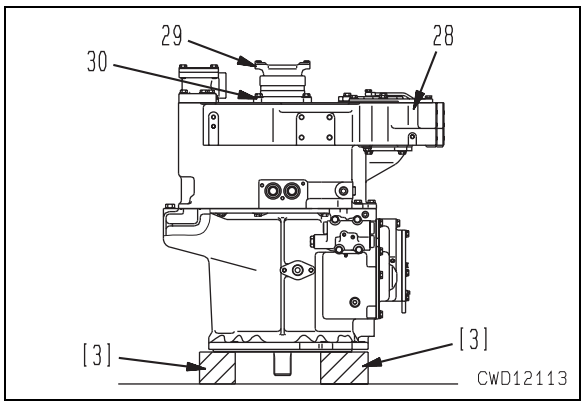
1) Set the power train assembly on blocks [1] and [2].
2) Sling HSS assembly (26) temporarily.
3) Remove the mounting bolts and separate HSS assembly (26) from transmission assembly (27).

HSS assembly: **750 kg**

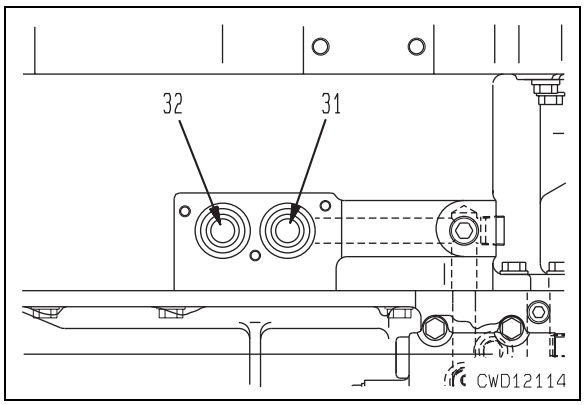


18. PTO assembly

1) Set the power train assembly on block [3] with PTO assembly (28) up.
2) Remove coupling (29) and retainer (30). [3*]

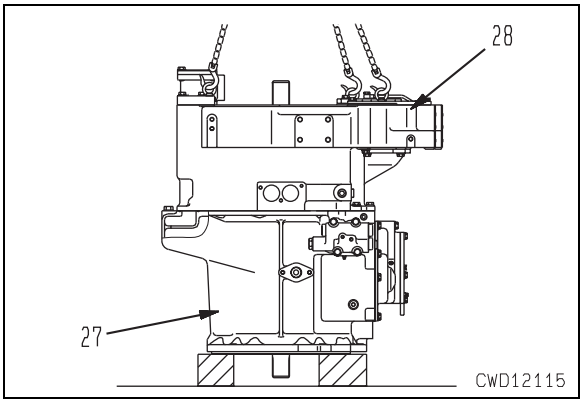


3) Remove sleeves (31) and (32).

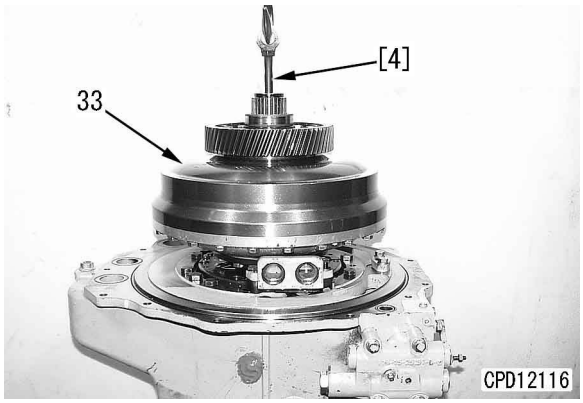


4) Sling PTO assembly (28) temporarily and remove the mounting bolts.
5) Sling PTO assembly (28) to separate it from transmission assembly (27).
   ★ The torque converter assembly will be left on the transmission side.

PTO assembly: **300 kg**



19. Remove 8 mounting bolts. Using eyebolt [4], lift off torque converter assembly (33).



CONNECTION

- Carry out connection in the reverse order to disconnection.

[*1] [*2]

★ Bend the cotter pin securely.

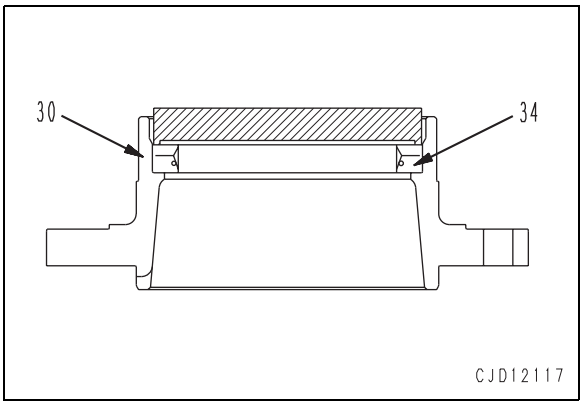
[*3]

- Fit oil seal (34) to retainer (30).

Oil seal fitting face: **Gasket sealant (LG-5)**

★ Apply the gasket sealant thinly to the inside surface of the housing hole and wipe off projected part.

Oil seal lip surface: **Grease (G2-LI)**



DISASSEMBLY AND ASSEMBLY OF TORQFLOW TRANSMISSION ASSEMBLY

SPECIAL TOOLS

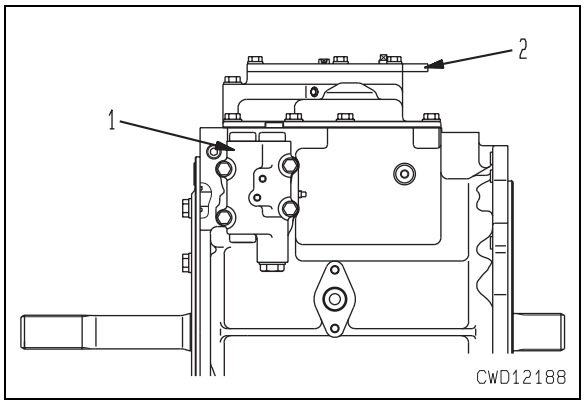
Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
D	1	791-415-1300	Puller assembly	■	1		
	2	799-301-1600	Oil leak tester	■	1		

DISASSEMBLY

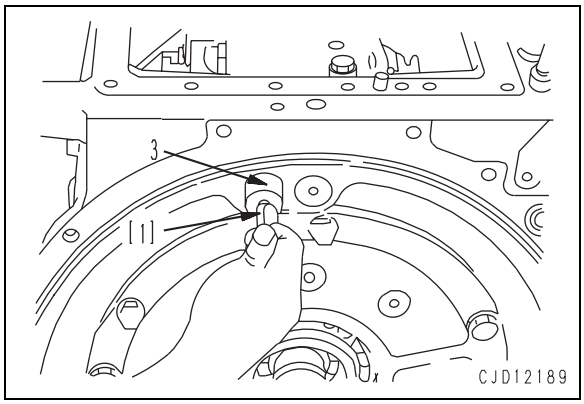
★ Store the removed discs and plates on a level place so that they will not be warped.

1. Relief valve assembly
Remove relief valve assembly (1).

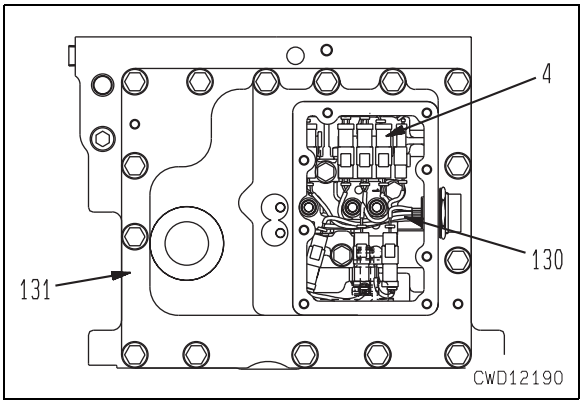
2. Control valve assembly
1) Remove cover (2).



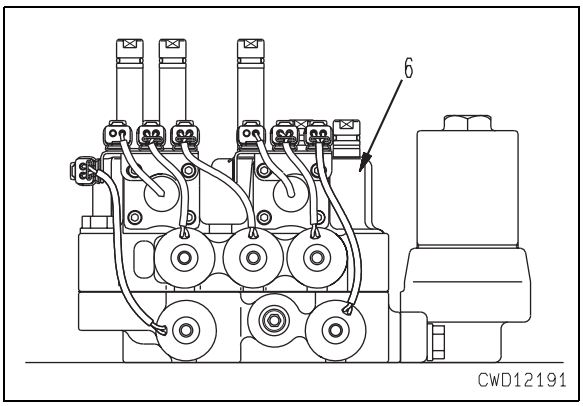
2) Using eyebolt [1], remove sleeve (3).



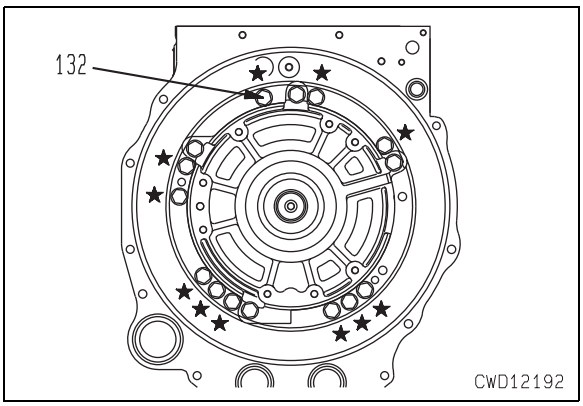
3) Disconnect 10 ECMV connectors (4).
4) Remove cover (131) and wiring harness (130) together.



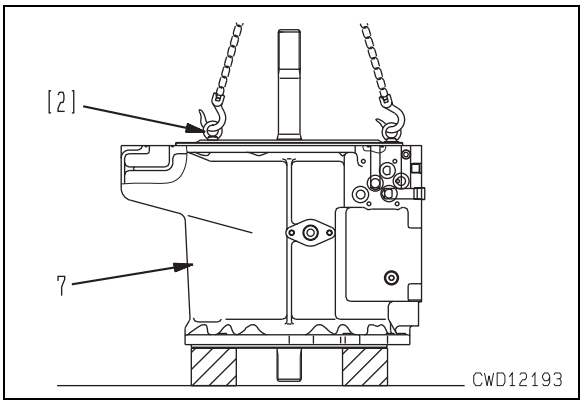
5) Remove control valve assembly (6).



3. Transmission case
1) Remove 9 tie rods (132) tightened together with the case and 2 case clamp bolts (marked with ★).

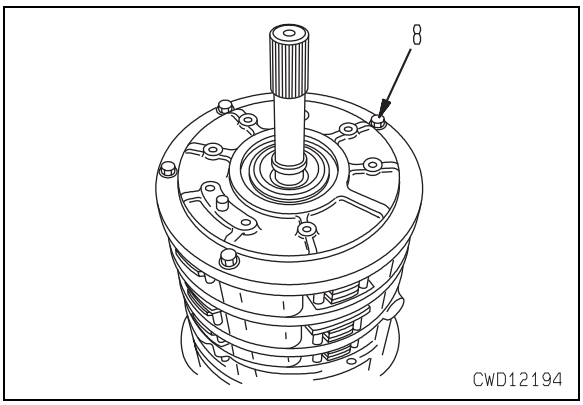


2) Using eyebolt [2], lift off transmission case (7).



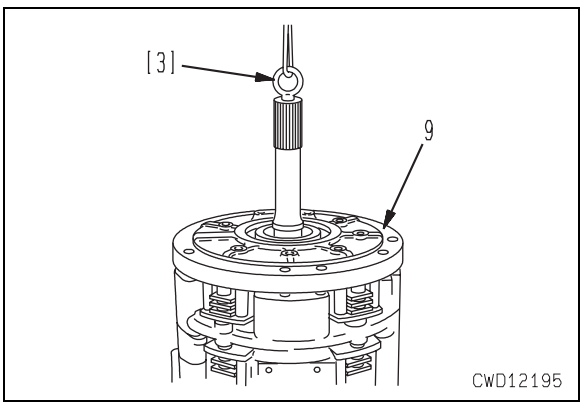
4. Tie bolts

Remove 4 remaining tie bolts (8)

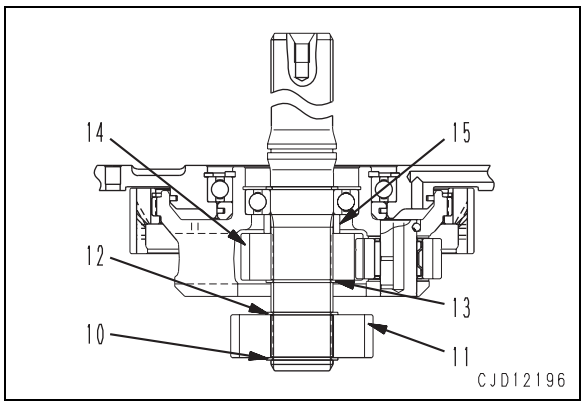


5. Input shaft/Front plate/No. 1 carrier assembly

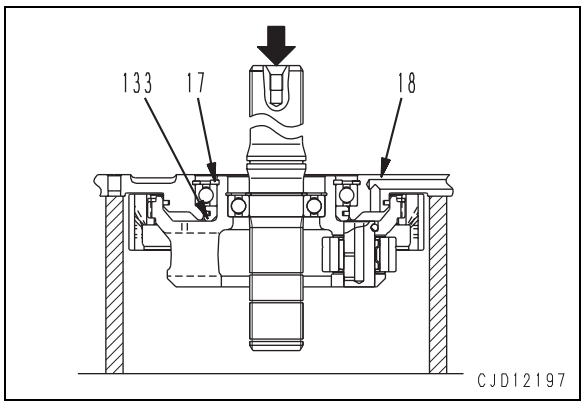
1) Using eyebolt [3], remove input shaft/front plate/No. 1 carrier assembly (9).



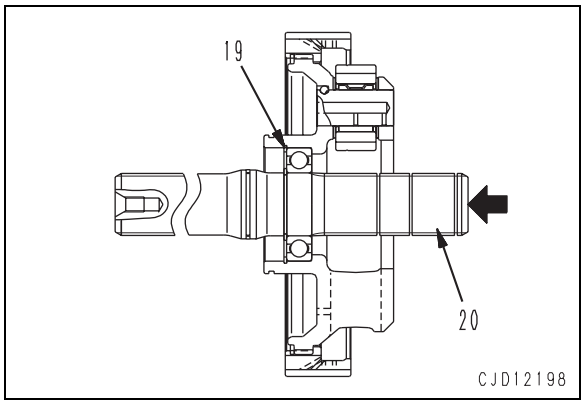
2) Disassemble the input shaft/front plate/No. 1 carrier assembly according to the following procedure.
   i) Remove snap ring (10), No. 2 sun gear (11), and snap ring (12).
   ii) Remove snap ring (13), No. 1 sun gear (14), and collar (15).



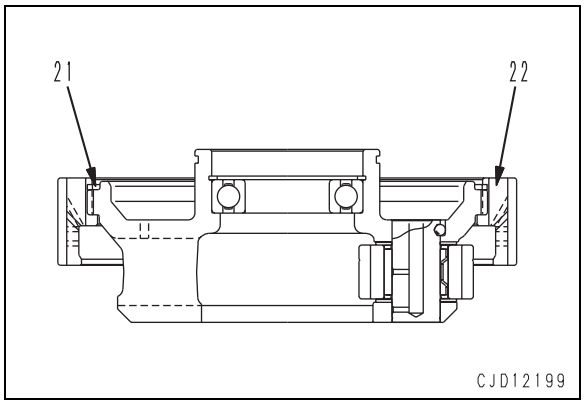
   iii) Remove snap ring (17).
   iv) Drive out the input shaft from the torque converter side and remove front cover (18).
   v) Remove collar (133)



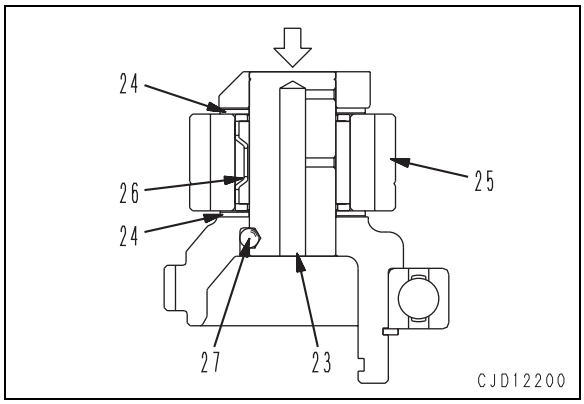
   vi) Remove snap ring (19), then remove input shaft (20) by driving it out to the torque converter side.



vii) Remove snap ring (21) and No. 1 ring gear (22).

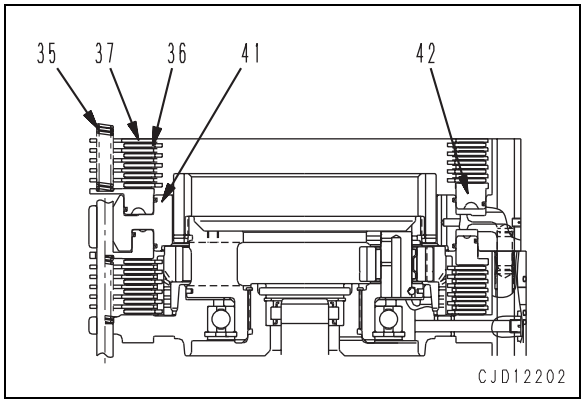


viii) Pull out shaft (23) and remove thrust washer (24), gear (25), bearing (26), and ball (27).
★ Take care not to lose the ball.



6. No. 1 discs, plates, and springs
1) Remove springs (35).
2) Remove discs (36) and plates (37).

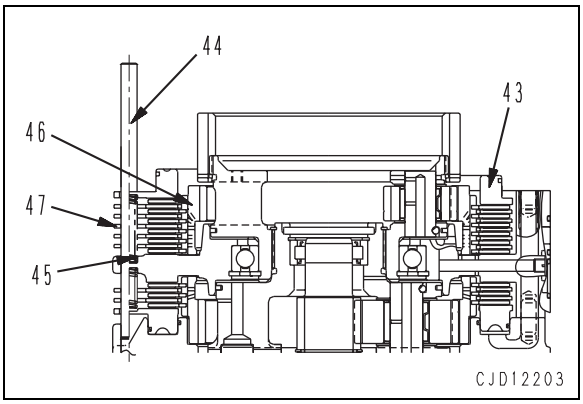
7. No. 1 housing assembly
1) Using eyebolts, remove No. 1 housing assembly (41).
2) Remove piston (42) from the housing.



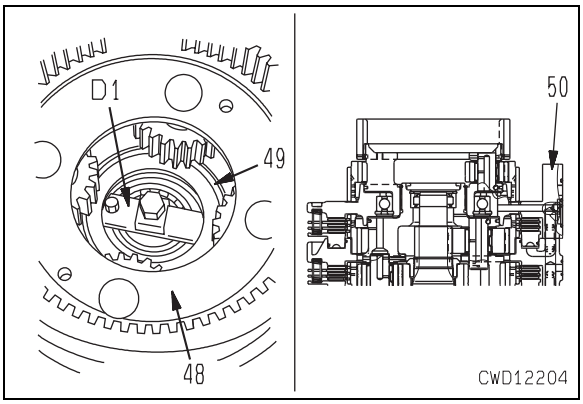
8. No. 2 piston
Remove No. 2 piston (43).

9. Guide pin
Remove guide pin (44).

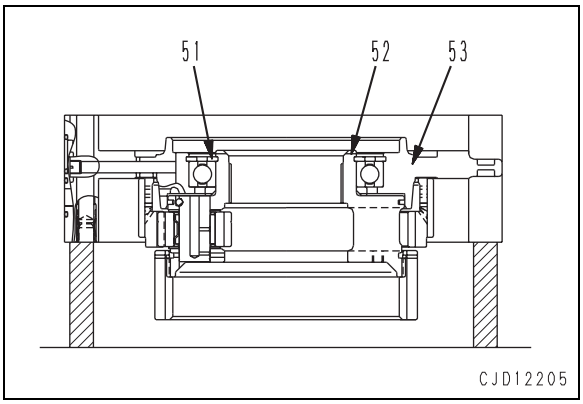
10. No. 2 discs, plates, and springs
1) Remove springs (45).
2) Remove discs (46) and plates (47).



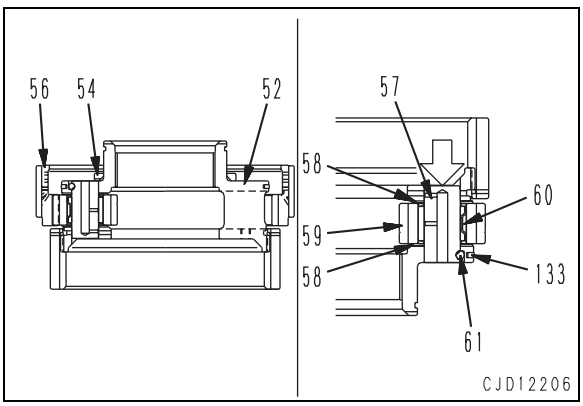
11. No. 2 housing and No. 2 carrier assembly
1) Using tool **D1**, push up No. 3 carrier (48) and remove snap ring (49) from groove.
2) Using eyebolts, remove No. 2 housing and No. 2 carrier assembly (50).



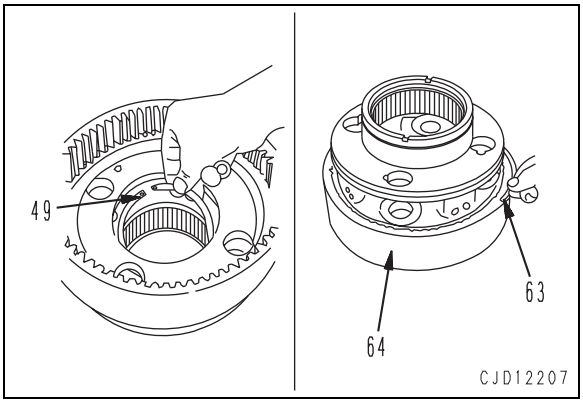
3) Disassemble No. 2 housing and No. 2 carrier assembly according to the following procedure.
   i) Remove snap ring (51) and pull No. 2 carrier assembly (52) out of No. 2 housing (53).



   ii) Remove spacer (54) from No. 2 carrier assembly (52).
   iii) Remove No. 2 ring gear (56).
   iv) Pull out shaft (57) and remove thrust washer (58), gear (59), bearing (60), and ball (61).
   v) Remove seal ring (133).



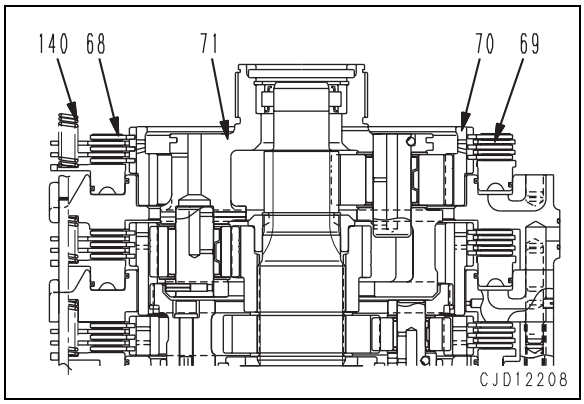
   vi) Remove snap ring (49) which was removed in step 11-1).
   vii) Remove snap ring (63) and ring gear (64).



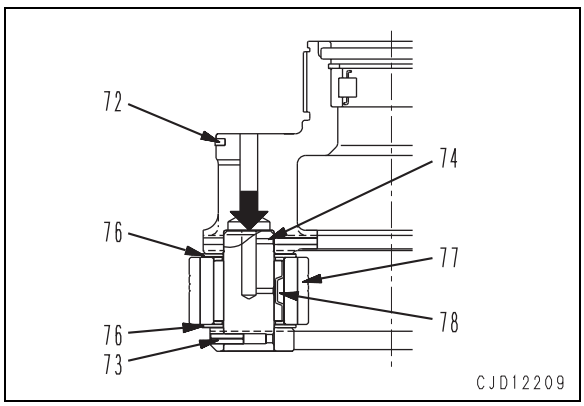
12. No. 3 discs and plates
Remove springs (140), discs (68), and plates (69).

13. No. 3 ring gear
Remove No. 3 ring gear (70).

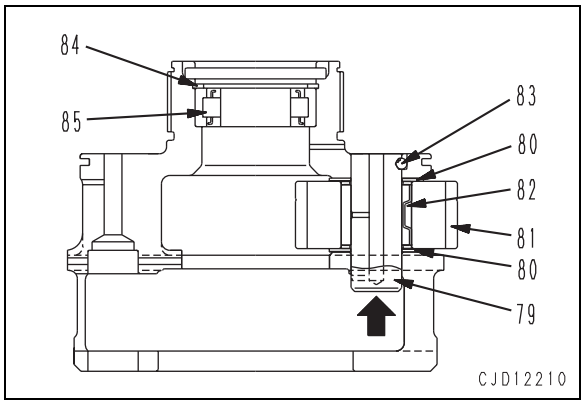
14. No. 3 and No. 4 carriers assembly
1) Remove No. 3 and No. 4 carriers (71).



2) Disassemble No. 3 and No. 4 carriers assembly according to the following procedure.
   i) Remove seal ring (72).
   ii) Drive pin (73) into shaft (74).
   iii) Drive out shaft (74) from No. 3 carrier side.
   iv) Remove thrust washer (76), No. 4 planetary gear (77), and bearing (78).
   ★ Pull the pin out of the shaft.

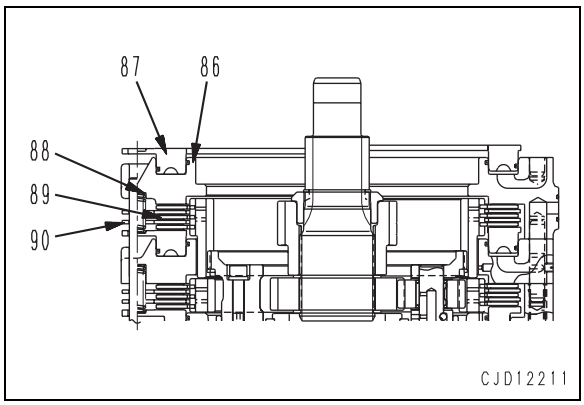


v) Drive out shaft (79) and remove thrust washer (80), No. 3 planetary gear (81), bearing (82), and ball (83).
★ Take care not to lose the ball.
vi) Remove snap ring (84) and bearing (85).

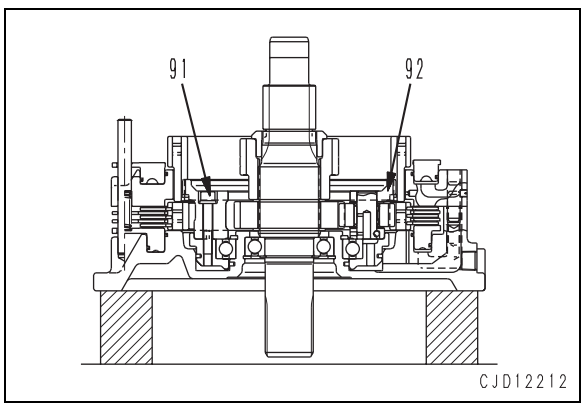


15. No. 3 housing
1) Remove No. 3 housing (86).
2) Remove No. 3 piston (87).

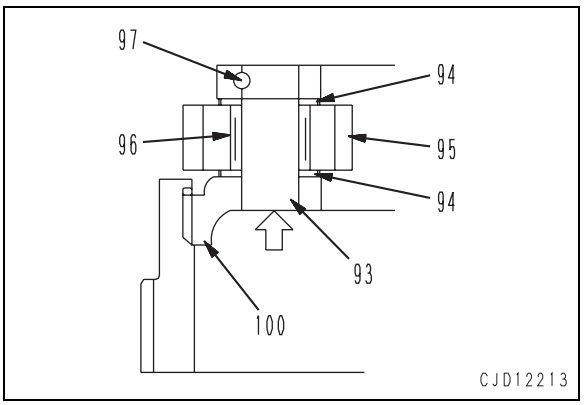
16. No. 4 discs, plates, and springs
1) Remove springs (88).
2) Remove discs (89) and plates (90).



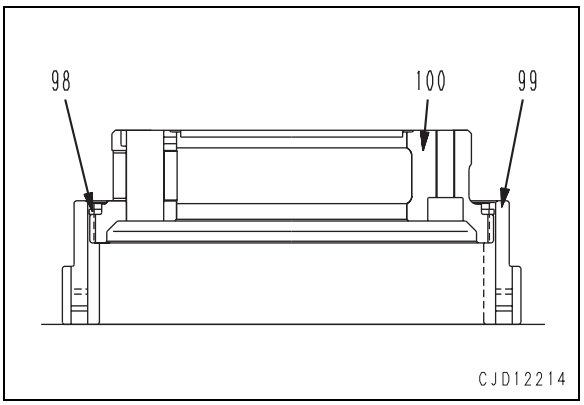
17. No. 5 carrier and No. 4 ring gear assembly
1) Remove mounting bolts (91).
2) Remove No. 5 carrier and No. 4 ring gear assembly (92).



3) Disassemble No. 5 carrier and No. 4 ring gear assembly according to the following procedure.
i) Drive out shaft (93) and remove thrust washer (94), gear (95), bearing (96), and ball (97) from carrier (100).
★ Take care not to lose the ball.



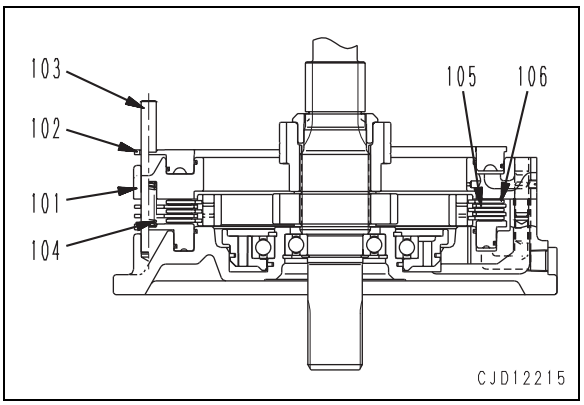
ii) Remove snap ring (98), then remove No. 4 ring gear (99) from carrier (100).



18. No. 4 housing assembly
1) Remove No. 4 housing assembly (101).
2) Remove No. 4 piston (102).

19. Guide pin
Remove guide pin (103).

20. No. 5 discs, plates, and springs
1) Remove springs (104).
2) Remove discs (105) and plates (106).



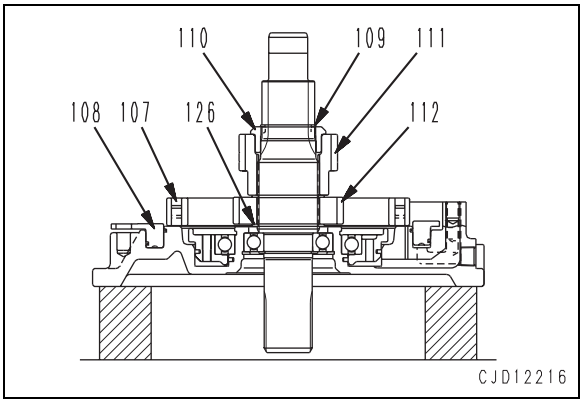
21. No. 5 ring gear
Remove No. 5 ring gear (107).

22. No. 5 piston
Remove No. 5 piston (108).

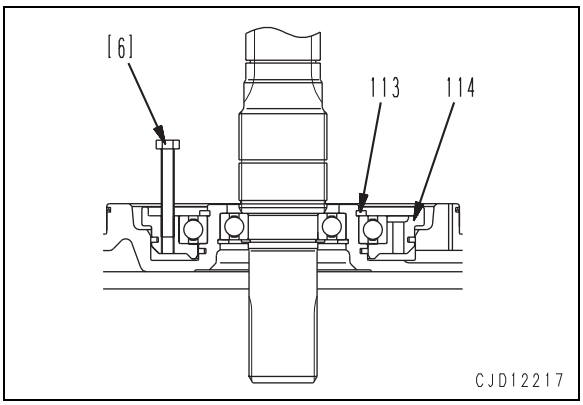
23. Collar
1) Remove snap ring (109).
2) Remove collar (110).

24. No. 4 sun gear
Remove No. 4 sun gear (111).

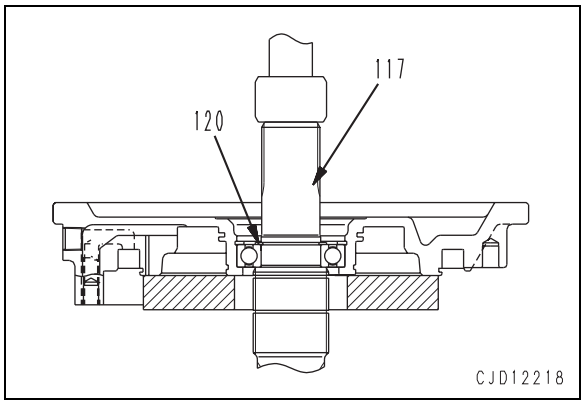
25. No. 5 sun gear
1) Remove No. 5 sun gear (112).
2) Remove snap ring (126).



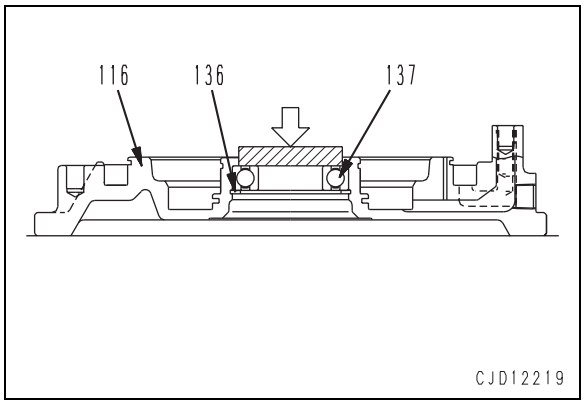
26. Cage (For fixing No. 5 carrier)
1) Remove snap ring (113).
2) Using forcing screws [6], remove cage (114).



27. Output shaft
1) Remove snap ring (120).
2) Push out shaft (117) with a press.
★ Since the shaft falls, receive it with wood blocks, etc.

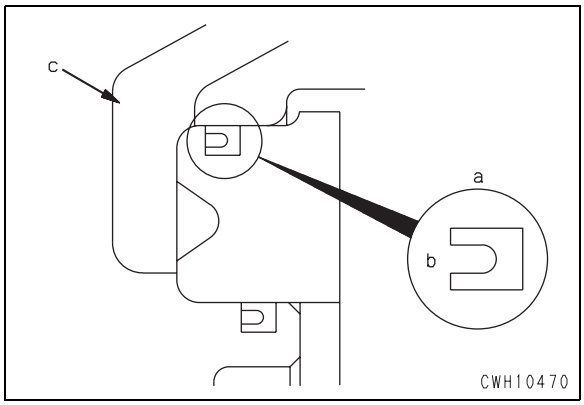


3) Remove snap ring (136).
4) Remove bearing (137) from case (116).



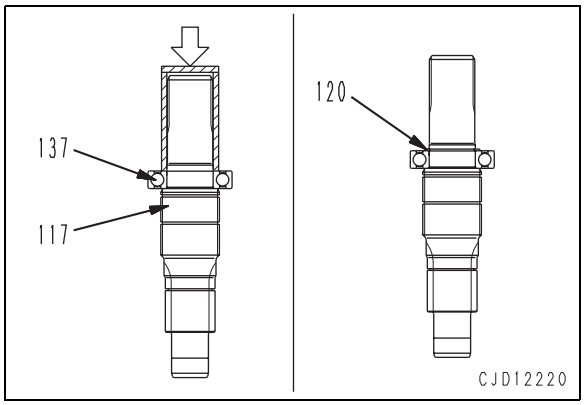
ASSEMBLY

- **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 the seal ring **a** of each piston with the pressure receiving side **b** directed to the housing **c** as shown in the figure.
  - ★ Apply grease (G2-LI) to each metallic seal ring and install it evenly.

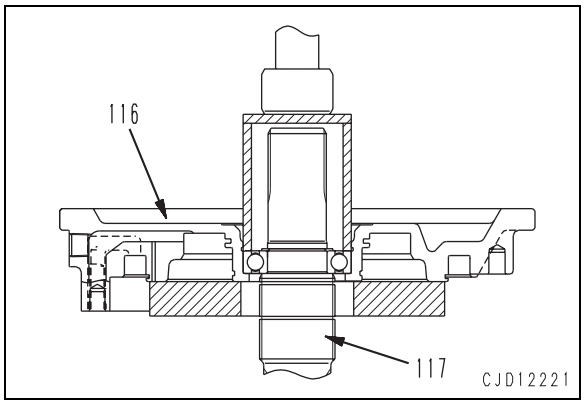


1. Output shaft

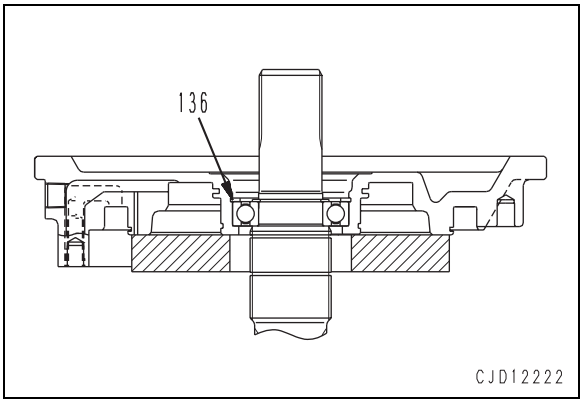
1) Press fit the bearing (137) to shaft (117) and install snap ring (120).



2) Using the push tool, install shaft assembly (117) to case (116).
   - ★ Push the outer race side of the bearing with a press to install the shaft assembly.

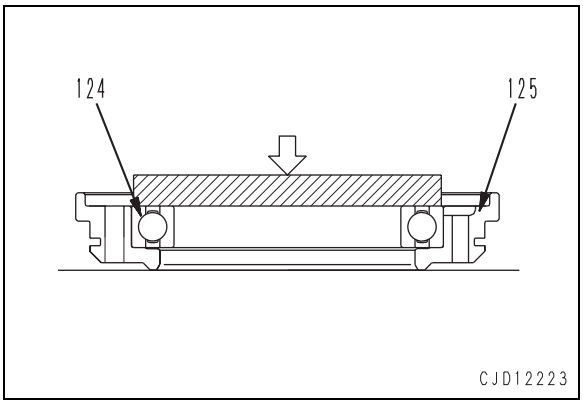


3) Install snap ring (136).

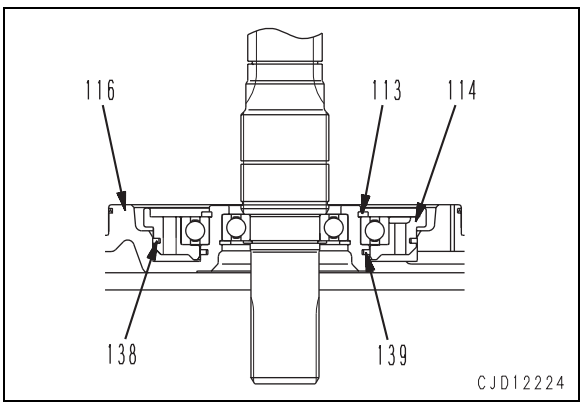


2. Cage (For fixing No. 5 carrier)

1) Using the push tool, press fit bearing (124) to cage (125).



2) Install seal rings (138) and (139).
   Seal ring: **Grease (G2-LI)**
3) Install cage (114) to case (116).
   - ★ Press fit the inner race side of the bearing.
4) Install snap ring (113).

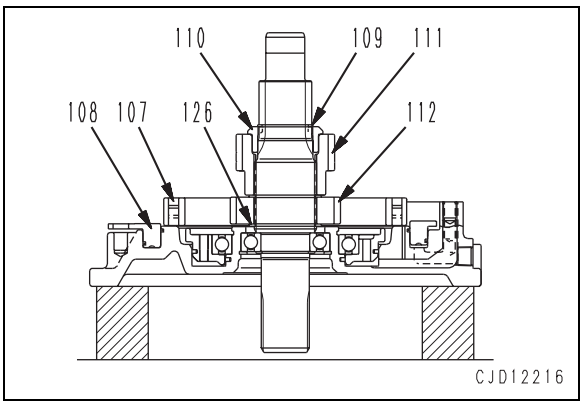


3. No. 5 sun gear
1) Install snap ring (126).
2) Install No. 5 sun gear (112).

4. No. 4 sun gear.
1) Install No. 4 sun gear (111).
2) Install collar (110).
3) Install snap ring (109).

5. No. 5 ring gear
Install No. 5 ring gear (107).

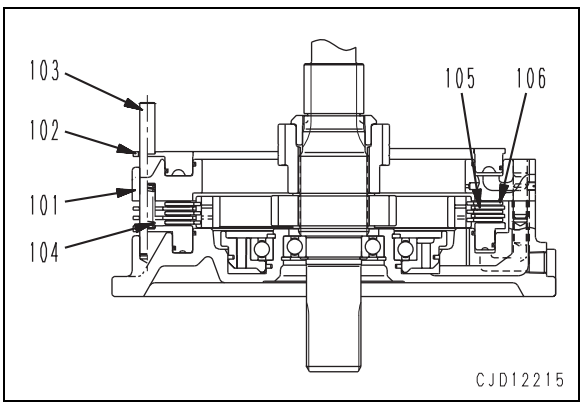
6. No. 5 piston
Install the seal ring and No. 5 piston (108).



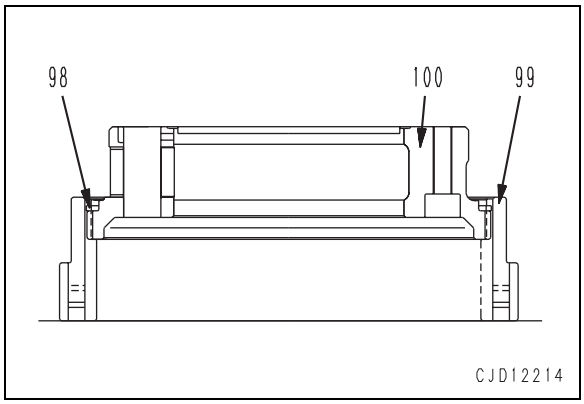
7. Guide pin
Install guide pin (103).

8. No. 5 discs, plates, and springs
1) Install discs (105) and plates (106).
★ Discs: 3 pieces, Plates: 2 pieces
2) Install springs (104).
★ Free length of spring: 59 mm

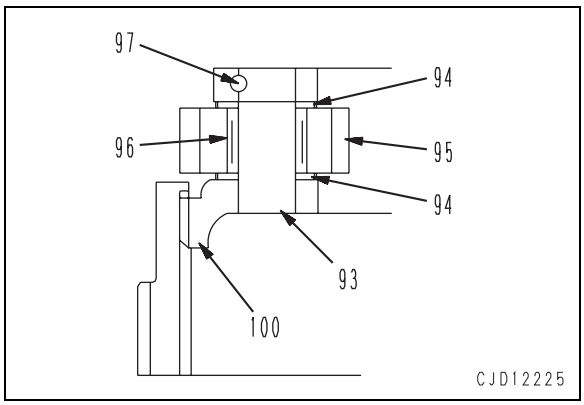
9. No. 4 housing
1) Install the seal ring and No. 4 piston (102).
2) Install No. 4 housing (101).
★ Check that spring (104) is fitted to the groove.



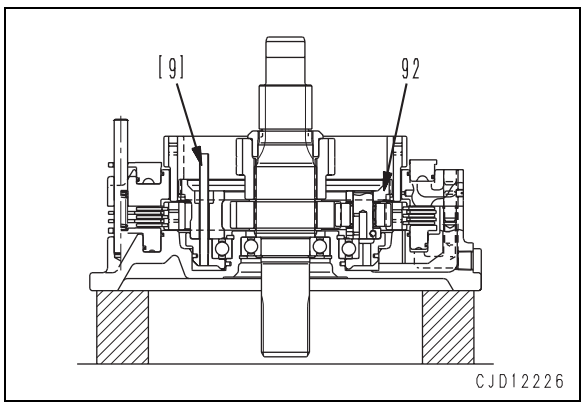
10. No. 5 carrier and No. 4 ring gear assembly
1) Assemble No. 5 carrier assembly according to the following procedure.
i) Set No. 4 ring gear (99) to carrier (100) and install snap ring (98).



ii) Install bearing (96) to gear (95) and fit thrust washers (94) to both sides, and then set them to carrier (100).
iii) Install ball (97) and shaft (93).



2) Using guide bolt [9], install No. 5 carrier and No. 4 ring gear assembly (92).
Mounting bolt: **Adhesive (LT-2)**
Mounting bolt:
66.1 ± 7.4 Nm {6.75 ± 0.75 kgm}



11. No. 4 discs, plates, and springs

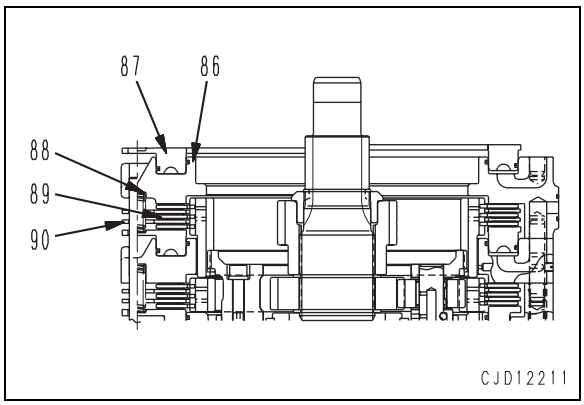
Install No. 4 discs (89), plates (90), and springs (88).

★ Discs: 3 pieces, Plates: 2 pieces

★ Free length of spring: 59 mm

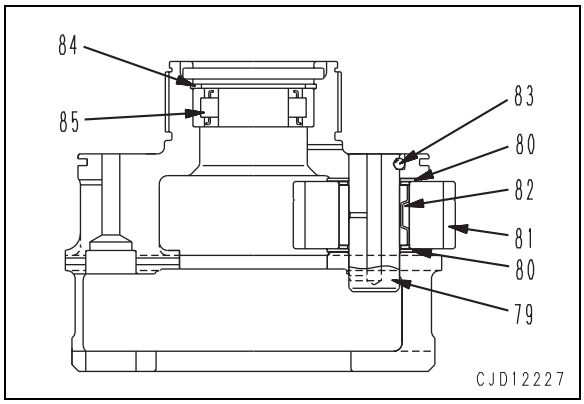
12. No. 3 housing assembly

1) Install the seal ring and No. 3 piston (87).
2) Install No. 3 housing (86).
   ★ Check that springs (88) are fitted in the grooves.

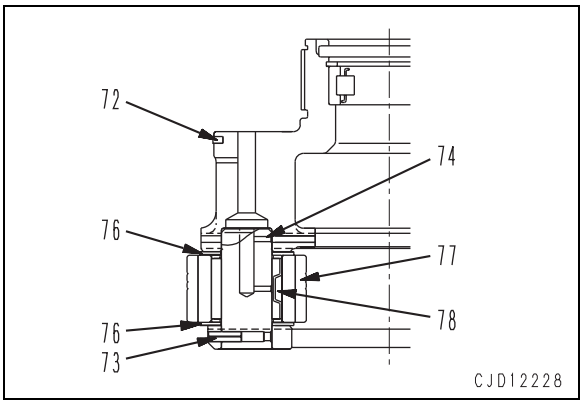


13. No. 3 and No. 4 carrier assembly

1) Assemble No. 3 and No. 4 carrier assembly according to the following procedure.
   i) Press fit bearing (85) and install snap ring (84).
   ii) Install bearing (82) to No. 3 planetary gear (81) and fit thrust washers (80) to both sides, and then set them to the carrier.
   iii) Install ball (83) and shaft (79).



   iv) Install bearing (78) to No. 4 planetary gear (77) and fit thrust washers (76) to both sides, and then set them to the carrier.
   v) Install shaft (74), matching its pin hole to the pin hole of the carrier.
   vi) Check that the pin holes are matched to each other and drive in pin (73).
   vii) Install seal ring (72).



2) Matching the sun gear to the ring gear, install No. 3 and No. 4 carrier assembly (71).
   ★ Take care that your fingers will not be caught.

14. No. 3 ring gear

Install No. 3 ring gear (70).

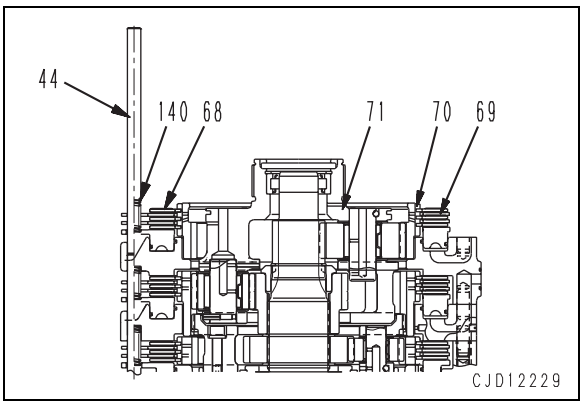
★ Install the ring gear with the notched side of the external teeth down.

15. Guide pin

Install guide pin (44).

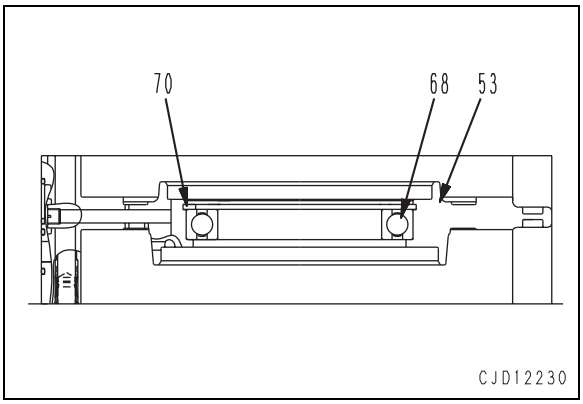
16. No. 3 discs and plates

1) Install No. 3 discs (68) and plates (69).
   ★ Discs: 3 pieces, Plates: 2 pieces
2) Install springs (140).
   ★ Free length of spring: 59 mm

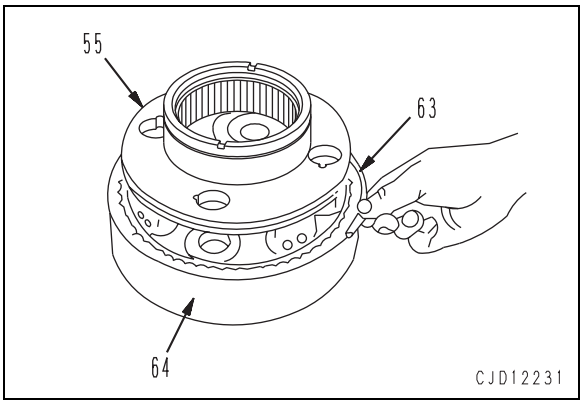


17. No. 2 housing and No. 2 carrier assembly

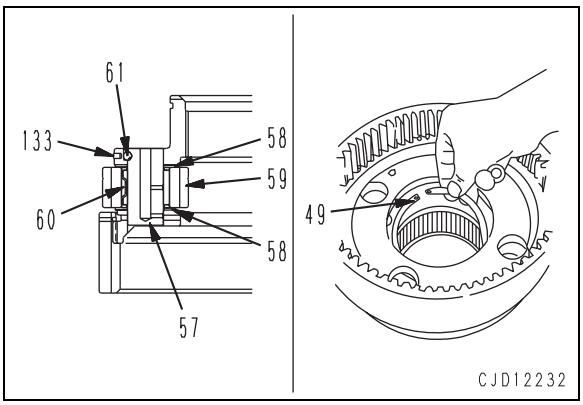
1) Assemble No. 2 housing according to the following procedure.
   i) Press fit bearing (68) to No. 2 housing (53) and install snap ring (70).



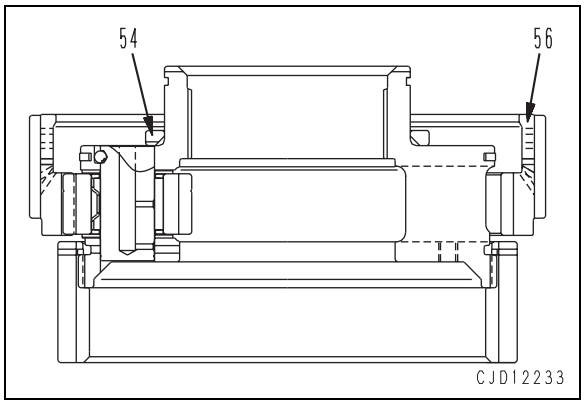
   ii) Set ring gear (64) to No. 2 carrier (55) and install snap ring (63).



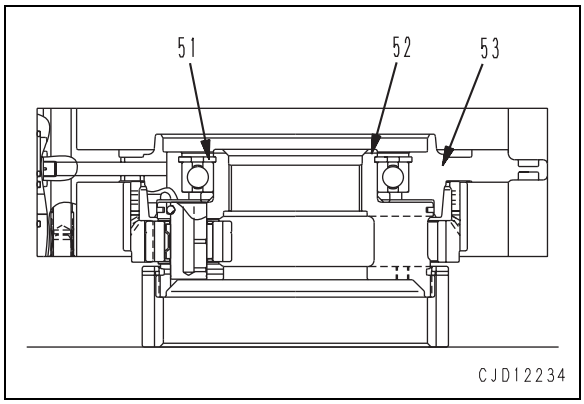
   iii) Install bearing (60) to gear (59) and fit thrust washers (58) to both sides, then set them to the carrier.
   iv) Install ball (61) and shaft (57).
      ★ After assembling the 2 gear sets, install snap ring (49).



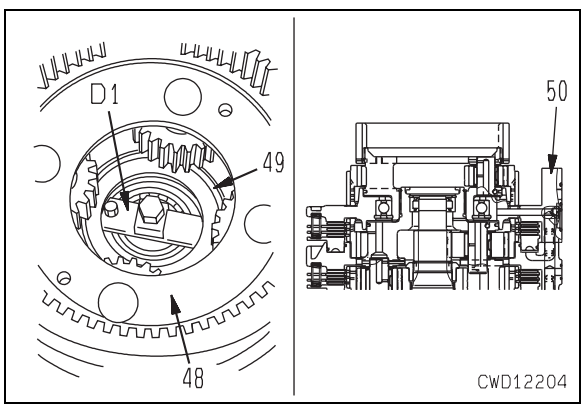
   v) Install the seal ring.
   vi) Install No. 2 ring gear (56).
   vii) Install spacer (54).
      ★ Install the spacer with the cut inside end directed to the carrier.



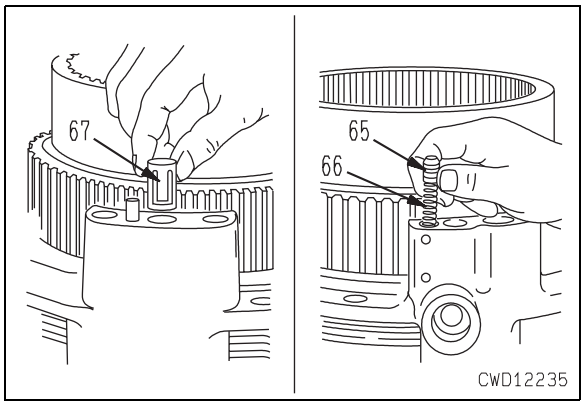
   viii) Install No. 2 housing (53) to carrier assembly (52).
      ★ Press fit the inner race side of the housing bearing.
   ix) Install snap ring (51).

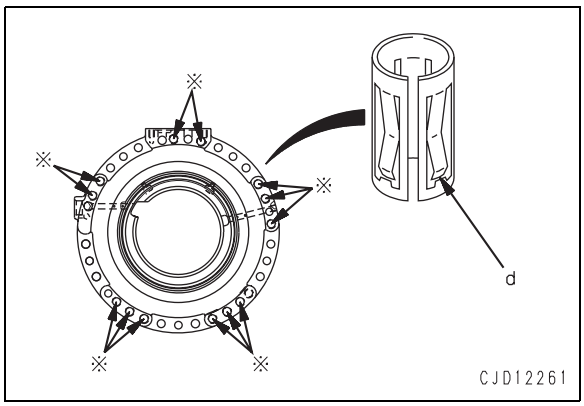


2) Using eyebolts, install No. 2 housing and No. 2 carrier assembly (50).
3) Using tool **D1**, push up No. 3 carrier (48) and install snap ring (49).



4) Install sleeve (67).
   ★ When installing the sleeve, install it to the bolt hole marked * in the figure with the slit **d** side down.
5) Install spring (66) and valve (65).





18. No. 2 discs and plates

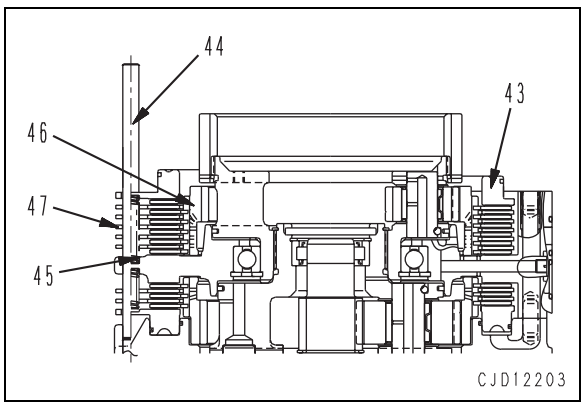
Install No. 2 discs (46) and plates (47).
★ Discs: 6 pieces, Plates: 5 pieces

19. No. 2 clutch springs

Install springs (45).
★ Free length of spring: 77 mm

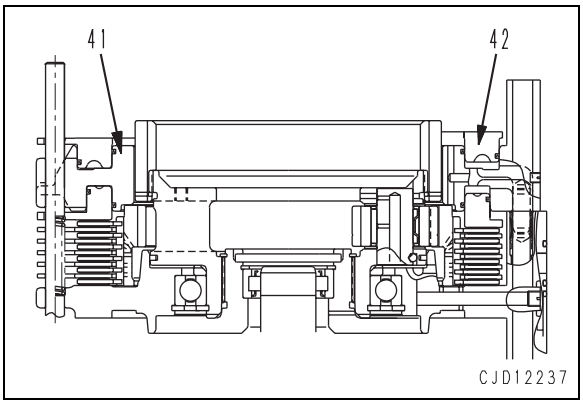
20. No. 2 piston

Install the seal ring and No. 2 piston (43), matching the spring to the spring groove.



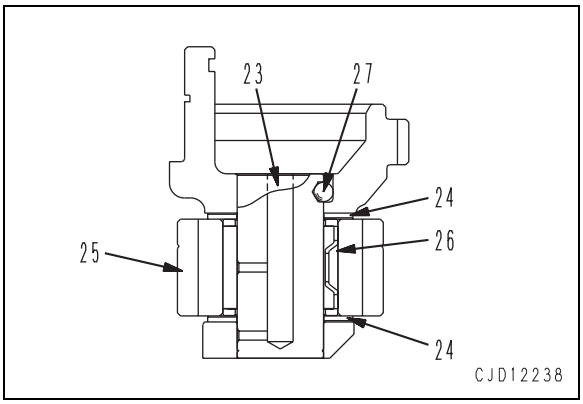
21. No. 1 housing assembly

1) Fit the seal ring and install No. 1 piston (42) to housing (41).
2) Using eyebolts, install No. 1 housing assembly (41), matching it to No. 2 piston.
   ★ Press the housing and hit the dowel pin.

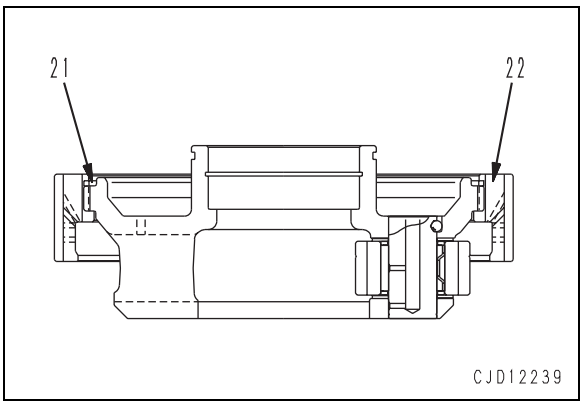


22. Input shaft and No. 1 carrier assembly

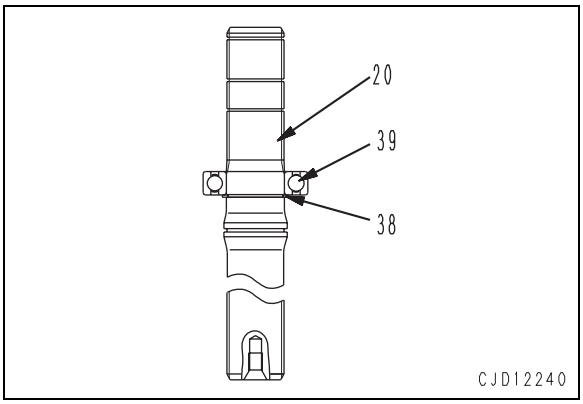
1) Assemble the input shaft and No. 1 carrier assembly according to the following procedure.
   i) Install bearing (26) to gear (25) and fit thrust washers (24) to both sides, and then set them to the carrier.
   ii) Install ball (27) and shaft (23).



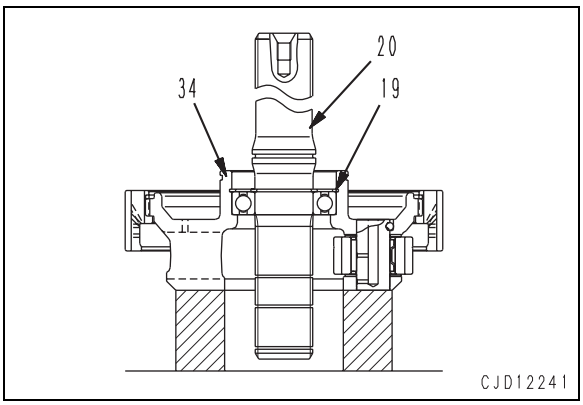
   iii) Set No. 1 ring gear (22) to No. 1 carrier and install snap ring (21).



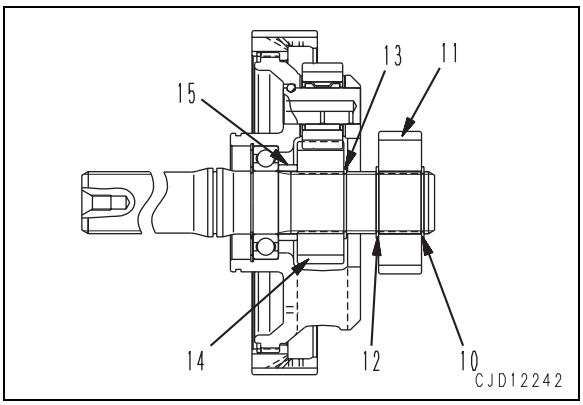
iv) Install snap ring (38) to input shaft (20), and then press fit bearing (39).



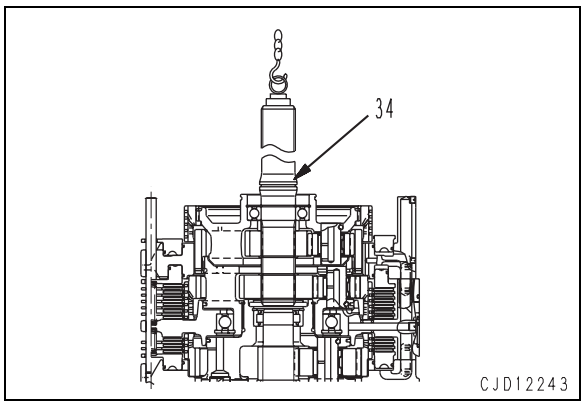
v) Install input shaft (20) to No. 1 carrier assembly (34), and then install snap ring (19).



vi) Install collar (15).
vii) Install No. 1 sun gear (14).
viii) Install snap rings (13) and (12).
ix) Install No. 2 sun gear (11) and snap ring (10).



2) Sling and install input shaft and No. 1 carrier assembly (34), meshing No. 2 sun gear with No. 1 planetary gear.

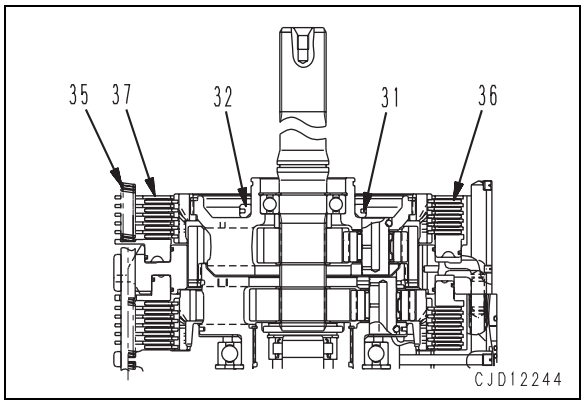


23. No. 1 discs, plates, and springs

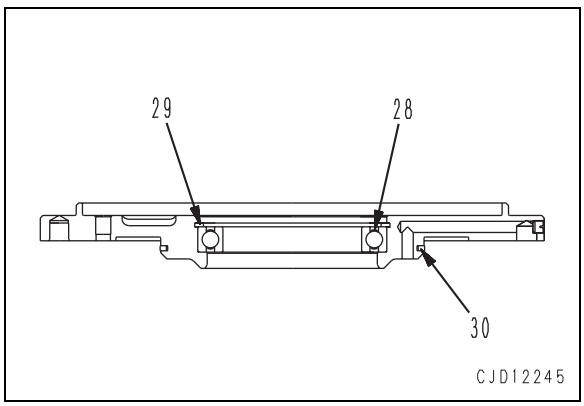
Install discs (36), plates (37), and springs (35).
★ Disc: 5 pieces, Plates: 5 pieces
★ Free length of spring: 77 mm

24. Front plate

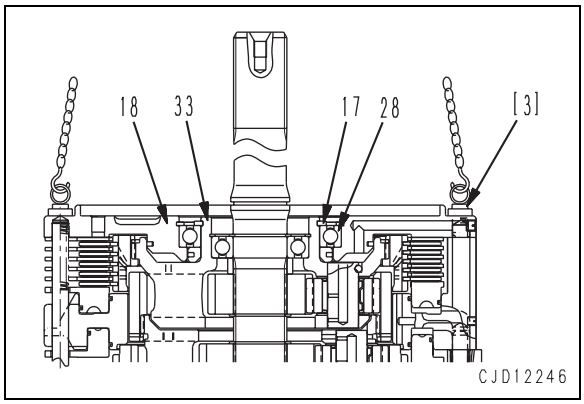
1) Fit seal ring (31) and install collar (32) to No. 1 carrier (33).



2) Install the following parts to the front plate.
   i) Press fit bearing (28) and install snap ring (29).
   ii) Install seal ring (30).



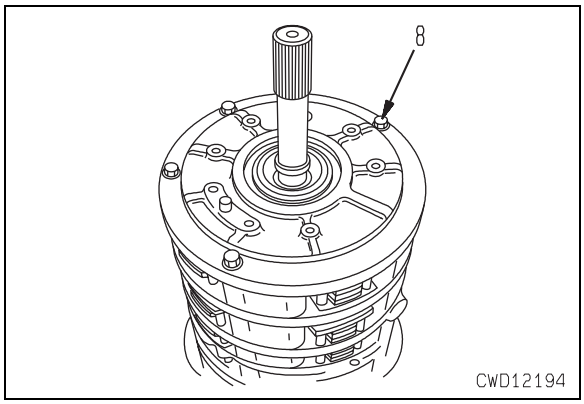
3) Using eyebolts [3], install front plate (18), matching it to the guide pin and spring.
4) Press fit the inner race side of bearing (28) to No. 1 carrier (33) and install snap ring (17).
   ★ Check that the spring is fitted to the cover.



25. Tie bolts

Install 4 tie bolts (8).

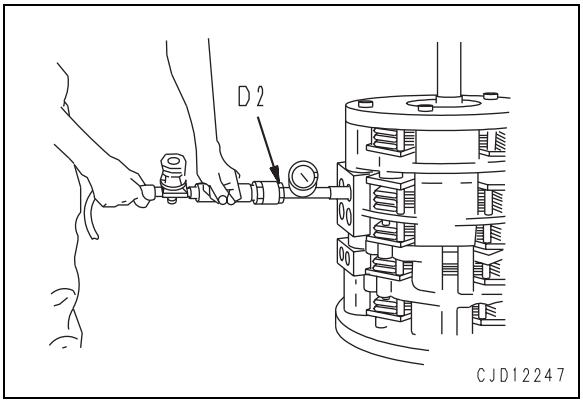
Tie bolt: **166.7 ± 9.8 Nm {17 ± 1 kgm}**



26. Operation check of piston

Using tool **D2**, check the operating condition and stroke of each piston.

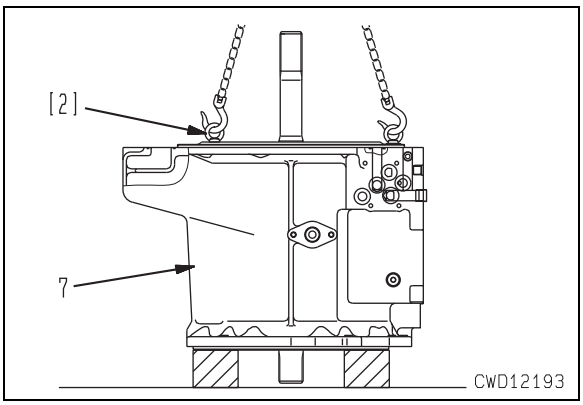
Piston	Standard stroke (mm)
No.1	5
No.2	6
No.3	3
No.4	3
No.5	3



27. Transmission case

Fit the O-ring and install transmission case (7), using eyebolts [2]. Then, install the remaining 9 tie bolts and 2 case clamping bolts.

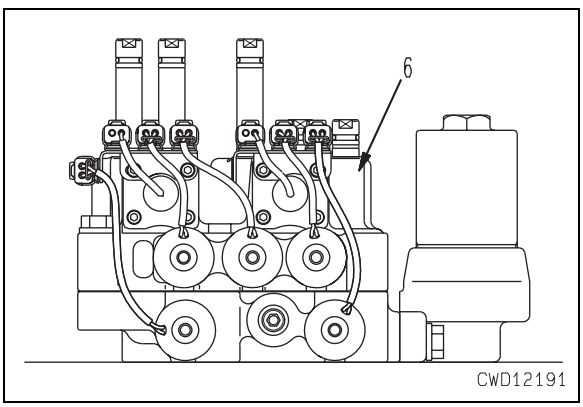
Tie bolt: **166.7 ± 9.8 Nm {17 ± 1 kgm}**



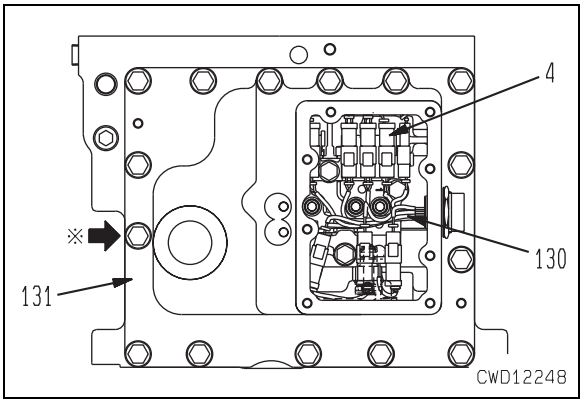
28. Control valve

1) Place the transmission on its side.
2) Fit the O-ring and install control valve assembly (6).

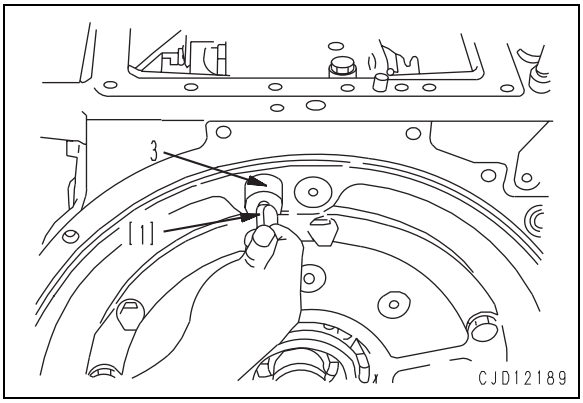
   Mounting bolt:
   49 ± 4.9 Nm {5 ± 0.5 kgm}



3) Install cover (131) and wiring harness together.
   Cover: **Gasket sealant (LG-6)**
   1 bolt marked with *:
   Gasket sealant (LG-6)
4) Connect 10 ECMV connectors (4).



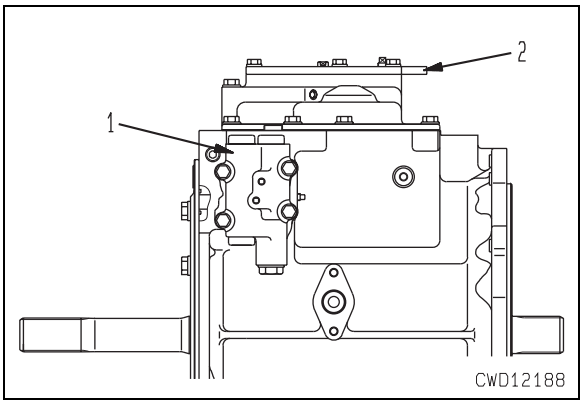
5) Fit the O-ring and install sleeve (3), using eyebolts [1].



6) Install cover (2).
   Cover: **Gasket sealant (LG-6)**

29. Relief valve

Install relief valve assembly (1).
Mounting bolt:
44.1 – 53.9 Nm {4.5 – 5.5 kgm}



DISASSEMBLY AND ASSEMBLY OF HSS ASSEMBLY

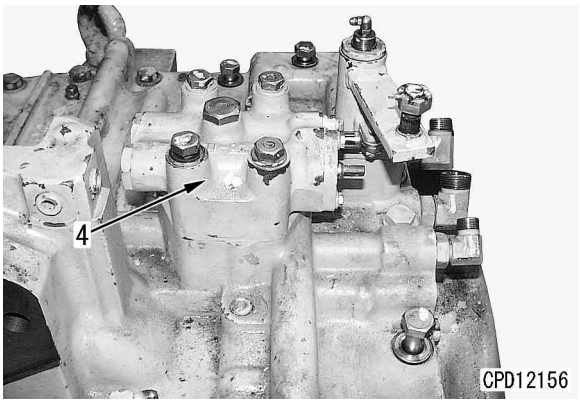
SPECIAL TOOLS

Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
E	1	791T-422-1320	Hanger	■	1		○
	2	790-302-1500	Wrench set	●	1		
	3	796-730-2300	Wrench	■	1		
	4	Commercially available or 795-630-1810	Torque wrench	●	1		

DISASSEMBLY

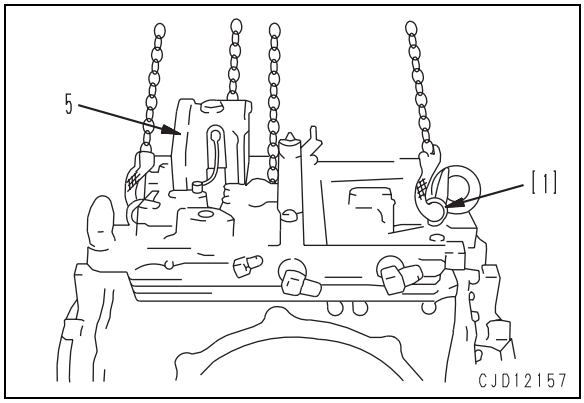
1. Brake valve assembly

Remove brake valve assembly (4).

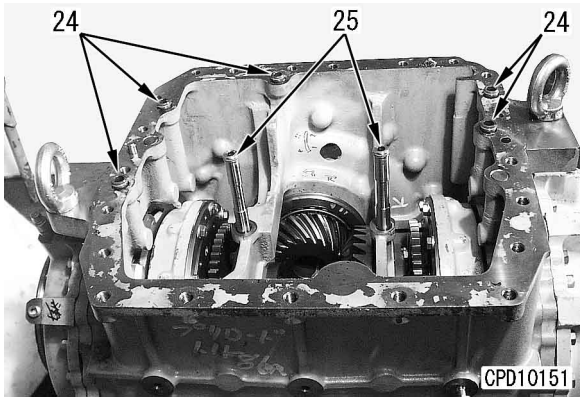


2. Cover assembly

1) Using eyebolts [1], remove cover assembly (5).



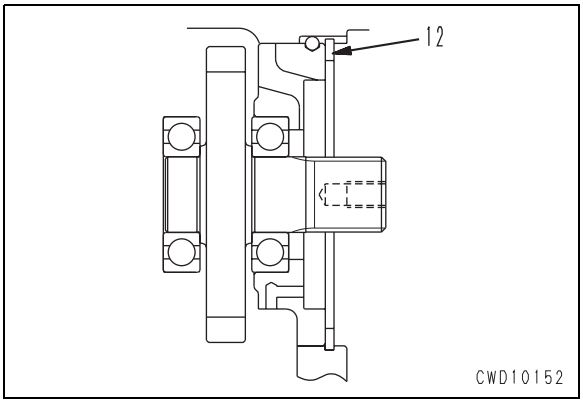
2) Remove 5 sleeves (24) and 2 sleeves (25) from the HSS case.



- **Disassembly of cover assembly**

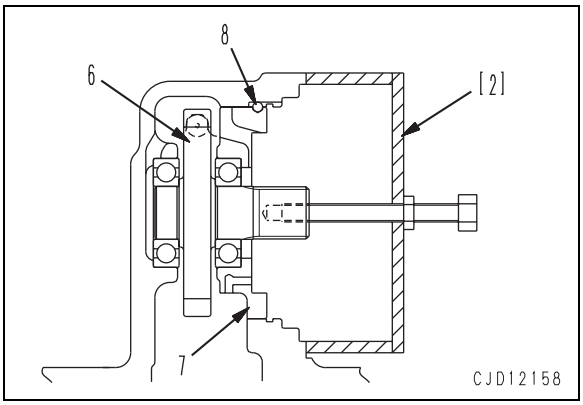
1) Input gear assembly

i) Remove snap ring (12).

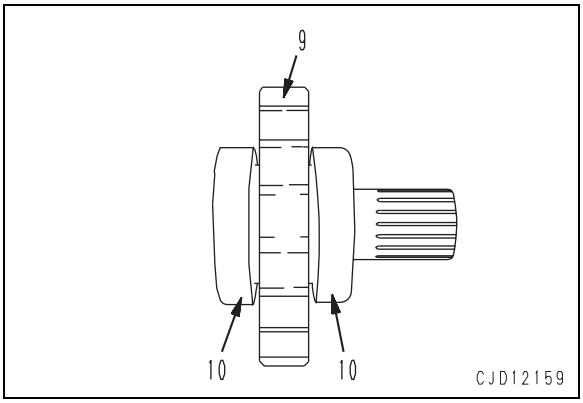


ii) Pull out gear assembly (6) and cage (7) as a unit with puller [2], then remove gear assembly (6) from cage (7).

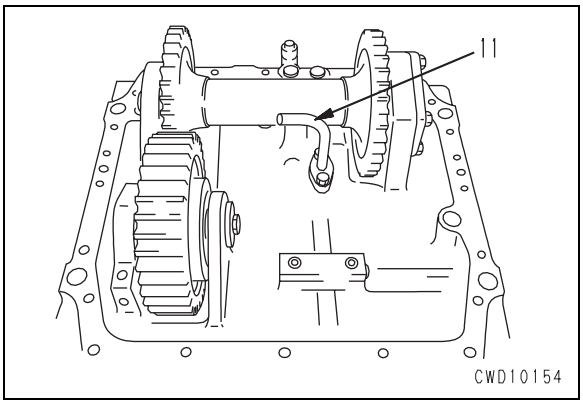
★ Take care not to lose ball (8).



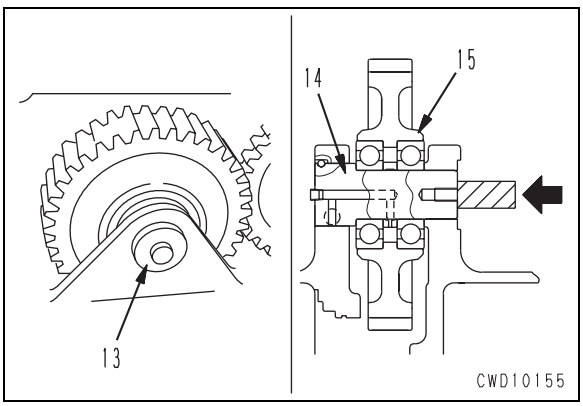
iii) Remove bearing (10) from gear (9).



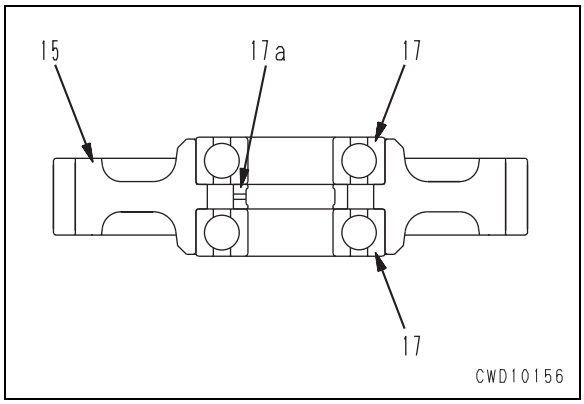
2) Intermediate gear assembly
   i) Remove tube (11).



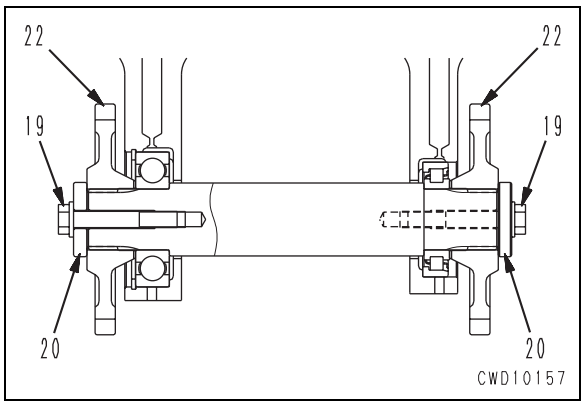
   ii) Remove the bolt and holder (13).
   iii) Drive out shaft (14) from the bolt side and remove gear (15).
      ★ Take care not to lose the ball.



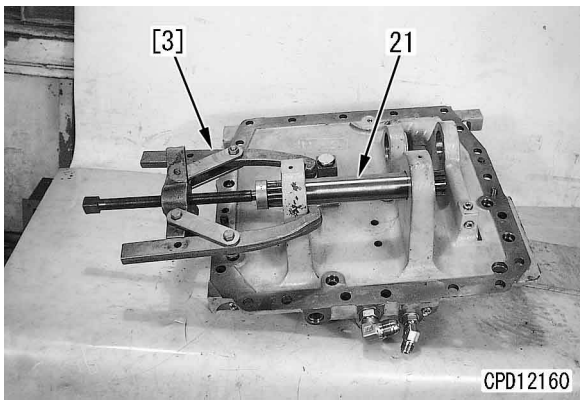
iv) Remove bearing (17) and spacer (17a) from gear (15).



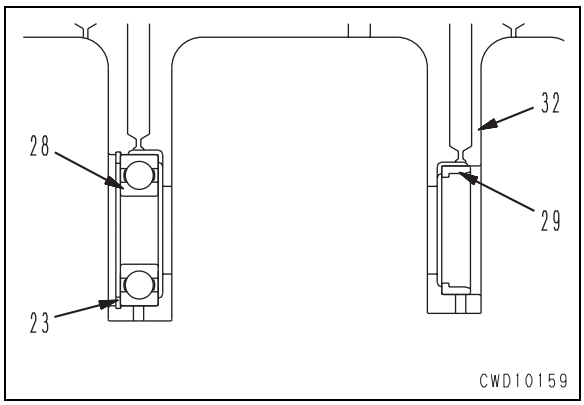
3) Left carrier drive gear
   i) Remove bolt (19) and holder (20).
   ii) Remove gear (22).



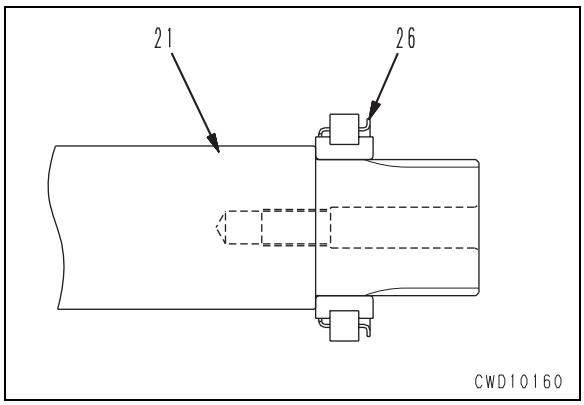
   iii) Using gear puller [3], push out shaft (21).



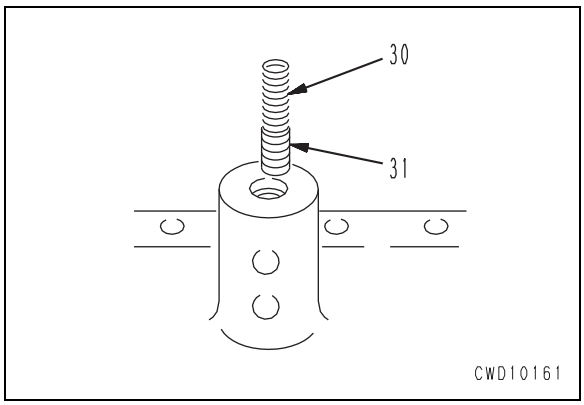
iv) Remove snap ring (23), then remove bearing (28) from cover (32).
v) Remove outer race (29) from cover (32).



vi) Remove bearing (26) from shaft (21).

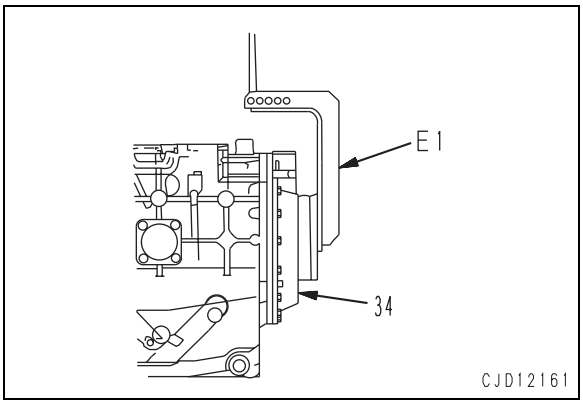


4) Remove the plug, spring (30), and valve (31).



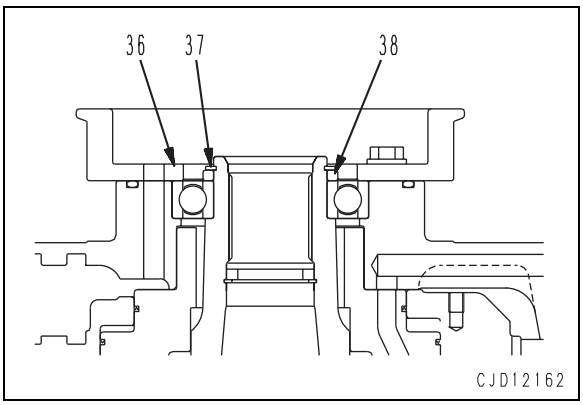
5. Brake and carrier assembly

1) Remove the mounting bolts, and then remove brake assembly (34) with tool **E1**.
★ Do not remove 4 hexagon socket head bolts.

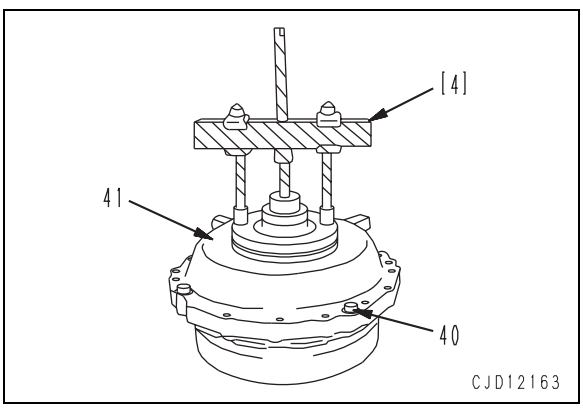


• **Disassembly of brake assembly**

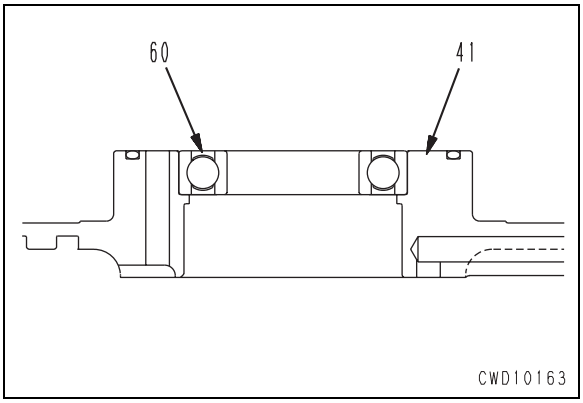
1) Remove flange (36).
2) Remove snap ring (37) and spacer (38).



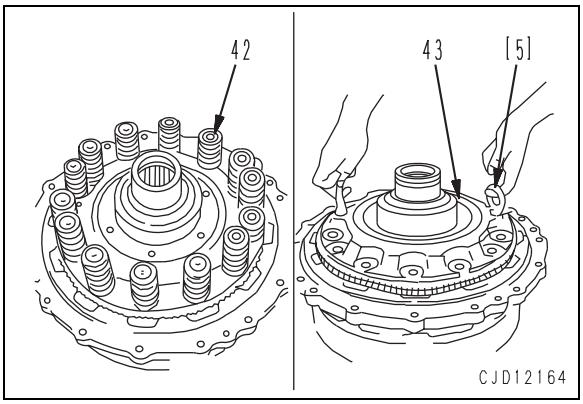
3) Set puller [4], loosen 4 hexagon socket head bolts (40) and remove cover (41).
★ The inner race side of the bearing comes out.
★ Do not remove bolts (40) until cover (41) comes off.



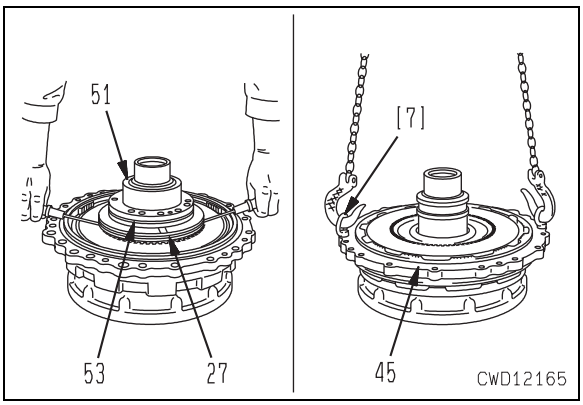
4) Remove bearing (60) from cover (41).



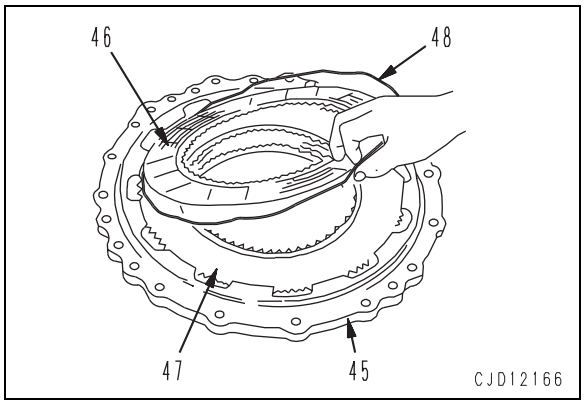
5) Remove spring (42).
6) Using eyebolts [5], remove piston (43).



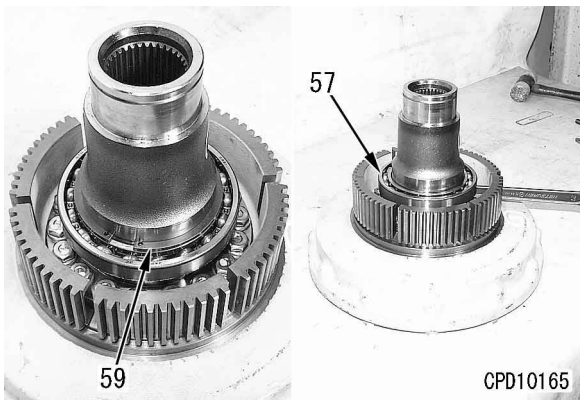
7) Push up and remove cage (51), taking care not to damage the disc.
8) Remove seal rings (53) and (27) from cage (51).
9) Using eyebolts [7], remove drum (45), discs, and plates as a unit.



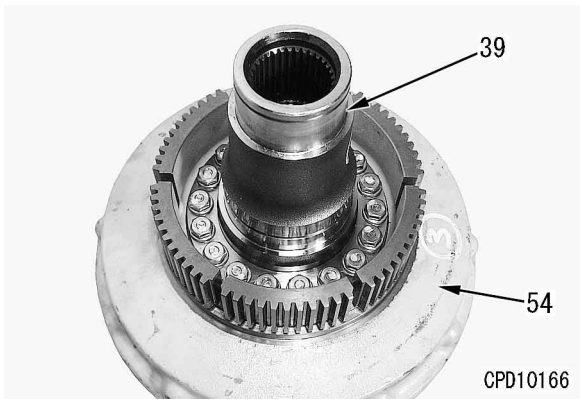
10) Remove discs (46), plates (47), and springs (48) from drum (45).



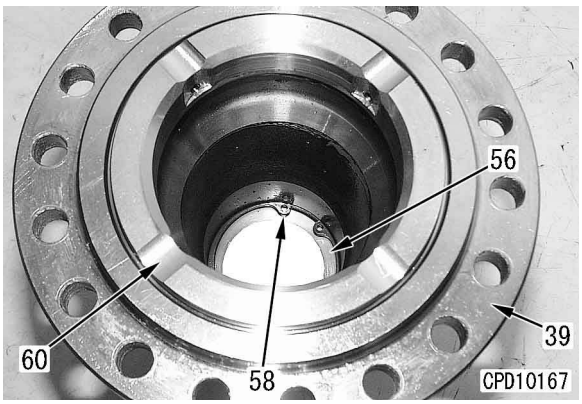
11) Remove snap ring (59) and bearing (57).
★ Pry up the bearing from the notch of the hub.



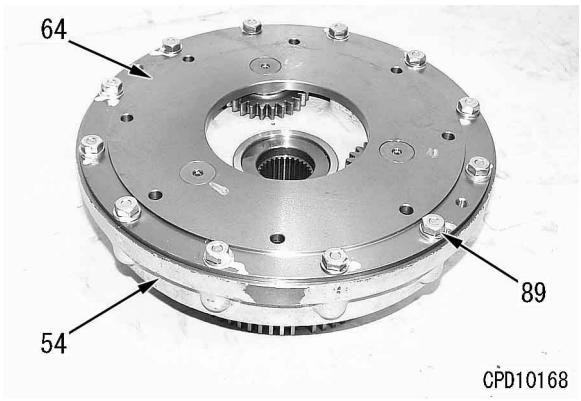
12) Remove 18 mounting bolts, and then remove hub (39) from hub (54).



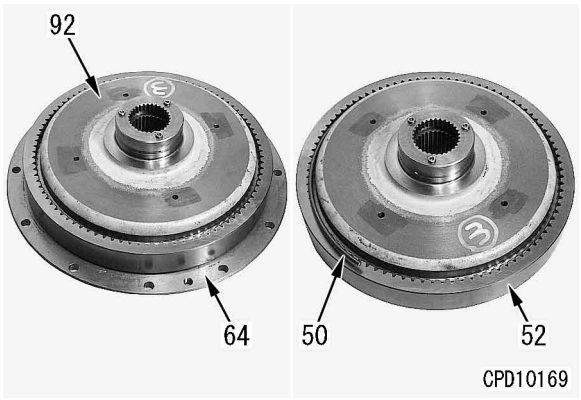
13) Remove bushing (60) from hub (39).
14) Remove snap ring (58), and then remove stopper (56) from the hub.



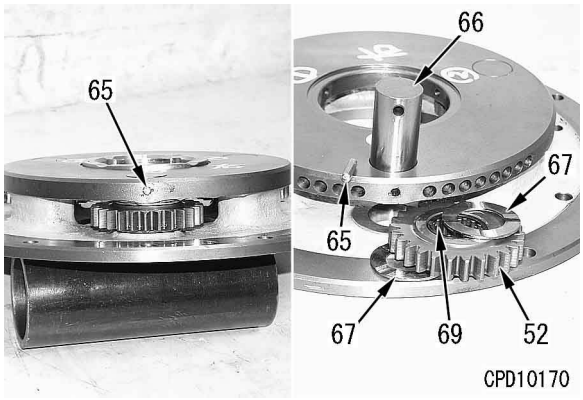
- **Disassembly of carrier assembly**
  1) Turn over the hub and carrier assembly and remove bolts (89), and then remove carrier assembly (64) from hub (54).



  2) Remove hub (92) from carrier assembly (64), then remove snap ring (50) and ring gear (52).

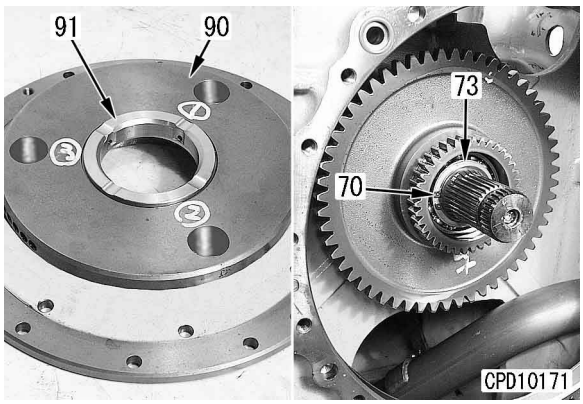


  3) Drive roll pin (65) into the shaft.
  4) Pull out shaft (66) and remove gear (52), thrust washer (67), and bearing (69).
     ★ Pull roll pin (65) out of the shaft.

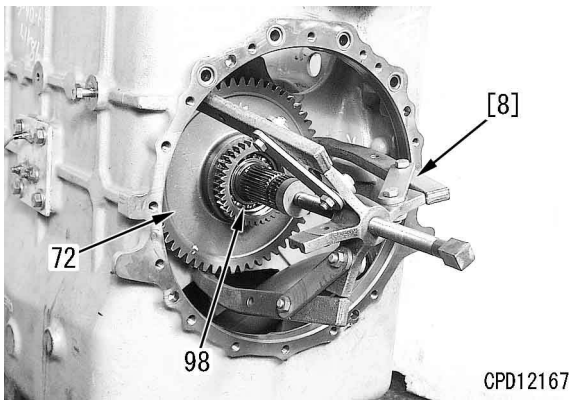


  5) Remove bushing (91) from carrier (90).

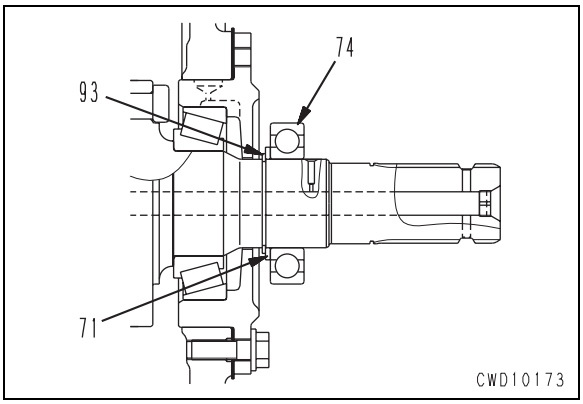
6. Sun gear
  1) Remove snap ring (70) and collar (73).



  2) Using gear puller [8], remove sun gear (72) and bearing (98).

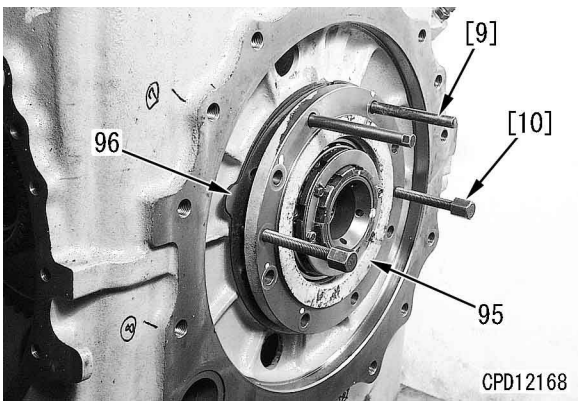


3) Using the bearing race puller, remove bearing (74).
4) Remove collar (71).
5) Remove snap ring (93).
   ★ Perform this work for only right side of the machine.

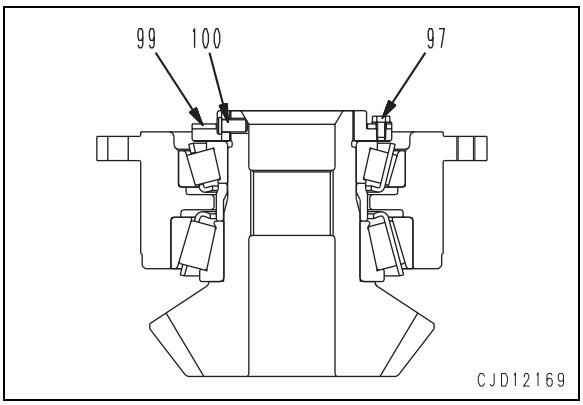


7. Bevel pinion assembly

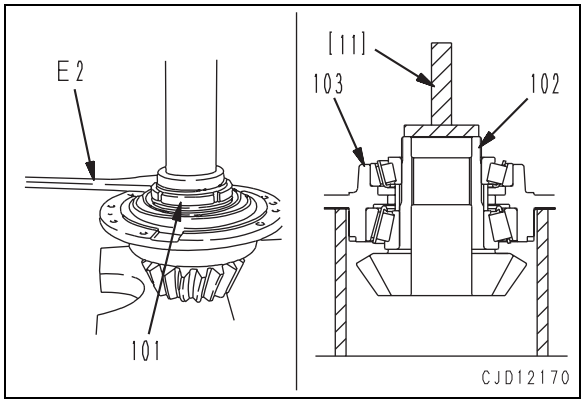
1) Remove the mounting bolts.
2) Using guide bolts [9] and forcing screws [10], remove bevel pinion assembly (95) and shim (96).
   ★ Check the quantity and thickness of the shims and store them.



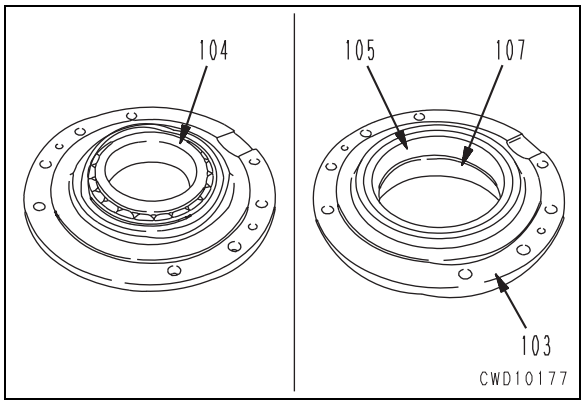
3) Disassembly of bevel pinion assembly
   i) Remove bolt (97), plate (99), and pin (100).



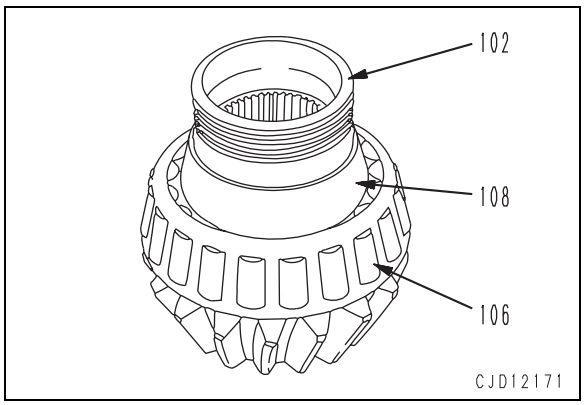
   ii) Secure the pinion with a press and remove nut (101) with tool **E2**.
   iii) Using push tools [11], remove bevel pinion (102) from cage (103).



   iv) Remove bearing (104).
   v) Remove outer races (105) and (107) from cage (103).

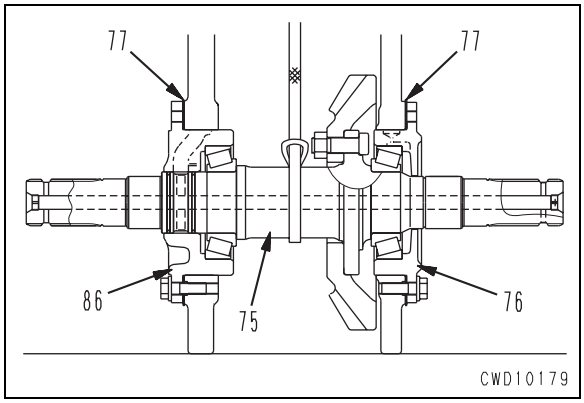


   vi) Remove bearing (106) and spacer (108) from bevel pinion (102).

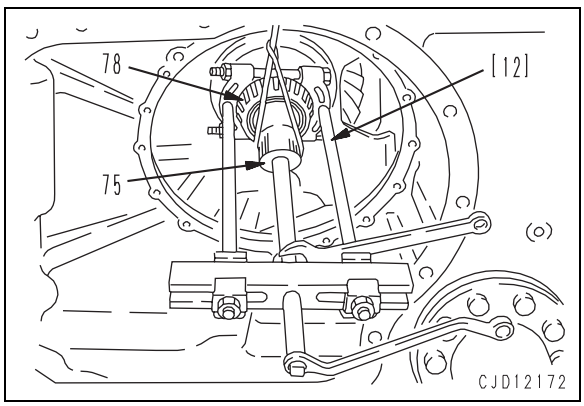


8. Bevel gear shaft and bevel gear assembly

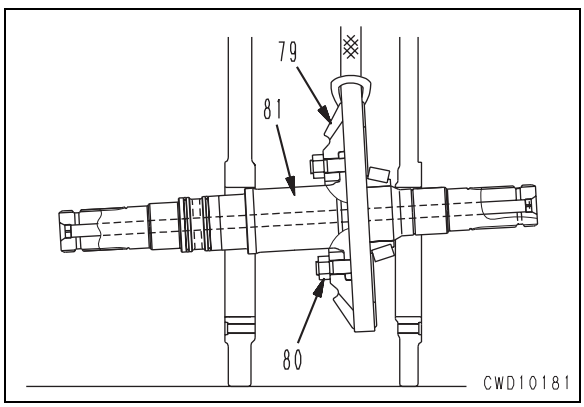
1) Sling bevel gear and shaft assembly (75) temporarily.
2) Remove cage assemblies (76) and (86).
   ★ Check the thickness, quantity, and positions of shims (77).
   ★ Since both cages are different from each other, make marks on them.



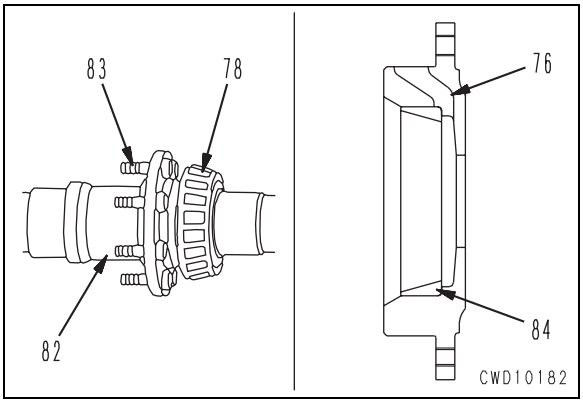
3) Move bevel gear and shaft assembly (75) to the left end and remove bearing (78) with puller [12].
   ★ Remove only the bearing on the left side of the machine.



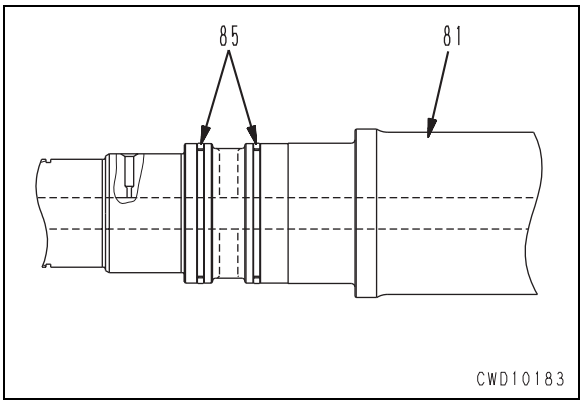
4) Sling bevel gear (79), remove mounting nut (80), and pull out bevel gear shaft assembly (81) to the right side of the machine.



5) Remove bearing (78) from bevel gear shaft (82).
6) Remove bolts (83).
7) Remove outer race (84) from cage (76).



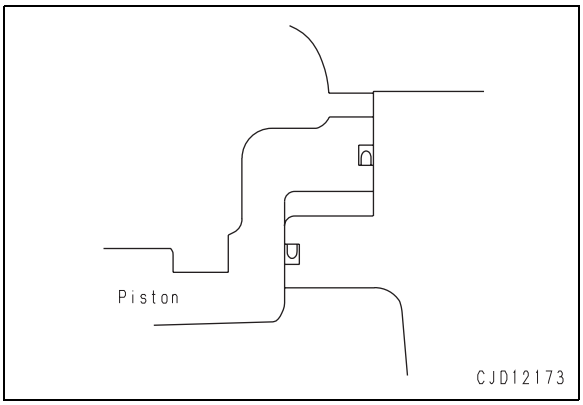
8) Remove seal ring (85) from bevel gear shaft (81).



ASSEMBLY

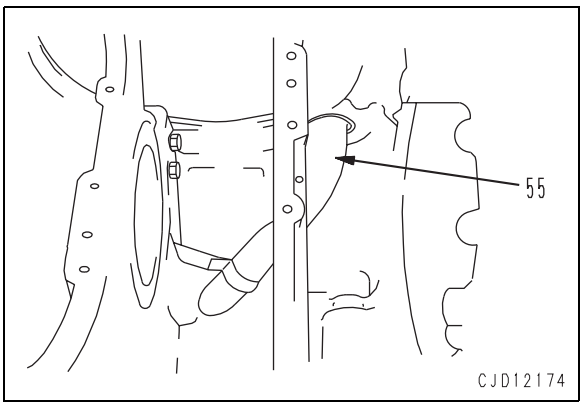
- **Precautions for assembly**
  - ★ Clean the all parts and check them for dirt or damage before installing.
  - ★ Drop engine oil onto the rotating parts of each bearing and rotate it several turns.
  - ★ Coat the sliding parts with engine oil before installing.
  - ★ Apply grease (G2-LI) to each piston 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 in the grooves.



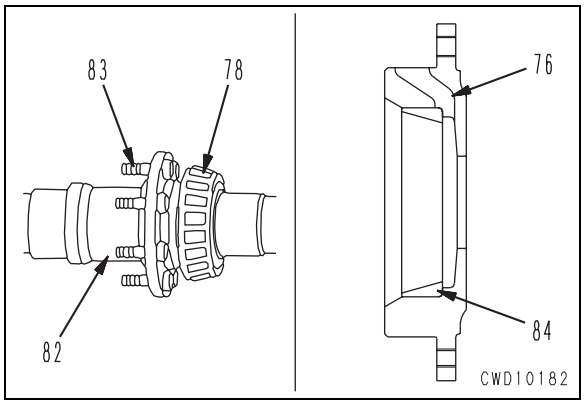
1. Suction tube

Install suction tube (55).

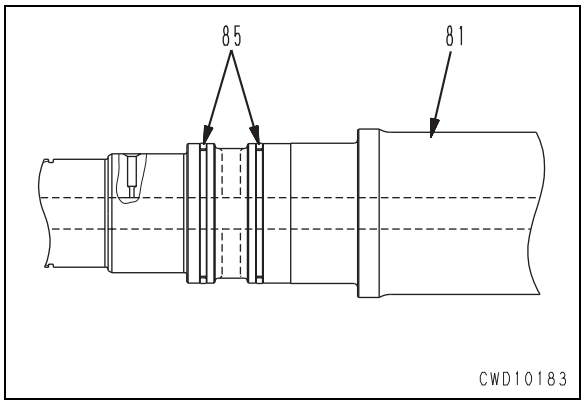


2. Bevel gear shaft and bevel gear assembly

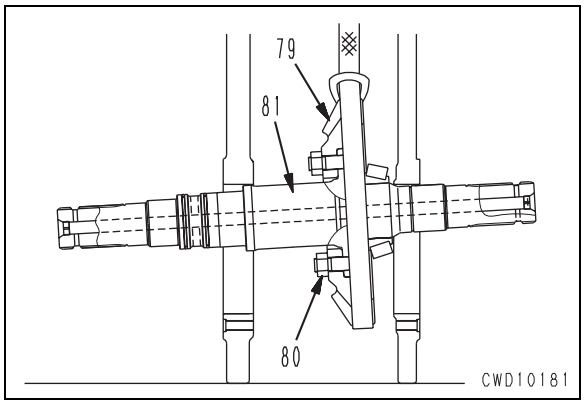
1) Install bolt (83) to bevel gear shaft (82)
2) Heat bearing (78) with a bearing heater, etc. and install it to the right side of the bevel gear shaft by shrink fit.
   - ★ If the bearing temperature is raised too high, the hardness of the heat-treated part lowers. Accordingly, do not raise the bearing temperature more than 120°C.
   - ★ 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).



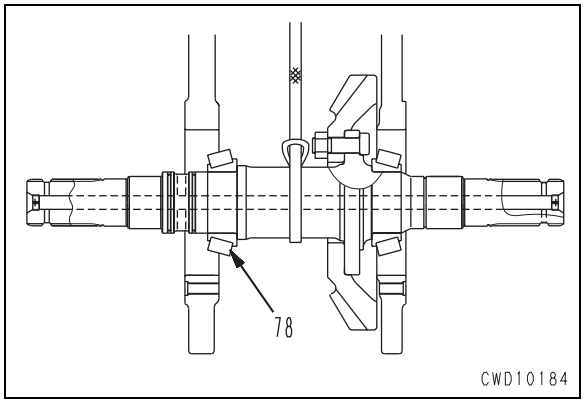
4) Install seal ring (85) to bevel gear shaft (81).



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.



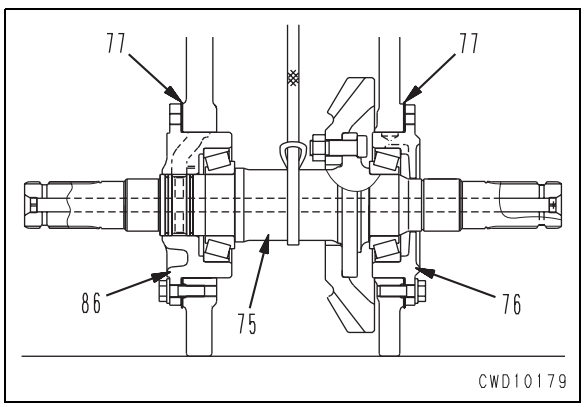
6) Heat bearing (78) with a bearing heater, etc. and install it to the left side of the bevel gear shaft by shrink fit.
   ★ If the bearing temperature is raised too high, the hardness of the heat-treated part lowers. Accordingly, do not raise the bearing temperature more than 120°C.
   ★ After installing 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

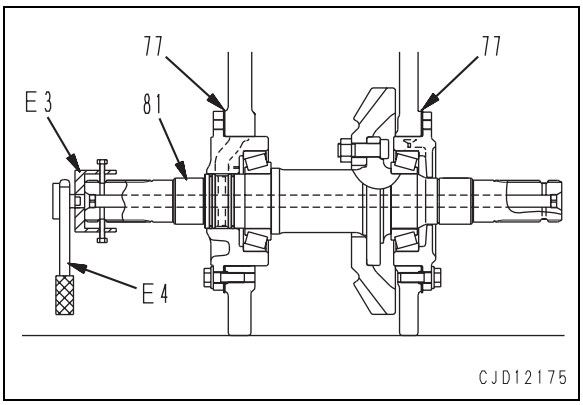
   Mounting bolt:
   98.1 – 122.6 Nm {10 – 12.5 kgm}
8) Tighten the bevel gear mounting nut permanently.
   ★ Place a plastic hammer, etc. between the bevel gear and case to lock them.

   Mounting nut:
   245 – 309 Nm {25 – 31.5 kgm}



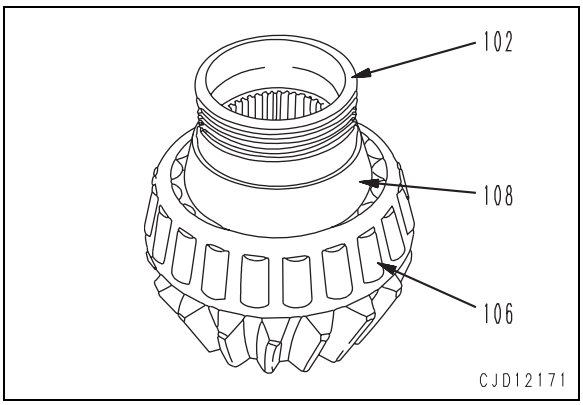
9) Adjusting pre-load
   ★ Adjust the pre-load with the bevel pinion assembly removed.
   i) Rotate the bevel gear and shaft assembly several turns to fit the bearing.
   ii) Install tool **E3** to the end of bevel gear shaft (81) and measure the rotation torque with a torque wrench **E4**.
      • Standard 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.

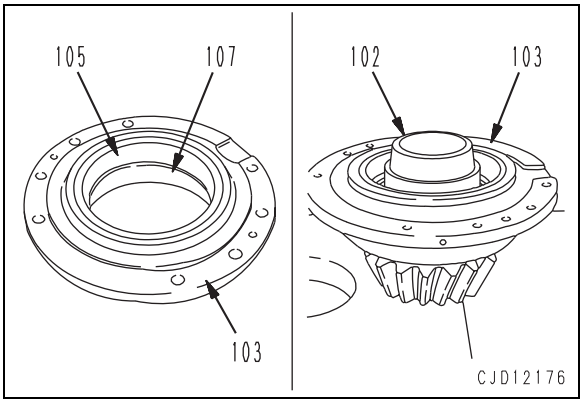


3. Bevel pinion assembly

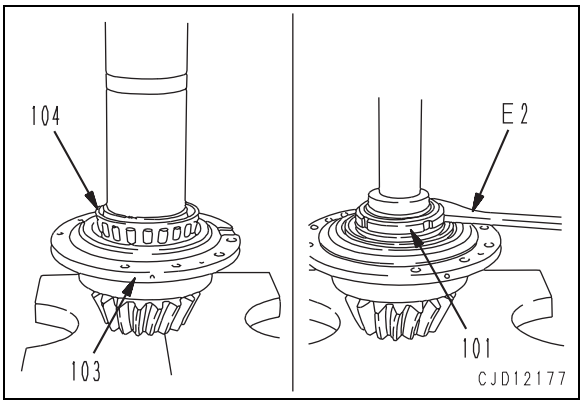
1) Assembly of bevel pinion
   i) Using the push tool, press fit bearing (106) to bevel pinion (102) and install spacer (108).



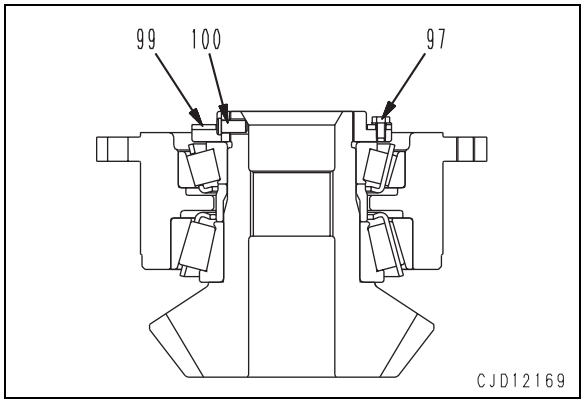
ii) Using the push tool, press fit outer races (105) and (107) to cage (103).
iii) Place bevel pinion (102) on the press stand and set cage (103).



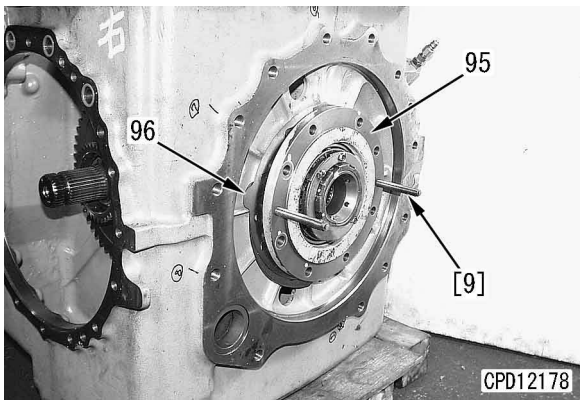
iv) Press fit bearing (104) to cage (103) with the press.
v) Secure the pinion with the press and tighten locknut (101) with tool **E2**.
Locknut: **Adhesive (LT-2)**
Locknut:
392 – 441 Nm {40 – 45 kgm}
vi) After tightening the nut, return it until 1 of 8 pin holes on it is matched to 1 of 5 pin holes on the pinion shaft.
★ Return the nut by 0 – 9°.
★ Tighten the nut, while turning the cage.
★ After tightening the nut, check that the bevel pinion rotates smoothly.



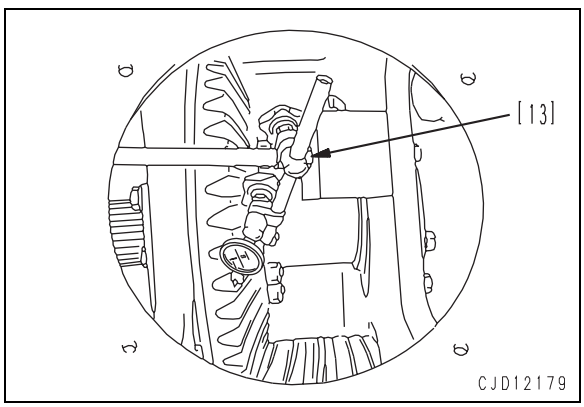
vii) Install pin (100) and plate (99), and then tighten bolt (97).
Bolt:
11.8 – 14.7 Nm {1.2 – 1.5 kgm}



4) 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

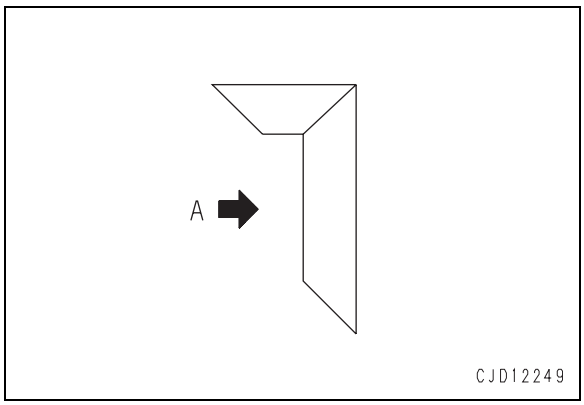


4. Adjusting backlash and tooth contact
1) Adjusting backlash
Apply the probe of dial gauge [13] to the tooth tip at the end of the bevel gear at right angles. Fix the bevel pinion and move the bevel gear forward and backward, and read the value at this time.
★ Standard backlash: 0.2 – 0.28 mm
★ Measure 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.

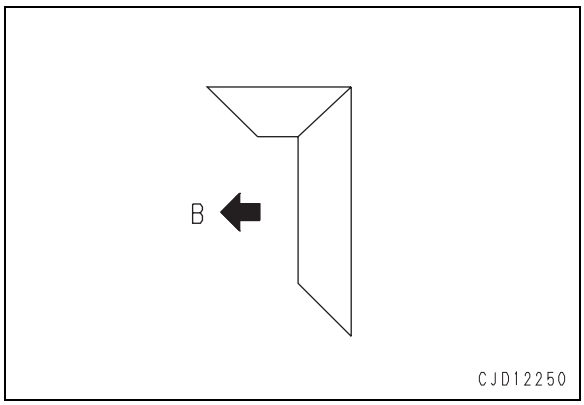


★ Adjust the backlash by increasing or decreasing the thickness of both shims. Do not change the total thickness of both shims, however, so that the pre-load will not change. (If the thickness of the shim on one side is increased, decrease the thickness of the other side, and vice versa.)

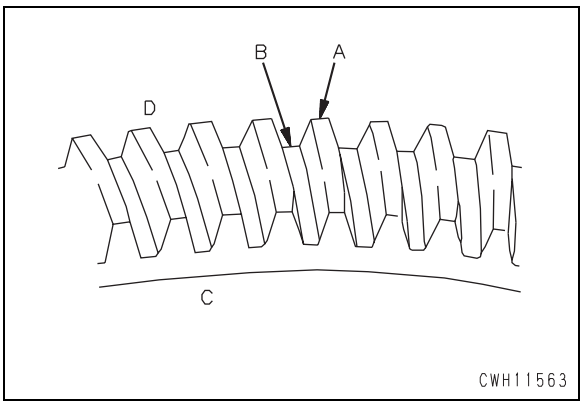
- When backlash is too small
  Decrease the thickness of the shim on the right side of the chassis and increase the thickness on the left side by the same quantity. (Move the bevel gear in direction **A**.)



- 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**.)



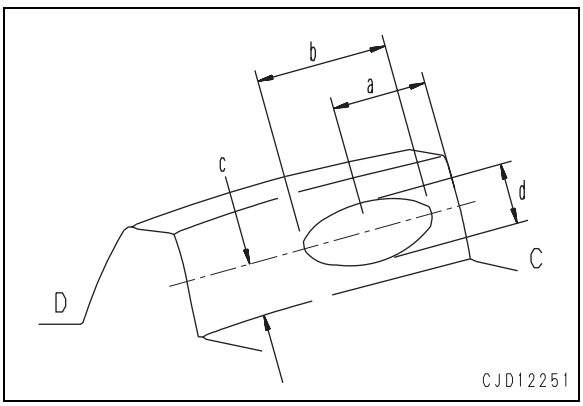
2) Adjusting tooth contact
Testing
i) Apply red lead thinly to the tooth surfaces of the bevel gear and turn the bevel gear in the forward and reverse directions, then check the tooth contact pattern on the bevel gear.



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
d) Width of tooth contact: 60 – 80% of tooth depth

Check that there is not a strong contact at the tips **A** or roots **B** of the teeth of both small end **C** and large en**d D**.

★ If the bevel gear and bevel pinion are adjusted in this way, their teeth come in contact with each other correctly when they are loaded.

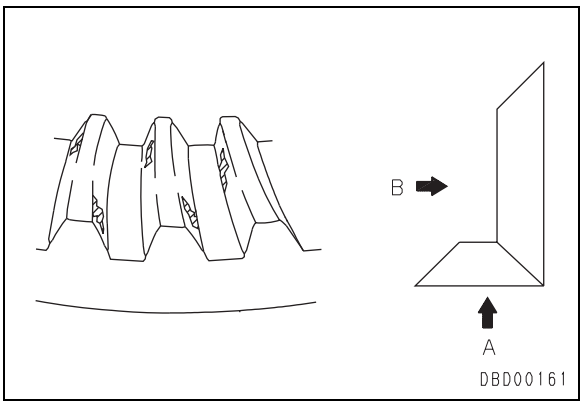


Adjusting

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.



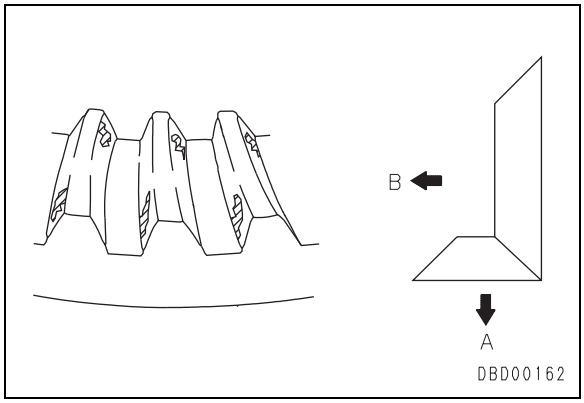
ii) If the bevel pinion is too close to the center line of the bevel gear, contact is at the large end of the bevel gear tooth faces curved outward and the small end of the bevel gear tooth faces curved inward.

• 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.

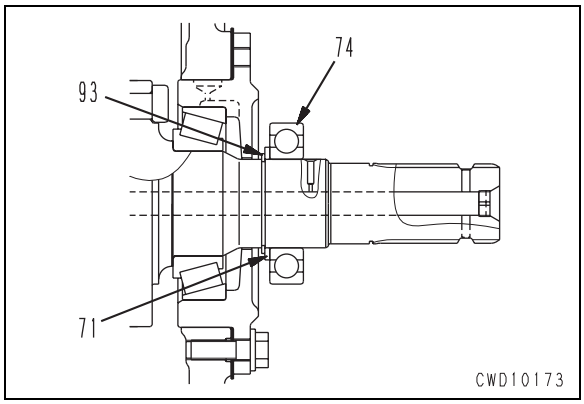
iii) When adjustment is finished, tighten the mounting bolts of the cage and bevel pinion assembly to the specified torque.

Mounting bolts of cage and bevel pinion assembly:
98 – 123 Nm {10 – 12.5 kgm}

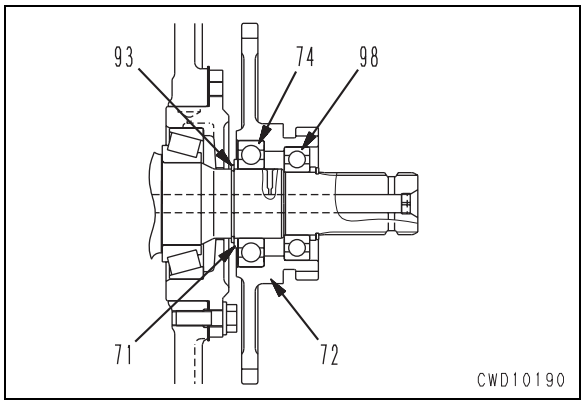


5. Sun gear

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.

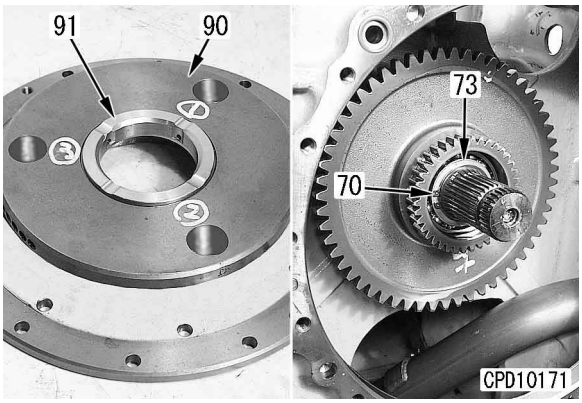


6) Install collar (73) and snap ring (70).

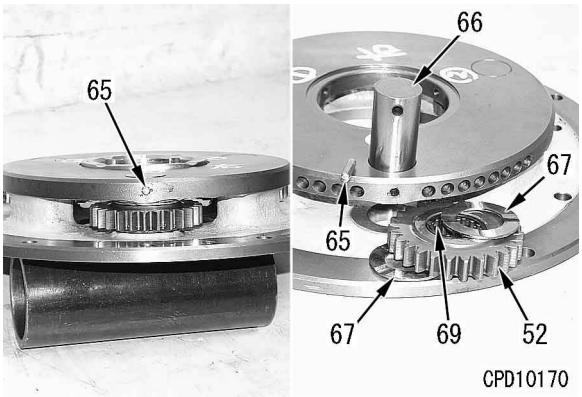
6. Brake and carrier assembly

• **Assembly of carrier assembly**

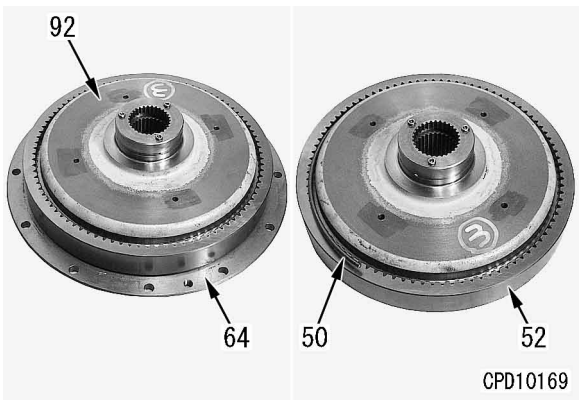
1) Install bushing (91) to carrier (90).



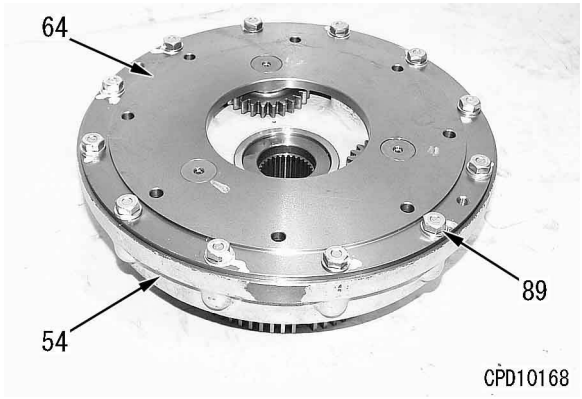
2) Install bearing (69) to gear (52). Fit thrust washers (67) to top and bottom of the bearing, then set them to the carrier.
3) Install shaft (66), matching the inside of the thrust washers and bearing to the shaft hole of the carrier.
   ★ Match the roll pin hole accurately.
4) Install roll pin (65).



5) Set hub (92) to ring gear (52) and install snap ring (50).
6) Install hub (92) to carrier assembly (64).

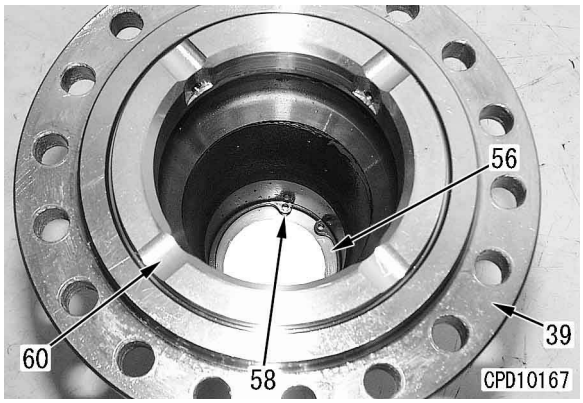


7) Install hub and carrier assembly (64) to hub (54) and tighten bolts (89).
   Mounting bolt:
   59 – 74 Nm {6 – 7.5 kgm}

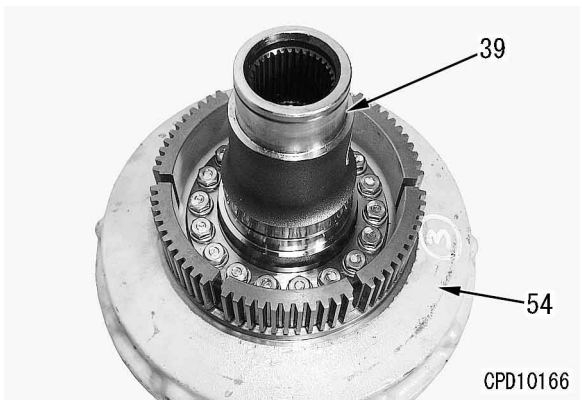


• **Assembly of brake assembly**

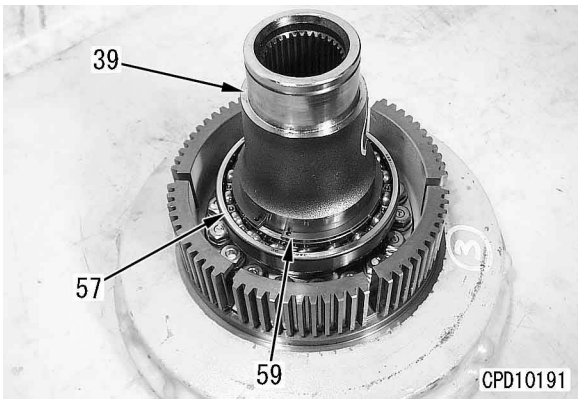
1) Install stopper (56) to the hub, then install snap ring (58).
2) Install bushing (60) to hub (39).



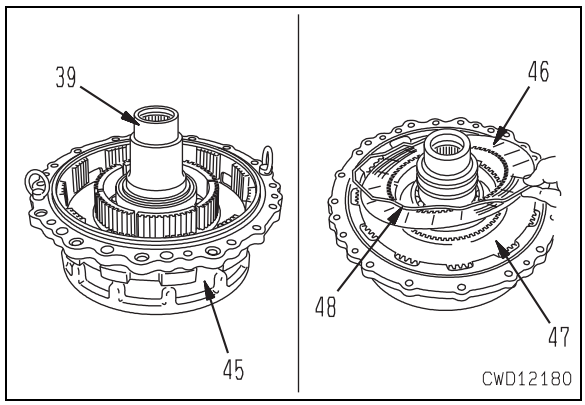
3) Install hub (39) to hub (54) with 18 mounting bolts.
   Mounting bolt:
   59 – 74 Nm {6 – 7.5 kgm}



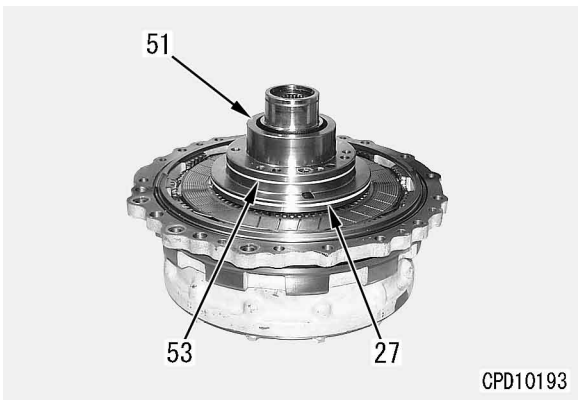
4) Install bearing (57) to hub (39).
5) Install snap ring (59).



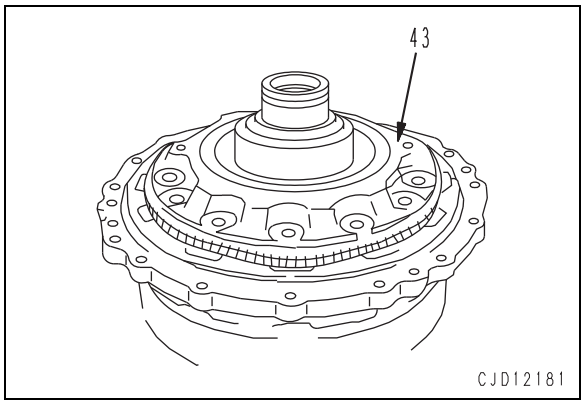
6) Set brake drum (45) to hub (39).
7) Install discs (46), plates (47), and springs (48).

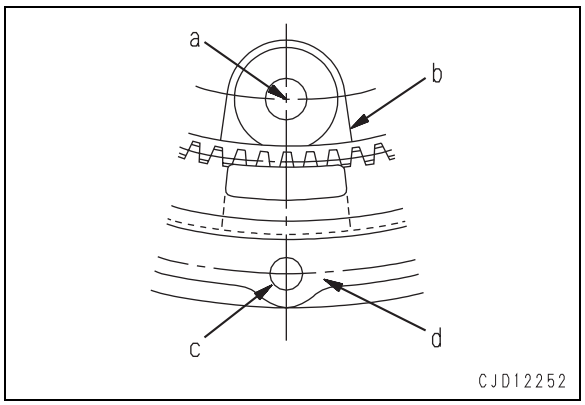


8) Install seal rings (27) and (53) and cage (51).
   ★ Roughly match the oil holes on the cage to the 4 oil holes on the drum.
   ★ Press fit the cage to the outer race side of the bearing.

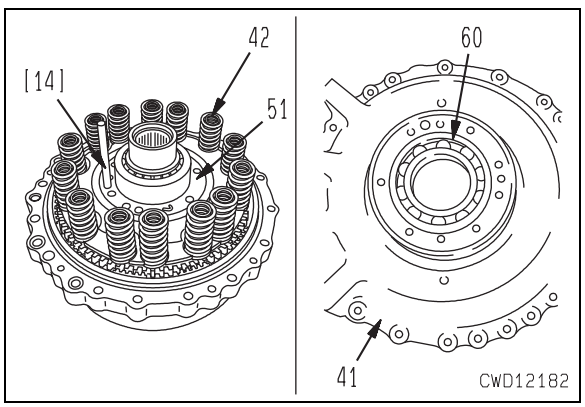


9) Install the seal ring to piston (43).
10) Install piston (43), aligning counter bore **b** having "assembly match mark **a**" with "13.5-drill" **c** and opposite side **d** having the drilled hole of the hydraulic circuit.

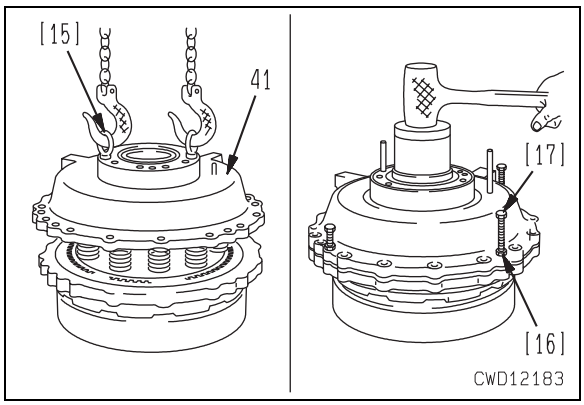




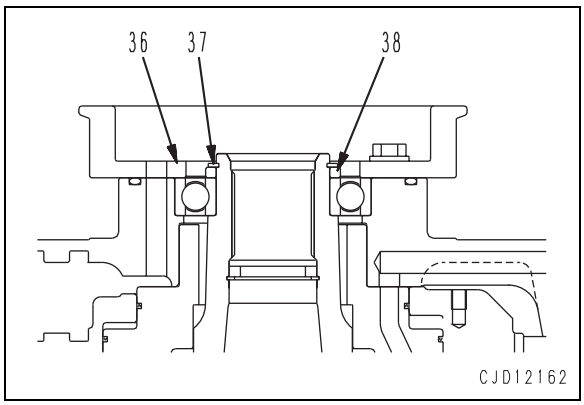
11) Install spring (42).
12) Install guide bolt [14] to cage (51).
13) Install bearing (60) to cover (41).



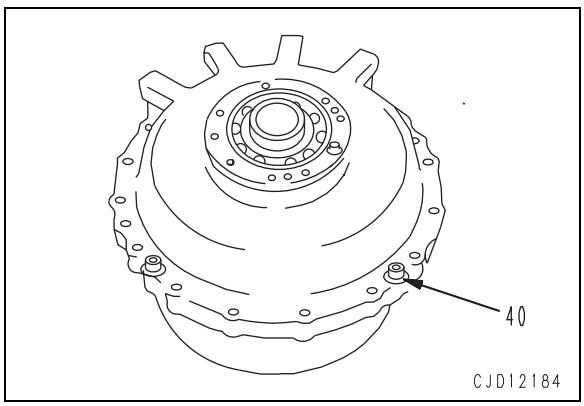
14) Using eyebolts [15] and matching to the guide bolt, set cover (41).
★ Check that the spring is fitted to both of the piston and case.
15) Compressing the spring with forcing screws [17] and nuts [16], press fit the inner race side of the bearing to the hub assembly.



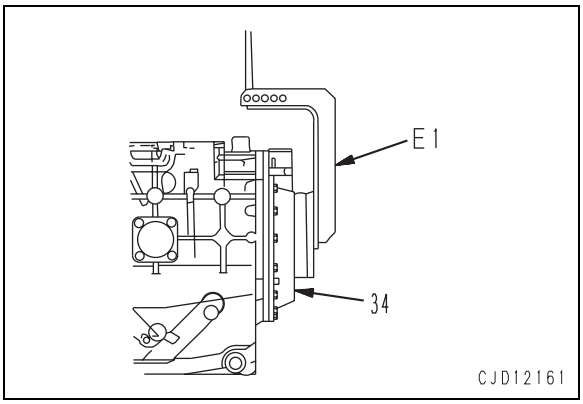
16) Install spacer (38) and snap ring (37).
17) Install flange (36).



18) Remove the bolts and nuts used to compress the spring, then install 4 bolts (40).



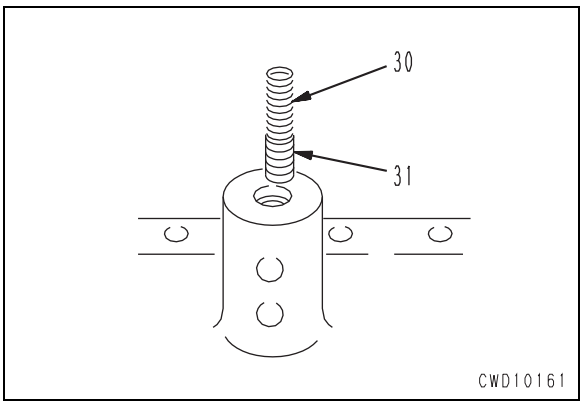
19) Brake and carrier assembly
i) Equalize the projection of the seal rings from the shaft on the carrier side.
ii) Using tool **E1**, install brake and carrier assembly (34).



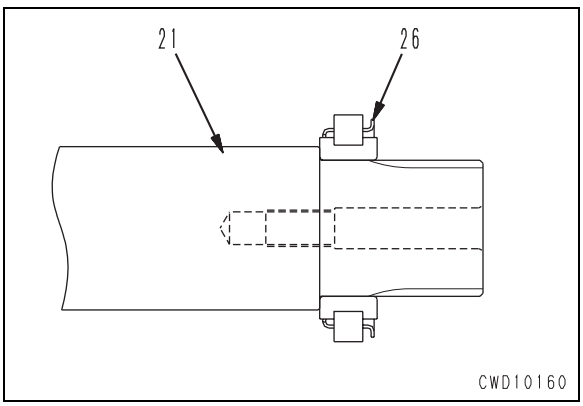
7. Cover assembly

- **Assembly of cover assembly**

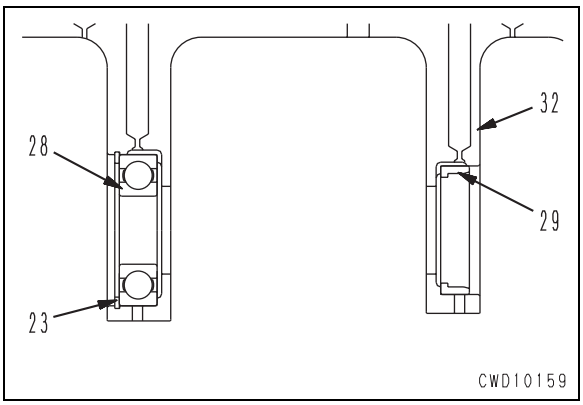
1) Install valve (31) and spring (30) to the cover, then install the plug.



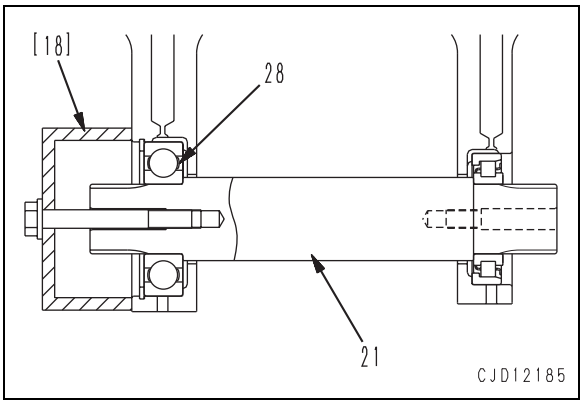
2) Left carrier drive gear
i) Press fit bearing (26) to shaft (21).



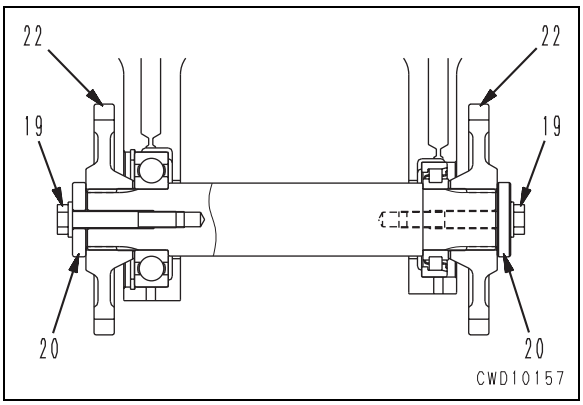
ii) Install outer race (29) to cover (32).
iii) Press fit bearing (28) to cover (32), then install snap ring (23).



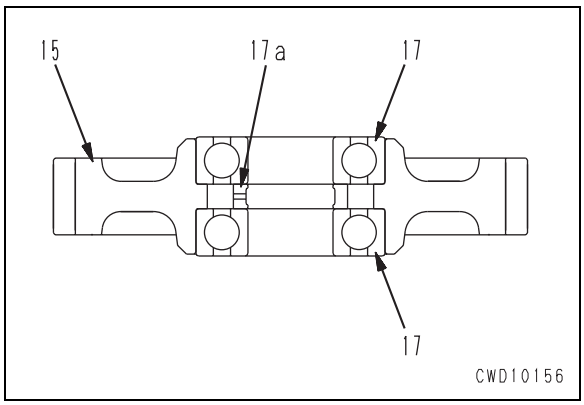
iv) Using puller [18], press fit shaft (21) to the inner race side of bearing (28).
★ Replace the bolt with one having different length.



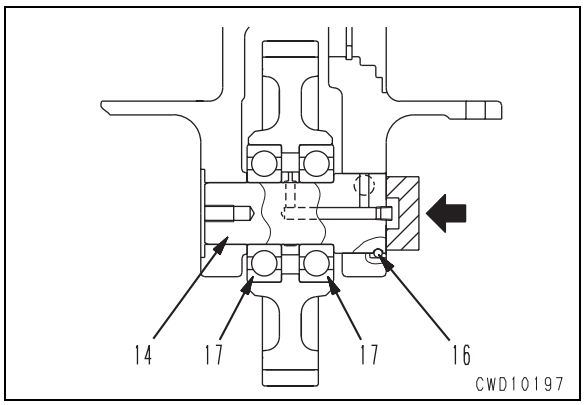
v) Install gear (22).
vi) Install holder (20) and tighten bolt (19).
Mounting bolt:
98 – 123 Nm {10 – 12.5 kgm}



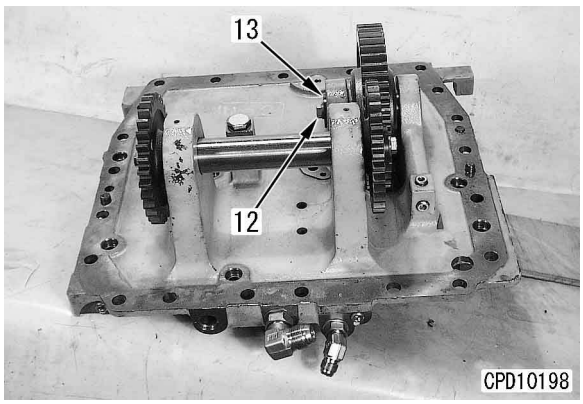
3) Intermediate gear assembly
i) Install bearing (17) and spacer (17a) to gear (15).



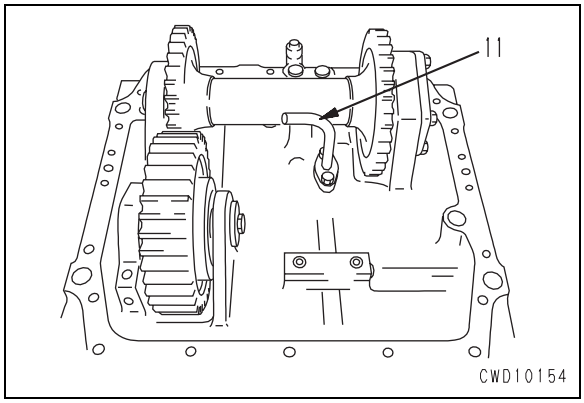
ii) Press fit shaft (14) to the inner race side of bearing (17). Fit ball (16) halfway and press fit completely.
★ Before the shaft enters the cover, position the ball accurately.



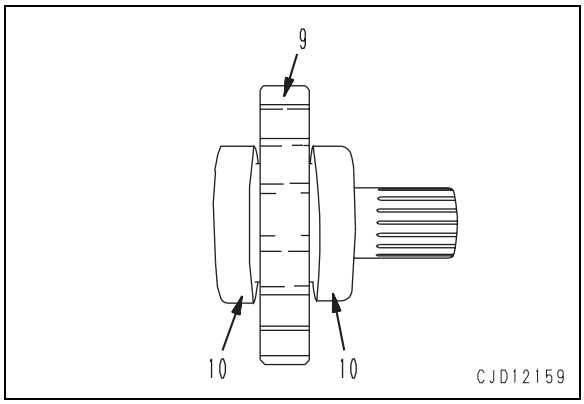
iii) Install holder (13) and tighten bolt (12).
Mounting bolt:
98 – 123 Nm {10 – 12.5 kgm}



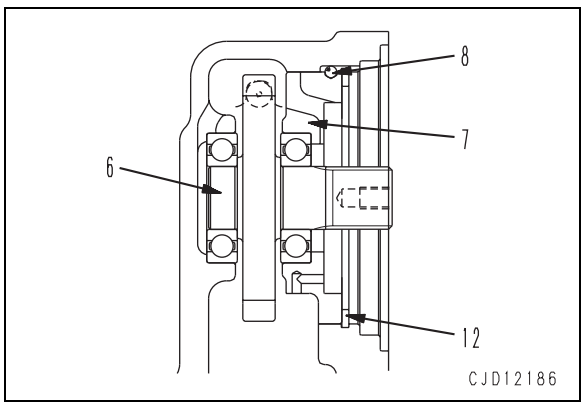
iv) Install tube (11).



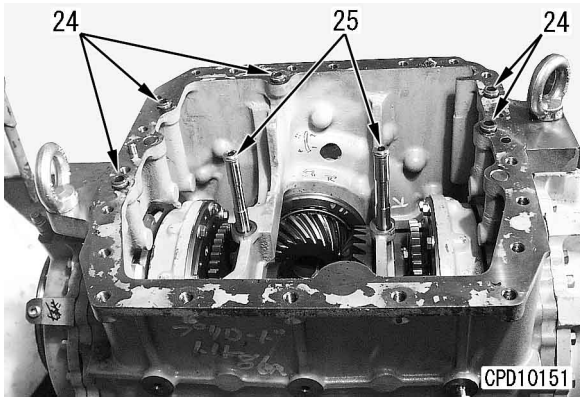
5) Input gear assembly
i) Install bearing (10) to gear (9).



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).



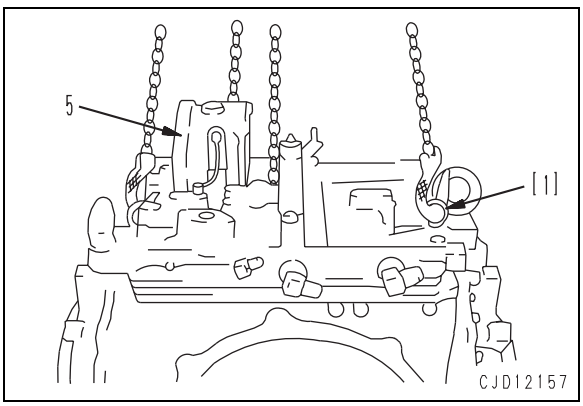
• **Installation of cover assembly**
1) Install 2 sleeves (25) and 5 sleeves (24) to the HSS case.



2) Using eyebolts [1], install cover assembly (5).

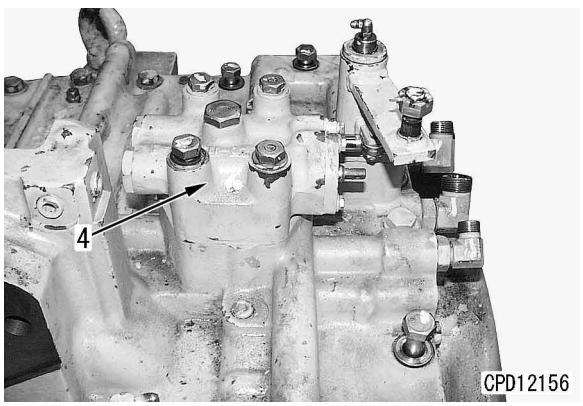
Mating face of cover:
Gasket sealant (LG-6)

★ Apply gasket sealant to both mating faces of the case and cover.
★ Apply gasket sealant to each mating face without breakage.



8. Brake valve assembly
Install brake valve assembly (4).

Mounting bolt:
44.1 – 53.9 Nm {4.5 – 5.5 kgm}

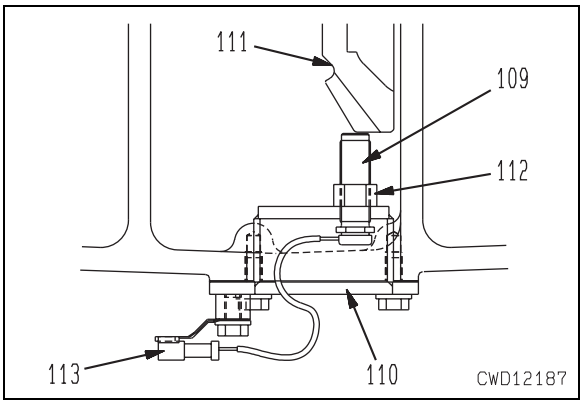


9. Adjustment and installation of speed sensor

1) Remove the locknut from speed sensor (109) and apply LG-5 to its threads generously.
2) Screw the speed sensor into mounting cover (110), and then install the cover to the HSS case.
3) Screw the speed sensor until its tip touches bevel gear (111), and then return it by 1/2 – 1 turn.
4) Remove the speed sensor and cover together and tighten locknut (112).
   ★ Tighten the locknut so that the speed sensor will not move.

   Locknut: **49 – 68.8 Nm {5 – 7 kgm}**
5) Install cover (110) and insert connector (113) in the holder.

   Mating faces of cover and HSS case: **Gasket sealant (LG-1)**
   ★ Install the cover so that the speed sensor will be on the right side.

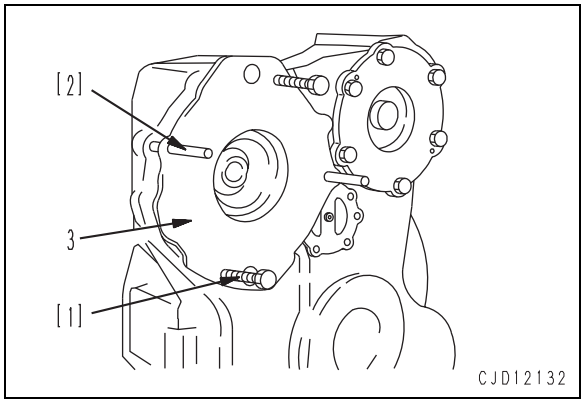


DISASSEMBLY AND ASSEMBLY OF PTO ASSEMBLY

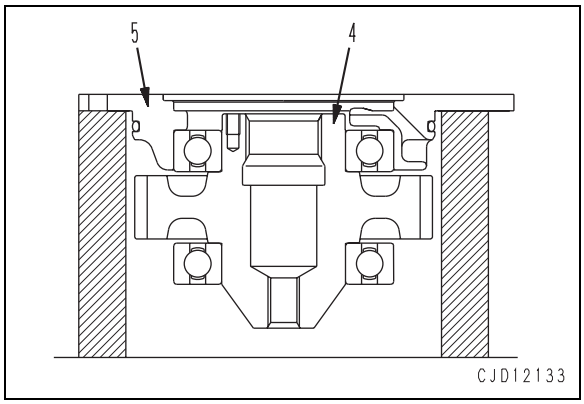
DISASSEMBLY

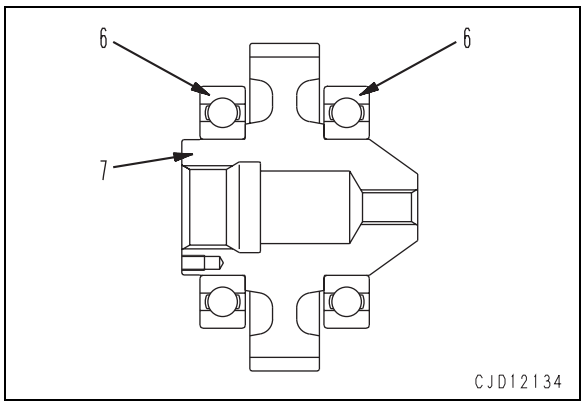
1. Cover assembly (right)

1) Remove the mounting bolts. Using forcing screws [1] and guide bolt [2], remove cover assembly (right) (3).



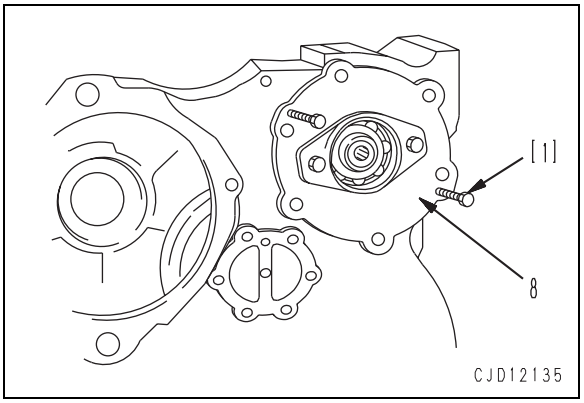
2) Drive out gear assembly (4) from cover (5).
3) Remove bearing (6) from gear (7).



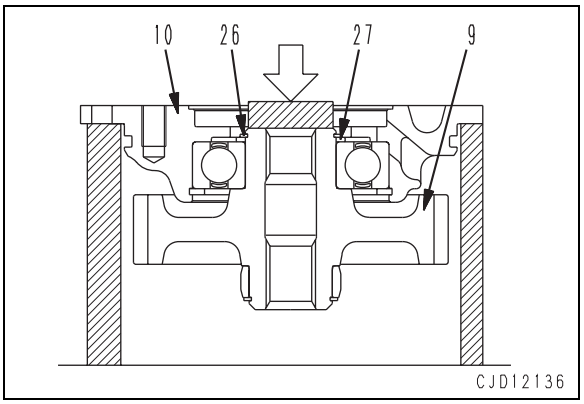


2. Cover assembly (left)

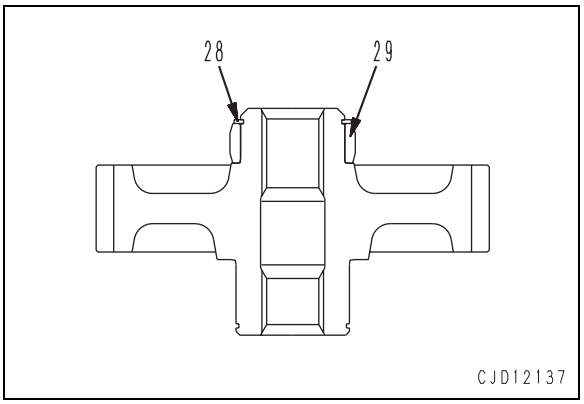
1) Remove the mounting bolts. Using forcing screws [1], remove cover assembly (left) (8).



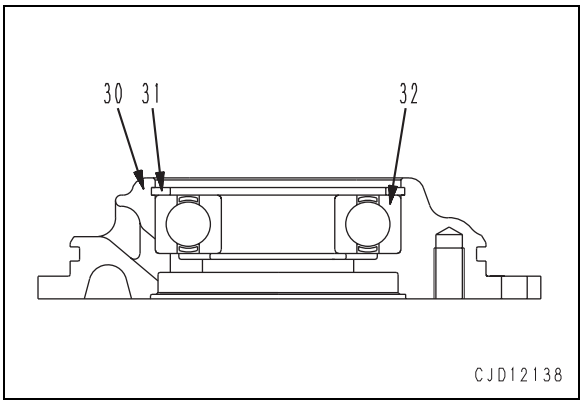
2) Remove snap ring (26) and spacer (27).
3) Drive out gear assembly (9) from cover (10).



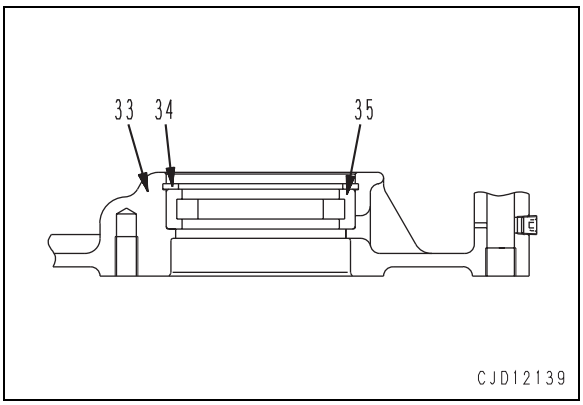
4) Remove snap ring (28) and inner race (29).



5) Remove snap ring (31) from cover (30), and then remove bearing (32).

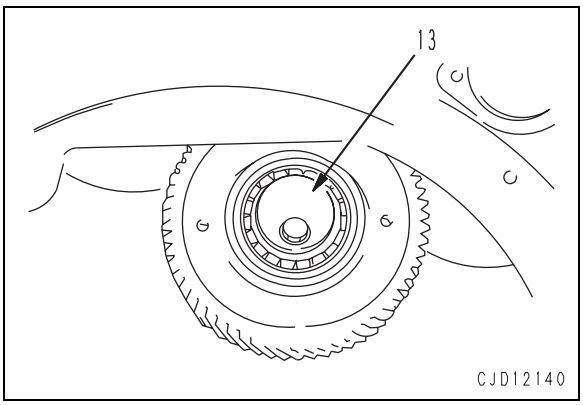


6) Remove snap ring (34) from PTO case (33), and then remove bearing (35).

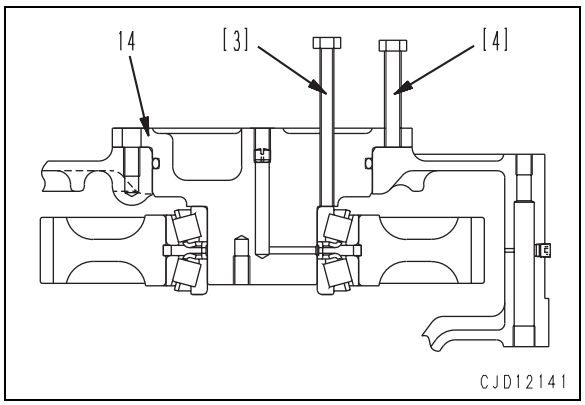


3. Idle gear

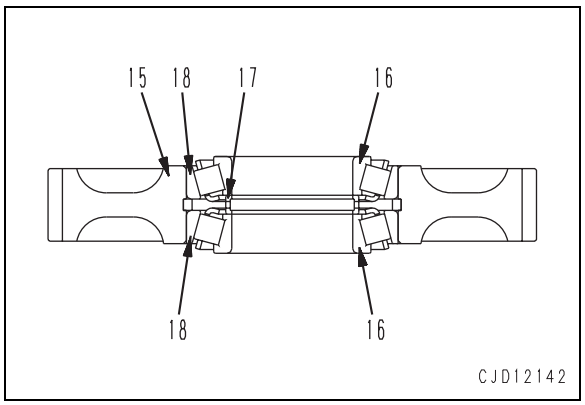
1) Remove the mounting bolts and plate (13).



2) Remove the mounting bolts on the shaft side. Using forcing screws [3] and [4], remove shaft (14).

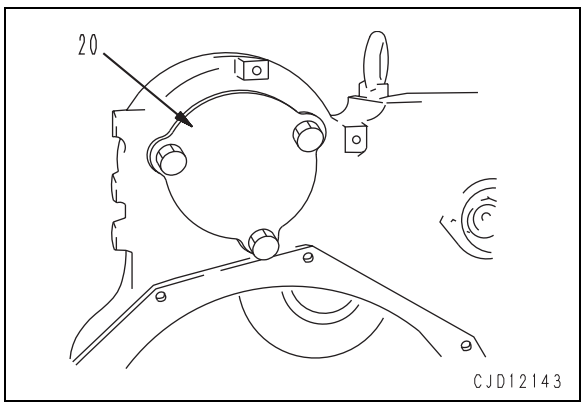


3) Remove bearing (16) and spacer (17) from gear (15).
   ★ When reusing bearing, do not change its combination with the outer race.
4) Remove outer race (18) from gear (15).



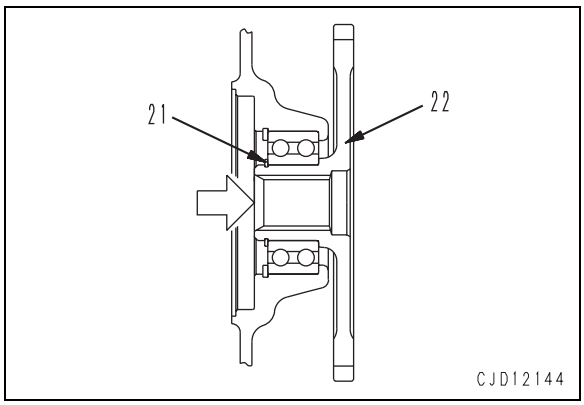
4. Cover

Remove cover (20) on the opposite side of cover assembly (right).

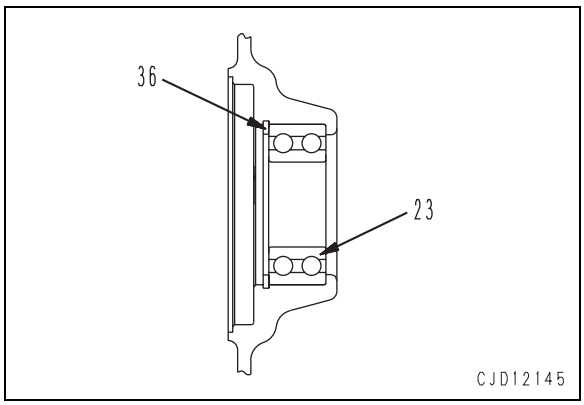


5. Scavenging pump drive gear

1) Remove snap ring (21).
2) Drive out gear (22) from the snap ring side.

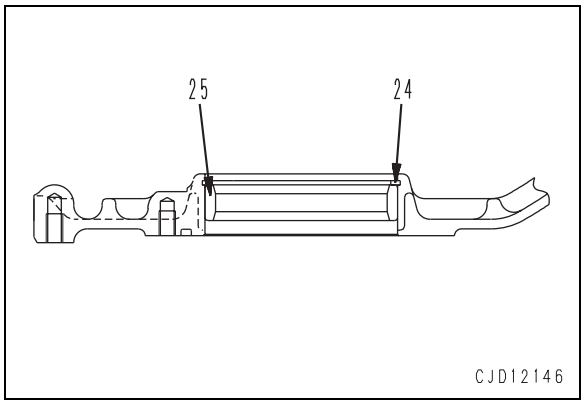


3) Remove snap ring (36) and bearing (23).



6. Outer race of input shaft bearing

Remove snap ring (24), and then remove outer race (25) from the PTO and torque converter case.

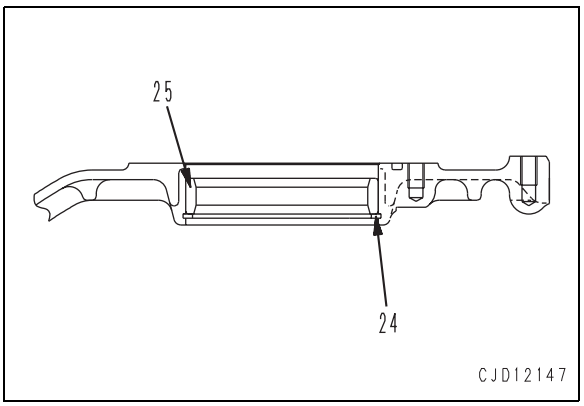


ASSEMBLY

★ 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.
★ Check that the snap rings are fitted in the grooves.

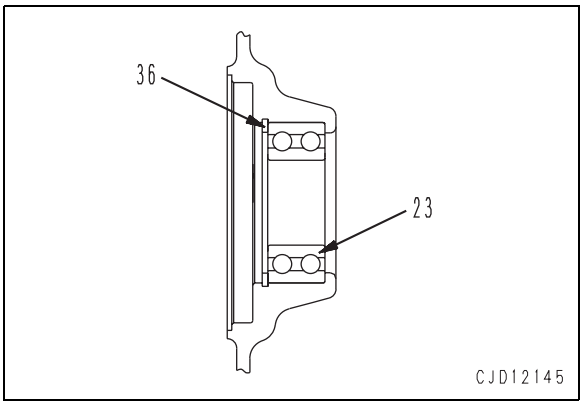
1. Outer race of input shaft bearing

1) Install snap ring (24) to the PTO and torque converter case.
2) Press fit outer race (25).
   ★ Do not press the snap ring with an excessive force.

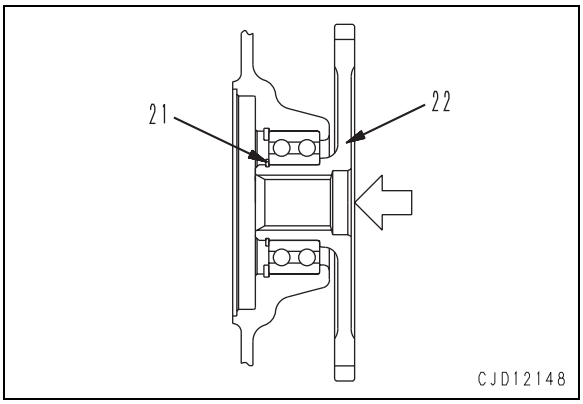


2. Scavenging pump drive gear

1) Install bearing (23) to the case.
2) Install snap ring (36).

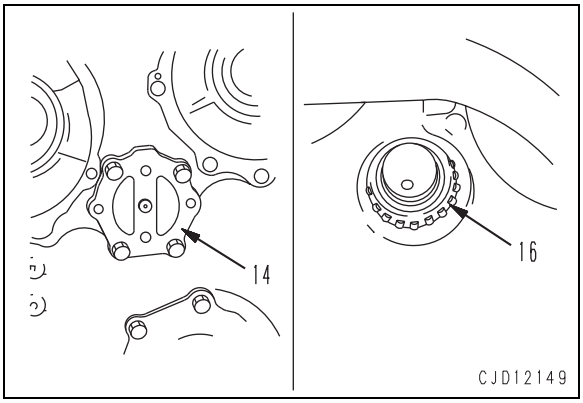


3) Install gear (22) to bearing (23).
4) Install snap ring (21).

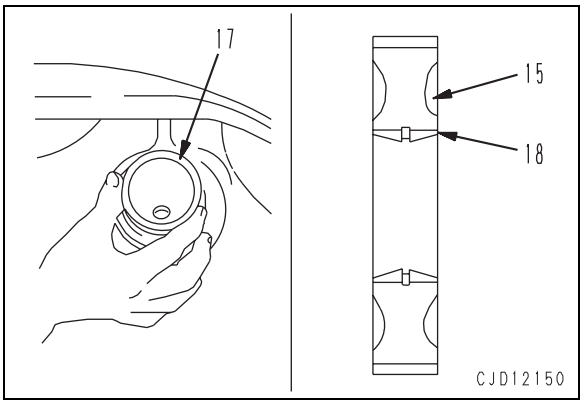


3. Idle gear

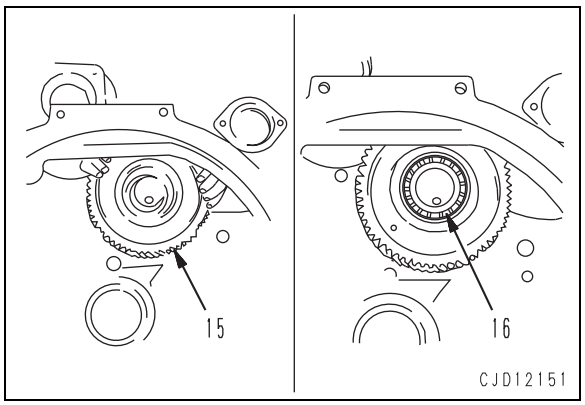
1) Install shaft (14).
   Mounting bolt:
   98 – 122.5 Nm {10 – 12.5 kgm}
2) Install bearing (16).



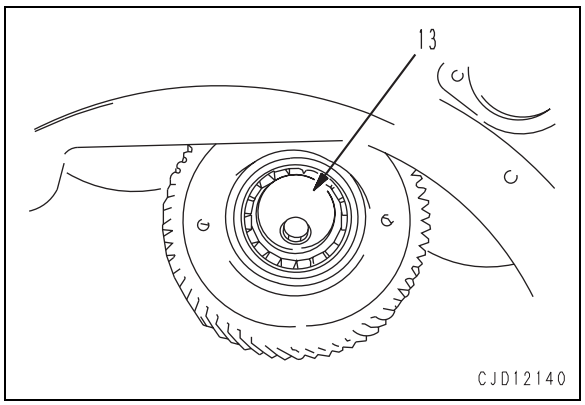
3) Install spacer (17).
4) Install outer race (18) to gear (15).



5) Install gear (15).
6) Install bearing (16).
   ★ Press fit the inner race side to the shaft.

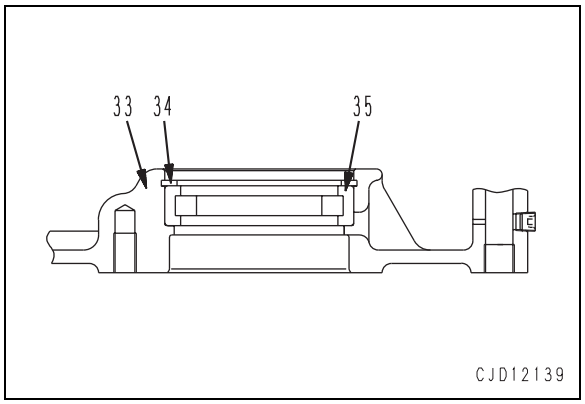


7) Install plate (13) and tighten the mounting bolts.
   Mounting bolt: **Adhesive (LT-2)**
   Mounting bolt:
   98 – 122.5 Nm {10 – 12.5 kgm}

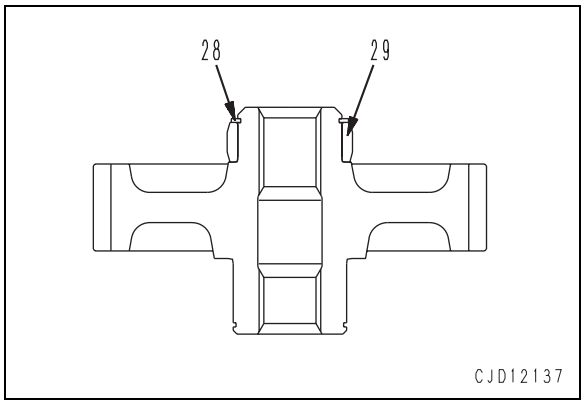


4. Cover assembly (left)

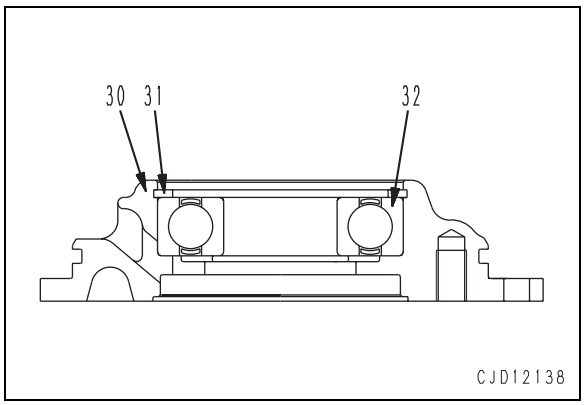
1) Install bearing (35) to case (33).
2) Install snap ring (34).



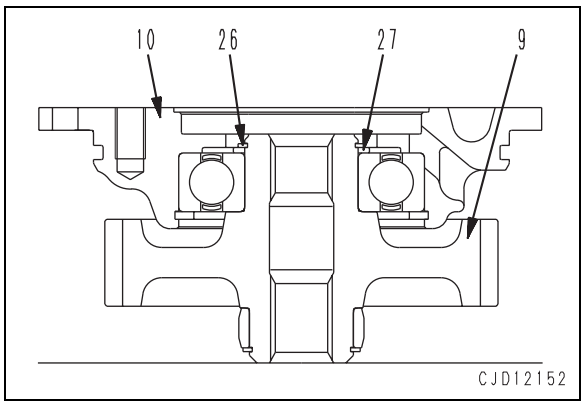
3) Install bearing inner race (29) to the gear.
4) Install snap ring (28).



5) Install bearing (32) to cover (30).
6) Install snap ring (31).

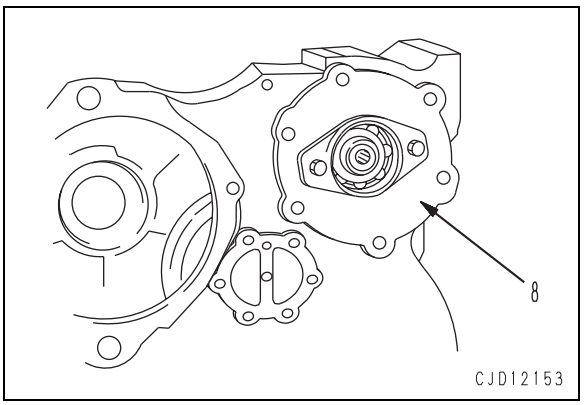


7) Install gear assembly (9) to cover (10).
8) Install spacer (27) and snap ring (26).

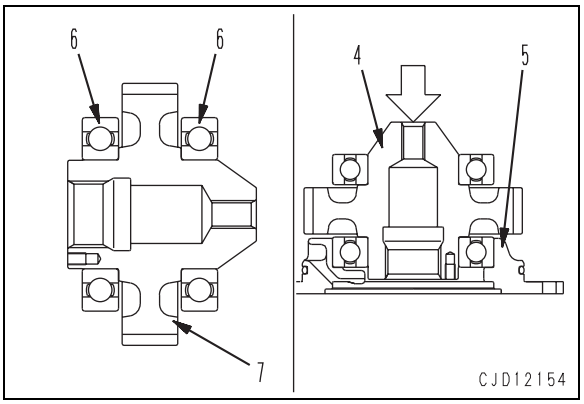


9) Install cover assembly (8), meshing it with the idle gear.
10) Tighten the mounting bolts.

Mounting bolt:
98 – 122.5 Nm {10 – 12.5 kgm}

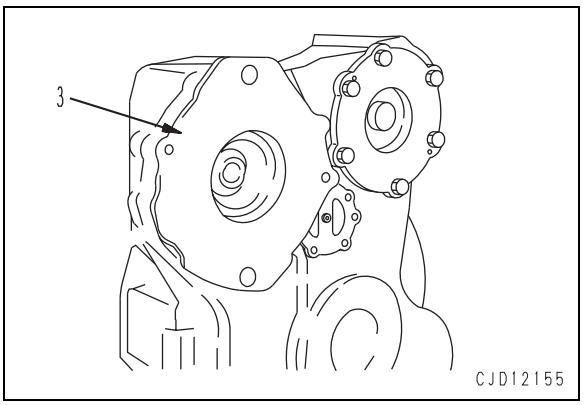


5. Cover assembly (right)
1) Install bearing (6) to gear (7).
2) Install gear assembly (4) to cover (5).

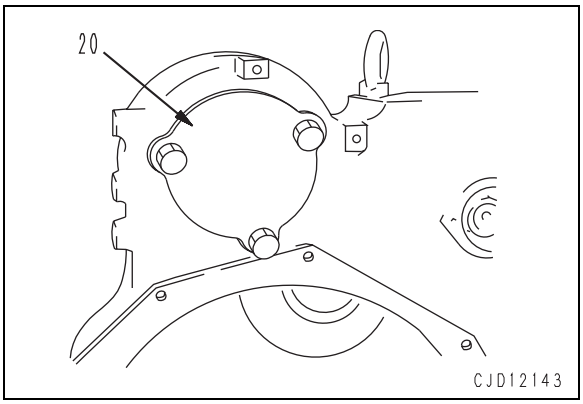


3) Install cover assembly (3), meshing it with the idle gear.
4) Tighten the mounting bolts.

Mounting bolt:
98 – 122.5 Nm {10 – 12.5 kgm}



6. Cover
Install cover (20).

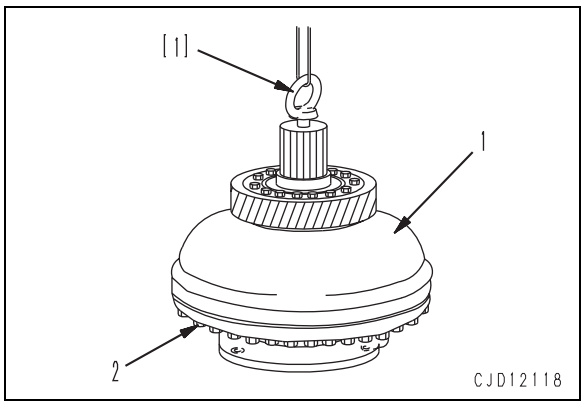


DISASSEMBLY AND ASSEMBLY OF TORQUE CONVERTER ASSEMBLY

DISASSEMBLY

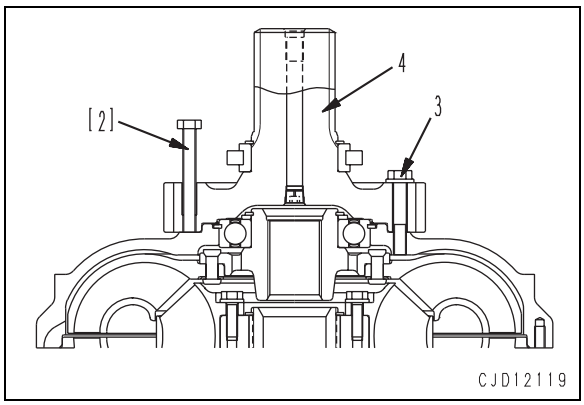
1. Case and turbine assembly

Remove 30 bolts (2) from underside. Using eye-bolt [1], remove case and turbine assembly (1).



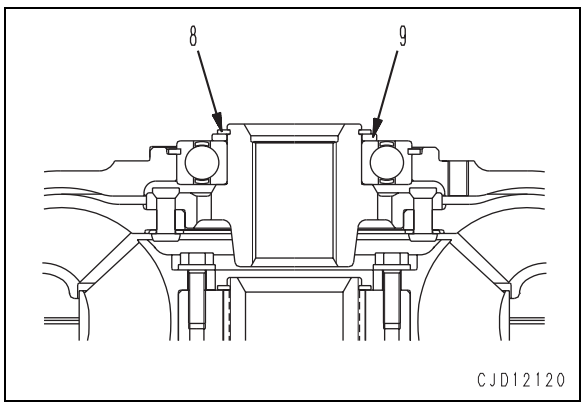
2. Gear and input shaft

1) Remove mounting bolts (3).
2) Using forcing screw [2], remove gear and input shaft (4).

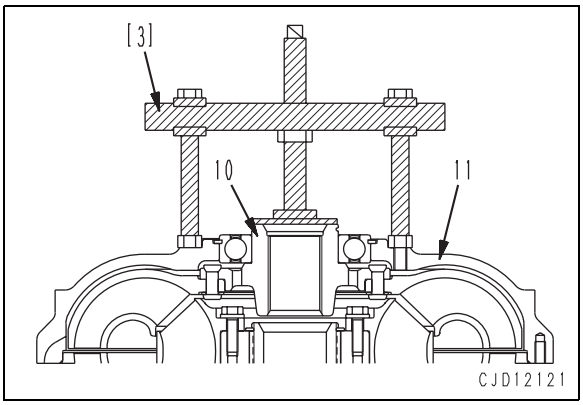


3. Case assembly

1) Remove snap ring (8).
2) Remove spacer (9).

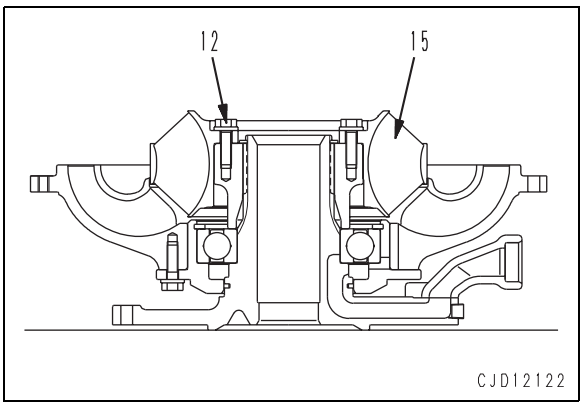


3) Using puller [3], disconnect case assembly (10) from turbine (11).

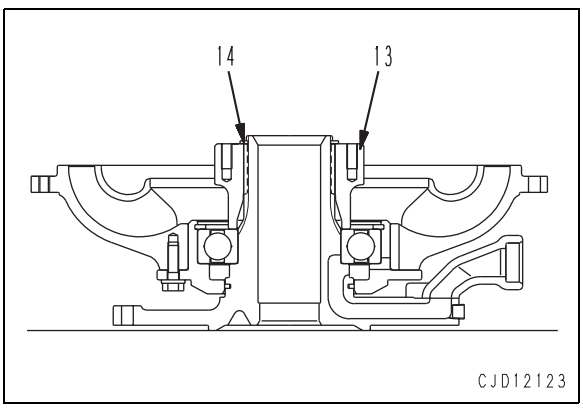


4. Stator

1) Remove mounting bolts (12) and stator (15).

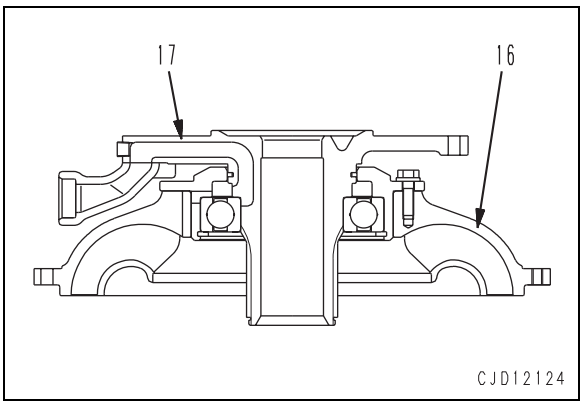


2) Remove snap ring (14) and race (13).

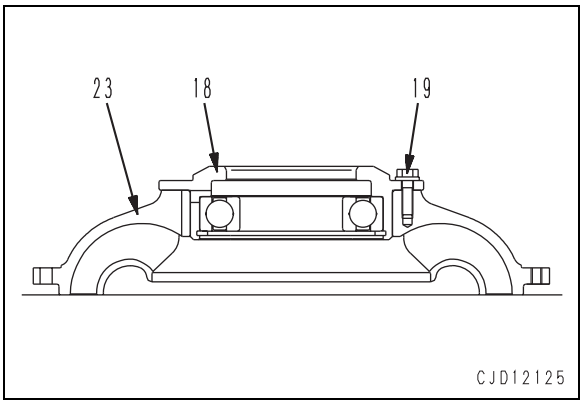


5. Pump assembly

1) Remove pump assembly (16) from stator shaft (17).



2) Remove mounting bolts (19), and then pull case assembly (18) out of pump assembly (23).

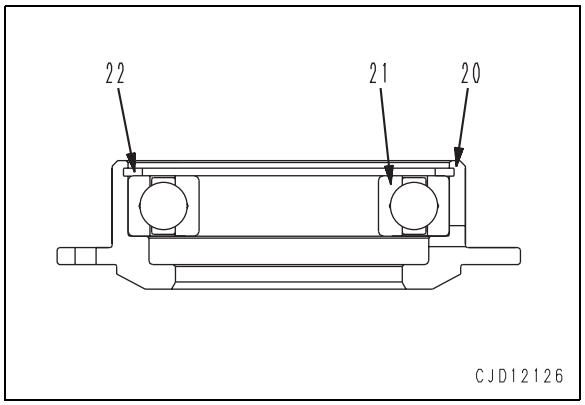


ASSEMBLY

★ 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.
★ Check that the snap rings are fitted in the grooves.
★ Apply grease (G2-LI) thinly to each seal ring.

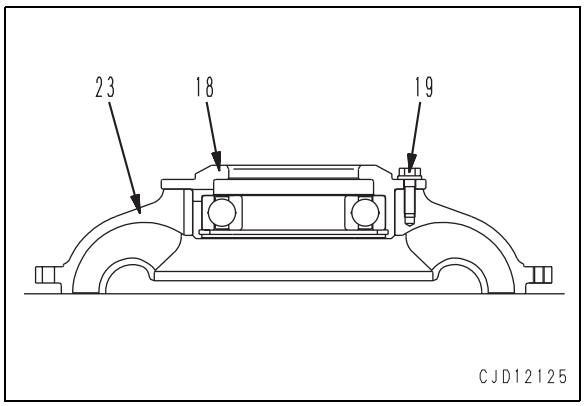
1. Pump assembly

1) Press fit bearing (21) to cage (20) and install snap ring (22).



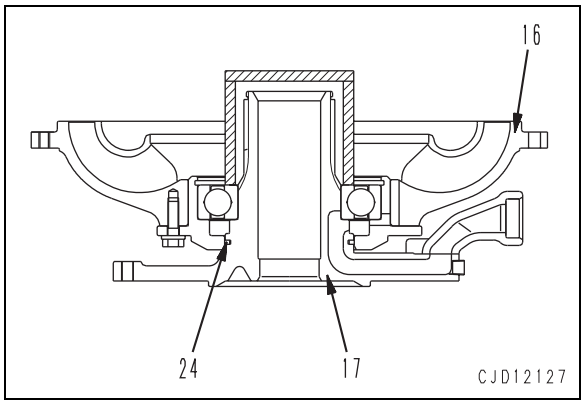
2) Install cage assembly (18) to pump (23) and tighten mounting bolts (19).

Mounting bolt:
58.9 – 73.6 Nm {6 – 7.5 kgm}



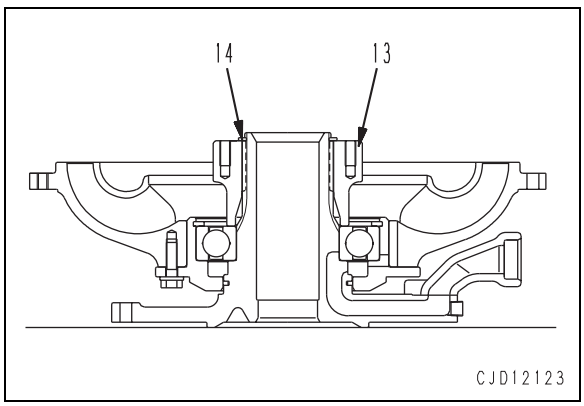
3) Install seal ring (24) to stator shaft (17).
   ★ Apply grease (G2-LI) to the seal ring and put the openings opposite to each other.

   Install pump assembly (16) to stator shaft (17).
   ★ Press the inner race side of the bearing to press fit.
   ★ After press fitting the bearing, drop engine oil a little onto it and rotate pump assembly (16) at least 10 turns.



2. Stator

1) Install race (13).
2) Install snap ring (14).

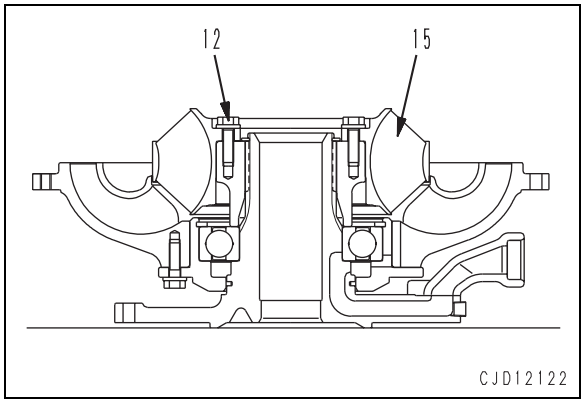


3) Install stator (15) and tighten bolts (12).

   Mounting bolt: **Adhesive (LT-2)**

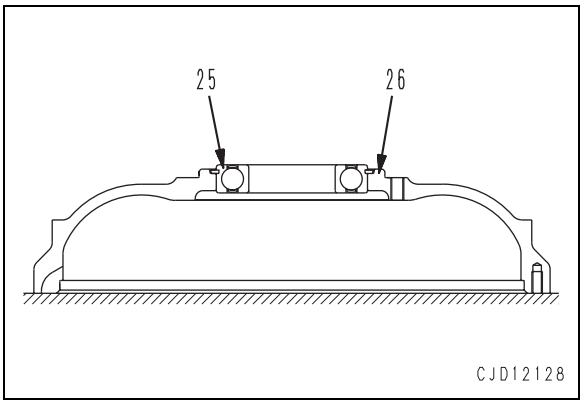
   Mounting bolt:

   58.9 – 73.6 Nm {6 – 7.5 kgm}

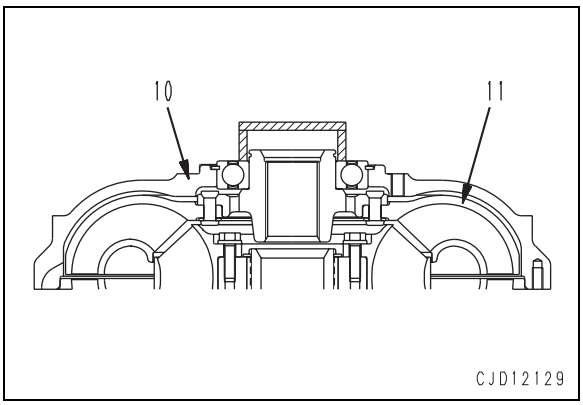


3. Case

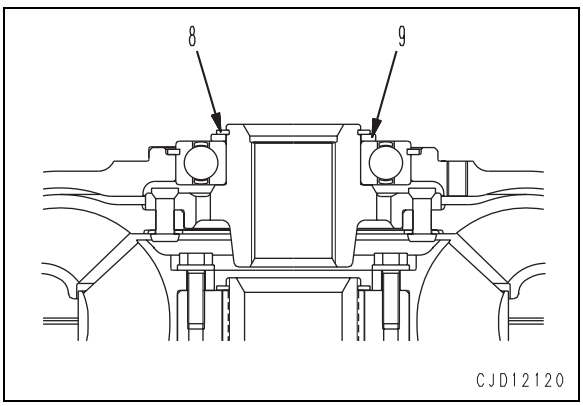
1) Install bearing (25) and case (26).



2) Press the inner race side of the bearing to install case assembly (10) to the boss of turbine (11).

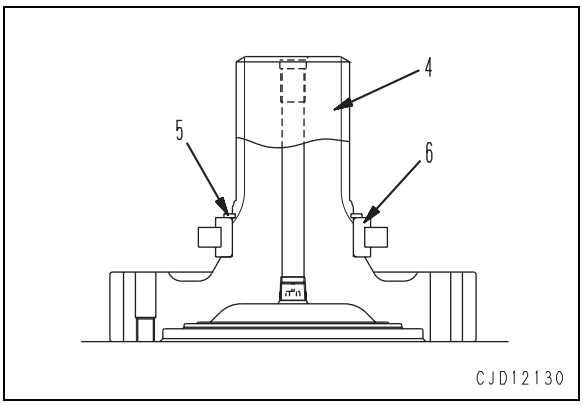


3) Install spacer (9).
4) Install snap ring (8).



4. Gear and input shaft

1) Press fit bearing (6) to input shaft (4).
2) Install snap ring (5).

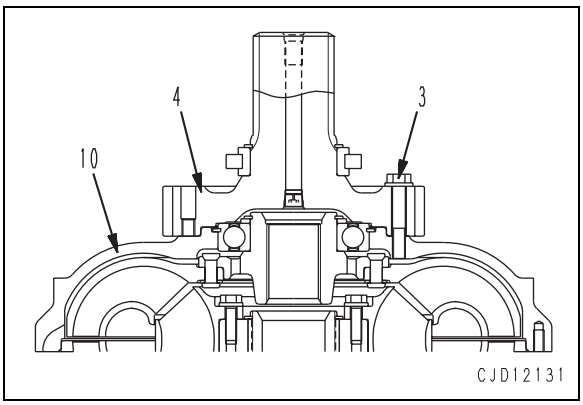


3) Install gear and input shaft (4) to case assembly (10) and tighten bolts (3).

Mounting bolt: **Adhesive (LT-2)**

Mounting bolt:

98 – 122.5 Nm {10 – 12.5 kgm}



5. Case and turbine assembly

1) Using eyebolts [1] and matching the case groove to the drain plug, install case and turbine assembly (1) and tighten 30 mounting bolts (2).

Mounting bolt: **Adhesive (LT-2)**

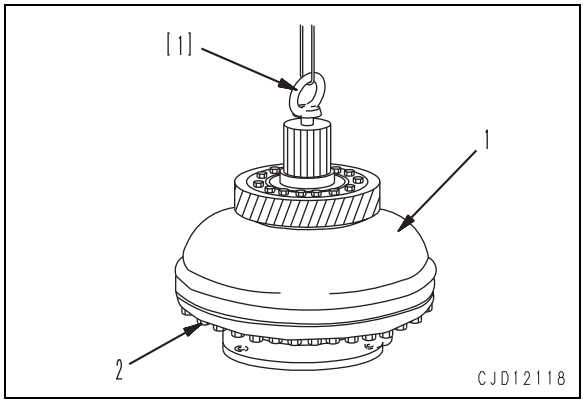
Mounting bolt:

49 – 58.8 Nm {5 – 6 kgm}

2) Install the drain plug.

Mounting bolt:

9.8 – 12.74 Nm {1.0 – 1.3 kgm}

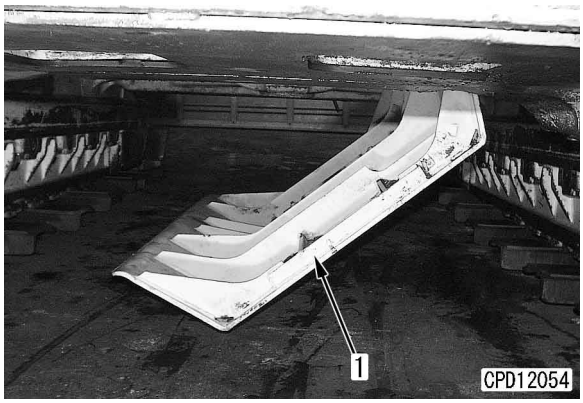


REMOVAL AND INSTALLATION OF SCAVENGING PUMP ASSEMBLY

REMOVAL

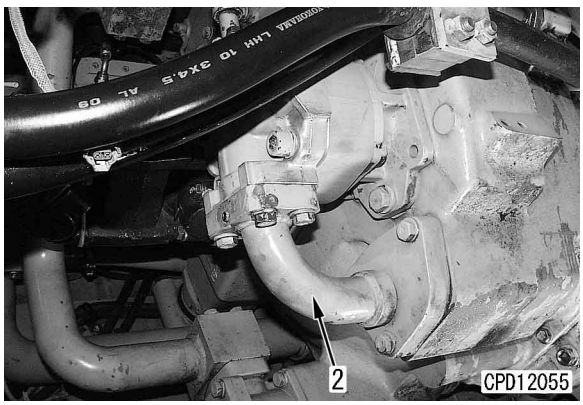
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Open undercover (1).



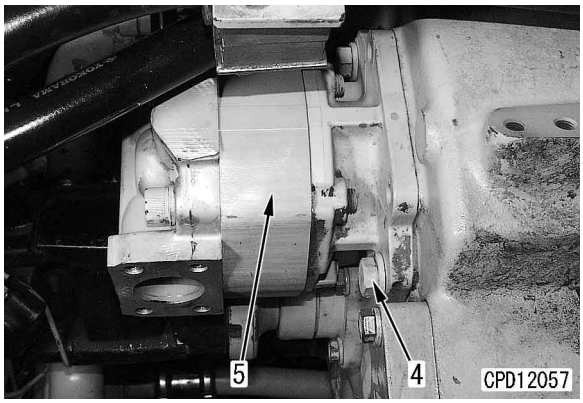
2. Drain the power train oil.
   Power train case: **Approx. 100 ℓ**

3. Disconnect suction tube (2).



4. Disconnect discharge hose (3).

5. Remove 2 mounting bolts (4) and scavenging pump assembly (5).



INSTALLATION

- Carry out installation in the reverse order to removal.

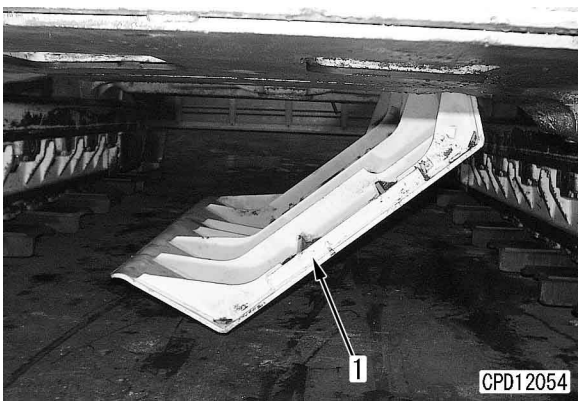
- **Refilling with oil**
  Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.
  Power train case: **Approx. 100 ℓ**

REMOVAL AND INSTALLATION OF HSS AND WORK EQUIPMENT PUMP ASSEMBLY

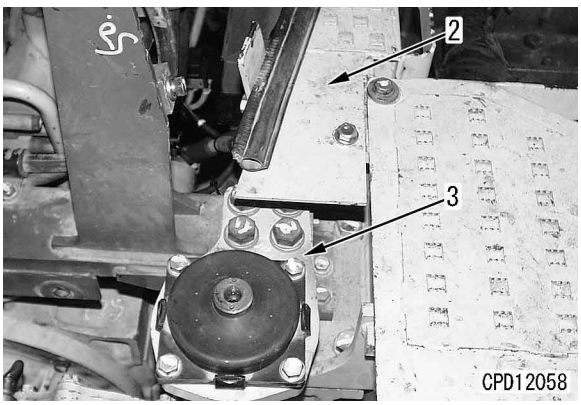
REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

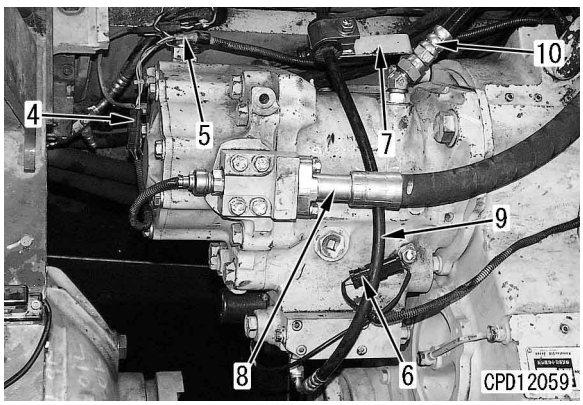
1. Drain the oil.
   Hydraulic tank: **D85EX-15; Approx. 150 ℓ**
   D85PX-15; Approx. 140 ℓ
2. Remove the engine hood assembly. For details, see REMOVAL OF ENGINE HOOD ASSEMBLY.
3. Remove the operator's cab assembly. For details, see REMOVAL OF OPERATOR'S CAB ASSEMBLY.
4. Remove the floor frame assembly. For details, see REMOVAL OF FLOOR FRAME ASSEMBLY.
5. Open undercover (1).



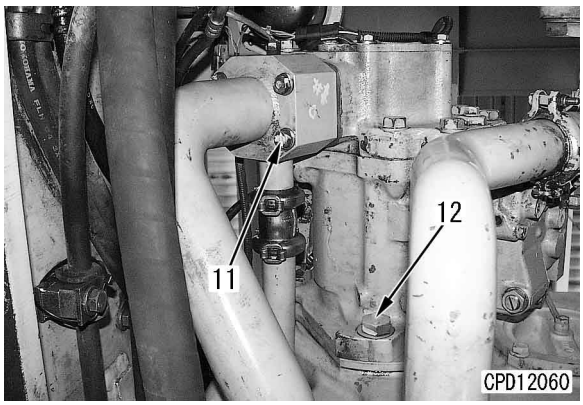
6. Remove cover (2) and floor frame mount bracket (right side) (3).



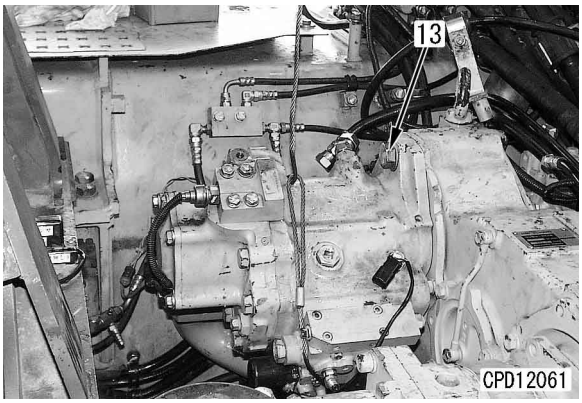
7. Disconnect oil pressure sensor connector HHP (4) and disconnect wiring harness clamp (5).
8. Disconnect TVC valve solenoid connector TVC (6).
9. Remove hose clamp bracket (7).
10. Disconnect pump hoses.
    - (8): Discharge hose
    - (9): LS pressure hose
    - (10): Drain hose



11. Remove 4 suction tube mounting bolts (11).
12. Remove 1 pump lower mounting bolt (12).

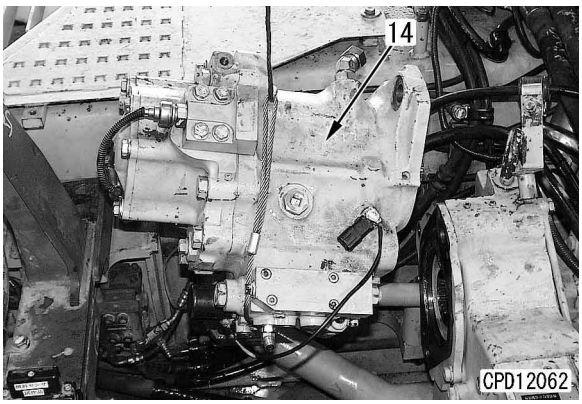


13. Sling the pump assembly temporarily and remove mounting bolts (13).



14. Lift off pump assembly (14).

Pump assembly: **113 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: **D85EX-15; Approx. 150 ℓ**
  D85PX-15; Approx. 140 ℓ

- **Bleeding air**
  Bleed air from the HSS and work equipment pump. For details, see TESTING AND ADJUSTING, Bleeding air from HSS and work equipment pump.

REMOVAL AND INSTALLATION OF FAN PUMP ASSEMBLY

REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

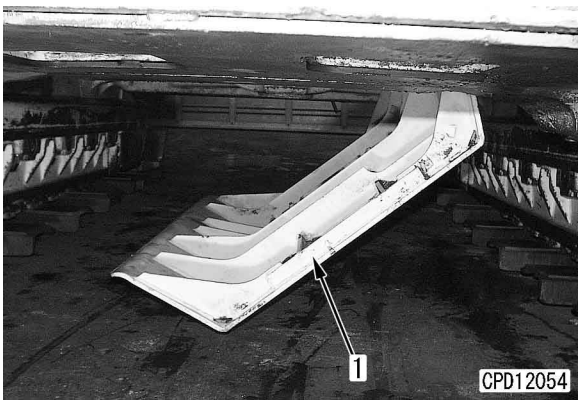
1. Drain the oil.
   Hydraulic tank: **D85EX-15; Approx. 150 ℓ**
   D85PX-15; Approx. 140 ℓ

2. Remove the engine hood assembly. For details, see REMOVAL OF ENGINE HOOD ASSEMBLY.

3. Remove the operator's cab assembly. For details, see REMOVAL OF OPERATOR'S CAB ASSEMBLY.

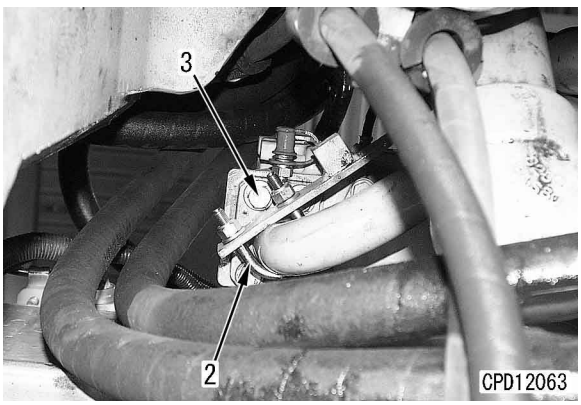
4. Remove the floor frame assembly. For details, see REMOVAL OF FLOOR FRAME ASSEMBLY.

5. Open undercover (1).



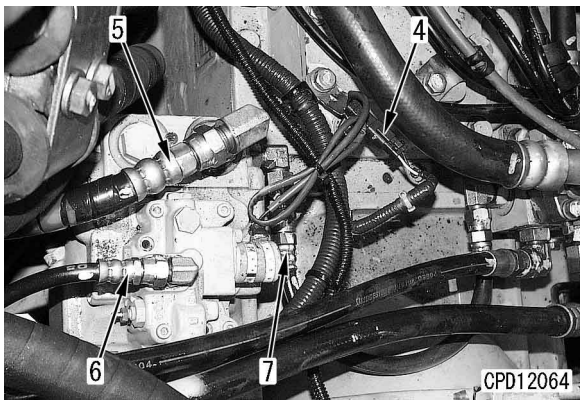
6. Remove tube clamp U-bolt (2).

7. Remove 4 suction tube mounting bolts (3).



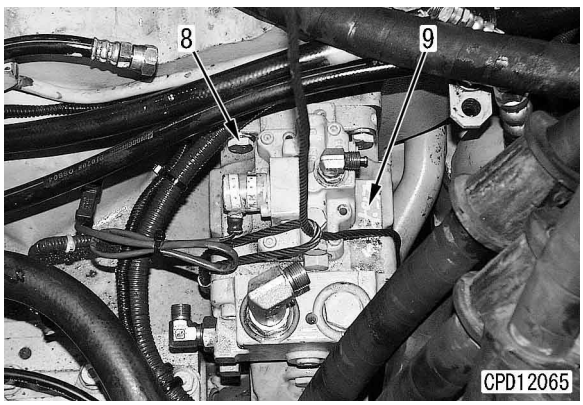
8. Disconnect EPC valve connector FAC (4).

9. Disconnect pump hoses.
   - (5): Discharge hose
   - (6): EPC valve basic pressure input hose
   - (7): Drain hose



10. Sling the pump assembly temporarily and remove mounting bolts (8).

11. Lift off pump assembly (9).
    Pump assembly: **28 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: **D85EX-15; Approx. 150 ℓ**
  D85PX-15; Approx. 140 ℓ
- **Bleeding air**
  Bleed air from the fan pump. For details, see TESTING AND ADJUSTING, Bleeding air from fan pump.

REMOVAL AND INSTALLATION OF POWER TRAIN AND LUBRICATING OIL PUMP ASSEMBLY

REMOVAL

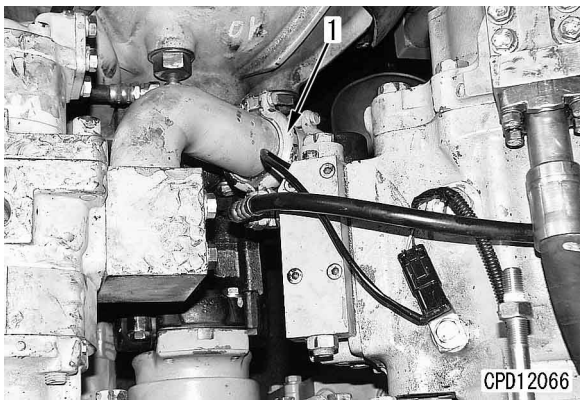
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove the engine hood assembly. For details, see REMOVAL OF ENGINE HOOD ASSEMBLY.

2. Remove the operator's cab assembly. For details, see REMOVAL OF OPERATOR'S CAB ASSEMBLY.

3. Remove the floor frame assembly. For details, see REMOVAL OF FLOOR FRAME ASSEMBLY.

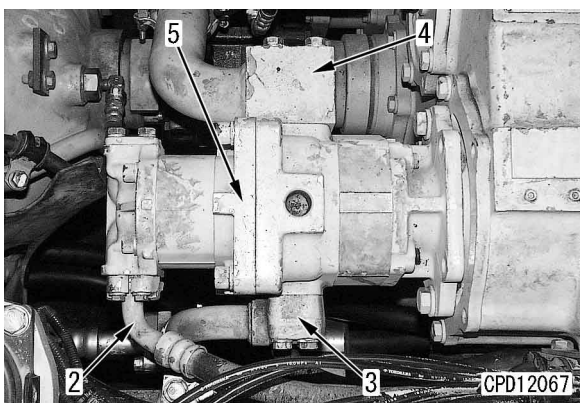
4. Remove tube clamp (1).



5. Disconnect the pump hose and tubes.
   - (2): Power train pump discharge hose
   - (3): Lubricating oil pump discharge tube
   - (4): Pump suction tube

6. Sling pump assembly (5) temporarily, remove the 2 mounting bolts, and then lift off pump assembly (5).

   Pump assembly: **25 kg**



INSTALLATION

- Carry out installation in the reverse order to removal.

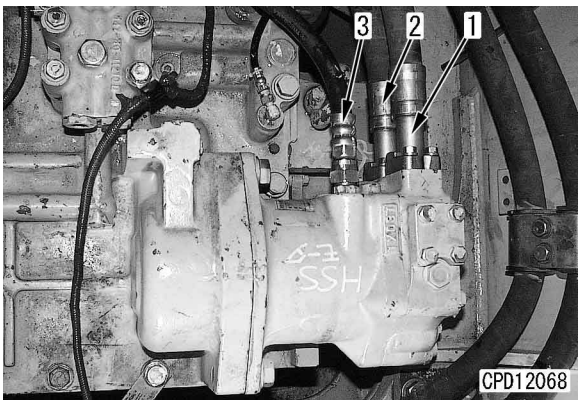
REMOVAL AND INSTALLATION OF HSS MOTOR ASSEMBLY

REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

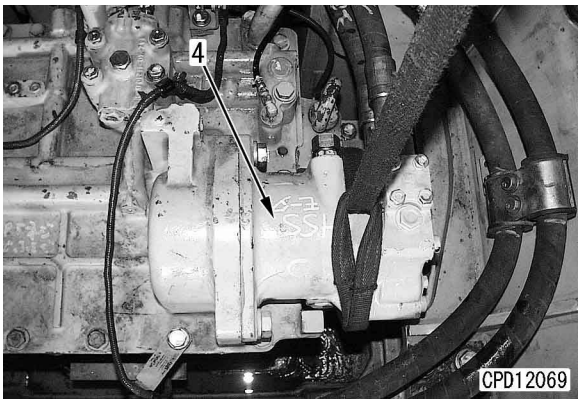
1. Remove the fuel tank assembly. For details, see REMOVAL OF FUEL TANK ASSEMBLY.

2. Disconnect the motor hoses.
   - (1): Main hose (Port PA)
   - (2): Main hose (Port PB)
   - (3): Drain hose



3. Sling motor assembly (4) temporarily, remove the 2 mounting bolts, and then lift off motor assembly (4).

   Motor assembly: **42 kg**



INSTALLATION

- Carry out installation in the reverse order to removal.

REMOVAL AND INSTALLATION OF FINAL DRIVE ASSEMBLY

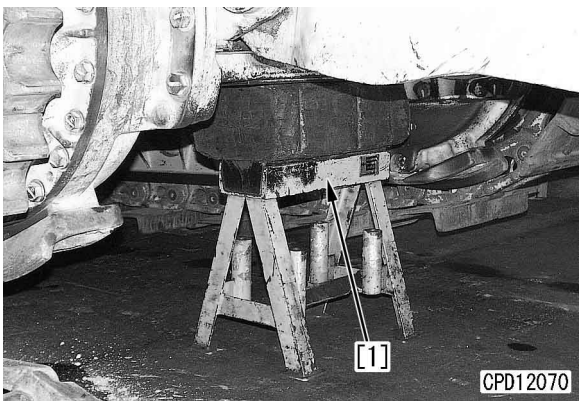
SPECIAL TOOLS

Symbol	Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
J1	790-337-1032	Lifting tool	■	1		
	791T-627-2110	Plate	■	1	N	○
	01643-32060	Washer	■	6		

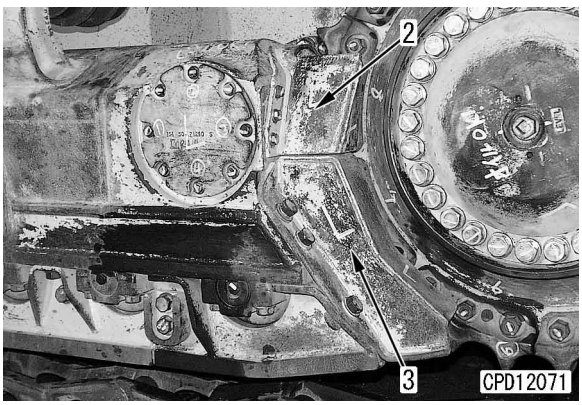
REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

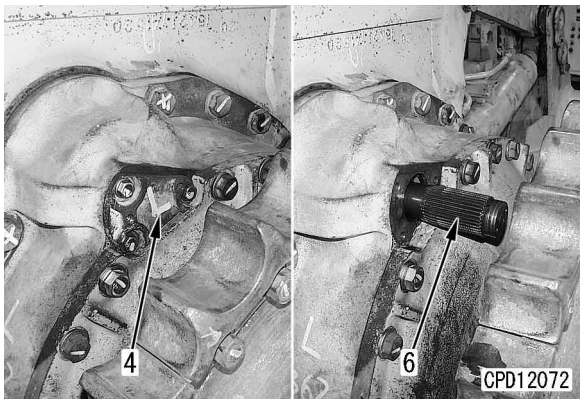
1. Expand the track shoe assembly. For details, see EXPANDING TRACK SHOE ASSEMBLY.
2. Raise the chassis with a jack or the ripper and set stand [1] under the frame.

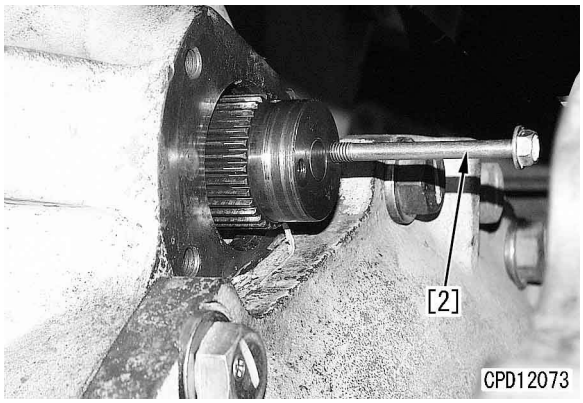


3. Remove guards (2) and (3).

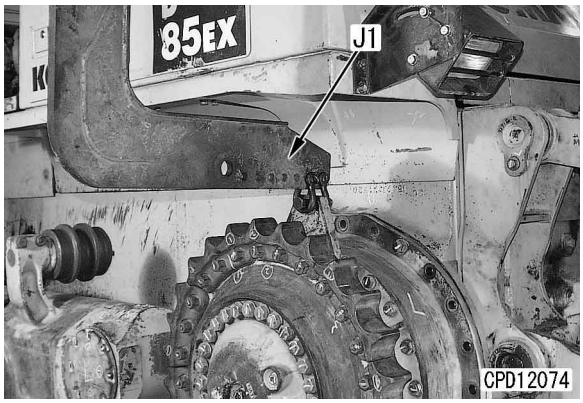


4. Remove cover (4).
5. Using forcing screw [2], pull out drive shaft (6).
   ★ If the shaft cannot be pulled out, set a jack and move the sprocket forward or in reverse until the shaft can be pulled out.
   ★ Pull out the shaft until it comes in contact with the sprocket.

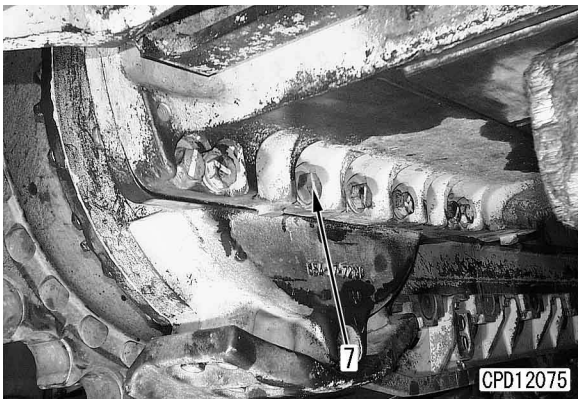




6. Remove the 2 final drive bolts, install tool **J1**, and sling the final drive assembly temporarily. [*1]



7. Remove inside mounting bolts (7) of the final drive assembly. [*2]



8. Remove the mounting bolts and lift off final drive assembly (8). [*3]

Final drive assembly: **1,000 kg**

INSTALLATION

- Carry out installation in the reverse order to removal.

[*1]
Tool mounting bolt:
455 – 565 Nm {46.5 – 58 kgm}

[*2]
Mounting bolt:
784 – 980 Nm {80 – 100 kgm}

[*3]
Mounting bolt:
784 – 980 Nm {80 – 100 kgm}

DISASSEMBLY AND ASSEMBLY OF FINAL DRIVE ASSEMBLY

SPECIAL TOOLS

Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
J	2	790-431-1031	Block	■	1		
		791-520-4140	Screw	■	2		
		790-101-2360	Plate	■	2		
		791-112-1180	Nut	■	2		
		791-546-1110	Adapter	■	2		
		790-201-2690	Plate	■	1		
		790-101-2102	Puller	■	1		
		790-101-1102	Hydraulic pump	■	1		
	3	790-431-1031	Block	■	1		
		791-520-4140	Screw	■	1		
		791-112-1180	Nut	■	2		
		01643-22460	Washer	■	2		
		791T-627-2130	Plate	■	1	N	○
		791T-627-2120	Push tool	■	1	N	○
		790-101-2102	Puller	■	1		
		790-101-1102	Hydraulic pump	■	1		
	4	791-580-1510	Installer	■	1		
	5	790-101-5201	Push tool kit	■	1		
		790-101-5281	Plate	■	1		
		790-101-5221	Grip	■	1		
		01010-51225	Bolt	■	1		

DISASSEMBLY

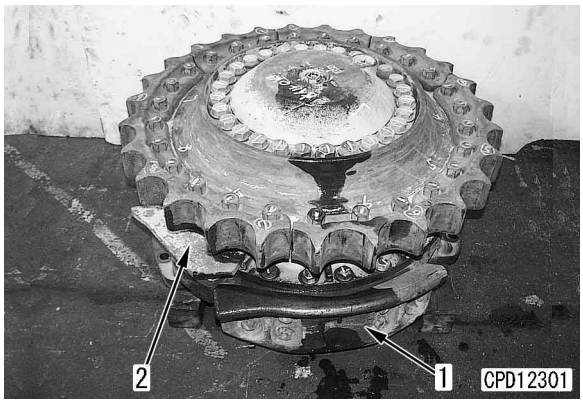
1. Draining oil

Remove the drain plug and drain the oil from the final drive case.

Final drive case: **Approx. 26 ℓ**

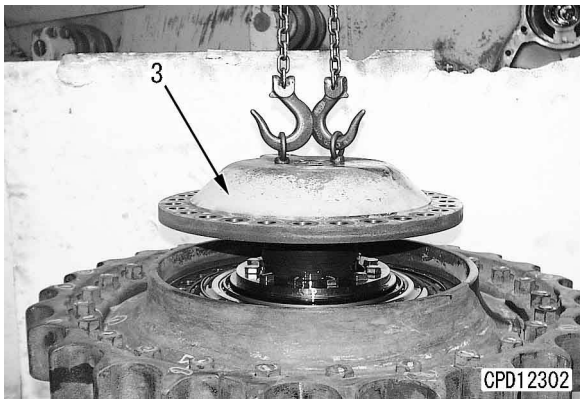
2. Wear guard and plate

1) Set the final drive assembly on a block with the sprocket side up.
2) Remove wear guard (1) and plate (2).



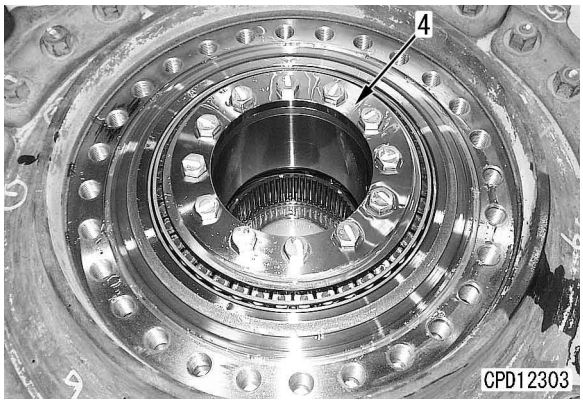
3. Shaft

Using eyebolts, remove shaft (3).

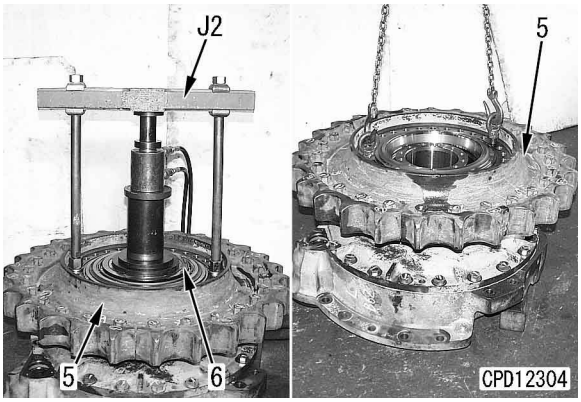


4. Sprocket hub assembly

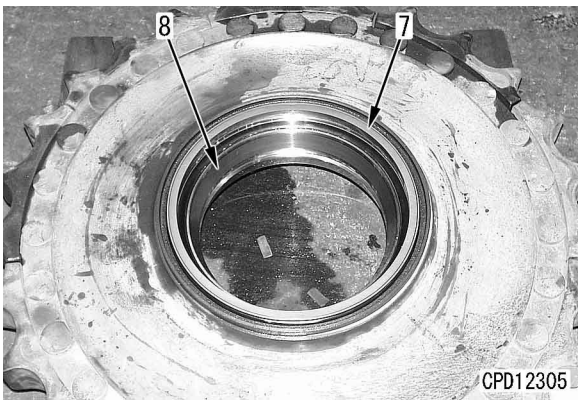
1) Remove the mounting bolts and plate (4).



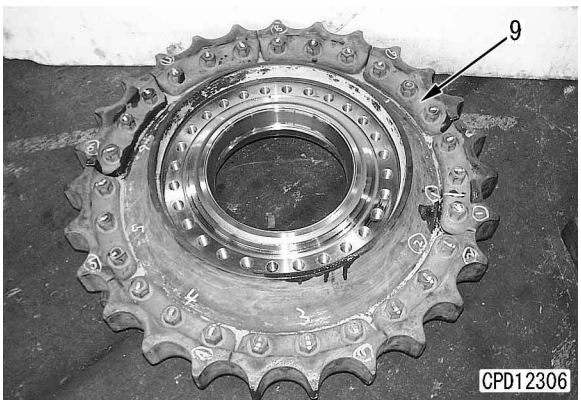
2) Using tool **J2**, disconnect sprocket hub assembly (5) and bearing (6).
3) Using eyebolts (3), remove sprocket hub assembly (5).



4) Remove floating seal (7) and 2 bearing outer races (8).
   ★ Store the floating seal in a safe place so that it will not be damaged.

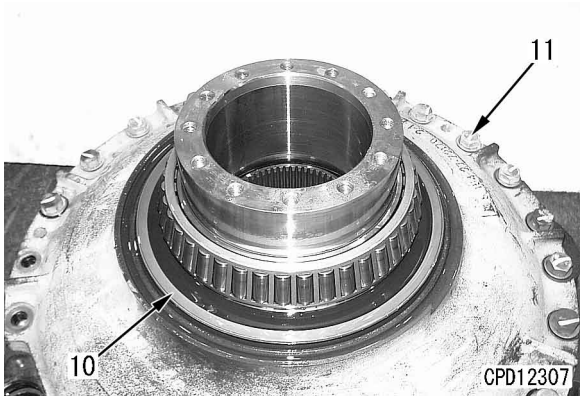


5) Turn over the sprocket hub assembly and remove sprocket (9).

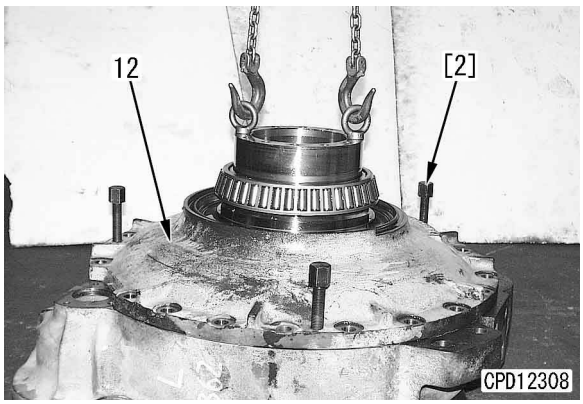


5. Cover assembly

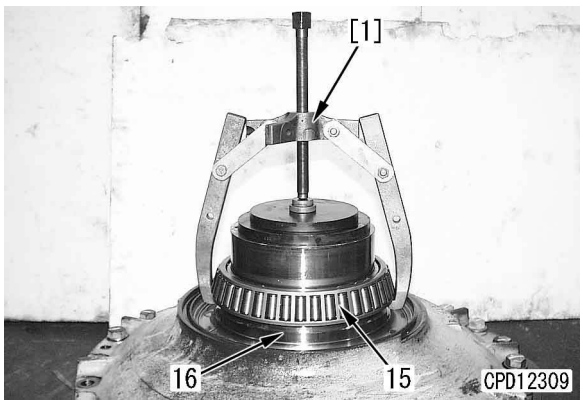
1) Remove floating seal (10).
   ★ Store the floating seal in a safe place so that it will not be damaged.
2) Remove mounting bolts (11).



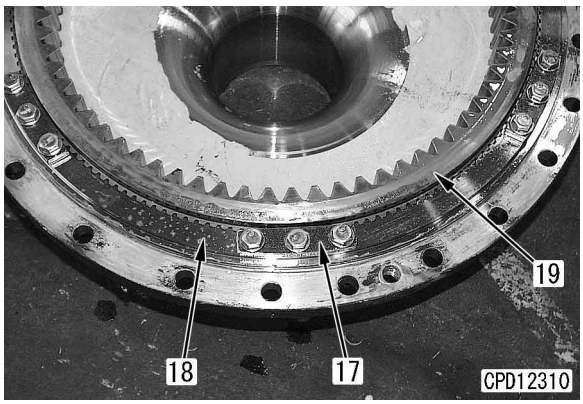
3) Using eyebolts, sling cover assembly (12) temporarily. Using 3 forcing screws [2], remove the cover assembly.



4) Using puller [1], pull out bearing (15) and remove spacer (16).

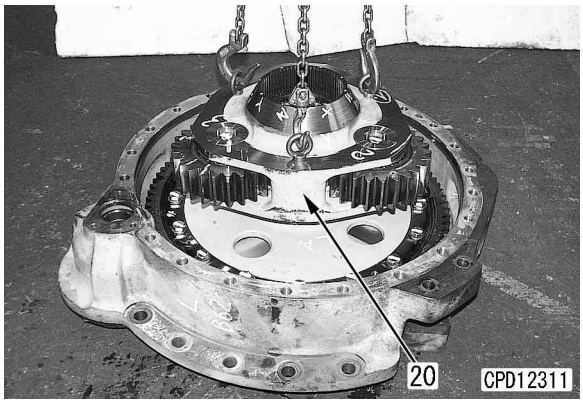


5) Turn over the cover assembly and remove 6 lock plates (17).
6) Remove ring (18) and ring gear (19).

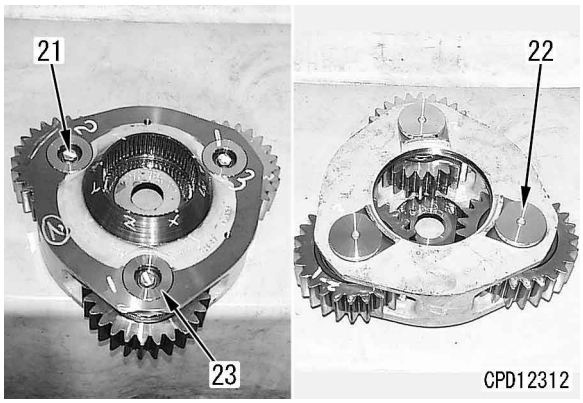


6. Carrier assembly

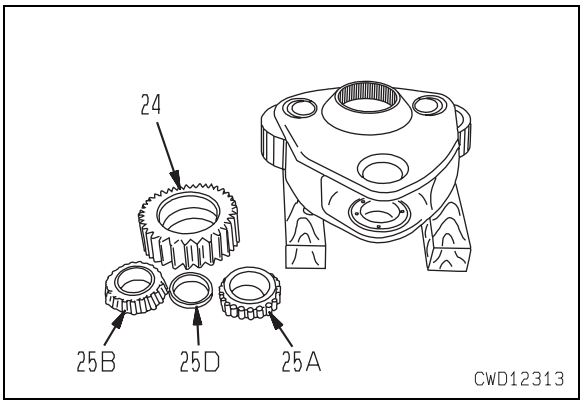
1) Using 3 eyebolts, remove carrier assembly (20).



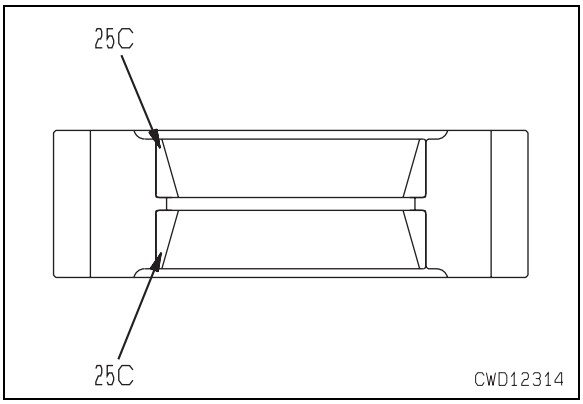
2) Remove bolts (21) and holder (22).



3) Pull out planetary gear shaft (23) and remove planetary gear (24) and bearings (25A) and (25B).
★ Take care of spacer (25D) between the bearings.

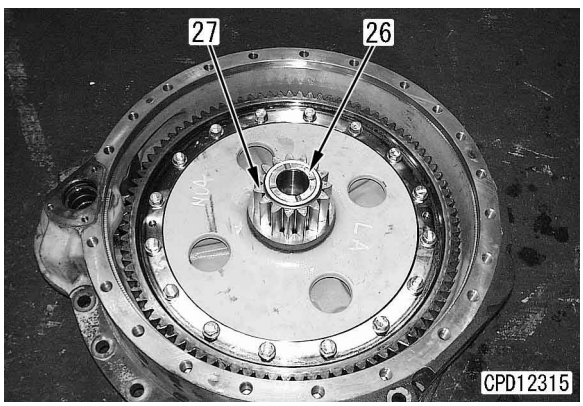


4) Remove 2 bearing outer races (25C).

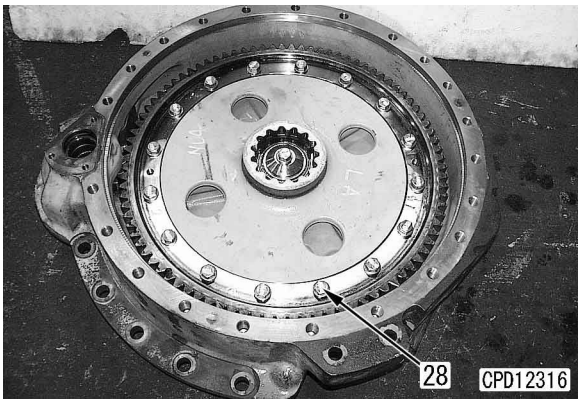


6. Hub and case assembly

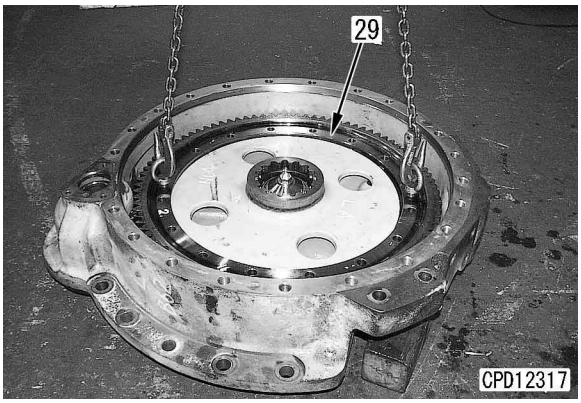
1) Remove thrust (26) and sun gear (27).



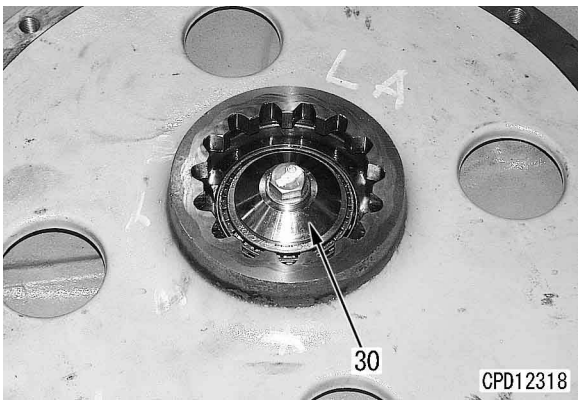
2) Remove gear mounting bolt (28).



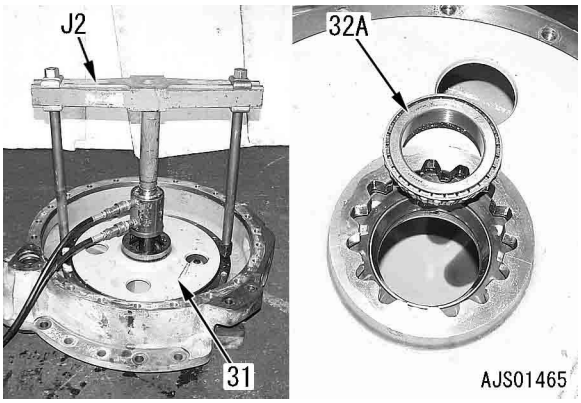
3) Using eyebolts, remove gear (29).



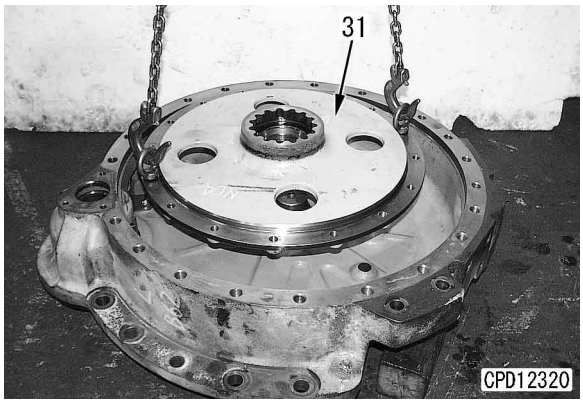
4) Remove the mounting bolts and plate (30).



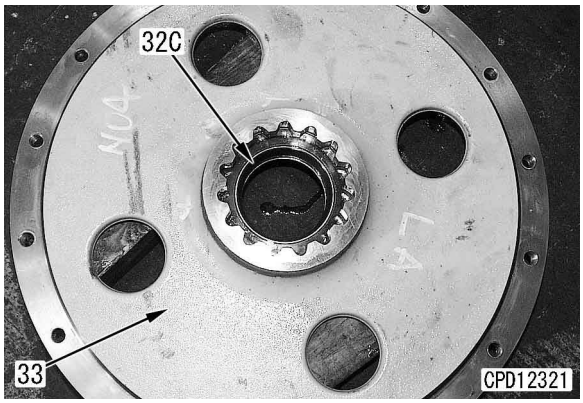
5) Using tool **J2**, remove hub assembly (31) and bearing (32A).



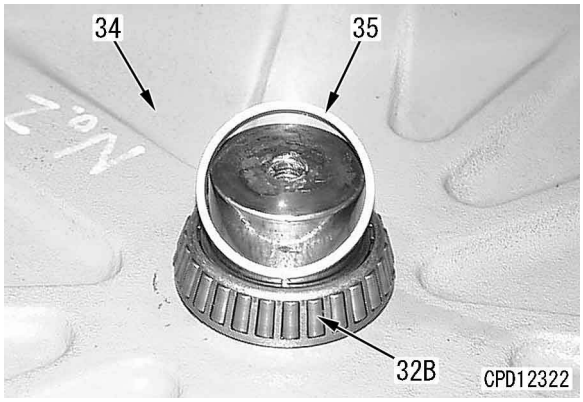
6) Using eyebolts, remove hub assembly (31).



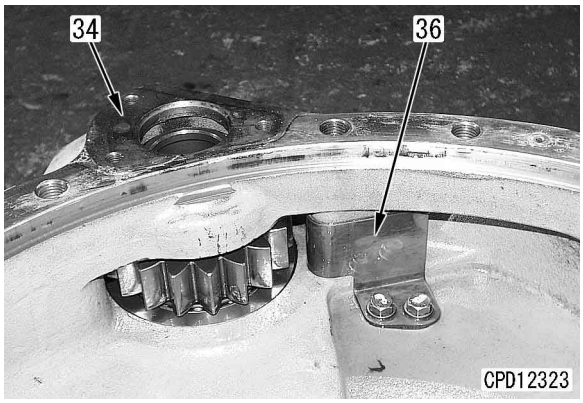
7) Remove 2 bearing outer races (32C) from hub (33).



8) Remove collar (35) and bearing (32B) from case (34).

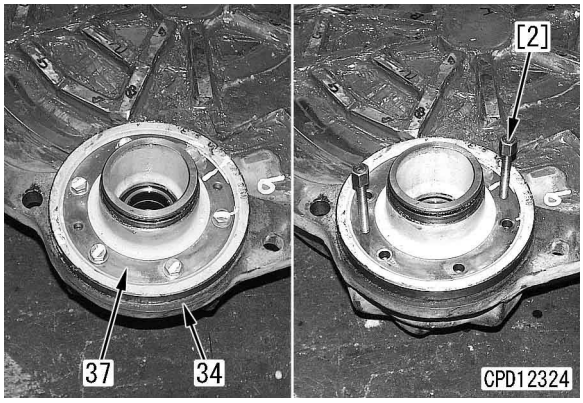


9) Remove oil sump plate (36) from case (34).

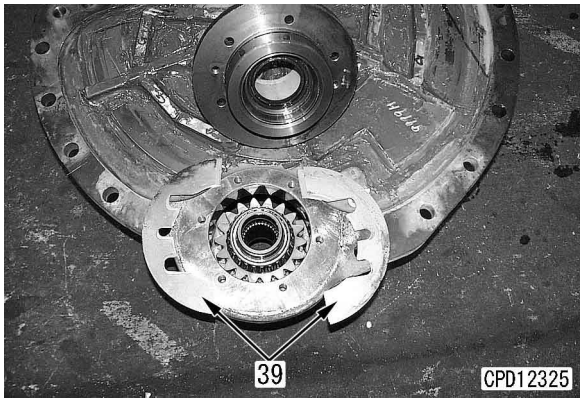


7. Cage assembly

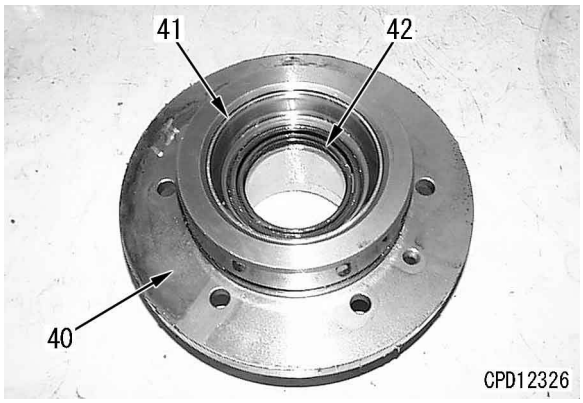
1) Remove the mounting bolts of cage assembly (37). Using forcing screw [2], remove the cage assembly from case (34).



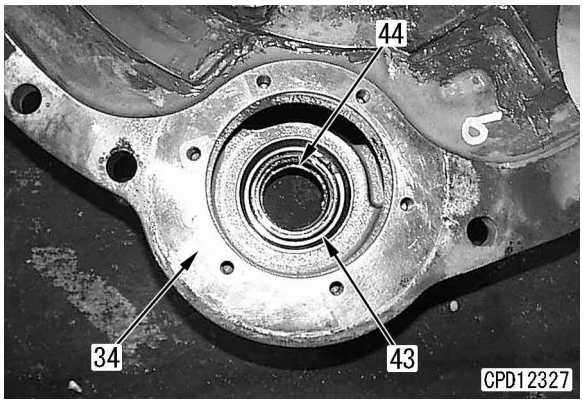
2) Remove shim (39).
   ★ Check the thickness and quantity of the inserted shims, then store them.



3) Remove outer race (41) and oil seal (42) from cage (40).

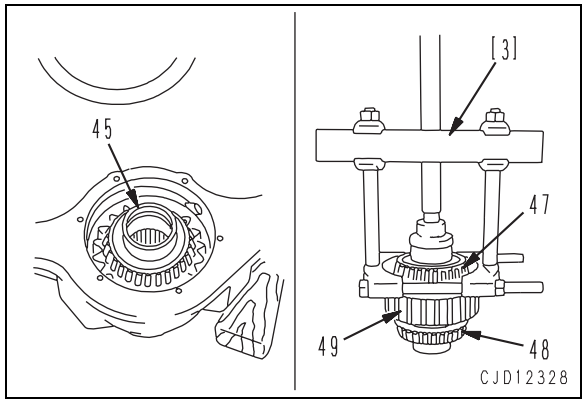


4) Remove outer race (43) and oil seal (44) from case (34).



8. Gear assembly

1) Remove gear assembly (45).
2) Using puller [3], remove bearings (47) and (48) from gear (49).

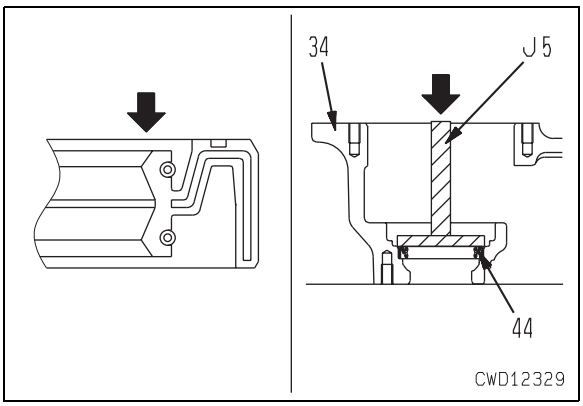


ASSEMBLY

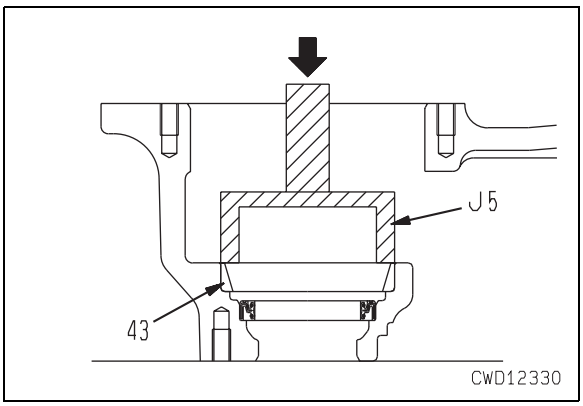
★ Clean the all parts and check them for dirt or damage before installing.
★ Coat sliding surfaces of each part with engine oil before installing.

1. Gear assembly

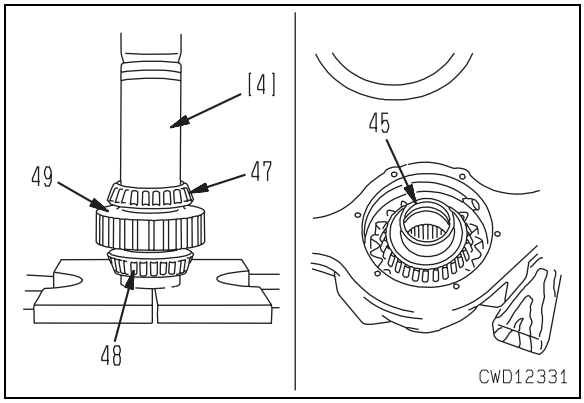
1) Using tool **J5**, install oil seal (44) to case (34).
   ★ When installing the oil seal, take care of its direction.
   ★ Apply gasket sealant thinly to the inside of the housing hole and wipe off the projected part.
   Oil seal lip: **Grease (G2-LI)**
   Oil seal fitting surface:
   Gasket sealant (LG-5)



2) Using tool **J5**, press fit bearing outer race (43) to case (34).
   • Press fitting force for outer race:
   1 – 14 kN {0.1 – 1.4 tons}

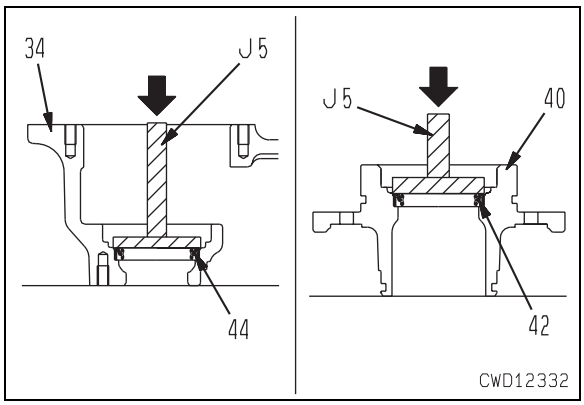


3) Using push tool [4], press fit bearings (47) and (48) to gear (49).
   • Press fitting force for bearing:
   6 – 17 kN {0.6 – 1.7 tons}
4) Install gear assembly (45).
   ★ Lower and install the gear assembly slowly so that the oil seal lip will not be damaged.

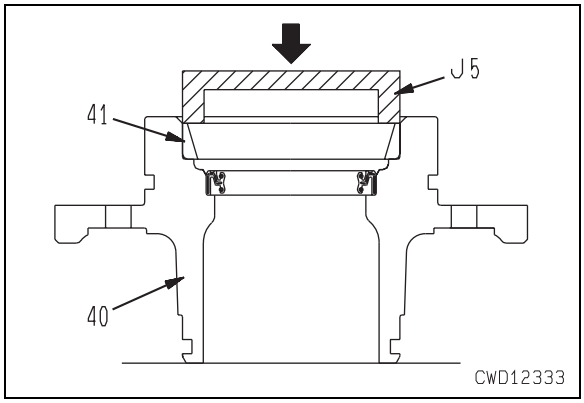


2. Cage assembly

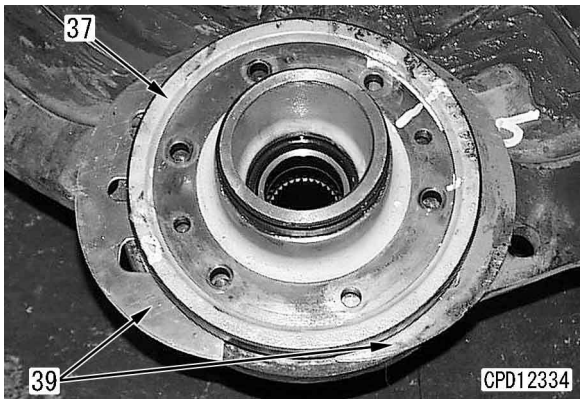
1) Using tool **J5**, install oil seal (42) to cage (40).
   ★ When installing the oil seal, take care of its direction.
   ★ Apply gasket sealant thinly to the inside of the housing hole and wipe off the projected part.
   Oil seal lip: **Grease (G2-LI)**
   Oil seal fitting surface:
   Gasket sealant (LG-5)



2) Using tool **J5**, press fit bearing outer race (41) to cage (40).
   - Press fitting force for bearing:
     1 – 14 kN {0.1 – 1.4 tons}



3) Install the O-ring to cage assembly (37) and adjust shim (39).



4) Adjustment of shim
   - Adjust the clearance of the pinion bearing according to the following procedure.
   i) Tighten mounting bolts **B**, **C**, **E**, and **F** of cage (40) evenly.
      Mounting bolt: **20 Nm {58 kgm}**
   ii) Under this condition, measure clearances **a** and **b** between cage (40) and case (34) with feeler gauges.
   iii) Set shim thickness **c** from the total of clearances **a** and **b**, referring to Table 1.
   iv) Install selected shim (39) to cage (40) and tighten the 6 mounting bolts of cage (40) evenly.
      Mounting bolt:
      98 – 123 Nm {10 – 12.5 kgm}

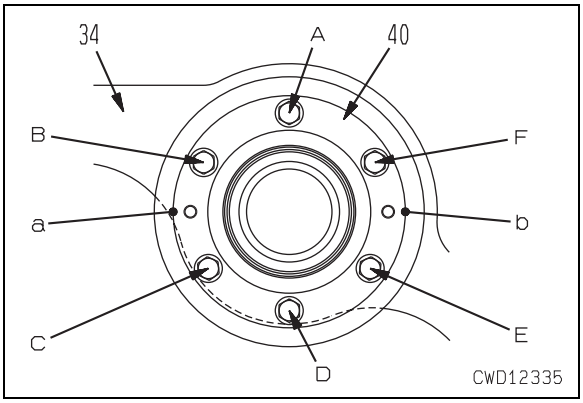
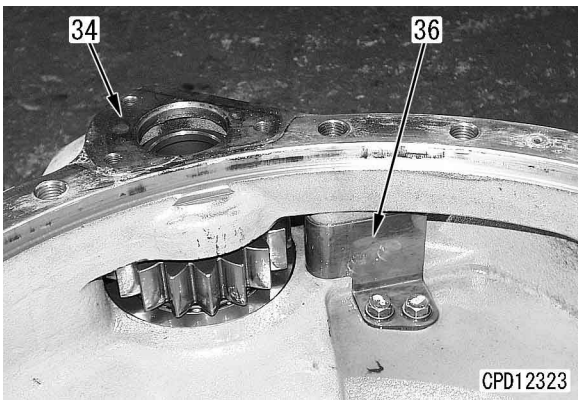


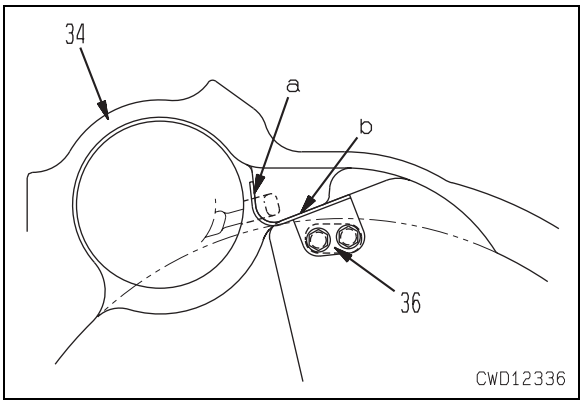
Table 1

a + b (mm)		Number of shims to be used			Total thickness of shims (mm)
Larger than	Below	t = 0.15	t = 0.5	t = 1.0	
2.95	3.05	5		1	1.75
3.05	3.15	2	1	1	1.80
3.15	3.25	9	1		1.85
3.25	3.35	6		1	1.90
3.35	3.45	3	1	1	1.95
3.45	3.55			2	2.00
3.55	3.65	7		1	2.05
3.65	3.75	4	1	1	2.10
3.75	3.85	1		2	2.15
3.85	3.95	8		1	2.20
3.95	4.05	5	1	1	2.25
4.05	4.15	2		2	2.30
4.15	4.25	9		1	2.35
4.25	4.35	6	1	1	2.40
4.35	4.45	3		2	2.45
4.45	4.55		1	2	2.50
4.55	4.65	7	1	1	2.55
4.65	4.75	4		2	2.60
4.75	4.85	1	1	2	2.65
4.85	4.95	8	1	1	2.70
4.95	5.05	5		2	2.75
5.05	5.15	2	1	2	2.80
5.15	5.25	9	1	1	2.85
5.25	5.35	6		2	2.90
5.35	5.45	3	1	2	2.95
5.45	5.55			3	3.00
5.55	5.65	7		2	3.05
5.65	5.75	4	1	2	3.10
5.75	5.85	3		3	3.15
5.85	5.95	8		2	3.20
5.95	6.05	5	1	2	3.25
6.05	6.15	2		3	3.30
6.15	6.25	9		3	3.35
6.25	6.35	6	1	2	3.40
6.35	6.45	3		3	3.45
6.45	6.55		1	3	3.50
6.55	6.65	7	1	2	3.55
6.65	6.75	4		3	3.60
6.75	6.85	1	1	3	3.65
6.85	6.95	8	1	2	3.70
6.95	7.05	5		3	3.75
7.05	7.15	2	1	3	3.80
7.15	7.25	9	1	2	3.85

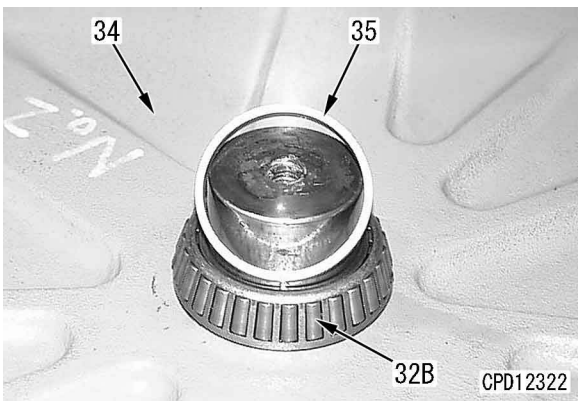
3. Hub and case assembly

1) Install oil sump plate (36) to case (34).
   ★ When installing the plate, press it against faces **a** and **b** of the case.
   Mounting bolt: **Adhesive (LT-2)**

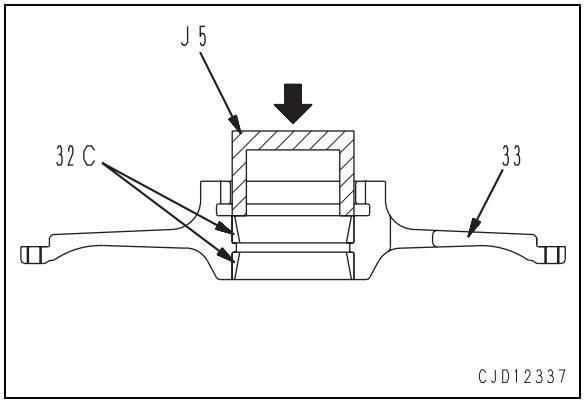




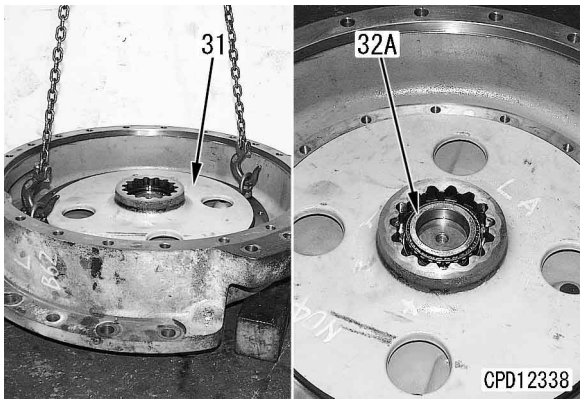
2) Using tool **J5**, press fit bearing (32B) to case (34).
   • Press fitting force for bearing:
   13 – 26 kN {1.3 – 2.6 tons}
3) Install collar (35).



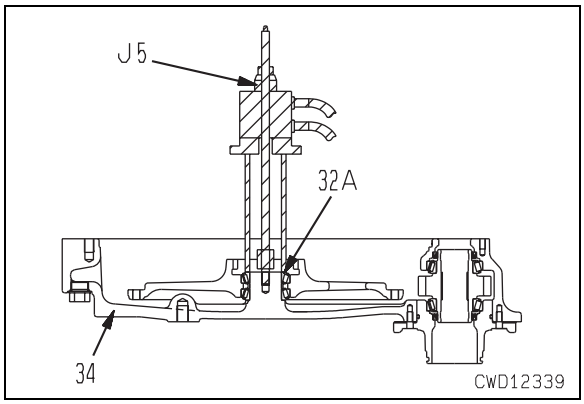
4) Using tool **J5**, press fit 2 bearing outer races (32C) to hub (33).
   • Press fitting force for outer race:
   2 – 15 kN {0.2 – 1.5 tons}



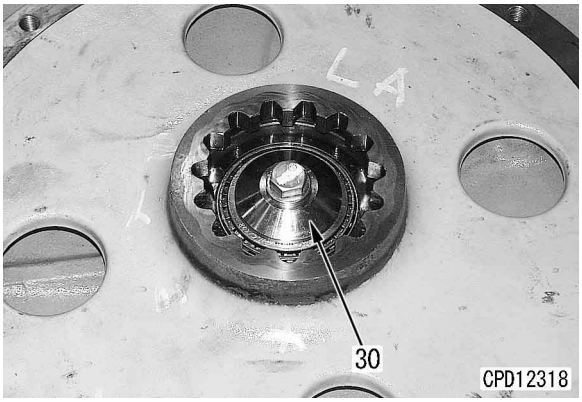
5) Using eyebolts, set hub assembly (31) to the shaft.
6) Set bearing (32A) to the shaft.



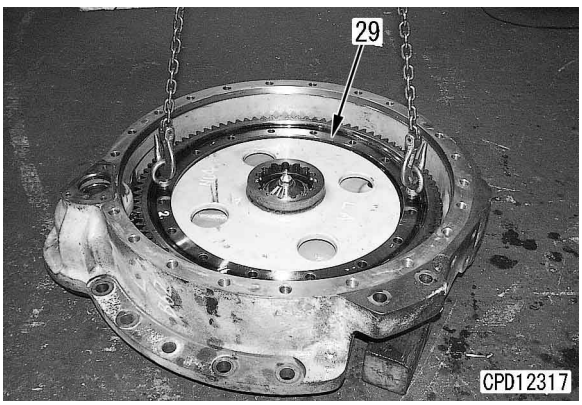
7) Using tool **J5**, press fit bearing (32A) to case (34).
   • Press fitting force for bearing:
   13 – 26 kN {1.3 – 2.6 tons}



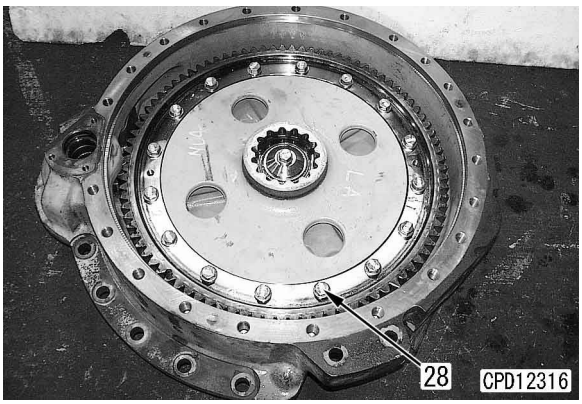
8) Install plate (30).
Mounting bolt: **Adhesive (LT-2)**
Mounting bolt:
230 – 289 Nm {23.5 – 29.5 kgm}



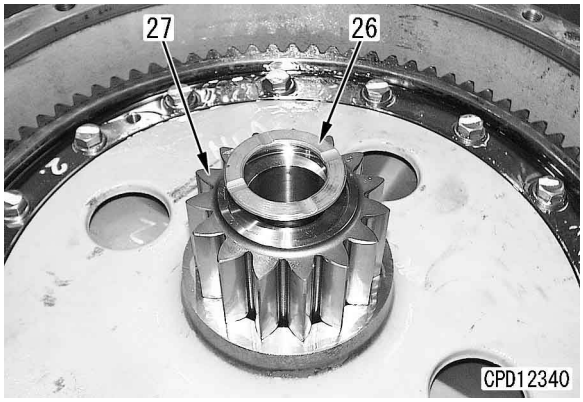
9) Using eyebolts, install gear (29).



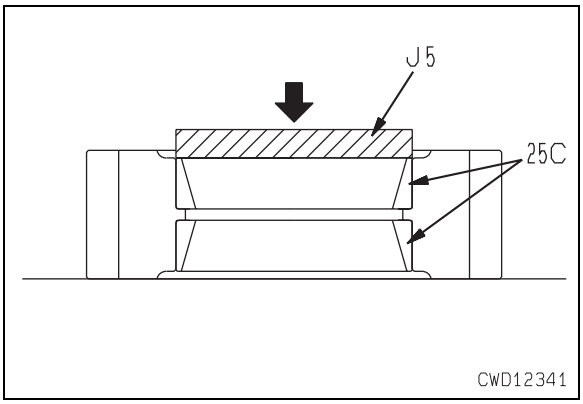
10) Tighten gear mounting bolts (28).
Mounting bolt: **Adhesive (LT-2)**
Mounting bolt:
230 – 289 Nm {23.5 – 29.5 kgm}



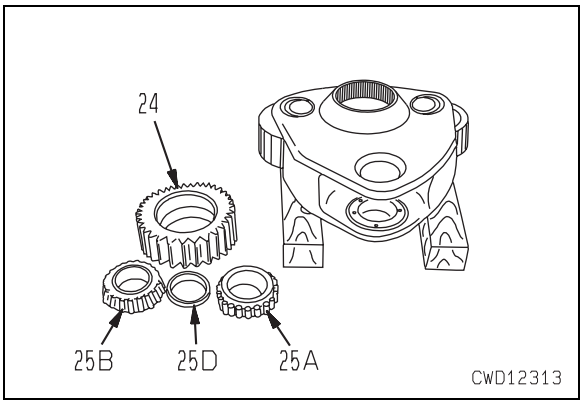
11) Install sun gear (27) and thrust (26).



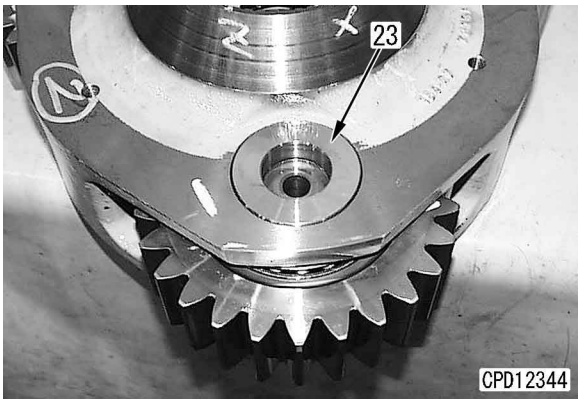
4. Carrier assembly
★ Since each bearing of the planetary gear is an assembly, match the identification marks of the inner race, outer race, and spacer when assembling.
1) Using tool **J5**, press fit bearing outer race (25C) to planetary gear (24).
• Press fitting force for bearing:
10 – 35 kN {1.0 – 3.6 tons}



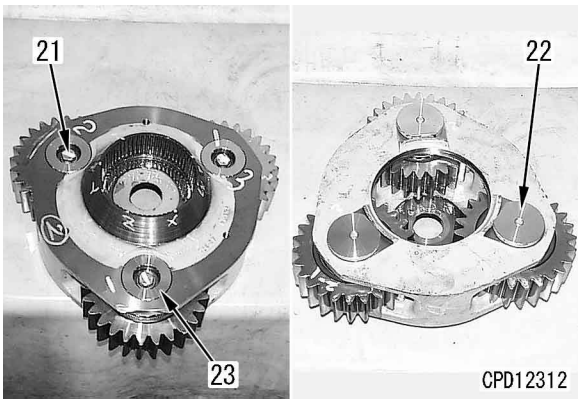
2) Install bearings (25A) and (25B) and spacer (25D) to planetary gear (24).



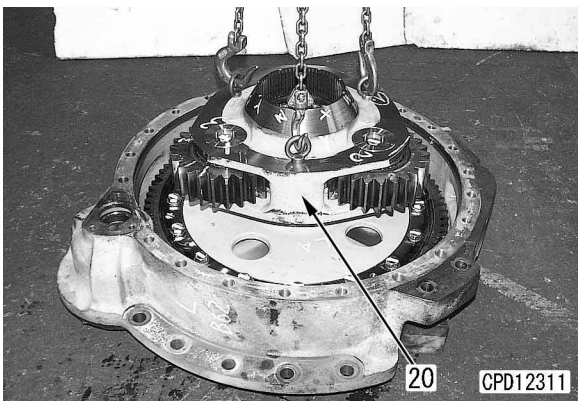
3) Set the planetary gear assembly to the carrier and press fit shaft (23).
   ★ Aligning the holes of the bearing and spacer with each other, press fit the shaft gradually.



4) Install bolt (21) and holder (22).
   Mounting bolt: **Adhesive (LT-2)**
   Mounting bolt:
   230 – 289 Nm {23.5 – 29.5 kgm}

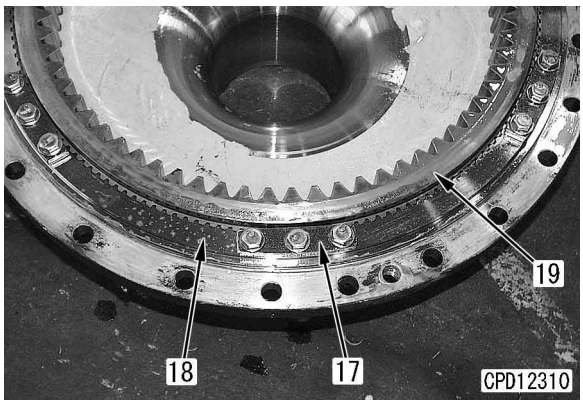


5) Using 3 eyebolts, install carrier assembly (20).

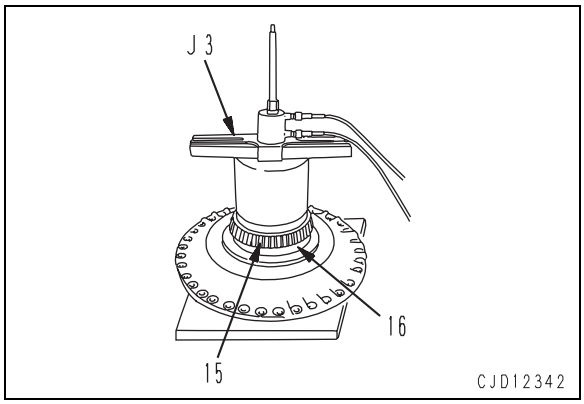


5. Cover assembly

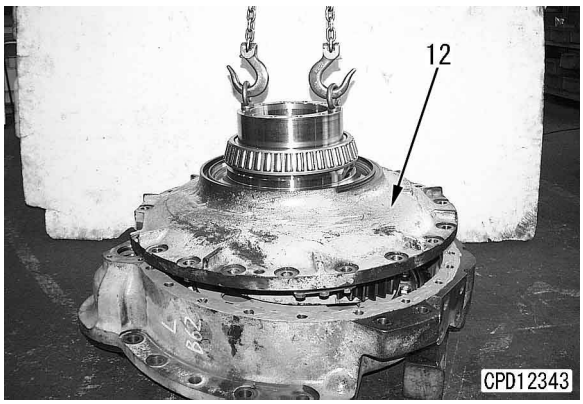
1) Install ring gear (19) and ring (18) and secure them with 6 lock plates (17).



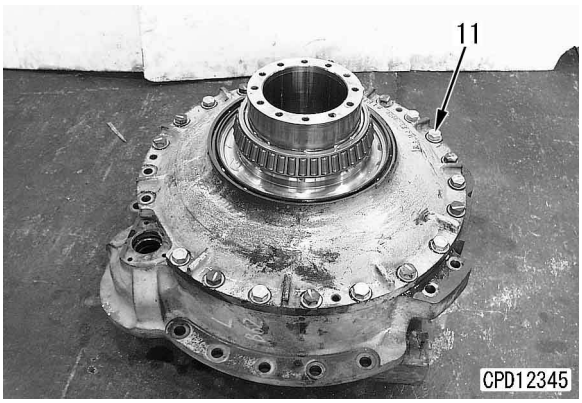
2) Install spacer (16).
3) Using tool **J3**, press fit bearing (15).
   • Press fitting force for bearing:
   24 – 52 kN {2.4 – 5.3 tons}



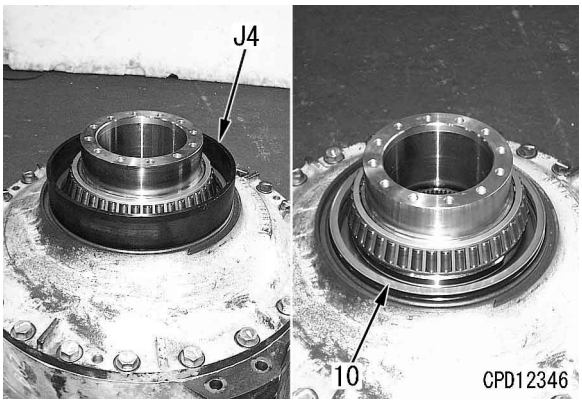
4) Using eyebolts, install the O-ring to cover assembly (12), and then install them to the case assembly.
   ★ Check that the mating faces of the case and cover are free from bruise, rust, oil, grease, dirt, and water.
   Mounting bolt: **Gasket sealant (LG-7)**



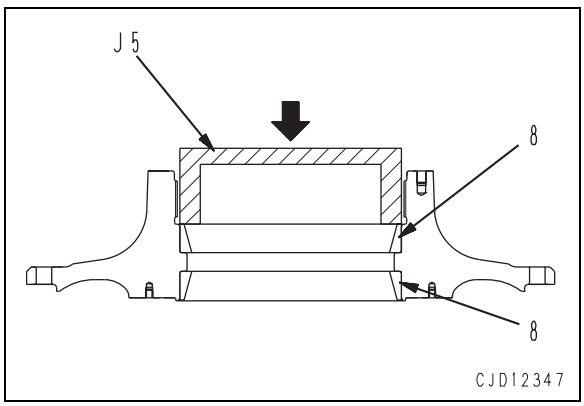
5) Tighten mounting bolts (11).
Mounting bolt:
455 – 565 Nm {46.5 – 58 kgm}



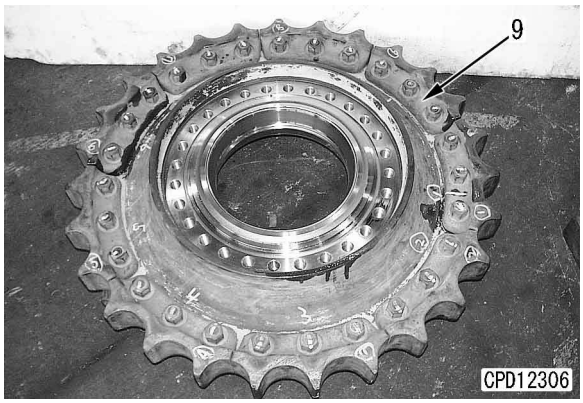
6) Using tool **J4**, press fit floating seal (10).
★ Degrease the O-ring and O-ring fitting surfaces thoroughly and dry them before installing.
★ After installing the floating seal, check that its slant is less than 1 mm.



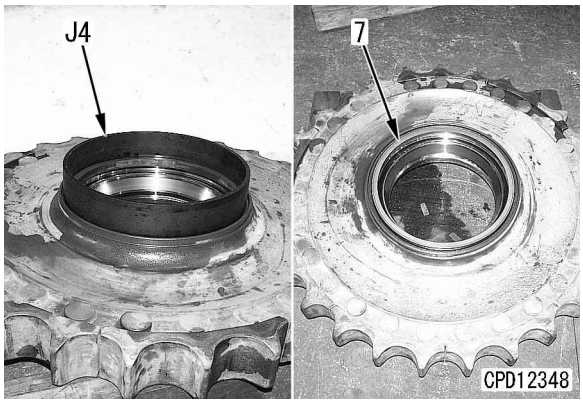
6. Sprocket hub assembly
1) Using tool **J5**, press fit bearing outer race (8).
• Press fitting force for bearing:
15 – 35 kN {1.5 – 3.6 tons}



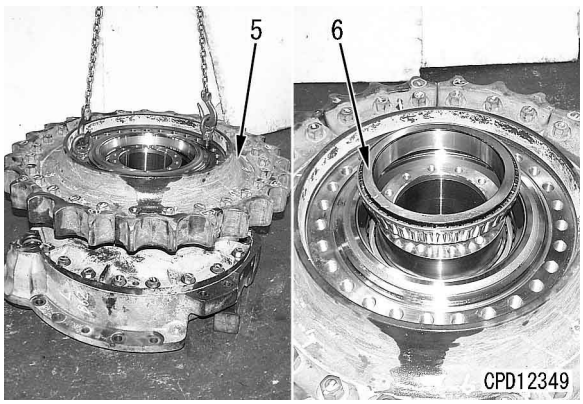
2) Install sprocket (9) to the sprocket hub.
Mounting bolt:
931 – 1,127 Nm {95 – 115 kgm}



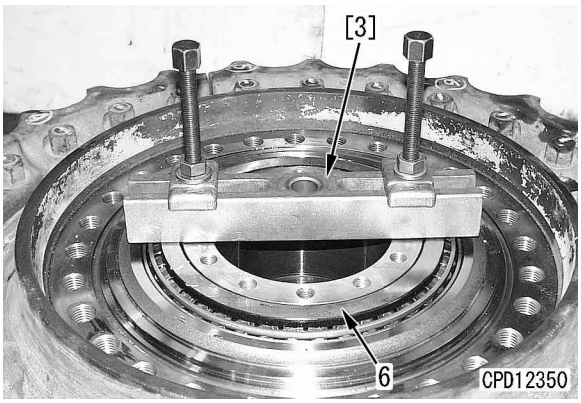
3) Using tool **J4**, press fit floating seal (7).
★ Degrease the O-ring and O-ring fitting surfaces thoroughly and dry them before installing.
★ After installing the floating seal, check that its slant is less than 1 mm.



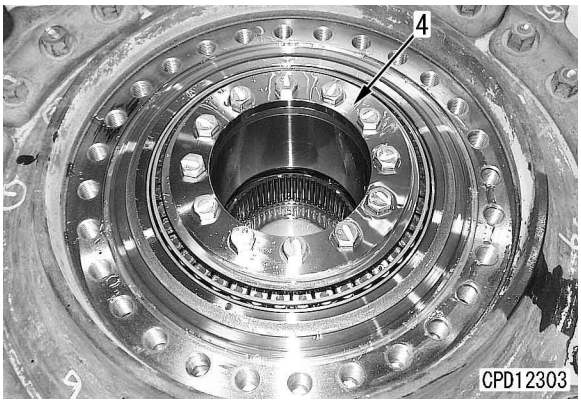
4) Using eyebolts, install sprocket hub assembly (5) to the cover assembly.
★ Check that the sliding surfaces of the floating seal are free from dirt and apply engine oil to them thinly.
5) Set bearing (6).



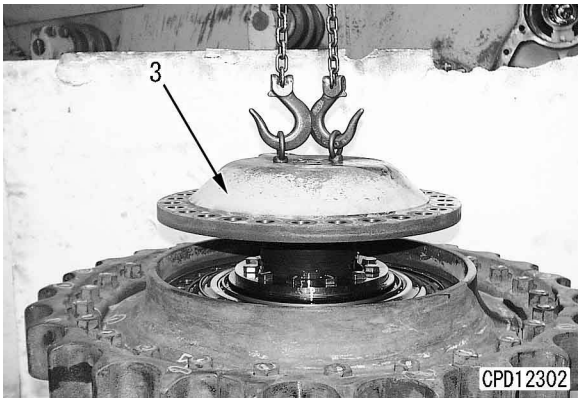
6) Using tool [3], press fit bearing (6).
★ Press fit the bearing, turning the sprocket hub assembly.
• Press fitting force for bearing:
24 – 52 kN {2.4 – 5.3 tons}



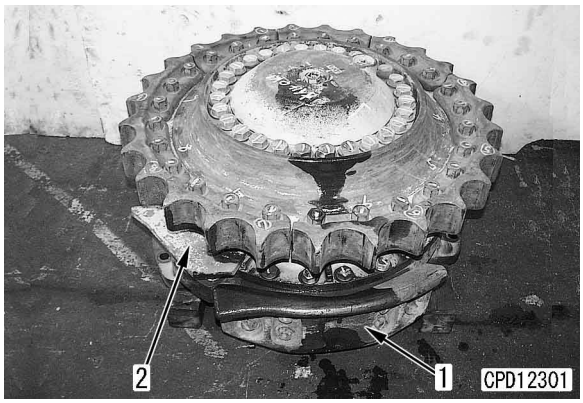
7) Install plate (4) and secure it with the mounting bolts.
Mounting bolt: **Adhesive (LT-2)**
Mounting bolt:
230 – 289 Nm {23.5 – 29.5 kgm}



7. Shaft
Install the O-ring to the sprocket hub assembly side. Using eyebolts, install shaft (3).
Mounting bolt:
824 – 1,030 Nm {84 – 105 kgm}



8. Wear guard and plate
1) Install plate (2).
Mounting bolt:
455 – 565 Nm {46.5 – 58 kgm}
2) Install wear guard (1)
Mounting bolt:
455 – 565 Nm {46.5 – 58 kgm}



• **Refilling with oil**
Tighten the drain plug and add oil through the oil filler.
★ After installing the final drive assembly to the chassis, check the oil level finally.
Final drive case: **Approx. 26 ℓ**
Oil filler plug and drain plug:
127 – 176 Nm {13 – 18 kgm}
Oil level gauge plug:
58.8 – 76.4 Nm {6 – 8 kgm}

REMOVAL AND INSTALLATION OF TRACK FRAME ASSEMBLY

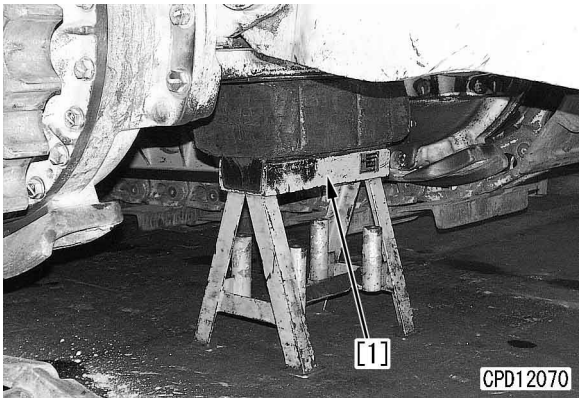
REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

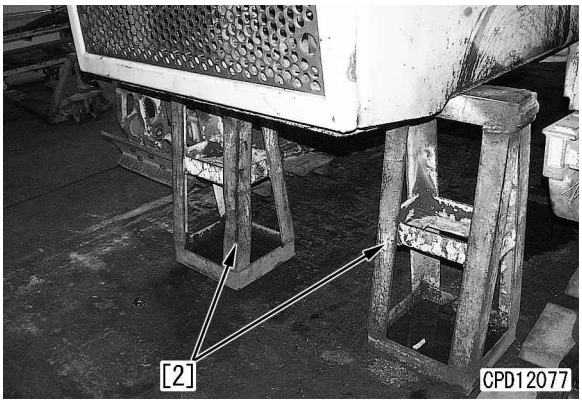
1. Remove the blade assembly. For details, see REMOVAL OF BLADE ASSEMBLY.

2. Expand the track shoe assembly. For details, see EXPANDING TRACK SHOE ASSEMBLY.

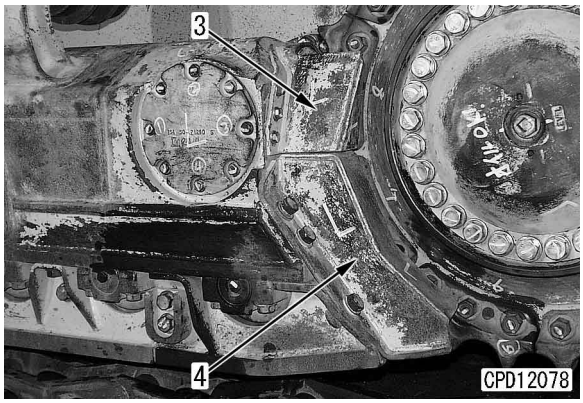
3. Raise the chassis with a jack or the ripper and set stand [1] under the frame to float the rear part of the chassis.



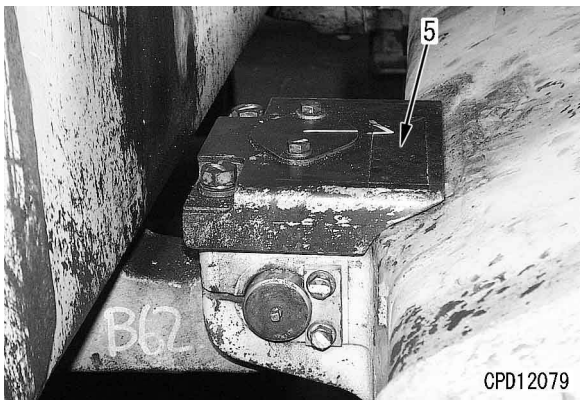
4. Set a hydraulic jack under the center of the equalizer bar to raise the front part of the chassis and set stand [2] under the frame to float the front part.
   ★ After floating the chassis, set the hydraulic jack and ripper again as auxiliary supports.



5. Remove guards (3) and (4).



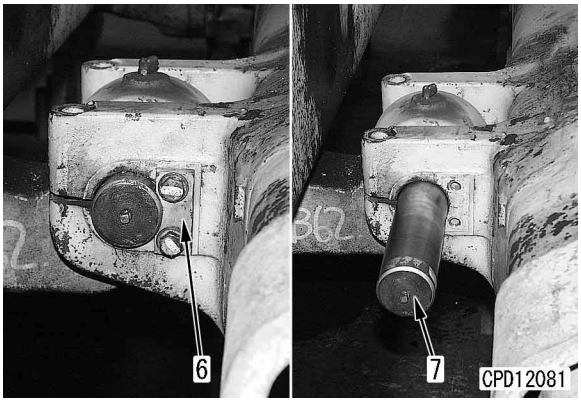
6. Remove cover (5) of the equalizer bar.



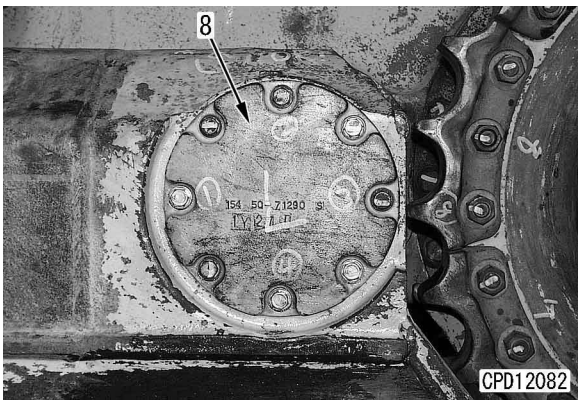
7. Temporarily sling the track frame assembly to be removed.

8. Remove pin lock plate (6) and pull out pin (7).
★ If the equalizer bar hole and track frame hole are not aligned, the pin cannot be removed easily. Adjust the hanging height of the track frame properly.

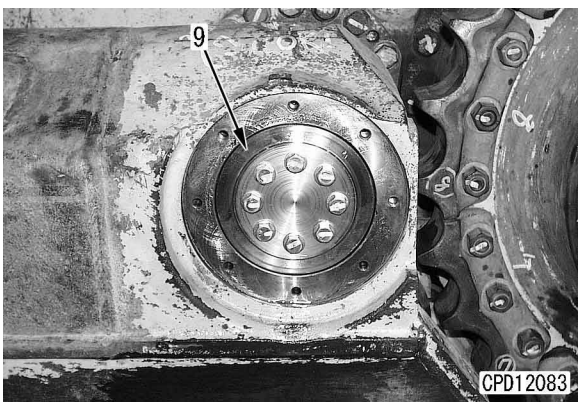
⚠ If the track frame assembly on the opposite side is floated before the pin is pulled out, support it on a block, etc.



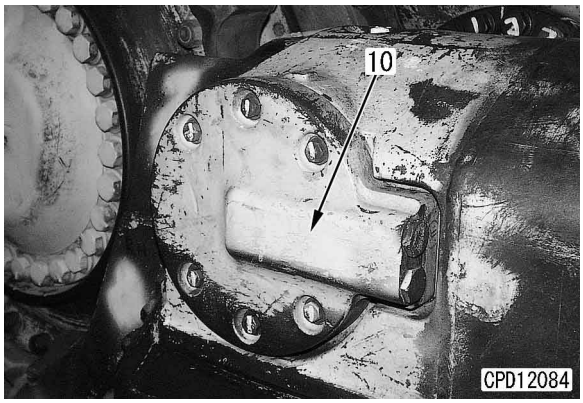
9. Removal of track frame assembly
• Left track frame assembly
1) Remove cover (8). [*1]



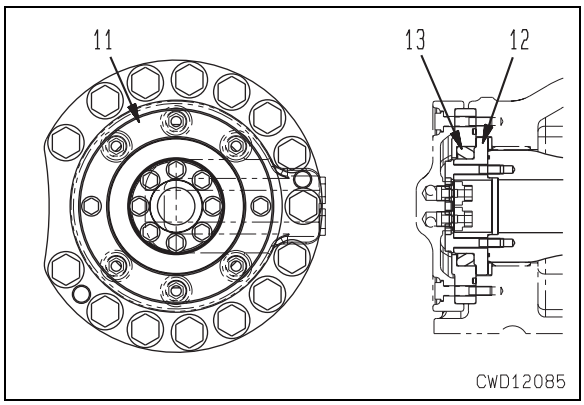
2) Remove spacer (9). [*2]
★ Receive the oil flowing out of the pivot case with an oil pan, etc.
Pivot case: **Approx. 8 ℓ**



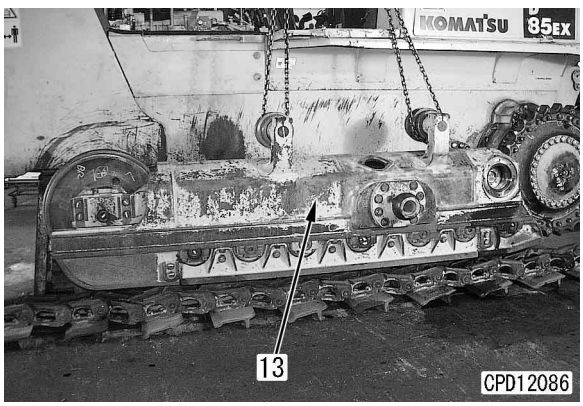
• Right track frame assembly
1) Remove cover (10). [*3]



2) Remove spacer (11). [*4]
★ Receive the oil flowing out of the pivot case with an oil pan, etc.
Pivot case: **Approx. 8 ℓ**
3) Remove washer (12).
★ Remove seal (13) and washer (12) together.



10. Lift off track frame assembly (13).
Track frame assembly:
D85EX-15; 2,160 kg
D85PX-15; 2,270 kg



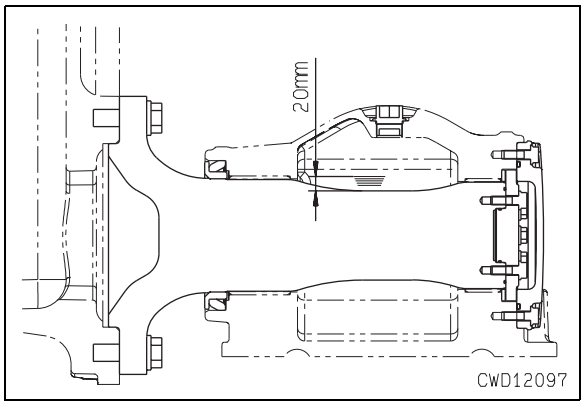
INSTALLATION

- Carry out installation in the reverse order to removal.

[*1] [*2] [*3] [*4]

Mounting bolt:
54 – 123 Nm {5.5 – 12.5 kgm}

- **Refilling with oil**
  Add oil through the oil filler at the upper section.
  ★ The oil level must be 20 mm from the top of the pivot shaft.
  Pivot shaft case: **Approx. 8 ℓ**
  Oil filler plug:
  127 – 176 Nm {13 – 18 kgm}



REMOVAL AND INSTALLATION OF IDLER ASSEMBLY

REMOVAL

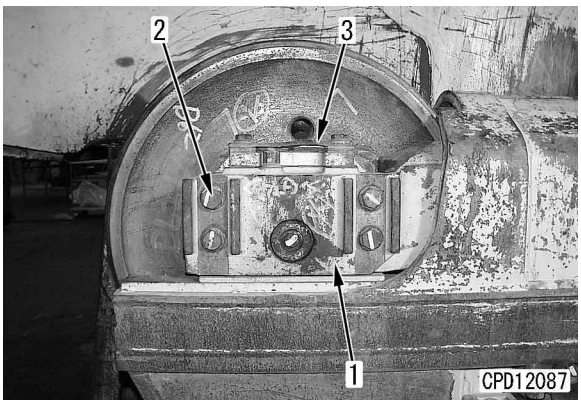
⚠ Disconnect the cable from the negative (–) terminal of the battery.

⚠ Never stand in front of the idler assembly to prevent danger.

1. Remove the blade assembly. For details, see REMOVAL OF BLADE ASSEMBLY.

2. Expand the track shoe assembly. For details, see EXPANDING TRACK SHOE ASSEMBLY.

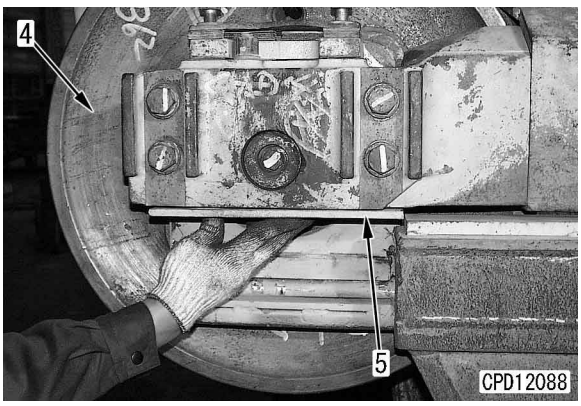
3. Loosen mounting bolts (2) of support (1) and spring seat clamping bolts and remove plate (3).



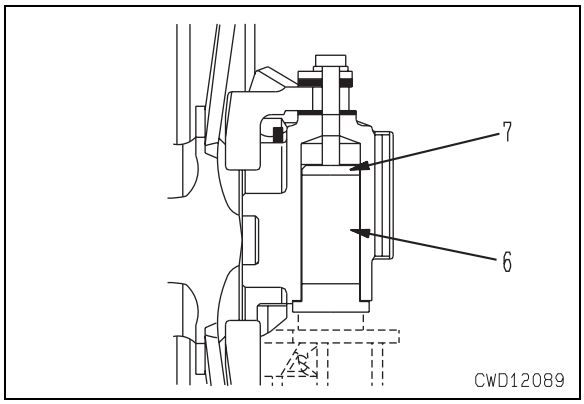
4. Pass wires through the hanging holes of idler assembly (4). Sling idler assembly (4) and slide it out forward along the top of the track frame.

   Idler assembly: **290 kg**

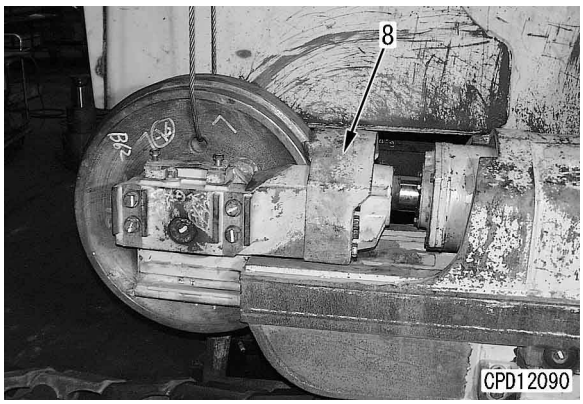
5. Remove guide plate (5).



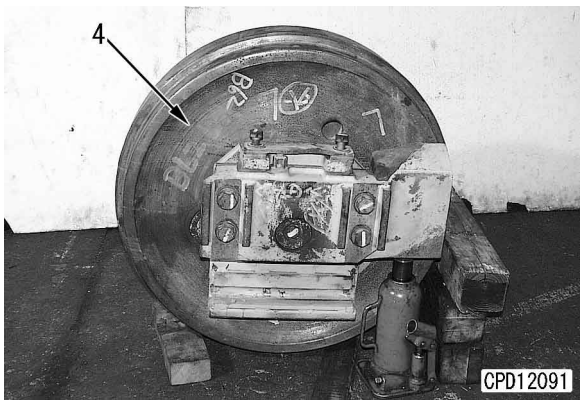
6. Remove spring (6) and seat (7).



7. Remove yoke (8).



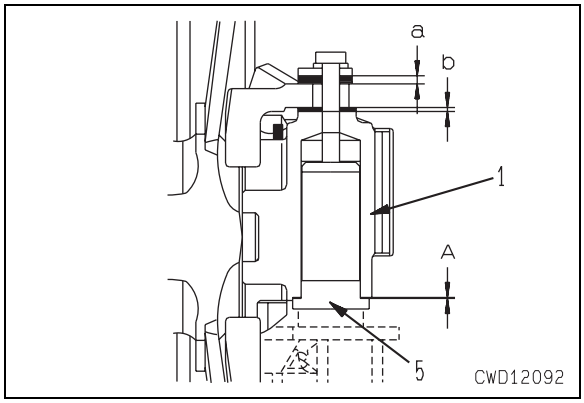
8. Lift off idler assembly (4).



INSTALLATION

- Carry out installation in the reverse order to removal.
  - ★ Install the idler assembly to the chassis with the oil filler plug on the left side of the chassis.

★ Adjustment of shims
Adjust the shims so that clearance **A** between idler support (1) and guide plate (5) will be 2 mm at every point.
- Standard thickness of shims : **a** = 8 mm
  : **b** = 4 mm
  - ★ Select shims **a** and **b** so that the total thickness of them (**a** + **b**) will be 12 mm.
  - ★ Set at least 4 pieces of the 1-mm thick shim on the **a** side and at least 2 pieces on the **b** side.



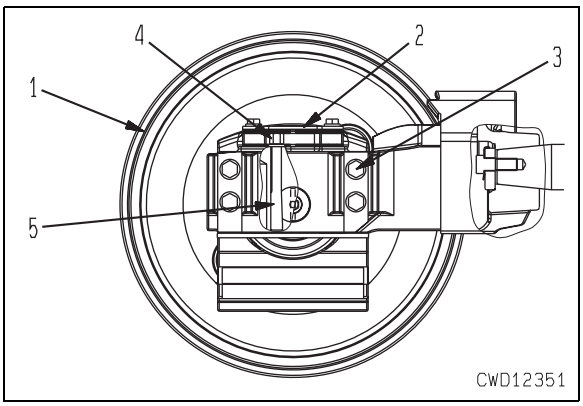
DISASSEMBLY AND ASSEMBLY OF IDLER ASSEMBLY

SPECIAL TOOLS

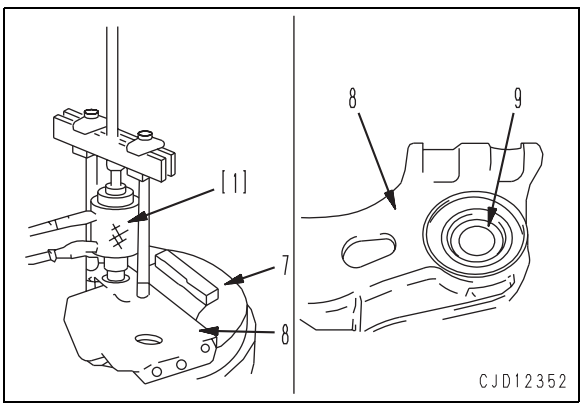
Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
L	1	791-530-1510	Installer	■	1		
	2	791-601-1000	Oil pump	■	1		

DISASSEMBLY

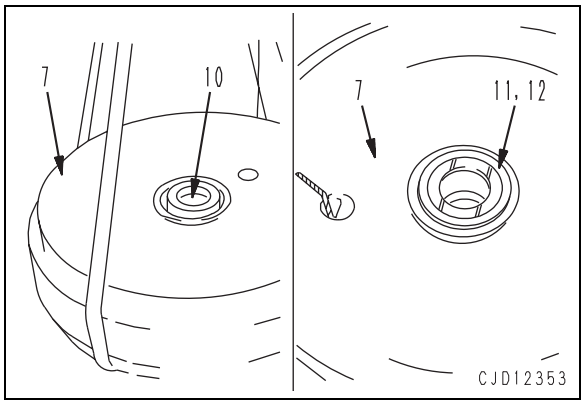
1. Remove the oil filler plug and drain the oil.
   Idler: **0.33 – 0.37** ℓ
2. Set idler (1) to a block.
3. Remove the spring seat mounting bolts and plate (2).
   ★ Record the number of the removed shims.
4. Remove support mounting bolts (3).
   ★ Record the number of the removed shims.
5. Remove nut (4) and drive out bolt (5) from the nut side.

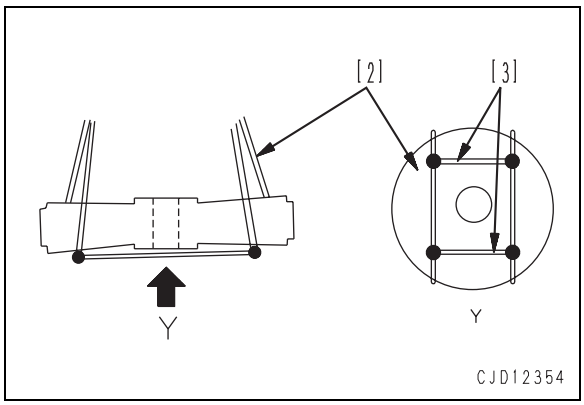


6. Using push puller [1], pull support (8) out of idler (7).
7. Remove floating seal (9) from support (8).

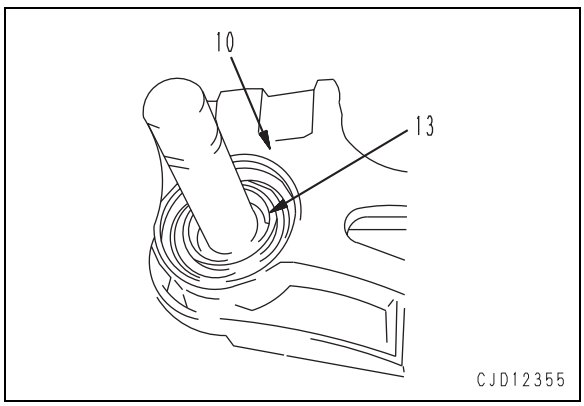


8. Sling idler (7) and pull it out of shaft and support assembly (10).
   ★ When hanging the idler with sling rope [2], prevent sling rope [2] from opening with wires or ropes [3].
9. Remove floating seals (11) and (12) from idler (7).



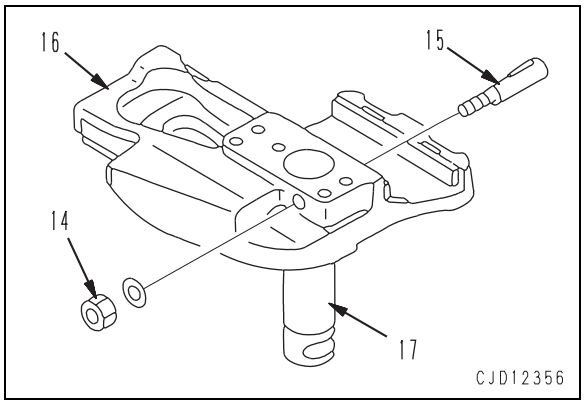


10. Remove floating seal (13) from shaft and support assembly (10).

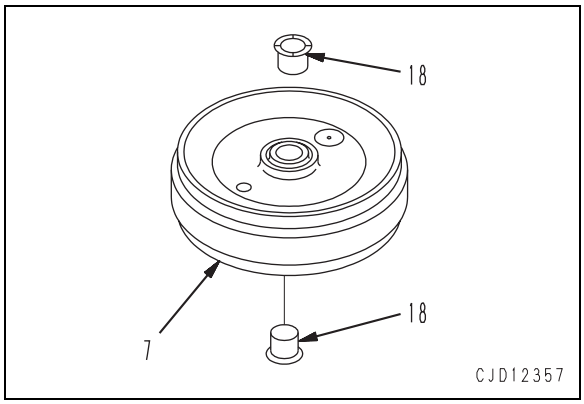


11. Remove nut (14) and drive out bolt (15) from the nut side.

12. Similarly to step 6, using push puller [1], pull shaft (17) out of support (16).

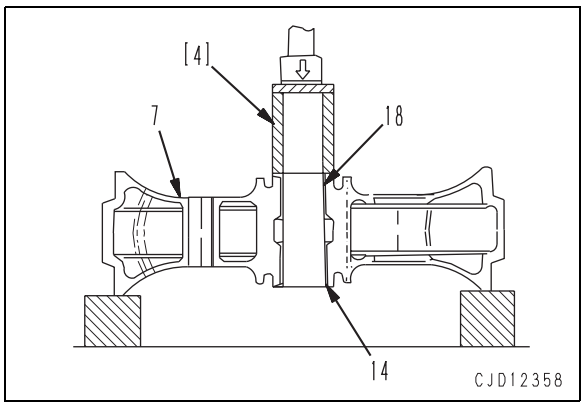


13. Remove 2 bushings (18) from idler (7).



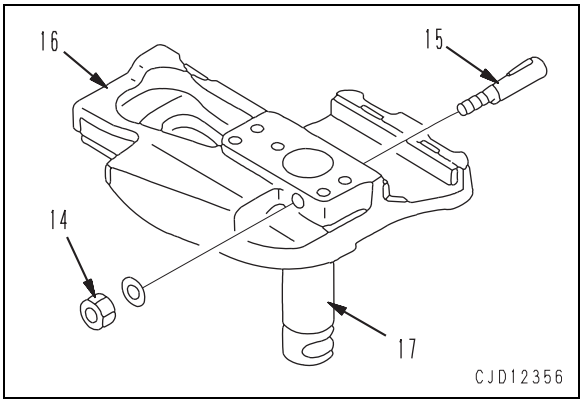
ASSEMBLY

1. Using push tool [4], press fit 2 bushings (18) to idler (7).
- Press fitting force for bushing:
  4.9 – 148.7 kN {1.5 – 15.2 tons}

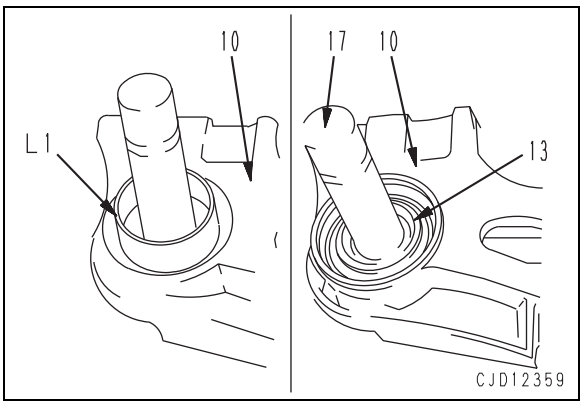


2. Install the O-ring to shaft (17), and then install them to support (16).
- ★ When installing shaft (17), match its groove to the groove of the support.
- ★ Install the shaft with the opposite end of the oil filler ahead.

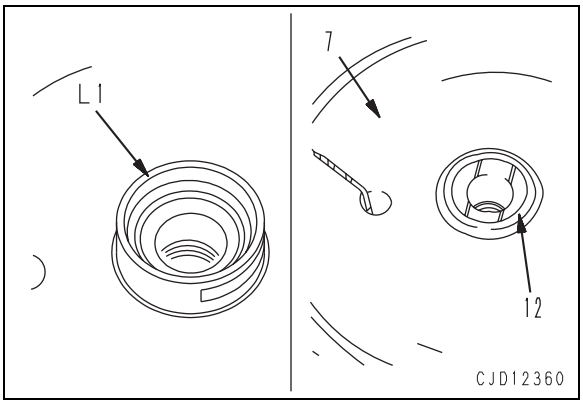
3. Drive bolt (15) and tighten nut (14).
Mounting nut:
157 – 255 Nm {16 – 26 kgm}



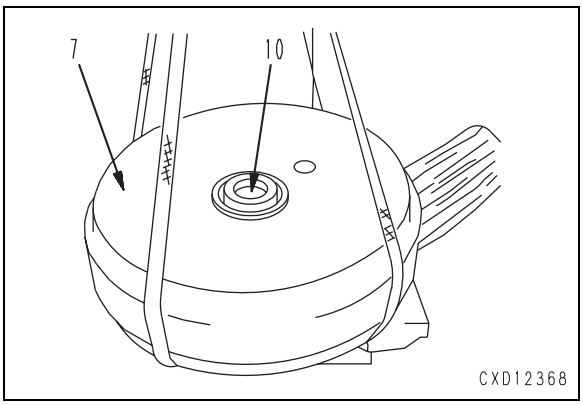
4. Using tool **L1**, install floating seal (13) to shaft and support assembly (10), and then install the O-ring to shaft (17).
- ★ Degrease the O-ring and O-ring fitting surfaces thoroughly and dry them before installing.
- ★ After installing the floating seal, check that its slant is less than 1 mm.

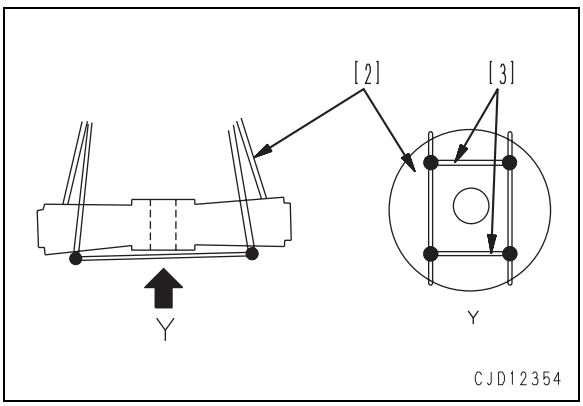


5. Using tool **L1**, install floating seal (12) to idler (7).
- ★ Degrease the O-ring and O-ring fitting surfaces thoroughly and dry them before installing.
- ★ After installing the floating seal, check that its slant is less than 1 mm.

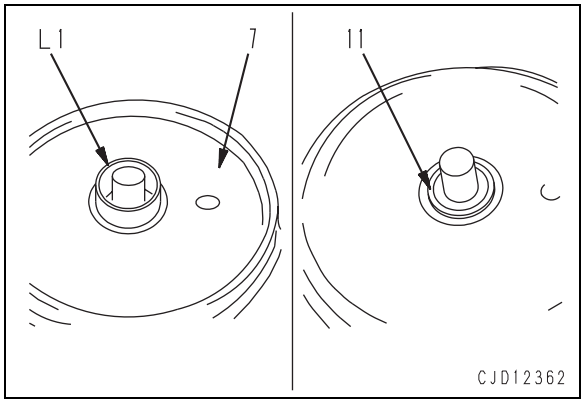


6. Sling idler (7) and install it to shaft support assembly (10).





7. Using tool **L1**, install floating seal (11) to idler (7).
- ★ Degrease the O-ring and O-ring fitting surfaces thoroughly and dry them before installing.
- ★ After installing the floating seal, check that its slant is less than 1 mm.

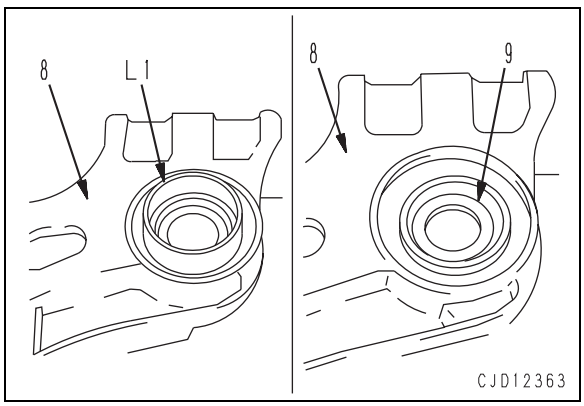


8. Refill the idler with oil.
- ★ The idler may be refilled with oil at this time. For the ordinary method of refilling with oil, see REFILLING WITH OIL.

Idler: Approx. **0.33 – 0.37** ℓ

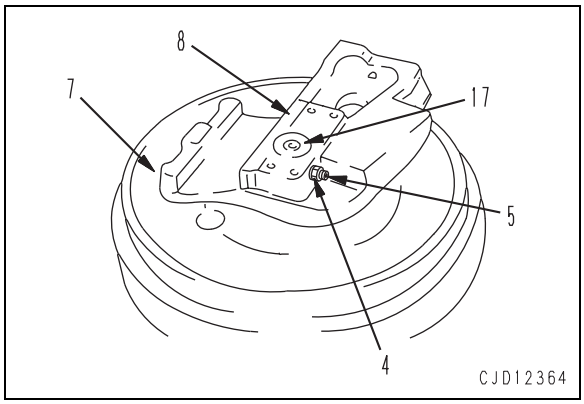
Oil fill plug: **157 – 255 Nm {16 – 26 kgm}**

9. Using tool **L1**, install floating seal (9) to support (8).
- ★ Degrease the O-ring and O-ring fitting surfaces thoroughly and dry them before installing.
- ★ After installing the floating seal, check that its slant is less than 1 mm.



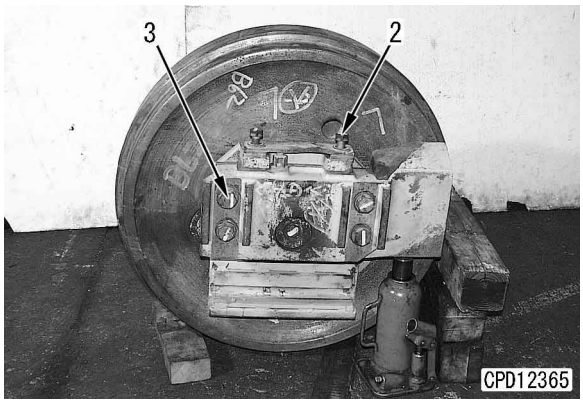
10. Install support (8) to idler (7).
★ When installing shaft (17), match its groove to the groove of the support.

11. Drive bolt (5) and tighten nut (4).
Mounting nut:
157 – 255 Nm {16 – 26 kgm}



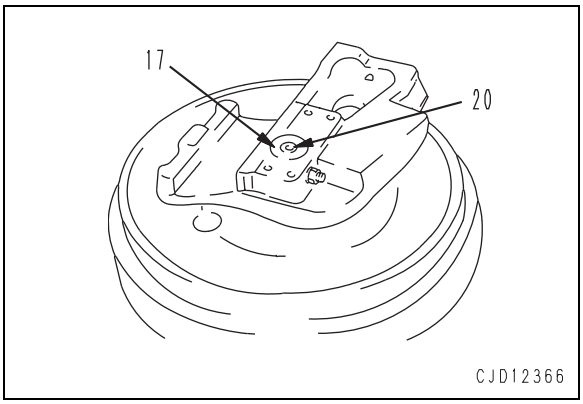
12. Set the shim and install support mounting bolts (3).

13. Set the shim and install spring seat clamping bolts (2).

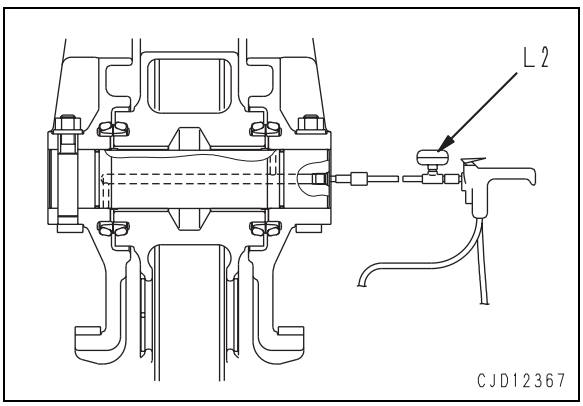


14. Refilling with oil

- **Ordinary method of refilling with oil**
  Remove plug (20) from shaft (17), add oil through the oil filler, and tighten plug (20).
  Idler: **Approx. 0.33 – 0.37 ℓ**
  Oil filler plug:
  157 – 255 Nm {16 – 26 kgm}



- **Filling with oil by evacuation**
  1) Remove plug (20) from shaft (17).
  2) Using tool **L2**, add oil through the oil filler and tighten plug (2).
  Idler: **Approx. 0.33 – 0.37 ℓ**
  Oil filler plug:
  157 – 255 Nm {16 - 26 kgm}



REMOVAL AND INSTALLATION OF RECOIL SPRING ASSEMBLY

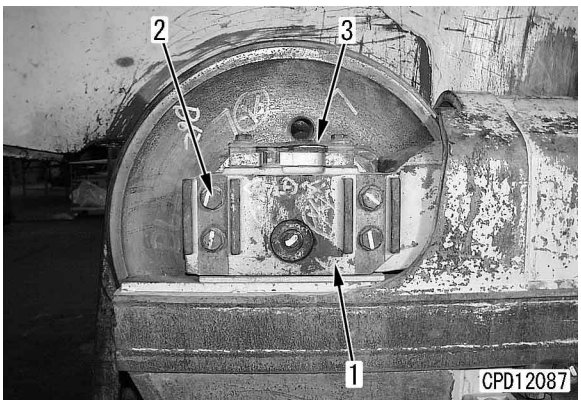
REMOVAL

⚠ Never stand in front of the idler assembly to prevent danger.

1. Remove the blade assembly. For details, see REMOVAL OF BLADE ASSEMBLY.

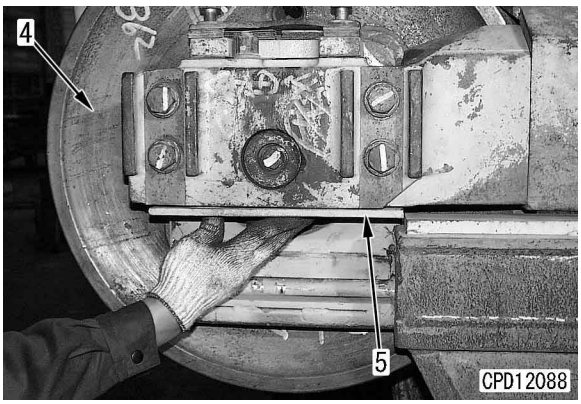
2. Expand the track shoe assembly. For details, see EXPANDING TRACK SHOE ASSEMBLY.

3. Loosen mounting bolts (2) of support (1) and spring seat clamping bolts and remove plate (3).

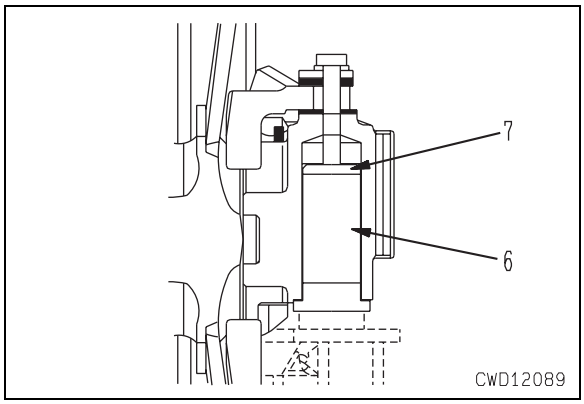


4. Pass wires through the hanging holes of idler assembly (4). Sling idler assembly (4) and slide it out forward along the top of the track frame.

5. Remove guide plate (5).

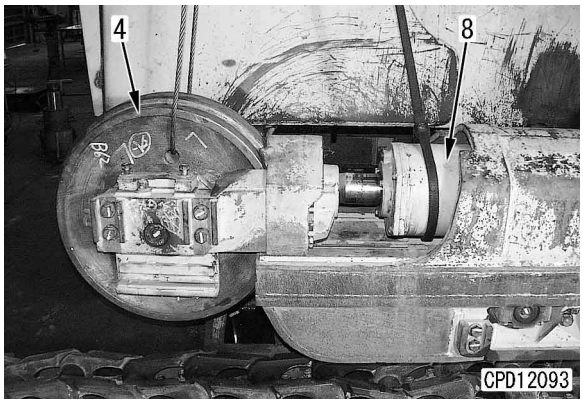


6. Remove spring (6) and seat (7).



7. Slide idler assembly (4) further and install wires on spring case (8) side, and then slide the assembly forward to remove.

Idler and recoil spring assembly: **640 kg**

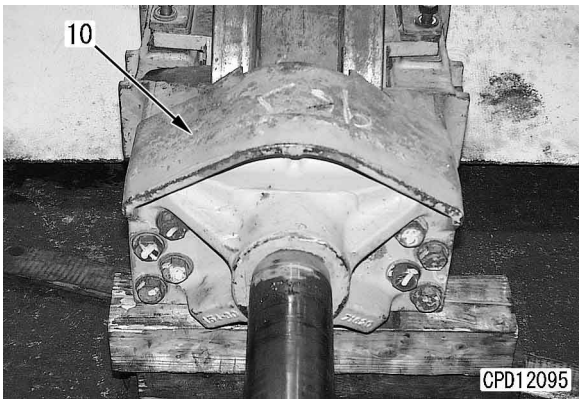


8. Set idler and recoil spring assembly (9).

⚠ Take measures to prevent the idler assembly from leaning for safety.

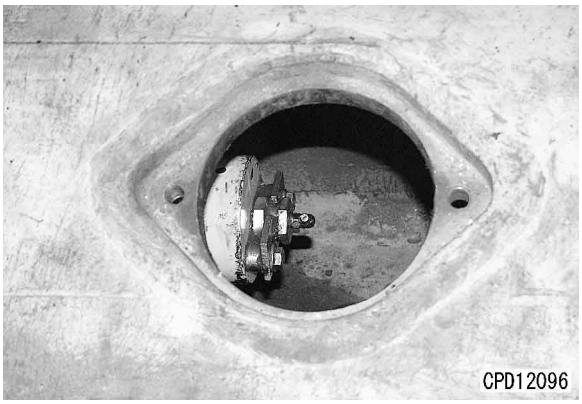
Idler assembly: **290 kg**

5. Remove the mounting bolts and yoke (10).
   Recoil spring assembly: **350 kg**



INSTALLATION

- Carry out installation in the reverse order to removal.
  - ★ Install the idler assembly to the chassis with the oil filler plug on the left side of the chassis.
  - ★ When installing the idler and recoil spring assembly to the chassis, check it through the lubricator adjustment window.



DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING ASSEMBLY

SPECIAL TOOLS

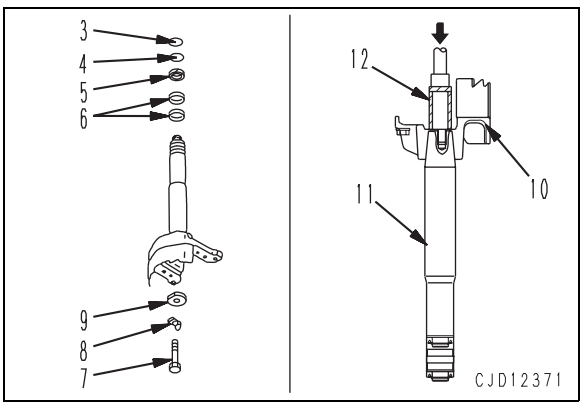
Symbol	Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
M1	791-685-8006	Compressor	■	1		
	791-635-3160	Extension	■	1		
	791T-630-2610	Spacer	■	1	N	○
	790-101-1300	Cylinder	■	1		
	790-101-1102	Hydraulic pump	■	1		

DISASSEMBLY

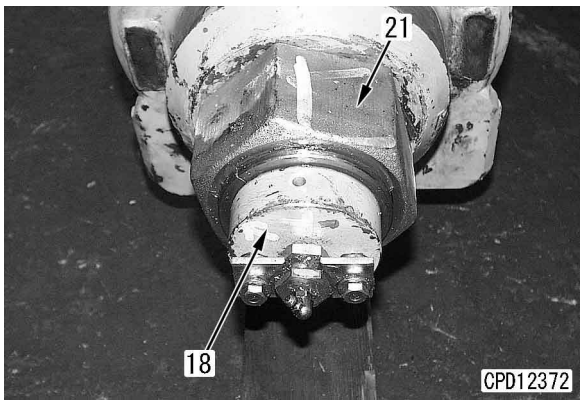
1. Remove yoke and piston assembly (2) from recoil spring assembly (1).

2. Disassembly of yoke and piston assembly

1) Remove snap ring (3), ring (4), packing (5), and ring (6).
2) Remove bolt (7), plate (8), and washer (9).
3) Using push tool (12) and a press, pull piston (11) out of yoke (10).

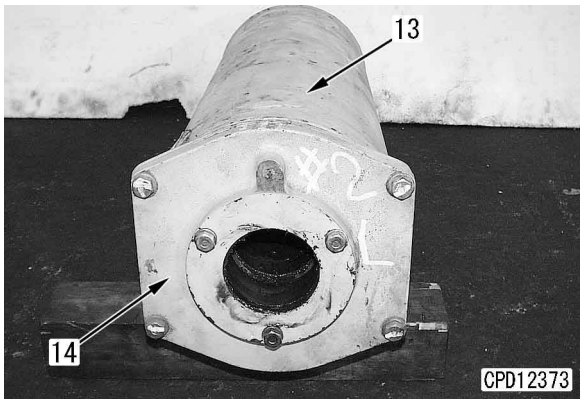


- If cylinder (18) is not broken and shaft end nut (21) is not lost, disassemble the yoke and piston assembly according to the following procedure.



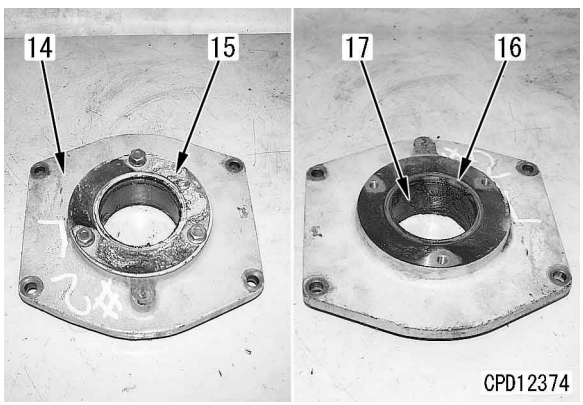
3. Remove holder (14) from recoil spring case (13).

⚠ Never stand in front or in the rear of the recoil spring assembly to prevent danger.

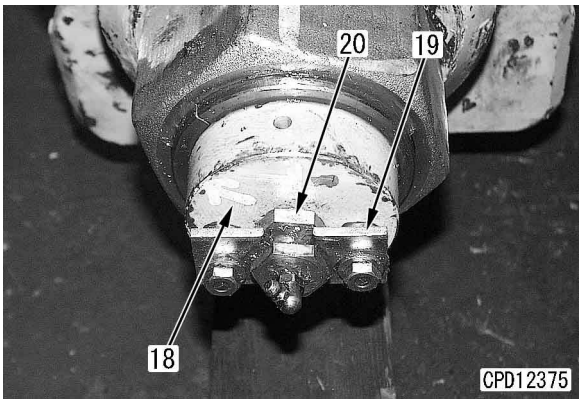


4. Disassembly of holder

1) Remove cover (15) from holder (14).
2) Remove seal (16) and bushing (17) from holder (14).



5. Remove lock plate (19) form cylinder (18), and then remove lubricator (20).



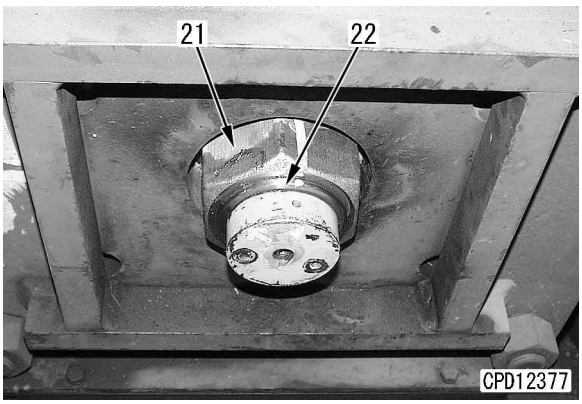
6. Set recoil spring assembly (1) to tool **M1**.

⚠ Set the spring securely since its installed load is large.

★ Installed load of spring: 23.2 kN {23,200 kg}

7. Apply hydraulic pressure to tool **M1** slowly to compress the spring, tighten nut (21) until spacer (22) can be removed, and remove the spacer.

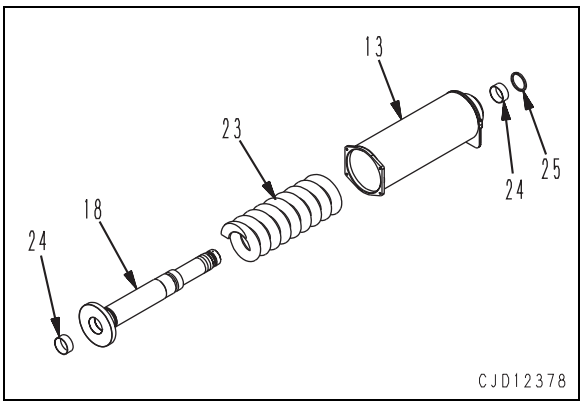
8. Remove nut (21) and reduce the hydraulic pressure slowly to release the spring.



9. Take recoil spring (23) and cylinder (18) out of recoil spring case (13).

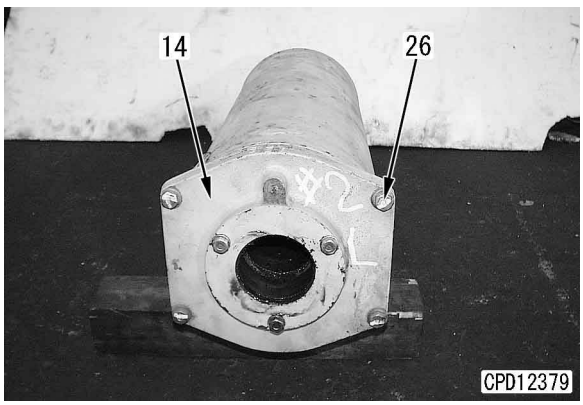
10. Remove bushing (24) from cylinder (18).

11. Remove seal (25) and bushing (24) from recoil spring case (13).



- When cylinder (18) is broken of shaft end nut (21) is lost, if mounting bolt (26) of holder (14) is removed, recoil spring (23) flies forward. Accordingly, disassemble according to the following procedure in this case.

⚠ Never stand in front or in the rear of the recoil spring assembly to prevent danger until holder (14) and recoil spring case (13) are separated and the recoil spring is taken out and safety is confirmed.



1) Set recoil spring assembly (1) to tool **M1**.

⚠ Set the spring securely since its installed load is large.

★ Installed load of spring: 23.2 kN {23,200 kg}

2) Apply hydraulic pressure slowly to secure recoil spring assembly (1).

3) Remove mounting bolt (26) of holder (14) under the condition in step 2).
4) Reduce the hydraulic pressure slowly to release the spring.

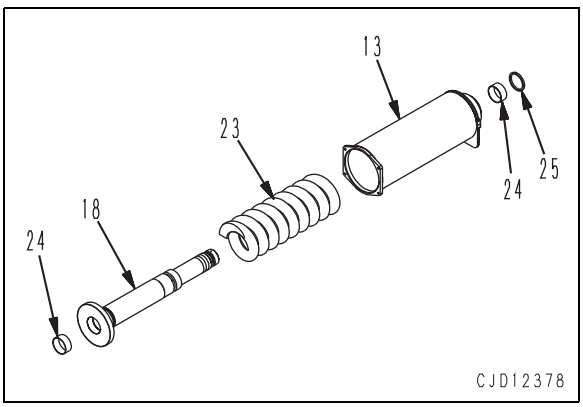
ASSEMBLY

1. Using the push tool, press fit bushing (24) to recoil spring case (13) and install seal (25).
- Press fitting force for bushing:
  19.6 – 29.4 kN {2.0 – 3.0 tons}

Bushing: **Grease (G2-LI)**

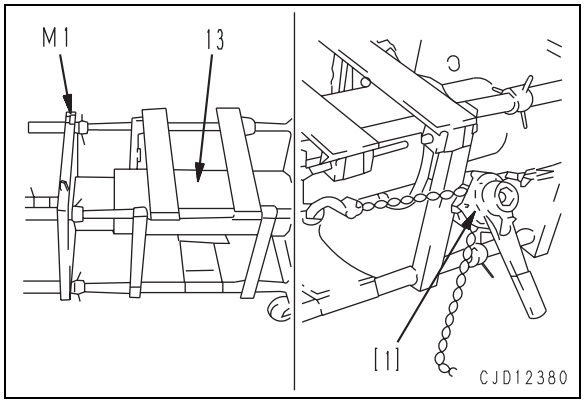
2. Using the push tool, press fit bushing (24) to cylinder (18).
- Press fitting force for bushing:
  19.6 – 29.4 kN {2.0 – 3.0 tons}

Bushing: **Grease (G2-LI)**

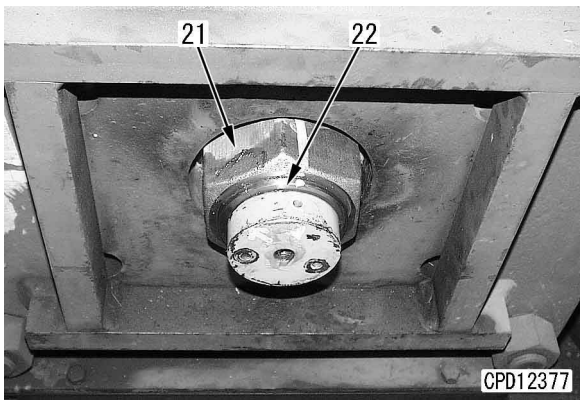


3. Install recoil spring (23) and cylinder (18) to recoil spring case (13) temporarily and set tool **M1**.

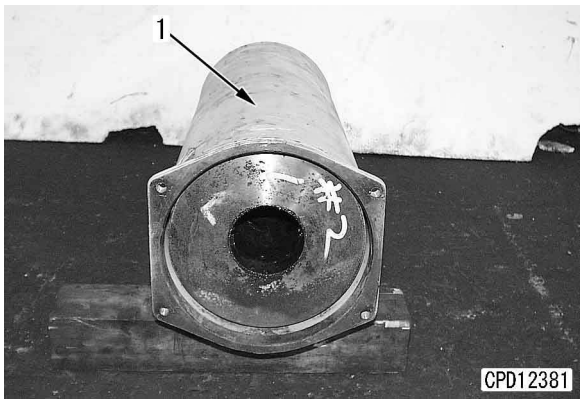
⚠ Set the spring securely since its installed load is large.
★ Installed load of spring:
227.5 kN {23.2 tons}
★ When compressing the spring, align it with the other parts by using lever block [1], etc. so that the threads will not be damaged.
★ Installed length of spring: 651 mm



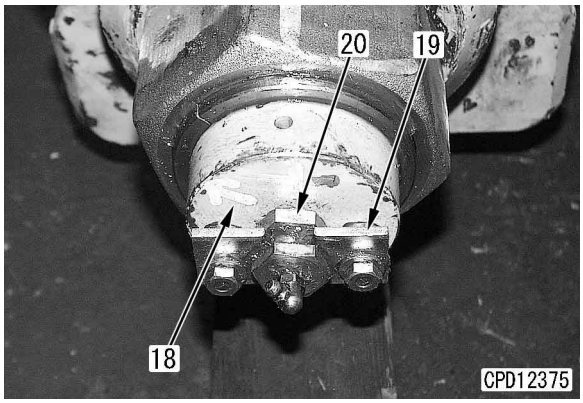
4. Install nut (21) and spacer (22).



5. Reduce the hydraulic pressure slowly to eliminate the spring tension, and then remove recoil spring assembly (1) from tool **M1**.



6. Install lubricator (20) to cylinder (18), and then install lock plate (19).

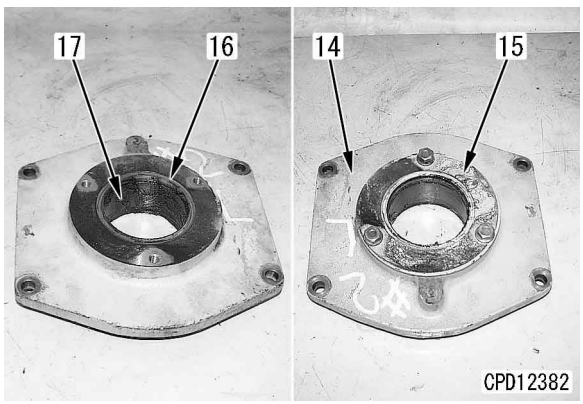


7. Assembly of holder

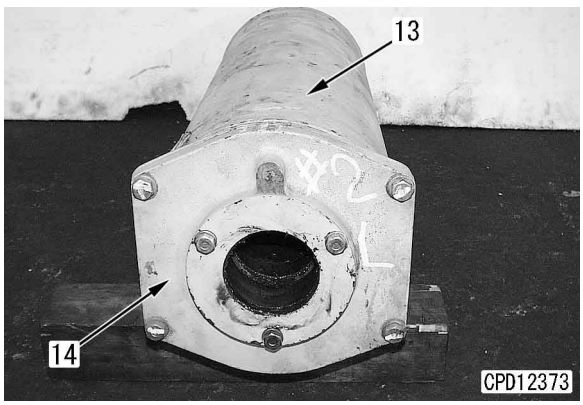
1) Press fit bushing (17) to holder (14) and install seal (16).
   - Press fitting force for bushing:
     19.6 – 29.4 kN {2.0 – 3.0 tons}

   Bushing and oil seal: **Grease (G2-LI)**

2) Install cover (15) to holder (14).



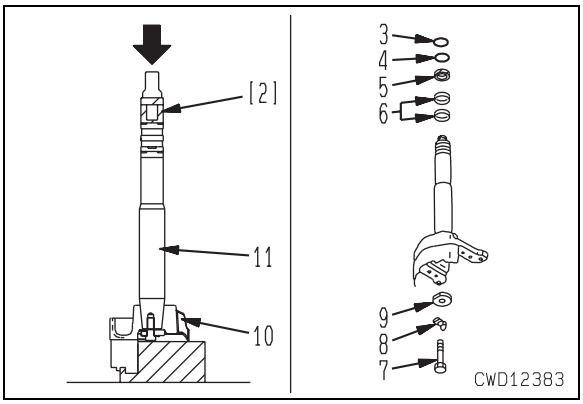
8. Install holder (14) to recoil spring case (13).



9. Assembly of yoke and piston assembly

1) Using push tool [2] and a press, press fit piston (11) to yoke (10).
   - Press fitting force for yoke:
     392 kN {40 tons}
2) Install washer (9) and plate (8) and tighten bolt (7).
   ★ Bend washer (9) securely.
3) Install ring (6), packing (5), ring (4), and snap ring (3).

   Packing and ring: **Grease (G2-LI)**



10. Install yoke and piston assembly (2) to recoil spring assembly (1).

REMOVAL AND INSTALLATION OF TRACK ROLLER ASSEMBLY

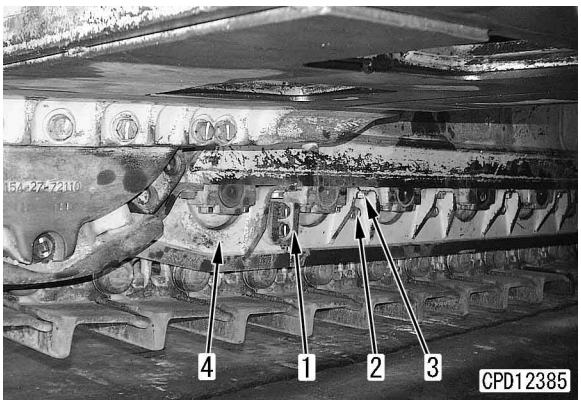
REMOVAL

1. Loosen the track shoe assembly. For details, see EXPANDING TRACK SHOE ASSEMBLY.

2. Remove 2 retainers (1) in the track frame and the 5 nuts of guard tension bolts (2). [*1]

3. Remove the 5 mounting bolts and track roller guard (3). [*2]

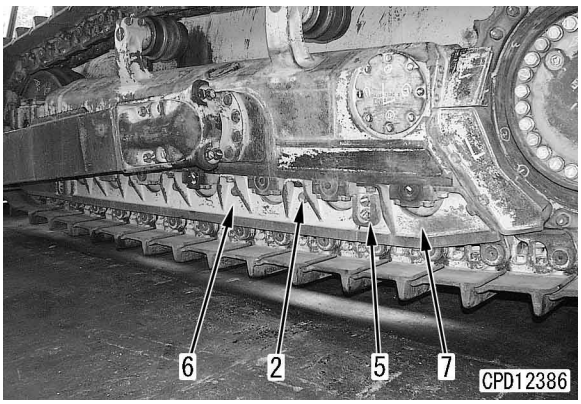
4. Remove the mounting bolts and rear roller guard (4). [*3]



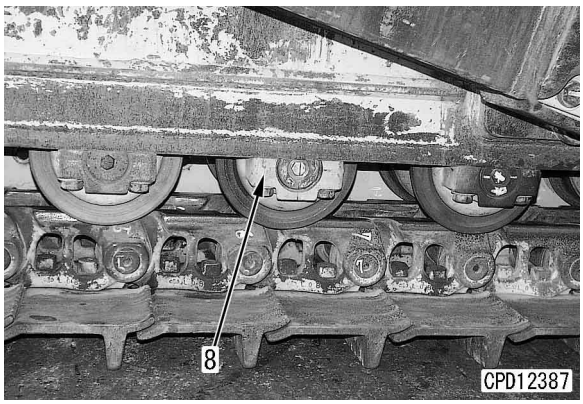
5. Remove guard tension bolt (2).
   ★ Take care of the guide spacer on the inside.

6. Remove 2 retainers (5) on the outside of the track frame, and then remove the 5 mounting bolts and track roller guard (6). [*4]

7. Remove the mounting bolts and rear roller guard (7). [*5]



8. Remove the mounting bolts of track roller assembly (8).



9. Start the engine and raise the chassis by operating the blade or ripper or by using a hydraulic jack and leave the track roller assembly on the track link.

   ⚠ When raising the chassis, be sure to apply the brake and lock the work equipment control lever. After raising the chassis, set a block on the track link to prevent danger.

10. Pull out and remove controller assembly (8).
    ★ Take care of the key on the inside.

    Track roller assembly:
    Single flange; 72 kg
    Double flange; 80 kg

INSTALLATION

- Carry out installation in the reverse order to removal.
  ★ Install the track roller assembly with the oil filler plug on the outside of the chassis.

[*1] [*2] [*3] [*4] [*5]

Mounting bolt:
471 – 829 Nm {48 – 84.5 kgm}

- Adjust the track shoe assembly tension. For details, see ADJUSTING TRACK SHOE ASSEMBLY TENSION.

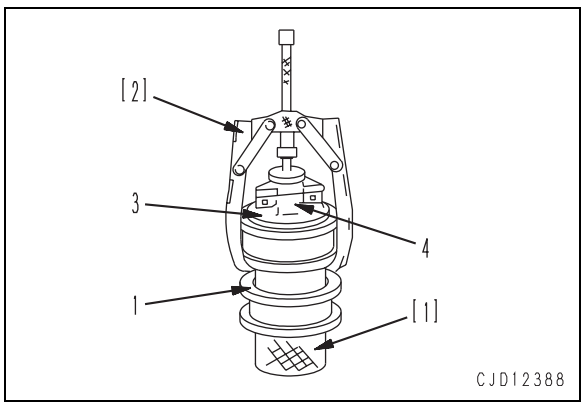
DISASSEMBLY AND ASSEMBLY OF TRACK ROLLER ASSEMBLY

SPECIAL TOOLS

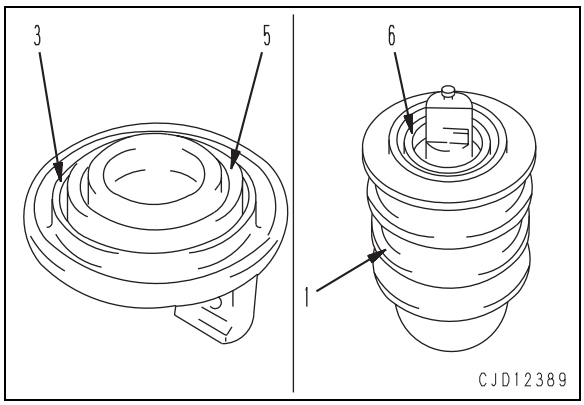
Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
N	1	791-651-1510	Installer	■	1		
	2	791-601-1000	Oil pump	■	1		

DISASSEMBLY

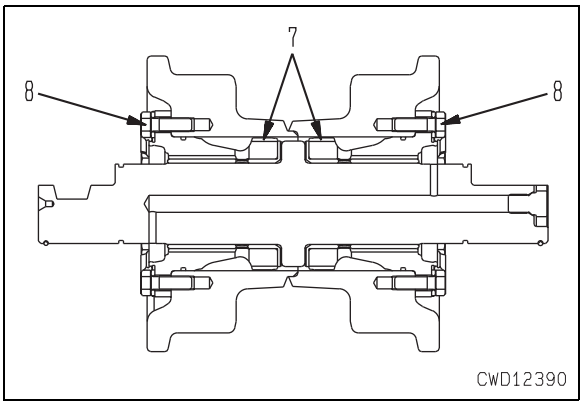
1. Remove the oil filler plug and drain the oil.
   Idler: **0.26 – 0.29** ℓ
2. Set track roller assembly (1) on the block [1]. Using push puller [2], push in collar (3) and then remove ring (4) and collar (3).



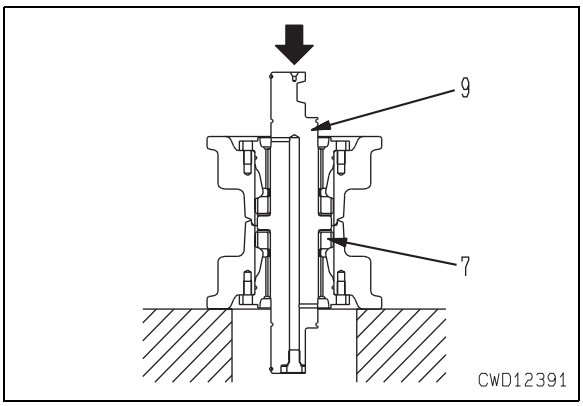
3. Remove floating seal (5) from collar (3).
4. Remove floating seal (6) and O-ring from track roller assembly (1).



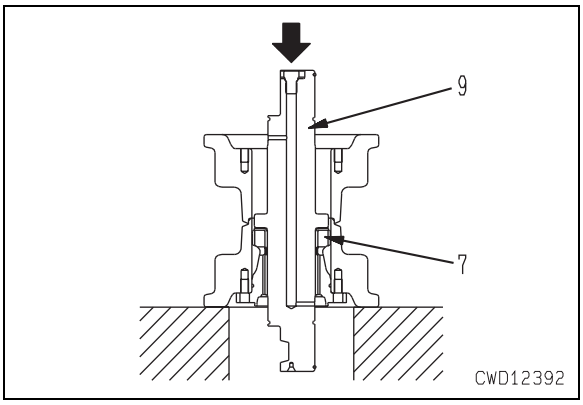
5. Remove collar (3), floating seal (5), (6) and O-ring on the opposite side, similarly to steps 2) – 4).
6. Remove mounting bolt (8) of bushing (7).



7. Set track roller assembly (1) on a block and push the end of shaft (9) to pull out bushing (7) and remove the O-ring.



8. Turn over track roller assembly (1) and set it on the block and push the end of shaft (9) to pull out bushing (7) and remove the O-ring on the opposite side.

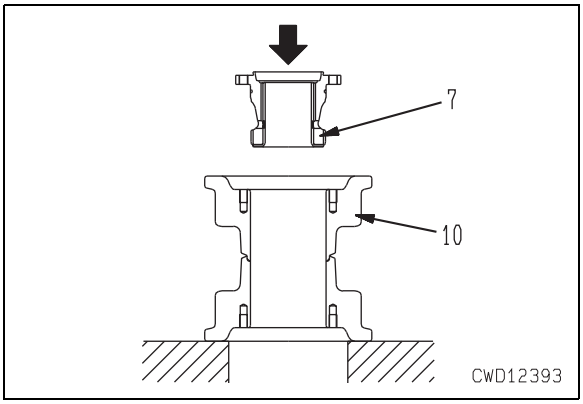


ASSEMBLY

★ Clean the all parts and check them for dirt or damage before installing.

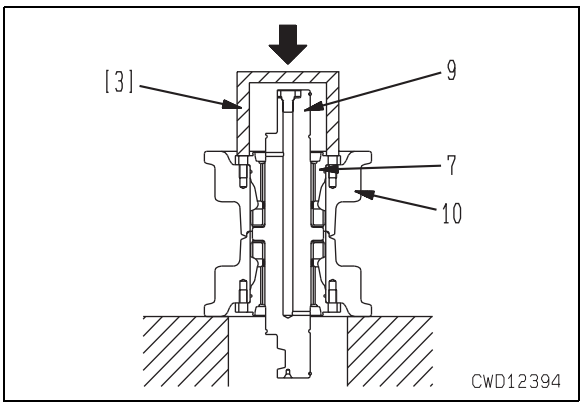
1. Set track roller (10) on a block.

2. Install the O-ring to bushing (7) and press fit them to track roller (10).
   ★ When installing the bushing, match it to the bolt hole of the track roller.
   Periphery of bushing:
   Gear oil (G0140)

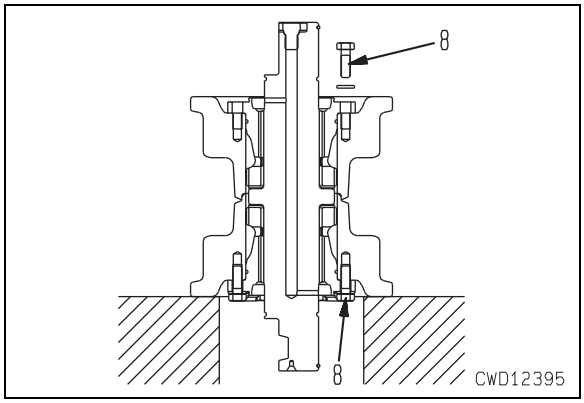


3. Turn over track roller (10) and set it on the block and insert shaft (9).

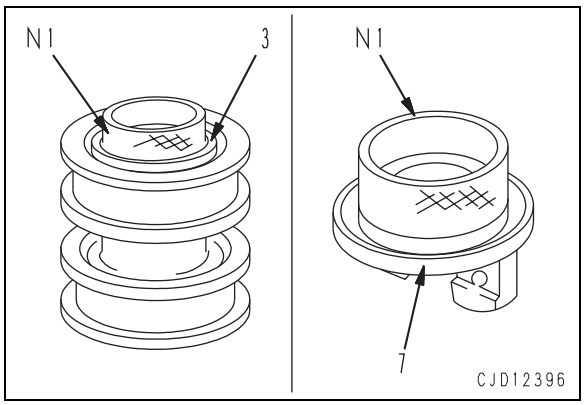
4. Install the O-ring to bushing (7) and using the push tool [3], press fit them to track roller (10).
   ★ When installing the bushing, match it to the bolt hole of the track roller.
   Periphery of bushing:
   Gear oil (G0140)



5. Install mounting bolt (8) of bushing (7).
   Initial torque: **49 ± 10 Nm {5 ± 1 kgm}**
   ★ After tightening, retighten by 90° ± 5°
   Mounting bolt:
   Molybdenum disulfide (LM-P)

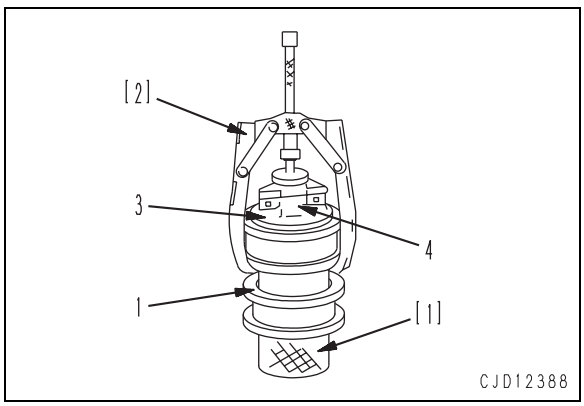


6. Using tool **N1**, install floating seal (5) to bushing (7) and collar (3).
   ★ Clean and degrease the O-ring and O-ring fitting surfaces thoroughly and dry them before installing.
   ★ After installing the floating seal, check that its slant is less than 1 mm.



7. Install the O-ring to shaft (9).
   ★ Take care not to damage the O-ring.
   Up to collar mounting portion of shaft:
   Molybdenum disulfide (LM-P)

8. Set track roller assembly (1) on the block [1]. Using push puller [2], push in collar (3) and install ring (4).

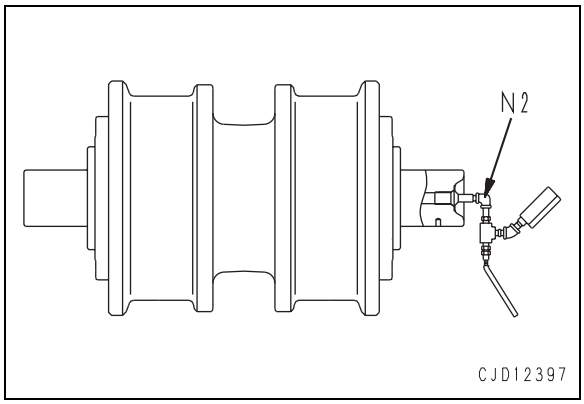


9. Turn over track roller assembly (1) and set it on the block, and then perform steps 7) – 8) on the opposite side.

10. Using tool **N2**, add oil through the oil filler and tighten the oil filler plug.

    Track roller: **Approx. 0.26 – 0.29 ℓ**

    Oil filler plug:
    157 – 255 Nm {16 – 26 kgm}

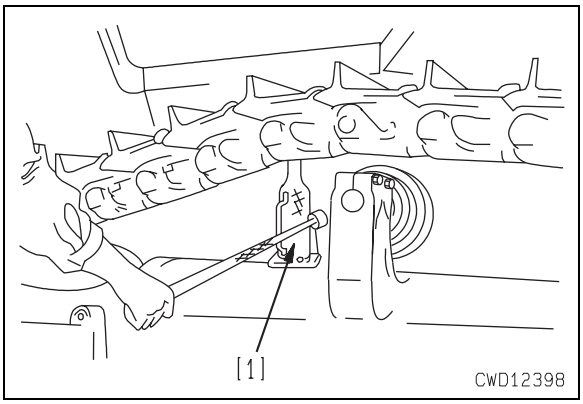


REMOVAL AND INSTALLATION OF CARRIER ROLLER ASSEMBLY

REMOVAL

1. Loosen the track shoe assembly. For details, see EXPANDING TRACK SHOE ASSEMBLY.

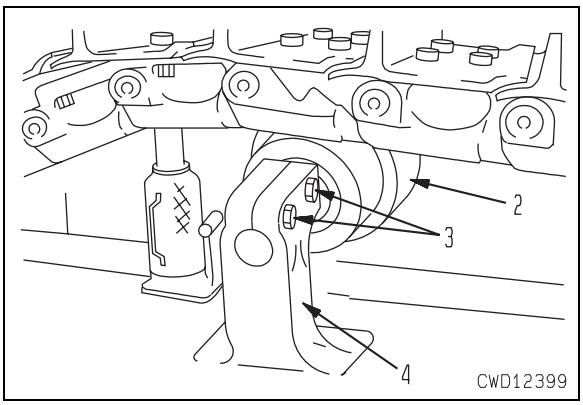
2. Using hydraulic jack [1], raise the track shoe.



3. Remove mounting bolts (3) of carrier roller assembly (2).

4. Sling carrier roller assembly (2) and remove it from support (4).

   Carrier roller assembly: **39 kg**



INSTALLATION

- Carry out installation in the reverse order to removal.

- Adjust the track shoe assembly tension. For details, see ADJUSTING TRACK SHOE ASSEMBLY TENSION.

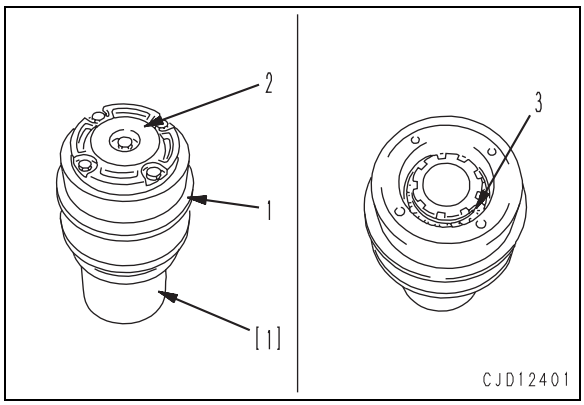
DISASSEMBLY AND ASSEMBLY OF CARRIER ROLLER ASSEMBLY

SPECIAL TOOLS

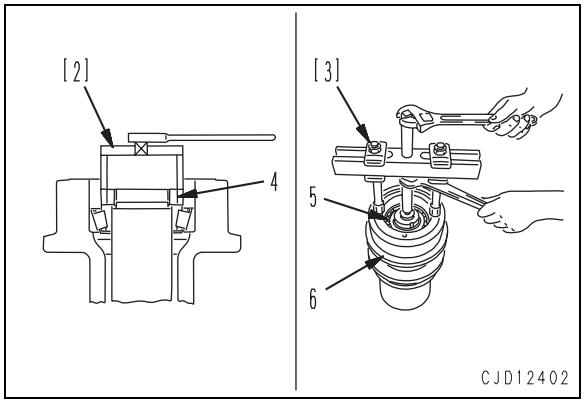
Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
N	1	791-651-1510	Installer	■	1		
	2	791-601-1000	Oil pump	■	1		

DISASSEMBLY

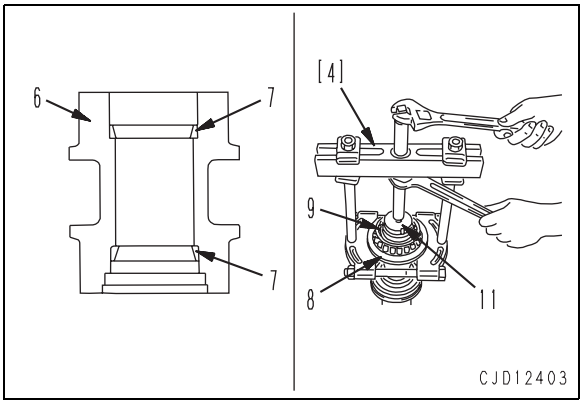
1. Remove the oil filler plug and drain the oil.
   Idler: **0.47 – 0.53** ℓ
2. Set carrier roller assembly (1) on a block [1].
3. Remove the mounting bolts, cover (2), and O-ring.
4. Remove ring (3).



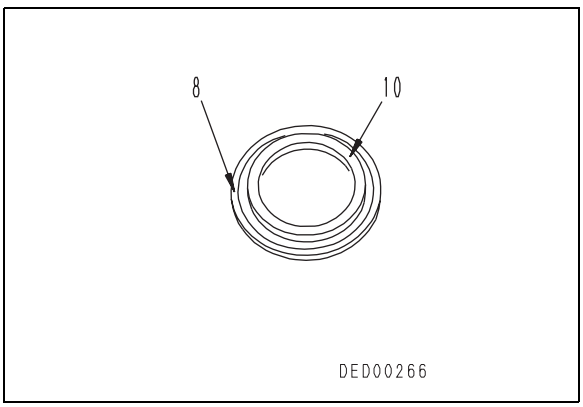
5. Using tool [2], remove nut (4).
6. Using puller [3], remove the fitted part of the bearing. Then, using eyebolts, remove bearing (5) and carrier roller (6) together.



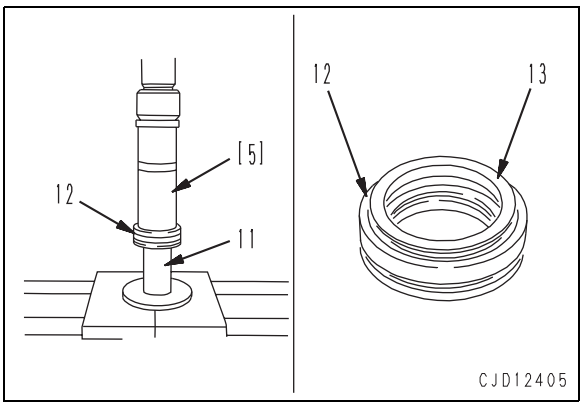
7. Remove outer race (7) of the bearing from carrier roller (6).
8. Using puller [4], remove collar (8) and bearing inner race (9) together from shaft (11).



9. Remove floating seal (10) from collar (8).



10. Using push tool [5], remove ring (12) from shaft (11).
11. Remove floating seal (13) from ring (12).

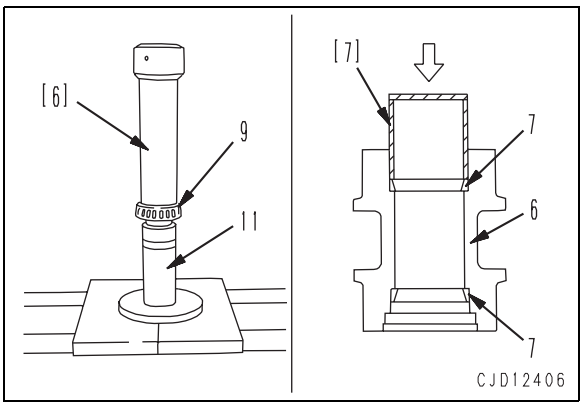


ASSEMBLY

★ Clean the all parts and check them for dirt or damage before installing.

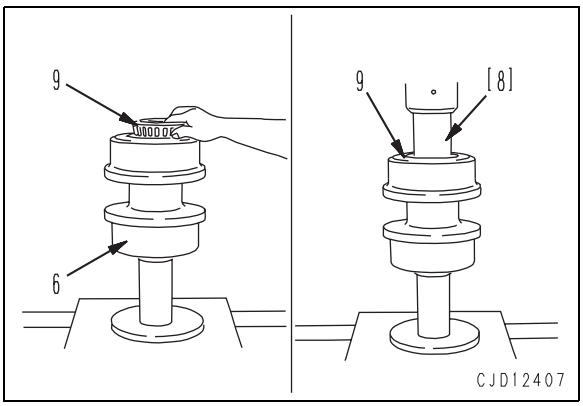
1. Using push tool [6], press fit bearing inner race (9) to shaft (11).

2. Using push tool [7], press fit bearing outer race (7) to carrier roller (6).



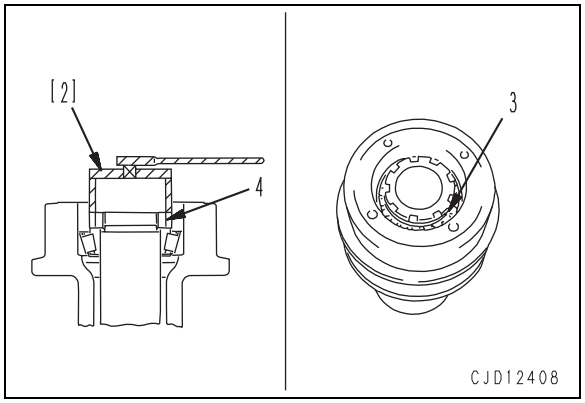
3. Set carrier roller (6) and bearing inner race (9) to shaft (11).

4. Using push tool [8], press fit bearing inner race (9).

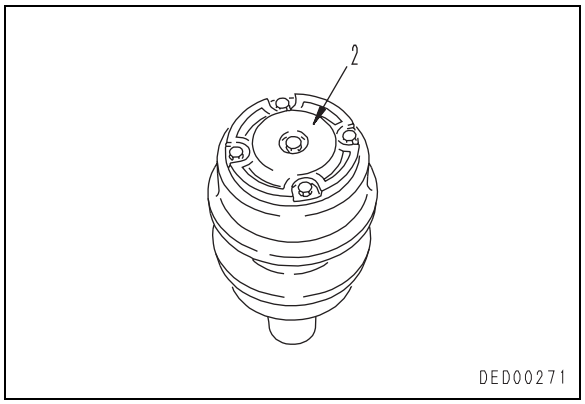


5. Using tool [2], tighten nut (4).
   Nut: **98 Nm {10 kgm}**
   ★ After nut (4) is tightened, if its hole is not matched to the hole on the shaft side, loosen it until the holes are aligned.

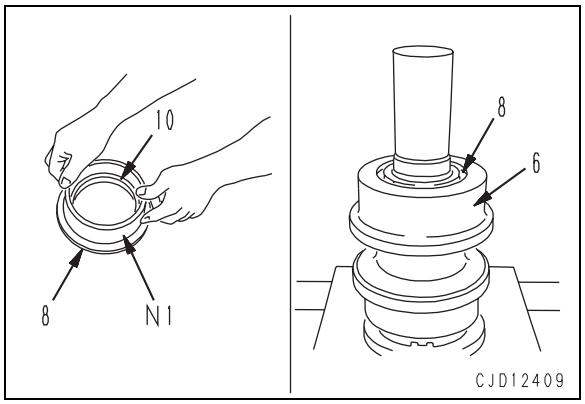
6. Install ring (3).
   ★ Check that the end play (clearance between the bearing and nut) is 0 – 0.22 mm.



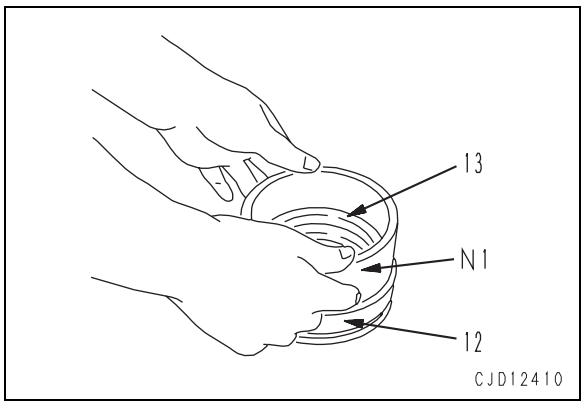
7. Install the O-ring and cover (2).



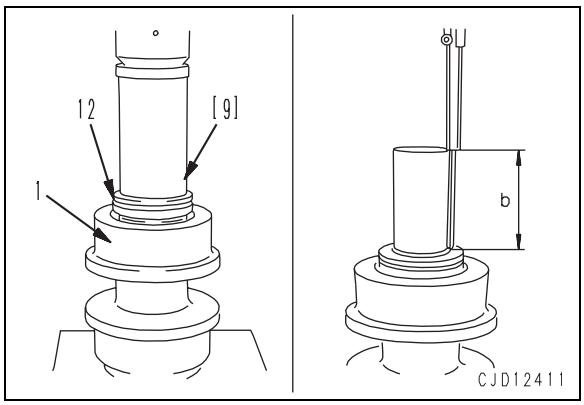
8. Using tool **N1**, install floating seal (10) to collar (8).
   ★ Clean and degrease the O-ring and O-ring fitting surfaces thoroughly and dry them before installing.
   ★ After installing the floating seal, check that its slant is less than 1 mm.
9. Fit the O-ring to collar (8) and install them to carrier roller (6), matching them to the dowel pin.
   ★ Take care not to damage the O-ring.



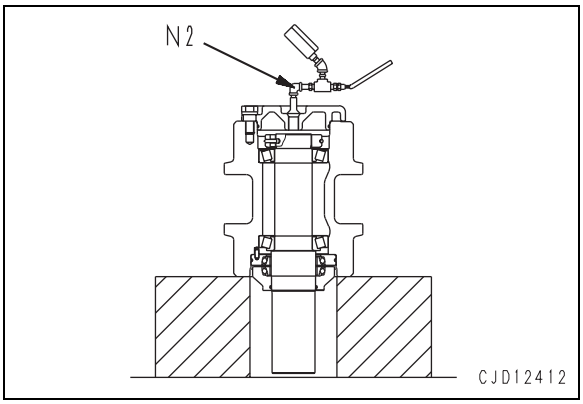
10. Using tool **N1**, install floating seal (13) to ring (12).
    - ★ Clean and degrease the O-ring and O-ring fitting surfaces thoroughly and dry them before installing.
    - ★ After installing the floating seal, check that its slant is less than 1 mm.



11. Using push tool [9], press fit ring (12) to carrier roller assembly (1).
    - Press fitting force for ring:
      40 – 73 kN {4.1 – 7.4 tons}
    - ★ Press fit the ring so that distance **b** between the shaft end and ring top will be 120 ± 0.2 mm.
    - ★ After press fitting the ring, check that its slant from the shaft is less than 0.4 mm.



12. Using tool **N2**, add oil through the oil filler and tighten the oil filler plug.
    - Carrier roller: **Approx. 0.47 – 0.53 ℓ**
    - Oil filler plug:
      157 – 255 Nm {16 – 26 kgm}



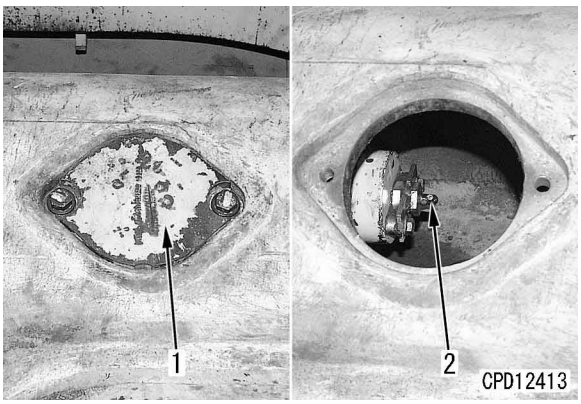
EXPANSION AND INSTALLATION OF TRACK SHOE ASSEMBLY

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.



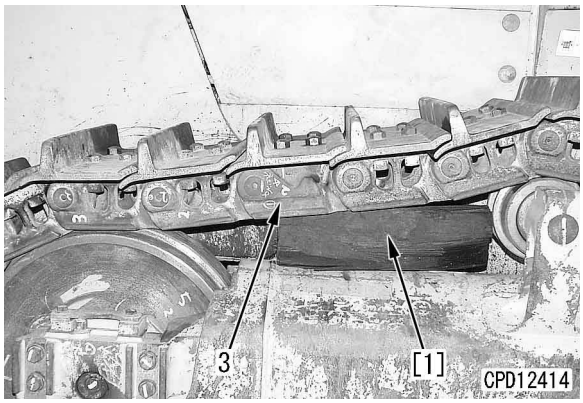
2. After the shoe is loosened, perform EXPANSION OF TRACK SHOE ASSEMBLY (Ordinary).

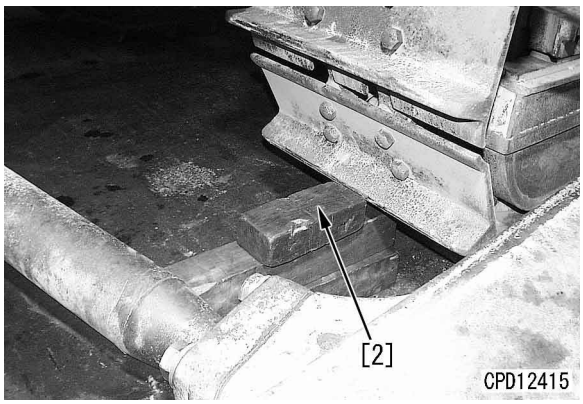
3. If the track shoe is not loosened by the above work, perform EXPANSION OF TRACK SHOE ASSEMBLY (When track frame has internal trouble).
   ★ The track frame may have an internal trouble (damage of the recoil spring or recoil spring set bolt, fall of the shaft end nut, etc.)

EXPANSION OF TRACK SHOE ASSEMBLY (Ordinary)

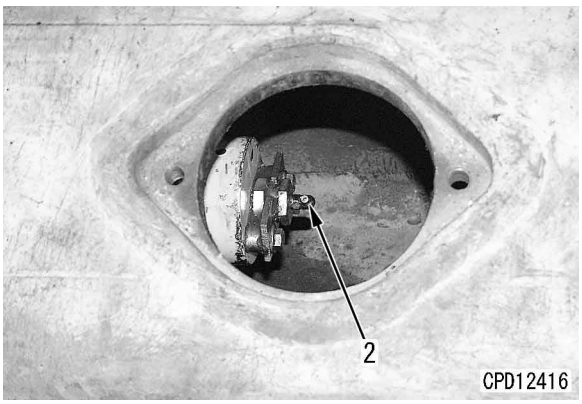
★ If any abnormality is not detected by CHECK BEFORE EXPANDING TRACK SHOE ASSEMBLY, perform the following procedure.

1. Set master link (3) in position.
   ★ Set the master link above the idler (a little after the center of the idler).
   ★ 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.

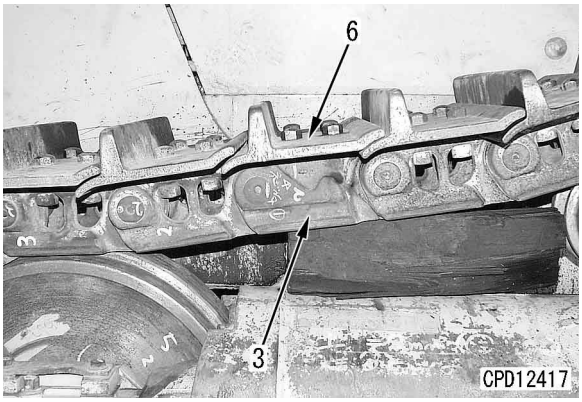




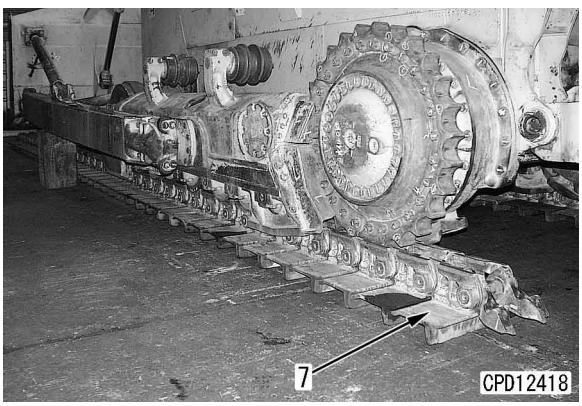
2. Loosen the track shoe. [*1]
   - ⚠ Do not loosen lubricator (2) more than 1 turn.
   - ★ If the track shoe is not loosened after the lubricator is loosened, move the machine forward and in reverse.



3. Remove track shoe (6). [*2]
   - ★ Loosen the 4 bolts by 1 – 2 turns each and check that they rotate lightly, and then pull them out. Do not pull them out one by one without checking their looseness.
   - ★ If the bolts are loosened forcibly while they are still tight, the threads of them and master link (3) may be damaged.



4. Sling the front end of the master link and move the machine slowly forward and in reverse to expand track shoe assembly (7).
   - ★ Length of track shoe: Approx. 10.5 m

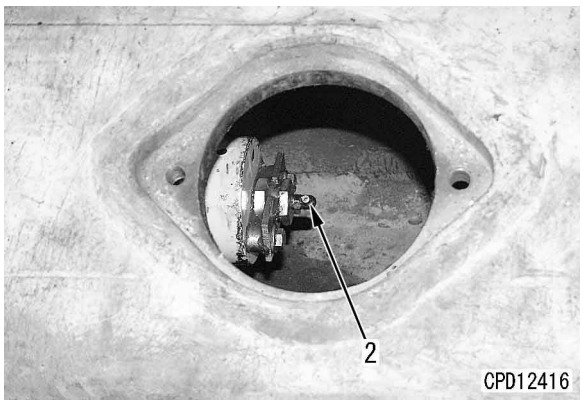


EXPANSION OF TRACK SHOE ASSEMBLY (When track frame has internal trouble)

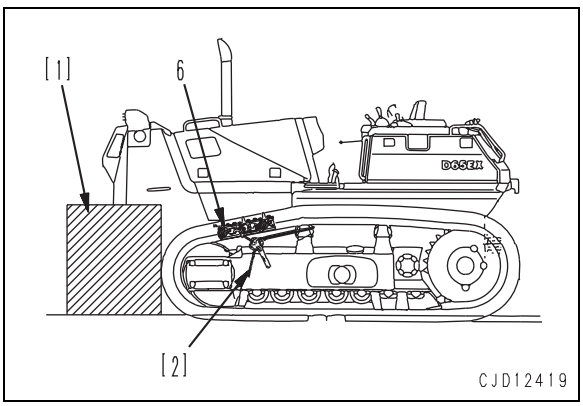
- ★ If any abnormality is detected by Check before expanding track shoe assembly, perform the following procedure.

⚠ 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.

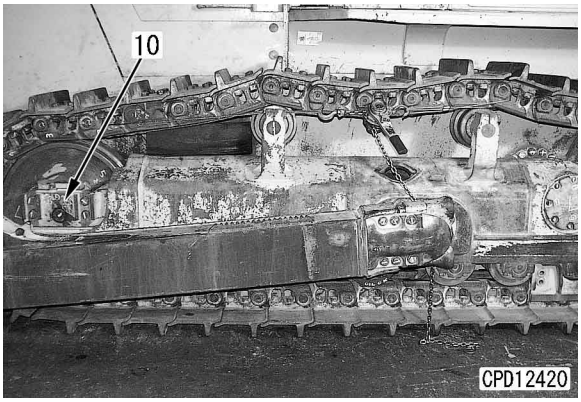
1. Loosen the track shoe. [*1]
   - ⚠ Do not loosen lubricator (2) more than 1 turn.
   - ★ If the track shoe is not loosened after the lubricator is loosened, move the machine forward and in reverse.
   - ★ Check that the all grease has been discharged.



2. Move the machine slowly forward against large block [1] 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.
   At this time, set the master link between the idler and front carrier roller.
   - ★ For safe work, apply lever block [2] between the carrier roller support and link.

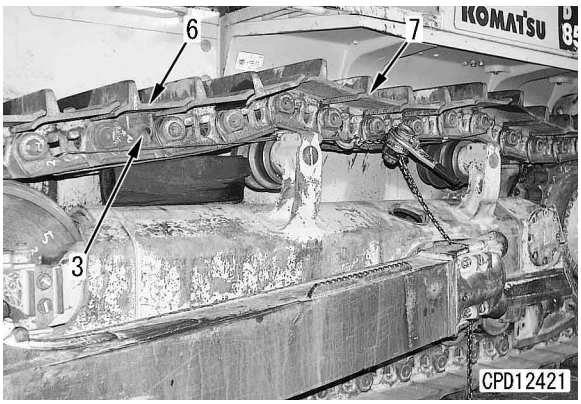


3. Remove idler guide (10).
   ★ Be sure to remove the idler guide at this time. If the track shoe is expanded without removing the idler guide, the idler guide moves forward and is pressed against the track frame. If the idler guide is removed at this time, the idler yoke assembly will jump forward.



4. Remove track shoe (6) and disconnect master link (3). [*2]
   ★ Loosen the 4 bolts by 1 – 2 turns each and check that they rotate lightly, and then pull them out.

5. Move the machine slowly in reverse to expand track shoe assembly (7).



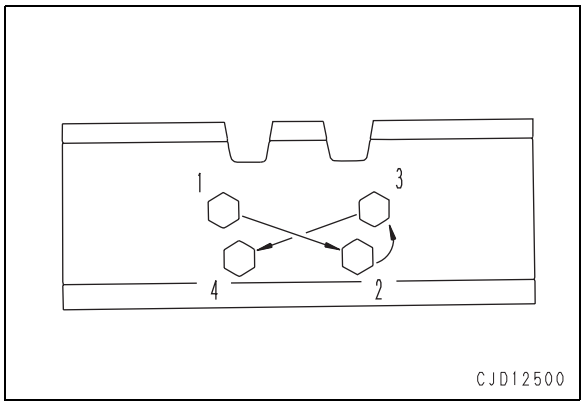
INSTALLATION

- 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.
   Shoe bolt: **Lubricant containing molybdenum disulfide (LM-P)**
   Shoe bolt (Regular link):
   - Single shoe:
     Initial torque: **343 ± 39 Nm {35 ± 4 kgm}**
     Retightening angle: **180° $^{0}_{-20}$**
   - Swamp shoe:
     Initial torque: **490 ± 49 Nm {50 ± 5 kgm}**
     Retightening angle: **180° $^{0}_{-20}$**

   ★ 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.



WHOLE DISASSEMBLY AND ASSEMBLY OF TRACK SHOE

SPECIAL TOOLS

Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
R	1	791-650-3000	Remover and installer	■	1		
		790-101-1300	Cylinder assembly	■	1		
		790-105-2300	Jack assembly	■	1		
		790-101-1102	Hydraulic pump	■	1		
	2	791-650-3500	Remover and installer	■	1		
		791-675-5542	Adapter	■	1		
		791-675-5571	Adapter	■	1		
		790-101-1300	Cylinder assembly	■	1		
		790-105-2300	Jack assembly	■	1		
		790-101-1102	Hydraulic pump	■	1		
	3	791-646-7531	Push tool	■	1		
	4	791-660-7460	Pin puller	■	1		
	5	791-646-7900	Plug push tool	■	1		
		• 790-434-1210	• Bar		1		
		• 790-434-1220	• Guide		1		
		791-646-7523	Bar	■	1		
		791-646-7590	Guide	■	1		
	6	791-632-1060	Installer	■	1		
	7	790-701-3000	Seal checker	■	1		
	8	791-646-8002	Lubricator	■	1		

★ For the whole disassembly of the track shoe, see "Parts judgment guide, Undercarriage, Lubricated track" and "Parts judgment guide, Undercarriage, Reversing procedure for lubricated track".

WHOLE DISASSEMBLY

1. Removal of shoe

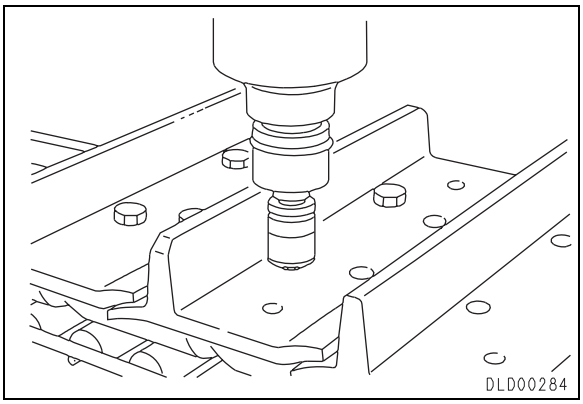
Sling the shoe assembly and set it with the shoe up on the floor and remove the shoe by using a shoe bolt impact wrench.

★ 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, it 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 80°C to prevent thermal deterioration of the seal and take measures to prevent the spatters from entering through the clearances among the links.

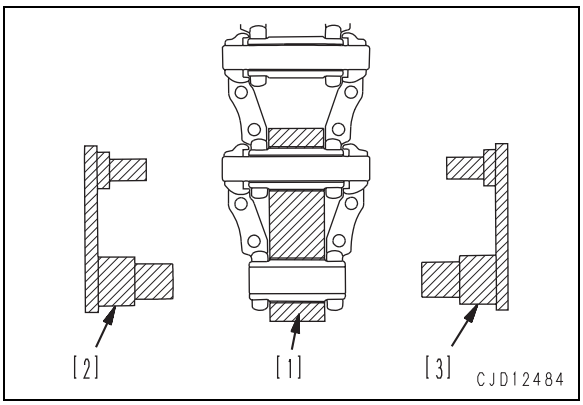


2. Disassembly of link

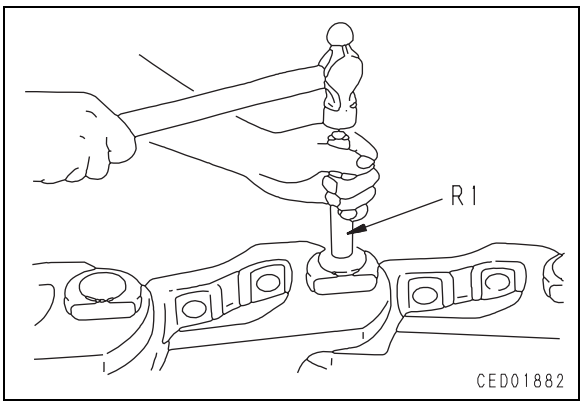
1) Set the link assembly on a link press and hit it with a hammer so that the bushing will be fitted to the jaw [1].

★ If the link tread, outside of the bushing, etc. are worn, adjust the height of jaw [1] or guide plate to align both disassembling jigs [2] and [3] with the pin and bushing so that the link hole will not be damaged when the link is assembled.

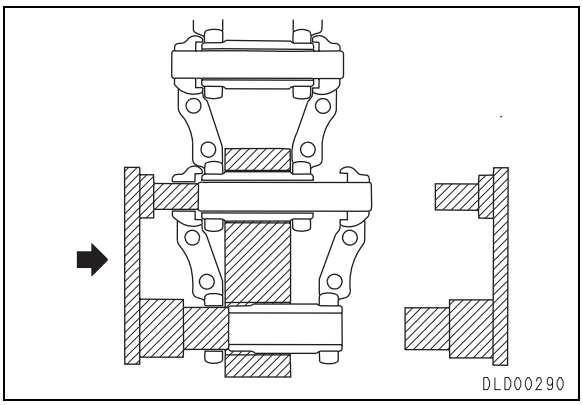
★ If the pin and bushing are not aligned well, the link hole may be damaged and the pin and bushing may be broken during disassembly work.



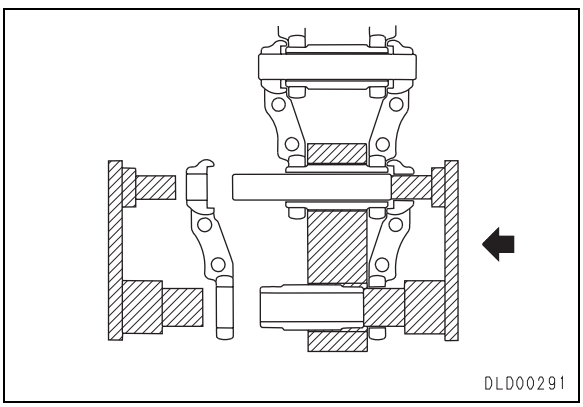
★ Using tool **R1**, drive the small plug of the pin inward after the disassembly work so that the workplace will not become dirty.



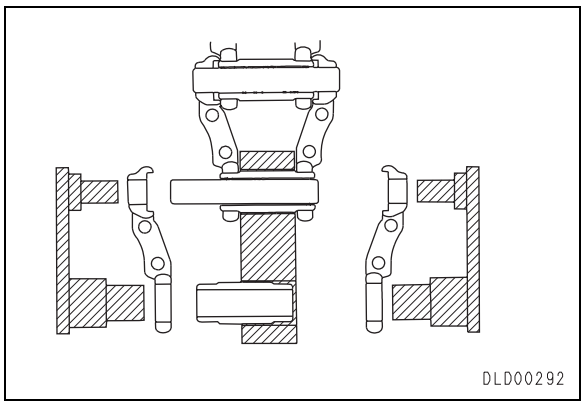
2) Operate the left cylinder to pull out the pin and bushing from the left link simultaneously.
★ Check the pulling out force of the pin and bushing to see if press fitting force for them necessary for reversed reassembly is obtained.



3) Return the left cylinder and operate the right cylinder to pull out the pin and bushing from the right link simultaneously.



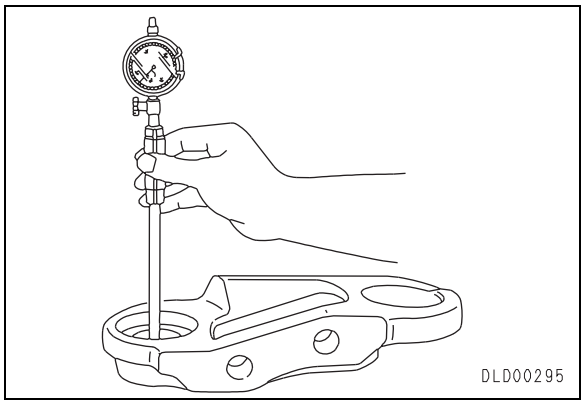
4) Return the right cylinder and take out the links, pins, bushings, and spacers on both sides and feed the next 1 set of the link assembly to the jaw.
★ If the bushing ends and sealing surfaces are damaged, oil will leak. Accordingly, handle them carefully.



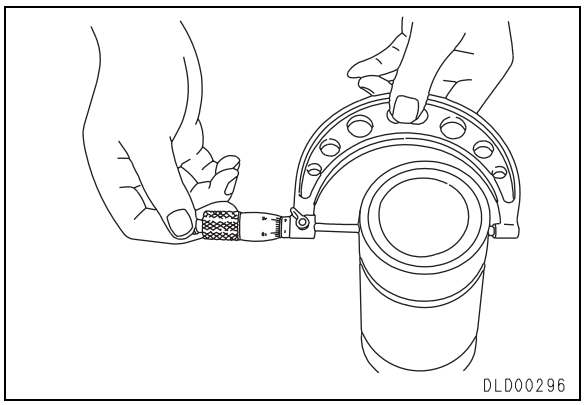
3. Inspection

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 "Parts judgment guide, Undercarriage, Lubricated track".

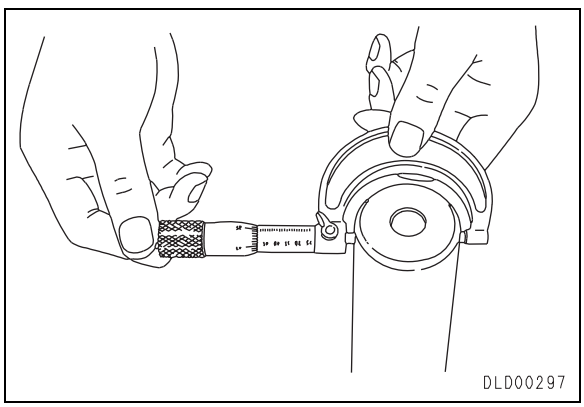
1) Check the parts visually for damage. If a part seems to be damaged, check it by dye penetrant test or magnaflux inspection. If it has any crack, it cannot be used again. Discard it.



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 MAINTENANCE STANDARD.



★ **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.



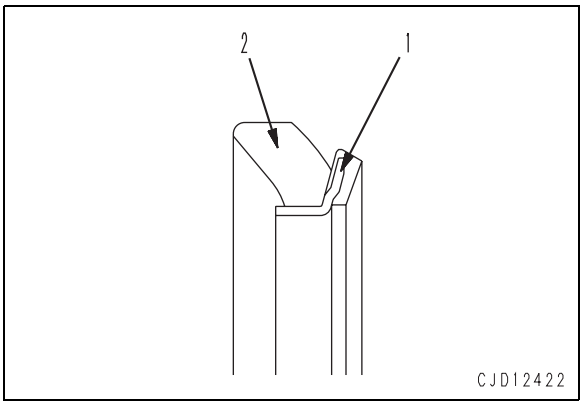
WHOLE ASSEMBLY

★ For the whole assembly of the track shoe, see "Parts judgment guide, Undercarriage, Reversing procedure for pin bushing".

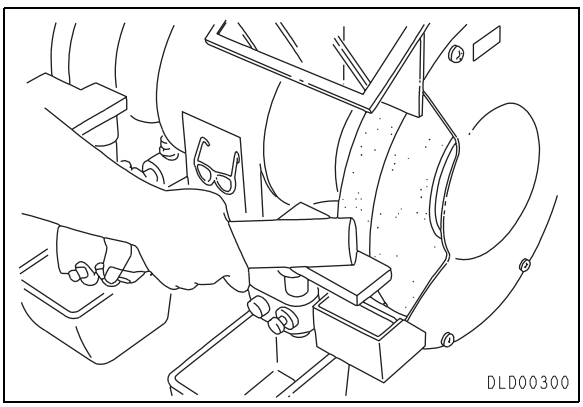
When recycling for lubricated track

1. Preparation work

1) Cleaning seal assembly
   Remove the seal assembly from the link and divide it into the seal ling and load ring, then clean them.
   ★ Since the seal ring (1) and load ring (2) are deteriorated easily by the cleaning liquid, clean them quickly. After cleaning them, wipe off the cleaning agent from them.



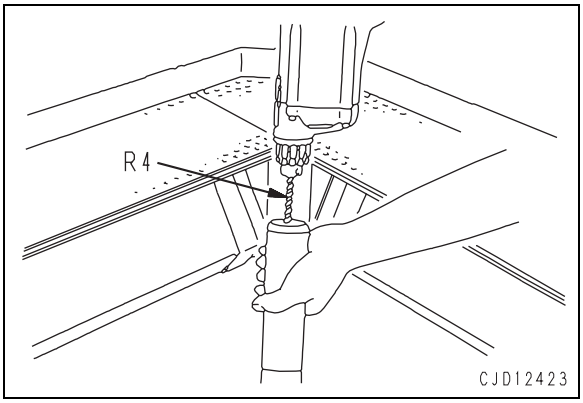
2) When reusing the pin, chamfer its end corners smoothly with a grinder. Remove the nodules sticking to the press fitting parts with the grinder, too.
   ★ If the ends are worn and sharpened, they may scuff the press fitting parts and cause oil leakage.



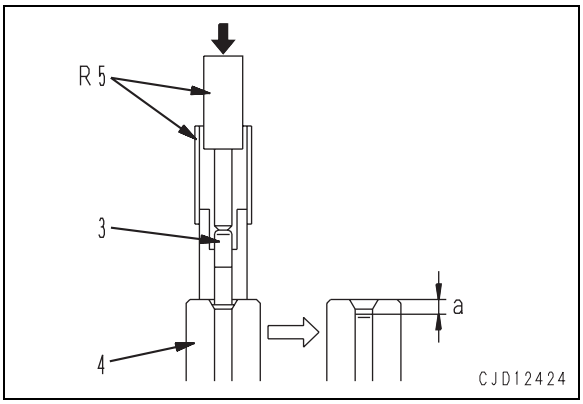
3) If the link, pin, bushing, and spacer are dirty, clean them. Remove the nodules sticking to the link and bushing with the grinder.

★ Since these parts rust easily, clean them just before assembling them.
★ Do not polish the bushing ends. If they are polished, oil may leak.

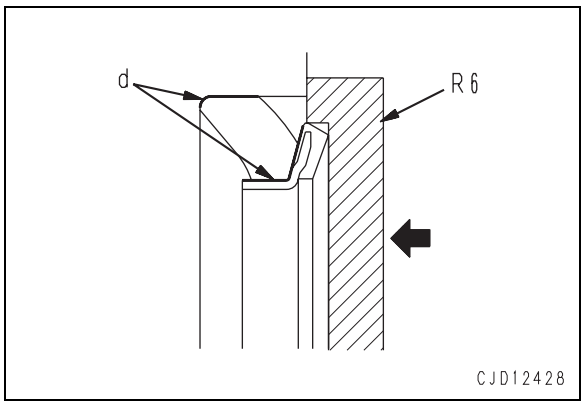
4) If the large plug was pulled out, drive it in by using tool **R5**.
★ In this case, clean the pin hole in advance by using tool **R4**.



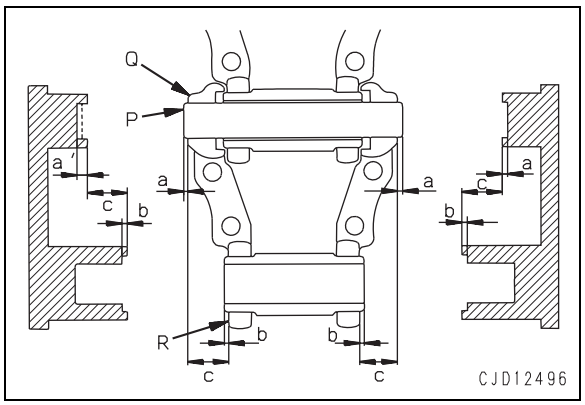
i) Insert the plug (3) through the plug insertion window into the guide hole.
ii) Push the bar with the hand until the plug stops.
iii) Push the plug with the bar to press the guide against the pin (4).
iv) Drive in the bar with a hammer.
★ Driving distance **a** from pin end: 6 ± 2 mm
★ If the chamfered part of the pin hole has been worn, chamfer it with a small-sized grinder (grindstone tip angle: 45° – 60°) so that the plug will not be damaged.
★ Coat the plug with GO90 and drive it with the small diameter end ahead.



5) Installation of seal assembly
Clean the counterbore portion **d** of the link carefully and push in the seal to the bottom by using tool **R6**.
★ If oil 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. When inserting the seal in the counterbore portion, take care that oil not stick to the seal and counterbore portion.



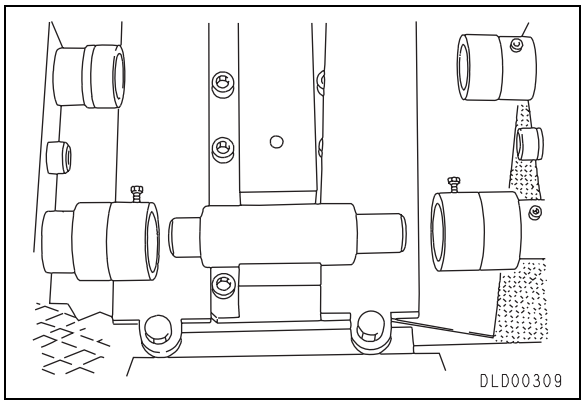
6) Adjust the dimensions of the press fitting jig of the link press to keep the projection of the pin and bushing constant and keep the installed dimensions of the seal within the standard range.
★ For the standard dimensions, see Dimensions table of press fitting jig of link press.
★ If the pin end (part **P**) or the sides of the link (parts **Q** and **R**) 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.



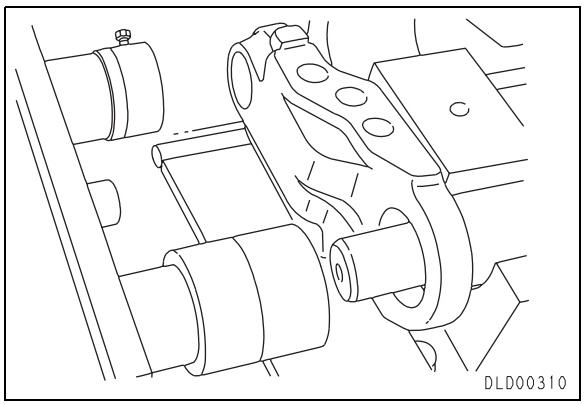
7) Adjust the relief pressure of the link press so that the pressing force of the press will not exceed the standard value.
   ★ If the pressing force is too strong, the spacer will be pressed forcibly against the bushing. As a result, the spacer may be broken and it and bushing may be worn abnormally.
   ★ Final pressing force for pin and bushing:
   588 kN {60 tons}
   Final pressing force ≒ 1.8 x Average press fitting force
   (Adjust the relief pressure of the link press to set the final pressing force.)

2. Assembly of link

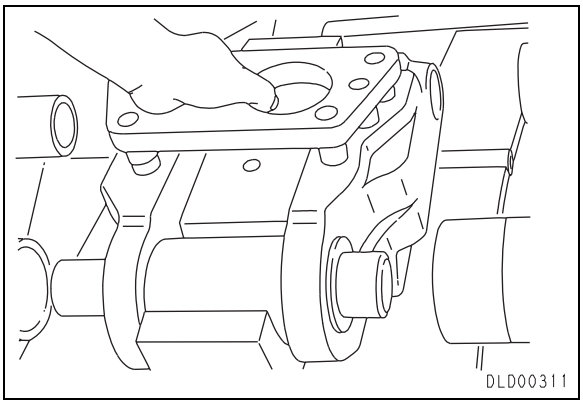
1) Apply oil (GO90) to the mating surfaces of the pin and bushing with a clean brush and assemble them, then set them before the jaw of the link press.
   ★ When reusing (reversing) the bushing, set the worn outside surface of the bushing on the shoe fitting side of the link (set the bushing with the worn outside surface up on the link press).



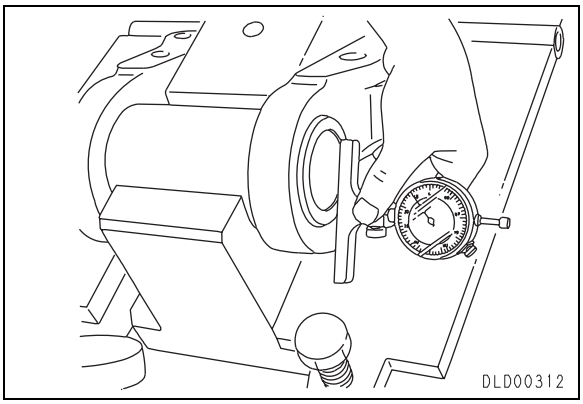
2) Press fit the master links on both bushing sides to the bushing with the shoe fitting faces up.
   ★ At this time, use the master links on the pin side as supports.
   ★ Press fitting force for bushing:
   68 – 108 kN {7 – 8 tons}



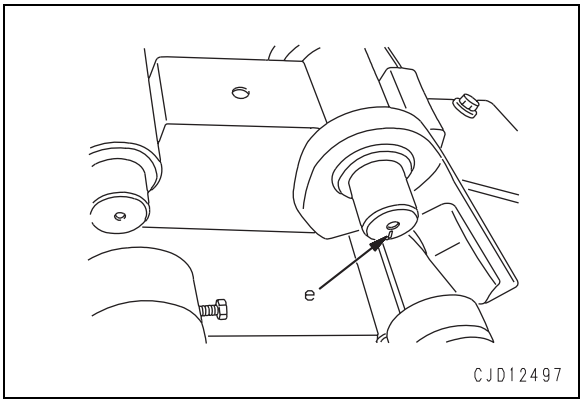
3) Using the shoe bolt hole pitch gauge, press fit the master links until the distance between the shoe bolt holes of both links is the standard value.
   ★ Remove the all steel chips caused by press fitting of the bushing with compressed air.
4) Turn over the master links and check that they are press fitted in parallel.



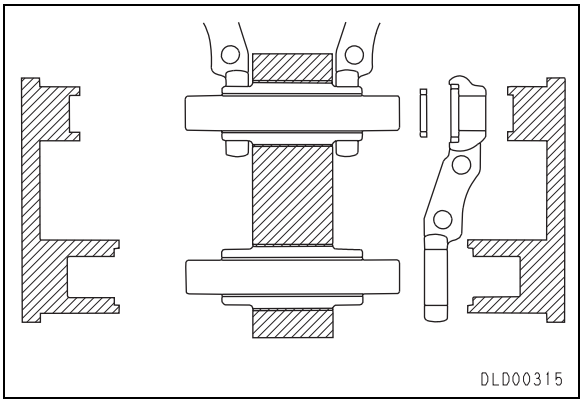
5) Measure the projections of the bushing on both sides with a depth gauge.
   ★ Adjust the press fitting jig of the link press so that the projections on both sides will be even.



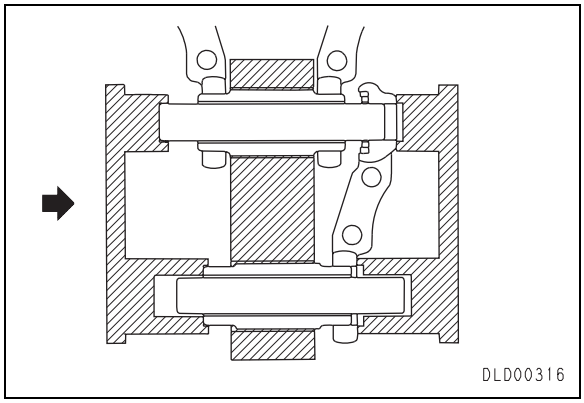
6) Send the master links and set the next pin and bushing.
   ★ When reusing a pin, install it so that its side hole **e** will be on the link tread side similarly to a new one. If it is not installed so, its strength may be lowered. Accordingly, indicate the direction of the side hole **e** on the end face to prevent a mistake.



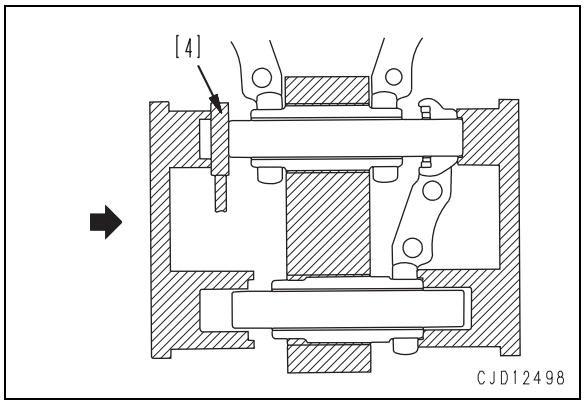
7) Set the right link and install the spacer to the pin.
   ★ Check that the seal surface and bushing end are free from dirt and apply oil (GO90) to them with a clean cloth or brush.
   ★ When installing the spacer, wipe it with a clean cloth.



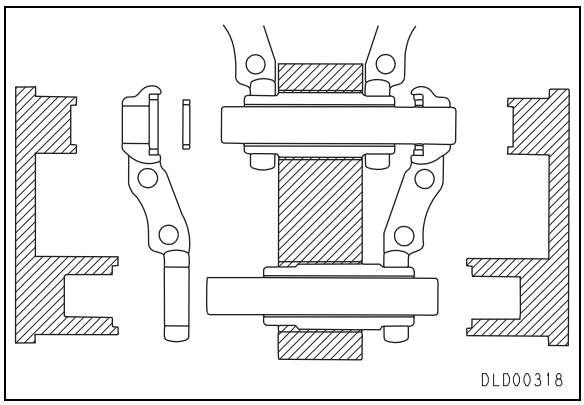
8) Set the right jig on the receiving side and the left one on the pushing side and press fit the pin and bushing simultaneously.
   ★ If the pin and bushing have play when they are press fitted, the seal may come off the link. To prevent this, press fit smoothly. If the seal comes off the link, stop press fitting and set the seal to the link correctly, then start press fitting again.
   ★ Press fitting force for pin and bushing:
   274 – 363 kN {28 – 37 tons}



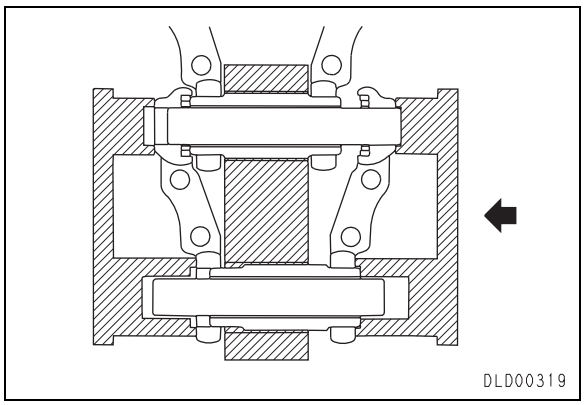
9) Using the spacer [4] for fine adjustment, press fit the pin and bushing until the pin end is fitted to the bottom of the receiving jig.
   ★ Adjust the depth of the receiving jig hole so that the projections of the pin on both sides will be even.



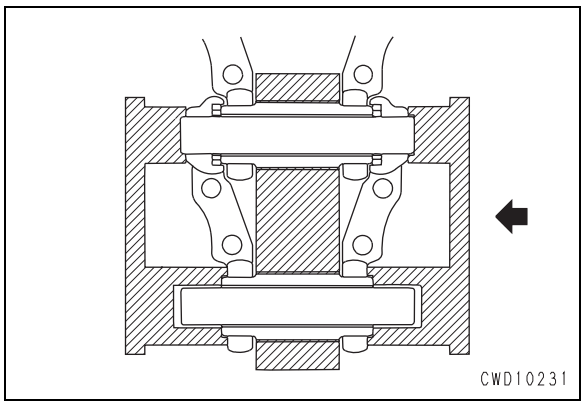
10) Set the left link and install the spacer to the pin.
   ★ Apply oil similarly to the right link.



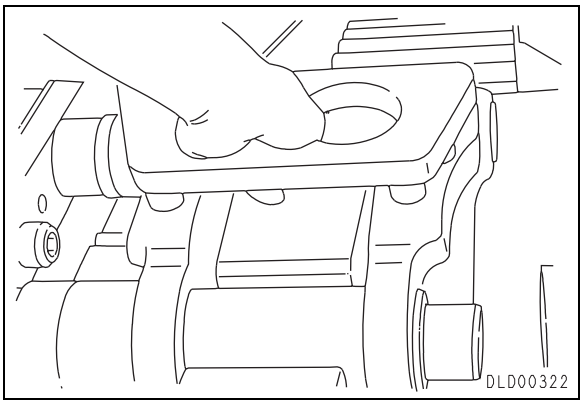
11) Set the left jig on the receiving side and the right one on the pushing side and press fit the left link.
★ When press fitting, take care that both seals and spacers will not come off.
★ Press fitting force for link:
274 – 363 kN {28 – 37 tons}



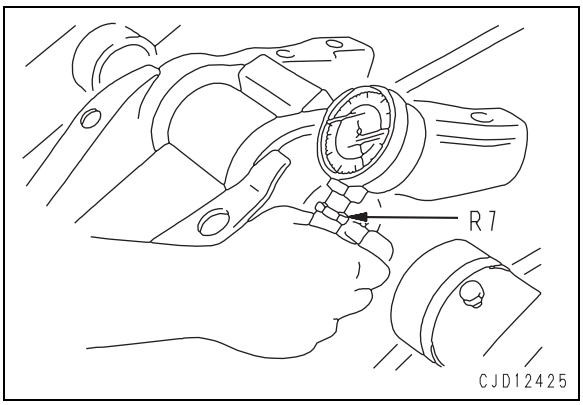
12) Press fit until the link, spacer, and bushing are fitted together.
★ Actually, you cannot see from outside if the above parts are fitted. Accordingly, control the hydraulic pressure of the link press. Set the relief pressure to a proper level and heighten the hydraulic pressure to that level.
For setting of the relief pressure, see Preparation work.
★ Check that adjacent 2 links can turn around each other.



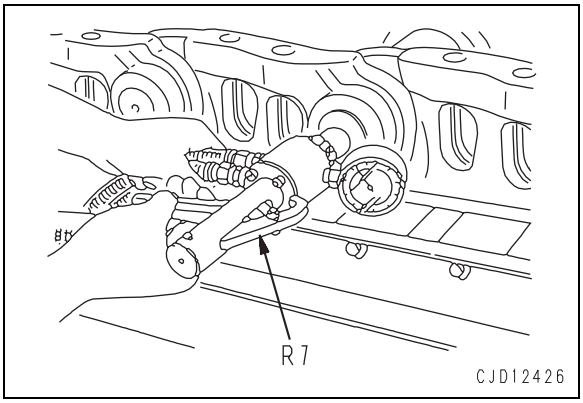
13) Using a shoe bolt hole pitch gauge, measure the distance between the shoe bolt holes and check that the result is within the standard range.
★ If the distance between the shoe bolt holes is longer than the standard range, disassemble and check for abnormality, then press fit again.
★ If the distance 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.



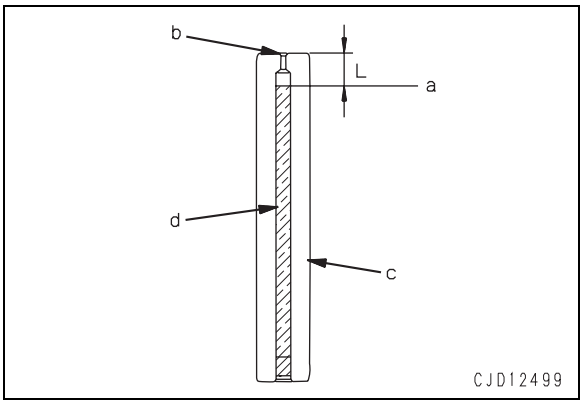
14) After each link is assembled, bleed air from the pin by using tool **R7** and check the sealing performance.
★ Keep the degree of vacuum inside the pin at 91 – 95 kPa {680 – 710 mmHg} for 5 seconds and check that the pressure does not change.
If the pressure changes, disassemble and check the seal. If the seal is free from abnormality, assemble again.



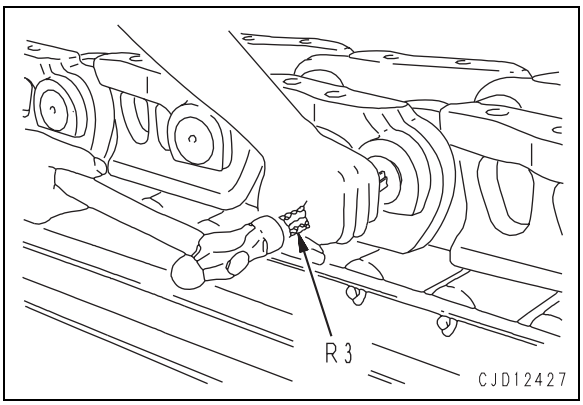
15) Using tool **R7**, supply oil (G090) until the oil supply pressure rises to 196 – 294 kPa {2 – 3 kg/cm^2}.
★ In a cold or very cold district, supply Komatsu genuine oil (150-19-19270 or 195-32-61990) having better low-temperature characteristics instead of G090.
★ If the oil pressure is heightened too much, it has bad effects on the seal. Take care.



★ Supply oil **d** to oil level **a** so that depth **L** of the hole of pin **c** will be in the following range when the link assembly is left with small plug side **b** up (with the link assembly on its side) for 30 minutes.
Dimension L: 35 – 60 mm



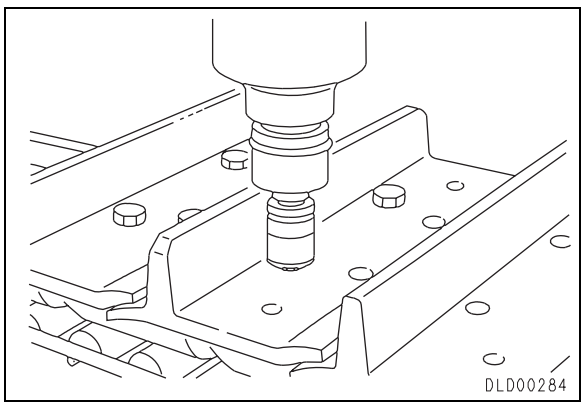
16) After supplying oil, drive in the small plug into the specified position, using tool **R3**.
★ Apply G090 around the small plug.
★ Drive in the small plug to the following depth.
Driving depth from end: 2.5 ± 1 mm



17) Assemble the master link on the pin side at last.
★ Check that the master links on both sides are press fitted in parallel.

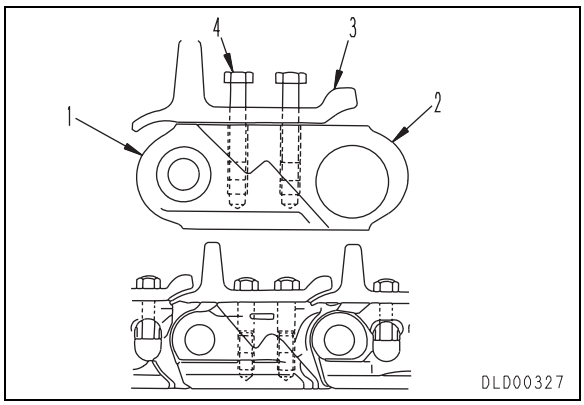
3. Installation of shoe

1) Set the link assembly on the bed and install the shoe with a shoe bolt impact wrench and a torque wrench.
★ 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).
Shoe bolt: **Lubricant containing molybdenum disulfide (LM-P)**
Shoe bolt (Regular link):
- Single shoe:
  Initial torque:
  343 ± 39 Nm {35 ± 4 kgm}
  Retightening angle: **120° ± 10°**
- Swamp shoe:
  Initial torque:
  784 ± 79 Nm {80 ± 8 kgm}
  Retightening angle: **120° ± 10°**

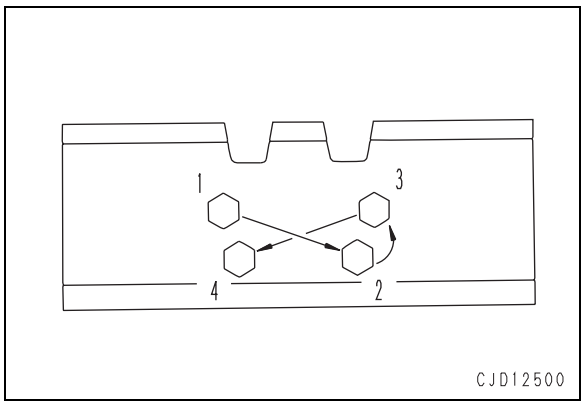


2) When installing a 2-piece shoe, place the assembled 2-piece shoes on a level place in 1 line with the shoe side up.
3) Pull pin-side master link (1) and bushing-side master link (2) together and set them to each other by the mating faces.
4) Place and fit shoe (3) to mating surface of the links.
5) Check that master bolt (4) can be tightened easily with the fingers, then connect the links with the master bolts.

Master bolt: **Lubricant containing molybdenum disulfide (LM-P)**
Master bolt (Master link)
- Single shoe:
  Initial torque:
  343 ± 39 Nm {35 ± 4 kgm}
  Retightening angle: **180° $^{0}_{-20}$**
- Swamp shoe:
  Initial torque:
  490 ± 49 Nm {50 ± 5 kgm}
  Retightening angle: **180° $^{0}_{-20}$**



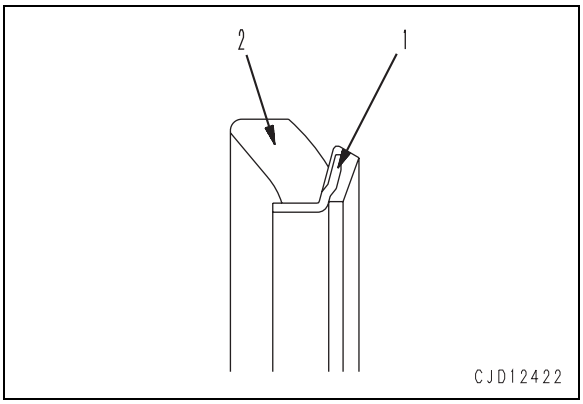
★ Tighten the bolts in the order of 1 – 4.



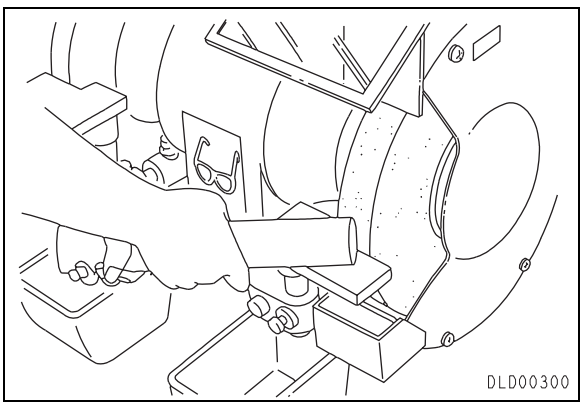
When recycling for grease-filled track

1. Preparation work

1) Cleaning seal assembly
   Remove the seal assembly from the link and divide it into the seal ling and load ring, 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.

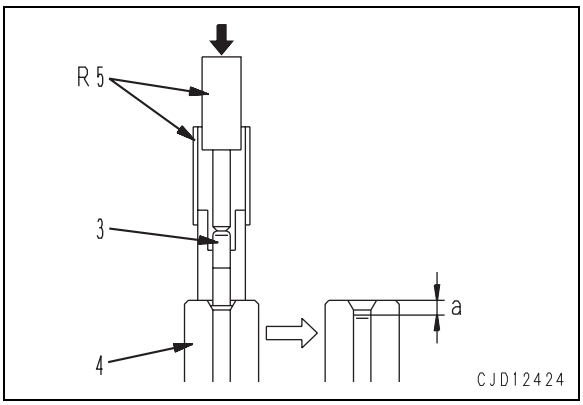


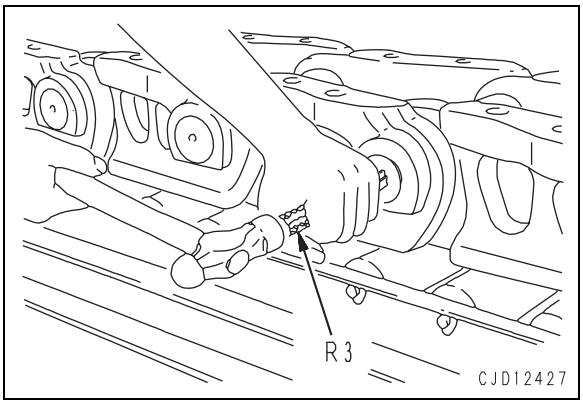
2) When reusing the pin, chamfer its end corners carefully with a grinder so that it will be press fitted smoothly.



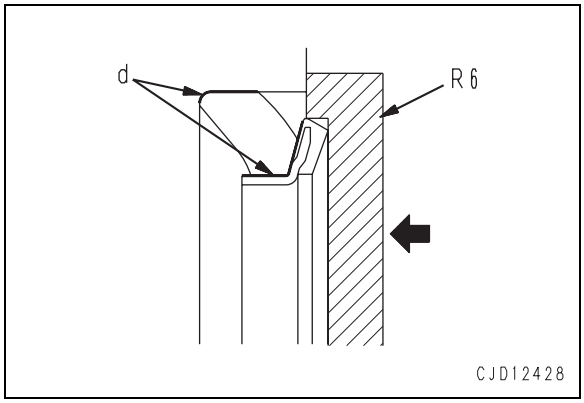
3) Drive in the large and small plugs by using tools **R3** and **R5**.
   i) Insert each plug through the plug insertion window into the guide hole.
      ★ Apply oil to the plug.
   ii) Push the bar with the hand until the plug stops.
   iii) Push the plug with the bar to press the guide against the pin.

iv) Drive in the bar with a hammer.
★ Driving distance **a** from pin end:
Small plug: 2.5 ± 1 mm
Large plug: 6.0 ± 2 mm
★ If the plugs were not pulled out when the shoe was disassembled, reuse them as they are.

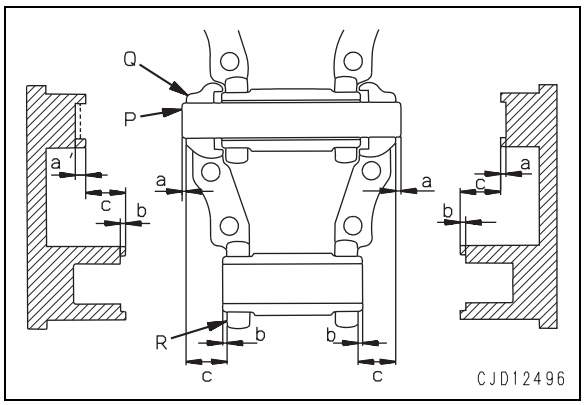




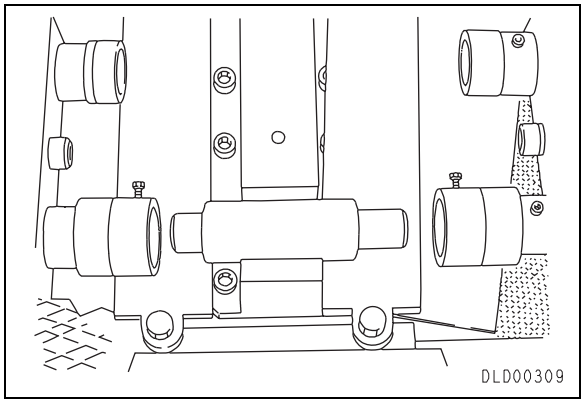
4) If the outside of the pin, surfaces of the spacer, and ends and inside of the bushing are dirty, clean them.
5) Apply grease to the outside of the pin and surfaces of the spacer.
6) Installation of seal assembly
Clean the counterbore portion of the link carefully and push in the seal to the bottom by using tool **R6**.
★ If 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.



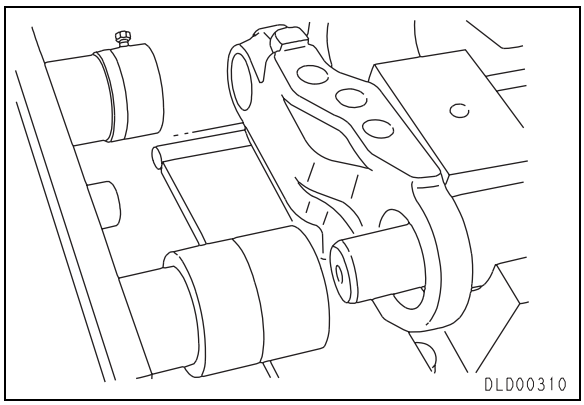
7) Adjust the dimensions of the press fitting jig of the link press to keep the projection of the pin and bushing constant and keep the installed dimensions of the seal within the standard range.
★ For the standard dimensions, see Dimensions table of press fitting jig of link press.
★ If the pin end (part **P**) or the sides of the link (parts **Q** and **R**) 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.



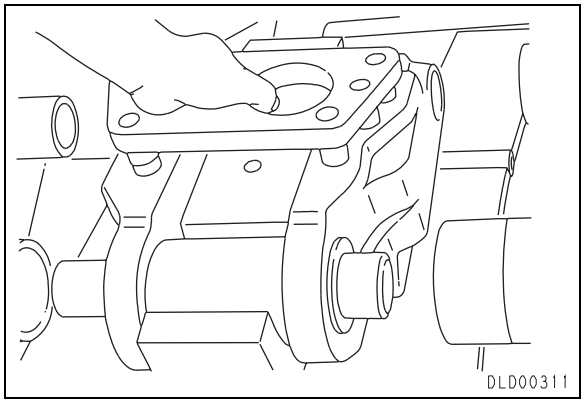
2. Assembly of link
1) Apply lithium grease (G2-LI) to the mating surfaces of the pin and bushing and assemble them, then set them before the jaw of the link press.
★ When reusing (reversing) the bushing, set the worn outside surface of the bushing on the shoe fitting side of the link (set the bushing with the worn outside surface up on the link press).



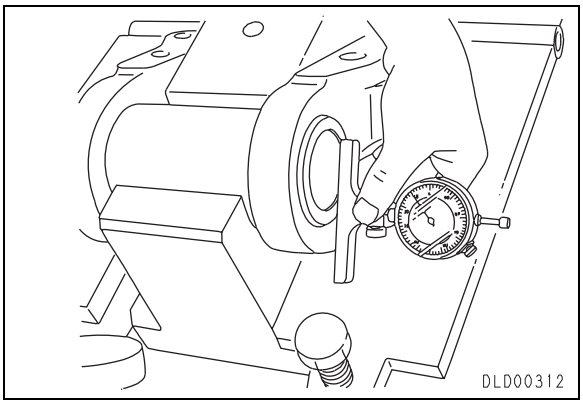
2) Press fit the master links on both bushing sides to the bushing with the shoe fitting faces up.
   ★ At this time, use the master links on the pin side as supports.
   ★ Press fitting force for bushing:
   68 – 108 kN {7 – 8 tons}



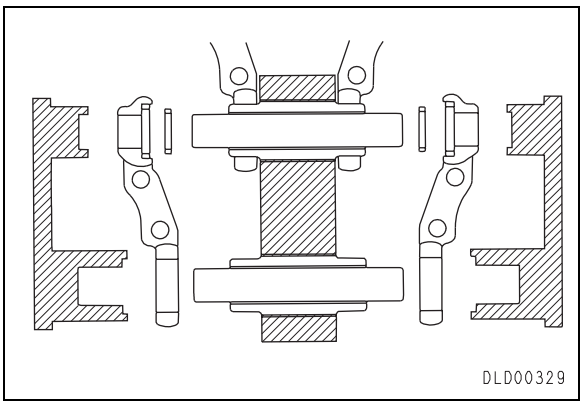
3) Using the shoe bolt hole pitch gauge, press fit the master links until the distance between the shoe bolt holes of both links is the standard value.
   ★ Remove the all steel chips caused by press fitting of the bushing with compressed air.
4) Turn over the master links and check that they are press 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.

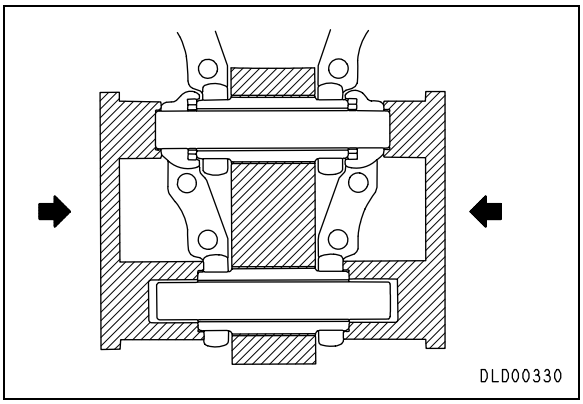


6) Send the master links and set the next pin and bushing.
   ★ When reusing a pin, install it so that its side hole will be on the link tread side similarly to a new one. If it is not installed so, its strength may be lowered. Accordingly, indicate the direction of the side hole on the end face to prevent 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 on the link tread side.

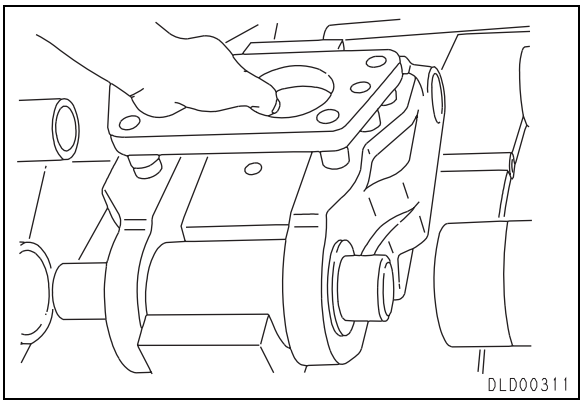


7) Set both links and operate both pushing jigs to press fit the pin and bushing simultaneously.
   ★ If the pin and bushing have play when they are press fitted, the seal may come off the link. To prevent this, press fit smoothly. If the seal comes off the link, stop press fitting and set the seal to the link correctly, then start press fitting again.

★ Final pressing force for pin and bushing:
588 kN {60 tons}
Final pressing force ≒ 1.8 x Average press fitting force
(Adjust the relief pressure of the link press to set the final pressing force.)



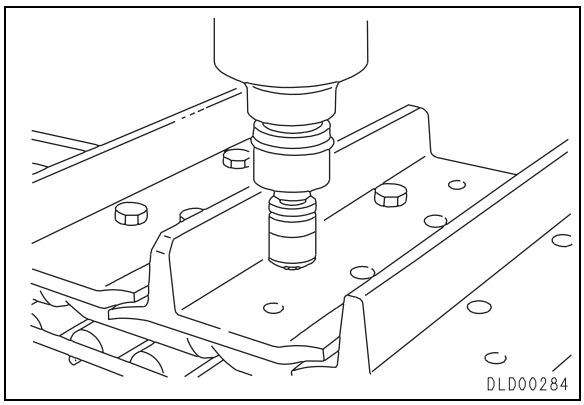
8) Using a shoe bolt hole pitch gauge, measure the distance between the shoe bolt holes. When the distance is in the standard range, stop press fitting.



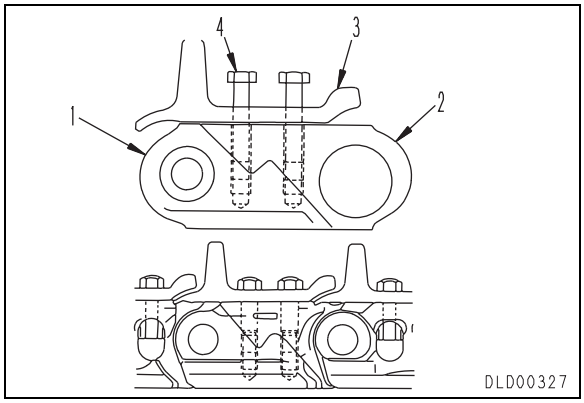
9) Assemble the master link on the pin side at last.
★ Check that the master links on both sides are press fitted in parallel.

3. Installation of shoe

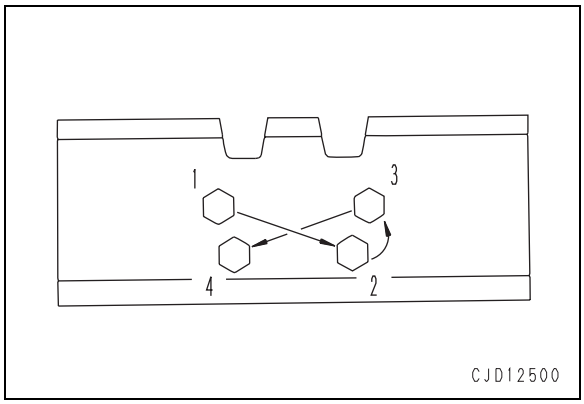
1) Set the link assembly on the bed and install the shoe with a shoe bolt impact wrench and a torque wrench.
★ When reusing (reversing) the bushing, set the worn outside surface of the bushing on the shoe fitting side of the link (set the bushing with the worn outside surface up on the link press).
Shoe bolt: **Lubricant containing molybdenum disulfide (LM-P)**
Shoe bolt (Regular link):
- Single shoe:
  Initial torque:
  343 ± 39 Nm {35 ± 4 kgm}
  Retightening angle: **120° ± 10°**
- Swamp shoe:
  Initial torque:
  784 ± 79 Nm {80 ± 8 kgm}
  Retightening angle: **120° ± 10°**



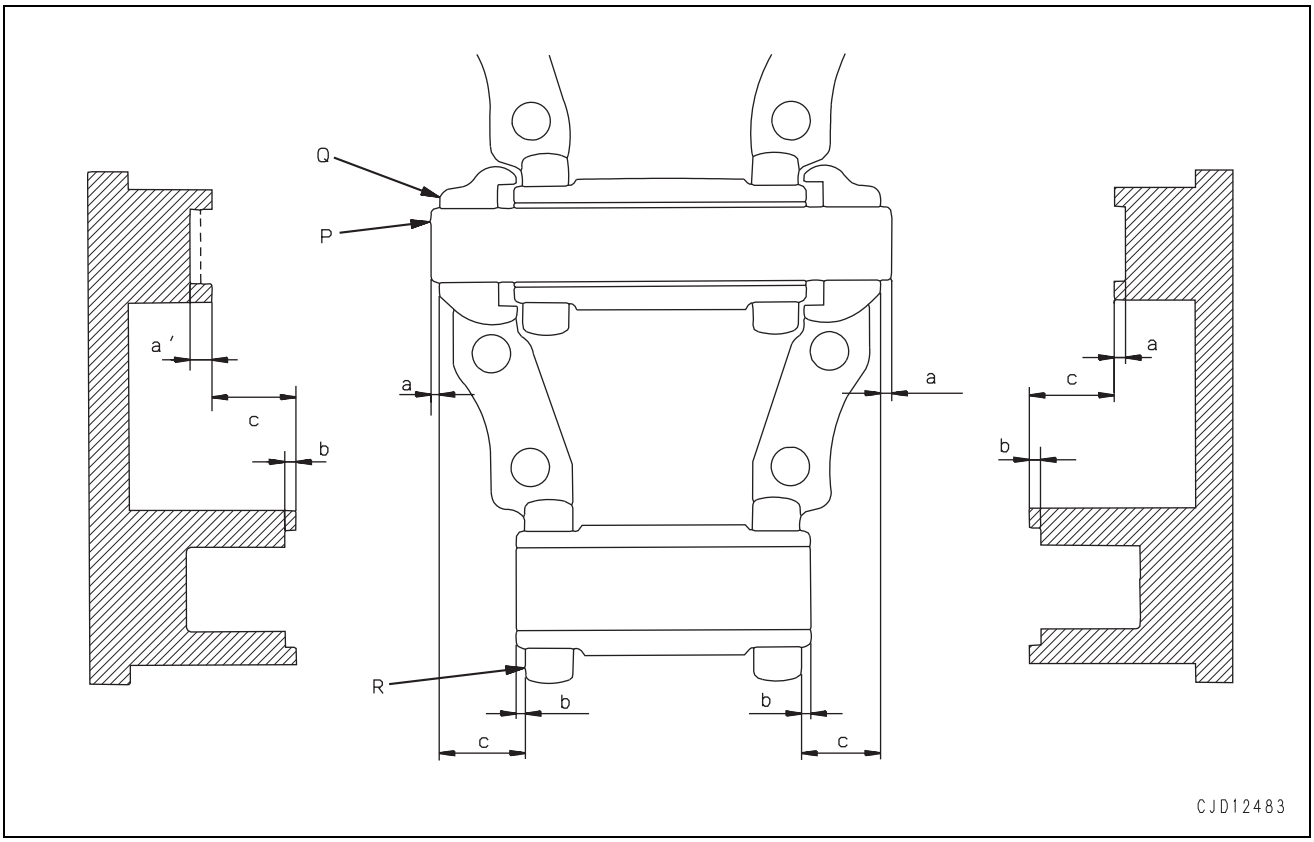
2) When installing the assembled 2-piece track shoes, place them on a level place in 1 line with the shoe side up.
3) Pull pin-side master link (1) and bushing-side master link (2) together and set them to each other by the mating faces.
4) Place and fit shoes (3) to the mating surface of the links.
5) Check that master bolt (4) can be tightened easily with the fingers, then connect the links with the master bolt.
Master bolt: **Lubricant containing molybdenum disulfide (LM-P)**
Master bolt (Master link)
- Single shoe:
  Initial torque: **343 ± 39 Nm {35 ± 4 kgm}**
  Retightening angle: **180°** $^{0}_{-20}$
- Swamp shoe:
  Initial torque: **490 ± 49 Nm {50 ± 5 kgm}**
  Retightening angle: **180°** $^{0}_{-20}$



★ Tighten the bolts in the order of 1 – 4.



DIMENSIONS TABLE OF FITTING JIG OF LINK PRESS



Adjusting

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.

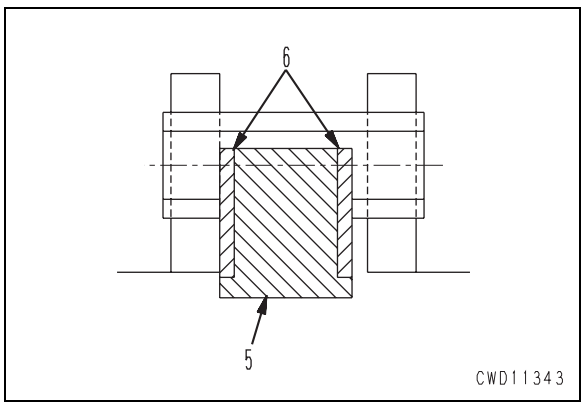
★ If the pin end (part **P**) or the sides of the link (parts **Q** and **R**) are worn, add the dimensions of the worn parts when adjusting the standard dimensions so that the projections of the pins and bushings on both sides will be even.

Unit: mm

Dimensions of jig		
a	b	c
4	2.0	47.9

Precaution

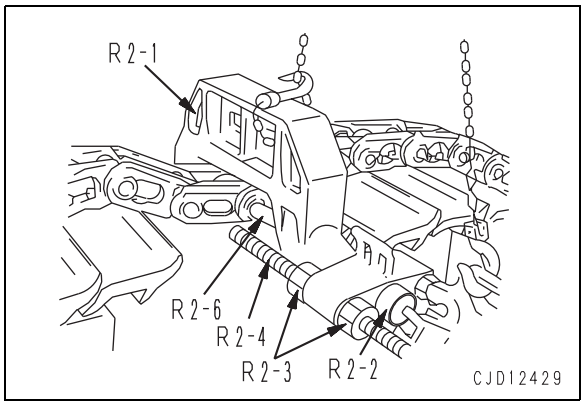
1. The link receiving faces of jaw (5) must be vertical.
2. Replaceable wear plate (6) shown below is desirable.



DISASSEMBLY OF 1 LINK IN THE FIELD

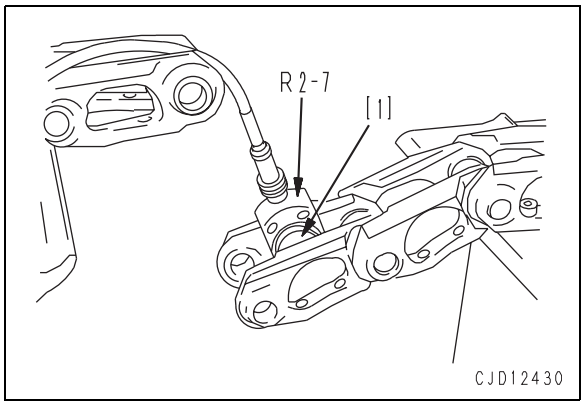
⚠ Only how to use the tools is explained below. For details of disassembly and assembly, see WHOLE DISASSEMBLY (OR ASSEMBLY) OF TRACK SHOE.

1. Using screw **R2-4** and nut **R2-3**, install frame **R2-1** to the cylinder.
2. Using the screw, install adapter **R2-5** to frame **R2-1**.
3. Set extension **R2-2** and pusher **R2-6**.
4. Apply hydraulic pressure to the hydraulic cylinder to pull out the 2 pins.

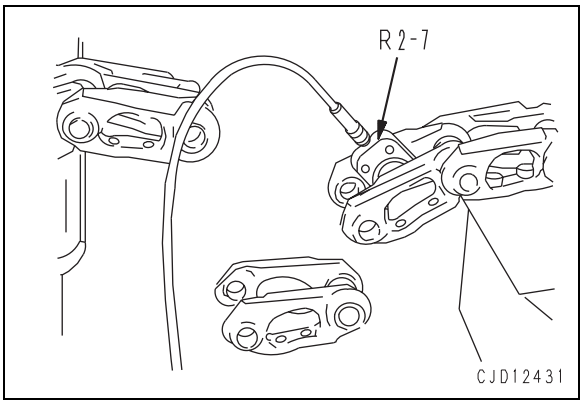


5. Install jack **R2-7** and spacer [1] of the following size to the tread side of the link.
   ★ If an electric pump is used, unnecessarily high hydraulic pressure may be applied. Accordingly, be sure use a hand pump.

   Size of spacer:
   Outside diameter 55 mm x Thickness 51 mm

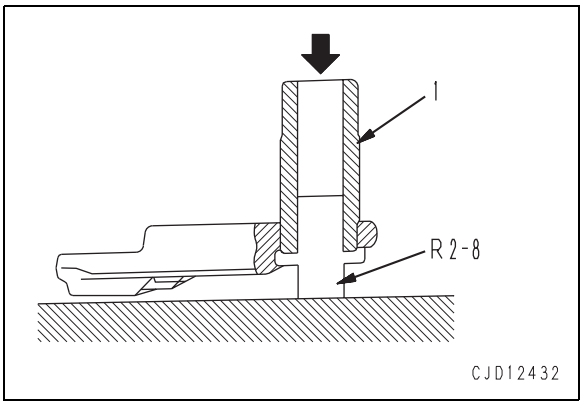


6. Apply high pressure to jack **R2-7** gradually to disconnect the link.

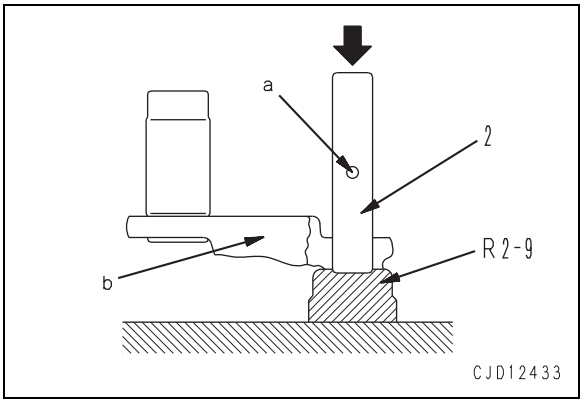


ASSEMBLY OF 1 LINK IN THE FIELD

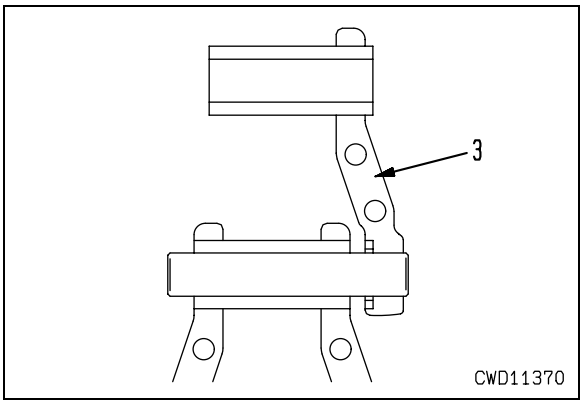
1. Assemble the link sub-assembly.
   1) Set tool **R2-8** on the tread side of the link and press fit bushing (1).
      ★ Press fitting force for bushing:
      69 – 108 kN {7 – 11 tons}



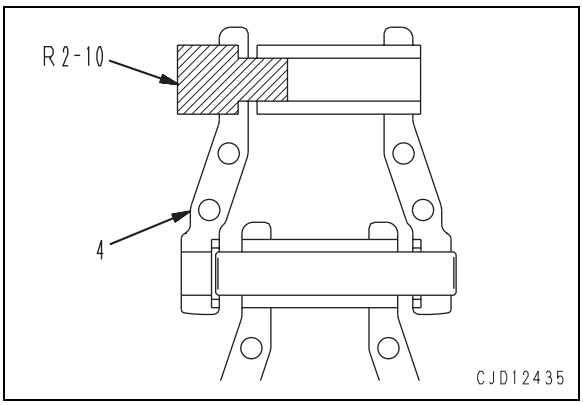
   2) Set tool **R2-9** to the end of link (on the pin side) and press fit pin (2).
      ★ Set the pin with its side hole **a** directed toward tread **b** of the link.
      ★ Pressing force for ping:
      206 – 255 kN {21 – 26 tons}



2. Set the link (3) to which link sub-assembly will be connected.

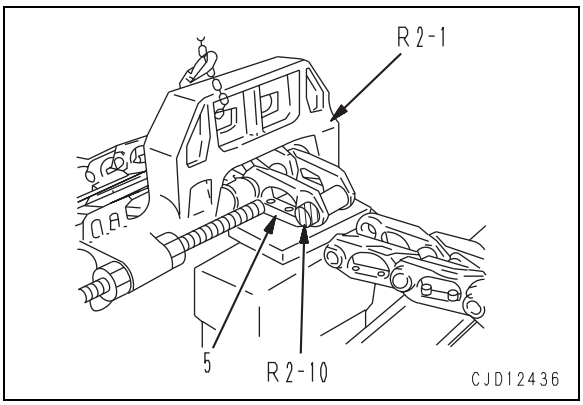


3. Set link (4) on the opposite side and support it with tool **R2-10**.



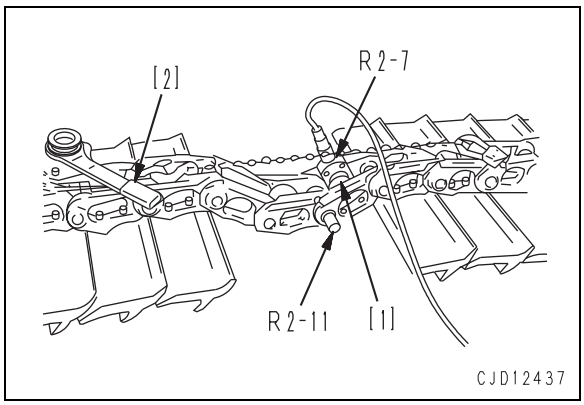
4. Set tool **R2** as in the procedure for removing the pin. Using tool **R2-1**, press fit the pin to link sub-assembly (5).

★ Pressing force for ping:
206 – 255 kN {21 – 26 tons}

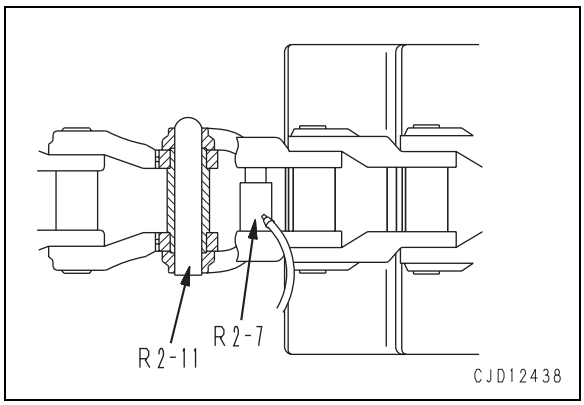


5. Connection of link

1) Set lever block [2].
2) Install jack **R2-7** and spacer [1] on the tread side of the link and apply hydraulic pressure to the jack until the link tip opens by 6 – 8 mm.
3) Operate lever block [2] to align the link hole and bushing hole, and then connect the link with guide **R2-11**.

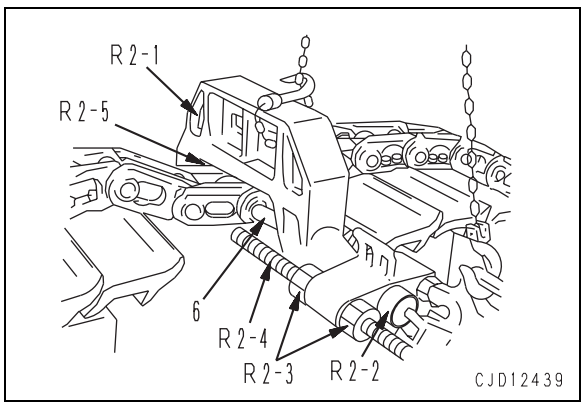


4) After connecting the link with guide **R2-11**, remove jack **R2-7**.

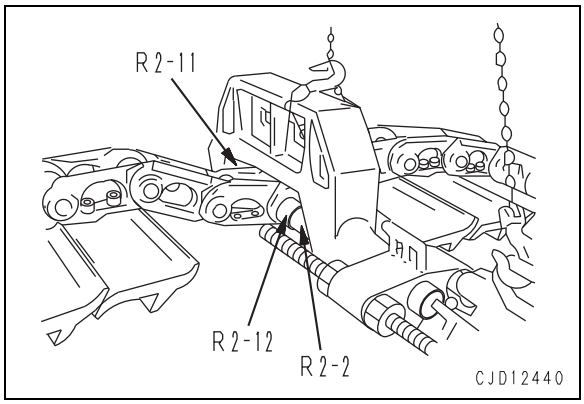


6. Press fitting of pin

1) Using screw **R2-4** and nut **R2-3**, install frame **R2-1** to the cylinder.
2) Using the screw, install adapter **R2-5** to frame **R2-1**.
3) Set extension **R2-2** and press fit pin (6).
   ★ Set the pin with its side hole directed toward the tread of the link.
   ★ Pressing force for ping:
   412 – 510 kN {42 – 52 tons}



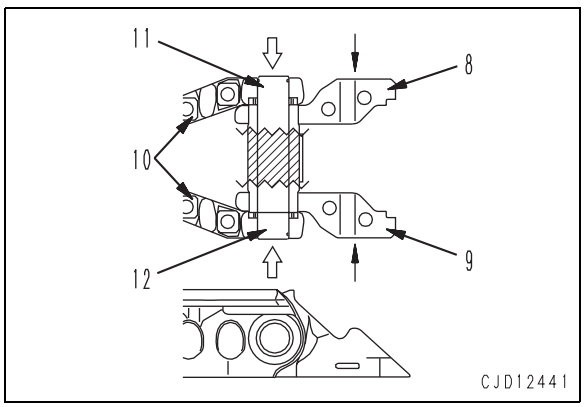
4) Remove adapter **R2-5** and set adapter **R2-11** in the large hole.
5) Set pusher **R2-12** to extension **R2-2**.
6) Apply the specified final pressing force to the 2 link connecting parts to install.



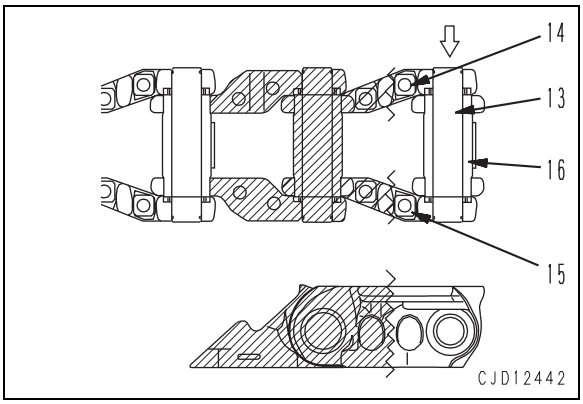
DISASSEMBLY OF MASTER LINK

1. Removal of track shoe assembly
Remove the track shoe assembly from the chassis.

2. Removal of master link
1) Cutting and removal of master link on bushing side with gas
Cut the parts marked VVV with gas and remove the hatched parts. Pull out master links (8) and (9) by moving them in the directions of white arrow. Furthermore, remove pins (11) and (12) from regular link (10) by pressing them with a press in the directions of black arrow.
Special tool: Gas cutting machine
: Tool **R**



2) Removal of master link on pin side
Cut the parts marked VVV with gas and remove the hatched parts. Remove pin (13) from link (14) by pressing it with a press in the direction of white arrow, and then remove pin (13) and link (15) from bushing (16) simultaneously.
Special tool: Gas cutting machine
: Tool **R**

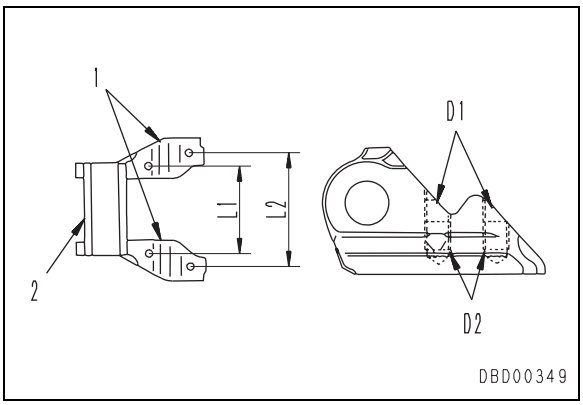


ASSEMBLY OF MASTER LINK

1. Assembly of link on bushing side
1) Press fit master link (1) on the bushing side to bushing (2) with a press.
★ Press fit both master links in parallel.
★ Do not damage the mating faces of the master links and end of the bushing.

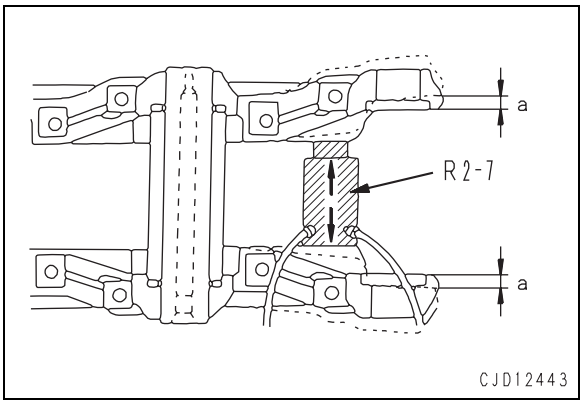
Unit: mm

L1	146
L2	182.8
D1	25 drill
D2	22 x 2.0

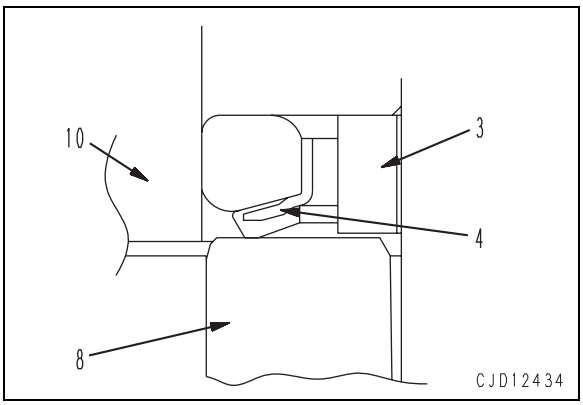


2. Installation of link on bushing side

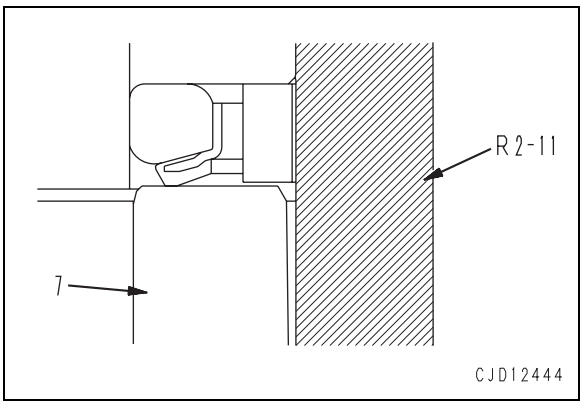
1) Expand the central part of the link tread with tool **R2-7** as shown in the figure (Expand the link tip by 6 – 8 mm).
a: 5 mm



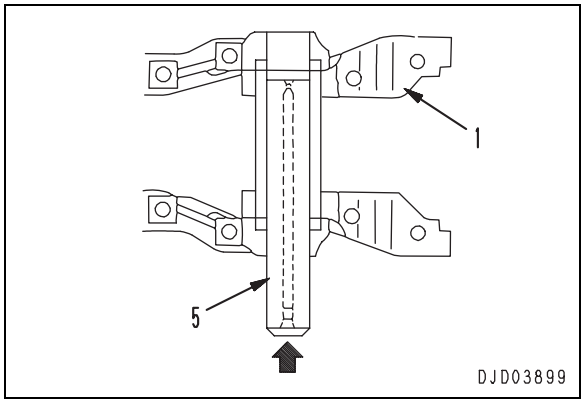
2) Set spacer (3) and seal assembly (4) to the counterbore of the link at the connecting section.



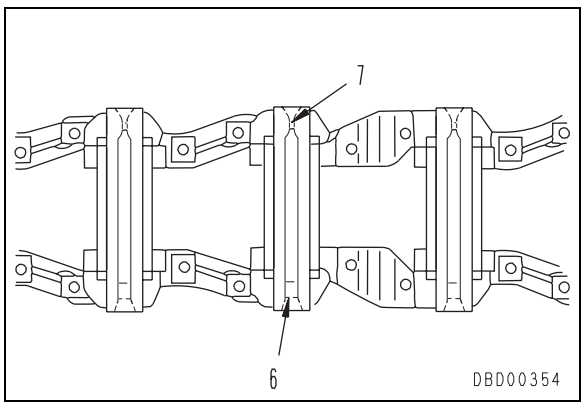
3) Align the holes of the pin and bushing (7) and connect with guide pin **R2-11**.



4) Press fit pin (5) with tool **R2** and install master link (1) on the bushing side.
★ Direct the side hole of the pin toward the link tread.

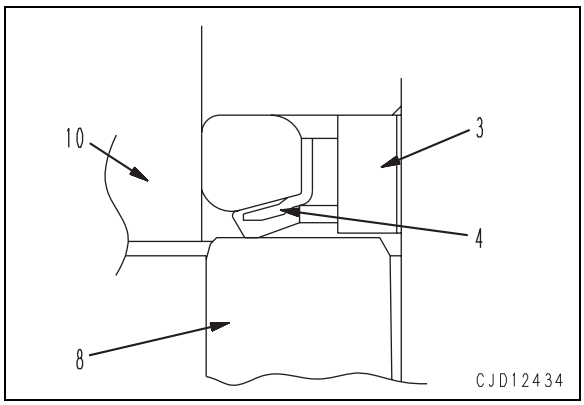


5) Install the shoe to the link at the connecting section.
6) Drive in large plug (6) with tool **R5**, add oil with tool **R8**, and drive in small plug (7) with **R5**.
★ Press fit both master links in parallel (on bushing side and pin side).
★ Do not damage the mating faces of the master links and end of the bushing.
★ The end play of the connecting section (the play of the links before and after the pin in the thrust direction) must be 0 – 0.13 mm.
★ Take care extremely that dirt or sand will not stick to the seal, spacer, ends of bushing, and mating face of the tapped hole.

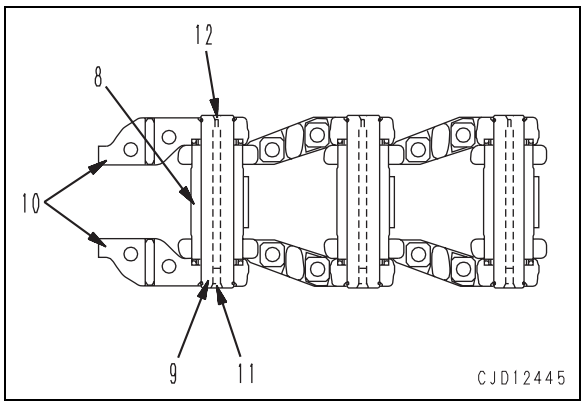


3. Installation of link on pin side

1) Set spacer (3) and seal assembly (4) to the counterbore of the master link.



2) Pass bushing (8) and pin (9), set master links (10) on the pin side from both sides, and press fit them with tool **R2**.
3) Drive in large plug (11) with tool **R5**, add oil with tool **R8**, and drive in small plug (12) with **R5**.

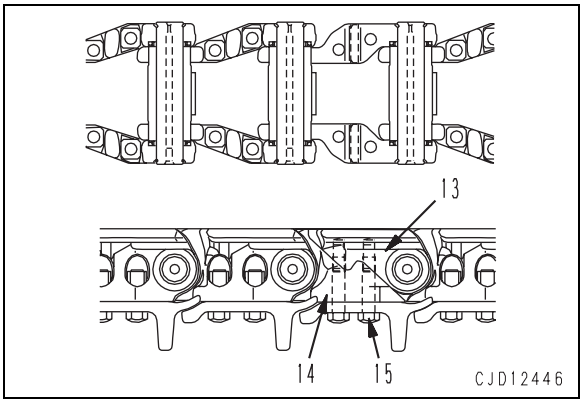


4. Connection of master link

1) Place the assembled 2-piece track shoes on a level place in 1 line with the shoe side up.
2) Pull pin-side master link (13) and bushing-side master link (14) together and set them to each other by the mating faces.
3) Place and fit the shoes to the mating surface of the links.
4) Check that master bolt (15) can be tightened easily with the fingers, then connect the links with the master bolt (15).

   Master bolt: **Lubricant containing molybdenum disulfide (LM-P)**

   Master bolt (Master link)
   - Single shoe:
     Initial torque: **343 ± 39 Nm {35 ± 4 kgm}**
     Retightening angle: **180° $^{0}_{-20}$**
   - Swamp shoe:
     Initial torque: **490 ± 49 Nm {50 ± 5 kgm}**
     Retightening angle: **180° $^{0}_{-20}$**



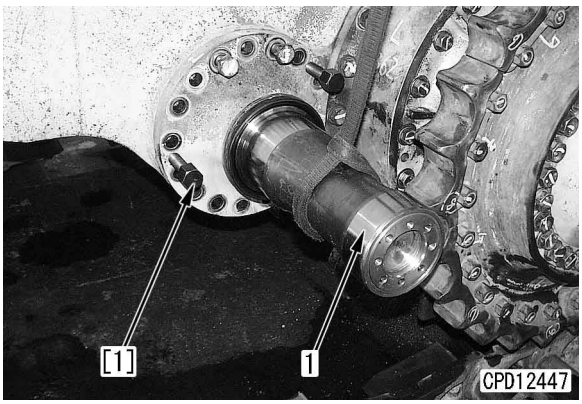
REMOVAL AND INSTALLATION OF PIVOT SHAFT ASSEMBLY

REMOVAL

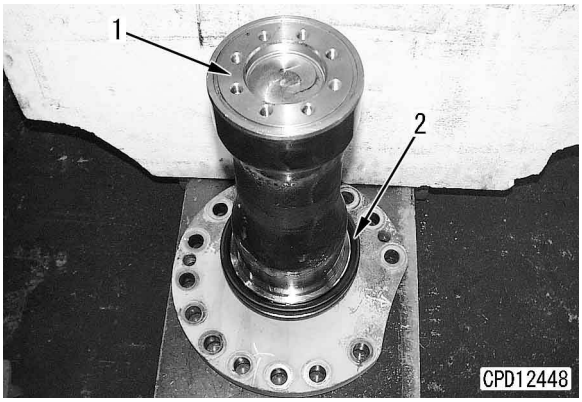
1. Remove the track frame assembly. For details, see Removal, installation of track frame assembly.

2. Remove the mounting bolts of pivot shaft assembly (1) (Leave 2 – 3 of them, however). [*1]

3. Sling pivot shaft assembly (1) temporarily and pull it out, using forcing screw [1].
   Pivot shaft assembly: **100 kg**



4. Remove seal (2) from pivot shaft assembly (1). [*2]

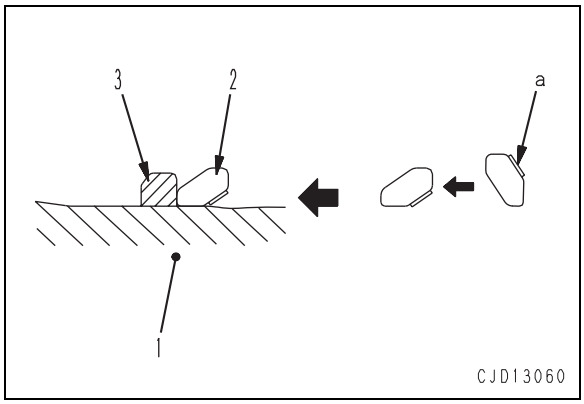


INSTALLATION

- Carry out installation in the reverse order to removal.

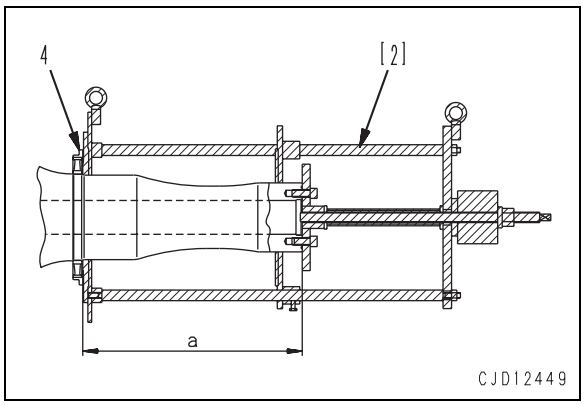
[*1]
Mounting bolt: **Adhesive (LT-2)**
Mounting bolt:
823 – 1,029 Nm {84 – 105 kgm}

[*2]
★ Install the seal according to the following procedure.
1) Reverse the seal (2) so that the relief letters **a** will be on the inside.
2) Install the reversed seal (2) to the shaft (1).
Seal: **Oil (EO-30)**



★ Use tool [2] to press fit ring (4).
- Press fitting of force:
  23.2 – 42.7 kN {2.37 – 4.35 tons}

★ Check that press fitting dimension **a** of the seal from the shaft end is proper.
- Press fitting dimension **a**: 412 ± 1mm

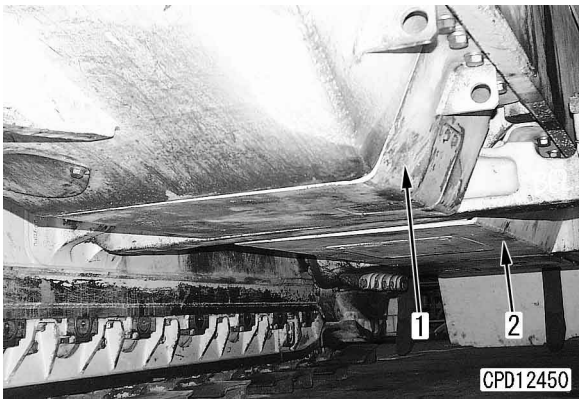


REMOVAL AND INSTALLATION OF EQUALIZER BAR ASSEMBLY

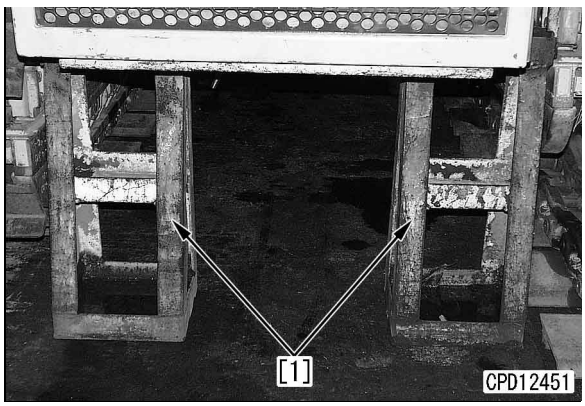
REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove engine undercover (1) and power train undercover (2).



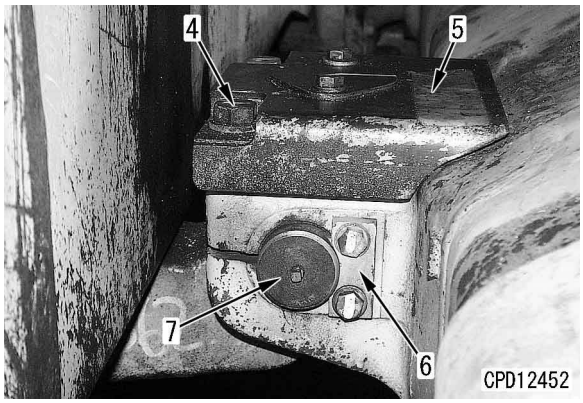
2. Set a hydraulic jack under the center of the equalizer bar to raise the front part of the chassis and set stand [1] under the frame to float the front part.



3. Remove 2 bolts (4) and cover (5). [*1]

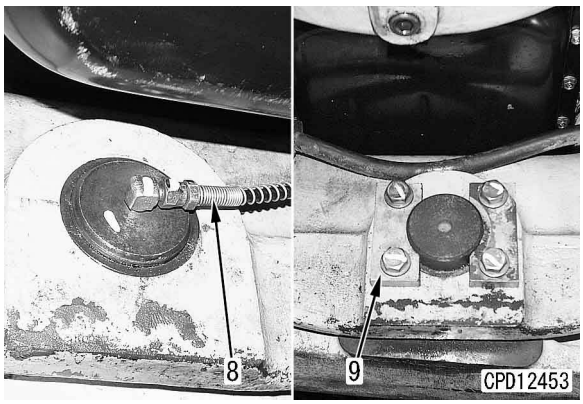
4. Remove lock plate (6) and side pin (7). [*2]
   - ★ If the equalizer bar hole and track frame hole are not aligned, the pin cannot be removed easily. Adjust the hanging height of the track frame properly.
   - ★ Repeat steps 3 and 4 to remove the pin on the opposite side.

   ⚠ If the track frame assembly on the opposite side is floated before the pin is pulled out, support it on a block, etc.

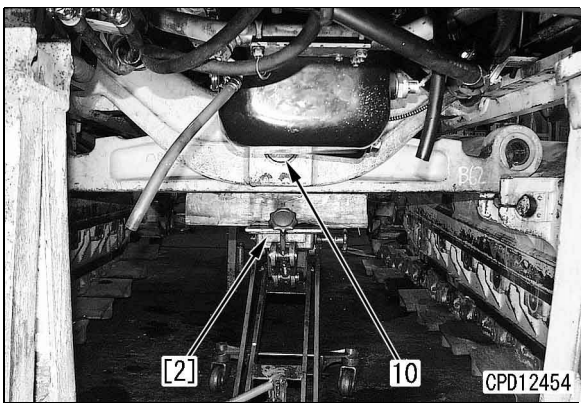


5. Remove grease hose (8).

6. Remove lock plate (9). [*3]

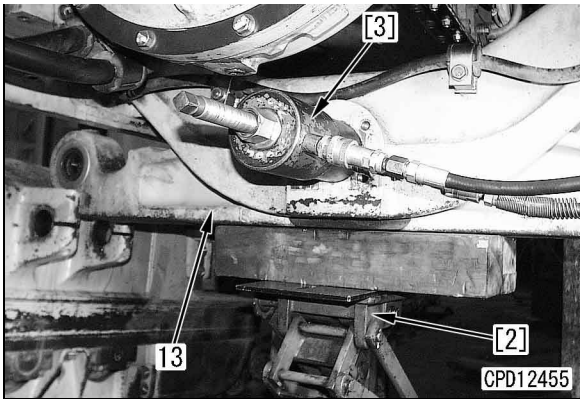


7. Set jack [2] at the center of equalizer bar center pin (10).



8. Using tool [3], pull out center pin (10). [*4]

9. Lower and remove equalizer bar (13) by operating jack [2].
   Equalizer bar assembly:
   D85EX-15; 158 kg
   D85PX-15; 204 kg



INSTALLATION

- Carry out installation in the reverse order to removal.

[*1]
Mounting bolt:
319 – 608 Nm {32.5 – 62 kgm}

[*2]
⚠ When aligning the pin holes, never insert your fingers in them.
★ Before installing the side pin, adjust the hanging height on the track frame to align the hole of the equalizer bar with the hole on the track frame side.
★ Direct the grease hole of the pin forward.
Equalizer bar side bushing:
Grease (G2-LI)
Mounting bolt:
54 – 123 Nm {5.5 – 12.5 kgm}

[*3]
Mounting bolt:
147 – 309 Nm {15 – 31.5 kgm}

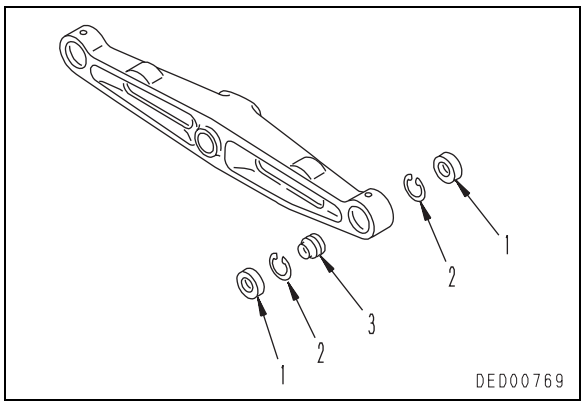
[*4]
⚠ When aligning the pin holes, never insert your fingers in them.
★ Before installing the center pin, adjust the jack [2] to align the hole of the equalizer bar with the hole on the track frame side.
Equalizer bar bushing and main frame bushing: **Grease (G2-LI)**

DISASSEMBLY AND ASSEMBLY OF EQUALIZER BAR ASSEMBLY

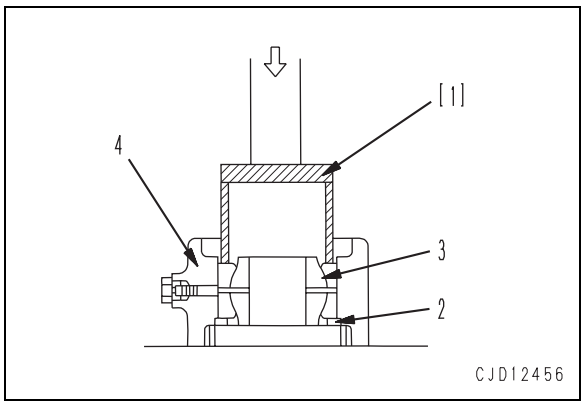
DISASSEMBLY

1. Remove the equalizer bar. For details, see REMOVAL OF EQUALIZER BAR.

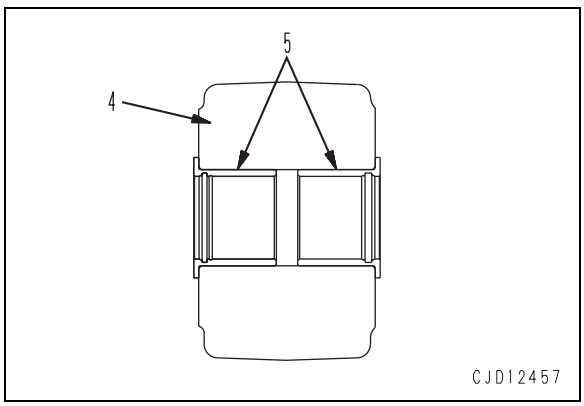
2. **Side bushing**
   1) Remove seal (1).
   2) Remove ring (2).



   3) Using tool [1], remove spherical bushing (3) from equalizer bar (4).

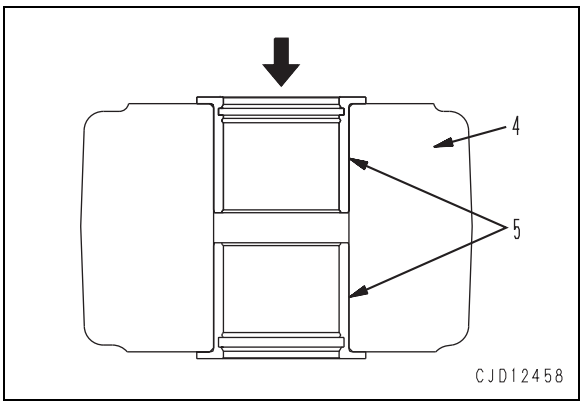


2. **Center bushing**
   Remove center bushing (5) from equalizer bar (4).

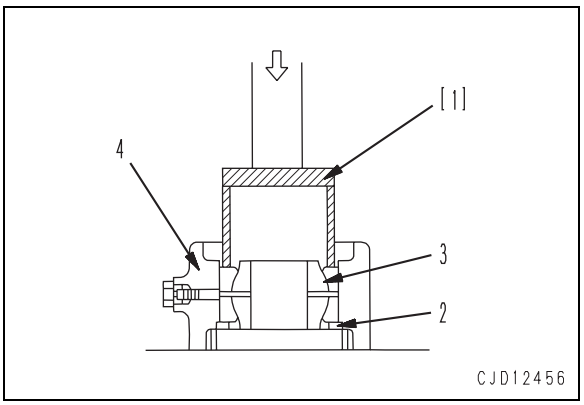


ASSEMBLY

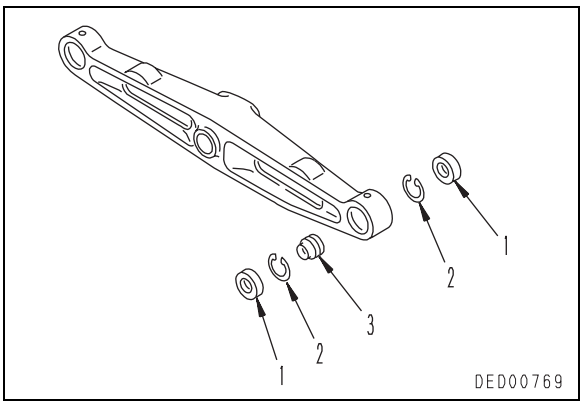
1. **Center bushing**
   Using a press, press fit center bushing (5) to equalizer bar (4).
   ★ Press fitting force for center bushing:
   57.8 – 161.7 kN {5.9 – 16.5 tons}
   Periphery of spherical bushing:
   Lubricant containing molybdenum disulfide (LM-P)



2. **Side bushing**
   1) Install ring (2) to one side of equalizer bar (4).
   2) Using the press, press fit spherical bushing (3) to equalizer bar (4).
      ★ Press fitting force for spherical bushing:
      49 – 118 kN {5 – 12 tons}
      Periphery of spherical bushing:
      Lubricant containing molybdenum disulfide (LM-P)



3) Install ring (2) on the opposite side.
4) Using the press, press fit seal (1).
   ★ Press fitting force for seal:
   57.8 – 161.7 kN {5.9 – 16.5 tons}
   Periphery of spherical bushing:
   Lubricant containing molybdenum disulfide (LM-P)
   Between spherical bushing and seal:
   Grease (G2-LI)



REMOVAL AND INSTALLATION OF WORK EQUIPMENT CONTROL VALVE ASSEMBLY

REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

⚠ Lower the work equipment to the ground. Referring to TESTING AND ADJUSTING, Releasing residual pressure in work equipment cylinder, release the residual pressure in the piping and lock the safety lock lever.

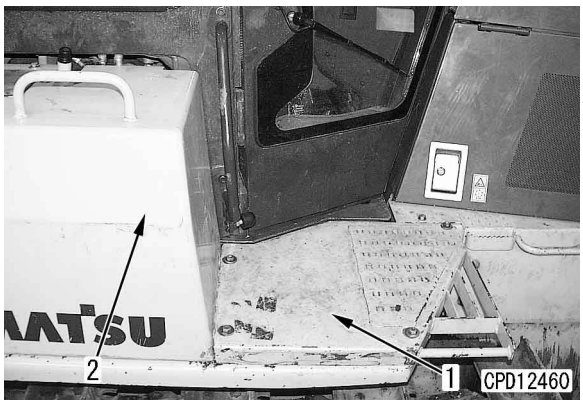
★ Plug the disconnected pipes and hoses to prevent foreign matter from entering them.

★ Put tags to the disconnected pipes and hoses to prevent a mistake in re-connecting them.

1. Drain the oil.

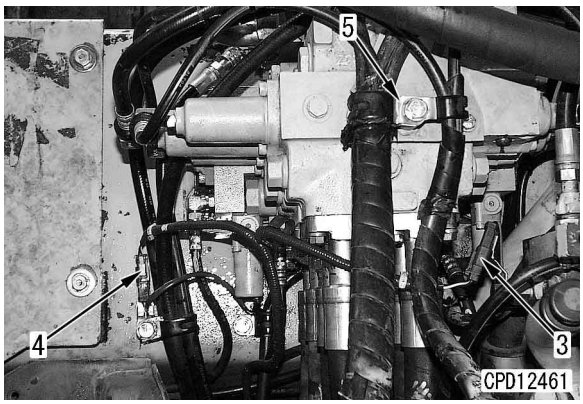
   Hydraulic tank: **D85EX-15; Approx. 150 ℓ**
   D85PX-15; Approx. 140 ℓ

2. Remove covers (1) and (2) from the right side of the chassis.



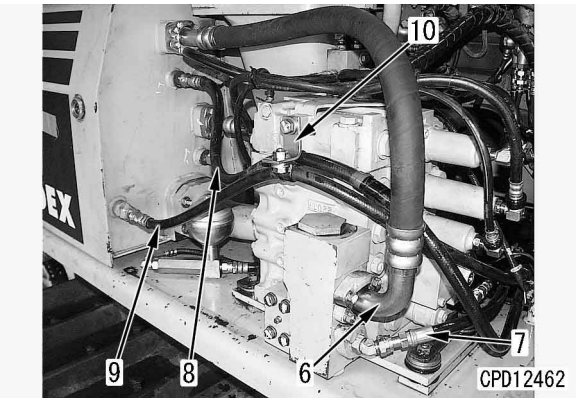
3. Disconnect solenoid connector HSA (3) for the left of the HSS and solenoid connector HSB (4) for the right of the HSS.

4. Remove PPC hose clamp (5).



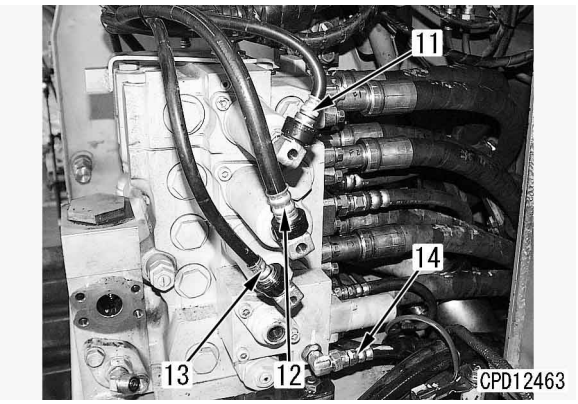
5. Disconnect the following hoses.
   - (6): Hydraulic tank return hose
   - (7): Fan motor drain hose
   - (8): Pump drain hose
   - (9): PPC drain hose

6. Remove hose clamp plate (10).

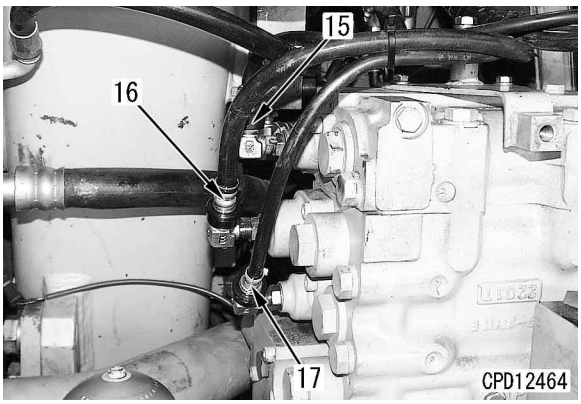


7. Disconnect the right PPC hoses. [*1]
   - (11): Ripper lift cylinder RAISE hose coupler (Port PA4) • Color band: Black
   - (12): Blade lift cylinder LOWER hose coupler (Port PA3) • Color band: Black
   - (13): Blade tilt cylinder LEFT tilt hose coupler (Port PA2) • Color band: Yellow

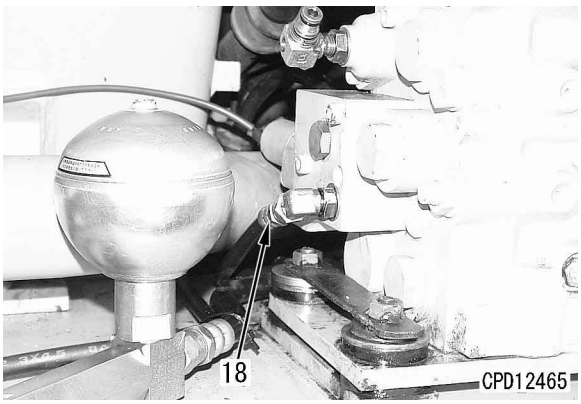
8. Disconnect hose (14) for the right of the HSS (Port PA1).



9. Disconnect the left PPC hoses. [*2]
   - (15): Ripper lift cylinder LOWER hose coupler (Port B4) • Color band: None
   - (16): Blade lift cylinder RAISE hose coupler (Port B3) • Color band: None
   - (17): Blade tilt cylinder RIGHT tilt hose coupler (Port B2) • Color band: Green



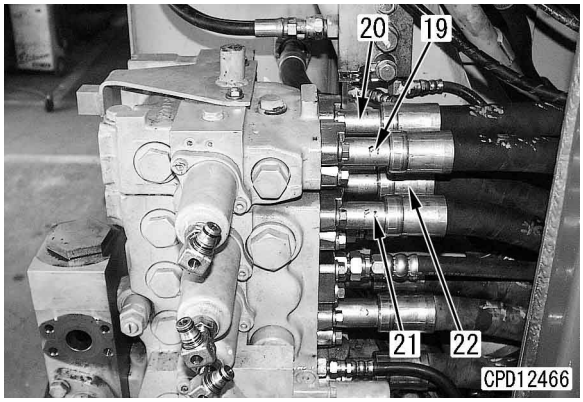
10. Disconnect hose (18) for the left of the HSS (Port PB1).

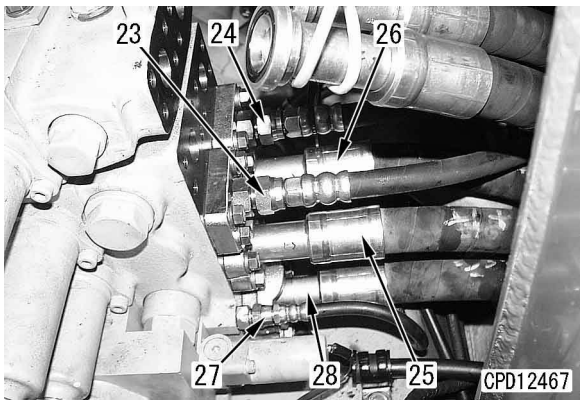


11. Disconnect the following 8 work equipment hoses.
   - (19): Ripper lift RAISE hose (Port A4)
   - (20): Ripper lift LOWER hose (Port B4)
   - (21): Blade lift RAISE hose (Port A3)
   - (22): Blade lift LOWER hose (Port B3)
   - (23): Blade tilt RIGHT hose (Port A2)
   - (24): Blade tilt LEFT hose (Port B2)
   - (25): HSS motor LEFT hose (Port A1)
   - (26): HSS motor RIGHT hose (Port B1)

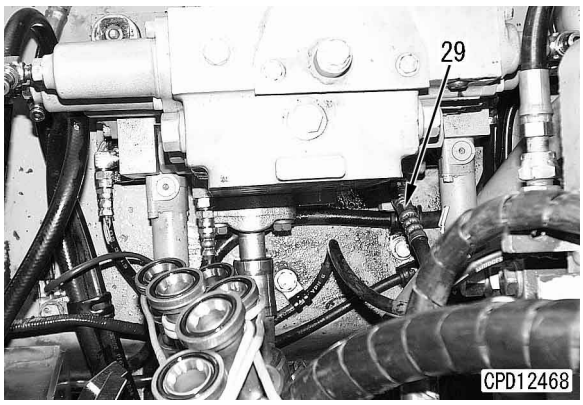
12. Disconnect drain hose (27).

13. Disconnect main hose (28).

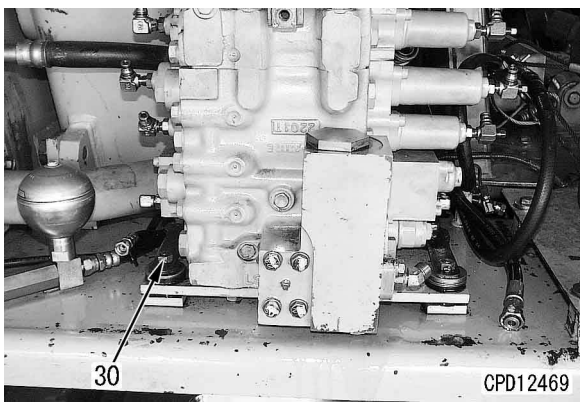




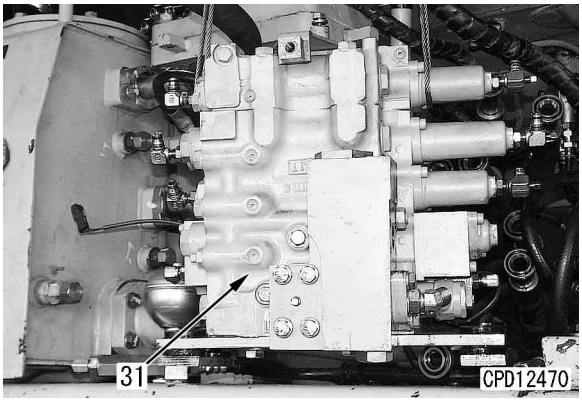
14. Disconnect LS hose (29).



15. Remove 4 work equipment control valve mounting bolts (30).



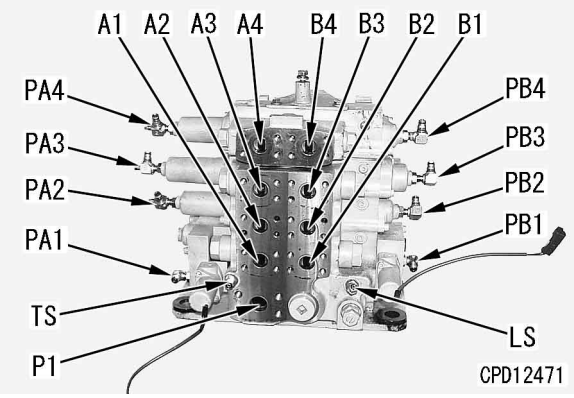
16. Lift off work equipment control valve assembly (31).
    Work equipment control valve assembly: **125 kg**



INSTALLATION

- Carry out installation in the reverse order to removal.

[*1] [*2]
- The connecting positions of the PPC hoses are indicated by their band colors. When installing them, check their band colors.
  - ★ Positions of PPC ports of work equipment control valve assembly
  - **PA4** (Ripper lift cylinder RAISE port)
  - **PA3** (Blade lift cylinder LOWER port)
  - **PA2** (Blade tilt cylinder LEFT tilt port)
  - **PA1** (Port for right of HSS)
  - **PB4** (Ripper lift cylinder LOWER port)
  - **PB3** (Blade lift cylinder RAISE port)
  - **PB2** (Blade tilt cylinder RIGHT tilt port)
  - **PB1** (Port for left of HSS)
  - ★ Positions of ports of work equipment control valve assembly
  - **A4** (Ripper lift RAISE port)
  - **B4** (Ripper lift LOWER port)
  - **A3** (Blade lift LOWER and FLOAT port)
  - **B3** (Blade lift RAISE port)
  - **A2** (Blade tilt LEFT port)
  - **B2** (Blade tilt RIGHT port)
  - **A1** (HSS motor RIGHT port)
  - **B1** (HSS motor LEFT port)
  - **TS** (Drain port)
  - **P1** (Main port)
  - **LS** (LS port)



- **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: **D85EX-15; Approx. 150 ℓ**
  D85PX-15; Approx. 140 ℓ

- **Bleeding air**
  Bleed air from the piping. For details, see TESTING AND ADJUSTING, Bleeding air from work equipment cylinders.

DISASSEMBLY AND ASSEMBLY OF WORK EQUIPMENT CONTROL VALVE ASSEMBLY

★ Only the precautions for assembling the work equipment control valve assembly are described in this section.
★ For the tightening torque of each part, see STRUCTURE AND OPERATION, Maintenance standard.

ASSEMBLY

★ Clean the all parts and check them for dirt or damage. Coat their sliding surfaces with engine oil before installing.
★ When assembling the suction valve, check that the spring is installed normally in the sleeve.
★ When assembling a relief valve or a plug, check that the cut part of the backup ring is closed and apply grease (G2-LI) to the periphery of the backup ring.
★ After installing the main relief valve assembly, adjust it, referring to TESTING AND ADJUSTING, Testing adjusting work equipment hydraulic pressure.

DISASSEMBLY AND ASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

SPECIAL TOOLS

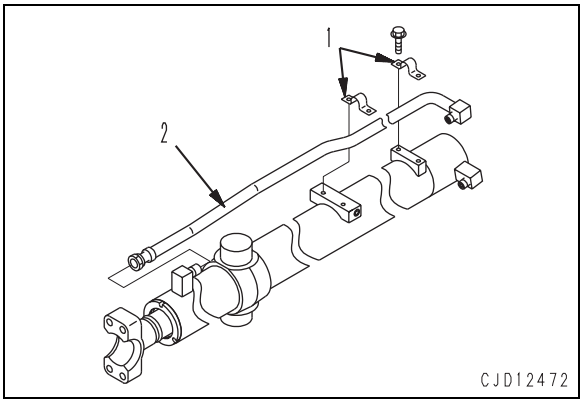
Symbol		Part No.	Part name		Necessity	Q'ty	New/Remodel	Sketch
U	1	790-502-1003	Cylinder head repair stand		■	1		
		790-101-1102	Hydraulic pump		■	1		
	2	790-102-3802	Wrench		■	1		
	3	790-302-1310	Socket	Blade lift	■	1		
		790-302-1350	Socket	Blade tilt	■	1		
		790-302-1340	Socket	Ripper lift	■	1		
	4	790-201-1702	Push tool KIT		■	1		
		• 790-101-5021	• Grip			1		
		• 01010-50816	• Bolt			1		
		• 790-201-1791	• Push tool	Blade lift		1		
		• 790-201-1821		Blade tilt		1		
		• 790-201-1811		Ripper lift		1		
				Ripper tilt		1		
	5	790-201-1500	Push tool KIT		■	1		
		• 790-101-5021	• Grip			1		
		• 01010-50816	• Bolt			1		
		• 790-201-1610	• Plate	Blade lift		1		
		• 790-201-1630		Blade tilt		1		
		• 790-201-1620		Ripper lift		1		
				Ripper tilt		1		
	6	790-720-1000	Expander		■	1		
	7	796-720-1660	Ring	Blade lift	■	1		
		07281-01159	Clamp		■	1		
		796-720-1680	Ring	Blade tilt	■	1		
		07281-01589	Clamp		■	1		
		796-720-1670	Ring	Ripper lift	■	1		
		07281-01279	Clamp		■	1		

DISASSEMBLY

1. Cylinder tube

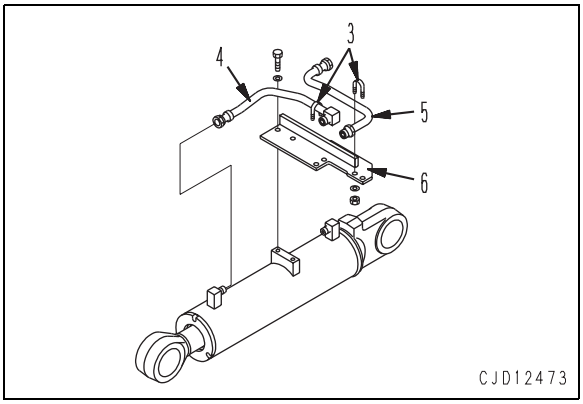
- **Blade lift cylinder**

1) Remove 2 clamps (1).
2) Remove cylinder tube (2).



- **Ripper lift cylinder**

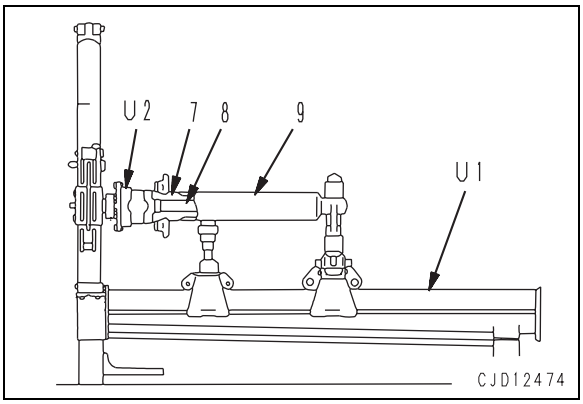
1) Remove 2 U-bolt clamps (3).
2) Remove 2 cylinder tubes (4) and (5).
3) Remove bracket (6).



2. Piston rod assembly

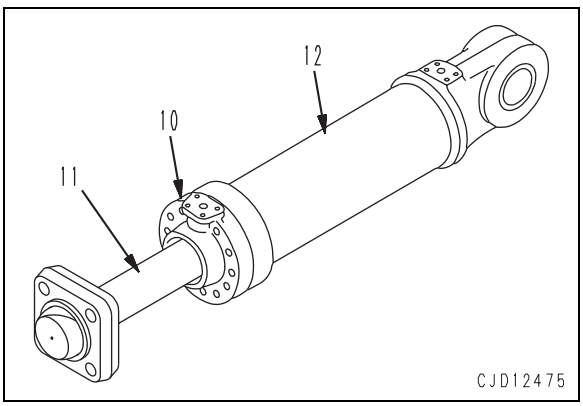
- **Blade lift and ripper lift cylinders**

1) Set the cylinder assembly to tool **U1**.
2) Using a hydraulic pump or a power wrench, disconnect head assembly (7) from the cylinder with tool **U2**.
3) Pull piston rod assembly (8) out of cylinder (9).
   ★ Put an oil pan, etc. under the cylinder to receive oil.



- **Blade tilt cylinder**

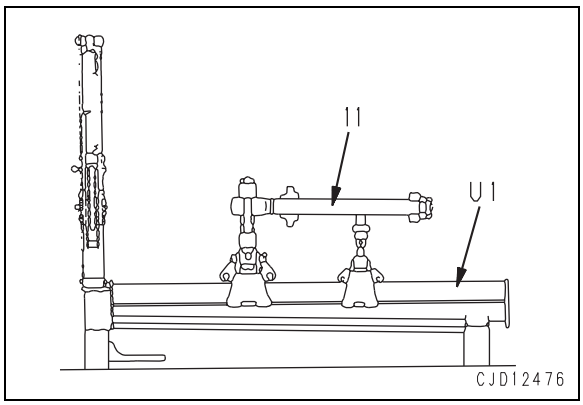
1) Remove the mounting bolts and disconnect head assembly (10).
2) Pull piston rod assembly (11) out of cylinder (12).
   ★ Put an oil pan, etc. under the cylinder to receive oil.



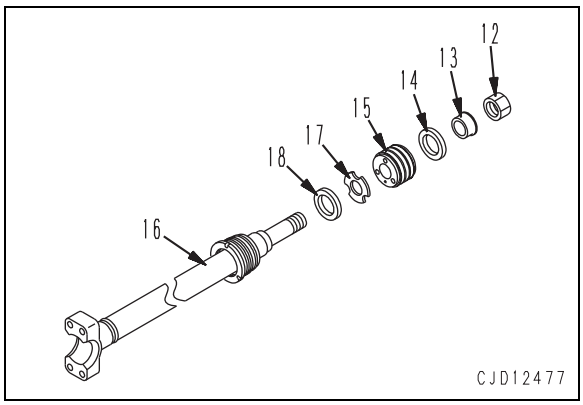
3. Piston assembly

- **Blade lift cylinder**

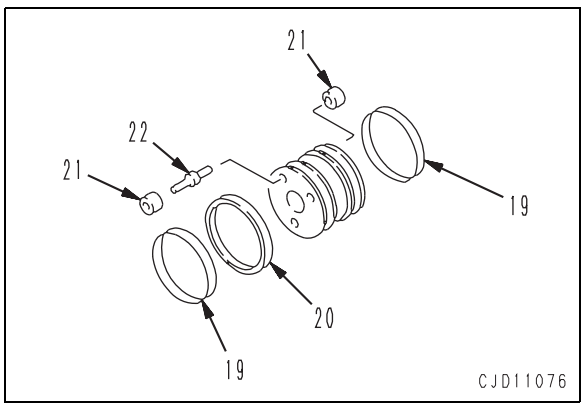
1) Set piston rod assembly (11) to tool **U1**.



2) Using tool **U3**, remove nut (12) from the cylinder.
3) Remove collar (13) and sleeve (14), and then remove piston assembly (15) from piston rod (16).
4) Remove retainer (17) and sleeve (18).

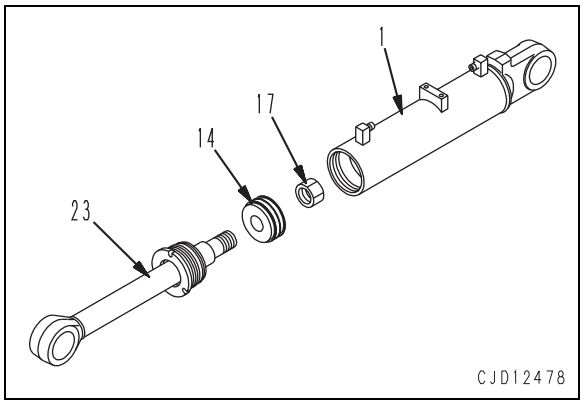


5) Disassemble the piston assembly according to the following procedure.
   i) Remove 2 wear rings (19).
   ii) Remove piston ring (20) from the piston.
   ★ Do not remove 6 seats (21) and 3 piston valves (22).

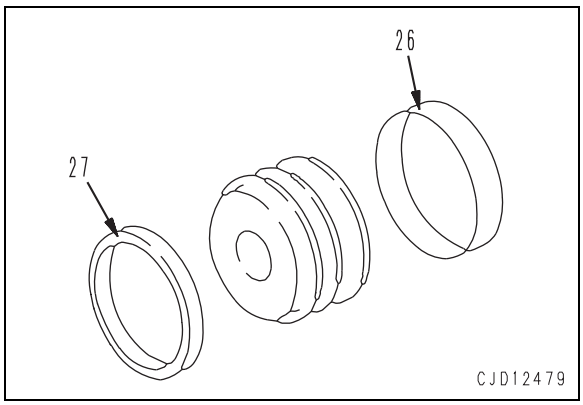


- **Blade tilt and ripper lift cylinders**

1) Set piston rod assembly (23) to tool **U1**.
2) Using tool **U3**, remove nut (24) from the cylinder.
3) Remove piston assembly (25) from piston rod (23).

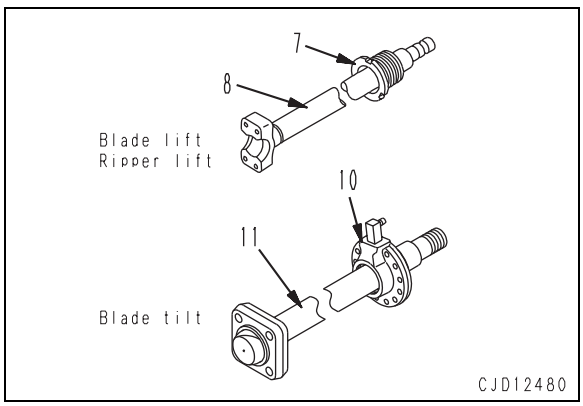


4) Remove wear ring (26) and piston ring (27) form the piston assembly.

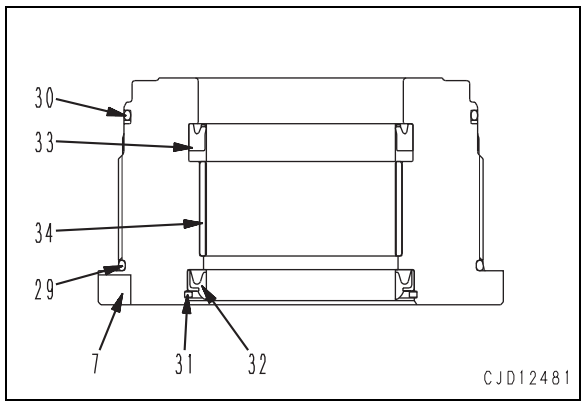


4. Head assembly

1) Remove head assembly (7) or (10) from piston rod (8) or (11).



2) Disassemble the head assembly according to the following procedure.
   i) Remove O-ring (29) and backup ring (30).
   ii) Remove snap ring (31) and dust seal (32).
   iii) Remove packing (33) and bushing (34).

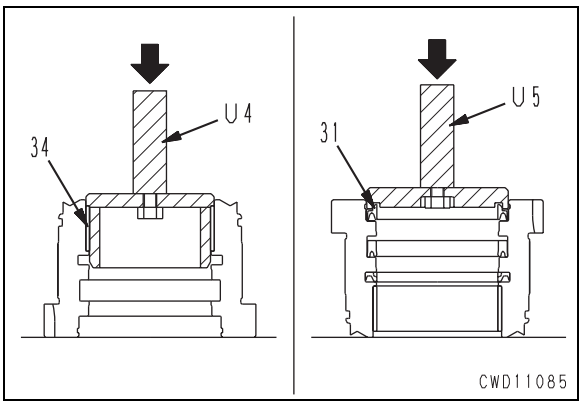


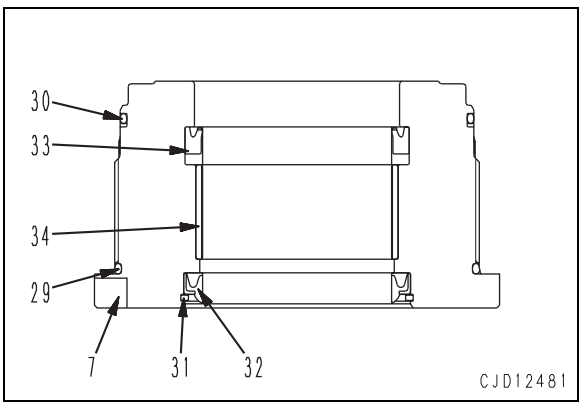
ASSEMBLY

★ Take care not to damage the packings, dust seals, O-rings, etc.
★ Clean the all parts. After installing them, cover the piping ports and pin holes to prevent dirt from entering.

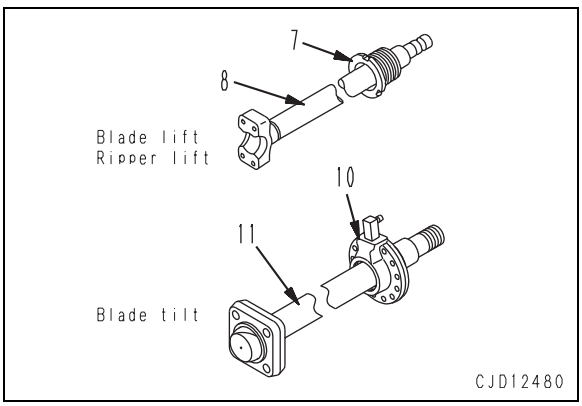
1. Head assembly

1) Assemble head assembly (7) according to the following procedure.
   i) Using tool **U4**, press fit bushing (34).
   ii) Install packing (33).
   iii) Using tool **U5**, install dust seal (32).
   iv) Install snap ring (31).
   v) Install O-ring (29) and backup ring (30).
      ★ When installing the backup ring, warm it in water at 50 – 60°C.



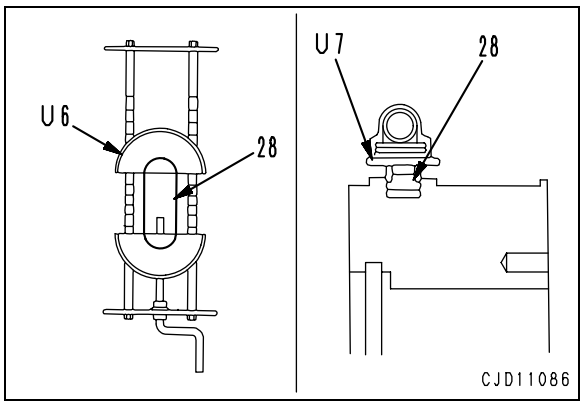


2) Fit the O-ring and install head assembly (7) or (10) to piston rod (8) or (11).

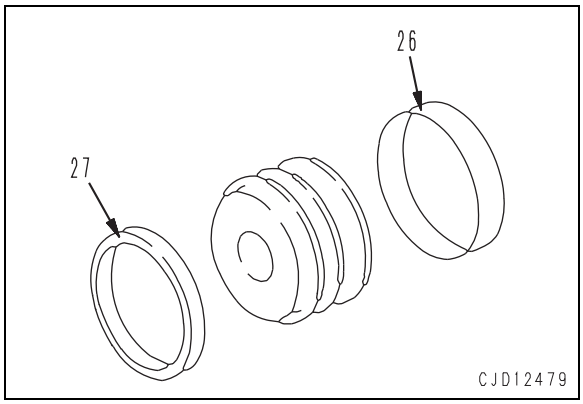


2. Assembly of piston assembly

1) Set piston ring (27) to tool **U6** and turn the handle 8 – 10 times to expand the piston ring.
2) Remove piston ring (27) from tool **U6** and install it to the piston.
3) Using tool **U7**, shrink piston ring (27).

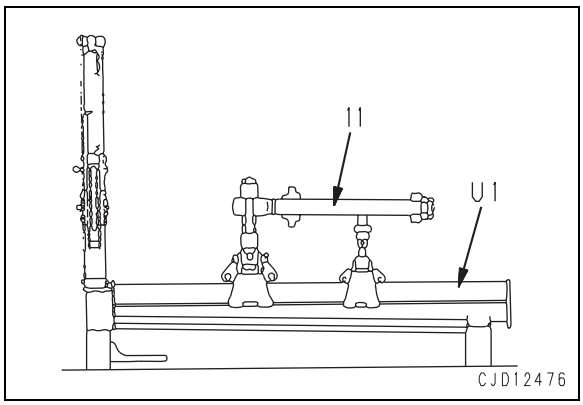


4) Install wear ring (26).



3. Piston assembly

Set piston rod (11) to tool **U1**.

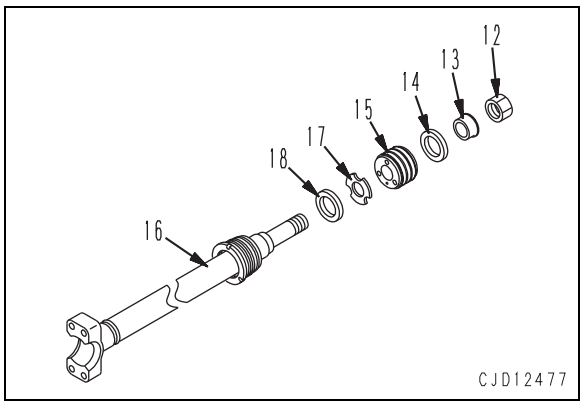


- **Blade lift cylinder**

1) Install retainer (17) and sleeve (18).
2) Install piston assembly (15) to piston rod (16), and then install sleeve (14) and collar (13).
3) Using tool **U3**, tighten nut (12) onto the cylinder.

Piston rod: **Adhesive (LT-2)**

Mounting nut:
2.16 ± 0.22 kNm {220 ± 22 kgm}

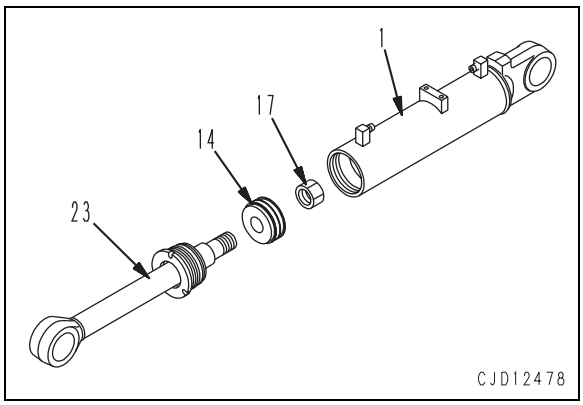


- **Blade tilt and ripper lift cylinders**

1) Set piston rod assembly (23) to tool **U1**.
2) Install piston assembly (25) to piston rod (23).
3) Using tool **U3**, tighten nut (24) onto the cylinder.

Piston rod: **Adhesive (LT-2)**

Mounting nut:
Blade tilt cylinder:
5.20 ± 0.52 kNm {530 ± 53 kgm}
Ripper lift cylinder:
3.97 ± 0.40 kNm {405 ± 40.5 kgm}



4. Piston rod assembly

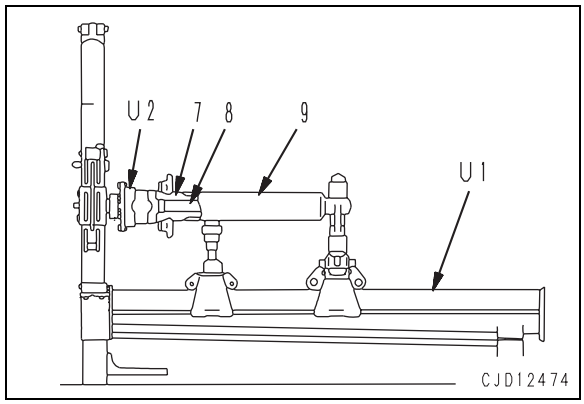
- **Blade lift and ripper lift cylinder**

1) Set cylinder (9) to tool **U1**.
2) Insert piston rod assembly (8) in cylinder (9).
★ Push in the piston rod to the stroke end.

Sealing part: **Grease (G2-LI)**

3) Using a hydraulic pump or a power wrench, install head assembly (7) to the cylinder with tool **U2**.

Head assembly:
Blade lift cylinder:
785 ± 78.5 Nm {80 ± 8.3 kgm}
Ripper lift cylinder:
1.03 ± 0.10 Nm {105 ± 10.5 kgm}



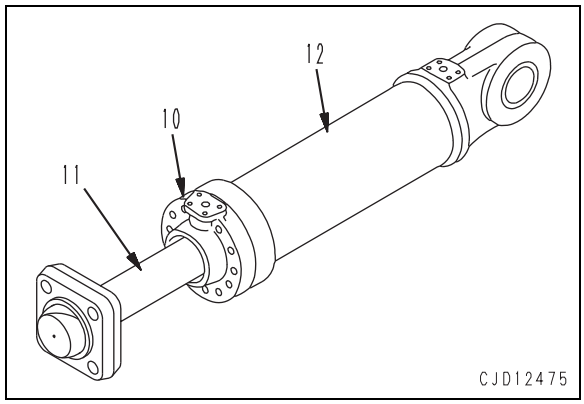
- **Blade tilt cylinder**

1) Set cylinder (12) to tool **U1**.
2) Insert piston rod assembly (11) in cylinder (12).
★ Push in the piston rod to the stroke end.

Sealing part: **Grease (G2-LI)**

3) Tighten the mounting bolts of head assembly (10).

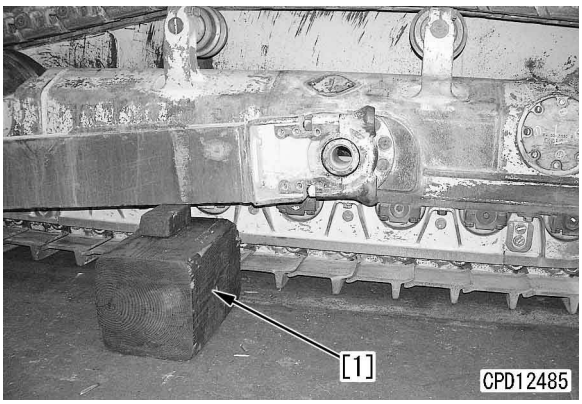
Head assembly:
250 ± 0.25 Nm {25.5 ± 2.5 kgm}



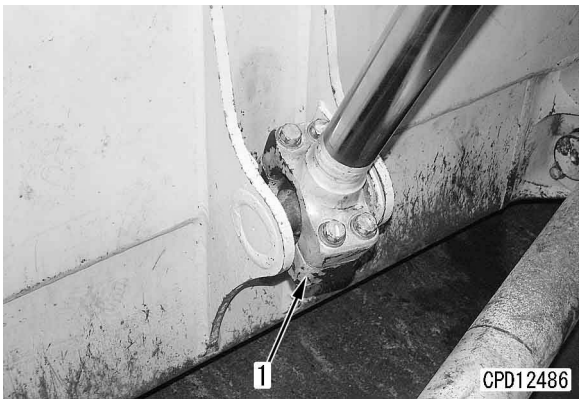
REMOVAL AND INSTALLATION OF BLADE ASSEMBLY

REMOVAL

⚠ Lower the work equipment horizontally to the ground and set blocks [1] to the right and left straight frames securely.

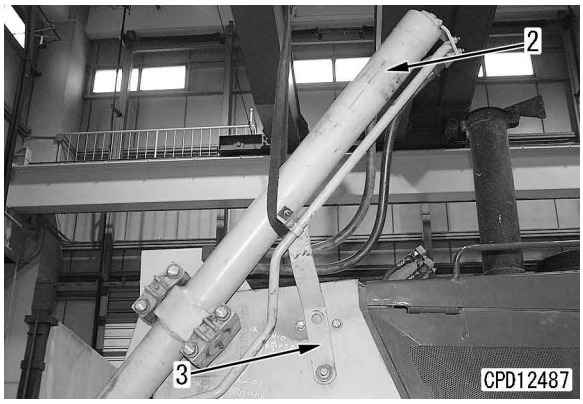


1. Remove cap (1) of the lift cylinder assembly. [*1]
   ★ Check the quantity and thickness of the shims.



2. Sling lift cylinder assembly (2) temporarily. Run the engine and retract the piston fully.

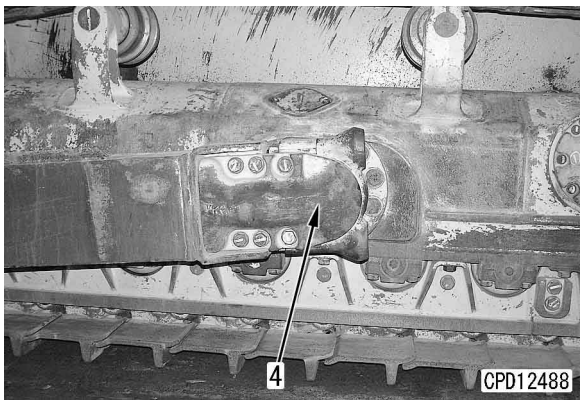
3. Using blade (3), fix lift cylinder assembly (2) to the radiator guard.
   ★ Bind the piston rod with wires, etc. so that it will not come out.



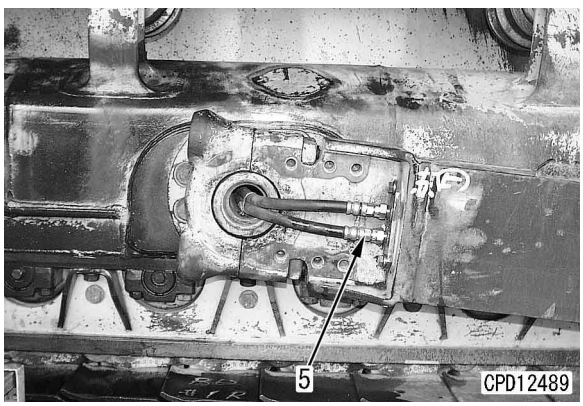
4. Similarly, disconnect the lift cylinder assembly on the opposite side from the blade.

   ⚠ Release the residual pressure in the work equipment cylinders. For details, see TESTING AND ADJUSTING, Releasing residual pressure in work equipment cylinders.

5. Remove left and right covers (4).

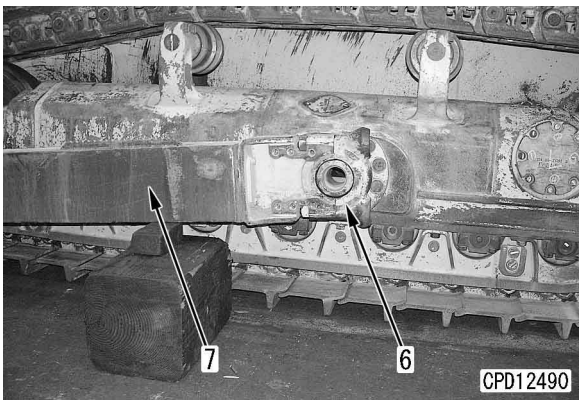


6. Disconnect 2 tilt hoses (5) from the right straight frame.
   ★ Make distinction marks to the hoses and plug them so that dirt will not enter the piping.



7. Remove left and right trunnion caps (6).

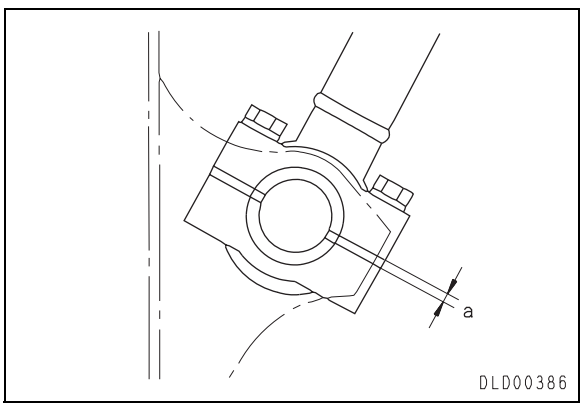
8. Remove blade assembly (7). [*2]
   ★ Run the engine and move the machine slowly in reverse to disconnect the blade assembly from the trunnion.
   Blade assembly:
   Straight tiltdozer; D85EX-15: 3,305 kg
   D85PX-15: 3,343 kg
   Semi-tiltdozer; D85EX-15: 3,575 kg



INSTALLATION

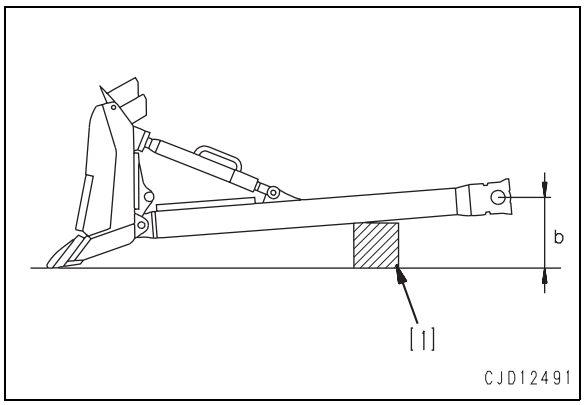
- Carry out installation in the reverse order to removal.

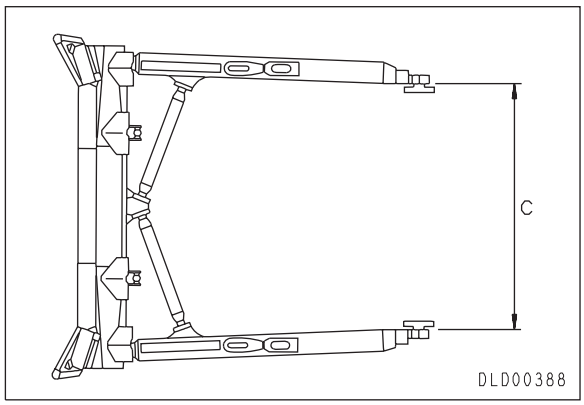
[*1]
   ★ Adjust clearance **a** at the cap mating surfaces to the following value with the shim and check that the trunnion turns smoothly.
      - Standard clearance **a**: 0.2 – 0.5 mm
      - Standard shim thickness: 4 mm
   ★ After installing the blade, adjust the blade tilting distance. For details, see TESTING AND ADJUSTING, Adjusting blade.



1) Remove cover (10).

[*2]
   ★ Adjust height **b** and width **c** of both straight frames to the following values with blocks [1], etc.
      - Height **b** of trunnion: 535 mm
      - Width of frame **c**: 2,762 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.

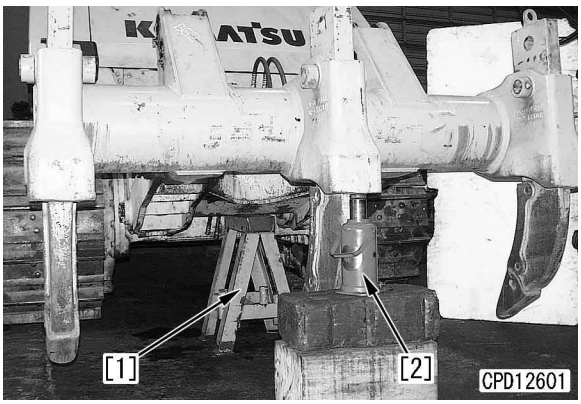
- **Bleeding air**
  Bleed air from the work equipment cylinders. For details, see TESTING AND ADJUSTING, Bleeding air from work equipment cylinders.

DISASSEMBLY AND ASSEMBLY OF RIPPER ASSEMBLY

For D85EX-15
DISASSEMBLY

1. Set jacks [2] under the respective centers stand [1] of the arm and beam of the ripper assembly.

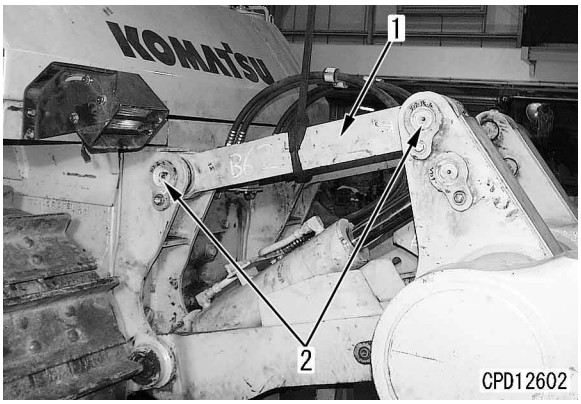
   ⚠ Lower the blade and apply and lock the brake securely.



2. Sling link (1) temporarily and remove the lock bolt of the pin.

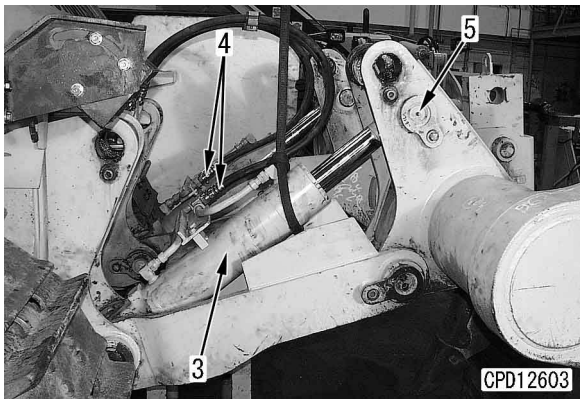
3. Remove pin (2) and link (1).
   ★ Remove the pin and link on the opposite side similarly.

   Link: **56 kg**



4. Sling lift cylinder assembly (3) temporarily and 2 disconnect hoses (4).

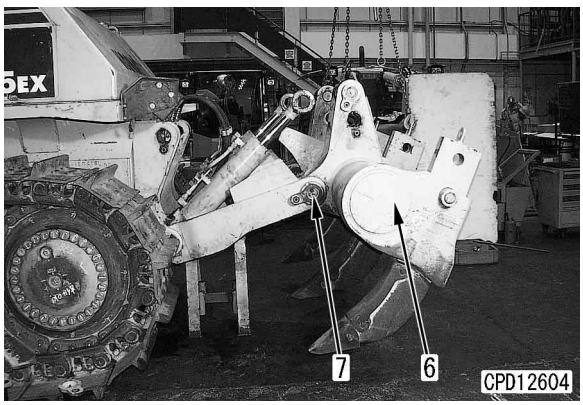
5. Remove the lock bolt of the pin, and then remove the pin (5).
   ★ Lower the lift cylinder assembly onto the arm, inserting a block between them.
   ★ Remove the pin on the opposite side similarly.



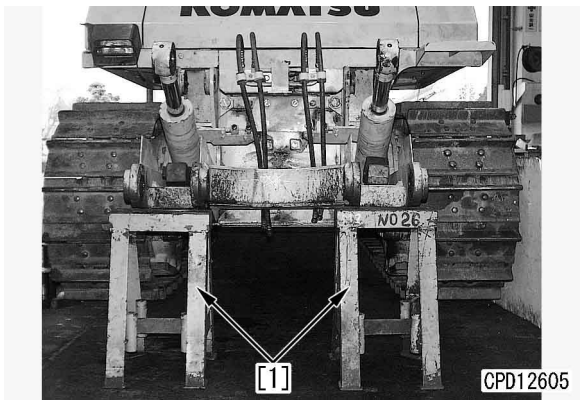
6. Sling beam (6) temporarily and remove the lock bolt of the pin.

7. Remove pin (7) and beam (6).
   ★ Remove the beam on the opposite side similarly.

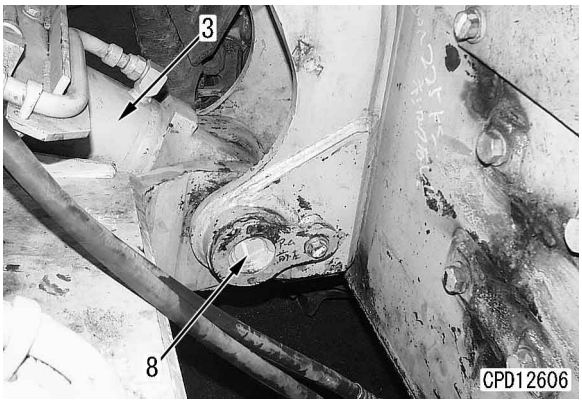
   Beam (with 3 shanks): **1,580 kg**



8. Remove stands [1] and set them under left and right sides of the arm.

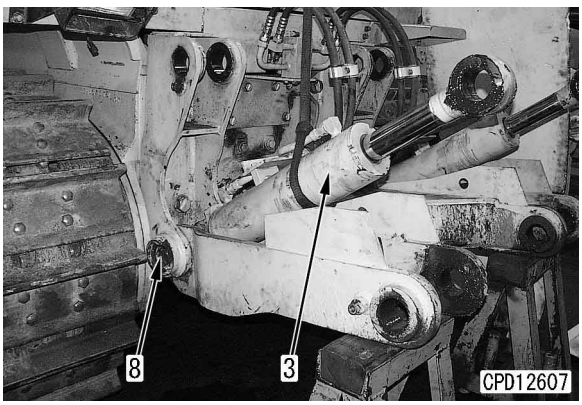


9. Sling lift cylinder assembly (3) temporarily and remove the lock bolt of pin (8).

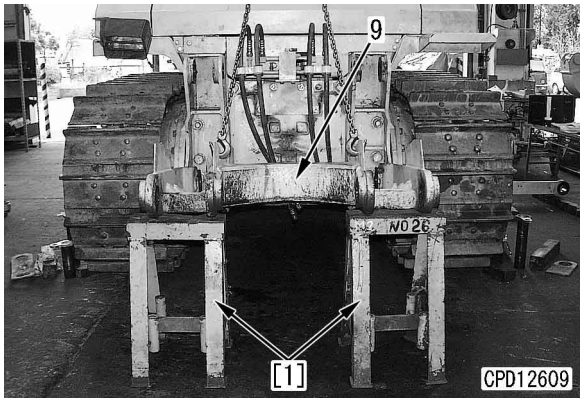


10. Pull out pin (8) and remove lift cylinder assembly (3).
    - ★ Pull out pin (8) to a position at which you can remove the lift cylinder assembly.
    - ★ Remove the lift cylinder assembly on the opposite side.

    Lift cylinder assembly: **87 kg**

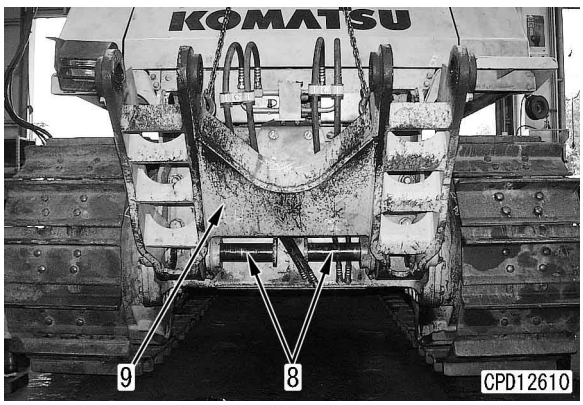


11. Sling arm (9) and remove stand [1].



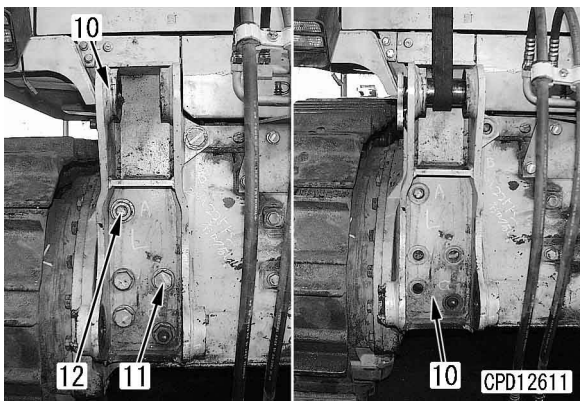
12. Pull out pin (8) and remove arm (9).
    - ★ Pull out pin (8) to a position at which you can remove arm (9).

    Arm: **345 kg**



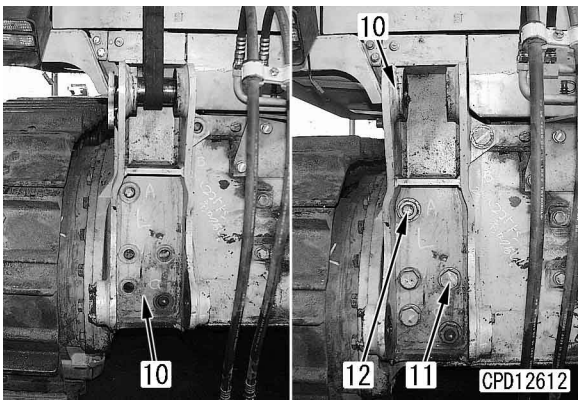
13. Sling bracket (10) temporarily and remove 4 bolt (11), 2 nuts (12), and bracket (10).
    - ★ Remove the bracket on the opposite side similarly.

    Bracket: **107 kg**

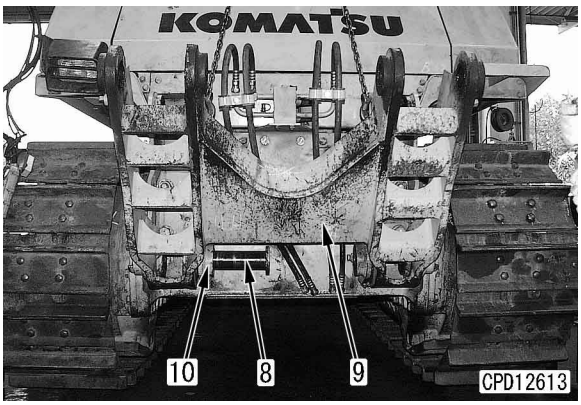


ASSEMBLY

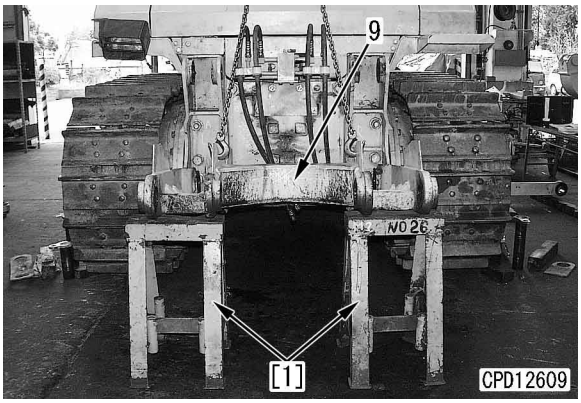
1. Sling and install bracket (10) and secure it with 4 bolts (11) and 2 nuts (12).
   ★ Install the bracket on the opposite side similarly.
   Bolt: **225 ± 25 Nm {23 ± 2.6 kgm}**
   Nut: **225 ± 25 Nm {23 ± 2.6 kgm}**



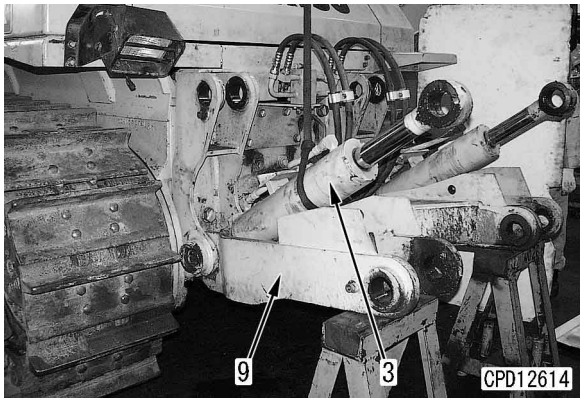
2. Sling arm (9) and install pin (8) to bracket (10).
   ⚠ When aligning the pin holes, never insert your fingers in them.
   ★ Insert pin (8) to a position to install arm (9).
   ★ Install the arm on the opposite side similarly.



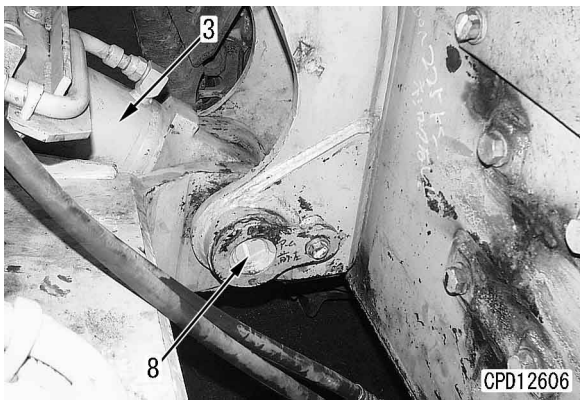
3. Set stands [1] under both sides of arm (9).



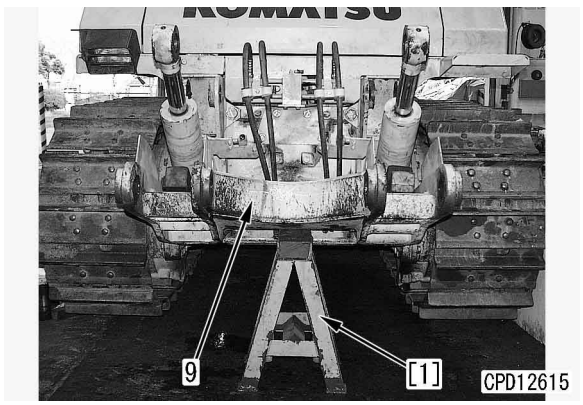
4. Sling lift cylinder assembly (3) and install it to arm (9).
   ★ Lower the lift cylinder assembly onto the arm, inserting a block between them.



5. Insert pin (8) and tighten the lock bolt.

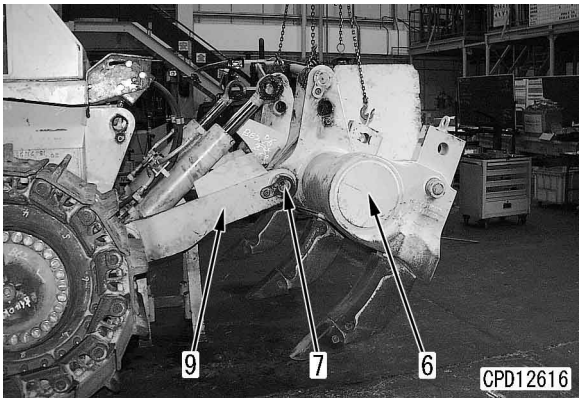


6. Remove stands [1] and set them under the center of arm (9).

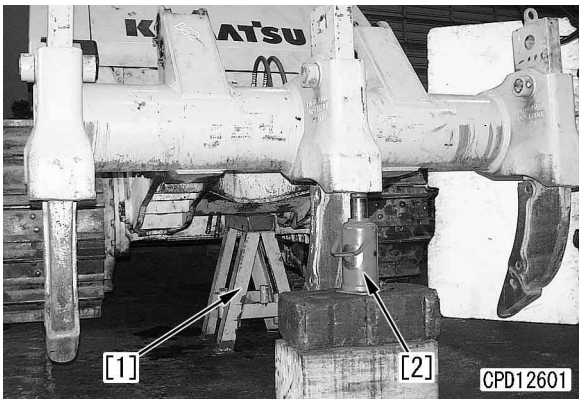


7. Sling beam (6) and install it to arm (9).

8. Insert pin (7) and tighten the lock bolt.
   ⚠ When aligning the pin holes, never insert your fingers in them.
   ★ Install the beam on the opposite side similarly.



9. Set jack [2] at the center of the beam.



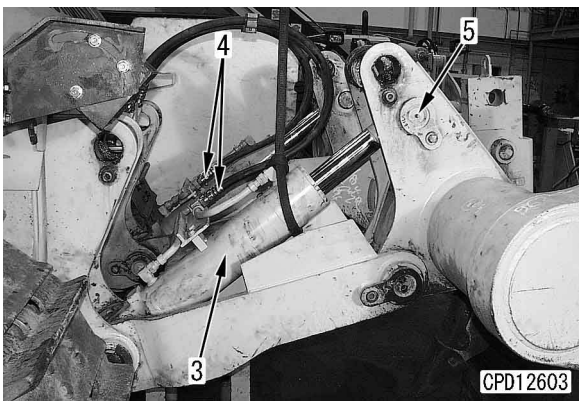
10. Connect lift cylinder hose (4).

11. Sling lift cylinder assembly (3) temporarily.

12. Run the engine and extract the piston rod to align the pin holes.

    ⚠ When aligning the pin holes, never insert your fingers in them.

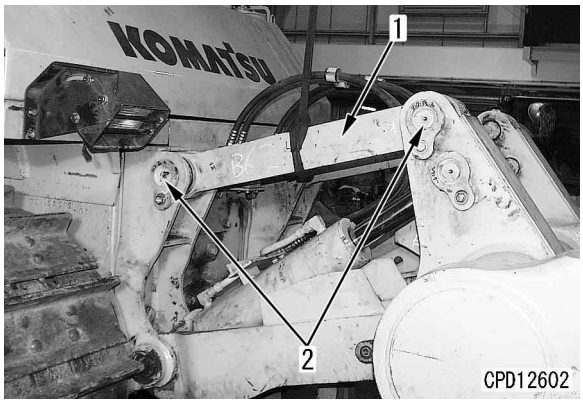
13. Install pin (5) and tighten the lock bolt.
    ★ Install the lift cylinder assembly on the opposite side similarly.



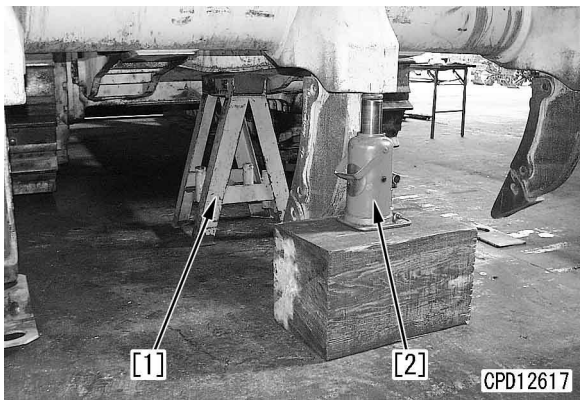
14. Sling link (1), align the pin holes, install pin (2), and tighten the lock bolt.

    ⚠ When aligning the pin holes, never insert your fingers in them.

    ★ Install the link on the opposite side similarly.



15. Run the engine, raise the ripper assembly, and remove stands [1] from under the arm and jack [2] from the center of the beam.



- **Bleeding air**
  ★ Bleed air from the work equipment cylinders. For details, see TESTING AND ADJUSTING, Bleeding air from work equipment cylinders.
  ★ Supply grease (G2-LI) to each connecting pin.

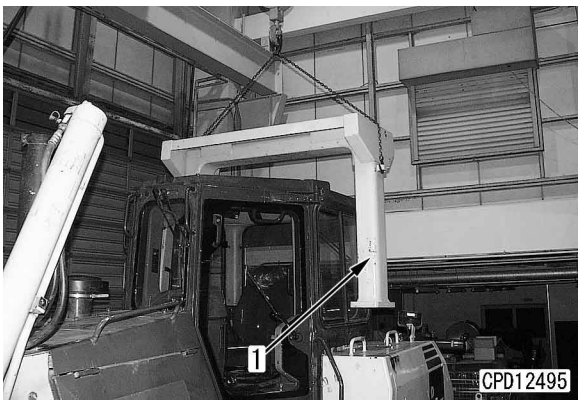
REMOVAL AND INSTALLATION OF ROPS GUARD ASSEMBLY

REMOVAL

1. Sling ROPS guard (1) temporarily.

2. Remove mounting bolts (2). [*1]

3. Lift off ROPS guard (1).
   ROPS guard: **371 kg**



INSTALLATION

- Carry out installation in the reverse order to removal.

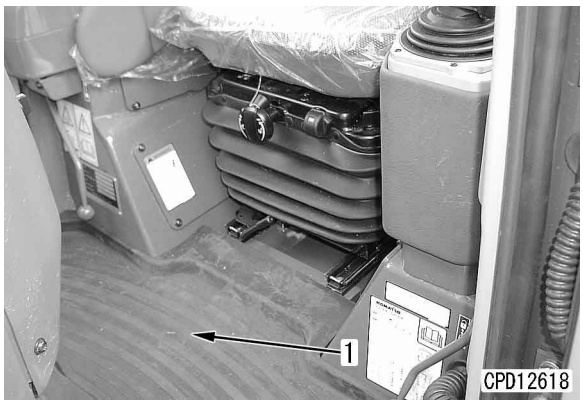
[*1]
Mounting bolt:
824 – 1,030 Nm {84 – 105 kgm}

REMOVAL AND INSTALLATION OF OPERATOR'S CAB ASSEMBLY

REMOVAL

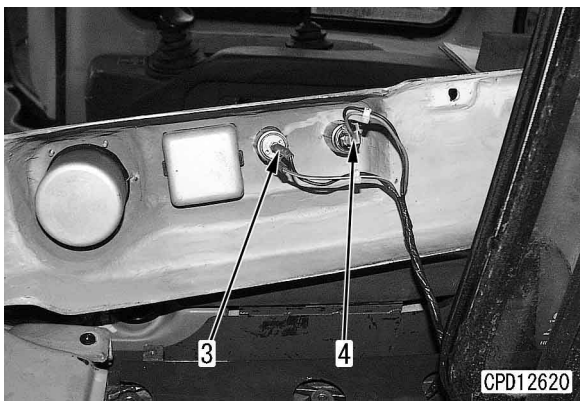
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove the ROPS guard. For details, see REMOVAL OF ROPS GUARD.
2. Remove floor mat (1).

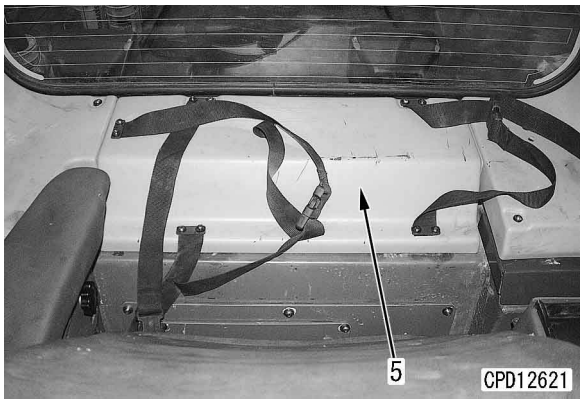


3. Remove the mounting bolts of left cover (2).

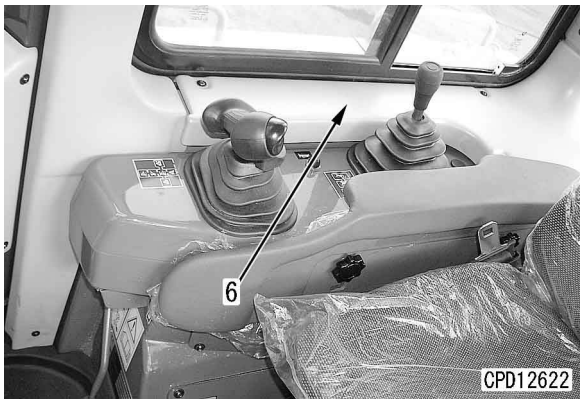
4. Turn over cover (2), disconnect cigarette lighter connector CIG (3) and accessory socket connector ACC (4), and remove cover (1). [*1]



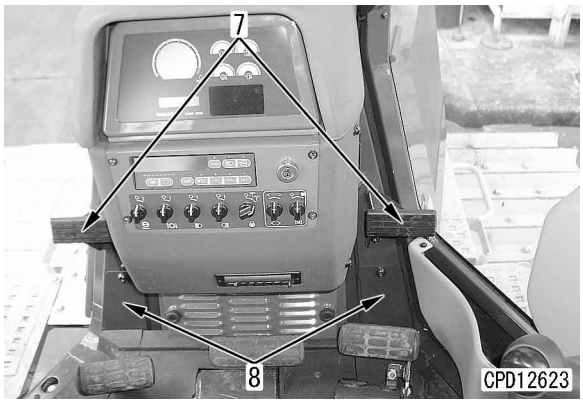
5. Remove rear cover (5).



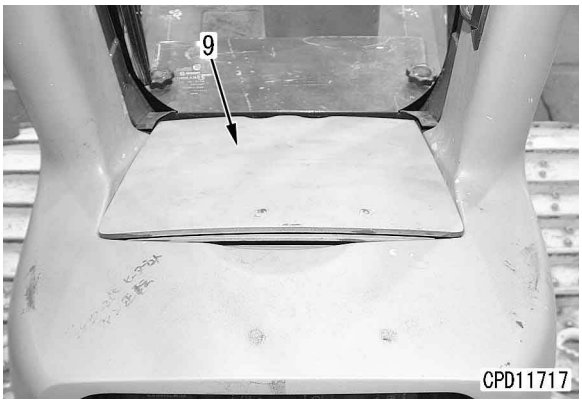
6. Remove right cover (6).



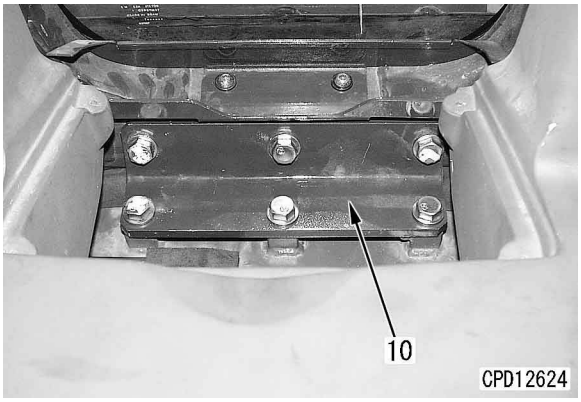
7. Remove both foot rests (7) and cover (8).



8. Remove hot and cool box (9).



9. Remove dashboard mounting bracket (10).

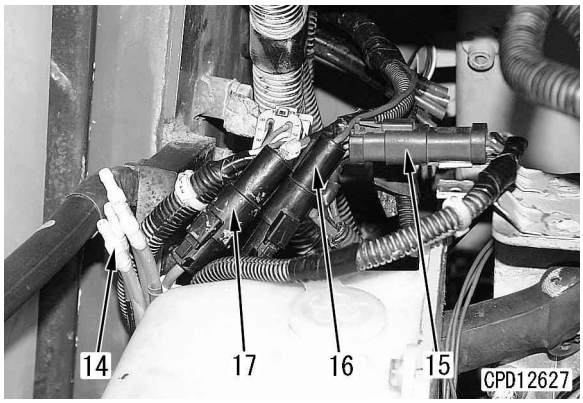


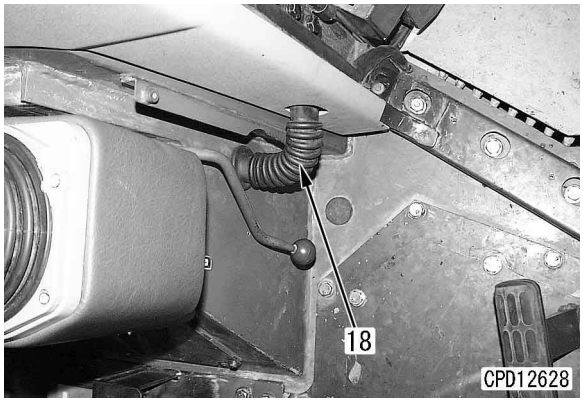
10. —

11. Open battery case cover (13).

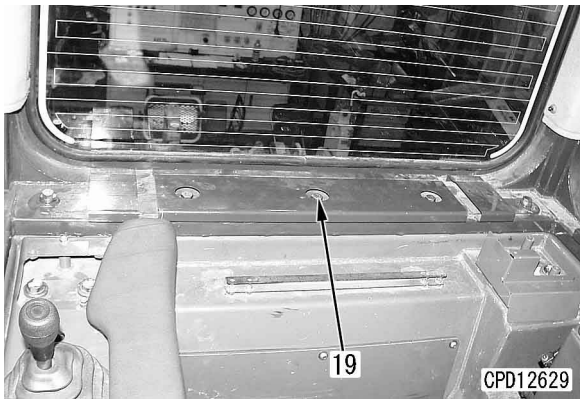
12. Disconnect 4 washer hoses (14). [*2]

13. Disconnect connectors 19 (15), 20 (16), and 21 (17). [*3]
    ★ After disconnecting the connectors and hoses, pull out grommet (18) in the operator's cab.

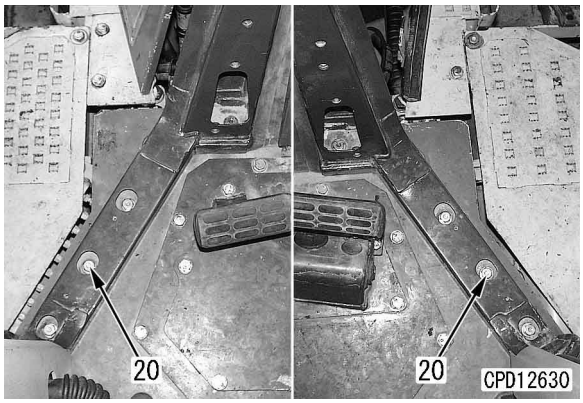




14. Remove mounting bolts (19) in the operator's cab.
    ★ Remove 5 bolts in the rear and 4 respective bolts on both sides.



15. Remove 4 respective mounting bolts (20) at both doors of the operator's cab.



16. Lift off operator's cab assembly (21).
    ★ When lifting off the operator's cab assembly, check that all the wire are disconnected.

    Operator's cab assembly: **410 kg**

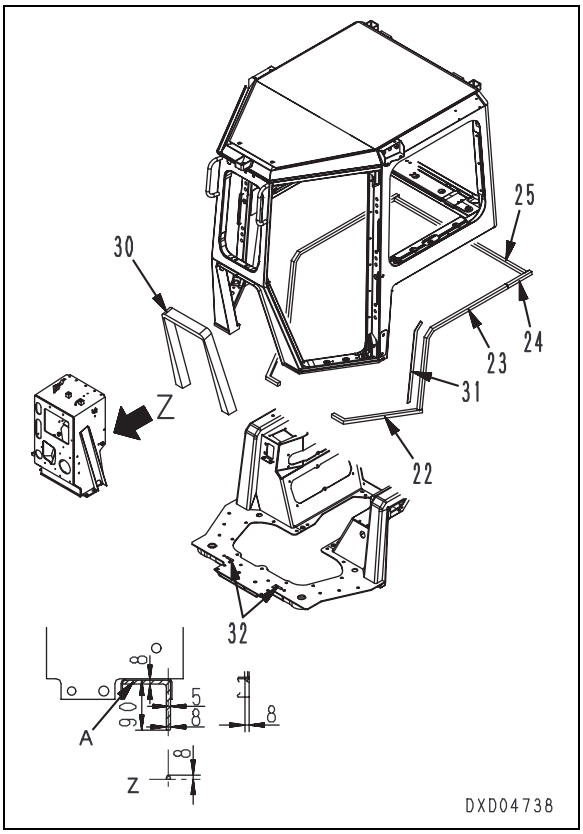
INSTALLATION

- Carry out installation in the reverse order to removal.

[*1] [*3]
    ★ When connecting the connectors, take care not to mistake their Nos.

[*2]
    ★ After connecting the windshield washer hose and connector, securely install the grommet to the through hole of the cab.

Arrangement of seals



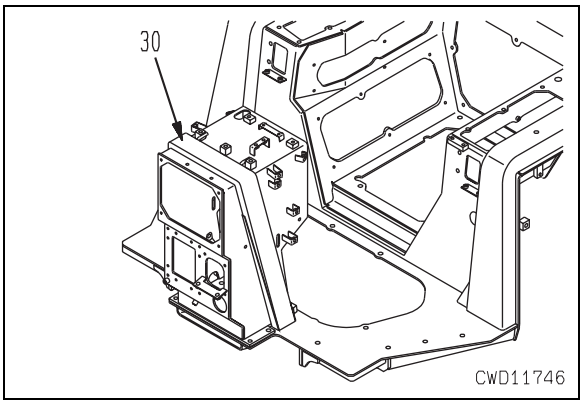
- Installation of seals to air conditioner box
    1) Remove dirt, oil, and grease from the top of the floor frame to apply gasket sealant (32).
    2) Apply the gasket sealant to the top of the floor frame.
        - For the parts to apply the gasket sealant, see view **Z** above. (Hunting of position **A**)

        (32): **Three bond 1207B**
    3) Fit seal (30) to the guide plate of the air conditioner box.

        Inside of seal: **Adhesive (LT-1A)**

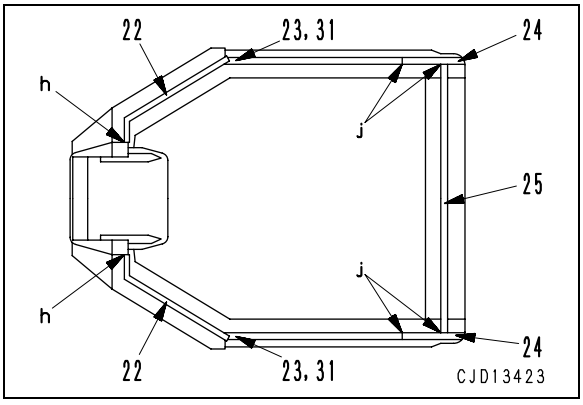
        ★ Pull down seal (30) to press the gasket sealant applied in 2).
        ★ Fill the clearance between seal (30) and floor frame with adhesive (LT-1A).

4) Apply grease (G2-LI) to the outside of seal (30) (sealing face against the cab).
   ★ Apply grease so that the cab will slip well and the seal will not be moved or deformed when the cab is installed.

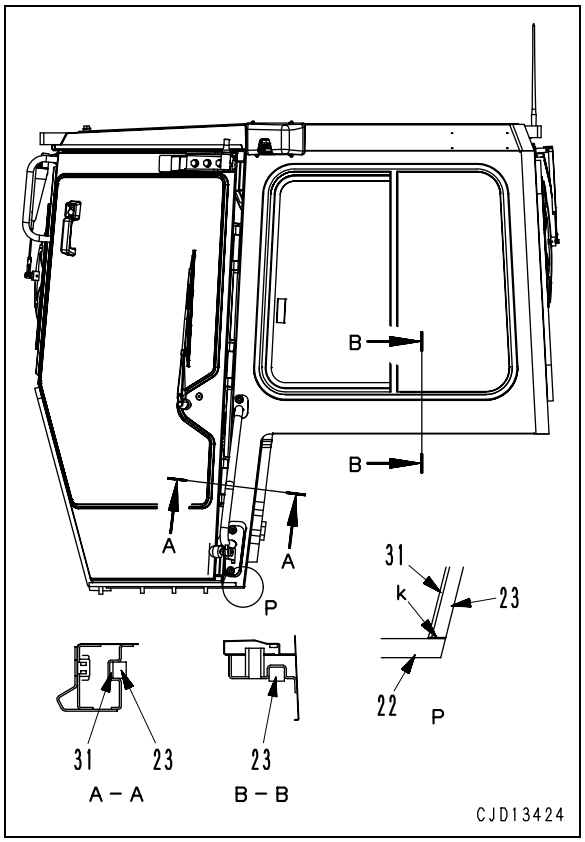


- Installation of seals of operator's cab mating faces
  1) Sling the operator's cab assembly.
  2) Remove dirt, oil, and grease from the seal fitting surfaces.

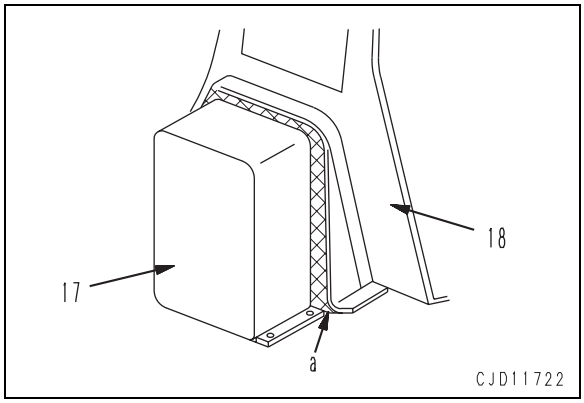
     ⚠ Do not stand under the operator's cab.
  3) Referring to the figure, stick seals (22), (23), (24), (25), and (31).
  4) Stick the seals in the order of (22), (31), (23), (24), and (25).
  5) Fit end part h of seal (22) to the air conditioner box to eliminate clearance.
  6) Fit part **j** (the joint) to eliminate clearance.
  7) Use the excessive part of seal (22) as seal (24).
     ★ Cab seen from bottom



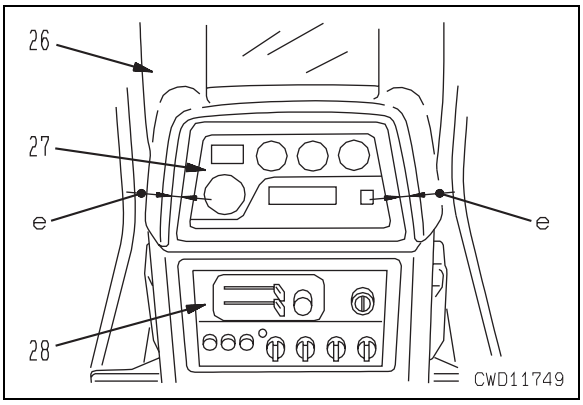
8) Cut seal (22) flush with seal (23). (See figure P.)
   • Fit part **k** (the joint) to eliminate clearance.
9) Seal (31) to the groove first, and then stick seal (23). (See section A – A.)

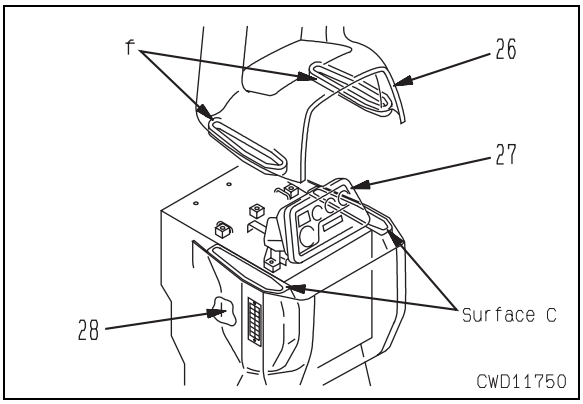


- When installing the operator's cab, obey the following points.
  1) Lower the operator's cab assembly onto the floor frame slowly.
     - ★ Since the reaction force of the seal sponge is large, lower the operator's cab assembly slowly.
     - ★ Check that the air conditioner duct seal on the cab side 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 (17) and cab (18) is fitted securely.
  4) Check that there is not clearance at joint **a** of the seal and front frame.

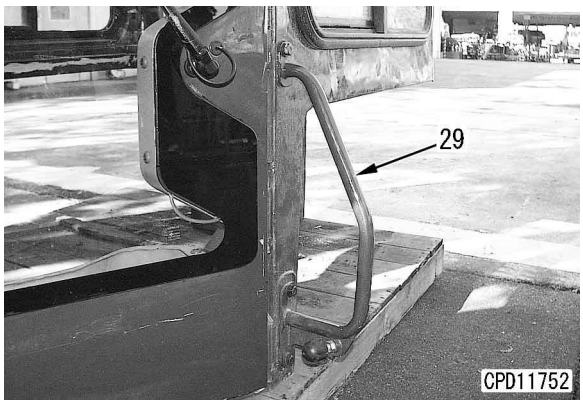


  5) Check that clearance **e** between cab-side air conditioner duct (26) and monitor (27) is even on both sides. At the same time, check that cab-side air conditioner duct seal **f** is fitted to faces **C** on both sides of dashboard-side air conditioner duct without deviating to the right or left.
     - ★ 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 dashboard mounting bracket.
  7) Measure the internal pressure. For details, see TESTING AND ADJUSTING OPERATOR'S CAB.

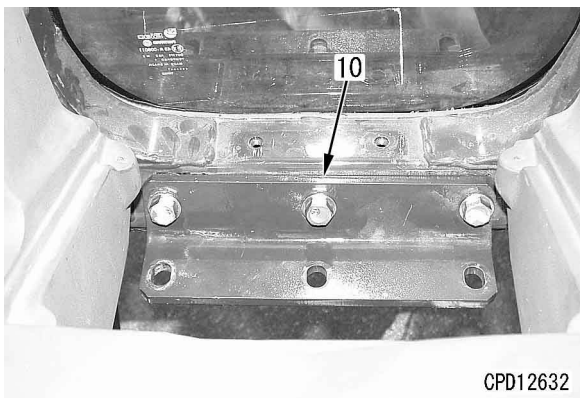




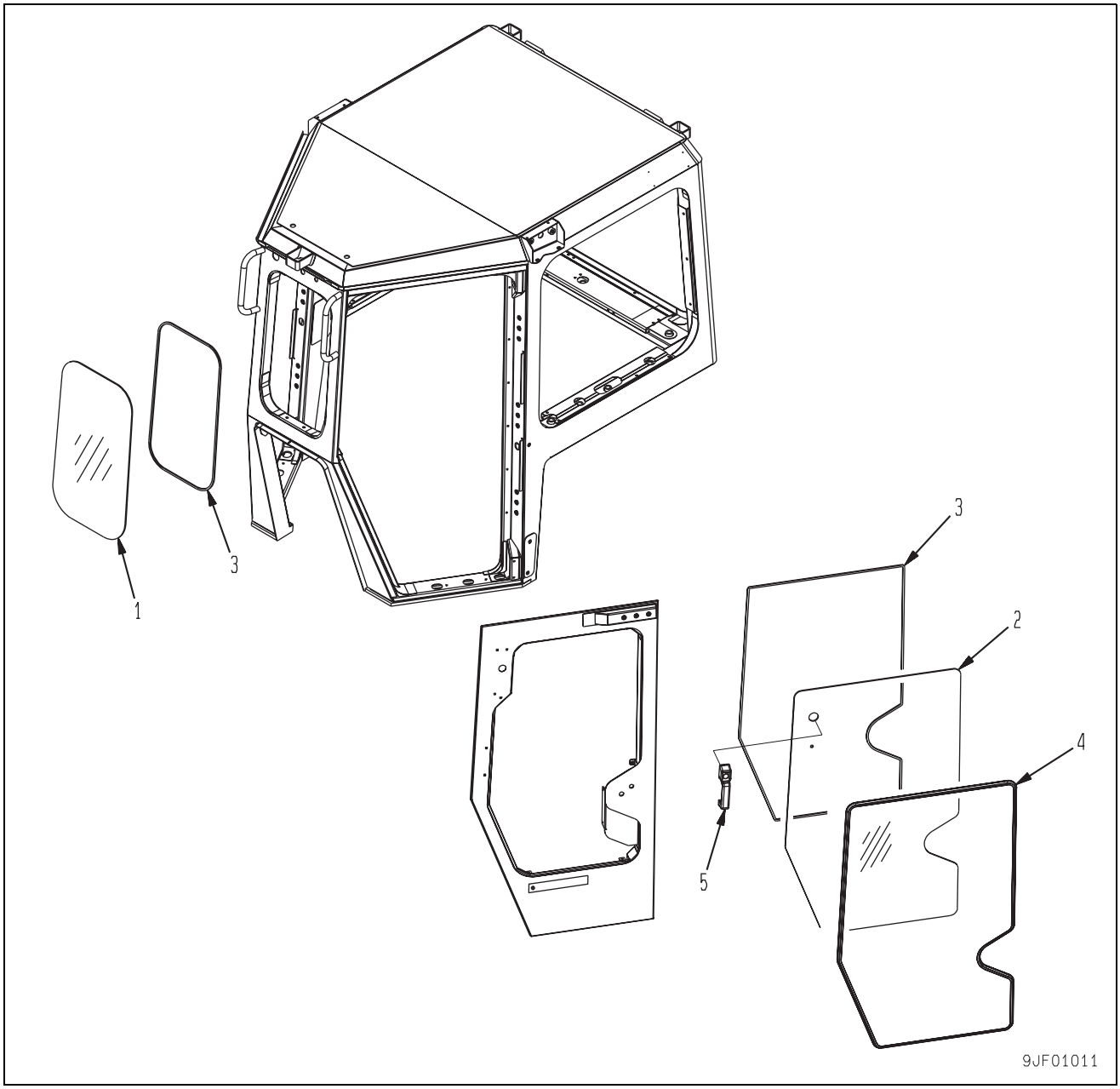
- Parts to be installed before operator's cab is mounted
  1) Install open lock stopper mounting grip (29).



  2) Install cab mounting L-plate (10) to the cab.



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

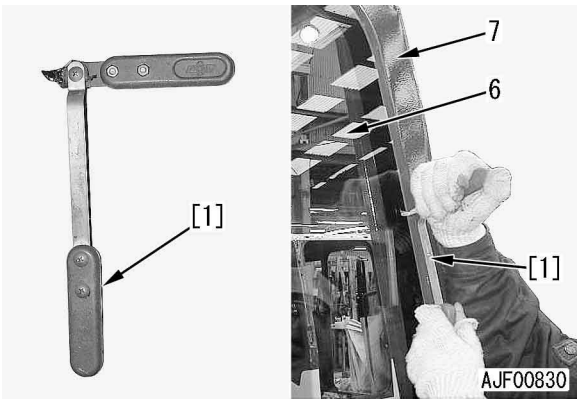
SPECIAL TOOLS

Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
X	1	793-498-1210	Lifter (Suction cup)	■	2		

REMOVAL

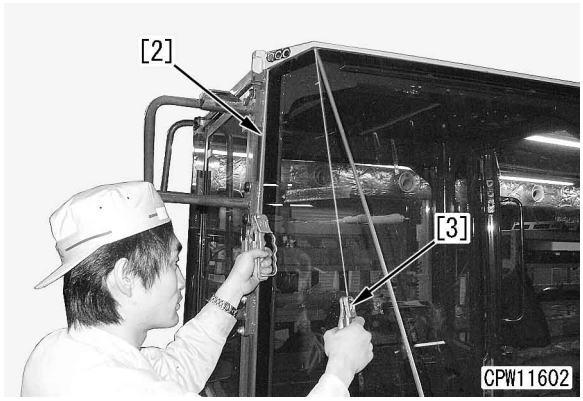
* Remove the window glass to be replaced according to the following procedure.

1. Using seal cutter [1], cut the adhesive between broken window glass (6) and operator's cab (metal sheet) (7).



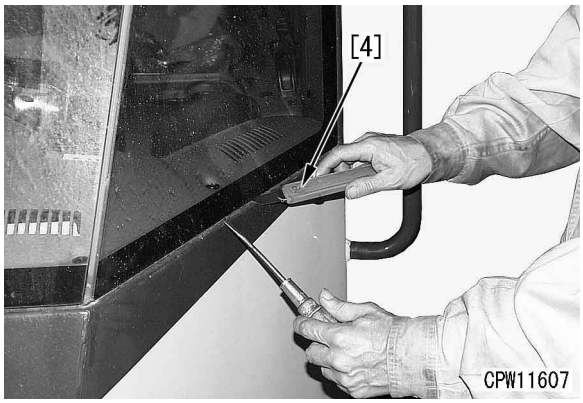
★ If a seal cutter is not available, make holes on the adhesive and both-sided adhesive tape with a drill and pass a fine wire (piano wire, etc.) [2] through the holes. Grip the both ends of the wire with priors [3], etc. (or hold them by winding them onto something) and move the wire to the right and 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.)

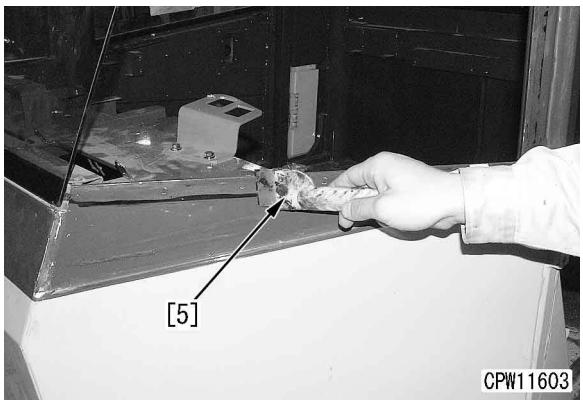


2. Remove the window glass.

INSTALLATION

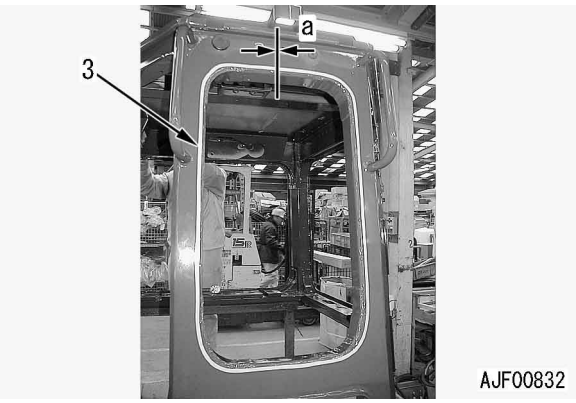
1. Using a knife and scraper [5], remove the remaining adhesive and both-sided adhesive tape from the metal sheets (glass sticking surfaces) of the operator's cab.
   ★ Remove the adhesive and both-sided adhesive tape to a degree that they will not affect adhesion of the new adhesive. Take care not to scratch the painted surfaces.
   (If the painted surfaces are scratched, adhesion will be lowered.)

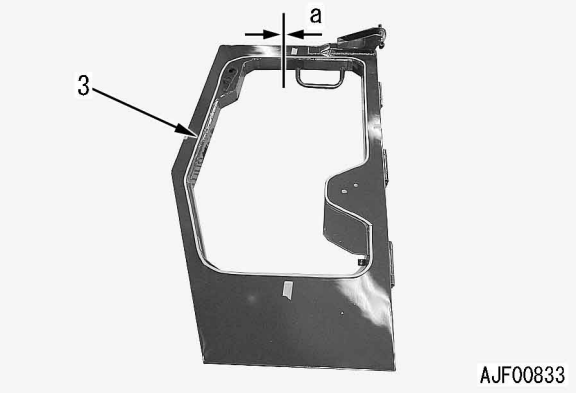
   (The following figure shows the operator's cab of a wheel loader.)



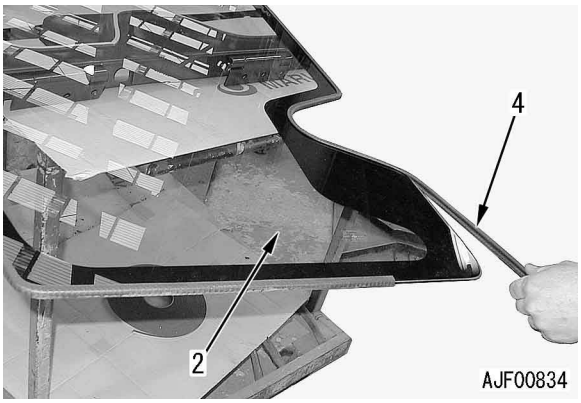
2. Remove oil, dust, dirt, etc. from the sticking surfaces of cab (7) and window glass (8) with white gasoline.
   ★ If the sticking surfaces are not cleaned well, the glass may not be stuck perfectly.
   ★ Clean the all black part on the back side of the window glass.
   ★ After cleaning the sticking 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.

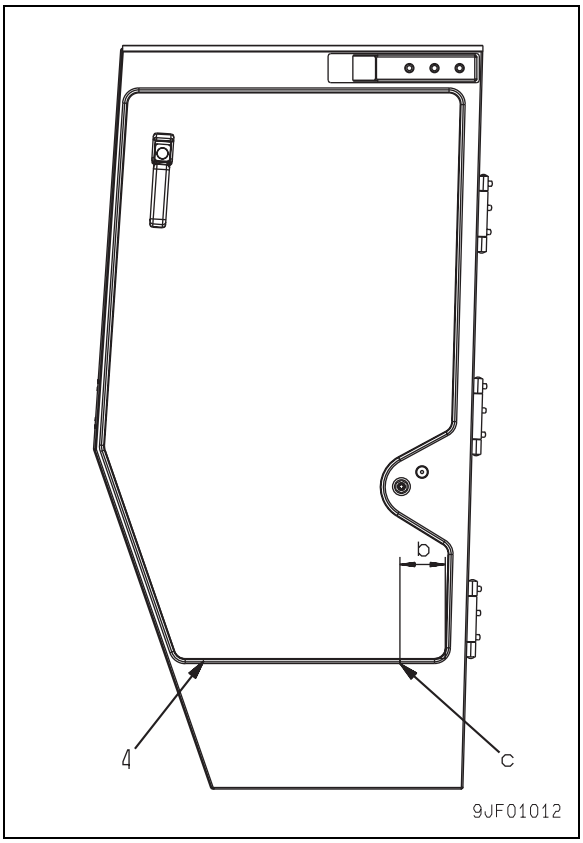




4. Install trim seals (4) to both door window glasses (2).



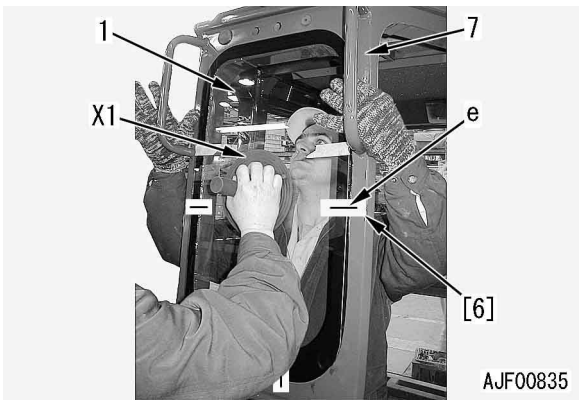
★ Install each trim seal (4) so that its finishing end and starting end will be jointed at position (c) and dimension (b) between the corner and position (c) will be 90 mm.

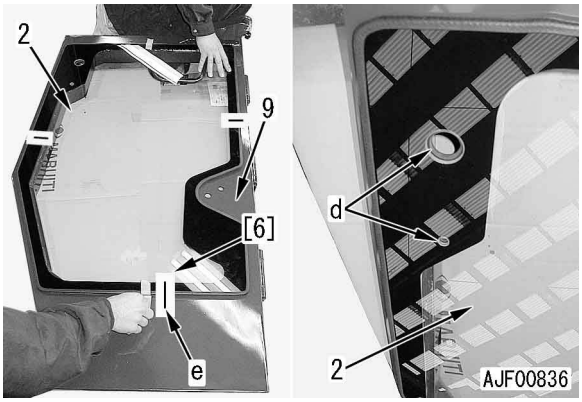


5. Position the new window glass.
   1) Using tool **X1**, set the window glass to the sticking position. Check the clearance between the window glass and the operator's cab on the right, left, upper, and lower sides, and then adjust it evenly.
      ★ Position front window glass (1) from inside of operator's 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).

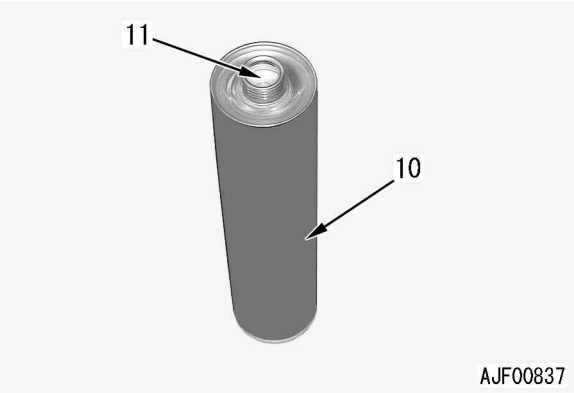
   3) Cut the tapes between window glasses (1) and (2) and operator's cab (7) with a knife, and then remove the window glasses.
      ★ Do not remove the tapes left on the window glasses and operator's cab before installing the window glasses.



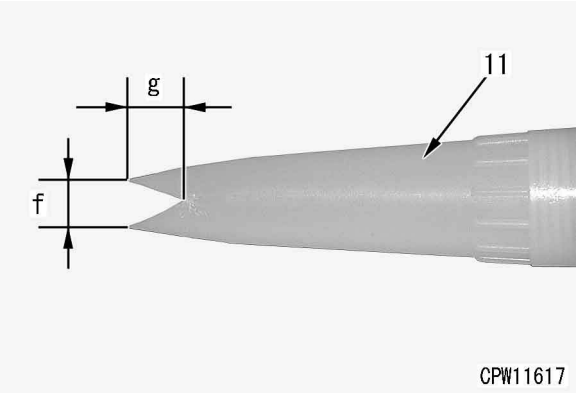


6. Apply adhesive.
   Adhesive: **Sikaflex 256HV manufactured by Sika Japan**
   - ★ Do not use primer.
   - ★ The using limit of the adhesive is 6 months after the date of manufacture. Do not use the adhesive after this limit.
   - ★ Keep the adhesive in a dark place where the temperature is below 25°C.
   - ★ Never heat the adhesive higher than 30°C.
   - ★ When reusing the adhesive, remove the all hardened part from the nozzle tip.

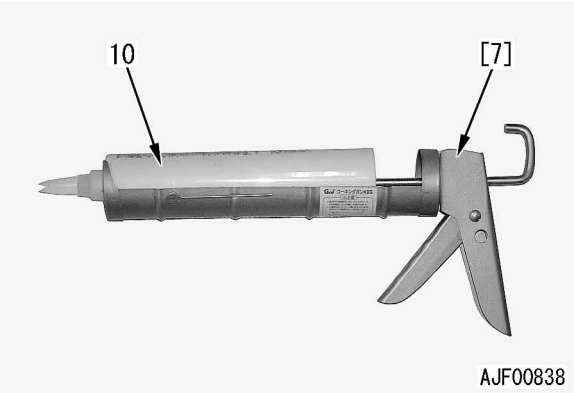
1) Break aluminum seal (11) of the outlet of adhesive cartridge (10) and install the nozzle.



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

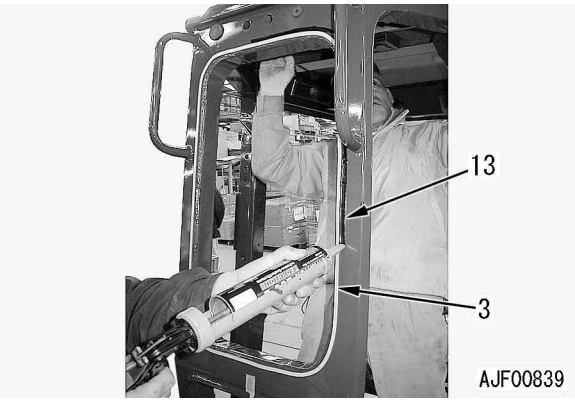


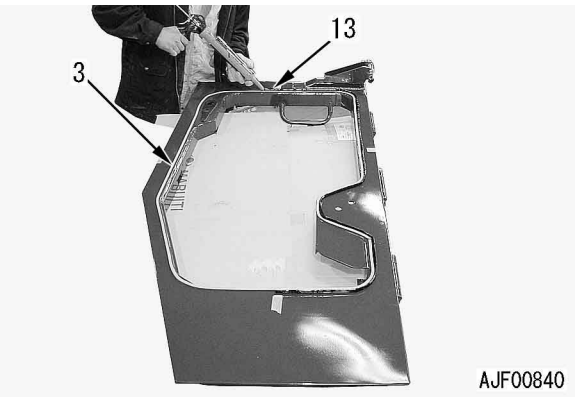
3) Set adhesive cartridge (10) to caulking gun [7].
   - ★ An electric caulking gun is more efficient.



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.

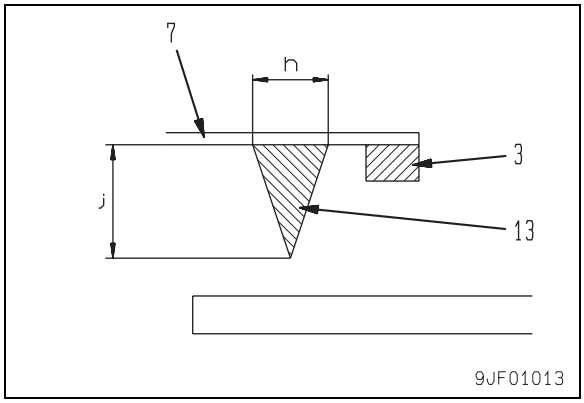




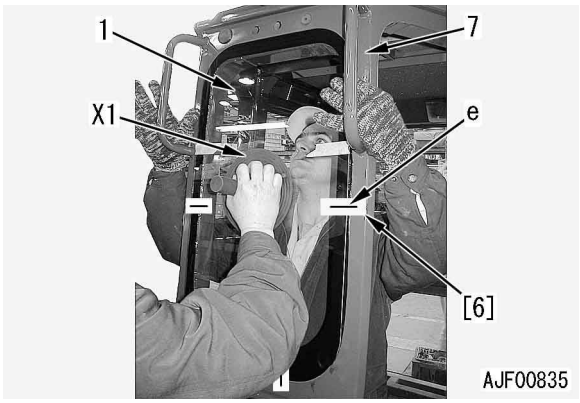
★ Apply adhesive (13) to dimensions (h) and (j) of both-sided adhesive tape (3) of operator's cab (7).
- Dimension (h): 10 mm
- Dimension (j) : 15 mm

★ Apply adhesive (13) higher than both-sided adhesive tape (3).

★ Apply the adhesive evenly.

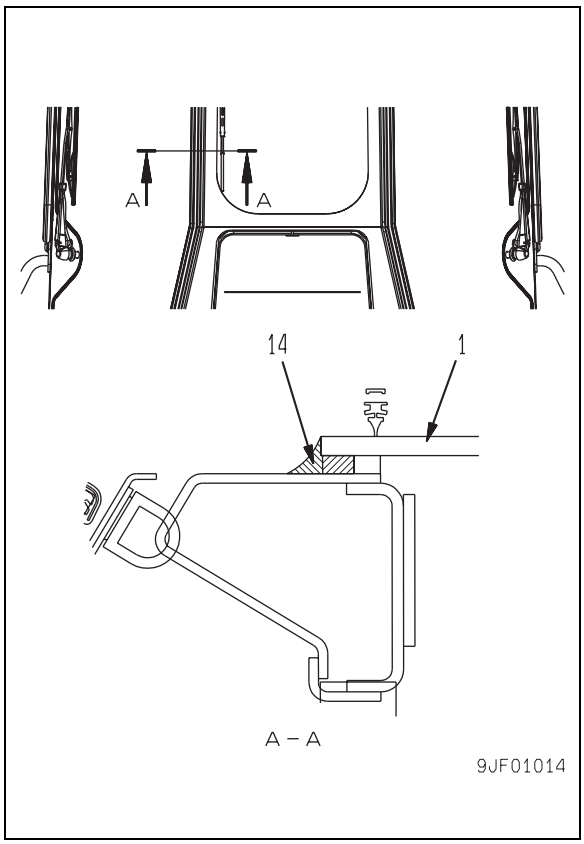


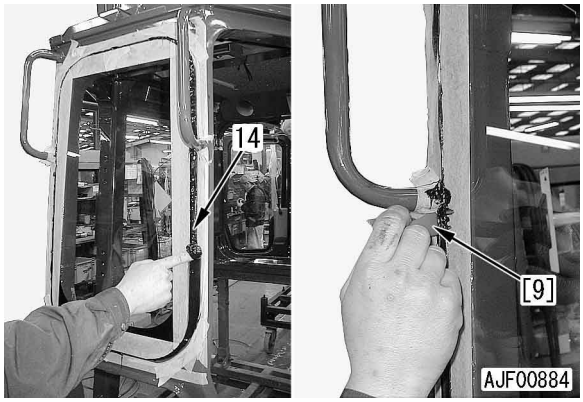
7. Install the front window glass.
   1) Using tool **X1**, match front window glass (1) to line (e) on positioning tapes [6] drawn in step 5 and install it to operator's cab (7).
      ★ Since the window glass cannot be removed and stuck again, stick it very carefully.
      ★ Stick the glass within 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.



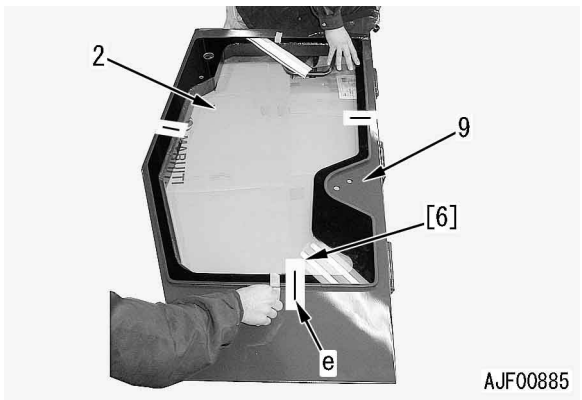
3) Mask front window glass (1) and operator's cab (7) with masking tapes [8].
4) Fill the clearance between front window glass (1) and operator's cab (7) with caulking material (14) all around the window.
   Caulking material:
   SEKISUI SILICONE SEALANT
   ★ The usable period of the following caulking material is 6 months after the date of manufacture. Do not use the caulking material after its usable period.

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.

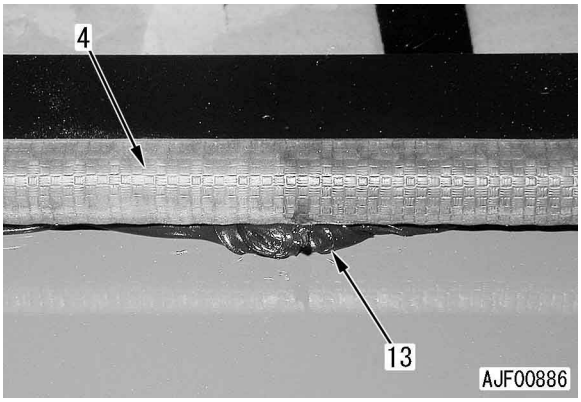


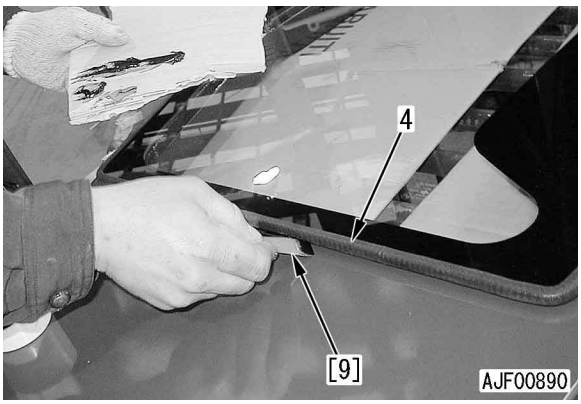


8. Install both door window glasses.
   1) Using tool **X1**, match both door window glasses (2) to lines (e) on positioning tapes [6] drawn in step 5 and install them to both doors (9).
      ★ Since the window glass cannot be removed and stuck again, stick it very carefully.
      ★ Stick the glass 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.



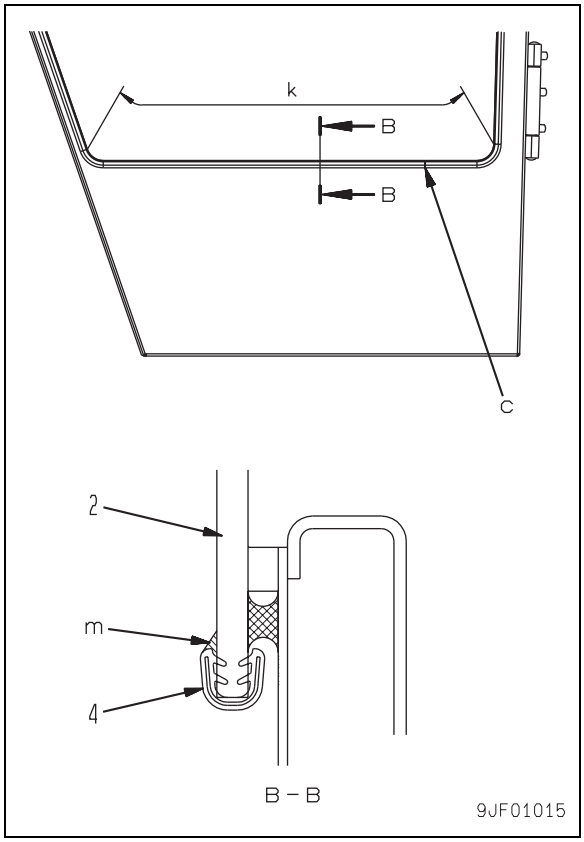
★ If adhesive (13) is projected from the trim seals (4) of stuck door window glasses on both sides, remove it with rubber spatula [9].





3) Fill the clearance between each door window glass and trim in the range of dimension (k).
   i) Mask the range of dimension (k) of each door window glass.
   ii) Fill clearance (m) between each door window glass (2) and trim seal (4) with caulking material.
   ★ The usable period of the following caulking material is 6 months after the date of manufacture. Do not use the caulking material after its usable period.
   ★ 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 lock the doors to 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 20°C and humidity of 60%).
    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(100V)	■	1		
	799-703-1110	Vacuum pump(220V)	■	1		
	799-703-1120	Vacuum pump(240V)	■	1		
	799-703-1401	Gas leak detector	■	1		

REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

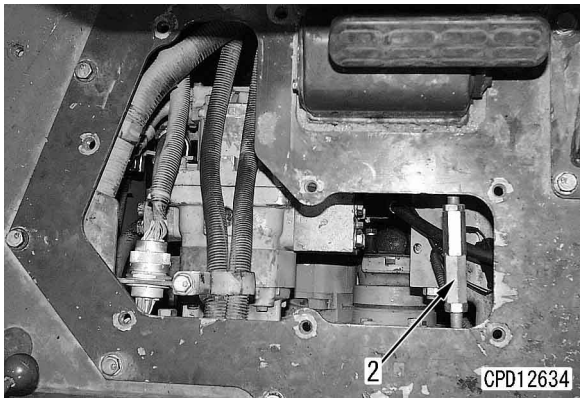
⚠ Lower the work equipment to the ground safely and release the residual pressure in the piping. For details, see TESTING AND ADJUSTING, Releasing residual pressure in work equipment cylinder.

1. Remove the engine hood assembly. For details, see REMOVAL OF ENGINE HOOD ASSEMBLY.

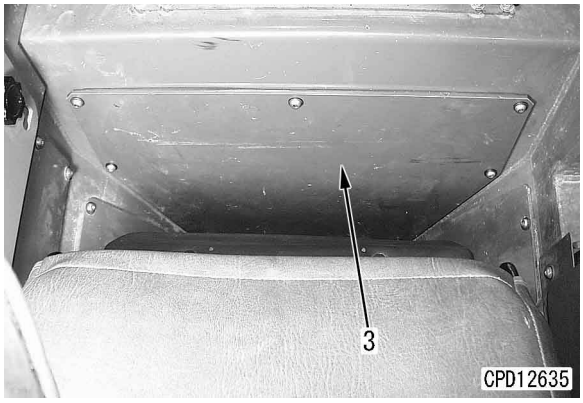
2. Remove the operator's cab assembly. For details, see REMOVAL OF OPERATOR'S CAB ASSEMBLY.

3. Remove cover (1).

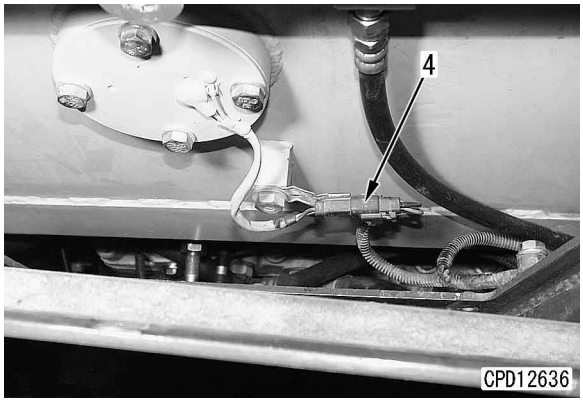
4. Disconnect turnbuckle (2) of the brake linkage. [*1]
   ★ Before disconnecting turnbuckle (2), check the pressing stroke of the brake.



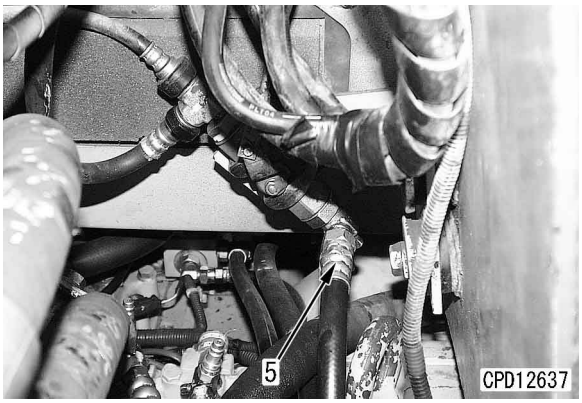
5. Remove rear cover (3).



6. Disconnect fuel level sensor wiring connector 423 (4).

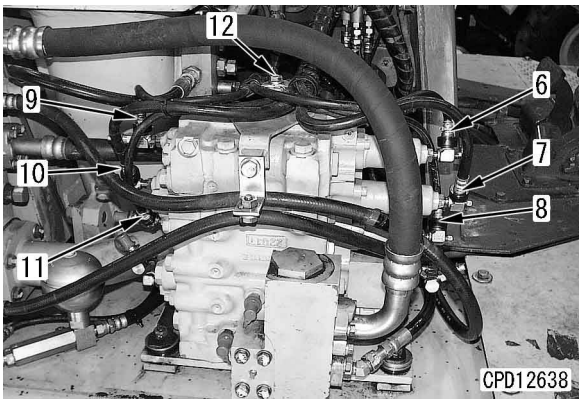


7. Disconnect accumulator hose (5).

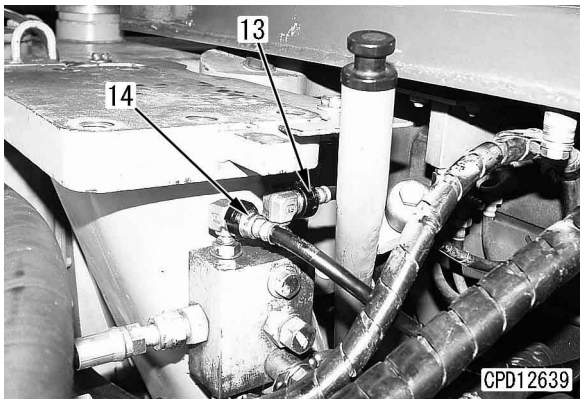


8. Disconnect 6 PPC hoses from the work equipment control valve. [*2]
   - Right-hand PPC hoses:
     (6) : Ripper lift cylinder RAISE hose
     Coupler (Port PA4), Color band: Black
     (7) : Blade lift cylinder LOWER hose
     Coupler (Port PA3), Color band: Black
     (8) : Blade tilt cylinder LEFT TILT hose
     Coupler (Port PA2), Color band: Yellow
   - Left-hand PPC hoses:
     (9) : Ripper lift cylinder LOWER hose
     Coupler (Port B4), Color band: Not used
     (10): Blade lift cylinder RAISE hose
     Coupler (Port B3), Color band: Not used
     (11): Blade tilt cylinder RIGHT TILT hose
     Coupler (Port B2), Color band: Green

9. Remove PPC hose clamp (12).

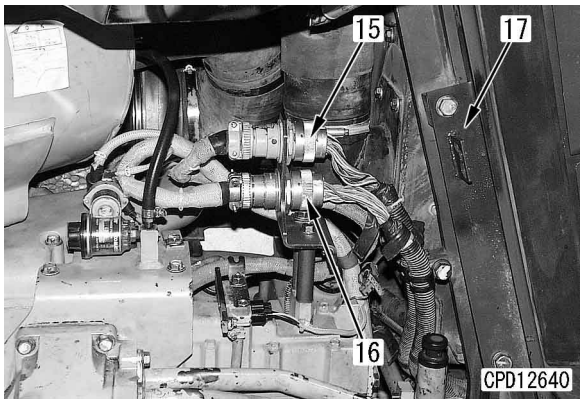


10. Disconnect 2 drain hoses from the drain merge block.
    (13): Ripper control valve drain hose
    (14): Blade control valve hose



11. Disconnect centralized connectors E21 (15) and E22 (16).

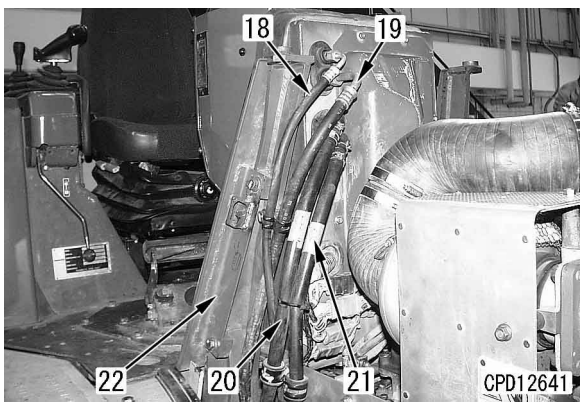
12. Remove right cover (17) on the dashboard side.



13. Disconnect receiver tank hose (18) and air conditioner compressor hose (19). [*3]
    ★ Before disconnecting the air conditioner hose, collect the refrigerant (R134a).

14. Disconnect heater hoses (20) and (21).
    ★ Close the heater hose valve on the engine side.
    ★ Stop the disconnected hoses with wooden plugs, etc.

15. Remove left cover (22) on the dashboard side.

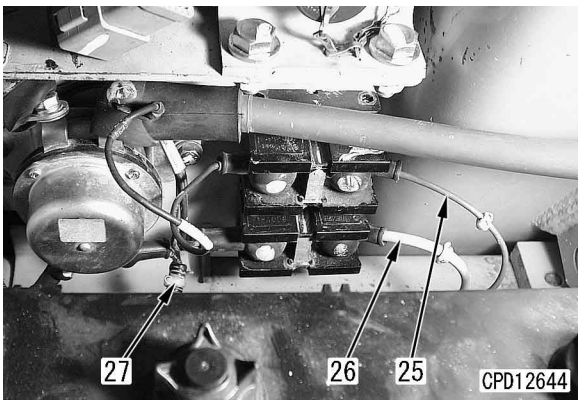


16. Open battery case cover (23).

17. Disconnect intermediate connector 101 (24).

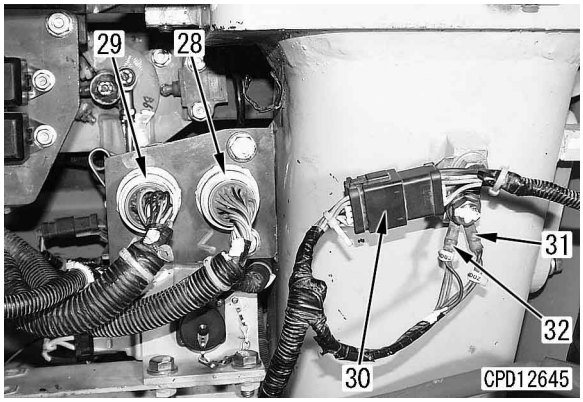
18. Disconnect fusible link terminals F32 (25) and F96 (26).

19. Disconnect battery relay terminal CN-SW (27).



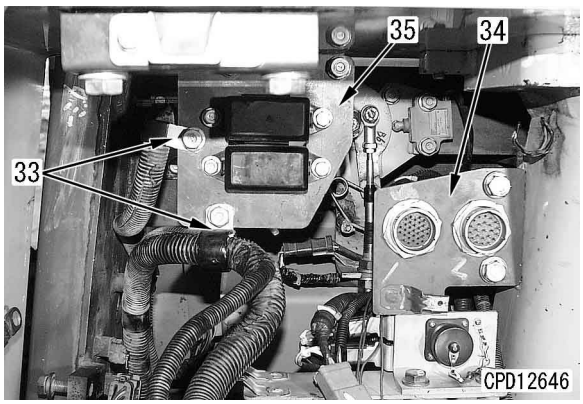
20. Disconnect intermediate connectors PL1 (28) and PL2 (29).

21. Disconnect intermediate connector PL5 (30), ground terminal GND02 (31), and GND03 (32).

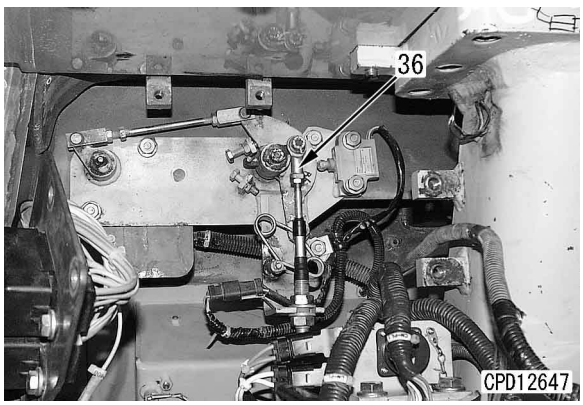


22. Remove 2 wiring harness clamps (33).

23. Remove intermediate connector mounting bracket (34) and fuse box mounting bracket (35).

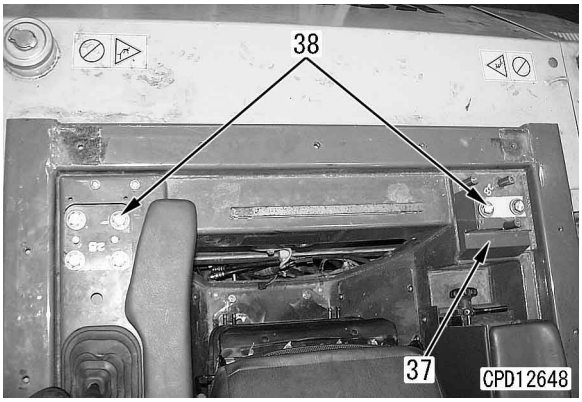


24. Remove parking brake lock lever cable assembly (36). [*4]

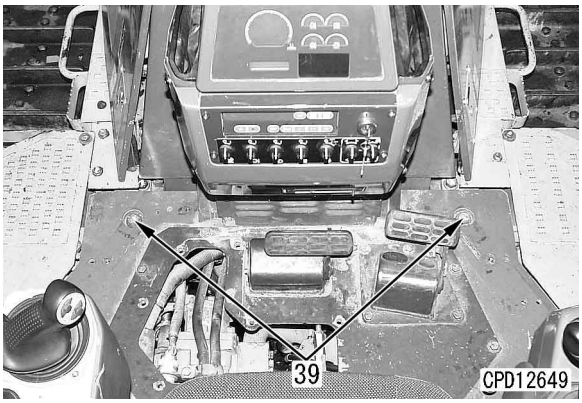


25. Remove bracket (37) on the left side of the rear section.

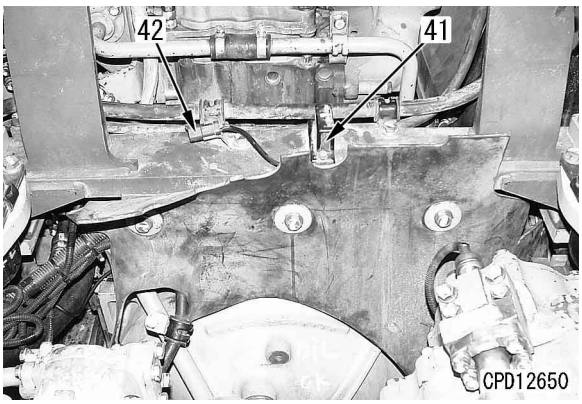
26. Remove 4 rear mounting bolts (38) on each side.



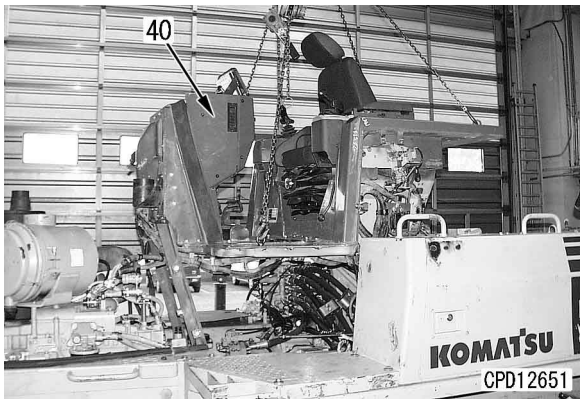
27. Remove 2 front mounting bolts (39) on each side.



28. Sling floor frame assembly (40) to a height at which you can disconnect connector PT2 (42) of pitch angle sensor (41), and then disconnect the connector.



29. Lift off floor frame assembly (40).
    ★ When lifting off the floor frame assembly, check that all the wires have been disconnected.
    Floor frame assembly: **440 kg**



INSTALLATION

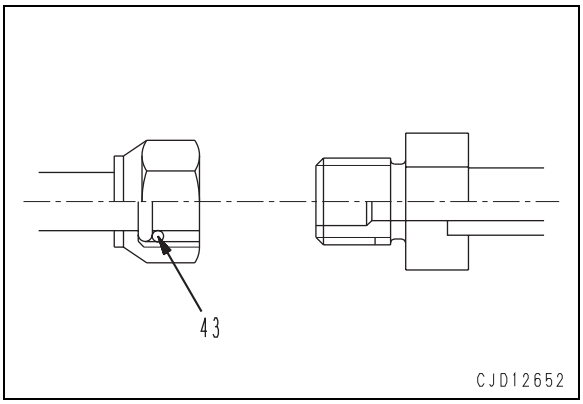
- Carry out installation in the reverse order to removal.

[*1] [*4]
★ Adjust the brake pedal. For details, see TESTING AND ADJUSTING, Adjusting brake pedal and parking brake lever.

[*2]
★ The connecting points of the PPC hoses are indicated by their band colors. When connecting each hose, check its band color.
- PPC ports of work equipment control valve assembly
  Ports for right side:
  (6) PA4 (Ripper lift cylinder RAISE port)
  (7) PA3 (Blade lift cylinder LOWER port)
  (8) PA2 (Blade tilt cylinder LEFT TILT port)
  Ports for left side:
  (9) PB4 (Ripper lift cylinder LOWER port)
  (10) PB3 (Blade lift cylinder RAISE port)
  (11) PB2 (Blade tilt cylinder RIGHT TILT port)

[*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 (43) is fitted to it.

★ Apply sufficient compressor oil (Showa-Shell Suniso 4G or 5G) to each O-ring.



Tightening torque of 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 circuit refrigerant gas**
  Using tool **X2**, charge the air conditioner circuit with air conditioner refrigerant gas (R134a).

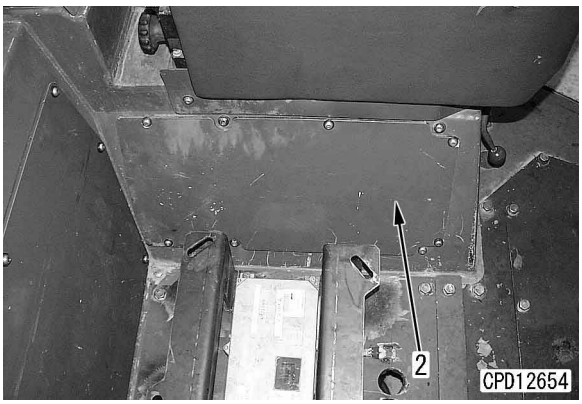
REMOVAL AND INSTALLATION OF ENGINE CONTROLLER ASSEMBLY

REMOVAL

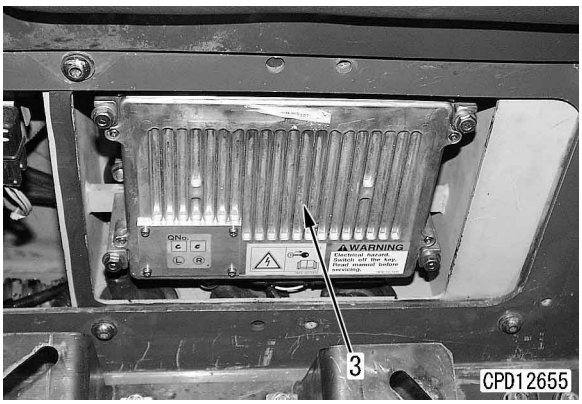
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove operator's seat assembly (1).
   Operator's seat assembly: **68 kg**

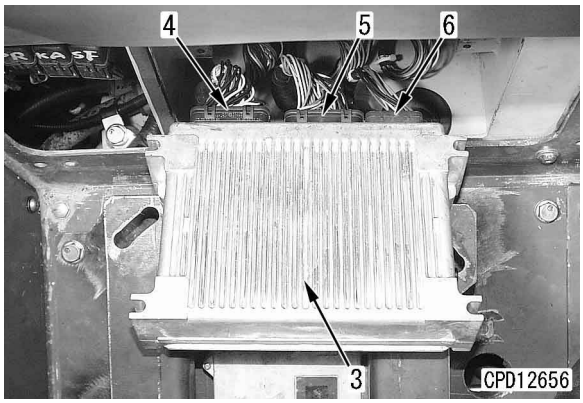
2. Remove left side cover (2).



3. Remove the 4 mounting bolts and take out engine controller assembly (3).



4. Disconnect wiring connectors EGC1 (4), EGC2 (5), and EGC3 (6) and remove engine controller assembly (3). [*1]
   ★ Each wiring connector is installed with 1 hexagon socket head screw on its back side.



INSTALLATION

- Carry out installation in the reverse order to removal.

★ For the method of changing the fuel injection amount adjustment after the engine assembly or engine controller is replaced, ask your Komatsu distributor.

[*1]
Mounting screw: **2.82 Nm {0.288 kgm}**

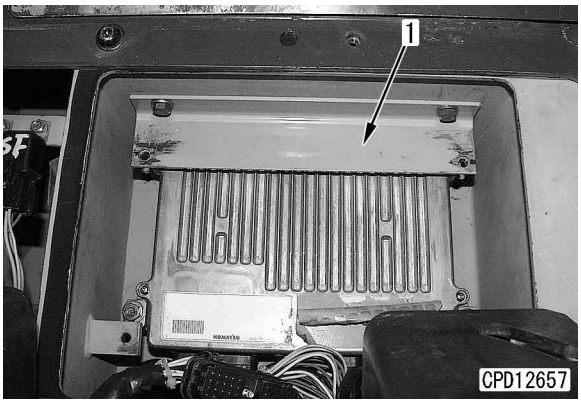
REMOVAL AND INSTALLATION OF STEERING AND TRANSMISSION CONTROLLER

REMOVAL

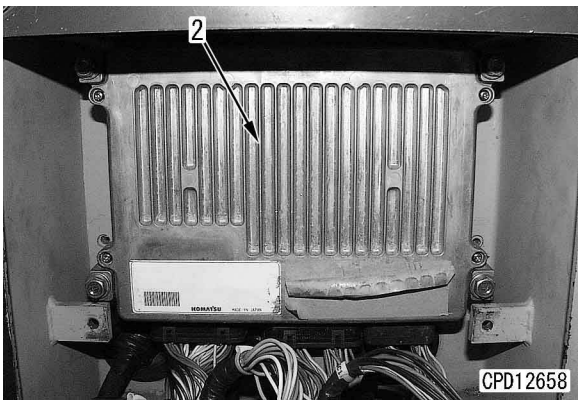
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove the engine controller assembly. For details, see REMOVAL OF ENGINE CONTROLLER ASSEMBLY.

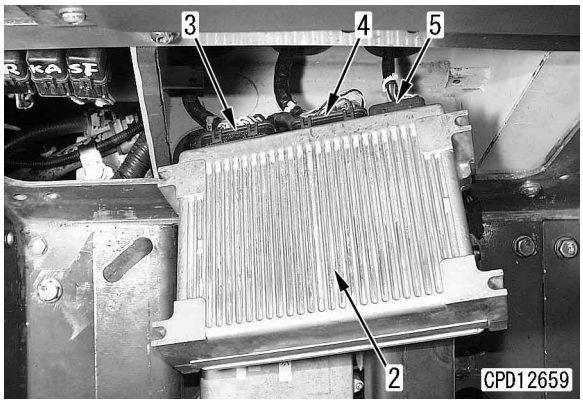
2. Remove engine controller assembly mounting plate (1).



3. Remove the 4 mounting bolts and take out steering and transmission controller assembly (2).



4. Disconnect wiring connectors STC1 (3), STC2 (4), and STC3 (5) and remove steering and transmission controller assembly (2). [*1]
   ★ Each wiring connector is installed with 1 hexagon socket head screw on its back side.



INSTALLATION

- Carry out installation in the reverse order to removal.

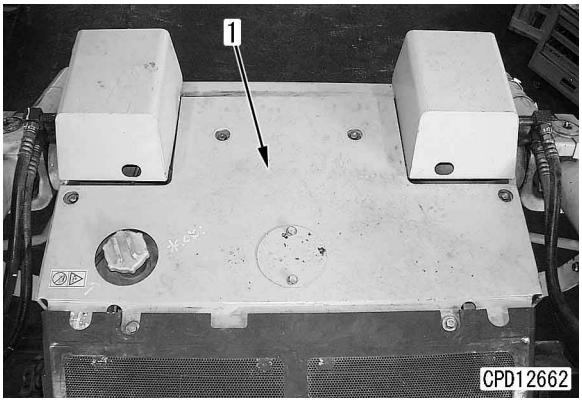
[*1]
Mounting screw: **2.82 Nm {0.288 kgm}**

REMOVAL AND INSTALLATION OF ENGINE HOOD ASSEMBLY

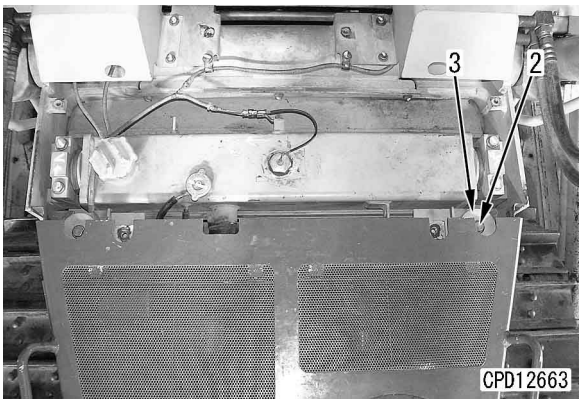
REMOVAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

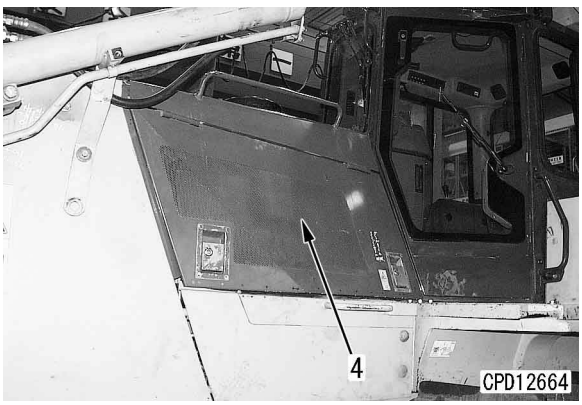
1. Remove radiator top cover (1).



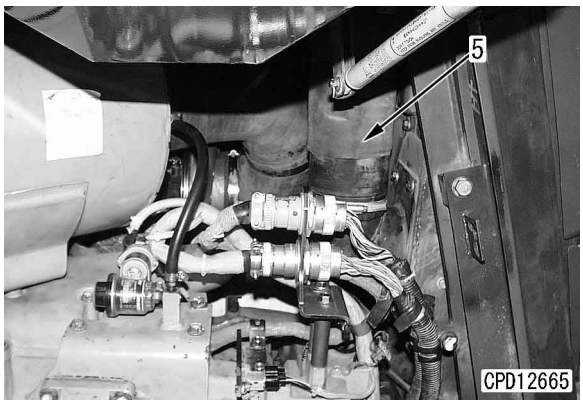
2. Remove mounting bolt (2) on the front side of the engine hood and remove plate (3).



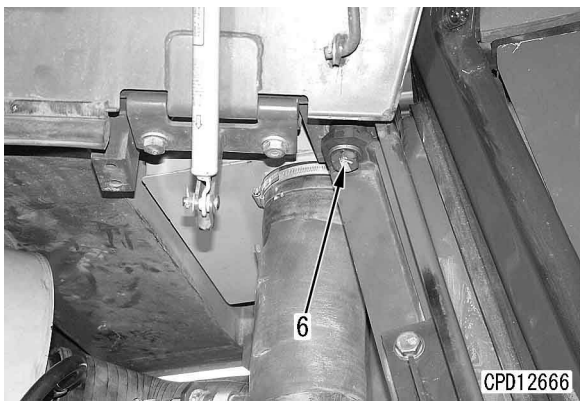
3. Open both engine side covers (4).



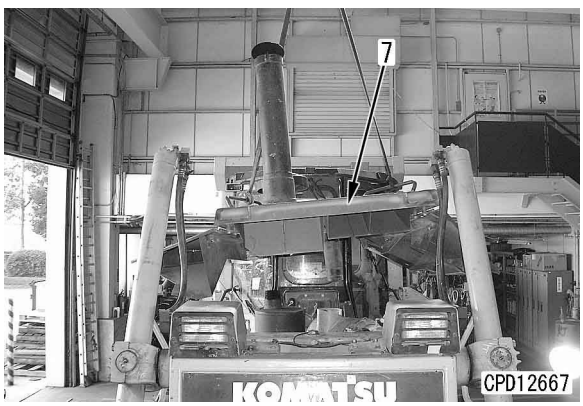
4. Loosen the clamp and disconnect air conditioner duct hose (5).



5. Remove 2 mounting bolts (6) on the rear side of the engine hood.



6. Lift off engine hood assembly (7).
   Engine hood assembly: **155 kg**



INSTALLATION

- Carry out installation in the reverse order to removal.

REMOVAL AND INSTALLATION OF FAN DRIVE ASSEMBLY

REMOVAL

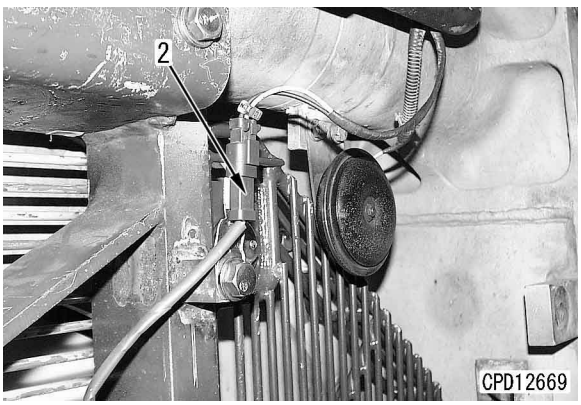
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Drain the hydraulic oil.

   Hydraulic tank: **D85EX-15; Approx. 150 ℓ**
   D85PX-15; Approx. 140 ℓ

2. Remove the mounting bolt and open fan guard (1).

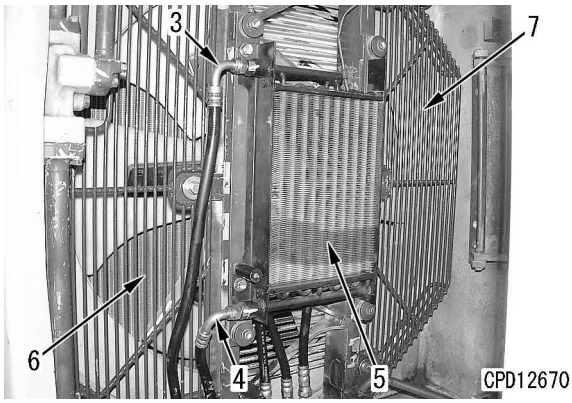
3. Disconnect fan motor solenoid wiring connector FAR2 (2).



4. Disconnect oil cooler hoses (3) and (4).
   ★ Plug the hoses to prevent dirt from entering them.

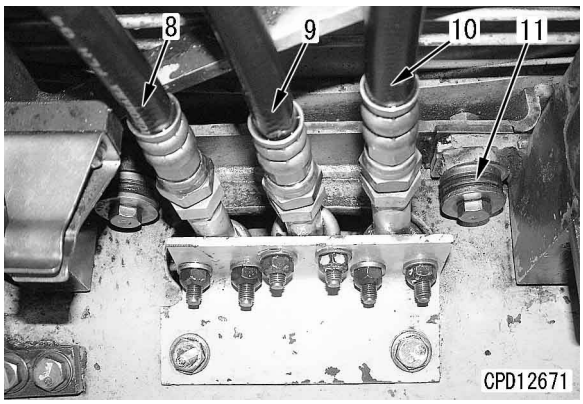
5. Remove hydraulic oil cooler assembly (5).

6. Remove both fan guards (6) and (7).

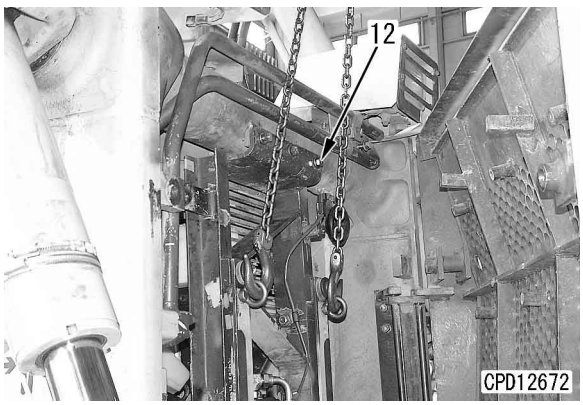


7. Disconnect 3 fan motor hoses (8), (9), (10).
   ★ Plug the hoses to prevent dirt from entering them.

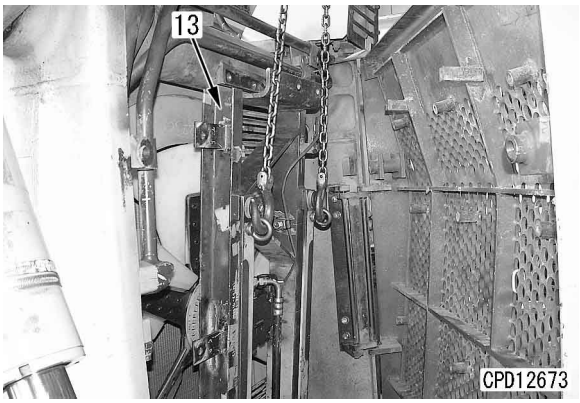
8. Remove 2 lower mounting bolts of the fan drive assembly and spring (11).



9. Sling the fan drive assembly temporarily and remove 3 upper mounting bolts (12).



10. Lift off fan drive assembly (13).
    Fan dry assembly: **73 kg**



INSTALLATION

- Carry out installation in the reverse order to removal.

- **Refilling with oil**
  Add oil to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.
  Hydraulic tank: **D85EX-15; Approx. 150 ℓ**
  D85PX-15; Approx. 140 ℓ

- **Bleeding air**
  Bleed air from the piping. For details, see TESTING AND ADJUSTING, Bleeding air from work equipment cylinders.

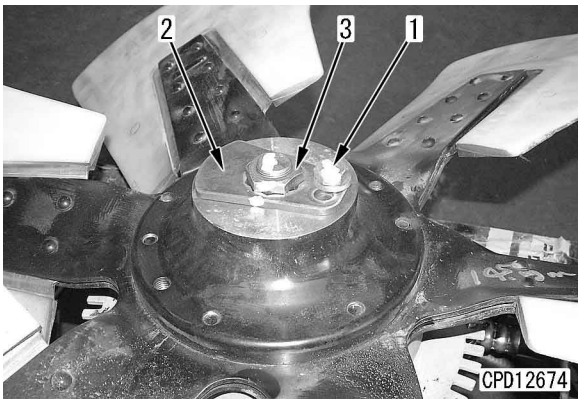
REMOVAL AND INSTALLATION OF FAN MOTOR ASSEMBLY

REMOVAL

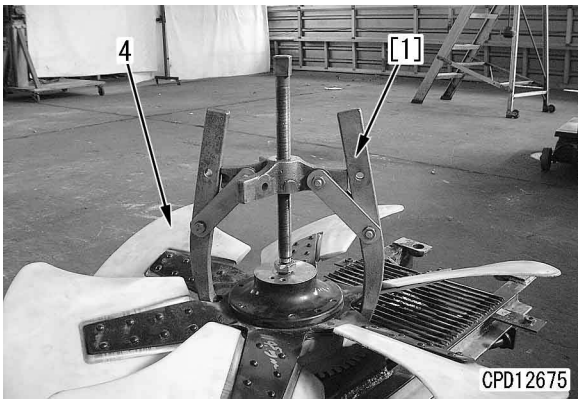
1. Remove the fan drive assembly. For details, see REMOVAL OF FAN DRIVE ASSEMBLY.

2. Remove mounting bolt (1) and lock plate (2).

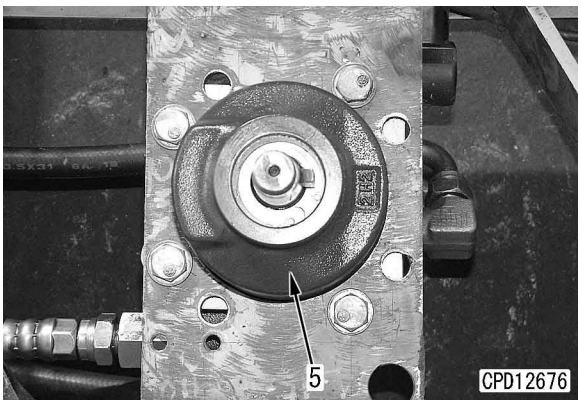
3. Remove nut (3). [*1]



4. Using puller [1], remove fan (4).



5. Remove the 4 mounting bolts and fan motor assembly (5).



INSTALLATION

- Carry out installation in the reverse order to removal.

[*1]

★ Tighten the nut to 142.2 Nm {14.5 kgm}. Then, align the holes on the front and back sides of the lock plate by retightening the nut by the minimum angle.

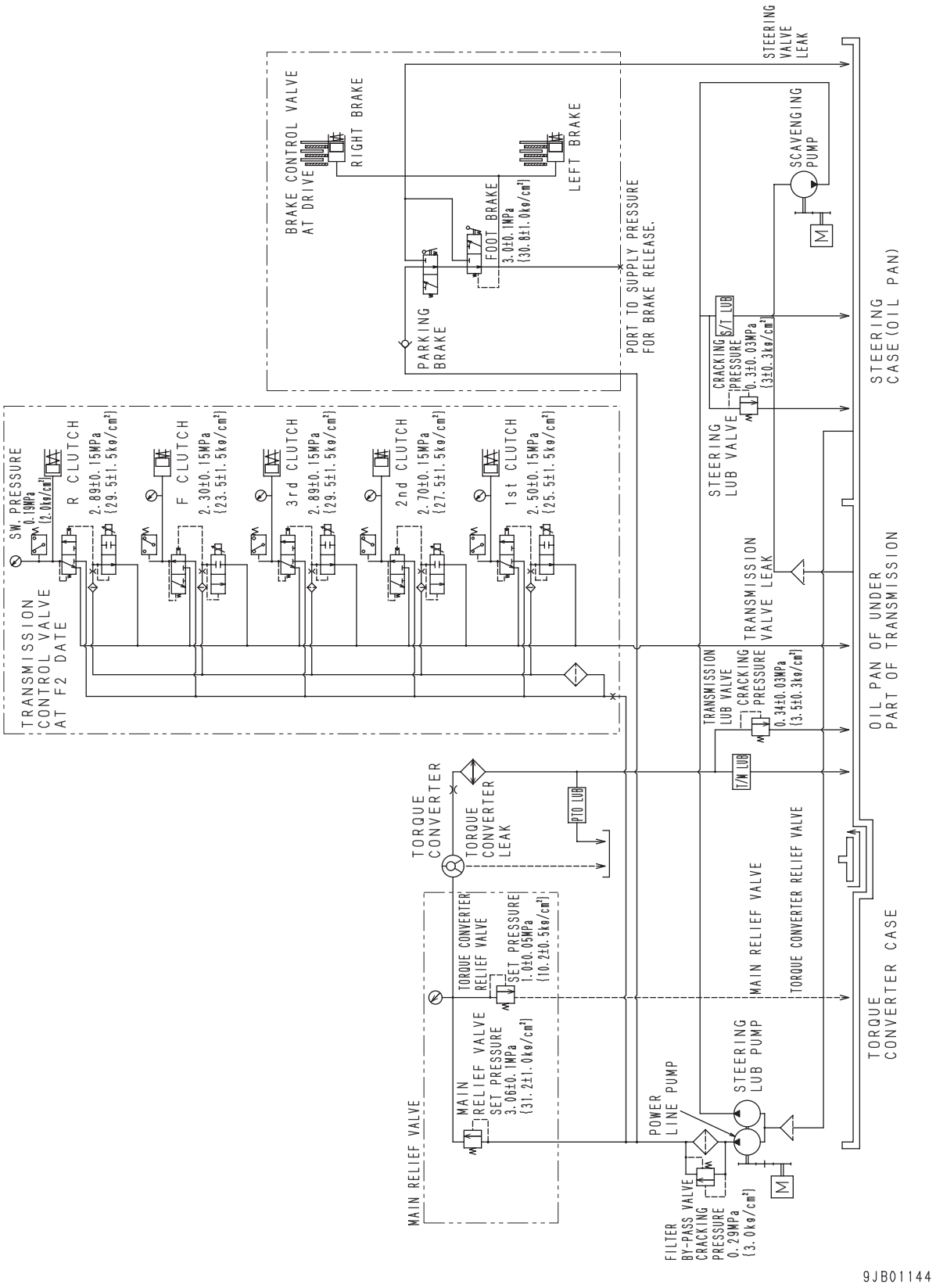
Mounting nut: 1

32.4 – 156.9 Nm {13.5 – 16 kgm}

90 OTHERS

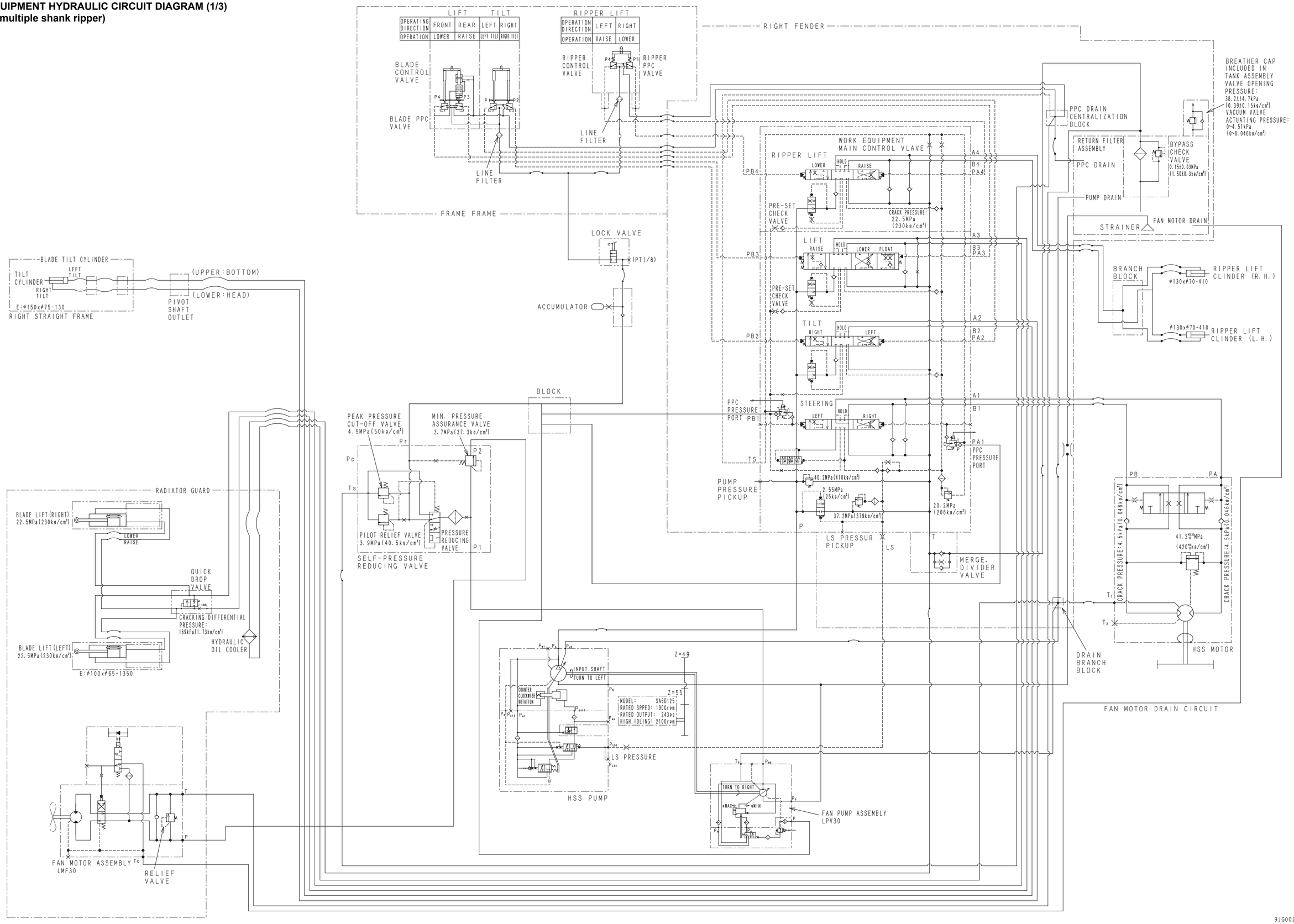
HYDRAULIC CIRCUIT DIAGRAM

POWER TRAIN HYDRAULIC CIRCUIT DIAGRAM



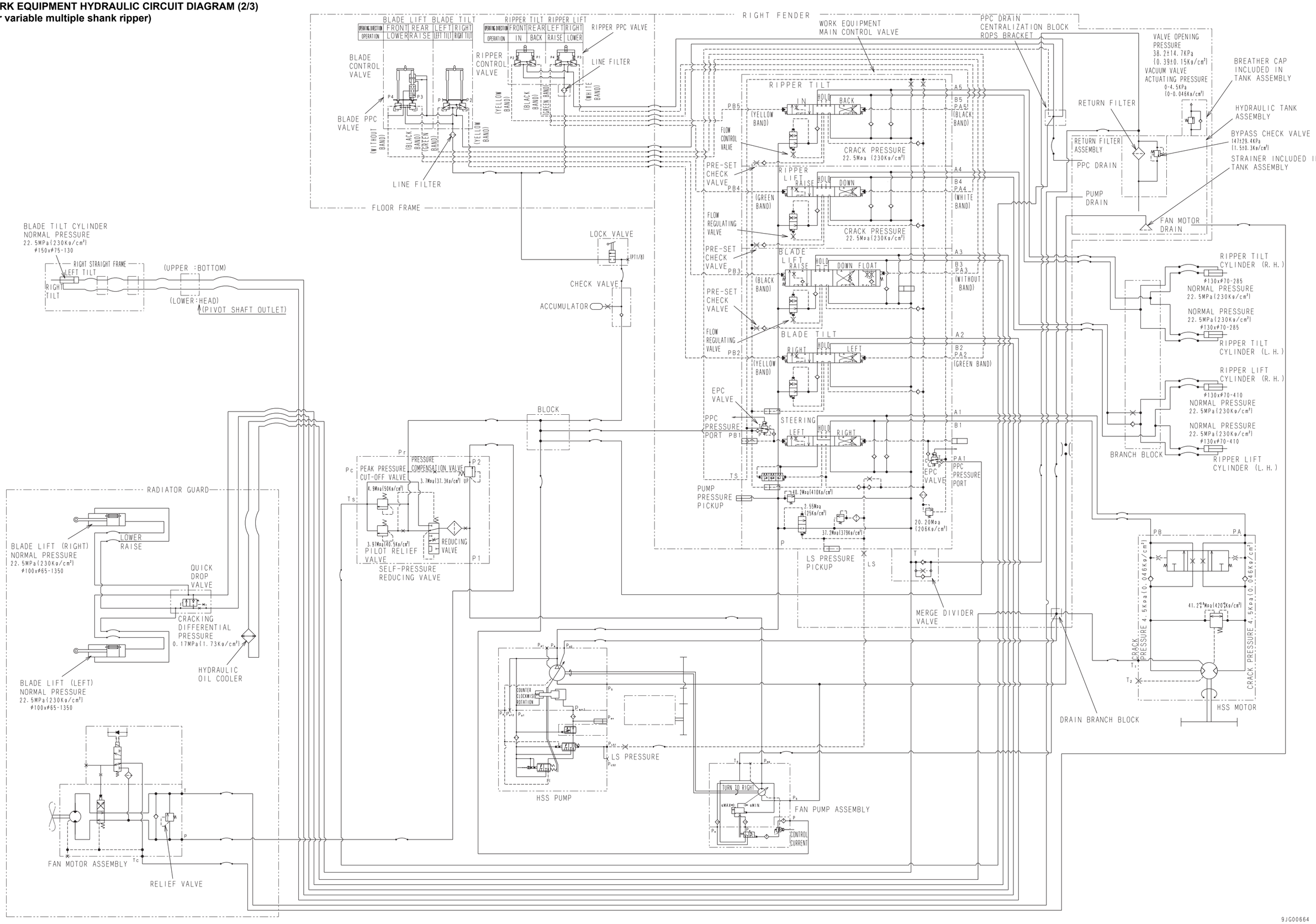
HYDRAULIC CIRCUIT DIAGRAM

WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM (1/3)
(For fixed multiple shank ripper)



HYDRAULIC CIRCUIT DIAGRAM

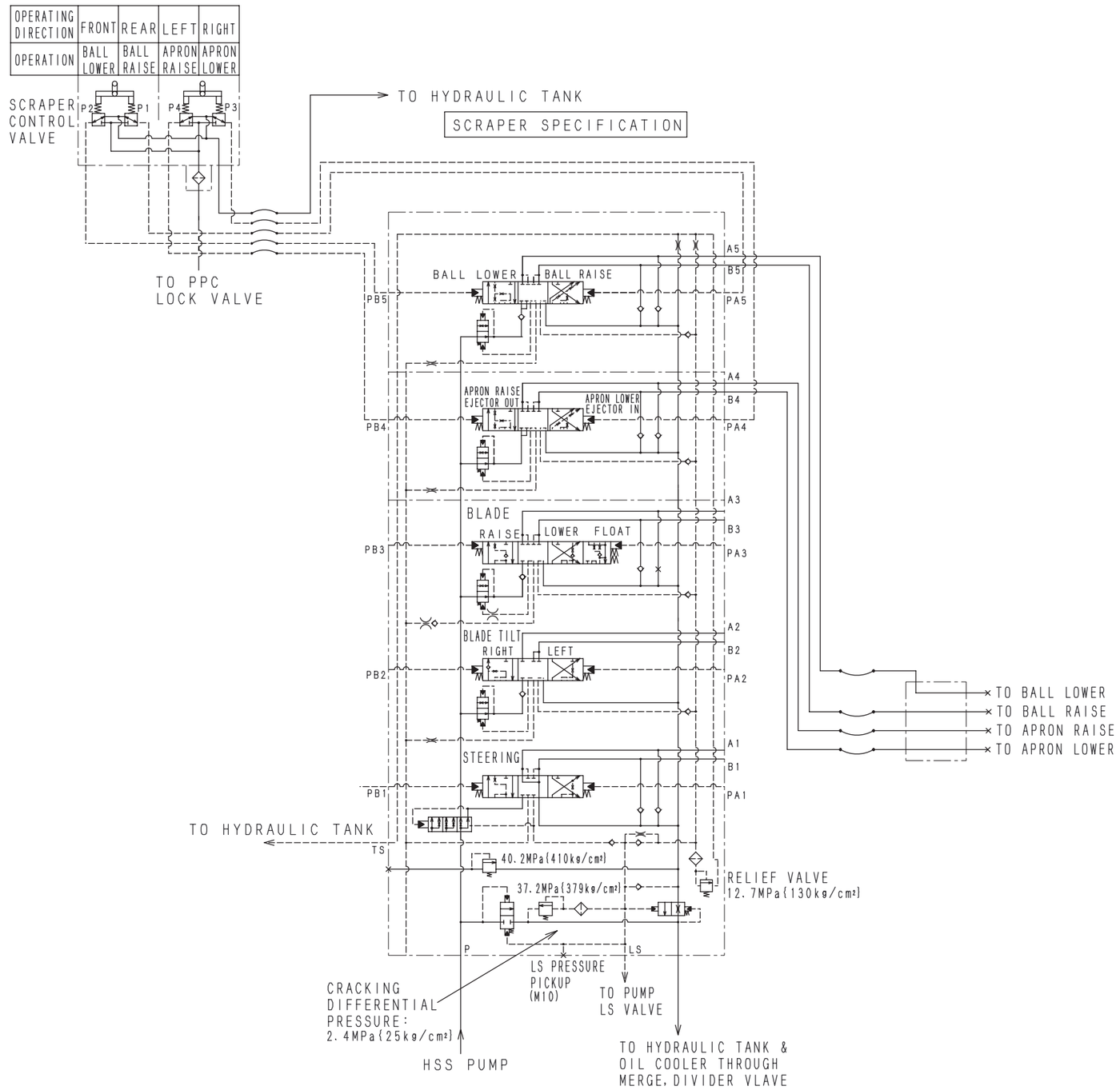
WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM (2/3)
(For variable multiple shank ripper)



9JG00664

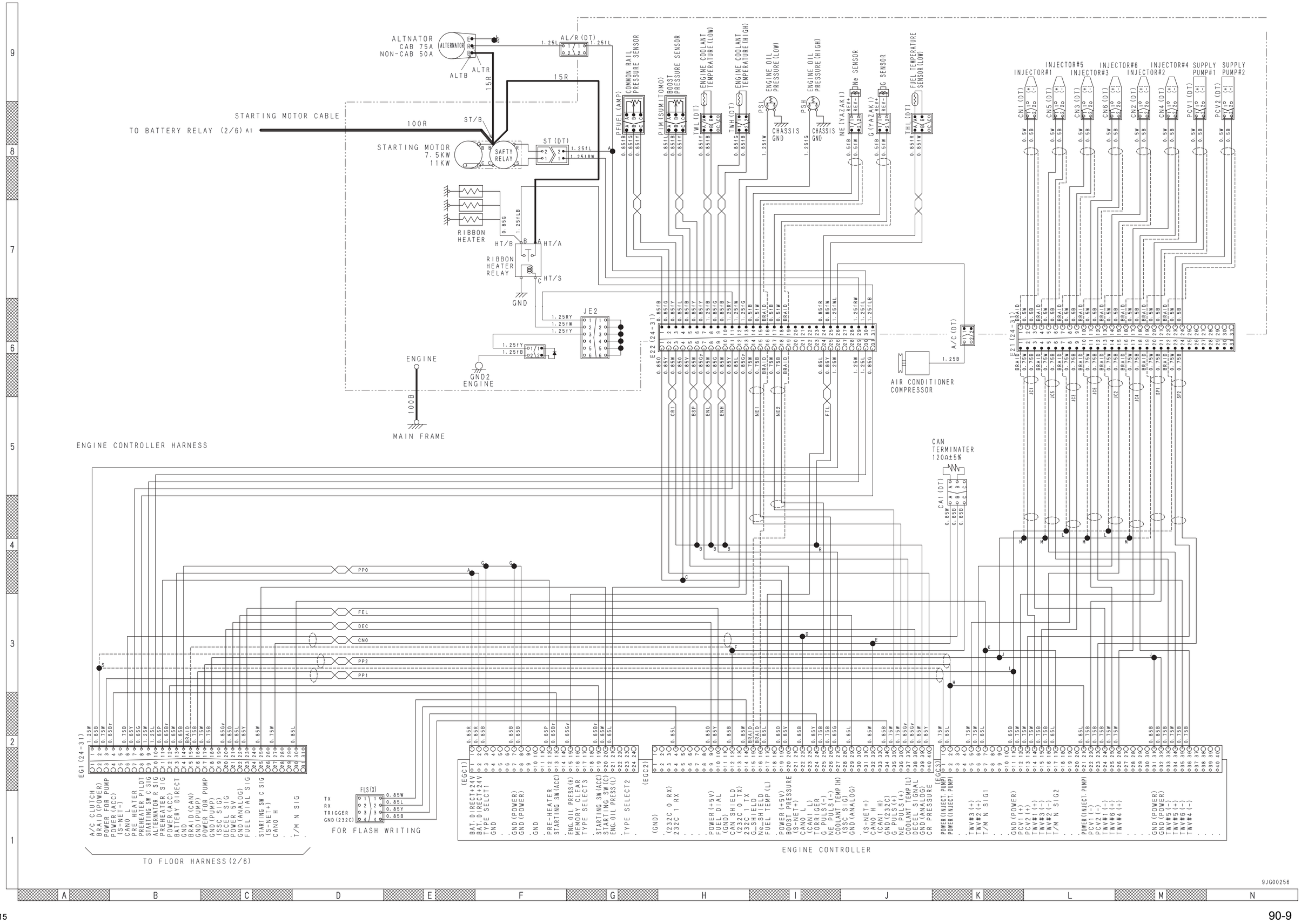
HYDRAULIC CIRCUIT DIAGRAM

WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM (3/3)

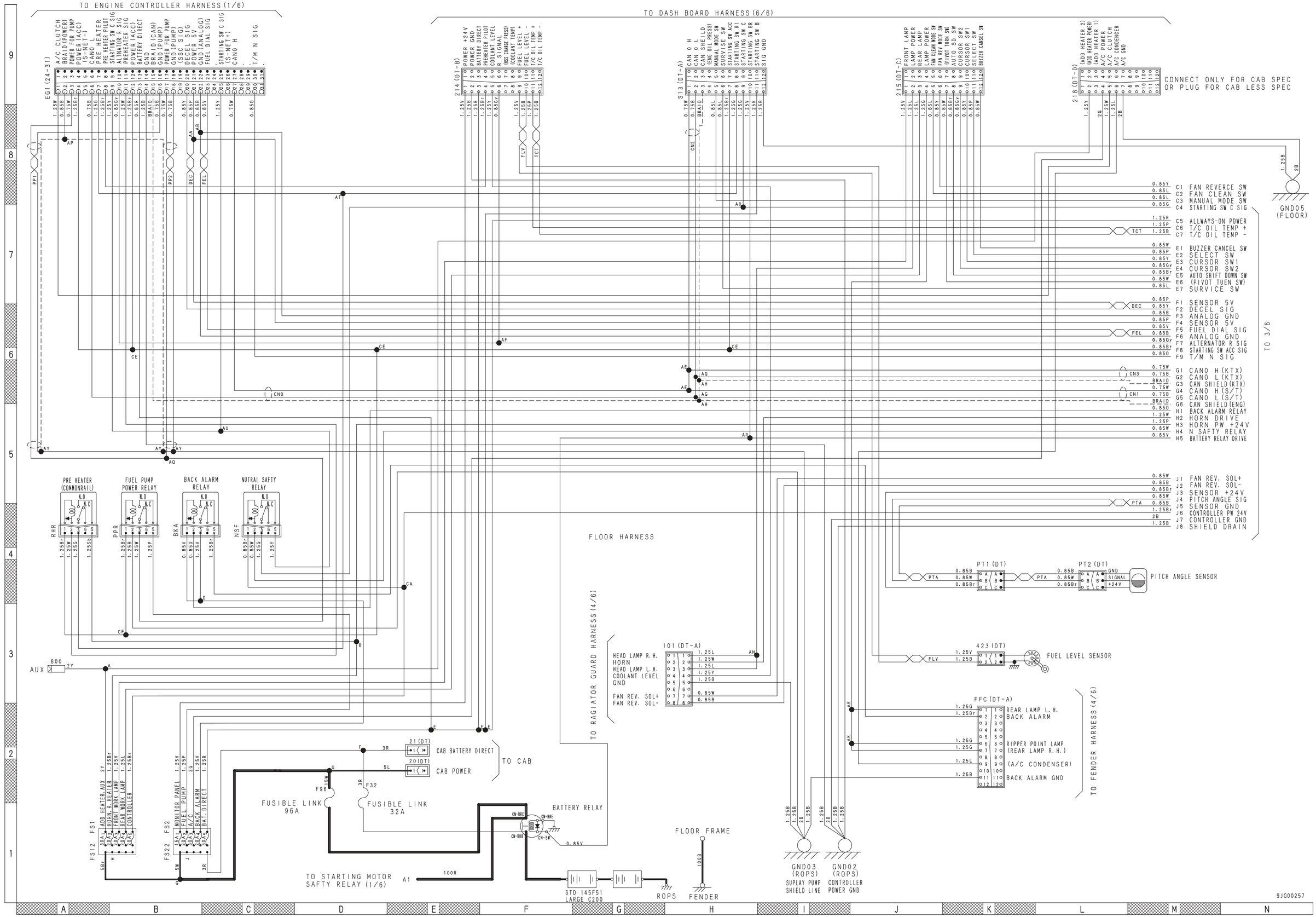


9JG00255

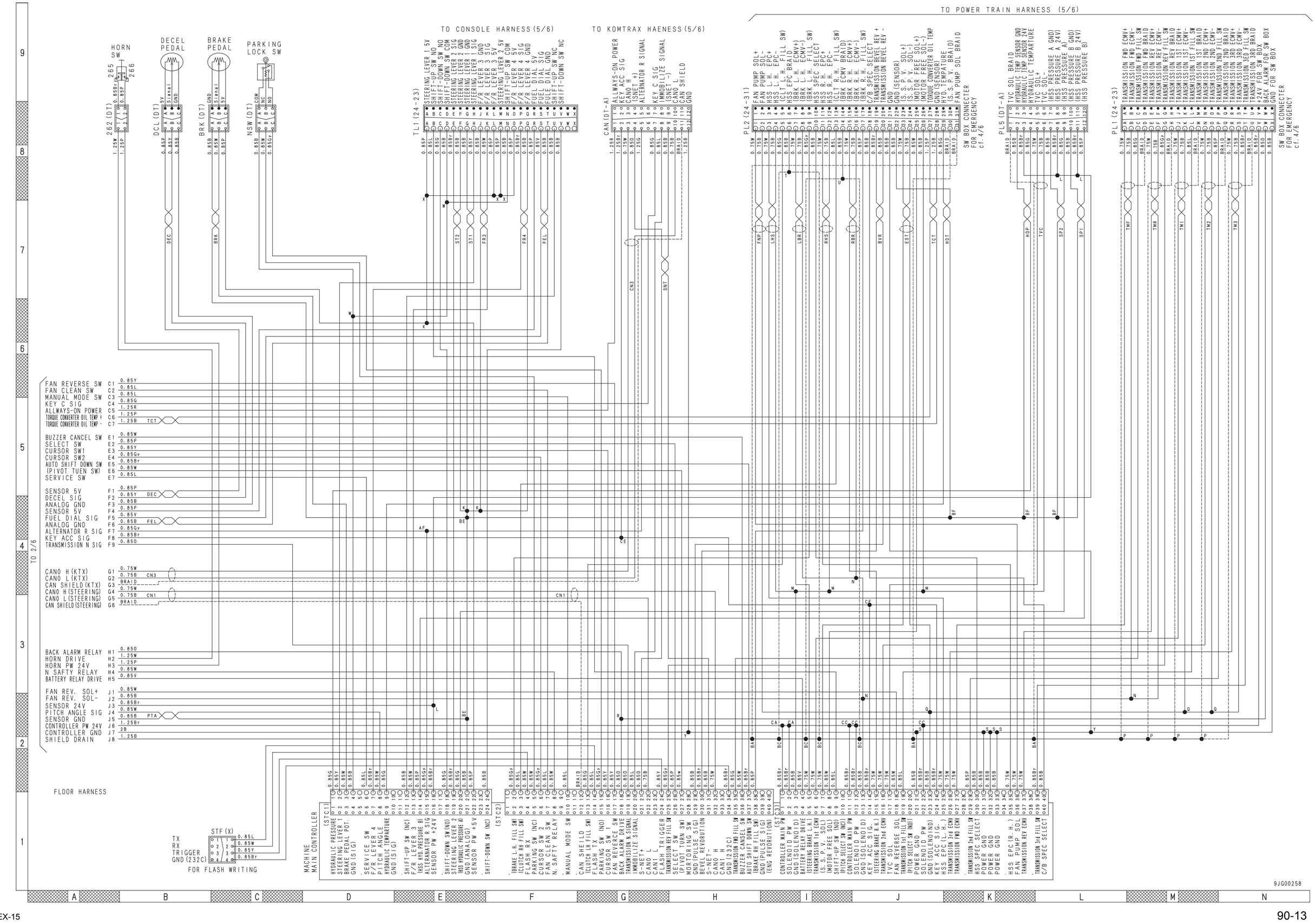
ELECTRICAL CIRCUIT DIAGRAM (1/6)



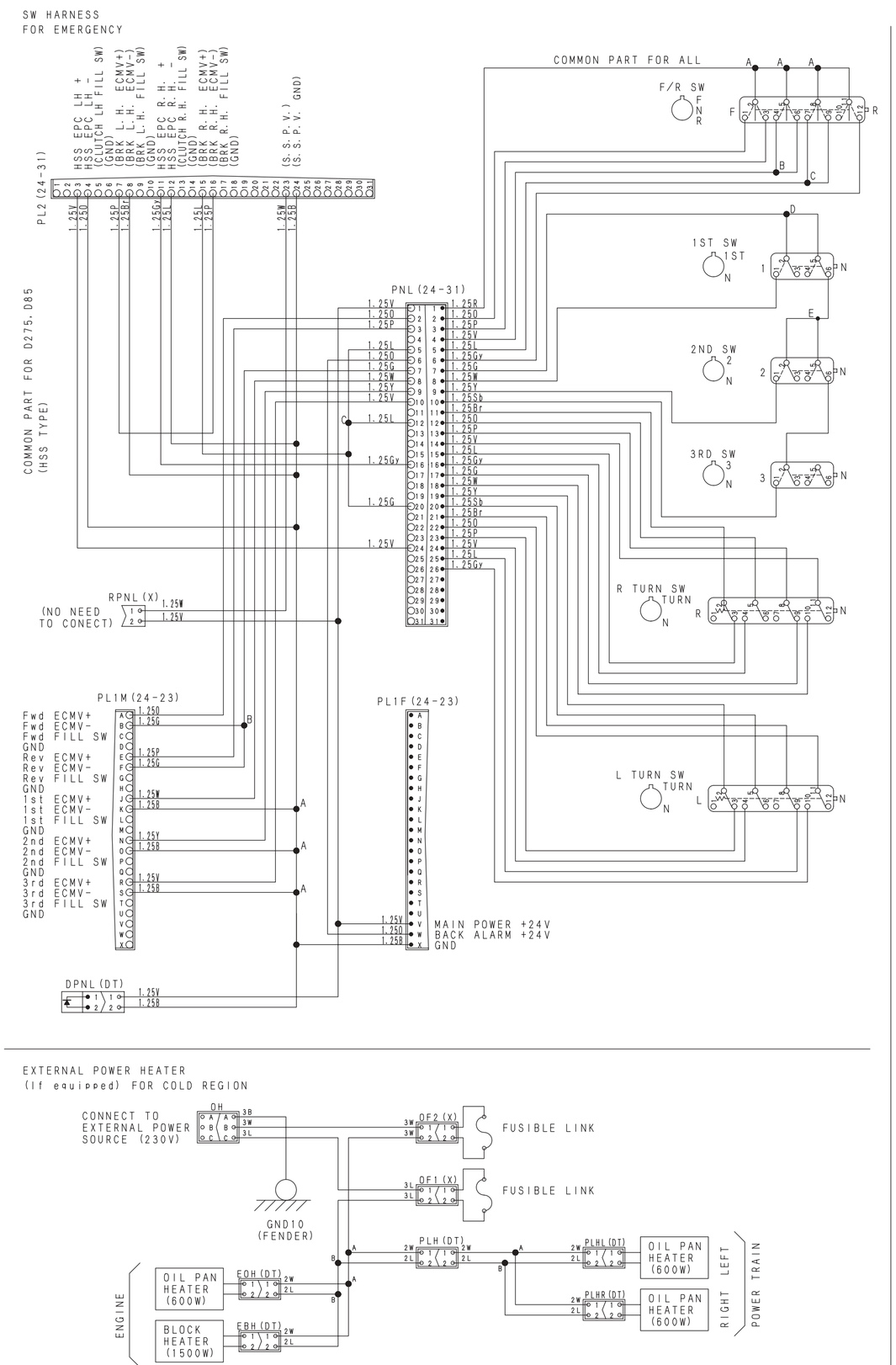
ELECTRICAL CIRCUIT DIAGRAM (2/6)

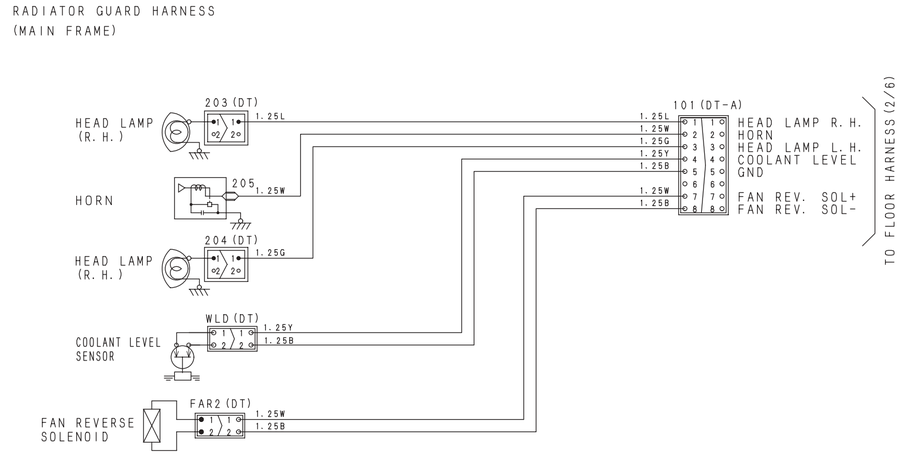


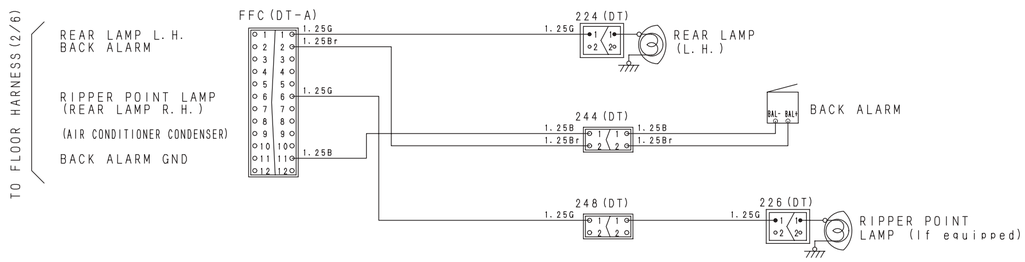
ELECTRICAL CIRCUIT DIAGRAM (3/6)

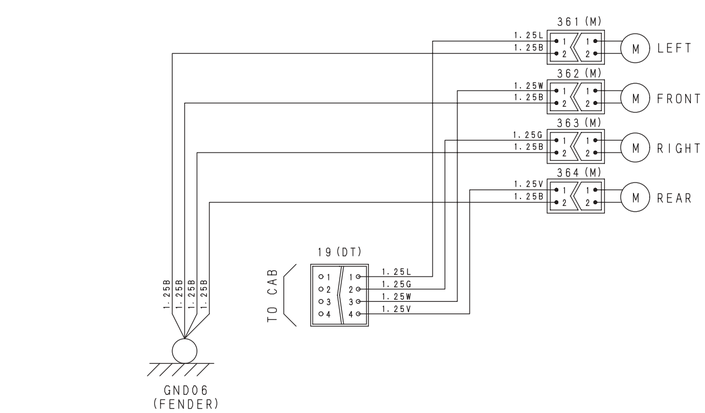


ELECTRICAL CIRCUIT DIAGRAM (4/6)









9JG00259

ELECTRICAL CIRCUIT DIAGRAM (5/6)

KOMTRAX
STD FOR DOMESTIC
(If equipped) FOR FOREIGN

KOMTRAX CONTROLLER TC300

CHECK CN 0

CHECK CN 1

CN3

CAN(DT-A)

TO FLOOR HARNESS(3/6)

AWAZU PLANT ASS'Y

TM CLUTCH ECMV

FORWARD BACKWARD 1ST 2ND 3RD

CONSOLE HARNESS

LEVER ASS'Y

FUEL DIAL

SHIFT UP SW

SHIFT DOWN SW

TO FLOOR HARNESS(3/6)

POWER TRAIN HARNESS
HSS TYPE

HSS EPC L.H.

HSS EPC R.H.

FAN PUMP CONTROL VALVE

TRANSMISSION BEVEL REVOLVING SENSOR

TORQUE CONVERTER TEMPERATURE SENSOR

HYDRAULIC TEMPERATURE SENSOR

WORK EQUIPMENT HYDROURIC PRESSURE

PUMP TVC SOLENOID

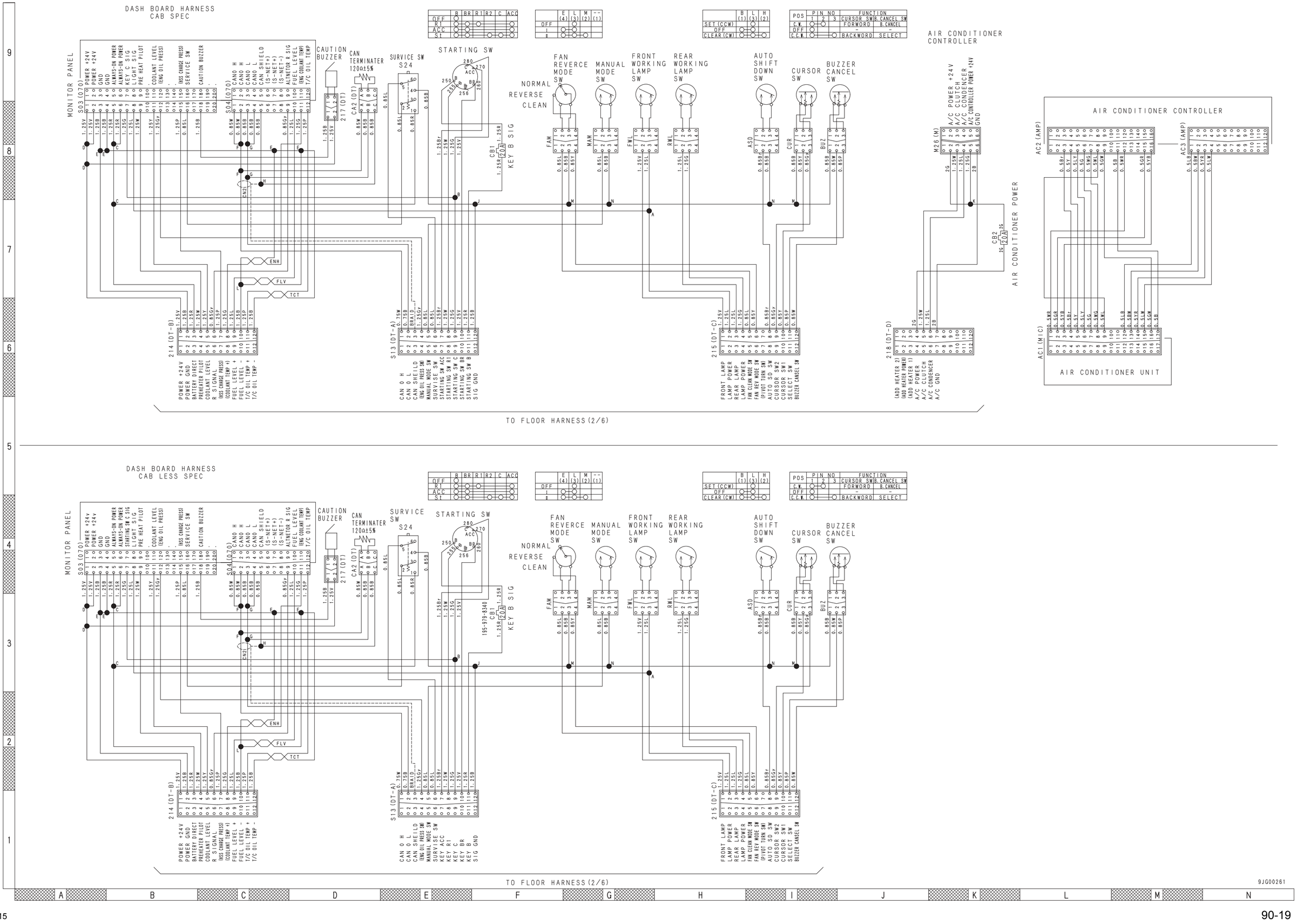
SW BOX CONNECER FOR EMERGENCY
cf. 4/6

SW BOX CONNECTOR FOR EMERGENCY
cf. 4/6

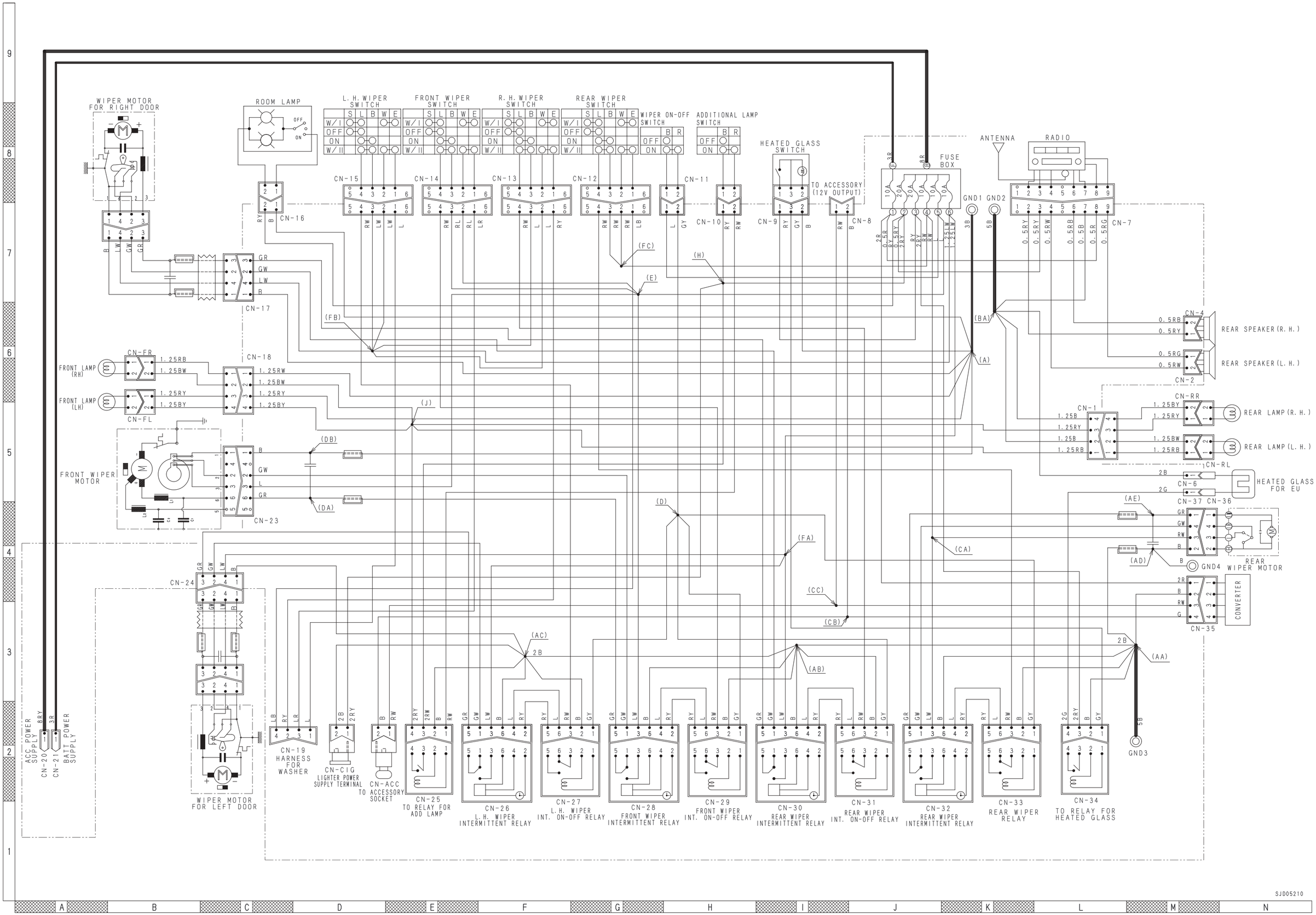
TO FLOOR HARNESS(3/6)

9JG00260

ELECTRICAL CIRCUIT DIAGRAM (6/6)



CAB ELECTRICAL CIRCUIT DIAGRAM



SJD05210