

SHOP

MANUAL

KOMATSU

D31EX, PX-21

D37EX, PX-21

MACHINE MODEL	SERIAL No.
D31EX-21	50001 and up
D31PX-21	50001 and up
D37EX-21	5001 and up
D37PX-21	5001 and up

- This shop manual may contain attachments 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.
- D31, D37EX, PX-21 mount the SAA4D102E-2 engine.
For details of the engine, see the 102-2 Series Engine Shop Manual.

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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 judgments. 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: } Each issued as one
Attachments volume: } 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):

10 - 3

-Item number (10. Structure and Function)
-Consecutive page number for each item.

Example 2 (Engine volume):

12 - 5

Unit number (1. Engine)
Item number (2. Testing and Adjusting)
Consecutive page number for each item.

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

Example:

10-4		12-203
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10-4-2	—	12-203-2
10-5		12-204

REVISED EDITION MARK

When a manual is revised, an edition mark (①②③....) 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

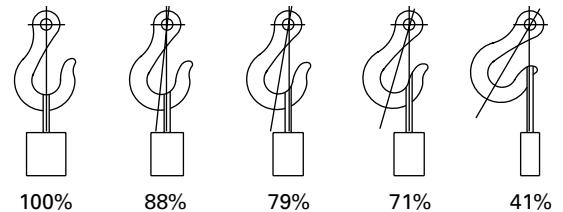
- 1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

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

Rope diameter	Allowable load	
	kN	tons
mm		
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.



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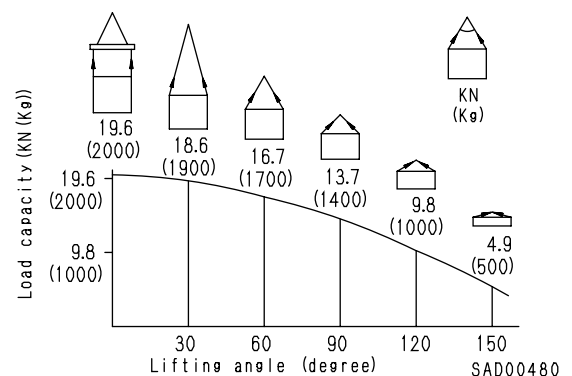
- 3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound onto the load.

! 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

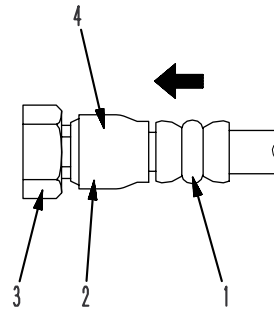


Fig. 2

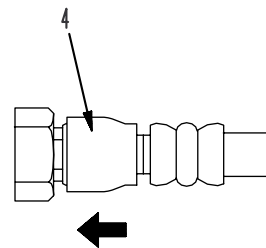


Fig. 3

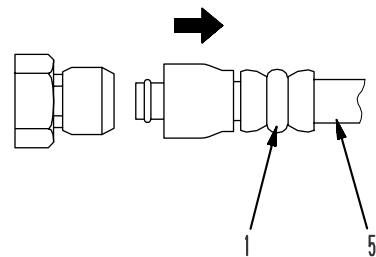


Fig. 4

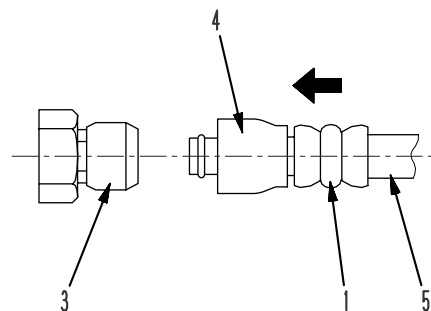
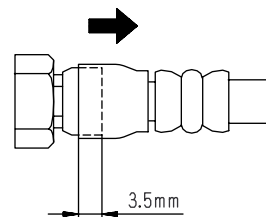


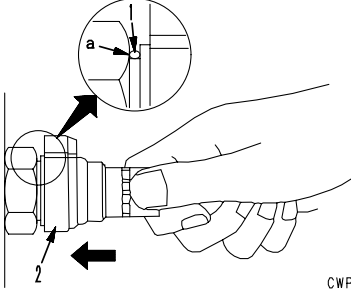
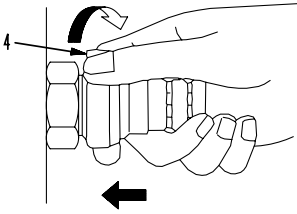
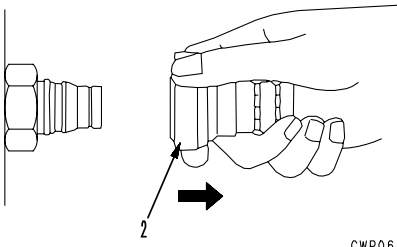
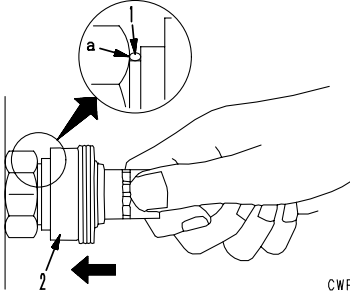
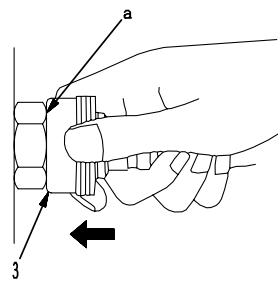
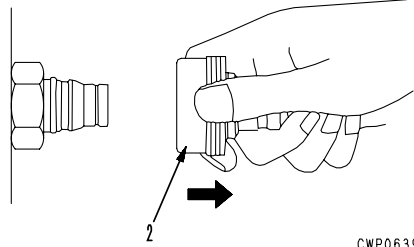
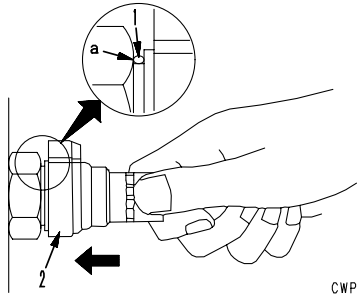
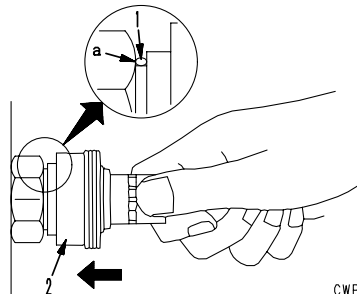
Fig. 5



CWP10701

FOREWORD

METHOD OF DISASSEMBLING, CONNECTING PUSH-PULL TYPE COUPLER

	Type 2	Type 3
Disassembly	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.  CWP06392 2) Hold in the condition in Step 1), and turn lever (4) to the right (clockwise).  CWP06394 3) Hold in the condition in Steps 1) and 2), and pull out whole body (2) to disconnect it.  CWP06396	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.  CWP06391 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.  CWP06393 3) Hold in the condition in Steps 1) and 2), and pull out whole body (2) to disconnect it.  CWP06395
Connection	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.  CWP06392	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.  CWP06391

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, features
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, polypropylene, tetrafluoroethylene 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	790-129-9070	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.

FOREWORD
COATING MATERIALS

Category	Komatsu code	Part No.	Q'ty	Container	Main applications, featuresr
Adhesives	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.
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 scuffing 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 lubricant	SYG2-400M	400 g (10 per case)	Belows type	• Used for places with heavy load

FOREWORD
STANDARD TIGHTENING TORQUE
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	    	
mm	mm	Nm	kgm
6	10	13.2 ± 1.4	1.35 ± 0.15
8	13	31 ± 3	3.2 ± 0.3
10	17	66 ± 7	6.7 ± 0.7
12	19	113 ± 10	11.5 ± 1
14	22	177 ± 19	18 ± 2
16	24	279 ± 30	28.5 ± 3
18	27	382 ± 39	39 ± 4
20	30	549 ± 59	56 ± 6
22	32	745 ± 83	76 ± 8.5
24	36	927 ± 103	94.5 ± 10.5
27	41	1320 ± 140	135 ± 15
30	46	1720 ± 190	175 ± 20
33	50	2210 ± 240	225 ± 25
36	55	2750 ± 290	280 ± 30
39	60	3290 ± 340	335 ± 35

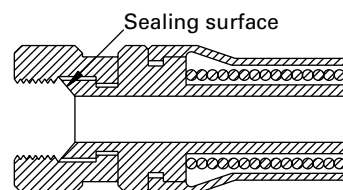
CDL00372

Thread diameter of bolt	Width across flats		
mm	mm	Nm	kgm
6	10	7.85 ± 1.95	0.8 ± 0.2
8	13	18.6 ± 4.9	1.9 ± 0.5
10	14	40.2 ± 5.9	4.1 ± 0.6
12	27	82.35 ± 7.85	8.4 ± 0.8

CDL00373

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

FOREWORD
STANDARD TIGHTENING TORQUE
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	14	65.7 ± 6.8	6.7 ± 0.7
12	17	112 ± 9.8	11.5 ± 1
16	22	279 ± 29	28.5 ± 3

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.

Nominal No.	Thread diameter	Width across flat	Tightening torque	
	mm	mm	Nm	kgm
02	14	Varies depending on type of connector.	34.3 ± 4.9	3.5 ± 0.5
03, 04	20		93.1 ± 9.8	9.5 ± 1
05, 06	24		142.1 ± 19.6	14.5 ± 2
10, 12	33		421.4 ± 58.8	43 ± 6
14	42		877.1 ± 132.3	89.5 ± 13.5

TABLE OF TIGHTENING TORQUES FOR O-RING BOSS PLUGS

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

Nominal No.	Thread diameter	Width across flat	Tightening torque	
	mm	mm	Nm	kgm
08	08	14	7.35 ± 1.47	0.75 ± 0.15
10	10	17	11.27 ± 1.47	1.15 ± 0.15
12	12	19	17.64 ± 1.96	1.8 ± 0.2
14	14	22	22.54 ± 1.96	2.3 ± 0.2
16	16	24	29.4 ± 4.9	3 ± 0.5
18	18	27	39.2 ± 4.9	4 ± 0.5
20	20	30	49 ± 4.9	5 ± 0.5
24	24	32	68.6 ± 9.8	7 ± 1
30	30	32	107.8 ± 14.7	11 ± 1.5
33	33	n	127.4 ± 19.6	13 ± 2
36	36	36	151.9 ± 24.5	15.5 ± 2.5
42	42	n	210.7 ± 29.4	21.5 ± 3
52	52	n	323.4 ± 44.1	33 ± 4.5

FOREWORD

STANDARD TIGHTENING TORQUE

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	35 - 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

Nominal 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	Circuits Classification		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	Yellow & 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.

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

2. Convert 550 mm into inches.

- 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.
- Carry out the same procedure as above to convert 55 mm to 2.165 inches.
- The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal point one place to the right) to return to the original value. This gives 550 mm = 21.65 inches.

Millimeters to inches

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

FOREWORD

CONVERSION TABLE

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

FOREWORD**CONVERSION TABLE****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	7.699	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.037	18.257	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

FOREWORD**CONVERSION TABLE****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

FOREWORD**CONVERSION TABLE****kg/cm² to lb/in²**1 kg/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

FOREWORD

CONVERSION TABLE

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.

$$1^{\circ}\text{C} = 33.8^{\circ}\text{F}$$

°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 International System of units (SI).
As for reference, conventionally used Gravitational System of units are indicated in parentheses { }.

Example:

N {kg}
Nm {kgm}
MPa {kg/cm²}
kPa {mmH₂O}
kPa {mmHg}
kW/rpm {HP/rpm}
g/kWh {g/HPh}

01 GENERAL

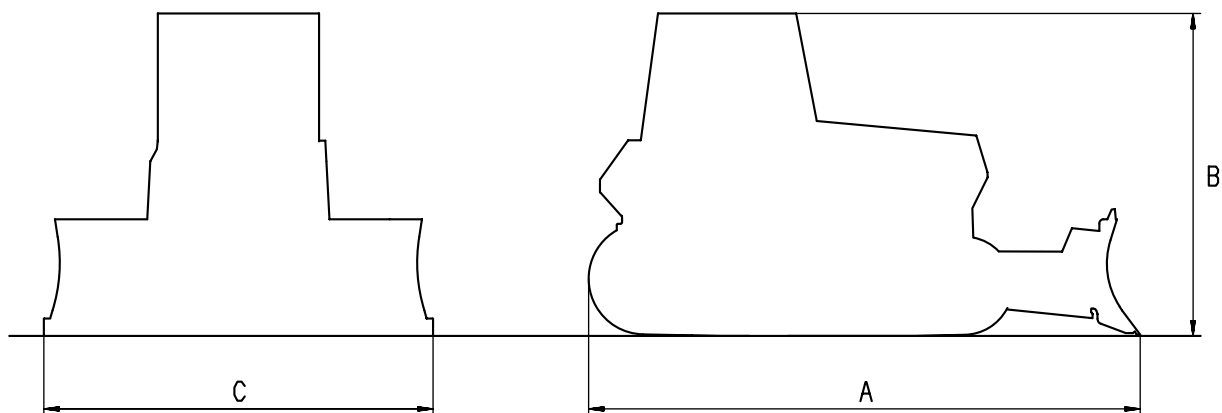
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SPECIFICATION DRAWING

D31EX-21 Power angle, power tilt dozer with ROPS canopy

D31PX-21 Power angle, power tilt dozer with ROPS canopy

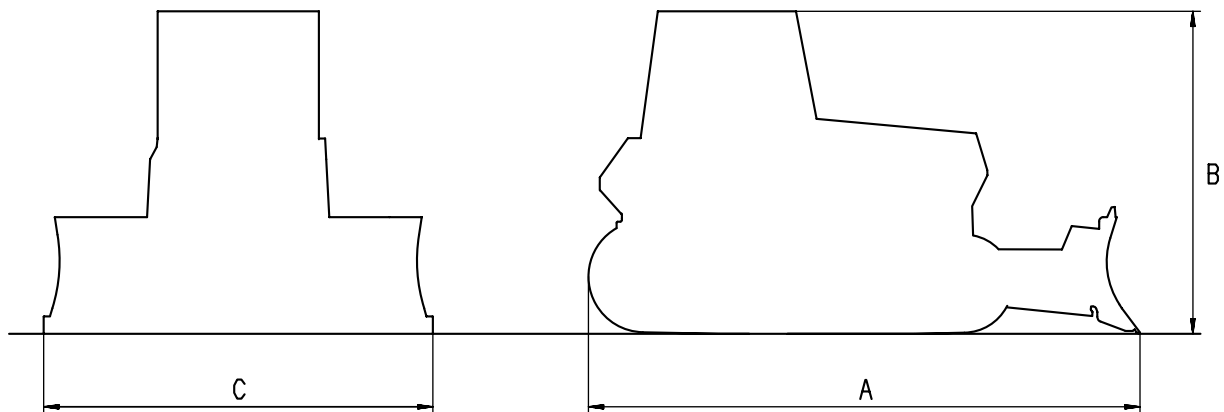
	Item	Unit	D31EX-21	D31PX-21	
			400 mm Single shoe	600 mm Single shoe	600 mm Swamp shoe
	Operating weight	kg	7,130	7,650	7,630
	Engine name	—	Komatsu SAA4D102E-2-B diesel engine		
	Engine rated horsepower	kW {HP} /rpm	56 {75} /2,000		
A	Overall length	mm	4,015	3,995	3,975
B	Overall height (not including antenna)	mm	2,700		2,720
C	Overall width	mm	2,435	3,200	
	Travel speed (1st/2nd/3rd)	FORWARD	km/h	4.3/6.5/8.5	
		REVERSE	km/h	4.3/6.5/8.5	



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D37EX-21 Power angle, power tilt dozer with ROPS canopy
D37PX-21 Power angle, power tilt dozer with ROPS canopy

	Item	Unit	D37EX-21	D37PX-21	
			400 mm Single shoe	600 mm Single shoe	600 mm Swamp shoe
	Operating weight	kg	7,410	7,770	7,750
	Engine name	—	Komatsu SAA4D102E-2-B diesel engine		
	Engine rated horsepower	kW {HP} /rpm	63 {85} /2,000		
A	Overall length	mm	4,015	3,995	3,975
B	Overall height (not including antenna)	mm	2,700		2,720
C	Overall width	mm	2,720	3,250	
	Travel speed (1st/2nd/3rd)	FORWARD	km/h	4.3/6.5/8.5	
		REVERSE	km/h	4.3/6.5/8.5	



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SPECIFICATIONS

Machine model			D31EX-21	D31PX-21	
			400 mm Single shoe	600 mm Single shoe	600 mm Swamp shoe
Serial No.			50001 – 50097	50001 – 50181	
Weight	Operating weight				
	• Bare tractor	kg	5,800	6,250	6,230
	• With power angle tiltdozer + ROPS cab	kg	7,130	7,650	7,630
	• With power angle tiltdozer + ROPS canopy	kg	7,470	7,990	7,970
Performance	Min. turning radius	m	2.3	2.6	2.6
	Gradeability	deg	30	30	30
	Stability (front, rear, left, right)	deg	35	35	35
	Travel speed	Forward 1st	km/h	4.3	4.3
		Forward 2nd	km/h	6.5	6.5
		Forward 3rd	km/h	8.5	8.5
		Reverse 1st	km/h	4.3	4.3
		Reverse 2nd	km/h	6.5	6.5
		Reverse 3rd	km/h	8.5	8.5
	Ground pressure	Bare tractor	kPa {kg/cm ² }	35.3 {0.36}	23.5 {0.24}
		With power angle tiltdozer + ROPS canopy	kPa {kg/cm ² }	43.2 {0.44}	28.4 {0.29}
		With power angle tiltdozer + ROPS cab	kPa {kg/cm ² }	45.1 {0.46}	29.4 {0.30}
Dimensions	Overall length	Bare tractor	mm	3,055	3,090
		With power angle tiltdozer + ROPS canopy	mm	4,015	3,995
		With power angle tiltdozer + ROPS cab	mm	4,085	4,065
	Overall width	Bare tractor	mm	1,850	2,250
		Power angle tiltdozer	mm	2,435	3,200
	Overall height	To tip of exhaust pipe	mm	2,700	2,700
		To top of operator's compartment	mm	2,015	2,015
		With ROPS cab installed (not including antenna)	mm	2,700	2,720
		With ROPS canopy installed	mm	2,700	2,720
	Track gauge		mm	1,450	1,650
	Length of track on ground		mm	2,010	2,185
	Width of track (standard track shoe)		mm	400	600
	Min. ground clearance		mm	315	385

GENERAL
SPECIFICATIONS

D37EX-21	D37PX-21				
400 mm Single shoe	600 mm Single shoe	600 mm Swamp shoe			
5001 – 5104	5001 – 5090				
6,030	6,330	6,310			
7,410	7,770	7,750			
7,750	8,110	8,090			
2.4	2.6	2.6			
30	30	30			
35	35	35			
4.3	4.3	4.3			
6.5	6.5	6.5			
8.5	8.5	8.5			
4.3	4.3	4.3			
6.5	6.5	6.5			
8.5	8.5	8.5			
33.3 {0.34}	23.5 {0.24}	22.5 {0.23}			
40.2 {0.41}	28.4 {0.29}	28.4 {0.29}			
42.1 {0.43}	29.4 {0.30}	29.4 {0.30}			
3,055	3,055	3,060			
4,015	3,995	3,975			
4,085	4,065	4,045			
1,850	2,250	2,250			
2,720	3,250	3,250			
2,700	2,700	2,720			
2,015	2,015	2,035			
2,700	2,700	2,720			
2,700	2,700	2,720			
1,450	1,650	1,650			
2,240	2,240	2,240			
400	600	600			
315	315	385			

GENERAL

SPECIFICATIONS

Machine model			D31EX-21	D31PX-21	
			400 mm Single shoe	600 mm Single shoe	600 mm Swamp shoe
Serial No.			50098 and up	50182 and up	
Weight	Operating weight				
	• Bare tractor	kg	5,800	6,250	6,230
	• With power angle tiltdozer + ROPS cab	kg	7,130	7,650	7,630
	• With power angle tiltdozer + ROPS canopy	kg	7,470	7,990	7,970
Performance	Min. turning radius	m	– (Pivot turn)	– (Pivot turn)	– (Pivot turn)
	Gradeability	deg	30	30	30
	Stability (front, rear, left, right)	deg	35	35	35
	Travel speed	Forward 1st	km/h	4.3	4.3
		Forward 2nd	km/h	6.5	6.5
		Forward 3rd	km/h	8.5	8.5
		Reverse 1st	km/h	4.3	4.3
		Reverse 2nd	km/h	6.5	6.5
		Reverse 3rd	km/h	8.5	8.5
	Ground pressure	Bare tractor	kPa {kg/cm ² }	35.3 {0.36}	23.5 {0.24}
		With power angle tiltdozer + ROPS canopy	kPa {kg/cm ² }	43.2 {0.44}	28.4 {0.29}
		With power angle tiltdozer + ROPS cab	kPa {kg/cm ² }	45.1 {0.46}	29.4 {0.30}
Dimensions	Overall length	Bare tractor	mm	3,055	3,090
		With power angle tiltdozer + ROPS canopy	mm	4,015	3,995
		With power angle tiltdozer + ROPS cab	mm	4,085	4,065
	Overall width	Bare tractor	mm	1,850	2,250
		Power angle tiltdozer	mm	2,435	3,200
	Overall height	To tip of exhaust pipe	mm	2,700	2,700
		To top of operator's compartment	mm	2,015	2,015
		With ROPS cab installed (not including antenna)	mm	2,700	2,720
		With ROPS canopy installed	mm	2,700	2,720
	Track gauge		mm	1,450	1,650
	Length of track on ground		mm	2,010	2,185
	Width of track (standard track shoe)		mm	400	600
	Min. ground clearance		mm	315	385

GENERAL
SPECIFICATIONS

D37EX-21	D37PX-21				
400 mm Single shoe	600 mm Single shoe	600 mm Swamp shoe			
5105 and up	5091 and up				
6,030	6,330	6,310			
7,410	7,770	7,750			
7,750	8,110	8,090			
– (Pivot turn)	– (Pivot turn)	– (Pivot turn)			
30	30	30			
35	35	35			
4.3	4.3	4.3			
6.5	6.5	6.5			
8.5	8.5	8.5			
4.3	4.3	4.3			
6.5	6.5	6.5			
8.5	8.5	8.5			
33.3 {0.34}	23.5 {0.24}	22.5 {0.23}			
40.2 {0.41}	28.4 {0.29}	28.4 {0.29}			
42.1 {0.43}	29.4 {0.30}	29.4 {0.30}			
3,055	3,055	3,060			
4,015	3,995	3,975			
4,085	4,065	4,045			
1,850	2,250	2,250			
2,720	3,250	3,250			
2,700	2,700	2,720			
2,015	2,015	2,035			
2,700	2,700	2,720			
2,700	2,700	2,720			
1,450	1,650	1,650			
2,240	2,240	2,240			
400	600	600			
315	315	385			

GENERAL

SPECIFICATIONS

Machine model			D31EX-21	D31PX-21	
			400 mm Single shoe	600 mm Single shoe	600 mm Swamp shoe
Serial No.			50001 and up		
Engine	Name		SAA4D102E-2-B		
	Type		4-cycle, water-cooled, in-line vertical type, 4 cylinders, direct injection, with turbocharger, air-cooled after cooler		
	No. of cylinders – bore x stroke		4 – 102 x 120		
	Piston displacement		ℓ {cc}		
	Performance	Rated horsepower	kW {HP} /rpm	56 {75}/2,000	
		Max. torque	Nm {kgm} /rpm	384 {39.2}/1,300	
		High idling	rpm	2,200	
		Low idling	rpm	800	
		Min. fuel consumption ratio	g/kWh {g/HPh}	211 {157}	
	Starting motor		24 V, 5.5 kW		
	Alternator		24 V, 25 A		
	Battery		12 V, 60 Ah x 2 (75D31R)		
	Radiator core type		D-5		
Power train system	HST pump	Type, number	Variable displacement piston pump x 2, Gear pump x 1		
		Discharge amount (variable pump) (charge pump)	63 40		
	HST pump	Set pressure (variable pump) (charge pump)	41.2 {420} 2.75 {28}		
		HST motor	Type, number	Variable displacement piston motor (3-stage selection, with parking brake) x 2	
	Discharge amount (Max.) (Medium) (Min.)		93 61 46		
			Final drive	Planetary gear, 2-stage reduction type, splash type lubrication	
		Undercarriage	Suspension		Rigid
Carrier roller			1 on each side		
Track roller			5 on each side	6 on each side	
Track shoe			Assembly type, single grouser, 38 on each side, pitch: 154.3 mm		
• 400 mm Single shoe			—		
• 600 mm Single shoe			Assembly type, single grouser, 40 on each side, pitch: 154.3 mm		
• 600 mm Swamp shoe			Assembly type, special swamp shoe, 40 on each side, pitch: 154.3 mm		

GENERAL

SPECIFICATIONS

D37EX-21	D37PX-21			
400 mm Single shoe	600 mm Single shoe	600 mm Swamp shoe		
5001 and up				
SAA4D102E-2-B				
4-cycle, water-cooled, in-line vertical type, 4 cylinders, direct injection, with turbocharger, air-cooled after cooler				
4 – 102 x 120				
3.92 {3,920}				
63 {85}/2,000				
412 {42.0}/1,300				
2,200				
800				
211 {157}				
24 V, 5.5 kW				
24 V, 25 A				
12 V, 60 Ah x 2 (75D31R)				
D-5				
Variable displacement piston pump x 2, Gear pump x 1				
63				
40				
41.2 {420}				
2.75 {28}				
Variable displacement piston motor (3-stage selection, with parking brake) x 2				
93				
61				
46				
Planetary gear, 2-stage reduction type, splash type lubrication				
Rigid				
1 on each side				
6 on each side				
Assembly type, single grouser, 41 on each side, pitch: 154.3 mm	—	—		
—	Assembly type, single grouser, 41 on each side, pitch: 154.3 mm	—		
—	—	Assembly type, special swamp shoe, 41 on each side, pitch: 154.3 mm		

GENERAL

SPECIFICATIONS

Machine model				D31EX-21	D31PX-21	
				400 mm Single shoe	600 mm Single shoe	600 mm Swamp shoe
Serial No.				50001 and up		
Work equipment hydraulic system	Hydraulic pump	Type, number	—	Gear type x 1		
		Theoretical discharge amount	cm ³ /rev	40.2		
		Max. discharge pressure	MPa {kg/cm ² }	20.6 {210}		
	Main control valve	Type, number	—	3-spool valve x 1		
		Operating method	—	Hydraulic pilot type		
	Lift cylinder	Type	—	Double-acting piston type		
		Cylinder bore	mm	85		
		Outside diameter of piston rod	mm	40		
		Piston stroke	mm	365		
		Max. distance between pins	mm	1,009		
		Min. distance between pins	mm	644		
	Tilt cylinder	Type	—	Double-acting piston type		
		Cylinder bore	mm	90		
		Outside diameter of piston rod	mm	45		
		Piston stroke	mm	139		
		Max. distance between pins	mm	598		
		Min. distance between pins	mm	459		
	Angle cylinder	Type	—	Double-acting piston type		
		Cylinder bore	mm	75		
		Outside diameter of piston rod	mm	40		
		Piston stroke	mm	393		
		Max. distance between pins	mm	1,083		
		Min. distance between pins	mm	690		
	Hydraulic tank		—	Box type (externally mounted control valve type)		
	Hydraulic filter		—	Tank return side		
	Oil cooler		—	Air-cooled type (SF-3)		
Work equipment	Type		—	Hydraulic type angle tilt dozer		
	Blade support method		—	Hydraulic cylinder type		
	Performance	Max. lifting height (from ground)	mm	860	855	920
		Max. lowering depth (from ground)	mm	385	380	315
		Max. tilt	mm	330	435	435
		Max. angle	deg	25	25	25
	Dimensions	Blade width	mm	2,435	3,200	3,200
		Blade height	mm	845	750	750
		Blade cutting angle	deg	57	57	59

GENERAL
SPECIFICATIONS

D37EX-21	D37PX-21				
400 mm Single shoe	600 mm Single shoe	600 mm Swamp shoe			
5001 and up					
Gear type x 1					
40.2					
20.6 {210}					
3-spool valve x 1					
Hydraulic pilot type					
Double-acting piston type					
85					
40					
365					
1,009					
644					
Double-acting piston type					
90					
45					
139					
598					
459					
Double-acting piston type					
75					
40					
393					
1,083					
690					
Box type (externally mounted control valve type)					
Tank return side					
Air-cooled type (SF-3)					
Hydraulic type angle tilt dozer					
Hydraulic cylinder type					
860	855	920			
385	380	315			
375	445	445			
25	25	25			
2,720	3,250	3,250			
940	895	895			
57	57	59			

WEIGHT TABLE

★ This Weight Table is for reference when handling components or when transporting the machine.

Unit: kg				
Machine model	D31EX-21	D31PX-21	D37EX-21	D37PX-21
Serial No.	50001 and up		5001 and up	
Engine, damper assembly (not including water or oil)	485	485	485	485
• Engine assembly	400	400	400	400
• Damper assembly	27	27	27	27
• Engine related parts (engine mount, air cleaner, muffler, etc.)	58	58	58	58
Cooling assembly	177	177	176	176
• Radiator	71	71	71	71
• Oil cooler	33	33	33	33
• Charge air cooler	15	15	15	15
Fuel tank (not including fuel)	106	106	106	106
HST pump	124	124	124	124
HST motor (each side)	130	130	130	130
Final drive (each side)	162	162	162	162
Sprocket (each side)	26	26	26	26
Frame assembly	1,790	1,880	1,860	1,900
• Main frame	1,110	1,150	1,130	1,170
• Front underguard	8	8	8	8
• Rear underguard (including inspection cover)	41	41	41	41
• Idler assembly (each side)	93	93	93	93
• Recoil spring assembly (each side)	70	70	70	70
• Track roller (each side)	27 x 5	27 x 6	27 x 6	27 x 6
• Carrier roller (each side)	16	16	16	16
Track shoe assembly				
• Single grouser shoe (400 mm)	520 x 2	520 x 2	560 x 2	560 x 2
• Single grouser shoe (600 mm)	—	690 x 2	—	710 x 2
• Swamp shoe (600 mm)	—	680 x 2	—	700 x 2
Hydraulic tank (not including hydraulic oil)	65	65	65	65
Hydraulic pump	6	6	6	6
Control valve				
• 3-spool valve	16	16	16	16
• 4-spool valve (with ripper)	19	—	19	—

GENERAL
WEIGHT TABLE

Unit: kg

Machine model	D31EX-21	D31PX-21	D37EX-21	D37PX-21
Serial No.	50001 and up		5001 and up	
Power angle tiltdozer assembly	945	1,020	990	1,050
• Blade	460	530	505	565
• Dozer frame	380	380	380	380
• Tilt cylinder assembly	20	20	20	20
• Angle cylinder assembly	22 x 2	22 x 2	22 x 2	22 x 2
Lift cylinder assembly	23 x 2	23 x 2	23 x 2	23 x 2
ROPS cab assembly	620	620	620	620
ROPS canopy assembly	310	310	310	310
Operator's seat	60	60	60	60
Floor frame assembly	220	220	220	220
Radiator guard assembly (including radiator mask)	175	175	180	180
Engine hood assembly	40	40	40	40
Engine side cover assembly (including left, right, top, bottom)	60	60	60	60
Front bracket (engine dividing wall)	45	45	45	45
Fender (left)	107	107	107	107
Fender (right)	113	113	113	113

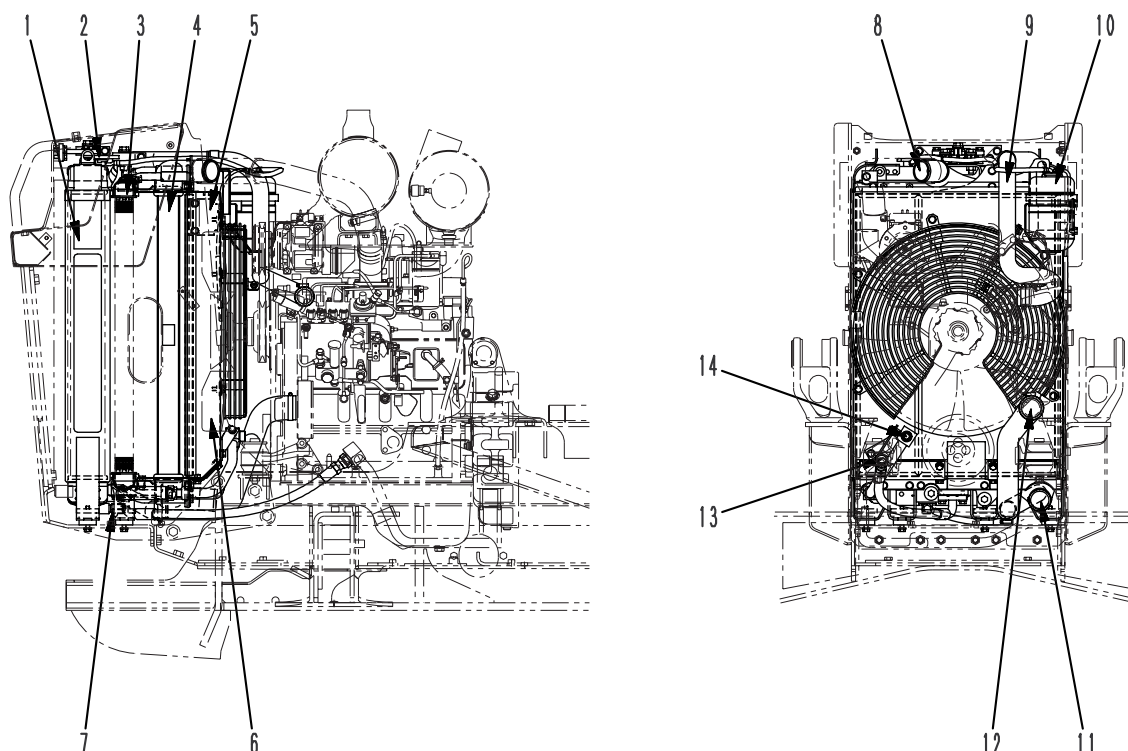
TABLE OF FUEL, COOLANT AND LUBRICANTS

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE								CAPACITY (ℓ)			
		-22 -30	-4 -20	14 -10	32 0	50 10	68 20	86 30	104°F 40°C	Specified	Refill		
Engine oil pan	Engine oil					SAE30				14	12.5		
					SAE10W								
					SAE10W-30								
					SAE15W-40								
Idler (left and right, each)						SAE30				0.16	0.16		
Hydraulic system						SAE10W				97	47		
						SAE10W-30							
						SAE15W-40							
Final drive case (left and right, each)						SAE30				3.5	3.5		
Fuel tank		Diesel fuel				ASTM D975 No.2				165	—		
						ASTM D975 No.1							
Grease fitting		Grease				Lithium-based grease No. 2				—	—		
Cooling system (including sub-tank)	Coolant		Add antifreeze							27	—		

10 STRUCTURE AND FUNCTION, MAINTENANCE STANDARD

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COOLING SYSTEM



9JB00805

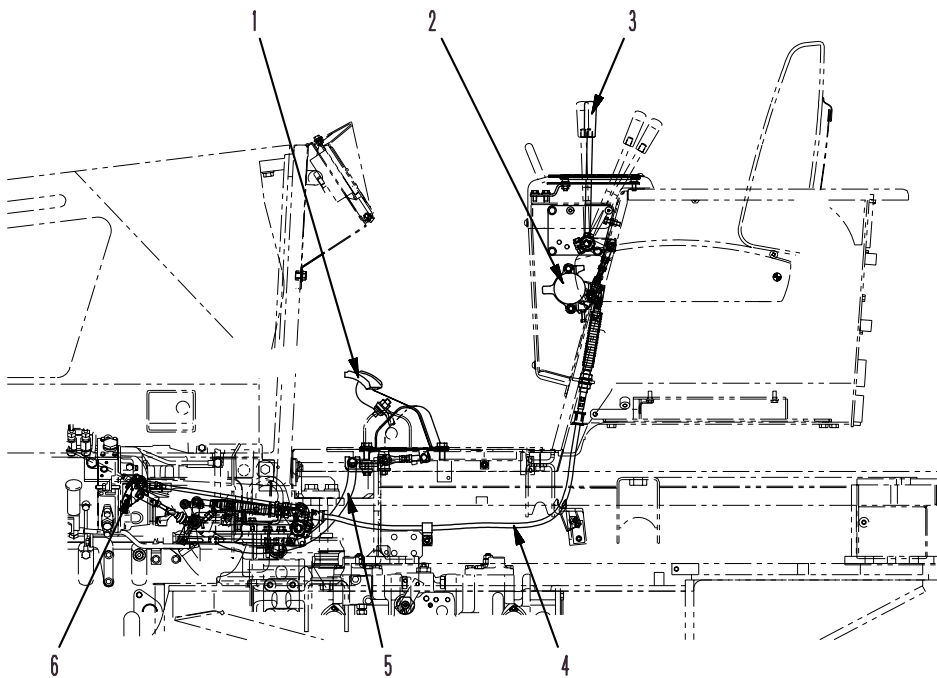
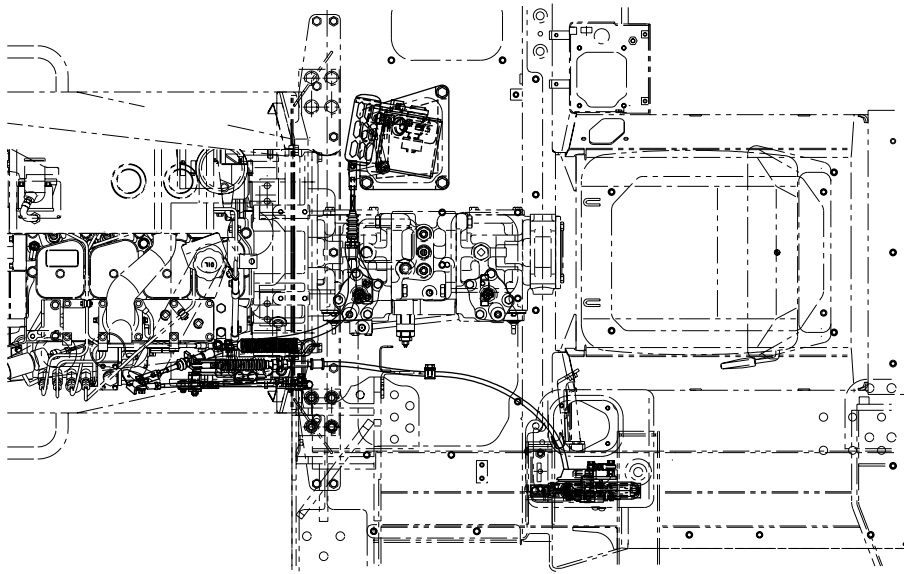
1. Radiator
2. Radiator cap
3. Oil cooler
4. After cooler
5. Shroud
6. Fan
7. Drain valve

8. After cooler outlet port
9. Radiator inlet port hose
10. Reservoir tank
11. After cooler inlet port
12. Radiator outlet port hose
13. Oil cooler inlet port hose
14. Oil cooler outlet port tube

Specifications

Item	Unit	Radiator	Oil cooler	After cooler
Core type	—	D-5	SF-3	AL-CFT
Fin pitch	mm	3.0	3.0	6.0/2
Total heat dissipation area	m ²	34.05	12.35	11.44
Pressure valve cracking pressure	kPa {kg/cm ² }	88.3 ± 14.7 {0.9 ± 0.15}	—	—
Vacuum valve cracking pressure	kPa {kg/cm ² }	0 – 4.9 {0 – 0.05}	—	—

ENGINE CONTROL



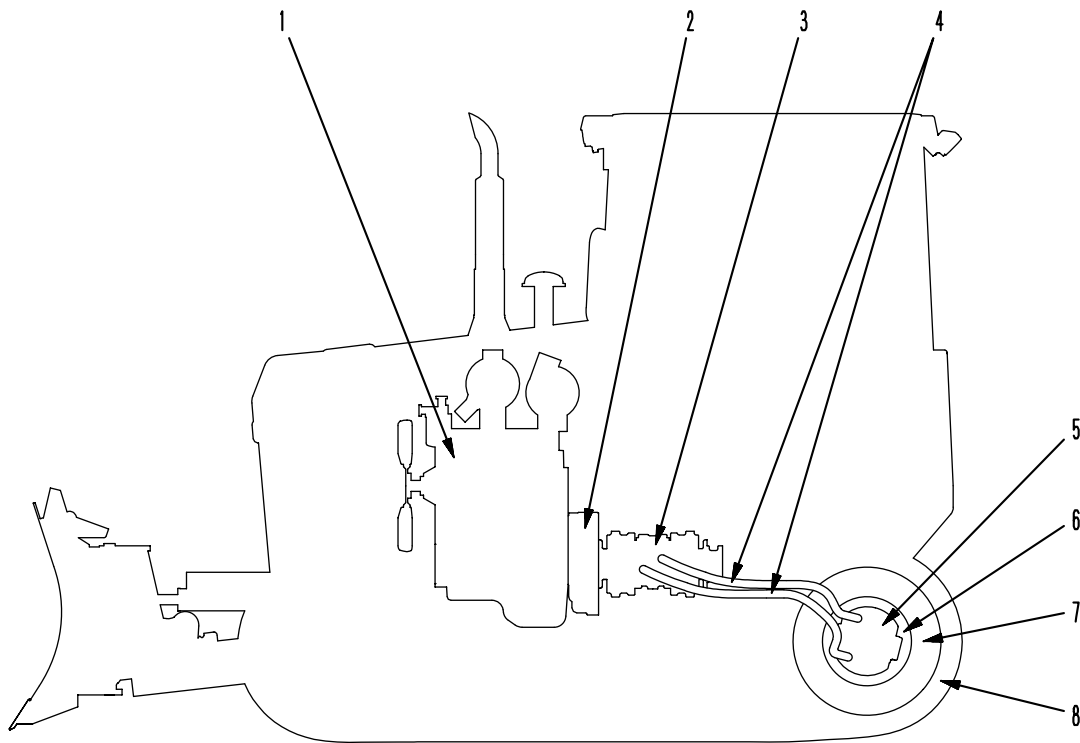
9JB00304

1. Decelerator pedal
2. Clutch
3. Fuel control lever
4. Fuel control cable
5. Decelerator cable
6. Governor lever

Outline

- The control of the engine speed is carried out with fuel control lever (3) or decelerator pedal (1).

POWER TRAIN

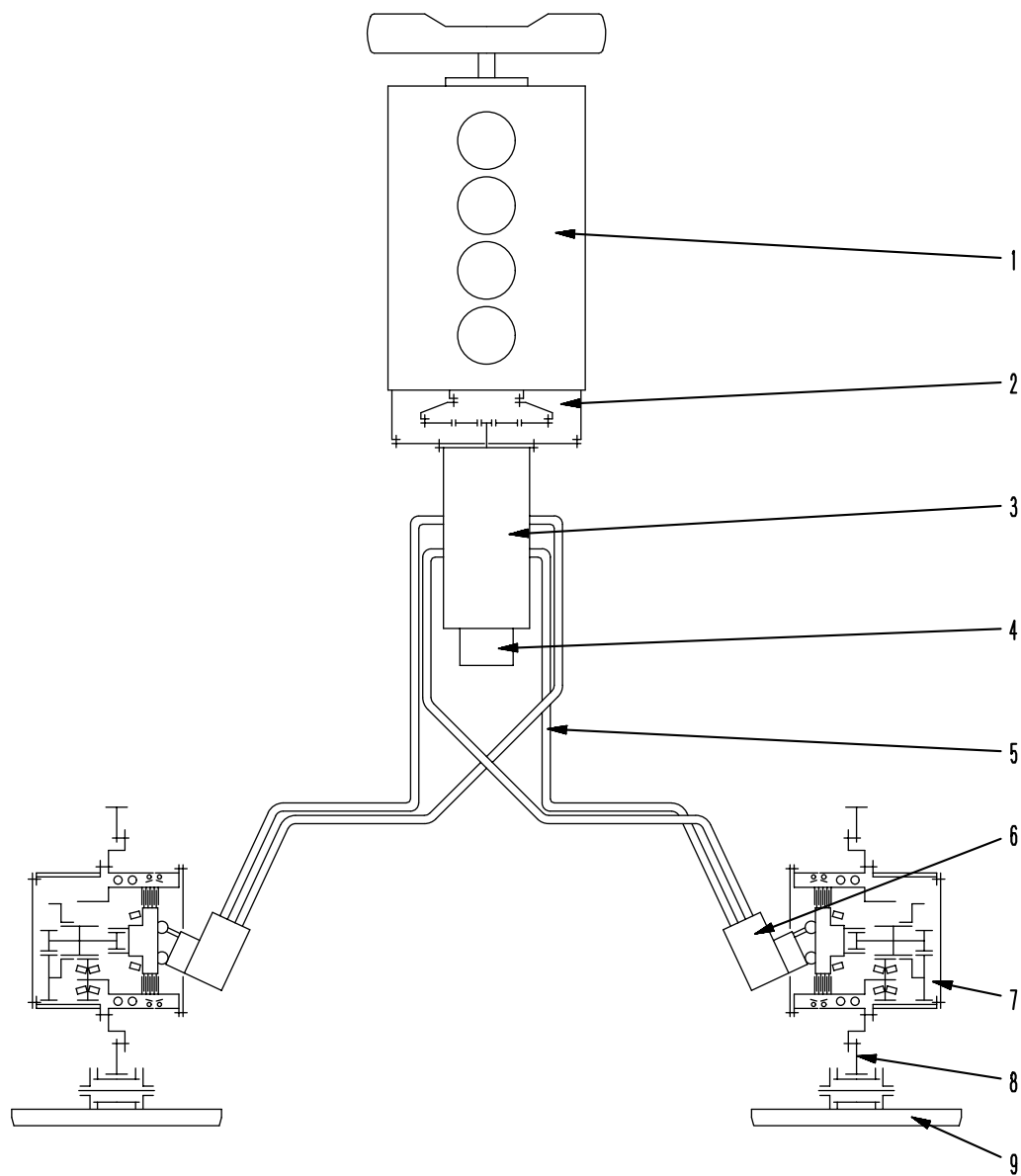


9JB00305

Outline

- The power generated by the engine (1) has its torsional vibration reduced by damper (2), and is then transmitted to the input shaft of the HST pump.
- HST pump (3) consists of swash plate type piston pumps for the left travel and right travel joined in tandem. The hydraulic power passes from each pump through high-pressure hoses (4) and is transmitted to left and right HST motors (5).
- HST pump (3) changes the discharge direction and discharge amount continuously in accordance with the movement of the swash plate of each pump to match the movement of the steering, direction, and speed lever. This changes the direction of rotation and speed of the left and right HST motors and controls the forward and reverse travel and turning of the machine.
- The hydraulic power transmitted to HST motor (5) is output from the motor output shaft as mechanical power, and is transmitted to final drive (6).
- Final drive (6) is a 2-stage planetary gear mechanism. It reduces the speed and rotates sprocket (7) to drive track shoe (8).

POWER TRAIN SYSTEM

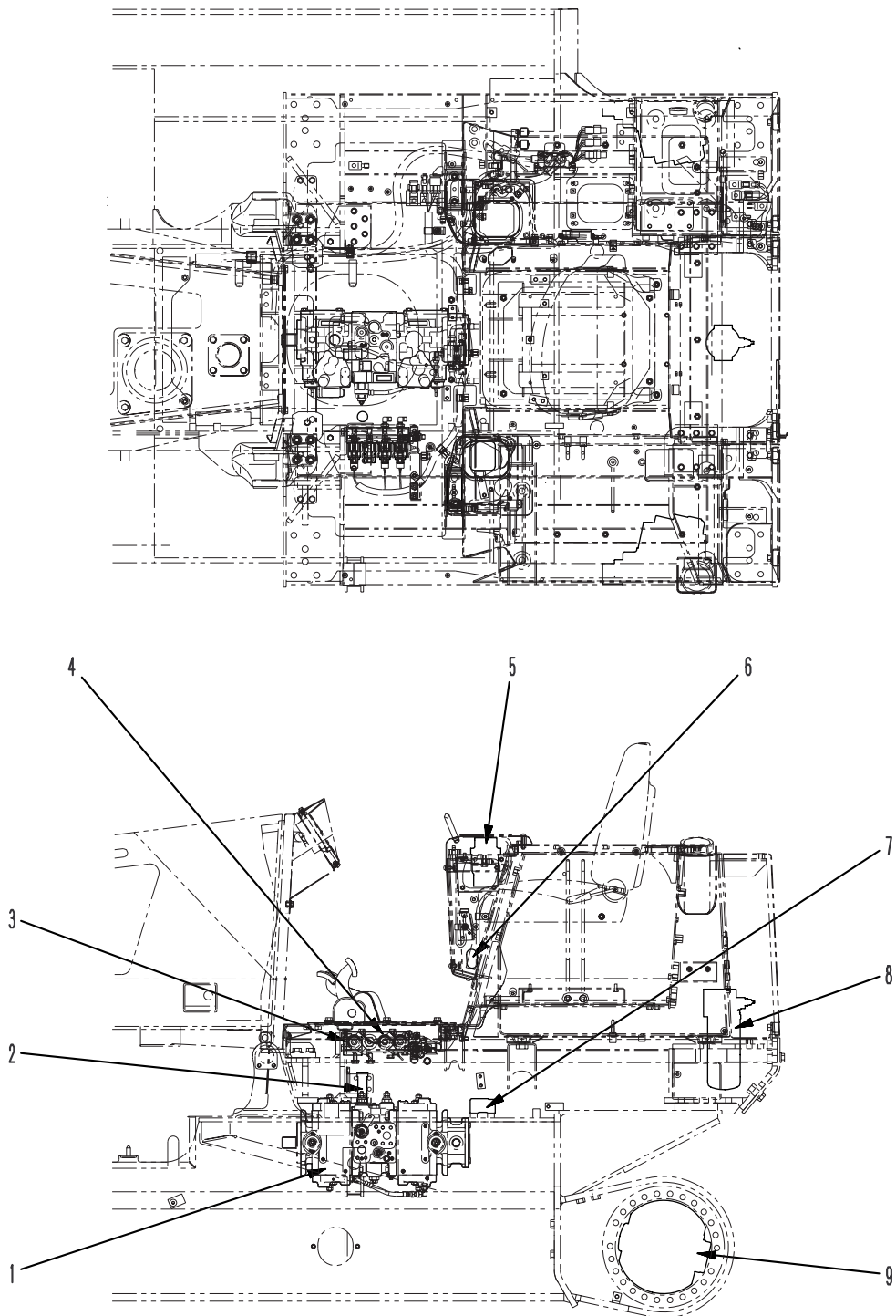


9JB00306

1. Engine
2. Damper
3. HST pump
4. Charge pump
5. High-pressure hose

6. HST motor
7. Final drive
8. Sprocket
9. Track shoe

HST HYDRAULIC EQUIPMENT ARRANGEMENT DIAGRAM



9JB00806

1. HST pump
2. Towing valve
3. Inching valve
4. 4-spool solenoid valve
5. Steering and REVERSE PPC valve

6. Shut-off valve
7. Auto gearshift valve
8. Charge pump oil filter
9. HST motor

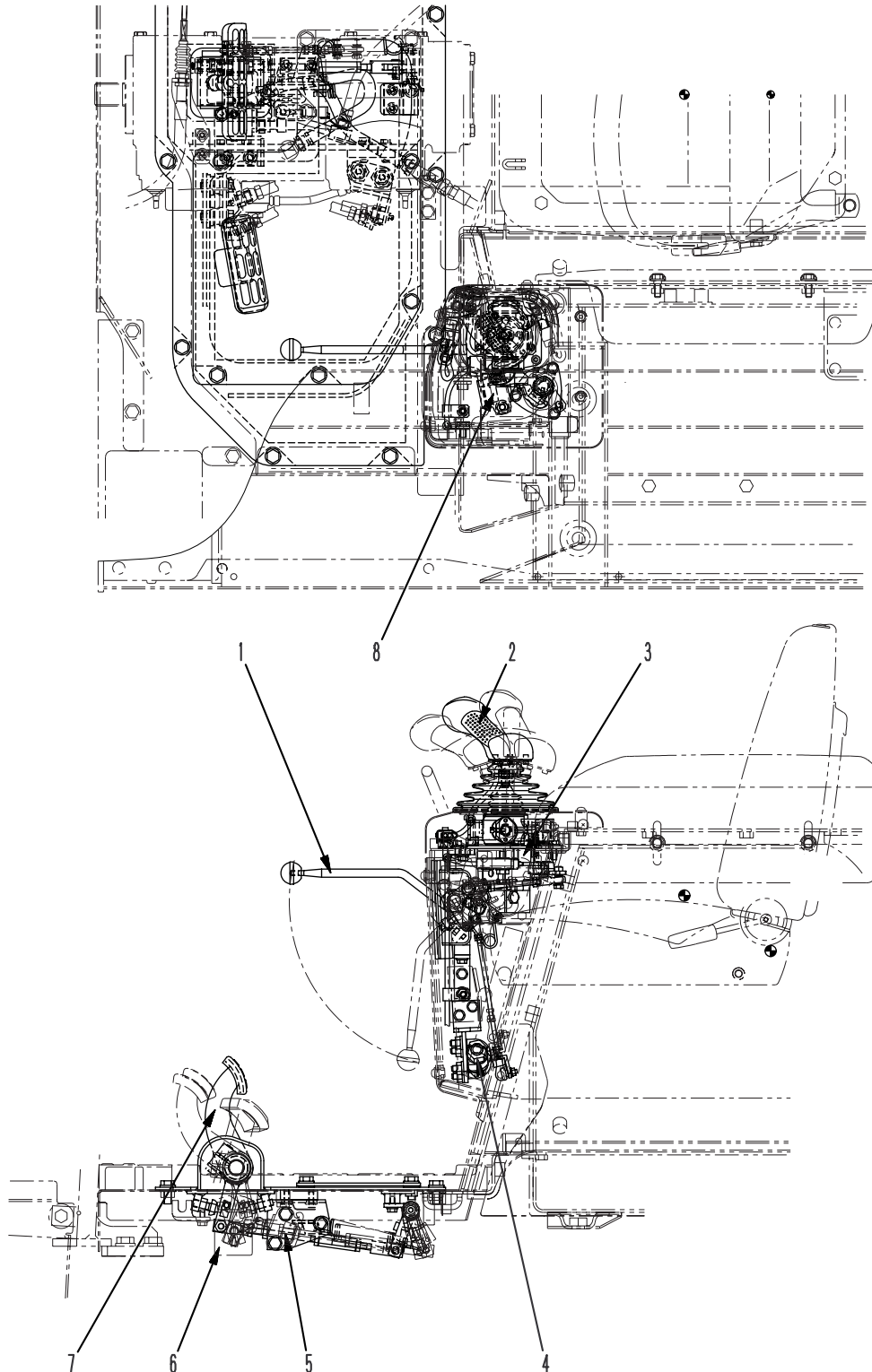
STEERING, BRAKE CONTROL

D31EX-21 Serial No. 50001 – 50097

D31PX-21 Serial No. 50001 – 50181

D37EX-21 Serial No. 5001 – 5104

D37PX-21 Serial No. 5001 – 5090



9JB00807

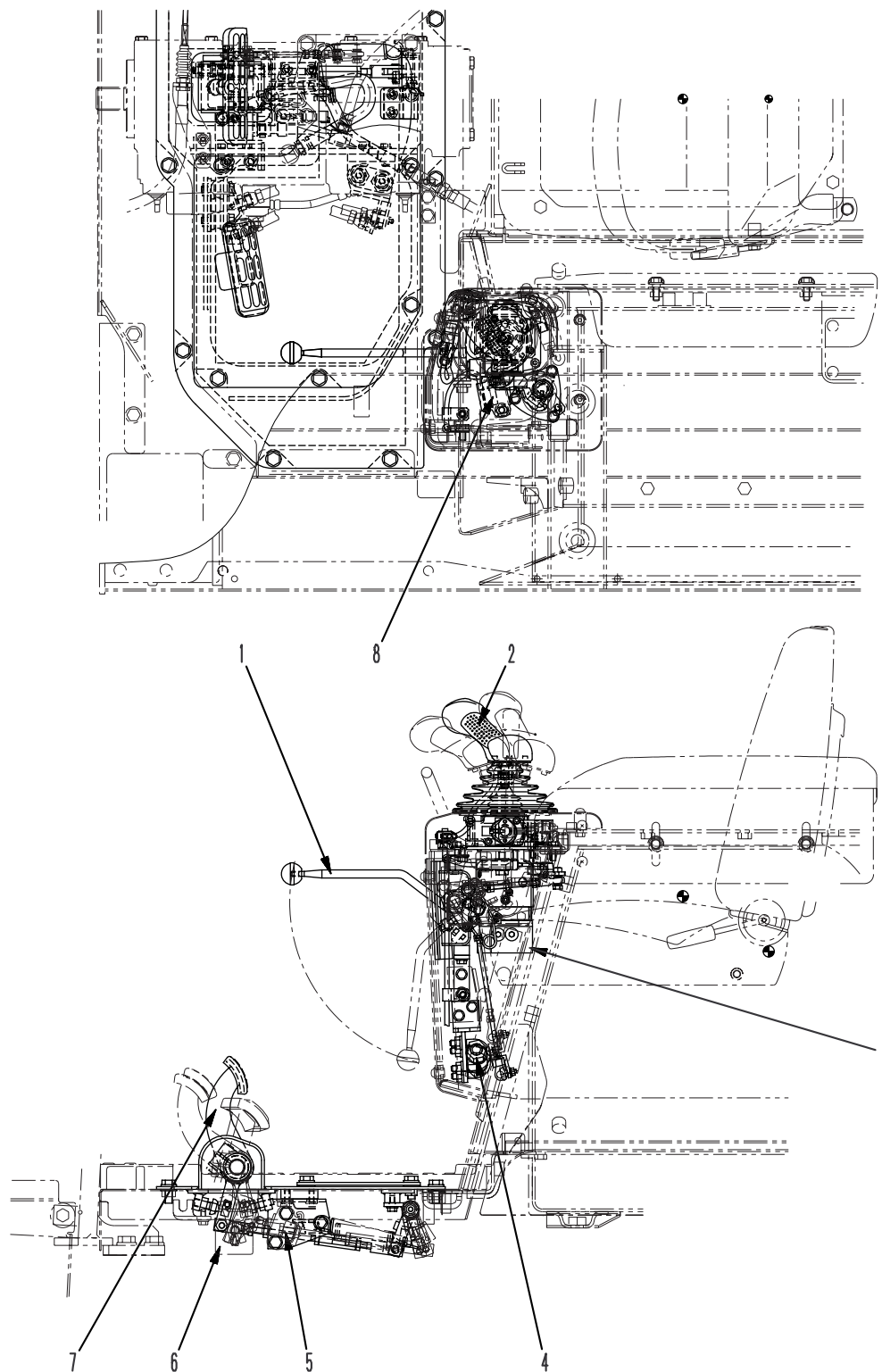
1. Parking brake lever
2. Steering, directional, and speed lever
3. Steering and directional PPC valve
4. Shut-off valve
5. Limit switch for center brake
6. Inching valve
7. Brake pedal
8. Neutral safety, parking brake limit switch

Outline

- Steering, direction, and speed lever (2) changes the volume of the HST pump continuously through steering and directional PPC valve (3) to steer and drive the machine forward or in reverse.
- If steering, direction, and speed lever (2) is operated to FORWARD and slightly to the left, the machine will turn gradually to the left. If the lever is operated fully to the left, it will carry out a spin turn to the left.
- Brake pedal (7) operates the spool of inching valve (6) according to the amount that it is depressed and actuates the left and right HST hydraulic brakes simultaneously.
If brake pedal (7) is depressed fully, the left and right HST hydraulic brakes are actuated suddenly at the same time, and the signal from center brake limit switch (5) is sent to the solenoid valve. After the machine stops, the parking brake built into the left and right HST motors is actuated.
- Parking brake lever (1) is interconnected with shut-off valve (4) and neutral safety and parking brake limit switch (8), and acts also as the parking brake.

D31EX-21 Serial No. 50098 and up
D31PX-21 Serial No. 50182 and up

D37EX-21 Serial No. 5105 and up
D37PX-21 Serial No. 5091 and up



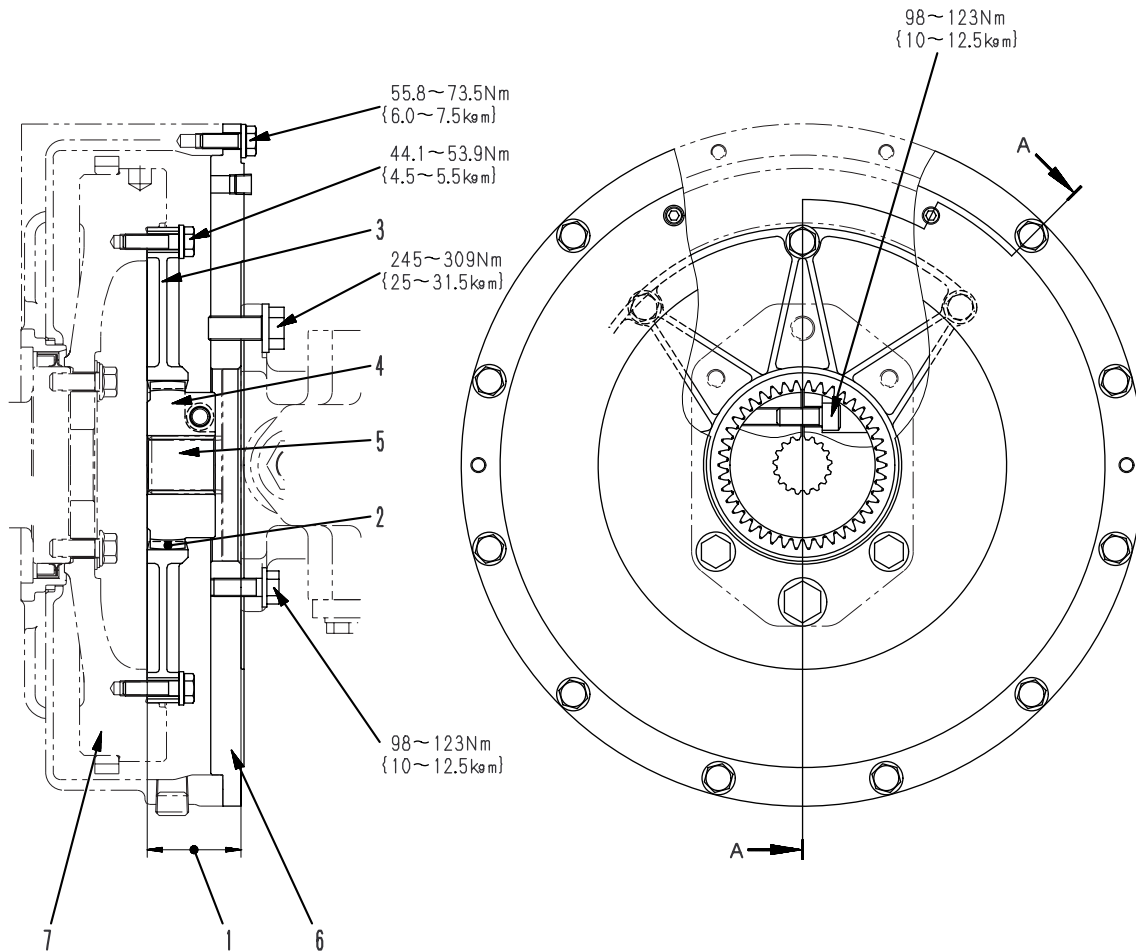
9JB01417

1. Parking brake lever
2. Steering, directional, and speed lever
3. Steering and directional PPC valve
4. Shut-off valve
5. Limit switch for center brake
6. Inching valve
7. Brake pedal
8. Neutral safety, parking brake limit switch

Outline

- Steering, direction, and speed lever (2) changes the volume of the HST pump continuously through steering and directional PPC valve (3) to steer and drive the machine forward or in reverse.
- If steering, direction, and speed lever (2) is operated to FORWARD and slightly to the left, the machine will turn gradually to the left. If the lever is operated fully to the left, it will carry out a pivot turn to the left.
- Brake pedal (7) operates the spool of inching valve (6) according to the amount that it is depressed and actuates the left and right HST hydraulic brakes simultaneously.
If brake pedal (7) is depressed fully, the left and right HST hydraulic brakes are actuated suddenly at the same time, and the signal from center brake limit switch (5) is sent to the solenoid valve. After the machine stops, the parking brake built into the left and right HST motors is actuated.
- Parking brake lever (1) is interconnected with shut-off valve (4) and neutral safety and parking brake limit switch (8), and acts also as the parking brake.

DAMPER



9JB00309

Unit: mm

No.	Check item	Criteria		Remedy
		Standard size	Repair limit	Adjust
1	Distance between HST pump mounting surface and tip of boss	62.0	±0.8	
2	Wear of inner teeth of coupling (resin)	Repair limit: 1.0		Replace

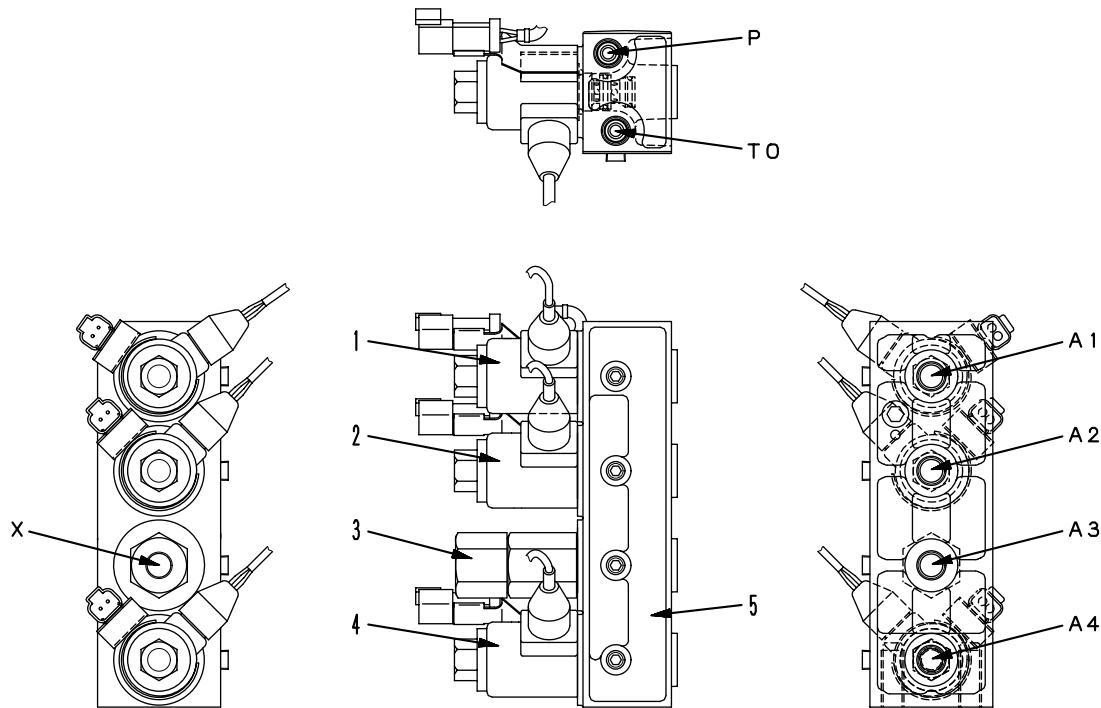
- 3. Coupling
- 4. Boss
- 5. HST pump input shaft
- 6. Cover
- 7. Flywheel

Outline

- The damper reduces the torsional vibration caused by variations in the engine torque, and acts to protect the engine and downstream drive system from the torsional vibration.
- The power from the engine is transmitted from flywheel (7) to coupling (3). Coupling (3) absorbs the torsional vibration and transmits the power through boss (4) to the HST pump.

SOLENOID VALVE

For 2nd selector, 3rd selector, HST brake selector, parking brake



9JB00310

P: From HST pump CPB

TO: Drain

A1: To auto gearshift valve PIN

A2: To left and right HST motor PCmin

A3: To HST pump EB1, EB2

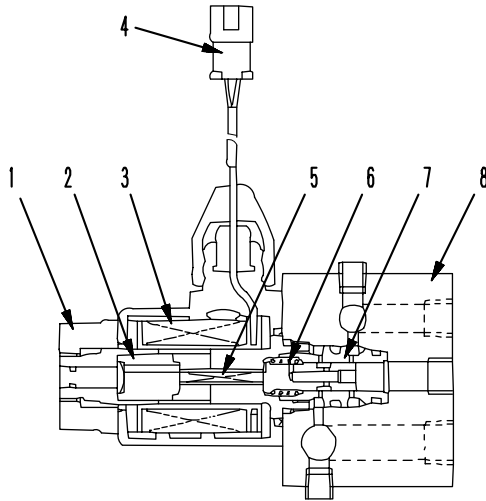
A4: To HST pump PPB

X: From 4-spool solenoid A4

1. 2nd selector solenoid valve
2. 3rd selector solenoid valve
3. HST brake selector valve
4. Parking brake solenoid valve
5. Block

Outline

- Four selector valves (solenoid valve x 3, hydraulic selector valve x 1) are installed to block (5).
- 2nd selector solenoid valve (1) outputs the selector oil pressure when the steering, direction, and speed lever shift switch is operated, and changes the HST motor capacity to 2nd speed.
- 3rd selector solenoid valve (2) outputs the selector oil pressure when the steering, direction, and speed lever shift switch is operated, and changes the HST motor capacity to 3rd speed.
- HST brake selector valve (3) outputs the selector oil pressure when the output pressure oil of parking brake solenoid valve (4) is drained, sets the HST pump capacity to Neutral, and actuates the HST hydraulic brake to stop the machine.
- The limit switch that is actuated when the brake pedal is depressed fully or the limit switch interconnected with the travel lock lever send a signal. Parking brake solenoid valve (4) then drains the selector oil pressure and applies the parking brake built into the HST motor.



9JB00311

- 1. Nut
- 2. Plunger
- 3. Coil

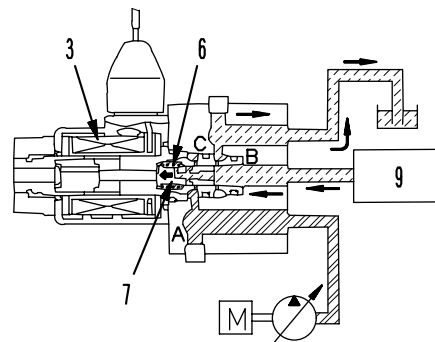
- 4. Connector
- 5. Push pin
- 6. Spring

- 7. Spool
- 8. Block

Operation

When solenoid is de-energized

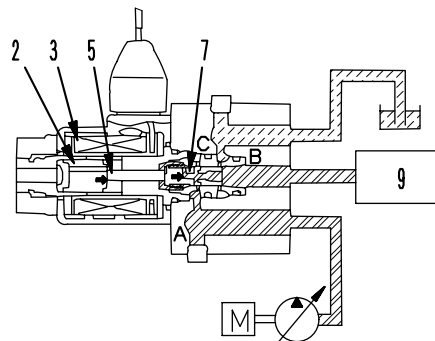
- The signal current does not flow from the controller, so coil (3) is de-energized.
- For this reason, spool (7) is pushed fully to the left by spring (6).
- As a result, port **A** closes and the flow of pressurized oil from the pump does not flow to actuator (9).
At the same time, the oil from actuator (9) flows from port **B** to port **C** and then, it is drained.



9JB00312

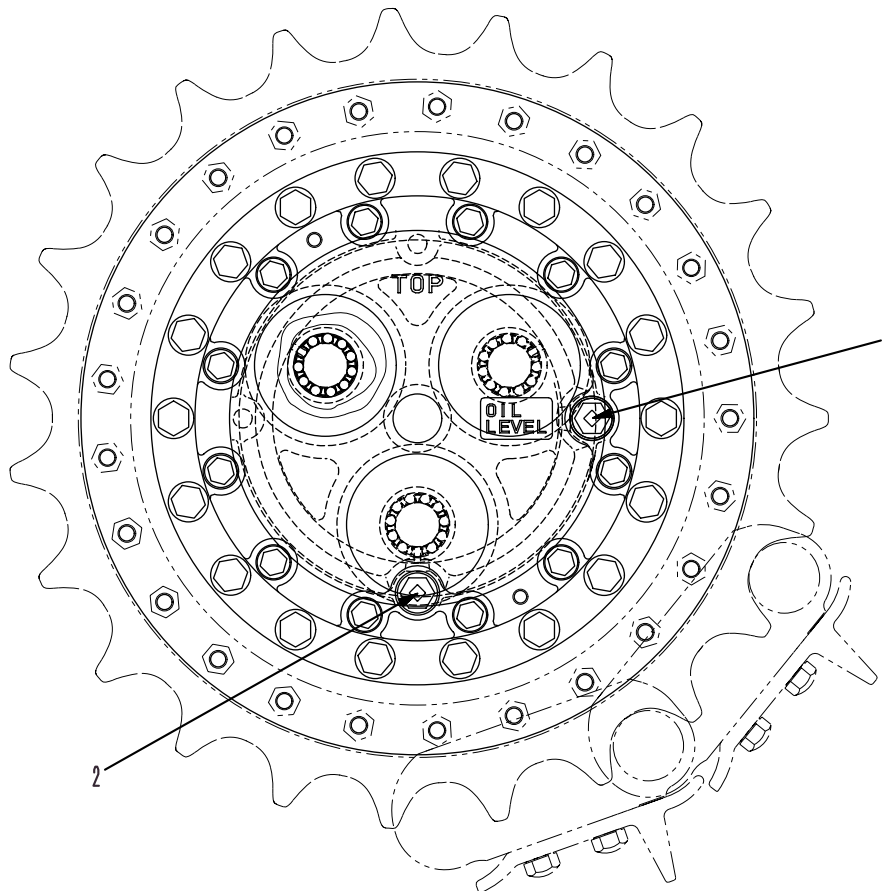
When solenoid is energized

- When the signal current flows to the solenoid valve, coil (3) is excited, and propulsion force to the right is generated in plunger (2).
- For this reason, spool (7) is pushed to the right by push pin (5).
- As a result, the pressurized oil from the pump flows from port **A** through port **B**, and goes to actuator (9).
At the same time, port **C** closes, so the oil is not drained.



9JB00313

FINAL DRIVE



9JB00314

1. Oil level plug
2. Drain plug

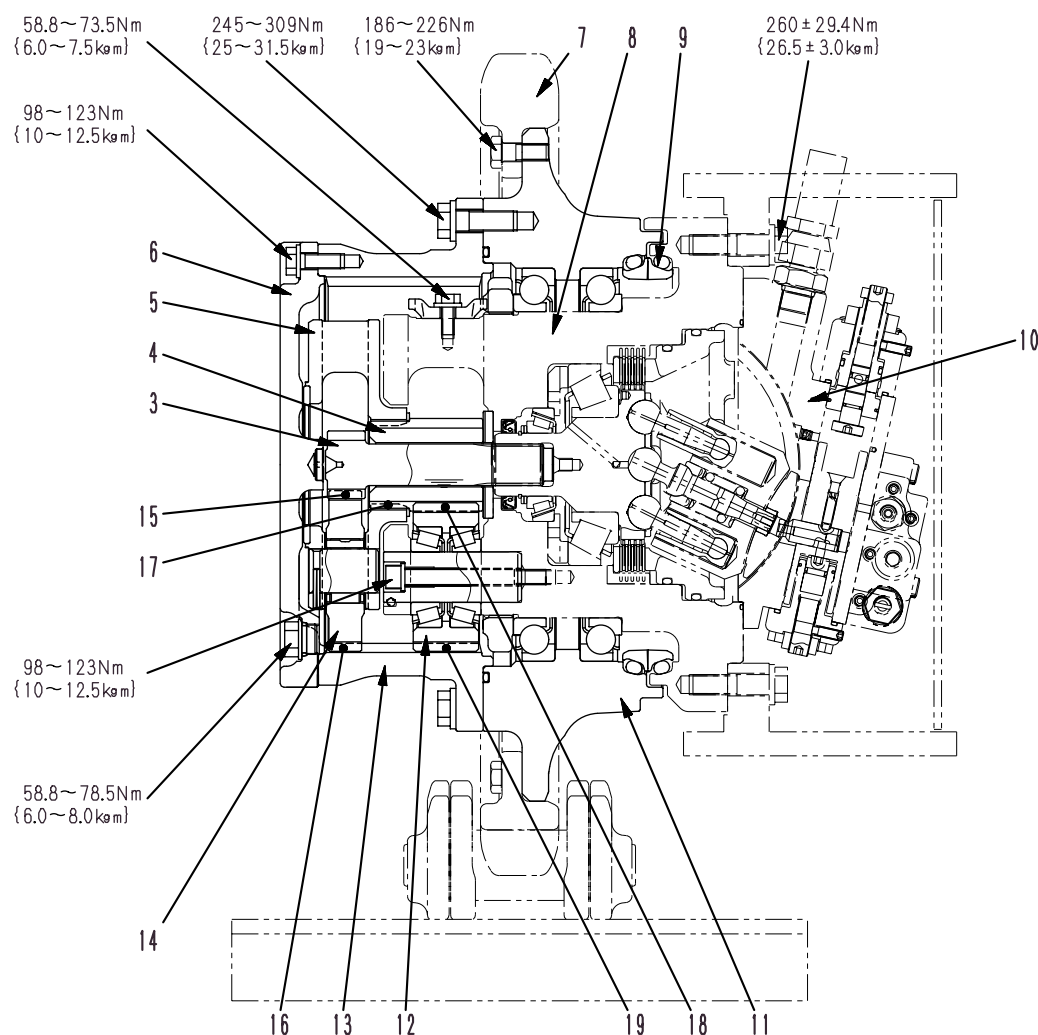
Outline

- The final drive is a planetary gear, 2-stage reduction type. It provides splash lubrication when the gear rotates. It is also possible to remove or install the final drive as a single unit.
- A floating seal is installed to the rotating and sliding portion of the sprocket to prevent the entry of sand or soil from outside and to prevent leakage of lubricating oil.

Specifications

Reduction ratio:

$$- ((14 + 88) / 14) \times ((20 + 88) / 20) + 1 = -38.343$$



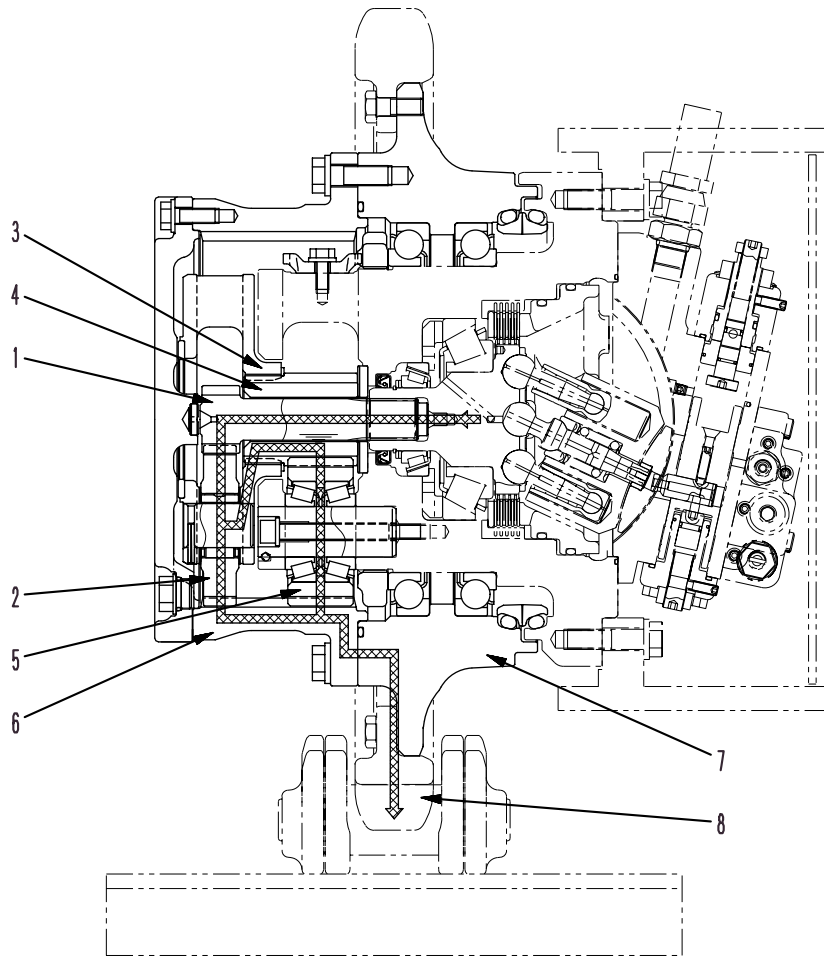
9JB00315

- | | |
|--------------------------------------|---|
| 3. No. 1 sun gear (No. of teeth: 14) | 9. Floating seal |
| 4. No. 2 sun gear (No. of teeth: 20) | 10. HST motor |
| 5. No. 1 planetary carrier | 11. Hub |
| 6. Cover | 12. No. 2 planetary pinion (No. of teeth: 34) |
| 7. Sprocket | 13. Ring gear (No. of teeth: 88) |
| 8. No. 2 planetary carrier | 14. No. 1 planetary pinion (No. of teeth: 37) |

Unit: mm

No.	Check item	Criteria		Remedy
		Standard clearance	Clearance limit	
15	Backlash of No. 1 sun gear and No. 1 planetary pinion	0.13 – 0.35	1.00	Replace
16	Backlash of No. 1 planetary pinion and ring gear	0.17 – 0.54	1.10	
17	Backlash of No. 1 planetary carrier and No. 2 sun gear	0.27 – 0.46	1.00	
18	Backlash of No. 2 sun gear and No. 2 planetary pinion	0.14 – 0.38	1.00	
19	Backlash of No. 2 planetary pinion and ring gear	0.18 – 0.54	1.10	

Path of power transmission



9JB00316

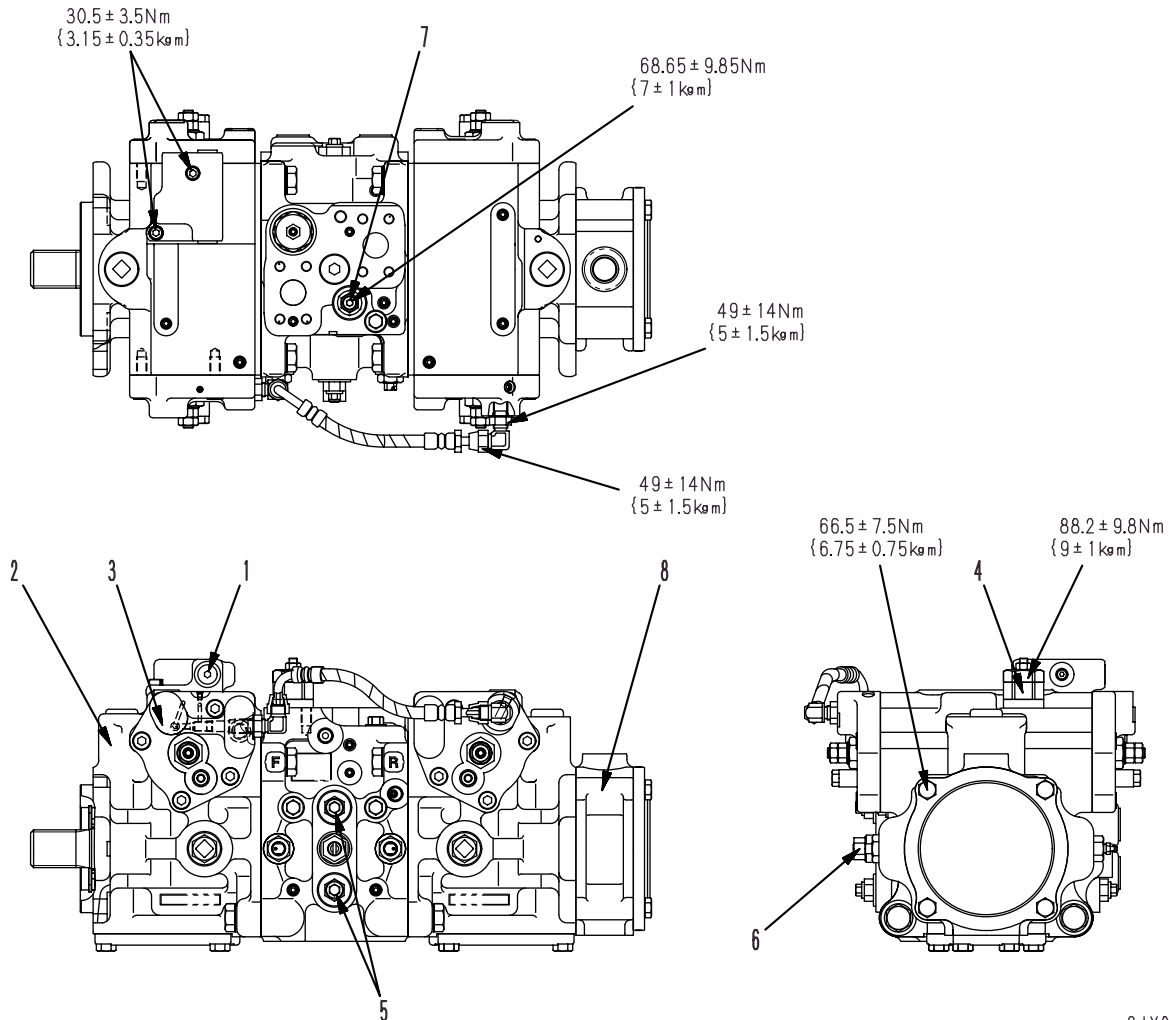
- The power from the HST motor goes from No. 1 sun gear (1) through No. 1 planetary pinion (2), is reduced and rotates in the opposite direction from the rotation of the HST motor, and is then transmitted to ring gear (6).
When this happens, No. 1 planetary pinion (2) forms one unit with No. 1 planetary carrier (3), and the power from No. 1 planetary carrier (3) is transmitted to No. 2 sun gear (4).
- The power transmitted to No. 2 sun gear (4) passes through No. 2 planetary pinion (5), has its speed reduced, and is transmitted to ring gear (6).
- The rotating power undergoes two-stage reduction, is transmitted to ring gear (6), passes through hub (7), and is transmitted to sprocket (8).

HST PUMP

Type: HPV63 + 63

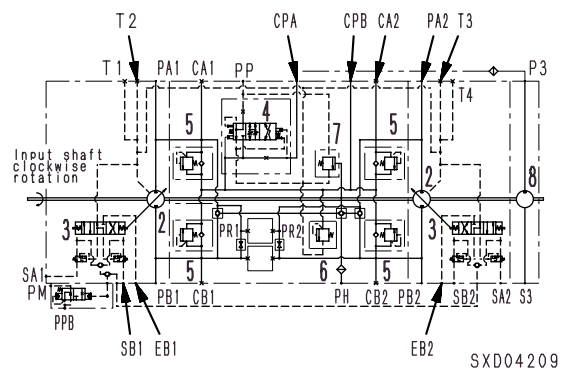
Structure

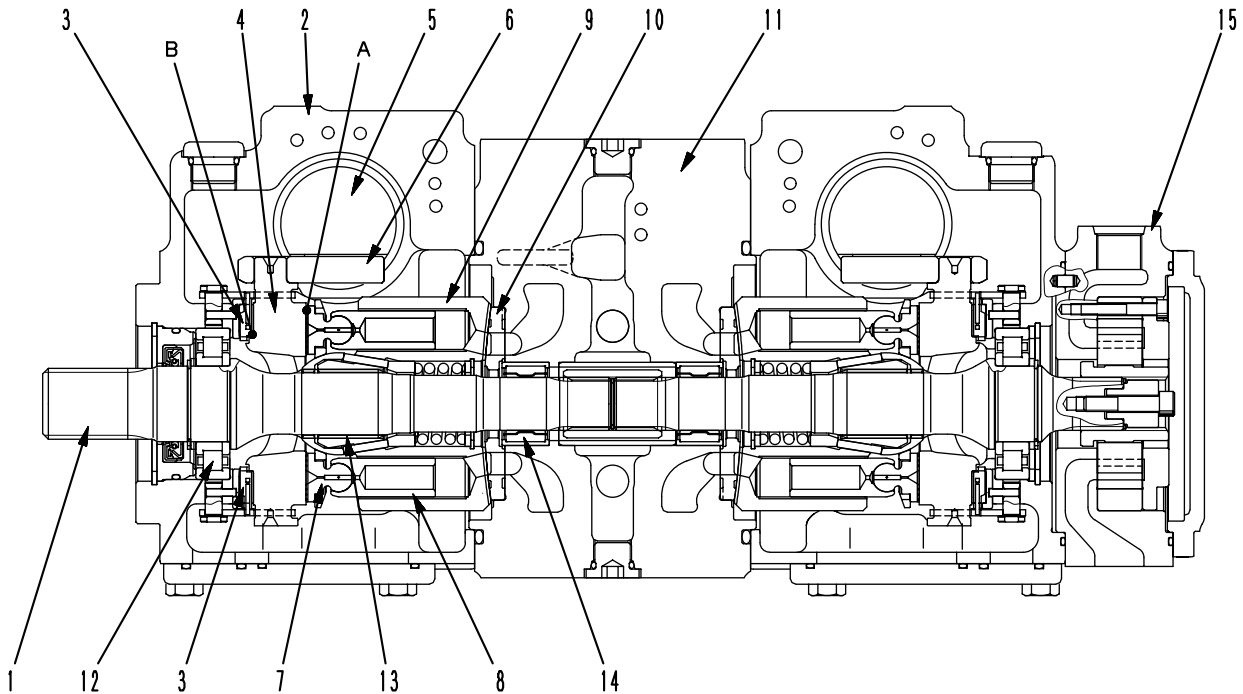
- This pump consists of a variable displacement swash plate tandem piston pump, drive piston, AS valve, safety-suction valve, charge safety valve, cut-off valve, and charge pump.



9JY00548

1. Parking brake valve
2. Piston pump
3. Drive piston
4. AS valve
5. Safety-suction valve
6. Charge safety valve
7. Cut-off valve
8. Charge pump





9JY00549

- | | |
|-------------------|-------------------|
| 1. Shaft | 9. Cylinder block |
| 2. Case | 10. Valve plate |
| 3. Cradle bearing | 11. End cap |
| 4. Rocker cam | 12. Bearing |
| 5. Drive piston | 13. Spline |
| 6. Slider | 14. Bearing |
| 7. Shoe | 15. Charge pump |
| 8. Piston | |

Outline

- The rotation and torque transmitted to the pump shaft is converted into 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 (normal $\longleftrightarrow$ 0 $\longleftrightarrow$ reverse discharge).

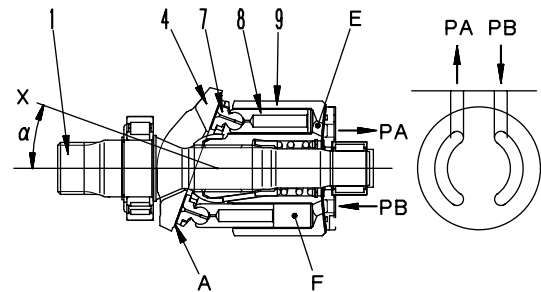
Structure

- Cylinder block (9) is supported to shaft (1) by spline (13). Shaft (1) is supported by front and rear bearings (12) and (14).
- The tip of piston (8) is a concave ball, and shoe (7) is caulked to it to form one unit. Piston (8) and shoe (7) form a spherical bearing.
- Rocker cam (4) has flat surface **A**, and shoe (7) is always pressed against this surface while sliding in a circular movement. Rocker cam (4) positions cradle bearing (3) between case (2) and cylindrical surface **B**, and rocks.
- Piston (8) carries out relative movement in the axial direction inside each cylinder chamber of cylinder block (9).
- Cylinder block (9) seals the pressure oil to valve plate (10) and carries out relative rotation. This surface is designed so that the oil pressure balance is maintained at a suitable level. The oil inside each cylinder chamber of cylinder block (9) is sucked in and discharged through valve plate (10).

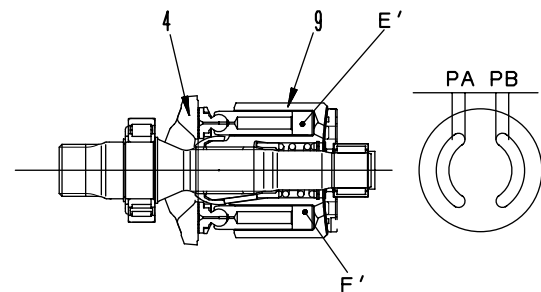
Operation

1. Operation of pump

- Cylinder block (9) rotates together with shaft (1), and shoe (7) slides on flat surface **A**. When this happens, angle α between center line **X** of rocker cam (4) and the axial direction of cylinder block (9) changes. (Angle α is called the swash plate angle.)
- Center line **X** of rocker cam (4) maintains swash plate angle α in relation to the axial direction of cylinder block (9), and flat surface **A** moves as a cam in relation to shoe (7).
- In this way, piston (8) slides on the inside of cylinder block (9), so a difference between volumes **E** and **F** is created inside cylinder block (9). The suction and discharge is carried out by an amount equal to this difference $F - E$.
- In other words, when cylinder block (9) rotates and the volume of chamber **F** becomes smaller, the oil is discharged during that stroke. On the other hand, the volume of chamber **E** becomes larger, and as the volume becomes larger, the oil is sucked in.
- If center line **X** of rocker cam (4) is in line with the axial direction of cylinder block (9) (swash plate angle = 0), the difference between volumes **E'** and **F'** inside cylinder block (7) becomes 0, so the pump does not carry out any suction or discharge of oil.

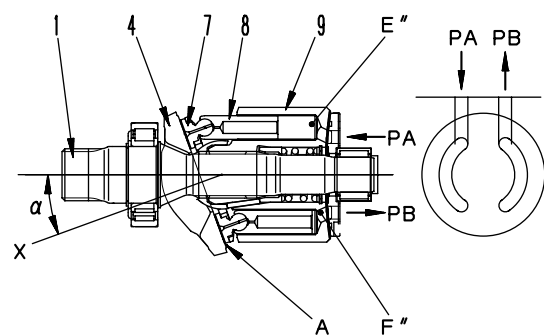


SKD00120



SKD00121

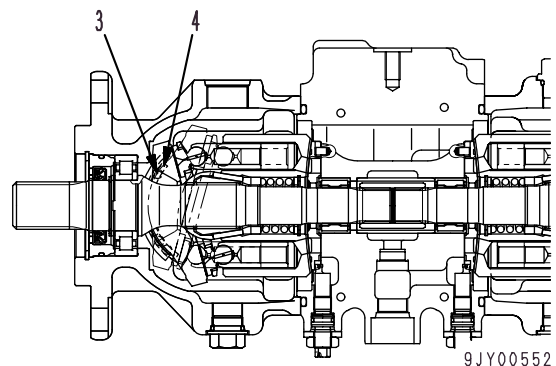
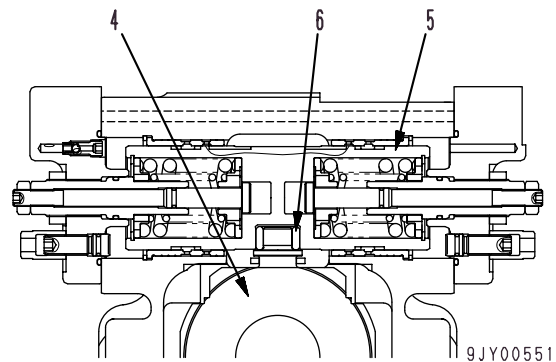
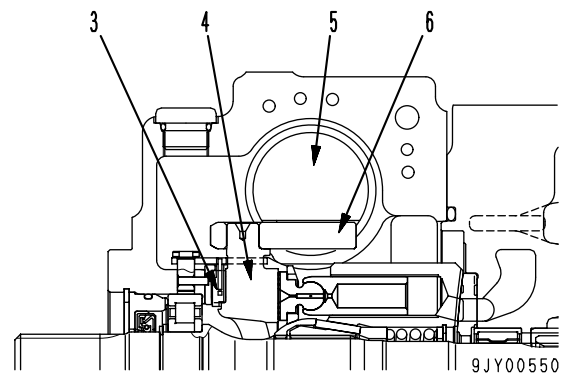
- Piston (8) slides on the inside of cylinder block (9), so a difference between volumes **E''** and **F''** is created inside cylinder block (9). The suction and discharge is carried out by an amount equal to this difference $E'' - F''$.
- In other words, when cylinder block (9) rotates and the volume of chamber **E''** becomes smaller, the oil is discharged during that stroke. On the other hand, the volume of chamber **F''** becomes larger, and the oil is sucked in during that stroke. When the angle of the swash plate is reversed, the suction and discharge of ports **PA** and **PB** are reversed.



SKD00122

2. Control of discharge amount

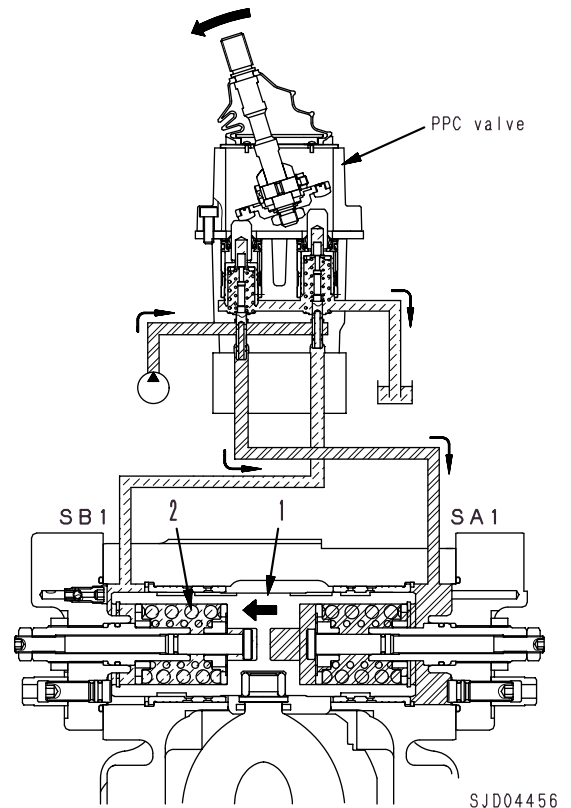
- If swash plate angle α becomes larger, the difference between volumes **E** and **F** becomes larger and discharge amount **Q** increases. Swash plate angle α is changed by drive piston (5).
- Drive piston (5) moves in a double-acting straight line movement according to the signal pressure from the PPC valve.
- This straight line movement is transmitted through slider (6) to rocker cam (4). Rocker cam (4), which is supported by the cylindrical surface to cradle bearing (3), then rocks on the cylindrical surface.
- For the pump, swash plate angle α is a maximum of $\pm 15.6^\circ$.



3. Operation of drive piston

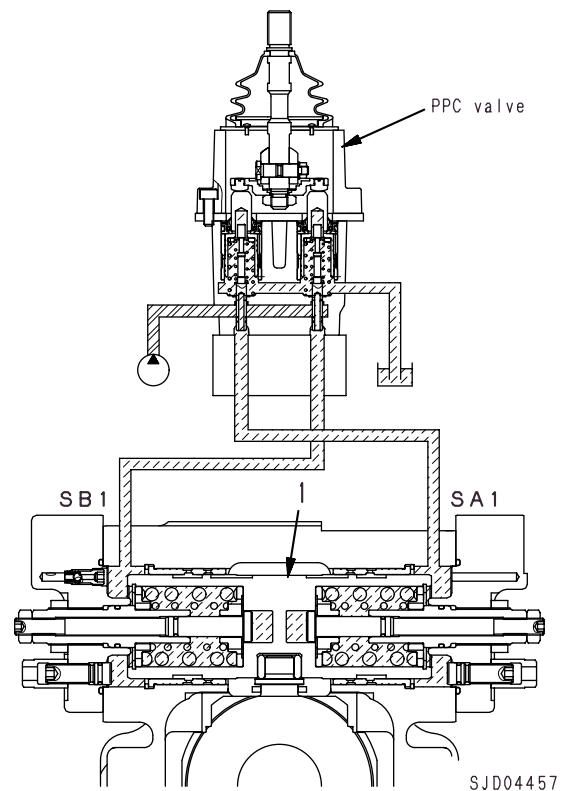
1) When lever is operated

- When the pressure oil from the PPC valve enters port **SA1**, drive piston (1) moves to the left to a position where the force of spring (2) and the oil pressure are balanced.

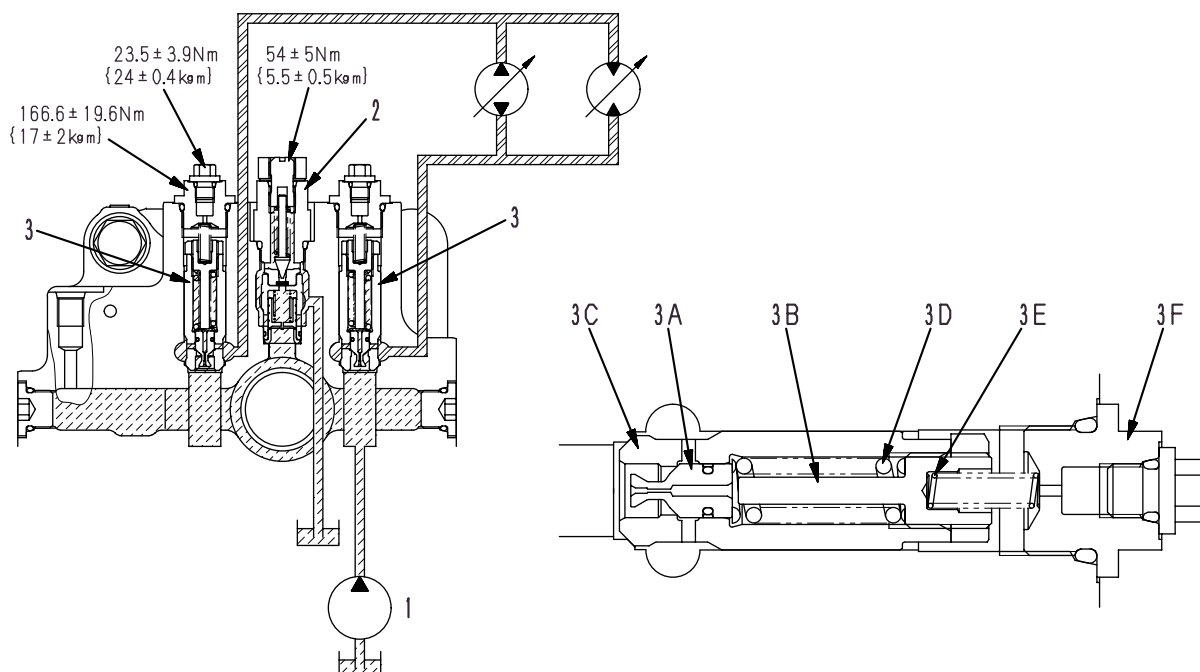


2) When lever is at neutral

- When no pressure oil enters from the PPC valve, drive piston (1) does not move, so the main pump is at neutral.



SAFETY-SUCTION VALVE



9JY00555

- 1. Charge pump
- 2. Charge safety valve
- 3. Safety-suction valve
 - 3A. Valve
 - 3B. Rod

- 3C. Sleeve
- 3D. Spring
- 3E. Spring
- 3F. Plug

1. When it is high-pressure relief valve

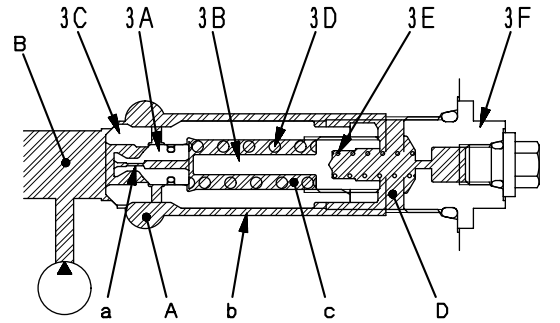
Function

- It restricts the maximum pressure inside the HST circuit to protect the circuit.

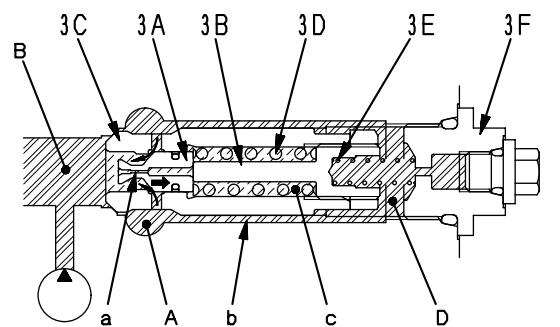
Operation

(valve at piston pump discharge side)

- Port **A** is connected to the pump circuit and port **B** is connected to the charge circuit. The pressure oil passes through drill hole **a** in piston (3A) and also fills port **C**.
- The oil at high-pressure port **A** passes through passage groove **b** in the body and also fills port **D**.
- Poppet (3A) is in tight contact with valve seat (3C).
- If abnormal pressure is generated in the circuit and the oil pressure at ports **A** and **D** reaches the pressure set by spring (3D), poppet (3A) is pushed to the right, and the oil at port **A** is relieved to port **B**, so the oil pressure at port **A** goes down.



9JY00556



9JY00557

2. When it is safety-suction valve

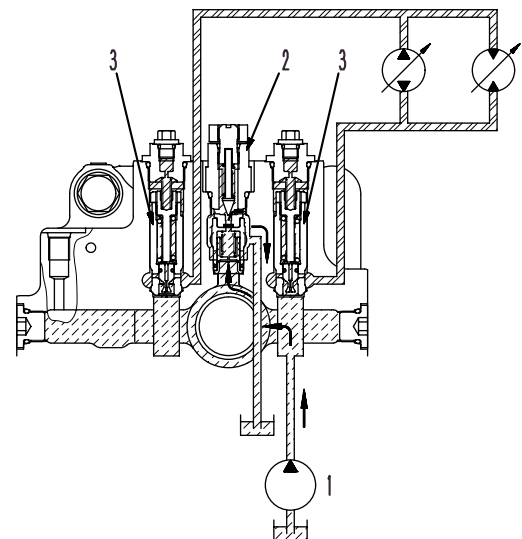
Function

- This ensures the oil flow in the HST closed circuit. It prevents the charge oil flow from flowing to the pump high-pressure side (discharge side).

Operation

1) When HST pump discharge amount is 0

- The HST closed circuit is sealed, so the charge pressure oil does not flow into the HST circuit.
- Therefore, the charge pressure oil from charge pump (1) all passes through charge safety valve (2) and is drained to the inside of the case.

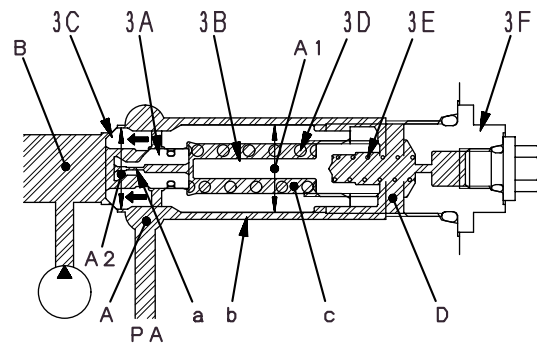
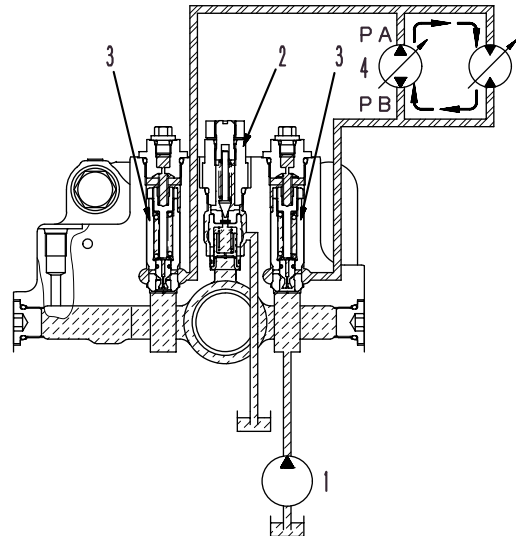


9JY00558

2) When HST pump discharge amount is being discharged from port **PA**

i) Valve at piston pump discharge side

- If pressure oil is being discharged from port **PA** of HST pump (4), port **PA** becomes the high-pressure side.
- This pressure oil at port **PA** passes through passage **b** in the body and flows into port **D**.
- When this happens, sleeve (3C) is pushed fully to the left because of the relationship of the difference in area ($A1 > A2$).
- Therefore, the pressure oil from charge pump (1) is prevented from flowing in.

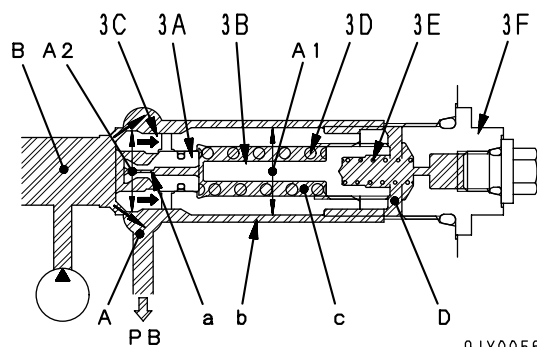


9JY00559

3. Valve at piston pump suction side

Operation

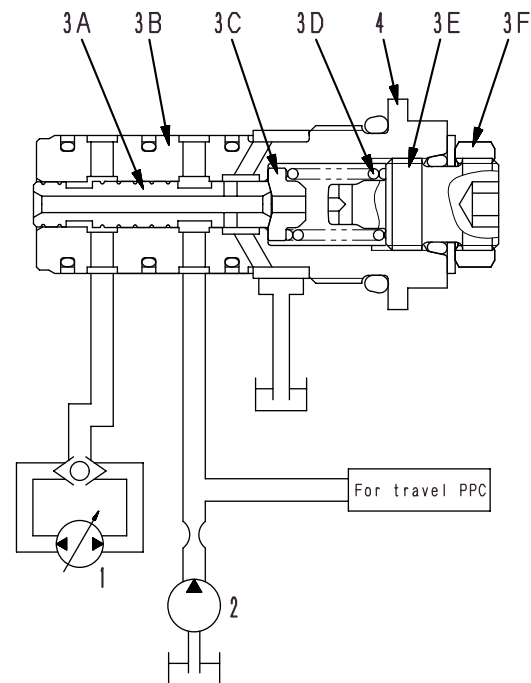
- Port **PB** becomes the suction side, so it is at low-pressure. Sleeve (3C) is pushed to the right by the charge pressure oil from the relationship of the difference in area ($A1 < A2$), and the seat of sleeve (3C) opens.
- As a result, the charge pressure oil at port **B** passes through this gap, flows to port **PB**, and carries out the charge action in the HST circuit.



9JY00560

CUT-OFF VALVE

1. HST pump
2. Charge pump
3. Cut-off valve
 - 3A. Spool
 - 3B. Sleeve
 - 3C. Seat
 - 3D. Spring
 - 3E. Adjustment screw
 - 3F. Locknut



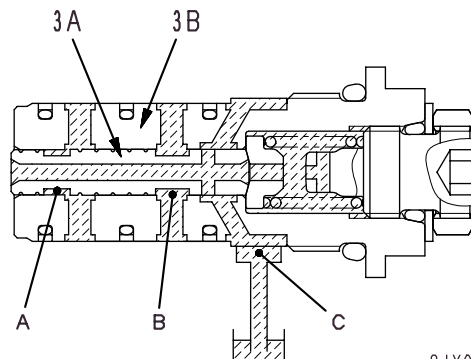
SXD04212

Function

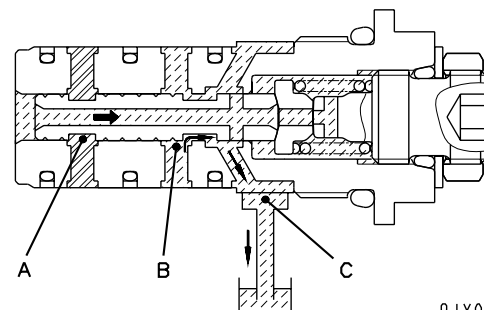
- The cut-off valve is installed to the HST pump. When the inside of the HST circuit reaches the maximum pressure, it limits the basic pressure of the HST pump PPC valve, reduces the swash plate angle of the HST pump, and limits the maximum pressure.

Operation

- Port **A** is connected to the HST circuit, port **B** is connected to the travel PPC basic circuit, and port **C** is connected to the HST pump drain. The pressure oil at chamber **B** is sealed by spool (3A) and sleeve (3B).
- The HST circuit pressure becomes high and is a force equivalent to the difference in the cross-sectional area of spool (3A) with the oil pressure at port **A**. But if it reaches the force set by spring (3D), spool (3A) is pushed to the right. The oil in chamber **B** flows to port **C**, so the pressure in chamber **B** goes down.
- When the pressure in chamber **B** goes down, the swash plate angle of the HST pump becomes smaller, and the rise in pressure in the HST circuit is suppressed.

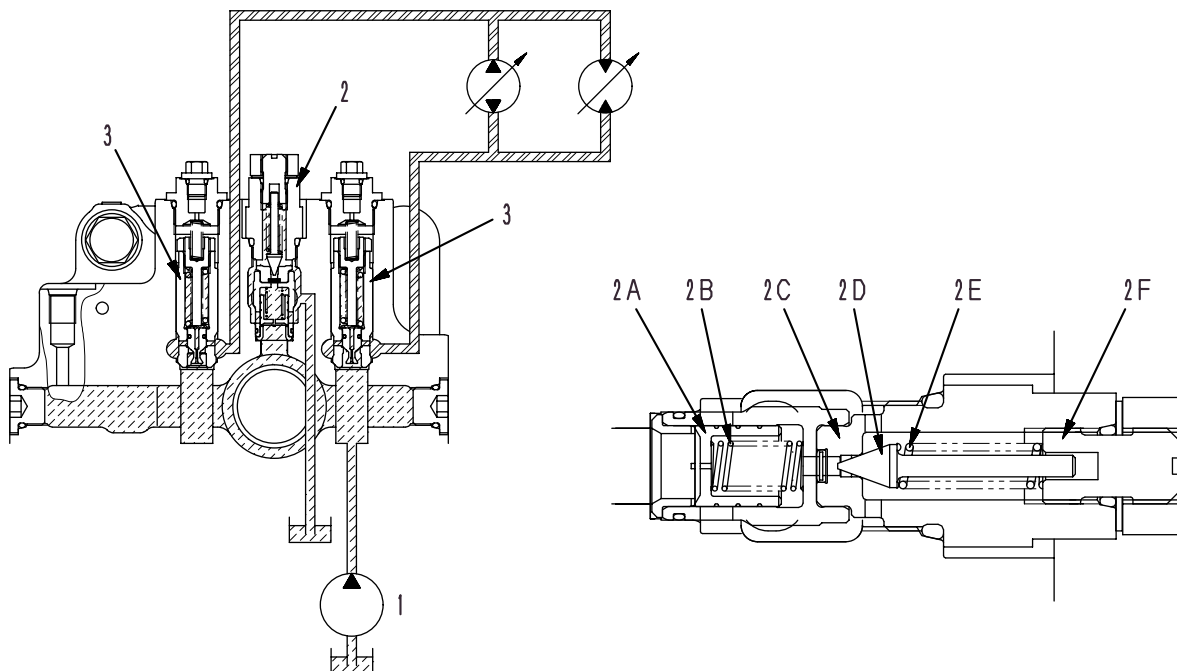


9JY00562



9JY00563

CHARGE SAFETY VALVE



9JY00564

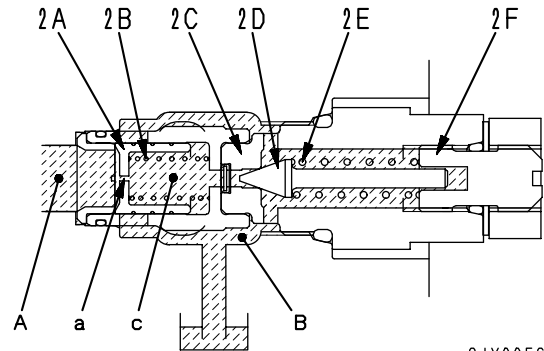
1. Charge pump
2. Charge safety valve
 - 2A. Valve
 - 2B. Spring
 - 2C. Valve seat
 - 2D. Poppet
 - 2E. Spring
 - 2F. Adjustment screw
3. Safety-suction valve

Function

- The charge safety valve is installed to the HST pump. It limits the maximum pressure in the charge circuit and protects the charge circuit.

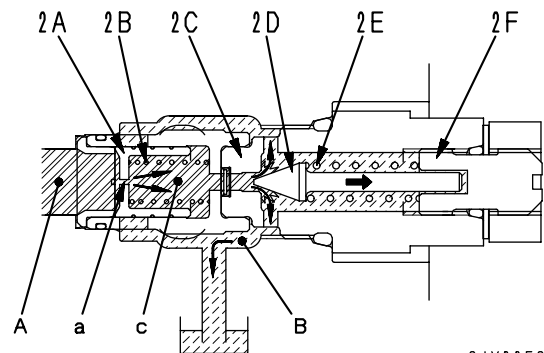
Operation

- Port **A** is connected to the charge circuit, and port **B** is connected through the HST pump case to the tank drain circuit. The pressure oil passes through orifice **a** in valve (2A) and fills chamber **C**. Poppet (2D) is in tight contact with valve seat (2C).



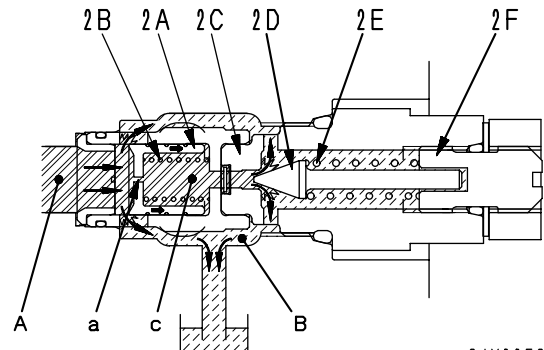
9JY00565

- If abnormal pressure is generated in the circuit or the shuttle valve of the HST motor is at neutral, and the pressure oil at port **A** and chamber **C** rises to the pressure set by the spring (2E), poppet (2D) is pushed to the right. The oil in chamber **C** is relieved to port **B**, so the pressure in chamber **C** goes down.



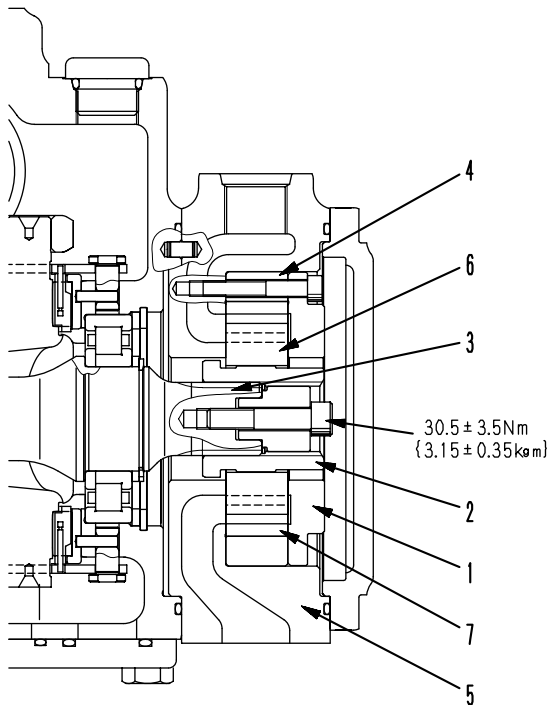
9JY00566

- When the pressure at port **C** goes down, a difference in pressure is generated between port **A** and chamber **C** through orifice **a** of valve (2A). Valve (2A) is pushed to the right by the oil pressure at port **A**, and the oil at port **A** is relieved to port **B**. In this way, the pressure in the charge circuit is prevented from rising any further.



9JY00567

CHARGE PUMP



9JY00568

1. Side plate
2. Coupling
3. Shaft
4. Outer ring
5. Case
6. Inner rotor
7. Outer rotor

Outline

- The HST charge pump is built into the HST pump and drives at the same time as the HST pump.
- It supplies oil to the AS valve and HST pump charge safety valve.
- The charge pump sucks in the oil from the hydraulic tank.

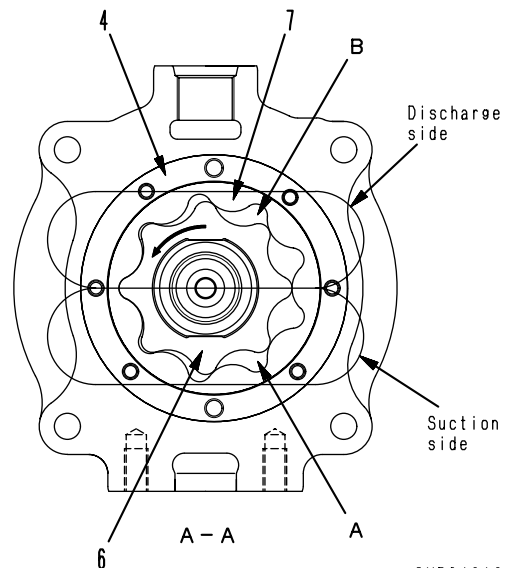
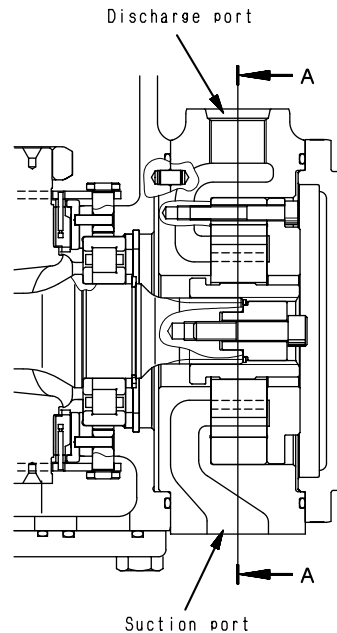
Specifications

Type: Trochoid pump

Theoretical discharge amount: 35 cc/rev

Operation

- The charge pump is connected to the HST pump shaft by coupling (2) and rotates inner rotor (6) and outer rotor (7).
- When inner rotor (6) and outer rotor (7) rotate, the capacity of chamber A increases, oil is sucked in, the capacity of chamber B decreases, and the oil is discharged.



SXD04213

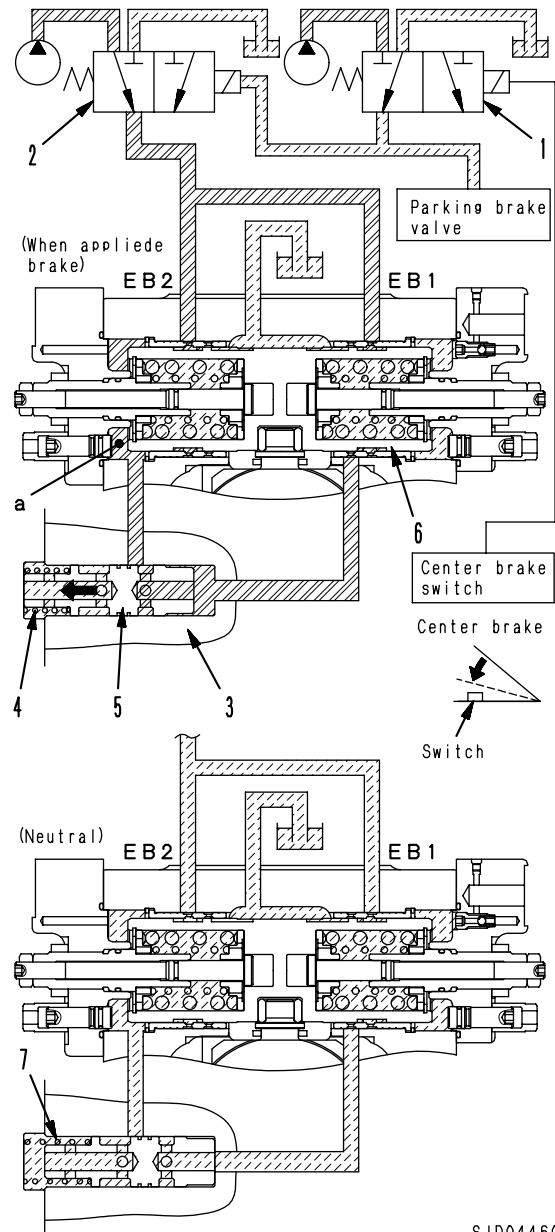
HST BRAKE QUICK RETURN CIRCUIT

Function

- If the machine is stopped suddenly by fully depressing the center brake, the HST pump capacity control piston is forcibly returned to Neutral by the oil pressure.

Operation

- When the center brake is depressed fully, solenoid valve (1) is turned OFF and the pressure becomes the drain pressure.
- Because the oil pressure in the pilot circuit of the HST brake valve (2) becomes the drain pressure, HST brake valve (2) sends oil to pump **EB1** and **EB2**.
- Oil flows to PPC priority valve (3) through the passage at the outside circumference of control piston (6), pushes against spring (4), and moves spool (5) to the left. The oil flows into piston chamber **a**, so control piston (6) returns to Neutral.
- When control piston (6) returns to Neutral, the flow of oil from **EB1** and **EB2** to the PPC priority valve is shut off. It is also connected to the drain, so the control piston remains at Neutral.

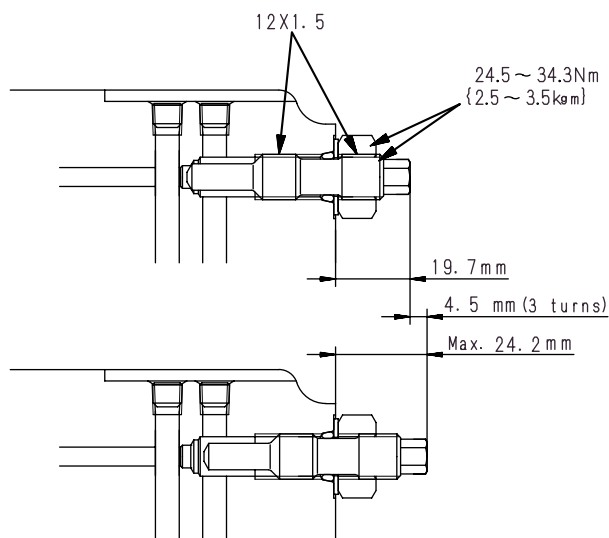
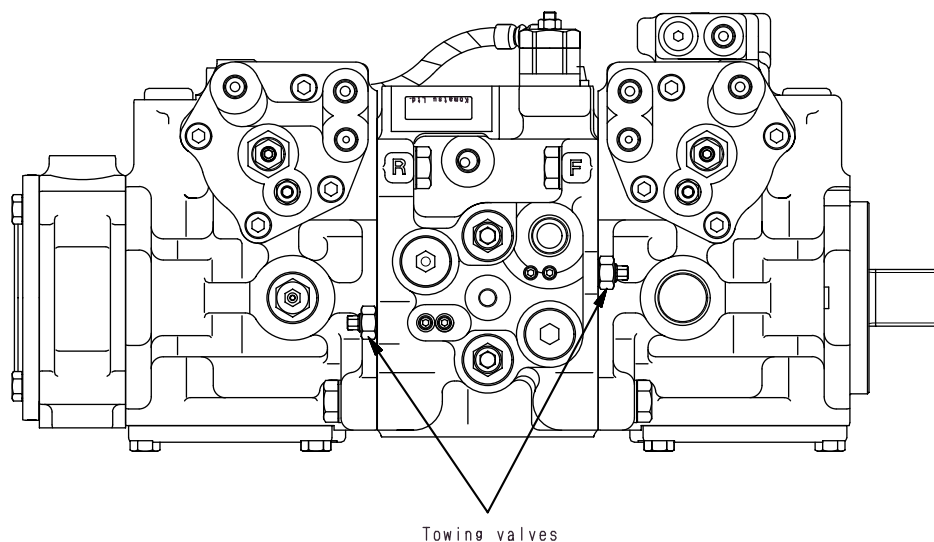


SJD04460

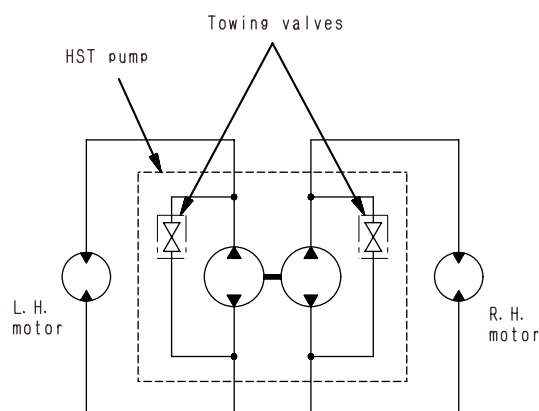
Unit: mm

No.	Check item	Criteria					Remedy
7	PPC priority valve spring	Standard size			Repair limit		Replace spring if damaged or deformed
		Free length x OD	Installed length	Installed load	Free length	Installed load	
		19.9 x 10.6	16.1	18.5 N/mm {1.89 kg/mm}	—	14.8 N/mm {1.50 kg/mm}	

TOWING VALVE



When being towed



SXD04215

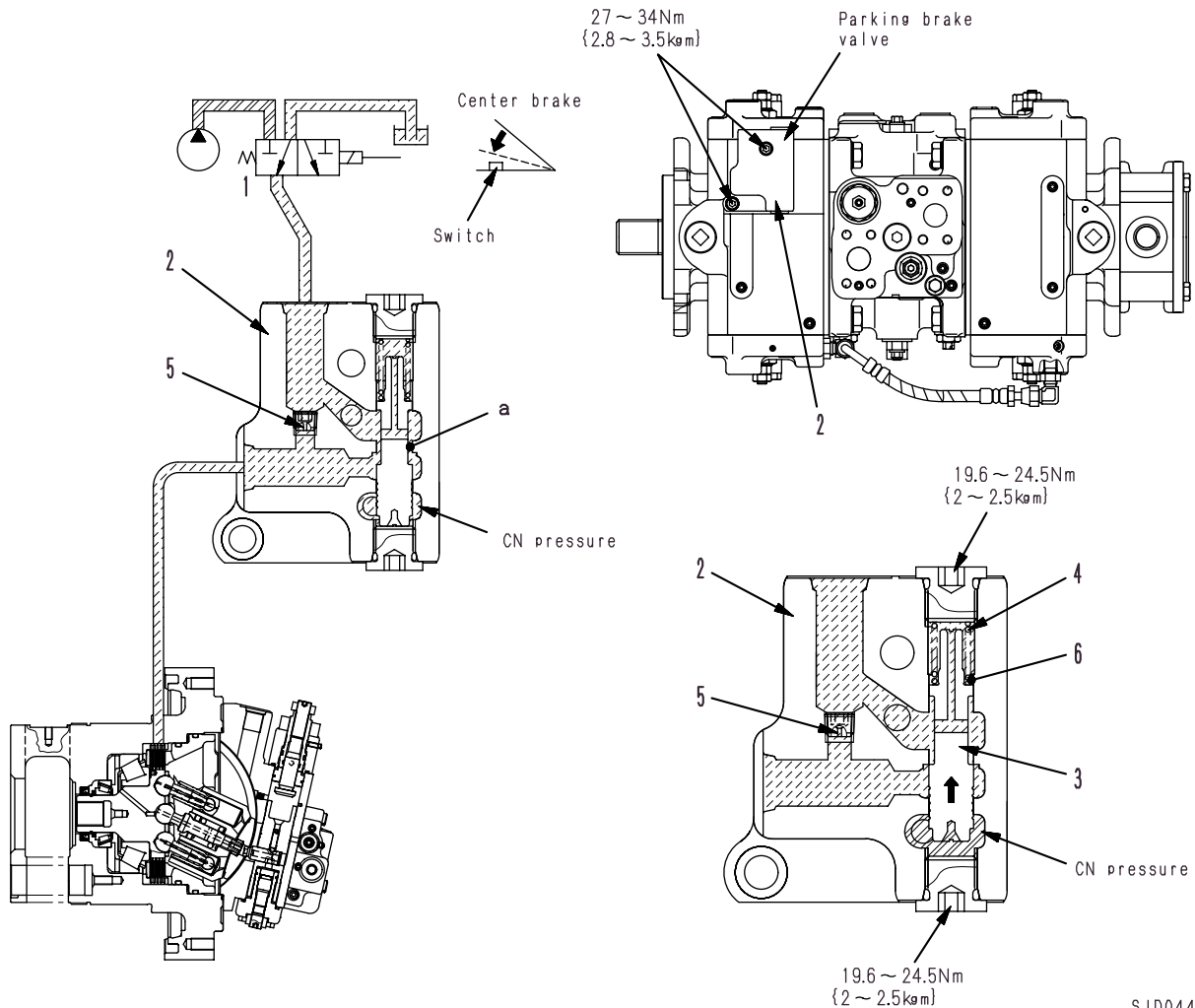
Function

- These valves are built into the top surface of the pump. There are two valves: the F valve (for the left track) and the R valve (for the right track).
- If there is a failure on the machine, it is possible to tow the machine by connecting the HST circuit.
- However, it is necessary to cancel the shaft brake of the motor at the same time.

Operation

- To actuate the towing valves, loosen the two valves a maximum of 4.5 mm (3 turns).

PARKING BRAKE VALVE



SJD04461

Function

- This valve is mounted to the pump and controls the parking brake (built into the travel motor).
- It detects if the machine is stopped or traveling, and controls the parking brake timer time to two stages to prevent the parking brake from being actuated when the machine is traveling.

Operation

1. Parking brake actuated

- When the center brake is depressed fully, the limit switch is actuated.
- Solenoid valve (1) is turned OFF, the drain circuit opens, and the oil from the parking brake passes through brake valve (2) and flows to the drain circuit of solenoid valve (1).
- Therefore, the parking brake is actuated by the spring force of the parking brake.

- 1) Parking brake actuated after machine is stopped
 - When the machine has been stopped, the CN pressure (maximum pressure of the HST pump displacement control piston chamber) is the drain pressure, so oil flows from opening **a** of the spool land and orifice (5).
 - Therefore, the timer time of the parking brake becomes shorter and the parking brake is applied immediately.

- 2) Parking brake actuated when machine has been traveling
- When the machine has been traveling, the CN pressure is high, so it pushes against spring (4), and spool (3) moves up.
 - When this happens, opening **a** of the spool land is closed, so oil flows only from orifice (5).
 - Therefore, the timer time of the parking brake becomes longer and prevents the parking brake from being applied when the machine is traveling.
 - When the traveling machine comes to a stop, the actuation is the same as in Item 1) above.

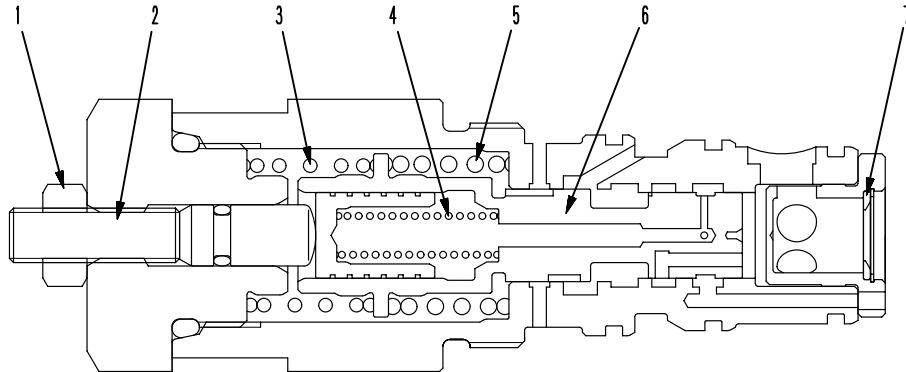
2. Parking brake released

- When the center brake is released, the limit switch is turned OFF.
- Solenoid valve (1) is turned ON and the oil pressure rises.
- The oil from solenoid valve (1) passes through the brake valve and flows to the parking brake.
- Therefore, the parking brake cylinder is actuated and the parking brake is released.

Unit: mm

No.	Check item	Criteria					Remedy
6	Parking brake valve spring	Standard size			Repair limit		Replace spring if damaged or deformed
		Free length x OD	Installed length	Installed load	Free length	Installed load	
		24.0 x 10.2	20.9	14.4 N/mm {1.47 kg/mm}	—	11.5 N/mm {1.18 kg/mm}	

AS VALVE



9JY00573

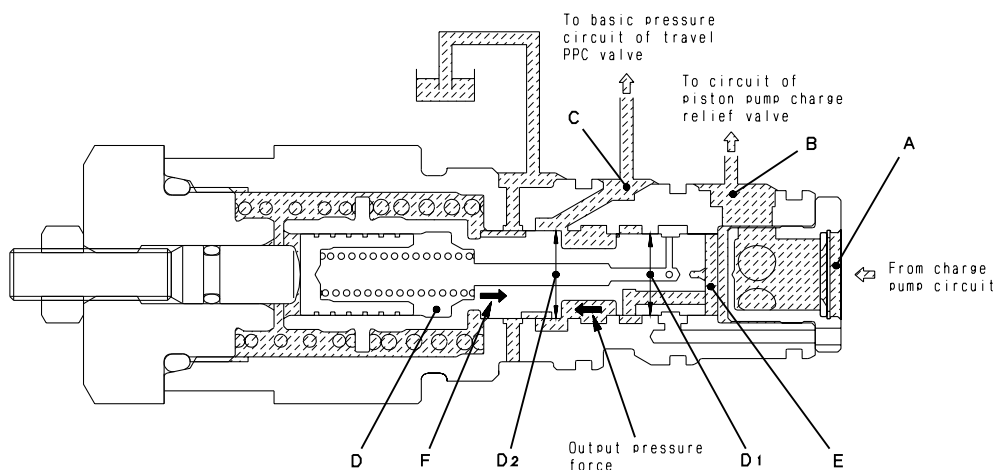
Function

- This valve is installed to the main piston pump. It reduces the pressure of the oil from the charge pump and controls it to the basic pressure of the travel PPC valve for the travel speed control.
- This outputs an oil pressure proportional to the change in the engine speed.

1. Locknut
2. Adjustment screw
3. Spring (plug end)
4. Spring (inside piston)
5. Spring (valve end)
6. Valve
7. Orifice

Operation

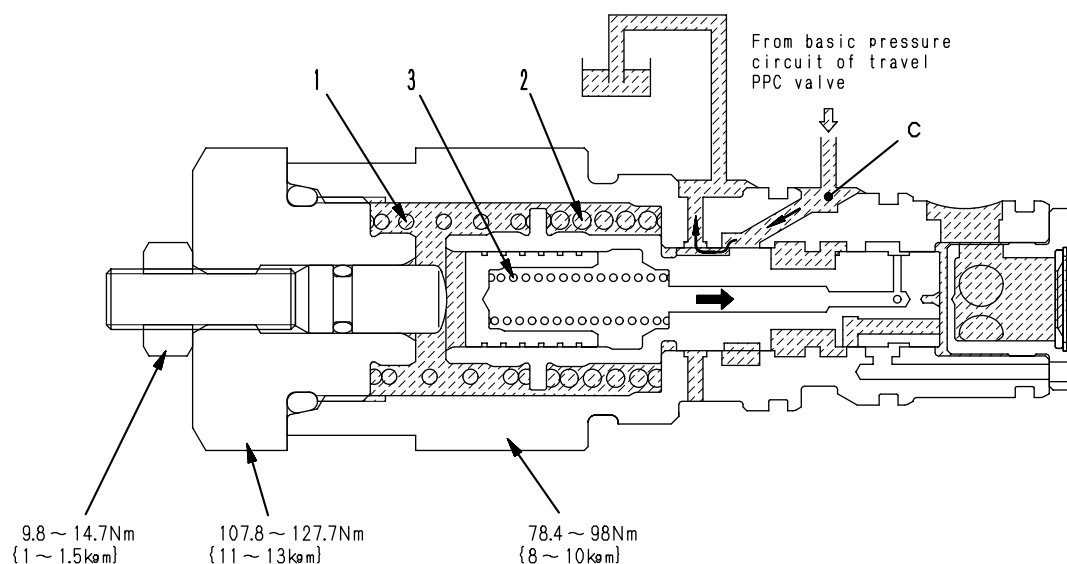
1. When reducing pressure



SXD04217

- The oil from the charge pump passes through orifice (7), and always flows from port **B** to the piston pump charge circuit.
- When the oil from the charge pump passes through orifice (7), a difference in pressure is formed between port **A** and port **B**. This difference in pressure is taken to chambers **D** and **E** of valve (6) and generates a hydraulic propulsion force in direction **F**.
- At the same time, the pressure oil is reduced from the charge relief pressure of port **B**, and is output to port **C** (valve area difference: $D2 > D1$) to balance with **F**.
- In other words, the control pressure matches the oil flow from the charge pump that increases or decreases according to the engine speed, and is output to port **C**.

2. When preventing overrun



SJD04462

- If the flow of oil from the charge pump becomes greater than the specified oil flow, valve (6) moves to the right, port **C** is connected with the drain circuit, and the basic pressure circuit of the travel PPC valve becomes the drain pressure.
- As a result, the output pressure of the travel PPC valve of the piston pump displacement control is also suddenly reduced, so the pump displacement is reduced.
- When the machine travels down a hill, the motor may act as a pump, so the braking oil pressure of the HST circuit acts as a braking force to prevent the machine from running away.

Unit: mm

No.	Check item	Criteria					Remedy
1	Spring	Standard size			Repair limit		Replace spring if damaged or deformed
		Free length	Installed length	Installed load (N{kg})	Free length	Installed load (N{kg})	
		23.0	18.6	117.6 {12}	—	94.1 {9.6}	
2	Spring	27.6	17.7	158.8 {16.2}	—	127 {13.0}	
3	Spring	31.3	23.8	29.4 {3.0}	—	23.5 {2.4}	

HST MOTOR

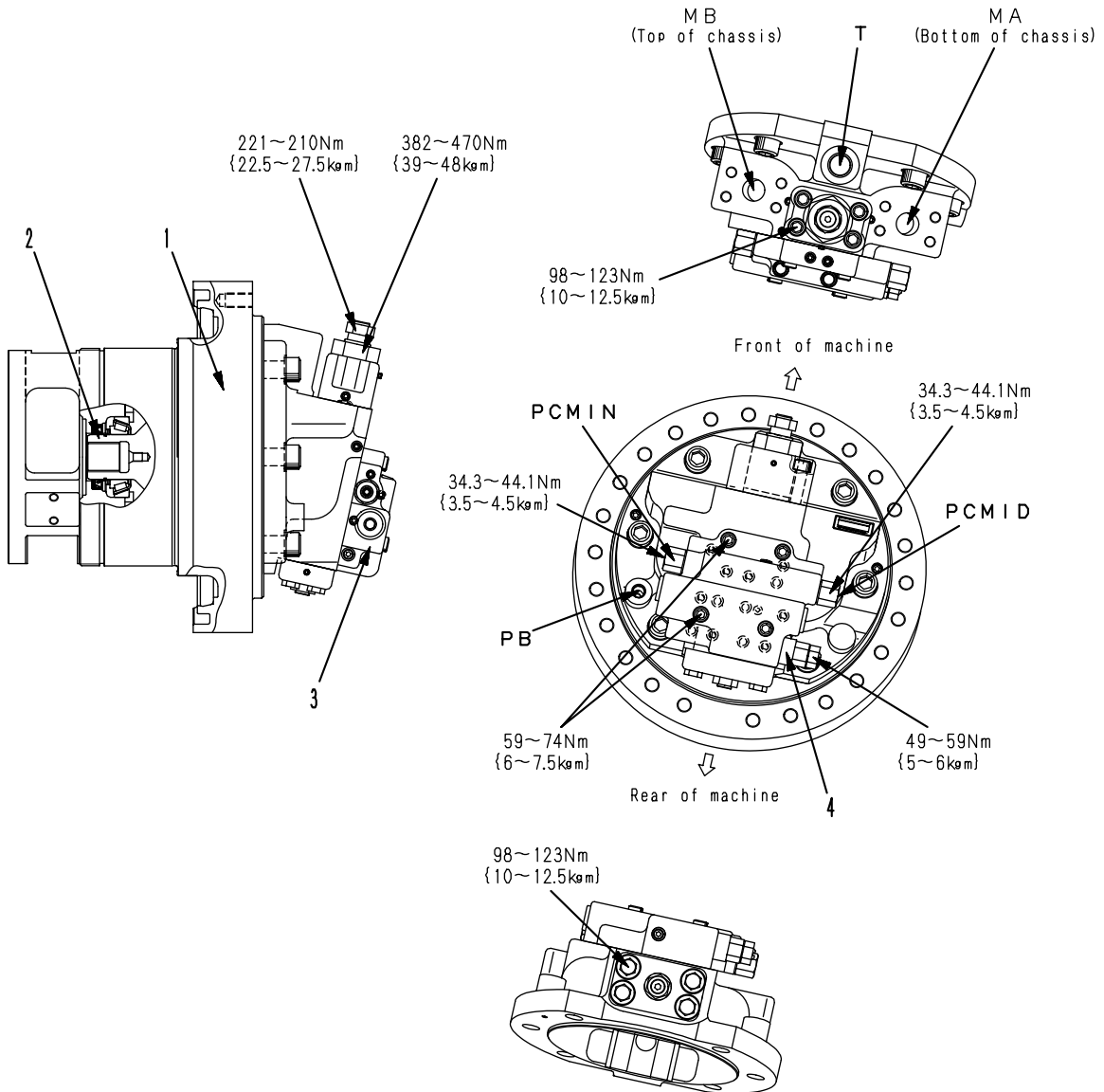
Model: KMV105

1. Left HST motor

Direction of rotation (as seen facing drive shaft)

Flows in from **MA**: Clockwise rotation

Flows in from **MB**: Counterclockwise rotation



SXD04219

1. 3rd variable bent axis piston motor (L.H.)
2. Drive shaft
3. 3rd valve
4. Charge relief valve

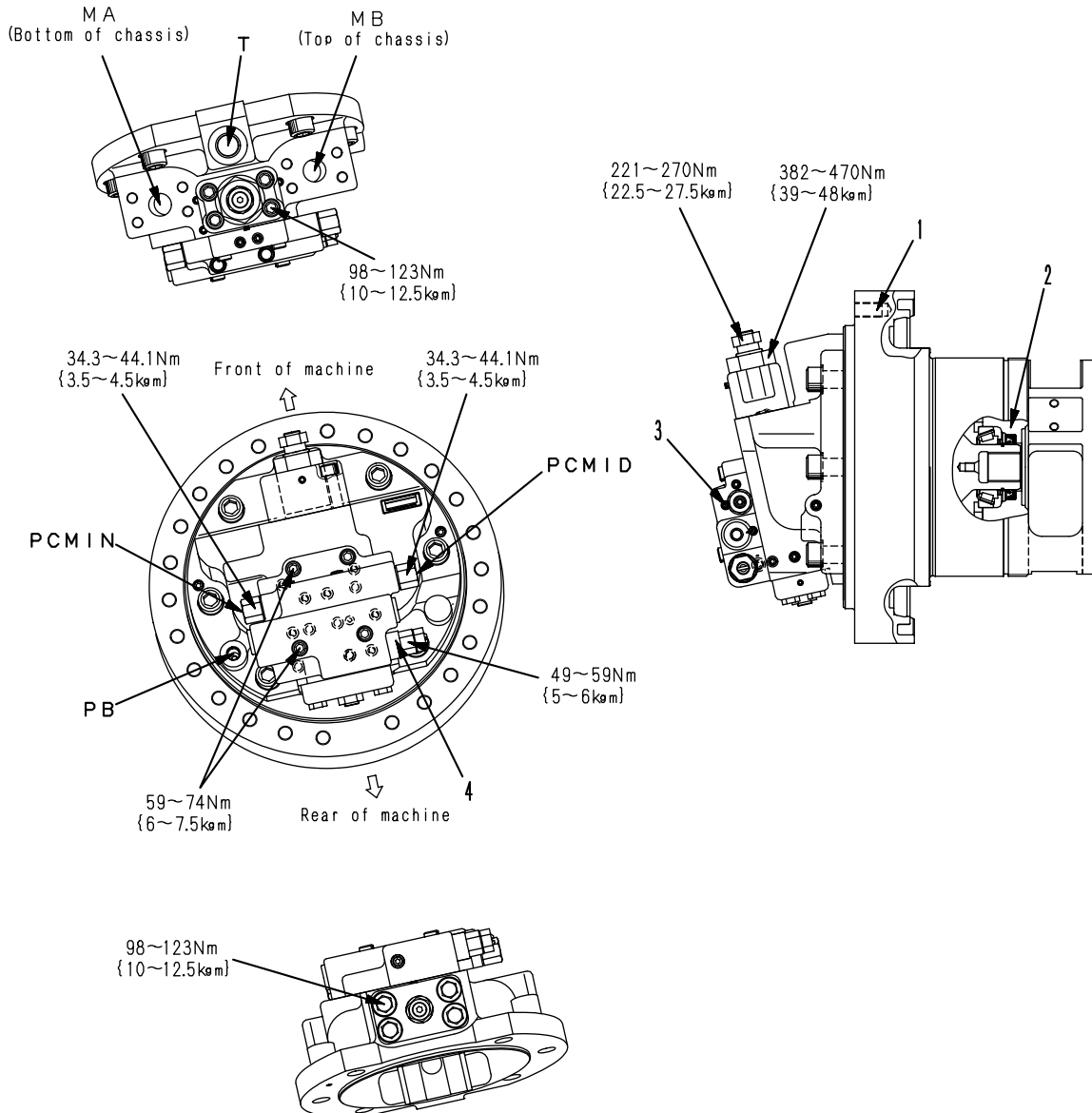
T: Drain
 MA: (high pressure when traveling forward) Discharge port
 MB: (high pressure when traveling in reverse) Discharge port
 PB: Parking brake cancel signal port
 PCMIN: 3rd spool q min signal port
 PCMID: 3rd spool q mid signal port

2. Right HST motor

Direction of rotation (as seen facing drive shaft)

Flows in from **MA**: Counterclockwise rotation

Flows in from **MB**: Clockwise rotation



SXD04220

1. 3rd variable bent axis piston motor (L.H.)

2. Drive shaft

3. 3rd valve

4. Charge relief valve

T: Drain

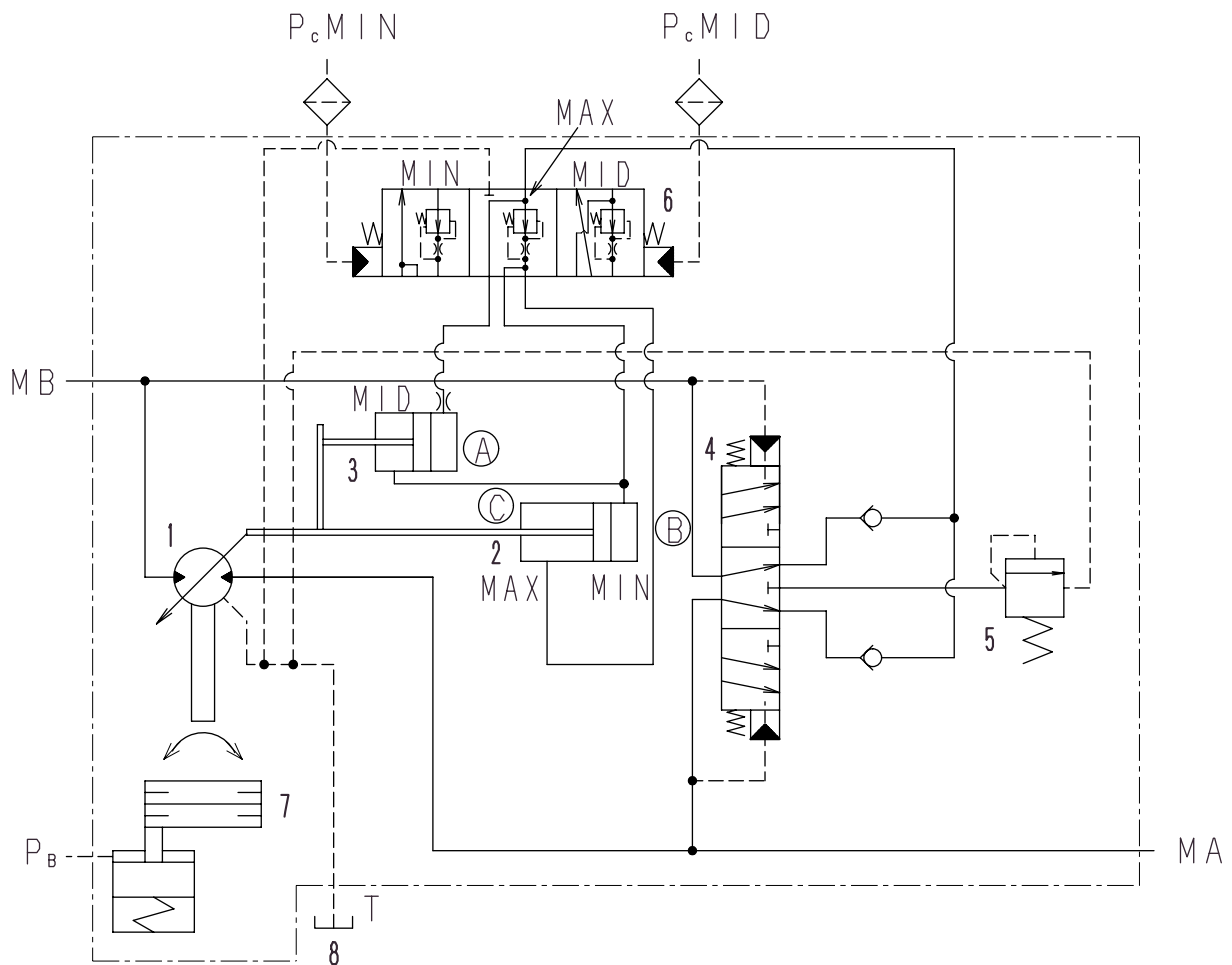
MA: (high pressure when traveling forward) Discharge port

MB: (high pressure when traveling in reverse) Discharge port

PB: Parking brake cancel signal port

PCMIN: 3rd spool q min signal port

PCMID: 3rd spool q mid signal port



9JY00578

1. 3rd variable shaft piston motor
2. Angled main piston
3. Angled sub piston
4. Shuttle valve
5. Charge relief valve
6. 3rd selector valve
7. Parking brake
8. Tank

Specifications

Model: KMV105

Type: 3-speed variable displacement, bent axis type piston pump

Theoretical discharge amount: 1st speed: 105 cc/rev; 2nd speed: 68 cc/rev; 3rd speed: 52 cc/rev

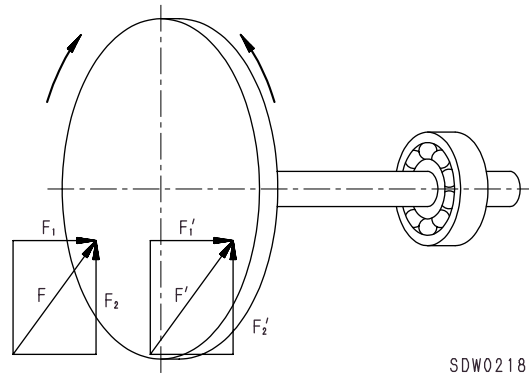
Charge relief valve set pressure: 2.06 – 2.16 MPa {21 – 22 kg/cm²}

Parking brake release pressure: 0.78 – 1.27 MPa {8 – 13 kg/cm²}

3. Operation of piston motor

Principle

- Let us assume that the shaft of a disc is supported to allow the disc to rotate freely. If force F is applied to this disc at an angle, this force F can be divided into force F_1 applied at a right angle to the face of the disc and force F_2 applied in the direction of the circumference of the disc. Force F_1 pushes the disc in the axial direction, and force F_2 rotates the disc in a clockwise direction.
- If force F' is applied to the disc instead of force F , the force can be divided in the same way into forces F'_1 and F'_2 , and force F'_2 will rotate the disc in a counterclockwise direction.

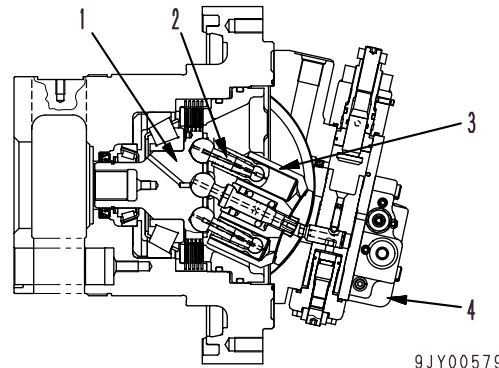


SDW02185

Structure

- Seven pistons (2) are installed with a spherical connection to the disc portion of output shaft (1). Pistons (2) are at a certain angle to drive shaft (1) and are fitted inside cylinder block (3).
- The angle of cylinder block (3) and pistons (2) is decided by the ON-OFF signal of the control pressure to PCMIN and PCMID of 3rd speed valve (4). The combination is as shown in the table.

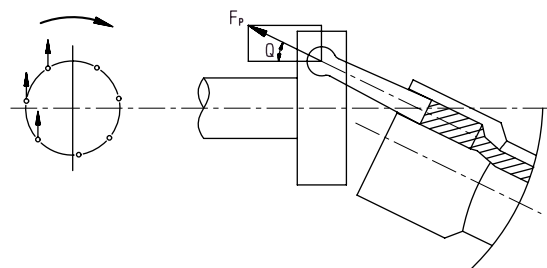
	PCMIN	PCMID
Motor capacity MAX (1st)	OFF	OFF
Motor capacity MID (2nd)	OFF	ON
Motor capacity MIN (3rd)	ON	OFF



9JY00579

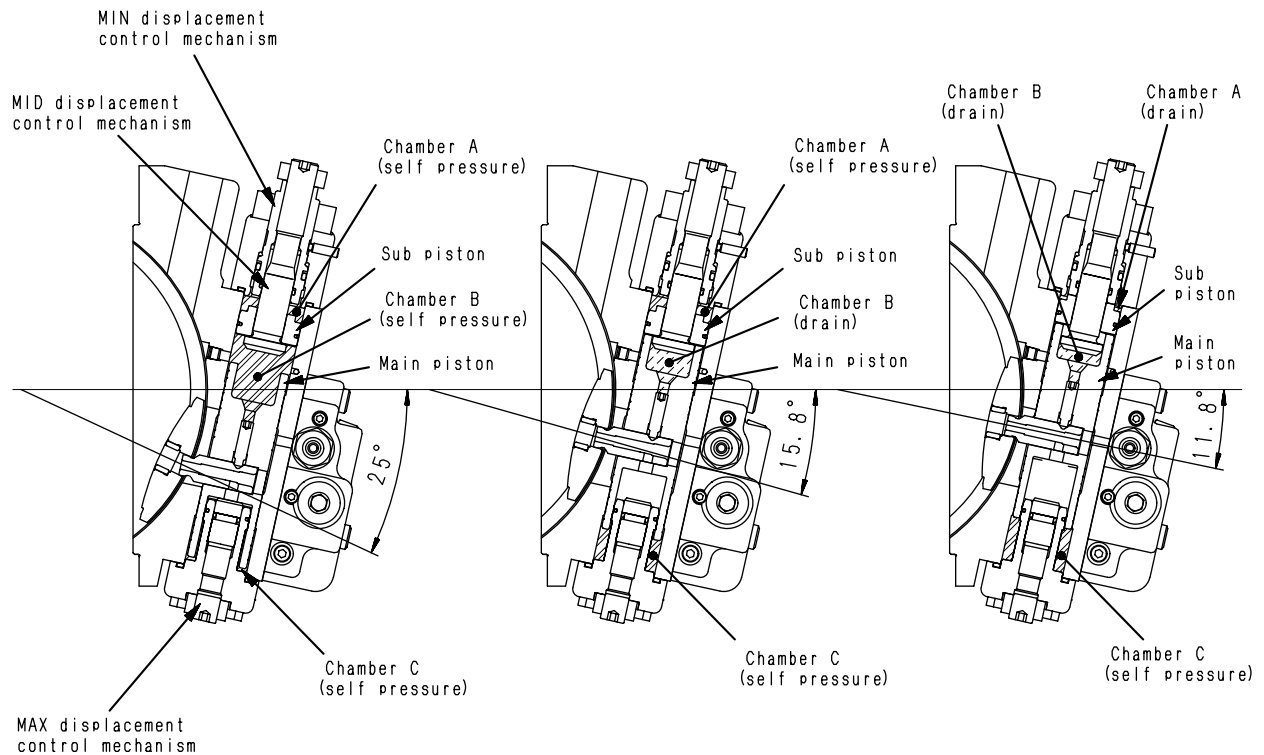
Operation

- The oil sent under pressure from the main piston pump enters from the piston motor inlet port. Oil pressure is formed at the rear face of piston (2), and drive shaft (1) is rotated by angle Q of piston (2) and the cylinder block.



SDW02187

4. Changing capacity of 3rd speed motor



SXD04221

	Motor capacity MAX (1st)	Motor capacity MID (2nd)	Motor capacity MIN (3rd)
Chamber A	ON	ON	OFF
Chamber B	ON	OFF	OFF
Chamber C	ON	ON	ON

Function

- As shown in the diagram above, when the main piston is at the lowest position, the motor capacity is MAX (1st speed).
- When the main piston is at the highest position, the motor capacity is MIN (3rd speed).
- When it is at the midpoint position, the motor capacity is MID (2nd speed). A sub piston is provided to produce the MID (2nd speed) motor capacity.
- When the motor capacity is MAX (1st speed), high pressure (self pressure) is being supplied to all of chamber A, chamber B, and chamber C. However, the main piston is at the lowest position because the area on which the high pressure is acting in chamber B is larger than the area on which the high pressure is acting in chamber C. As a result, the combined force generates a force in the downward direction.

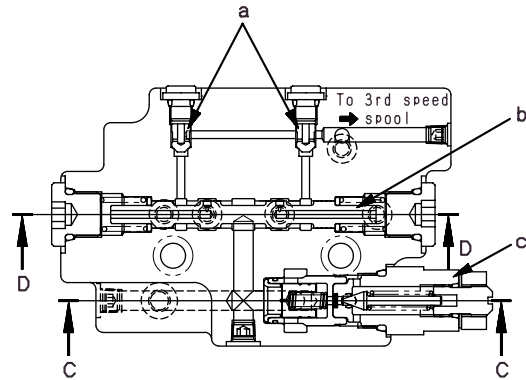
Operation

- The 3rd speed mechanism includes chamber A, chamber B, and chamber C. Each of these chambers has its high pressure (self pressure) turned ON (supplied) and OFF (drained) by the 3rd speed valve, and the main piston and sub piston are actuated.
- The area on which the self pressure is acting in chamber A and chamber B of the sub piston is the same. However, the high pressure (self pressure) acting on chamber A is greater than the high pressure acting on chamber B (the pressure is lower than the self pressure for chamber A because the self pressure passes through a throttle), so the sub piston is pushed down.

5. 3rd speed valve and shuttle valve

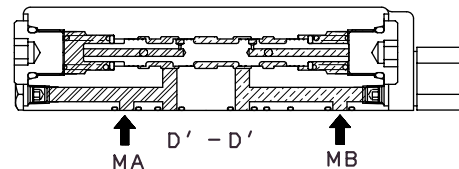
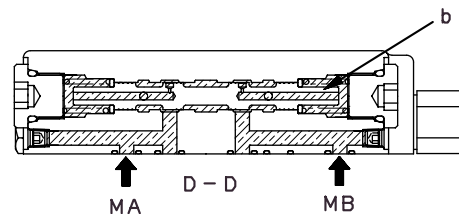
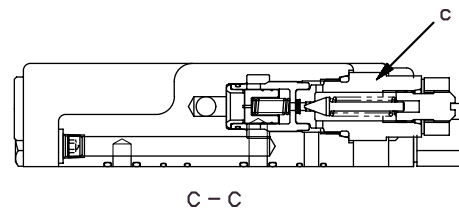
Function

- The pressure at the high-pressure side is selected at HST main pressures **MA** and **MB**, and is supplied to the 3rd speed spool.
- A shuttle valve is provided to select the pressure from the low-pressure side and supply it to the charge relief valve.



Operation

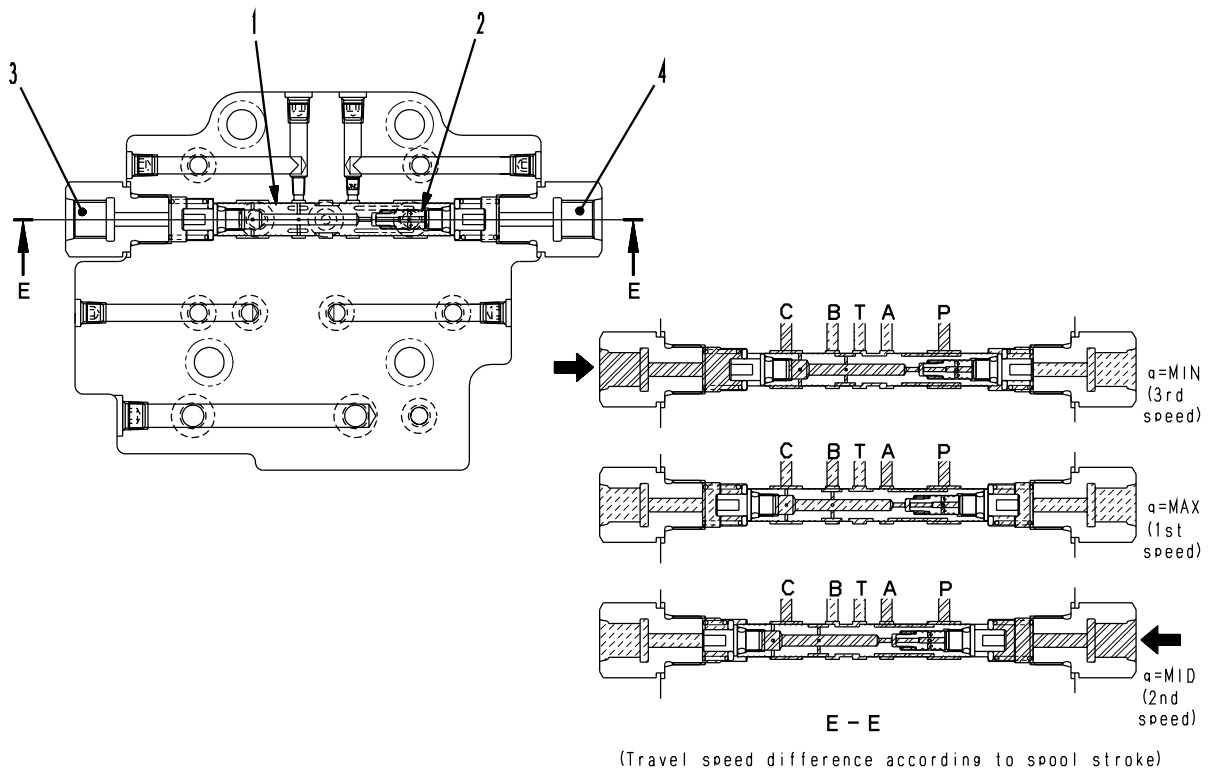
- With cross section D-D, HST main pressure **MA** is taken to the left end face of the shuttle valve; HST main pressure **MB** is taken to the right end face of the shuttle valve.
- The position of the shuttle valve at cross section D-D is the neutral position when the difference in pressure between **MA** and **MB** is small. Pressures **MA** and **MB** are both taken to the 3rd speed spool.
- Because of the two check valves, a higher pressure than **MA** and **MB** is taken to the spool of the shuttle valve. In this case, the passage to the charge relief valve is shut off.
- With the position of the shuttle valve at cross section D-D, when **MA** > **MB**, the shuttle valve moves to the right, **MA** is selected as the high pressure, and is taken to the 3rd speed spool. **MB** is selected as the low pressure and is taken to the charge relief valve.
- When **MA** < **MB**, the shuttle valve moves to the left, **MB** is selected as the high pressure, and is taken to the 3rd speed spool. **MA** is selected as the low pressure and is taken to the charge relief valve.



SXD04222

- a: Check valve
b: Shuttle valve
c: Charge relief valve

6. 3rd speed valve



SXD04223

1. 3rd speed spool
2. Flow control valve
3. PCMIN port
4. PCMID port

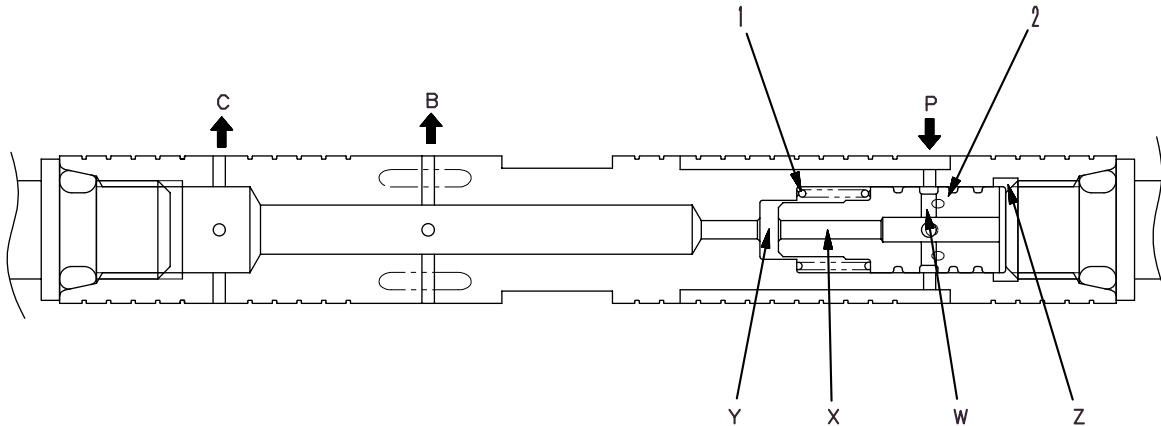
Function

- The HST main pressure at the high-pressure side is selected by the shuttle valve and is taken to portion **P**.
- 3rd speed spool (1) is moved by pressures PCMIN and PCMID, so this pressure is supplied to rounds **A**, **B**, and **C**, which are connected to chamber **A**, chamber **B**, and chamber **C** of the 3rd speed mechanism.

Operation

- When both PCMIN (3) and PCMID (4) are OFF, 3rd speed spool (1) is at neutral, and pressure **P** is supplied to all of **A**, **B**, and **C**.
- However, the supply to **A** passes through the groove on the outside circumference of the spool. Compared with this, the supply to **B** and **C** passes through flow control valve (2) built into 3rd speed spool (1).
- As a result, the pressure at **A** is the highest and the pressure at **B** and **C** is slightly lower. [**q** = MAX (1st speed)]
- When PCMIN (3) is OFF and PCMID (4) is ON, 3rd speed spool (1) moves to the left and pressure **P** is supplied to **A** and **C**, while **B** is drained to the tank. [**q** = MID (2nd speed)]
- When PCMIN (3) is ON and PCMID (4) is OFF, 3rd speed spool (1) moves to the right and pressure **P** is supplied to **C**, while **A** and **B** are drained to the tank.

7. Flow control valve (built into 3rd speed spool)



9JY00583

1. Spring
2. Spool

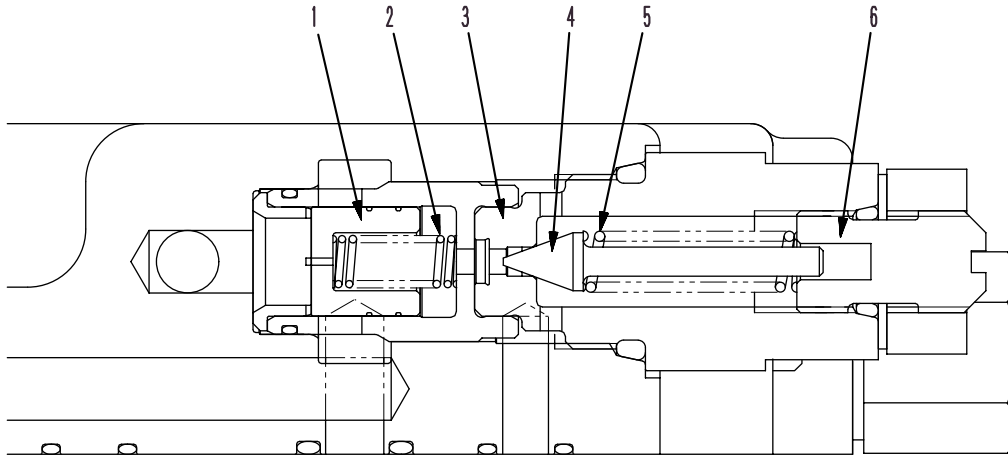
Function

- The high pressure of the HST main pressure is selected by the shuttle valve and is taken to portion **P**.
- The pressure at this portion **P** changes from approx. 2.45 MPa {25 kg/cm²} (charge pressure) to a maximum of 47.1 MPa {48 kg/cm²}.
- The flow control valve supplies an almost constant oil flow to **B** and **C**, regardless of the change in pressure at portion **P**.
- This constant oil flow can be set as desired by the diameter of the throttle and spring (1).

Operation

- The oil inside spool (2) of the flow control valve flows **W** → **X** → **Y**. Portion **X** is a throttle.
 - The position of the spool (area of opening at portion **W**) is determined by the differential pressure between chamber **Y** and chamber **Z** and the force of spring (1).
- 1) When oil does not flow **W** → **X** → **Y**
 - There is no difference in pressure between chamber **Y** and chamber **Z**, so spool (2) is moved to the right end by the force of spring (1), and the area of opening at portion **W** becomes the maximum.
 - 2) When flow of oil is generated **W** → **X** → **Y**
 - A difference in pressure between chamber **Y** and chamber **4** is generated by the throttle and becomes **P_Y < P_Z**. The spool moves to the left and the area of opening at portion **W** is reduced.
 - The position of the spool (area of opening at portion **W**) is determined by the position where the force of spring (1) is balanced with differential pressure $\Delta P = P_Z - P_Y$.
 - As a result, the flow from **W** → **X** → **Y** can be controlled to an almost constant value, regardless of the pressure at portion **P**.

8. Charge relief valve



9JY00584

1. Valve
2. Spring
3. Valve seat

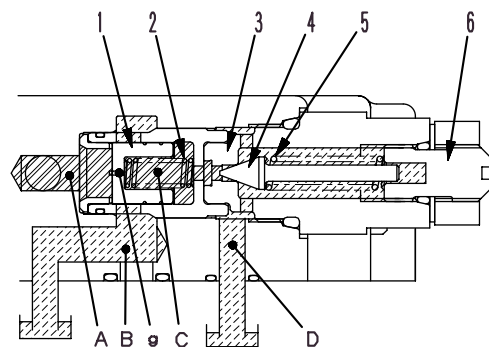
4. Poppet
5. Spring
6. Adjustment screw

Function

- The charge relief valve is installed inside the 3rd speed valve. It prevents the pressure at the HST main low-pressure side (charge pressure) selected by the shuttle valve from going above the set pressure. At the same time, it relieves the determined oil flow inside the motor case and prevents the motor from overheating.
- In addition, it discharges the dirtiest oil inside the HST main circuit to the outside and acts to keep the inside of the HST main circuit clean.

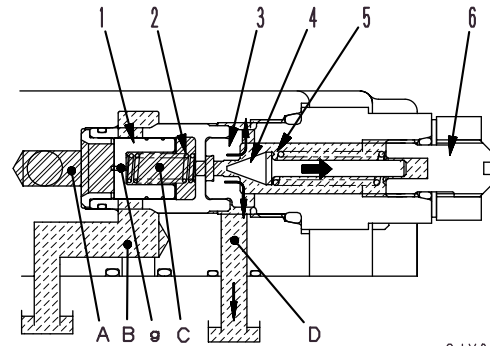
Operation

- Port **A** connects the pressure at the HST main low-pressure side (charge circuit) selected by the shuttle valve.
- In addition, ports **B** and **D** are connected to the tank drain circuit through the HST motor case.
- The pressure oil passes through orifice **g** in valve (1) and fills chamber **C**. Poppet (4) is fitted tightly to valve seat (5).



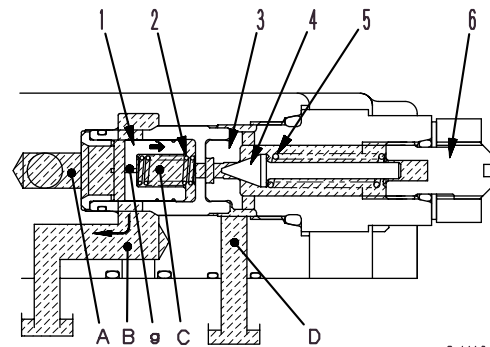
9JY00585

- If abnormal pressure is generated inside the circuit, and the oil pressure in port **A** and chamber **C** rises to the pressure set by spring (5), poppet (4) is pushed to the right, and the oil in chamber **C** is relieved to port **D**, so the oil pressure in chamber **C** goes down.



9JY00586

- When the oil pressure in chamber **C** goes down, a difference in pressure between ports **A** and **C** is generated by orifice **g** of valve (1).
- Valve (1) is pushed to the right by the oil pressure at port **A**, and the oil at port **A** is relieved to port **B**.
- As a result, the pressure in the charge circuit is prevented from rising any further.

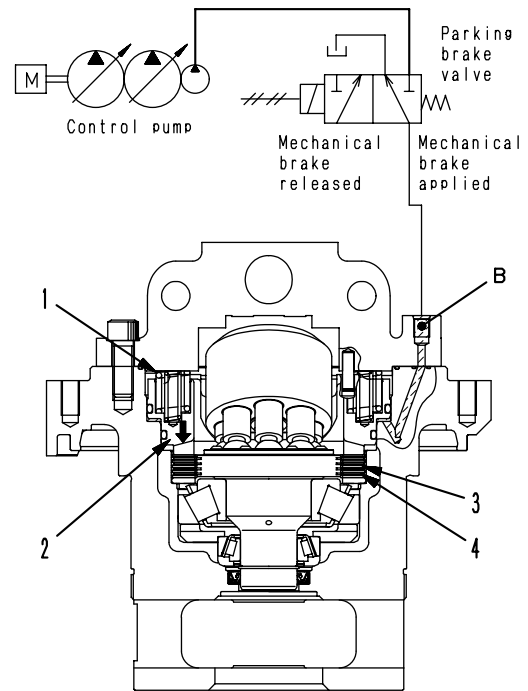


9JY00587

9. Actuation of parking brake

1) When parking brake valve is de-energized

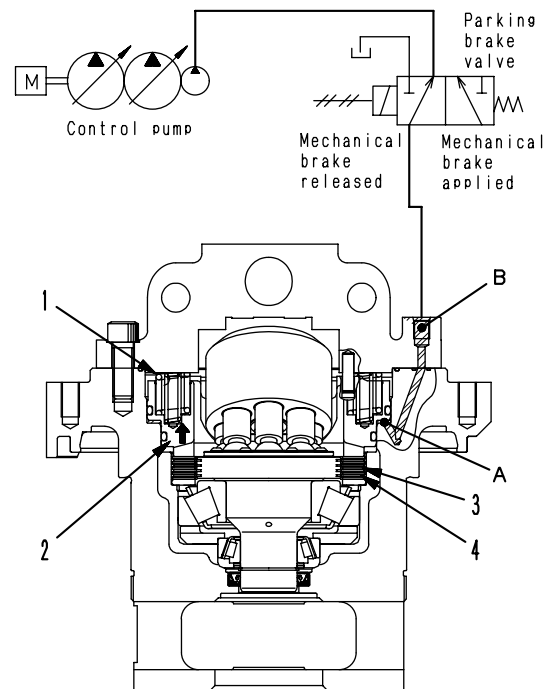
- If the parking brake valve is de-energized, the pressure oil of the control pump is shut off and port **B** is connected to the tank.
- As a result, brake piston (2) is pushed down by brake spring (1), disc (3) and plate (4) are pushed together, and the brake is applied.



SXD04224

2) When parking brake valve is energized

- If the parking brake valve is energized, the valve is switched, the pressure oil from the control pump enters port **B**, and flows into brake chamber **A**.
- The oil entering chamber **A** overcomes brake spring (1) and pushes brake piston (2) up. As a result, disc (3) and plate (4) separate, and the brake is released.



SXD04225

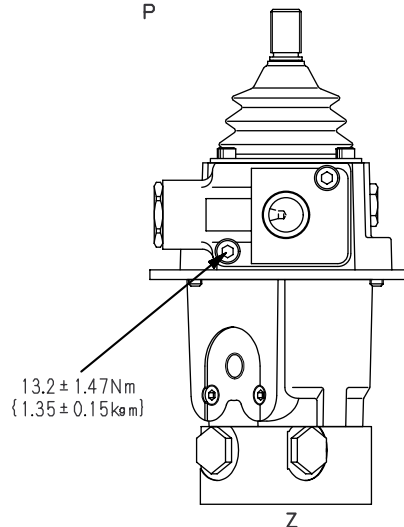
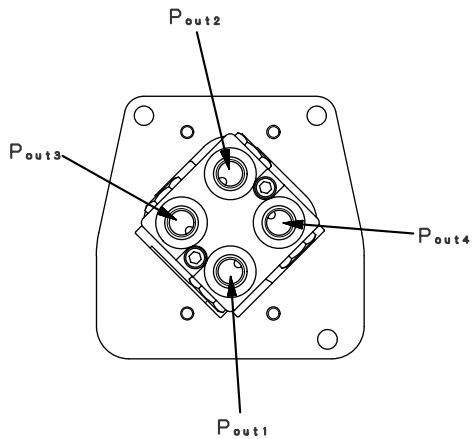
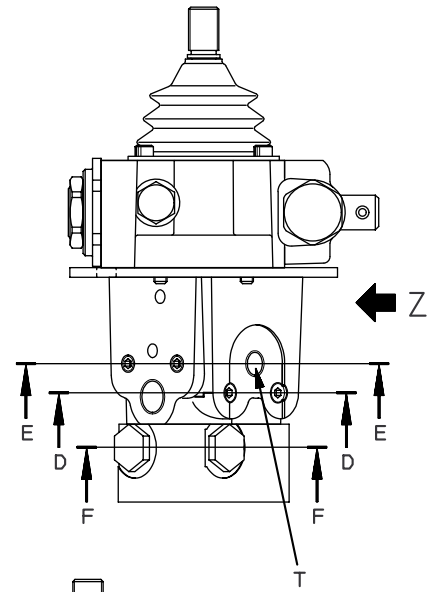
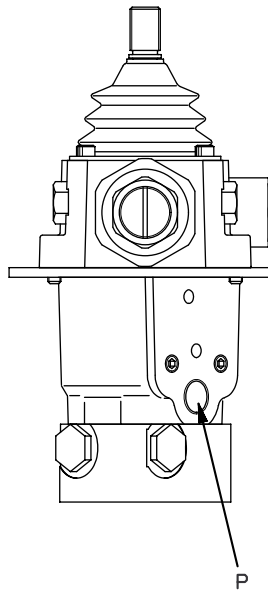
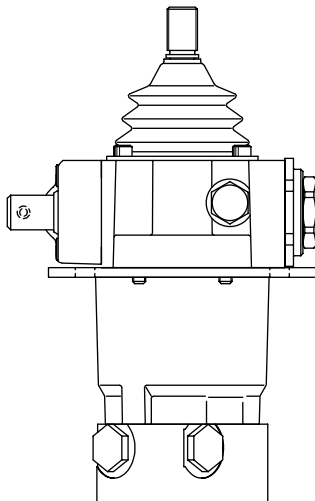
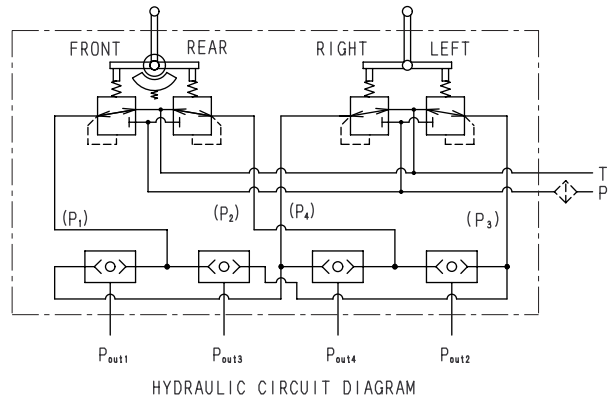
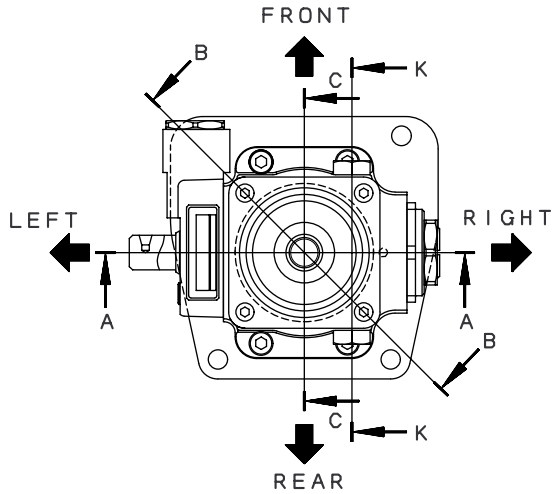
STEERING, DIRECTIONAL PPC VALVE

D31EX-21 Serial No. 50001 – 50097

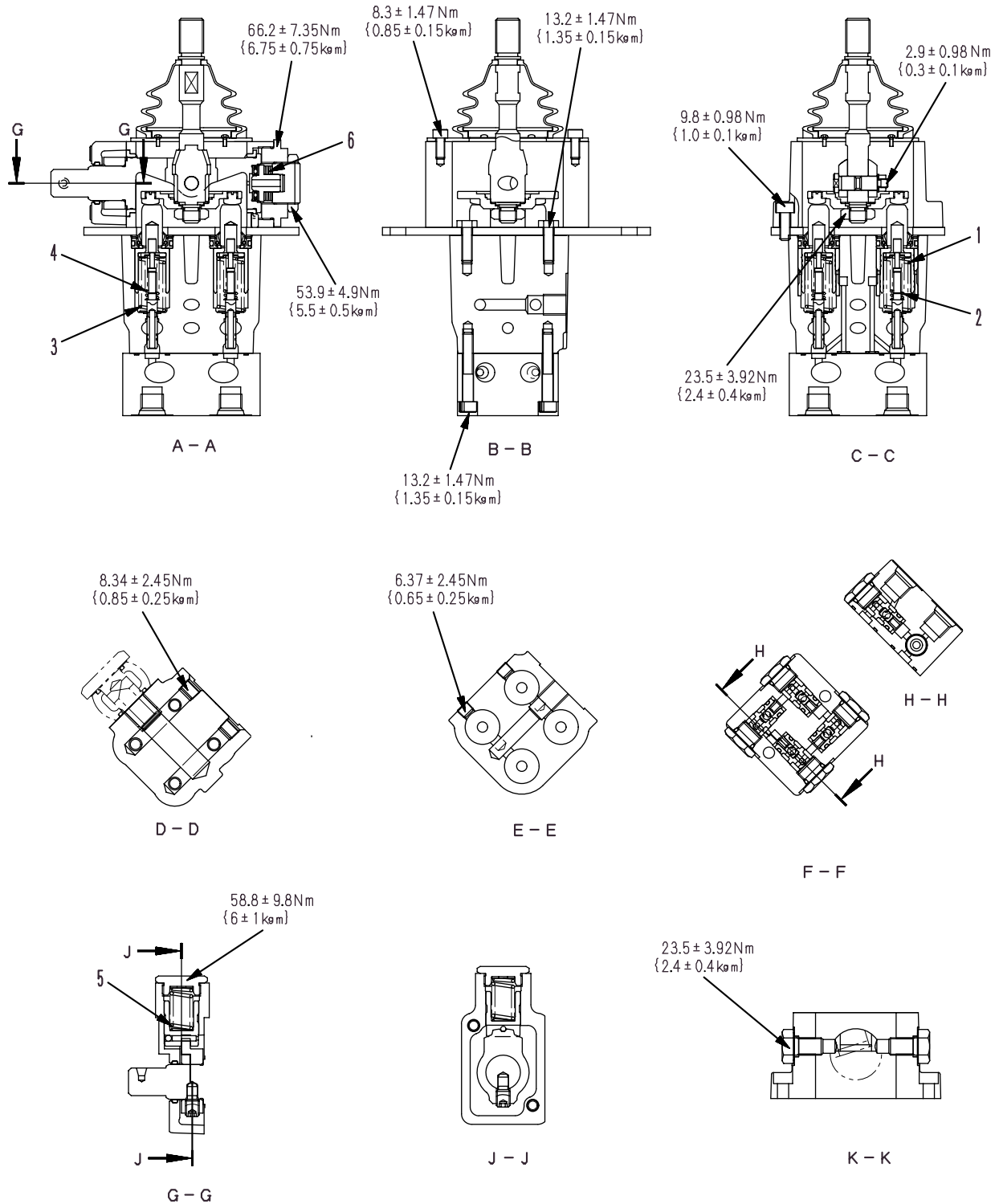
D31PX-21 Serial No. 50001 – 50181

D37EX-21 Serial No. 5001 – 5104

D37PX-21 Serial No. 5001 – 5090



9JY00590



9JY00996

STRUCTURE AND FUNCTION, MAINTENANCE STANDARD
STEERING, DIRECTIONAL PPC VALVE

P: From control pump

T: To tank

POUT1: To HST pump flow control piston (R.H. FORWARD)

POUT2: To HST pump flow control piston (L.H. REVERSE)

POUT3: To HST pump flow control piston (L.H. FORWARD)

POUT4: To HST pump flow control piston (R.H. REVERSE)

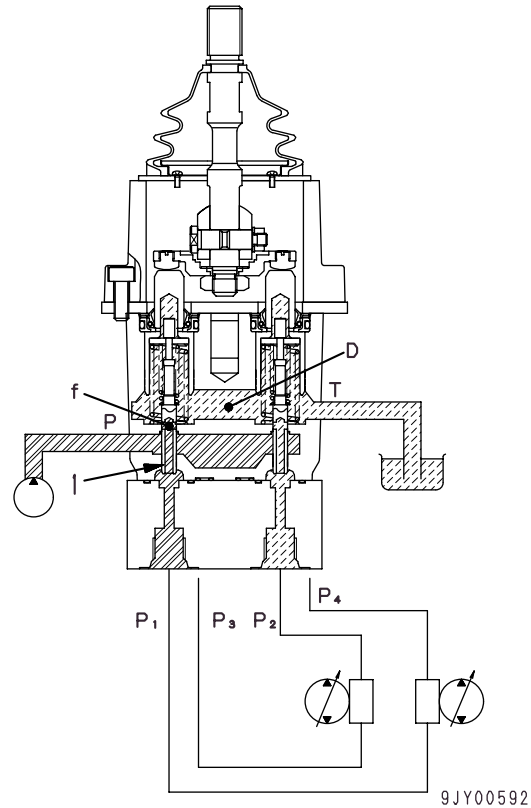
Unit: mm

No.	Check item	Criteria					Remedy
1	Centering spring (for P1, P2)	Standard size			Repair limit		Replace spring if damaged or deformed
		Free length x OD	Installed length	Installed load (N{kg})	Free length	Installed load (N{kg})	
		33.8 x 15.5	31.9	35.3 {3.60}	—	28.2 {2.88}	
2	Metering spring (for P1, P2)	26.65 x 8.1	25.6	9.7 {0.99}	—	7.7 {0.79}	
3	Centering spring (for P3, P4)	50.05 x 15.5	31.9	51.5 {5.26}	—	41.3 {4.21}	
4	Metering spring (for P3, P4)	25.82 x 8.25	25.6	2.4 {0.24}	—	1.9 {0.19}	
5	Notch spring	26.96 x 13.2	24.5	49.0 {5.0}	—	39.2 {4.0}	
6	Disc brake spring	1.55 x 20.0	1.28	1195.6 {122.0}	—	956.5 {97.6}	

Operation

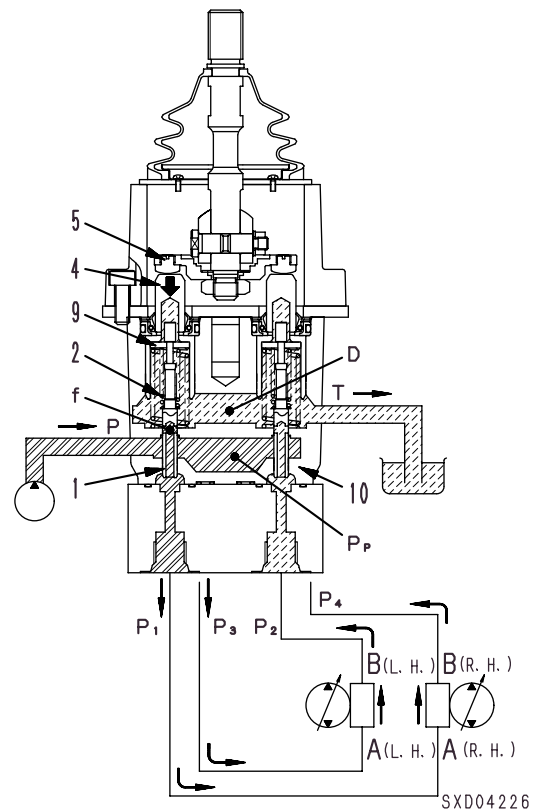
1. At Neutral

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



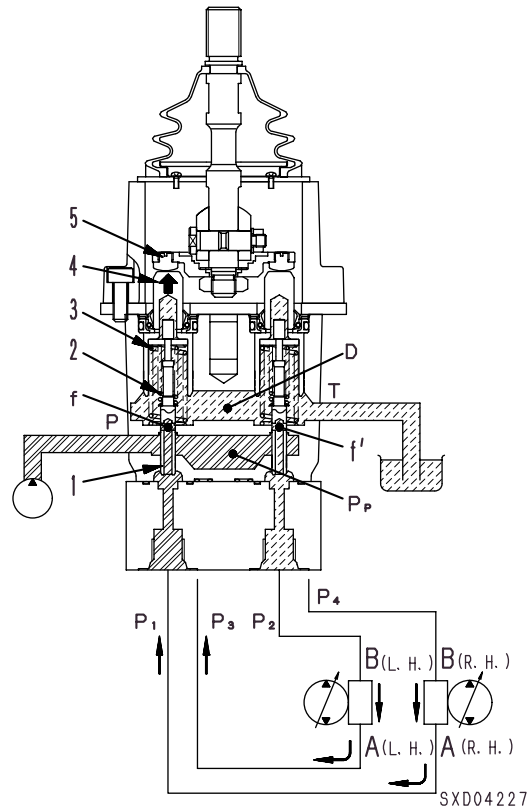
2. During fine control (Neutral → fine control)

- 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, when fine control hole **f** is shut off from drain chamber **D**, at almost the same time, it connects with pump pressure chamber **PP**. The pilot pressure oil of the control pump passes through fine control hole **f** and the shuttle valve, and goes from ports **P1** and **P3** to port **A** (right) and port **A** (left).
- When the pressure at ports **P1** and **P3** becomes high, spool (1) is pushed back. When fine control hole **f** is shut off from pump pressure chamber **PP**, at almost the same time, it connects with drain chamber **D** and releases the pressure at ports **P1** and **P3**.
- As a result, spool (1) moves up and down so that the force of metering spring (2) is balanced with the pressure at ports **P1** and **P3**. The relation between the positions of spool (1) and body position (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 ports **P1** and **P3** also rises in proportion to the movement of the control lever.
- The HST pump displacement control piston moves to a position where the pressure in chamber **A** (same as pressure at ports **P1** and **P3**) is balanced with the force of the return spring.



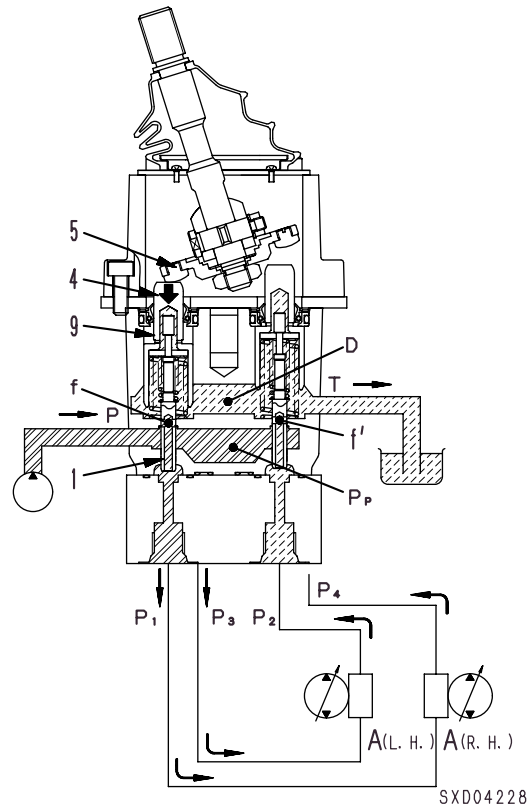
3. During fine control (when control lever is returned)

- When disc (5) starts to be returned, spool (1) is pushed up by the pressure at port **P1** (**P3**) 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 ports **P1** and **P3** is released.
- If the pressure at ports **P1** and **P3** goes down too far, spool (1) is pushed down by metering spring (2). Fine control hole **f** is shut off from drain chamber **D**, and at almost the same time, it is connected to pump pressure chamber **PP**. Pump pressure is supplied until the pressure at ports **P1** and **P3** 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 ports **P2** and **P4**, is taken to chamber **B**, and the oil fills the chamber.



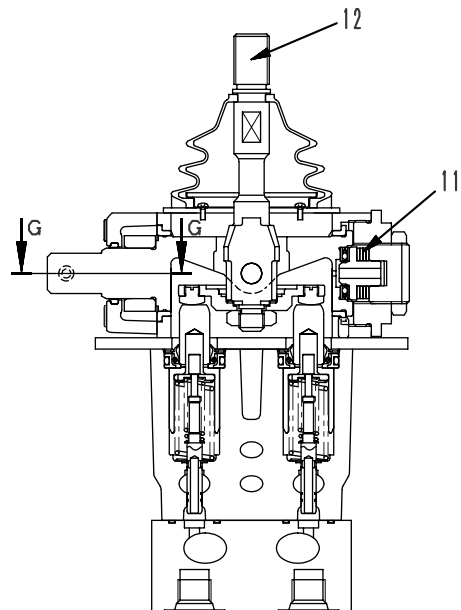
4. When lever is operated fully

- 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 from the control pump passes through fine control hole **f** and the shuttle valve, is taken from ports **P1** and **P3** to chamber **A**, and pushes the HST pump displacement control piston.
- The return oil from chamber **B** passes from ports **P2** and **P4** through fine control hole **f'**, and then flows to drain chamber **D**.

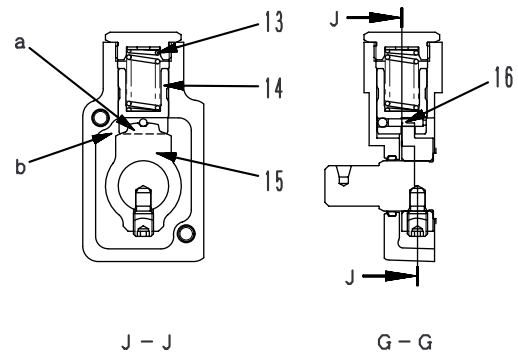


5. When operated to FORWARD (REVERSE) (characteristics of operating effort)

- When lever (12) is operated to FORWARD (REVERSE), protrusion **a** of boss (15) contacts pin (16) installed to piston (14) that is being held by spring (13). (Operating effort characteristics graph **C**)
- If lever (12) is operated further, protrusion **a** of boss (15) pushes up piston (14) with pin (16) installed. (Operating effort characteristics graph **A**)
- The fine control lever is held by the disc brake (11) over the whole range of movement of the lever, so even if the lever is released, it will be held at the desired position. (Operating effort characteristics graph **D**)
- When the lever is operated to the end of its stroke, pin (16) is pushed into concave portion **b** of boss (15), so the lever is held at the full stroke position. When returning the lever (12), it pushes pin (16) up at concave portion **b**. (Operating effort characteristics graph **B**)



A - A

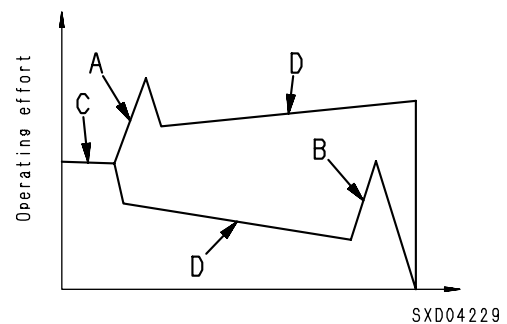


J - J

G - G

9JY00596

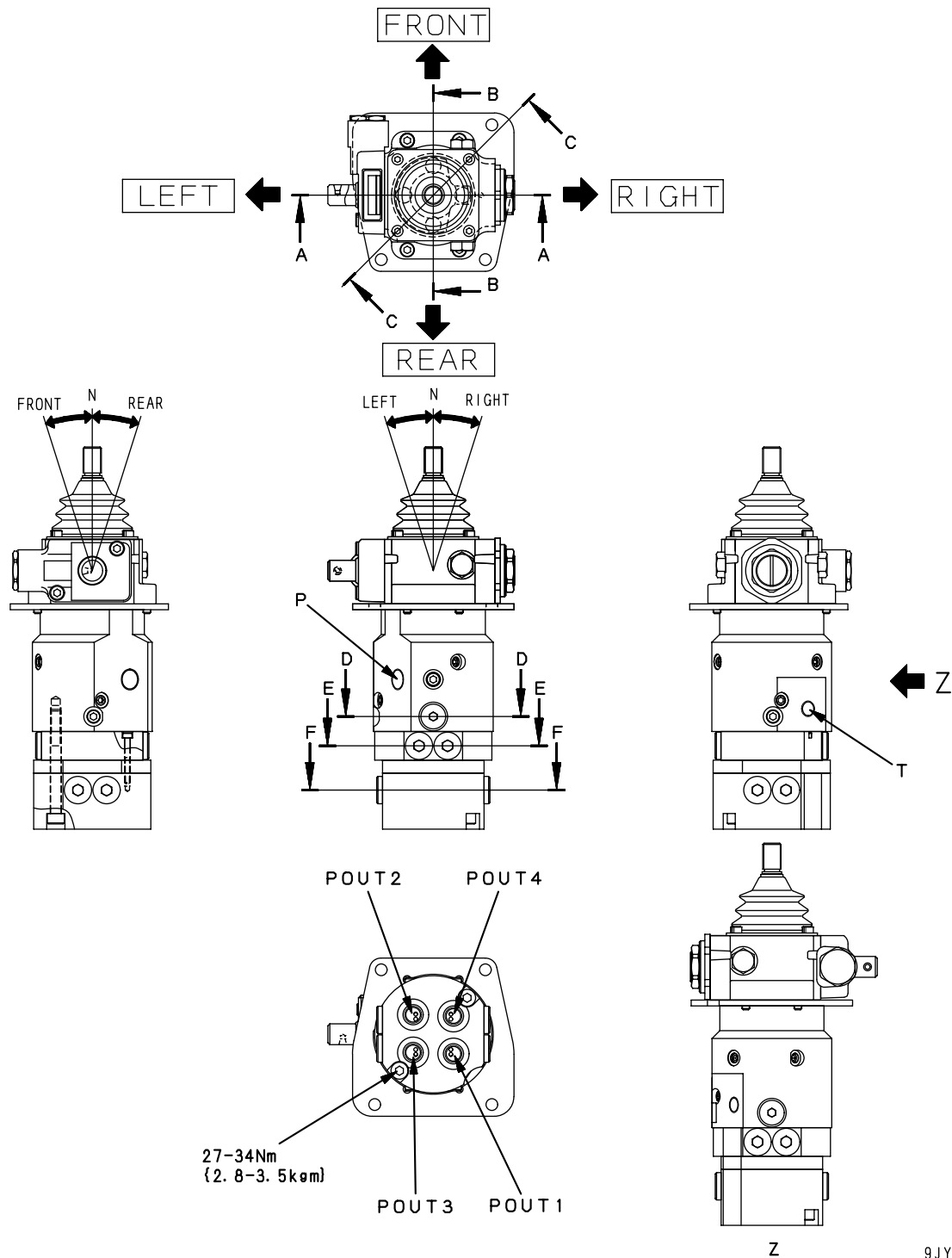
Operating effort characteristics graph
(forward, reverse directions)

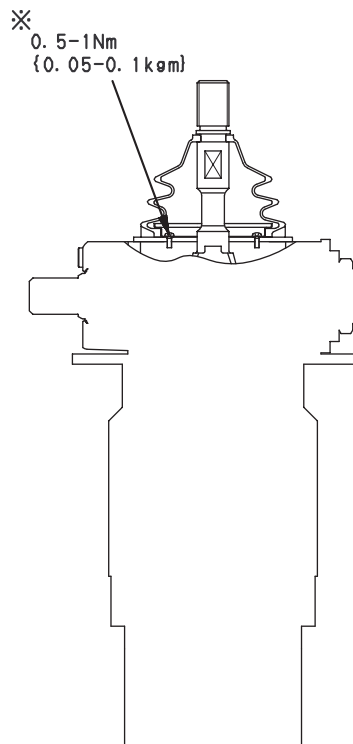


D31EX-21 Serial No. 50098 and up
D31PX-21 Serial No. 50182 and up

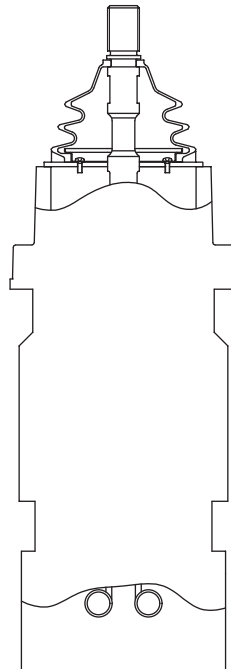
D37EX-21 Serial No. 5105 and up
D37PX-21 Serial No. 5091 and up

★ Do not disassemble this valve. If it is disassembled, its output pressure characteristics and operating effort characteristics need to be adjusted.

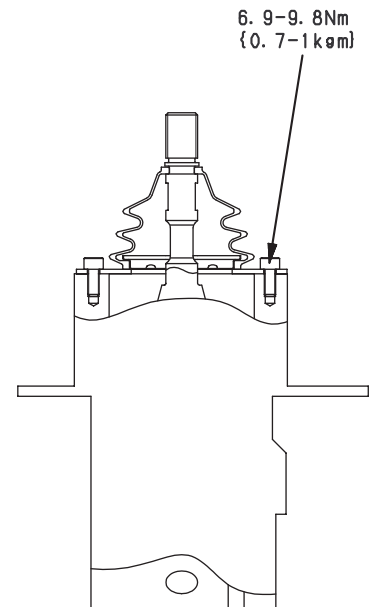




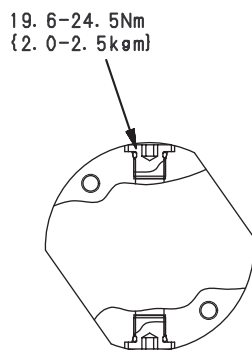
A - A



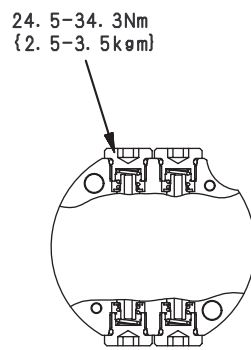
B - B



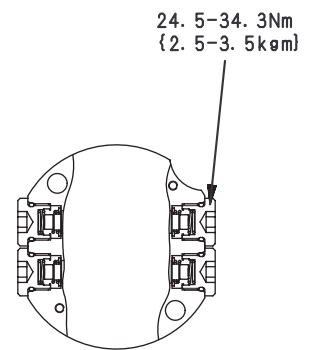
C - C



D - D



E - E



F - F

9JY01740

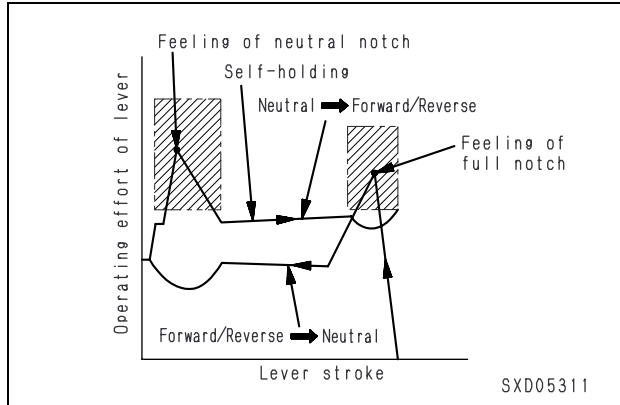
P: From control pump
T: To tank

POUT1: To HST pump flow control piston (R.H. FORWARD)
POUT2: To HST pump flow control piston (L.H. REVERSE)
POUT3: To HST pump flow control piston (L.H. FORWARD)
POUT4: To HST pump flow control piston (R.H. REVERSE)

1. Operating effort characteristics

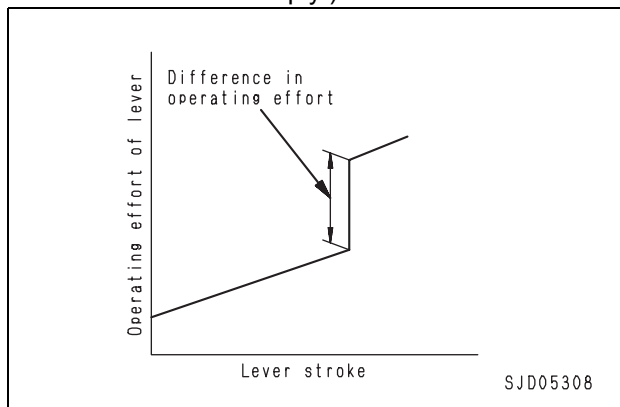
1) Forward-Reverse travel operation

- The control lever holds itself in the middle range.
(Notches are felt at the neutral position and lever stroke end.)



2) Steering operation

- Free return
(When a pivot turn is started, the operating effort rises sharply.)

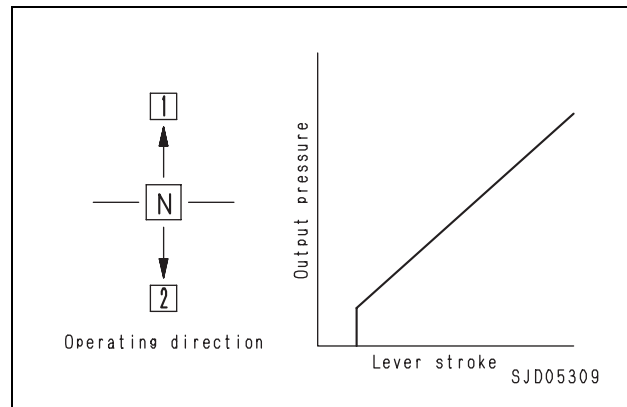


2. Output pressure characteristics

1) Forward-Reverse travel operation

○: Output port

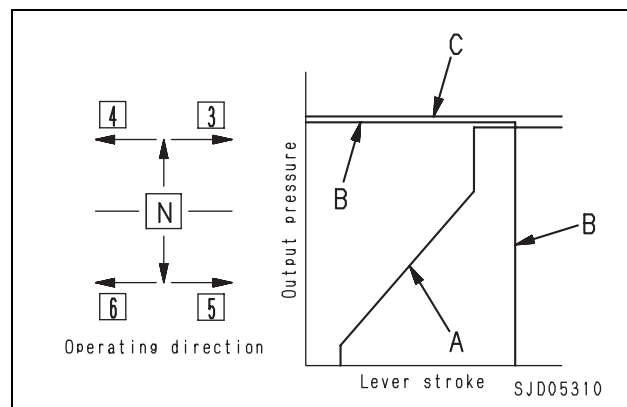
Output port Operating direction		Port 1	Port 2	Port 3	Port 4
1	N ↔ Forward	○	—	○	—
2	N ↔ Reverse	—	○	—	○



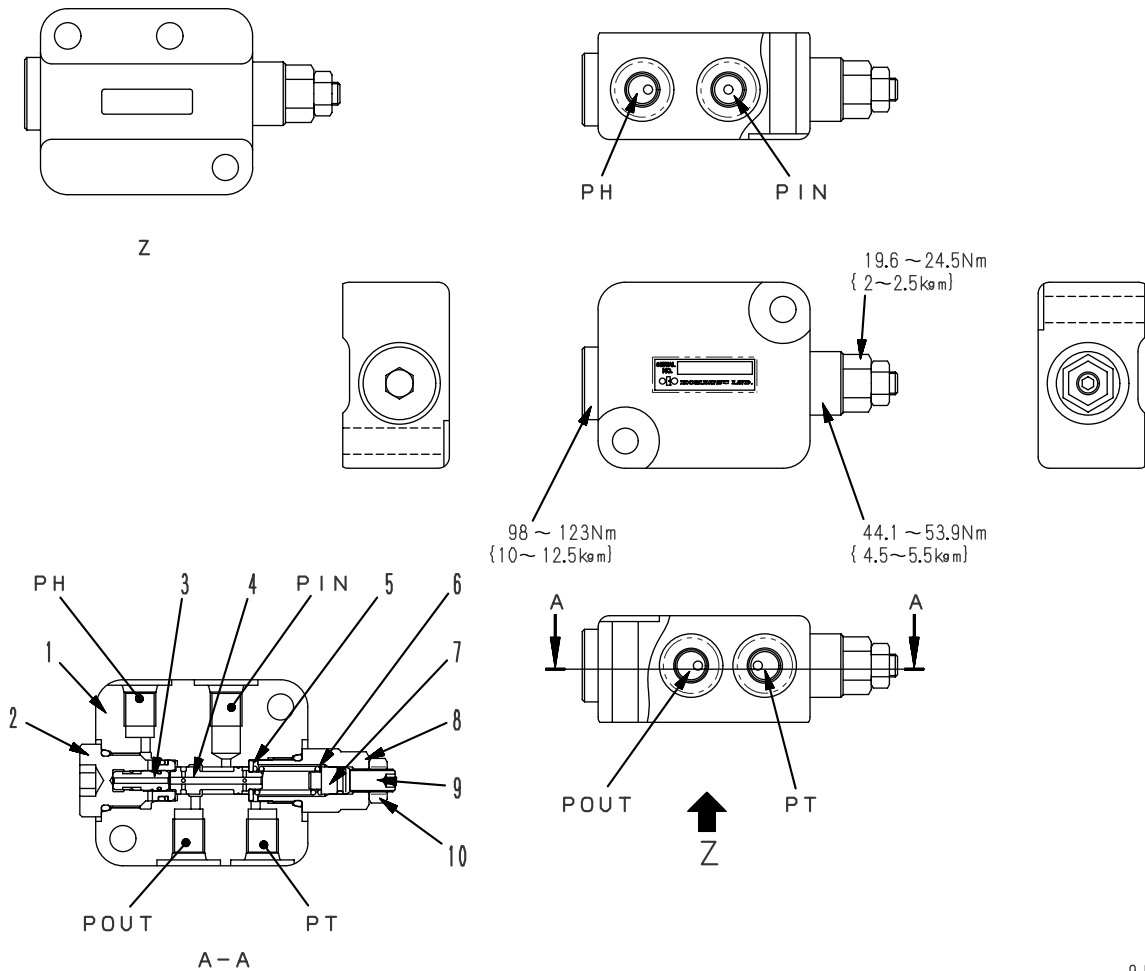
2) Steering operation

When the operation patterns are as shown in the following table, the output ports have characteristics A, B, and C shown below.

Output port Operating direction		Port 1	Port 2	Port 3	Port 4
3	Forward ↔ Right	B	–	C	A
4	Forward ↔ Left	C	A	B	–
5	Reverse ↔ Right	A	C	–	B
6	Reverse ↔ Left	–	B	A	C



AUTOMATIC GEARSHIFTING VALVE



9JY00599

1. Block
2. Plug
3. Piston
4. Spool
5. Washer
6. Spring
7. Seat
8. Plug
9. Adjustment screw
10. Locknut

PH: From HST pump load pressure circuit
 PIN: From 2nd speed signal electromagnetic valve
 POUT: To travel motor 3rd speed selector valve
 PT: To tank

Function

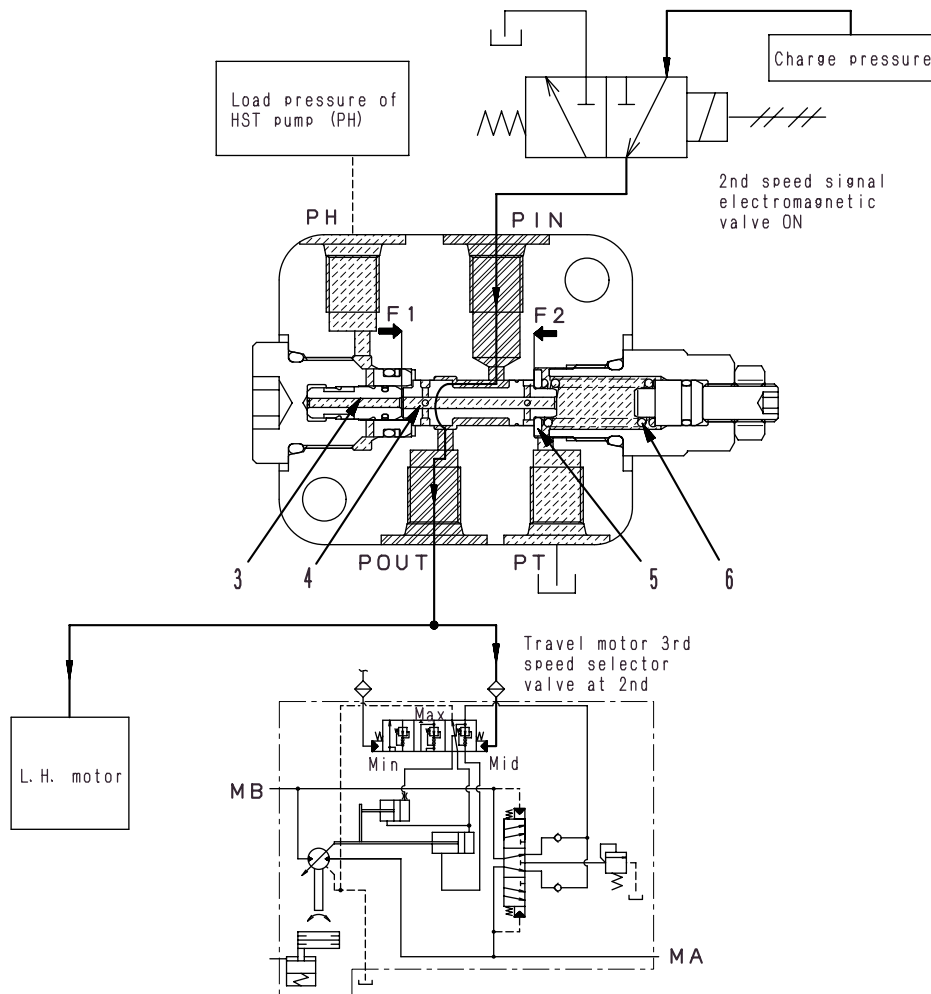
- The 1st, 2nd, and 3rd travel speeds are set by operating the button in the operator's compartment. This actuates the electromagnetic valve and inputs a signal to the 3rd speed selector valve built into the travel motor. (Manual operation)
- Compared with this, when the load pressure of the HST pump becomes high when traveling in 2nd speed, the automatic gearshifting valve automatically increases the motor capacity and shifts down to 1st speed.
- If the load pressure becomes smaller when traveling in 1st speed, it makes the motor capacity smaller and shifts up to 2nd speed.
- In this way, the towing force from 1st speed to 2nd speed is effectively used, so the ease of operation is improved.

Operation

No.	Travel mode	HST pump load pressure	Automatic gearshifting valve control
1	When traveling in 2nd speed	$PH < 35.3 \text{ MPa} \{360 \text{ kg/cm}^2\}$	Holds 2nd speed
2	When traveling in 2nd speed	$PH \geq 35.3 \text{ MPa} \{360 \text{ kg/cm}^2\}$	Shifts down to 1st
3	When traveling in 1st speed	$PH > 12.7 \text{ MPa} \{130 \text{ kg/cm}^2\}$	Holds 1st speed
4	When traveling in 1st speed	$PH \leq 12.7 \text{ MPa} \{130 \text{ kg/cm}^2\}$	Shifts up to 2nd

1. When traveling in 2nd speed and $PH < 35.3 \text{ MPa} \{360 \text{ kg/cm}^2\}$

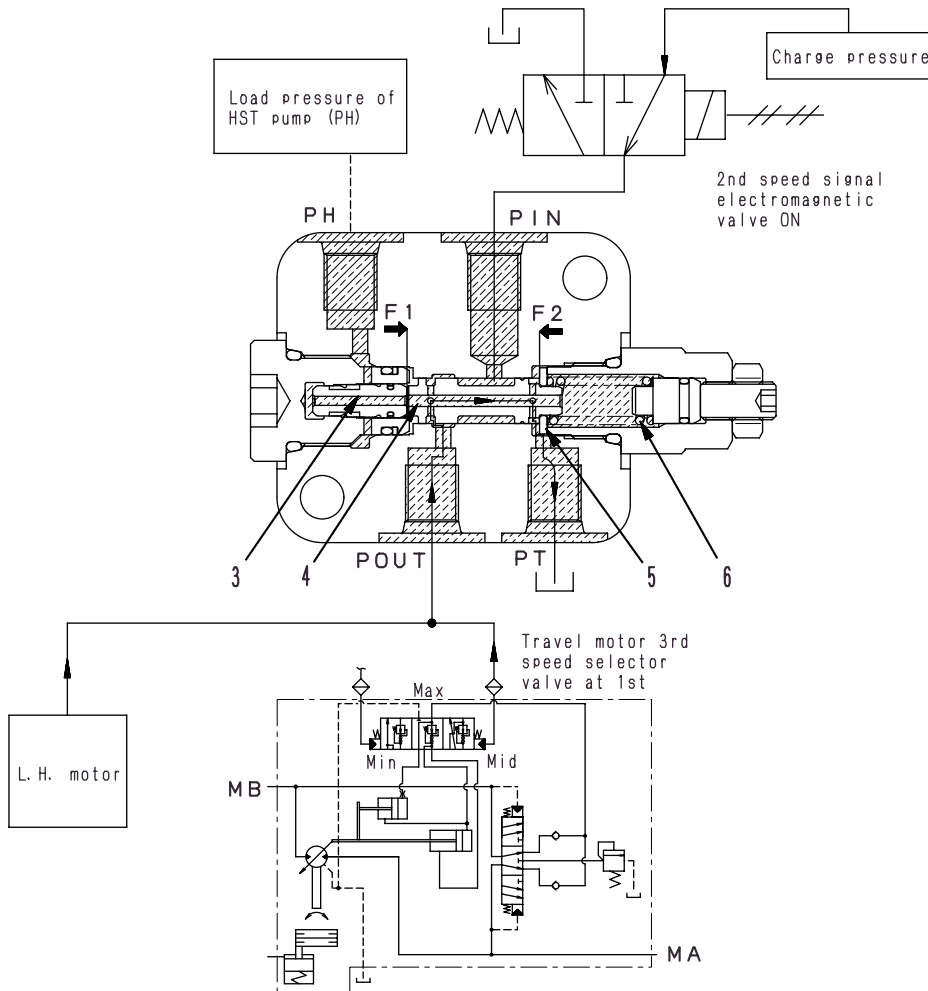
- The load pressure of the HST pump is received, and the pushing force (F1) of piston (3) and the pushing force (F2) of spring (6) through washer (5) acts on spool (4).
- However, $F1 < F2$, so the charge pressure acts on the 3rd speed selector valve of the travel motor and holds the travel in 2nd speed.



SX004231

2. When traveling in 2nd speed and $PH > 35.3$ MPa {360 kg/cm²}

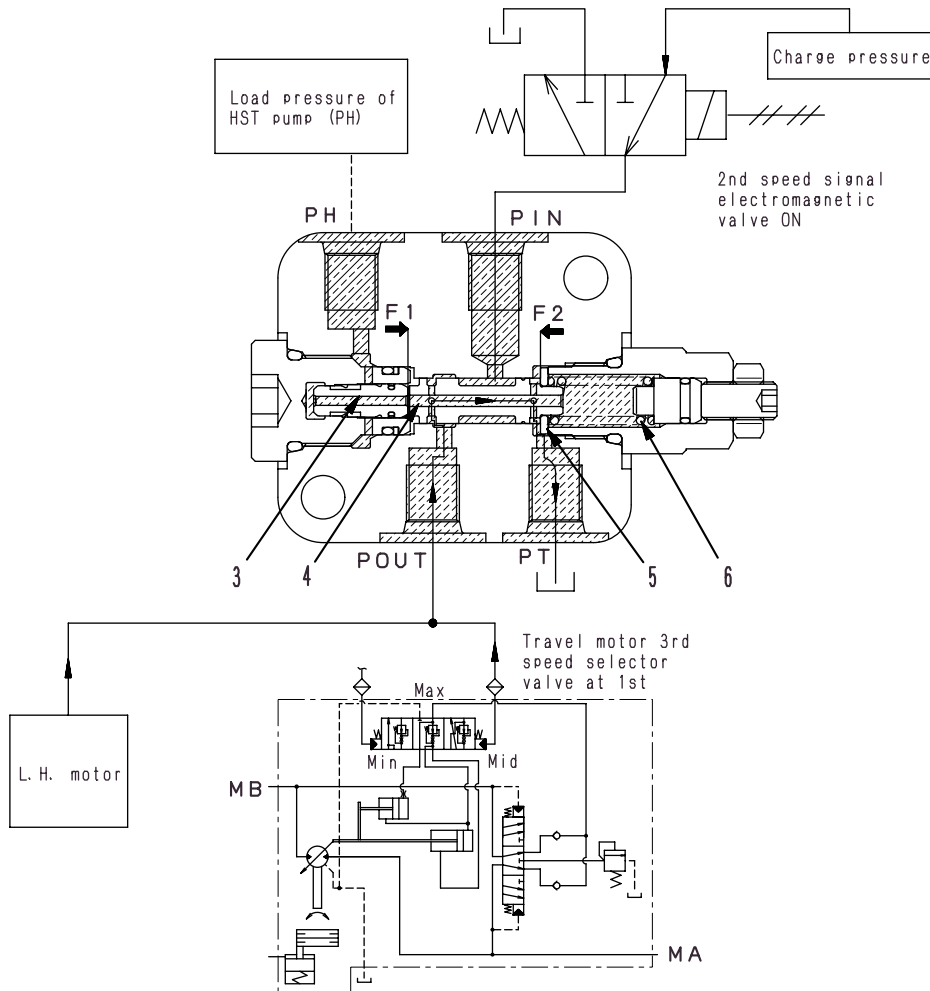
- $F1 > F2$, so the charge pressure does not act on the 3rd speed selector valve of the travel motor, and the motor shifts down to 1st speed.
- The difference between the shifting pressure of 35.3 MPa {360 kg/cm²} when the transmission shifts down 2nd → 1st and the shifting pressure of 12.7 MPa {130 kg/cm²} when the transmission shifts up 1st → 2nd is set by the difference in area of piston (3).



SXD04232

3. When traveling in 1st speed and $PH > 12.7$ MPa {130 kg/cm²}

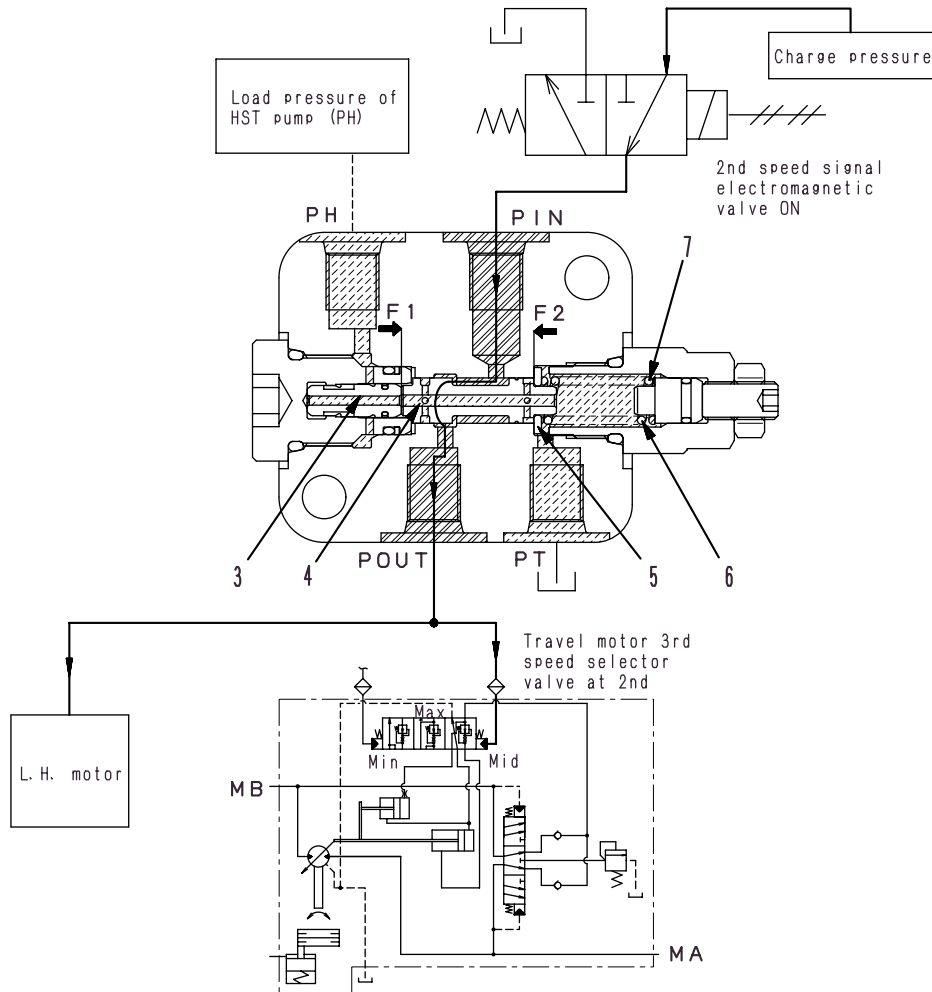
- $F1 > F2$, so the charge pressure does not act on the 3rd speed selector valve of the travel motor, and the motor is held at 1st speed.
- The difference between the shifting pressure of 35.3 MPa {360 kg/cm²} when the transmission shifts down 2nd → 1st and the shifting pressure of 12.7 MPa {130 kg/cm²} when the transmission shifts up 1st → 2nd is set by the difference in area of piston (3).



SXD04233

4. When traveling in 1st speed and PH < 12.7 MPa {130 kg/cm²}

- F1 < F2, so the charge pressure acts on the 3rd speed selector valve of the travel motor, and the motor is shifted up to 2nd speed.

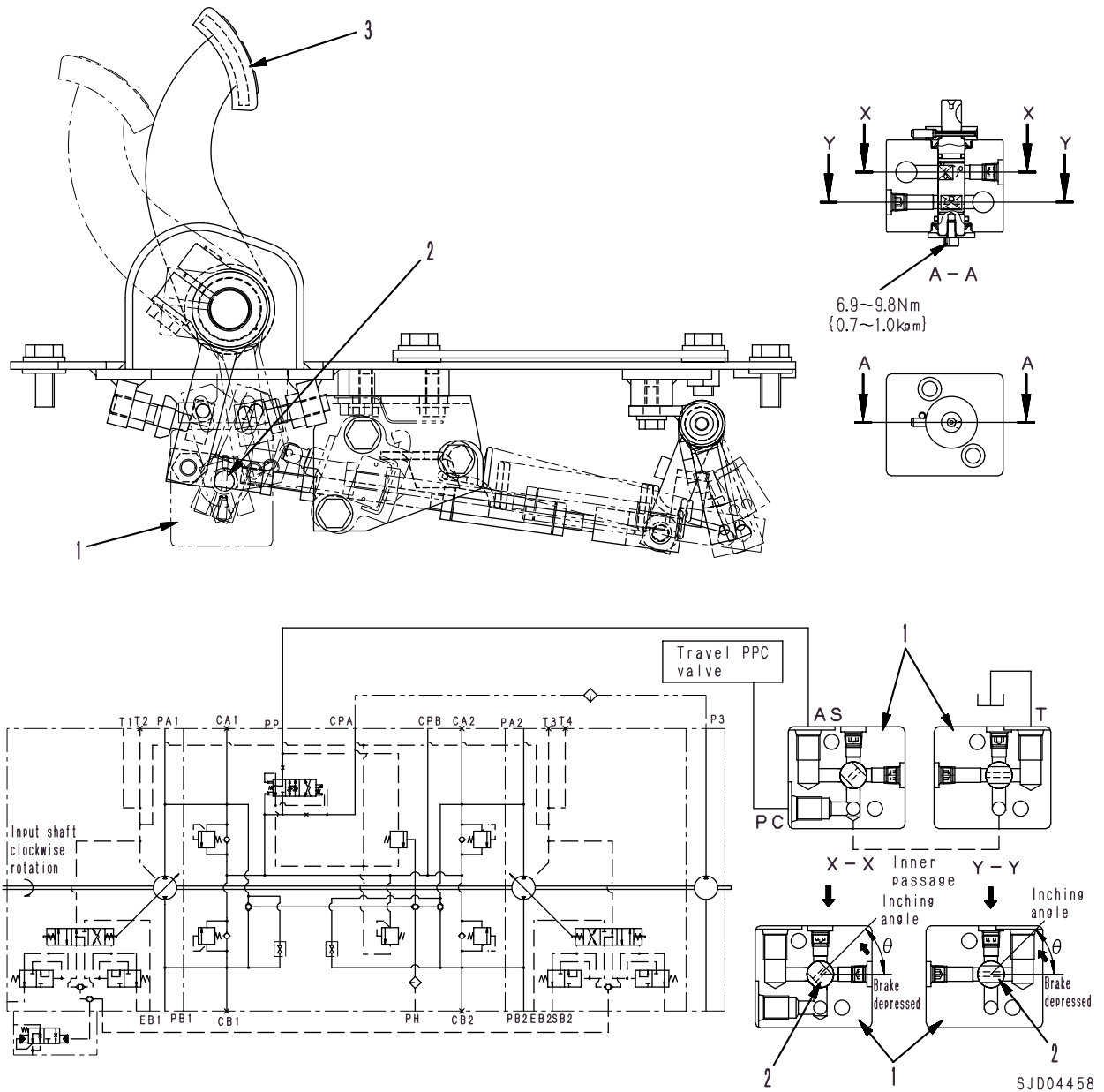


SJD04463

Unit: mm

No.	Check item	Criteria					Remedy
7	Spring	Standard size			Repair limit		Replace spring if damaged or deformed
		Free length	Installed length	Installed load	Free length	Installed load	
		35.9	30	142.1 N {14.5 kg}	—	135.2 N {13.8 kg}	

INCHING VALVE



1. Inching valve
2. Shaft
3. Center brake pedal

Function

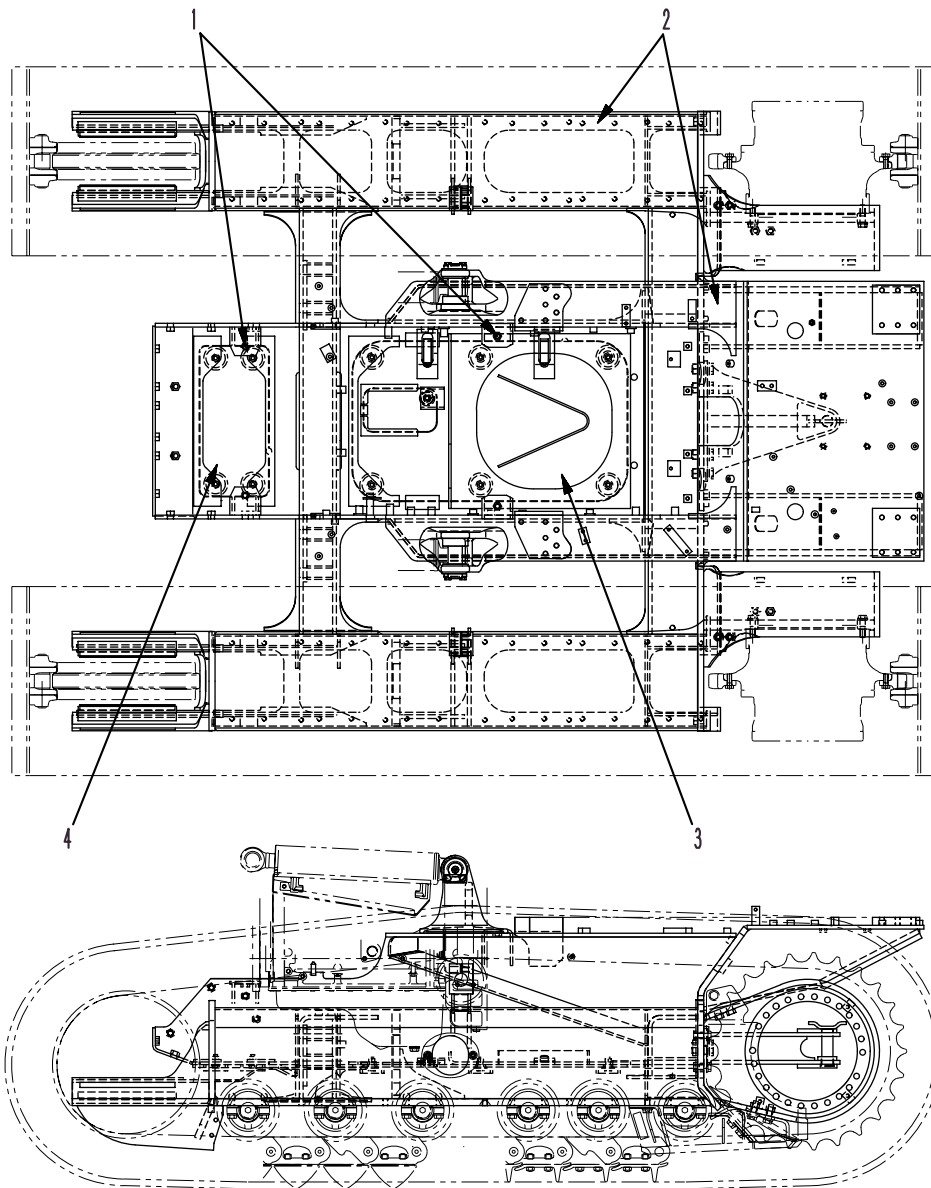
- Shaft (2) of inching valve (1) reduces the basic pressure of the speed control valve (travel PPC valve) according to the angle of rotation, and controls the HST hydraulic braking force.
- When center brake pedal (3) is depressed, inching valve (1) closes the passage from AS to PC and opens the passage from PC to T.

Operation

- Inching valve (1) is interconnected with center brake pedal (3), and shaft (2) rotates. The basic pressure of the travel PPC valve closes the passage from AS to PC and opens the passage from PC to T, so PC is gradually drained to the tank. When the brake pedal is depressed fully, the basic pressure of the travel PPC valve closes the passage from AS to PC completely and opens the passage from PC to T.

FRAME ASSEMBLY

★ The drawing shows the D31PX-21.



9JB00808

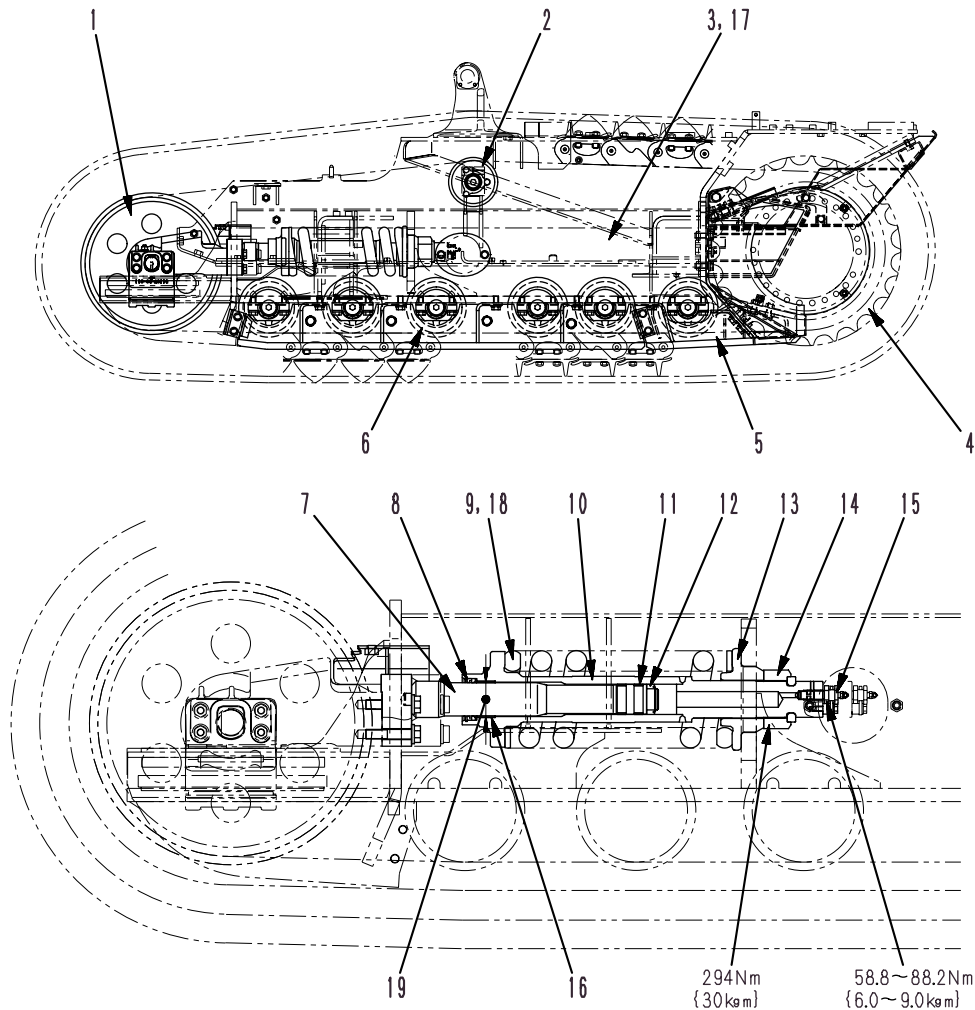
1. Engine mount
2. Frame assembly
3. Rear underguard
4. Front underguard

Outline

- A hull frame structure with the main frame, track frame, and underguard forming one unit is used.

TRACK FRAME, RECOIL SPRING

★ The drawing shows the D31PX-21.



9JB00809

1. Idler
2. Carrier roller
3. Track frame
4. Sprocket
5. Track roller guard
6. Track roller
7. Rod
8. Dust seal, oil seal

9. Recoil spring
10. Cylinder
11. Wear ring
12. U-packing
13. Pilot
14. Nut
15. Lubricator
16. Bushing

Unit: mm

No.	Check item	Criteria					Remedy
17	Deformation of track frame	Item			Repair limit		Correct
		Curvature Twisting Opening of idler portion			7 (for length of 3,000) 3 (for length of 300) 5		
18	Recoil spring	Standard size			Repair limit		Replace
		Free length x OD	Installed length	Installed load	Free length	Installed load	
		465 x ϕ 161	375.6	71.5 kN {7,300 kg}	454	63.7 kN {6,500 kg}	
19	Clearance between rod and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
			Shaft	Hole			
		ϕ 55	-0.030 -0.076	+0.163 +0.006	0.036 – 0.239	0.5	

Outline

- Recoil spring (9) moves rod (7) to the front or rear when grease is added or removed from lubricator (15), and adjusts the track tension. Recoil spring (9) also acts to absorb any sudden shock applied to idler (1).

Grease : G2-LI
Filling amount of grease: 160 cc

- Track roller

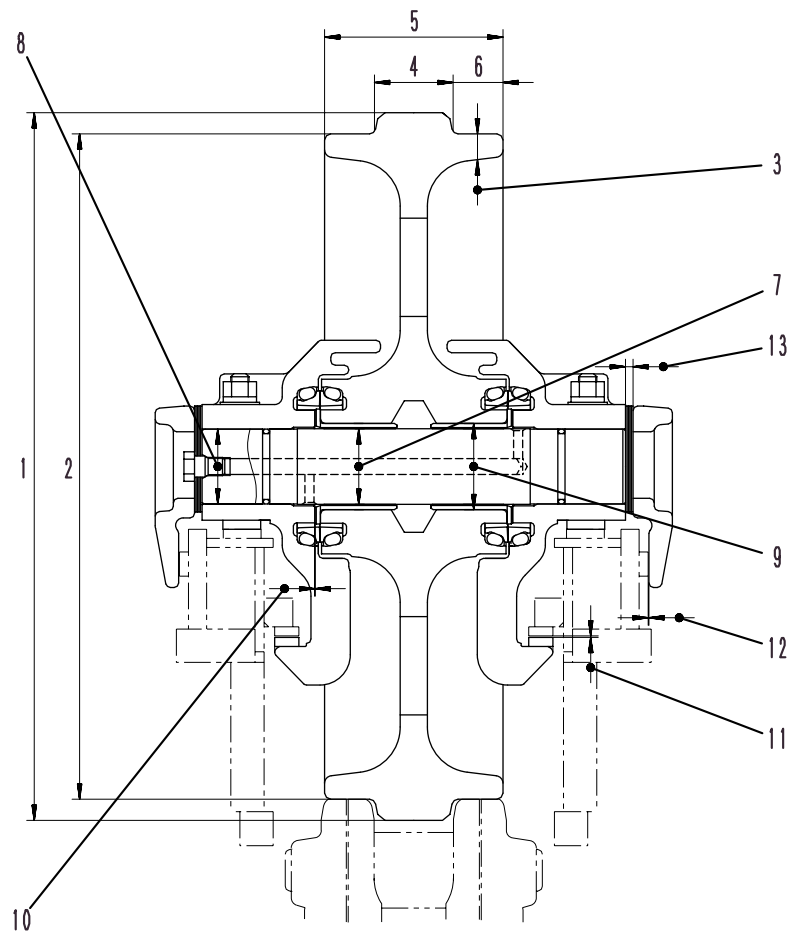
Model	Q'ty	Flange type and arrangement
D31EX-21	5	S, S, S, S, S (S, W, S, W, S)
D31PX-21 D37EX-21 D37PX-21	6	S, S, S, S, S, S (S, W, S, S, W, S)

S : Single flange

W : Double flange

The arrangement inside () indicates the arrangement when the double flange roller (If equipped) is installed.

IDLER



9JB00818

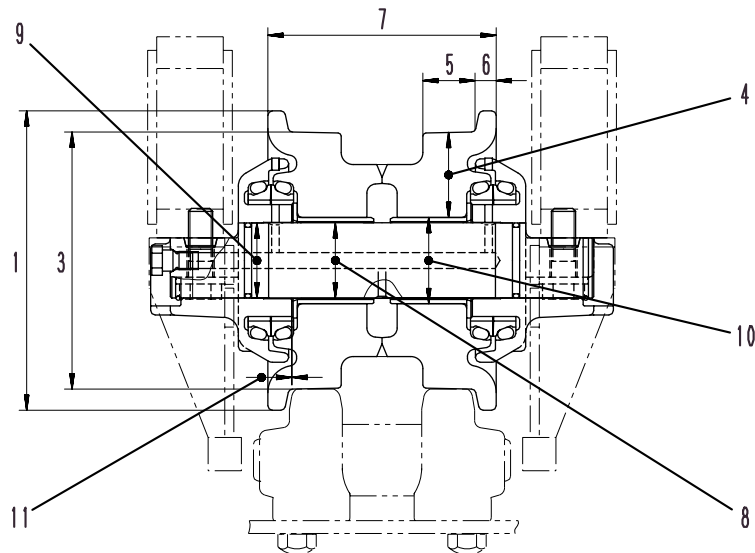
STRUCTURE AND FUNCTION, MAINTENANCE STANDARD
IDLER

Unit: mm

No.	Check item	Criteria				Remedy	
1	Outside diameter of protrusion	Standard size		Repair limit		Rebuild or replace	
		φ 468		—			
2	Outside diameter of tread	φ 440		φ 424			
3	Thickness of tread surface (center of tread width)	17		10			
4	Width of protrusion	52		—			
5	Overall width	118		—			
6	Width of tread	33		39			
7	Clearance between idler shaft and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		φ 50	−0.250 −0.300	+0.140 +0.069	0.319 – 0.440	1.5	
8	Clearance between idler shaft and support	φ 49.7	−0.250 −0.300	+0.062 0	0.250 – 0.362	—	
9	Interference between idler and bushing	Standard size	Tolerance		Standard interference	Interference limit	
			Shaft	Hole			
		φ 57	+0.117 +0.087	+0.040 0	0.047 – 0.117	—	
10	Side clearance of idler (both sides)	Standard clearance			Clearance limit		
		0.490 – 0.910			1.5		
11	Clearance between guide plate and support	0.2 – 3.8			12.0		Rebuild or replace
12	Clearance between guide plate and side plate	0.5			3.0		Adjust shim or replace plate
13	Standard shim thickness at side plate mount portion	5.0					
—	Oil level	159 ± 10 cc (Engine oil: EO30-CD)				—	

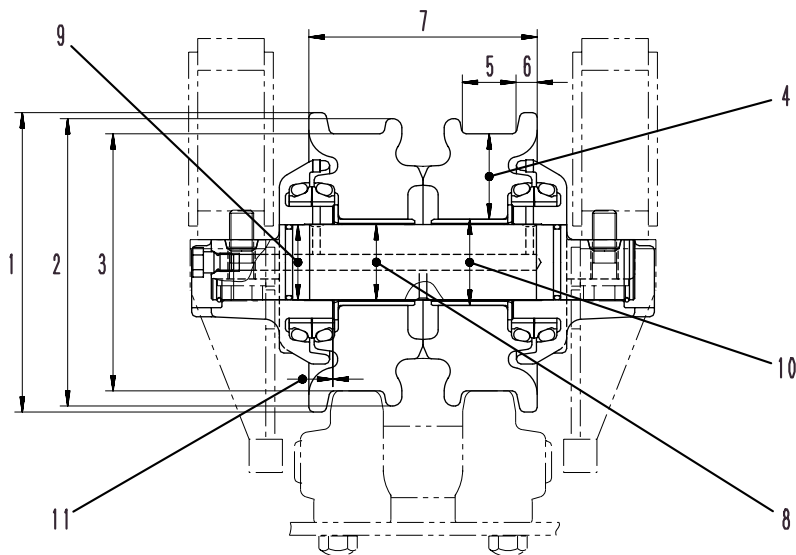
TRACK ROLLER

SINGLE FLANGE TYPE



9JB00819

DOUBLE FLANGE TYPE

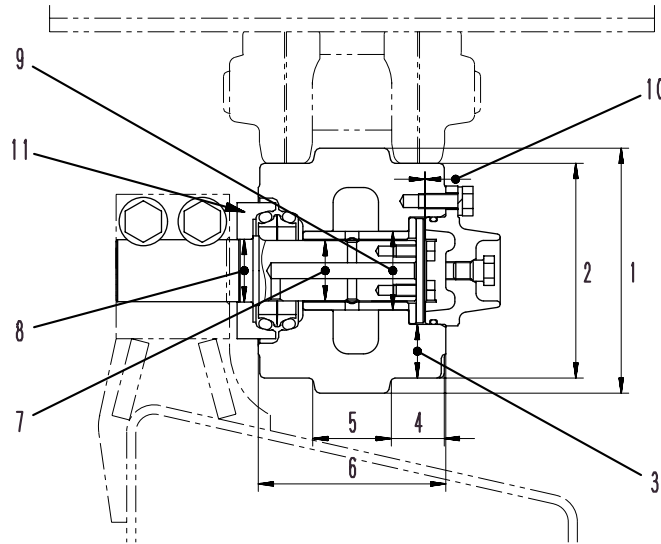


9JB00820

Unit: mm

No.	Check item		Criteria				Remedy	
1	Outside diameter of flange (outside)		Standard size		Repair limit		Rebuild or replace	
			ϕ 198		—			
2	Outside diameter of flange (inside) (Double flange)		ϕ 190		—			
3	Outside diameter of tread		ϕ 170		ϕ 156			
4	Thickness of tread surface (center of tread width)		56.5		49.5			
5	Width of tread	Single flange	34.5		40.5			
		Double flange	35.5		41.5			
6	Width of flange		14		8			
7	Overall width		151		—		—	
8	Clearance between shaft and bushing		Standard size	Tolerance		Standard clearance	Clearance limit	Replace
				Shaft	Hole			
			ϕ 50	−0.250 −0.350	+0.140 +0.069	0.319 – 0.440	1.5	
9	Clearance between shaft and collar		ϕ 49.7	−0.250 −0.350	+0.062 0	0.250 – 0.362	—	
10	Interference between roller and bushing		Standard size	Tolerance		Standard interference	Interference limit	
				Shaft	Hole			
			ϕ 57	+0.117 +0.087	+0.040 0	0.047 – 0.117	—	
11	Side clearance of track roller (both sides)		Standard clearance		Clearance limit			
			0.290 – 0.710		1.5			
—	Oil level		150 cc (Gear oil: GO140)				—	

CARRIER ROLLER

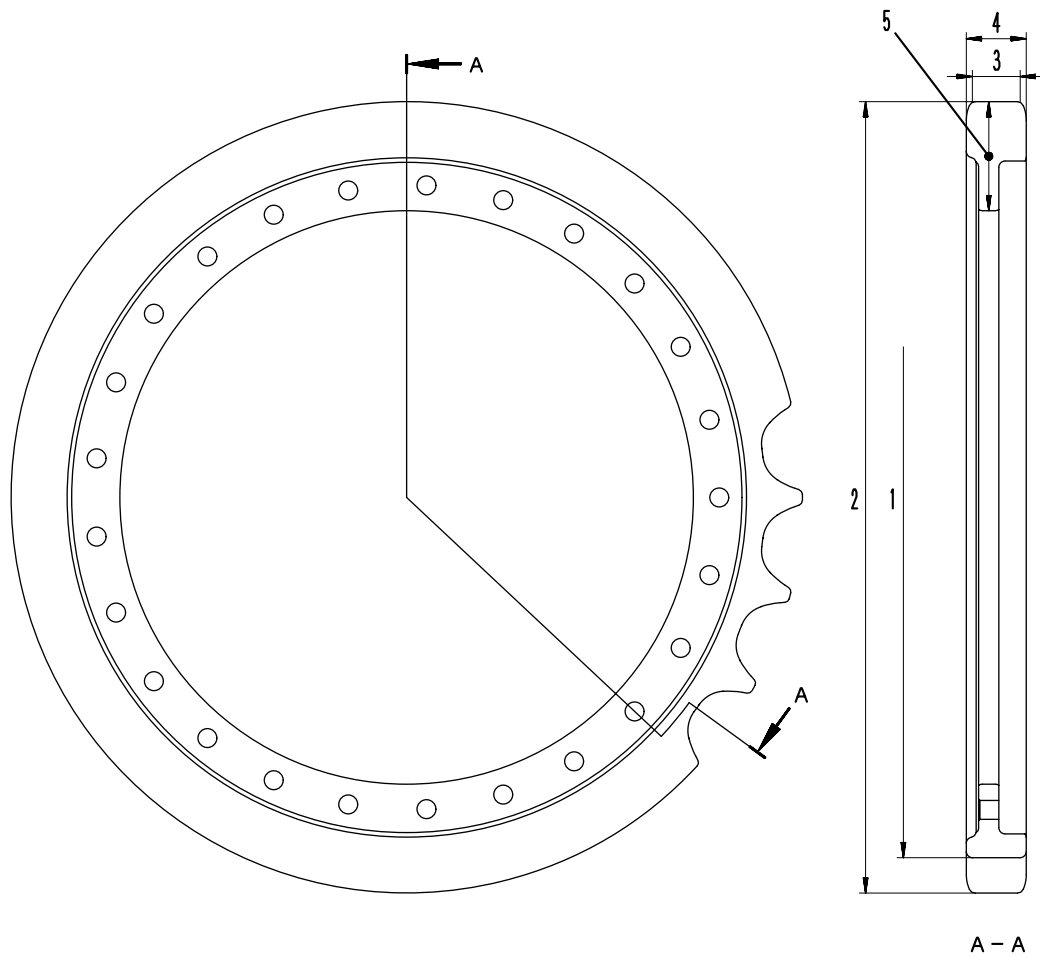


9JB00821

Unit: mm

No.	Check item	Criteria					Remedy
1	Outside diameter of flange	Standard size			Repair limit		Rebuild or replace
		φ 162			—		
2	Outside diameter of tread	φ 142			φ 128		
3	Thickness of tread surface (center of tread width)	35.5			28.5		
4	Width of tread	35			42		
5	Width of flange	52			42		
6	Overall width	124			—		—
7	Clearance between shaft and bushing	Standard size φ 40	Tolerance		Standard clearance 0.080 – 0.158	Clearance limit 1.0	Replace
			Shaft	Hole			
8	Interference between shaft and seal guard	Standard size φ 41.5	Tolerance		Standard interference 0.115 – 0.170	Interference limit —	
			Shaft	Hole			
9	Interference between roller and bushing	φ 52	+0.062 +0.032	+0.030 0	0.002– 0.062	—	
10	Side clearance of carrier roller	Standard clearance			Clearance limit		
		0.580 – 0.700			1.5		
11	Press-fitting force of seal guard	65.7 – 99.1 kN {6.7 – 10.1 ton}					Adjust
—	Oil level	200 – 220 cc (Gear oil: GO140B)					—

SPROCKET



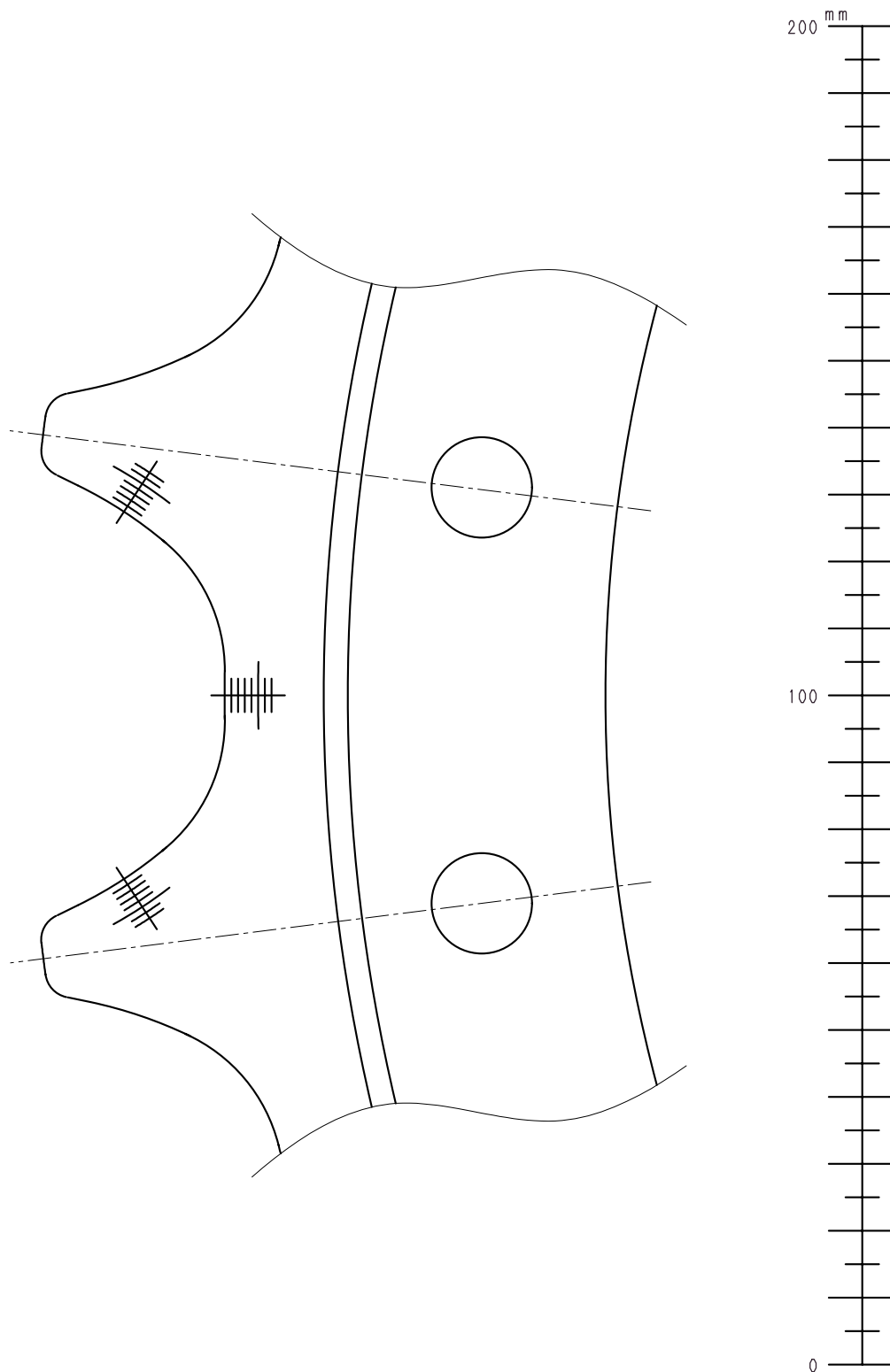
9JB00822

Unit: mm

No.	Check item	Criteria			Remedy
		Standard size	Tolerance	Repair limit	
1	Wear of diameter at root of tooth	ϕ 568.9	+1.0 -2.0	ϕ 556.9	Rebuild or replace
2	Wear of diameter at tip of tooth	ϕ 628	$\pm$ 2.0	ϕ 616	
3	Wear of width at tip of tooth	38	—	32	
4	Wear of width at root of tooth	47.5	$\pm$ 1.5	42	
5	Thickness of root of tooth	56.95	+1.5 -2.0	50.95	

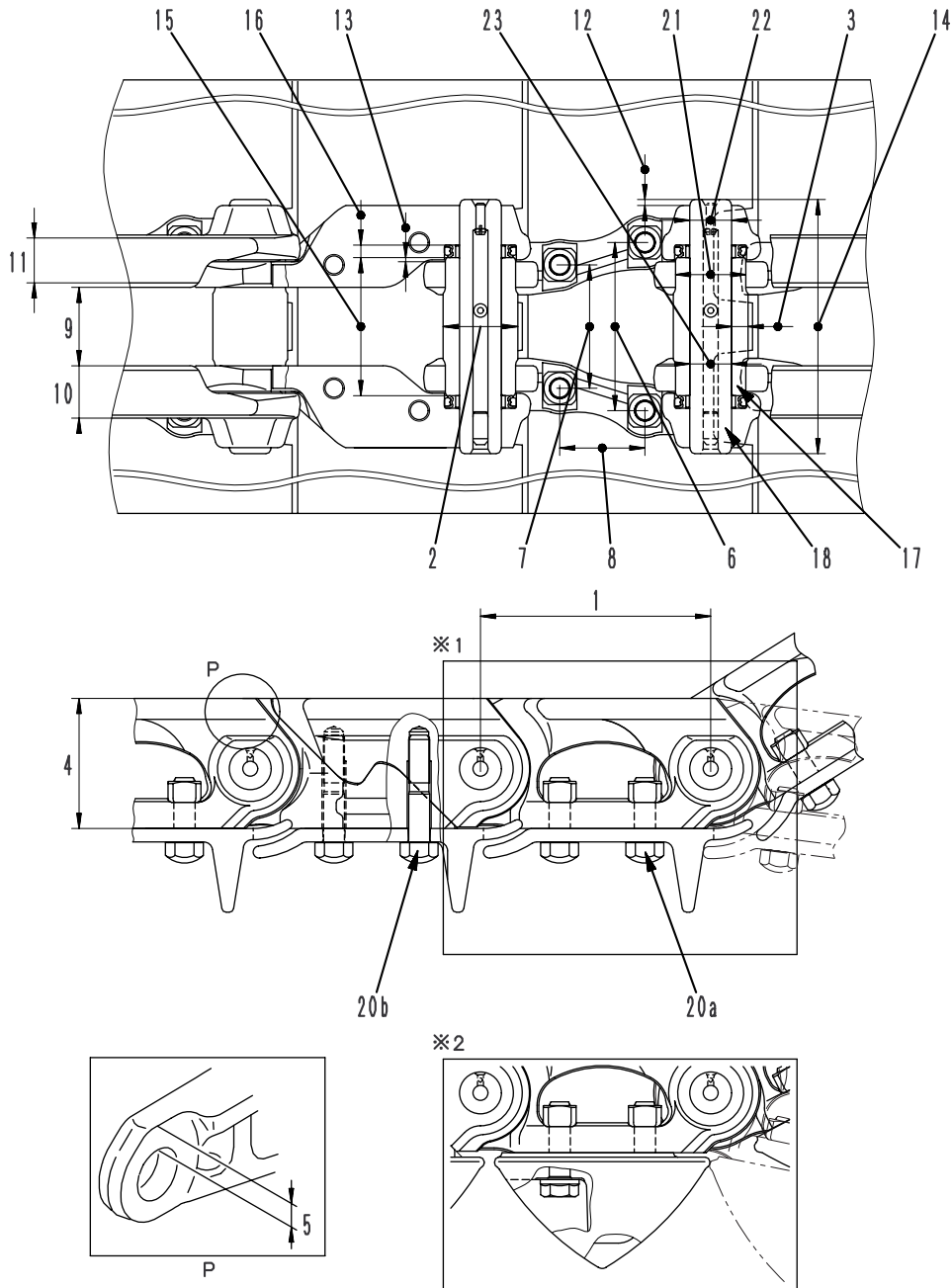
DIMENSIONS OF SHAPE OF SPROCKET TOOTH (ACTUAL SIZE)

★ Make the dimensions of the scale the actual size and copy on to an OHP sheet.



9JB00823

TRACK SHOE



9JB00824

- ※1. Single shoe
- ※2. Swamp shoe

★ Portion P shows the link at the side where the bushing is press fitted.

STRUCTURE AND FUNCTION, MAINTENANCE STANDARD

TRACK SHOE

Unit: mm

No.	Check item		Criteria			Remedy
1	Link pitch		Standard size		Repair limit	Turn or replace
			154.3		157.3	
2	Outside diameter of bushing		Standard size	Turn		
				Light load	Heavy load	
			50	41.6	44.5	
3	Thickness of bushing		10.7	2.3	5.2	
4	Height of link		Standard size		Repair limit	Correct or replace
			87		80	
5	Thickness of link (bushing press-fitting portion)		23.5		16.5	Replace
6	Shoe bolt pitch		112.4			
7			82.4			
8			57.0			
9	Link	Inside width	52.4			Correct or replace
10		Overall width	35.0			
11		Tread width	30.1			
12	Protrusion of pin		4.0			Adjust or replace
13	Protrusion of regular bushing		2.75			
14	Total length of pin		170			
15	Total length of bushing (master bushing)		92.3			
16	Thickness of spacer		8.4			
17	Press-fitting force	Bushing	19.6 – 49.0 kN {2 – 5 ton}			—
18		Regular pin	78.4 – 117.6 kN {8 – 12 ton}			
※19		Master pin	—			

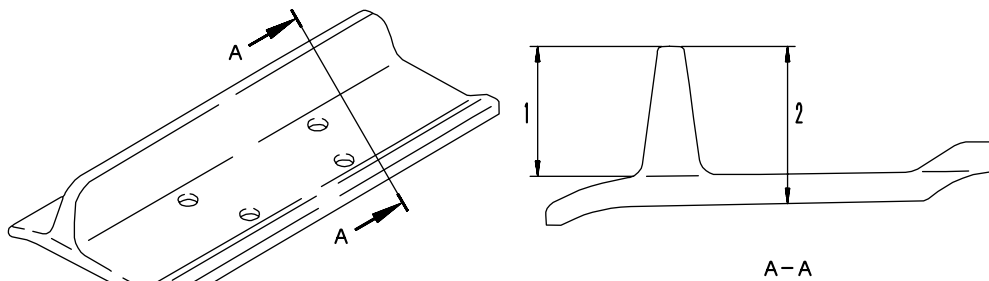
Items marked with ※ indicate dry type track.

Unit: mm

No.	Check item		Criteria			Remedy	
20	Shoe bolt	a. Regular link	Tightening torque (Nm {kgm})		Tightening angle (°)	Tighten	
			265 ± 30 {27 ± 3}		—		
		b. Master link	Tightening torque (Nm {kgm})		Tightening angle (°)		Lower limit torque (Nm {kgm})
			150 ± 40 {15 ± 4}		180 ± 10		255 {26}
	No. of shoes (one side)		D31EX : 38 D31PX : 40 D37EX : 41 D37PX : 41			—	
21	Interference between bushing and link		Standard size	Tolerance		Standard interference	
				Shaft	Hole		
			φ 47	+0.287 +0.247	+0.062 0	0.185 – 0.287	
22	Interference between regular pin and link		φ 28	+0.150 0	–0.148 –0.200	0.148 – 0.350	
23	Clearance between regular pin and bushing		Standard size	Tolerance		Standard clearance	
				Shaft	Hole		
			φ 28	+0.150 0	+0.830 +0.330	0.180 – 0.830	
※ 24	Interference between master pin and link		Standard size	Tolerance		Standard interference	
				Shaft	Hole		
			—	—	—	—	
※ 25	Clearance between master pin and bushing		Standard size	Tolerance		Standard clearance	
				Shaft	Hole		
			—	—	—	—	

Items marked with ※ indicate dry type track.

SINGLE SHOE

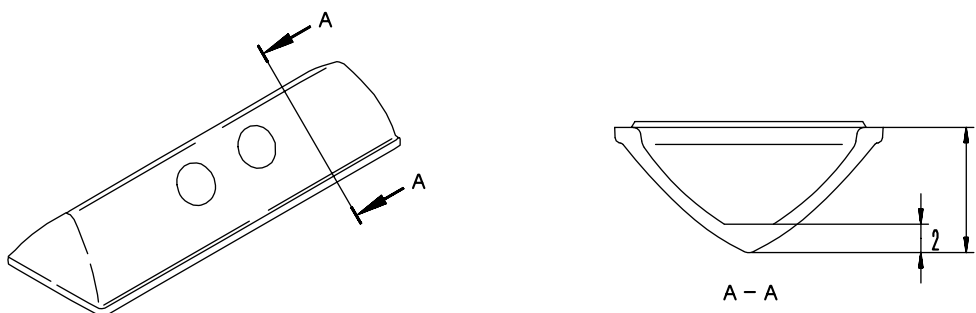


9JB00825

Unit:mm

No.	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Height of grouser	47	20	Rebuild or replace
2	Thickness of plate portion	56	29	

SWAMP SHOE

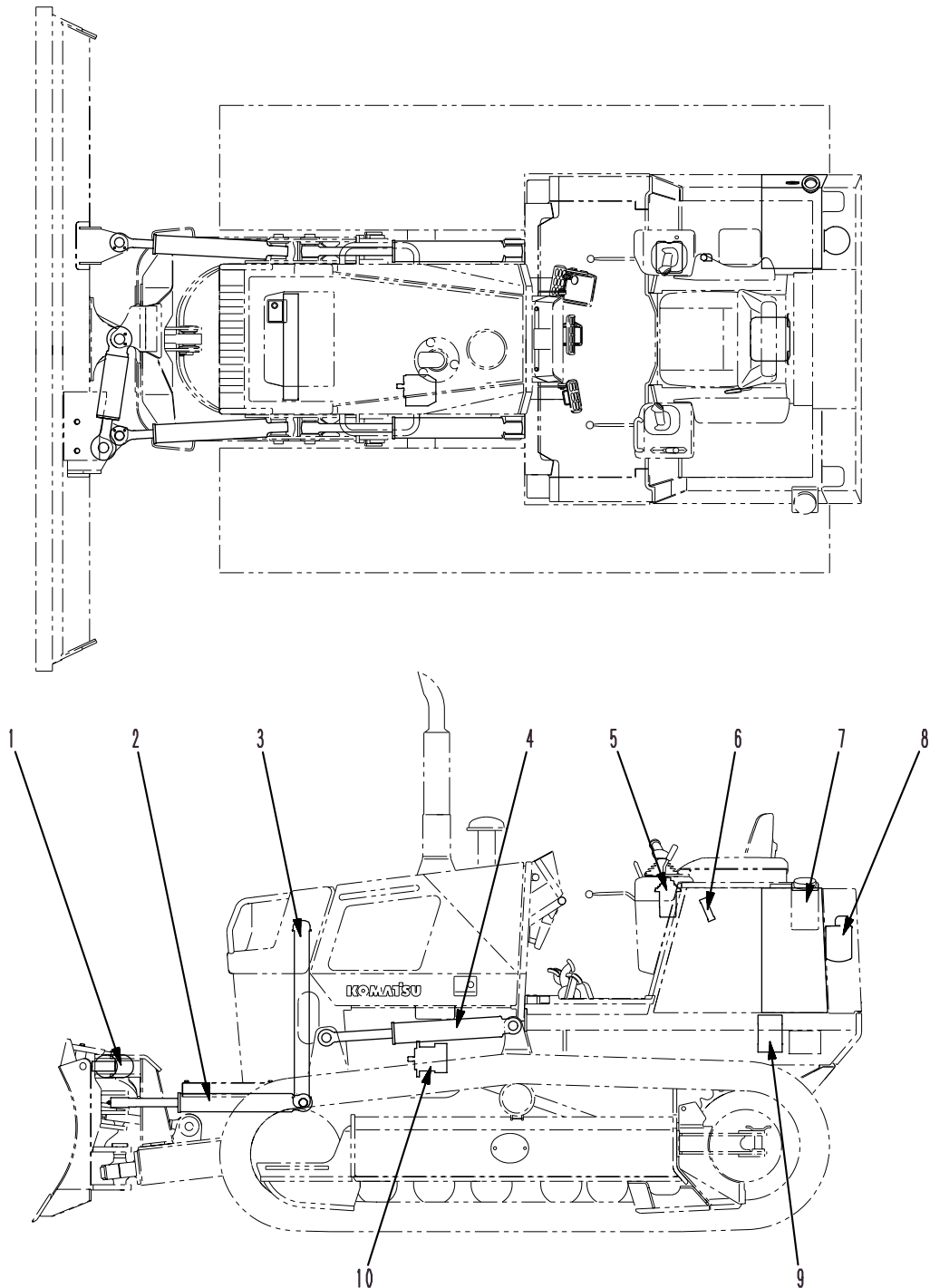


SED01630

Unit:mm

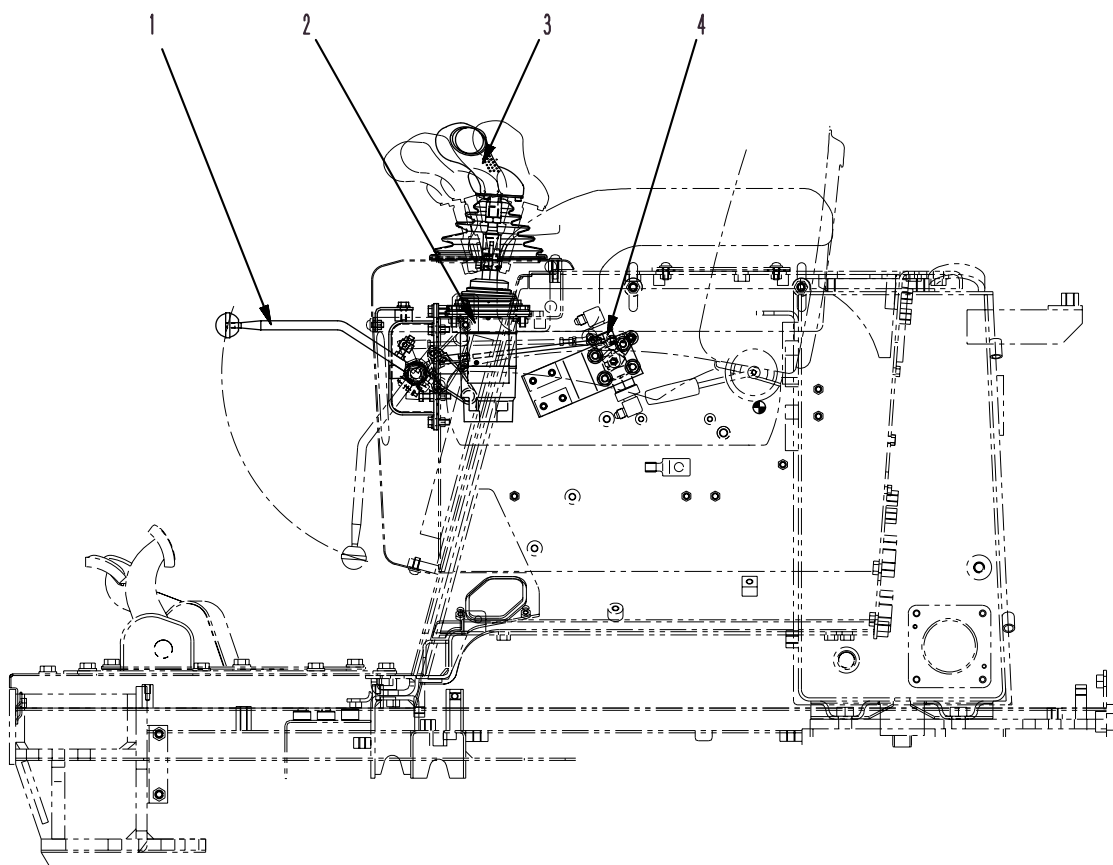
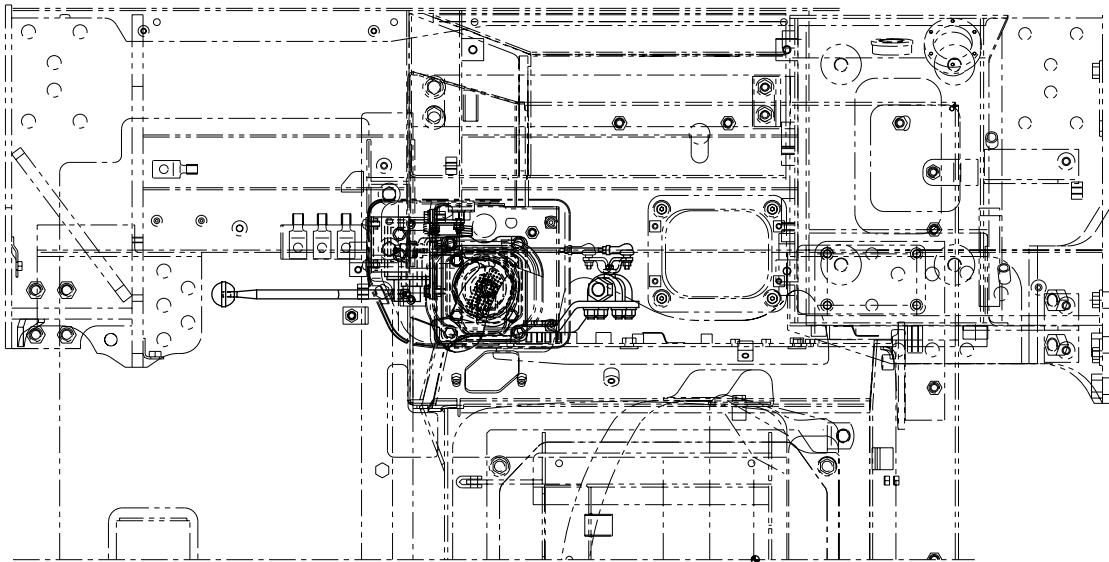
No.	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Height of grouser	74.5	62.5	Rebuild or replace
2	Thickness of grouser	17	5	

ARRANGEMENT OF HYDRAULIC EQUIPMENT FOR WORK EQUIPMENT



9JB00810

WORK EQUIPMENT CONTROL



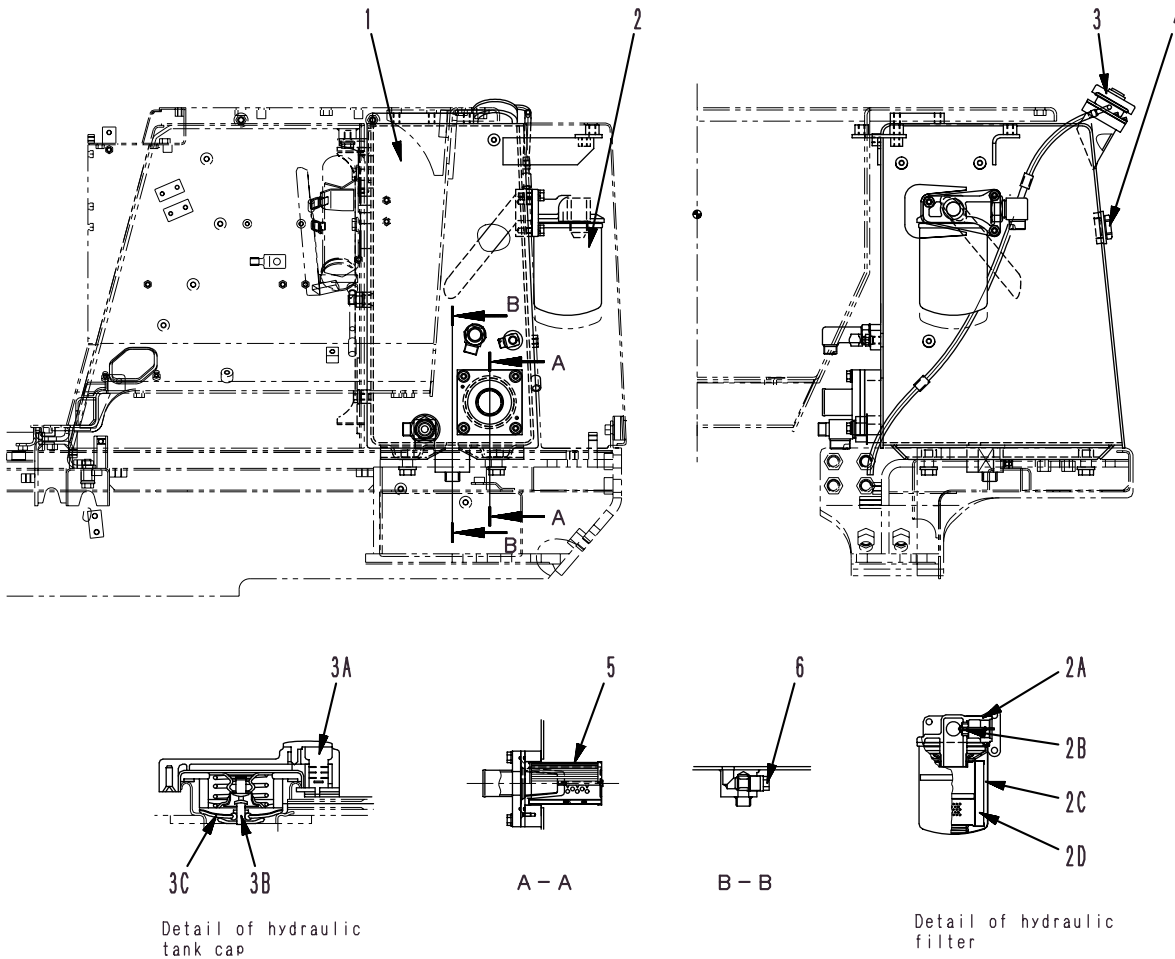
9JB00325

1. Safety lock lever
2. Work equipment PPC valve
3. Blade control lever
4. Shut-off valve

Outline

- Control of the work equipment is carried out from blade control lever (3) through work equipment PPC valve (2) to move the control valve spool.
- When safety lock lever (1) is set to the LOCK position, shut-off valve (4) is interconnected, so blade control lever (3) moves but the work equipment cannot be operated.
- When blade control lever (3) is at the FLOAT position, the hydraulic detent of work equipment PPC valve (2) is actuated and it is possible to self hold blade control lever (3).
When safety lock lever (1) is set to the LOCK position, the hydraulic detent is canceled, so blade control lever (3) is restored to the HOLD position.
- When the engine is stopped, even if blade control lever (3) is at the FLOAT position, the hydraulic detent is not actuated, so blade control lever (3) is restored to the HOLD position.

HYDRAULIC TANK, FILTER



SXD04235

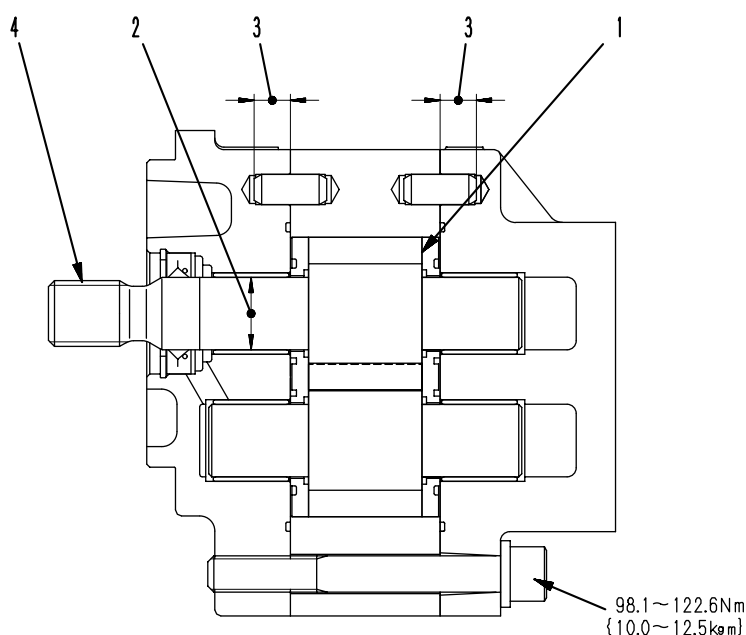
- | | |
|---------------------|-----------------------|
| 1. Hydraulic tank | 3. Hydraulic tank cap |
| 2. Hydraulic filter | 3A. Key cylinder |
| 2A. Bracket | 3B. Suction valve |
| 2B. Safety valve | 3C. Pressure valve |
| 2C. Cartridge | 4. Sight gauge |
| 2D. Filter | 5. Strainer |
| | 6. Drain plug |

Specifications

Item		Specified value
Hydraulic tank capacity		66.4 ℓ
Hydraulic tank cap	Pressure valve cracking pressure	38.2 ± 14.7 kPa {0.39 ± 0.15 kg/cm ² }
	Vacuum valve actuation pressure	0 – 4.51 kPa {0 – 0.046 kg/cm ² }
Hydraulic filter	Cracking pressure	103 ± 29.4 kPa {1.05 ± 0.3 kg/cm ² }
	Filtering precision	10 μm
	Filtering area	3,400 cm ²
	Filtering flow	86 ℓ/min

HYDRAULIC PUMP

SAR(2)040



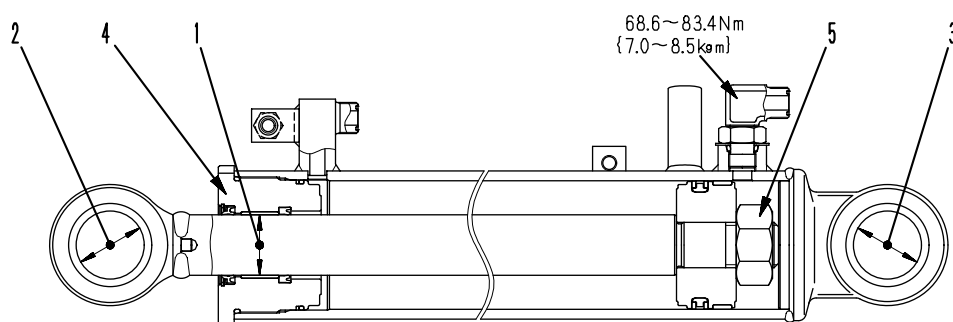
9JB00342

Unit: mm

No.	Check item	Criteria				Remedy
1	Side clearance	Standard clearance		Clearance limit		Replace
		0.100 – 0.150		0.190		
2	Clearance between inside diameter of plain bearing and outside diameter of gear shaft	0.060 – 0.125		0.200		
3	Pin driving-in depth	Standard size	Tolerance		Repair limit	
		12	0 –0.5		—	
4	Spline shaft rotating torque	2.9 – 6.9 Nm {0.3 – 0.7 kgm}				
—	Discharge amount Oil: SAE10WCD Oil temperature: 45 – 55 °C	Speed (rpm)	Discharge pressure (MPa {kg/cm ² })	Standard discharge amount (ℓ/min)	Discharge amount limit (ℓ/min)	—
		3,000	20.6 {210}	111	103	

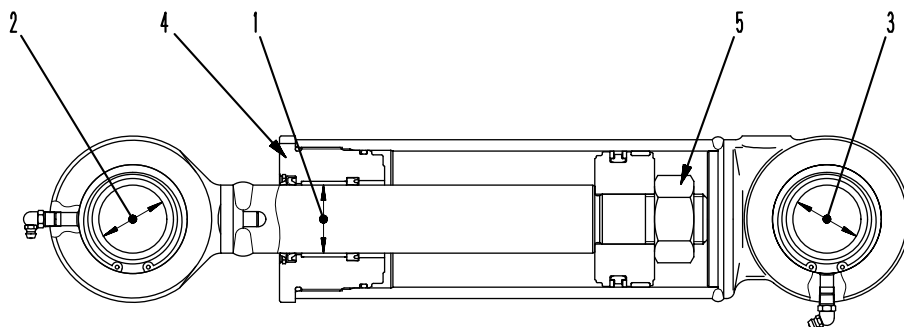
WORK EQUIPMENT CYLINDER

Lift cylinder



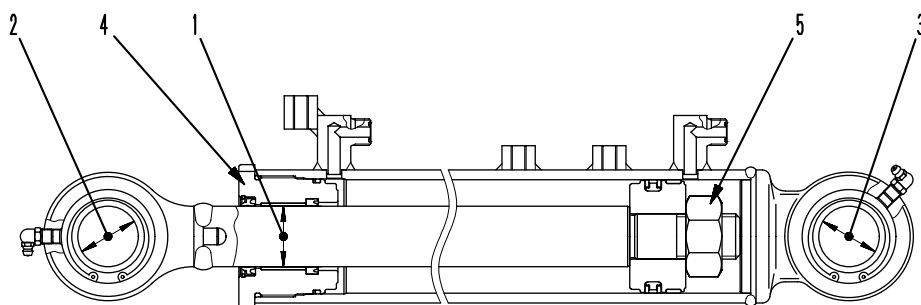
9JB00811

Tilt cylinder



9JB00812

Angle cylinder



9JB00813

Unit: mm

No.	Check item		Criteria					Remedy
1	Clearance between piston rod and bushing	Name of cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	Replace bushing
		Lift	φ 40	−0.025	+0.132	0.031 – 0.219	0.519	
				−0.087	+0.006			
				Tilt	φ 45			
−0.087	+0.007							
Angle	φ 40	−0.025	+0.132			0.031 – 0.219	0.519	
		−0.087	+0.006					
		2	Clearance between piston rod support shaft and bushing	Lift	φ 45			
Tilt	φ 45			−0.025	+0.003	0.010 – 0.067	0.5	
Angle	φ 40			−0.025	+0.003	0.010 – 0.090	0.5	
3	Clearance between cylinder bottom support shaft and bushing	Lift	φ 45	−0.025	+0.142	0.105 – 0.206	1.0	
		Tilt	φ 45	−0.025	+0.003	0.010 – 0.067	0.5	
		Angle	φ 40	−0.025	+0.003	0.010 – 0.090	0.5	
4	Tightening torque of cylinder head	Lift	637 ± 63.5 Nm {65 ± 6.5 kgm}					Tighten
		Tilt	677 ± 67.5 Nm {69 ± 6.9 kgm}					
		Angle	569 ± 57.0 Nm {58 ± 5.8 kgm}					
5	Tightening torque of cylinder piston lock nut	Lift	785 ± 78.5 kNm {80 ± 8 kgm} (Width across flats: 46 mm)					
		Tilt	1.08 ± 0.11 kNm {110 ± 11 kgm} (Width across flats: 50 mm)					
		Angle	785 ± 78.5 kNm {80 ± 8 kgm} (Width across flats: 46 mm)					

CONTROL VALVE

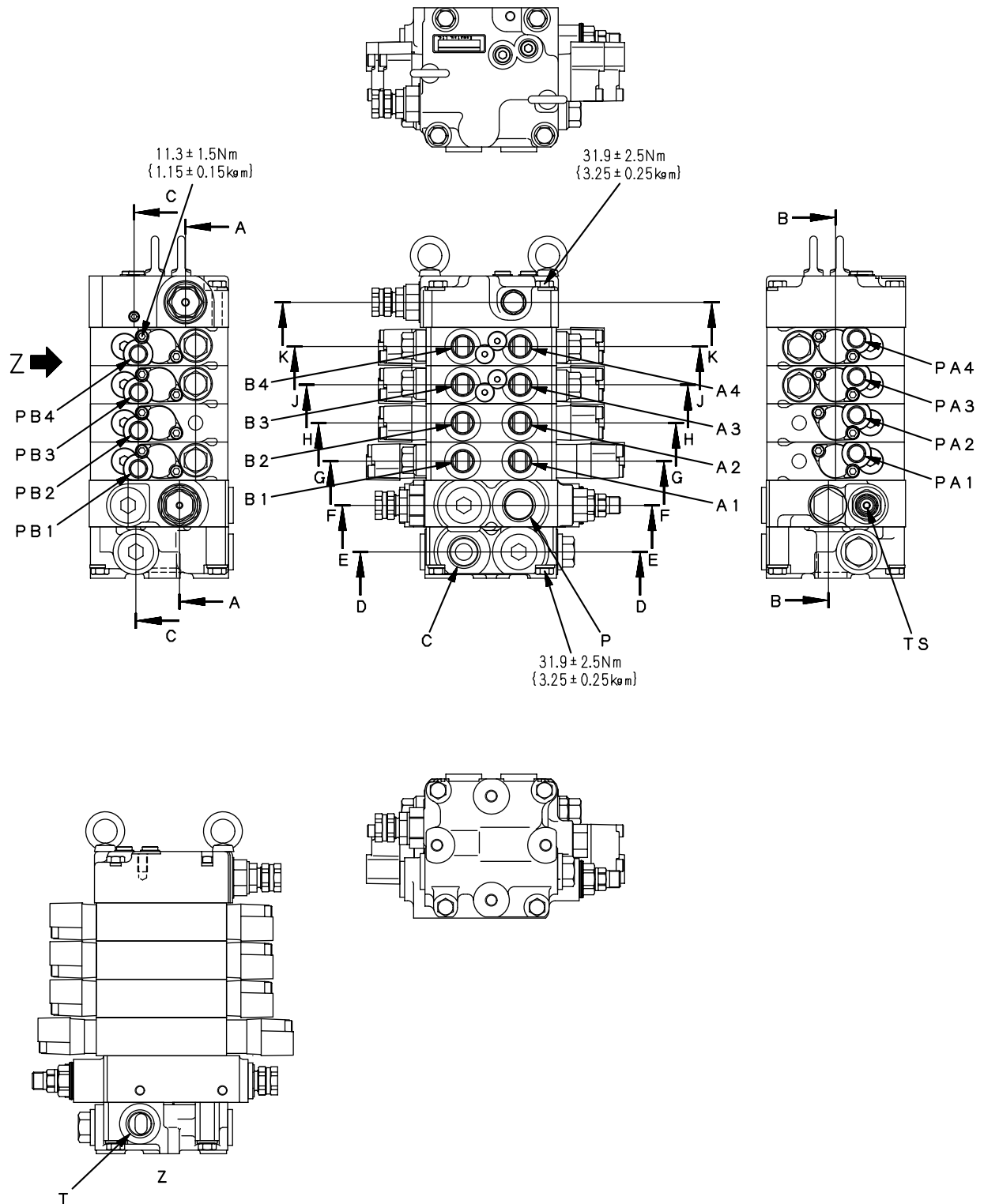
Outline

- This external view diagram shows the ripper valve.
- ★ The standard valve does not have the ripper section.

P: Pump port
T: Tank port (to tank)
C: Cooler port (oil cooler)

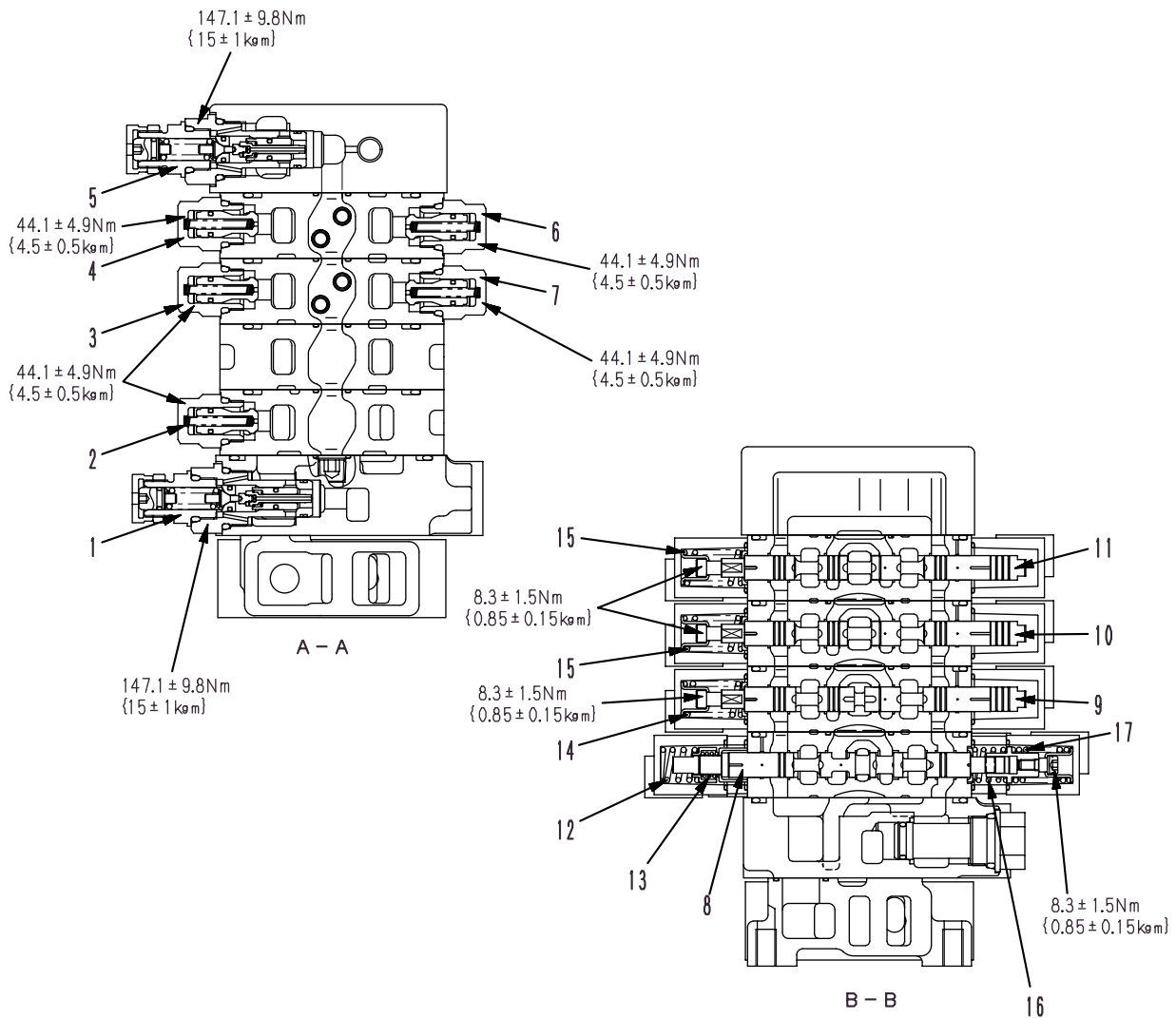
A1: To lift cylinder head
B1: To lift cylinder bottom
A2: To tilt cylinder bottom
B2: To tilt cylinder head
A3: Angle cylinder
B3: Angle cylinder
A4: To ripper cylinder bottom
B4: To ripper cylinder head

(1/5)



9JY00604

(2/5)



9JY01000

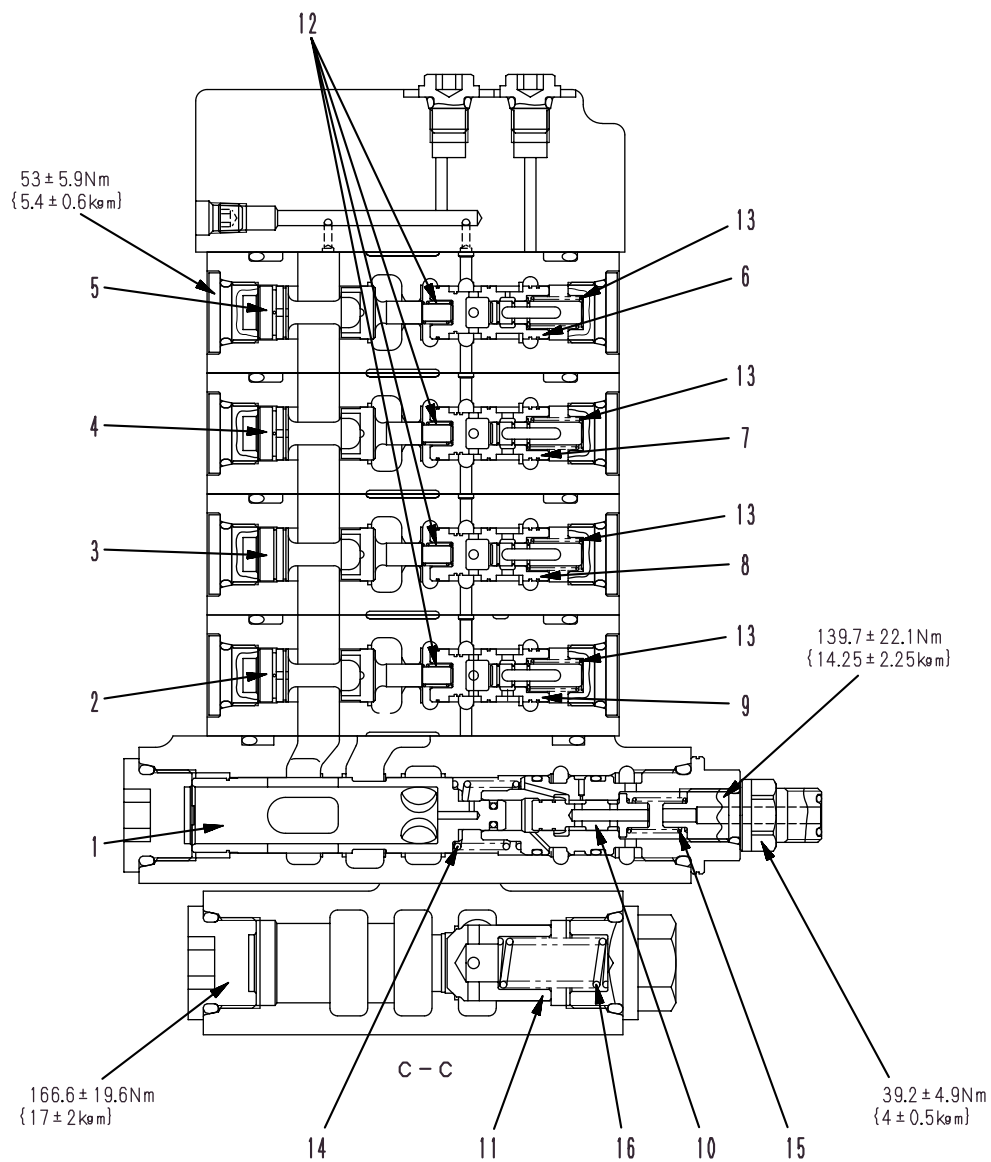
1. Main relief valve
2. Suction valve (lift bottom)
3. Suction valve (angle)
4. Suction valve (ripper head)
5. Safety valve
6. Suction valve (ripper bottom)

7. Suction valve (angle)
8. Spool (lift)
9. Spool (tilt)
10. Spool (angle)
11. Spool (ripper)

Unit: mm

No.	Check item	Criteria					Remedy
12	Spool return spring (lift RAISE)	Standard size			Repair limit		Replace spring if damaged or deformed
		Free length x OD	Installed length	Installed load (N{kg})	Free length	Installed load (N{kg})	
		19.34 x 17.2	18.57	34.0 {3.43}	—	26.9 {2.74}	
13	Spool return spring (lift RAISE)	11.28 x 12.6	8.73	34.0 {3.43}	—	26.9 {2.74}	
14	Spool return spring (tilt)	32.0 x 17.4	28.5	55.9 {5.7}	—	44.7 {4.56}	
15	Spool return spring (angle, ripper)	29.3 x 17.6	28.5	24.5 {2.5}	—	19.6 {2.0}	
16	Spool return spring (lift LOWER)	17.05 x 17.2	16.5	13.7 {1.4}	—	11.0 {1.12}	
17	Spool return spring (lift FLOAT)	40.73 x 17.4	28.5	188.8 {19.25}	—	151.0 {15.4}	

(3/5)



9JY01001

- | | |
|---|--|
| 1. Unload valve | 7. Pressure compensation valve R (angle) |
| 2. Pressure compensation valve F (lift) | 8. Pressure compensation valve R (tilt) |
| 3. Pressure compensation valve F (tilt) | 9. Pressure compensation valve R (lift) |
| 4. Pressure compensation valve F (angle) | 10. LS selector piston |
| 5. Pressure compensation valve F (ripper) | 11. Cooler bypass valve |
| 6. Pressure compensation valve R (ripper) | |

★ The F and R in the above list indicate the following valves.

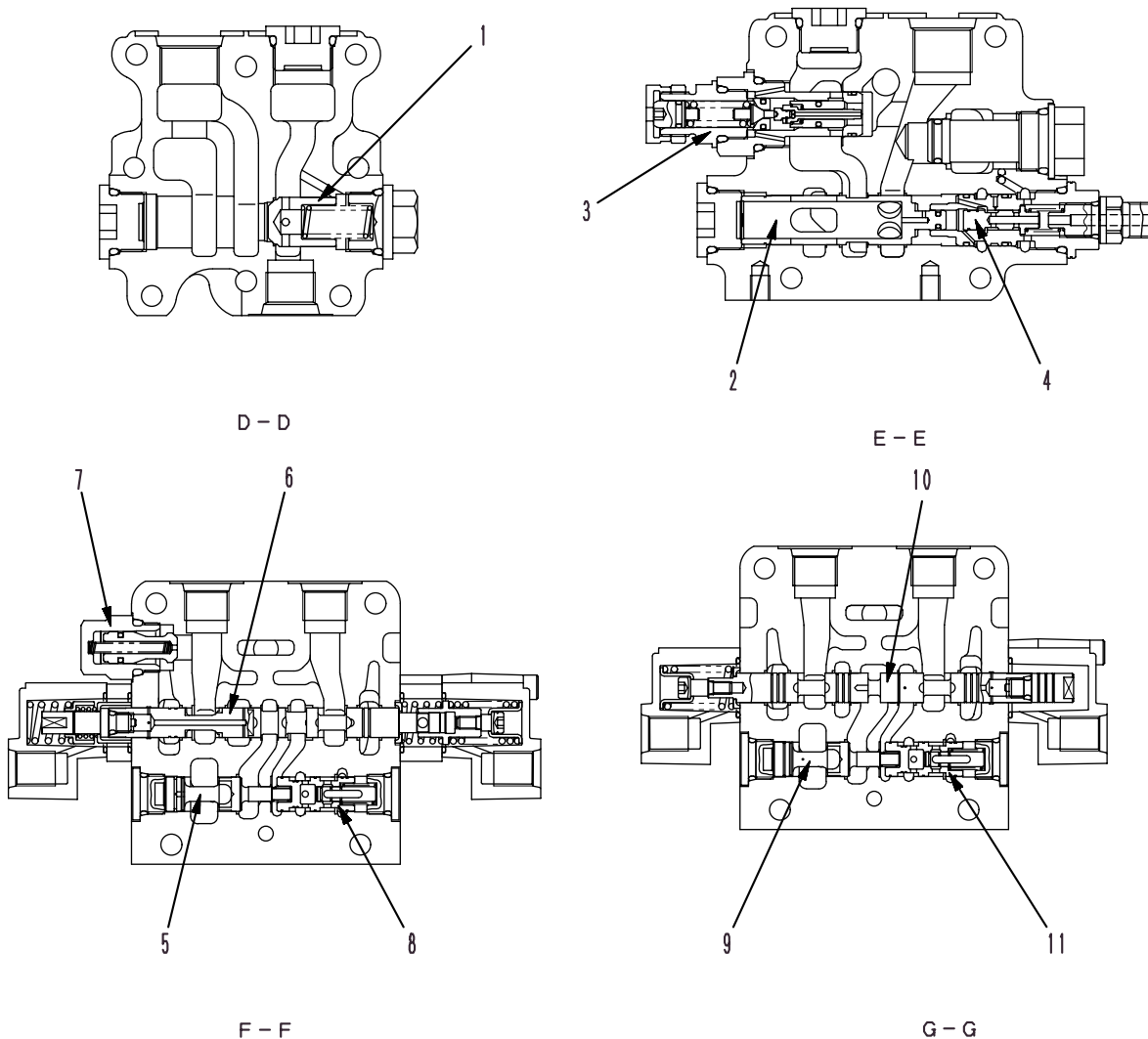
F: Flow control valve

R: Pressure reducing valve

Unit: mm

No.	Check item	Criteria					Remedy
12	Pressure compensation valve spring (flow control valve end)	Standard size			Repair limit		Replace spring if damaged or deformed
		Free length x OD	Installed length	Installed load (N{kg})	Free length	Installed load (N{kg})	
		15.4 x 6.0	8.0	7.45 {0.76}	—	5.96 {0.61}	
13	Pressure compensation valve spring (reducing pressure valve end)	23.0 x 8.4	15.0	6.86 {0.7}	—	5.49 {0.56}	
14	Unload valve spring	37.6 x 18.0	18.0	70.6 {7.2}	—	56.49 {5.76}	
15	LS selector piston spring	18.72 x 9.3	16.0	3.43 {0.35}	—	2.75 {0.28}	
16	Cooler bypass valve spring	43.8 x 13.2	29.0	98.1 {10.0}	—	78.5 {8.0}	

(4/5)



9JY00607

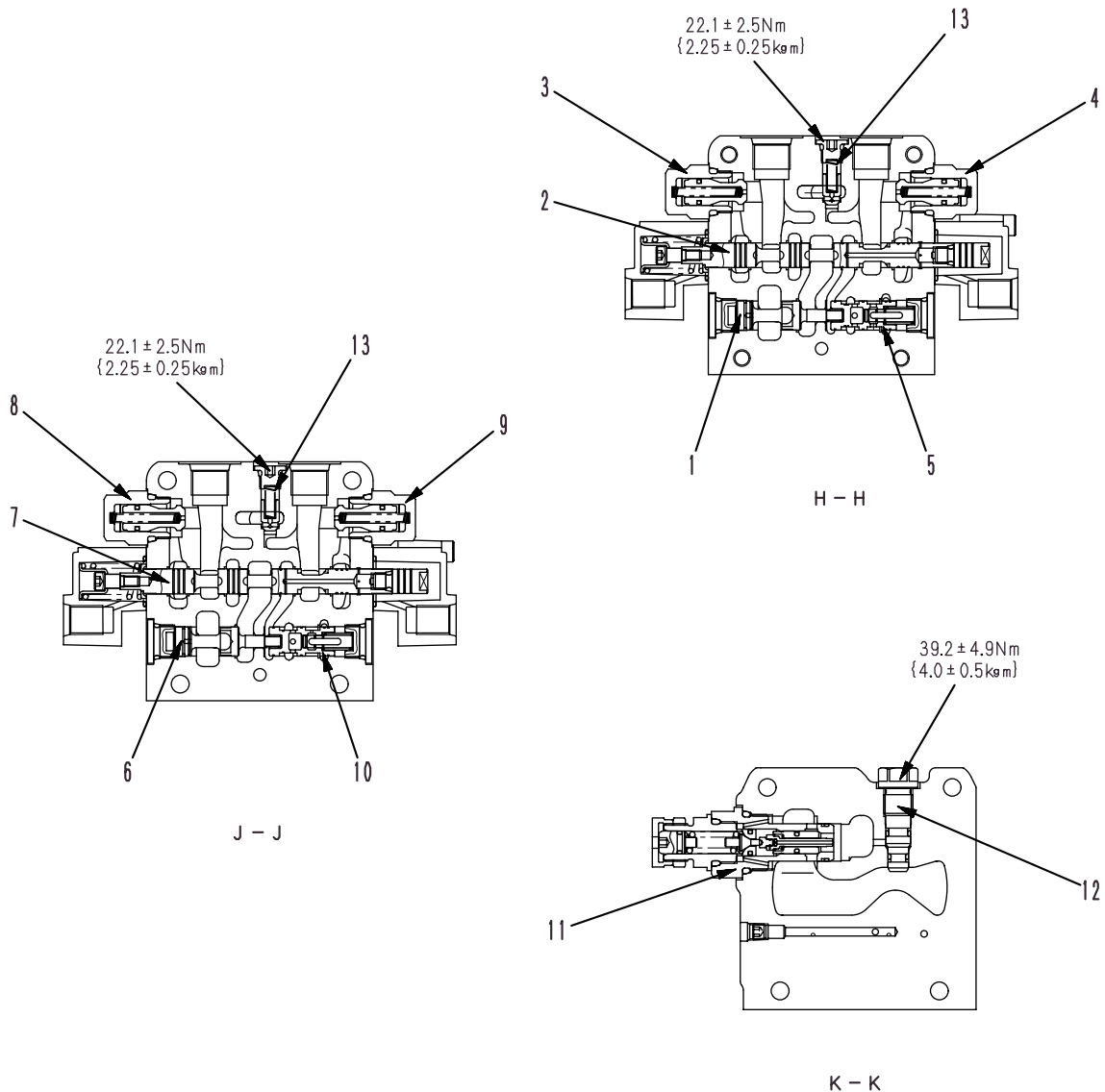
1. Cooler bypass valve
2. Unload valve
3. Main relief valve
4. LS selector piston
5. Pressure compensation valve F (lift)
6. Spool (lift)
7. Suction valve (lift)
8. Pressure compensation valve R (lift)
9. Pressure compensation valve F (tilt)
10. Spool (tilt)
11. Pressure compensation valve R (tilt)

★ The F and R in the above list indicate the following valves.

F: Flow control valve

R: Pressure reducing valve

(5/5)



9JY01002

- | | |
|---|--|
| 1. Pressure compensation valve F (angle) | 7. Spool (ripper) |
| 2. Spool (angle) | 8. Suction valve |
| 3. Suction valve | 9. Suction valve |
| 4. Suction valve | 10. Pressure compensation valve R (ripper) |
| 5. Pressure compensation valve R (angle) | 11. Safety valve |
| 6. Pressure compensation valve F (ripper) | 12. Pressure bleed plug |

★ The F and R in the above list indicate the following valves.
F: Flow control valve, R: Pressure reducing valve

Unit: mm

No.	Check item	Criteria					Remedy
13	Check valve spring (angle, ripper)	Standard size			Repair limit		Replace spring if damaged or deformed
		Free length x OD	Installed length	Installed load (N{kg})	Free length	Installed load (N{kg})	
		21.9 x 5.0	15.8	1.96 {0.2}	—	1.57 {0.16}	

CLSS

1. Outline of CLSS

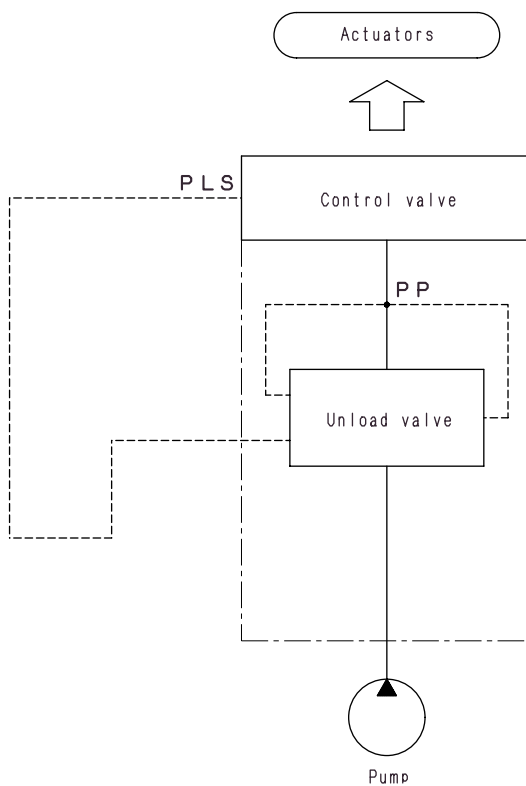
Features

CLSS stands for Closed center Load Sensing System, and has the following features.

- Fine control not influenced by load
- Control enabling digging even with fine control
- Ease of compound operation ensured by flow divider function using area of opening of spool during compound operations

Structure

- The CLSS consists of a gear pump, control valve, and the actuators.



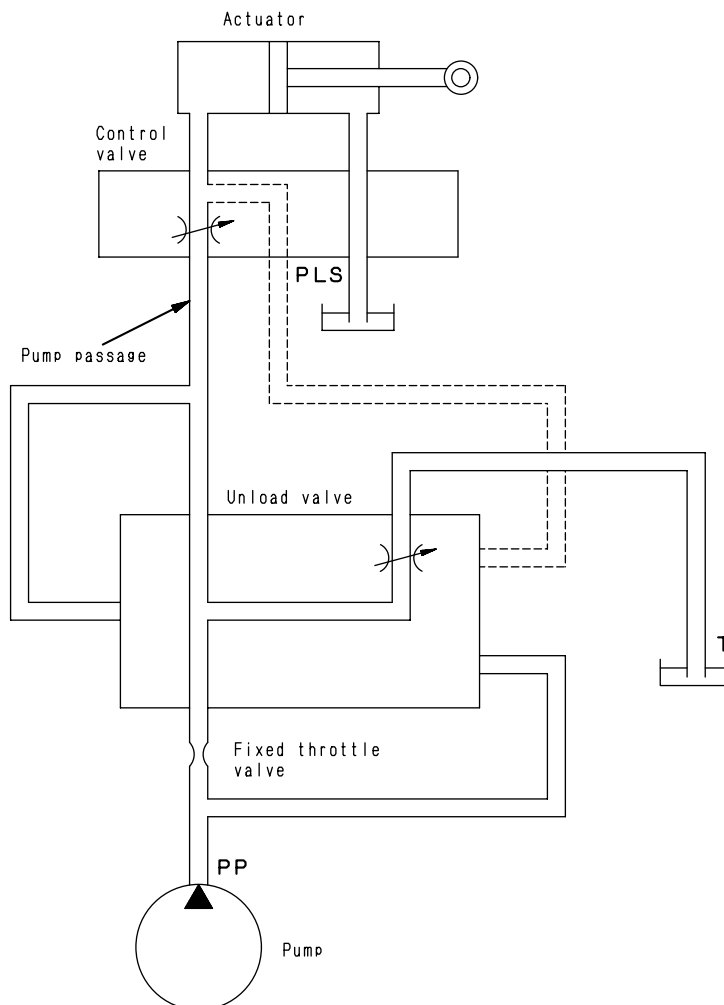
SXD04236

2. Basic principle

1) Unload valve flow control

- The unload valve controls the LS differential pressure, which is the difference between pump discharge pressure **PP** and control valve outlet port LS pressure **PLS** (actuator load pressure), so that ΔPLS becomes constant. (LS differential pressure $\Delta\text{PLS} = \text{pump discharge pressure } \text{PP} - \text{LS pressure } \text{PLS}$)
- If the LS differential pressure becomes lower than the set pressure, the unload valve reduces the flow of the drain oil to the circuit. When the pressure becomes higher than the set pressure, it increases the flow.

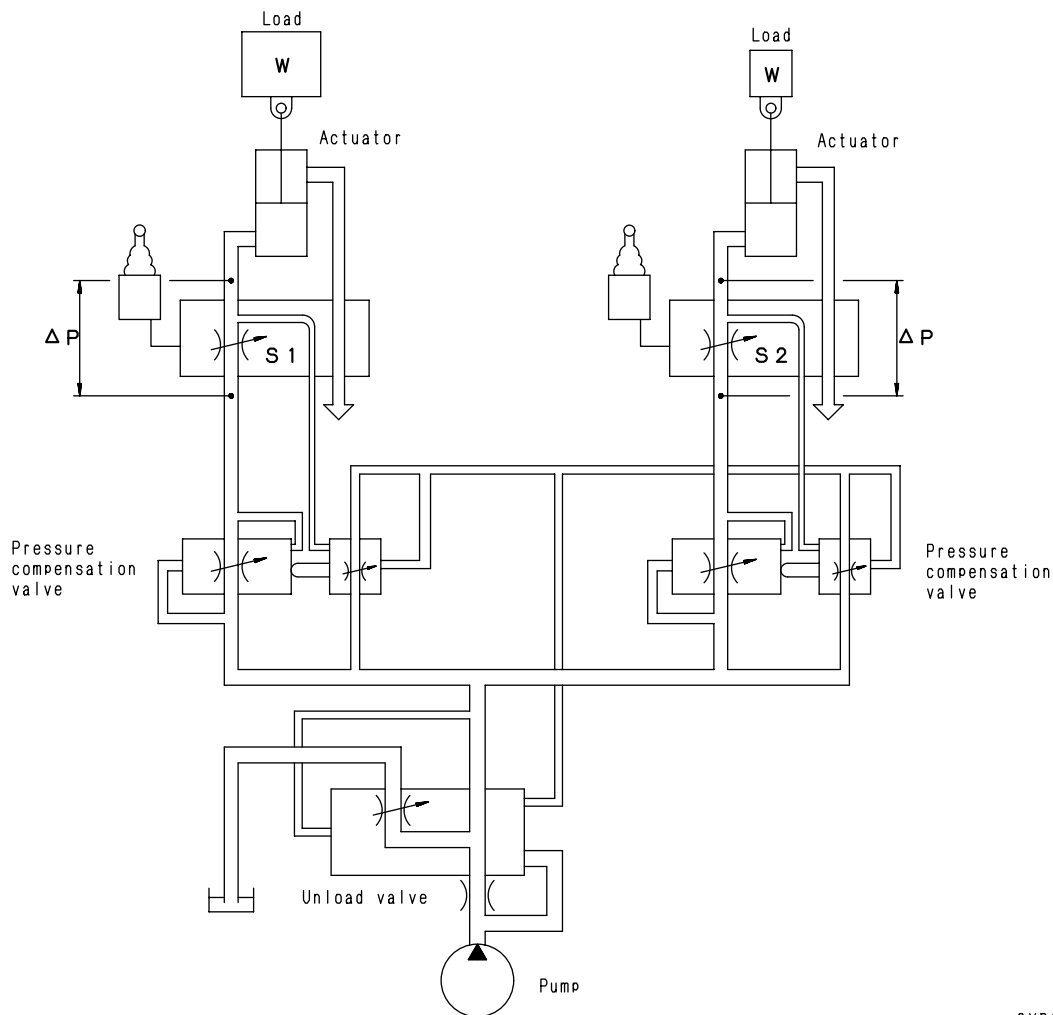
- ★ For details of the operation, see the section on the unload valve.



SXD04237

2) Pressure compensation control

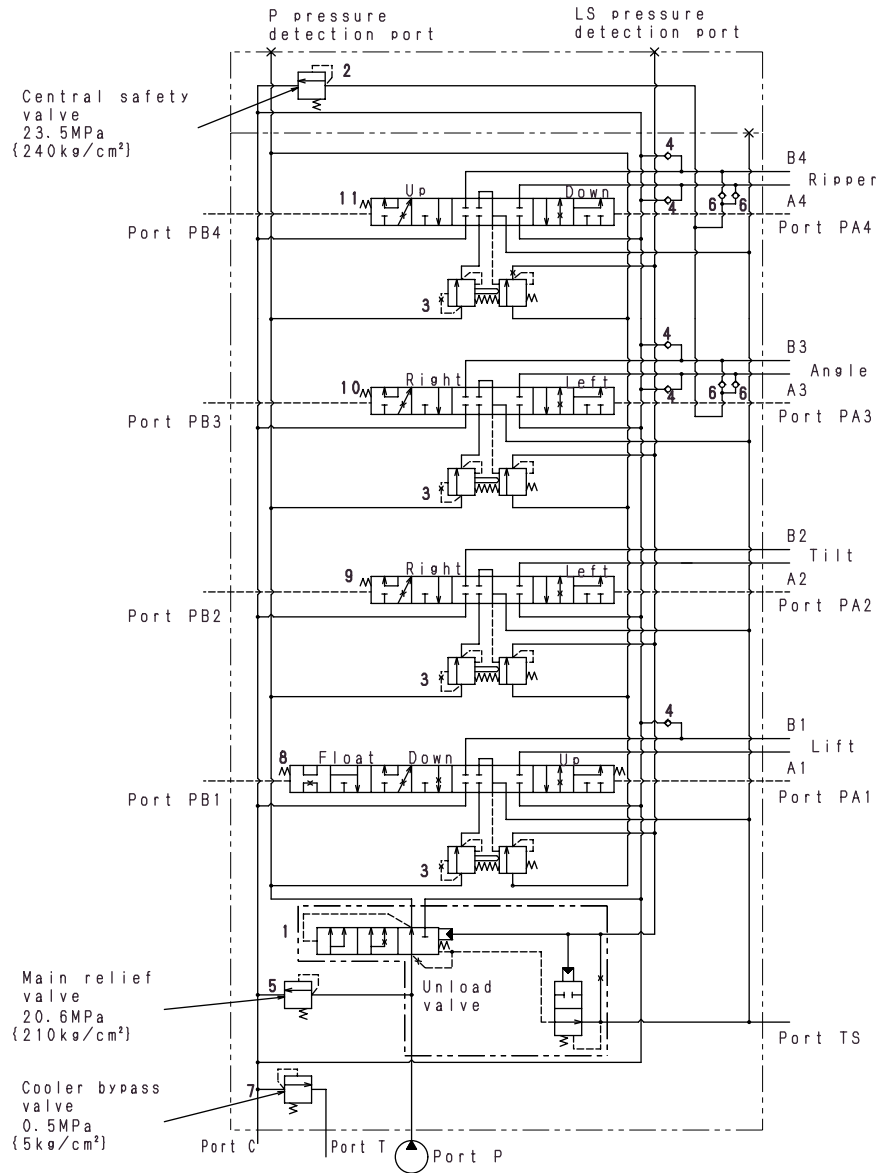
- A pressure compensation valve to balance the load is installed at the inlet port side of the control valve spool. When more than one actuator is used in compound operations, this valve makes the pressure difference ΔP the same between the upstream flow (inlet port) of each spool notch and the downstream flow (outlet port).
- In this way, the oil flow from the pump is divided in proportion to the areas of opening **S1** and **S2** of each valve that is operated.



SXD04238

3. Functions and operation of each valve

1) Names of hydraulic circuits and valves



Hydraulic circuit diagram

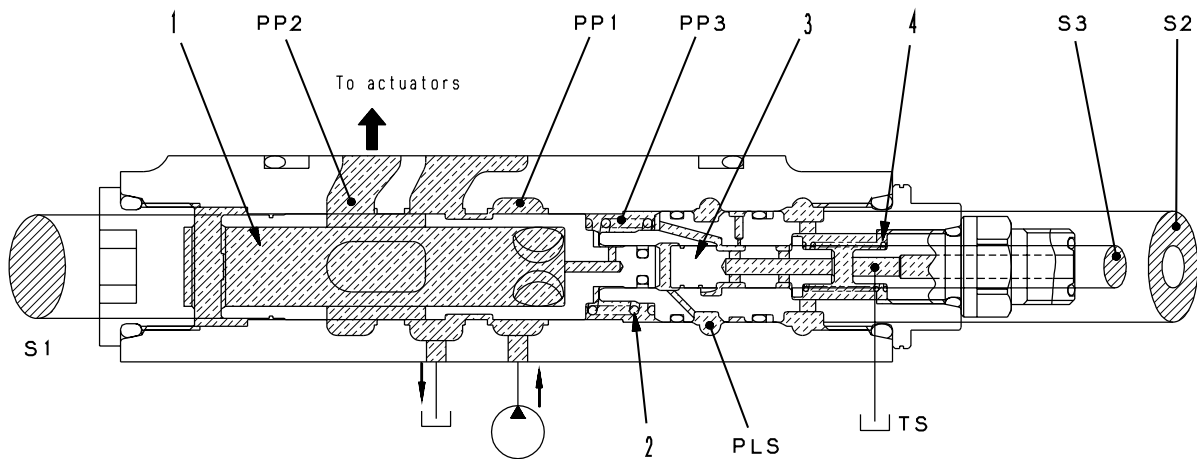
SJD04459

- | | |
|--|--|
| 1. Unload valve | 6. Check valve |
| 2. Safety valve
(set pressure: 23.5 MPa {240 kg/cm ² }) | 7. Cooler bypass valve
(cracking pressure: 0.5 MPa {5 kg/cm ² }) |
| 3. Pressure compensation valve | 8. Lift spool |
| 4. Suction valve | 9. Tilt spool |
| 5. Main relief valve
(set pressure: 20.6 MPa {210 kg/cm ² }) | 10. Angle spool |
| | 11. Ripper spool |

2) Unload valve

- In the case of a fixed pump system, the unload valve has functions including those of variable pump and LS valve.

i) When control valve is at HOLD



SXD04240

Function

- When the control valve is at HOLD, pump discharge amount **Q** is all relieved to the tank circuit. This reduces the pressure loss from the pump to the tank.

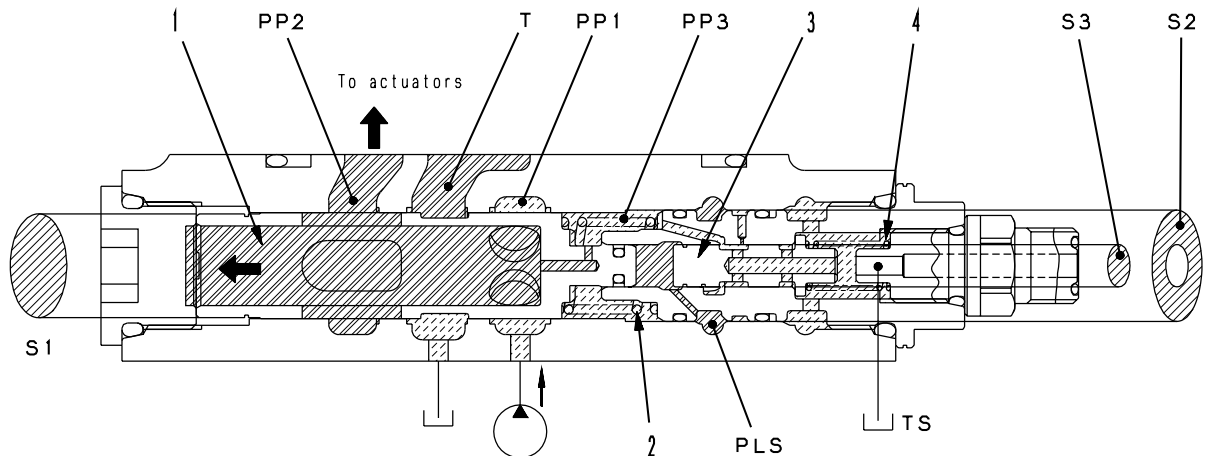
Operation

- At the left end of spool (1), pump pressure **PP2** ($\cong$ **PP1**) is acting on area **S1**, and at the right end of spool (1), pump pressure **PP3** and the force of spring (2) are acting on area **S2**. In addition, LS pressure **PLS** is acting on area **S3**.
- When the control valve is at HOLD, LS pressure **PLS** is not generated. Piston (3) is set at the left position by spring (4), pressure **PP3** is connected to **TS**, and becomes much lower than pump pressure **PP1**.
- Therefore, pump pressure **PP2** ($\cong$ **PP1**) is set only by the force of spring (2) to a maximum of 0.53 MPa {5.4 kg/cm²}.

ii) Control valve operated

Function

- When the control valve is operated, an amount of oil corresponding to the opening of the spool flows to the actuator.
- When the control valve is operated, pump discharge pressure **PP1** is set to LS pressure **PLS** + 1.5 MPa {15 kg/cm²}.

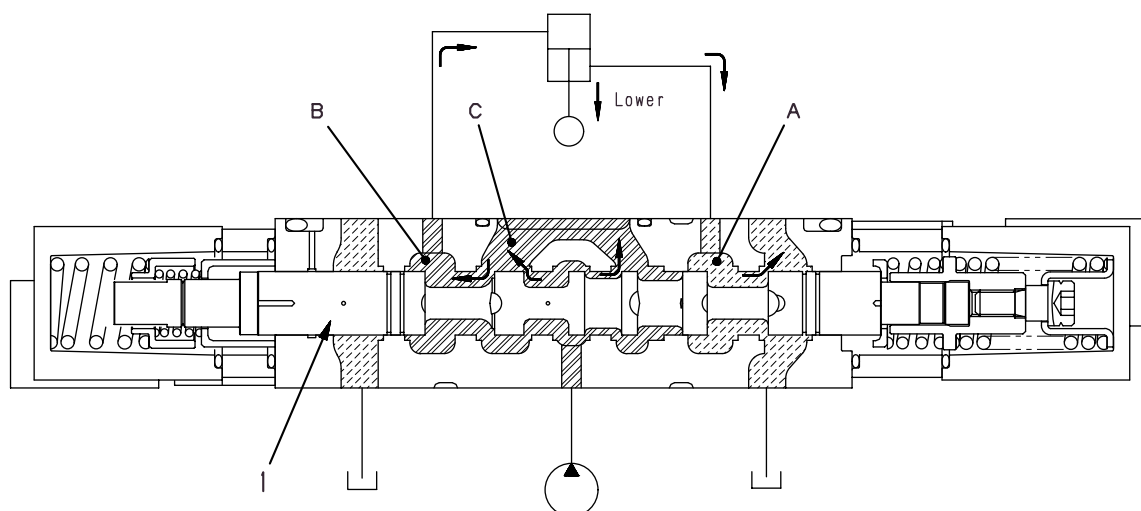


SXD04241

Operation

- The operation is the same regardless of whether the control valve is being fully operated or used for fine control.
- When more than one actuator is used at the same time, and the condition becomes pump discharge < actuator demand, spool (1) moves further to the left to the end of the stroke.
- As a result, pump circuits **PP1** and **PP2** and tank circuit **T** are shut off, and all the pump discharge amount flows to the actuators.
- When the control valve is operated fully, LS pressure **PLS** is generated and acts on area **S1** at the left end of piston (3) and area **S3** at the right end of spool (1).
- When LS pressure **PLS** reaches 0.07 MPa {0.7 kg/cm²}, piston (3) overcomes the force of spring (4) and moves fully to the right.
- As a result, the connection between the spring chamber of spring (2) and port **TS** is cut off and the condition becomes **PP1 = PP2**.
- Spool (1) moves to the left so that the difference in pressure between pump pressure **PP1** and LS pressure **PLS** becomes 1.5 MPa {15 kg/cm²}.
- In addition, when the control valve is at neutral, the oil being drained to the circuit **T** all flows to the actuators.

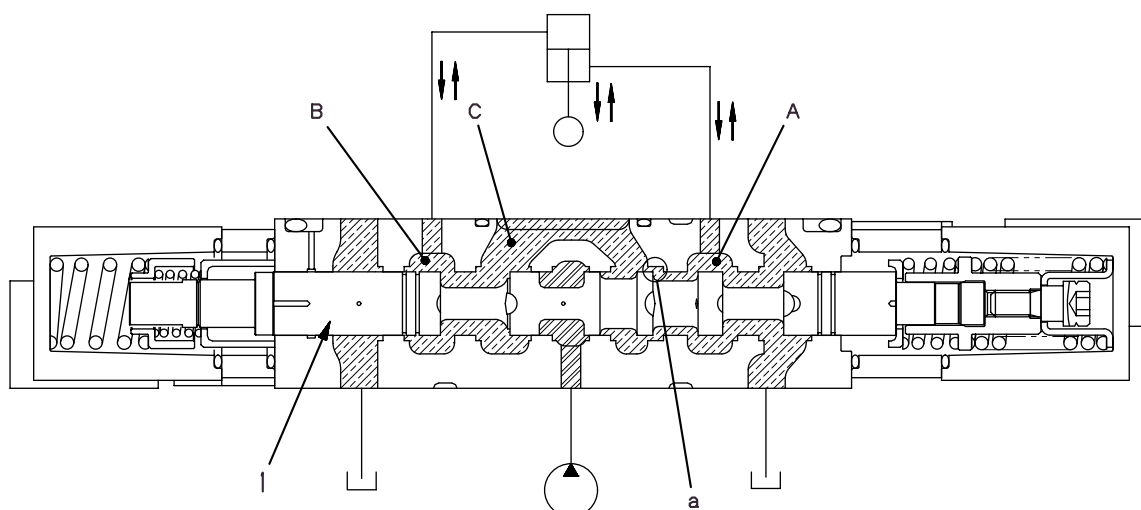
- 3) Work equipment operated
- i) When lift is operated to LOWER



SXD04242

- When the lift is operated to LOWER, spool (1) moves to the right from the HOLD position, and the oil from the pump enters bridge circuit C, passes through cylinder port B, and enters the cylinder bottom.
- When this happens, the oil at the cylinder head passes through cylinder port A and is drained.

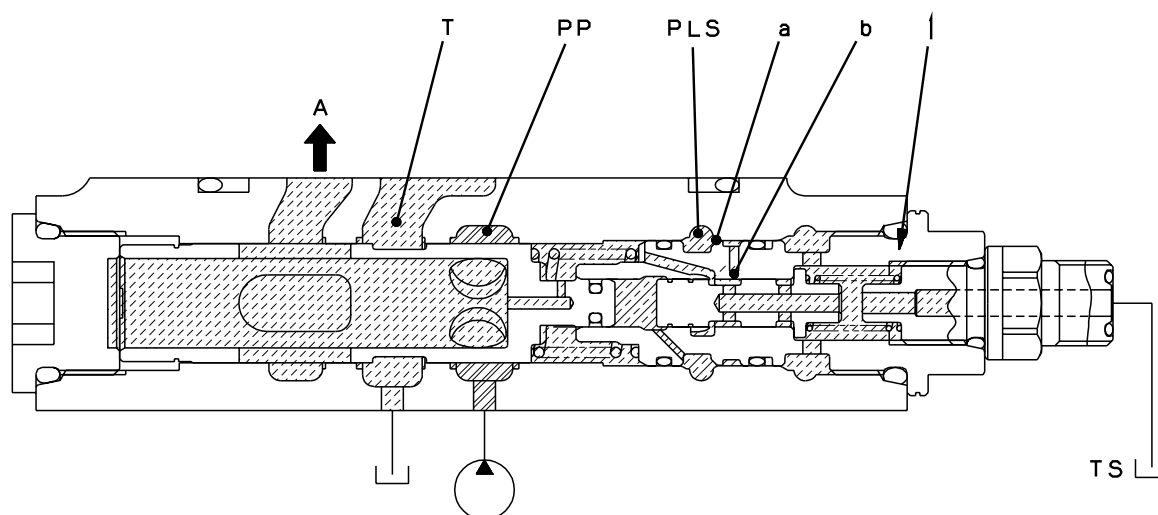
- ii) When lift is operated to FLOAT



9JY00613

- When the lift is operated to FLOAT, spool (1) moves further to the right. The oil from the pump does not enter bridge circuit C.
- The oil at cylinder port B is connected to the drain circuit through bridge circuit C, opening a, and cylinder port A.

4) LS bypass plug



9JY00614

PP: Pump circuit
 PLS: LS circuit
 TS: Seal drain circuit
 A: To each valve

Function

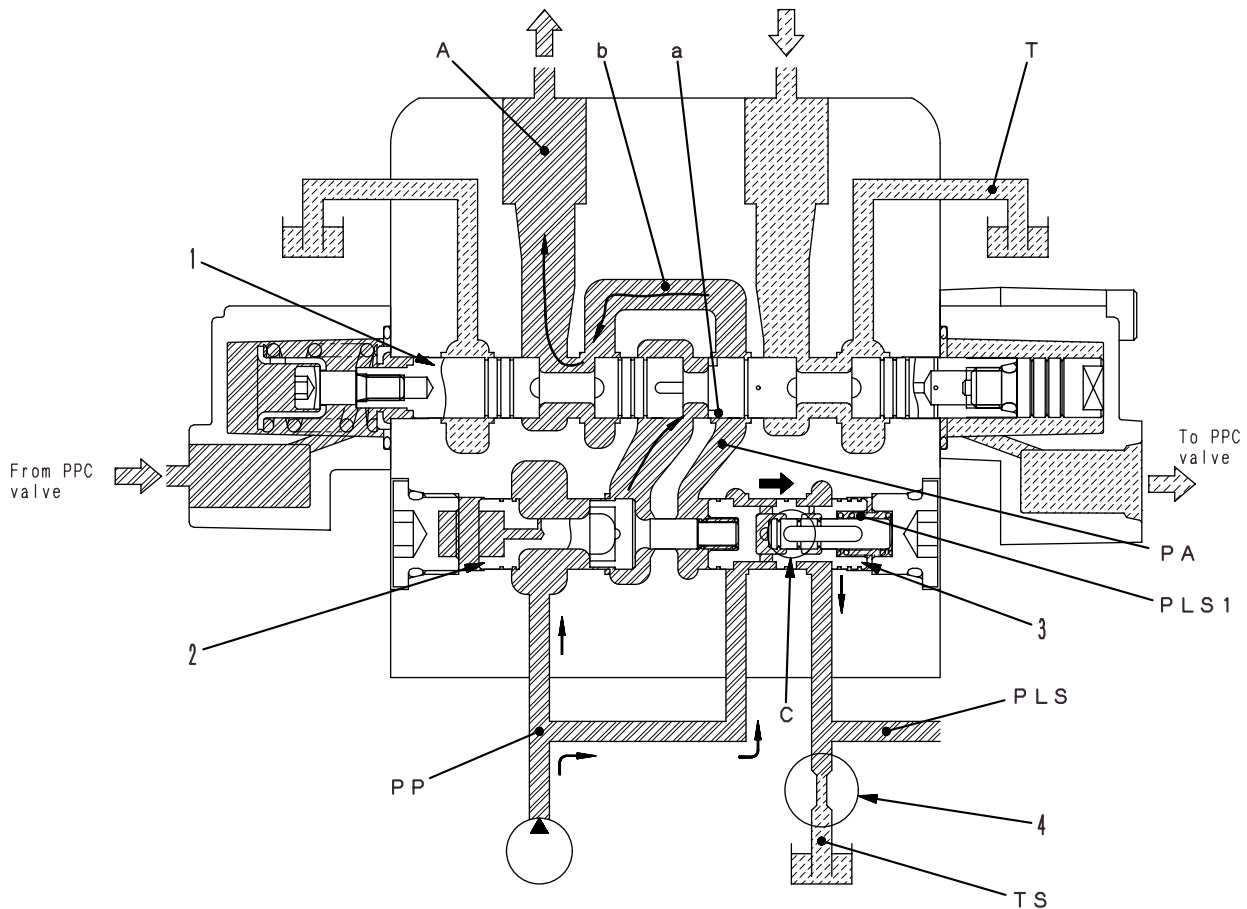
- It releases the residual pressure of LS pressure **PLS**.
- It makes the speed of the rise in pressure of LS pressure **PLS** more gentle. In addition, with this discarded throttled flow, it creates a pressure loss in the throttled flow of the spool or shuttle valve, and increases the stability by lowering the effective LS differential pressure.

Operation

- The pressurized oil for LS circuit **PLS** passes from clearance filter **a** (formed by the clearance between LS bypass plug (1) and the valve body) through orifice **b** and flows to seal drain circuit **TS**.

5) Introduction of LS pressure

For lift, tilt, angle, ripper valve



SXD04243

Function

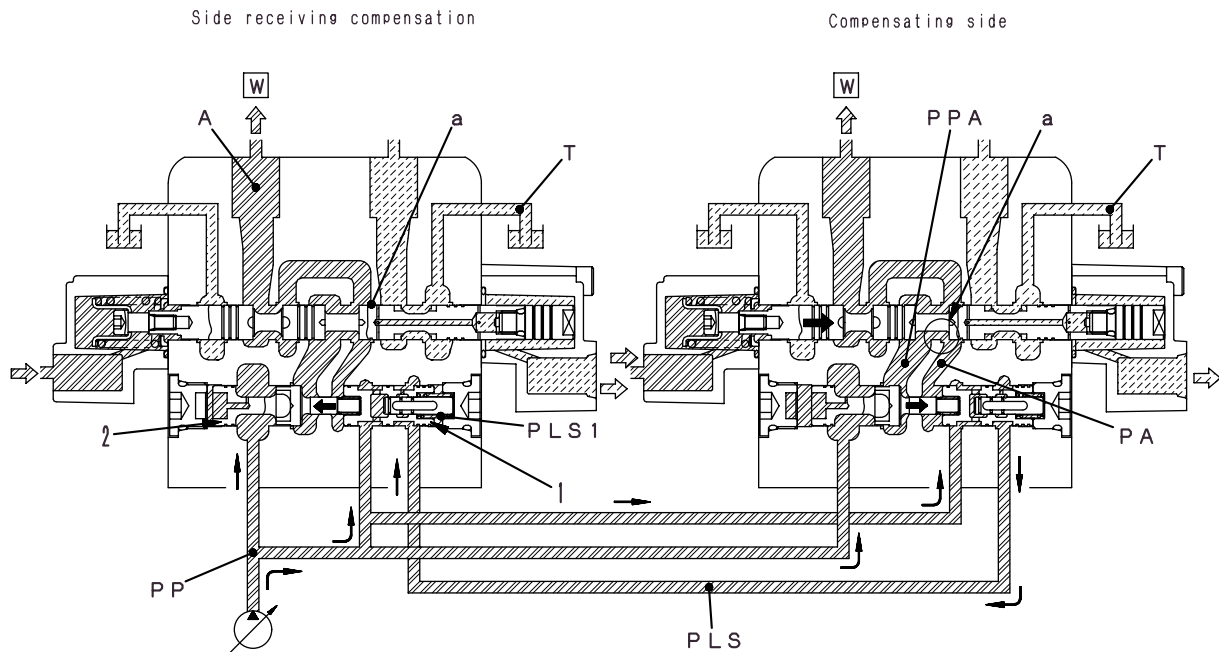
- The LS pressure is the actuator load pressure at the outlet port end of the control valve.
- It actually reduces pump pressure **PP** at pressure reducing valve (3) of the pressure compensation valve to the same pressure as actuation circuit pressure **A**, and sends it to the LS circuit **PLS**.

Operation

- When spool (1) is operated, pump discharge pressure **PP** flows from flow control valve (2) and notch **a** in spool (1) through bridge passage **b** to actuator circuit **A**.
- At the same time, pressure reducing valve (3) also moves to the right, so pump pressure **PP** has its pressure reduced by the pressure loss at notch **C**. It is introduced to LS circuit **PLS**, and then goes to spring chamber **PLS1**.
- When this happens, LS circuit **PLS** is connected to tank circuit **TS** from LS bypass plug (4). (See the section on the LS bypass plug).

- Actuator circuit pressure **PA** (=A) acts on the left end of pressure reducing valve (3); the reduced pump discharge pressure **PP** acts on the other end.
- As a result, pressure reducing valve (3) is balanced at a position where actuator circuit pressure **PA** and the pressure of spring chamber **PLS1** are the same. Pump discharge pressure **PP** is reduced at notch **C**, becomes actuator circuit pressure **A**, and is taken to LS circuit **PLS**.

6) Pressure compensation valve



SXD04244

Function

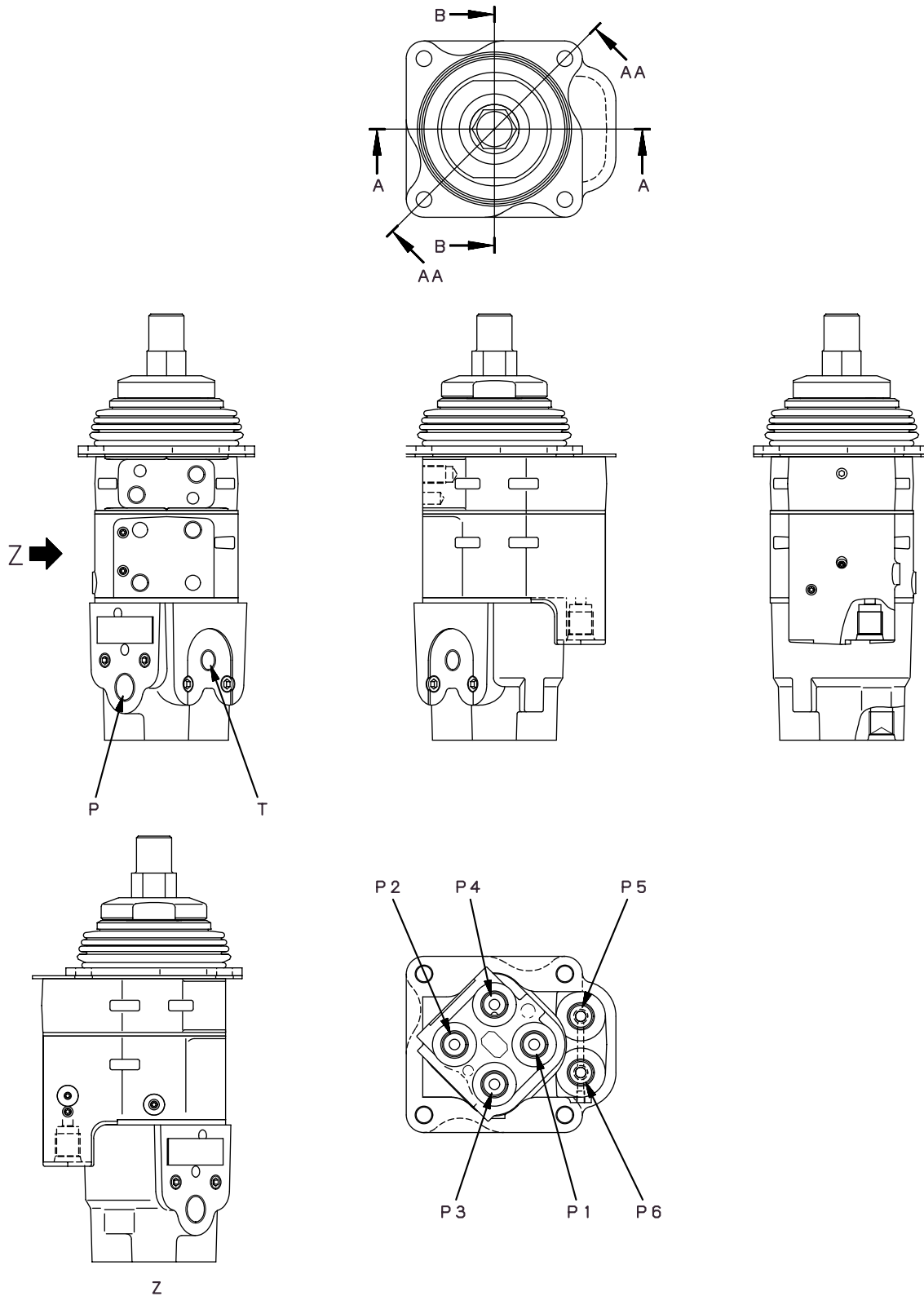
- During compound operations, if the load pressure becomes lower than the other actuator and the oil flow tries to increase, compensation is received. (When this happens, the other actuator being used for compound operation (right side) is at a higher load than the actuator on this side (left side).)

Operation

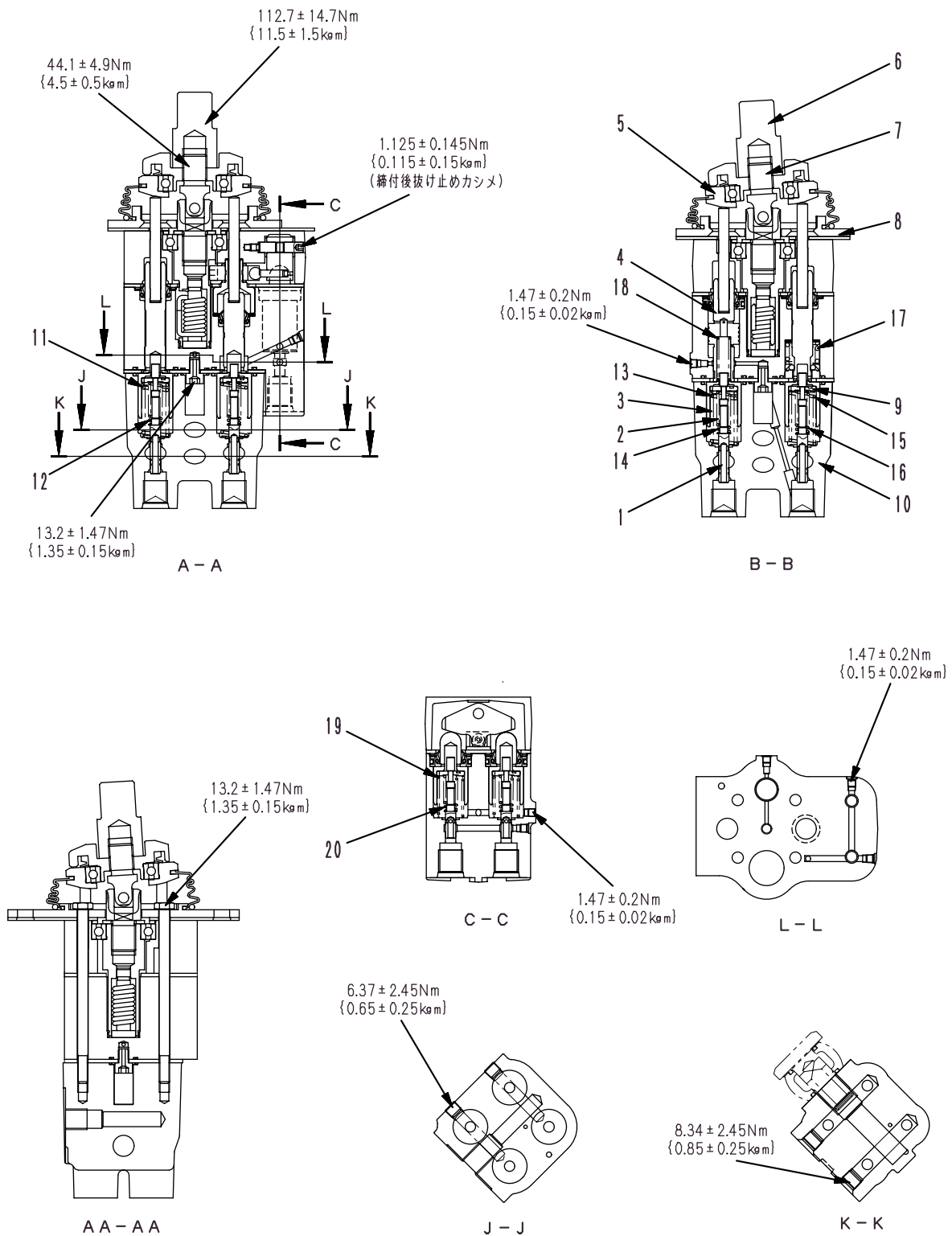
- If the load pressure of the other actuator (right side) becomes higher during compound operations, the oil flow in actuator circuit **A** on this side (left side) tries to increase.
- If this happens, the LS pressure **PLS** of the other actuator acts on spring chamber **PLS1**, and pressure reducing valve (1) and flow control valve (2) are pushed to the left.
- Flow control valve (2) throttles the area of opening between pump circuit **PP** and spool upstream **PPA**, and pressure loss is generated between **PP** and **PPA**.
- Flow control valve (2) and pressure reducing valve (1) are balanced in position where the difference in pressure between **PLS** and **PA** acting on both ends of pressure reducing valve (2) and the pressure loss between **PP** and **PPA** on both sides of flow control valve (2) are the same.
- In this way, the pressure difference between upstream pressure **PPA** and downstream pressure **PA** of both spools used during compound operations is the same, so the pump flow is divided in proportion to the area of opening of notch **a** of each spool.

WORK EQUIPMENT PPC VALVE

For blade lift, tilt, angle



9JY00617



9JY01004

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

- P: From control pump
T: To hydraulic tank
P1: To blade tilt valve (left tilt)
P2: To blade tilt valve (right tilt)
P3: To blade lift valve (RAISE)
P4: To blade lift valve (LOWER)
P5: To blade angle valve (right angle)
P6: To blade angle valve (left angle)

Unit: mm

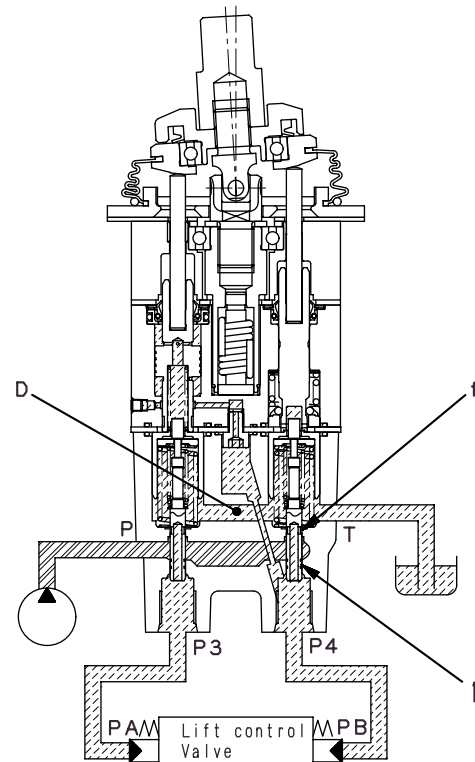
No.	Check item	Criteria					Remedy
11	Centering spring (for port P1, P2)	Standard size			Repair limit		Replace spring if damaged or deformed
		Free length x OD	Installed length	Installed load (N{kg})	Free length	Installed load (N{kg})	
		50.05 x 15.5	31.9	80.8 {8.24}	—	64.6 {6.59}	
12	Metering spring (for port P1, P2)	26.8 x 8.15	24.6	16.7 {1.7}	—	13.7 {1.4}	
13	Centering spring (for port P3)	50.35 x 15.5	31.9	62.8 {6.4}	—	50.0 {5.1}	
14	Metering spring (for port P3)	26.53 x 8.15	24.6	9.0 {0.92}	—	7.2 {0.73}	
15	Centering spring (for port P4)	52.06 x 15.5	31.6	137.4 {14.0}	—	109.9 {11.2}	
16	Metering spring (for port P4)	26.0 x 8.15	24.9	9.02 {0.92}	—	7.22 {0.74}	
17	Detent spring (for port P4)	20.39 x 19.5	13.0	159.3 {16.25}	—	127.5 {13.0}	
18	Detent spring (for port P3)	45.36 x 7.5	26.0	38.44 {3.92}	—	30.79 {3.14}	
19	Centering spring (for port P5, P6)	33.42 x 15.5	23.2	19.6 {2.0}	—	15.7 {1.6}	
20	Metering spring (for P5, P6)	21.5 x 8.15	20.7	15.7 {1.6}	—	12.6 {1.28}	

Operation

1. At Neutral

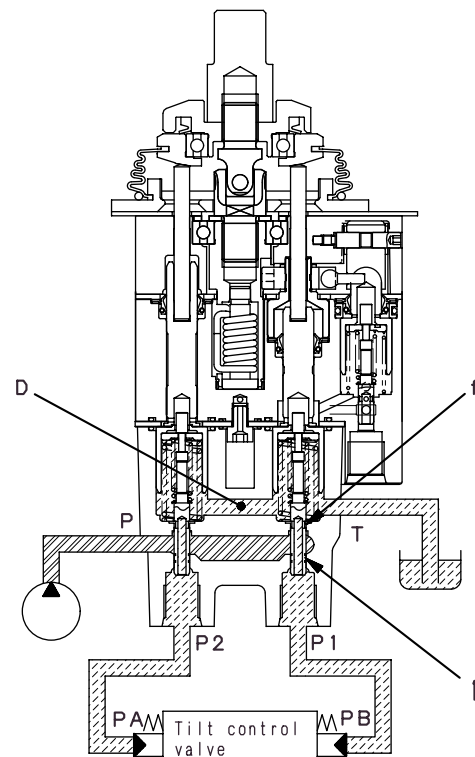
1) For blade lift

- Ports **PA** and **PB** of the blade lift control valve and ports **P3** and **P4** of the PPC valve are connected to drain chamber **D** through fine control hole **f** of spool (1).



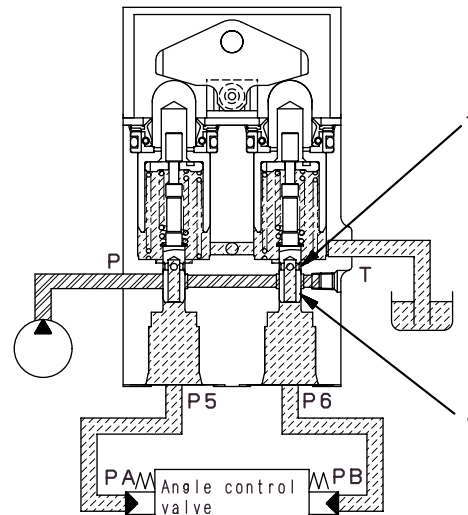
2) For blade tilt

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



3) For blade angle

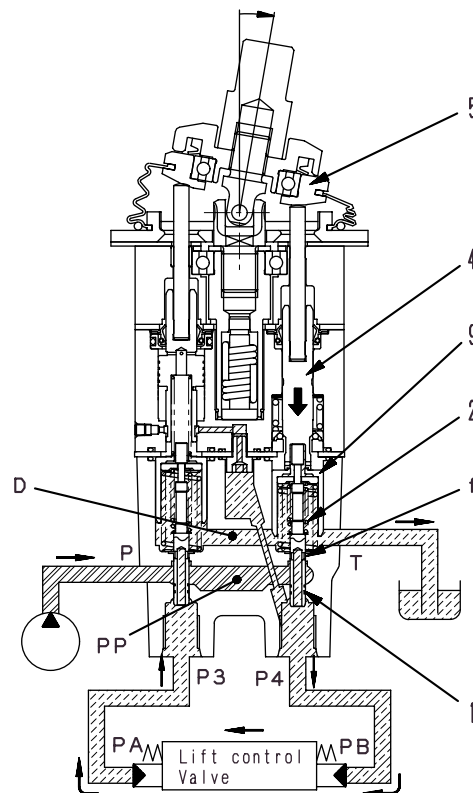
- Ports **PA** and **PB** of the blade angle control valve and ports **P5** and **P6** of the PPC valve are connected to drain chamber **D** through fine control hole **f** of spool (1).



9JY00621

2. During fine control (Neutral → fine control)

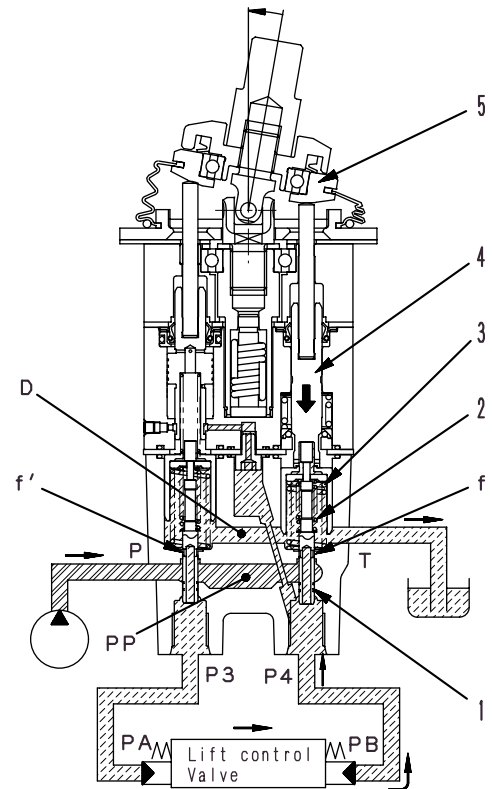
- When piston (4) is pushed by disc (5), retainer (9) is pushed, and spool (1) is also pushed through metering spring (2), and moves down.
- As a result, if fine control hole **f** is shut off from drain chamber **D**, at almost the same time, it is connected with pump pressure chamber **PP**, and the pilot pressure oil from the control pump passes through fine control hole **f** and flows from port **P4** to port **PB**.
- When the pressure at port **P4** 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 releases the pressure at port **P4**.
- As a result, spool (1) moves up and down so that the force of metering spring (2) is balanced with the pressure at port **P4**. 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 **P4** also rises in proportion to the movement of the control lever.
- The control valve spool moves to a position where the pressure in chamber **PB** (same as pressure at port **P4**) is balanced with the force of the return spring.



9JY00622

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

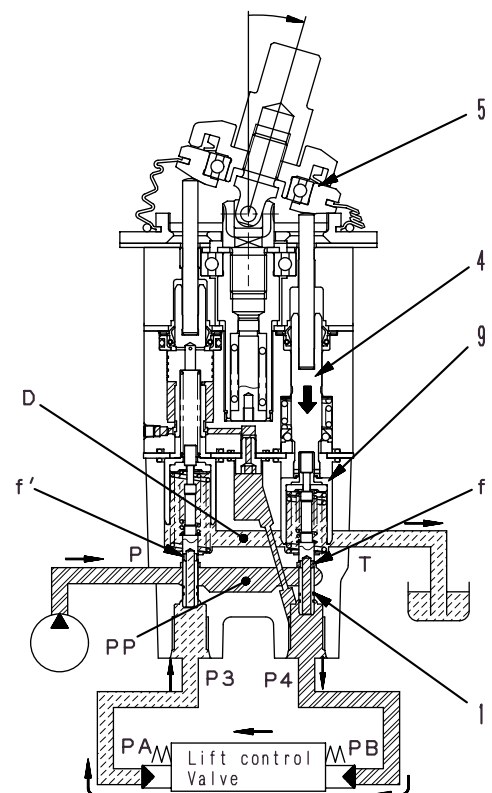
- When disc (5) starts to be returned, spool (1) is pushed up by the pressure at port **P4** and the force of centering spring (3).
- As a result, fine control hole **f** is connected to drain chamber **D**, so the pressure oil at port **P4** is relieved.
- If the pressure at port **P4** goes down too far, spool (1) is pushed down by metering spring (2). Fine control hole **f** is shut off from drain chamber **D**, and at almost the same time, it is connected to pump pressure chamber **PP**. Pump pressure is supplied until the pressure at port **P4** 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 **P3**, is taken to chamber **PA**, and the oil fills the chamber.



9JY00623

4. When lever is operated fully

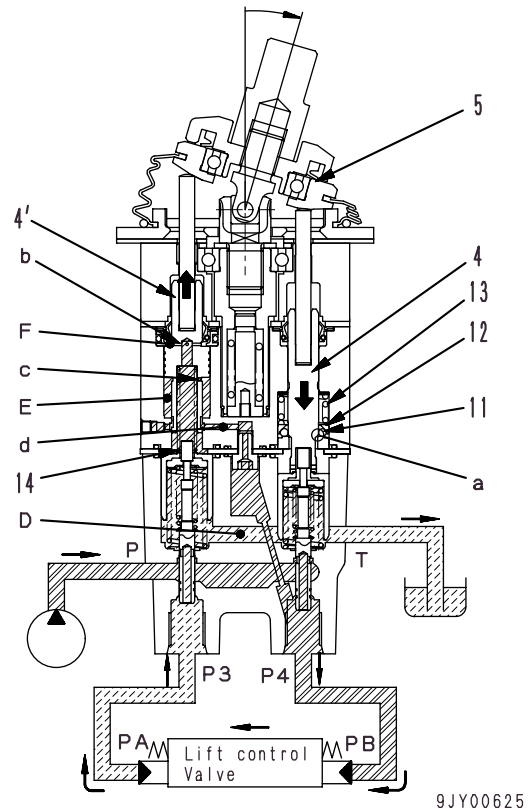
- When disc (5) pushes down piston (4) and retainer (9) pushes down spool (1), fine control hole **f** is shut off from drain chamber **D** and is connected to pump pressure chamber **PP**.
- Therefore, the pilot pressure oil from the control pump passes through fine control hole **f**, is taken from port **P4** to chamber **PB**, and pushes the control valve spool.
- The return oil from chamber **PA** passes from port **P3** through fine control hole **f'**, and then flows to drain chamber **D**.



9JY00624

5. When blade is operated to FLOAT

- When piston (4) at the port **P4** 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 **P4**, so more or less the same pressure is applied as is applied to port **P4**.
- 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.



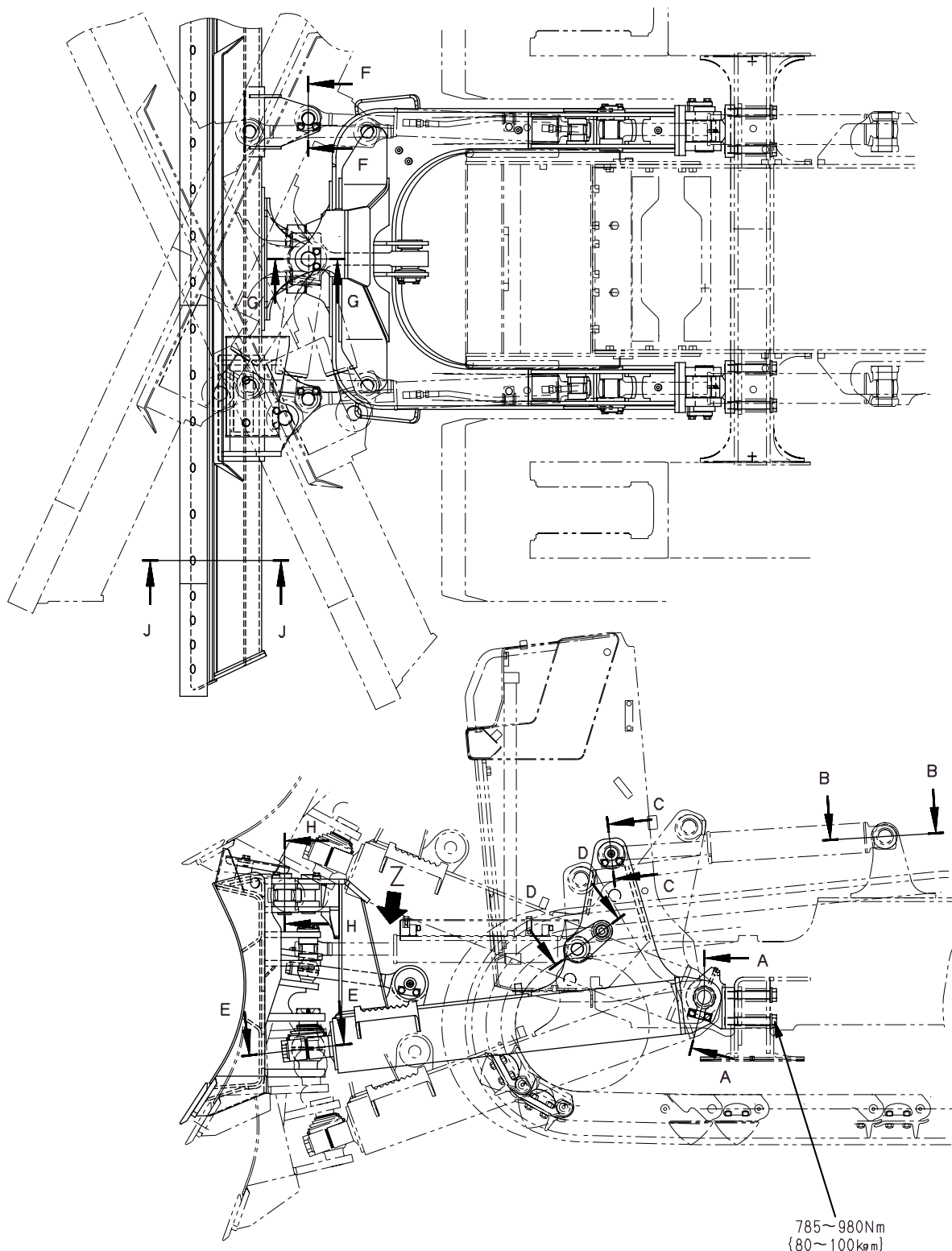
6. When blade is released from FLOAT

- 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 FLOAT position is canceled.

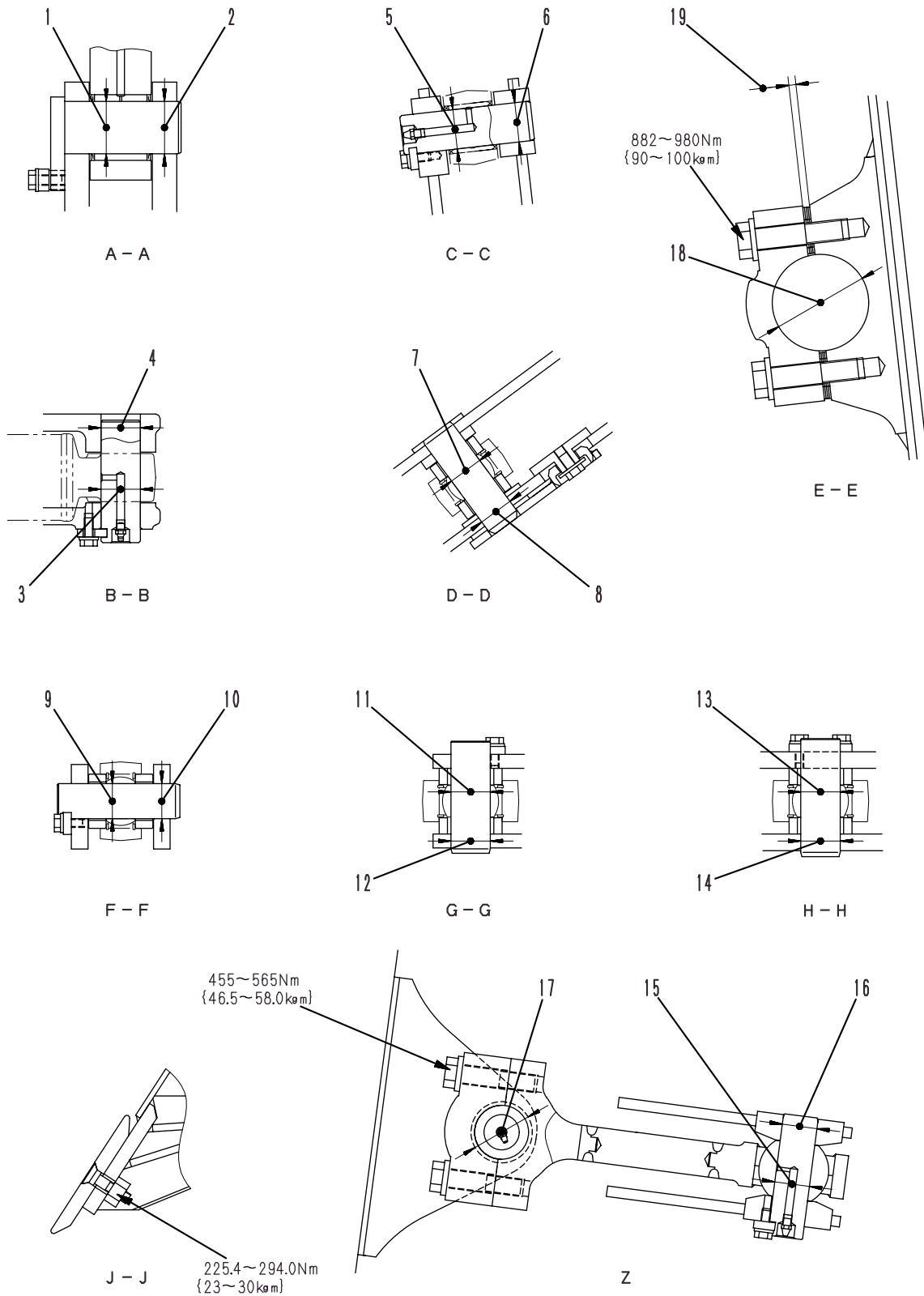
WORK EQUIPMENT

WORK EQUIPMENT

★ The drawing shows the D31PX-21.



9JB00814



9JB00815

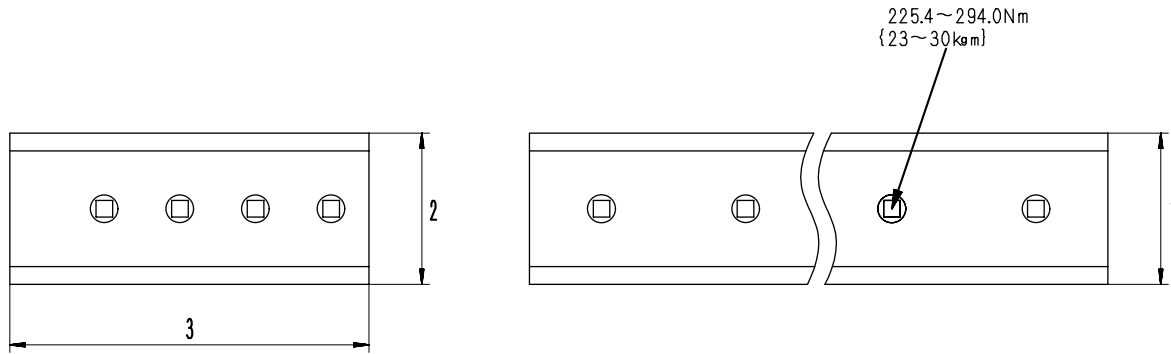
STRUCTURE AND FUNCTION, MAINTENANCE STANDARD

WORK EQUIPMENT

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between frame connecting pin and bushing	φ 60	-0.030 -0.076	+0.174 +0.100	0.130 – 0.250	1.2	Replace
2	Clearance between frame connecting pin and frame bracket			+0.300 +0.100	0.130 – 0.376	1.0	
3	Clearance between lift cylinder bottom pin and bushing	φ 45	-0.025 -0.064	+0.142 +0.080	0.105 – 0.206	1.0	
4	Clearance between lift cylinder bottom pin and frame bracket			+0.039 0	0.025 – 0.103	1.0	
5	Clearance between lift cylinder head pin and bushing	φ 45	-0.025 -0.064	+0.142 +0.080	0.105 – 0.206	1.0	
6	Clearance between lift cylinder head pin and frame bracket			+0.400 +0.100	0.125 – 0.464	1.0	
7	Clearance between angle cylinder bottom pin and bushing	φ 40	-0.025 -0.087	+0.003 -0.015	0.010 – 0.067	0.5	
8	Clearance between angle cylinder bottom pin and frame bracket			+0.400 +0.100	0.125 – 0.487	1.0	
9	Clearance between angle cylinder head pin and bushing	φ 40	-0.025 -0.087	+0.003 +0.015	0.010 – 0.090	0.5	
10	Clearance between angle cylinder head pin and blade bracket			+0.400 +0.100	0.125 – 0.487	1.0	
11	Clearance between tilt cylinder bottom pin and bushing	φ 45	-0.025 -0.064	+0.003 -0.015	0.010 – 0.067	0.5	
12	Clearance between tilt cylinder bottom pin and frame bracket			+0.400 +0.100	0.125 – 0.464	1.0	
13	Clearance between tilt cylinder head pin and bushing	φ 45	-0.025 -0.064	+0.003 -0.015	0.010 – 0.067	0.5	
14	Clearance between tilt cylinder head pin and blade bracket			+0.400 +0.100	0.125 – 0.464	1.0	
15	Clearance between pitching rod pin and bushing	φ 40	-0.025 -0.064	+0.039 0	0.025 – 0.103	0.5	
16	Clearance between pitching rod pin and frame bracket			+0.300 +0.100	0.125 – 0.364	1.0	
17	Clearance between blade spherical portion and pitching rod cap	S φ 70	-0.250 -0.750	+1.500 0	0.250 – 2.250	—	Adjust shim
18	Clearance between blade center spherical portion and frame cap	S φ 110	—	—	0.5	—	
19	Standard shim thickness at blade center spherical portion and frame cap	8.0					

CUTTING EDGE, END BIT



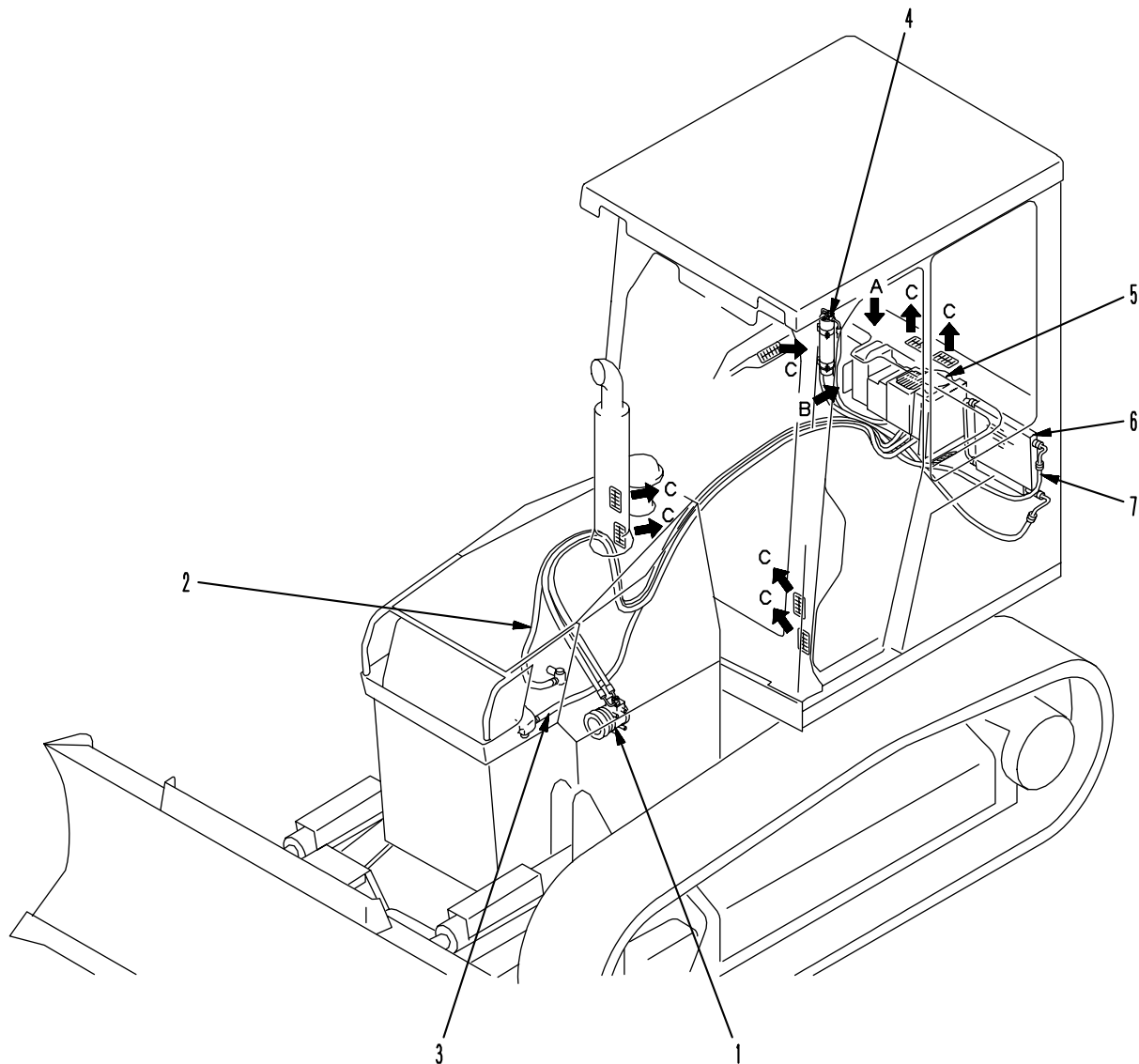
9JB00329

Unit: mm

No.	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Height of cutting edge		160	110	Replace
2	Height of end bit		160	110	
3	Width of end pit	D31EX	380	—	
		D31PX	380	—	
		D37EX	370	—	
		D37PX	405	—	

CAB RELATED

AIR CONDITIONER PIPING



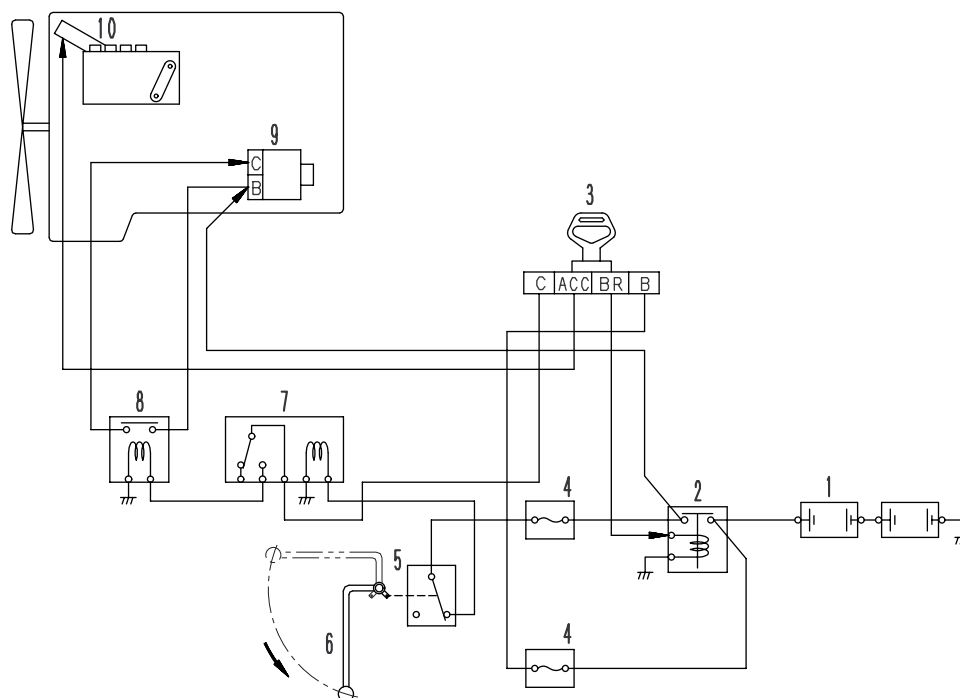
9JB00346

1. Compressor
2. Hot water pick-up piping
3. Hot water return piping
4. Receiver tank
5. Air conditioner unit
6. Condenser
7. Refrigerant piping

- A: Fresh air intake port
B: Recirculated air circulation port
C: Hot air/cold air vent

SAFETY MECHANISM WHEN STARTING ENGINE

For parking brake lever



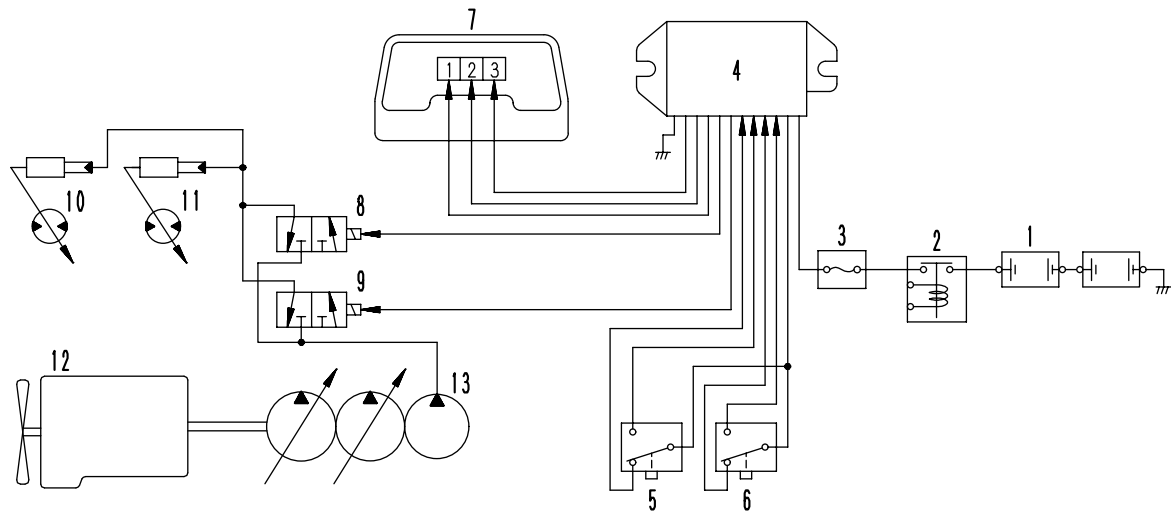
9JB00333

1. Battery
2. Battery relay
3. Starting switch
4. Fuse box
5. Neutral safety, parking brake limit switch
6. Parking brake lever
7. Neutral safety, parking brake relay
8. Safety relay
9. Starting motor
10. Engine stop solenoid

Function

- Neutral safety, parking brake limit switch (5) is linked to parking brake lever (6), so if parking brake lever (6) is not set to the LOCK position, the starting circuit is not switched ON and the engine cannot be started.
- When parking brake lever (6) is set to the LOCK position, the steering, direction, and speed lever is automatically returned to the Neutral position.

GEARSHIFT CONTROL SYSTEM



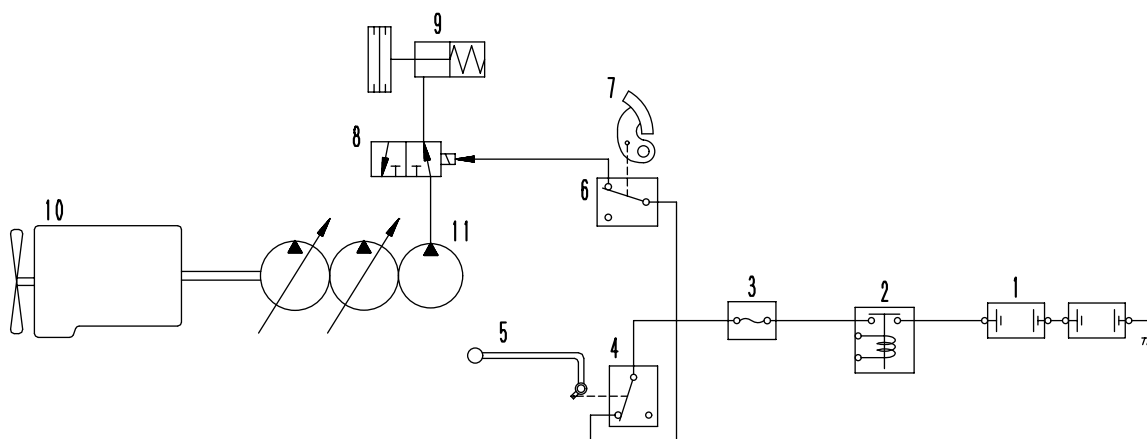
9JB00334

1. Battery
2. Battery relay
3. Fuse box
4. Shift controller
5. Shift UP switch
6. Shift DOWN switch
7. Monitor panel
8. 2nd speed selector solenoid valve
9. 3rd speed selector solenoid valve
10. L.H. HST motor
11. R.H. HST motor
12. Engine
13. Charge pump

Function

- Each time shift UP switch (5) on the steering, direction, and speed lever is pressed, the transmission shifts up 1st → 2nd → 3rd; each time shift DOWN switch (6) is pressed, the transmission shifts down 3rd → 2nd → 1st. The speed range display lamp on monitor panel (7) lights up according to the transmission speed. (When the starting switch is turned ON, it automatically displays 1st.)
- If any abnormality occurs in the shift signal (short circuit in wiring, etc.), the existing speed range is held. If there is an abnormal drop in the voltage of the power supply (less than 16 – 18 V), the speed range is held in 1st.

PARKING BRAKE CONTROL SYSTEM



9JB00335

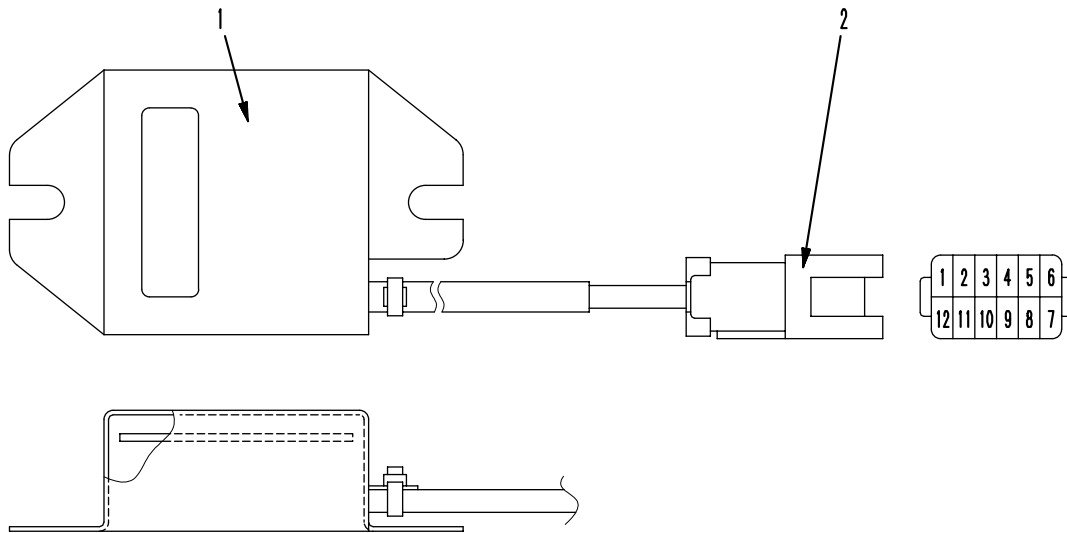
1. Battery
2. Battery relay
3. Fuse box
4. Neutral safety, parking brake limit switch
5. Parking brake lever
6. Center brake limit switch
7. Brake pedal
8. Parking brake solenoid valve
9. Parking brake
10. Engine
11. Charge pump

Function

- Neutral safety, parking brake limit switch (4) is interconnected with parking brake lever (5). If parking brake lever (5) is not set to the FREE position, parking brake (9) is not released, and the machine cannot travel.
- Center brake limit switch (6) is interconnected with brake pedal (7). If brake pedal (7) is depressed fully, parking brake (9) is applied.

COMPONENT EQUIPMENT OF SYSTEM

SHIFT CONTROLLER



9JB00336

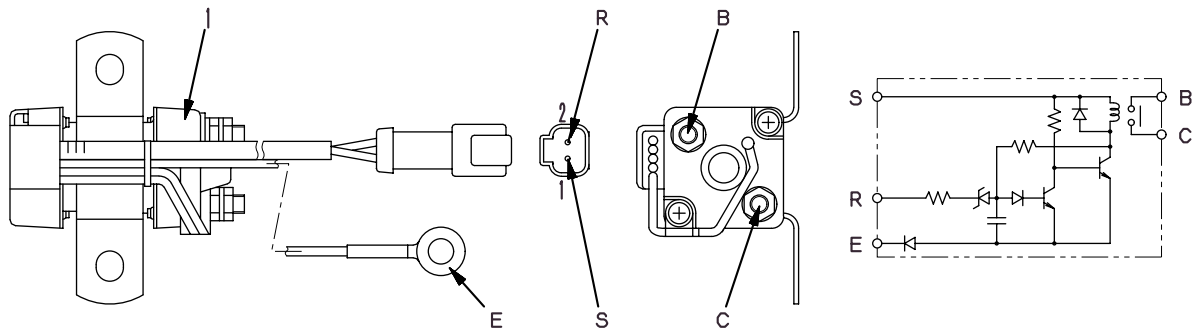
1. Controller
2. Connector

Input/output signals

AMP040-16P [CN-41]

Pin No.	Signal Name	Input/output signal
1	Power source (24 V)	—
2	GND	—
3	Shift UP switch N. O.	Input
4	Shift UP switch N. C.	Input
5	Shift DOWN switch N. O.	Input
6	Shift DOWN switch N. C.	Input
7	Shift switch power source (12 V)	—
8	Speed range display lamp (1st)	Output
9	Speed range display lamp (2nd)	Output
10	Speed range display lamp (3rd)	Output
11	2nd speed selector solenoid valve	Output
12	2nd speed selector solenoid valve	Output

SAFETY RELAY



9JB00337

1. Relay body

S: To starting switch terminal C

R: To alternator terminal R

B: To starting motor terminal B

C: To starting motor terminal C

E: Ground

2ND SELECTOR SOLENOID VALVE

3RD SELECTOR SOLENOID VALVE

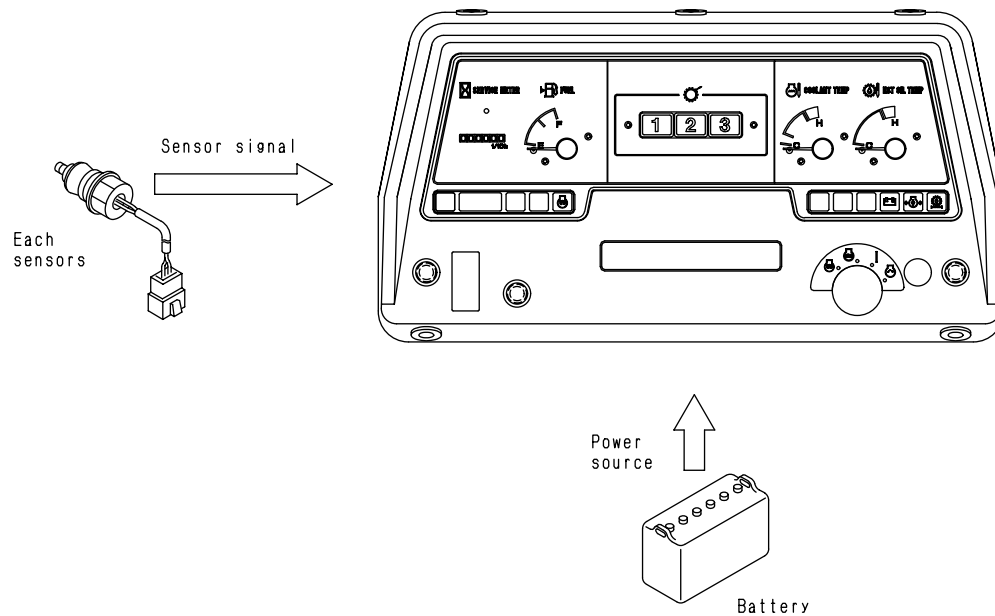
PARKING BRAKE SOLENOID VALVE

★ See section on **solenoid valve**.

MONITOR PANEL

★ See section on **monitor system**.

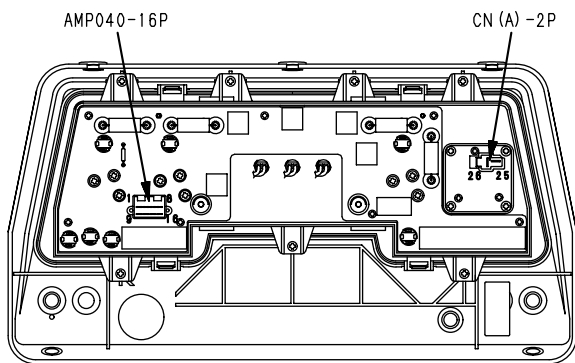
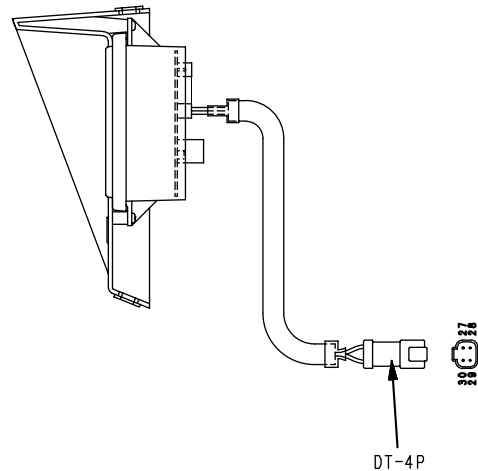
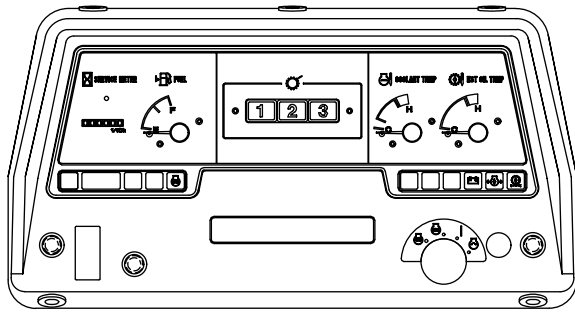
MONITOR SYSTEM



9JB00351

- The monitor system is a system to inform the operator of the condition of the machine. There are sensors installed to various parts of the machine to observe the machine condition. This data is swiftly processed and displayed on the panel to inform the operator.
- The content of the panel displays can be broadly divided into the following.
 1. Monitor portion that issues a warning when there is any abnormality on the machine
 2. Gauges that always display the condition of the machine (coolant temperature, HST oil temperature, fuel level)
- The monitor system consists of the monitor panel, sensors, and power supply. The monitor panel and sensors are connected by wiring harnesses. The power supply for the monitor panel is taken from the battery.

MONITOR PANEL



9JB00352

Outline

- The monitor panel consists of the monitor portion that issues a warning when there is any abnormality in the machine, the gauges that always display the condition of the machine, and the service meter.
- Inside the monitor, there is the CPU (Central Processing Unit). This processes the data and outputs or displays the result.
- Lamps are used for the monitor display.
- Analog meters with indicators are used for the gauge display.

Input/output signal

AMP040-16P [CN-41]

Pin No.	Signal Name	Input/output signal
1	Power source (24 V)	—
2	—	—
3	GND	—
4	Night lighting	Input
5	—	—
6	—	—
7	Pre-heating	Input
8	Fuel level	Input
9	HST oil temperature	Input
10	Charge filter clogging	Input
11	Engine oil pressure	Input
12	Charge level	Input
13	—	—
14	—	—
15	—	—
16	Coolant temperature	Input

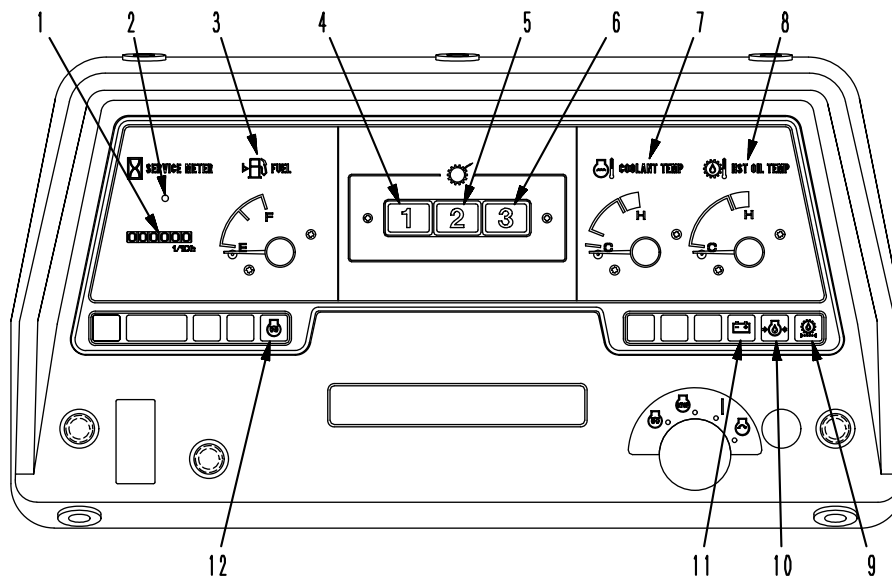
CN (A) -2P [CN-40]

Pin No.	Signal Name	Input/output signal
25	GND	—
26	Alternator generator signal	Input

DT-4P [CN-42]

Pin No.	Signal Name	Input/output signal
27	Travel speed signal (1st)	Input
28	Travel speed signal (2nd)	Input
29	Travel speed signal (3rd)	Input
30	GND	—

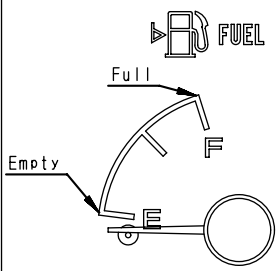
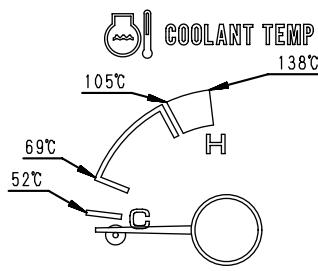
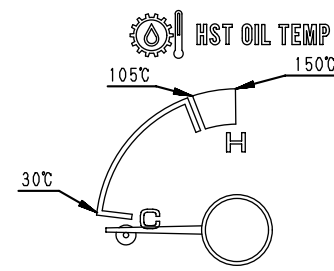
Operation



9JB00353

No.	Display category	Display item	Display range	Display method	Display color	Remarks
1	Service meter		0 – 99999.9 h	Counts hours when engine is running (when alternator is generating electricity)	—	Displays time in hours
2	Service meter indicator		When service meter is working	Flashes when service meter is working	Green	Lamp
3	Gauge	Fuel level	See diagram on right	See diagram on right (Details of gauges)	—	Analog meter with indicator
4	Indicator	1st	When in 1st	Lights up when transmission is in 1st	Green	Lamp
5		2nd	When in 2nd	Lights up when transmission is in 2nd		
6		3rd	When in 3rd	Lights up when transmission is in 3rd		
7	Gauge	Coolant temperature	See diagram on right	See diagram on right (Details of gauges)	—	Analog meter with indicator
8		HST oil temperature	See diagram on right	See diagram on right (Details of gauges)		
9	Caution	Charge filter clogging	When above specified pressure 200 kPa {2.0 kg/cm ² }	Always lights up when starting switch is turned ON, goes out when engine starts Display: When normal: OFF When abnormal: Lights up (Charge filter clogging lights up only when engine is running.)	Red	Lamp
10		Engine oil pressure	When below specified pressure 49 kPa {0.5 kg/cm ² }			
11		Battery charge	When there is problem with charging (charge voltage < battery voltage)			
12	Pilot	Preheating	When preheating	Lights up when starting switch is at HEAT, goes out after engine starts to display completion of preheating	Green	

DETAILS OF GAUGES

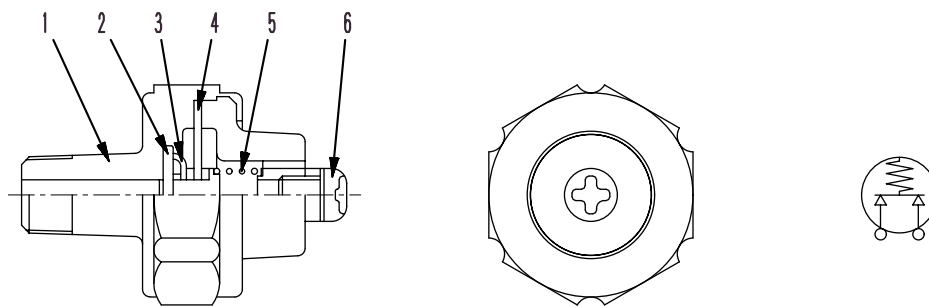
FUEL GAUGE	ENGINE WATER TEMPERATURE GAUGE	HST OIL TEMPERATURE GAUGE
 FUEL Full Empty F E	 COOLANT TEMP 105°C 138°C 69°C 52°C H C	 HST OIL TEMP 105°C 150°C 30°C H C 9JB00354

SENSORS

- The signals from the sensors are input directly to the panel.
- There are two types of sensors: contact type and resistance type.
- The contact type sensors always have one side connected to the chassis ground.

Category of display	Type of sensor	Method of sensor	When normal	When abnormal
Caution	Engine oil pressure	Contact	OFF (open)	ON (closed)
	Charge filter clogging	Contact	OFF (open)	ON (closed)
Gauges	Coolant temperature	Resistance	—	—
	HST oil temperature	Resistance	—	—
	Fuel level	Resistance	—	—

ENGINE OIL PRESSURE SENSOR



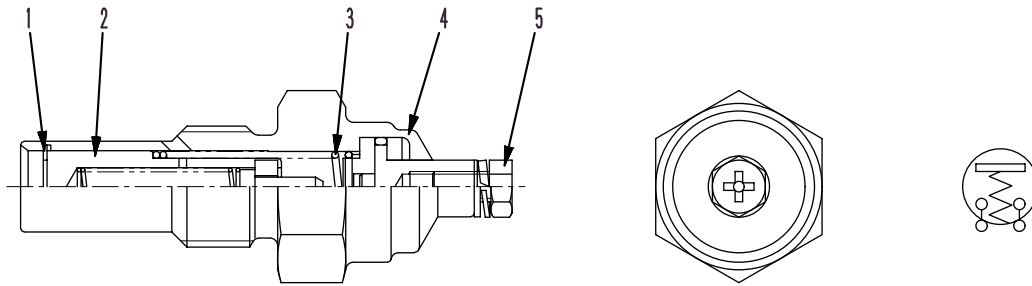
9JB00338

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

Function

- The engine oil pressure sensor is installed to the engine cylinder block. Diaphragm (4) detects the oil pressure, and if it goes below the specified pressure, the switch is turned ON, the relay is actuated, the output is turned OFF, and the caution lamp lights up.

CHARGE FILTER CLOGGING SENSOR



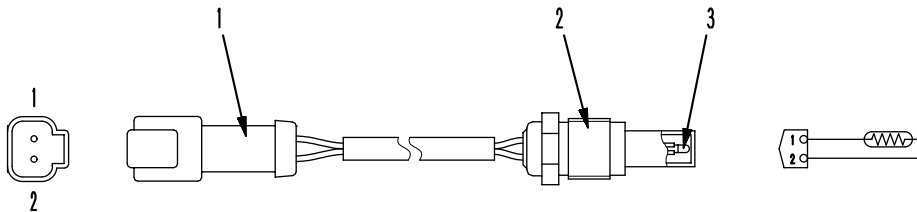
9JB00339

1. Internal ring
2. Contact
3. Spring
4. Body
5. Terminal

Function

- The charge filter clogging sensor is installed to the charge pump oil filter. Contact (2) detects the oil pressure, and if it goes above the specified pressure, the switch is turned ON, the output signal is sent to the monitor panel, and the caution lamp lights up.

COOLANT TEMPERATURE SENSOR HST OIL TEMPERATURE SENSOR



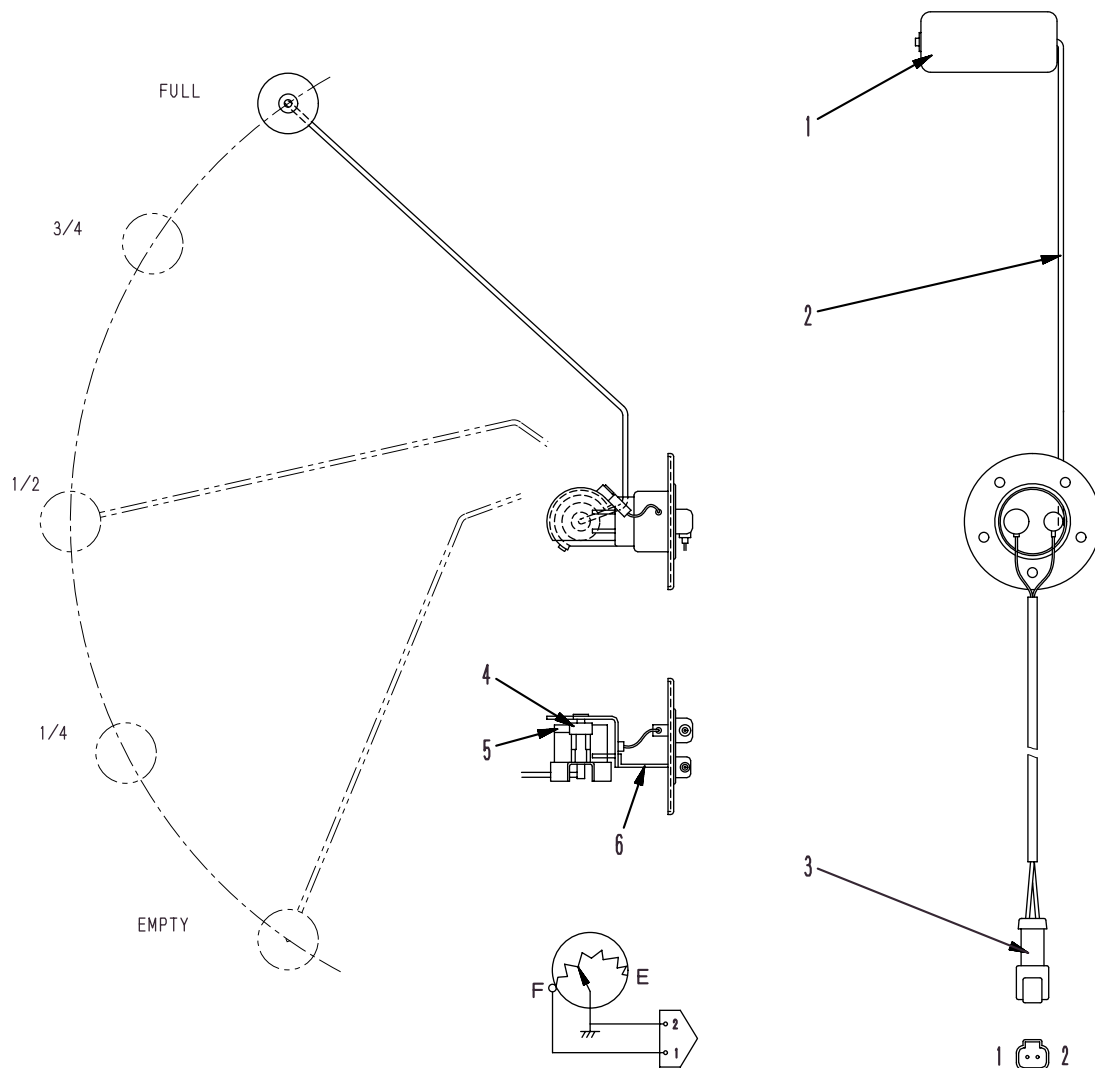
9JB00340

1. Connector
2. Plug
3. Thermistor

Function

- These sensors are installed to the engine cylinder block and pump suction pipe. Any change in temperature is detected as a change in the resistance of thermistor (3), and the signal is sent to the monitor panel to display the temperature.

FUEL LEVEL SENSOR



9JB00341

1. Float
2. Arm
3. Connector
4. Variable resistance
5. Contact
6. Body

Function

- The fuel level sensor is installed to the fuel tank, and the float (1) moves up and down according to the amount of fuel remaining in the tank. The movement of float (1) actuates variable resistor (4) through arm (2), and the signal is sent to the monitor panel to display the fuel level.

20 TESTING AND ADJUSTING

STANDARD VALUE TABLE

STANDARD VALUE TABLE FOR ENGINE	20-2
STANDARD VALUE TABLE FOR CHASSIS	20-4
STANDARD VALUE TABLE FOR ELECTRICAL SYSTEM	20-9

TESTING AND ADJUSTING	20-101
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TROUBLESHOOTING	20-201
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★ 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.

- ⚠ When carrying out testing, adjusting, or troubleshooting, park the machine on level ground, insert the safety pins, and use 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.

STANDARD VALUE TABLE FOR ENGINE

D31EX-21, D31PX-21

Applicable machine model				D31EX-21, D31PX-21	
Machine serial No.				D31EX-21:50001 and up D31PX-21:50001 and up	
Engine				SAA4D102E-2	
Category	Item	Condition	Unit	Standard value	Permissible value
Engine related	Engine speed	High idling	rpm	2,200±50	2,200±50
		Low idling		800± ₀ ⁵⁰	800± ₀ ⁵⁰
		Rated speed		2,000	2,000
	Boost pressure	HST relief + work equipment relief	kPa {mmHg}	Min. 97 {Min. 730}	87 {650}
	Exhaust gas temperature	Whole speed range (Atmospheric temp.:20°C)	°C	Max. 650	700
	Exhaust gas color	At sudden acceleration	Bosch scale	Max. 4.5	6.5
		At high idling		Max. 1.0	2.0
	Valve clearance (Normal temperature)	Intake valve	mm	0.25	—
		Exhaust valve		0.51	—
	Compression pressure (SAE30 or SAE15W-40 oil)	Oil temperature:40–60°C (Engine speed:320–360rpm)	MPa {kg/cm ² }	Min. 2.41 {24.6}	1.69 {17.2}
	Blow-by pressure (SAE30 or SAE15W-40 oil)	(Water temp:operating range) At rated output	Pa {mmH ₂ O}	Max. 490 {50}	980 {100}
	Oil pressure	(Water temp:operating range) At high idling (SAE30 or SAE15W-40 oil)	MPa {kg/cm ² }	0.34–0.69 {3.5–7.0}	0.25 {2.5}
		At low idling (SAE30 or SAE15W-40 oil)	MPa {kg/cm ² }	Min. 0.15 {1.5}	0.07 {0.7}
		At high idling (SAE10W oil)	MPa {kg/cm ² }	0.29–0.59 {3.0–6.0}	0.21 {2.1}
		At low idling (SAE10W oil)	MPa {kg/cm ² }	Min. 0.10 {1.0}	0.07 {0.7}
	Oil temperature	Whole speed range (inside oil pan)	°C	90–110	120
	Fuel injection timing	Compression Before Top Dead Center	°(degree)	11±1	11±1

D37EX-21, D37PX-21

Applicable machine model				D37EX-21, D37PX-21	
Machine serial No.				D37EX-21:5001 and up D37PX-21:5001 and up	
Engine				SAA4D102E-2	
Category	Item	Condition	Unit	Standard value	Permissible value
Engine related	Engine speed	High idling	rpm	2,200±50	2,200±50
		Low idling		800± ⁵⁰ ₀	800± ⁵⁰ ₀
		Rated speed		2,000	2,000
	Boost pressure	HST relief + work equipment relief	kPa {mmHg}	Min. 115 {Min. 860}	103 {770}
	Exhaust gas temperature	Whole speed range (Atmospheric temp.:20°C)	°C	Max. 650	700
	Exhaust gas color	At sudden acceleration	Bosch scale	Max. 4.5	6.5
		At high idling		Max. 1.0	2.0
	Valve clearance (Normal temperature)	Intake valve	mm	0.25	—
		Exhaust valve		0.51	—
	Compression pressure (SAE30 or SAE15W-40 oil)	Oil temperature:40–60°C (Engine speed:320–360rpm)	MPa {kg/cm ² }	Min. 2.41 {24.6}	1.69 {17.2}
	Blow-by pressure (SAE30 or SAE15W-40 oil)	(Water temp:operating range) At rated output	Pa {mmH ₂ O}	Max. 490 {50}	980 {100}
	Oil pressure	(Water temp:operating range) At high idling (SAE30 or SAE15W-40 oil)	MPa {kg/cm ² }	0.34–0.69 {3.5–7.0}	0.25 {2.5}
		At low idling (SAE30 or SAE15W-40 oil)	MPa {kg/cm ² }	Min. 0.15 {1.5}	0.07 {0.7}
		At high idling (SAE10W oil)	MPa {kg/cm ² }	0.29–0.59 {3.0–6.0}	0.21 {2.1}
		At low idling (SAE10W oil)	MPa {kg/cm ² }	Min. 0.10 {1.0}	0.07 {0.7}
	Oil temperature	Whole speed range (inside oil pan)	°C	90–110	120
	Fuel injection timing	Compression Before Top Dead Center	°(degree)	12±1	12±1

STANDARD VALUE TABLE FOR CHASSIS

Cate gory	Item		Condition		Unit	Standard value	Permissible value
Travel	Fuel control lever		- Center of lever knob - Engine stopped	Slow→full throttle	mm	150±20	150±20
	Directional lever		- Center of lever knob - Engine stopped	Forward ↔ Reverse (Full stroke)		55±10	55±10
	Steering lever		- Engine:low idling - Center of lever knob	N–left, right turn		55±10	55±10
	Brake pedal		- Engine:low idling - Center of pedal			78±10	78±10
	Decelerator pedal		- Engine stopped - Center of pedal			66±10	66±10
	Work equipment control lever		- Engine stopped - Center of lever knob - Angle:Incline of lever	Neutral–Raise		47±10	47±20
				Neutral–Lower		47±10	47±20
				Neutral–Float		71±10	71±20
				Neutral–LH, RH tilt	52±10	52±20	
				Neutral–LH, RH angle	Degree	15±3	15±6
Operating force	Fuel control lever		- Engine stopped 20 mm from end of lever knob	Low idling→ High idling	N {kg}	29.4±19.6 {3.0±2}	58.8 {6.0}
				High idling →Low idling		68.6±19.6 {7±2}	108 {11.0}
	Directional lever		- Engine:low idling - Center of lever knob	N–Forward, reverse		19.6 – 67.6 {2 – 6.9}	11.8 – 84.3 {1.2 – 8.6}
				Gear shift switch		- Engine:low idling - Button switch	Shift up
	Shift down	6.9 – 12.7 {0.7 – 1.3}	14.7 {1.5}				
	Steering lever		- Engine:low idling - Center of lever knob	N–LH, RH turn		17.6 – 41.2 {1.8 – 4.2}	10.8 – 51.9 {1.1 – 5.3}
	Brake pedal		- Engine:low idling - Center of pedal			186±49 {19±5.0}	284 {29}
	Decelerator pedal		- Engine stopped - Center of pedal			78.4±19.6 {8.0±2.0}	118 {12}
	Work equipment control lever		- Engine: low idling - Center of lever knob	Neutral–Raise		23.5±10 {2.4±1.0}	39.2 {4.0}
				Neutral–Lower		26.5±10 {2.7±1.0}	39.2 {4.0}
				Neutral–Float		70.6±22 {7.2±2.2}	118 {12}
				Neutral–LH, RH tilt		26.5±10 {2.7±1.0}	39.2 {4.0}
				Neutral–LH, RH angle	Nm {kgm}	2.9–5.4 {0.3–0.55}	8.3 {0.9}
Hydraulic pressure	PPC valve output pressure	Travel PPC valve	- Engine: full throttle - Hydraulic oil tempera- ture: 45 – 55°C - Tow valve: lock - Travel lever: 3rd	Forward stroke end	MPa {kg/cm ² }	Min. 2.21 {Min. 22.5}	Below 2.21 {Below 22.5}
				Reverse stroke end		Min. 2.21 {Min. 22.5}	Below 2.21 {Below 22.5}
		Steering PPC valve		LH steering stroke end		Min. 2.21 {Min. 22.5}	Below 2.21 {Below 22.5}
				RH steering stroke end		Min. 2.21 {Min. 22.5}	Below 2.21 {Below 22.5}

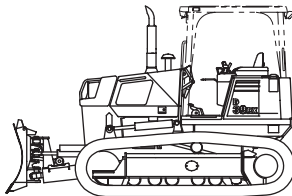
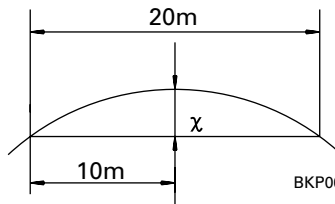
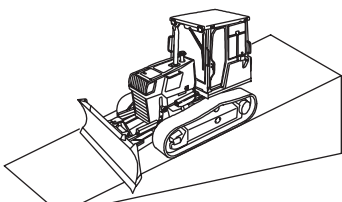
TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR CHASSIS

Cate gory	Item		Condition		Unit	Standard value	Permissible value		
Hydraulic pressure	PPC valve output pressure	Work equip- ment PPC valve	Neutral–Raise		MPa {kg/cm ² }	Min. 1.65 {Min. 16.8}	Below 1.65 {Below 16.8}		
			Neutral–Lower			Min. 1.37 {Min. 14.0}	Min. 1.37 {Min. 14.0}		
			Neutral–Float			Min. 2.01 {Min. 21.0}	Below 2.01 {Below 21.0}		
			Neutral–LH, RH tilt			Min. 1.72 {Min. 17.5}	Below 1.72 {Below 17.5}		
			Neutral–LH, RH angle			Min. 1.96 {Min. 20.0}	Below 1.96 {Below 20.0}		
	HST oil pressure	High pressure cut-off pressure	• Engine: full throttle • Hydraulic oil tempera- ture: 45–55°C • Travel lever: LH or RH steering stroke end	Forward		L.H. steering stroke end	37.3 – 43.1 {380 – 440}	36.3 – 44.1 {370 – 450}	
						R.H. steering stroke end	37.3 – 43.1 {380 – 440}	36.3 – 44.1 {370 – 450}	
				Reverse		L.H. steering stroke end	37.3 – 43.1 {380 – 440}	36.3 – 44.1 {370 – 450}	
						R.H. steering stroke end	37.3 – 43.1 {380 – 440}	36.3 – 44.1 {370 – 450}	
		Charge circuit pressure	• Engine: full throttle • Hydraulic oil tempera- ture: 45–55°C	• Travel lever: neutral		3.14±0.29 {32±3.0}	3.14±0.29 {32±3.0}		
				• Travel lever: forward stroke end • Travel lever: LH or RH steering stroke end		2.55±0.29 {26±3.0}	2.55±0.49 {26±5.0}		
		AS pressure	• Hydraulic oil tempera- ture: 45–55°C • Travel lever: neutral	Engine: 1,100rpm Brake pedal: released		0.44 – 0.78 {4.5 – 8.0}	0.34 – 0.83 {3.5 – 8.5}		
				Engine: 1,800rpm Brake pedal: released		2.19 – 2.48 {22.3–25.3}	1.94 – 2.58 {19.8 – 26.3}		
		Solenoid output pressure	2nd speed switching pres- sure	• Engine: full throttle • Hydraulic oil tempera- ture: 45–55°C • Travel lever: neutral		2nd speed		3.14±0.29 {32±3.0}	3.14±0.49 {32±5.0}
			3rd speed switching pres- sure			3rd speed		3.14±0.29 {32±3.0}	3.14±0.49 {32±5.0}
	Parking brake release pres- sure		Safety lock lever released			3.14±0.29 {32±3.0}	3.14±0.49 {32±5.0}		
	HST brake sig- nal pressure		Safety lock lever acti- vated			3.14±0.29 {32±3.0}	3.14±0.49 {32±5.0}		
	Work equipment pump relief pressure		• Engine: full throttle • Hydraulic oil tempera- ture: 45–55°C				20.6 ^{+0.49} _{–0.29} {210 ⁺⁵ _{–3} }	17.6 {180}	

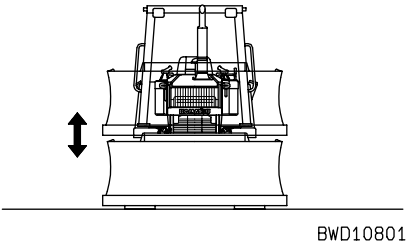
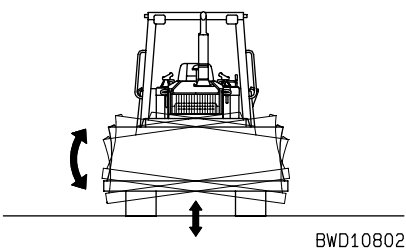
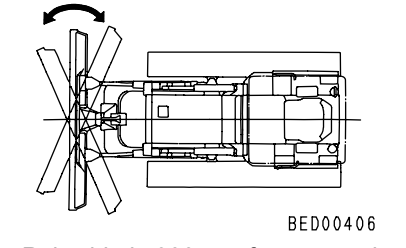
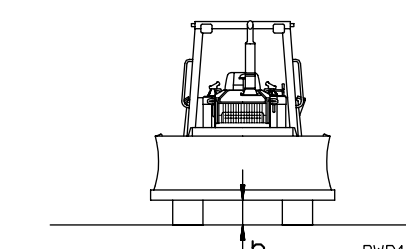
TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR CHASSIS

Cate gory	Item	Condition		Unit	Standard value	Permissible value	
Power train	Travel speed	• Engine: full throttle • Travel lever: stroke end	Forward	1st	km/h	4.3±0.2	4.3±0.4
			2nd	6.5±0.3		6.5±0.6	
			3rd	8.5±0.4		8.5±0.8	
		Reverse	1st	4.3±0.2		4.3±0.4	
			2nd	6.5±0.3		6.5±0.6	
			3rd	8.5±0.4		8.5±0.8	
	Travel deviation	 BWD10301 • Engine: full throttle • Hydraulic oil temperature: 45–55°C • Run up for at least 10 m, and measure deviation when traveling next 20 m on flat ground ★ Use a hard horizontal surface. (concrete, etc.)  BKP00107 ★ Measure dimension x		mm	Max.120	Max.150	
		Hydraulic drift of travel	 BWD10347 • Engine: full throttle • Hydraulic oil temperature: 45–55°C • Travel lever : neutral • Speed range: 1st speed • Safety lock lever : FREE • Stop machine on 20° slope.	Measure the distance the machine moves in 1 minute	m	Max. 3.6	Min. 4.0

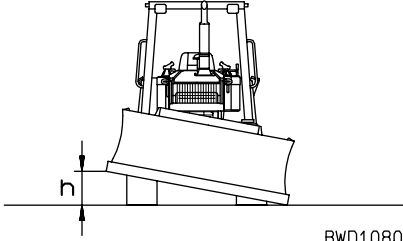
TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR CHASSIS

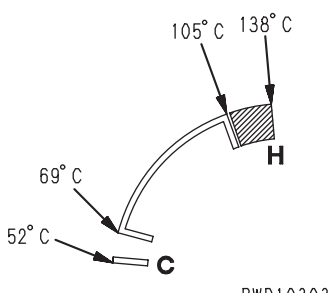
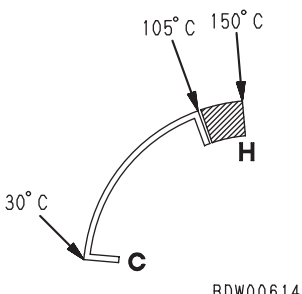
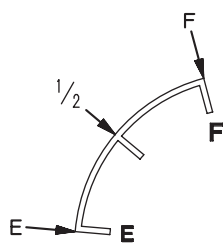
Cate gory	Item	Condition	Unit	Standard value	Permissible value
Work equip- ment speed	Blade raise Ground ↕ Raise fully	Lift 	Raise	2.0±0.2	2.5
			Lower	1.4±0.2	2.1
	Blade tilt LH tilt fully ↕ RH tilt fully	Tilt 	LH tilt	1.7±0.2	2.1
			RH tilt	1.7±0.2	2.1
	Blade angle LH angle fully ↕ RH angle fully	Angle 	LH angle	2.6±0.5	3.3
		★ Raise blade 300mm from ground • Machine on level ground • Engine: full throttle • Hydraulic oil temperature: 40–60°C	RH angle	2.6±0.5	3.3
Hydraulic drift of work equipment	Blade	 ★ Raise blade 300 mm from ground and meas- ure hydraulic drift for the next 15 minutes.	mm/ 15min	Max. 50	Max. 50

TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR CHASSIS

Cate gory	Item		Condition	Unit	Standard value	Permissible value
Work equipment	Hydraulic drift of work equipment	Blade tilt	 ★ Tilt blade fully and contact ground. • Machine on level ground • Control lever in Neutral • Engine stopped • Hydraulic oil temperature: 40–60°C • Start to measure immediately after setting in position. • Measure the amount of hydraulic drift for the next 15 minutes.	mm/ 15min	Max. 100	Max. 100
	Leakage of cylinder	Lift cylinder	• Engine: full throttle • Hydraulic oil temperature: 45–55°C • Fully extend piston rod of cylinder to be measured, disconnect head side hose. • Amount of leakage after relieved 1 minute.	cc/ min.	1.6	6.5
		Tilt cylinder			1.6	6.5
		Angle cylinder			1.5	6.0
	Blade time lag		• Engine: full throttle • Hydraulic oil temperature: 45–55°C • Lower blade from max. RAISE position and measure time taken from point where blade contacts ground to point where idlers rise from ground.	sec.	1.0	Max.1.5

STANDARD VALUE TABLE FOR ELECTRICAL SYSTEM

Sys tem	Component		Connector No.	Inspection method	Judgement table	Measurement conditions										
Machine monitor	Monitor panel	Display														
		Coolant tem- perature	CN20 (1)–(2)	Measure resistance	<table><tr><th>Coolant temperature</th><th>Sensor resistance value</th></tr><tr><td>52°C</td><td>Approx. 80 Ω</td></tr><tr><td>69°C</td><td>Approx. 50 Ω</td></tr><tr><td>105°C</td><td>Approx. 15.5 Ω</td></tr><tr><td>120°C</td><td>Approx. 10 Ω</td></tr></table> 	Coolant temperature	Sensor resistance value	52°C	Approx. 80 Ω	69°C	Approx. 50 Ω	105°C	Approx. 15.5 Ω	120°C	Approx. 10 Ω	1) Turn starting switch OFF and insert dummy resistance or measure resistance value of sensor. 2) Turn starting switch ON and check display. 3) Connect socket.
		Coolant temperature	Sensor resistance value													
52°C	Approx. 80 Ω															
69°C	Approx. 50 Ω															
105°C	Approx. 15.5 Ω															
120°C	Approx. 10 Ω															
HST oil tem- perature	CN12 (1)–(2)	Measure resistance	<table><tr><th>Power train oil teperature</th><th>Sensor resistance value</th></tr><tr><td>30°C</td><td>Approx. 205 Ω</td></tr><tr><td>60°C</td><td>Approx. 56 Ω</td></tr><tr><td>80°C</td><td>Approx. 30 Ω</td></tr><tr><td>105°C</td><td>Approx. 15.5 Ω</td></tr><tr><td>120°C</td><td>Approx. 10 Ω</td></tr></table> 	Power train oil teperature	Sensor resistance value	30°C	Approx. 205 Ω	60°C	Approx. 56 Ω	80°C	Approx. 30 Ω	105°C	Approx. 15.5 Ω	120°C	Approx. 10 Ω	1) Turn starting switch OFF and insert dummy resistance or measure resistance value of sensor. 2) Turn starting switch ON and check display. 3) Connect socket.
Power train oil teperature	Sensor resistance value															
30°C	Approx. 205 Ω															
60°C	Approx. 56 Ω															
80°C	Approx. 30 Ω															
105°C	Approx. 15.5 Ω															
120°C	Approx. 10 Ω															
Fuel level	CN13 (1)–(2)	Measure resistance	<table><tr><th>Fuel level</th><th>Sensor resistance value</th></tr><tr><td>E</td><td>Approx. 70 Ω</td></tr><tr><td>1/2</td><td>Approx. 30 Ω</td></tr><tr><td>F</td><td>Approx. 12 Ω</td></tr></table> 	Fuel level	Sensor resistance value	E	Approx. 70 Ω	1/2	Approx. 30 Ω	F	Approx. 12 Ω					
Fuel level	Sensor resistance value															
E	Approx. 70 Ω															
1/2	Approx. 30 Ω															
F	Approx. 12 Ω															

TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR ELECTRICAL SYSTEM

Sys tem	Component	Connector No.	Inspection method	Judgement table	Measurement conditions					
Machine monitor	Coolant temperature sensor (coolant temperature gauge) HST oil temperature sensor (HST oil temperature gauge)	CN20 (male) CN12 (male)	Measure resistance	If the condition is as shown in the table below, the sensor is normal. <table><tr><th>Atmosphere temperature</th><th>Normal</th></tr><tr><td>120°C 106°C 100°C 80°C 60°C 50°C</td><td>Approx. 10 Ω Approx. 14 Ω Approx. 16.5 Ω Approx. 30 Ω Approx. 56 Ω Approx. 80 Ω</td></tr></table>	Atmosphere temperature	Normal	120°C 106°C 100°C 80°C 60°C 50°C	Approx. 10 Ω Approx. 14 Ω Approx. 16.5 Ω Approx. 30 Ω Approx. 56 Ω Approx. 80 Ω	1) Turn starting switch OFF 2) Disconnect CN20 (Coolant temperature sensor) Disconnect CN12 (HST oil temperature sensor)	
	Atmosphere temperature	Normal								
	120°C 106°C 100°C 80°C 60°C 50°C	Approx. 10 Ω Approx. 14 Ω Approx. 16.5 Ω Approx. 30 Ω Approx. 56 Ω Approx. 80 Ω								
	Engine oil pressure sensor	—	Continuity	If the condition is as shown in the table below, the sensor is normal. <table><tr><td>Engine oil pressure Min. 0.049MPa {0.5kg/cm²}</td><td>No continuity</td></tr><tr><td>Engine oil pressure Max. 0.049MPa {0.5kg/cm²}</td><td>Continuity</td></tr></table>	Engine oil pressure Min. 0.049MPa {0.5kg/cm ² }	No continuity	Engine oil pressure Max. 0.049MPa {0.5kg/cm ² }	Continuity	1) Start engine	
	Engine oil pressure Min. 0.049MPa {0.5kg/cm ² }	No continuity								
Engine oil pressure Max. 0.049MPa {0.5kg/cm ² }	Continuity									
Fuel level sensor (fuel gauge)	CN13 (male) — —	Measure resistance	If the condition is as shown in the table below, the sensor is normal. (25°C) <table><tr><td colspan="2">CN13 (male)(1)–(2)</td></tr><tr><td>Full</td><td>Approx. 12 Ω max.</td></tr><tr><td>Empty</td><td>Approx. 85–110 Ω</td></tr></table>	CN13 (male)(1)–(2)		Full	Approx. 12 Ω max.	Empty	Approx. 85–110 Ω	1) Turn starting switch OFF
CN13 (male)(1)–(2)										
Full	Approx. 12 Ω max.									
Empty	Approx. 85–110 Ω									
Alternator	Alternator R terminal – chassis	Measure voltage	While engine is running (more than 1/2 throttle)→27.5–29.5V ★ If the battery is old, or after starting in cold areas, the voltage may not rise for sometime.	1) Start engine						
Charge filter clogging sensor	—	Continuity	If the condition is as shown in the table below, the sensor is normal. <table><tr><td rowspan="2">Differential pressure of filter</td><td>Min. 0.2 MPa {2 kg/cm²}</td><td>Continuity</td></tr><tr><td>Max. 0.2 MPa {2 kg/cm²}</td><td>No Continuity</td></tr></table>	Differential pressure of filter	Min. 0.2 MPa {2 kg/cm ² }	Continuity	Max. 0.2 MPa {2 kg/cm ² }	No Continuity	1) Start engine	
Differential pressure of filter	Min. 0.2 MPa {2 kg/cm ² }	Continuity								
	Max. 0.2 MPa {2 kg/cm ² }	No Continuity								

TESTING AND ADJUSTING

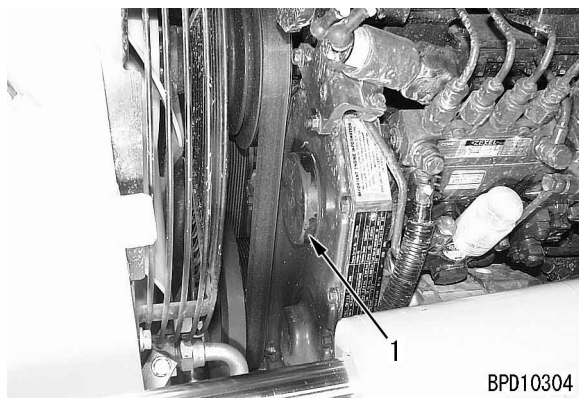
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TOOLS LIST FOR TESTING AND ADJUSTING

Test measurement item	Symbol		Part No.	Part name	Remarks		
Engine speed	A	1	799-203-8001	Multi-tachometer	Digital display L:60 – 2,000rpm H:60 – 19,000rpm		
		2	795-790-2500	Adapter (Drive)			
Water temperature, oil temperature	B		799-101-1502	Digital temperature gauge	–50 – 1,200°C		
Oil pressure	C	1	799-101-5002	Hydraulic tester	Pressure gauge: 2.5, 5.9, 39.2, 58.8MPa {25, 60, 400, 600kg/cm ² }		
			790-261-1203	Digital hydraulic tester	Pressure gauge: 68.6MPa{700kg/cm ² }		
		2	799-401-2320	Pressure gauge	1.0MPa{10kg/cm ² }		
		3	• 799-101-5160	• Nipple	PT1/8		
			799-101-5220	Nipple	10 X 1.25		
			07002-11023	O-ring			
		4	799-401-2910	Nipple	Both male and female: 9/16–18UNF (Female: PT 1/8)		
			07043-00108	Plug	PT1/8 (For 799-401-2910)		
			02896-11008	O-ring	PT1/8 (For 799-401-2910)		
			799-401-2920	Nipple	Both male and female: 11/16–16UNF (Female: PT 1/8)		
			07043-00108	Plug	PT 1/8 (For 799-401-2920)		
			02896-11009	O-ring	PT 1/8 (For 799-401-2920)		
		Compression pressure	E	1	795-502-1205	Compression gauge	0 – 6.9MPa{0 – 70kg/cm ² }
				2	795-502-1700	Adapter	
Blow-by pressure	F	1	799-201-1504	Blow-by kit	0 – 4.9MPa{0 – 500mmH ₂ O}		
		2	795-790-1950	Nozzle (Tool)			
Valve clearance	G		Commercially available	Feeler gauge	—		
Exhaust color	H	1	799-201-9000	Handy smoke checker	Discoloration: 0 – 70% (With standard color)		
		2	Commercially available	Smoke meter	(Discoloration X 1/10 ÷ Bosch index)		
Operating force	I	79A-264-0020	Push-pull scale	0 – 294N{0 – 30kg}			
		79A-264-0090	Push-pull scale	0 – 490N{0 – 50kg}			
Stroke, hydraulic drift	J		Commercially available	Scale	—		
Work equipment speed	K		Commercially available	Stopwatch	—		
Troubleshooting of sensors and wiring harnesses	L		799-601-7100	T-adapter kit	—		
Troubleshooting of voltage, resistance	M		Commercially available	Tester	—		
Fuel injection timing	Q		795-799-1130	Gear	—		
	R1		795-799-1900	Pin assembly	Made of metal		
	R2		795-799-1950	Lock pin	Made of metal		
Release of parking brake	S		790-190-1500	Pump assembly	—		
Boost pressure	T		799-201-2202	Gauge assembly	With hose		

MEASURING ENGINE SPEED

- ⚠ Be careful not to touch any hot part when removing or installing the measuring tools.
- ★ Measure the engine speed under the following conditions.
- Engine coolant temperature: Within operating range
 - Hydraulic oil temperature: 40 – 60°C
1. Remove the engine side cover (left).
 2. Remove cover (1).
 - ★ Use a filter wrench to remove and install the cover.



3. Install adapter **A2** and connect it to the body of multi-tachometer **A1**.



4. Start the engine and set the measuring condition, then measure the engine speed.
 - Set the fuel control lever to the low idling and high idling positions, and measure the engine speed at each position.

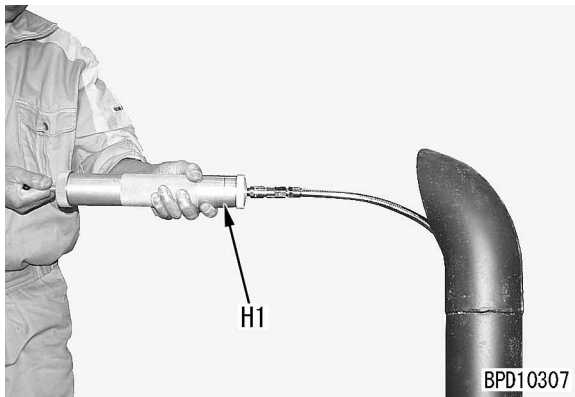


MEASURING EXHAUST COLOR

- When measuring the exhaust color in the field without compressed air and power source, use tool **H1**. When taking records of official data, use tool **H2**.
- ★ Before measuring, heighten the coolant temperature to the operating range.
- ⚠ Be careful not to touch any hot part when removing or installing the measuring tools.

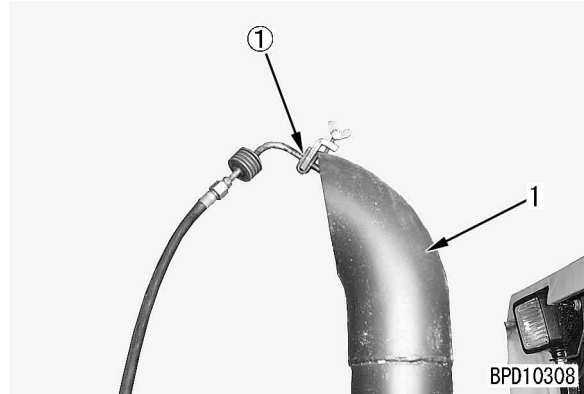
Measuring with H1

1. Install filter paper to tool **H1**.
2. Insert exhaust gas suction adapter in the exhaust pipe. Heighten the engine speed sharply and operate the handle of tool **H1** simultaneously to have the filter paper absorb the exhaust gas.
3. Remove the filter paper and compare it with the attached scale.

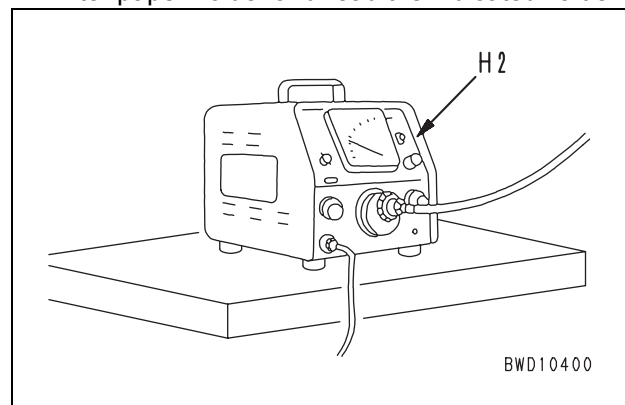


Measuring with H2

1. Insert probe ① of **H2** in the outlet of exhaust pipe (1) and secure it to the exhaust pipe with the clip.



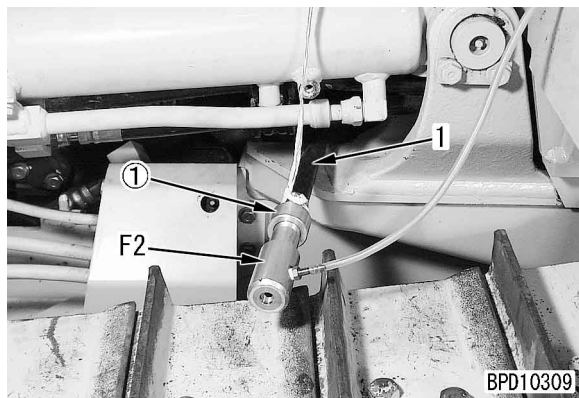
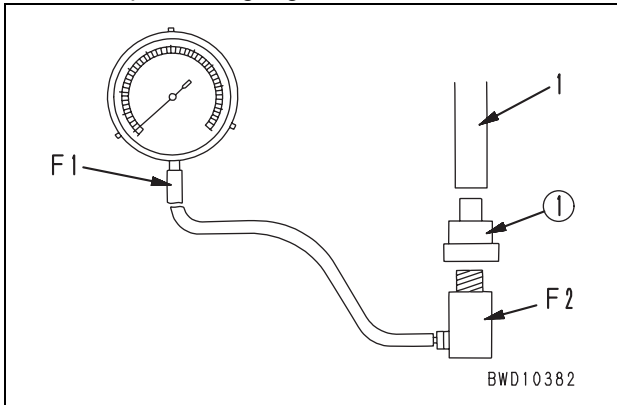
2. Connect the probe hose, accelerator switch outlet, and air hose to **H2**.
 - ★ Limit the applied air pressure to 1.47 MPa {15 kg/cm²}.
3. Connect the power cable to an AC 100 V outlet.
 - ★ When connecting the power cable, check that the power switch of **H2** is turned off.
4. Loosen the cap nut of the suction pump and set the filter paper.
 - ★ Set the filter paper securely so that the exhaust gas will not leak.
5. Turn on the power switch of **H2**.
6. Heighten the engine speed sharply and depress the accelerator pedal of tool **H2** simultaneously to have the filter paper absorb the exhaust gas.
7. Remove the contaminated filter paper and place it on clean filter paper (at least 10 sheets) in the filter paper holder and read the indicated value.



MEASURING BLOW-BY PRESSURE

- ★ Before measuring, heighten the coolant temperature to the operating range.

1. Connect blow-by nozzle **F2** to the end of engine breather hose (1).
2. Install pressure gauge **F1** to **F2**.



3. Run the engine at the rated output and measure the blow-by pressure.

- ⚠ Take care not to touch the hot parts or rotating parts during measurement.
- ★ The regular blow-by pressure is measured while the engine is running at the rated output.
- If it is impossible to run the engine at the rated output, 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.

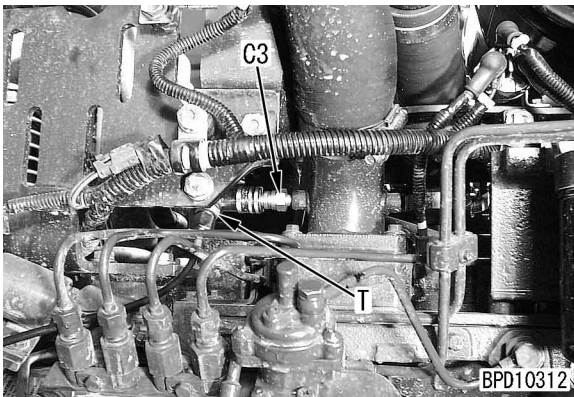
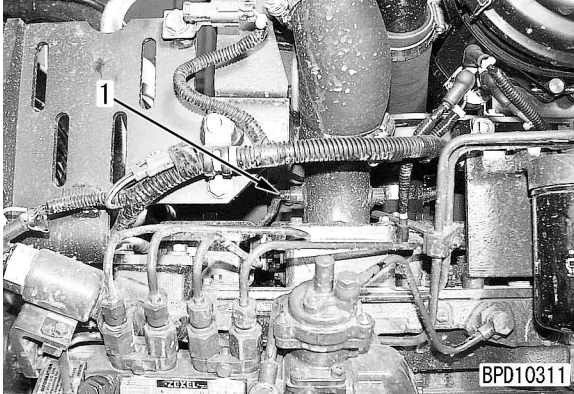


MEASURING INTAKE AIR PRESSURE (BOOST PRESSURE)

⚠ Take care not to touch the hot parts or rotating parts when installing and removing the measuring instruments and during measurement.

- Engine coolant temperature for measurement: Within operating range

1. Remove boost pressure measurement plug (1) (PT 1/8) and install nipple **C3** of the oil pressure gauge kit instead.



2. Referring to MEASURING AND ADJUSTING HST OIL PRESSURE, "1. Measuring high cut-off oil pressure 1), 2)", turn down the travel brake bypass valve lever until it stops.

- ★ Until the brake is applied.

3. Connect the hose for measuring the oil pressure to nipple **C3** and pressure gauge **T** (200 kPa {1,500 mmHg}).

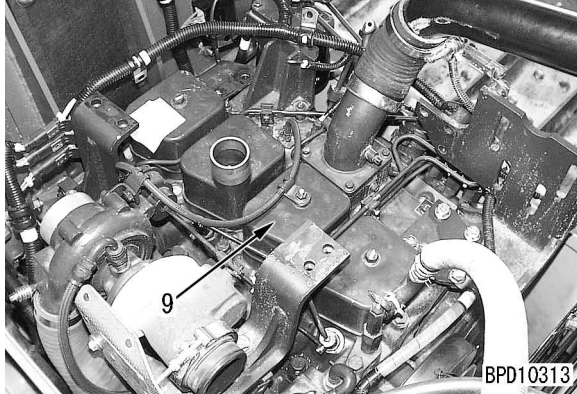
- ★ When using the measuring hose of the oil pressure measuring kit, be sure to bleed air from the hose according to the following procedure.
- Run the engine at a medium speed or higher range, and bleed the oil from the hose by inserting the gauge about a half to open the self-seal part repeatedly.
- ★ Be sure to perform the above operation since the gauge does not work if there is oil in the hose.



4. Run engine at full throttle and measure the gauge pressure when travel circuit and work equipment circuit are relieved.

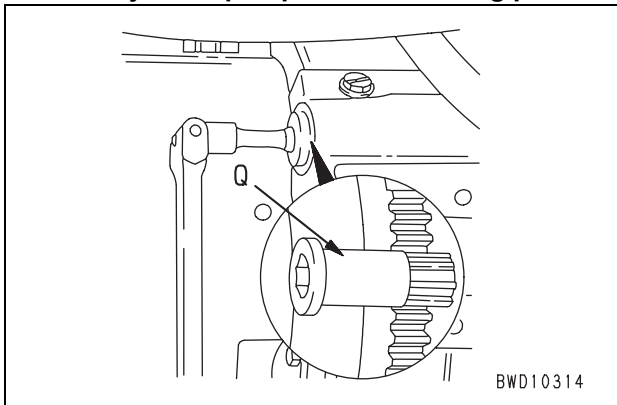
ADJUSTING VALVE CLEARANCE

1. Remove the air cleaner and remove the muffler assembly together with the bracket, then remove cylinder head cover (9).

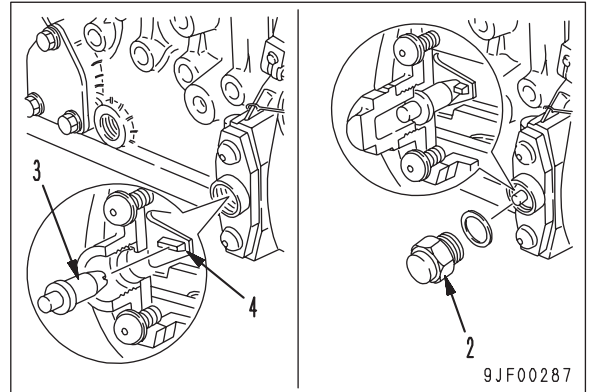


2. Set cranking tool **Q** to the flywheel.

★ Since the timing pin cannot be pushed into the timing gear, mesh "timing pin (3) of the fuel injection pump" with the timing pointer.



3. Remove timing pin plug (2) and turn over timing pin (3), then crank the flywheel forward with cranking tool **Q** until timing pin (3) meshes with timing pointer (4).
4. When the timing point is meshed, adjust the clearances of the valves marked ● in the valve arrangement table. At this time, make match marks on the crank pulley and timing gear case and remove the timing pin.



5. Crank the crankshaft forward by 1 turn and match the match marks made in 4 above, then adjust the clearances of the other valves marked ○.

Valve arrangement

Cylinder NO.	1	2	3	4
Exhaust valve	●	○	●	○
Intake valve	●	●	○	○

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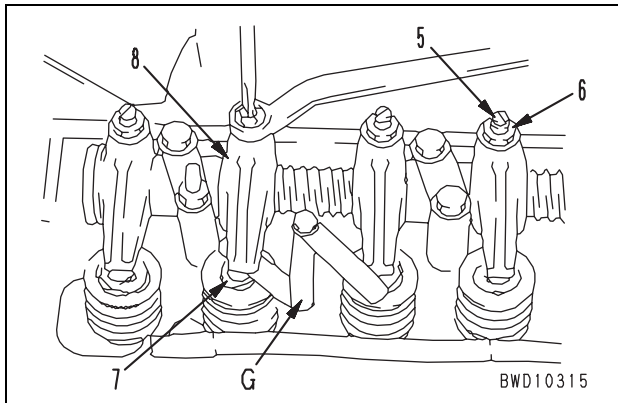
TESTING AND ADJUSTING

ADJUSTING VALVE CLEARANCE

- ★ Loosen lock nut (6) of adjustment screw (5) and insert specified thickness gauge **G** in the clearance between valve stem (7) and rocker arm (8) and adjust the clearance with the adjustment screw so that the thickness gauge can be moved lightly, then tighten the lock nut to secure the adjustment screw.

 **kgm** Locknut: **24.0 Nm {2.45 kgm}**

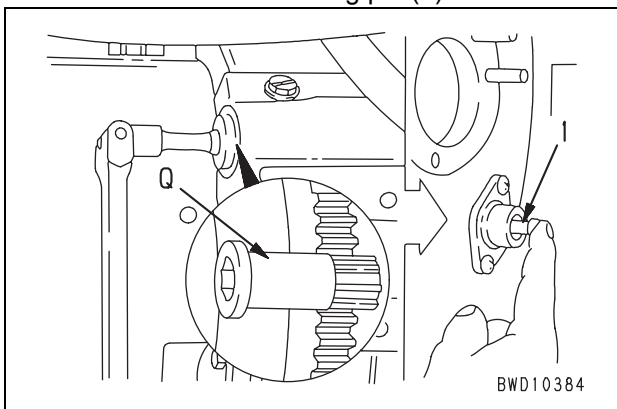
- ★ The firing order of the engine is 1-3-4-2.
- ★ Valve clearance
Intake side: 0.25 mm
Exhaust side: 0.51 mm



TESTING ADJUSTING FUEL INJECTION TIMING

1. Testing

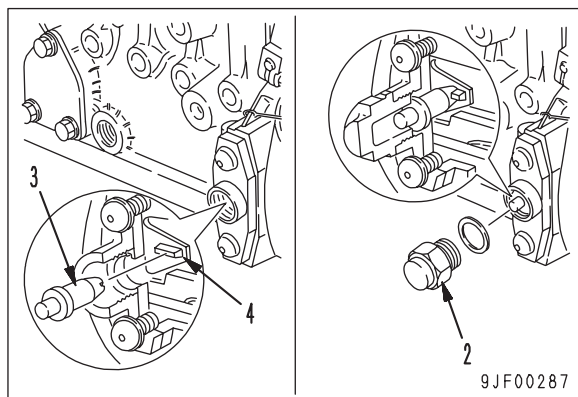
- ★ Remove the work equipment pump assembly.
- 1) Crank the crankshaft forward with cranking tool **Q** until timing pin (1) enters the hole of the timing gear.
- ★ Timing pin (1) may be replaced with lock pin **R2** (made of metal) at this time.
- 2) After the timing pin enters the hole of the gear, remove fuel injection pump plug (2) and turn over timing pin (3) and check that the tip of pin (3) is meshed with timing pointer (4) on the fuel injection pump side.
- ★ Pin assembly **R1** (made of metal) may be used instead of timing pin (3).



2. Adjusting

If timing pin (3) is not meshed

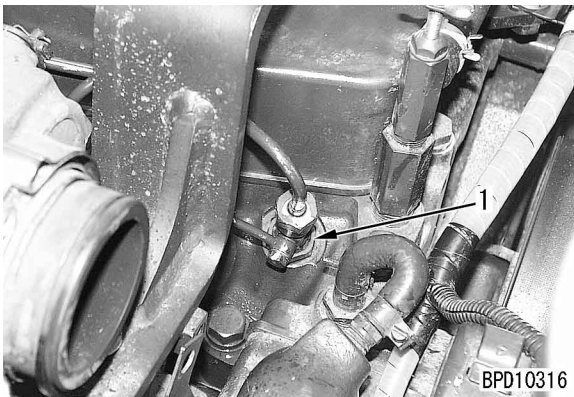
- 1) Remove the fuel injection pump. For details, see REMOVAL OF FUEL INJECTION PUMP.
- 2) Rotate the camshaft of the fuel injection pump to mesh timing pin (3) with timing pointer (4).
- 3) Install the fuel injection pump. For details, see INSTALLATION OF FUEL INJECTION PUMP.



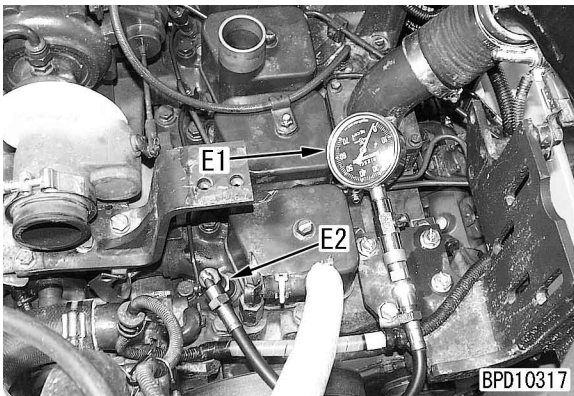
MEASURING COMPRESSION PRESSURE

⚠ While measuring the compression pressure, take care not to touch the exhaust manifold, etc. to get burnt and not to catch your clothes in the fan or fan belt.

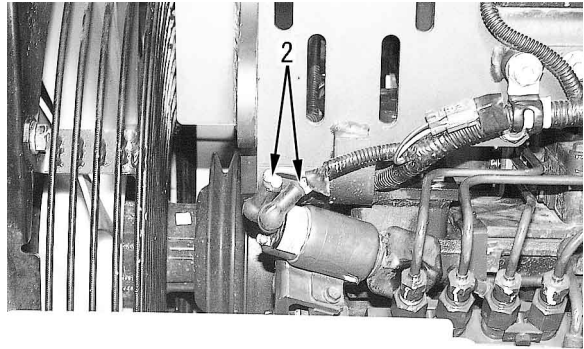
1. Warm up the engine until the oil temperature is 40 – 60°C.
 - ★ Since the air cleaner and muffler must be removed before adjustment of the valve clearance, warm up the engine first.
2. Adjust the valve clearance accurately. For details, see ADJUSTING VALVE CLEARANCE.
3. Remove nozzle holder (1).



4. Install adapter E2 to the nozzle holder mounting part, then connect compression gauge E1.



5. Disconnect 2 engine stop solenoid wires (2).



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6. Crank the engine with the starting motor and measure the compression pressure.
 - ★ Read the compression pressure when the pointer of the compression gauge stops.
 - ★ When measuring the compression pressure, measure the engine speed and check that it is in the standard range.

After measuring the compression pressure, install the nozzle holder

 Thread portion: **Anti-seizure agent (MOLYCOAT 1000 or equivalent)**

 **Nozzle holder assembly:**
60 ± 9 Nm {6.12 ± 0.92 kgm}

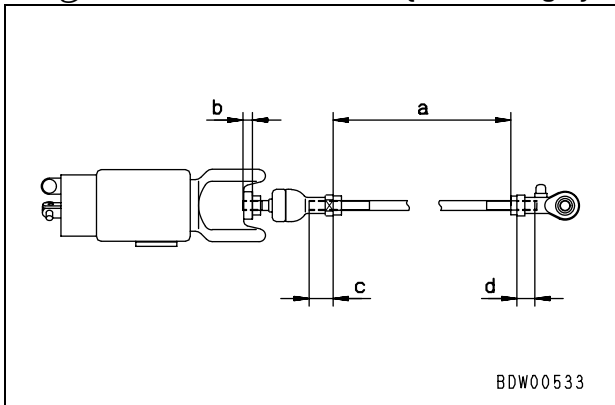
ADJUSTING ENGINE STOP SOLENOID LINKAGE

1. Assemble the solenoid and linkage.

- Installed length of rod "a": 163 mm
- Screwing depth "b" on solenoid side: 6 mm
- Screwing depth "c" of intermediate portion: 15 mm
- Screwing depth "d" on yoke side: 12 mm
- Apply adhesive (LT-2) to the thread portion of the rod. Do not apply it to the range of 5 mm from each end to prevent the joint from sticking, however.

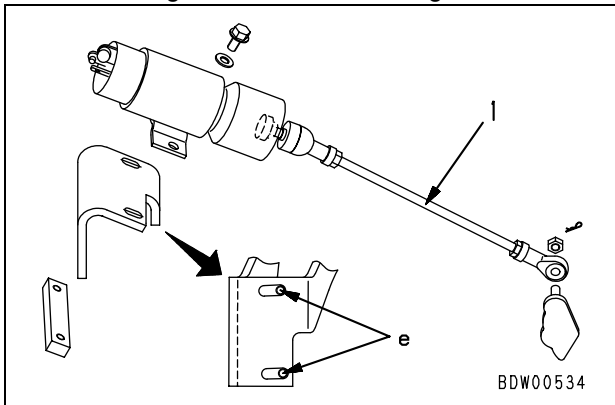


Locknut: $4.9 \pm 1 \text{ Nm}$ $\{0.5 \pm 0.1 \text{ kgm}\}$

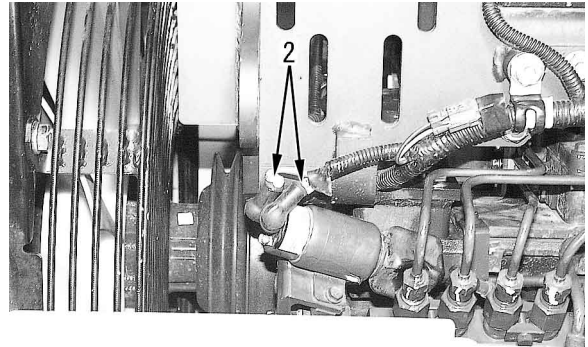


2. Install solenoid linkage assembly (1) to the engine temporarily.

- ★ Install the solenoid linkage assembly, matching it to injection pump-side ends "e" of the oblong holes of the mounting bracket.



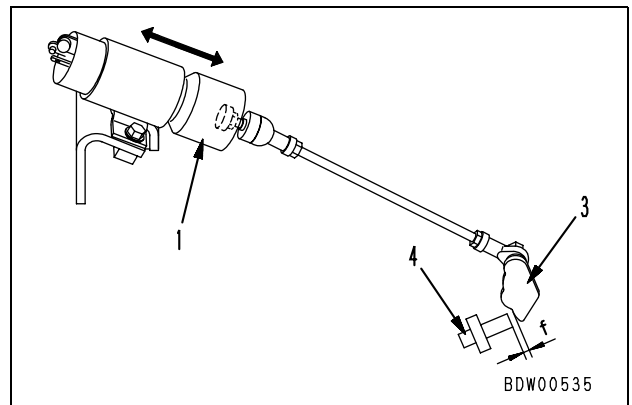
3. Connect solenoid wire (2).



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4. Turn the starting switch to the ON position.

5. Move solenoid linkage assembly (1) toward the fan so that clearance "f" between injection pump stop lever (3) and stopper (4) will be the following value under this condition.
Clearance f: 1 – 2 mm



6. Tighten the mounting bolts securely and operate the solenoid several times to confirm the following items.

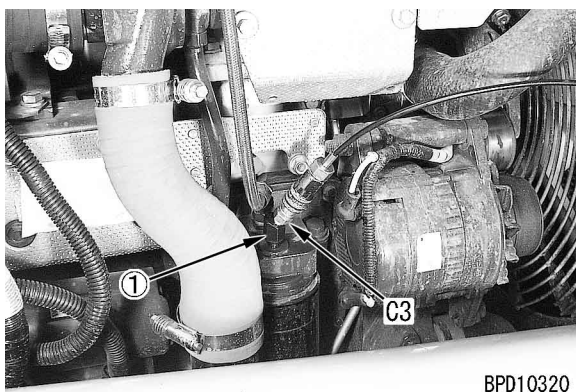
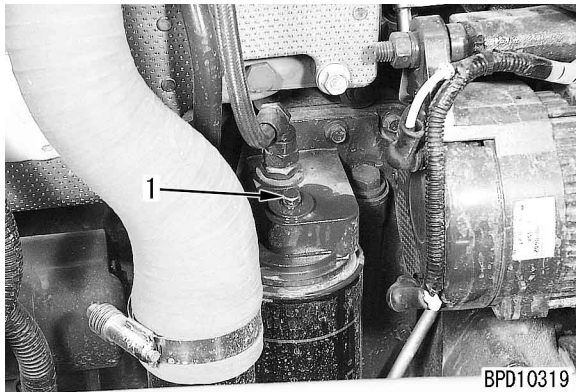
- 1) The solenoid does not heat up when it operates.
- 2) The rubber boot and linkage do not interfere with the other engine parts.

MEASURING ENGINE OIL PRESSURE

- ★ Measure the engine oil pressure under the following condition.

- Engine coolant temperature: Within operating range

1. Remove plug (1) (PT 1/8) from the oil filter top and install adapter ① and nipple **C3** of oil pressure kit **C1**, then connect oil pressure gauge **C2** (9.8 MPa {10 kg/cm²}).



2. Start the engine and measure the oil pressure at low idling and high idling.



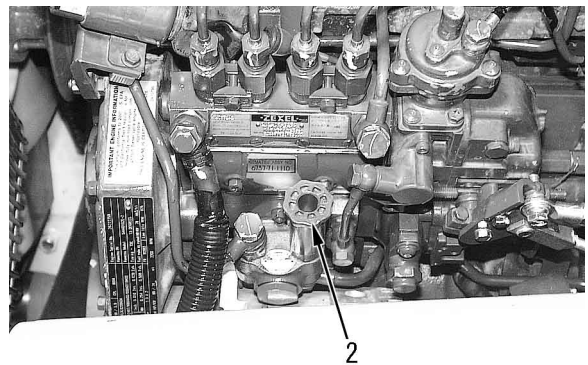
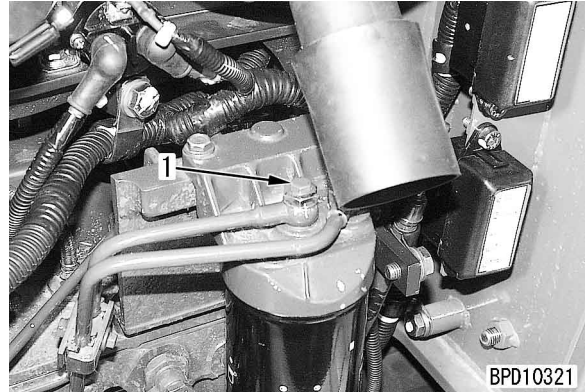
BLEEDING AIR FROM FUEL CIRCUIT

1. Bleeding air automatically

- ★ Air can be bled in a shorter time if the fuel tank is full.
- 1) Set the fuel lever to the medium speed position.
- 2) Turn the starting switch to the START position and hold it there for 20 seconds.
 - ★ At this time, the starting motor runs for 2 seconds, then stops. The air bleeding motor pump continues operating to bleed air, however.
 - ★ Keep the key at the START position either the engine starts or not.
- 3) Return the key of starting switch to the ON position, and wait for about 30 seconds.
- 4) Repeat step 2).
 - ★ Keep the key at the START position for 20 seconds even if the engine starts.
- 5) Return the starting switch to the ON position and check that the engine can continue running.
 - ★ If the engine stalls at this time, repeat step 4).

2. Bleeding air manually

- 1) Loosen air bleed plug (1).
- 2) Move priming pump (2) of the feed pump up and down to let the fuel overflow from the air bleed plug until bubbles do not come out any more.
- 3) Tighten the air bleed plug.

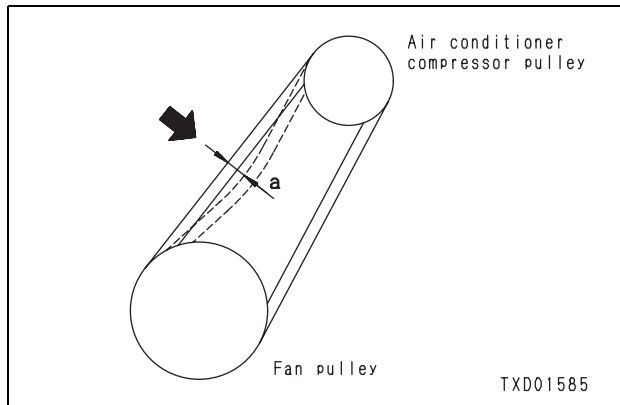


TESTING AND ADJUSTING TENSION OF AIR CONDITIONER COMPRESSOR BELT

1. Testing belt tension

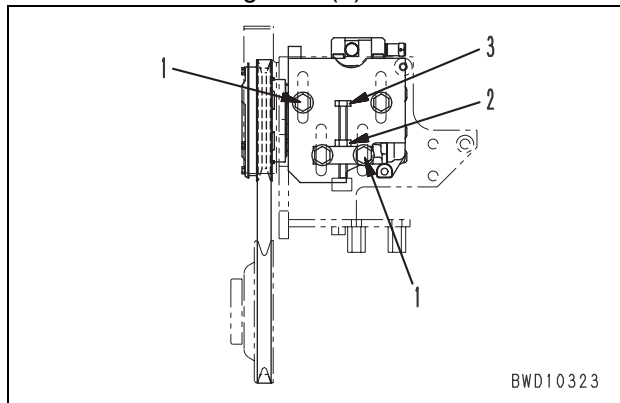
Press the middle point of the belt between the fan pulley and compressor pulley with force of 98 N {10 kg} and measure deflection "a" of the belt.

Deflection "a": 15 – 18 mm



2. Adjusting belt

- 1) Loosen 4 compressor mounting bolts (1).
- 2) Loosen locknut (2) and tighten adjustment bolt (3) to adjust the belt tension.
- 3) After adjusting the belt tension to the standard value, tighten locknut (2) and compressor mounting bolts (1).



MEASURING AND ADJUSTING HST OIL PRESSURE

Measuring

- ★ HST oil temperature when measuring: Follow measurement conditions in STANDARD VALUE TABLE

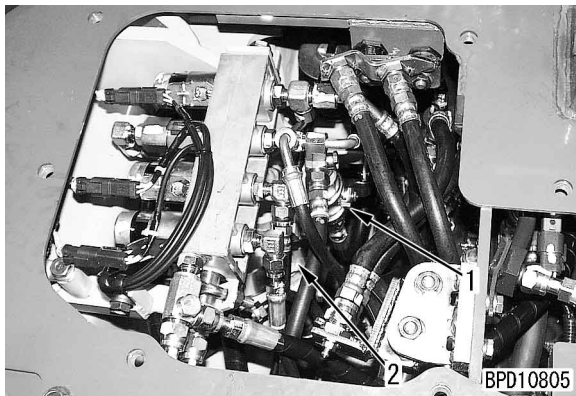
⚠ When measuring the high-pressure cut-off oil pressure, charge circuit oil pressure, and drive piston actuation pressure, there is danger that the parking brake may be released by the tow valve and that the machine may move. To prevent the machine from moving, put the blocks under the tracks when measuring the oil pressure, and finish measuring the oil pressure quickly.

⚠ If it is not necessary to start the engine during the procedure for measuring the HST, always stop the engine before starting the measurement.

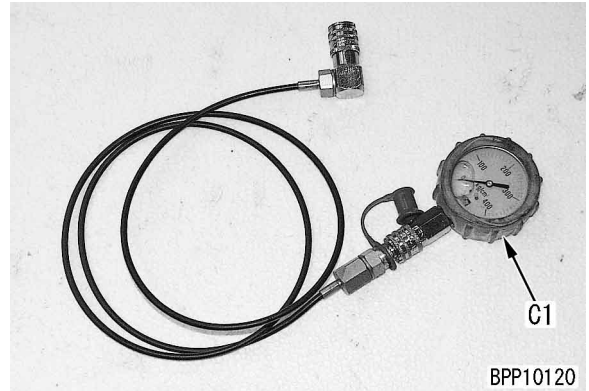
- ★ The high relief pressure cannot be measured since it is the pressure to operate the safety valve of the main circuit.

1. Measuring high cut-off oil pressure

- 1) Stop the engine.
- 2) Loosen the hydraulic oil filler cap to release the residual pressure from the hydraulic tank.
- 3) Remove the floor cover.
- 4) Turn tow valve lever (1) of the travel brake circuit downward until it stops (to the full close position).
 - ★ Take care not to let the pin fall.



- 5) Remove oil pressure pickup plug (2) (Thread dia. = 10 mm, Pitch = 1.25 mm) between the HST pump and auto shift valve and install adapter ① and nipple C3 of oil pressure kit C1, then connect oil pressure gauge C1 (58.8 MPa {600 kg/cm²}).



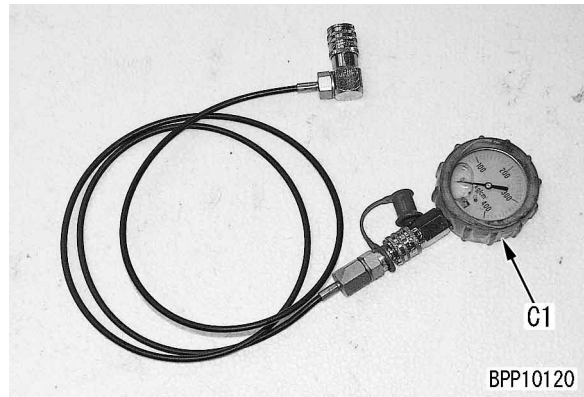
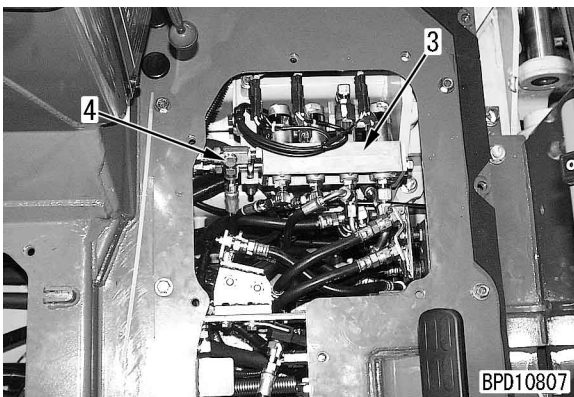
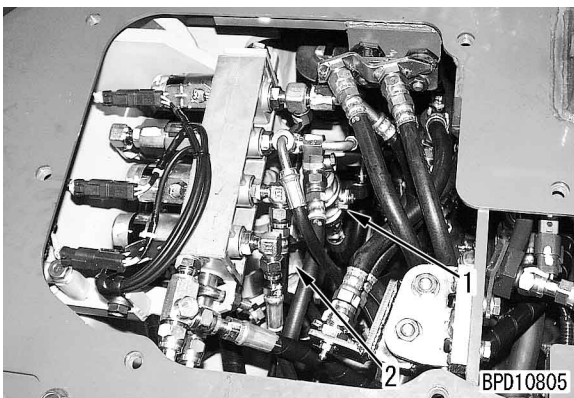
- 6) Start the engine.
- 7) Set the forward-reverse lever to the Forward or Reverse position and pull the fuel control lever gradually and check that the machine does not move, then pull the fuel control lever to the full throttle position and measure the cut-off oil pressure.
 - ★ Move the forward-reverse lever to the stroke end.
- 8) When measuring the oil pressure for steering to right or left during forward or reverse travel, move the steering lever to the right or left stroke end and measure the oil pressure.



- ★ Be careful of the following when measuring the HST oil pressure.
 - ⚠ Always move the machine to flat ground when measuring the HST oil pressure.

2. Measuring charge circuit pressure

- 1) Stop the engine.
- 2) Loosen the hydraulic oil filler cap to release the residual pressure from the hydraulic tank.
- 3) Remove the floor cover.
- 4) Turn tow valve lever (1) of the travel brake circuit downward until it stops (to the full close position). (Same conditions as when measuring high-pressure cut-off)
- 5) Remove oil pressure pickup plug (4) (Thread dia. = 10 mm, Pitch = 1.25 mm) from the inlet of solenoid valve block and install nipple **C3** of oil pressure kit **C**, then connect oil pressure gauge **C1** (5.9 MPa {60 kg/cm²})..



- 6) Start the engine.
- 7) Run the engine at high idling and measure the charge circuit pressure under the following conditions when the hydraulic oil temperature is 45 - 55°C.
 - i) Directional lever at Neutral
 - ii) Travel lever at end of FORWARD stroke and end of left steering stroke
 - iii) Travel lever at end of FORWARD stroke and end of right steering stroke



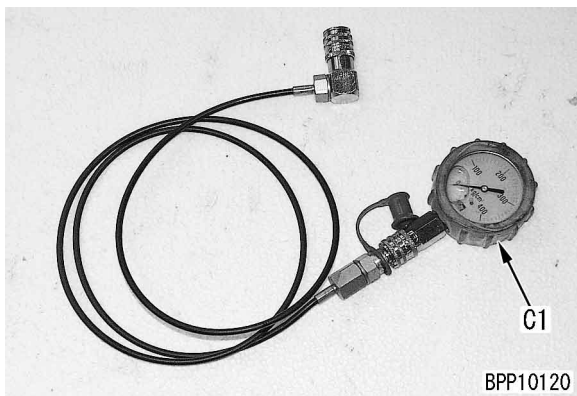
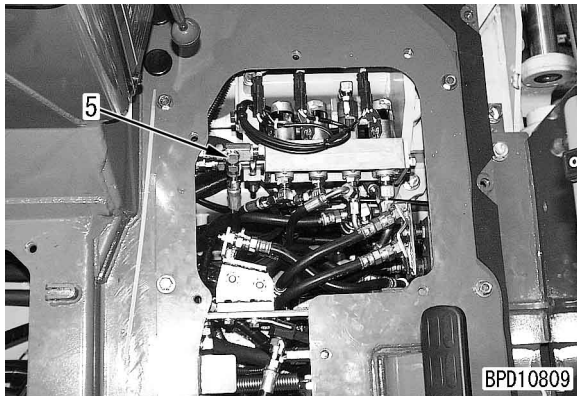
3. Measuring control oil pressure (AS pressure)

- 1) Stop the engine.
- 2) Loosen the hydraulic oil filler cap to release the residual pressure from the hydraulic tank.
- 3) Remove the floor cover.
- 4) Remove oil pressure pickup plug (5) (Thread dia. = 10 mm, Pitch = 1.25 mm) from the control pressure outlet of the HST pump and install the adapter and nipple **C3** of oil pressure kit **C1**, then connect oil pressure gauge **C1** (5.9 MPa {60 kg/cm²}).

TESTING AND ADJUSTING

MEASURING AND ADJUSTING HST OIL PRESSURE

- 5) Set tachometer **A2**. For details, see MEASURING ENGINE SPEED.

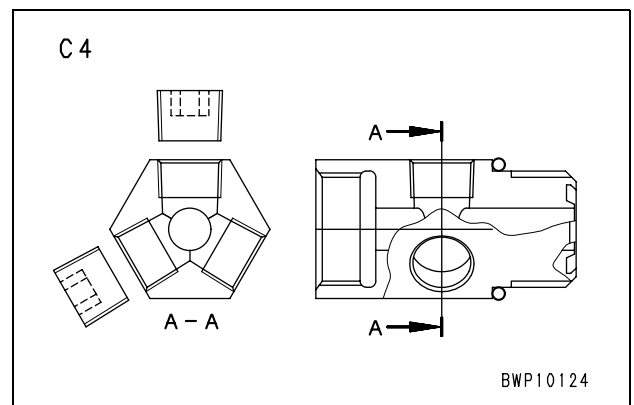
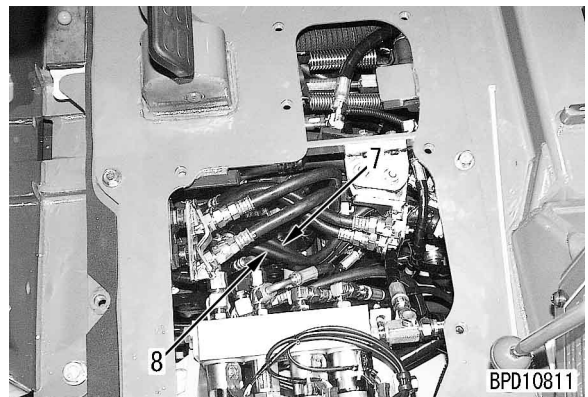


- 6) Start the engine.
- 7) Measure the control pressure (AS pressure) under the following conditions.
 - Follow the measurement conditions in the STANDARD VALUE TABLE.
 - Set the engine speed to 1,100 rpm and release the brake pedal.
 - Set the engine speed to 1,800 rpm and release the brake pedal.
 - Run the engine at full throttle and depress the brake pedal.



4. **Measuring servo piston operating pressure (Output pressure of travel and steering PPC valves)**

- 1) Stop the engine.
- 2) Loosen the hydraulic oil filler cap to release the residual pressure from the hydraulic tank.
- 3) Remove the floor cover.
- 4) Turn tow valve lever (1) of the travel brake circuit downward until it stops (to the full close position).
- 5) Disconnect the hose of the circuit to be measured among "front" ends (7) and (8) and "rear" ends of the servo piston inlet hoses.
The hoses to be disconnected are forward side (7) and reverse side (8) of front pump and forward side and reverse side of rear pump
- 6) Install adapter **C4** and nipple **C3** of oil pressure kit **C**, then connect oil pressure gauge **C1** (5.9 MPa {60 kg/cm²}).



- 7) Measuring output pressure for travel (Travel PPC valve)
 - Follow the measurement conditions in the STANDARD VALUE TABLE.
- 8) Measuring output pressure for steering (Steering PPC valve)

Run the engine at full throttle and move the steering lever without moving the machine and measure the oil pressure.

 - Follow the measurement conditions in the STANDARD VALUE TABLE.



Adjusting

- ★ The high pressure relief valve cannot be adjusted since it is the safety valve of the main circuit.

1. Adjusting high pressure cut-off valve

- ★ If the high cut-off oil pressure is abnormal, adjust high pressure cut-off valve (11) according to the following procedure.

- 1) Remove the floor cover.
- 2) Loosen locknut (12) and turn the adjustment screw (13) to adjust the high cut-off oil pressure.

- ★ The function of the adjustment screw is as shown below.

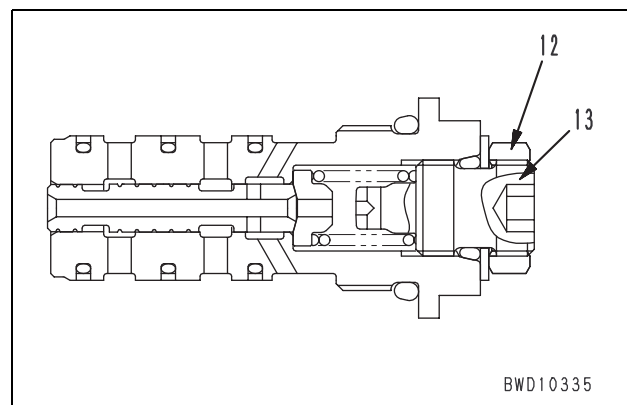
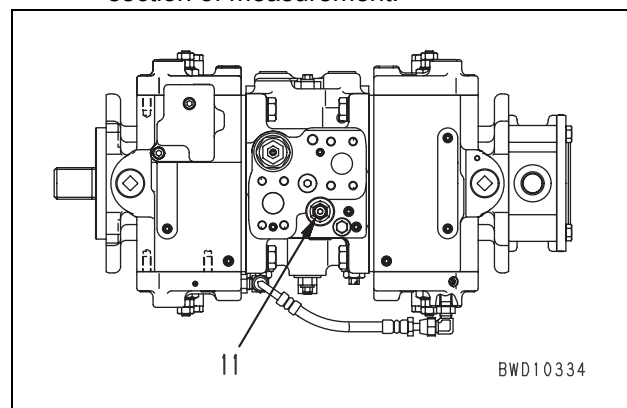
- If it is turned to the right, the pressure is heightened.
- If it is turned to the left, the pressure is lowered.

- ★ Quantity of adjustment by 1 turn of adjustment screw: 19.7 MPa {201 kg/cm²}

- 3) After adjusting, tighten locknut (12).

 **kgm** Locknut: **49 – 64 Nm {5 – 7 kgm}**

- ★ After adjustment is finished, measure the cut-off oil pressure, referring to the above section of measurement.



- ★ After adjustment is finished, measure the cut-off oil pressure, referring to the above section of measurement.

TESTING AND ADJUSTING

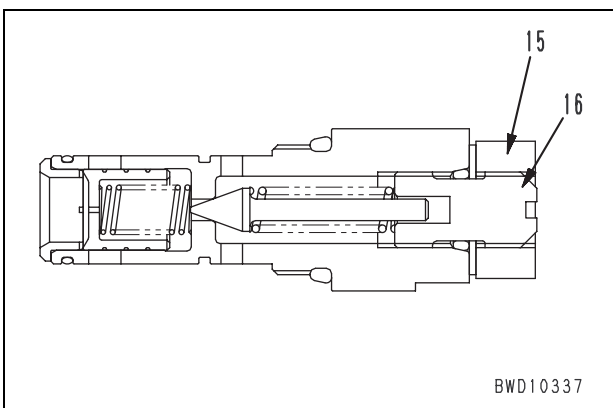
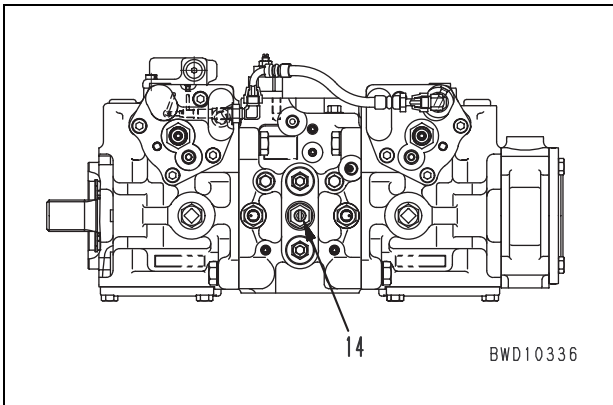
MEASURING AND ADJUSTING HST OIL PRESSURE

2. Adjusting charge safety valve (pump mounting)

- ★ If the charge circuit oil pressure is abnormal, adjust charge safety valve (14) according to the following procedure.
 - 1) Remove the undercover.
 - 2) Loosen locknut (15) and turn the adjustment screw (16) to adjust the charge circuit oil pressure.
- ★ The function of the adjustment screw is as shown below.
 - If it is turned to the right, the pressure is heightened.
 - If it is turned to the left, the pressure is lowered.
- ★ Quantity of adjustment by 1 turn of adjustment screw: 1.55 MPa {15.8 kg/cm²}
- 3) After adjusting, tighten locknut (15).

🔧 Locknut:

58.8 – 78.5 Nm {6 – 8 kgm}
- ★ After adjustment is finished, measure the charge circuit oil pressure, referring to the above section of measurement.

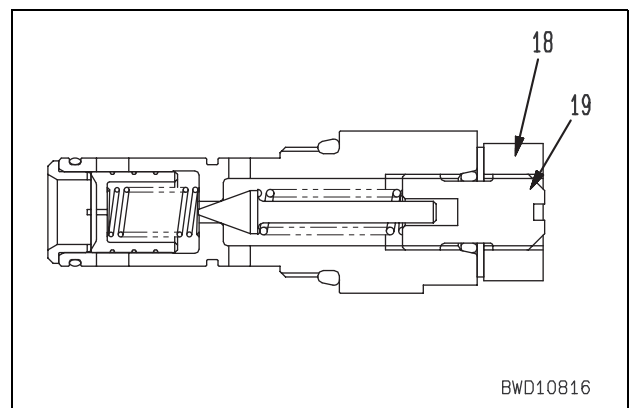
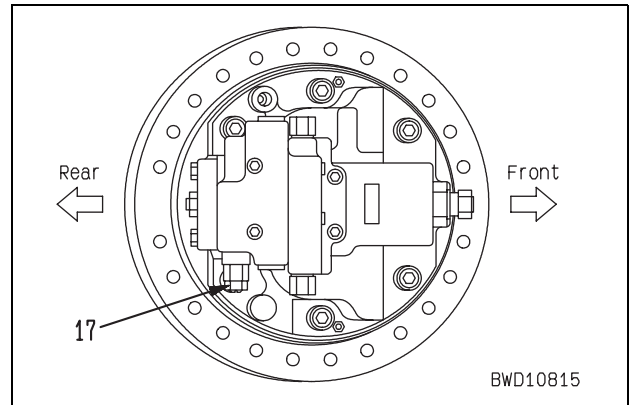


3. Adjusting charge relief valve (motor mounting)

- ★ If the charge circuit oil pressure is abnormal, adjust charge relief valve (17) according to the following procedure.
 - 1) Remove the motor cover.
 - 2) Loosen locknut (18) and turn the adjustment screw (19) to adjust the charge circuit oil pressure.
- ★ The function of the adjustment screw is as shown below.
 - If it is turned to the right, the pressure is heightened.
 - If it is turned to the left, the pressure is lowered.
- ★ Quantity of adjustment by 1 turn of adjustment screw: 1.02 MPa {10.4 kg/cm²}
- 3) After adjusting, tighten locknut (18).

🔧 Locknut:

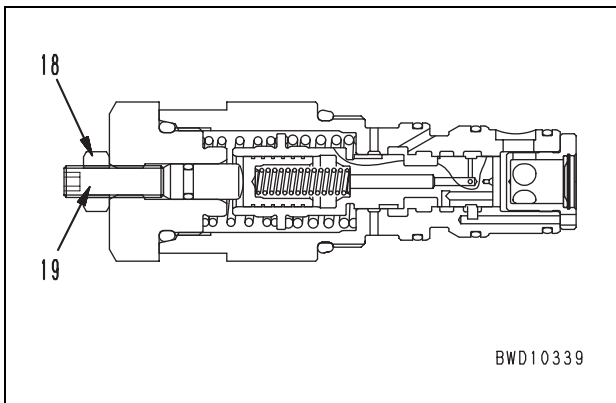
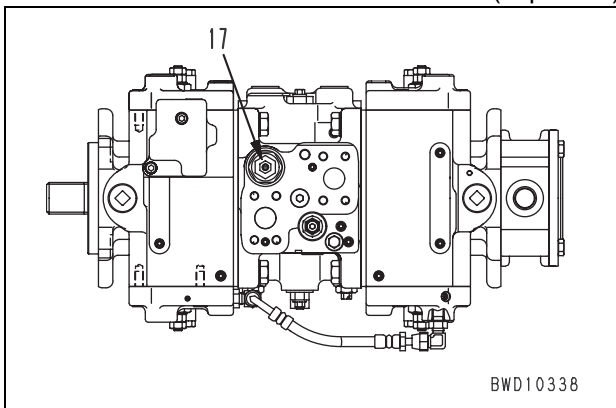
58.8 – 78.5 Nm {6 – 8 kgm}
- ★ After adjustment is finished, measure the charge circuit oil pressure, referring to the above section of measurement.



4. Adjusting AS valve

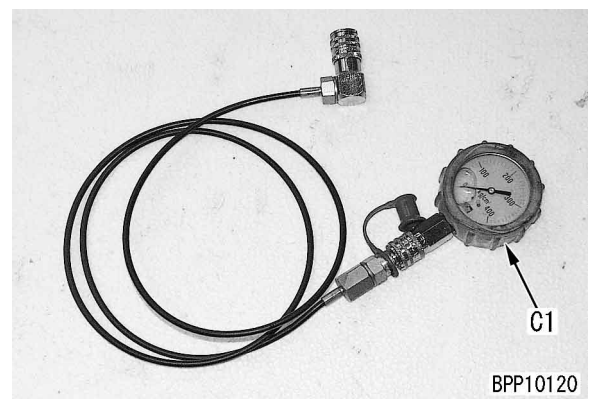
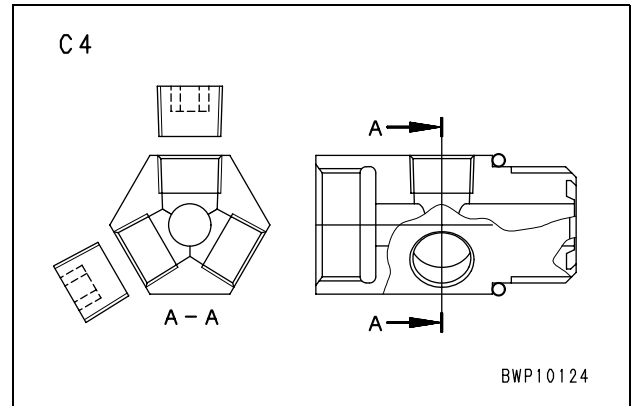
- ★ If the control oil pressure is abnormal, adjust AS valve (17) according to the following procedure.
 - 1) Remove the floor frame assembly.
 - 2) Loosen locknut (18) and turn the adjustment screw (19) to adjust the control oil pressure.
 - ★ The function of the adjustment screw is as shown below.
 - If it is turned to the right, the pressure is heightened.
 - If it is turned to the left, the pressure is lowered.
 - ★ Quantity of adjustment by 1 turn of adjustment screw: 0.24 MPa {2.4 kg/cm²}
 - 3) After adjusting, tighten locknut (18).
-  Locknut:
- 9.8 – 14.7 Nm {1 – 1.5 kgm}**
- ★ After adjustment is finished, measure the control oil pressure, referring to the above section of measurement.
 - ★ When measuring the control oil pressure after adjusting the adjustment screw, lower the engine speed to stabilize the position of the internal parts (spool, spring, etc.) before measuring.
 - ★ When measuring the control oil pressure, check that the oil temperature is within the specified range.
 - Oil temperature (condition):

45 – 55°C (important)



MEASURING SOLENOID VALVE OUTPUT PRESSURE

- ★ Oil temperature for measurement: 45 – 55°C
1. Disconnect the outlet hose of the solenoid valve to be measured and install adapter **C4** and nipple **C3** between the measuring portion and hose.
 2. Install oil pressure gauge **C1** (5.9 MPa {60 kg/cm²}) to nipple **C3**.
 3. Run the engine at full throttle and measure the output pressure according to the conditions in the following table.



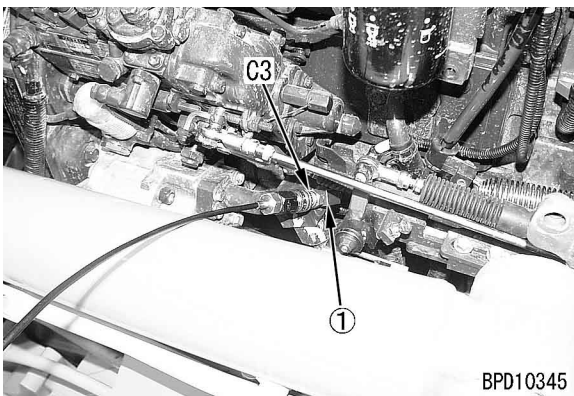
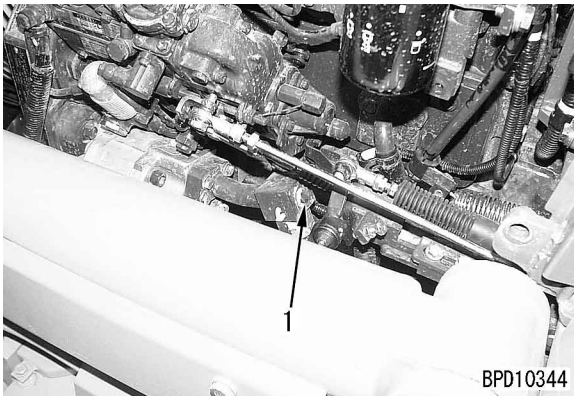
Solenoid name		Measurement condition			State of machine	State of solenoid	Oil pressure (MPa {kg/cm ² })	Remarks
		Fuel control lever	Travel lever	Safety lock lever				
1	2nd gear speed selector	Full	Neutral	—	1st gear speed	OFF	0	—
					2nd gear speed	ON	3.2 ± 0.3 {32 ± 3}	
					3rd gear speed	OFF	0	
2	3rd gear speed selector	Full	Neutral	—	1st gear speed	OFF	0	—
					2nd gear speed	OFF	0	
					3rd gear speed	ON	3.2 ± 0.3 {32 ± 3}	
3	Parking brake	Full	Neutral	Released	Brake is released	ON	3.2 ± 0.3 {32 ± 3}	—
				Locked	Brake is applied	OFF	0	
4	HST (Oil pressure changeover valve)	Full	Neutral	Released	Signal is OFF	OFF	0	—
				Locked	Signal is ON	ON	3.2 ± 0.3 {32 ± 3}	

MEASURING AND ADJUSTING WORK EQUIPMENT MAIN RELIEF PRESSURE

- ⚠ Stop the machine on a level ground and lower the blade to the ground and apply the parking brake.
- ⚠ Loosen the hydraulic oil filler cap slowly to release the internal pressure of the hydraulic tank.
- ★ When installing the oil pressure gauge, remove the all dirt and sand from the plug.

1. Measuring

- ★ Oil temperature for measurement: 45 – 55°C
- 1) Remove the engine side cover (left upper).
- 2) Remove oil pressure pickup plug (1) (Thread dia. = 10 mm, Pitch = 1.25 mm) and install adapter ① and nipple **C3** of oil pressure gauge kit **C**, then connect oil pressure gauge **C1** (39.2 MPa {400 kg/cm²}).



- 3) Relieve circuit of the blade lift, blade tilt, and angle cylinders one by one and measure the oil pressure.



- ★ A safety valve is installed to only the angle cylinder circuit. If only the angle cylinder relief pressure is low, the safety valve may be set low.

TESTING AND ADJUSTING MEASURING AND ADJUSTING WORK EQUIPMENT MAIN RELIEF PRESSURE

2. Adjusting

- 1) Remove the mounting bolts of the operator's seat and turn the seat forward.
- 2) Loosen locknut (3) of relief valve (2) and turn adjustment nut (4) to adjust the relief pressure.

⚠ Never remove adjustment nut (4). (If it is loosened too much, it will be removed from the threaded part. Accordingly, take care extremely when removing.)

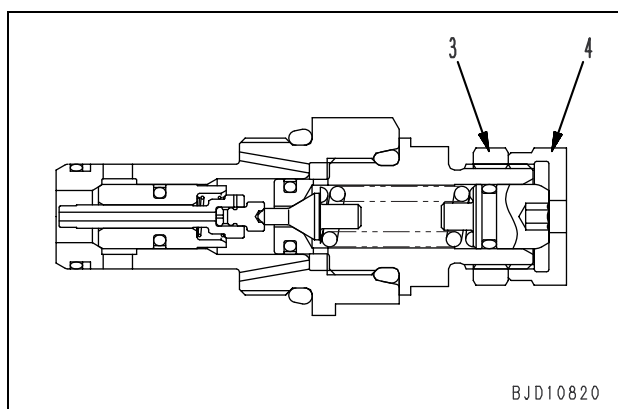
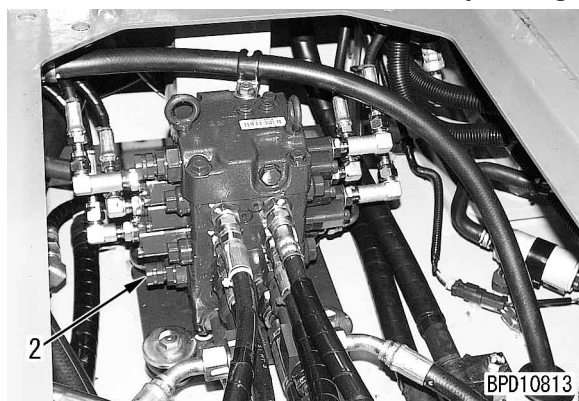
★ The function of the adjustment nut is as shown below.

- If it is turned to the right, the pressure is heightened.
- If it is turned to the left, the pressure is lowered.

★ Quantity of adjustment by 1 turn of adjustment nut: 19.6 MPa {200 kg/cm²}

🔧 Adjustment nut:

39 – 49 Nm {4 – 5 kgm}

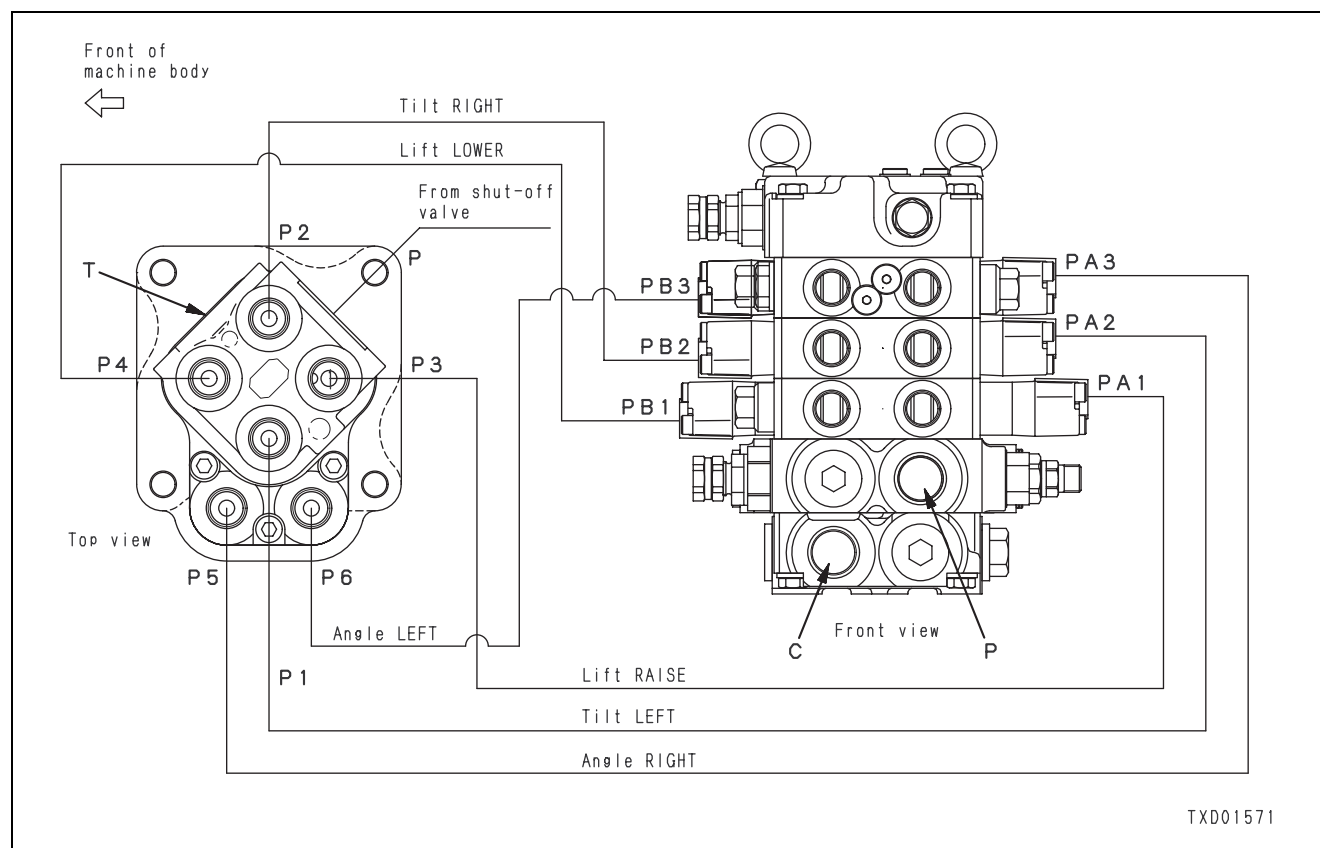
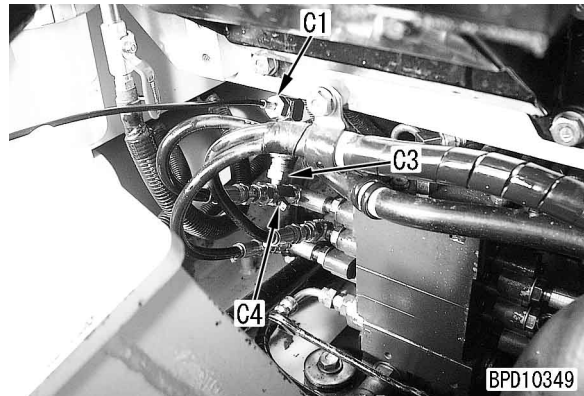


MEASURING PPC VALVE OUTPUT PRESSURE

★ Oil temperature for measurement: 45 – 55°C

1. Measuring PPC valve output pressure

- 1) Disconnect the hose of the circuit to be measured (See the following figure).
- 2) Install adapter **C4** and nipple **C3**.
- 3) Install oil pressure gauge **C1** (5.9 MPa {60 kg/cm²}) to nipple **C3**.
- 4) Run the engine at full throttle and operate the control lever of the circuit to be measured, then measure the oil pressure.

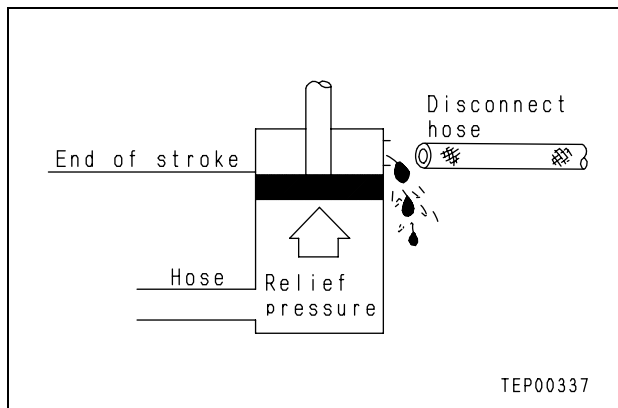


MEASURING LEAKAGE INSIDE CYLINDER

- If the quantity of hydraulic drift exceeds the standard value, measure it to see if its cause is on the cylinder side or on the control valve side according to the following procedure.
 - ★ Oil temperature for measurement: 45 – 55°C
- 1. Measuring position**
 - 1) Blade lift cylinder
 - Ride on a block until the front part of the track shoe is on it and extract the cylinder rod to the stroke end.
 - 2) Blade tilt cylinder
 - Extract the cylinder rod to the stroke end to lower the blade tip to the ground.
 - 3) Blade angle cylinder
 - Extract the angle cylinder rod to the stroke end to lower the blade to the ground.

2. Measuring

- 1) Disconnect the piping on the head side and plug the piping on the machine side.
 ⚠ Take care not to disconnect the piping on the bottom side.
- 2) Run the engine at full throttle to apply relief pressure to the bottom side of the cylinder.
- 3) Measure leakage for 1 minute after 30 seconds.



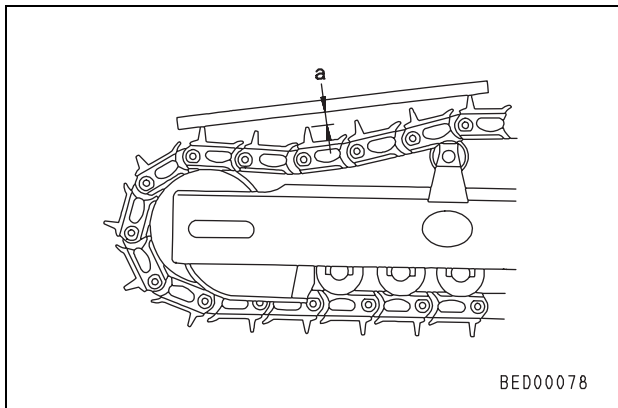
BLEEDING AIR FROM HYDRAULIC CYLINDERS

- ★ When a hydraulic cylinder is removed and installed or replaced or when the hydraulic piping is removed, bleed air from the hydraulic cylinders according to the following procedure.
- 1) Run the engine idle for about 5 minutes.
 - 2) Run the engine at low speed and raise the cylinder up and down 4 – 5 times.
 - ★ Move the piston rod to about 100 mm before the stroke end and never relieve the oil.
 - 3) Run the engine at full throttle and perform the operation in 2) above, then run the engine at low speed and move the piston rod to the stroke end to relieve the oil.
 - 4) Bleed air from the other cylinders according to the steps 2) and 3) above.

TESTING AND ADJUSTING TRACK SHOE TENSION

⚠ Since the machine must be moved to adjust the track shoe tension, be sure to set the work equipment safety lock lever to the "LOCK" position.

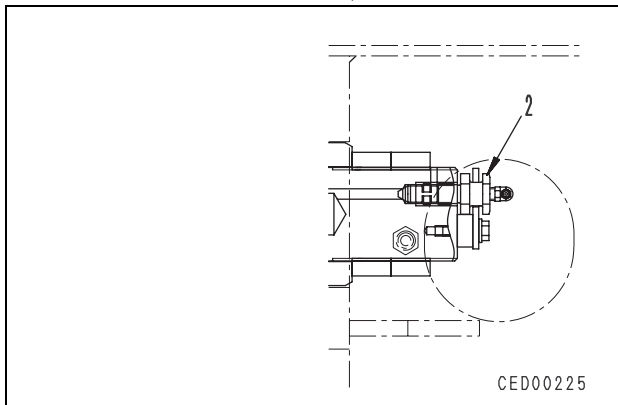
1. Stop the machine on a level ground.
 - ★ Move the machine forward and stop it without applying the brake.
2. Place a straight bar between the front idler and carrier roller and adjust clearance "a" between it and grouser at center.
 - ★ Dimension "a": 20 – 30 mm



3. Tensing track shoe

Supply grease through lubricator (2).

- ★ If the grease does not flow in, move the machine forward slowly. Stop without applying the brake at this time, too.



4. Loosening track shoe

Loosen lubricator (2) gradually.

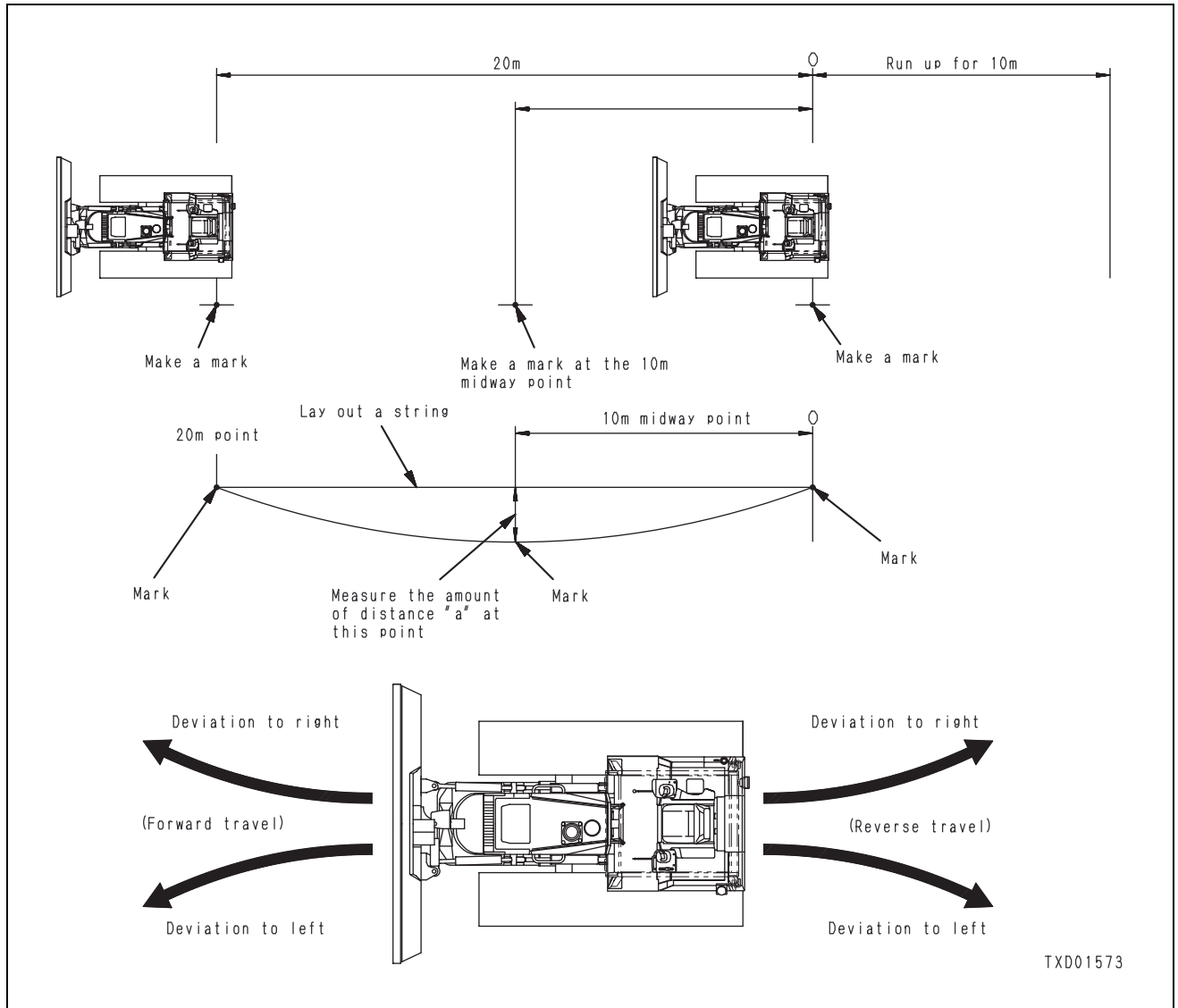
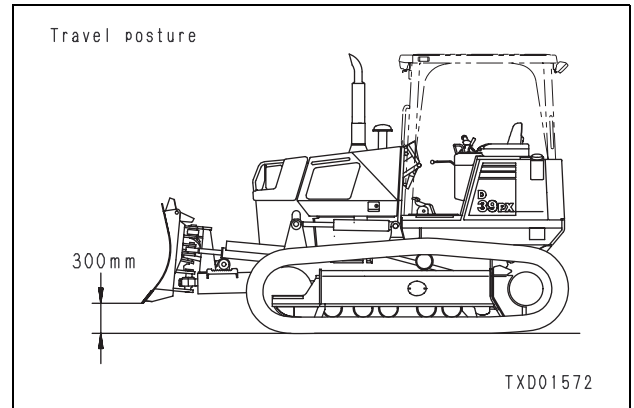
- ⚠** Since high pressure is applied to the lubricator, do not loosen it more than 1 turn. If the grease does not flow out, move the machine forward and in reverse slowly.

TESTING AND ADJUSTING TRAVEL DEVIATION

- ★ Perform the following work while no load is applied to the machine or while the machine is traveling on a hard, flat ground. (concrete, etc.)

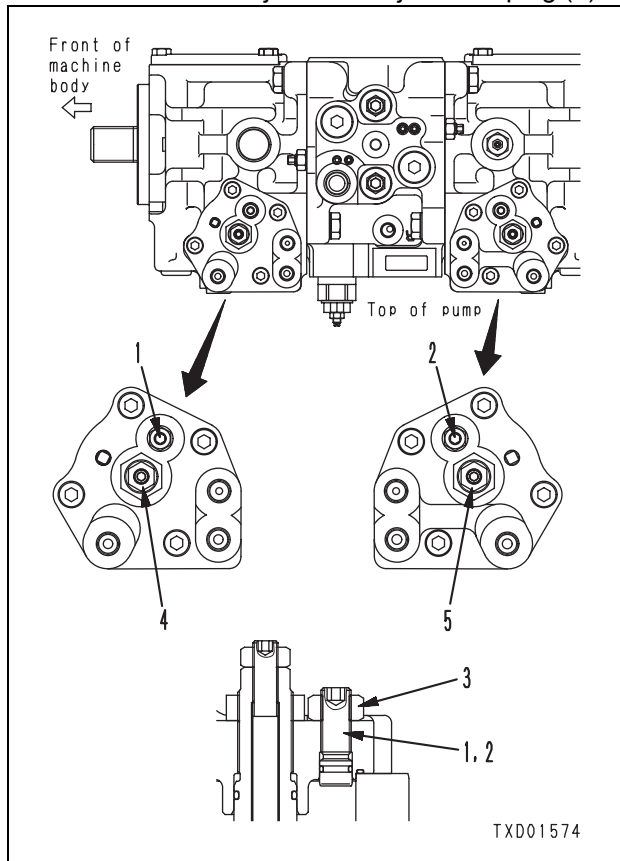
1. Measurement by traveling

- 1) Set the machine in the traveling position.
 - ★ When driving the machine, raise the blade to about 300 mm above the ground.
- 2) After approach run of 10 m, measure the travel deviation a in the travel of 20 m.
 - ★ When measuring the travel deviation, run the engine at full throttle.
 - ★ At this time, install a pressure gauge and measure the pump discharge pressure, too.



2. Adjusting travel deviation

- 1) Check the position of the adjustment plug of the HST pump.
 - When machine deviates during reverse travel: Adjust with adjustment plug (1).
 - When machine deviates during forward travel: Adjust with adjustment plug (2).

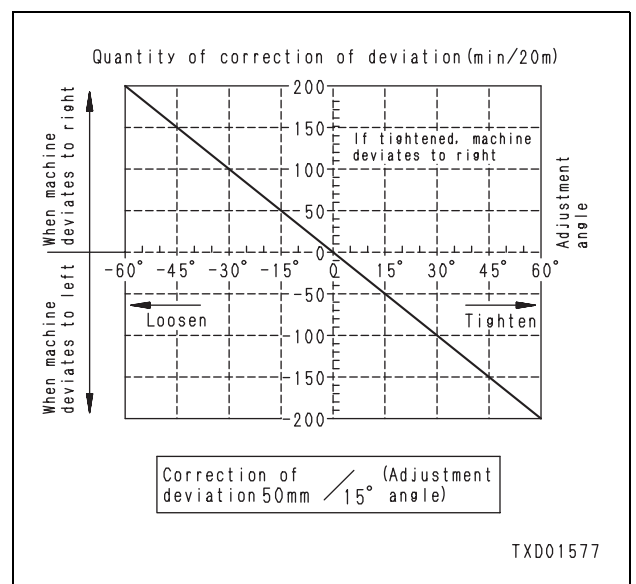
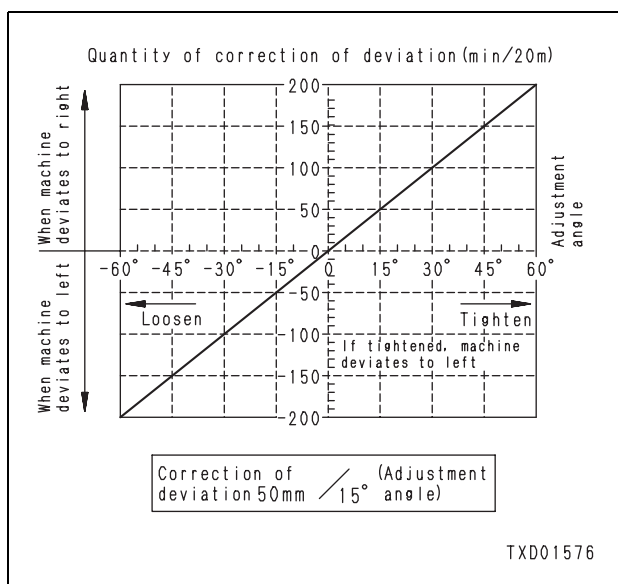
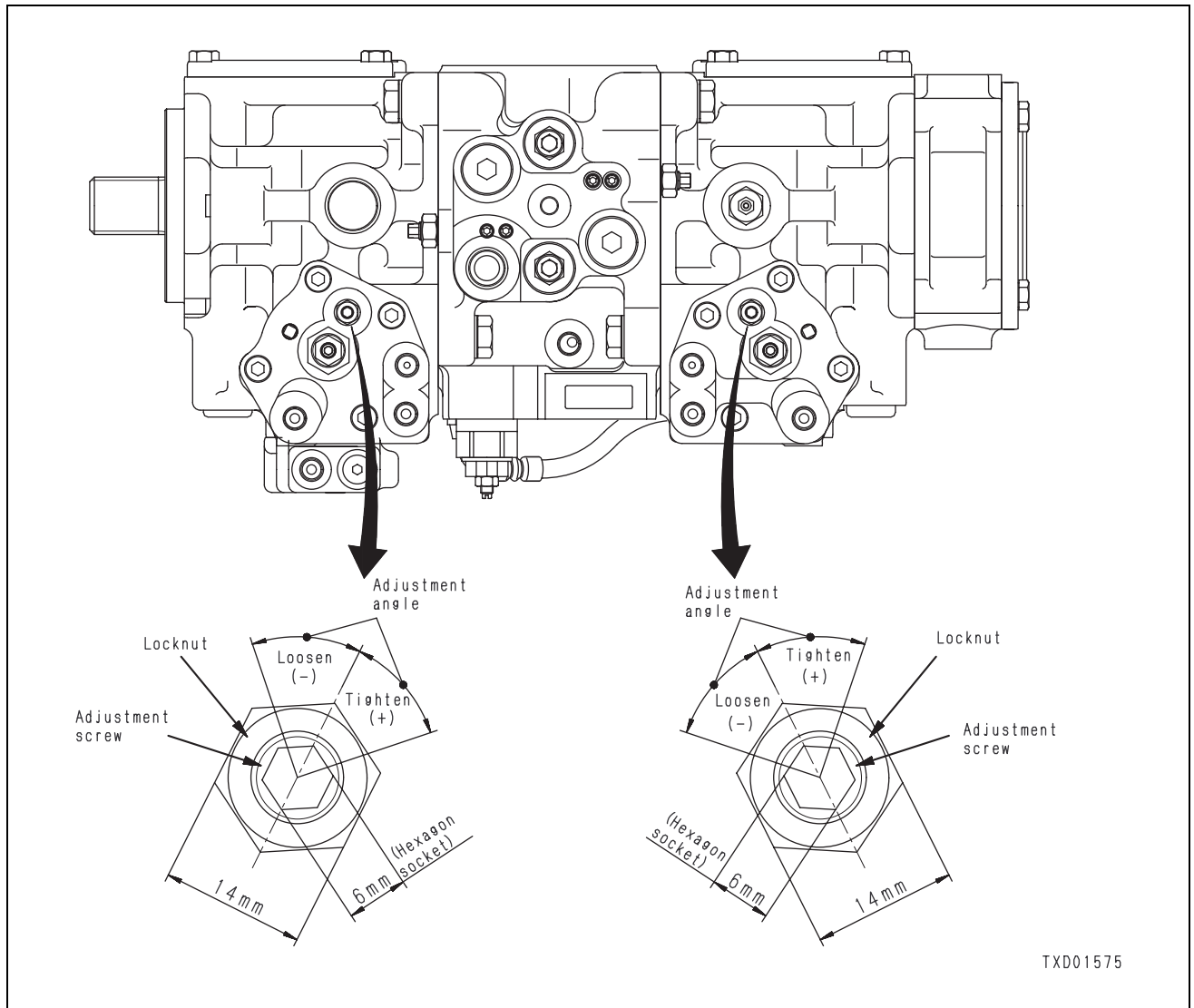


- 3) Fix the hexagonal wrench and loosen locknut (3).
 - ★ Before loosening the locknut, make match mark on the adjustment plug to check the turning angle of the plug.
 - ★ Loosening angle of locknut: 90 – 180°
- 4) Turn the angled by the adjustment angle guessed in advance.
- 5) Tighten the locknut.
 - ⚙️ Locknut: **49 – 56.8 Nm {5 – 6 kgm}**
- 6) Check the travel deviation again. If it is not within the standard range, adjust it again.
 - ★ Never touch screws (4) and (5).

- ★ Check the deviating direction and quantity of deviation and correct them according to the table on the next page. Guess the plug to be turned and its adjustment angle in advance.
- 2) Insert hexagonal wrench (width across flats: 6 mm) in adjustment plug (1) or (2).
 - ★ Insert the hexagonal wrench securely.

TESTING AND ADJUSTING

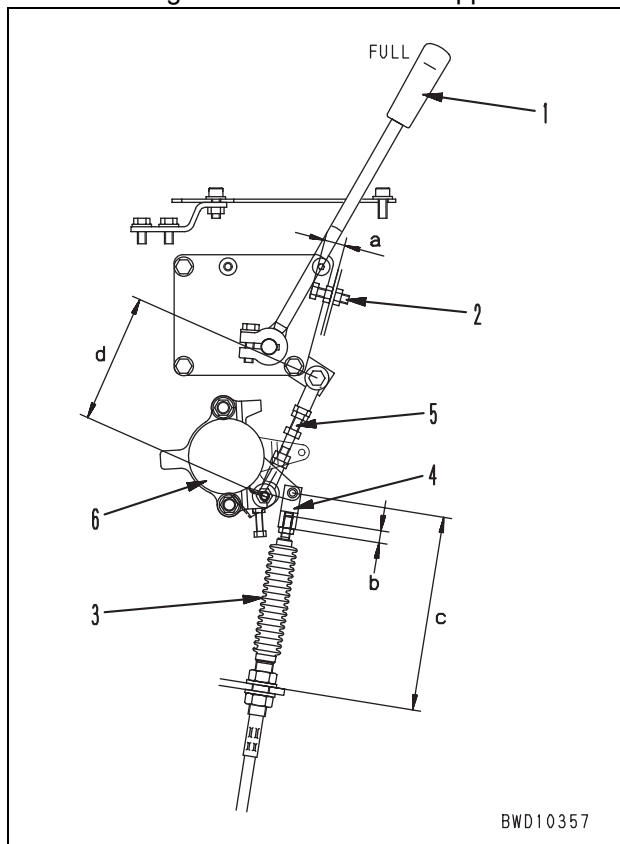
TESTING AND ADJUSTING TRAVEL DEVIATION



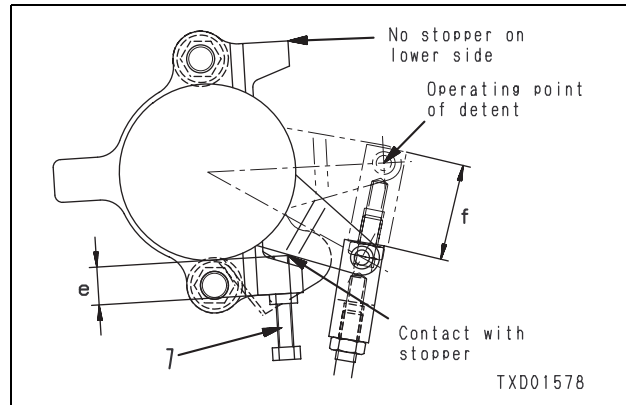
ADJUSTING FUEL CONTROL LINKAGE

1. Adjusting operator frame section

- 1) Adjust projection distance "a" of FULL-side stopper bolt (2) of fuel control lever (1), screwing distance "b" of cable (3) in yoke (4), and length "c" of the tip of cable (3).
 - ★ Distance "a": 19 mm
 - Distance "b": 11.5 mm
 - Length "c": 172.5 mm
- 2) Adjust dimension "d" of connecting rod (5) between the fuel control lever and clutch assembly (6).
 - ★ Dimension "d": 123 mm
 - ★ Install the fuel control lever, pressing it against the FULL-side stopper.



- 3) Adjust dimension "e" of FULL-side stopper bolt (7) of clutch assembly (6).
 - ★ Dimension "e": 15 – 16 mm
 - ★ If dimension "d" of rod (5) and/or dimension "c" of the tip of cable (3) are/is shorter than the specified value(s), stroke "f" (37 mm) of the lever of clutch assembly (6) cannot be obtained. Accordingly, be sure to adjust those dimensions accurately.

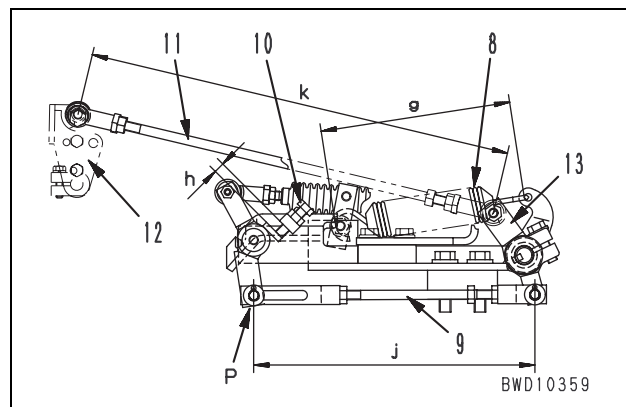


2. Adjusting bracket assembly section

- 1) Adjust rod (9) to set installed length "g" of spring (8).
 - ★ Length "g": 164 – 166 mm
 - ★ Standard dimension "j" of rod (9): 241.5 mm
- 2) Adjust dimension "h" of the tip of FULL-side stopper bolt (10).
 - ★ Dimension "h": 9 mm

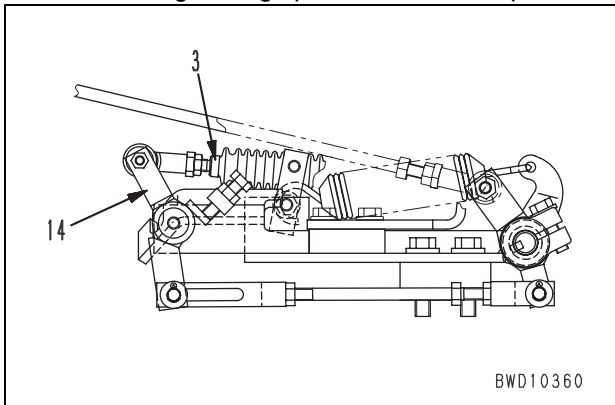
3. General adjustment

- 1) Install rod (11) between governor relay (12) and lever (13).
 - ★ Adjust the length of rod (11) so that governor relay (12) will be in contact with the FULL-side stopper and there will be no clearance between the pin of part P and the oblong hole end of the rod.
 - ★ Standard dimension "k" of rod (11): 366 mm

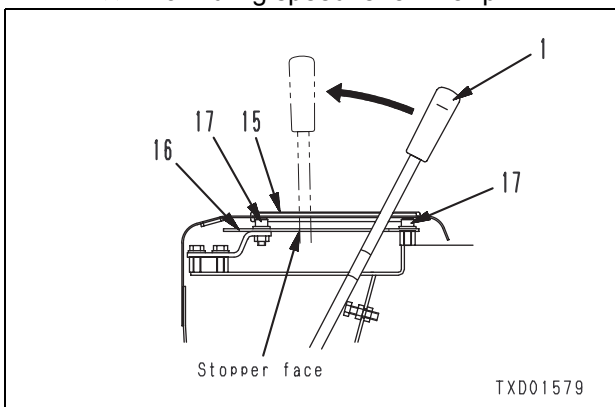


- 2) Set the fuel control lever to the FULL position and install fuel control cable (3) to lever (14).

★ High idling speed: $2,200 \pm 50$ rpm



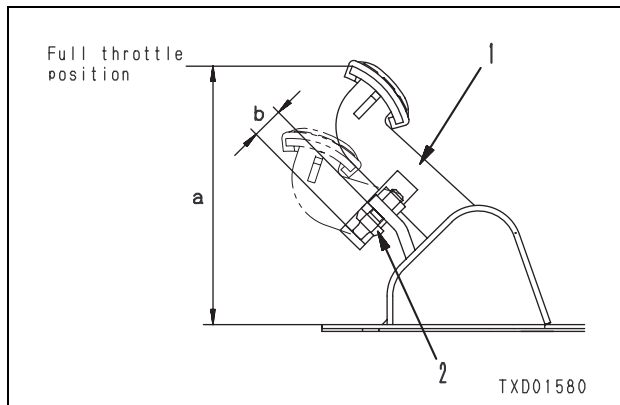
- 3) Adjusting low idling stopper
 - i) Remove rubber cover (15).
 - ii) Loosen bolt (17) of low idling stopper plate (16).
 - iii) Move fuel control lever (1) until the governor relay of the fuel injection pump comes in contact with the low idling stopper, then move it to about the middle point of its stroke.
 - iv) Move fuel control lever (1) again until the governor relay comes in contact with the low idling stopper.
- ★ At this time, push out low idling stopper plate (16) forward. This position is the low idling position of fuel control lever (1).
- v) With low idling stopper plate (16) in contact with the fuel control lever, tighten bolt (17).
- ★ Low idling speed: 825 ± 25 rpm



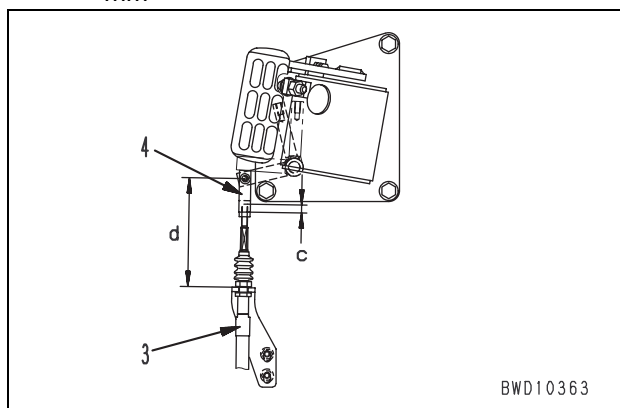
ADJUSTING DECELERATOR PEDAL LINKAGE

Adjusting

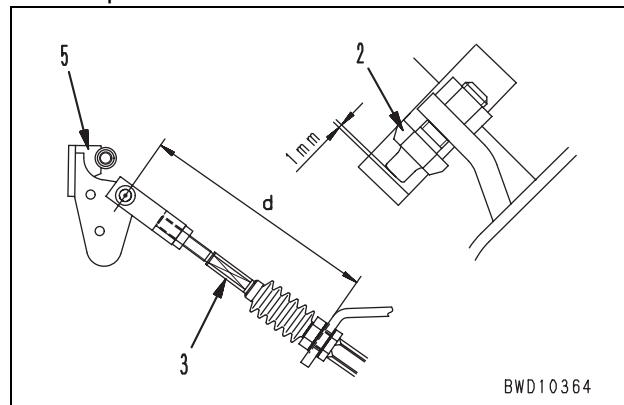
1. Fix full stopper bolt (2) at height "a" of pedal (1) above the floor.
 - ★ Pedal height "a": 205 mm (With rubber cover removed)
 - ★ Projection distance "b" of full stopper bolt: 25 mm



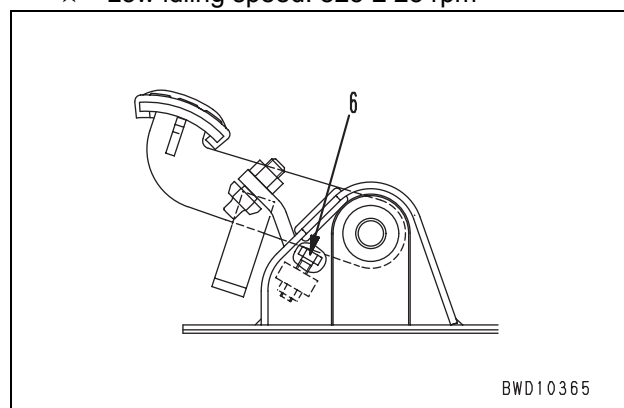
2. Adjust screwing distance "c" of cable (3) in yoke (4) and length "d" of the tip of cable (3).
 - ★ Dimension "c": 11 mm, Dimension "d": 141 mm



3. With injection pump governor lever (5) at the FULL position, connect cable (3).
 - ★ Standard installed length "d" of cable (3): 158.5 mm
 - ★ At this time, check that there is clearance of 1 mm between full stopper bolt (2) and stopper.



4. Adjust pedal idle stopper bolt (6) and fix it with the locknut so that the engine speed will be as follows when the pedal is pressed to the stroke end.
 - ★ Low idling speed: 825 ± 25 rpm

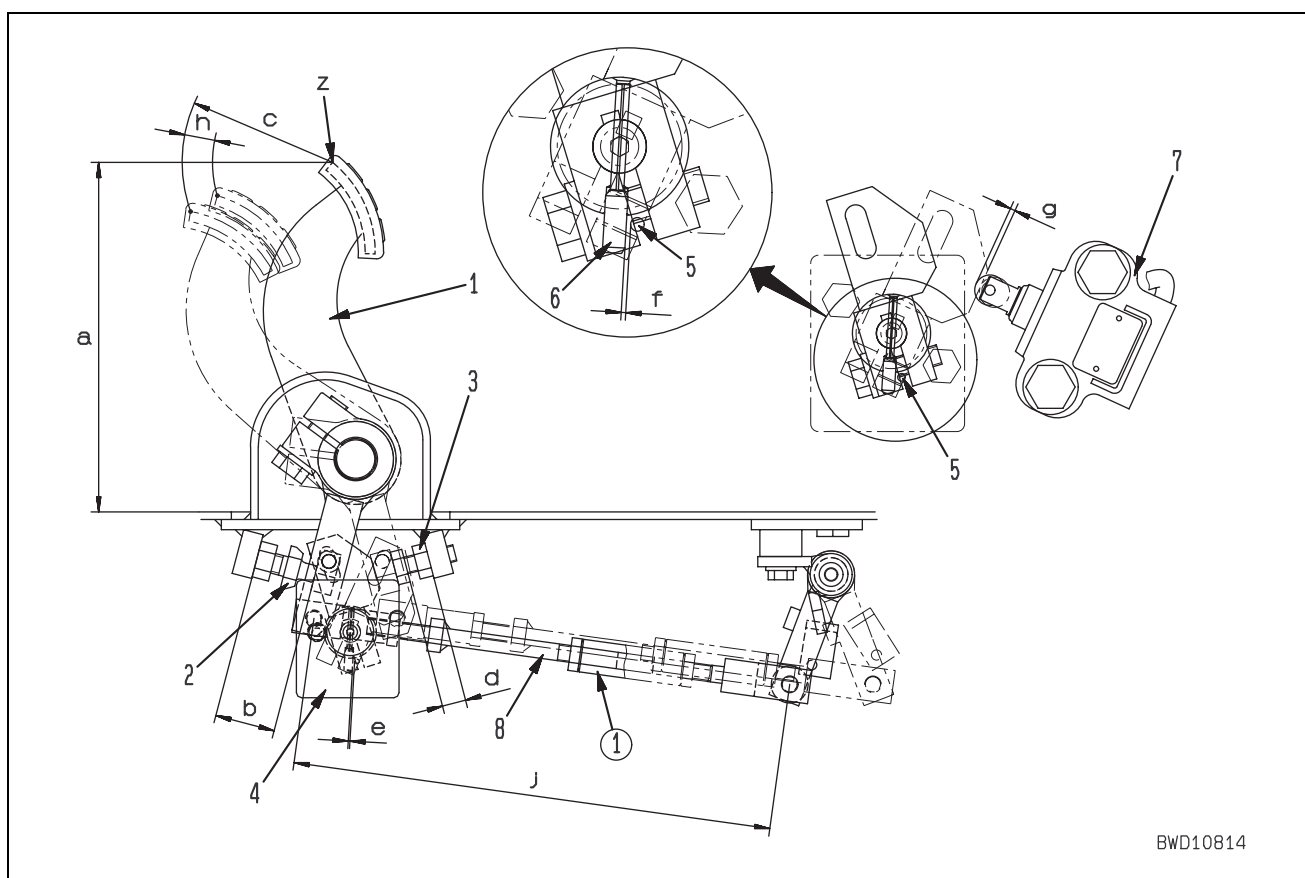


TESTING AND ADJUSTING

ADJUSTING BRAKE PEDAL LINKAGE

Adjusting

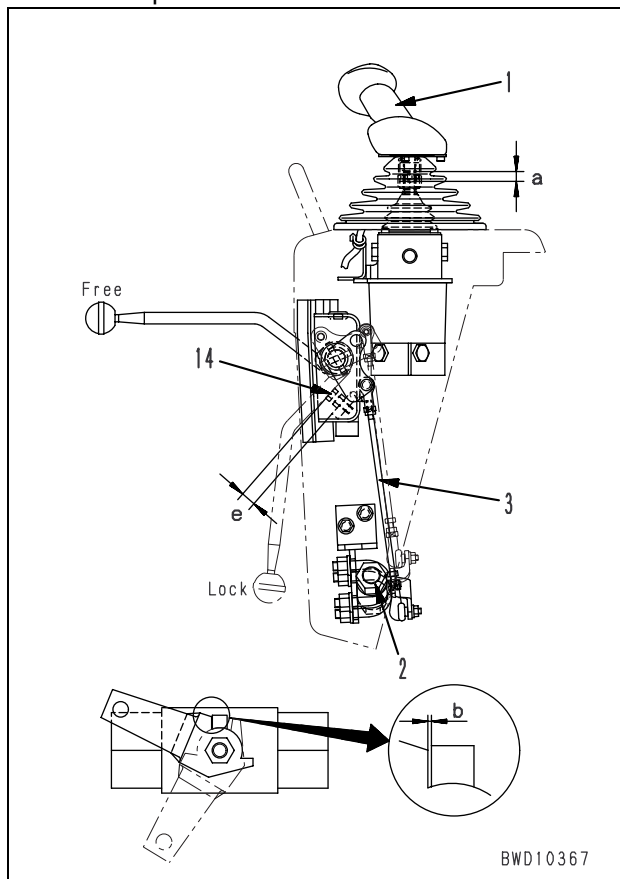
1. Adjust height "a" of brake pedal (1) above the floor with stopper bolt (2).
 - ★ Height "a": 208 mm
 - ★ Standard dimension "b" of stopper bolt (2): 36 mm
2. Adjust stroke "c" of brake pedal (1) with stopper bolt (3).
 - ★ Stroke "c": $89^{+3.5}_0$ mm
 - ★ Standard dimension "d" of stopper bolt (3): 21 mm
3. Install valve (4) so that clearance "e" between it and stopper pin (5) will be 0.5 – 1.0 mm when "the pedal is released".
4. Install valve (6) so that clearance "f" between it and stopper pin (5) will be 0.5 – 1.0 mm when "the pedal is pressed to the stroke end".
5. Install limit switch (7) so that stroke "g" will be 2 – 2.5 mm.
6. Adjust effective stroke "h" of the 2-stage spring for the brake pedal to 18 – 29 mm.
 - ★ If turnbuckle ① is shortened by 1 turn, the 2nd-stage pedal stroke is increased by about 4.5 mm at part Z.
 - ★ Standard length "j" of rod (8): 286 – 292 mm



ADJUSTING STEERING/DIRECTIONAL/GEAR SHIFT LEVER AND LOCK LEVER

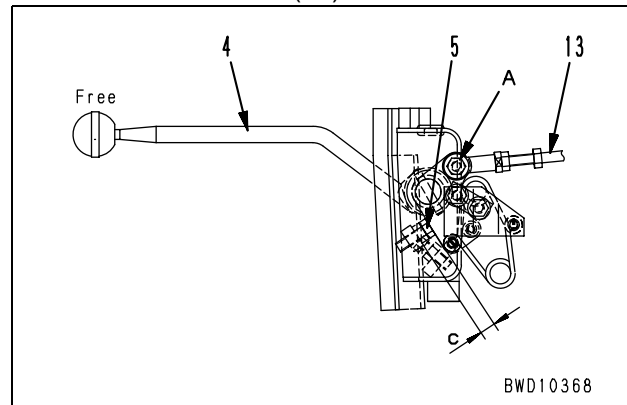
1. Adjusting steering control

- ★ Before installing the boot after repairing wiring, etc., operate the lever to check that the wiring does not interfere with an edge of the valve, cover, etc.
- 1) Standard screwing distance "a" of knob (1): 12 mm
- 2) When adjusting the position of the lock lever, adjust stopper bolt (14) so that clearance "b" between the lever and stopper will be 0.1 – 0.5 mm when shut-off valve (2) is closed fully.
 - ★ Standard projection distance "e" of stopper bolt: 17 mm



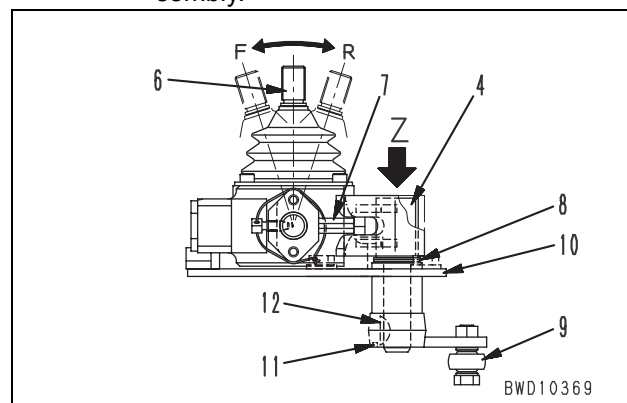
2. Adjusting steering lock lever

- Adjust stopper bolt (5) so that lock lever (4) will be in parallel with the top of the floor frame.
- ★ Standard projection distance "c" of stopper bolt: 125 mm
- ★ Disconnect rod (13).

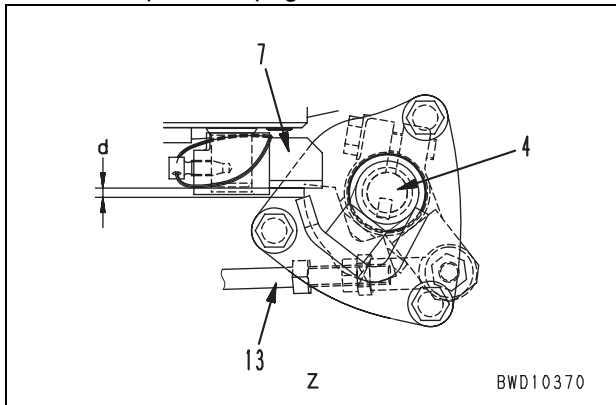


3. Adjusting lock position of PPC valve

- 1) Set directional lever (6) in the vertical position.
- 2) Adjust the height of lock lever (4) with shim (8) so that lock lever (4) will enter lock plate (7) without interfering with the lock plate.
 - ★ Part No. of shim:
 - 11Y-43-11850 (0.5 mm)
 - 11Y-43-11860 (0.3 mm)
- 3) Procedure for adjusting shim
 - i) Disconnect rod end (9) and remove the 3 bolts of bracket (10), then remove lock lever assembly (4).
 - ii) Remove boss (11) and key (12) and insert shim (8) between lock lever (4) and bracket (10) to adjust the height of lock lever (4).
 - iii) If the height of lock lever (4) is adjusted properly by the work in ii) above, reassemble in the reverse order to disassembly.



- 4) Check that clearance "d" between lock lever (4) and lock plate (7) is 2 ± 1 mm, then connect rod (13) to part **A** in the illustration on the previous page.



⚠ After adjusting, move the directional lever to the forward or reverse position and then move the lock lever to the lock position and check that the lever is returned to the neutral position securely. Then, move the directional lever to the opposite position and perform the same operation again.

ADJUSTING PROXIMITY SWITCH OF BACKUP BUZZER (ALARM)

1. Adjusting operation to turn on alarm

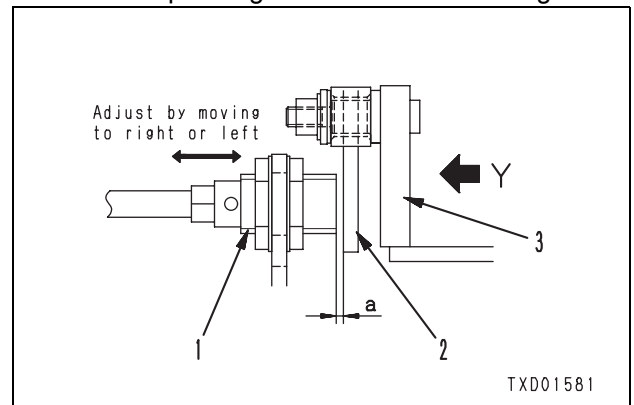
- 1) Adjust clearance "a" between proximity switch (1) and reflection lever (2) for reverse travel.

★ Clearance "a": 2 ± 0.5 mm

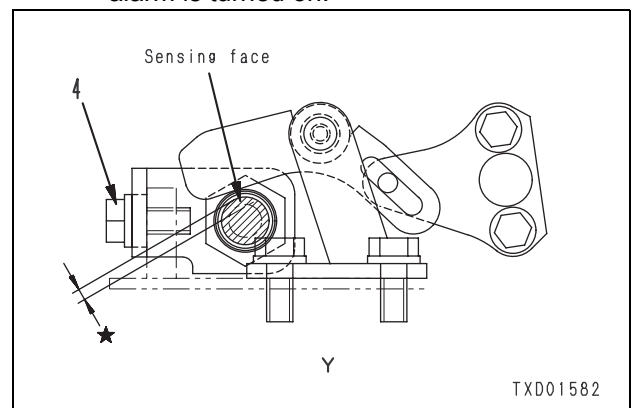
★ Precaution for installing bracket (3)

If bracket (3) is not installed in parallel with lever (2), lever (2) will scuff and the lapping distance of the switch-on position marked ★ will change.

- 2) Move the directional lever slowly to the reverse position and adjust the height of the proximity switch with adjustment bolt (4) so that the alarm will sound at point "P" where the operating effort of the lever changes.



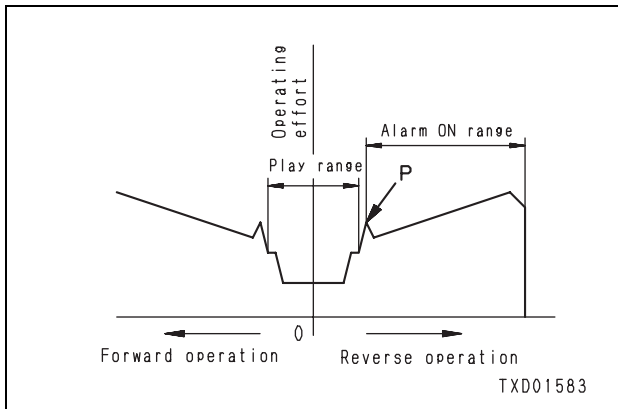
- 3) If lapping distance marked ☆ below is about 3.5 mm and clearance "a" is 2 ± 0.5 mm, the alarm is turned on.



TESTING AND ADJUSTING ADJUSTING STEERING/DIRECTIONAL/GEAR SHIFT LEVER AND LOCK LE-

2. Relationship between PPC valve operating effort graph and position to turn on alarm

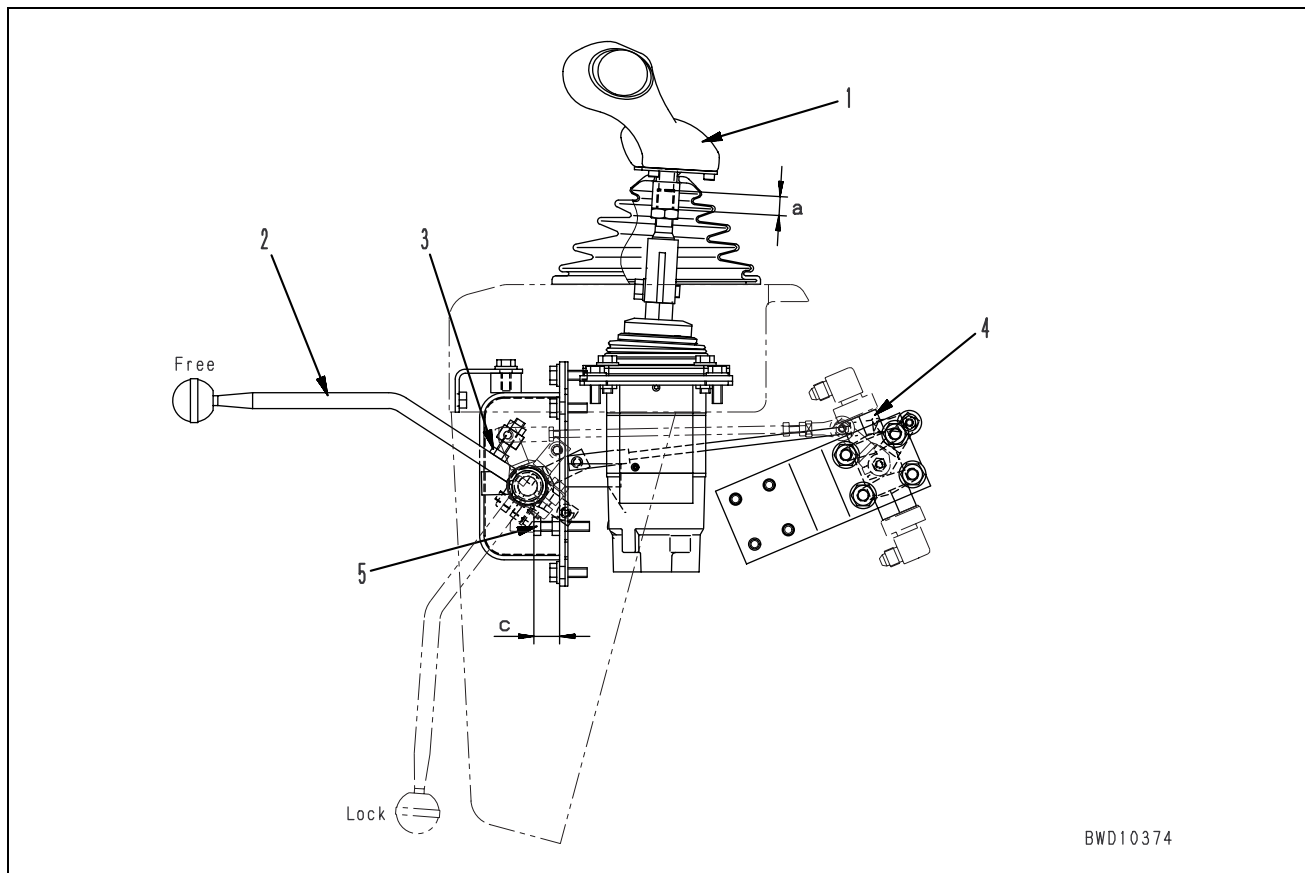
- Point **P**: The alarm must be turned on at the point of the maximum operating effort of the detent.



ADJUSTING BLADE CONTROL LEVER AND LOCK LEVER

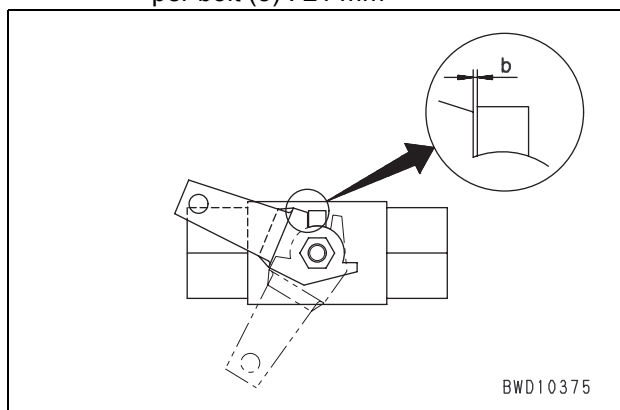
1. Adjusting blade control

- 1) Standard screwing distance "a" of knob (1):
12 – 15 mm



2. Adjusting blade lock lever

- 1) Adjust stopper bolt (3) so that lock lever (2) will be in parallel with the top of the floor frame.
- 2) Adjust stopper bolt (5) so that clearance "b" between the lever of shut-off valve (4) and stopper will be 0.1 – 0.5 mm when lock lever (2) is set to the LOCK position.
 - ★ Standard projection distance "c" of stopper bolt (5) : 21 mm



ADJUSTING WORK EQUIPMENT PPC VALVE

- ★ If the work equipment control lever has much play, adjust it according to the following procedure.

⚠ Lower the work equipment to the ground and stop the engine. Then, loosen the hydraulic oil filler cap slowly to release the internal pressure of the hydraulic tank.

1. Removing PPC valve

- ★ Adjust so that disc (1) and locknut (2) in the figure will be seen.

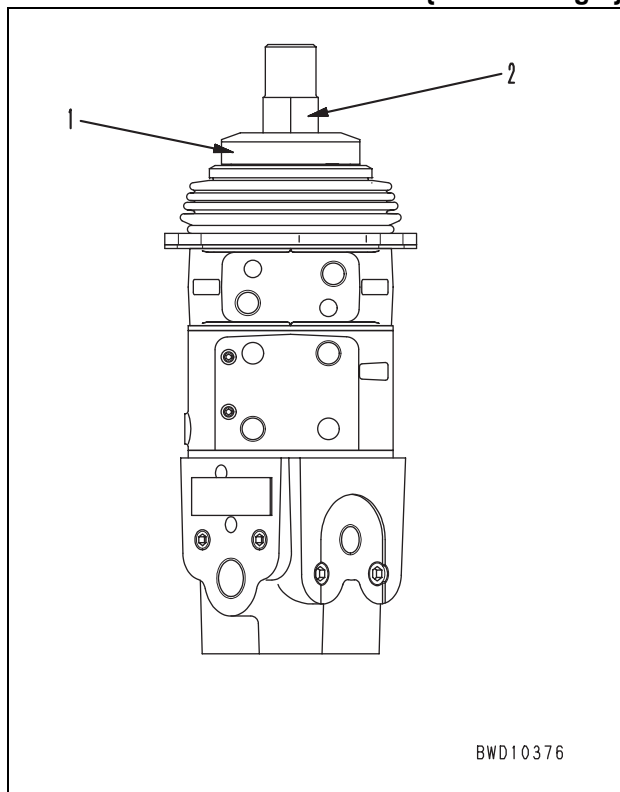
2. Loosen locknut (2) and screw in disc (1) to adjust the play.

- ★ Play of lever: Max. 3 mm (at center of lever knob)
- ★ If locknut (2) is tightened, the play of the lever is reduced a little. Accordingly, count in the reduction of the play when adjusting.

3. Fix disc (1) and tighten locknut (2) to the specified torque.

 Locknut:

$112.5 \pm 14.5 \text{ Nm}$ { $11.5 \pm 1.5 \text{ kgm}$ }



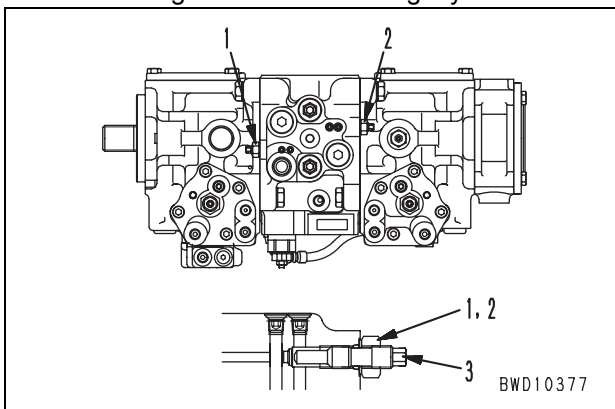
PROCEDURE FOR RELEASING PARKING BRAKE

- ★ If the parking brake of the travel motor cannot be released and the machine needs to be towed, release it according to the following procedure.
- ★ Connect a special pump assembly to the towing machine and release the parking brake with the oil pressure of the pump.

1. Connecting pump assembly

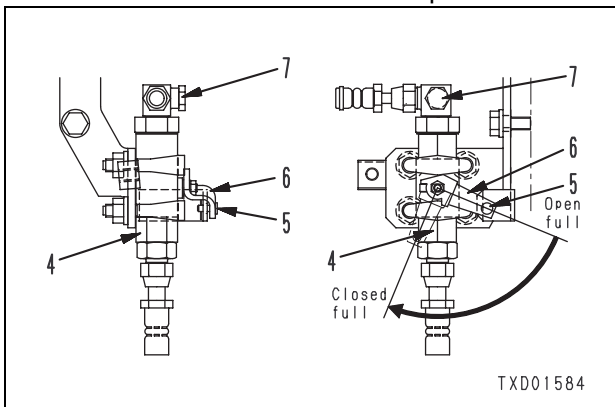
⚠ Apply blocks to the tracks of the machine so that the machine will not move.

- 1) Remove the floor cover.
- 2) Loosen locknuts (1) and (2) of the towing valves (3) on the HST pump, then loosen valves (3) by "2 turns".
- ★ Tighten the locknuts lightly.

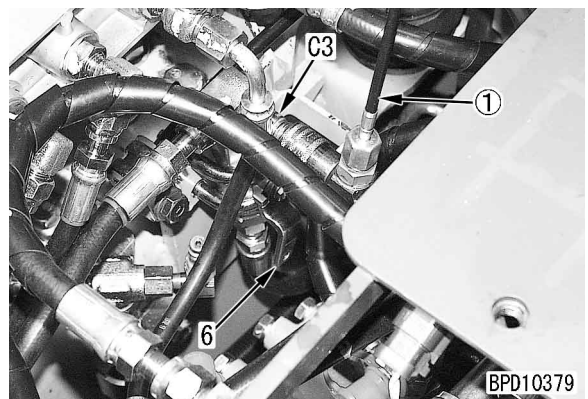
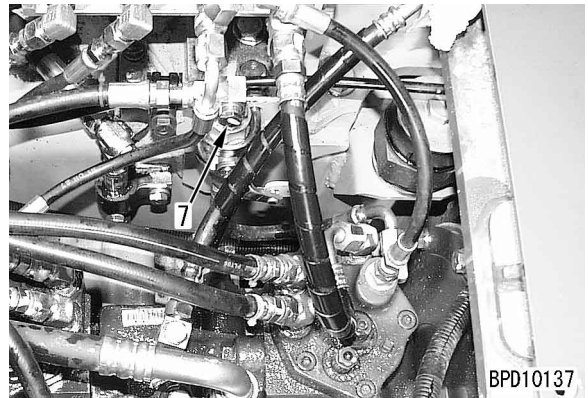


- 3) Remove lock pin (5) of bypass valve (4) and turn lever (6) downward until it stops (to the full open position).

★ Take care not to let the pin fall.



- 4) Remove oil pressure pickup plug (7) (Thread dia. = 10 mm, Pitch = 1.25 mm) and install nipple C3 of oil pressure gauge kit C.



TESTING AND ADJUSTING

PROCEDURE FOR RELEASING PARKING BRAKE

- 5) Install hose ① and pressure gauge ② to the pump assembly **S** for releasing the parking brake, then connect hose ① to nipple **C3**.
- 6) Releasing parking brake and towing
 - 1) Watching the oil pressure gauge of the pump assembly **S** for releasing the parking brake, operate lever ③ and adjust relief valve ④ so that the oil pressure will be "2.7 – 3.1 MPa {28 – 32 kg/cm²}".
 - ★ If the oil pressure exceeds "3.1 MPa {32 kg/cm²}", the component parts of the brake may be damaged. If the oil pressure is below "1.5 MPa {15 kg/cm²}", the parking brake is not released completely. Accordingly, be sure to keep the oil pressure at "1.5 – 3.1 MPa {15 – 32 kg/cm²}".



- 2) The parking brake is released by the above operation. Remove the blocks from the tracks and tow the machine at speed below 2 km/h.
- ★ Observe the oil pressure gauge of the pump assembly while towing the machine. If the gauge pressure lowers to "1.5 MPa {15 kg/cm²}", stop towing and heighten the oil pressure to the specified level.
- 3) After finishing towing, disconnect hydraulic hose ① of the pump assembly **S** and replace nipple **C3** with plug (7) and return lever (6) of bypass valve (4) to the original position and secure it with lock pin (5).
- 4) Tighten 2 towing valves (3) of the HST pump and tighten locknuts (2) and (1).



Valve:

24.5 – 34.5 Nm {2.5 – 3.5 kgm}

Locknut:

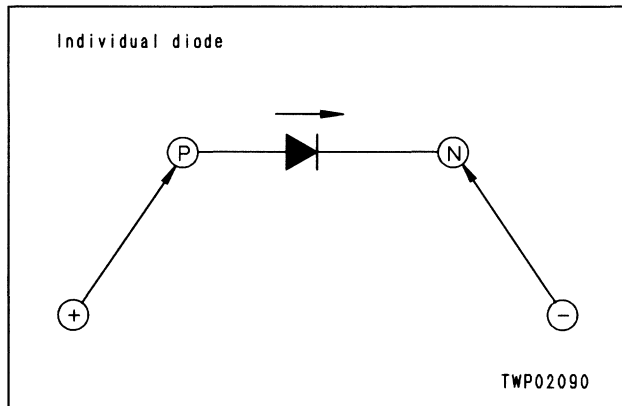
24.5 – 34.5 Nm {2.5 – 3.5 kgm}

PROCEDURE FOR INSPECTING DIODE

- Inspect a diode or a harness containing a diode according to the following procedure.
- Use a digital tester having a diode range.

1. Apply the red (+) test pin to the anode (P) side of the diode and apply the black (–) test pin to the cathode (N) side.

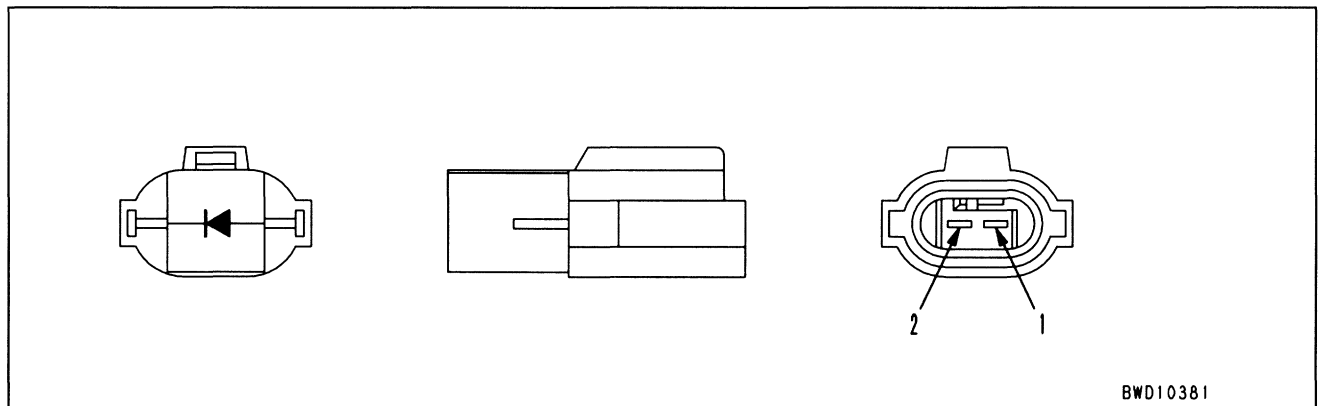
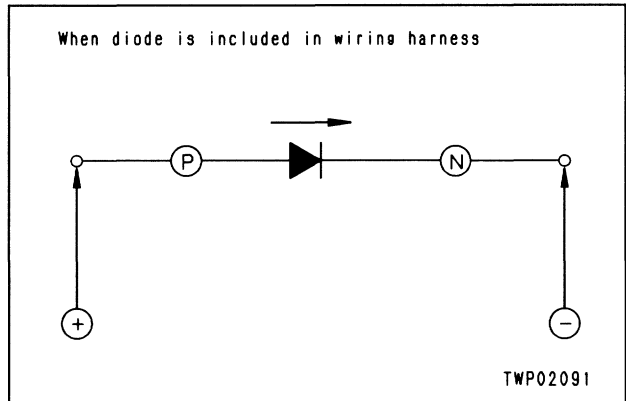
★ The conductive direction mark is made on the diode surface.



2. If the diode range is selected, the tester indicates the voltage of the internal battery.

- If this voltage does not change, the diode has not conductivity.
- If this voltage changes, the diode has conductivity (is normal) (Note).
- If this voltage is 0 or almost 0, the diode is shorted internally.

Note) A silicon diode indicates 450 – 600 in normal condition.



TROUBLESHOOTING

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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.

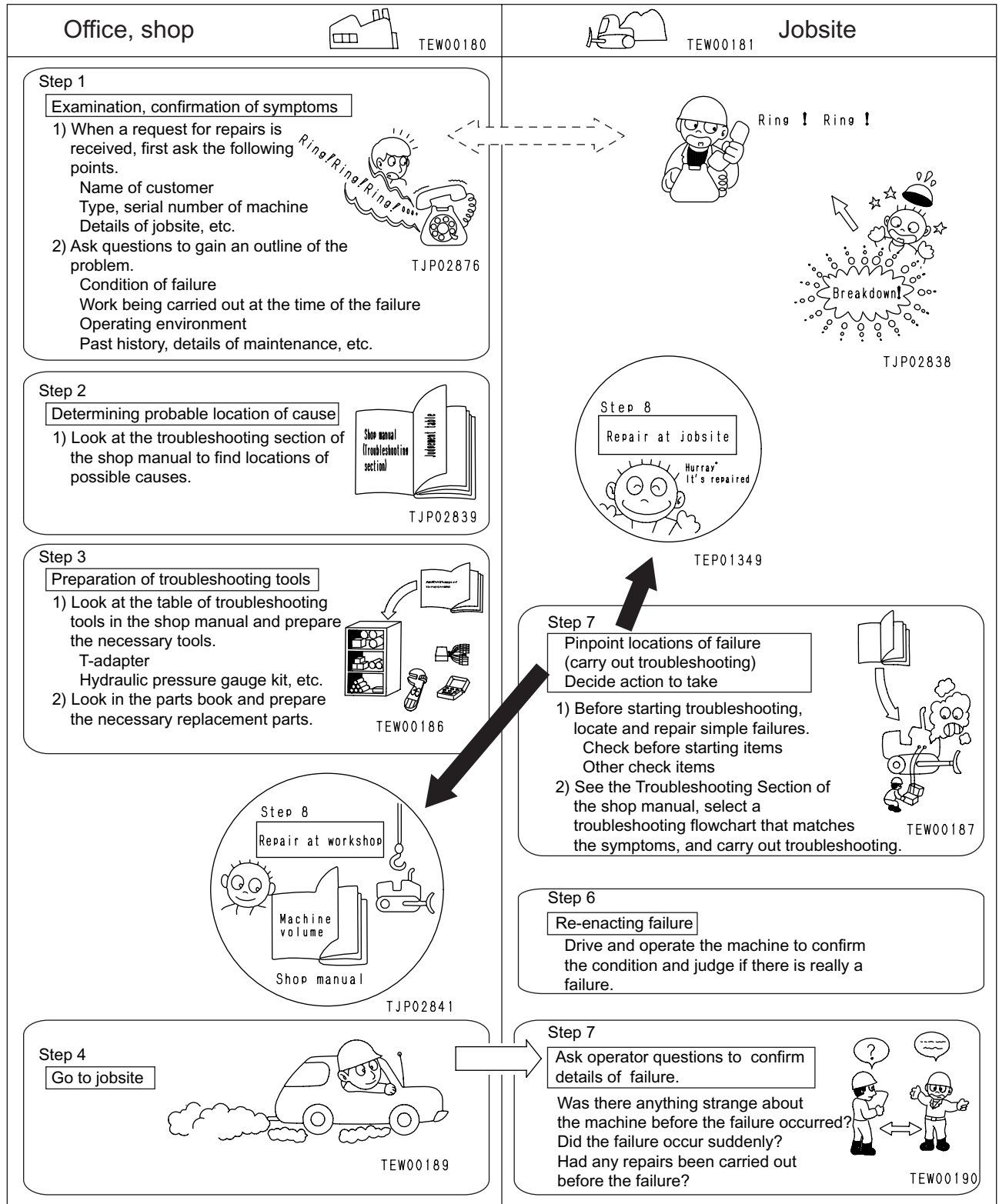
5. Troubleshooting

- 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



POINTS TO REMEMBER WHEN CARRYING OUT MAINTENANCE

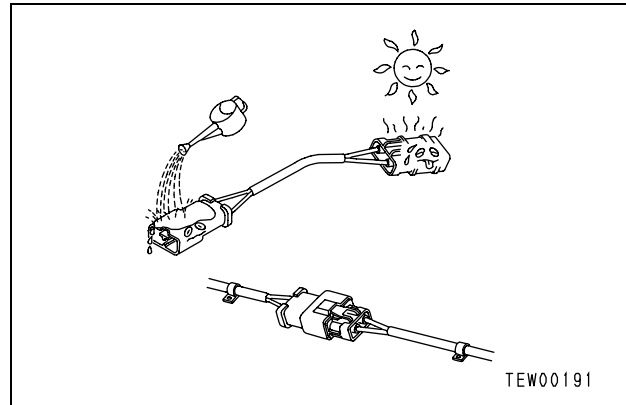
To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct operation, maintenance and inspection, troubleshooting, and repairs must be carried out. This section deals particularly with correct repair procedures for mechatronics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

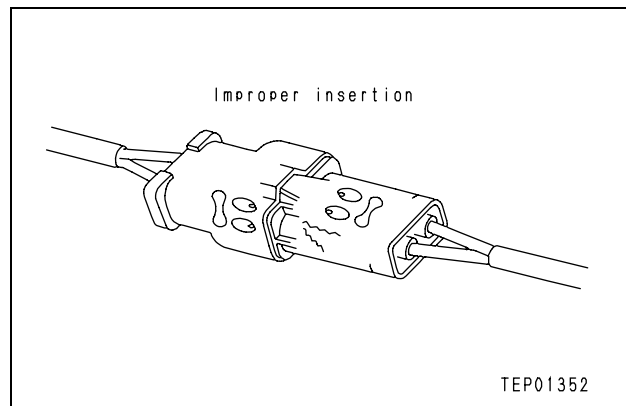
Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations, they are frequently removed and installed again, so they are likely to suffer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



Main failures occurring in wiring harness

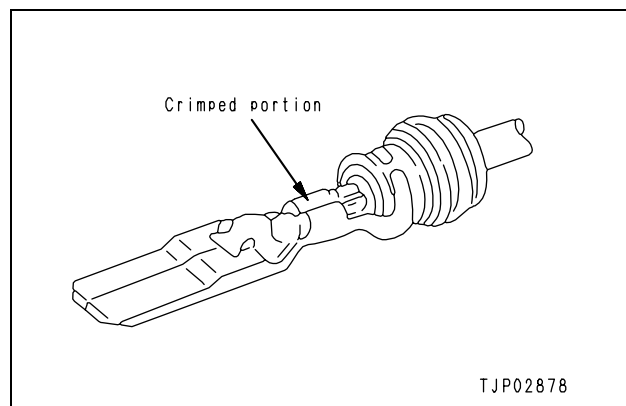
1) Defective contact of connectors (defective contact between male and female)

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



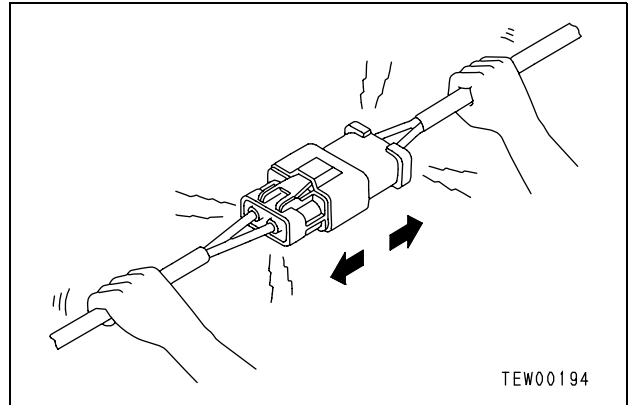
2) Defective crimping or soldering of connectors

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



3) Disconnections in wiring

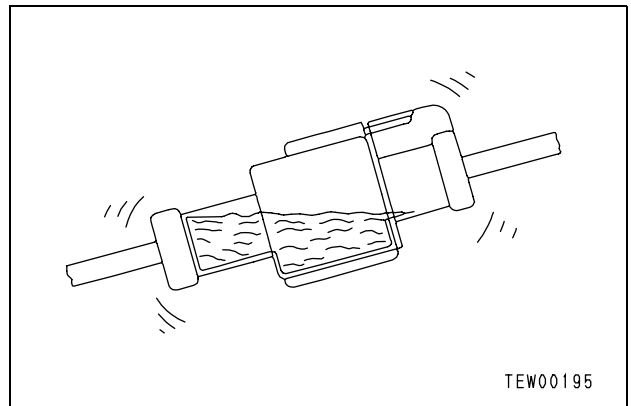
If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping of the connector may separate, or the soldering may be damaged, or the wiring may be broken.



4) High-pressure water entering connector

The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector, depending on the direction of the water jet.

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.

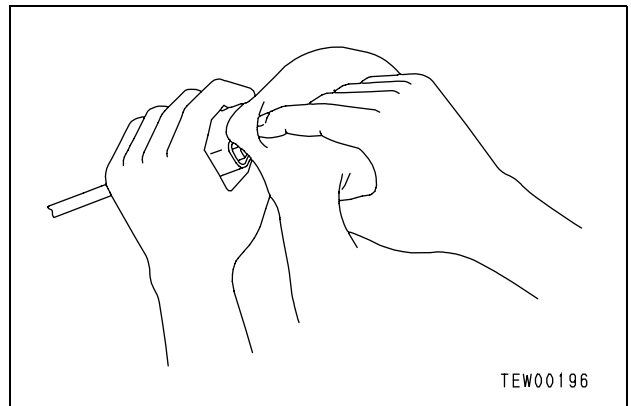


5) Oil or dirt stuck to connector

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.

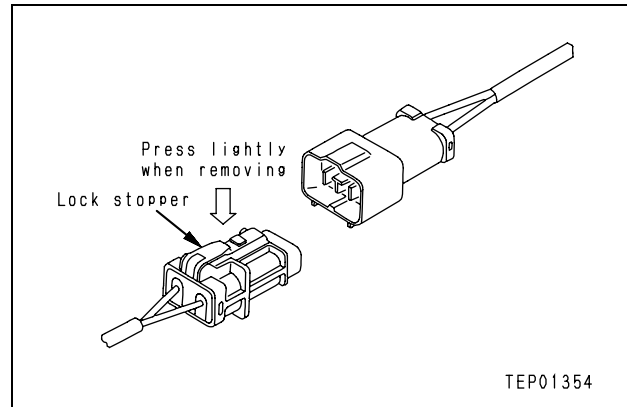


2) Removing, installing, and drying connectors and wiring harnesses

• Disconnecting connectors

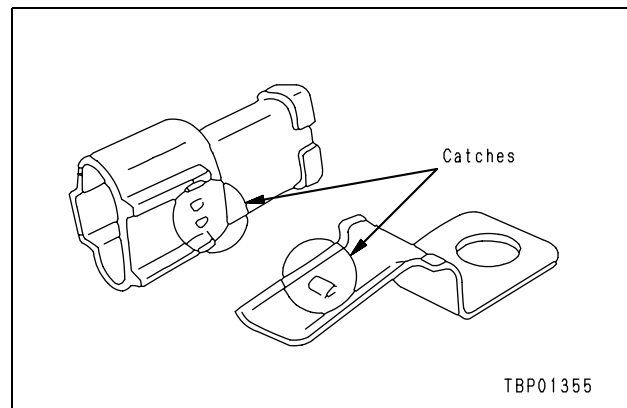
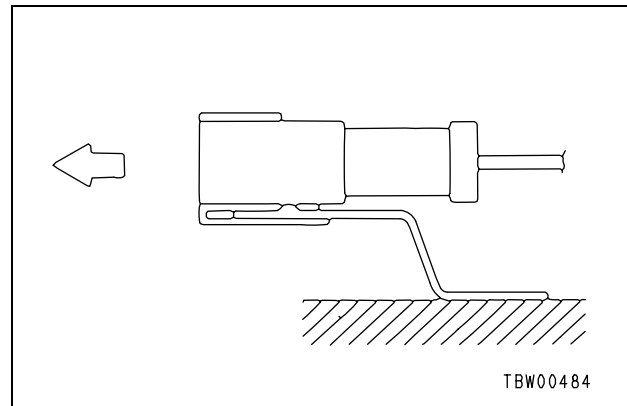
- 1) Hold the connectors when disconnecting.
When disconnecting the connectors, hold the connectors and not the wires. For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.

★ Never pull with one hand.



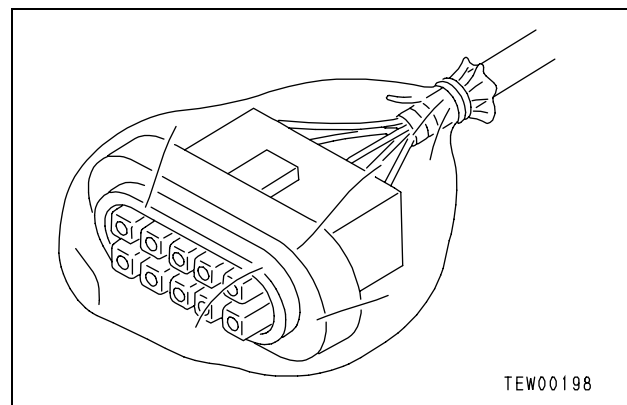
- 2) When removing from clips
When removing a connector from a clip, pull the connector in a parallel direction to the clip.

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



- 3) Action to take after removing connectors
After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.

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



- **Connecting connectors**

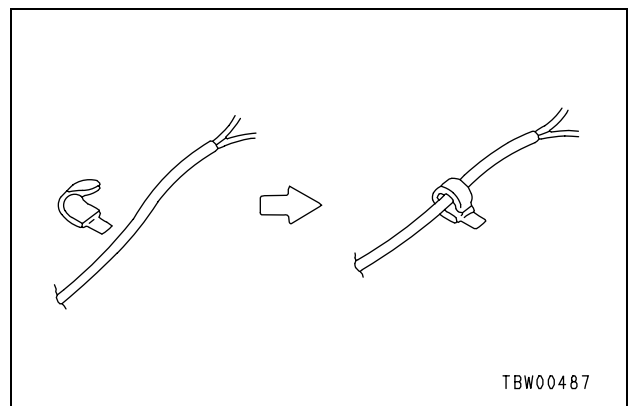
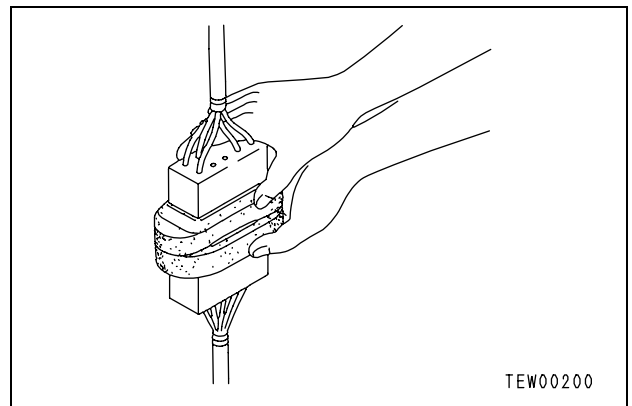
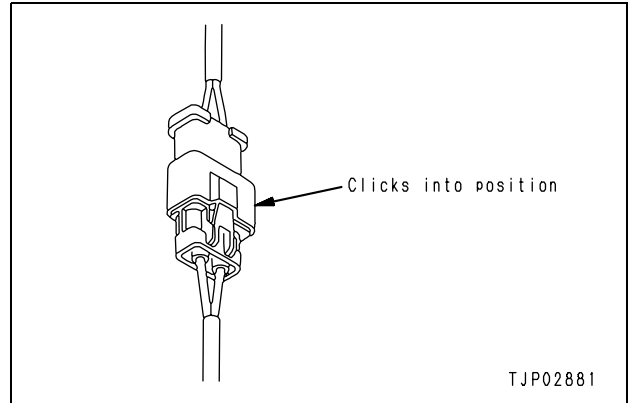
- 1) Check the connector visually.
 - 1) Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).
 - 2) Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.
 - 3) Check that there is no damage or breakage to the outside of the connector.
 - ★ If there is any oil, water, or dirt stuck to the connector, wipe it off with a dry cloth. If any water has got inside the connector, warm the inside of the wiring with a dryer, but be careful not to make it too hot as this will cause short circuits.
 - ★ If there is any damage or breakage, replace the connector.
- 2) Fix the connector securely.

Align the position of the connector correctly, then insert it securely.

For connectors with lock stopper, push in the connector until the stopper clicks into position.
- 3) Correct any protrusion of the boot and any misalignment of the wiring harness

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

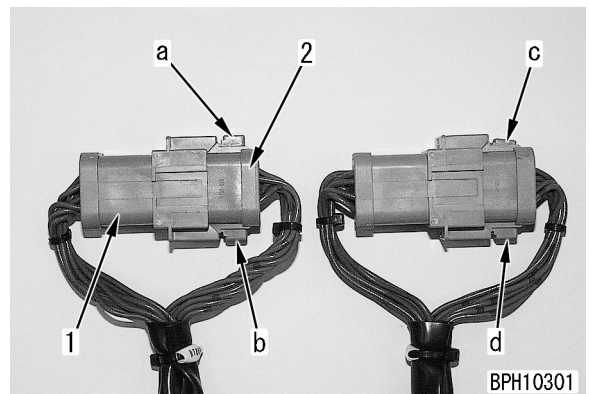
 - ★ If the connector cannot be corrected easily, remove the clamp and adjust the position.
- 4) If the connector clamp has been removed, be sure to return it to its original position. Check also that there are no loose clamps.



- **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**



• **Drying wiring harness**

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

If water gets directly on the connector, do as follows.

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

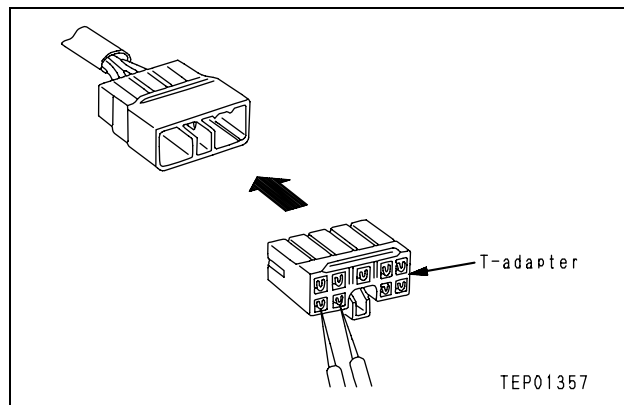
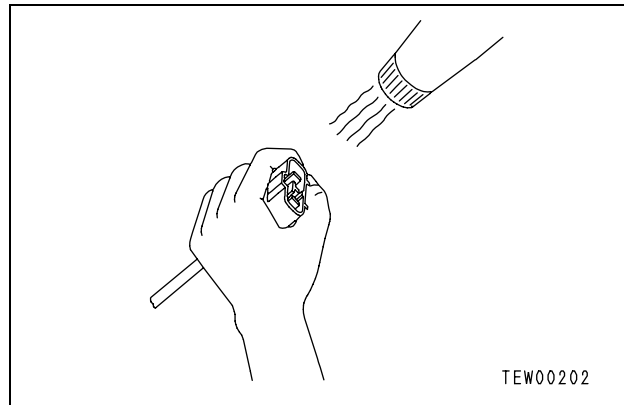
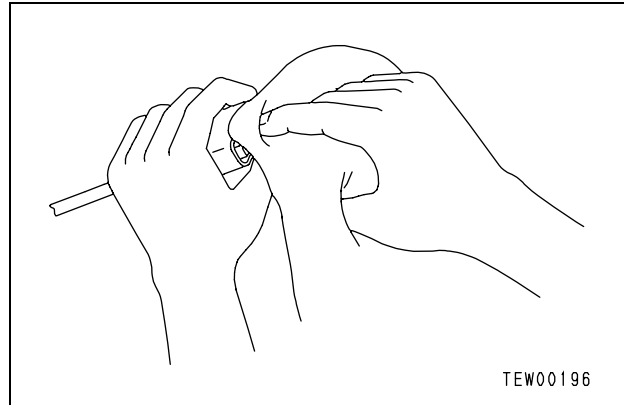
★ If the connector is blown dry with compressed air, there is the risk that oil in the air may cause defective contact, so remove all oil and water from the compressed air before blowing with air.

- 2) Dry the inside of the connector with a dryer. If water gets inside the connector, use a dryer to dry the connector.

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

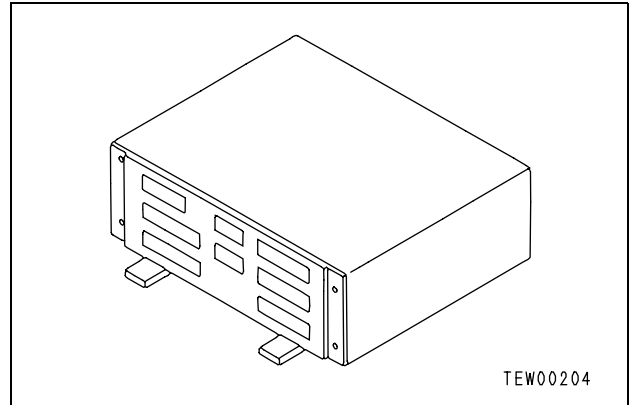
- 3) Carry out a continuity test on the connector. After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.

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

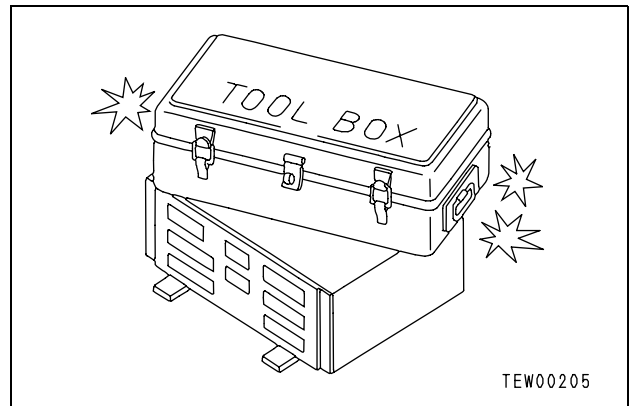


3) Handling control box

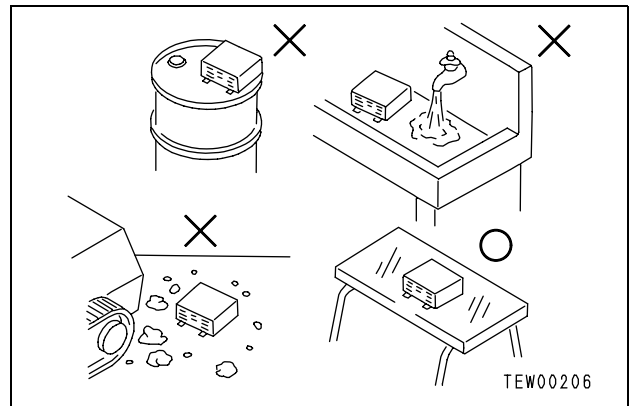
- 1) The control box contains a microcomputer and electronic control circuits. These control all of the electronic circuits on the machine, so be extremely careful when handling the control box.
- 2) Do not open the cover of the control box unless necessary.



- 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

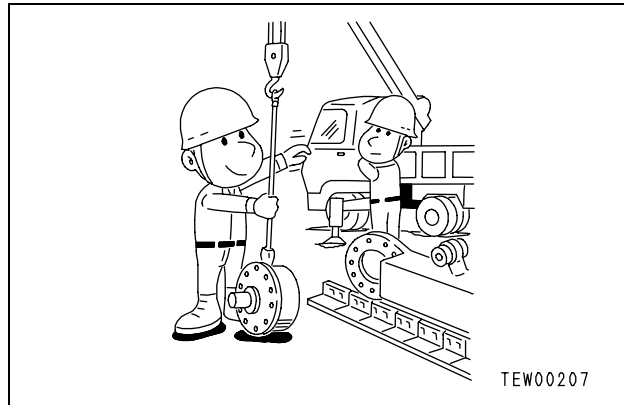
With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

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

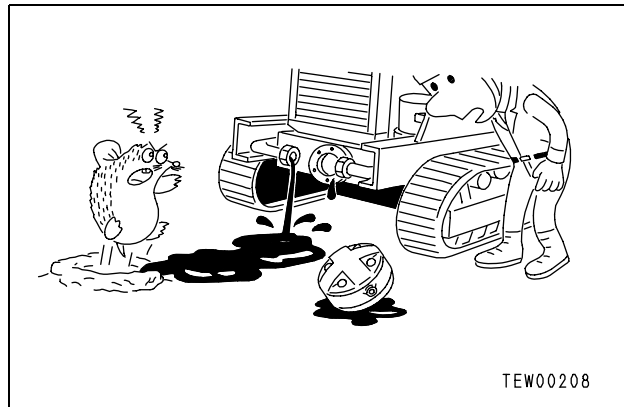
If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to confirm the performance after repairs, so it is desirable to use unit exchange. Disassembly and maintenance of hydraulic equipment should be carried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



3) Sealing openings

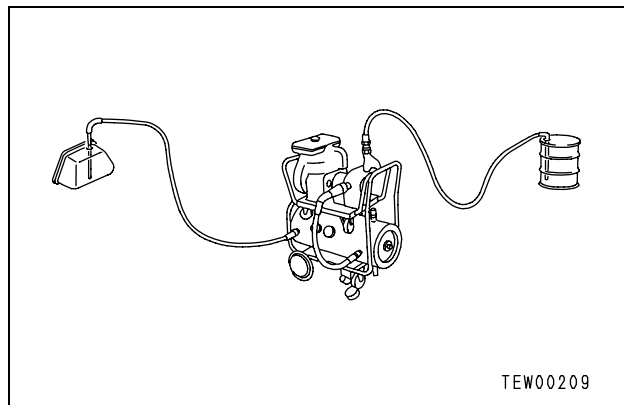
After any piping or equipment is removed, the openings should be sealed with caps, tapes, or vinyl bags to prevent any dirt or dust from entering. If the opening is left open or is blocked with a rag, there is danger of dirt entering or of the surrounding area being made dirty by leaking oil so never 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.



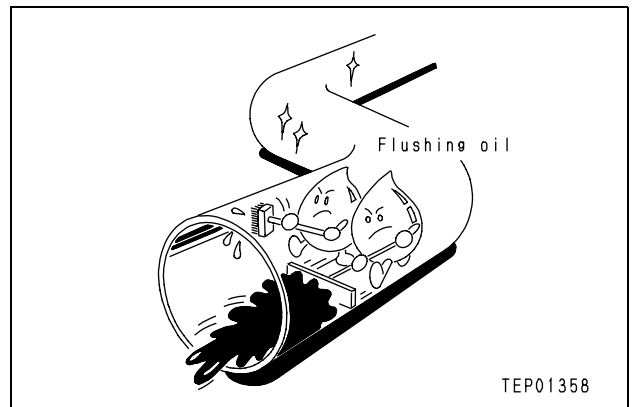
5) Change hydraulic oil when the temperature is high.

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.

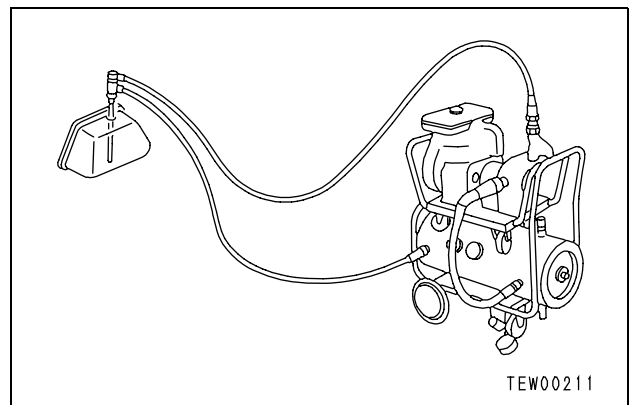
Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.



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
Lubricating oil, coolant	1. Check fuel level, type of fuel	—	Add fuel
	2. Check for impurities in fuel	—	Clean, drain
	3. Check hydraulic oil level	—	Add oil
	4. Check engine oil level (oil pan oil level), type of oil	—	Add oil
	5. Check coolant level	—	Add water
	6. Check dust indicator for clogging	—	Clean or replace
	7. Check hydraulic filter and charge filter	—	Replace
Electrical equipment	8. Check for looseness, corrosion of battery terminal, wiring	—	Tighten or replace
	9. Check for looseness, corrosion of alternator terminal, wiring	—	Tighten or replace
	10. Check for looseness, corrosion of starting motor terminal, wiring	—	Tighten or replace
Hydraulic, mechanical equipment	11. Check for abnormal noise, smell	—	Repair
	12. Check for oil leakage	—	Repair
	13. Carry out air bleeding	—	Bleed air
Electrics, electrical equipment	14. Check battery voltage (engine stopped)	20 – 30V	Replace
	15. Check battery electrolyte level	—	Add or replace
	16. Check for discolored, burnt, exposed wiring	—	Replace
	17. Check for missing wiring clamps, hanging wiring	—	Repair
	18. Check for water leaking on wiring (be particularly careful attention to water leaking on connectors or terminals)	—	Disconnect connector and dry
	19. Check for blown, corroded fuses	—	Replace
	20. Check alternator voltage (engine running at 1/2 throttle or above)	After running for several minutes : 27.5 – 29.5V	Replace
	21. Check operating sound of battery (when switch is turned ON/OFF)	—	Replace

METHOD OF USING TROUBLESHOOTING CHARTS

1. Category of troubleshooting code number

Troubleshooting Code No.	Component
E-OO	Troubleshooting of electrical system
H-OO	Troubleshooting of hydraulic, mechanical system
M-OO	Troubleshooting of machine monitor system

2. Method of using YES/NO troubleshooting flowchart

1) Troubleshooting code number and problem

The title at the top of the troubleshooting chart gives the failure code and problem with the machine.

Example: M-13 Abnormality in buzzer

2) General precautions

When carrying out troubleshooting, precautions are given at the top of the page under the title and marked with ★.

The common precautions are marked ★ in the Contents, so they must always be followed checked before carrying out the troubleshooting.

Example: ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

★ Always connect any disconnected connectors before going on the next step.

3) Distinguishing conditions

Even with the same problem, the method of troubleshooting may differ according to the model, component, or problem. In such cases, the failure mode is further divided into sections marked with small letters (for example, a)), so go to the appropriate section to carry out troubleshooting.

If the troubleshooting table is not divided into sections, start troubleshooting from the first check item in the flowchart.

Example: a) When starting switch is turned ON (3 sec), buzzer does not sound

b) Buzzer always sounds

4) Method of following troubleshooting chart

- Check or measure the item inside

YES

 or

NO

, and according to the answer follow either the YES line or the NO line to go to the next

--

.

(Note: The number written at the top right corner of the

--

 is an index number; it does not indicate the order to follow.)

- Following the YES or NO lines according to the results of the check or measurement will lead finally to the Cause box. Check the cause and take the action given in the Remedy box on the right.
- To the left of the

--

 there is

--

 (a box formed by a broken line). This contains the methods for inspection or measurement, and the judgement values.

If the judgement values to the left of the

--

 are correct or the answer to the question inside the

--

 is YES, follow the YES line; if the judgement value is not correct, or the answer to the question is NO, follow the NO line.

- The

--

 gives the preparatory work needed for inspection and measurement, and the judgement values. If this preparatory work is neglected, or the method of operation or handling is mistaken, there is danger that it may cause mistaken judgment, or the equipment may be damaged. Therefore, before starting inspection or measurement, always read the instructions carefully, and start the work in order from the first item.

5) Position of installation, pin number

For details of the connector pin number and check and measurement locations of the connector pin numbers appearing in the flowchart, see CONNECTOR TYPE AND MOUNTING LOCATION.

TYPES AND LOCATIONS OF CONNECTORS

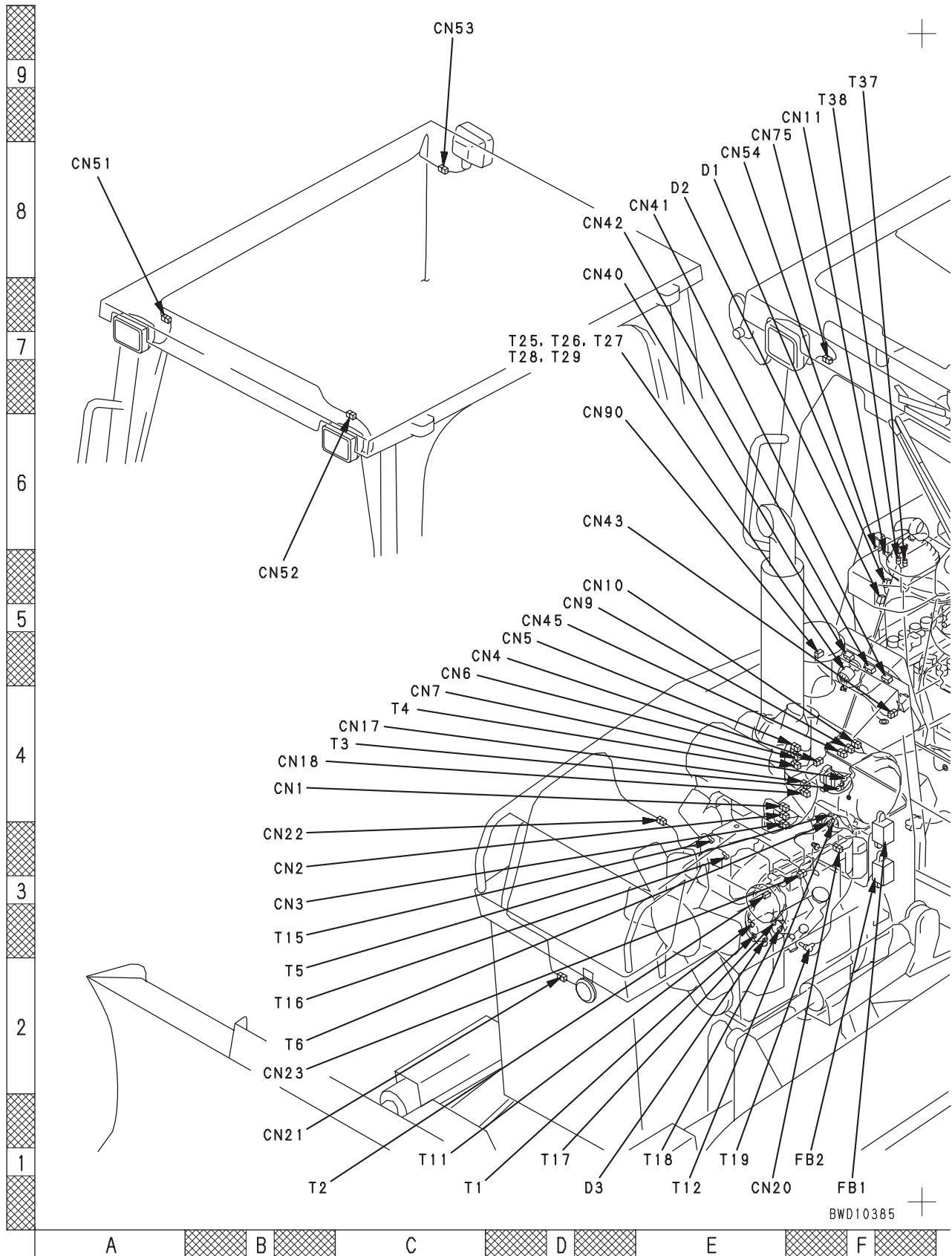
Con- nector No.	Type	Num- ber of pins	Location	Add- ress
CN1	DT	2	Intermediate connector	B-4
CN2	DT	4	Intermediate connector	B-3
CN3	DT	4	Intermediate connector	B-3
CN4	DT	2	Safety relay	D-5
CN5	DT	6	Intermediate connector	D-5
CN6	DT	4	Intermediate connector (Starting switch)	C-5
CN7	SWP	12	Intermediate connector (Panel)	C-4
CN9	DT	4	Intermediate connector	D-5
CN10	DT	12	Intermediate connector	D-5
CN11	Relay	6	Relay (Backup alarm)	F-9
CN12	DT	2	HST oil temperature sensor	J-1
CN13	DT	2	Fuel level sensor	J-4
CN14	DT	3	Intermediate connector	J-3
CN15	DT	2	Air bleed pump for fuel system	J-2
CN17	DTHD	1	Auxiliary power supply	C-4
CN18	DTHD	1	For backup	B-4
CN20	DT	2	Engine coolant sensor	E-1
CN21	090II	2	Horn	B-1
CN22	DT	2	Intermediate connector (Horn)	B-3
CN23	X	1	Air conditioner compressor	B-2
CN25	DT	3	Brake pedal limit switch	G-1
CN26	DT	3	Neutral safety parking brake	I-1
CN27	DT	6	Intermediate connector (Shift switch)	I-1
CN28	DT	2	Gear shifting solenoid	H-1
CN29	DT	2	Gear shifting solenoid	G-1
CN31	DT	2	Parking brake solenoid	G-1
CN32	DT	12	Gear shift controller	H-1
CN33	DT	4	Intermediate connector	J-6
CN34	Y	2	For power supply of cab	J-6
CN38	C03	3	Gear shift switch	J-2
CN39	C03	3	Gear shift switch	J-2
CN40	CN(A)	2	Panel	D-7
CN41	040	16	Panel	E-8
CN42	DT	4	Panel (Travel speed indicator lamp)	D-8
CN43	KES	3	Lamp switch	D-6
CN45	DT	8	Tele-management system	D-5
CN51	DT	2	Headlamp (Right)	A-8
CN52	DT	2	Headlamp (Left)	B-5
CN53	DT	2	Rear lamp	C-9
CN54	Relay	6	Relay (Headlamp)	E-8
CN56	DT	2	Backup alarm proximity switch	J-1
CN57	Relay	6	Relay (Backup alarm)	J-3
CN58	DT	2	Backup alarm buzzer (Japan)	J-4
CN60	PA	9	Radio (Cab specification)	J-7
CN61	PA	9	Cassette player (Cab specification)	J-7

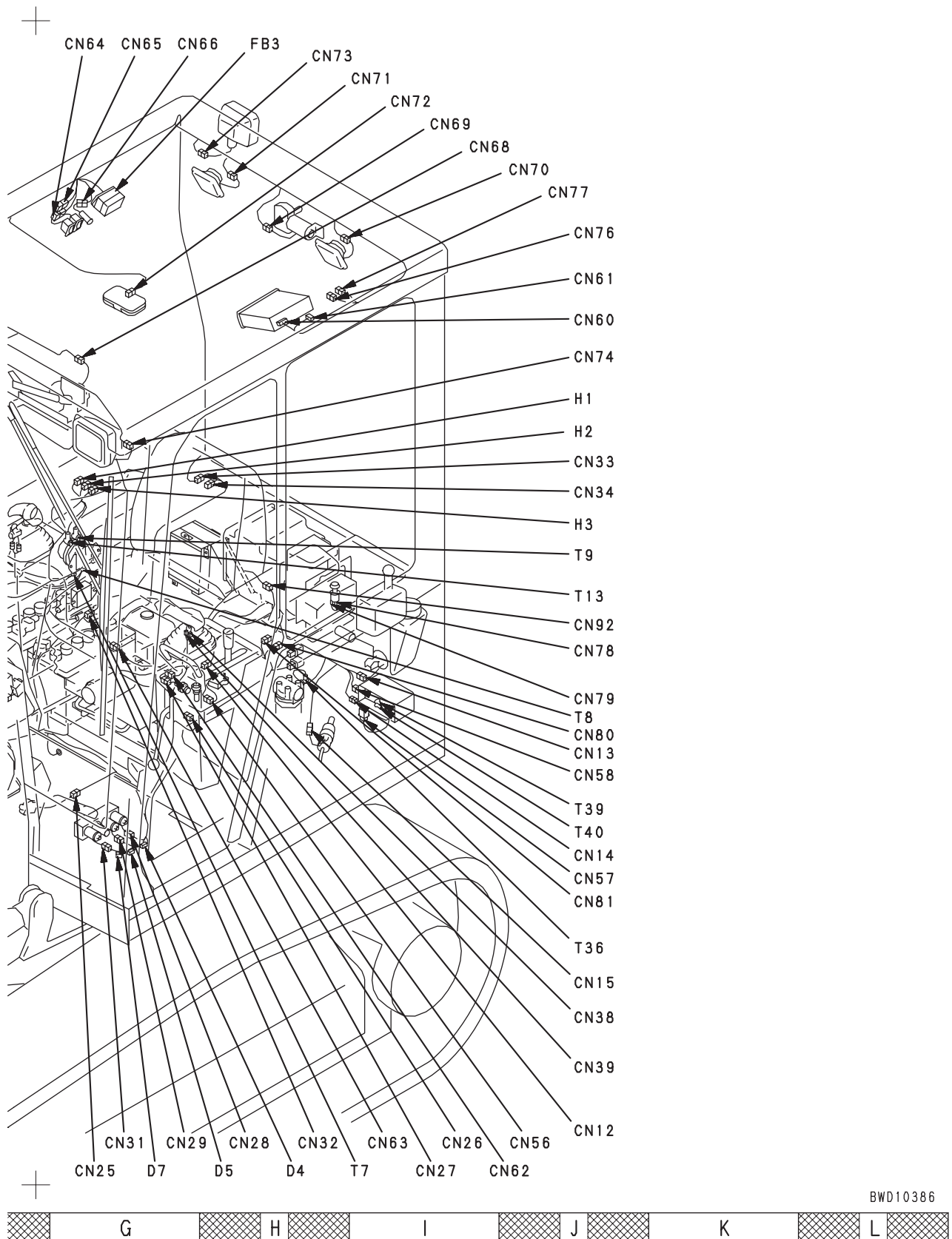
Con- nector No.	Type	Num- ber of pins	Location	Add- ress
CN62	KES	2	Rear washer (Cab specification)	J-1
CN63	KES	2	Front washer (Cab specification)	I-1
CN64	KES	6	Rear wiper switch (Cab specification)	G-9
CN65	KES	6	Front wiper switch (Cab specification)	G-9
CN66	KES	2	Breaker switch (Cab specification)	G-9
CN68	SWP	6	Front wiper motor (Cab specification)	I-8
CN69	SWP	4	Rear wiper motor (Cab specification)	I-8
CN70	KES	2	Rear speaker (Left) (Cab specification)	J-8
CN71	KES	2	Rear speaker (Right) (Cab specification)	I-9
CN72	KES	2	Room lamp (Cab specification)	I-9
CN73	DT	2	Rear lamp (Cab specification)	H-9
CN74	DT	2	Headlamp (Left) (Cab specification)	J-7
CN75	DT	2	Headlamp (Right) (Cab specification)	E-9
CN76	040	12	Control panel (Cab specification)	J-8
CN77	040	16	Control panel (Cab specification)	J-8
CN78	—	1	Cigarette lighter (Cab specification)	J-5
CN79	—	1	Cigarette lighter (Cab specification)	J-4
CN80	SWP	16	Air conditioner unit (Cab specification)	J-4
CN81	DT	4	Air conditioner unit (Cab specification)	J-3
CN90	KES	4	Car heater (Machine with ROPS)	D-7
CN92	DT	2	Heater switch (Machine with ROPS)	J-5
CNT1	Terminal	1	Starting motor terminal B	C-1
CNT2	Terminal	1	Starting motor terminal C	B-1
CNT3	Terminal	1	Safety relay terminal B	C-4
CNT4	Terminal	1	Safety relay terminal C	C-4
CNT5	Terminal	1	Heater relay terminal S	B-2
CNT6	Terminal	1	Heater relay terminal L	B-2
CNT7	Terminal	1	Battery relay terminal B	I-1
CNT8	Terminal	1	Battery relay terminal M	J-4
CNT9	Terminal	1	Battery relay terminal (—)	J-5
CNT11	Terminal	1	Starting motor terminal B	C-1
CNT12	Terminal	1	Heater relay terminal B	E-1
CNT13	Terminal	1	Battery relay terminal (+)	J-5
CNT15	Terminal	1	Alternator terminal B	B-3
CNT16	Terminal	1	Alternator terminal R	B-2
CNT17	Terminal	1	Engine stop solenoid (+)	D-1
CNT18	Terminal	1	Engine stop solenoid (—)	E-1
CNT19	Terminal	1	Engine oil pressure switch	E-1
CNT25	Terminal	1	Starting switch terminal B	D-7
CNT26	Terminal	1	Starting switch terminal BR	D-7
CNT27	Terminal	1	Starting switch terminal ACC	D-7
CNT28	Terminal	1	Starting switch terminal C	D-7
CNT29	Terminal	1	Starting switch terminal R	D-7
CNT36	Terminal	1	HST charge filter	J-2
CNT37	Terminal	1	Horn switch	F-9

TESTING AND ADJUSTING**TYPES AND LOCATIONS OF CONNECTORS**

Con- nector No.	Type	Num- ber of pins	Location	Add- ress
CNT38	Terminal	1	Horn switch	F-9
CNT39	Terminal	1	Backup alarm (Overseas)	J-3
CNT40	Terminal	1	Backup alarm (Overseas)	J-3
CNTH1	L	2	Fusible link	J-6
CNTH2	L	2	Fusible link	J-6
CNTH3	L	2	Fusible link	J-6
CND1	SWP	2	Battery relay circuit BR	E-8
CND2	SWP	2	Alternator circuit R	E-8
CND3	SWP	2	Engine stop relay	D-1
CND4	SWP	2	Gear shifting solenoid	H-1
CND5	SWP	2	Gear shifting solenoid	H-1
CND7	SWP	2	Parking brake solenoid	G-1
FB1	—		Fuse box	F-1
FB2	—		Fuse box	F-1
FB3	—		Fuse box (Cab specification)	H-9

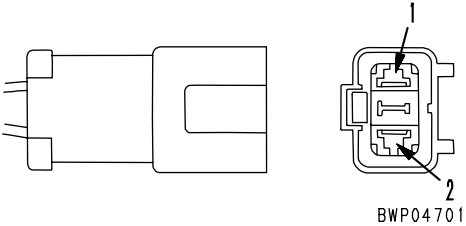
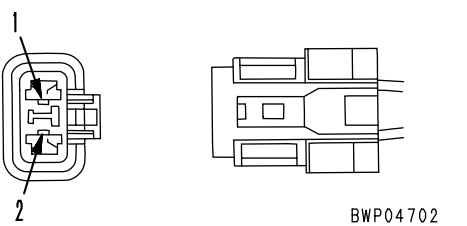
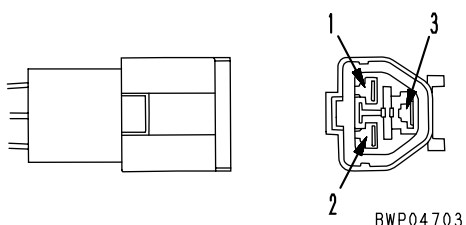
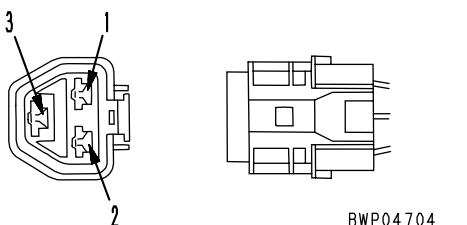
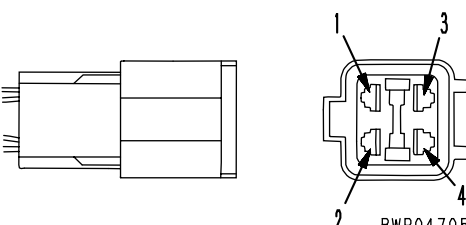
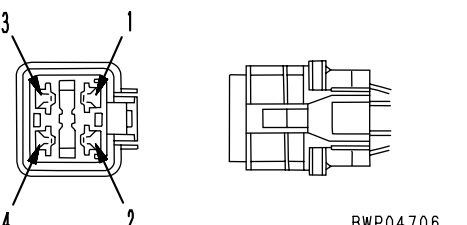
CONNECTOR ARRANGEMENT DIAGRAM





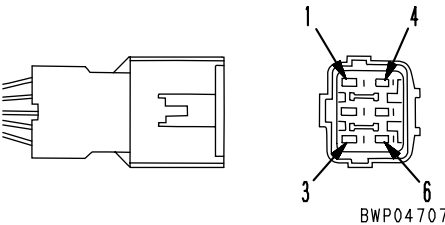
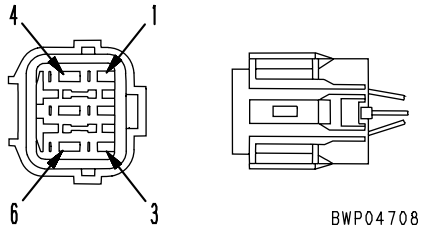
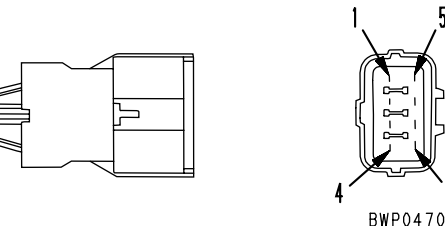
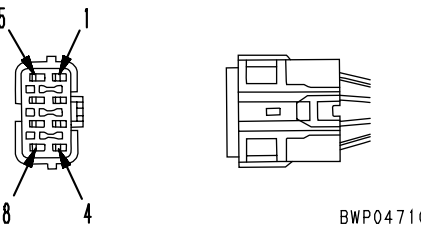
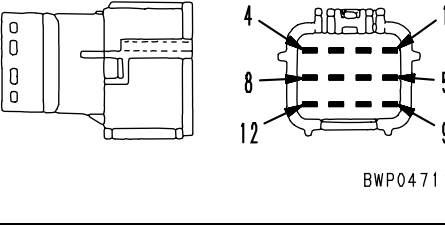
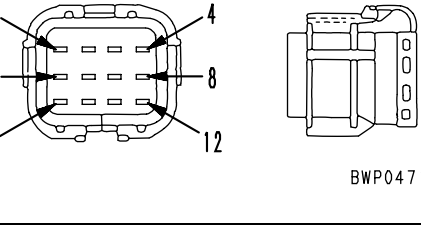
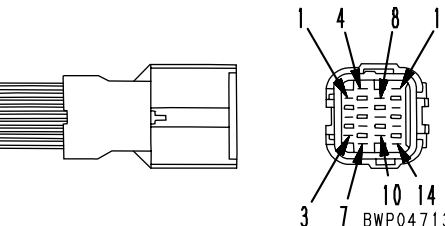
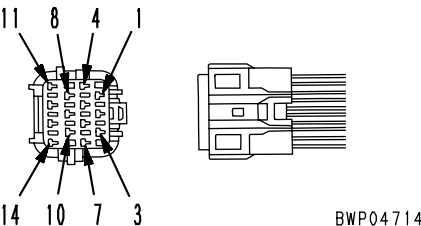
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

★ 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.

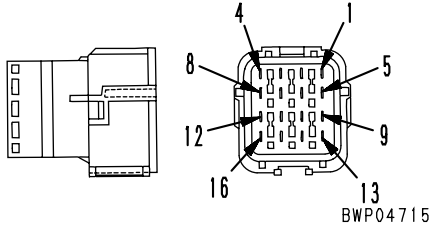
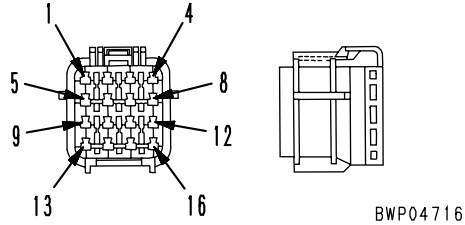
No. of pins	X type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
1	Part No.: 08055-00181	Part No.: 08055-00191	799-601-7010
2			799-601-7020
	Part No.: 08055-00282	Part No.: 08055-00292	
3			799-601-7030
	Part No.: 08055-00381	Part No.: 08055-00391	
4			799-601-7040
	Part No.: 08055-00481	Part No.: 08055-00491	
—	Terminal part No.: 79A-222-3370 • Electric wire size: 0.85 • Grommet: Black • Q'ty: 20	Terminal part No.: 79A-222-3390 • Electric wire size: 0.85 • Grommet: Black • Q'ty: 20	—
—	Terminal part No.: 79A-222-3380 • Electric wire size: 2.0 • Grommet: Red • Q'ty: 20	Terminal part No.: 79A-222-3410 • Electric wire size: 2.0 • Grommet: Red • Q'ty: 20	—

TESTING AND ADJUSTING

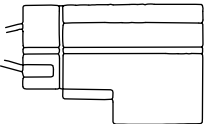
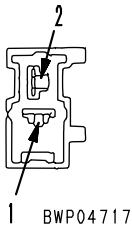
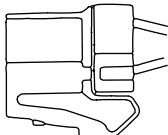
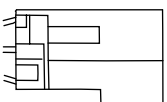
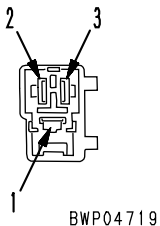
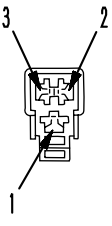
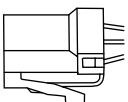
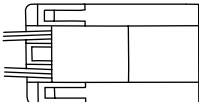
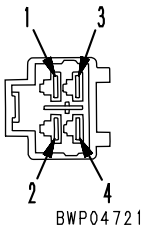
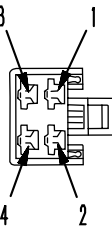
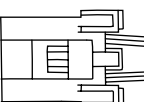
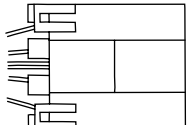
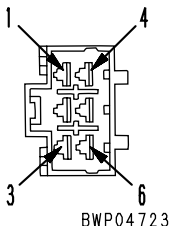
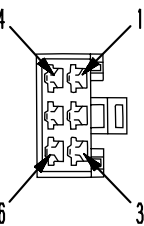
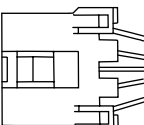
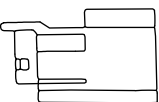
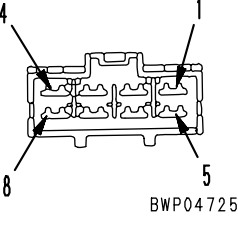
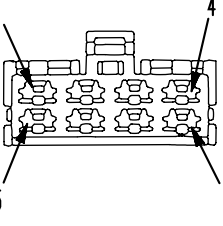
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	SWP type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
6	 BWP04707	 BWP04708	799-601-7050
	Part No.: 08055-10681	Part No.: 08055-10691	
8	 BWP04709	 BWP04710	799-601-7060
	Part No.: 08055-10881	Part No.: 08055-10891	
12	 BWP04711	 BWP04712	799-601-7310
	Part No.: 08055-11281	Part No.: 08055-11291	
14	 BWP04713	 BWP04714	799-601-7070
	Part No.: 08055-11481	Part No.: 08055-11491	

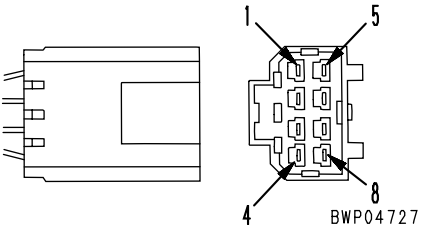
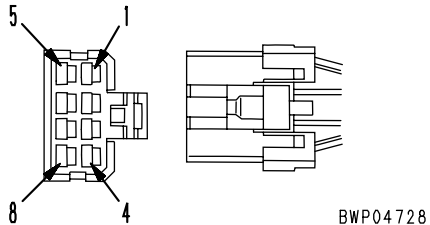
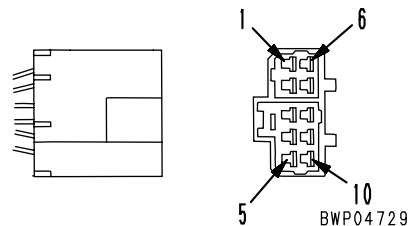
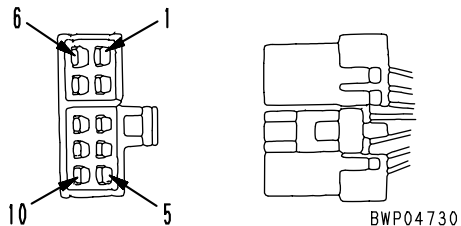
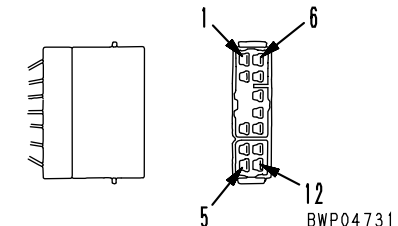
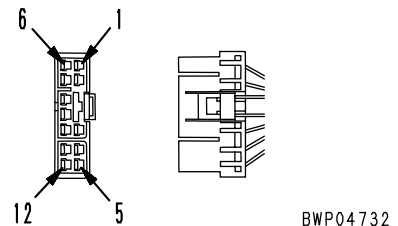
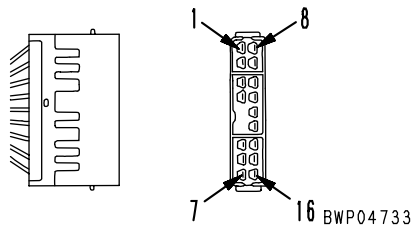
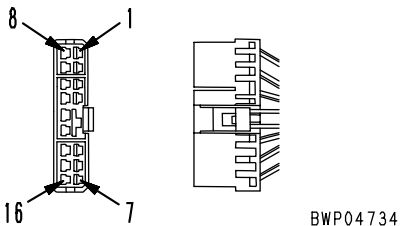
TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	SWP type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
16	 BWP04715	 BWP04716	799-601-7320
	Part No.: 08055-11681	Part No.: 08055-11691	
—	Terminal part No.: • Electric wire size: 0.85 • Grommet: Black • Q'ty: 20	Terminal part No.: • Electric wire size: 0.85 • Grommet: Black • Q'ty: 20	—
—	Terminal part No.: • Electric wire size: 1.25 • Grommet: Red • Q'ty: 20	Terminal part No.: • Electric wire size: 1.25 • Grommet: Red • Q'ty: 20	—

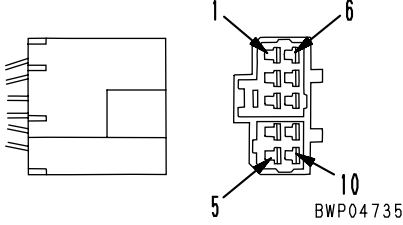
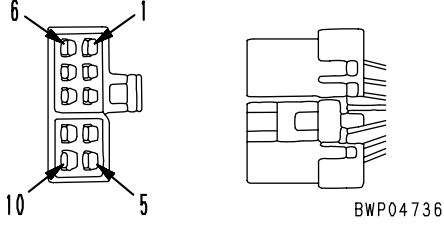
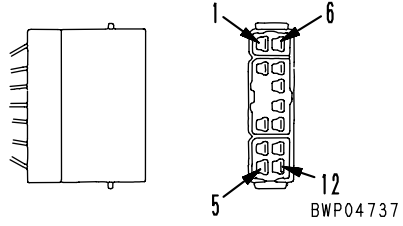
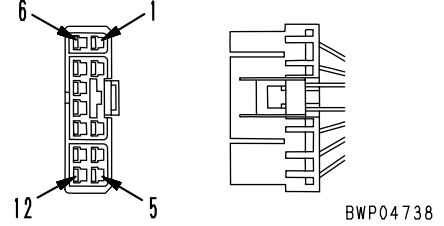
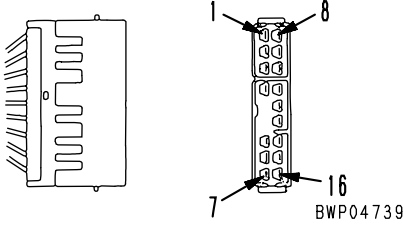
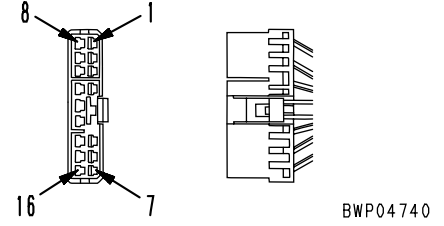
TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	M type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
1	Part No.: 08056-00171	Part No.: 08056-00181	799-601-7080
2	  BWP04717	  BWP04718	799-601-7090
	Part No.: 08056-00271	Part No.: 08056-00281	
3	  BWP04719	  BWP04720	799-601-7110
	Part No.: 08056-00371	Part No.: 08056-00381	
4	  BWP04721	  BWP04722	799-601-7120
	Part No.: 08056-00471	Part No.: 08056-00481	
6	  BWP04723	  BWP04724	799-601-7130
	Part No.: 08056-00671	Part No.: 08056-00681	
8	  BWP04725	  BWP04726	799-601-7390
	Part No.: 08056-00871	Part No.: 08056-00881	

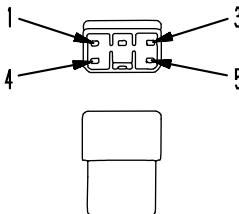
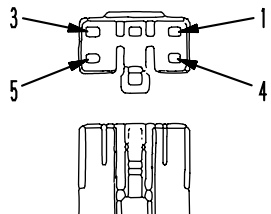
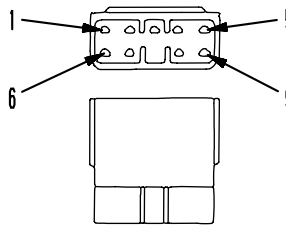
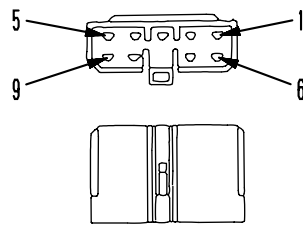
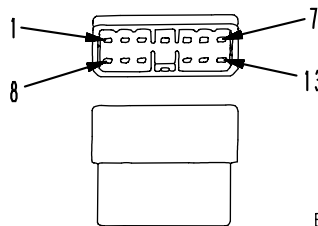
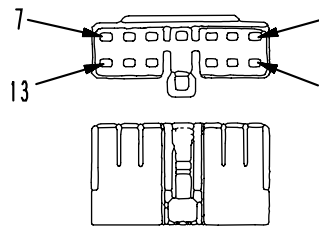
TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	S type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8	 Part No.: 08056-10871	 Part No.: 08056-10881	799-601-7140
10 (White)	 Part No.: 08056-11071	 Part No.: 08056-11081	799-601-7150
12 (White)	 Part No.: 08056-11271	 Part No.: 08056-11281	799-601-7350
16 (White)	 Part No.: 08056-11671	 Part No.: 08056-11681	799-601-7330

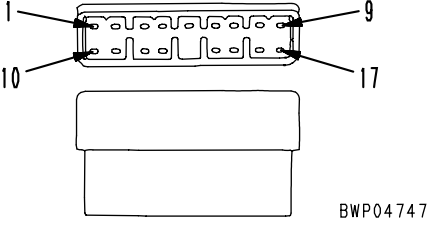
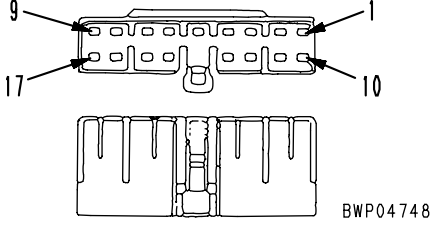
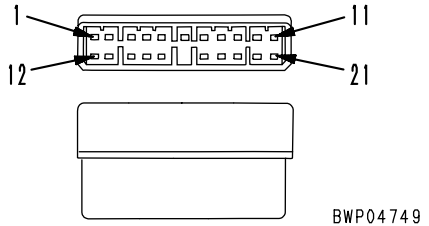
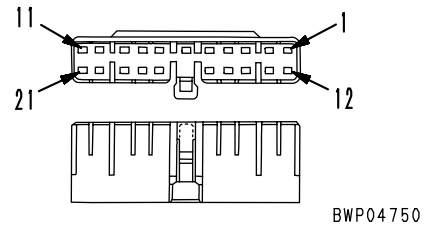
TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No.of pins	S type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10 (Blue)			—
	—	—	
12 (Blue)			799-601-7160
	Part No.: 08056-11272	Part No.: 08056-11282	
16 (Blue)			799-601-7170
	Part No.: 08056-11672	Part No.: 08056-11682	

TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

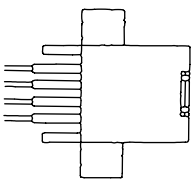
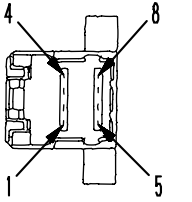
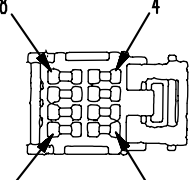
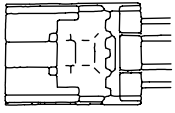
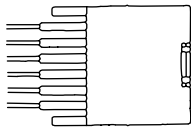
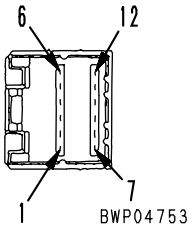
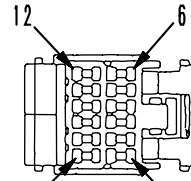
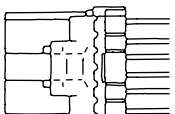
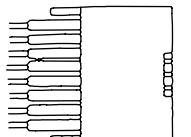
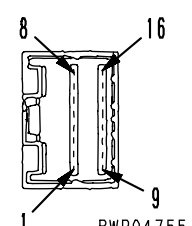
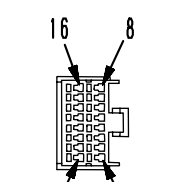
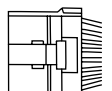
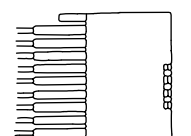
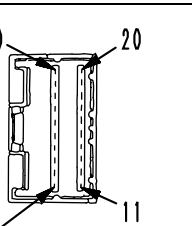
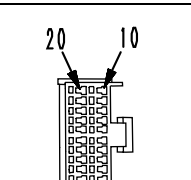
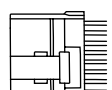
No. of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
7	Body part No.: 79A-222-2640 (Q'ty: 5)	Body part No.: 79A-222-2630 (Q'ty: 5)	—
11	Body part No.: 79A-222-2680 (Q'ty: 5)	Body part No.: 79A-222-2670 (Q'ty: 5)	—
5	 BWP04741	 BWP04742	799-601-2710
	Body part 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)	

TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
17	 Body part No.: 79A-222-2730 (Q'ty: 2)	 Body part No.: 9A-222-2720 (Q'ty: 2)	799-601-2730
21	 Body part No.: 79A-222-2750 (Q'ty: 2)	 Body part No.: 79A-222-2740 (Q'ty: 2)	799-601-2740
	Terminal part No.: 79A-222-2770 (Q'ty: 50)	Terminal part No.: 79A-222-2760 (Q'ty: 50)	—

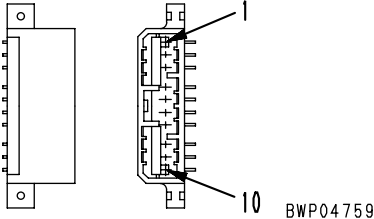
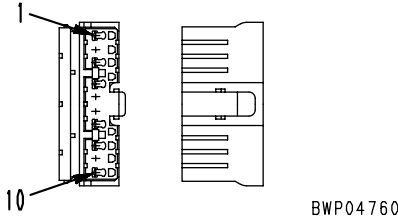
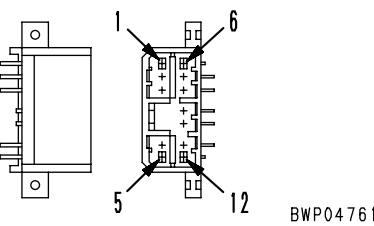
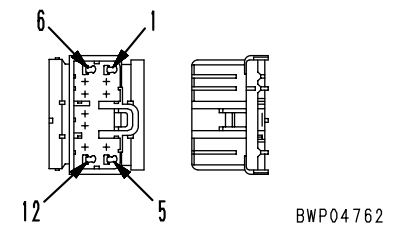
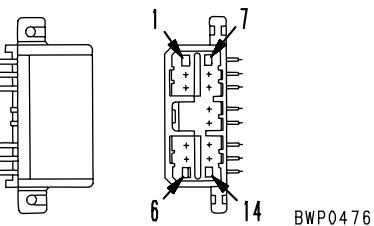
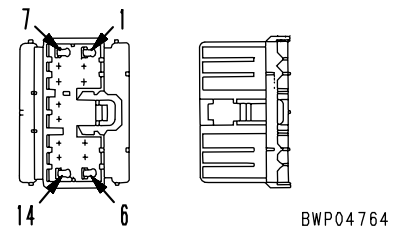
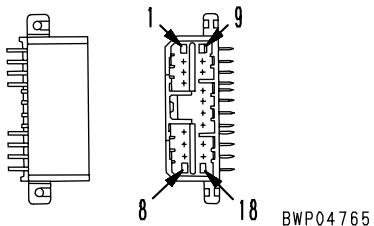
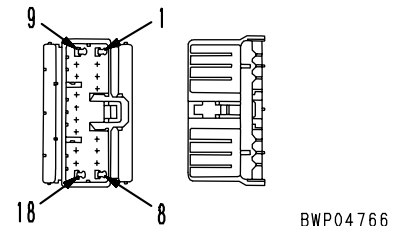
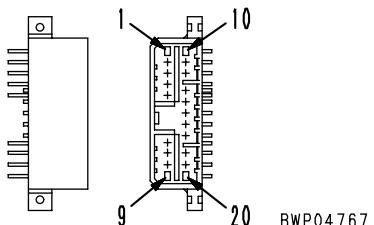
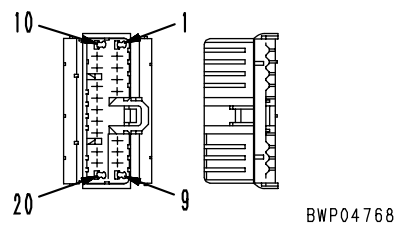
TESTING AND ADJUSTING

CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

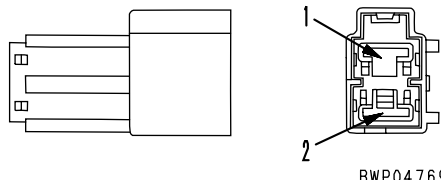
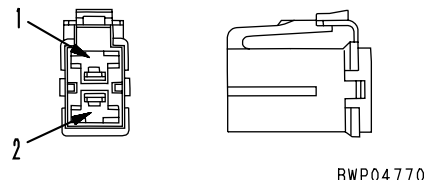
No. of pins	AMP040 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8	  BWP04751	  BWP04752	799-601-7180
	—	Housing part No.: 79A-222-3430 (Q'ty: 5)	
12	  BWP04753	  BWP04754	799-601-7190
	—	Housing part No.: 79A-222-3440 (Q'ty: 5)	
16	  BWP04755	  BWP04756	799-601-7210
	—	Housing part No.: 79A-222-3450 (Q'ty: 5)	
20	  BWP04757	  BWP04758	799-601-7220
	—	Housing part No.: 79A-222-3460 (Q'ty: 5)	

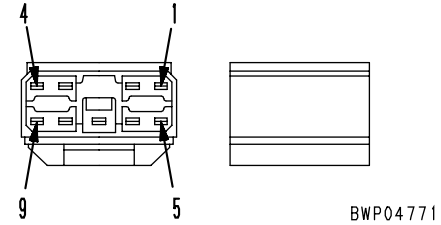
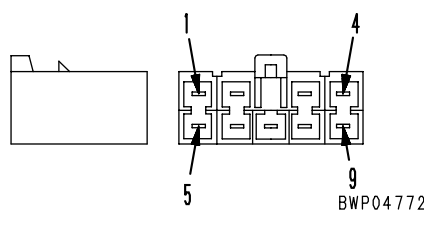
★ Terminal part No.: 79A-222-3470 (No relation with number of pins)

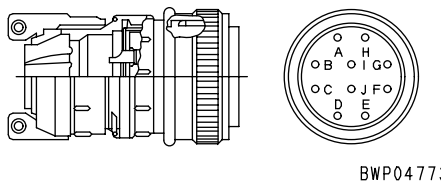
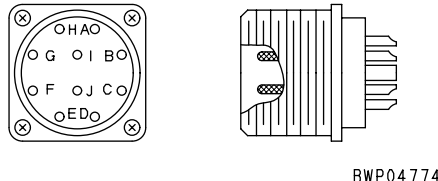
TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	AMP070 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10	 BWP04759	 BWP04760	799-601-7510
	—	Part No.: 08195-10210	
12	 BWP04761	 BWP04762	799-601-7520
	—	Part No.: 08195-12210	
14	 BWP04763	 BWP04764	799-601-7530
	—	Part No.: 08195-14210	
18	 BWP04765	 BWP04766	799-601-7540
	—	Part No.: 08195-18210	
20	 BWP04767	 BWP04768	799-601-7550
	—	Part No.: 08195-20210	

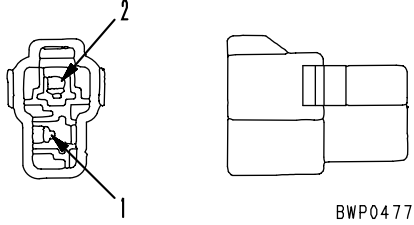
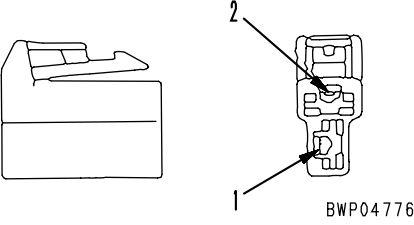
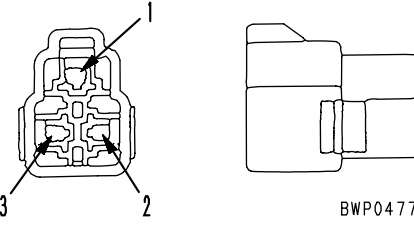
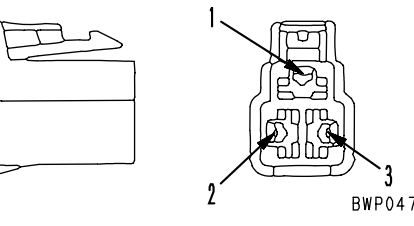
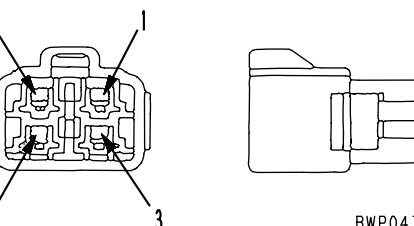
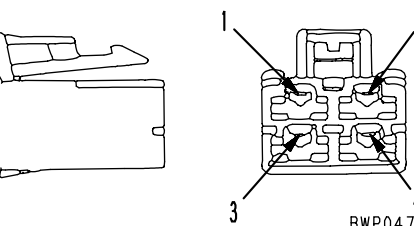
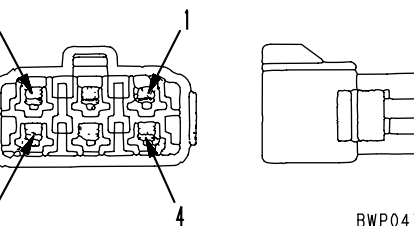
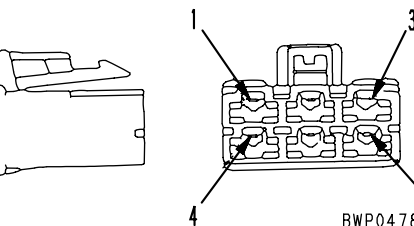
TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No.of pins	L type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2			—
	—	—	

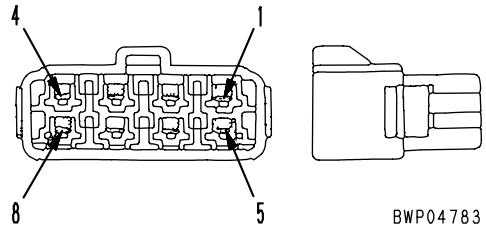
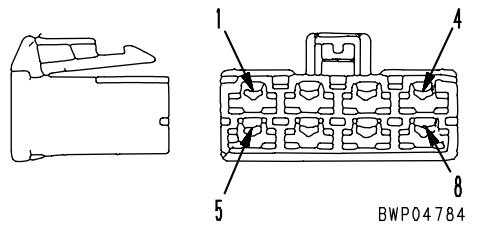
No.of pins	Connector for PA		
	Male (female housing)	Female (male housing)	T-adapter Part No.
9			—
	—	—	

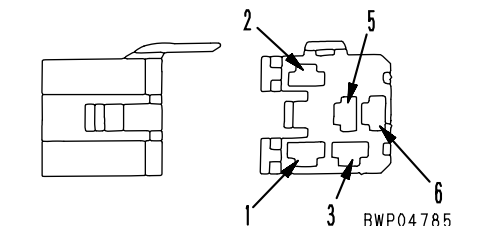
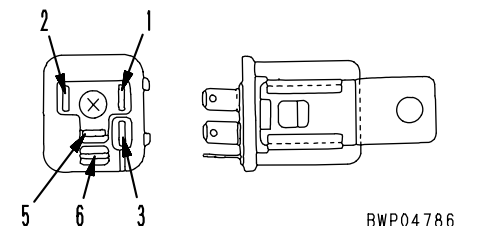
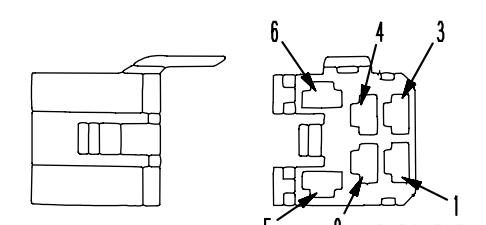
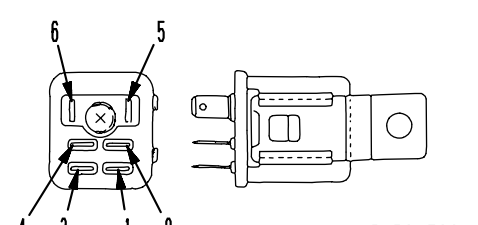
No.of pins	Bendix MS connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10			799-601-3460
	—	—	

TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	KES 1 (Automobile) connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2	 BWP04775	 BWP04776	—
	Part No.: 08027-10210 (Natural color) 08027-10220 (Black)	Part No.: 08027-10260 (Natural color) 08027-10270 (Black)	
3	 BWP04777	 BWP04778	—
	Part No.: 08027-10310	Part No.: 08027-10360	
4	 BWP04779	 BWP04780	—
	Part No.: 08027-10410 (Natural color) 08027-10420 (Black)	Part No.: 08027-10460 (Natural color) 08027-10470 (Black)	
6	 BWP04781	 BWP04782	—
	Part No.: 08027-10610 (Natural color) 08027-10620 (Black)	Part No.: 08027-10660 (Natural color) 08027-10670 (Black)	

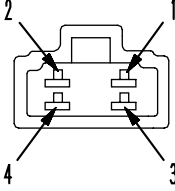
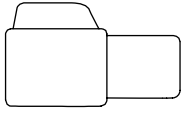
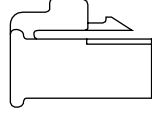
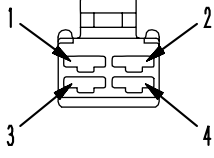
TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	KES 1 (Automobile) connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8	 BWP04783	 BWP04784	—
	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	 BWP04785	 BWP04786	799-601-7360
	—	—	
6	 BWP04787	 BWP04788	799-601-7370
	—	—	

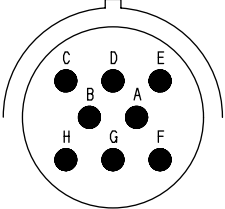
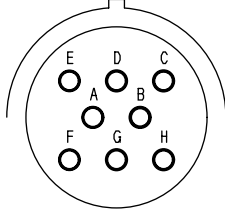
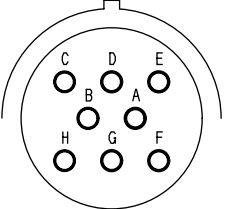
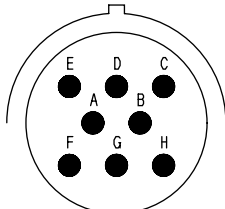
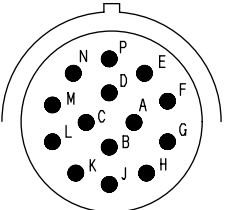
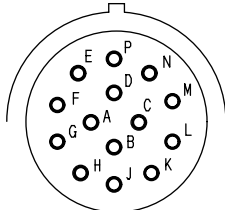
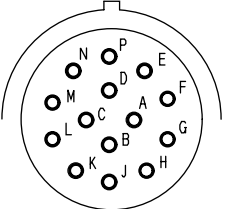
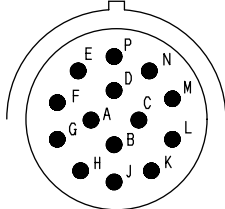
TESTING AND ADJUSTING

CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	F type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
4	  BWP03905	  BWP03906	—
	—	—	

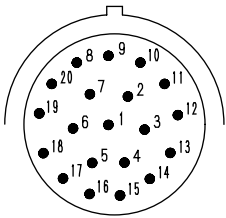
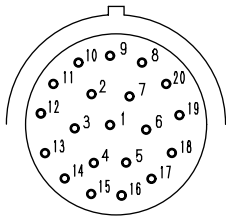
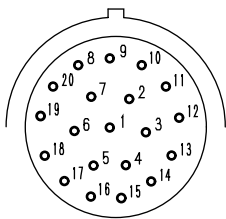
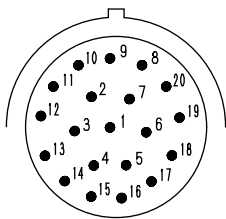
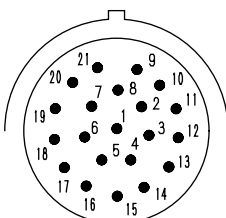
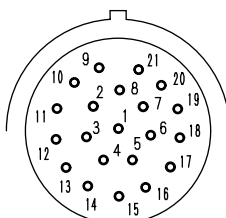
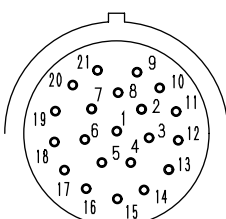
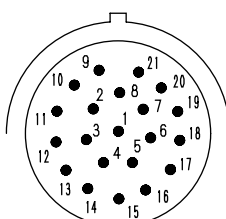
TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

[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 terminal)	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	799-601-9210
	Pin (female terminal)	Pin (male terminal)	
18-14 (2)	 BWP05003	 BWP05004	799-601-9220
	Part No.: 08191-12201, 08191-12202, 08191-12205, 08191-12206	Part No.: 08191-13101, 08191-13102, 08191-13105, 08191-13106	
	Pin (male terminal)	Pin (female terminal)	799-601-9230
	 BWP05005	 BWP05006	
18-14 (2)	Part No.: 08191-21201, 08191-21202, 08191-21205, 08191-21206	Part No.: 08191-24101, 08191-24102, 08191-24105, 08191-24106	799-601-9230
	Pin (female terminal)	Pin (male terminal)	
	 BWP05007	 BWP05008	
	Part No.: 08191-22201, 08191-22202, 08191-22205, 08191-22206	Part No.: 08191-23101, 08191-23102, 08191-23105, 08191-23106	

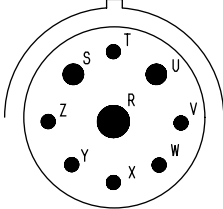
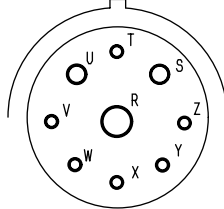
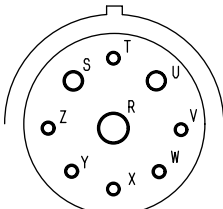
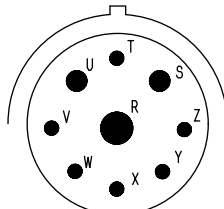
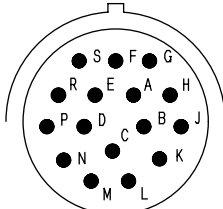
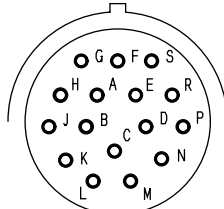
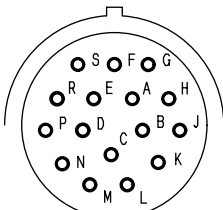
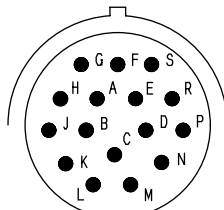
TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

[The pin No. is also marked on the connector (electric wire insertion end)]

Type (shell size code)	HD30 Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
18-20 (3)	Pin (male terminal)	Pin (female termial)	799-601-9230
	 BWP05009	 BWP05010	
	Part No.:08191-31201, 08191-31202	Part No.:08191-34101, 08191-34102	799-601-9230
	Pin (female terminal)	Pin (male terminal)	
18-21 (4)	 BWP05011	 BWP05012	799-601-9240
	Part No.:08191-32201, 08191-32202	Part No.:08191-33101, 08191-33102	
	Pin (male terminal)	Pin (female termial)	799-601-9240
	 BWP05013	 BWP05014	
18-21 (4)	Part No.:08191-41201, 08191-42202	Part No.:08191-44101, 08191-44102	799-601-9240
	Pin (female terminal)	Pin (male terminal)	
	 BWP05015	 BWP05016	
	Part No.:08191-42201, 08191-42202	Part No.:08191-43101, 08191-43102	

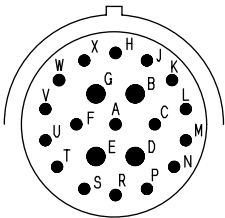
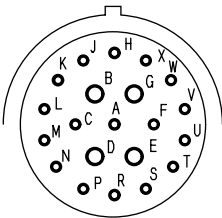
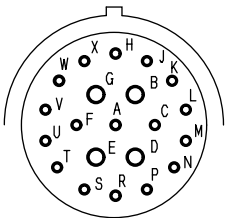
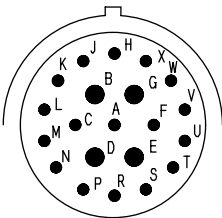
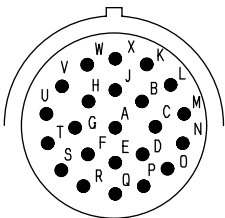
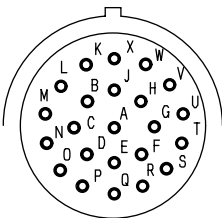
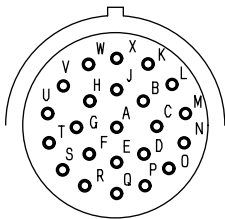
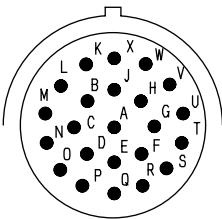
TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

[The pin No. is also marked on the connector (electric wire insertion end)]

Type (shell size code)	HD30 Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
24-9 (5)	Pin (male terminal)	Pin (female terminal)	799-601-9250
	 BWP05017	 BWP05018	
	Part No.:08191-51201, 08191-51202	Part No.:08191-54101, 08191-54102	799-601-9250
	Pin (female terminal)	Pin (male terminal)	
24-16 (6)	 BWP05019	 BWP05020	799-601-9260
	Part No.:08191-52201, 08191-52202	Part No.:08191-53101, 08191-53102	
	Pin (male terminal)	Pin (female terminal)	799-601-9260
	 BWP05021	 BWP05022	
	Part No.: 08191-61201, 08191-62202, 08191-61205, 08191-62206	Part No.: 08191-64101, 08191-64102, 08191-64105, 08191-64106	799-601-9260
	Pin (female terminal)	Pin (male terminal)	
	 BWP05023	 BWP05024	
	Part No.: 08191-62201, 08191-62202, 08191-62205, 08191-62206	Part No.: 08191-63101, 08191-63102, 08191-63105, 08191-63106	

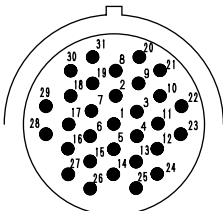
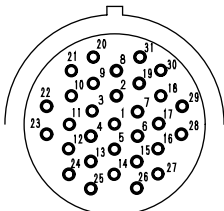
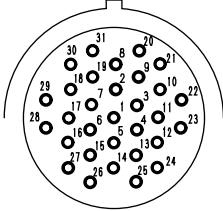
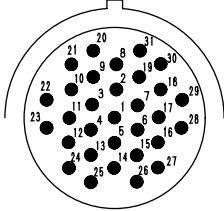
TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

[The pin No. is also marked on the connector (electric wire insertion end)]

Type (shell size code)	HD30 Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
24-21 (7)	Pin (male terminal)	Pin (female termial)	799-601-9270
	 BWP05025	 BWP05026	
	Part No.: 08191-71201, 08191-71202, 08191-71205, 08191-71206	Part No.: 08191-74101, 08191-74102, 08191-74105, 08191-74106	799-601-9270
	Pin (female terminal)	Pin (male terminal)	
24-22 (8)	 BWP05027	 BWP05028	799-601-9280
	Part No.: 08191-72201, 08191-72202, 08191-72205, 08191-72206	Part No.: 08191-73101, 08191-73102, 08191-73105, 08191-73106	
	Pin (male terminal)	Pin (female terminal)	799-601-9280
	 BWP05029	 BWP05030	
24-22 (8)	Part No.: 008191-81201, 08191-81202, 08191-81203, 08191-81204, 08191-81205, 08191-80206	Part No.: 08191-84101, 08191-84102, 08191-84103, 08191-84104, 08191-84105, 08191-84106	799-601-9280
	Pin (female terminal)	Pin (male terminal)	
	 BWP05031	 BWP05032	799-601-9280
	Part No.: 08191-82201, 08191-82202, 08191-82203, 08191-82204, 08191-82205, 08191-82206	Part No.: 08191-83101, 08191-83102, 08191-83103, 08191-83104, 08191-83105, 08191-83106	

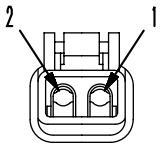
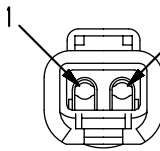
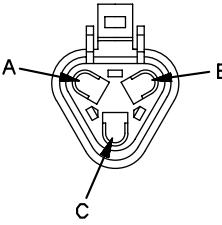
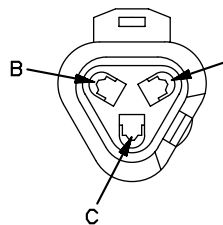
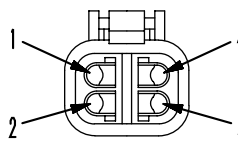
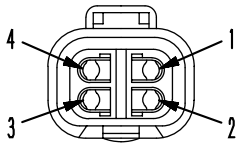
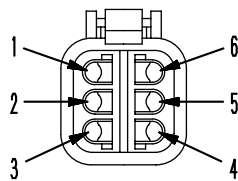
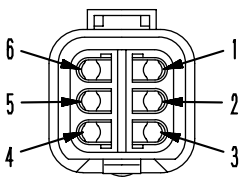
TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

[The pin No. is also marked on the connector (electric wire insertion end)]

Type (shell size code)	HD30 Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
24-31 (9)	Pin (male termial)	Pin (female terminal)	799-601-9290
	 BWP05033	 BWP05034	
	Part No.: 08191-91203, 08191-91204, 08191-91205, 08191-91206	Part No.: 08191-94103, 08191-94104, 08191-94105, 08191-94106	799-601-9290
	Pin (female terminal)	Pin (male terminal)	
	 BWP05035	 BWP05036	
	Part No.: 08191-92203, 08191-92204, 08191-92205, 08191-92206	Part No.: 08191-93103, 08191-93104, 08191-93105, 08191-93106	

TESTING AND ADJUSTING
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

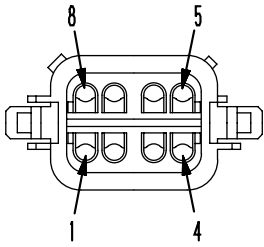
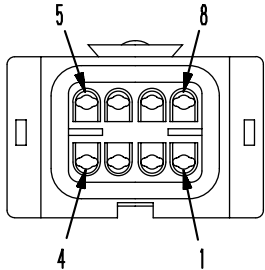
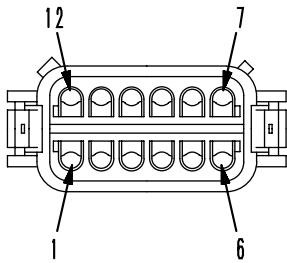
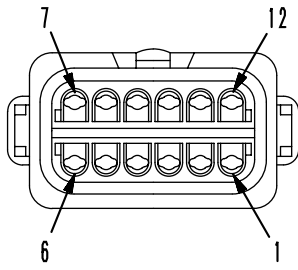
[The pin No. is also marked on the connector (electric wire insertion end)]

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)	

TESTING AND ADJUSTING

CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

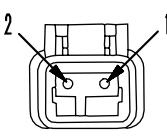
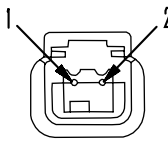
[The pin No. is also marked on the connector (electric wire insertion end)]

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)	
10	 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)	

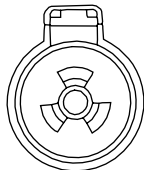
TESTING AND ADJUSTING

CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

[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.
2	 BWP05051	 BWP05052	—
	Part No.: 08192-31200 (Contact size#12) 08192-41200 (Contact size #8) 08192-51200 (Contact size #4)	Part No.: 08192-31100 (Contact size#12) 08192-41100 (Contact size #8) 08192-51100 (Contact size #4)	

TROUBLESHOOTING FOR ELECTRICAL SYSTEM (E-MODE)

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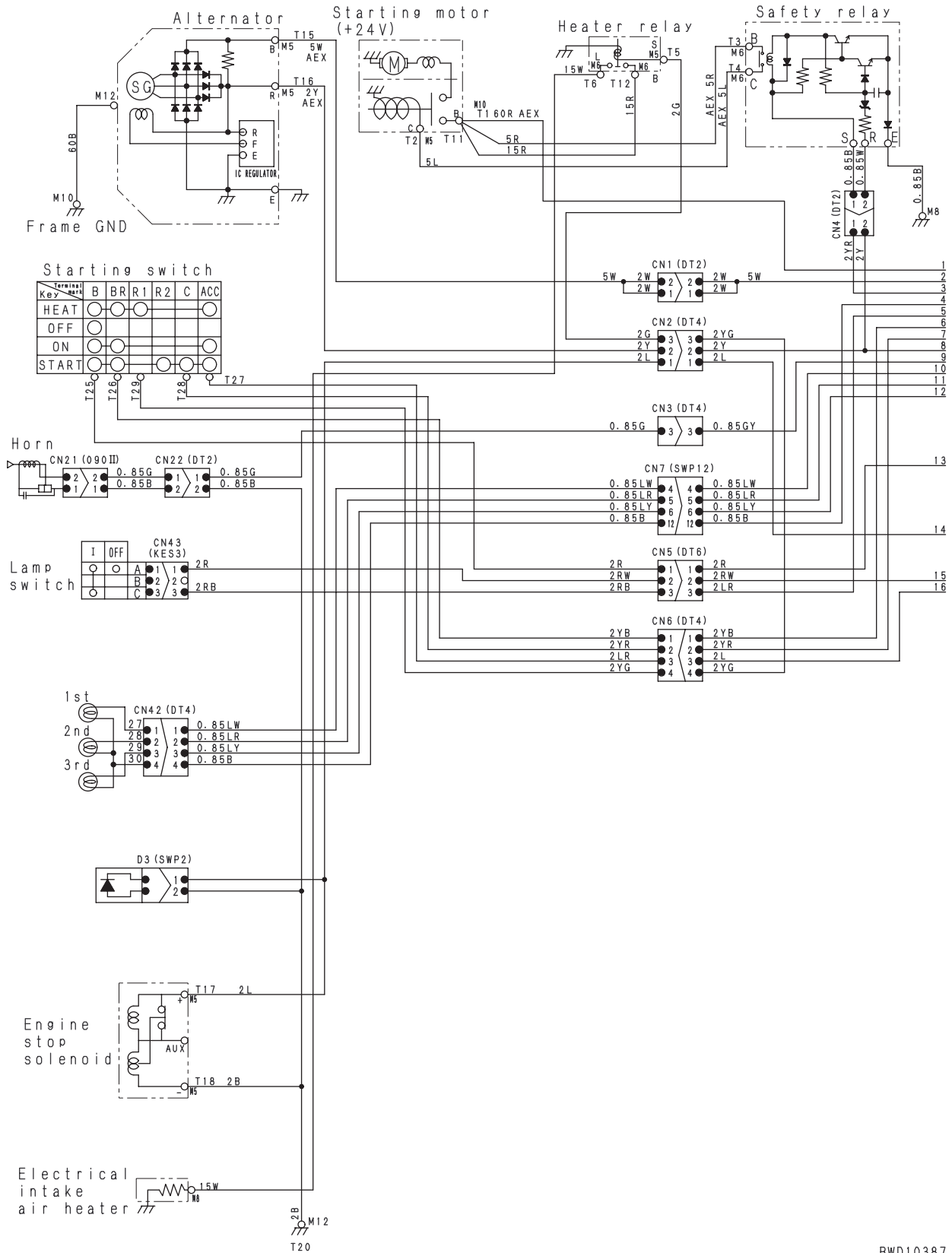
- ★ Before carrying out the troubleshooting, check that all the related connectors are properly connected.
- ★ Always connect any disconnected connectors before going on to the next step.

TABLE OF FAILURE MODES AND CAUSES (ELECTRICAL SYSTEM)

Parts that can cause failure Failure mode		Battery	Starting motor	Panel switch	Battery relay	Wiring harness	Lamp	Caution lamp	Oil pressure sensor	Engine stop solenoid	Air conditioner compressor	Air conditioner magnet relay	Blower motor	Air conditioner switch	Heater relay	Horn	Fuse	Wiper motor	Windshield washer motor	Washer nozzle	Washer piping
1	When starting switch is turned on, starting motor does not rotate	☐	☐	☐	☐																
2	Engine does not start (Engine stop solenoid does not operate normally)									☐											
3	Headlamp does not light up (Headlamp and rear lamp)	☐		☐	☐	☐		☐													
4	When starting switch is turned to HEAT position, engine is not heated	☐		☐		☐									☐						
5	Windshield wiper does not operate					☐										☐	☐				
6	Washing water does not spout					☐													☐	☐	☐
7	Air conditioner does not work	☐			☐	☐					☐	☐	☐	☐							
8	Parking brake cannot be released (Parking brake solenoid does not operate)					☐															
9	Travel speed control is abnormal	☐				☐															
10	Backup alarm does not sound during reverse travel																				
11	Horn does not sound															☐					

Travel speed controller	Solenoid	Gear shift switch	Backup buzzer	Proximity switch	Limit switch	This troubleshooting
						If there is any fault, go to troubleshooting code E-0X (YES/NO)
						E-1
						E-2
						E-3
						E-4
						E-5
						E-6
						E-7
	○				○	E-8
○	○	○				E-9
			○	○		E-10
						E-11

ELECTRICAL CIRCUIT DIAGRAM FOR EACH SYSTEM



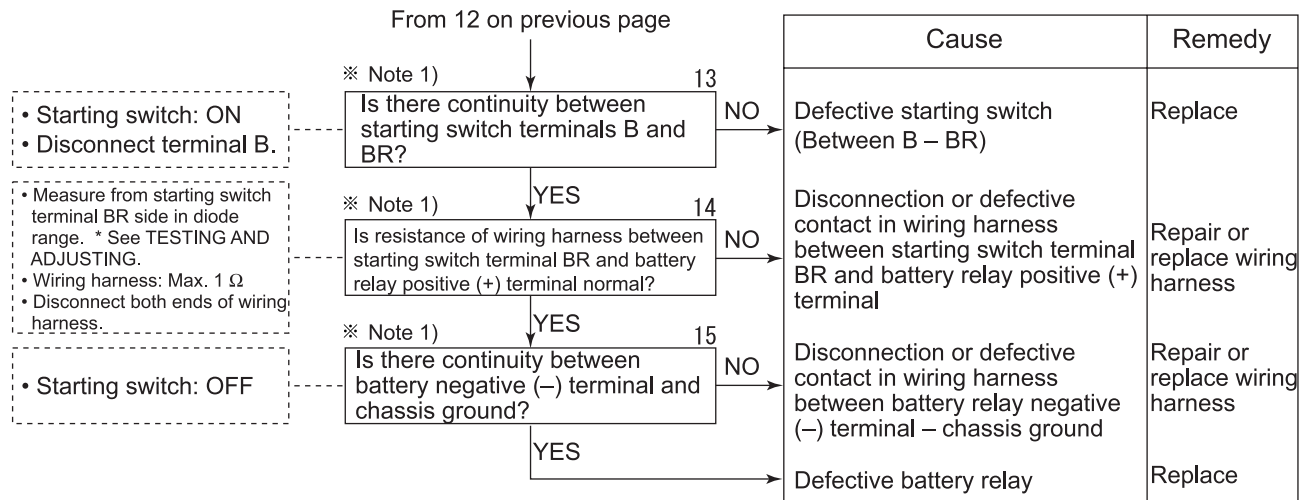
BWD10387



E-1. When starting switch is turned on, starting motor does not rotate

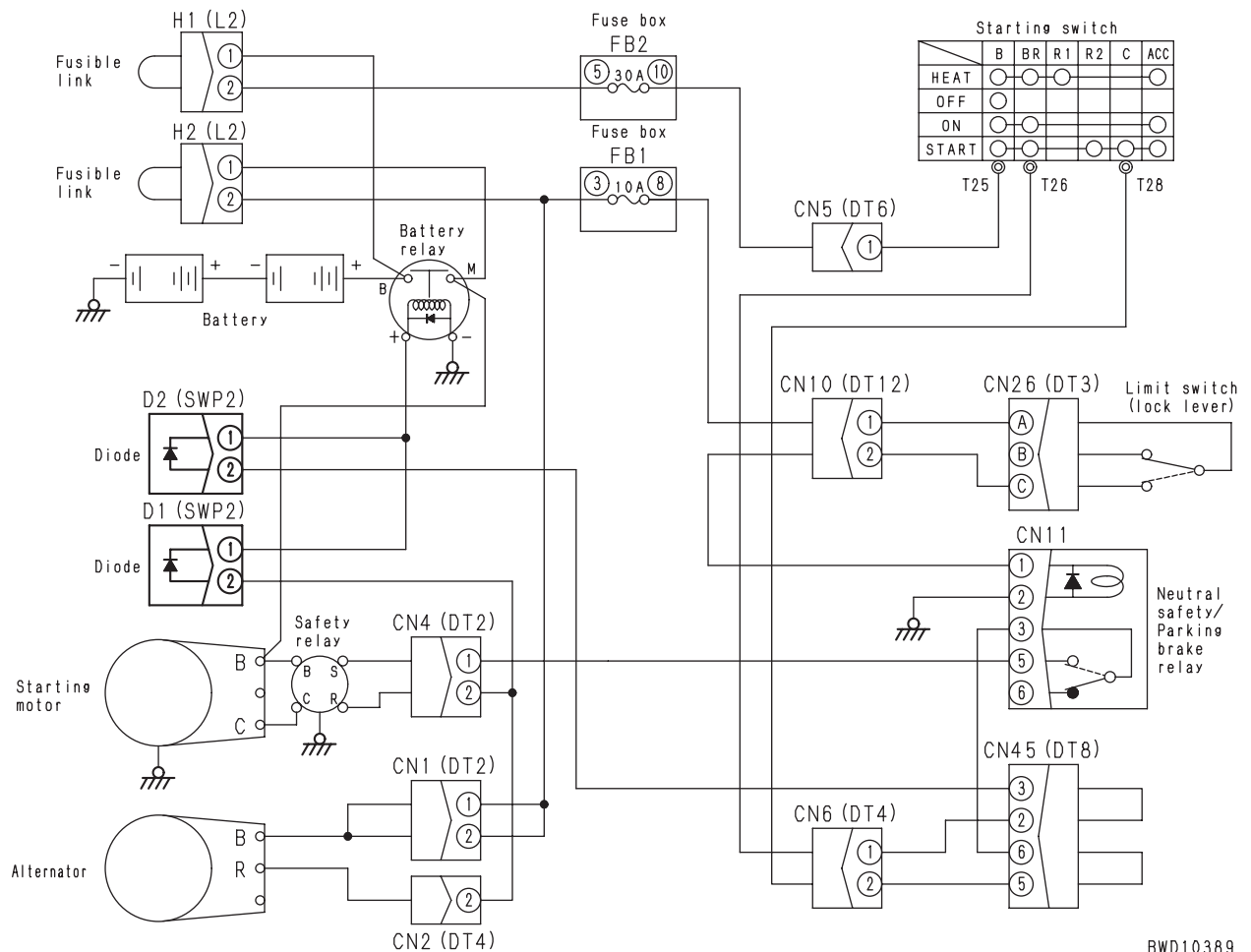
- ★ Before carrying out the troubleshooting, check that fuses FB1 No. 3 and FB2 No. 5 and fusible links CNH1 and H2 are normal.





※ Note 1) This may be checked by testing if the lamp lights up or if the horn sounds normally.

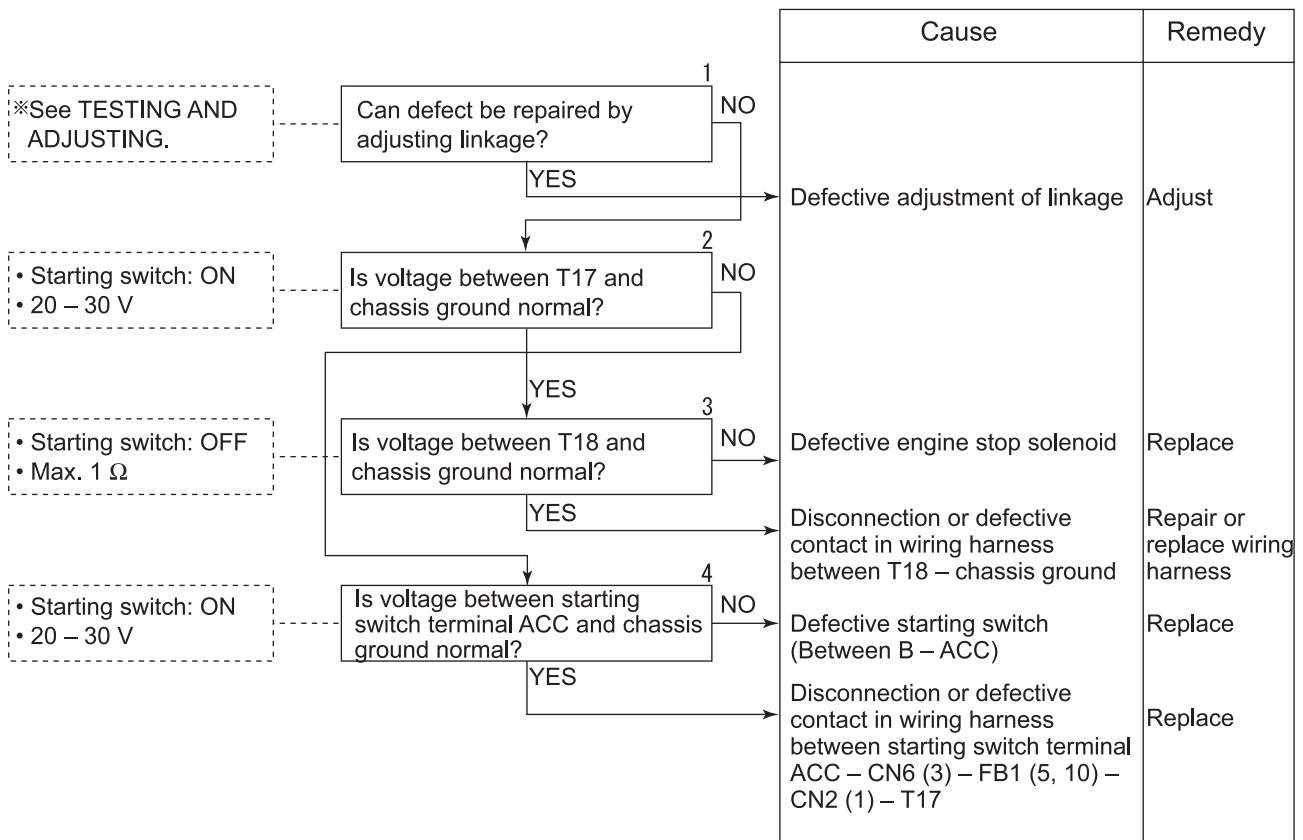
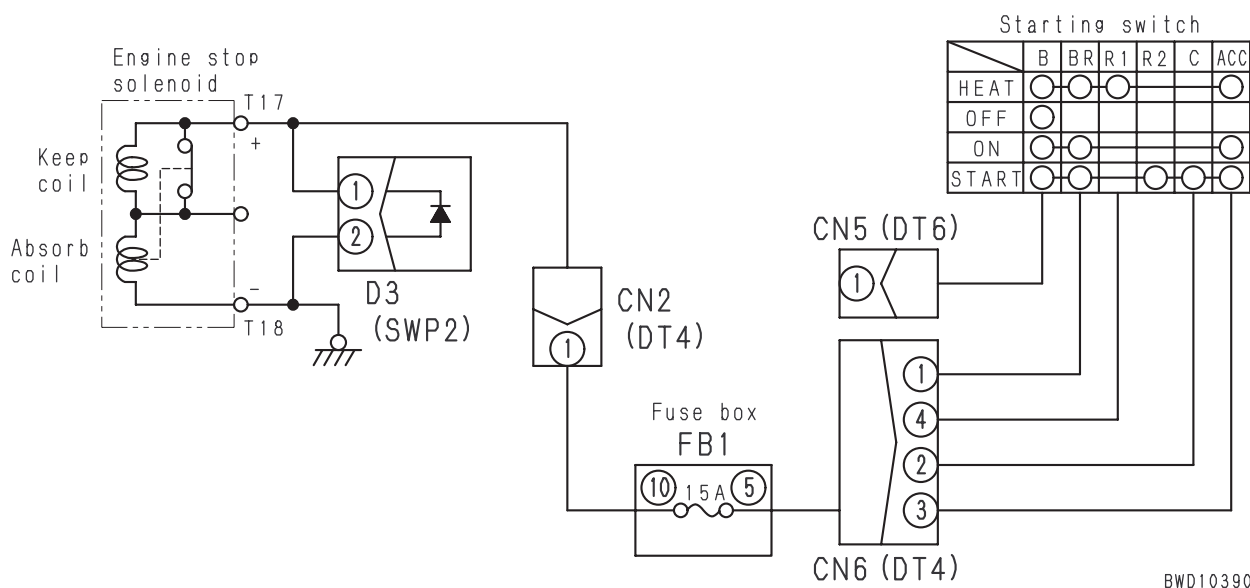
E-1. Related electrical circuit diagram



BWD10389

E-2. Engine does not start (Engine stop solenoid does not operate normally)

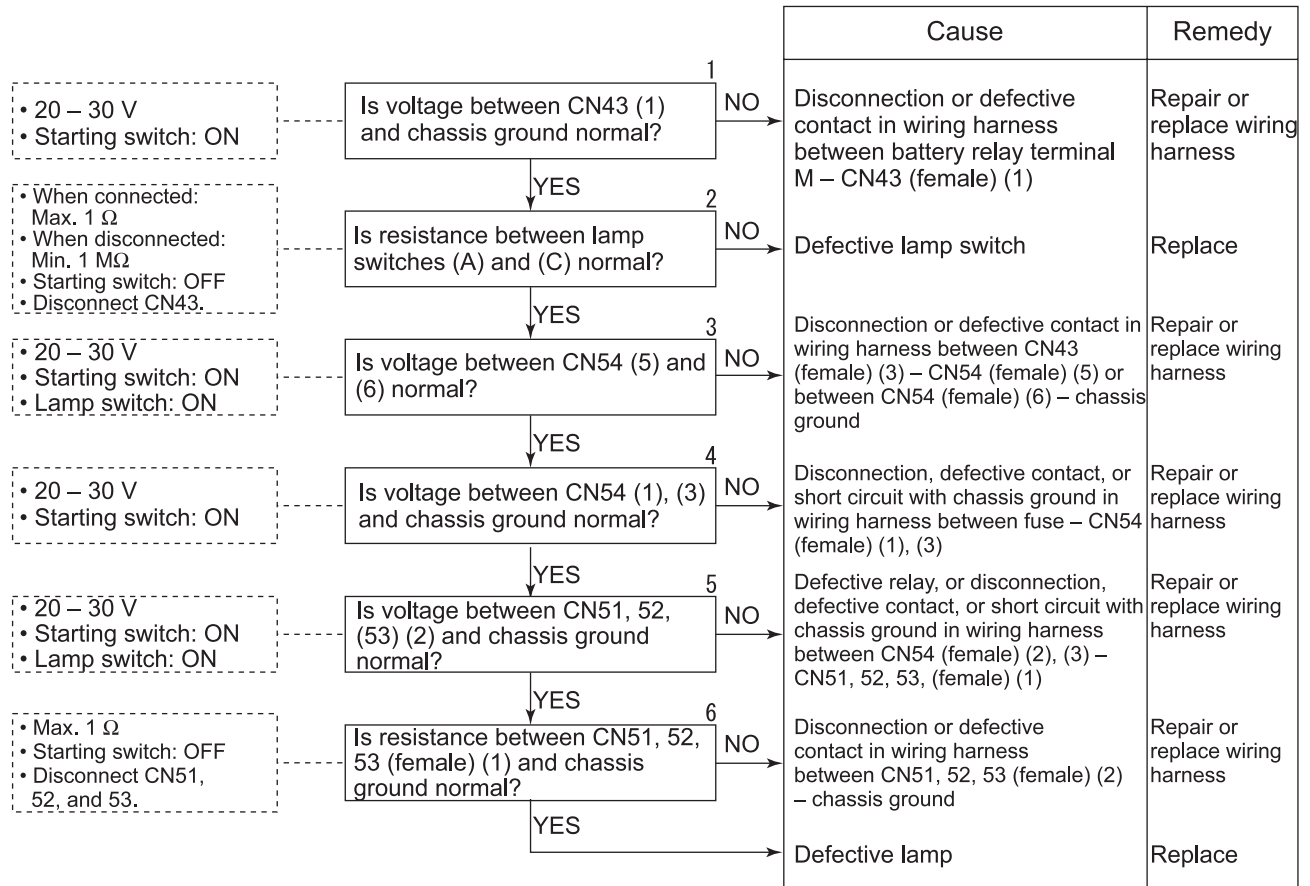
- ★ Carry out the following troubleshooting when the starting motor rotates normally.
- ★ Before carrying out the troubleshooting, check that fuse FB1 No. 5 is normal.

**E-2. Related electrical circuit diagram**

BWD10390

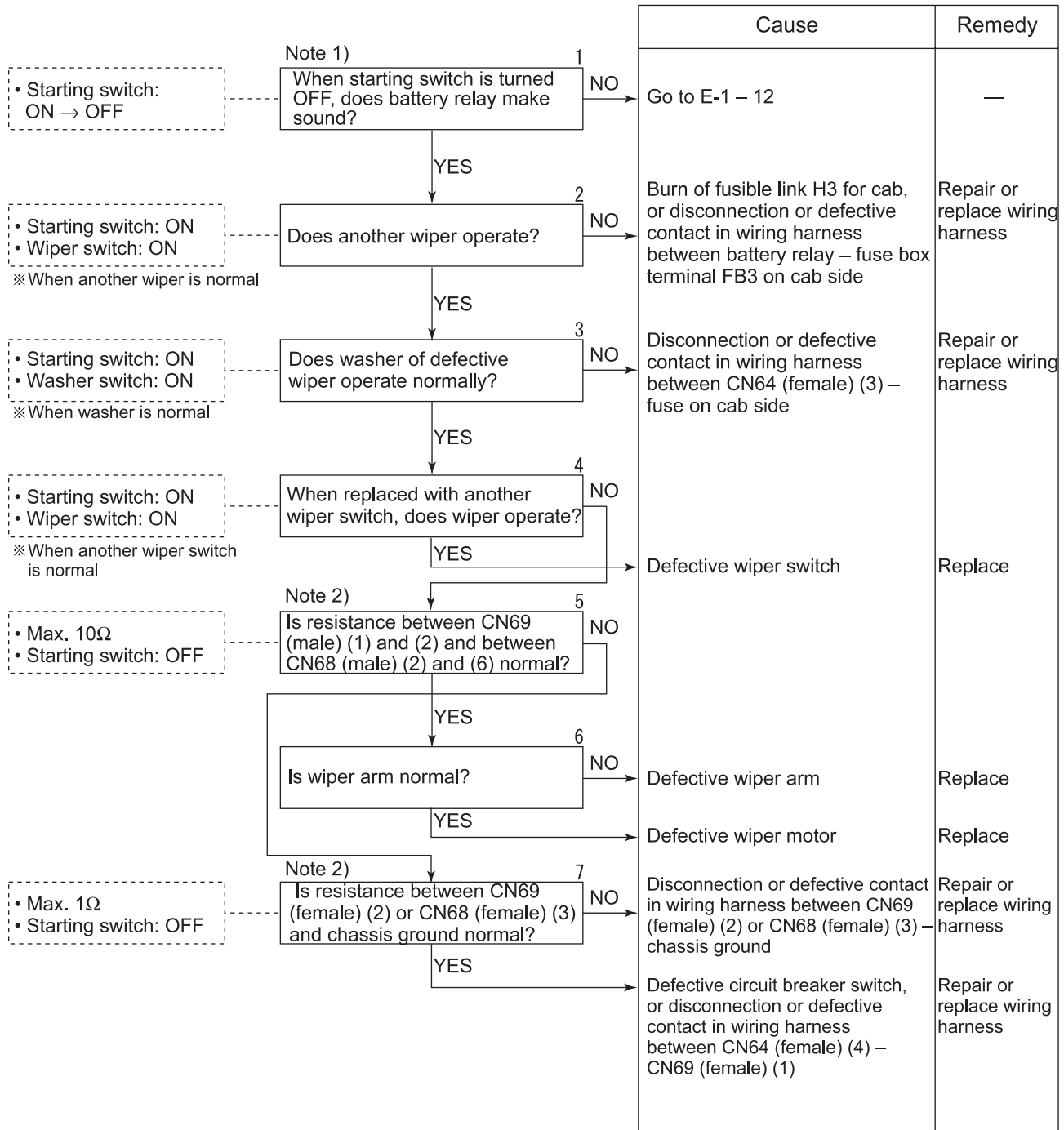
E-3. Headlamp does not light up

- ★ Carry out the following troubleshooting when breakage of the bulb, etc. is not detected by visual inspection. (If breakage of the bulb is detected, replace the bulb.)
- ★ Before carrying out the troubleshooting, check that fusible link CNH2 and fuse FB1 No. 1 are normal.



E-5. Windshield wiper does not operate

- ★ Carry out the following troubleshooting when the battery is normal.
- ★ Before carrying out the troubleshooting, check that the respective fuses and circuit breaker switches for the windshield wipers are normal.



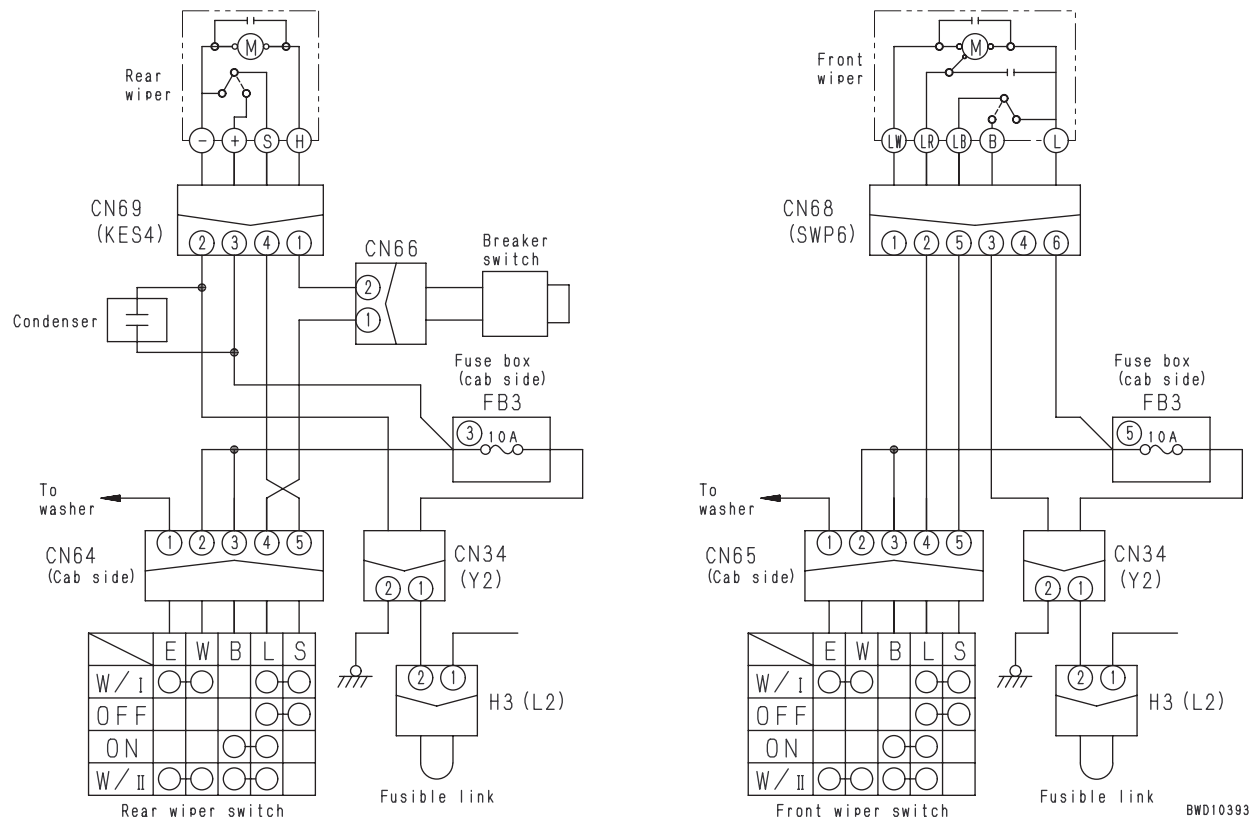
Note 1) If the circuit of the lamp (headlamp or rear lamp) or horn is normal, this may be checked by testing if the lamp lights up or if the horn sounds normally.

Note 2) This troubleshooting is explained by using the rear wiper as an example. For the connector Nos. corresponding to the front wiper, see Table 1.

Table 1

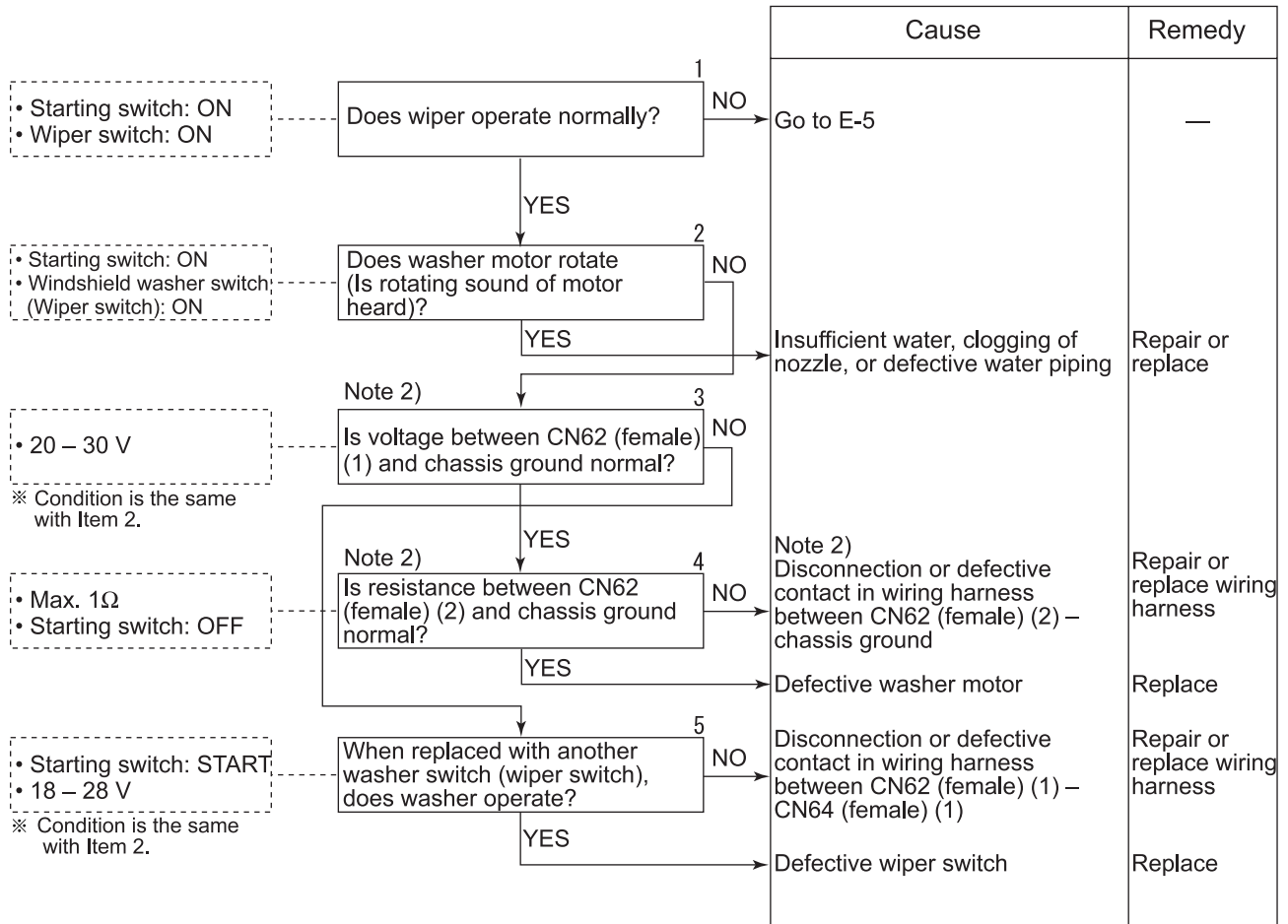
Wiper name	Rear wiper	Front wiper
Connector No.	CN64	CN65
	CN69	CN68

E-5. Related electrical circuit diagram



E-6. Washing water does not spout

- ★ Carry out the following troubleshooting when the battery is normal.
- ★ Before carrying out the troubleshooting, check that the respective fuses for the windshield wipers are normal.

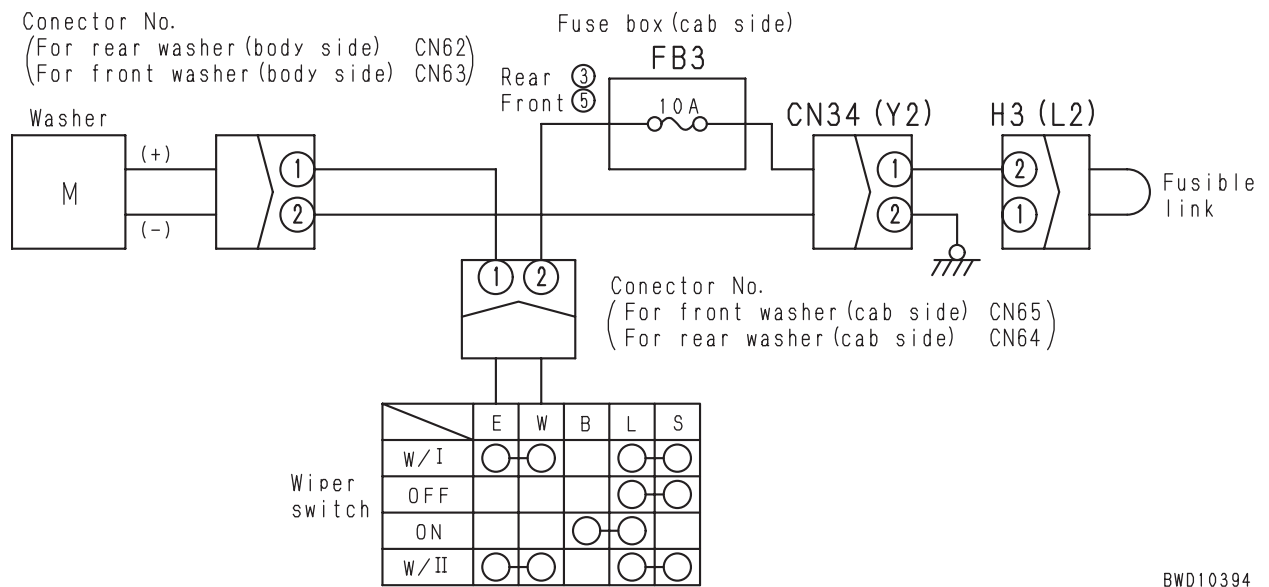


Note 1) If the circuit of the lamp (headlamp or rear lamp) or horn is normal, this may be checked by testing if the lamp lights up or if the horn sounds normally.

Note 2) This troubleshooting is explained by using the left washer as an example. For the connector Nos. corresponding to CN11 on the cab side of another washer, see below.

Wiper name	Rear washer	Front washer
Connector No.	CN64	CN65
	CN62	CN63

E-6. Related electrical circuit diagram

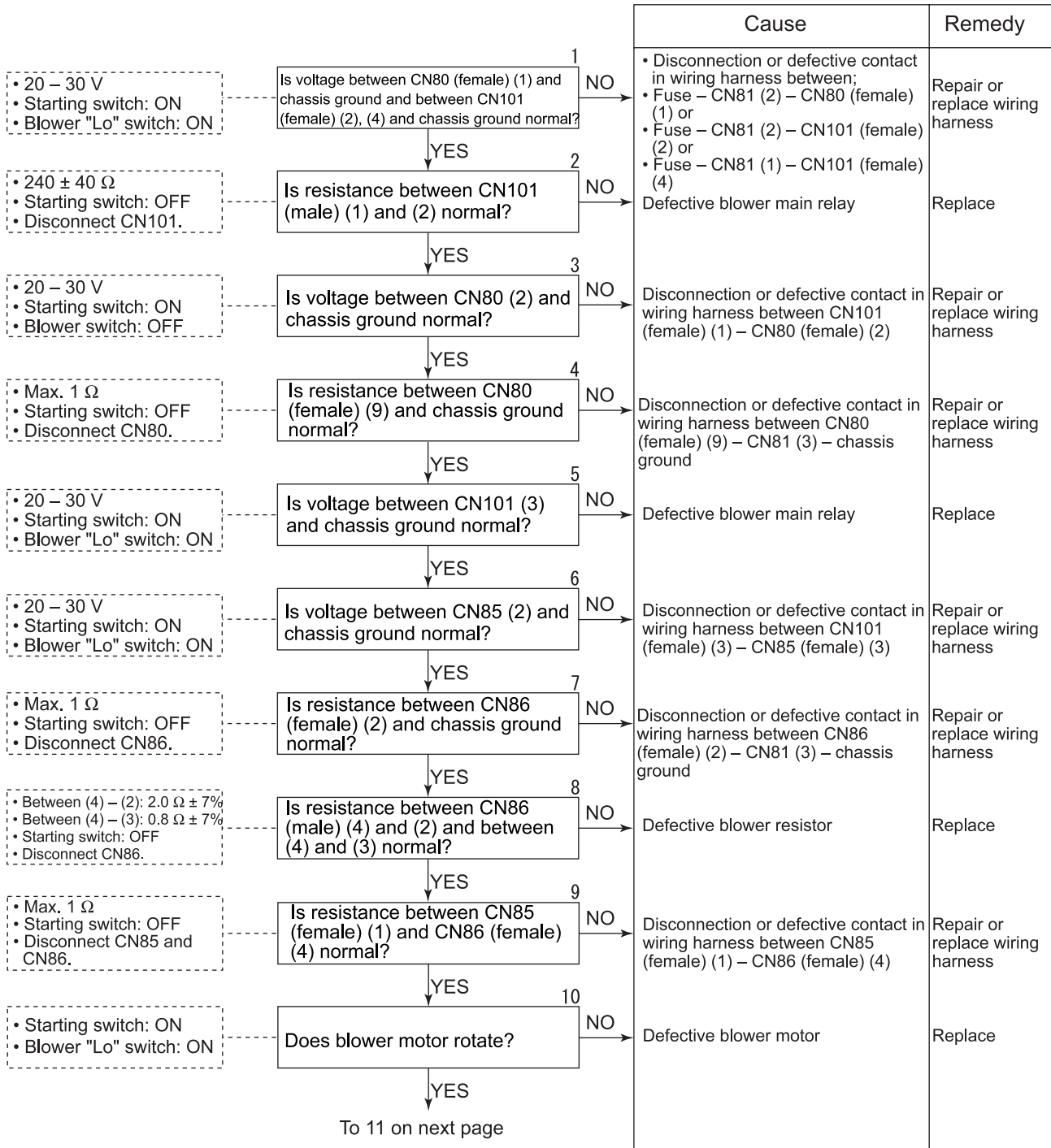


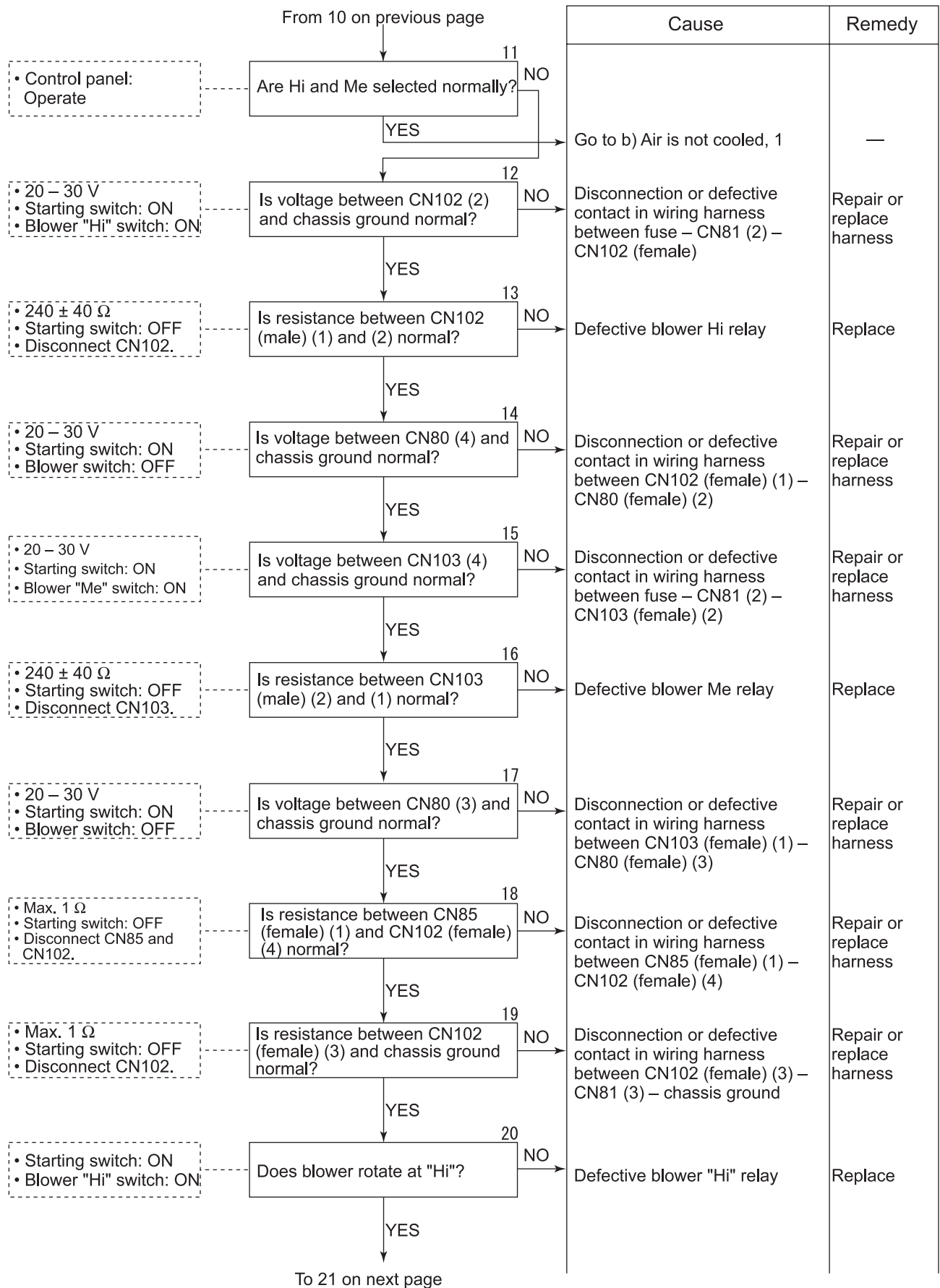
BWD10394

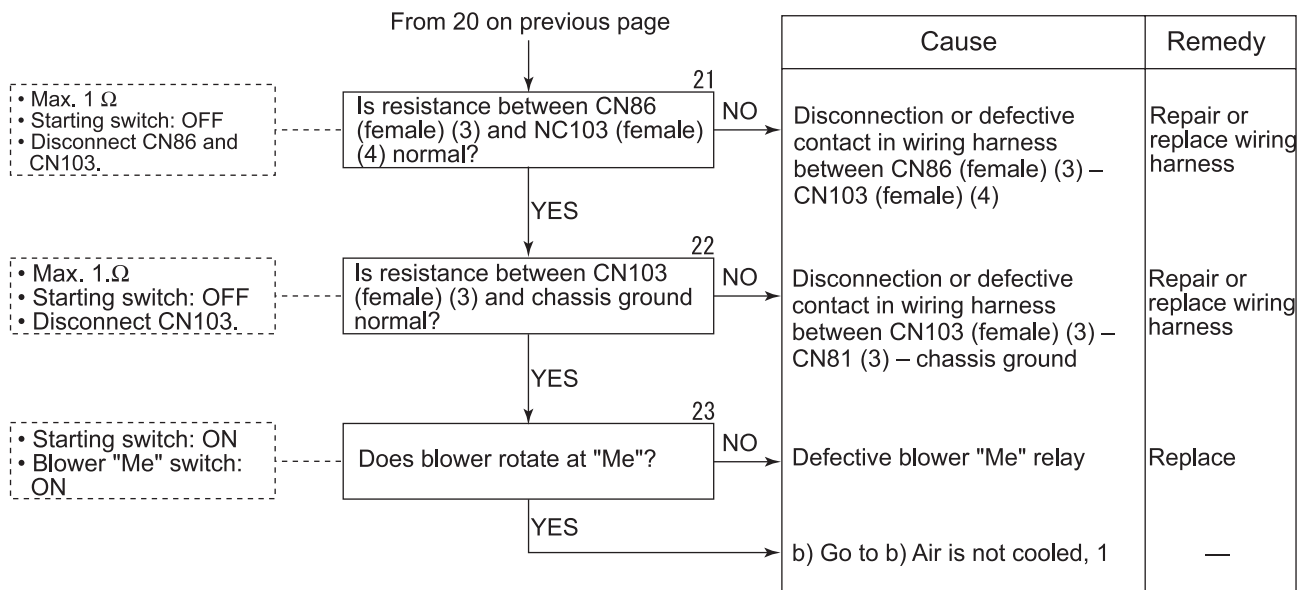
E-7. Air conditioner does not work

- ★ Carry out the following troubleshooting when the battery and battery relay are normal.
- ★ Before carrying out the troubleshooting, check that fuse (FB2) No. 3 is normal.

a) Air does not blow out

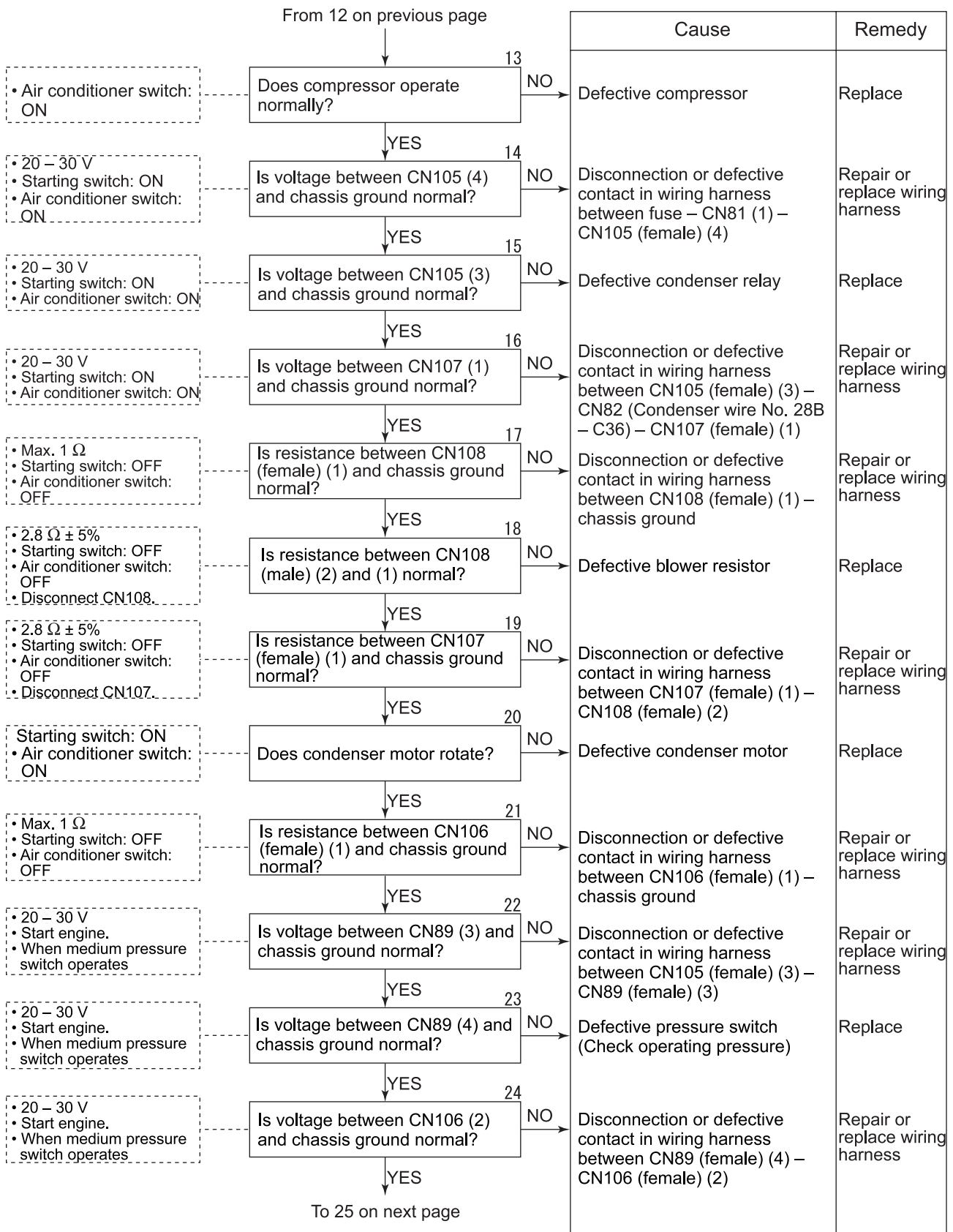






b) Air is not cooled

			Cause	Remedy
• Max. 1 Ω • Starting switch: OFF • Disconnect CN80 and CN88.	1 Is resistance between CN80 (female) (6) and CN88 (female) (1) and between CN80 (female) (8) – CN88 (female) (2) normal?	NO	Disconnection or defective contact in wiring harness between CN80 (female) (6) – CN88 (female) (1) or between CN80 (female) (8) – CN88 (female) (2)	Repair or replace wiring harness
	YES	2		
• Max. 3500 Ω • Starting switch: OFF • Disconnect CN80.	Is resistance between CN80 (female) (6) and (8) normal?	NO	Defective frost thermistor (Check for improper sensing temperature)	Replace
	YES	3		
• 20 – 30 V • Starting switch: ON • Air conditioner switch: ON • Blower switch: ON	Is voltage between CN104 (2) and chassis ground or between CN105 (female) (2) and chassis ground normal?	NO	Disconnection or defective contact in wiring harness between fuse – CN81 (2) – CN104 (female) (2) or CN105 (female) (2)	Repair or replace wiring harness
	YES	4		
• 240 $\pm$ 40 Ω • Starting switch: OFF • Disconnect CN104 and CN105.	Is resistance between CN104 (male) (2) and (1) and between CN105 (male) (2) and (1) normal?	NO	Defective compressor clutch relay or condenser relay	Replace
	YES	5		
• Max. 1 Ω • Starting switch: OFF • Disconnect CN104 and CN105.	Is resistance between CN104 (female) (1) and CN105 (female) (1) normal?	NO	Disconnection or defective contact in wiring harness between CN104 (female) (1) – CN105 (female) (1)	Repair or replace wiring harness
	YES	6		
• 20 – 30 V • Starting switch: ON • Air conditioner switch: ON • Blower switch: ON	Is voltage between CN89 (1) and chassis ground normal?	NO	Disconnection or defective contact in wiring harness between CN104 (female) (1), CN105 (female) – CN89 (female) (1)	Repair or replace wiring harness
	YES	7		
• 20 – 30 V • Starting switch: ON • Air conditioner switch: ON • Blower switch: ON	Is voltage between CN89 (2) and chassis ground normal?	NO	Defective pressure switch (Check operating pressure)	Replace
	YES	8		
• 20 – 30 V • Starting switch: ON • Air conditioner switch: ON • Blower switch: ON	Is voltage between CN80 (5) and chassis ground normal?	NO	Disconnection or defective contact in wiring harness between CN89 (female) (2) – CN80 (female) (5)	Repair or replace wiring harness
	YES	9		
• 20 – 30 V • Starting switch: ON • Air conditioner switch: ON • Blower switch: ON	Is voltage between CN104 (3) and chassis ground normal?	NO	Disconnection or defective contact in wiring harness between fuse – CN81 (1) – CN104 (female) (3)	Repair or replace wiring harness
	YES	10		
• 20 – 30 V • Starting switch: ON • Air conditioner switch: ON • Blower switch: ON	Is voltage between CN104 (4) and chassis ground normal?	NO	Defective compressor clutch relay	Replace
	YES	11		
• 20 – 30 V • Starting switch: ON • Air conditioner switch: ON • Blower switch: ON	Is voltage between CN81 (4) and chassis ground normal?	NO	Disconnection or defective contact in wiring harness between CN104 (female) (4) – CN81 (male) (4)	Repair or replace wiring harness
	YES	12		
• Air conditioner switch: ON	Does magnetic clutch operate normally?	NO	Defective magnetic clutch	Replace
	YES			
To 13 on next page				



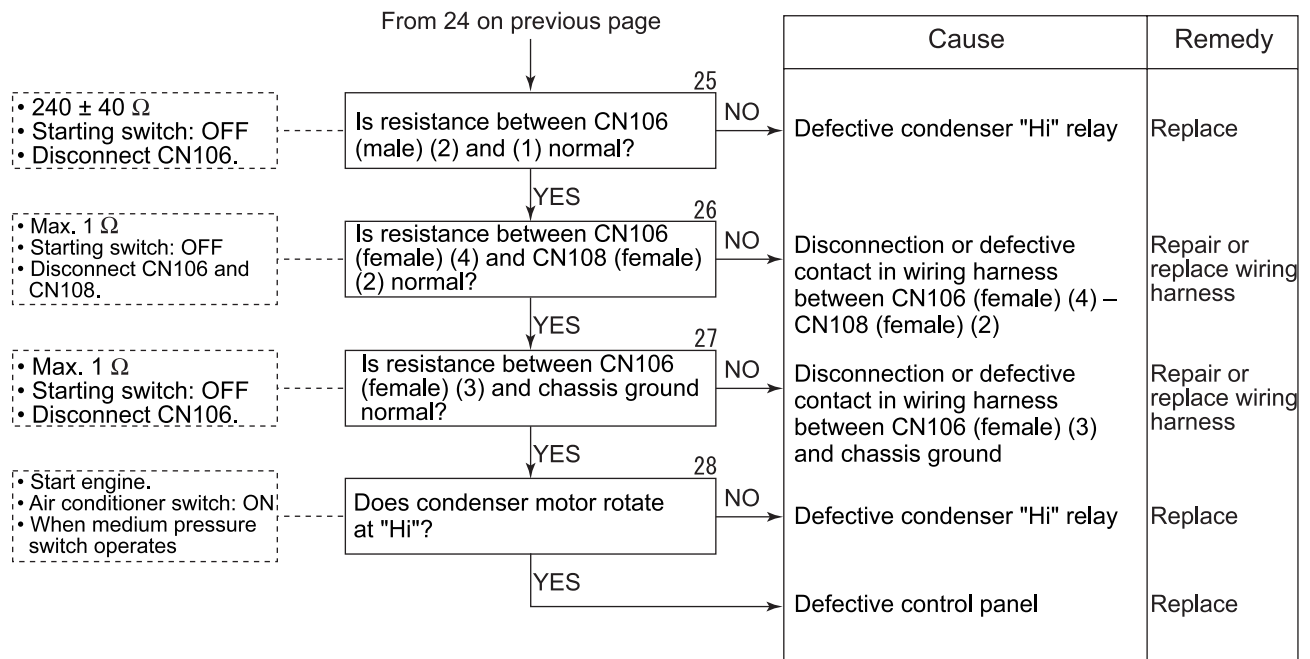
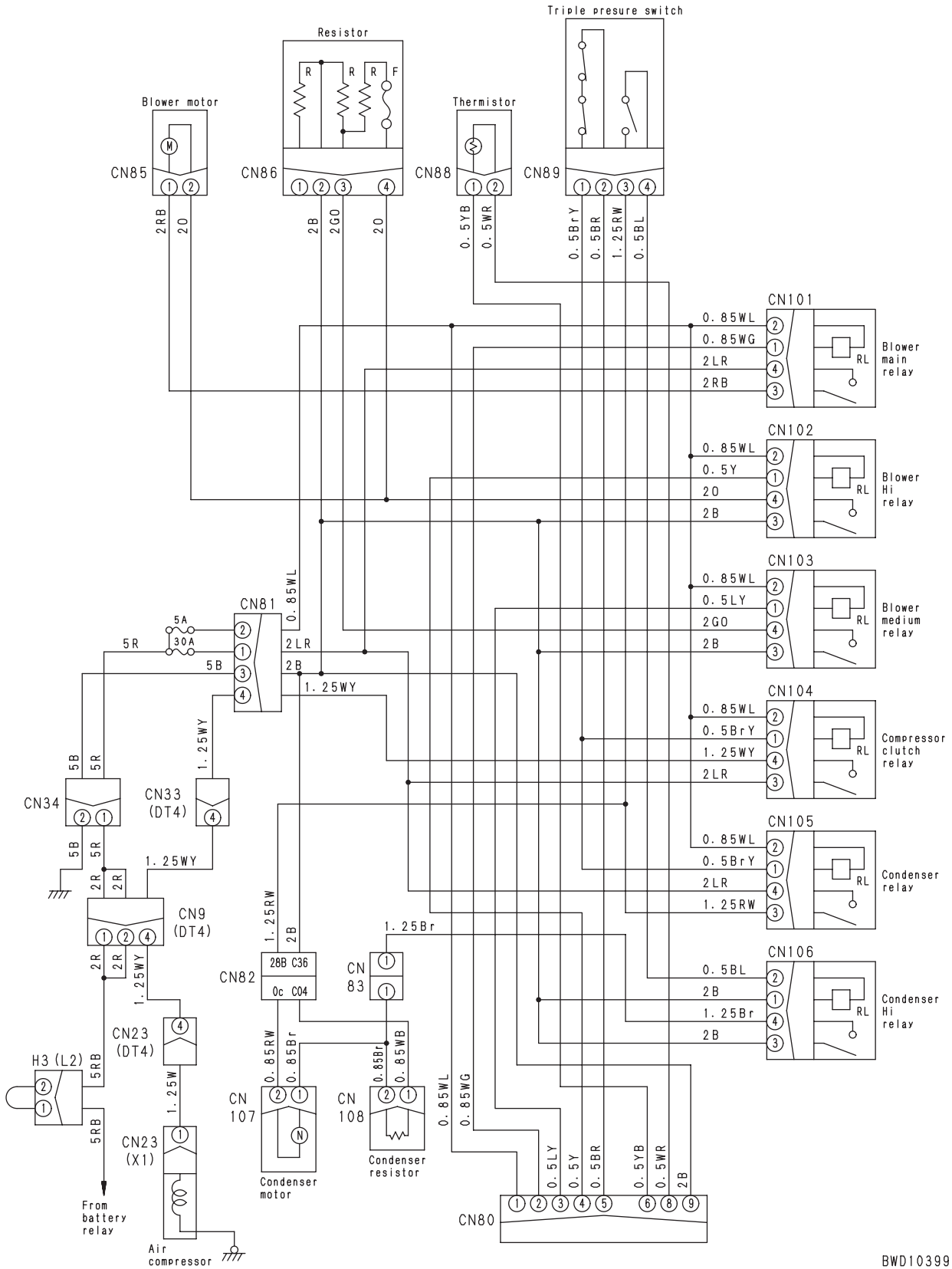


Table 1 Specifications of pressure switch

Pressure specifications of triple pressure switch (443440-005*)		
Operating procedure	High/Low pressure side	DIFF (Min. 0.02) [Min. 0.2] 0.2 ON DIFF 0.59 ± 0.2 [6.0 ± 2.0] OFF 0.196 ± 0.02 [2.0 ± 0.2] 0.225 ± 0.025 [2.3 ± 0.3] 3.14 ± 0.02 [32 ± 0.5] MPa {kg/cm²}
	Medium pressure side	ON OFF 1.23 ± 0.12 [12.55 ± 1.2] 1.52 ± 0.08 [15.5 ± 0.8] MPa {kg/cm²}
Airtightness pressure	3.53MPa {36.0kg/cm²}	
Pressure resistance	5.30MPa {54.0kg/cm²}	

E-7. Related electrical circuit diagram

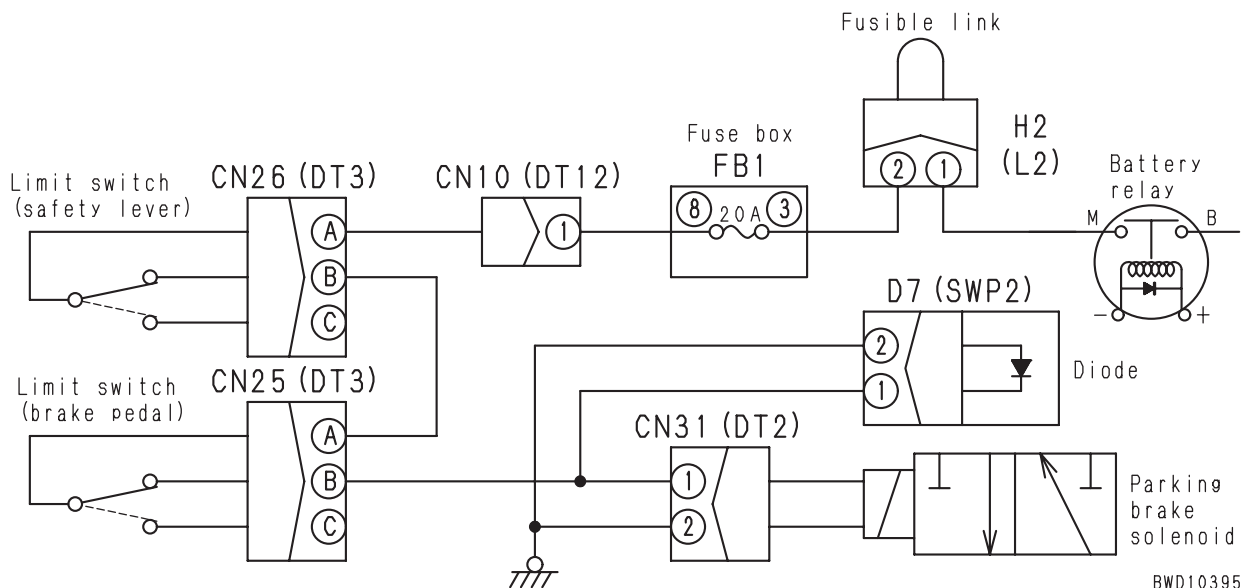


BWD10399

E-8. Parking brake cannot be released (Parking brake solenoid does not operate)

★ Before carrying out the troubleshooting, check that fusible link H2 and fuse FB1 No. 3 are normal.

			Cause	Remedy
• 20 – 30 V • Starting switch: ON	1	Is voltage between CN26 (A) and chassis ground normal?	NO Disconnection or defective contact in wiring harness between battery relay – CN26 (female) (A)	Repair or replace wiring harness
• 20 – 30 V • Starting switch: ON • Safety lever: Release ※ Before troubleshooting, check operation of limit switch of safety lever.	2	Is voltage between CN25 (A) and chassis ground normal?	NO • Defective limit switch of lock lever or • Disconnection or defective contact in wiring harness between CN26 (female) (B) – CN25 (female) (A)	• Replace • Repair or replace wiring harness
• 20 – 30 V • Starting switch: ON • Safety lever: Release • Brake pedal: Release ※ Before troubleshooting, check operation of limit switch of brake pedal.	3	Is voltage between CN31 (1) and chassis ground normal?	NO • Defective limit switch of brake pedal or • Disconnection or defective contact in wiring harness between CN25 (female) (B) – CN31 (female) (1)	• Replace • Repair or replace wiring harness
• Max. 1 Ω • Starting switch: OFF • Disconnect CN31.	4	Is resistance between CN31 (female) (2) and chassis ground normal?	NO Disconnection or defective contact in wiring harness between CN31 (female) (2) – chassis ground	Repair or replace wiring harness
• Between (1) – (2): 20 – 60 Ω • Between (1), (2) – chassis ground: Min. 1 MΩ • Starting switch: OFF • Disconnect CN31.	5	Is resistance between CN31 (male) (1) and (2) normal and are they insulated from machine body?	NO Defective brake release solenoid	Replace
		YES	Defective solenoid valve or hydraulic/mechanical system	—

E-8. Related electrical circuit diagram

E-9. Travel speed control is abnormal

- ★ Before carrying out the troubleshooting, check that fusible link H2 and fuse FB1 No. 3 are normal.
- ★ If only display of the gear speed on the monitor panel is abnormal, go to M-10.

a) When gear shift switch is pressed, gear speed does not change or gear speed changes by itself (Gear shift switch or controller is abnormal)

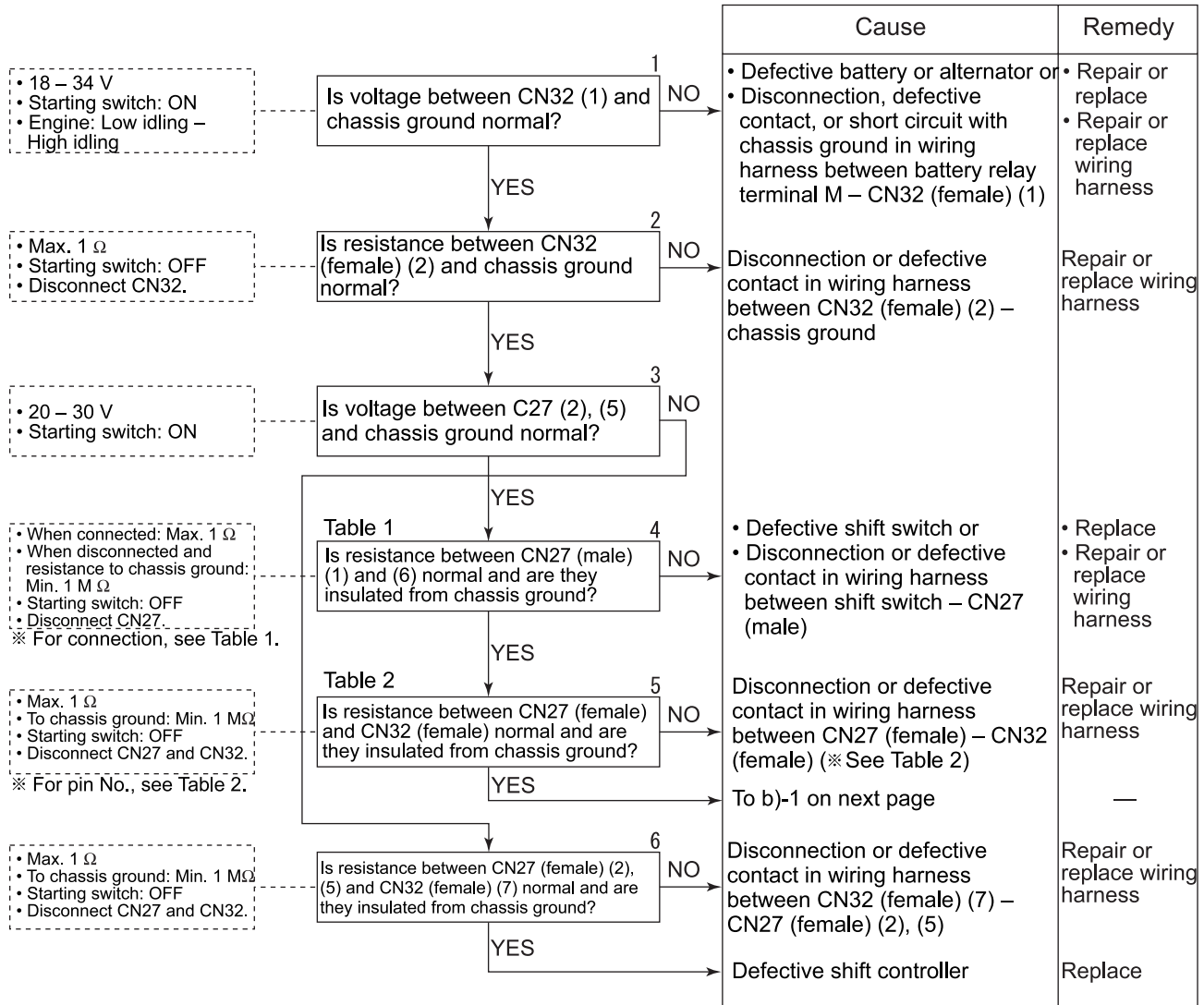


Table 1

Connector and pin No.		Shift-up switch		Shift-down switch	
		Push	Release	Push	Release
CN27	(1)	○			
	(2)	○	○		
	(3)		○		
	(4)			○	
	(5)			○	○
	(6)				○

Table 2 Connection table of pins of CN27 and CN32

Connector on shift switch side and pin No.		Connector on shift controller side and pin No.	
CN27	(1) —	(3)	CN32
	(3) —	(4)	
	(4) —	(5)	
	(6) —	(6)	

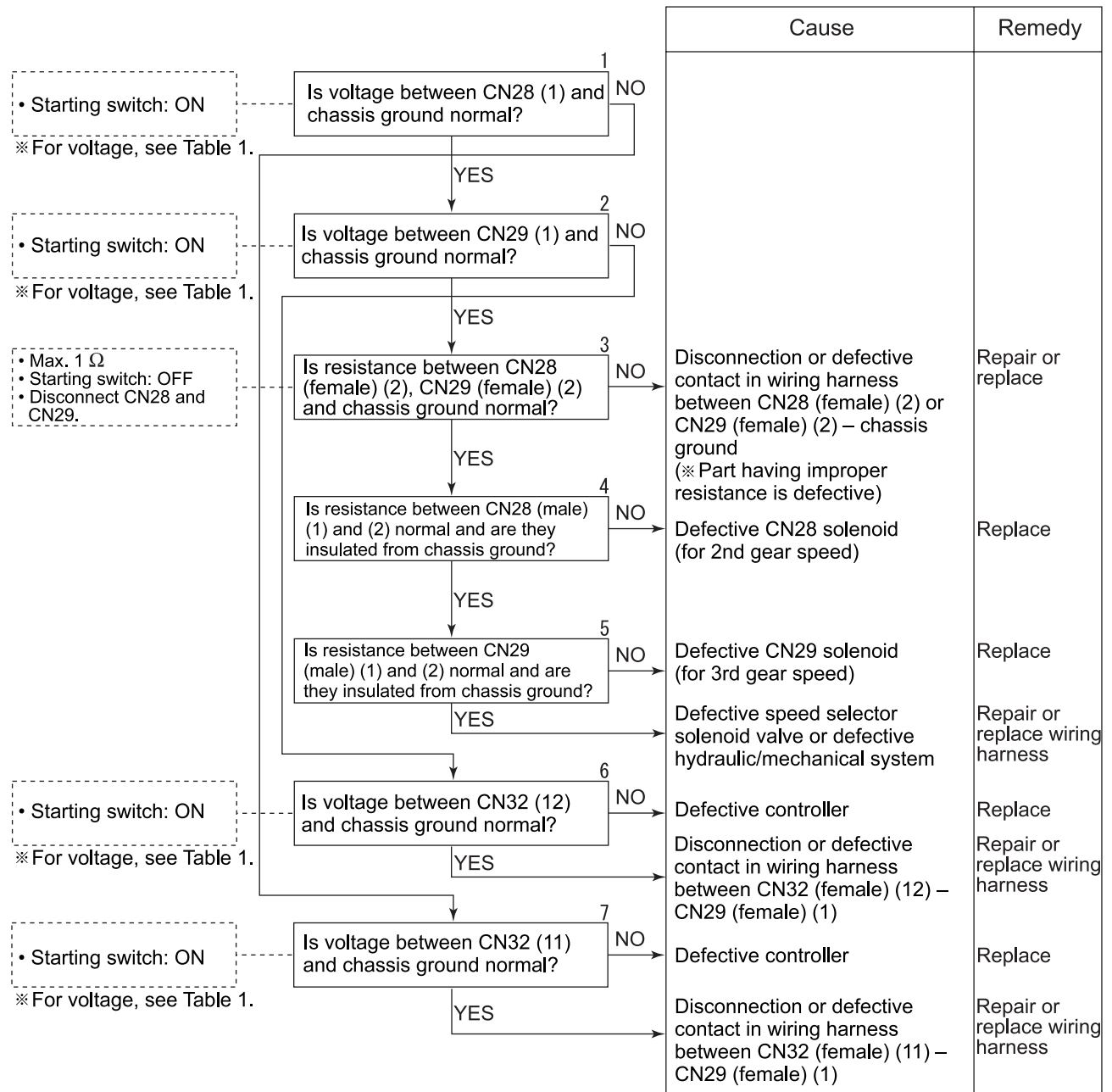
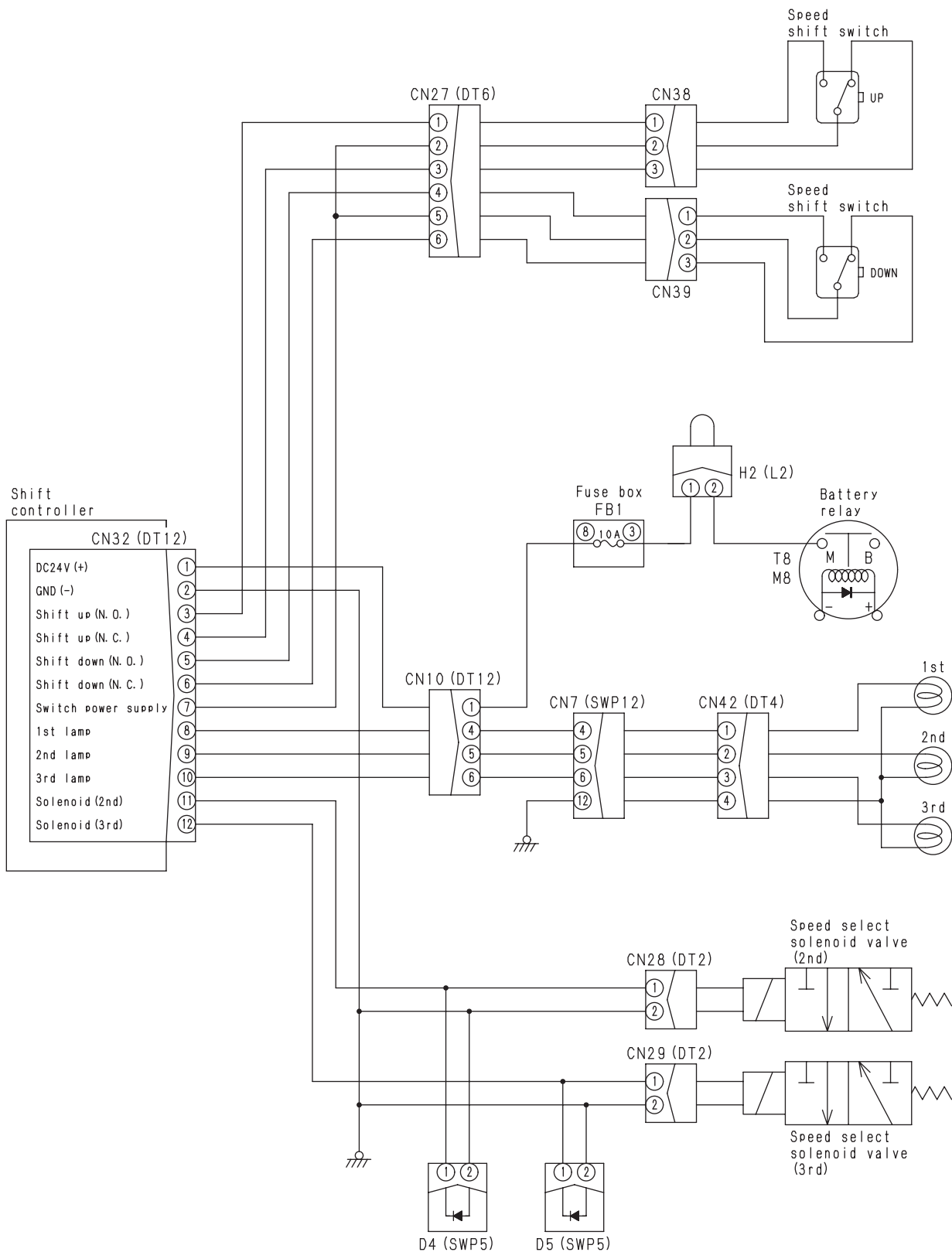
b) Gear speed cannot be selected normally (Travel speed changeover solenoid is abnormal)

Table 1

	1st gear	2nd gear	3rd gear
Between CN28 (1) – Chassis ground	Max. 1 V	20V – 30V	Max. 1 V
Between CN29 (1) – Chassis ground	Max. 1 V	Max. 1 V	20V – 30V

※ When starting switch is turned ON, gear speed is set to "1st".

E-9. Related electrical circuit diagram



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E-10. Backup alarm does not sound during reverse travel

- ★ Before carrying out the troubleshooting, check that fusible link H2 and fuse FB2 No. 2 are normal.
- ★ Before carrying out the troubleshooting, adjust the proximity switch (See TESTING AND ADJUSTING).

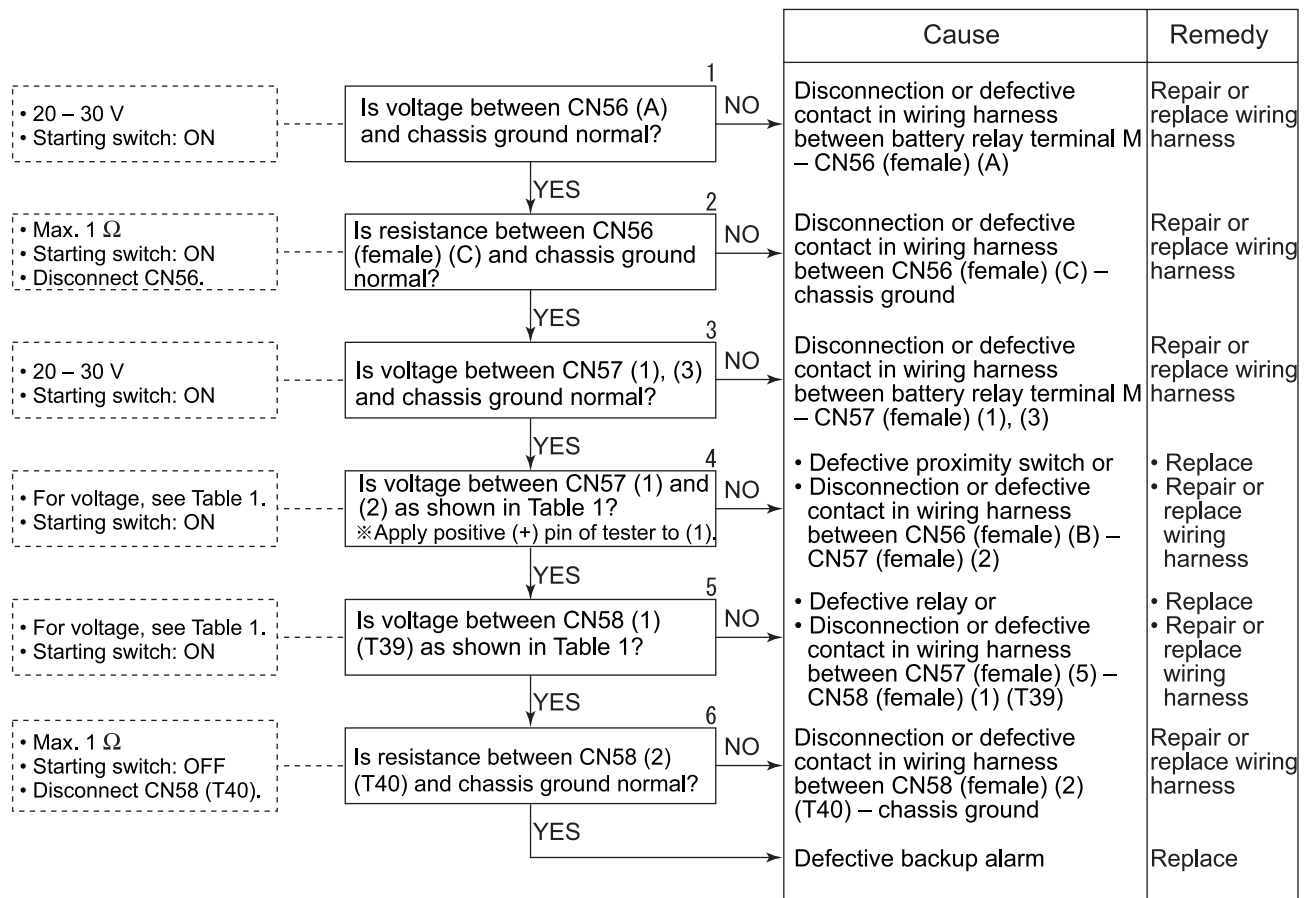
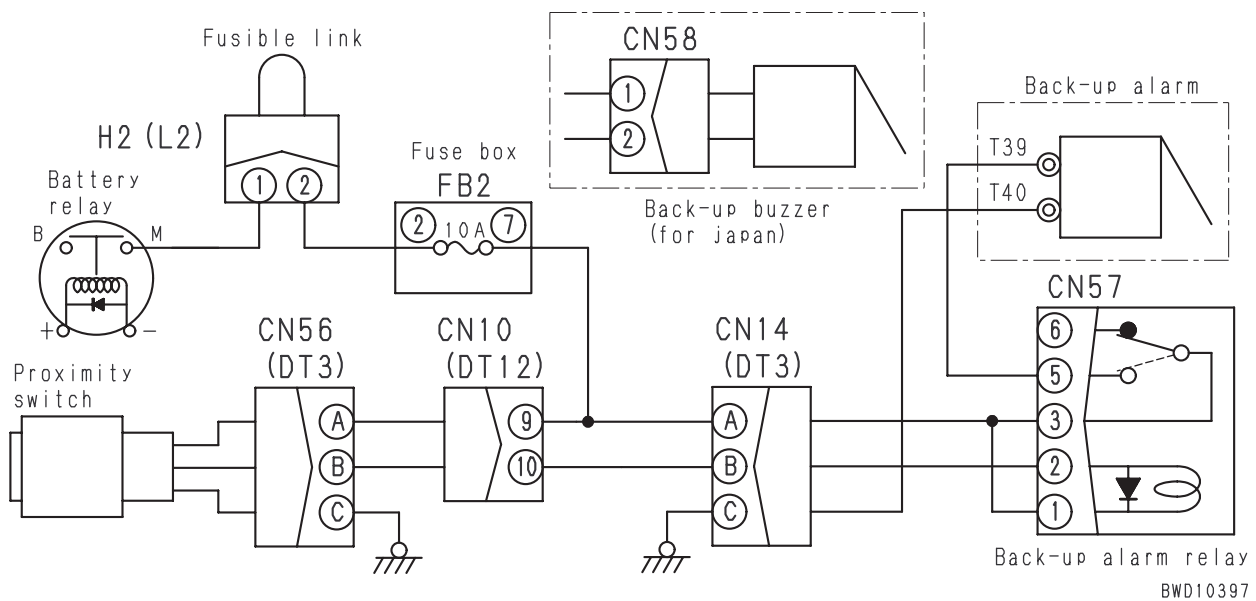


Table 1 Voltage when proximity switch is turned ON and OFF

	Forward, Neutral	Reverse
Between CN57 (1) – (2)	Max. 1 V	20V – 30V
Between CN58 (1) (T39) – Chassis ground	Max. 1 V	20V – 30V

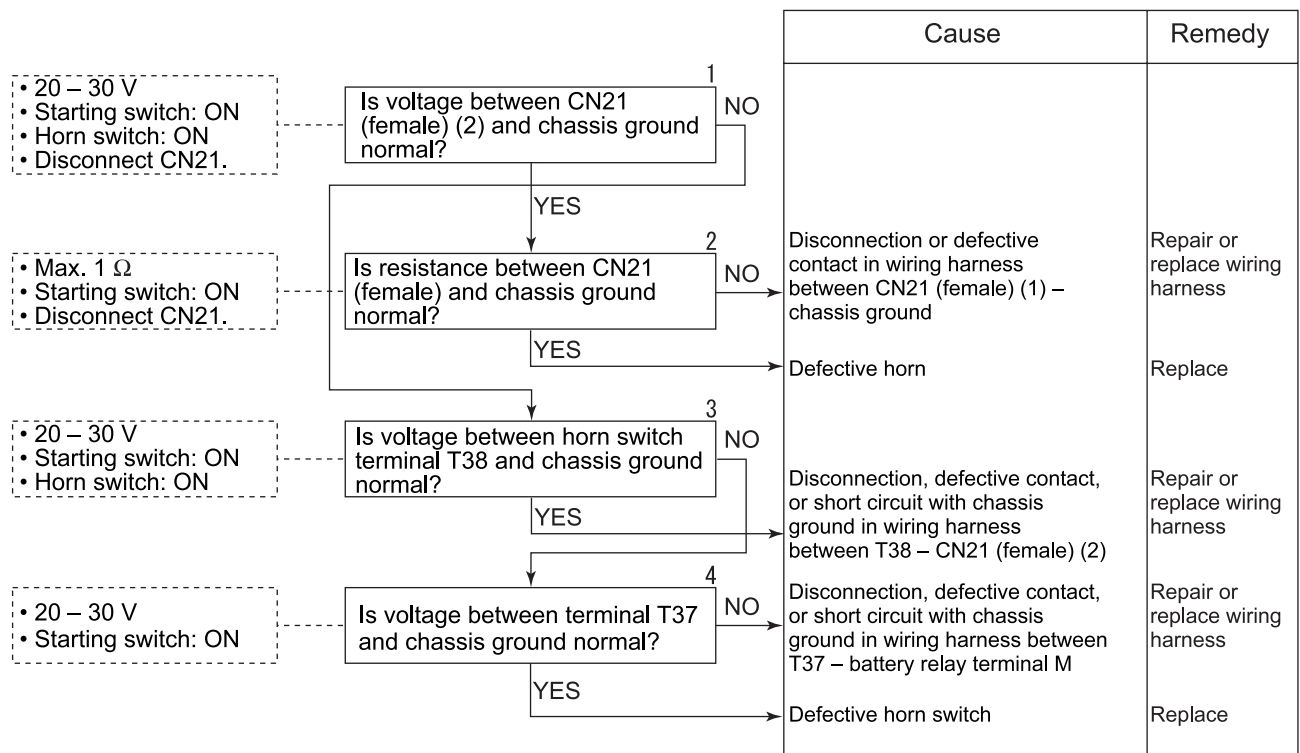
← Note that voltage difference is shown.

E-10. Related electrical circuit diagram

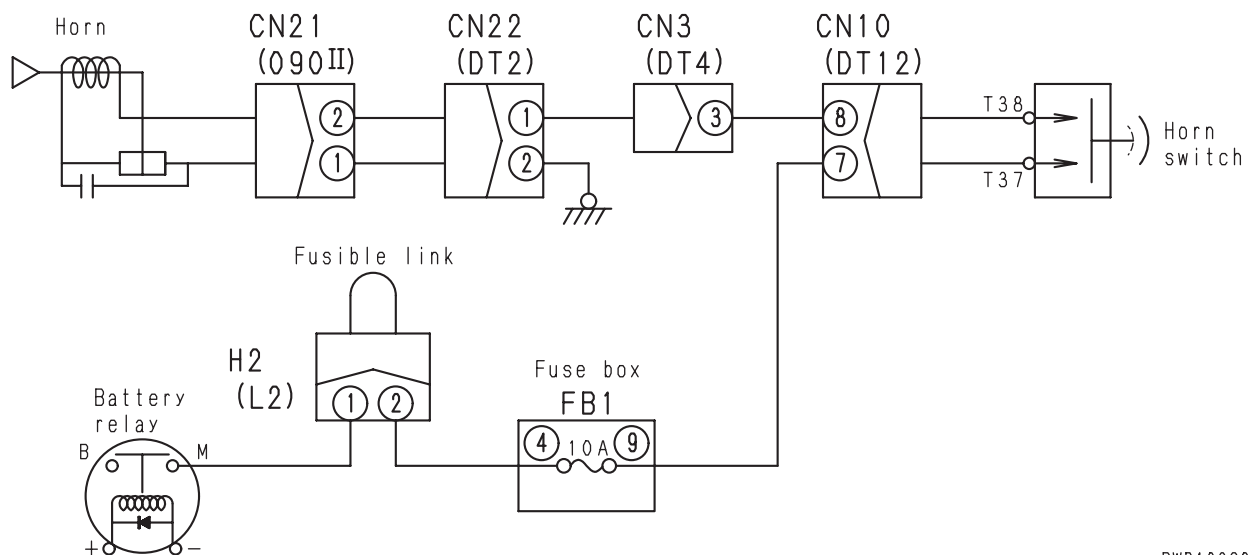


E-11. Horn does not sound

- ★ Before carrying out the troubleshooting, check that fusible link H2 and fuse FB1 No. 4 are normal.



E-11 Electric circuit diagram for each system



BWD10398

TROUBLESHOOTING FOR HYDRAULIC AND MECHANICAL SYSTEM (H-MODE)

Table of failure modes and causes (Hydraulic and mechanical systems)	20-402
H-1. Machine does not travel in either direction or it stops suddenly	20-404
H-2. Machine does not travel in one direction	20-405
H-3. Machine travels while travel lever is in neutral	20-405
H-5. Machine deviates while travel lever is in partial position	20-405
H-7. Machine swings momentarily when it starts on flat ground	20-405
H-11. Turning time lag is large	20-405
H-12. When operator intends to turn gradually, machine turns sharply	20-405
H-13. Machine does not return quickly to straight travel position	20-405
H-14. Machine is not decelerated smoothly or travel speed cannot be controlled on downhill ground	20-405
H-15. Machine deviates when it is decelerated	20-405
H-4. Machine deviates when travel lever is moved to stroke end	20-406
H-6. Machine moves back when operator starts on uphill ground	20-406
H-8. Machine starts sharply	20-406
H-10. Starting time lag is large	20-408
H-16. Maximum travel speed is low or output power is insufficient or acceleration is low	20-409
H-17. Engine stalls	20-410
H-18. HST noise is large	20-411
H-19. HST oil temperature rises too high	20-412
H-20. Gear speed does not change	20-412
H-21. Abnormal sound is heard from around work equipment pump or HST pump	20-413
H-22. Any work equipment does not move	20-413
H-23. Speed or power of each work equipment is low	20-414
H-24. Speed or power of blade lift of blade tilt cylinder is low	20-414
H-25. Speed or power of blade angle cylinder is low	20-415
H-26. Hydraulic drift of blade lift cylinder is large	20-416
H-27. Hydraulic drift of blade tilt cylinder is large	20-416
H-28. Hydraulic drift of blade angle cylinder is large	20-417

TABLE OF FAILURE MODES AND CAUSES (HYDRAULIC AND MECHANICAL SYSTEMS)

Failure mode		Parts that can cause failure									
		Charge pump	Pump unit (including servo piston)	Charge relief valve	High-pressure cut-off valve	High-pressure relief suction valve	AS valve	Motor unit	Piston motor side	Control valve side	Low-pressure relief valve (Flushing valve)
		HST pump					HST motor				
1	Machine does not travel in either direction or it stops suddenly	☐	☐	☐			☐	☐	☐	☐	☐
2	Machine does not travel in one direction		☐			☐			☐		☐
3	Machine travels while travel lever is in neutral		☐								☐
4	Machine deviates when travel lever is moved to stroke end		☐					☐			
5	Machine deviates while travel lever is in partial position		☐								☐
6	Machine moves back when operator starts on uphill ground		☐								☐
7	Machine swings momentarily when it starts on flat ground		☐								☐
8	Machine starts sharply		☐								☐
9	Machine swings momentarily when it starts		☐			☐					☐
10	Starting time lag is large	☐	☐	☐							☐
11	Turning time lag is large		☐				☐				☐
12	When operator intends to turn gradually, machine turns sharply		☐								☐
13	Machine does not return quickly to straight travel position		☐								☐
14	Machine is not decelerated smoothly or travel speed cannot be controlled on downhill ground		☐								☐
15	Machine deviates when it is decelerated		☐								☐
16	Maximum travel speed is low or output power is insufficient or acceleration is low	☐		☐	☐		☐	☐			☐
17	Engine stalls		☐	☐	☐		☐				
18	HST noise is large	☐	☐	☐				☐			
19	HST oil temperature rises too high		☐	☐	☐						
20	Gear speed does not change							☐	☐		
21	Abnormal sound is heard from around work equipment pump or HST pump		☐								
22	Any work equipment does not move										
23	Speed or power of each work equipment is low										
24	Speed or power of blade lift of blade tilt cylinder is low										
25	Speed or power of blade angle cylinder is low										
26	Hydraulic drift of blade lift cylinder is large										
27	Hydraulic drift of blade tilt cylinder is large										
28	Hydraulic drift of blade angle cylinder is large										

TESTING AND ADJUSTING

TABLE OF FAILURE MODES AND CAUSES (HYDRAULIC AND MECHANICAL SYSTEMS)

2nd gear speed selector solenoid valve	3rd gear speed selector solenoid valve	Parking brake solenoid valve	Work equipment pump (including PTO)	Strainer	Hydraulic cylinder	Unload valve	Main relief valve	Safety valve (Angle circuit)	Spool	Quick drop valve	Cooling system	Looseness of piping, entrained air, oil leakage	Linkage	Engine	If there is any fault, go to troubleshooting code H-OX (YES/NO)
Solenoid valve	Hydraulic system of work equipment												Linkage	Engine	This troubleshooting
		☐													H-1
															H-2
															H-3
															H-4
															H-5
		☐													H-6
															H-7
		☐													H-8
		☐													H-9
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			☐	☐								☐			H-21
			☐			☐	☐								H-22
			☐			☐	☐								H-23
					☐				☐			☐	☐		H-24
					☐			☐	☐			☐	☐		H-25
					☐				☐	☐					H-26
					☐				☐						H-27
					☐			☐	☐						H-28

H-1. Machine does not travel in either direction or it stops suddenly

- ★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.
- ★ Check the electric system first. If it is normal, carry out the following troubleshooting.

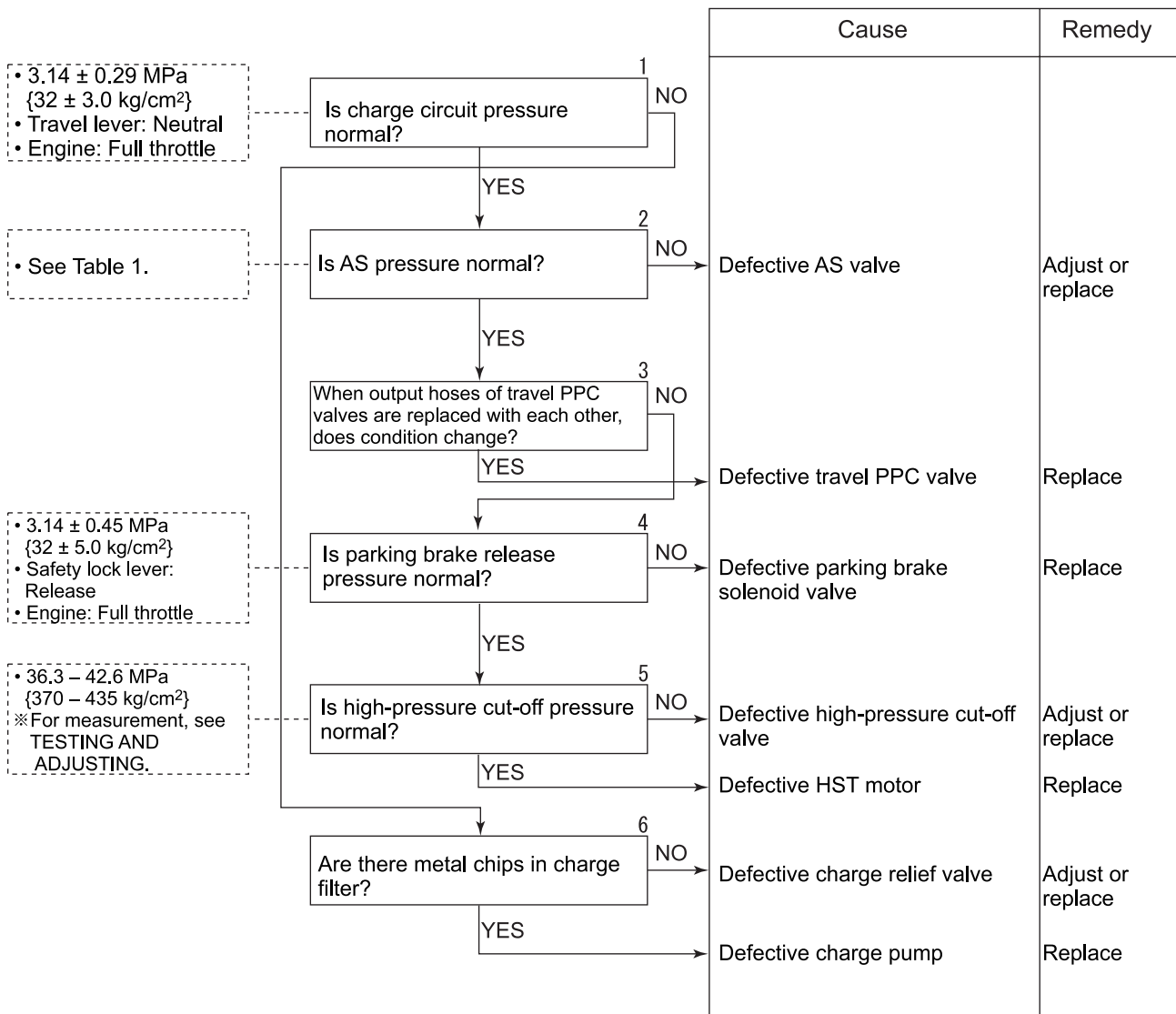
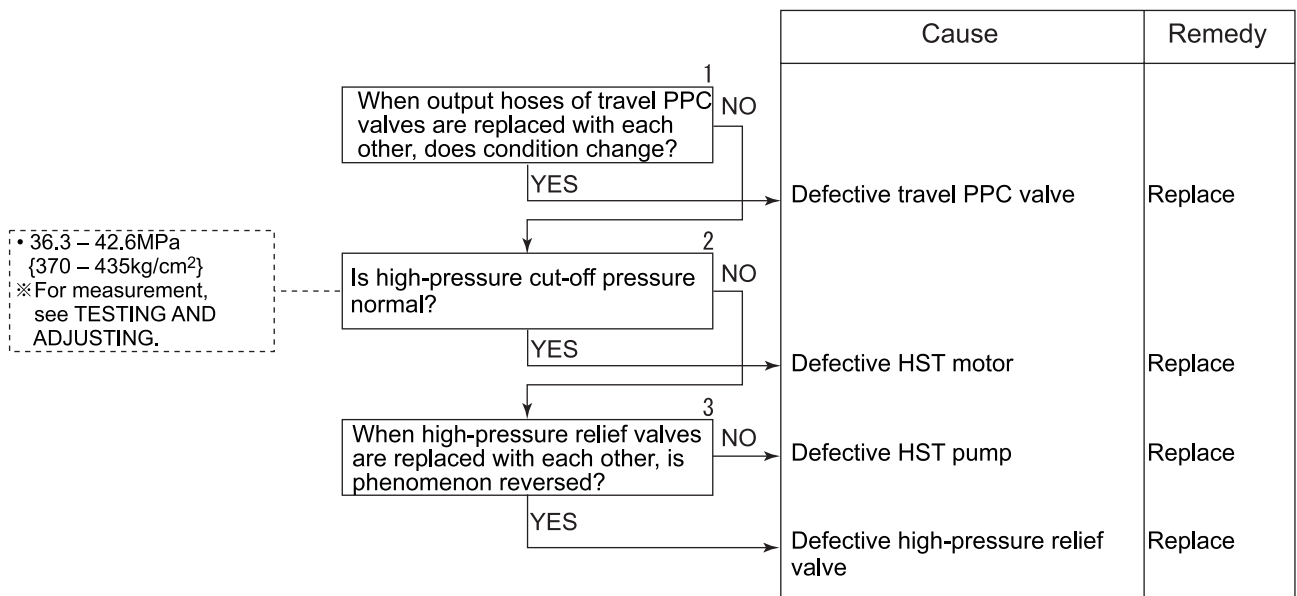


Table 1 AS pressure

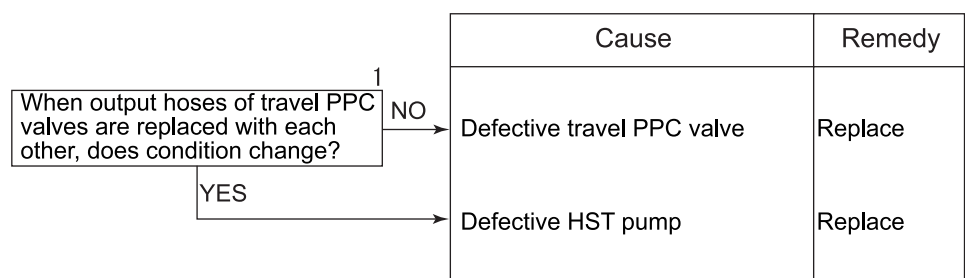
Engine speed (rpm)	Operation of brake pedal	Oil pressure MPa {kg/cm ² }
1,100	Released	0.29 – 0.78 {3.0 – 8.0}
1,800	Released	1.76 – 2.40 {18 – 24.5}
Full	Pressed	Max. 0.49 {Max. 5.0}

H-2. Machine does not travel in one direction

★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.

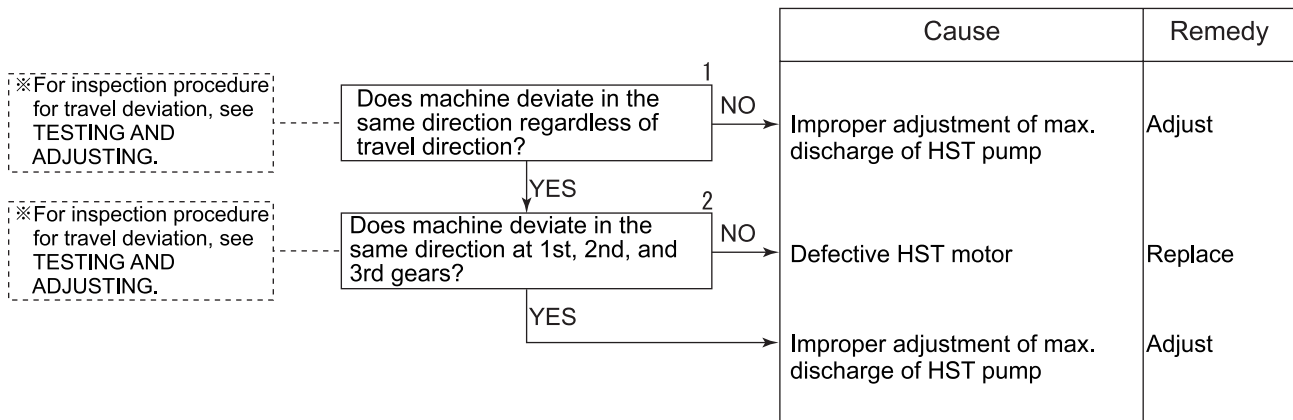
**H-3. Machine travels while travel lever is in neutral****H-5. Machine deviates while travel lever is in partial position****H-7. Machine swings momentarily when it starts on flat ground****H-11. Turning time lag is large****H-12. When operator intends to turn gradually, machine turns sharply****H-13. Machine does not return quickly to straight travel position****H-14. Machine is not decelerated smoothly or travel speed cannot be controlled on downhill ground****H-15. Machine deviates when it is decelerated**

★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.

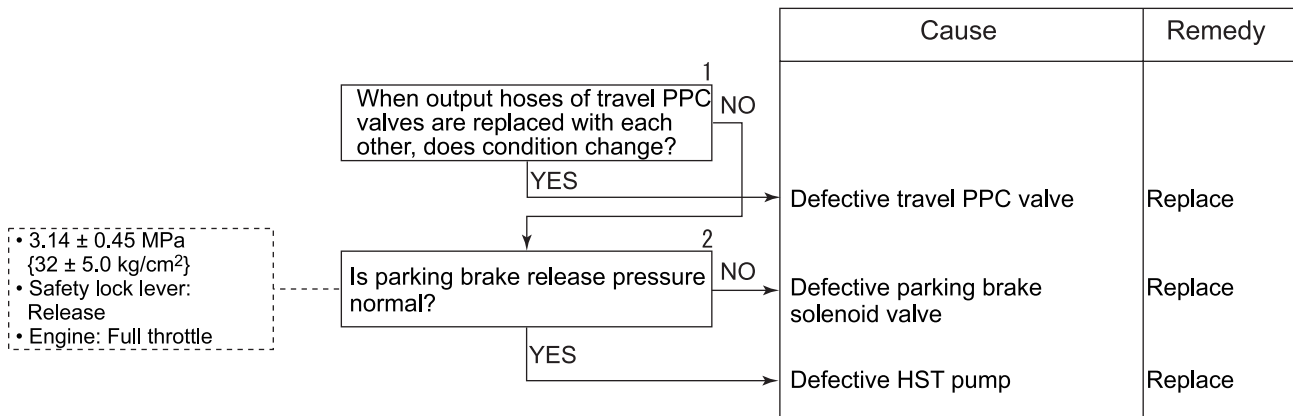


H-4. Machine deviates when travel lever is moved to stroke end

★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.

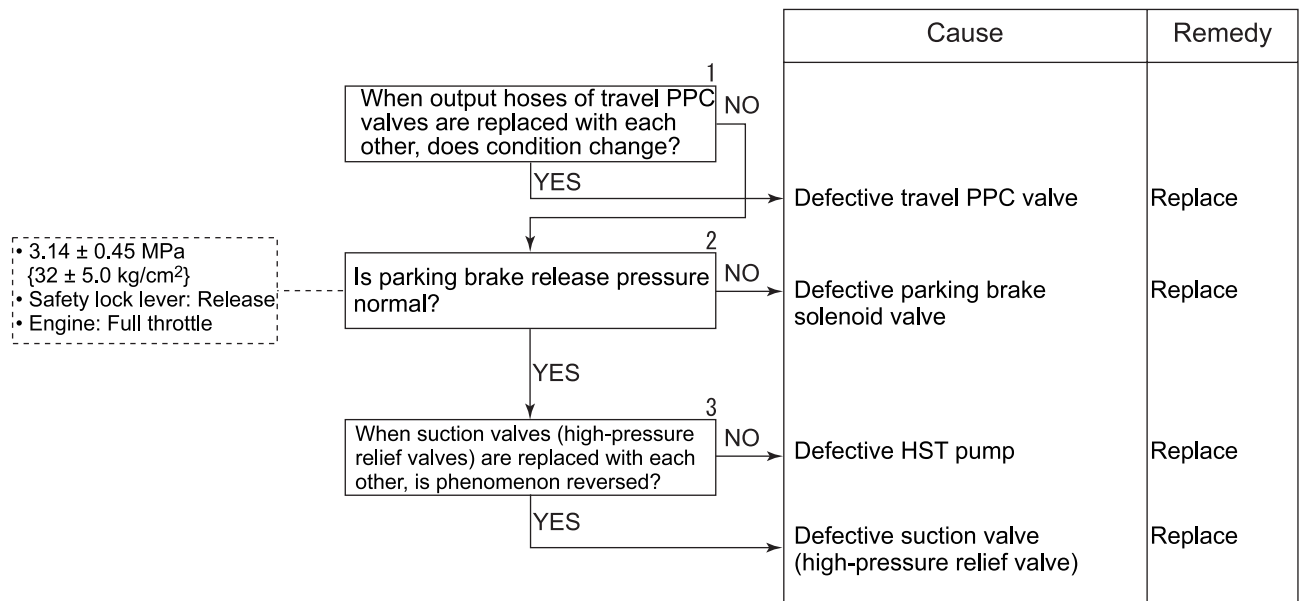
**H-6. Machine moves back when operator starts on uphill ground****H-8. Machine starts sharply**

- ★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.
 ★ Check the electric system first. If it is normal, carry out the following troubleshooting.



H-9. Machine swings momentarily when it starts

- ★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.
- ★ Check the electric system first. If it is normal, carry out the following troubleshooting.



H-10. Starting time lag is large

- ★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.
- ★ Check the electric system first. If it is normal, carry out the following troubleshooting.

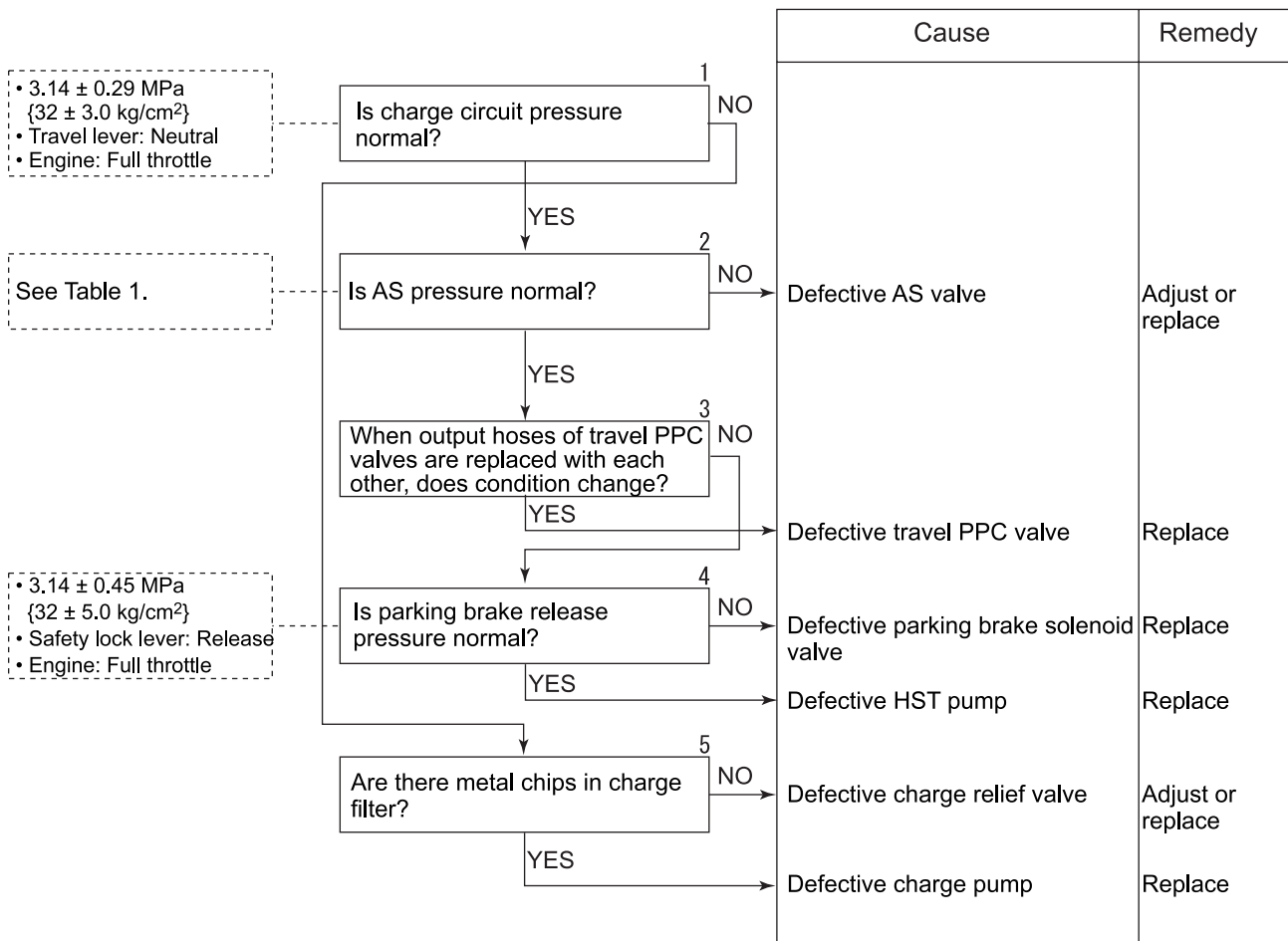


Table 1 AS pressure

Engine speed (rpm)	Operation of brake pedal	Oil pressure MPa {kg/cm ² }
1,100	Released	0.29 – 0.78 {3.0 – 8.0}
1,800	Released	1.76 – 2.40 {18 – 24.5}
Full	Pressed	Max. 0.49 {Max. 5.0}

H-16. Maximum travel speed is low or output power is insufficient or acceleration is low

- ★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.
- ★ Check the electric system first. If it is normal, carry out the following troubleshooting.

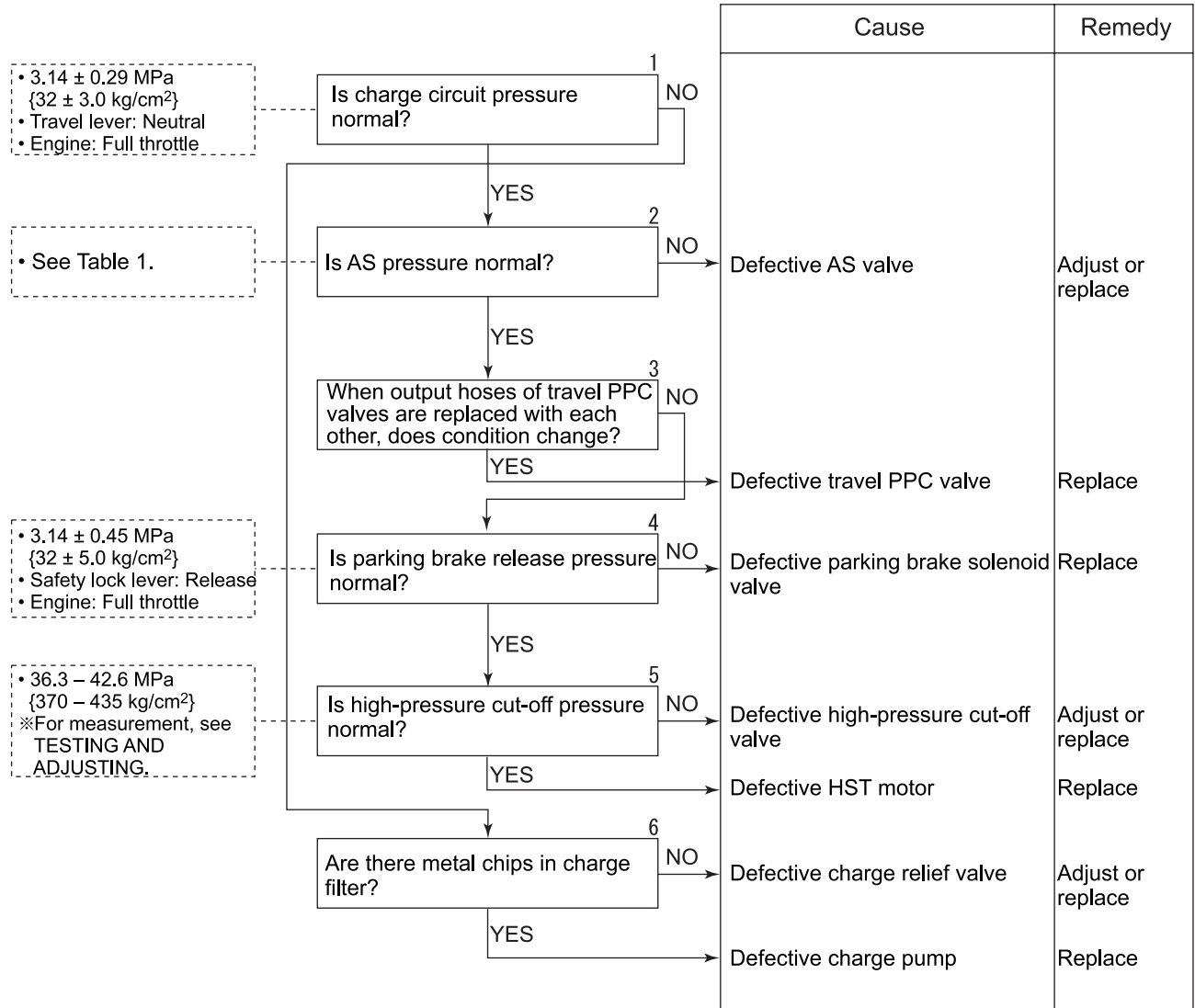


Table 1 AS pressure

Engine speed (rpm)	Operation of brake pedal	Oil pressure MPa {kg/cm ² }
1,100	Released	0.29 – 0.78 {3.0 – 8.0}
1,800	Released	1.76 – 2.40 {18 – 24.5}
Full	Pressed	Max. 0.49 {Max. 5.0}

H-17. Engine stalls

★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.

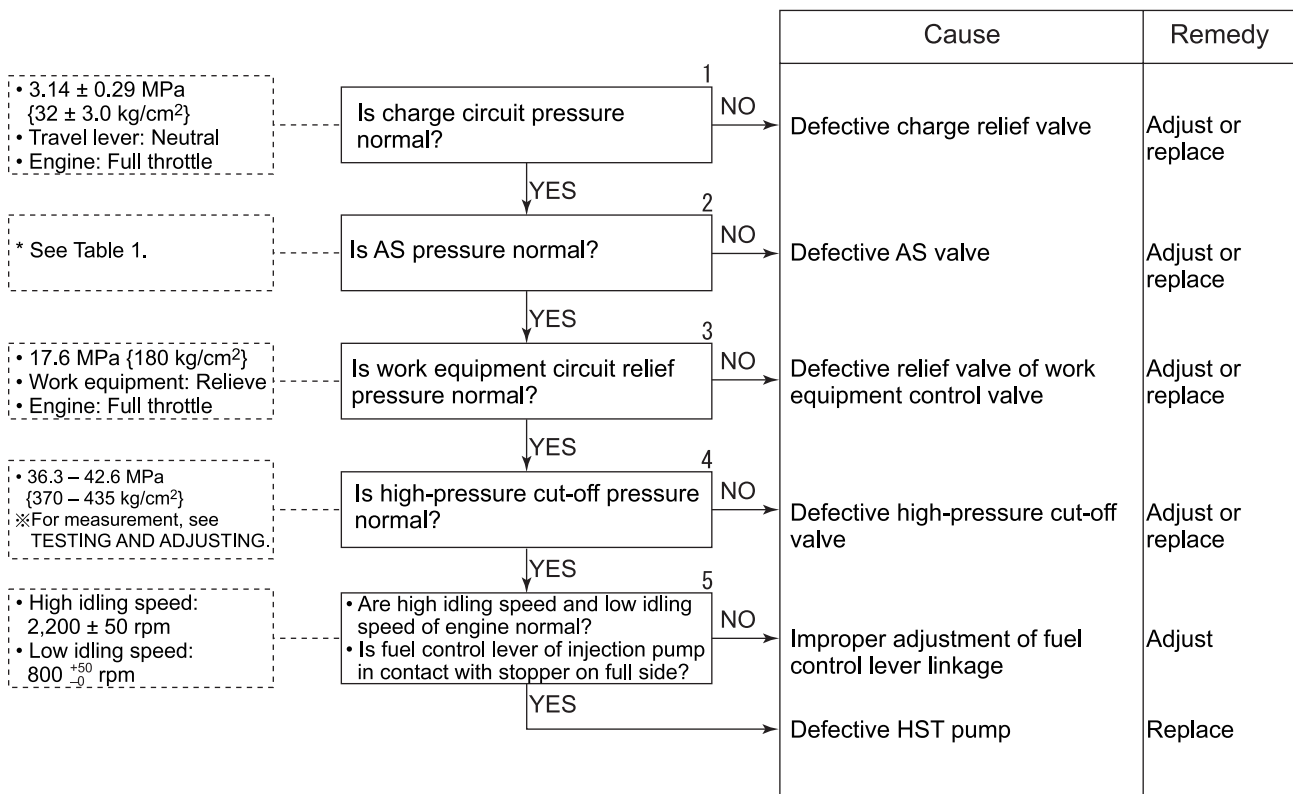
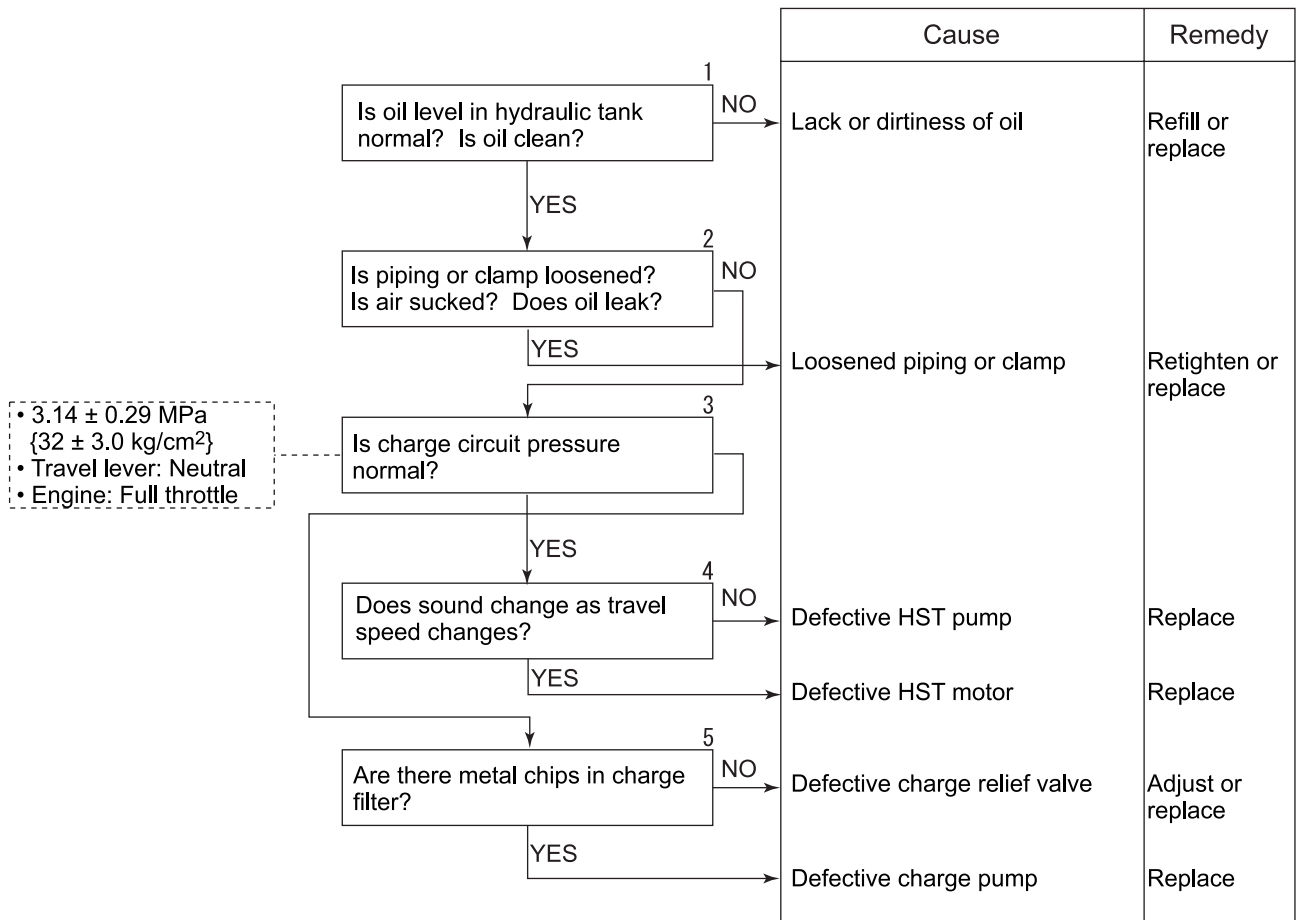


Table 1 AS pressure

Engine speed (rpm)	Operation of brake pedal	Oil pressure MPa {kg/cm ² }
1,100	Released	0.29 – 0.78 {3.0 – 8.0}
1,800	Released	1.76 – 2.40 {18 – 24.5}
Full	Pressed	Max. 0.49 {Max. 5.0}

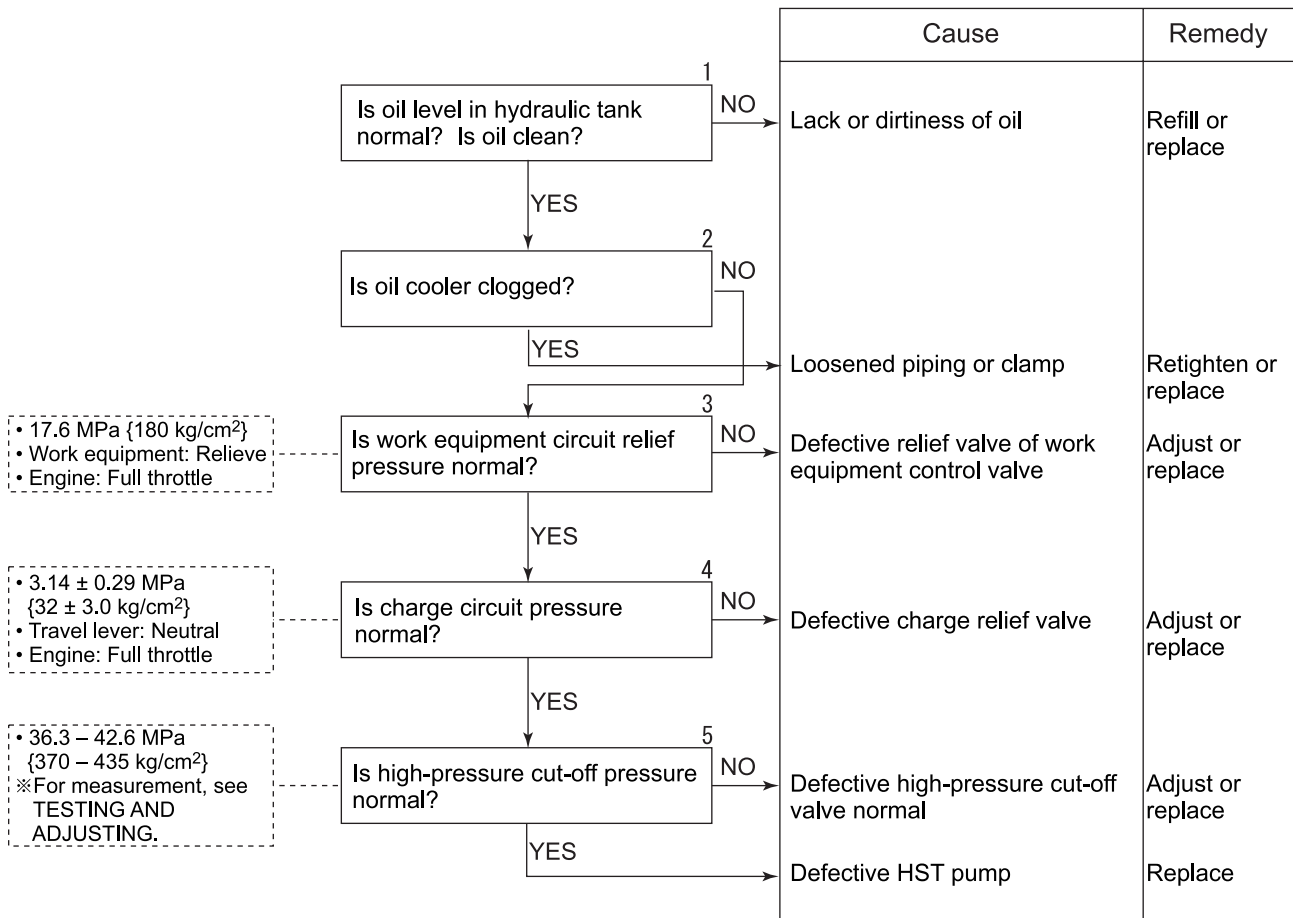
H-18. HST noise is large

★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.



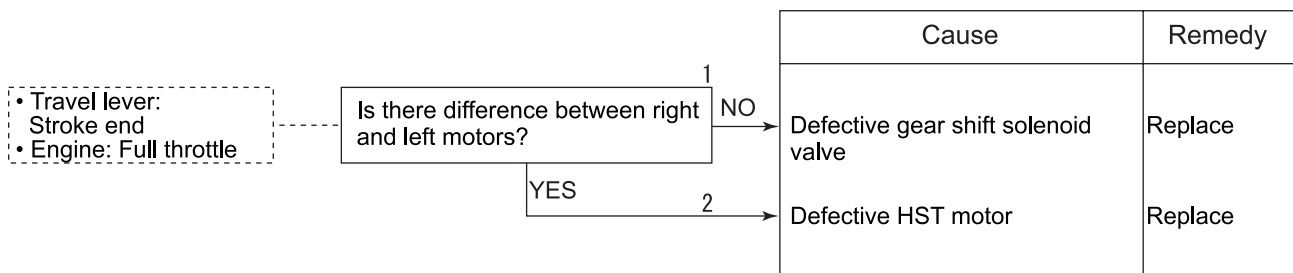
H-19. HST oil temperature rises too high

★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.



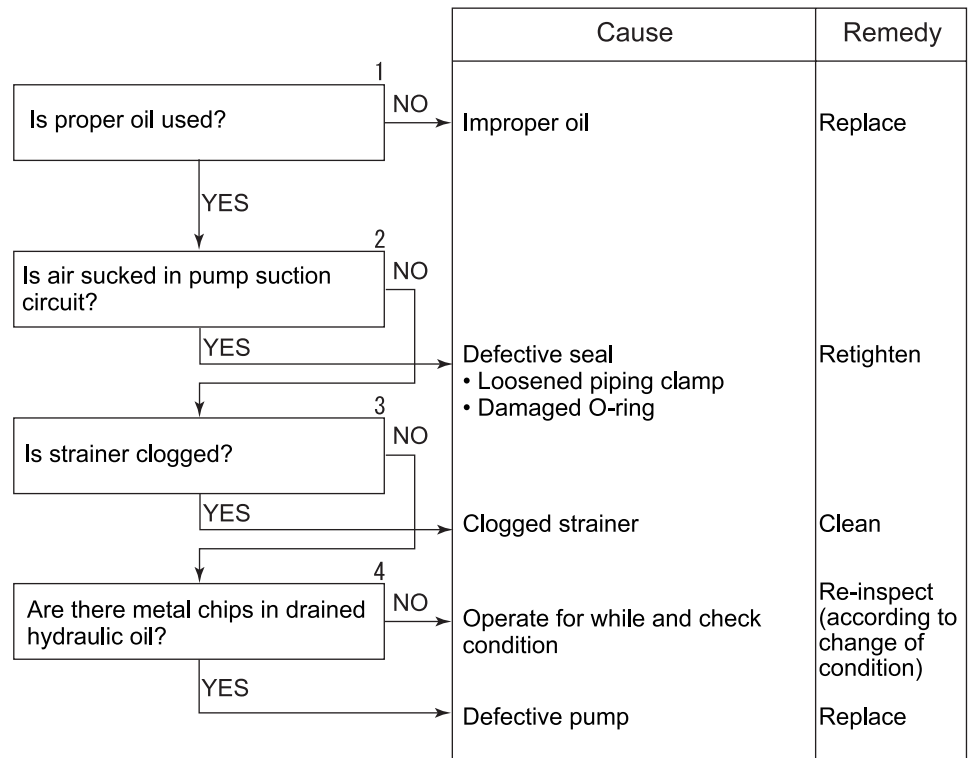
H-20. Gear speed does not change

★ Check the electric system first. If it is normal, carry out the following troubleshooting.

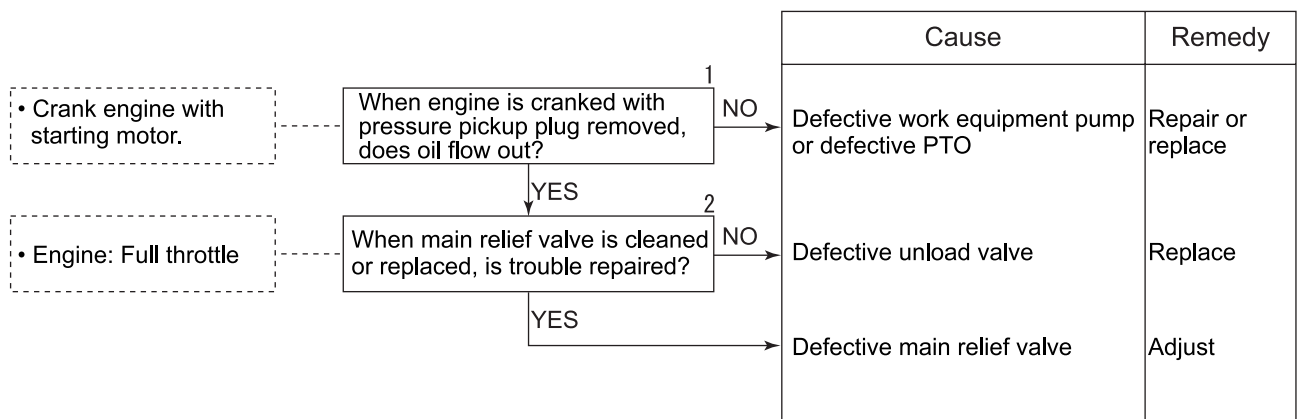


H-21. Abnormal sound is heard from around work equipment pump or HST pump

★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.

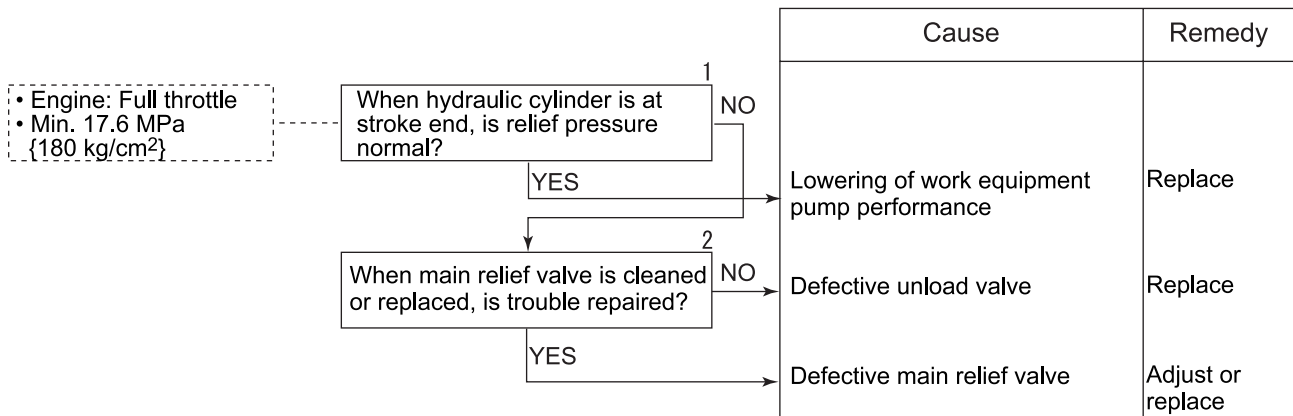
**H-22. Any work equipment does not move**

★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.

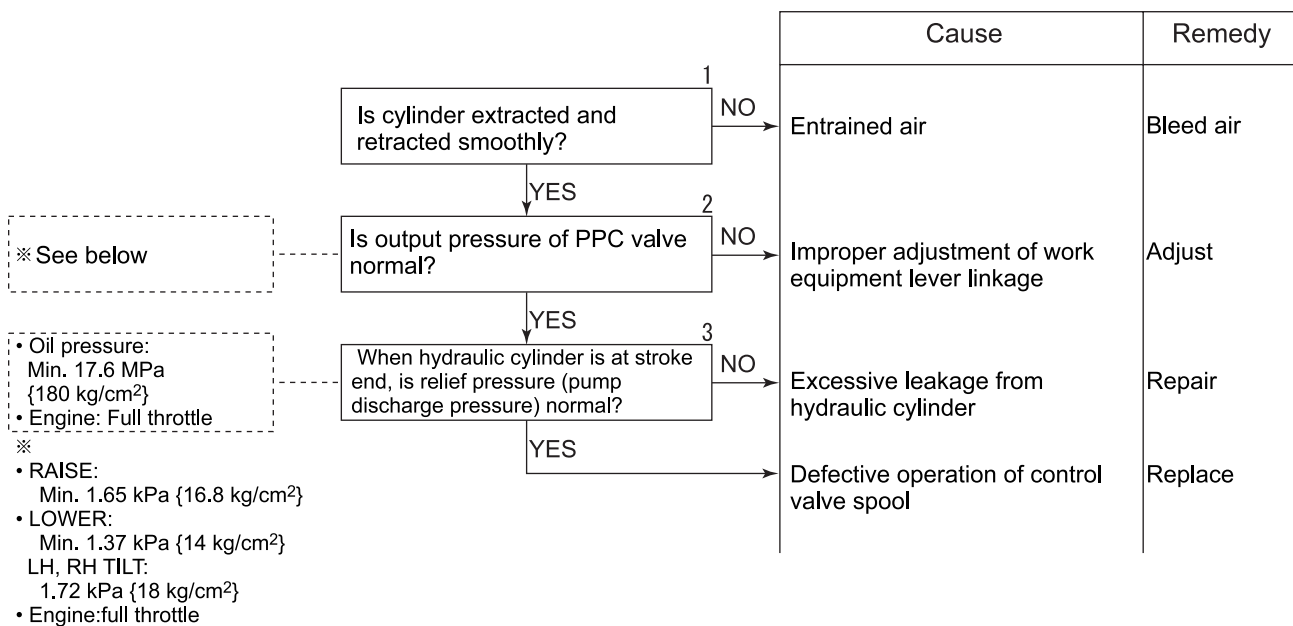


H-23. Speed or power of each work equipment is low

★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.

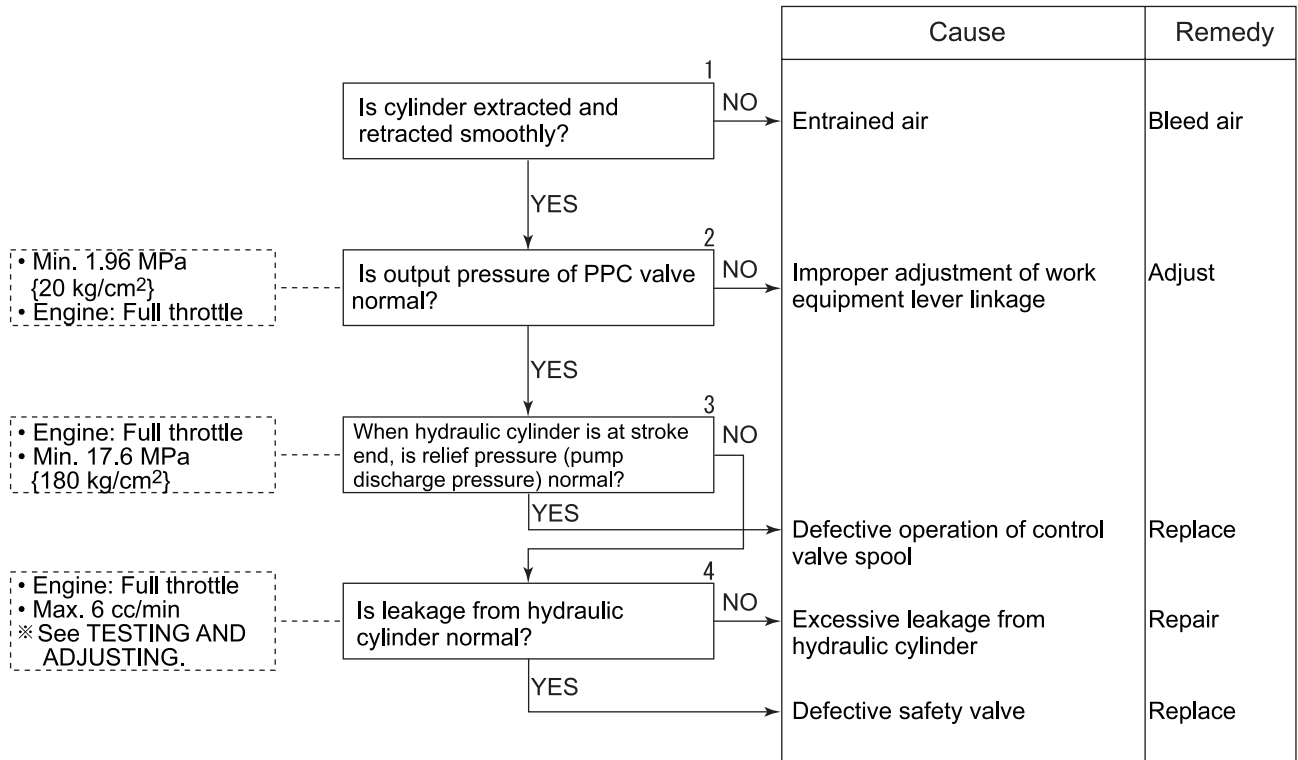
**H-24. Speed or power of blade lift of blade tilt cylinder is low**

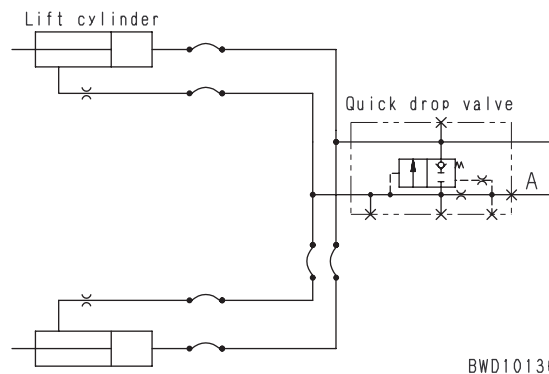
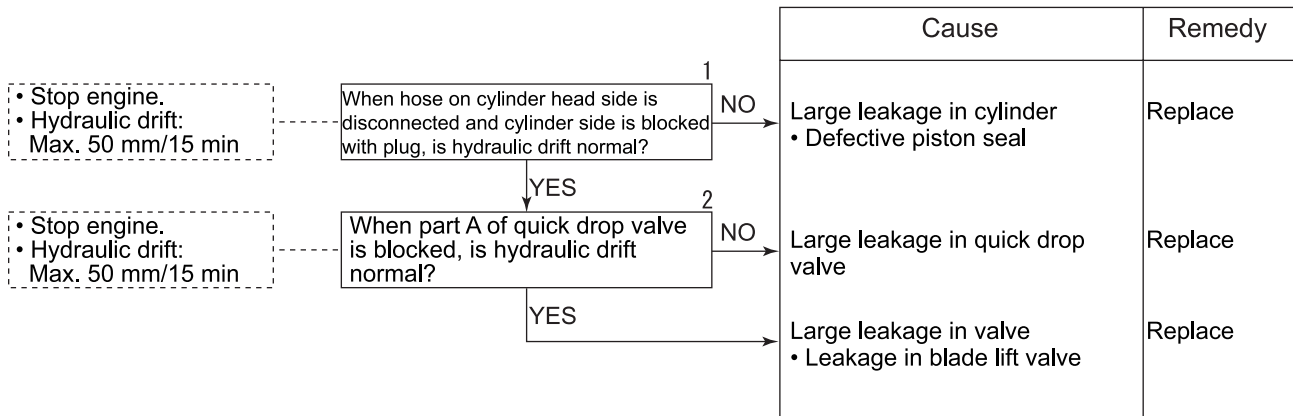
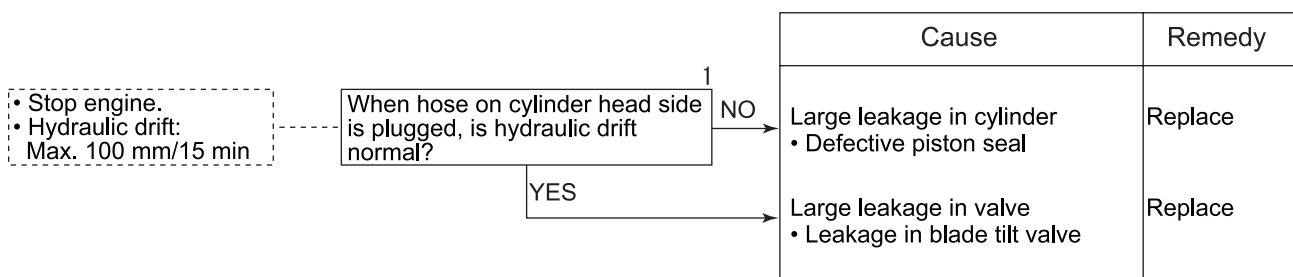
- ★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.
- ★ Check the blade to see if it has been modified.
- ★ Carry out the following troubleshooting when the angle cylinder is normal.

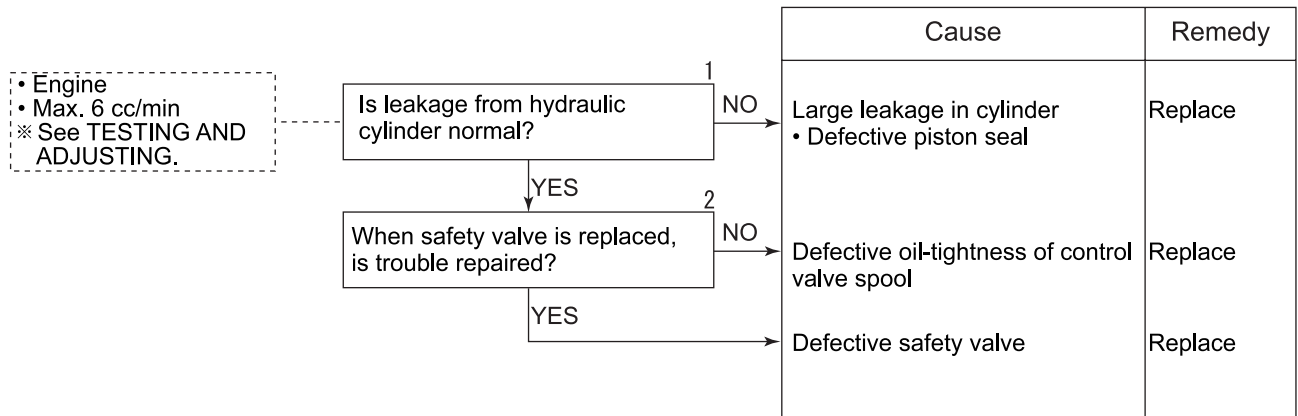


H-25. Speed or power of blade angle cylinder is low

- ★ Before carrying out the troubleshooting, check the oil level in the hydraulic tank.
- ★ Check the blade to see if it has been modified.
- ★ Carry out the following troubleshooting when the boom and tilt cylinders are normal.



H-26. Hydraulic drift of blade lift cylinder is large**H-27. Hydraulic drift of blade tilt cylinder is large**

H-28. Hydraulic drift of blade angle cylinder is large

TROUBLESHOOTING FOR MACHINE MONITOR SYSTEM (M-MODE)

Table of failure modes and causes (Machine monitor system).....	20-502
Electric circuit diagram for each system	20-504
M-1. When starting switch is turned ON, monitor panel is not turned on	20-506
M-2. Trouble in preheating caution lamp	20-507
a) Preheating monitor does not light up	20-507
b) Preheating monitor keeps lighting up	20-507
M-3. Caution item lights up	20-508
a) Charge caution lamp lights up while engine is running.....	20-508
b) Oil pressure caution lamp lights up while engine is running.....	20-509
c) HST filter clogging caution lamp lights up (while filter is not clogged)	20-509
M-4. Trouble in HST oil temperature gauge	20-510
a) Gauge does not rise above C (lowest point).....	20-510
b) Gauge does not lower below H (Highest point).	20-510
c) HST oil temperature indicated by gauge is different from actual temperature	20-511
M-5. Trouble in engine water temperature gauge.....	20-512
a) Gauge does not rise above C (lowest point).....	20-512
b) Gauge does not lower below H (Highest point).	20-512
c) Engine water temperature indicated by gauge is different from actual temperature.....	20-513
M-6. Trouble in fuel level gauge	20-514
a) Gauge does not rise above E (lowest point).....	20-514
b) Gauge does not lower below F (Highest point).....	20-514
c) Fuel level indicated by gauge is different from actual level.....	20-515
M-7. Service meter does not operate after engine is started.....	20-516
M-8. Monitor panel lamp does not light up (while headlamp is normal)	20-517
M-9. Trouble in display of travel speed (while actual travel speed is normal)	20-518
a) Travel speed is not displayed	20-518
b) Displayed speed is different from actual travel speed	20-518

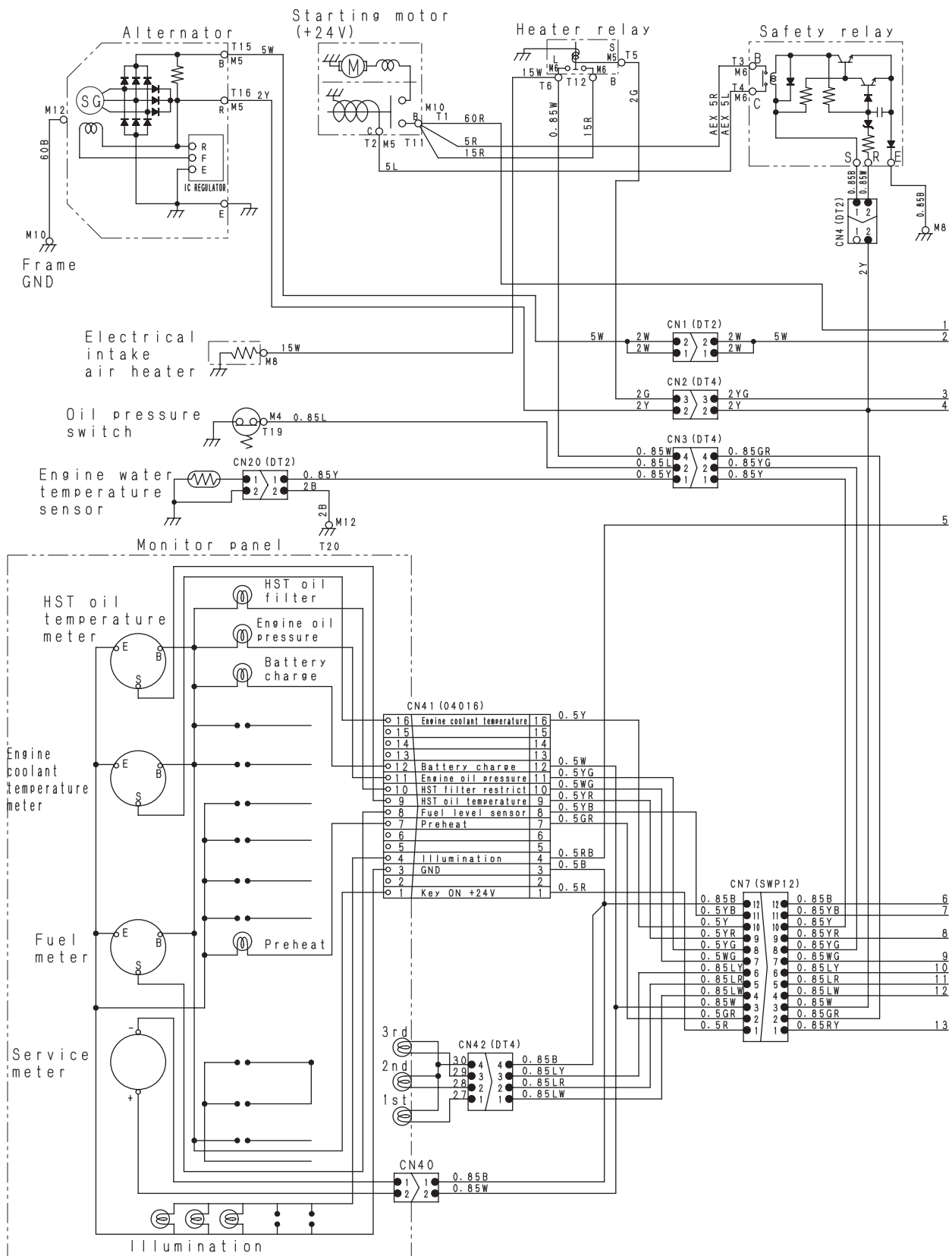
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.

TABLE OF FAILURE MODES AND CAUSES (MACHINE MONITOR SYSTEM)

Parts that can cause failure Failure mode		Power supply system	Engine water temperature	HST oil temperature	Fuel level	Engine oil pressure	HST filter	Alternator system	Preheating system	Gear shift switch	Travel speed controller	Monitor panel	If there is any fault, go to troubleshooting code M-OX (YES/NO) This troubleshooting
		Sensors											
1	When starting switch is turned ON, monitor panel is not turned on	☐										☐	M-1
2	Trouble in preheating caution lamp								☐			☐	M-2
3	Caution item lights up					☐	☐	☐				☐	M-3
4	Trouble in HST oil temperature gauge			☐								☐	M-4
5	Trouble in engine water temperature gauge		☐									☐	M-5
6	Trouble in fuel level gauge				☐							☐	M-6
7	Service meter does not operate after engine is started							☐				☐	M-7
8	Monitor panel lamp does not light up (while headlamp is normal)											☐	M-8
9	Trouble in display of travel speed (while actual travel speed is normal)									☐	☐	☐	M-9

ELECTRIC CIRCUIT DIAGRAM FOR EACH SYSTEM

Monitor system

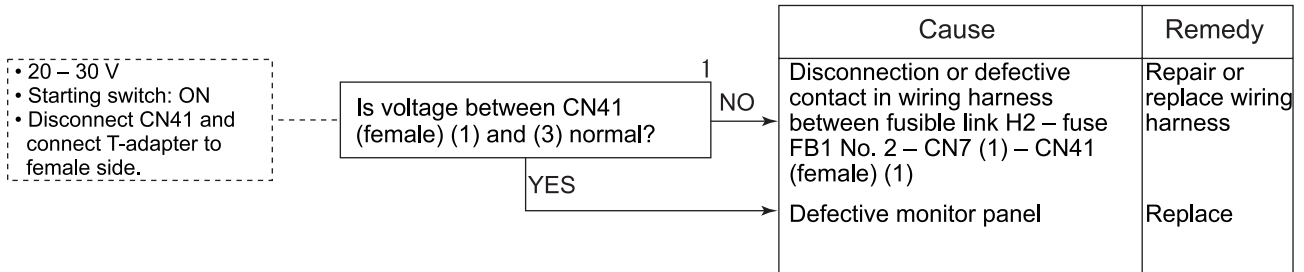
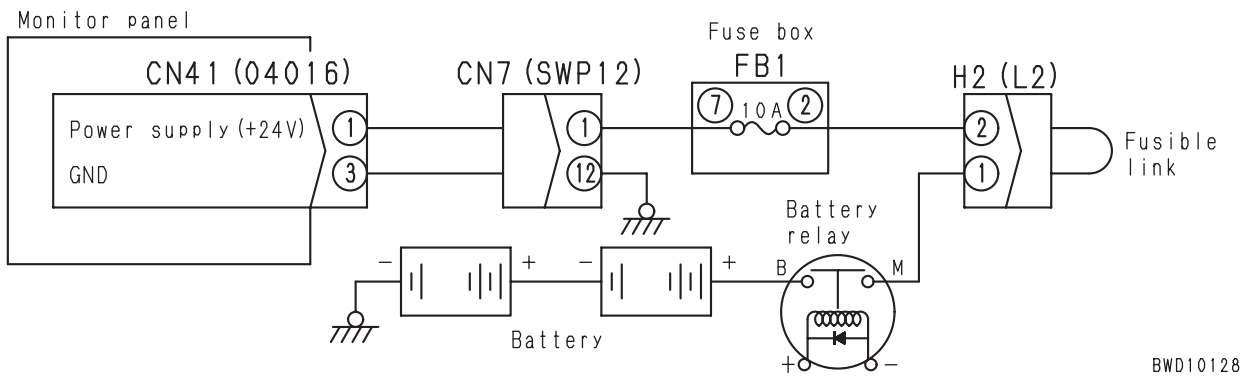
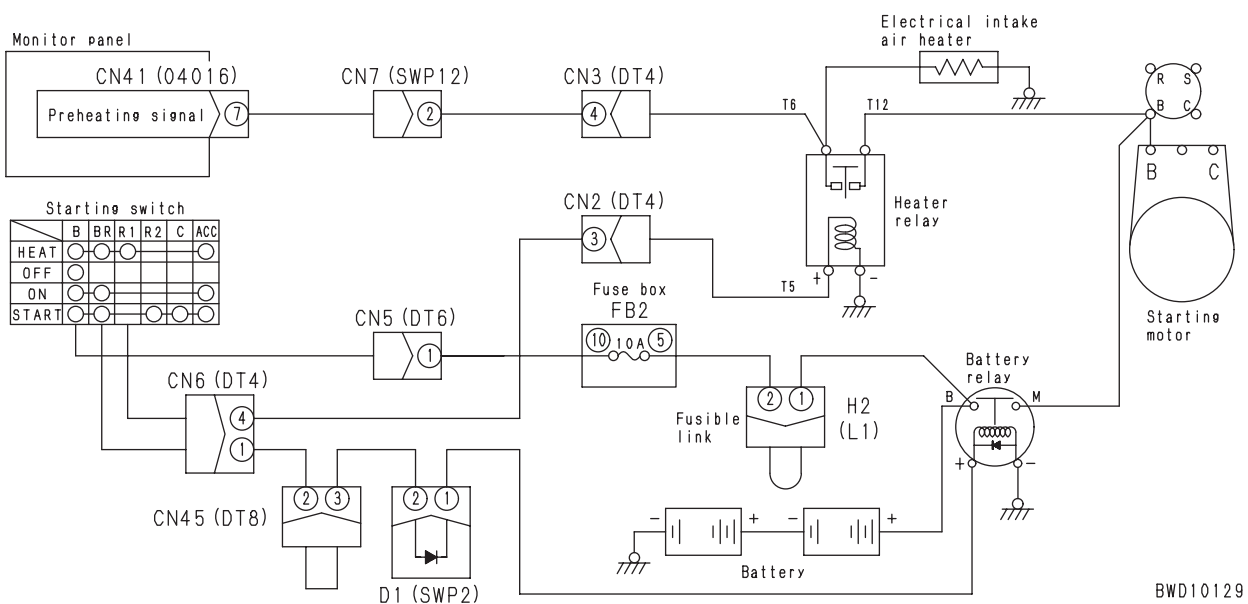


BWD10126



M-1. When starting switch is turned ON, monitor panel is not turned on

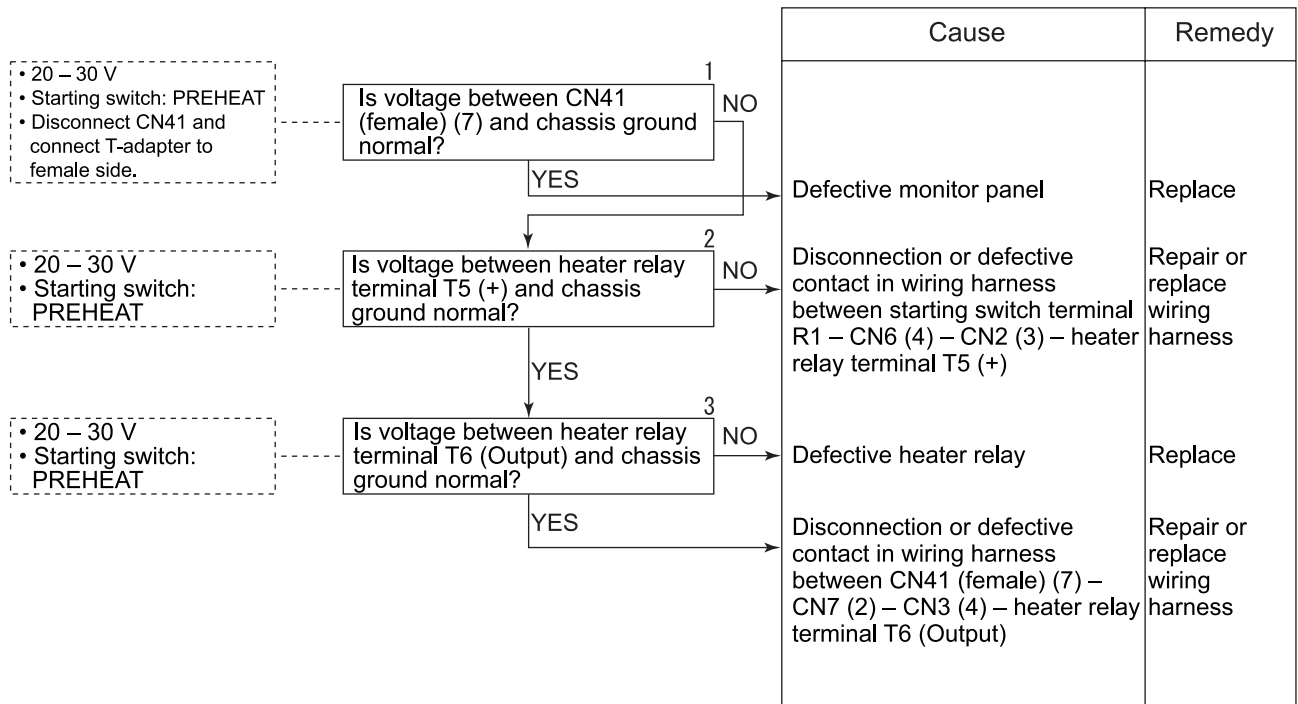
- ★ Carry out the following troubleshooting when the battery and battery relay are normal.
- ★ Before carrying out the following troubleshooting, check that fuse FB1 No. 2 and fusible link H2 are normal. (If any of them is broken, check for short circuit with chassis ground in wiring harness between CN41 (1) – CN7 (1) – fuse FB1 No. 2 – fusible link H2.)
- ★ Check the bulb visually for breakage. (If it is broken, replace it.)

**M-1 Related electrical circuit diagram****M-2 Related electrical circuit diagram**

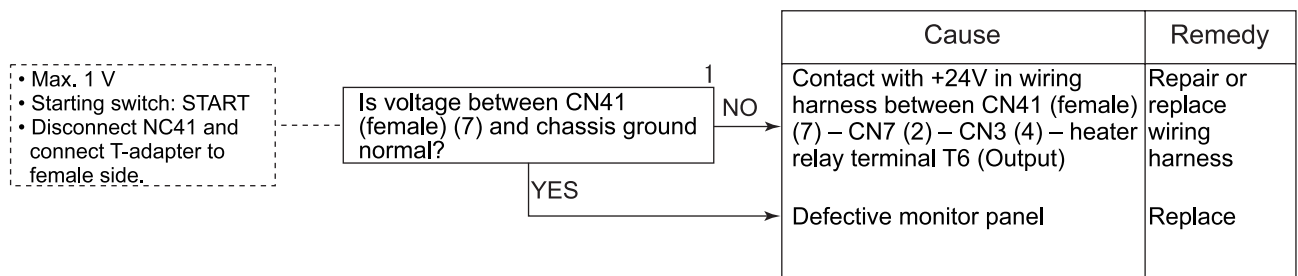
M-2. Trouble in preheating caution lamp

- ★ Carry out the following troubleshooting when the battery and battery relay are normal.
- ★ Before carrying out the following troubleshooting, check that fuse FB2 No. 5 and fusible link H1 are normal.
(If any of them is broken, check for short circuit with chassis ground in wiring harness between heater relay terminal T5 (+) – CN2 (3) – CN6 (4) – starting switch terminal R1 and between starting switch terminal B – CN5 (1) – fuse FB2 No. 5 – fusible link H2.)

a) Preheating monitor does not light up



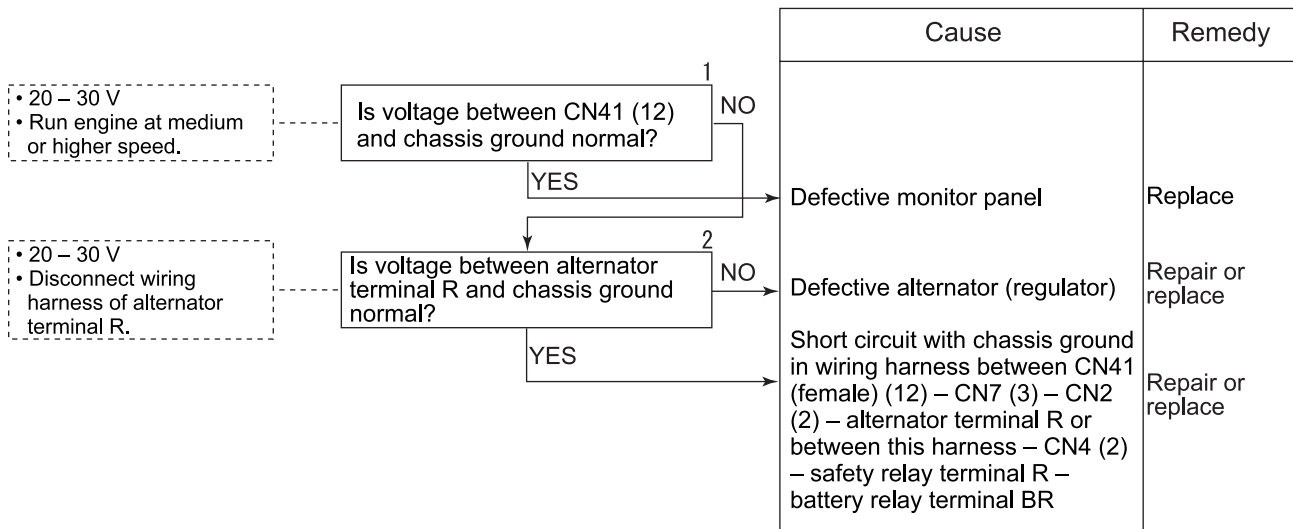
b) Preheating monitor keeps lighting up



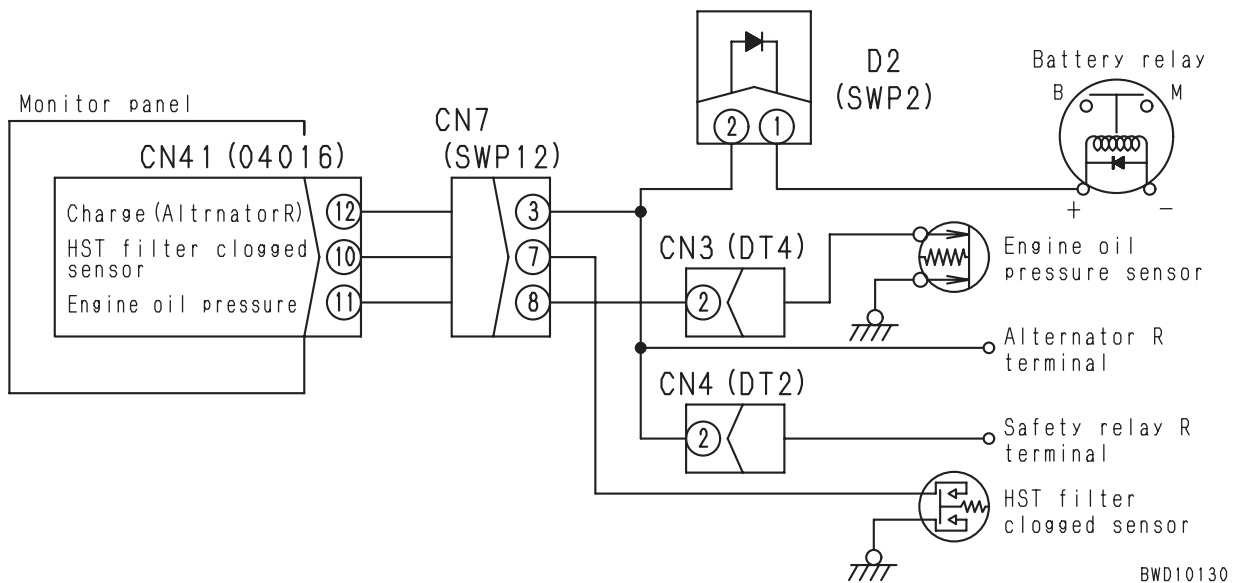
* For the electrical circuit diagram, see the previous page.

M-3. Caution item lights up

a) Charge caution lamp lights up while engine is running



M-3 Related electrical circuit diagram

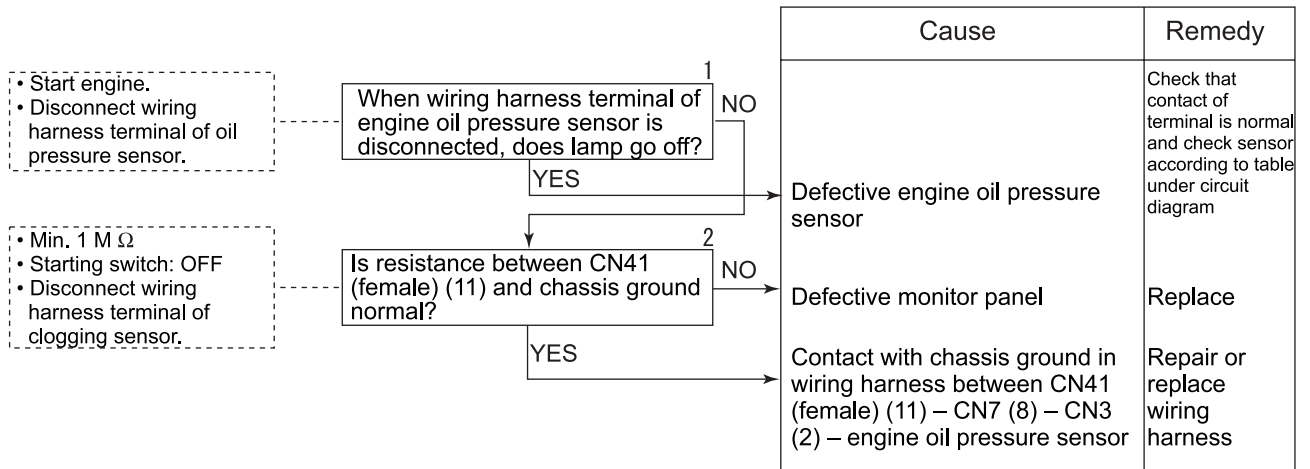
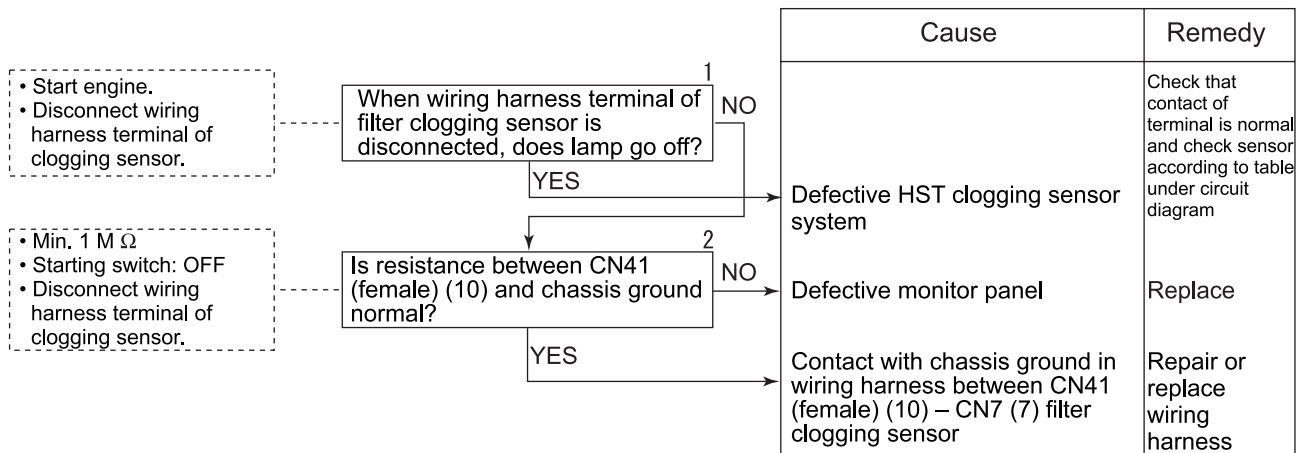


If the result of the continuity check of the engine oil pressure sensor is as follows, the sensor is normal.

Engine oil pressure sensor	Engine oil pressure: Min. 49 kPa {0.5 kg/cm ² }	There is not continuity
	Engine oil pressure: Max. 49 kPa {0.5 kg/cm ² }	There is continuity
HST filter clogging sensor	Differential pressure between before and after filter: Min. 200 kPa {2 kg/cm ² }	There is continuity
	Differential pressure between before and after filter: Max. 200 kPa {2 kg/cm ² }	There is not continuity

b) Oil pressure caution lamp lights up while engine is running

★ Before carrying out the following troubleshooting, check that the engine oil pressure is normal.

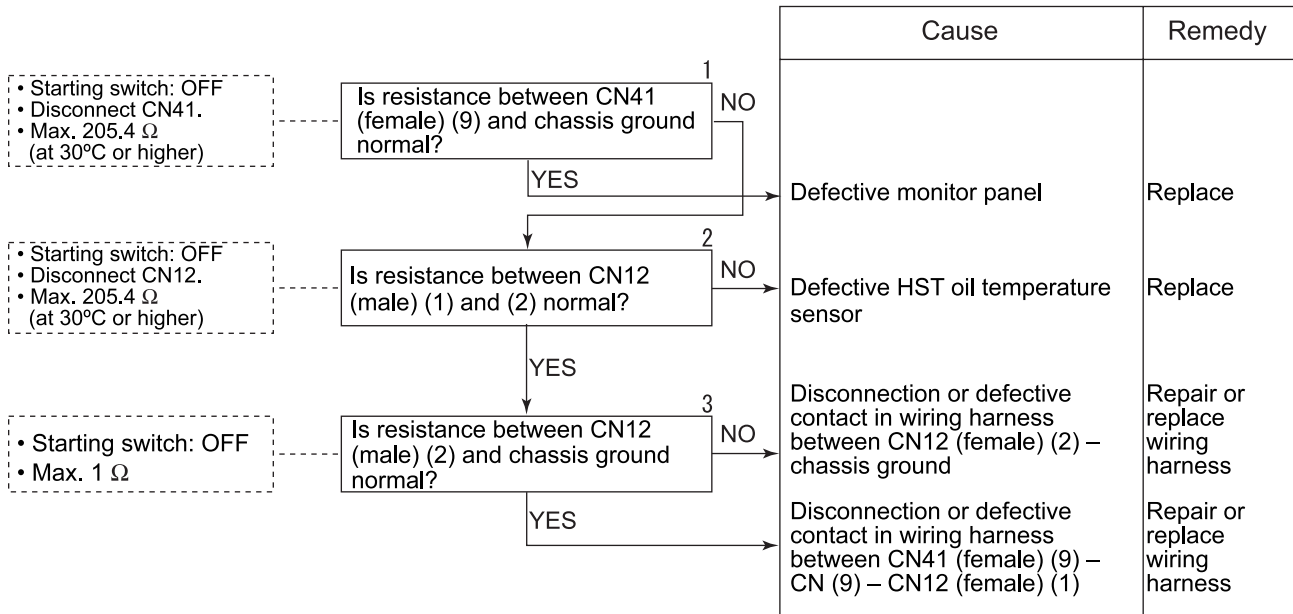
**c) HST filter clogging caution lamp lights up (while filter is not clogged)**

M-4. Trouble in HST oil temperature gauge

- ★ Before carrying out the following troubleshooting, check that the engine oil pressure caution lamp and charge caution lamp light up when the starting switch is turned on.

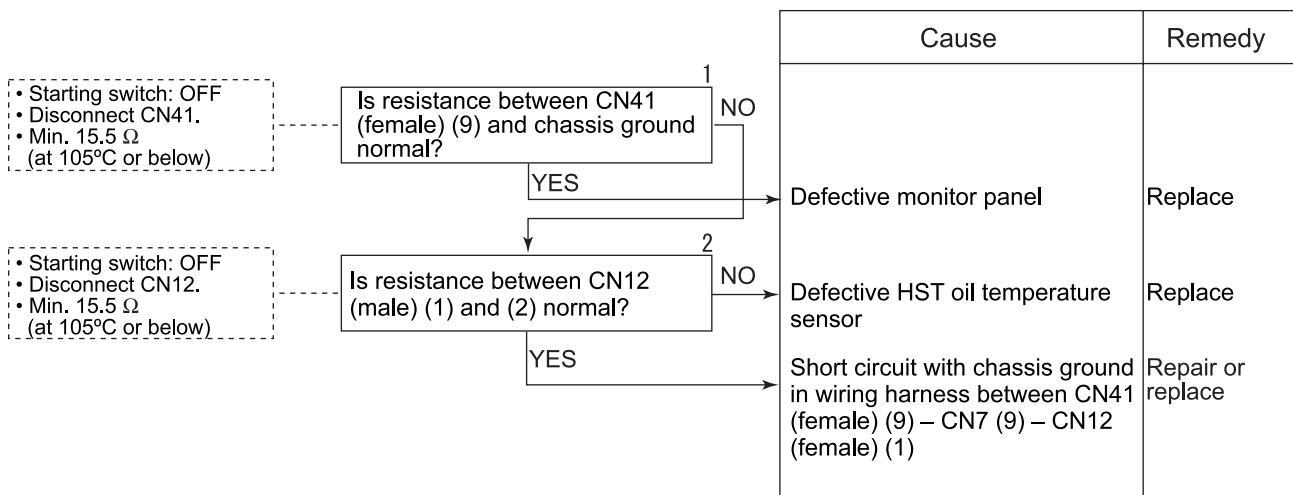
a) Gauge does not rise above C (lowest point).

- ★ Before carrying out the following troubleshooting, check that the temperature of the HST oil (hydraulic oil) is above 30°C.

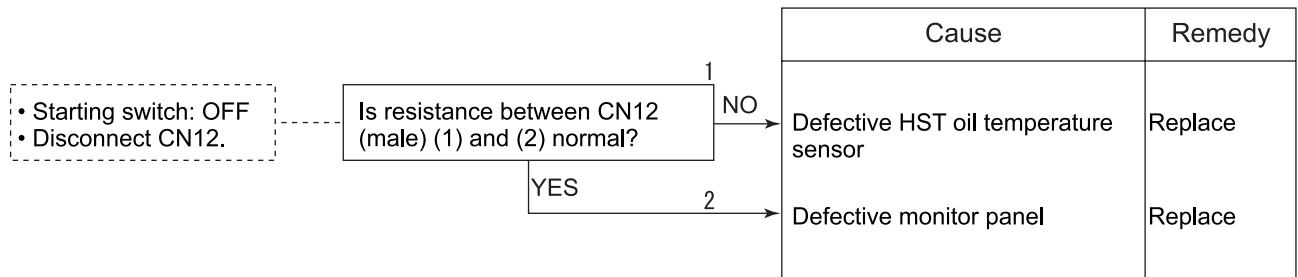


b) Gauge does not lower below H (Highest point).

- ★ Before carrying out the following troubleshooting, check that the temperature of the HST oil (hydraulic oil) is below 150°C.



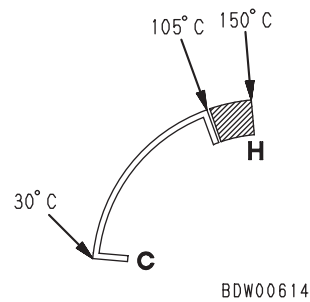
c) HST oil temperature indicated by gauge is different from actual temperature



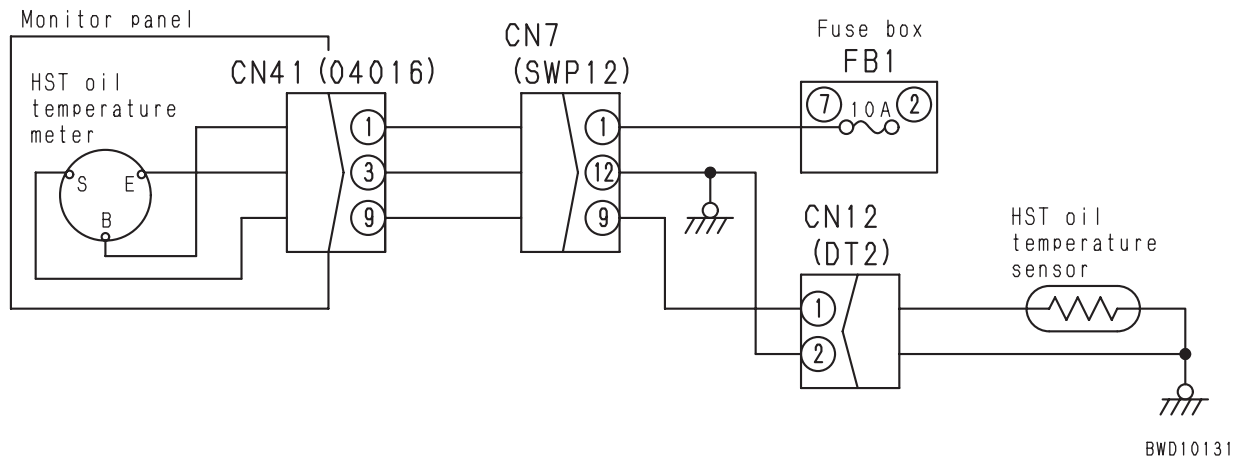
Table

HST oil temperature (°C)	Resistance (Ω)
50 ± 0.2	80 ± 10
60 ± 0.2	56.3 ± 3
80 ± 0.2	29.5 ± 2.5
100 ± 0.3	16.5 ± 0.9
106 ± 0.3	14.3 ± 0.5
120 ± 0.3	10 ± 0.3

HST oil temperature and indication by gauge



M4 Related electrical circuit diagram

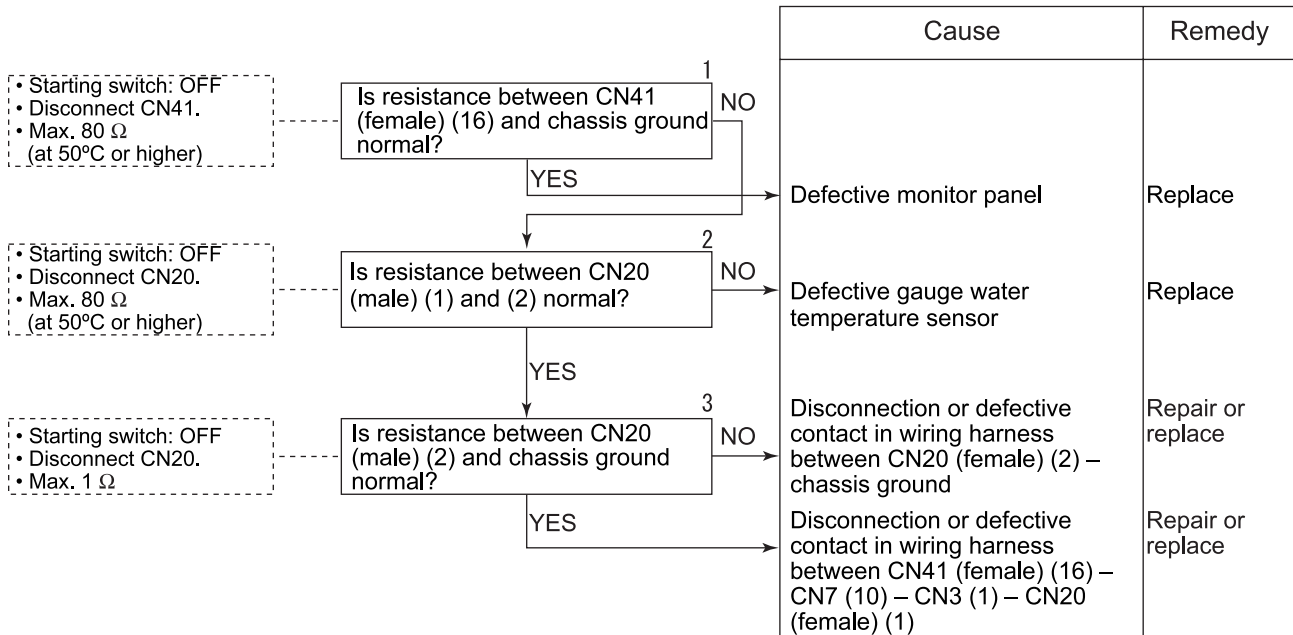


M-5. Trouble in engine water temperature gauge

- ★ Before carrying out the following troubleshooting, check that the engine oil pressure caution lamp and charge caution lamp light up when the starting switch is turned on.

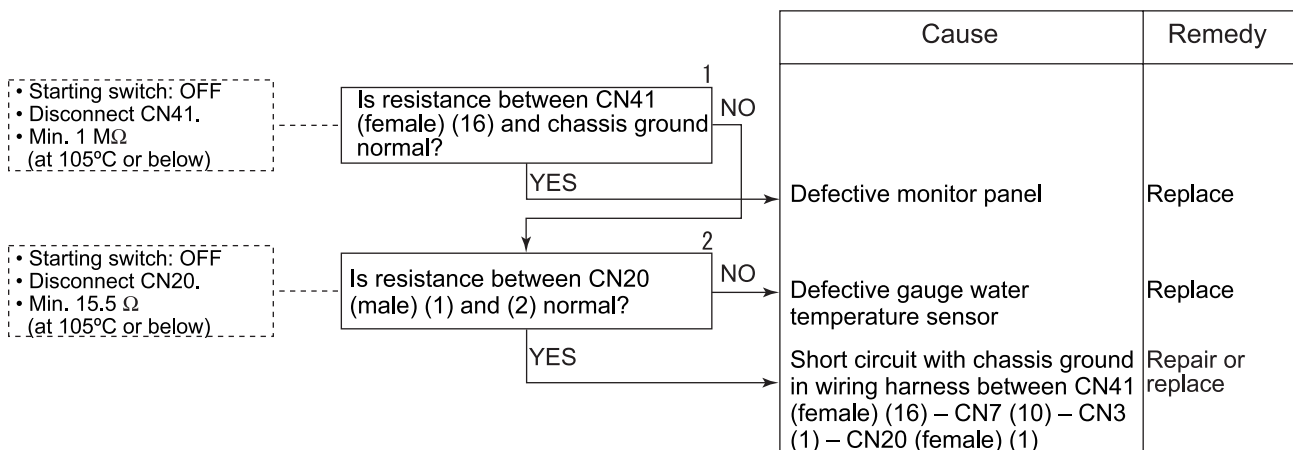
a) Gauge does not rise above C (lowest point).

- ★ Before carrying out the following troubleshooting, check that the temperature of the engine water is above 52°C.

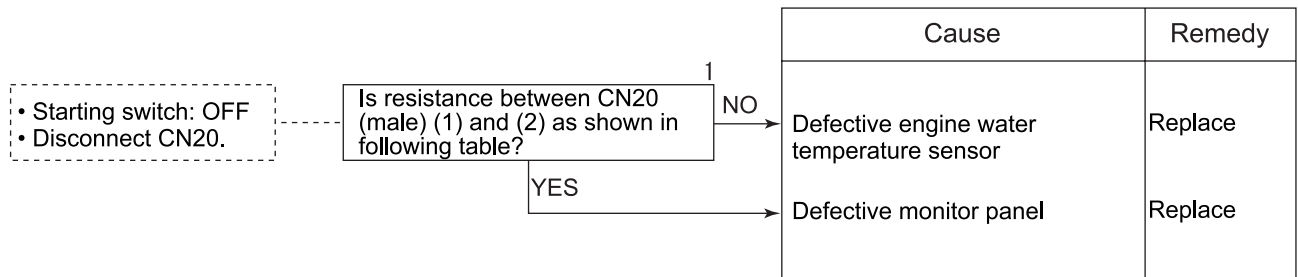


b) Gauge does not lower below H (Highest point).

- ★ Before carrying out the following troubleshooting, check that the temperature of the engine water is below 105°C.



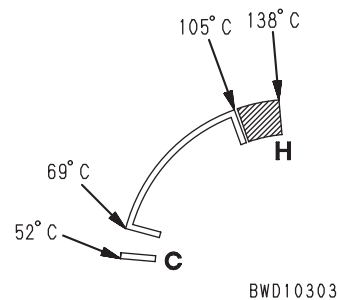
c) Engine water temperature indicated by gauge is different from actual temperature



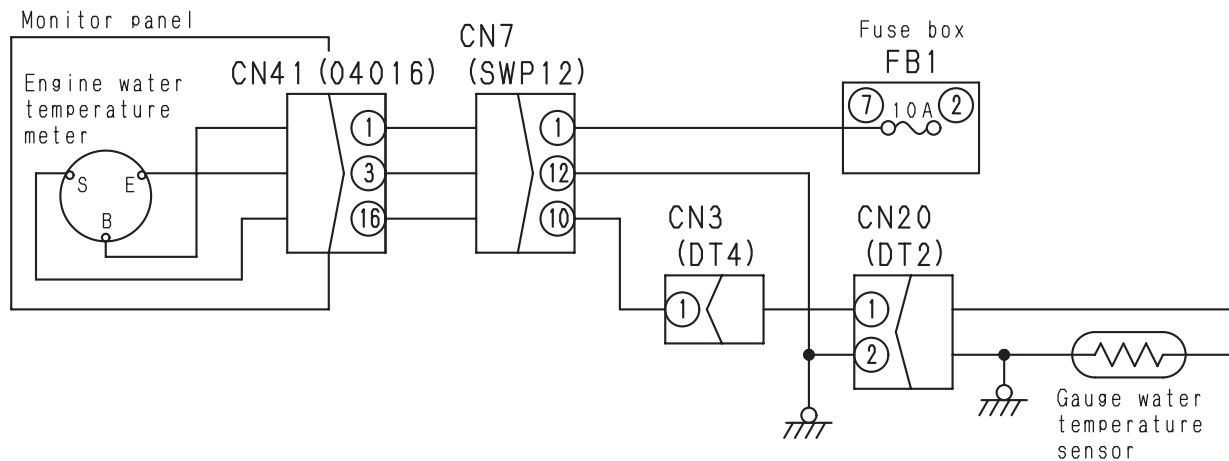
Table

HST oil temperature (°C)	Resistance (Ω)
50 ± 0.2	80 ± 10
60 ± 0.2	56.3 ± 3
80 ± 0.2	29.5 ± 2.5
100 ± 0.3	16.5 ± 0.9
106 ± 0.3	14.3 ± 0.5
120 ± 0.3	10 ± 0.3

Engine water temperature and indication by gauge



M5 Related electrical circuit diagram



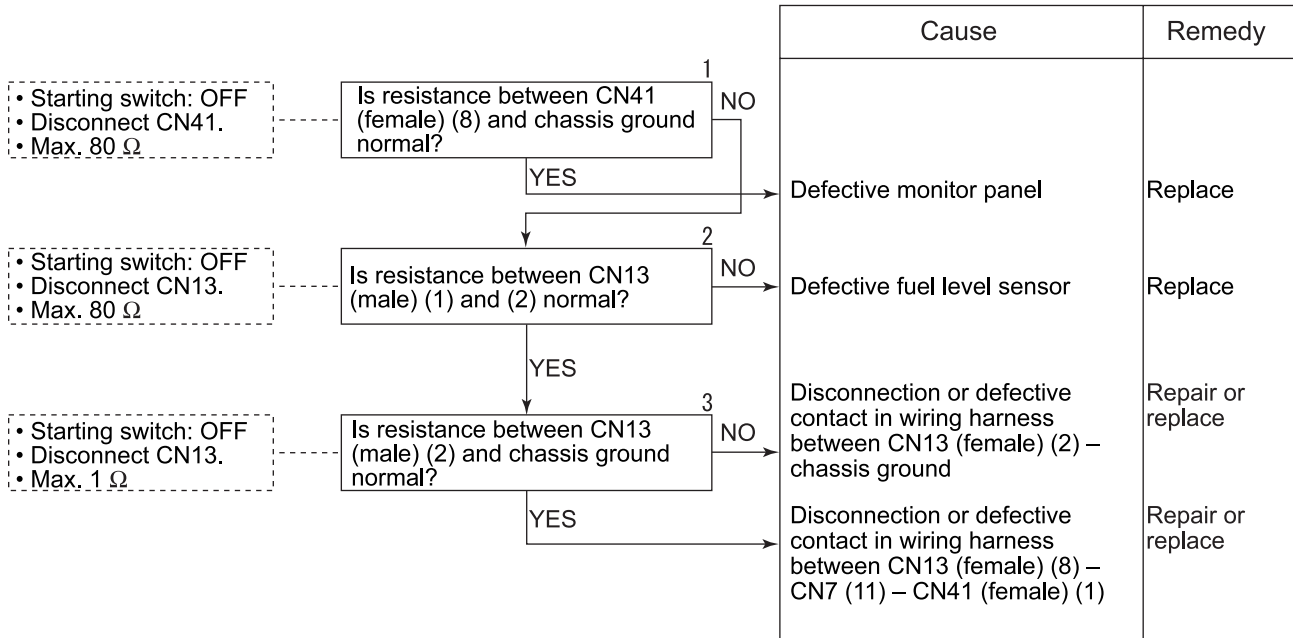
BWD10132

M-6. Trouble in fuel level gauge

- ★ Before carrying out the following troubleshooting, check that the engine oil pressure caution lamp and charge caution lamp light up when the starting switch is turned on.

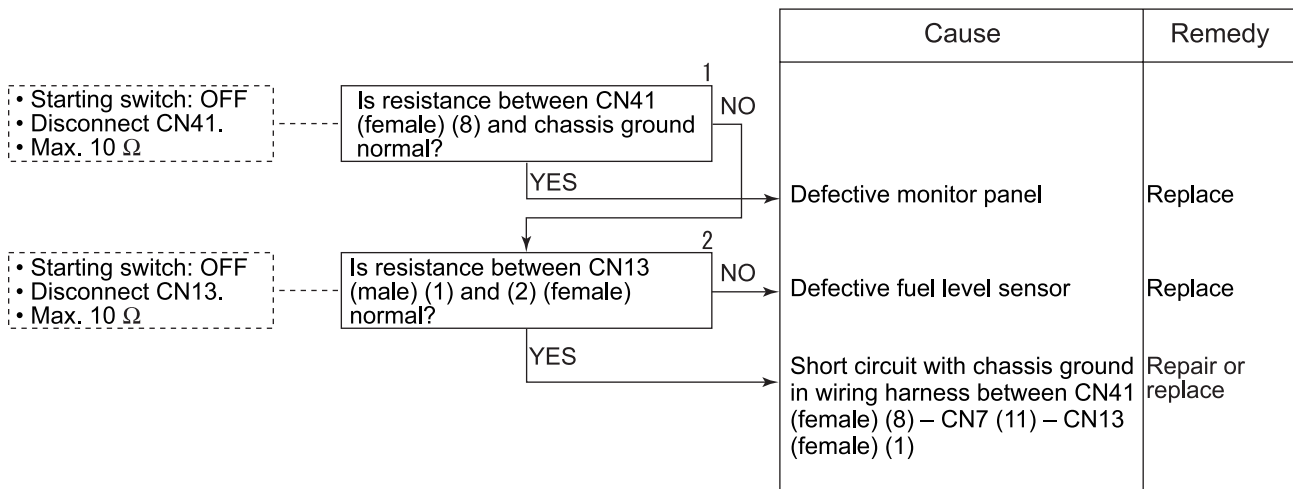
a) Gauge does not rise above E (lowest point).

- ★ Before carrying out the following troubleshooting, check that the fuel tank is not empty.



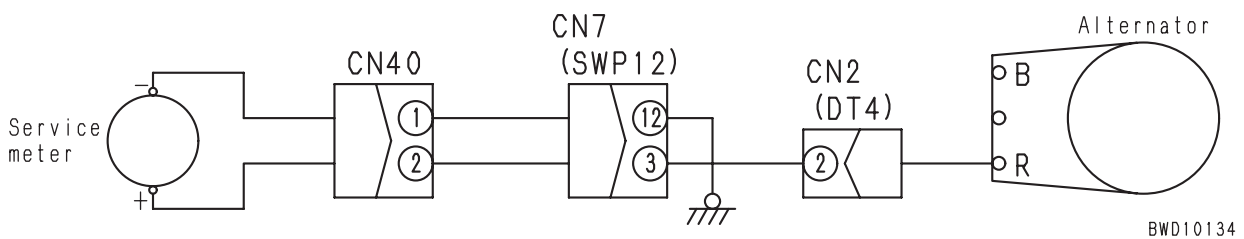
b) Gauge does not lower below F (Highest point).

- ★ Before carrying out the following troubleshooting, check that the fuel tank is not full.



M-7. Service meter does not operate after engine is started

		Cause	Remedy
• 20 – 30 V • Engine speed: Medium or higher	Is voltage between CN40 (female) (1) and (2) normal? YES NO	Defective service meter	Replace
	Is resistance between CN40 (female) (1) and chassis ground normal? YES NO	Disconnection or defective contact in wiring harness between CN40 (female) (1) – CN7 (12) – chassis ground	Repair or replace wiring harness
• Max. 1 Ω • Starting switch: OFF • Disconnect CN40.	Is voltage between alternator terminal R and chassis ground normal? YES NO	Defective alternator	Repair or replace
	Is voltage between alternator terminal R and chassis ground normal? YES NO	Disconnection or defective contact in wiring harness between CN40 (female) (2) – CN7 (3) – CN2 (2) – alternator terminal R	Repair or replace wiring harness

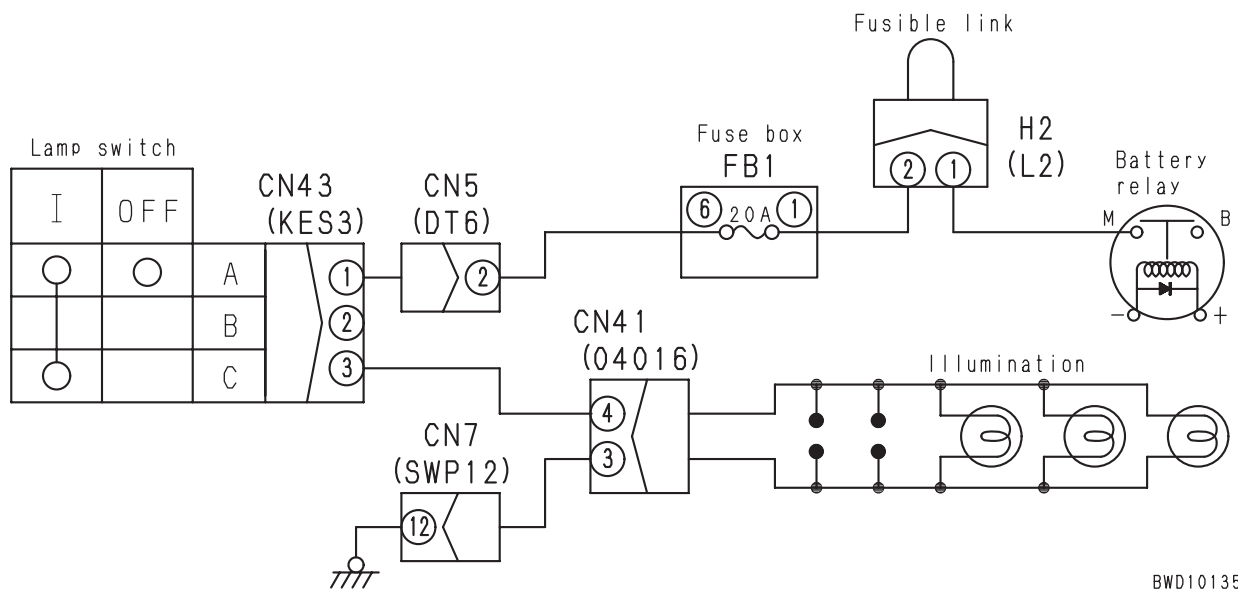
M-7 Related electrical circuit diagram

M-8. Monitor panel lamp does not light up (while headlamp is normal)

(Carry out the following troubleshooting when the headlamp lights up normally. If the headlamp does not light up, execute "E-3" first.)

- ★ Check the bulb visually for breakage. (If it is broken, replace it.)

		Cause	Remedy
• 20 – 30 V • Starting switch: ON • Lamp switch: ON	Is voltage between CN41 (4) and chassis ground normal? YES NO	Disconnection or defective contact in wiring harness between CN41 (female) (4) – CN43 (female) (3) (up to branch)	Repair or replace wiring harness
	Is resistance between CN41 (female) (4) and chassis ground normal? YES NO	Disconnection or defective contact in wiring harness between CN41 (female) (3) – CN7 (12) – chassis ground Defective monitor panel	Repair or replace wiring harness Replace

M-8 Related electrical circuit diagram

M-9. Trouble in display of travel speed (while actual travel speed is normal)

- ★ Check the bulb visually for breakage. (If it is broken, replace it.)
- ★ Before carrying out the following troubleshooting, check that fuse FB1 No. 3 and fusible link H2 are normal.

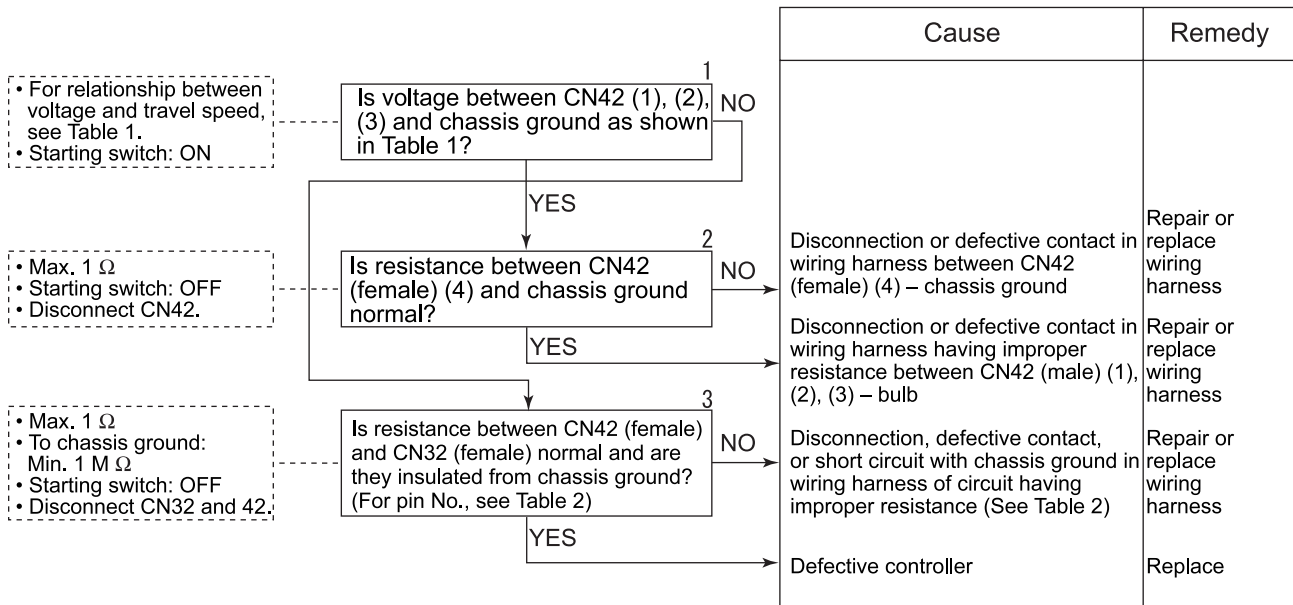
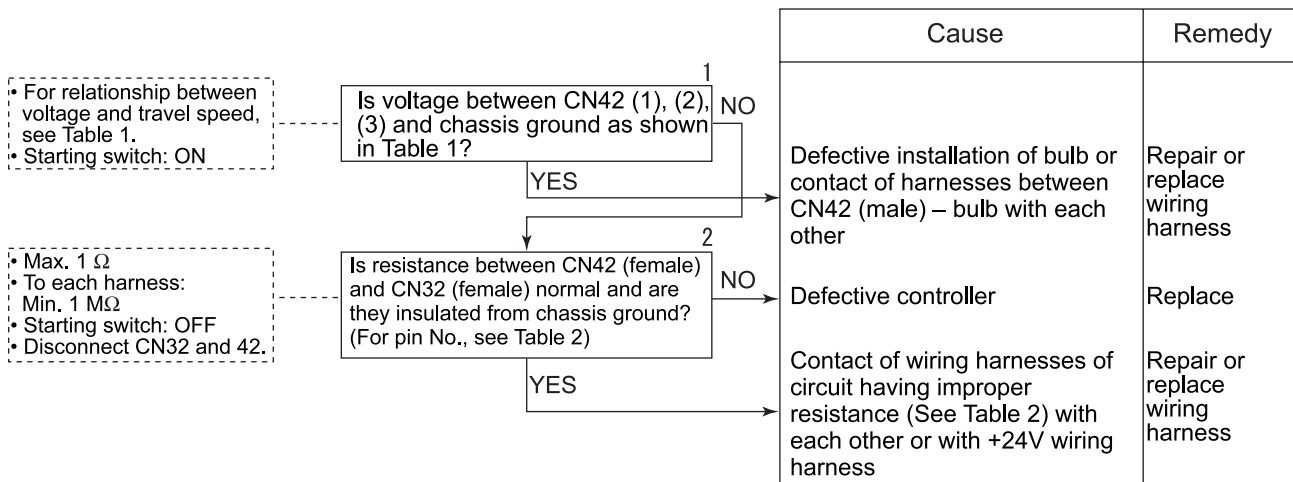
a) Travel speed is not displayed**b) Displayed speed is different from actual travel speed**

Table 1

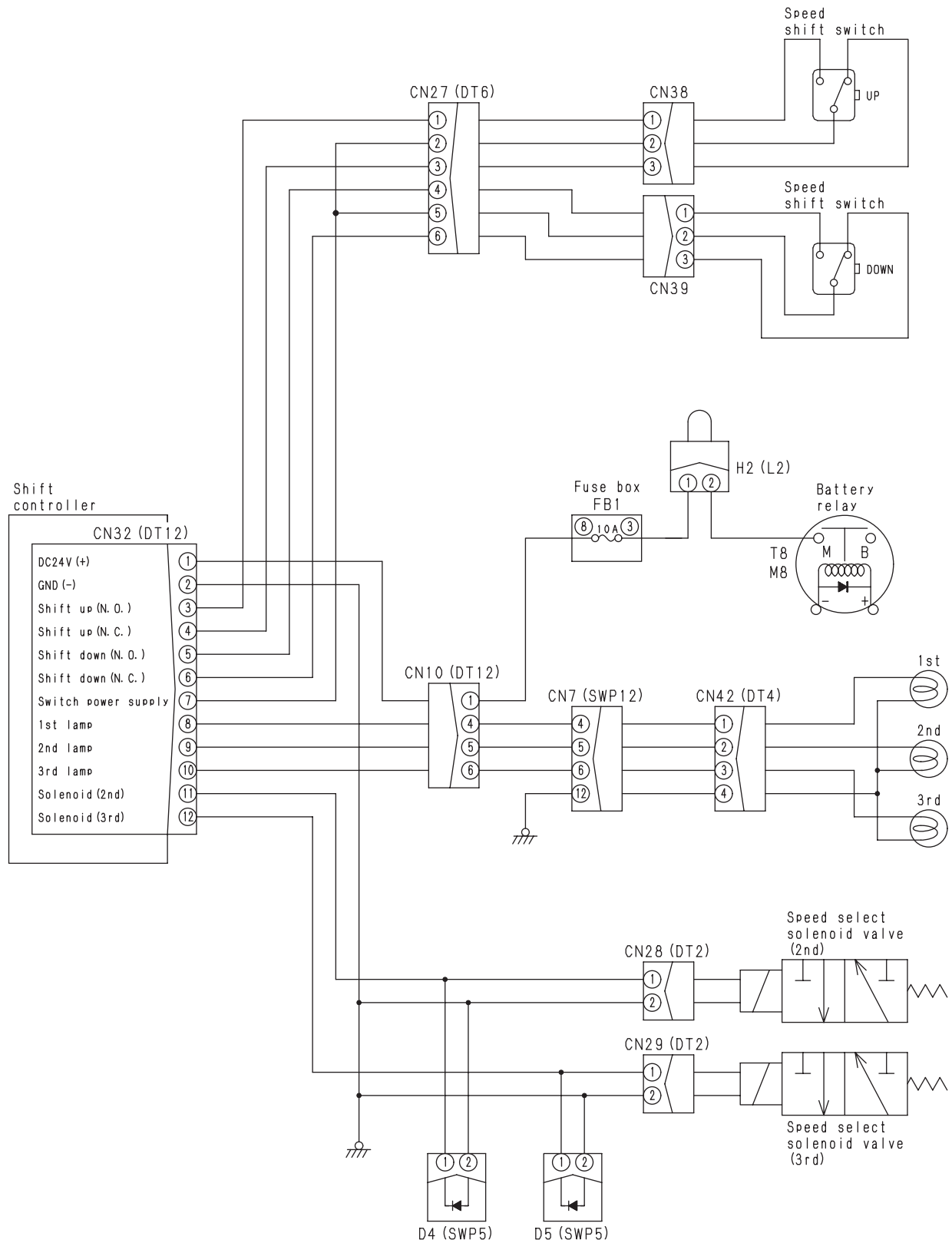
Connector CN42	1st	2nd	3rd
Between (1) – (4)	20 –30V	Max. 1 V	Max. 1 V
Between (2) – (4)	Max. 1 V	20 –30V	Max. 1 V
Between (3) – (4)	Max. 1 V	Max. 1 V	20 –30V

* When starting switch is turned on (1st gear speed is selected at first)

Table 2

Travel speed lamp	Circuit
1st	Between CN42 (female) (1) – CN32 (female) (8)
2nd	Between CN42 (female) (2) – CN32 (female) (9)
3rd	Between CN42 (female) (3) – CN32 (female) (10)

M-9 Related electrical circuit diagram



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30 DISASSEMBLY AND ASSEMBLY

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METHOD OF USING MANUAL

1. When removing or installing unit assemblies

- 1) When removing or installing a unit assembly, the order of work and techniques used are given for the removal operation; the order of work for the installation operation is not given.
- 2) Any special techniques applying only to the installation procedure are marked , and the same mark is placed after the relevant step in the removal procedure to indicate which step in the installation procedure it applies to.

(Example)

REMOVAL OF ○ ○ ○ ○ ASSEMBLY Title of operation



..... Precautions related to safety when carrying out the operation

1. X X X X (1) Step in operation

★ Technique or important point to remember when removing XXXX (1).

2. △ △ △ △ (2):  Indicates that a technique is listed for use during installation

3. □ □ □ □ assembly (3)



..... Quantity of oil or water drained

INSTALLATION OF ○ ○ ○ ○ ASSEMBLY Title of operation

- Carry out installation in the reverse order to removal.

 Technique used during installation

★ Technique or important point to remember when installing △ △ △ △ (2)

- Adding water, oil Step in operation

★ Point to remember when adding water or oil



..... Quantity when filling with oil and water

2. General precautions when carrying out installation or removal (disassembly or assembly) of units are given together as PRECAUTIONS WHEN CARRYING OUT OPERATION, so be sure to follow these precautions when carrying out the operation.

3. Listing of special tools

- 1) For details of the description, part number, and quantity of any tools (A1, etc.) that appear in the operation procedure, see the SPECIAL TOOLS LIST given in this manual.

PRECAUTIONS WHEN CARRYING OUT OPERATION

[When carrying out removal or installation (disassembly or assembly) of units, be sure to follow the general precautions given below when carrying out the operation.]

1. Precautions when carrying out removal work

- If the coolant contains antifreeze, dispose of it correctly.
- After disconnecting hoses or tubes, cover them or fit 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 prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors. Do not pull the wires.
- Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.
- Check the number and thickness of the shims, and keep in a safe place.
- When raising components, be sure to use lifting equipment of ample strength.
- When using forcing screws to remove any components, tighten the forcing screws uniformly in turn.
- Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.

★ Precautions when handling piping during disassembly

Fit the following blind plugs into the piping after disconnecting it during disassembly operations.

1) Hoses and tubes using sleeve nuts

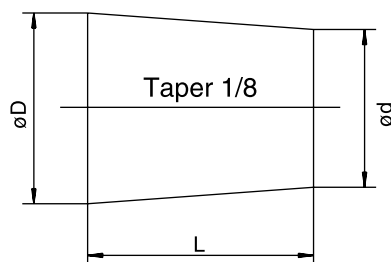
Nominal number	Plug (nut end)	Sleeve nut (elbow end) Use the two items below as a set
02	07376-50210	07221-20210 (Nut), 07222-00210 (Plug)
03	07376-50315	07221-20315 (Nut), 07222-00312 (Plug)
04	07376-50422	07221-20422 (Nut), 07222-00414 (Plug)
05	07376-50522	07221-20522 (Nut), 07222-00515 (Plug)
06	07376-50628	07221-20628 (Nut), 07222-00616 (Plug)
10	07376-51034	07221-21034 (Nut), 07222-01018 (Plug)
12	07376-51234	07221-21234 (Nut), 07222-01219 (Plug)

2) 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

3) 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 and lock plates securely.
 - When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2 – 3 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 fitting snap rings, check that the snap ring is fitted 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 at low idling.
 - 2) Operate the work equipment control lever to operate the hydraulic cylinder 4 – 5 times, stopping the cylinder 100 mm from the end of its 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 operation

- If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the 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, always 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-○○○-○○○ cannot be supplied (they are items to be locally manufactured).
- ★ Necessity: ■ Cannot be substituted, must always be installed (used)
● Extremely useful if available or 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, can be 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
Removal, installation of fuel injection pump assembly	A	1	795-799-1131	Gear	■	1			Cranking of engine
		2	795-799-1390	Remover	■	1			Removal of injection pump gear
3		795-799-1170	Puller	●	1			Removal of nozzle holder	
4		790-331-1110	Wrench	■	1			Installation of cylinder head bolt	
Disassembly, assembly of final drive assembly	J	1	791-830-1320	Rod	■	1			Pulling out of planetary pinion shaft
			01580-01613	Nut	■	1			
			01643-31645	Washer	■	1			
			790-101-2540	Washer	■	1			
			790-101-2102	Puller assembly	■	1			
			790-201-2830	Spacer	■	1			
			790-101-1102	Hydraulic pump	■	1			
	2	791-427-1410	Wrench	■	1	N		Loosening, tightening of round nut	
	3	791-545-1510	Installer	■	1			Installation of floating seal	
Disassembly, assembly of idler assembly	L	1	791T-430-3210	Push tool	■	1		○	Press fitting of idler bushing
		2	791-675-1510	Installer	■	1			Installation of idler floating seal
3		791T-430-3220	Push tool	■	1		○	Press fitting of track roller bushing	
4		791-651-1510	Installer	■	1			Installation of track roller floating seal	
5		790-601-1000	Oil pump	■	1			Charging with oil, air leakage check	
Disassembly, assembly of carrier roller assembly		6	791-430-3230	Installer	■	1			Installation of carrier roller floating seal

DISASSEMBLY AND ASSEMBLY

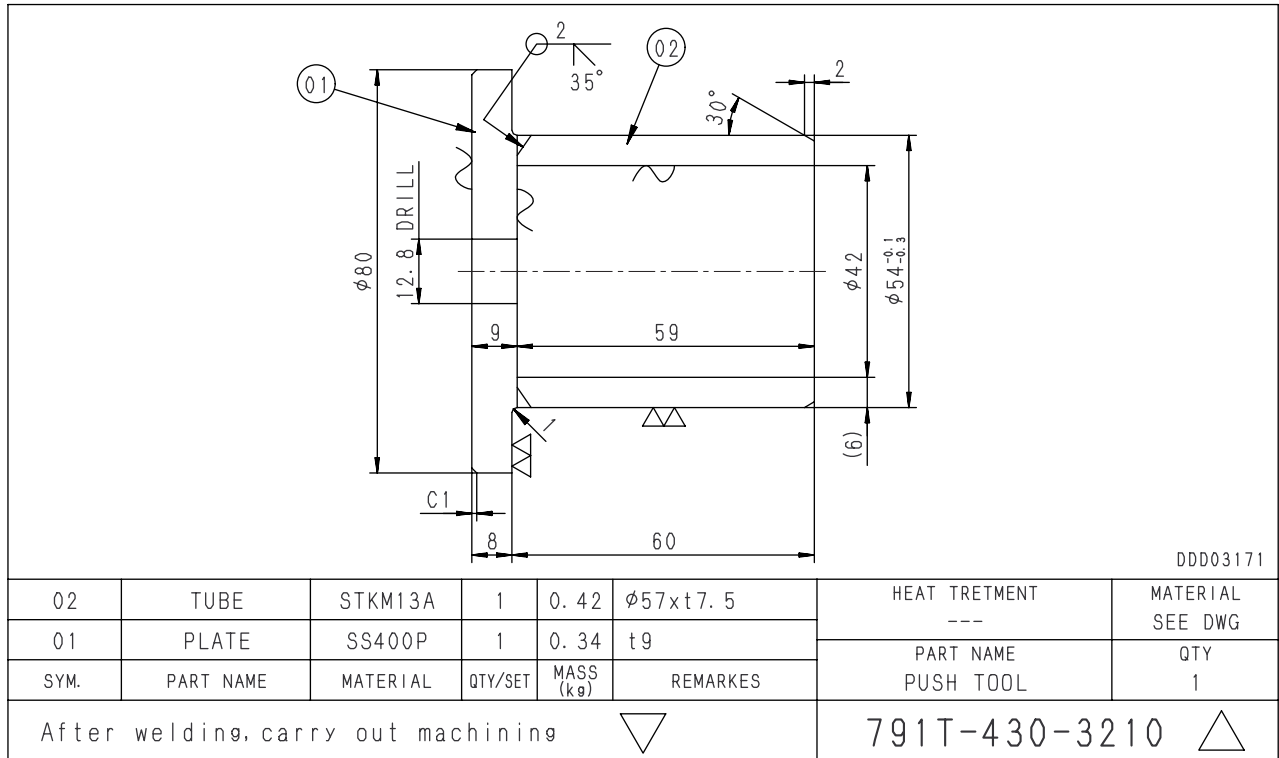
SPECIAL TOOL LIST

Component	Symbol	Part No.	Part Name	Necessity	Q'ty	New/Remodel	Sketch	Nature of work, remarks
Disassembly, assembly of recoil spring assembly	M	791-685-8006	Compressor (B)	■	1			Removal, installation of recoil spring
		790-201-2860	Spacer	■	1			
		791-635-3160	Extension	■	1			
		790-101-1600	Cylinder (686 kN {70 tons})	■	1			
		790-101-1102	Pump	■	1			
Disassembly, assembly of track	R	791-630-3200	Remover	■	1			Removal, installation of ring pin
		790-101-1300	Cylinder (980 kN {100 tons})	■	1			
		790-101-1102	Hydraulic pump	■	1			
Disassembly, assembly of hydraulic cylinder assembly	1	790-502-1003	Repair stand	■	1			Disassembly, assembly of hydraulic cylinder
		790-101-1102	Pump	■	1			
	2	790-330-1100	Wrench	■	1			Removal, installation of cylinder head
	3	790-302-1270	Socket	■	1			Loosening, tightening of piston nut
	5	790-720-1000	Expander	■	1			Installation of piston ring
		796-720-1650	Rubber band	●	1			
	6	07281-01029	Clamp	●	1			Press fitting of bushing
		790-201-1702	Push tool kit		1			
		790-201-1751	• Push tool	■	1			
		790-101-5021	• Grip	■	1			
	7	01010-50816	• Bolt	■	1			Press fitting of dust seal
		790-201-1500	Push tool kit		1			
		790-201-1560	• Plate	■	1			
		790-101-5021	• Grip	■	1			
		01010-50816	• Bolt	■	1			

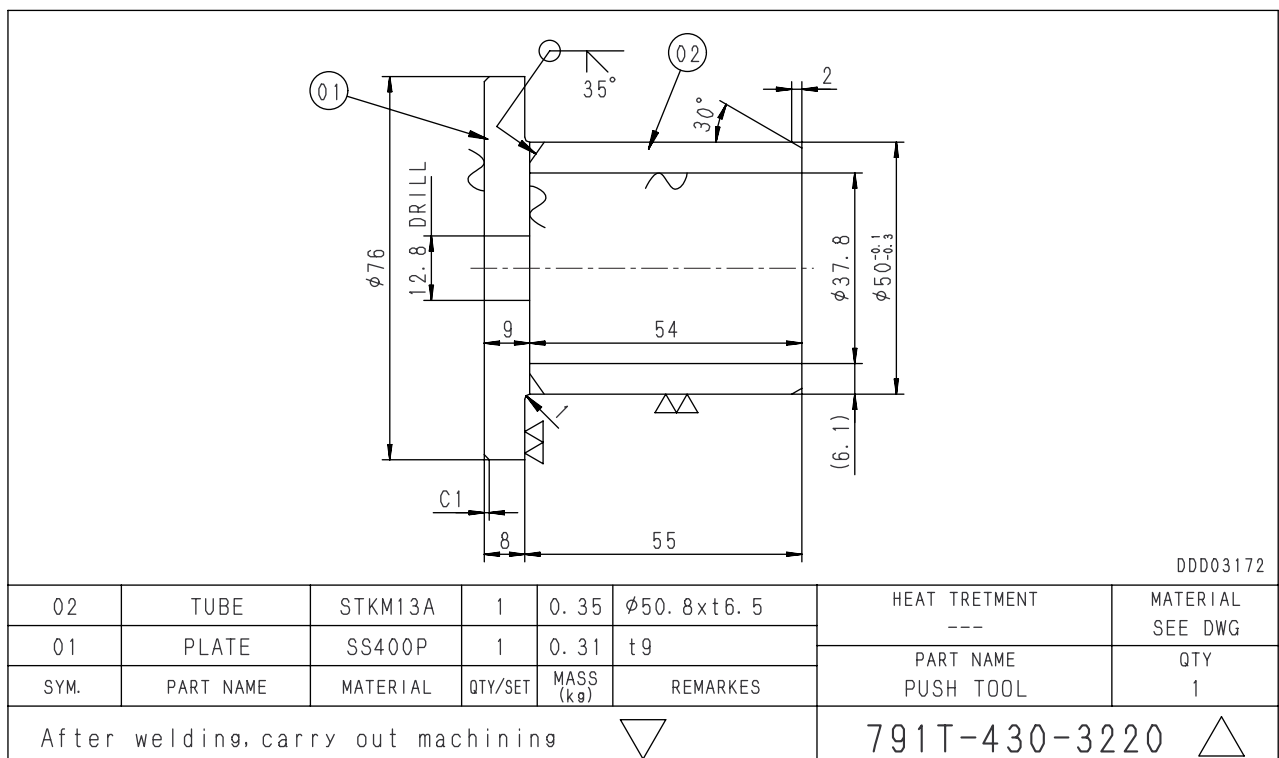
SKETCHES OF SPECIAL TOOLS

NOTE: Komatsu cannot accept any responsibility for special tools manufactured according to these sketches.

L1 Push tool



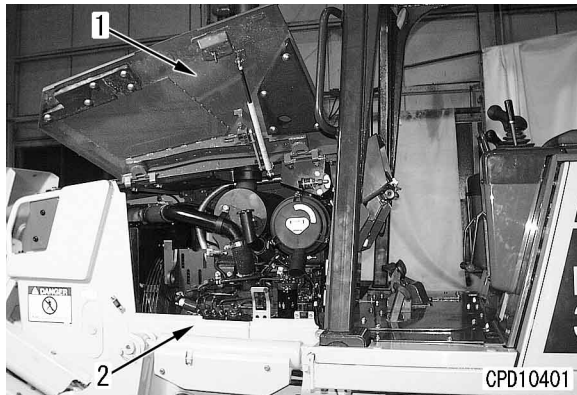
L3 Push tool



REMOVAL OF FUEL INJECTION PUMP ASSEMBLY

1. Open up both engine hoods (1).

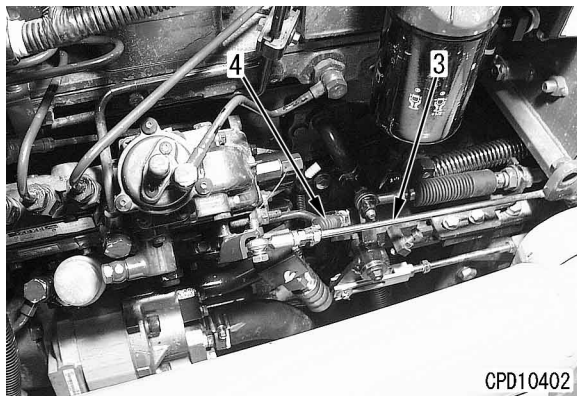
2. Remove left engine side cover (2).



3. Close the fuel stop valve.

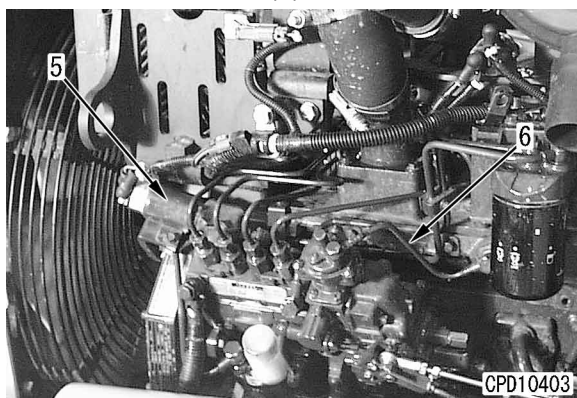
4. Disconnect fuel control linkage (3). ※ 1

5. Disconnect decelerator pedal linkage (4). ※ 2

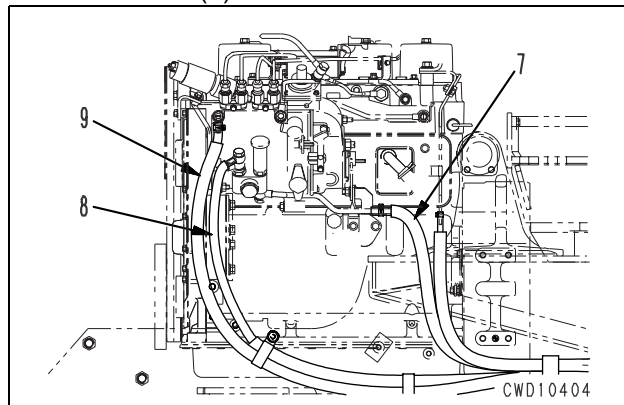


6. Remove engine stop solenoid (5). ※ 3

7. Disconnect air tube (6).



8. Disconnect fuel inlet hoses (7) and (8) and return hose (9).

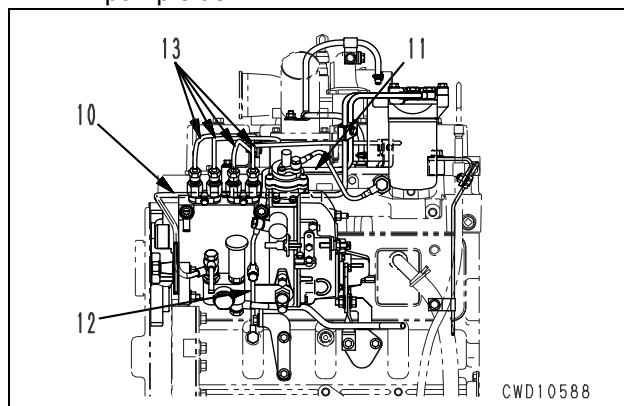


9. Remove fuel tubes (10) and (11).

10. Remove lubrication tube (12).

11. Disconnect 4 fuel injection tubes (13).

★ Disconnect the tube end on the fuel injection pump side.



DISASSEMBLY AND ASSEMBLY

FUEL INJECTION PUMP ASSEMBLY

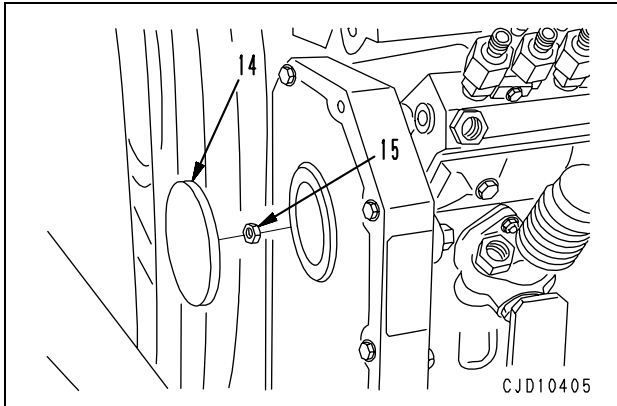
12. Remove cap (14).

※ 4

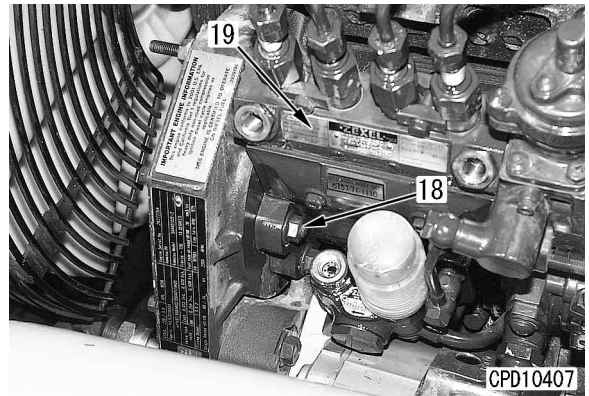
13. Remove injection pump nut (15).

※ 5

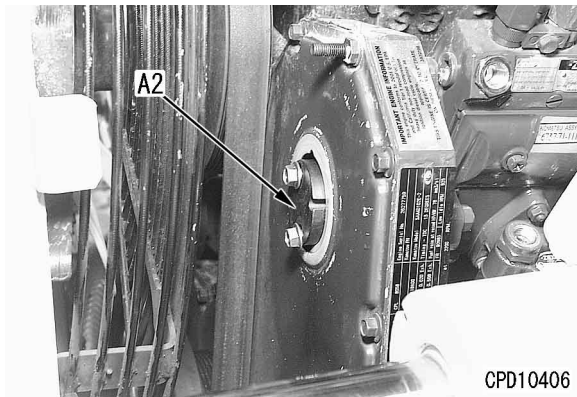
- ★ Remove with a filter wrench, etc.
- ★ Take care not to drop the nut in the case.



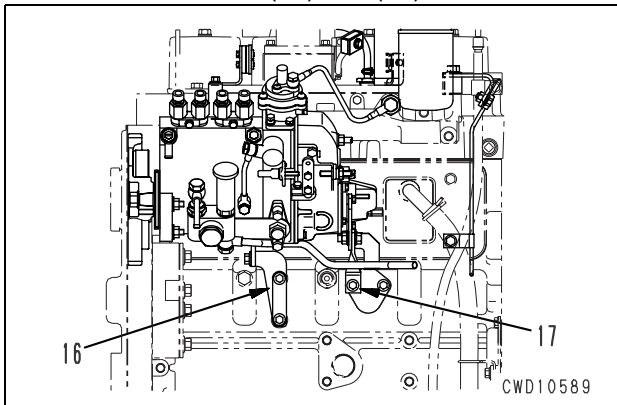
16. Remove 4 mounting bolts (18) and fuel injection pump assembly (19).



14. Using tool A2, disconnect the shaft and drive gear of the fuel injection pump.



15. Remove brackets (16) and (17).



INSTALLATION OF FUEL INJECTION PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Adjust the fuel control linkage. For details, see TESTING AND ADJUSTING, Adjusting fuel control linkage.

※ 2

- ★ Adjust the decelerator pedal linkage. For details, see TESTING AND ADJUSTING, Adjusting decelerator pedal linkage.

※ 3

- ★ Adjust the engine stop solenoid linkage. For details, see TESTING AND ADJUSTING, Adjusting engine stop solenoid linkage.

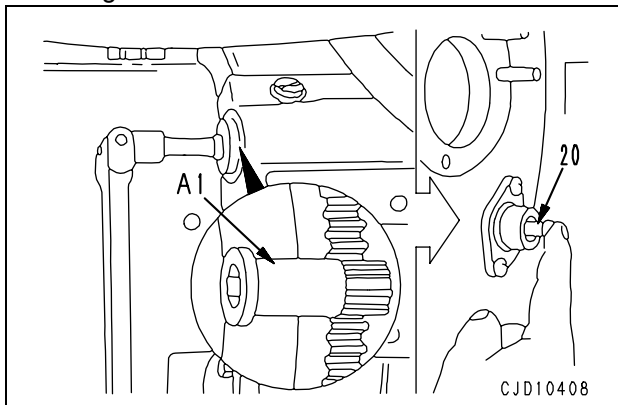
※ 4

- ★ Tighten the cap by turning it by 180 degrees.

※ 5

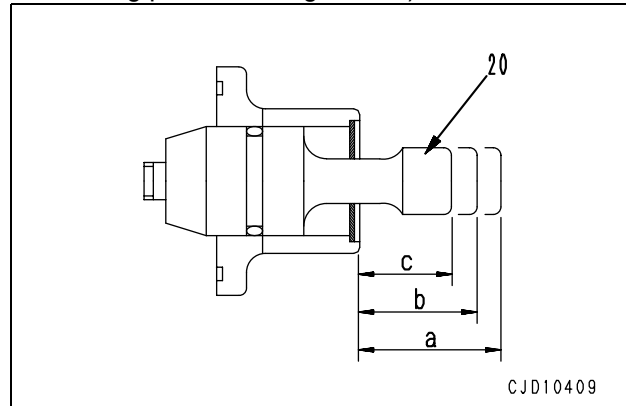
- ★ Install the fuel injection pump assembly according to the following procedure.

- 1) Using tool **A1**, crank the engine forward slowly and push No. 1 cylinder compression top dead center positioning pin (20) into the gear.

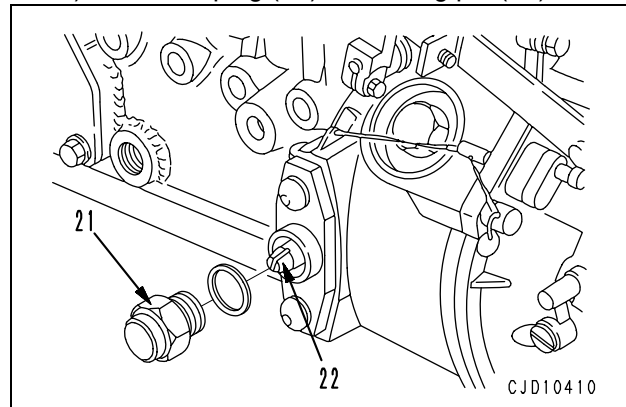


- ★ Referring to the following, push positioning pin (20) into the gear securely.
 - Dimension "a" of pin in free state: 24 mm
 - Dimension "b" of pin when it is in contact with gear: 20 mm
 - Dimension "c" of pin when it is pushed into gear: 16 mm

- ★ Stop barring immediately after the positioning pin is pushed in (to prevent the positioning pin from being broken).

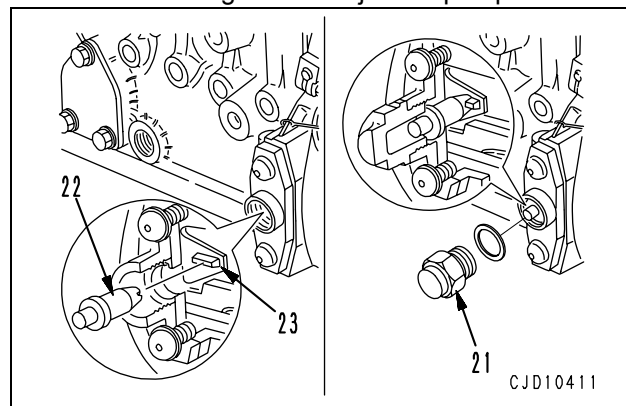


- 2) Remove plug (21) and timing pin (22).



- 3) Reverse the fitting position of timing pin (22) and match the groove of the timing pin to pointer (23) in the pump and tighten plug (21) temporarily.

- ★ If the tooth of pointer (23) is not matched to the hole of the timing pin, match it by turning the fuel injection pump shaft.

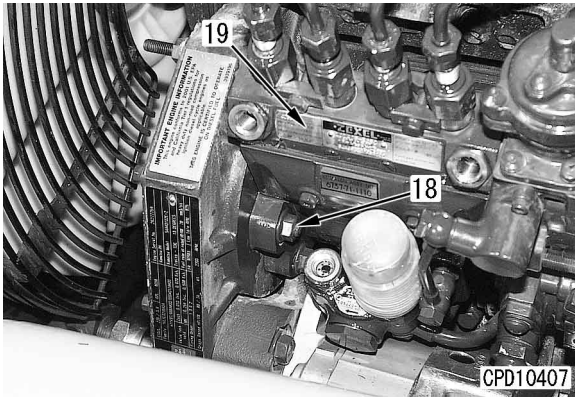


DISASSEMBLY AND ASSEMBLY

FUEL INJECTION PUMP ASSEMBLY

- 4) Install fuel injection pump assembly (19) and tighten nut (18).

 **Nut: $43 \pm 6 \text{ Nm}$ $\{4.38 \pm 0.61 \text{ kgm}\}$**



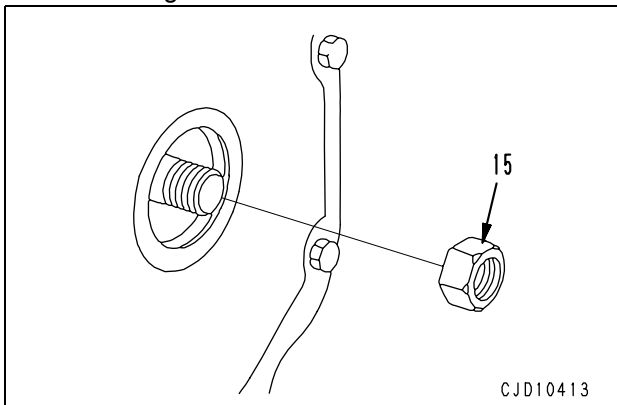
- 5) Tighten fuel injection pump nut (15).

★ When installing the nut, take care extremely not to drop it in the case.

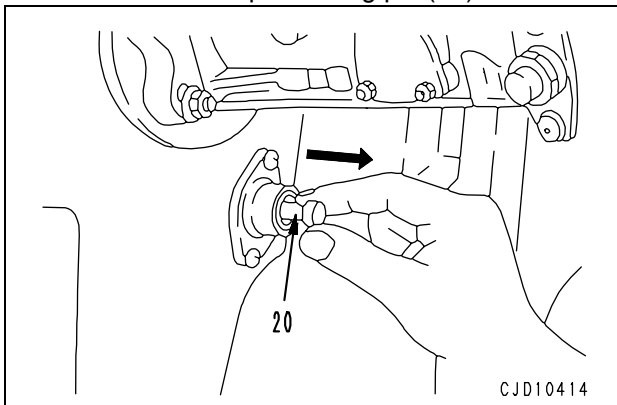
 **Nut: $12.5 \pm 2.5 \text{ Nm}$ $\{1.27 \pm 0.25 \text{ kgm}\}$**

★ This value is not the final torque.

★ Do not heighten the tightening torque of the nut more than above value so that the No. 1 cylinder compression top dead center positioning pin will not be damaged.

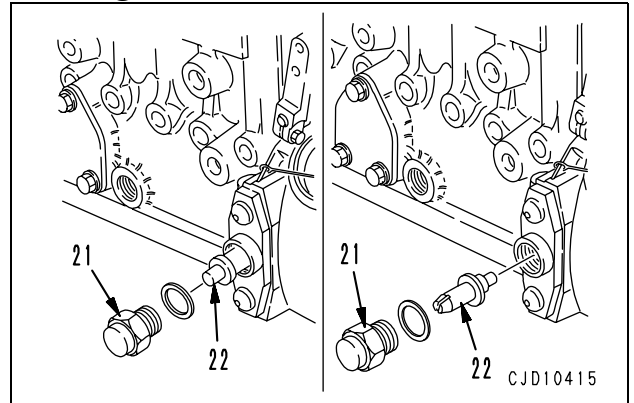


- 6) Disengage No. 1 cylinder compression top dead center positioning pin (20).



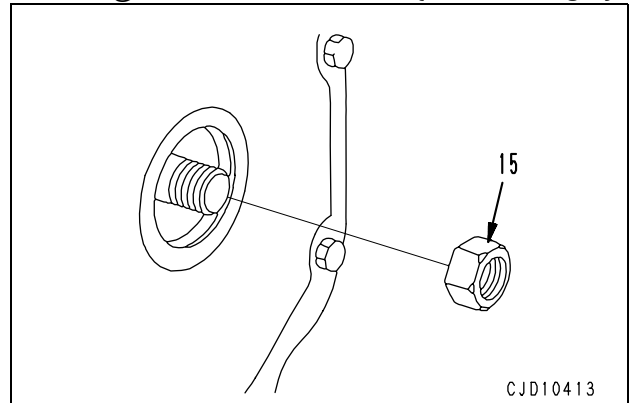
- 7) Remove plug (21) and install timing pin (22) in the reversed fitting position, then install the plug to the fuel injection pump.

 **Plug: 14.7 Nm $\{1.5 \text{ kgm}\}$**



- 8) Tighten fuel injection pump nut (15) securely.

 **Nut: $95 \pm 10 \text{ Nm}$ $\{9.7 \pm 1.02 \text{ kgm}\}$**



- After the above work, carry out installation in the reverse order to removal.

★ Adjust the fuel injection timing. For details, see TESTING AND ADJUSTING, Adjusting fuel injection timing.

• Bleeding air

Bleed air from the fuel circuit. For details, see TESTING AND ADJUSTING, Bleeding air from fuel circuit.

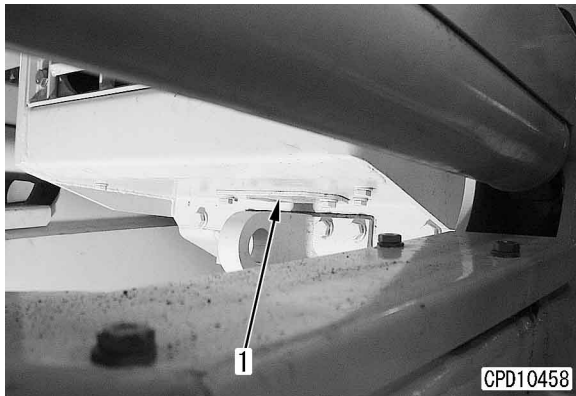
REMOVAL OF CYLINDER HEAD ASSEMBLY

- ⚠ Disconnect the cable from the negative (–) terminal of the battery.
- ⚠ If the water temperature in the radiator is high, you may get scalded. Accordingly, wait until the water temperature lowers, then drain.

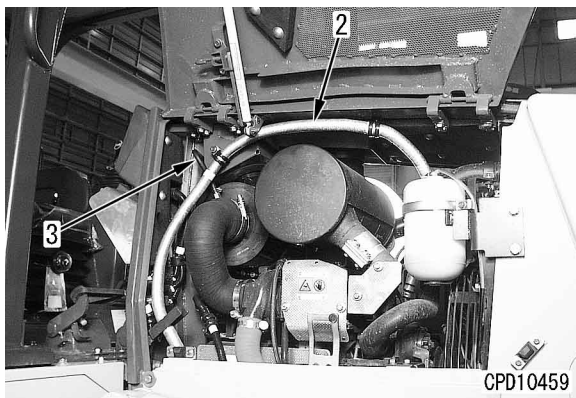
1. Remove the mounting bolts and cover (1).
2. Loosen the radiator cap and drain the cooling water.



Radiator: Approx. 20 ℓ



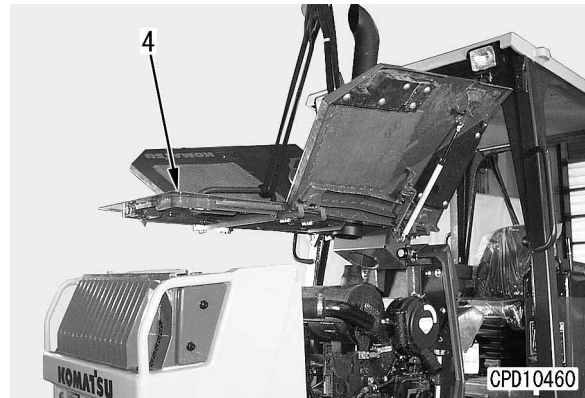
3. Close the fuel stop valve.
4. Remove clip of heater hose (2) and disconnect dust indicator hose (3).
 - ★ Disconnect the dust indicator hose end on the air cleaner side.



5. Using eyebolts, lift off engine hood (4).



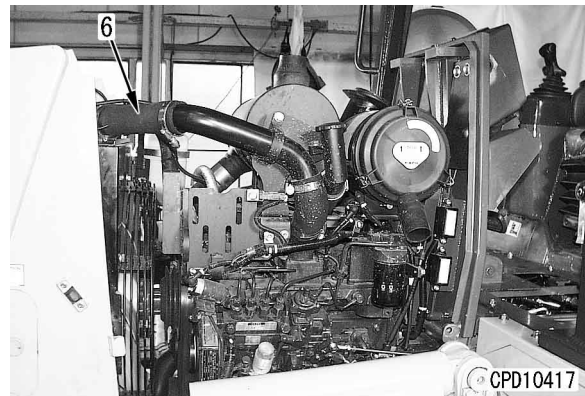
Engine hood: 45 kg



6. Remove both engine covers (5).



7. Disconnect charge air cooler hose (6).

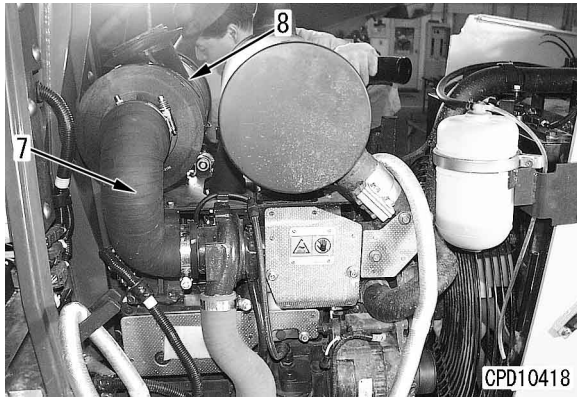


DISASSEMBLY AND ASSEMBLY

CYLINDER HEAD ASSEMBLY

8. Disconnect air cleaner hose (7). ※ 2

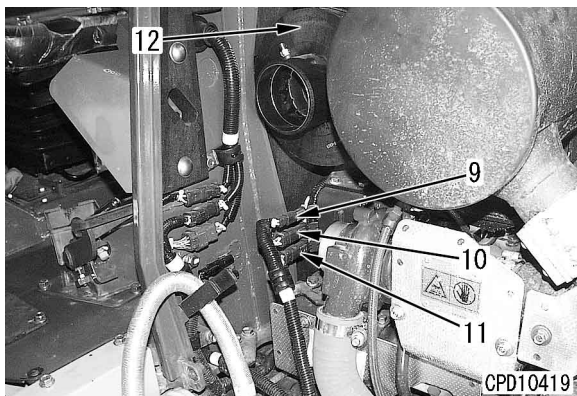
9. Remove air cleaner band (8). ※ 3



10. Disconnect the 3 wiring connectors, then disconnect the wiring harness clamp.

- (9): (CN1)
- (10): (CN2)
- (11): (CN3)

11. Remove the mounting bolt and air cleaner assembly (12). ※ 4



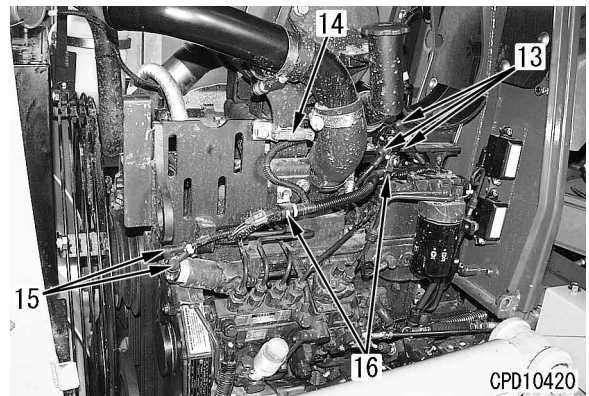
12. Disconnect 3 wiring connectors (13) and remove the heater relay. ※ 5

- Secured with bolt (CNT5)
- Secured with nut (CNT6), (CNT12)

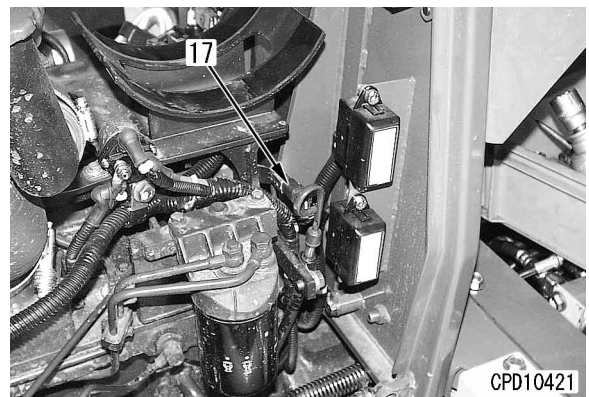
13. Disconnect compressor wiring connector (CN23) (14).

14. Disconnect engine stop solenoid wiring harnesses (CNT17) and (CNT18) (15).

15. Disconnect wiring harness clamp (16).

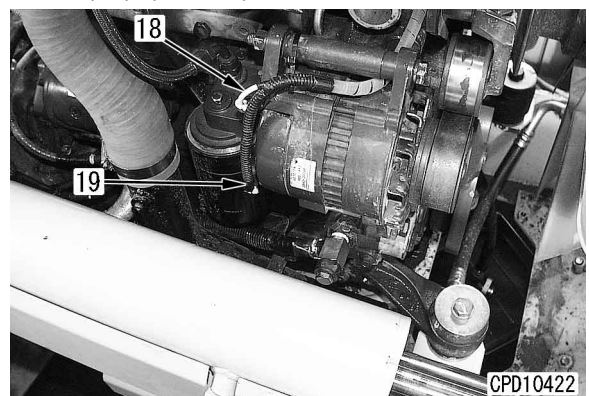


16. Disconnect engine water temperature sensor connector (CN20) (17).



17. Disconnect 2 alternator wiring harnesses. ※ 6

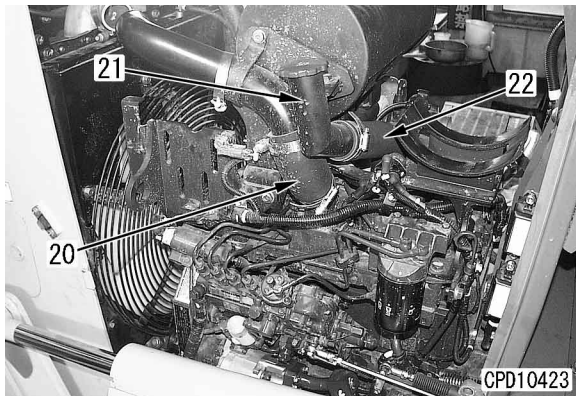
- (18): (CNT15)
- (19): (CNT16)



DISASSEMBLY AND ASSEMBLY**CYLINDER HEAD ASSEMBLY**

18. Disconnect charge air cooler hose (20). ※ 7

19. Disconnect oil filler tube (21) and oil filler hose (22).



20. Disconnect harness clamp (23) and remove muffler clamp (24). ※ 8

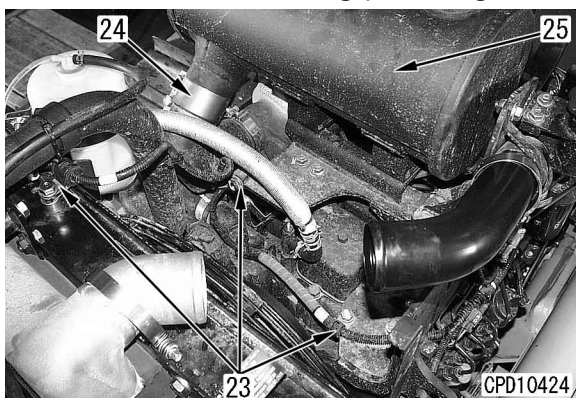
21. Remove the mounting bolts and lift off muffler assembly (25).

★ Remove the 4 upper and 2 lower muffler mounting bolts.



Muffler assembly:

40 kg (Including bracket)



22. Remove reservoir tank (26). ※ 9

23. Disconnect radiator hose (27). ※ 10

24. Disconnect heater hose (28).

25. Remove compressor bracket (29).

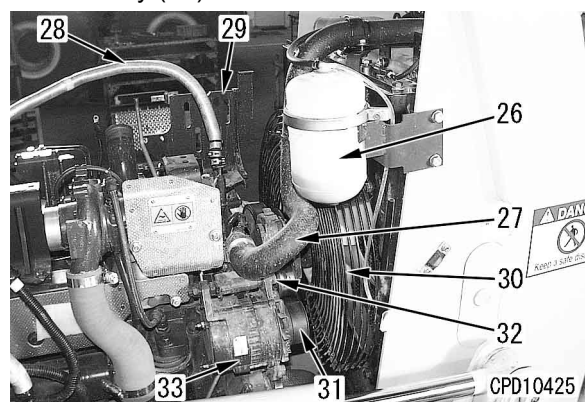
26. Remove fan guard (30).

★ Remove only the right fan guard.

27. Remove fan belt (31). ※ 11

★ Using a wrench, etc., remove the fan belt from the tension pulley.

28. Remove 2 mounting bolts (32) and alternator assembly (33).



29. Remove the brackets and clamps from 2 places and disconnect 4 fuel tubes (34). ※ 12

★ Disconnect the fuel tubes in order from the No. 1 tube (on the fan side).

30. Disconnect the linkage of engine stop solenoid (35) and remove the engine stop solenoid. ※ 13

31. Remove the clamp and 2 delivery tubes (36). ※ 14

32. Remove the mounting bolt and bracket (37). ※ 15

★ Remove the bracket and the fuel filter together.

DISASSEMBLY AND ASSEMBLY

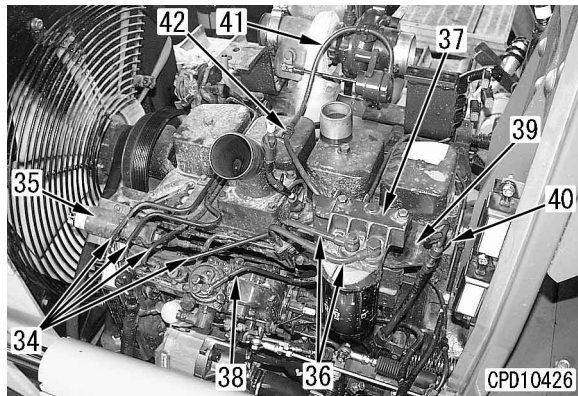
CYLINDER HEAD ASSEMBLY

33. Remove air tube (38).

34. Remove bracket (39) and spill tube (40).

35. Disconnect boost hose (41) and remove clamp (42).

★ Disconnect boost hose end on the intake side.



36. Remove water drain tube (43).

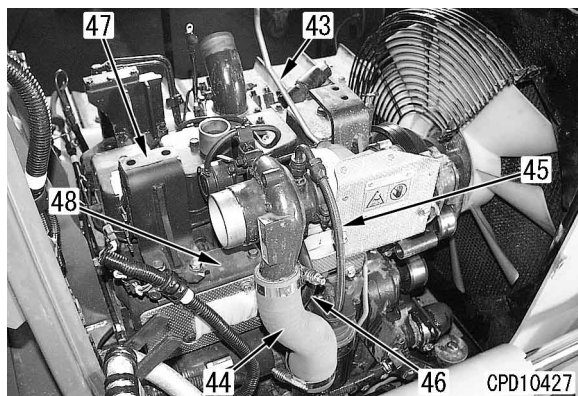
★ Remove the 2 mounting bolts, and the tube is removed and divided into 2 pieces.

37. Disconnect charge air cooler hose (44). ※16

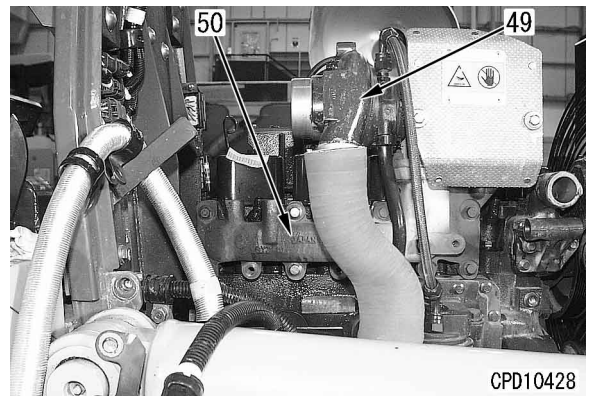
38. Disconnect turbocharger lubrication inlet tube (45) and outlet tube (46). ※17

★ Disconnect end of tube (45) on the oil filter side.

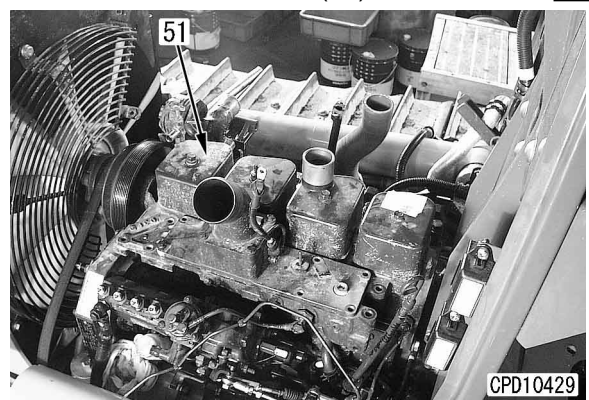
39. Remove bracket (47) and cover (48).



40. Remove turbocharger assembly (49) and exhaust manifold (50). ※18



41. Remove 4 head covers (51). ※19



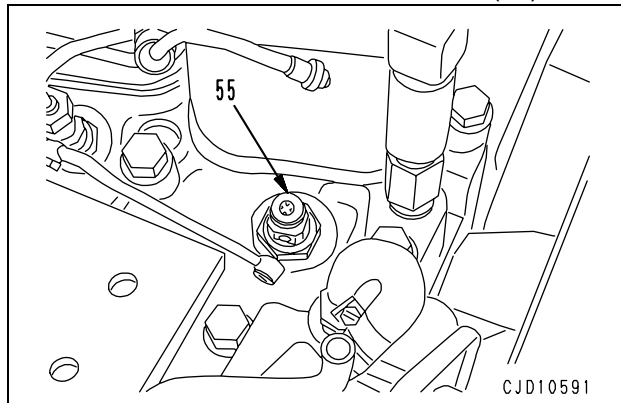
42. Remove the intake air heater ground wire, connector (52), intake air heater (53), and cover (54). ※20



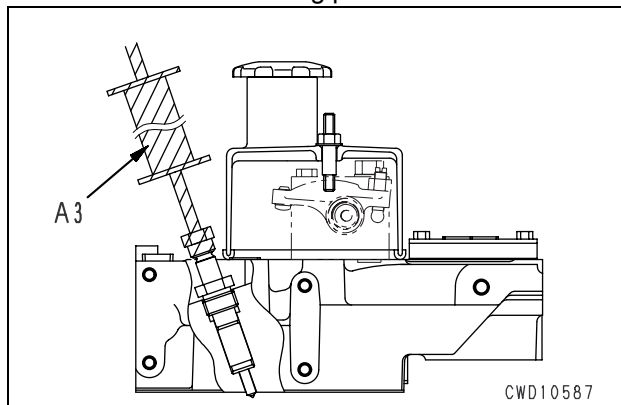
DISASSEMBLY AND ASSEMBLY

CYLINDER HEAD ASSEMBLY

43. Remove 4 nozzle holder assemblies (55).

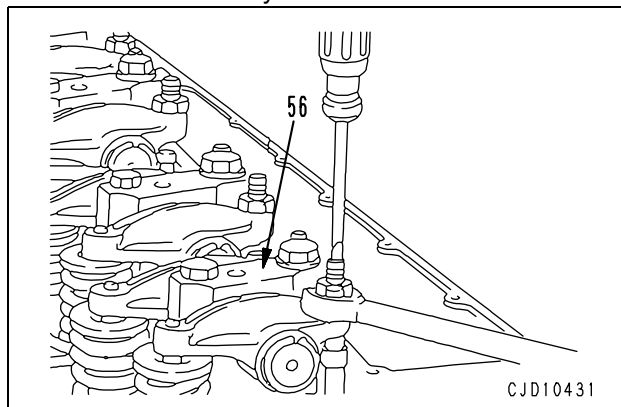


- ★ If the nozzle holder is difficult to remove, use tool **A3**.
- ★ Take care that dirt and foreign matter will not enter the mounting part of the nozzle holder.

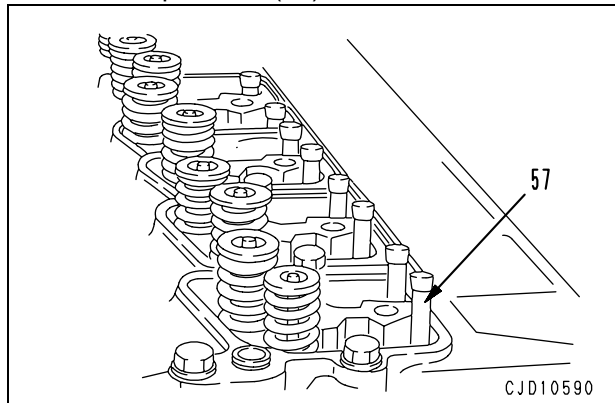


44. Remove rocker arm assembly (56). ※21

- ★ Loosen the locknut, then loosen the adjustment screw by 2 – 3 turns.



45. Remove push rod (57).

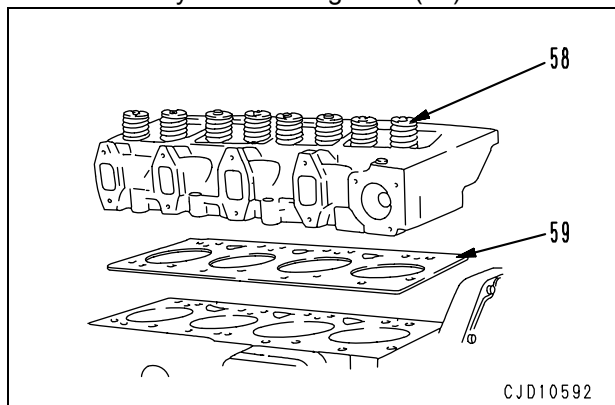


46. Lift off cylinder head assembly (58).



Cylinder head assembly: **40 kg**

47. Remove cylinder head gasket (59).



INSTALLATION OF CYLINDER HEAD ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ When connecting the hose, apply spray grease to the mating part (tube).

 Charge air cooler hose clamp:
 $5.9 \pm 0.5 \text{ Nm } \{0.6 \pm 0.05 \text{ kgm}\}$

※ 2

 Air cleaner hose clamp:
 $5.9 \pm 0.5 \text{ Nm } \{0.6 \pm 0.05 \text{ kgm}\}$

※ 3

 Band: **$9.8 \pm 1.0 \text{ Nm } \{1.0 \pm 0.1 \text{ kgm}\}$**

※ 4

- ★ Install the air cleaner cover with the top mark up.

※ 5

 Bolt: **$1.86 - 2.45 \text{ Nm } \{0.19 - 0.25 \text{ kgm}\}$**
 Nut: **$2.45 - 2.94 \text{ Nm } \{0.25 - 0.3 \text{ kgm}\}$**

※ 6

 Nut: **$23.5 - 29.4 \text{ Nm } \{2.4 - 3 \text{ kgm}\}$**

※ 7

- ★ When connecting the hose, apply spray grease to the mating part (tube).

 Charge air cooler hose clamp:
 $5.9 \pm 0.5 \text{ Nm } \{0.6 \pm 0.05 \text{ kgm}\}$

※ 8

- ★ Use a new clamp.

 Clamp: **$8.8 \pm 0.5 \text{ Nm } \{0.9 \pm 0.05 \text{ kgm}\}$**

※ 9

- ★ Pass the reservoir tank drain hose through the guide pipe of the shroud.

※ 10

 Radiator hose clamp:
 $8.8 \pm 0.5 \text{ Nm } \{0.9 \pm 0.05 \text{ kgm}\}$

※ 11

 Tension pulley bolt:
 $43 \pm 6 \text{ Nm } \{4.38 \pm 0.61 \text{ kgm}\}$

※ 12

 Bracket mounting bolt:
 $24 \pm 4 \text{ Nm } \{2.45 \pm 0.41 \text{ kgm}\}$

※ 13

- ★ Adjust the engine stop solenoid linkage. For details, see TESTING AND ADJUSTING, Adjusting engine stop solenoid linkage.

※ 14

 Bracket mounting bolt:
 $24 \pm 4 \text{ Nm } \{2.45 \pm 0.41 \text{ kgm}\}$

※ 15

 Bracket mounting bolt:
 $24 \pm 4 \text{ Nm } \{2.45 \pm 0.41 \text{ kgm}\}$

※ 16

- ★ When connecting the hose, apply spray grease to the mating part (tube).

 Charge air cooler hose clamp:
 $5.9 \pm 0.5 \text{ Nm } \{0.6 \pm 0.05 \text{ kgm}\}$

※ 17

 Nipple: **$34 \pm 5 \text{ Nm } \{3.5 \pm 0.5 \text{ kgm}\}$**
 Bolt: **$10 \pm 2 \text{ Nm } \{1.0 \pm 2.0 \text{ kgm}\}$**

※ 18

 Nut: **$29.4 - 44.2 \text{ Nm } \{3 - 4.5 \text{ kgm}\}$**

※ 19

 Bolt: **$24 \pm 4 \text{ Nm } \{2.45 \pm 0.41 \text{ kgm}\}$**

※ 20

- ★ Secure clearance of at least 10 mm between the ground wire and fuel tube.

※ 21

- Install the rocker arm assembly and cylinder head assembly according to the following procedure.

- ★ Check that there is not dirt or foreign matter on the mating face of the cylinder head and in the cylinders.

1) Set cylinder head gasket (59) to the cylinder block.

- ★ Check that the gasket is matched to the holes of the block.

2) Sling cylinder head assembly (58) and set it to the cylinder block.

3) Install push rod (57).

4) Install rocker arm assembly (56) and tighten the bolt with your fingers.

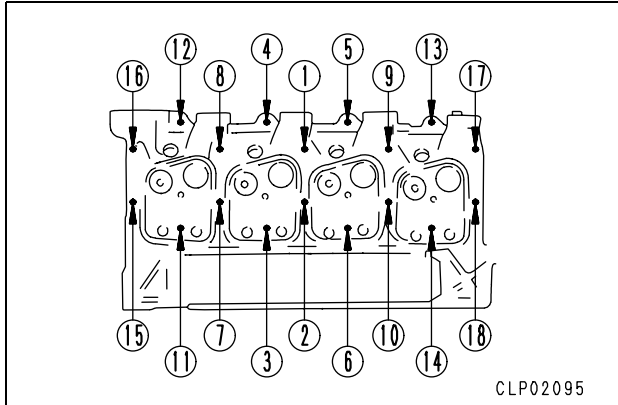
- ★ Check that the adjustment screw ball is fitted to the socket of the push rod.

DISASSEMBLY AND ASSEMBLY**CYLINDER HEAD ASSEMBLY**

- 5) Tighten the cylinder head mounting bolts in the order shown in the following figure.

 Apply engine oil (SAE15W-40) to the threads and seats of the mounting bolts.

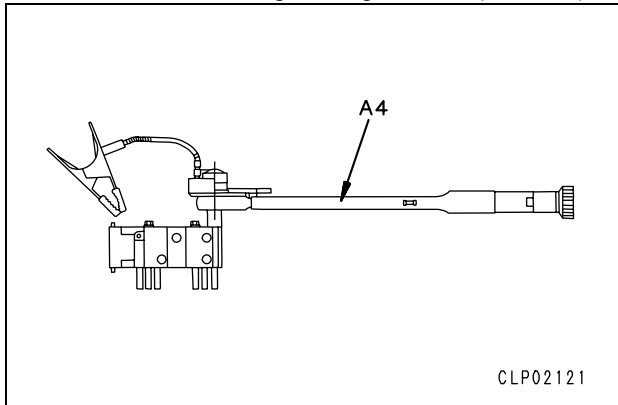
 **Cylinder head mounting bolt:**
1st time: Tighten to 90 ± 5 Nm $\{9.18 \pm 0.51 \text{ kgm}\}$ in the order of ① – ⑱.



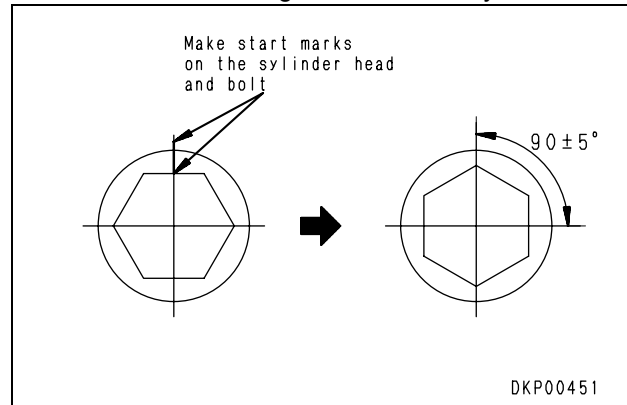
2nd time: Tighten to 120 ± 5 Nm $\{12.24 \pm 0.51 \text{ kgm}\}$ in the order of ③, ⑥, ⑪, and ⑭.

3rd time:

- i) When using tool **A4**
- Tighten bolts by $90 \pm 5^\circ$ in the order of ① – ⑱ with an angle tightening wrench (Tool **A4**).

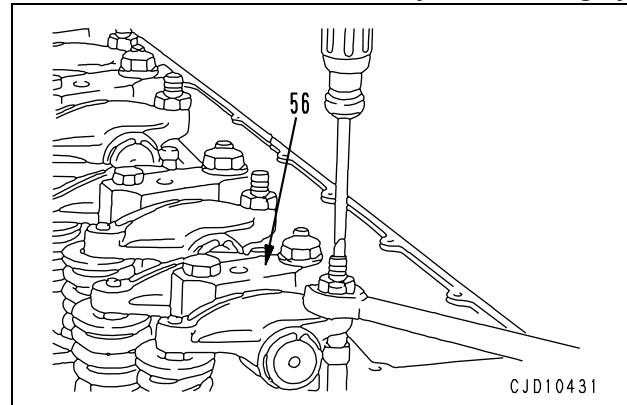


- ii) When not using tool **A4**
- Make marks on the bolts and head with a marker pen, then tighten each bolt by $90 \pm 5^\circ$.



- 6) Tighten rocker arm assembly (56).

 **Rocker arm mounting bolt:**
 24 ± 4 Nm $\{2.45 \pm 0.41 \text{ kgm}\}$



- ★ Adjust the valve clearance. For details, see TESTING AND ADJUSTING, Adjusting valve clearance.

- **Refilling with water**

- ★ Add water through the water filler to the specified level. Run the engine until the water is heated, then check the water level again.

- **Bleeding air**

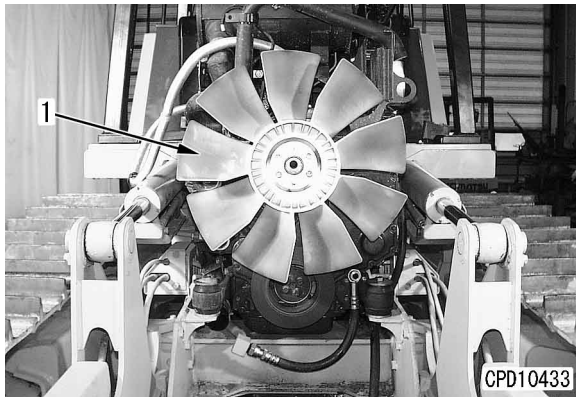
- ★ Bleed air from the fuel circuit. For details, see TESTING AND ADJUSTING, Bleeding air from fuel circuit.

REMOVAL OF ENGINE FRONT SEAL

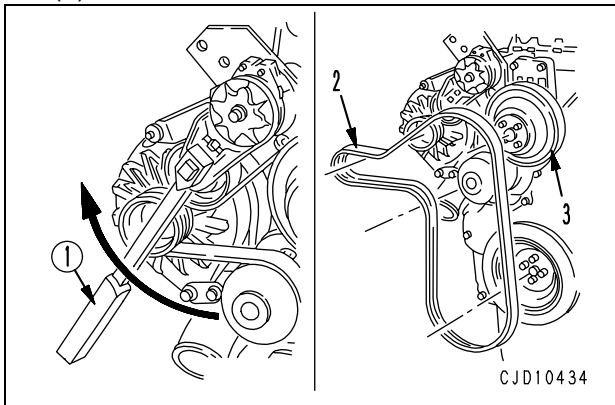
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove the radiator guard assembly. For details, see REMOVAL OF RADIATOR GUARD ASSEMBLY.

2. Remove 4 mounting bolts and fan (1).

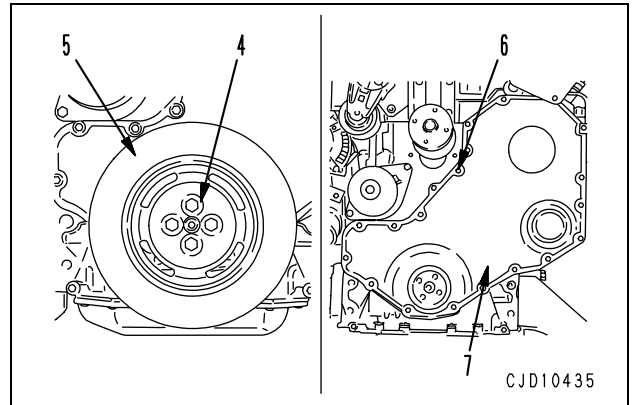


3. Using lever ①, remove fan belt (2) and pulley (3).

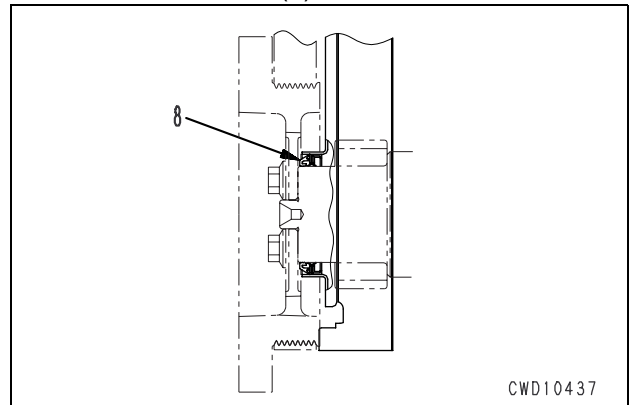


4. Remove 4 mounting bolts (4) and crankshaft pulley/vibration damper (5). ※ 1

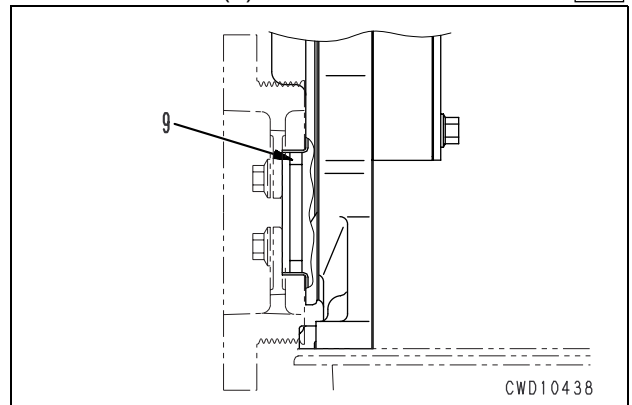
5. Remove 27 mounting bolts (6) and cover (7). ※ 2



6. Remove dust seal (8).



7. Remove seal (9). ※ 3



INSTALLATION OF ENGINE FRONT SEAL

- Carry out installation in the reverse order to removal.

※ 1

 **kgm** Mounting bolt of crankshaft pulley/vibration damper:

$125 \pm 5 \text{ Nm}$ { $12.75 \pm 0.51 \text{ kgm}$ }

- ★ Install the crankshaft pulley/vibration damper lightly, then install the fan belt and tighten the mounting bolts to the specified torque.

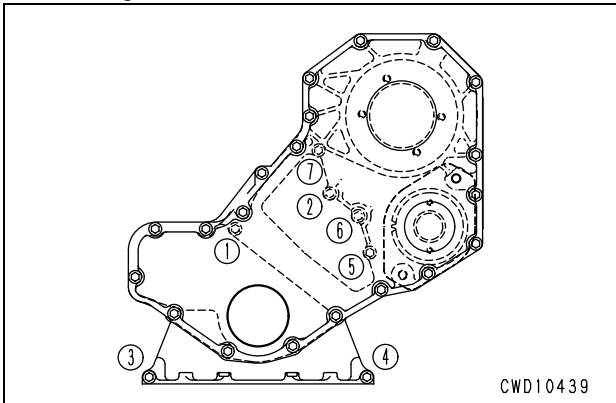
※ 2

- ★ The gasket must not be projected more than 0.25 mm from the oil pan mating face.
- ★ Apply ThreeBond 1207D or equivalent in line 1 – 2 mm thick to the gasket mating face of the cover.
- ★ Fit the gasket to the cover before installing them to the engine.

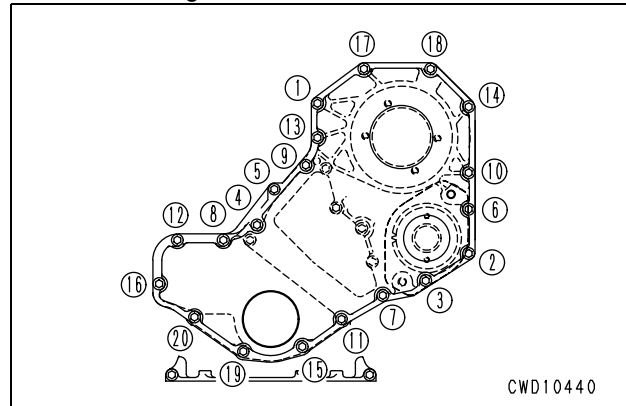
 **kgm** Cover mounting bolt:

$24 \pm 4 \text{ Nm}$ { $2.45 \pm 0.41 \text{ kgm}$ }

- ★ Tighten the 7 cover mounting bolts in the order shown in the following instruction drawings ① – ⑦.



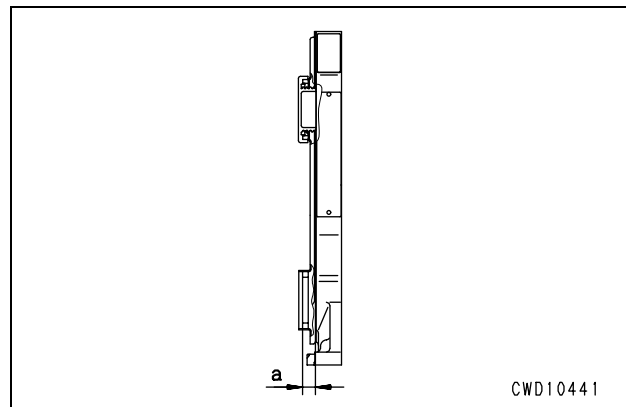
- ★ Tighten the 20 cover mounting bolts in the order shown in the following instruction drawings ① – ⑳.



※ 3

- ★ Press fitting dimension of seal "a":

$18 \pm 0.38 \text{ mm}$

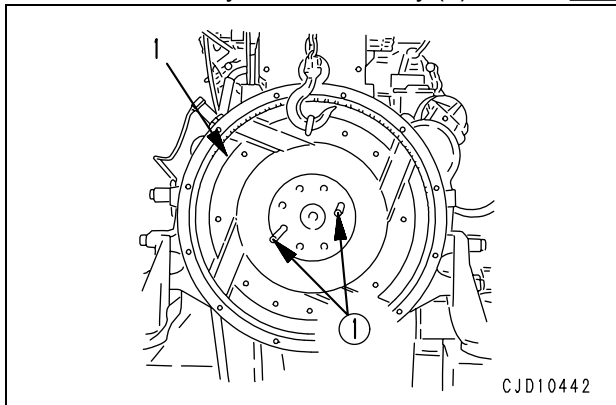


REMOVAL OF ENGINE REAR SEAL

⚠ Disconnect the cable from the negative (–) terminal of the battery.

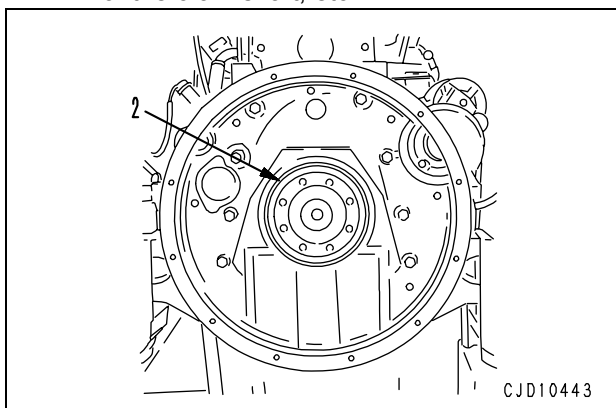
1. Remove the damper. For details, see REMOVAL OF DAMPER.

2. Remove the mounting bolts and set guide bolts ① and lift off flywheel assembly (1). ※ 1

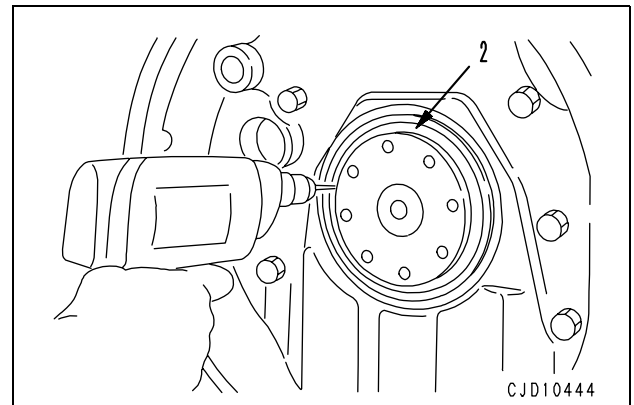


3. Remove seal (2). ※ 2

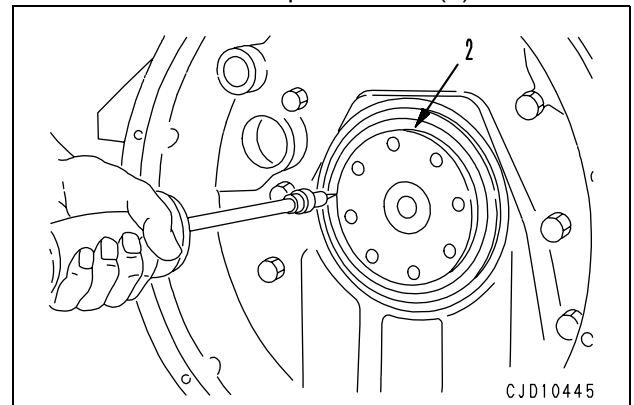
- ★ Make a hole about 3 mm in diameter on the seal carrier. Install the dent puller to the slide hammer and insert them in the above hole and pull out the seal.
- ★ The seal can be also removed by breaking the seal carrier with a screwdriver, etc. In this case, however, take care not to damage the seal fitting part of the flywheel, wear ring of the crankshaft, etc.



- ★ Make a hole about 3 mm in diameter on the seal carrier.



- ★ Install the dent puller to the slide hammer and insert them in the drilled hole and slide the hammer to pull out seal (2).



INSTALLATION OF ENGINE REAR SEAL

- Carry out installation in the reverse order to removal.

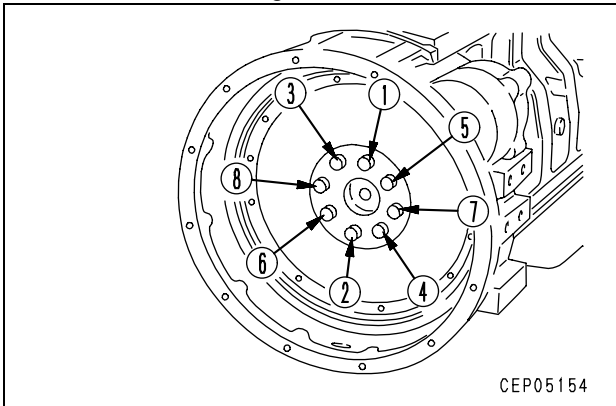
※ 1



Flywheel mounting bolt:

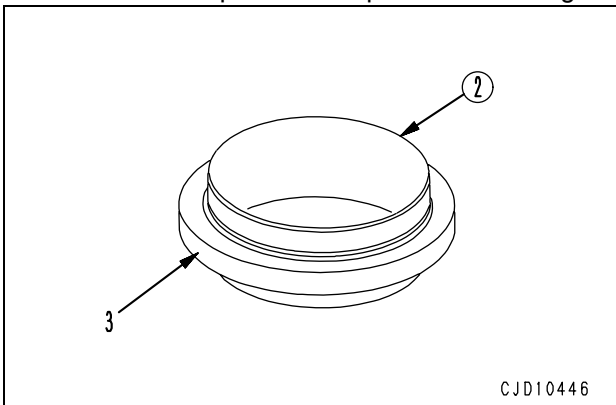
 $137 \pm 7 \text{ Nm } \{13.97 \pm 0.71 \text{ kgm}\}$

- ★ Tighten the mounting bolts in the order shown in the figure.

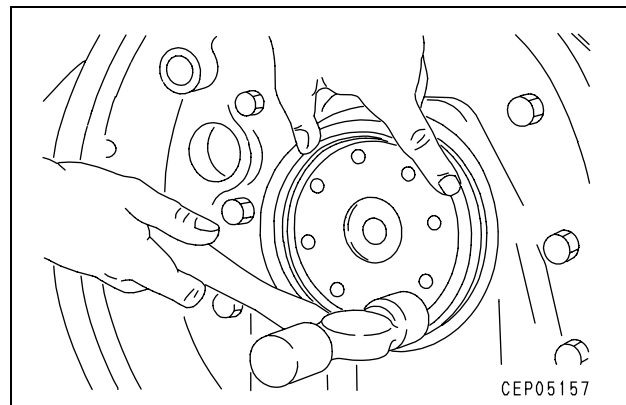
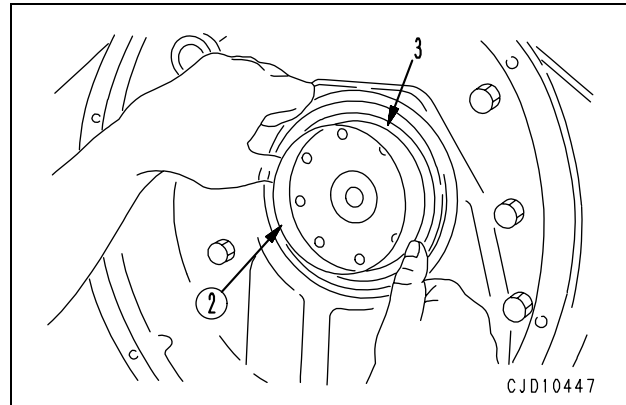


※ 2

- ★ Install the oil seal according to the following procedure.
- 1) Install pilot ② to new oil seal (3).
- ★ Before installing the oil seal, degrease and dry the seal mating face of the crankshaft and seal lip surface to prevent oil leakage.



- 2) Insert the assembly of pilot ② and oil seal (3) in the crankshaft and push the seal into the flywheel.
- 3) Pull out pilot ②. Push in the oil seal from the inside of the front cover outward.
- 4) Using an aligning tool, install the seal to the proper depth of the housing.
- ★ Hit around the aligning tool lightly with a hammer to install the seal, checking that the seal carrier is not bent.



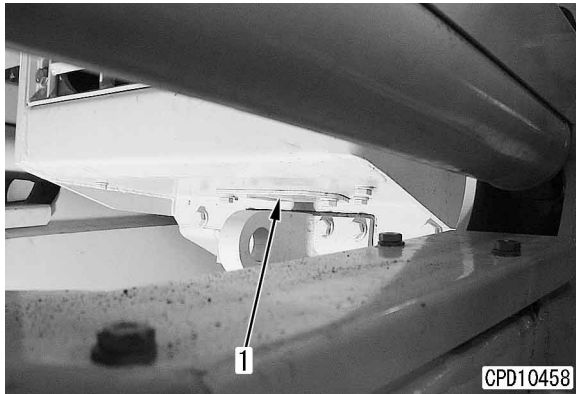
REMOVAL OF RADIATOR GUARD ASSEMBLY

- ⚠ Disconnect the cable from the negative (–) terminal of the battery.
- ⚠ Lower the work equipment to the ground and stop the engine. Then, loosen the hydraulic oil filler cap slowly to release the internal pressure of the hydraulic tank.
- ⚠ If the water temperature in the radiator is high, you may get scalded. Accordingly, wait until the water temperature lowers, then drain.

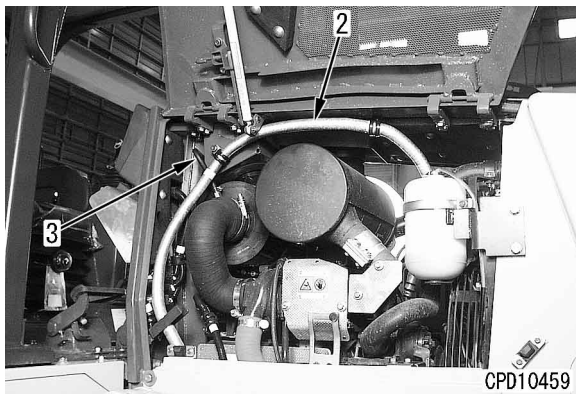
1. Remove the mounting bolts and cover (1).
2. Loosen the radiator cap and drain the cooling water.



Radiator: Approx. 15 ℓ



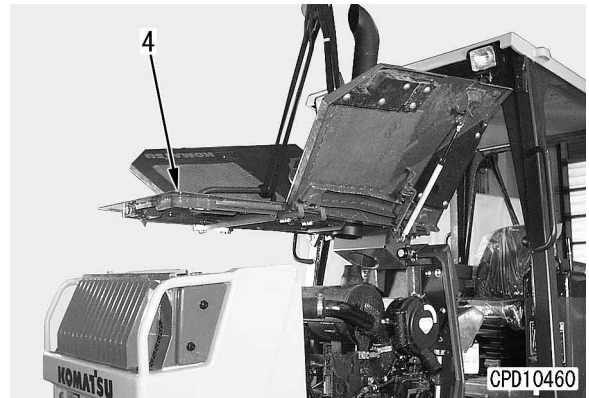
3. Remove clip of heater hose (2) and disconnect dust indicator hose (3).
 - ★ Disconnect the dust indicator hose end on the air cleaner side.



4. Using eyebolts, lift off engine hood (4).



Engine hood: 80 kg



5. Remove both engine covers (5).



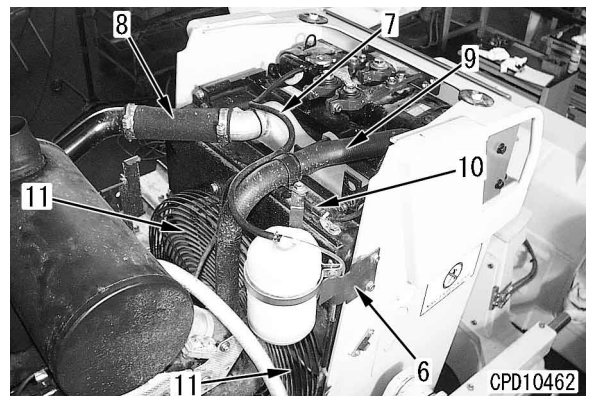
6. Remove reservoir tank bracket (6) and disconnect reservoir tank hose (7). ※ 1

7. Disconnect charge air cooler outlet hose (8).

8. Disconnect radiator inlet hose (9).

9. Disconnect horn wiring connector (CN22) (10).

10. Remove both fan guards (11).

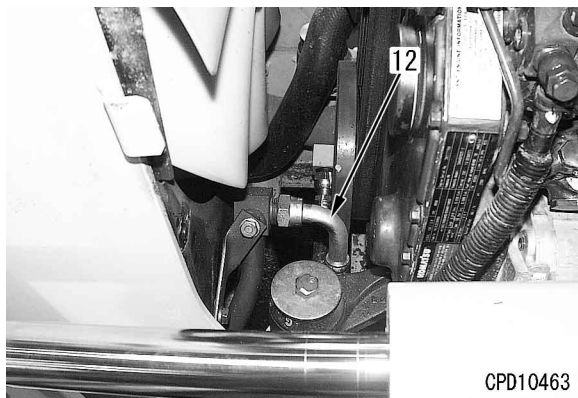


DISASSEMBLY AND ASSEMBLY

RADIATOR GUARD ASSEMBLY

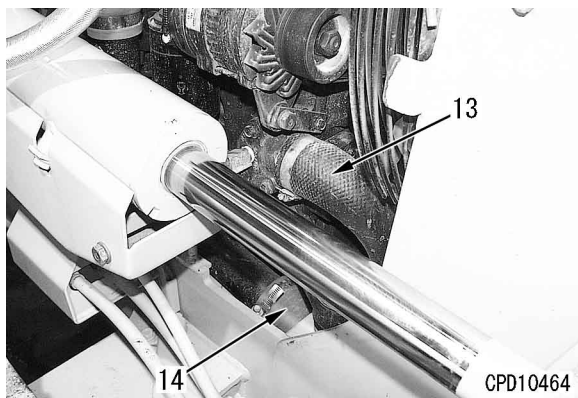
11. Disconnect oil cooler outlet hose (12).

★ Prepare a blind plug before disconnecting the hose.



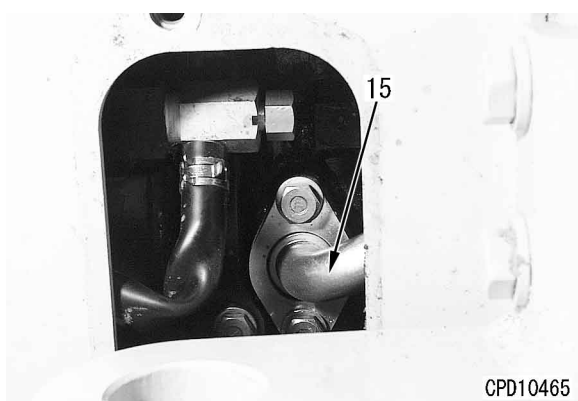
12. Disconnect radiator outlet hose (13).

13. Disconnect charge air cooler inlet hose (14).

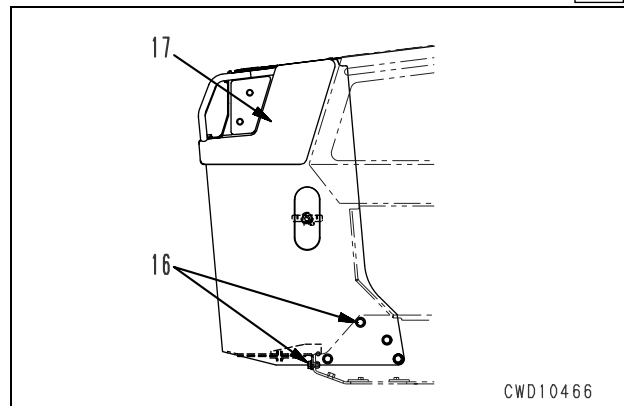


14. Disconnect oil cooler inlet hose (15).

★ Prepare a blind plug before disconnecting the hose.



15. Sling radiator guard assembly (17) temporarily and remove 8 mounting bolts (16) from both sides and 2 from the underside. ※ 2



16. Lift off radiator guard assembly (17).



Radiator guard assembly: 370 kg



INSTALLATION OF RADIATOR GUARD ASSEMBLY

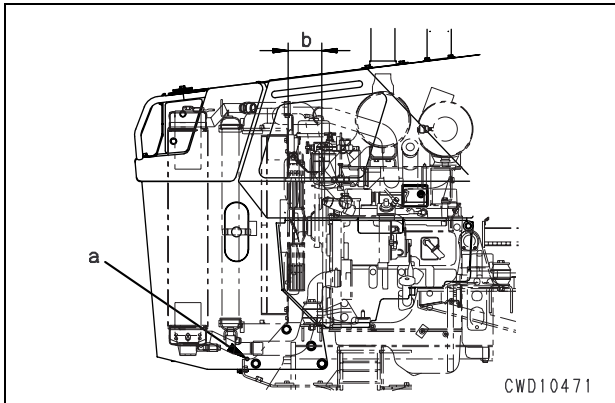
- Carry out installation in the reverse order to removal.

※ 1

- ★ Pass the reservoir tank drain hose through the guide pipe of the shroud.
- ★ When connecting the hose, apply spray grease to the mating part (tube).
 Radiator hose clamp:
 $8.8 \pm 0.5 \text{ Nm} \{0.9 \pm 0.05 \text{ kgm}\}$
-  Charge air cooler hose clamp:
 $5.9 \pm 0.5 \text{ Nm} \{0.6 \pm 0.05 \text{ kgm}\}$

※ 2

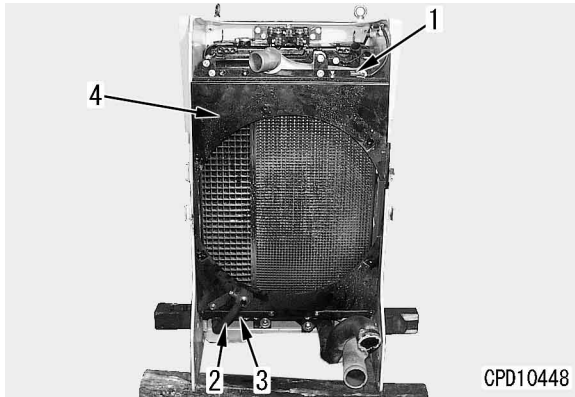
- ★ When installing the radiator guard assembly, peep through hole "a" to check that there is not clearance between the stopper and frame on each side.
- ⚠ Never insert your finger in hole "a".
 Mounting bolt:
 $245 - 309 \text{ Nm} \{25 - 31.5 \text{ kgm}\}$
- ★ Install the radiator guard assembly so that distance "b" between back side of the shroud and the compressor bracket of the air conditioner will be 142 mm.



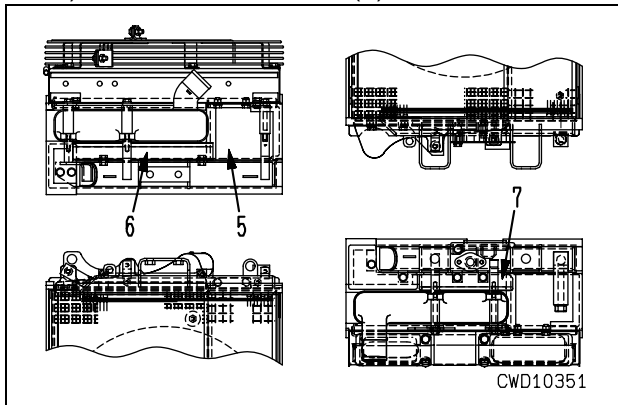
- **Refilling with water**
 - ★ Add water through the water filler to the specified level. Run the engine to heighten the water temperature. Then, check the water level again.
- **Refilling with oil (Hydraulic tank)**
 - ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.
- **Bleeding air (HST circuit)**
 - ★ Bleed air from the HST pump circuit. For details, see REMOVAL OF HST PUMP ASSEMBLY.

DISASSEMBLY AND ASSEMBLY**DISASSEMBLY OF RADIATOR, OIL COOLER, AND CHARGE AIR COOLER ASSEMBLIES****1. Charge air cooler assembly**

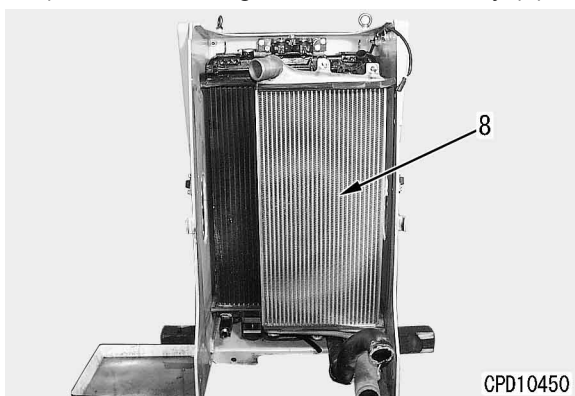
- 1) Remove horn wiring (1).
- 2) Remove tube (2).
- 3) Remove cover (3) and shroud (4).



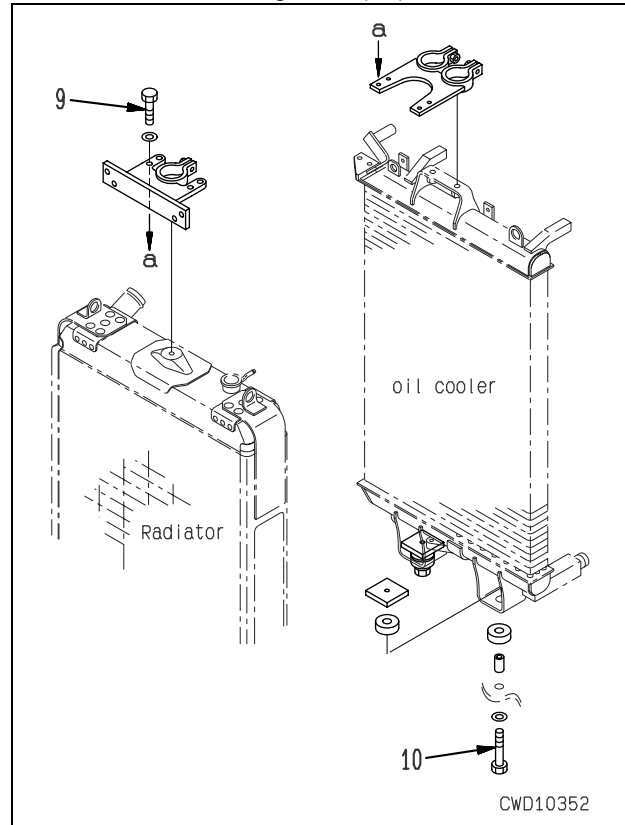
- 4) Remove upper covers (5) and (6).
- 5) Remove lower cover (7).



- 6) Remove charge air cooler assembly (8).

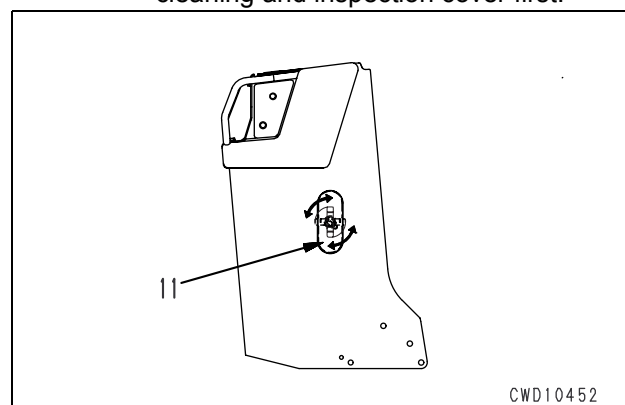
**2. Oil cooler assembly**

- 1) Remove 4 upper mounting bolts (9) and 2 lower mounting bolts (10).



- 2) Remove left cleaning and inspection cover (11).

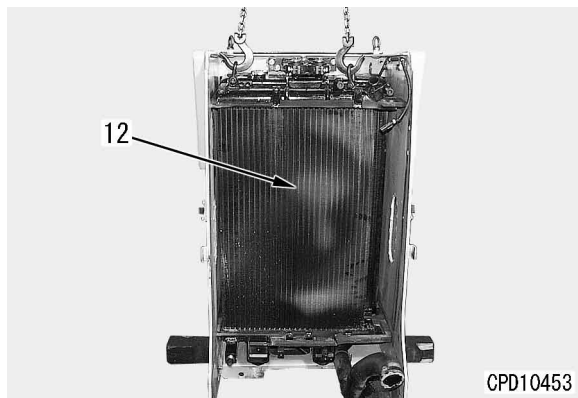
- ★ If the mounting bolt of the cleaning and inspection cover is loosened with an impact wrench, it is loosened too much and the bolt pin is broken. Accordingly, loosen it with a wrench by hand.
- ★ If the oil cooler assembly is removed without removing the cleaning and inspection cover, the pin may touch and break the core. Accordingly, remove the cleaning and inspection cover first.



- 3) Lift off oil cooler assembly (12).

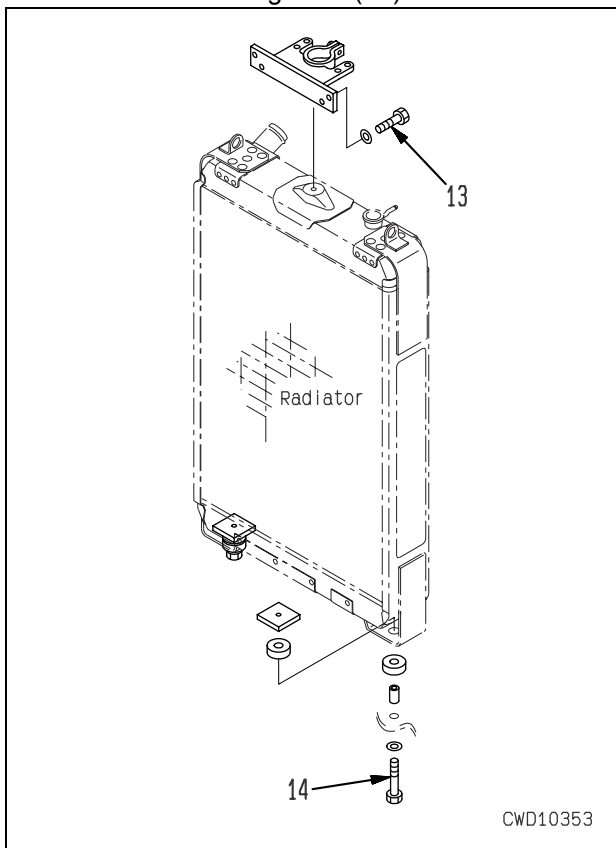


Oil cooler: **35 kg**



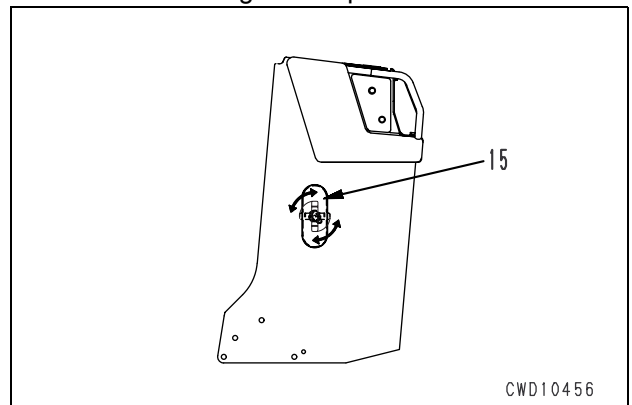
3. Radiator assembly

- 1) Remove 4 upper mounting bolts (13) and 2 lower mounting bolts (14).



- 2) Remove right cleaning and inspection cover (15).

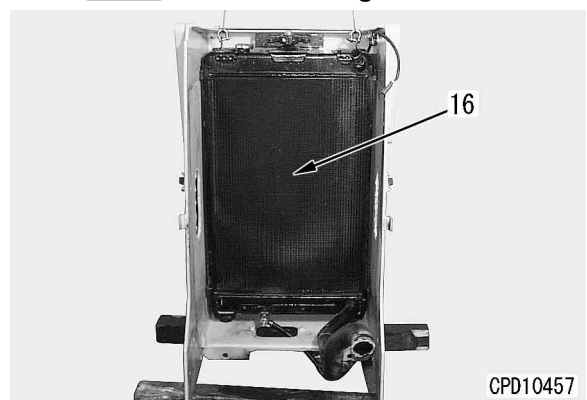
- ★ If the mounting bolt of the cleaning and inspection cover is loosened with an impact wrench, it is loosened too much and the bolt pin is broken. Accordingly, loosen it with a wrench by hand.
- ★ If the oil cooler assembly is removed without removing the cleaning and inspection cover, the pin may touch and break the core. Accordingly, remove the cleaning and inspection cover first.



- 3) Lift off radiator (16).



Radiator: **80 kg**



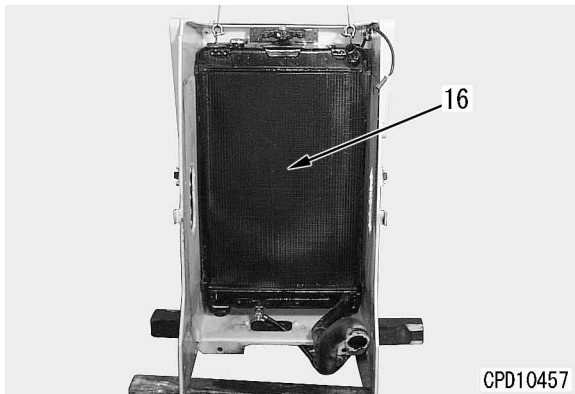
ASSEMBLY OF RADIATOR, OIL COOLER, AND CHARGE AIR COOLER ASSEMBLIES

1. Radiator assembly

- 1) Sling and install radiator assembly (16).
 - ★ When inserting the radiator assembly in the radiator guard, apply grease to the seat.

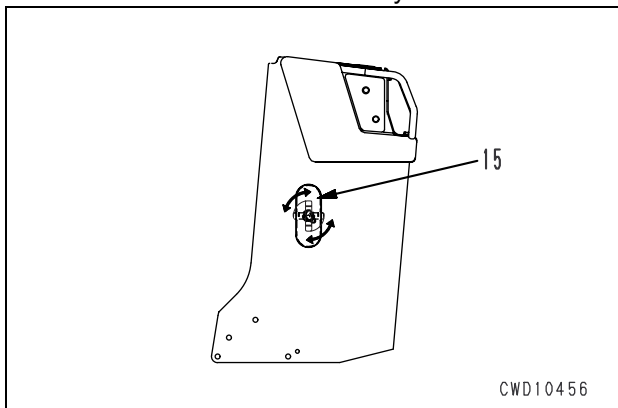


Radiator: 80 kg

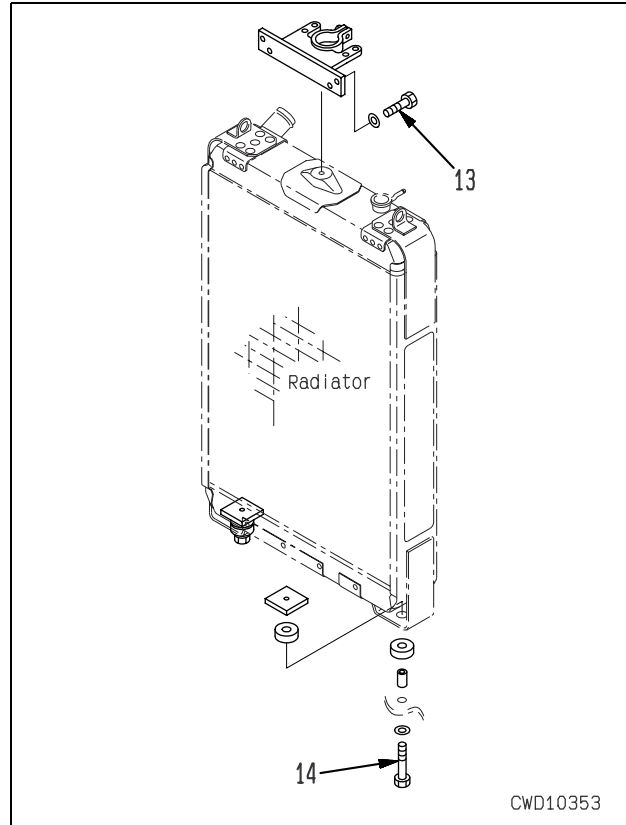


- 2) Install right cleaning and inspection cover (15).

- ★ If the mounting bolt of the cleaning and inspection cover is tightened with an impact wrench, it is tightened too much and the bolt pin is broken. Accordingly, tighten it with a wrench by hand.



- 3) Install 2 lower mounting bolts (14) and 4 upper mounting bolts (13).

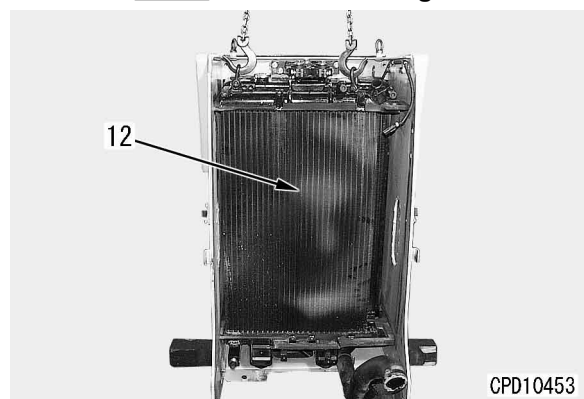


2. Oil cooler assembly

- 1) Sling and install oil cooler assembly (12).
 - ★ When inserting the oil cooler assembly in the radiator guard, apply grease to the seat.



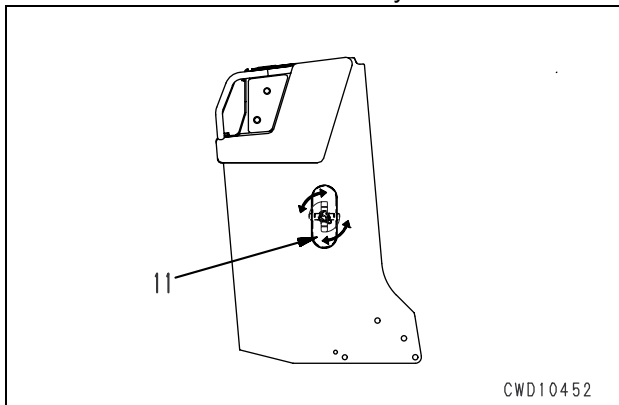
Oil cooler: 35 kg



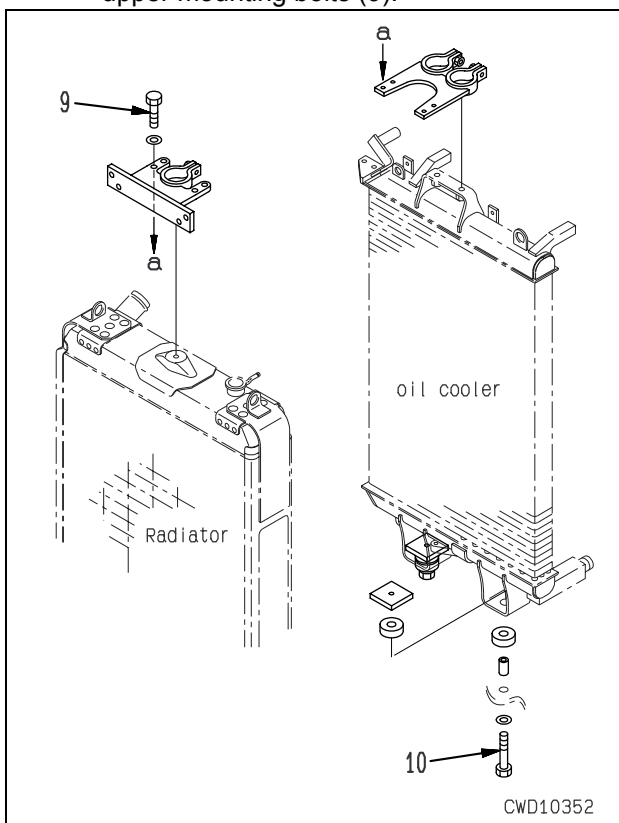
DISASSEMBLY AND ASSEMBLY RADIATOR, OIL COOLER, AND CHARGE AIR COOLER ASSEMBLIES

- 2) Install left cleaning and inspection cover (11).

★ If the mounting bolt of the cleaning and inspection cover is tightened with an impact wrench, it is tightened too much and the bolt pin is broken. Accordingly, tighten it with a wrench by hand.

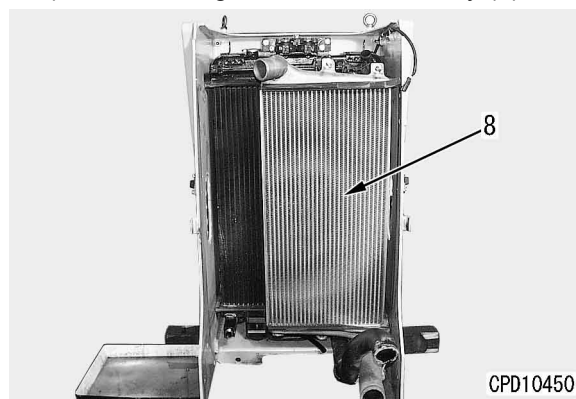


- 3) Install 2 lower mounting bolts (10) and 4 upper mounting bolts (9).

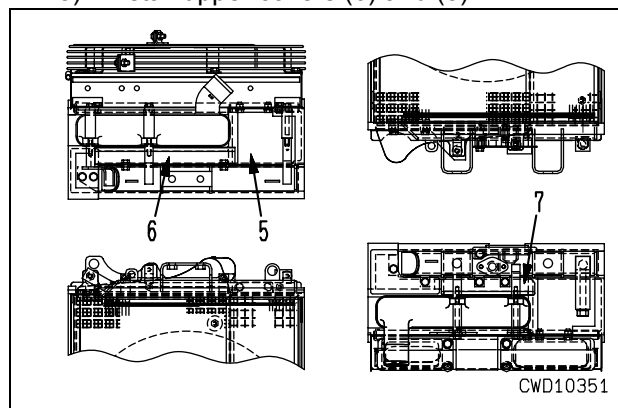


3. Charge air cooler assembly

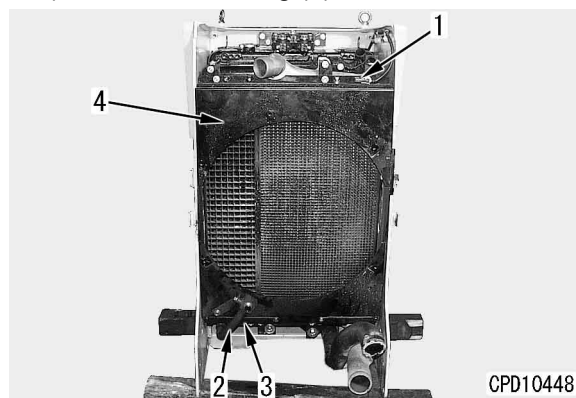
- 1) Install charge air cooler assembly (8).



- 2) Install lower cover (7).
- 3) Install upper covers (6) and (5).



- 4) Install shroud (4) and cover (3).
- 5) Install tube (2).
- 6) Install horn wiring (1).



REMOVAL OF ENGINE ASSEMBLY

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove the radiator guard assembly. For details, see REMVAL OF RADIATOR GUARD ASSEMBLY.

2. Remove the operator's cab frame assembly. For details, see REMVAL OF OPERATOR'S CAB FRAME ASSEMBLY.

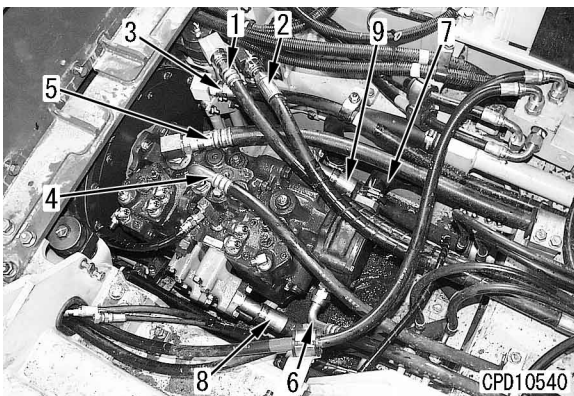
3. Disconnect main control valve hoses (1) and (2).
 • (1): To oil cooler (Hose color band: Blue)
 • (2): To Hydraulic pump (Hose color band: Red)

4. Disconnect hydraulic tank hose (3).
 • From oil cooler to hydraulic tank filter

5. Disconnect the following 8 HST pump hoses.

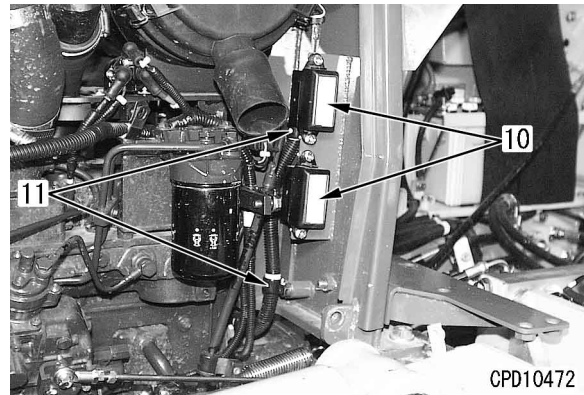
- ※ 1
- (4): From charge filter
 - (5): To drain
 - (6): To charge filter
 - (7): From hydraulic tank
 - (8): To upper travel motor, R.H. reverse (Hose color band: Blue)
 : To lower travel motor, L.H. forward (Hose color band: Yellow)
 - (9): To upper travel motor, R.H. forward (Hose color band: Green)
 : To lower travel motor, L.H. reverse (Hose color band: Orange)

★ The photograph shows the D39-21, but in the case of the D31 and D37-21, there is a branch hose, so disconnect the branch hose also.



6. Remove 2 fuse boxes (10) and disconnect 3 wiring harness clamps (11).

★ Among the 3 clamps, 1 is installed inside.



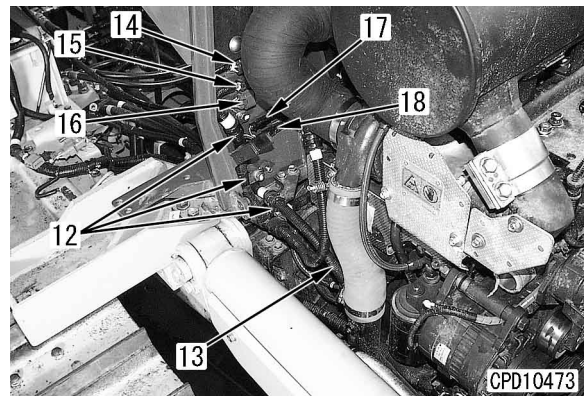
7. Disconnect 4 wiring harness clamps (12).

★ Among the 4 clamps, 1 is installed inside and another is secured together with a part.

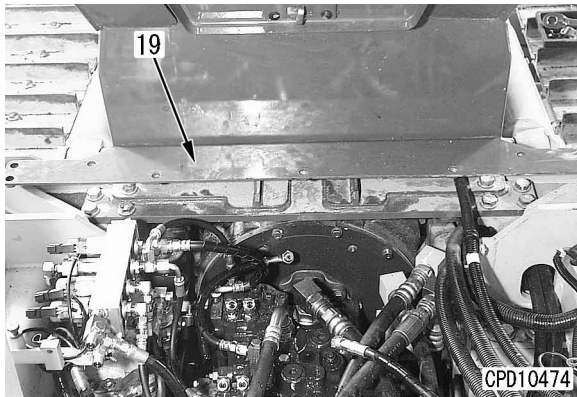
8. Disconnect starting motor wiring harness (13).
 ★ Only positive (+) side.

9. Disconnect the following 5 wiring connectors.

- (14): (CN6) for panel
- (15): (CN5) for panel
- (16): (CN7) for panel
- (17): (CN17) for auxiliary power supply
- (18): (CN18) for backup power supply



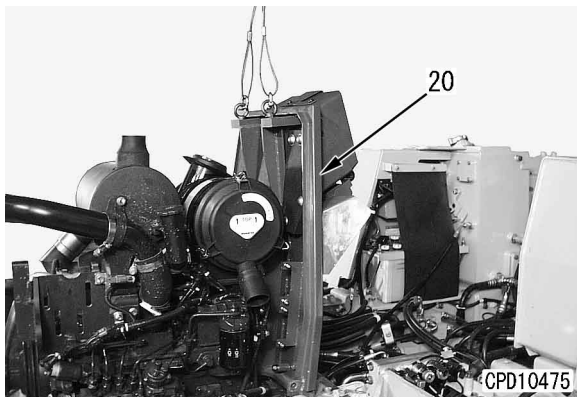
10. Remove the 3 mounting bolts and cover (19).



11. Remove the 8 mounting bolts and lift off front bracket (20). ※ 2



Front bracket: 65 kg



12. Disconnect the following 2 hoses of work equipment pump (21). ※ 3

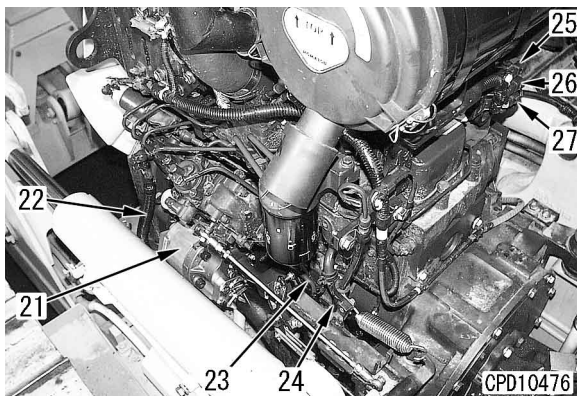
- Upper hose: Discharge
- Lower hose: Suction

13. Disconnect the following 3 fuel hoses.

- (22): Fuel outlet
- (23): Fuel inlet
- (24): Fuel outlet

14. Disconnect the following 3 wiring connectors.

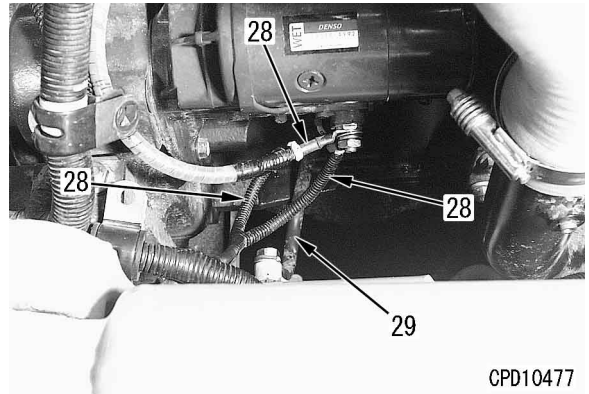
- (25): (CN1)
- (26): (CN2)
- (27): (CN3)



15. Disconnect 3 starting motor wiring harnesses (28).

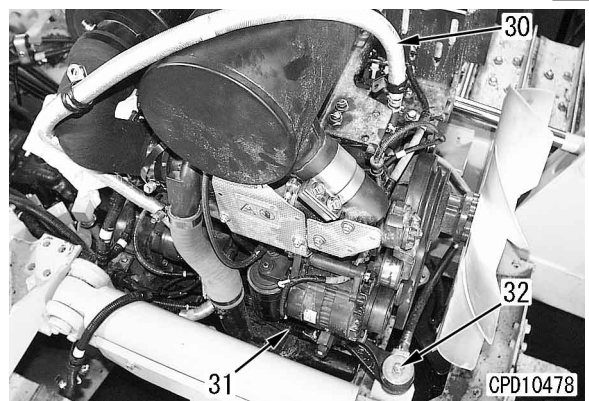
- (CNT1): Starting motor terminal B
- (CNT2): Starting motor terminal C

16. Disconnect engine ground wire (29). ※ 4



17. Disconnect heater hoses (30) and (31).

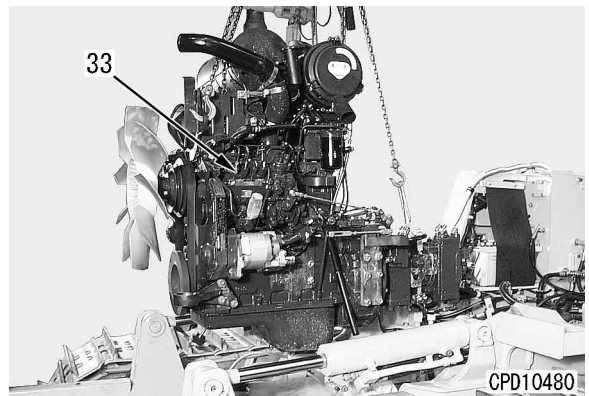
18. Remove 4 engine mounting bolts (32) from the front and rear sections. ※ 4



19. Sling engine assembly (33).



Engine assembly:
650 kg (Including HST pump assembly)



INSTALLATION OF ENGINE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1



Flange mounting bolt:

98 – 123 Nm {10 – 12.5 kgm}

※ 2



Mounting bolt: **Adhesive (LT-2)**

※ 3



Hose clamp:

8.8 ± 0.5 Nm {0.9 ± 0.05 kgm}

※ 4

- ★ Install the engine ground wire terminal vertically.

※ 5



Mounting bolt: **Adhesive (LT-2)**

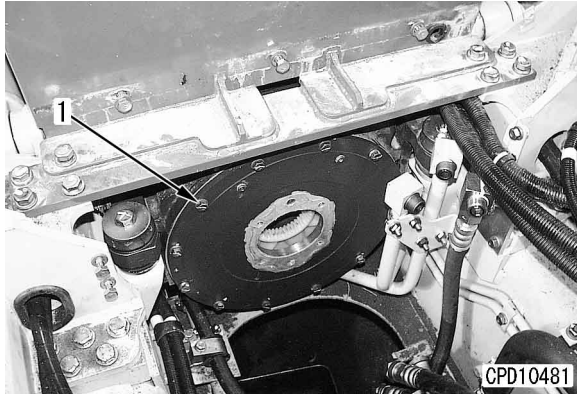


Mounting bolt:

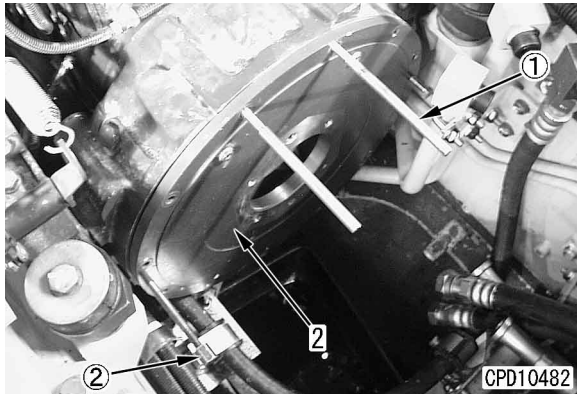
245 – 308.7 Nm {25 – 31.5 kgm}

REMOVAL OF DAMPER

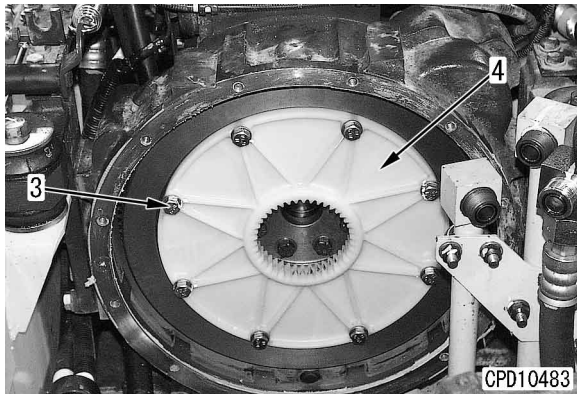
1. Remove the operator's cab frame assembly. For details, see REMOVAL OF OPERATOR'S CAB FRAME ASSEMBLY.
2. Remove the HST pump assembly. For details, see REMOVAL OF HST PUMP ASSEMBLY.
3. Remove 12 cover mounting bolts (1). ※ 1



4. Using guide bolt ① and forcing screw ②, remove cover (2).



5. Remove 8 coupling mounting bolts (3) and coupling (4). ※ 2



INSTALLATION OF DAMPER

- Carry out installation in the reverse order to removal.
 - ★ Clean the pump mating face thoroughly.
 - ★ Take care not to apply too much gasket sealant.

※ 1

- ★ Apply gasket sealant to the mating faces of the HST pump assembly and cover and to those of flywheel housing and cover.



Mating face:

Gasket sealant (LG-6)

Mounting bolt:

58.8 – 73.5 Nm {6 – 7.5 kgm}

※ 2

- ★ Install the coupling with the inside projection directed toward the output (pump) side.

Mounting bolt: **Adhesive (LT-2)**

Mounting bolt:

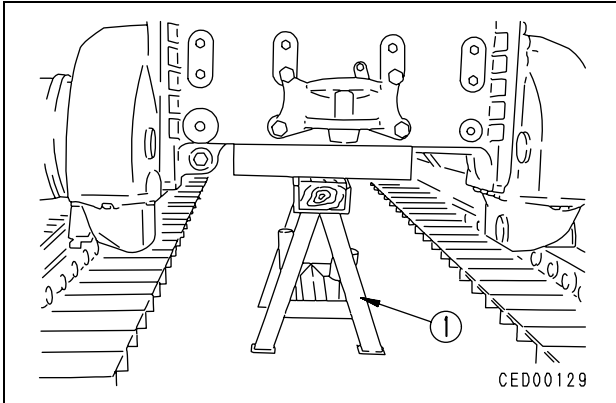
44.1 – 53.9 Nm {4.5 – 5.5 kgm}

REMOVAL OF TRAVEL MOTOR AND FINAL DRIVE ASSEMBLY

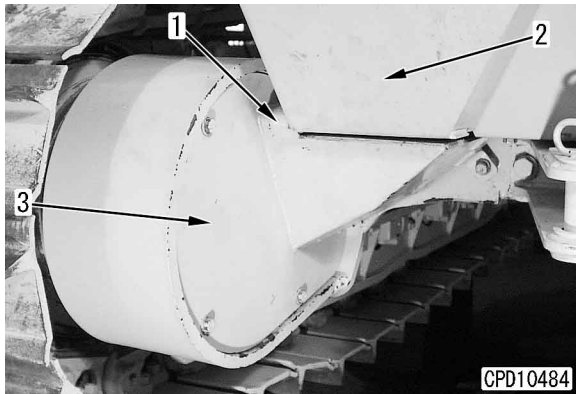
⚠ Lower the work equipment to the ground and stop the engine. Then, loosen the hydraulic oil filler cap slowly to release the internal pressure of the hydraulic tank.

1. Spread the track shoe. For details, see **SPREADING TRACK SHOE**.

2. Using hydraulic jacks, lift up the machine body and set stand ① under the steering case.



3. Remove covers (1), (2), and (3).



4. Disconnect main hoses (4) and (5).

※ 1

- (4): Left travel motor, reverse
(Hose color band: Orange)
- (5): Left travel motor, forward
(Hose color band: Yellow)
- (4): Right travel motor, reverse
(Hose color band: Blue)
- (5): Right travel motor, forward
(Hose color band: Green)

5. Disconnect pilot hoses (6) and (7).

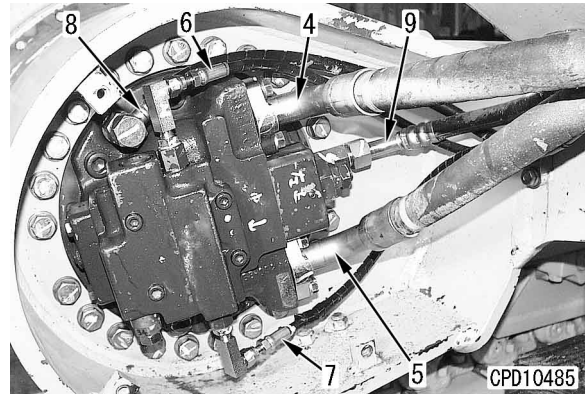
- (6): Left travel motor, change to 3rd gear speed
(Hose color band: Green)
- (7): Left travel motor, change to 2nd gear speed
(Hose color band: Yellow)
- (6): Right travel motor, change to 2nd gear speed
(Hose color band: Yellow)
- (7): Right travel motor, change to 3rd gear speed
(Hose color band: Green)

6. Disconnect parking brake hose (8).

- Hose color band: Orange

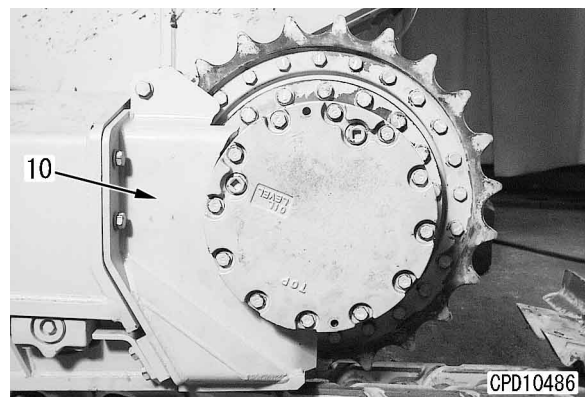
7. Disconnect drain hose (9).

- ★ Plug the disconnected pipes and hoses to prevent foreign matter from entering them.



8. Remove the mounting bolts and guard (10).

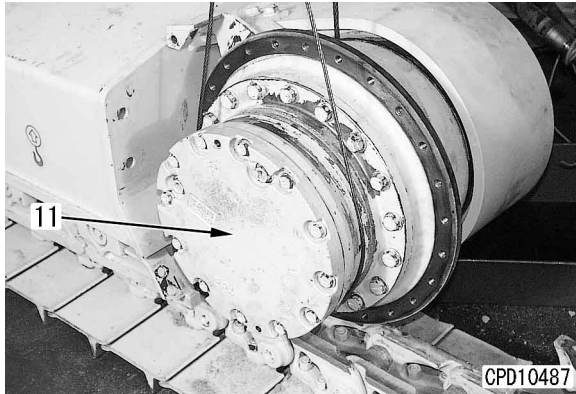
※ 2



9. Sling travel motor and final drive assembly (11) temporarily.
10. Remove the 24 mounting bolts and travel motor and final drive assembly (11).
 - ★ If shims are inserted, check their quantity and positions.



Travel motor and final drive assembly
(Each side): **300 kg**



INSTALLATION OF TRAVEL MOTOR AND FINAL DRIVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1



Mounting bolt:

98 – 123 Nm {10 – 12.5 kgm}

※ 2



Guard mounting bolt: **Adhesive (LT-2)**

- ★ Take extreme care that each hose will not be twisted when connected.
- **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 (HST circuit)**
 - ★ Bleed air from the HST pump circuit. For details, see INSTALLATION OF HST PUMP ASSEMBLY.

DISASSEMBLY OF TRAVEL MOTOR AND FINAL DRIVE ASSEMBLY

1. Draining oil

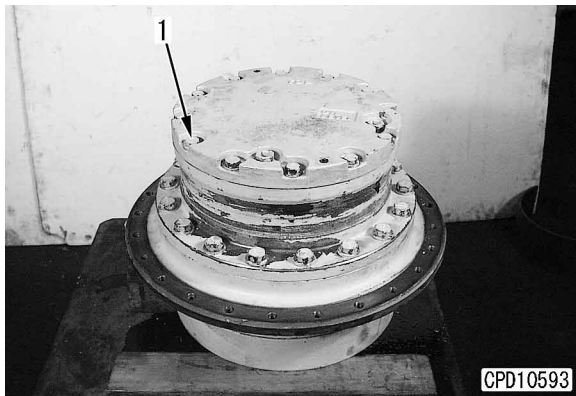
Remove the drain plug to drain the oil from the final drive case.



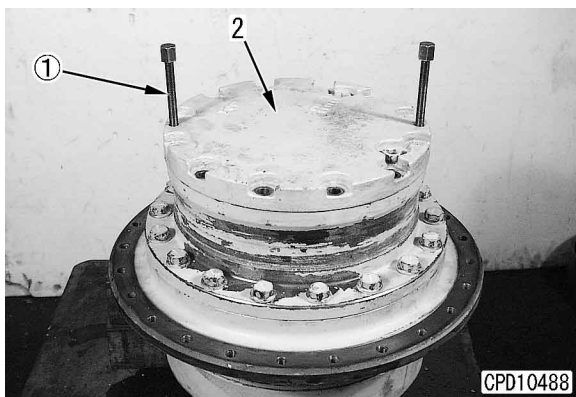
Final drive case: 3.91 ℓ

2. Cover

1) Remove 12 mounting bolts (1).

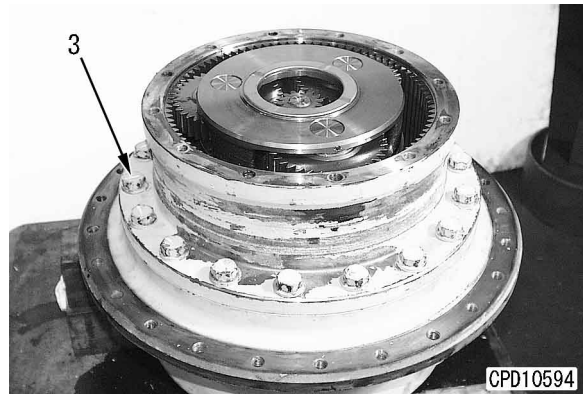


2) Using 2 forcing screws ①, remove cover (2).

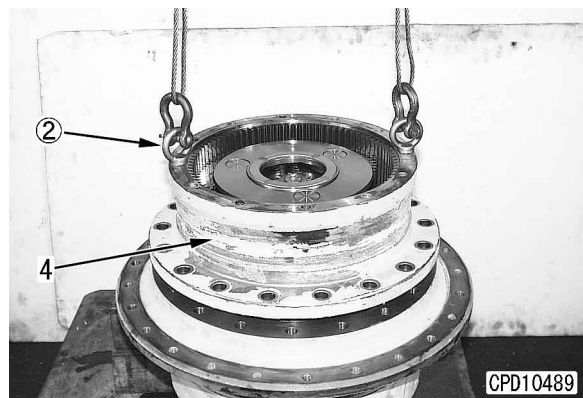


3. Ring gear

1) Remove 18 mounting bolts (3).



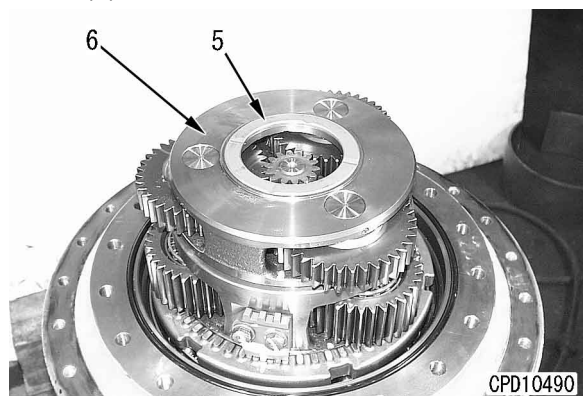
2) Using 2 forcing screws ②, remove ring gear (4).



4. No. 1 planetary carrier assembly

1) Remove thrust washer (5).

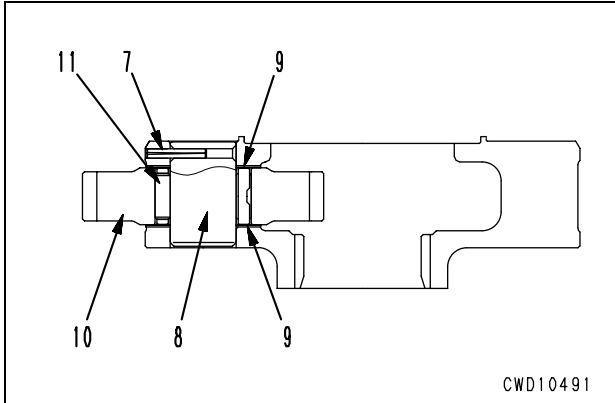
2) Remove No. 1 planetary carrier assembly (6).



DISASSEMBLY AND ASSEMBLY

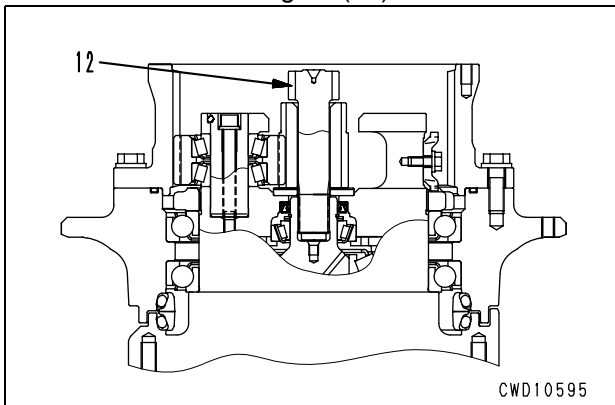
TRAVEL MOTOR AND FINAL DRIVE ASSEMBLY

- 3) Disassemble No. 1 planetary carrier assembly according to the following procedure.
 - i) Drive pin (7) into shaft (8).
 - ★ 3 sets
 - ii) Remove shaft (8) from No. 1 planetary carrier assembly.
 - ★ After removing the shaft, remove pin (7) from shaft (8).
 - ★ 3 sets
 - iii) Remove 2 thrust washers (9), gear (10), and bearing (11).
 - ★ 3 sets.



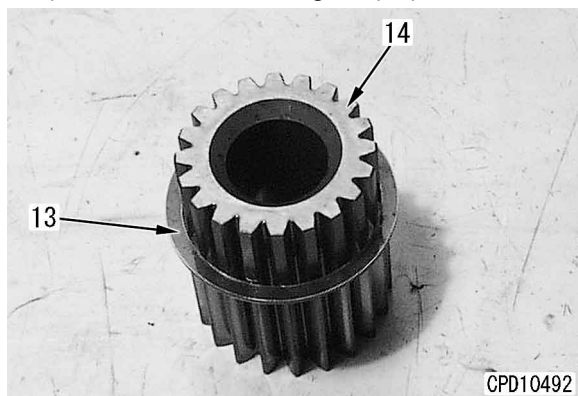
5. No. 1 sun gear

Remove No. 1 sun gear (12) first.



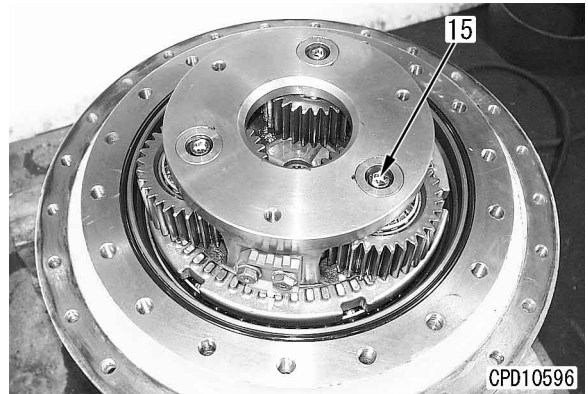
6. No. 2 sun gear

- 1) Remove thrust washer (13).
- 2) Remove No. 2 sun gear (14).

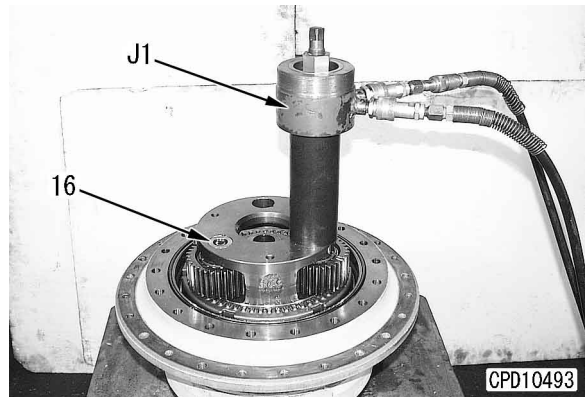


7. No. 2 planetary carrier assembly (Travel motor case)

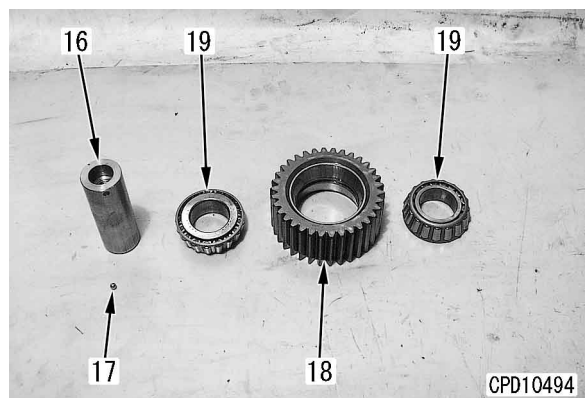
- 1) Remove mounting bolts (15).
 - ★ 3 sets



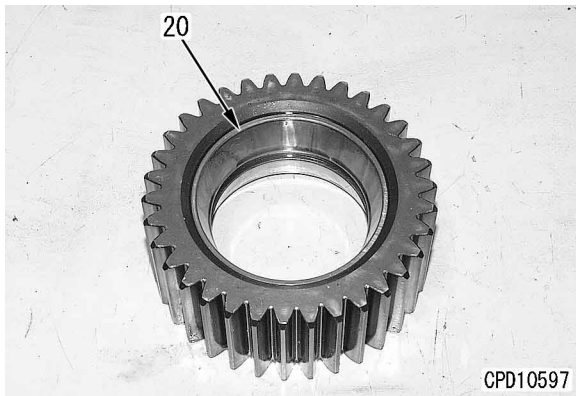
- 2) Using tools J1, pull shaft (16) out of No. 2 planetary carrier assembly.
 - ★ 3 sets



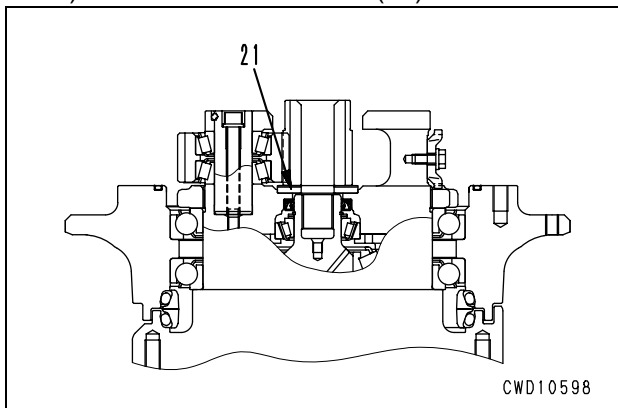
- 3) Remove ball (17).
 - ★ 3 sets
- 4) Remove gear (18) from No. 2 planetary carrier assembly.
 - ★ 3 sets
- 5) Remove 2 inner race bearings (19) from gear (18).
 - ★ 3 sets



- 6) Remove 2 outer race bearings (20) from the gear.
★ 3 sets

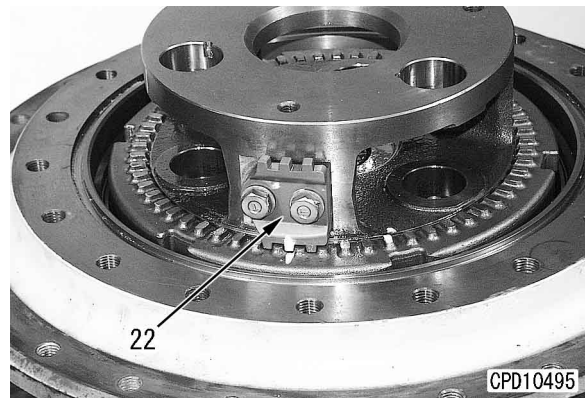


- 7) Remove thrust washer (21).

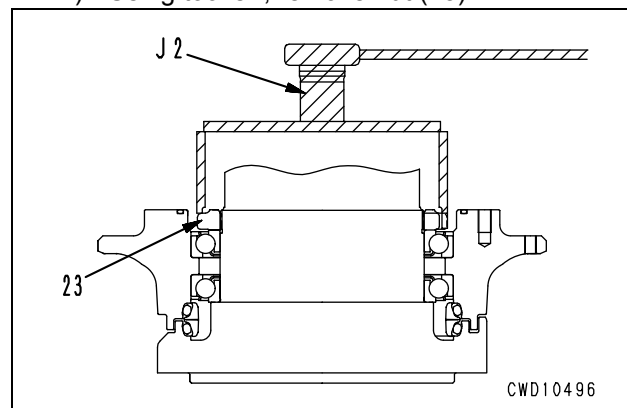


8. Hub assembly

- 1) Remove lock plate (22).



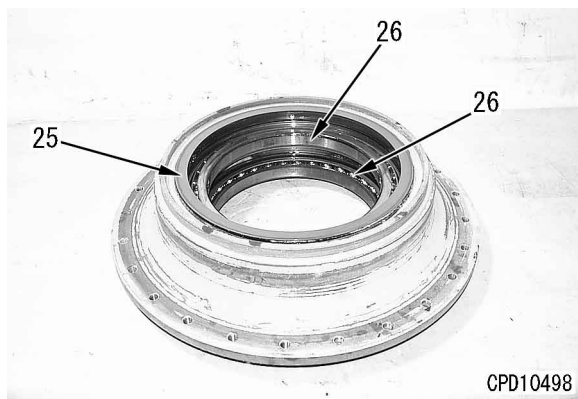
- 2) Using tool J2, remove nut (23).



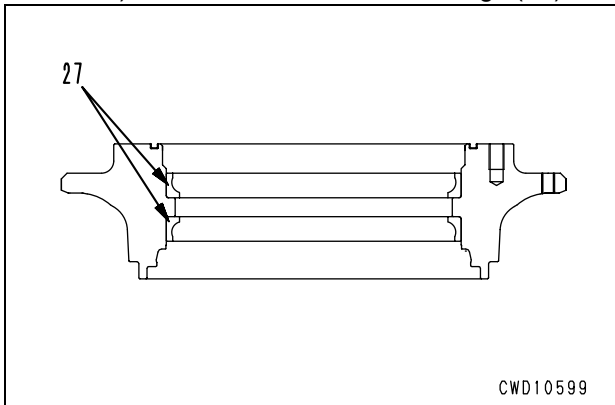
- 3) Using 2 eyebolts ③, remove hub assembly (24) from No. 2 planetary carrier assembly (travel motor case).



- 4) Disassemble the hub assembly according to the following procedure.
 - i) Remove floating seal (25).
 - ii) Remove 2 inner race bearings (26).



- iii) Remove 2 outer race bearings (27).



9. Travel motor case (No. 2 planetary carrier assembly)

Remove floating seal (28) from travel motor case (29).



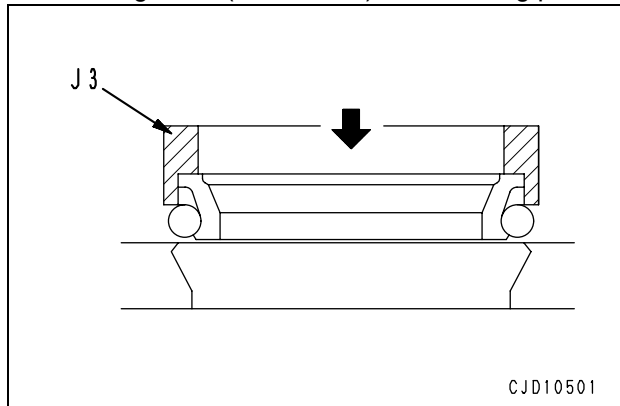
ASSEMBLY OF TRAVEL MOTOR AND FINAL DRIVE ASSEMBLY

- ★ Clean the all parts and check them for dirt or damage. Coat their sliding surfaces with engine oil before installing.
- ★ Adjust the pre-load at the normal temperature while the temperature difference between the travel motor case, bearing, hub, and nut is 3° or less.

1. Travel motor case (No. 2 planetary carrier assembly)

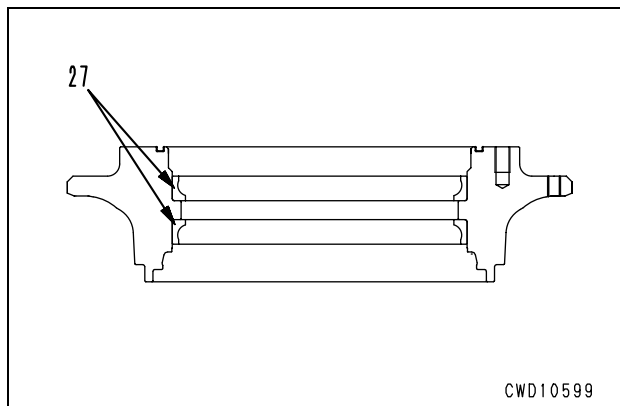
Using tool J3, install floating seal (28).

- ★ Remove all oil and grease from the O-ring and O-ring contact surface, and dry them before installing the floating seal.
- ★ Insert the tool by pushing the O-ring.
- ★ After installing the floating seal, check that its slant is within 1 mm.
- ★ After installing the floating seal, thinly apply engine oil (SAE30-CD) to the sliding parts.

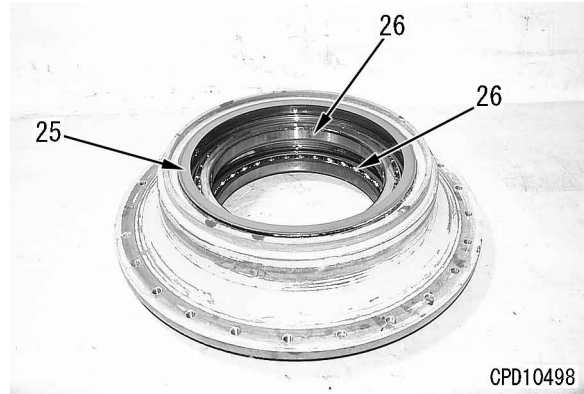


2. Assembly of hub assembly

- 1) Using the push tool, press fit 2 outer race bearings (27).
 - ★ Press fit each bearing until its outer race end comes in full contact with the hub.
 - ★ After press fitting each bearing, check that a thickness gauge of 0.03 mm cannot go through the clearance between the outer race end and hub.



- 2) Using the push tool, press fit 2 inner race bearing (26).
- 3) Using tool J3, install floating seal (25) to the hub assembly.
 - ★ For the installation procedure, see step 1 above.



- 4) Using eyebolts ③, set hub assembly (24) to No. 2 planetary carrier assembly (travel motor case).



DISASSEMBLY AND ASSEMBLY

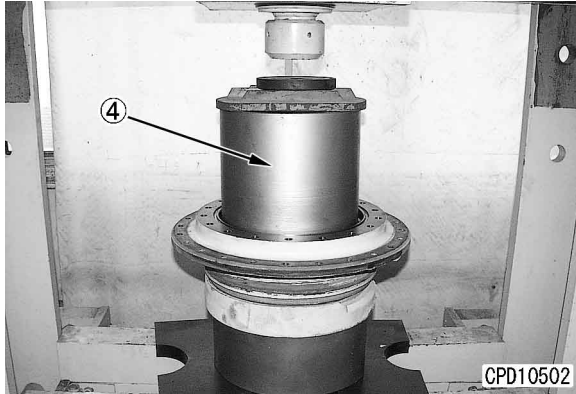
TRAVEL MOTOR AND FINAL DRIVE ASSEMBLY

- ★ Tighten the nuts and adjust the pre-load on the bearing according to the following procedure.

- 1) Using push tool ④, press the inner race on the bearing on the nut side with a press.

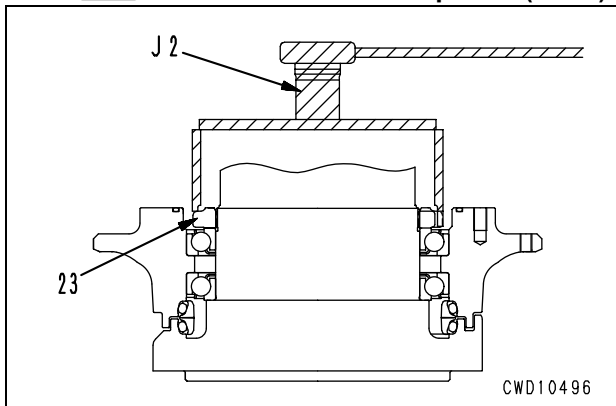
- ★ Pressing force on inner race:
8.8 – 12.7 kN {0.9 – 1.3 tons}

- ★ After installing hub assembly (24), revolve the hub by 2 – 3 turns against the travel motor case.

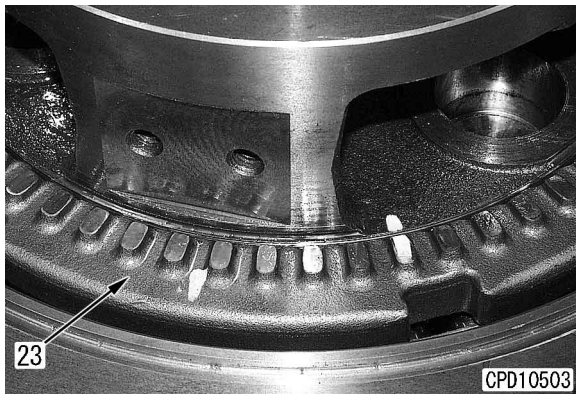


- 2) Using tool J2, tighten nut (23) to 245 Nm {25 kgm} temporarily.

 Nut: **Anti-Friction compound (LM-P)**



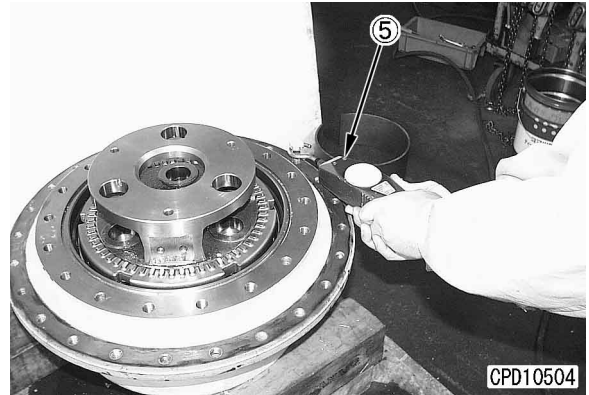
- 3) Make match marks on nut (23) and travel motor case.



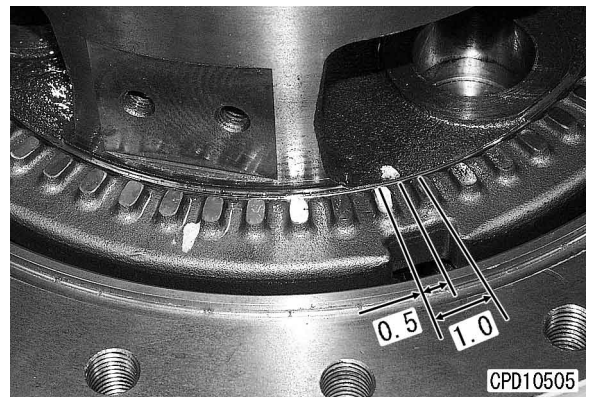
- 4) Using push-pull scale ⑤, tighten the nut so that the rotating force of the hub will be as follows to adjust the pre-load on the bearing.

 Nut: **245 – 490 Nm {25 – 50 kgm}**

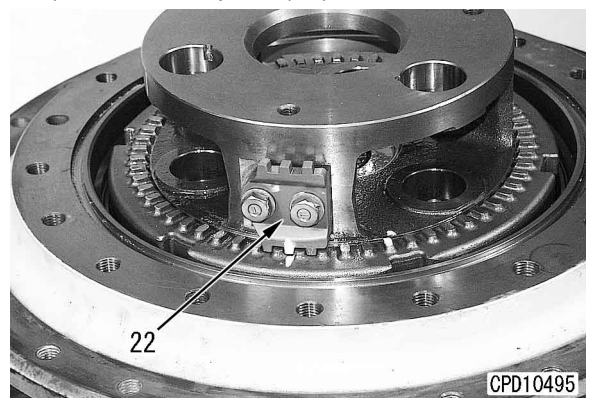
- ★ Rotating force: 127 – 206 N {13 – 21 kg}



- ★ When tightening the nut to the above torque, check by the match marks that the nut rotates by 0.5 – 1 notch.



- 5) Install lock plate (22).

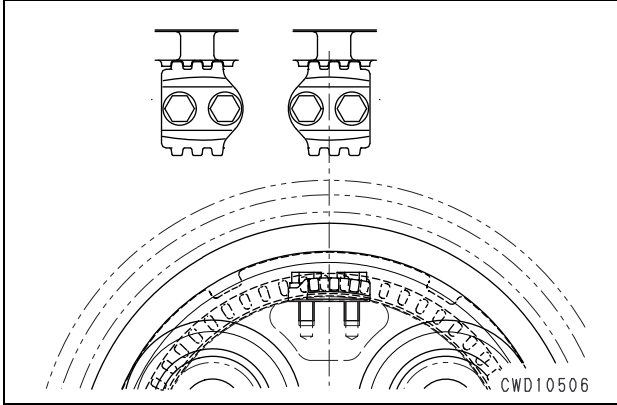


DISASSEMBLY AND ASSEMBLY

TRAVEL MOTOR AND FINAL DRIVE ASSEMBLY

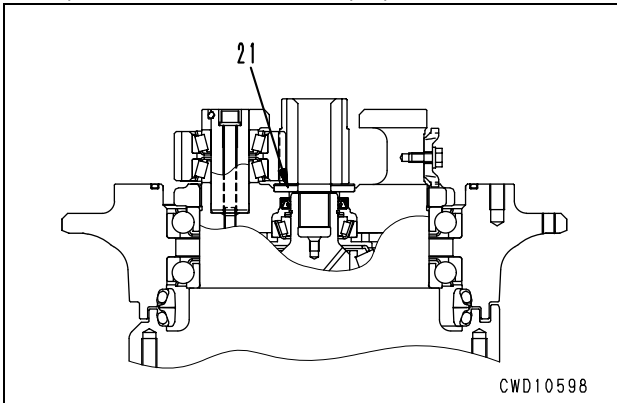
- ★ If the lock plate is turned over, it deviates by 1/2 notch. Accordingly, install it so that its claw will be fitted to a notch of the nut.

 Threads of mounting bolt:
Adhesive (LT-2)
 Mounting bolt:
58.8 – 73.5 Nm {6 – 7.5 kgm}



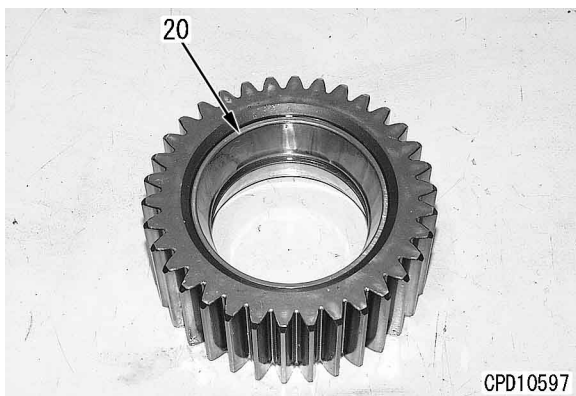
3. No. 2 planetary carrier assembly

- 1) Install thrust washer (21).



- 2) Install 2 outer race bearings (20) to the gear.

★ 3 sets



- 3) Install 2 inner race bearings (19) to gear (18).

★ 3 sets

- 4) Install gear (18) to No. 2 planetary carrier assembly.

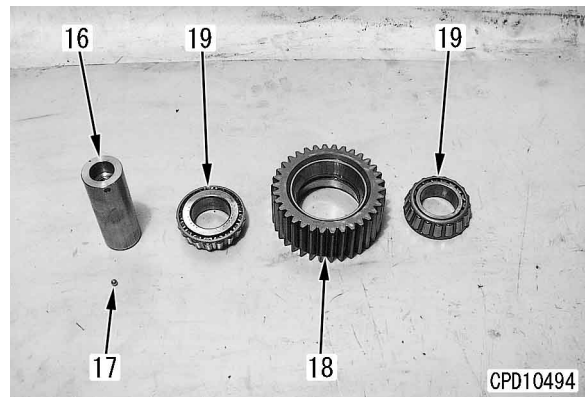
★ 3 sets

- 5) Install shaft (16) and ball (17) to No. 2 planetary carrier assembly.

★ Install the shaft by expansion fit.

★ Match the hole of the shaft to that of the carrier and install the shaft by hitting it lightly with a plastic hammer, etc.

★ 3 sets

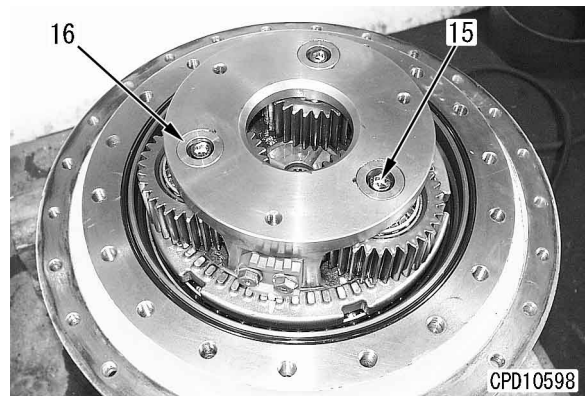


- 6) Tighten mounting bolt (15).

 Mounting bolt:
98 – 122.5 Nm {10 – 12.5 kgm}

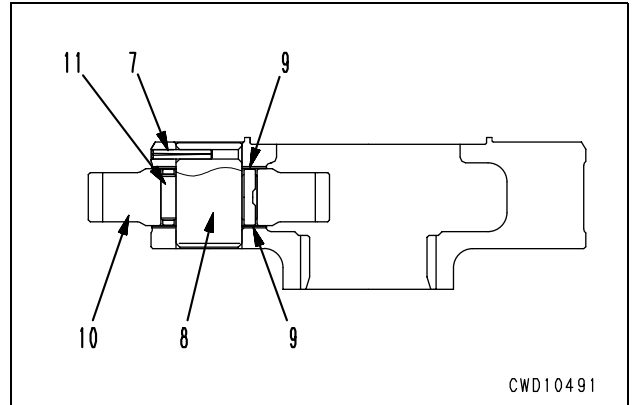
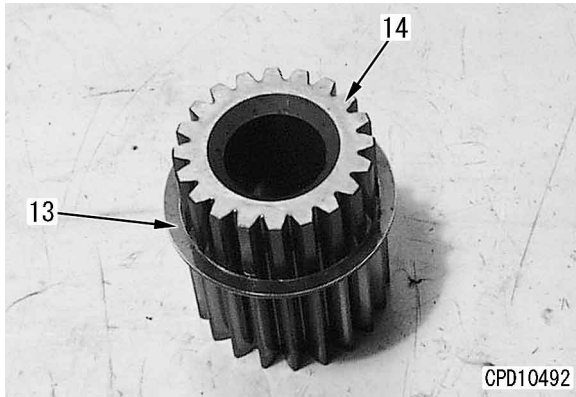
★ After assembling No. 2 planetary carrier assembly, check that gear (18) rotates smoothly.

★ 3 sets



4. No. 2 sun gear

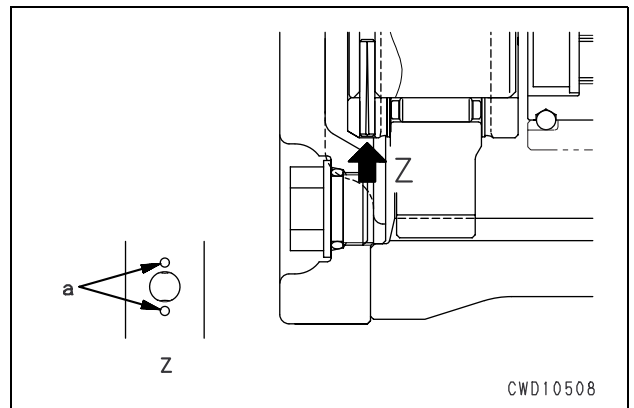
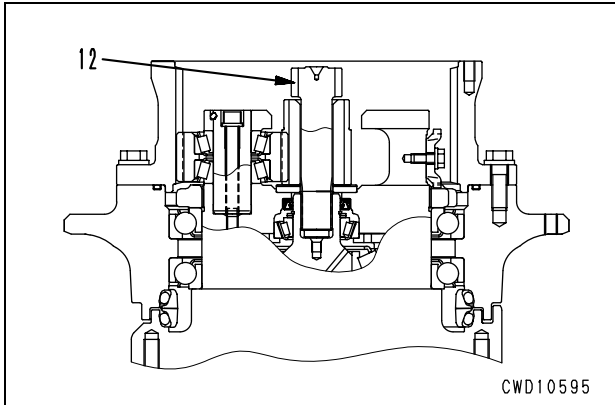
Install sun gear (14) and thrust washer (13) to No. 2 planetary carrier assembly.



★ After inserting the pin, bend pin "a" of the carrier.

5. No. 1 sun gear

Install No. 1 sun gear (12).



★ After assembling No. 1 planetary carrier assembly, check that gear (10) rotates smoothly.

6. No. 1 planetary carrier assembly

1) Assemble No. 1 planetary carrier assembly according to the following procedure.

★ Replace the thrust washers and pin with new ones.

i) Install bearing (11) to gear (10) and fit upper and lower thrust washers (9), then set gear (10) to No. 1 planetary carrier assembly.

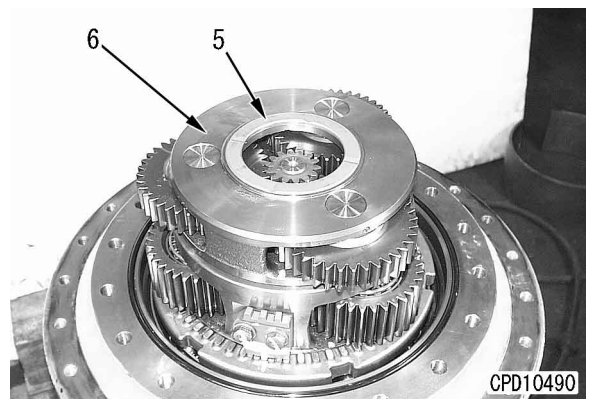
ii) Match the pin hole of shaft (8) to that of the carrier and install shaft (8) by hitting it lightly with a plastic hammer, etc.

★ Take care not to damage the thrust washers.

iii) Insert pin (7).

2) Install No. 1 planetary carrier assembly (6).

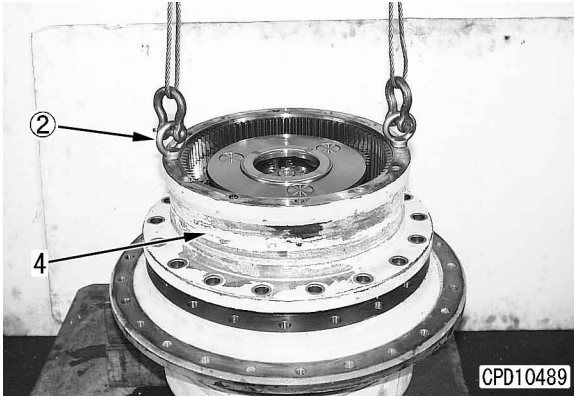
3) Install thrust washer (5).



7. Ring gear

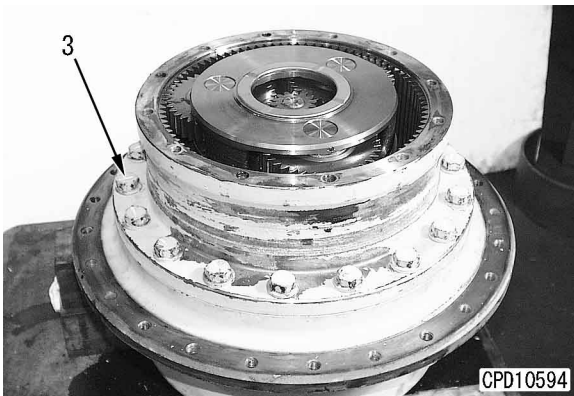
- 1) Fit the O-ring to the hub side. Using eye-bolts ② and matching the bolt holes of ring gear (4) to those of the hub, install ring gear (4).

★ Degrease the mating faces of the ring gear and hub.



- 2) Tighten ring gear (4) with 18 mounting bolts (3).

 **kgm** Mounting bolt:
245 – 308.7 Nm {25 – 31.5 kgm}

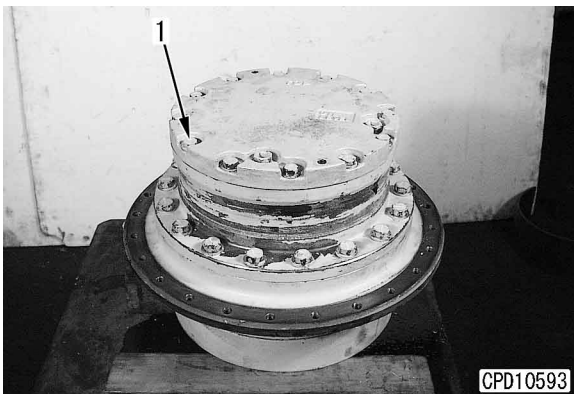


8. Cover

- 1) Using 2 through bolts ①, install cover (2).
- 2) Install cover (2) to the ring gear with 12 mounting bolts (1).

 Cover mating face:
Gasket sealant (1207B)

 **kgm** Mounting bolt:
98 – 122.5 Nm {10 – 12.5 kgm}



9. Refilling with oil

Tighten the plug and add engine oil through the oil filler.

 **kgm** Plug: **58.8 – 78.4 Nm {6.0 – 8.0 kgm}**



Final drive case: Approx.

3.91 ℓ (SAE30-CD)

- ★ Check the oil level after installing the travel motor and final drive assembly to the machine body.

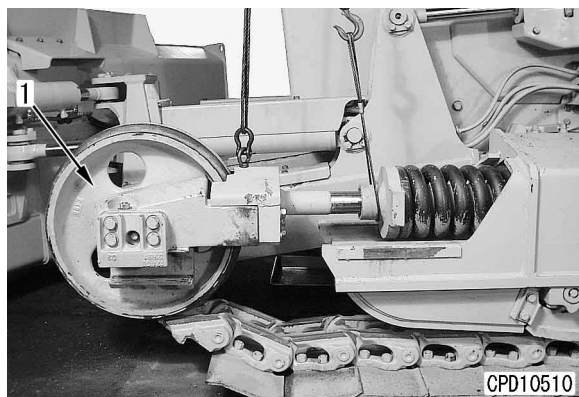
REMOVAL OF IDLER AND RECOIL SPRING ASSEMBLY

1. Spread the track shoe. For details, see SPREADING TRACK SHOE.
2. Pull out idler and recoil spring assembly (1) and sling it by the rod to remove it.



Idler and recoil spring assembly:

170 kg



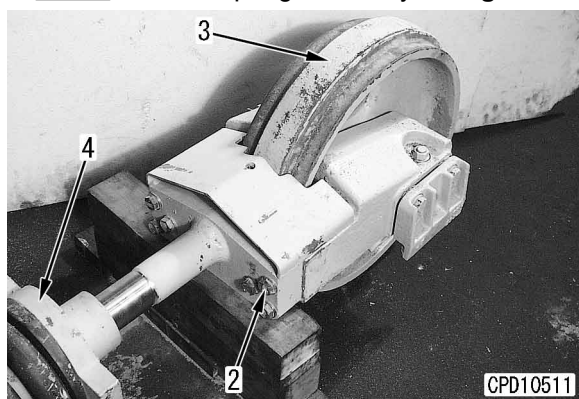
3. Remove bolt (2) and separate idler (3) and recoil spring assembly (4) from each other.



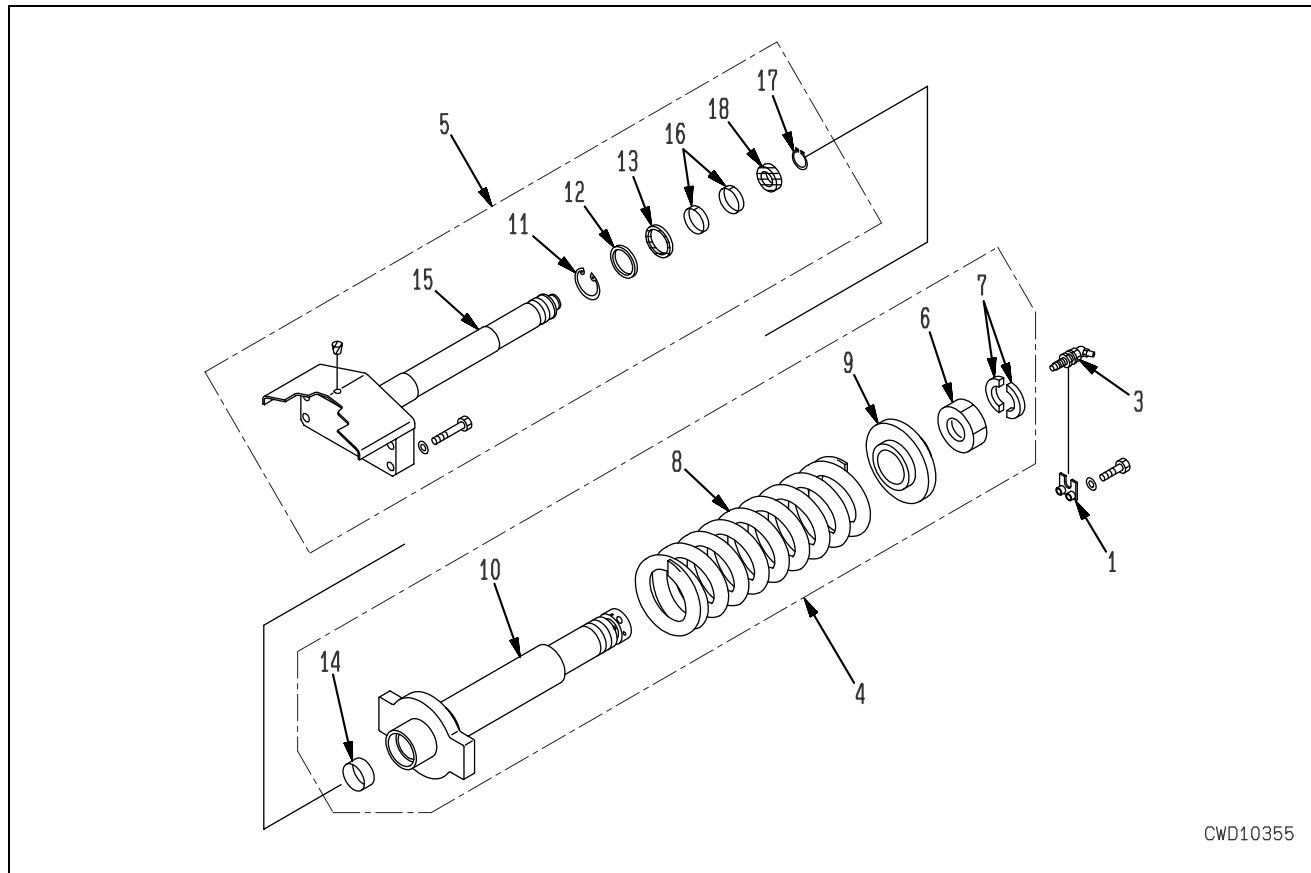
Idler: **100 kg**



Recoil spring assembly: **70 kg**



DISASSEMBLY OF RECOIL SPRING ASSEMBLY



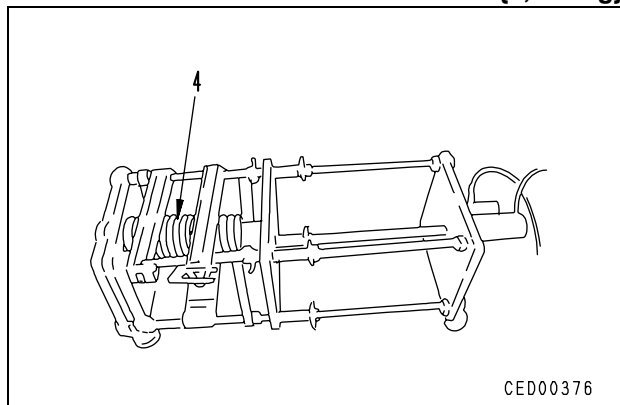
CWD10355

1. Remove the mounting bolts and lock plate (1).
2. Remove valve (3)
3. Remove rod assembly (5) from recoil spring assembly (4).

4. Disassembly of recoil spring assembly

- 1) Set recoil spring assembly (4) to tool M.
 ⚠ Since the installed load of the spring is large and dangerous, set it securely.
 ★ Installed load of spring:

71.54 kN {7,300 kg}



CED00376

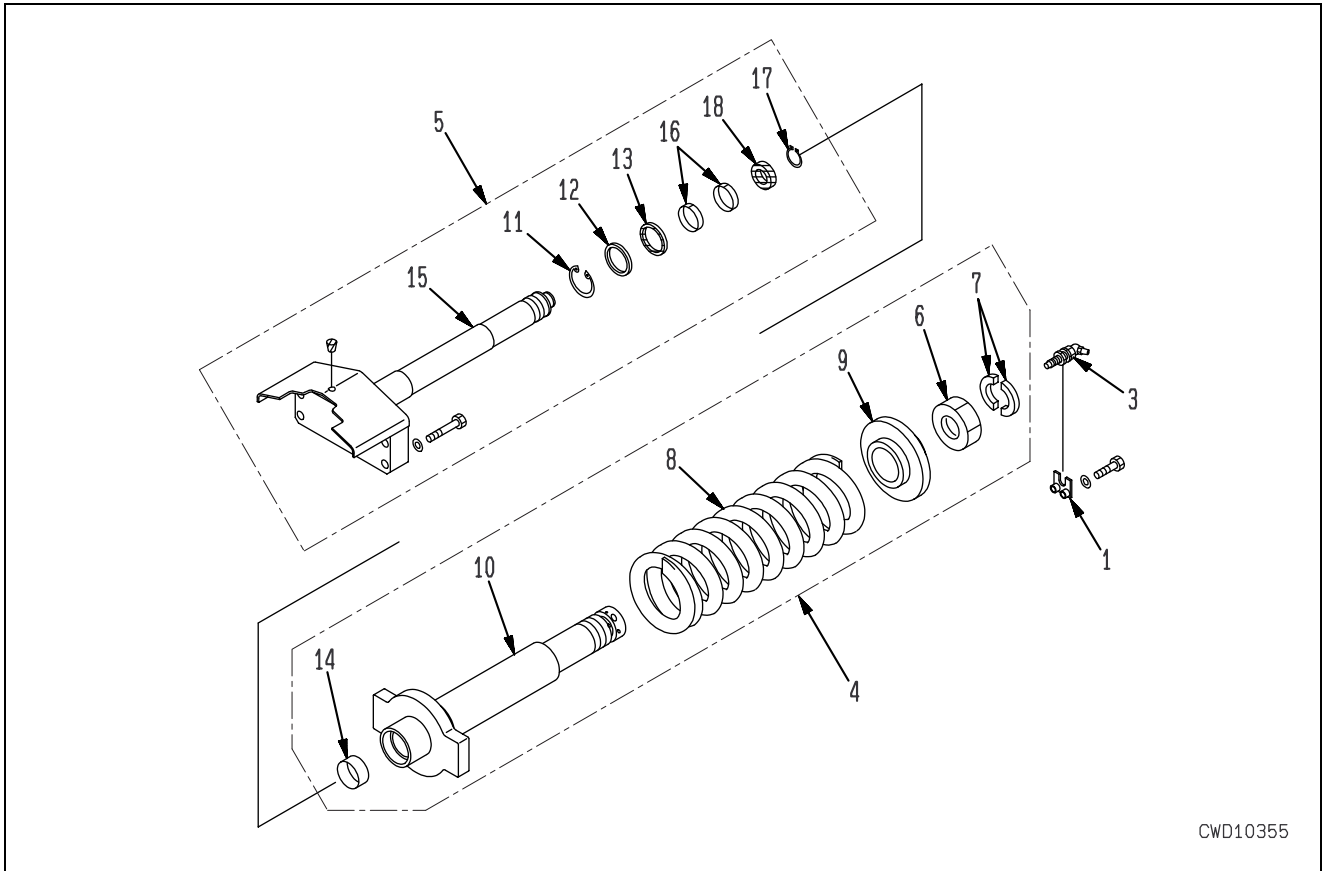
- 3) Remove 2 lock plates (7) and nut (6).
 ★ Compress the spring until the nut becomes loose.
 ★ Release the hydraulic pressure slowly to lower the tension of the spring to zero.
- 4) Remove pilot (9) and cylinder (10) from spring (8).
- 5) Remove snap ring (11), spacer (12), dust seal (13), and bushing (14) from cylinder (10).

5. Disassembly of rod assembly

- 1) Remove wear ring (16) from rod assembly (5).
- 2) Remove snap ring (17) and U-packing (18).

- 2) Apply hydraulic pressure slowly to compress the spring and tighten nut (6).

ASSEMBLY OF RECOIL SPRING ASSEMBLY

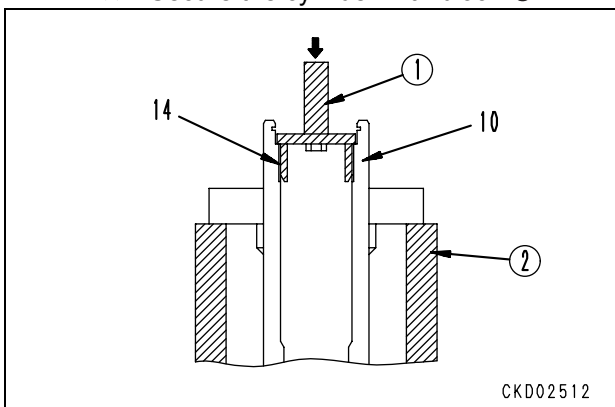


1. Assembly of rod assembly

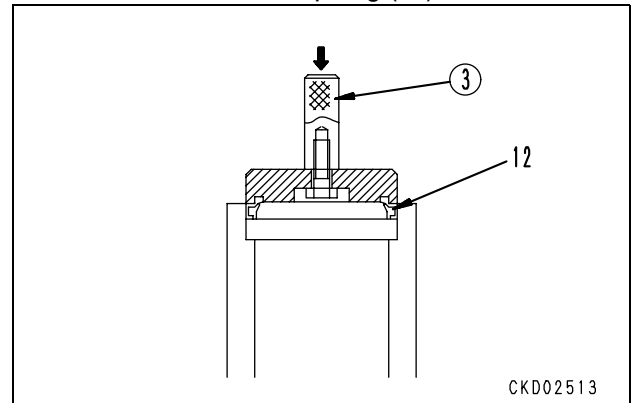
- 1) Install U-packing (18) to rod assembly (5) and secure it with snap ring (17).
- 2) Install wear ring (16).

2. Assembly of recoil spring assembly

- 1) Using push tool ①, press fit bushing (14) to cylinder (10).
★ Secure the cylinder with block ②.



- 3) Using push tool ③, install spacer (12) and secure it with snap ring (11).

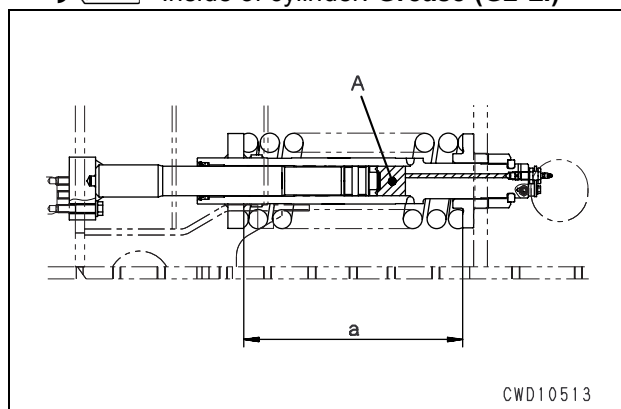


- 2) Install seal (13) to cylinder (10).

- 4) Install cylinder (10) and pilot (9) to spring (8), then set them to tool **M**.
- 5) Apply hydraulic pressure slowly to compress the spring.
- 6) Set the installed length of the spring to "a".
- 7) Position the spring with nut (6) and lock it with lock plate (7).
 Nut: **294 Nm {30.0 kgm}**
- 8) Remove recoil spring assembly (4) from the tool.

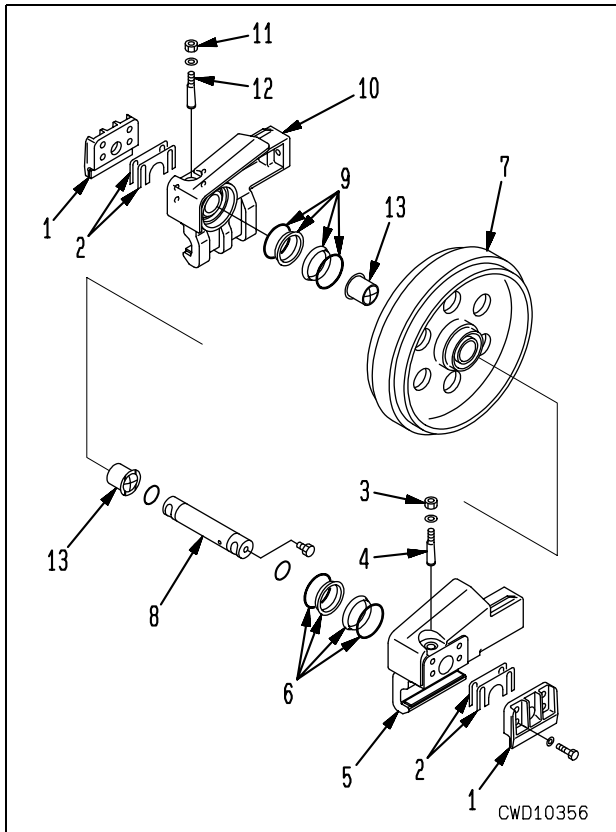
3. Supply at least 120 cc of grease to cylinder (10), taking care not to leave any bubble in part "A".

 Inside of cylinder: **Grease (G2-LI)**



4. Install rod assembly (5) to recoil spring assembly (4).
 ★ Install the rod with valve (3) loosened, then insert the rod assembly.
5. Secure valve (3) with lock plate (1).
 ★ Install the valve with the fitting out.
 Valve: **58.8 – 88.2 Nm {6 – 9 kgm}**

DISASSEMBLY OF IDLER ASSEMBLY



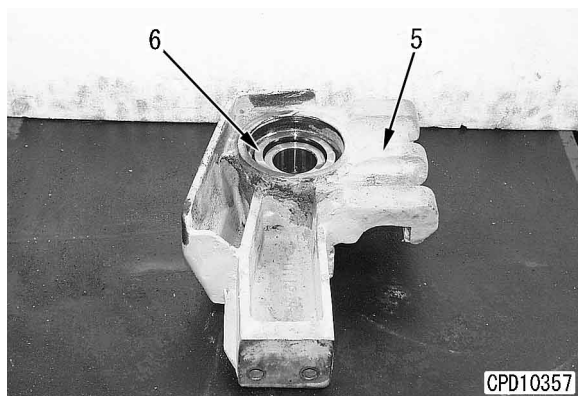
1. Remove mounting bolts, guide (1), and shims (2).

★ Check the quantity of the shims.

2. Remove nut (3) and bolt (4).

3. Remove support (5).

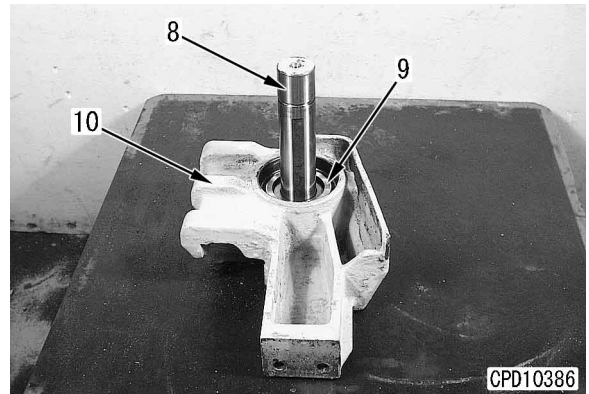
4. Remove floating seals (6) from support (5) and idler (7).



5. Pull idler (7) out of the shaft and support assembly.

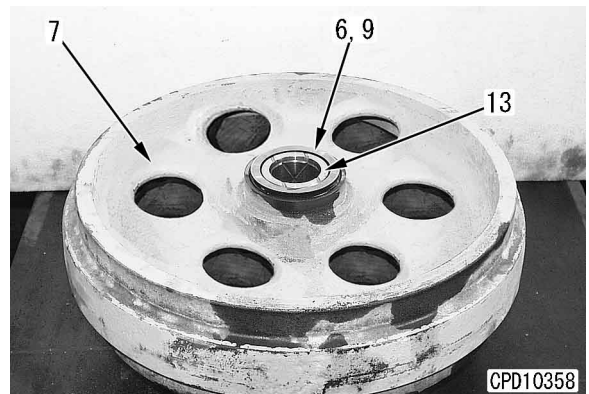
★ Oil of 160 cc is filled in. Drain it at this time or spread cloths so that the floor will not be stained with it.

6. Remove floating seals (9) from idler (7) and shaft and support assembly.

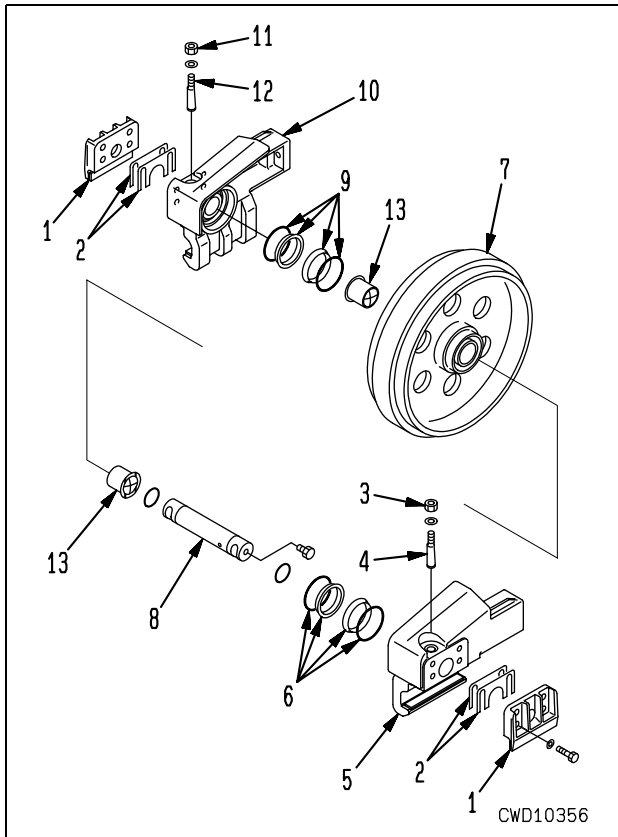


7. Remove nut (11) and bolt (12).

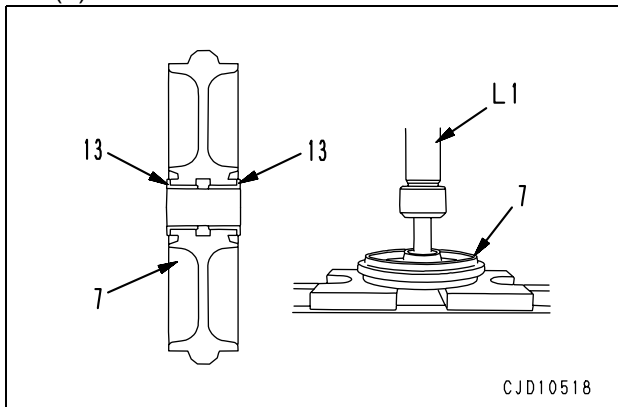
8. Remove 2 bushings (13) from idler (7).



ASSEMBLY OF IDLER ASSEMBLY



1. Using tool L1, press fit 2 bushings (13) to idler (7).



2. Fit the O-ring to shaft (8), then install them to support (10).

3. Insert bolt (12) in support (10) and tighten nut (11).

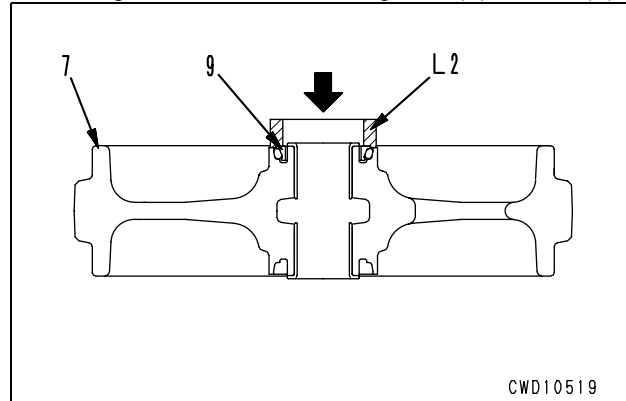


Bolt: **Liquid adhesive (LT-2)**

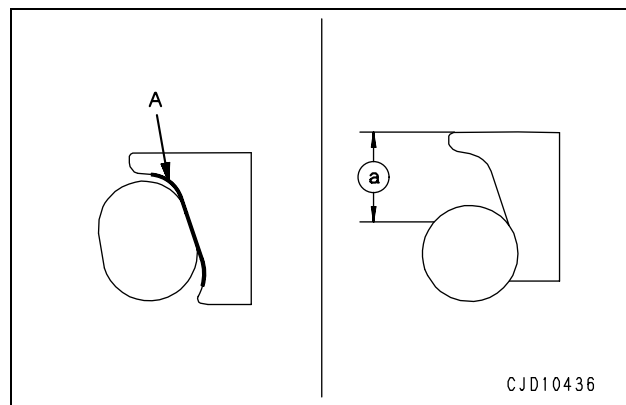
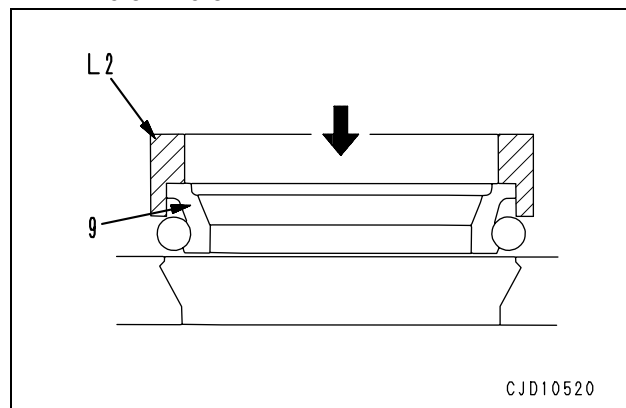


Nut: **89 – 123 Nm {9 – 12.5 kgm}**

4. Using tool L2, install floating seal (9) to idler (7).

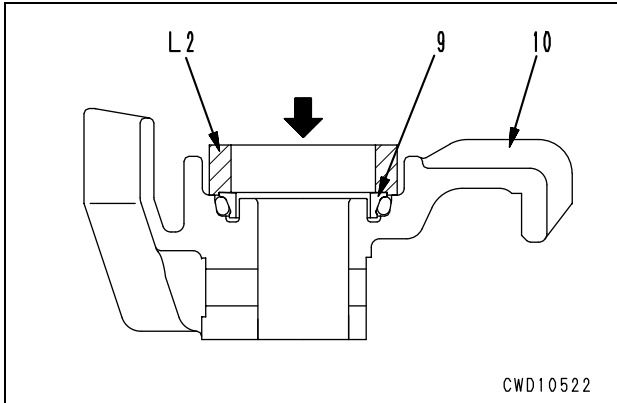


- ★ When installing the floating seal, degrease and dry the mating faces of the O-ring and floating seal (indicated with **thick line A**) completely. The contact surfaces of the floating seal must be free from dirt.
- ★ After installing the floating seal, check that its slant is within 1mm and its projection "a" is 6.5 – 10.5 mm.



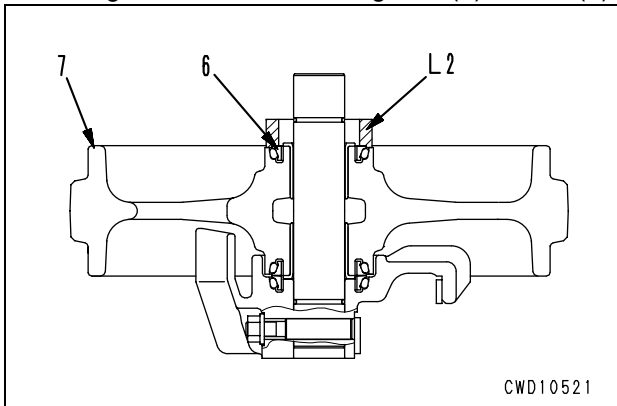
5. Using tool **L2**, install floating seal (9) to support (10).

★ For precautions for installing the floating seal, see ★ in step 4 above.

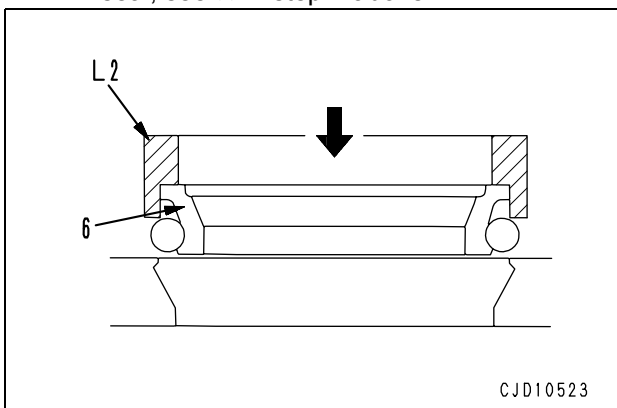


6. Install idler (7) to the shaft and support assembly.

7. Using tool **L2**, install floating seal (6) to idler (7).

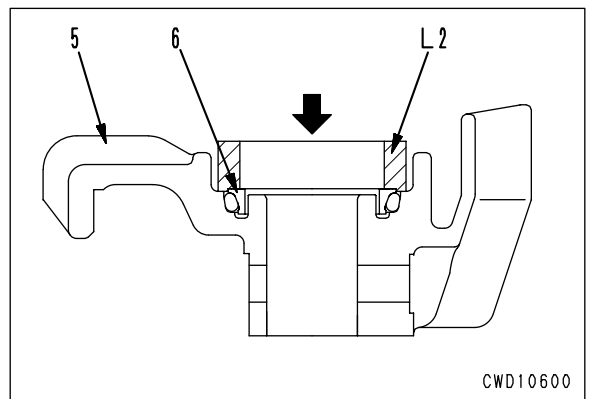


★ For precautions for installing the floating seal, see ★ in step 4 above.



8. Using tool **L2**, install floating seal (6) to support (5).

★ For precautions for installing the floating seal, see ★ in step 4 above.



9. Fit the O-ring to shaft (8).

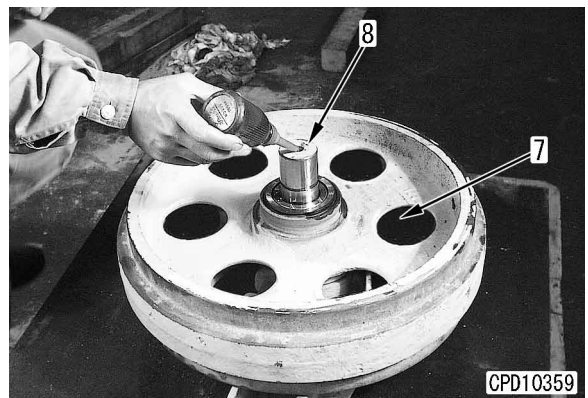
10. Supply oil through the hole of shaft (8) and tighten the plug.



Oil: Approx. **160 cc (SAE30-CD)**



Plug: **98 – 137 Nm {10 – 14 kgm}**



11. Install support (5).

12. Insert bolt (4) in support (5) and tighten nut (3).



Bolt: **Liquid adhesive (LT-2)**



Nut: **89 – 123 {9 – 12.5 kgm}**

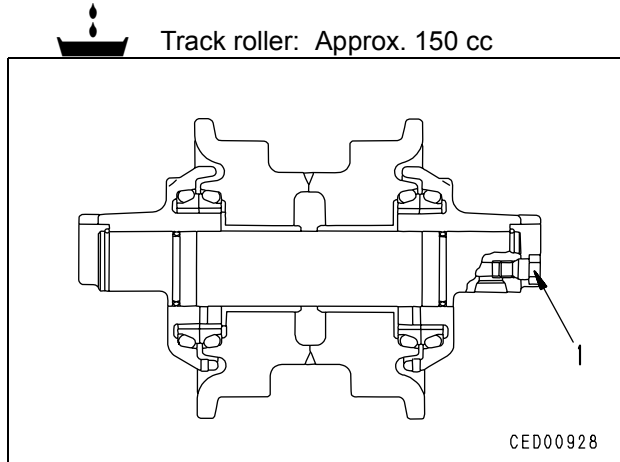
13. Install shims (2) and guide (1).



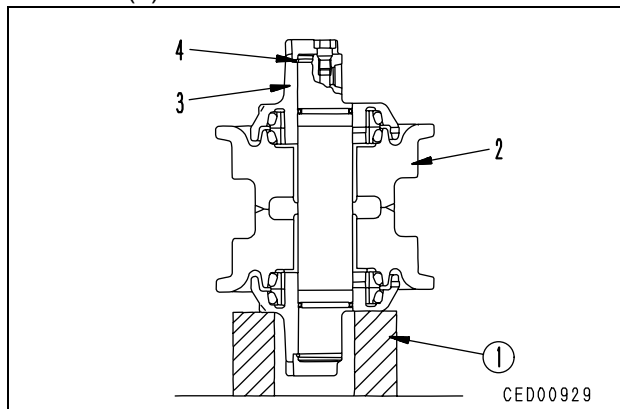
Bolt: **Liquid adhesive (LT-2)**

DISASSEMBLY OF TRACK ROLLER ASSEMBLY

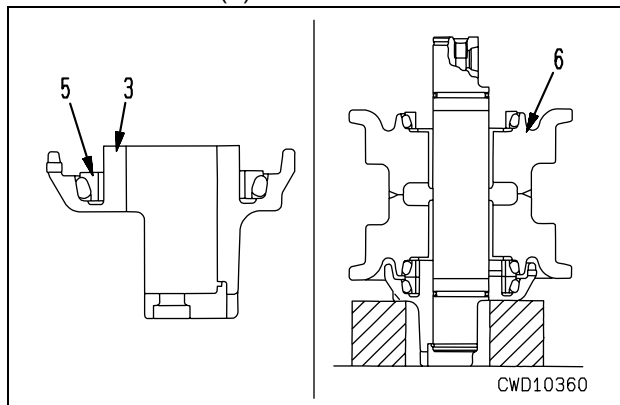
1. Remove plug (1) and drain oil.



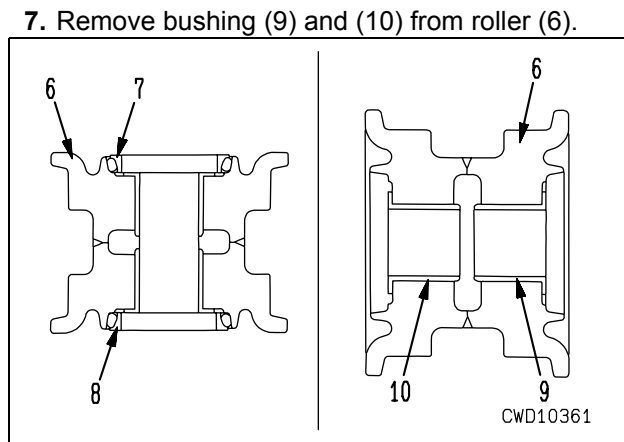
2. Set roller assembly (2) to block ①.
3. Push collar (3) and pull out ring (4), then remove collar (3).



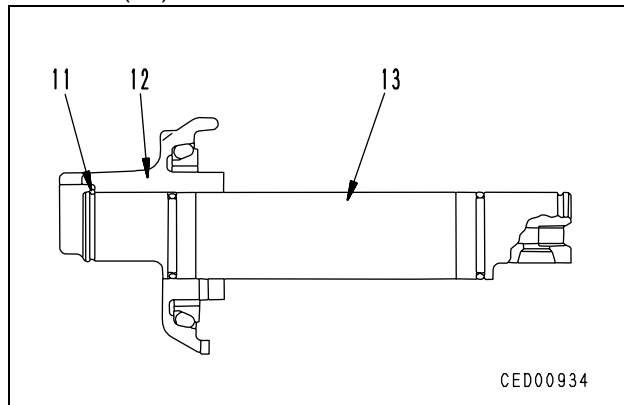
4. Remove floating seal (5) from collar (3).
5. Pull out roller (6) from shaft.



6. Remove floating seals (7) and (8) from roller (6).

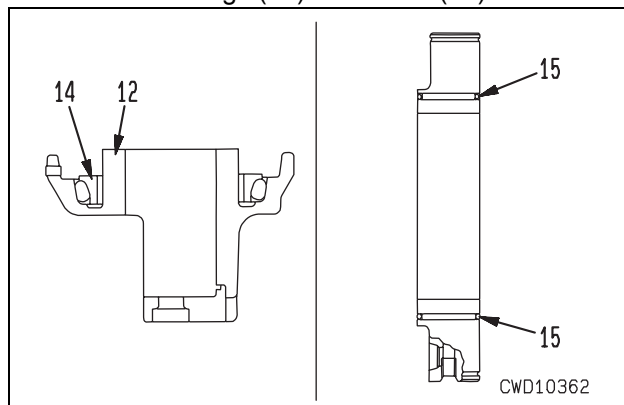


8. Remove ring (11), then remove collar (12) from shaft (13).



9. Remove floating seal (14) from collar (12).

10. Remove O-rings (15) from shaft (13).

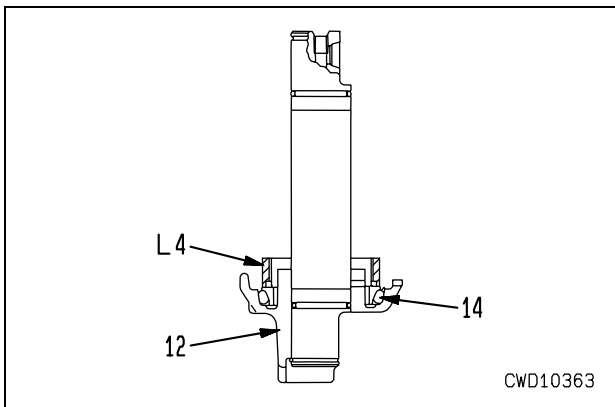
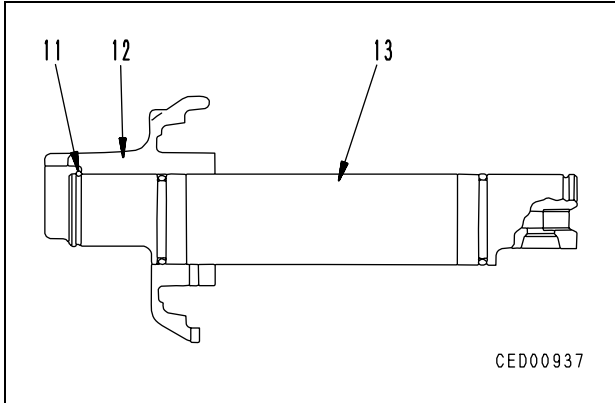


ASSEMBLY OF TRACK ROLLER ASSEMBLY

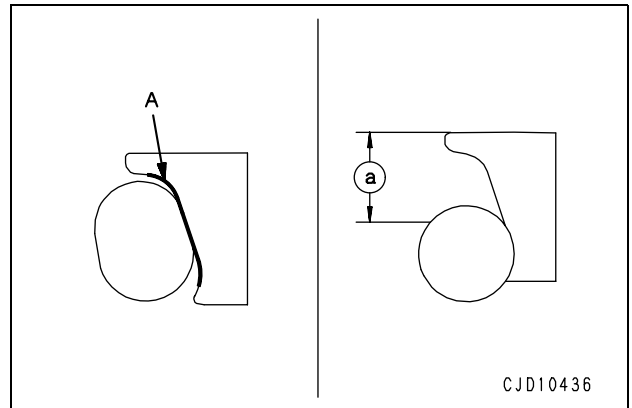
1. Fit O-rings (15) to shaft (13) and assemble collar (12), then install ring (11).

★ After assembling, tighten plug (1) temporarily.

2. Using tool L4, install floating seal (14) to collar (12).



- ★ Precautions when assembling floating seal.
- 1) When assembling the floating seal, degrease and dry the parts indicated with thick line A (O-ring and mating face of the O-ring).
 - 2) After assembling the floating seal, check that the angle of the seal is less than 1 mm.
 - 3) After assembling, check that protrusion ① of the floating seal is within a range of 7 – 11 mm.



3. Using push tool ①, press fit bushings (9) and (10) to roller (6).

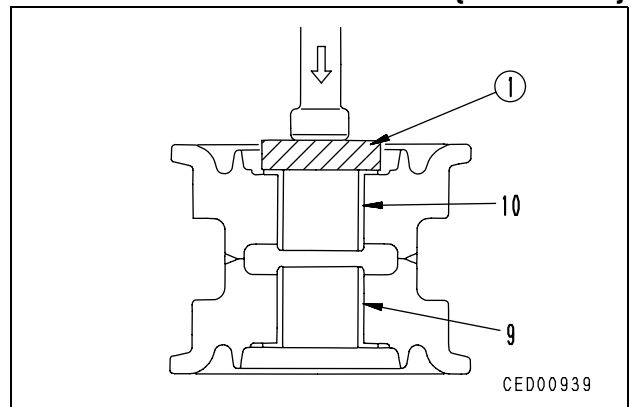


Bushing press-fitting portion:

Engine oil (EO30-CD)

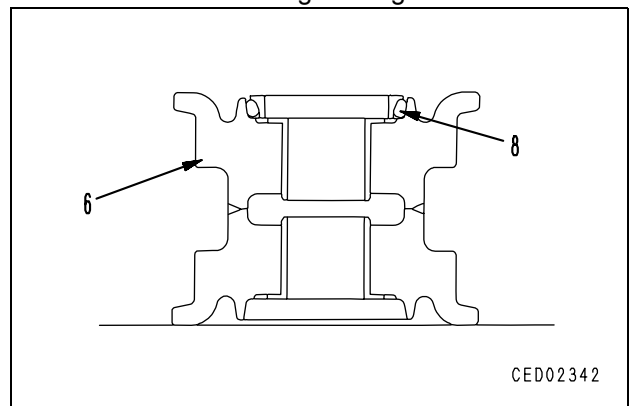
- ★ Bushing press-fitting force:

29.4 ± 3.92 kN {3.0 ± 0.4 ton}



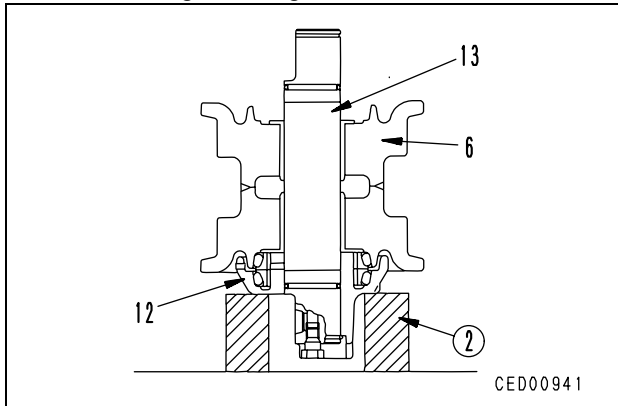
4. Install floating seal (8) to roller (6).

- ★ For details of the precautions when installing the floating seals, see Step 2, ★ Precautions when assembling floating seal.



DISASSEMBLY AND ASSEMBLY**IDLER ASSEMBLY**

5. Set shaft (13) and collar (12) assembly on block ②, then assemble roller (6).
- ★ Coat the sliding surface of the floating seal with engine oil, and make sure that no dirt or dust sticks to the surface.
 - ★ When assembling the roller, coat the shaft or bushing with engine oil.

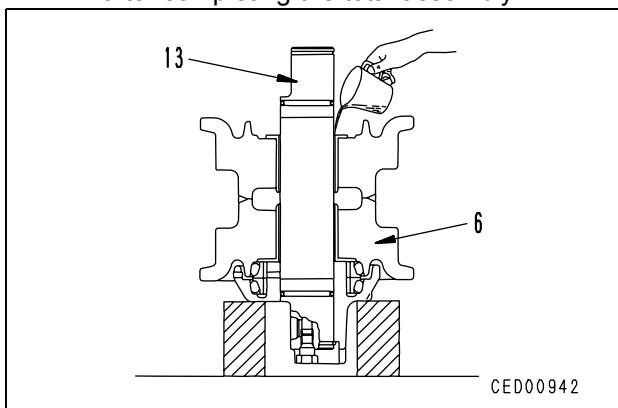
**6. Refilling with oil**

Pour oil through clearance between shaft (13) and roller (6).

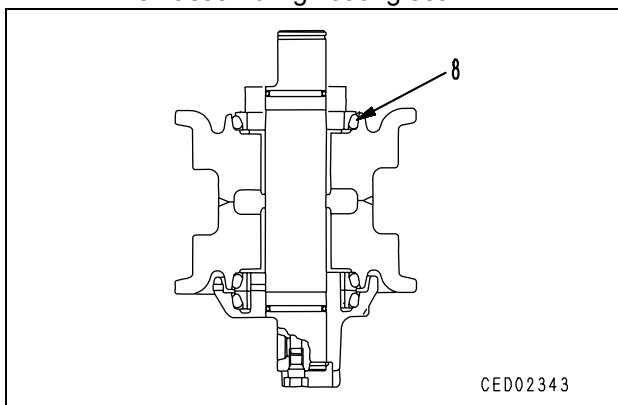


Roller: **Approx. 150 cc (EO30-CD)**

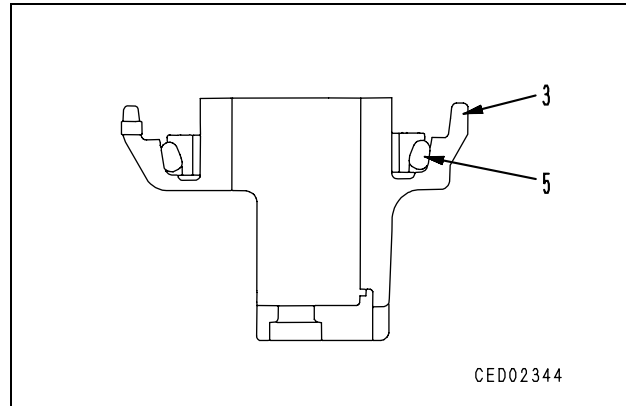
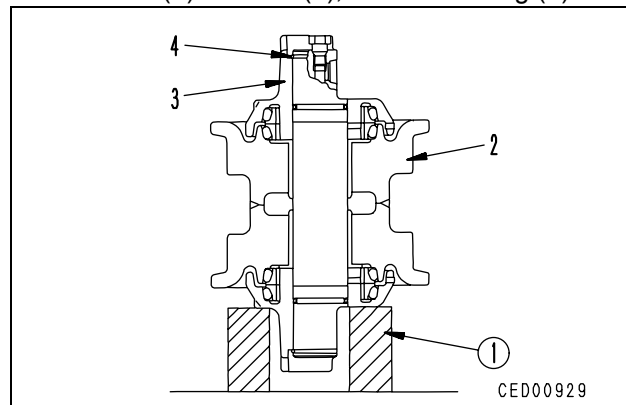
- ★ When using tool B to add the oil, add the oil after completing the total assembly.

**7. Install floating seal (8).**

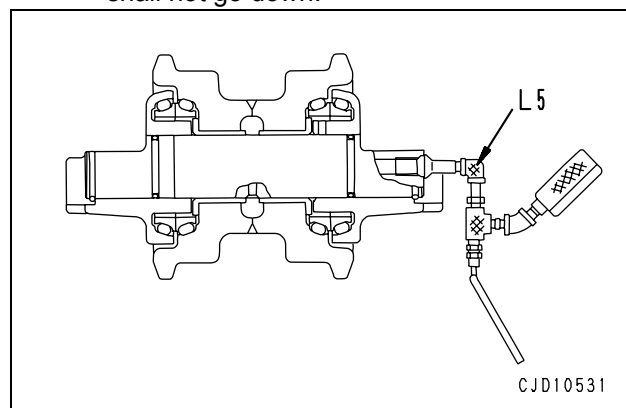
- ★ For details of the precautions when installing the floating seals, see Step 2, ★ Precautions when assembling floating seal.

**8. Install floating seal (5) to collar (3).**

- ★ For details of the precautions when installing the floating seals, see Step 2, ★ Precaution when assembling floating seal.
- ★ Coat the sliding surface of the floating seal with engine oil, and make sure that no dirt or dust sticks to the surface.

**9. Fit roller (2) to collar (3), then install ring (4).****10. Using tool L5, apply basic pressure to roller oil filler port, and check for leakage of air from seal.**

- ★ Basic pressure: 0.1 MPa {1 kg/cm²}
- ★ Method of checking
The basic pressure shall be maintained for 10 seconds and the indicator of the gauge shall not go down.

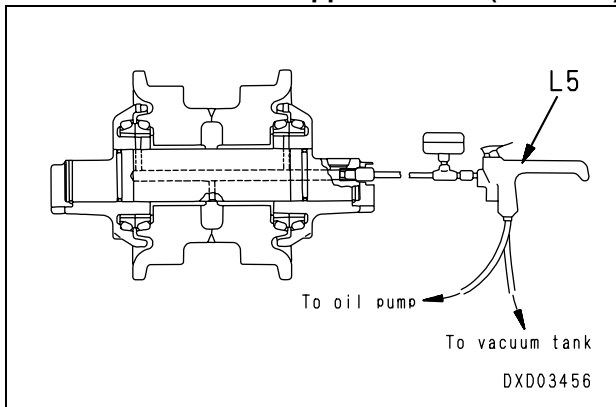


11. If oil was not added in Step 6, use tool **L5**, to fill track roller assembly with oil.



Track roller oil:

Approx. 150 cc (EO30-CD)



12. Checking oil level

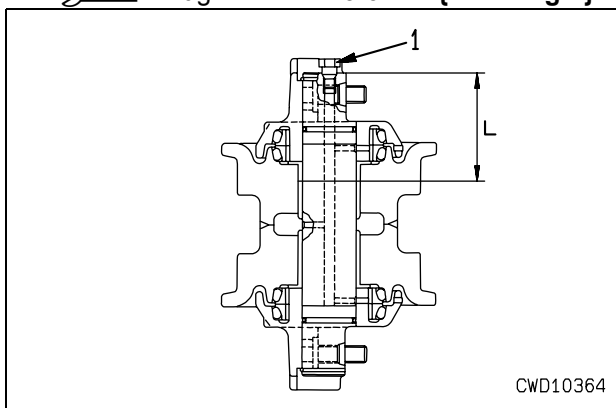
Stand the track roller as shown in the diagram below and leave it for a short time, then insert a wire from the oil filler port and check height **L** to the oil surface.

- ★ Distance **L** from end face of shaft to oil surface: 106 mm

13. Tighten plug (1).

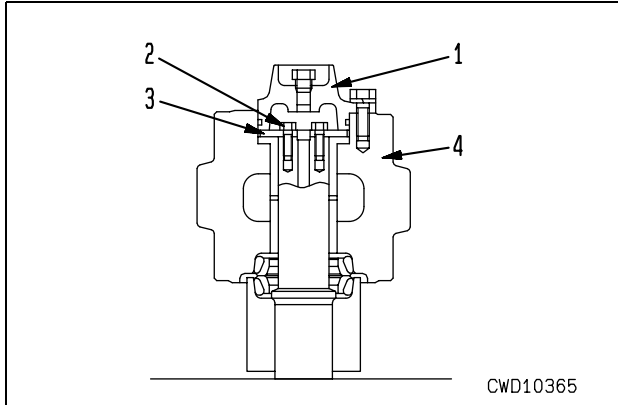


kgm Plug: **$117.7 \pm 19.6 \text{ Nm}$ $\{12 \pm 2 \text{ kgm}\}$**



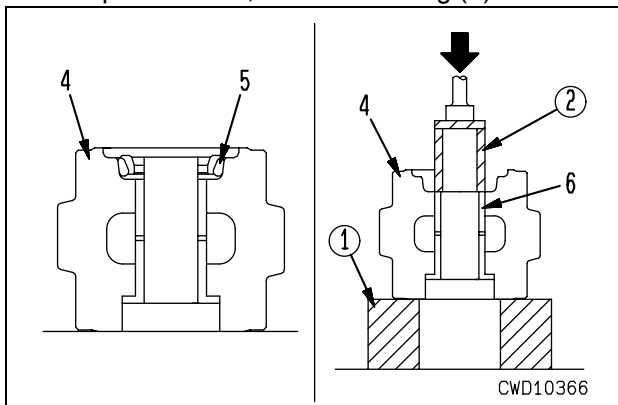
DISASSEMBLY OF CARRIER ROLLER ASSEMBLY

1. Remove cap (1) from carrier roller assembly.
2. Remove bolt (2), then remove plate (3).
3. Remove roller assembly (4).



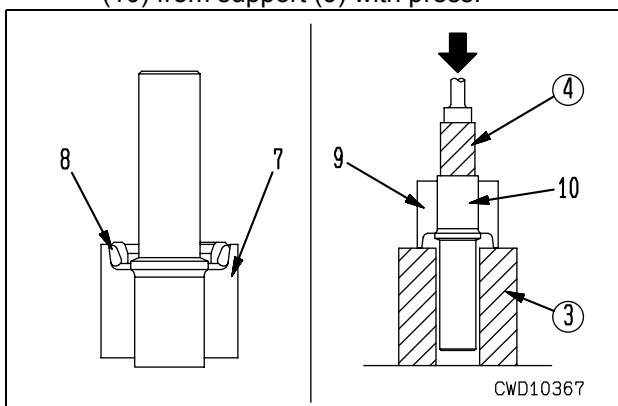
4. Disassembly of roller assembly

- 1) Remove floating seal (5) from roller assembly (4).
- 2) Set roller assembly on block ①, and using push tool ②, remove bushing (6).



5. Disassembly of shaft, support assembly

- 1) Remove floating seal (8) from shaft and support assembly (7).
- 2) Set shaft and support assembly (7) on block ③, and using push tool ④, remove shaft (10) from support (9) with press.



ASSEMBLY OF CARRIER ROLLER ASSEMBLY

1. Assembly of shaft, support assembly.

- 1) Set support (9) on block (5), and using push tool (6), press fit shaft (10).

★ Press-fitting force:

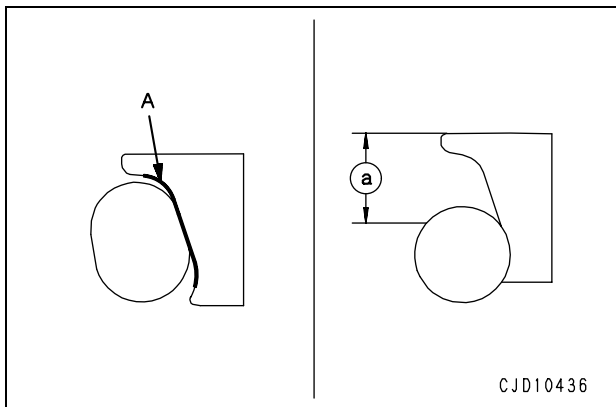
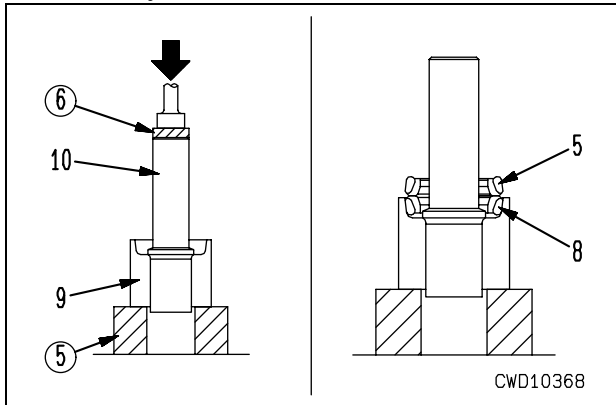
19.6 – 106.8 kN (2 – 10.9 ton)

 Shaft: **Anti-friction compound (LM-P)**

- 2) Install floating seals (8) and (5).

★ When installing the floating seal, degrease and dry the parts indicated with thick line A (O-ring and mating face of the O-ring).

★ After installing the floating seal, check that its slant is within 1 mm and its projection "a" is 4 – 8 mm.



2. Assembly of roller assembly.

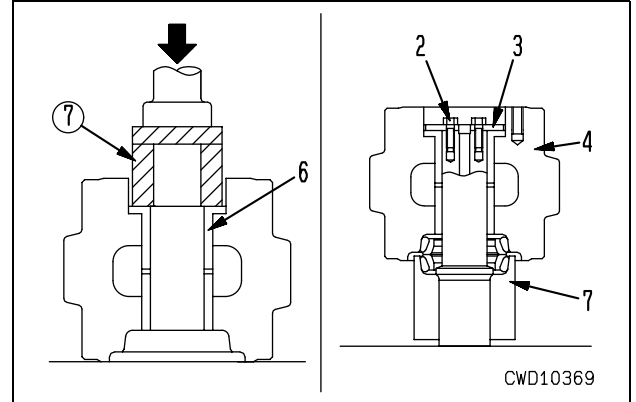
Using push tool (7), press fit bushing (6).

3. Set shaft and support assembly (7) in position, and assemble roller assembly (4).

4. Assemble plate (3), and tighten with bolt (2).

 Mounting bolt:

176.5 ± 19.6 Nm {18 ± 2 kgm}

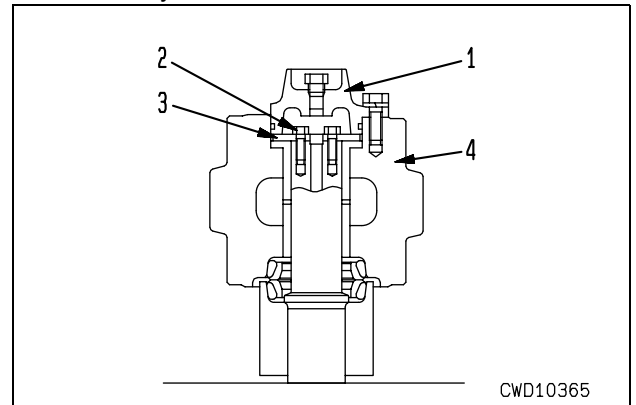


5. Fill roller with oil.



Carrier roller: **Approx. 200 – 220 cc**
(Engine oil EO30-CD)

6. Fit O-ring to cap (1) and install to carrier roller assembly.

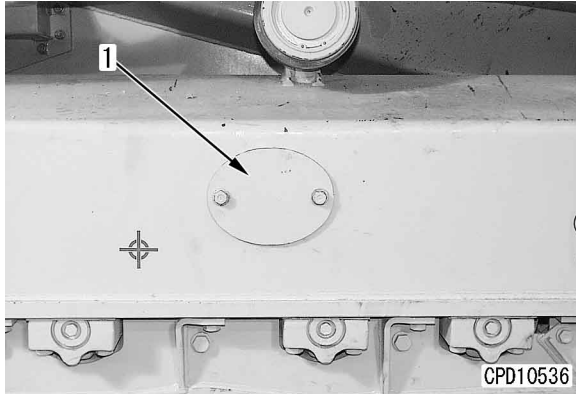


SPREADING TRACK SHOE ASSEMBLY

1. Position the master link properly.

- ★ Start the engine and position each master link in front of the idler.
- ★ Set a block, jack, etc. under the track shoe in front of each idler.

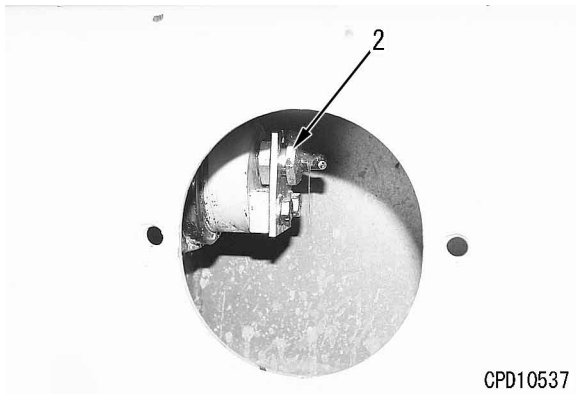
2. Remove mounting bolts and cover (1).



3. Loosen lubricator (2) to lower the tension of the track shoe.

※ 1

- ⚠ Since the pressure in the recoil spring cylinder is very high, do not loosen the lubricator more than one turn. If the track tension is not lowered, move the machine forward and in reverse.



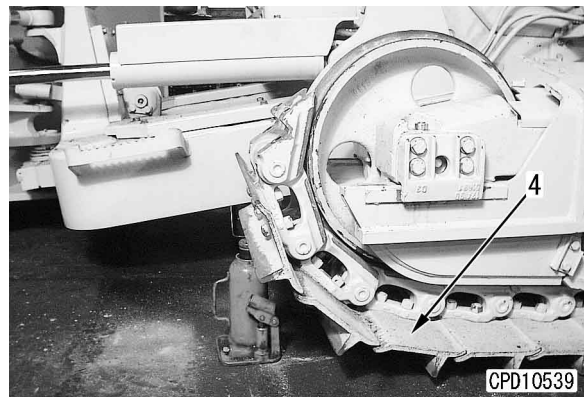
4. Remove the track shoe of master link (3).

※ 2

- ★ Pull both sides of the master link with wires and chain blocks and remove the master link bolts to disconnect the master link.



5. Guiding the track link end with a crane, move the machine slowly in reverse to spread the track shoe assembly (4).



INSTALLATION OF TRACK SHOE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Adjust the tension of the track shoe. For details, see TESTING AND ADJUSTING, Testing adjusting tension of track shoe.
- ★ Tension of track shoe: **20 – 30 mm**

※ 2



Master link bolt:

**Seizure prevention compound
(MARUZEN MOLYMAX No. 2 or
equivalent)**



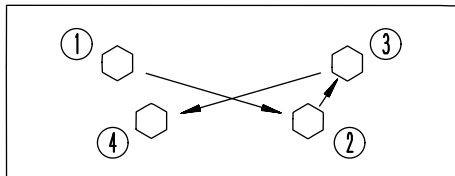
Master link bolt:

Initial torque:

147.1 ± 19.6 Nm {15 ± 2 kgm}

Retightening angle: **180 ± 10°**

- ★ When winding the track shoe, use a bar, etc. to prevent the link from parting from the sprocket.
- ★ Take proper measures so that the mating faces and threads of the master link will not be rusted, bruised, or deformed. In addition, check that the mating faces and threads are free from dirt.
- ★ Tighten the master link bolts in the order of ① – ④.



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REMOVAL OF HST PUMP ASSEMBLY

⚠ Lower the work equipment to the ground and stop the engine. Then, loosen the hydraulic oil filler cap slowly to release the internal pressure of the hydraulic tank.

1. Remove the operator's cab frame assembly. For details, see REMOVAL OF OPERATOR'S CAB FRAME ASSEMBLY.

2. Disconnect main control valve hoses (1) and (2).

- (1): To oil cooler (Hose color band: Blue)
- (2): To Hydraulic pump (Hose color band: Red)

3. Disconnect hydraulic tank hose (3).

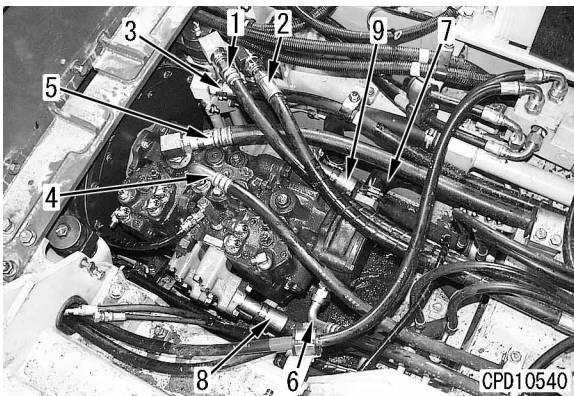
- From oil cooler to hydraulic tank filter

4. Disconnect the following 8 HST pump hoses.

※ 1

- (4): From charge filter
- (5): To drain hole
- (6): To charge filter
- (7): From hydraulic tank
- (8): To upper travel motor, R.H. reverse (Hose color band: Blue)
- : To lower travel motor, L.H. forward (Hose color band: Yellow)
- (9): To upper travel motor, R.H. forward (Hose color band: Green)
- : To lower travel motor, L.H. reverse (Hose color band: Orange)

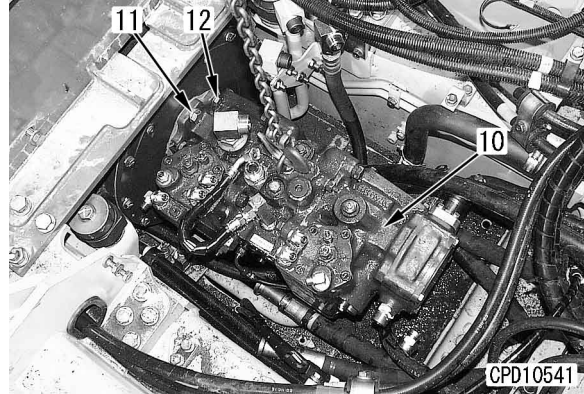
★ The photograph shows the D39-21, but in the case of the D31 and D37-21, there is a branch hose, so disconnect the branch hose also.



5. Sling HST pump (10) temporarily and remove upper and lower mounting bolts (11) and (12).

※ 2

- Bolt (11): 2 pieces
- Bolt (12): 4 pieces



6. Lift off HST pump assembly (10).



HST pump assembly: **140 kg**

INSTALLATION OF HST PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.
- ★ Take extreme care that each hose will not be twisted when connected.

※ 1



Flange bolt:

98 – 123 Nm {10 – 12.5 kgm}

※ 2



Threads of mounting bolt:

Gasket sealant (LG-5)



Bolt (11):

245 – 309 Nm {25 – 31.5 kgm}



Bolt (12):

98 – 123 Nm {10 – 12.5 kgm}

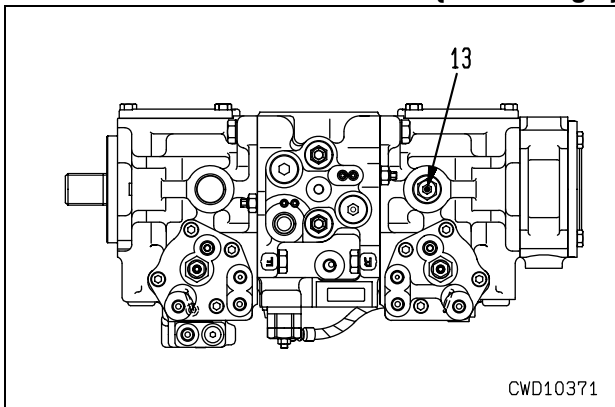
- Bleeding air**

- Before starting the engine, loosen bleeder (13) and check that oil is oozing out through the bleeder.
- When oil containing no bubbles flows out, tighten the bleeder.



Bleeder:

7.8 – 9.8 Nm {0.8 – 1.0 kgm}



- 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.

REMOVAL OF MAIN CONTROL VALVE ASSEMBLY

- ⚠** Lower the work equipment to the ground and stop the engine. Then, loosen the hydraulic oil filler cap slowly to release the internal pressure of the hydraulic tank.
- ★ Plug the disconnected pipes and hoses to prevent foreign matter from entering them.
 - ★ Put tags to the disconnected hoses to prevent a mistake in re-connecting them.

1. Remove the 4 mounting bolts and rear cover (1).



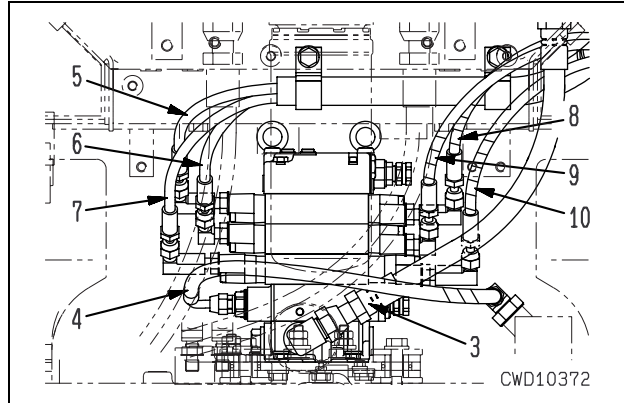
2. Remove the 4 mounting bolts and charge pump oil filter bracket (2).

- ★ Move the bracket aside so that it will not be an obstacle to the work to disconnect the equipment hoses.



3. Disconnect the following 8 main control valve PPC hoses.

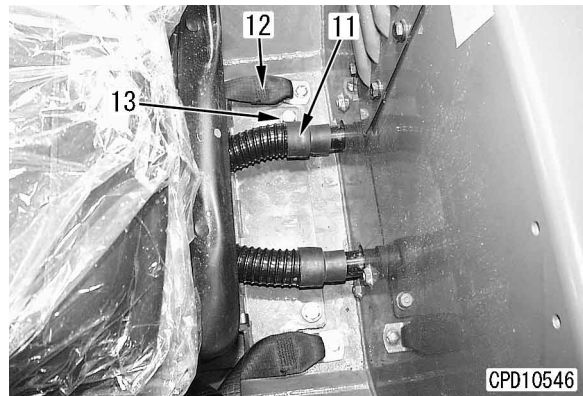
- (3): Return to hydraulic tank
- (4): To suction pipe
- (5): Angle right (Hose color band: Green)
- (6): Tilt left (Hose color band: White)
- (7): Lift up (Hose color band: Red)
- (8): Angle left (Hose color band: Blue)
- (9): Tilt right (Hose color band: Brown)
- (10): Lift down (Hose color band: Orange)



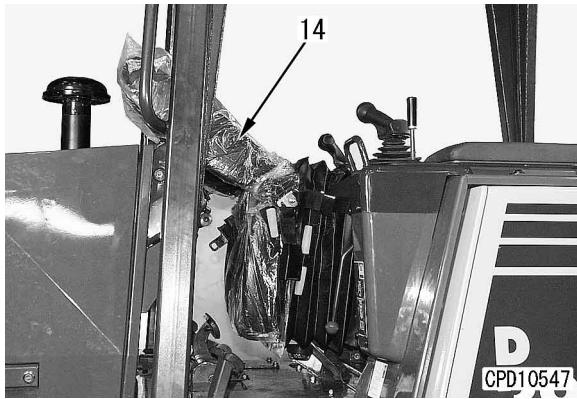
4. Disconnect 2 heater hoses (11).

5. Remove the 2 mounting bolts and seat belt (12).

6. Remove mounting bolts (13).



7. Lean the operator's seat assembly (14) forward.

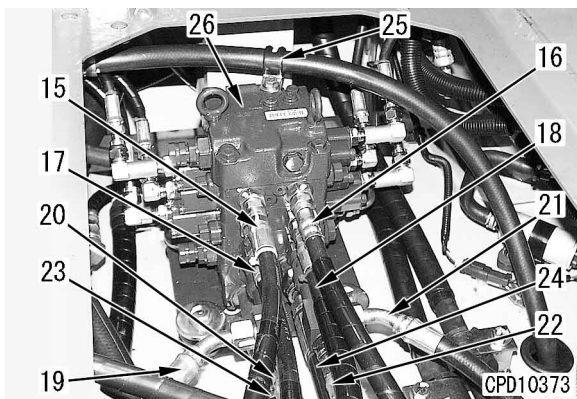


8. Disconnect the following 10 main control valve main hoses.

- (15): Angle left
- (16): Angle right
- (17): Tilt right
- (18): Tilt left
- (19), (20): Lift down
- (21), (22): Lift up
- (23): To oil cooler (Hose color band: Blue)
- (24): To hydraulic pump (Hose color band: Red)

9. Remove clamp (25).

10. Remove the 4 mounting bolts and main control valve assembly (26).



INSTALLATION OF MAIN CONTROL VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.
 - ★ Take extreme care that each hose will not be twisted when connected.
- **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 (HST circuit)**
 - ★ Bleed air from the HST pump circuit. For details, see INSTALLATION OF HST PUMP ASSEMBLY.

DISASSEMBLY OF MAIN CONTROL VALVE ASSEMBLY

Disassembly of main control valve assembly 1/2

- ★ Since the safety valve assembly cannot be set to proper pressure while it is mounted on the machine, do not disassemble it.
- ★ Do not remove the upper and lower covers and each block.

1. Plug (Pressure releasing)

- 1) Remove plug (1) to release the pressure from the circuit.
- 2) Remove the O-ring and backup rings (2) and (3).

2. Unload valve

- 1) Remove unload valve assembly (4).
- 2) Remove the O-ring and ring (6) from sleeve (5).
- 3) Remove plug (7) and spring (8) from sleeve (5).
- 4) Remove plug (9) and spring (10).
 - ★ Do not remove the spool, seal, and LS selector valve.

3. Pressure compensation valve

- Remove 6 plugs (11), 3 springs (12), and 3 springs (13).
- ★ Do not remove the valve and piston.

4. Suction valve assemblies

- Remove 3 suction valve assemblies (14).
- ★ Do not disassemble the suction valve assembly.

5. Main relief valve assembly

- Remove main relief valve assembly (15), O-ring, and ring (16).
- ★ Do not disassemble the main relief valve.

6. Check valves (Angle)

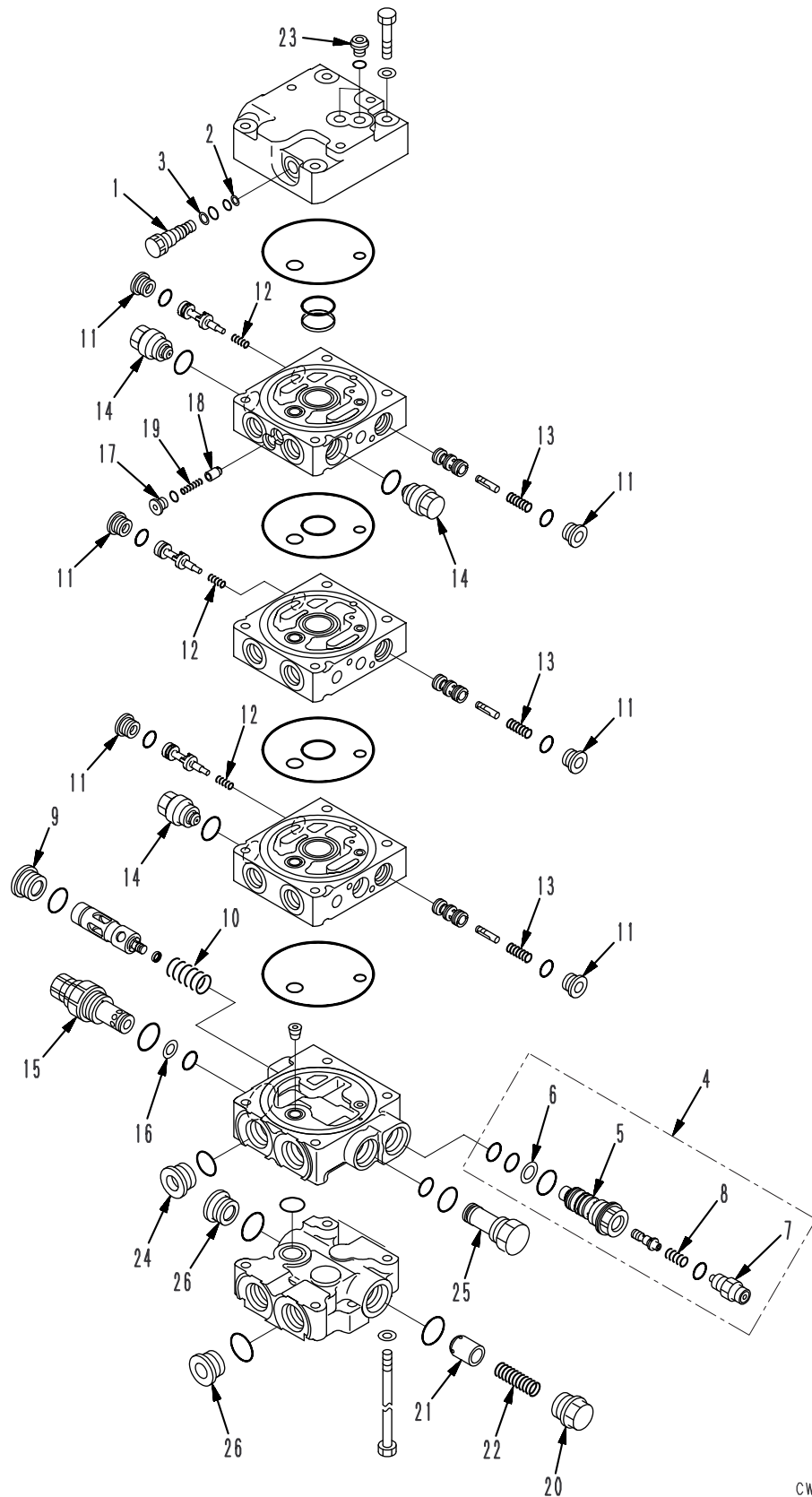
- Remove 2 plugs (17), 2 valves (18), and 2 springs (19).

7. Cooler bypass valve

- Remove plug (20), valve (21), and spring (22).

8. Plugs

- Remove 2 plugs (23), plug (24), plug (25), and 2 plugs (26).



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Disassembly of main control valve assembly 2/2

1. Angle control valve

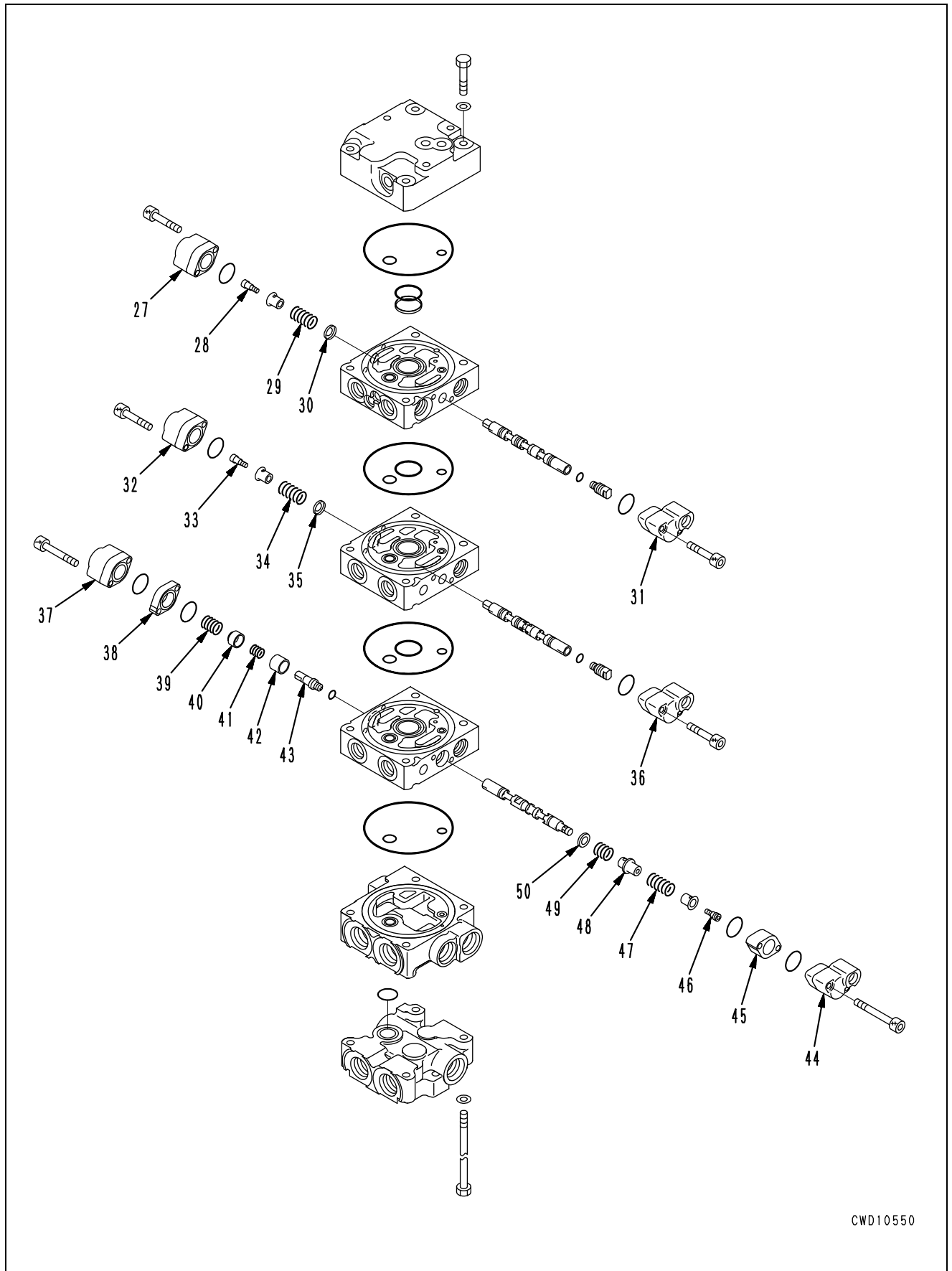
- 1) Remove the mounting bolts, case (27), bolt (28), spring (29), and retainer (30).
 - ★ When loosening bolt (28), take care extremely not to damage the spool.
- 2) Remove the mounting bolts and case (31).
 - ★ Do not remove the retainer, spool, and plug.
 - ★ Since the spring has a part No. different from the others, check its free length.

2. Tilt control valve

- 1) Remove the mounting bolts, case (32), bolt (33), spring (34), and retainer (35).
 - ★ When loosening bolt (33), take care extremely not to damage the spool.
- 2) Remove the mounting bolts and case (36).
 - ★ Do not remove the retainer, spool, and plug.
 - ★ Since the spring has a part No. different from the others, check its free length.

3. Lift control valve

- 1) Remove the mounting bolts, cases (37) and (38), spring (39), retainer (40), spring (41), retainer (42), and plug (43).
 - ★ When loosening plug (43), take care extremely not to damage the spool.
- 2) Remove the mounting bolts, cases (44) and (45), bolt (46), spring (47), retainer (48), spring (49), and retainer (50).
 - ★ Remove bolt (46) from the spool without taking the spool out of the block.
 - ★ When loosening bolt (46) take care extremely not to damage the spool.
 - ★ Do not remove the spool and retainer.
 - ★ Since the spring has a part No. different from the others, check its free length.



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ASSEMBLY OF MAIN CONTROL VALVE ASSEMBLY

Assembly of main control valve assembly 1/2

- ★ Apply engine oil to the sliding surfaces before assembling.
- ★ As a result of disassembly, if the spool or block has any defect, replace the assembly.
- ★ Degrease the plug and female screw of the spool with DRY SOL, etc. and dry them completely before tightening. Do not apply pressure on them for at least 2 hours after they are tightened.

1. Lift control valve

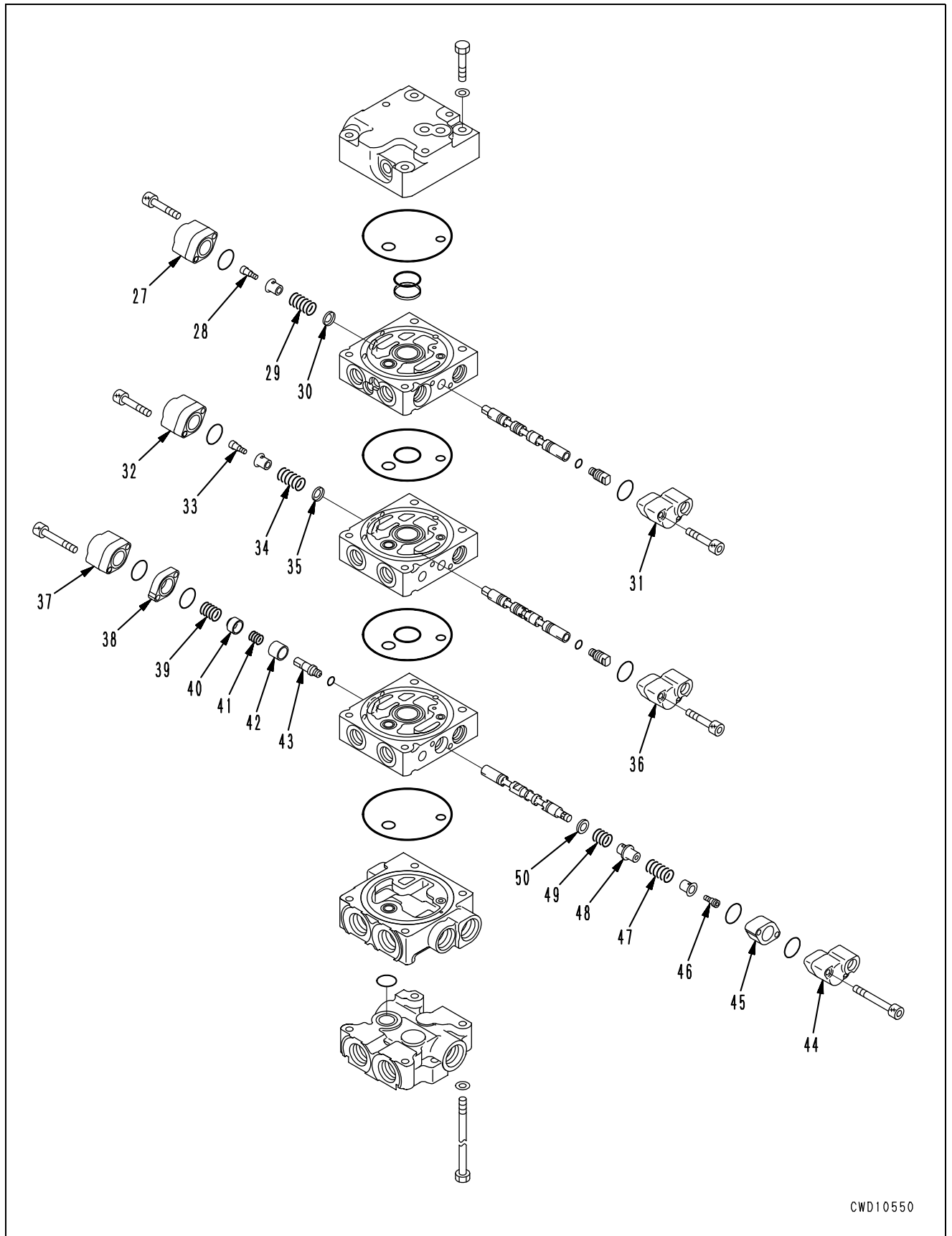
- 1) Install retainer (50), spring (49), retainer (48), and spring (47) to the spool.
- 2) Tighten bolt (46) in the spool.
 - ★ Apply 1 drip (approx. 0.02 g) of LOC-TITE (No. 638) to the bolt.
 - ★ Tighten the bolt without taking the spool out of the block. Bolt: **6.9 – 9.8 Nm {0.7 – 1.0 kgm}**
- 3) Fit the O-ring to cases (45) and (44).
- 4) Install cases (45) and (44) to the block with the mounting bolts.
  Bolt: **11.8 – 14.7 Nm {1.2 – 1.5 kgm}**
- 5) Fit the O-ring to plug (43) and install them to the block.
- 6) Install retainer (42), spring (41), retainer (40), and spring (39) to the block.
- 7) Tighten plug (43).
  Plug: **14.7 – 19.6 Nm {1.5 – 2 kgm}**
- 8) Fit the O-ring to cases (38) and (37).
- 9) Install cases (38) and (37) to the block with the mounting bolts.
  Bolt: **11.8 – 14.7 Nm {1.2 – 1.5 kgm}**

2. Tilt control valve

- 1) Fit the O-ring to case (36).
- 2) Install case (36) to the block with the mounting bolts.
  Bolt: **11.8 – 14.7 Nm {1.2 – 1.5 kgm}**
- 3) Install retainer (35) and spring (34) to the block with bolt (33).
  Bolt: **6.9 – 9.8 Nm {0.7 – 1.0 kgm}**
- 4) Fit the O-ring to case (32).
- 5) Install case (32) to the block with the mounting bolts.
  Bolt: **11.8 – 14.7 Nm {1.2 – 1.5 kgm}**

3. Angle control valve

- 1) Fit the O-ring to case (31).
- 2) Install case (31) to the block with the mounting bolts.
  Bolt: **11.8 – 14.7 Nm {1.2 – 1.5 kgm}**
- 3) Install retainer (30) and spring (29) to the block with bolt (28).
  Bolt: **6.9 – 9.8 Nm {0.7 – 1.0 kgm}**
- 4) Fit the O-ring to case (27).
- 5) Install case (27) to the block with the mounting bolts.
  Bolt: **11.8 – 14.7 Nm {1.2 – 1.5 kgm}**



Assembly of main control valve assembly 2/2**1. Plugs**

- 1) Fit the O-ring and tighten plug (26).
★ 2 sets
 Plug:
147 – 186.2 Nm {15 – 19 kgm}
- 2) Fit the O-ring and tighten plug (25).
 Plug: **49 – 58.8 Nm {5 – 6 kgm}**
- 3) Fit the O-ring and tighten plug (24).
 Plug:
147 – 186.2 Nm {15 – 19 kgm}
- 4) Fit the O-ring and tighten plug (23).
 Plug:
19.6 – 27.5 Nm {2 – 2.8 kgm}

2. Cooler bypass valve

- 1) Fit the O-ring to plug (20).
- 2) Install spring (22) and valve (21) to the block with plug (20).
 Plug:
147 – 186.2 Nm {15 – 19 kgm}

3. Check valve (Angle)

- 1) Fit the O-ring to plug (17).
- 2) Install spring (19) and valve (18) to the block with plug (17).
★ 2 sets
 Plug:
19.6 – 24.5 Nm {2 – 2.5 kgm}

4. Main relief valve assembly

- 1) Fit the O-ring and ring (16).
- 2) Screw main relief valve assembly (15) into the block.
 Main relief valve assembly:
137 – 157 Nm {14 – 16 kgm}

5. Suction valve

- Fit the O-ring and screw suction valve (14) into the block.
- ★ 3 sets
 Suction valve:
39.2 – 49 Nm {4 – 5 kgm}

6. Pressure compensation valve

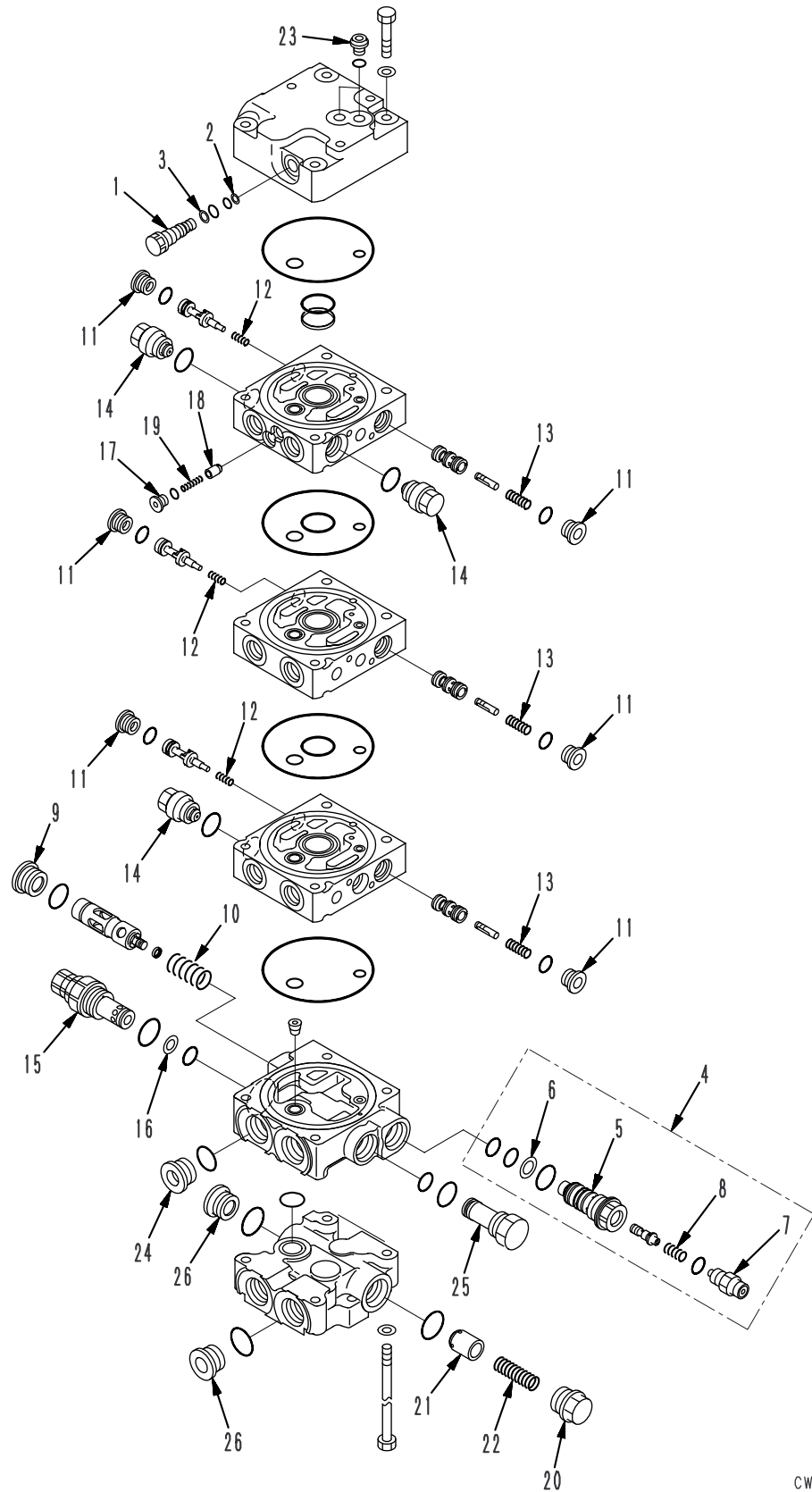
- 1) Install 3 springs (13) and 3 springs (12) to the block.
- 2) Fit 6 O-rings to 6 plugs (11).
- 3) Screw plug (11) into the block.
 Plug: **47 – 58.8 Nm {4.8 – 6 kgm}**

7. Unload valve

- 1) Install spring (10) to the block.
- 2) Fit the O-ring to plug (9) and screw them into the block
 Plug:
147 – 186.2 Nm {15 – 19 kgm}
- 3) Fit the O-ring to plug (7).
- 4) Install spring (8) and plug (7) to sleeve (5).
- 5) Screw plug (7) into sleeve (5).
 Plug:
34.3 – 44.1 Nm {3.5 – 4.5 kgm}
- 6) Fit the O-ring and ring (6) to sleeve (5).
- 7) Screw unload valve assembly (4) into the block.
 Unload valve assembly:
117.6 – 161.8 Nm {12 – 16.5 kgm}

8. Plug (Pressure releasing)

- 1) Fit the O-ring and backup rings (3) and (2) to plug (1).
- 2) Screw pressure releasing plug (1) into the block.
 Plug:
34.3 – 44.1 Nm {3.5 – 4.5 kgm}



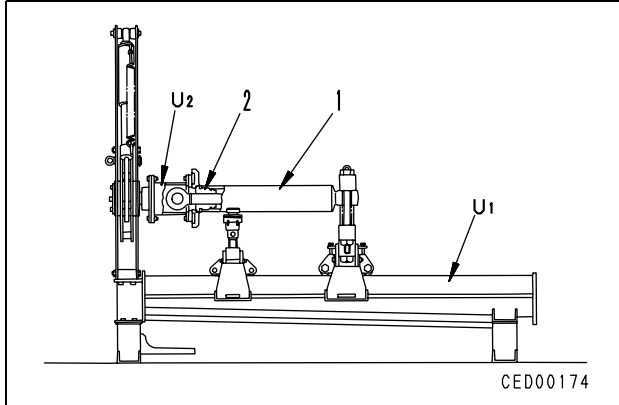
CWD10549

DISASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLIES

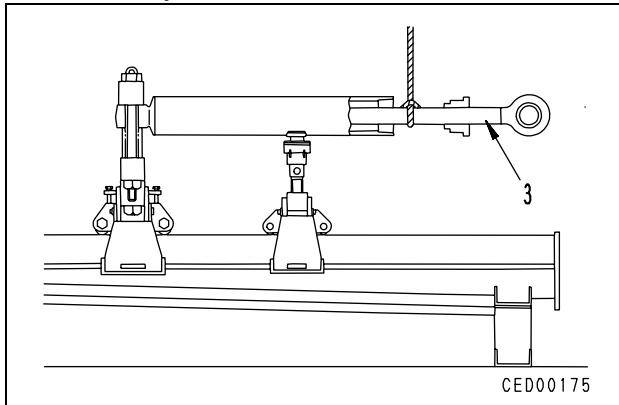
(Blade lift, angle, and tilt cylinders)

1. Piston rod assembly

- 1) Set cylinder assembly (1) to tool **U1**.
- 2) Using a hydraulic pump or a power wrench and tool **U2**, disconnect head assembly (2).

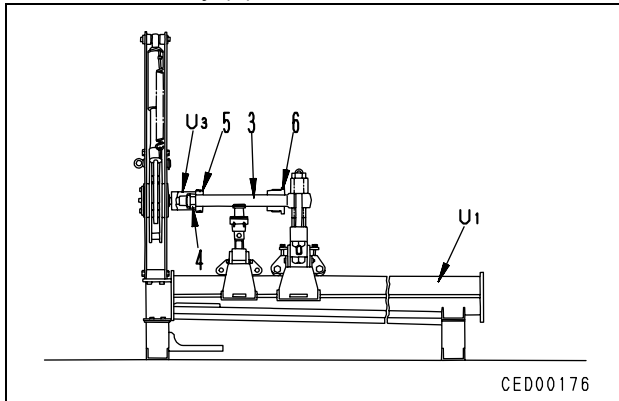


- 3) Pull out piston rod assembly (3).
★ Place an oil receiving pan, etc. under the cylinder bottom to receive the oil.



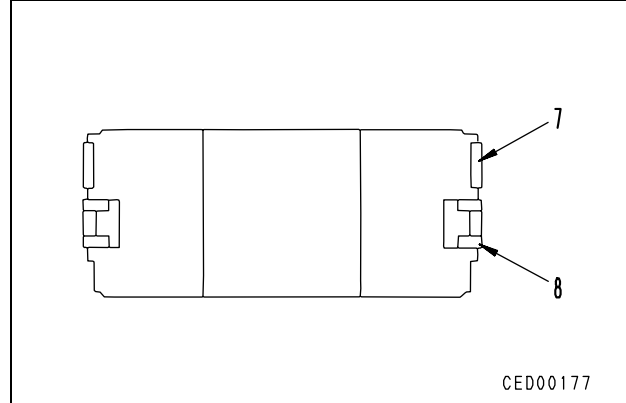
2. Piston assembly and head assembly

- 1) Set piston rod assembly (3) to tool **U1**.
- 2) Using tool **U3**, remove nylon nut (4).
★ Width across flats: 50 mm (Common to all cylinders)
- 3) Remove piston assembly (5) and head assembly (6).



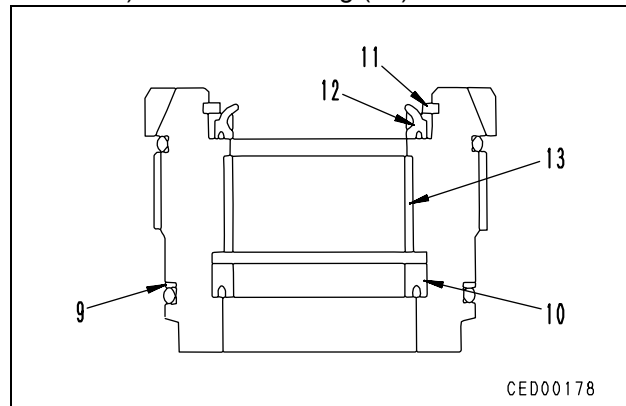
4) Disassembly of piston assembly

- i) Remove wear ring (7).
- ii) Remove piston ring (8).



5) Disassembly of head assembly

- i) Remove backup ring (9) and O-ring.
- ii) Remove packing (10)
- iii) Remove snap ring (11) and dust seal (12).
- iv) Remove bushing (13).



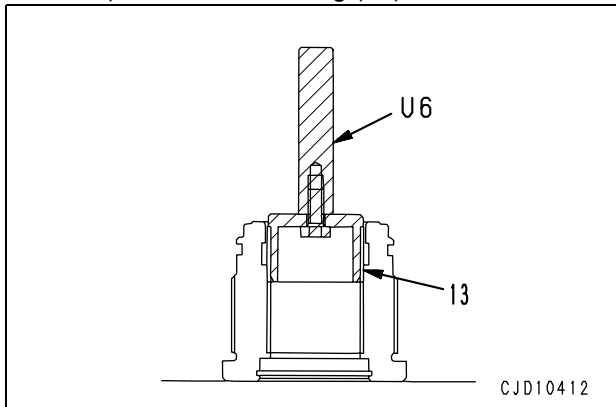
ASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLIES

(Blade lift, angle, and tilt cylinders)

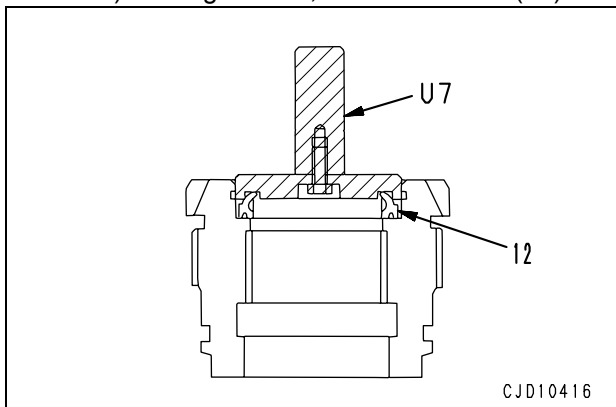
- ★ Apply engine oil to the sliding surfaces of each part and take care not to damage the rod, packing, dust seal, and O-ring.

1. Head assembly and piston assembly

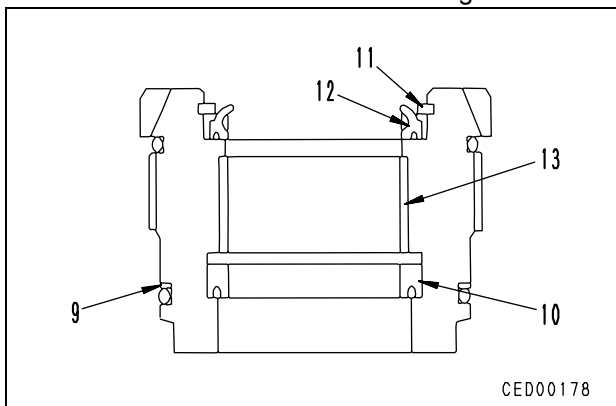
- 1) Assembly of head assembly
 - i) Press fit bushing (13) with tool **U6**.



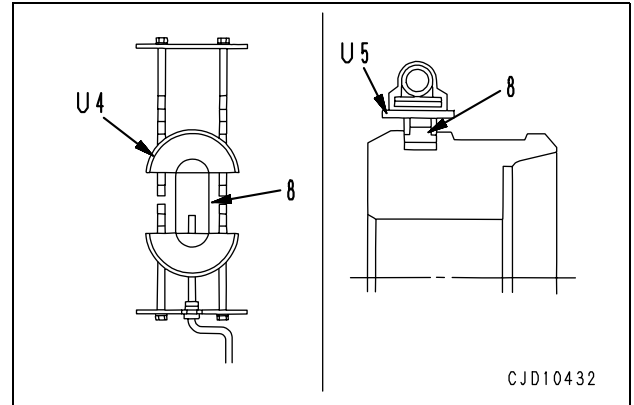
- ii) Using tool **U7**, install dust seal (12).



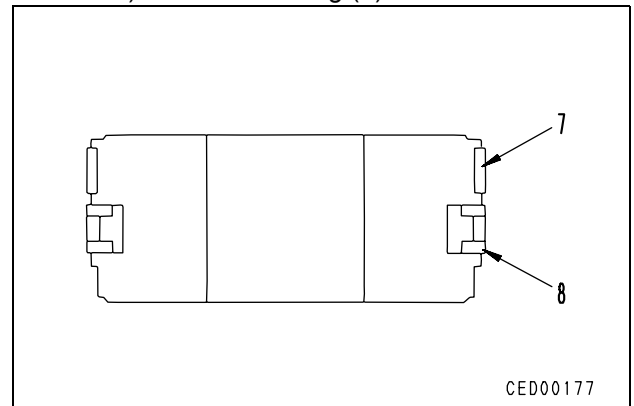
- iii) Install snap ring (11).
- iv) Install packing (10).
- v) Install backup ring (9) and O-ring.
 - ★ Warm the backup ring in water at 50 – 60°C before installing it.



- 2) Disassembly of piston assembly
 - i) Set piston ring (8) to tool **U4**.
 - ii) Rotate the handle by 8 – 10 turns to expand the piston ring.
 - iii) Remove piston ring (8) from tool **U4**.
 - iv) Install piston ring (8) to piston assembly (5).
 - v) Using tool **U5**, reduce piston ring (8).



- vi) Install wear ring (7).



2. Piston rod assembly

- 1) Set the piston rod to tool **U1**.
- 2) Install head assembly (6) and piston assembly (5).
- 3) Using tool **U3**, tighten nut (4).



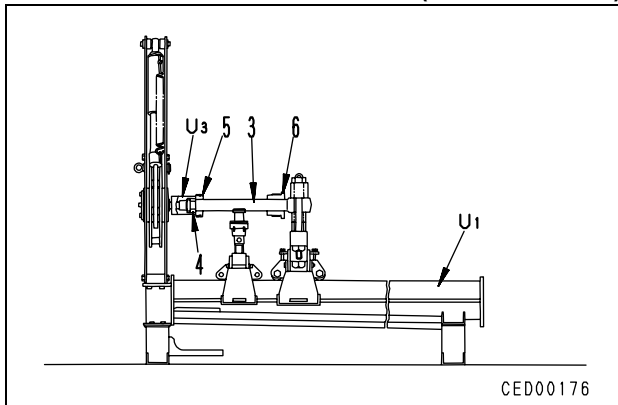
Cylinder name	Width across flats	Tightening torque of nut
Blade lift	46 mm	785 ± 78.5 Nm {80 ± 8 kgm}
Blade angle	46 mm	785 ± 78.5 Nm {80 ± 8 kgm}
Blade tilt	50 mm	1,080 ± 108 Nm {110 ± 11 kgm}

- ★ Before installing the nut, degrease the threads of the piston rod thoroughly.

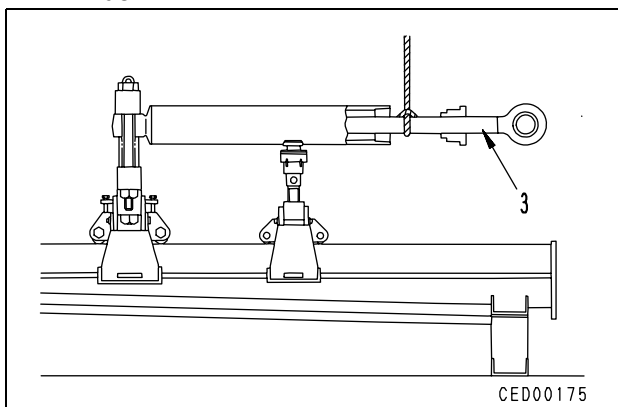


Threads of rod:

Adhesive (LOCTITE N262)



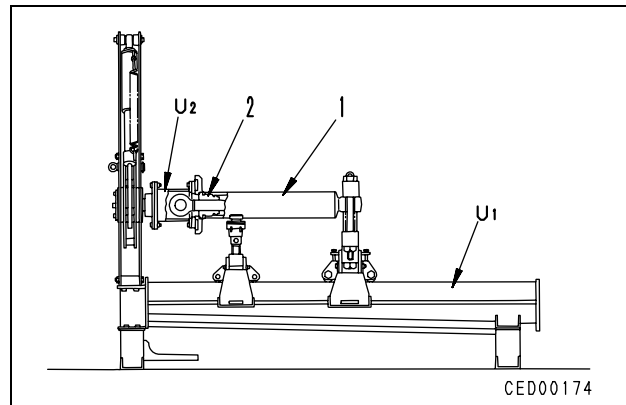
- 4) Set cylinder (1) to tool **U1**.
- 5) Install piston rod assembly (3) to the cylinder.



- 6) Using a hydraulic pump or a power wrench and tool **U2**, tighten head assembly (2).



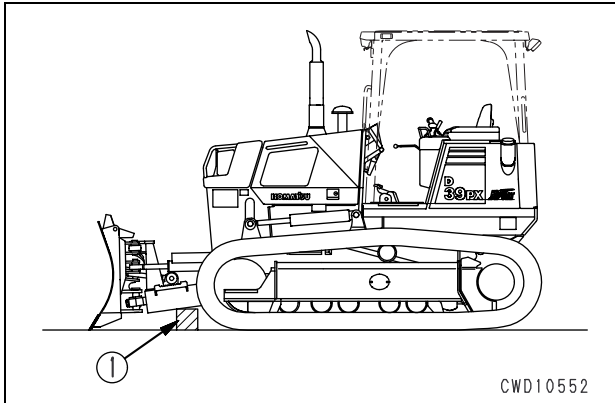
Cylinder name	Tightening torque of head
Blade lift	637 ± 63.7 Nm {65 ± 6.5 kgm}
Blade angle	569 ± 56.9 Nm {58 ± 5.8 kgm}
Blade tilt	677 ± 67.5 Nm {69 ± 6.9 kgm}



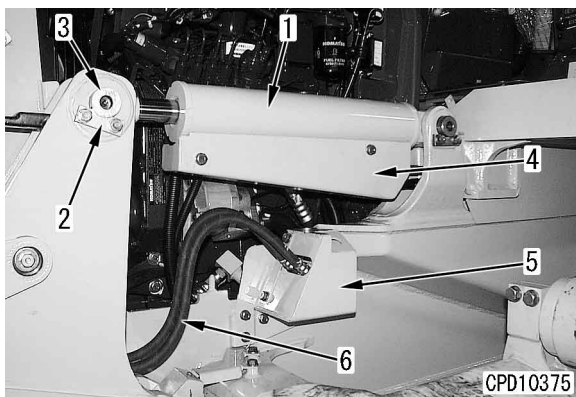
REMOVAL OF BLADE ASSEMBLY

⚠ Referring to TESTING AND ADJUSTING, Bleeding air from hydraulic cylinder, release the pressure from the piping, then loosen the oil filler cap of the hydraulic tank to release the pressure from the tank.

1. Lower the blade to level ground and set block ① under the work equipment frame.

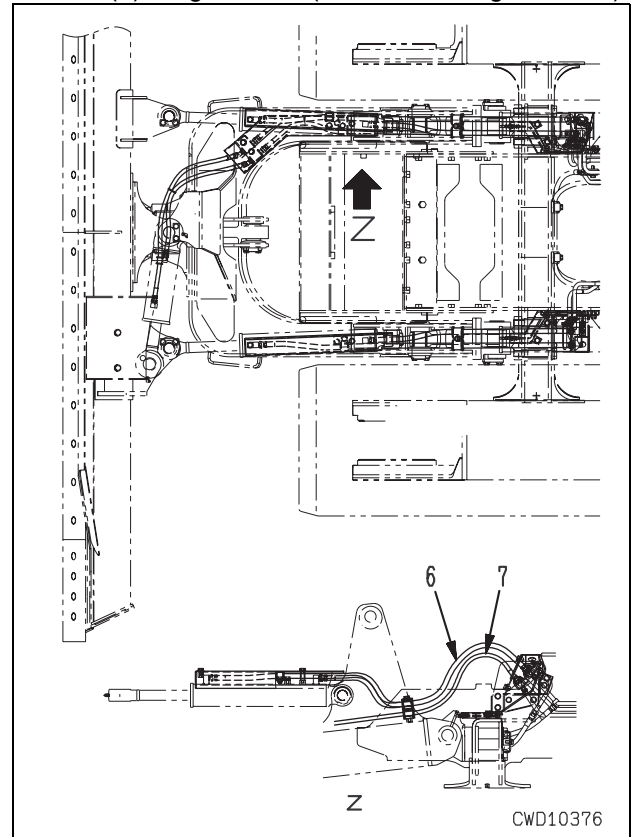


2. Sling lift cylinder (1) temporarily.
3. Remove lock plate (2) and pull out cylinder head pin (3).
※ 1
★ Both sides
4. Secure the head side of lift cylinder (1) to the engine hood knob with ropes, etc.
★ The head side of the cylinder may be secured to the knob of the cab or ROPS.
★ Both sides
5. Remove covers (4) and (5).
★ Both sides



6. Disconnect the following 6 cylinder hoses.

- (6): Tilt hose (Left side: 2)
- (7): Angle hoses (Left side: 2, Right side: 2)

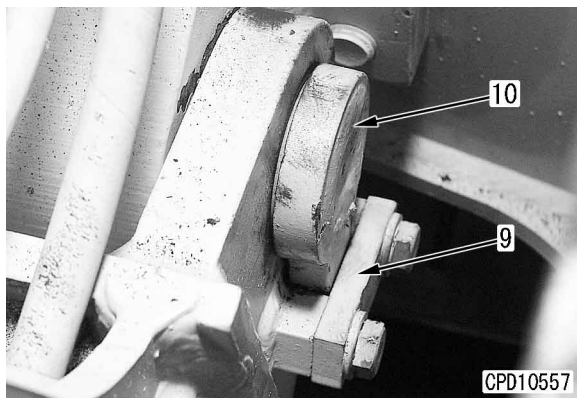


7. Sling work equipment assembly (8) temporarily.
★ Connect the rear hanging wires to a chain block, etc. to balance the work equipment assembly.



8. Remove lock plate (9) and pull out frame fitting pin (10). ※ 2

★ Both sides



9. Lift off work equipment assembly (8).



Work equipment assembly:

950 kg (D31EX-21)
 1,050 kg (D31PX-21)
 1,000 kg (D37EX-21)
 1,100 kg (D37PX-21)

INSTALLATION OF BLADE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

⚠ When aligning the pin holes, use a bar. Never insert your fingers in the pin holes.

※ 2

⚠ When aligning the pin holes, use a bar. Never insert your fingers in the pin holes.

- **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.

- **Greasing**

★ After assembling the blade assembly, apply grease to the removed pins securely.

REMOVAL OF OPERATOR'S SEAT FRAME ASSEMBLY

- ⚠ Disconnect the cable from the negative (–) terminal of the battery.
- ⚠ Lower the work equipment to the ground and stop the engine. Then, loosen the hydraulic oil filler cap slowly to release the internal pressure of the hydraulic tank.
- ⚠ Loosen the heater hose valve (If the machine is equipped with the heater or air conditioner).
- ⚠ Close the fuel stop valve.

1. Drain the hydraulic oil.



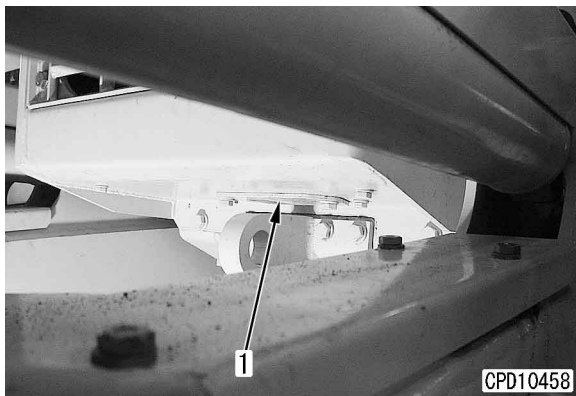
Hydraulic tank: **47 ℓ**

2. Remove the mounting bolts and cover (1).

3. Loosen the radiator cap and drain the cooling water.



Radiator: Approx. **15 ℓ**



4. Remove the mounting bolts and cover (2).

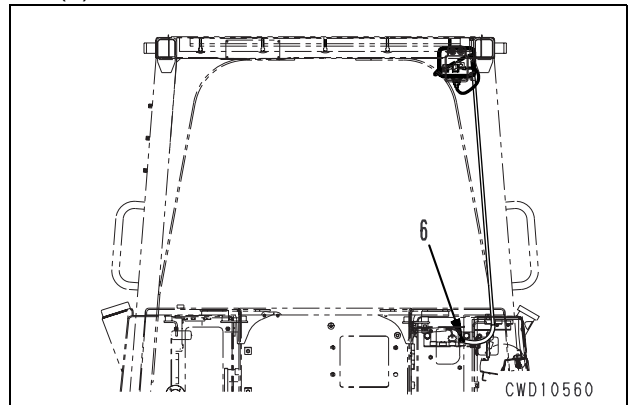
★ Both sides



5. Remove rear covers (3), (4), and (5).



6. Disconnect rear lamp wiring connector (CN33) (6).



7. Lift off ROPS guard (7).

※ 1



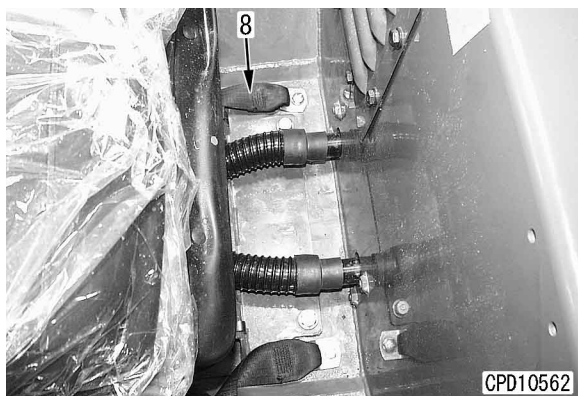
ROPS guard: **340 kg**



DISASSEMBLY AND ASSEMBLY

OPERATOR'S SEAT FRAME ASSEMBLY

8. Remove the 2 mounting bolts and seat belt (8).



9. Remove 2 pins (9).



10. Lift off operator's seat assembly (10).



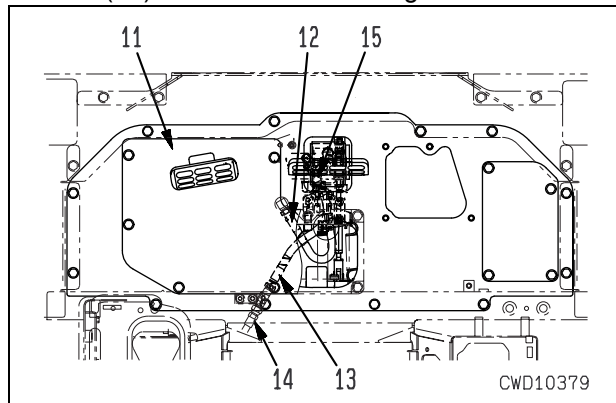
Operator's seat assembly: **45 kg**



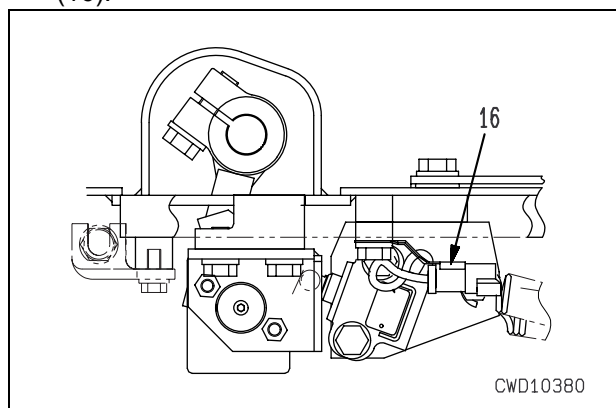
11. Remove the mounting bolts and cover (11).

12. Disconnect the following 4 hoses.

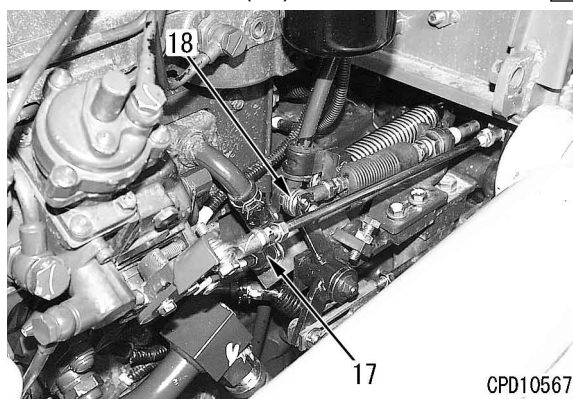
- (12): Port **P** side of HST pump
- (13): Floor junction side
- (14): Floor junction side
- (15): Port **P** side of inching valve



13. Disconnect limit switch wiring connector (CN25) (16).



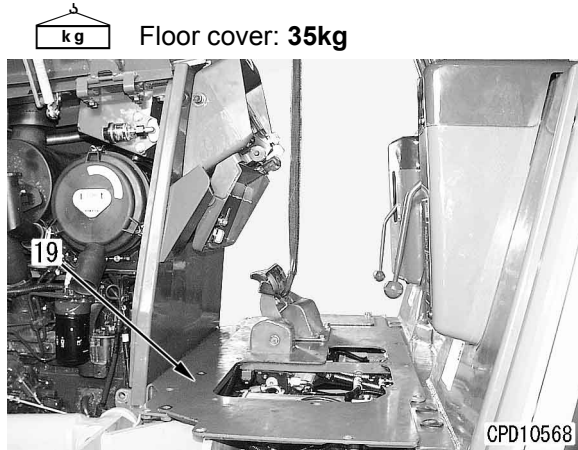
14. Disconnect decelerator pedal cable (17) and fuel control cable (18). ※ 2



DISASSEMBLY AND ASSEMBLY

OPERATOR'S SEAT FRAME ASSEMBLY

15. Remove the mounting bolts and lift off floor cover (19).



16. Disconnect the following 4-spool solenoid valve wiring connectors.

- (20): (CN28) 2nd gear speed select connector (Color band: Yellow)
- (21): (CN29) 3rd gear speed select connector (Color band: Green)
- (22): (CN31) Parking brake connector (Color band: Orange)

17. Disconnect the following 2 hoses.

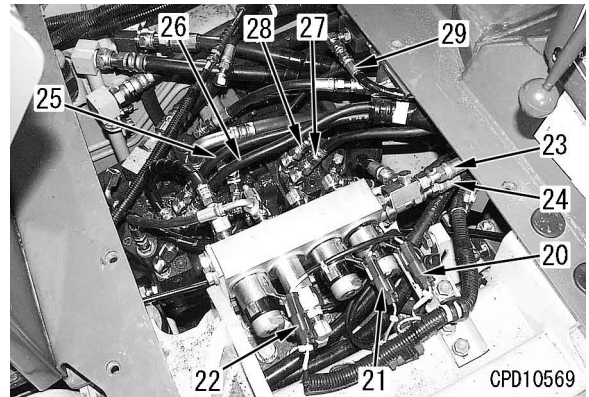
- (23): Port P side of work equipment PPC lock
- (24): Port T side of drain collecting block

18. Disconnect the following 4 travel motor PPC hoses

- (25): Left travel forward (Hose color band: Yellow)
- (26): Left travel reverse (Hose color band: Orange)
- (27): Right travel forward (Hose color band: Green)
- (28): Right travel reverse (Hose color band: Blue)

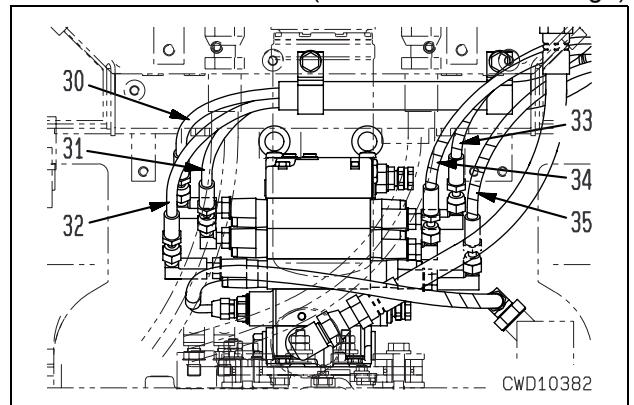
19. Disconnect drain collecting block hose (29).

★ The photograph shows the D39-21, but in the case of the D31 and D37-21, there is a branch hose, so disconnect the branch hose also.



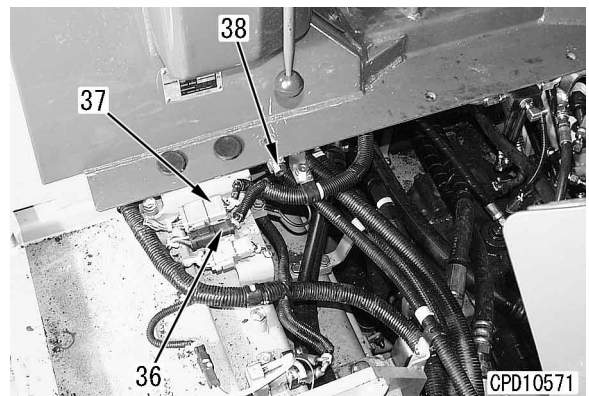
20. Disconnect the following 6 work equipment PPC hoses.

- (30): Angle right (Hose color band: Green)
- (31) Tilt left (Hose color band: White)
- (32), (33): Lift up (Hose color band: Red)
- (34): Angle left (Hose color band: Blue)
- (35): Tilt right: (Hose color band: Brown)
- (46), (47): Lift down (Hose color band: Orange)

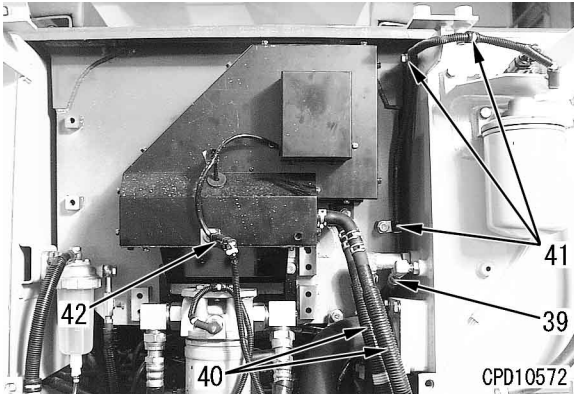


21. Disconnect the following 2 floor wiring harness connectors and the floor ground wire.

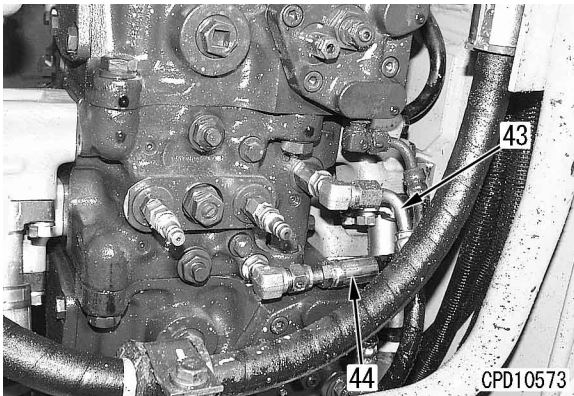
- (36): (CN9)
- (37): (CN10)
- (38): Floor ground wire



22. Disconnect drain collecting block hose (39).
23. Disconnect 2 heater hoses (40). (If the machine is equipped with the heater or air conditioner)
24. Disconnect 3 floor wiring harness clamps (41).
25. Disconnect heater unit wiring connector (CN92) (42). (If the machine is equipped with the heater or air conditioner)



26. Disconnect HST pump hoses (43) and (44).
 - (43): **CPB** port side of HST pump
 - (44): **PH** port side of HST pump



27. Remove the mounting bolts and lift off operator's seat frame assembly (45). ※ 3



Operator's seat frame assembly:

170 kg



INSTALLATION OF OPERATOR'S SEAT FRAME ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1



Mounting bolt:

245 – 309 Nm {25 – 31.5 kgm}

※ 2

- ★ Adjust the decelerator pedal linkage and fuel control linkage. For details, see TESTING AND ADJUSTING, Adjusting decelerator pedal linkage and Adjusting fuel control linkage.

※ 3



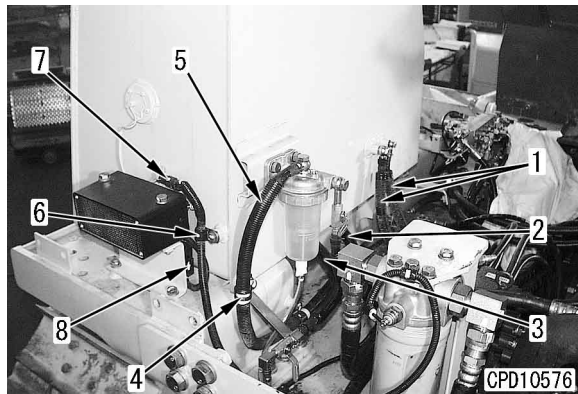
Mounting bolt: **25.5 Nm {2.6 kgm}**

- **Refilling with water**
 - ★ Add water through the water filler to the specified level. Run the engine to heighten the water temperature. Then, check the water level again.
- **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 (HST circuit)**
 - ★ Bleed air from the HST pump circuit. For details, see INSTALLATION OF HST PUMP ASSEMBLY.

REMOVAL OF FUEL TANK ASSEMBLY

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Remove the operator's cab frame assembly. For details, see REMOVAL OF OPERATOR'S CAB FRAME ASSEMBLY.
2. Close the fuel stop valve.
3. Disconnect 2 fuel return hoses (1).
4. Disconnect the 2 fuel tank hoses.
 - Hose (2): From fuel tank to fuel filter
 - Hose (3): From fuel tank to fuel drain valve
5. Remove clamp (4) and disconnect fuel hose (5).
 - ★ When removing the clamp, remove the fuel drain valve bracket, too.
6. Remove clamp (6) and disconnect the following 2 connectors.
 - (7): (CN13) Fuel sensor connector
 - (8): (CN14) Backup alarm relay connector



7. Remove cap (9) and eyebolts. ※ 1

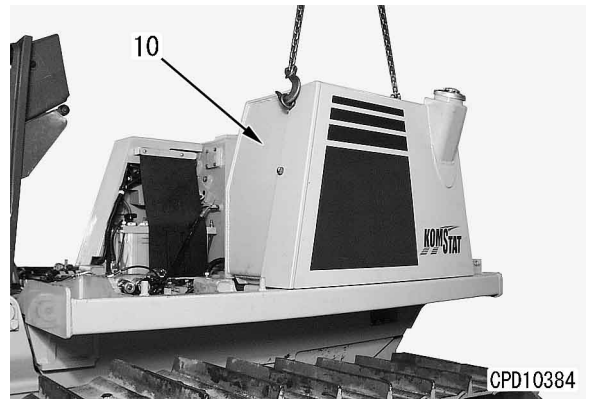


8. Lift off fuel tank assembly (10).



Fuel tank assembly:

110 kg (Dry weight)



INSTALLATION OF FUEL TANK ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1



Mounting bolt: **Adhesive (LT-2)**

REMOVAL OF HYDRAULIC TANK ASSEMBLY

- ⚠ Disconnect the cable from the negative (–) terminal of the battery.
- ⚠ Lower the work equipment to the ground and stop the engine. Then, loosen the hydraulic oil filler cap slowly to release the internal pressure of the hydraulic tank.

1. Remove the operator's cab frame assembly. For details, see REMOVAL OF OPERATOR'S CAB FRAME ASSEMBLY.

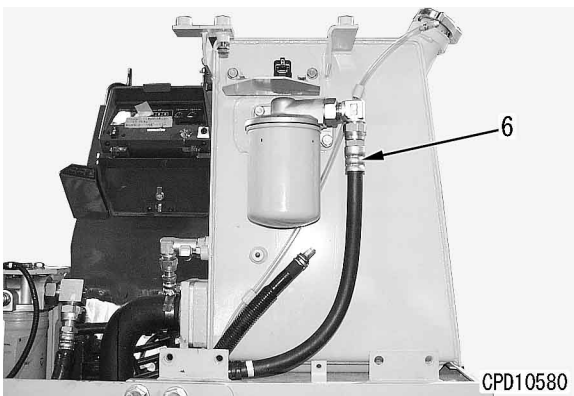
2. Disconnect the following 5 hoses.



- (1): Delivery hose
- (2): Work equipment valve return hose
- (3): Left travel motor return hose
- (4): Right travel motor return hose
- (5): HST pump return hose



3. Disconnect oil filter hose (6).



4. Remove cap (7) and mounting bolts.



5. Remove battery cover bolt (8).

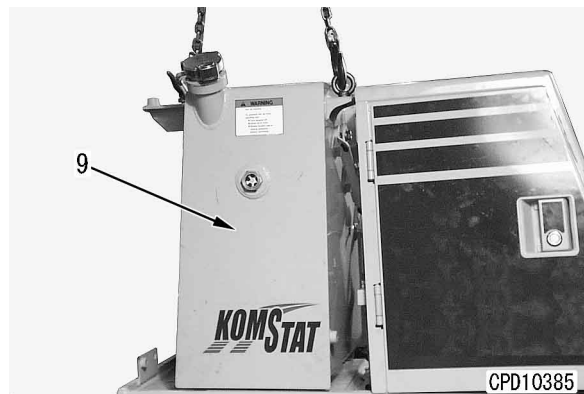
- ★ After removing the bolt, move the battery cover so that the hydraulic tank assembly will come off easily.



6. Lift off hydraulic tank assembly (9).



Hydraulic tank assembly: **70 kg**



INSTALLATION OF HYDRAULIC TANK ASSEMBLY

- Carry out installation in the reverse order to removal.
 - ★ Take extreme care that each hose will not be twisted when connected.

※ 1



Clamp: $8.8 \pm 0.5 \text{ Nm}$ { $0.9 \pm 0.05 \text{ kgm}$ }

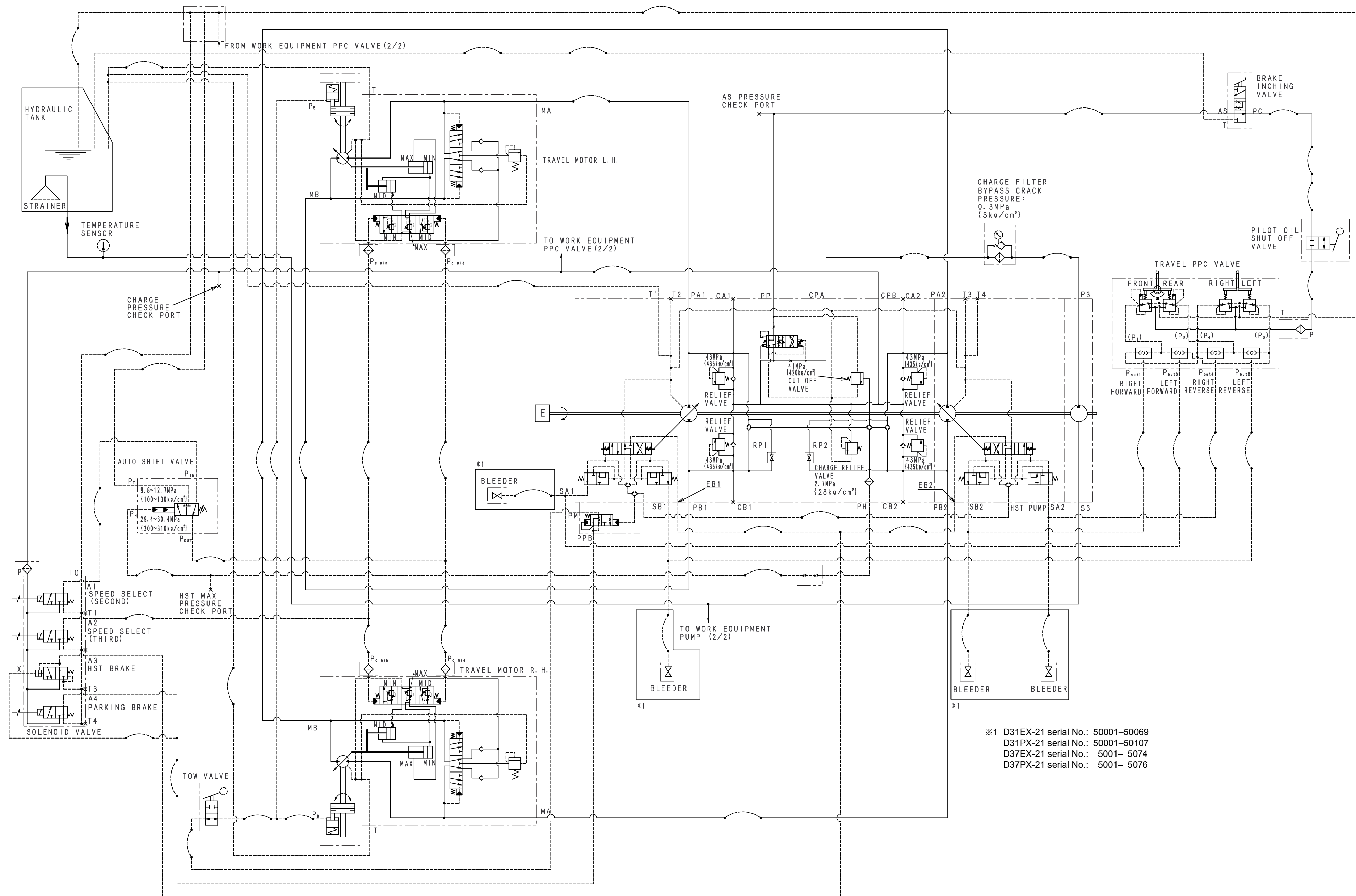
- **Refilling with oil (Hydraulic tank)**
 - ★ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.
- **Bleeding air (HST circuit)**
 - ★ Bleed air from the HST pump circuit. For details, see INSTALLATION OF HST PUMP ASSEMBLY.

90 OTHERS

HYDRAULIC CIRCUIT DIAGRAM (1/2)	90-3
D31EX-21 Serial No. 50001 – 50097	
D31PX-21 Serial No. 50001 – 50181	
D37EX-21 Serial No. 5001 – 5104	
D37PX-21 Serial No. 5001 – 5090	
HYDRAULIC CIRCUIT DIAGRAM (1/2)	90-3-2
D31EX-21 Serial No. 50098 and up	
D31PX-21 Serial No. 50182 and up	
D37EX-21 Serial No. 5105 and up	
D37PX-21 Serial No. 5091 and up	
HYDRAULIC CIRCUIT DIAGRAM (2/2)	90-5
HYDRAULIC CIRCUIT DIAGRAM (2/2) (For D37EX, PX-21 EU spec.)	90-5-2
ELECTRICAL CIRCUIT DIAGRAM (1/2)	90-7
ELECTRICAL CIRCUIT DIAGRAM (2/2)	90-9
ELECTRICAL CIRCUIT DIAGRAM FOR AIR CONDITIONER	90-11

HYDRAULIC CIRCUIT DIAGRAM (1/2)

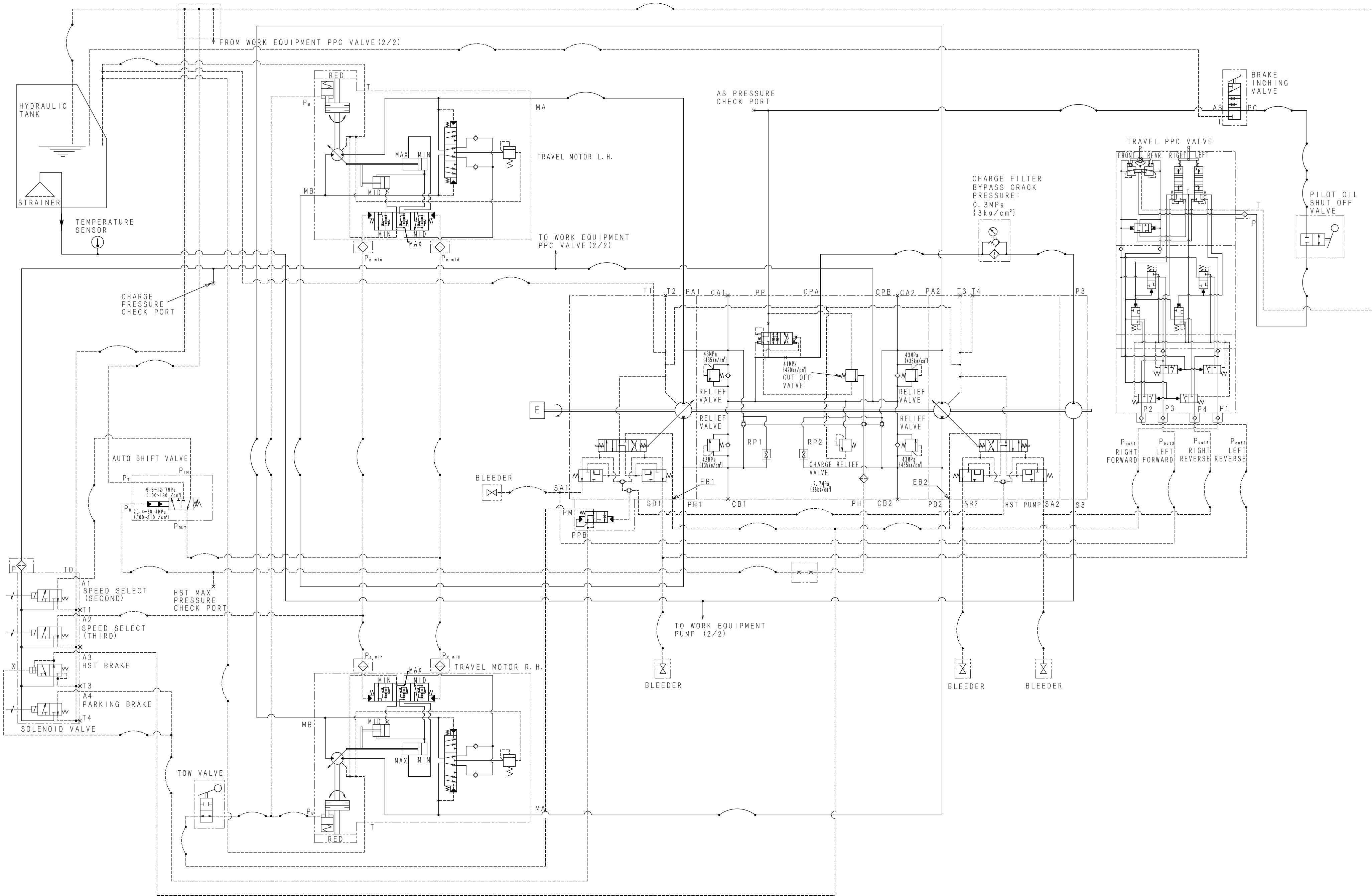
D31EX-21 Serial No. 50001 – 50097, D37EX-21 Serial No. 5001 – 5104
D31PX-21 Serial No. 50001 – 50181, D37PX-21 Serial No. 5001 – 5090



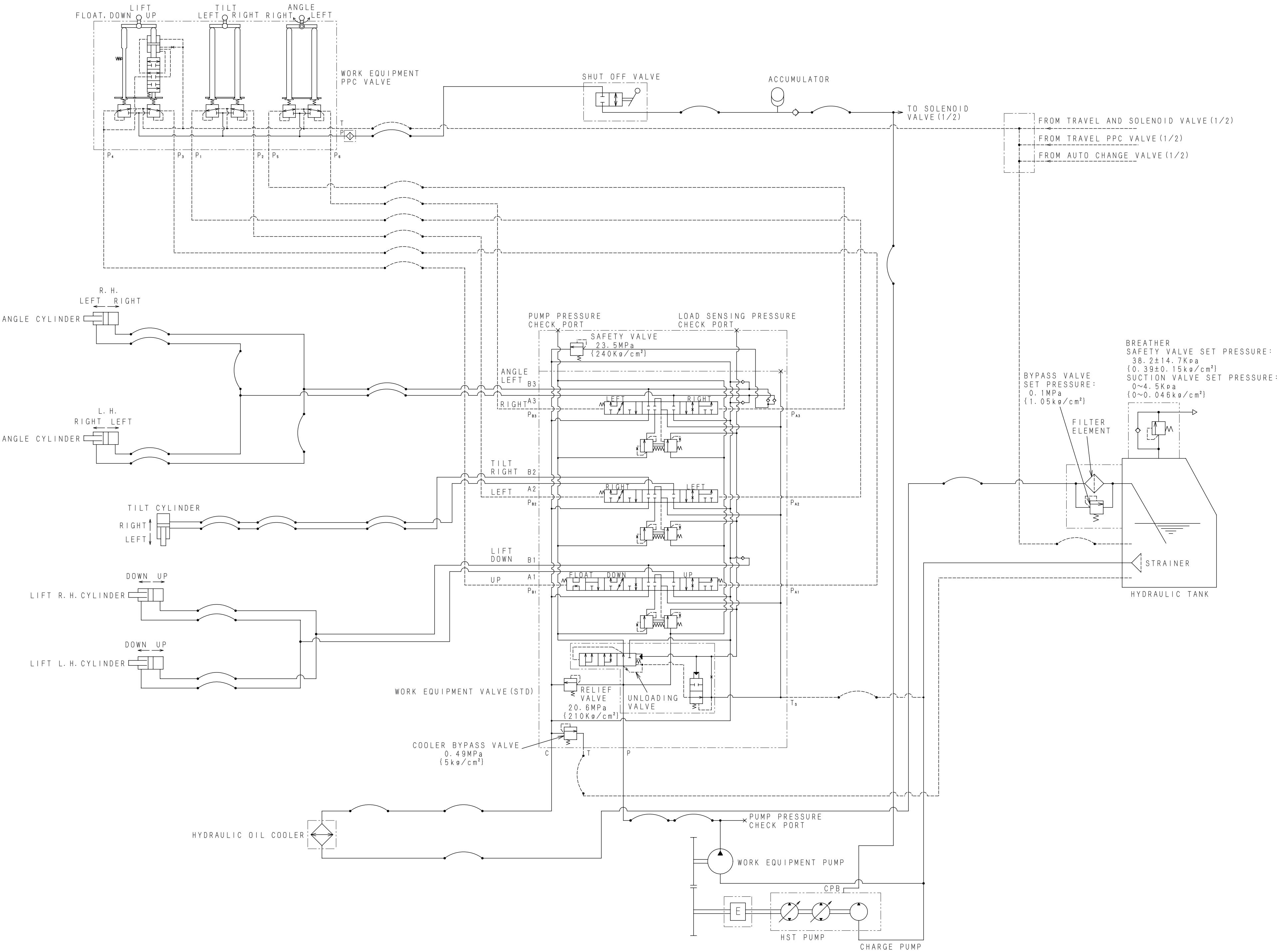
※1 D31EX-21 serial No.: 50001–50069
D31PX-21 serial No.: 50001–50107
D37EX-21 serial No.: 5001– 5074
D37PX-21 serial No.: 5001– 5076

HYDRAULIC CIRCUIT DIAGRAM (1/2)

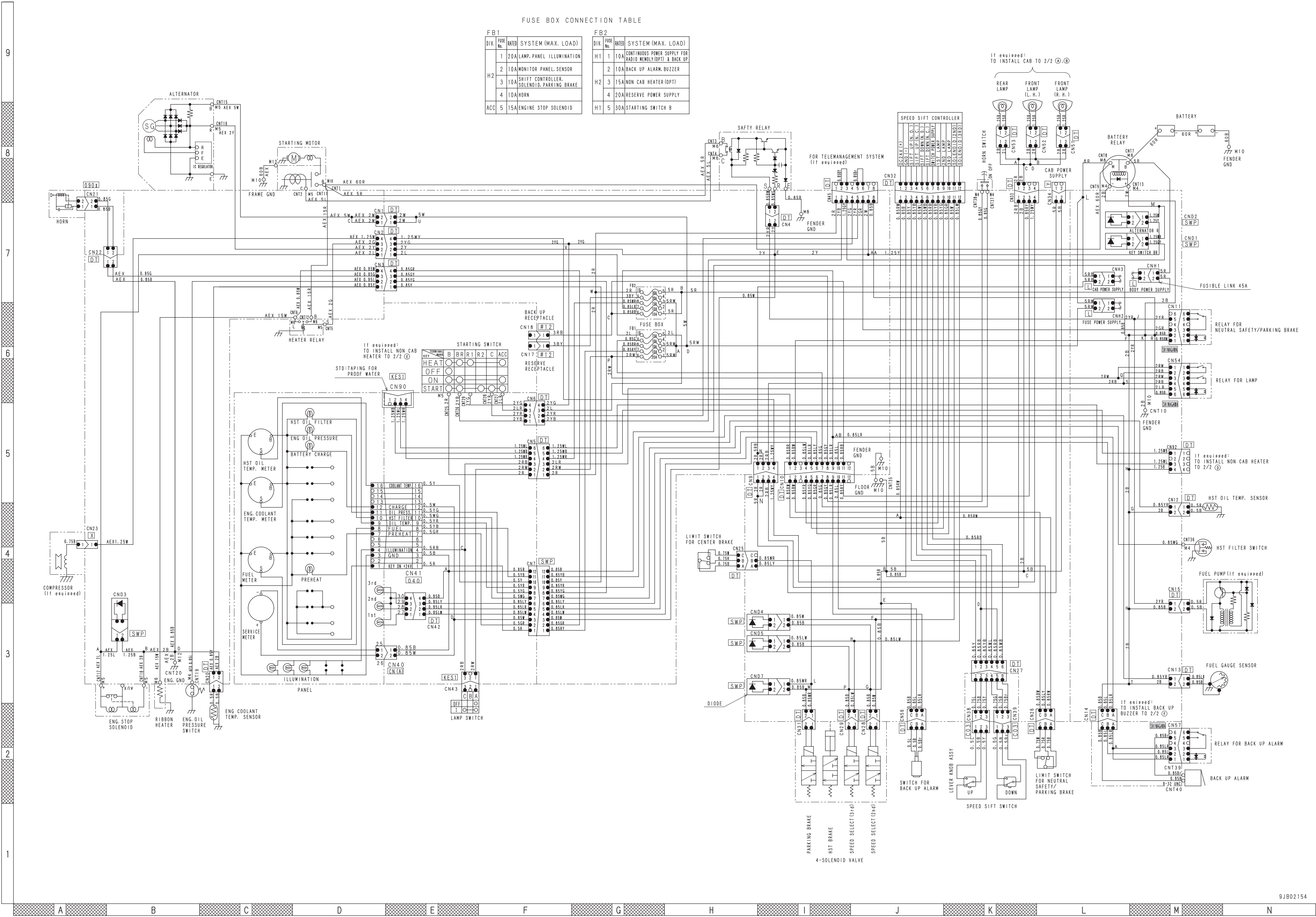
D31EX-21 Serial No. 50098 and up, D37EX-21 Serial No. 5105 and up
D31PX-21 Serial No. 50182 and up, D37PX-21 Serial No. 5091 and up



HYDRAULIC CIRCUIT DIAGRAM (2/2) FOR D37EX, PX-21 EU SPEC.



ELECTRICAL CIRCUIT DIAGRAM (1/2)

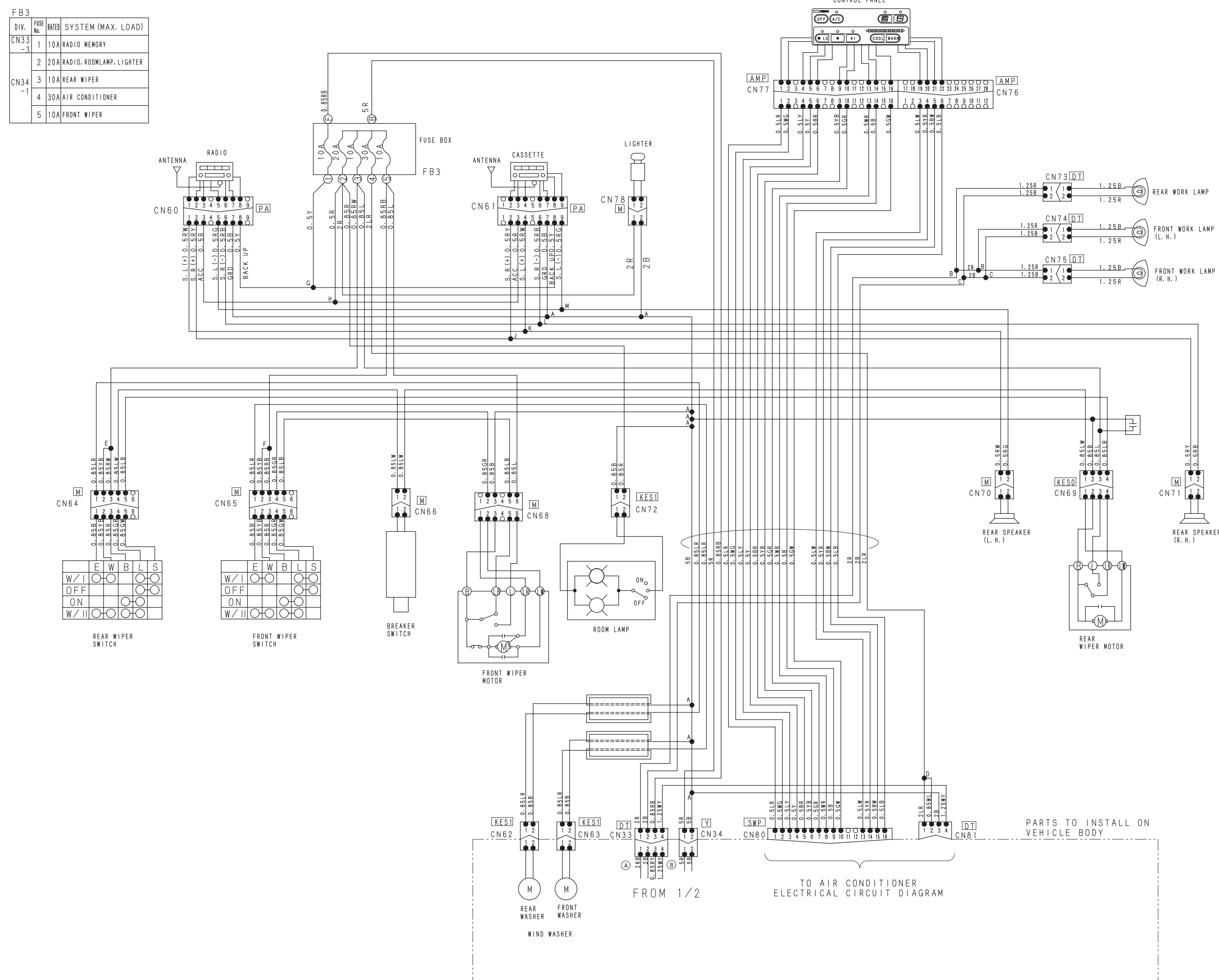


ELECTRICAL CIRCUIT DIAGRAM (2/2)

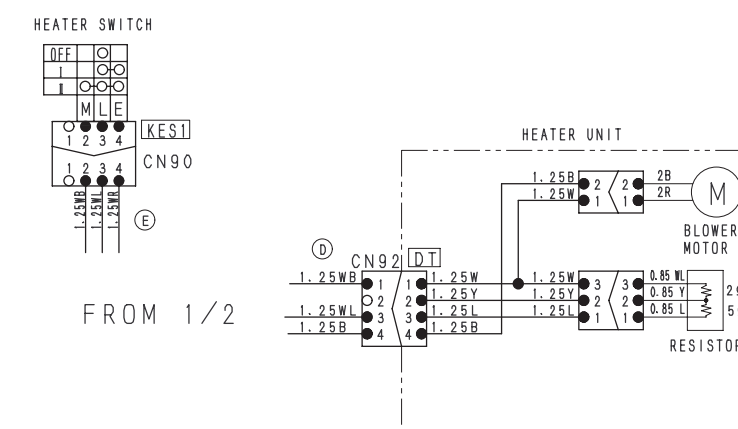
FUSE BOX CONNECTION TABLE

FB3			
DIV.	FUSE No.	RATED	SYSTEM (MAX. LOAD)
CN33 -3	1	10A	RADIO MEMORY
	2	20A	RADIO, ROOMLAMP, LIGHTER
	3	10A	REAR WIPER
	4	30A	AIR CONDITIONER
	5	10A	FRONT WIPER

If equipped: TO INSTALL CAB

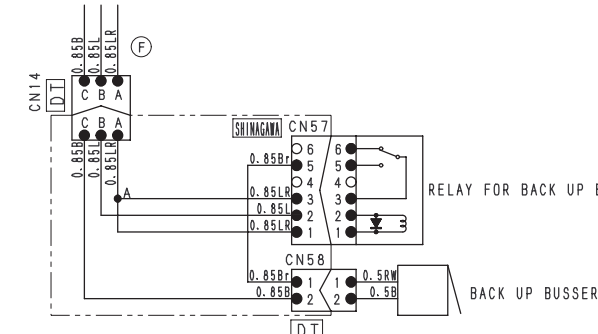


If equipped: TO INSTALL NON CAB HEATER



STD FOR JAPAN:TO INSTALL BACK UP BUZZER

FROM 1/2



ELECTRICAL CIRCUIT DIAGRAM FOR AIR CONDITIONER

