SHOP MANUAL

KOMATSU

PW180-7E0

MACHINE MODEL	SERIAL NUMBER
PW180-7E0	**H55051 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.
- PW180-7E0 mount the SAA6D107E-1 engine.
- For details of the engine, see the 107 Series Engine Shop Manual.

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SAFETY

SAFETY NOTICE

IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for the safe operation of your machine. The service and repair techniques recommended and described in this manual are both effective and safe methods of operation. Some of these operations require the use of tools specially designed for the 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 & 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, glasses, 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

1. Before adding oil or making repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.
2. 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.
3. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
4. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

PRECAUTIONS DURING WORK

1. 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.
2. 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.
3. Before starting work, remove the leads from the battery. ALWAYS remove the lead from the negative (-) terminal first.
4. 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.
5. 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.
6. When removing components, be careful not to break or damage the wiring, Damaged wiring may cause electrical fires.
7. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips on to the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip, or can even start fires.
8. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.
9. Be sure to assemble all parts again in their original places. Replace any damaged part 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.

10. 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.
11. 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.
12. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.
13. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.
14. 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.

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Mark	Indication	Action required
○	Page to be newly added	Add
●	Page to be replaced	Replace
()	Page to be deleted	Discard

Pages having no marks are those previously revised or made additions.

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GENERAL

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

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

GENERAL

This section lists the general machine dimensions, performance specifications, component weights, and fuel, coolant and lubricant specification charts.

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.

TESTING, ADJUSTING AND TROUBLESHOOTING

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” to “Causes” are also included in this section.

DISASSEMBLY AND ASSEMBLY

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

NOTICE

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your distributor for the latest information.

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 to cover all models

Attachment volume: Each issued as one to cover all models

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

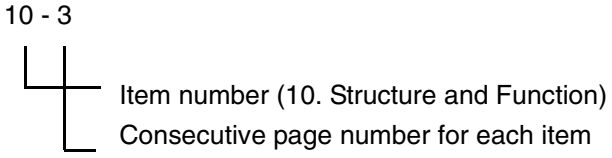
DISTRIBUTION AND UPDATING

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

FILING METHOD

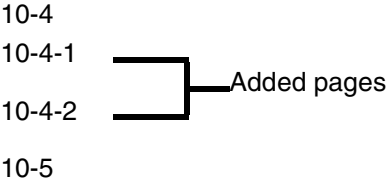
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3. Additional pages: Additional pages are indicated by a hyphen (-) and numbered after the page number. File as in the example.

Example:



REVISED EDITION MARK

When a manual is revised, an edition mark (①②③…) is recorded on the bottom outside corner of the pages.

REVISIONS

Revised pages are shown at the LIST OF REVISED PAGES between the title page and SAFETY page.

SYMBOLS

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

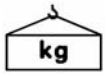
Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work.
★	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire or when working posture is important, etc.
	Tightening torque	Places that require special attention for tightening torque during assembly.
	Coat	Places to be coated with adhesives 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

⚠ WARNING

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 interface with the part to be removed.

WIRE ROPES

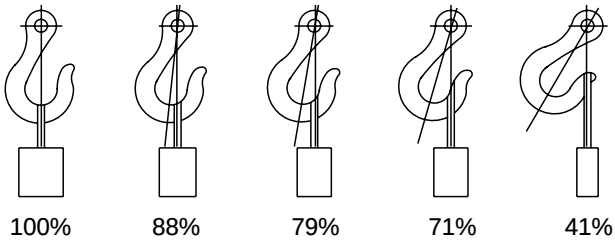
3. Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

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

Rope diameter	Allowable load	
mm	kN	tons
10	9.8	1.0
11.2	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 1/6 or 1/7 of the breaking strength of the rope used.

4. 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.

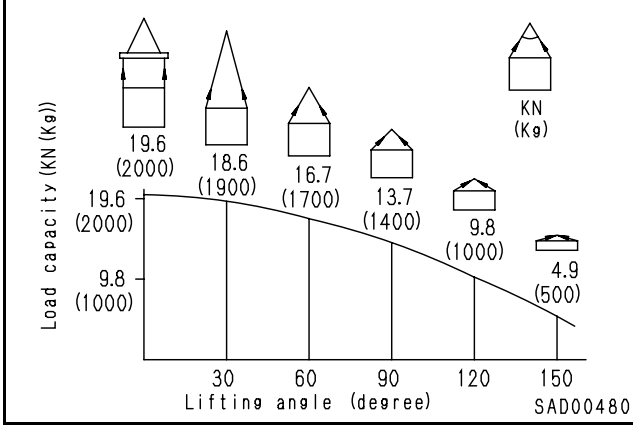


5. Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.

⚠ WARNING

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

6. 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 (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various hanging angles. When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended. This weight becomes 1000 kg when two ropes make a 120° hanging angle. On the other hand, two ropes are subject to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°



COATING MATERIALS

○ The recommended coating materials prescribed in the shop manuals are listed below.

Category	Code	Part No.	Quantity	Container	Main applications, features
Adhesives	LT-1A	790-129-9030	150 g	Tube	● Used to prevent rubber gaskets, rubber cushions and cork plugs from coming out
	LT-1B	790-129-9050	20 g (2 pes.)	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, chemicals ● Used for anti-loosening and sealant purposes 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 or 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	179-129-9140	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	● Features: Resistance to heat, chemicals ● Used at joint portions subject to high temperature.
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-3	790-129-9070	1 kg	Can	● Features: Resistance to heat ● Used as sealant for flange surfaces and bolts at high temperature locations; used to prevent seizure. ● Used as sealant for heat resistant gasket for at high temperature locations such as engine pre-combustion chamber, exhaust pipe.

Category	Code	Part No.	Quantity	Container	Main applications, features
Gasket sealant	LG-4	790-129-9020	200 g	Tube	● Features: Resistance to water, oil ● Used as sealant for flange surface, thread. ● Also possible to use as sealant for flanges with large clearance. ● Used as sealant for mating surfaces of final drive case, transmission case.
	LG-5	790-129-9080	1 kg	Polyethylene container	● Used as sealant for various threads, pipe joints, flanges. ● Used as sealant for tapered plugs, elbows, nipples of hydraulic piping.
	LG-6	09940-00011	250 g	Tube	● Features: Silicon based, resistant to heat, cold. ● Used as sealant for flange surface, thread. ● Used as sealant for oil pan, final drive case, etc.
	LG-7	09920-00150	150 g	Tube	● Features: Silicon based, quick hardening type. ● Used as sealant for flywheel housing, intake manifold, oil pan, thermostat housing, etc.
	Three bond 1211	790-129-9090	100 g	Tube	● Used as heat-resisting sealant for repairing engines.
Molybdenum disulphide lubricant	LM-G	09940-00051	60 g	Can	● Used as lubricant for sliding parts (to prevent 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 SYGA160CNLI	Various	Various	● General purpose type
	G2-CA	SYG2-400CA SYG2-350CA SYG2-400CA-A SYG2-160CA SYG2-160CNCA	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.

STANDARD TIGHTENING TORQUE

STANDARD TIGHTENING TORQUE OF BOLTS AND NUTS

The following charts give the standard tightening torques of bolts and nuts. Exceptions are given in DISASSEMBLY AND ASSEMBLY.

Thread diameter of bolt	Width across flats		
mm	mm	Nm	kgm
6	10	13.2 ± 1.4	1.35 ± 0.15
8	13	31.4 ± 2.9	3.20 ± 0.3
10	17	65.7 ± 6.8	6.70 ± 0.7
12	19	112 ± 9.8	11.5 ± 1.0
14	22	177 ± 19	18 ± 2.0
16	24	279 ± 29	28.5 ± 3
18	27	383 ± 39	39 ± 4
20	30	549 ± 58	56 ± 6
22	32	745 ± 78	76 ± 8
24	36	927 ± 98	94.5 ± 10
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	3280 ± 340	335 ± 35

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

TIGHTENING TORQUE OF HOSE NUTS

Use these torques for hose nuts.

Nominal No.	Thread diameter	Width across flat	Tightening torque	
	mm	mm	Nm	kgm
02	14	19	24.5 ± 4.9	2.5 ± 0.5
03	18	24	49 ± 19.6	5 ± 2
04	22	27	78.5 ± 19.6	8 ± 2
05	24	32	137.3 ± 29.4	14 ± 3
06	30	36	176.5 ± 29.4	18 ± 3
10	33	41	196.1 ± 49	20 ± 5
12	36	46	245.2 ± 49	25 ± 5
14	42	55	294.2 ± 49	30 ± 5

TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

Use these torques for split flange bolts.

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

TIGHTENING TORQUES FOR HOSES (Taper seal type and face seal type)

- Unless there are special instructions, tighten the hoses (taper the hoses (taper seal type and face seal type) to the torque below.
- Apply the following torque when the threads are coated (wet) with engine oil.

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

TIGHTENING TORQUE FOR 107 ENGINE SERIES (BOLTS AND NUTS)

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

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

TIGHTENING TORQUE FOR 107 ENGINE SERIES (EYE JOINTS)

Use these torque values for eye joints (unit: mm).

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

TIGHTENING TORQUE FOR 107 ENGINE SERIES (TAPERED SCREWS)

Use these torque values for tapered screws (unit: inch).

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

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:05WB indicates a cable having a nominal number 05 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 strand (mm)	Cross section (mm)			
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	—	Black & White	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 & Red
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 TABLES

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.

   A. Locate the number 50 in the vertical column at the left side, take this as (1), then draw a horizontal line from (1).

   B. Locate the number 5 in the row across the top, take this as (2), then draw a perpendicular line down from (2).

   C. Take the point where the two lines cross as (3). This point (3) gives the value when converting from millimeters to inches. Therefore, 55 millimeters = 2.165 inches.

2. Convert 550 mm into inches.

   A. The number 550 does not appear in the table, so divide by 10 (move the decimal one place to the left) to convert it to 55 mm.

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

   C. The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal one place to the right) to return to the original value. This gives 550 mm = 21.65 inches.

(2)

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
						(3)				
(1) 50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Millimeters to Inches **1 mm = 0.03937 in**

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound **1 kg = 2.2046 lb**

	0	1	2	3	4	5	6	7	8	9
0	0	2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.53	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

Litre to U.S. Gallon **1 L = 0.2642 U.S. Gal**

	0	1	2	3	4	5	6	7	8	9
0	0	0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.113	2.378
10	2.642	2.906	3.170	3.434	3.698	3.963	4.227	4.491	4.755	5.019
20	5.283	5.548	5.812	6.076	6.340	6.604	6.869	7.133	7.397	7.661
30	7.925	8.189	8.454	8.718	8.982	9.246	9.510	9.774	10.039	10.303
40	10.567	10.831	11.095	11.359	11.624	11.888	12.152	12.416	12.680	12.944
50	13.209	13.473	13.737	14.001	14.265	14.529	14.795	15.058	15.322	15.586
60	15.850	16.115	16.379	16.643	16.907	17.171	17.435	17.700	17.964	18.228
70	18.492	18.756	19.020	19.285	19.549	19.813	20.077	20.341	20.605	20.870
80	21.134	21.398	21.662	21.926	22.190	22.455	22.719	22.983	23.247	23.511
90	23.775	24.040	24.304	24.568	24.832	25.096	25.361	25.625	25.889	26.153

Litre to U.K. Gallon **1 L = 0.21997 U.K. Gal**

	0	1	2	3	4	5	6	7	8	9
0	0	0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.950	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.699	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.037	18.257	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

kgm to ft. lb. **1 kgm = 7.233 ft. lb.**

	0	1	2	3	4	5	6	7	8	9
0	0	7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	296.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	1005.4
140	1012.6	1019.9	1027.1	1034.3	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.63	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

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

	0	1	2	3	4	5	6	7	8	9
0	0	14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.4	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.1	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	995.6	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	19324	1949	1963	1977
140	1991	2005	2034	2048	2062	2077	2091	2105	2119	
150	2134	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2389	2404
170	2418	2432	2446	2460	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	2603	2617	2631	2646	2660	2674	2688
190	2702	2717	2731	2745	2759	2773	2788	2802	2816	2830
200	2845	2859	2873	2887	2901	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3343	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

Temperature

Fahrenheit Centigrade Conversion; a simple way to convert a Fahrenheit temperature reading into a Centigrade temperature reading or vise 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.

°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	60	140.0	35.0	95	203.0
-22.8	-9	15.8	-3.3	26	78.8	16.1	61	141.8	35.6	96	204.8
-22.2	-8	17.6	-2.8	27	80.6	16.7	62	143.6	36.1	97	206.6
-21.7	-7	19.4	-2.2	28	82.4	17.2	63	145.4	36.7	98	208.4
-21.1	-6	21.2	-1.7	29	84.2	17.8	64	147.2	37.2	99	210.2
-20.6	-5	23.0	-1.1	30	86.0	18.3	65	149.0	37.8	100	212.0
-20.0	-4	24.8	-0.6	31	87.8	18.9	66	150.8	40.6	105	221.0
-19.4	-3	26.6	0	32	89.6	19.4	67	152.6	43.3	110	230.0
-18.9	-2	28.4	0.6	33	91.4	20.0	68	154.4	46.1	115	239.0
-18.3	-1	30.2	1.1	34	93.2	20.6	69	156.2	48.9	120	248.0
-17.8	0	32.0	1.7	35	95.0	21.1	70	158.0	51.7	125	257.0
-17.2	1	33.8	2.2	36	96.8	21.7	71	159.8	54.4	130	266.0
-16.7	2	35.6	2.8	37	98.6	22.2	72	161.6	57.2	135	275.0
-16.1	3	37.4	3.3	38	100.4	22.8	73	163.4	60.0	140	284.0
-15.6	4	39.2	3.9	39	102.2	23.3	74	165.2	62.7	145	293.0
-15.0	5	41.0	4.4	40	104.0	23.9	75	167.0	65.6	150	302.0
-14.4	6	42.8	5.0	41	105.8	24.4	76	168.8	68.3	155	311.0
-13.9	7	44.6	5.6	42	107.6	25.0	77	170.6	71.1	160	320.0
-13.3	8	46.4	6.1	43	109.4	25.6	78	172.4	73.9	165	329.0
-12.8	9	48.2	6.7	44	111.2	26.1	79	174.2	76.7	170	338.0
-12.2	10	50.0	7.2	45	113.0	26.7	80	176.0	79.4	175	347.0

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/cm^2}

kPa {mmH_2O}

kPa {mmHg}

kw/rpm {HP/rpm}

g/kwh {g/HPh}

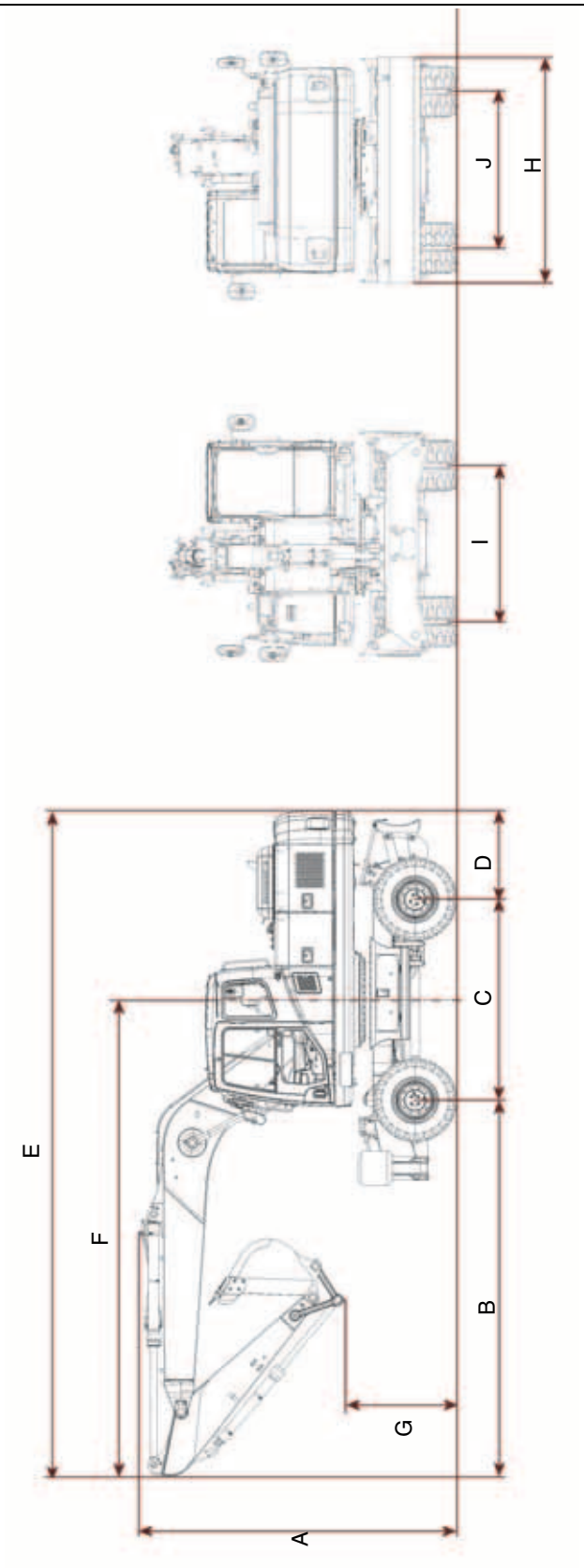
01 GENERAL

Specification Dimension Drawings
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SPECIFICATION DIMENSION DRAWINGS

DIMENSIONS

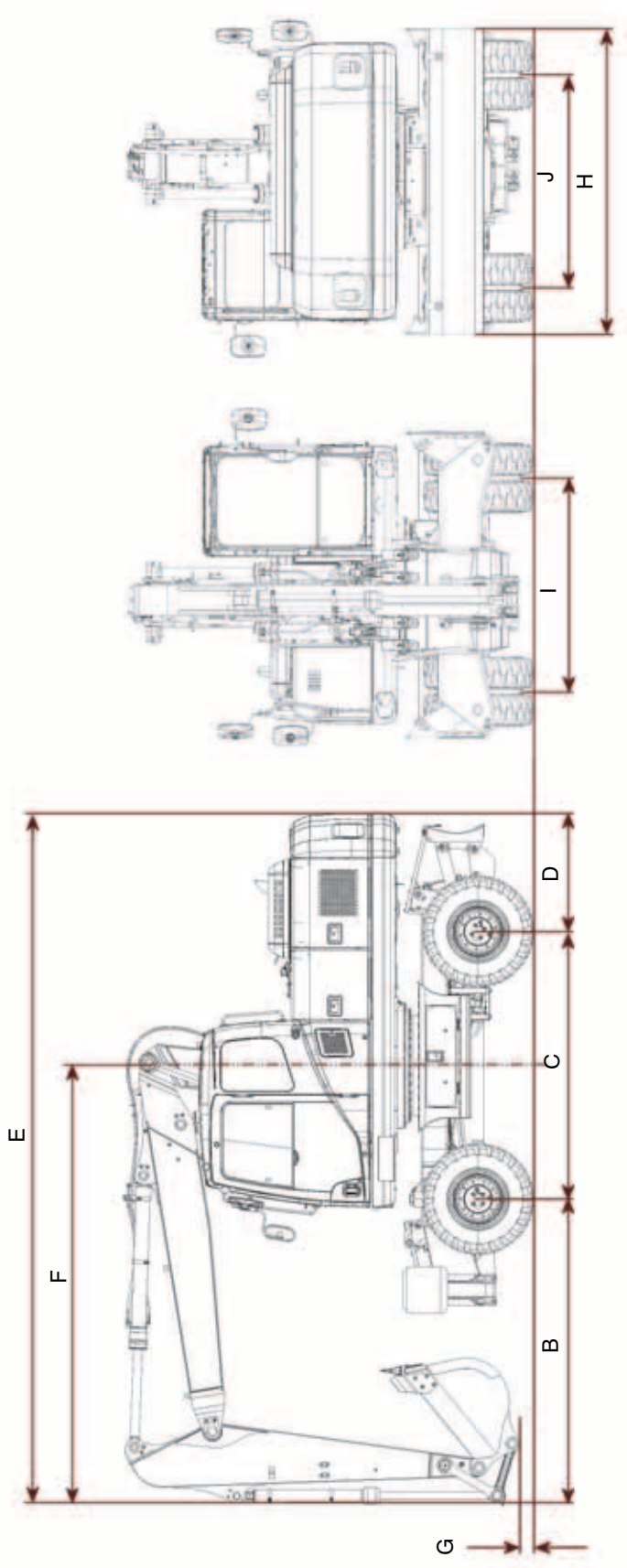
1 PIECE BOOM



	Description		2.25m	2.6m	2.9m
A	Overall height		3,720		
B	Front overhang		5,100		
C	Wheelbase		2,600		
D	Rear overhang		1,200		
E	Overall length		8,900		
F	Front swing radius		6,400		
G	Work equipment ground clearance		922	800	624
H	Overall width	2.5 m axle	2,550		
		2.75 m axle	2,750		
I	Front axle	2.5 m axle	1,914		
		2.75 m axle	2,124		
J	Rear axle	2.5 m axle	1,914		
		2.75 m axle	2,124		

DIMENSIONS

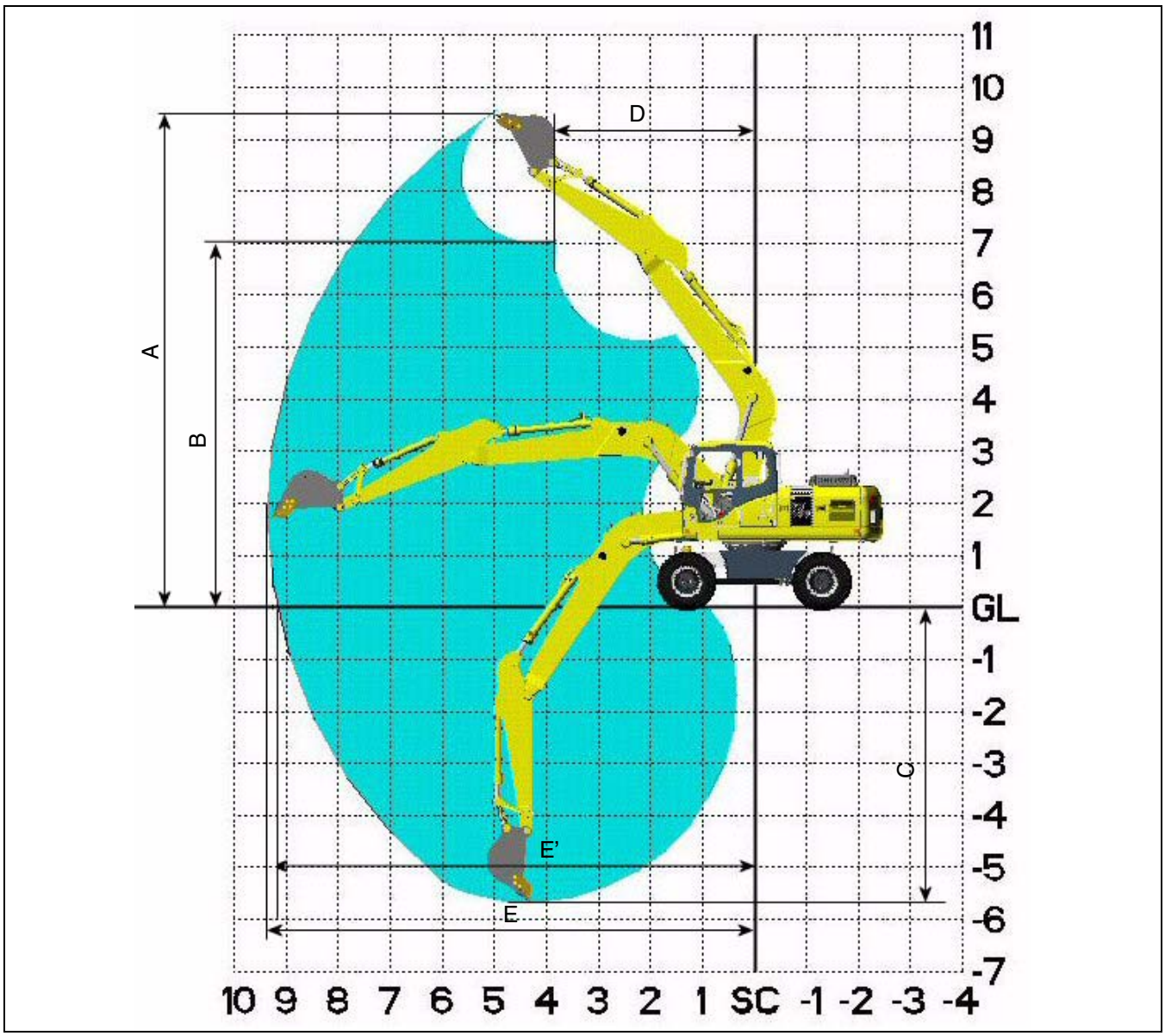
2 PIECE BOOM



	Description		2.25m	2.6m	2.9m
A	Overall height		3,972		3,960
B	Front overhang		2,994	2,917	3,050
C	Wheelbase		2,600		
D	Rear overhang		1,200		
E	Overall length		6,794	6,717	6,850
F	Front swing radius		4,341		
G	Work equipment ground clearance		551	205	368
H	Overall width	2.5 m axle	2,550		
		2.75 m axle	2,750		
I	Front axle	2.5 m axle	1,914		
		2.75 m axle	2,124		
J	Rear axle	2.5 m axle	1,914		
		2.75 m axle	2,124		

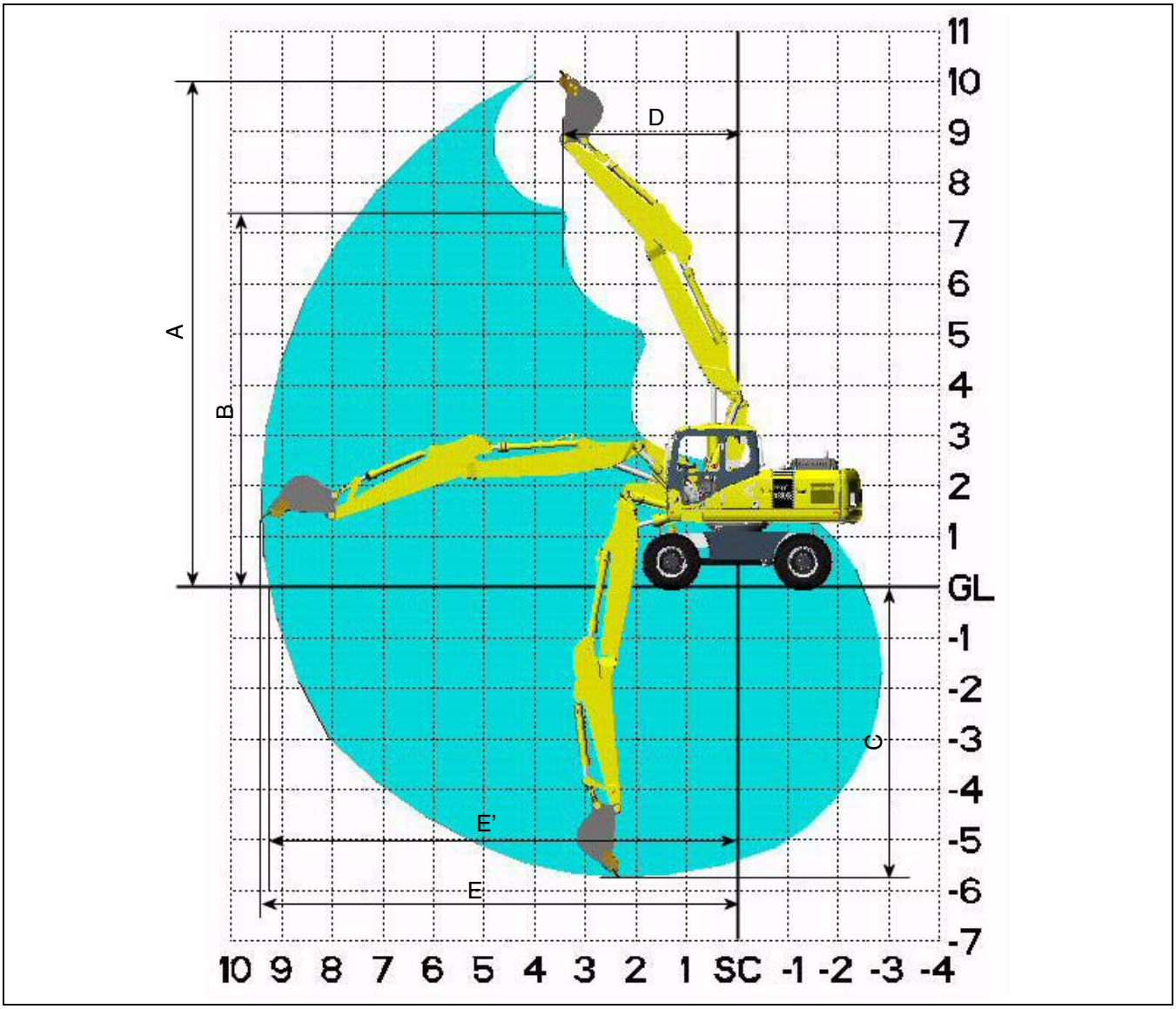
WORKING RANGES

1 PIECE BOOM



Arm length mm		2250	2600	2900
A	Max. digging height	9,948	9,562	9,756
B	Max. dumping height	6,915	7,064	7,236
C	Max. digging depth	5,321	5,676	5,966
D	Min. swing radius	3,543	3,829	4,057
E'	Max. digging reach GL	8,907	9,227	9,509
E	Max. digging reach	9,061	9,345	9,929

2 PIECE BOOM



Arm length mm		2250	2600	2900
A	Max. digging height	9,942	10,129	10,350
B	Max. dumping height	7,283	7,489	7,709
C	Max. digging depth	5,400	5,742	6,044
D	Min. swing radius	3,065	3,311	3,511
E'	Max. digging reach GL	8,907	9,227	9,509
E	Max. digging reach	9,080	9,401	9,683

SPECIFICATIONS

Machine model				PW180-7E0
Serial Number				H55051 and up
Bucket capacity			m^3	0.8
Operating weight			kg	17,160
Performance	Max. digging force (using power max. function)	2.25	kN {kg}	102.0 {10,400}
		2.6		
		2.9		
	Swing speed		rpm	11.5
	Swing max. slope angle		deg.	21.5
	Travel speed		km/h	Cr: 2.5 Lo: 10 Hi: 35 (Germany:20)
	Gradeability		deg. kPa {kg cm^2}	35 36.3 {0.37}
	Standard Tyre Width		mm	10.00 - 20

Machine model							PW180-7E0	
Serial Number							H55051 and up	
Engine	Model Type No. of cylinders - bore x stroke Piston displacement				mm l {cc}		SAA6D107E-1 4-cycle, water-cooled, in-line, vertical, direct injection, with turbo charger 6 - 107 x 124 6.69 {6690}	
	Performance	Flywheel horsepower Max. torque Max. speed at no load Min. speed at no load			kW/rpm Nm/rpm rpm rpm		108.4/2000 622.9/1500 2,060 1,050	
	Starting motor Alternator Battery						24V, 5.5 kW 24V, 60 A 12V, 120 Ah x 2	
	Radiator core type						Triple Cooler	
Hydraulic system	Hydraulic pump	Type x No. Delivery Set pressure			l/min MPa (kg/cm²)		HPV140, variable displacement Piston type: 308 x 1 Piston type: 37.2 {380}	
	Control valve	Type x No. Control method	1 Piece Boom				7-spool + 1 service spool type x 1 Hydraulic	
			2 Piece Boom				8-spool + 1 service spool type x 1 Hydraulic	
	Hydraulic motor	Travel motor Swing motor					A6VM120 HAXT/63W-VZB380A-SK, Piston type (with counter balance valve): x 1 MSF85P, Piston type (with safety valve, holding brake): x 1	
	Hydraulic cylinder 1 Piece Boom	Type					Boom	Arm	Bucket
							Double acting piston	Double acting piston	Double acting piston
		Inside diameter of cylinder Diameter of piston rod Stroke Max. distance between pins Min. distance between pins			mm mm mm mm mm		120 85 1,015 2,700 1,685	120 85 1,342 3,246 1,904	120 85 1,027 2,528 1,501
	Hydraulic cylinder 2 Pice Boom	Type				Adjust	Boom	Arm	Bucket
						Double acting piston	L.H / R.H	Double acting piston	Double acting piston
							Double acting piston		
		Inside diameter of cylinder Diameter of piston rod Stroke Max. distance between pins Min. distance between pins			mm mm mm mm mm	160 100 761 2,041 1,280	120 85 932 2,395 1,463	120 85 1,342 3,246 1,904	120 85 1,027 2,528 1,501
	Hydraulic tank						Closed box type		
	Hydraulic filter						Tank return side		
	Hydraulic cooler						CF40-1 (Air cooled)		

WEIGHT TABLE

This weight table is for use when handling components or when transporting the machine.

Unit: kg

Machine model		PW180-7E0
Serial Number		H55051 and up
Engine assembly • Engine • Damper • Hydraulic pump		673 553 6 114
Radiator oil cooler assembly		151.54
Hydraulic tank, filter assembly (excluding hydraulic oil)		122
Fuel tank (excluding fuel)		120
Revolving frame		1,513
Operator's cab		286
Operator's seat	Mechanical	38
	Air Suspension	42
Counterweight		3,501
Swing machinery		170
Control valve		117
Travel motor		75
Center swivel joint		95

1 PIECE BOOM

Unit: kg

Machine model		PW180-7E0
Serial Number		H55051 and up
Boom assembly		1,117
Arm assembly (with no piping)	2.25 m	480
	2.6 m	524
	2.9 m	590
Bucket assembly		900
Boom cylinders		156.2 x 2
Arm cylinder	S/V	165.6
	S/V less	169.7
Bucket cylinder		96.6
Boom foot pin		28.8
Boom cylinder pins		6.1 x 2 and 28.6
Arm cylinder pins		9.9 and 11.6
Boom/Arm pivot pin		18.9
Bucket linkage and pins		163.2

2 PIECE BOOM

Unit: kg

Machine model		PW180-7E0
Serial Number		H55051 and up
Boom assembly	1st Boom	430
	2nd Boom	598
Arm assembly	2.25 m	480
	2.6 m	524
	2.9 m	590
Bucket assembly		900
Boom cylinders		144 x 2
Adjust cylinder		201
Arm cylinder	S/V	165.6
	S/V less	169.7
Bucket cylinder		96.6
Boom foot pin		28.8
Boom cylinder pins		6.1 x 2 and 28.6
Adjust cylinder pins		13.9 and 23.7
Arm cylinder pins		9.9 and 11.6
Boom/Arm pivot pin		18.9
Bucket Linkage and pins		163.2

FUEL, COOLANT AND LUBRICANTS

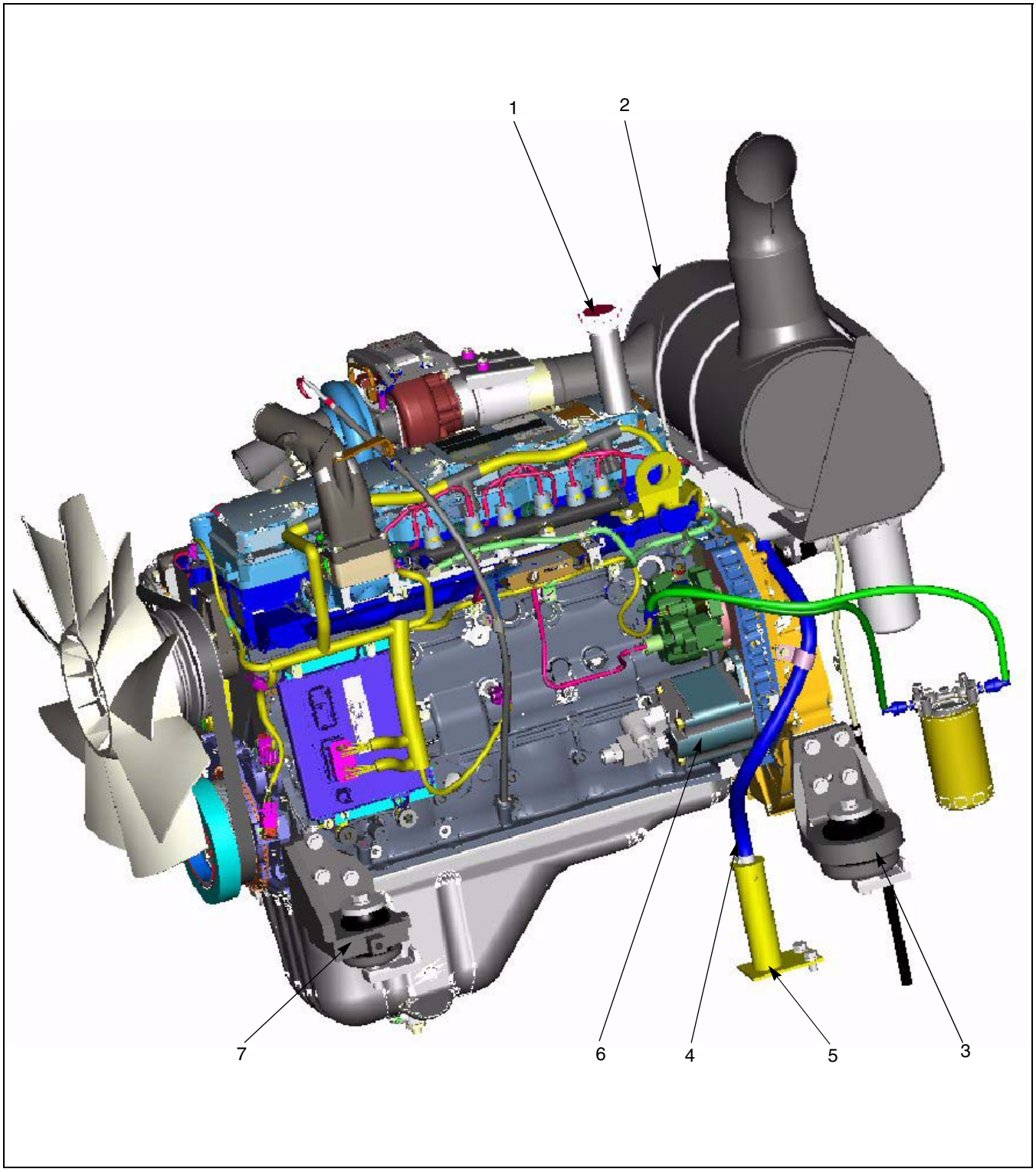
RESERVOIR		KIND OF FLUID	AMBIENT TEMPERATURE			CAPACITY (l)	
			-22 -4 14 32 50 68 86 104°F -30 -20 -10 0 10 20 30 40°C			Specified	Refill
Engine oil pan		Engine oil	-30°C	30°C	Komatsu EOS0W30	26	26
			-25°C	40°C	Komatsu EOS5W40		
			-20°C	40°C	Komatsu EO10W30DH		
			-15°C	50°C	Komatsu EO15W40DH		
			0°C	40°C	Komatsu EO30DH		
Swing machinery case			-30°C	50°C	Komatsu TO30	4.5	4.5
PTO gear case						0.75	0.75
Hydraulic system			-25°C	40°C	Komatsu EOS5W40	160	120
			-20°C	40°C	Komatsu EO10W30DH		
			-15°C	50°C	Komatsu EO15W40DH		
		Hydraulic oil	-20°C	50°C	Komatsu HO46-HM		
Fuel tank		Diesel fuel	ASTM		ASTM D975 No. 2	325	—
Cooling system		Water	Add antifreeze			17.6	—
Axles	Front	Multi oil	Fuchs titan hydra 20W-40			11.5	—
	Rear					9.5	—
Transmission + clutch			BP traction 8			4.85	4.85
Hubs	Front		Fuchs titan hydra 20W-40			2.5	—
	Rear					2.0	—

❍ For the H-046-HM, use the oil recommended by Komatsu.

10 STRUCTURE, FUNCTION AND MAINTENANCE STANDARD

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ENGINE RELATED PARTS

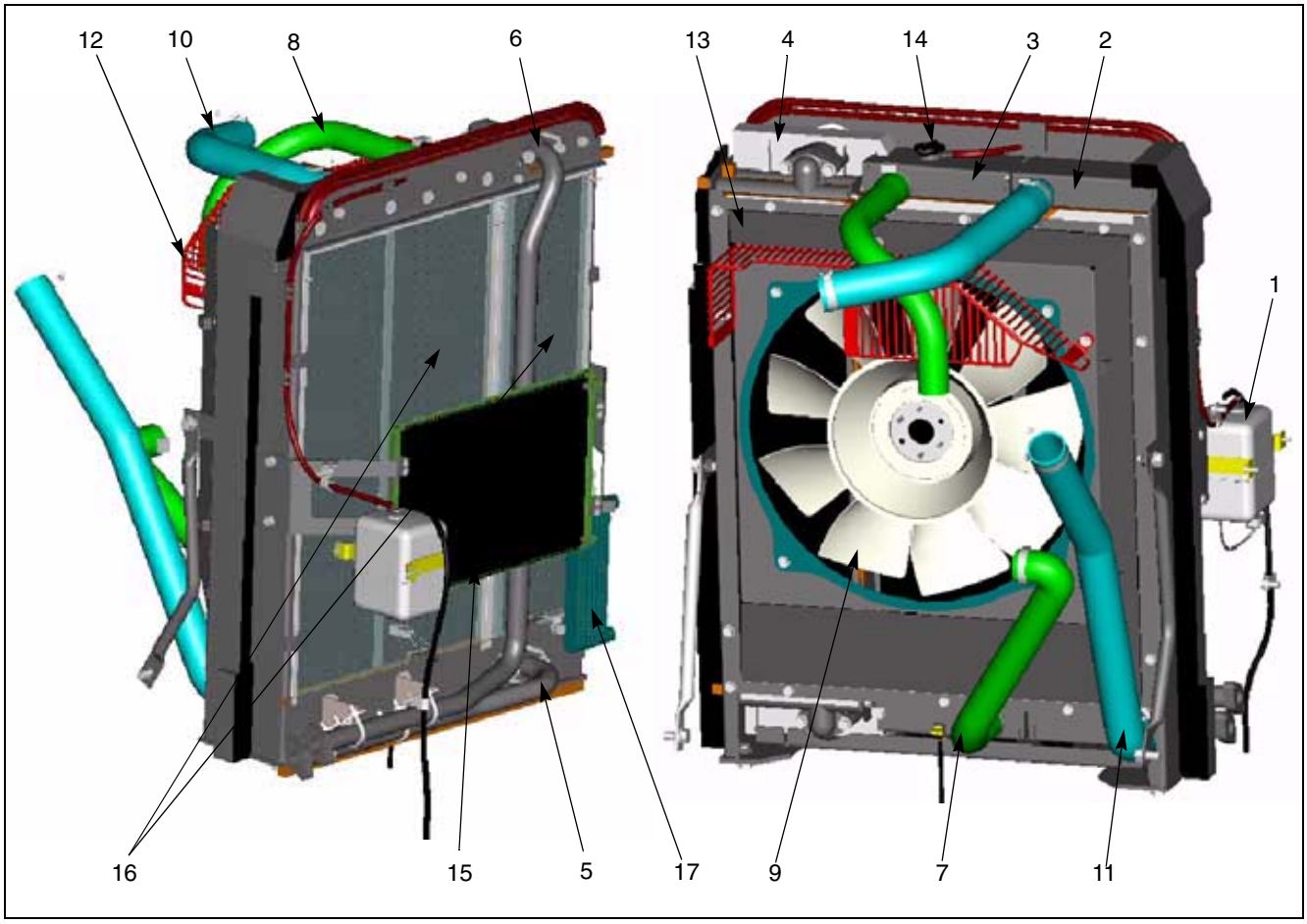


1. Breather cap
2. Muffler
3. Rear engine mount
4. Breather hose
5. Oil catcher tube
6. Brake/Steer pump
7. Front engine mount

OUTLINE

- The damper assembly is a wet type.

RADIATOR • OIL COOLER • CHARGE AIR COOLER



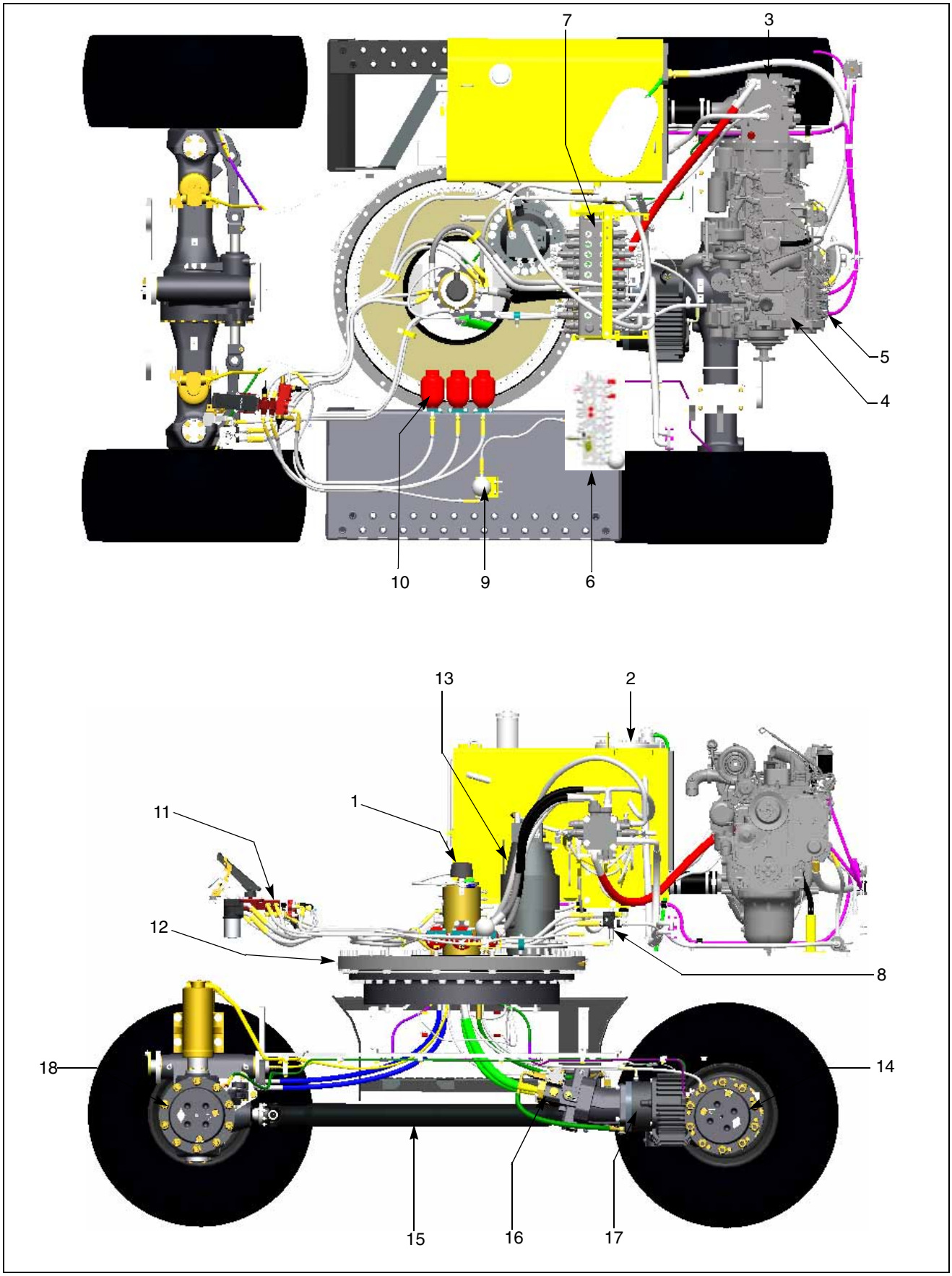
1. Reservoir tank
2. Charge Air cooler
3. Radiator
4. Oil Cooler
5. Oil Cooler outlet tube
6. Oil Cooler inlet tube
7. Radiator outlet hose
8. Radiator inlet hose
9. Fan
10. Charge Air Oil Cooler outlet hose
11. Charge Air Oil Cooler inlet hose
12. Fan guard
13. Shroud
14. Radiator Cap
15. Condenser assy
16. Net
17. Fuel cooler

SPECIFICATIONS:

Combination Cooler

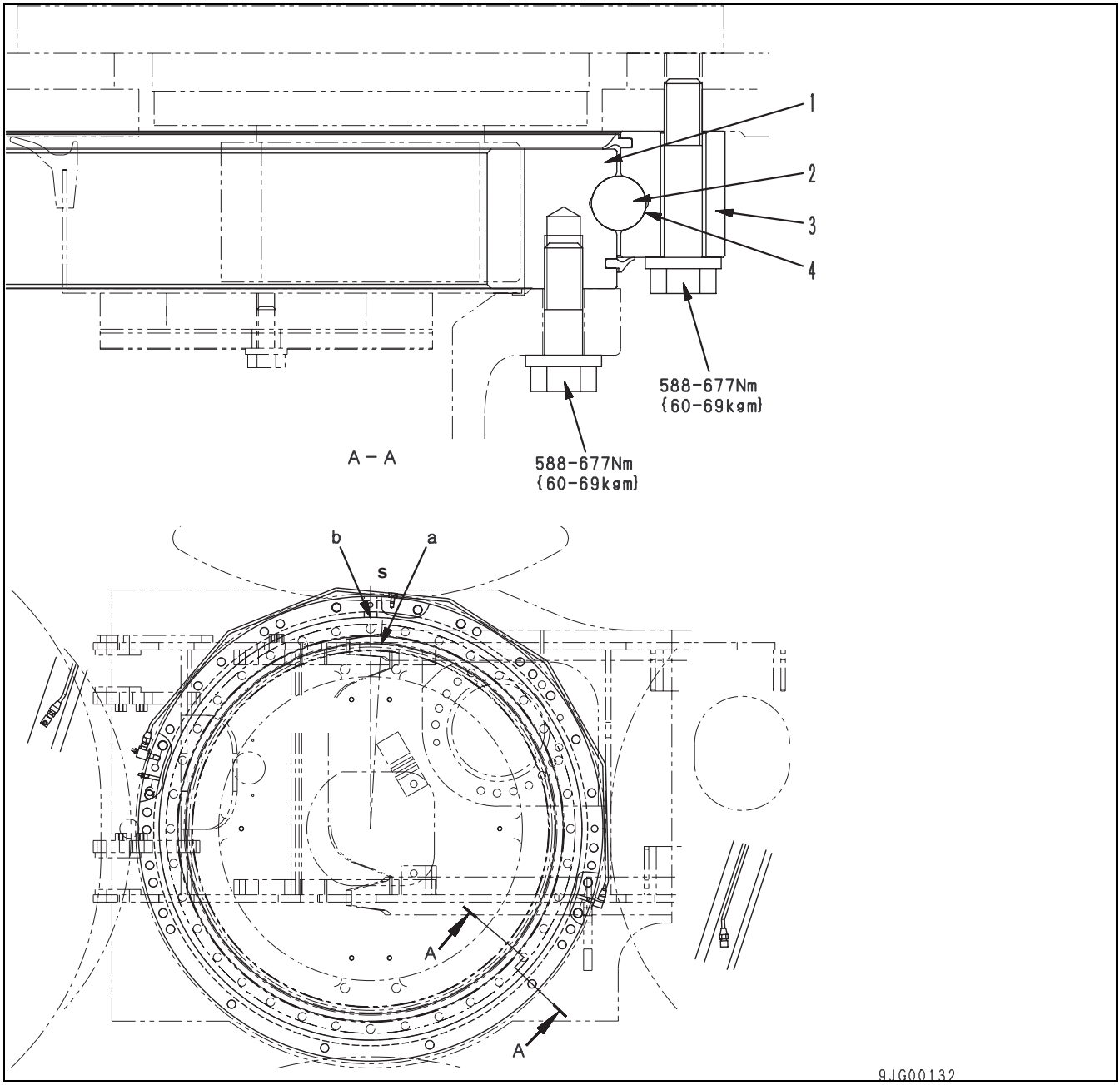
	Oil	Coolant	Air
Max working pressure. bar	15	0.5	1.53
Max. working temperature at 45°C ambient °C	100	100	75
Cooler volume l.	2	6.9	-

POWER TRAIN



1. Centre swivel joint
2. Hydraulic tank
3. Main pump
4. Engine
5. Gear pump
6. PPC solenoid valve inc.
   Clutch control sol
   Travel direction sol
7. Main control valve
8. Priority valve
9. Clutch control accumulator
10. Accumulators
11. Power brake valve
12. Swing circle
13. Swing motor / machinery
14. Rear axle
15. Propshaft
16. Travel motor
17. Transmission
18. Front axle

SWING CIRCLE



1	Swing circle inner race (No. of teeth: 99)
2	Ball
3	Swing circle outer race
a	Inner race soft zone S position
b	Outer race soft zone S position

SPECIFICATIONS

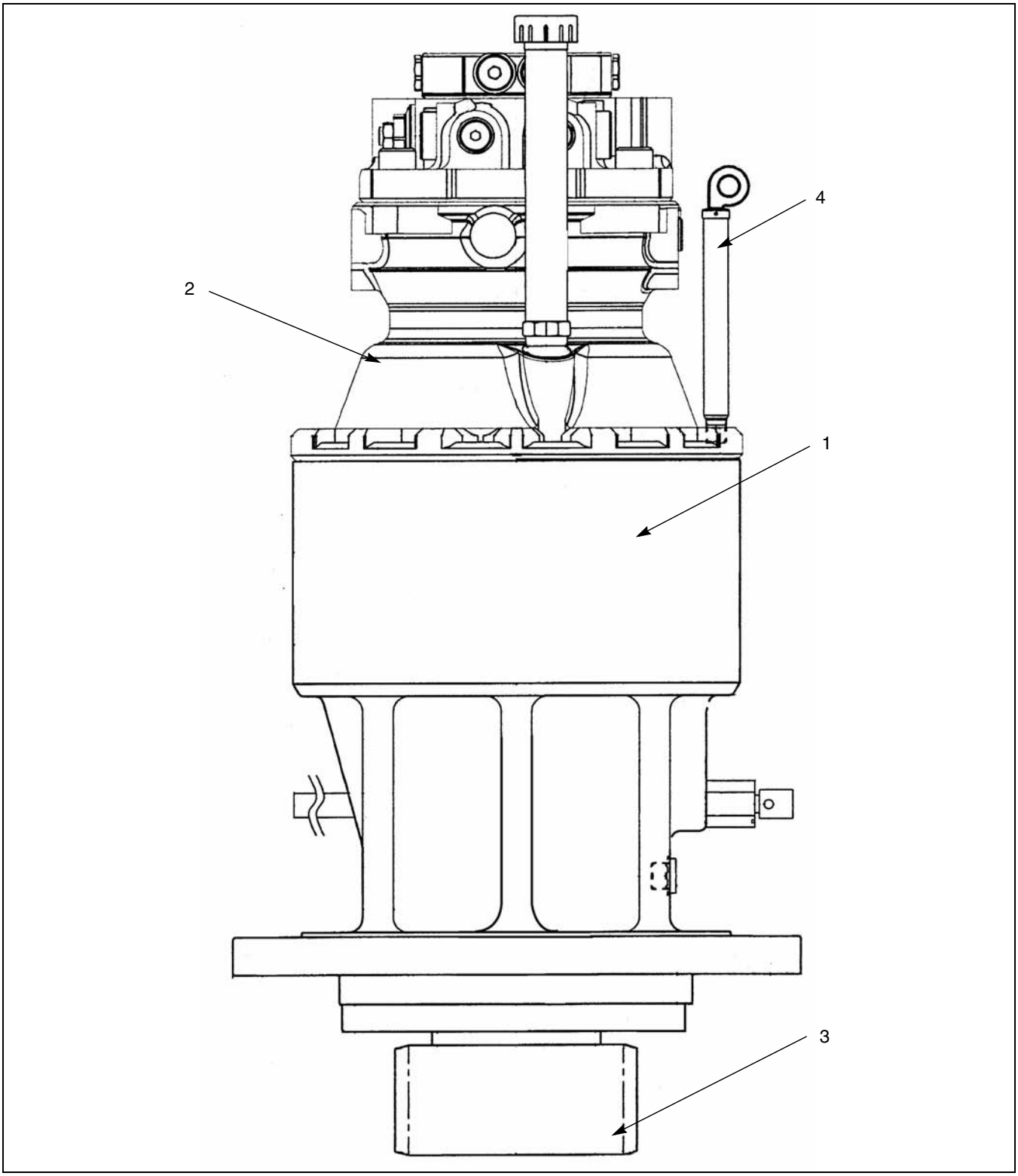
Reduction ratio:

$$\frac{99}{13} = 7.615$$

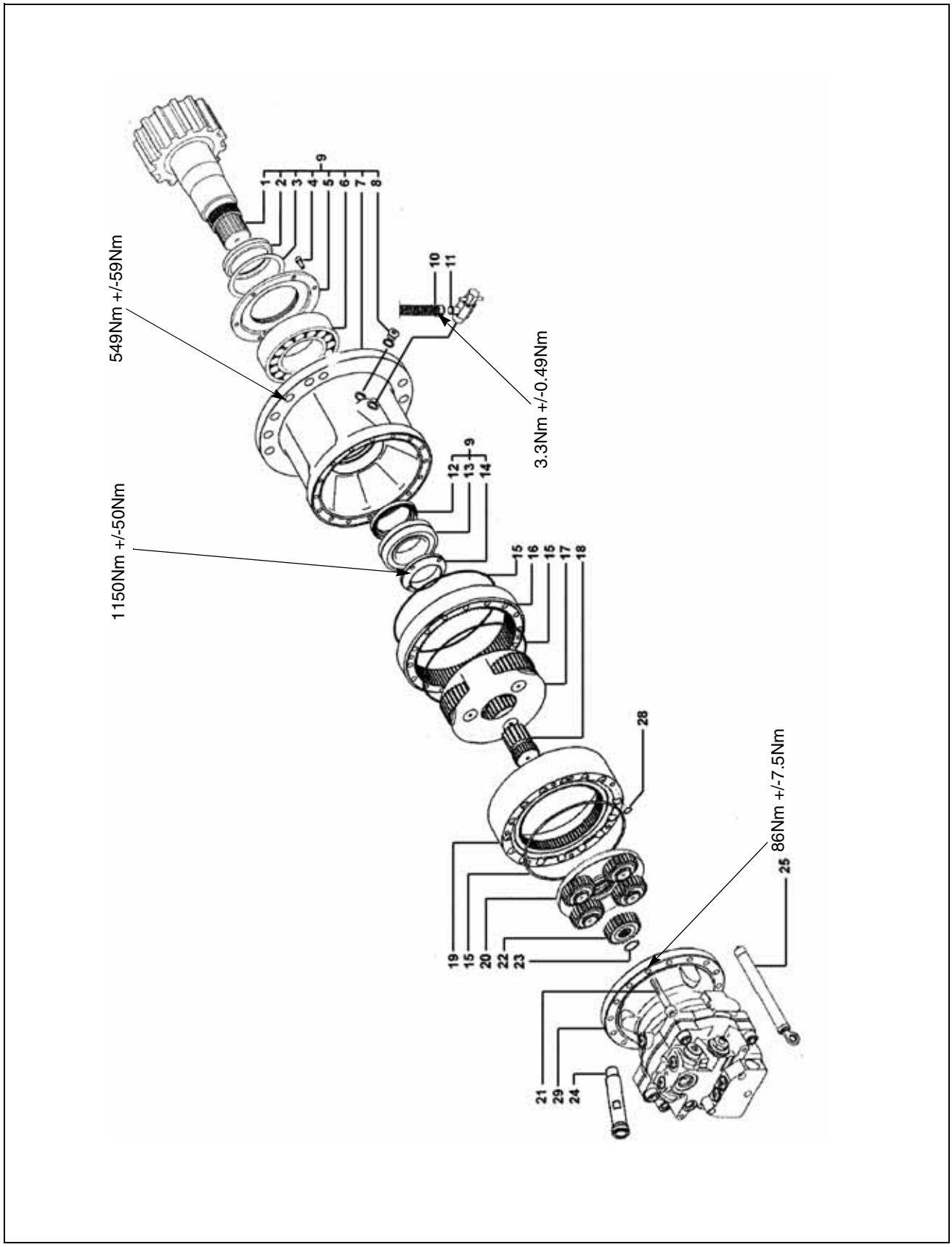
Amount of grease: 10.5 litres

No	Check item	Criteria		Remedy
4	Axial clearance of bearing	Standard clearance	Clearance limit	Replace
	(when mounted on chassis)	0.5-1.6	3.2	

SWING MACHINERY & MOTOR



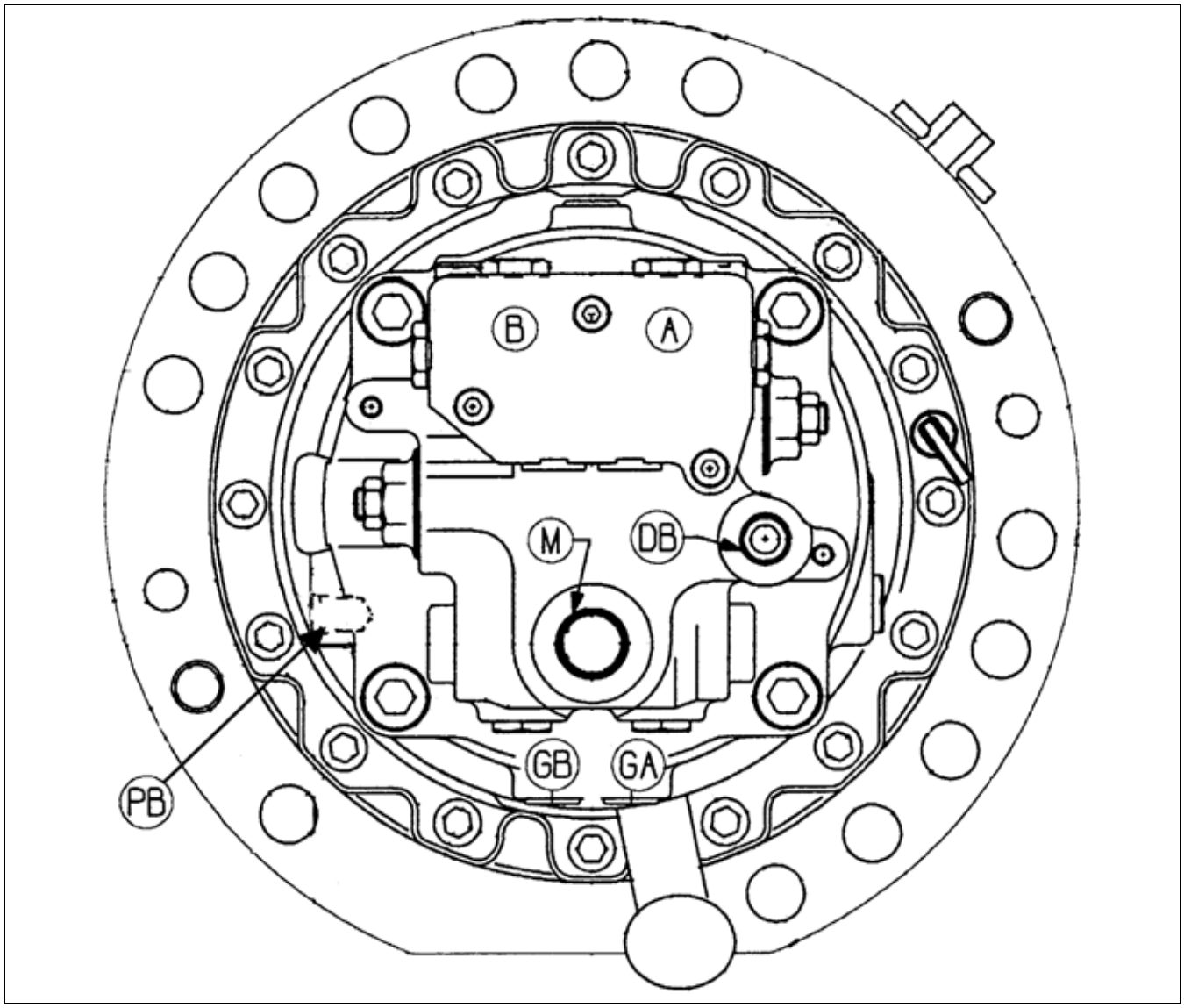
1. Swing machinery
2. Swing motor
3. Swing pinion
4. Dipstick


549Nm +/-59Nm
1150Nm +/-50Nm
3.3Nm +/-0.49Nm
86Nm +/-7.5Nm
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
15
17
18
28
19
15
20
22
23
25
21
29
24

1.	Pinion shaft	15.	O-ring
2.	Spacer	16.	Toothed ring
3.	Sealing	17.	Reduction assembly
4.	Screw	18.	Sun gear
5.	Cover	19	Cover
6.	Bearing	20.	Reduction assembly
7.	Gearbox housing	21.	Screw
8.	Plug	22.	Sun gear
9.	Output assembly	23.	Circlip
10.	Lubrication kit	24.	Lubrication kit
11.	Cock	25.	Lubrication kit
12.	Seal ring	28.	O-ring
13.	Bearing	29.	Hydraulic motor
14.	Nut		

SWING MOTOR

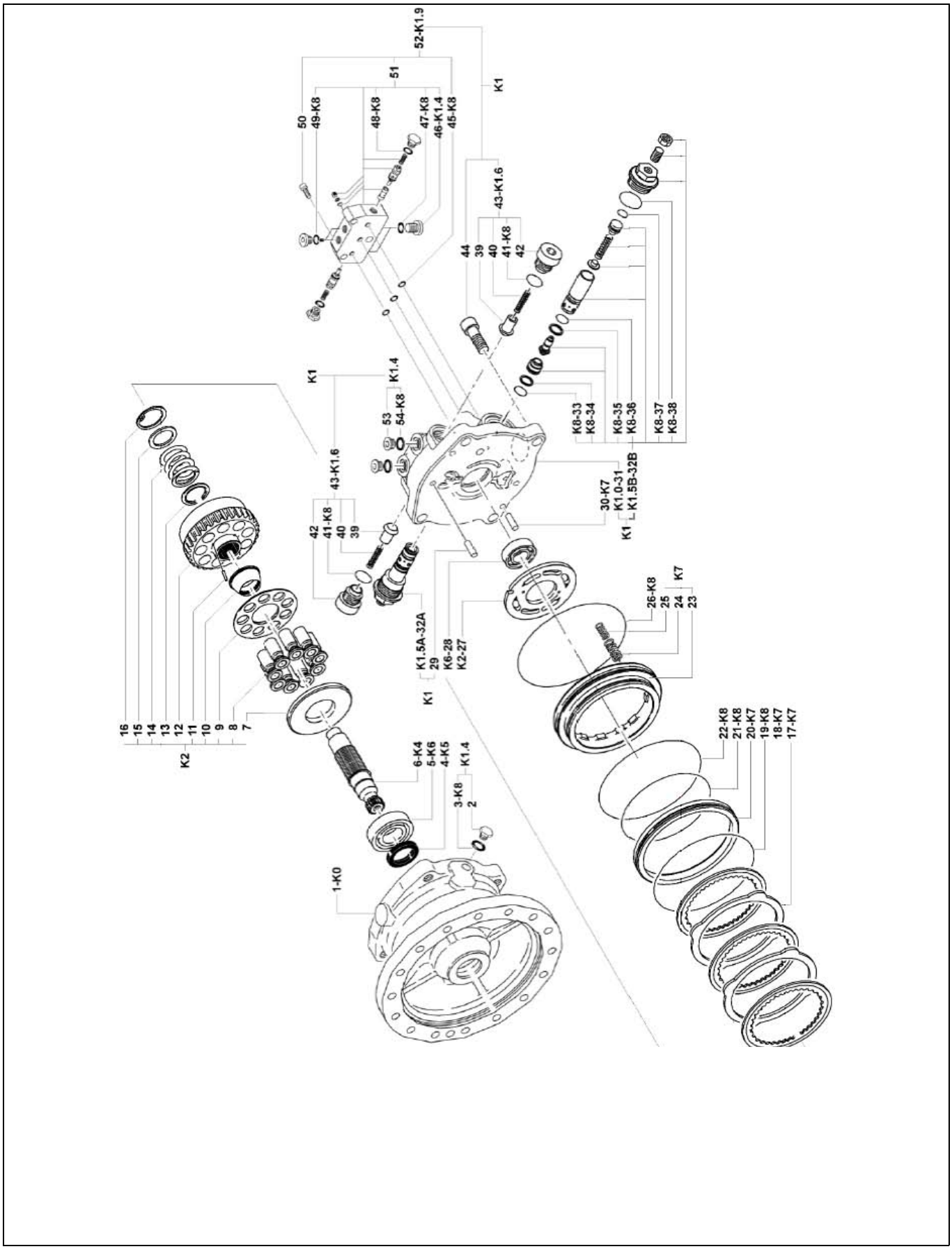
MSF 85P



A	Service ports
B	
M	Anti-cavitation
DB	Drain port
GA	Pressure gauge ports
GB	
PB	Brake port

SPECIFICATIONS

	PW180-7E0
Model	MSF85P
Theoretical displacement	87.3 cm^3/rev
Safety valve set pressure	28.4 MPa {290 kg/cm^2}
Rated revolving speed	1,553 rpm
Brake release pressure	1.9 MPa {19 kg/cm^2}


52-K1.9
51
K1
50
49-K8
48-K8
47-K8
46-K1.4
45-K8
43-K1.6
44
39
40
41-K8
42
K1
K1.4
53
54-K8
K8-33
K8-34
K8-35
K8-36
K8-37
K8-38
43-K1.6
42
41-K8
40
39
30-K7
K1.0-31
K1.5B-32B
K1
L
26-K8
25
24
23
K7
K1.5A-32A
29
K6-28
K2-27
K1
16
15
14
13
12
11
10
9
8
7
K2
6-K4
5-K6
4-K5
K1.4
3-K8
2
1-K0
22-K8
21-K8
20-K7
19-K8
18-K7
17-K7

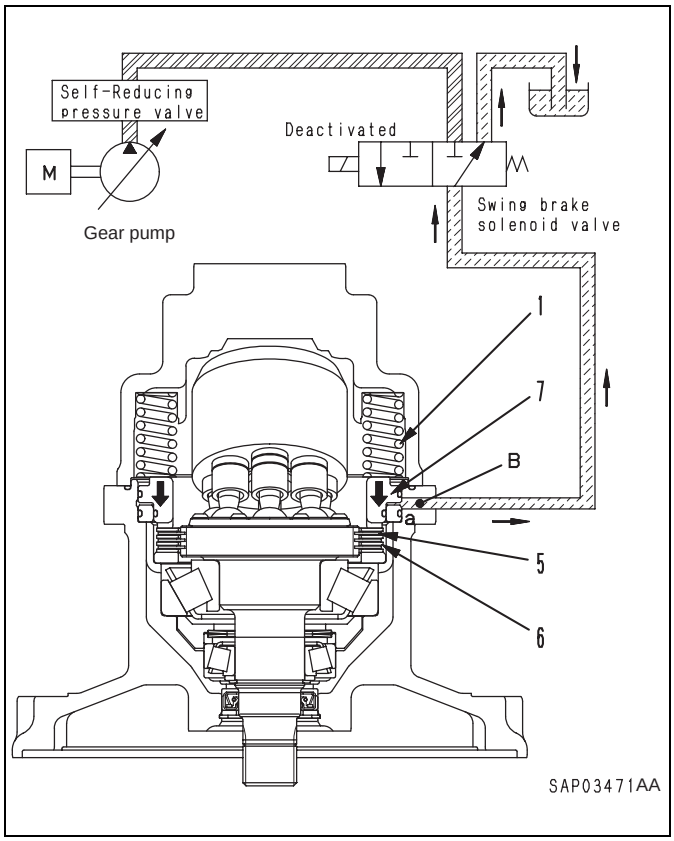
Kit	Ref. No.	Description	Kit	Ref. No.	Description
K0	1	Motor housing kit	K2	13	Collar
K1		Base plate assembly		14	Spring
	29	Pin		15	Collar washer
	31	Base plate		16	Circlip
	32A	Relief valve		27	Valve plate
	32B	Relief valve	K4	6	Motor shaft assembly
	43	Anti-cavitation valve assembly	K5	4	Motor seal ring
	44	Screw	K6		Bearings assembly
	52	Anti-swing back valve		5	Bearing
	53	Plug		28	Bearing
	54	O-ring	K7		Brake assembly
K1.0	31	Base plate		17	Steel disc
K!.4		Plug assembly		18	Brake disc
	2	Plug		20	Brake spacer
	3	O-ring		23	Brake piston
	46	Plug		24	Spring
	47	O-ring		25	Spring
	53	Plug		30	Pin
	54	O-ring	K8		Seal assembly
K1.5A	32A	Relief valve assembly		3	O-ring
K1.5B	32B	Relief valve assembly		19	O-ring
K1.6	43	Anti-cavitation valve assembly		21	O-ring
	39	Check valve		22	O-ring
	40	Spring		26	O-ring
	41	O-ring		33	O-ring
	42	Plug		34	Backup ring
K1.9	52	Anti-swing back valve assembly		35	Backup ring
	45	O-ring		36	O-ring
	51	Anti-swing back valve		37	O-ring
	50	Screw		38	O-ring
K2		Cylinder Block Assembly		41	O-ring
	7	Thrust plate		45	O-ring
	8	Piston		47	O-ring
	9	Retainer plate		48	O-ring
	10	Spherical bush		49	O-ring
	11	Pin		52	O-ring
	12	Cylinder block			

Operation of swing lock

1. When swing lock solenoid valve is deactivated

When the swing lock solenoid valve is deactivated, the pressurized oil from the gear pump is shut off and port **B** is connected to the tank circuit.

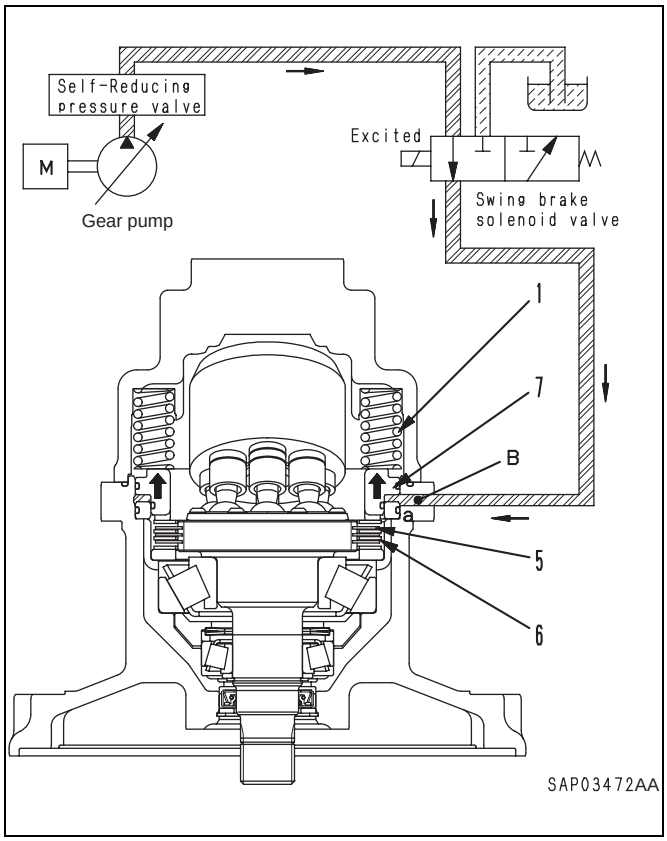
As a result, brake piston (7) is pushed down by brake spring (1), discs (5) and plates (6) are pushed together, and the brake is applied.



2. When swing lock solenoid valve is excited

When the swing lock solenoid valve is excited, the valve is switched and the pressure oil from the gear pump enters port **B** and flows to brake chamber **a**.

The pressure oil entering chamber **a** overcomes brake spring (1) and pushes brake piston (7) up. As a result, discs (5) and plates (6) are separated and the brake is released.



RELIEF VALVE PORTION

1. Outline

The relief portion consists of check valves (2) and (3), shuttle valves (4) and (5), and relief valve (1).

2. Function

When the swing is stopped, the outlet port circuit of the motor from the control valve is closed, but the motor continues to rotate under inertia, so the pressure at the output side of the motor becomes abnormally high, and this may damage the motor.

To prevent this, the abnormally high pressure oil is relieved to port **S** from the outlet port of the motor (high-pressure side) to prevent any damage.

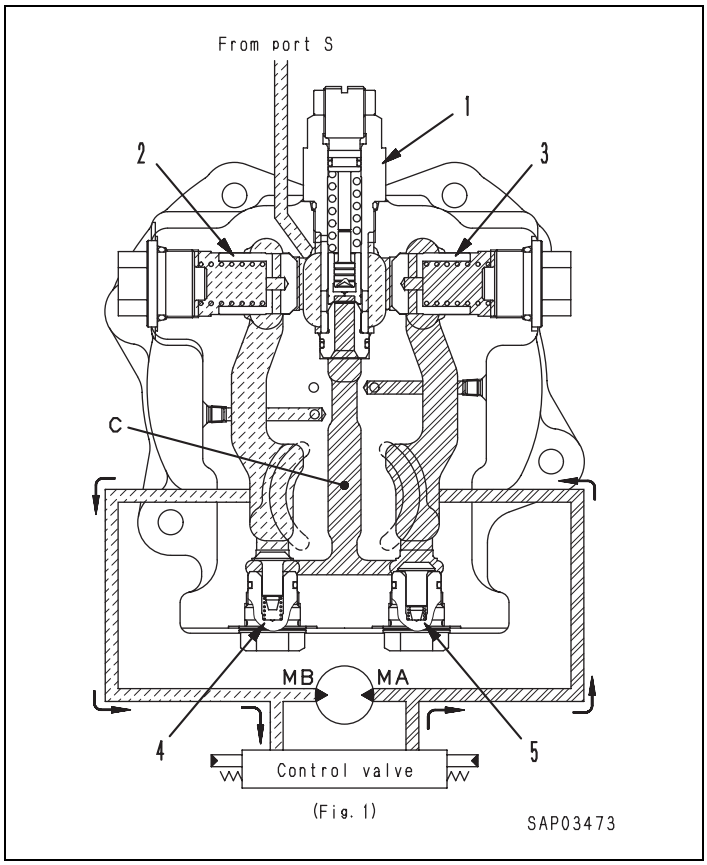
Operation

1. When starting swing.

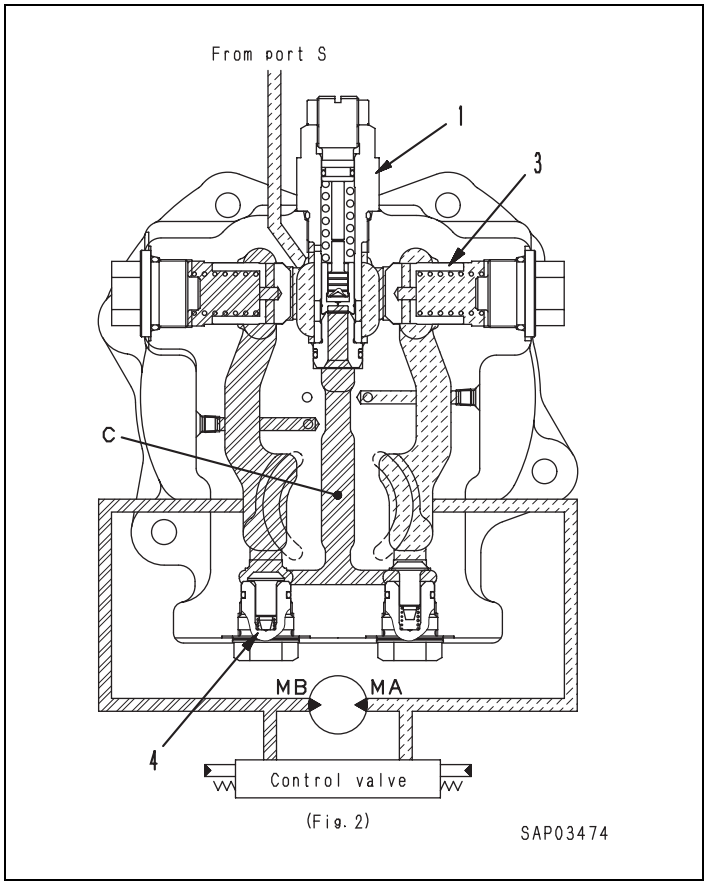
When the swing control lever is operated to swing right, the pressure oil from the pump passes through the control valve and is supplied to port MA. As a result, the pressure at port MA rises, the starting torque is generated in the motor, and the motor starts to rotate. The oil from the outlet port of the motor passes from port MA through the control valve and returns to the tank. (Fig. 1)

2. When stopping swing.

When the swing control lever is returned to neutral, the supply of pressure oil from the pump to port MA is stopped. With the oil from the outlet port of the motor, the return circuit to the tank is closed by the control valve, so the pressure at port MB rises. As a result, rotation resistance is generated in the motor, so the braking effect starts.
If the pressure at port MB becomes higher than the pressure at port MA, it pushes shuttle valve A (4) and chamber C becomes the same pressure as port MB. The oil pressure rises further until it reaches the set pressure of relief valve (1). As a result, a high braking torque acts on the motor and stops the motor. (Fig.2)
When relief valve (1) is being actuated, the relief oil and oil from port S passes through check valve B (3) and is supplied to port MA. This prevents cavitation at port MA.

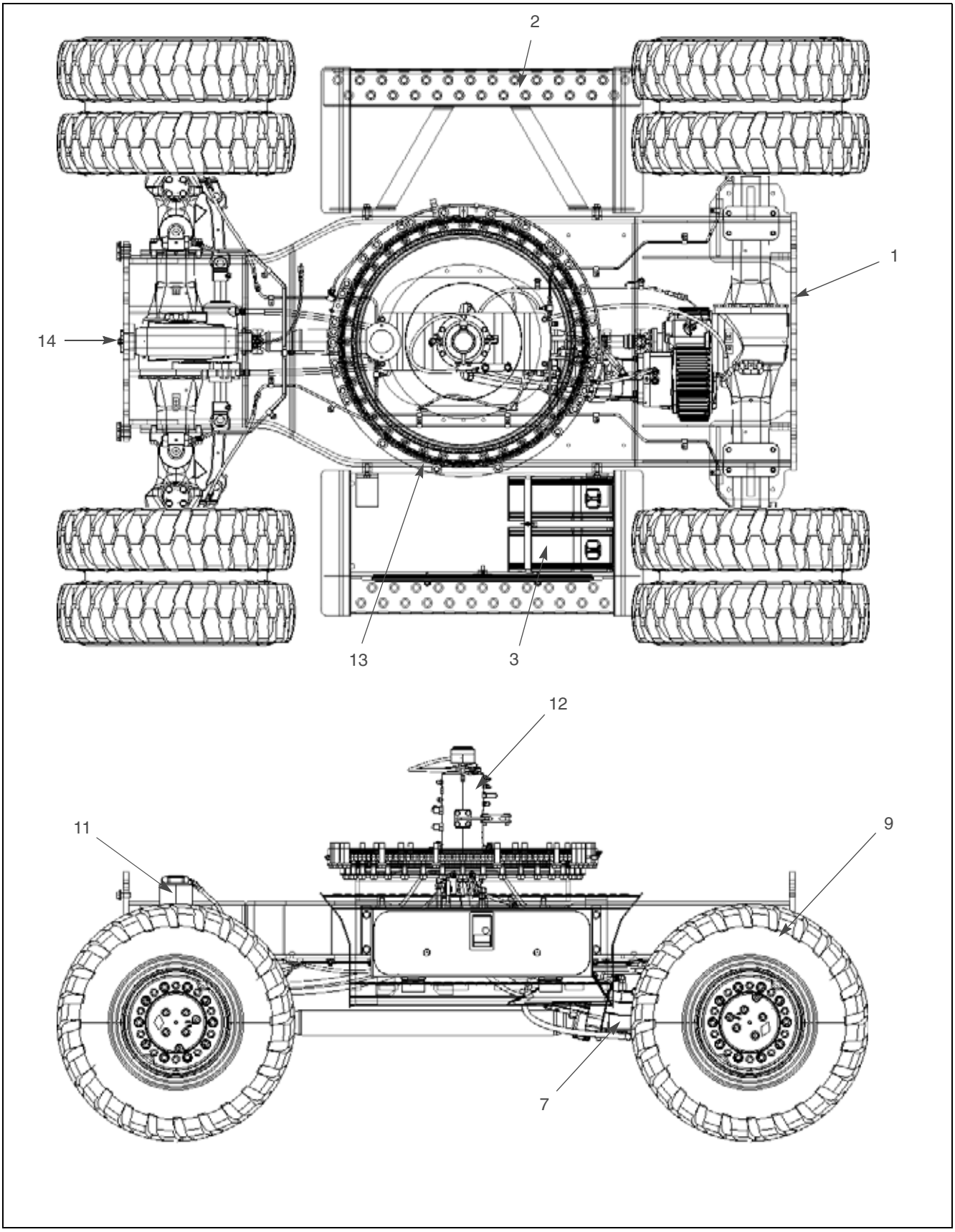


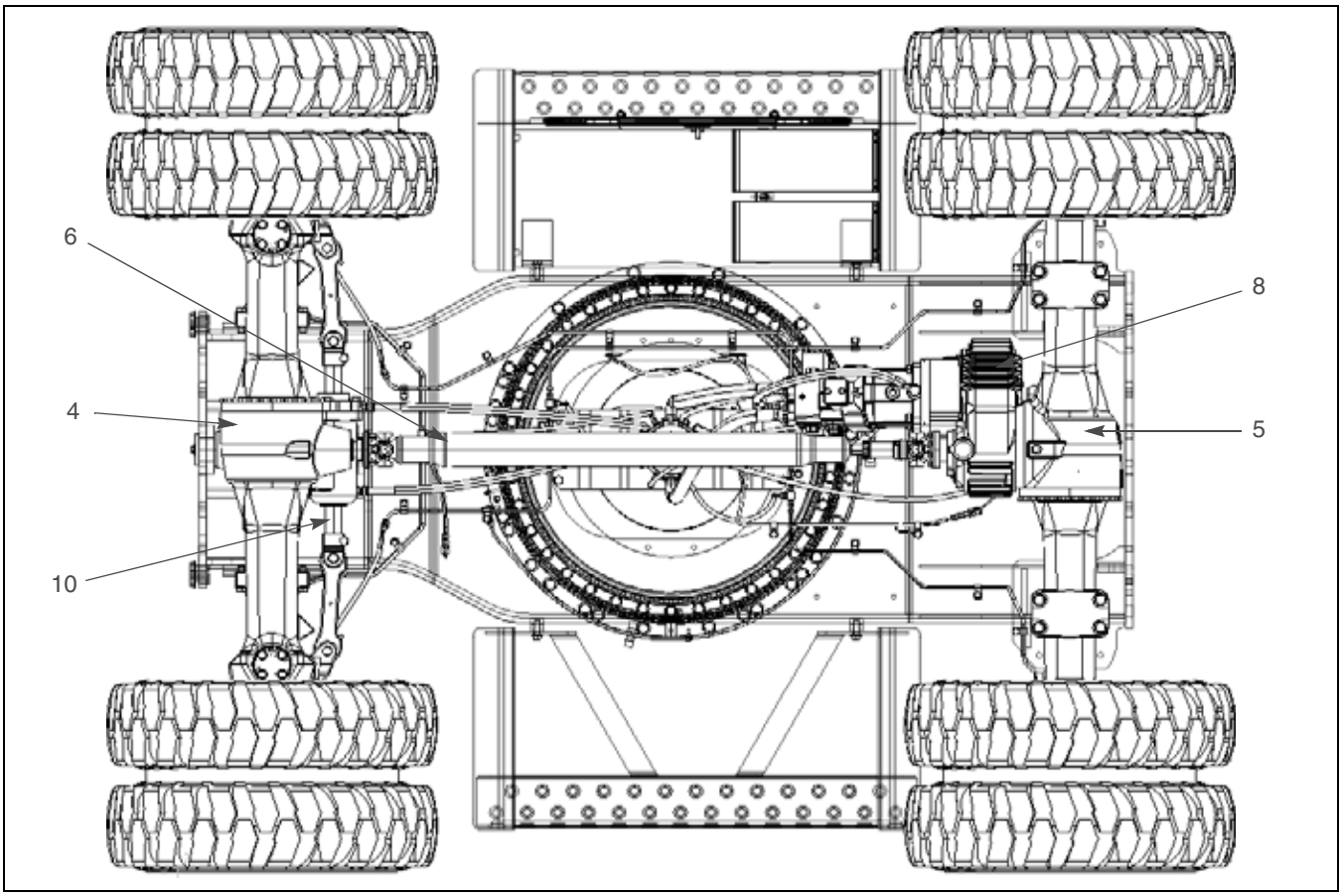
(Fig. 1) SAP03473



(Fig. 2) SAP03474

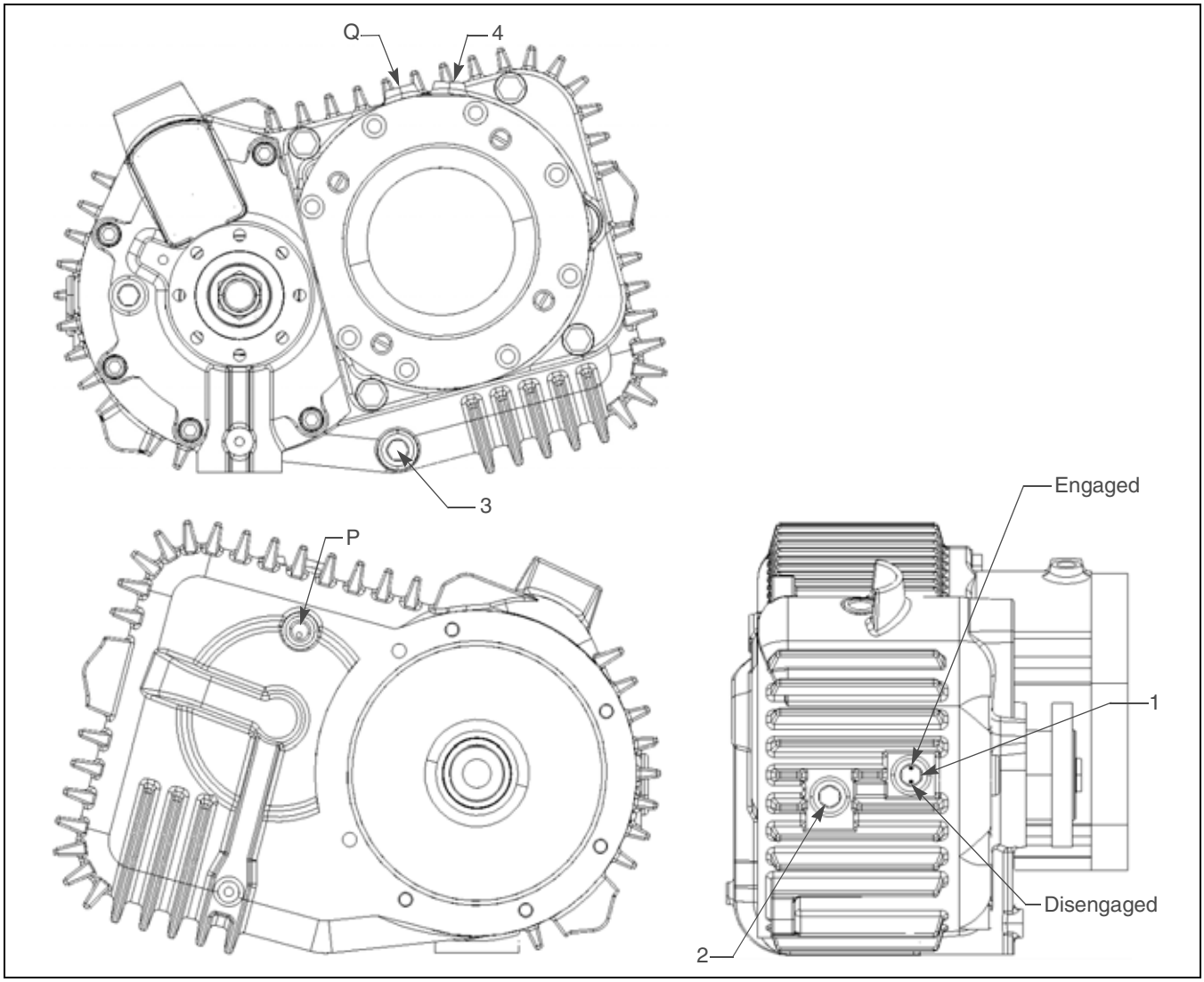
UNDERCARRIAGE





1.	Undercarriage	8.	Transmission
2.	Step	9.	Double Wheel Assy
3.	Wheel Chock	10.	Steering Cylinder
4.	Front Oscillating Steering Axle	11.	Suspension Lock Cylinders
5.	Rear Axle	12.	Swivel Joint
6.	Propshaft	13.	Slew Ring
7.	Travel motor	14	Axle Oscillation pin

TRANSMISSION



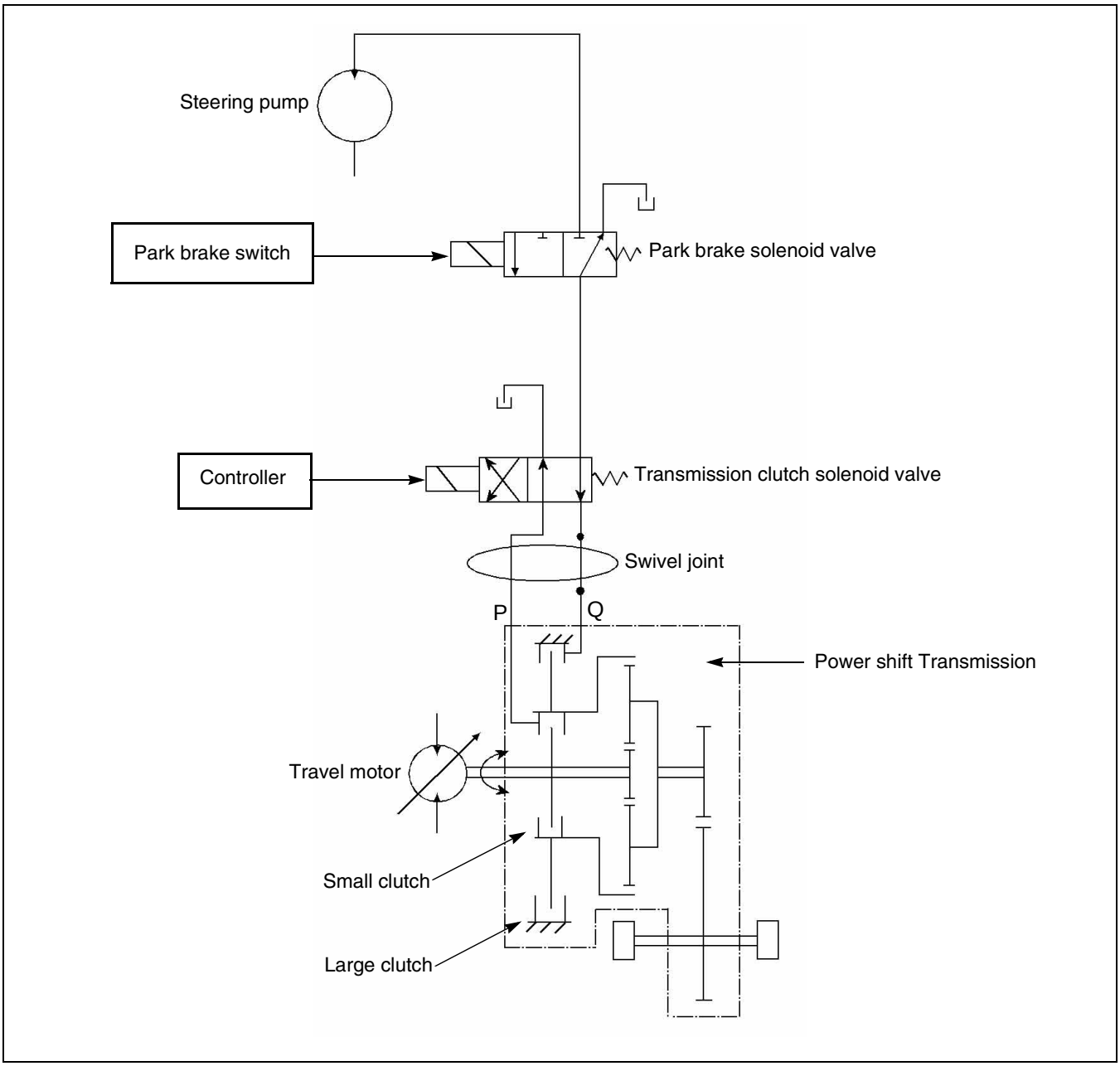
1. Transmission disengagement pin (for towing)
2. Oil filler plug
3. Oil drain plug
4. Breather

SPECIFICATIONS:

Type	Single motor two speed automatic power shift
Gear ratio	Small clutch (High gear) 1.32: 1
	Large clutch (Low gear) 4.93: 1
Pressure required to disengage clutches (Large & Small)	58 $^{+}/_{-}$ 7 bar.
Output shaft	DIN 120 (8stud) fixing.
Oil capacity	4.85 litres.
Oil change interval	1000 hours

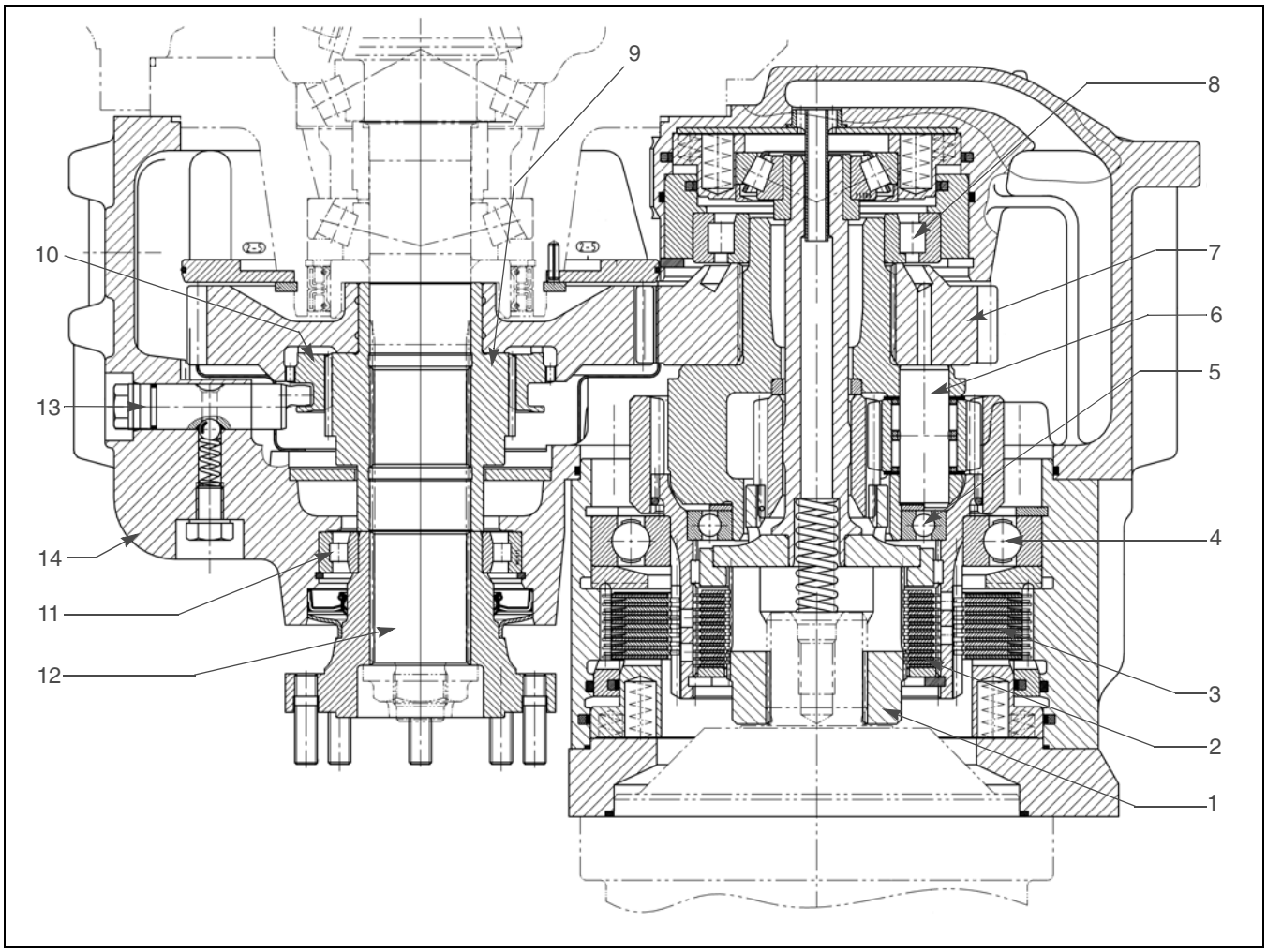
FUNCTION

Pressure applied in port P will disengage the small clutch, low speed will be selected. Pressure applied in port Q will disengage the large clutch, high speed will be selected. No pressure in port P and Q will engage both small and large clutches. When both clutches are engaged this locks the input shaft of the transmission to the housing locking the transmission, this is used for the park brake condition.



Hi = sun + planets locked together, planetary drive = (1.32: 1)

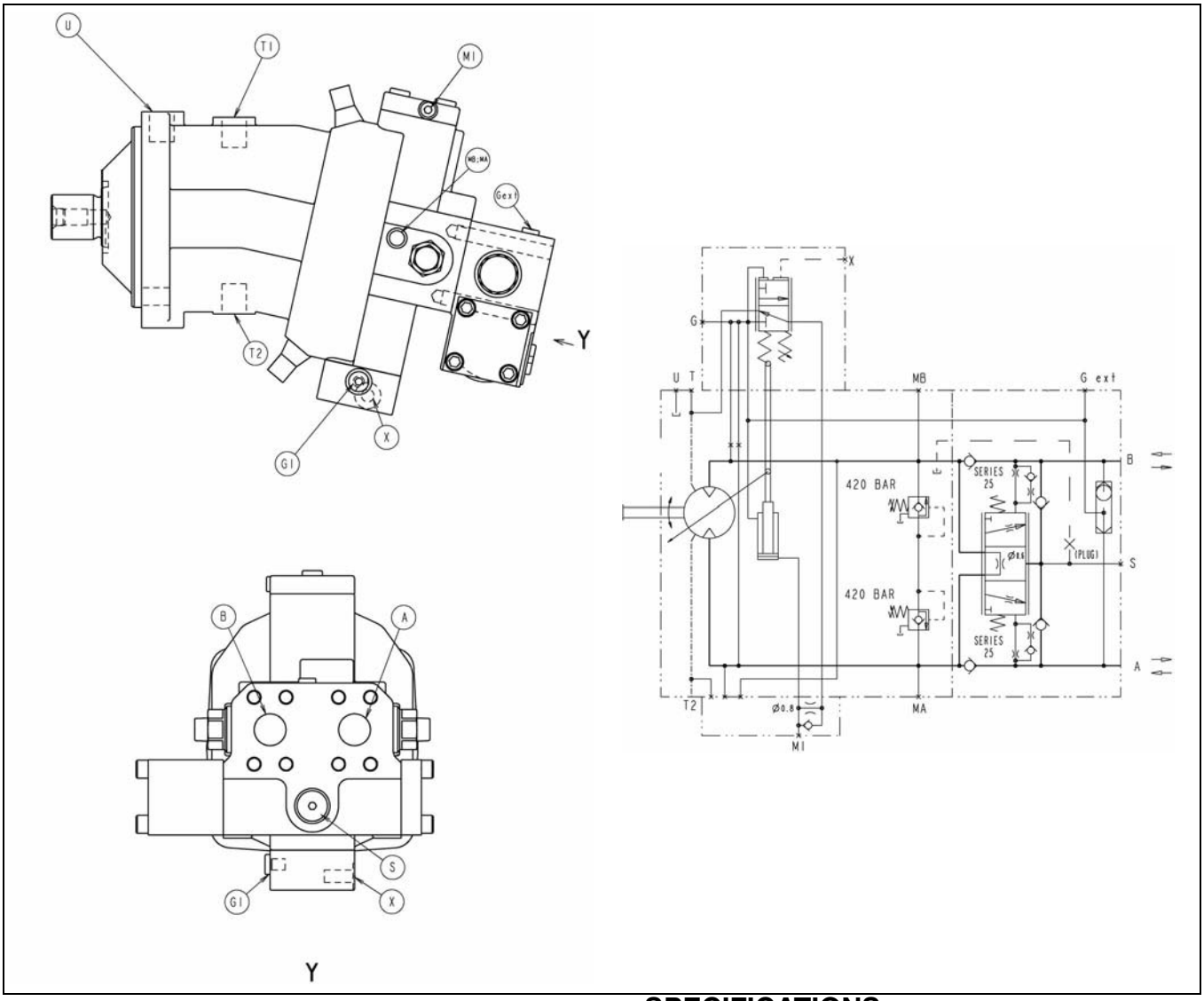
Lo = sun drives planets annulus is held, planet carrier is the output = (4.93: 1)



1.	Sleeve	8.	Roller Bearing
2.	Small clutch pack (high gear)	9.	Spur Gear
3.	Large clutch pack (low gear)	10.	Coupling
4.	Ball Bearing	11.	Bearing
5.	Bearing	12.	Flange
6.	Epicyclic Gearbox	13.	Pin
7.	Spur Gear	14.	Casing

TRAVEL MOTOR

A6VM120 HAXT/63W-VZB380A-SK



A	Service port
B	Service port
G_1	Port for synchronous control of a number of units and for remote control pressure
X	Pilot pressure port
T_1	Case drain port
T_2	Case drain port
U	Flushing port
S	Boosting
MA:MB	Gauge ports (one either side)
Gext	Brake release port - external
M_1	Gauge port control pressure

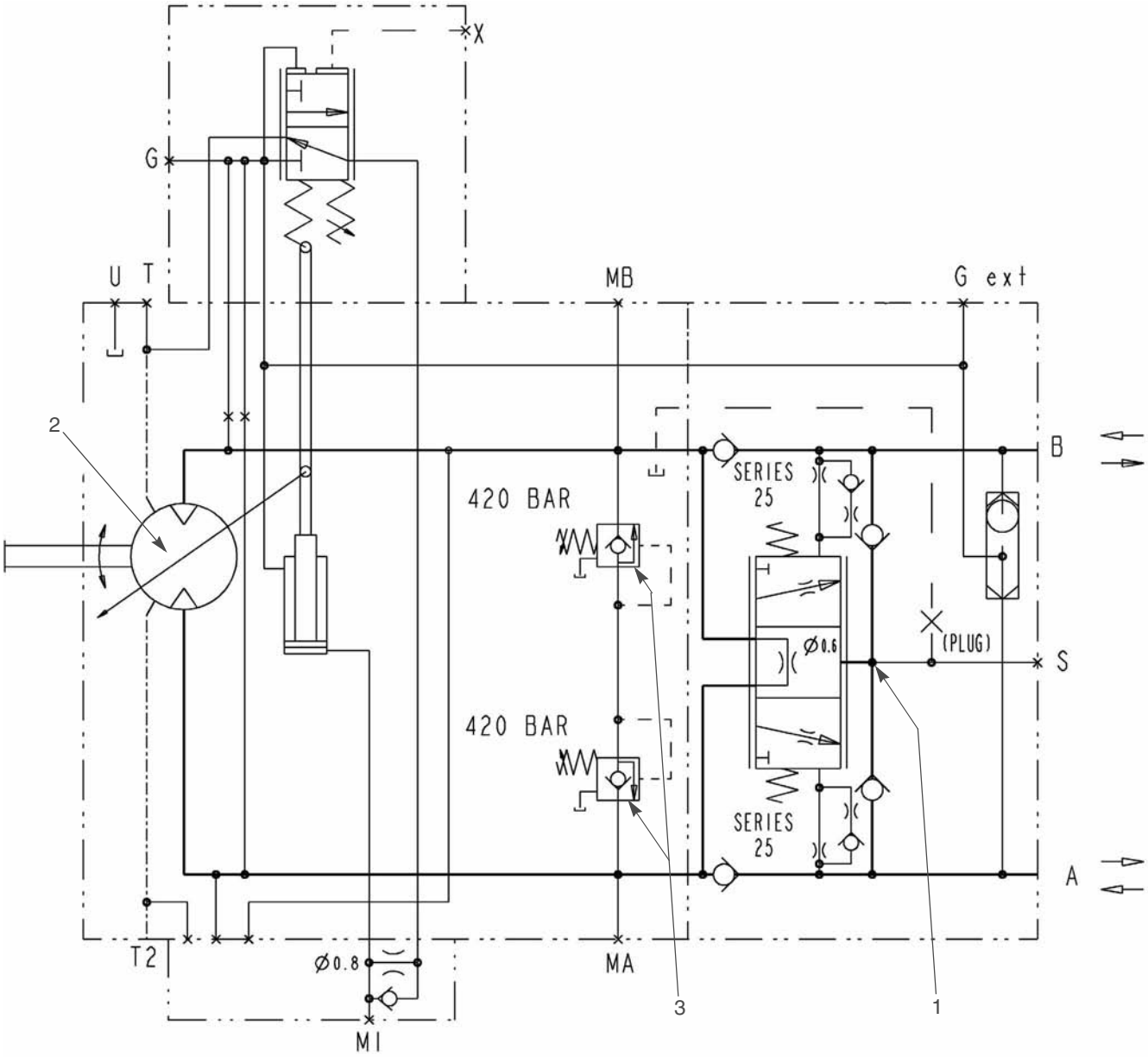
SPECIFICATIONS

Type	120cc unit
Min displacement setting	41cc/rev
Brake relief valve setting	420 bar
Counterbalance valve pressure setting	7 bar

FUNCTION

The travel motor is a device for driving the transmission by converting the hydraulic power into mechanical torque.
Oil is delivered via the main valve to ports A/B and this flow rotates a rotary group which is connected to the motor output splines which are positioned to the transmission input.

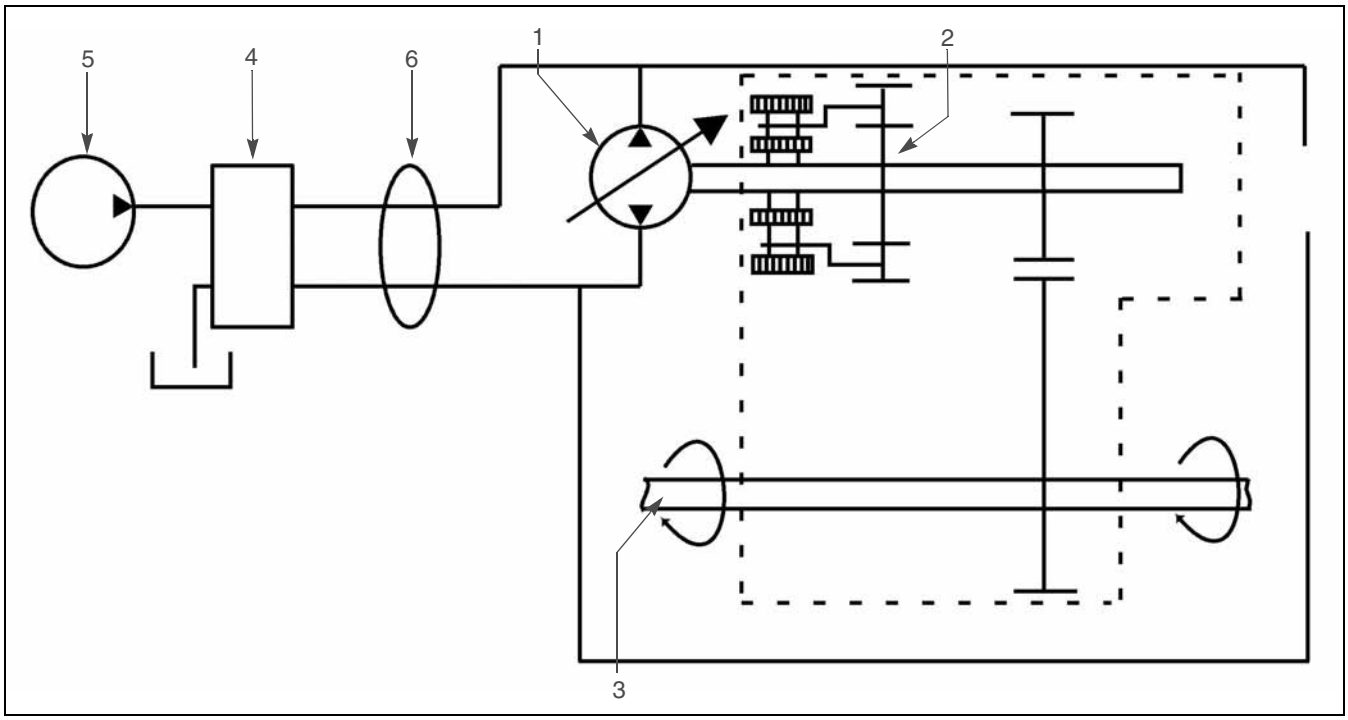
Travel Motor



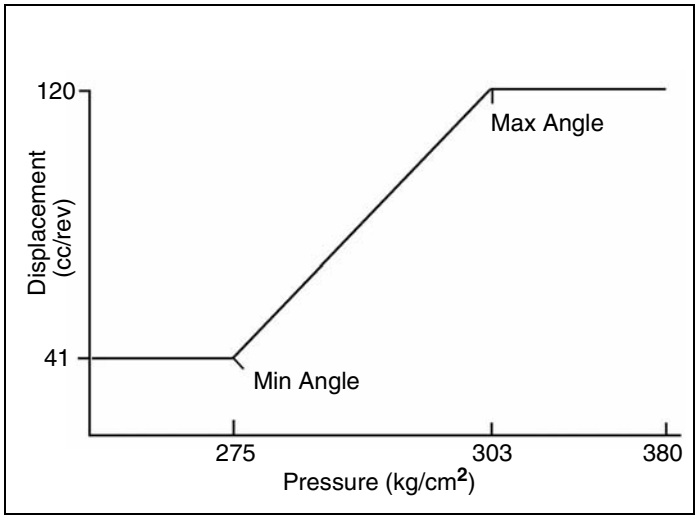
1. Counterbalance valve
2. Motor
3. Relief valve

OPERATION OF TRAVEL MOTOR

1. During normal travel

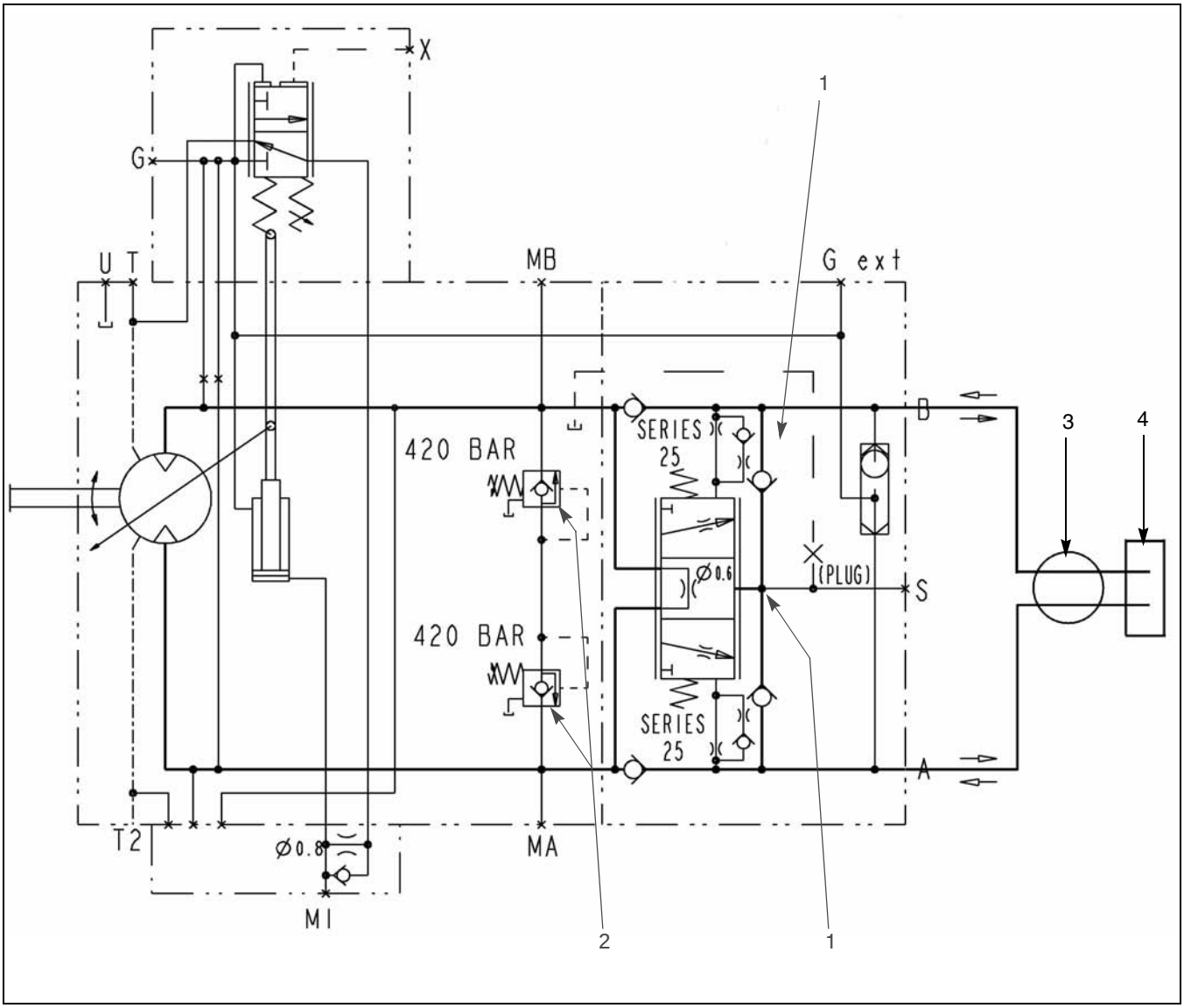


1. Travel motor
2. Transmission and clutch
3. Drive shafts
4. Main control valve
5. Main pump
6. Swivel joint



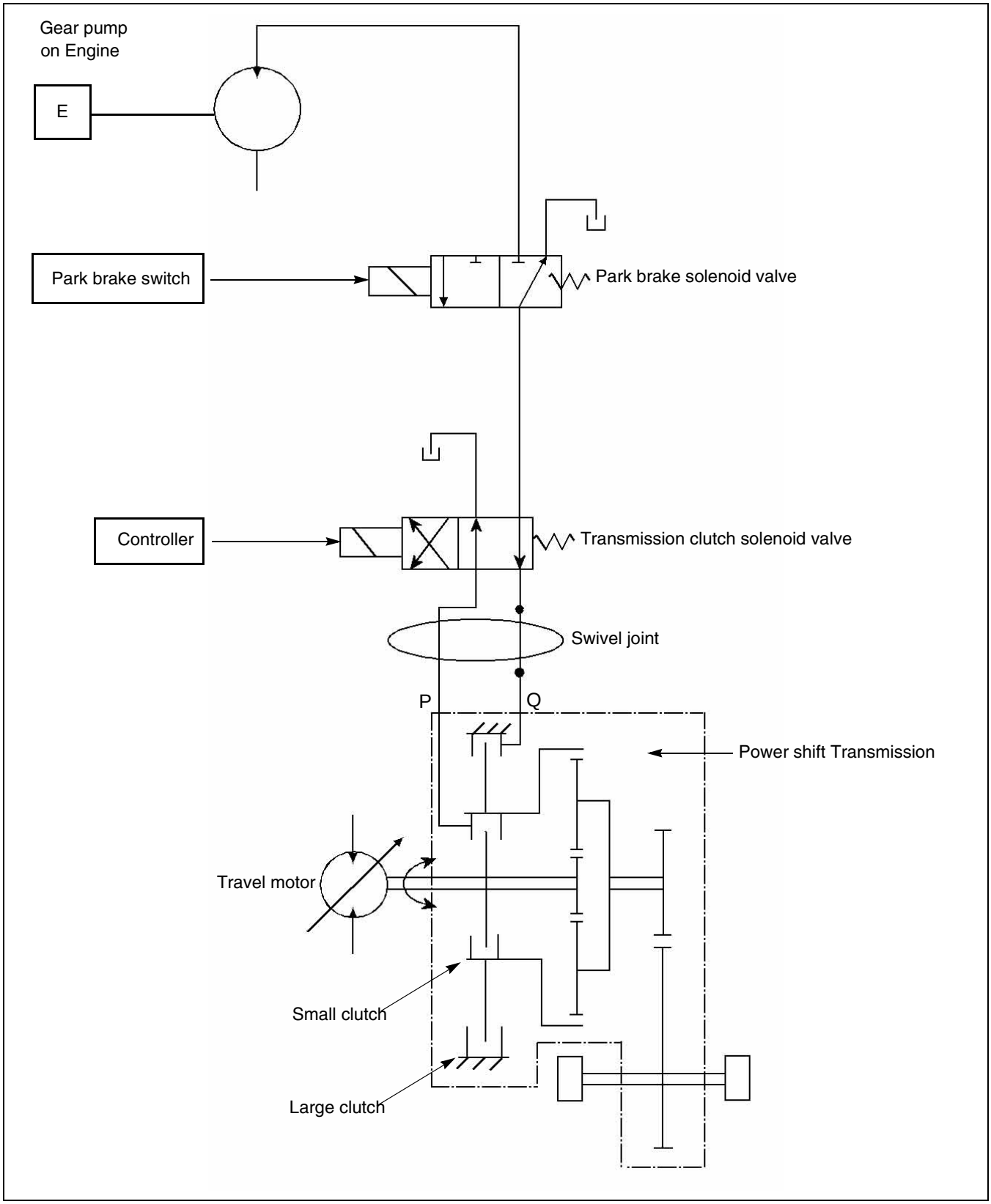
- Oil is supplied to the travel motor from the control valve by the travel spool. When the spool is opened the machine accelerates from the stationary the pressure at the travel motor rises to maximum. This high pressure is used to set the displacement of the travel motor to maximum to give maximum torque.
- As the machine speed increases, so pressure required to move the machine will reduce. This reducing pressure is used to reduce the displacement of the travel motor to allow increasing speed. The travel motor changes from maximum displacement to preset minimum. Displacement changes according to the diagram.

2. Control of speed downhill
   At high speed when the machine is travelling downhill, machine speed must be limited to prevent overspeed of travel motor, transmission and axles. In the downhill condition the machine weight is driving the machine and pressure at the travel motor inlet becomes low. This low pressure is used to close the counterbalance valve.This allows the counterbalance valve springs to centralise the spool. The travel motor will rotate because it is driven from the wheels and so oil in the travel motor is circulated at high pressure through the brake valves. This oil circulated at high pressure through the brake valves slows the machine speed down.



1. Counterbalance valve
2. Relief valve
3. Swivel joint
4. Main control valve

CLUTCH CONTROL CIRCUIT



FUNCTION

The clutches maintain the drive between the travel motor and the transmission low or high sped. The low and high gear are combined within the same clutch pack and gear selection is provided by the Hi/ Lo speed transmission clutch solenoid.

A clutch is disengaged by applying pressure to that particular clutch piston and the system does not allow pressure to be applied to both clutch pistons at the same time.

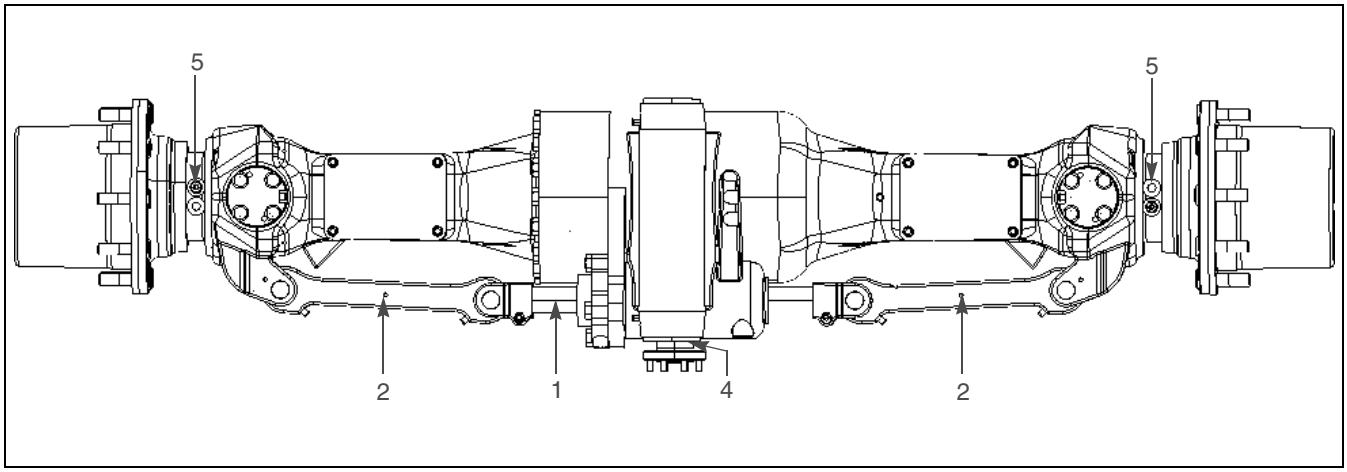
1. Pressure applied to transmission port 'P' disengages the high speed clutch pack meaning the low speed clutch pack is engaged - low speed has been selected.
2. Pressure applied to transmission port 'Q' disengages the low speed clutch pack meaning the high speed clutch pack is engaged - high speed has been selected.
3. When there is no pressure applied to port 'Q' and port 'P', both low speed and high speed clutches are engaged meaning the parking brake has been applied.

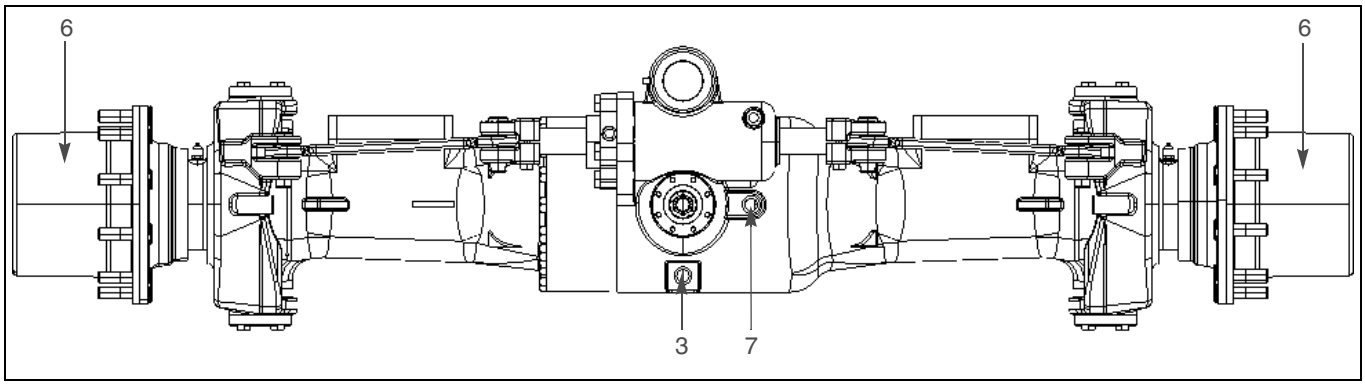
AXLE

OUTLINE

- Each axle consists of an axle housing supporting the chassis weight, a differential set in the axle housing, a final drive, and a brake provided at each end.
- A trunnion-type axle shaft with a king pin at the final drive end is used to enable the direction of the machine to be changed.

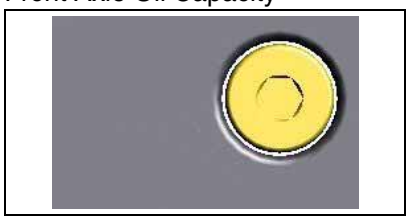
FRONT AXLE





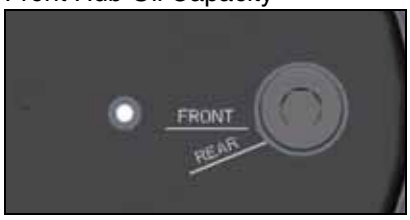
1. Steer cylinder
2. Track control arms
3. Axle housing
4. Drive shaft input
5. Brake line input
6. Wheel hub
7. Oil level plug

Front Axle Oil Capacity

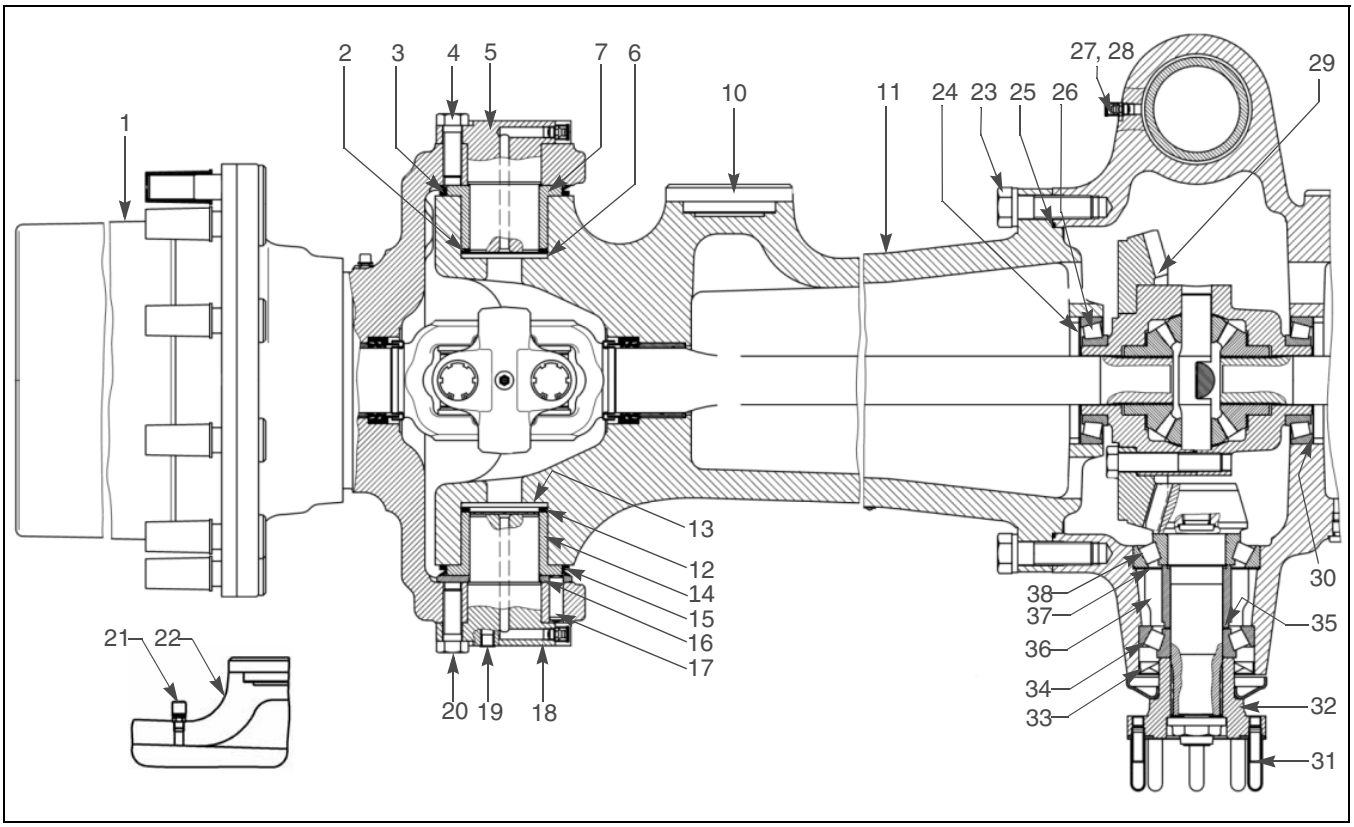


PW180 11.5 Litres

Front Hub Oil Capacity

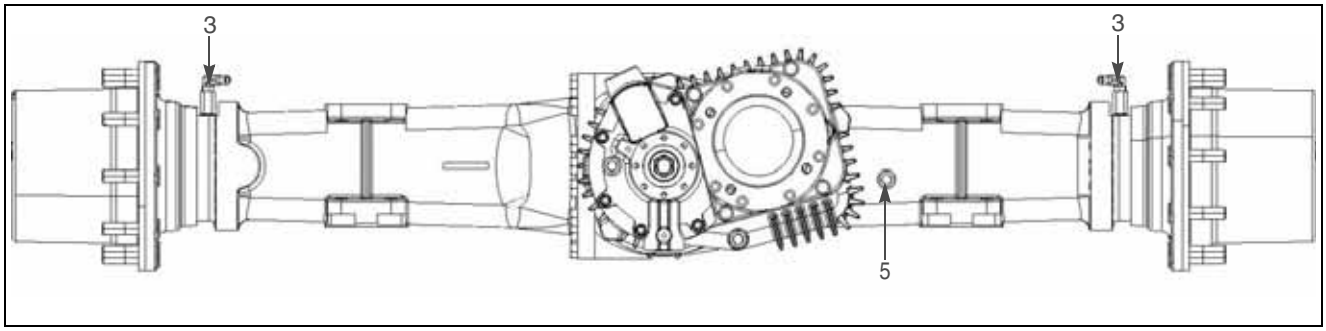


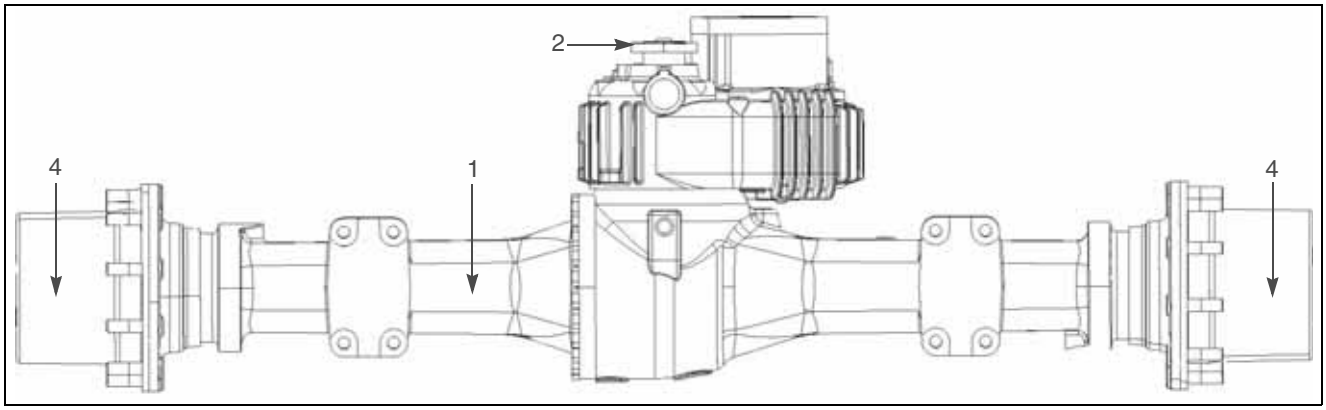
PW180 2.5 Litres



1.	Planetary holder	20.	Screw
2.	O-ring	21.	Axle body long steering
3.	Seal ring	22.	Air valve
4.	Screw	23.	Screw
5.	Pin	24.	Shim ring
6.	Disk/Washer	25.	O-ring
7.	Bushing	26.	Roller bearing
8.	Lip seal	27.	Protection cap
9.	Bushing	28.	Nipple
10.	Pressure pad	29.	Bevel gear
11.	Axle body short steering	30.	Shim ring
12.	O-ring	31.	Planetary holder
13.	Disk/Washer	32.	Flange
14.	Bushing	33.	Lip seal
15.	Seal ring	34.	Roller bearing
16.	Ring	35.	Shim ring
17.	Parallel pin	36.	Bushing
18.	Pin	37.	Shim ring
19.	Security dowel	38.	Roller bearing

REAR AXLE

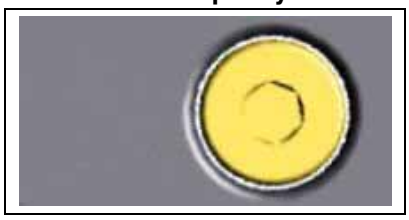




1. Axle housing
2. Drive shaft input
3. Brake line input
4. Wheel hub

5 Oil level plug

Rear Axle Oil Capacity

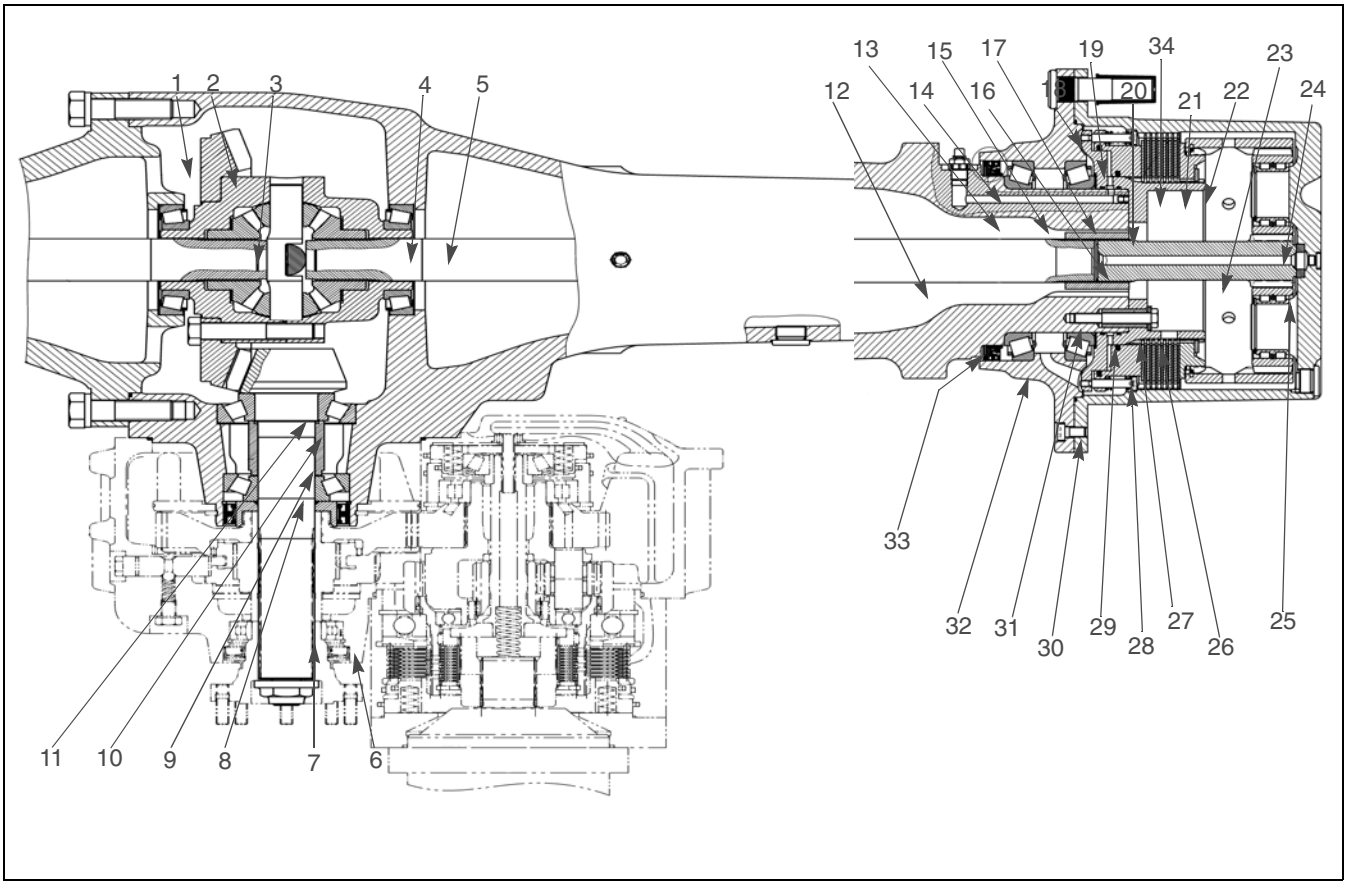


PW180 2.5m Axle	9.5 Litres

Rear Hub Oil Capacity



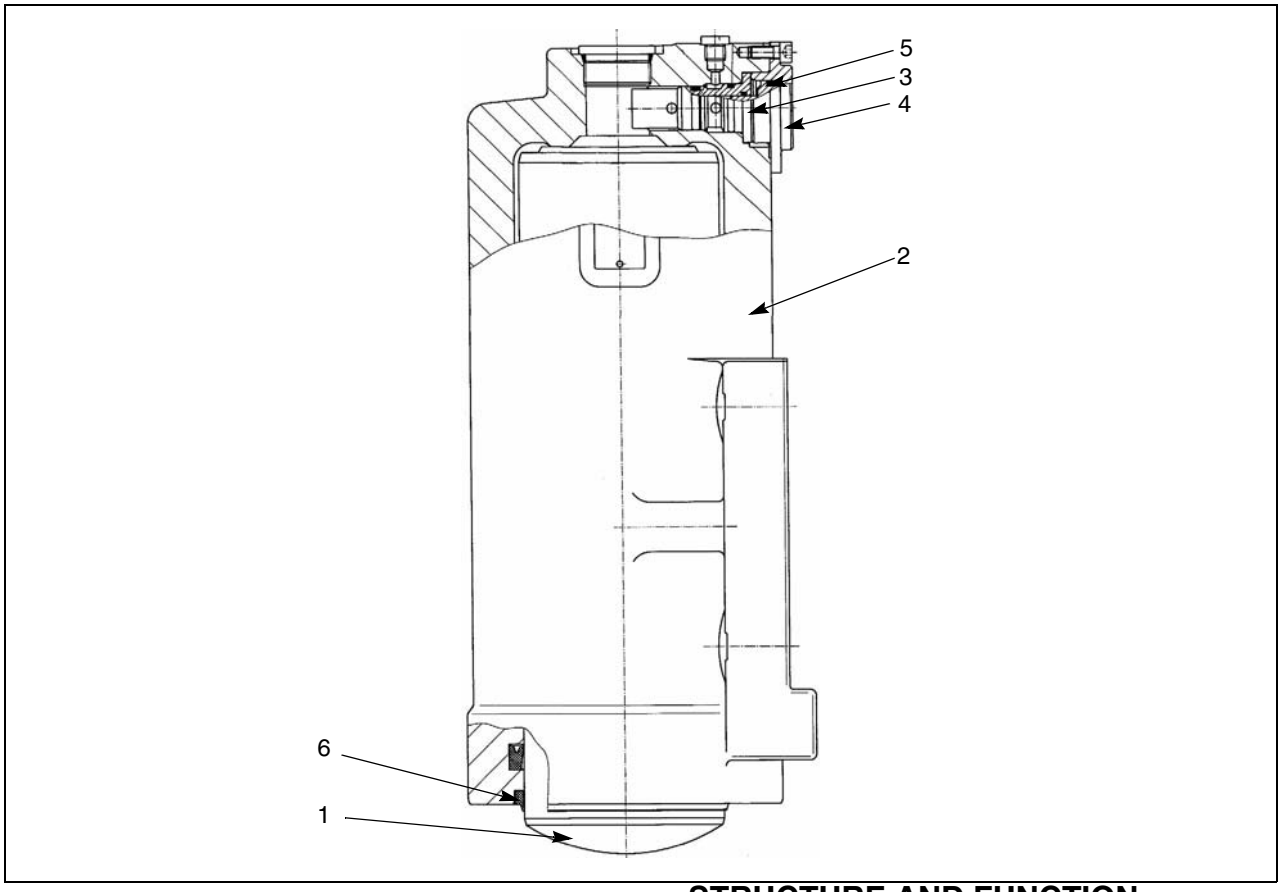
PW180	2 Litres



1.	Screw	18.	Hub
2.	O-ring	19.	O-ring
3.	Roller Bearing	20.	Plug
4.	Beval Gear	21.	Circlip
5.	Roller Bearing	22.	Hollow Wheel
6.	Nut	23.	Gear Pinion
7.	Flange	24.	Planetary Holder
8.	Lip Seal	25.	Screw Plug
9.	Roller Bearing	26.	Screw
10.	Bushing	27.	Disk/Washer
11.	Roller Bearing	28.	Brake
12.	Shaft	29.	Bushing
13.	Adjusting Ring	30.	Cylinder Head Screw
14.	Tube Fitting	31.	Circlip
15.	Roller Bearing	32.	Gasket
16.	Sleeve	33.	Seal Ring
17.	Roller Bearing	34.	Brake Disc

- When the service brake is applied, braking is carried out in pairs to diagonally opposite wheels, the braking is after the final gear reduction giving improved axle lock.

SUSPENSION LOCK CYLINDER



1. Plunger
2. Cylinder housing
3. Check valve cartridge
4. Switching cylinder
5. Control spool
6. Wiper

SPECIFICATIONS

Piston Diameter	100mm
Stroke	180mm
Pilot Pressure Min.	2.8 MPa

STRUCTURE AND FUNCTION

Plunger cylinder with in built check valve.

The check valve is designed as a leak free ball seat valve which is released by a control spool.

The control conduit is connected to both axle lock cylinders, the pilot pressure piloting the check valve in the cylinder head is also pre loading the cylinders during pendulum motion therefore only one conduit to the cylinders is necessary.

CIRCUIT

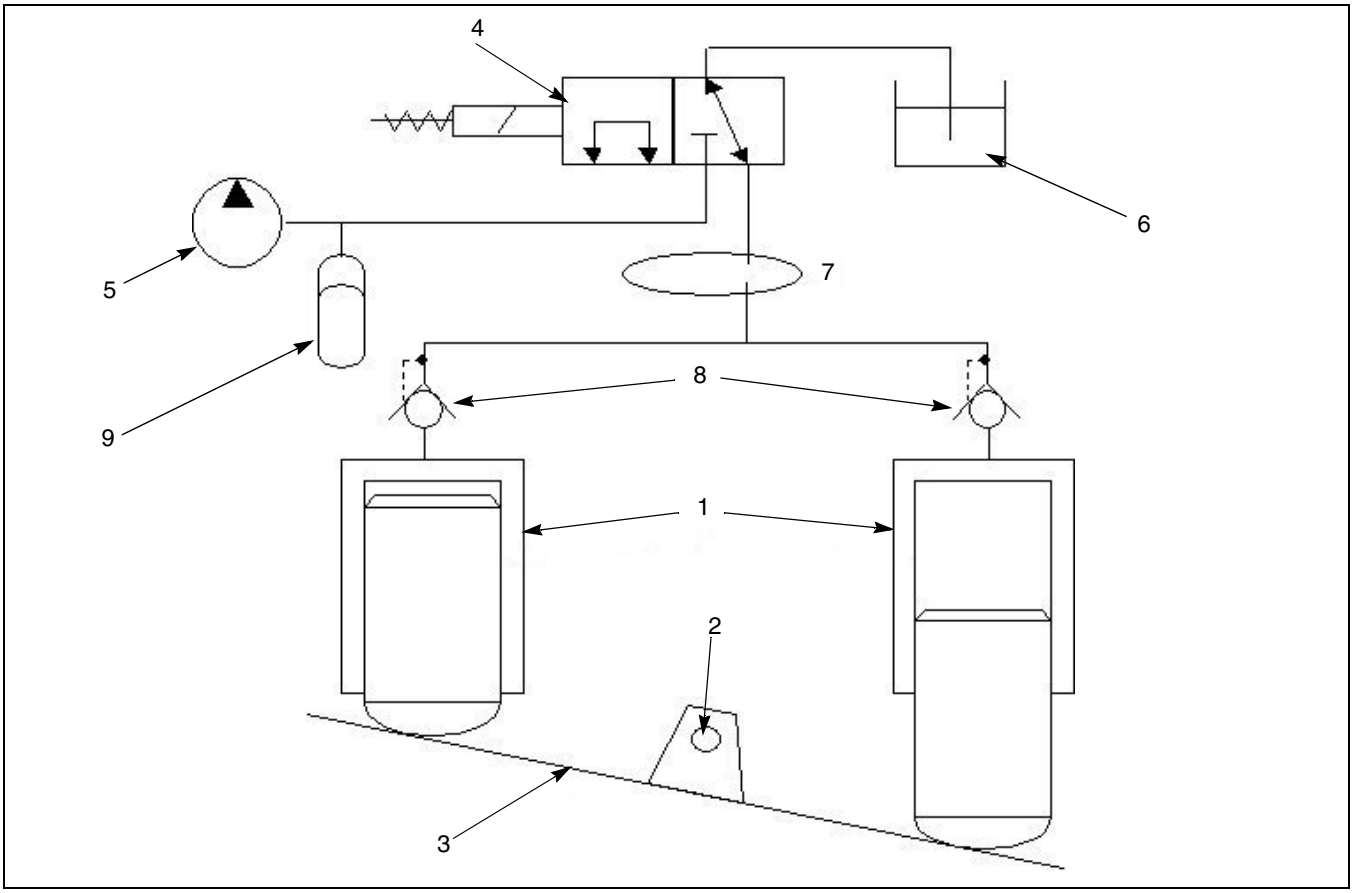
PURPOSE

The undercarriage of wheeled hydraulic excavators has one of the two driven axles mounted so it can oscillate. This makes it possible to fully utilise the excavators rimpull in rough terrain - all of the wheels being constantly in contract with the ground. A suspension cylinder is fitted on each side of the undercarriage to lock the axle during digging or lifting work.

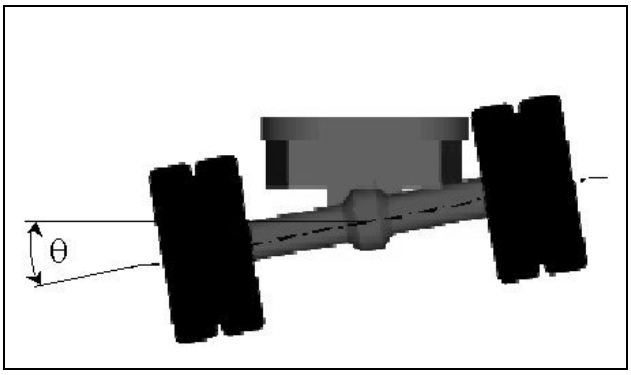
Locking the axle increases the excavators stability.

The oscillating axle (3) is mounted on axle mount pin (2) in the centre of the excavator. The two cylinders (1) which are full of hydraulic oil are connected through pipelines to the suspension lock solenoid valve (4).

When the excavator is being moved on the jobsite, the suspension lock solenoid valve should be engernised so that the hydraulic oil in the cylinder can be returned to tank as the axle is oscillating up and down. Before commencing excavating operations, the oscillation lock solenoid valve should be de-energised to pressurise the oil in the cylinders. This will lock the axle in the position it is in.



1. Cylinder
2. Axle mount pin
3. Oscillating axle
4. Oscillation lock solenoid valve
5. Pump
6. Hydraulic tank
7. Swivel joint
8. PPC operated check valve
9. Accumulator

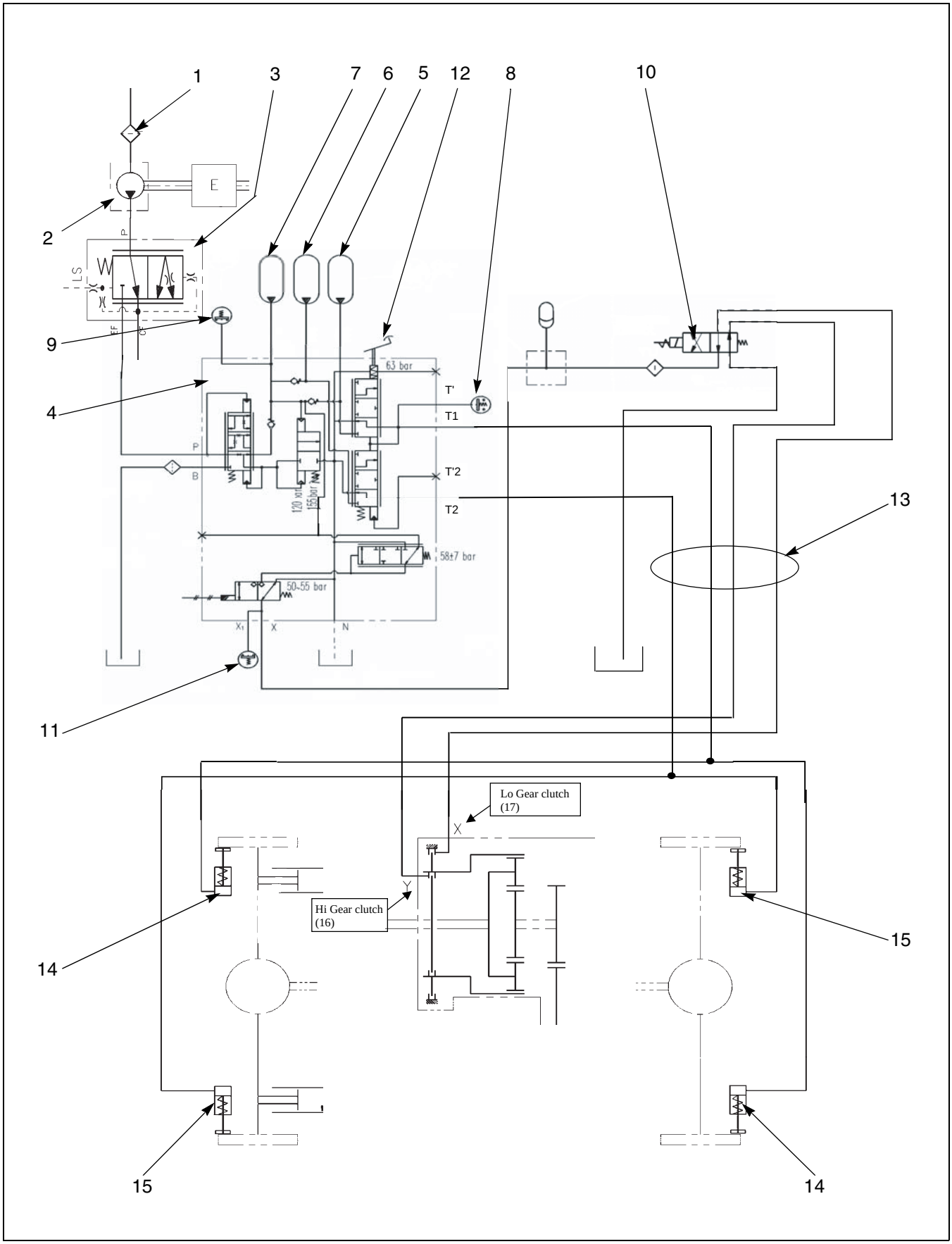


AXLE OSCILLATION

Axle oscillation: $= 10^{o}$

Minimum turning radius PW180 = 6.8m.

BRAKING SYSTEM



1. Hydraulic oil filter
2. Gear pump
3. Priority valve
4. Brake control valve
5. Accumulator - service brake (0.75 l.)
6. Accumulator - service brake (0.75 l.)
7. Accumulator - parking brake (0.75 l.)
8. Pressure switch - stop light (5 +/- 2 bar)
9. Pressure switch - accumulator (70 +/- 5 bar)
10. Transmission clutch control solenoid
11. Pressure switch (parking brake) - (40 +/- 1 bar) < less than activates
12. Brake pedal
13. Swivel joint
14. Service brake cylinder
15. Service brake cylinder
16. Small (high speed) clutch
17. Large (low speed) clutch

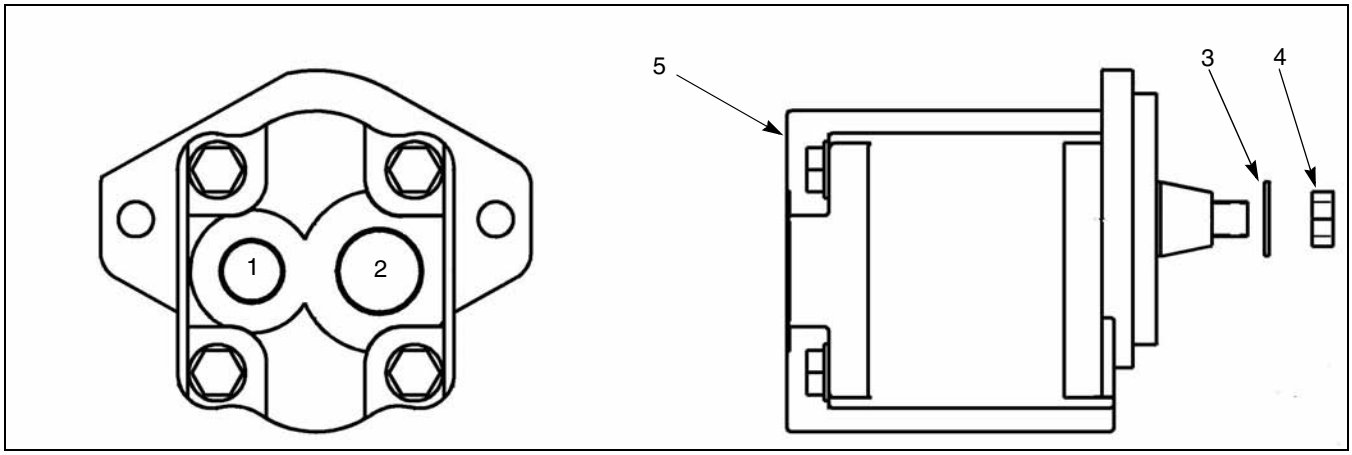
STRUCTURE AND FUNCTION

The brake system is fully hydraulic. Hydraulic oil is supplied at high pressure by gear pump to a priority valve giving priority to the steering circuit first and secondly to the braking circuit, when the steering is not being used in the steering circuit. The brake system gets the full flow when braking, oil is sent to the brake valve which provides braking pressure to two separate braking circuits (service brakes). In the event of failure of the power supply, the accumulators provide brake pressure to allow the machine to be safely stopped.

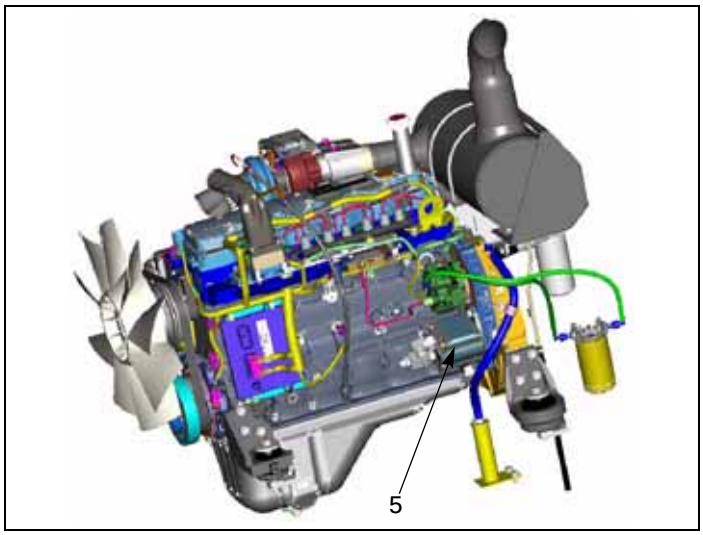
A parking brake is provided which is operated by selecting park brake switch in cab. This de-energises both high and low gear signals and locks the transmission gears.

If there is no pressure the parking brake will activate.

BRAKE/STEER PUMP



1. Delivery port (outlet)
2. Suction port (inlet)
3. Washer
4. Nut
5. Pump assembly



SPECIFICATIONS

Type	gear pump
Rated speed	2500 RPM
Displacement	25cc/REV
Rated pressure	250 bar
Max. input shaft torque	250Nm
Rotation	Anti-clockwise*

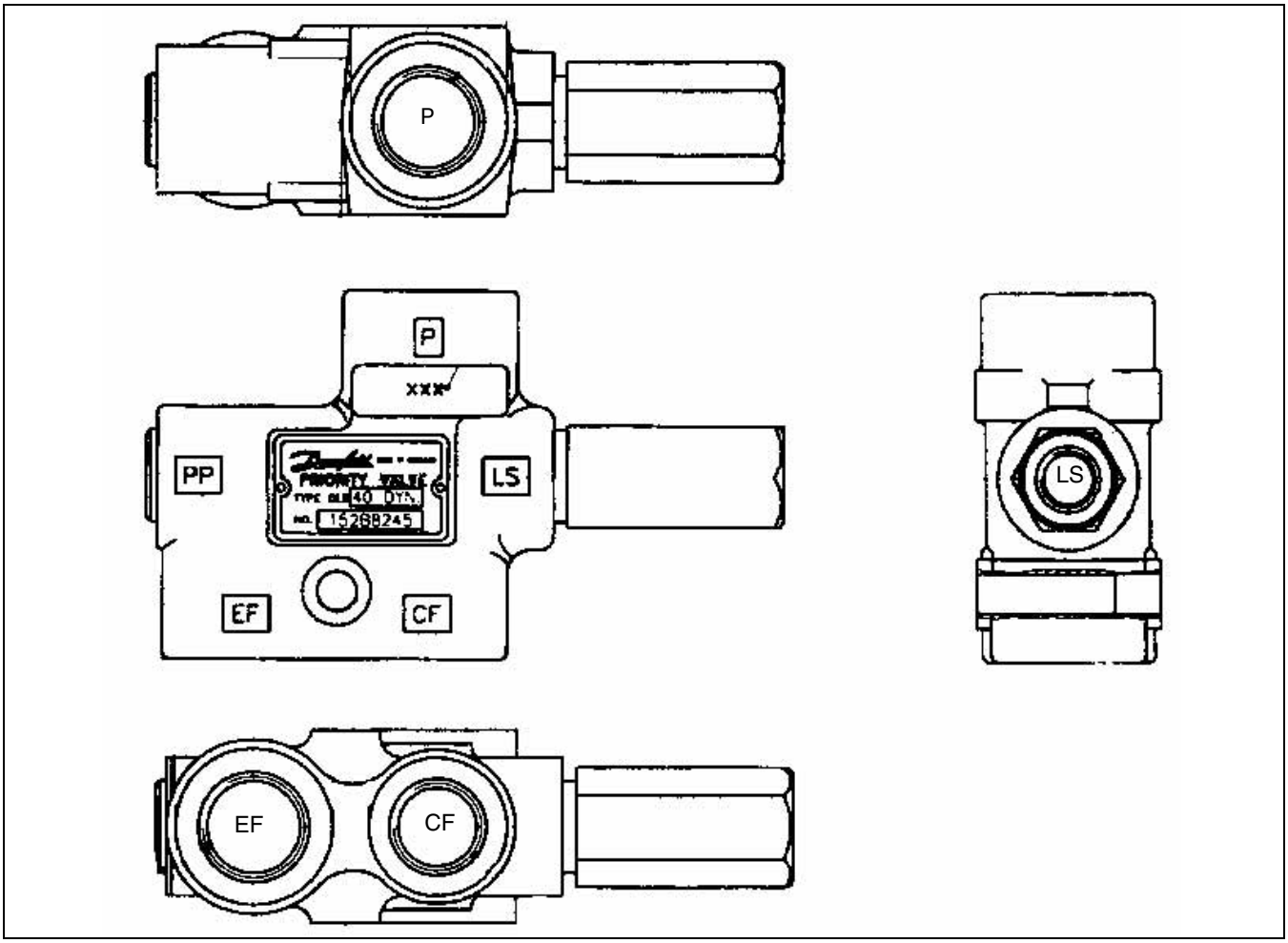
* Rotation direction when viewed on shaft.

FUNCTION

The brake/steer pumps function is to produce the necessary oil flow/pressure to operate the brake, steering and pilot pressure control circuits.

The pump is directly driven off the engine ancillary Power Take Off (P.T.O.)

PRIORITY VALVE



P	Pressure port (from pump)
EF	Output port to brake system
CF	Output port to steering system
LS	Load sensing port from steering valve

SPECIFICATION

Priority valve control spring pressure	7 bar

FUNCTION

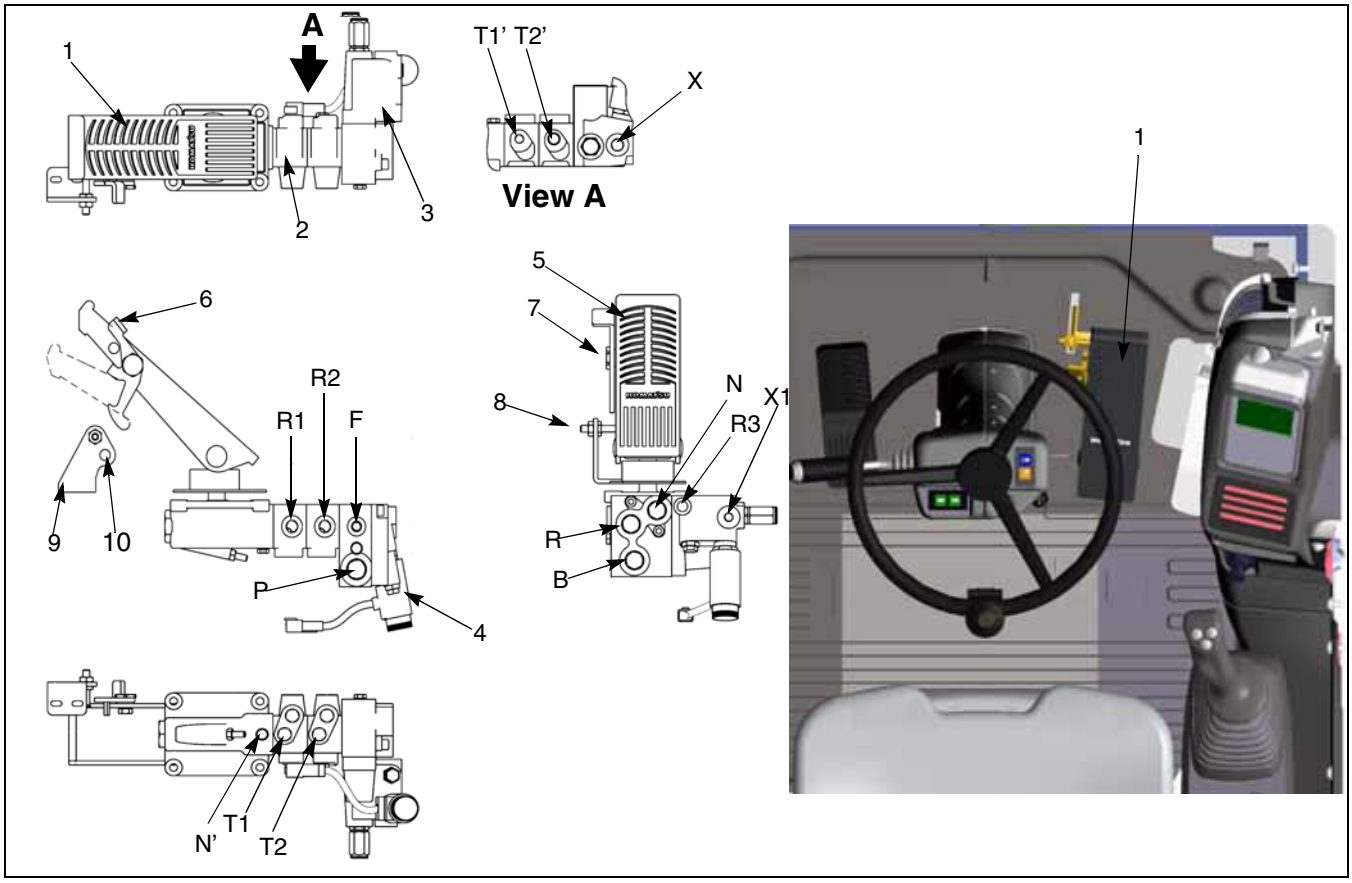
When the steering wheel is turned, the oil flow is distributed in such a way that the oil flow necessary for steering is led to the steering unit through the CF connection.

The remaining oil flow is available for use of the brake valve, through the EF connection.

The distribution is controlled by the LS signal from the steering unit; so that the oil flow to the steering unit is always determined by the actual steering rate.

Steering takes priority

POWER BRAKE VALVE



1	Brake system support pedal with hook	F	Accumulator pressure switch	P	Feed from priority valve
2	Brake module	R	Accumulator (charging valve stabiliser)	B	Return
3	Accumulator charging valve	R1	Accumulator (service brake)	N	Tank
4	3 ways complete solenoid valve	R2	Accumulator (service brake)	N'	Tank (plugged)
5	Pedal rubber	T1'	Service brake pressure switch	R3	Plugged (Accumulator on italian machine)
6	Latch pedal	T2'	Service brake pressure switch (plugged)		
7	Latch pedal fixing screw	T2	Service brake		
8	Latch pin	T1	Service brake		
9	Latch pin stirrup	X	Parking brake		
10	Brake proximity switch mounting hole	X1	Parking brake pressure switch		

SPECIFICATIONS

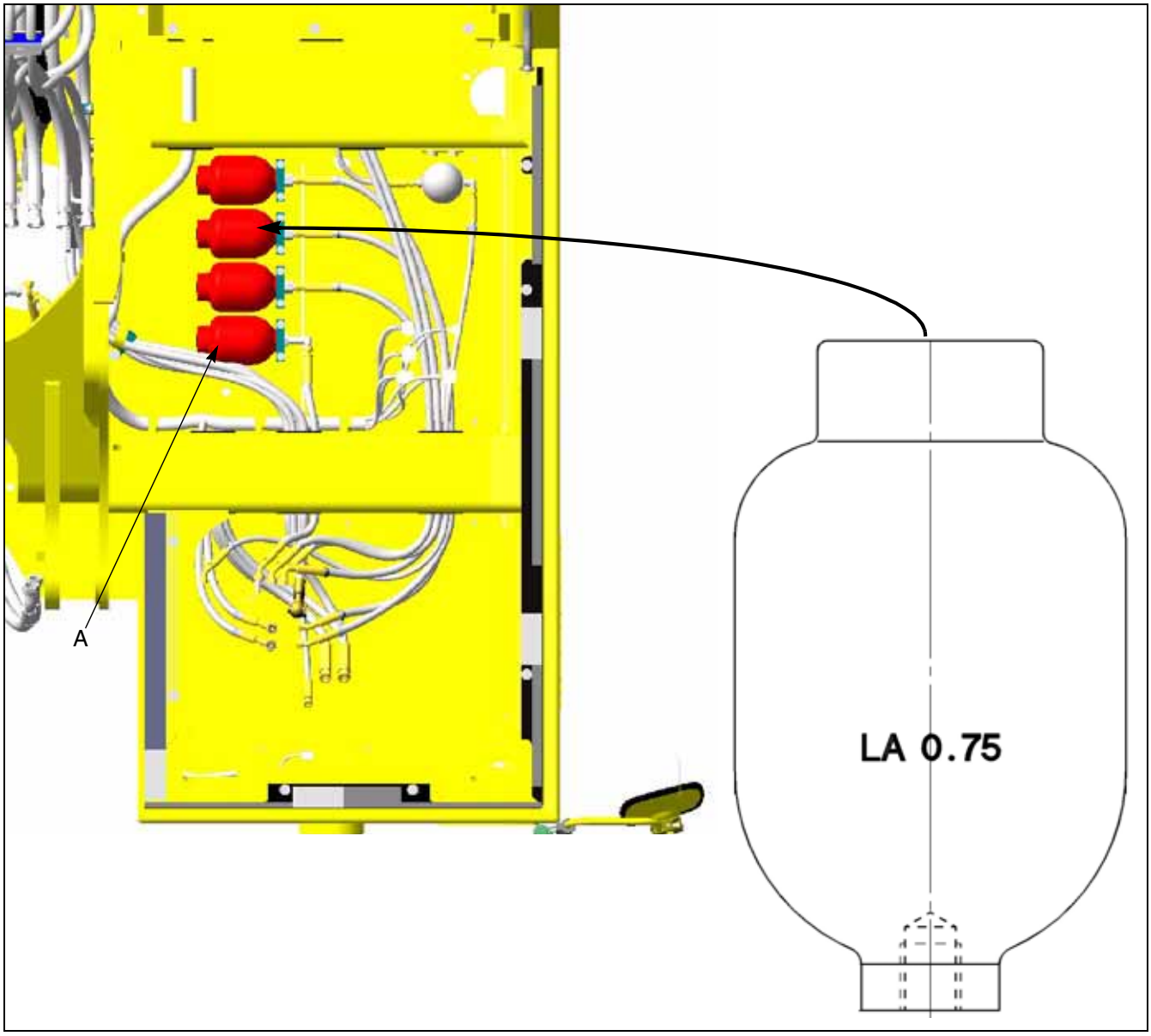
Accumulator charge pressure	(cut in) = 120 $^{+}/_{-}$ 5 bar
	(cut out) = 155 $^{+0}/_{-2}$ bar
Service brake pressure	63 bar
Park brake pressure	58 $^{+}/_{-}$ 7 bar

FUNCTION

The main function of the power brake valve is to gradually reduce the machines travelling speed when the pedal is slowly depressed. The higher the force applied to depress the pedal, the greater the deceleration of the machine, until the machine is eventually in a stationary position.

An alternative function of the power brake valve is the digging brake application, if the machine is to be used for digging, the power brake valve should be fully depressed until the pedal is locked and the latching hook is secured on its location pin. This will prevent the machine from "Travelling" when it is being used for digging

ACCUMULATOR FOR BRAKE VALVE



SPECIFICATIONS

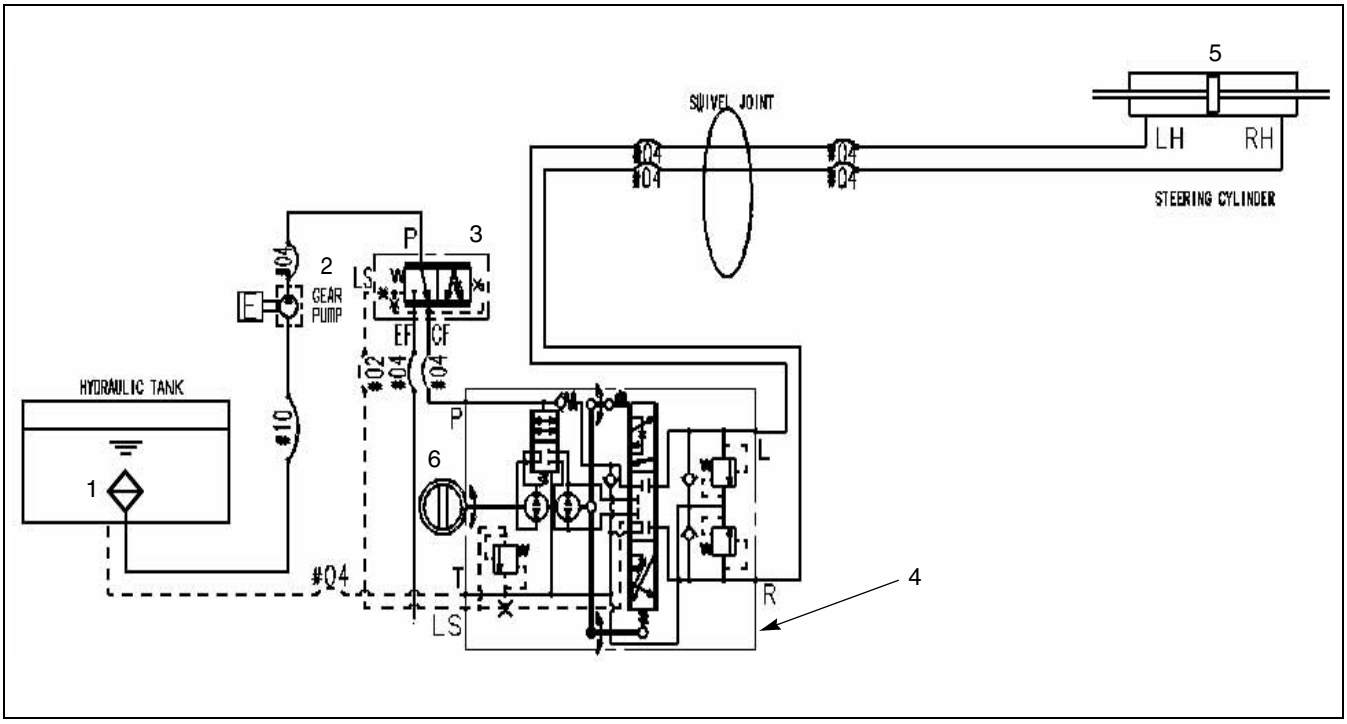
1.	Nominal capacity	0.75L
2.	Max. working pressure	210 bar
3.	Max. △ p dynamic	175 bar
4.	Working temperature	- 30° to 125° C
5.	Diaphragm	NBR
6.	Fluid	Mineral oil
7.	Body	Forged steel
8.	Surface finish	Rust preventative coating
9.	Pre-charge gas	Nitrogen
10.	Pre-charge pressure	50 bar

STRUCTURE AND FUNCTION

- The accumulators are installed below the operators cab accessible from the under covers.
- Installed into the brake circuit the accumulators provide pressure to the brakes in the event of a power failure ensuring the machine is stopped safely.

NOTE: Accumulator A is only installed on italian specification machines.

STEERING SYSTEM



1.	Hydraulic filter	4.	Steering valve
2.	Brake/steer pump	5.	Steering cylinder
3.	Priority valve	6.	Steering wheel

STRUCTURE AND FUNCTION

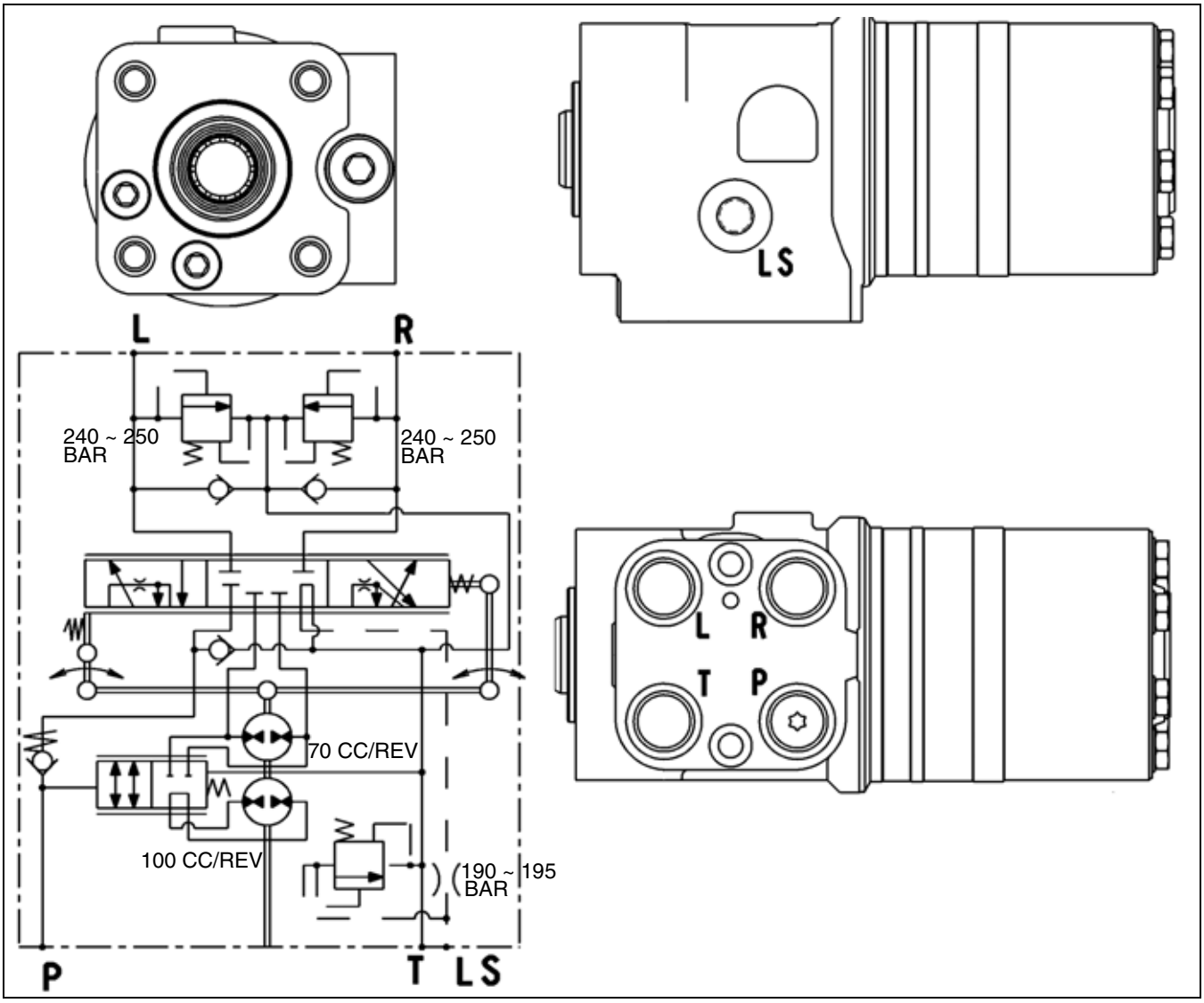
- The steering is fully hydraulic. The oil sent by the brake/steer pump (2) mounted on the PTO at the front of the engine, flows via the priority valve (3) to the steering valve (4). From here it is passed through swivel joint to steering cylinder (5). the steering cylinder then extends or retracts to move the tie-rod and steer the machine
- In the event of a failure of the hydraulic system the machine can be steered by emergency steering. The steering valve acts as a pump to send oil to the steering cylinder.

STEERING COLUMN



1. Steering wheel
2. Steering column
3. Pedal
4. Hose connections
5. Orbitrol valve
6. Mounting bracket
7. Sunshine sensor

ORBITROL VALVE



P	Pressure port (from priority valve)
T	Tank port
L	Left turn port
R	Right turn port
LS	Load sensing port (to priority valve)

Specifications

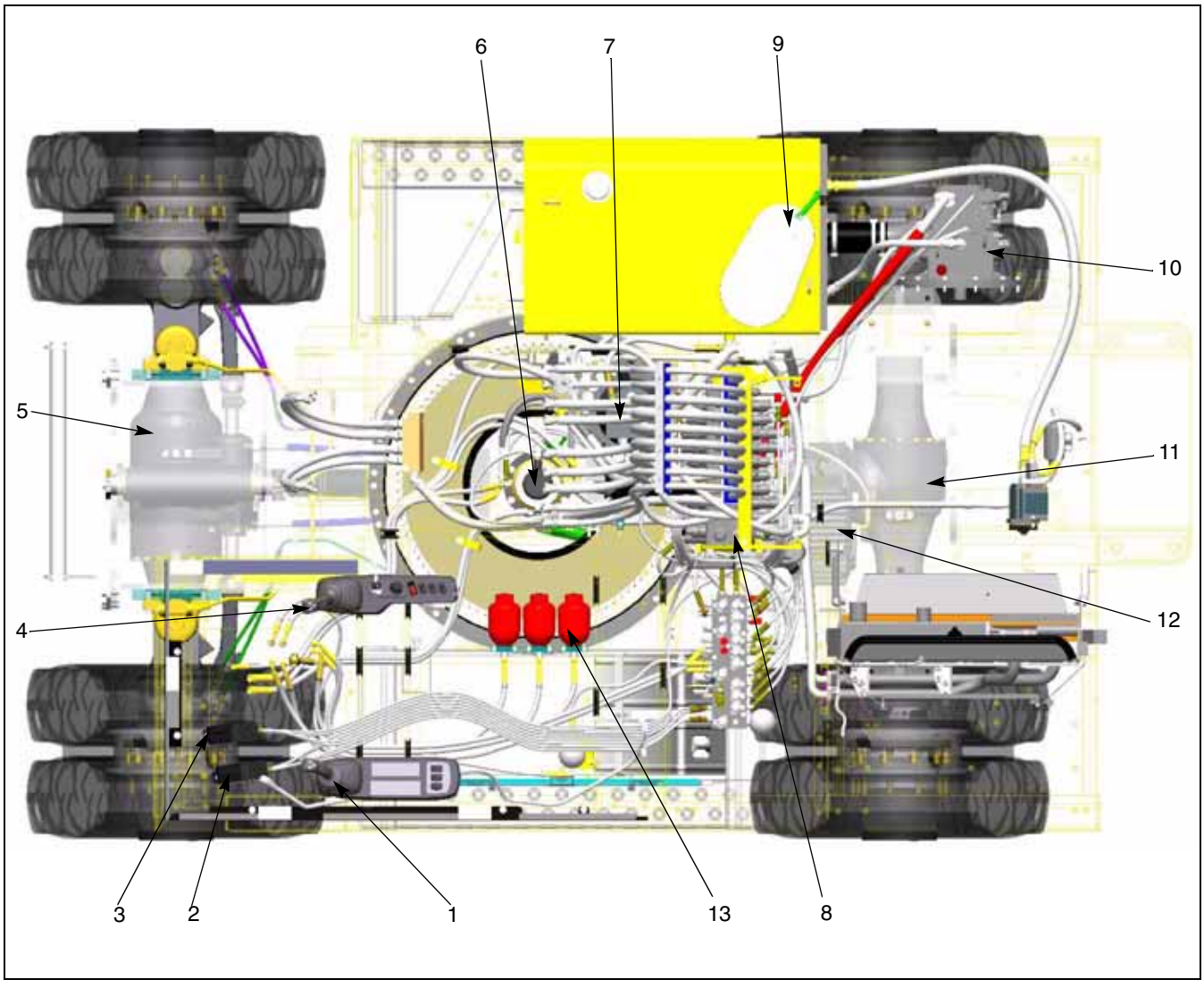
Nominal displacement (normal operation)	240cc/rev
Nominal displacement (emergency operation)	80cc/rev
Relief valve setting	$190^{+5}/_{-0}$ bar

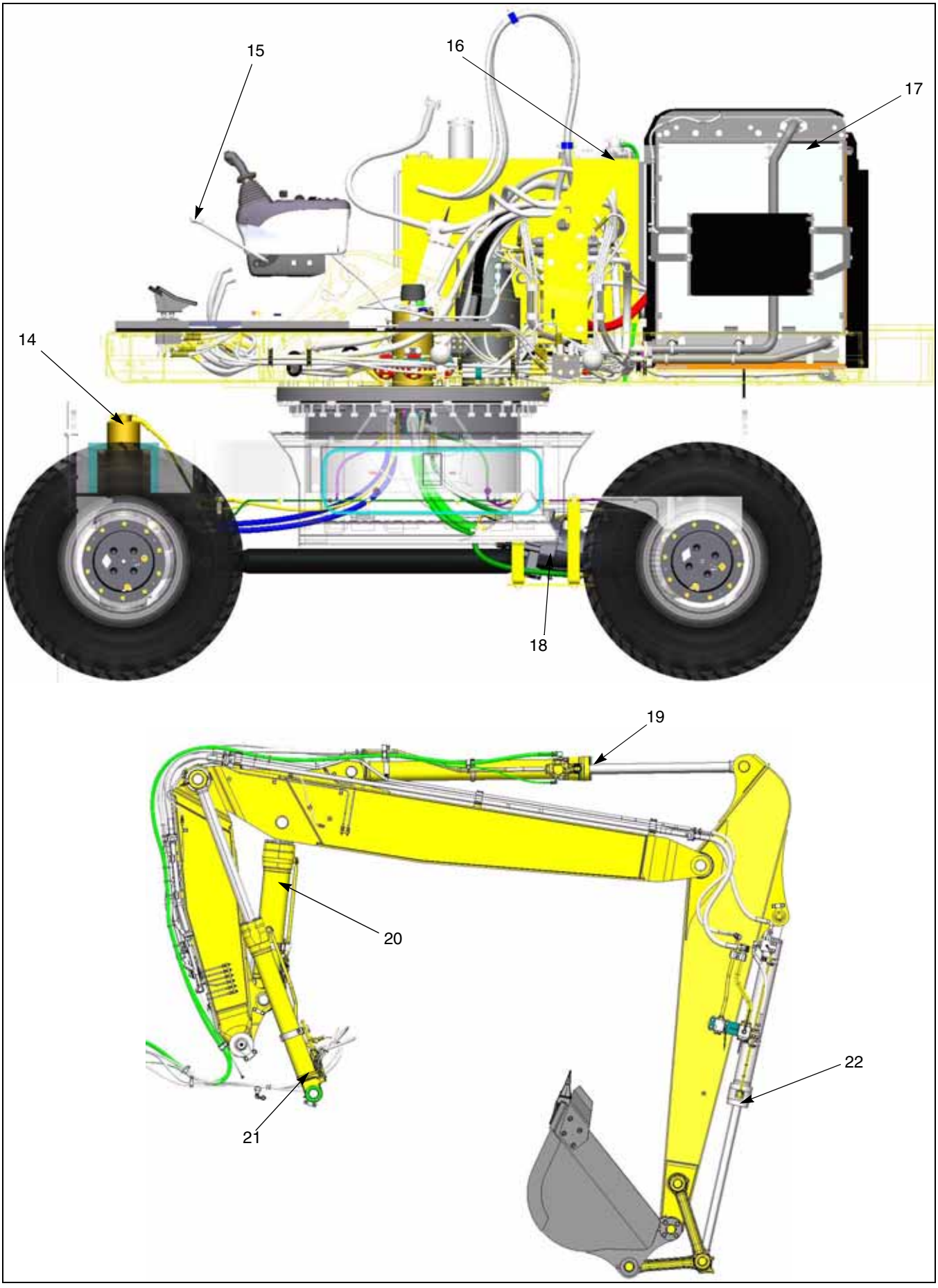
Structure and Function

- The steering is fully hydraulic, the oil sent by the brake/steer pump on the front of the engine flows via the priority valve to the orbitrol valve, and finally to the steering cylinder which controls, extends or retracts the tie rod on the axle to steer the machine.
- In the event of failure of the power supply the machine can be steered by 'Emergency steering', the steering valve acts as a pump to send oil to the steering cylinders.

HYDRAULIC EQUIPMENT LAYOUT DRAWINGS

1.	L.H PPC valve	12.	Transmission
2.	HCU pedal	13.	Brake accumulators
3.	2nd boom adjust pedal	14.	Suspension cylinder
4.	R.H PPC valve	15.	Safety lock lever
5.	Front axle	16.	Hydraulic tank
6.	Swivel joint	17.	Combination cooler
7.	Swing motor	18.	Travel motor
8.	Control valve	19.	Arm cylinder
9	Hydraulic filter	20.	2nd boom adjust cylinder
10	Main pump	21.	1st boom cylinder
11	Rear axle	22.	Bucket cylinder



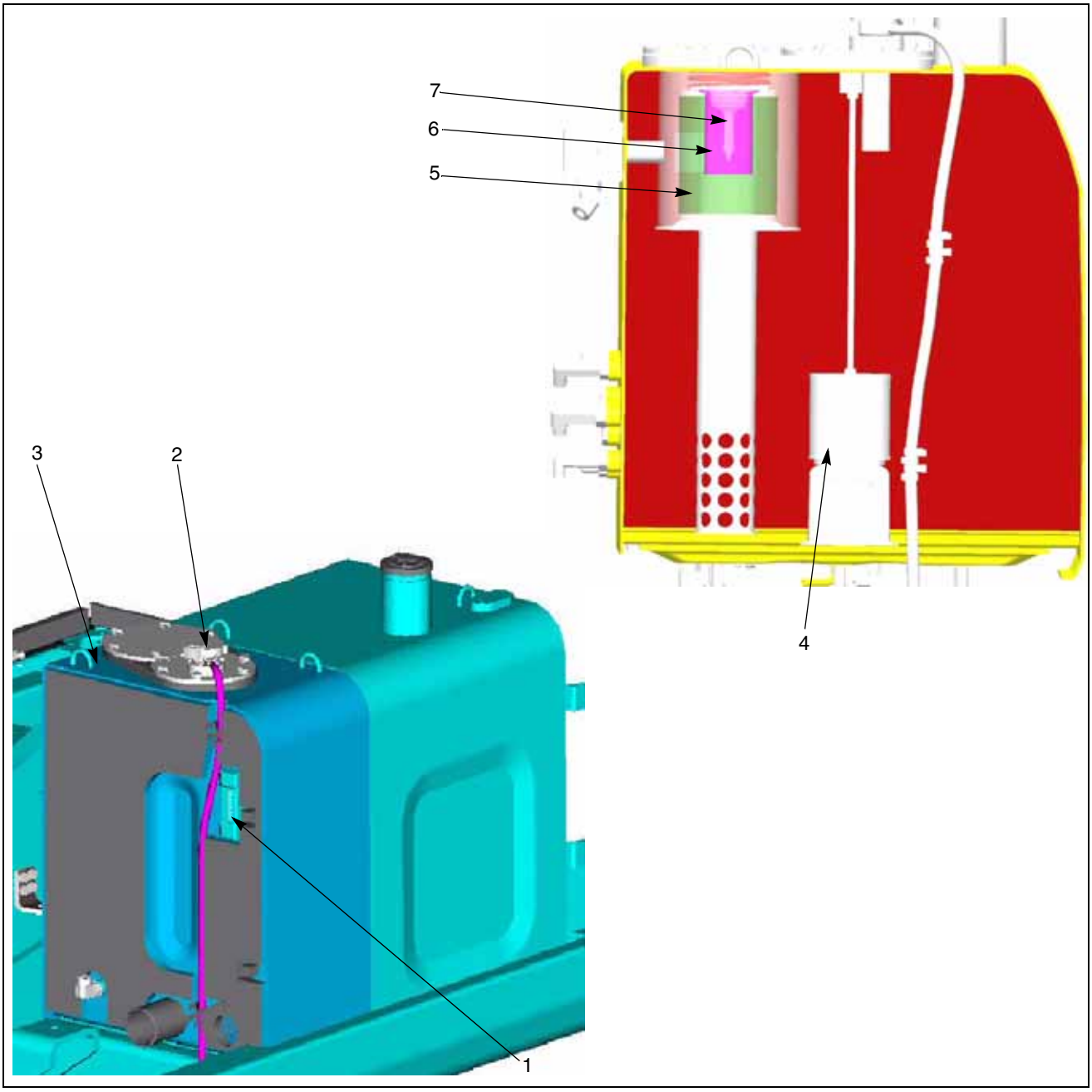

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HYDRAULIC CIRCUIT DIAGRAM

(Please refer to Section 90)

.

HYDRAULIC TANK



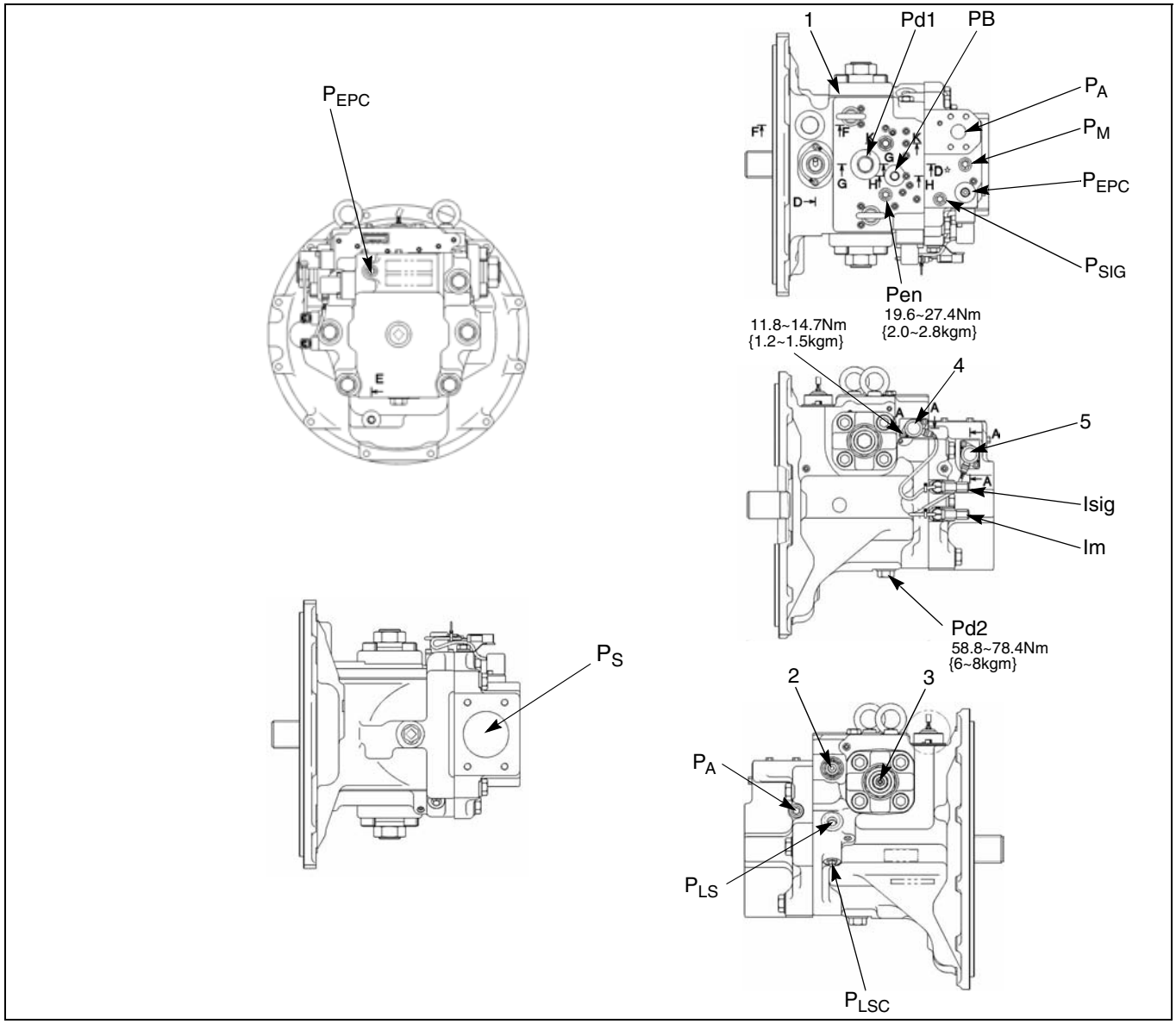
1. Sight gauge
2. Oil filler cap
3. Hydraulic tank
4. Suction strainer
5. Filter element
6. Strainer
7. Bypass valve

SPECIFICATIONS

Tank	166 Litres
Amount of oil inside tank	120 Litres
Pressure valve	
Relief cracking pressure	16.7 $^{+}/_{-}$6.9 kPa
	{0.17 $^{+}/_{-}$0.07 kg/cm^2}
Suction cracking pressure	0 - 0.49 kPa
	{0 - 0.005 kg/cm^2}
Bypass valve set pressure	150 $^{+}/_{-}$ 30 kPa
	{1.5 $^{+}/_{-}$ 0.3 kg/cm^2}

HYDRAULIC PUMP

HPV125



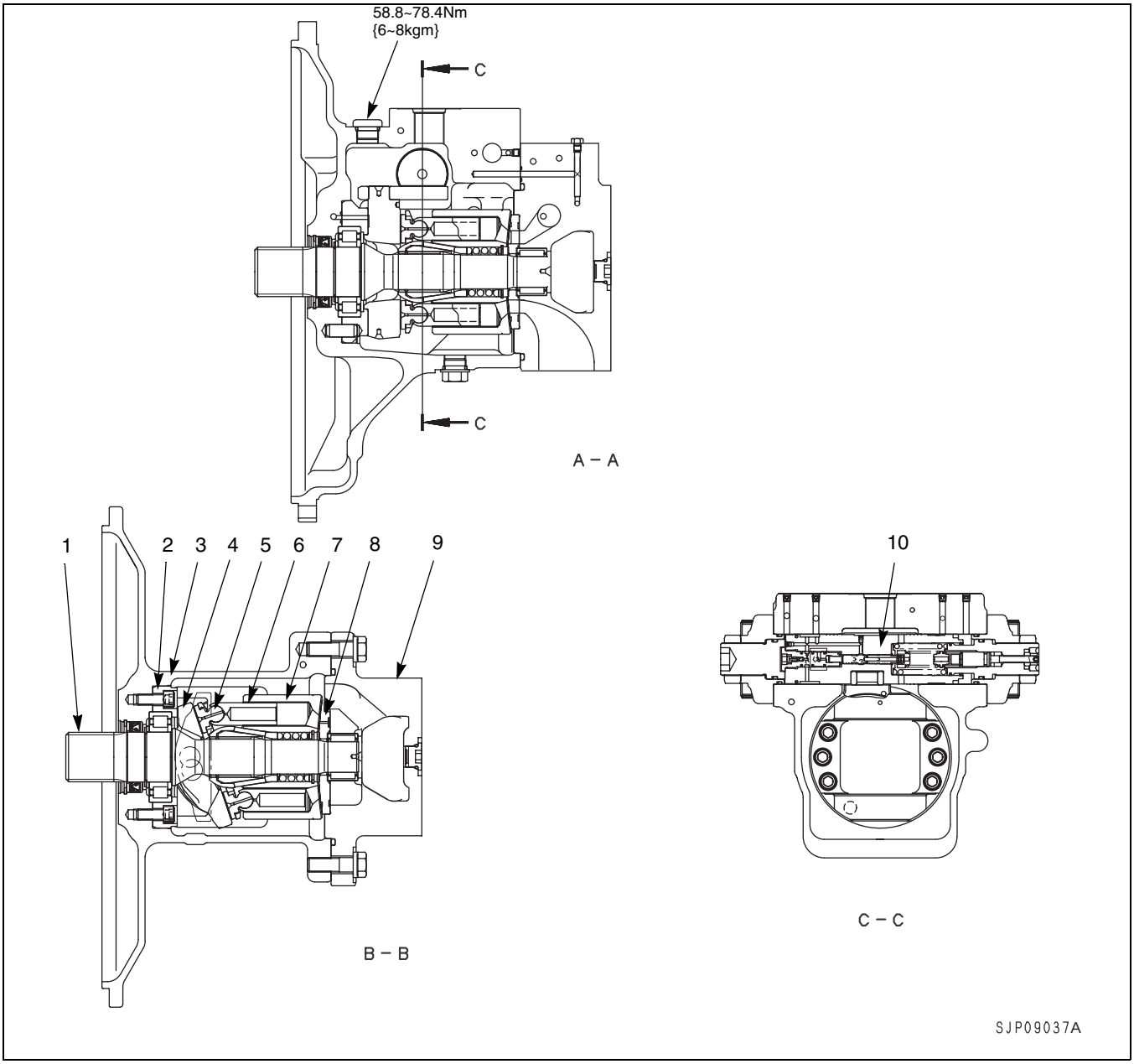
1. Main pump
2. LS valve
3. PC valve
4. LS-EPC valve
5. PC-EPC valve

Im :PC mode selector current
Isig :S set selector current
P_A :Pump delivery port
P_A :Pump delivery pressure detection port
PB :Pump pressure input port
Pd1 :Case drain port
Pen :Pump control pressure detection port
Pd2 :Drain port

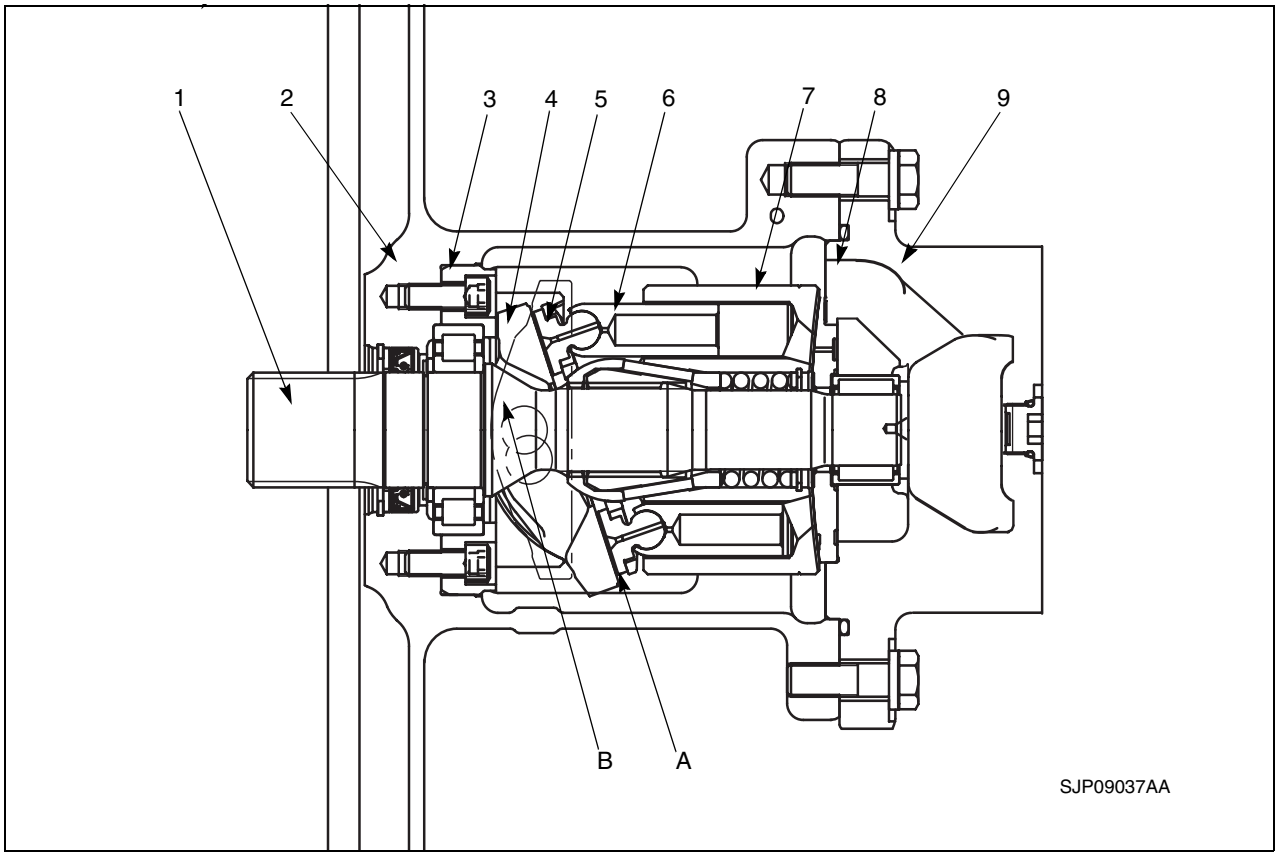
P_{LS} :Load pressure input port
P_{LSC} :Load pressure detection port
P_S :Pump suction port
P_{LSC}:LS set selector pressure detection port
P_M:PC set selector pressure detection port
P_{EPC}:EPC basic pressure input port
P_{EPC}:EPC basic pressure checking port
P_{SIG} :LS set change pressure checking port

Outline

•This pump consists of a variable capacity swash plate piston pumps, PC valve, LS valve, and EPC valve.



1. Shaft (Front)
2. Cradle
3. Case (Front)
4. Rocker cam
5. Shoe
6. Piston
7. Cylinder block
8. Valve plate
9. End cap
10. Servo piston



FUNCTION

- The rotation and torque transmitted to the pump shaft are 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.

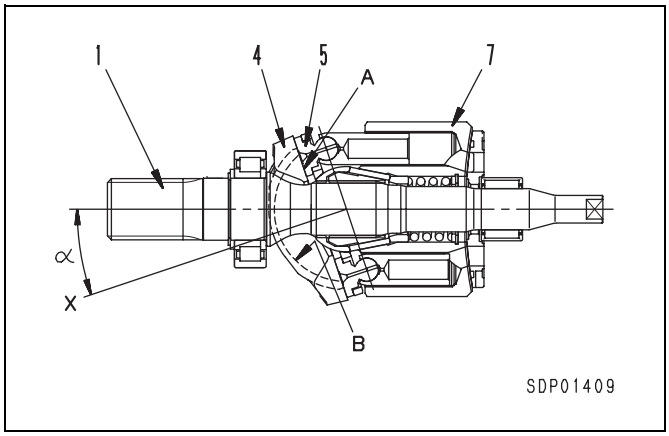
STRUCTURE

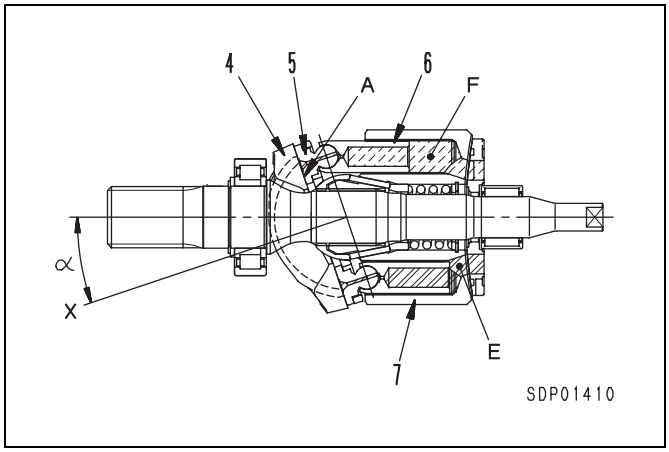
- Cylinder block (7) is supported to shaft (1) by a spline, and shaft (1) is supported by the front and rear bearings.
- The tip of piston (6) is a concave ball, and shoe (5) is caulked to it to form one unit. Piston (6) and shoe (5) form a spherical bearing.
- Rocker cam (4) has flat surface **A**, and shoe (5) is always pressed against this surface while sliding in a circular movement.
- Rocker cam (4) brings high pressure oil at cylinder surface **B** with cradle (2), which is secured to the case, and forms a static pressure bearing when it slides.
- Piston (6) carries out relative movement in the axial direction inside each cylinder chamber of cylinder block (7).
- The cylinder block seals the pressure oil to valve plate (8) and carries out relative rotation. This surface is designed so that the oil pressure balance is maintained at a suitable level. The oil inside each cylinder chamber of cylinder block (7) is sucked in and discharged through valve plate (8).

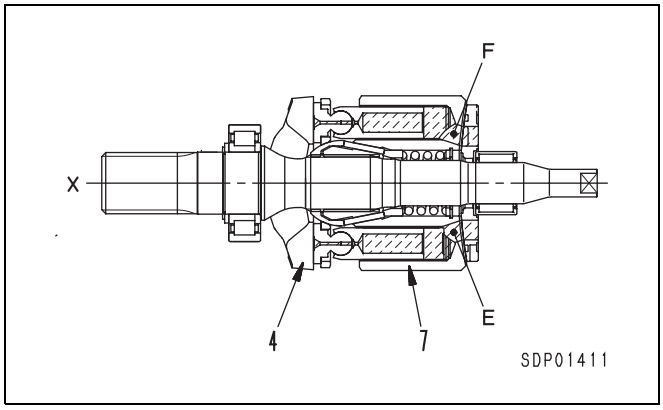
Operation

1. Operation of pump

- Cylinder block (7) rotates together with shaft (1), and shoe (5) slides on flat surface **A**.
- When this happens, rocker cam (4) moves along cylindrical surface **B**, so angle α between center line **X** of rocker cam (4) and the axial direction of cylinder block (7) 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 (7), and flat surface **A** moves as a cam in relation to shoe (5).
- In this way, piston (6) slides on the inside of cylinder block (7), so a difference between volumes **E** and **F** is created inside cylinder block (7). The suction and discharge is carried out by this difference **F - E**.
- In other words, when cylinder block (7) 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 as the volume becomes bigger, the oil is sucked in.
- If center line **X** of rocker cam (4) is in line with the axial direction of cylinder block (7) (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.
- (In actual fact, the swash plate angle never becomes 0.)

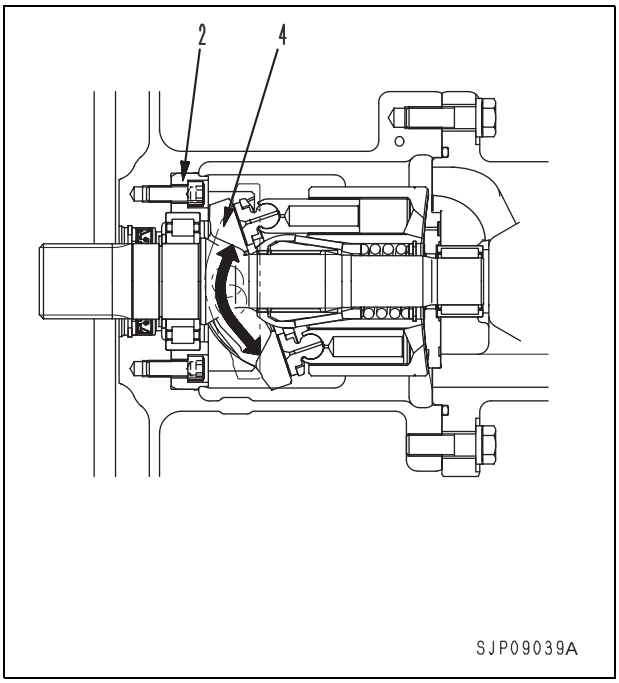


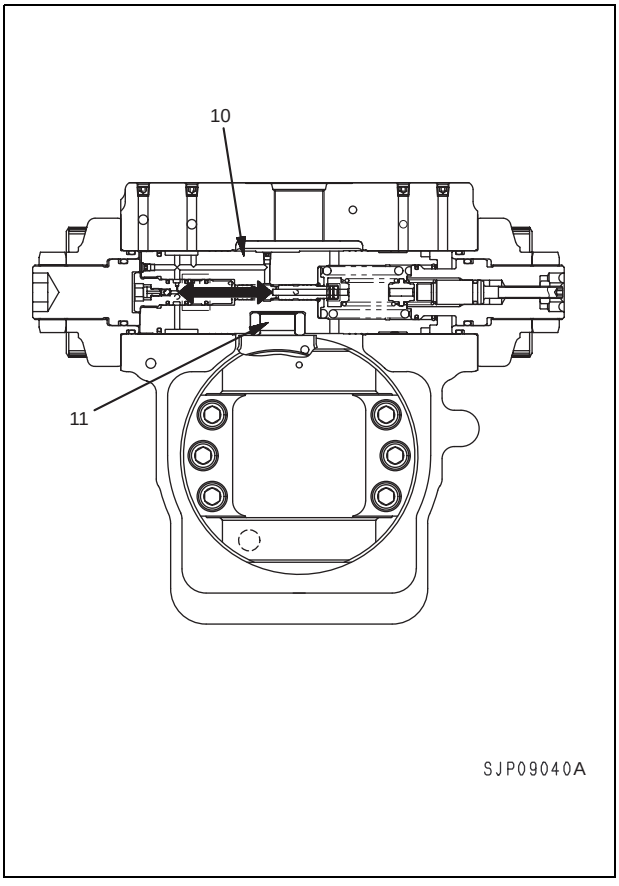




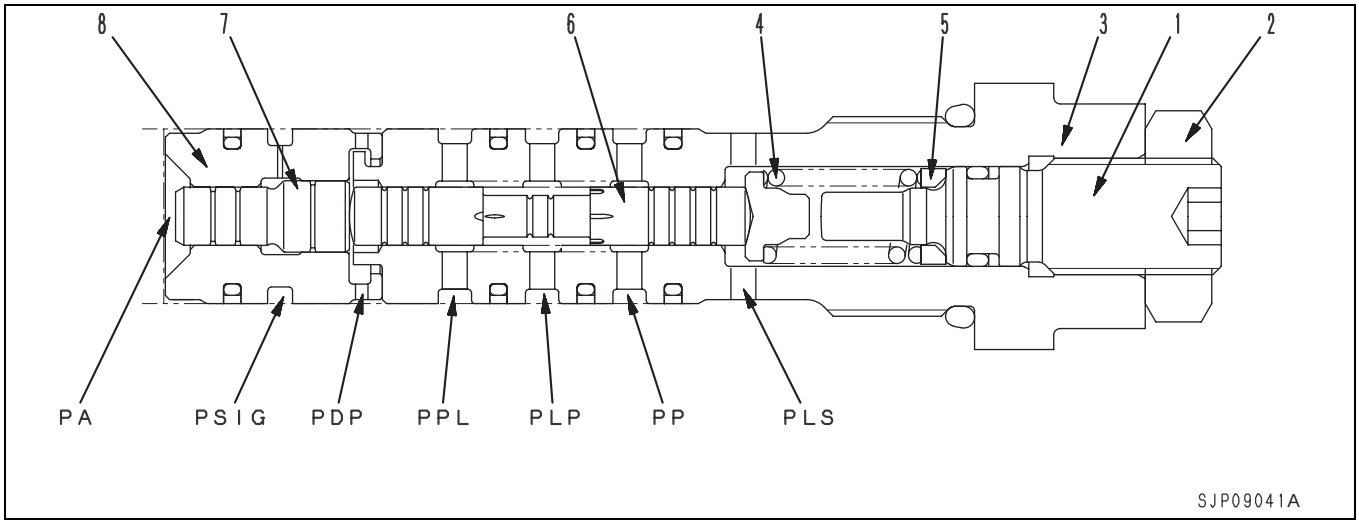
2. Control of discharge amount

- If the 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 servo piston (102).
- Servo piston (10) moves in a reciprocal movement ($\leftrightarrow$) according to the signal pressure from the PC and LS valves. This straight line movement is transmitted through rod (11) to rocker cam (4), and rocker cam (4), which is supported by the cylindrical surface to cradle (2), slides in a rotating movement in direction of arrow.
- With servo piston (10), the area receiving the pressure is different on the left and the right, so main pump discharge pressure (self pressure) **PP** is always brought to the chamber receiving the pressure at the small diameter piston end.
- Output pressure **Pen** of the LS valve is brought to the chamber receiving the pressure at the large diameter end. The relationship in the size of pressure **PP** at the small diameter piston end and pressure **Pen** at the large diameter end, and the ratio between the area receiving the pressure of the small diameter piston and the large diameter piston controls the movement of servo piston (10).





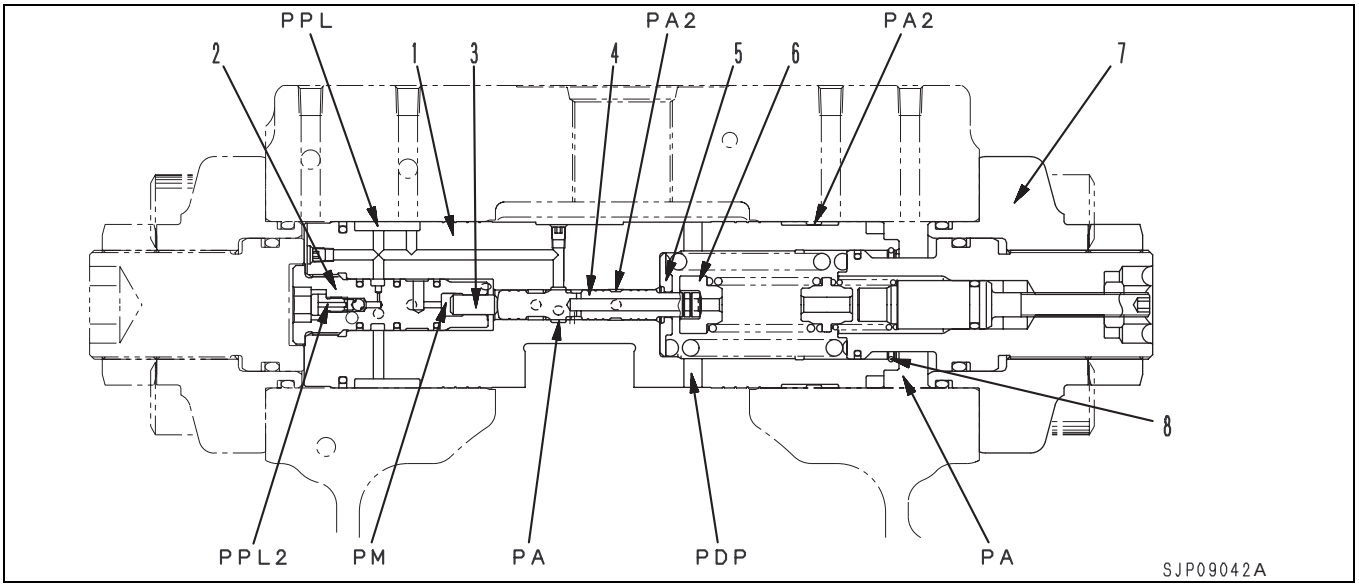
LS VALVE



1. Plug
2. Locknut
3. Sleeve
4. Spring
5. Seat
6. Spool
7. Piston
8. Sleeve

PA:Pump port
PP:Pump port
PDP:Drain port
PLP:LS control pressure output port
PLS:LS pressure input port
PPL:PC control pressure input port
PSIG:LS mode selection pilot port

PC VALVE



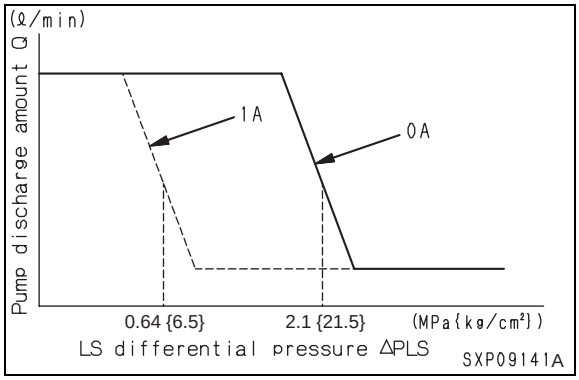
1. Servo piston assembly
2. Plug
3. Pin
4. Spool
5. Retainer
6. Seat
7. Cover
8. Wiring

PA:Pump port
PA2:Pump pressure pilot port (= PA)
PDP:Drain port
PM:PC mode selector pressure pilot port
PPL:PC control pressure output port (to LS valve)
PPL2:PC control pressure output port (to serve piston)

FUNCTION

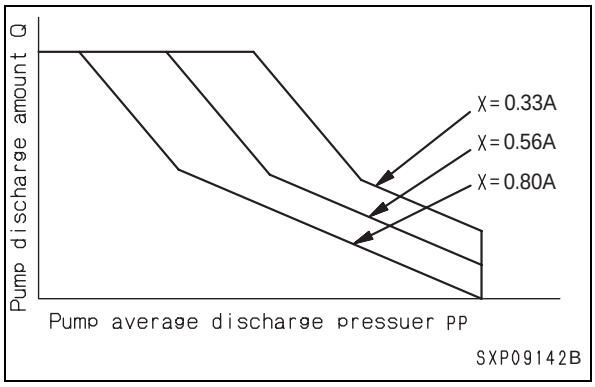
1. LS valve

- The LS valve detects the load and controls the discharge amount.
- This valve controls main pump discharge amount **Q** according to differential pressure ∆**PLS** (=**PP - PLS**) [called the LS differential pressure] (the difference between main pump pressure **PP** and control valve outlet port pressure **PLS**).
- Main pump pressure **PP**, pressure **PLS** {called the LS pressure} coming from the control valve output, and pressure **Psig** {called the LS selector pressure} from the proportional solenoid valve enter this valve. The relationship between discharge amount **Q** and differential pressure ∆**PLS**, (the difference between main pump pressure **PP** and LS pressure **PLS**) (= **PP - PLS**) changes as shown in the diagram at the right according to LS pressure selector current **isig** of the LS-EPC valve.
- When isig changes between 0 and 1A, the set pressure of the spring changes according to this, and the selector point for the pump discharge amount changes at the rated central valve between 0.64 ↔ 2.1 MPa {6.5 ↔ 21.5 kg/cm²}.



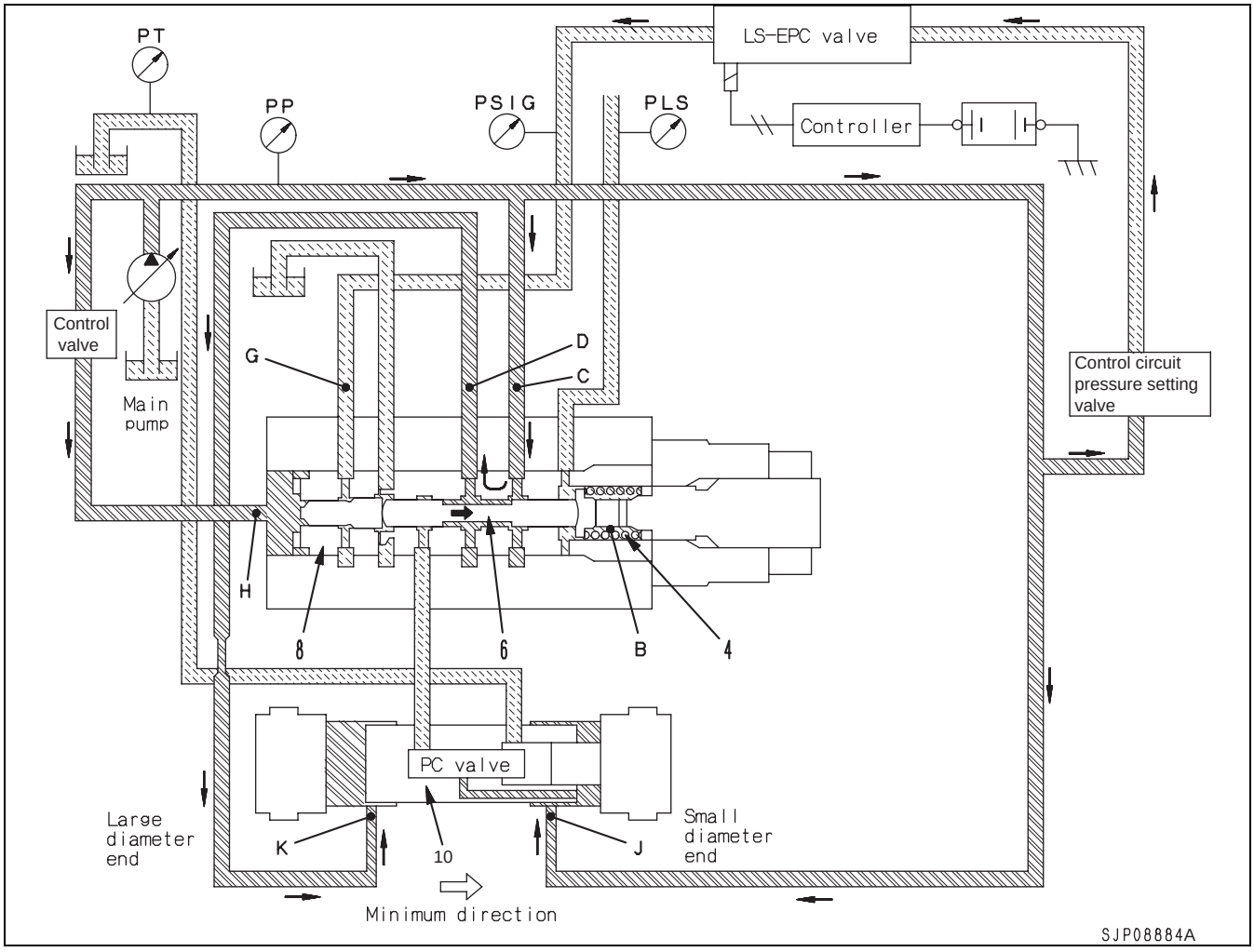
2. PC valve

- When the pump discharge pressure **PP1** (self-pressure) is high, the PC valve controls the pump so that no more oil than the constant flow (in accordance with the discharge pressure) flows even if the stroke of the control valve becomes larger. In this way, it carries out equal horsepower control so that the horsepower absorbed by the pump does not exceed the engine horsepower.
- In other words, If the load during the operation becomes larger and the pump discharge pressure rises, it reduces the discharge amount from the pump; and if the pump discharge pressure drops, it increases the discharge amount from the pump. The relationship pump discharge pressures (**PP)** and pump discharge amount **Q** is shown on the right, with the current given to the PC-EPC valve solenoid shown as a parameter. The controller senses the actual speed of the engine, and if the speed drops because of an increase in the load, it reduces the pump discharge amount to allow the speed to recover. In other words, when the load increases and the engine speed drops below the set value, the



command current to the PC-EPC valve solenoid from the controller increases according to the drop in the engine speed to reduce the pump swash plate angle.

OPERATION

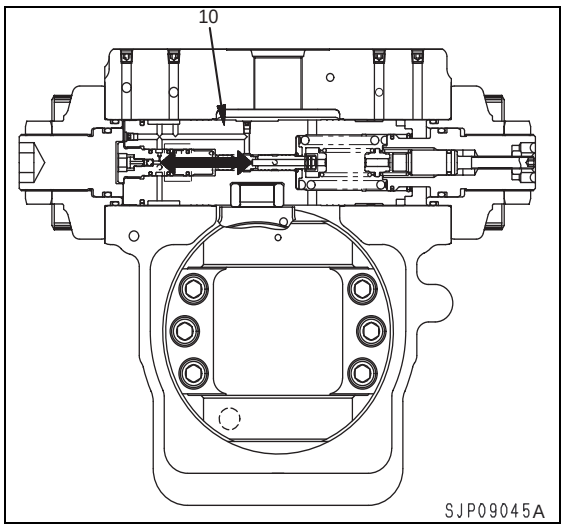


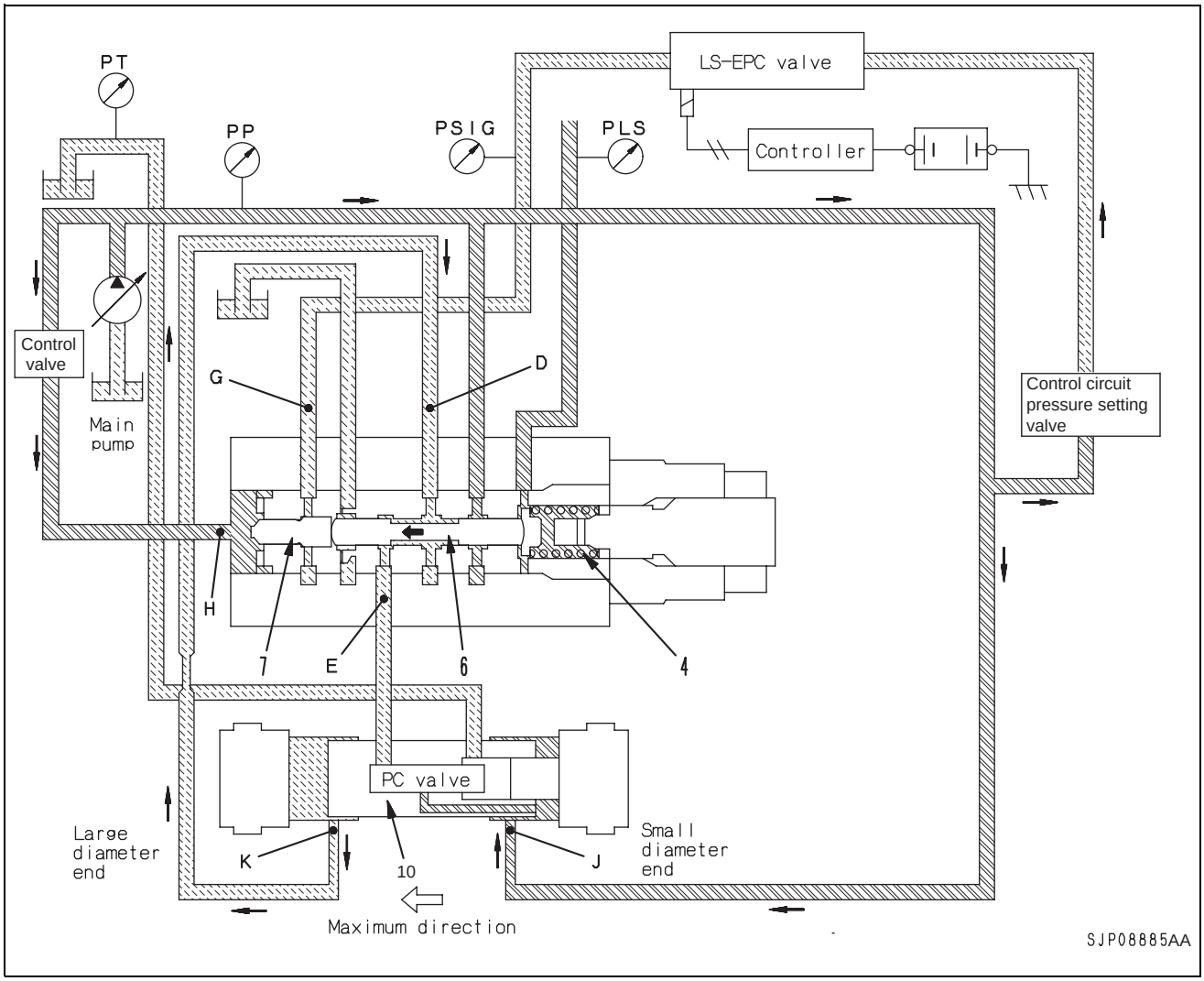
1. LS valve

1.1. When control valve is at neutral position

- The LS valve is a three-way selector valve, with pressure **PLS** (LS pressure) from the inlet port of the control valve brought to spring chamber **B**, and main pump discharge pressure **PP** coming from the control valve output brought to port **H** of sleeve (8). The size of this LS pressure **PLS** + force **Z** of spring (4) and the main pump pressure (self pressure) **PP** determines the position of spool (6). However, the size of the output pressure **PSIG** (the LS selection pressure) of the EPC valve for the LS valve entering port **G** also changes the position of spool (6). (The set pressure of the spring changes).
- Before the engine is started, servo piston (10 is pushed to the left. (See the diagram on the right)
- When the engine is started and the control lever is at the neutral position, LS pressure **PLS** is 0 MPa {0 kg/cm²}. (It is interconnected with the drain circuit through the control valve spool.)

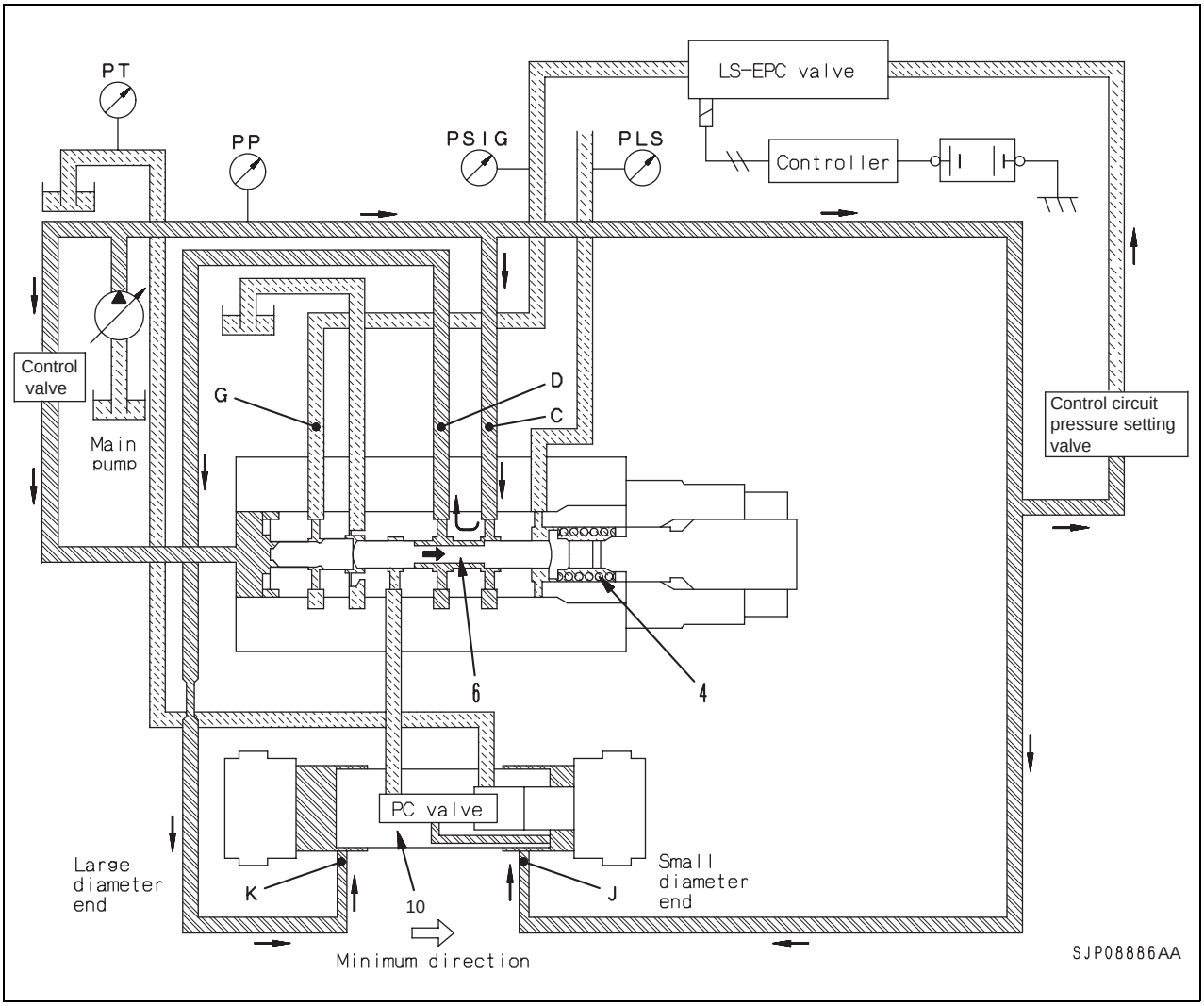
At this point, spool (6) is pushed to the right,and port **C** and port **D** are connected. Pump pressure **PP** enters the large diameter end of the piston from port **K** and the same pump pressure **PP** also enters port **J** at the small diameter end of the piston, so the swash plate is moved to the minimum angle by the difference in the area of the piston (10).





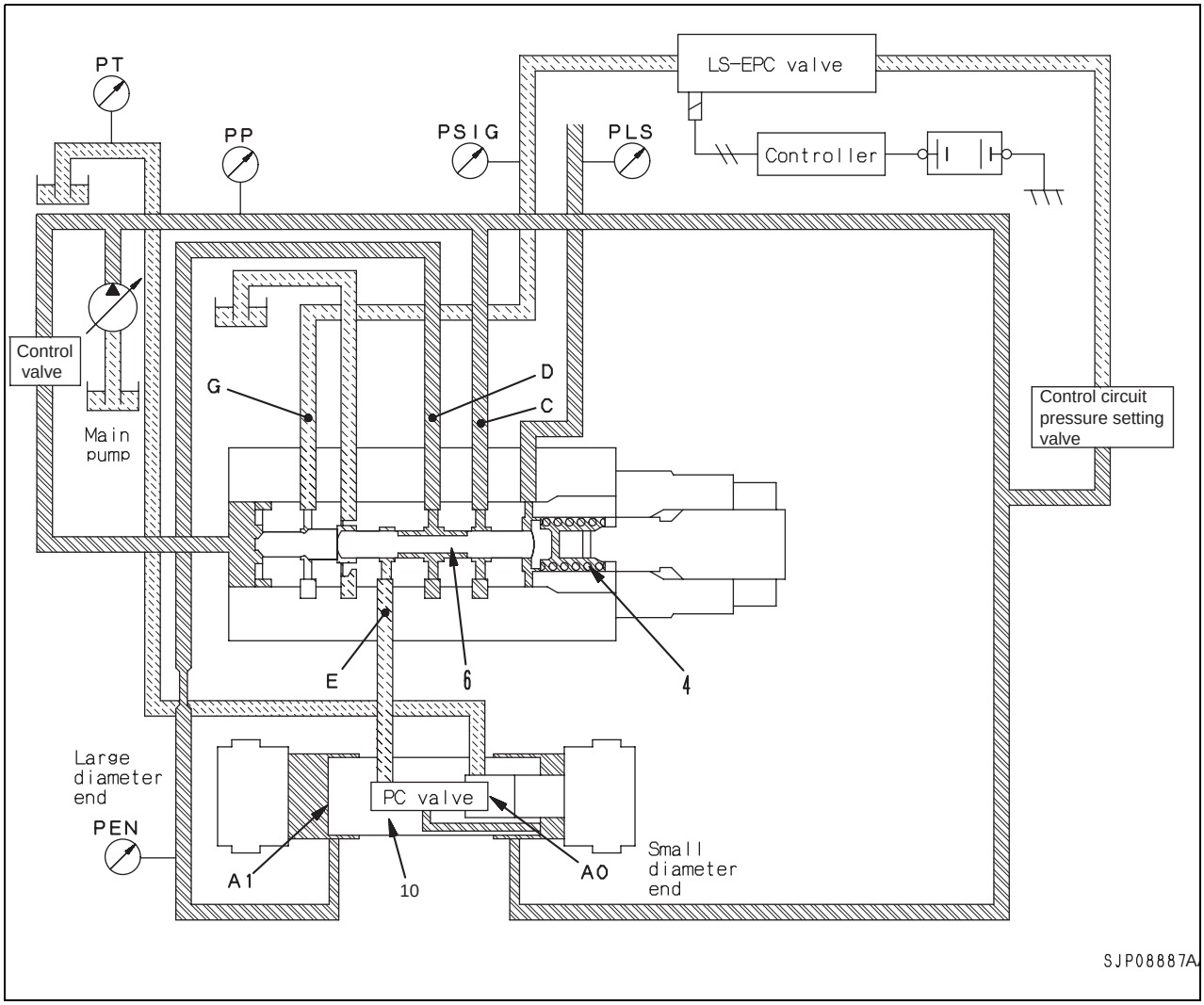
1.2. Operation in increase direction for pump discharge amount

- When the difference between the main pump pressure **PP** and LS pressure **PLS**, in other words, LS differential pressure ∆**PLS,** becomes smaller (for example, when the area of opening of the control valve becomes larger and pump **PP** drops), spool (6) is pushed to the left by the combined force of LS pressure **PLS** and the force of spring (4).
- When spool (6) moves, port **D** and port **E** are joined and connected to the PC valve. When this happens, the PC valve is connected to the drain port, so circuit **D - K** becomes drain pressure **PT**. (The operation of the PC valve is explained later).
- For this reason, the pressure at the large diameter end of servo piston (10) becomes drain pressure **PT**, and pump pressure **PP** enters port **J** at the small diameter end, so servo piston (10) is pushed to the left. Therefore, the swash plate moves in the direction to make the discharge amount larger. If the output pressure of the EPC valve for the LS valve enters port **G**, this pressure creates a force to move piston (7) to the right. If piston (7) is pushed to the right, it acts to make the set pressure of spring (4) weaker, and the difference between **PLS** and **PP** changes when ports **D** and **E** of spool (6) are connected.



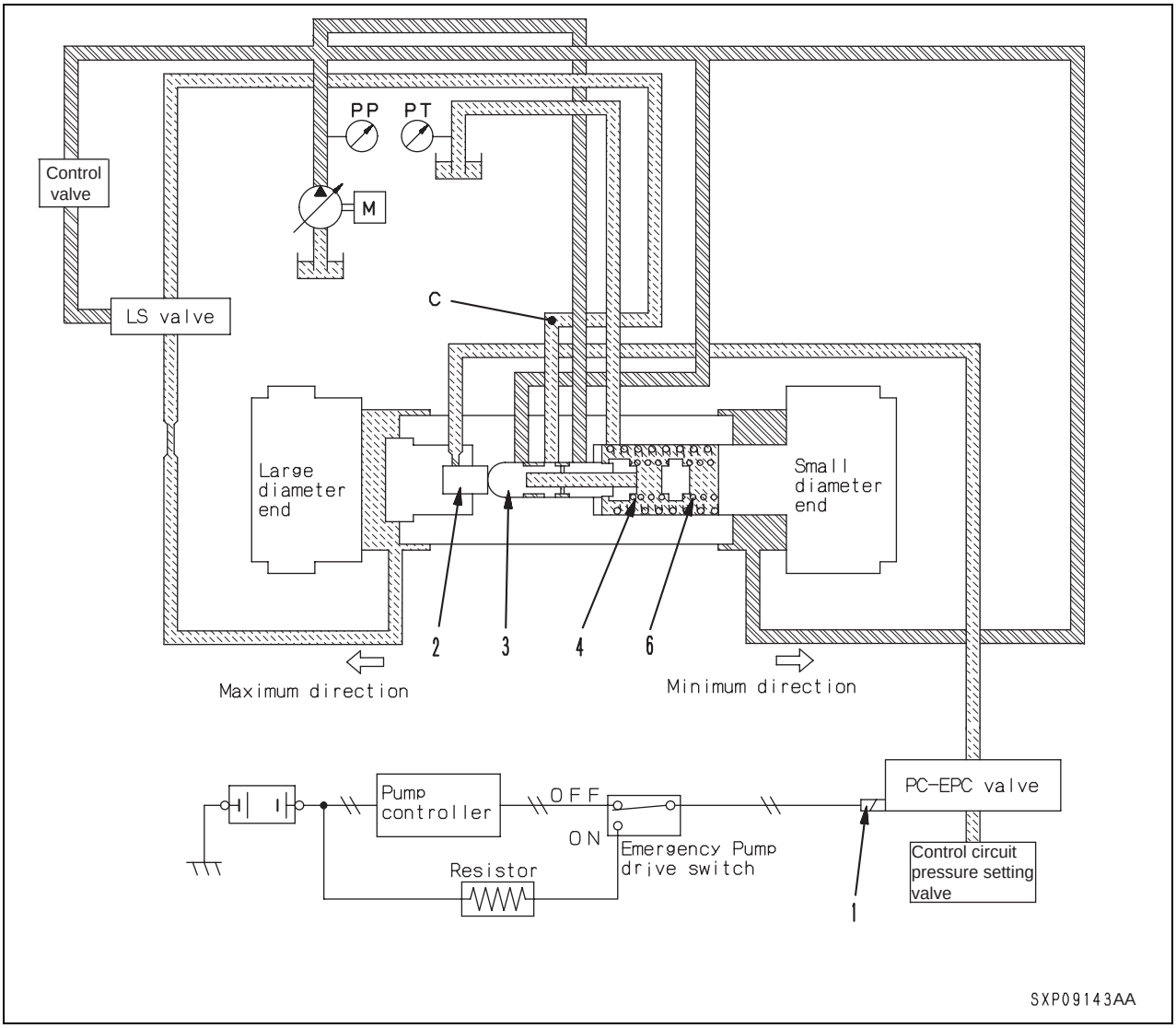
1.3. Operation in decrease direction for pump discharge amount

- The following explains the situation if the servo piston (10) moves to the right (the discharge amount becomes smaller). When LS differential pressure ∆**PLS** becomes larger (for example, when the area of opening of the control valve becomes smaller and pump pressure **PP** rises), pump pressure **PP** pushes spool (6) to the right.
- When spool (6) moves, main port pressure **PP** flows from port **C** and port **D** and from port **K**, it enters the large diameter end of the piston.
- Main pump pressure **PP** also enters port **J** at the small diameter end of the piston, but because of the difference in area between the large diameter end and the small diameter end of servo piston (10), servo piston (10) is pushed to the right.
- As a result, the swash plate moves in the direction to make angle smaller.
- If LS selection pressure **PSIG** enters port **G**, it acts to make the set pressure of spring (4) weaker.



1.4. When servo piston is balanced

- Let us take the area receiving the pressure at the large diameter end of the piston as **A1**, the area receiving the pressure at the small diameter end as **A0**, and the pressure flowing into the large diameter end of the piston as **Pen**. If the main pump pressure **PP** of the LS valve and the combined force of force **Z** of spring (4) and LS pressure **PLS** are balanced, and the relationship is **A0** x **PP** = **A1** x **Pen**, servo piston (10) will stop in that position, and the swash plate will be kept at an intermediate position. (It will stop at a position where the opening of the throttle from port **D** to port **E** and from port **C** to port **D** of spool (6) is approximately the same.)
- At this point, the relationship between the area receiving the pressure at both ends of piston (10) is **A0: A1** = 1:2, so the pressure applied to both ends of the piston when it is balanced becomes **PP: Pen =** 2:1.
- The position where spool (6) is balanced and stopped is the standard center, and the force of spring (4) is adjusted so that it is determined when **PP - PLS** = 2.1 MPa {21.5 kg/cm²}. However, if **PSIG** (the output pressure of 0 ↔ 2.9 MPa {0 ↔ 30 kg/cm²} of the EPC valve of the LS valve) is applied to port **G**, the balance stop position will change in proportion to pressure **PSIG** between **PP - PLS** = 2.1 ↔ 0.64 MPa {21.5 ↔ 6.5 kg/cm²}.



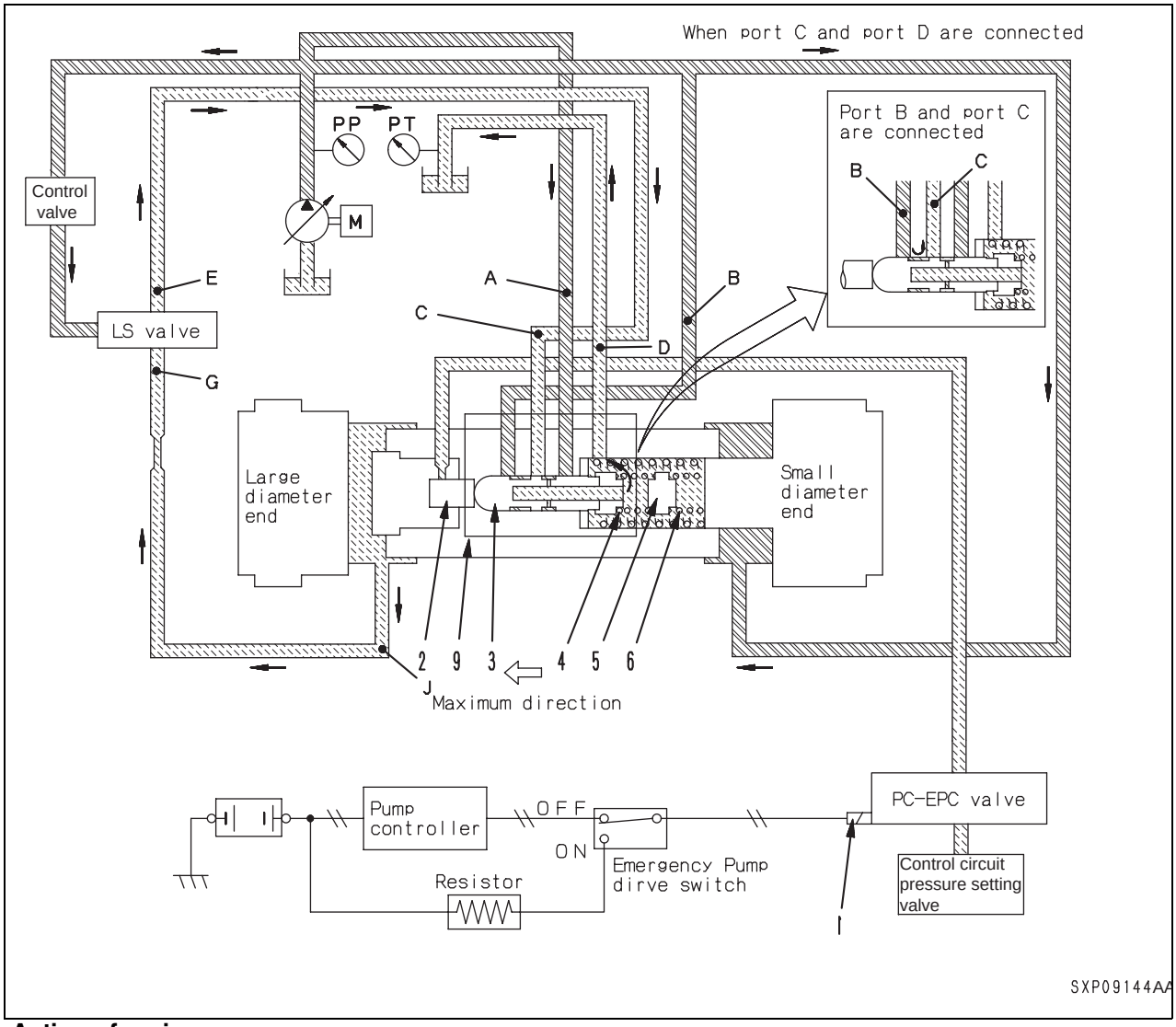
2. PC Valve

2.1. When pump controller is normal

a). When the load on the actuator is small and pump pressures PP

① Movement of PC-EPC solenoid (1)

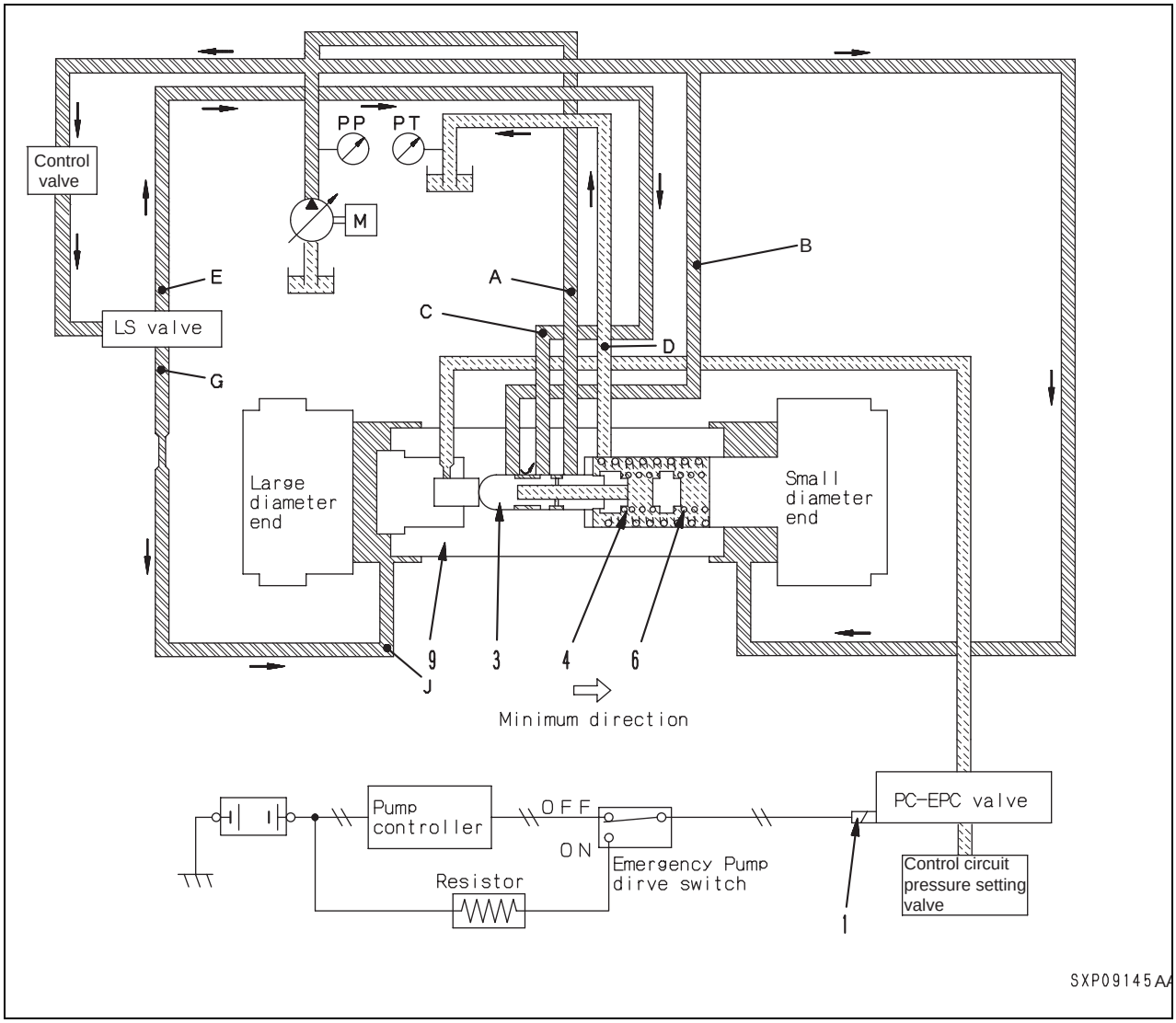
- The command current from the pump controller flows to PC-EPC solenoid (1).This command current acts on the PC-EPC valve and outputs the signal pressure. When this signal pressure is received, the force pushing pin (2) is changed.
- On the opposite side to the force pushing this pin (2) is the spring set pressure of springs (4) and (6) and pump pressure **PP** (self pressure) pushing spool (3). Pin (2) stops at a position where the combined force pushing spool (3) is balanced, and the pressure (pressure of port **C**) output from the PC valve changes according to this position.
- The size of command current **X** is determined by the nature of the operation (lever operation), the selection of the working mode, and the set value and actual value for the engine speed.



② **Action of spring**

- The spring load of springs (4) and (6) in the PC valve is determined by the swash plate position.
- If servo piston (9) moves to the right, spring (6) is compressed, and if it moves further to the right, spring (6) contacts seat (5) and is fixed in position. In other words, the spring load is changed by servo piston (9) extending or compressing springs (4) and (6).
- If the command circuit input to PC-EPC valve solenoid (1) changes further, the force pushing pin (2) changes, and the spring load of springs (4) and (6) also changes according to the valve of the PC-EPC valve solenoid command current.
- Port **C** of the PC valve is connected to port **E** of the LS valve (see (1) LS valve). Self pressure **PP** enters port **B** and the small diameter end of servo piston (9), and enters port **A** also.

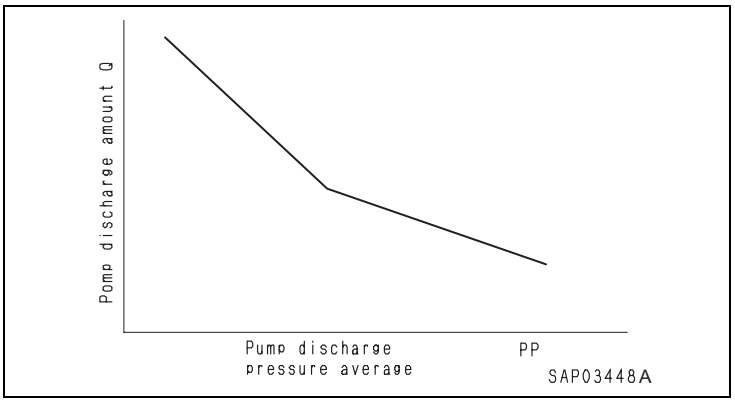
- When pump pressures **PP** is small, spool (3) is on the left relative to servo piston (9). At this point, port **C** and **D** are connected, and the pressure entering the LS valve becomes drain pressure **PT**. If port **E** and port **G** of the LS valve are connected (see 1. LS valve), the pressure entering the large diameter end of the piston from port **J** becomes drain pressure **PT**, and servo piston (9) moves to the left. In this way, the pump discharge amount moves in the direction of increase.
- As servo piston (9) moves further to the left, springs (4) and (6) expand and the spring force becomes weaker. When the spring force becomes weaker, spool (3) moves to the right relative to servo piston (9), so the connection between port **C** and port **D** is cut, and the pump discharge pressure ports **B** and **C** are connected. As a result, the pressure at port **C** rises, and the pressure at the large diameter end of the piston also rises, so the movement of servo piston (9) to the left is stopped.
- In other words, the stop position for servo piston (9) (= pump discharge amount) is decided at the point where the force of springs (4) and (6) and the pushing force from the PC-EPC valve solenoid and the pushing force created by the pressures **PP** acting on the spool (3) are in balance.



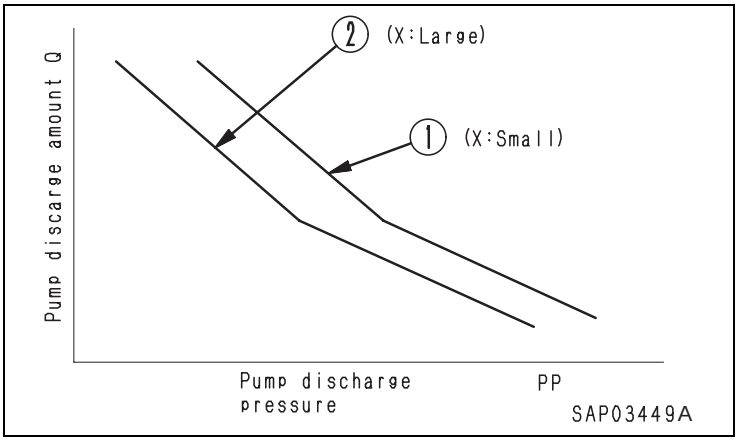
b). When load on actuator is large and pump discharge pressure is high

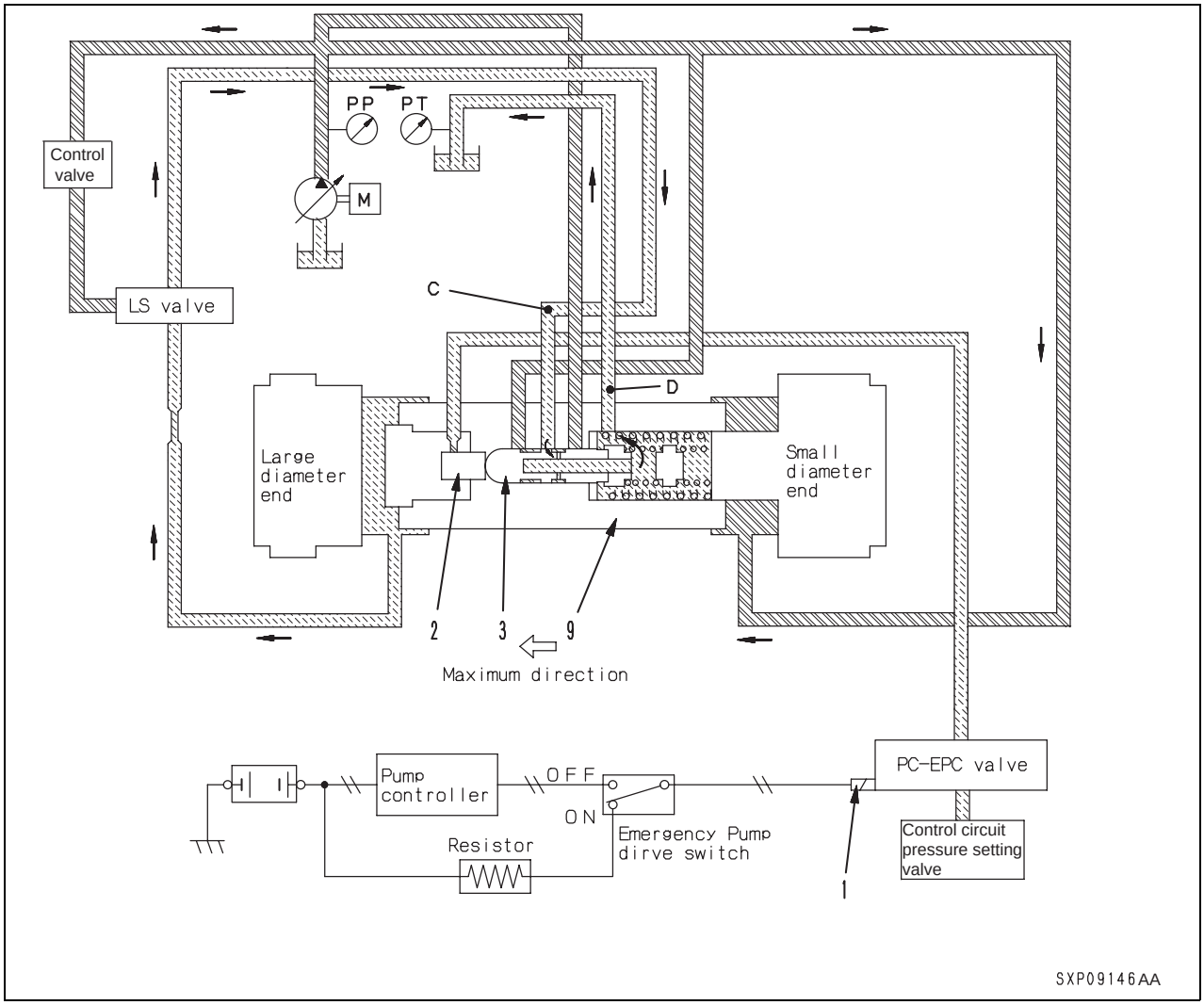
- When the load is large and pump discharge pressure **PP** is high, the force pushing servo piston (9) to the left becomes larger and spool (3) moves to the position in the diagram above. When this happens, as shown in the diagram above, part of the pressurized oil from port **B** flows out through port **C** where the LS valve is actuated to port **D**, and the pressurized oil flowing from port **C** to the LS valve becomes approximately half of main pump pressure **PP.**
- When port **E** and port **G** of the LS valve are connected (see 1 LS valve), the pressure from port **J** enters the large diameter end of servo piston (9), and servo piston (9) stops.
- If main pump pressure **PP** increases further and servo piston (9) moves further to the left, main pump pressure **PP** flows to port **C** and acts to make the discharge amount the minimum. When servo piston (9) moves to the right, springs (4) and (6) are compressed and push back spool (3). When spool (3) moves to the left relative to servo piston (9), the opening joining port **C** and port **D** becomes larger. As a result, the pressure at port **C** (= **J**) drops, and servo piston (9) stops moving to the right.
- The position in which servo piston (9) stops when this happens is further to the right than the position when pump pressure **PP** is low.

- The relation of pressure **PP** and the position of servo piston (9) forms a bent line graph because of the double-spring effect of springs (4) and (6). The relationship between pump pressure **PP** and pump discharge amount **Q** is shown in the graph on the right.



- If command current **X** sent to PC-EPC valve solenoid (1) increases further, the relationship between pump pressure **PP**, and pump discharge amount **Q** is proportional to the pushing force of the PC-EPC valve solenoid and moves in parallel. In other words, the pushing force of PC-EPC solenoid (1) is added to the force pushing to the right because of the pump pressure applied to the spool (3), so the relationship between the pump pressure **PP** and **Q** moves from ② to ① in accordance with the increase in **X**.

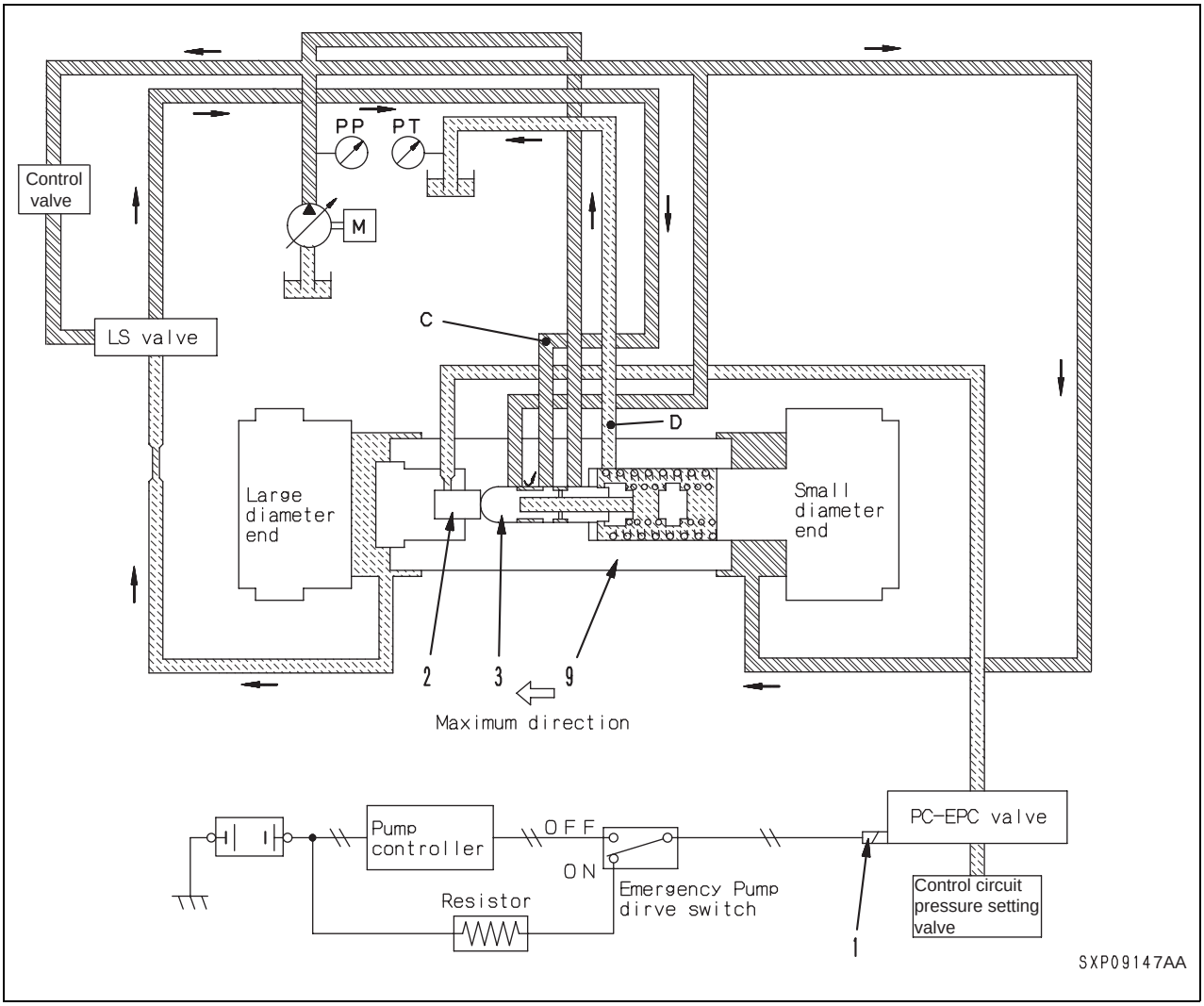




2.2. When pump controller is abnormal and Emergency pump drive switch is on

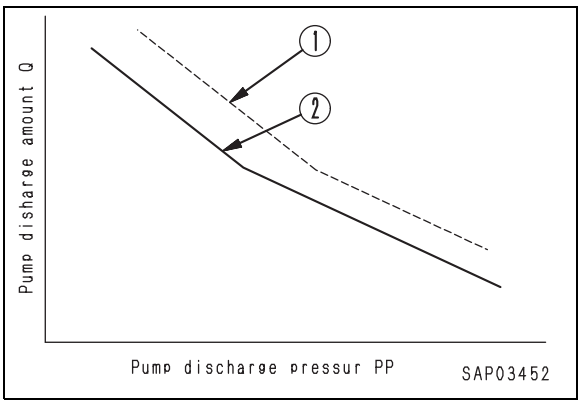
a. When load on main pump is light

- If there is a failure in the pump controller, turn emergency pump drive switch **ON** to switch to the resistor side. In this case, the power source is taken directly from the battery. But if the current is used as it is, it is too large, so use the resistor to control the current flowing to PC-EPC valve solenoid (1).
- When this is done, the current becomes constant, so the force pushing pin (2) is also constant.
- If the main pump pressure **PP** is low, and the force of PC-EPC valve solenoid (1) is weaker than the spring set force, spool (3) is balanced at a position to the left relative to servo piston (9).
- At this point, port **C** is connected to the drain port **D**, and the large diameter end of the servo piston (9) also becomes the drain pressure **PT** through the LS valve. When this happens, the pressure at the small diameter end of the piston is large, so servo piston (9) moves in the direction to make the discharge amount larger.

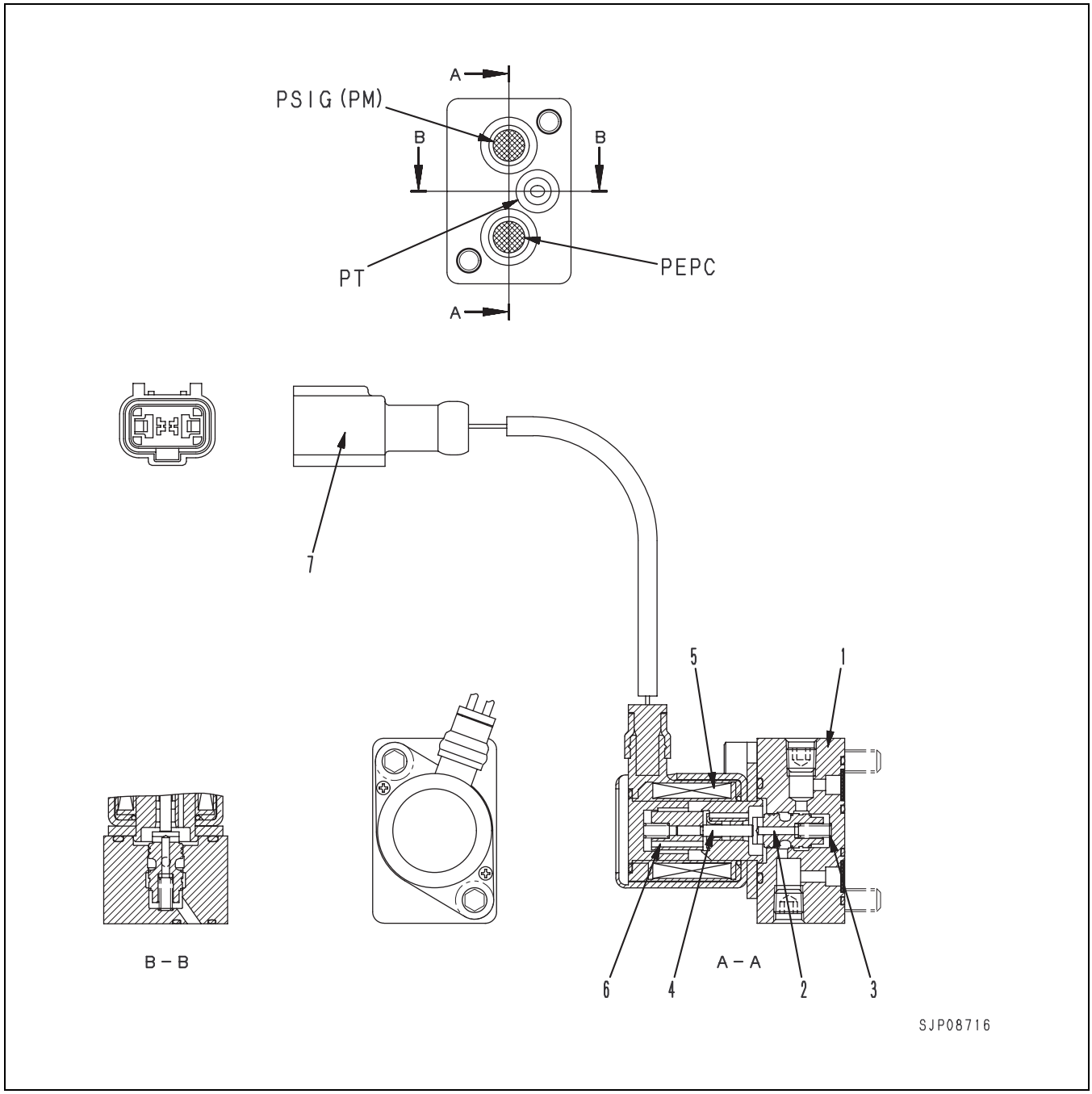


b. When main pump load is heavy

- In the same way as in the previous item, when the emergency pump drive switch is **ON**, the command current sent to PC-EPC valve solenoid (1) becomes constant. For this reason, the force of pin (2) pushing spool (3) is constant.
- If main pump pressures **PP** increase, servo piston (9) moves further to the left than when the main pump load is light, and spool (3) is balanced at the position in the diagram above.
- In this case, the pressure from port **B** flows to port **C**, this makes servo piston (9) move to the right (to make the discharge amount smaller) by the same mechanism as explained in item 2.1.b, and stops at a position to the left of the position when the load on the pump is light. In other words, even when the emergency pump drive switch is **ON**, the curve for the pump pressure **PP** and discharge amount **Q** is determined as shown in the diagram for the valve of the current sent to the PC-EPC valve solenoid through the resistor.
- The curve when the emergency pump drive switch is **ON** is curve ②, which is to the left of curve ① for when the pump controller is normal.



LS(PC)-EPC VALVE

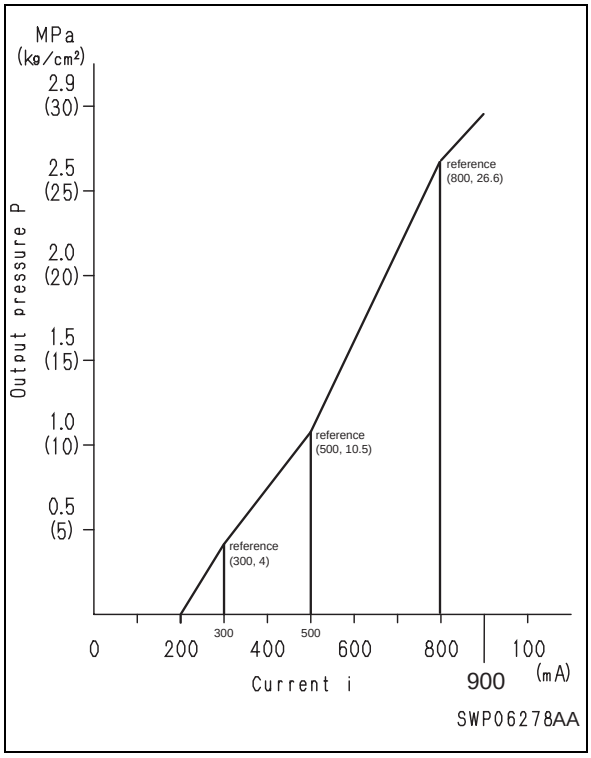


1. Body
2. Spool
3. Spring
4. Rod
5. Coil
6. Plunger
7. Connector

PSIG(PM): To LS(PC) valve
PT : To tank
PEPC : From self-reducing pressure valve

FUNCTION

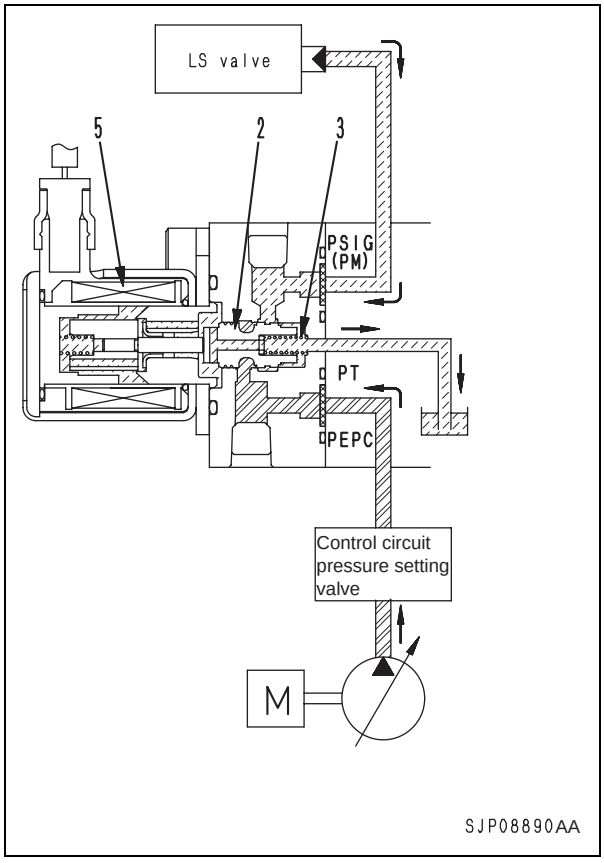
- The EPC valve consists of the proportional solenoid portion and the hydraulic valve portion.
- When it receives signal current **i** from the pump controller, it generates the EPC output pressure in proportion to the size of the signal, and outputs it to the LS (PC) valve.



OPERATION

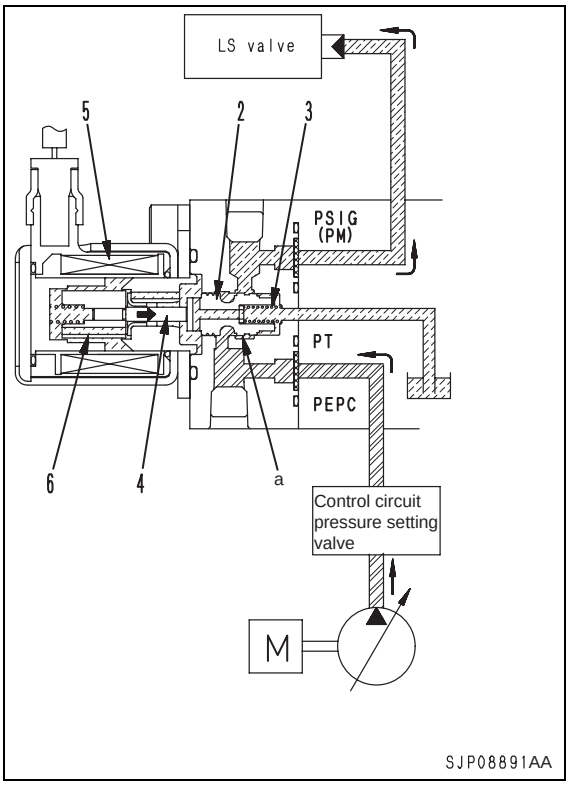
1. When signal current is 0 (coil de-energized)

- When there is no signal current flowing from the controller to coil (5), coil (5) is de-energized.
- For this reason, spool (2) is pushed to the left in the direction of the arrow by spring (3).
- As a result, port **PEPC** closes and the pressurized oil from the main pump does not flow to the LS (PC) valve.
- At the same time, the pressurized oil from the LS (PC) valve passes from port **PSIG(PM)** through port **PT** and is drained to the tank.



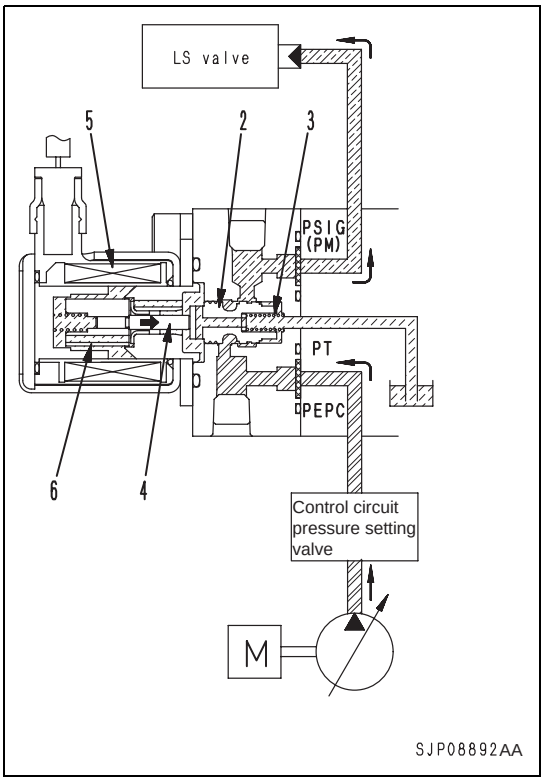
2. When signal current is very small (coil energized)

- When a very small signal current flows to coil (5), coil (5) is energized, and a propulsion force is generated which pushes plunger (6) to the right.
- Push pin (4) pushes spool (2) to the right, and pressurized oil flows from port **PEPC** to port **PSIG(PM)**.
- When the pressure at port **PSIG(PM)** rises and the load of spring (3) + the force acting on surface **a** of spool (2) becomes greater than the propulsion force of plunger (6), spool (2) is pushed to the left. The circuit between port **PEPC** and port **PSIG(PM)** is shut off, and at the same time, port **PSIG(PM)** and port **PT** are connected.
- As a result, spool (2) is moved right or left until the propulsion force of plunger (6) is balanced with the load of spring (3) + pressure of port **PSIG(PM)**.
- Therefore, the circuit pressure between the EPC valve and the LS (PC) valve is controlled in proportion to the size of the signal current.

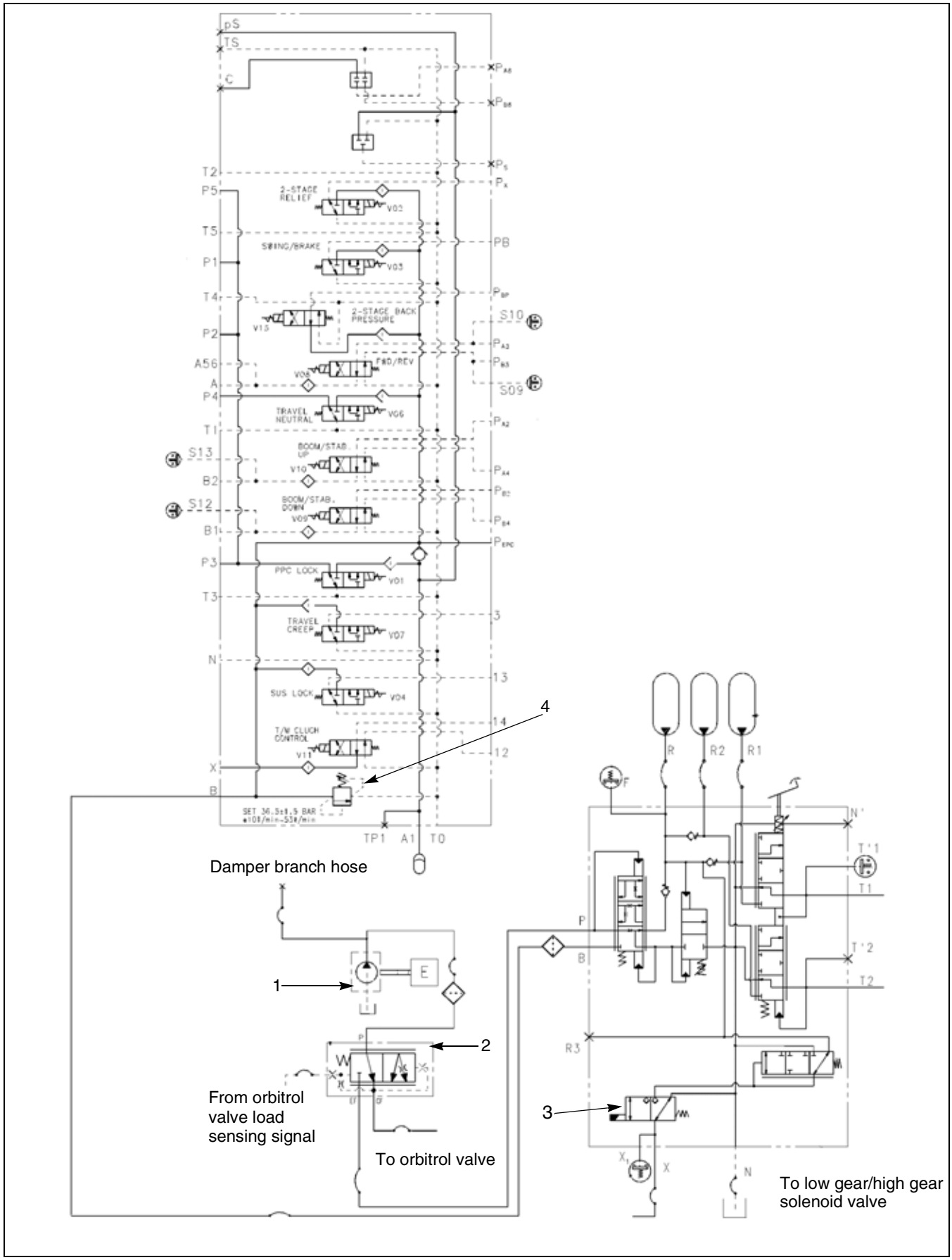


3. When signal current is maximum (coil energized)

- When the signal current flows to coil (5), coil (5) is energized.
- When this happens, the signal current is at its maximum, so the propulsion force of plunger (6) is also at its maximum.
- For this reason, spool (2) is pushed fully to the right by push pin (4).
- As a result, the maximum flow of pressurized oil from port **PEPC** flows to port **PSIG(PM)**, and the circuit pressure between the EPC valve and LS (PC) valve becomes the maximum.
- At the same time, port **PT** closes and stops the oil from flowing to the tank.



PILOT PRESSURE CONTROL (PPC) SYSTEM



1. Gear Pump
2. Steering/Braking priority valve
3. Power Brake Valve
4. Pressure Reducing Valve
   Incorporated in Main Solenoid Valve Block

FUNCTION

- The PPC Pump less system discharges pressurised oil to operate the PPC circuit and solenoid valve assemblies.

OPERATION

- The PPC pump less system utilizes the return line oil from the power brake valve, oil is supplied to the steering / braking circuits from a gear pump driven by the engine. Oil is prioritised to the steering circuit via the priority valve with the remaining oil flow feeding the power brake valve. The return line from the brake valve passes through a relief valve to maintain a pressure of $36^{+}/_{-}1.5$ BAR.

CONTROL VALVE

PW180-7E0

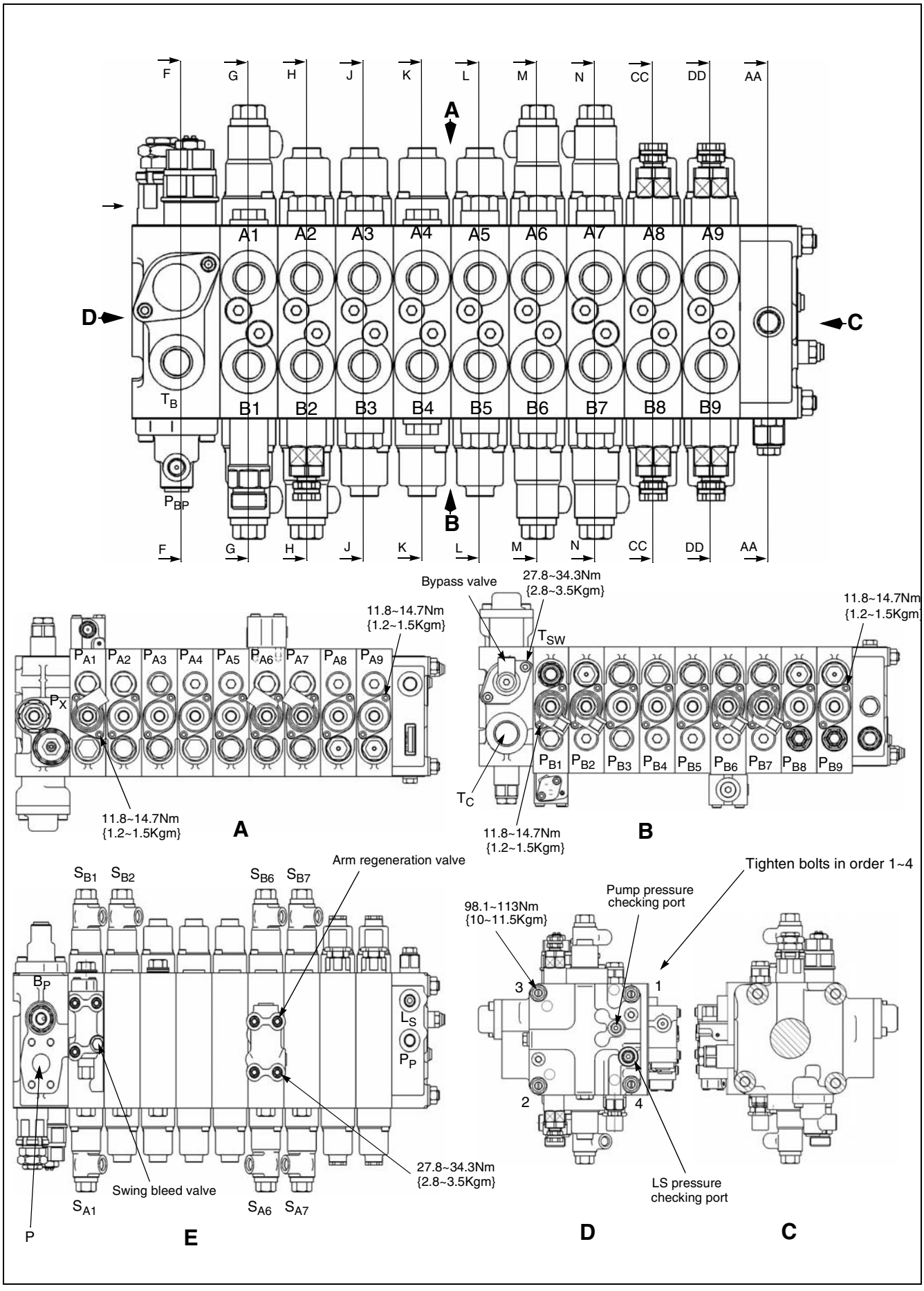
OUTLINE

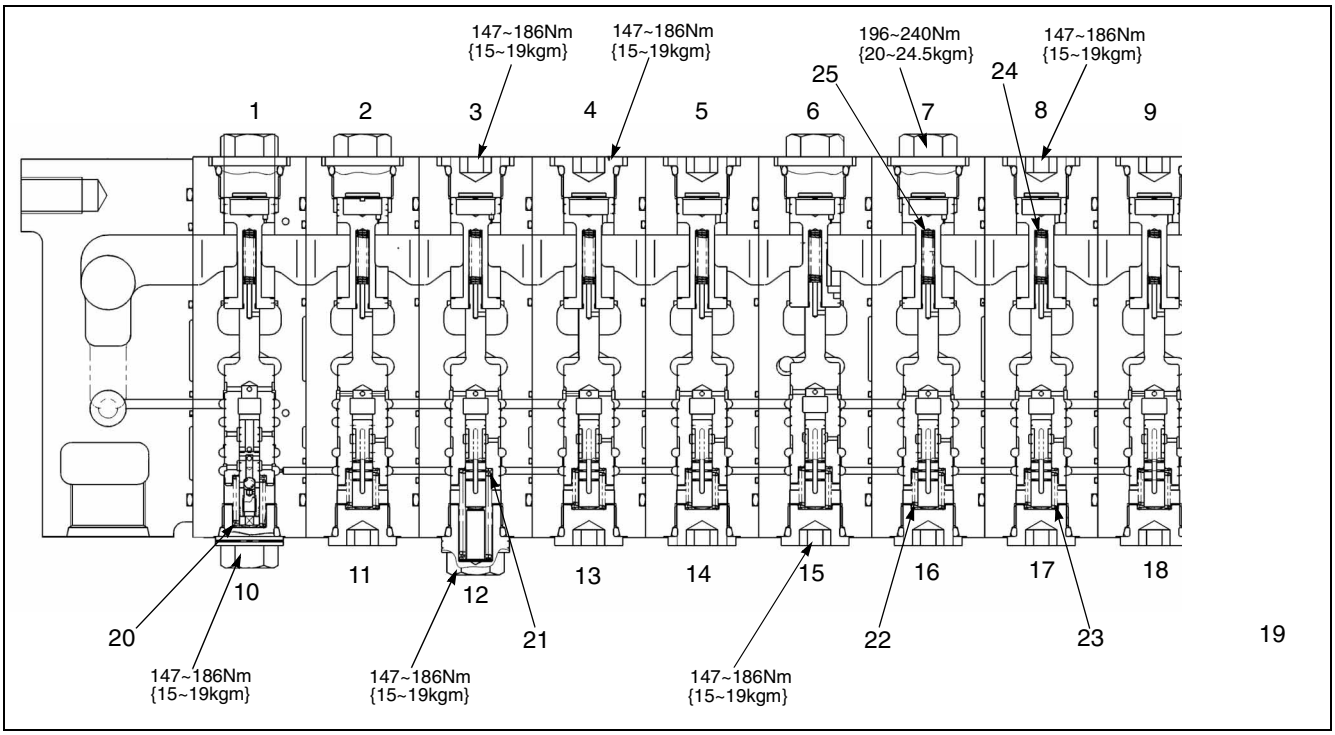
The following four types of control valve are set.

- 7-spool (monoboom + service valve)
- 8-spool (monoboom + two service valve)
- 8-spool (2P boom + service valve)
- 9-spool (2P boom + two service valve)
  - Each service valve is an add-on type where one valve each can be added, so it is possible to add valves or remove valves if necessary.
    (Maximum: 9 spool)

An explanation of the external appearance and the cross section is given only for the 9-spool valve (2P boom + two service valve)

A1.	To swing motor LH	P_{A1}.	From swing PPC valve LEFT	P_{P}.	from main pump
A2.	To boom cyl bott	P_{A2}.	From boom PPC valve RAISE	P_{X}.	from 2-stage relief sol valve
A3.	To travel fwd	P_{A3}.	From travel PPC valve FORWARD	P_{BP}	from 2-stage lift check sol valve
A4.	To stabilizer cyl bott	P_{A4}.	From stabilizer PPC valve RAISE	P.	From pump
A5.	To adjust cyl bott	P_{A5}.	From adjust cyl PPC valve EXTEND	B_{P}.	from boom RAISE PPC
A6.	To arm cyl head	P_{A6}.	From arm cyl PPC valve DUMP	S_{A1}.	from boom RAISE PPC valve
A7.	To bucket cyl head	P_{A7}.	From bucket cyl PPC valve DUMP	S_{A6}.	from travel PPC valve
A8.	To service	P_{A8}.	From service PPC valve	S_{A7}.	from travel PPC valve
A9.	To service	P_{A9}.	From service PPC valve	S_{B1}.	from boom RAISE PPC
B1.	To swing motor RH	P_{B1}.	From swing PPC valve RIGHT	S_{B2}.	from travel PPC valve
B2.	To boom cyl head	P_{B2}.	From boom PPC valve LOWER	S_{B6}.	from travel PPC valve
B3.	To travel rev	P_{B3}.	From travel PPC valve REVERSE	S_{B7}.	from travel PPC valve
B4.	To stabilizer cyl bott	P_{B4}.	From stabilizer PPC valve LOWER	T_{SW}.	to swing motor
B5.	To adjust cyl head	P_{B5}.	From adjust cyl PPC valve RETRACT	T_{S1}.	to tank
B6.	To arm cyl bott	P_{B6}.	From arm cyl PPC valve DIG	$L_{S.}$	to pump LS valve
B7.	To bucket cyl bott	P_{B7}.	From bucket cyl PPC valve DIG	T_{C}.	to oil cooler
B8.	To service	P_{B8}.	From service PPC valve	$T_{B.}$	to tank
B9.	To service	P_{B9}.	From service PPC valve		

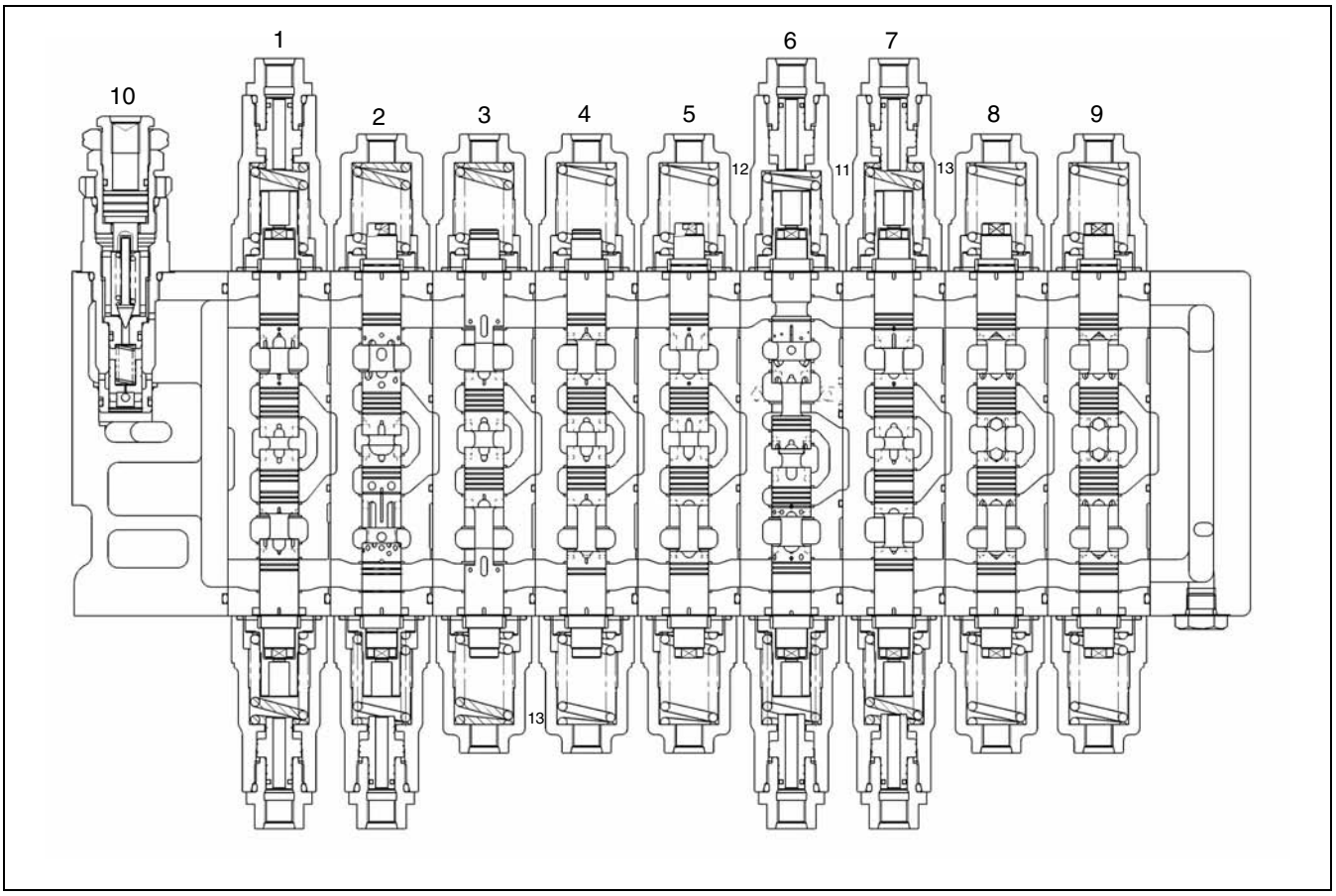

F
G
H
J
K
L
M
N
CC
DD
AA
A
A1
A2
A3
A4
A5
A6
A7
A8
A9
D
C
T_B
B1
B2
B3
B4
B5
B6
B7
B8
B9
P_{BP}
B
Bypass valve
27.8~34.3Nm
{2.8~3.5Kgm}
11.8~14.7Nm
{1.2~1.5Kgm}
P_{A1}
P_{A2}
P_{A3}
P_{A4}
P_{A5}
P_{A6}
P_{A7}
P_{A8}
P_{A9}
P_X
T_{SW}
P_{B1}
P_{B2}
P_{B3}
P_{B4}
P_{B5}
P_{B6}
P_{B7}
P_{B8}
P_{B9}
T_C
A
B
Arm regeneration valve
Tighten bolts in order 1~4
S_{B1}
S_{B2}
S_{B6}
S_{B7}
98.1~113Nm
{10~11.5Kgm}
Pump pressure
checking port
B_P
L_S
P_P
3
1
2
4
27.8~34.3Nm
{2.8~3.5Kgm}
Swing bleed valve
LS pressure
checking port
S_{A1}
S_{A6}
S_{A7}
P
E
D
C



1. Pressure compensation valve (Swing Left)
2. Pressure compensation valve (Boom Raise)
3. Pressure compensation valve (Travel Forward)
4. Pressure compensation valve (Stabilizer Raise)
5. Pressure compensation valve (2PBoom Raise)
6. Pressure compensation valve (Arm Dump)
7. Pressure compensation valve (Bucket Dump)
8. Pressure compensation valve (Service)
9. Pressure compensation valve (Service)
10. Pressure compensation valve (Swing Right)
11. Pressure compensation valve (Boom Lower)
12. Pressure compensation valve (Travel Reverse)
13. Pressure compensation valve (Stabilizer Lower)
14. Pressure compensation valve (2PBoom Raise)
15. Pressure compensation valve (Arm Dig)
16. Pressure compensation valve (Bucket Dig)
17. Variable pressure compensation valve (Service)
18. Variable pressure compensation valve (Service)
19. Unload valve

Unit:mm

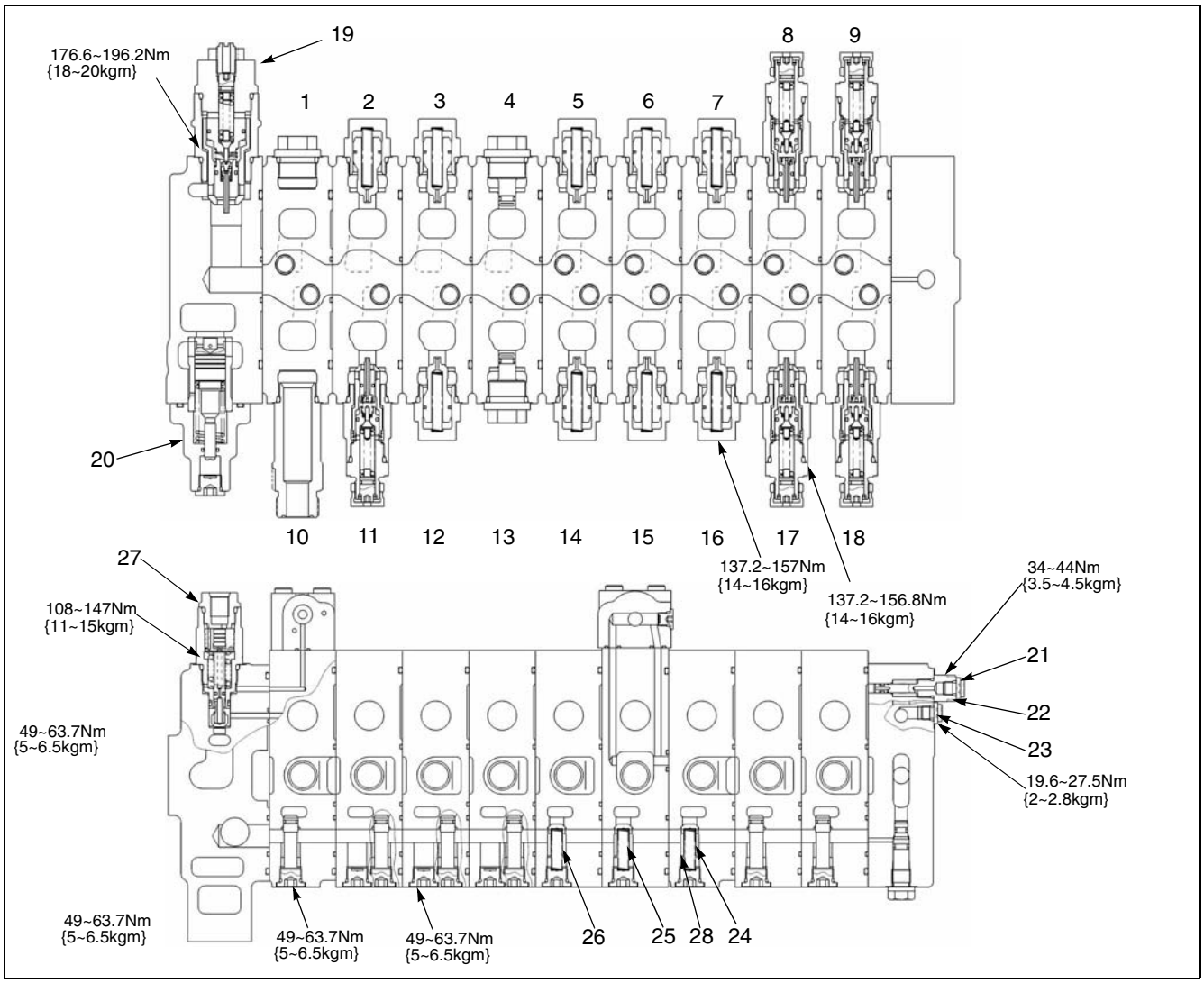
No	Check Item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	
20.	Control valve spring	32.5 x 14.2	23	17.6Nm (1.8kgm)		13.7Nm (1.4kgm)	If damaged or deformed, replace spring
21.	Control valve spring	7.8 x 14.2	40	66.4Nm (6.8kgm)		53.1Nm (5.4kgm)	
22.	Control valve spring	27.5 x 14.2	18	17.6Nm (1.8kgm)		13.7Nm (1.4kgm)	
23.	Control valve spring	27.5 x 14.2	18	17.6Nm (1.8kgm)		13.7Nm (1.4kgm)	
24.	Control valve spring	36.2 x 5.3	23.5	29.4Nm (3kgm)		23.4Nm (2.3kgm)	
25.	Control valve spring	36.5 x 5.3	23.5	29.4Nm (3kgm)		23.4Nm (2.3kgm)	



1.	Spool (Swing)	6.	Spool (Arm)
2.	Spool (Boom)	7.	Spool (Bucket)
3.	Spool (Travel)	8.	Spool (Service)
4.	Spool (Stabilizer)	9.	Spool (Service)
5.	Spool (2PBoom)	10.	Main relief valve

Unit:mm

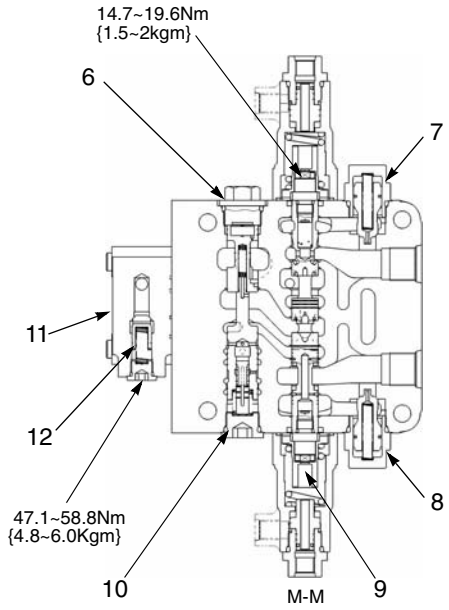
No	Check Item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Out-side diameter	Installed length	Installed load	Free length	Installed load	
11.	Spool return spring	45.7 x 28	45	55.9Nm (5.7kgm)		47.3Nm (4.7kgm)	If damaged or deformed, replace spring
12.	Spool return spring	42.4 x 28	41	92.2Nm (9.4.kgm)		78.0Nm (7.8kgm)	
13.	Spool return spring	45.6 x 28	45	53.5.Nm (5.5kgm)		45.3Nm (4.5kgm)	



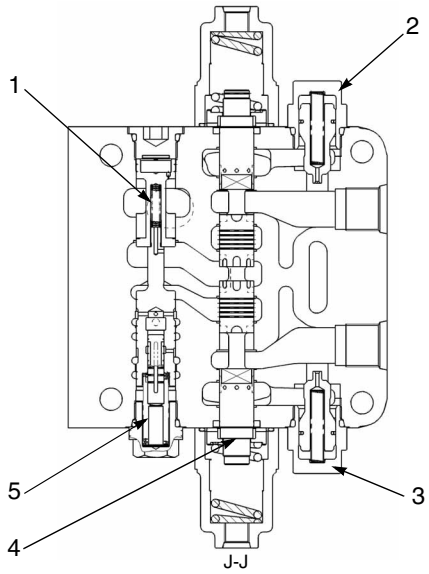
1. N/A
2. Suction valve (Boom Raise)
3. Suction valve (Travel Forward)
4. N/A
5. Suction valve (2PBoom Extend)
6. Suction valve (Arm Dump)
7. Suction valve (Bucket Dump)
8. Variable safety suction valve (Service)
9. Variable safety suction valve (Service)
10. N/A
11. Suction valve (Boom Lower)
12. Suction valve (Travel Reverse)
13. N/A
14. Suction valve (2PBoom Retract)
15. Suction valve (Arm Dig)
16. Suction valve (Bucket Dig)
17. Variable safety suction valve (Service)
18. Variable safety suction valve (Service)
19. Safety suction valve
20. 2-stage lift check valve
21. L_S pressure detection valve
22. L_S pressure plug
23. Pump pressure detection plug
24. Check valve Bucket
25. Check valve Arm
26. Check valve 2P Boom
27. L_S separation valve

Unit:mm

No	Check Item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	If damaged or deformed, replace spring
28.	Check valve spring	41.5 x 8.5	31.5	5.9Nm (0.6kgm)		4.7Nm (0.48kgm)	



Arm control valve

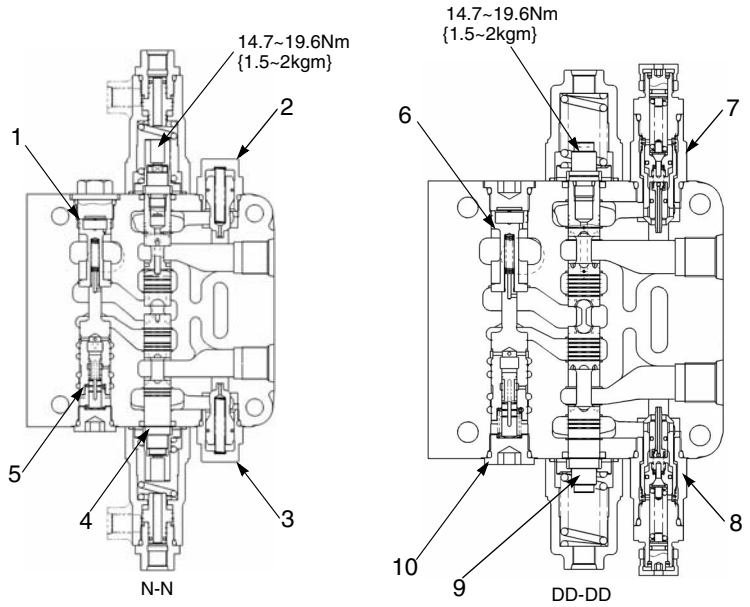


Travel control valve

1.	Pressure compensation valve	7.	Suction valve
2.	Suction valve	8.	Suction valve
3.	Suction valve	9.	Spool (Arm)
4.	Spool (Travel)	10.	Pressure compensation valve
5	Pressure compensation valve	11.	Arm regeneration valve
6.	Pressure compensation valve		

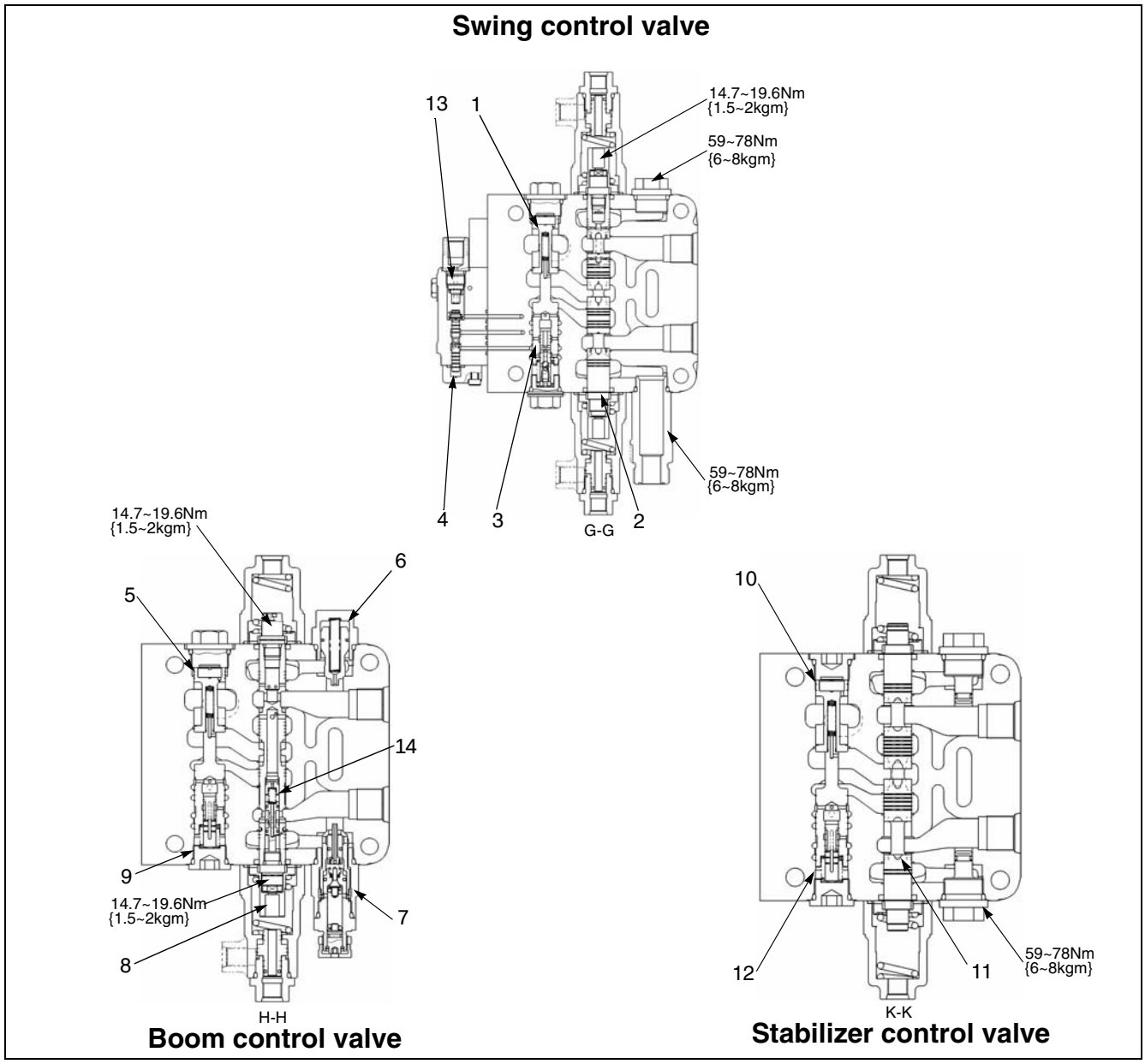
Unit:mm

No	Check Item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	
12	Check valve spring	41.5 x 8.5	26.5	8.8Nm (0.9kgm)		7Nm (0.7kgm)	If damaged or deformed, replace spring



Bucket control valve **Service control valve**

1.	Pressure compensation valve	6.	Pressure compensation valve
2.	Suction valve	7.	Variable safety suction valve (Service)
3.	Suction valve	8.	Variable safety suction valve (Service)
4.	Spool (Bucket)	9.	Spool (service)
5.	Pressure compensation valve	10.	Pressure compensation valve

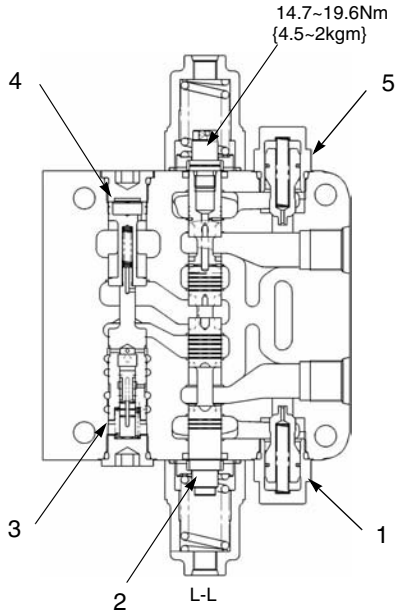


1. Pressure compensation valve
2. Spool (Swing)
3. Pressure compensation valve
4. Swing bleed valve
5. Pressure compensation valve
6. Suction valve
7. Suction valve
8. Spool (Boom)
9. Pressure compensation valve
10. Pressure compensation valve
11. Spool (Stabilizer)
12. Pressure compensation valve

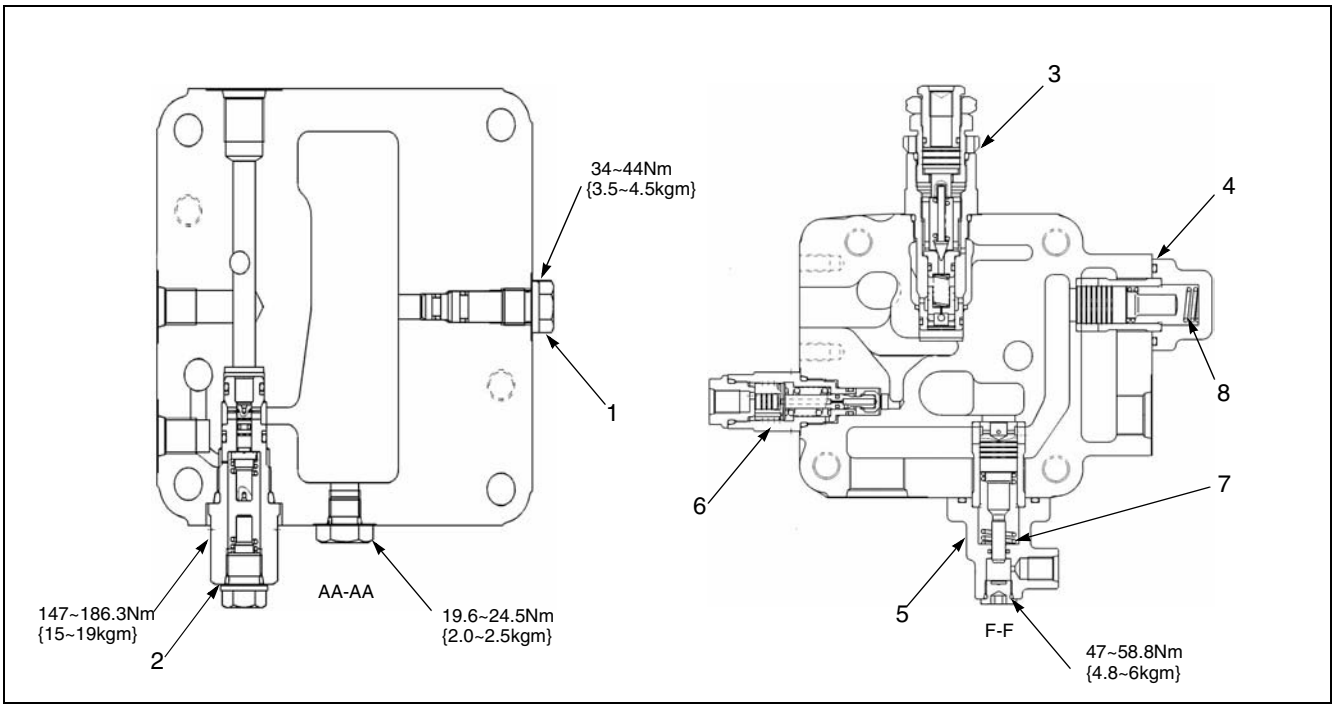
Unit:mm

No	Check Item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Out-side diameter	Installed length	Installed load	Free length	Installed load	If damaged or deformed, replace spring
13.	Bleed spool return spring	41.5 x 8.5	26.5	8.8Nm (0.9kgm)		7Nm (0.7kgm)	

Second boom control valve



1. Suction valve
2. Spool (2nd Boom)
3. Pressure compensation valve
4. Pressure compensation valve
5. Suction valve



1. Pressure relief plug
2. Unload valve
3. Main relief valve
4. Oil cooler bypass valve
5. 2-stage lift check valve
6. L_S separation valve

Unit:mm

No	Check Item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	
7.	Lift check valve spring	72.7 x 20.6	42.5	135.3Nm (13.8kgm)		112.7Nm 11.5(kgm)	If damaged or deformed, replace spring
8.	Cooler bypass valve spring	72.7 x 20.6	42.5	135.3Nm (13.8kgm)		112.7Nm 11.5(kgm)	

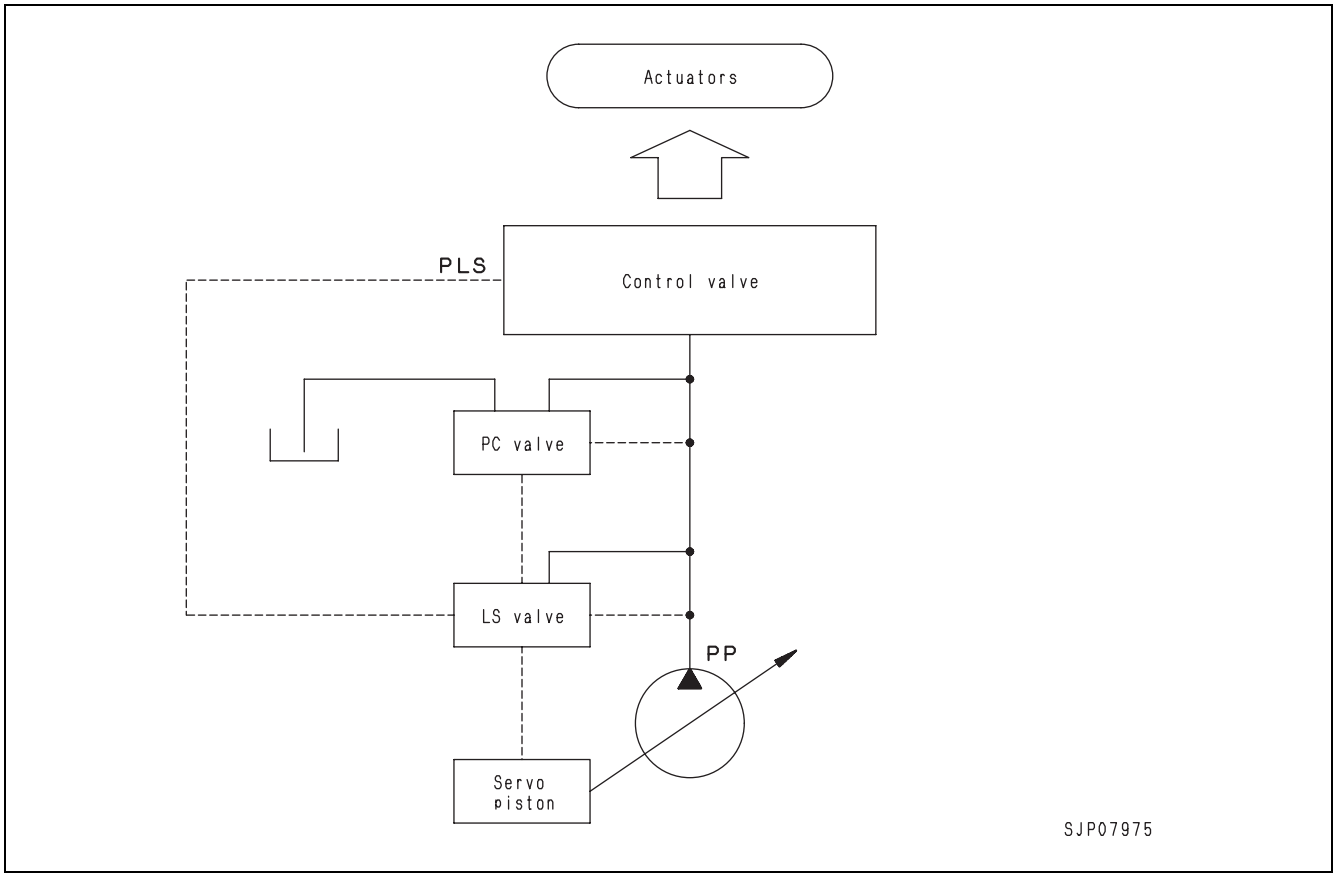
CLSS

OUTLINE OF CLSS

FEATURES

CLSS is an abbreviation for Closed centre 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
- Energy saving using variable pump control



STRUCTURE

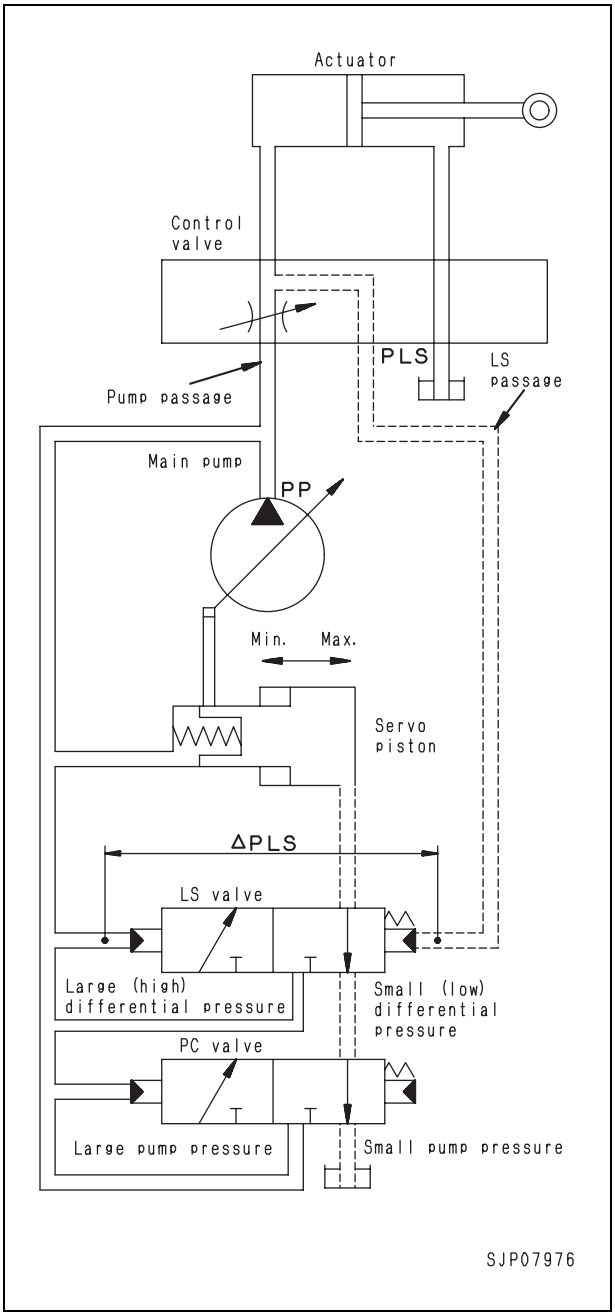
- The CLSS consists of a main pump, control valve, and actuators for the work equipment.
- The main pump body consists of the pump itself, the PC valve and LS valve.

BASIC PRINCIPLE

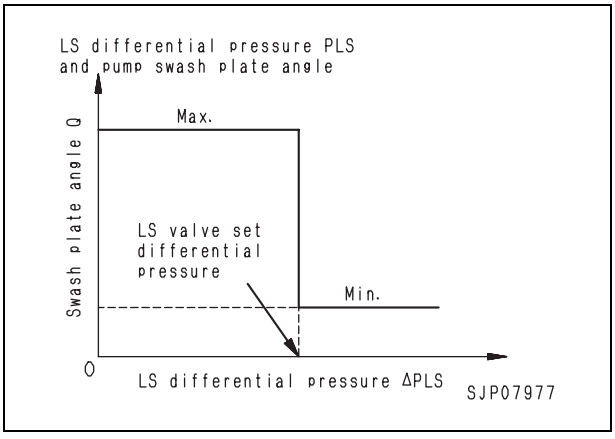
1. Control of pump swash plate angle

- The pump swash plate angle (pump discharge amount) is controlled so that LS differential pressure ∆**PLS** (the difference between pump (discharge) pressure **PP** and control valve outlet port LS pressure **PLS**) (load pressure of actuator) is constant.

  (LS pressure ∆**PLS** = Pump discharge pressure **PP**-LS pressure **PLS**)

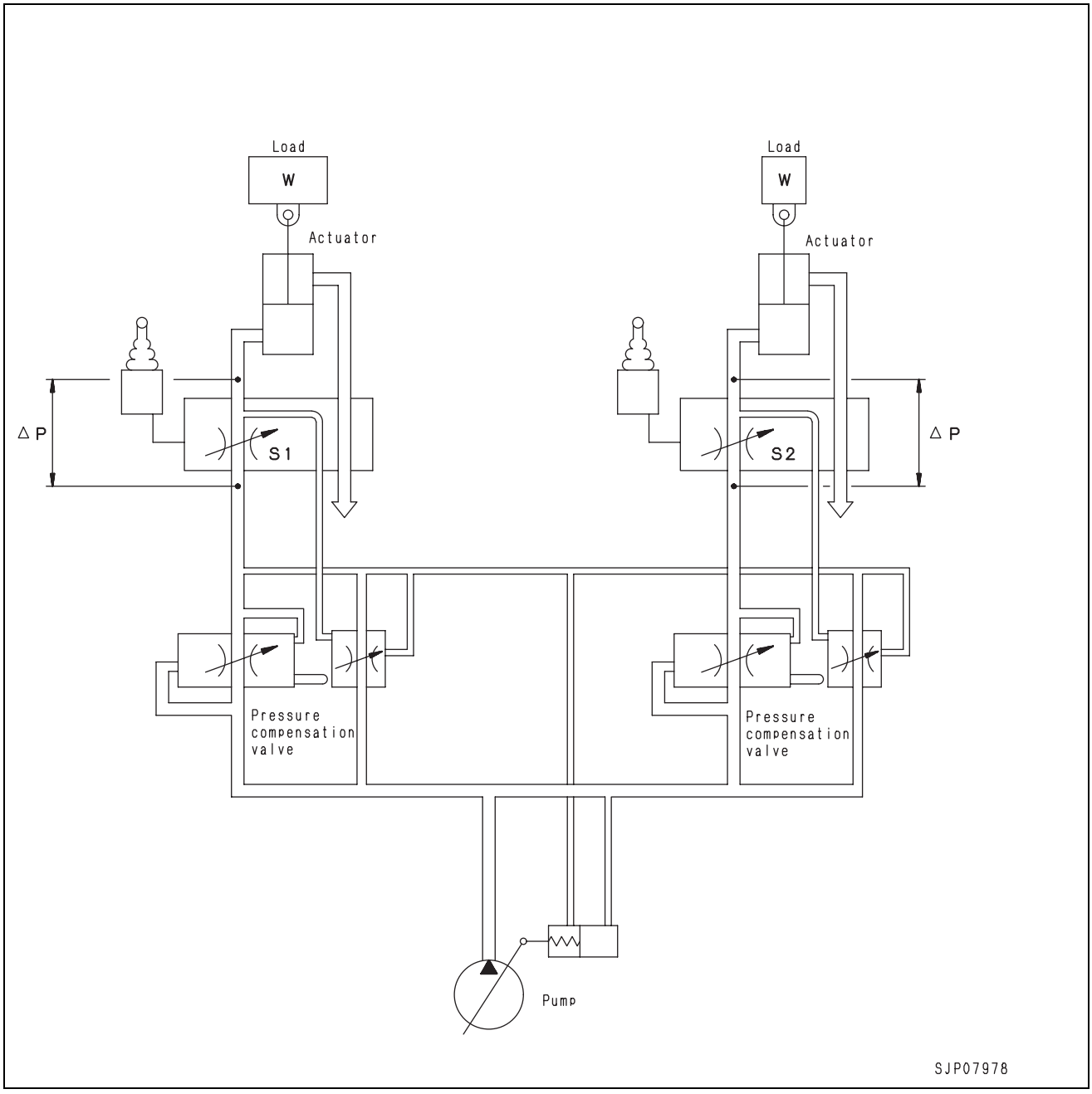


- If LS differential pressure ∆**PLS** becomes lower than the set pressure of the LS valve (when the actuator load pressure is high), the pump swash plate moves towards the maximum position; if the set pressure becomes higher than the set pressure of the LS valve (when the actuator load pressure is low), the pump swash plate moves towards the minimum position.
  - For details of the operation, see HYDRAULIC PUMP.



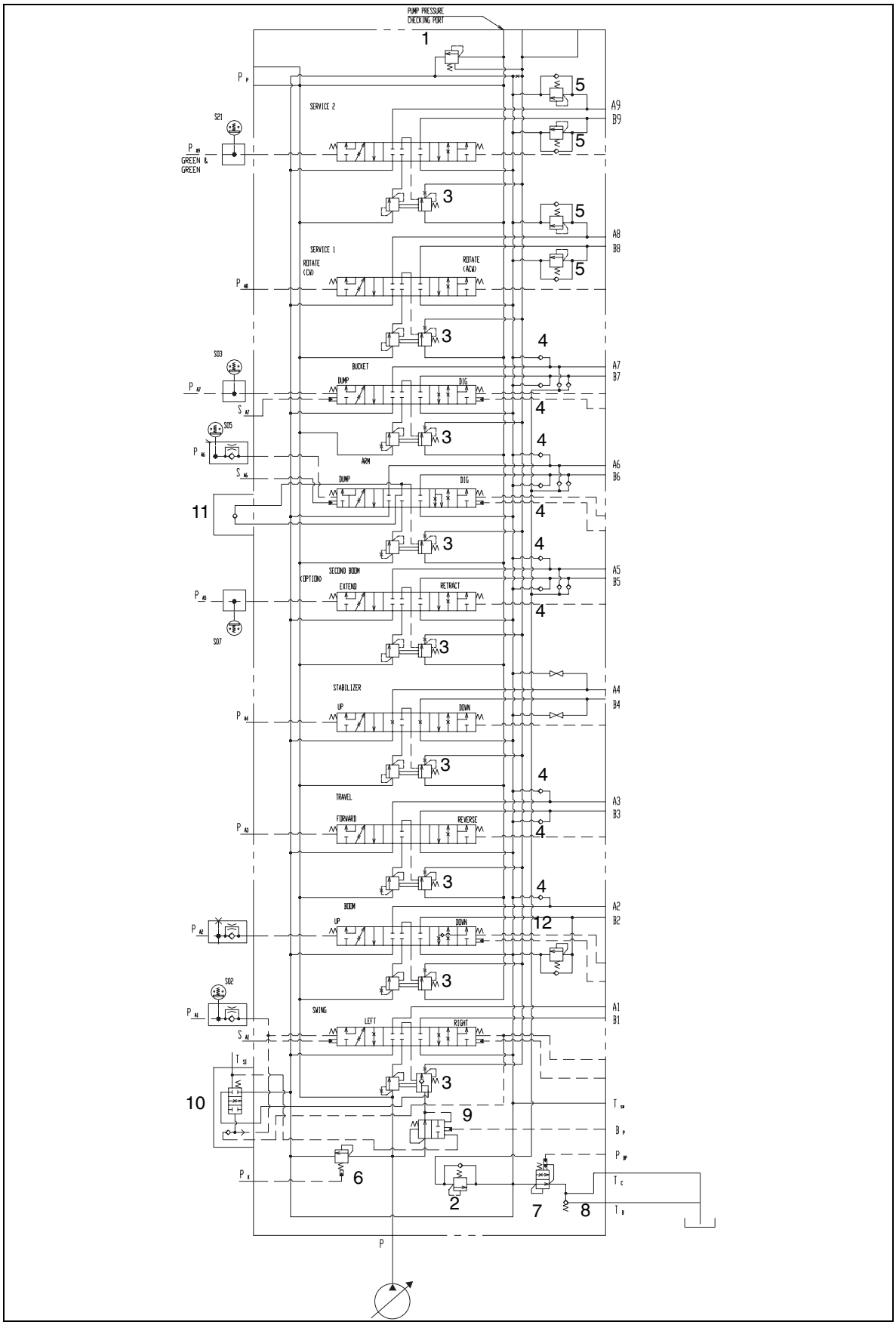
2. Pressure compensation control

- A pressure compensation valve is installed to the inlet port side of the control valve spool to balance the load.
  When to actuators are operated together, this valve acts to make pressure difference ∆**P** between the upstream (inlet port) and downstream (outlet port) the same, regardless of the size of the load (pressure). In this way, the flow of oil from the pump is divided (compensated) in proportion to the area of openings **S1** and **S2** of each valve when it is operated.



OPERATION FOR EACH FUNCTION AND VALVE

Hydraulic circuit diagram and name of valves



1. Unload valve
Set pressure: 3.38 MPa {34.5 kg/cm²}

2. Safety-suction valve
Set pressure: 38.2 MPa {390 kg/cm²}

3. Pressure compensation valve

4. Check valve

5. Safety valve
Set pressure: 24.7 MPa {250 kg/cm²}

6. Main relief valve
Set pressure: Normal: 34.8 MPa {355 kg/cm²}
When rising: 37.3 MPa {380 kg/cm²}

7. Back pressure valve.
Lo: 0.4 MPa (4kg/cm²)
Hi: 0.8 MPa (8kg/cm²)

8. Cooler bypass valve
Set pressure: 0.4MPa (4kg/cm²)

9. L_S separation valve

10. Swing bleed valve

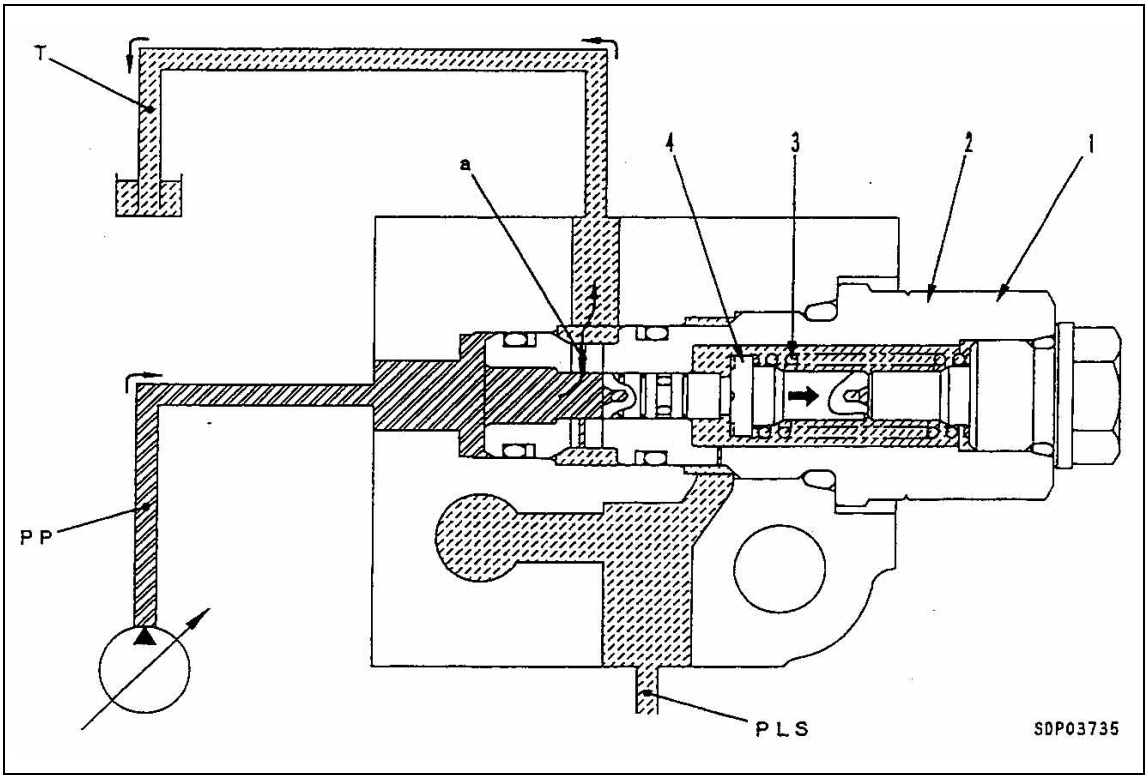
11. Arm check valve

12 Safety valve
Set pressure: 33.3MPa (340kg/cm^2)

1. Unload valve

FUNCTION

1. When the control valve is at neutral, pump discharge amount **Q** discharged by the minimum swash plate angle is released to the tank circuit. At this time, pump discharge pressure **PP** is set at 3.38 MPa {34.5 kg/cm²} by spring (3) inside the valve. (LS pressure **PLS**: 0 MPa {0 kg/cm²})



OPERATION

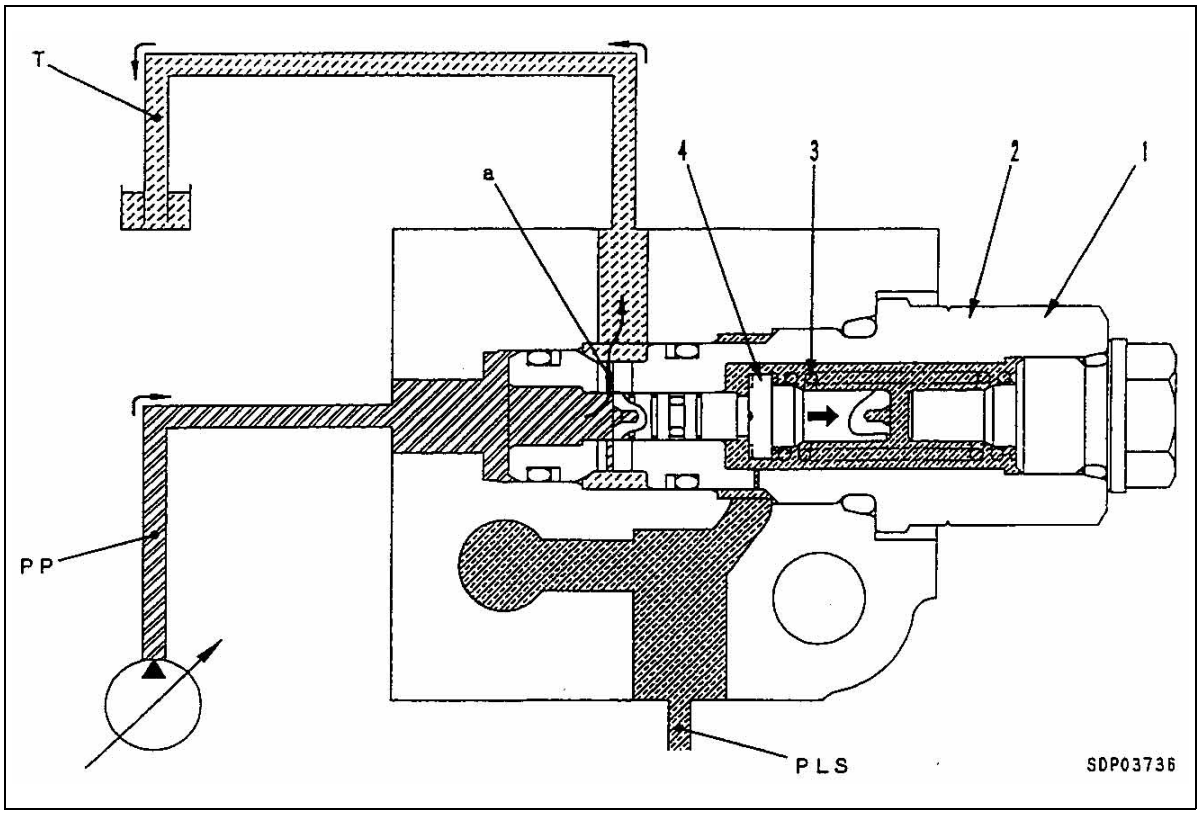
When control valve is neutral

- Pump discharge pressure **PP** is acting on the left end of unload spool (4) and LS pressure **PLS** is acting on the right end.
- When the control valve is at neutral, LS pressures **PLS** is 0, so only pump discharge pressures **PP** has any effect and **PP** is set by only the load of spring (3).
- As pump discharge pressure **PP** rises and reaches the load of spring (3), (3.38 MPa {34.5 kg/cm²}) spool (4) is moved to the right in the direction of the arrow. Pump discharge pressures **PP** then passed through the drill hole in sleeve (2) and is connected to tank circuit T.
- In this way, pump discharge pressure **PP** is set to 3.38 MPa {34.5 kg/cm²}

1.	Unload valve
2.	Sleeve
3.	Spring
4.	Spool

PP:	Pump circuit (pressure)
PLS:	LS circuit (pressure)
T:	Tank circuit (pressure)

2. During fine control of the valve, when the demand flow for the actuator is within the amount discharged by the minimum swash plate angle of the pump, pump discharge pressure **PP** is set to LS pressure **PLS** + 3.38 MPa {34.5 kg/cm²}.
   When the differential pressure between the pump discharge pressure **PP** and LS pressure **PLS** reaches the load of spring (3) (3.38 MPa {34.5 kg/cm²}), the unload valve opens, so LS differential pressure **PLS** becomes 3.38 MPa {34.5 kg/cm²}.



OPERATION

Fine control of control valve

- When fine control is carried out on the control valve, LS pressure **PLS is** generated and acts on the right end of the spool (4).
  When this happens, the area of the opening of the control valve spool is small, so there is a big difference between LS pressure **PLS** and pump discharge pressure **PP**.
- When the differential pressure between pump discharge pressure **PP** and LS pressure **PLS** reaches the load of the spring (3) (3.38 MPa {34.5 kg/cm²}), spool (4) is moved to the right in the direction of the arrow, and pump circuit **PP** and tank circuit **T** are connected.
- In other words, pump discharge pressure PP is set to a pressure equal to the spring force (3.38 MPa {34.5 kg/cm²}) + LS pressure PLS, and LS differential pressure PLS becomes 3.38 MPa {34.5 kg/cm²}.

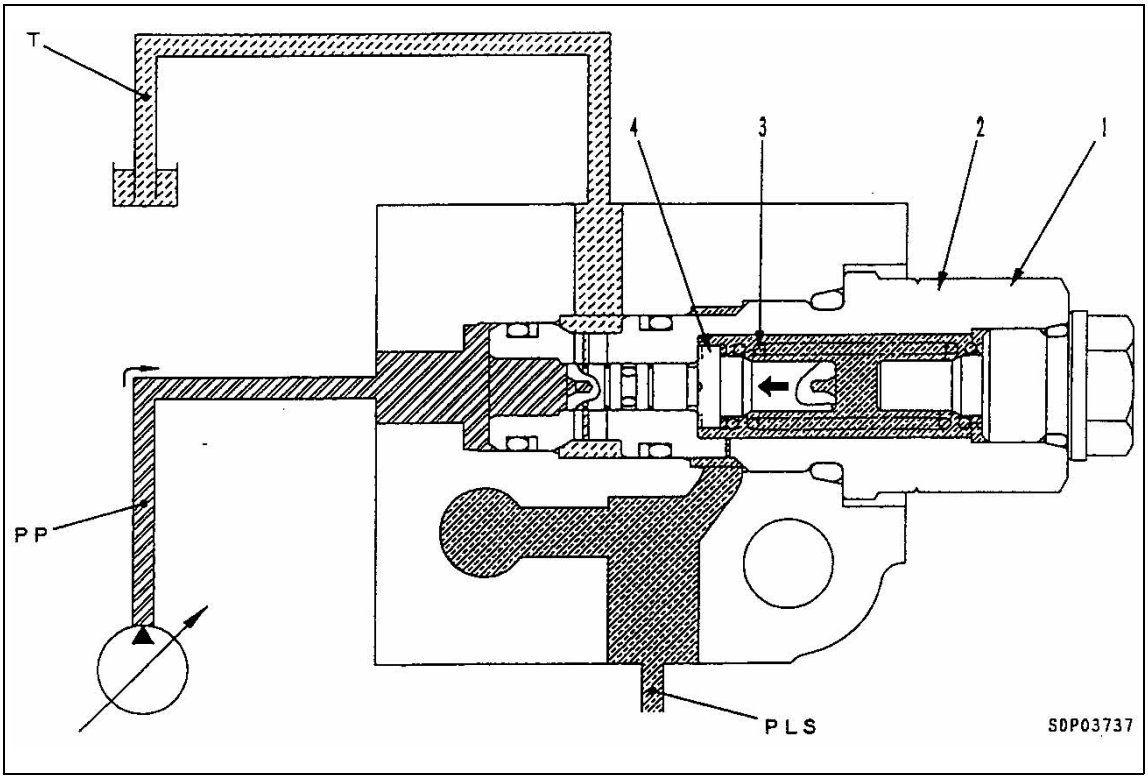
1. Unload valve
2. Sleeve
3. Spring
4. Spool

PP: Pump circuit (pressure)

PLS: LS circuit (pressure)

T: Tank circuit (pressure)

3. When the control valve is being operated and the demand flow for the actuator becomes greater than the pump discharge from the minimum swash plate angle, the flow of the oil out to tank circuit **T** is cut off and all of pump discharge amount **Q** flows to the actuator circuit.



OPERATION

Control valve operated

- When fine control valve is operated to a bigger stroke, LS pressure **PLS** is generated and acts on the right end of the spool (4). When this happens, the area of the opening of the control valve spool is large, so the difference between LS pressure **PLS** and pump discharge pressure **PP** is small.
- For this reason, the differential pressure between pump discharge pressure **PP** and LS pressure **PLS** does not reach the load of spring (3) (2.45MPa {25kg/cm^2}), so spool (4) is pushed to the left by spring (3).
- As a result, pump circuit **PP** and tank circuit **T** are shut off, and all the pump discharge amount **Q** flows to the actuator circuit.

1. Unload valve
2. Sleeve
3. Spring
4. Spool

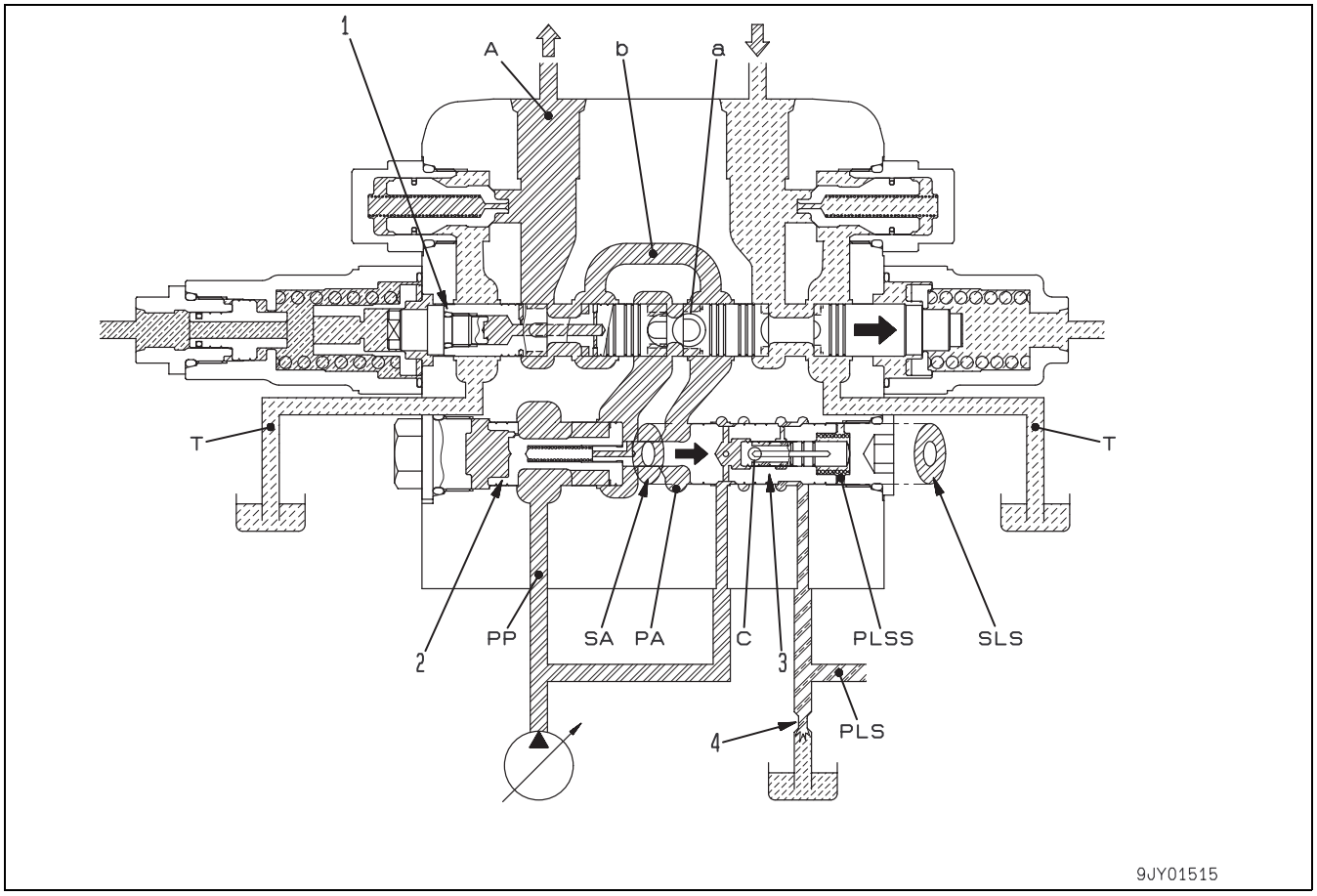
PP: Pump circuit (pressure)

PLS: LS circuit (pressure)

T: Tank circuit (pressure)

2. Introduction of LS pressure

WORK EQUIPMENT VALVE



FUNCTION

- The LS pressure is the actuator load pressure at the outlet port end of the control valve.
- Actually, pump discharge pressure **PP** is reduced by reducing valve (3) of the pressure compensation valve to the same pressure as actuator circuit pressure **A** and sent to LS circuit **PLS**.
- In the travel valve, actuator circuit pressure **A** is directly introduced to LS circuit **PLS**.

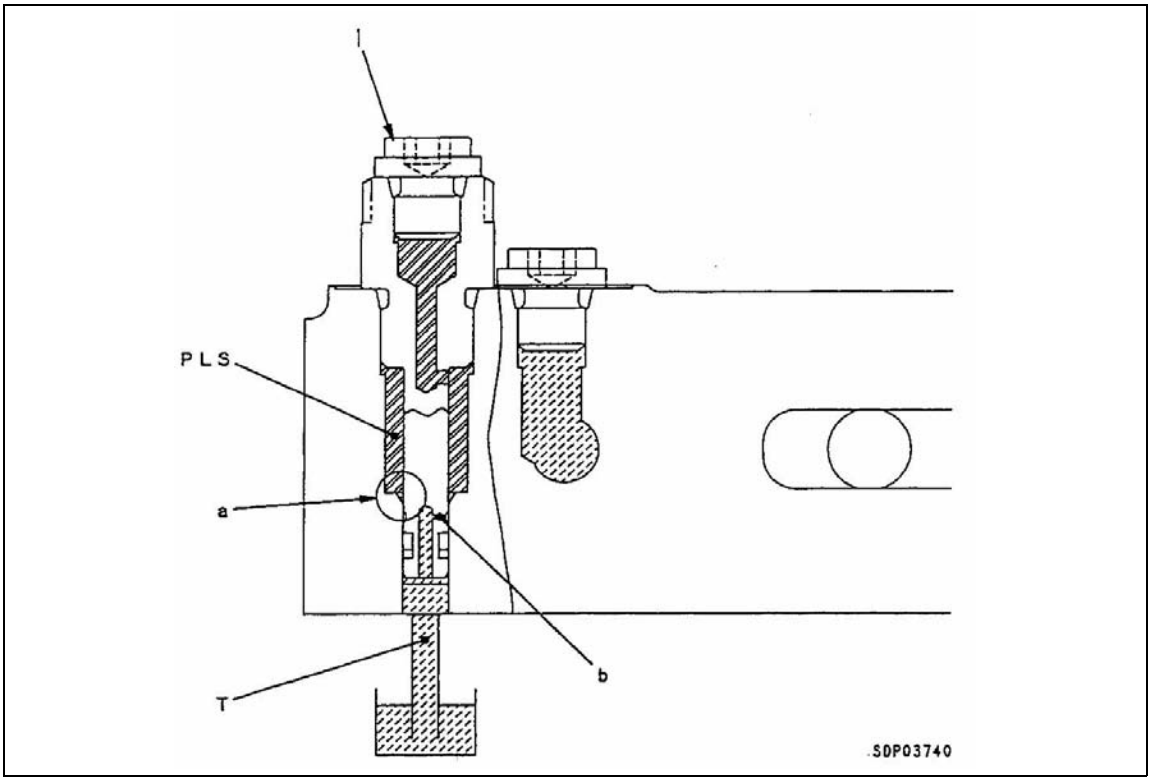
Operation

- When spool (1) is operated, pump discharge pressure **PP** flows from flow control valve (2) through notch (a) in the spool and bridge passage (b) to actuator circuit **A**.
- At the same time, reducing valve (3) also moves to the right, so pump discharge pressure **PP** is reduced by the pressure loss at notch (c). It goes to LS circuit **PLS**, and then goes to spring chamber **PLSS.**
- When this happens, LS circuit **PLS** is connected to tank circuit T from LS bypass plug (4) (See the section on the LS bypass plug).
- The areas at both ends of reducing valve (3) are the same (SA = SLS), and actuator circuit pressure PA acts on the **SA** end. The reduced pump discharge pressure **PP** acts on **SLS** at the other end.
- As a result, reducing valve (3) is balanced at a position where actuator circuit pressure **PA** and the pressure of spring chamber **PLSS** are the same. Pump discharge pressure **PP** reduced at notch (c) becomes actuator pressure **A** and is introduced into LS circuit **PLS**.

3. LS Bypass plug

OUTLINE

1. This releases the residual pressure of LS pressure **PLS**.
2. 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 the LS circuit **PLS** passes from the clearance filter **a** (formed by the clearance between LS plug (1) and the valve body) through orifice **b** and flows to the tank circuit **T**.

1. LS bypass plug

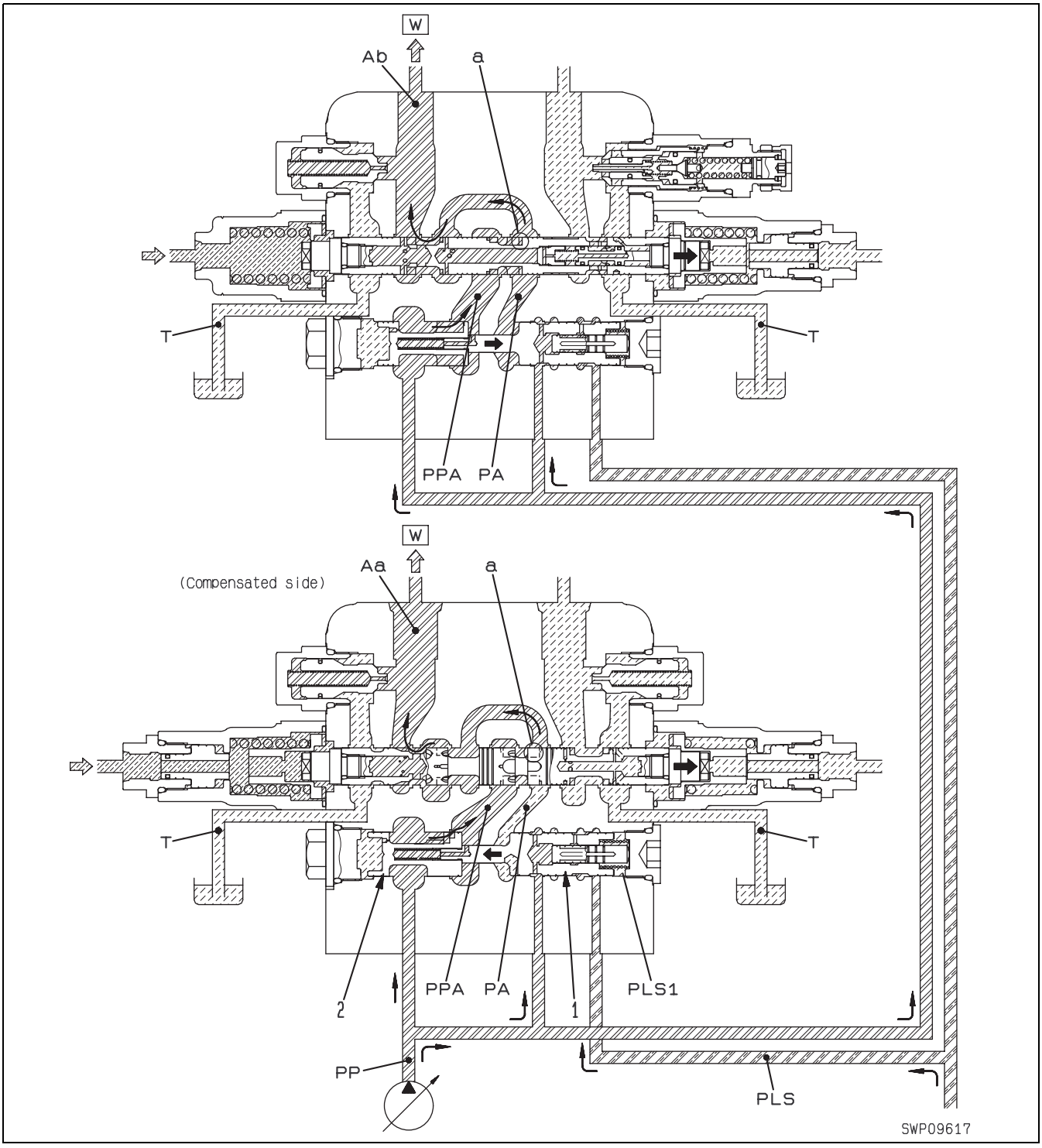
PLS: LS circuit (pressure)

T: Tank circuit (pressure)

4. Pressure compensation valve

FUNCTION

- When the load pressure becomes lower than another actuator and the flow is going to increase during a compound operation, this valve compensates the load pressure. (At the time, the load pressure of another actuator under compound operation (the upper side) is higher than that of the actuator on this side (the lower side).



Operation

- When the load pressure of another actuator side (the upper side) rises during a compound operation, the flow in the actuator circuit **Aa** on this side (the lower side) is apt to increase.
- In this case, the LS pressure **PLS** of another actuator is applied to the spring chamber **PLS1** and pushes the pressure reducing valve (1) and the flow control valve (2) to the left side.
- The flow control valve (2) throttles the opening area between the pump circuit **PP** and the spool upstream **PPA** and causes a pressure loss between **PP** and **PPA**.
- The flow control valve (2) and the pressure reducing valve (1) balance each other where the pressure difference between **PA** applied to the both end faces of the pressure reducing valve (1) and **PLS** becomes the same as the pressure loss between **PP** before and after the flow control valve and **PPA**.
- So, the pressure differences between the upstream pressures **PPA** and the downstream pressures **PA** of the both spools under compound operation become the same, and the pump flow is distributed in proportion to the opening area of each spool notch **a**.

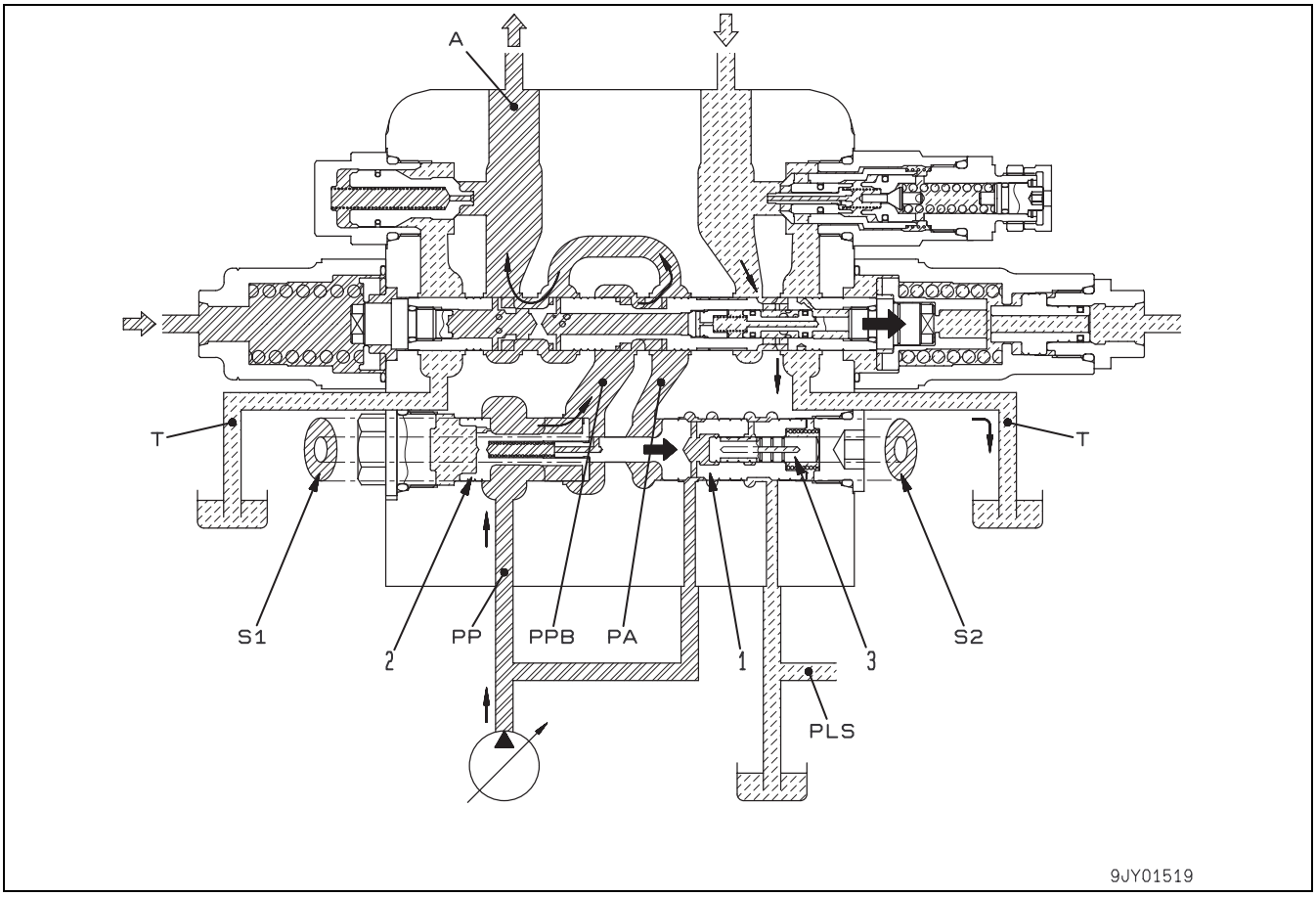
5. Area ratio of pressure compensation valve

FUNCTION

- The pressure compensation valve slightly adjust the ratio (**S2/S1**) of the area **S1** on the left side of the flow control valve (2) and the area **S2** on the right side of the pressure reducing valve (1) to suite the characteristics of each actuator and determines the compensation characteristics.

S1: Area of the flow control valve (2) - area of the piston (3)

S2: Area of the pressure reducing valve (1) - area of the piston (3)



Area ratio (S1:S2) and compensation characteristics

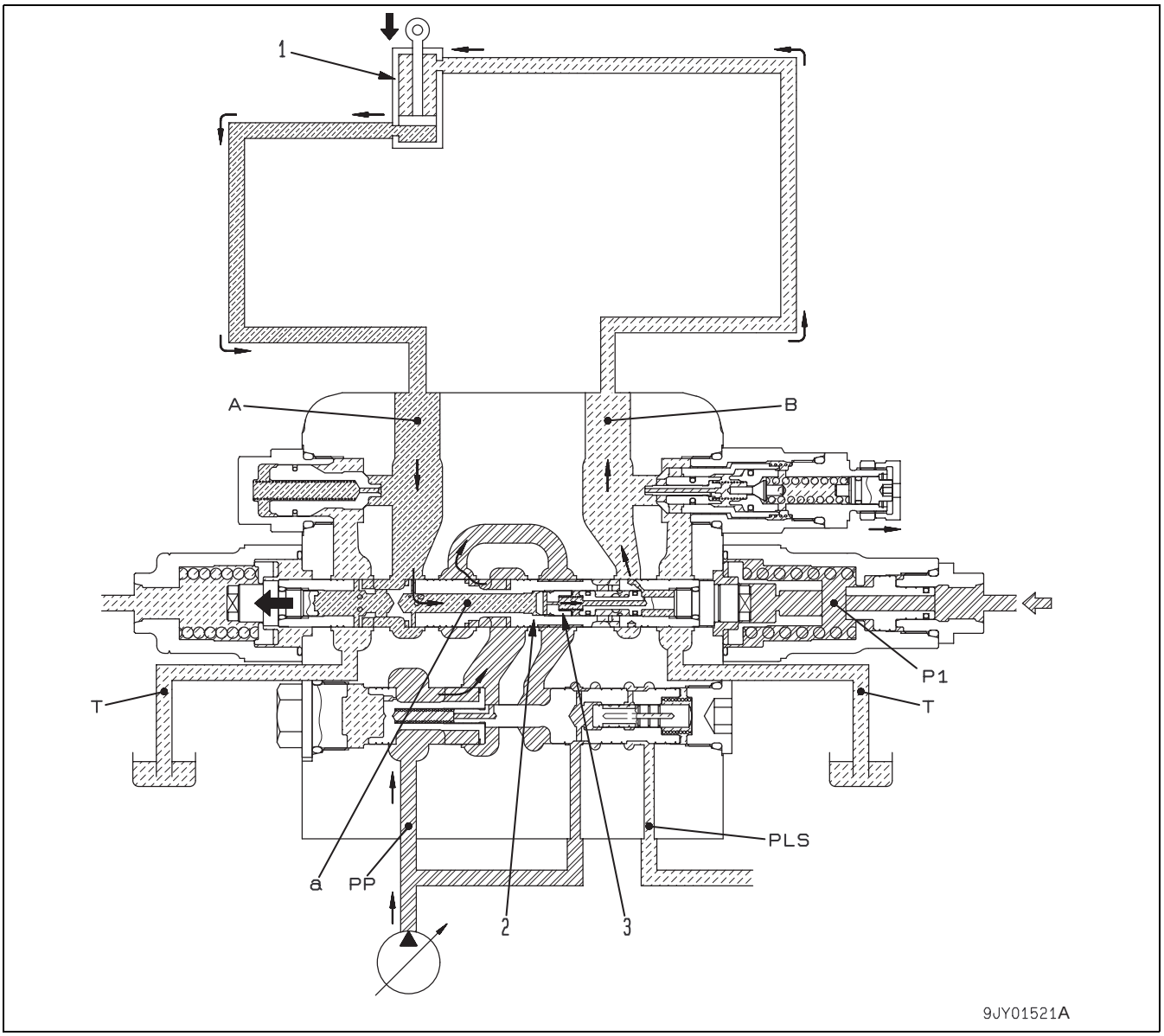
- When the ratio is 1.00:The expression [Pump (discharge) pressure **PP** – Spool notch upstream pressure **PPB**] ≒ [LS circuit pressure **PLS** – Actuator circuit pressure **PA** (= **A**)] can be held, and the flow is distributed as per the spool opening area ratio.
- When the ratio is more than 1.00:The expression **PP** – **PPB** > **PLS** – **PA** (= **A**) can be held, and the flow is distributed less than the spool opening area ratio.
- When the ratio is less than 1.00:The expression **PP** – **PPB** < **PLS** – **PA** (= **A**) can be held, and the flow is distributed more than the spool opening area ratio.

6. Boom regeneration circuit

1. Boom lower and own weight fall

FUNCTION

- When the boom is lowered and falls due to its own weight because the bottom pressure **A** in the cylinder (1) is higher than the head pressure **B**, this circuit brings the return flow on the bottom side to the head side to increase the cylinder speed.



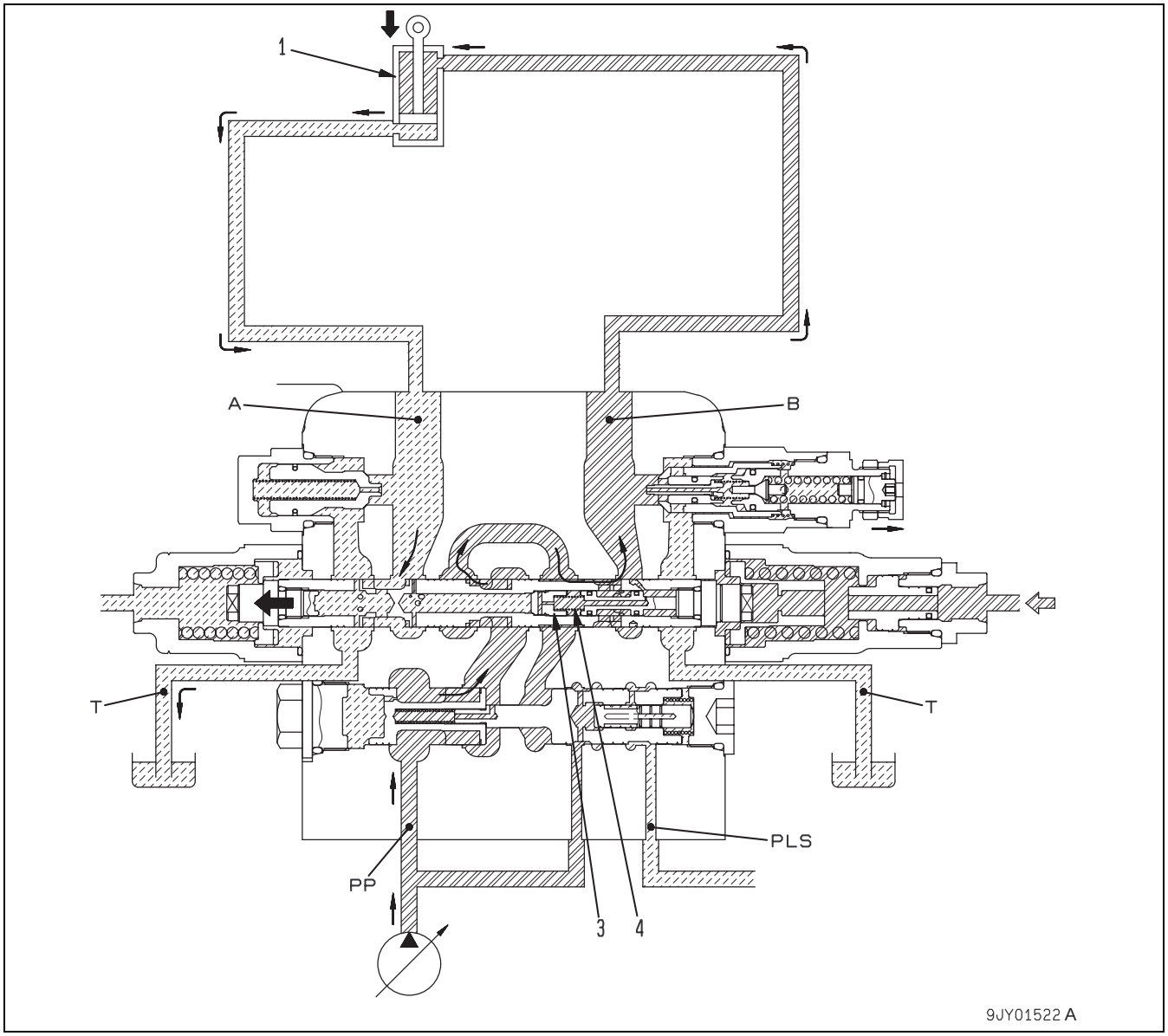
Operation

- When the boom is lowered and falls due to its own weight, the bottom side pressure **A** in the boom cylinder (1) will rise above the head side pressure **B**.
- At the time, part of the return flow on the bottom side passes through the regeneration passage **a** of the boom spool (2), pushes the check valve (3) to open it and flows to the head side.
- This increases the boom lower speed.

2. Boom lower load process

FUNCTION

- When the head pressure **B** of the cylinder (1) is higher than the bottom pressure **A** while the boom is lowered and the boom is in the load process, the check valve (3) will be closed, and the circuits on the head side and the bottom side will be interrupted.



Operation

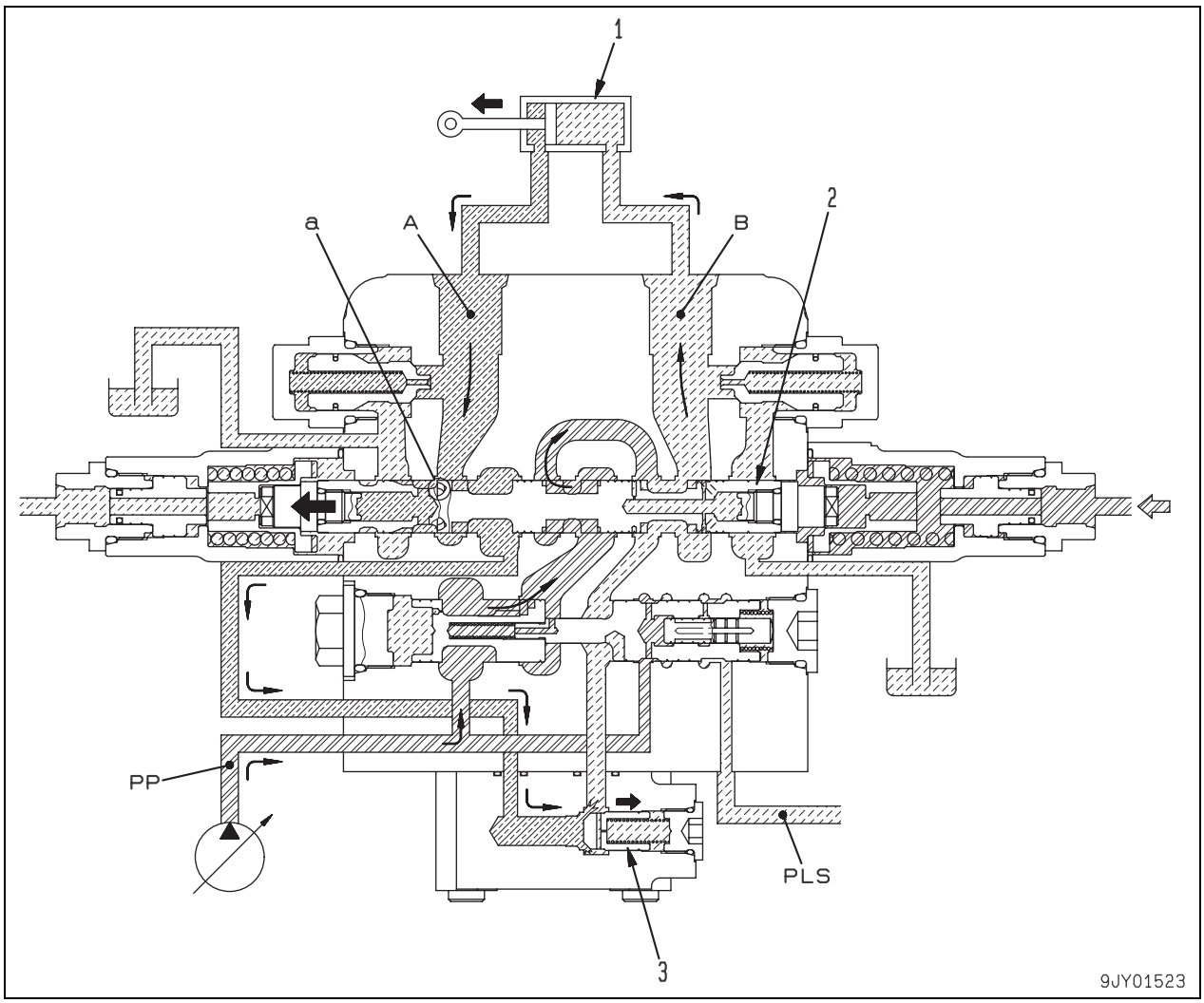
- When the boom is lowered and is in the load process, the head side pressure **B** of the boom cylinder (1) rises above the bottom side pressure **A**
- At the time, the head side pressure **B** and the spring (4) close the check valve (3), and the circuits on the head side and the bottom side are interrupted.

7. Arm regeneration circuit

1. Arm lower and own weight fall

FUNCTION

- When the arm falls due to its own weight because the head pressure **A** in the arm cylinder (1) is higher than the bottom pressure **B** during arm digging, this circuit brings the return flow on the head side to the bottom side to increase the cylinder speed.



Operation

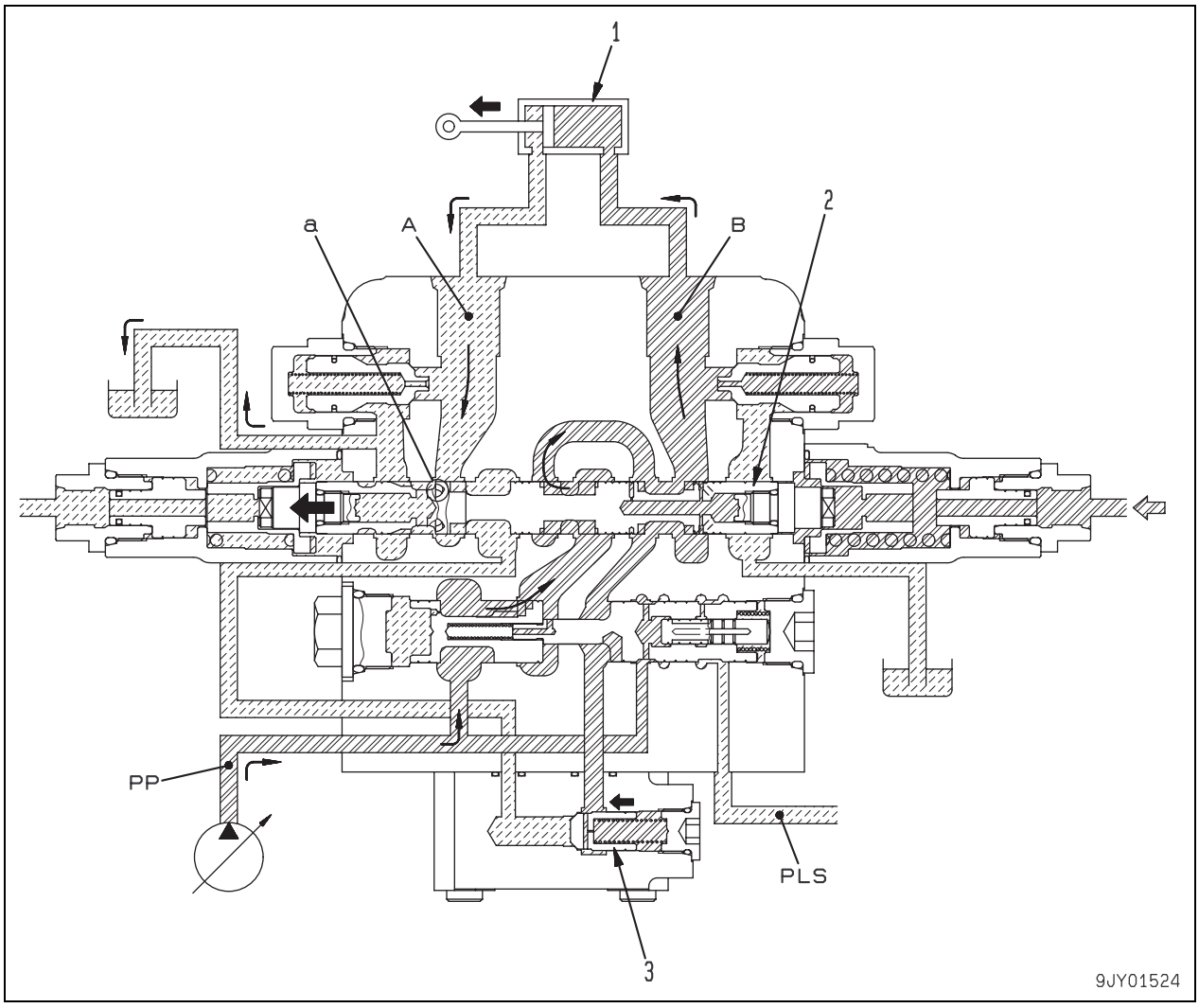
- When the arm falls for digging due to its own weight, the head side pressure **A** in the arm cylinder (1) will rise above the bottom side pressure **B**.
- At the time, part of the return flow on the head side passes through the regeneration passage of the arm spool (2), pushes the check valve (3) to open it and flows to the bottom side.
- This increases the arm digging speed.

1.	Arm cylinder
2.	Arm spool
3.	Check valve
A:	Head circuit (pressure)
B:	Bottom circuit (pressure)
PP:	Pump circuit (pressure)

2. Arm digging process

FUNCTION

- When the bottom pressure B of the cylinder (1) rises above the head pressure **A** and the arm enters the digging process, the check valve (3) will be closed and the circuits on the head side and the bottom side will be interrupted.



Operation

- When the arm is in the digging process, the bottom side pressure B of the arm cylinder (1) will rise, close the check valve (3) and interrupt the circuits on the head side and the bottom side.

1. Arm cylinder
2. Arm spool
3. Check valve

A: Head circuit (pressure)

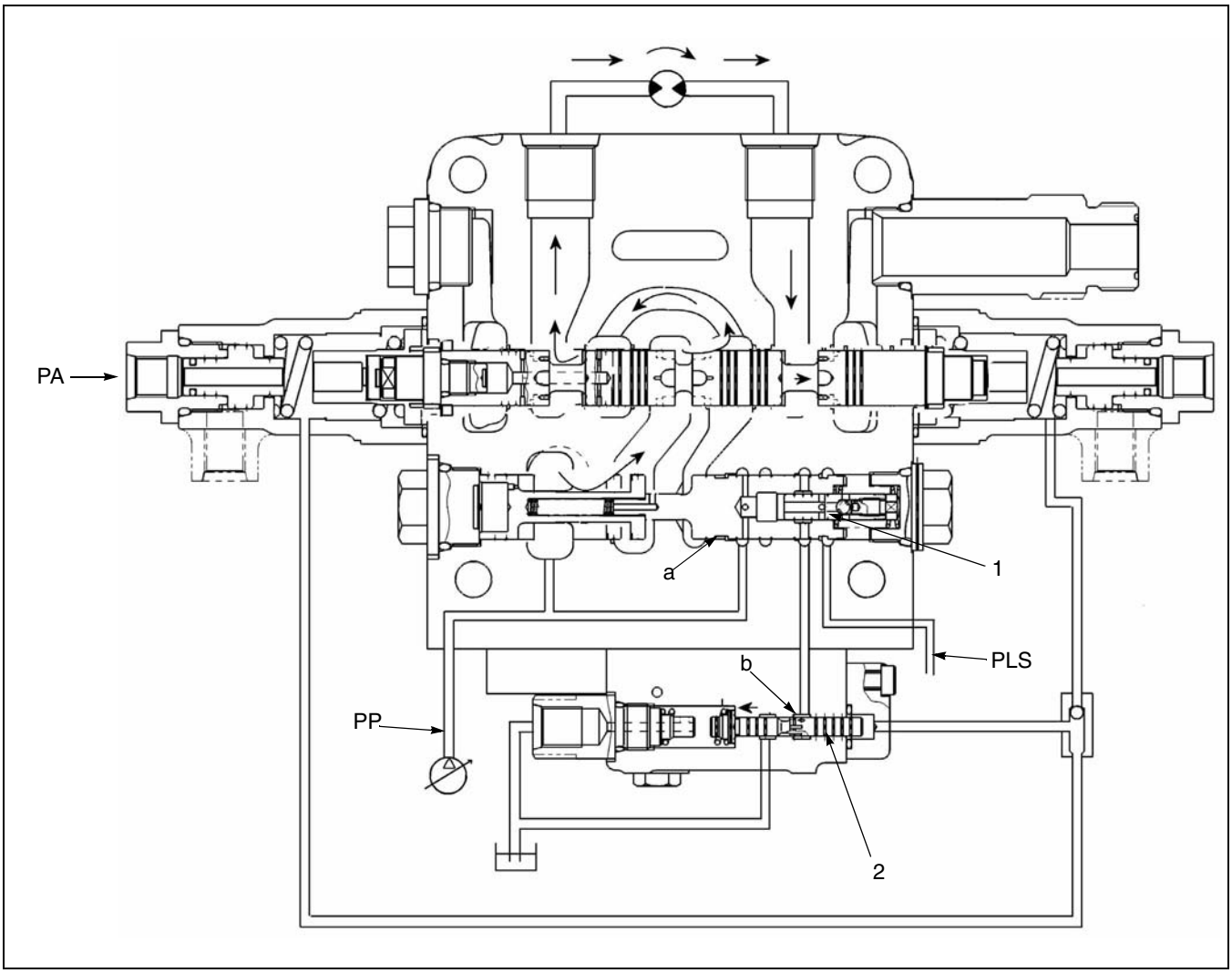
B: Bottom circuit (pressure)

PP: Pump circuit (pressure)

8. Swing bleeding valve

FUNCTION

- When the machine swings, the bleeding valve installed to the pressure reducing valve works so that the LS pressure rises gradually and the machine swings smoothly.



Operation (In fine control operation)

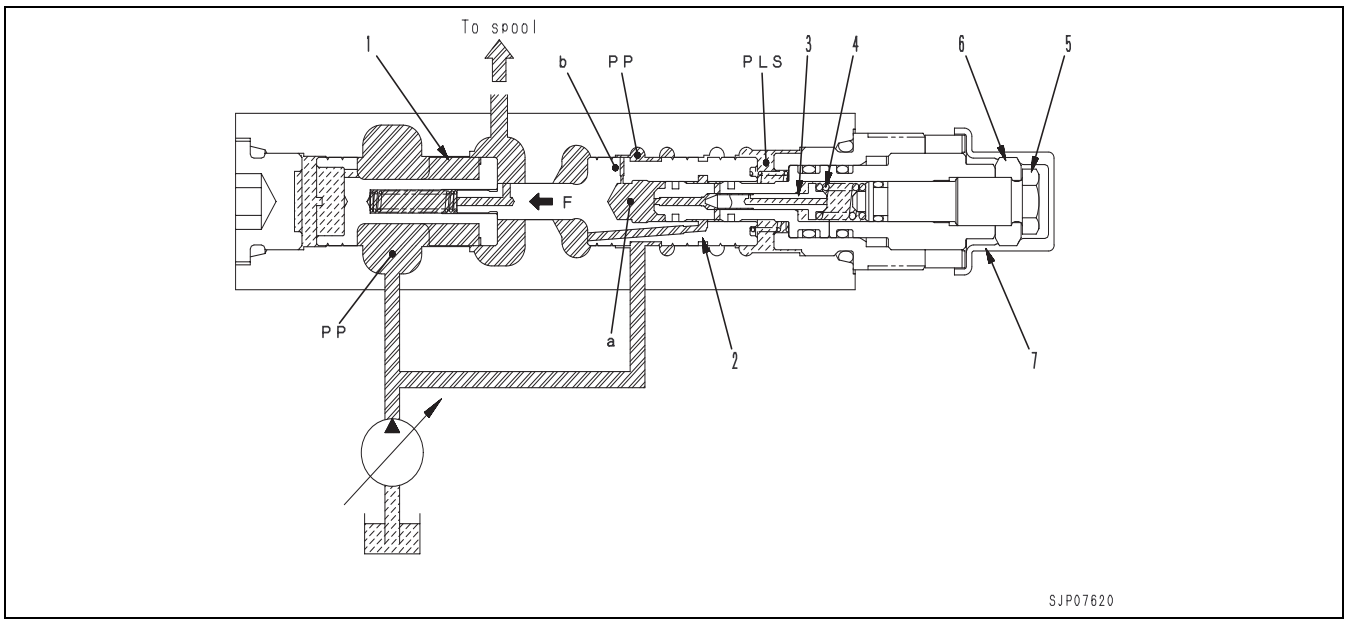
- The pressure reducing valve moves to the right and notch **a** connects to the LS circuit. As a result, pump circuit **PP**, bleed-off circuit, and Ls circuit are connected through piston (1).
- Bleeding spool (2) moves to the left in proportion as swing **PPC** pressure **PA** rises. In the fine control area, notch **b** chokes the bleed-off circuit and determines the intermediate pressure before the lowered pressure is applied to pump discharge pressure **PP** and Ls pressure **PLS**.
- Accordingly, the intermediate pressure is set lower than pump discharge pressure **PP** and raised as bleeding spool (2) moves. As a result, Ls pressure **PLS** rises gradually.
- When the lever is in neutral or operated fully, the bleed-off circuit is closed.

1. Compensation valve piston
2. Spool (Bleeding valve)

9. Variable type pressure compensation valve (for service)

FUNCTION

- It is possible to adjust the division of the oil flow to the service valve (for attachment) when operated together with the main control valve (boom RAISE, etc.). (Variable in proportion to surface area)
- The force of spring (4) can be adjusted with screw (5).



Simultaneous operation with work equipment under heavy load (boom RAISE, etc.)

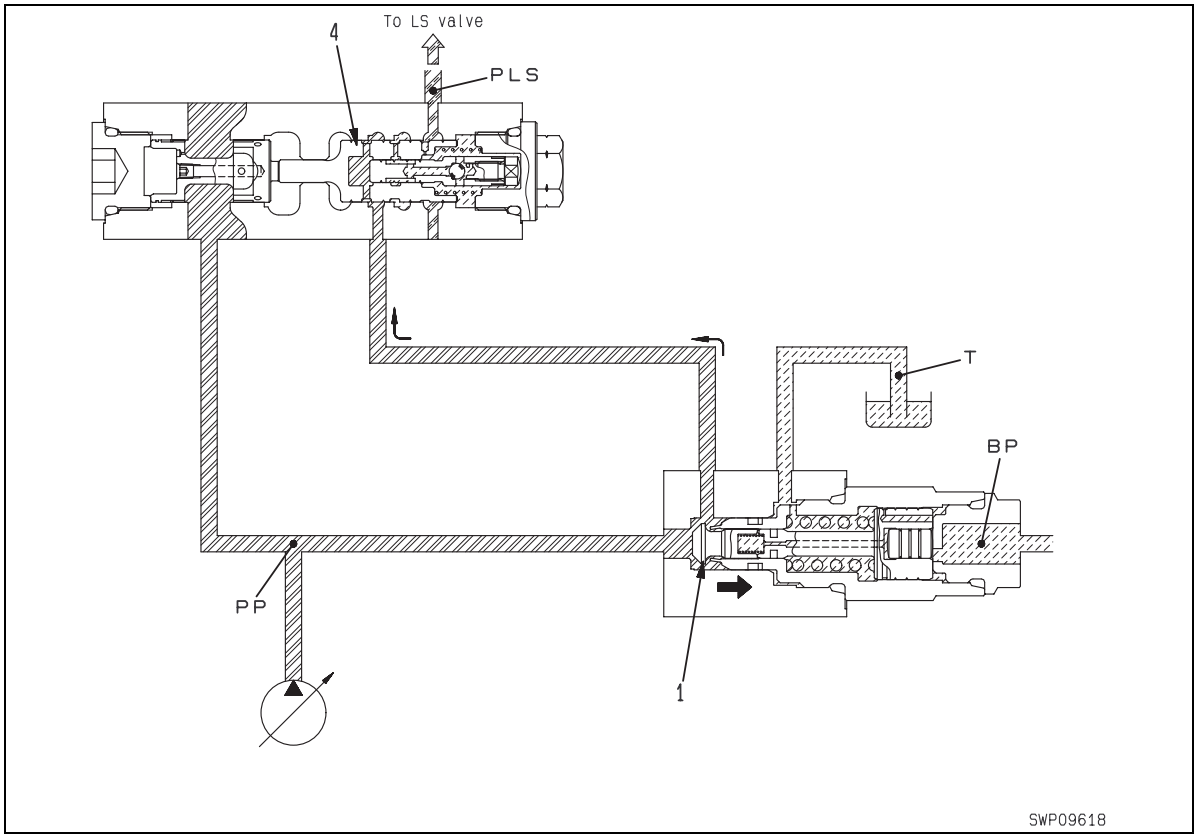
- Pump pressure **PP** and LS pressure **PLS** are determined by other work equipment.
- When the pressure in chamber **a** reaches the set pressure of spring (4), poppet (3) opens and the pressure in chamber **a** is maintained at a pressure lower than the pump pressure at throttle **b**.
- As a result, force F, which is trying to close flow control (1) of the reducing valve (2), becomes small.
  In other words, it is set to a condition where the area ratio becomes smaller, so flow control valve e (1) moves to the right and the flow of oil from the pump to the service valve increases.

1. Flow control valve
2. Reducing valve
3. Poppet
4. Spring
5. Screw
6. Locknut
7. Plastic cap

10. LS select valve

FUNCTION

- When the swing + boom RAISE are operated together, this valve ensures the pump flow to drive the swing, and prevents the swing LS pressure from flowing into the LS circuit PLS. In this way, it prevents the boom RAISE speed from dropping

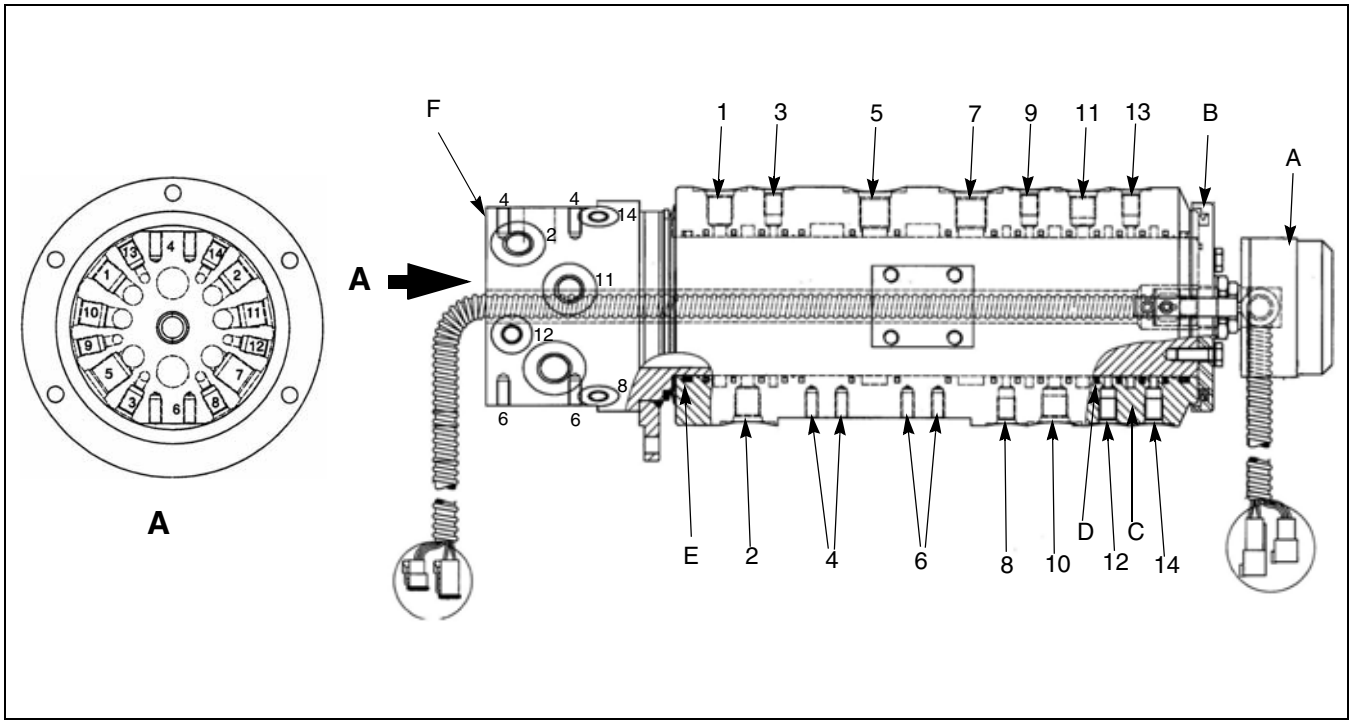


Operation

1. Normal operation

- Normally, except when boom RAISE is operated, the pilot pressure does not act on pilot port **BP**.
- In this condition, pump pressure **PP** pushes valve (1) open and goes to reducing valve (4) of the swing valve. When the swing is operated, LS pressure **PLS** is generated in accordance with the load pressure and flows to the pump LS valve.

CENTRE SWIVEL JOINT



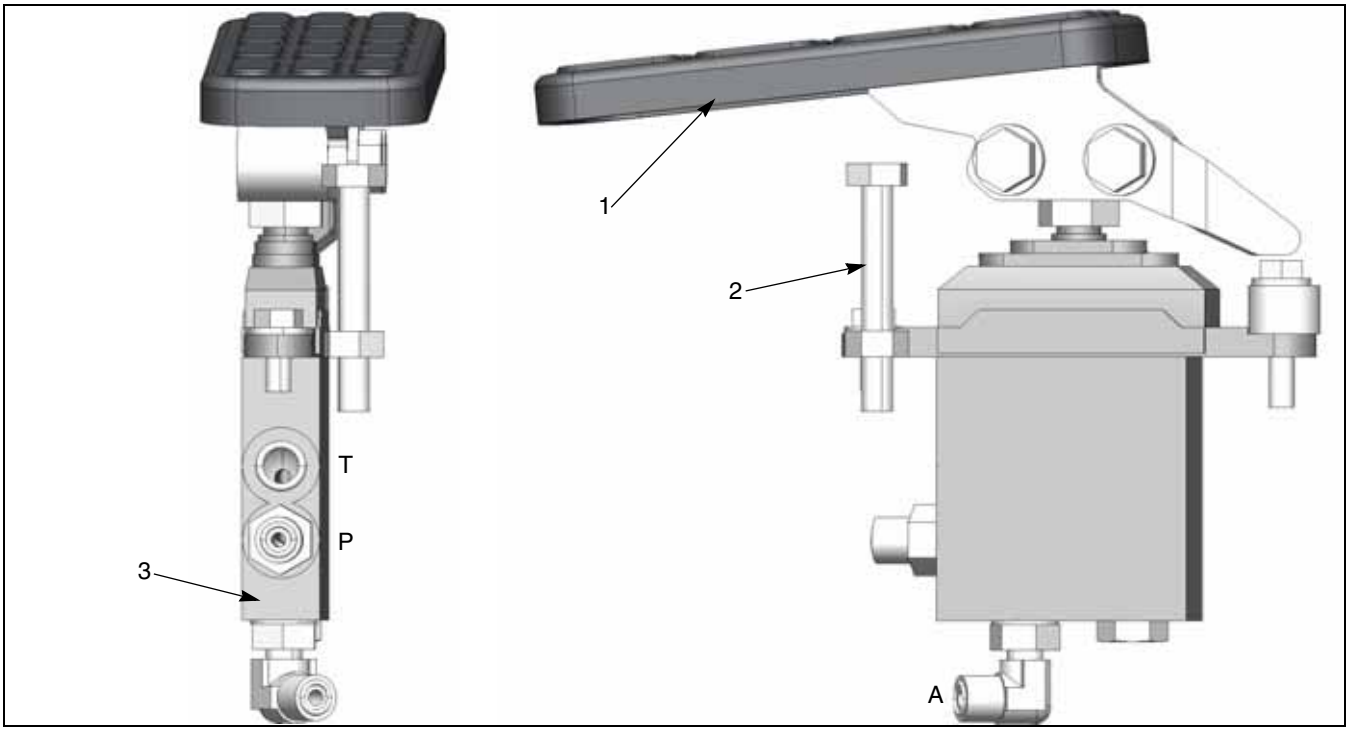
1. Steering left
2. Drain
3. Motor volume pilot
4. Travel motor A
5. Undercarriage attachment cylinder head
6. Travel motor B
7. Undercarriage attachment cylinder bottom
8. Service brake-1
9. Service brake-2
10. Steering right
11. Blanked off
12. Transmission large clutch
13. Suspension lock
14. Transmission small clutch

A. Slip ring assembly
B. Cover
C. Housing
D. Sealing ring
E. O-ring/backup ring seal
F. Rotor

Unit: mm

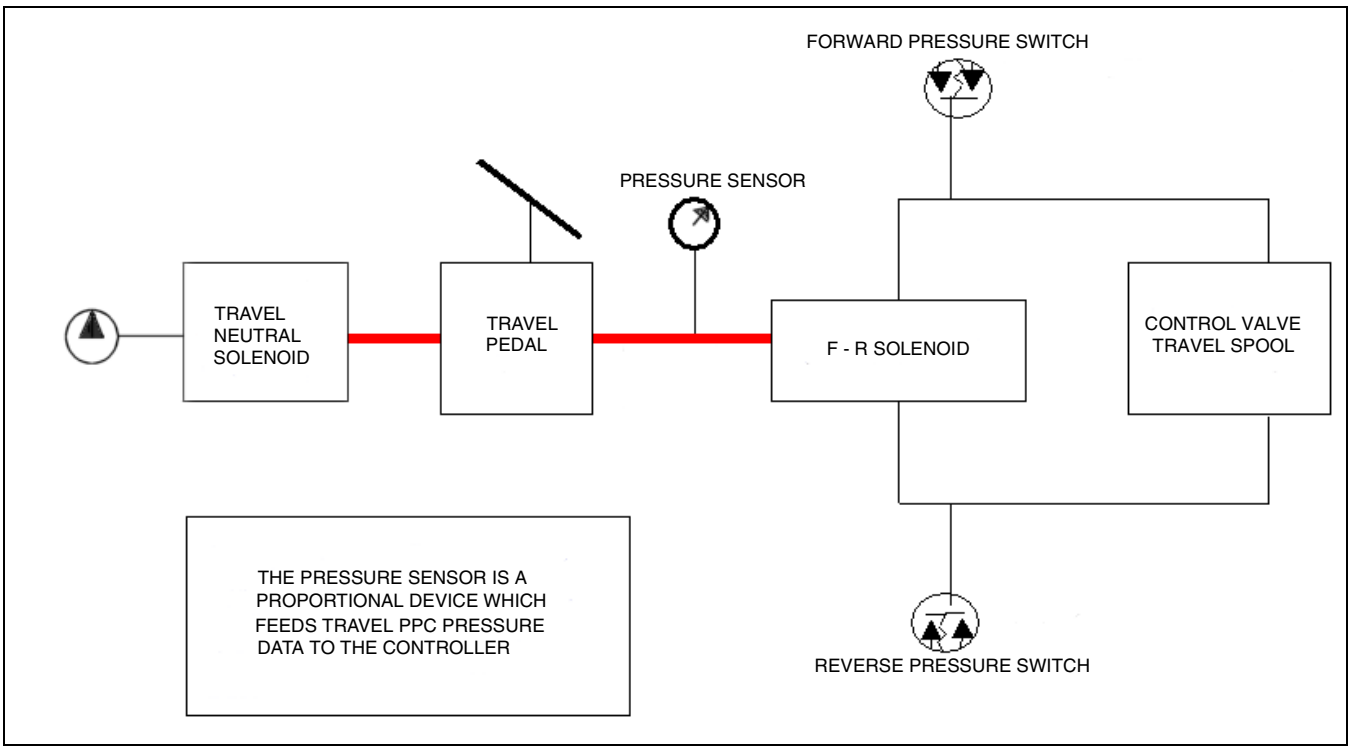
No.	Check Item	Criteria			Remedy
		Standard Size	Standard clearance	Repair limit	
1	Internal shaft	$110^{-0.02}_{-0.06}$	Max.=0.21 Min.=0.12	>=0.26	Replace
2	External rotor	$110^{0.15}_{0.10}$			

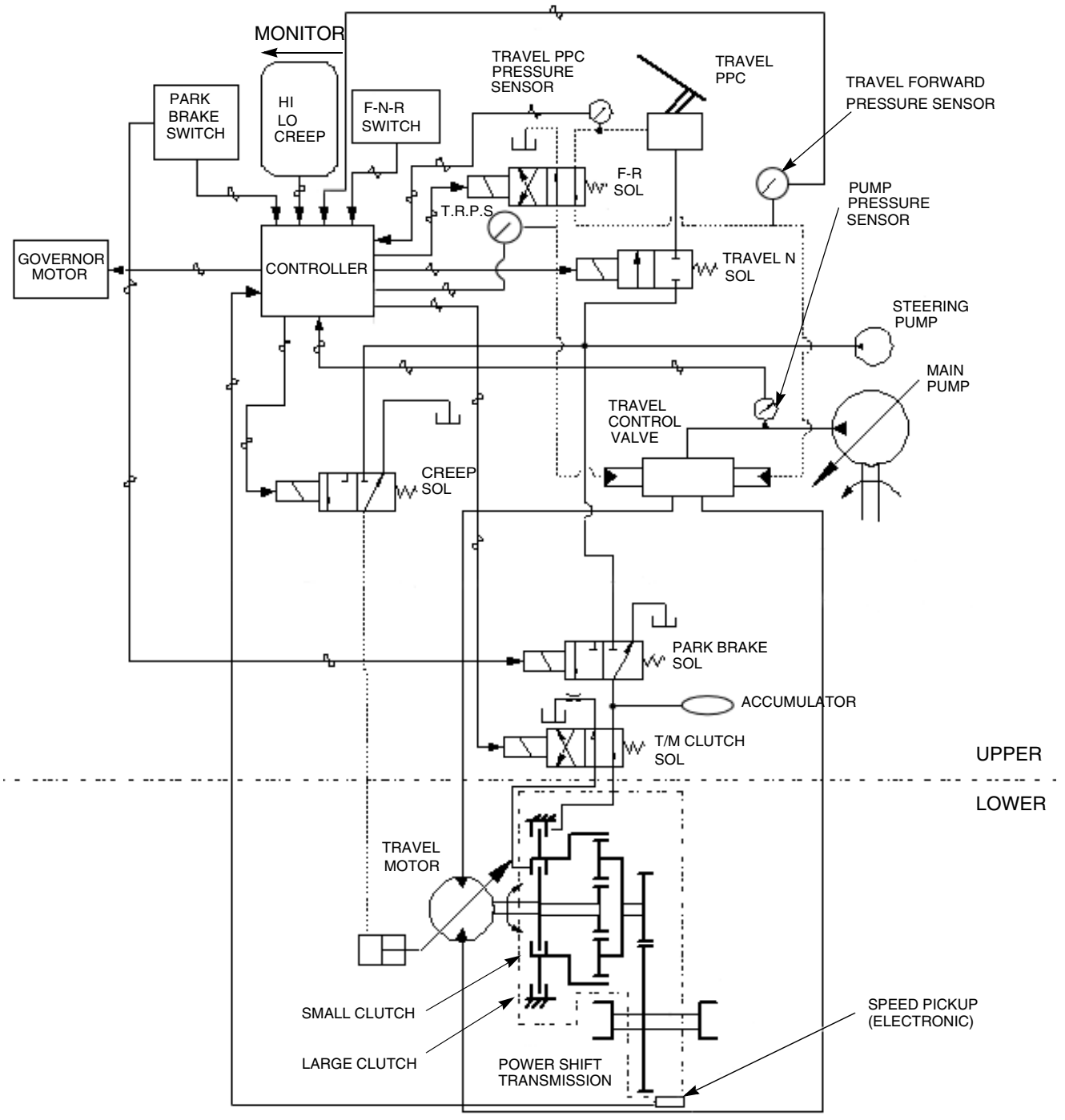
TRAVEL PPC PEDAL



1. Pedal
2. Pedal Adjuster
3. Valve

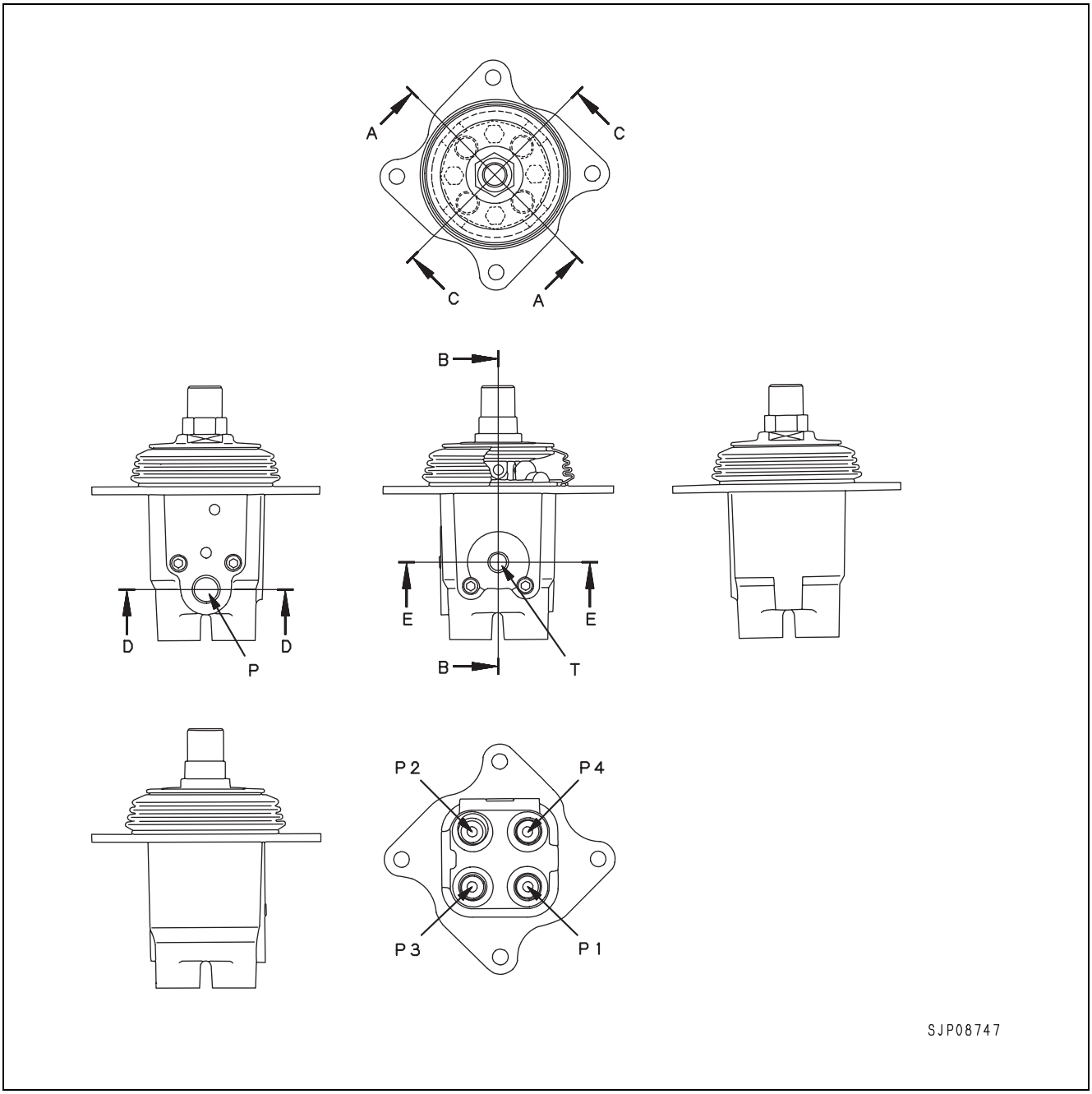
A. To forward-reverse solenoid
P. To travel neutral solenoid
T. To tank





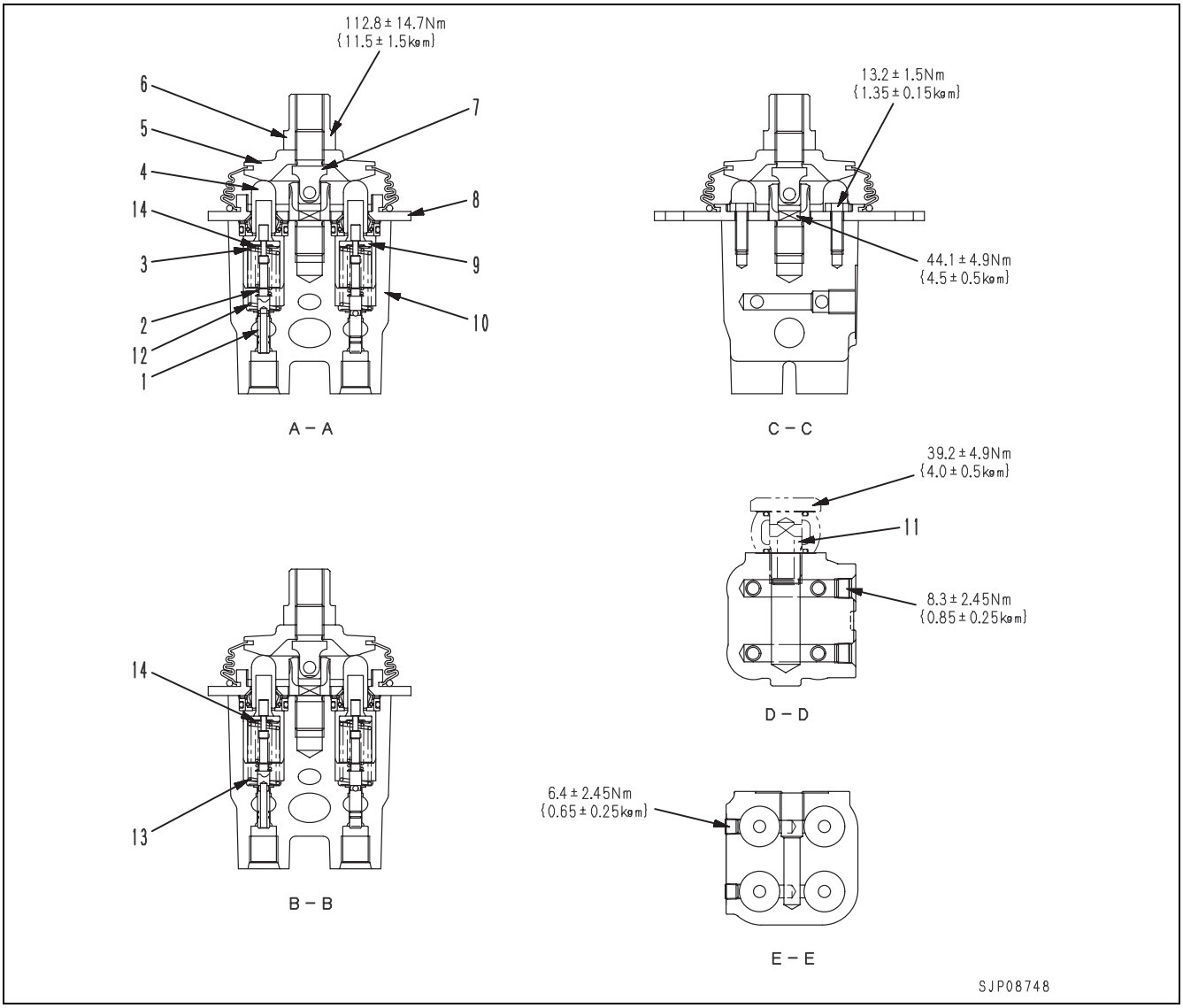
T.R.P.S - Travel Reverse Pressure Sensor

WORK EQUIPMENT • SWING PPC VALVE



P. From main pump
T. To tank

P1. Left: Arm DUMP / Right: Boom / Stabilizer LOWER
P2. Left: Arm DIG / Right: Boom / Stabilizer RAISE
P3. Left: Swing LEFT / Right: Bucket DIG
P4. Left: Swing RIGHT / Right: Bucket DUMP



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

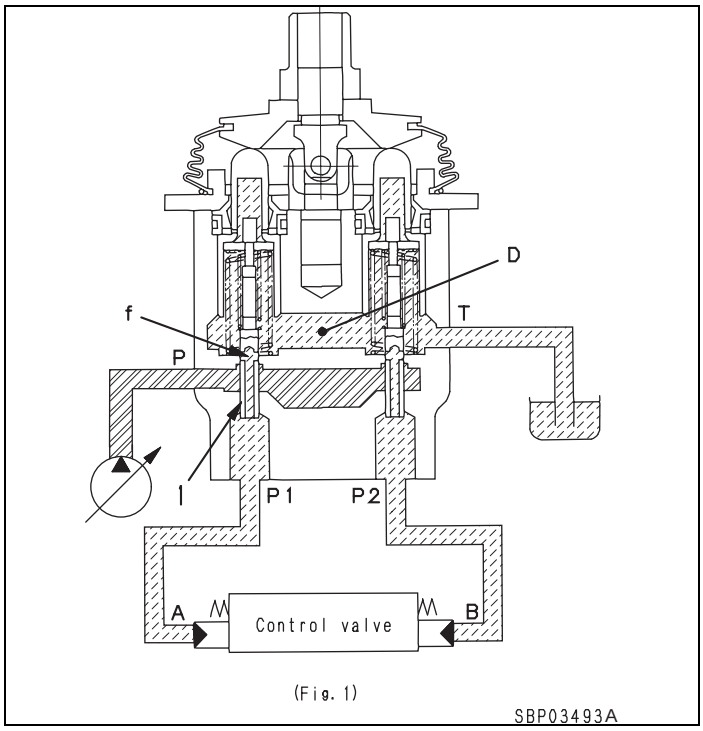
Unit: mm

No.	Check item	Criteria					Remedy
12	Centering spring (For P3 and P4)	Standard size			Repair limit		If damaged or deformed, replace spring
		Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	
		38.7 x 15.5	34	9.81 N {1.0 kg}	—	7.85 N {0.8 kg}	
13	Centering spring (For P3 and P4)	42.5 x 15.5	34	17.7 N {1.8 kg}	—	14.1 N {1.44 kg}	
14	Metering spring	26.5 x 8.2	24.9	16.7 N {1.7 kg}	—	13.3 N {1.36 kg}	

OPERATION

1. At neutral

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



(Fig. 1)
SBP03493A

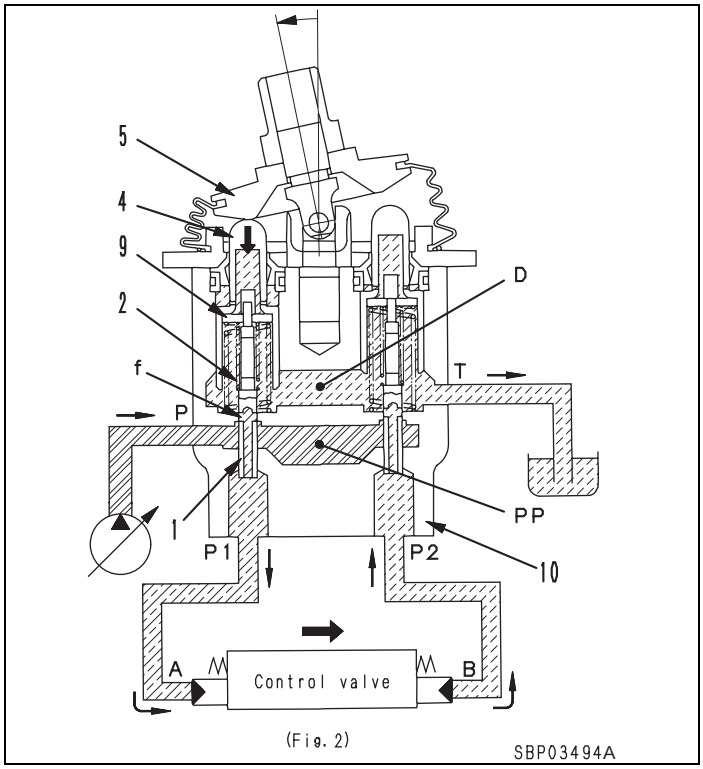
2. During fine control (neutral → fine control)

When piston (4) starts to be pushed by disc (5), retainer (9) is pushed; spool (1) is also pushed by metering spring (2), and moves down.

When this happens, fine control hole **f** is shut off from drain chamber **D**, and at almost the same time, it is connected to pump pressure chamber **PP**, so pilot pressure oil from the control circuit passes through fine control hole **f** and goes from port **P1** to port **A**.

When the pressure at port **P1** becomes higher, spool (1) is pushed back and fine control hole **f** is shut off from pump pressure chamber **PP**. At almost the same time, it is connected to drain chamber **D** to release the pressure at port **P1**. When this happens, spool (1) moves up or down so that the force of metering spring (2) is balanced with the pressure at port **P1**. The relationship in the position of spool (1) and body (10) (fine control hole **f** is at a point midway between drain hole **D** and pump pressure chamber **PP**) does not change until retainer (9) contacts spool (1).

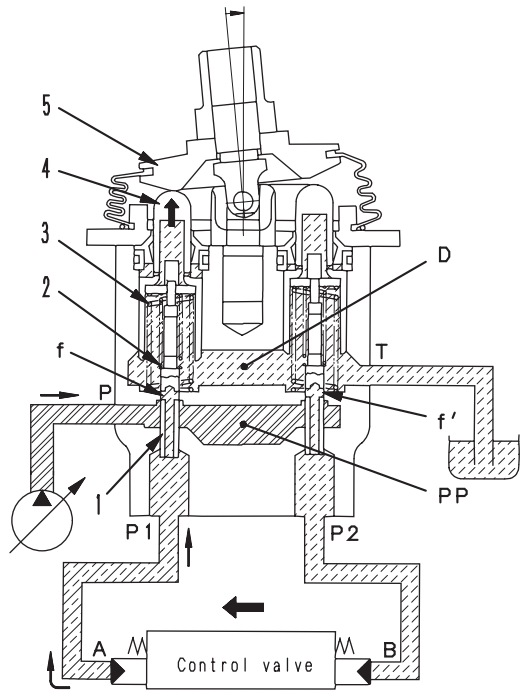
Therefore, metering spring (2) is compressed proportionally to the amount of movement of the control lever, so the pressure at port **P1** also rises in proportion to the travel of the control lever. In this way, the control valve spool moves to a position where the pressure in chamber **A** (the same as the pressure at port **P1**) and the force of the control valve spool return spring are balanced. (Fig. 2)



(Fig. 2)
SBP03494A

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

- When disc (5) starts to be returned, spool (1) is pushed up by the force of centering spring (3) and the pressure at port **P1**.
  When this happens, fine control hole **f** is connected to drain chamber **D** and the pressure oil at port **P1** is released.
  If the pressure at port **P1** drops too far, spool (1) is pushed down by metering spring (2), and fine control hole **f** is shut off from drain chamber **D**. At almost the same time, it is connected to pump pressure chamber **PP**, and the pump pressure is supplied until the pressure at port **P1** recovers to a pressure that corresponds to the lever position.
  When the spool of the control valve returns, oil in drain chamber **D** flows in from fine control hole **f** in the valve on the side that is not working. The oil passes through port **P2** and enters chamber **B** to fill the chamber with oil. (Fig. 3)

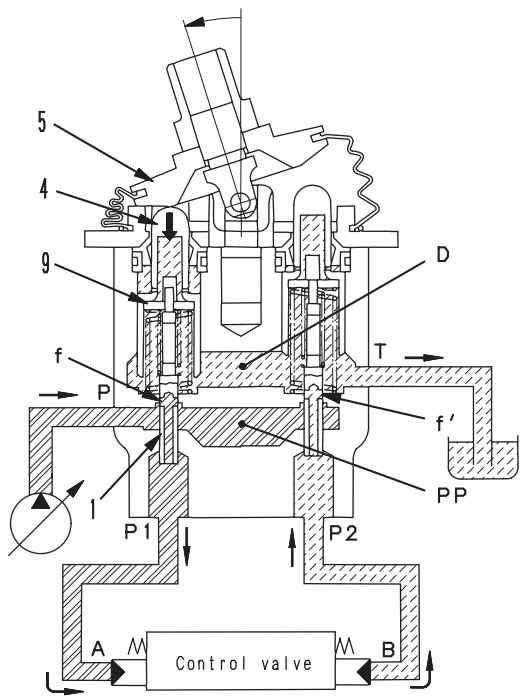


(Fig. 3)
SBP03495A

4. At full stroke

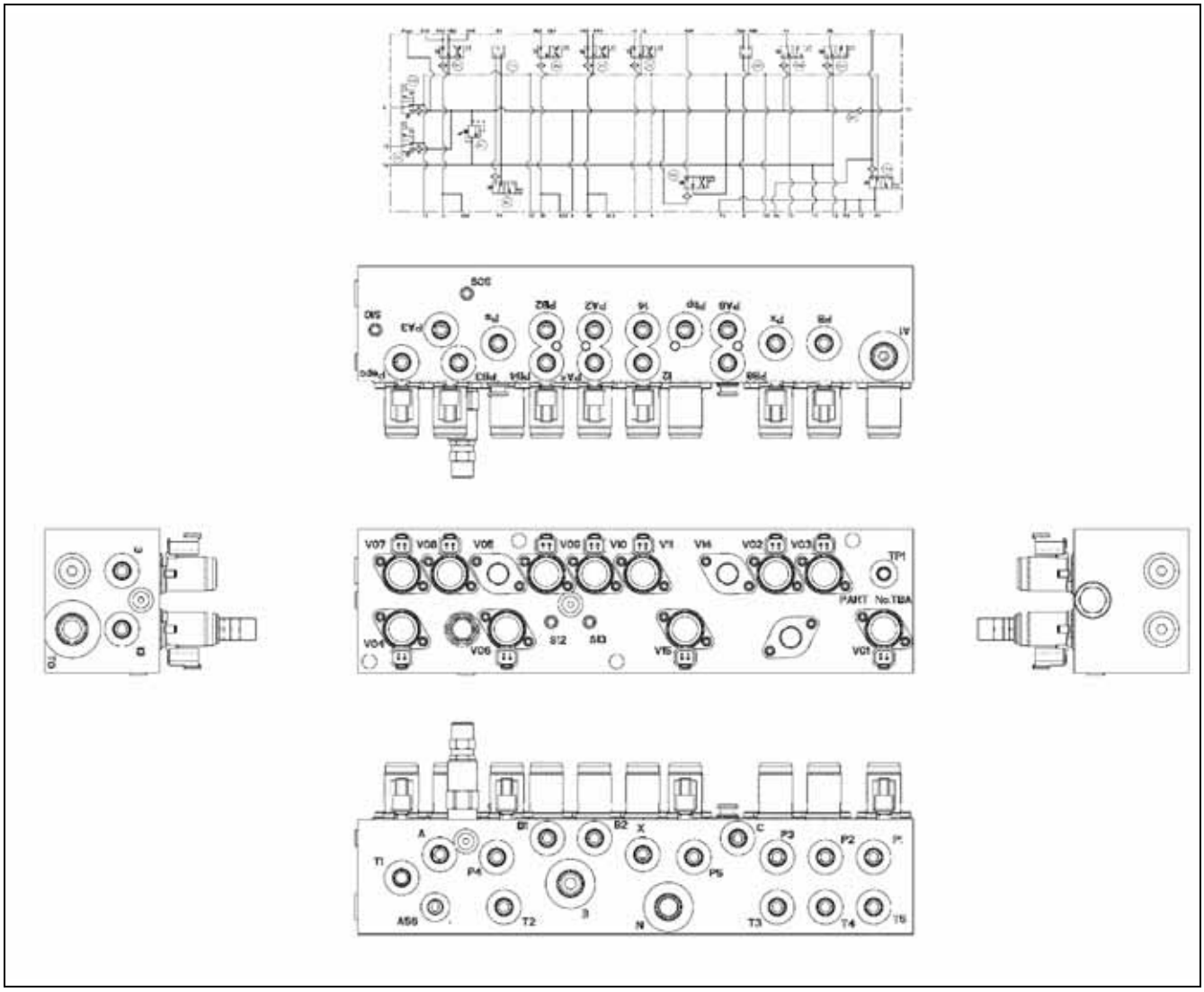
When disc (5) pushes down piston (4), and retainer (9) pushes down spool (1), fine control hole **f** is shut off from drain chamber **D**, and is connected with pump pressure chamber **PP**. Therefore, the pilot pressure oil from the control circuit passes through fine control hole **f** and flows to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

The oil returning from chamber **B** passes from port **P2** through fine control hole **f** and flows to drain chamber **D**. (Fig. 4)



(Fig. 4)
SBP03496A

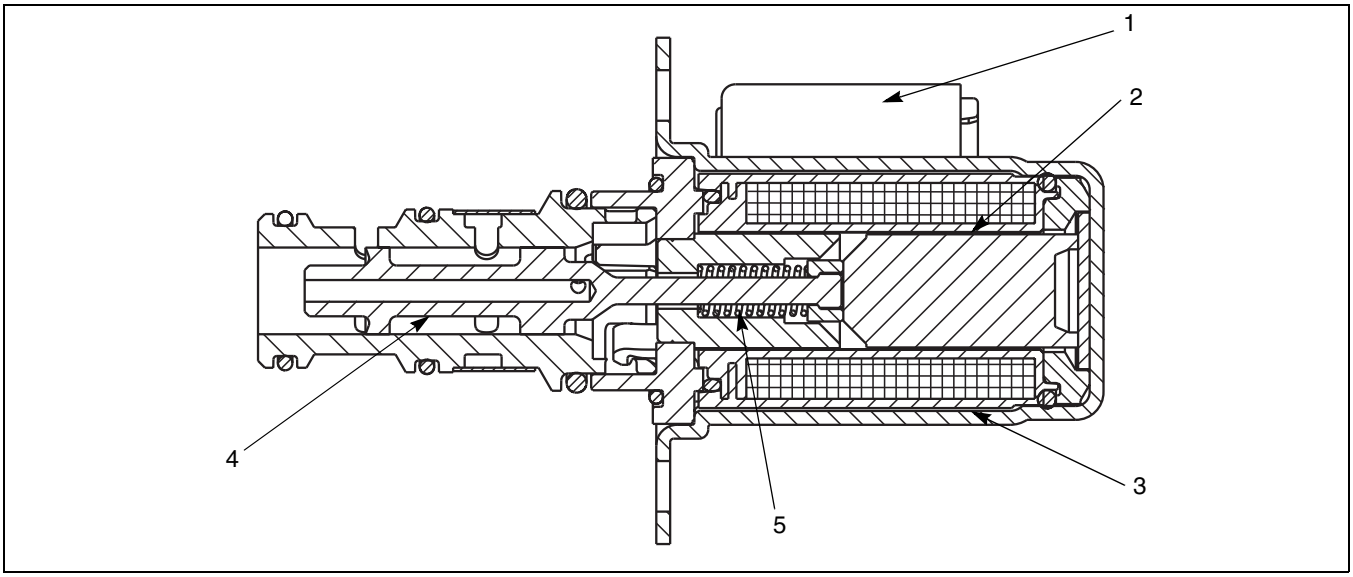
SOLENOID VALVE BLOCK



A	To travel pedal valve port A
A1	Accumulator port
B	To brake valve port B
B1	To R.H PPC control valve port P1
B2	To R.H PPC control valve port P2
N	To brake valve port N
P1	To 2nd HCU valve port P
P2	To 2nd boom valve port P
P3	To L.H PPC control valve port P
P4	To travel pedal valve port P
P5	To R.H PPC control valve port P
TPI	Test point
TO	To tank
T1	To travel pedal valve port T
T2	To R.H PPC control valve port T
T3	To L.H PPC control valve port T
T4	To 2nd boom valve port T
T5	To 2nd HCU valve port T
X	To brake valve port X
PA2	To Main valve port PA2
PA3	To Main valve port PA3
PA4	To Main valve port PA4
PA8	Blanked
PB	To swing motor port PB
PBP	To Main valve port PBP
PB2	To Main valve port PB2
PB3	To Main valve port PB3
PB4	To Main valve port PB4
PB8	Blanked
PS	Blanked
PX	To Main valve port PX
3	To swivel joint port 3
12	To swivel joint port 12
13	To swivel joint port 13
14	To swivel joint port 14
A56	Travel pressure sensor
S09	Travel reverse pressure switch
S10	Travel forward pressure switch
S12	Boom/stabiliser down pressure switch
S13	Boom/stabiliser up pressure switch
V01	PPC lock solenoid
V02	2 stage relief solenoid
V03	Swing brake solenoid
V04	Suspension lock solenoid
V06	Travel neutral solenoid
V07	Travel creep solenoid
V08	Forward/Reverse solenoid
V09	Boom/stabiliser down solenoid
V10	Boom/stabiliser up solenoid
V11	Transmission clutch control solenoid
V13	Service EPC valve solenoid
V15	2 stage back pressure solenoid

SOLENOID VALVE BLOCK

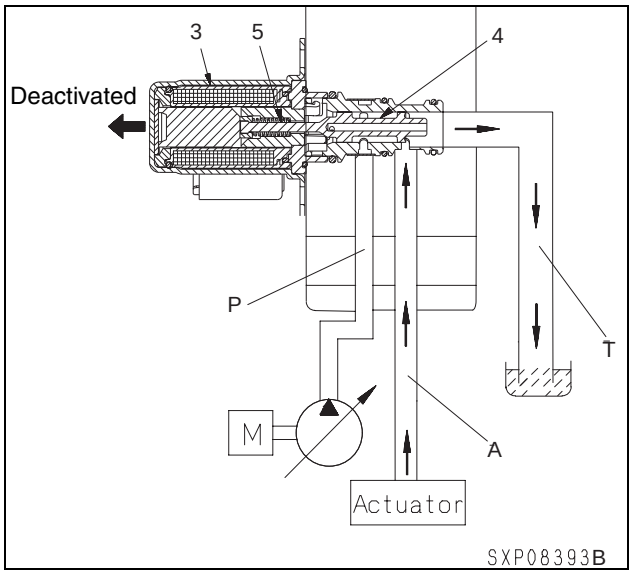
2 Position 3 way valve



This solenoid valve is fitted to the following ports:

V01	PPC lock Solenoid
V02	2 stage relief solenoid
V03	Swing brake solenoid
V04	Suspension lock solenoid
V06	Travel neutral solenoid
V07	Travel creep solenoid

1. Connector
2. Plunger
3. Coil
4. Spool
5. Spring



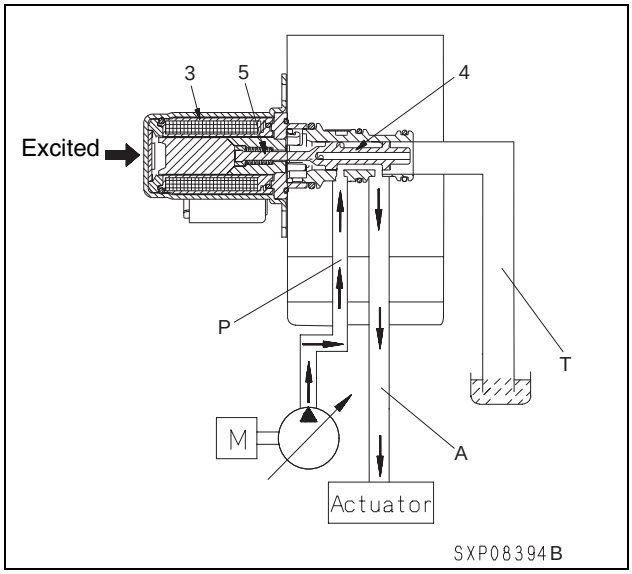
OPERATION

When solenoid is deactivated

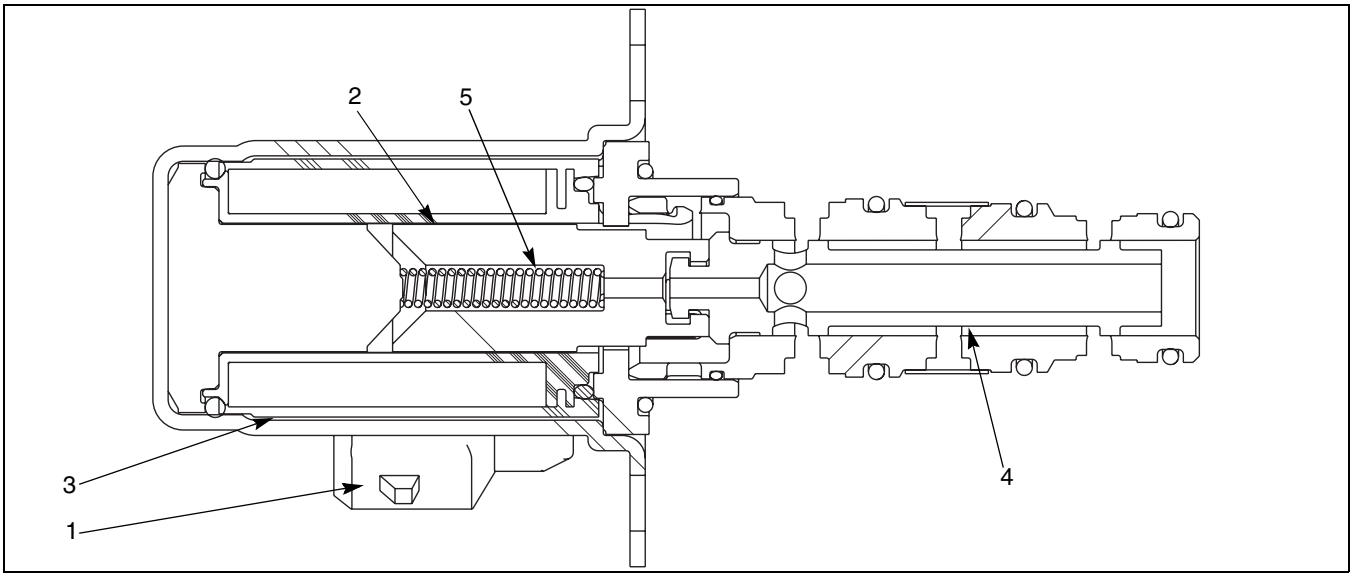
- Since the signal current does not flow from the controller, coil (3) is turned off
  Accordingly, spool (4) is pressed by spring (5) against the left side.
  By this operation, the passage from **P** to **A** is closed and the hydraulic oil from the control circuit does not flow into the actuator.
  At this time, the oil from the actuator is drained through ports **A** and **T** into the tank.

When solenoid is excited

- The signal current flows from the controller to coil (3), and the latter is excited.
  Accordingly, spool (4) is pushed to the right side.
  By this operation, the hydraulic oil from the control circuit flows through port **P** and spool (4) to port **A** then flows into the actuator.
  At this time, port **T** is closed and the oil does not flow into the tank.



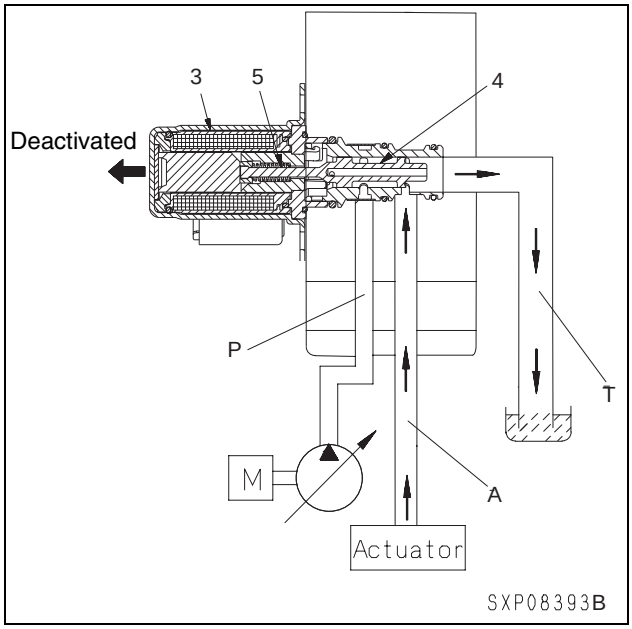
2 Position 4 way valve



This solenoid valve is fitted to the following ports:

V08	Forward / reverse solenoid
V09	Boom / stabiliser down solenoid
V10	Boom / stabiliser up solenoid
V11	Transmission clutch control solenoid
V14	Clamshell solenoid
V15	2 stage back pressure solenoid

1. Connector
2. Plunger
3. Coil
4. Spool
5. Spring



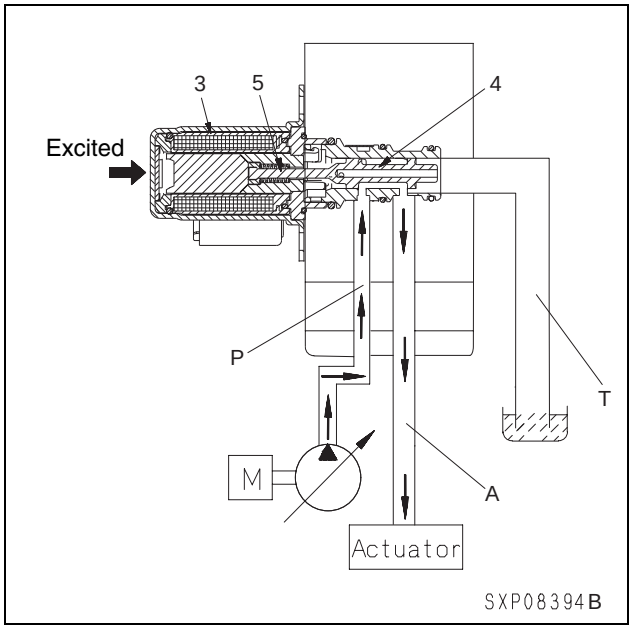
OPERATION

When solenoid is deactivated

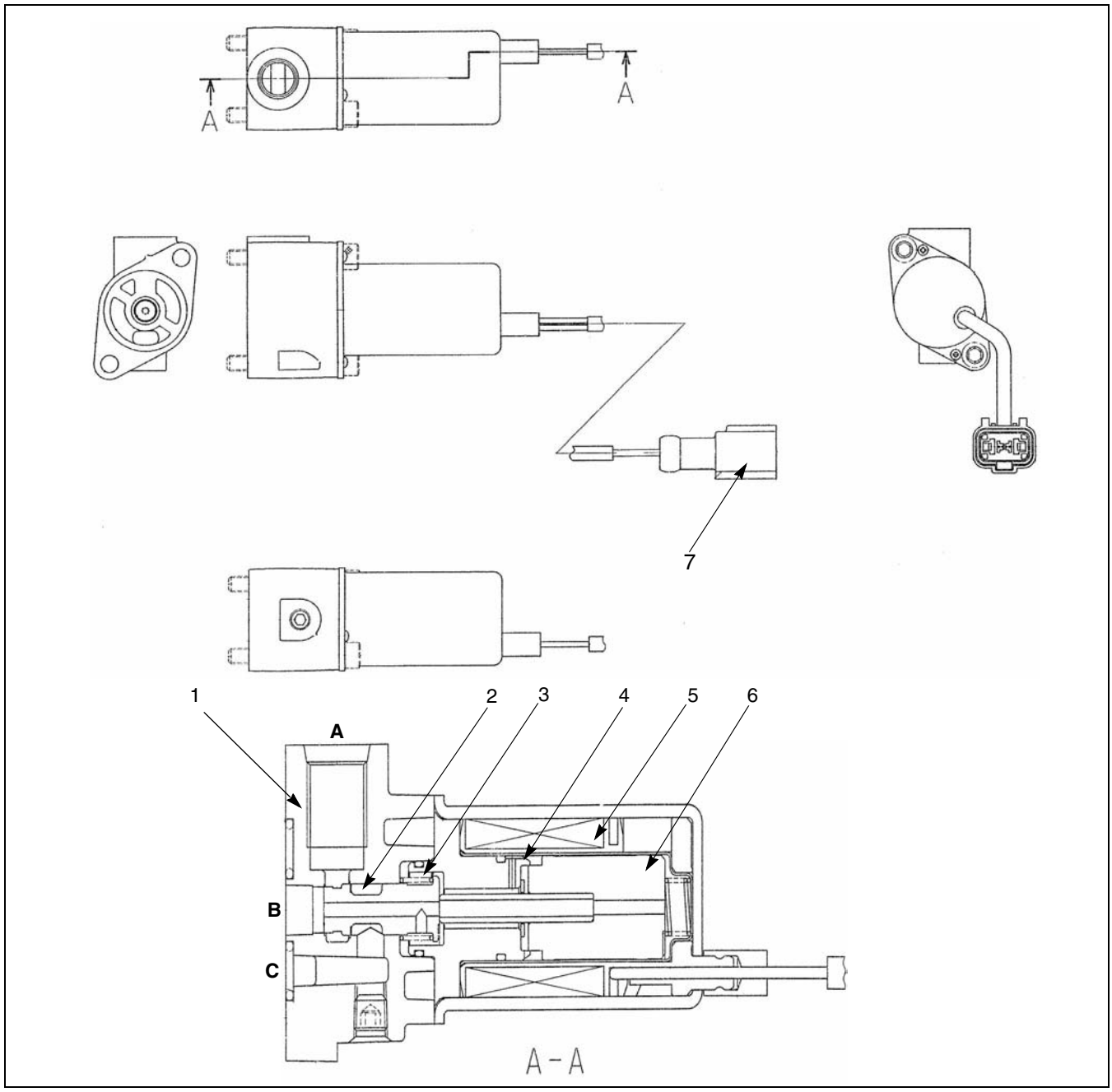
- Since the signal current does not flow from the controller, coil (3) is turned off
  Accordingly, spool (4) is pressed by spring (5) against the left side.
  By this operation, the passage from **P** to **A** is closed and the hydraulic oil from the control circuit does not flow into the actuator.
  At this time, the oil from the actuator is drained through ports **A** and **T** into the tank.

When solenoid is excited

- The signal current flows from the controller to coil (3), and the latter is excited.
  Accordingly, spool (4) is pushed to the right side.
  By this operation, the hydraulic oil from the control circuit flows through port **P** and spool (4) to port **A** then flows into the actuator.
  At this time, port **T** is closed and the oil does not flow into the tank.



ATTACHMENT EPC VALVE

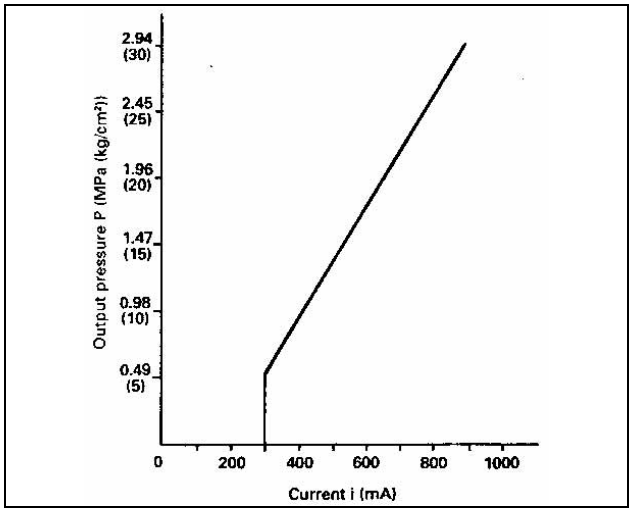


A. Port C (to service solenoid)
B. Port T (to tank)
C. Port P (from PPC pressure reducing valve)

1. Body
2. Spool
3. Spring
4. Push pin
5. Coil
6. Plunger
7. Connector

FUNCTION

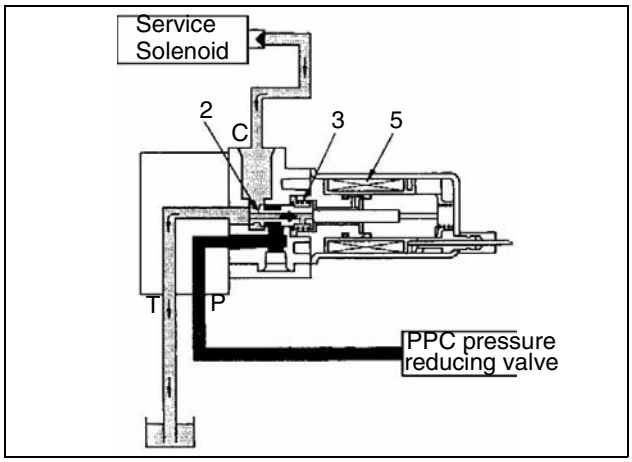
- The EPC valve consists of the proportional solenoid portion and the hydraulic valve portion.
- When it receivers signal current **i** from the pump controller, it generates EPC output pressure **P** in proportion to the size of the signal, and outputs it to the control valve via the service solenoid.



OPERATION

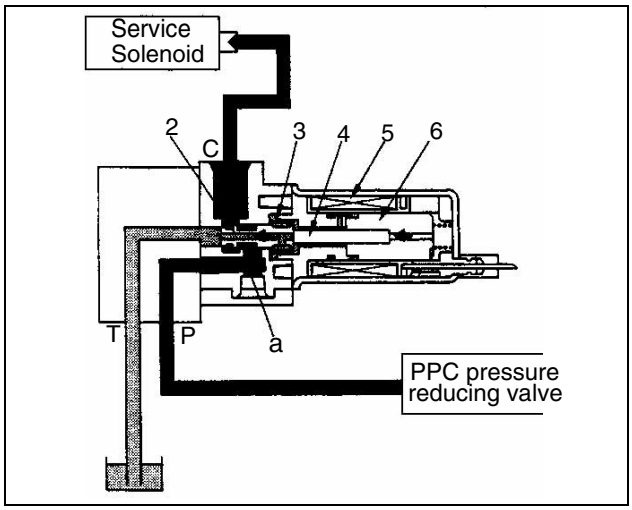
1. When signal current is 0 (coil deactivated)

- There is no signal current flowing from the controller to coil (5), coil (5) is deactivated.
- For this reason, spool (2) is pulled to the right in the direction of the arrow by spring (3).
- As a result, port **P** closes and the pressurised oil from the pressure regulating valve does not flow to the Att pedal.



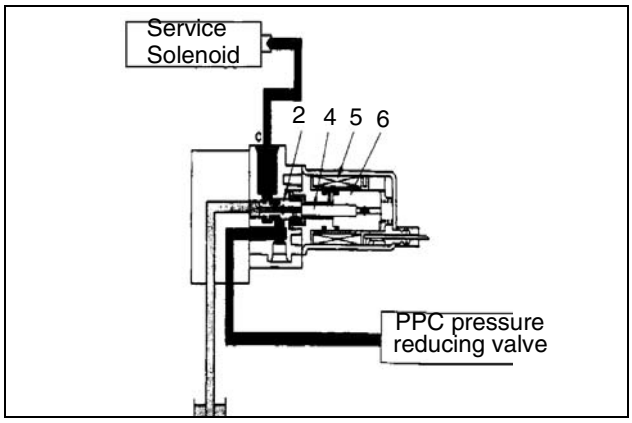
2. When signal current is very small (coil excited)

- When a very small signal current flows to coil (5), coil (5) is excited, and a propulsion force is generated, which pushes plunger (6) to the left in the direction of the arrow.
- Push pin (4) pushes spool (2) to the left in the direction of the arrow and pressurised oil flows from port P to port C.
- When the pressure at port C rises and the load of spring (3) + the force acting on surface **a** of spool (2) becomes greater than the proportion force of plunger (6), spool (2) is pushed to the right. The circuit between port P and port C is shut off, and at the same time, port C and port T are connected.
- As a result, spool (2) is moved to the left or right until the propulsion force of plunger (6) is balanced with the load of spring (3) + pressure of port C.
- Therefore, the circuit pressure between the EPC valve and the Att pedal is controlled in proportion to the size of the signal current.

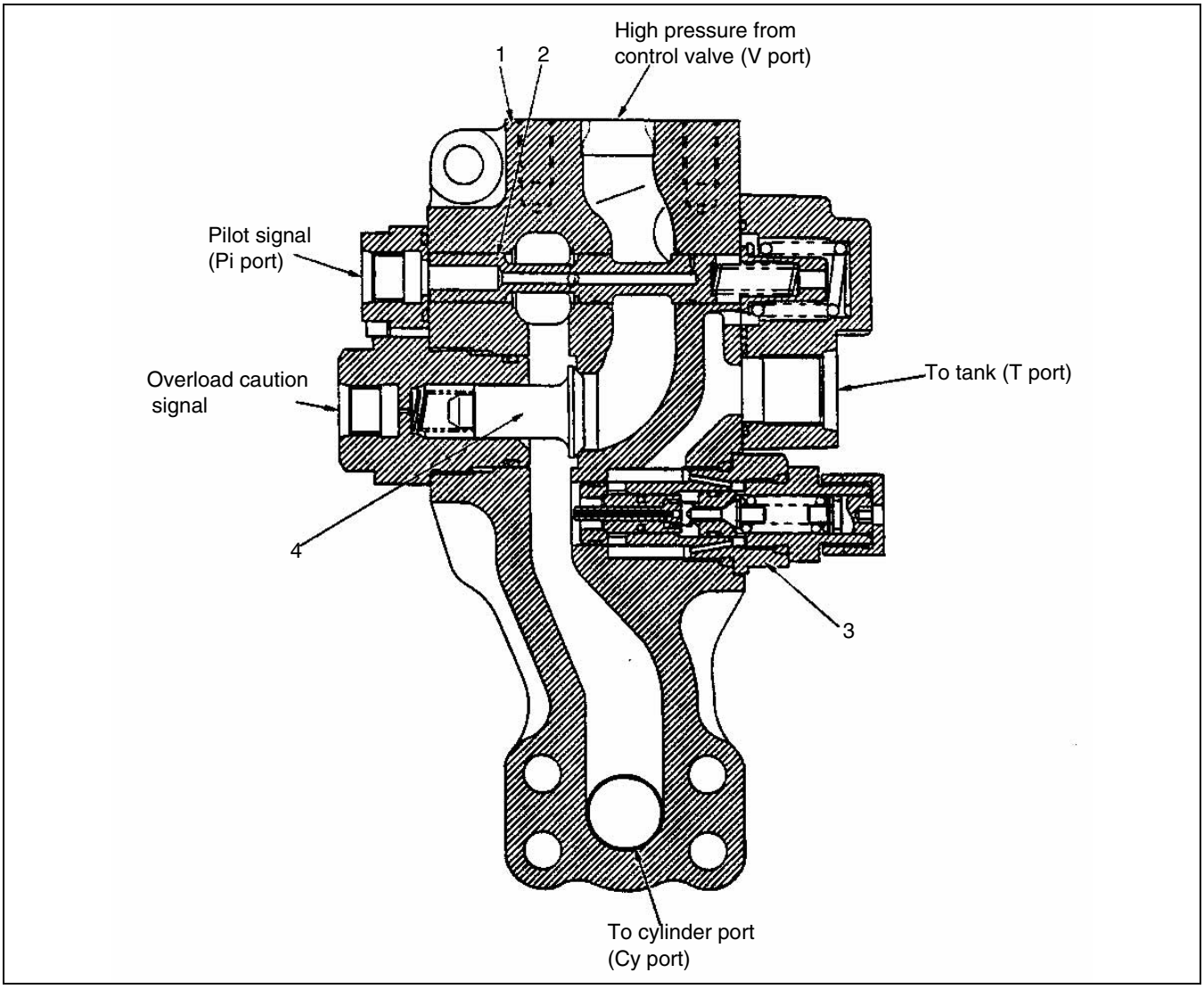


3. When signal current is maximum (coil excited)

- when the signal current flows to coil (5), coil (5) is excited.
- When this happens, the signal current is at its maximum, so the propulsion force of plunger (6) is also at its maximum.
- For this reason spool (2) is pushed to the left in the direction of the arrow by push pin (4).
- As a result, the maximum flow of pressurised oil from port **P** flows at its maximum to port **C**, and the circuit pressure between EPC valve and Att pedal becomes the maximum.
  At the same time, port **T** closes and stops the oil from flowing to the tank.



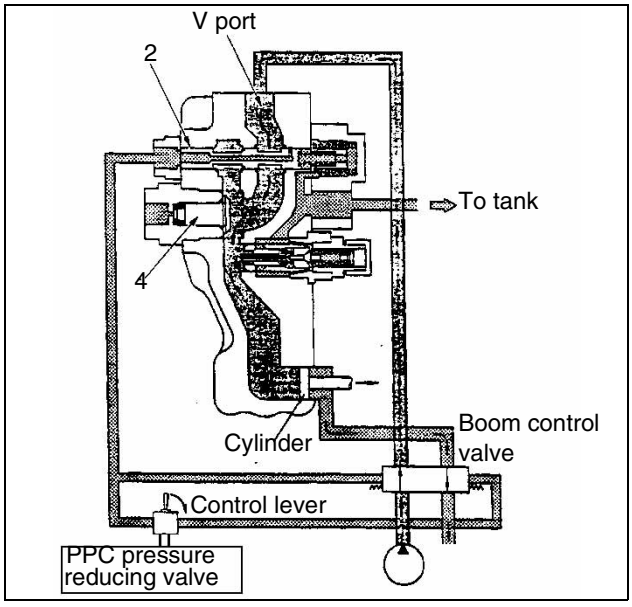
BOOM SAFETY VALVE



OPERATION

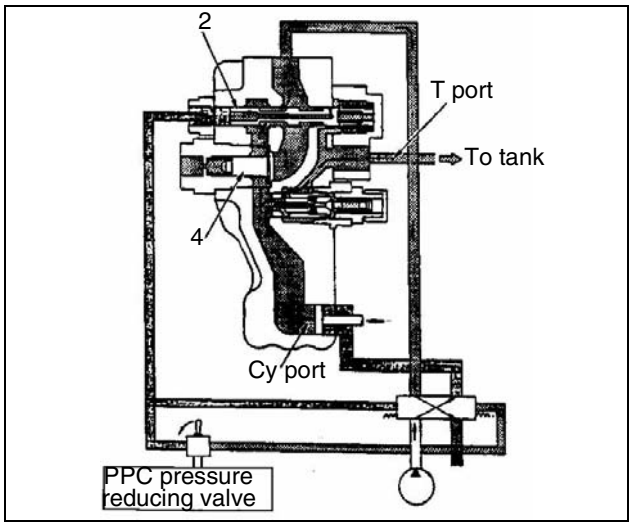
Boom Raise

- During boom raising the pilot signal from wrist control operates control valve spool to direct high pressure oil to port **V** of hose burst valve.
- This pressure lifts check valve (4) from seat and high pressure oil flows in the bottom of the cylinder raising the boom.



Boom Lower

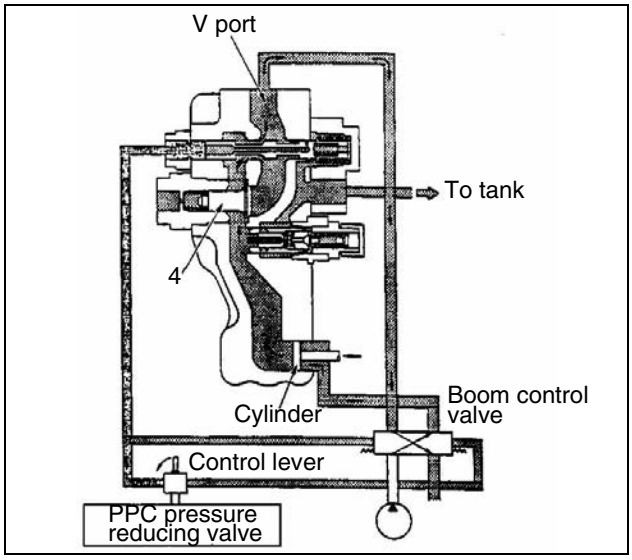
- During boom lowering the pilot signal reverses the flow through the control valve spool. High pressure oil flows to the head side of the cylinder. Oil in the bottom side of the cylinder flows through the port **Cy** of the valve. The pilot signal also opens the spool (2) of the hose burst valve and allows oil to flow back to tank.



When hose burst occurs

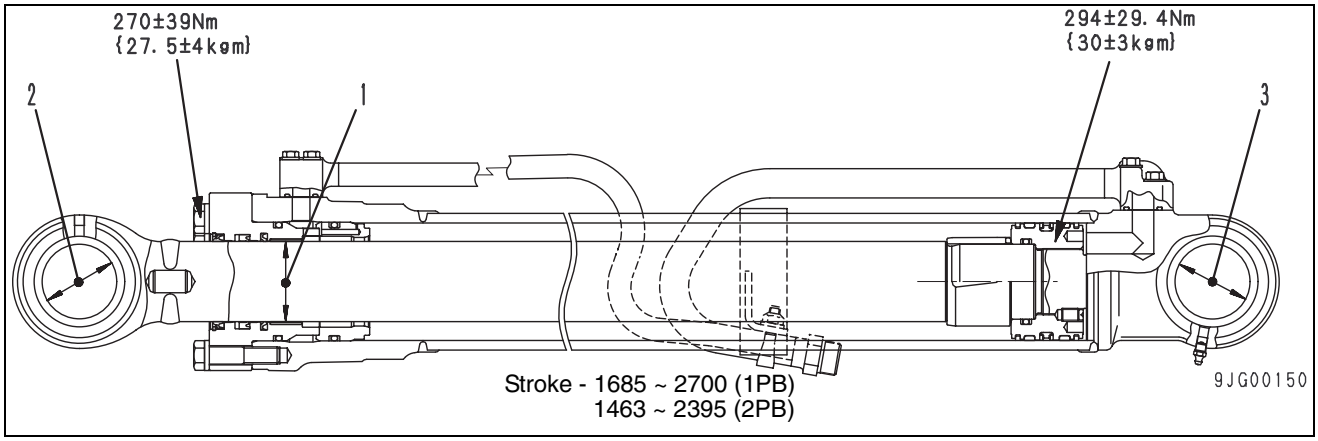
(operation to lower safety)

- The sudden loss of pressure at port **V** will cause check valve (4) to re-seat and so the valve is locked.

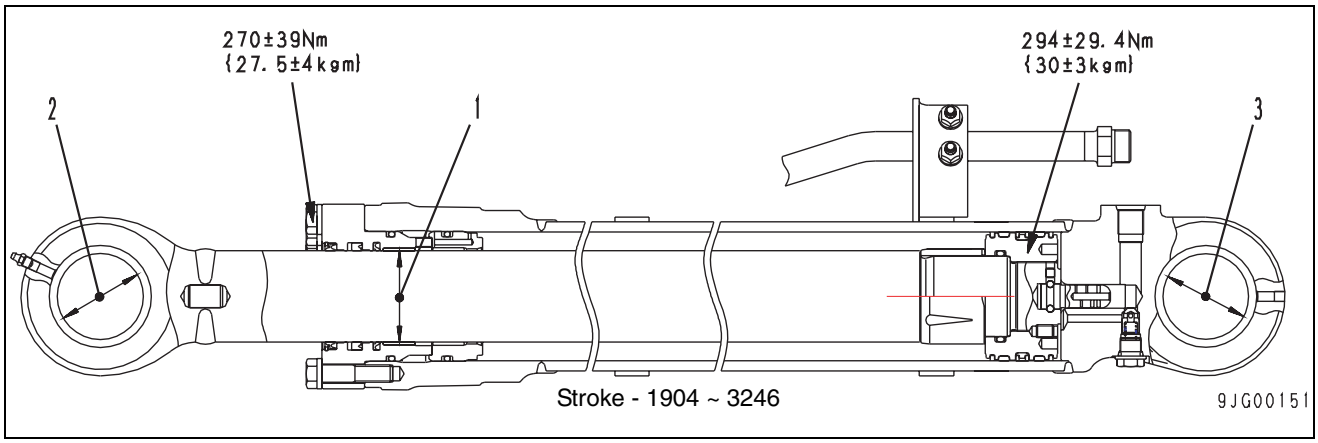


HYDRAULIC CYLINDER

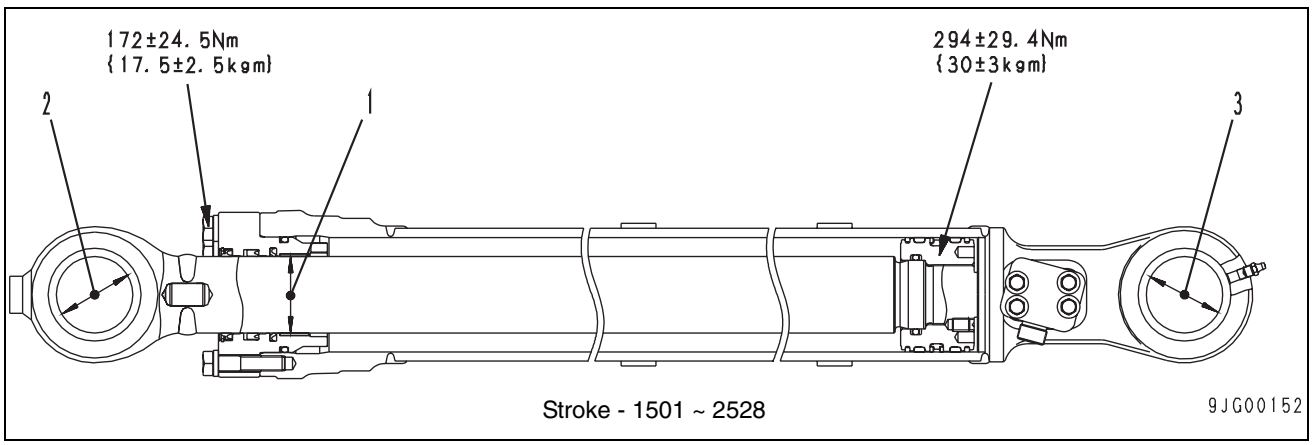
BOOM CYLINDER



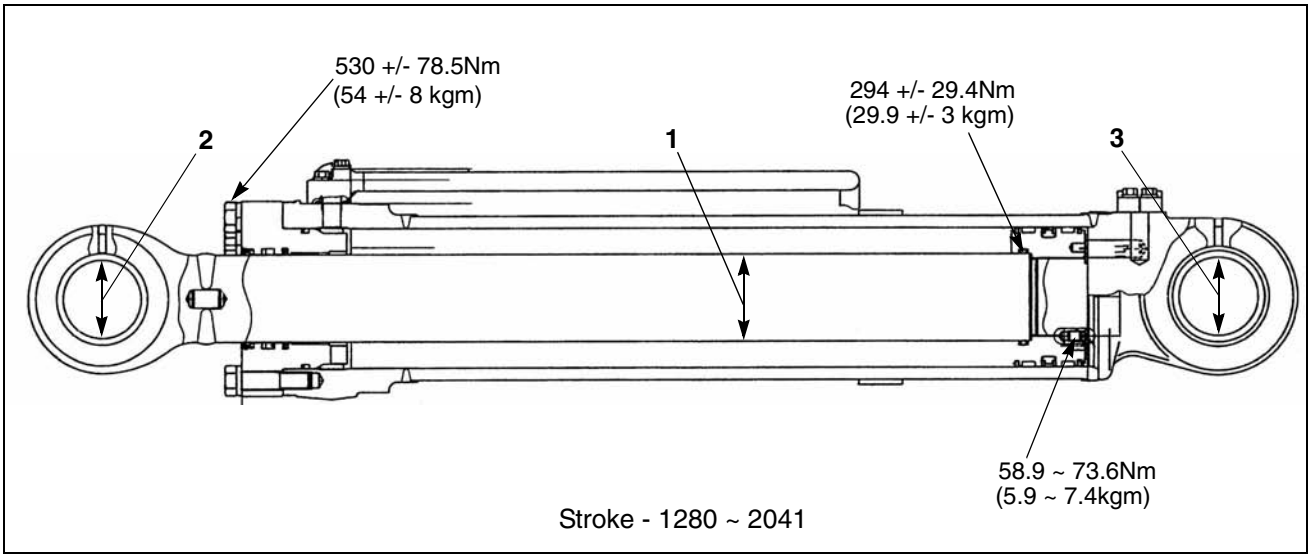
ARM CYLINDER



BUCKET CYLINDER



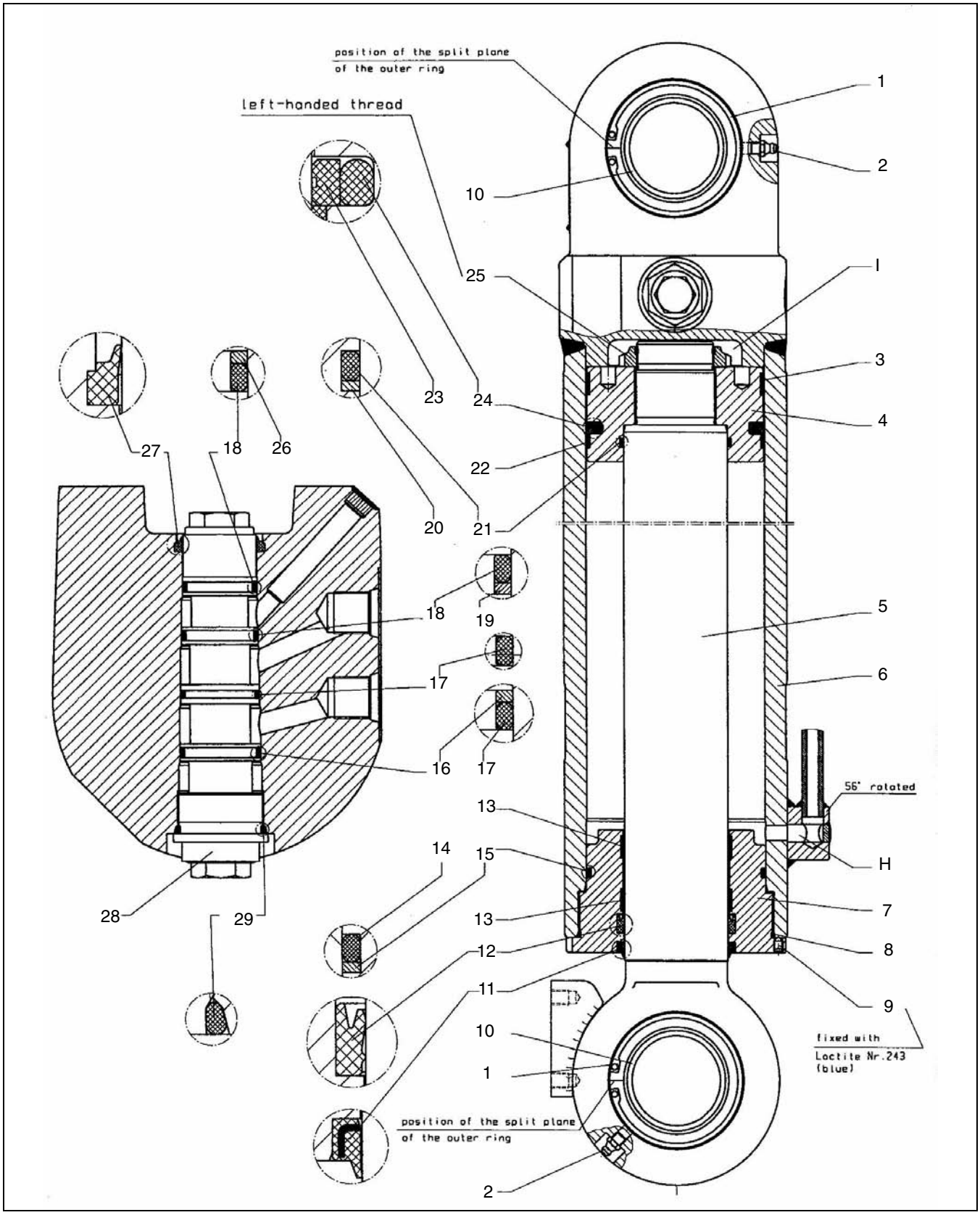
ADJUST CYLINDER



Unit: mm

No.	Check item		Criteria					Remedy
		Cylinder	Standard size	Tolerance		Standard clearance	Repair limit	
				Shaft	Hole			
-1	Clearance between piston rod and bushing	2 piece boom	85	-0.036 -0.090	+0.222 +0.047	0.083 ~ 0.312	0.445	Replace bushing
		Arm	85	-0.036 -0.090	+0.222 +0.047	0.083 ~ 0.312	0.445	
		Bucket	70	-0.030 -0.076	+0.259 +0.063	0.093 ~ 0.335	0.445	
		Adjust	100	-0.036 -0.090	+0.257 +0.047	0.083 ~ 0.347	0.445	
		1 Piece boom	85	-0.036 -0.090	+0.222 +0.047	0.083 ~ 0.312	0.445	
2	Clearance between piston rod support pin and bushing	2 piece boom	80	-0.030 -0.060	+0.211 +0.124	0.154 ~ 0.271	1.0	Replace pin or bushing
		Arm	80	-0.030 -0.076	+0.211 +0.124	0.154 ~ 0.287	1.0	
		Bucket	70	-0.030 -0.076	+0.198 +0.124	0.154 ~ 0.274	1.0	
		Adjust	90	-0.036 -0.090	+0.457 +0.370	0.406 ~ 0.547	1.0	
		1 Piece boom	80	-0.030 -0.060	+0.211 +0.124	0.154 ~ 0.271	1.0	
3	Clearance between cylinder bottom support pin and bushing	2 piece boom	70	-0.030 -0.060	+0.190 +0.070	0.100 ~ 0.250	1.0	
		Arm	80	-0.030 -0.076	+0.211 +0.124	0.154 ~ 0.287	1.0	
		Bucket	70	-0.030 -0.060	+0.198 +0.124	0.154 ~ 0.258	1.0	
		Adjust	90	-0.036 -0.090	+0.457 +0.370	0.406 ~ 0.547	1.0	
		1 Piece boom-	70	-0.030 -0.060	+0.190 +0.070	0.100 ~ 0.250	1.0	

OUTRIGGER CYLINDER



1. Circlip
2. Grease nipple
3. Piston wear-ring
4. Piston
5. Piston rod
6. Cylinder
7. Guide
8. O-ring
9. Grub screw
10. Spherical plain bearing
11. Wiper
12. O-ring
13. Rod wear-ring
14. O-ring
15. Back-up ring
16. Cut back-up ring
17. O-ring
18. O-ring
19. Cut back-up ring
20. Back-up ring
21. O-ring
22. Back-up ring
23. Turcon-Glyd-ring
24. O-ring
25. Self locking groove nut
26. Cut back-up ring
27. Wiper
28. Pilot operated double check valve cartridge
29. O-ring

Function

Guide (7) guides the piston rod (5) which is sealed by o-ring (12). O-ring (12) is protected against dirt by wiper (11).

When oil flows through port **I** to the piston side of the cylinder the piston rod (5) extends out of the cylinder (6).

The piston is guided in the cylinder (6) by the piston guide ring (7). It is sealed against the cylinder wall by piston wear-ring (3), Turcon-glyd-ring (23), o-ring (24) and backup ring (22). The guide (7) is sealed against the cylinder (6) by O-ring (14) and backup ring (15).

When oil flows through port H to the rod side of the cylinder the piston rod retracts.

Important

Depressurising the cylinder

The check valve built into the cylinder prevents any cylinder movement due to oil leakage within the control block or sudden loss of hydraulic pressure due to a hose burst.

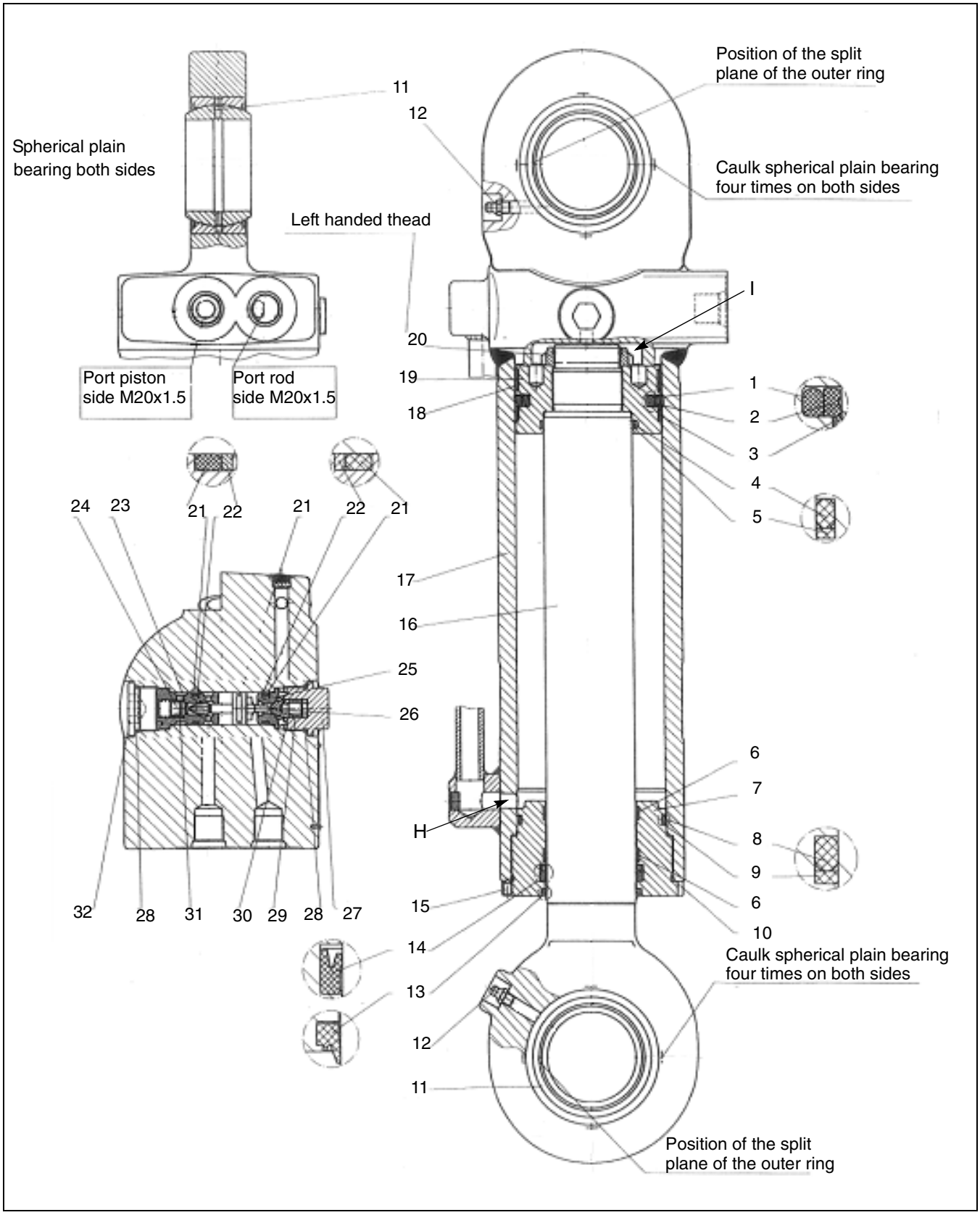
The built in check valve also holds hydraulic pressure within the cylinder when the hydraulic hoses are removed from the cylinder.

Depressurise the cylinder before opening

To depressurise the cylinder, loosen the plug (28) carefully and wait until the pressure has been released.

To be absolutely sure the plug can be completely removed.

DOZER CYLINDER



1. O-ring
2. Turcon-glyd-ring
3. Backup ring
4. O-ring
5. Backup ring
6. Rod wear-ring
7. Guide
8. O-ring
9. Backup ring
10. O-ring
11. Spherical plain bearing
12 Grease nipple
13. Wiper
14. U-ring
15. Grub screw
16. Piston rod
17. Cylinder
18. Piston wear-ring
19. Piston
20. Self locking groove nut
21. O-ring
22. Backup ring
23. Valve seat
24. Throttle bolt
25. Valve seat
26. Control spool
27. Screw plug
28. O-ring
29. Valve poppet
30. Pressure spring
31. Pressure spring
32. Screw plug

Function

Guide (7) guides the piston rod (16) which is sealed by u-ring (14). U-ring (14) is protected against dirt by wiper (13).
When oil flows through port **I** to the piston side of the cylinder the piston rod (16) extends out of the cylinder (17).
The piston is guided in the cylinder (17) by the piston guide ring (7). It is sealed against the cylinder wall by piston wear-ring (18), Turcon glyd-ring (2), o-ring (1) and backup ring (3). The guide (7) is sealed against the cylinder (17) by o-ring (8) and backup ring (9).
When oil flows through port H to the rod side of the cylinder the piston rod retracts.

Important

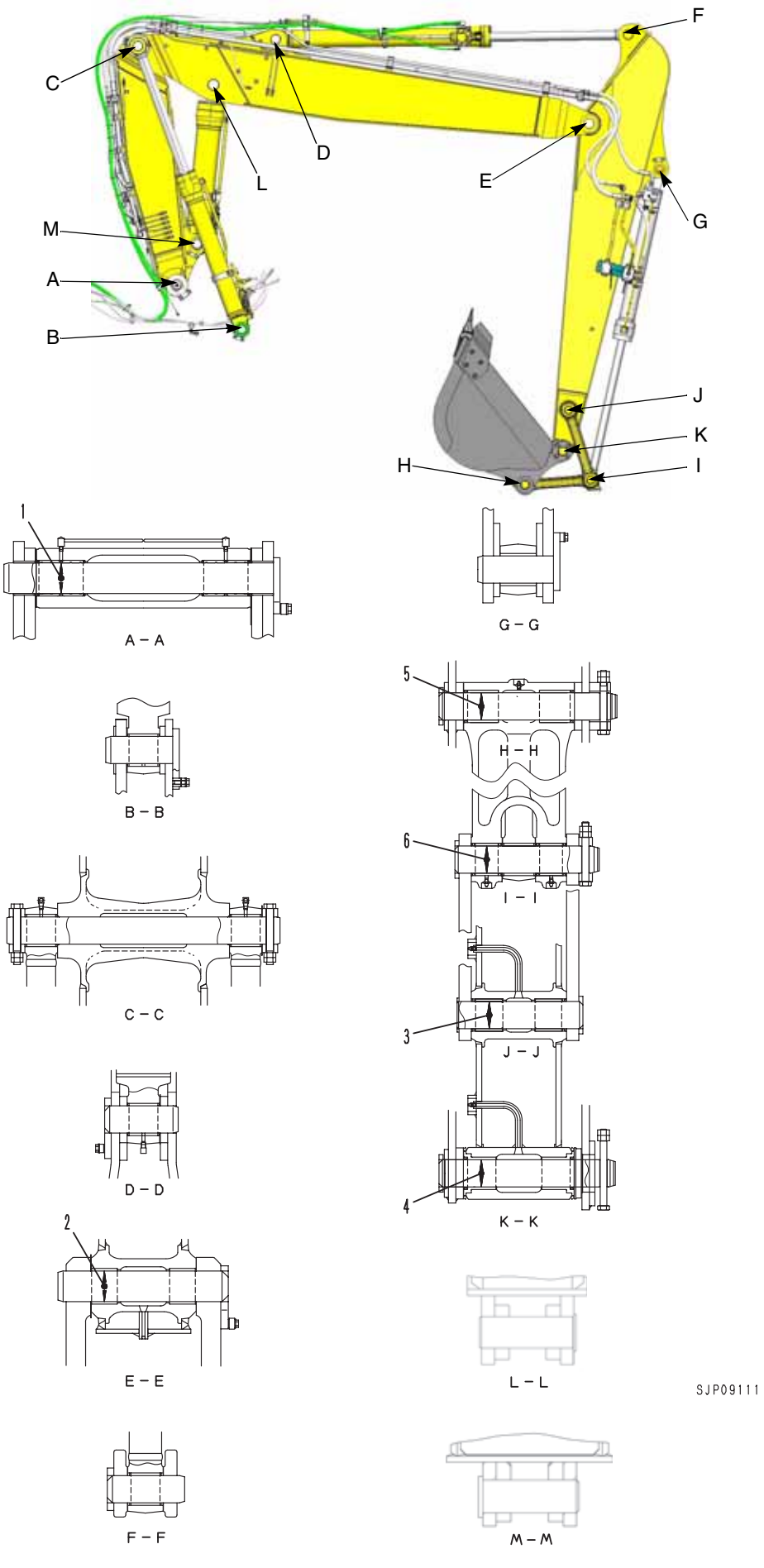
Depressurising the cylinder

The check valve built into the cylinder prevents any cylinder movement due to oil leakage within the control block or sudden loss of hydraulic pressure due to a hose burst.
The built in check valve also holds hydraulic pressure within the cylinder when the hydraulic hoses are removed from the cylinder.

Depressurise the cylinder before opening

To depressurise the cylinder, loosen the plug (32) carefully using an allen key and wait until the pressure has been released.
To be absolutely sure the plug can be completely removed.

WORK EQUIPMENT

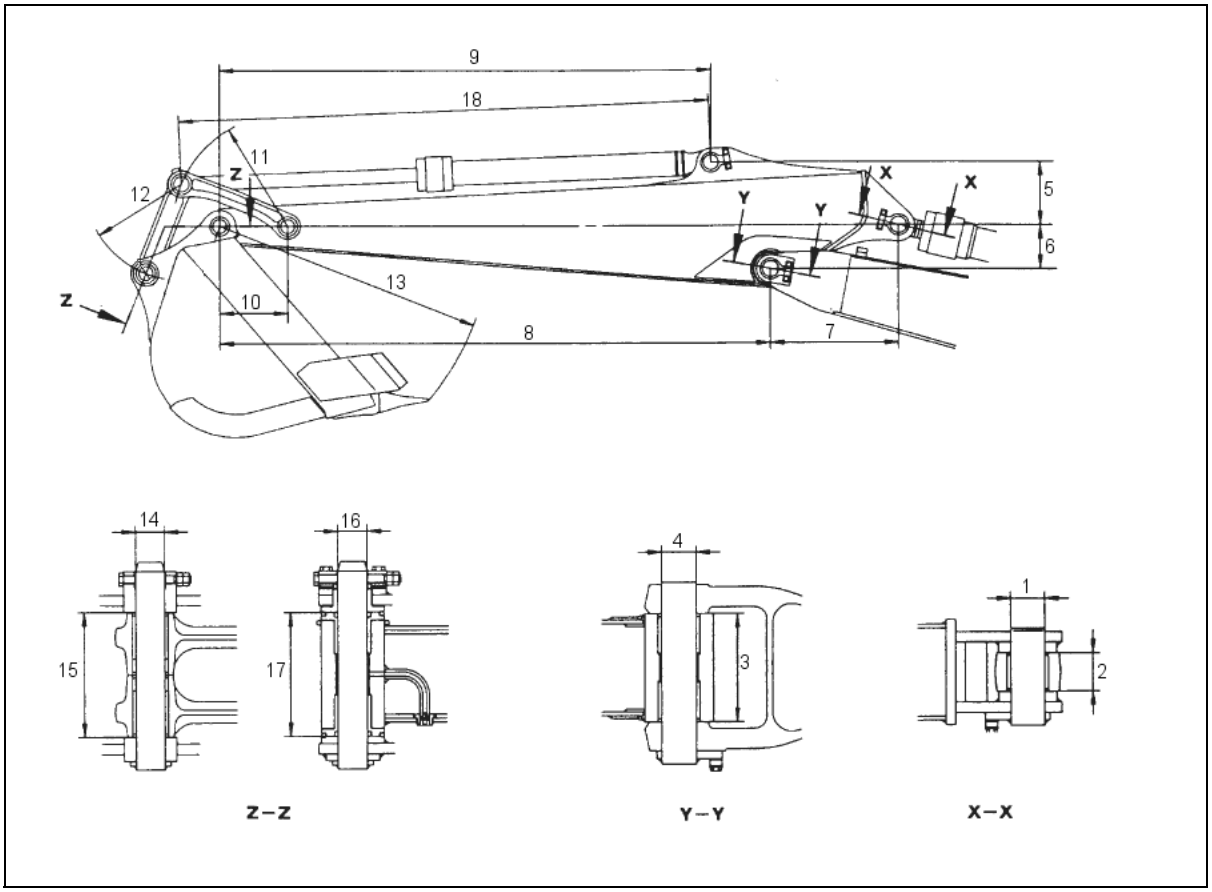


Work Equipment

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between connecting pin and bushing of revolving frame and boom	80	-0.030 -0.060	+0.215+ 0.180	0.210 ~ 0.275	1.0	Replace
2	Clearance between connecting pin and bushing of boom and arm	80	-0.030 -0.104	+0.213 +0.164	0.194 ~ 0.317	1.0	
3	Clearance between connecting pin and bushing of arm and link	70	-0.030 -0.076	+0.158+ 0.078	0.108 ~ 0.234	1.0	
4	Clearance between connecting pin and bushing of arm and bucket	70	-0.030 -0.076	+0.135+ 0.074	0.104 ~ 0.211	1.0	
5	Clearance between connecting pin and bushing of link and bucket	70	-0.030 -0.076	+0.157+ 0.078	0.108 ~ 0.233	1.0	
6	Clearance between connecting pin and bushing of link and link	70	-0.030 -0.076	+0.265 +0.215	0.245 ~ 0.341	1.0	

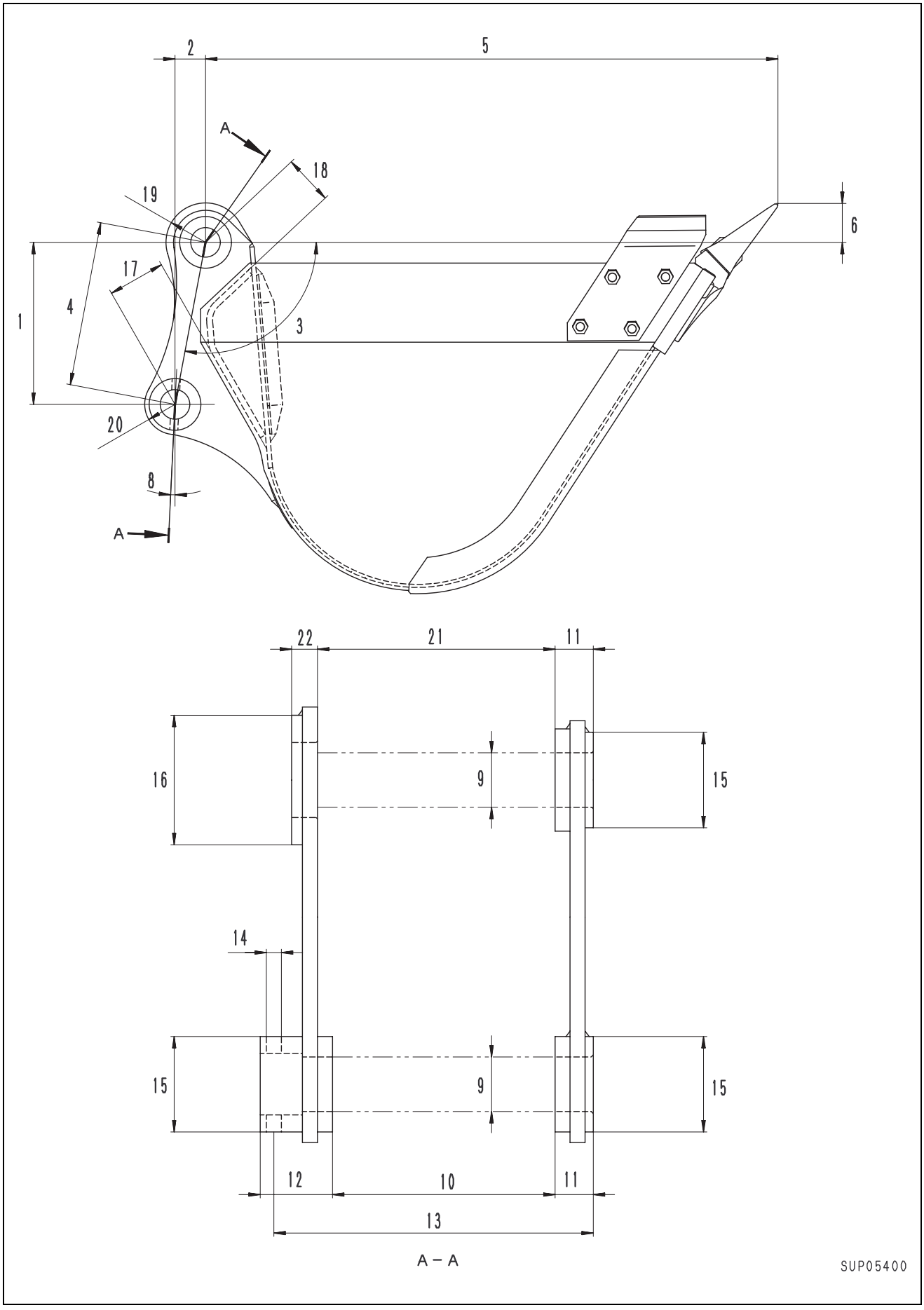
1.DIMENSION OF ARM



Unit: mm

Model No.		PW180-7E0 Arm Size (M)		
		2.25	2.6	2.9
1		∅ 80		
2		$99.3\ ^{+1.5}_{0}$		
3		$286\ ^{0}_{-0.5}$		
4		∅ 80		
5		422.4 ±1.0	414.7 ±1.0	430.6 ±1.0
6		217.2 ±0.5	196.3 ±0.5	200.8 ±0.5
7		741.6 ±1.0	747.4 ±1.0	746.3 ±1.0
8		2,245.8	2,603	2,893
9		2,333.8 ±2.0	2,331.7 ±2.0	2,328.8 ±2.0
10		330 ±1.0		
11		583 ±0.5		
12		524 ±0.5		
13		1,382		
14		⌀ 70		
15		$310\ ^{0}_{-1.3}$		
16		⌀ 70		
17	Arm as individual part	$276\ ^{0}_{-0.5}$		
	When pressfitting bushing	310		
18	Min.	1,501		
	Max.	2,528		

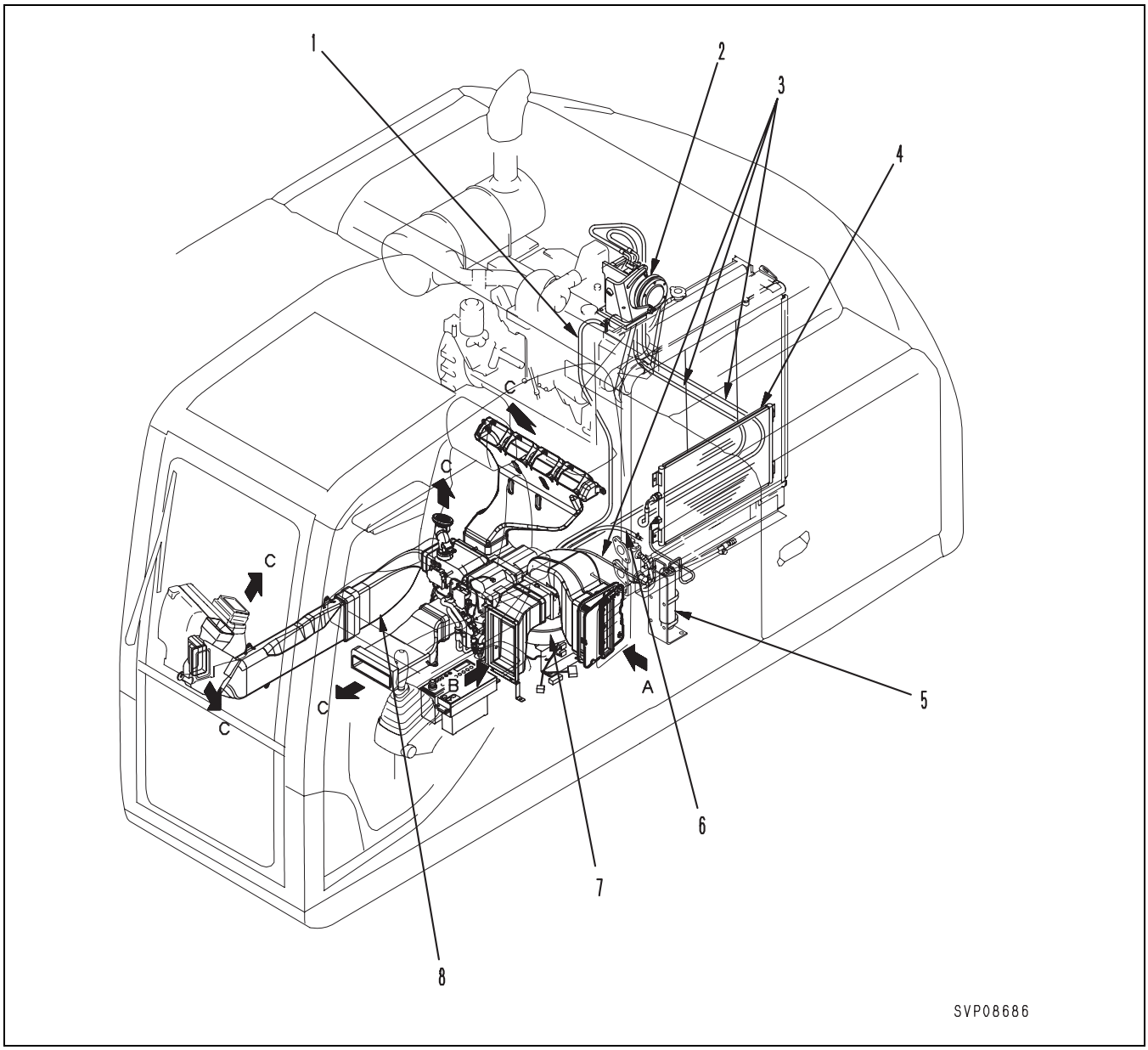
2.DIMENSION OF BUCKET



	PW180-7E0
1	400.5 ± 0.5
2	14.8 ± 0.5
3	97º 7’
4	400.8
5	1,334.7
6	180.7
7	–
8	0
9	ϕ70
10	311.5 ± 1
11	50
12	96
13	440.5
14	ϕ18
15	ϕ130
16	ϕ160
17	135
18	112
19	80
20	80
21	339.5 ± 1
22	44

AIR CONDITIONER

AIR CONDITIONER PIPING



1. Hot water pickup piping
2. Air conditioner compressor
3. Refrigerant piping
4. Condenser
5. Receiver tank
6. Hot water return piping
7. Air conditioner unit
8. Duct

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

ELECTRICAL WIRING DIAGRAM

Please refer to section 90.

ELECTRICAL SYSTEM

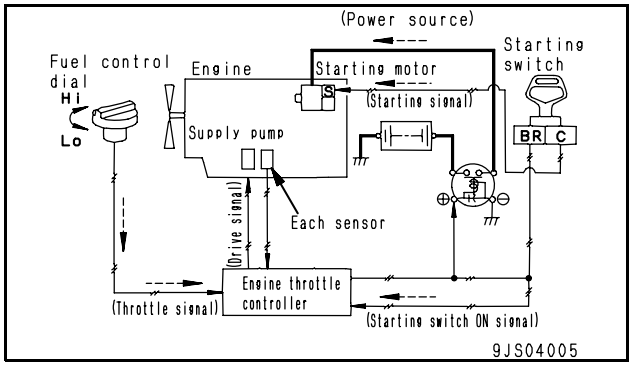
Engine Control

1. OPERATION OF SYSTEM

Starting engine

- When the starting switch is turned to the START position, the starting motor. Then, the starting motor turns to start the engine.

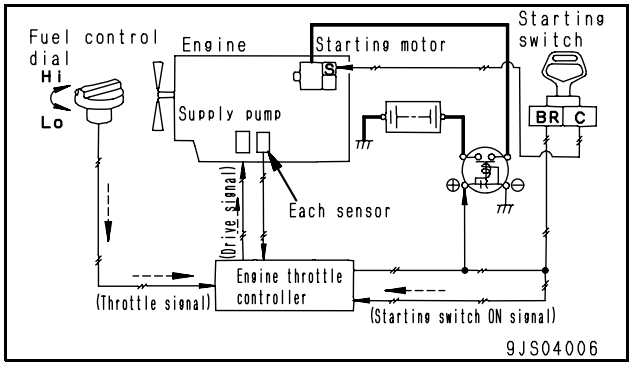
  When it happens, the engine controller checks the signal voltage from the fuel control dial and sets the engine speed to the speed set by the fuel control dial.



Engine speed control

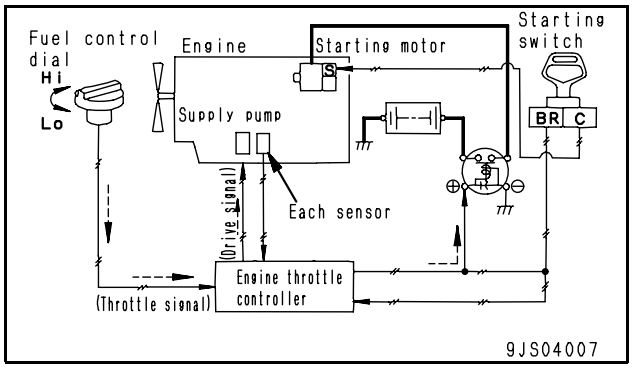
- The fuel control dial sends a signal voltage corresponding to the rotation angle to the engine

  The engine controller sends a driving signal to the supply pump depending on the signal voltage to control the fuel injection pump and eventually controls the engine speed.



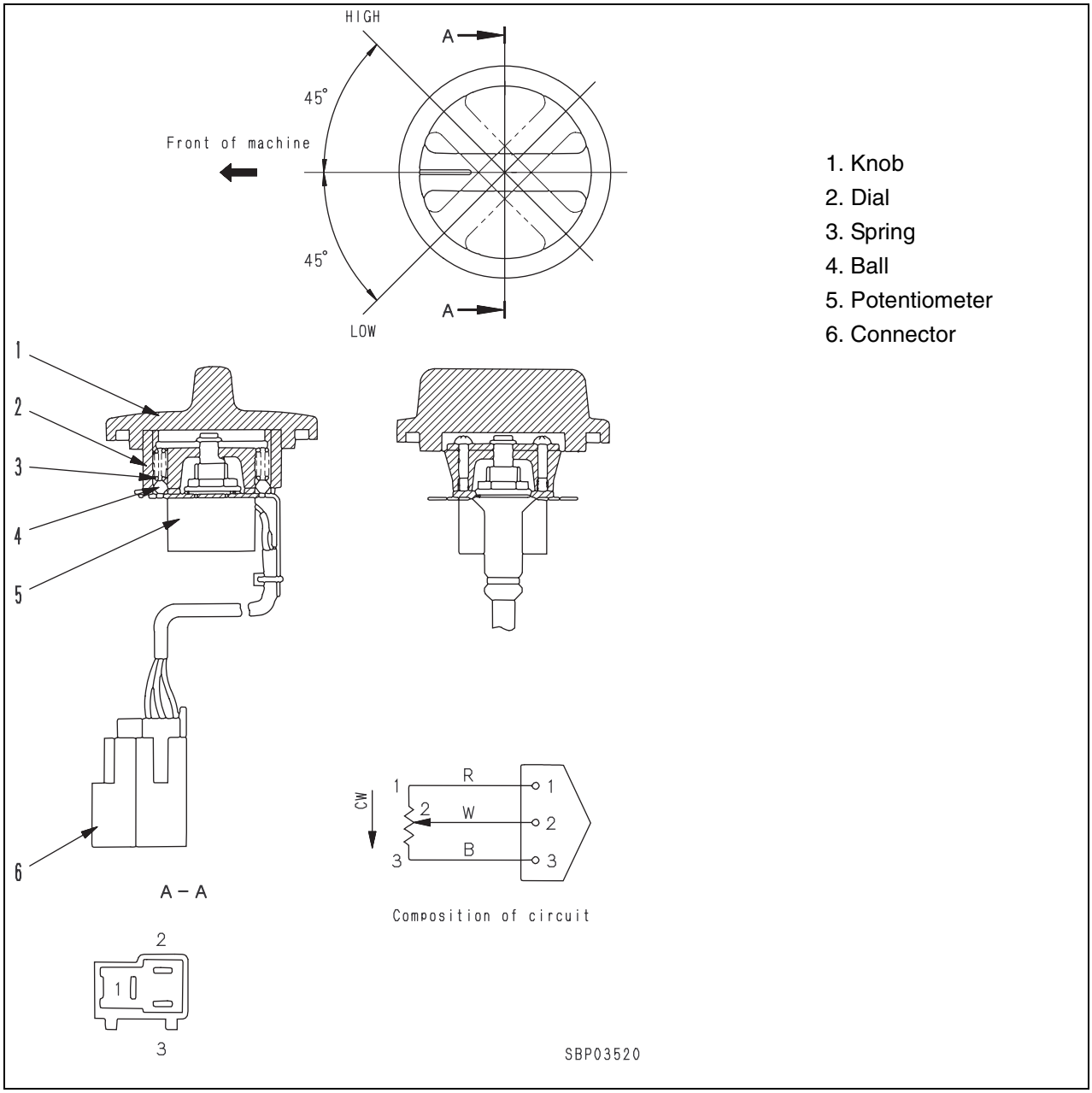
Stopping engine

- When detecting that the starting switch is set to the STOP position, the engine controller cuts the signal of the supply pump drive solenoid to stop the engine.



2. COMPONENT

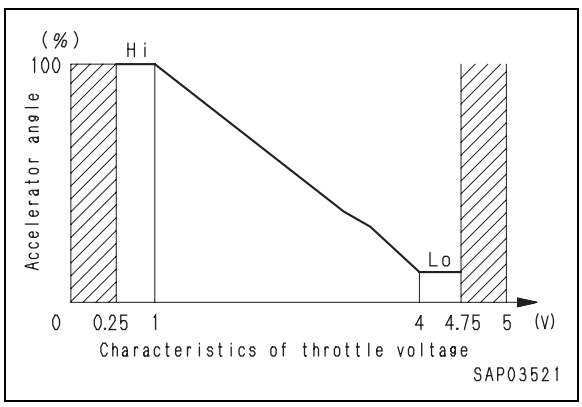
Fuel control dial



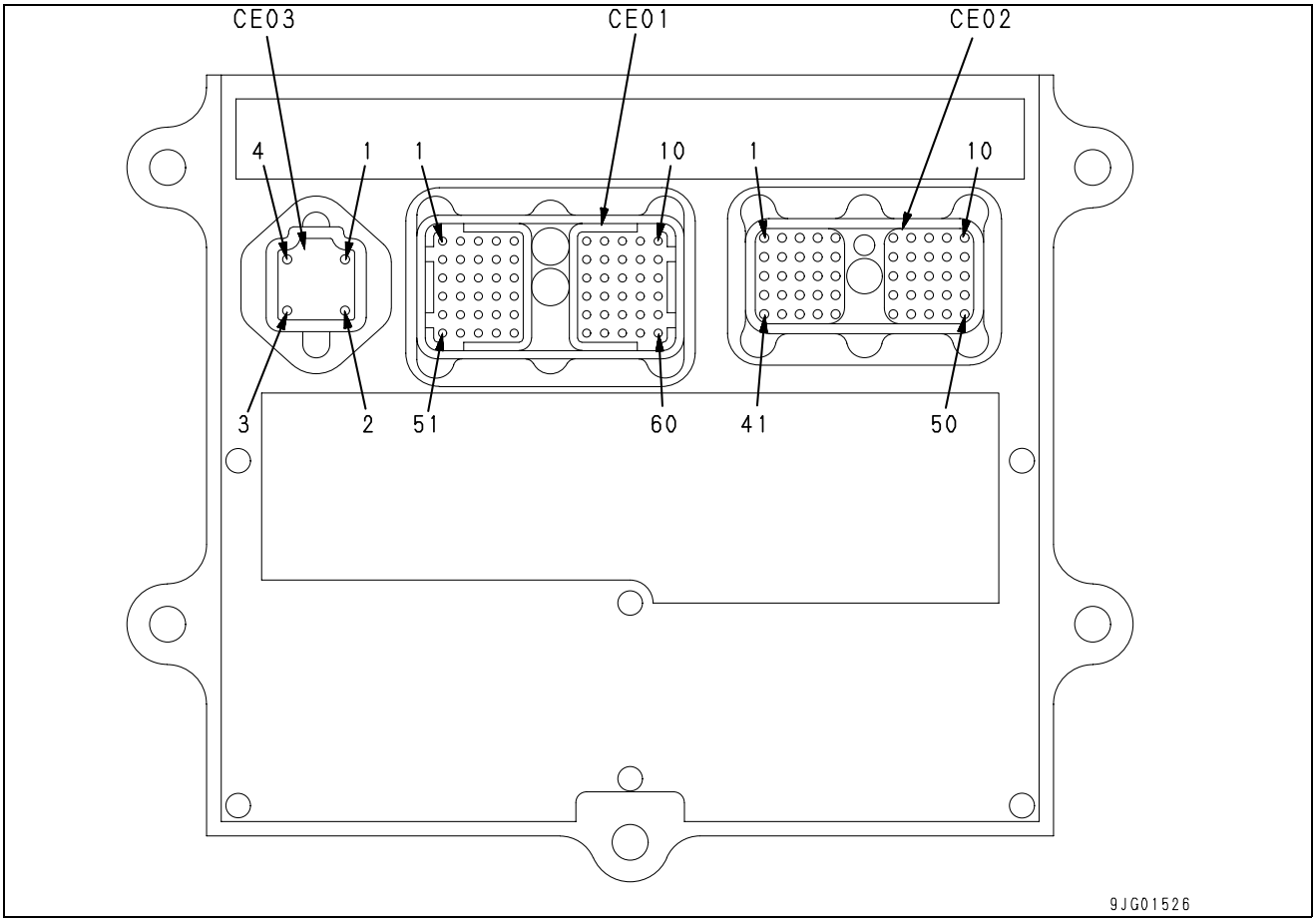
1. Knob
2. Dial
3. Spring
4. Ball
5. Potentiometer
6. Connector

Function

- The fuel control dial is installed near the monitor panel, and a potentiometer (5) is installed under the knob. The potentiometer shaft is turned by turning the knob (1).
- As the potentiometer shaft is turned, the resistance of the variable resistor in the potentiometer changes and a throttle signal is sent to the engine controller.
  The hatched area in the graph (shown at right) is the abnormality detection area.



Engine controller



CN-CE01 (*: Never connect to NC as malfunctions and errors occur)

Pin No.	Signal name	Title panel	Pin No.	Signal name	Title panel
1	Electric power supply for lift pump		18	NC (*)	
2	Electric power supply for IMA		19	NC (*)	
3	Atmosphere sensor		20	NC (*)	
4	NC (*)		21	NC (*)	
5	NC (*)		22	Engine brake drive	D
6	CAN (-)		23	Boost temperature sensor	B
7	NC (*)		24	NC (*)	
8	CAN (+)		25	Common rail pressure sensor	B
9	NC (*)		26	G sensor (+)	B
10	NC (*)		27	NE sensor (+)	B
11	Lift pump return		28	Engine brake return	
12	NC (*)		29	NC (*)	
13	NC (*)		30	NC (*)	
14	NC (*)		31	NC (*)	D
15	Coolant temperature sensor		32	IMA return	C
16	5V electric power supply for sensor		33	5V electric power supply for sensor	
17	Oil pressure sensor		34	NC (*)	

CN-CE01 (*: Never connect to NC as malfunctions and errors occur)

Pin No.	Signal name	Title panel
35	NC (*)	A
36	NC (*)	
37	5V electric power supply for sensor	A
38	GND	C
39	NC (*)	
40	NC (*)	
41	NC (*)	
42	NC (*)	C
43	NC (*)	
44	Boost pressure sensor	B
45	Injector #1 (+)	D
46	Injector #5 (+)	D
47	G sensor (-)	C
48	Ne sensor (-)	C
49	NC (*)	
50	NC (*)	
51	Injector #2 (-)	C
52	Injector #3 (-)	C
53	Injector #1 (-)	C
54	Injector #2 (+)	D
55	Injector #3 (+)	D
56	Injector #4 (+)	D
57	Injector #6 (+)	D
58	Injector #4 (-)	C
59	Injector #6 (-)	C
60	Injector #5 (-)	C

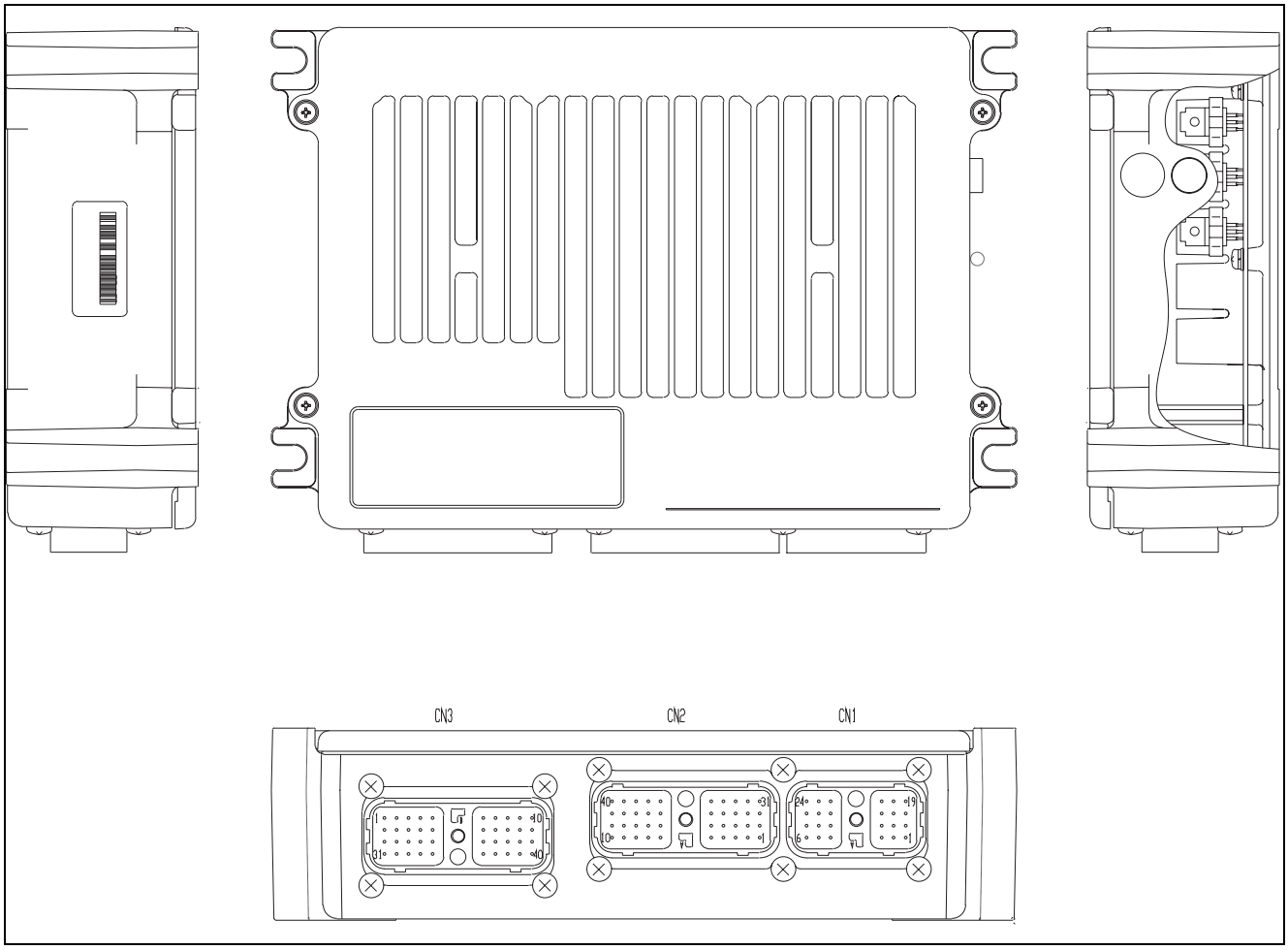
CN-CE02 (*: Never connect to NC as malfunctions and errors occur)

Pin No.	Signal name	Input/ Output
1	NC (*)	
2	NC (*)	
3	NC (*)	
4	NC (*)	
5	NC (*)	
6	NC (*)	
7	NC (*)	
8	NC (*)	
9	Fuel control dial (+)	
10	NC (*)	
11	NC (*)	
12	NC (*)	
13	NC (*)	
14	NC (*)	
15	NC (*)	
16	NC (*)	
17	NC (*)	
18	NC (*)	
19	NC (*)	
20	NC (*)	
21	NC (*)	
22	Fuel control dial (+5V)	
23	Fuel control dial (-)	
24	NC (*)	
25	NC (*)	
26	NC (*)	
27	NC (*)	
28	NC (*)	
29	NC (*)	
30	NC (*)	
31	NC (*)	
32	NC (*)	
33	GND	
34	NC (*)	
35	NC (*)	
36	NC (*)	
37	NC (*)	
38	NC (*)	
39	Key switch (ACC)	
40	Electrical intake air heater relay drive	
41	NC (*)	
42	Electrical intake air heater relay drive	
43	NC (*)	
44	NC (*)	
45	NC (*)	
46	CAN (+)	
47	CAN (-)	
48	NC (*)	
49	PWM OUTPUT	
50	NC (*)	

CN-CE03(*: Never connect to NC as malfunctions and errors occur)

Pin No.	Signal name	Input/ Output
1	GND	
2	NC (*)	
3	Electric power supply (+24V constantly)	
4	NC (*)	

Engine throttle and pump controller



Input and output signals

CN-1

Pin	Signal name	Input/
1	Travel PPC pressure sensor	Input
2	R pump pressure sensor	Input
3	2ND service potrntio	Input
4	Signal GND	
5	Abnormality in auto-greasing controller	Input
6	Service pressure switch	Input
7	Overload sensor (analog)	Input
8	F pump pressure sensor	Input
9	1st service potrntio	Input
10	Signal GND	
11	Knob SW (power max.)	Input
12	Travel reverse press. switch	Input
13		
14	Angle sensor	Input
15	NC	Input
16	Travel PPC pressure power	Output
17	Start Switch (Terminal C)	Input
18	Breaker switch	Input
19		
20		
21	GND (analog GND)	
22	POT_PWR	Output
23	Start switch (terminal ACC)	Input
24	Boom/Outrigger select switch	Input

CN-2

Pin	Signal name	Input/
1	NC	Output
2	Swing emergency switch	Input
3	Quick coupler low press. SW	Input
4	232C_RxD	Input
5	Arm dump pressure switch	Input
6	Travel forward pressure	Input
7	Model selection 4 switch	Input
8		
9	PPC lock (relay)	Output
10	NC	Input
11	NC	Output
12	CAN shield	
13	Model selection 5	Input
14	232C_TxD	Output
15	Arm DIG switch	Input
16	Swing pressure switch	Input
17	Model selection 3	Input
18	Boom/Outrigger sol. relay	Output
19	Suspension lock relay	Output
20	NC	Input
21	S_NET	Input/ output
22	CAN0_L	Input/ output
23	CAN1_L	Input/ output
24	Flash memory write enable signal	Input
25	Boom down pressure switch	Input
26	Bucket dump pressure switch	Input
27	Machine selection 2	Input
28	Swing proximity switch	Input
29	GND (pulse GND)	
30	Speed pickup sensor	Input
31	GND (S_NET GND)	
32	CAN0_H	Input/ output
33	CAN1_H	Input/ output
34	GND (232C GND)	
35	Boom raise pressure switch	Input
36	Bucket DIG pressure switch	Input
37	Model selection switch 1	Input
38	Swing lock switch	Input
39	Pulse GND	
40		

CN-3

Pin	Signal name	Input/
1	VB (controller power)	Input
2	VIS (solenoid power)	Input
3	SOL_COM (solenoid com-	
4	Battery relay drive signal	Output
5	1st service LH flow control EPC	Output
6	LS-EPC solenoid	Output
7	Merge/Flow divider solenoid	Output
8	2 stage relief solenoid	Output
9	2nd service neutral SW	Input
10	Travel direction F switch	Input
11	VB (controller power)	Input
12	VIS (solenoid power)	Input
13	SOL_COM (solenoid common gnd)	
14	KEY signal	Input
15	1st service RH flow control EPC	Output
16	PC-EPC solenoid	Output
17	Creep solenoid	Output
18		
19	Park brake pressure switch	Input
20	Travel direction N switch	Input
21	GND (controller GND)	
22	VIS (solenoid power)	Input
23	SOL_COM (solenoid com-	
24	KEY signal	Input
25	2nd service LH flow control EPC	Output
26	Suspension lock solenoid	Output
27	Transmission clutch solenoid	Output
28	Travel FR solenoid	Output
29	Tilting pod SW	Input
30	Travel direction R switch	Input
31	GND (controller GND)	
32	GND (controller GND)	
33	GND (controller GND)	
34	NC	
35	2nd service RH flow control EPC	Output
36	2 stage back pressure sole-	Output
37	Swing brake solenoid	Output
38	Travel N solenoid	Output
39	Low brake pressure switch	Input
40	1st service neutral SW	Input

ELECTRONIC CONTROL SYSTEM

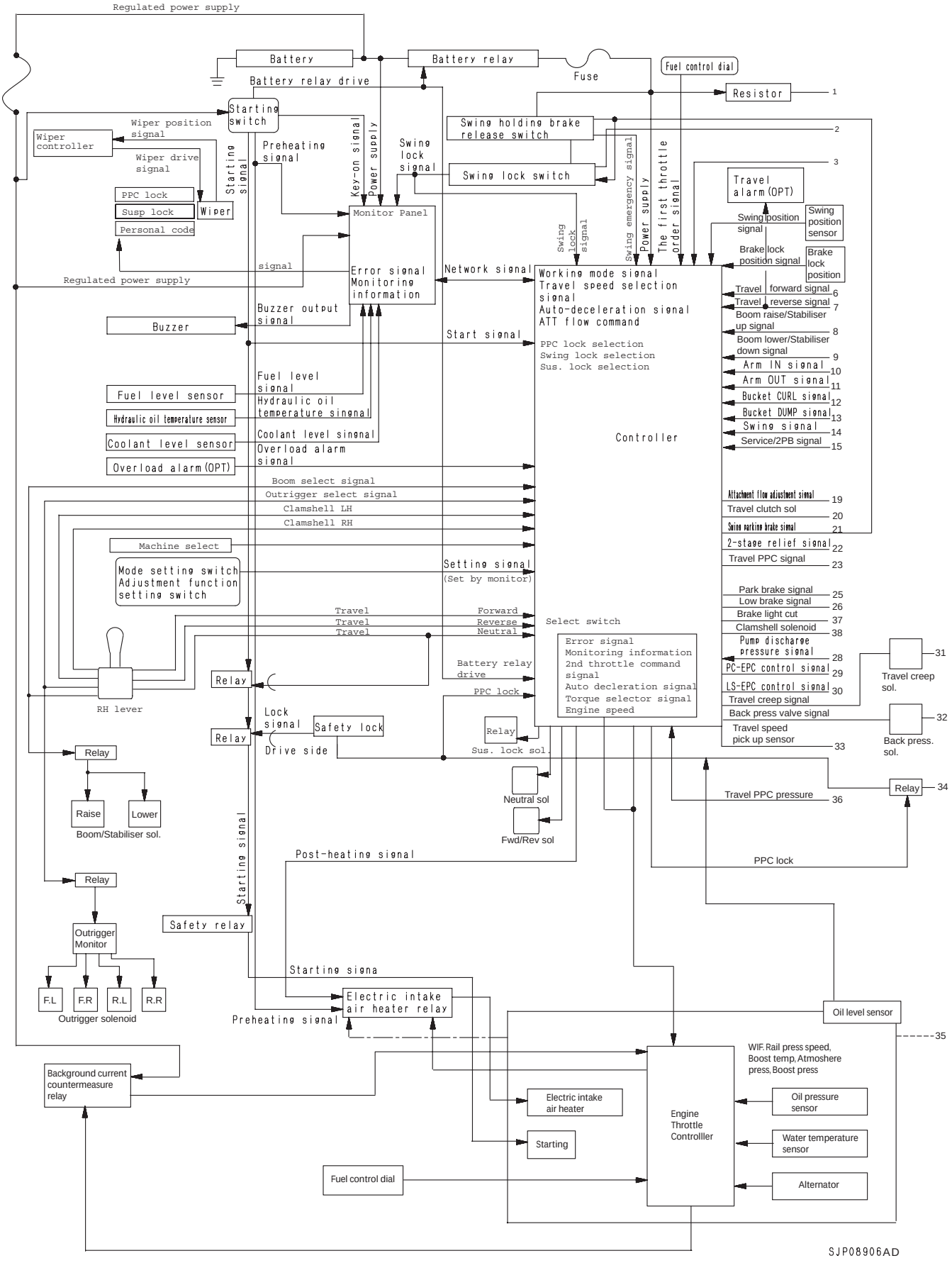
Control function

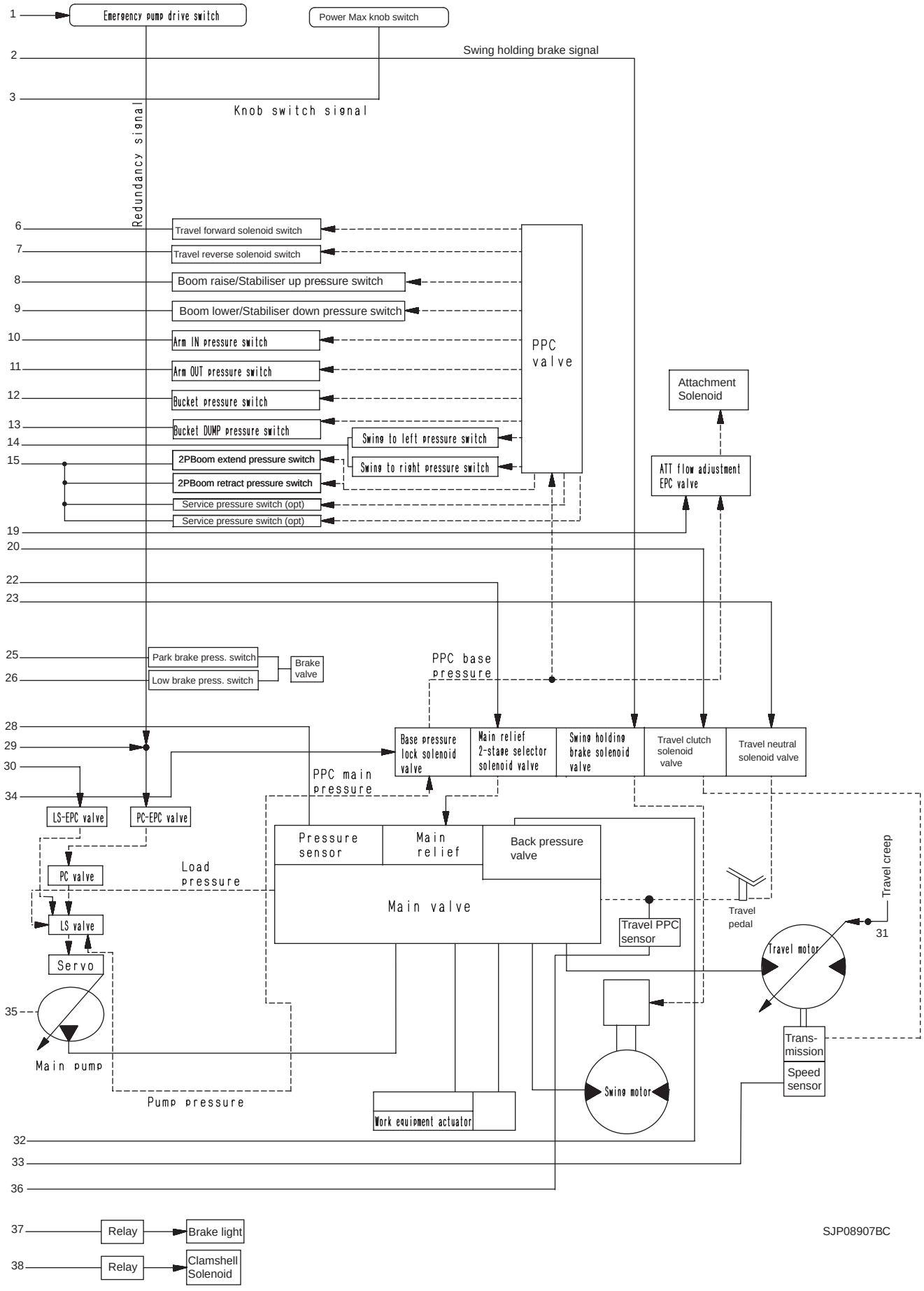
Electronic control system

1. Engine/Pump composite control function
2. Pump/Valve control function
3. One-touch power maximizing function
4. Auto-deceleration function
5. Auto-warm-up/Overheat prevention function
6. Swing control function
7. Travel control function
8. ATT flow control, ATT direction control
9. System component parts
10. Speed sensing function
11. Brake light control function

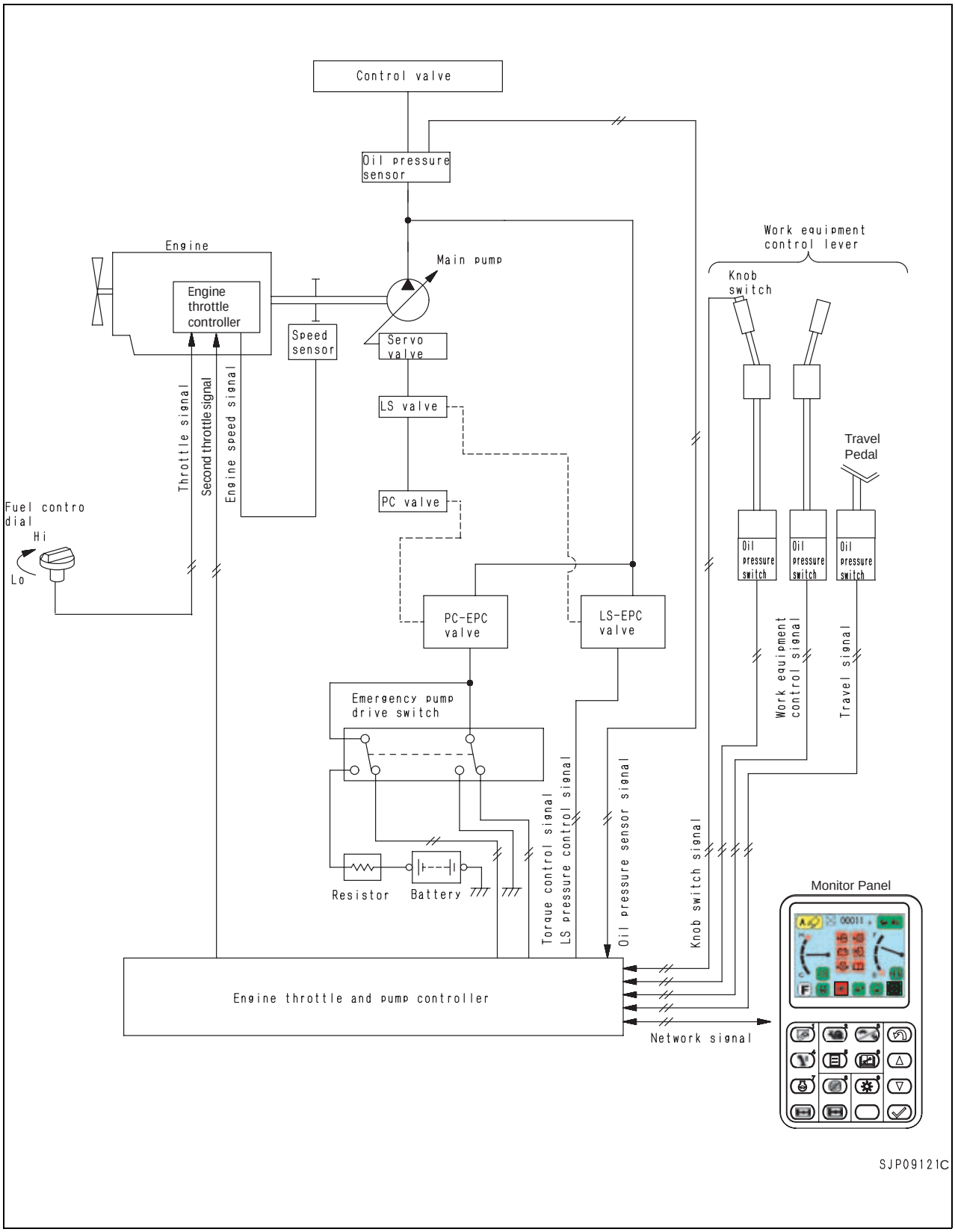
- For the self-diagnosis function, see “TROUBLE SHOOTING".

MACHINE CONTROL SYSTEM DIAGRAM



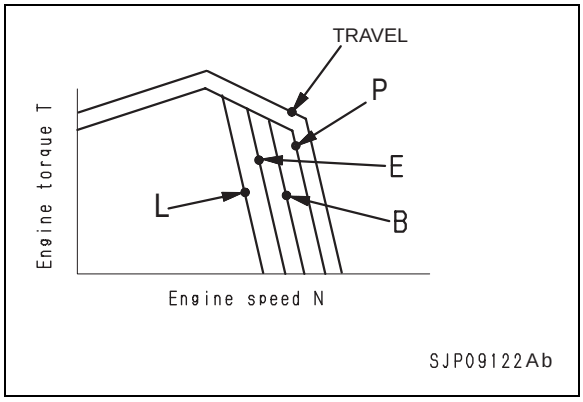

1
Emergency pump drive switch
Power Max knob switch
2
Swing holding brake signal
3
Knob switch signal
Redundancy signal
6
Travel forward solenoid switch
7
Travel reverse solenoid switch
8
Boom raise/Stabiliser up pressure switch
9
Boom lower/Stabiliser down pressure switch
10
Arm IN pressure switch
11
Arm OUT pressure switch
12
Bucket pressure switch
13
Bucket DUMP pressure switch
14
Swing to left pressure switch
15
2PBoom extend pressure switch
Swing to right pressure switch
2PBoom retract pressure switch
Service pressure switch (opt)
Service pressure switch (opt)
PPC valve
Attachment Solenoid
ATT flow adjustment EPC valve
19
20
22
23
25
Park brake press. switch
26
Low brake press. switch
Brake valve
PPC base pressure
28
29
30
34
Base pressure lock solenoid valve
Main relief 2-stage selector solenoid valve
Swing holding brake solenoid valve
Travel clutch solenoid valve
Travel neutral solenoid valve
PPC main pressure
LS-EPC valve
PC-EPC valve
Pressure sensor
Main relief
Back pressure valve
PC valve
Load pressure
Main valve
Travel creep
Travel pedal
Travel PPC sensor
31
LS valve
Servo
Travel motor
35
Main pump
Trans-mission
Speed sensor
Swing motor
Pump pressure
Work equipment actuator
32
33
36
37
Relay
Brake light
38
Relay
Clamshell Solenoid
SJP08907BC

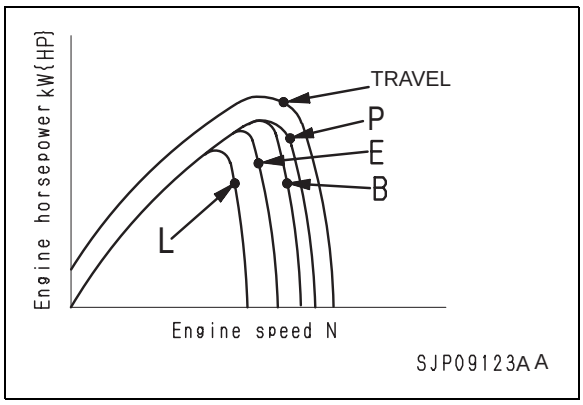
1. Engine and Pump control function

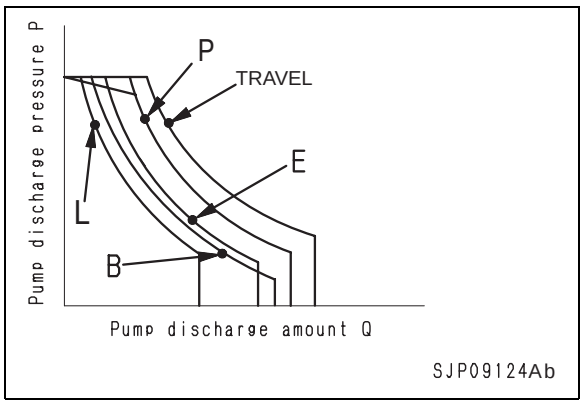


FUNCTION

- The operator can set the work mode switch on the monitor panel to mode P, E, B or L and select proper engine torque and pump absorption torque according to the type of work.
- The engine throttle and pump controller detects the speed of the engine governor set with the fuel control dial and the actual engine speed and controls them so that the pump will absorb all the torque at each output point of the engine, according to the pump absorption torque set in each mode.







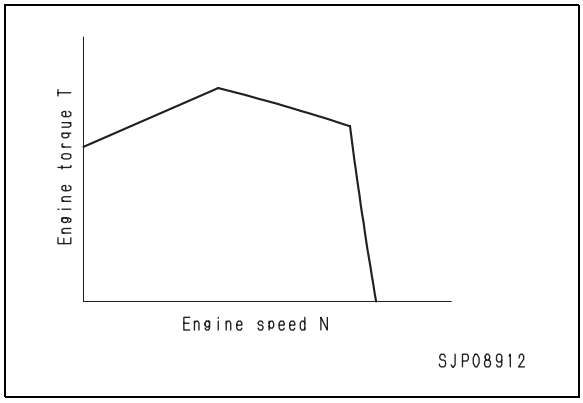
1. Control method in each mode

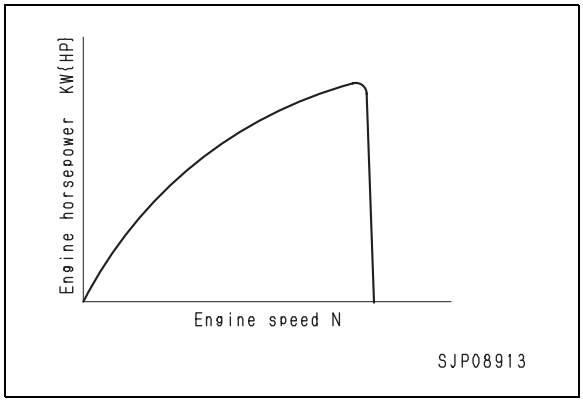
Mode P

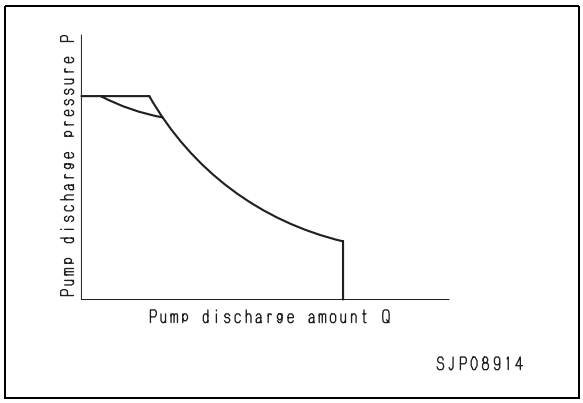
- Matching point in mode P: Rated speed

Model	PW180-7E0
Mode P Working	1,900 rpm

- If the pump load increases and the pressure rises, the engine speed lowers.
  At this time, the controller lowers the pump discharge so that the engine speed will be near the full output point. If the pressure lowers, the controller increases the pump discharge so that the engine speed will be near the full output point.
  By repeating these operations, the controller constantly uses the engine near the full output point.



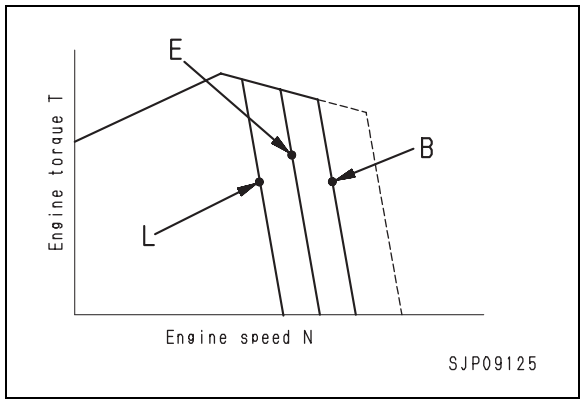




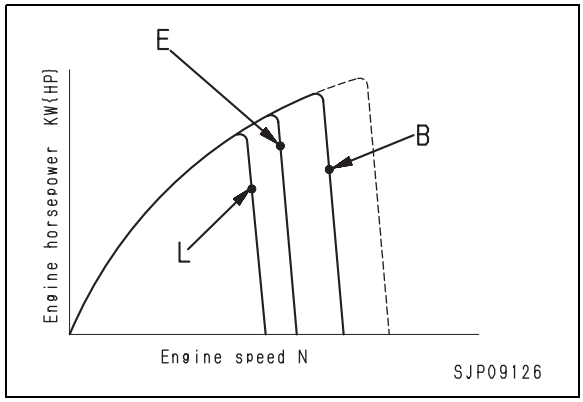
Mode E / Mode B / Mode L

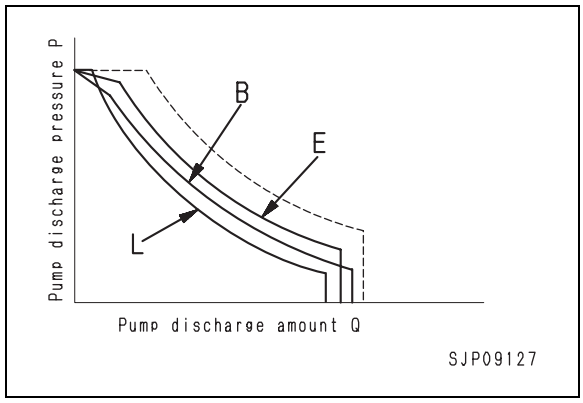
Mode	Digging	Breaker	Finishing
Partial output point	85%	75%	70%

Mode	PW180-7E0
Mode E	1,750 RPM
Mode B	1,850 RPM
Mode L	1,600 RPM

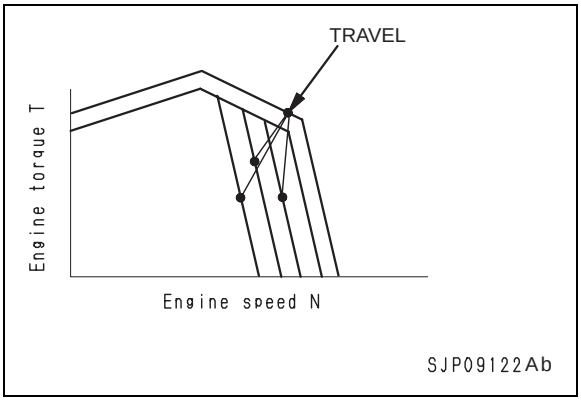


- At this time, the controller keeps the pump absorption torque along the constant horsepower curve and lower the engine speed by the composite control of the engine and pump.
  By this method, the engine is used in the low fuel consumption area.





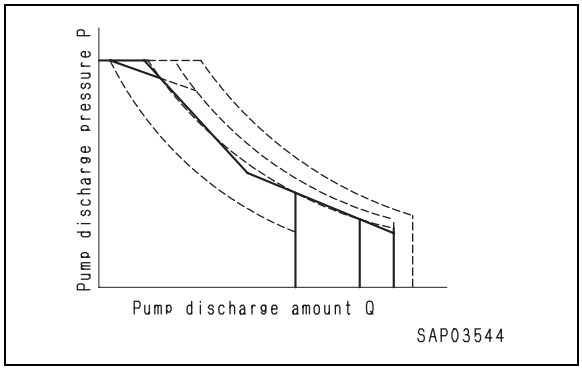
- When travel is activated in each mode matching point changes to travel matching point.



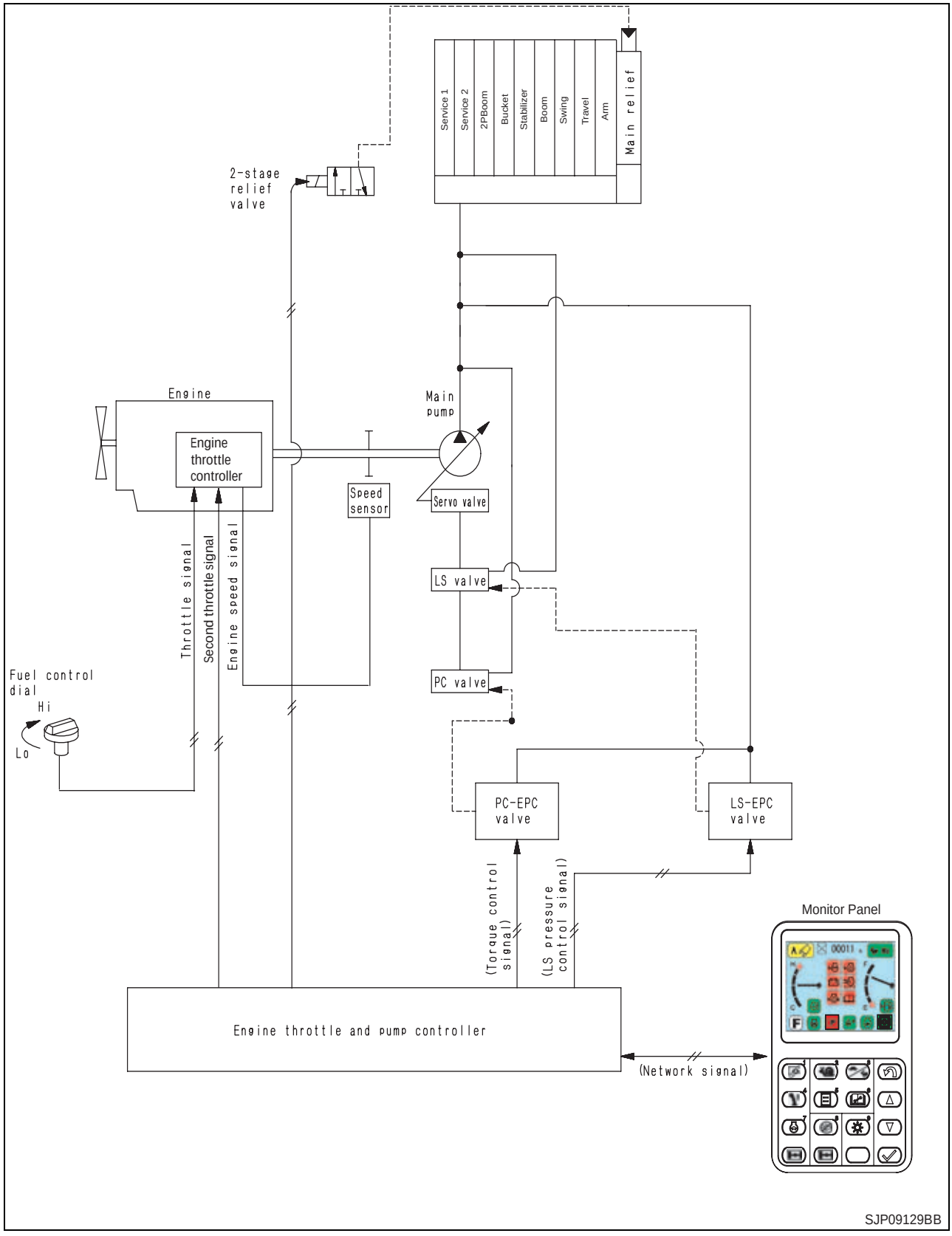
1.1. Function to control when emergency pump drive switch is turned ON

- Even if the controller or a sensor has a trouble, the functions of the machine can be secured with pump absorption torque almost equivalent to mode E by turning on emergency pump drive switch (10).
  In this case, a constant current flows from the battery to the EPC valve for PC and the oil pressure is sensed by only the EPC valve for PC.





2. Pump/Valve control function

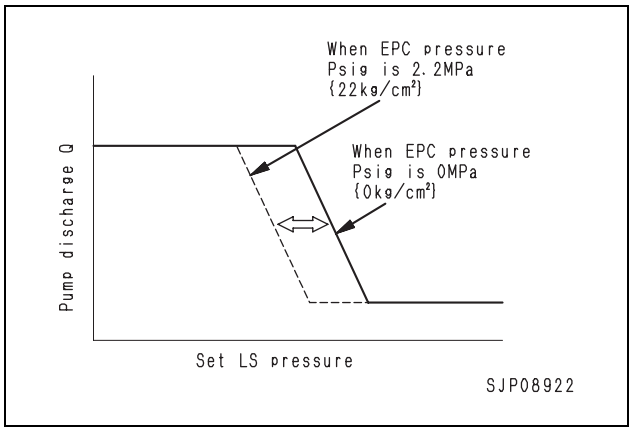


FUNCTION

- The machine is matched to various types of work properly with the 2-stage relief function to increase the digging force, etc.

2.1. LS control function

- The change point (LS set differential pressure) of the pump discharge in the LS valve is changed by changing the output pressure from the LS-EPC valve to the LS valve according to the operating condition of the actuator.
- By this operation, the start-up time of the pump discharge is optimized and the composite operation and fine control performance is improved.



2.2. Cut-off function

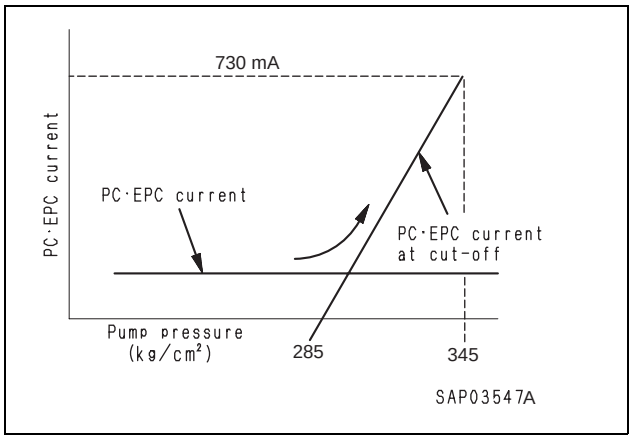
- When the cut-off function is turned on, the PC-EPC current is increased to near the maximum value.

  By this operation, the flow rate in the relief state is lowered to reduce fuel consumption.

- Operating condition for turning on cut-off function

Condition
● The value of the pressure sensors is above 27.9 MPa {285 kg/cm²} and the one-touch power maximizing function is not turned on

The cut-off function does not work, however, while the machine is travelling in mode A.

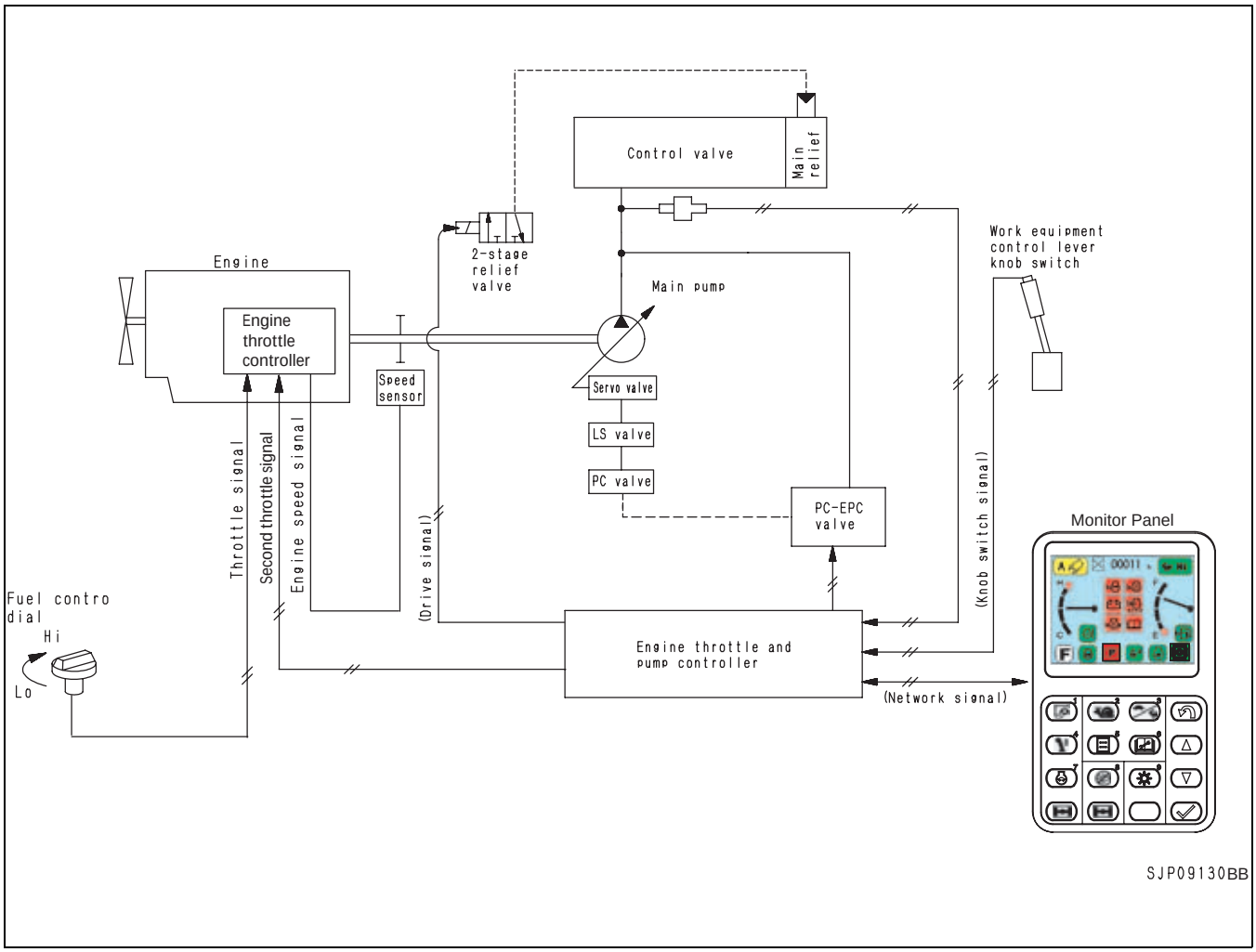


2.3. 2-stage relief function

- The relief pressure in the normal work is 34.8 MPa {355 kg/cm²}. If the 2-stage relief function is turned on, however, the relief pressure rises to about 37.2 MPa {380 kg/cm²}.
- By this operation, the hydraulic force is increased further.
- Operating condition for turning on 2-stage relief function

Condition	Relief pressure
● During travel ● When swing lock switch is turned on ● When boom is lowered ● When one-touch power maximising function is turned on ● When L mode is operated	34.8 MPa {355 kg/cm²} ⇓ 37.2 MPa {380 kg/cm²}

3. One-touch power maximizing function

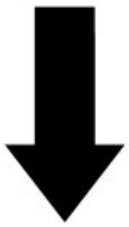


FUNCTION

- Power can be increased for approximately 8 seconds by depressing the power max switch on LH work equipment lever.
- The power max function is available in "P" and "E" working modes only.

3.1. One-touch power maximizing function

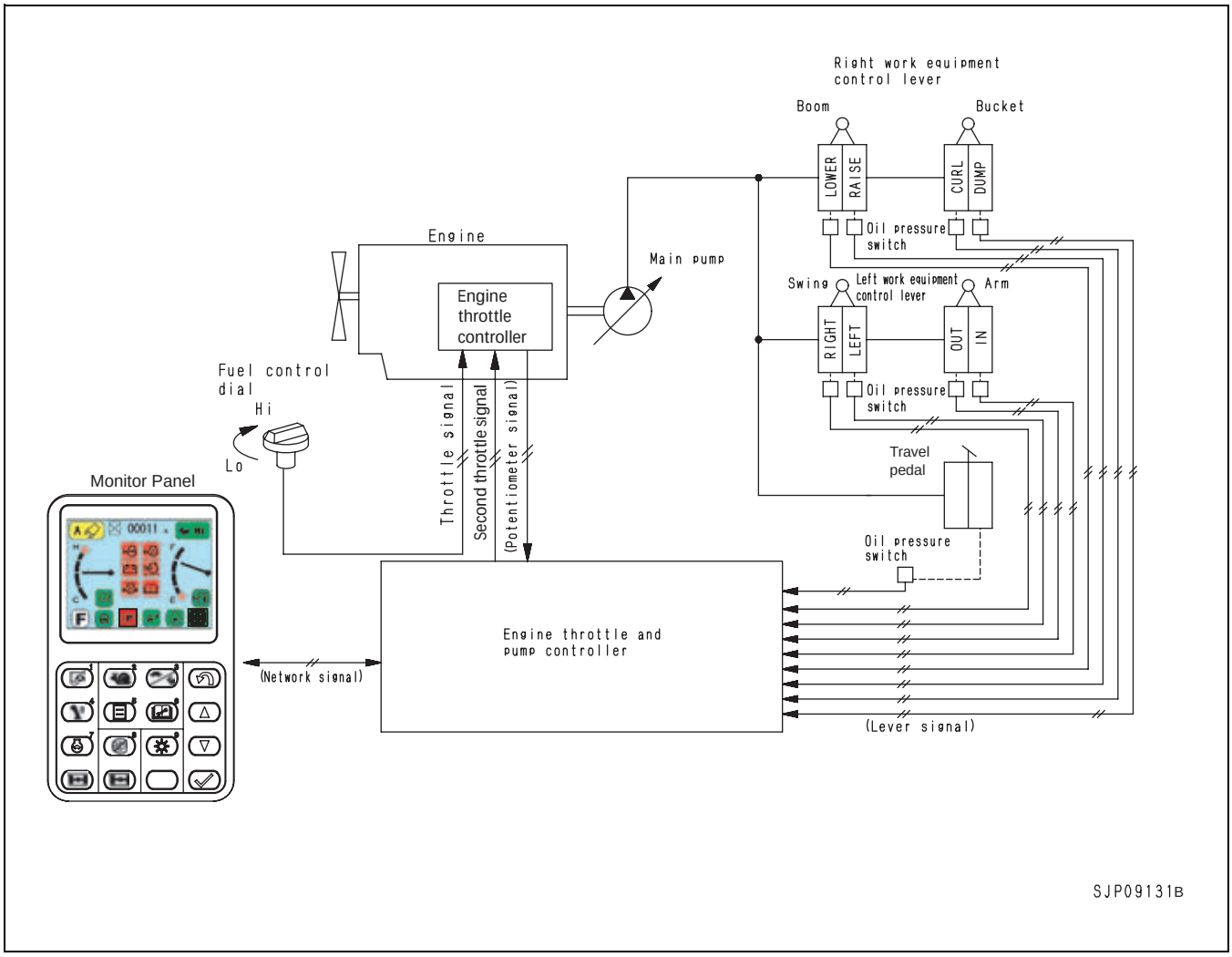
- When the operator needs more digging force to dig up a large rock, etc., if the left knob switch is pressed, the hydraulic force is increased about 7% to increase the digging force.
- If the left knob switch is turned on in working mode "P" or "E", each function is set automatically as shown below.



Software cut-off function

Working mode	Engine/Pump control	2-stage relief function	Operation time	
P, E	Matching at rated output point	34.8 MPa {355 kg/cm²} ⇓ 37.2 MPa {380 kg/cm²}	Automatically reset at 8.5 sec.	Cancel

4. Auto-deceleration function



FUNCTION

- If all the control levers are set in NEUTRAL while waiting for a dump truck or work, the engine speed is lowered to the medium level automatically to reduce the fuel consumption and noise.
- If any lever is operated, the engine speed rises to the set level instantly.

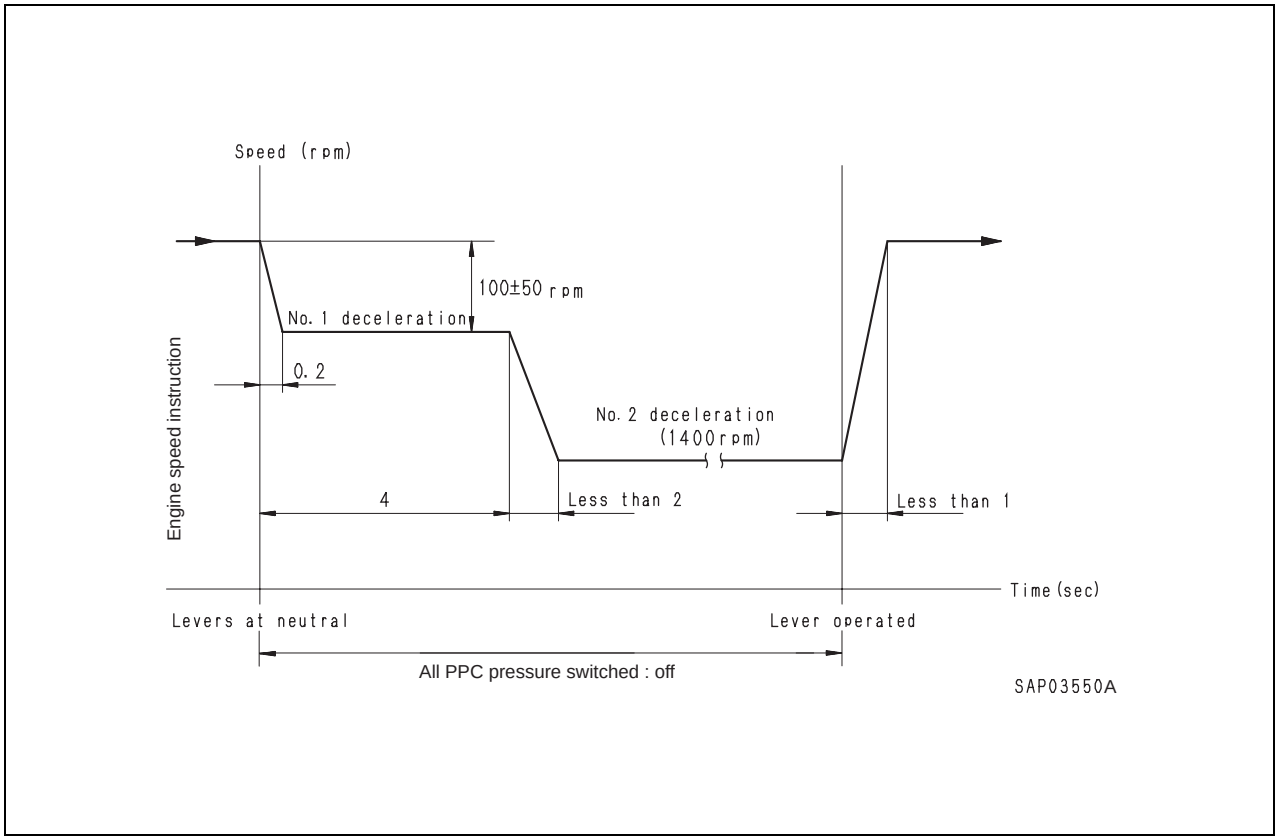
OPERATION

WHEN CONTROL LEVERS ARE SET IN NEUTRAL

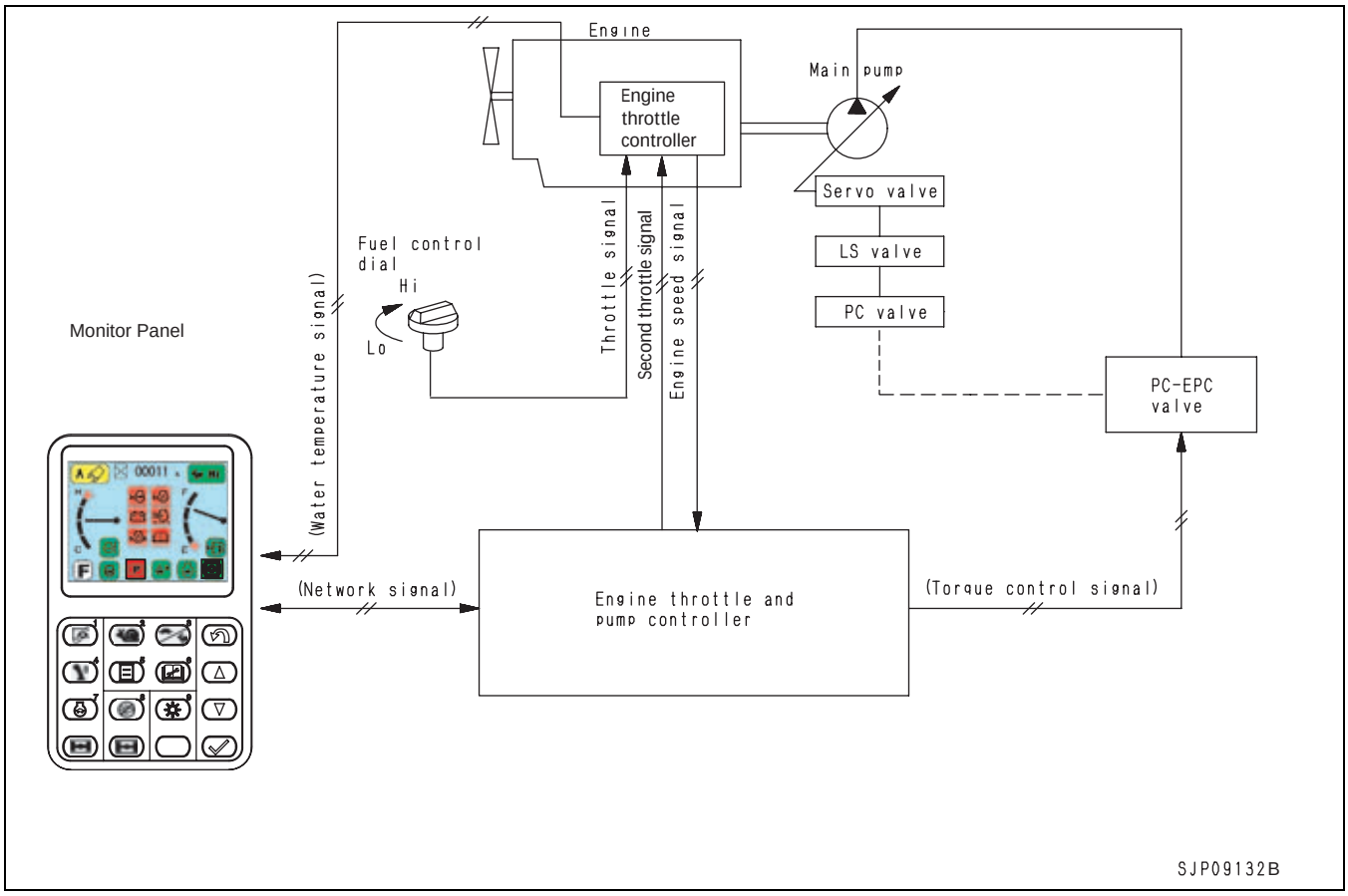
- If all the control levers are set in NEUTRAL while the engine speed is above the decelerator operation level (about 1,400 rpm), the engine speed lowers instantly to the first deceleration level about 100 rpm lower than the set speed.
- If 4 more seconds pass, the engine speed lowers to the second deceleration level (about 1,400 rpm) and keeps at that level until any lever is operated again.

WHEN ANY CONTROL LEVER IS OPERATED

- If any control lever is operated while the engine speed is kept at the second deceleration level, the engine speed rises instantly to the level set with the fuel control dial.



5. Auto-warm-up/Overheat and White Smoke prevention function



FUNCTION

- After the engine is started, if the engine cooling water temperature is below 30°C, the engine speed is raised automatically to warm up the engine. If the engine cooling water temperature rises too high during work, the pump load is reduced to prevent overheating.
- To prevent white smoke the heater relay is activated for 100 seconds if the air temperature is below 30°C.

5.1. Auto-warm-up function

- After the engine is started, if the engine cooling water temperature is low, the engine speed is raised automatically to warm up the engine.

Operating condition (All)
Water temperature: Below 30°C. Engine speed: Max. 1,200 rpm

➡

Operated
Engine speed: Max. 1,200 rpm

⬇

	Resetting condition (Any one)
Auto	Water temperature: Above 30°C
	Auto-warm-up operation time: Min. 10 minutes
Manual	Fuel control dial: Kept at 70% of full level for 3 sec. or longer

➡

Reset
Engine speed: Any level

5.2. Overheat prevention function

- If the engine cooling water temperature rises too high during work, the pump load and engine speed are reduced to prevent overheating.
- This function is turned on when the water temperature rises above 100°C or hydraulic oil temperature reaches 95°C.

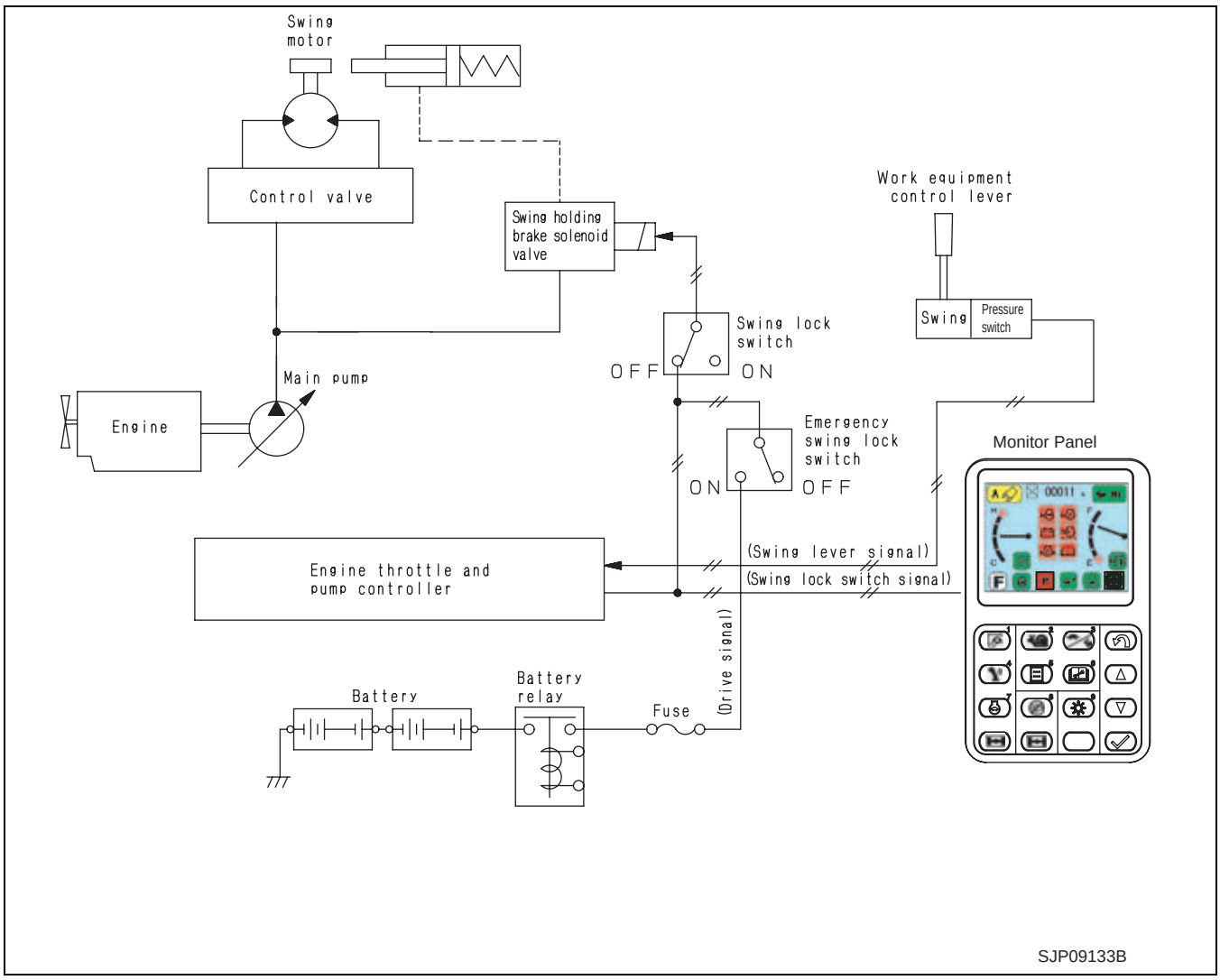
Operating condition	Operation/Remedy	Resetting condition
Water temperature: Above 105°C or Hydraulic oil temperature: Above 105°C	Work mode: Any mode Engine speed: Low idle Monitor alarm lamp: Lights up Alarm buzzer: Sounds	Water temperature: Below 105°C Hydraulic oil temperature: Below 105°C Fuel control dial: Return to low idle position once. ➧ Under above condition, controller is set to condition before operation of function. (Manual reset)

Operating condition	Operation/Remedy	Resetting condition
Water temperature: Above 102°C or Hydraulic oil temperature: Above 102°C	Work mode: Mode P, E, OR B Engine speed: Keep as is. Monitor alarm lamp: Lights up. Lower pump discharge.	Water temperature: Below 102°C Hydraulic oil temperature: Below 102°C ➧ Under above condition, controller is set to condition before operation of function. (Automatic reset)

Operating condition	Operation/Remedy	Resetting condition
Water temperature: Above 100°Cor Hydraulic oil temperature: Above 100°C	Work mode: Mode P or E Engine speed: Keep as is. Lower pump discharge.	Water temperature: Below 100°C Hydraulic oil temperature: Below 100°C ➧ Under above condition, controller is set to condition before operation of function. (Automatic reset)

Operating condition	Operation/Remedy	Resetting condition
Hydraulic oil temperature: Above 95°C	Work mode: Travel Engine speed: Keep as is. Lower travel speed.	Water temperature: Below 95°C Hydraulic oil temperature: Below 95°C ➧ Under above condition, controller is set to condition before operation of function. (Automatic reset)

6. Swing control function



FUNCTION

The Swing lock and swing holding brake functions are installed.

6.1. Swing lock and swing holding brake functions

- The swing lock function (manual) is used to lock machine from swinging at any position. The swing holding brake function (automatic) is used to prevent hydraulic drift after the machine stops swinging.
- Swing lock switch and swing lock/holding brake

※Operation of swing holding brake release switch

- If the controller, etc. has a problem, the swing holding brake does not work normally, and the machine cannot swing, the swing lock can be reset with the swing holding brake release switch

-

Lock switch	Lock lamp	Function	Operation
OFF	OFF	Swing holding brake	If swing lever is set in neutral, swing brake operates in about 5 sec. If swing lever is operated, brake is released and machine can swing freely.
ON	ON	Swing lock	Swing lock operates and machine is locked from swinging. Even if swing lever is operated, swing lock is not reset and machine does not swing.

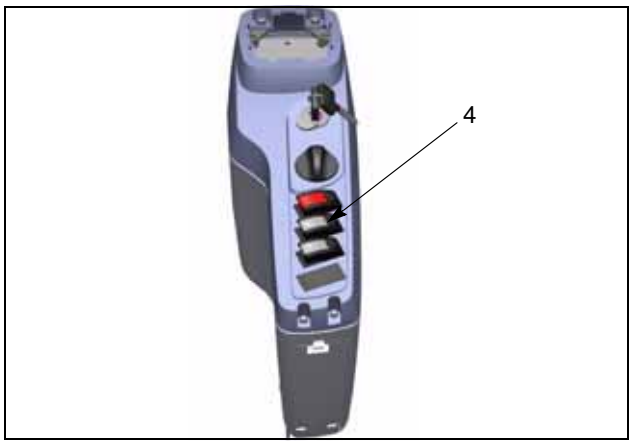
- .

Swing holding brake release switch	OFF (When controller is normal)		On (with PPC signal) (when controller is normal)		ON (When control has trouble)	
Swing lock switch	ON	OFF	On	Off	ON	OFF
Swing brake	Swing lock is turned on.	Swing holding brake is turned on.	Swing lock is turned on	Machine will swing	Swing lock is turned on.	Swing lock is cancelled.

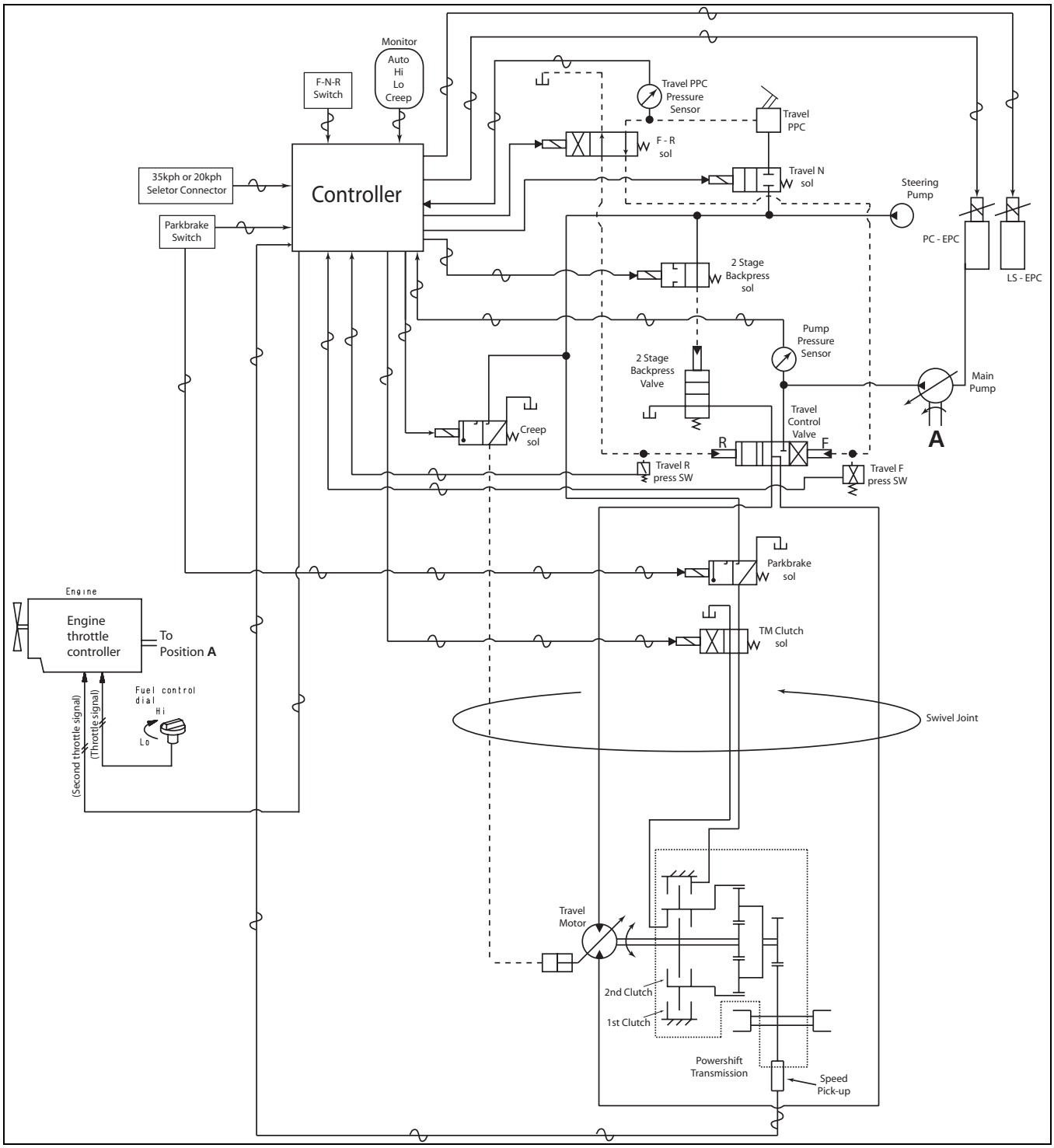
- Even if the swing holding brake release switch is turned on, if the swing lock switch is turned on, the swing brake is not released.
- If the swing lock is reset, swinging is stopped by only the hydraulic brake of the safety valve. Accordingly, if swinging is stopped on a slope, the upper structure may drift hydraulically.

6.2. Quick hydraulic oil warm-up function when swing lock switch is turned on

- If swing lock switch (4) is turned on, the pump-cut function is cancelled and the relief pressure rises from 34.8 MPa {355 kg/cm²} to 37.2 MPa {380 kg/cm²}. If the work equipment is relieved under this condition, the hydraulic oil temperature rises quickly and the warm-up time can be shortened.



7. Travel control function



FUNCTION

- The pump is controlled and the travel speed is changed manually or automatically, to secure proper travel performance matched to the type of work and jobsite during travel.

7.1. Pump control function during travel

- If the machine travels in a work mode other than mode P, the work mode and the engine speed remain unchanged and the pump absorption torque is increased.
  - For details, see ENGINE/PUMP COMPOSITE CONTROL FUNCTION.

7.2. Travel speed change function

- Manual change with travel speed button on the monitor panel.
- If the travel speed switch is changed between CREEP, LO, and HI, the governor/pump controller controls the pump capacity and motor capacity at each gear speed (as shown in the table below) to change the travel speed. (See engine speed table, right).

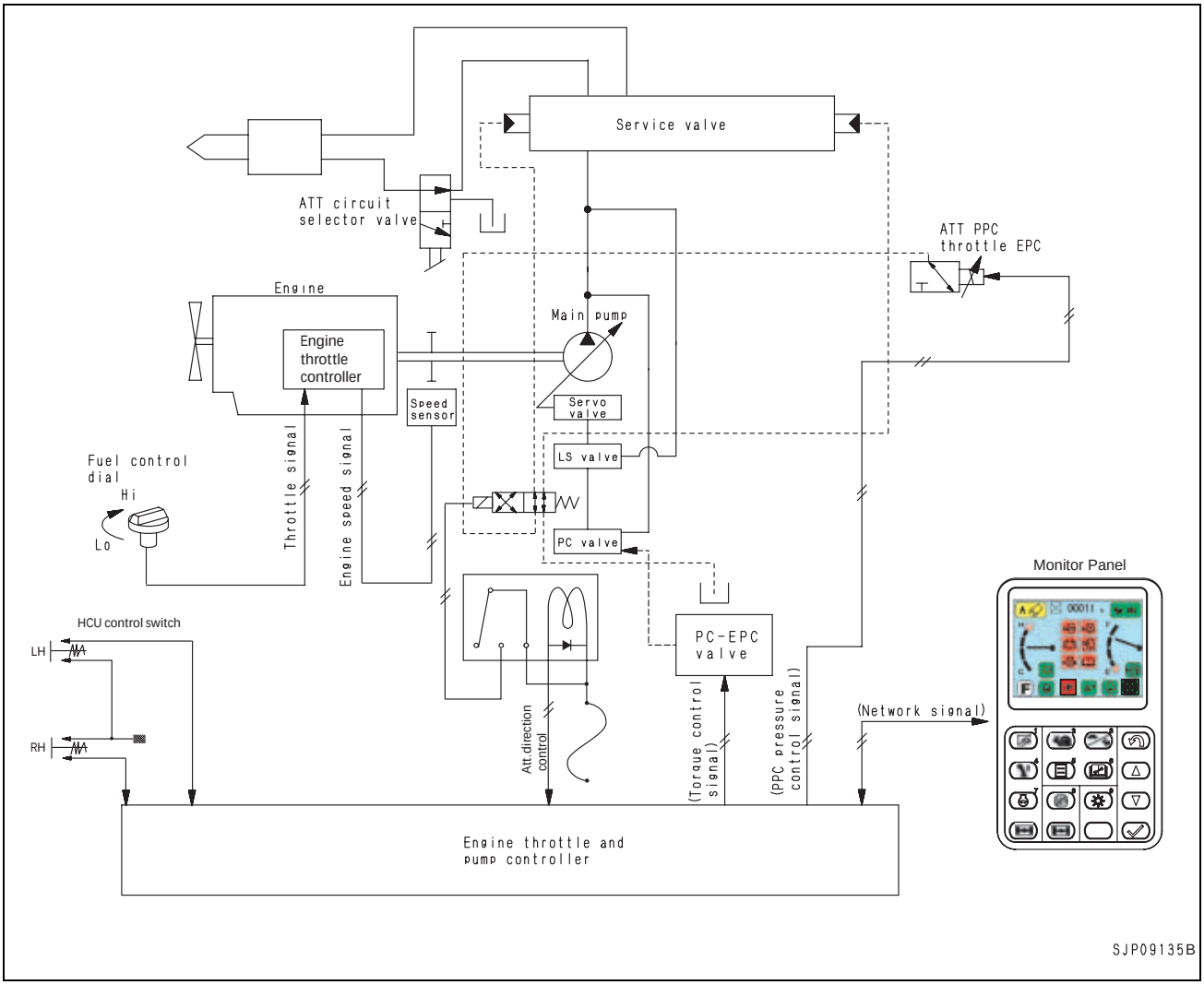
Travel speed switch	CREEP	LO	HI	AUTO (LO~HI)
Pump capacity (%)	80	100	100	
Motor capacity	Max.	Min~Max	Min~Max	Min~Max
Travel speed (km/h)	2.5	0 ~9.5	0 - 35 0 - 20	0 - 35 0 - 20 (German spec.)

- Automatic change by engine speed
- The travel speed changes to Hi level automatically if the travel speed has been Hi.
- Automatic change by pump discharge pressure
- While the machine is traveling with the travel speed switch at Hi, if the load is increased because of an upslope ground, etc. and the travel pressure keeps above 35 MPa {357 kg/cm²} for 0.5 seconds, the travel motor capacity is changed automatically and the travel speed is lowered (to the LO level) (The travel speed switch is kept at Hi, however).
- While the machine is travelling at LO, if the load is reduced on a flat or downslope ground, etc. and the travel pressure keeps below 23 MPa {234 kg/cm²} for 0.5 seconds, the travel motor capacity is changed automatically and the travel speed is set to Hi again.
- Controller does not change the travel mode in travel HI/LO switch unless a mode continues for more than 0.5 seconds.
- From CREEP to other mode, or from other mode to CREEP, travel mode should be changed immediately.
- Default mode should be the last mode when starter switch was turned off.
- Maximum speed 2100 rpm.

Maximum engine speed:

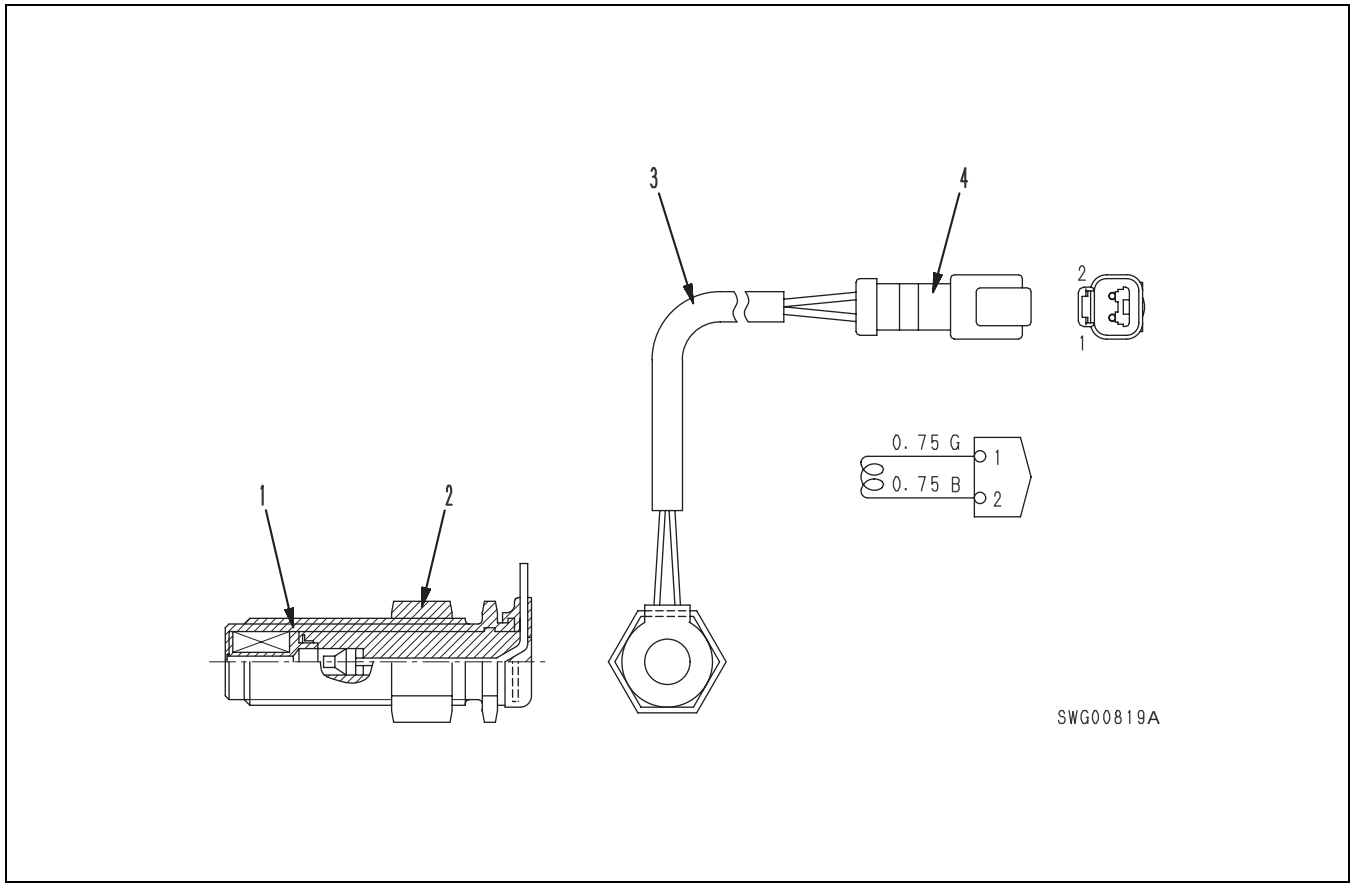
Max. Engine speed	
Travel	2450 rpm
P Mode	2150 rpm
E Mode	2010 rpm
L Mode	1830 rpm
B Mode	2040 rpm

8. ATT flow control, ATT direction control



9. System component parts

9.1. Engine revolution sensor

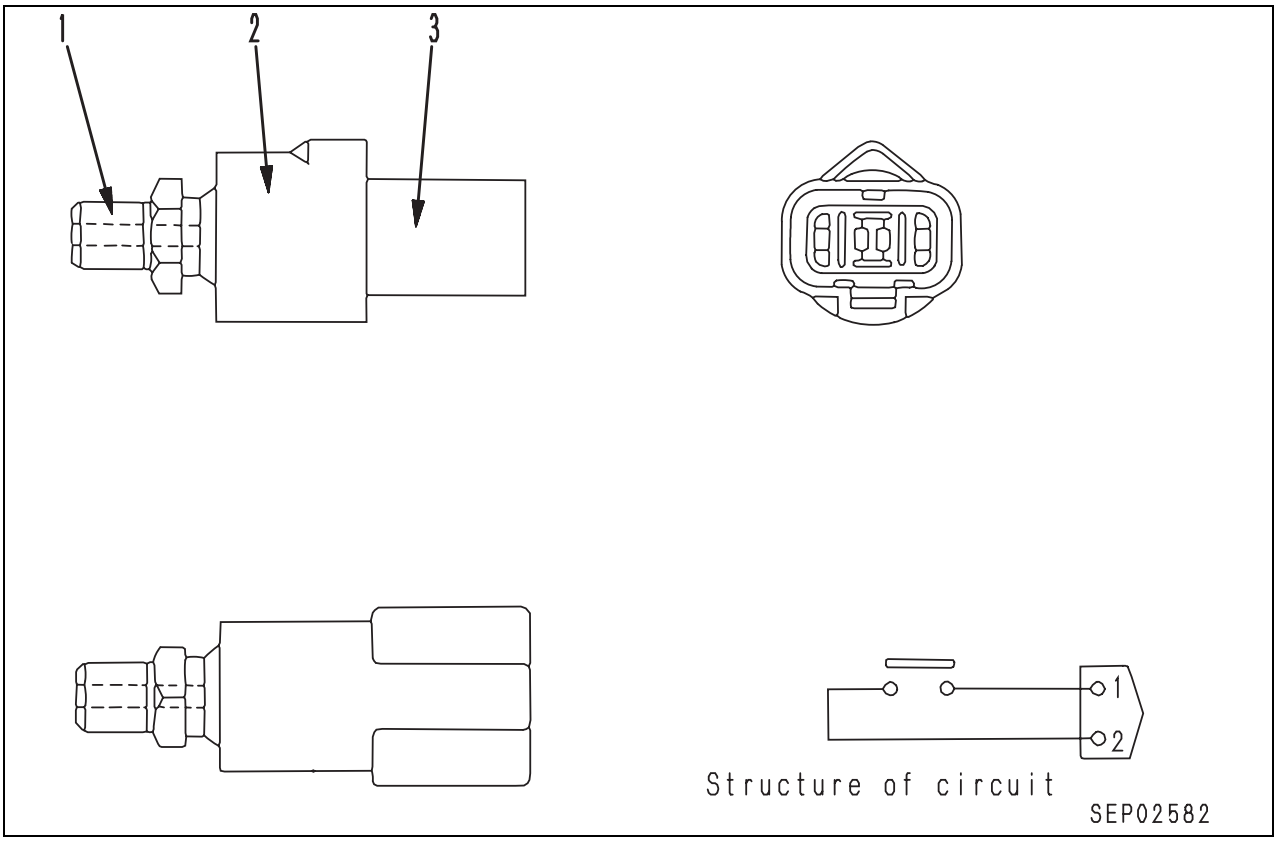


1. Sensor
2. Locknut
3. Wiring harness
4. Connector

FUNCTION

- The engine revolution sensor is installed to the ring gear of the engine flywheel. It electrically calculates the number of the gear teeth which pass in front of it and transmits the result to the engine throttle and pump controller.
- A magnet is used to sense the gear teeth. Each time a gear tooth passes in front of the magnet, a current is generated.

9.2. PPC oil pressure switch



1. Plug
2. Switch
3. Connector

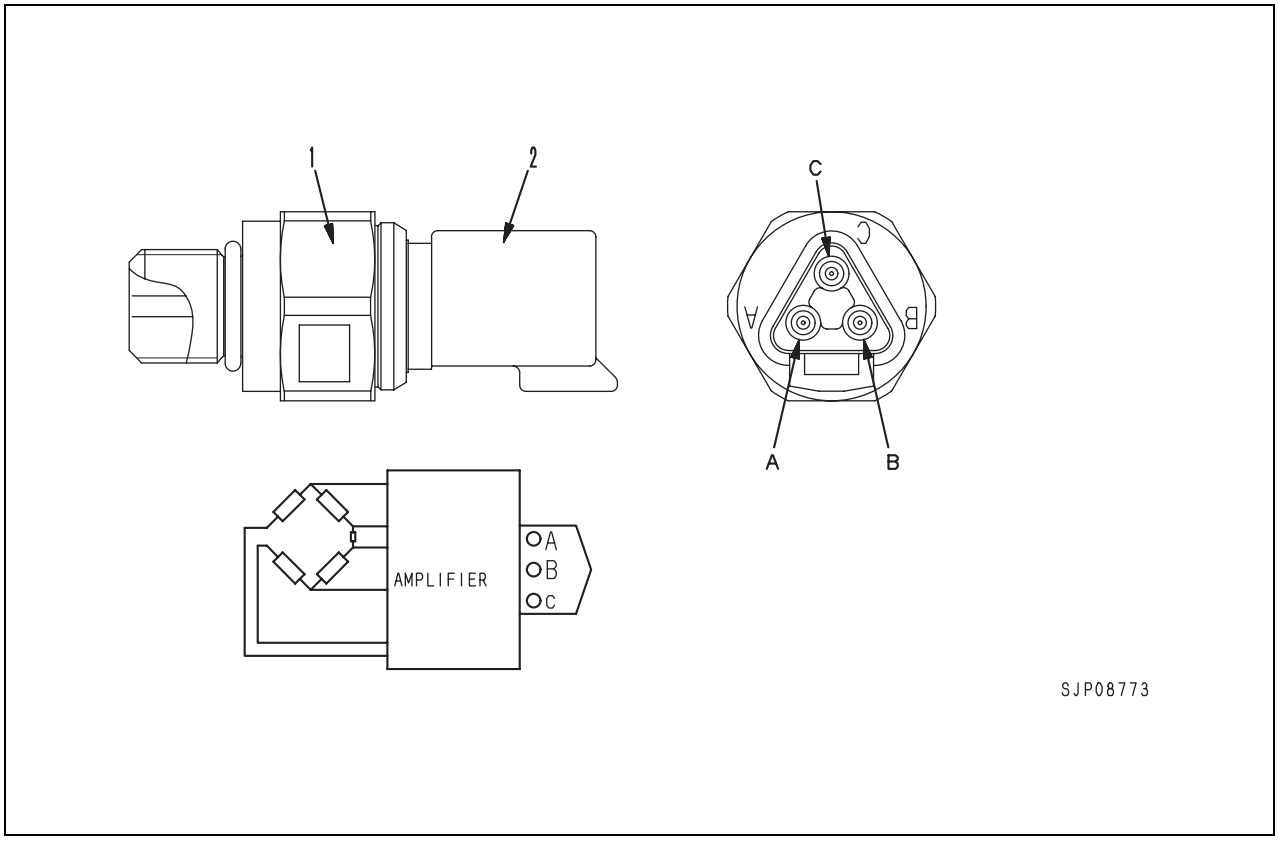
SPECIFICATIONS

Type of contacts: Normally open contacts
Operating (ON) pressure:0.5 ± 0.1 MPa
{5.0 ± 1.0 kg/cm²}
Resetting (OFF) Pressure: 0.3 ± 0.5 MPa
{3.0 ± 0.5 kg/cm²}

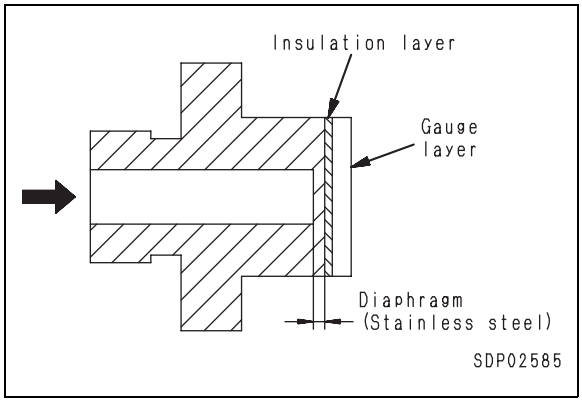
FUNCTION

- The PPC line has 10 pressure switches, the 12-station solenoid block has 4 pressure switches which check the operating condition of each actuator by the PPC pressure and transmit it to the governor/pump controller.

9.3. Pump pressure sensor



1. Sensor
2. Connector

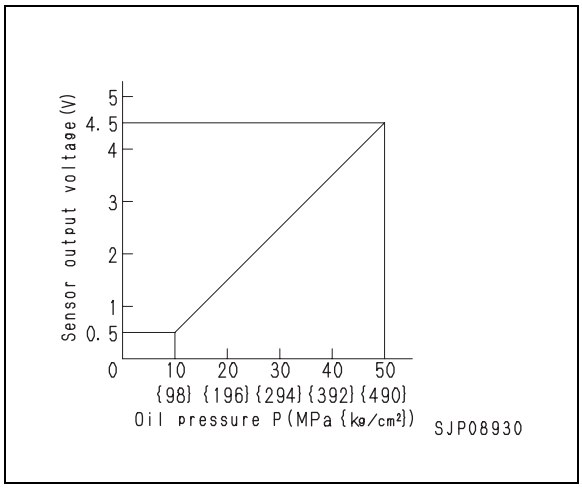


FUNCTION

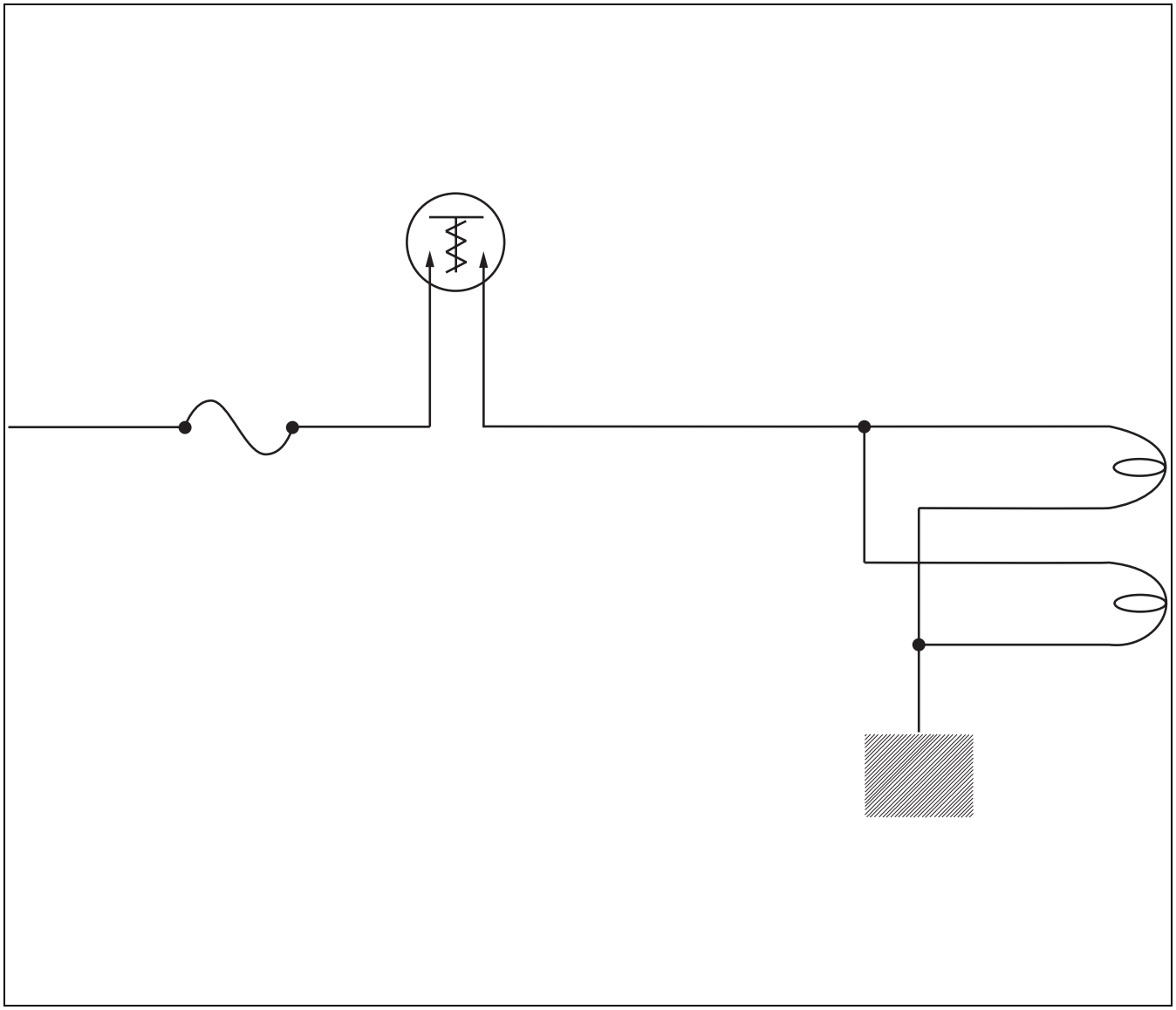
- The pump pressure sensor is installed to the inlet circuit of the control valve. It converts the pump discharge pressure into a voltage and transmits it to the governor/pump controller.

OPERATION

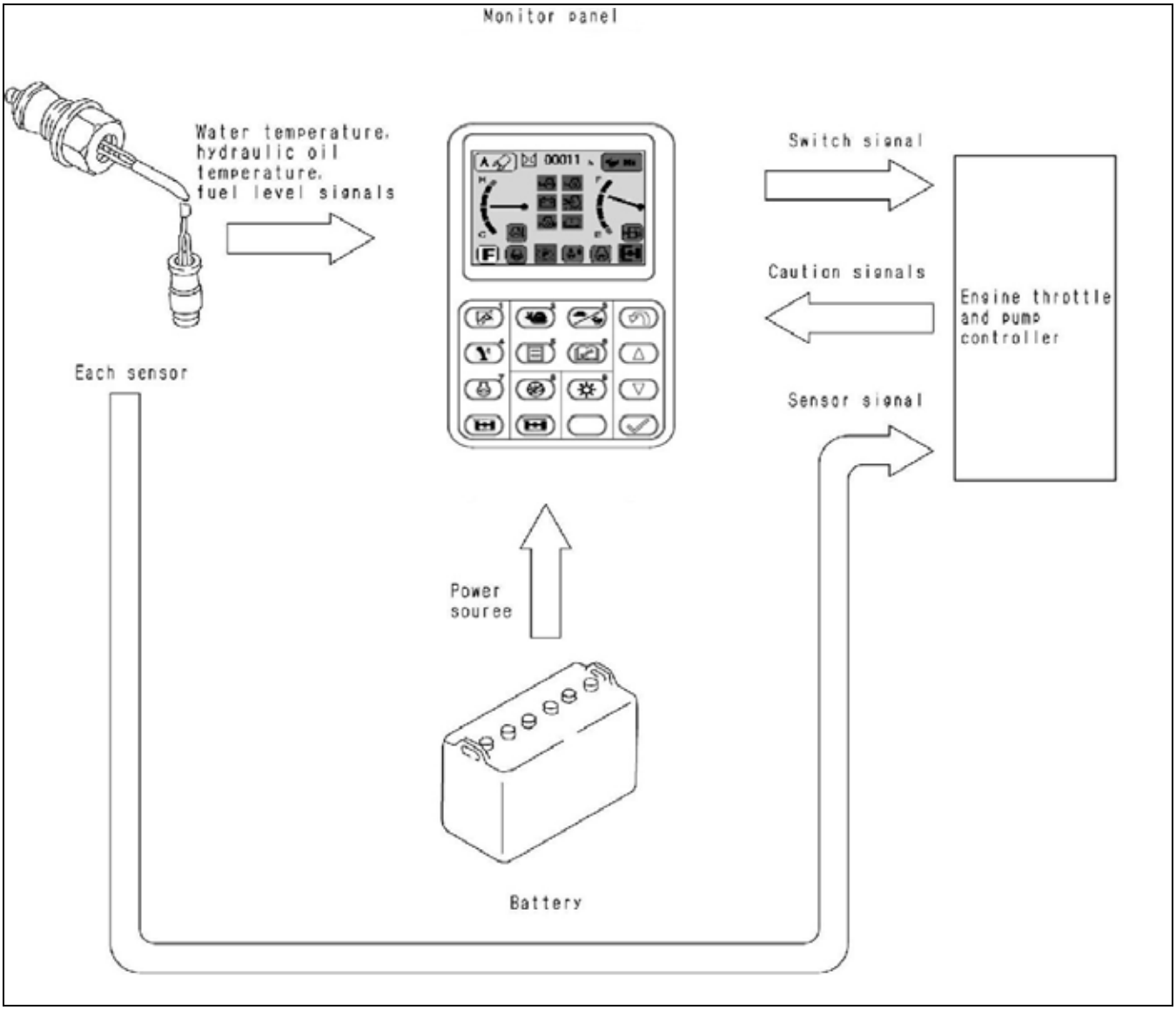
- The oil pressure applied from the pressure intake part presses the diaphragm of the oil pressure sensor, the diaphragm is deformed.
- The gauge layer facing the diaphragm measures the deformation of the diaphragm by the change of its resistance, then converts the change of the resistance into a voltage and transmits it to the amplifier (voltage amplifier).
- The amplifier amplifies the received voltage and transmits it to the governor/pump controller.
- Relationship between pressure P (MPa {kg/cm²}) and output voltage (V) is as follows.
  V = 0.08 [0.008] x P + 0.5.



10. Brake light control function



MACHINE MONITOR SYSTEM

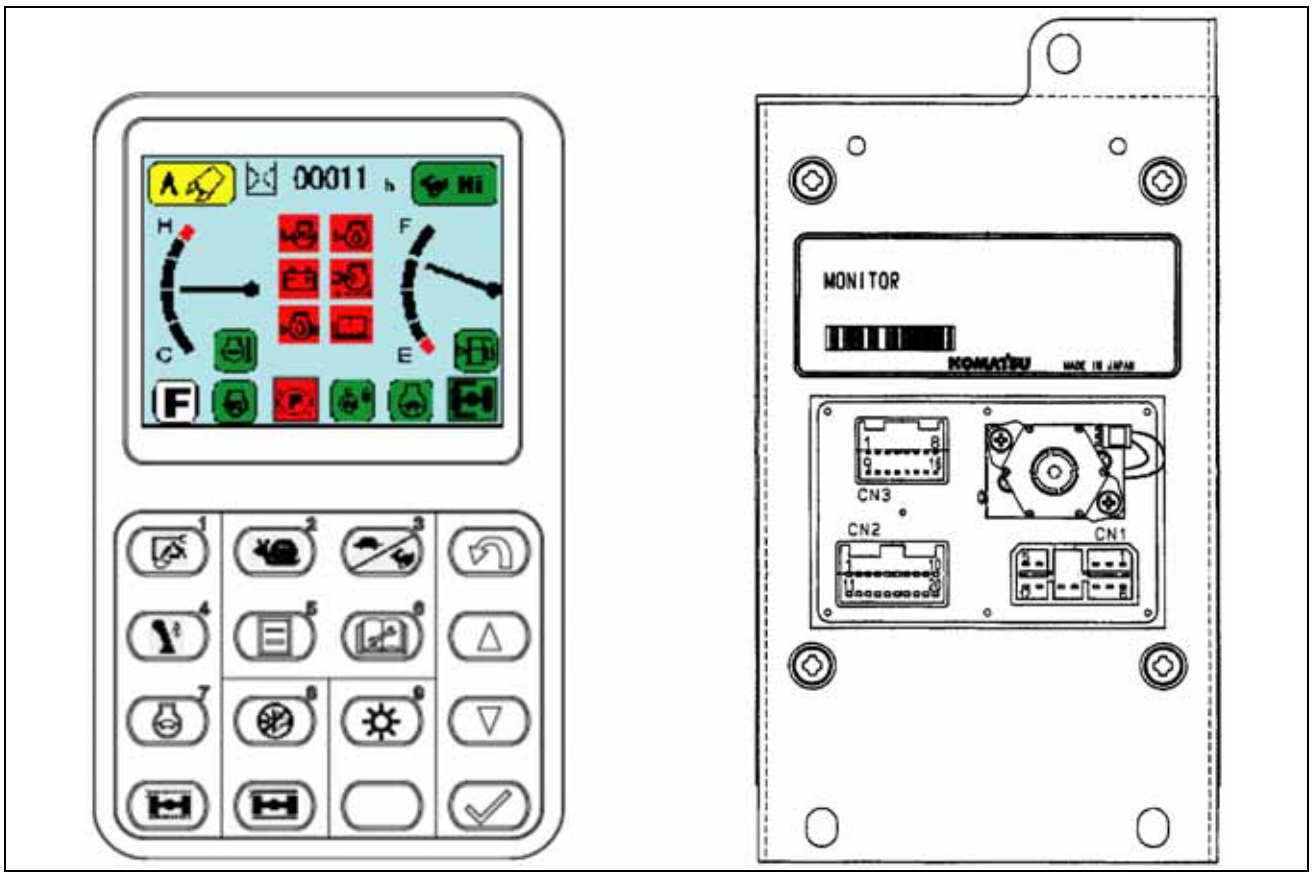


- The monitor system monitors the condition of the machine with sensors installed on various parts of the machine. It processes and immediately displays the obtained information on the panel notifying the operator of the condition of the machine.
  The panel is roughly divided as follows.

1. Monitor section to output alarms when the machine has troubles
2. Gauge section to display the condition constantly (Coolant temperature, hydraulic oil temperature, fuel level, etc.)

- The monitor panel also has various mode selector switches and functions to operate the machine control system.

MONITOR PANEL



OUTLINE

- The monitor panel has the functions to display various items and the functions to select modes and electric parts.

  The monitor panel has a CPU (Central Processing Unit) in it to process, display, and output the information.

  The monitor display unit consists of LCD (Liquid Crystal Display). The switches are flat sheet switches.

Input and output signals

CN1

Pin No.	Signal name	Input/ Output
1	Key ON (Battery)	Input
2	Key ON (Battery)	Input
3	Washer	Output
4	Key SW (C)	Input
5	Wiper (W)	Input
6	GND	-
7	GND	Input
8	VB+ (24V)	Input
9	Wiper (+)	Output
10	Wiper (-)	Input
11		
12	Wiper P	Input

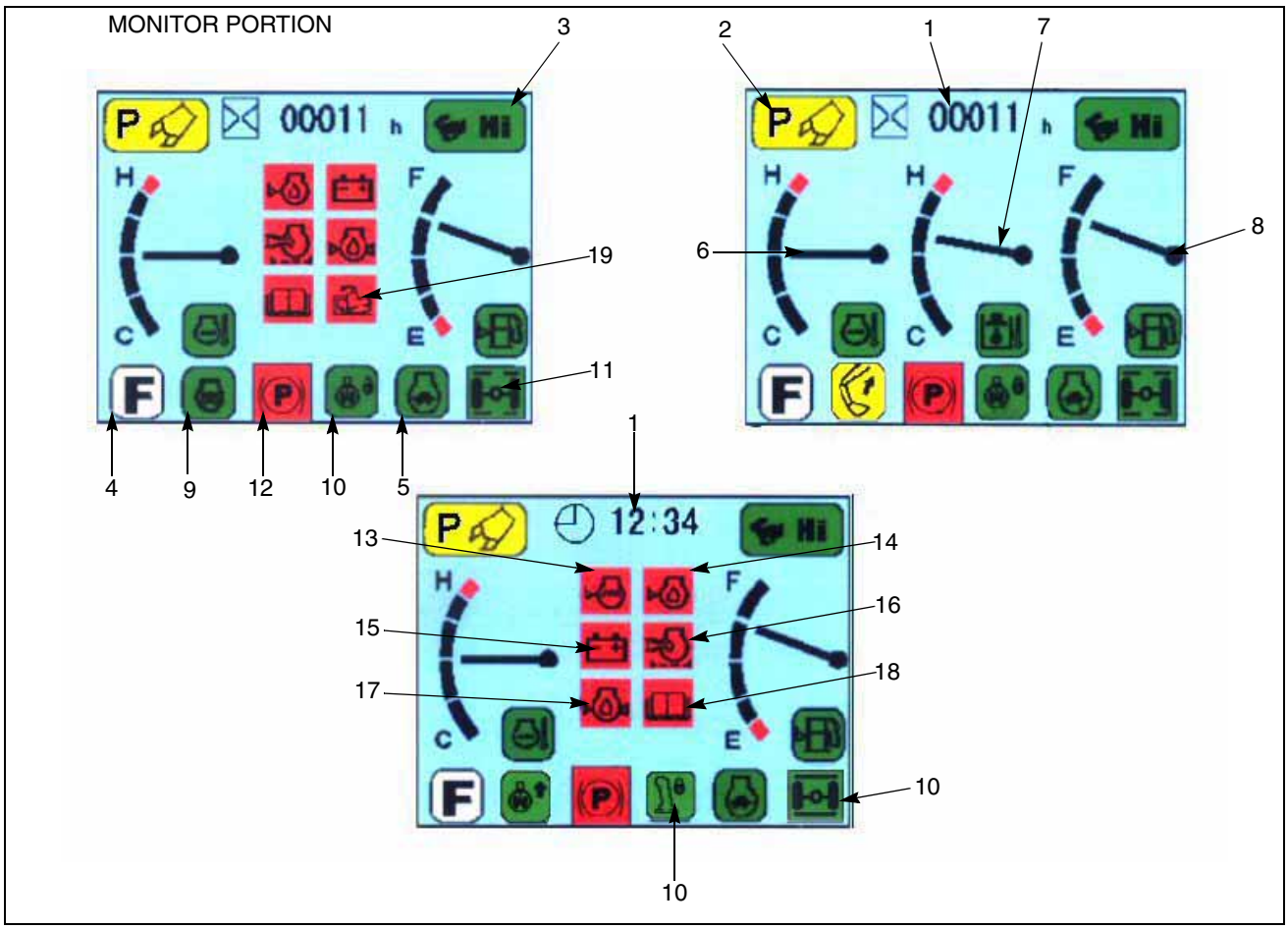
CN2

Pin No.	Signal name	Input/ Output
1		Input
2	Fuel level	Input
3	Coolant level	Input
4	Wiper switch (HI)	Input
5	Air cleaner clogging	Input
6	NC	Input
7	Wiper switch (INT)	Input
8	Engine oil level	Input
9	N/W signal	Input/ Output
10	N/W signal	Input/ Output
11	Charge level	Input
12	Hydraulic-oil temp	Input
13	GND (Analog)	Input
14	Starter cut relay output	Input
15	Window limit switch	Input
16	Washer switch	Input
17	Swing Lock	Input
18	Pre-heating	Input
19	Light switch input	Input
20	N/W GND	-

CN3

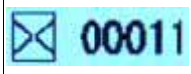
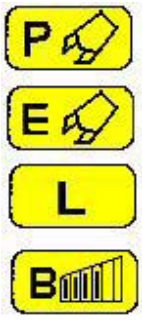
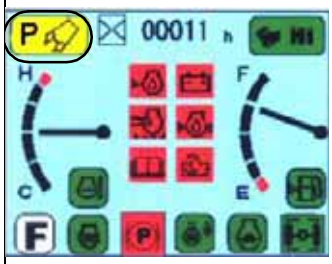
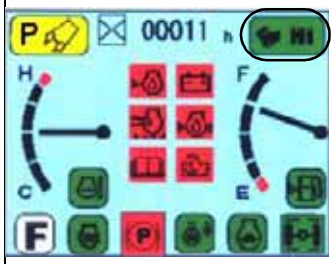
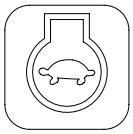
Pin No.	Signal name	Input/ Output
1		Input
2		Input
3		Input
4		Input
5		Input
6		Input
7	Serial CTS signal	Input
8	Serial RTS signal	Input
9	Serial TXD signal	Input/ Output
10	Serial RXD signal	Input/ Output
11	Boot switch	Input
12		Input
13	GND	-
14	CAN (Shield)	Input
15	CAN (+)	Input
16	CAN(-)	Input

MONITOR CONTROL, DISPLAY PORTION



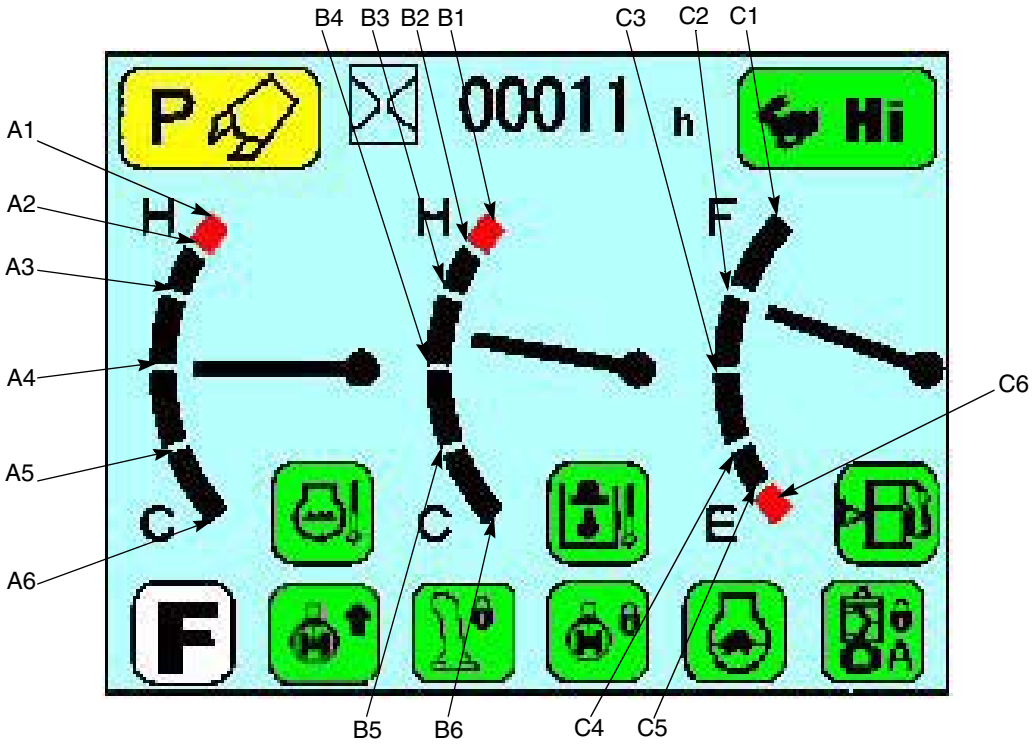
1.	Hour meter / Clock	11.	Suspension lock (Manual) / Suspension lock (Auto)
2.	Working mode	12.	Parking brake
3.	Travel modes	13.	Radiator level caution
4.	Travel direction	14.	Engine oil level caution
5.	Auto-deceleration	15.	Battery charge caution
6.	Engine water temperature gauge	16.	Air filter caution
7.	Hydraulic oil temperature gauge	17.	Engine oil pressure caution
8.	Fuel gauge	18.	Service interval warning
9.	Pre heating / One touch power up (Power max) / Upper structure position	19.	Overload caution
10.	Swing lock / PPC lock		

MONITOR ITEMS AND DISPLAY

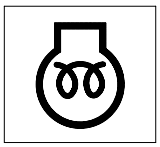
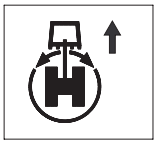
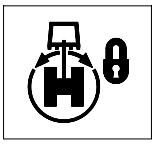
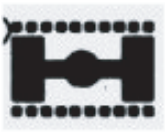
Item No.	Symbol	Display item	Display method	
1.		Service meter indicator	When service meter is	Lights up when service meter is working, engine not running and ignition is on.
		Clock	Other than above, clock is shown	
2.		Working mode	Displays set mode in top left hand corner of monitor as shown in diagram below. 	
3.		Travel speed	Displays set speed in top right hand corner of monitor. CR=Creep Lo=Low speed Hi=High speed At=Automatic 	
4.		Travel Directions	Displays the travel direction set by the 3 way switch on the right hand wrist control lever.	
5.		Auto-deceleration	ON ⇔ OFF	Displays actuation status
6.		Engine water temperature gauge	see “Monitor Gauge Displays” on page 179.	

Item No.	Symbol	Display item	Display method
7.		Hydraulic oil temperature gauge	see “Monitor Gauge Displays” on page 179.
8.		Fuel gauge	

Monitor Gauge Displays

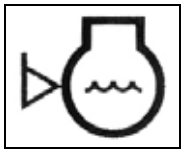
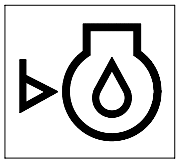
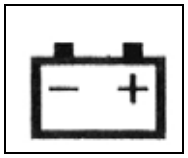
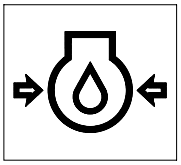
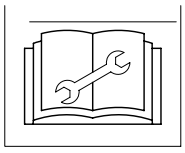


Gauge	Range	Temperature, volume	Indicator	Buzzer sound
Engine water temperature (°C)	A1	105	Red	Yes
	A2	102	Red	No
	A3	100	Green	No
	A4	80	Green	No
	A5	60	Green	No
	A6	30	White	No
Hydraulic oil temperature (°C)	B1	105	Red	Yes
	B2	102	Red	No
	B3	100	Green	No
	B4	80	Green	No
	B5	40	Green	No
	B6	20	White	No
Fuel level (l)	C1	325	Green	No
	C2	270	Green	No
	C3	216	Green	No
	C4	108	Green	No
	C5	78	Green	No
	C6	48	Red	No

<table>
<tr><th>Item No.</th><th>Symbol</th><th>Display item</th><th colspan="2">Display method</th><th>Priority</th></tr>
<tr><td rowspan="6">9.</td><td rowspan="4">  </td><td rowspan="4">Pre-heating</td><td>Continuous set time</td><td>Preheating monitor status</td><td rowspan="4">1</td></tr>
<tr><td>Up to 30 sec.</td><td>ON</td></tr>
<tr><td>From 30 sec. to 40 sec.</td><td>Flashes</td></tr>
<tr><td>More than 40 sec.</td><td>OFF</td></tr>
<tr><td rowspan="3">  </td><td rowspan="3">Power Max.</td><td>Power Max. switch status</td><td>Power max. monitor status</td><td rowspan="3">2</td></tr>
<tr><td>Being pressed</td><td>Lights up but goes out after approx. 9 sec. when kept pressed</td></tr>
<tr><td>Not being pressed</td><td>Flashes</td></tr>
<tr><td>  </td><td>Upper structure position</td><td colspan="2">When the upper structure is correctly positioned facing forward this display is constant. If the position is slightly off this display flashes</td><td>3</td></tr>
<tr><td rowspan="3">10.</td><td rowspan="3">  </td><td rowspan="3">Swing lock</td><td>Swing lock switch</td><td>Swing lock monitor</td><td rowspan="3">2</td></tr>
<tr><td>OFF</td><td>OFF</td></tr>
<tr><td>ON</td><td>ON</td></tr>
<tr><td>  </td><td>PPC lock</td><td colspan="2">When PPC lock switches in the ON position this display is ON.</td><td>1</td></tr>
<tr><td rowspan="2">11.</td><td>  </td><td>Automatic suspension lock</td><td colspan="3">When displayed:
Travel pedal operated - suspension lock OFF
Travel pedal not operated - suspension lock ON</td></tr>
<tr><td>  </td><td>Manual suspension lock</td><td colspan="3">When displayed:
Suspension lock ON</td></tr>
<tr><td>12.</td><td>  </td><td>Parking brake</td><td colspan="3">When displayed: Park brake ON
When not displayed: Park brake OFF</td></tr>
</table>

Checks before starting (caution lamps all light up), when maintenance interval is exceeded.

If the checks before starting or maintenance interval is exceeded items light up, the display of the hydraulic oil temperature gauge and the hydraulic oil temperature display are stopped, and the following cautions are displayed.

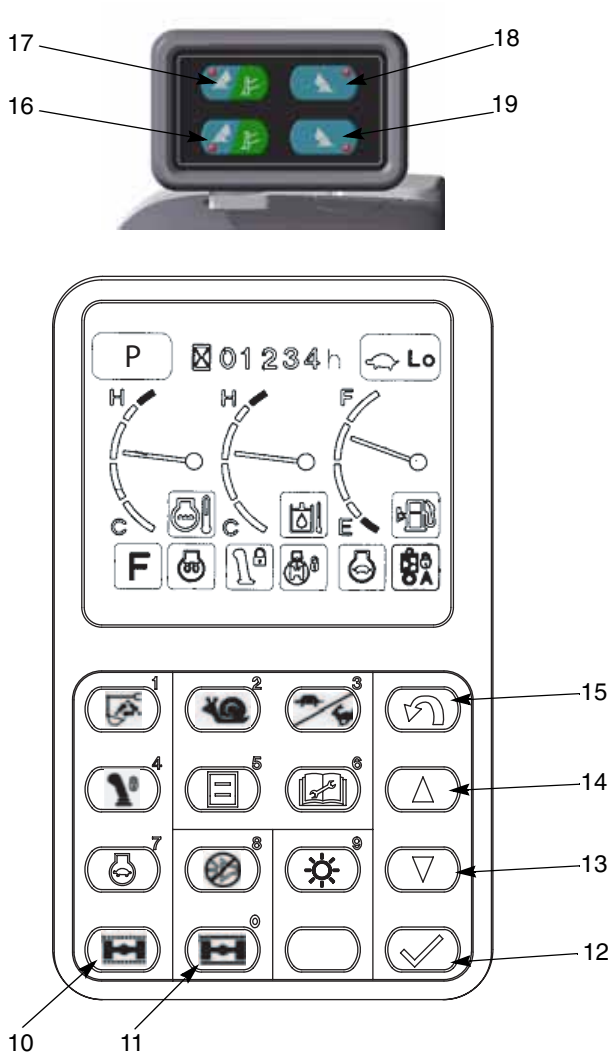
Item No.	Symbol	Display item	Check before starting item	When engine is stopped	When engine is running
13.		Radiator water level	Yes	Lights up when abnormal	When abnormal, lights up and buzzer sounds
14.		Engine oil level	Yes	Lights up when abnormal	--
15.		Battery charge	Yes	--	Lights up when abnormal
16.		Air filter blocked	Yes	--	Lights up when abnormal
17.		Engine oil pressure	Yes	--	When abnormal, lights up and buzzer sounds
18.		Service interval	No	Lights up when maintenance is due. Lights up for only 30 sec. after key is turned ON, then goes out.	
19.		Overload caution	Yes	When in L mode: Lights up when abnormal and buzzer sounds	

The problems that have occurred are displayed in order from the left.

When the above cautions are displayed, if the hydraulic oil temperature is high or low, only the symbol is displayed.

Condition of hydraulic oil	Colour of symbol
Low temperature (below B6 or equivalent)	Black on white background
Normal (B6 - B2)	No display
High temperature (below B2)	White on red letters

KEYPAD LAYOUT



(1) Working mode select
(2) Creep speed
(3) High/low speed select
(4) Control lever lock
(5) Menu select key
(6) Service menu
(7) Engine auto deceleration
(8) Buzzer cancel
(9) Brightness adjust
(10) Suspension auto lock
(11) Suspension lock
(12) Accept key
(13) Scroll down
(14) Scroll up
(15) Undo key
(16) Rear left outrigger/blade
(17) Front left outrigger/blade
(18) Front right outrigger
(19) Rear right outrigger

1. WORKING MODE SELECTOR SWITCH (BASIC SWITCH)

This switch (1) is used to set the power and movement of the work equipment.

Operations can be carried out more easily by selecting the mode to match the type of operation.

P mode: For heavy-load operations

E mode: For operations with emphasis on fuel economy

L mode: For fine-control operations and lifting

B mode: For breaker operations

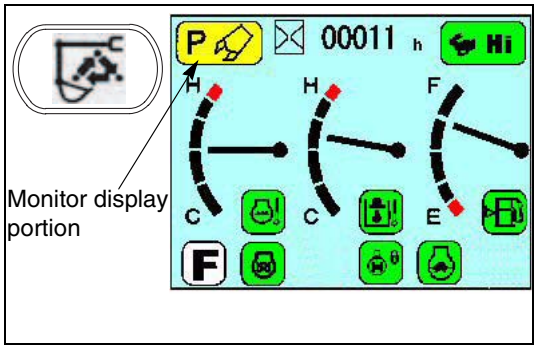
- When the engine is started, the working mode is set automatically to P mode. When the switch is pressed, the system will scroll through each mode in turn. The display on the monitor display portion changes for each mode.
- If you require a default setting other than 'P mode' please consult your Komatsu distributor or dealership to have the setting amended.

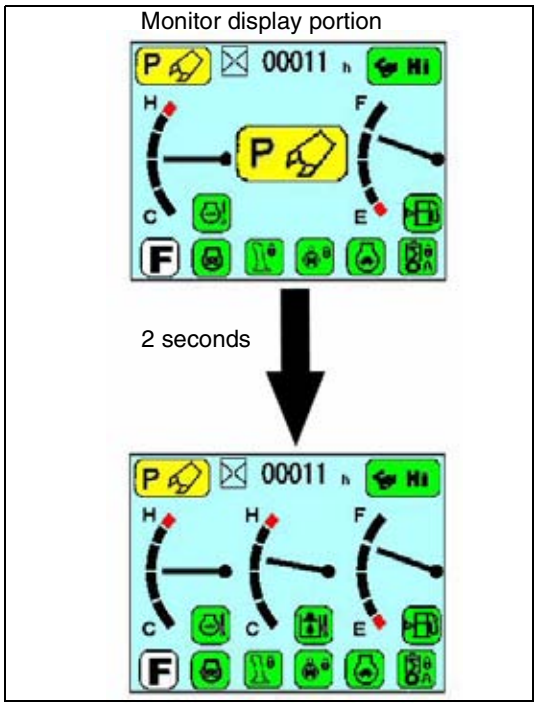
REMARK

When the mode selector switch is pressed, the mode is displayed in the centre of the monitor display, and the screen returns to the normal screen after 2 seconds. (The diagram on the right is an example of the display for the P mode.)

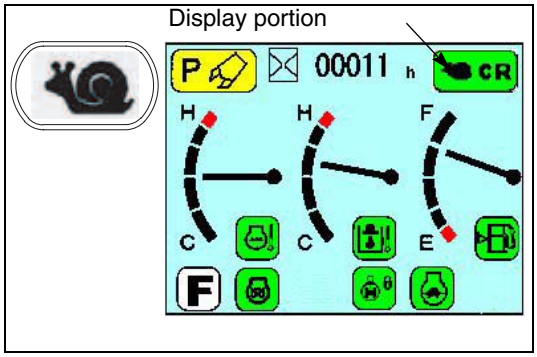
⚠ WARNING

When using the breaker, do not use P mode. There is danger that the breaker may be damaged.





2. CREEP SPEED SELECTOR SWITCH



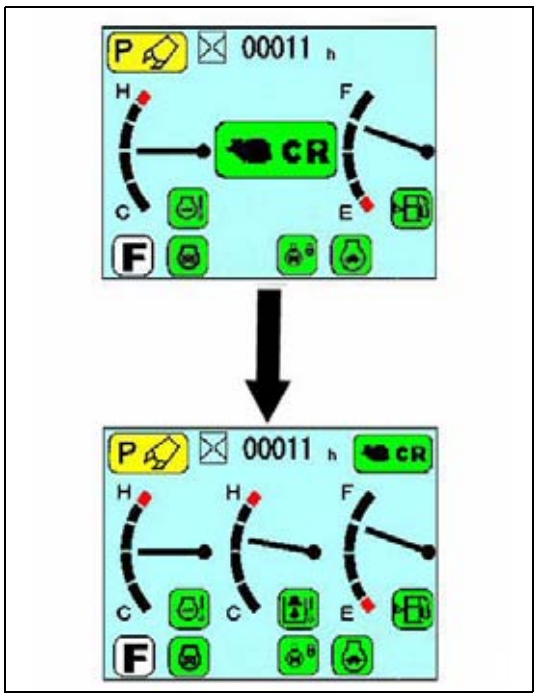
This switch (2) is used to set the travel mode to creep.

CR lights up: Creep mode travel (0-2.5kph).

To cancel creep speed, press Hi/Lo switch (3).

REMARK

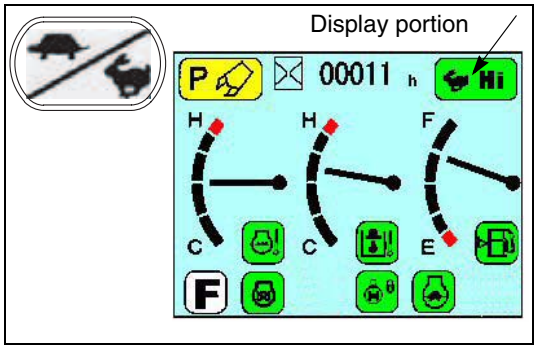
When creep speed is selected the mode is displayed in the centre of the screen for 2 seconds before returning to the normal screen display.



3. HIGH/LOW SPEED SELECTOR SWITCH

This switch (3) is used to set the travel speed in 3 stages.

Lo lights up:	Low-mode travel
Hi lights up:	Hi-mode travel
AT lights up:	Auto mode travel

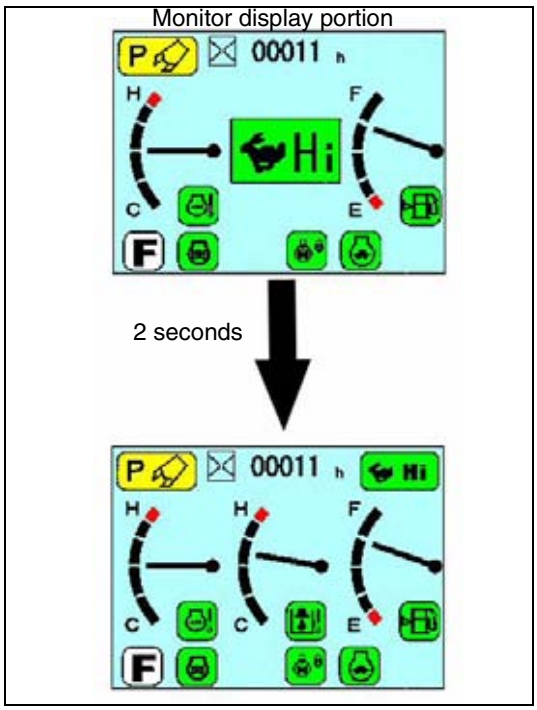


When the engine is started, the speed is automatically set to the last value before engine was stopped.

Each time that the switch is pressed, the display changes Lo→Hi→At→Lo in turn.

When travelling in auto mode (AT), if more travel torque is needed, such as when traveling on soft ground or on slopes, the speed automatically switches to low speed (Lo), so there is no need to operate the switch.

- When loading or unloading from a trailer, always travel at low speed. Never operate the travel speed selector switch during the loading or unloading operation.



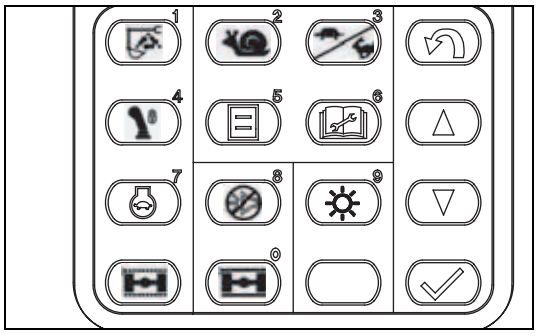
REMARK

Each time that the travel speed selector switch is operated, the mode is displayed in the centre of the monitor display, and the screen returns to the normal screen after 2 seconds.

4. CONTROL LEVER LOCK SWITCH

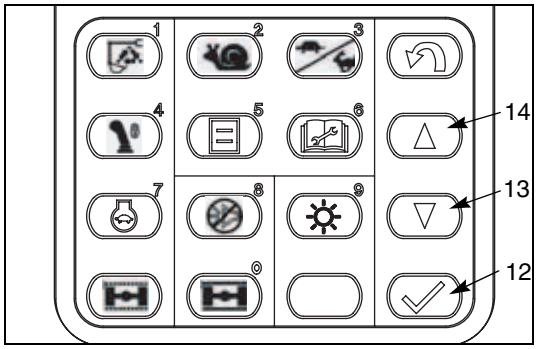
Depressing control lever lock switch will stop lever functionality. Lever lock switch must be engaged when machine travels on highway to prevent accidental use of work equipment.

The display will illuminate on the monitor when active.

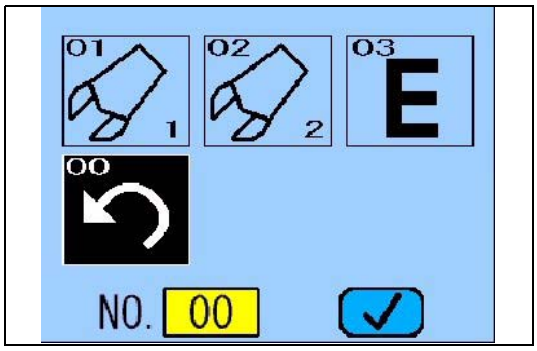


5. MENU SELECT SWITCH

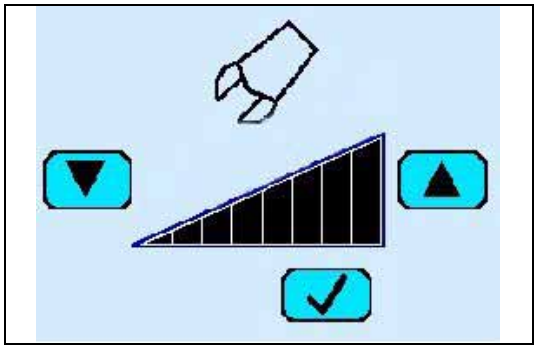
1. This switch (5) is used to select the attachment hydraulic flow setting in each of the working modes P, E, and B.



2. When the working mode is P or E
3. Press select switch (5) and the normal screen on the monitor display changes to the screen shown in the diagram on the right.

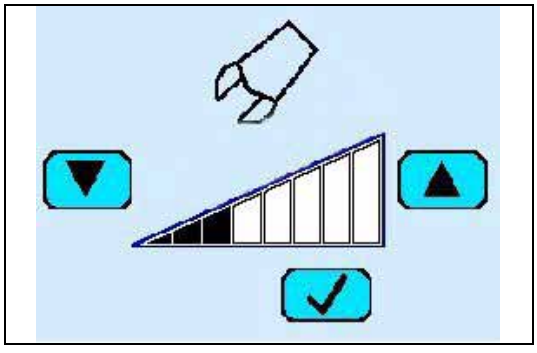


4. Select 01 from the screen and the monitor display changes to the flow setting screen shown on the right (Full flow). By pressing down switch (13) the flow can be reduced.



OR

Select 02 from screen and the monitor display changes to the flow setting on the right. Press up switch (14) or down switch (13) to adjust to the desired flow.



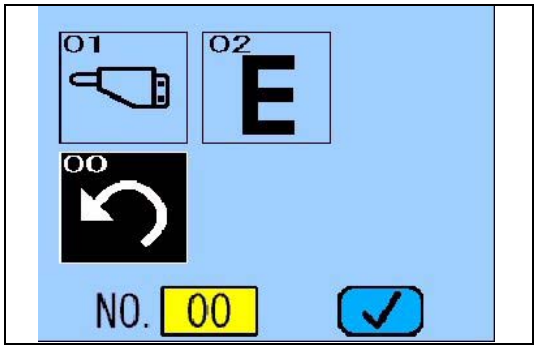
5. After completing the flow setting, press input confirmation switch (12).
   The monitor display will return to the normal screen.

REMARK

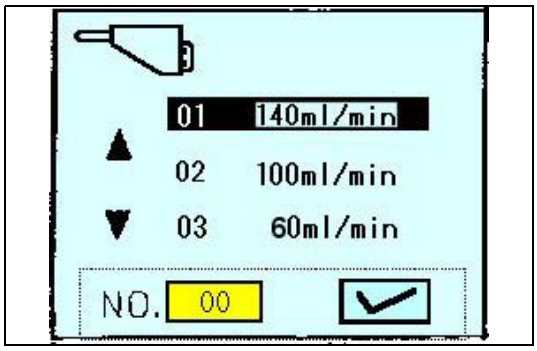
The flow can be adjusted for the attachment installed.

- When the working mode is B mode

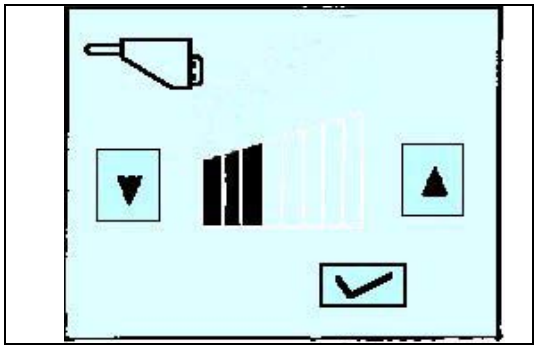
1. Press menu select switch (5) and the normal screen on the monitor display changes to the screen shown in the diagram on the right.



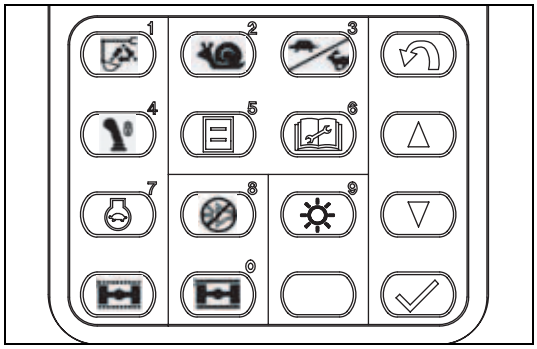
2. Select 01 from screen and the monitor display changes to the flow setting screen shown on the right.
3. Press up switch (14) or down switch (13) to adjust to the desired flow.
4. After completing the flow setting, press input confirmation switch (12).



5. With the operation in Step 3, the flow setting screen changes to the fine flow adjustment screen shown in the diagram on the right.
6. Press up switch (14) or down switch (13) to adjust to the desired flow.
7. After completing the flow setting, press input confirmation switch (12).
   The monitor display will return to the normal screen.



6. SERVICE MENU SWITCH



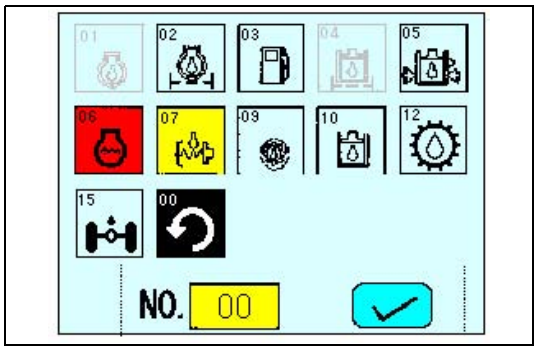
- This switch (6) is used to check the time remaining to maintenance.
- When this switch (6) is pressed, the screen on the monitor display changes to the maintenance screen shown in the diagram below right.

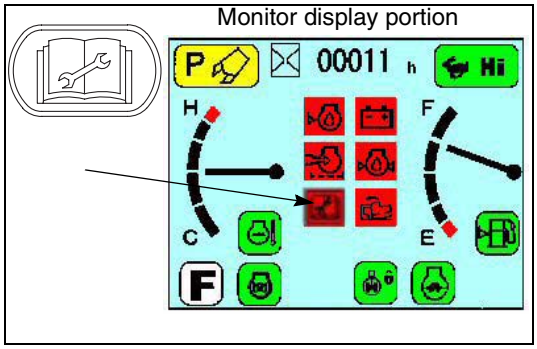
  The time remaining to maintenance is indicated by the color of each monitor display. After confirming the maintenance time, carry out the maintenance.

  White display:More than 30 hours remaining to maintenance

  Yellow display:Less than 30 hours remaining to maintenance

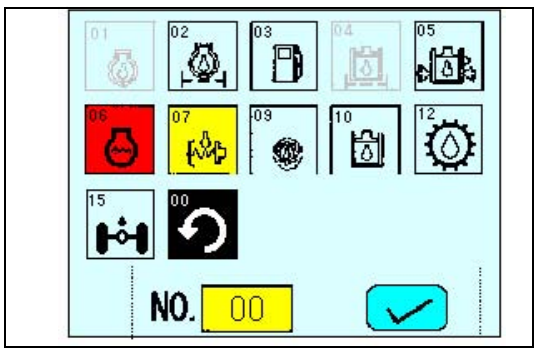
  Red display:Maintenance time has already passed





NOTICE

- **If the monitor display changes to the maintenance warning screen when the engine is started or when the machine is being operated, stop operations immediately. When this happens, the monitor corresponding to the maintenance warning screen will light up red.**
- **Press switch (6) to display the maintenance screen and check that there is no abnormality in any other monitor.**
- **If another monitor is lit up red on the maintenance screen, carry out maintenance for that item also.**
- The maintenance display items are as follows.

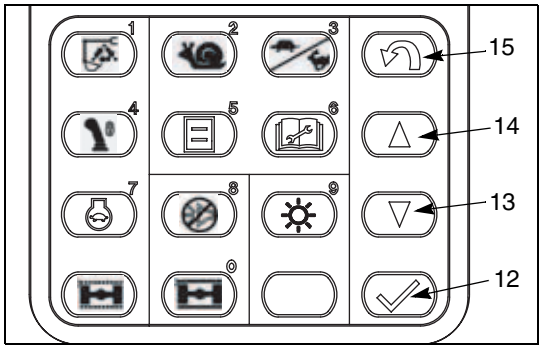


Monitor No.	Maintenance item	Default set screen (H)
01	Change engine oil	500
02	Replace engine oil filter	500
03	Replace fuel filter	500
04	Replace hydraulic oil filter	1000
05	Replace hydraulic tank breather	500
07	Check damper case oil level, add oil	1000
09	Change swing machinery case oil	1000
10	Change hydraulic oil	5000
12	Change transmission oil	1000
15	Change axle oil	1000

If it is desired to change the setting for the maintenance interval, please contact your Komatsu distributor.

- The method of checking the time remaining to maintenance is as follows.

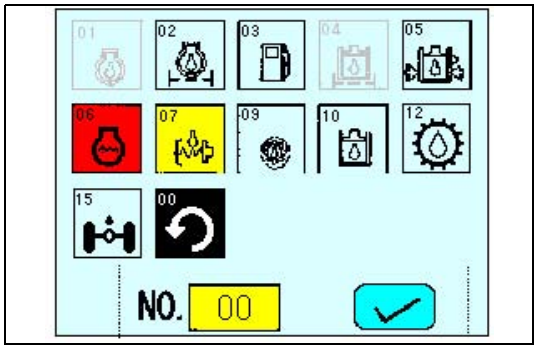
1. Look at the maintenance screen, press up switch (14) or down switch (13) on the monitor switch portion, until required item is highlighted.
   (The colour of the monitor for the selected item is inverted to black)



REMARK

It is possible to enter the number of the item from the keypad (i.e. enter 12 for transmission oil)

2. After highlighting the monitor item, press input confirmation switch (12). The display screen will switch to the time remaining to maintenance.
   (Press back switch (15) to return to the previous screen.)



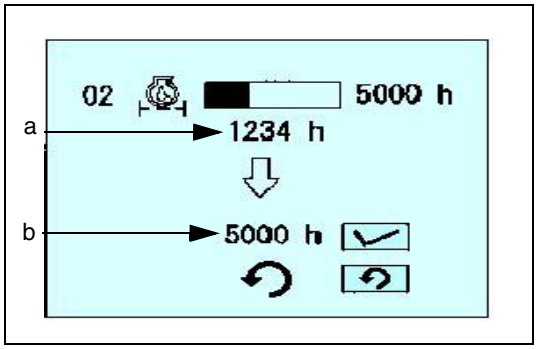
3. Check the time remaining to maintenance.
   (a): Time remaining to maintenance

   (b): Default setting for maintenance interval

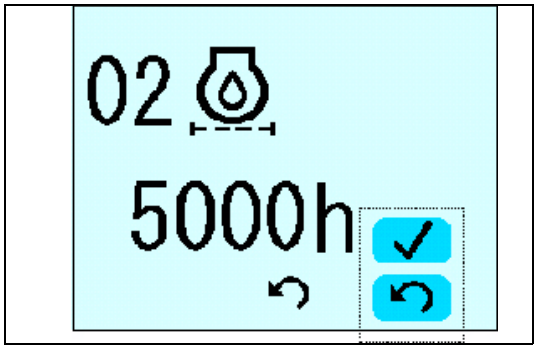
   When only checking the time remaining to maintenance, press back switch (15) twice.

   The screen will return to the normal operation monitor screen.

   When canceling the time remaining to maintenance and returning to the default time setting, press input confirmation switch (12). The screen will switch to the default setting screen.



4. After checking the time on the default setting screen, press input confirmation switch (12).
   The screen will return to the maintenance screen.
   (Press back switch (15) to return to the previous screen.)



7. AUTO-DECELERATION SWITCH

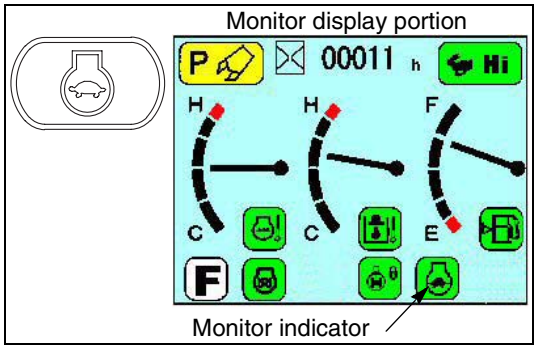
When this auto-deceleration switch (7) is depressed, the auto-deceleration is actuated. If the control levers and foot pedals are in the neutral position, the engine speed is automatically lowered to reduce fuel consumption.

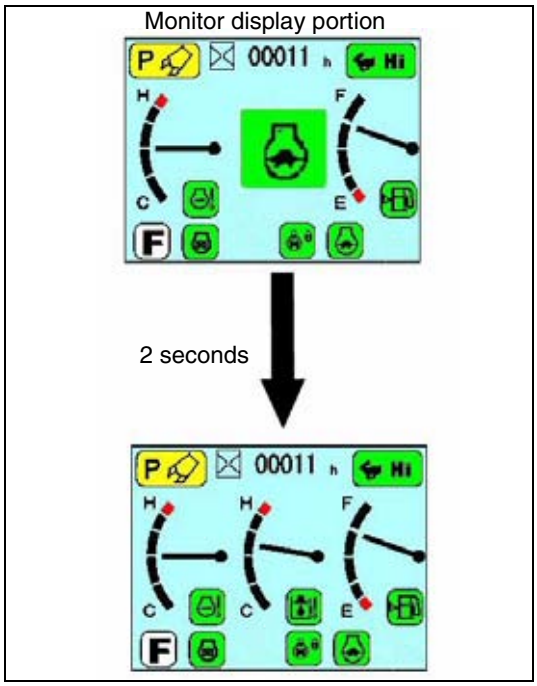
Monitor display ON: Auto-deceleration actuated.

Monitor display OFF: Auto-deceleration cancelled.

REMARK

When the auto-deceleration switch is pressed and the auto-deceleration is actuated, the mode is displayed in the centre of the monitor display, and the screen returns to the normal screen after 2 seconds.



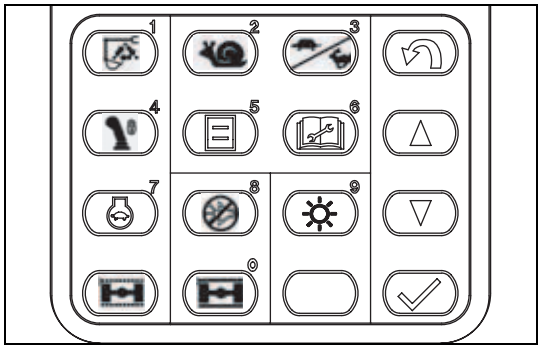


8. BUZZER CANCEL SWITCH

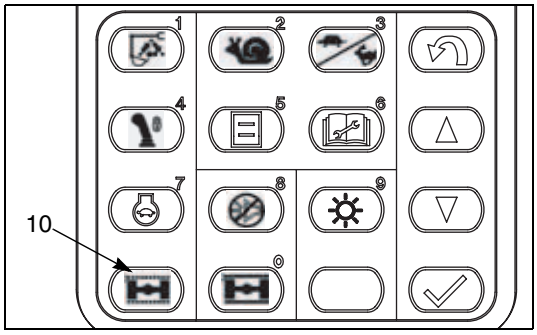
This is used to stop the alarm buzzer when it has sounded to warn of some abnormality that has occurred whilst the machine is operating.

9. CONTRAST ADJUSTMENT SWITCH

When the contrast adjustment switch (9) is depressed this brings up the adjustment menu. For more information see “ADJUSTMENT SCREENS” on page 194.



10. AUTOMATIC SUSPENSION LOCK SWITCH



Release the front axle suspension lock, using switch.

Press switch (10) for Front axle suspension 'auto' mode i.e. when travel pedal is depressed, front axle suspension travels freely and when travel pedal is not depressed, front axle suspension is locked, as long as machine is stationary. To disengage press (10) again.

The auto suspension lock indicator will illuminate when automatic suspension lock is selected.

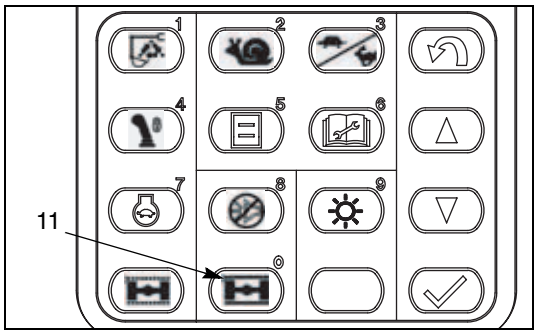
⚠ WARNING

Take care when using undercarriage attachments to stabilize the machine, and suspension lock simultaneously, as locked front axle may suddenly become free.

REMARK

Permanent and automatic suspension lock cannot be active at the same time. Each mode can be turned on and off by their individual switches.

11. PERMANENT SUSPENSION LOCK SWITCH

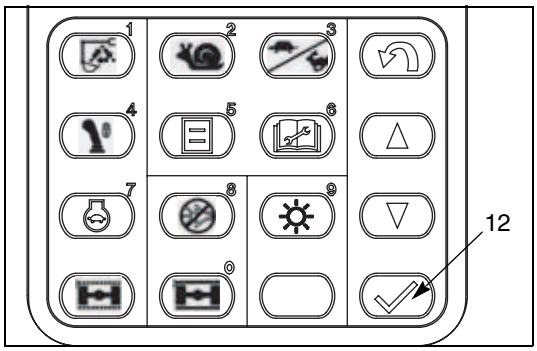


Press switch (11) in order to engage permanent front axle lock. Front axle will be fixed in place when engaged, the permanent suspension lock indicator will illuminate. To disengage lock, press switch (11) again.

REMARK

When front axle is locked it is not possible to travel in high. If high speed travel is selected, axle will not lock.

12. INPUT CONFIRMATION SWITCH



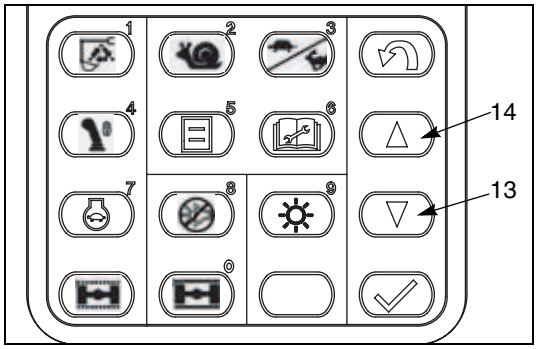
Press this switch (12) to confirm the selected mode when in the maintenance mode, brightness/contrast adjustment mode, or select mode.

13. SCROLL DOWN

14. SCROLL UP

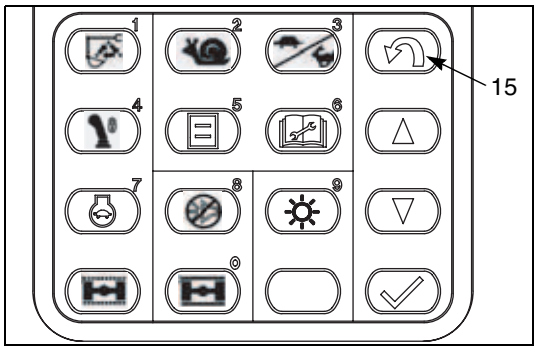
Press up switch (14) or down switch (13) when in the menu screens will allow you to move up and down the menu options.

In certain menus they can also be used to increase and decrease displayed values (i.e. breaker force)



15. UNDO SWITCH

Pressing switch (15) whilst in the monitor menu screens, will return you back to the previous screen displayed.



16. REAR LEFT OUTRIGGER/BLADE SWITCH

This switch enables selection of rear left outrigger or rear blade Light illuminates when active.

17. FRONT LEFT OUTRIGGER/BLADE SWITCH

This switch enables selection of front left outrigger / front blade. Light illuminates when active.

18. FRONT RIGHT OUTRIGGER SWITCH

Allows operation of front right outrigger only.

Light on switch illuminates when activated.

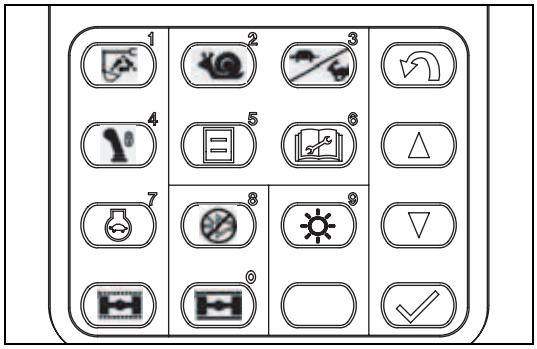
19. REAR RIGHT OUTRIGGER SWITCH

Allows operation of rear right outrigger.
Light on switch illuminates when activated.



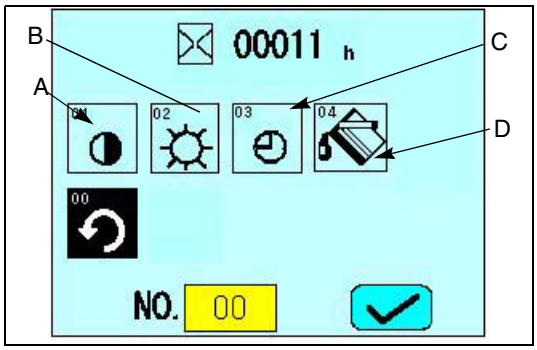
LIQUID CRYSTAL MONITOR ADJUSTMENT SWITCH

Press switch (9) to adjust the brightness and contrast of the monitor display screen.



ADJUSTMENT SCREENS

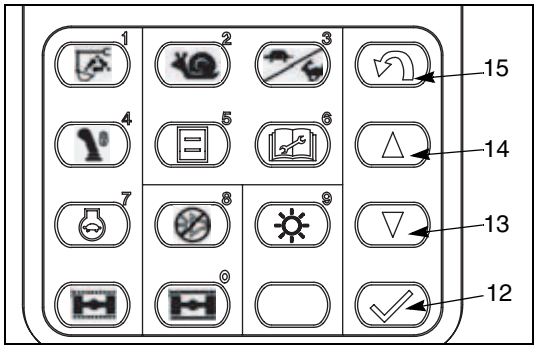
1. When contrast adjustment switch (9) is pressed, the monitor display screen changes to the screen shown in the diagram on the right.

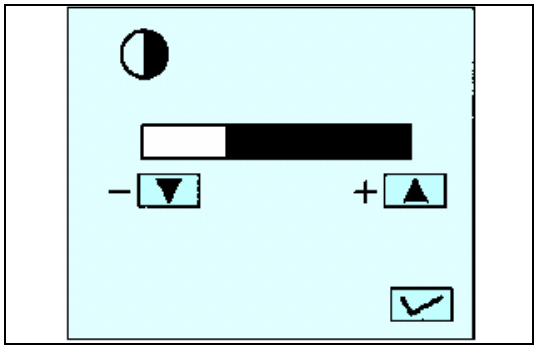


(A)	Contrast adjust
(B)	Brightness adjust
(C)	Clock adjust
(D)	Background adjust

- (A).Adjusting contrast

2. Use the brightness/contrast screen and press up switch (14) or down switch (13) to select the contrast monitor.
   (The selected monitor is inverted to black.)
3. When the screen changes to the contrast adjustment screen, press up switch (14) or down switch (13) to adjust the contrast.
4. After completing adjustment of the contrast, press input confirmation switch (12). This will store the new setting and return you to the adjustment menu.

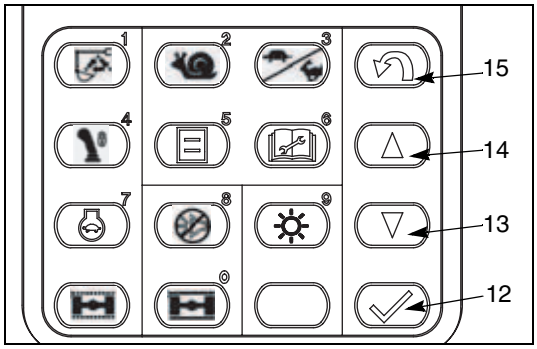




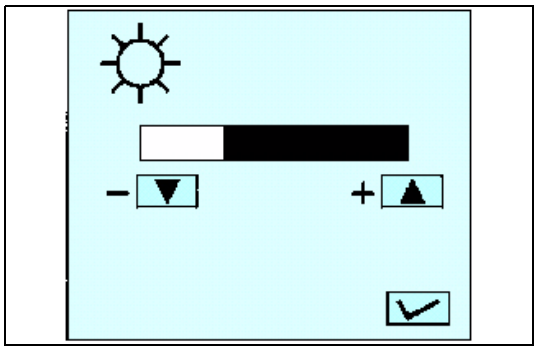
REMARK

As normal, within any menu, press switch (15) to return to the previous screen at any time.

- (B). Adjusting brightness

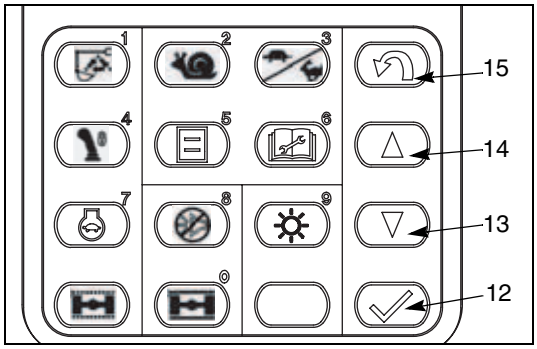


1. Use the adjustment screen and press up switch (14) or down switch (13) to select the brightness monitor.
   (The selected monitor is inverted to black.)

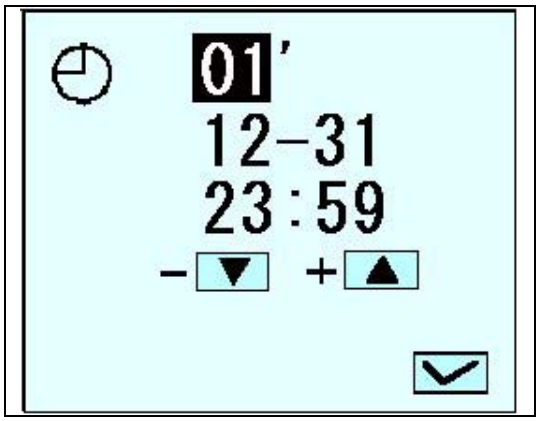


2. When the screen changes to the brightness adjustment screen, press up switch (14) or down switch (13) to adjust the brightness.
3. After completing adjustment of the brightness, press input confirmation switch (12). This will return you to the above menu and store the new setting.

- (C). Adjusting the clock



1. Use the adjustment screen and press up switch (14) or down switch (13) to select the clock monitor.
   (The selected monitor is inverted to black.)
2. When the screen changes to the clock adjustment screen, press up switch (14) or down switch (13) to adjust the year, to move to the date press input confirmation switch (12), the order in which the cursor moves is shown below:

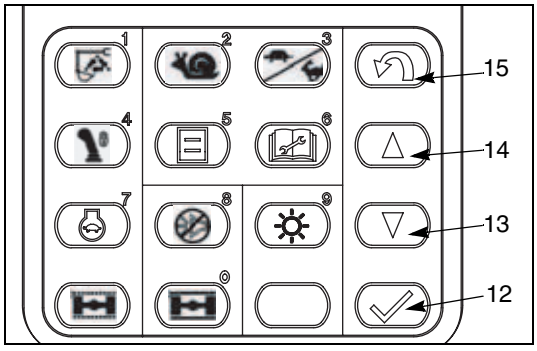


Year → Month → Day → Hour → Minute

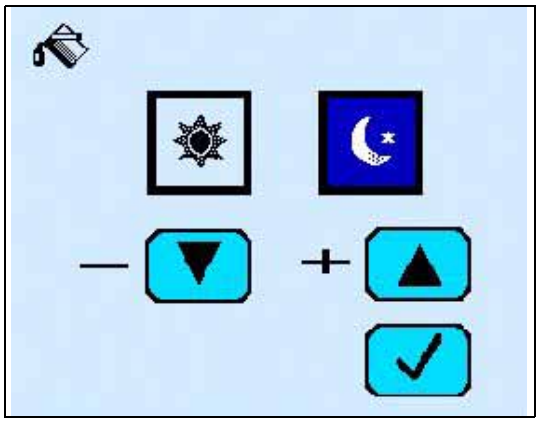
3. After completing adjustment of the clock, press input confirmation switch (12). This will return you to the above menu and store the new setting.

- (D). Adjusting background colour

1. Use the adjustment screen and press up switch (14) or down switch (13) to select the background colour monitor.
   (The selected monitor is inverted to black.)
2. When the screen changes to the background colour adjustment screen, press up switch (14) or down switch (13) to adjust the colour day time and for night time, the different combinations of colours are shown below: Day time/Night time.



Light blue/Dark blue ⟶ Dark blue/Light blue

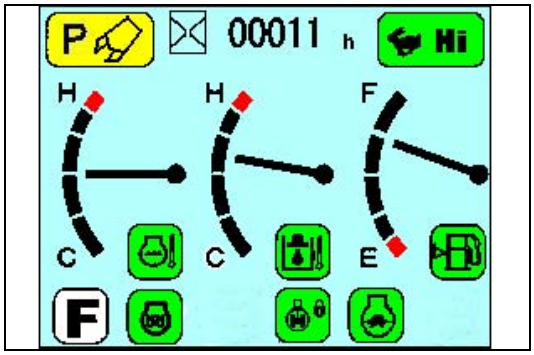


3. After completing adjustment of the background colour, press input confirmation switch (12). This will return you to the above menu and store the new setting.

PASSWORD FUNCTION

- If the password function is active, the engine will not start unless the password is input correctly when starting.
- When setting this function or when changing the password, it is necessary to go from the normal screen to the setup screen and input the pass word.

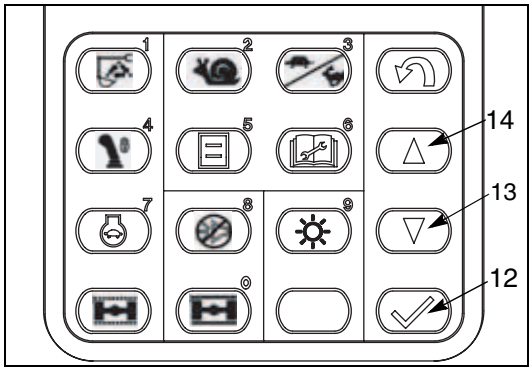
  This becomes possible 10 minutes after the starting switch is turned ON and the monitor screen has changed to the normal screen.

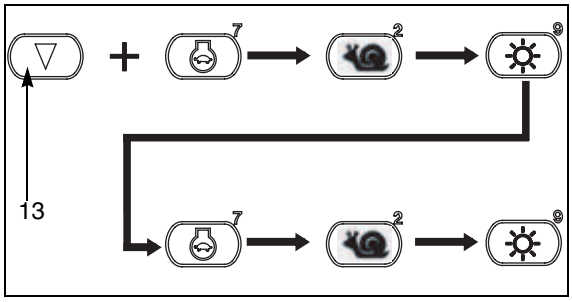


METHOD OF SETTING, CHANGING PASSWORD

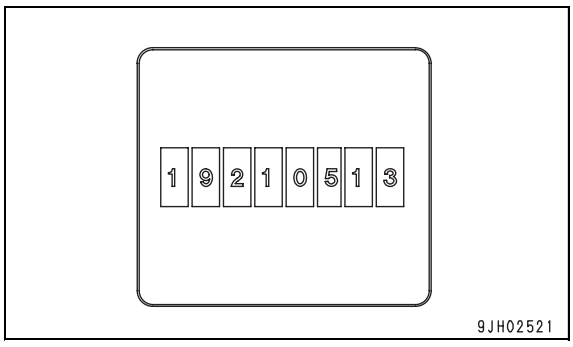
1. Turn Starter key switch to 'on' position (wait 10 minutes). Press and hold down switch (13). Using the 10 digit key pad, input the following number sequence: 7->2->9->7->2->9

   If input correctly, the display screen will change to an 8 digit numerical input screen.



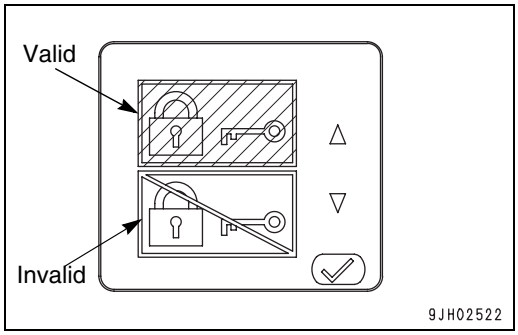


2. On the input screen, use the 10-key pad to input an 8-digit number [19210513]. When the final digit [number 3] is input, the screen will change to the Valid/Invalid screen for the password function.



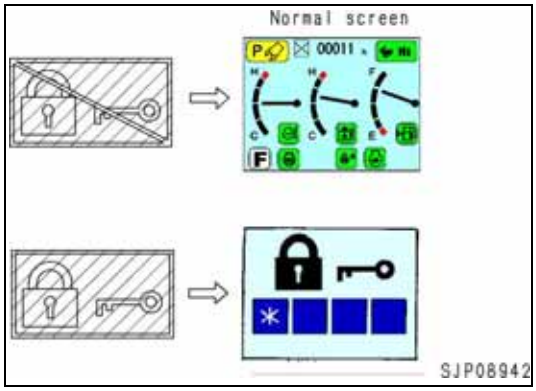
3. Press control switch (14) or (13) to set to Valid/ Invalid.

   The diagram on the right shows the screen when control switch (13) is pressed and the screen is set to [Valid].



   If [Invalid] is selected and input confirmation switch (12) is pressed, the password function will be made invalid, and the screen will return to the normal screen.

   If [Valid] is selected and input confirmation switch (12) is pressed, the password function will be made valid, and the screen will change to the screen for inputting the 4-digit number.

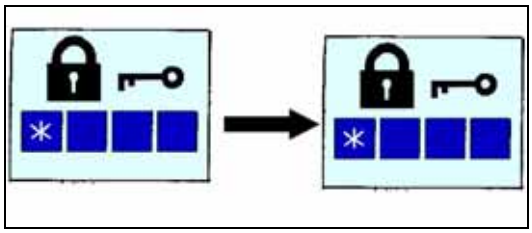


4. Input a 4-digit number on the input screen (the lock and key symbol are displayed), then press input confirmation switch (12).

   When the input confirmation switch is pressed, you will be requested to input the same 4-digit number again, so input the same 4-digit number, then press input confirmation switch (12) to confirm the password.

   Numerals 1 and 2 are displayed at the top right corner of the screen to distinguish between the 1st input screen and the 2nd input screen.

   When the password is confirmed, the screen will return to the normal screen.

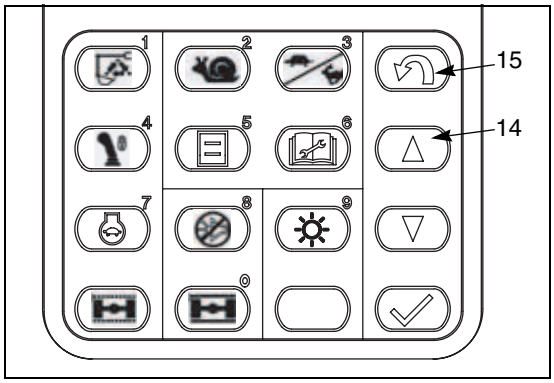


NOTE: If the number input the second time is different from the number input the first time, the password will not be confirmed and the screen will return to the first screen, so input the same 4-digit password 2 times in succession.

SERVICE METER CHECK FUNCTION

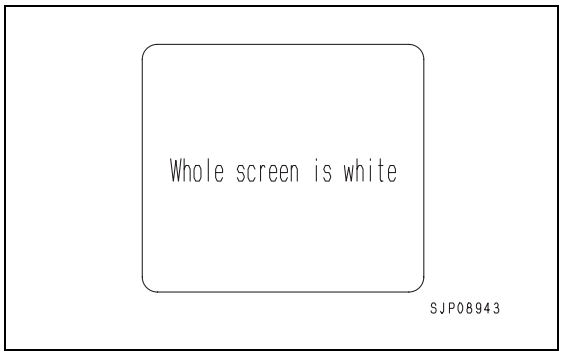
- When the starting switch is in the OFF position, press return switch (15) and control switch (14) of the monitor at the same time, and the service meter will be shown on the display.
- This display is shown only while the two switches are being pressed. When the switches are released, the display goes out.

NOTE: It takes 3 - 5 seconds after the switches are pressed for the service meter display to appear.



DISPLAY LCD CHECK FUNCTION

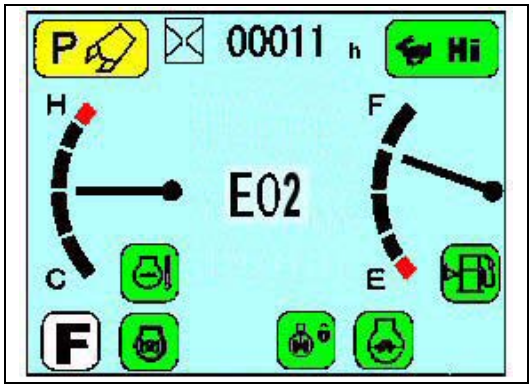
- On the password input screen or on the normal screen, if monitor return switch (15) and working mode (A) switch are kept pressed at the same time, all the LCD display will light up and the whole screen will become white, so the display can be checked.
- If any part of the display is black, the LCD has been damaged.



USER CODE DISPLAY FUNCTION

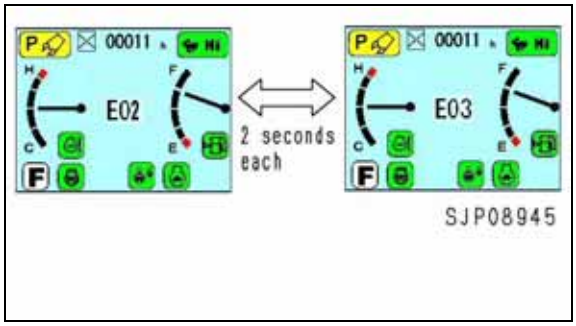
- If there is any problem in operating the machine, the user code is displayed on the monitor to advise the operator of the steps to take.

  This code display appears on the operator screen.



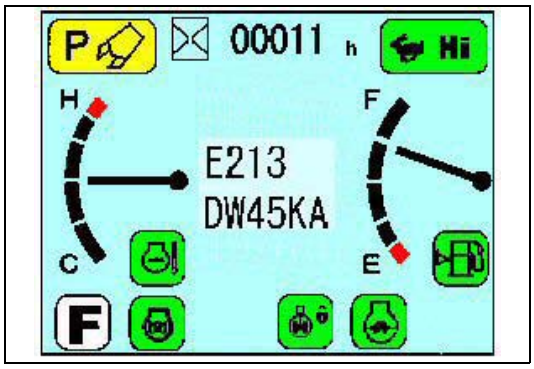
- On the operator screen, the user code is displayed on the portion for the hydraulic oil temperature gauge.

- If more than one user code is generated at the same time, the user codes are displayed in turn for 2 seconds each to display all the user codes.



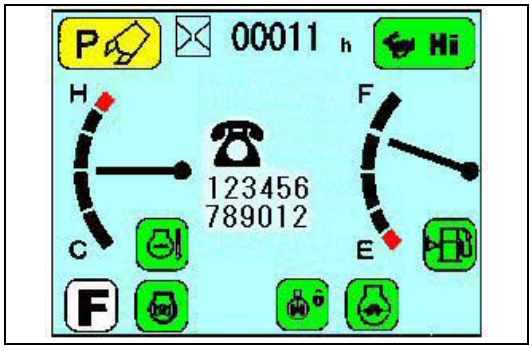
- While the user code is being displayed, if the input confirmation switch is pressed, the service code and failure code can be displayed.
- If there is more than one service code or failure code, the display switches every 2 seconds and displays all the service codes/failure codes that caused the user code to be displayed.

  If service codes/failure codes have occurred, but they did not cause the user code to be displayed, this function does not display them.



- If the telephone number has been set using the telephone number input on the service menu, it is possible to switch on the service code/failure code and display the telephone symbol and telephone number.

  For details of inputting and setting the telephone number, see SPECIAL FUNCTIONS OF MONITOR PANEL in the TESTING AND ADJUSTING section.



OVERLOAD WARNING DEVICE

OUTLINE

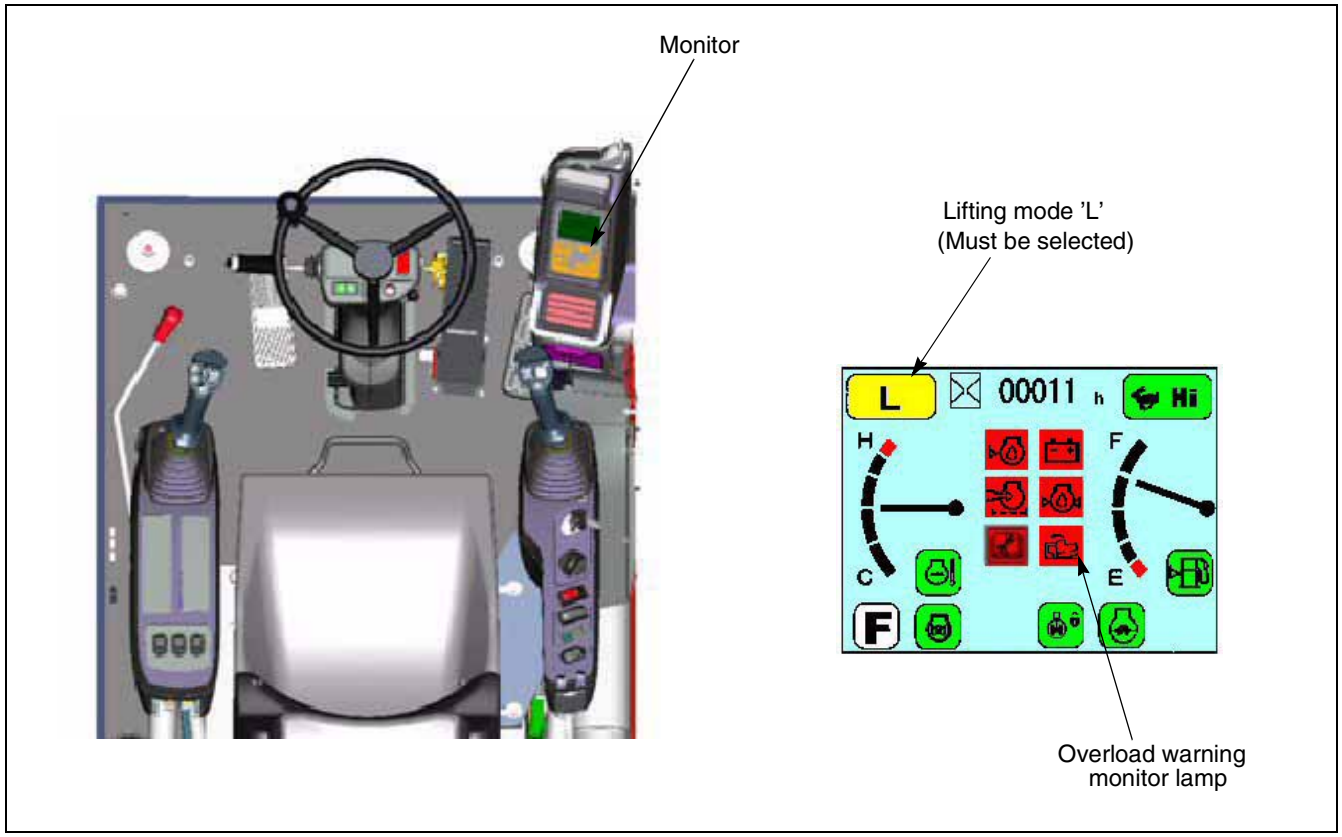
FUNCTION

- This device is installed to warn the operator when the machine lifts an excessive weight.

STRUCTURE

- When an excessive weight is lifted, the oil pressure increases at the bottom side of the boom cylinders. When this happens, a pressure switch is activated which lights the monitor lamp to warn the operator. When the monitor lamp lights, immediately lower the weight to the ground or bring the arm closer in the operator to prevent the machine from tipping over.

NOTE: The overload caution system can only be activated when the lifting mode (L) is activated on the monitor panel.

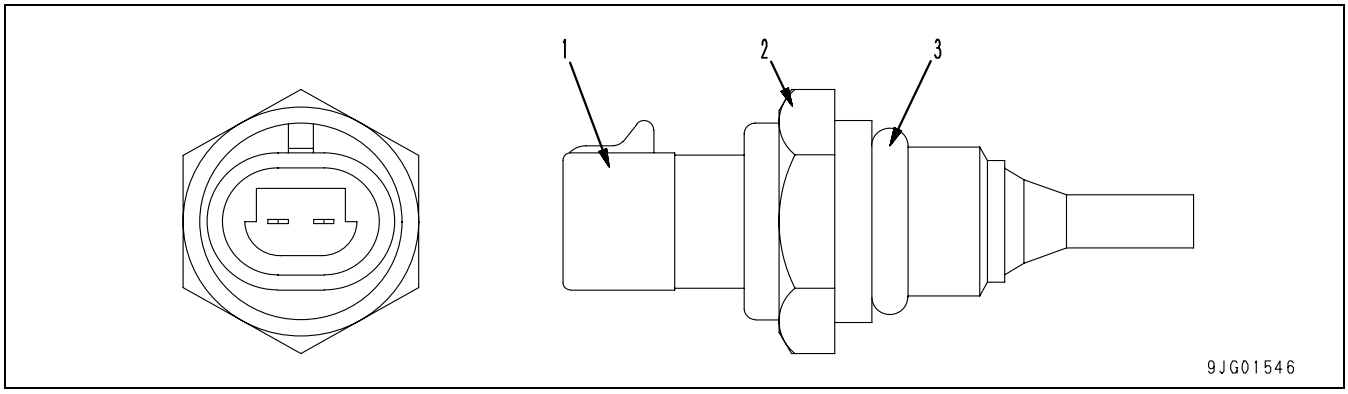


SENSOR

- The signals from the sensors are input directly to the engine controller and pump controller monitor.
  The contact type sensors are always connected at one end to the chassis GND

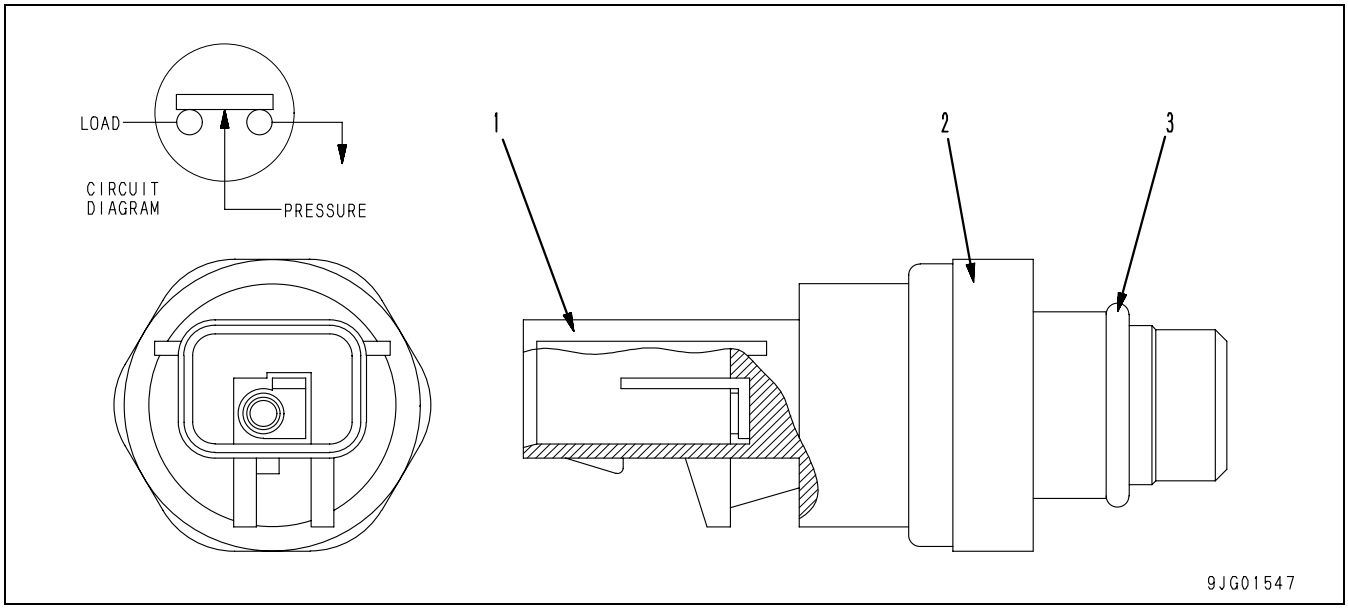
Sensor name	Type of sensor	When normal	When abnormal	Input controller
Coolant level	Contact	ON (Closed)	OFF (Open)	Monitor
Engine oil level	Contact	ON (Closed)	OFF (Open)	
Engine oil pressure	Contact	ON (Open)	OFF (Closed)	Engine controller
Coolant temperature	Resistance	—	—	
Fuel level	Resistance	—	—	Monitor
Air cleaner clogging	Contact	OFF (Closed)	ON (Open)	
Hydraulic oil temperature	Resistance	—	—	
Main pump oil pressure	Analog	—	—	Pump controller
Overload caution		—	—	Monitor
Engine speed	Resistance	—	—	Engine controller
Transmission speed		—	—	
Swing proximity	Inductive	—	—	Monitor
Travel PPC	Analog	—	—	Controller
PPC pressure	Contact	OFF (Open)	ON (Closed)	
Park brake pressure				
Brake accumulator low pressure				
Brake stop light				

Coolant temperature sensor



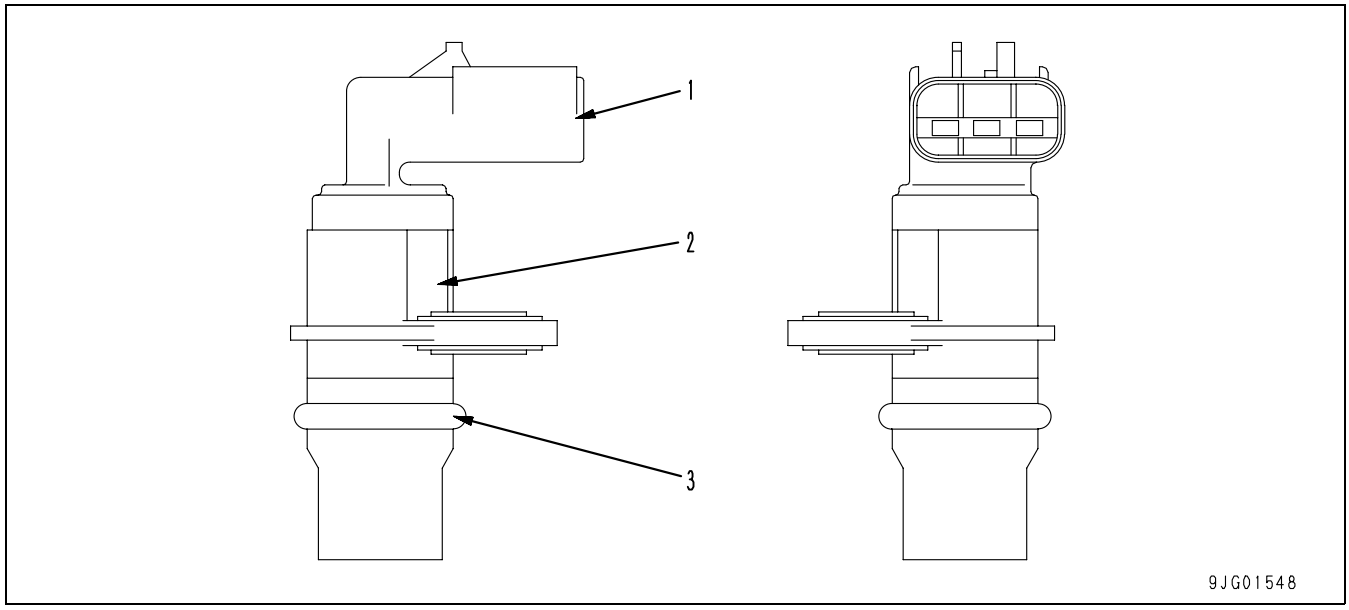
1. Sensor
2. O-ring
3. Connector

Oil pressure switch



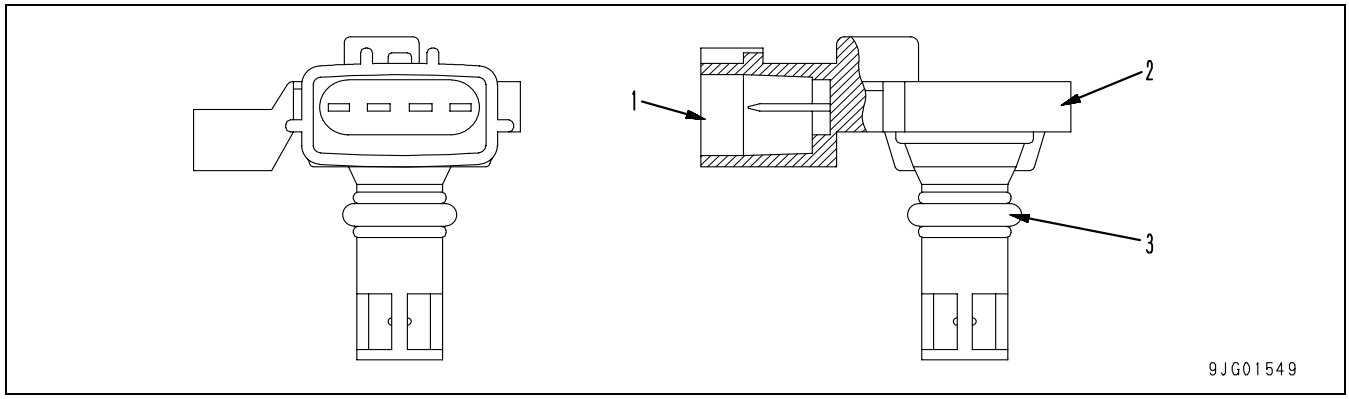
1. Connector
2. Sensor
3. O-ring

Rotation sensor



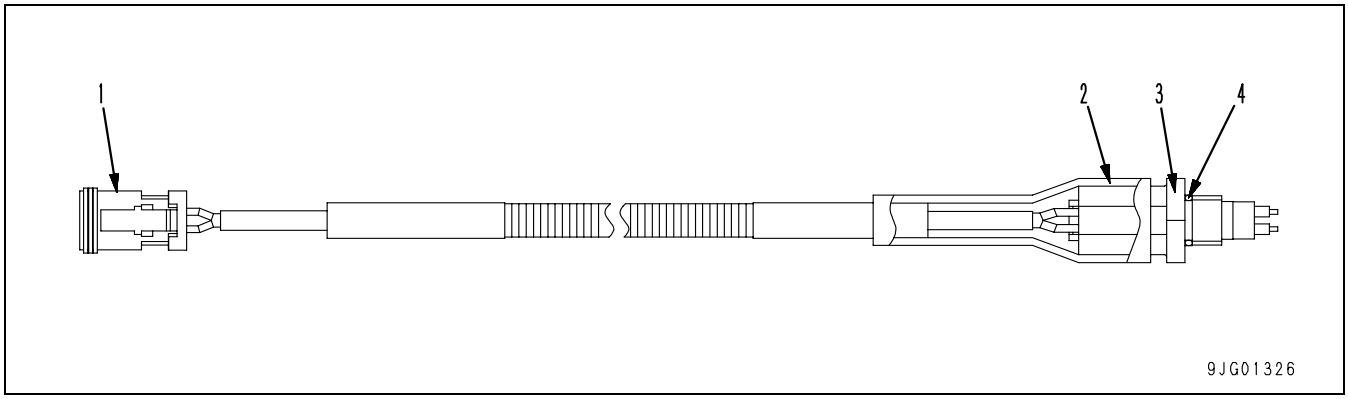
1. Connector
2. Sensor
3. O-ring

Boost pressure and temperature sensor



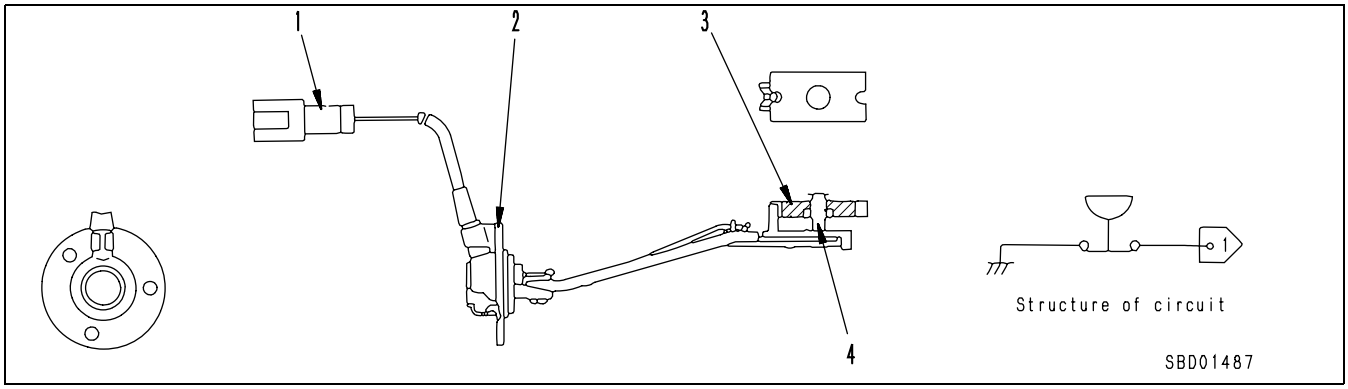
1. Connector
2. Sensor
3. O-ring

WIF (Water-In-Fuel detection) sensor



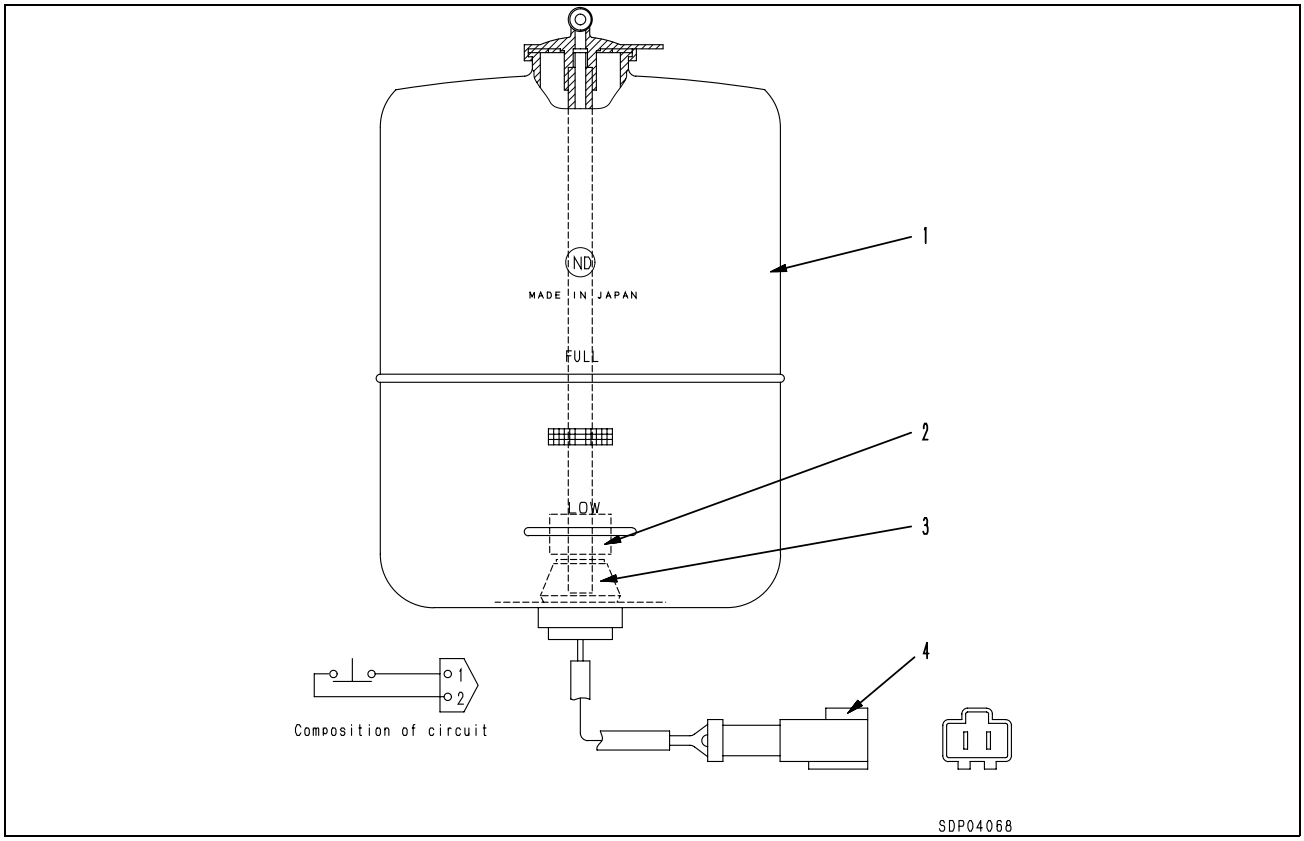
1. Connector
2. Tube
3. Sensor
4. O-ring

Engine oil level sensor



1. Connector
2. Bracket
3. Float
4. Switch

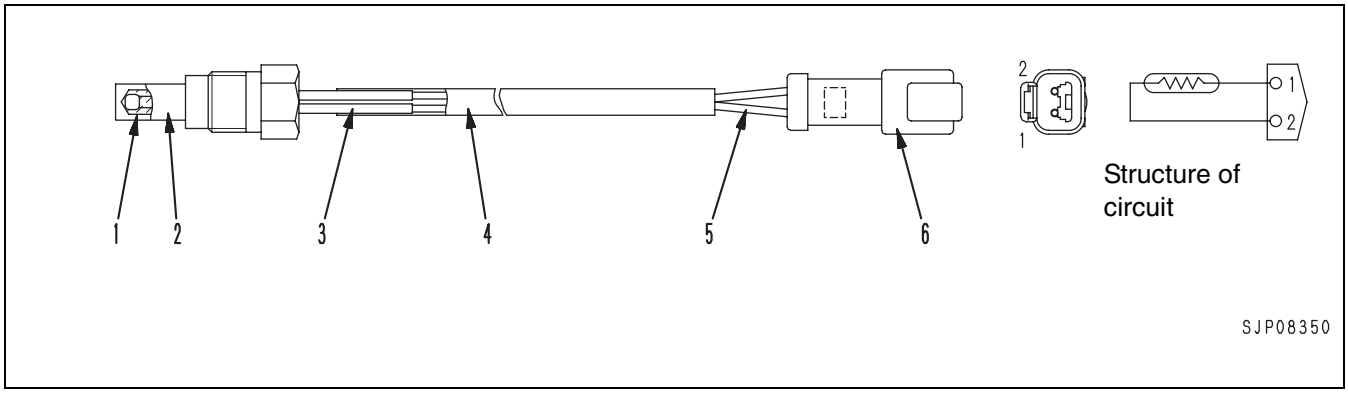
Coolant level sensor



1. Sub-tank
2. Float
3. Sensor
4. Connector

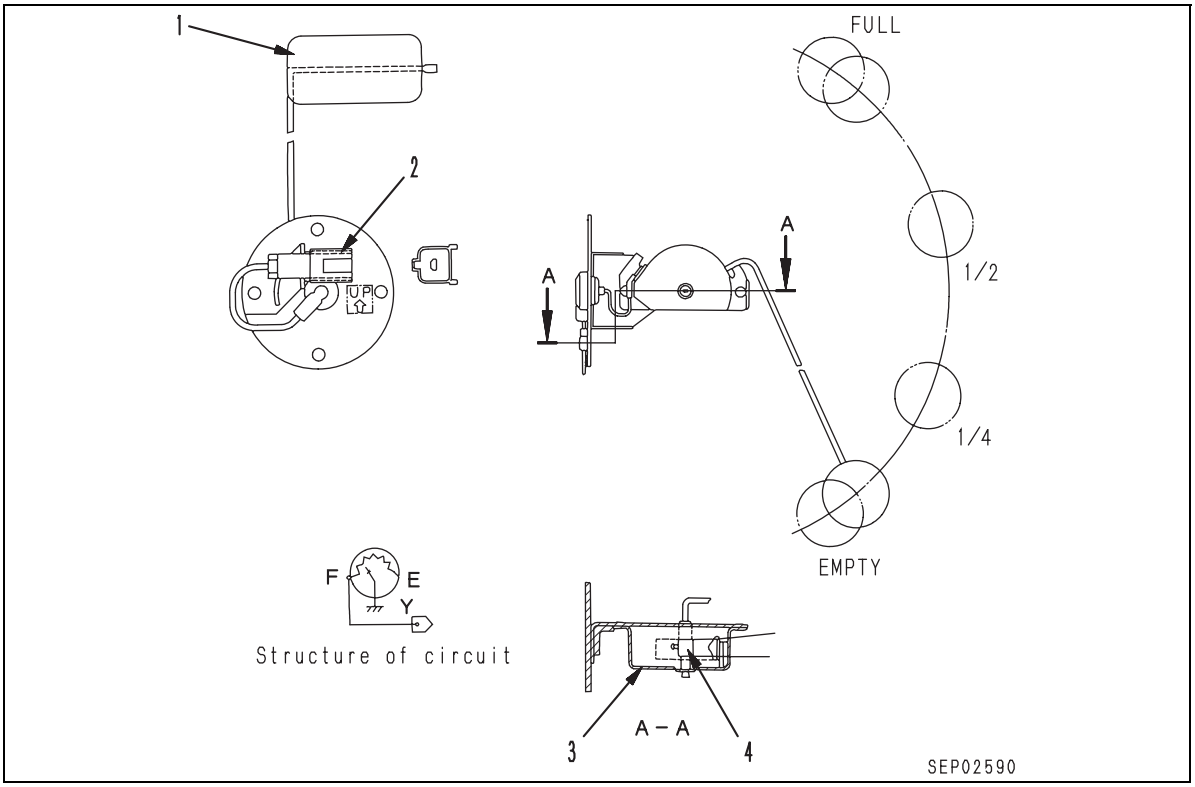
Coolant temperature sensor

Hydraulic oil temperature sensor



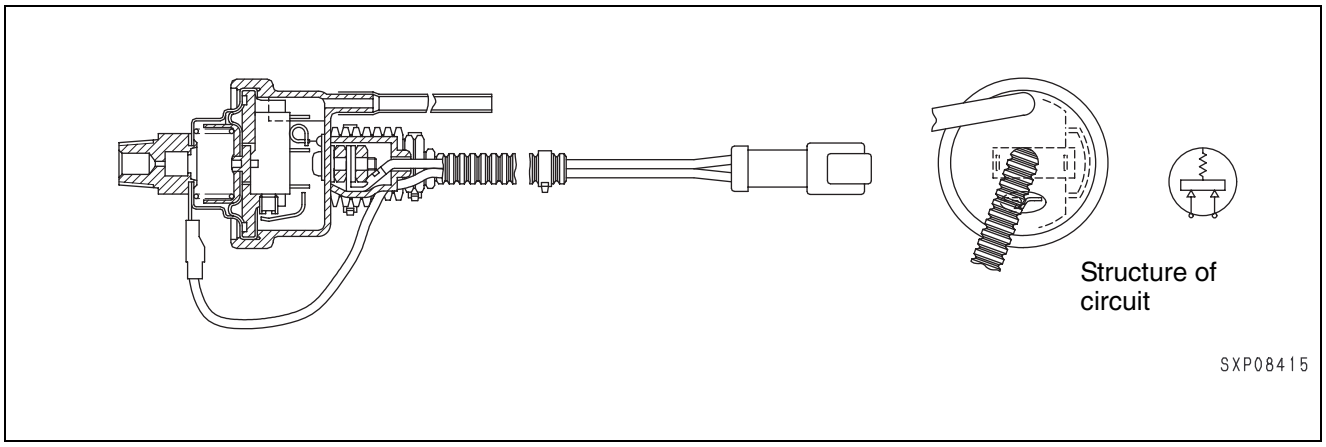
1. Thermistor
2. Body
3. Tube
4. Tube
5. Wire
6. Connector

Fuel level sensor

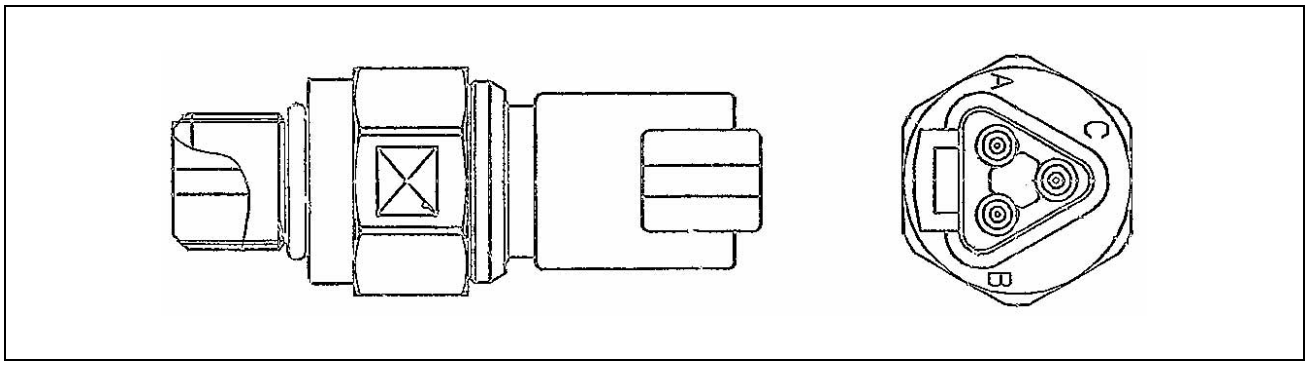


1. Float
2. Connector
3. Cover
4. Variable resistor

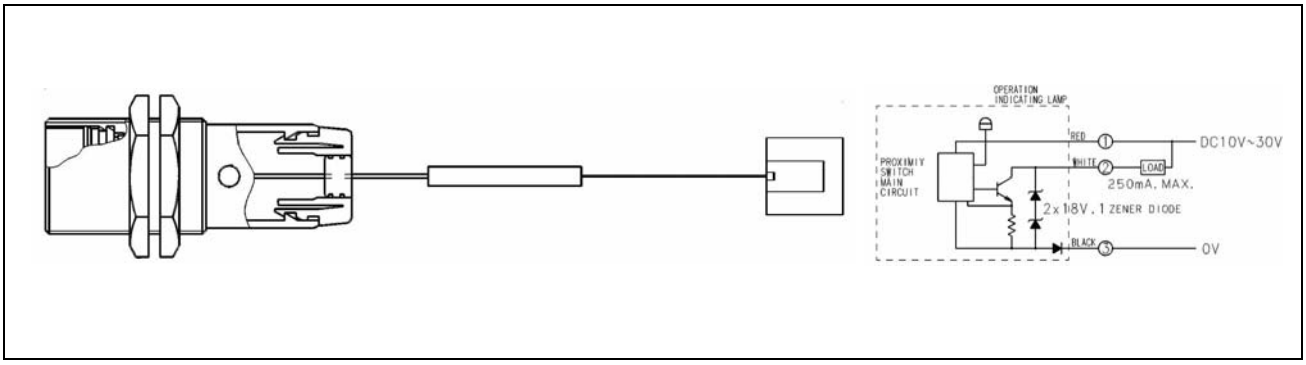
Air cleaner clogging sensor



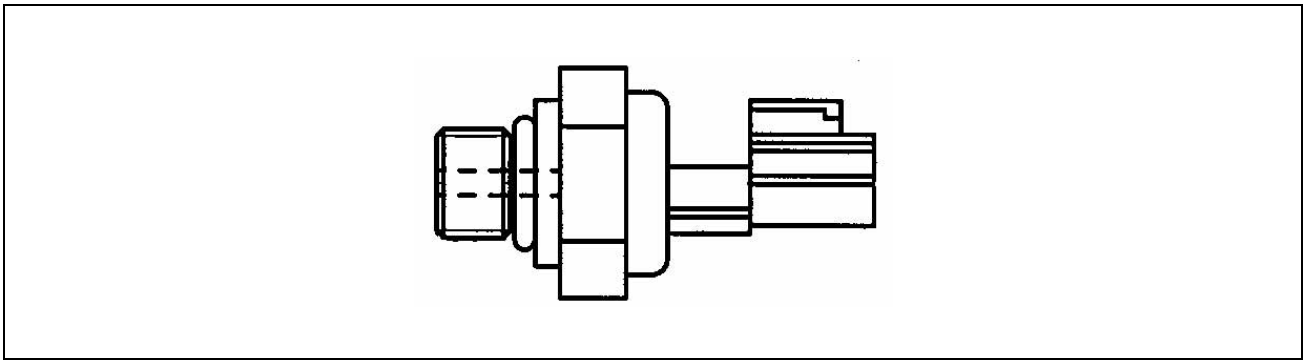
Overload Caution sensor



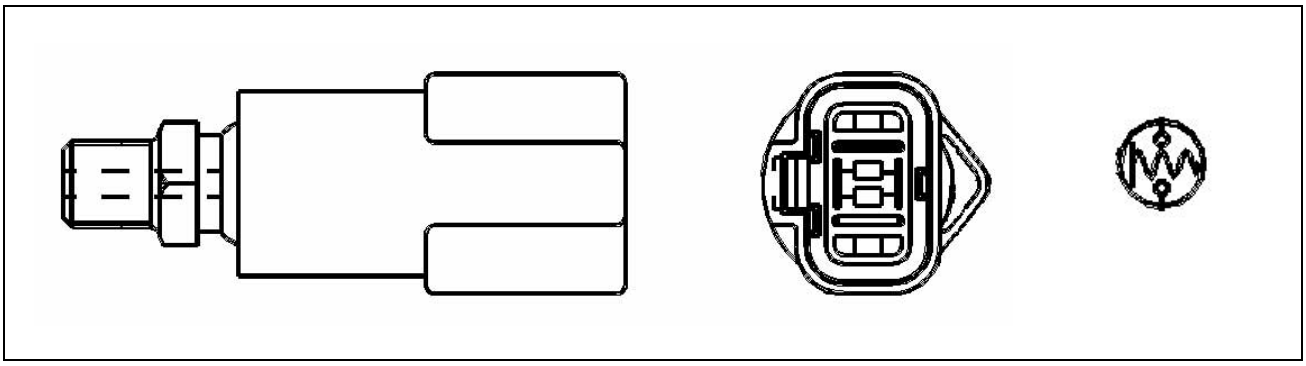
Swing proximity sensor



Travel PPC sensor

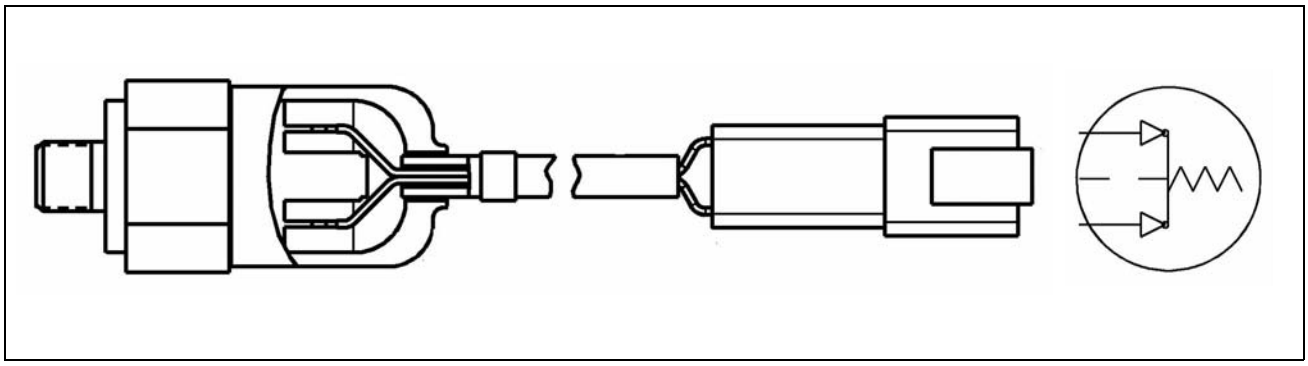


PPC pressure sensor

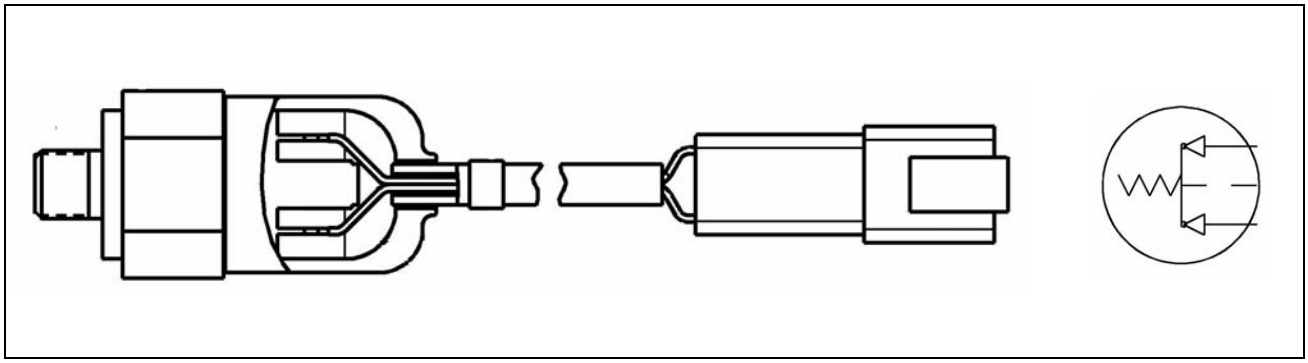


Park brake pressure sensor

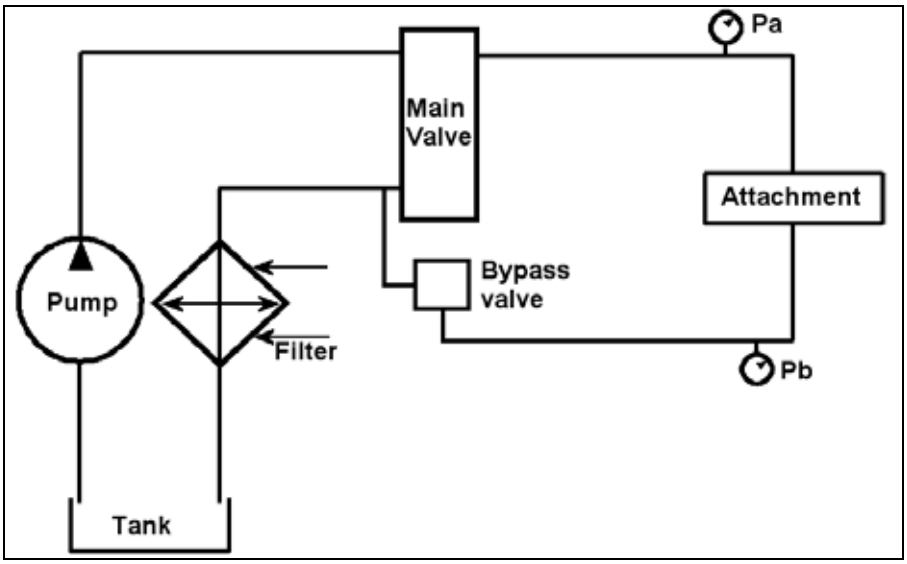
Brake accumulator low pressure sensor



Brake stop light sensor



1st ATTACHMENT CIRCUIT HYDRAULIC PERFORMANCE (MAIN VALVE BYPASSED)

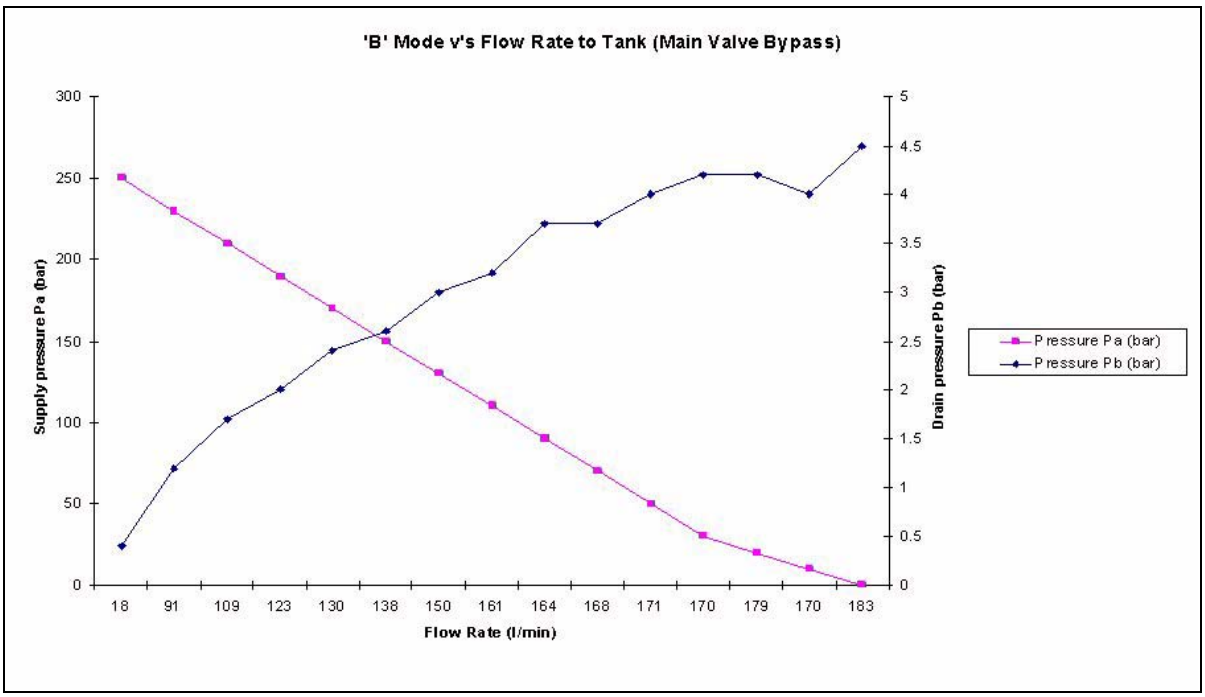


The performance of the hydraulic system when operating the 1st attachment circuit is shown below.

The pressure **Pa** is that which is observed at the inlet to the attachment.

The pressure **Pb** is the pressure observed in the breaker low back pressure return line (back pressure) measured at the attachment outlet connection.

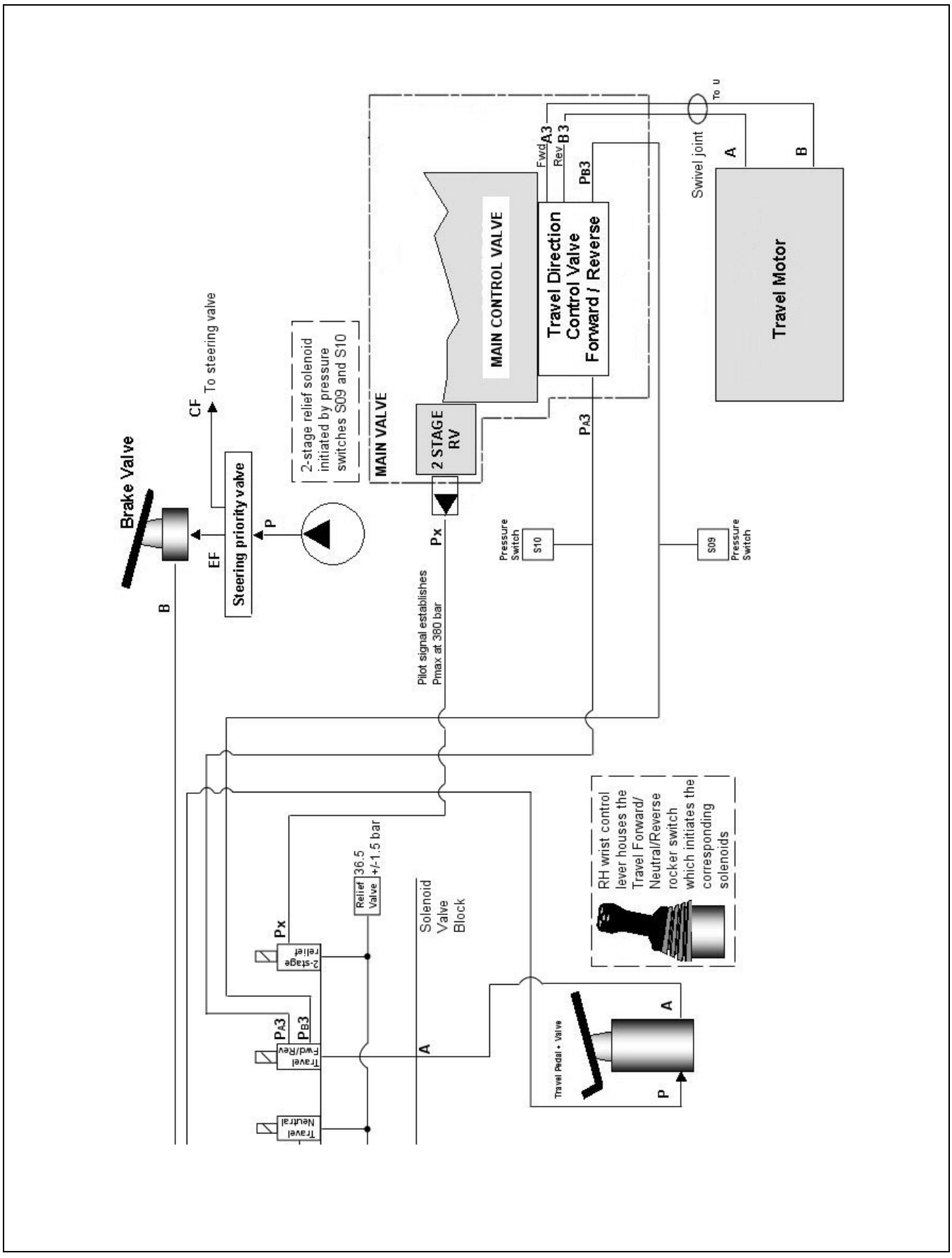
The figures below show the pressures at points **Pa** and **Pb** for varying flow through the attachment in B mode.



NOTE: The data given here is intended as a guide only. This is because the data is typical for an excavator of this type therefore there will be variation from one machine to another.

TRAVEL SYSTEM

TRAVEL CIRCUIT



OPERATIONAL AND CONTROL FEATURES

Operational and Control features (1)

- Machine speed relates to hydraulic motor speed.
- Hydraulic motor speed depends upon the flow of hydraulic oil, which depends upon size of the aperture created by the position of the spool in the control valve.
- The position of the spool in the main control valve relates to the pressure level created by the pilot pressure control valve (PPC). This takes the form of a pressure regulating valve (pressure reducer) operated by the travel pedal. The further the pedal is pressed the higher the pilot pressure is generated, resulting in a greater level of proportional spool movement and corresponding oil flow rate to the motor.
- Hydraulic motor direction is controlled by the position of the travel 'forward and reverse' solenoid valve which in turn directs the pilot signal from the foot pedal control valve to the pilot section of the main control valve travel spool. The foot pedal control valve receives its pressure supply from the 'travel / neutral solenoid valve'.
- Initiation of the 'forward and reverse' solenoid is via the switch on the front face of the RH control lever. This is interlocked with the travel / neutral solenoid valve.

Operational and Control features (2)

- For a fixed oil flow the speed of the machine is governed by the level of motor displacement. Higher the displacement, the lower the speed and visa versa.
- The level of motor torque per unit of pressure is also a product of displacement.
- Motor displacement and the corresponding speed and torque characteristics are therefore affected by the following operations:
  - **Operators Input via travel mode switch**

    Selection of creep mode by the operation of the travel creep solenoid. This valve sets the travel motor displacement to maximum, this in turn represents the lowest speed per litre of flow and the highest torque per unit of pressure. This represents a maximum travel speed of 2.5 kph.

  - **Torque Maximisation**

    When travel / reverse solenoid is selected the respective pressure switch in the line initiates the 2 stage relief valve solenoid valve. This valve directs a pilot signal into connection Px. This action raises the pressure of the 2 stage relief valve in the main direction control valve to 385 bar. This increase in pressure raises the torque potential of the hydraulic motor.

Operational and Control features (3)

Operator's Input via travel mode switch

- In Hi mode the controller automatically defaults the transmission clutch control solenoid valve in to the off condition. This gives a travel speed range of 0 - 35 kph.
- In Lo mode the controller energises the transmission clutch control solenoid valve in the on position. This gives a travel speed of 0 - 10 kph.

NOTE: Signal on Hi mode enables the drive through to Lo mode.

In both of these operating modes, when the motor pressure reduces to 310 bar the displacement changes from maximum to minimum.

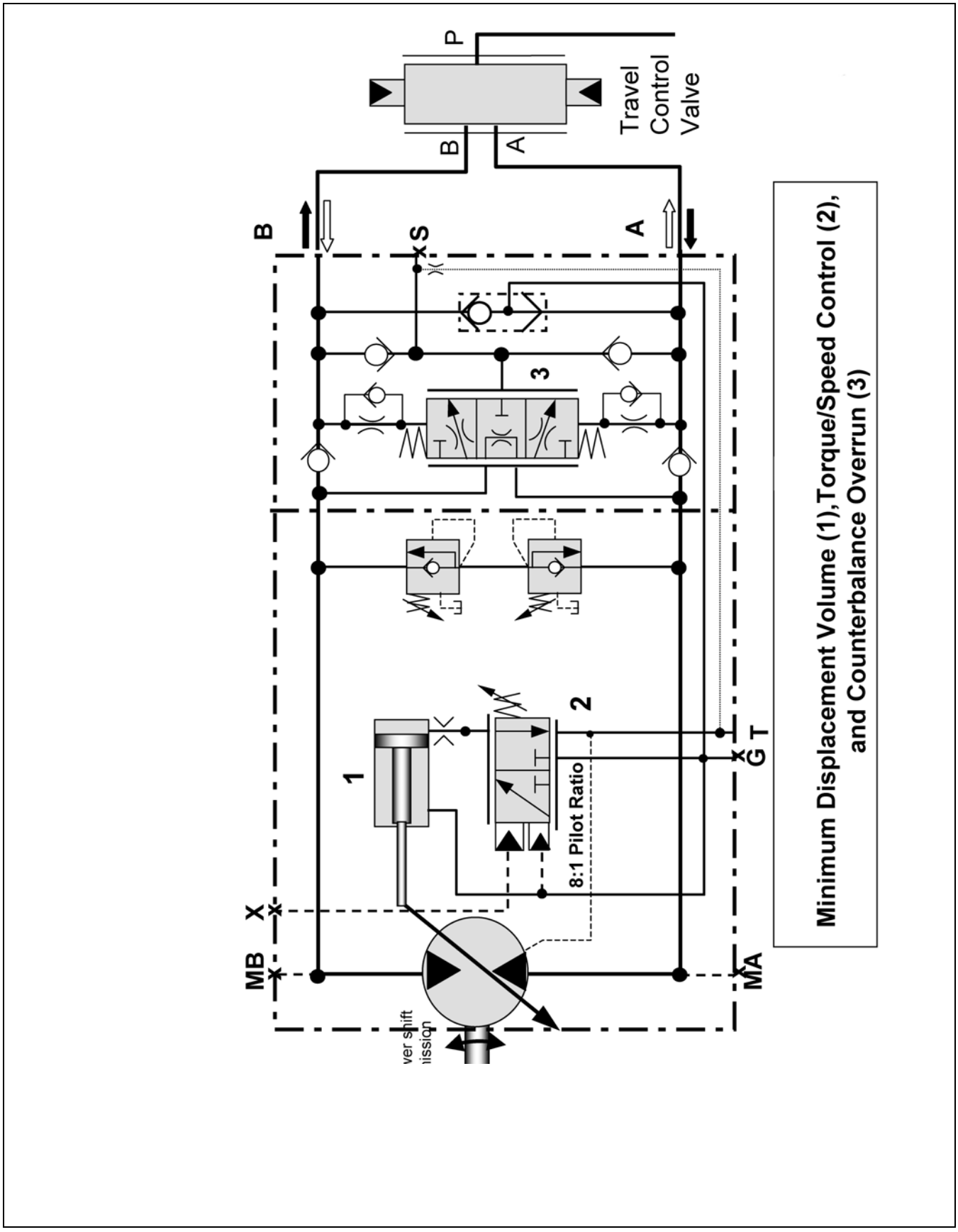
The valve has a switching range of 33 bar. This gives a progressive decrease in motor displacement, resulting in a controlled increased rate of speed and corresponding reduction in traction force.

⚠ WARNING

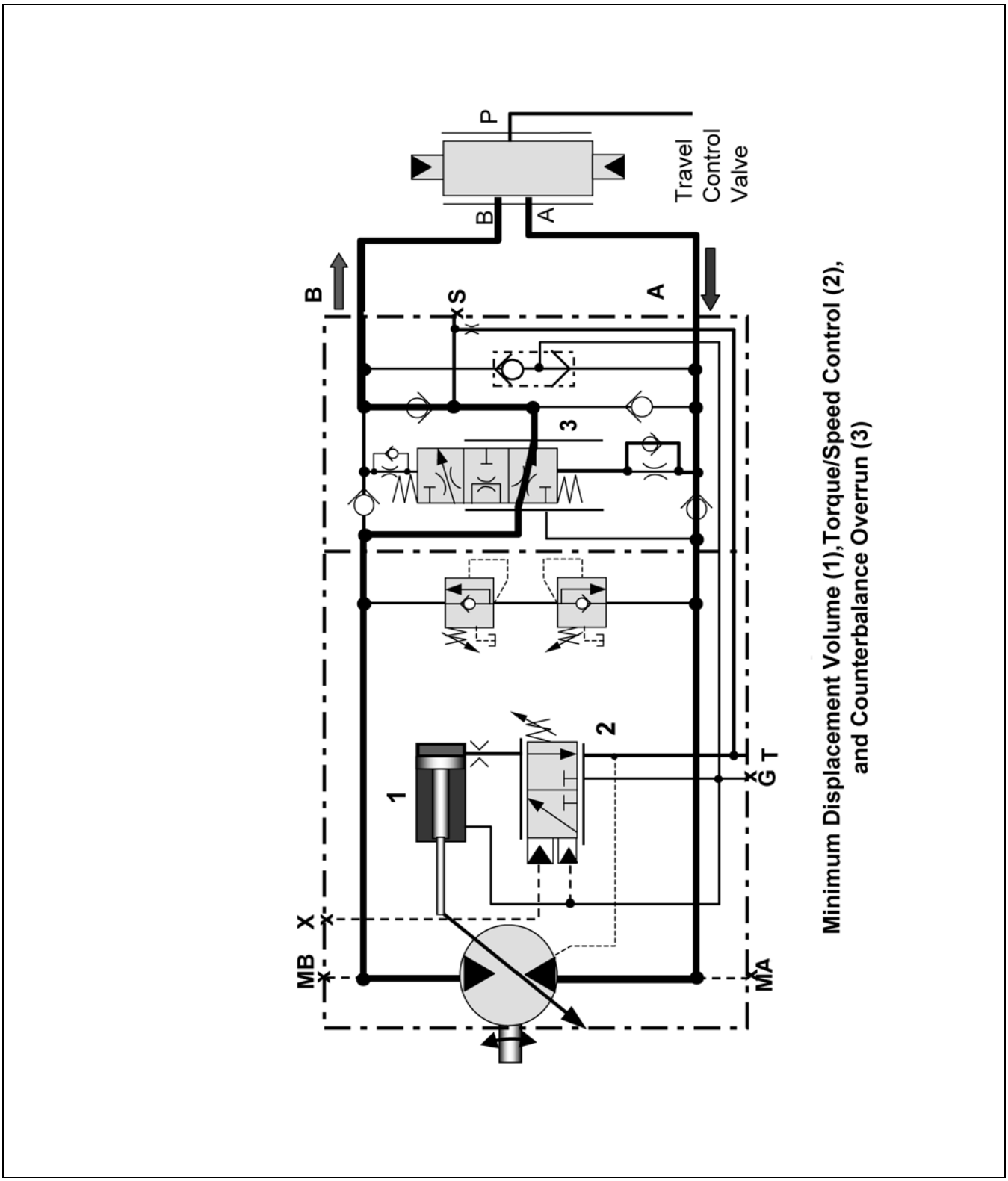
OVERRUN PROTECTION. This is dealt with through the action of the counterbalance spool in the motor control block.When the machine begins to overrun the travel motor momentarily changes its operational mode and becomes a pump. The change in pressure within the supply and return line causes the normal pilot signal on the counterbalance valve to fall, thereby allowing it to slightly close. This action causes the pressure to rise on the motor return side thereby providing a braking force and controlled vehicle movement.

1. Travel Motor.

1.1. Shown in the neutral position.

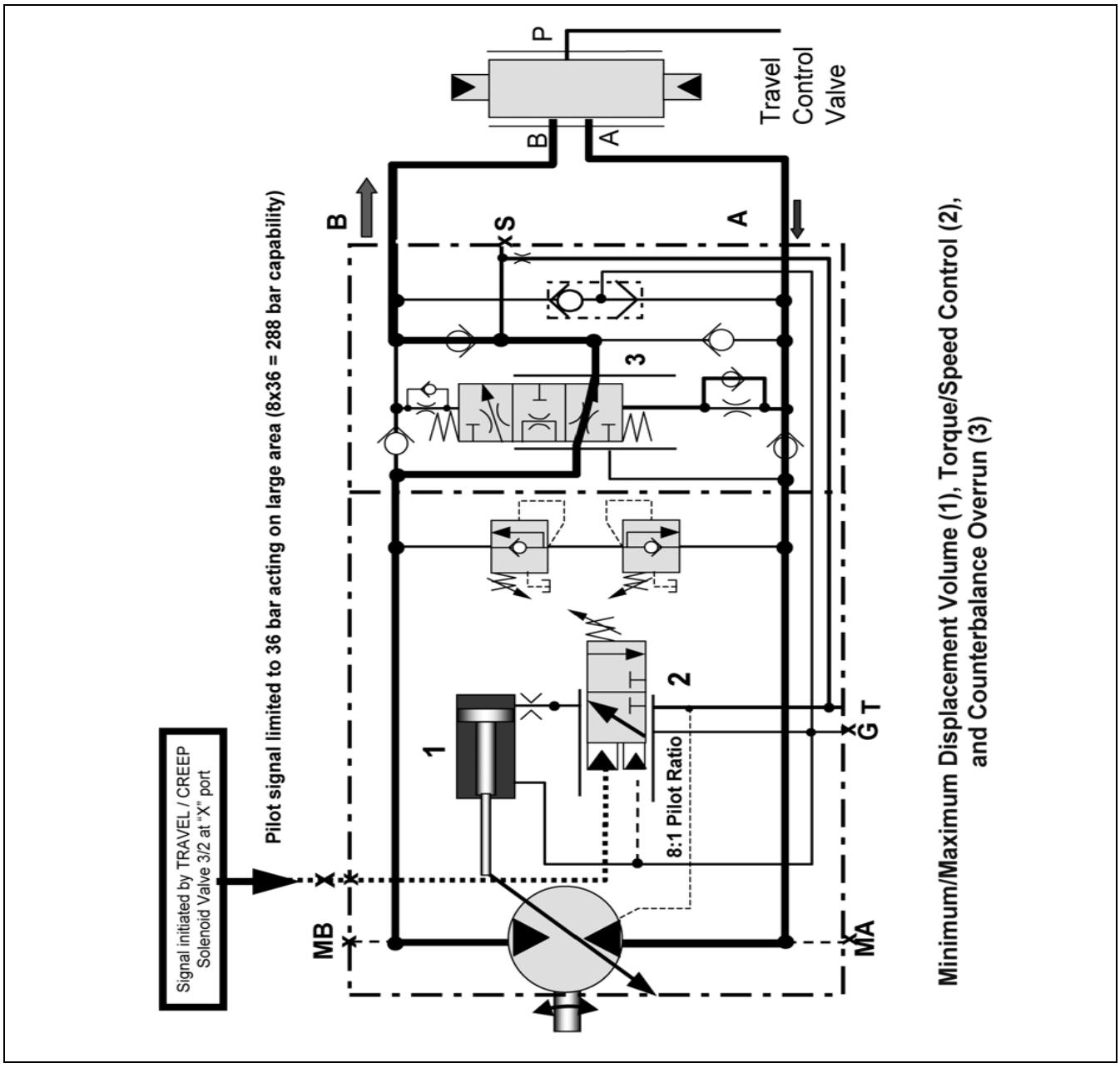


1.2. Flow path representing: Low Torque - High speed with counterbalance taking up an active position. (Default for Travel)
The counterbalance valve (3) is activated which allows a constant flow of oil around the circuit. From port A through to port B the motor displacement is at minimum pending maximum speed. the speed of the machine is governed by the level of motor displacement.

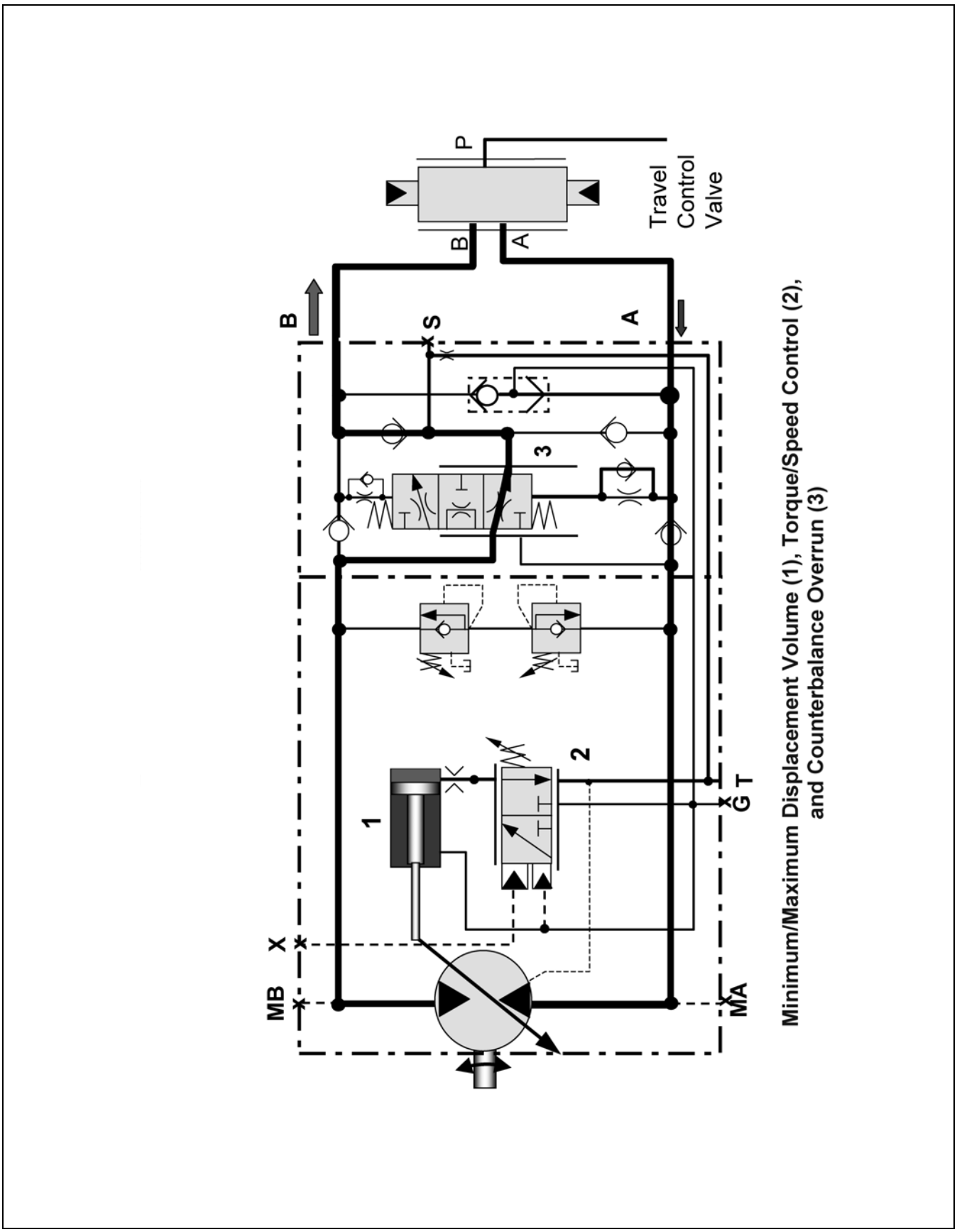


1.3. Introduction of Creep control: High Torque - Low Speed.

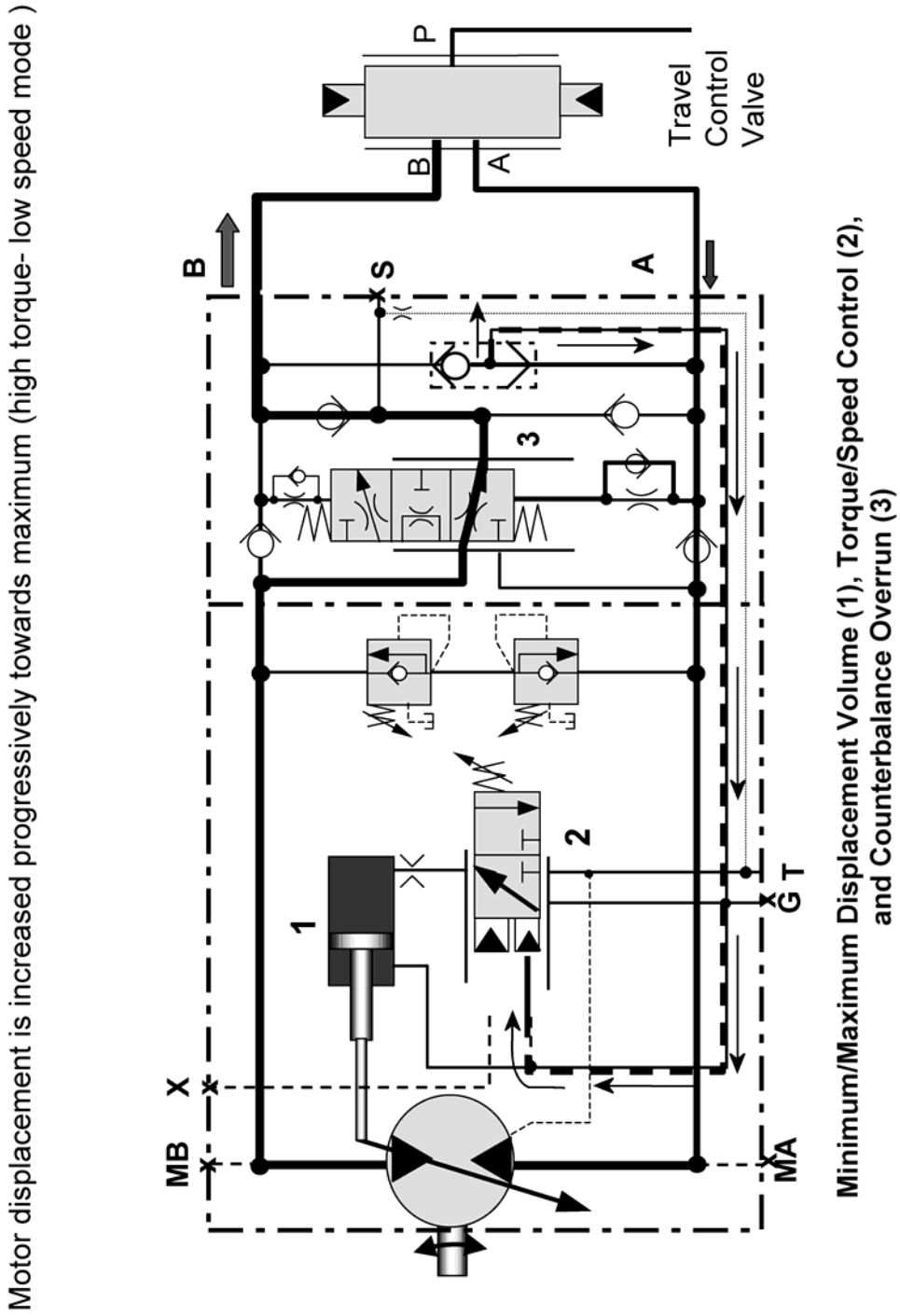
It can be seen from the diagram that the spool moves across on the torque speed control valve (2) which directs the flow to move the servo and supply the motor displacement to maximum giving creep speed of 2.5kph



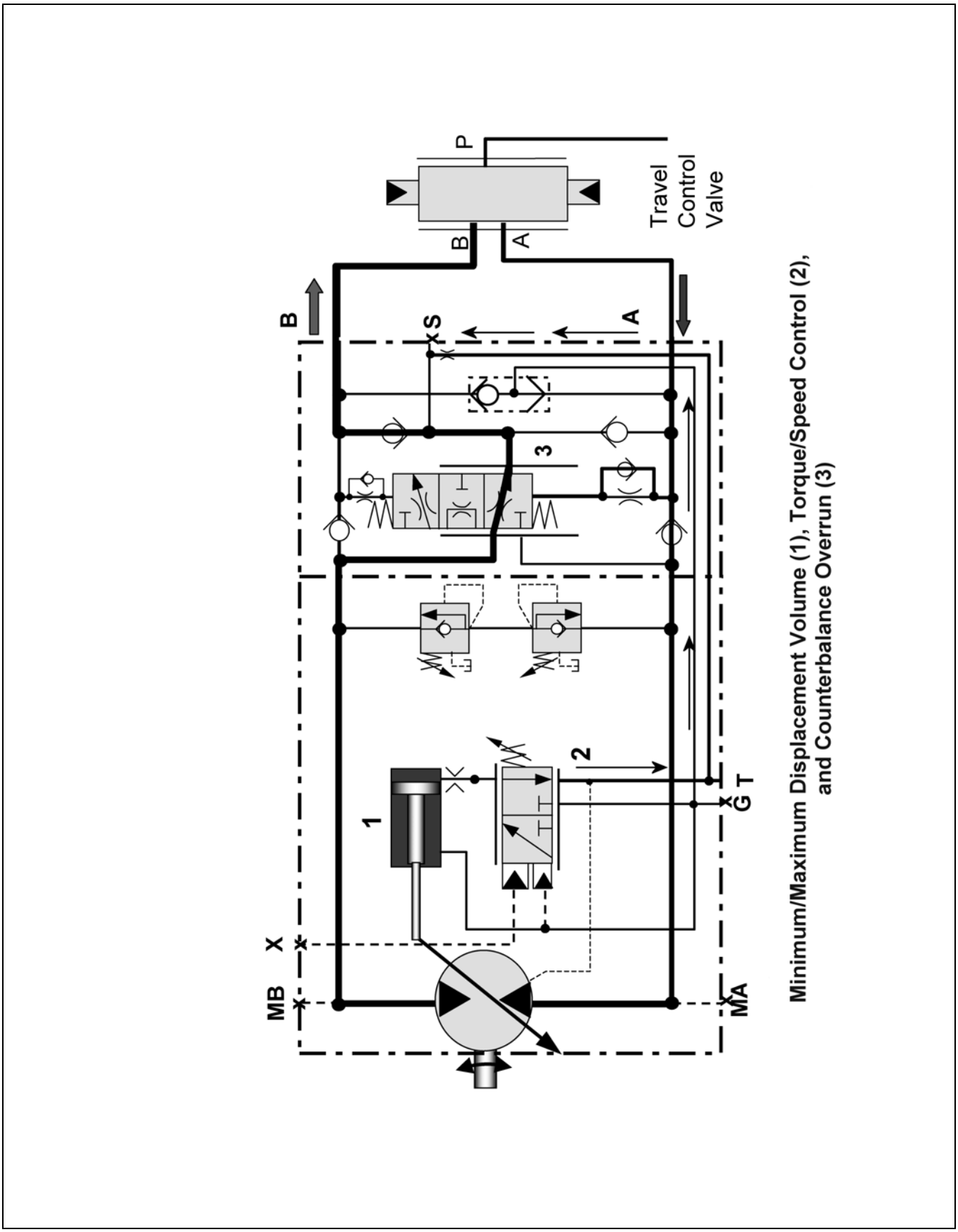
1.4. Opposing load torque on motor increases causing Torque / Speed control valve to react. Diagram showing Hi speed with minimum displacement



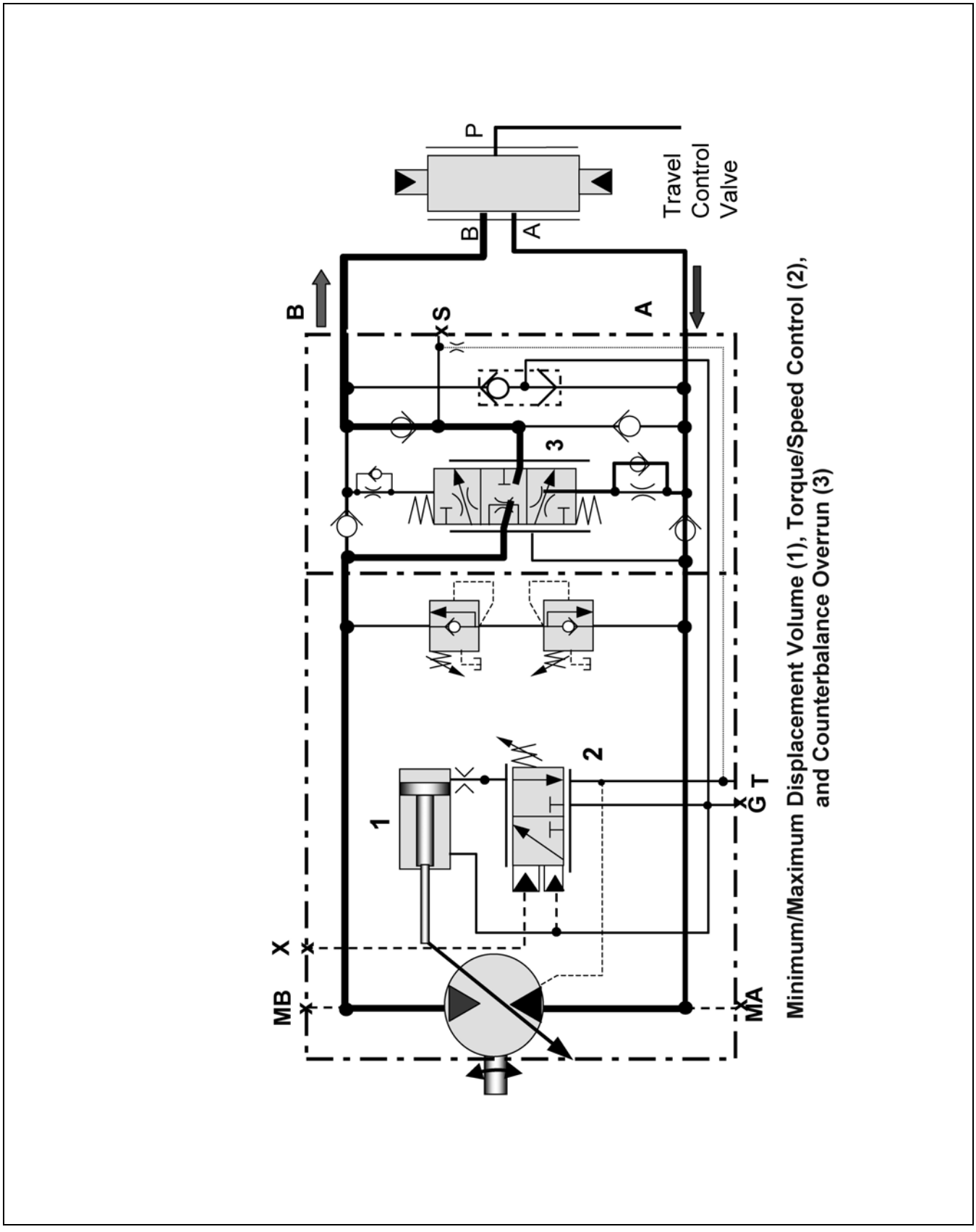
1.4.1 Motor displacement is increased progressively towards maximum: High Torque - Low Speed mode. During travel the travel motor will engage low speed if the spool (2) moves across which will move the motor displacement towards maximum providing low speed



1.5. Motor begins to overrun and pressure falls on supply side: This causes counterbalance valve to begin to close and throttle return flow from motor.

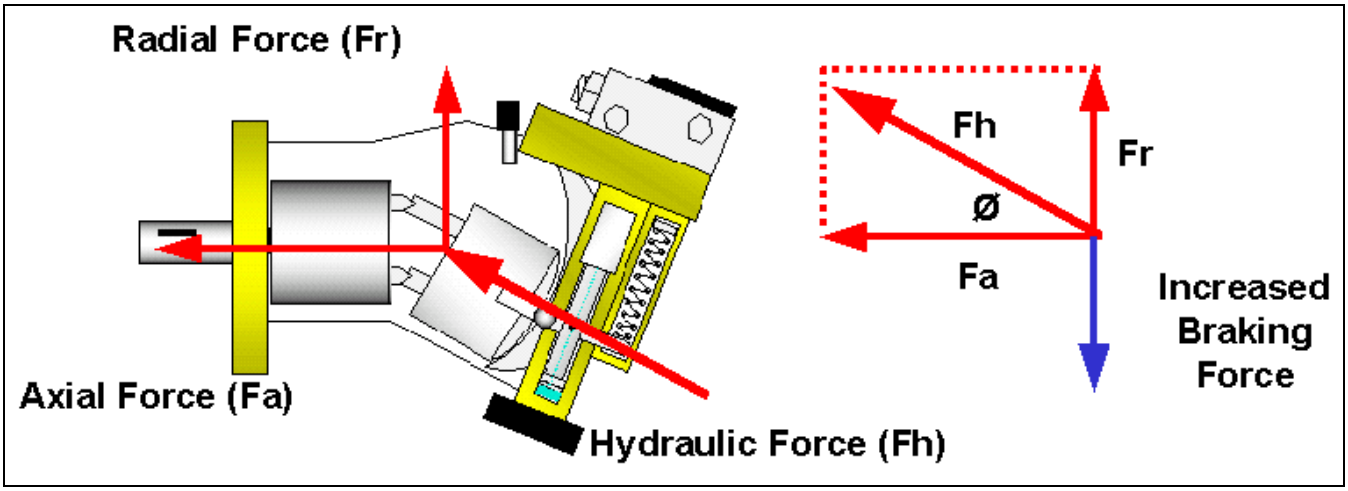


1.6. Motor begins to overrun and pressure falls on supply side: This causes counterbalance valve to begin to close and throttle return to flow motor. Pressure line in return line rises providing a braking torque.



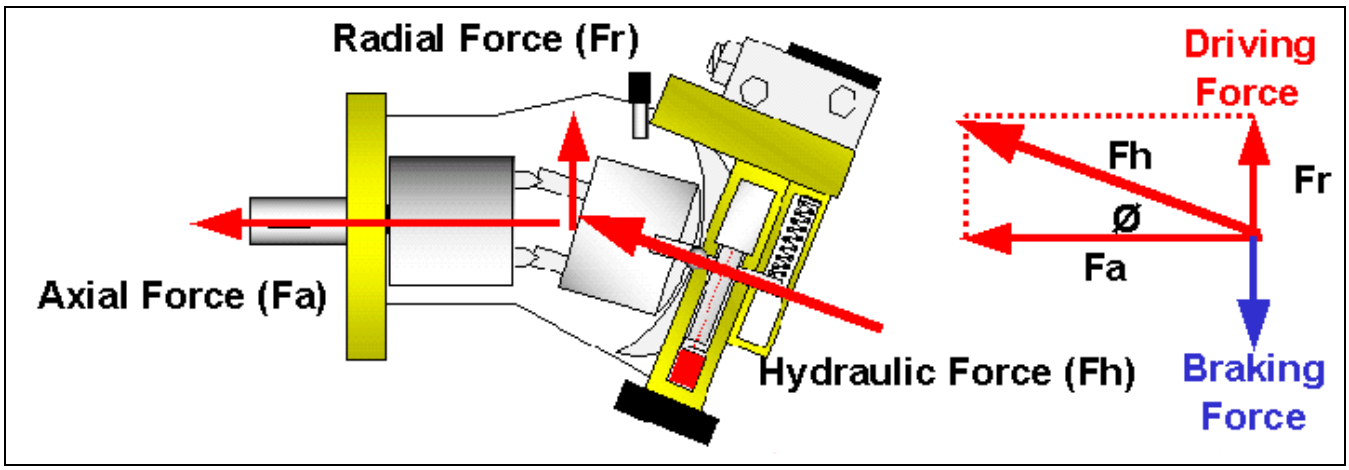
1.7. Travel Motor Performance.

1.7.1 High Torque - Low Speed.



- Ø represents motor maximum displacement angle (usually 35°), Fr represents the radial force developed by the hydraulic oil pressure which in turn develops the corresponding driving or braking torque.
- Where a high starting torque is required the operation of the travel creep solenoid valve will move the motor into this mode via the torque speed control valve at the motor.
- The same action will occur automatically when the motor load pressure due to the opposing torque reaches the setting of the torque speed control valve.
- In an overrun situation the rise in pressure in the motor return line as the counterbalance valve closes will also increase and provide an effective braking torque.

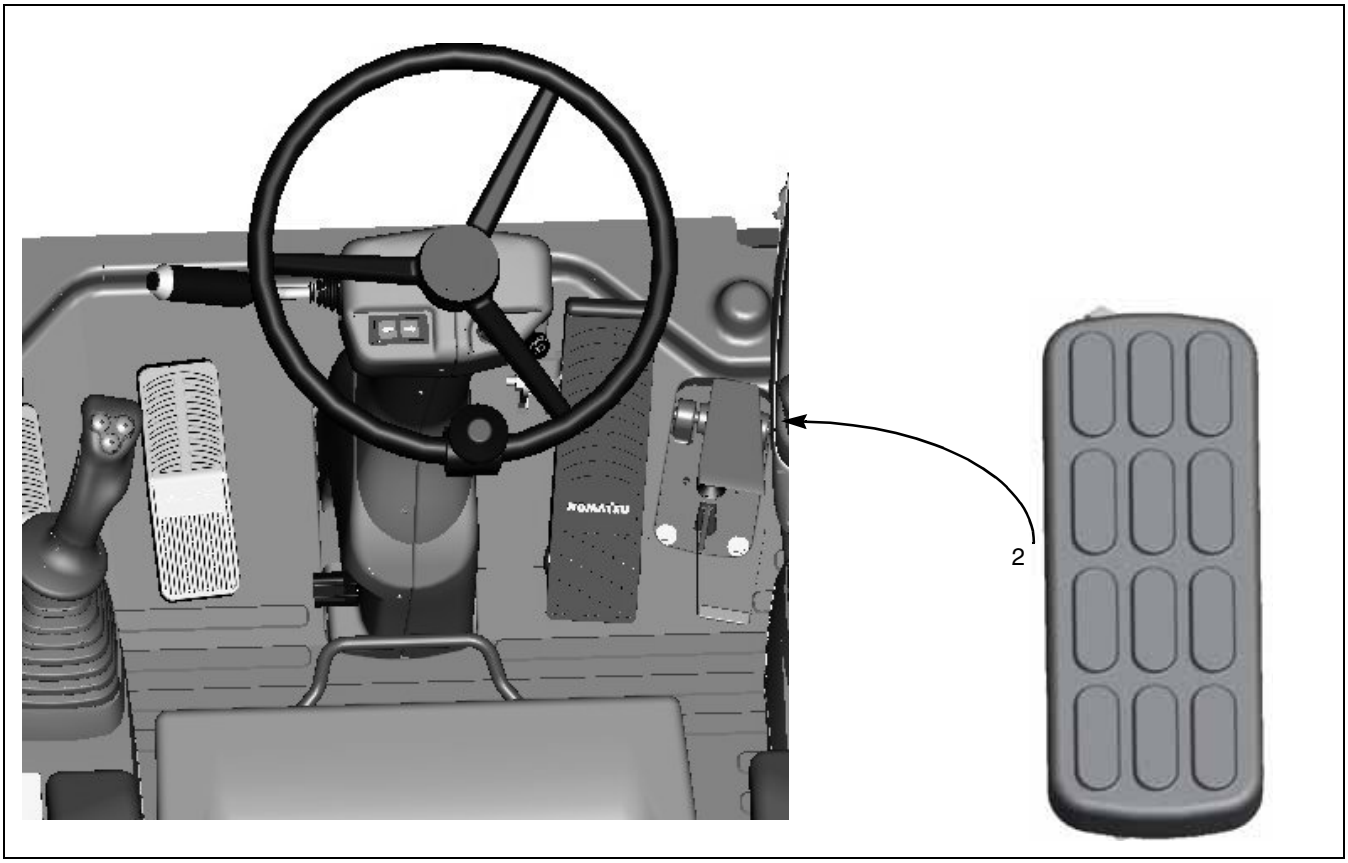
1.7.2 Low Torque - High Speed.



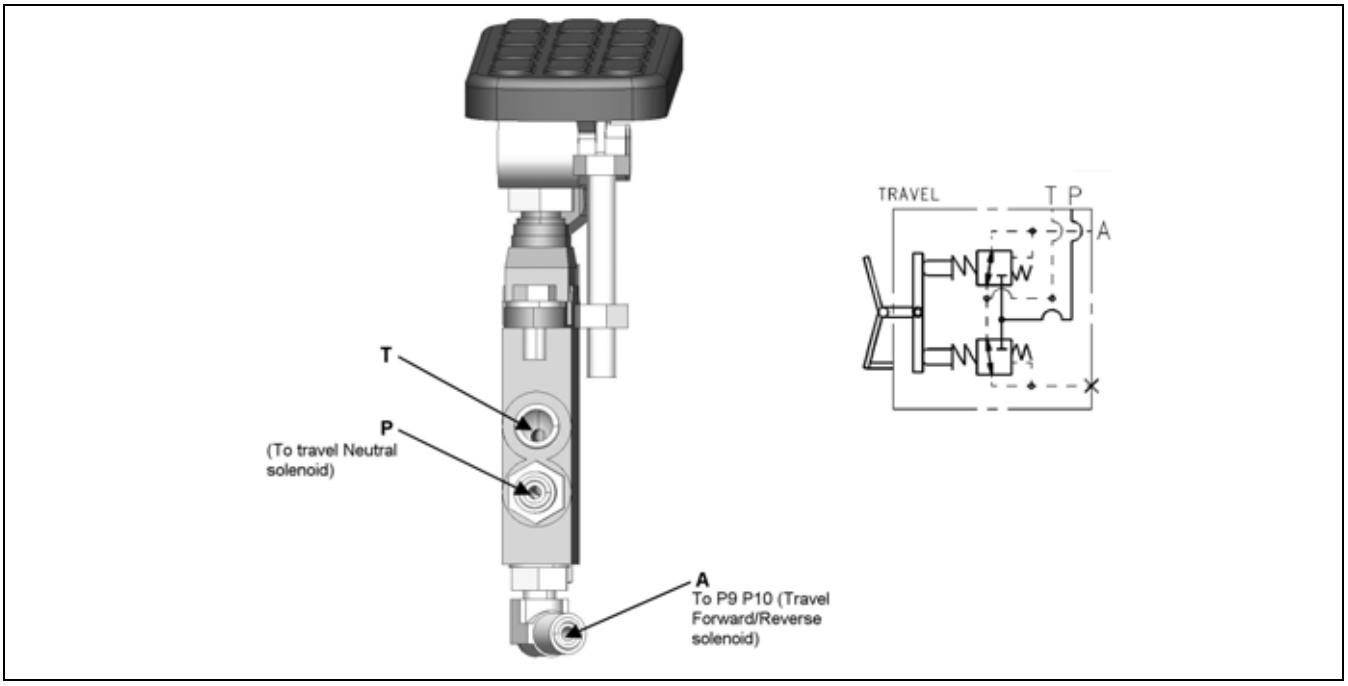
- Ø represents motor minimum displacement angle (usually about 5 to 7°). Fr represents the radial force developed by the hydraulic oil pressure which in turn develops the corresponding driving or braking torque.

Motor size:
41 - 120cm³ / rev for machines rated at 35 kph.

2. Travel Pedal

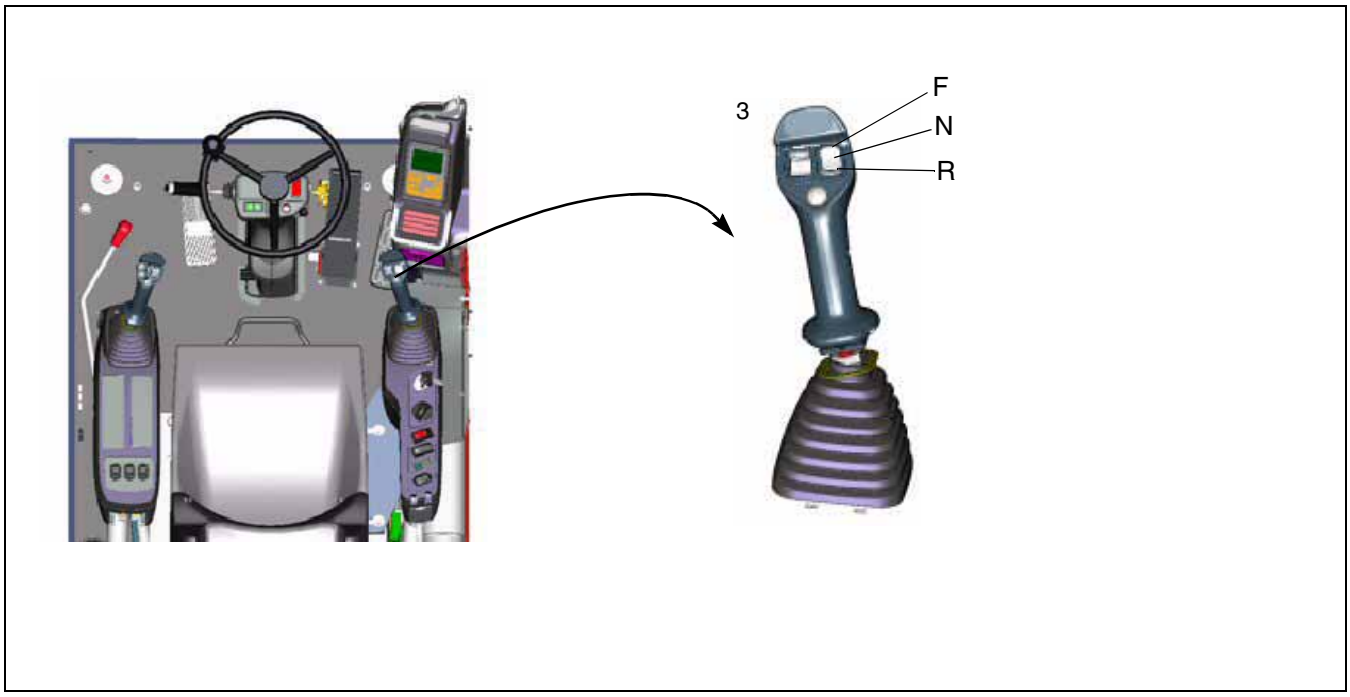


2.1. Travel Pedal Schematic.

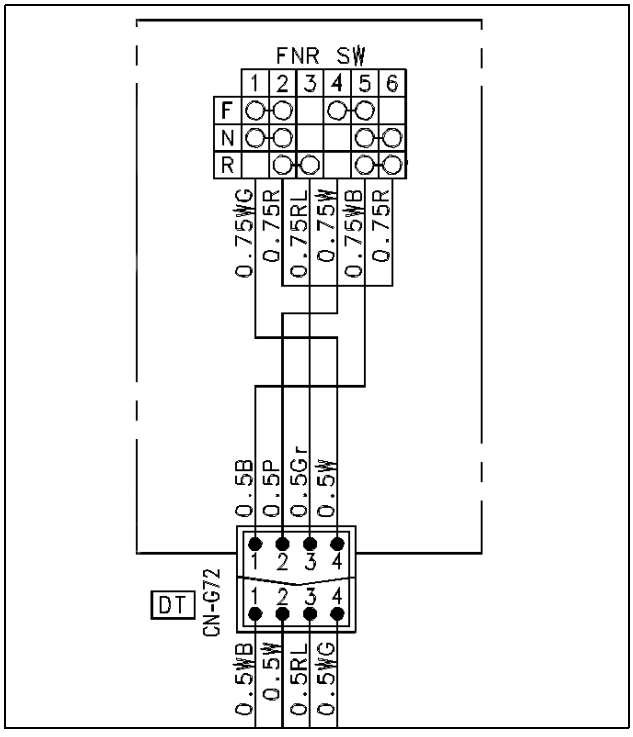


2.2. Travel Pedal: Located to the extreme right of the steering column on the floor of the Operators cab, a proportional valve when activated controls the flow of oil to the travel motor.

3. Forward / Neutral / Reverse Switch (F-N-R)



3.1. F-N-R Switch Schematic.



3.2. F-N-R Switch: Located on the front of the RH control lever, this rocker type switch determines whether the travel direction is forward, reverse or neutral.

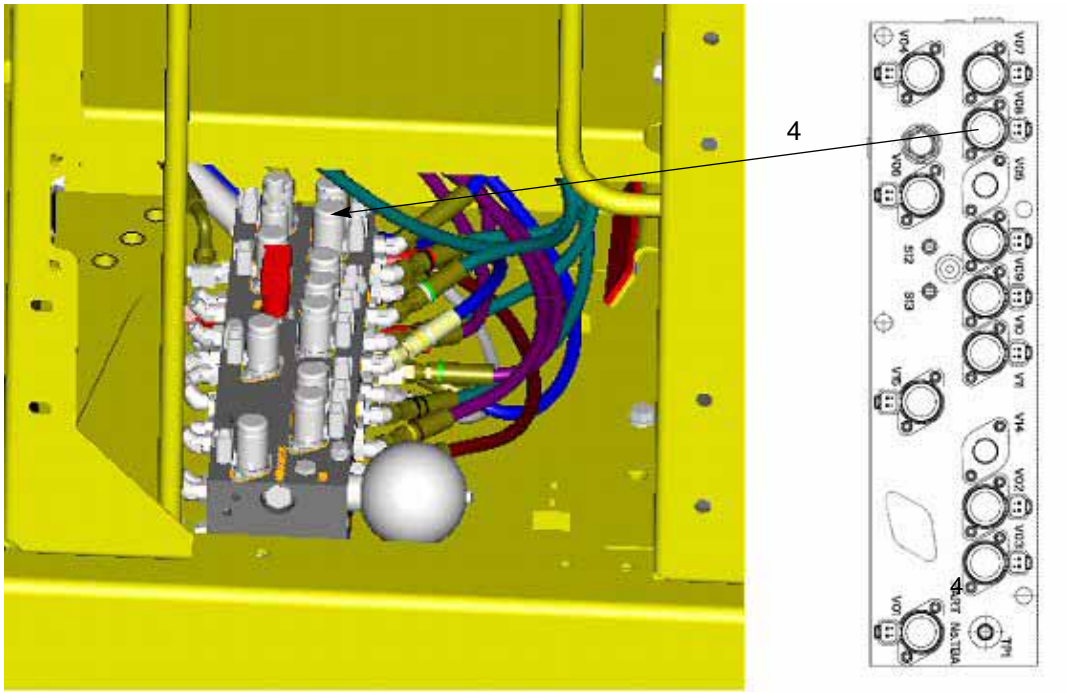
NOTE: Machine cannot be started unless the switch is in the neutral position.

The signals of this switch go to the controller and the controller operates the travel Neutral solenoid and the travel Forward/Reverse solenoid.

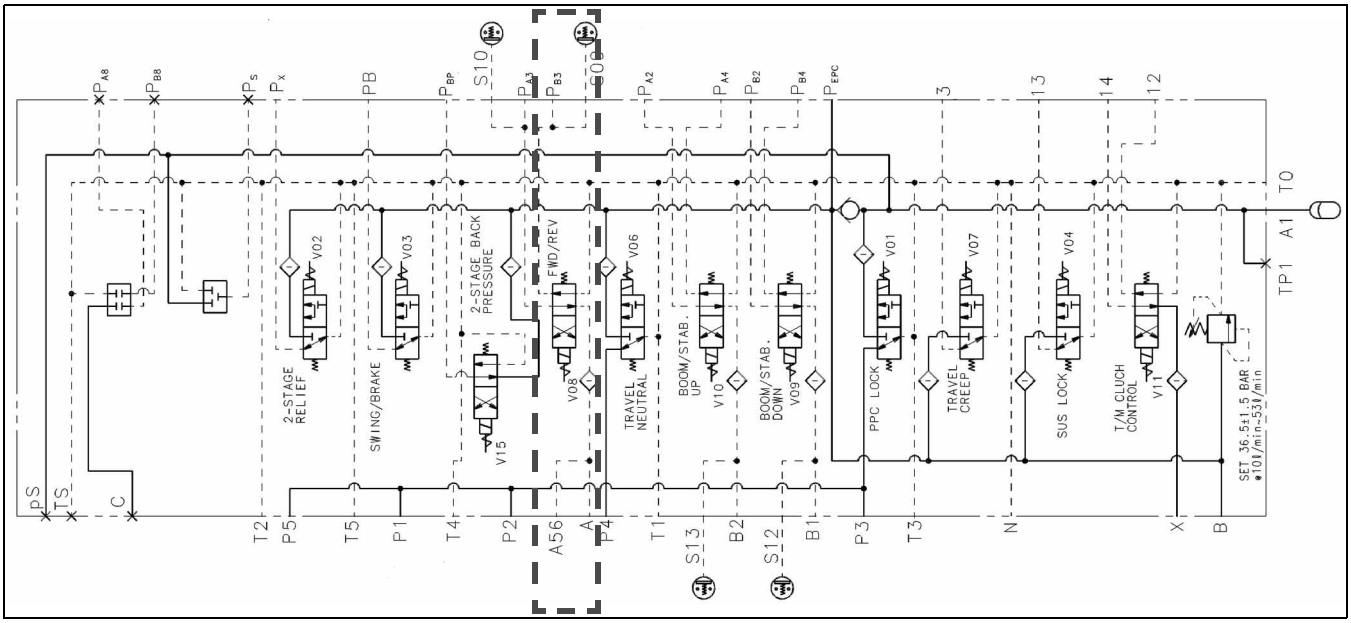
F/N/R Status Table

FNR Signal			Status
F	N	R	
0	0	0	N (Error)
0	0	1	N
0	1	0	R
0	1	1	N (Error)
1	0	0	F
1	0	1	N (Error)
1	1	0	N (Error)
1	1	0	N (Error)

4. Forward / Reverse Travel Solenoid

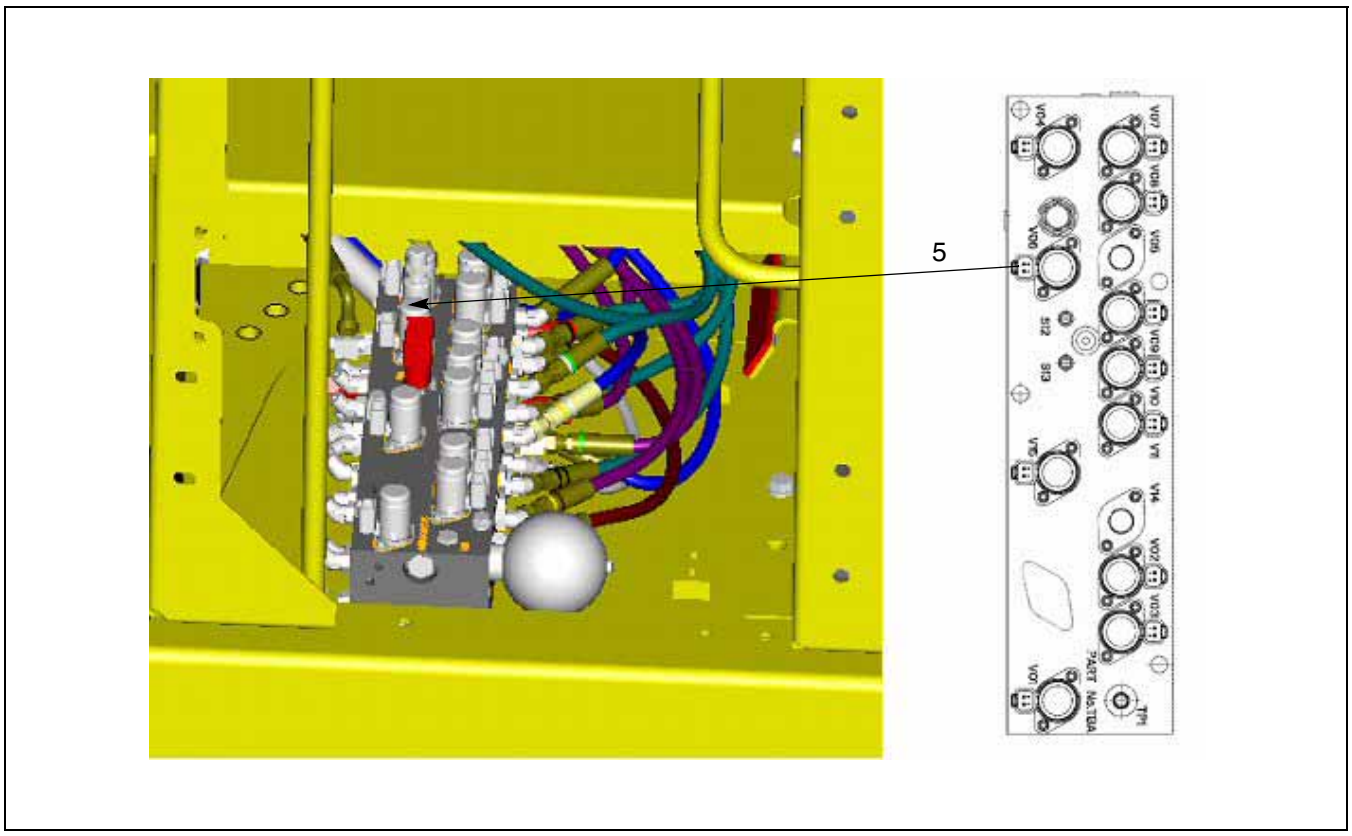


4.1. Forward / Reverse Travel Solenoid Schematic

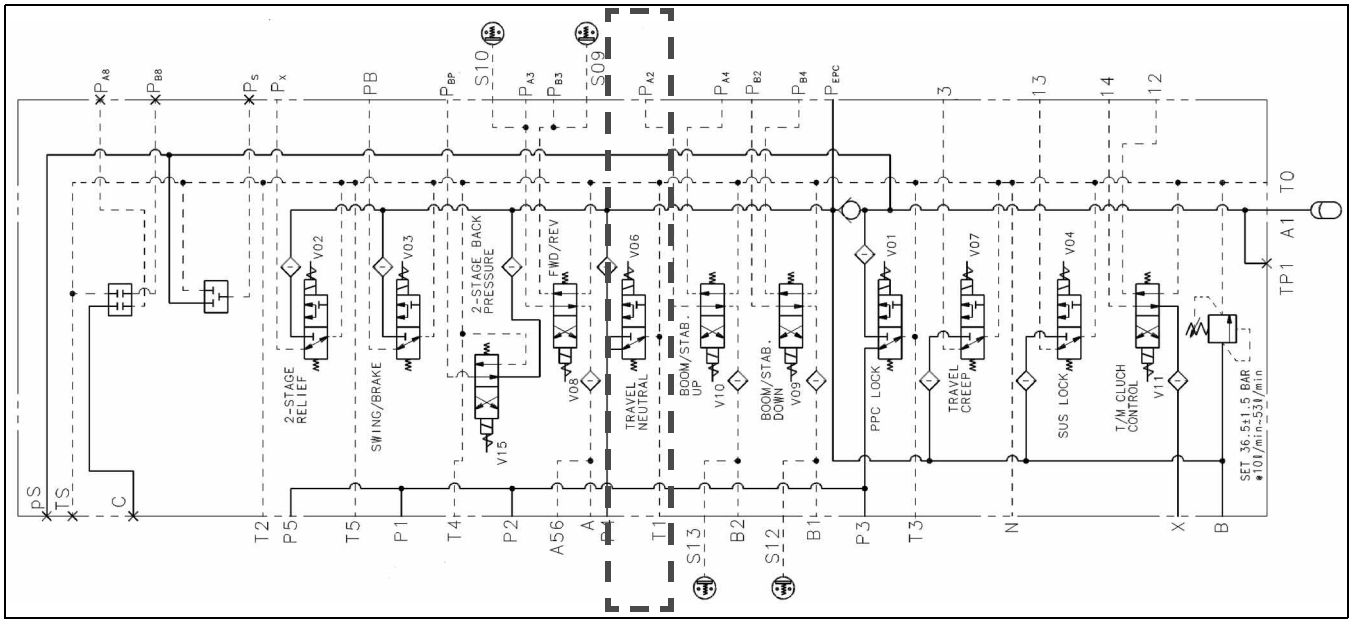


4.2. Forward / Reverse Travel Solenoid: Located on the solenoid block in the service compartment at the rear of the operators cab. This device controls the travel motor direction (forward or reverse) by a signal from the F-N-R switch. Solenoid energised ~Forward or Reverse. Travel is engaged, this is interlocked with the travel neutral solenoid. If travel Reverse is selected, controller drives this valve and travel PPC pressure spool is reversed.

5. Travel / Neutral Solenoid.

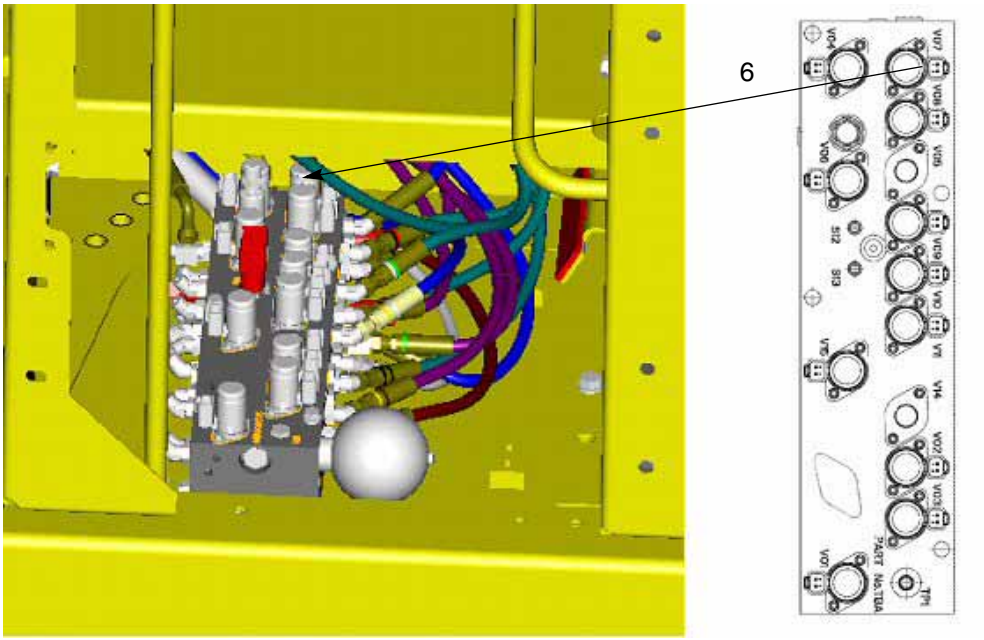


5.1. Travel Neutral Solenoid Schematic.

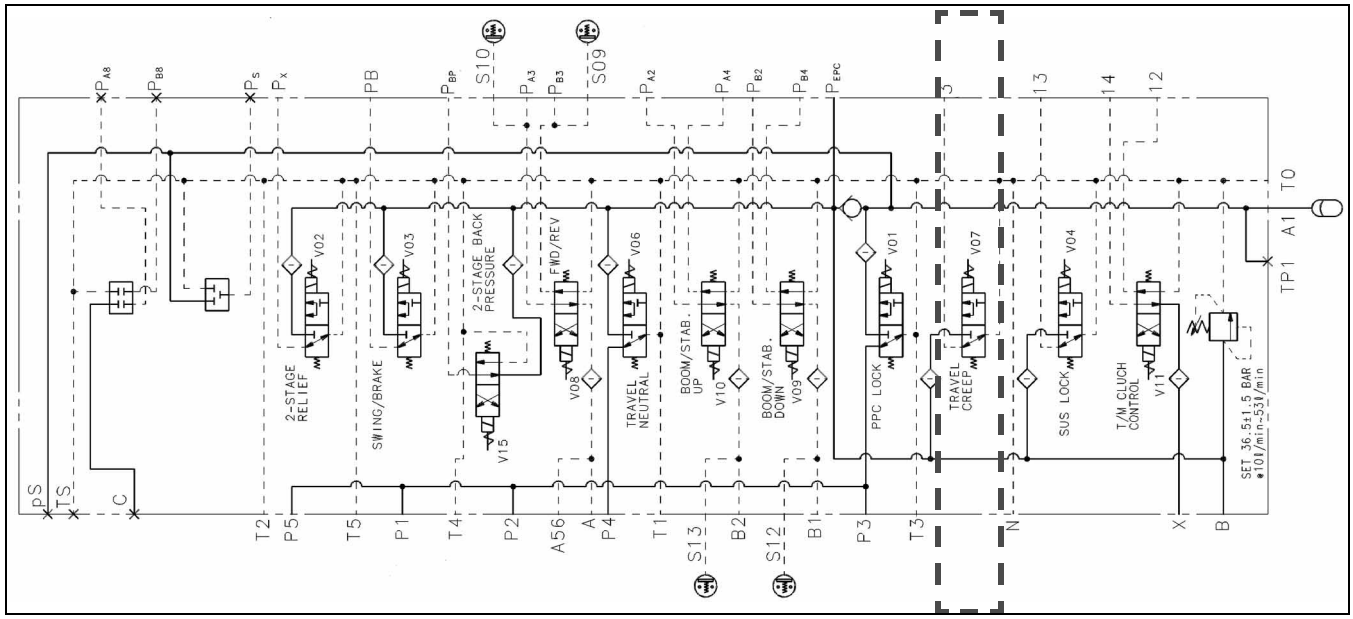


5.2. Travel Neutral Solenoid: Located on the solenoid manifold in the service compartment at the rear of the operators cab. This device interlocks with the forward / reverse solenoid to give supply pressure to the foot pedal control valve.
Solenoid active - PPC pressure to foot valve
Solenoid inactive - No pressure to foot valve
If the travel neutral signal is selected the controller doesn't drive this solenoid so no PPC travel.

6. Travel Creep Solenoid.



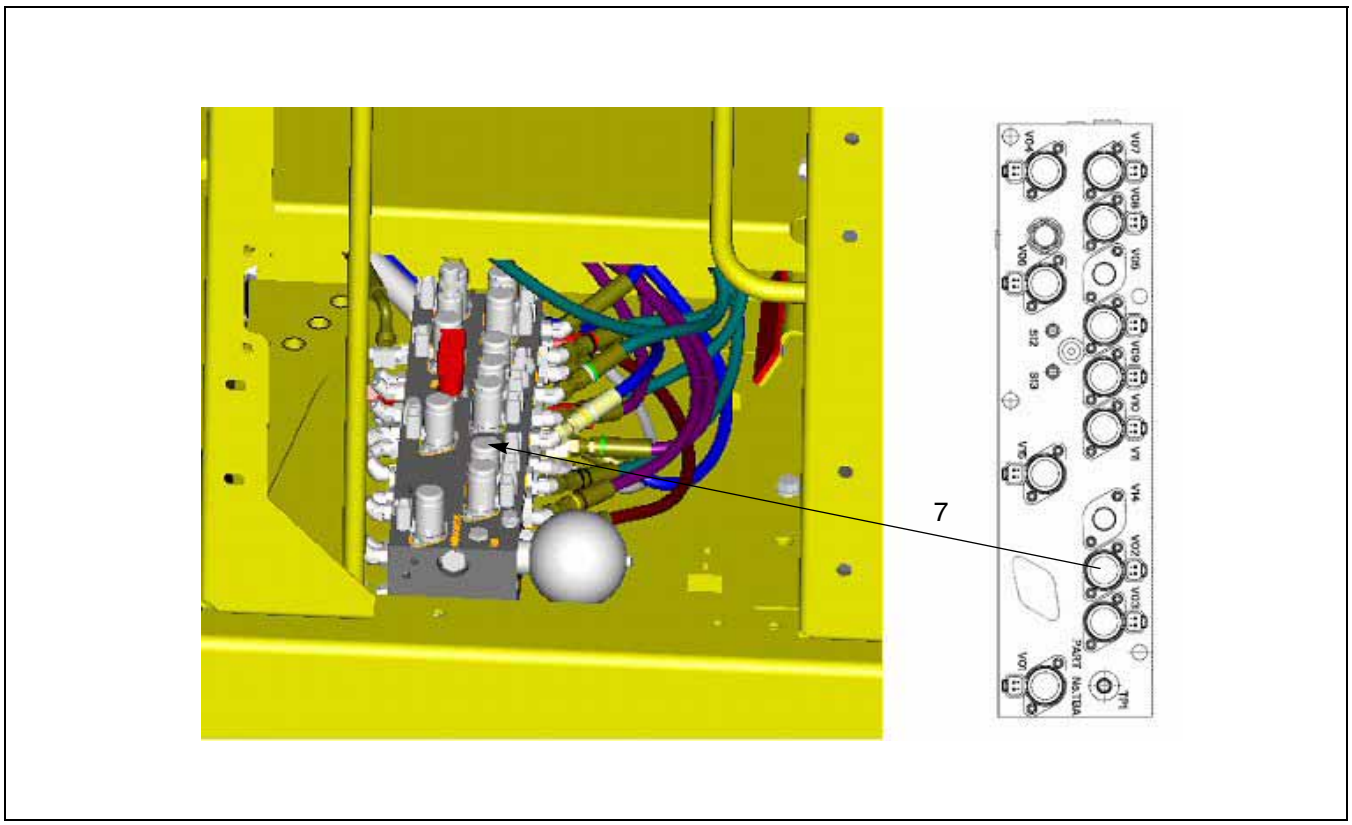
6.1. Travel Creep Solenoid Schematic.



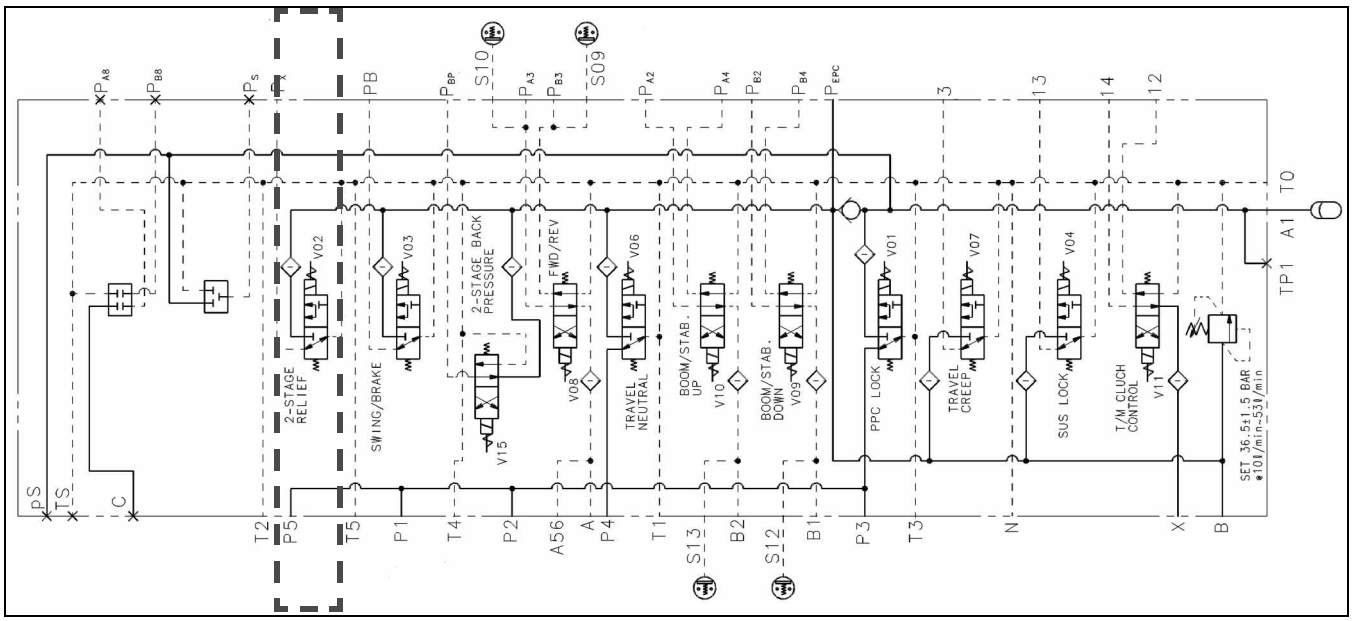
6.2. Travel Creep Solenoid: Located on the solenoid manifold in the service compartment at the rear of the operators cab. When this device is activated 'CREEP' mode is selected and sends PPC pressure to port X on travel motor, ensure travel motor stays at maximum displacement.

Creep Solenoid	Travel Mode Selected	Travel Speed (kph)
On	Creep	0 - 1.5
Off	Low	0 - 9
Off	High	0 - 35
Off	Auto	0 - 35

7. 2-Stage Relief Solenoid.



7.1. 2-Stage Relief Solenoid Schematic.



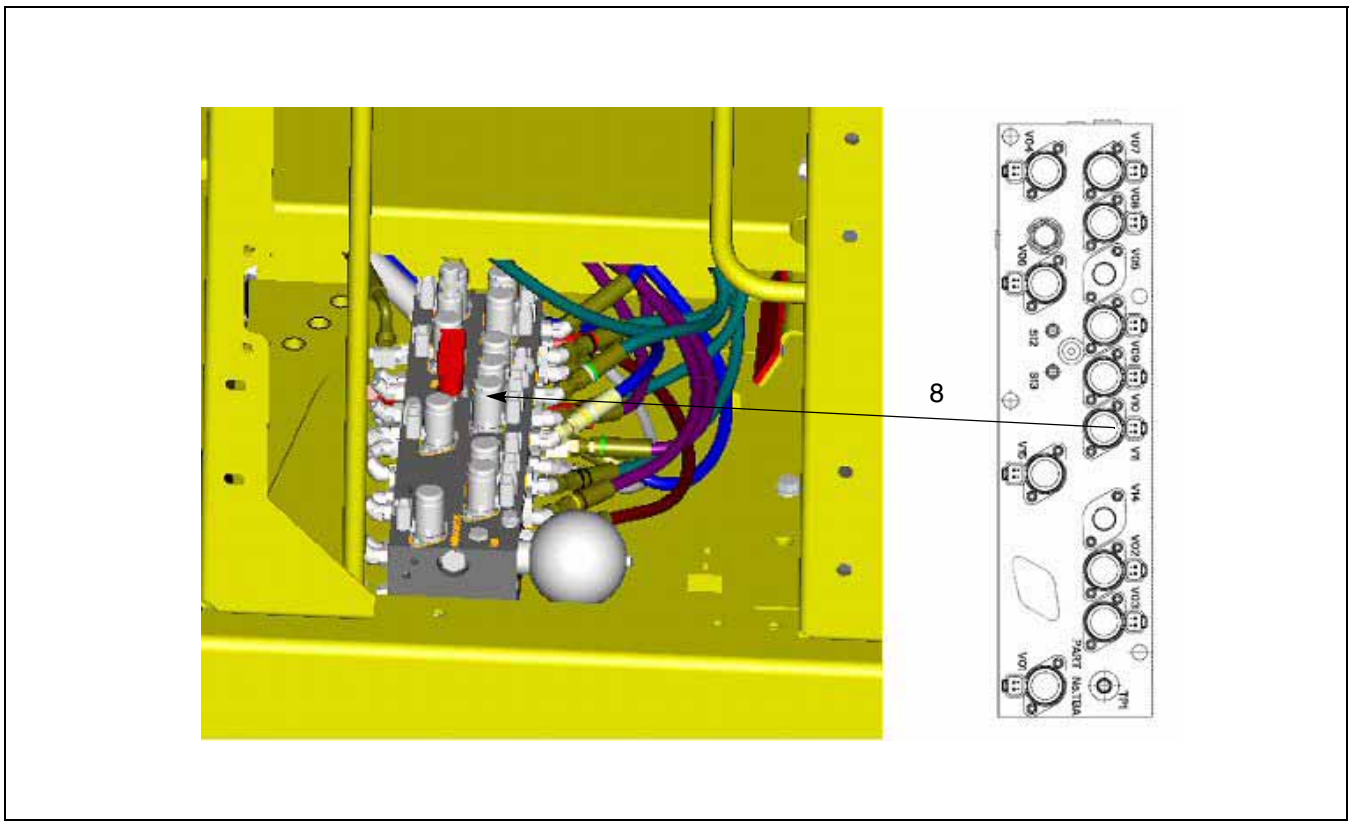
7.2. 2-Stage Relief Solenoid: Located on the solenoid manifold in the service compartment at the rear of the operators cab. This device is activated when the forward / reverse travel solenoid is selected.

- The relief pressure in the normal working mode is 34.8 Mpa (355 kg/cm²). If the 2-stage relief function is turned on, however, the relief pressure rises to about 37.2 MPa (380 kg/cm²). By this operation, the hydraulic force is increased.

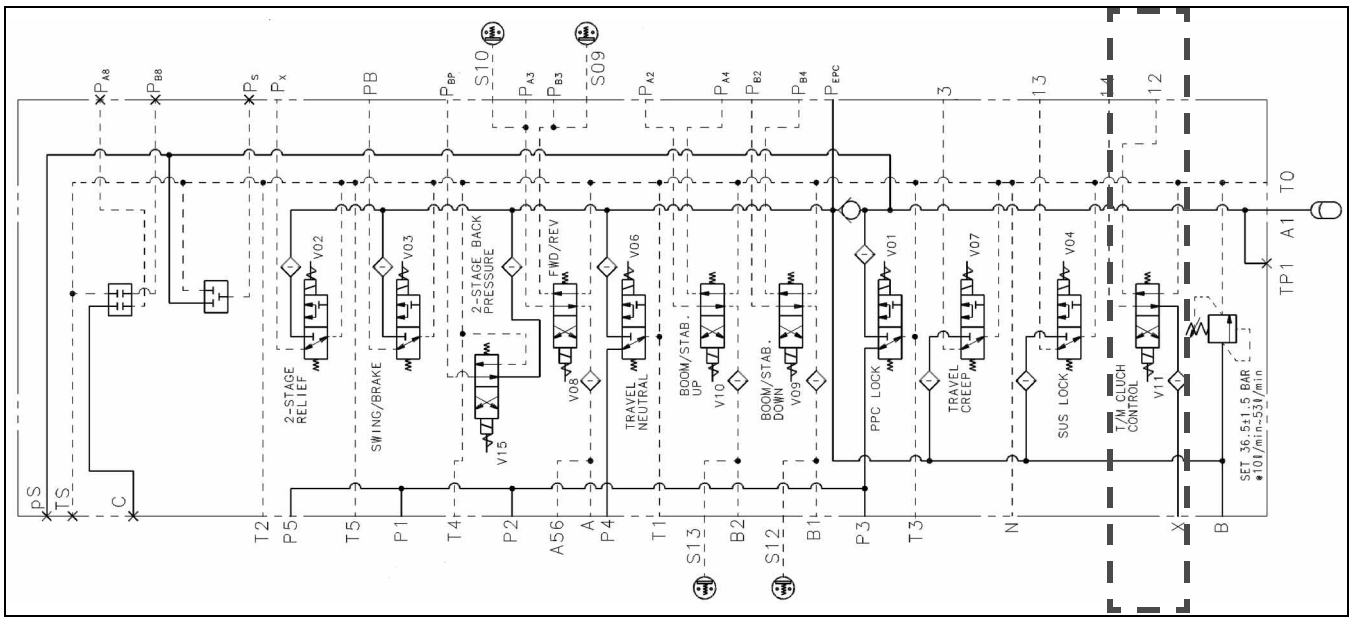
- Operating condition for turning on 2-stage relief function.

Condition	Relief pressure
During travel	34.8 Mpa (355 kg/cm^2) ↓ ↓ 37.2 Mpa (380 kg/cm^2)
When swing lock switch is turned on	
When boom is lowered	
When one-touch power maximizing function is turned on.	
When L mode is operated	

8. Transmission Clutch Control Valve



8.1. Transmission Clutch Control Valve Schematic.



8.2. Hi / Lo Solenoid Valve: Located on the solenoid block in the service compartment at the rear of the operators cab. This device is activated when 'LO' speed is selected.

Solenoid On	Lo	0 - 9 kph
Solenoid Off	Hi	0 - 35 kph *

*: To max speed

STEERING SYSTEM

OPERATING PRINCIPLES

When the steering wheel is turned the demand for fluid at port 'P' of the orbitrol valve causes the CF signal level to fall. The priority spool is now forced upwards by the spring creating a flow path into the CF port. Turning the steering wheel also connects the 'P' port of the orbitrol valve to the service 'L' and the service port 'R' to tank.

Simultaneously the service port pressure is connected to the priority valve LS connection on its spring side. This action causes the priority spool to take up a modulation condition balanced by the pilot pressure ''pp'' from the CF line on one side and the service port pressure and spring on the opposite.

This results in a pressure drop across the metering valve section of the orbit unit equal to the priority spool spring rating.

Therefore $\triangle P = pp - LS$

$= P1 - P2$

At this stage the priority valve becomes a pressure compensator for the steering unit forming a pressure compensated flow control. This ensures a constant rate of steering irrespective of changes in steering cylinder forces.

Dynamic Steering

In the static steering unit, the LS connection is drained to tank via the spool / sleeve set when the steering unit is in the neutral position.

In the dynamic steering unit the drain connection has been made active. The spool of the dynamic priority valve has a port drilled connecting the CF port to the LS port. During normal running conditions there is approximately 0.5 lpm flowing.

Therefore when the spool in the priority valve is actuated during steering the spring chamber is filled with oil via the spool drilling.

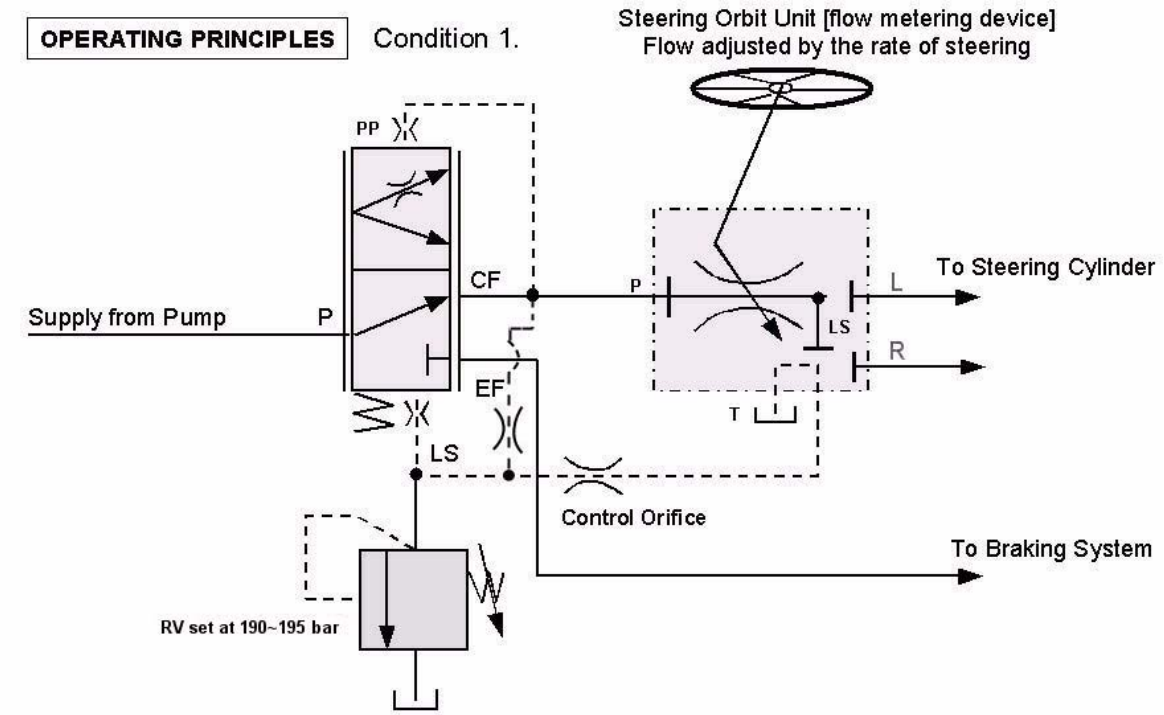
In the static LS system the LS chamber is filled with oil from the LS port in the steering unit.

2 - stage principle

Any valve operation in which the main stage is controlled by a pilot stage and involves the application of a control orifice to create a pressure differential between the ends of the main stage to offset the effect of the main stage spring is operating on the 2-stage principle.

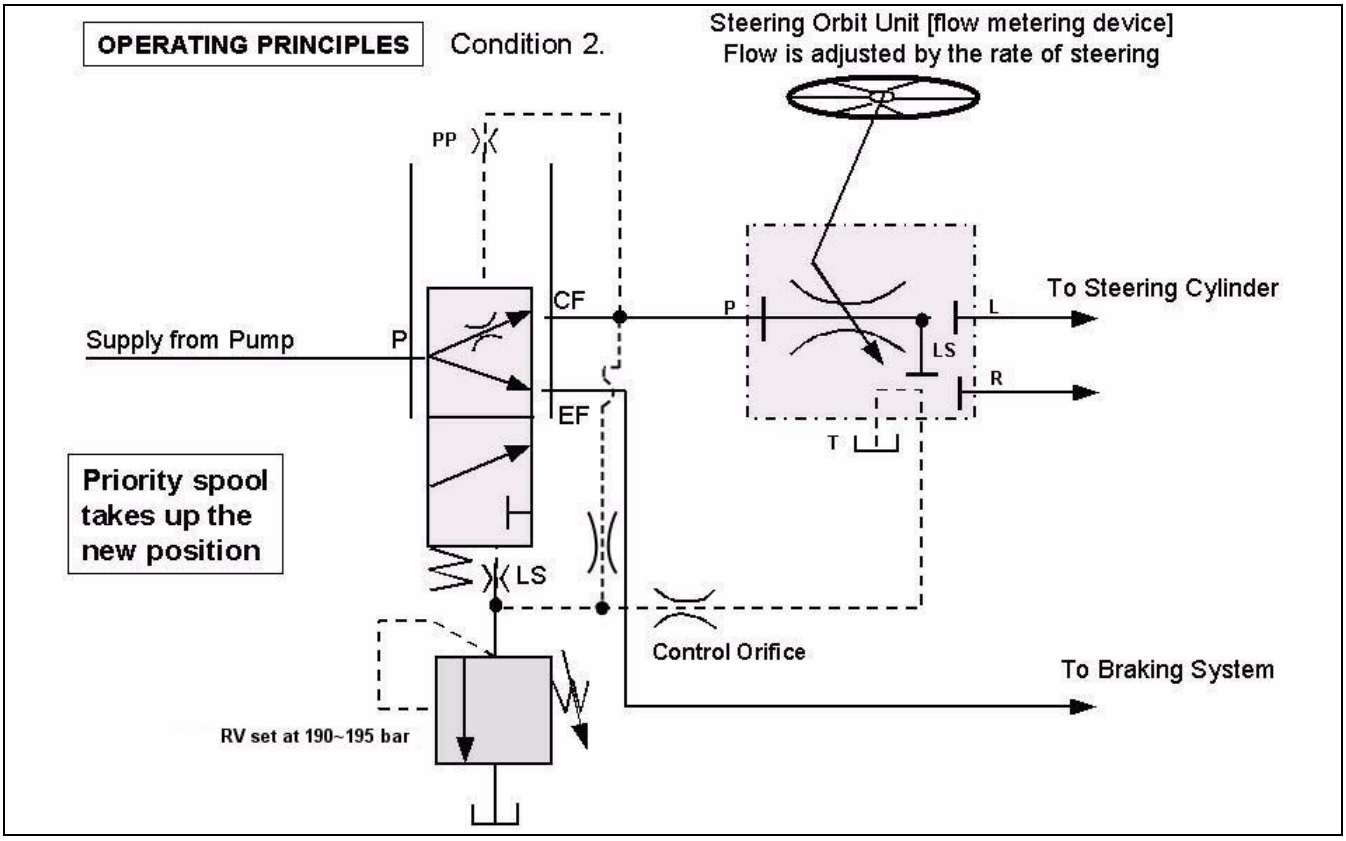
This applies to pressure control valves but also that of flow control devices incorporating pilot relief valve control.

1. Condition 1.

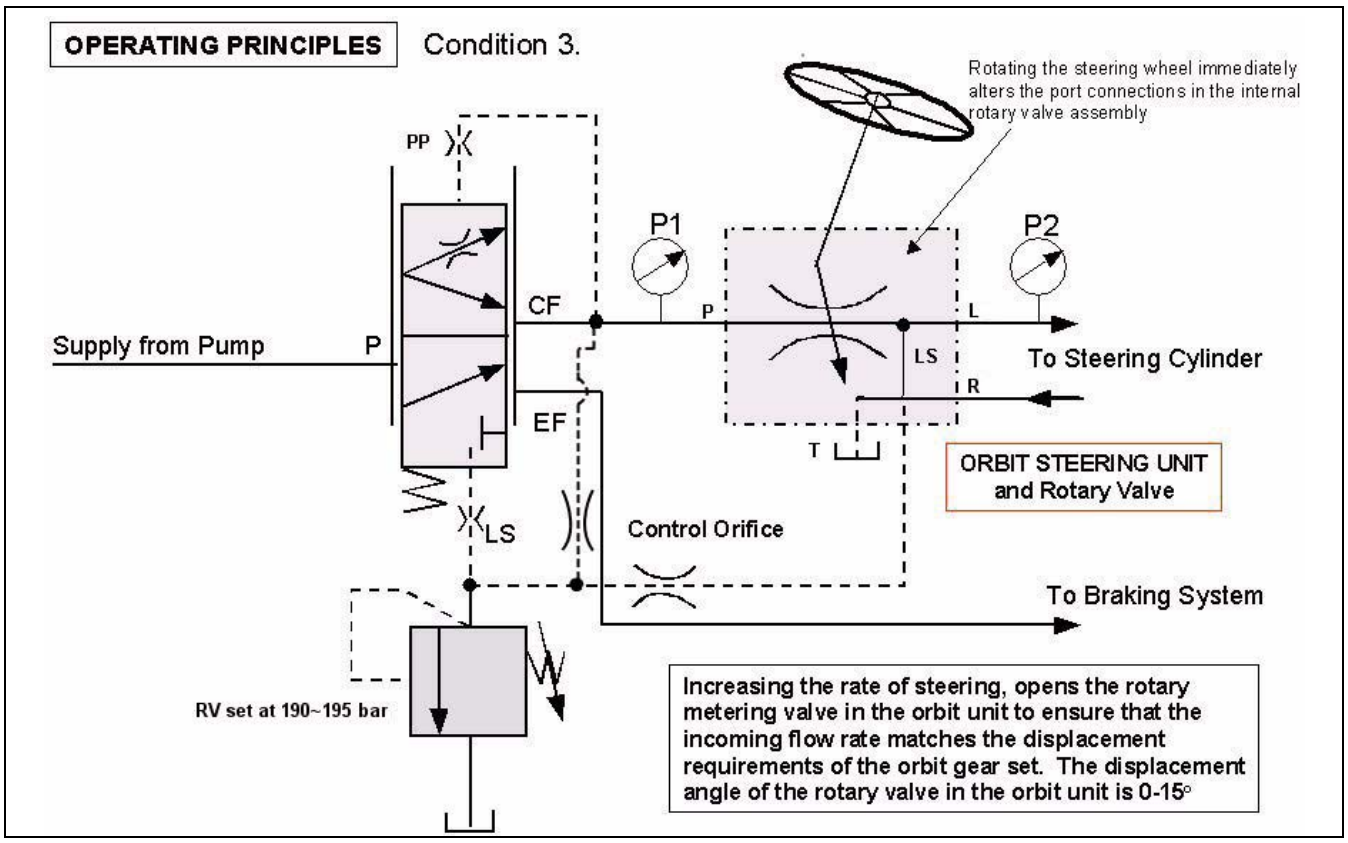


Note. When the steering wheel is released the orbit unit is closed centre [P is blocked] and the LS connection is drained to tank. With the pump running the priority valve is piloted down against the low rated spring [4,7 or 10bar.] The oil is then directed in to the EF line towards the braking circuit.

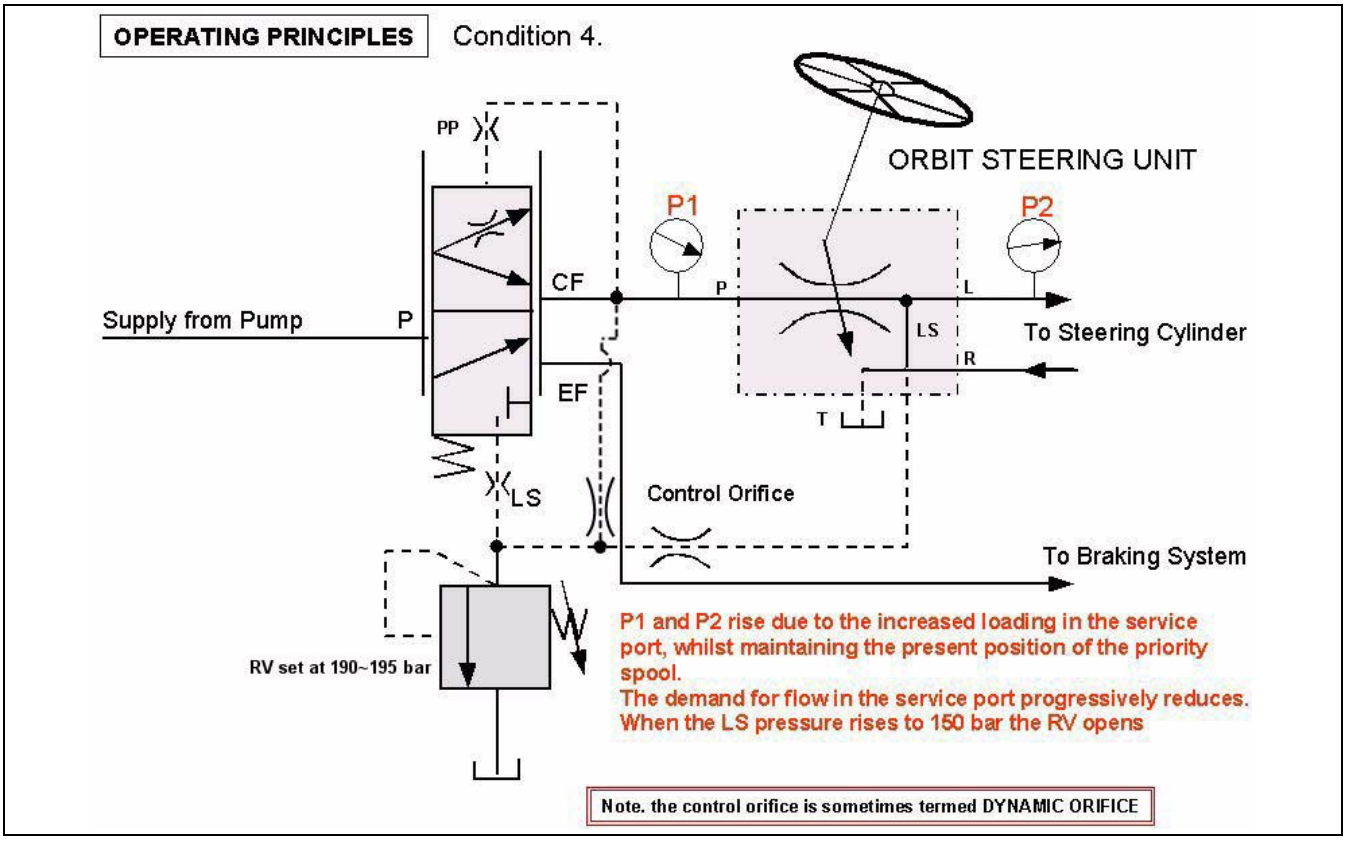
2. Condition 2.



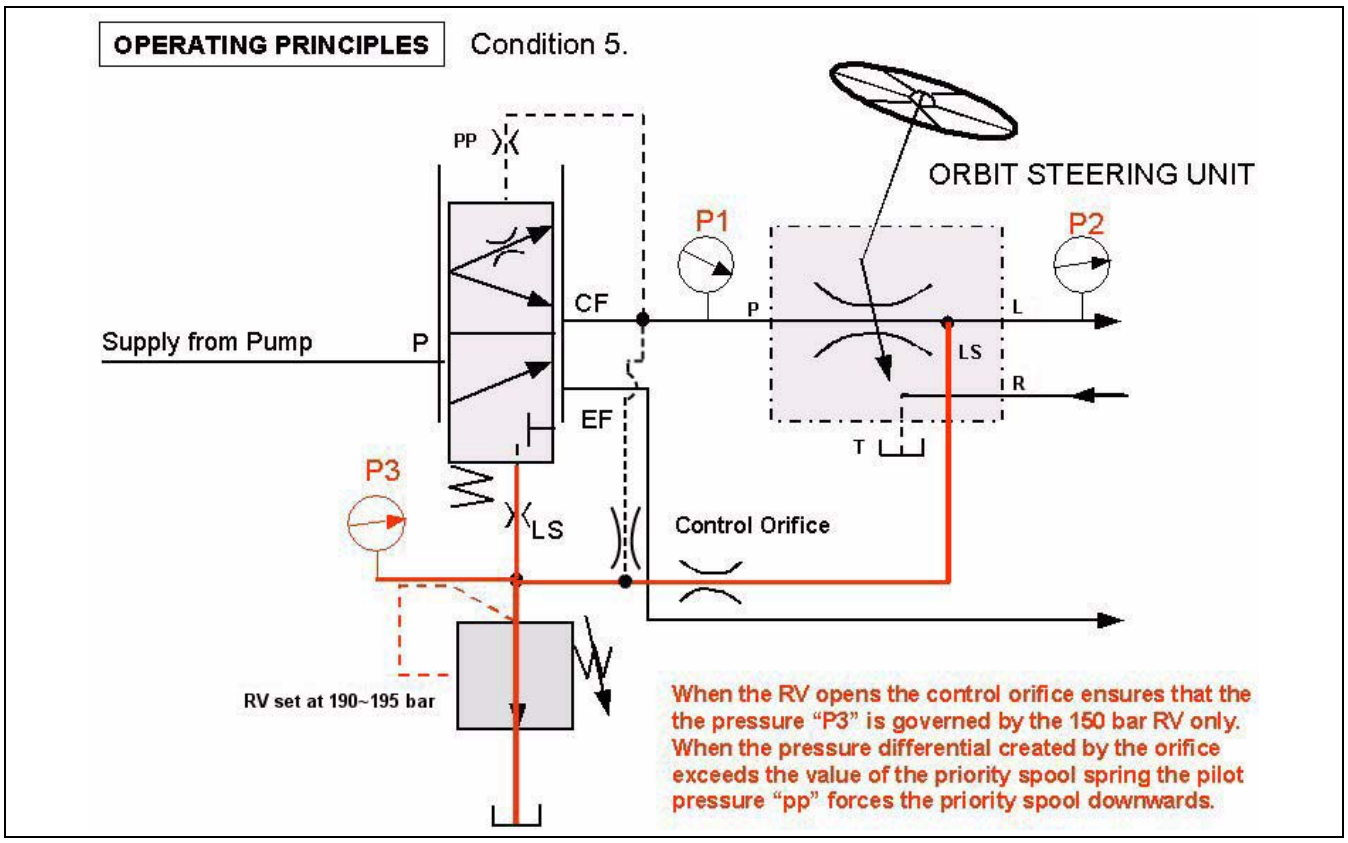
3. Condition 3.



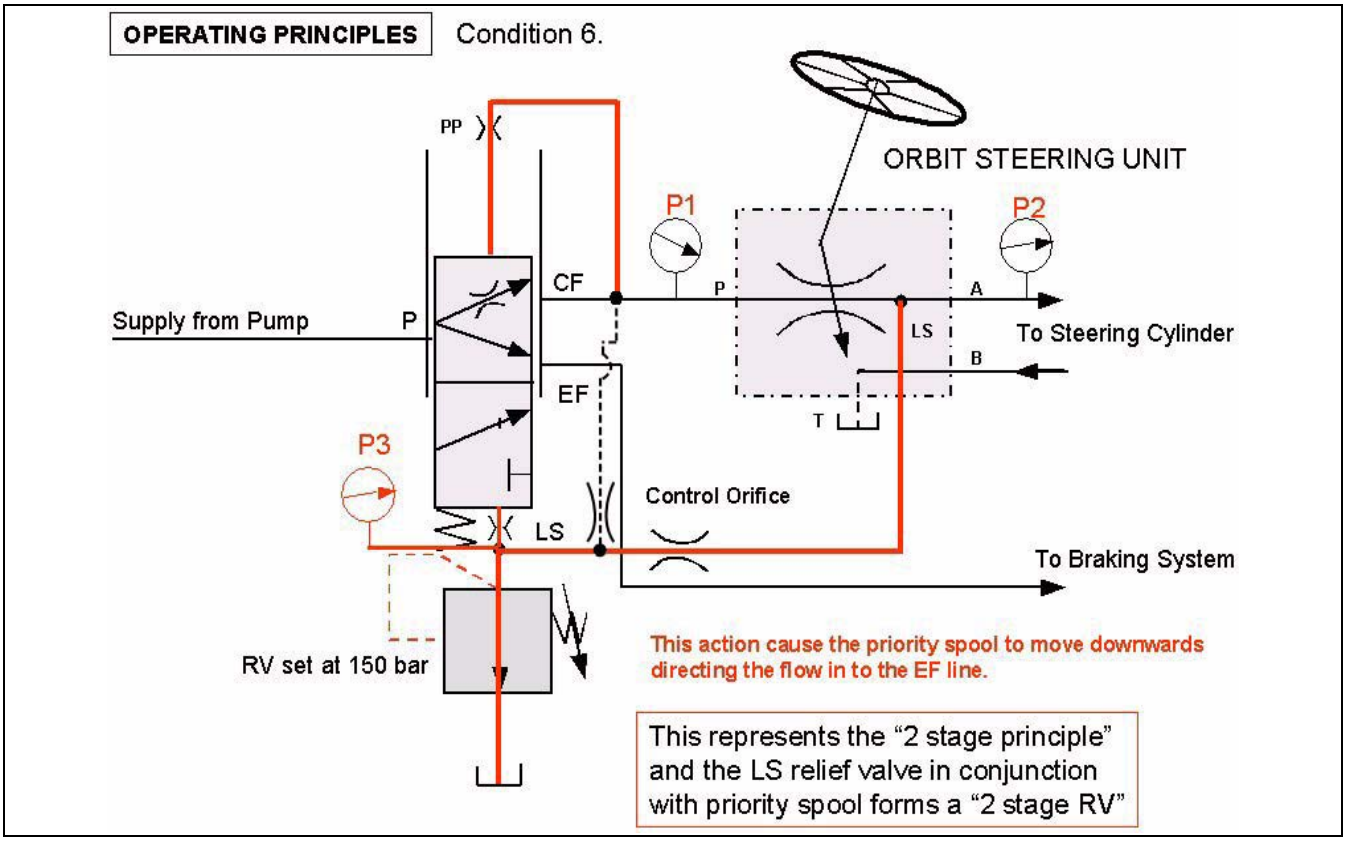
4. Condition 4.



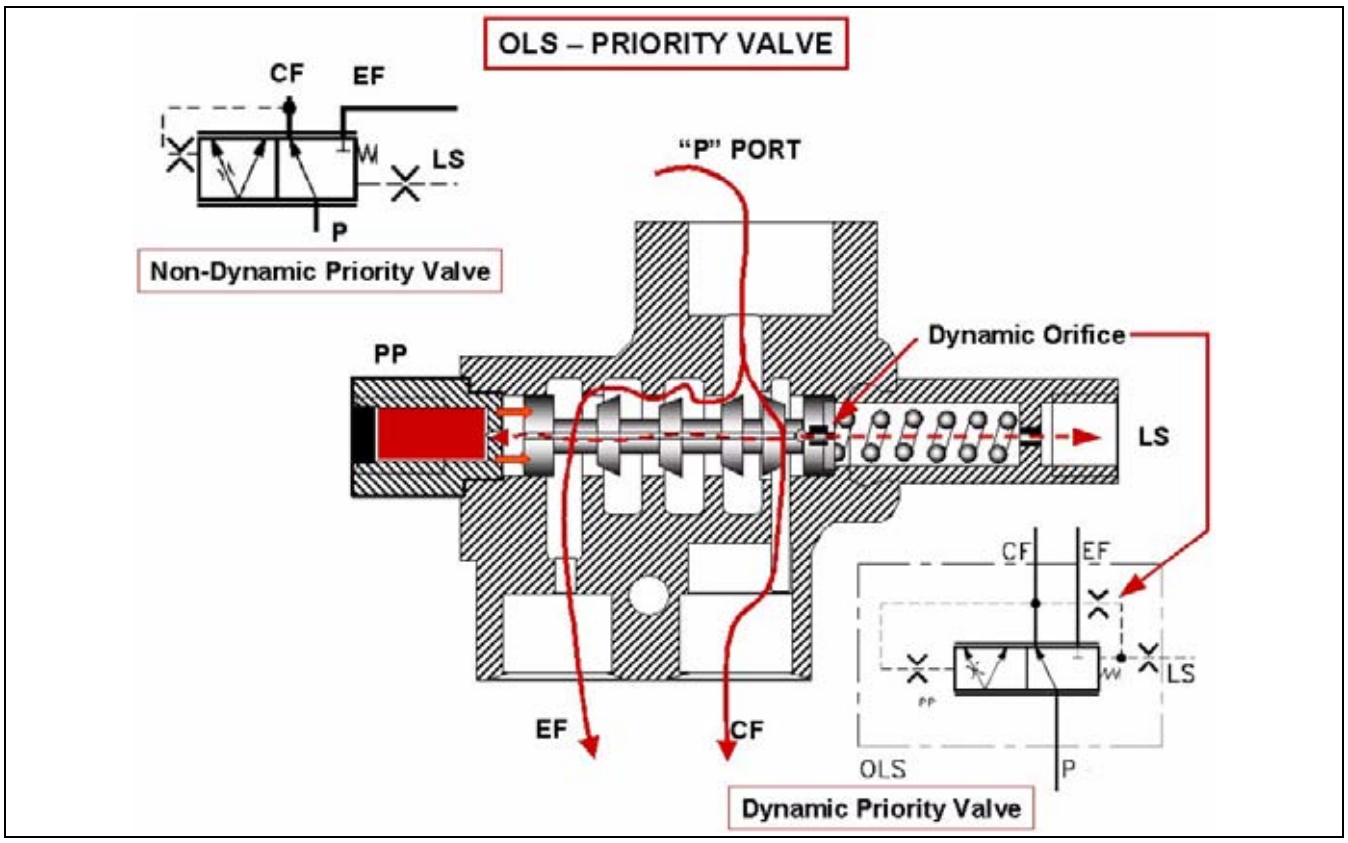
5. Condition 5.



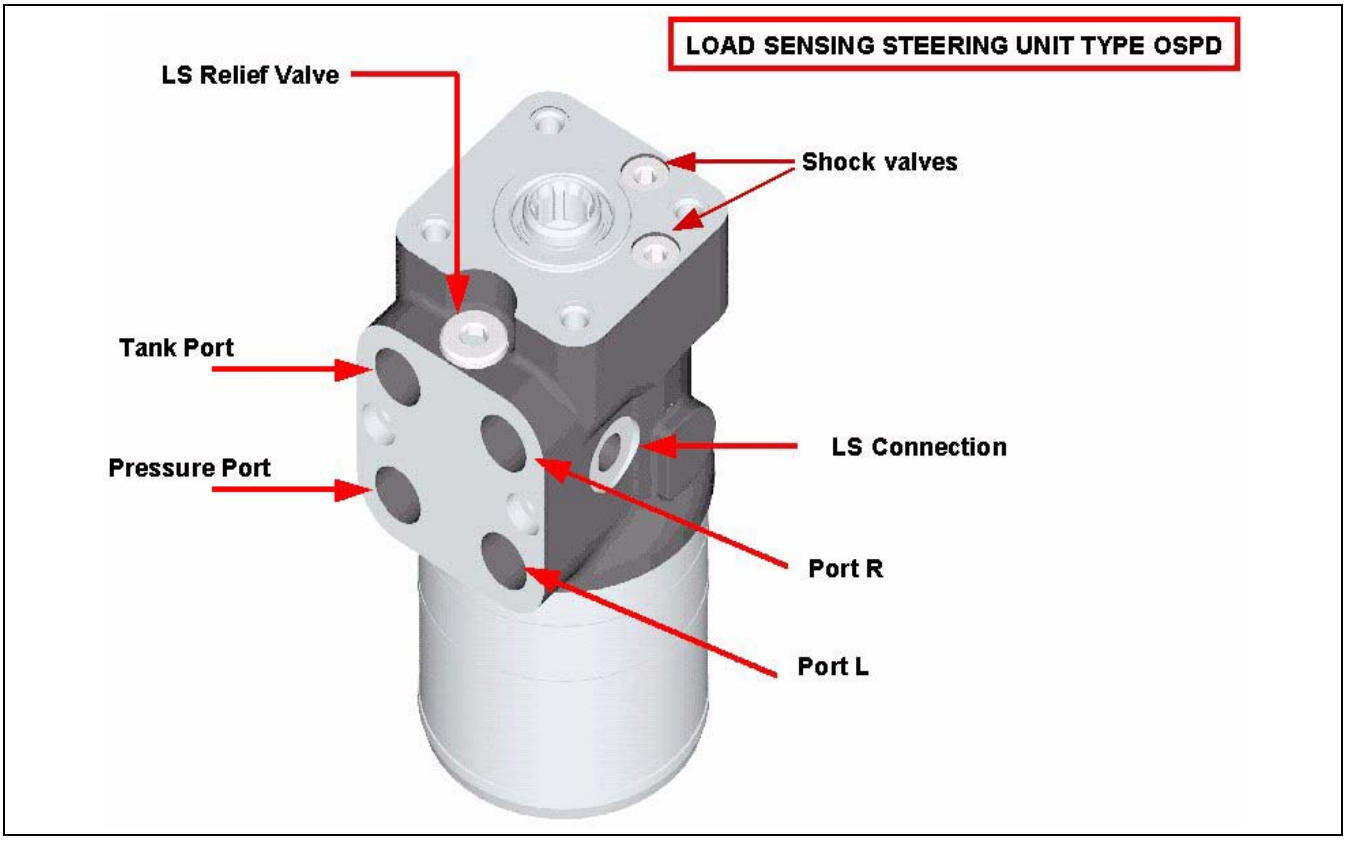
6. Condition 6.



7. OLS Priority Valve.



8. Load sensing steering unit

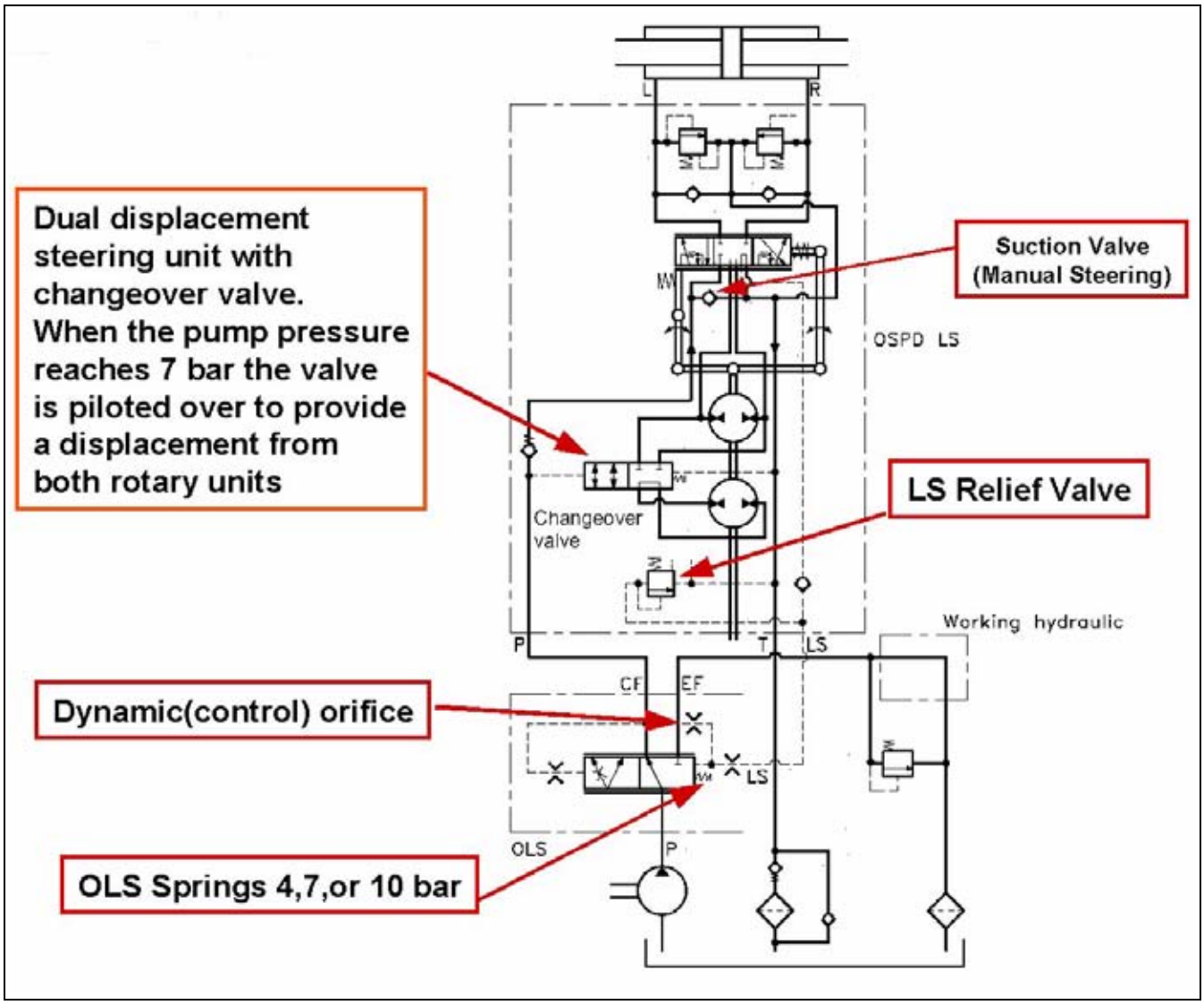


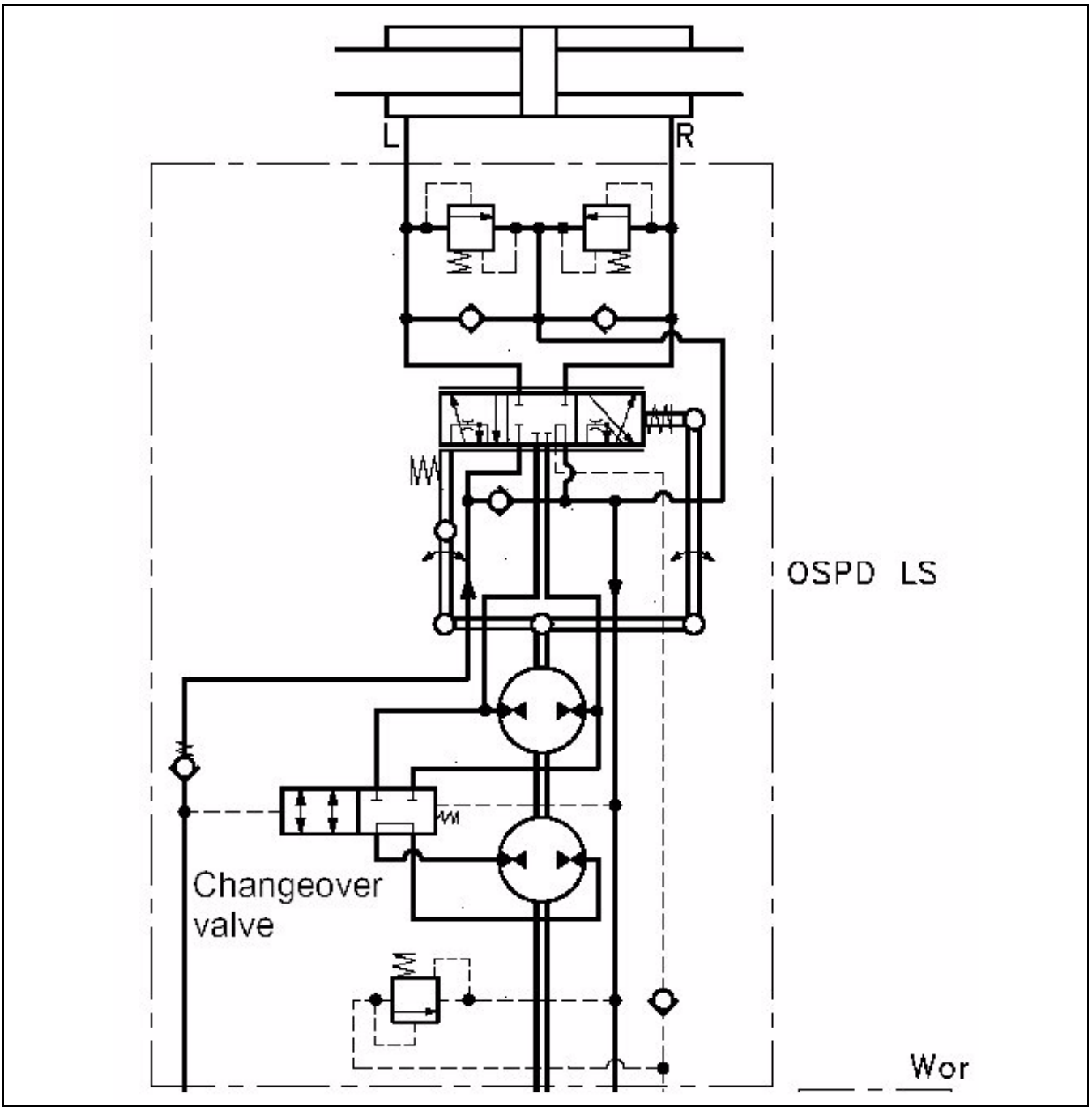
Technical data

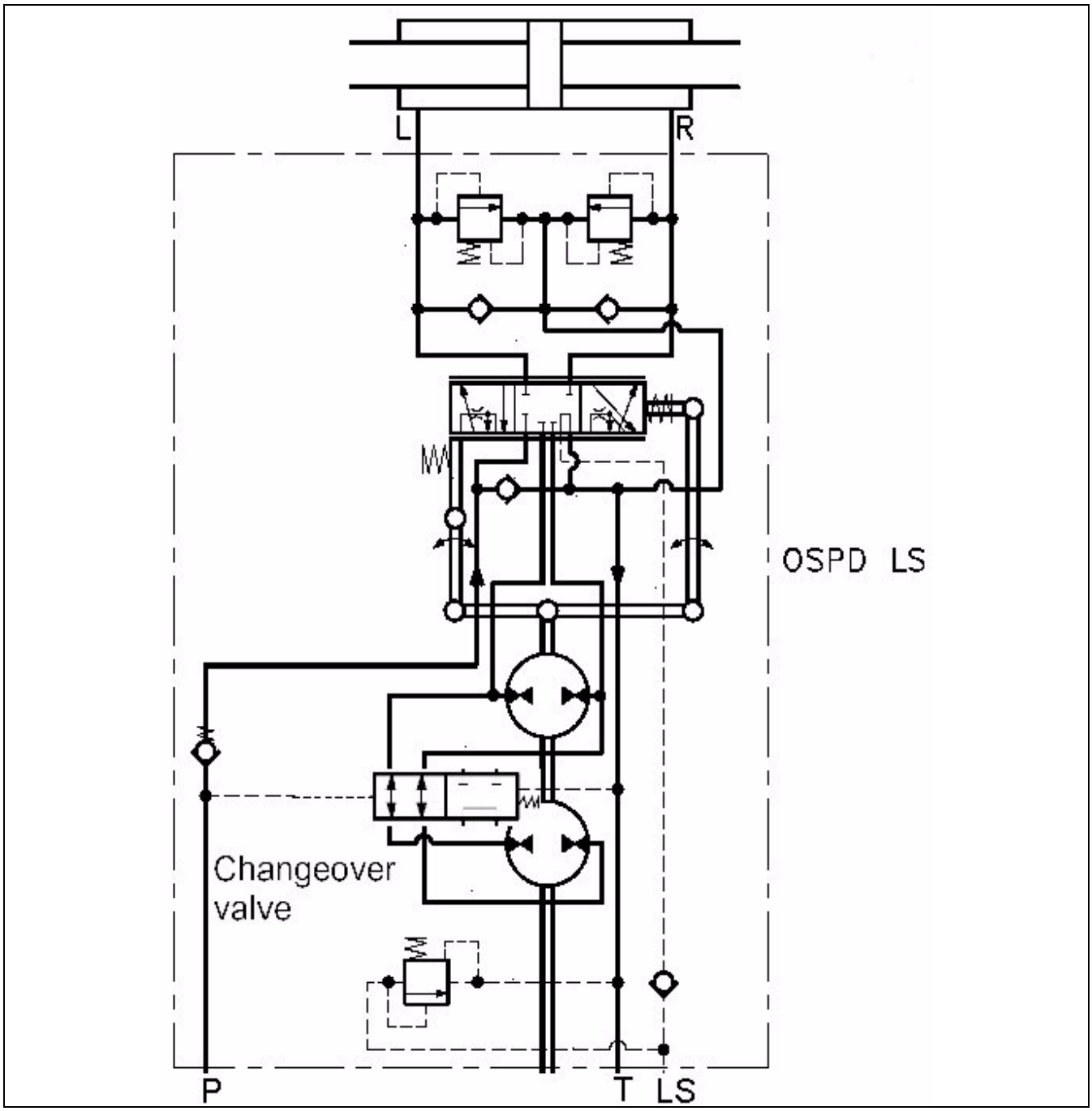
Displacement	OSPD 80/240	Small gear set	80 cc/rev.
		Large gear set	160 cc/rev.
		Combined gear set	240 cc/rev.

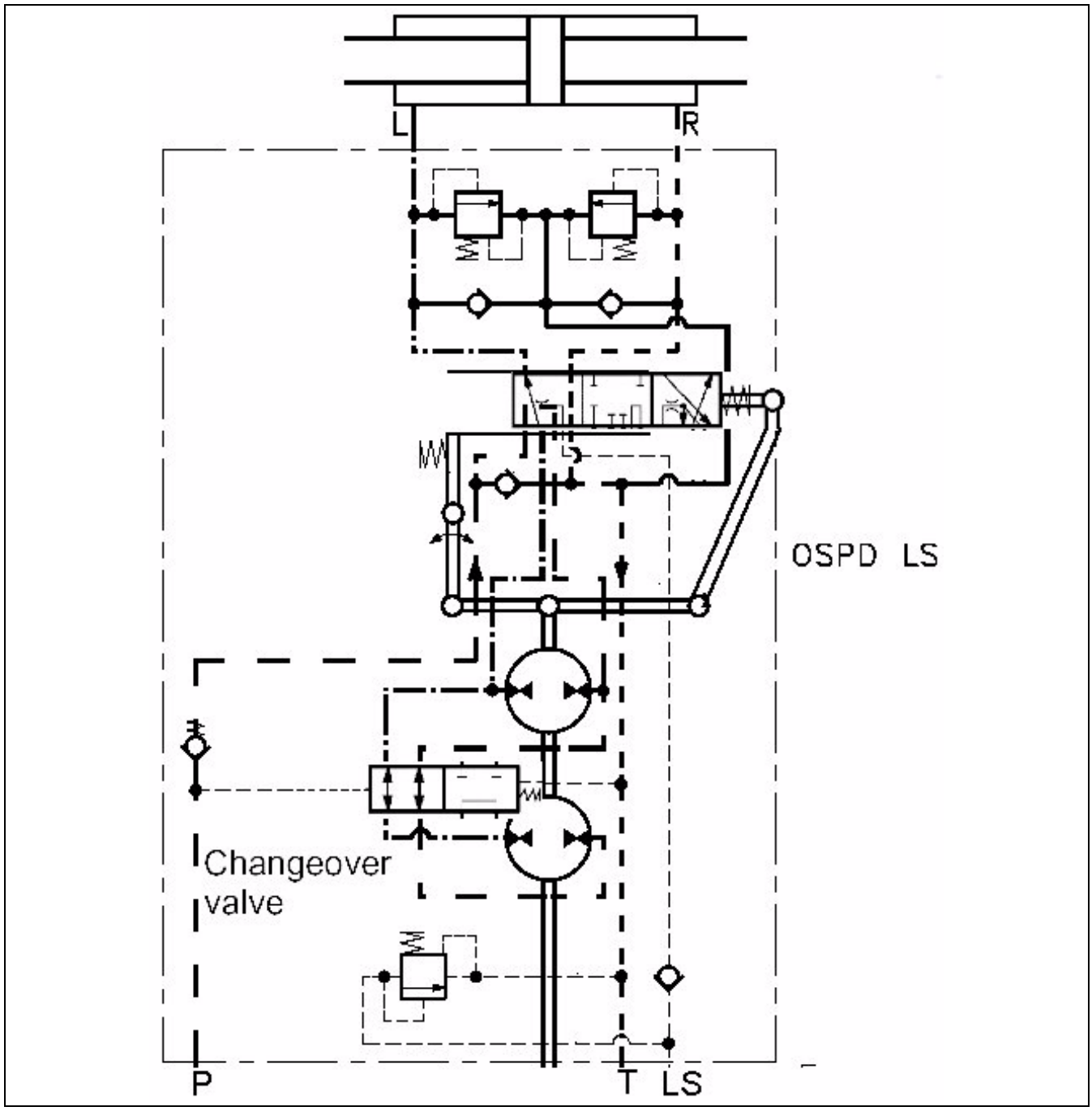
Valve functions	Pilot pressure relief valve
	Shock valves
	Suction valves
	Check valves in LS-connection
	Check valves in P connection

Pressure	Max. steering pressure	195 bar


Dual displacement steering unit with changeover valve. When the pump pressure reaches 7 bar the valve is piloted over to provide a displacement from both rotary units
Suction Valve (Manual Steering)
LS Relief Valve
Dynamic(control) orifice
OLS Springs 4,7,or 10 bar
L
R
OSPD LS
Changeover valve
Working hydraulic
P
T
LS
CF
EF
OLS


L
R
OSPD LS
Changeover valve
Wor


L
R
OSPD LS
Changeover valve
P
T
LS


L
R
OSPD LS
Changeover valve
P
T
LS

SERVICE BRAKE AND SUSPENSION SYSTEM

BRAKING SYSTEM

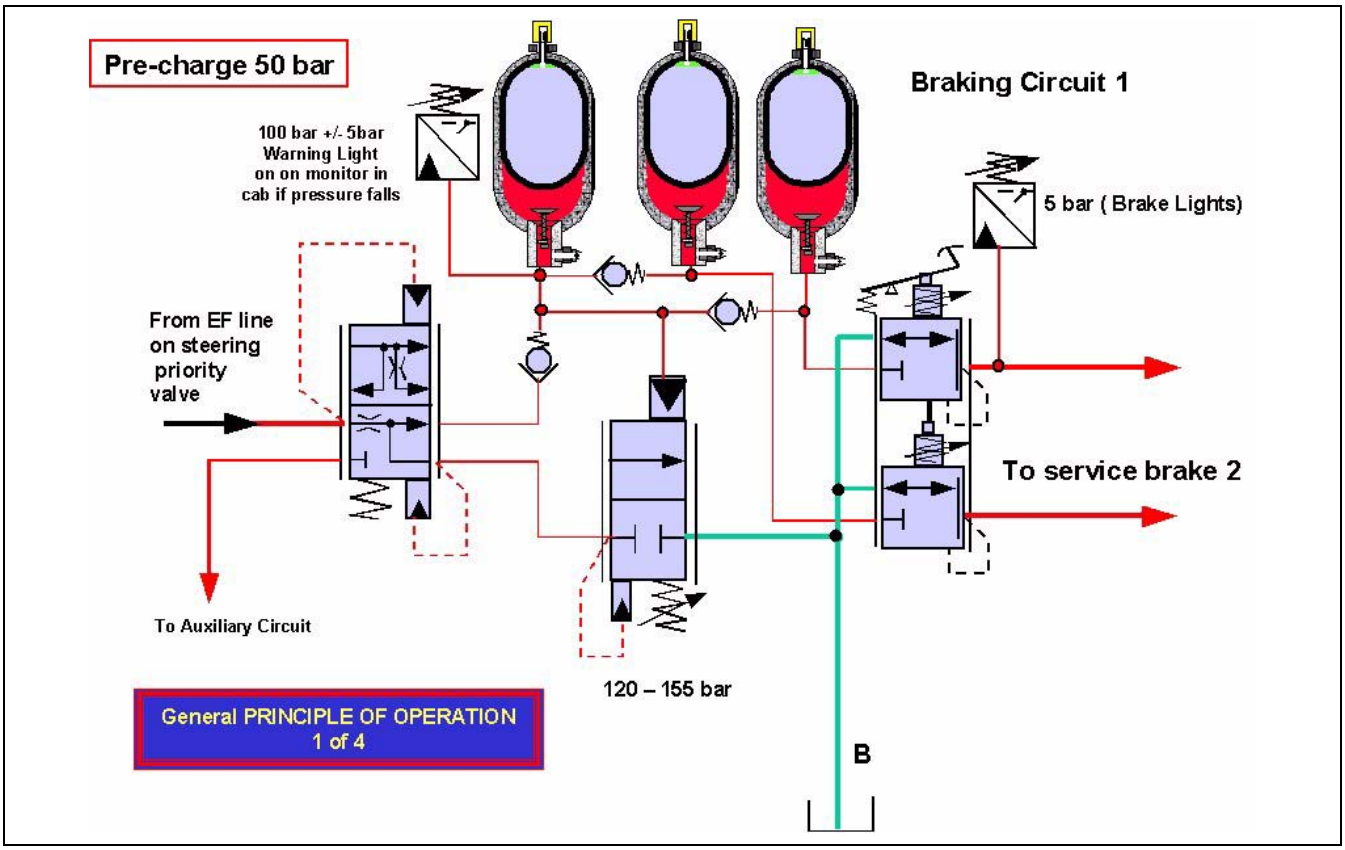
The hydraulic braking system unit contains the following services.

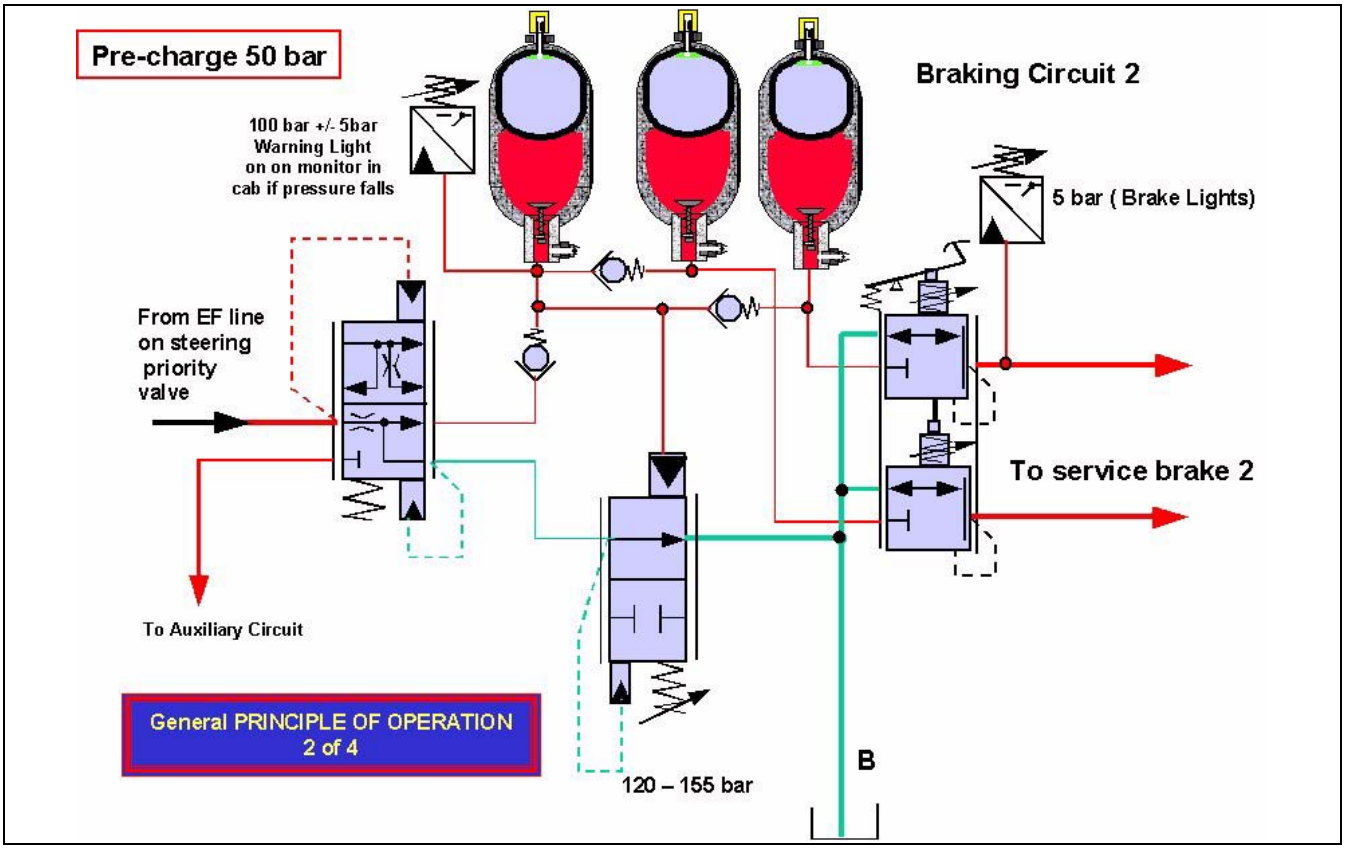
- Inlet Bypass Valve:
  distributing flow to other services when braking demand is low or not required.
- Accumulators:
  for fluid storage providing a number of brake operations (usually 5 ~ 8 operations depending upon accumulator capacity)
- Check Valves:

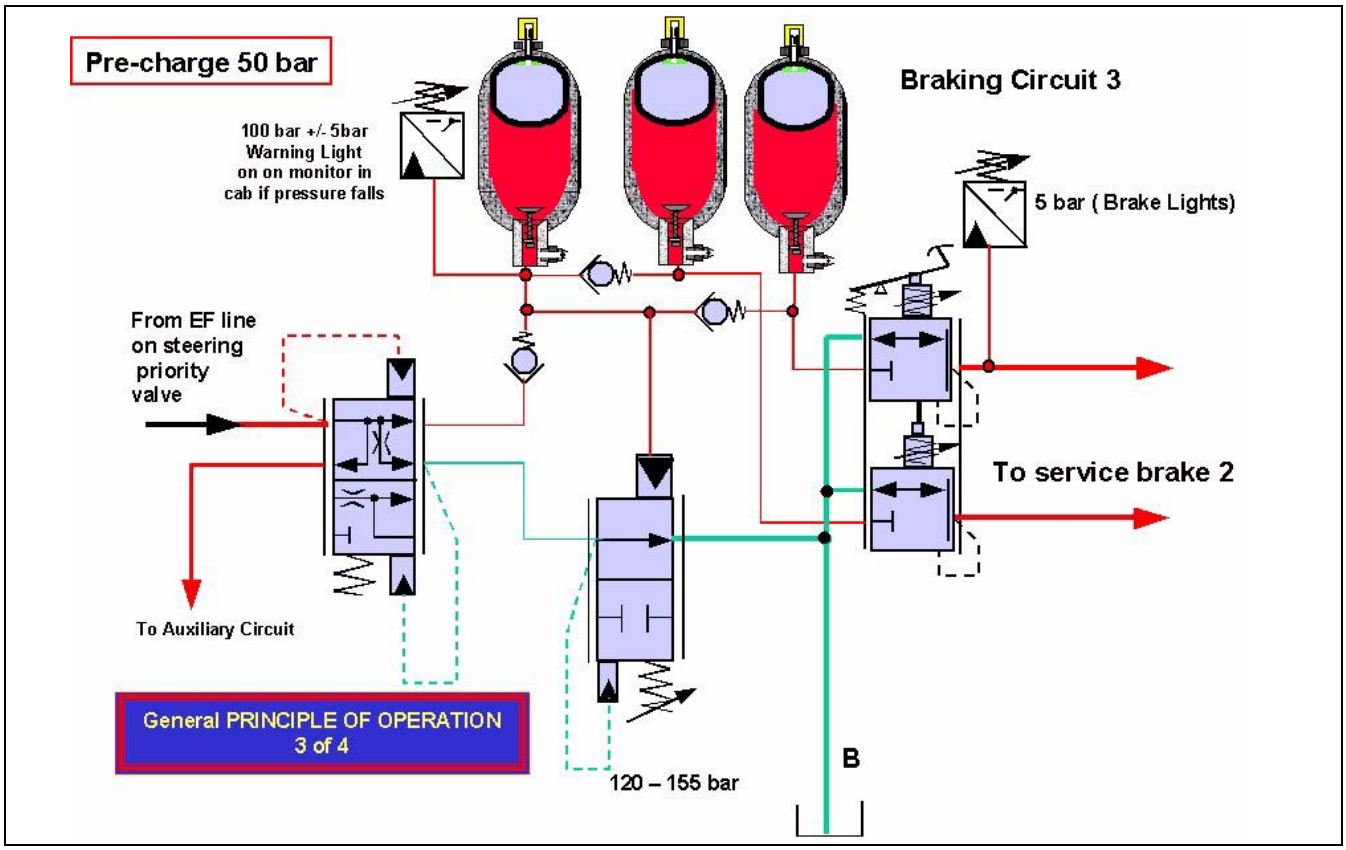
  to isolate the inlet supply from the charged accumulators and isolate individually charged accumulators from each other, thereby allowing individual brake circuits to be controlled.

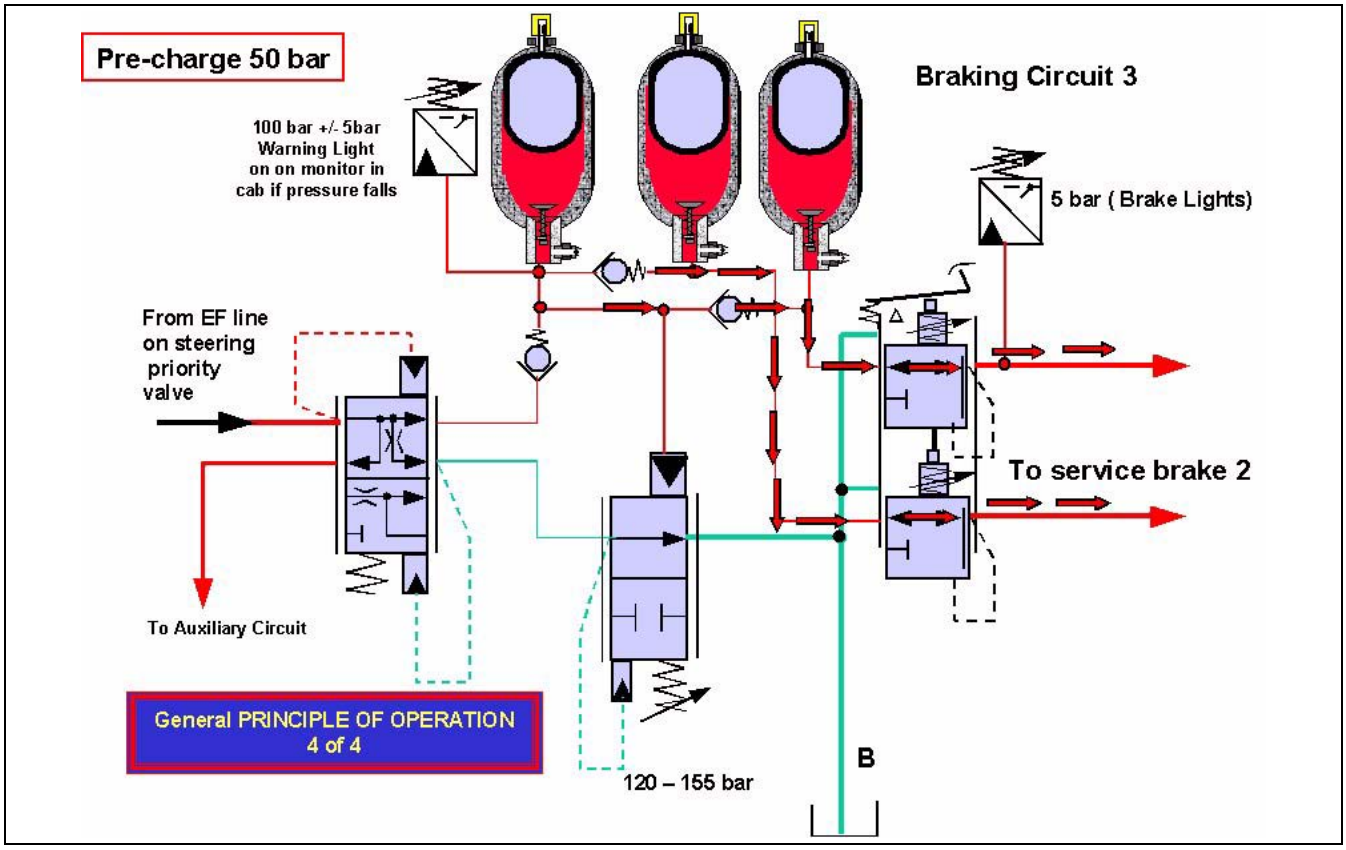
NOTE: Service brakes 1 and 2 are individually supplied but simultaneously applied.

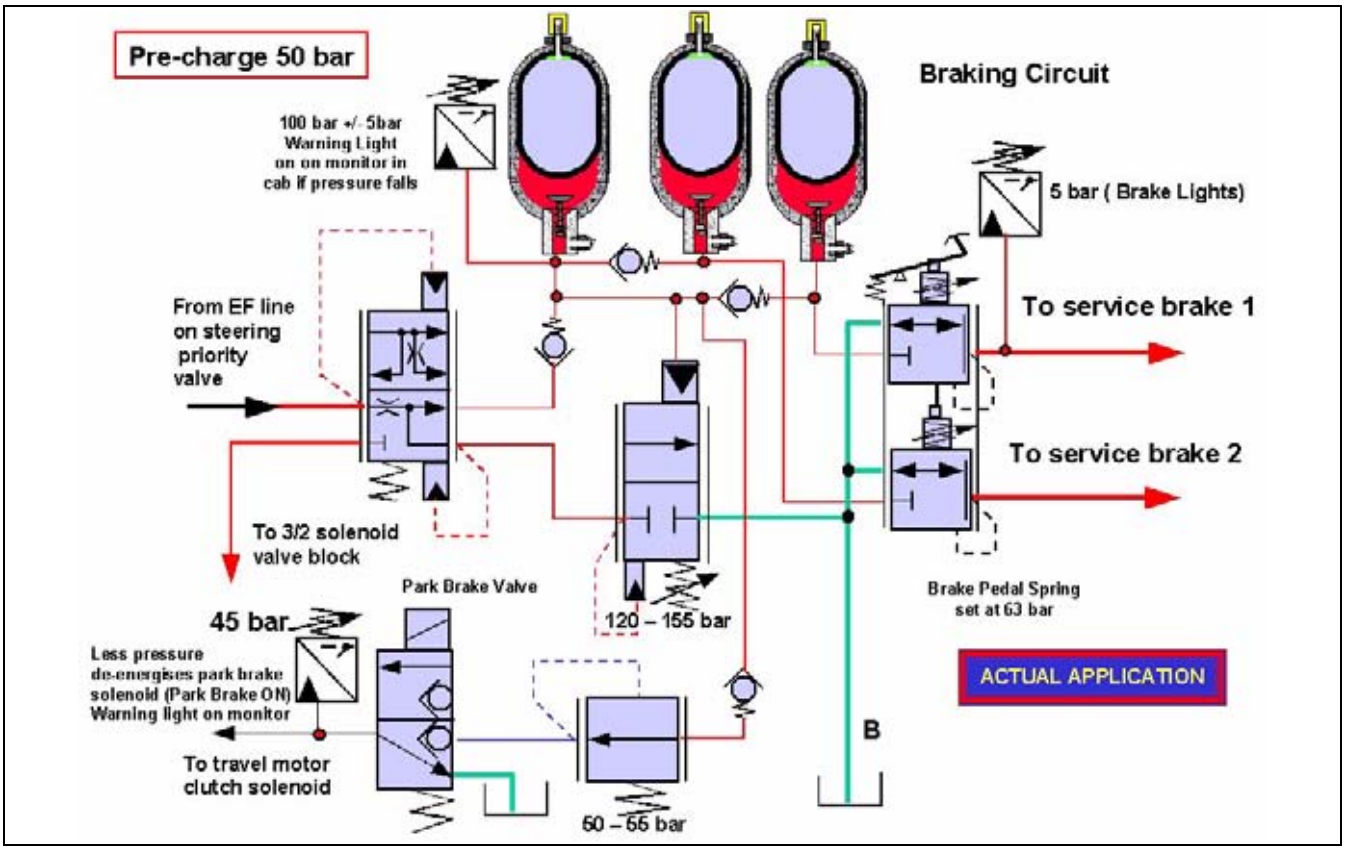
- Pressure Limiting Valve:
  to control the maximum pressure in the accumulators. This valve provides relief valve protection and diverts the fluid via its unloaded valve action.


Pre-charge 50 bar
Braking Circuit 1
100 bar +/- 5bar
Warning Light
on on monitor in
cab if pressure falls
5 bar (Brake Lights)
From EF line
on steering
priority
valve
To service brake 2
To Auxiliary Circuit
120 – 155 bar
General PRINCIPLE OF OPERATION
1 of 4
B


Pre-charge 50 bar
Braking Circuit 2
100 bar +/- 5bar
Warning Light
on on monitor in
cab if pressure falls
5 bar (Brake Lights)
From EF line
on steering
priority
valve
To service brake 2
To Auxiliary Circuit
General PRINCIPLE OF OPERATION
2 of 4
120 – 155 bar
B


Pre-charge 50 bar
100 bar +/- 5bar
Warning Light
on on monitor in
cab if pressure falls
Braking Circuit 3
5 bar (Brake Lights)
From EF line
on steering
priority
valve
To service brake 2
To Auxiliary Circuit
General PRINCIPLE OF OPERATION
3 of 4
120 – 155 bar
B


Pre-charge 50 bar
100 bar +/- 5bar
Warning Light
on on monitor in
cab if pressure falls
Braking Circuit 3
5 bar (Brake Lights)
From EF line
on steering
priority
valve
To service brake 2
To Auxiliary Circuit
General PRINCIPLE OF OPERATION
4 of 4
120 – 155 bar
B



OPERATION

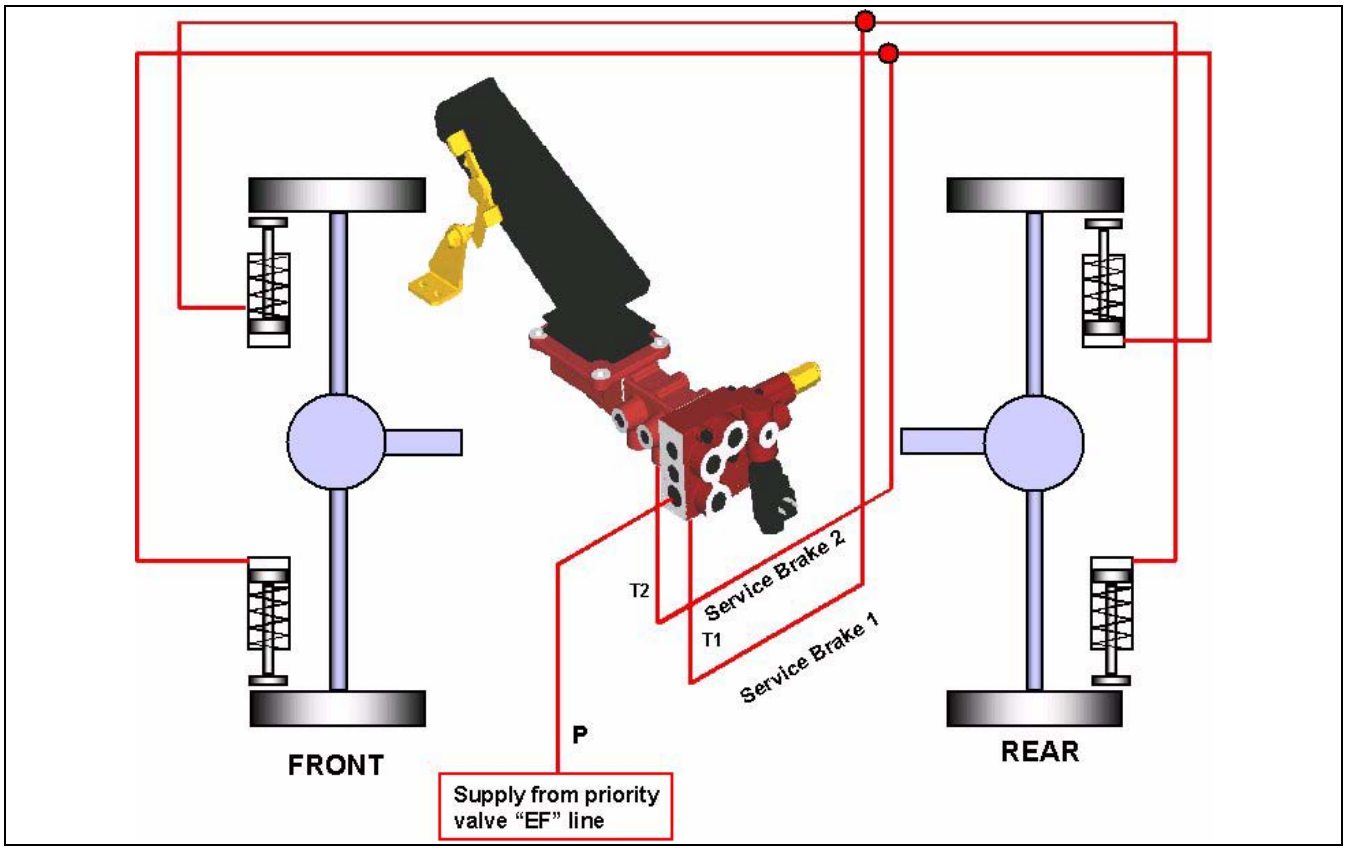
- Oil from the steering priority valve passes at a controlled rate to charge the accumulators. The inlet bypass valve is spring biased into the position shown and hydraulically balanced.
- When the oil pressure in the accumulators reach the cracking pressure of the pressure limiting valve it begins to open. The valve in this example has a pressure override of 35 bar.

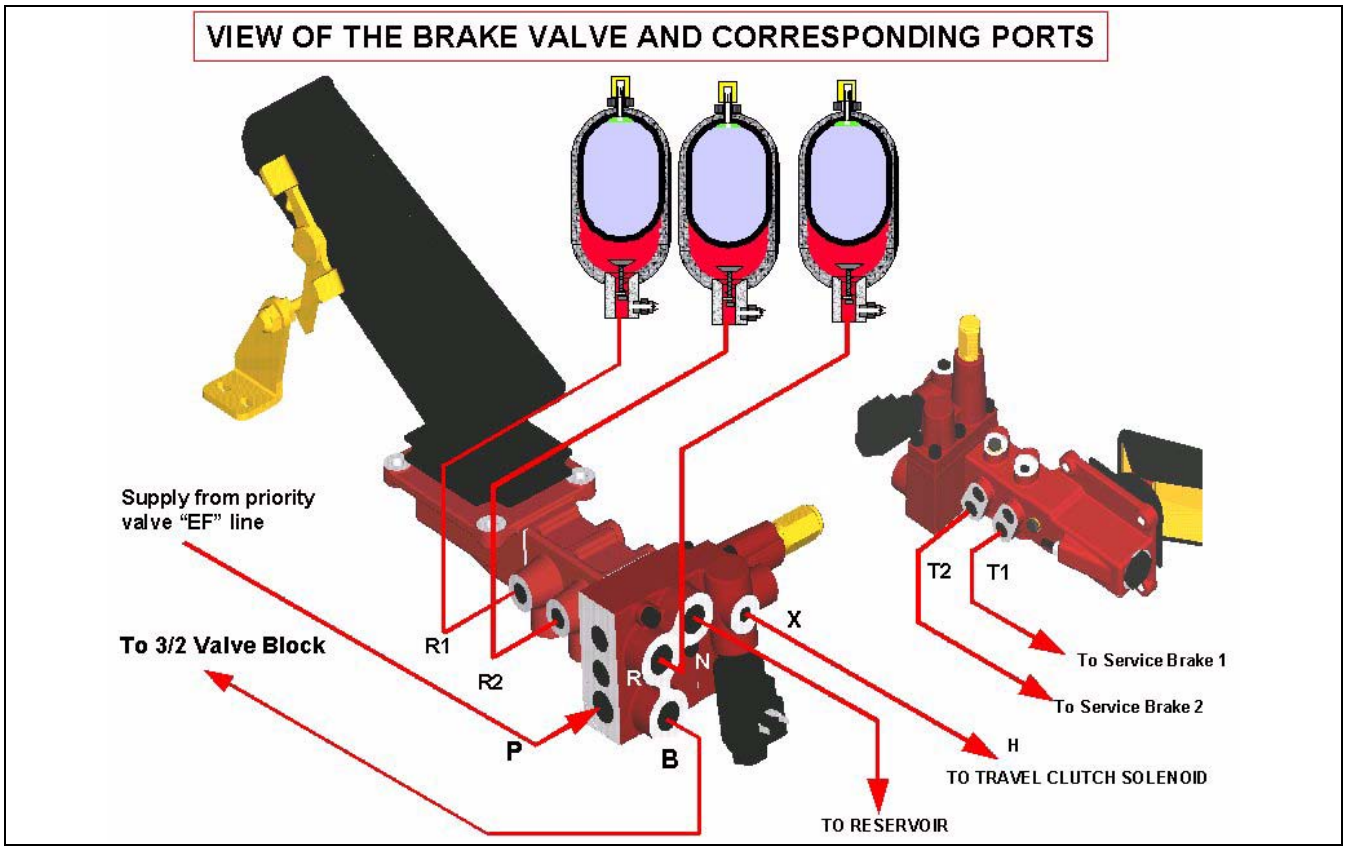
  Between 120 and 155 bar the accumulators continue to charge until the bottom pilot signal on the inlet bypass valve is diverted to tank, allowing the inlet bypass valve to move downwards thereby diverting all the incoming flow to the auxiliary circuit.

  If the break pedal is now operated oil at a controlled pressure will be sent to the service brakes, the brake force being controlled by the pre-loading of the valve by the action of the pedal.

  As the brakes are applied the accumulator volumes and associated pressure will fall. This action will allow the pressure limiting valve to gradually close as the pressure falls below 155 bar.

  Eventually, the flow path through the valve will close causing the pilot signal on the bottom of the inlet bypass valve to be re-established. This in turn will move the inlet bypass in to its upper most position, closing off the supply to the auxiliary circuit and charging the accumulators once again.


T2
Service Brake 2
T1
Service Brake 1
P
FRONT
REAR
Supply from priority valve "EF" line


VIEW OF THE BRAKE VALVE AND CORRESPONDING PORTS
Supply from priority valve "EF" line
To 3/2 Valve Block
R1
R2
P
R
N
B
X
H
T2
T1
To Service Brake 1
To Service Brake 2
TO TRAVEL CLUTCH SOLENOID
TO RESERVOIR

20 TESTING AND ADJUSTING

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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.

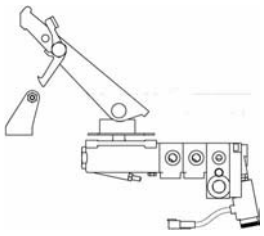
- When carrying out testing, adjusting, or troubleshooting, park the machine on level ground, insert the safety pins, and use blocks to prevent the machine from moving.
- When carrying out work together with other workers, always use signals and do not let unauthorized people near the machine.
- When 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 RELATED PARTS

Applicable model				PW180-7E0	
Engine					
Item	Measurement condition		Unit	Standard value for new machine	Service limit value
Engine speed	High idling		rpm	2,060 ±50	
	Low idling			1,050 ±50	
	Rated speed			2,000 ±20	
Exhaust gas color	At sudden acceleration LO idle - HI idle		Bosch index	Max. 1.2	–
	At high idling			Max. 1.2	–
Valve clearance (Normal temperature)	Intake valve		mm	0.25	0.152 - 0.381
	Exhaust valve			0.51	0.381 - 0.762
Oil pressure	● SAE0W30E0S, SAE5W40E0S, SAE10W30DH, SAE15W40DH, SAE30DH engine oil ● Coolant temperature : Operating range	High idle	kPa (kg/cm²}	Min. 0.29 {Min. 3.0}	0.25 {2.5}
		Low idle		Min. 0.10 {Min. 1.0}	0.07 {0.7}
Compression pressure	Oil temperature: 40–60ºC Engine speed: 250 - 280 rpm		MPa {kg/cm^2}	Min. 2.4 {Min. 24.6}	1.69 {17.2}
Blow-by pressure	(Water temperature: operating range) At rated output		kPa {mmH_2O	Max. 0.98 {Max. 100}	1.96 {200}
Oil temperature	Whole speed range (inside oil pan)		ºC	80-110	120
Fan belt tension	Deflection when pressed with finger force of approx. 58.8 N{6 kg}		mm	8	Min. 6, Max. 10
Air conditioner compressor belt tension			mm	5–8	

STANDARD VALUE TABLE FOR CHASSIS RELATED PARTS

Applicable model				PW180-7E0	
Category	Item	Measurement Condition	Unit	Standard value	Permissible value
Engine speed	Pump at relief P mode	● Engine water temperature: Within operation range ● Hydraulic oil temperature: Within operation range ● Engine at high idling ● Arm in relief condition	rpm	1,950 ±100	1,950 ±100
	At pump relief + one touch power up P mode	● Engine water temperature: Within operation range ● Hydraulic oil temperature: Within operation range ● Engine at high idling ● Arm relief + One-touch power max. switch in ON condition		1,950 ±100	1,950 ±100
	Speed when auto-deceleration is operated	● Engine at high idling ● Auto-deceleration switch in ON condition ● All control levers in NEUTRAL condition		1,400 ±100	1,400 ±100
Spool stroke	Boom control valve		mm	8 ±0.5	8 ±0.5
	Arm control valve				
	Bucket control valve				
	Swing control valve				
	Travel control valve				
	Adjust control valve (2PBoom only)				
	Stabiliser control valve				
Travel of control levers	Boom control lever	● Engine stopped ● At center of control lever grip ● Max. reading up to stroke end (excepting lever play in NEUTRAL position)	mm	60.5 ±3.5	60.5 ±3.5
	Arm control lever			60.5 ±3.5	60.5 ±3.5
	Bucket control lever			60.5 ±3.5	60.5 ±3.5
	Swing control lever			60.5 ±3.5	60.5 ±3.5
	Travel control pedal			9.2 ±0.2	9.2 ±0.2
	Play of control lever			Max. 3.0	Max. 3.0
Operating force of control levers	Boom control lever	● Hydraulic oil temperature: Within operation range ● Engine at high idling ● At center of control lever grip ● At tip in case of pedal ● Max. reading up to stroke end	N{kg}	17 ±3.9 {1.7 ±0.4}	Max. 24.5 {Max. 2.5}
	Arm control lever			17 ±3.9 {1.6 ±0.4}	Max. 24.5 {Max. 2.5}
	Bucket control lever			14 ±2.9 {1.4 ±0.3}	Max. 21.6 {Max. 2.2}
	Swing control lever			14 ±2.9 {1.4 ±0.3}	Max. 21.6 {Max. 2.2}
	Travel control pedal			55.4 ±5 {5.5 ±0.5}	Max. 65 {Max. 6.5}
	Brake pedal			340 ±17 {35 ±3.5}	Max. 510 {Max. 52.5}

Applicable model					PW180-7E0 (Std)	
Category	Item	Measurement Condition		Unit	Standard value	Permissible value
Hydraulic pressure	Unload pressure	● Hydraulic oil temperature: Within operation range ● Engine at high idling ● Working mode: P mode ● Hydraulic pump output pressure with all control levers in NEUTRAL position		MPa {kg/cm^2}	3.38 ±1.0 {34.5 ±10}	3.38 ±1.0 {34.5 ±10}
	Boom	● Hydraulic oil temperature: Within operation range ● Engine at high idling ● Working mode: P mode ● Hydraulic pump output pressure with all measurement circuits relieved ● Values inside parenthesis: Hydraulic oil pressure with one-touch power max. switch in ON mode (reference only)			34.8 ±1.0 {355 ±10}	33.3–36.8 {340–375}
	Arm					
	Bucket				37.3 ±1.0 {380 ±10}	36.3–39.2 {370–400}
	Swing				30.9 ±1.5 {315 ±15}	28.9–32.9 {295–335}
	Travel				38.2 ±1.0 {390 ±10}	37.3–40.2 {380–410}
	Stabiliser					
	Control circuit source pressure	● Hydraulic oil temperature: Within operation range ● Engine running at high idling ● Control circuit pressure setting valve input (12 station solenoid valve block port B)			$3.72^{+0}_{-0.3}$ $\{38^{+0}_{-3}\}$	3.2–3.72 {32.6–38}
	LS control circuit (Δ PLS)	● Hydraulic oil temperature: Within operation range ● Engine at high idling ● Working mode: L mode ● Disconnect the LS EPC solenoid CN V22 ● Hydraulic pump pressure - LS pressure	● Roadwheels raised off ground ● LO travel speed ● Service brake disengaged travel pedal fully depressed		2.06 ±0.1 {21 ±1}	2.06 ±0.1 {21 ±1}

Applicable model					PW180-7E0 (Std)	
Category	Item	Measurement Condition		Unit	Standard value	Permissible value
Swing	Swing brake angle	 ● Hydraulic oil temperature: Within operation range ● Engine running at high idling ● Working mode: A mode ● Swing circle misalignment amount when stopping after 180° turn		deg	Max. 102	Max. 132
	Time taken to swing from start	 ● Hydraulic oil temperature: Within operation range ● Engine running at high idling ● Working mode: A mode ● Time required for passing points 90 and 180° from starting point. ● Speeds quoted are with rated bucket (1,850kg)	90°	sec	3.7 ±0.3	Max. 4.0
			180°		5.4 ±0.4	Max. 5.7

Applicable model				PW180-7E0	
Category	Item	Measurement Condition	Unit	Standard value	Permissible value
Swing	Time taken to swing	 ● Hydraulic oil temperature: Within operation range ● Engine running at high idling ● Working mode: P mode ● Time required for 5 more turns after making initial one turn	sec	26.0 ±2.5	Max. 30
	Hydraulic drift of swing	 ● Hydraulic oil temperature: Within operation range ● Engine stopped ● Keeping upper structure transverse on slope of 15 degrees ● Notching a mating mark on inner and outer races of swing circle ● Mating mark misalignment amount during 5 minutes	mm	0	0
	Leakage from swing motor	● Hydraulic oil temperature: Within operation range ● Engine running at high idling ● Swing lock switch: ON ● Leakage amount for one minute during swing relief	cc/min	Max. 21	

Applicable model					PW180-7E0	
Category	Item	Measurement Condition		Unit	Standard value	Permissible value
Travel	Travel speed (1)	 ● Machine in road travel posture ● Engine running at high idle ● Hydraulic oil temperature 45~55°C ● Run up for at least 200M or until the max travel speed is stabilised,then measure time taken to travel the next 50M on flat ground	CR	sec.	72±10%	
			LO		18 $^{+2}$ / $_{-0}$	
			Hi 20km/h		9 $^{+1}$ / $_{-0}$	
			Hi 35km/h		5.1 $^{+0.5}$ / $_{-0}$	
	Travel speed (2)	 ● Raise machine road wheels off ground using work equipment and chassis attachments ● Engine running at high idle ● Service brake and park brake both disengaged ● Fully depress travel pedal and measure propshaft rotations. ● Hydraulic oil temperature 45~55°C. Within operation range	CR	rpm	230 ±5%	
			LO		930±5%	

Applicable model					PW180-7E0	
Category	Item		Measurement Condition	Unit	Standard value	Permissible value
Leakage of travel motor	Leakage of travel motor		● Engine running at high idle ● Hydraulic oil temperature 45~55°C. Within operation range. ● Apply service brake and relieve travel circuit. ● Disconnect transmission drain line.	ℓ/min	5 ±1	Max. 10
Work equipment	Hydraulic drift of work equipment	Whole work equipment (tooth tip fall amount)	 (including rated bucket {1845kg}) ● Hydraulic oil temperature: Within operation range ● Flat and level ground ● Work equipment in measurement posture as illustrated above ● Engine stopped ● Work equipment control lever in NEUTRAL position ● Fall amount for 15 minutes as measured every 5 minutes starting immediately after initial setting	mm	Max. 255	Max. 900
		Boom cylinder (cylinder retraction amount)			Max. 5	Max. 27
		Arm cylinder (cylinder extension amount)			Max. 45	Max. 240
		Bucket cylinder (cylinder retraction amount)			Max. 5	Max. 58
		Second Boom adjust cylinder (Cyl retraction amount)			Max. 5	Max. 30

Applicable model					PW180-7E0	
Category	Item	Measurement Condition		Unit	Standard value	Permissible value
Work equipment	Work equipment speed	Mono boom boom lift	 ● Hydraulic oil temperature: Within operation range ● Engine running at high idle ● Working mode: A ● Time required from raise stroke end till bucket touches ground	RAISE	4.5 ±0.4	Max. 5.3
				LOWER	3.5 ±0.5	Max. 4.1
		Twopieceboom 1st boom lift	 ● Hydraulic oil temperature: Within operation range ● Engine running at high idle ● Working mode: A ● Time required from raise stroke end till bucket touches ground	RAISE	4.5 ±0.4	Max. 5.3
				LOWER	3.5 ±0.3	Max. 4.1
		Twopieceboom 2nd boom adjust	 ● Hydraulic oil temperature: Within operation range ● Engine running at high idle ● Working mode: A ● Time required from raise stroke end till lower stroke end	RAISE	5.7 ±0.5	Max. 6.7
				LOWER	6.2 ±0.5	Max. 6.2

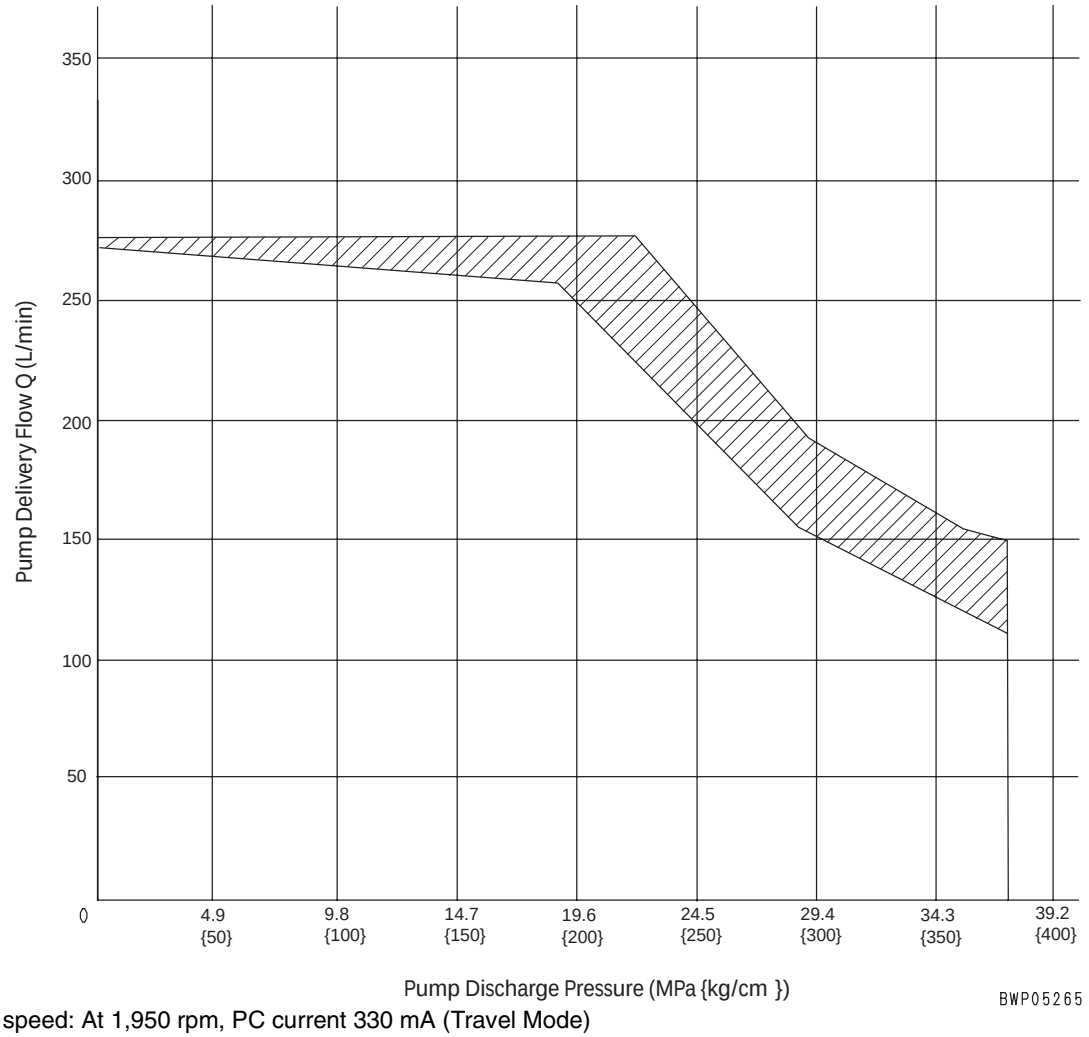
Applicable model						PW180-7E0	
Category		Item	Measurement Condition		Unit	Standard value	Permissible value
Chassis attachments	Chassis atachment speeds	Outrigger	● Hydraulic oil temperature: Within operation range ● Engine running at high idle ● Working mode: P ● Time required for 1 outrigger raise stroke end to lower stroke end.	RAISE	Sec.	4.0 ±0.5	Max. 5.0
				LOWER		4.0 ±0.4	Max. 4.8
		Dozer Blade	● Hydraulic oil temperature: Within operation range ● Engine running at high idle ● Working mode: P ● Time required from raise stroke end to lower stroke end.	RAISE		2.0 ±0.3	Max. 2.6
				LOWER		2.0 ±0.3	Max. 2.6

Applicable model					PW180-7E0	
Category	Item		Measurement Condition	Unit	Standard value	Permissible value
Work equipment	Work equipment speed	Arm	 ● Hydraulic oil temperature: Within operation range ● Engine running at high idling ● Working mode: P mode ● Time required from dumping stroke end to digging stroke end	IN	3.7 ±0.4	Max. 4.5
				OUT	3.1 ±0.3	Max. 3.7
		Bucket	 ● Hydraulic oil temperature: Within operation range ● Engine running at high idling ● Working mode: P mode ● Time required from dumping stroke end to digging stroke end	CURL	2.9 ±0.3	Max. 3.5
				DUMP	2.6 ±0.3	Max. 3.2
	Time lag	Monoboom boom lift	 ● Hydraulic oil temperature: Within operation range ● Engine running at low idling ● Working mode: P mode ● Operate full boom down from stroke end till bucket touches ground. Measure delay from bucket touching ground to bucket starting to push the machine up.		Max. 1.0	Max. 1.2

Applicable model					PW180-7E0	
Cate-gory	Item		Measurement Condition	Unit	Standard value	Permissible value
Work equipment	Time lag	Arm	 ● Hydraulic oil temperature: Within operation range ● Engine running at low idling ● Working mode: P mode ● Operate full arm curl from dumping stroke end to full retraction. Measure delay when arm pauses midway through operation	sec	Max. 1.0	Max. 1.2
		Bucket	 ● Hydraulic oil temperature: Within operation range ● Engine running at low idling ● Working mode: P mode ● Operate full bucket curl from dumping stroke end to full retraction. Measure delay when bucket pauses midway through operation		Max. 1.0	Max. 1.2
	Internal leakage	Cylinders	● Hydraulic oil temperature: Within operation range ● Engine running at high idling ● Leakage amount for one minute with cylinder or travel to be measured in relief condition	cc/ min	5	20
		Center swivel joint			10	50

Applicable model					PW180-7E0	
Cate-gory	Item		Measurement Condition	Unit	Standard value	Permissible value
Work equipment	Time lag	Two piece boom 1st boom lift	 ● Hydraulic oil temperature: Within operation range ● Engine running at low idle ● Operate full boom down from stroke end till bucket touches ground. Measure delay from bucket touching ground to bucket starting to push the machine up.	sec	Max. 1.0	Max. 1.2
		Two piece boom 2nd boom adjust	 ● Hydraulic oil temperature: Within operation range ● Engine running at low idle ● Operate full boom adjust down from stroke end till bucket touches ground. Measure delay from bucket touching ground to bucket starting to push the machine up.	sec	Max. 1.0	Max. 1.2
		Outrigger	● Hydraulic oil temperature: Within operation range ● Engine running at low idle ● Raise outrigger off ground then operate full lower ● Measure delay from when outrigger touches ground to outrigger starting to lift machine up		Max. 1.0	Max. 1.2
		Blade	● Hydraulic oil temperature: Within operation range ● Engine running at low idle ● Raise blade off ground then operate full lower ● 'Measure delay from when blade touches ground to blade starting to lift machine up		Max. 1.0	Max. 1.2
Performance of hydraulic pump	Hydraulic pump delivery		See next page	ℓ/ min	See next page	

Applicable model				PW180-7E0	
Category	Item	Measurement Condition	Unit	Standard value	Permissible value
Performance of hydraulic pump	Discharge amount of hydraulic pump				



Pump speed: At 1,950 rpm, PC current 330 mA (Travel Mode)

Check point	Pump discharge pressure (MPa {kg/cm^2})	Standard value for discharge amount Q (ℓ/min)	Judgement standard lower limit Q (ℓ/min)
As desired	P1	See graph	See graph

● When measuring with the pump mounted on the machine, if it is impossible to set the engine speed to the specified speed with the fuel control dial, take the pump discharge amount and the engine speed at the point of measurement, and use them as a base for calculating the pump discharge amount at the specified speed.

Flow control characteristic of PC valve (STD)

- The values in this table are used as reference values when carrying out troubleshooting.

Applicable model				PW180-7E0 (Std)
Category	**Item**	**Measurement Condition**	**Unit**	**Reference Value**
Characteristics of PC flow control valve	Time required for turning from 0 to 90 degrees with boom raised	 ● Hydraulic oil temperature: Within operation range ● Engine at high idling ● Working mode: P mode ● Rated load applied to bucket ● Solid and flat ground ● Time required till passing spot of 90 degrees starting from illustrated posture and with boom raised	sec	Mono boom 3.7 ±0.4 Two piece boom 3.7 ±0.4

20 TESTING AND ADJUSTING

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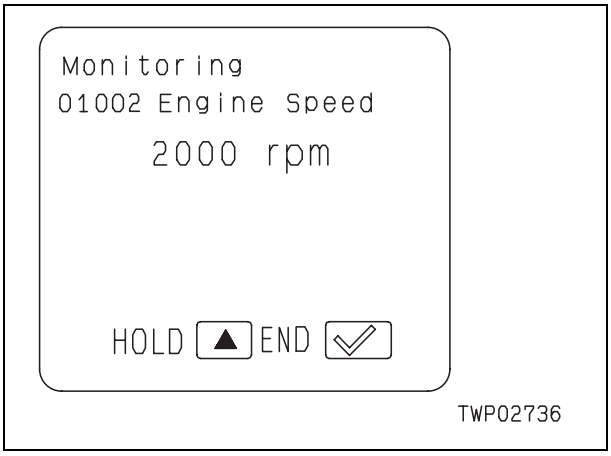
MEASURING ENGINE SPEED

- Measure the engine speed with the monitoring function of the machine monitor.
- Measure the engine speed under the following condition.
  - Engine coolant temperature: Within operating range
  - Hydraulic oil temperature: Within operating range

1. Preparation work

Operate the machine monitor so that the engine speed can be monitored.

- For the operating method of the machine monitor, see “SPECIAL FUNCTION OF MONITOR PANEL” on page 20- 159.
- Monitoring code: 01002 Engine speed



2. Measuring low idle speed

2.1. Start the engine and set the fuel control dial in the low idle (MIN) position.

2.2. Set all the levers and pedals for work equipment control, swing control, and travel in neutral and measure the engine speed.



3. Measuring high idle speed

3.1. Start the engine and set the fuel control dial in the high idle (MAX) position.

3.2. Set the working mode in the power mode (P) and turn the auto-decelerator OFF.

3.3. Set all the levers and pedals for work equipment control, swing control, and travel in neutral and measure the engine speed.

4. Measuring 2-pump relief speed

4.1. Start the engine and operate the arm cylinder to the IN stroke end.

4.2. Set the fuel control dial in the high idle (MAX) position and set the working mode in the power mode (P).

4.3. Operate the left work equipment control lever to relieve the arm circuit at the IN stroke end and measure the engine speed.

5. Measuring 2-pump relief and power maximizing speed (near rated speed)

5.1. Start the engine and operate the arm cylinder to the IN stroke end.

5.2. Set the fuel control dial in the high idle (MAX) position and set the working mode in the power mode (P).

5.3. While operating the left work equipment control lever to relieve the arm circuit at the IN stroke end and depressing the power maximizing switch, measure the engine speed.

- The power maximizing function is reset automatically in about 8.5 seconds even if the switch is kept depressed. Accordingly, measure the engine speed in that period.

6. Measuring auto-deceleration speed

6.1. Start the engine, set the fuel control dial in the high idle position (MAX), and turn the auto-decelerator ON.

6.2. Set all the levers and pedals for work equipment control, swing control, and travel in neutral and measure the engine speed when the auto-decelerator operates.

- The engine speed lowers to a certain level about 5 seconds after all the levers and pedals are set in neutral. This level is the auto-deceleration speed.

MEASURING INTAKE AIR PRESSURE (BOOST PRESSURE)

- Measuring tools for intake air pressure (boost pressure)

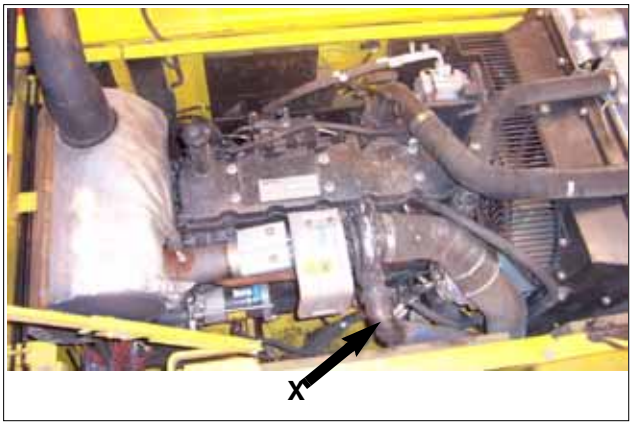
Symbol	Part No.	Part name
R	799-201-2202	Boost gauge kit

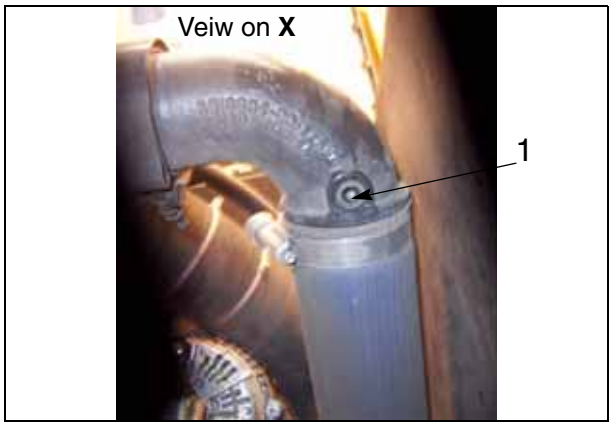
WARNING

Stop the machine on a level ground and lower the work equipment to the ground.

- Measure the intake air pressure under the following condition.
  - Engine coolant temperature: Within operating range
  - Hydraulic oil temperature: Within operating range

1. Open the engine hood and remove intake air pressure pickup plug (1) from the intake air connector.





2. Install nipple of boost gauge kit **R** and connect it to gauge [2].

3. Run the engine at middle or higher speed and bleed oil from the hose.
   - Insert the connecting parts of the gauge and hose about a half and open the self-seal on the hose side repeatedly, and the oil will be drained.
   - If Pm kit (A) is available, you use the air-bleeding coupling (790-261-1130) in that kit.
   - If oil is left in the hose, the gauge does not work. Accordingly, be sure to drain the oil.

4. Set the working mode in the power mode (P) and turn the swing lock switch ON.
   - If the swing lock switch is turned ON, the main relief valve is set for high-pressure relief.

5. While running the engine at high idle, relieve the arm circuit and measure the intake air pressure.



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

MEASUREMENT OF EXHAUST GAS COLOUR

- Exhaust gas colour measurement tool

Mark		Part No.	Part Name
B	1	799-201-9000	Handy Smoke Checker
	2	Commercial product	Smoke Meter

⚠ CAUTION

Be careful not to touch the highly heated parts, while fitting and detaching a measurement tool.

- If no compressed air or power is available in the field, use Handy Smoke Checker **B1**. Otherwise for recording official data, use Smoke Meter **B2**.

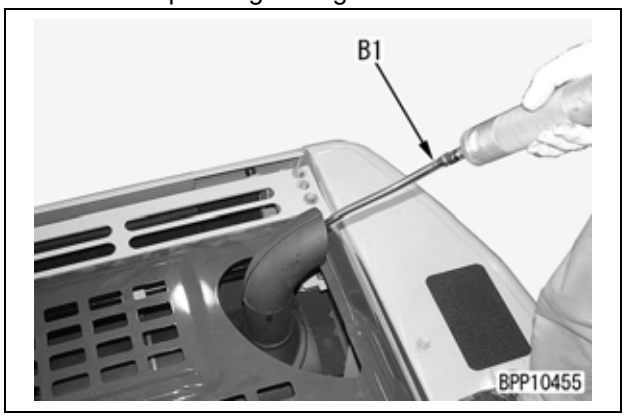
1. Measurement with Handy Smoke Checker **B1**.

1.1. Fit a filtering paper to Handy Smoke Checker **B1**.

1.2. Insert the exhaust gas intake pipe into the exhaust pipe.

1.3. Start the engine and keep it running until the engine cooling water temperature comes within the operating range.

1.4. Let the exhaust gas stay on the filtering paper by operating a handle on Handy Smoke Checker **B1**, when the engine speed is suddenly accelerated or kept at high idling.

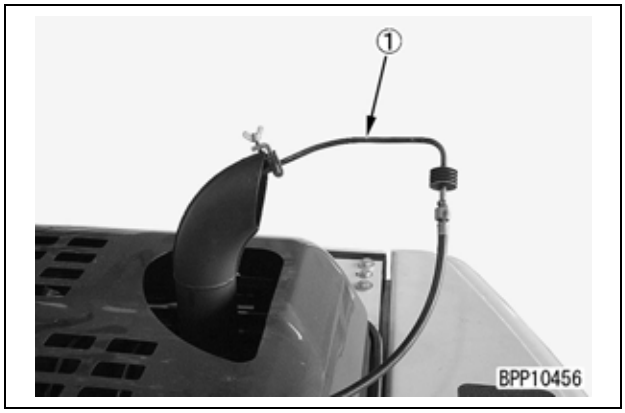


1.5. Take out the filtering paper and compare it with the attached scale for judgement.

1.6. After the measurement, make sure the machine is back to normal condition.

2. Measurement with Smoke Meter B2

2.1. Insert probe ① of the Smoke Meter **B2** into the exhaust gas pipe outlet, and fasten it to the outlet with a clip.



2.2. Connect the probe hose, accelerator switch outlet and air hose to the Smoke Meter **B2**.

Keep the pressure of the supplied compressed air below 1.5 MPa {15 kg/cm^2}.

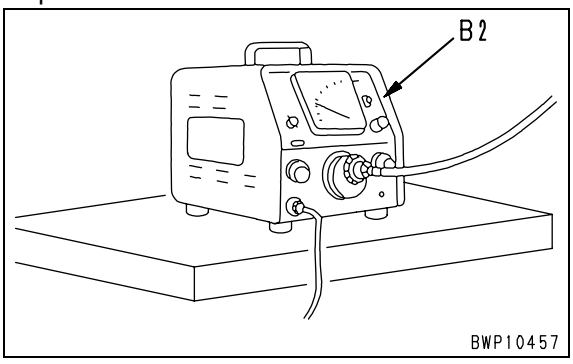
2.3. Connect the power cable to an outlet of AC100V.

Confirm that the Smoke Meter power switch is in the OFF position, before connecting the power cable to an outlet.

2.4. Fit a filtering paper by loosening the suction pump cap nut.

Fit the filtering paper securely so that air may not leak.

2.5. Move the Smoke Meter **B2** power switch to the ON position.



2.6. Start the engine and keep it running until the engine water temperature rises to the operating range.

2.7. Let the exhaust gas stay on the filtering paper by depressing the accelerator pedal of Smoke Meter **B2**, when the engine speed is suddenly accelerated or kept at high idling.

2.8. Put the polluted filtering paper on non-polluted filtering paper (more than 10 sheets) in the filtering paper holder, and read the indicated value.

2.9. Detach the measurement tool after the measurement, and make sure that the machine is back to normal condition.

ADJUSTING VALVE CLEARANCE

- Measuring tools for valve clearance

Symbol		Part No.	Part name
B	1	795-799-1131	Gear
	2	Commercially available	Thickness gauge

⚠ WARNING

Stop the machine on a level ground and lower the work equipment to the ground.

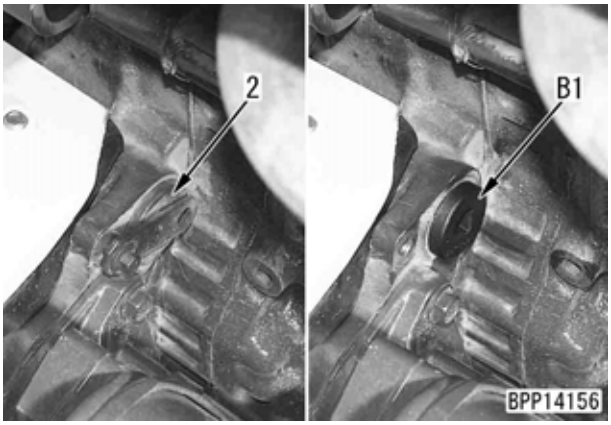
- Measure the valve clearance under the following condition.
  - Engine coolant temperature: Normal temperature

1. Open the engine hood and remove the belt guard from the top of the air conditioner compressor.

2. Remove cylinder head cover (1).
   - Since the breather connector on the rear side of the cylinder head cover is connected to the flywheel housing through the O-ring, pull it together with the cylinder head cover.



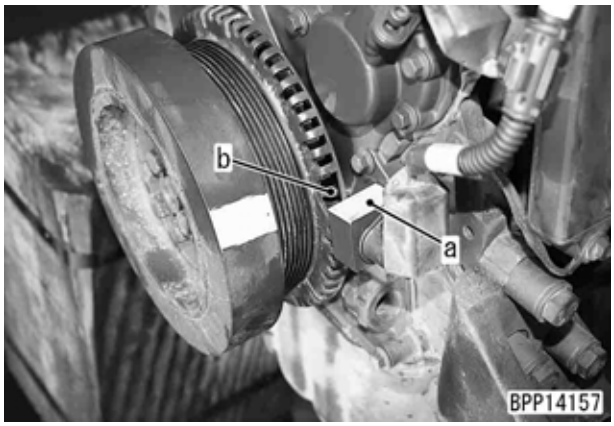
3. Remove plug (2) from the top of the starting motor and insert gear **B1**.



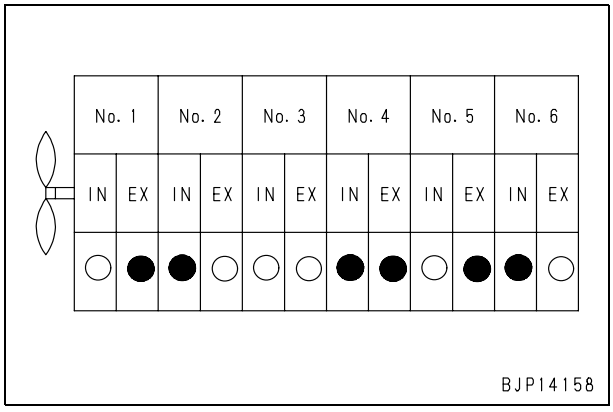
4. Rotate the crankshaft forward with gear **B1** and set wide slit (b) of the rotation sensor ring to projection top (a) of front cover.
   - Projection top (a) must be within the range of wide slit (b) when it is seen from the air conditioner compressor side.
   - If you can see the yellow marks of projection top (a) and wide slit (b), you may set them to each other.

⚠ WARNING

When the crankshaft is set as above, the piston in the No. 1 or No. 6 cylinder is not set to the compression top dead center (TDC). Take care.



5. Check the movement of the rocker arm of the No. 1 cylinder to judge the valve to be adjusted.
   - If you can move the rocker arms of air intake valves (IN) with the hand by the valve clearance, adjust the valves marked with ○ in the valve arrangement drawing.
   - If you can move the rocker arms of exhaust valves (EX) with the hand by the valve clearance, adjust the valves marked with ● in the valve arrangement drawing.
   - Valve arrangement drawing



6. Adjust the valve clearance according to the following procedure.

6.1. While fixing adjustment screw (3), loosen locknut (4).

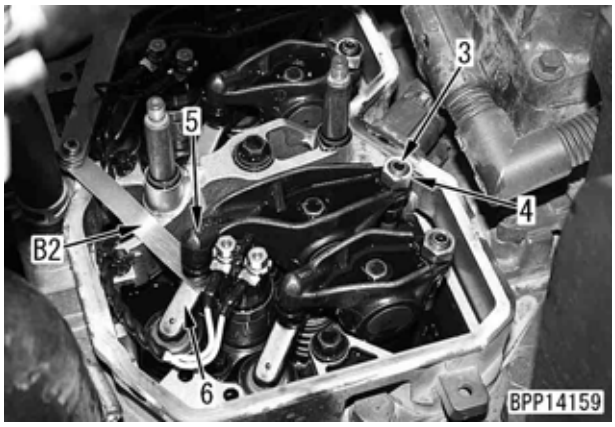
6.2. Insert thickness gauge **B2** in the clearance between rocker arm (5) and crosshead (6) and adjust the valve clearance with adjustment screw (3).

- With the thickness gauge inserted, turn the adjustment screw to a degree that you can move the thickness gauge lightly.

6.3. While fixing adjustment screw (3), tighten locknut (4).

N·m Locknut:
24 ± 4 Nm {2.45 ± 0.41 kgm}

- After tightening the locknut, check the valve clearance again.



7. Rotate the crankshaft forward by 1 turn and set wide slit (b) to projection top (a) according to step 4.

8. Adjust the other valve clearances according to steps (5) and (6).
   - If the valves marked with ● in the valve arrangement drawing were adjusted in steps (5) and (6), adjust the valves marked with ○.
   - If the valves marked with ○ in the valve arrangement drawing were adjusted in steps (5) and (6), adjust the valves marked with ●.

9. After finishing adjustment, remove the adjusting tools and return the removed parts.

⚠ WARNING

Remove gear B1 without fail.

N·m Cylinder head cover mounting nut:
24 ± 4 Nm {2.45 ± 0.41 kgm}

MEASURING COMPRESSION PRESSURE

- Measuring tools for compression pressure

Symbol		Part No.	Part name
C	1	795-502-1590	Compression gauge
	2	795-799-6700	Puller
	3	795-790-4410	Adapter
		6754-11-3130	Gasket

⚠ WARNING

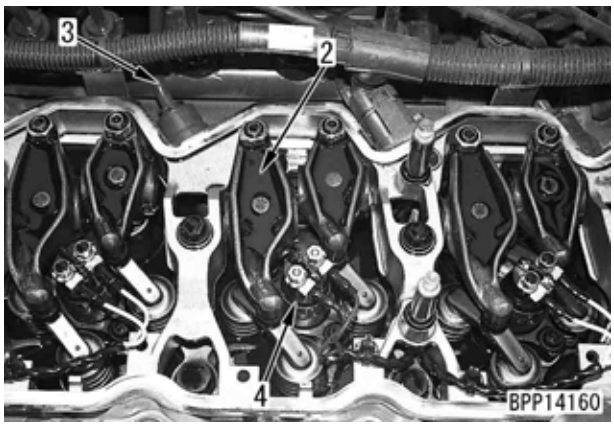
Stop the machine on a level ground and lower the work equipment to the ground.

- Measure the compression pressure under the following condition.
  - Engine oil temperature: 40 – 60°C

1. Open the engine hood and remove cylinder head cover (1).
   - Since the breather connector on the rear side of the cylinder head cover is connected to the flywheel housing through the O-ring, pull it together with the cylinder head cover.



2. Remove the mounting bolts of rocker arm assembly (2) on the exhaust side, and then remove rocker arm assembly (2).
   - When removing the injector, you do not need to remove the rocker arm assembly on the intake side.
3. Remove fuel tube (3), and then remove inlet connector (7) in the cylinder head.
   - The inlet connector is connecting the fuel tube to the injector.
4. Disconnect injector wiring harness. Using tool **C2**, remove injector (4).



5. Install adapter **C3** to the injector mounting part with the injector clamp and connect compression gauge **C1**.
   - Install the gasket to the adapter end without fail.

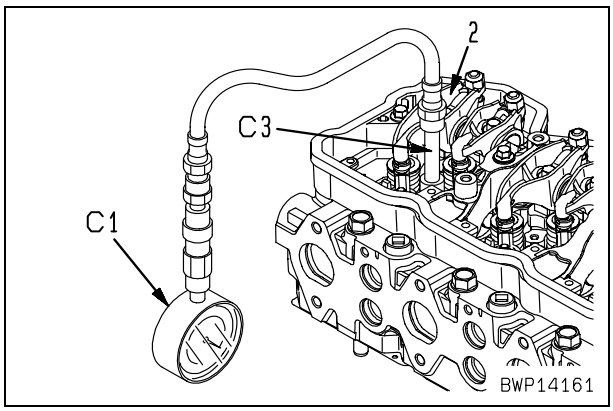
N·m

Injector clamp mounting bolt:

1st time :3.5 ± 0.35 Nm
{0.36 ± 0.04 kgm}
2nd time :75 ± 5 ° (Angle tightening)

   - If a little quantity of engine oil is applied the joint of the adapter and gauge, air does not leak easily.

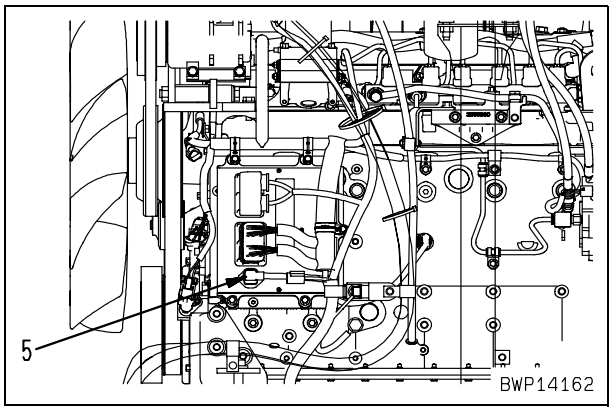
6. Install rocker arm assembly (2) on the exhaust side and adjust the valve clearance.
   a See “Adjusting valve clearance”.



7. Disconnect **CE03** connector (5) of the engine controller.

⚠ WARNING

- **If the connector is not disconnected, the engine will start during measurement and it will be dangerous.**
- **Since the CE03 connector is a part of the power supply circuit of the engine controller, cover the connector on the machine side with a vinyl sheet, etc. to prevent electric leakage and ground fault.**



8. Rotate the engine with the starting motor and measure the compression pressure.
   a Read the gauge when the pointer is stabilized.

9. After finishing measurement, remove the measuring tools and return the removed parts.
   - Install the injector and inlet connector according to the following procedure.

9.1. Apply new engine oil (SAE15W-40) to the O-ring of injector (4) and cylinder head.

9.2. Install injector (4) with the fuel inlet hole directed to the air intake manifold.

9.3. Install injector clamp (6) and tighten the mounting bolt by 3 – 4 threads.

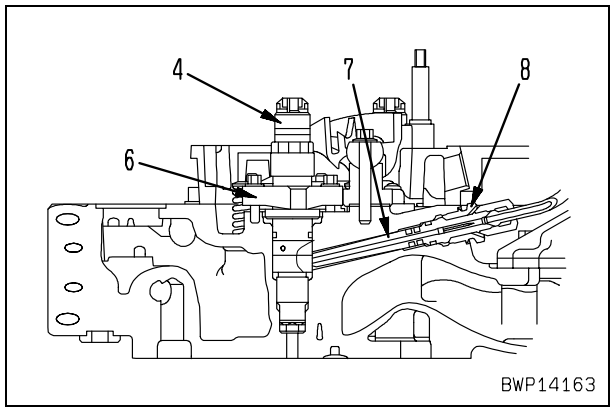
9.4. Install inlet connector (7) and tighten inlet connector retainer temporarily.

9.5. Tighten the mounting bolt of injector clamp (6) securely.

N·m Injector clamp mounting bolt:
1st time :3.5 ± 0.35 Nm {0.36 ± 0.04 kgm}
2nd time :75 ± 5 ° (Angle tightening)

9.6. Tighten inlet connector retainer (8) securely.

N·m Inlet connector retainer:
50 ± 5 Nm {5.1 ± 0.5 kgm}



- Tighten the bolts and nuts other than the injector and inlet connector to the following torque.

N·m Injector wiring harness nut:
1.5 ± 0.25 Nm {0.15 ± 0.026 kgm}
Fuel tube sleeve nut:
35 ± 3.5 Nm {3.6 ± 0.4 kgm}
Rocker arm assembly mounting bolt:
36 ± 6 Nm {3.7 ± 0.6 kgm}

- Adjust the valve clearance. For details, see “Adjusting valve clearance”.

N·m Cylinder head cover mounting nut:
24 ± 4 Nm {2.45 ± 0.41 kgm}

MEASURING BLOW-BY PRESSURE

- Measuring tools for blow-by pressure

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

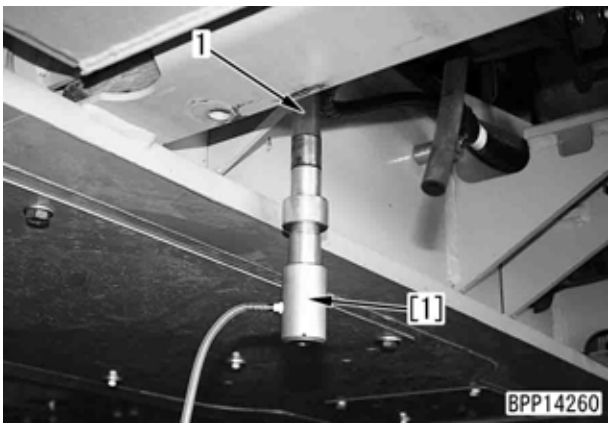
⚠ WARNING

Stop the machine on a level ground and lower the work equipment to the ground.

- Measure the blow-by pressure under the following condition.
  - Engine coolant temperature: Within operating range
  - Hydraulic oil temperature: Within operating range

1. Remove the undercover of the hydraulic pump.

2. Install tool and adapter [1] of blow-by checker **D1** or blow-by tool **D2** to breather hose (1) and connect gauge [2].



3. Start the engine, set the working mode in the power mode (P), and turn the swing lock switch ON.
   - If the swing lock switch is turned ON, the main relief valve is set for high-pressure relief.

4. While running the engine at high idle, relieve the arm circuit and measure the blow-by pressure.
   - Read the gauge when the pointer is stabilized.



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

MEASURING ENGINE OIL PRESSURE

- Measuring tools for engine oil pressure

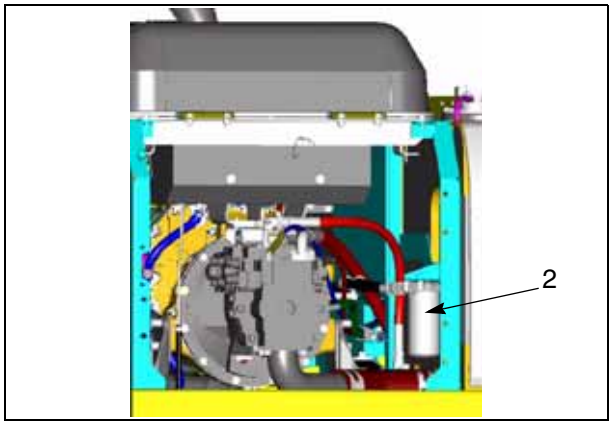
Symbol		Part No.	Part name
E	1	799-101-5002	Hydraulic tester
		790-261-1204	Digital hydraulic tester
	2	799-401-2320	Hydraulic tester

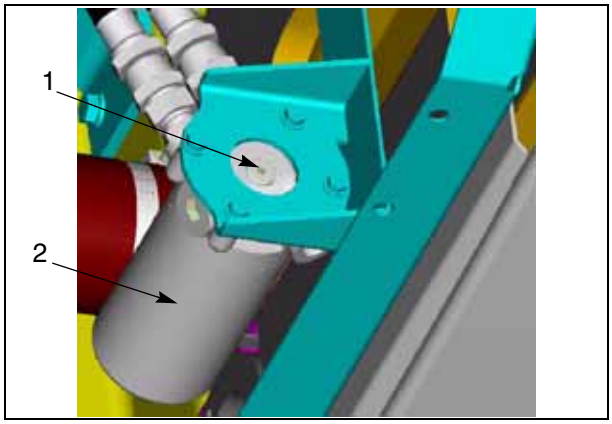
⚠ WARNING

Stop the machine on a level ground and lower the work equipment to the ground.

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

1. Open the side cover of the pump room and remove oil pressure pickup plug (1) from the engine oil filter.





2. Install nipple of hydraulic tester **E1** and connect hydraulic tester **E2**.
3. Start the engine and turn the auto-decelerator OFF.
4. Run the engine and measure the engine oil pressure at high idle and low idle.



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

HANDLING FUEL SYSTEM PARTS

- Precautions for checking and maintaining fuel system

The common rail fuel injection system (CRI) consists of more precise parts than the conventional fuel injection pump and nozzle. If foreign matter enters this system, it can cause a trouble.

When checking and maintaining the fuel system, take care more than the past. If dust, etc. sticks to any part, wash that part thoroughly with clean fuel.

- Precautions for replacing fuel filter cartridge

Be sure to use the Komatsu genuine fuel filter cartridge.

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

RELEASING RESIDUAL PRESSURE FROM FUEL SYSTEM

- Pressure is generated in the low-pressure circuit and high-pressure circuit of the fuel system while the engine is running.

  Low-pressure circuit:

  Feed pump – Fuel main filter – Supply pump

  High-pressure circuit:

  Supply pump – Common rail – Injector

- The pressure in both low-pressure circuit and high-pressure circuit lowers to a safety level automatically 30 seconds after the engine is stopped.
- Before the fuel circuit is checked and its parts are removed, the residual pressure in the fuel circuit must be released completely. Accordingly, observe the following.

⚠ WARNING

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

MEASURING FUEL PRESSURE

- Measuring tools for fuel pressure

Symbol		Part No.	Part name
F	1	799-101-5002	Hydraulic tester
		790-261-1204	Digital hydraulic tester
	2	6732-81-3170	Adapter (10 × 1.0 mm ✕ R1/8)
		6215-81-9710	O-ring
	3	799-401-2320	Hydraulic tester

⚠ WARNING

Stop the machine on a level ground and lower the work equipment to the ground.

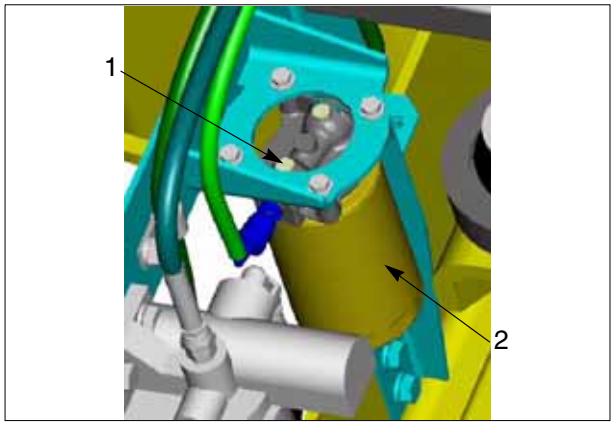
- Measure only the fuel pressure in the low-pressure circuit from the feed pump through the fuel main filter to the supply pump and the return circuit from the supply pump/common rail/injector to fuel tank.

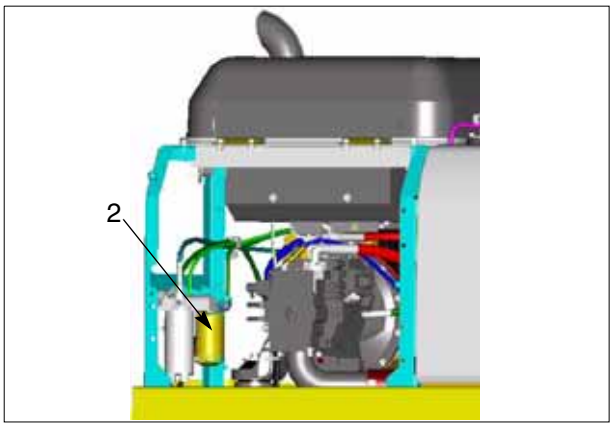
⚠ WARNING

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

1. Measuring pressure in fuel low-pressure circuit

1.1. Open the engine hood and remove fuel pressure pickup plug (1) from the fuel main filter (2).





1.2. Install adapter **F2** and nipple of hydraulic tester **F1** and connect them to oil pressure gauge [F3]

- Use the oil pressure gauge of 2.5 MPa {25 kg/cm^2}.

1.3. Run the engine at low idle and measure the pressure in the fuel low-pressure circuit.

- If the pressure in the fuel low-pressure circuit is in the following range, it is normal.

At low idle	0.5 – 1.3 MPa {5.1 – 13.3 kg/cm^2}
During cranking	0.3 – 1.1 MPa {3.1 – 11.3 kg/cm^2}

⚠ WARNING

If the engine cannot be started, you may measure the fuel pressure while rotating the engine with the starting motor. Do not rotate for more than 20 seconds continuously, however, for protection of the starting motor.

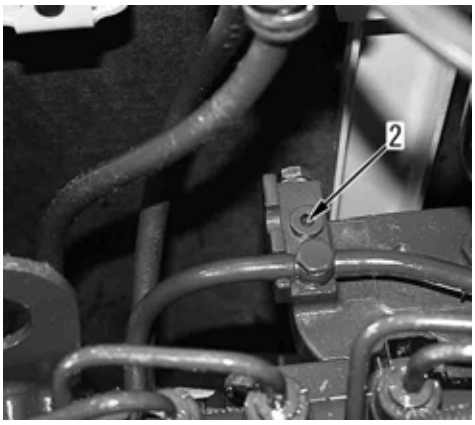


1.4. After finishing measurement, remove the measuring tools and return the removed parts.

N·m Fuel pressure pickup plug:
10 ± 2 Nm {1 ± 0.2 kgm}

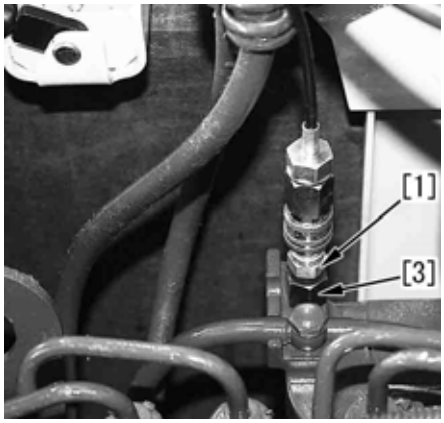
2. Measuring pressure in fuel return circuit

2.1. Open the engine hood and remove fuel pressure pickup plug (2) from the fuel return block.



2.2. Install nipple [3] of hydraulic tester **F1** and nipple [1] and connect them to hydraulic tester **F3**.

- Nipple [3]:
  790-301-1181, 07002-11223



2.3. Run the engine at low idle and measure the pressure in the fuel return circuit.

- If the pressure in the fuel return circuit is in the following range, it is normal.

At low idle	Max. 0.02 MPa
During cranking	{Max. 0.19 kg/cm^2}

⚠ WARNING

If the engine cannot be started, you may measure the fuel pressure while rotating the engine with the starting motor. Do not rotate for more than 20 seconds continuously, however, for protection of the starting motor.



2.4. After finishing measurement, remove the measuring tools and return the removed parts.

N·m Fuel pressure pickup plug:
24 ± 4 Nm {2.4 ± 0.4 kgm}

MEASURING FUEL RETURN RATE AND LEAKAGE

- Measuring tools for fuel return rate and leakage

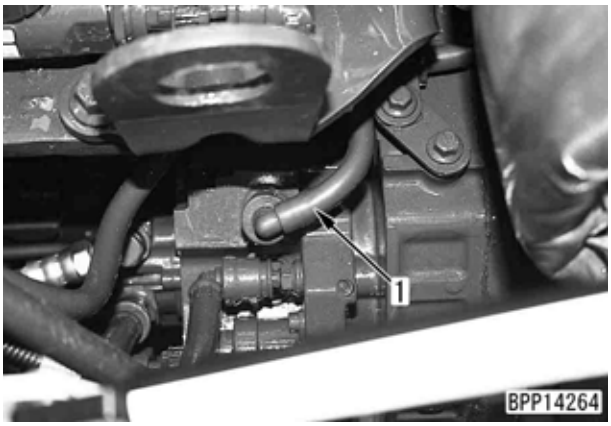
Symbol		Part No.	Part name
G	1	(Not set yet)	Supply pump testing tool
	2	(Not set yet)	Pressure limiter testing tool
	3	(Not set yet)	Injector testing tool
	4	Commercially available	Measuring cylinder

⚠ WARNING

Stop the machine on a level ground and lower the work equipment to the ground.

1. Measuring return rate from supply pump

1.1. Open the engine hood and disconnect return hose (1) of the supply pump.



1.2. Connect testing tool **G1** to the supply pump side and insert its end in measuring cylinder **G4**.

1.3. Connect blocking tool **G1** to the return hose side to prevent the fuel from leaking.

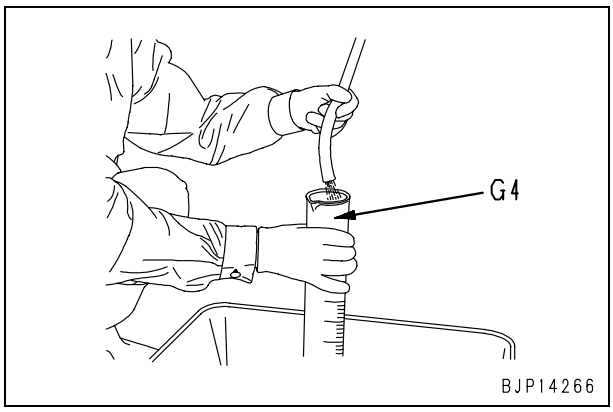
1.4. Run the engine at low idle and measure the return rate from the supply pump.

- If the return rate from the supply pump is in the following range, it is normal.

At low idle	Max. 1,000 cc/min
During cranking	Max. 140 cc/min

⚠ WARNING

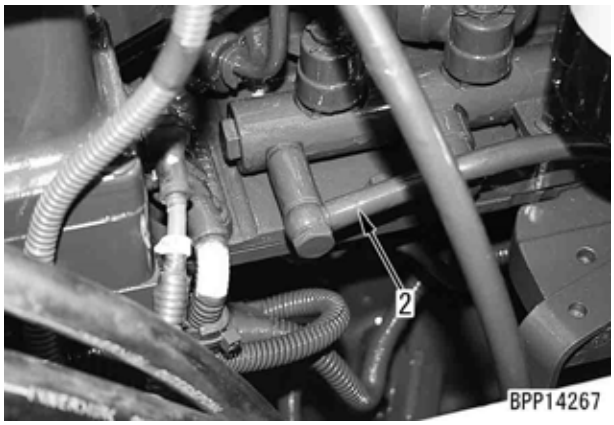
If the engine cannot be started, you may measure the fuel return rate while rotating the engine with the starting motor. Do not rotate for more than 20 seconds continuously, however, for protection of the starting motor.



1.5. After finishing measurement, remove the measuring tools and return the removed parts.

2. Measuring leakage from pressure limiter

2.1. Open the engine hood and disconnect return hose (2) of the pressure limiter.



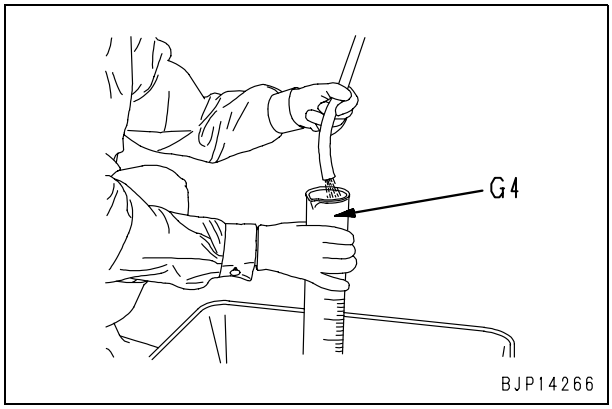
2.2. Connect testing tool **G2** to the pressure limiter side and insert its end in measuring cylinder **G4**.

2.3. Connect blocking tool **G2** to the return hose side to prevent the fuel from leaking.

2.4. Run the engine at low idle and measure the leakage from the pressure limiter.

- If the leakage from the pressure limiter is in the following range, it is normal.

At low idle	0 cc (No leakage)

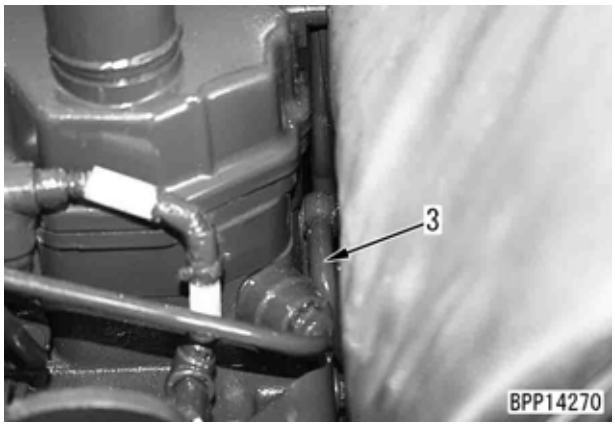


2.5. After finishing measurement, remove the measuring tools and return the removed parts.

N·m Joint bolt:
24 ± 4 Nm {2.4 ± 0.4 kgm}

3. Measuring return rate from injector

3.1. Open the engine hood and disconnect return hose (3) of the cylinder head.



3.2. Connect testing tool **G3** to the cylinder head side and insert its end in measuring cylinder **G4**.

3.3. Connect blocking tool **G3** to the return hose side to prevent the fuel from leaking.

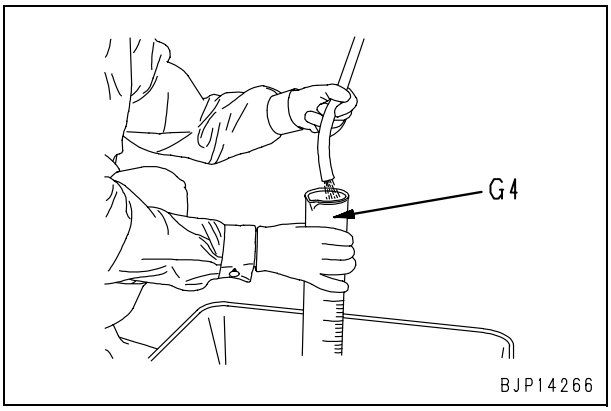
3.4. Run the engine at low idle and measure the return rate from the injector.

- If the return rate from the injector is in the following range, it is normal.

At low idle	Max. 180 cc/min
During cranking	Max. 90 cc/min

⚠ WARNING

If the engine cannot be started, you may measure the fuel return rate while rotating the engine with the starting motor. Do not rotate for more than 20 seconds continuously, however, for protection of the starting motor.



3.5. After finishing measurement, remove the measuring tools and return the removed parts.

N·m Joint bolt:
24 ± 4 Nm {2.4 ± 0.4 kgm}

BLEEDING AIR FROM FUEL CIRCUIT

- If fuel is used up or if a fuel circuit part is removed and installed, bleed air from the fuel circuit according to the following procedure.

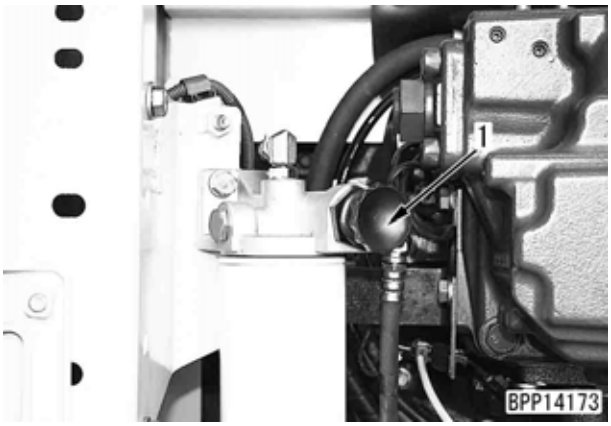
⚠ WARNING

Stop the machine on a level ground and lower the work equipment to the ground.

1. Fill the fuel tank with fuel.
   - Add fuel until the float of the sight gauge reaches the maximum position.

2. Open the side cover of the pump room.

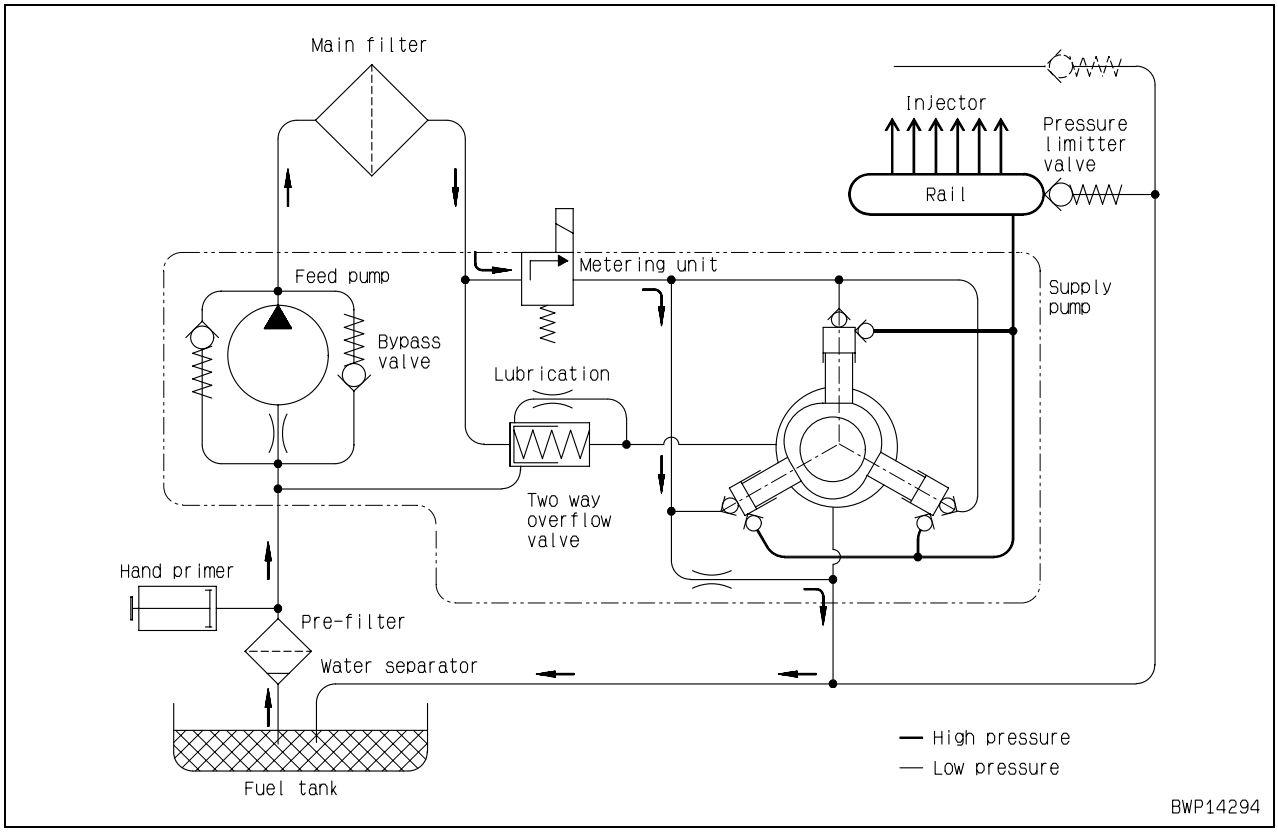
3. Loosen knob (1) of the feed pump and pull it out, and then operate it forward and backward.
   - Move the knob until it becomes heavy.
   - The plug at the top of the fuel main filter does not need to be removed.



4. After bleeding air, push in and tighten knob (1).

- Air bleeding route of fuel circuit

  Fuel tank ✕✕✕✕ Pre-filter ✕✕✕✕ Feed pump ✕✕✕✕ Main filter ✕✕✕✕ Metering unit ✕✕✕✕ Fuel tank



Checking fuel circuit for leakage

⚠ WARNING

- **Very high pressure is generated in the high-pressure circuit of the fuel system. If fuel leaks while the engine is running, it is dangerous since it can catch fire.**
- **After checking the fuel system or removing its parts, check it for fuel leakage according to the following procedure.**
- **Stop the machine on a level ground and lower the work equipment to the ground.**

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

1. Spray color checker (developer) over the fuel supply pump, common rail, fuel injector, and joints of the high-pressure piping.
2. Run the engine at speed below 1,000 rpm and stop it after its speed is stabilized.
3. Check the fuel piping and devices for fuel leakage.
   - Check mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   - If any fuel leakage is detected, repair it and check again from step 2.
4. Run the engine at low idle.
5. Check the fuel piping and devices for fuel leakage.
   - Check mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   - If any fuel leakage is detected, repair it and check again from step 2.
6. Run the engine at high idle.
7. Check the fuel piping and devices for fuel leakage.
   - Check around the high-pressure circuit parts coated with the color checker for fuel leakage.
   - If any fuel leakage is detected, repair it and check again from step 2.
8. Run the engine at high idle and load it.
   - Relieve the arm circuit at the IN stroke end.
9. Check the fuel piping and devices for fuel leakage.
   a Check mainly around the high-pressure circuit parts coated with the color checker for fuel leakage.
   a If any fuel leakage is detected, repair it and check again from step 2.
   a If no fuel leakage is detected, check is completed.

CHECKING AND ADJUSTING AIR CONDITIONER COMPRESSOR BELT TENSION

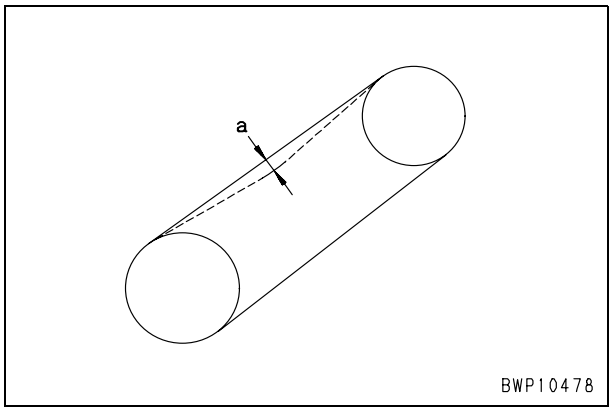
⚠ WARNING

Stop the machine on a level ground and lower the work equipment to the ground.

Checking

1. Open the engine hood and remove the belt guard from the top of the air conditioner compressor.

2. Press the intermediate point of the belt between fan pulley and compressor pulley with a finger and measure deflection (a) of the belt.
   - Belt pressing force: 98 N {10 kg}



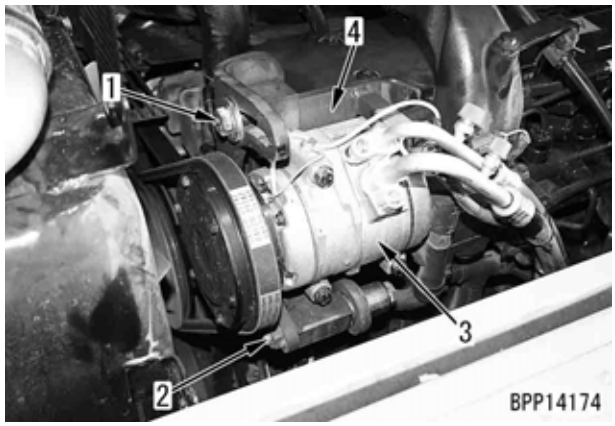
Adjusting

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

1. Loosen bolts (1) and (2).

2. Move compressor (3) and bracket (4) together to adjust the belt tension.

3. After positioning compressor (3), tighten bolts (1) and (2).
   - Check each pulley for breakage, wear of the V-groove, and contact of the V-belt and V-groove.
   - If the V-belt is so lengthened that the adjustment allowance is eliminated or it has a cut or a crack, replace it.
   - If the belt is replaced, adjust their tension again after operating the machine for 1 hour.
   - After tightening the bolts, check the belt tension again according the above procedure.



4. After finishing measurement, return the removed parts.

MEASUREMENT OF CLEARANCE IN SWING CIRCLE BEARINGS

- Swing circle bearing clearance measurement tools

Mark	Part No.	Part Name
H	Commercial Product	Dial Gauge

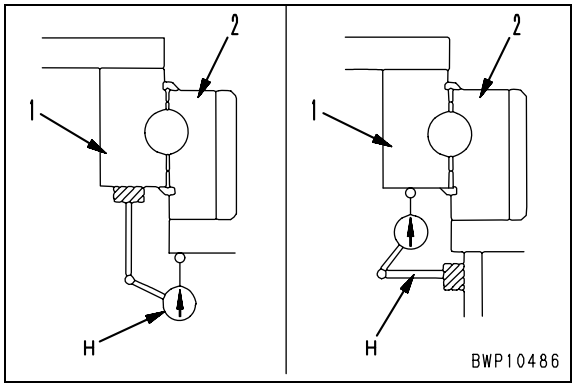
- Follow the steps explained below, when measuring clearance in the swing circle bearing on the actual machine.

⚠ CAUTION

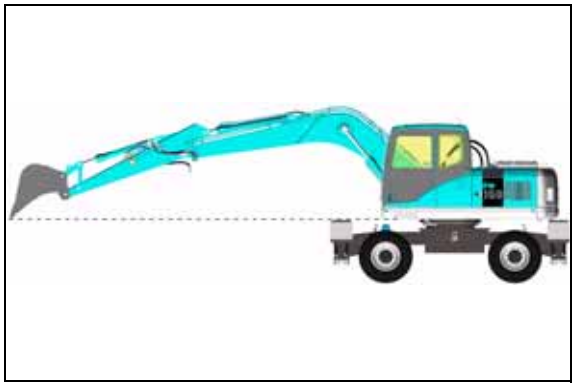
Be careful not to put a hand or foot under the undercarriage, while taking measurement.

1. Attach dial gauge **H** to swing circle outer race (1) or inner race (2), and position the probe end on the surface of the inner race (2) or outer race (1) as shown.
   - Set dial gauge **H** at the machine front or rear

.



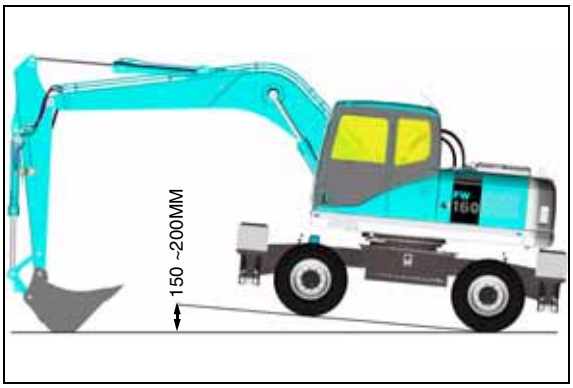
2. Keep the work equipment in the max. reach posture and keep the height of the bucket teeth tip level with the lower height of the revolving frame.



- The upper structure is lowered at the front and raised at the rear at this time.

3. Set dial gauge **H** to zero.

4. Hold the arm nearly perpendicular to the ground, and lower the boom until the machine is raised at the front.
   - The upper structure is raised at the front and lowered at the rear at this time.



5. Read off the value in dial gauge **H** in this condition.
   - The value indicated in dial gauge **H** expresses clearance in the bearings.
6. Return the machine to the posture in Item 2, and confirm reading of dial gauge **H** is zero.
   - If zero value is not indicated, repeat the steps in Items 3 through 5.

INSPECTION AND ADJUSTMENT OF HYDRAULIC OIL PRESSURE IN HYDRAULIC CIRCUIT FOR WORK EQUIPMENT, SWING AND TRAVEL

- Inspection and adjustment tools

Mark		Part No.	Part Name
J	1	799-101-5002	Hydraulic Tester
		790-261-1203	Digital Type Hydraulic Tester
	2	799-101-5220	Grease Fitting (10 x 1.25 mm)
		07002-11023	O-ring

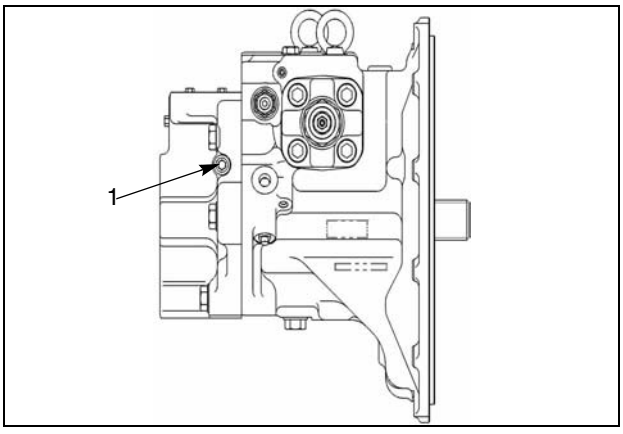
- Hydraulic oil pressure in the hydraulic circuit for work equipment, swing and travel (hydraulic pump output pressure) may be also confirmed with a monitoring function in the monitor panel (special function of monitor panel).

MEASUREMENT

1. Pre-measurement work

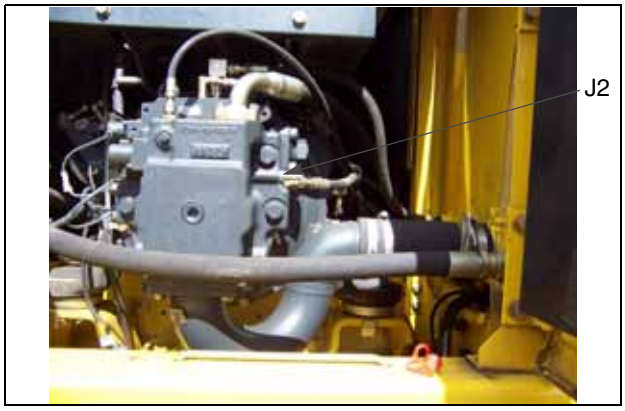
Lower the work equipment to the ground and stop the engine. After the engine is stopped, (but with the ignition switch in the **ON** position and the safety lever still **ENGAGED**), operate the control levers several times to release the remaining pressure in the hydraulic system. Then loosen the oil filler cap to release any pressure in the hydraulic tank.

1.1. Remove hydraulic oil pressure measuring plug (1).



1.2. Fit tool **J2** and connect it to oil pressure gauge of hydraulic tester **J1**.

Use an oil pressure gauge with the capacity of 58 MPa{600 kg/cm^2}.



1.3. Start the engine and keep it running until the hydraulic oil temperature rises to the operating range.



2. Measurement of Unload Pressure

2.1. Start the engine.

2.2. Measure hydraulic oil pressure, when the engine is running at high idling and all the control levers are moved to the NEUTRAL position.

- Hydraulic oil pressure when the unload valve unloads is displayed.

3. Measurement of work equipment relief pressure

3.1. Start the engine and move the cylinder to be measured to its stroke end.

3.2. Measure hydraulic oil pressure, when the engine is running at high idling and the cylinder is in relief condition.

- Hydraulic oil pressure when the main relief valve is in relief condition is displayed.
- If one-touch power max. switch is depressed, the oil pressure is turned to high relief pressure, and if released, it is turned to low relief pressure.

- Keep the swing lock switch in the OFF position during the inspection. If it is moved to the ON position, hydraulic oil pressure is turned to high relief pressure, as the constant 2-stage relief valve is moved to the ON position.

4. Measurement of swing relief pressure

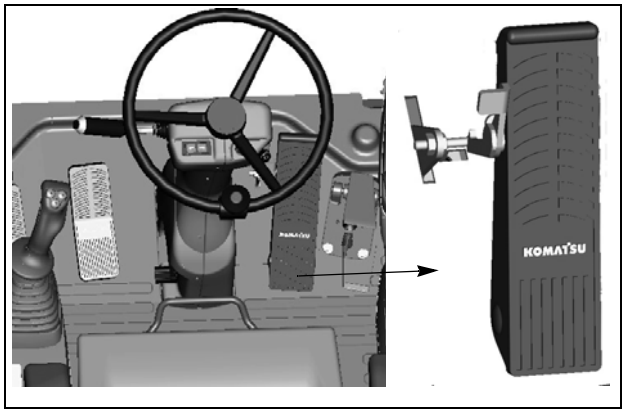
4.1. Start the engine and move the swing lock switch to the ON position.

4.2. Measure hydraulic oil pressure when the engine is running at high idling and the swing circuit is relieved.

- Hydraulic oil pressure when the swing motor safety valve is relieved is displayed.
- The swing motor relief pressure is lower than the main relief pressure.

5. Measurement of travel circuit relief pressure

5.1. Start the engine and apply service brake to prevent travel, select forward or reverse travel.



5.2. Measure hydraulic oil pressure when the engine is running at high idling and the travel circuit is relieved.

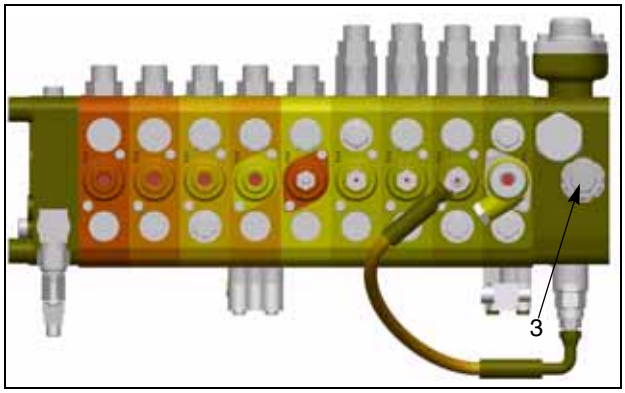
- Hydraulic oil pressure with the main relief valve in relief condition is displayed. In the travel circuit relief, the pressure is high pressure relief all the time.

ADJUSTMENT

- The unload valve and the safety valve for boom LOWER cannot be adjusted.

1. Adjustment of main relief pressure (high pressure setting side)

- If relief pressure of the high pressure in the work equipment and travel circuits is not normal, adjust the high pressure setting side of main relief valve (3) in the following manner.
- The high pressure setting is in the state in which the 2-stage relief solenoid valve is turned **ON** and the pilot pressure is applied to the changeover port.



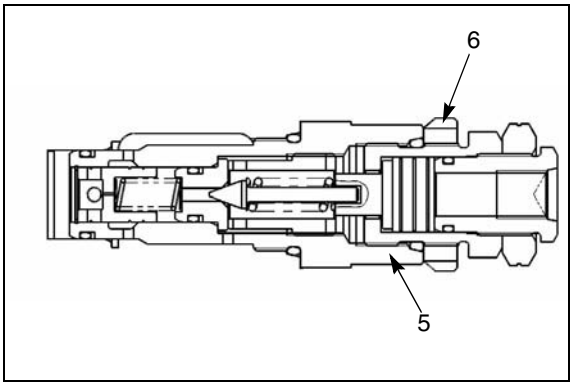
1.1. Disconnect the pilot hose on main relief valve (3).

1.2. Loosen lock nut (5) and adjust the pressure by turning holder (6).

- If the holder is turned to the right, the pressure rises.
  If the holder is turned to the left, the pressure falls.
- Adjustment amount per turn of holder:

Approx. 12.5 MPa{approx. 128 kg/cm^2}

N·m Lock nut: **53.5±4.9 Nm{5.5±0.5 kgm**



1.3. Check the pressure again after the adjustment, following the aforementioned steps for measurement.

- When measuring the pressure, reconnect the pilot hose.
- If high pressure setting side is adjusted, low pressure setting side is also affected, so adjust it, too.

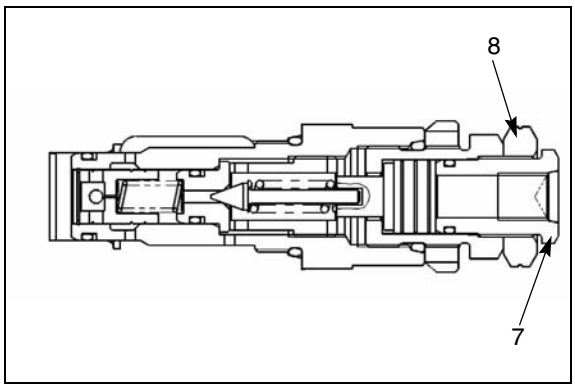
1. Adjustment of main relief pressure (low pressure setting side)
   - When low pressure relief pressure of the work equipment is not normal, or when adjustment is made of the high pressure setting side, adjust the low pressure side of the main relief valve, too.
   - The high pressure setting is the state in which the 2-stage relief solenoid is turned **OFF** and **NO** pilot pressure is applied to the changeover port.

1.1. Disconnect pilot hose.

1.2. Loosen lock nut (7) and adjust the pressure by turning holder (8).
   - If the holder is turned to the right, the pressure rises. If the holder is turned to the left, the pressure falls.
   - Adjustment amount per turn of holder:

Approx. 12.5 MPa{approx. 128 kg/cm^2}

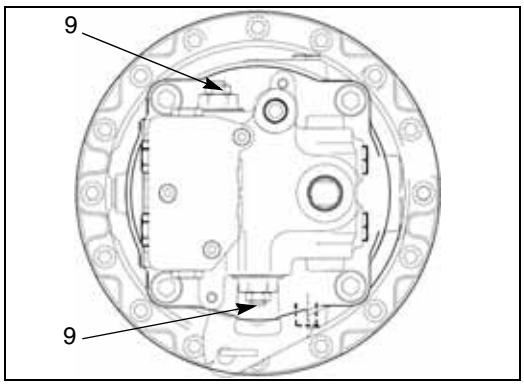
N·m Lock nut: **53.5±4.9 Nm{5.5±0.5 kgm}**



1.3. Check the pressure again after the adjustment, following the aforementioned steps for measurement.

❊ When measuring the pressure, reconnect the pilot hose.

2. Adjusting swing relief pressure
   - If the relief pressure of the swing circuit is abnormal, adjust swing motor safety valves (9) according to the following procedure.



2.1. Hold screw (9), loosen locknut (10).
   - Fix the screw with a hexagonal wrench.

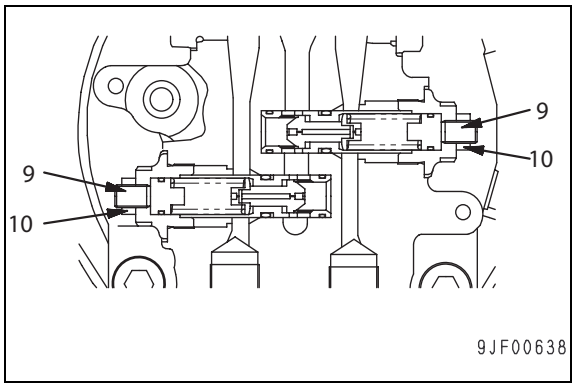
2.2. Turn screw (9) to adjust the pressure.
   - If the screw is

     Turned to the right, the pressure rises.

     Turned to the left, the pressure lowers.
   - Quantity of adjustment per turn of screw:

Approx. 9.8 MPa {Approx. 100 kg/cm^2}

N·m Lock nut: **39.2 ± 4.9 Nm {4.0 ± 0.5 kgm}**



2.3. After finishing adjustment, check again that the pressure is normal according to the procedure for measurement described above.

INSPECTION AND ADJUSTMENT OF CONTROL CIRCUIT OIL PRESSURE

- Control circuit oil pressure inspection and adjustment tools

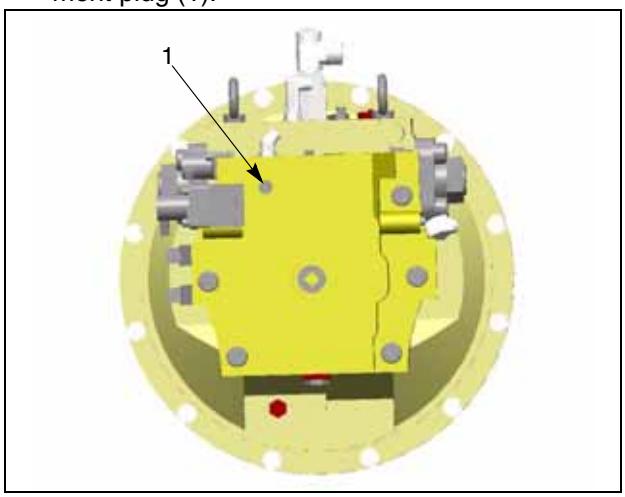
Mark		Part No.	Part Name
J	1	799-101-5002	Hydraulic Tester
		790-261-1203	Digital Type Hydraulic Tester
	2	799-101-5220	Grease Fitting (14 x 1.5 mm)
		07002-11023	O-ring

MEASUREMENT

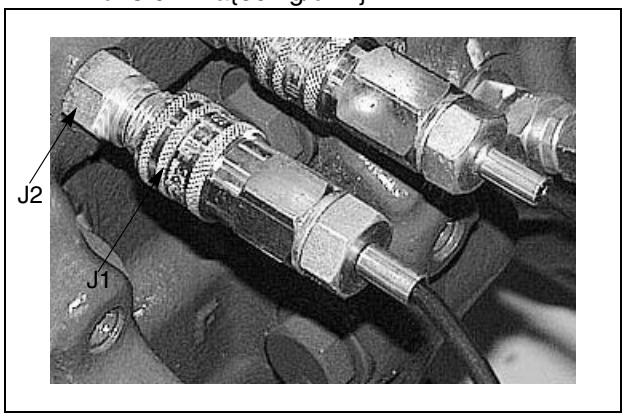
⚠ CAUTION

Lower the work equipment to the ground and stop the engine. After the engine is stopped, (but with the ignition switch in the ON position and safety lever still ENGAGED), operated the control levers several times to release the remaining pressure in the hydraulic system. Then loosen the oil filler cap to release any pressure in the hydraulic tank.

1. On main pump remove oil pressure measurement plug (1).



2. Fit tool **J2** and connect it to oil pressure gauge ① of hydraulic tester **J1**.
   - Use an oil pressure gauge with the capacity of 5.9 MPa{60 kg/cm^2}.



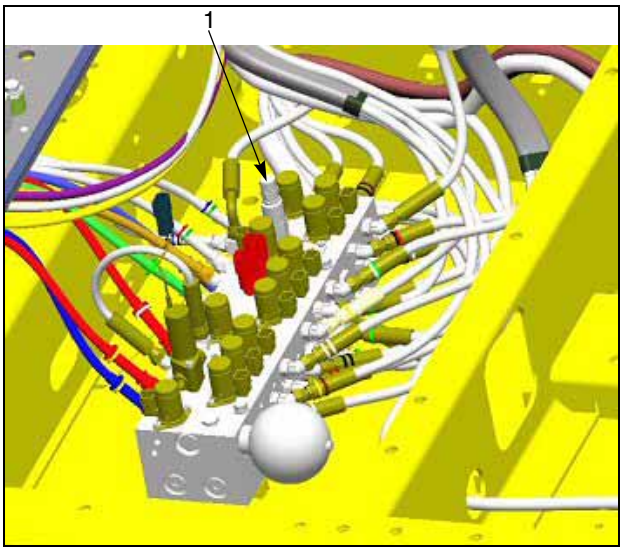
3. Start the engine and keep it running until the hydraulic oil temperature rises to the operating range.
4. Measure oil pressure with the engine running at high idling and all the control levers in the NEUTRAL position.

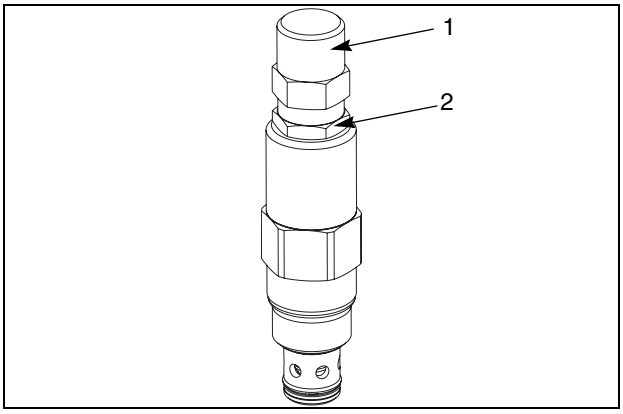


5. After completing the measurement, remove the measuring equipment and set the machine to its original condition.

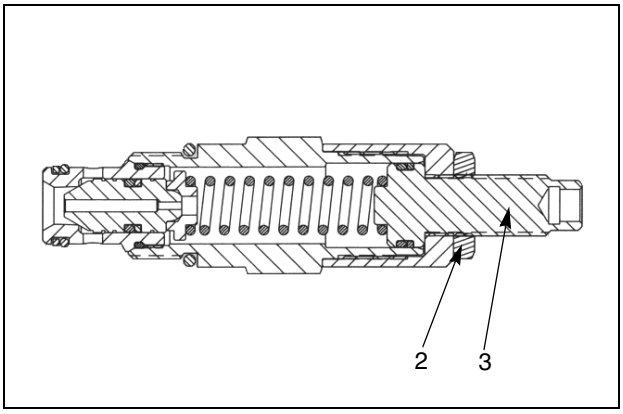
PROCEDURE FOR PRESSURE REDUCING ADJUSTMENT

1. Remove dust cap (1) from relief valve (a).
2. Loosen off adjusting lock screw nut (2).





3. Tighten adjusting screw (3) to increase pressure and loosen to decrease pressure.



4. When at correct pressure tighten lock nut (2) and replace dust cap (1).

INSPECTION AND ADJUSTMENT OF PUMP PC (VALVE INLET) CONTROL OIL PRESSURE

- Pump PC control circuit oil pressure inspection and adjustment tools

Mark		Part No.	Part Name	No. Off
J	1	799-101-5002	Hydraulic Tester	2
		790-261-1203	Digital Type Hydraulic Tester	2
	2	799-101-5220	Grease Fitting (10 x 1.25 mm)	2
		07002-11023	O-ring	2

MEASUREMENT

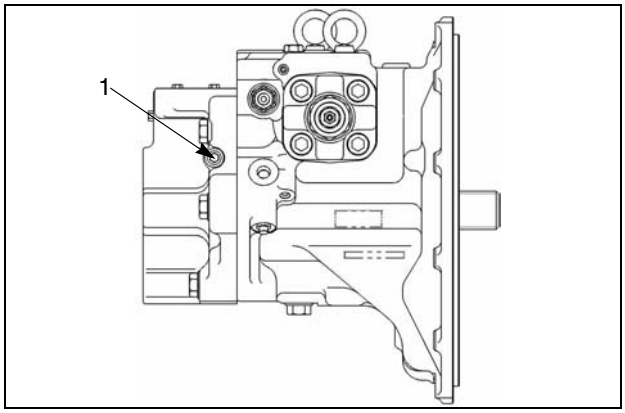
- Implement measuring the pump PC control circuit oil pressure after confirming that the work equipment, swing and travel circuit oil pressure as well as the control circuit original oil pressure are normal.

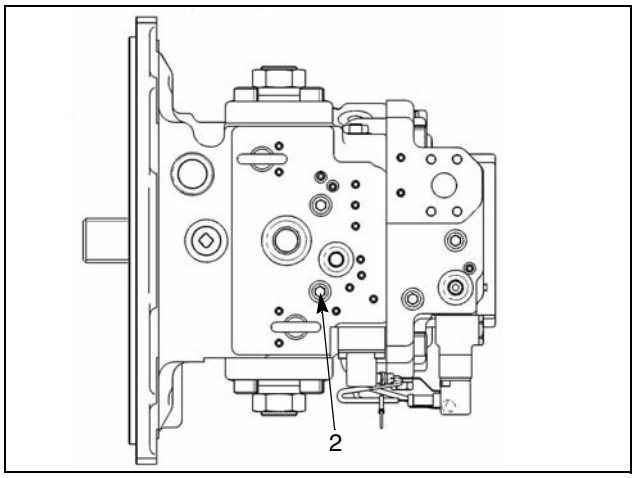
⚠ CAUTION

Lower the work equipment to the ground and stop the engine. After the engine is stopped, (but with the ignition switch in the ON position and safety lever still ENGAGED), operated the control levers several times to release the remaining pressure in the hydraulic system. Then loosen the oil filler cap to release any pressure in the hydraulic tank.

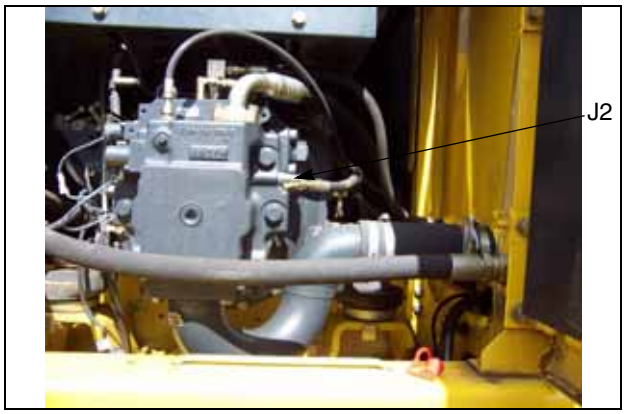
1. Measurement of PC valve output pressure (servo piston inlet pressure)
   - Measure PC valve output pressure (servo piston inlet pressure) and pump delivery pressure together, and compare the two pressures.

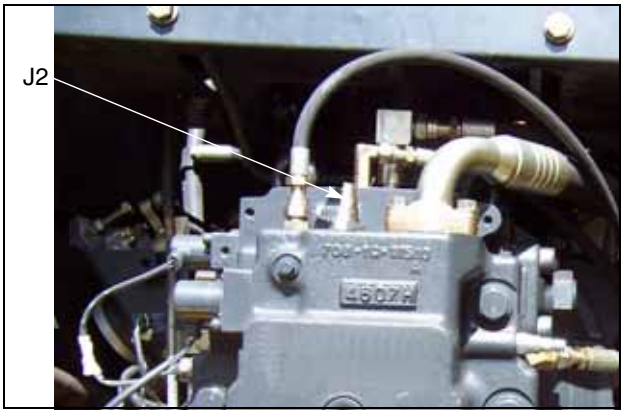
1.1. Remove oil pressure measurement plugs (1) and (2).
   - Plug (1): For measuring the pump delivery pressure
     Plug (2): For measuring the pump PC valve delivery pressure





1.2. Fit tool **J2** to each port (1 and 2), connect each tool to oil pressure gauge of hydraulic tester **J1**.
   - Use an oil pressure gauge with the capacity of 58.8 MPa{600 kg/cm^2}





1.3. Start the engine and keep it running until the hydraulic oil temperature rises to the operating range.



1.4. Measure the pump delivery pressure and PC valve output pressure (servo piston inlet pressure) together with the engine running at high idling, after setting the machine at the following conditions.

Working mode: A mode

Swing lock switch: ON (switched to high pressure relief with 2-stage relief turned ON)

Work equipment, swing and travel circuit: Arm digging relief

- Judgement method:
  When the ratio between the pump delivery pressure and PC valve output pressure (servo piston output pressure) reaches the following values, both pressures are judged normal.

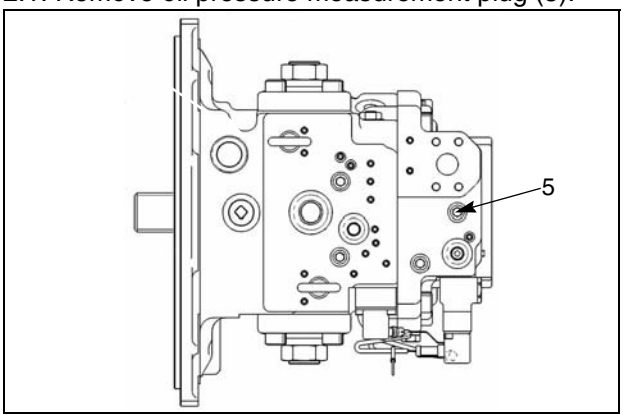
Pressure to be measured	Pressure ratio
Pump delivery pressure	1
PC valve outlet pressure	Approx. 3/5

- If there is any abnormality with PC valve or servo piston, the PC valve output pressure (servo piston output pressure) equals to the pump delivery pressure, or approximates to 0 pressure.

1.5. Disconnect tools **J1** and **J2** replace plugs (1) and (2).

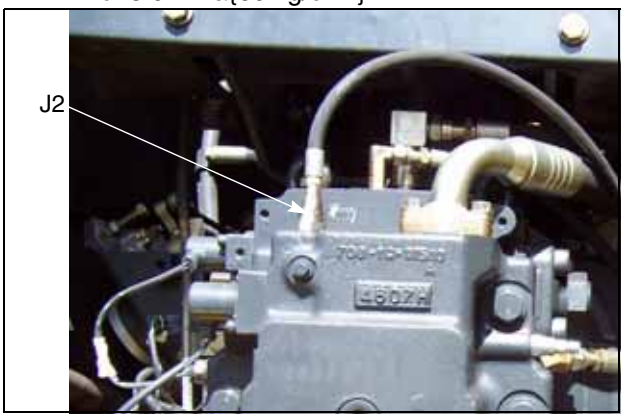
2. Measurement of PC-EPC output pressure

2.1. Remove oil pressure measurement plug (5).



2.2. Fit tool **J2** and connect it to oil pressure gauge of hydraulic tester **J1**.

- Use an oil pressure gauge with the capacity of 5.9 MPa{60 kg/cm^2}.



2.3. Start the engine and keep it running until the hydraulic oil pressure rises to the operating range.



2.4. Measure the hydraulic oil pressure with all the control levers kept in the NEUTRAL position and the engine running at high idle and at low idle.

- If PC-EPC valve output pressure changes to the following values, it is judged normal.

Engine speed	Control lever	Hydraulic oil pressure
Low idle	Neutral	2.9 MPa {30 kg/cm^2}
High idle		0{0}

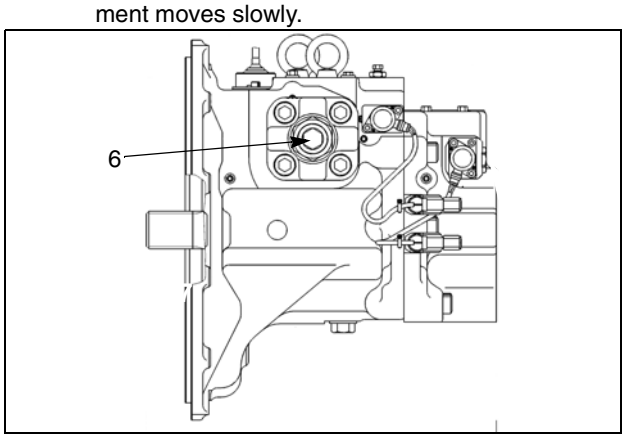
2.5. Disconnect tools **J1** and **J2**. Replace plug (5).

ADJUSTMENT

- If any of the phenomena mentioned below occurs and PC valve malfunctioning is suspected, adjust PC valve (6).

  As workload increases, the engine rpm sharply drops.

  While the engine rpm is normal, the work equipment moves slowly.

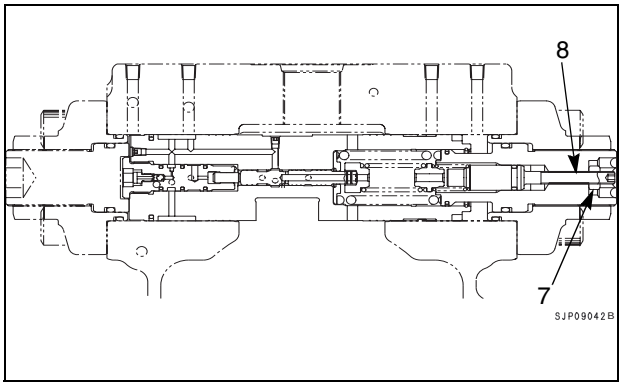


1. Loosen lock nut (7) and make adjustment, turning adjusting screw (8).
   - If the holder is turned to the right, the pump absorption torque rises.
     If the holder is turned to the left, the pump absorption torque falls.
   - The adjustable range with the adjusting screw is as shown below.

     Left turn: Less than 1 turn

     Right turn: Less than 1/2 turn (less than 180 degrees)

Lock nut: **27.50–34.3Nm{2.8–3.5kgm}**



- Re-tighten lock nut (7).

2. Confirm that the PC valve output pressure (servo piston inlet pressure) is normal after the adjustment, following the measurement steps explained earlier.

INSPECTION AND ADJUSTMENT OF PUMP LS VALVE CONTROL OIL PRESSURE

- Pump LS control circuit oil pressure inspection and adjustment tools

Mark		Part No.	Part Name	No. Off
K	1	799-101-5002	Hydraulic Tester	2
		790-261-1203	Digital Type Hydraulic Tester	2
	2	799-101-5220	Grease Fitting (10 x 1.25 mm)	2
		07002-11023	O-ring	2
	3	799-401-1340	Differential Pressure Gauge	2

MEASUREMENT

- Measure pump LS control circuit oil pressure after confirming that the work equipment, swing and travel circuit oil pressure as well as control circuit original pressure are normal.

⚠ CAUTION

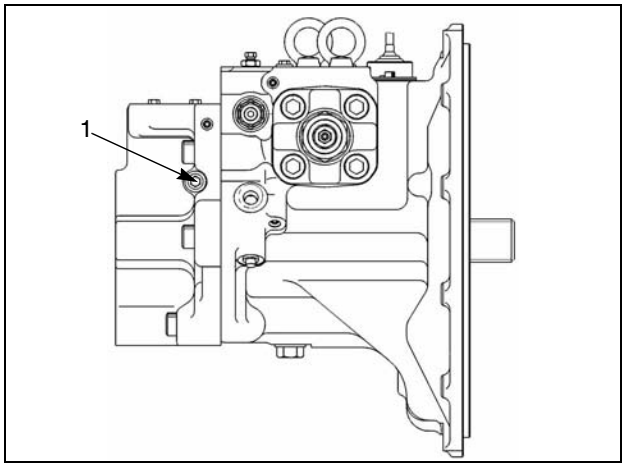
Lower the work equipment to the ground and stop the engine. After the engine is stopped, (but with the ignition switch in the ON position and safety lever still ENGAGED), operated the control levers several times to release the remaining pressure in the hydraulic system. Then loosen the oil filler cap to release any pressure in the hydraulic tank.

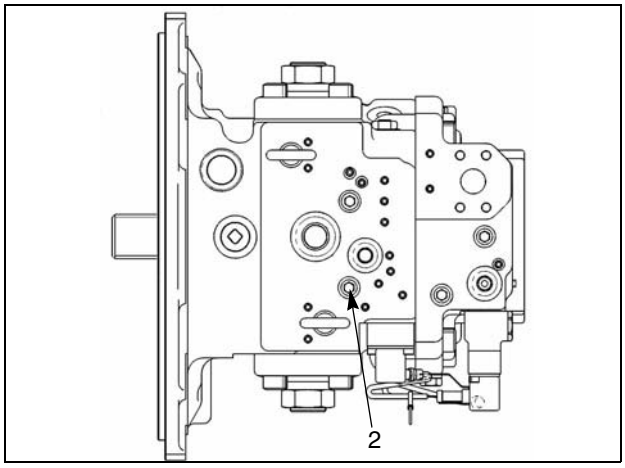
1. Measurement of LS valve output pressure (servo piston inlet pressure)

- Measure LS valve output pressure (servo piston inlet pressure) and pump delivery pressure together, and compare both pressures thereafter.

1.1. Remove oil pressure measurement plugs (1) and (2).

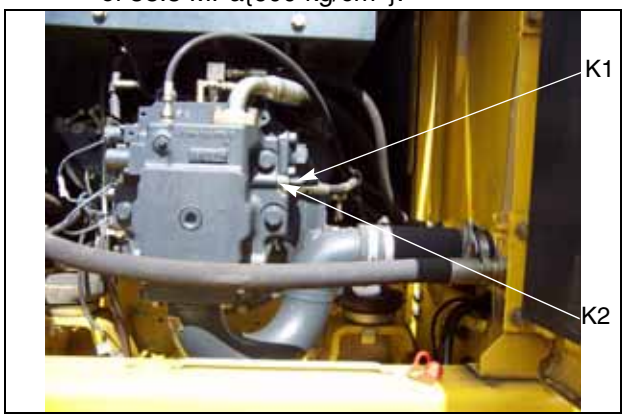
- Plug (1): For measuring the pump delivery pressure
- Plug (2): For measuring the pump LS valve delivery pressure





1.2. Fit tool **K2** to each port (1 and 2), connect each tool to oil pressure gauge of hydraulic tester **K1**.

- Use an oil pressure gauge with the capacity of 58.5 MPa{600 kg/cm^2}.



1.3. Start the engine and keep it running until the hydraulic oil temperature rises to the operating range.



1.4. Measure the pump delivery pressure and valve output pressure (servo piston inlet pressure) together with the engine running at high idling, after setting the machine at the following conditions.

- Auto decel: Off.
- One touch power max: Off.
- Work equipment operation: Neutral.

Raise road wheels clear of ground using work equipment & chassis attachments.
Release brake.
Select LO travel speed.
Fully depress travel pedal.

- Judgement method:
  When the ratio between the pump delivery pressure and LS valve output pressure (servo piston output pressure) reaches the following values, both pressures are judged normal.

Oil pressure to be measured	Oil pressure ratio	
	All control levers in NEUTRAL	During test.
Pump delivery pressure	Nearly equal pressure	1
LS valve delivery pressure		Approx. 3/5

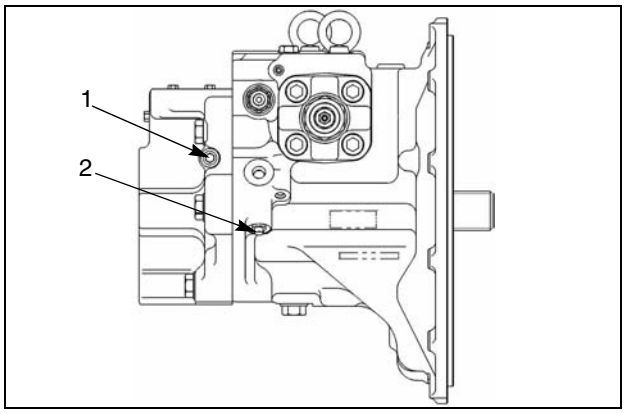
1.5. Detach all the measurement tools after the measurement and make sure that the machine is back to normal condition.

2. Measurement of LS differential pressure

- LS differential pressure can be obtained by measuring pump delivery pressure and LS pressure (actuator loaded pressure) at the same time and computing the difference of both pressures.

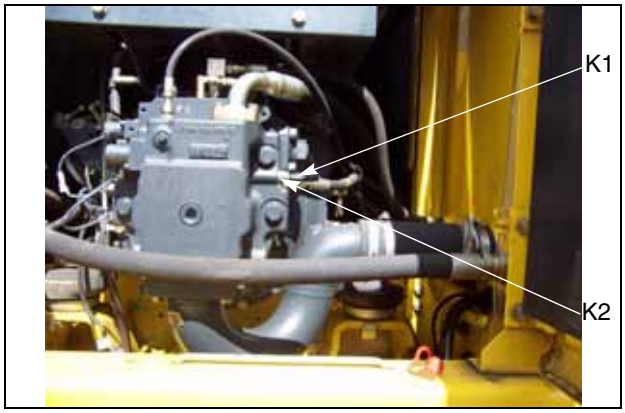
2.1. Remove oil pressure measurement plugs (1) and (2).

- Plug (1): For measuring the pump delivery pressure
- Plug (2): For measuring the pump LS pressure



2.2. Fit tool **K2** to each port (1 and 2) connect each tool to oil pressure gauge ① of hydraulic tester **K1** or differential pressure gauge **K3**.

- When using a differential pressure gauge:
  Connect pump delivery pressure to the high pressure side and LS pressure to the low pressure side.
  A differential pressure gauge requires DC 12V power. Connect it with one battery.
- When using an oil pressure gauge:
  Use an oil pressure gauge with the capacity of 58.5 MPa{600 kg/cm^2}.
  The max. differential pressure is no more than approx. 40 MPa{3.9 kg/cm^2}. The same gauge may be used throughout the measurement.



2.3. Start the engine and keep it running until the hydraulic oil temperature rises to the operating range.



2.4. Measure pump delivery pressure and LS pressure (actuator loaded pressure). Together with the engine running at high idling, after setting the machine at the following conditions.

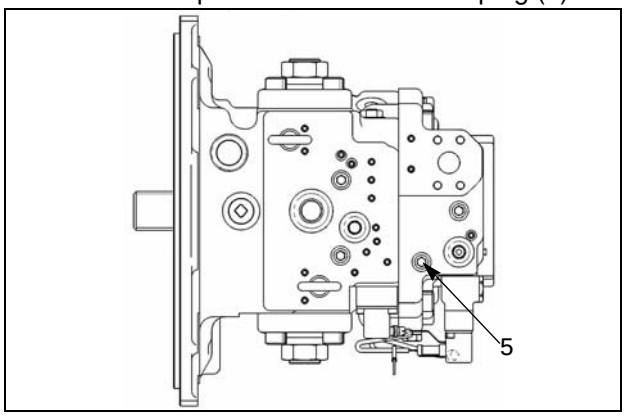
- Auto decel: Off
- One touch power max.: Off
- Work equipment operation: Neutral
- Raise road wheels clear of ground using work equipment and chassis attachments.
  Release brake
  Select LO travel speed
  Fully depress travel pedal
- Attention should be given to the surroundings for safety while operating with the wheels off the ground.
- Calculation of LS differential pressure:
  LS differential pressure = Pump delivery pressure – LS pressure
- If LS differential pressure is in the following conditions, it is judged normal.

Control lever position	LS differential pressure
All levers in NEUTRAL	Unload pressure (see standard value table)
During test	Max. LS differential pressure (see standard value table)

2.5. Detach all the measurement tools after the measurement, and make sure that the machine is back to normal condition.

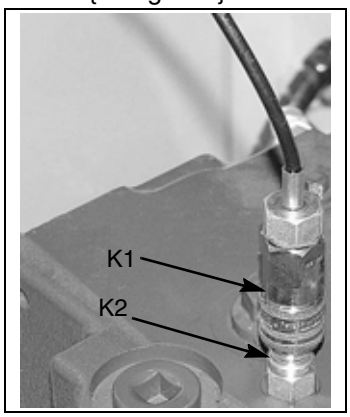
3. Measurement of LS-EPC valve output pressure

3.1. Remove oil pressure measurement plug (5).



3.2. Fit tool **K2** and connect it with oil pressure gauge ① of hydraulic tester **K1**.

- Use an oil pressure gauge with the capacity of 5.9 MPa{60 kg/cm^2}.



3.3. Start the engine and keep it running until the hydraulic oil temperature rises to the operating range.



3.4. Measure the oil pressure under the following conditions:

- Fuel dial: Full
- Auto decel: Off.
- One touch power max: Off.
- If LS-EPC valve output pressure changes to the following values, the pressure is normal.

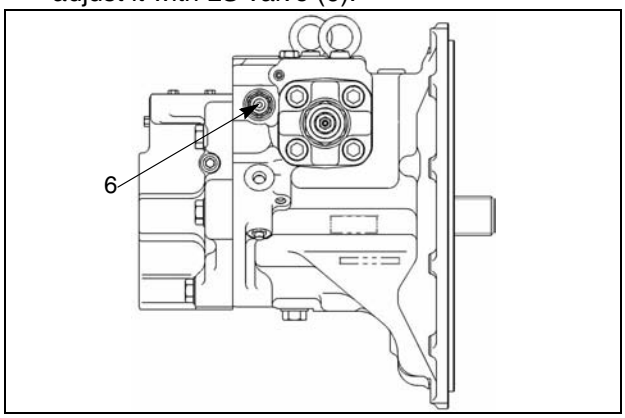
.

Working Mode	Work Equip. Operation	Travel Pedal	Hydraulic Pressure
A	Neutral	Neutral	{30} 900 mA
L	Arm dump relief	Pump relieved	{16} 580 mA

3.5. Detach all the measurement tools after the measurement, and make sure that the machine is back to normal condition.

ADJUSTMENT

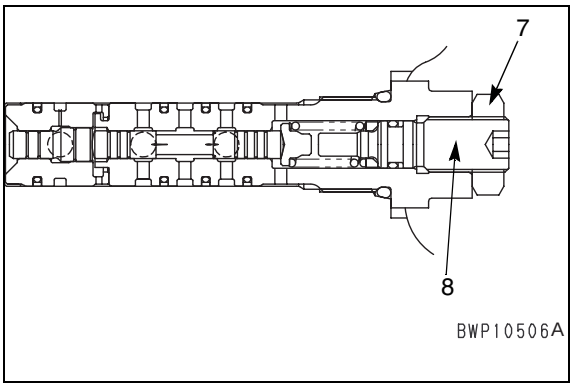
- When LS differential pressure is not normal, adjust it with LS valve (6).



1. Loosen lock nut (7) and adjust the pressure by turning adjusting screw (8).
   - If the adjusting screw is turned to the right, the differential pressure rises.
     If the adjusting screw is turned to the left, the differential pressure falls.
   - Adjustment amount (LS differential pressure) per turn of adjusting screw:

1.3 MPa{13.3 kg/cm^2}

N·m Lock nut: **49–64 Nm{5–7 kgm}**



2. After the adjustment, re-tighten lock nut, confirm that LS differential pressure is normal, following the steps for measurement explained earlier.

MEASUREMENT OF SOLENOID VALVE OUTPUT PRESSURE

- Solenoid valve output pressure measurement tools

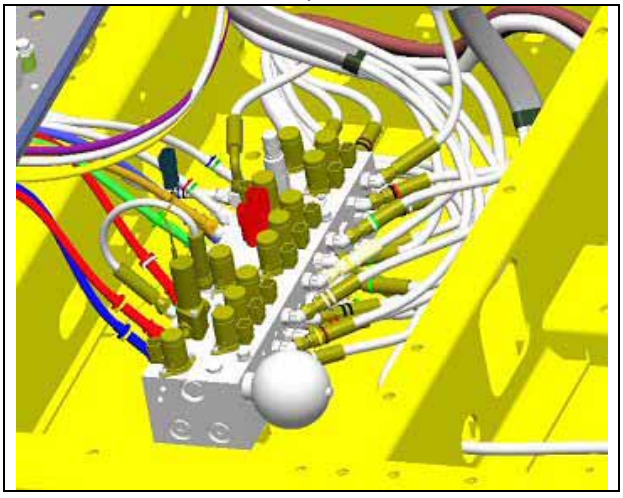
Mark		Part No.	Part Name
L	1	799-101-5002	Hydraulic Tester
		790-261-1203	Digital Type Hydraulic Tester
	2	799-401-2910	Grease Fitting (Size 02)
		07002-01423	O-ring

- Measure solenoid valve output pressure after confirming that control circuit original pressure is normal.

⚠ CAUTION

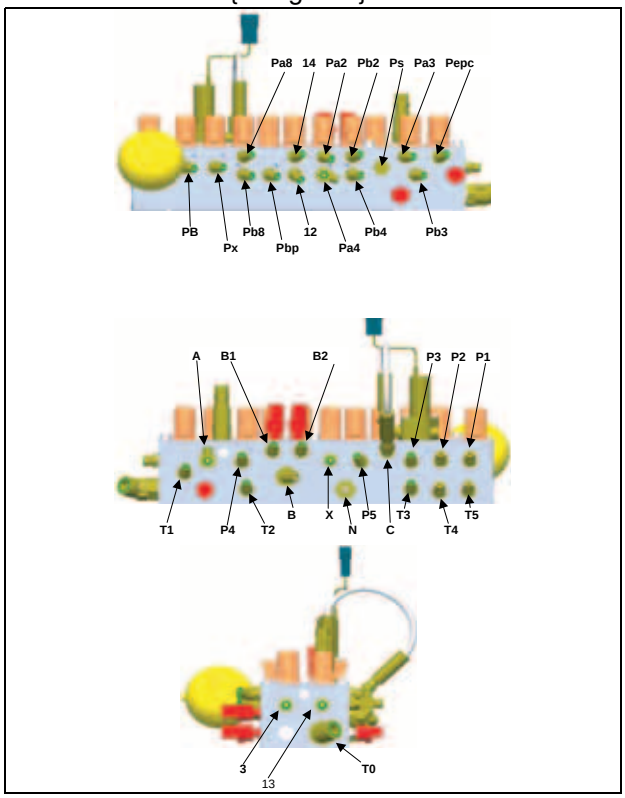
Lower the work equipment to the ground and stop the engine. After the engine is stopped, (but with the ignition switch in the ON position and safety lever still ENGAGED), operated the control levers several times to release the remaining pressure in the hydraulic system. Then loosen the oil filler cap to release any pressure in the hydraulic tank.

1. Disconnect the hoses of solenoid valve to be measured at the outlet side.
   - Hoses to the solenoid valve block are located under the walkway in the service area behind the operators cab.



No.	Solenoid valve to be measured
3	Travel creep solenoid valve
12	Transmission clutch control (1st Gear)
13	Suspension lock solenoid valve
14	Transmission clutch control (2nd Gear)
P1,P2, P3 or P5	PPC hydraulic pressure lock solenoid valve
P4	Travel neutral solenoid valve
P_{A2}	Boom/Stabilizer solenoid valve (boom up)
P_{A3}	Travel solenoid (Forward)
P_{A4}	Boom/Stabilizer solenoid valve (stabilizer up)
P_{A8}	Arm rotate solenoid valve (cw)
P_{B2}	Boom/Stabilizer solenoid valve (boom down)
P_{B3}	Travel solenoid (reverse
P_{B4}	Boom/Stabilizer solenoid valve (stabilizer down)
P_{B8}	Arm rotate solenoid valve (acw)
P_{BP}	2-stage back pressure solenoid valve
PB	Swing brake solenoid valve
PS	Blanked
PX	2-stage relief solenoid valve

2. Connect fitting **L2** to outlet port to be measured.
3. Fit tool ① of hydraulic tester **L1** and connect it to oil pressure gauge ②.
   - Use an oil pressure gauge with the capacity of 5.9 MPa{60 kg/cm^2}.



4. Start the engine and keep it running until the hydraulic oil temperature rises to the operating range.



5. Run the engine at full throttle, then turn each solenoid valve ON or OFF by operating the control lever switch, and measure the pressure.
   - For conditions for turning each solenoid valve ON or OFF, refer to the ensuing "Table for Functioning Conditions" for each solenoid valve.
   - How each solenoid valve functions can be confirmed with monitoring function in the monitor panel. (Special Function of Machine Monitor)
   - When each output pressure shows the following values, it is judged normal

.

Solenoid Valve	Output Pressure
OFF (De-energised)	0{0}
ON (Energised)	3.8MPa{38.7kg/cm^2}

6. Detach all the measurement tools after the measurement, and make sure that the machine is back to normal condition.

Solenoid valve block

Table for Functioning Conditions - Travel creep solenoid valve.

Functioning Condition		Functioning
Travel Creep	Creep selected	On
	Creep not selected	Off
	Stationary	On

Table for Functioning Conditions - Transmission Clutch Control Solenoid valve. (HIGH gear / LO gear)

Functioning Condition	Functioning
LO gear clutch disengaged (Default = HI speed)	OFF
HI gear clutch disengaged (LO speed travel)	ON

Table for Functioning Conditions - Suspension lock solenoid valve.

Functioning Condition		Functioning
Suspension lock switch ON	Suspension lock cancelled	ON
Suspension lock switch OFF	Suspension lock actuated	OFF

Table for Functioning Conditions - PPC lock solenoid valve.

Functioning Condition		Functioning
Safety lock lever	Locked	OFF
	Released	ON

Table for Functioning Conditions - Travel neutral solenoid valve.

Functioning Condition		Functioning
Travel Neutral	When travel forward selected	On
	When travel reverse selected	
	When travel neutral selected	Off
	Lock lever raised	

Table for Functioning Conditions - Boom / Stabilizer solenoid valve. (boom / stabilizer UP)

Functioning Condition	Functioning
Boom up (Default)	OFF
Stab up	ON

Table for Functioning Conditions - Travel solenoid valve. (forward / reverse)

Functioning Condition	Functioning
Forward (Default)	OFF
Reverse	ON

Table for Functioning Conditions - Arm rotate solenoid valve. (ANTI-CLOCKWISE / CLOCKWISE)

Functioning Condition	Functioning
No operation	OFF
Clockwise rotation (Solenoid de-energised)	Rotate right
Anti-clockwise rotation (Solenoid actuated)	Rotate left

Table for Functioning Conditions - Boom / Stabilizer solenoid valve. (boom / stabilizer DOWN)

Functioning Condition	Functioning
Boom down (Default)	OFF
Stab down	ON

Table for Functioning Conditions - 2 Stage back pressure solenoid valve.

Functioning Condition	Functioning
Back pressure	OFF
No back pressure	ON

Table for Functioning Conditions - Swing brake solenoid valve.

Functioning Condition		Functioning
Swing or work equipment lever operated	Brake cancelled	ON
All levers except travel at neutral (5 seconds after returning to neutral)	Brake on	OFF
Swing lock switch is in ON position		

Table for Functioning Conditions - 2 stage relief solenoid valve.

<table>
<tr><th colspan="3">Functiong Condition</th><th>Functioning</th></tr>
<tr><td colspan="3">When overheat setting of 1st stage is ON</td><td rowspan="3">OFF</td></tr>
<tr><td colspan="3">When overheat setting of 2nd stage is ON</td></tr>
<tr><td colspan="3">When all the signals for work equipment, swing and travel are OFF</td></tr>
<tr><td colspan="3">When swing lock switch is ON</td><td rowspan="5">ON</td></tr>
<tr><td colspan="3">When travel signal is ON</td></tr>
<tr><td colspan="3">When working mode is L mode</td></tr>
<tr><td colspan="3">When boom LOWER signal is ON</td></tr>
<tr><td rowspan="2">When working mode is A or E mode</td><td rowspan="2">When left knob is switched</td><td>If signals other than swing operation only ON</td></tr>
<tr><td>If swing operation only is ON</td><td rowspan="2">OFF</td></tr>
<tr><td colspan="3">In conditions other than above</td></tr>
</table>

MEASUREMENT OF PPC VALVE OUTPUT PRESSURE

- PPC valve output pressure measurement tools

Mark	Part No.	Part Name
M	799-101-5002	Hydraulic Tester
	790-261-1203	Digital Type Hydraulic Tester

- Measure PPC valve output pressure after confirming that control circuit original pressure is normal.

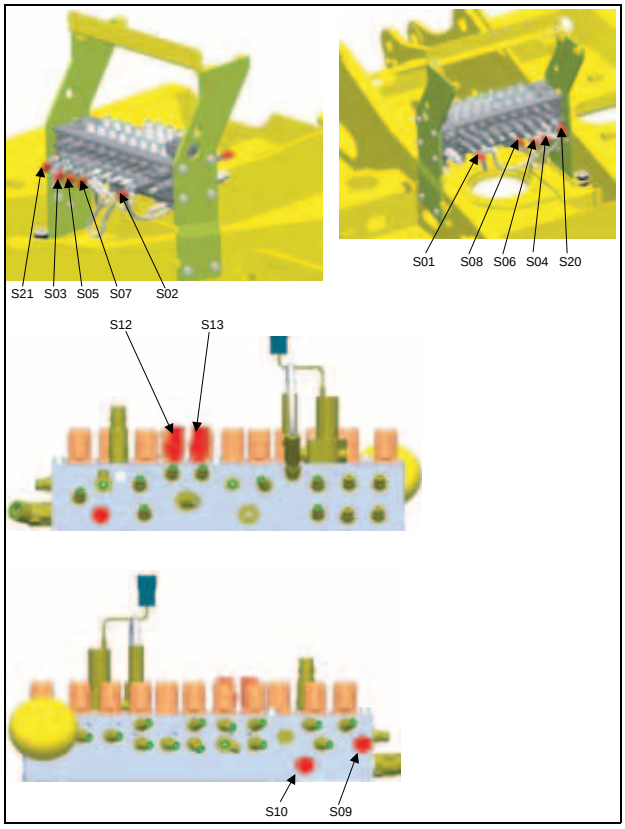
⚠ CAUTION

Lower the work equipment to the ground and stop the engine. After the engine is stopped, (but with the ignition switch in the ON position and safety lever still ENGAGED), operated the control levers several times to release the remaining pressure in the hydraulic system. Then loosen the oil filler cap to release any pressure in the hydraulic tank.

1. Remove PPC oil pressure switches (see table) in the hydraulic circuits to be measured.

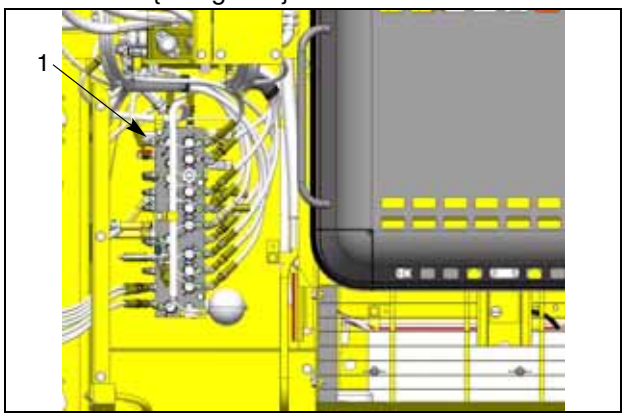
N°.	Circuit to be measured	Location
S01	Swing right	Main valve
S02	Swing left	Main valve
S03	Bucket dump	Main valve
S04	Bucket dig	Main valve
S05	Arm dump	Main valve
S06	Arm dig	Main valve
S07	2nd Boom extend	Main valve
S08	2nd Boom retract	Main valve
S09	Travel reverse	Solenoid valve block
S10	Travel forward	Solenoid valve block
S12	Boom/Stabilizer down	Solenoid valve block
S13	Boom/Stabilizer up	Solenoid valve block
S20	2nd HCU	Main valve
S21	2nd HCU	Main valve

3. Start the engine and keep it running until the hydraulic oil temperature rises to the operating range.



2. Fit tool ① of hydraulic tester **M** and connect oil pressure gauge ② .

- Use an oil pressure gauge with the capacity of 5.9 MPa{60 kg/cm^2}.





4. Measure the pressure when the engine is running at high idling and the control lever of the circuit to be measured is in the NEUTRAL position and then at full stroke.

- If PPC valve output pressure is at the level shown below, it is judged normal.

Lever Control	Hydraulic Pressure
In NEUTRAL	0{0}
At full stroke	Nearly equal to control original pressure (see standard value table)

5. Detach all the measurement tools, and make sure that the machine is back to normal condition.

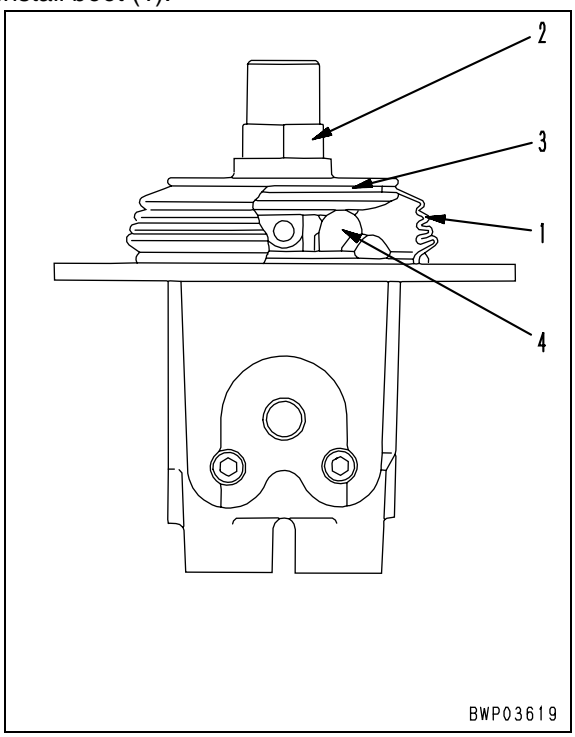
ADJUSTMENT OF WORK EQUIPMENT AND SWING PPC VALVE

- If there is excessive play in the work equipment or swing lever, adjust it in the following manner.

1. Take off boot (1).
2. Loosen lock nut (2) and screw in disc (3) until it contacts the heads of four pistons (4).
   - Do not move the piston while doing this work.
3. Keep disc (3) in place and tighten lock nut (2) to the specified tightening torque.

N·m Lock nut: **98–12 7Nm{10–13 kgm}**

4. Install boot (1).



NOTE: This adjustment must be carried out in a clean environment. Do not allow dirt particles under the boot.

TESTING TRAVEL MOTOR RELIEF PRESSURE

- The travel motor has two pressure relief valves which control the deceleration of the machine. One operates in forward travel and one in reverse.
  - Set pressure = 42 MPa (428 kg/cm^2)

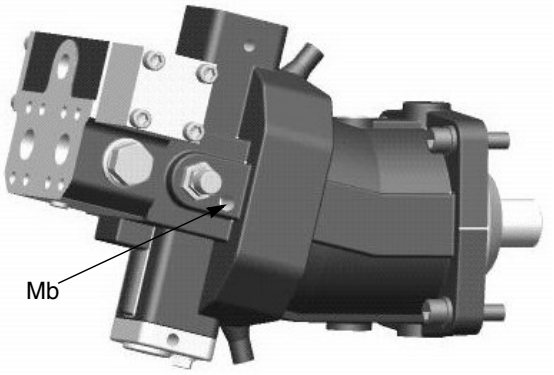
MEASURING TRAVEL MOTOR RELIEF PRESSURE.

Oil temperature should be 45 - 50°

- Fit a 600 kg/cm^2 pressure gauge to port Mb on the front travel motor.
- Test the machine on a downhill slope with a smooth surface and long enough to allow the pressure to stabilize. If the slope is steep (more than 5 degrees) test in LOW mode, otherwise test in HIGH mode.
- Travel forward at approximately half maximum speed (for the selected mode), then release the travel pedal. Read the pressure gauge after the pressure stabilizes.

NOTE: Always use a gauge which can be read safely when travelling the machine.
Alternatively use a gauge which records the pressure reading and study the data after the machine has been stopped.

- If it is necessary to check the other relief valve then swap the relief cartridges between ports and check the second relief by travelling the machine forward.
- it is extremely dangerous to travel the machine at high speed in reverse - always check the relief valves as shown above.



(Ma opposite side)

ADJUSTING TRAVEL MOTOR RELIEF PRESSURE

The valve controlling deceleration of forwards travel is located on the left side of the motor (facing forward) the same side as port **Ma**.

The valve controlling deceleration of reverse travel is located on the right side of the motor (facing forward) the same side as port **Mb**.

- Remove seal and cap from the valve.
- Loosen locking nut.
- Turn adjustment screw clockwise to increase, and counterclockwise to decrease the pressure.
- Tighten locknut.

NOTE: The set pressure cannot be measured whilst making an adjustment.
Always repeat the measurement to check the set pressure after adjusting.

TESTING PROPSHAFT SPEED

MEASURING ROTATING SPEED OF PROPSHAFT

- Lift the wheels from the ground using the blade and outriggers or work equipment.
- Set the machine to high idle.
- Measure in CREEP and LO travel speeds.
- Gently depress the travel pedal to full stroke.

⚠ WARNING

Hazard from rotating wheels exists.

- Allow the speed of the propshaft / wheels to stabilize for a few minutes then measure the rotating speed of the propshaft using an optical tachometer.
- Gently release the travel pedal to stop the wheel rotation.
- Always change rotating speed slowly. Sudden release of the travel pedal could damage the transmission or motors.
- **Judgement table**

Oil temperature 45 ~ 50°C

Check Item		Unit	Standard	Remarks
Travel Speed - CREEP	A Mode	rpm	230 +/-5%	If too high check travel EPC valve.
Travel Speed - LO	A Mode		930 +/-5%	If the speed is out of tolerance refer to troubleshooting section. Do not attempt to adjust travel motor displacement.

NOTE: With the machine in 'Travel Speed-Hi' it is not possible to judge propshaft speed. In this condition the propshaft speed will appear to hunt. This phenomenon is caused by the machine overspeed control logic and is not a fault.

TESTING TRANSMISSION CLUTCH CONTROL CIRCUIT

DESCRIPTION

The transmission contains two clutches which engage HI and LO gear. The clutches are engaged or disengaged by the clutch control solenoid valve. Energising the clutch control solenoid valve will select LO gear and de-energising the solenoid valve will select HI gear. When the solenoid valve is energised, port X is connected to tank (i.e. no pressure) and port Y is pressurised. In this condition the LO gear clutch (large diameter) is engaged and the HI gear clutch (small diameter) is disengaged. If the clutch control solenoid is de-energised, then port Y is connected to tank and port X is pressurised. In this condition, the HI gear clutch is engaged the LO gear clutch is disengaged.

LO gear = High torque (LO speed)

HI gear = Low torque (HI speed)

The actuation pressure for the transmission clutches is supplied from an accumulator via a pressure reducing valve and park brake solenoid valve mounted in the power brake valve. The park brake solenoid valve must be energised to feed the actuation pressure to either HI or LO clutch (via another accumulator to enhance gear shift). With the park brake valve de-energised, both clutches are engaged and so the park brake is engaged.

1. Measuring clutch actuation pressure

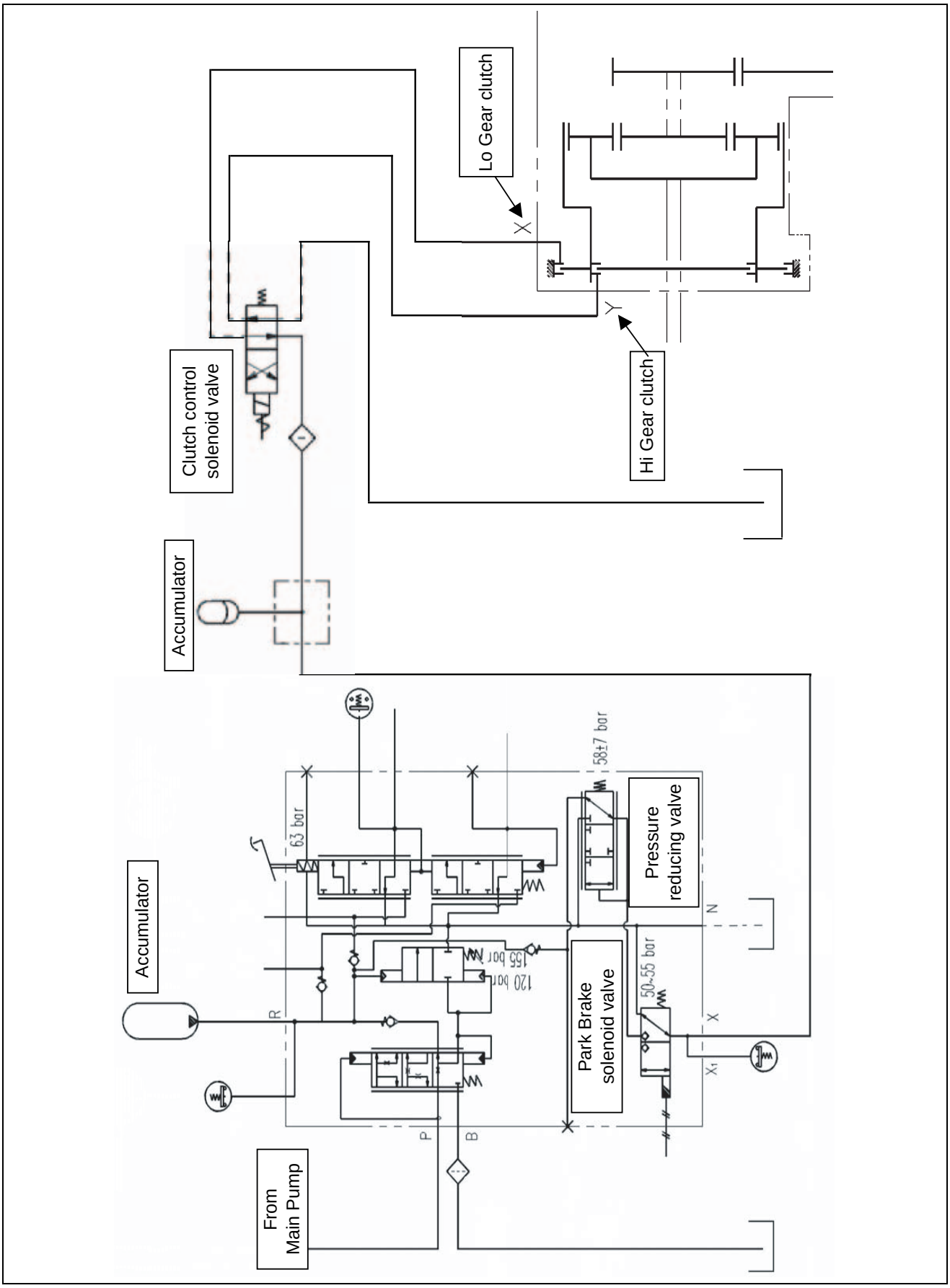
Oil temperature 45 ~ 55°C

Fit the tee's to clutch ports X and Y on the transmission. Fit 150 kg/cm^2 pressure gauge to the third leg of the tee. With the engine running and the park brake disengaged measure the pressure at port X and Y in the conditions shown in the judgment table.

- **Judgement table**

Travel mode	Pressure MPa (kg/cm^2)	
	Port X	Port Y
HI (Park brake off)	0	5.8 $^+$ / $^-$ 0.7 (59 $^+$ / $^-$ 7)
LO (Park brake off)	5.8 $^+$ / $^-$ 0.7 (59 $^+$ / $^-$ 7)	0
CREEP (Park brake off)	5.8 $^+$ / $^-$ 0.7 (59 $^+$ / $^-$ 7)	0
PARK BRAKE ON	0	0

If the pressure is low or high then the power brake valve must be changed (the pressure reducing valve is not adjustable).If the pressure is 0, check flow to power brake valve and accumulator charge pressure.


Lo Gear clutch
Hi Gear clutch
Clutch control solenoid valve
Accumulator
Accumulator
Pressure reducing valve
Park Brake solenoid valve
From Main Pump
63 bar
58±7 bar
50~55 bar
120 bar
155 bar
R
P
B
N
X
X1

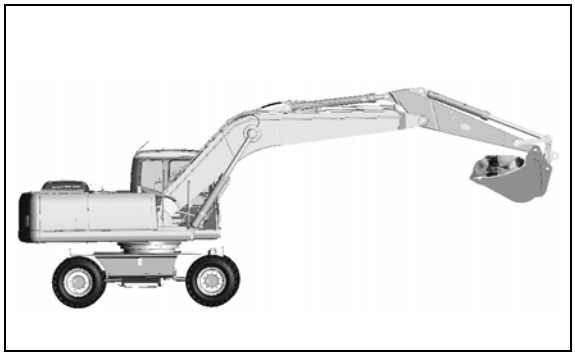
INSPECTION OF LOCATIONS OF HYDRAULIC DRIFT OF WORK EQUIPMENT

- If there is any hydraulic drift in the work equipment (cylinders), check in the following manner to determine if the cause is in the cylinder packing or in the control valve.

1. Inspection of boom and bucket cylinders

1.1. Set the work equipment in the same posture as when measuring hydraulic drift, and stop the engine.

- Fill the bucket with earth or apply the rated load to the bucket.

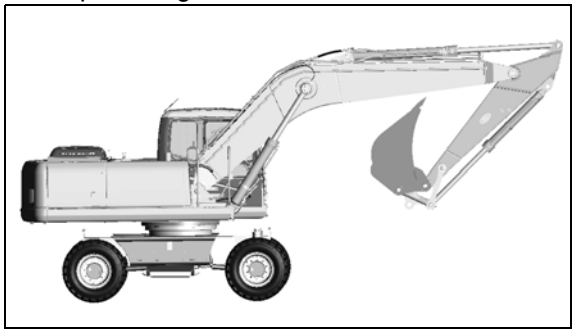


1.2. Operate the control lever to the RAISE position or the bucket control lever to the CURL position.

- If the lowering speed increases, the cylinder packing is defective.
- If there is no change, the control valve is defective.
- Operate the control lever with the engine starting switch in the ON position.
- If pressure in the accumulator has dropped, run the engine for approx. 10 seconds to recharge the accumulator again.

2. Inspection of arm cylinder

2.1. Operate the arm cylinder to move the arm to the position 100 mm before the digging stroke end, and stop the engine.



2.2. Operate the arm control lever to move the arm to the digging side.

- If the lowering speed increases, the cylinder packing is defective.
- If there is no change, the control valve is defective.
- Operate the control lever with the engine starting switch in the ON position.
- If pressure in the accumulator has dropped, run the engine for approx. 10 seconds to charge the accumulator again.

[Reference]If the cause of the hydraulic drift is in the defective packing, and the above operation is carried out, downward movement is accelerated for the following reasons.

2.2.1 If the work equipment is set to the above posture (holding pressure applied to the bottom end), the oil at the bottom end leaks to the head end. However, the volume at the head end is smaller than the volume at the bottom end by the volume of the rod end, so the internal pressure at the head end increases because of the oil flowing in from the bottom end.

2.2.2 When the internal pressure at the head end increases, the pressure at the bottom end also rises in proportion to this. The balance is maintained at a certain pressure (this differs according to the amount of leakage) by repeating this procedure.

2.2.3 When the pressure is balanced, the downward movement becomes slower. If the lever is then operated according to the procedure given above, the circuit at the head end is opened to the drain circuit (the bottom end is closed by the check valve), so the oil at the head end flows to the drain circuit and the downward movement becomes faster.

3. Inspection of PPC valve

Measure the amount of hydraulic drift of the work equipment when the accumulator is charged with pressure and the safety lock lever is put to the LOCK and FREE positions.

- Operate the control lever with the engine starting switch in the ON position.
- If pressure in the accumulator has dropped, run the engine for approx. 10 seconds to charge the accumulator again.
- If there is any difference in the hydraulic drift between LOCK and FREE positions, the PPC valve is defective (some internal failure).

RELEASE OF REMAINING PRESSURE IN HYDRAULIC CIRCUIT

1. Release of residual pressure from hydraulic tank.

⚠ CAUTION

The hydraulic tank is enclosed and pressurised. When removing a hose or a plug connected to the hydraulic tank, release the residual pressure from the hydraulic tank according to the following procedure.

1.1. Lower the work equipment to the ground in a stable posture and stop the engine.

1.2. Slowly loosen oil filler cap of the hydraulic tank to release the air from the tank.

2. Release of residual pressure from hydraulic cylinder circuit.

⚠ CAUTION

When disconnecting the piping between a hydraulic cylinder and the control valve, release the residual pressure from the piping according to the following procedure.

2.1. Referring to previous step "Release of residual pressure from hydraulic tank"

- Leave the oil filler cap of he hydraulic tank removed.

2.2. Turn the starting switch to the **ON** position and set the safety lock lever in the **FREE** position, and then operate the work equipment control levers on both sides forward backward, to the right and to the left.

- The control valve is driven with the pressure in the accumulator. If it is operated 2-3 times, the pressure lowers.

2.3. Start the engine and run it at low idling for 5 seconds to heighten the pressure in the accumulator. Stop the engine.

2.4. Repeat above steps 2.2 and 2.3 2-3 times, and all residual pressure is released from the piping.

3. Release residual pressure from swing motor circuit.

- Release the residual pressure from the swing motor circuit by performing the procedure for 2. Release of residual pressure from hydraulic cylinder.

4. Release of residual pressure from travel motor circuit

- Since the control valve spool of the travel motor is open, release the residual pressure from the travel motor circuit by performing the procedure for 1. release of residual pressure from hydraulic tank.

MEASUREMENT OF OIL LEAKAGE

- Measuring device for oil leakage

Symbol	Part Number	Part Name
R	Purchased	Measuring Cylinder

- Measure the oil leakage under the following condition.
  - Hydraulic oil temperature: Within operating range.

1. Measuring leakage from boom cylinder

1.1. Run the engine and raise the boom to the stroke end.

⚠ CAUTION

Referring to RELEASE OF RESIDUAL PRESSURE FROM HYDRAULIC CIRCUIT, release the residual pressure from the piping on the boom cylinder head side (Operate the lever only in the RAISE direction, however).

1.2. Disconnect hoses (1) on the cylinder head side block it with a plug.

⚠ CAUTION

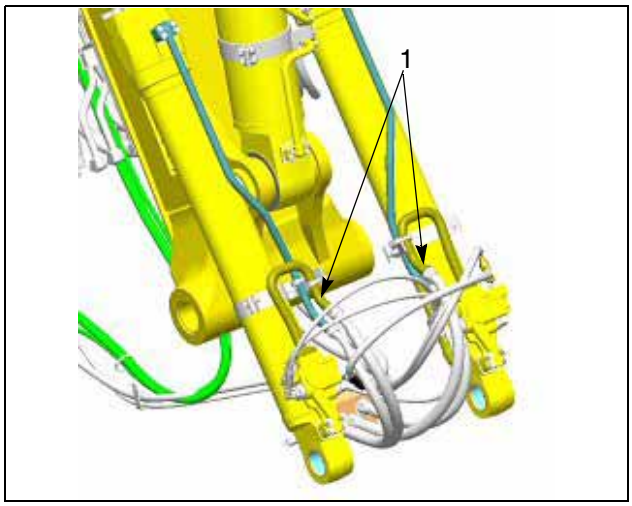
Take care not to disconnect the hose on the cylinder bottom side.

1.3. Run the engine at high idling and relieve the boom cylinder by operating the boom control lever in the **RAISE** direction.

⚠ CAUTION

Take care not to operate the boom control lever in the lower direction.

1.4. Start measuring the oil leakage 30 seconds after the boom cylinder is relieved and measure for 1 minute.



1.5. After finishing the measurement, make sure that the machine is back to normal condition.

2. Measuring leakage from arm cylinder

2.1. Run the engine and move the arm to the digging stroke end.

⚠ CAUTION

Referring to RELEASE OF RESIDUAL PRESSURE FROM HYDRAULIC CIRCUIT, release the residual pressure from the piping on the arm cylinder head side (Operate the lever only in the digging direction however).

2.2. Disconnect hose (2) on the cylinder head end and block the hose end with a plug.

⚠ CAUTION

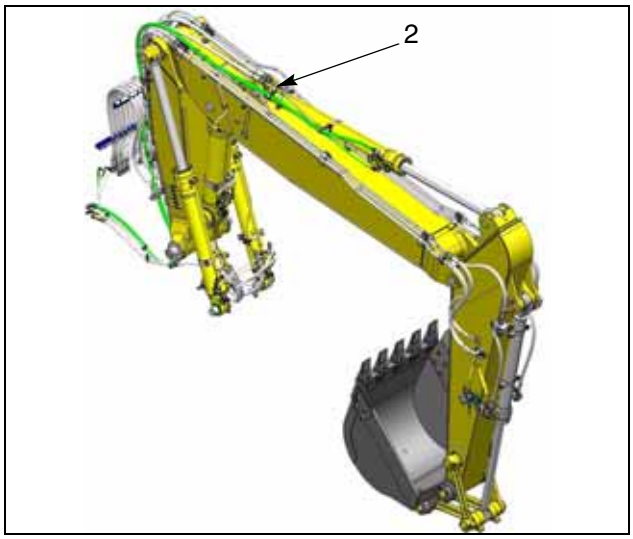
Be careful not to disconnect the hose at the cylinder bottom end.

2.3. Run the engine at high idling and relieve the arm cylinder by operating the arm control lever in the **DIGGING** direction.

⚠ CAUTION

Take care not to operate the arm control lever in the DUMP direction.

2.4. Continue this condition for 30 seconds, then measure the oil leakage amount for one minute.



2.5. After the measurement, make sure that the machine is back to normal condition.

3. Measuring leakage from bucket cylinder

3.1. Run the engine and curl the bucket to the stroke end.

⚠ CAUTION

Referring to RELEASE OF RESIDUAL PRESSURE FROM HYDRAULIC CIRCUIT, release the residual pressure from the piping on the bucket cylinder head side (Operate the lever only in the CURL direction).

3.2. Disconnect hose (3) at the cylinder head end block the hose end with a plate.

⚠ CAUTION

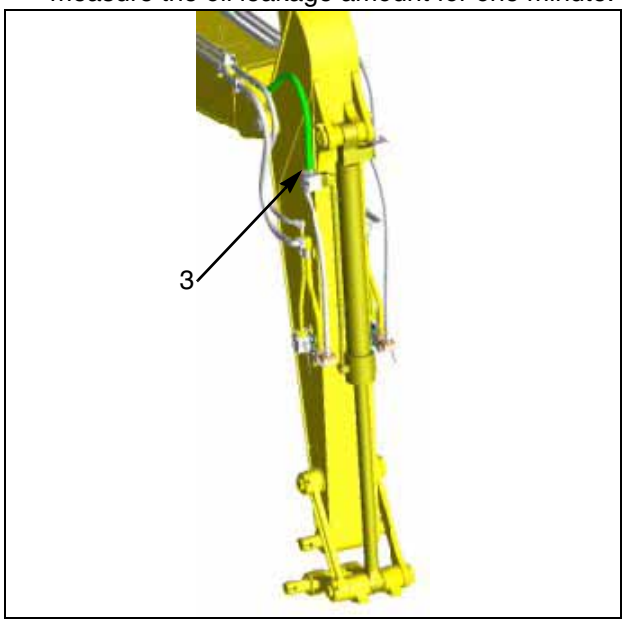
Be careful not to disconnect the hose at the cylinder bottom end.

3.3. Run the engine at high idling and relieve the bucket cylinder by operating the bucket control lever in the **CURL** direction.

⚠ CAUTION

Take care not to operate the bucket control lever in the DUMP direction.

3.4. Continue this condition for 30 seconds, then measure the oil leakage amount for one minute.



3.5. After the measurement, make sure that the machine is back to normal condition.

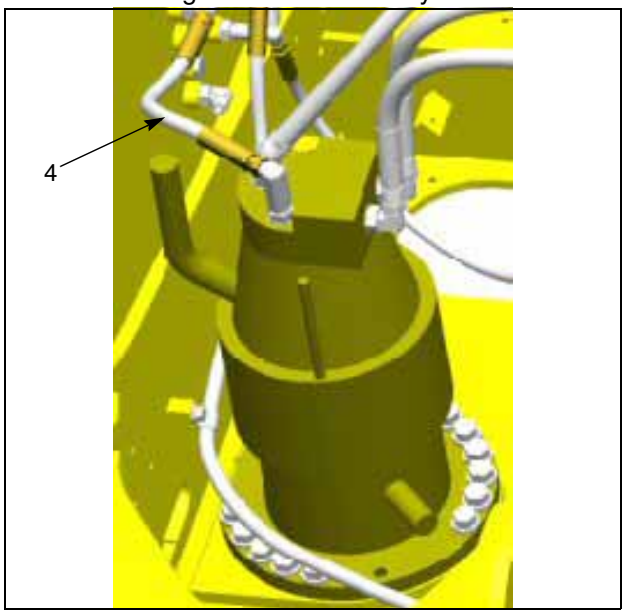
4. Measuring leakage from swing motor

4.1. Disconnect drain hose (4) and fit a blind plug in the hose.

4.2. Turn the swing lock switch to the ON position.

4.3. Run the engine at high idle and relieve the swing circuit and measure the oil leakage.

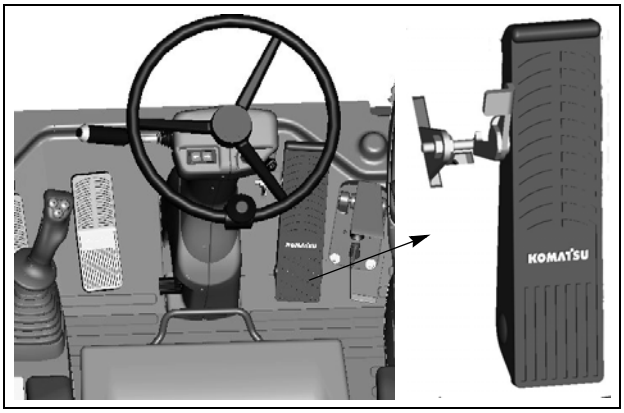
- Start measuring the oil leakage 30 seconds after the swing motor circuit is relieved and measure for 1 minute.
- After the first measurement, turn the upper structure by 180 degrees and take measurement again in the same way.



4.4. After finishing the measurement, make sure that the machine is back to normal condition.

5. Measuring leakage from travel motor

5.1. With the safety lock lever in the ENGAGED position the PPC switch in the OFF position, the engine running at high idle and the service brake locked in the ON position. Raise the hydraulic oil temperature to be in the range 40~50°C.



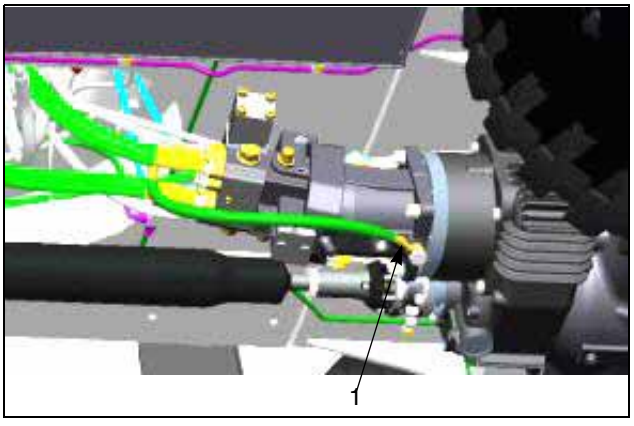
5.2. Disconnect flushing hose (1) of the travel motor and fit a blind plug in the hose end.

5.3. Using the travel pedal, put the travel circuit into relief.

5.4. Port A or B are set under pressure above the setting of relief valves (i.e. 380 bar)

- Since any incorrect operation of the controls may lead to a serious accident. Only do this test in a secure area marked with adequate warning signs.
- Start measuring the oil leakage 30 seconds after the travel motor circuit is relieved and measure for 1 minute.
- Measure the oil leakage several times, moving the motor little by little (changing the positions of the valve plate, cylinder, those of the cylinder and piston).

.



5.5. After the measurement, make sure that the machine is back to normal condition.

Leakage - 4 ~ 6 litres / min Normal
Leakage > 10 litres / min Abnormal

Repair or replace travel if motor is found to have an abnormal level of oil leakage.

AIR BLEEDING OF VARIOUS PARTS

Air bleeding item / Contents of Work	Steps for air bleeding					
	1	2	3	4	5	6
	Bleeding air from hydraulic pump	Starting engine	Bleeding air from cylinder	Bleeding air from swing motor	Bleeding air from travel motor	Checking oil level and starting work
• Replacement of hydraulic oil • Cleaning of strainer	●	●	●	● (See note)	● (See note)	●
• Replacement of return filter element		●	→	→	→	●
• Replacement or repair of hydraulic pump • Removing suction piping	●	●	●	→	→	●
• Replacement or repair of control valve • Removal of control valve piping		●	●	→	→	●
• Replacement or repair of cylinder • Removal of cylinder piping		●	●	→	→	●
• Replacement or repair of swing motor • Removal of swing motor piping		●	→	●	→	●
• Replacement or repair of travel motor • Removing travel motor piping		●	→	→	●	●
• Replacement or repair of swivel joint • Removal of swivel joint		●	→	→	→	●

NOTE: Bleed air from the swing motor and travel motor only when oil in the casing is drained.

1. Bleeding air from hydraulic pump

1.1. Loosen air bleeder (1) by 4 turns and remove the oil filler cap of the hydraulic tank.

- Leave the machine under the above condition for 10 minutes.

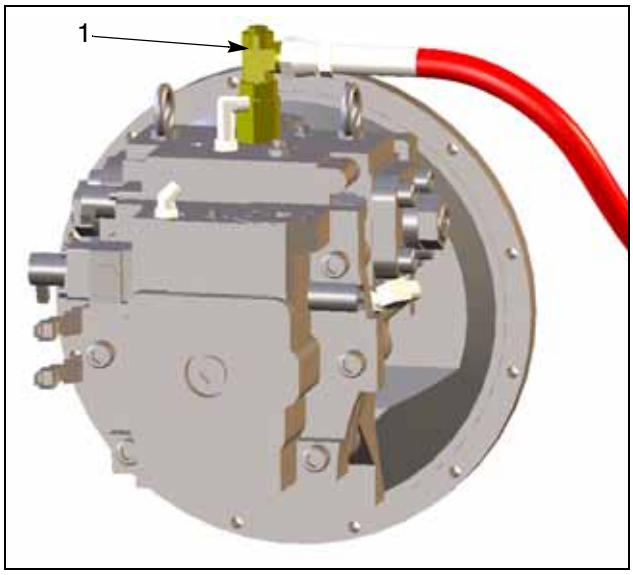
1.2. After oil flows out of bleeder (1) run the engine at low idle.

- If the engine water temperature is low and the automatic warm up operation is started, stop the engine temporarily and reset the automatic warm up operation with fuel control dial (Set the starting switch in the ON position and hold the fuel control dial in MAX position for 3 seconds and the automatic warm up operation is reset.)
- Set the safety lock lever in the DISENGAGED position so that you will not operate a lever by mistake.

1.3. After clear oil flows out of bleeder (1) tighten the bleeder.

N·m Bleeder: **7.8–9.8 Nm {0.8–1.0 kgm}**

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2. Starting engine

When running the engine after the engine after performing step 1, keep its speed at low idle for 10 minutes.

3. Bleeding air from cylinder

- If a cylinder was replaced, bleed air from it before connecting the work equipment. In particular, the boom cylinder does not move to the lowering stroke end, if it is installed to the work equipment.

3.1. Run the engine at low idle for about 5 minutes.

3.2. Running the engine at low idle, raise and lower the boom 4-5 times.

- Stop the piston rod about 100mm before each stroke end. Do not relieve the oil.

3.3. Running the engine at high idle, perform step 2.

3.4. Running the engine at low idle, move the piston rod to the stroke end and relieve the oil.

3.5. Bleed air from the arm cylinder and bucket cylinder according to steps 2-4.

4. Bleeding air from swing motor

4.1. Motor unit

- Bleed air from the motor unit according to the following procedure.

4.1.1 Run the engine at low idle

4.1.2 Swing to the right and left slowly to bleed air.

4.2. Parking brake circuit

- Normally, air in the parking brake circuit is bled by swinging the machine in step 1. If you feel dragging of the brake circuit according to the following procedure.

4.2.1 Loosen the fitting of brake hose (2) and start the engine.

4.2.2 Run the engine at low idle and set the swing holding brake release switch to the release switch to the RELEASE and NORMAL positions repeatedly. After clear oil oozes out, tighten the fitting.

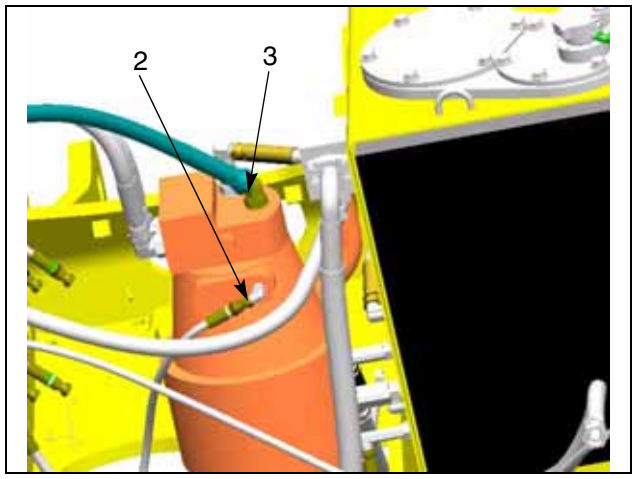
4.3. Safety valve circuit

- Normally, air in the safety valve circuit is bled by swinging the machine in step 1. If abnormal sound comes out from around the safety valve during swinging operation, however, bleed air from the safety valve circuit according to the following procedure.

4.3.1 Loosen fittings (3) and start the engine.

4.3.2 Run the engine at low idle. After clear oil oozes out, tighten the fitting.

N·m Plug: **9.8 - 12.74Nm {1.0 - 1.3kgm}**

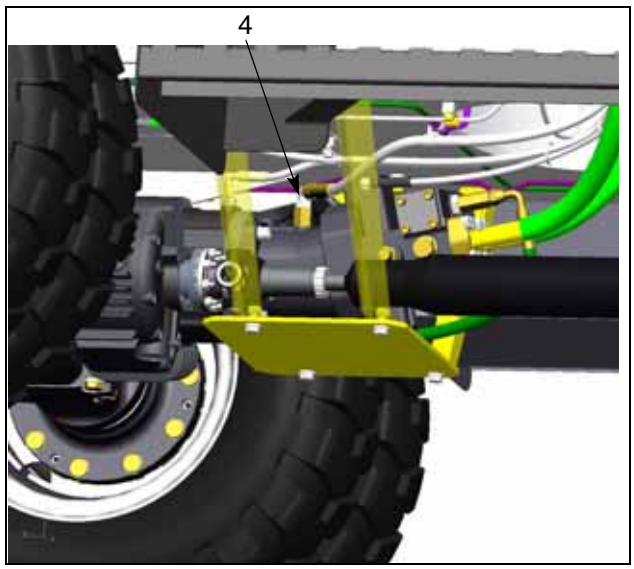


5. Bleeding air from travel motor

5.1. Loosen motor drain hose fitting (4)

5.2. Run engine at low idle and repeat forward and reverse operations 4 or 5 times. After clear oil flows out, retighten the fitting.

- Limit the operation to the travel to a degree where the machine just starts to move.



6. Checking oil level and starting work

6.1. Run the engine, retract the arm cylinder and bucket cylinder to the stroke ends, lower the work equipment to the ground, and stop the engine.



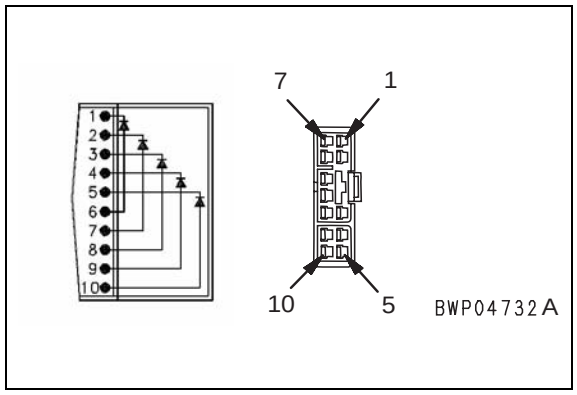
6.2. Check the oil level by the sight gauge at the back of the hydraulic tank.

- If the oil level is between lines H and L, it is normal.
- If the oil level is below line L, add new oil.

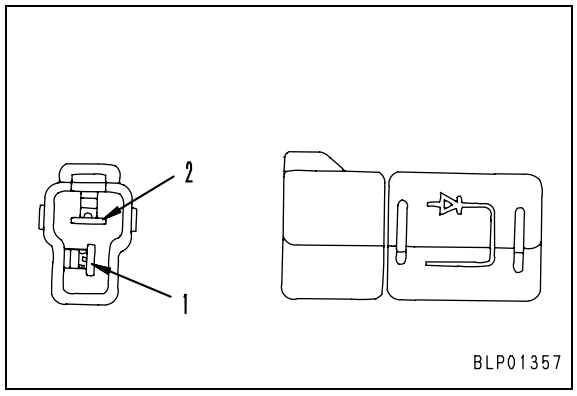
INSPECTION PROCEDURES FOR DIODE

- Check an assembled-type diode (10 pins) and single diode (2 pins) in the following manner.
- The continuity direction of an assembled-type diode is as shown in the diagram below.

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- The continuity direction of a single diode is shown on the diode surface



1. When using digital type circuit tester

1.1. Switch the testing mode to diode range and confirm the indicated value.

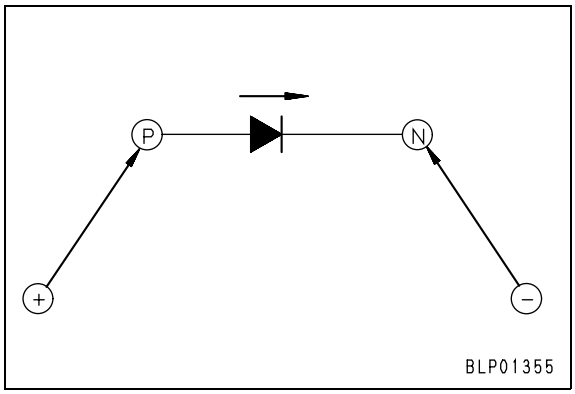
- Voltage of the battery inside is displayed with conventional circuit testers.

1.2. Put the red probe (+) of the test lead to the anode (P) and the black probe (–) to the cathode (N) of diode, and confirm the displayed value.

1.3. Determine if a specific diode is good or no good with the indicated value.

- No change in the indicated value: No continuity (defective).
- Change in the indicated value: Continuity established (normal) (Note)

NOTE: A silicon diode shows a value between 400 and 600.



2. When using analog type circuit tester

2.1. Switch the testing mode to resistance range.

2.2. Check the needle swing in case of the following connections.

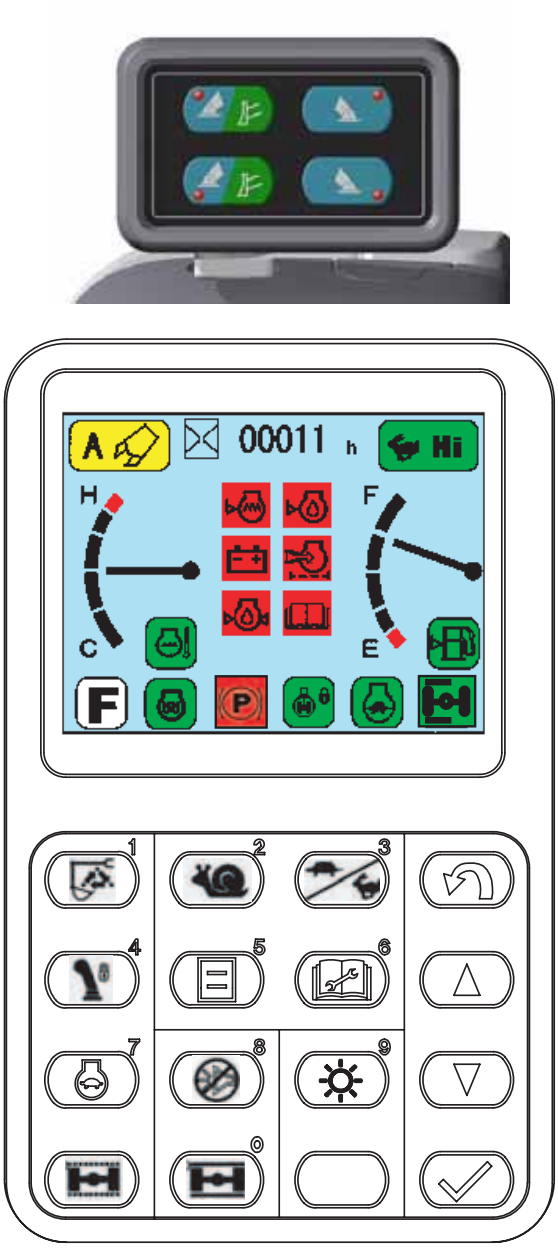
2.2.1 Put the red probe (+) of the test lead to the anode (P) and the black probe (–) to the cathode (N) of diode.

2.2.2 Put the red probe (+) of the test lead to the cathode (N) and the black probe (–) to the anode (P) of diode.

2.3. Determine if a specific diode is good or no good by the way the needle swings.

- If the needle does not swing in Case i), but swings in Case ii): Normal (but the breadth of swing (i.e. resistance value) will differ depending on a circuit tester type or a selected measurement range)
- If the needle swings in either case of i) and ii): Defective (short-circuited internally)
- If the needle does not swing in any case of i) and ii): Defective (short-circuited internally)

SPECIAL FUNCTION OF MONITOR PANEL



[1] Figure input switch 1
[2] Figure input switch 2
[3] Figure input switch 3
[4] Figure input switch 4
[5] Figure input switch 5
[6] Figure input switch 6
[7] Figure input switch 7
[8] Figure input switch 8
[9] Figure input switch 9
[0] Figure input switch 0

Undo switch
Scroll up switch
Scroll down switch
Input confirmation switch

1. Monitor panel functions - conventional and special

The monitor panel is provided with conventional and special functions, and various kind of information are shown in the multi-display. Display items consists of automatic display items that are preset in the monitor panel and others that are shown by switch operations.

1. Conventional function: Operator's Menu

This is a function by which an operator can set or show displays by switch operations. The display contents are those which are normally shown.

Operator's Menu	
1	Function for inputting and setting password, see page 20-161.
2	Function for showing Komatsu's logo, see page 20-161.
3	Function for machine inspection before starting day's work, see page 20-161.
4	Function for showing machine maintenance, see page 20-161.
5	Function for showing precaution items, see page 20-162.
6	Function for confirming working mode and travel speed, see page 20-162.
7	Function for display of ordinary items, see page 20-162.
8	Function for adjusting display luminance and contrast, colour and clock see page 20-162.
9	Function for adjusting breaker and attachment flow rate, see page 20-163.
10	Function for confirming maintenance information, see page 20-166.
11	Function for showing service meter reading or clock, see page 20-166.
12	Function for showing occurrence of caution item, see page 20-166.
13	Function for showing users' code No., see page 20-166.
14	Function for showing service code No. and failure code No., see page 20-167.

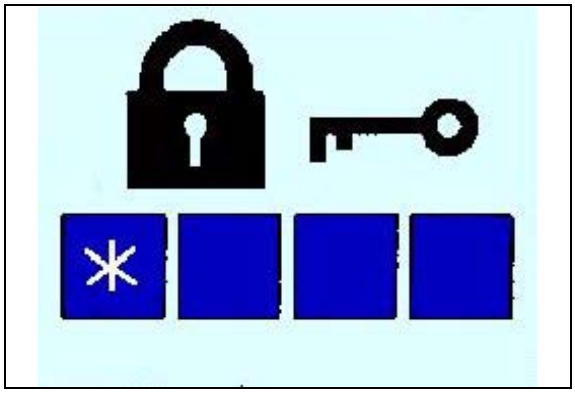
2. Special function: Service Menu

This is a function by which a service mechanic can set or show displays by special switch operations. The display contents are those which are not normally shown. It is mainly used for inspection, adjustment, trouble-shooting or special setting of machines.

Service Menu		
01	Function for monitoring	
02	Function for abnormality history	Electrical system
		Mechanical system
03	Function for maintenance history	
04	Function for maintenance mode change	
05	Function for recording phone No.	
06	Function for initial value setting and default	Mode with key on
		Language
		Unit
		With/without service circuit
07	Function for adjustment	Pump absorbtion torque
		Compound Op. ATT. flow adjustment
		1st ATT flow R adjustment
		1st ATT flow L adjustment
		2nd ATT flow R adjustment
		2nd ATT flow L adjustment
08	Cylinder cut-out	
09	No Injection	

OPERATION OF OPERATORS MENU AND DISPLAY (OUTLINE)

- This section introduces only the outline of the operator's menu. For details on the contents and operation steps of each menu, refer to the operation and maintenance manual or section 10 ("STRUCTURE, FUNCTION AND MAINTENANCE STANDARDS") in this shop manual chapter on monitor system.



1. Function for inputting and setting password

When the engine starting switch is turned ON, the password inputting display is shown.

- This display is shown only when a password is registered.

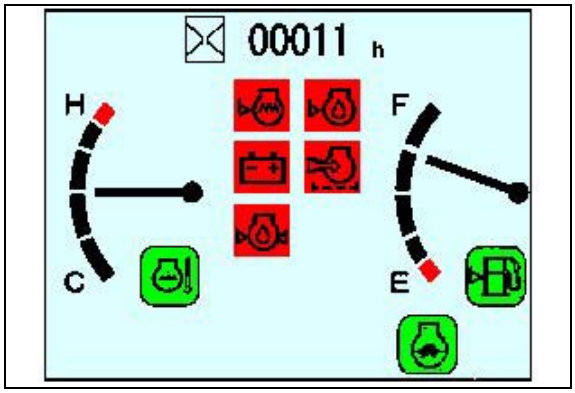


2. Function for showing KOMATSU logo

When a password is input, or when the engine starting switch is turned ON, KOMATSU logo is shown for two seconds.

3. Function for machine inspection before starting day's work

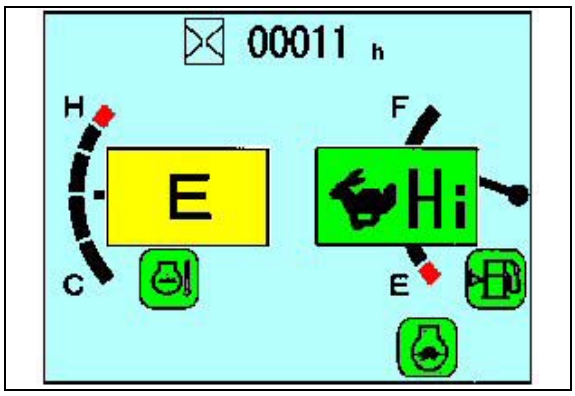
Following the KOMATSU logo, the display of machine inspection before starting day's work is shown for 2 seconds.



4. Function for machine maintenance

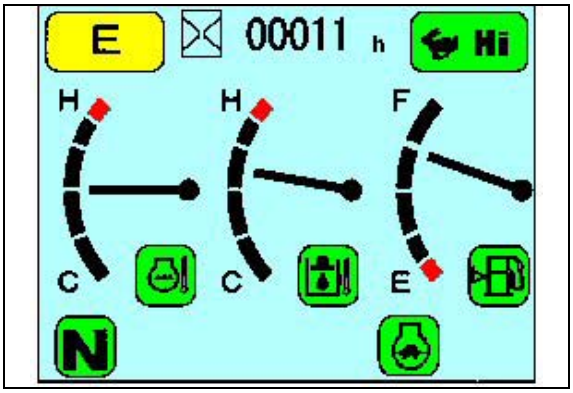
Following the display of machine inspection before starting day's work, the maintenance mark appears for 30 seconds, if there is a service item whose maintenance time is approaching or has just passed.

- This display appears only when the maintenance function is set.



5. Function for showing precaution items

If there is any item of machine inspection before starting day's work that indicates some abnormality, a corresponding symbol mark is shown after the display of machine inspection before starting day's work.

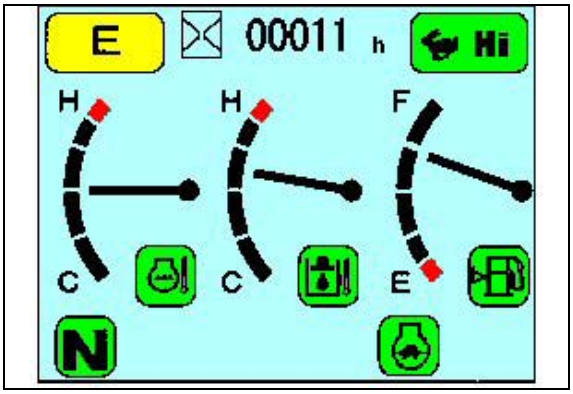


6. Function for confirming working mode and travel speed

7. Function for display of ordinary items

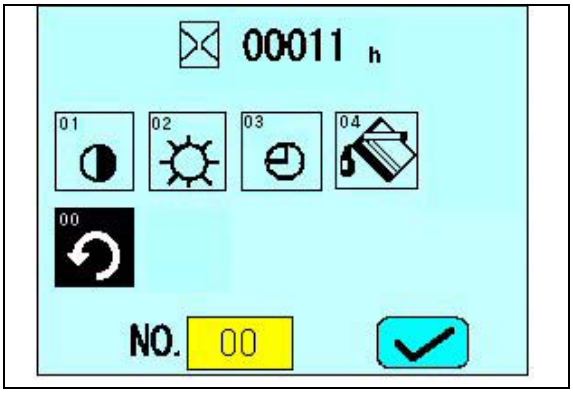
The display of confirming working mode and travel speed is switched to this display of ordinary items.

- If the working mode setting or travel speed setting is changed, or auto-deceleration FNR setting is activated while this is in display, an amplified corresponding symbol mark is shown for two seconds.
- In this display, a symbol mark for preheat monitor is shown only when preheating is carried out.



8. Function for adjusting display luminance and contrast

Contrast, brightness, clock and background colour of the display can be adjusted by firstly pressing Maintenance key [6] on the monitor then selecting item [01], [02], [03] or [04] to adjust.

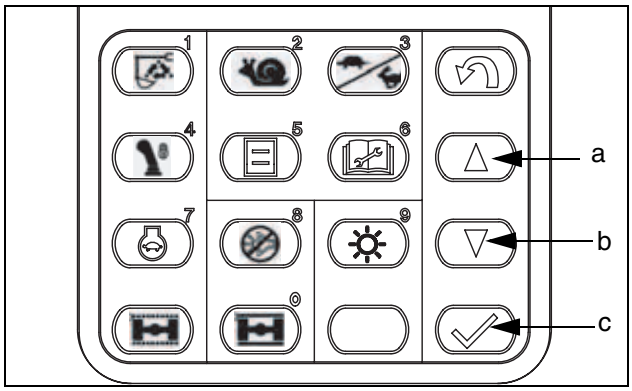


9. Function for adjusting breaker and attachment flow rate (For machines equipped with breaker attachment)

When a breaker or other attachments are used, hydraulic pump flow rate can be adjusted by operating the select switch.

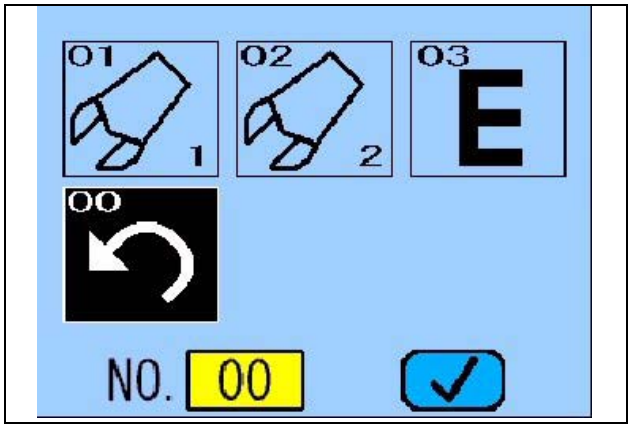
- Note that the symbol mark and contents of display partially differ between the breaker

Select switch (5) is used to select the hydraulic flow setting in each of the working modes P, E and B.

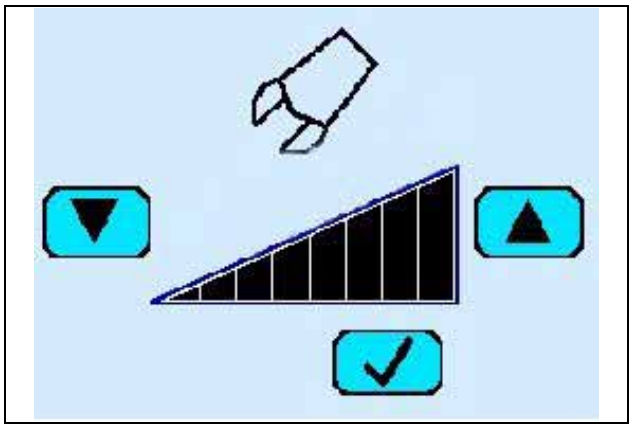


9.1. When the working mode is P or E

9.1.1 Press switch (5) and normal screen on monitor display changes to the screen shown in the diagram on the right

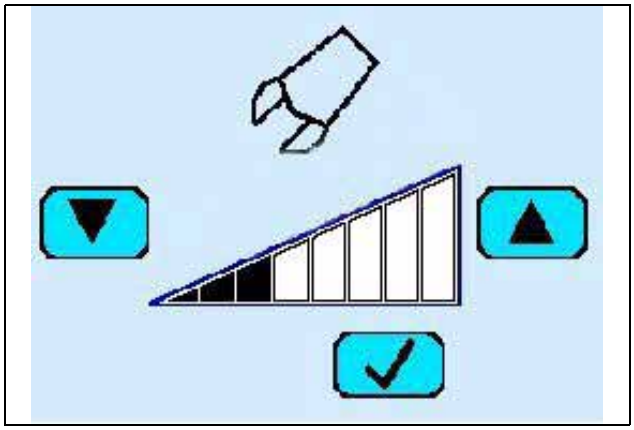


9.1.2 Select 01 from the screen and the monitor display changes to the flow setting screen shown on the right (Full Flow). By pressing down switch (b) the flow can be reduced.



OR

Select 02 from screen and the monitor display changes to the flow setting. Press up switch (a) or down switch (b) to adjust to the desired flow.



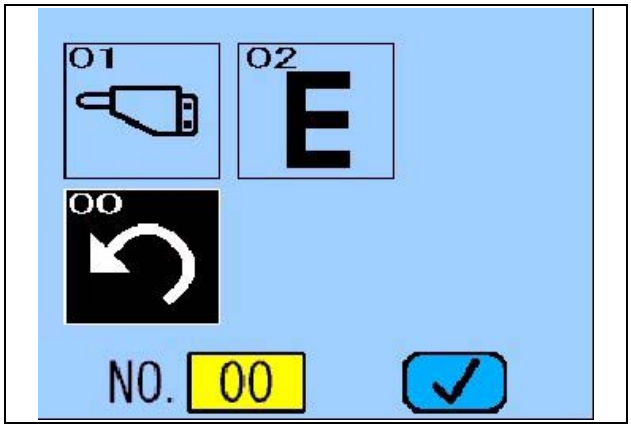
9.1.3 After completing the flow setting, press input confirmation switch (c).
The monitor display will return to the normal screen.

REMARK

The flow can be adjusted for the attachment installed.

9.2. When working mode is B mode.

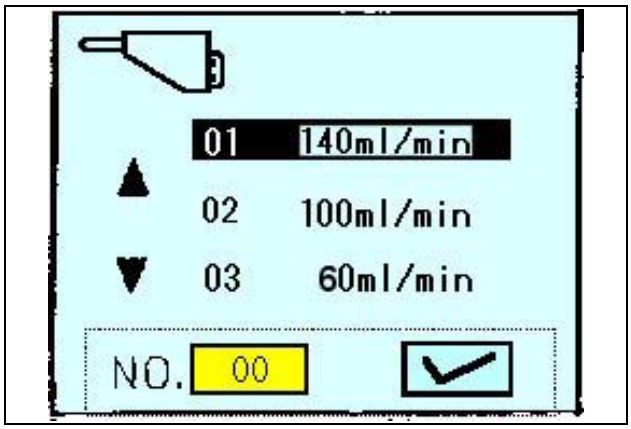
9.2.1 Press menu select switch (5) and the normal screen on the monitor display changes to the screen shown in the diagram on the right.



9.2.2 Select 01 from screen and the monitor display changes to the flow setting screen shown on the right.

9.2.3 Press up switch (a) or down switch (b) to adjust to the desired flow.

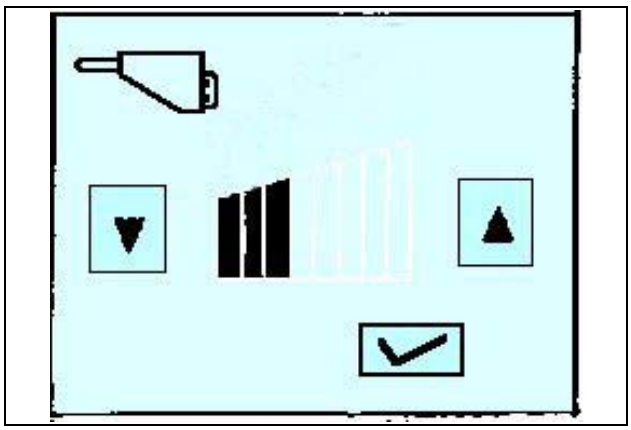
9.2.4 After completing the flow setting, press input confirmation switch (c).

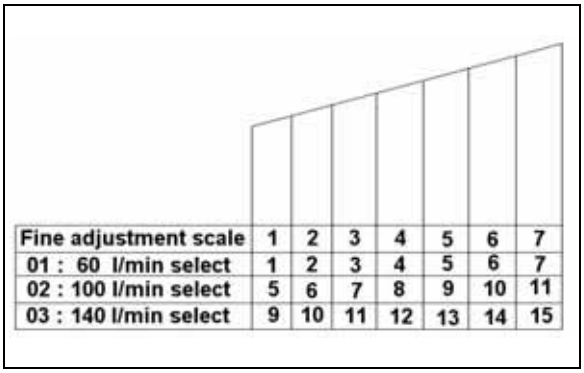


9.2.5 With the operation in step 3, the flow setting screen changes to the fine flow adjustment screen shown in the diagram on the right.

9.2.6 Press up switch (a) or down switch (b) to adjust to the desired flow.

9.2.7 After completing the flow setting press input confirmation switch (c).
The monitor display will return to the normal screen.





Fine adjustment scale	1	2	3	4	5	6	7
01 : 60 l/min select	1	2	3	4	5	6	7
02 : 100 l/min select	5	6	7	8	9	10	11
03 : 140 l/min select	9	10	11	12	13	14	15

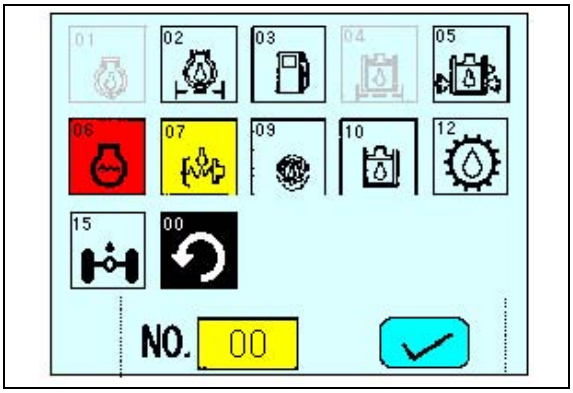
For approximate flow rate setting look at flow rate table below.

Segment	Oil flow (l/min.)	EPC Current (mA)
1	30	500
2	40	515
3	50	535
4	60	545
5	70	560
6	80	573
7	90	587
8	100	600
9	110	605
10	120	618
11	130	625
12	140	640
13	150	650
14	160	665
15	170	675

10. Function for confirming maintenance information

Detailed information on maintenance items (set time and elapse of time) can be confirmed and reset after the confirmation is feasible by operating the maintenance switch.

- Use service Menu for setting or releasing maintenance items and setting maintenance time.



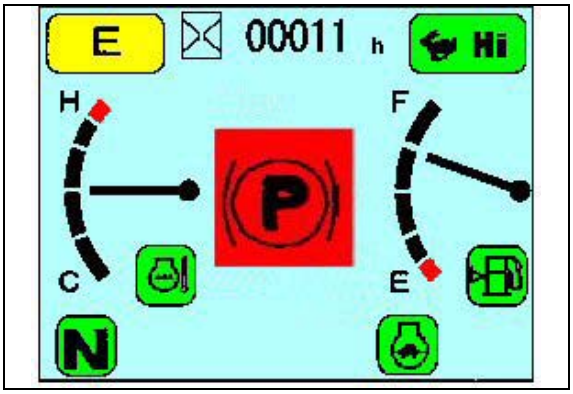
11. Function for showing service meter reading or clock

When key is turned to first position, the monitor is switched on but the engine is not. In this position the service meter reading is displayed. When starting up the engine, this display changes to the clock.

12. Function for showing occurrence of caution item

If any of the caution items occurs, the magnified corresponding symbol mark is shown.

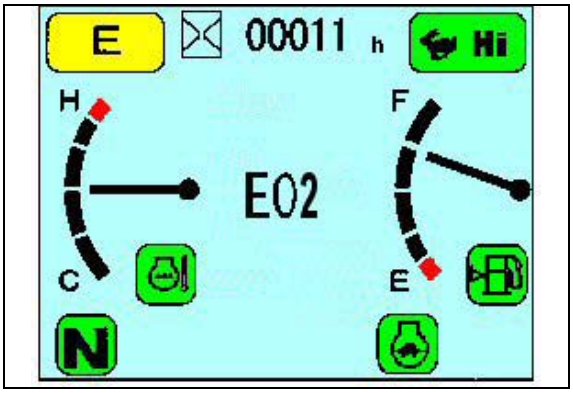
A. Park brake
B. Low Brake Pressure
C. Undercarriage Attach Select.



13. Function for showing users' code No.

When a problem occurs on the machine, the user's code is automatically displayed depending on the magnitude of the trouble to call attention of the operator for a proper action.

- This display turns to the display of service code and failure code, if operating the switch (Refer to Item No. 12)
- Relation between User Code and Action Directed to Operator



User Code	Failed System	Action Directed to Operator
E02	PC-EPC Valve	Ordinary work may be resumed by turning the emergency pump drive switch ON, but call for the inspection service immediately.
E03	Swing Brake	Release the brake after turning emergency swing and parking brake switch ON. When applying the swing brake, operate the swing lock switch manually. The swing brake may not be released depending on the nature of the trouble. In either case, call for the inspection service immediately.
E05	Governor	The governor control has become inoperable. Operate the governor control lever manually. For fixing the lever at full throttle position, use a fixing bolt provided at the bracket. In this case, call for the inspection service immediately.
E20	Travel	Emergency travel

14. Function for showing service code No. and failure code No.

If the following switching operation is made while the users' code No. is shown, a phone symbol (if registered), phone numbers (if registered), service code No. and failure code No. are shown in turn.

- Switching operation: ☑ (keep the switch depressed)
- The following display is repeated in turn, while the switch is depressed.

① Telephone symbol mark

⇩

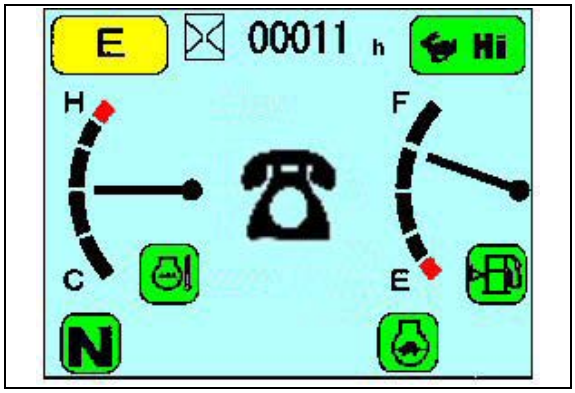
② Telephone No.

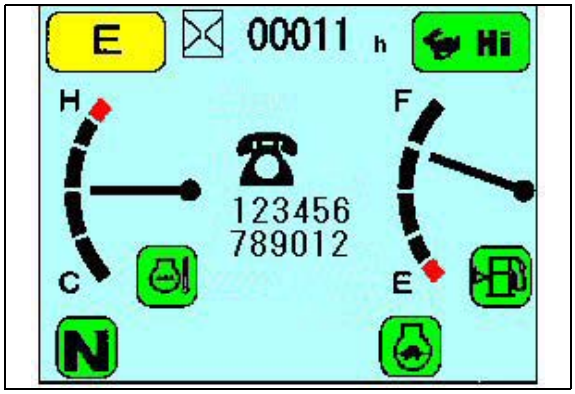
⇩

③ Service code N^{o}. and failure code N^{o}.

The telephone symbol mark and telephone No. are shown only when they are registered in the monitor panel.
For registration, correction and deletion of telephone No., use Service Menu.

- For details on the displayed service code No. and failure code No., refer to the Table for Failure Code Nos.





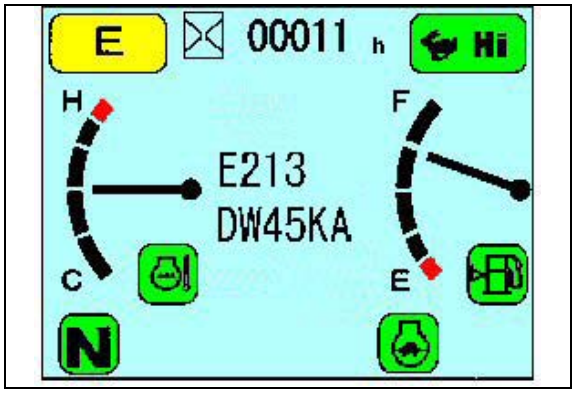


TABLE FOR FAILURE CODE NO.

User code	Failure code	Trouble (Displayed on screen)	Alarm buzzer	Component in charge	Category of record
	989L00	Engine Controller Lock Caution 1		MON	Electrical system
	989M00	Engine Controller Lock Caution 2		MON	Electrical system
E20	**989N00**	Engine Controller Lock Caution 3		MON	Electrical system
	6B2JMA	Travel Hydraulic Abnormality		PUMP	Electrical system
	AA10NX	Air Cleaner Clogging		MON	Mechanical system
	AB00KE	Charge Voltage Low		MON	Mechanical system
	B@BAZG	Eng Oil Press. Low	▲	ENG	Mechanical system
	B@BAZK	Eng Oil Level Low		MON	Mechanical system
	B@BCNS	Eng Water Overheat	▲	ENG	Mechanical system
	B@BCZK	Eng Water Level Low	▲	MON	Mechanical system
	B@HANS	Hydr Oil Overheat	▲	PUMP	Mechanical system
E10	**CA111**	EMC Critical Internal Failure	●	ENG	Electrical system
E10	**CA115**	Eng Ne and Bkup Speed Sens Error	●	ENG	Electrical system
E11	**CA122**	Chg Air Press Sensor High Error	●	ENG	Electrical system
E11	**CA123**	Chg Air Press Sensor Low Error	●	ENG	Electrical system
E14	**CA131**	Throttle Sensor High Error	●	ENG	Electrical system
E14	**CA132**	Throttle Sensor Low Error	●	ENG	Electrical system
	CA143	Oil, Pressure, Fueling Error	●	ENG	Electrical system
E15	**CA144**	Coolant Temp Sens High Error	●	ENG	Electrical system
E15	**CA145**	Coolant Temp Sens Low Error	●	ENG	Electrical system
	CA146	Coolant, Temp, Fueling Error	●	ENG	Electrical system
E15	**CA153**	Chg Air Temp Sensor High Error	●	ENG	Electrical system
E15	**CA154**	Chg Air Temp Sensor Low Error	●	ENG	Electrical system
E11	**CA155**	Chg Air Temp High Speed Derate	●	ENG	Electrical system
E15	**CA187**	Sens Supply 2 Volt Low Error	●	ENG	Electrical system
E15	**CA221**	Ambient Press Sens High Error	●	ENG	Electrical system
E15	**CA222**	Ambient Press Sens Low Error	●	ENG	Electrical system
E15	**CA227**	Sens Supply 2 Volt High Error	●	ENG	Electrical system
	CA234	Eng Overspeed	●	ENG	Mechanical system
E15	**CA238**	Ne Speed Sens Supply Volt Error	●	ENG	Electrical system
E11	**CA271**	IMV/PCV1 Short Error	●	ENG	Electrical system
E11	**CA272**	IMV/PCV1 Open Error	●	ENG	Electrical system
E11	**CA322**	Inj #1 (L#1) Open/Short Error	●	ENG	Electrical system
E11	**CA323**	Inj #5 (L#5) Open/Short Error	●	ENG	Electrical system
E11	**CA324**	Inj #3 (L#3) Open/Short Error	●	ENG	Electrical system
E11	**CA325**	Inj #6 (L#6) Open/Short Error	●	ENG	Electrical system
E11	**CA331**	Inj #2 (L#2) Open/Short Error	●	ENG	Electrical system
E11	**CA332**	Inj #4 (L#4) Open/Short Error	●	ENG	Electrical system
E10	**CA342**	Calibration Code Incompatibility	●	ENG	Electrical system
E10	**CA351**	Injectors Drive Circuit Error	●	ENG	Electrical system
E15	**CA352**	Sens Supply 1 Volt Low Error	●	ENG	Electrical system
E15	**CA386**	Sens Supply 1 Volt High Error	●	ENG	Electrical system
	CA415	Oil, pressure, RPM error	●	ENG	Electrical system
E15	**CA428**	Water in Fuel Sensor High Error	●	ENG	Electrical system
E15	**CA429**	Water in Fuel Sensor Low Error	●	ENG	Electrical system
E15	**CA435**	Eng Oil Press Sw Error	●	ENG	Electrical system
E10	**CA441**	Battery Voltage Low Error	●	ENG	Electrical system
E10	**CA442**	Battery Voltage High Error	●	ENG	Electrical system
E11	**CA449**	Rail Press Very High Error	●	ENG	Electrical system
E11	**CA451**	Rail Press Sensor High Error	●	ENG	Electrical system
E11	**CA452**	Rail Press Sensor Low Error	●	ENG	Electrical system
E11	**CA488**	Chg Air Temp High Torque Derate	●	ENG	Electrical system
E15	**CA553**	Rail Press High Error	●	ENG	Electrical system
E11	**CA559**	Rail Pressure Very Low Error	●	ENG	Electrical system

User code	Failure code	Trouble (Displayed on screen)	Alarm buzzer	Component in charge	Category of record
E15	**CA559**	Rail Press Low Error	●	ENG	Electrical system
E15	**CA689**	Eng Ne Speed Sensor Error	●	ENG	Electrical system
E15	**CA697**	ECM Internal Temperature Sensor High Error		PUMP	Electrical system
E15	**CA698**	ECM Internal Temperature Sensor Low Error		PUMP	Electrical system
E15	**CA731**	Eng Bkup Speed Sens Phase Error	●	ENG	Electrical system
E10	**CA757**	All Persistant Data Lost Error	●	ENG	Electrical system
E15	**CA778**	Eng Bkup Speed Sensor Error	●	ENG	Electrical system
E10	**CA1117**	Persistant data lost eror	●	ENG	Electrical system
E0E	**CA1633**	KOMNET Datalink Timeout Error	●	ENG	Electrical system
E14	**CA2185**	Throt Sens Sup Volt High Error	●	ENG	Electrical system
E14	**CA2186**	Throt Sens Sup Volt Low Error	●	ENG	Electrical system
E11	**CA2249**	Rail Press Very Low Error	●	ENG	Electrical system
E11	**CA2311**	IMV Solenoid Error	●	ENG	Electrical system
E15	**CA2555**	Grid Htr Relay Volt Low Error	●	ENG	Electrical system
E15	**CA2556**	Grid Htr Relay Volt High Error	●	ENG	Electrical system
	D110KB	Battery Relay Short		ENG	Electrical system
E01	**D19JKZ**	Personal Code Relay Abnormality	●	MON2	Electrical system
	D862KA	GPS Antenna Discon		MON2	Electrical system
E02	**DA25KP**	Pressure Sensor Power Abnormality		PUMP	Electrical system
	DA25KQ	Model Selection Abnormality		PUMP	Electrical system
E0E	**DA2RMC**	CAN Discon (Pump Con Detected)	●	PUMP	Electrical system
E0E	**DAFRMC**	CAN Discon (Monitor Detected)	●	MON	Electrical system
E20	**DDC3KZ**	Outrigger Switch Select Abnormality		PUMP	Electrical system
	DDHPAKP	Abnormality in Pump Pressure		PUMP	Electrical system
	DDP4KX	Travel PPC Pressure Switch Abnormality		PUMP	Electrical system
E20	**DDWCKZ**	Direction Switch Abnormality		PUMP	Electrical system
	DGH2KB	Hydr Oil Sensor Short		PUMP	Electrical system
	DH1 OKS	Pressure Sensor Power Abnormality		PUMP	Electrical system
	DHPAMA	Pump Press Sensor Abnormality		PUMP	Electrical system
E20	**DHS5KX**	Travel PPC Sensor Abnormality		PUMP	Electrical system
	DHX1MA	Overload Sensor Abnormality (Analog)		PUMP	Electrical system
E20	**DLT4KA**	Speed Sensor Discon		PUMP	Electrical system
E20	**DW27KA**	Transmission Clutch Solenoid Discon		PUMP	Electrical system
E20	**DW27KB**	Transmission Clutch Solenoid Short		PUMP	Electrical system
E20	**DW44KB**	Travel FR Solenoid Short		PUMP	Electrical system
E20	**DW44KA**	Travel FR Solenoid Discon		PUMP	Electrical system
E03	**DW45KA**	Swing Brake Sol Discon	●	PUMP	Electrical system
E03	**DW45KB**	Swing Brake Sol Short	●	PUMP	Electrical system
E20	**DW4AKA**	Suspesion Lock Solenoid Discon		PUMP	Electrical system
E20	**DW4AKB**	Suspension Lock Solenoid Short		PUMP	Electrical system
	DW4CKA	PPC Lock Solenoid Discon		PUMP	Electrical system
	DW4CKB	PPC Lock Solenoid Short		PUMP	Electrical system
E20	**DW4MKA**	Creep Solenoid Discon		PUMP	Electrical system
E20	**DW4MKB**	Creep Solenoid Short		PUMP	Electrical system
E20	**DW91KA**	Travel N Sol Discon		PUMP	Electrical system
E20	**DW91KB**	Travel N Sol Short		PUMP	Electrical system
	DWA2KA	2		PUMP	Electrical system
	DWA2KB	Service Sol Short		PUMP	Electrical system
	DWK0KA	2-stage Sol Discon		PUMP	Electrical system
	DWK0KB	2-stage Sol Short		PUMP	Electrical system
	DWK2KA	2 Stage Back pressure Solenoid Discon		PUMP	Electrical system
	DWK2KB	2 Stage Back Pressure Solenoid Short		PUMP	Electrical system
E02	**DXA8KA**	PC-EPC Sol Discon	●	PUMP	Electrical system
E02	**DXA8KB**	PC-EPC Sol Short	●	PUMP	Electrical system
	DXE0KA	LS-EPC Sol Discon		PUMP	Electrical system
	DXE0KB	LS-EPC Sol Short		PUMP	Electrical system
	DXE4KA	Service Current EPC Discon		PUMP	Electrical system

User code	Failure code	Trouble (Displayed on screen)	Alarm buzzer	Component in charge	Category of record
	DXE4KB	Service Current EPC Short		PUMP	Electrical system
	DY20KA	Wiper Working Abnormality		PUMP	Electrical system
	DY20MA	Wiper Parking Abnormality		PUMP	Electrical system
	DY2CKB	Washer Drive Short		PUMP	Electrical system
	DY2DKB	Wiper Drive (For) Short		PUMP	Electrical system
	DY2EKB	Wiper Drive (Rev) Short		PUMP	Electrical system

- Entry order of items in table

  The items are entered in the order of their failure codes (incremental order).

- User code

  Attached:If the failure code is detected, the user code, failure code, and telephone No. (if registered) are displayed on the ordinary screen to notify the operator of the abnormality.

  Not attached:Even if the failure code is detected, the machine monitor does not notify the operator of the abnormality.

- Alarm buzzer

  ●:When occurrence of an error is notified to the operator, the buzzer sounds (The operator can stop the buzzer with the alarm buzzer cancel switch).

  ▲:Since the caution monitor is also turned ON, its function sounds the buzzer.

- Component in charge

  MON: The machine monitor is in charge of detection of abnormality.

  ENG: The engine controller is in charge of detection of abnormality.

  PUMP: The pump controller is in charge of detection of abnormality.

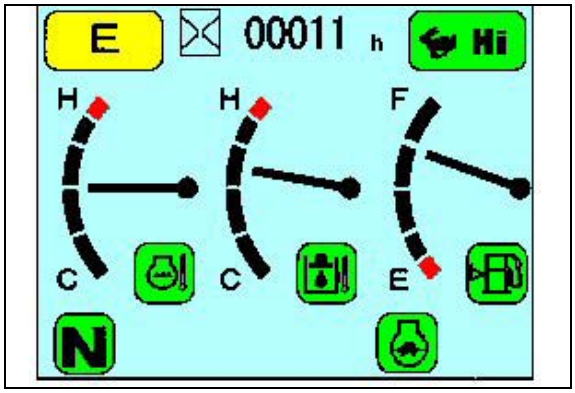
- Category of record

  Mechanical system: Abnormality information is recorded in the mechanical system abnormality record.

  Electrical system: Abnormality information is recorded in the electrical system abnormality record.

OPERATION AND DISPLAY OF SERVICE MENU

Way of switching to Service Menu



- When using Service Menu, change the display to Service Menu display through the following special operation.

1. Confirmation of display

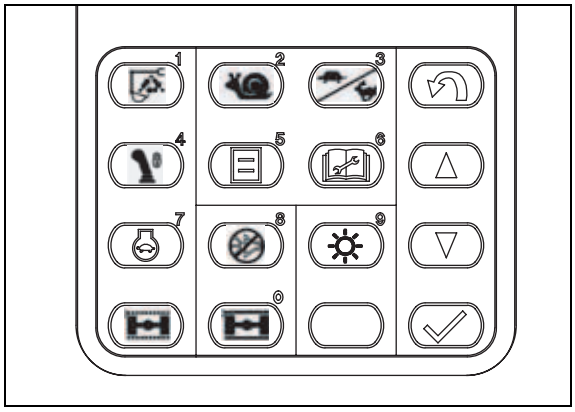
   Confirm that the display of ordinary items is shown (Normally engine stopped).

   - Changing to Service Menu cannot be made from displays other than this.

2. Switch operation

   Operate the switch as instructed below.

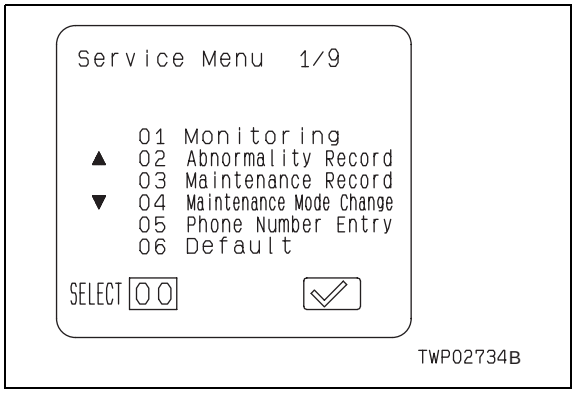
   - Switch operation: [▲] + [1] → [2] → [3]



3. Showing Service Menu display

   The display is changed to the initial display of Service Menu program. Select an appropriate item from among the menu.

No.	Service Menu
01	Monitoring
02	Abnormality Record
03	Maintenance Record
04	Maintenance Mode Change
05	Phone Number Entry
06	Default
07	Adjustment
08	Cylinder Cut - Out
09	No Injection



4. Termination of Service Menu function

   When terminating the initial display or any subsequent display of Service Menu, do that through any one of the following methods.

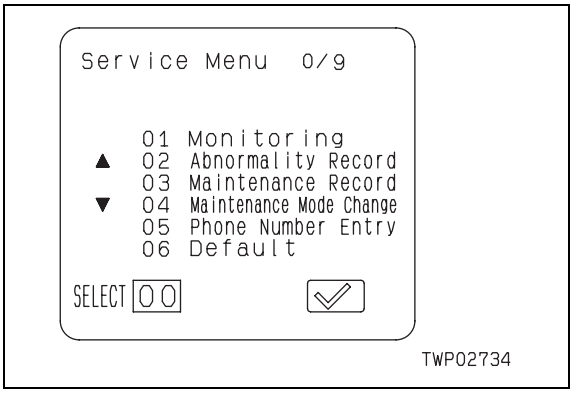
   ①Depress [↶] switch. (This method may be used for terminating any display)

   ②If "Return" switch is shown, depress it.

   ③If "Return" menu is shown, call that menu and depress [✓] switch.

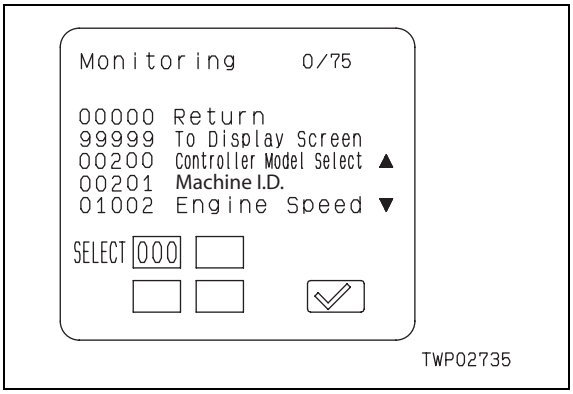
1. Function of Monitoring [01]

The monitor panel monitors signals from an assortment of switches, sensors and actuators installed in various parts of the machine. Monitored information can be put in display or confirmed on a real time basis through the following operations.



1.1. Selection of menu

Select "01 Monitoring" in the initial display of Service Menu and depress [√] switch.



1.2. Setting of monitoring item

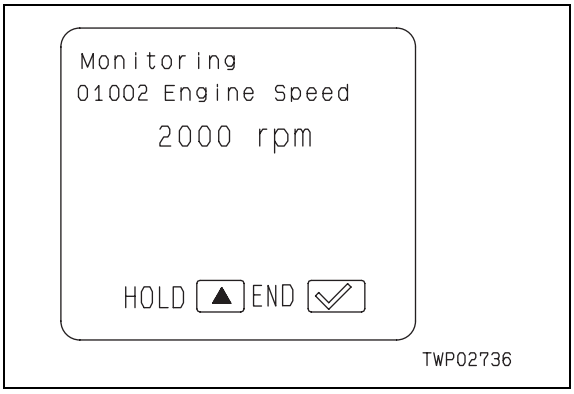
Select or register an item to be monitored through the following switch operation.

- [▲] switch: Selection
- [▼] switch: Selection
- [√] switch: Registration

- A monitoring item can be set in any number between the min. one to the max. four. (Depending upon the selected item, the max. number maybe less than four)
- In case of monitoring 1 to 3 items, move to the monitored information display through any of the following switch operations, after the registration work has been completed.
  - Keep [√] switch depressed. (For about 3 seconds)
  - Select Menu 999 and depress [√] switch.
- The display automatically moves to the display of monitored information, when all of the registrable items have been duly registered.
- Monitored information are transmitted via communication circuits. Thus the number of selected items can impact the communication speed. If truly real time monitoring is required, reduce the selected items to the minimum.
- For details on the monitoring items, display unit, etc., refer to the Table for Monitoring Items.

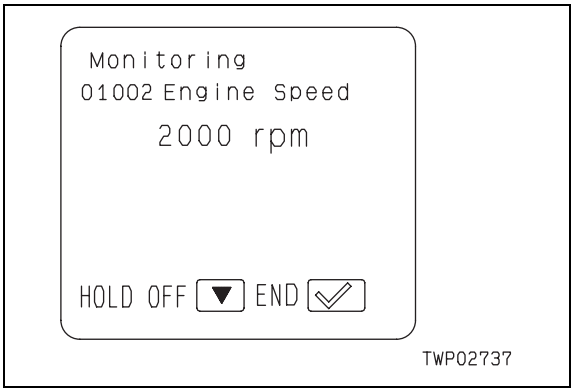
1.3. Monitoring operation

Call the monitoring information display and confirm the monitored information, while operating the machine.



1.4. Monitored information holding function

If [▲] switch is depressed while monitoring, all the monitored information are put on hold. If [▼] switch is depressed in this condition, information holding is released.



1.5. Machine setting mode switching function

If it becomes necessary to change the settings of working mode, select mode, travel speed and auto-decel while in the monitoring display windows, for example engine speed (code 01002), depress switch 1 on the monitor keypad, the mode confirmation display is shown. Then each can be changed as normal.

- An illustration at right shows the display in P mode. Symbol marks are partially different in B mode.
- When a specific setting is confirmed, depress [√] switch, then the display returns to that of monitoring.
- In case a specific setting has been changed while monitoring, the new setting is still maintained when returning from Service Menu to Operator's Menu after the monitoring is finished.

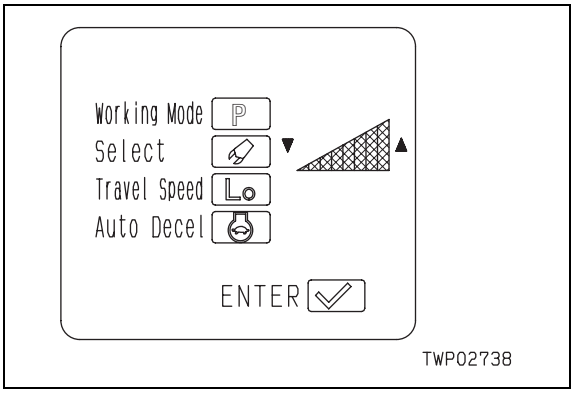


Table for Monitoring Items

Code No.	Monitoring item (Display on screen)	Unit (Initial setting: ISO)			Component in charge	Remarks
		ISO	meter	inch		
00200	Controller Model Select	—			PUMP	
00201	Machine ID	—			ENG	
01002	Engine speed	r/min	rpm	rpm	ENG	
01601	2nd Eng. Speed Command	r/min	rpm	rpm	PUMP	
40011	Travel Speed	KpH	KpH	MpH	MON	
07101	Travel PPC Pressure	MPa	kg/cm^2	psi	PUMP	
01100	Pump Pressure	MPa	kg/cm^2	psi	PUMP	
04107	Coolant Temperature	°C	°C	°F	ENG	
04401	Hydr. Oil Temperature	°C	°C	°F	PUMP	
01300	PC-EPC Sol. Curr.	mA	mA	mA	PUMP	
01500	LS-EPC Sol. Curr.	mA	mA	mA	PUMP	
01700	Service Sol. Curr.	mA	mA	mA	PUMP	
01701	Service Solenoid 2 Curr.	mA	mA	mA	PUMP	
01702	Service Solenoid 3 Curr.	mA	mA	mA	PUMP	
01703	Service Solenoid 4 Curr.	mA	mA	mA	PUMP	
03200	Battery Voltage	V	V	V	PUMP	
03203	Battery Power Supply	V	V	V	ENG	
04300	Battery Charge Vol.	V	V	V	MON	
01006	Engine Speed	rpm	rpm	rpm	PUMP	
36400	Rail Pressure	MPa	kg/cm^2	psi	ENG	
37400	Ambient Pressure	kPa	kg/cm^2	psi	ENG	
18500	Charge Temperature	°C	°C	°F	ENG	
36500	Boost Pressure	kPa	kg/cm^2	psi	ENG	Absolute value indication (including atmospheric pressure)
36700	Engine Torque Ratio	%	%	%	ENG	
18700	Engine Output Torque	Nm	kgm	lbft	ENG	
32902	Angle sensor Deg.	Deg.	Deg.	Deg.	MON	
03000	Fuel Dial Pos Sens Volt	V	V	V	ENG	
04200	Fuel Level Sensor Vol.	V	V	V	MON	
04105	Eng. Water Temp. Vol. Lo	V	V	V	ENG	
04402	Hydr. Temp. Sonser Vol.	V	V	V	PUMP	
37401	Ambient Press Sens Volt	V	V	V	ENG	
18501	Charge Temp Sens Volt	V	V	V	ENG	
36501	Charge Press Sens Volt	V	V	V	ENG	
36401	Rail Pressure Sens Volt	V	V	V	ENG	
17500	Engine Power Mode	—			ENG	
31701	Throttle Position	%	%	%	ENG	
31706	Final Throttle Position	%	%	%	ENG	
18600	Inject Fueling Command	mg/st	mg/st	mg/st	ENG	
36200	Rail Press Command	MPa	kg/cm^2	psi	ENG	
36300	Injection Timing Command	CA	CA	CA	ENG	
37300	Fuel Rate	ℓ/h	ℓ/h	gal/h	ENG	
01602	2nd Eng. Speed Command	%	%	%	PUMP	
13113	Main Pump Absorb Torque	Nm	kgm	lbft	PUMP	
15900	Boom Bottom Pressure	MPa	kg/cm^2	psi	PUMP	

Code No.	Monitoring item (Display on screen)		Unit (Initial setting: ISO)			Component in charge	Remarks
			ISO	meter	inch		
01900	Pressure Switch 1	Swing	ON•OFF			PUMP	
		Boom Lower	ON•OFF			PUMP	
		Boom Raise	ON•OFF			PUMP	
		Arm Curl	ON•OFF			PUMP	
		Arm Dump	ON•OFF			PUMP	
01901	Pressure Switch 2	Bucket Curl	ON•OFF			PUMP	
		Bucket Dump	ON•OFF			PUMP	
		Service	ON•OFF			PUMP	
		Travel Forward	ON•OFF			PUMP	
		Travel Reverse	ON•OFF			PUMP	
02300	Solenoid Valve 1	Travel Junction	ON•OFF			PUMP	
		Swing Brake	ON•OFF			PUMP	
		2-Stage Relief	ON•OFF			PUMP	
		Travel Speed	ON•OFF			PUMP	
02301	Solenoid Valve 2	Suspension Lock	ON•OFF			PUMP	
		PPC Lock	ON•OFF			PUMP	
		2-Stage Back Pressure	ON•OFF			PUMP	
		Travel Neutral	ON•OFF			PUMP	
		Travel Forward/Reverse	ON•OFF			PUMP	
		Boom/Outrigger	ON•OFF			PUMP	
02200	Switch Input 1	Travel Sw. F	ON•OFF			PUMP	
		Travel Sw. R	ON•OFF			PUMP	
		Lever Sw. (P.Max)	ON•OFF			PUMP	
		Swing Release Sw.	ON•OFF			PUMP	
		Swing Brake Sw.	ON•OFF			PUMP	
		Travel Sw. N	ON•OFF			PUMP	
02201	Switch Input 2	Model Select 1	ON•OFF			PUMP	
		Model Select 2	ON•OFF			PUMP	
		Model Select 3	ON•OFF			PUMP	
		Model Select 4	ON•OFF			PUMP	
		Model Select 5	ON•OFF			PUMP	
		Overload Alarm	ON•OFF			PUMP	
02202	Switch Input 3	Key Switch (ACC)	ON•OFF			PUMP	
02203	Switch Input 4	Boom/Outrigger	ON•OFF			PUMP	
		Breaker Sw.	ON•OFF			PUMP	
		Service R Sw.	ON•OFF			PUMP	
		Service L Sw.	ON•OFF			PUMP	
		Safety Lock Sw.	ON•OFF			PUMP	
		Quick Coupler	ON•OFF			PUMP	
02204	Switch Input 5	Parking Brake	ON•OFF			PUMP	
		Brake Pressure Low	ON•OFF			PUMP	
		Travel position	ON•OFF			PUMP	
		Lever Neutral 1	ON•OFF			PUMP	
		Lever Neutral 2	ON•OFF			PUMP	
03700	Controller Output 1	Battery Relay	ON•OFF			MON	
04500	Monitor input 1	Key Switch	ON•OFF			MON	
		Start	ON•OFF			MON	
		Preheat	ON•OFF			MON	
		Light	ON•OFF			MON	
		Rad. Level	ON•OFF			MON	

Code No.	Monitoring item (Display on screen)		Unit (Initial setting: ISO)			Component in charge	Remarks
			ISO	meter	inch		
04501	Monitor Input 2	Air cleaner	ON•OFF			MON	
		Eng. Oil Level	ON•OFF			MON	
		Battery Charge	ON•OFF			MON	
04502	Monitor Input 3	Swing Brake Sw.	ON•OFF			MON	
04503	Monitor Function Switchs	F1	ON•OFF			MON	
		F2	ON•OFF			MON	
		F3	ON•OFF			MON	
		F4	ON•OFF			MON	
		F5	ON•OFF			MON	
		F6	ON•OFF			MON	
04504	Monitor 1st & 2nd Row Switches	SW1	ON•OFF			MON	
		SW2	ON•OFF			MON	
		SW3	ON•OFF			MON	
		SW4	ON•OFF			MON	
		SW5	ON•OFF			MON	
		SW6	ON•OFF			MON	
18800	Water In Fuel		ON•OFF			ENG	WIF: Water In Fuel
20216	ECM Build Version		—			ENG	
20217	ECM CAL Data Ver		—			ENG	
18900	ECM Internal Temp		°C	°C	°F	ENG	
20400	ECM Serial No		—			ENG	
20227	Monitor Ass'y P/N		—			MON	
20402	Monitor Serial No		—			MON	
20200	Monitor Prog. Version		—			MON	
20229	Pump Con. Ass'y P/N		—			PUMP	
20403	Pump Con. Serial No		—			PUMP	
20230	Pump Con. Prog. P/N		—			PUMP	
20212	Pump Con. Prog. Version		—			PUMP	

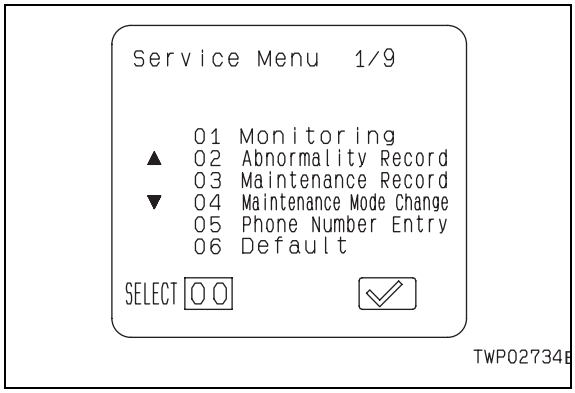
- Select the most favorite display unit from among the prepared three kinds, i.e. ISO, meter and inch. When changing one display unit for another, refer to "Unit" in the initial value setting of Service Menu.
- Abbreviations, ABN and NOR, stand for the following conditions.
  ABN: Abnormal, NOR: Normal

2. Function for Abnormality Record [02]

The monitor panel records failures that occurred on the machines in the past after classifying them into failures in the electric system and those in the mechanical system. Information on them can be displayed through the following operation.

2.1. Selection of menu

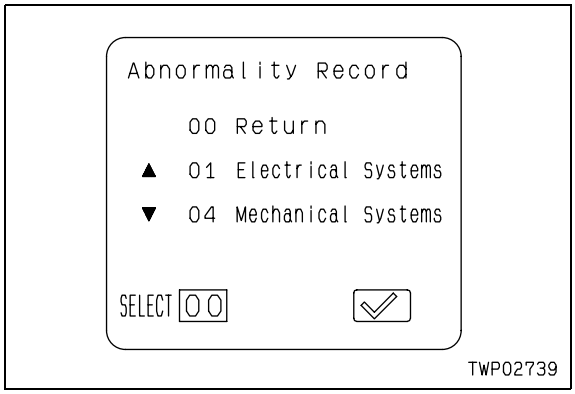
Select 02 Abnormality Record in the initial display of Service Menu and depress [√] switch.



2.2. Selection of Submenu

Select an appropriate item from Submenu in the Abnormality Record display and depress [√] switch.

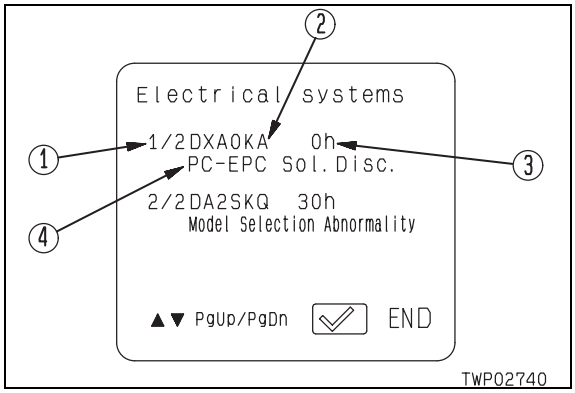
No.	Abnormality Record Submenu
00	Return (termination of Abnormality Record)
01	Electrical System
02	Mechanical Systems



2.3. Information shown in display of Abnormality Record in the electrical system

①:The numerator expresses sequence of failure occurrence, counting from the latest one. The denominator expresses the total number of a specific failure recorded.

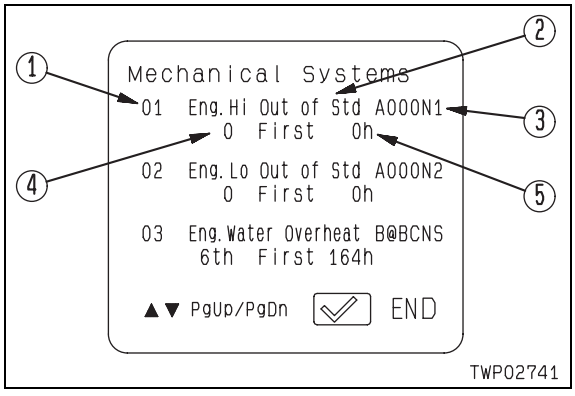
②:Failure Code No. (system in 4 digits and phenomenon in 2 digits)
③:Time elapsed since the occurrence of the first failure
④:Contents of failure



- Refer to see “TABLE FOR FAILURE CODE NO.” on page 20- 168.

2.4. Information shown in display of Failure History in the mechanical systems

①:Record No.
②:Contents of Failure
③:Failure Code No. (system in 4 digits and phenomenon in 2 digits)
④:Total number of occurrence
⑤:Service meter reading at the initial occurrence



- Refer to see “TABLE FOR FAILURE CODE NO.” on page 20- 168.

2.5. Resetting Electrical Systems

- Resetting Electrical Systems (deletion) is possible only with the electrical system. The failure history in the mechanical system cannot be reset.
- For resetting any specific or all information in the Electrical Systems, follow the operation explained below.

A. Through the following switch operation, call the resetting display in the display of Electrical Systems.

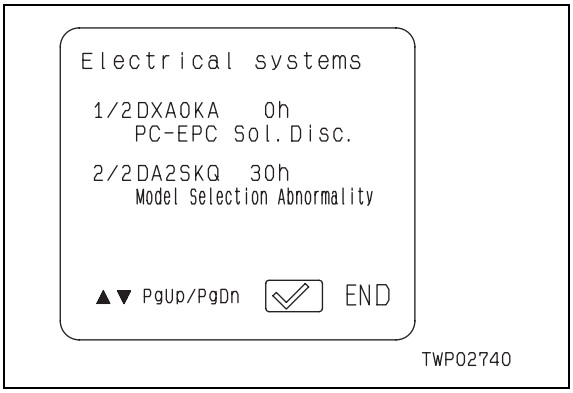
- Switch operation:

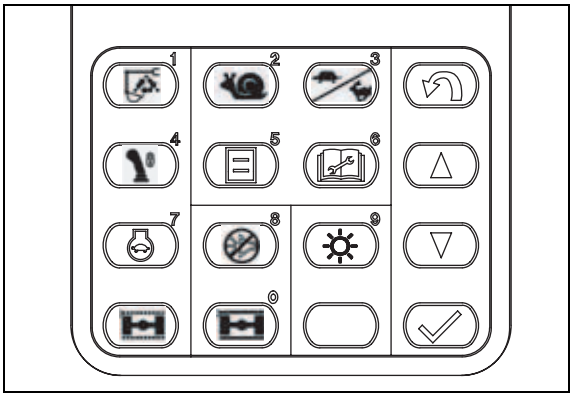
  [▲] +[1] → [2] → [3]

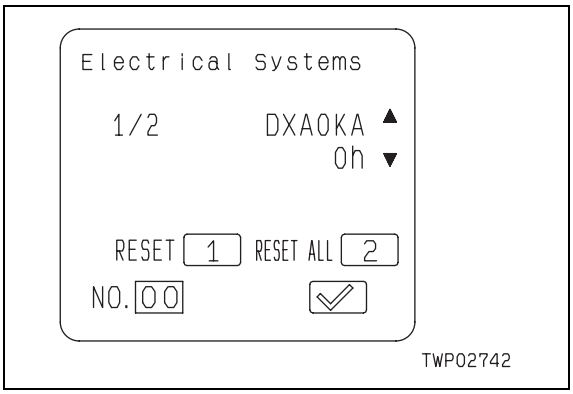
- This is the same switch operation in changing the display to Service Menu.

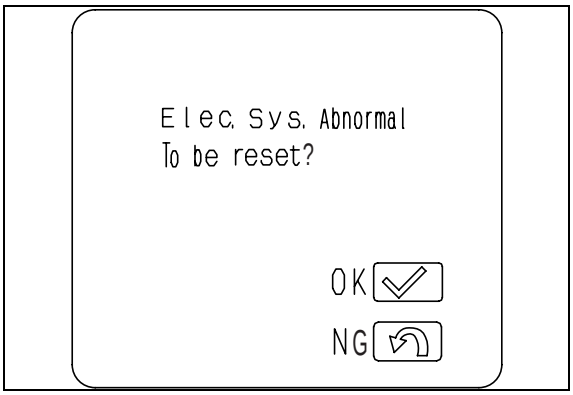
B. Operate the switch, following the instructions shown in the resetting display.

- When resetting specific information only, call the display of that specific information and reset it with either [▲] switch or [▼] switch.
- When resetting all the information, a display will be shown asking you to confirm your choice.



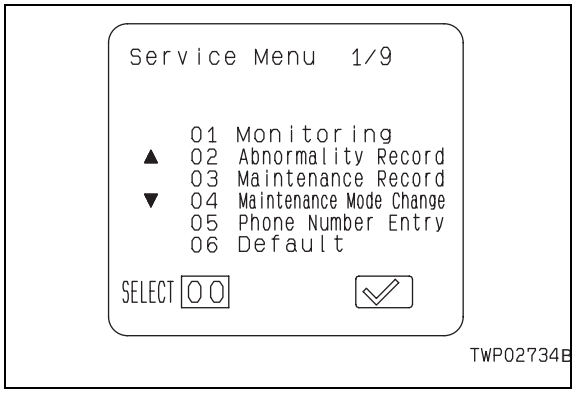






3. Function for Maintenance Record [03]

The monitor panel records information on the maintenance of filters and oils. The stored information can be displayed through the following switch operation.

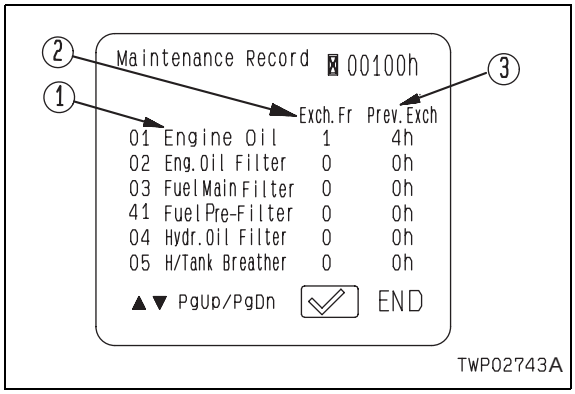


3.1. Selection of menu

Select 03 Maintenance Record in Service Menu and depress [✓] switch.

3.2. Information to be displayed

①:Name of oils and filters
②:Times of replacement to date
③:Service meter reading at the latest replacement



Code	Name Of Oils And Filters
01	Engine Oil
02	Emgime Oil Filter
03	Fuel Main Filter
41	Fuel Pre-Filter
04	Hydraulic Oil Filter
05	Hydraulic Tank Breather
06	Corrosion Ressistor
07	PTO Oil
09	Swing machinery
10	Hydraulic Oil
12	Transmission Oil
15	Axle Oil

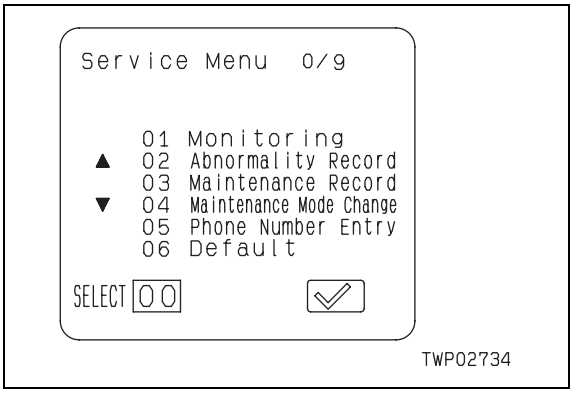
4. Function for Maintenance Mode Change [04]

Conditions set for controlling maintenance display function can be changed in the following manner.

- Turn the function effectual or ineffectual.
- Change the set interval for replacement.

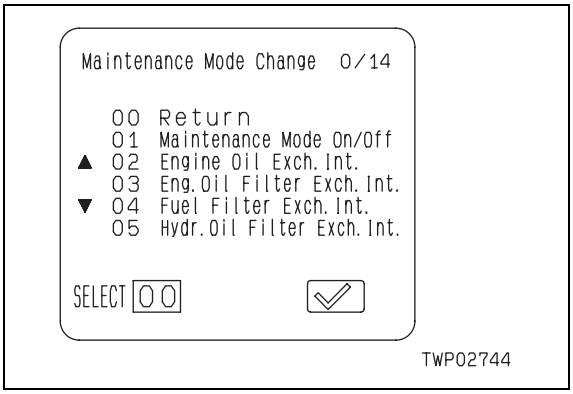
4.1. Selection of menu

Select 04 Maintenance Mode Change in the initial display of Service Menu, and depress [√] switch.



4.2. Selection of item to be changed

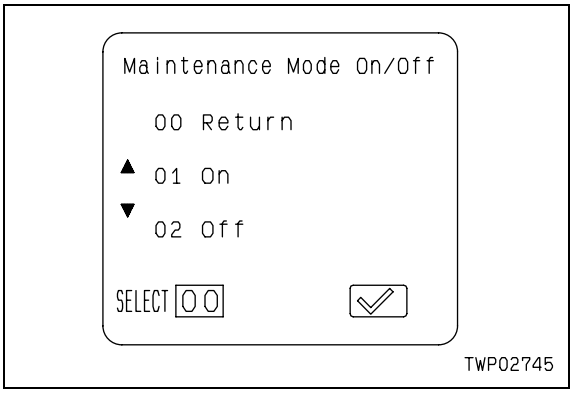
Select an item to be changed in the display of Maintenance Mode Change Selecting Menu.



No.	Maintenance mode change item
00	Return
01	Maintenance Mode On/Off
02	Engine Oil Exch. Int.
03	Engine Oil Filter Exch. Int.
04	Fuel Main Filter Exch. Int.
05	Fuel Pre-Filter Exch. Int.
06	Hydr. Oil Filter Exch. Int.
07	H/Tank Breather Exch. Int.
08	Corro. Resis. Exch. Int.
09	PTO Oil Service Int.
10	S/Machinery Oil Exch. Int.
11	Hydraulic Oil Exch. Int.
12	Transmission Oil Exch. Int.
13	Axle Oil Exch. Int.
14	Use Default Values

- 01 and 14 menus are provided for setting the whole maintenance mode, while those from 02 through 13 are for setting individual items.

4.3. Contents of Maintenance Mode On/Off



- Use: The maintenance display function of all oil and filter-related items are turned effectual. (Irrespective of whether "On" or "Off" set for individual items, this setting prevails)
- Do not use: The maintenance display function of all oil and filter-related items are turned ineffectual. (Irrespective of whether "On" or "Off" set for individual items, this setting prevails)

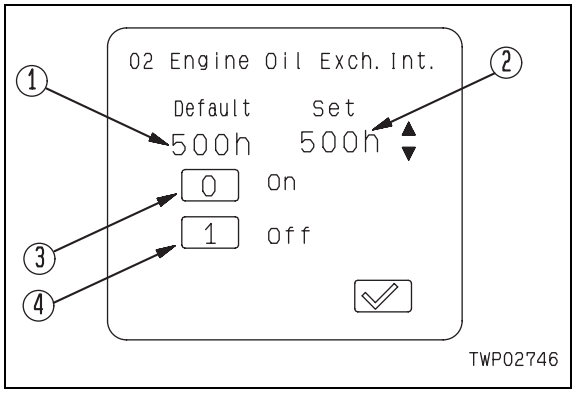
4.4. Set contents of individual items

①:Default: The maintenance time set in the monitor (recommended by the manufacturer and cannot be changed).

②:Set: Maintenance time that can be freely set. The maintenance mode program functions based on this maintenance time. (The maintenance time can be increased or decreased by 50 hours with [▲] or [▼] switch)

③:On: Maintenance display function with this instruction becomes effectual.

④:Off: Maintenance display with this instruction becomes ineffectual.



- The lowest maintenance time is 50 h.

4.5. Set contents of "Use Default Values"

When selecting this menu and depressing the switch [✓], all individual time settings are returned to the factory settings.

5. Function for Phone Number Entry [05]

In the display of User Code, a telephone number and Error Code are shown alternately. Phone number can be input or modified in the following manner.

- If there is no Phone number registered, the display for Phone numbers does not appear.

5.1. Selection of menu

Select 05 Phone Number Entry menu in the display of Service Menu, and depress [√] switch.

5.2. Changing the display

Select Entry next to change the display to the Phone Number Entry display.

- Even if a Phone number is already inputted, it is deleted, upon switching to the Phone Number Entry display.

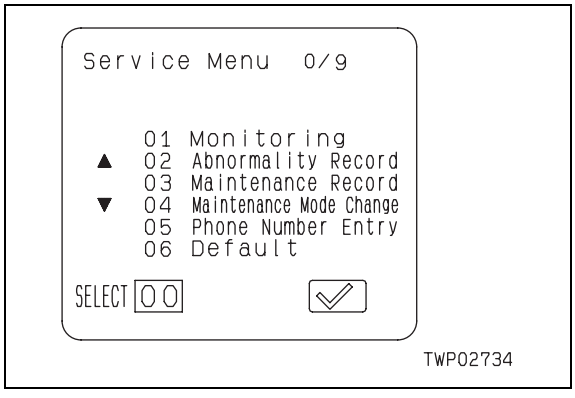
5.3. Entry and setting Phone number

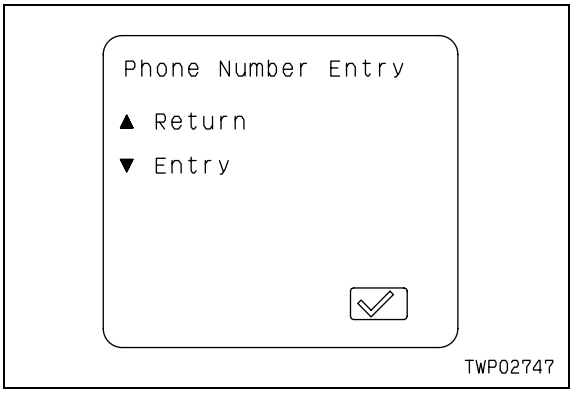
Follow the method explained below, enter a Phone number in the Phone Number Entry display. (Entry automatically begins with a cursor at the left end)

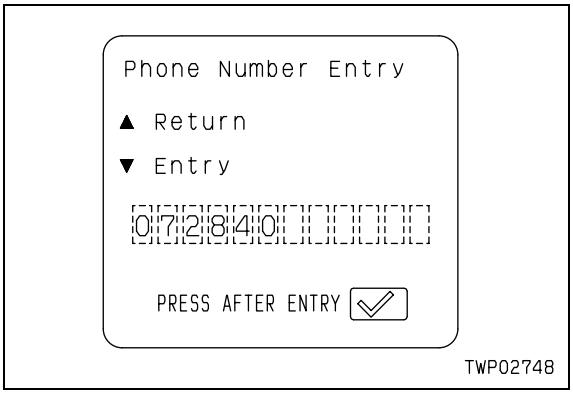
A. Enter a number into a cursor at the left end (using characters 0-9).

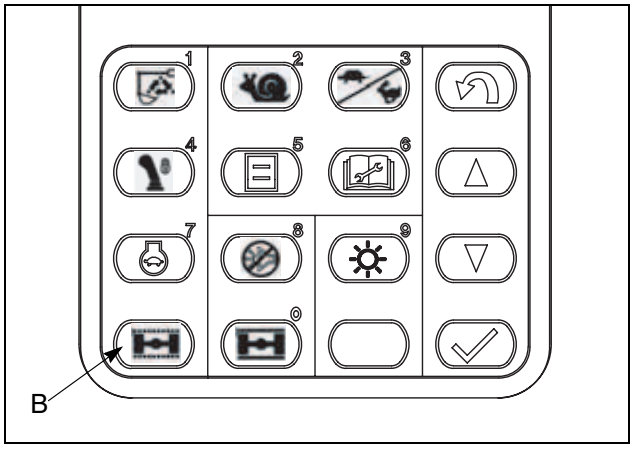
B. Depress [√] switch when all the numbers have been entered.

- Numbers can be entered up to the max. 12 digits, but omit unnecessary digits.
- When entering a wrong number, depress [B] switch, then the cursor goes back by one digit.
- When input is finished, the display changes to Entry display shown above. If the inputted Phone number is shown in this display, the input is connect.









6. Function for Default [06]

It is possible to change the following settings for the monitor panel as well as the machine. Make changes as required.

- Working mode when the engine starting switch is in the ON position.
- Display unit in the monitoring function
- With/Without Service Circuit.

6.1. Selection of menu

Select 06 "Default menu" in the initial display of Service Menu, and depress [√] switch.

6.2. Selection of submenu

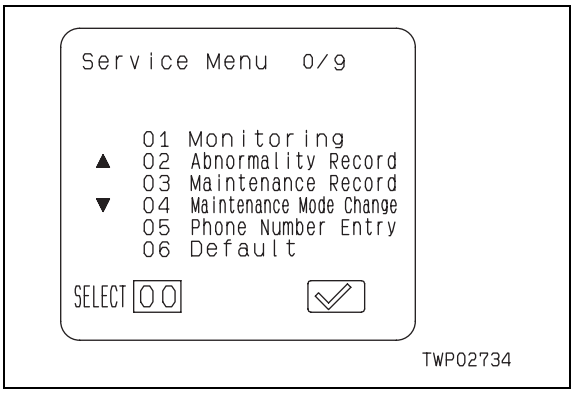
Select an item to change from the submenu, and depress [√] switch.

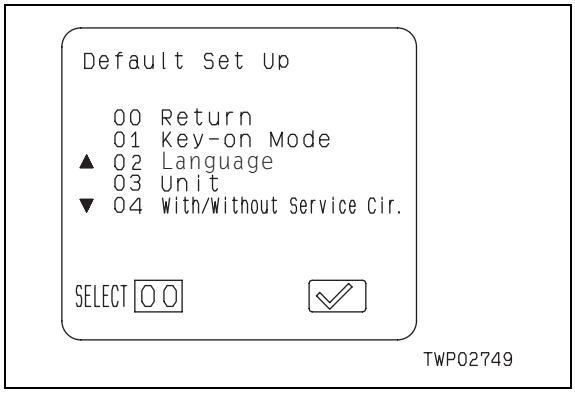
No.	Default submenu
00	Return (Termination of Default)
01	Key-on Mode
02	Language
03	Unit
04	With/Without Service Circuit

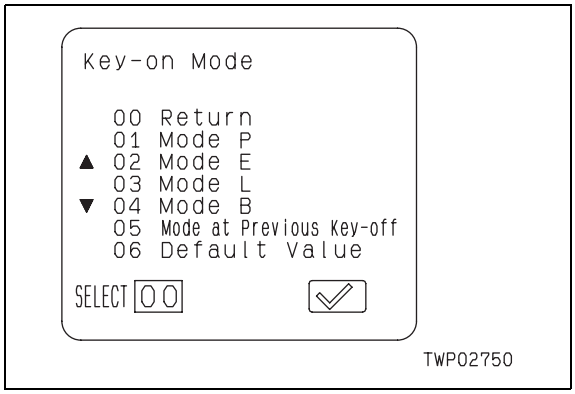
6.3. Function for Key-on Mode

When the engine starting switch is turned ON, a working mode can be set that is shown in the monitor panel.

- P, E, L and B Modes: If any of them is set, the machine always starts up with that working mode, when turning the engine starting switch ON.
- Mode at Previous Key-off: If this mode is set, the machine starts up with the same working mode as when the machine was last used.
- Default Value: If this mode is set, the machine starts up with the mode (P mode) set at the original factory setting.
- Irrespective of this setting mode, a machine "With service circuit" always starts up with B mode, when the engine starting switch is turned ON at the subsequent operation, if that was the working mode used in the last machine work.



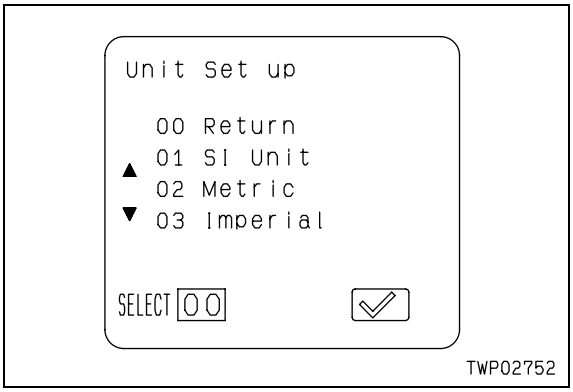




6.4. Function for unit selection

As the unit to be used in the monitoring function display of Service Menu, three kinds of unit are provided.

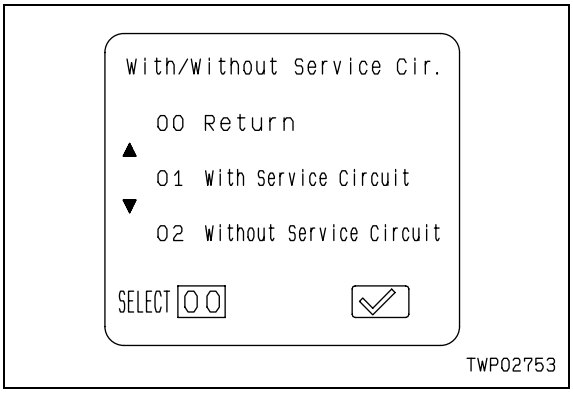
- Unit used for default setting in the monitor panel is SI, i.e. International System of Units.



6.5. Function for selecting distinction of With/Without Service Circuit.

It is possible in this function to set a distinction between with or without service circuit.

- With Service Circuit: When an attachment is installed.
- Without Service Circuit: When no attachment is installed.
- If "With Service Circuit" setting is not made in this display, when it is actually installed on a specific machine, the SELECT function in Operator's Mode (attachment oil flow rate adjustment) cannot be used.

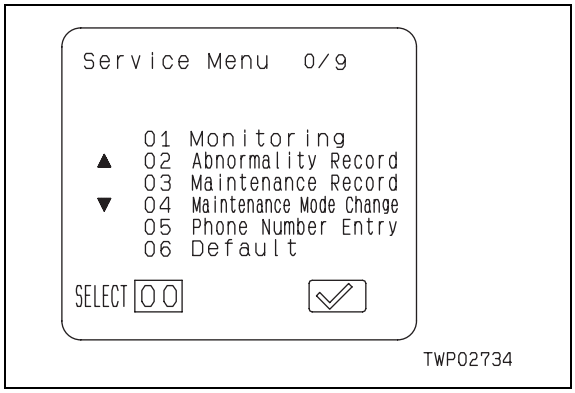


7. Function for Adjustment [07]

The monitor panel has a function of making various adjustments of the machine.

7.1. Selection of menu

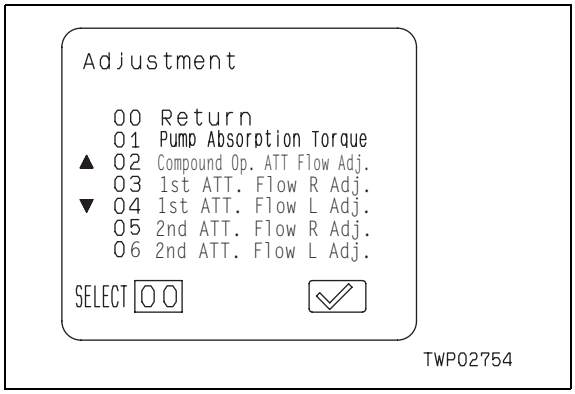
Select 07 adjustment in the initial display of Service Menu, and depress [√] switch.



7.2. Selection of submenu

Select an item to change from the submenu and depress [√] switch.

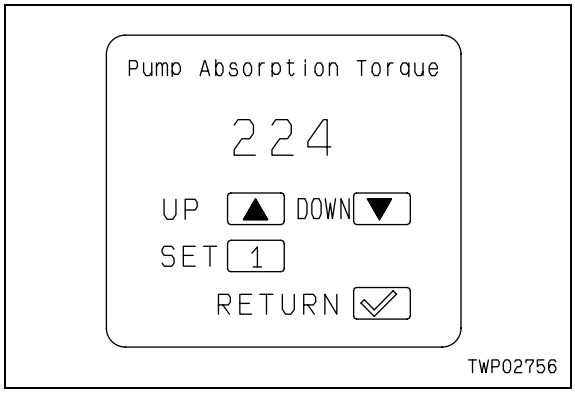
No.	Adjustment submenu
00	Return (termination of adjustment)
01	Pump Absorbtion Torque
02	Compound Op. ATT. Flow Adj.
03	1st ATT. Flow R Adj.
04	1st ATT. Flow L Adj.
05	2nd ATT. Flow R Adj.
06	2nd ATT. Flow L Adj.



7.3. Function for Pump Absorption Torque adjustment.

The pump absorption torque can be adjusted within the range shown in the table below.

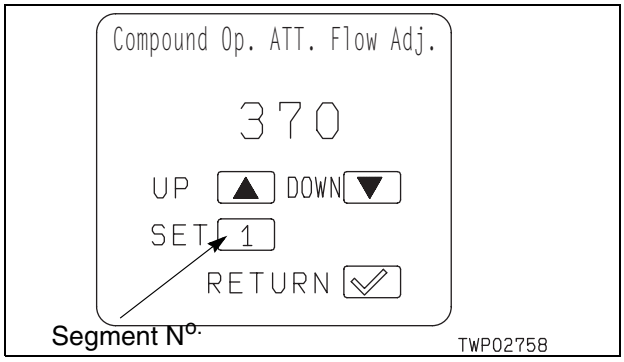
Adjustment value	Torque adjustment value
220	+4.0 kgm
221	+3.0 kgm
222	+2.0 kgm
223	+1.0 kgm
224	0.0 kgm
225	–1.0 kgm
226	–2.0 kgm
227	–3.0 kgm
228	–4.0 kgm

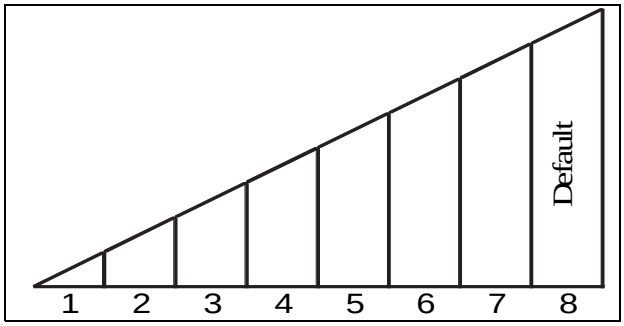


7.4. Function for ATT. Flow Adjust.

When a machine is used for a compound operation i.e Boom raise and service attachment is altered. Distribution of hydraulic pump oil flow can be adjusted within the range shown in the table below.

Adjustment value	Distribution of oil flow to attachment
370	0.5 x normal flow
371	0.7 x normal flow
372	1.0 x normal flow
373	0.4 x normal flow





Adjustment value 370 (Heavy ATT)

Segment	Oil flow (L/min)	EPC current (mA)
1	30	485
2	35	495
3	40	504
4	50	532
5	60	540
6	80	582
7	100	615
8 (Default)	115	644

Adjustment value 371 (Medium ATT

Segment	Oil flow (L/min)	EPC current (mA)
1	30	485
2	39	504
3	56	533
4	70	558
5	84	585
6	112	638
7	140	688
8 (Default)	160	722

Adjustment value 372 (Light ATT)

Segment	Oil flow (L/min)	EPC current (mA)
1	30	485
2	55	535
3	80	582
4	100	615
5	120	651
6	160	722
7	200	780
8 (Default)	230	900

Adjustment value 373 (Super heavy ATT)

Segment	Oil flow (L/min)	EPC current (mA)
1	30	485
2	30	485
3	35	495
4	40	504
5	48	428
6	64	548
7	80	582
8 (Default)	92	600

8. Function of cylinder cut out mode operation [08]

Operator can operate the machine in the cylinder cut out mode with the monitor panel.
Cylinder cut out mode operation means to run the engine with 1 or more fuel injectors disabled electrically to rduce the number of effective cylinders. This operation is used to find out a cylinder which does not output power normally (or, combustion in it is abnormal).

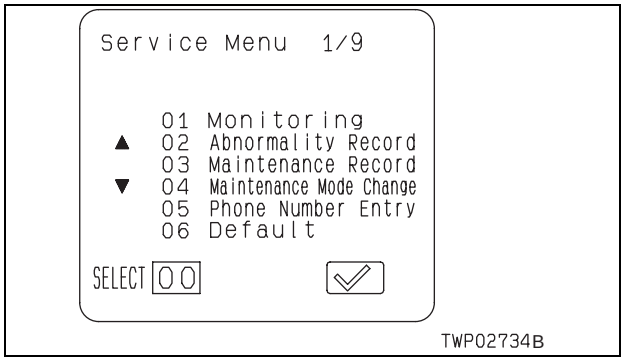
8.1. Selecting menu.
On the initial screen of the service menu, select "09 cylinder cut out mode operation" and press the [✓] switch.

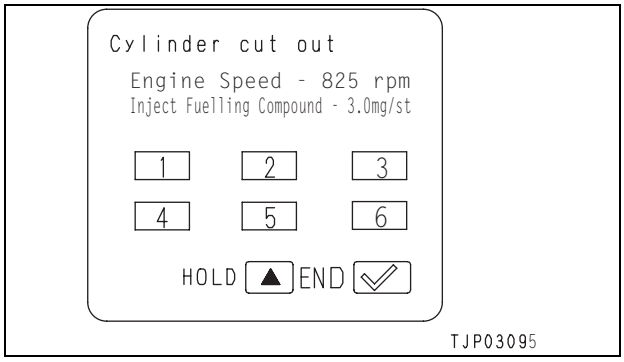
8.2. Setting cylinders to be disabled.
Press switches [1] - [6] on the monitor panel corresponding to the cylinder No. to be disabled.

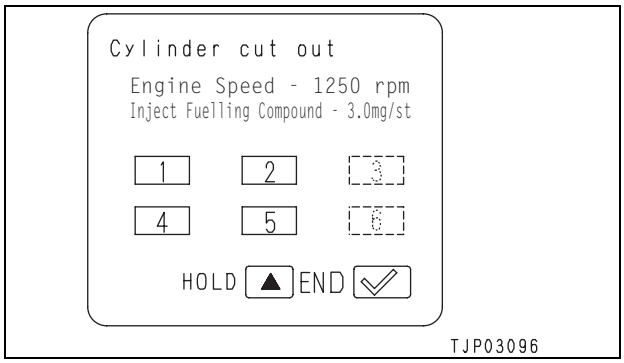
- After a switch is pressed, if the cylinder No. corresponding to it on the monitor panel is displayed in a white frame, the cylinder iss disabled (If setting is wrong, press the same switch again).
- Only one or more cylinders can be disabled for the reduced cylinder mode operation.

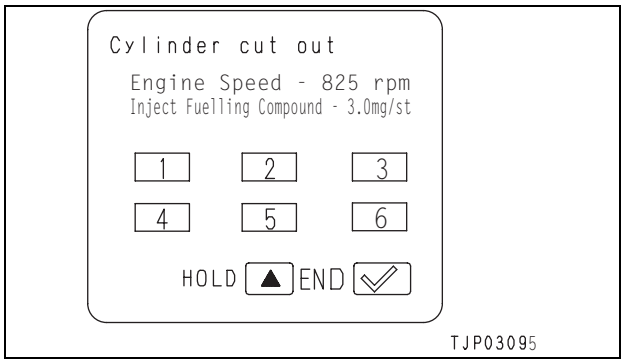
8.3. Cancelation of disabled cylinders.
Press switches [1] - [6] on the monitor panel corresponding to the disabled cylinder No. to cancel disabling of those cylinders.

- After a switch is pressed, if the cylinder No. corresponding to it on the monitor panel is displayed black in a black frame, disabling of the cylinder is cancelled







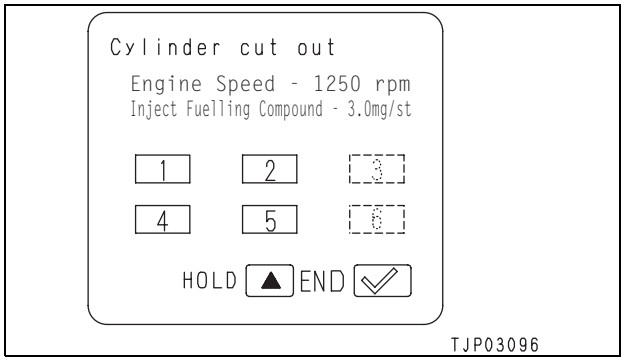


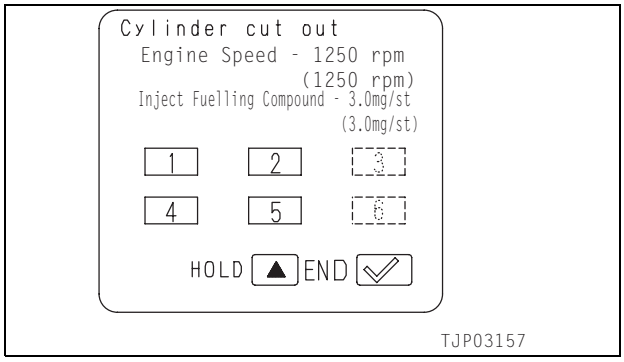
8.4. Function of holding engine speed.

If the [▲] switch is pressed while the reduced cylinder mode operation screen is used, the engine speed is held and displayed on the lower line.

If the [▼] switch is pressed while the engine speed is held, holding the engine speed is cancelled and the engine speed displayed on the lower line goes off.

- If the holding function is used, the held engine speed is displayed in () on the lower line and the current engine speed is displayed on the upper line.
- The holding function can be used both in and out of the cylinder cut out made.





REMARK

How to use holding function effectively.

The engine speed displayed by the holding function is held on the screen until the holding function is cancelled, regardless of setting and canaellation of the cylinder cut out mode. Accodingly, a defedtive cylinder can be found out effectively according to the following procedure.

8.4.1 Run the engine normally (without disabling any cylinder) and hold the engine speed.

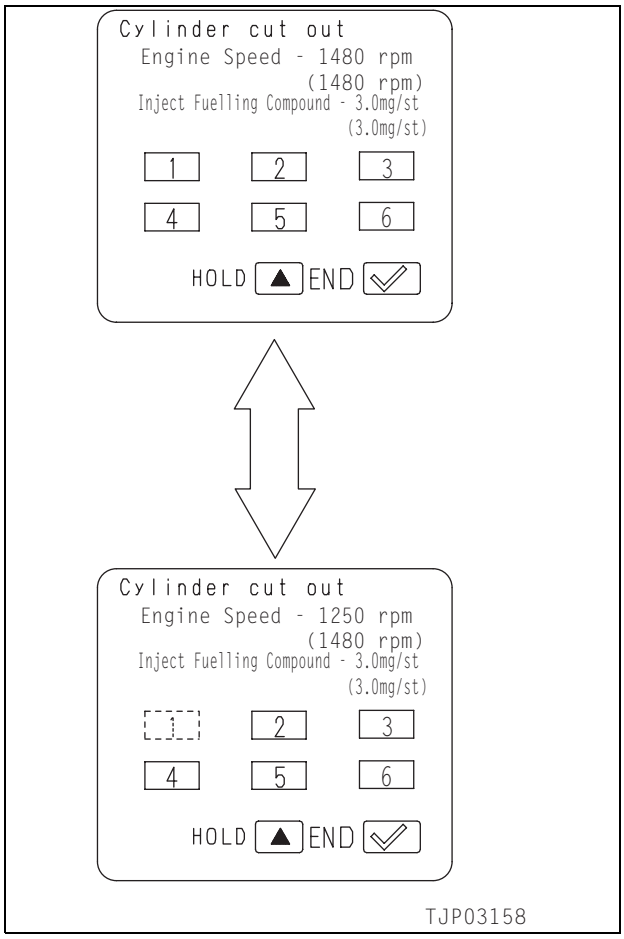
8.4.2 Disable a cylinder to be checked.

8.4.3 Run the engine under the same condition as normal operation in step (1) and compare the engine speed at this time with the held egine speed.

8.4.4 Cancel the cylinder cut out mode, regardless of the change of the engine speed.

8.4.5 Repeat steps (2) - (4) to check the other cylinders

- If the engine speed does not lower at all or lowers less when the cylinder is selected for the cylinder cut out mode operation, combustion in that cylinder must be abnormal.

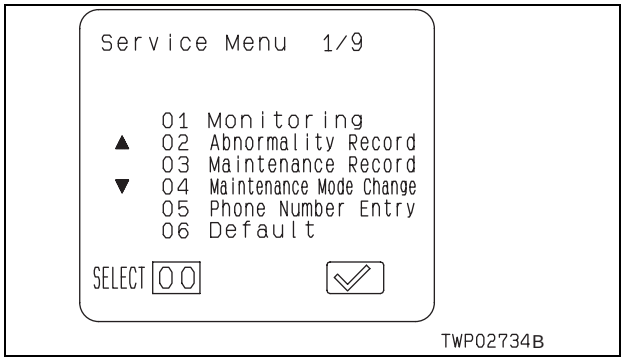


9. Function of no injection cranking [09]

No injection cranking denotes stopping injection of fuel from the injector even if the engine is run from the starting motor. This mode is used, for instance, for measurement of compressive pressure.

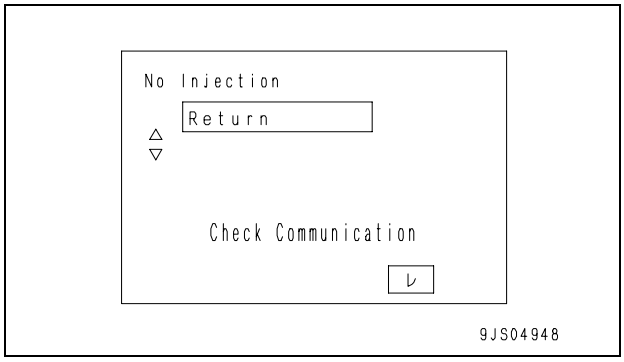
- This setting must be done after stopping the engine.

9.1. Selecting menu
Select “09 No Injection Cranking” from the service menu initial screen and press [✓] switch.

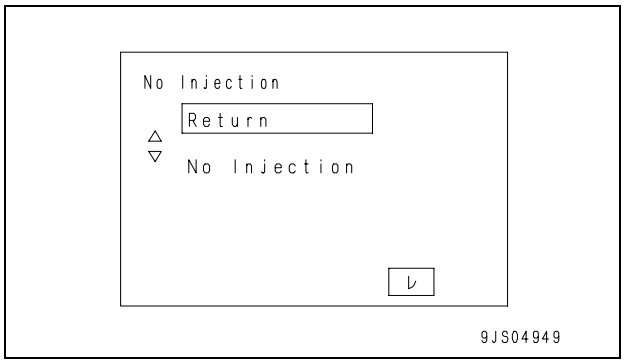


9.2. The initial screen for the no injection cranking will appear.

- “Check Communication” will be displayed in red.

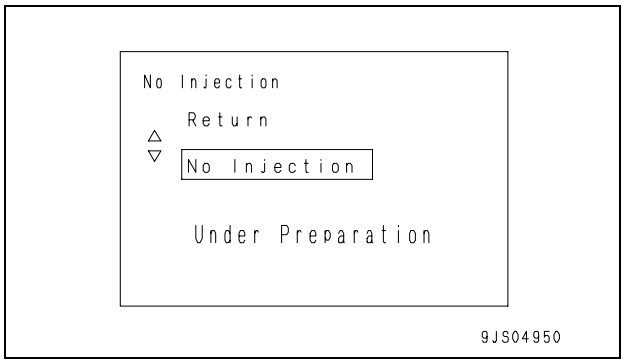


9.3. As the checkup is over, following screen appears.



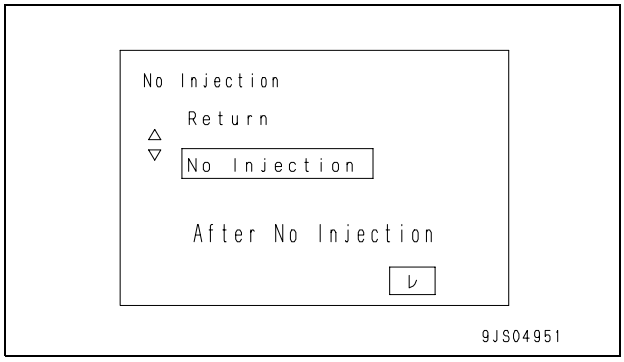
9.4. Select “No Injection” and press [✓] switch.
“Under Preparation” will be displayed on the screen.

- The letters “Under Preparation” are displayed in red.



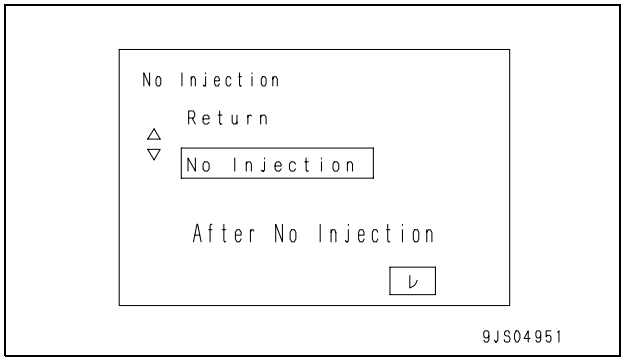
9.5. As the preparation for no injection cranking is completed, display of “Under Preparation” is replaced with “After No Injection”.

- The letters “After No Injection” are displayed in green.



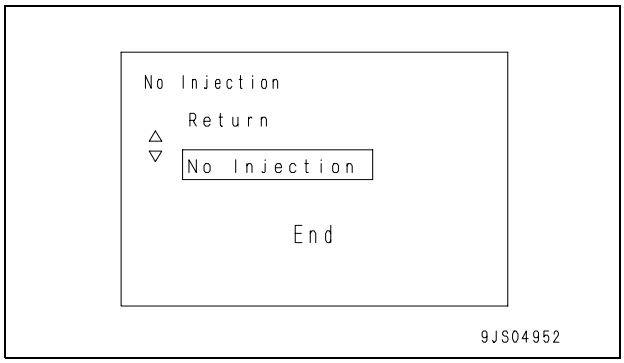
9.6. From this state, crank the engine using the starting motor.

- Limit the cranking time to 20 seconds to protect the starting motor.



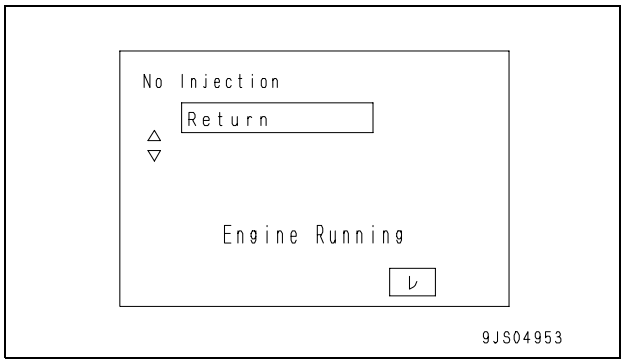
9.7. After the no injection cranking is over, press [✓] switch from the previous screen and the letters “End” will be displayed for 3 seconds.

- The letters “End” are displayed in green.



9.8. Press “Return” when ending the no injection cranking.

- If the no injection cranking function is inadvertently selected while the engine is running, “Engine Running” will appear as No Injection in step 4) is selected. This “Engine Running” display remains on the screen even after the engine is stopped. Restoring the service menu screen alone deletes the display.



PREPARATIONS FOR TROUBLESHOOTING ELECTRICAL SYSTEM

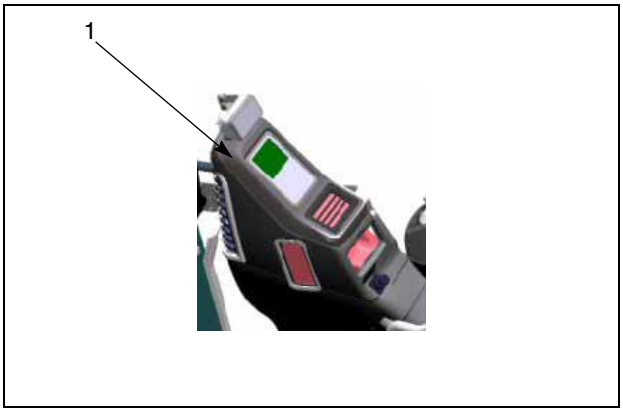
- When diagnosing electric circuits related to the monitor panel and governor pump controller, first open up the connector portions in the following manner.

1. Monitor panel

1.1. Take off cover (1).

- The cover is fixed with one upper and lower clip. Pull it up for the removal.

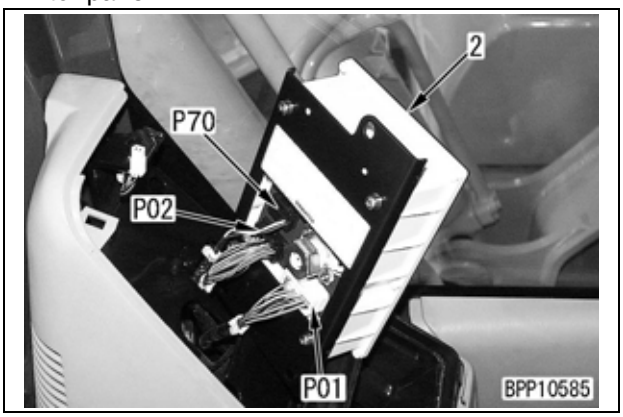
.



1.2. Remove the 3 mounting screws and disconnect monitor panel (2) from the mount.

- Take care not to drop the mounting screws in the console.

1.3. Insert or connect a T-adaptors for troubleshooting to connectors **P01**, **P02** and **P70** of the monitor panel.



1. Governor pump controller

- The governor pump controller is installed inside the cover behind the operator's seat.

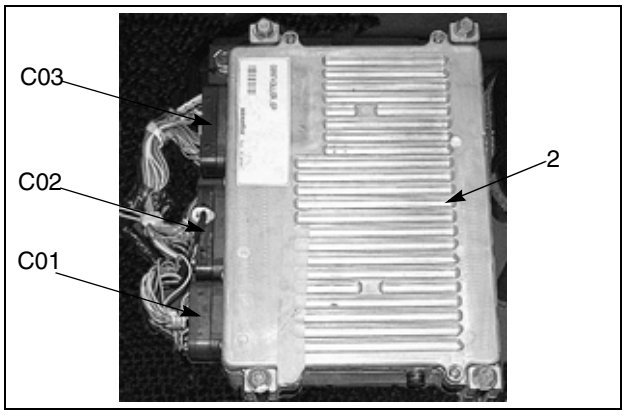
1.1. Take off cover (1).



1.2. Insert or connect a T-adapter for diagnosis with **C01**, **C02** and **C03** connectors of governor pump controller (2).

- The connectors are fixed with screws. Loosen the screws and detach the connectors.
- When putting the connectors back into position, tighten them to the specified torque.

N·m Screw: **2.82Nm {0.288 kgm}**



TROUBLESHOOTING

POINTS TO REMEMBER WHEN TROUBLESHOOTING 20-202
SEQUENCE OF EVENTS IN TROUBLESHOOTING 20-203
POINTS TO REMEMBER WHEN CARRYING OUT MAINTENANCE 20-204
CHECKS BEFORE TROUBLESHOOTING 20-213
CLASSIFICATION AND STEPS FOR TROUBLESHOOTING 20-214
CONNECTOR LOCATION CHART AND ELECTRICAL CIRCUIT DIAGRAM BY SYSTEM 20-221
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS 20-250
TROUBLESHOOTING WHEN SERVICE CODE "ELECTRICAL SYSTEM" AND FAILURE CODE "MECHANICAL SYSTEM" ARE INDICATED 20-304
TROUBLESHOOTING OF ELECTRICAL SYSTEM (E-MODE) 20-502
TROUBLESHOOTING OF ELECTRICAL SYSTEM (ERROR CHECKING OF ITEMS WITHOUT MONITOR CODES) 20-602
TROUBLESHOOTING OF HYDRAULIC AND MECHANICAL SYSTEM (H-MODE) 20-703

POINTS TO REMEMBER WHEN TROUBLESHOOTING

⚠ CAUTION

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,
Be extremely careful not to touch any hot parts or to get caught in any rotating parts.
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

2.1. Have any other problems occurred apart from the problem that has been reported?

2.2. Was there anything strange about the machine before the failure occurred?

2.3. Did the failure occur suddenly, or were there problems with the machine condition before this?

2.4. Under what conditions did the failure occur?

2.5. Had any repairs been carried out before the failure?

2.6. When were these repairs carried out?

2.7. Has the same kind of failure occurred before?

3. Check before troubleshooting

3.1. Check the oil level

3.2. Check for any external leakage of oil from the piping or hydraulic equipment.

3.3. Check the travel of the control levers.

3.4. Check the stroke of the control valve spool.

3.5. 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 re-enact 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.

5.1. Start from the simple points.

5.2. Start from the most likely points.

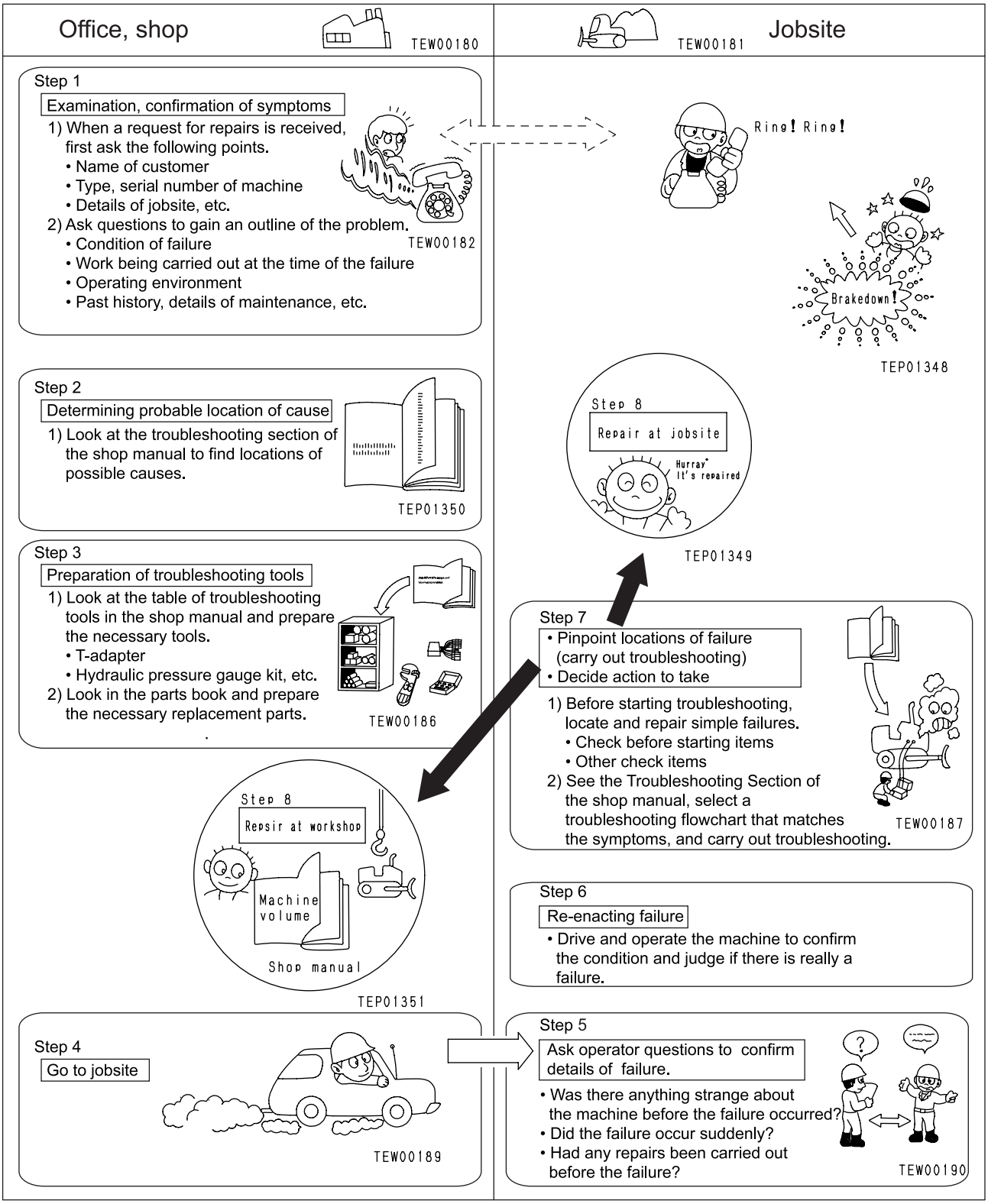
5.3. Investigate other related parts or information.

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.

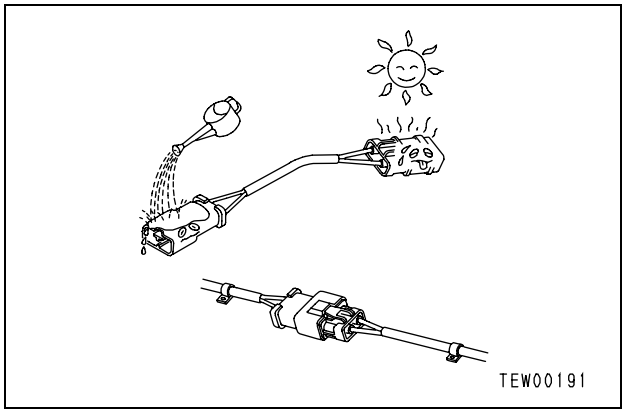
  To prevent this, always investigate why the problem occurred. Then, remove the root cause.

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).



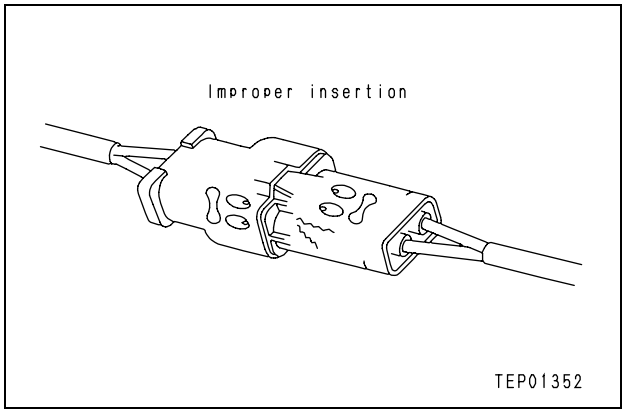
1. Points to remember when handling electric equipment

1.1. Handling wiring harnesses and connectors

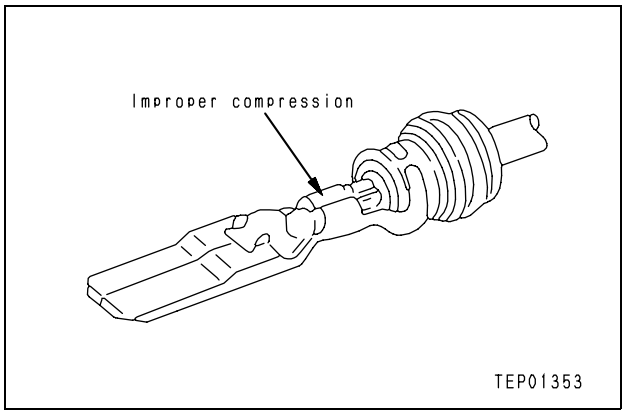
Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protectors or tubes used for protecting the wiring.
Compared with other electrical components fitted in boxes or cases, wiring harnesses are 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

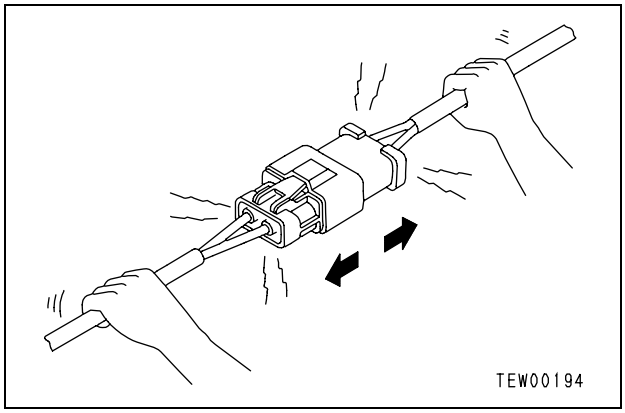
A. Defective contact of connectors (defective contact between male and female)
Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned,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



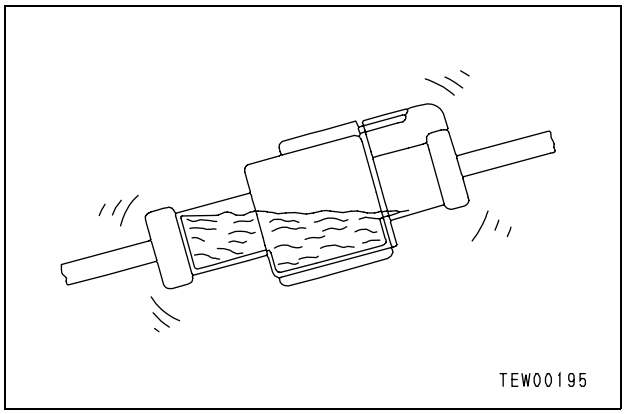
B. Defective crimping or soldering of connectors
The pins of the male and female connectors are in contact at the crimped terminal or soldered portion, but if there is excessive force brought to bear on the wiring, the plating at the joint will peel and cause improper connection or breakage.



C. 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.

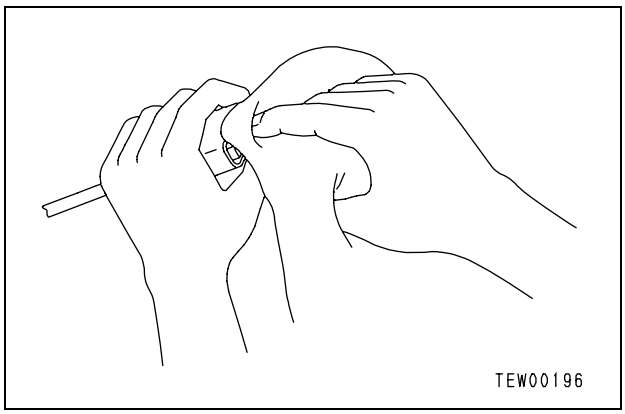


D. High-pressure water entering connector.
The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector, depending on the direction of the water jet.
As already said, the connector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



E. 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.

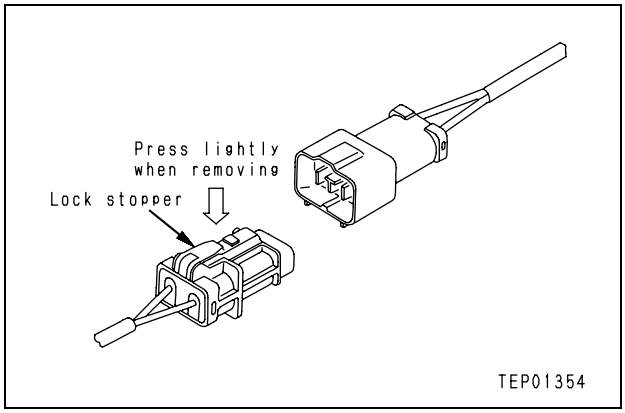


1.2. Removing, installing, and drying connectors and wiring harnesses

- Disconnecting connectors

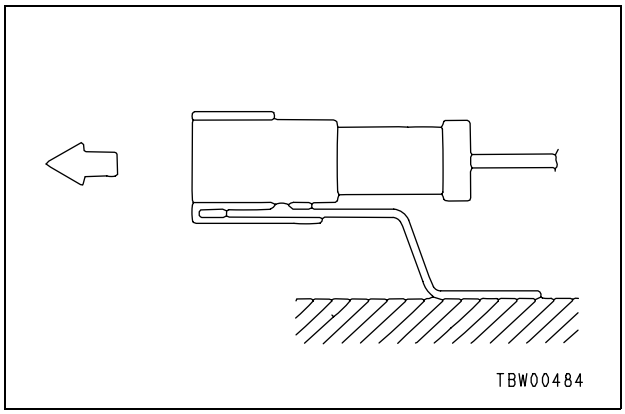
A. Hold the connectors when disconnecting.
When disconnecting the connectors, hold the connectors and not the wires. For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper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

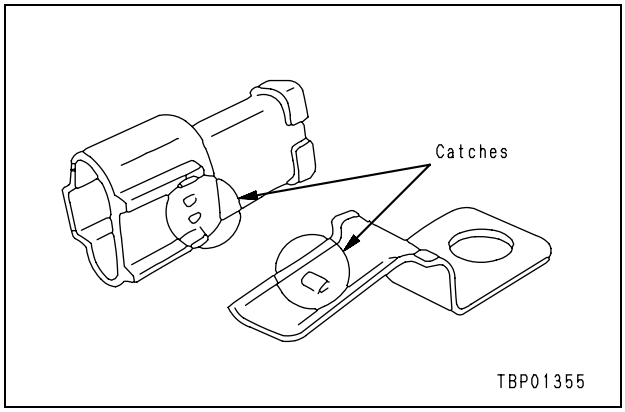
- Never pull with one hand.



B. When removing from clips
When removing a connector from a clip, pull the connector in a parallel direction to the clip.

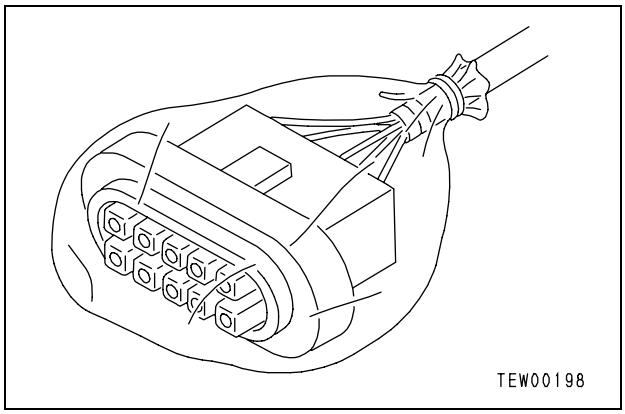
- If the connector is twisted up and down or to the left or right, the housing may break.





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

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



- Connecting connectors

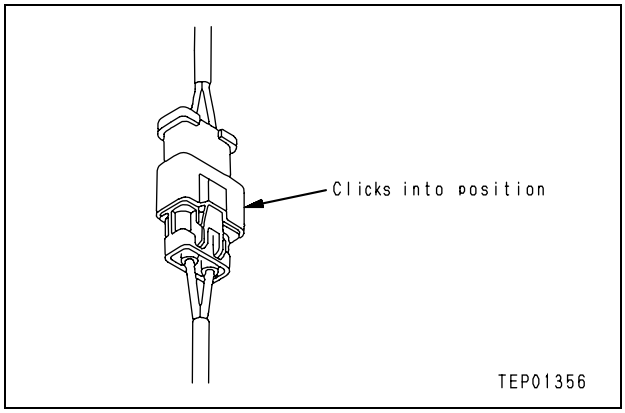
A. Check the connector visually.

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

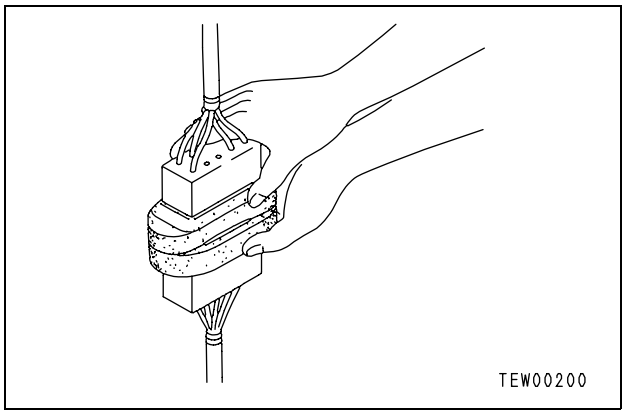
ii. Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.

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

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



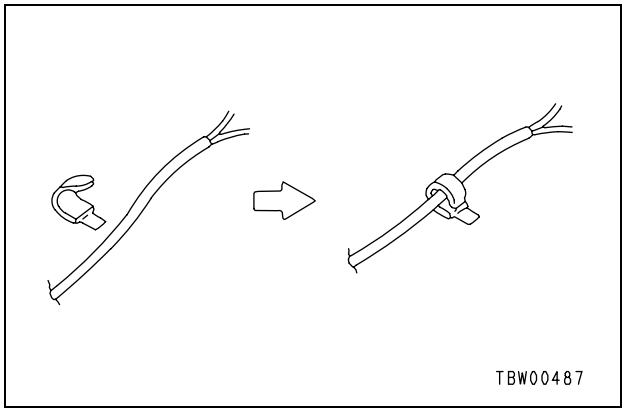
B. Fix the connector securely.
Align the position of the connector correctly, then insert it securely.
For connectors with lock stopper, push in the connector until the stopper clicks into position.



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

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



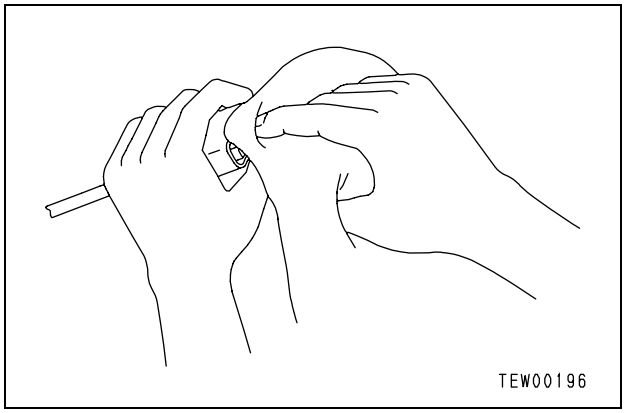
- Drying wiring harness

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

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

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

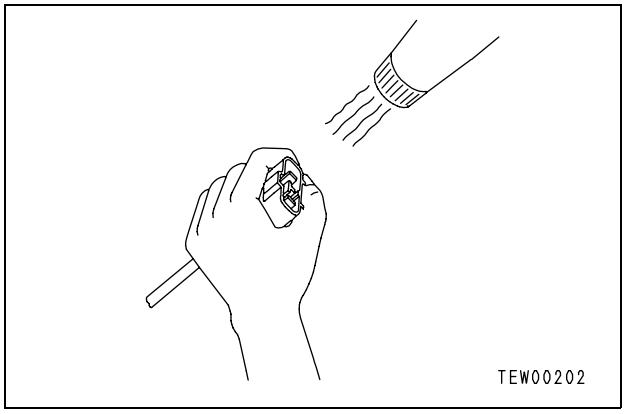
- If the connector is blown dry with compressed air, there is the risk that oil in the air may cause defective contact, so remove all oil and water from the compressed air before blowing with air.



B. Dry the inside of the connector with a dryer.

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

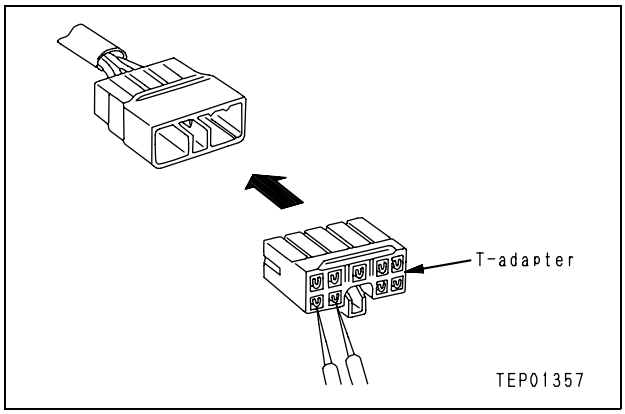
- Hot air from the dryer can be used, but regulate the time that the hot air is used in order not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.



C. Carry out a continuity test on the connector.

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

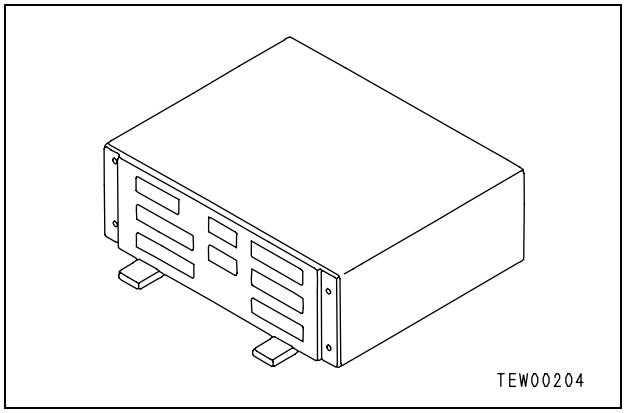
- After completely drying the connector, blow it with contact restorer and reassemble.



1.3. Handling control box

A. 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.

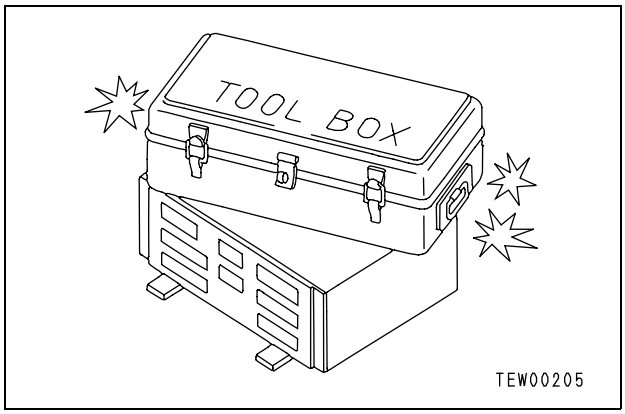
B. Do not open the cover of the control box unless necessary.



C. Do not place objects on top of the control box.

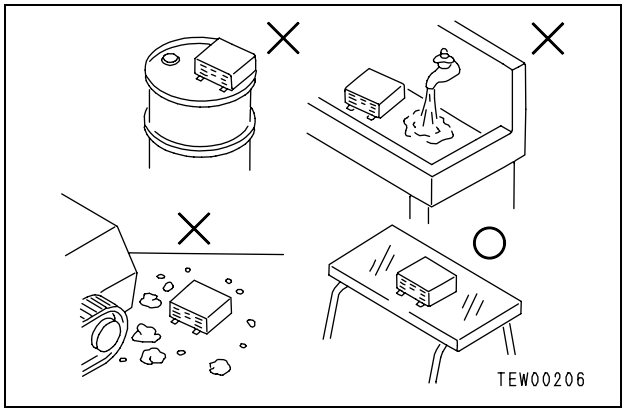
D. Cover the control connectors with tape or a vinyl bag.
Never touch the connector contacts with your hand.

E. During rainy weather, do not leave the control box in a place where it is exposed to rain.



F. 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).

G. 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 trouble-shooting electric circuits

2.1. Always turn the power OFF before disconnecting or connect connectors.

2.2. Before carrying out troubleshooting, check that all the related connectors are properly inserted.

- Disconnect and connect the related connectors several times to check.

2.3. 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.

2.4. 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.

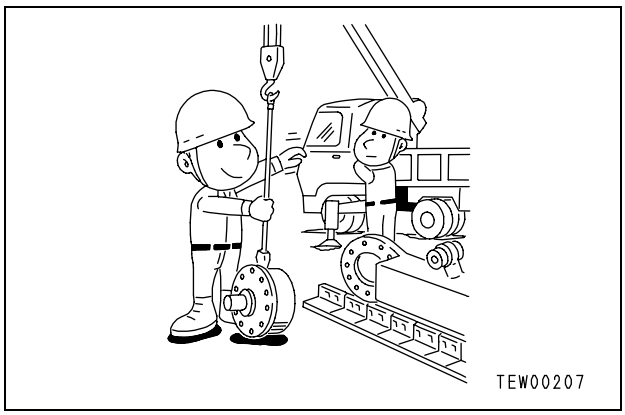
- If there is any change, there is probably defective contact in that circuit.

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.

3.1. 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.



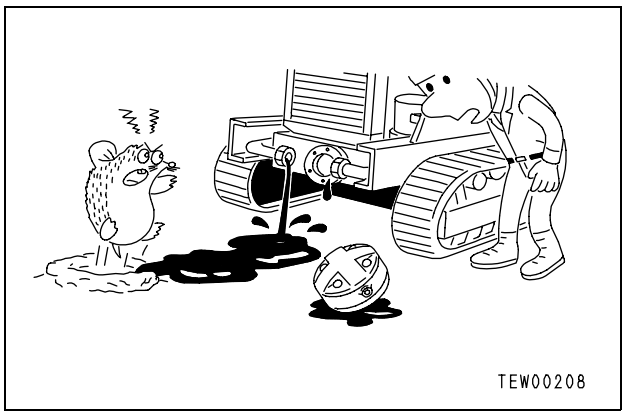
3.2. Disassembly and maintenance work in the field

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.

3.3. Sealing openings

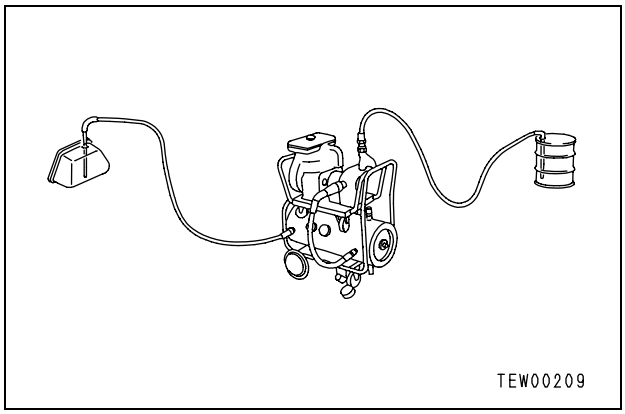
After any piping or equipment is removed, the openings should be sealed with caps, tapes, or vinyl bags to prevent any dirt or dust from entering. If the opening is left open or is blocked with a rag, there is danger of dirt entering or of the surrounding area being made dirty by leaking oil so never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



3.4. 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.

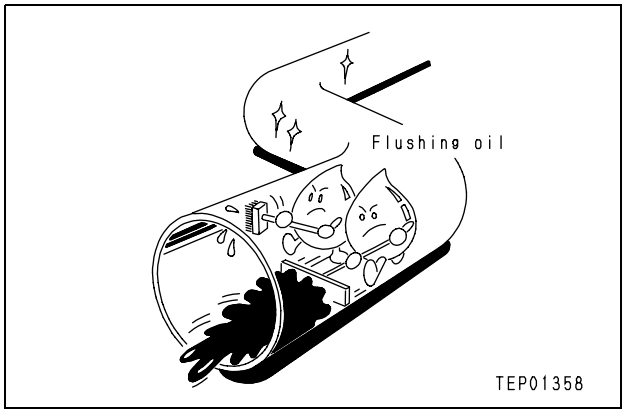


3.5. Change hydraulic oil when the temperature is high.

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.

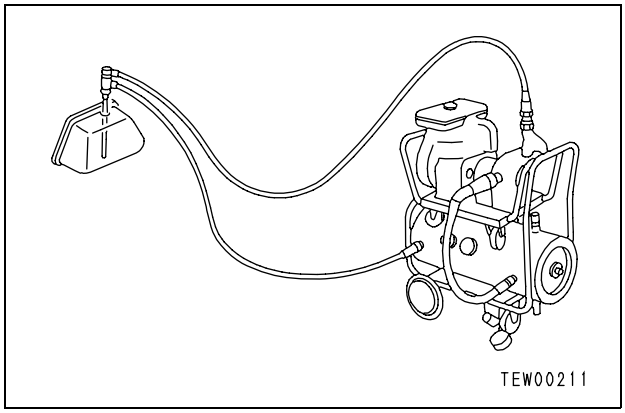
3.6. Flushing operations

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.



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

CLASSIFICATION AND STEPS FOR TROUBLESHOOTING

Classification of troubleshooting

Mode	Content
Code display	Troubleshooting when Service Code (electrical system) and Failure Code (mechanical system) are displayed.
E mode	Troubleshooting of electrical system
H mode	Troubleshooting of hydraulic and mechanical systems
(Engine)	Troubleshooting of engine assembly (refer to the shop manual for engine in 102 series)

Steps for troubleshooting

If some phenomenon occurs on a machine that looks like a failure, identify the corresponding troubleshooting No. and proceed to the explanations for diagnosis.

1. Troubleshooting steps when calling User Code display in the monitor panel

If User Code display, enter service mode on monitor to display Service Code. Following displayed Service Code for the electrical system, carry out the troubleshooting along the corresponding code display.

2. Troubleshooting steps when the electrical system Service Code or mechanical system Failure Code is recorded in the failure history:

If not calling User Code in the monitor panel, check the electrical system Service Code or mechanical system Failure Code, using the failure history function of the monitor panel.

- If Service Code in the electrical system is recorded, delete the all codes once and revive the code in the display again to check if the same abnormality still persists.
- Failure Code in the mechanical system cannot be deleted.

3. Troubleshooting steps without User Code display and no failure history is available

If there is no display of User Code nor the failure history in the monitor panel, it is possible that a failure that the monitor panel cannot diagnose by itself may have occurred in any of the electrical, hydraulic or mechanical system. In such a case, re-examine the phenomenon, find out the most similar phenomenon from among "Failure like Phenomena and Troubleshooting No." and carry out troubleshooting related to the phenomenon in question.

Failure-looking Phenomenon and Troubleshooting No.

No.	Failure-looking phenomenon		Troubleshooting			
			Code display	E mode	H mode	(Engine)
Action to be taken concerning Service Code, User Code and Failure Code						
1	Display User Code in monitor panel		According to displayed code			
2	Display Service Code in electrical system after checking failure history					
3	Display Failure Code in mechanical system after checking failure history					
Engine-related failure						
4	Engine does not start up easily. (It always takes some time to start up the engine)					S-1
5	Engine does not start	Engine does not rotate		E-1		S-2 ①
6		Engine rotates, but there is no exhaust gas				S-2 ②
7		There is exhaust gas, but engine does not start				S-2 ③
8	Engine pickup is poor. (Engine does not follow acceleration)					S-3
9	Engine stops while in operation				H-2	S-4
10	Engine rotation is irregular. (There is hunting)					S-5
11	Engine is short of output, or lacks power				H-1	S-6
12	Color of exhaust gas is too dark. (Incomplete combustion)					S-7
13	Excessive engine oil consumption, or color of exhaust gas is blue					S-8
14	Premature engine oil contamination					S-9
15	Excessive fuel consumption					S-10
16	Engine cooling water is mixed with engine oil, spurts out or decreases					S-11
17	Engine oil amount increases. (Water or fuel gets in)					S-13
18	Abnormal noises are heard					S-15
19	Excessive vibrations are caused					S-16
20	Auto-decelerator does not work			E-2	H-5	
21	Engine auto warming-up device does not work			E-3		
22	Engine preheater does not work			E-7		
Failure related to work equipment, swing and travel						
23	Speeds of all work equipment, travel and swing are slow, or they lack power				H-1	S-6
24	Engine rotation drops sharply or stalls				H-2	S-4
25	All work equipment, travel and swing do not move			E-8	H-3	
26	There are abnormal noises from around hydraulic pump				H-4	
27	Fine control mode function works poorly, or shows slow response				H-6	

No.	Failure-looking phenomenon	Troubleshooting			
		Code display	User code	H mode	(Engine)
Work equipment-related failure					
29	Boom moves slowly or lacks power		E-21, 22	H-7	
30	Arm moves slowly or lacks power		E-23, 24	H-8	
31	Bucket moves slowly or lacks power		E-25, 26	H-9	
32	Boom, arm or bucket does not move			H-10	
33	Natural drift of work equipment is too fast			H-11	
34	Work equipment time lag is too big			H-12	
35	Other work equipment moves, when specific work equipment is relieved			H-13	
36	One-touch power max. switch does not work	E-9, 21–26		H-14	
Compound operation-related failure					
37	In compound operation, work equipment with larger load moves slowly			H-15	
38	In swing + boom RAISE operation, boom moves slowly			H-16	
39	In swing + travel operation, travel speed drops sharply			H-17	
Travel-related failure					
40	Machine tends to swerve while in travel				
41	Travel speed is slow				
42	Machine is difficult to steer, or lacks power				
43	Travel speed cannot be shifted or is slow or fast			H18	
Swing-related failure					
44	Machine does not swing		E-27	H-23	
45	Swing acceleration is poor, or swing speed is slow			H-24	
46	Upper structure overruns excessively, when stopping swing			H-25	
47	There is a big shock caused when stopping swing			H-26	
48	There is abnormal noise generated when stopping swing			H-27	
49	There is natural drift while in swing			H-28	
Monitor panel-related failure (Operator's Menu: ordinary display)					
50	No display appears in monitor panel at all		E-10		
51	Part of display is missing in monitor panel		E-11		
52	Descriptions on monitor panel do not apply to the machine model		E-12		
53	In startup inspection, radiator water level caution symbol is displayed on the monitor panel, when the engine is running	B@BCZK			
54	In startup inspection, engine oil level caution symbol is displayed, when the engine is stopped (with the starting key in the ON position)	B@BAZK			

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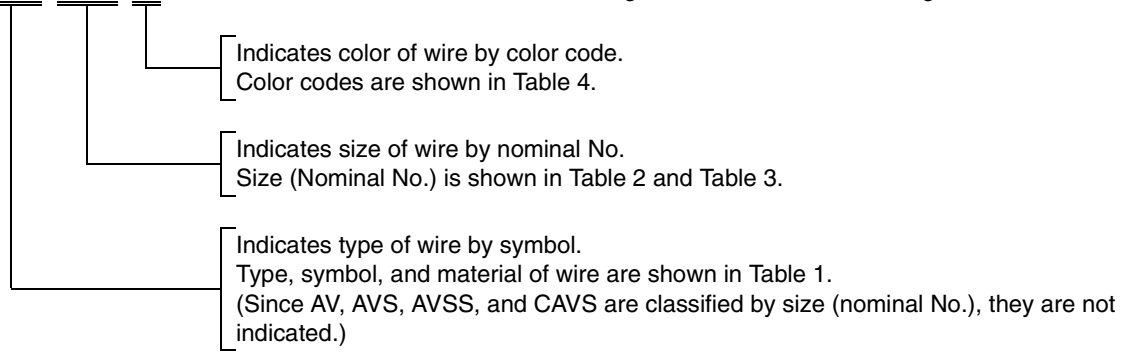
No.	Failure-looking phenomenon	Troubleshooting			
		Code display	User code	H mode	(Engine)
55	In startup inspection, maintenance hour monitor lamp lights up red	Refer to Operation and Maintenance Manual			
56	While engine is running, battery charging caution symbol is displayed on the monitor panel.	AB00KE			
57	While engine is running, fuel level monitor lamp lights up red		E-13		
58	While engine is running, air cleaner clogging charging caution symbol is displayed on the monitor panel.	AA10NX			
59	While engine is running, engine cooling water temperature gauge is diplayed in red range	B@BCNS			
60	While engine is running, hydraulic oil temperature gauge is diplayed in red range	B@HANS			
61	Engine cooling water temperature gauge does not display correctly		E-14		
62	Hydraulic oil temperature gauge does not display correctly		E-15		
63	Fuel gauge does not display correctly		E-16		
64	Swing lock monitor does not display correctly		E-17		
65	When operating monitor switch, no display appears		E-18		
66	Windshield wiper does not work		E-19		
67	Warning buzzer cannot be stopped		E-20		
Monitor panel-related failure (Service Menu: Special Function Display)					
68	In monitoring function, "Boom RAISE" cannot be displayed correctly		E-21		
69	In monitoring function, "Boom LOWER" cannot be displayed correctly		E-22		
70	In monitoring function, "Arm DIGGING" cannot be displayed correctly		E-23		
71	In monitoring function, "Arm DUMPING" cannot be displayed correctly		E-24		
72	In monitoring function, "Bucket DIGGING" cannot be displayed correctly		E-25		
73	In monitoring function, "Bucket DUMPING" cannot be displayed correctly		E-26		
74	In monitoring function, "Swing" cannot be displayed correctly		E-27		
75	In monitoring function, "Travel" cannot be displayed correctly		E-28		
76	In monitoring function, "2 Piece Boom" cannot be displayed correctly		E-29		
Other failure					
77	Air conditioner does not work		E-301		
78	Travel alarm does not sound		E-31		

How to read electric wire code

- In this section, electric wire codes specific to PW180-7E0 are explained.

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

Example: AEX 0.85 L - - - Indicates blue, heat-resistant, low-voltage wire for automobile, having nominal No. of 0.85



1. Type, symbol, and material

AV, AVS, and AVSS are different in only thickness and outside diameter of the cover. AEX is similar to AV in thickness and outside diameter of AEX and different from AV, AVS, and AVSS in material of the cover. CAVS has circularly compressed conductor and is different from AV and AVS in outside diameter.

(Table 1)

Type	Symbol	Material		Using temperature range (°C)	Example of use for reference
Low-voltage wire for automobile	AV	Conductor	Annealed copper for electric appliance	–30 to +60	General wiring (Nominal No. 8 and above)
		Insulator	Soft polyvinyl chloride		
Thin-cover, low-voltage wire for automobile	AVS AVSS	Conductor	Annealed copper for electric appliance		AVS: General wiring (Nominal No. 3 – 5) AVSS: General wiring (Nominal No. 2)
		Insulator	Soft polyvinyl chloride		
Heat-resistant, low-voltage wire for automobile	AEX	Conductor	Annealed copper for electric appliance	–50 to +110	General wiring in extremely cold district, wiring at high-temperature place
		Insulator	Heat-resistant crosslinked polyethylene		
Thin-cover, low-voltage, circularly compressed wire for automobile	CAVS	Conductor	Annealed copper for electric appliance	–30 to +60	General wiring (Nominal No. 0.5 – 1.25)
		Insulator	Soft polyvinyl chloride		

2. Dimensions

AVS, AV, AEX, AVSS

(Table 2)

Nominal No.			0.5f	(0.5)	0.75f	(0.85)	1.25f	(1.25)	2f	2	3f	3	5
Conductor		Number of strands/ Diameter of strand	20/0.18	7/0.32	30/0.18	11/0.32	50/0.18	16/0.32	37/0.26	26/0.32	58/0.26	41/0.32	65/0.32
		Sectional area (mm^2)	0.51	0.56	0.76	0.88	1.27	1.29	1.96	2.09	3.08	3.30	5.23
		d (Approx.)	1.0		1.2		1.5		1.9	1.9	2.3	2.4	3.0
Cover D	AVS	Standard	—		—		—		—	—	3.5	3.6	4.4
	AV	Standard	—		—		—		—	—	—	—	—
	AEX	Standard	2.0		2.2		2.7		3.0	3.1	—	3.8	4.6
	AVSS	Standard	—		—		—		2.7	2.7	—	—	—

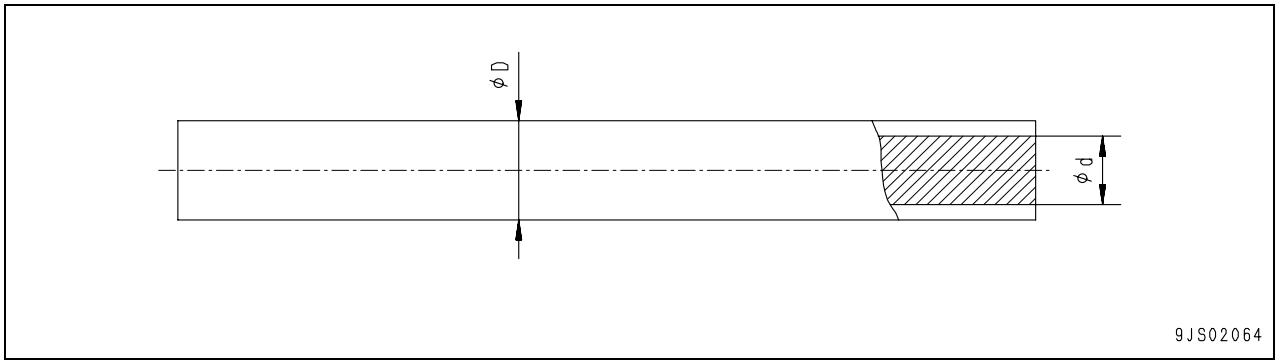
Nominal No.			8	15	20	30	40	50	60	85	100
Conductor		Number of strands/Diameter of strand	50/0.45	84/0.45	41/0.80	70/0.80	85/0.80	108/0.80	127/0.80	169/0.80	217/0.80
		Sectional area (mm^2)	7.95	13.36	20.61	35.19	42.73	54.29	63.84	84.96	109.1
		d (Approx.)	3.7	4.8	6.0	8.0	8.6	9.8	10.4	12.0	13.6
Cover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

CAVS

(Table 3)

Nominal No.			0.5	0.85	1.25
Conductor		Number of strands/ Diameter of strand	7/Compressed circularly	11/Compressed circularly	16/Compressed circularly
		Sectional area (mm^2)	0.56	0.88	1.29
		d (Approx.)	0.9	1.1	1.4
Cover D	CAVS	Standard	1.7	1.9	2.2

"f" of nominal No. denotes "flexible".



3. Color codes table

(Table 4)

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

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

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

4. Types of circuits and color codes

(Table 5)

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

CONNECTOR LOCATION CHART AND ELECTRICAL CIRCUIT DIAGRAM BY SYSTEM

Connector table

Connector No.	Type	No.of Pin	Name of Device	Address
A01	X	4	Intermediate Connector	H-6
A02	X	4	Intermediate Connector	H-5
A03	DT	12	Intermediate Connector	I-6
A04	SWP	14	Intermediate Connector	I-6
A04	Terminal	1	Ground (Chassis)	DS-5
A05	SWP	16	Intermediated connector	I-5
A06	SWP	16	Intermediated connector	I-5
A07	SWP	16	Intermediated connector	H-5
A08	SWP	8	Intermediate connector	I-5
A09	SWP	8	Intermediated connector	I-5
A11	DT	3	Swivel Joint Connector	DU-5
A12	DT	4	Swivel Joint Connector	AA-6
A13	DT	4	Swivel Joint Connector	DU-5
A14	DT	3	Swivel Joint Connector	AA-6
A20	Terminal	1	Battery Relay (E Terminal)	AK-5
A21	Terminal	1	Battery Relay (BR Terminal)	AK-6
A22	Terminal	1	Battery Relay (M Terminal)	AJ-5
A23	Terminal	1	Battery Relay (B Terminal)	AJ-6
A24	Terminal	1	Heater relay (Contact)	AI-6
A25	Terminal	1	Heater Relay (Contact)	AI-5
A26	Terminal	1	Heater relay (contact)	AI-5
A27	X	2	Starter Safety Relay (S & R Terminals).	AJ-7
A28	Terminal	1	Starter Safety Relay (B Terminal)	AI-7
A29	Terminal	1	Starter Safety Relay (C Terminal).	AJ-7
A31	DT	2	Air cleaner clogging system	E-4
A33	X	2	Radiator Water Level sensor	E-4
A34	L	2	Fusible Link (60A)	AL-6
A35	M	2	Fusible Link (30A)	F-4
A40	KESO	1	Alarm Horn (low tone)	X-7
A41	Spade	1	Alarm Horn (high tone)	W-7
A50	Spade	1	Washer Motor Connector	E-4
A51	DT	3	Pump hydraulic oil pressure sensor	R-6 + BE-2
A53	Bullet	1	Back up alarm (OPT)	DC-4

Connector No.	Type	No.of Pin	Name of Device	Address
A54	X	1	Fuel Level Sensor	X-6
A55	DT	2	Hydraulic Oil Temperature Sensor	AC-5
A56	DT	3	Travel PPC oil pressure sensor	M-5
A57	DT	2	Transmission Speed Sensor	DR-5
A64	Terminal	1	Revolving Frame Grounding	E-4
A65	Terminal	1	Revolving Frame Grounding	E-4
A84	X	4	Rear Work light harness conn	AE-5
A85	X	1	Rear Work Light on Counter weight	AF-8
A86	DT	2	Work Equipment Lights	ED-3
A89	KES1	1	Boom Light RH (OPT)	EC-6
A90	KES1	1	Boom light LH (OPT)	EB-6
A90	DT	3	Swing proximity switch	X-4
A91	DT	2	Arm Marker Light (OPT)	EB-7
A92	DT	2	Lights	Z-5
A93	DT	2	Lights	Z-5
A99	SWP	8	Intermediated connector	I-5
AS1	DT	3	Angle sensor (Japan spec.)	CI-3
AB	Terminal	2	Alternator (B)	DO-4
C01	DRC	24	Governor Pump Controller	AX-6
C02	DRC	40	Governor Pump Controller	AX-6
C03	DRC	40	Governor Pump Controller	AX-6
C09	S	8	Model selection connector	AX-6
CE02	DRC	50	Engine controller	DM-8
CE03	DTP	4	Engine controller	DM-7
D01	SWP	8	Assembled type diode	AX-6
D02	SWP	8	Assembled type diode	AX-6
D05	KES1	2	Assembled type diode	CE-5
D06	KES1	2	Assembled type diode	CE-5
D10	KES1	2	Assembled type diode	CE-5 + DJ-3
D11	KES1	2	Assembled type diode	CE-5 + DJ-3
E01	Terminal	1	Ribbon heater	AF-5
E03	X	2	Engine oil level sensor	DN-2
E05	X	1	Compressor for air conditioner	AF-5
E06	M	3	Fuel dial	BP-8
E06	DT	2	Water in fuel sensor	AF-4
E12	Connector	3	Alternator (IG + L)	DO-4

Connector No.	Type	No.of Pin	Name of Device	Address
F01	KES1	4	Flasher unit	CK-5
F02	Yazaki	2	Operator cab beacon	AQ-7
FB1	-	20	Fuse box	BC-5
FB2	-	20	Fuse box	BC-3
G02	DT	14	Steering Column	BU-5 + DG-2
G3	AMP	7	Steering Column switch assy	DG-4
G4	AMP	7	Steering Column switch assy	DG-4
G05	DT	12	Steering Column	BU-5 + DH-2
G7	DT	4	Rear Lights L.H	AK-3
G8	DT	4	Rear Lights R.H	AD-6
G10	X	2	Harness for licence No. plate	AG-5
G12	DT	6	Front light connector (R.H)	X-3
G13	DT	6	Front light connector (L.H)	B-3
G33	DT	4	Heated seat (OPT)	BE-3
G51	Bullet	1	Engine compartment lamp (OPT)	AE-7
G52	KES0	4	Lower wiper (OPT)	B-3
G53	DT	2	Beacon	AE-7
G70	DT	12	LH Wrist control lever switch	BB-4
G71	DT	4	RH Wrist control lever switch	BP-7
G72	DT	12	Proportional control / F.N.R switches	BP-7
G99	Britax	10	Park Brake	BQ-3
G101	Britax	2	Indicator Switch	DI-6
G103	Britax	2	High beam indicator	DJ-6
G105	Britax	5	Road lights switch	DH-6
G120	Britax	10	Hazard switch	DJ-6
G164	DT	3	Overload Caution Sensor	B-4
H08	M	8	Intermediate Connector	AR-4 + AY-5
H09	S	8	Intermediate Connector	AR-4 + AY-5
H10	S	16	Intermediate Connector	CC-5
H11	S	16	Intermediate Connector	CC-6
H12	S	12	Intermediate Connector	CC-6
H15	090	20	Intermediate Connector	BP-7
J01	J	20	Junction connector (Blue)	CD-5
J02	J	20	Junction connector (Orange)	CD-5
J03	J	20	Junction connector (Black)	CD-5
J04	J	20	Junction connector (Green)	CD-5

Connector No.	Type	No.of Pin	Name of Device	Address
J05	J	20	Junction connector (Pink)	CD-4
J06	J	20	Junction connector (Green)	CE-4
J07	J	20	Junction connector (Black)	CE-4
J08	J	20	Junction connector (Black)	CE-4
J09	J	20	Junction connector (Green)	CE-4
J10	J	20	Junction connector (Orange)	CE-4
K02	DT	2	CAN resistor	AF-4
K19	M	2	Pump resistor (for driving emerg. pump)	AX-5
K31	DT	3	CAN terminating resistor	CX-5
M07	Britax	10	Lamp switch	BQ-3
M13	M	2	Speaker (right)	AQ-7
M19	Yazaki	2	Cigar lighter	BI-6
M26	S	12	Air Con Unit	CO-4
M27	Yazaki	18	Air Con Unit	CO-4
M29	AMP	20	Air Con control panel	BC-5
M30	AMP	16	Air Con control panel	BC-5
M31	M	4	Power supply	CE-4
M33	Sumitomo	4	Air Con Unit	CO-5
M33	M	2	Heated seat switch	BC-5
M38	M	2	Quick coupler switch (Option)	BQ-3
M40	M	2	Working lamp (LH)	AP-5
M40	AMP	8	Radio	AQ-7
M41	M	2	Working lamp (RH)	AO-6
M41	AMP	8	Radio	AQ-7
M45	D	12	Network bus	AY-6
M50	AMP	8	Intermediate Connector (Radio)	AQ-7
M51	Amp	8	Intermediate Connector (Radio)	AQ-7
M71	M	2	Cab Room Lamp	AQ-6 + CC-6
M72	M	4	DC/DC convertor	AY-6
M73	M	2	Speaker (left)	AR-6
M79	M	2	12V elec. equip. socket (Phone Socket)	CE-7
M80	DT	2	Refueling pump connection	W-4
N08	KES	12	Service connector	AY-6 + CE-6
P01	070	12	Monitor Panel	CX-5
P02	040	20	Monitor Panel	CW-5
P05	M	2	Beacon Switch (Option)	BC-5

Connector No.	Type	No.of Pin	Name of Device	Address
P06	M	2	Lower Wiper (Option)	BC-5
P10	DT	8	Outrigger Switch	CX-5
P15	YOSO	2	Air Conditioner Sunlight sensor	DG-6
P17	Sumiomo	2	Air Con Hi/Lo pressure sw.	BY-4
P47	X	1	Water in fuel sensor	AD-5
P70	040	16	Monitor Panel	CX-6
R10	JDK	6	Beacon light relay	AX-6
R11	JDK	6	Starter cut relay	AX-5
R13	JDK	6	Starter cut relay (Personal code)	CH-6
R16	JDK	6	Additional lamp relay	AX-6
R17	JDK	6	Grid heater relay	AX-5
R18	JDK	6	Lower wiper relay	CJ-6
R20	JDK	6	Boom / outrigger select relay	AY-5
R22	JDK	6	Starter cut relay (Travel N)	CD-5
R23	JDK	6	Engine controller (1) relay	CI-6
R24	JDK	6	Engine controller (2) relay	CI-6
R30	Sumitomo	5	Air Con unit (Blower Relay)	CO-5
R31	AMP	4	Air Con Unit (Compressor Relay)	CO-4
R42	JDK	6	Emergency relay (Travel F)	CJ-5
R43	JDK	6	Emergency relay (Travel R)	CJ-5
R44	JDK	6	Horn relay	CI-5
R45	JDK	6	PPC lock relay	CI-5
R52	JDK	6	Cab light	CJ-6
R53	JDK	6	Reversing warning relay	AY-6
R54	JDK	6	Quick coupler relay	BQ-3
RT1	S	16	Roto tilt connector	CO-5
RT2	DT	4	Roto tilt connector	BC-4
RT3	DT	6	Roto tilt connector	BX-5
S01	X	2	Swing RH oil pressure switch	T-4 + AD-3
S02	X	2	Swing LH oil pressure switch	Q-3
S03	X	2	Bucket dumping oil pressure switch	Q-5
S04	X	2	Bucket digging oil pressure switch	T-6
S05	X	2	Arm dump oil pressure switch	Q-5
S06	X	2	Arm digging oil pressure switch	T-6
S07	X	2	2PB extend oil pressure switch	Q-4
S08	X	2	2PB retract oil pressure switch	S-5

Connector No.	Type	No.of Pin	Name of Device	Address
S09	X	2	Travel reverse oil pressure switch	N-5
S10	X	2	Travel forward oil pressure switch	N-5
S12	X	2	Stabilizer + boom down oil pressure switch	M-5
S13	X	2	Stabilizer + boom up oil pressure switch	M-5
S14	M	3	PPC hydraulic lock switch	BB-4
S17	DT	2	Park brake oil pressure switch	BU-5
S18	DT	2	Low brake oil presssure switch	BU-5
S19	DT	2	Stop lights oil pressure switch	BU-4
S21	OTAX	6	Pump emergency driving switch	BQ-3
S22	OTAX	6	Swing and parking brake emergency switch	BQ-3
S28	DT	12	Intermediate connector (RH console pump + swing emergency switch)	BQ-7
S29	DT	12	Intermediate connector (RH console travel + F.N.R emergency switch)	BR-5 + CB-4
S30	DT	2	Quick coupler Switch	Y-6
S95	DT	4	Intermediate connector	BR-5 + CB-4
S96	OTAX	6	Emegency travel switch	BQ-2
SB	Terminal	1	Starter	DN-3
SC	Terminal	1	Starter	DN-3
T05	Terminal	1	Earth to floor frame	CE-4
T11	Terminal	1	Earth	AR-4
V01	DT	2	PPC Pressure Lock Solenoid	L-3
V02	DT	2	2 Stage Relief Solenoid	M-3
V03	DT	2	Swing Brake Sol	M-3
V04	DT	2	Suspension Lock Solenoid	M-6
V06	DT	2	Travel Neutral Solenoid	M-5
V07	DT	2	Creep solenoid	M-5
V08	DT	2	Travel F/R solenoid	M-5
V09	DT	2	Boom / Stabilizer down solenoid	M-5
V10	DT	2	Boom / Stabilizer up solenoid	M-4
V11	DT	2	Transmission clutch solenoid	M-4
V12	DT	2	Park brake solenoid valve	BU-4
V15	DT	2	Transmission back pressure solenoid	DW-4
V15	DT	2	Front attatchment solenoid (LHS)	M-4
V16	DT	2	Front attachment solenoid (RHS)	DW-5
V16	DT	2	Quick coupler solenoid	Y-6
V17	DT	2	Rear attatchment solenoid (LHS)	DU-5

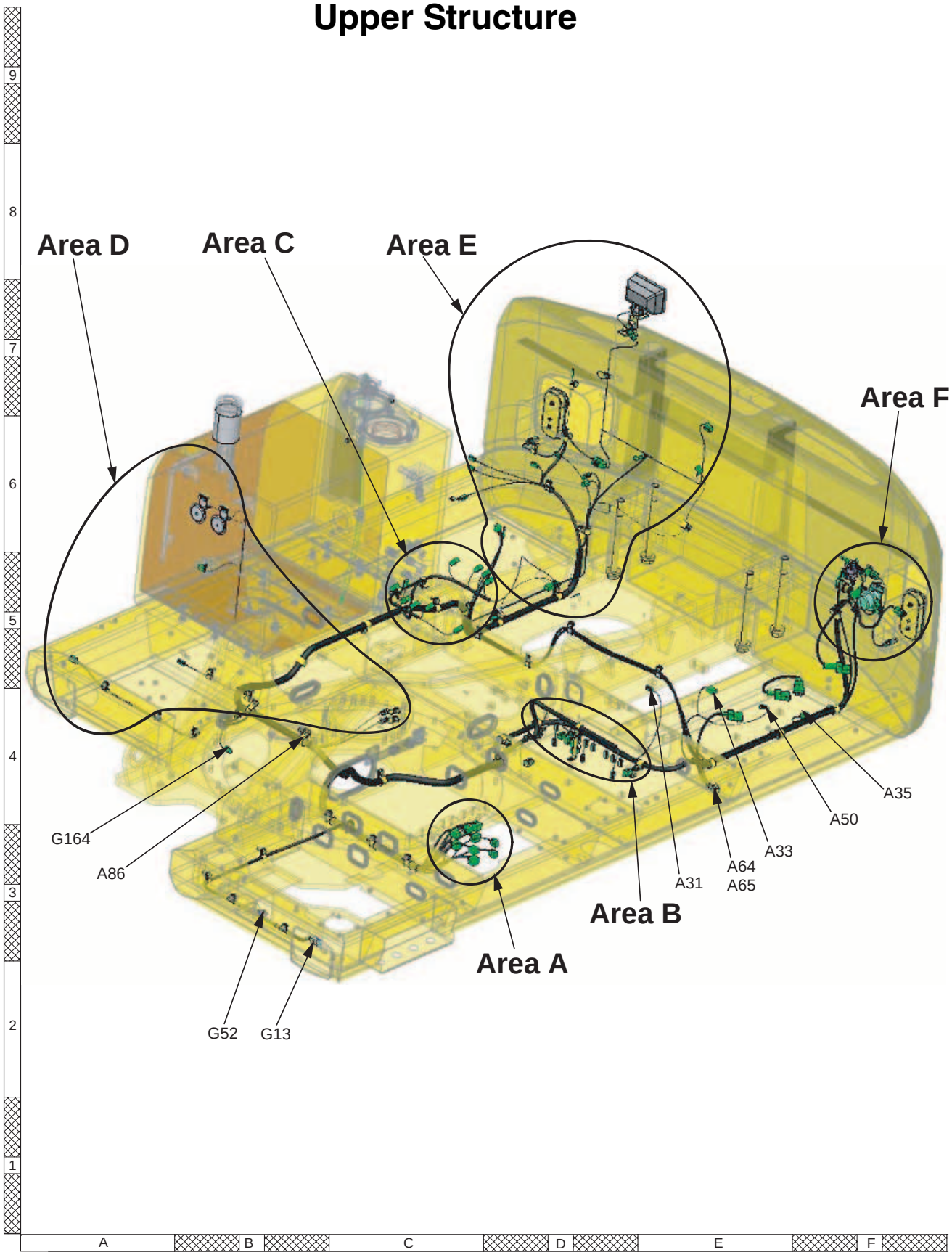
Connector No.	Type	No.of Pin	Name of Device	Address
V18	DT	2	Rear attatchment solenoid (RHS)	DU-5
V21	DT	2	PC-EPC solenoid valve	AC-6
V22	DT	2	LS-EPC solenoid valve	AC-6
V23	X	2	1st service LH EPC	K-4
V24	X	2	1st service RH EPC	L-6
V25	X	2	2nd Service LH EPC	K-4
V26	X	2	2nd Service RH EPC	L-6
W03	M	2	Rear Limit Switch	AQ-7
W04	M	6	Wiper Motor	AO-4 + CU-3
X05	M	4	Swing lock switch	BQ-3
40	Yazaki	2	Rear lamp (Op cab)	AQ-7

Connector No.	Detailed information
D or DT	Product of Deutsch USA DT type connector (08192-XXXXX)
L	Product of Yazaki Corporation L type connector (08056-2XXXX)
J	Product of Sumitomo Wiring Systems 090 type splice
M	Product of Yazaki M type connector (08056-0XXXX)
Grote	Product of Grote & Hartmann Germany
S	Product of Yazaki S type connector (08056-1XXXX)
X	Product of Yazaki X type connector (08055-0XXXX)
PA	Product of Yazaki PA type connector
SWP	Product of Yazaki SWP type connector (08055-1XXXX)
DRC	Product of Deutsch USA DRC type connector
040	Product of Japan AMP 040 type connector
070	Product of Japan AMP 070 type connector
Y050	Product of Yazaki 050 type connector
S090	Product of Sumitomo 090 type connector
Y090	Product of Yazaki 090 type connector
YAZAKI	Yazaki-made connector
KES0	KESO type connector (08027-0XXXX)
KES1	KES1 type connector (08027-1XXXX)
Terminal	Round pin type single terminal connector
Terminal	Round terminal
DENSO	Product of DENSO (Japan)
Sumitomo	Sumitomo made connector
JDK	Product of JIDSHA DENKI KOGYO

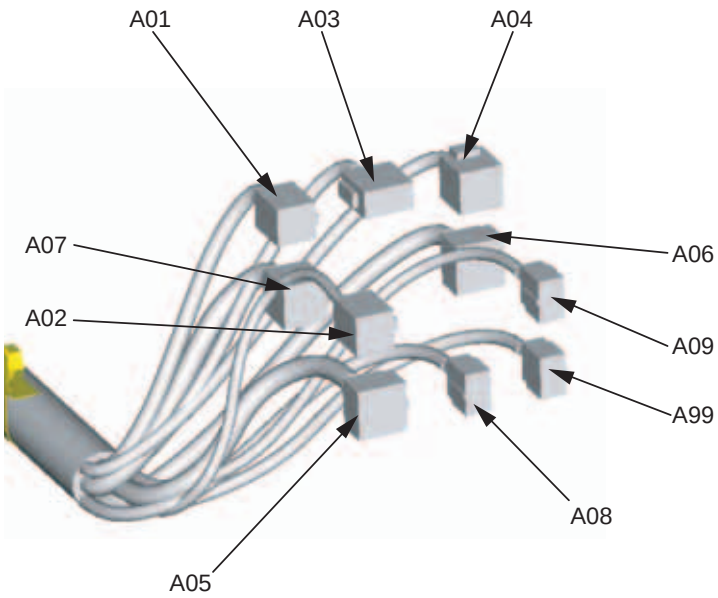
*An affiliated company of Mitsubishi Cable Industries, Ltd.

CONNECTOR LOCATIONS

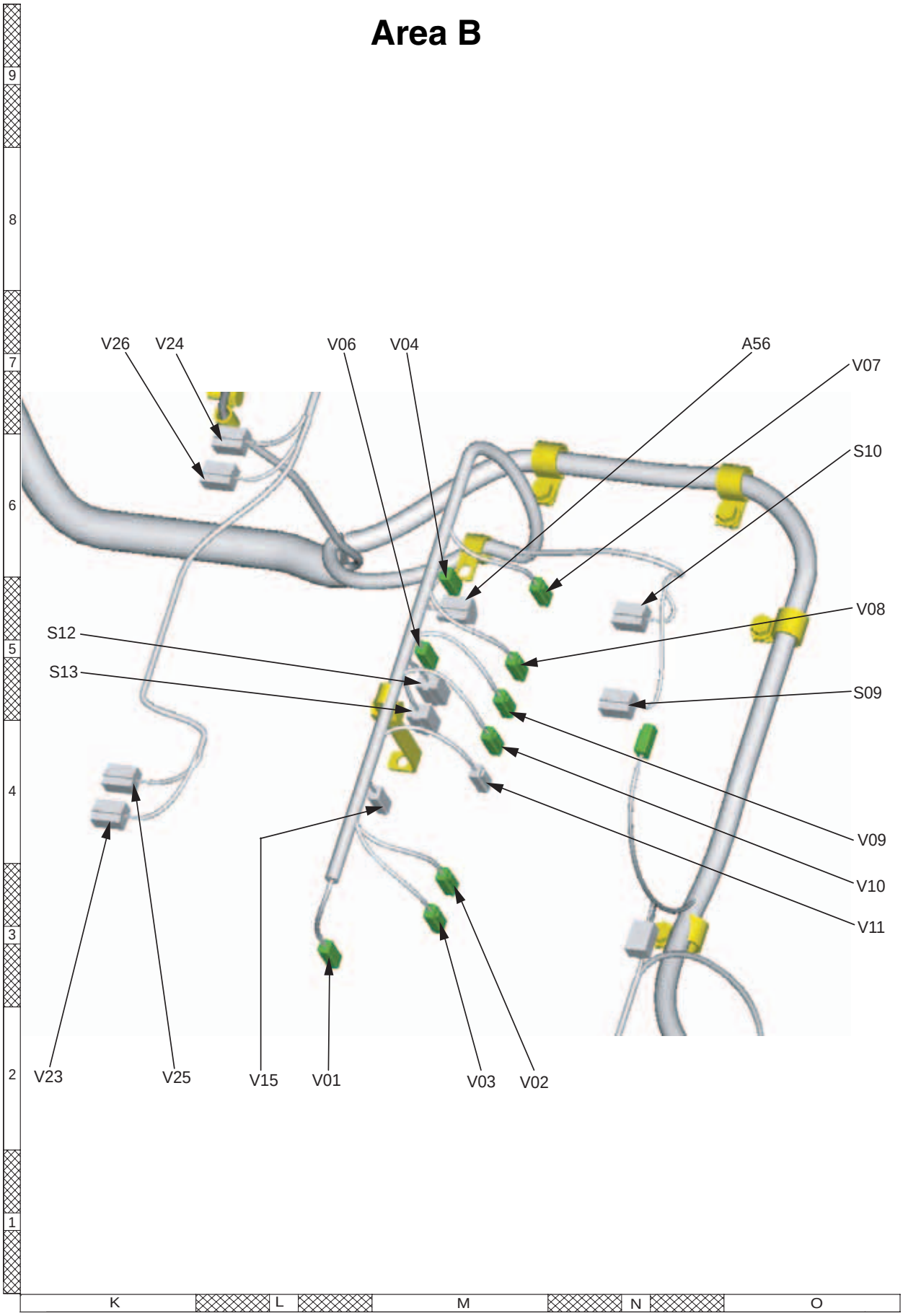
Upper Structure



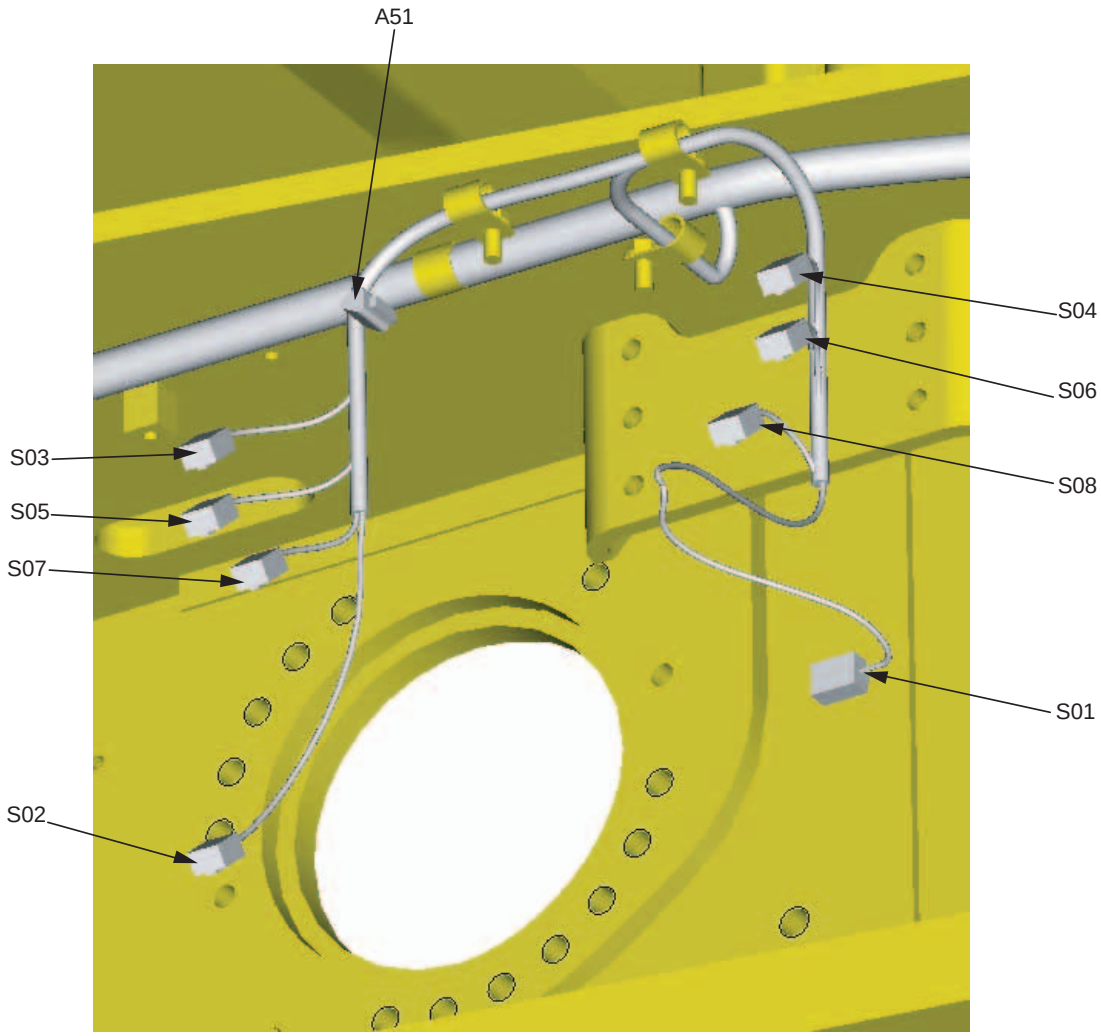
Area A



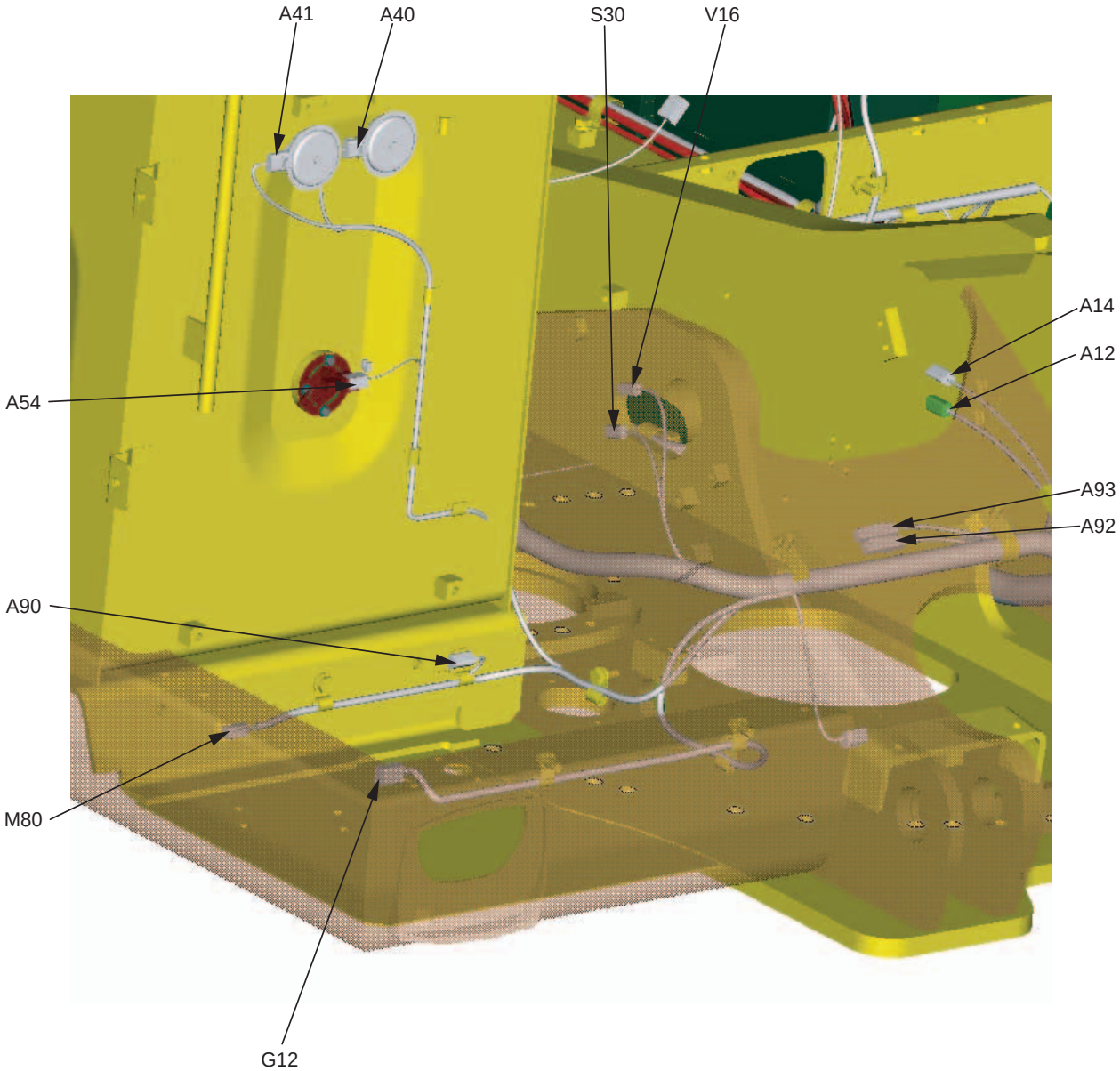
Area B


V26
V24
V06
V04
A56
V07
S10
V08
S12
S13
S09
V09
V10
V11
V23
V25
V15
V01
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V02
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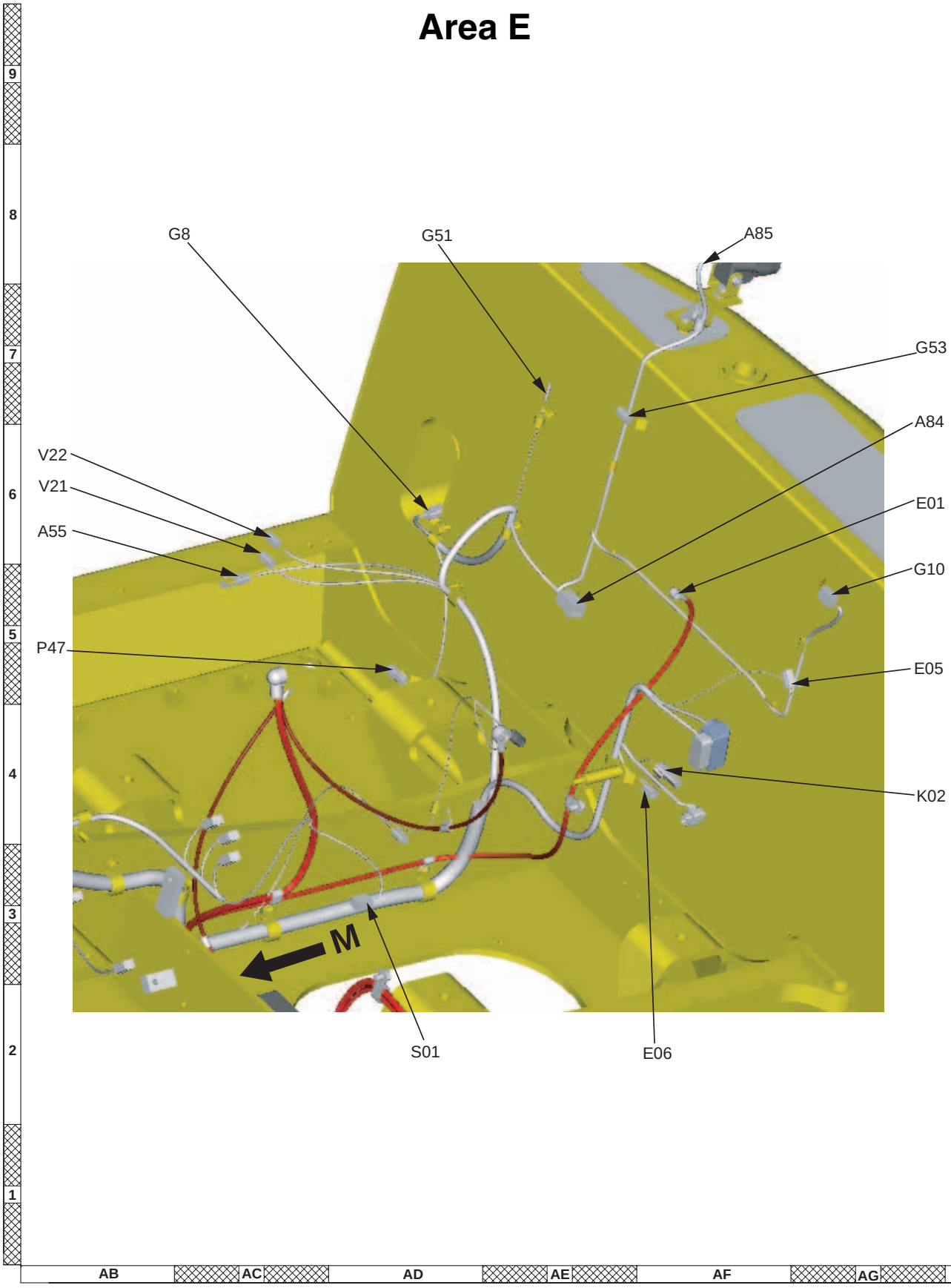
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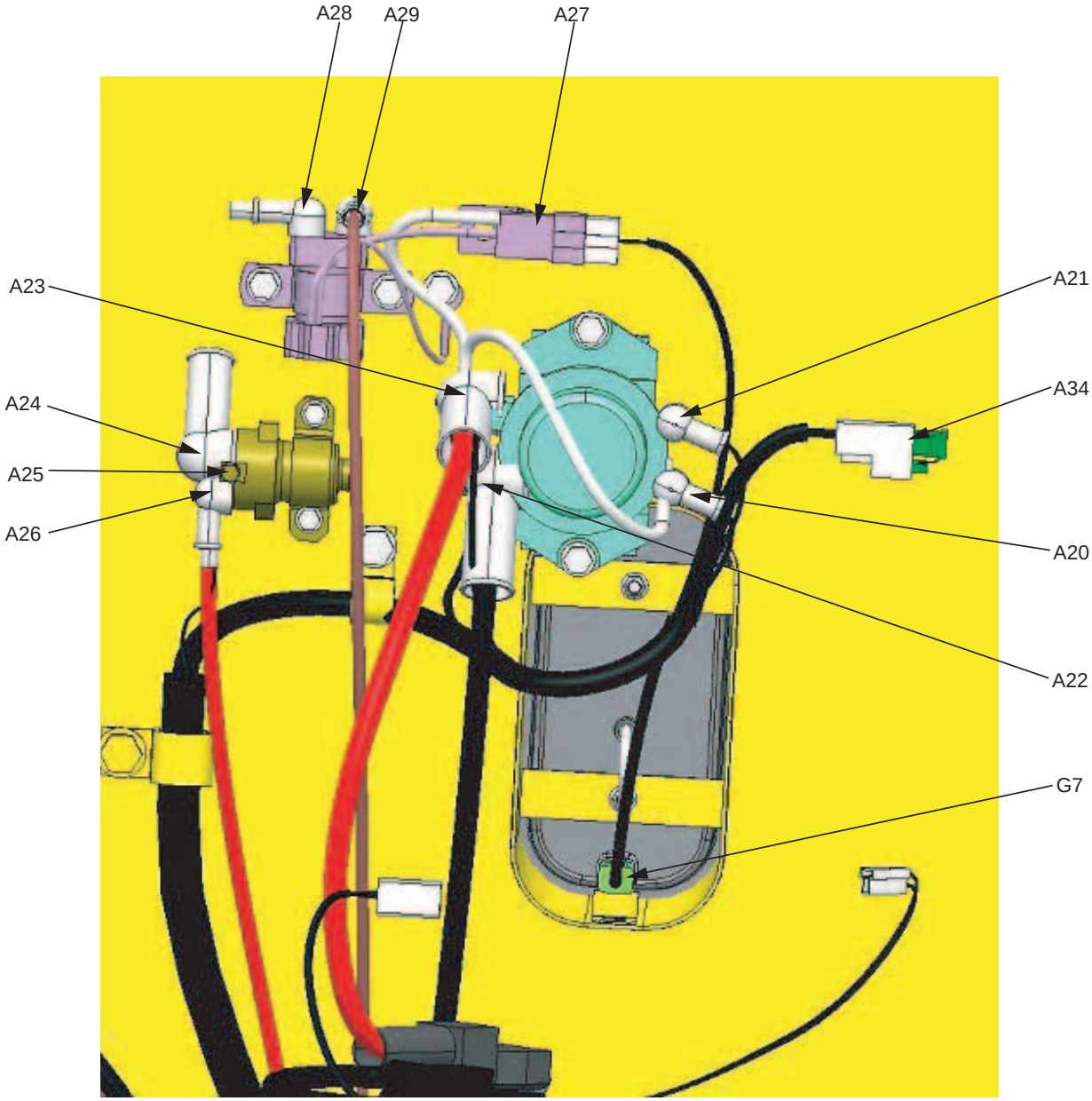
Area D



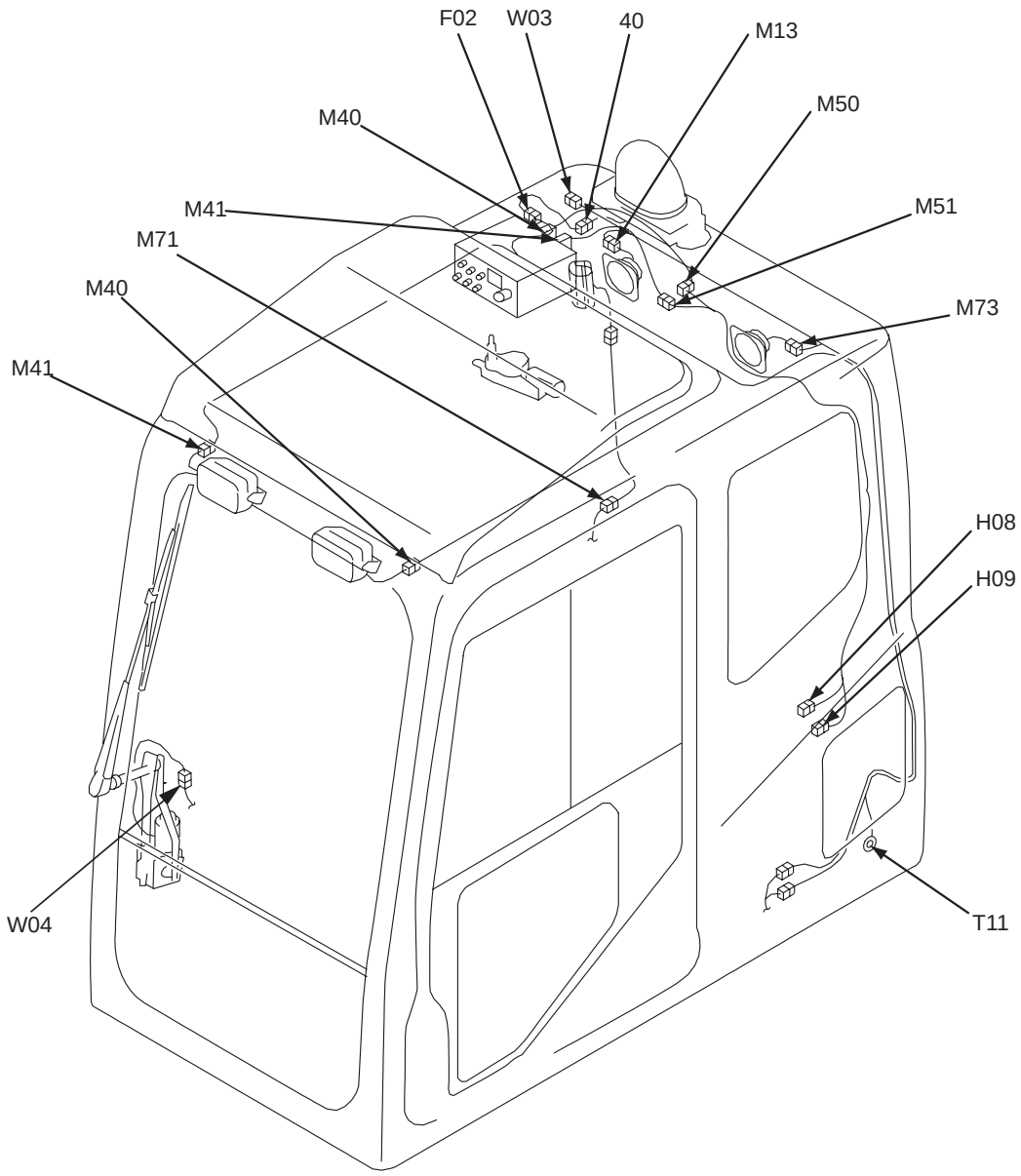
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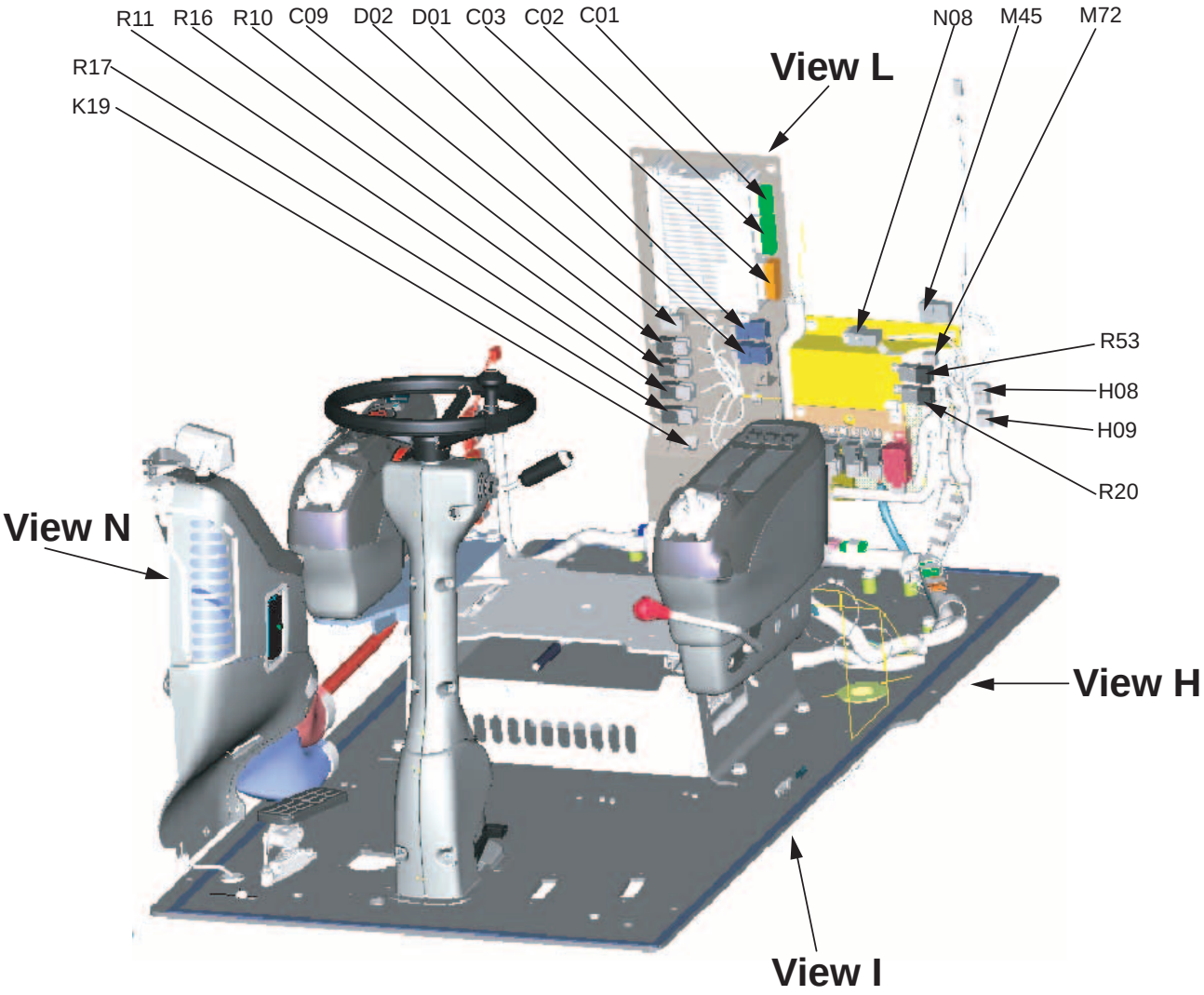

G8
G51
A85
G53
A84
V22
V21
A55
E01
G10
P47
E05
K02
M
S01
E06
9
8
7
6
5
4
3
2
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AB
AC
AD
AE
AF
AG

Area F

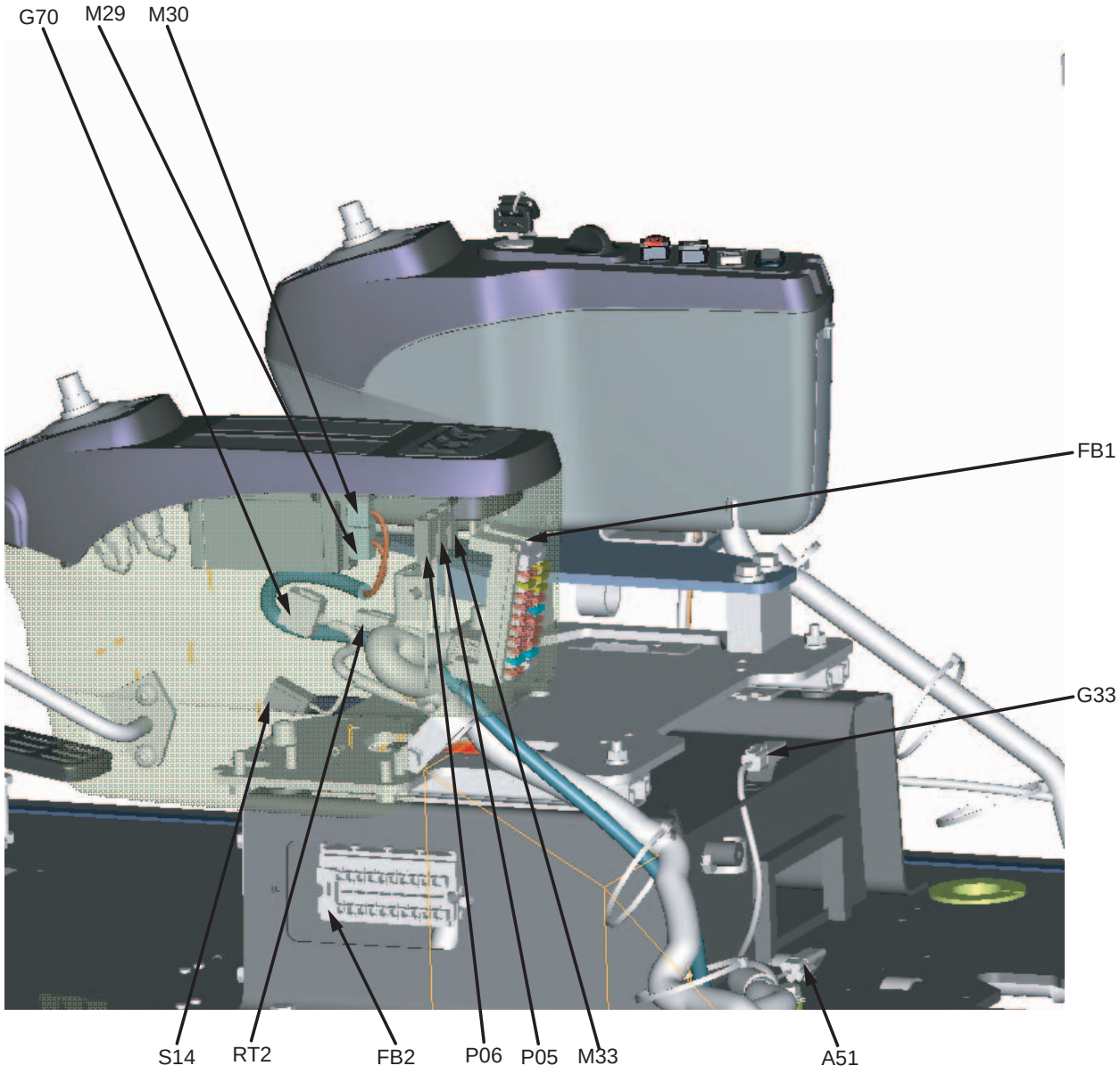


Operator Cab

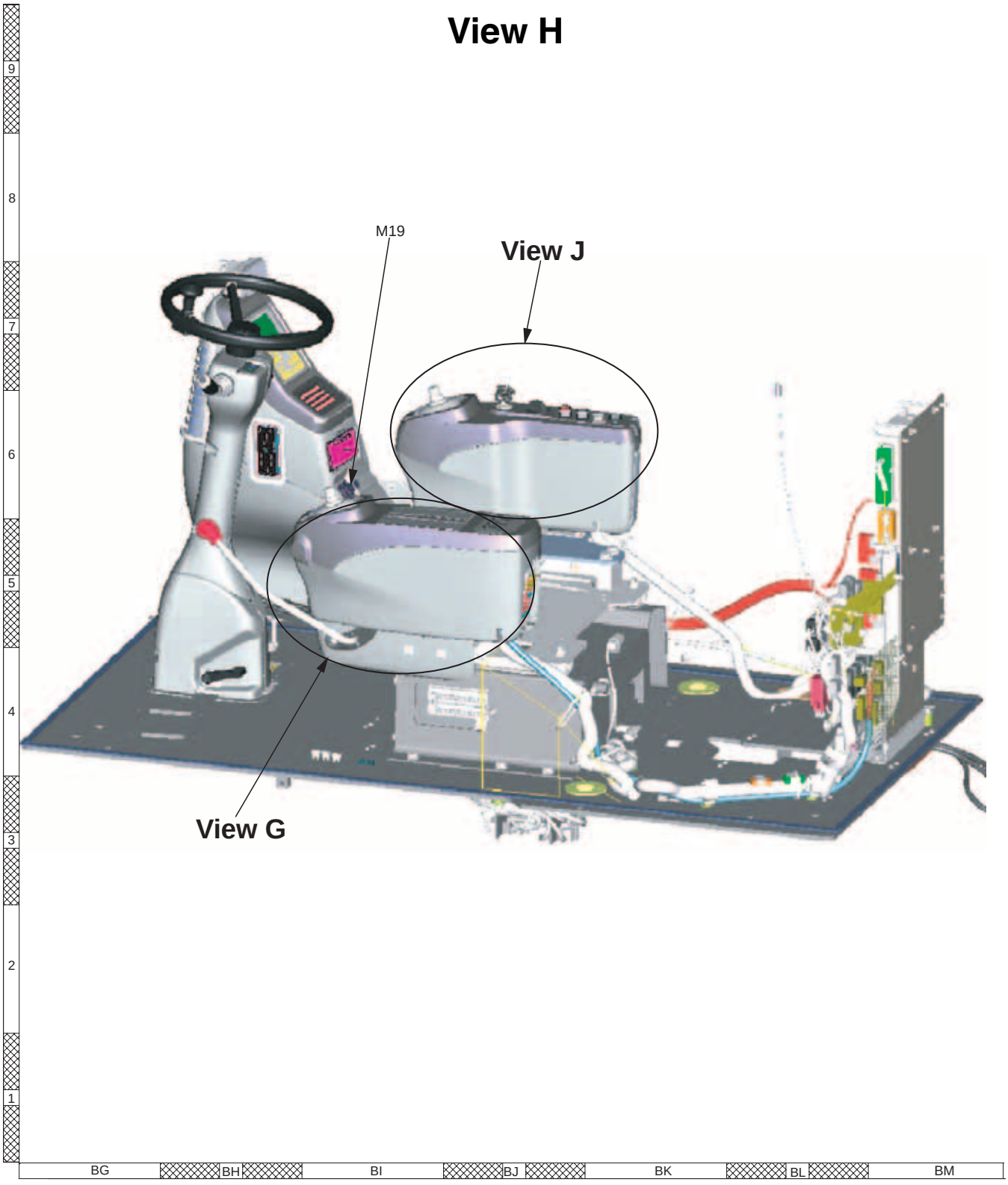



R11
R16
R10
C09
D02
D01
C03
C02
C01
R17
K19
N08
M45
M72
View L
R53
H08
H09
R20
View N
View H
View I

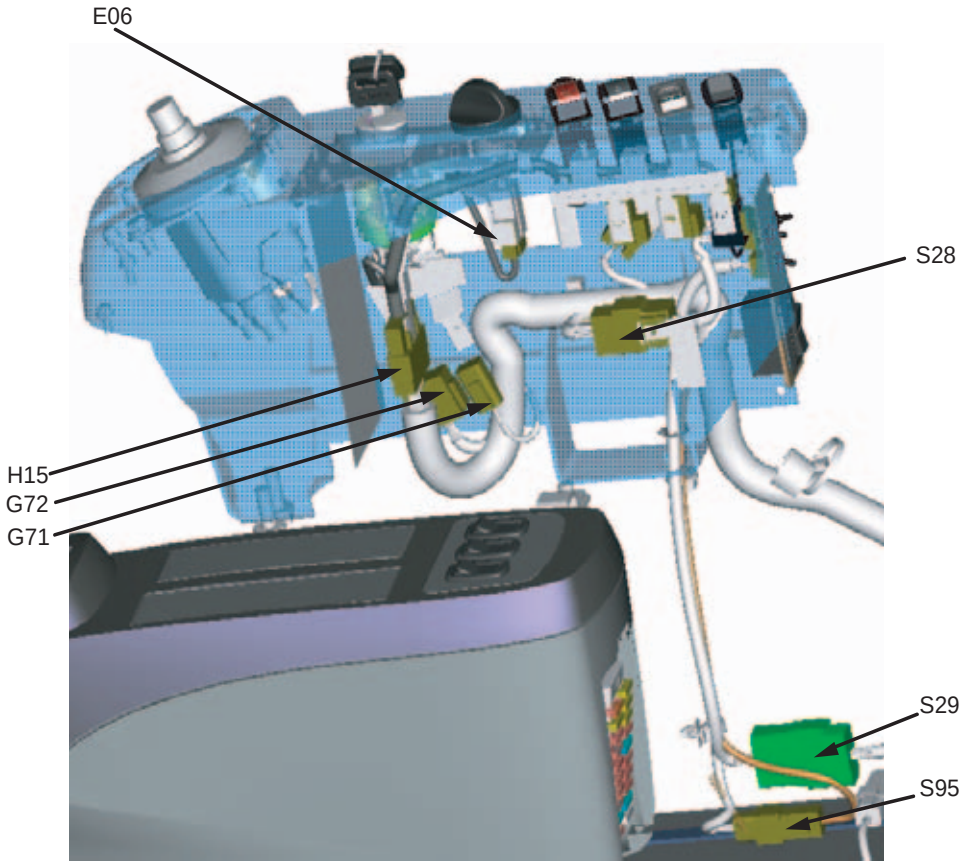
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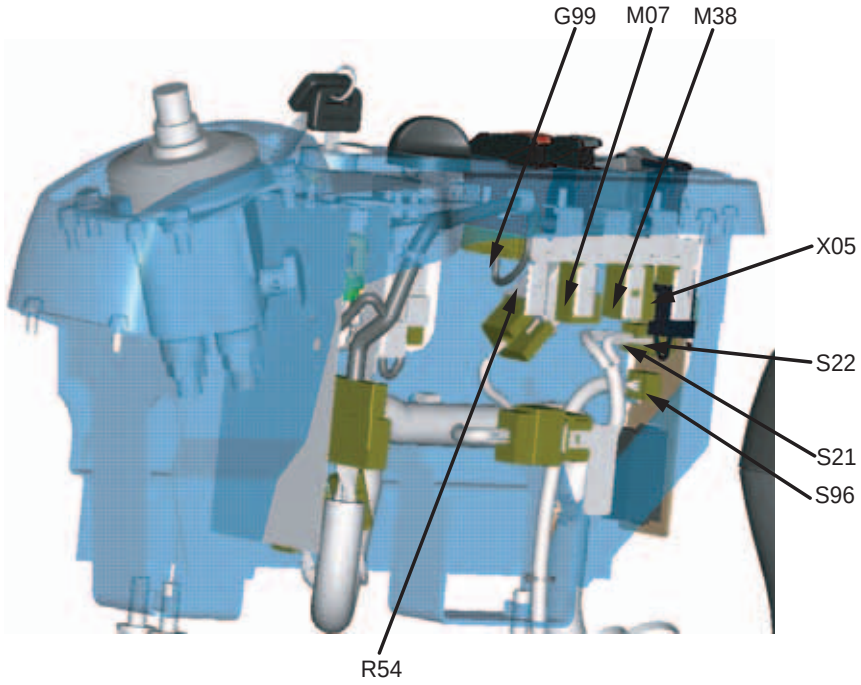


View H

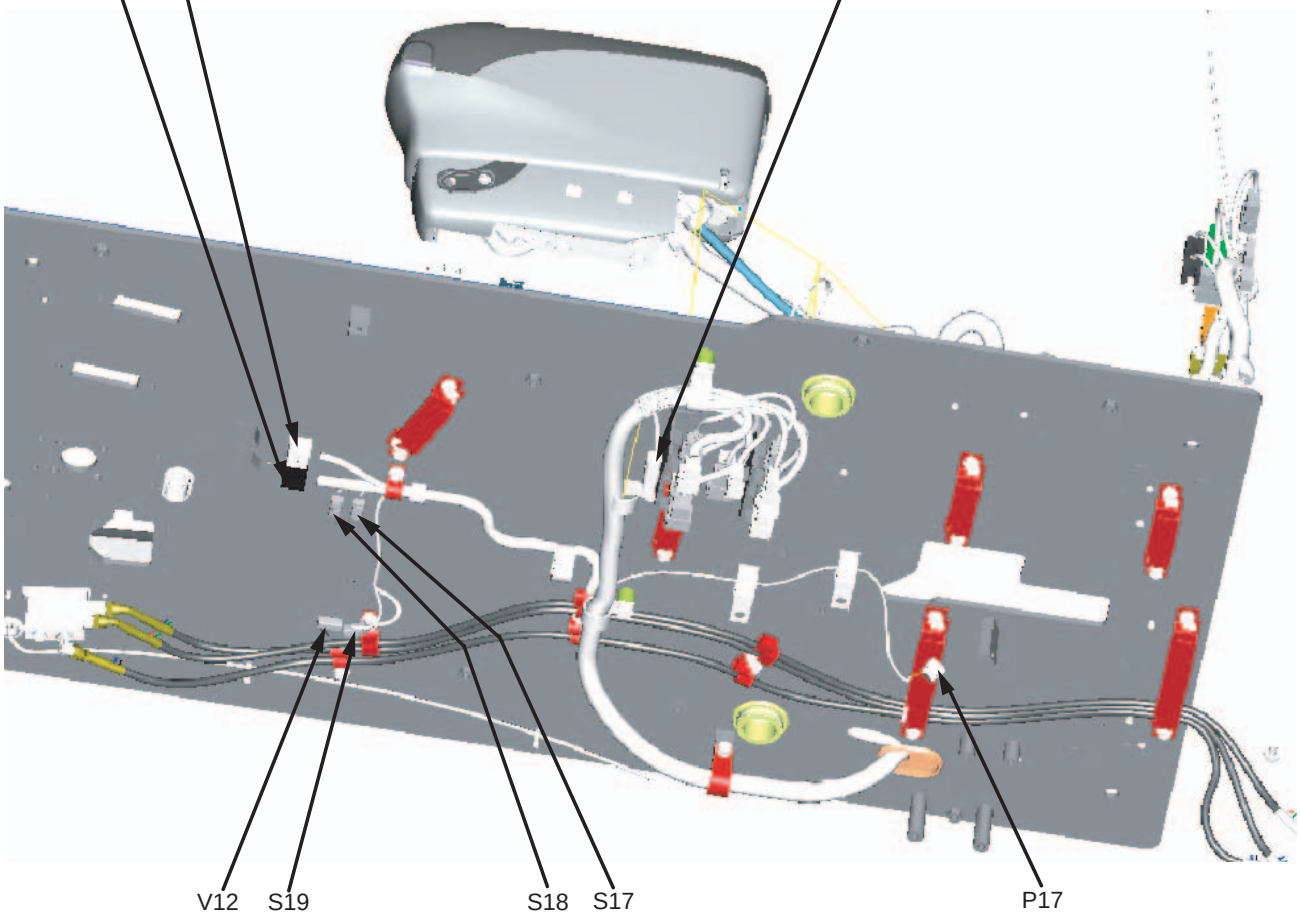


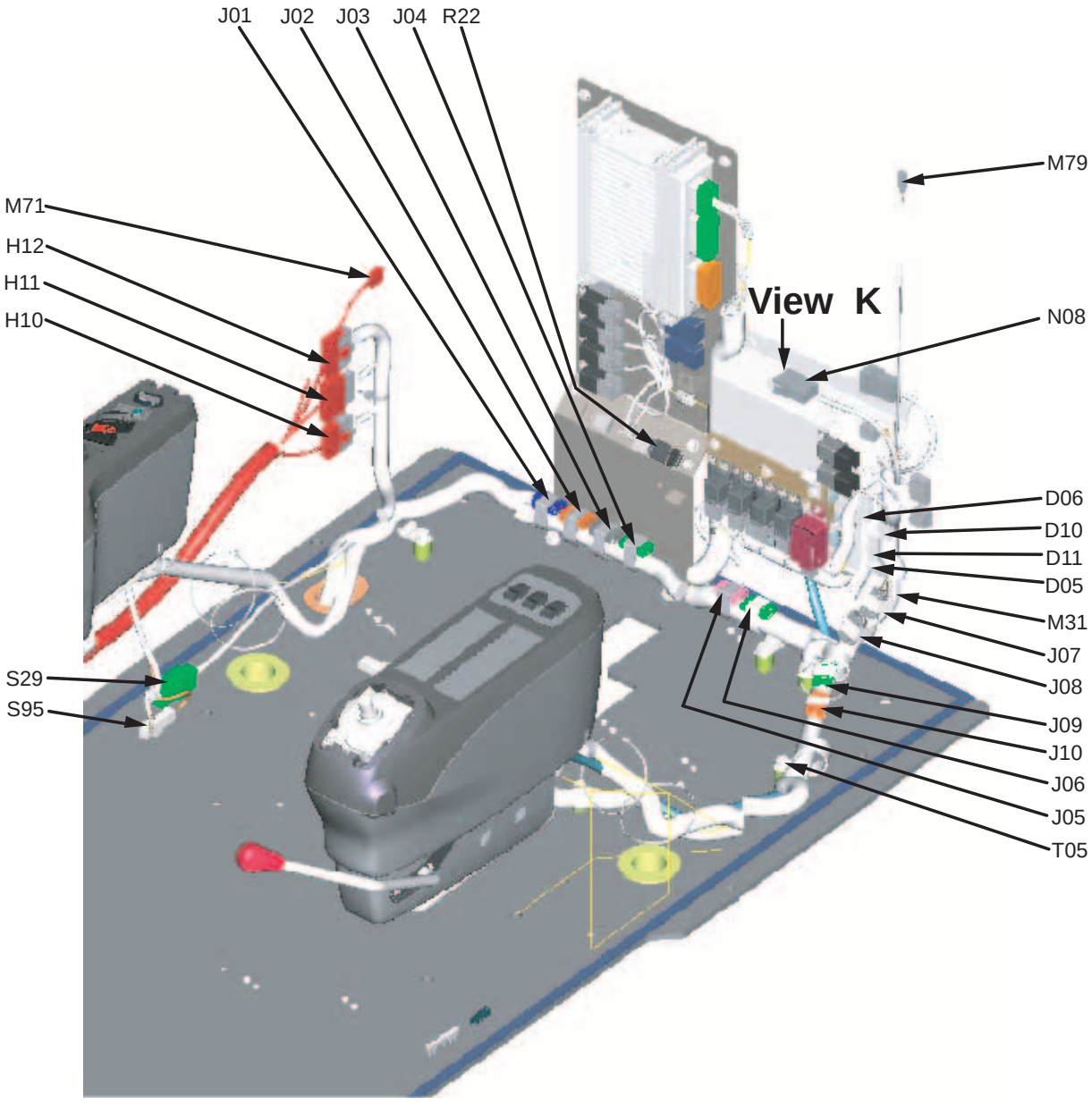
View J



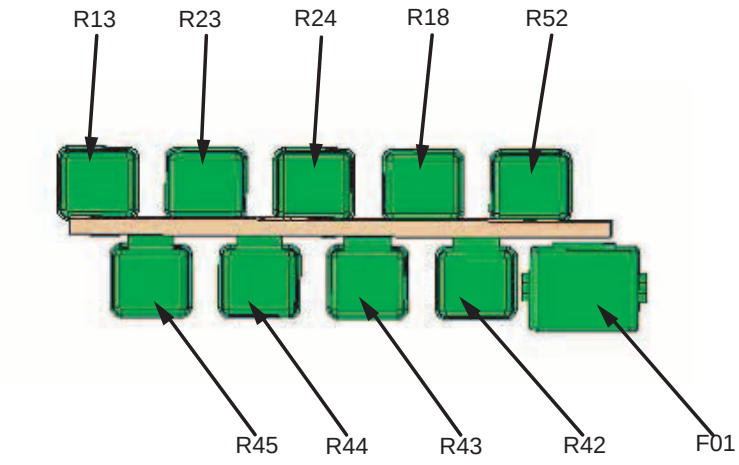


View I

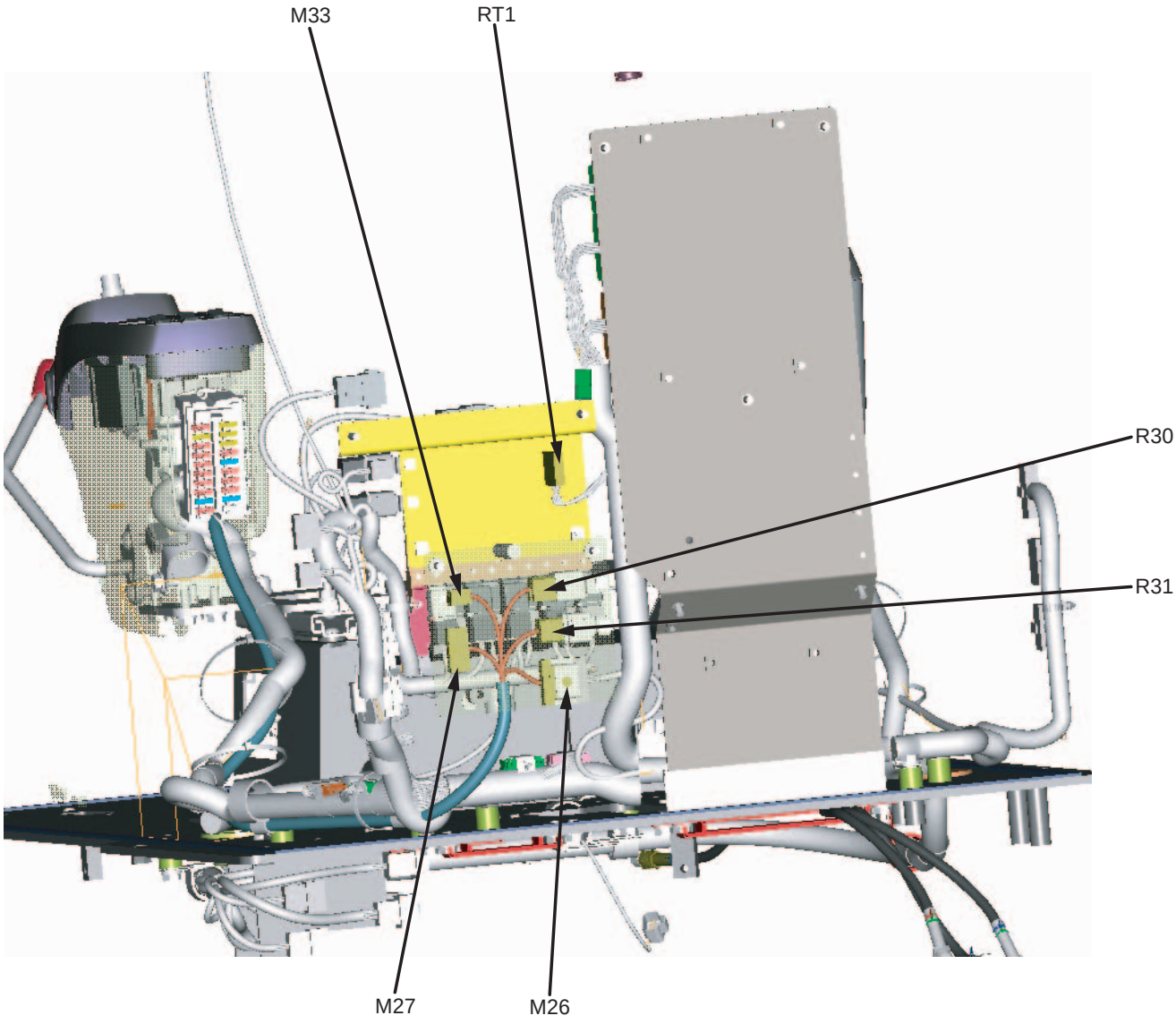



J01
J02
J03
J04
R22
M79
M71
H12
H11
H10
View K
N08
D06
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D05
M31
J07
J08
J09
J10
J06
J05
T05
S29
S95

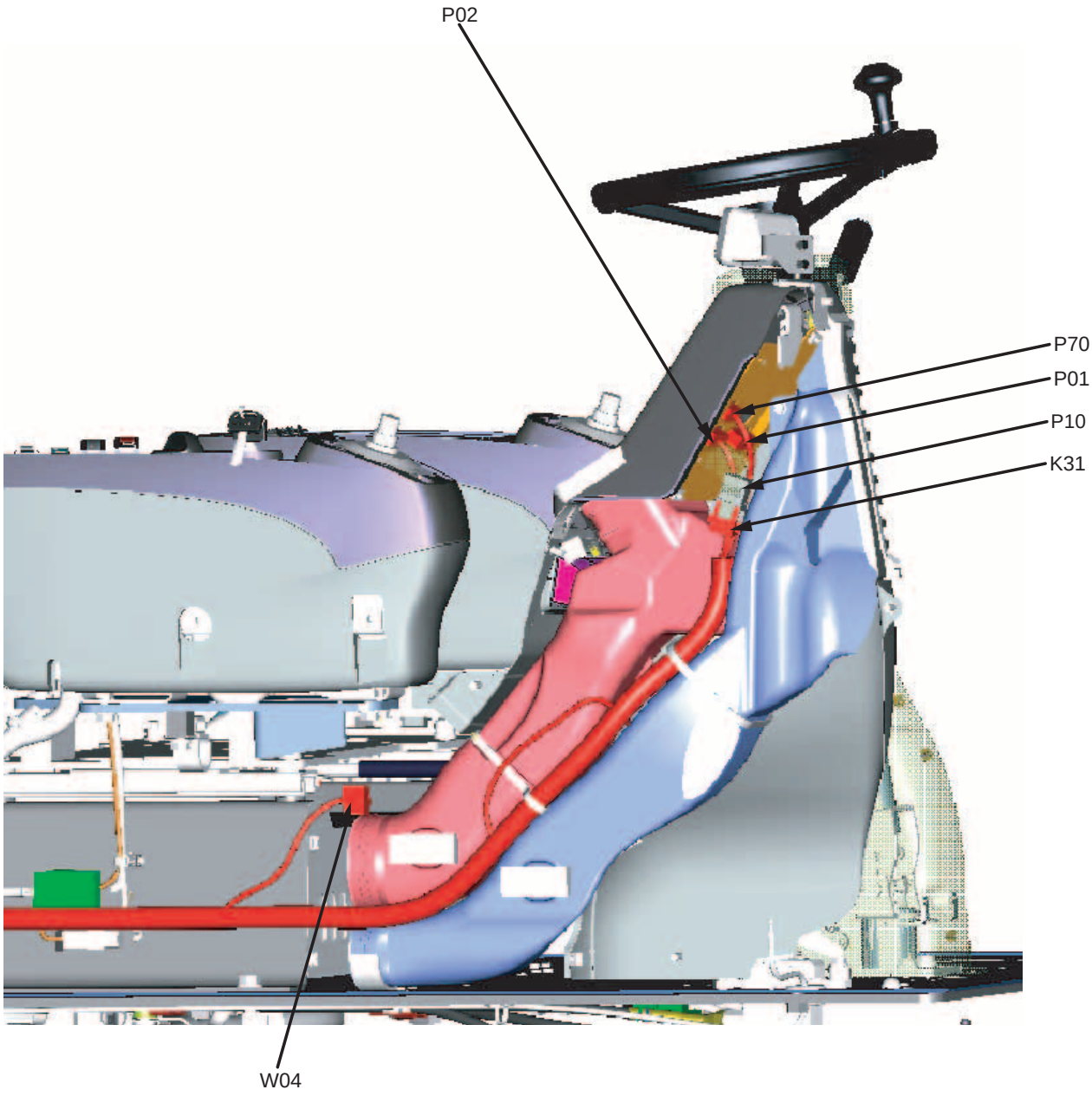
View K



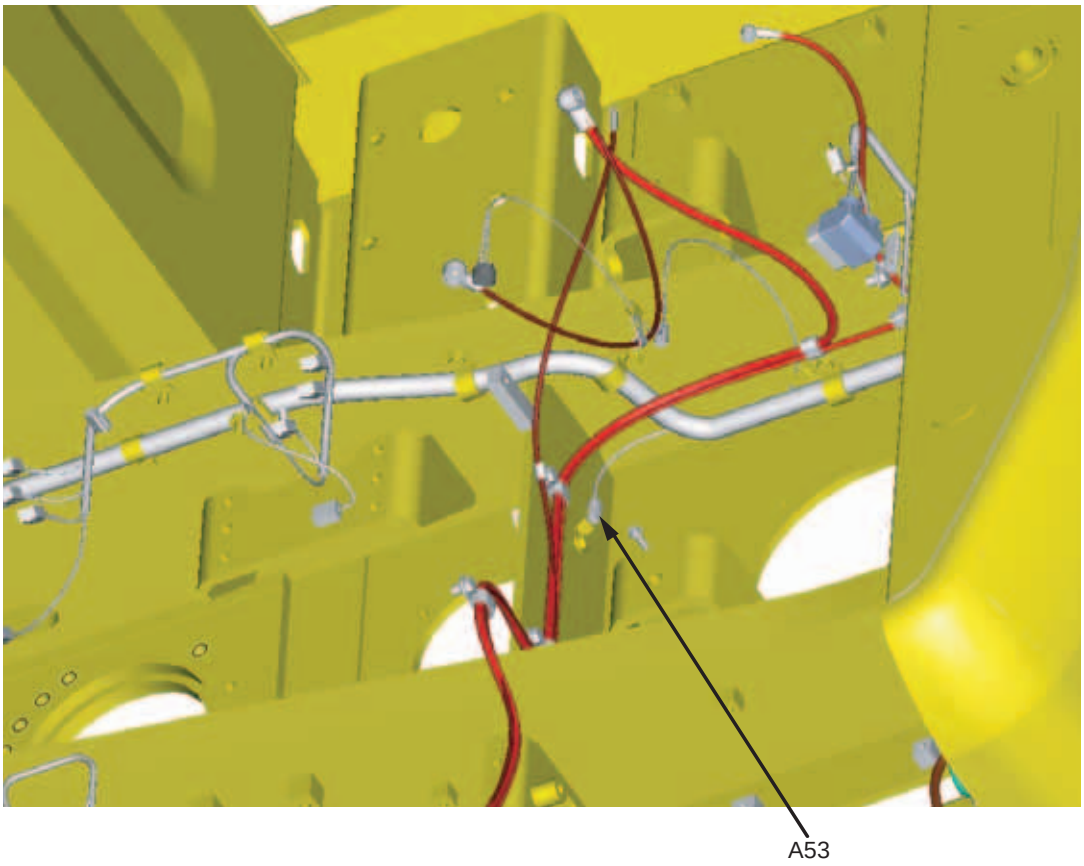
View L



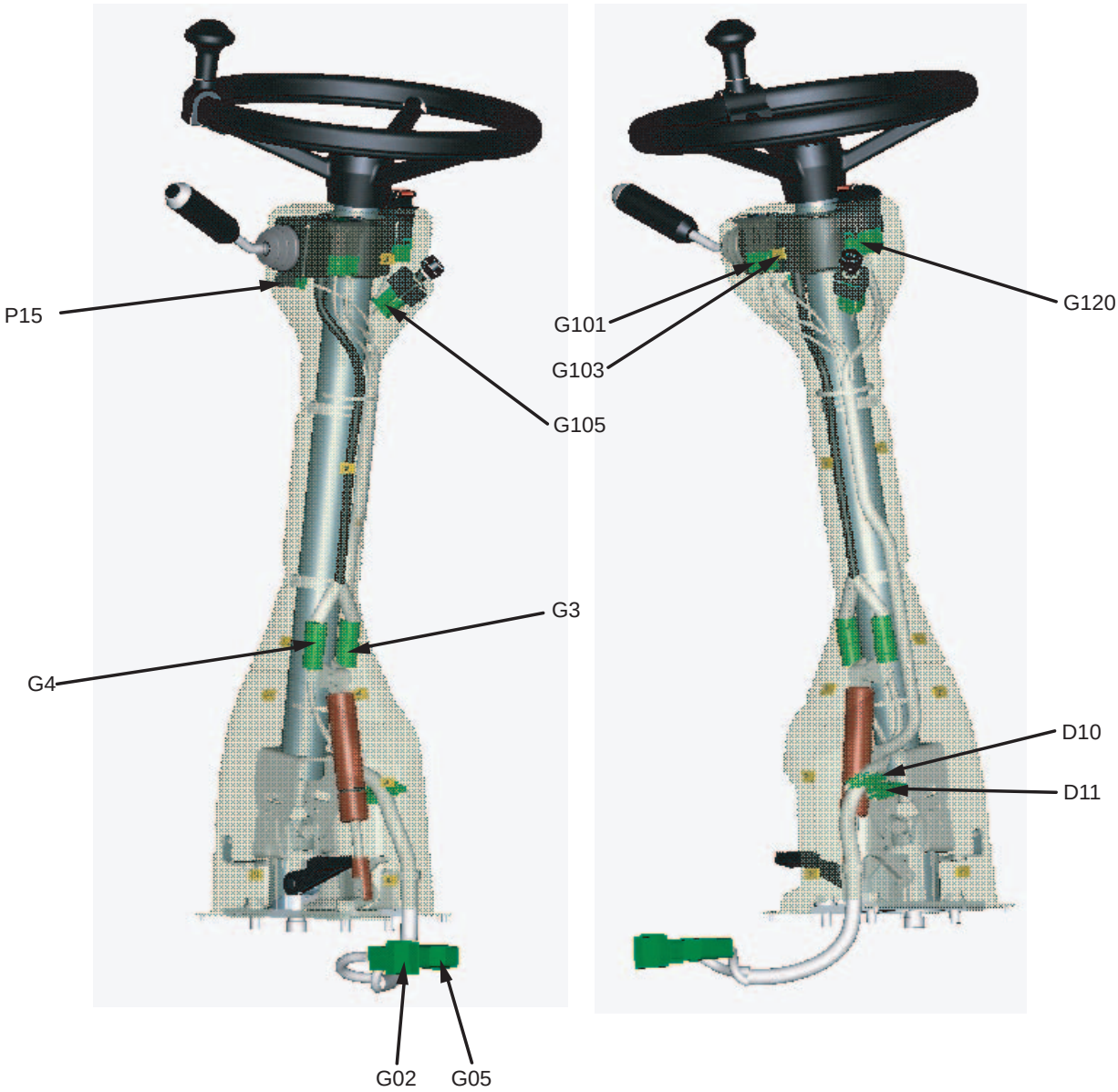
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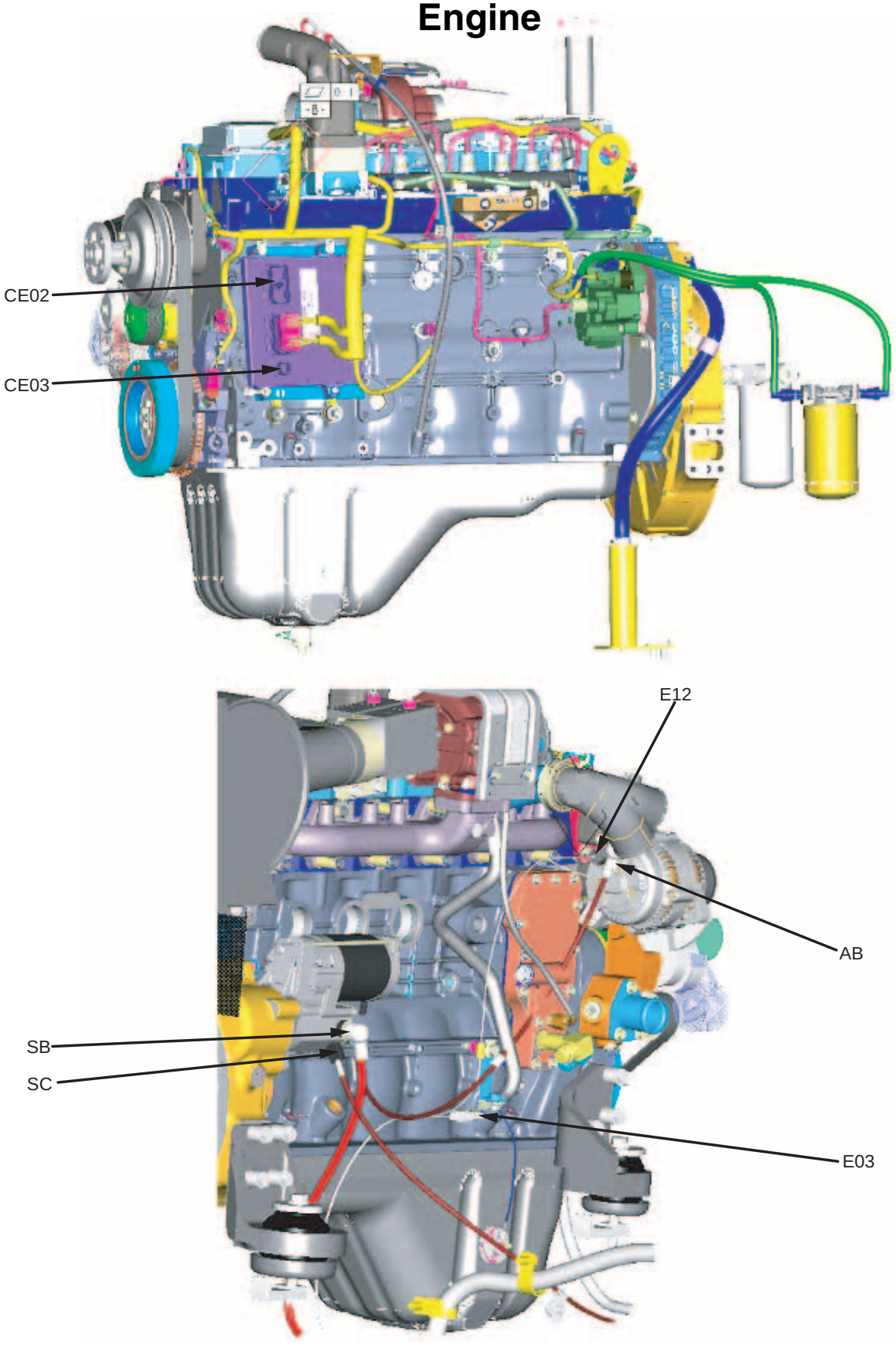
View M



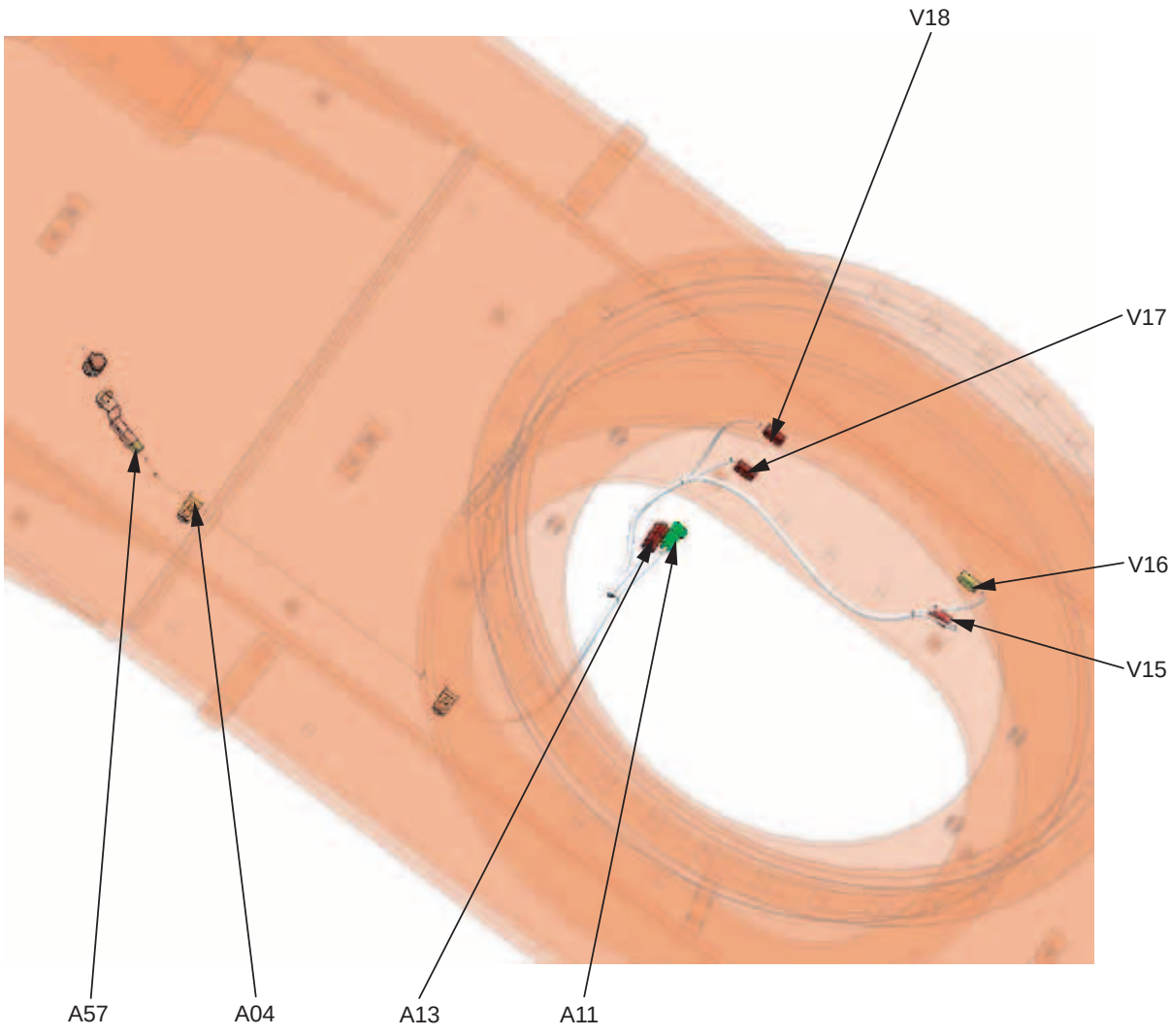
Steering Column



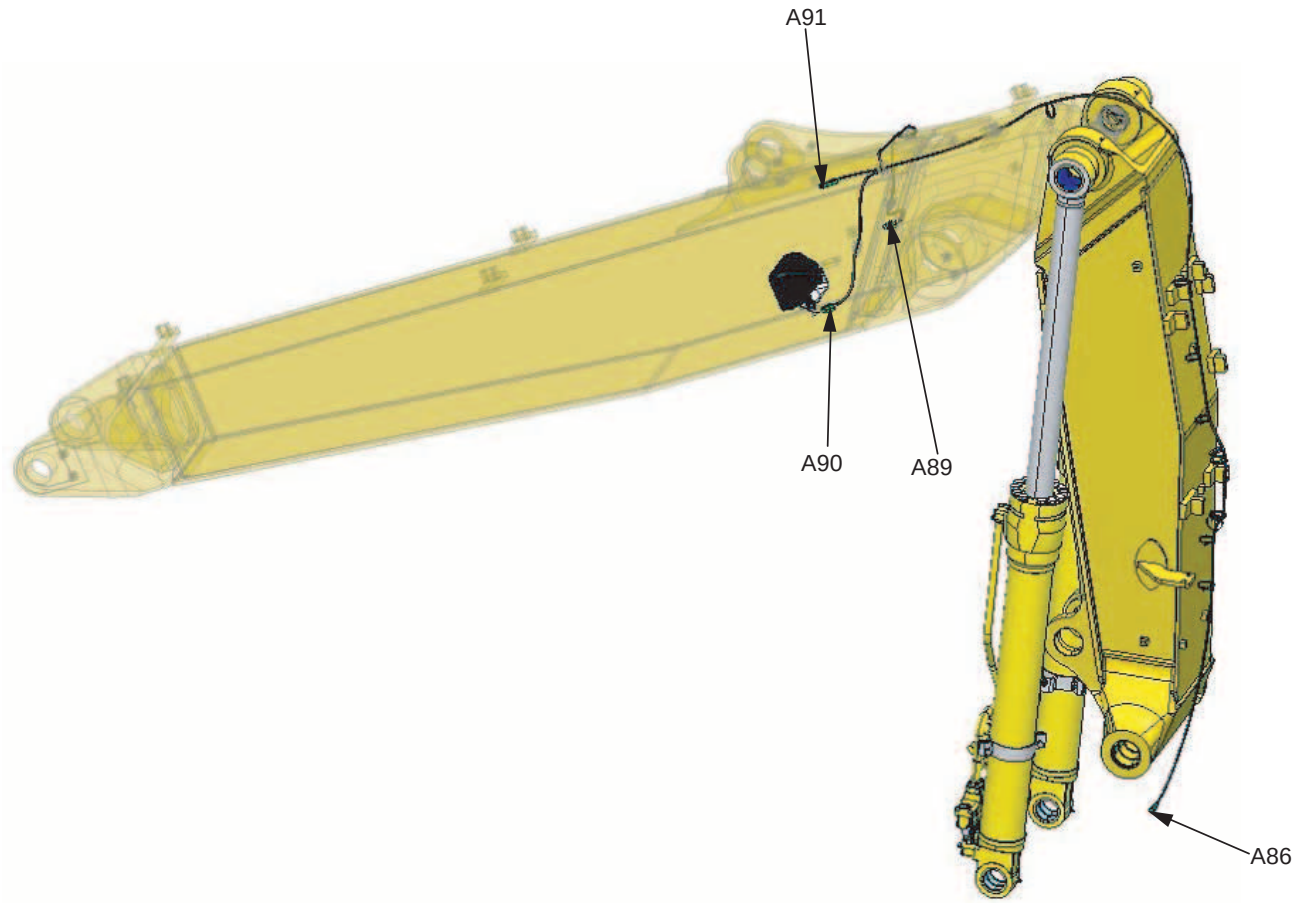
Engine



Undercarriage

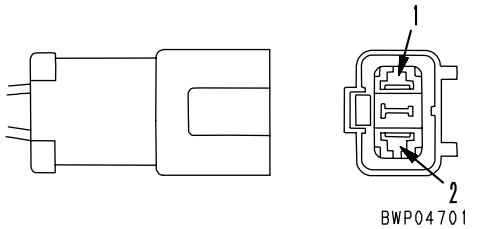
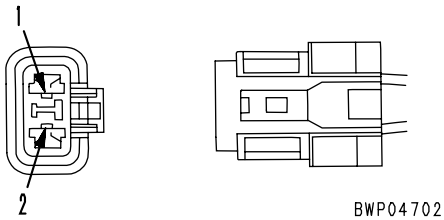
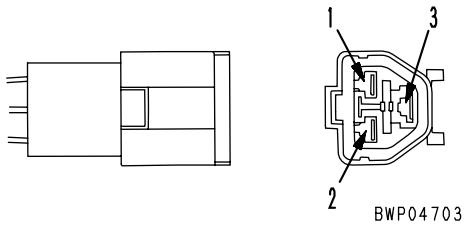
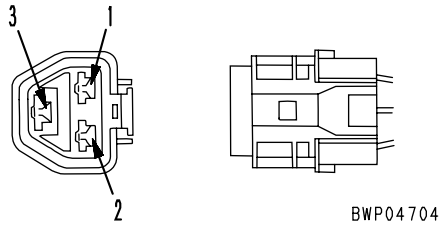
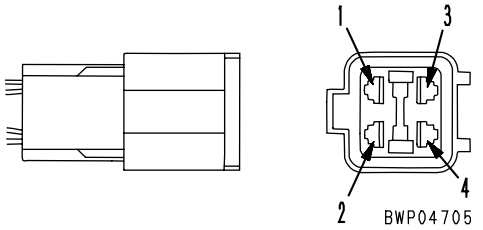
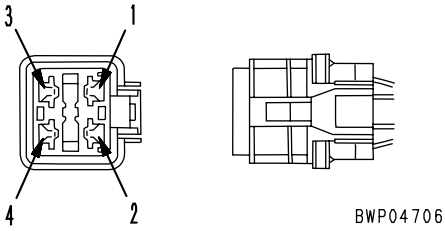


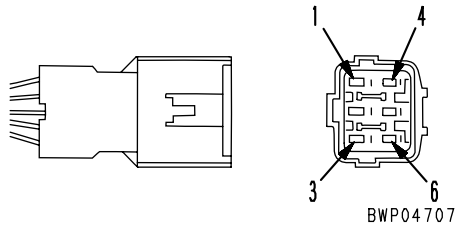
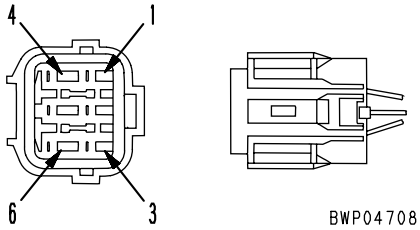
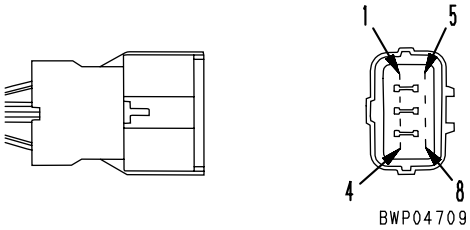
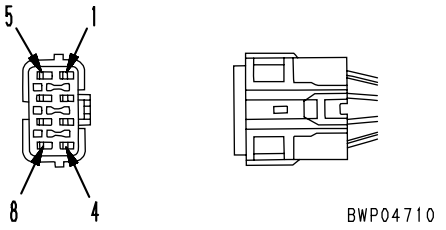
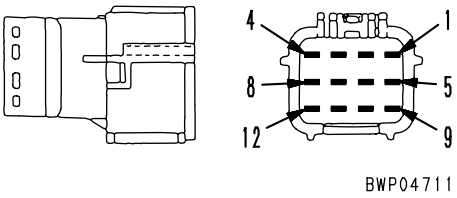
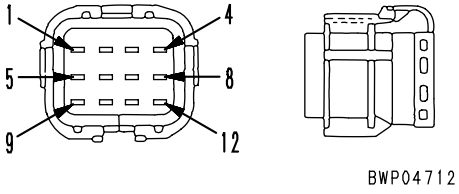
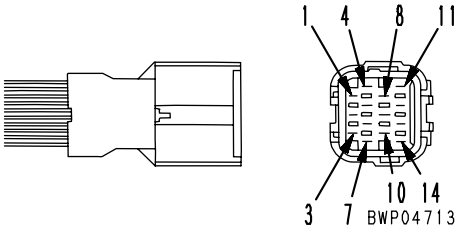
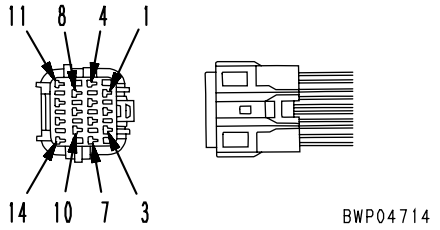
Work Equipment

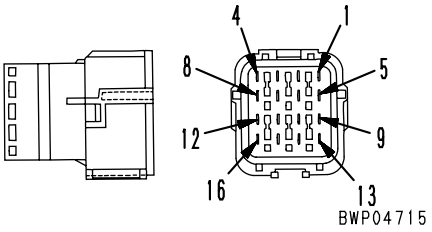
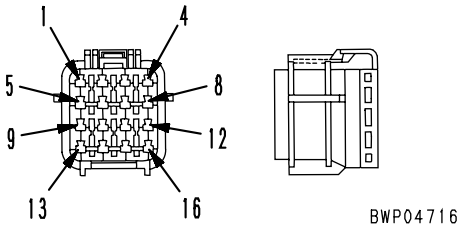


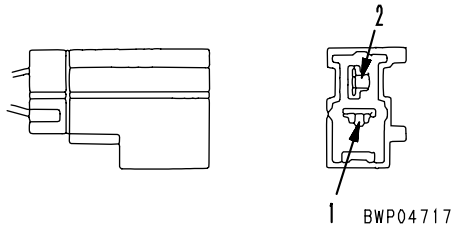
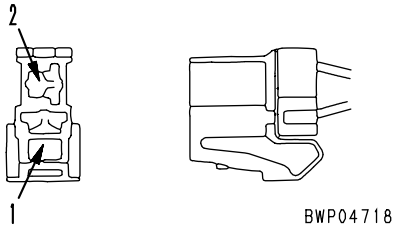
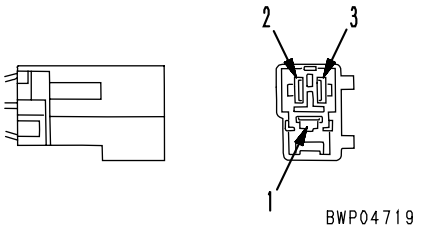
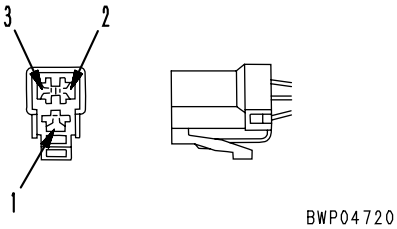
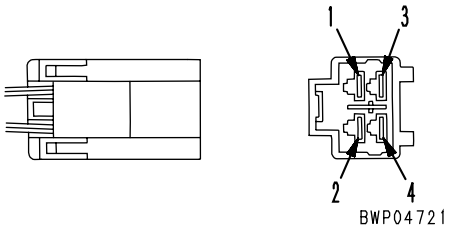
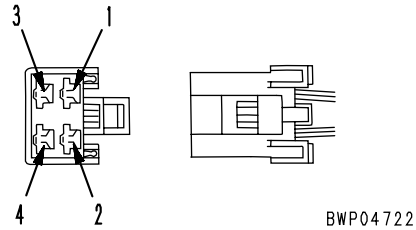
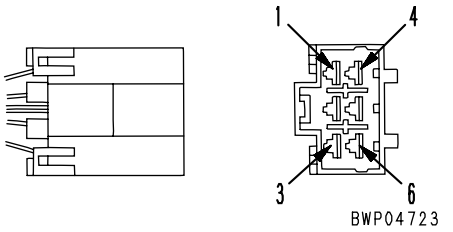
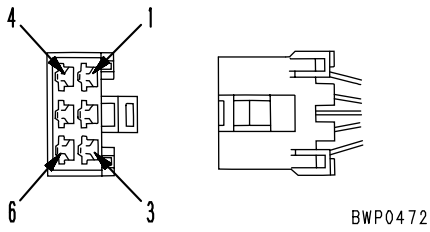
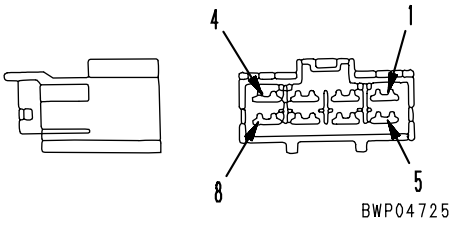
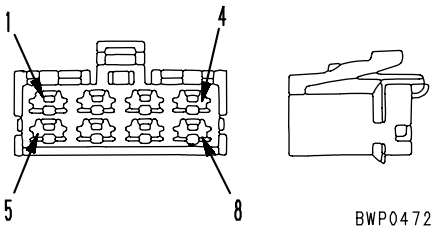
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

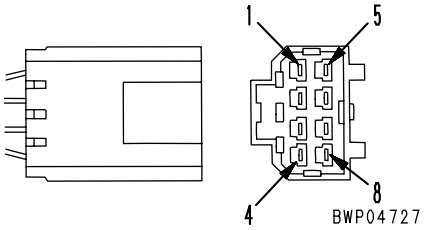
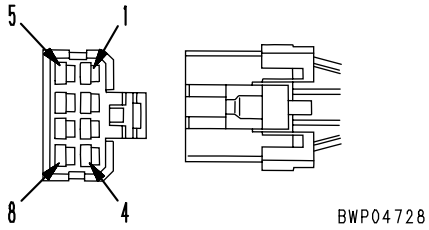
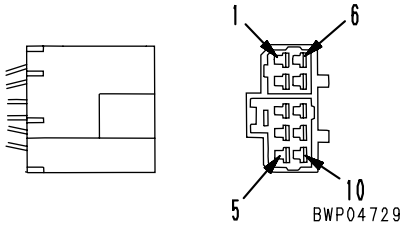
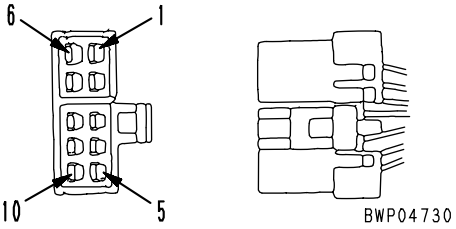
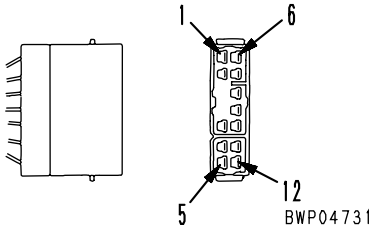
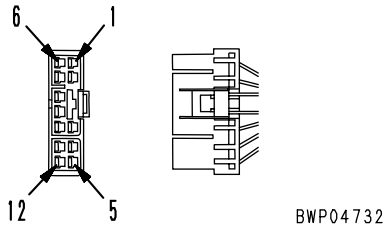
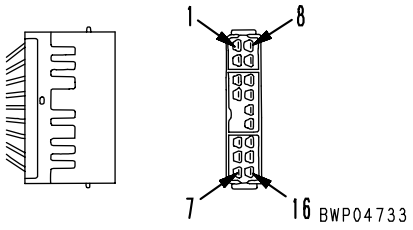
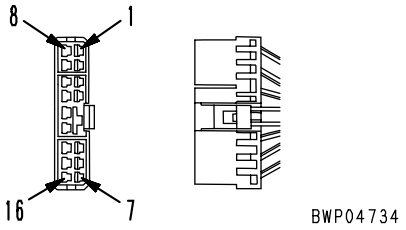
- The terms male and female refer to the pins, while the terms male housing and female housing refer to the mating portion of the housing.

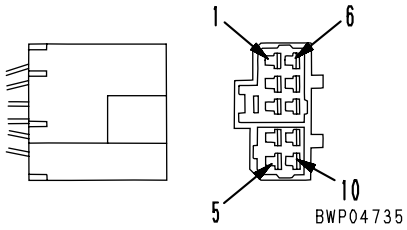
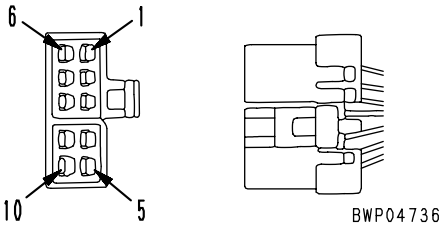
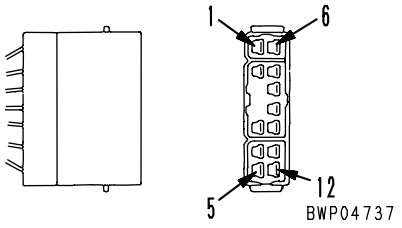
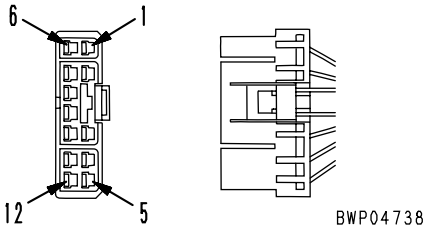
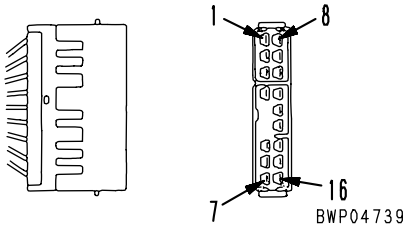
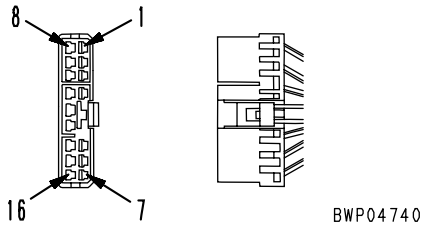
No.of pins	X type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
1	Part No.: 08055-00181	Part No.: 08055-00191	799-601-7010
2			799-601-7020
	Part No.: 08055-00282	Part No.: 08055-00292	
3			799-601-7030
	Part No.: 08055-00381	Part No.: 08055-00391	
4			799-601-7040
	Part No.: 08055-00481	Part No.: 08055-00491, 08055-00492	
—	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	—

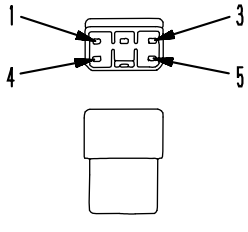
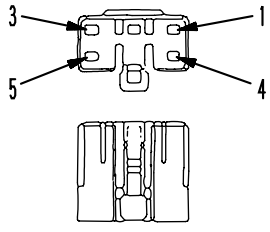
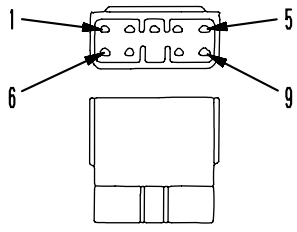
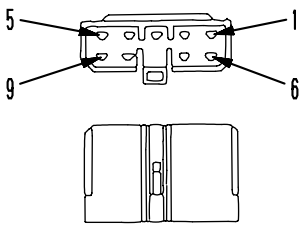
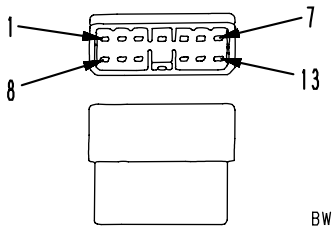
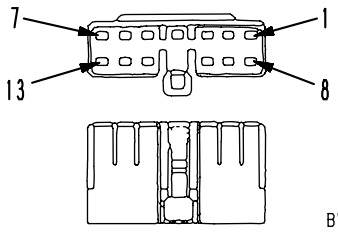
No.of pins	SWP type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
6			799-601-7050
	Part No.: 08055-10681	Part No.: 08055-10691	
8			799-601-7060
	Part No.: 08055-10881, 08055-10882	Part No.: 08055-10891, 08055-10892	
12			799-601-7310
	Part No.: 08055-11281	Part No.: 08055-11291	
14			799-601-7070
	Part No.: 08055-11481, 08055-11482	Part No.: 08055-11491, 08055-11492	

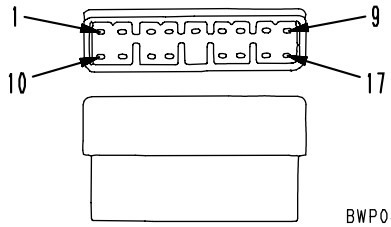
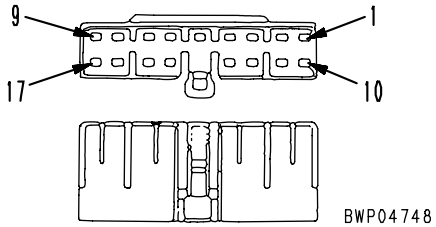
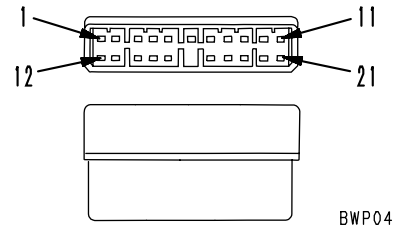
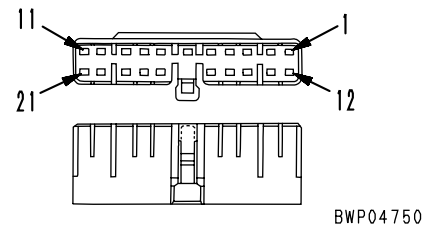
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<tr><td>Male (female housing)</td><td>Female (male housing)</td><td>T-adapter Part No.</td></tr>
<tr><td rowspan="2">16</td><td> 
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</td><td rowspan="2">799-601-7320</td></tr>
<tr><td>Part No.: 08055-11681, 08055-11682</td><td>Part No.: 08055-11691, 08055-11692</td></tr>
<tr><td>—</td><td>Terminal part No.:
● Electric wire size: 0.85
● Grommet: Black
● Q’ty: 20</td><td>Terminal part No.:
● Electric wire size: 0.85
● Grommet: Black
● Q’ty: 20</td><td>—</td></tr>
<tr><td>—</td><td>Terminal part No.:
● Electric wire size: 1.25
● Grommet: Red
● Q’ty: 20</td><td>Terminal part No.:
● Electric wire size: 1.25
● Grommet: Red
● Q’ty: 20</td><td>—</td></tr>
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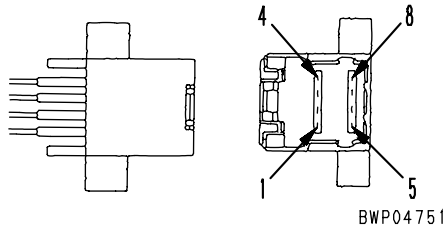
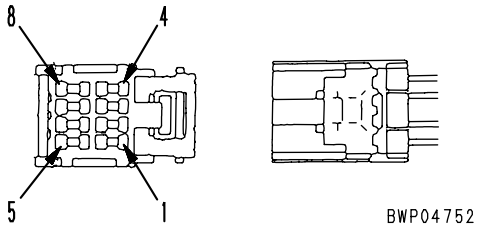
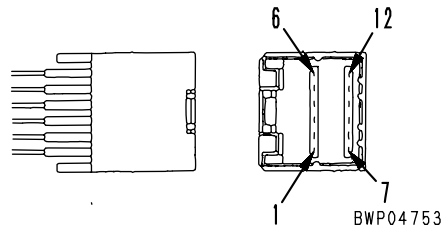
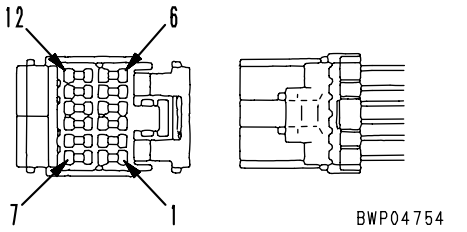
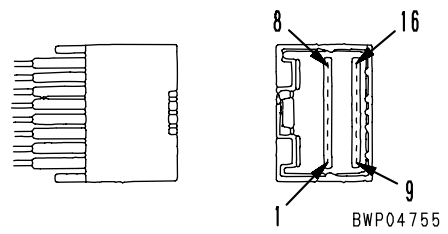
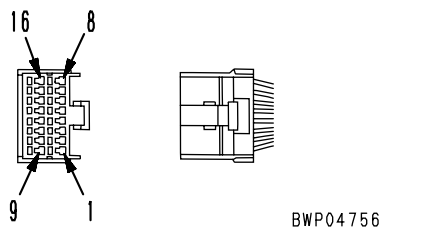
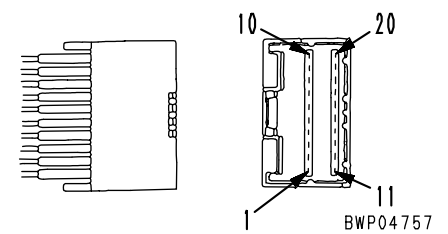
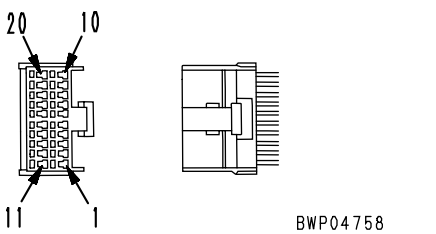
No.of pins	M type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
1	Part No.: 08056-00171	Part No.: 08056-00181	799-601-7080
2			799-601-7090
	Part No.: 08056-00271	Part No.: 08056-00281	
3			799-601-7110
	Part No.: 08056-00371	Part No.: 08056-00381	
4			799-601-7120
	Part No.: 08056-00471	Part No.: 08056-00481	
6			799-601-7130
	Part No.: 08056-00671	Part No.: 08056-00681	
8			799-601-7390
	Part No.: 08056-00871	Part No.: 08056-00881	

No.of pins	S type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8			799-601-7140
	Part No.: 08056-10871	Part No.: 08056-10881	
10 (White)			799-601-7150
	Part No.: 08056-11071	Part No.: 08056-11081	
12 (White)			799-601-7350
	Part No.: 08056-11271	Part No.: 08056-11281	
16 (White)			799-601-7330
	Part No.: 08056-11671	Part No.: 08056-11681, 08056-11682	

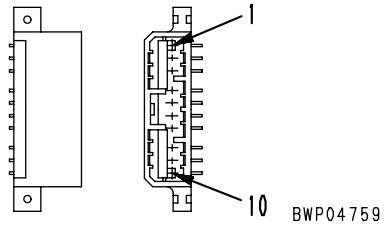
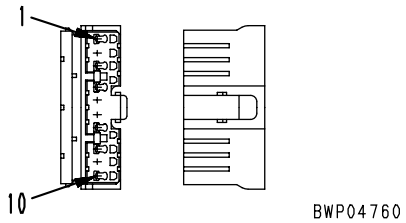
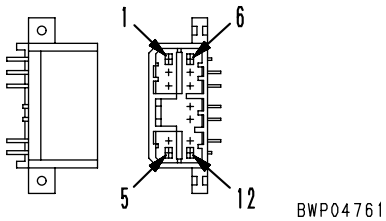
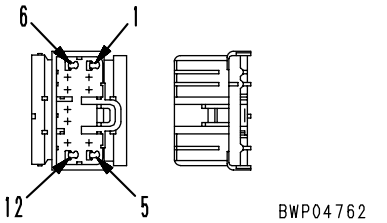
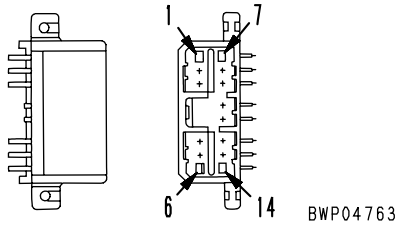
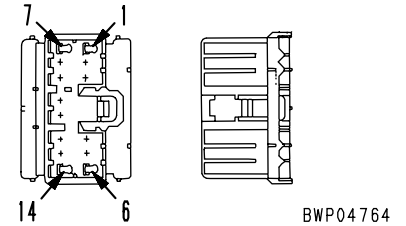
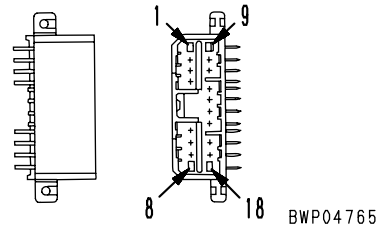
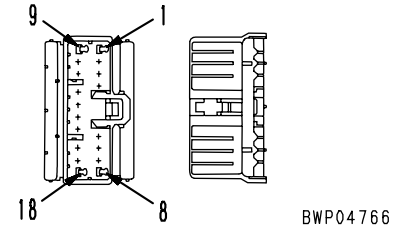
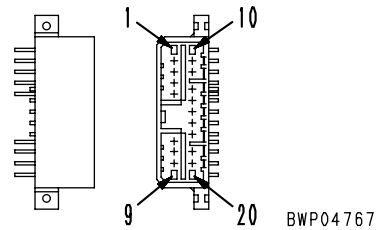
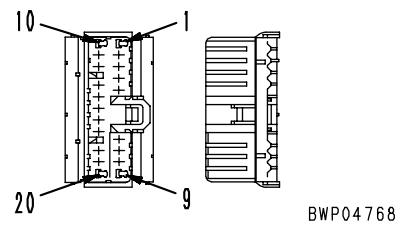
<table>
<tr><td rowspan="2">No.of pins</td><td colspan="3">S type connector</td></tr>
<tr><td>Male (female housing)</td><td>Female (male housing)</td><td>T-adapter Part No.</td></tr>
<tr><td rowspan="2">10 (Blue)</td><td> 
</td><td> 
</td><td rowspan="2">—</td></tr>
<tr><td>—</td><td>—</td></tr>
<tr><td rowspan="2">12 (Blue)</td><td> 
</td><td> 
</td><td rowspan="2">799-601-7160</td></tr>
<tr><td>Part No.: 08056-11272, 08056-11271</td><td>Part No.: 08056-11282, 08056-11281</td></tr>
<tr><td rowspan="2">16 (Blue)</td><td> 
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</td><td rowspan="2">799-601-7170</td></tr>
<tr><td>Part No.: 08056-11672, 08056-11671</td><td>Part No.: 08056-11682</td></tr>
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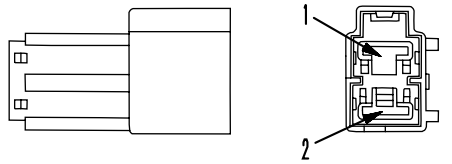
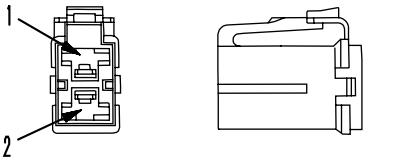
No.of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
7	Body part No.: 79A-222-2640 (Q'ty: 5)	Body part No.: 79A-222-2630 (Q'ty: 5)	—
11	Body part No.: 79A-222-2680 (Q'ty: 5)	Body part No.: 79A-222-2670 (Q'ty: 5)	—
5	 BWP04741	 BWP04742	799-601-2710
	Body part No.: 79A-222-2620 (Q'ty: 5)	Body part No.: 79A-222-2610 (Q'ty: 5)	
9	 BWP04743	 BWP04744	799-601-2950
	Body part No.: 79A-222-2660 (Q'ty: 5)	Body part No.: 79A-222-2650 (Q'ty: 5)	
13	 BWP04745	 BWP04746	799-601-2720
	Body part No.: 79A-222-2710 (Q'ty: 2)	Body part No.: 79A-222-2690 (Q'ty: 2)	

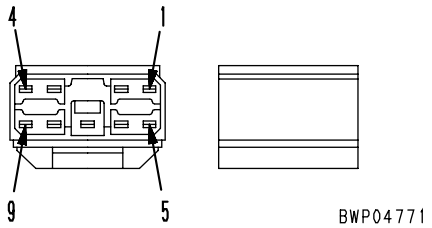
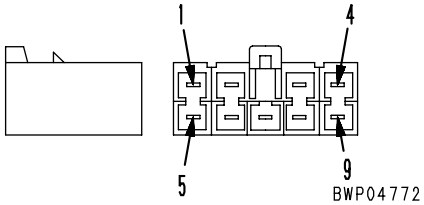
No.of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
17			799-601-2730
	Body part No.: 79A-222-2730 (Q'ty: 2)	Body part No.: 79A-222-2720 (Q'ty: 2)	
21			799-601-2740
	Body part No.: 79A-222-2750 (Q'ty: 2)	Body part No.: 79A-222-2740 (Q'ty: 2)	
	Terminal part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

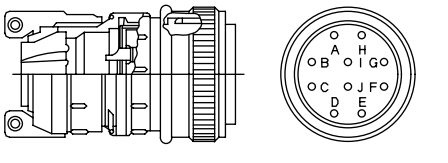
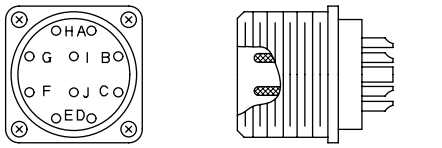
No.of pins	AMP040 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8			799-601-7180
	—	Housing part No.: 79A-222-3430 (Q'ty: 5)	
12			799-601-7190
	—	Housing part No.: 79A-222-3440 (Q'ty: 5)	
16			799-601-7210
	—	Housing part No.: 79A-222-3450 (Q'ty: 5)	
20			799-601-7220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

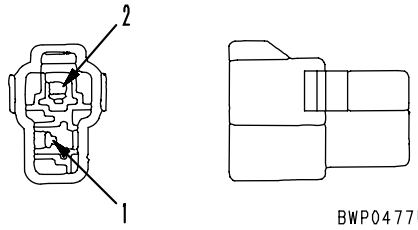
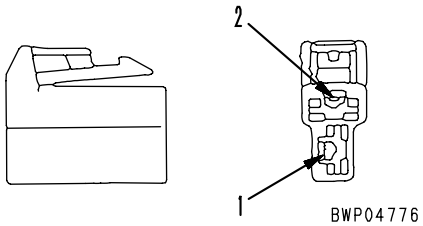
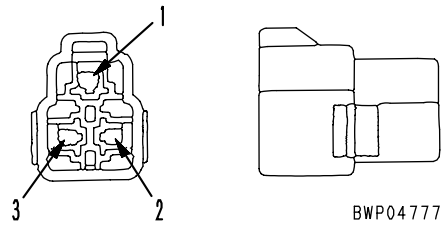
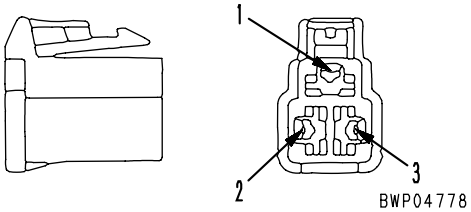
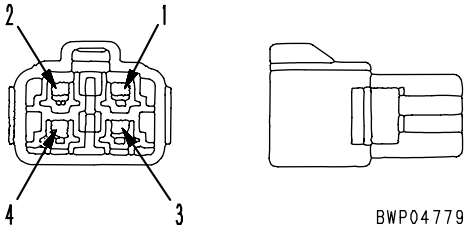
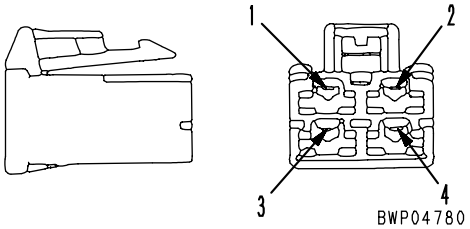
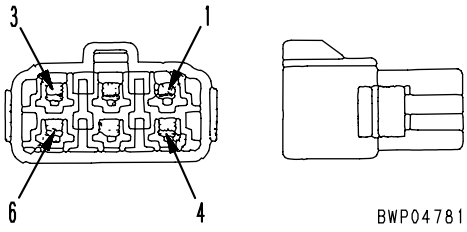
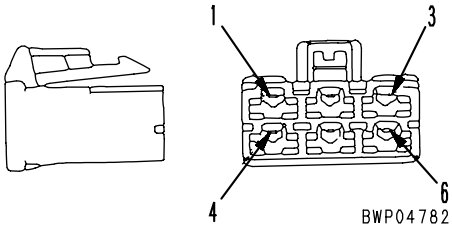
- Terminal part No.: 79A-222-3470 (No relation with number of pins)

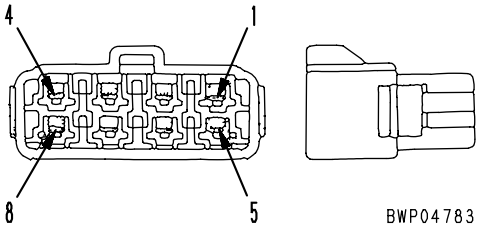
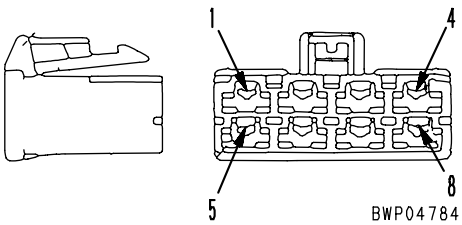
No.of pins	AMP070 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10			799-601-7510
	—	Part No.: 08195-10210	
12			799-601-7520
	—	Part No.: 08195-12210	
14			799-601-7530
	—	Part No.: 08195-14210	
18			799-601-7540
	—	Part No.: 08195-18210	
20			799-601-7550
	—	Part No.: 08195-20210	

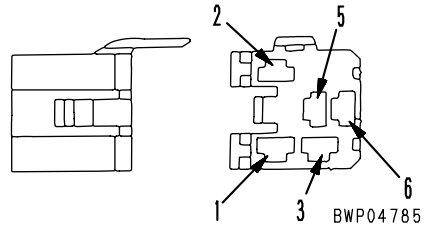
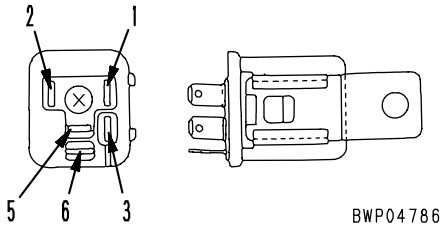
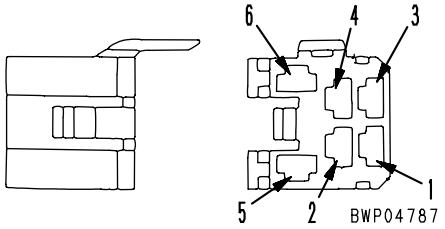
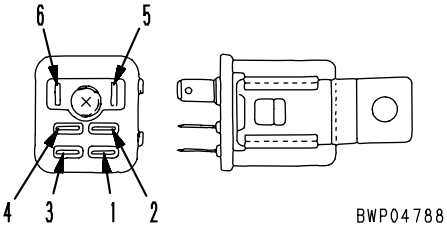
No.of pins	L type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2	 BWP04769	 BWP04770	—
	—	—	

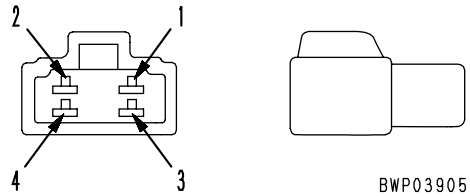
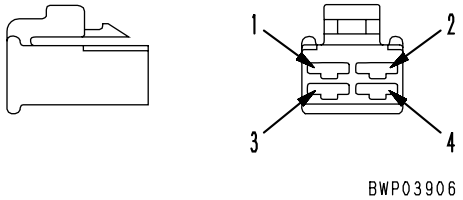
No.of pins	Connector for PA		
	Male (female housing)	Female (male housing)	T-adapter Part No.
9	 BWP04771	 BWP04772	—
	—	—	

No.of pins	Bendix MS connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10	 BWP04773	 BWP04774	799-601-3460
	—	—	

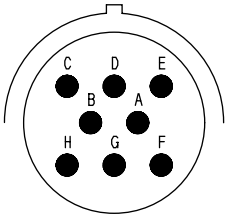
No.of pins	KES 1 (Automobile) connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2			—
	Part No.:08027-10210 (Natural color) 08027-10220 (Black)	Part No.:08027-10260 (Natural color) 08027-10270 (Black)	
3			—
	Part No.:08027-10310	Part No.:08027-10360	
4			—
	Part No.:08027-10410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

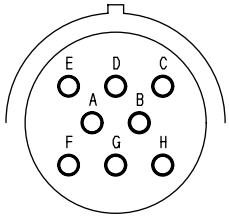
No.of pins	KES 1 (Automobile) connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8			—
	Part No.:08027-10810 (Natural color) 08027-10820 (Black)	Part No.:08027-10860 (Natural color) 08027-10870 (Black)	

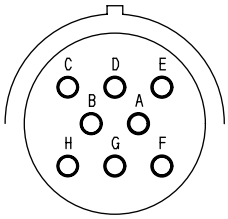
No.of pins	Connector for relay (Socket type)		
	Male (female housing)	Female (male housing)	T-adapter Part No.
5			799-601-7360
	—	—	
6			799-601-7370
	—	—	

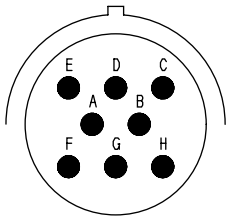
No.of pins	F type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
4			—
	—	—	

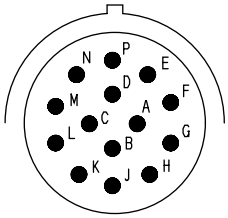
[The pin No. is also marked on the connector (electric wire insertion end)]

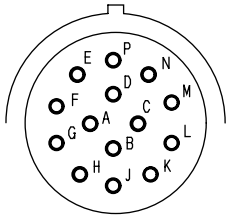
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<tr><td>Body (plug)</td><td>Body (receptacle)</td><td>T-adapter Part No.</td></tr>
<tr><td rowspan="4">18-8 (1)</td><td>Pin (male terminal)</td><td>Pin (female termial)</td><td rowspan="2">799-601-9210</td></tr>
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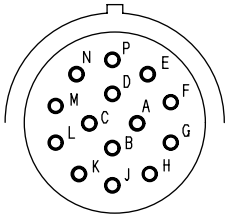
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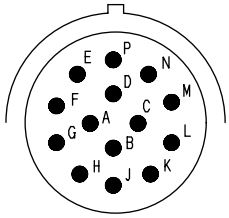
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<tr><td>Pin (female terminal)</td><td>Pin (male termial)</td><td rowspan="2">799-601-9210</td></tr>
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BWP05003</td><td> 

BWP05004</td></tr>
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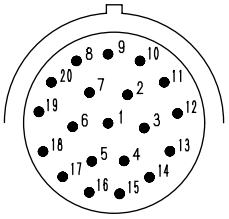
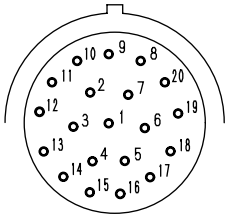
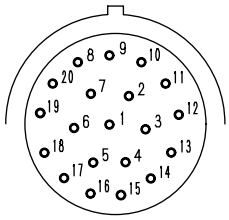
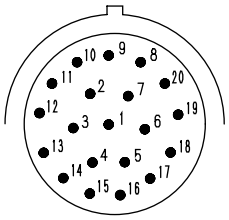
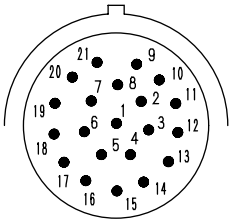
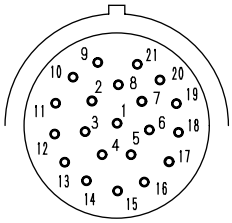
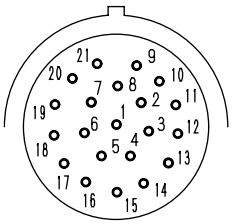
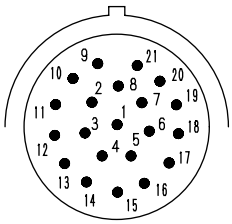
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<tr><td>Pin (female terminal)</td><td>Pin (male termial)</td><td rowspan="2">799-601-9220</td></tr>
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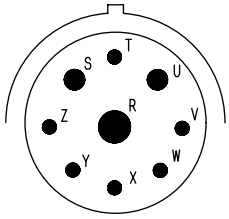
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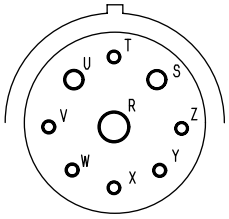
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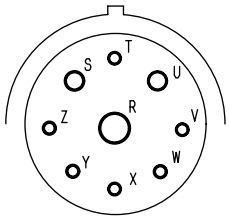
[The pin No. is also marked on the connector (electric wire insertion end)]

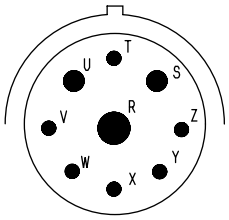
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<tr><td rowspan="2">Type (shell size code)</td><td colspan="3">HD30 Series connector</td></tr>
<tr><td>Body (plug)</td><td>Body (receptacle)</td><td>T-adapter Part No.</td></tr>
<tr><td rowspan="4">18-20 (3)</td><td>Pin (male terminal)</td><td>Pin (female termial)</td><td rowspan="2">799-601-9230</td></tr>
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<tr><td>Part No.:08191-31201, 08191-31202</td><td>Part No.:08191-34101, 08191-34102</td></tr>
<tr><td>Pin (female terminal)</td><td>Pin (male termial)</td><td rowspan="2">799-601-9230</td></tr>
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<tr><td>Part No.:08191-32201, 08191-32202</td><td>Part No.:08191-33101, 08191-33102</td></tr>
<tr><td rowspan="4">18-21 (4)</td><td>Pin (male terminal)</td><td>Pin (female termial)</td><td rowspan="2">799-601-9240</td></tr>
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<tr><td>Pin (female terminal)</td><td>Pin (male termial)</td><td rowspan="2">799-601-9240</td></tr>
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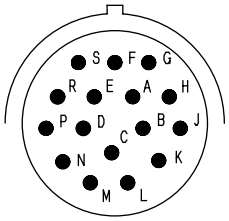
[The pin No. is also marked on the connector (electric wire insertion end)]

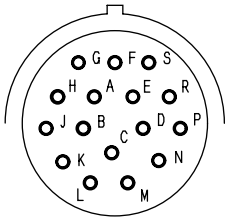
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<tr><td>Body (plug)</td><td>Body (receptacle)</td><td>T-adapter Part No.</td></tr>
<tr><td rowspan="5">24-9 (5)</td><td>Pin (male terminal)</td><td>Pin (female termial)</td><td rowspan="3">799-601-9250</td></tr>
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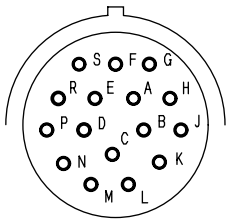
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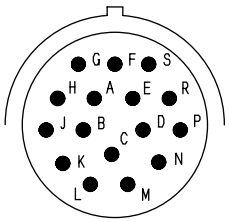
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<tr><td>Part No.:08191-52201, 08191-52202</td><td>Part No.:08191-53101, 08191-53102</td></tr>
<tr><td rowspan="5">24-16 (6)</td><td>Pin (male terminal)</td><td>Pin (female termial)</td><td rowspan="3">799-601-9260</td></tr>
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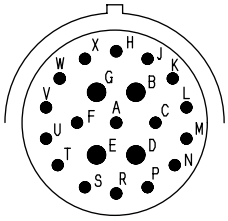
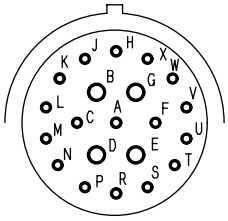
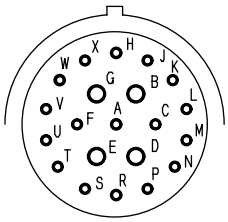
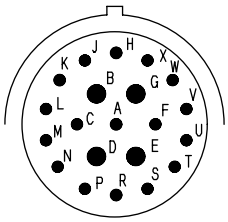
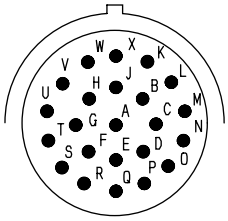
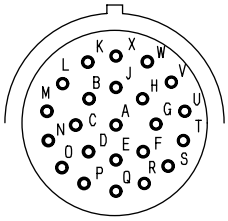
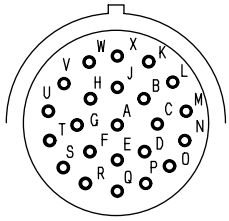
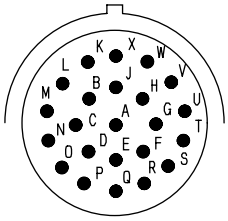
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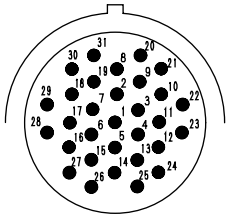
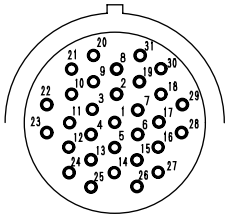
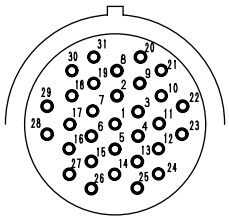
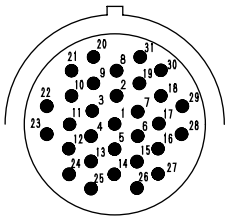
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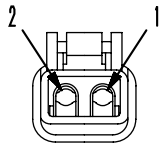
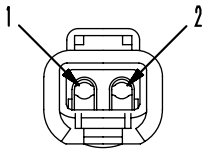
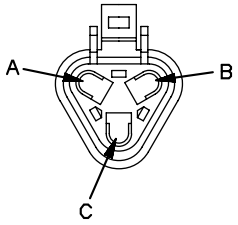
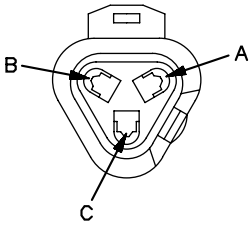
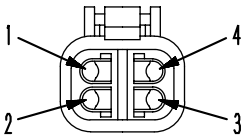
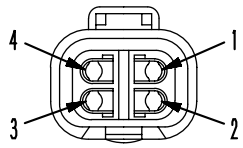
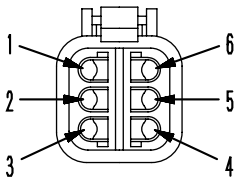
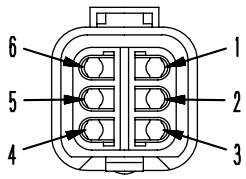
[The pin No. is also marked on the connector (electric wire insertion end)]

<table>
<tr><td rowspan="2">Type (shell size code)</td><td colspan="3">HD30 Series connector</td></tr>
<tr><td>Body (plug)</td><td>Body (receptacle)</td><td>T-adapter Part No.</td></tr>
<tr><td rowspan="4">24-21 (7)</td><td>Pin (male terminal)</td><td>Pin (female termial)</td><td rowspan="2">799-601-9270</td></tr>
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<tr><td>Part No.:08191-71201, 08191-71202,
08191-71205, 08191-71206</td><td>Part No.:08191-74101, 08191-74102,
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<tr><td>Pin (female terminal)</td><td>Pin (male termial)</td><td rowspan="2">799-601-9270</td></tr>
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<tr><td>Part No.:08191-72201, 08191-72202,
08191-72205, 08191-72206</td><td>Part No.:08191-73101, 08191-73102,
08191-73105, 08191-73106</td></tr>
<tr><td rowspan="4">24-22 (8)</td><td>Pin (male terminal)</td><td>Pin (female termial)</td><td rowspan="2">799-601-9280</td></tr>
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08191-81205, 08191-80206</td><td>Part No.:08191-84101, 08191-84102
08191-84103, 08191-84104
08191-84105, 08191-84106</td></tr>
<tr><td>Pin (female terminal)</td><td>Pin (male termial)</td><td rowspan="2">799-601-9280</td></tr>
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08191-82203, 08191-82204
08191-82205, 08191-82206</td><td>Part No.:08191-83101, 08191-83102
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08191-83105, 08191-83106</td></tr>
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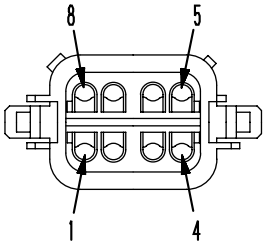
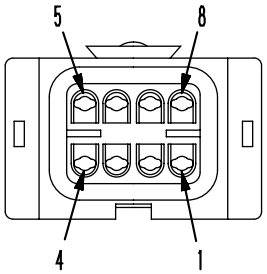
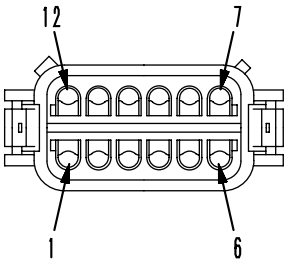
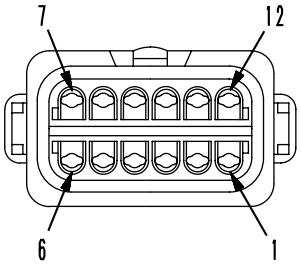
[The pin No. is also marked on the connector (electric wire insertion end)]

Type (shell size code)	HD30 Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
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	
	Pin (female terminal)	Pin (male termial)	799-601-9290
	 BWP05035	 BWP05036	
	Part No.:08191-92203, 08191-92204, 08191-92205, 08191-92206	Part No.:08191-93103, 08191-93104, 08191-93105, 08191-93106	

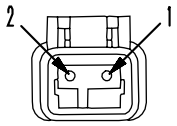
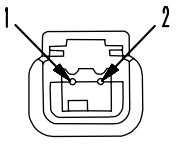
[The pin No. is also marked on the connector (electric wire insertion end)]

No.of pins	DT Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2	 BWP05037	 BWP05038	799-601-9020
	Part No.:08192-12200 (normal type) 08192-22200 (fine wire type)	Part No.:08192-12100 (normal type) 08192-22100 (fine wire type)	
3	 BWP05039	 BWP05040	799-601-9030
	Part No.:08192-13200 (normal type) 08192-23200 (fine wire type)	Part No.:08192-13100 (normal type) 08192-23100 (fine wire type)	
4	 BWP05041	 BWP05042	799-601-9040
	Part No.:08192-14200 (normal type) 08192-24200 (fine wire type)	Part No.:08192-14100 (normal type) 08192-24100 (fine wire type)	
6	 BWP05043	 BWP05044	799-601-9050
	Part No.:08192-16200 (normal type) 08192-26200 (fine wire type)	Part No.:08192-16100 (normal type) 08192-26100 (fine wire type)	

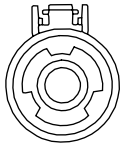
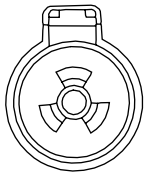
[The pin No. is also marked on the connector (electric wire insertion end)]

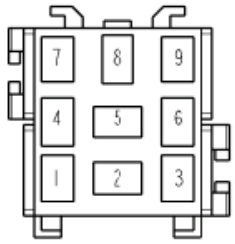
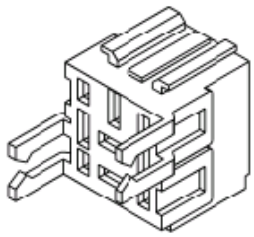
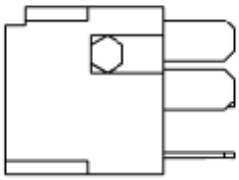
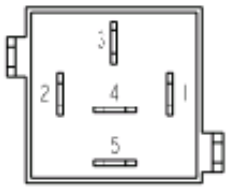
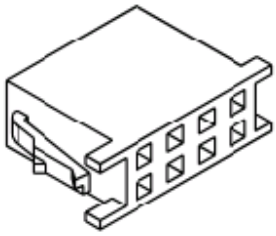
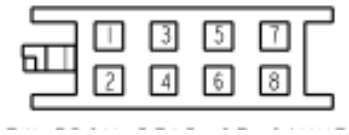
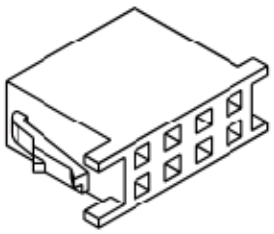
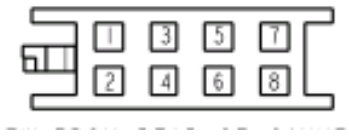
No.of pins	DT Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
8	 BWP05045	 BWP05046	8GR:799-601-9060 8B:799-601-9070 8G:799-601-9080 8BR:799-601-9090
	Part No.:08192-1820☐ (normal type) 08192-2820☐ (fine wire type)	Part No.:08192-1810☐ (normal type) 08192-2810☐ (fine wire type)	
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)	

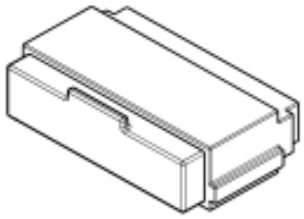
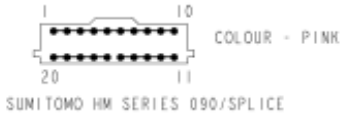
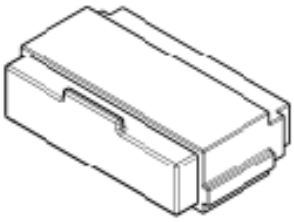
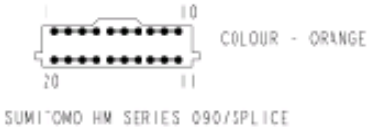
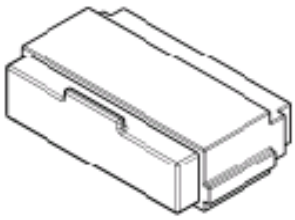
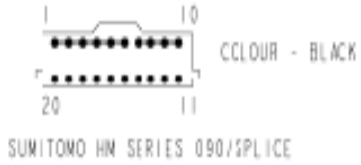
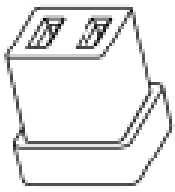
[The pin No. is also marked on the connector (electric wire insertion end)]

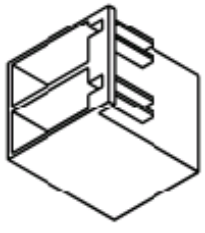
No.of pins	DTM Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2	 BWP05049	 BWP05050	799-601-9010
	Part No.: 08192-02200	Part No.: 08192-02100	

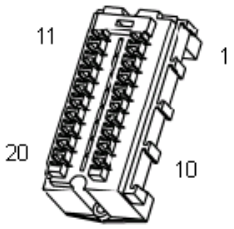
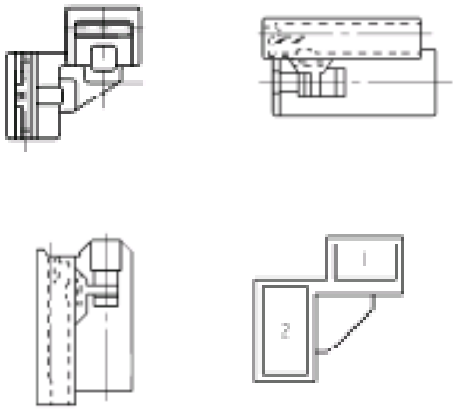
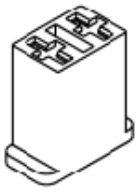
[The pin No. is also marked on the connector (electric wire insertion end)]

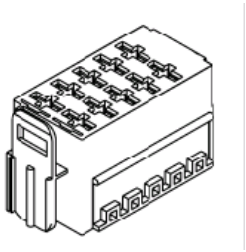
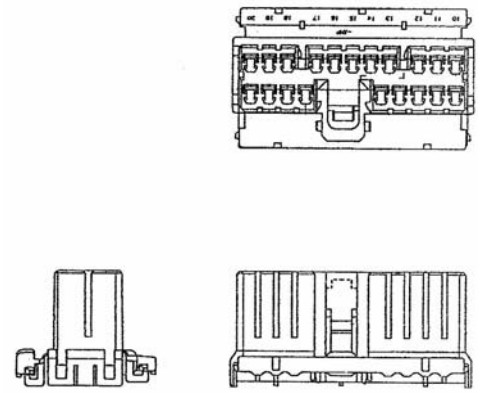
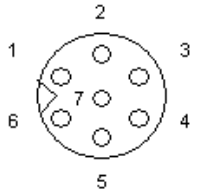
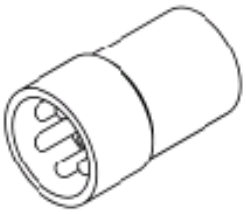
No.of pins	DTHD Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2	 BWP05051	 BWP05052	—
	Part No.:08192-31200 (Contact size#12) 08192-41200 (Contact size #8) 08192-51200 (Contact size #4)	Part No.:08192-31100 (Contact size#12) 08192-41100 (Contact size #8) 08192-51100 (Contact size #4)	

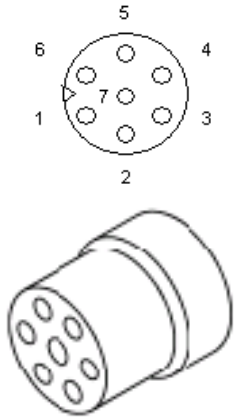
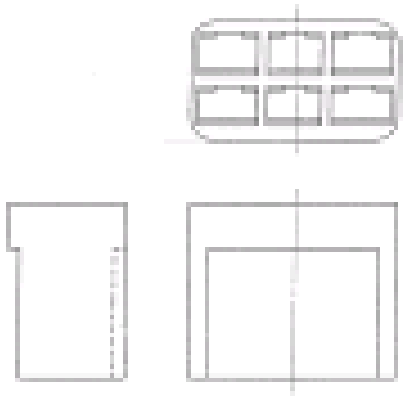
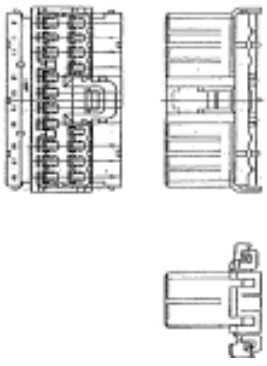
No.of pins	Miscellaneous connectors	
	Body (plug)	Body (receptacle)
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	Part No.:20K-06-31960	Part No.:
5		
	Part No.:20K-06-32130	Part No.:
8		
	Part No.:20K-06-32170	Part No.:
8		
	Part No.:20K-06-K32160	Part No.:

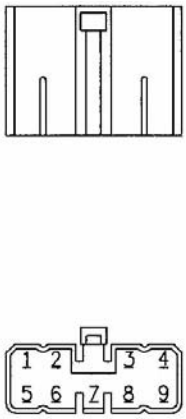
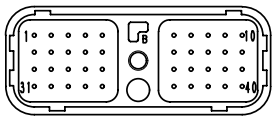
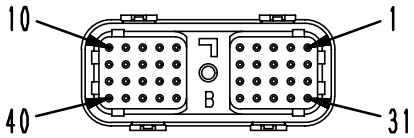
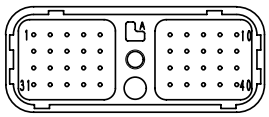
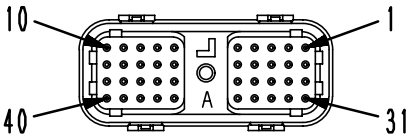
No.of pins	Miscellaneous connectors	
	Body (plug)	Body (receptacle)
20		
	Part No.:20K-06-31460	Part No.:
20		
	Part No.:20K-06-31470	Part No.:
20		
	Part No.:20K-06-31450	Part No.:
2		
	Part No.:	Part No.:

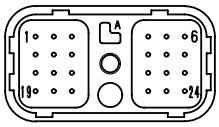
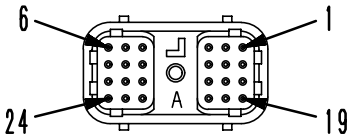
2		
	Part No.:20K-06-32380	Part No.:

No. of Pins	Body (plug)	Body (receptacle)
20		
	Part No.:20K-06-32230	Part No.:
		
	Part No.:198-Z11-2650	Part No.:
2		
	Part No.:20K-06-31820	Part No.:

No. of Pins	Body (plug)	Body (receptacle)
12		
	Part No.:20K-06-31810	Part No.:
		
	Part No.:20K-06-31870	Part No.:
20		
	Part No.:7821-92-7370	Part No.:
7	 	
	Part No.:20K-06-31850	Part No.:

No. of Pins	Body (plug)	Body (receptacle)
7		
	Part No.:20K-06-31860	Part No.:
6		
	Part No.:20G-06-K1420	Part No.:
		
	Part No.:7821-92-7360	Part No.:

No. of Pins	Body (plug)	Body (receptacle)	T-adapter part No.
			
	Part No.:20Y-06-13590	Part No.:	
40 (A)	 BJD12726	 BJD12727	799-601-9350
	-	Part No.: 7821-93-3130	
40 (B)	 BJD12724	 BJD12725	799-601-9350
	-	Part No.: 7821-93-3130	

No. of Pins	Body (plug)	Body (receptacle)	T-adapter part No.
24	 BJD12722	 BJD12723	799-601-9360
	-	Part No.: 7821-93-3110	

T-boxes and T-adapters table

- The Nos. in the columns are the part Nos. of the T-boxes, T-adapters, and other parts. The Nos. in the lines are the kit Nos. of the T-adapter kits.

Part No.	Part name	Number of pins	Identification symbol	T-adapter kit																Out of kit
				799-601-2500	799-601-2700	799-601-2800	799-601-2900	799-601-3000	799-601-5500	799-601-6000	799-601-6500	799-601-7000	799-601-7100	799-601-7400	799-601-7500	799-601-8000	799-601-9000	799-601-9100	799-601-9200	799-601-9300	
799-601-2600	T-box (for ECONO)	21		q		q	q						q	q		q					
799-601-3100	T-box (for MS)	37						q													
799-601-3200	T-box (for MS)	37						q													
799-601-3300	T-box (for ECONO)	24								q											
799-601-3360	• Plate for MS (24-pin)									q											
799-601-3370	• Plate for MS (17-pin)									q											
799-601-3380	• Plate for MS (14-pin)									q											
799-601-3410	Adapter for BENDIX (MS)	24	MS-24P							q	q										
799-601-3420	Adapter for BENDIX (MS)	24	MS-24P							q	q										
799-601-3430	Adapter for BENDIX (MS)	17	MS-17P							q	q										
799-601-3440	Adapter for BENDIX (MS)	17	MS-17P							q	q										
799-601-3450	Adapter for BENDIX (MS)	5	MS-5P						q	q											
799-601-3460	Adapter for BENDIX (MS)	10	MS-10P							q	q										
799-601-3510	Adapter for BENDIX (MS)	5	MS-5S						q	q											
799-601-3520	Adapter for BENDIX (MS)	17	MS-17P						q	q											
799-601-3530	Adapter for BENDIX (MS)	19	MS-19P							q	q										
799-601-2910	Adapter for BENDIX (MS)	14	MS-14P						q	q											
799-601-3470	Case									q											
799-601-2710	Adapter for MIC	5	MIC-5P	q	q		q							q							
799-601-2720	Adapter for MIC	13	MIC-13P	q	q		q							q							
799-601-2730	Adapter for MIC	17	MIC-17P	q	q	q	q						q	q		q					
799-601-2740	Adapter for MIC	21	MIC-21P	q	q	q	q						q	q		q					
799-601-2950	Adapter for MIC	9	MIC-9P									q	q	q		q					
799-601-2750	Adapter for ECONO	2	ECONO2P	q	q																
799-601-2760	Adapter for ECONO	3	ECONO13P	q	q																
799-601-2770	Adapter for ECONO	4	ECONO4P	q	q																
799-601-2780	Adapter for ECONO	8	ECONO8P	q	q																
799-601-2790	Adapter for ECONO	12	ECONO12P	q	q																
799-601-2810	Adapter for DLI	8	DLI-8P	q	q																
799-601-2820	Adapter for DLI	12	DLI-12P	q	q																
799-601-2830	Adapter for DLI	16	DLI-16P	q	q																
799-601-2840	Extension cable (ECONO type)	12	ECONO12P	q	q									q							
799-601-2850	Case			q																	
799-601-4210	Adapter for DRC	50	DRC50																		q
799-601-7010	Adapter for X (T-adapter)	1												q		q					
799-601-7020	Adapter for X	2	X2P									q	q	q		q					
799-601-7030	Adapter for X	3	X3P									q	q	q		q					
799-601-7040	Adapter for X	4	X4P									q	q	q		q					

Part No.	Part name	Number of pins	Identification symbol	T-adapter kit																Out of kit
				799-601-2500	799-601-2700	799-601-2800	799-601-2900	799-601-3000	799-601-5500	799-601-6000	799-601-6500	799-601-7000	799-601-7100	799-601-7400	799-601-7500	799-601-8000	799-601-9000	799-601-9100	799-601-9200	799-601-9300	
799-601-7050	Adapter for SWP	6	SW6P									q	q	q						
799-601-7060	Adapter for SWP	8	SW8P									q	q	q						
799-601-7310	Adapter for SWP	12	SW12P																	q
799-601-7070	Adapter for SWP	14	SW14P											q		q				
799-601-7320	Adapter for SWP	16	SW16P																	q
799-601-7080	Adapter for M (T-adapter)	1												q		q				
799-601-7090	Adapter for M	2	M2P									q	q	q		q				
799-601-7110	Adapter for M	3	M3P									q	q	q		q				
799-601-7120	Adapter for M	4	M4P									q	q	q		q				
799-601-7130	Adapter for M	6	M6P									q	q	q		q				
799-601-7340	Adapter for M	8	M8P																	q
799-601-7140	Adapter for S	8	S8P									q	q	q		q				
799-601-7150	Adapter for S (White)	10	S10P									q	q	q		q				
799-601-7160	Adapter for S (Blue)	12	S12P									q	q	q						
799-601-7170	Adapter for S (Blue)	16	S16P									q	q	q		q				
799-601-7330	Adapter for S (White)	16	S16PW													q				
799-601-7350	Adapter for S (White)	12	S12PW																	q
799-601-7180	Adapter for AMP040	8	A8P											q						
799-601-7190	Adapter for AMP040	12	A12P											q		q				
799-601-7210	Adapter for AMP040	16	A16P									q	q	q		q				
799-601-7220	Adapter for AMP040	20	A20P									q	q	q		q				
799-601-7230	Short connector for X	2										q	q	q		q				
799-601-7240	Case											q	q							
799-601-7270	Case													q						
799-601-7510	Adapter for 070	10	07-10												q					
799-601-7520	Adapter for 070	12	07-12												q					
799-601-7530	Adapter for 070	14	07-14												q					
799-601-7540	Adapter for 070	18	07-18												q					
799-601-7550	Adapter for 070	20	07-20												q					
799-601-7360	Adapter for relay	5	REL-5P																	q
799-601-7370	Adapter for relay	6	REL-6P																	q
799-601-7380	Adapter for JFC	2																		q
799-601-9010	Adapter for DTM	2	DTM2														q		q	
799-601-9020	Adapter for DT	2	DT2														q		q	
799-601-9030	Adapter for DT	3	DT3														q		q	
799-601-9040	Adapter for DT	4	DT4														q		q	
799-601-9050	Adapter for DT	6	DT6														q		q	
799-601-9060	Adapter for DT (Gray)	8	DT8GR														q		q	
799-601-9070	Adapter for DT (Black)	8	DT8B														q		q	
799-601-9080	Adapter for DT (Green)	8	DT8G														q		q	
799-601-9090	Adapter for DT (Brown)	8	DT8BR														q		q	
799-601-9110	Adapter for DT (Gray)	12	DT12GR														q		q	
799-601-9120	Adapter for DT (Black)	12	DT12B														q		q	

Part No.	Part name	Number of pins	Identification symbol	T-adapter kit																Out of kit
				799-601-2500	799-601-2700	799-601-2800	799-601-2900	799-601-3000	799-601-5500	799-601-6000	799-601-6500	799-601-7000	799-601-7100	799-601-7400	799-601-7500	799-601-8000	799-601-9000	799-601-9100	799-601-9200	799-601-9300	
799-601-9130	Adapter for DT (Green)	12	DT12G														q		q		
799-601-9140	Adapter for DT	12	DT12BR														q		q		
799-601-9210	Adapter for HD30-18	8	D18-8														q	q			
799-601-9220	Adapter for HD30-18	14	D18-14														q	q			
799-601-9230	Adapter for HD30-18	20	D18-20														q	q			
799-601-9240	Adapter for HD30-18	21	D18-21														q	q			
799-601-9250	Adapter for HD30-24	9	D24-9														q	q			
799-601-9260	Adapter for HD30-24	16	D24-16														q	q			
799-601-9270	Adapter for HD30-24	21	D24-21														q	q			
799-601-9280	Adapter for HD30-24	23	D24-23														q	q			
799-601-9290	Adapter for HD30-24	31	D24-31														q	q			
799-601-9310	Plate for HD30 (24-pin)																q	q		q	
799-601-9320	T-box (for DT/HD)	12															q	q		q	
799-601-9330	Case																q				
799-601-9340	Case																	q			
799-601-9350	Adapter for DRC	40	DRC-40																	q	
799-601-9360	Adapter for DRC	24	DRC-24																	q	
799-601-9410	Adapter for engine (CRI-T2)	2	G																		q
799-601-9420	Adapter for engine (CRI-T2) Adapter for engine (CRI-T3)	3	A3																		q
799-601-9430	Adapter for engine (CRI-T2) Adapter for engine (CRI-T3)	2	P																		q
799-601-9440	Adapter for engine (CRI-T2)	3	1,2,3																		q
795-799-5520	Adapter for engine (HPI-T2)	2	S																		q
795-799-5530	Adapter for engine (HPI-T2) Adapter for engine (CRI-T3)	2	C																		q
795-799-5540	Adapter for engine (HPI-T2) Adapter for engine (CRI-T3)	2	A																		q
795-799-5460	Adapter for engine (HPI-T2)	3																			q
795-799-5470	Adapter for engine (HPI-T2)	3																			q
795-799-5480	Adapter for engine (HPI-T2)	3																			q
799-601-4160	Adapter for engine (CRI-T3)	2	OIL																		q
799-601-4340	Adapter for engine (CRI-T3)	2	1,2,3																		q
799-601-4130	Adapter for engine (CRI-T3)	3	FCIN																		q
799-601-4140	Adapter for engine (CRI-T3)	3	FCIG																		q
799-601-4150	Adapter for engine (CRI-T3)	3	FCIB																		q
799-601-4180	Adapter for engine (CRI-T3)	3	FCIP3																		q
799-601-4190	Adapter for engine (CRI-T3)	3	1,2,3																		q
799-601-4240	Adapter for engine (CRI-T3)	3	1,2,3																		q
799-601-4250	Adapter for engine (CRI-T3)	3	1,2,3																		q
799-601-4330	Adapter for engine (CRI-T3)	3	1,2,3																		q
799-601-4230	Adapter for engine (CRI-T3)	4	1,2,3,4																		q
799-601-4260	Adapter for controller (ENG)	4	DTP4																		q
799-601-4210	Adapter for controller (ENG)	50	DRC50																		q

Part No.	Part name	Number of pins	Identification symbol	T-adapter kit																Out of kit
				799-601-2500	799-601-2700	799-601-2800	799-601-2900	799-601-3000	799-601-5500	799-601-6000	799-601-6500	799-601-7000	799-601-7100	799-601-7400	799-601-7500	799-601-8000	799-601-9000	799-601-9100	799-601-9200	799-601-9300	
799-601-4220	Adapter for controller (ENG)	60	DRC60																	q
799-601-4280	Box for controller (PUMP)	121																		q
799-601-9720	Adapter for controller (HST)	16	HST16A																	q
799-601-9710	Adapter for controller (HST)	16	HST16B																	q
799-601-9370	Adapter for controller (HST)	26	HST26A																	q

TROUBLESHOOTING WHEN FAILURE CODE IS INDICATED

Before carrying out troubleshooting when failure code is displayed 20-303
INFORMATION CONTAINED IN TROUBLESHOOTING TABLE 20-304
Failure Code [6B2JMA] (Abnormality in travel PPC switch hydraulics) 20-306
Failure code [989L00] Engine Controller Lock Caution 1 20-307
Failure code [989M00] Engine Controller Lock Caution 2 20-307
Failure code [989N00] Engine Controller Lock Caution 3 20-308
Failure code [AA10NX] Air Cleaner Clogging 20-308
Failure code [AB00KE] Charge Voltage Low 20-309
Failure code [B@BAZG] Eng Oil Press. Low 20-310
Failure code [B@BAZK] Eng Oil Level Low 20-310
Failure code [B@BCNS] Eng Water Overheat 20-311
Failure code [B@BCZK] Eng Water Level Low 20-311
Failure code [B@HANS] Hydr Oil Overheat 20-312
Failure code [CA111] EMC Critical Internal Failure 20-312
Failure code [CA115] Engine Neutral and Backup Speed Sensor Error 20-313
Failure code [CA122] Chg Air Press Sensor High Error 20-314
Failure code [CA123] Chg Air Press Sensor Low Error 20-316
Failure code [CA131] Throttle Sensor High Error 20-318
Failure code [CA132] Throttle Sensor Low Error 20-320
Failure code [CA144] Coolant Temp Sens High Error 20-322
Failure code [CA145] Coolant Temp Sens Low Error 20-324
Failure code [CA153] Chg Air Temp Sensor High Error 20-326
Failure code [CA154] Chg Air Temp Sensor Low Error 20-328
Failure code [CA155] Chg Air Temp High Speed Derate 20-330
Failure code [CA187] Sens Supply 2 Volt Low Error 20-332
Failure code [CA221] Ambient Press Sens High Error 20-334
Failure code [CA222] Ambient Press Sens Low Error 20-336
Failure code [CA227] Sens Supply 2 Volt High Error 20-338
Failure code [CA234] Eng Overspeed 20-339
Failure code [CA238] Ne Speed Sens Supply Volt Error 20-340
Failure code [CA271] IMV/PCV1 Short Error 20-341
Failure code [CA272] IMV/PCV1 Open Error 20-342
Failure code [CA322] Inj #1 (L#1) Open/Short Error 20-344
Failure code [CA323] Inj #5 (L#5) Open/Short Error 20-346
Failure code [CA324] Inj #3 (L#3) Open/Short Error 20-348
Failure code [CA331] Inj #2 (L#2) Open/Short Error 20-352
Failure code [CA332] Inj #4 (L#4) Open/Short Error 20-354
Failure code [CA342] Calibration Code Incompatibility 20-356
Failure code [CA352] Sens Supply 1 Volt Low Error 20-360
Failure code [CA386] Sens Supply 1 Volt High Error 20-362
Failure code [CA428] Water in Fuel Sensor High Error 20-364
Failure code [CA435] Eng Oil Press Sw Error 20-368
Failure code [CA441] Battery Voltage Low Error 20-369
Failure code [CA442] Battery Voltage High Error 20-372
Failure code [CA449] Rail Press Very High Error 20-374
Failure code [CA451] Rail Press Sensor High Error 20-376
Failure code [CA452] Rail Press Sensor Low Error 20-378
Failure code [CA488] Chg Air Temp High Torque Derate 20-380

Failure code [CA553] Rail Press High Error 20-380
Failure code [CA559] Rail Press Low Error 20-381
Failure code [CA689] Eng Ne Speed Sensor Error 20-384
Failure code [CA731] Eng Bkup Speed Sens Phase Error 20-386
Failure code [CA757] All Continuous Data Lost Error 20-388
Failure code [CA778] Eng G Speed Sensor Error 20-390
Failure code [CA1633] KOMNET Datalink Timeout Error 20-392
Failure code [CA2185] Throttle Sensor Supply Voltage High Error 20-394
Failure code [CA2186] Throttle Sensor Supply Voltage Low Error 20-395
Failure code [CA2249] Rail Press Very Low Error 20-396
Failure code [CA2311] IMV Solenoid Error 20-398
Failure code [CA2555] Grid Htr Relay Volt High Error 20-400
Failure code [CA2556] Grid Heater Relay Volt Low Error 20-402
Failure Code [D110KB] (Short-circuiting in battery relay) 20-404
Failure code [D19JKZ] Personal Code Relay Abnormality 20-406
Failure code [DA25KP] Press. Sensor Power Abnormality 20-408
Failure code [DA2RMC] Pump Comm. Abnormality 20-410
Failure Code [DA2SKQ] (Abnormality in inputting model code) 20-412
Failure Code [DA2SKQ] (Abnormality in inputting model code) 20-414
Failure code [DAFRMC] Monitor Comm. Abnormality 20-416
Failure Code [DDHPAKP] (Abnormality in pump pressure sensor) 20-418
Failure Code [DDP4KX] (Abnormality in travel PPC pressure switch) 20-420
Failure Code [DDWCKZ] (Abnormality in travel direction control switch) 20-421
Failure Code [DH1OKS] (Abnormality in Pressure sensor power source) 20-422
Failure code [DHPAMA] F Pump Press Sensor Abnormality 20-424
Failure Code [DHS5KX] (Abnormality in travel PPC sensor) 20-426
Failure Code [DHX1MA] (Abnormality in overload caution sensor) 20-428
Failure Code [DLT4KA] (Disconnection in transmission speed sensor in pump controller system) 20-430
Failure Code [DW27KA] (Disconnection in Transmission Clutch solenoid) 20-432
Failure Code [DW27KB] (Short-circuiting in Transmission Clutch solenoid) 20-434
Failure Code DW4AKA (Disconnection in suspension lock solenoid) 20-436
Failure Code [DW4AKB] (Short circuiting in suspension lock solenoid) 20-438
Failure Code [DW4CKA] (Disconnection in PPC lock solenoid) 20-440
Failure code [DW4CKB] PPC Lock Sol. S/C 20-442
Failure Code [DW4MKA] (Disconnection in Creep solenoid) 20-444
Failure Code [DW4MKB] (Short-circuiting in Creep solenoid) 20-446
Failure Code [DW44KA] (Disconnection of Travel F/R solenoid) 20-448
Failure Code [DW44KB] (Short-circuiting of Travel F/R solenoid) 20-450
Failure Code [DW45KA] (Disconnection in Swing Parking Brake solenoid) 20-452
Failure code [DW45KB] Swing Brake Sol. S/C 20-454
Failure Code [DW91KA] (Disconnection in Travel Neutral solenoid) 20-456
Failure Code [DW91KB] (Short-circuiting in Travel Neutral Solenoid) 20-458
Failure Code [DWK0KB] (Short-circuiting in 2-Stage Relief Solenoid) 20-462
Failure Code [DWK2KA] (Disconnection in 2-stage Back Pressure solenoid) 20-464
Failure Code [DWK2KB] (Short circuiting in 2-stage back pressure solenoid) 20-466
Failure Code [DXA0KA] (Disconnection in PC-EPC solenoid system) 20-468
Failure Code [DXA0KB] (Short-circuiting in PC-EPC solenoid) 20-470
Failure Code [DXE0KA] (Disconnection in LS-EPC solenoid system) 20-472
Failure Code [DXE0KB] (Short-circuiting in LS-EPC solenoid) 20-473
Failure Code [DXE4KA] (Disconnection in attachment oil flow rate adjusting EPC) 20-474
Failure Code [DXE4KB] (Short-circuiting in attachment oil flow rate adjusting EPC) 20-479
Failure code [DY20KA] Wiper Working Abnormality 20-484
Failure code [DY20MA] Wiper Parking Abnormality 20-486
Failure code [DY2CKB] Washer Drive S/C 20-488
Failure code [DY2DKB] Wiper Drive (For) S/C 20-490
Failure code [DY2EKB] Wiper Drive (Rev) S/C 20-492

Before carrying out troubleshooting when failure code is displayed

Connection table of fuse box

a This connection table shows the devices to which each power supply of the fuse box supplies power (A switch power supply is a device which supplies power while the starting switch is in the ON position and a constant power supply is a device which supplies power while the starting switch is in the OFF and ON positions).

a When carrying out troubleshooting related to the electrical system, you should check the fuses and fusible links to see if the power is supplied normally.

Type of power supply	Fusible link	Fuse	Fuse No.	Fuse capacity	Destination of power
Switch power supply	A34 (65 A)	FB1	1	10 A	Controller (Switched Power)
			2	20 A	Chassis attachment solenoids (controller)
			3	10 A	PPC Lock
			4	10 A	Cigarette lighter
					Windshield washer motor
			5	10 A	Horn and power max. switch.
	A34 (65 A)		6	10 A	Lower wiper and auto pre-heat relay
			7	10 A	Beacon
			8	25 A	Low brake pressure
			9	10 A	Flasher
			10	10 A	Refuel pump
	A34 (65 A)		11	20 A	Air conditioner unit
			12	20 A	Monitor (Switched power)
			13	20 A	Spare fuse
			14	10 A	Optional power supply (24V) and heated seat
			15	20 A	RH PPC lever power
	Starting switch ACC		20	5 A	Engine controller (ACC signal)
Constant power supply	A34 (65 A)	FB2	1	5 A	Travel FNR
			2	10 A	Park brake
			3	20 A	Work lights (C/W, boom + operator cab rear) and quick coupler
			4	25 A	Worklights (Operators cab front)
			5	20 A	Worklights (Operators fitment option)
	A35 (30 A)		11	20 A	Road lights (Master fuse)
			12	10 A	Rototilt controller (1)
			13	10 A	(Spare)
			14	10 A	(Spare)
			15	10 A	(Spare)

INFORMATION CONTAINED IN TROUBLESHOOTING TABLE

- The troubleshooting table and the related circuit diagrams contain the following information. Grasp their contents fully before proceeding to actual troubleshooting work.

User Code	Failure Code	Failure phenomenon	Title of failure phenomenon shown in failure history
Display in monitor panel	Display in monitor panel		
Failure content	Failure status as detected by monitor panel or controller		
Response from monitor panel or controller	Action taken by the monitor panel or controller to protect an affected system or equipment, when they detect some failure.		
Phenomenon occurring on machine	Phenomenon that occurs on the machine, resulting from the above action taken by the monitor panel or controller		
Relative information	Information on the failure occurred as well as the troubleshooting		

	Cause		Standard value in normal and references for troubleshooting
Presumed cause and standard value in normal	1 2 3 4 5	Cause that presumably triggered failure in question (The assigned No. is for filing purpose only. It does not stand for any priority)	<Content Included> • Standard value in normal by which to pass "Good" or "No good" judgement over the presumed cause • Reference for passing the above "Good" or "No Good" judgement <Phenomenon of Wiring Harness Failure> • Disconnection There is a faulty contact at the connector or disconnection of wiring harness occurred. • Defective grounding A wiring harness that is not connected with a grounding circuit has a contact with the grounding circuit. • Short-circuiting A wiring harness that is not connected with a 24 V electric circuit has a contact with the electric circuit. <Precaution for Troubleshooting> 1. Connector No. display method and handling of T-adapter Insert or connect T-adapters in the following manner before starting troubleshooting unless otherwise instructed. • If there is no indication of "male" or "female" in a specific connector No., disconnect the connector and insert the T-adapter into both male and female sides. • If there is an indication of "male" or "female" in a specific connector No., disconnect the connector and connect the T-adapter with only one side of either "male" or "female". 2. Entry sequence of pin No. and handling of circuit tester lead Connect the positive (+) lead and the negative (–) lead OFF a circuit tester in the following manner unless otherwise instructed. • Connect the positive (+) lead with the pin No. indicated at the front or the wiring harness. • Connect the negative (–) lead with the pin No. indicated at the front or the wiring harness.

Relative Electrical Circuit Diagram

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

- Connector No.: Indicates (Type - numbers of a pin) (colour)
- Arrow: Roughly indicates the location in the machine where it is installed.

Failure Code [6B2JMA] (Abnormality in travel PPC switch hydraulics)

User Code	Failure Code	Failure phenomenon	Incorrect non-volatile memory data (in pump controller)
—	**6B2JMA**		
Failure content	• Hydraulic signal activates one pressure switch (Either forward or reverse but R.H PPC work lever switch selects opposite travel direction.		
Response from controller	• Error code is displayed on the monitor panel.		
Phenomenon occurring on machine	• Engine speed raises when travel pedal is operated but machine does not travel.		
Relative information	• This error ocurs when hydraulic PPC travel hoses are connected to incorrect ports. Countermeasure - Swap hoses.		

Failure code [989L00] Engine Controller Lock Caution 1

User code	Failure code	Trouble	Engine controller lock caution 1 (Machine monitor system)
—	**989L00**		
Contents of trouble	• Engine controller lock is detected (Factor 1).		
Action of machine monitor	• None in particular. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• Engine cannot be started.		
Related information	• If this failure code is displayed after machine monitor is replaced, user password must be changed to one before replacement. • Method of reproducing failure code: Turn starting switch ON.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Replacement of machine monitor	This trouble may be caused by replacement of machine monitor.

Failure code [989M00] Engine Controller Lock Caution 2

User code	Failure code	Trouble	Engine controller lock caution 2 (Machine monitor system)
—	**989M00**		
Contents of trouble	• Engine controller lock is detected (Factor 2).		
Action of machine monitor	• None in particular. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• Engine cannot be started.		
Related information	• If this failure code is displayed after machine monitor is replaced, user password must be changed to one before replacement. • Method of reproducing failure code: Turn starting switch ON.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Replacement of machine monitor	This trouble may be caused by replacement of machine monitor.
	2	Defective machine monitor	If this failure code is displayed while machine monitor is not replaced, machine monitor may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

Failure code [989N00] Engine Controller Lock Caution 3

User code	Failure code	Trouble	Engine controller lock caution 3 (Machine monitor system)
—	**989N00**		
Contents of trouble	• Engine controller lock is detected (Factor 3).		
Action of machine monitor	• Tries automatic resetting. • If cause of failure disappears, system resets itself.		
Problem that appears on machine			
Related information	• Method of reproducing failure code: Failure code is not reproduced since system is reset automatically.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defective engine controller	If this failure code is displayed repeatedly, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

Failure code [AA10NX] Air Cleaner Clogging

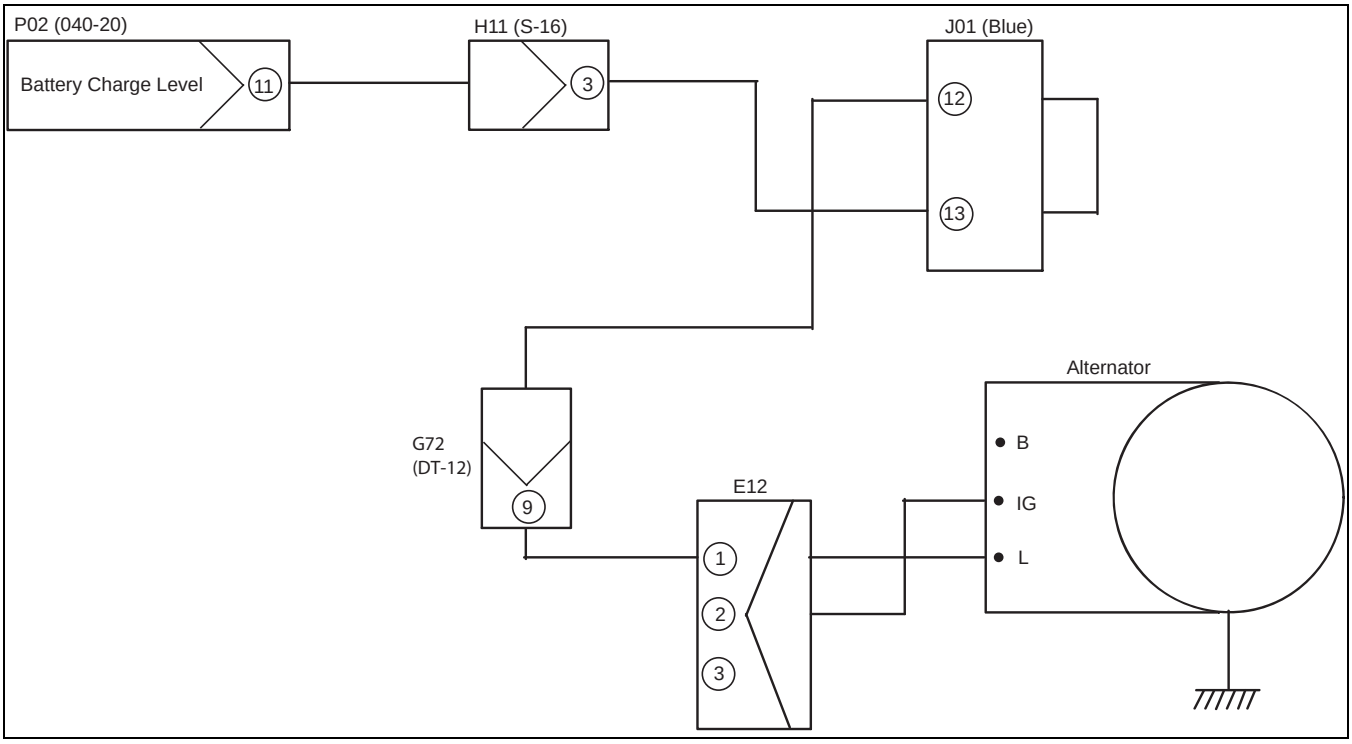
User code	Failure code	Trouble	Air cleaner clogging (Machine monitor system)
—	**AA10NX**		
Contents of trouble	• While engine was running, signal circuit of air cleaner clogging switch detected clogging of air cleaner (sensor contact opened).		
Action of machine monitor	• Displays air cleaner clogging monitor on machine monitor. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• If machine is operated as it is, engine may be damaged.		
Related information	• Condition of air cleaner clogging switch signal can be checked with monitoring function. (Code: 04501 Monitor input 2) • Method of reproducing failure code: Start engine.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Clogging of air cleaner (when system is normal)	Air cleaner may be clogged. Check it for clogging and then clean or replace if clogged.
	2	Defective air cleaner clogging monitor system	If cause 1 is not detected, air cleaner clogging monitor system may be defective. Carry out troubleshooting for "E-7 Caution item flashes while engine is running" in E-mode.

Failure code [AB00KE] Charge Voltage Low

User code	Failure code	Trouble	Charge voltage low (Machine monitor system)
—	**AB00KE**		
Contents of trouble	• While engine is running, signal circuit of alternator detected low charge voltage (below 7.8 V).		
Action of machine monitor	• Displays charge level monitor on machine monitor. • Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine	• If machine is operated as it is, battery may not be charged.		
Related information	• Signal voltage of alternator can be checked with monitoring function. (Code: 04300 Charge voltage) • Method of reproducing failure code: Start engine.		

Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting		
	1	Defective charge of alternator (when system is normal)	a Prepare with starting switch OFF, then start engine and carry out troubleshooting.		
			E12 (male)	Engine speed	Voltage
			Between ① – chassis ground	Min. medium speed	27.5 – 29.5 V
	2	Defective charge level monitor	If cause 1 is not detected, charge level monitor system may be defective. Carry out troubleshooting for "E-7 Caution item flashes while engine is running" in E-mode.		



Failure code [B@BAZG] Eng Oil Press. Low

User code	Failure code	Trouble	Engine oil pressure low (Engine controller system)
—	**B@BAZG**		
Contents of trouble	• While engine was running, signal circuit of engine oil pressure switch detected low engine oil pressure (sensor contact opened).		
Action of controller	• Displays engine oil pressure monitor on machine monitor. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• If machine is operated as it is, engine may be damaged.		
Related information	• Engine oil pressure switch signal is input to engine controller and then transmitted to machine monitor. • Method of reproducing failure code: Start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Lowering of engine oil pressure (when system is normal)	Engine oil pressure may be low. Check it and remove cause if it is low.
	2	Defective engine oil pressure monitor system	If cause 1 is not detected, engine oil pressure monitor system may be defective. Carry out troubleshooting for "E-8 Emergency stop item lights up while engine is running" in E-mode.

Failure code [B@BAZK] Eng Oil Level Low

User code	Failure code	Trouble	Engine oil level low (Machine monitor system)
—	**B@BAZK**		
Contents of trouble	• When starting switch is turned ON (but engine is not started), signal circuit of engine oil level switch detected low engine oil level (sensor contact opened).		
Action of machine monitor	• Displays engine oil level monitor on machine monitor. • Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine	• If machine is operated as it is, engine may be damaged.		
Related information	• Engine oil level switch signal can be checked with monitoring function. (Code: 04501 Monitor input 2) • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Lowering of engine oil level (when system is normal)	Engine oil level may be low. Check it and add new oil if it is low.
	2	Defective engine oil level monitor system	If cause 1 is not detected, engine oil level monitor system may be defective. Carry out troubleshooting for "E-2 Basic check item lights up when starting switch is turned ON (but engine is not started)" in E-mode.

Failure code [B@BCNS] Eng Water Overheat

User code	Failure code	Trouble	Engine coolant overheat (Engine controller system)
—	**B@BCNS**		
Contents of trouble	• While engine was running, signal circuit of engine coolant temperature sensor detected overheating of engine coolant (above about 102°C).		
Action of controller	• Displays engine coolant temperature monitor with red on machine monitor. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• If machine is operated as it is, engine may be seized.		
Related information	• Engine coolant temperature sensor signal is input to engine controller and then transmitted to machine monitor. • Engine coolant temperature can be checked with monitoring function (Code: 04107 Engine coolant temperature) • Method of reproducing failure code: Start engine.		

		Cause	Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Overheating of engine coolant (when system is normal)	Engine coolant may be overheating. Check it and remove cause if it is overheating.
	2	Defective engine coolant temperature gauge system	If cause 1 is not detected, engine coolant temperature gauge system may be defective. Carry out troubleshooting for "E-9 Engine coolant temperature gauge does not work normally" in E-mode.

Failure code [B@BCZK] Eng Water Level Low

User code	Failure code	Trouble	Engine coolant level low (Machine monitor system)
—	**B@BCZK**		
Contents of trouble	• When starting switch is turned ON (but engine is not started), signal circuit of radiator coolant level sensor detected low radiator coolant level (sensor contact opened).		
Action of machine monitor	• Displays radiator coolant level monitor on machine monitor. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• If machine is operated as it is, engine may overheats.		
Related information	• Condition of radiator coolant level switch can be checked with monitoring function (Code: 04500 Monitor input 1) • Method of reproducing failure code: Turn starting switch ON.		

		Cause	Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Lowering of radiator coolant level (when system is normal)	Radiator coolant level may be low. Check it and add coolant if it is low.
	2	Defective radiator coolant level monitor system	If cause 1 is not detected, radiator coolant level monitor system may be defective. Carry out troubleshooting for "E-2 Basic check item lights up when starting switch is turned ON (but engine is not started)" in E-mode.

Failure code [B@HANS] Hydr Oil Overheat

User code	Failure code	Trouble	Hydraulic oil overheat (Pump controller system)
—	**B@HANS**		
Contents of trouble	• While engine was running, signal circuit of hydraulic oil temperature sensor detected overheating of hydraulic oil (above about 102°C).		
Action of controller	• Displays hydraulic oil temperature monitor with red on machine monitor. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• If machine is operated as it is, engine may be seized.		
Related information	• Hydraulic oil temperature sensor signal is input to engine controller and then transmitted to machine monitor. • Hydraulic oil temperature can be checked with monitoring function (Code: 04401 Hydraulic oil temperature) • Method of reproducing failure code: Start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Overheating of hydraulic oil (when system is normal)	Hydraulic oil may be overheating. Check it and remove cause if it is overheating.
	2	Defective hydraulic oil temperature gauge system	If cause 1 is not detected, hydraulic oil temperature gauge system may be defective. Carry out troubleshooting for "E-10 Hydraulic oil temperature gauge does not work normally" in E-mode.

Failure code [CA111] EMC Critical Internal Failure

User code	Failure code	Trouble	Critical internal failure (Engine controller system)
E10	**CA111**		
Contents of trouble	• Memory or power supply circuit in engine controller is defective.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine does not start.		
Related information			

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Defective engine controller	Engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

Failure code [CA115] Engine Neutral and Backup Speed Sensor Error

User code	Failure code	Trouble	Engine Neutral and Backup speed sensor error (Engine controller system)
E10	**CA115**		
Contents of trouble	• Both signals of engine Neutral speed sensor and engine Backup speed sensor are abnormal.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine stops. • Engine does not start.		
Related information	• Method of reproducing failure code: Start engine.		

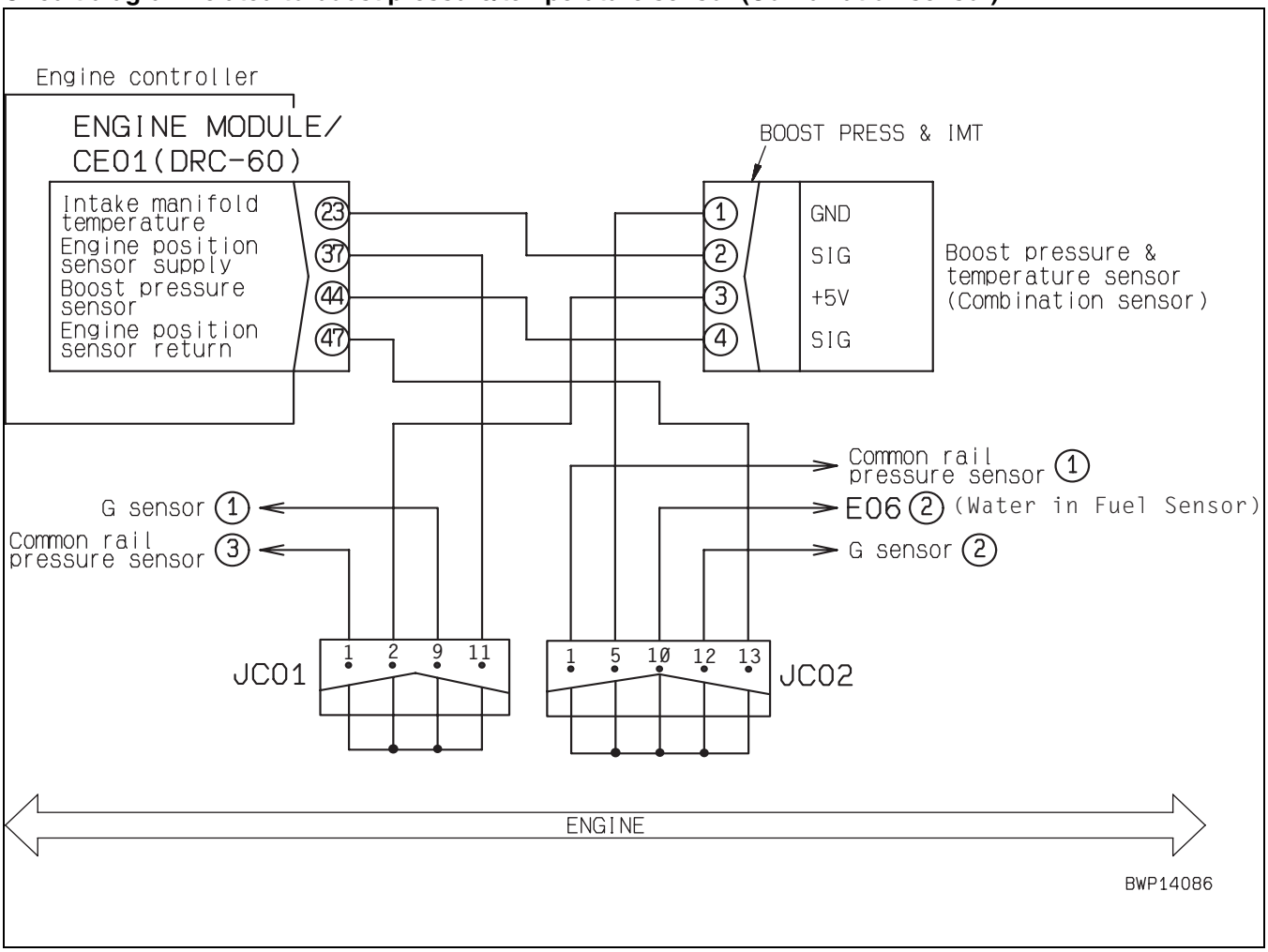
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defective connection of sensor connector	Connectors of Neutral speed sensor and Backup speed sensor may be connected defectively (or connected to wrong parts). Check them directly.

Failure code [CA122] Chg Air Press Sensor High Error

User code	Failure code	Trouble	Charge air pressure sensor high error (Engine controller system)
E11	**CA122**		
Contents of trouble	• Pressure signal circuit of boost pressure/temperature sensor detected high voltage.		
Action of controller	• Fixes charge pressure value and continues operation.		
Problem that appears on machine	• Engine output lowers.		
Related information	• Signal voltage on boost pressure side of boost pressure/temperature sensor can be checked with monitoring function. (Code: 36501 Boost pressure sensor voltage) • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective sensor power supply 2 system	If failure code [**CA227**] is also indicated, carry out troubleshooting for it first.			
	2	Defective boost pressure/ temperature sensor [pressure signal system]	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			BOOST PRESS & IMT		Voltage	
			Between ③ – ①	Power supply	4.75 – 5.25 V	
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.			
	3	Hot short (Short circuit with 5 V/24 V circuit) in wiring harness	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Wiring harness between CE01 (female) ㊹ – BOOST PRESS & IMT (female) ④		Voltage	Max. 1 V
	4	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) ㊹ – BOOST PRESS & IMT (female) ④ and between CE01 (female) ㊲ – JC01 – BOOST PRESS & IMT (female) ③		Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts between boost pressure/temperature sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	6	Defective engine controller	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			CE01		Voltage	
			Between ㊲ – ㊼	Power supply	4.75 – 5.25 V	

Circuit diagram related to boost pressure/temperature sensor (Combination sensor)

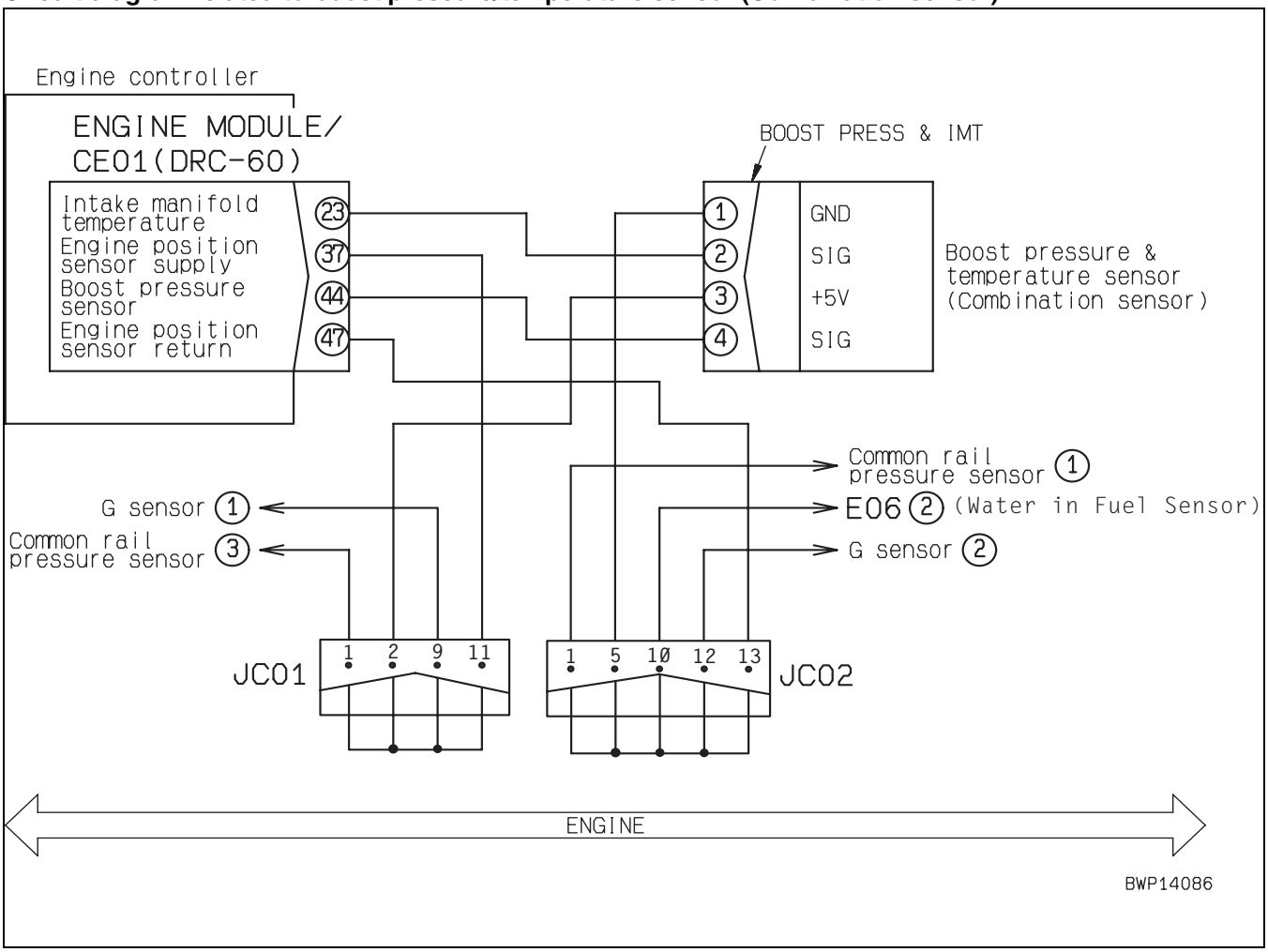


Failure code [CA123] Chg Air Press Sensor Low Error

User code	Failure code	Trouble	Charge air pressure sensor low error (Engine controller system)
E11	**CA123**		
Contents of trouble	• Pressure signal circuit of boost pressure/temperature sensor detected low voltage.		
Action of controller	• Fixes charge pressure value and continues operation.		
Problem that appears on machine	• Engine output lowers.		
Related information	• Signal voltage on boost pressure side of boost pressure/temperature sensor can be checked with monitoring function. (Code: 36501 Boost pressure sensor voltage) • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective sensor power supply 2 system	If failure code [**CA187**] is also indicated, carry out troubleshooting for it first.			
	2	Defective boost pressure/ temperature sensor [pressure signal system]	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			BOOST PRESS & IMT		Voltage	
			Between ③ – ①	Power supply	4.75 – 5.25 V	
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.			
	3	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) ㊹ – BOOST PRESS & IMT (female) ④		Resistance	Min. 100 kΩ
	4	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) ㊹ – BOOST PRESS & IMT (female) ④ and between CE01 (female) ㊼ – JC02 – BOOST PRESS & IMT (female) ①		Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts between boost pressure/temperature sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	6	Defective engine controller	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			CE01		Voltage	
			Between ㊲ – ㊼	Power supply	4.75 – 5.25 V	

Circuit diagram related to boost pressure/temperature sensor (Combination sensor)

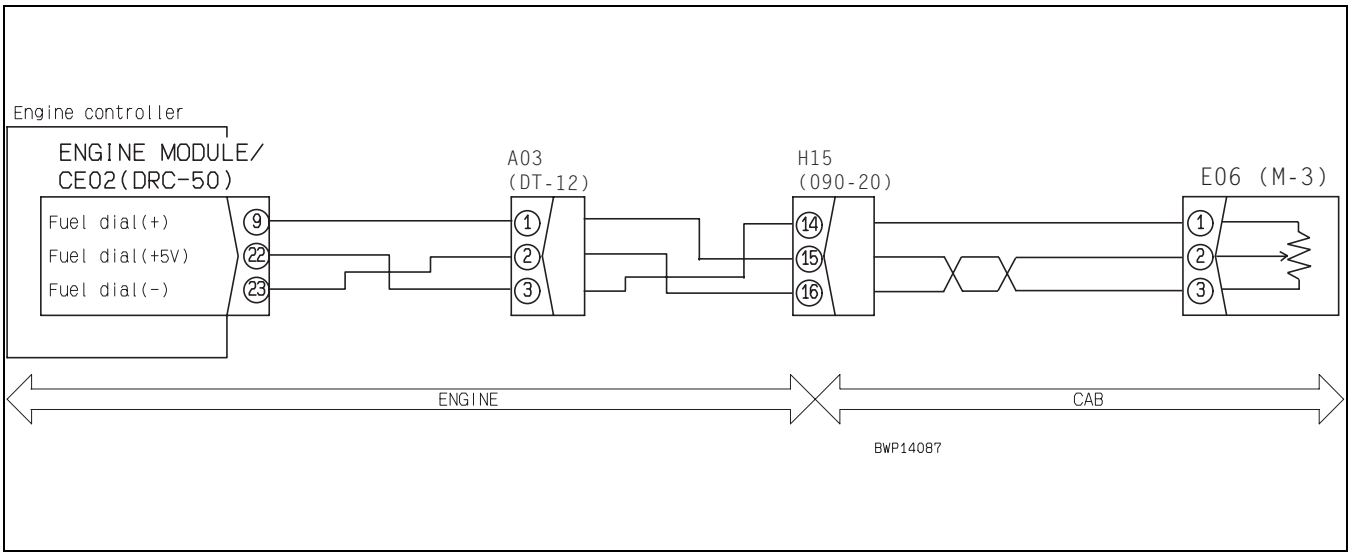


Failure code [CA131] Throttle Sensor High Error

User code	Failure code	Trouble	Throttle sensor high error (Engine controller system)
E14	**CA131**		
Contents of trouble	• Signal circuit of fuel control dial detected high voltage.		
Action of controller	• If trouble occurs while starting switch is in ON position, controller fixes voltage value to level just before detection of trouble and continues operation. • If starting switch is turned ON while voltage is abnormally high, controller continues operation with voltage at 100% value.		
Problem that appears on machine	• Engine speed cannot be controlled with fuel control dial.		
Related information	• Signal voltage of fuel control dial can be checked with monitoring function. (Code: 03000 Fuel control dial voltage) • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective throttle sensor power supply system	If failure code [**CA2185**] is also indicated, carry out troubleshooting for it first.			
	2	Defective fuel control dial	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			E06		Voltage	
			Between (1) – (3)	Power supply	4.75 – 5.25 V	
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.			
	3	Hot short (Short circuit with 5 V/24 V circuit) in wiring harness	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Wiring harness between CE02 (female) (9) – E06 (female) (2)		Voltage	Max. 1 V
	4	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE02 (female) (9) – E06 (female) (2) and between CE02 (female) (22) – E06 (female) (1)		Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts between fuel control dial – machine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	6	Defective engine controller	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			CE02		Voltage	
			Between (22) – (23)	Power supply	4.75 – 5.25 V	

Cicuit diagram related to fuel control dial

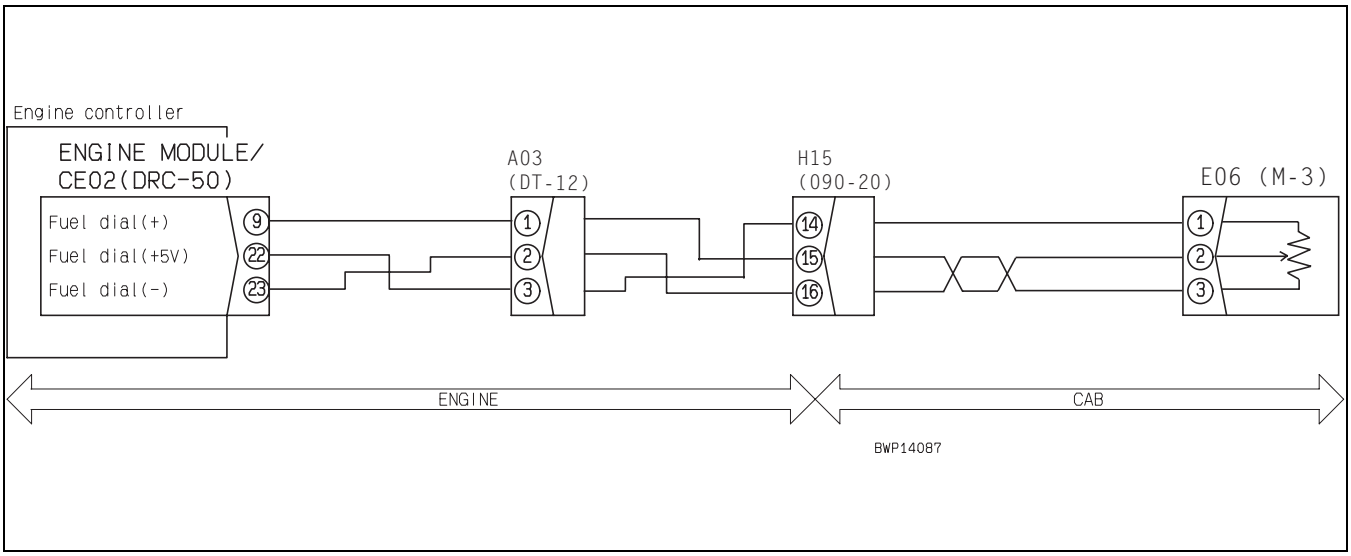


Failure code [CA132] Throttle Sensor Low Error

User code	Failure code	Trouble	Throttle sensor low error (Engine controller system)
E14	**CA132**		
Contents of trouble	• Signal circuit of fuel control dial detected low voltage.		
Action of controller	• If trouble occurs while starting switch is in ON position, controller fixes voltage value to level just before detection of trouble and continues operation. • If starting switch is turned ON while voltage is abnormally high, controller continues operation with voltage at 100% value.		
Problem that appears on machine	• Engine speed cannot be controlled with fuel control dial.		
Related information	• Signal voltage of fuel control dial can be checked with monitoring function. (Code: 03000 Fuel control dial voltage) • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective throttle sensor power supply system	If failure code [**CA2186**] is also indicated, carry out troubleshooting for it first.			
	2	Defective fuel control dial	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			E06		Voltage	
			Between (1) – (3)	Power supply	4.75 – 5.25 V	
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.			
	3	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE02 (female) (9) – E06 (female) (2)		Resistance	Min. 100 kΩ
	4	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE02 (female) (9) – E06 (female) (2) and between CE02 (female) (23) – E06 (female) (3)		Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts between fuel control dial – machine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	6	Defective engine controller	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			CE02		Voltage	
			Between (22) – (23)	Power supply	4.75 – 5.25 V	

Cicuit diagram related to fuel control dial

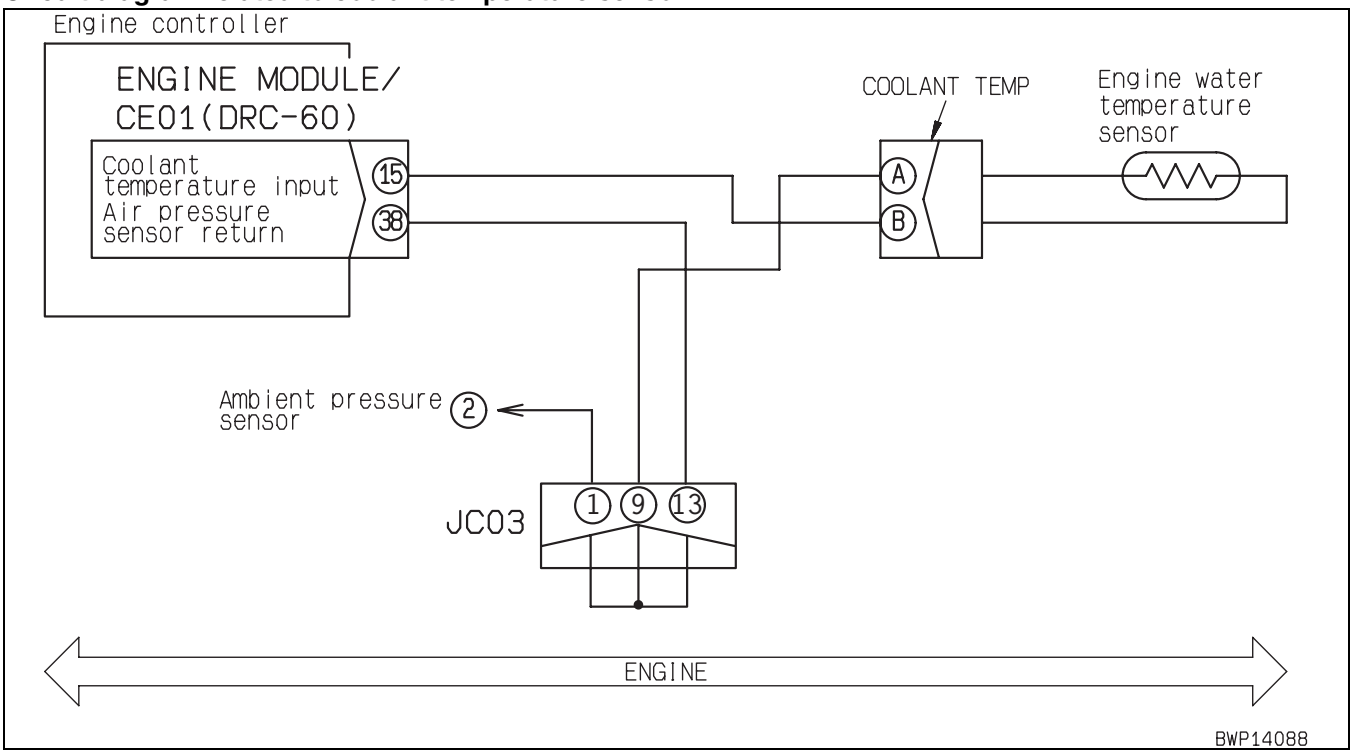


Failure code [CA144] Coolant Temp Sens High Error

User code	Failure code	Trouble	Coolant temperature sensor high error (Engine controller system)
E15	**CA144**		
Contents of trouble	• Signal circuit of coolant temperature sensor detected high voltage.		
Action of controller	• Fixes coolant temperature value and continues operation.		
Problem that appears on machine	• Exhaust gas becomes white. • Overheat prevention function does not work.		
Related information	• Signal voltage of coolant temperature sensor can be checked with monitoring function. (Code: 04105 Coolant temperature sensor voltage) • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective coolant temperature sensor	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			COOLANT TEMP (male)	Resistance	
			Between (A) – (B)	0.18 – 160 kΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (15) – COOLANT TEMP (female) (B)	Resistance	Max. 10 Ω
			Wiring harness between CE01 (female) (38) – JC03 – COOLANT TEMP (female) (A)	Resistance	Max. 10 Ω
	3	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (15) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts between coolant temperature sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	5	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CE01 (female)	Resistance	
			Between (15) – (38)	0.18 – 160 kΩ	

Circuit diagram related to coolant temperature sensor

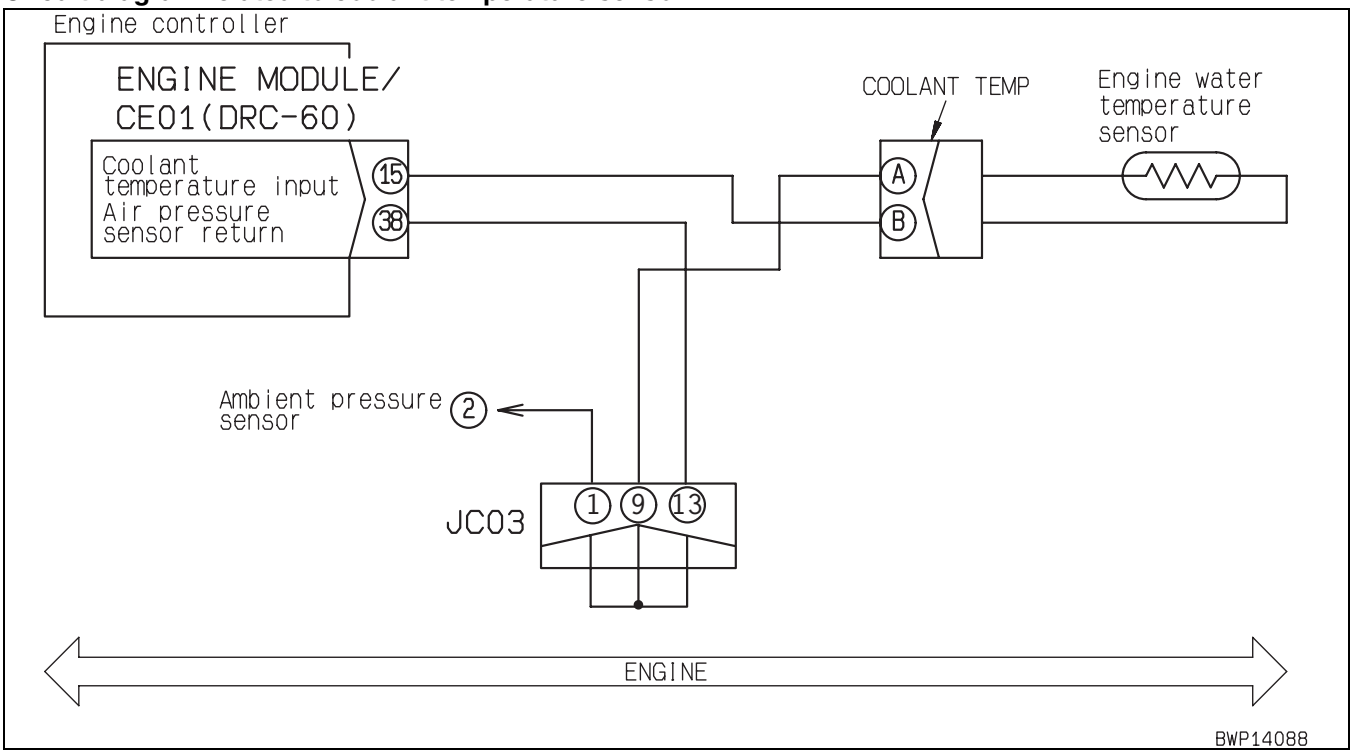


Failure code [CA145] Coolant Temp Sens Low Error

User code	Failure code	Trouble	Coolant temperature sensor low error (Engine controller system)
E15	**CA145**		
Contents of trouble	• Signal circuit of coolant temperature sensor detected low voltage.		
Action of controller	• Fixes coolant temperature value and continues operation.		
Problem that appears on machine	• Exhaust gas becomes white. • Overheat prevention function does not work.		
Related information	• Signal voltage of coolant temperature sensor can be checked with monitoring function. (Code: 04105 Coolant temperature sensor voltage) • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective coolant temperature sensor	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			COOLANT TEMP (male)	Resistance		
			Between (A) – (B)	0.18 – 160 kΩ		
			Between (B) – chassis ground	Min. 100 kΩ		
	2	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (15) – COOLANT TEMP (female) (B)	Resistance	Min. 100 kΩ	
	3	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (15) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
	4	Defective wiring harness connector	Connecting parts between coolant temperature sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	5	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CE01 (female)	Resistance		
			Between (15) – (38)	0.18 – 160 kΩ		
			Between (15) – chassis ground	Min. 100 kΩ		

Circuit diagram related to coolant temperature sensor

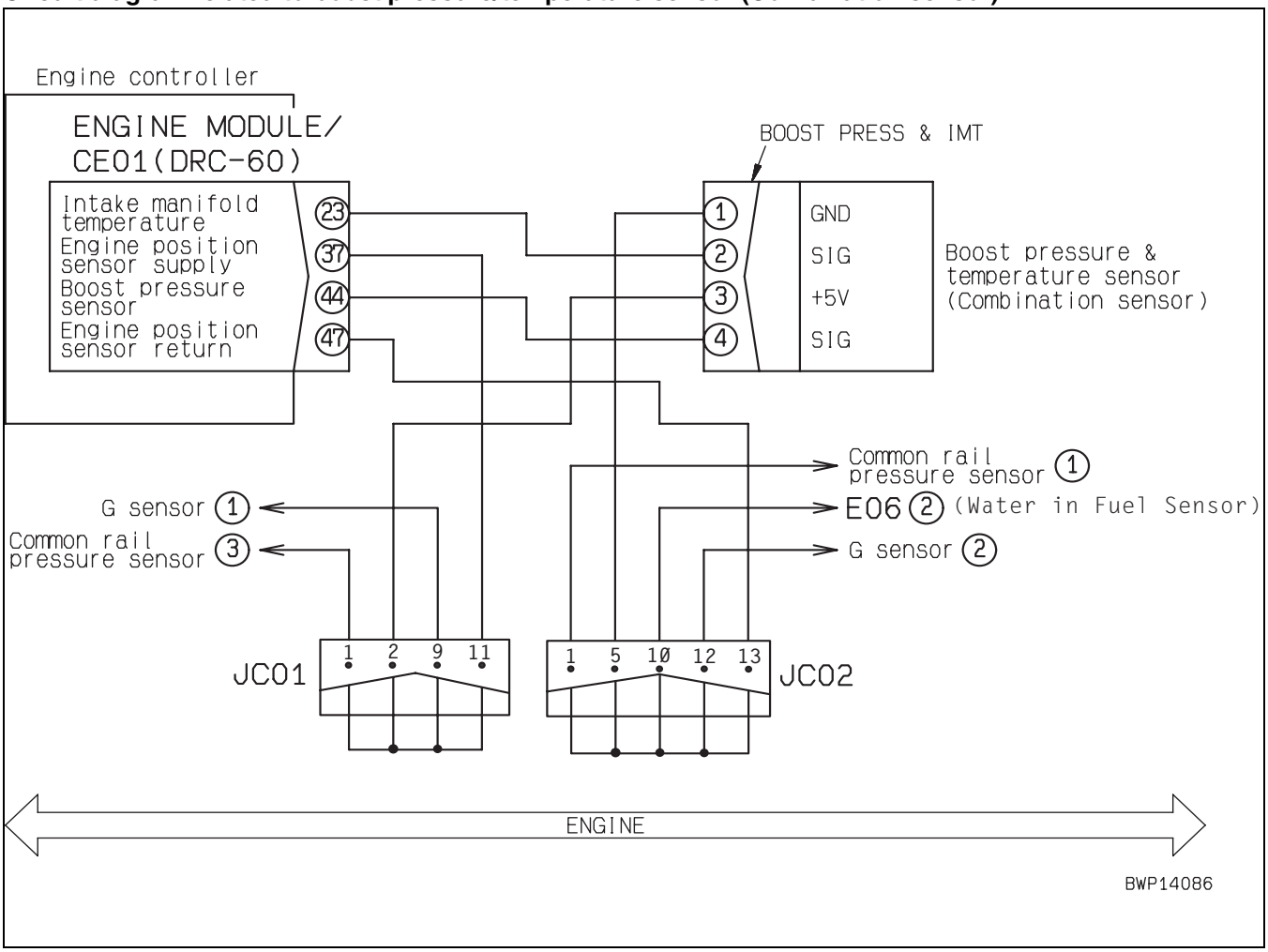


Failure code [CA153] Chg Air Temp Sensor High Error

User code	Failure code	Trouble	Charge air temperature sensor high error (Engine controller system)
E15	**CA153**		
Contents of trouble	• Temperature signal circuit of boost pressure/temperature sensor detected high voltage.		
Action of controller	• Fixes charge temperature value and continues operation.		
Problem that appears on machine	• Exhaust gas becomes white. • Engine protection function based on boost temperature does not work		
Related information	• Signal voltage on boost temperature side of boost pressure/temperature sensor can be checked with monitoring function. (Code: 18501 Boost temperature sensor voltage) • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective boost pressure/ temperature sensor [temperature signal system]	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			BOOST PRESS & IMT (male)	Resistance	
			Between (2) – (1)	0.18 – 160 kΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (23) – BOOST PRESS & IMT (female) (2)	Resistance	Max. 10 Ω
			Wiring harness between CE01 (female) (47) – JC02 – BOOST PRESS & IMT (female) (1)	Resistance	Max. 10 Ω
	3	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (23) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts between boost pressure/temperature sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	5	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CE01 (female)	Resistance	
			Between (23) – (47)	0.18 – 160 kΩ	

Circuit diagram related to boost pressure/temperature sensor (Combination sensor)

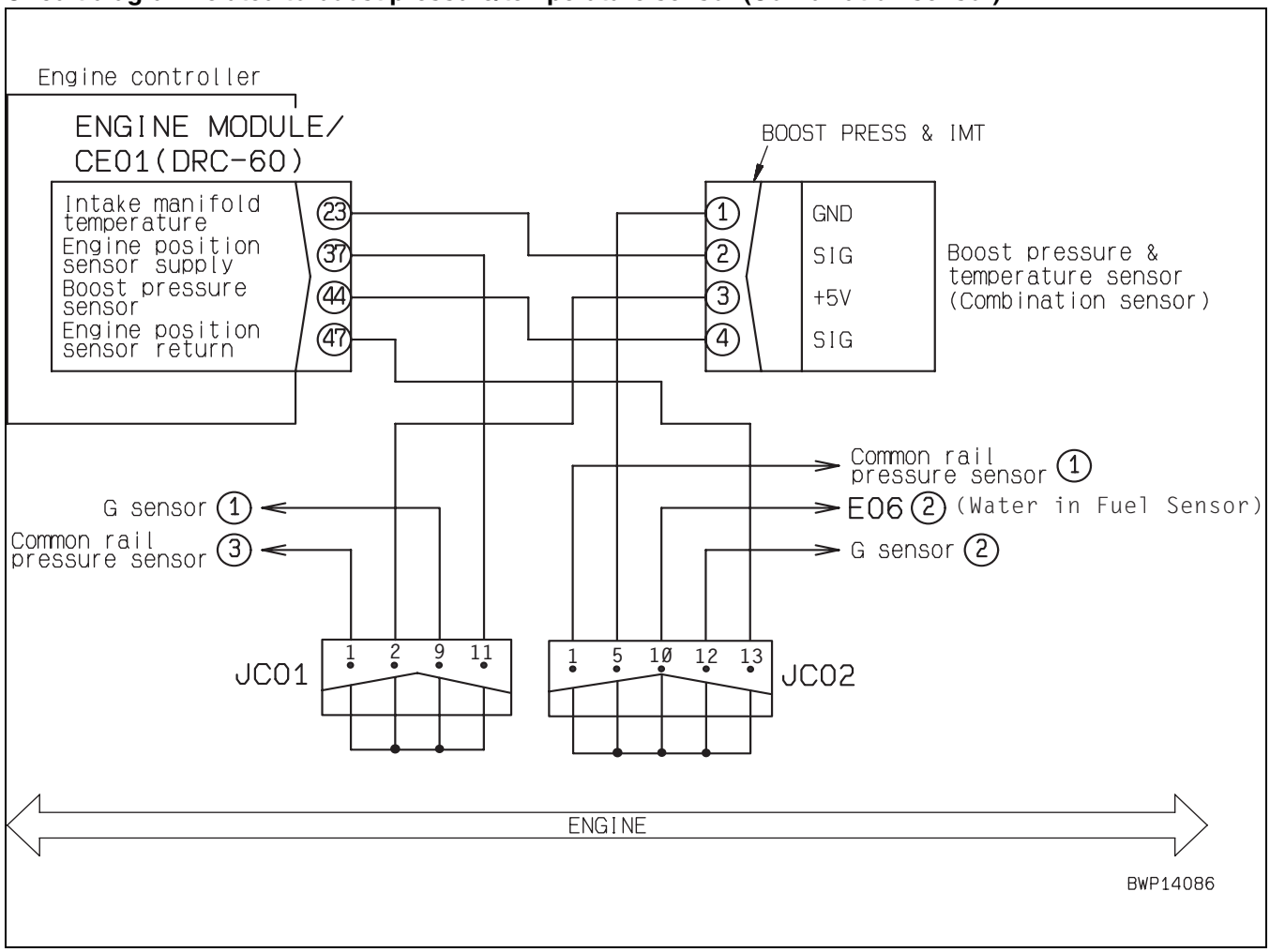


Failure code [CA154] Chg Air Temp Sensor Low Error

User code	Failure code	Trouble	Charge air temperature sensor low error (Engine controller system)
E15	**CA154**		
Contents of trouble	• Temperature signal circuit of boost pressure/temperature sensor detected low voltage.		
Action of controller	• Fixes charge temperature value and continues operation.		
Problem that appears on machine	• Exhaust gas becomes white. • Engine protection function based on boost temperature does not work		
Related information	• Signal voltage on boost temperature side of boost pressure/temperature sensor can be checked with monitoring function. (Code: 18501 Boost temperature sensor voltage) • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective boost pressure/ temperature sensor [temperature signal system]	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			BOOST PRESS & IMT (male)	Resistance		
			Between (2) – (1)	0.18 – 160 kΩ		
			Between (2) – chassis ground	Min. 100 kΩ		
	2	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (23) – BOOST PRESS & IMT (female) (2)	Resistance	Min. 100 kΩ	
	3	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (23) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
	4	Defective wiring harness connector	Connecting parts between boost pressure/temperature sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	5	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CE01 (female)	Resistance		
			Between (23) – (47)	0.18 – 160 kΩ		
			Between (23) – chassis ground	Min. 100 kΩ		

Circuit diagram related to boost pressure/temperature sensor (Combination sensor)



Failure code [CA155] Chg Air Temp High Speed Derate

User code	Failure code	Trouble	Charge air temperature high speed derate (Engine controller system)
E11	**CA155**		
Contents of trouble	• Temperature signal of boost pressure/temperature sensor exceeded control upper temperature limit.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Engine output lowers. • Engine stops.		
Related information	• Boost temperature can be checked with monitoring function. (Code: 18500 Boost temperature) • Method of reproducing failure code: Start engine		

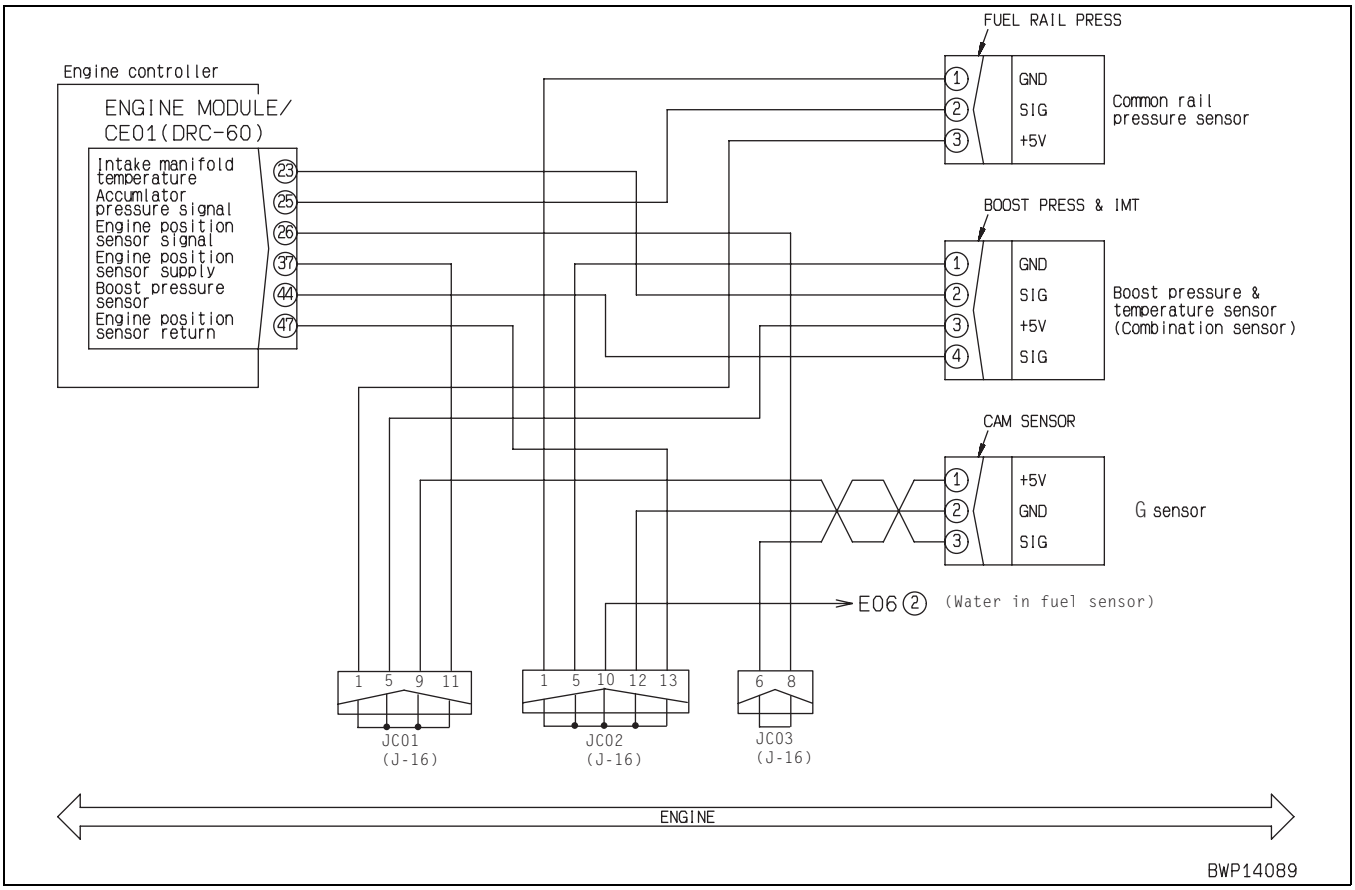
	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Lowering of cooling performance of aftercooler	Cooling performance of aftercooler may be low. Check following points directly. • Looseness and breakage of fan belt. • Insufficiency of cooling air • Clogging of aftercooler fins
	2	Abnormal rise of turbocharger outlet temperature	Outlet temperature of turbocharger may be abnormally high. Check related parts directly.
	3	Defective engine controller	If causes 1 – 2 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

Failure code [CA187] Sens Supply 2 Volt Low Error

User code	Failure code	Trouble	Sensor power supply 2 voltage low error (Engine controller system)
E15	**CA187**		
Contents of trouble	• Low voltage was detected in sensor power supply 2 circuit.		
Action of controller	• Fixes boost pressure value and continues operation. • Fixes charge temperature value and continues operation. • Limits output and continues operation.		
Problem that appears on machine	• Engine output lowers.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor or wiring harness	a Disconnect connector with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Disconnect sensors and wiring harness at right in order and carry out operation to reproduce trouble. If "E" of failure code goes off when a sensor or wiring harness is disconnected, that sensor or wiring harness is defective.	Boost pressure/temperature sensor	BOOST PRESS & IMT
				Common rail pressure sensor	FUEL RAIL PRESS
				G sensor	CAM SENSOR
				Engine wiring harness	CE01
	2	Defective wiring harness connector	Connecting parts between each sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	3	Defective engine controller	If causes 1 – 2 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to sensor power supply 2

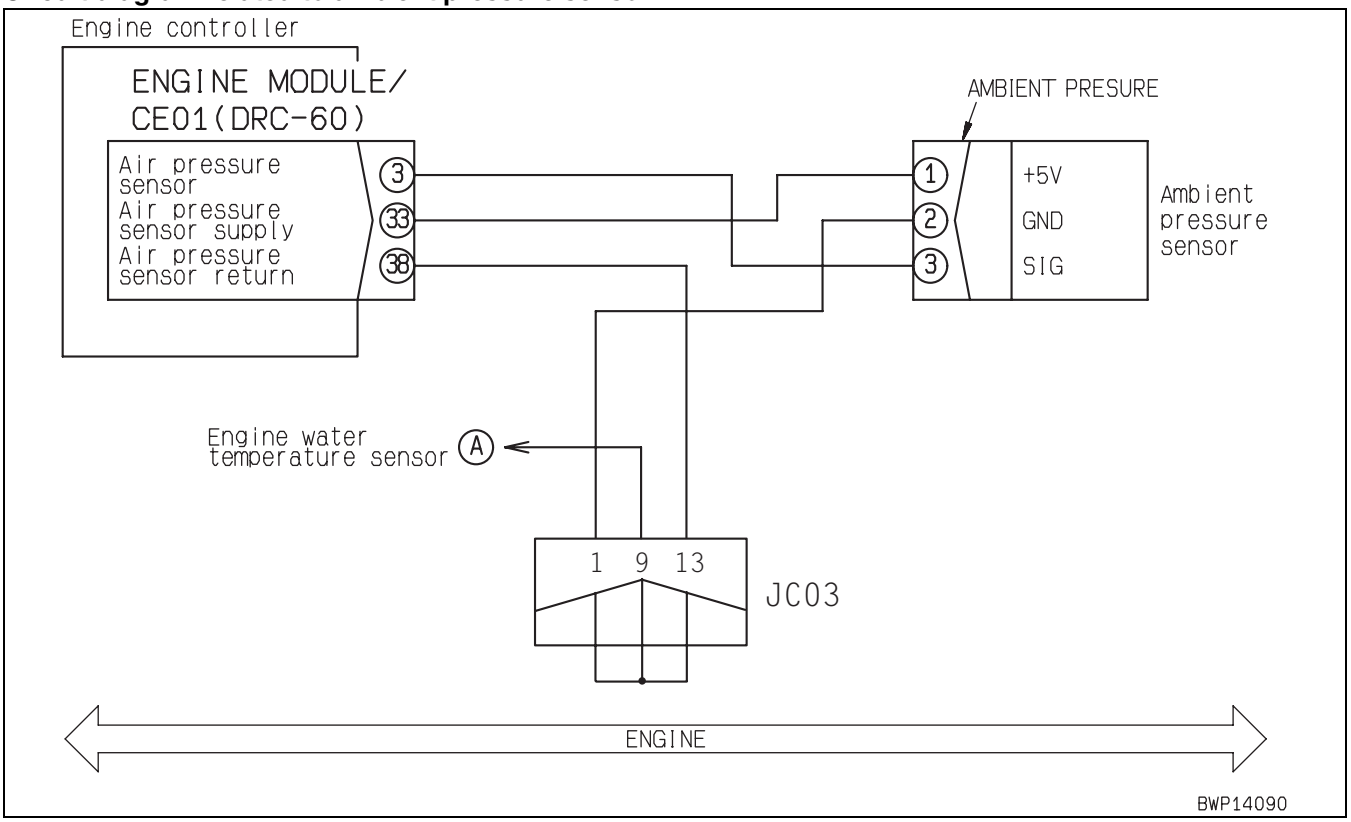


Failure code [CA221] Ambient Press Sens High Error

User code	Failure code	Trouble	Ambient pressure sensor high error (Engine controller system)
E15	**CA221**		
Contents of trouble	• High voltage was detected in signal circuit of ambient pressure sensor.		
Action of controller	• Fixes ambient pressure value and continues operation.		
Problem that appears on machine	• Engine does not start easily. • Engine output lowers.		
Related information	• Signal voltage of ambient pressure sensor can be checked with monitoring function. (Code: 37401 Ambient pressure sensor voltage • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power supply 1 system	If failure code [**CA386**] is also indicated, carry out troubleshooting for it first.		
	2	Defective ambient pressure sensor	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			AMBIENT PRESURE		Voltage
			Between (1) – (2)	Power supply	4.75 – 5.25V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Hot short (Short circuit with 5V/24V circuit) in wiring harness	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between CE01 (female) (3) – AMBIENT PRESSURE (female) (3)	Voltage	Max. 1 V
	4	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (3) – AMBIENT PRESSURE (female) (3) and between CE01 (female) (33) – AMBIENT PRESSURE (female) (1)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts between ambient pressure sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	6	Defective engine controller	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			CE01		Voltage
			Between (33) – (38)	Voltage	4.75 – 5.25 V

Circuit diagram related to ambient pressure sensor

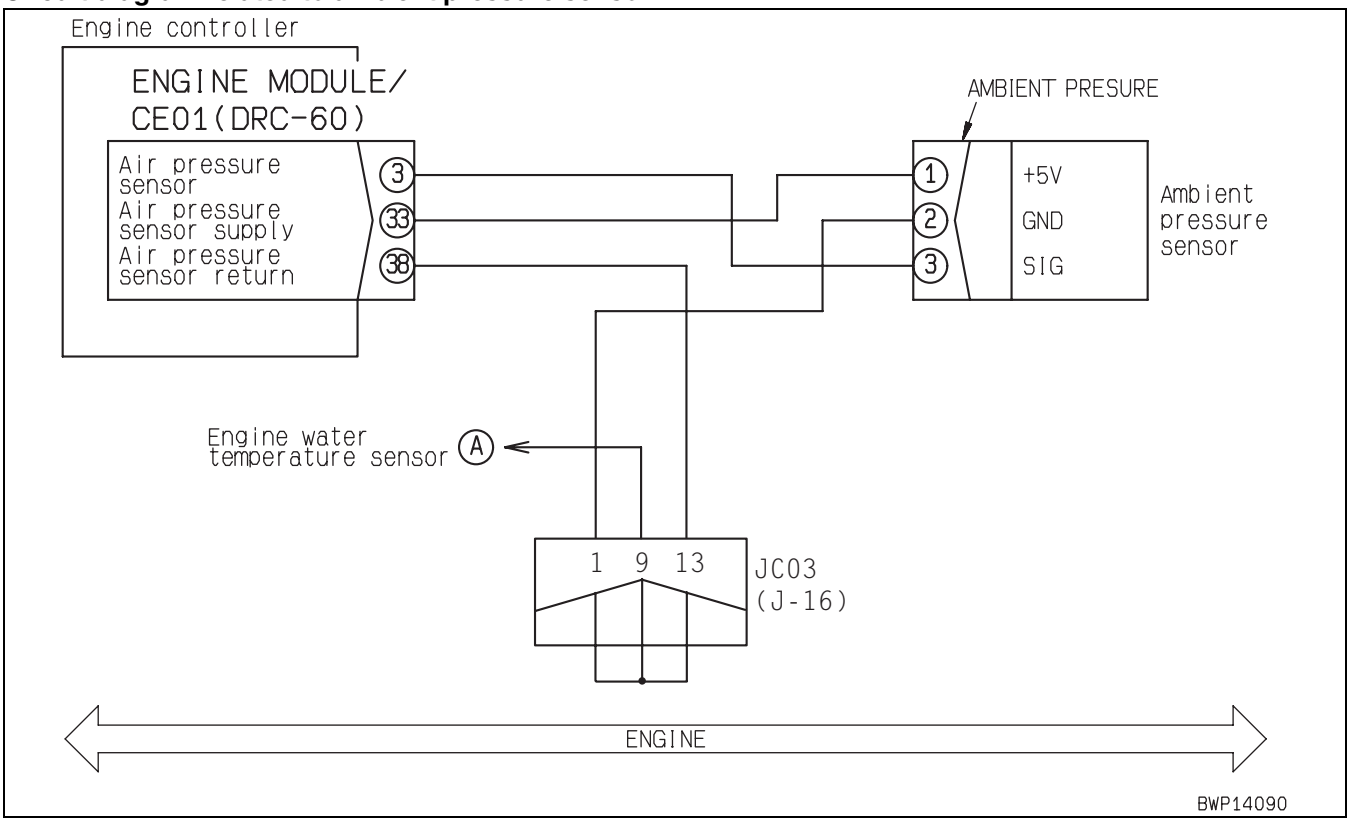


Failure code [CA222] Ambient Press Sens Low Error

User code	Failure code	Trouble	Ambient pressure sensor low error (Engine controller system)
E15	**CA222**		
Contents of trouble	• Low voltage was detected in signal circuit of ambient pressure sensor.		
Action of controller	• Fixes ambient pressure value and continues operation.		
Problem that appears on machine	• Engine does not start easily. • Engine output lowers.		
Related information	• Signal voltage of ambient pressure sensor can be checked with monitoring function. (Code: 37401 Ambient pressure sensor voltage • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power supply 1 system	If failure code [**CA352**] is also indicated, carry out troubleshooting for it first.		
	2	Defective ambient pressure sensor	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			AMBIENT PRESURE		Voltage
			Between (1) – (2)	Power supply	4.75 – 5.25V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (3) – AMBIENT PRESSURE (female) (3)	Resistance	Min. 100 kΩ
	4	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (3) – AMBIENT PRESSURE (female) (3) and between CE01 (female) (38) – JC03 – AMBIENT PRESSURE (female) (2)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts between ambient pressure sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	6	Defective engine controller	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			CE01		Voltage
			Between (33) – (38)	Voltage	4.75 – 5.25 V

Circuit diagram related to ambient pressure sensor

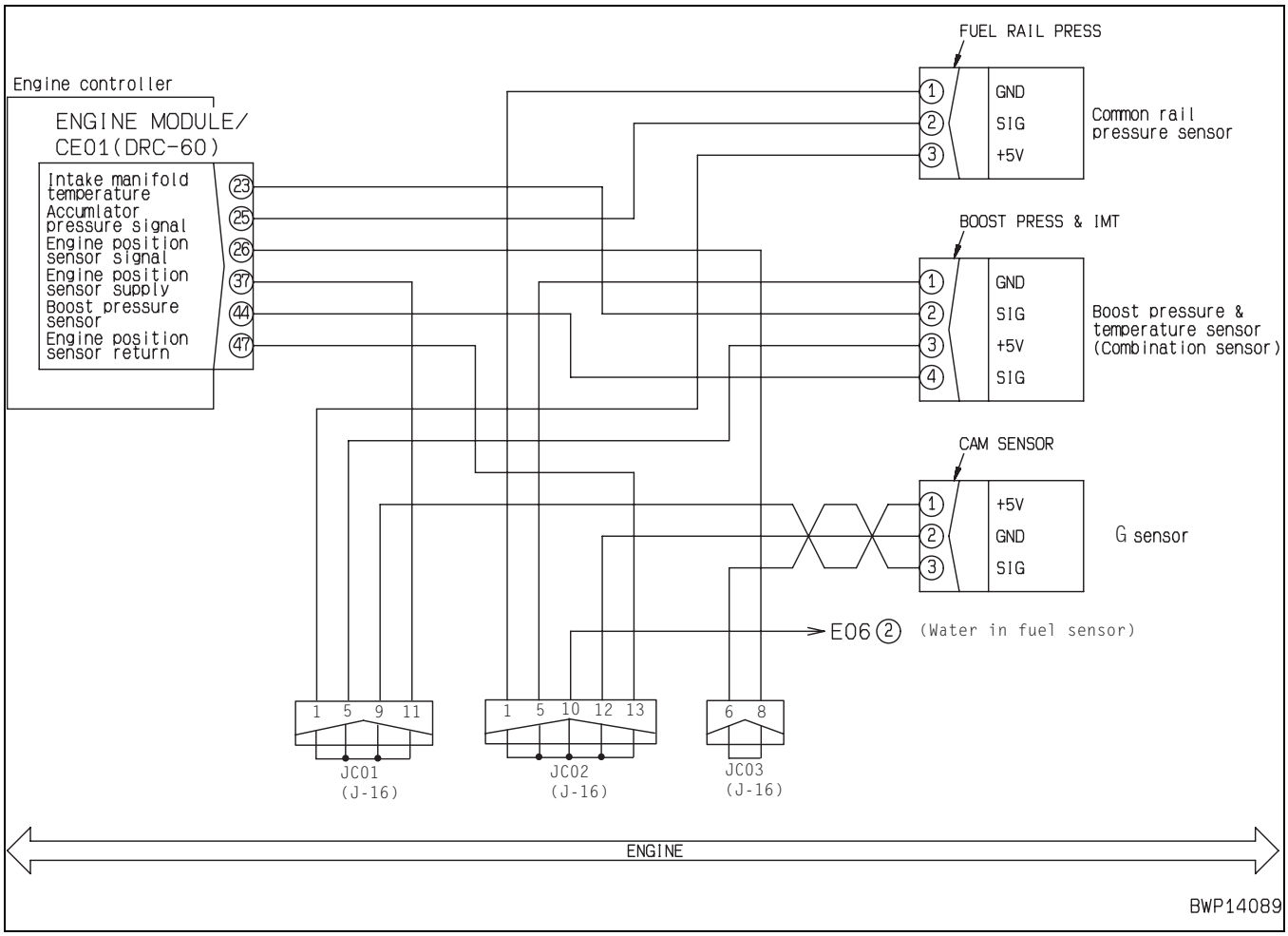


Failure code [CA227] Sens Supply 2 Volt High Error

User code	Failure code	Trouble	Sensor power supply 2 voltage high error (Engine controller system)
E15	**CA227**		
Contents of trouble	• High voltage was detected in sensor power supply 2 circuit.		
Action of controller	• Fixes boost pressure value and continues operation. • Fixes charge temperature value and continues operation. • Limits output and continues operation.		
Problem that appears on machine	• Engine output lowers.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Defective wiring harness connector	Connecting parts between each sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation
	2	Defective engine controller	If cause 1 is not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

Circuit diagram related to sensor power supply 2



Failure code [CA234] Eng Overspeed

User code	Failure code	Trouble	Engine overspeed (Engine controller system)
—	**CA234**		
Contents of trouble	• Engine speed exceeded control upper speed limit.		
Action of controller	• Stops injection until engine speed lowers to normal level.		
Problem that appears on machine	• Engine speed fluctuates.		
Related information	• Engine speed can be checked with monitoring function. (Code: 01002 Engine speed) • Method of reproducing failure code: Run engine at high idle.		

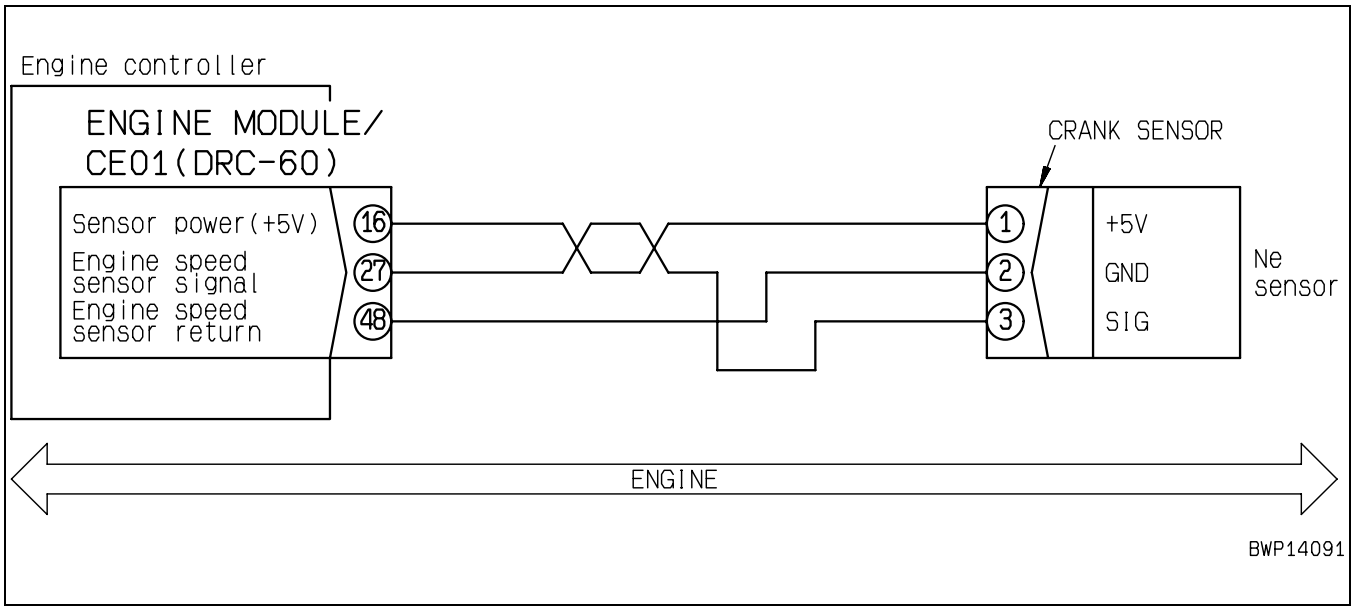
	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Use of improper fuel	Fuel used may be improper. Check it directly.
	2	Improper use	Machine may be used improperly. Teach operator proper using method.
	3	Defective engine controller	If cause 1 is not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

Failure code [CA238] Ne Speed Sens Supply Volt Error

User code	Failure code	Trouble	Ne speed sensor power supply voltage error (Engine controller system)
E15	**CA238**		
Contents of trouble	• Low voltage was detected in power supply circuit of engine Ne speed sensor.		
Action of controller	• Continues control with signal from engine Bkup speed sensor.		
Problem that appears on machine	• Engine does not start easily. • Engine hunts.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor or wiring harness	a Disconnect connector with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Disconnect sensor and wiring harness at right in order and carry out operation to reproduce trouble. If "E" of failure code goes off when sensor or wiring harness is disconnected, that sensor or wiring harness is defective.	Ne speed sensor	CRANK SENSOR
				Engine wiring harness	CE01
	2	Defective wiring harness connector	Connecting parts between each sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		

Circuit diagram related to engine Ne speed sensor

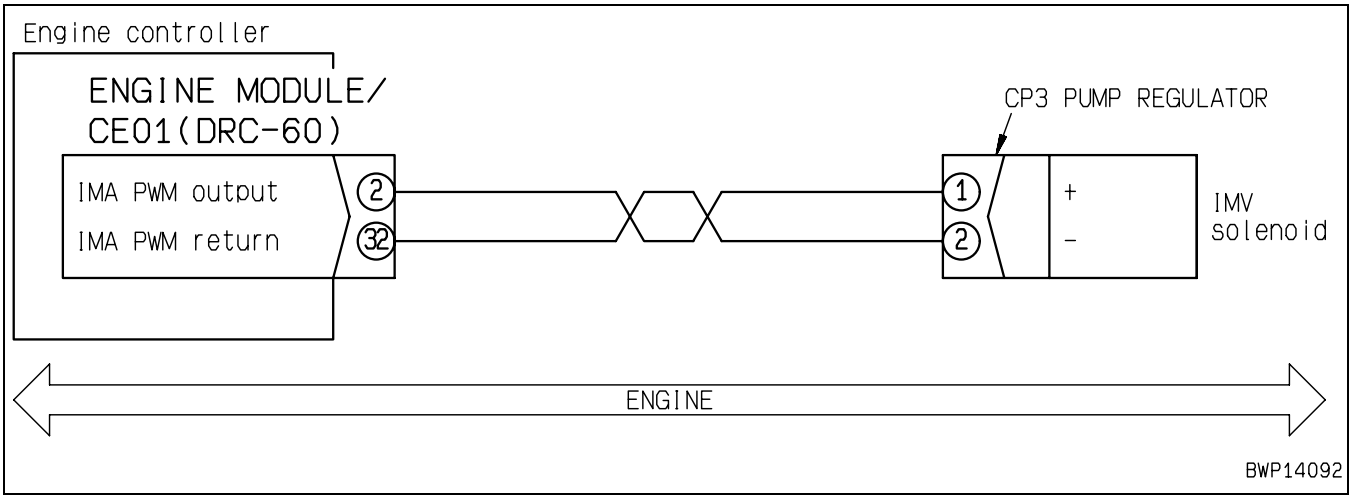


Failure code [CA271] IMV/PCV1 Short Error

User code	Failure code	Trouble	IMV/PCV1 short circuit error (Engine controller system)
E11	**CA271**		
Contents of trouble	• Short circuit was detected in drive circuit of supply pump actuator.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine speed does not rise from low idle. • Engine output lowers. • Common rail fuel pressure rises above command value.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective supply pump actuator	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CP3 PUMP REGULATOR (male)	Resistance	
			Between (1) – chassis ground	Min. 100 kΩ	
	2	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (2) – CP3 PUMP REGULATOR (female) (1)	Resistance	Min. 100 kΩ
	3	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (2) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts between supply pump actuator – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	5	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CE01 (female)	Resistance	
			Between (2) – chassis ground	Min. 100 kΩ	

Circuit diagram related to supply pump actuator (metering unit)

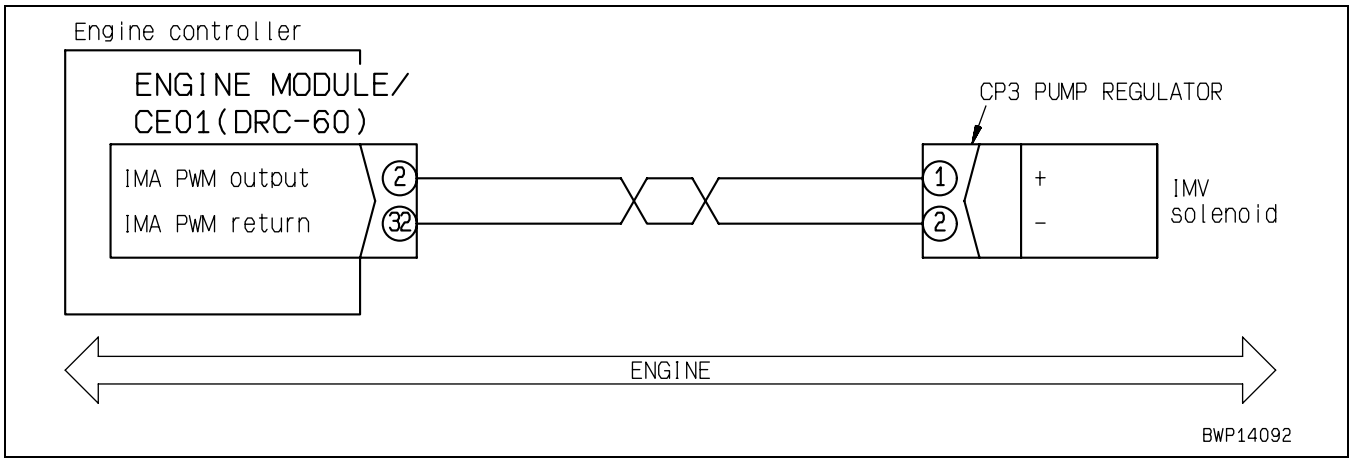


Failure code [CA272] IMV/PCV1 Open Error

User code	Failure code	Trouble	IMV/PCV1 open error (Engine controller system)
E11	**CA272**		
Contents of trouble	• Opening was detected in drive circuit of supply pump actuator.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine runs but its operation is unstable. • Common rail fuel pressure rises above command value.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective supply pump actuator	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CP3 PUMP REGULATOR (male)	Resistance	
			Between (1) – (2)	Max. 5 Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (2) – CP3 PUMP REGULATOR (female) (1)	Resistance	Max. 10 Ω
			Wiring harness between CE01 (female) (32) – CP3 PUMP REGULATOR (female) (2)	Resistance	Max. 10 Ω
	3	Hot short (Short circuit with 24V circuit) in wiring harness	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between CE01 (female) (2) – CP3 PUMP REGULATOR (female) (1)	Voltage	Max. 3 V
	4	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (2) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts between supply pump actuator – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	6	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CE01 (female)	Resistance	
			Between (2) – (32)	Max. 5 Ω	

Circuit diagram related to supply pump actuator (metering unit)

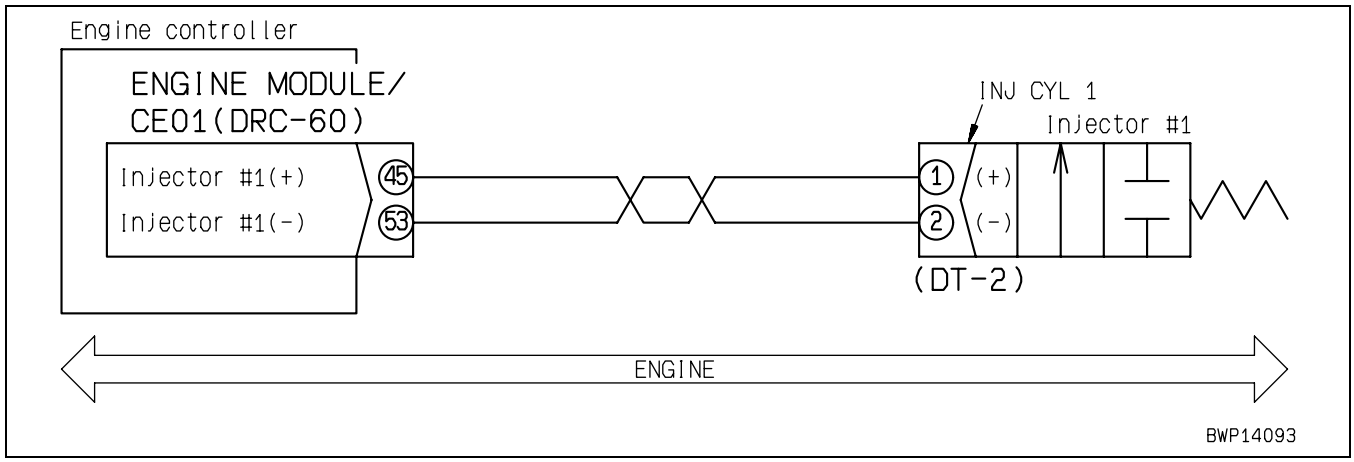


Failure code [CA322] Inj #1 (L#1) Open/Short Error

User code	Failure code	Trouble	Injector #1 (L#1) open/short circuit error (Engine controller system)
E11	**CA322**		
Contents of trouble	• Opening or short circuit was detected in drive circuit of No. 1 injector.		
Action of controller	• None in particular.		
Problem that appears on machine	• Combustion becomes irregular or engine hunts. • Engine output lowers.		
Related information	• Method of reproducing failure code: Start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective engine controller	If following failure codes are also displayed, trouble is in engine controller. [**CA322**], [**CA324**], [**CA331**]			
	2	Defective No. 1 injector	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			INJ CYL 1 (male)	Resistance		
			Between (1) – (2)	Max. 2 Ω		
			Between (1) – chassis ground	Min. 100 kΩ		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (45) – INJ CYL 1 (female) (1)	Resistance	Max. 2 Ω	
			Wiring harness between CE01 (female) (53) – INJ CYL 1 (female) (2)	Resistance	Max. 2 Ω	
	4	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (45) – INJ CYL 1 (female) (1)	Resistance	Max. 2 Ω	
	5	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (45) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness between CE01 (female) (53) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
	6	Defective wiring harness connector	Connecting parts between No. 1 injector – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	7	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CE01 (female)	Resistance		
			Between (45) – (53)	Max. 2 Ω		
			Between (45) – chassis ground	Min. 100 kΩ		

Circuit diagram related to No. 1 injector

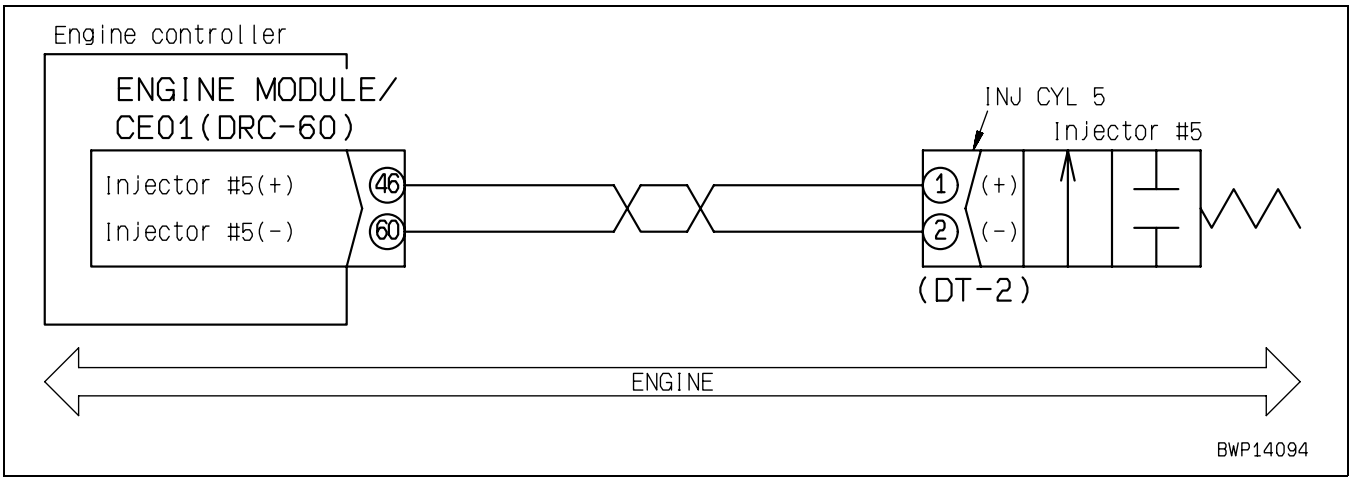


Failure code [CA323] Inj #5 (L#5) Open/Short Error

User code	Failure code	Trouble	Injector #5 (L#5) open/short circuit error (Engine controller system)
E11	**CA323**		
Contents of trouble	• Opening or short circuit was detected in drive circuit of No. 5 injector.		
Action of controller	• None in particular.		
Problem that appears on machine	• Combustion becomes irregular or engine hunts. • Engine output lowers.		
Related information	• Method of reproducing failure code: Start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective engine controller	If following failure codes are also displayed, trouble is in engine controller. [**CA323**], [**CA325**], [**CA332**]			
	2	Defective No. 5 injector	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			INJ CYL 5 (male)	Resistance		
			Between (1) – (2)	Max. 2 Ω		
			Between (1) – chassis ground	Min. 100 kΩ		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (46) – INJ CYL 5 (female) (1)	Resistance	Max. 2 Ω	
			Wiring harness between CE01 (female) (60) – INJ CYL 5 (female) (2)	Resistance	Max. 2 Ω	
	4	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (46) – INJ CYL 5 (female) (1)	Resistance	Max. 2 Ω	
	5	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (46) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness between CE01 (female) (60) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
	6	Defective wiring harness connector	Connecting parts between No. 5 injector – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	7	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CE01 (female)	Resistance		
			Between (46) – (60)	Max. 2 Ω		
			Between (46) – chassis ground	Min. 100 kΩ		

Circuit diagram related to No. 5 injector

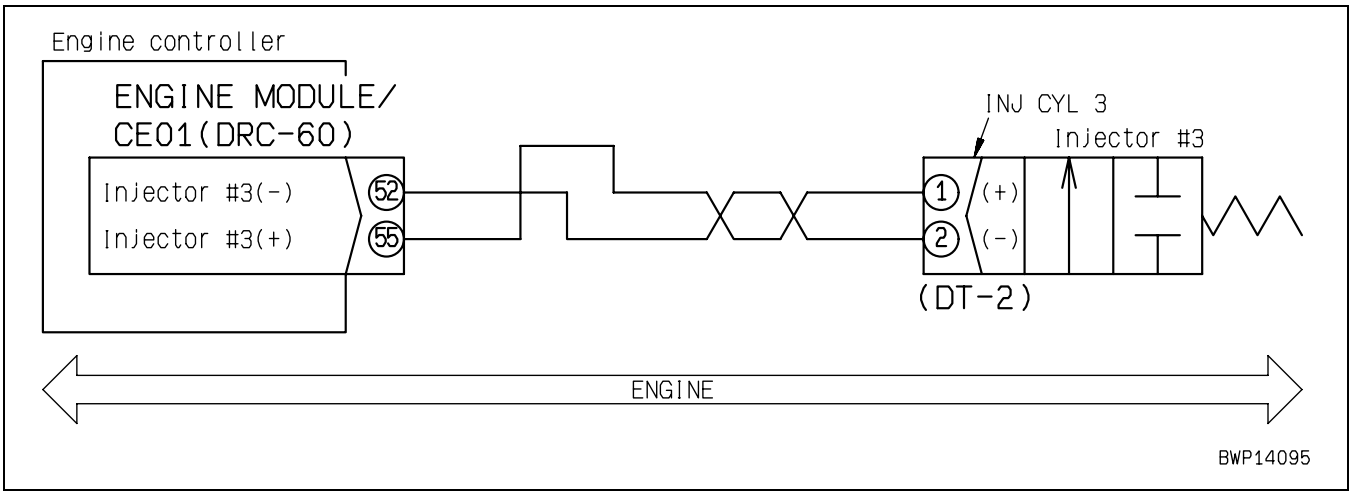


Failure code [CA324] Inj #3 (L#3) Open/Short Error

User code	Failure code	Trouble	Injector #3 (L#3) open/short circuit error (Engine controller system)
E11	**CA324**		
Contents of trouble	• Opening or short circuit was detected in drive circuit of No. 3 injector.		
Action of controller	• None in particular.		
Problem that appears on machine	• Combustion becomes irregular or engine hunts. • Engine output lowers.		
Related information	• Method of reproducing failure code: Start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective engine controller	If following failure codes are also displayed, trouble is in engine controller. [**CA322**], [**CA324**], [**CA331**]			
	2	Defective No. 3 injector	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			INJ CYL 3 (male)	Resistance		
			Between (1) – (2)	Max. 2 Ω		
			Between (1) – chassis ground	Min. 100 kΩ		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (55) – INJ CYL 3 (female) (1)	Resistance	Max. 2 Ω	
			Wiring harness between CE01 (female) (52) – INJ CYL 3 (female) (2)	Resistance	Max. 2 Ω	
	4	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (55) – INJ CYL 3 (female) (1)	Resistance	Max. 2 Ω	
	5	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (55) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness between CE01 (female) (52) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
	6	Defective wiring harness connector	Connecting parts between No. 3 injector – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	7	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CE01 (female)	Resistance		
			Between (55) – (52)	Max. 2 Ω		
			Between (55) – chassis ground	Min. 100 kΩ		

Circuit diagram related to No. 3 injector

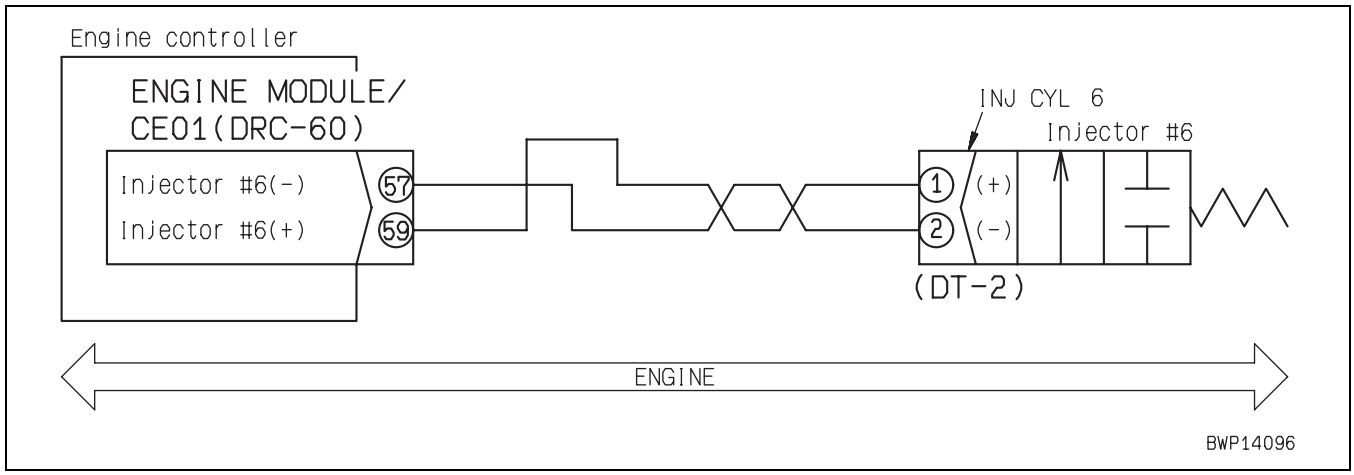


Failure code [CA325] Inj #6 (L#6) Open/Short Error

User code	Failure code	Trouble	Injector #6 (L#6) open/short circuit error (Engine controller system)
E11	**CA325**		
Contents of trouble	• Opening or short circuit was detected in drive circuit of No. 6 injector.		
Action of controller	• None in particular.		
Problem that appears on machine	• Combustion becomes irregular or engine hunts. • Engine output lowers.		
Related information	• Method of reproducing failure code: Start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective engine controller	If following failure codes are also displayed, trouble is in engine controller. [**CA323**], [**CA325**], [**CA332**]			
	2	Defective No. 6 injector	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			INJ CYL 6 (male)	Resistance		
			Between (1) – (2)	Max. 2 Ω		
			Between (1) – chassis ground	Min. 100 kΩ		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (57) – INJ CYL 6 (female) (1)	Resistance	Max. 2 Ω	
			Wiring harness between CE01 (female) (59) – INJ CYL 6 (female) (2)	Resistance	Max. 2 Ω	
	4	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (57) – INJ CYL 6 (female) (1)	Resistance	Max. 2 Ω	
	5	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (57) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness between CE01 (female) (59) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
	6	Defective wiring harness connector	Connecting parts between No. 6 injector – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	7	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CE01 (female)	Resistance		
			Between (57) – (59)	Max. 2 Ω		
			Between (57) – chassis ground	Min. 100 kΩ		

Circuit diagram related to No. 6 injector

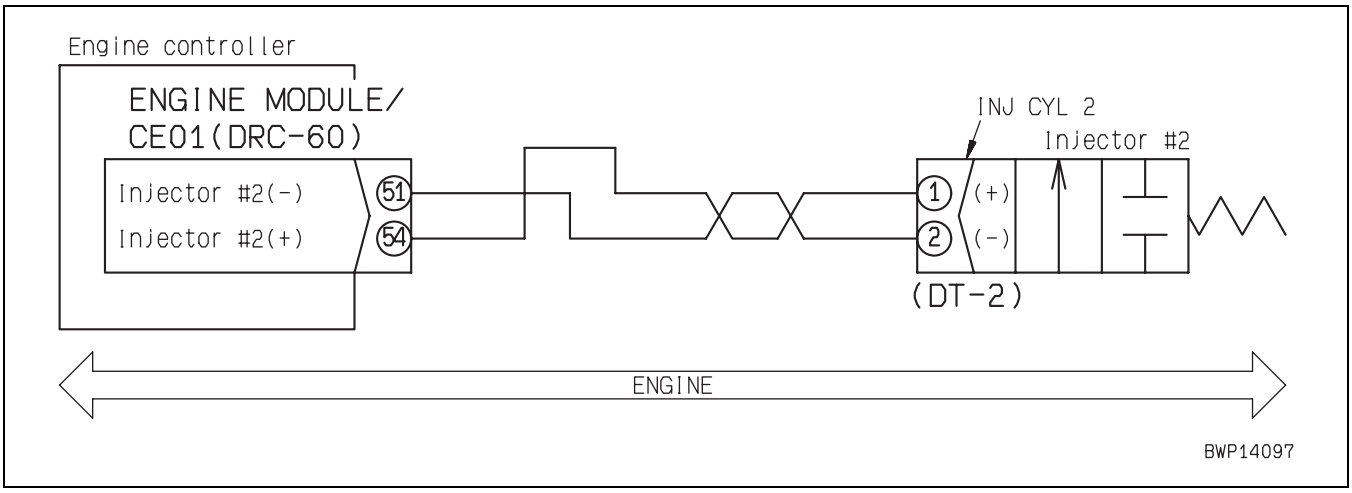


Failure code [CA331] Inj #2 (L#2) Open/Short Error

User code	Failure code	Trouble	Injector #2 (L#2) open/short circuit error (Engine controller system)
E11	**CA331**		
Contents of trouble	• Opening or short circuit was detected in drive circuit of No. 2 injector.		
Action of controller	• None in particular.		
Problem that appears on machine	• Combustion becomes irregular or engine hunts. • Engine output lowers.		
Related information	• Method of reproducing failure code: Start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective engine controller	If following failure codes are also displayed, trouble is in engine controller. [**CA322**], [**CA324**], [**CA331**]			
	2	Defective No. 2 injector	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			INJ CYL 2 (male)	Resistance		
			Between (1) – (2)	Max. 2 Ω		
			Between (1) – chassis ground	Min. 100 kΩ		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (54) – INJ CYL 2 (female) (1)	Resistance	Max. 2 Ω	
			Wiring harness between CE01 (female) (51) – INJ CYL 2 (female) (2)	Resistance	Max. 2 Ω	
	4	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (54) – INJ CYL 2 (female) (1)	Resistance	Max. 2 Ω	
	5	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (54) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness between CE01 (female) (51) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
	6	Defective wiring harness connector	Connecting parts between No. 2 injector – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	7	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CE01 (female)	Resistance		
			Between (54) – (51)	Max. 2 Ω		
			Between (54) – chassis ground	Min. 100 kΩ		

Circuit diagram related to No. 2 injector

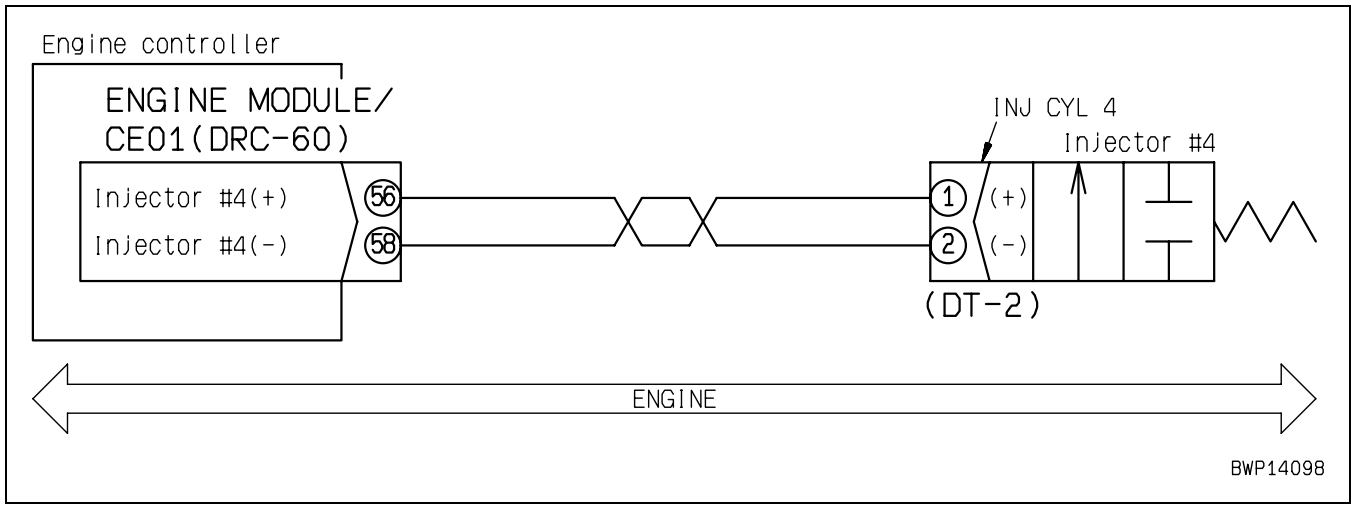


Failure code [CA332] Inj #4 (L#4) Open/Short Error

User code	Failure code	Trouble	Injector #4 (L#4) open/short circuit error (Engine controller system)
E11	**CA332**		
Contents of trouble	• Opening or short circuit was detected in drive circuit of No. 4 injector.		
Action of controller	• None in particular.		
Problem that appears on machine	• Combustion becomes irregular or engine hunts. • Engine output lowers.		
Related information	• Method of reproducing failure code: Start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective engine controller	If following failure codes are also displayed, trouble is in engine controller. [**CA323**], [**CA325**], [**CA332**]			
	2	Defective No. 4 injector	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			INJ CYL 4 (male)	Resistance		
			Between (1) – (2)	Max. 2 Ω		
			Between (1) – chassis ground	Min. 100 kΩ		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (56) – INJ CYL 4 (female) (1)	Resistance	Max. 2 Ω	
			Wiring harness between CE01 (female) (58) – INJ CYL 4 (female) (2)	Resistance	Max. 2 Ω	
	4	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (56) – INJ CYL 4 (female) (1)	Resistance	Max. 2 Ω	
	5	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (56) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness between CE01 (female) (58) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
	6	Defective wiring harness connector	Connecting parts between No. 4 injector – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	7	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CE01 (female)	Resistance		
			Between (56) – (58)	Max. 2 Ω		
			Between (56) – chassis ground	Min. 100 kΩ		

Circuit diagram related to No. 4 injector



Failure code [CA342] Calibration Code Incompatibility

User code	Failure code	Trouble	Calibration code incompatibility (Engine controller system)
E10	**CA342**		
Contents of trouble	• Incompatibility of data occurred in engine controller.		
Action of controller	• None in particular.		
Problem that appears on machine	• Continues normal operation. • Engine stops or does not start.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

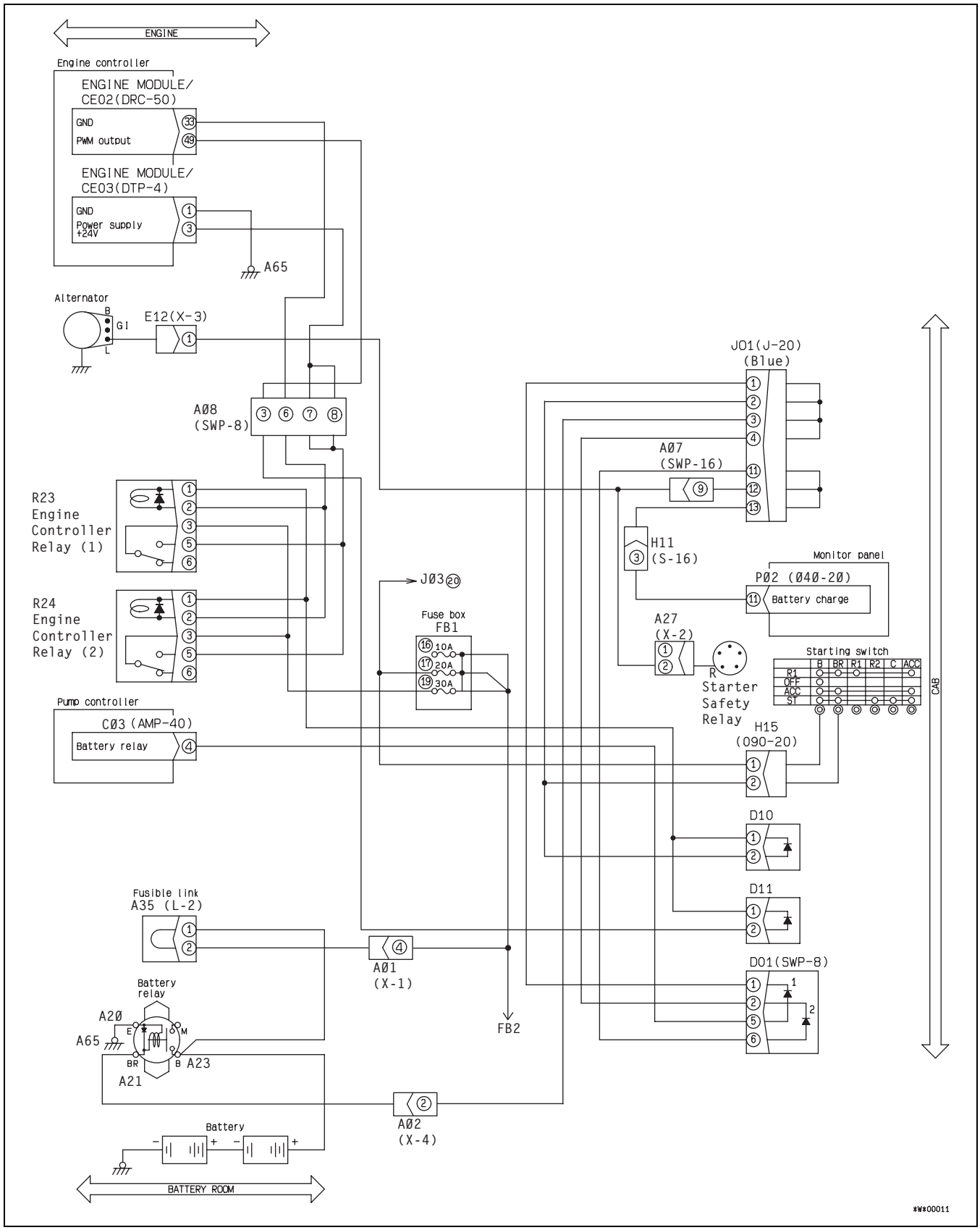
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defect in related system	If another failure code is displayed, carry out troubleshooting for it.
	2	Defective engine controller	Engine controller may be defective. (Troubleshooting cannot be carried out.)

Failure code [CA351] Injectors Drive Circuit Error

User code	Failure code	Trouble	Injectors Drive Circuit Error (Engine controller system)
E10	**CA351**		
Contents of trouble	• There is error in drive power circuit of injector.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Exhaust gas becomes black. • Combustion becomes irregular. • Engine output lowers. • Engine cannot be started.		
Related information	• Method of reproducing failure code: Start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defect in related system	If another failure code is displayed, carry out troubleshooting for it.		
	2	Defective fuse No. 19	If fuse is broken, circuit probably has ground fault.		
	3	Defective relay for engine controller power supply	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Replace relay (R23, R24) for engine controller with another relay and perform reproducing operation. If "E" of failure code goes off at this time, replaced relay is defective.		
	4	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between FB1-19 – R23, R24 (female) (3)	Resistance	Max. 0.5 Ω
			Wiring harness between R23, R24 (female) (5) – CE03 (female) (3)	Resistance	Max. 0.5 Ω
			Wiring harness between CE03 (female) (1) – chassis ground (T12)	Resistance	Max. 10 Ω
	5	Defective engine controller	If causes 1 – 4 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to engine controller

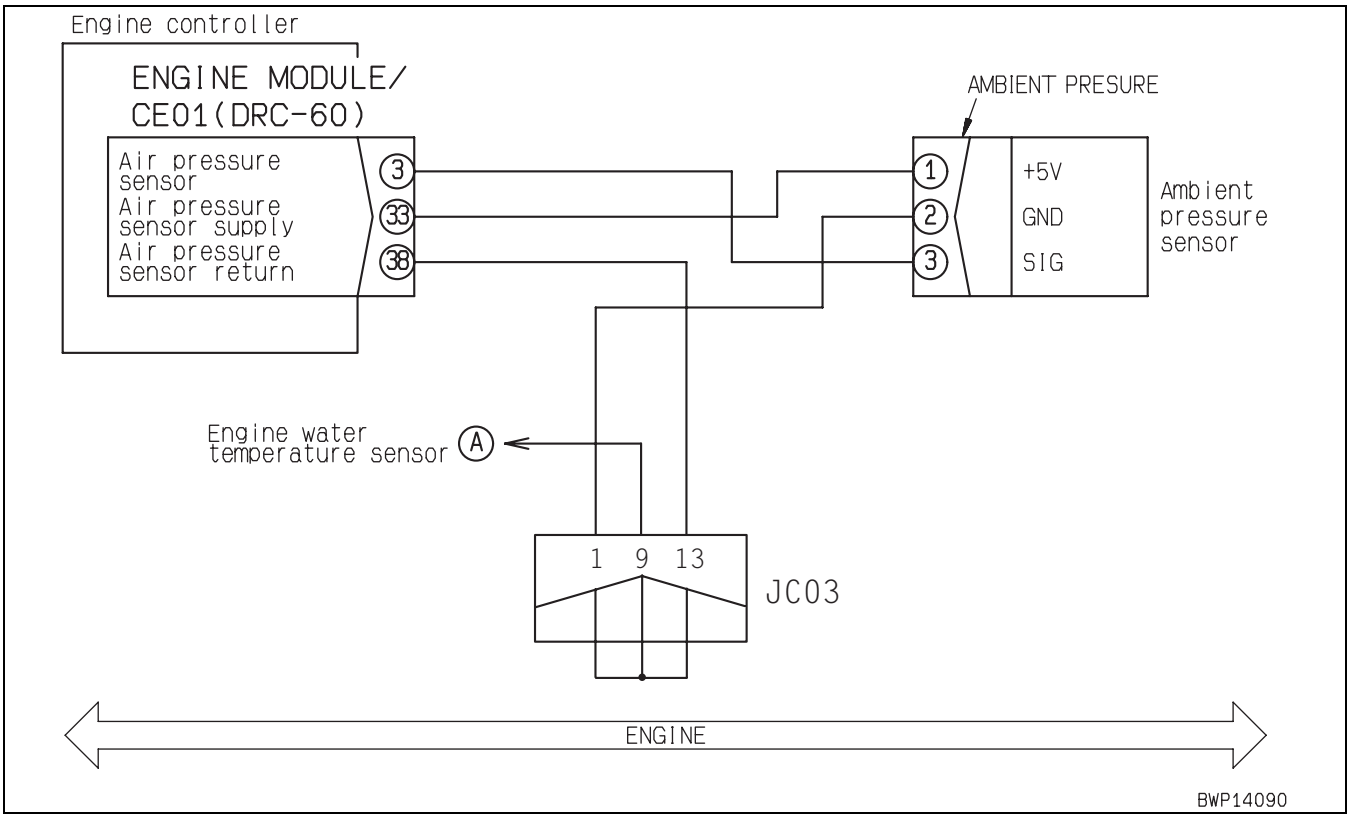


Failure code [CA352] Sens Supply 1 Volt Low Error

User code	Failure code	Trouble	Sensor power supply 1 voltage low error (Engine controller system)
E15	**CA352**		
Contents of trouble	• Low voltage was detected in sensor power supply 1 circuit.		
Action of controller	• Fixes ambient pressure value and continues operation.		
Problem that appears on machine	• Engine does not start easily. • Engine output lowers.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor or wiring harness	a Disconnect connector with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Disconnect sensor and wiring harness at right in order and carry out operation to reproduce trouble. If "E" of failure code goes off when sensor or wiring harness is disconnected, that sensor or wiring harness is defective.	Ambient pressure sensor	AMBIENT PRESURE
				Engine wiring harness	CE01
	2	Defective wiring harness connector	Connecting parts between ambient pressure sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	3	Defective engine controller	If causes 1 – 2 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to sensor power supply 1

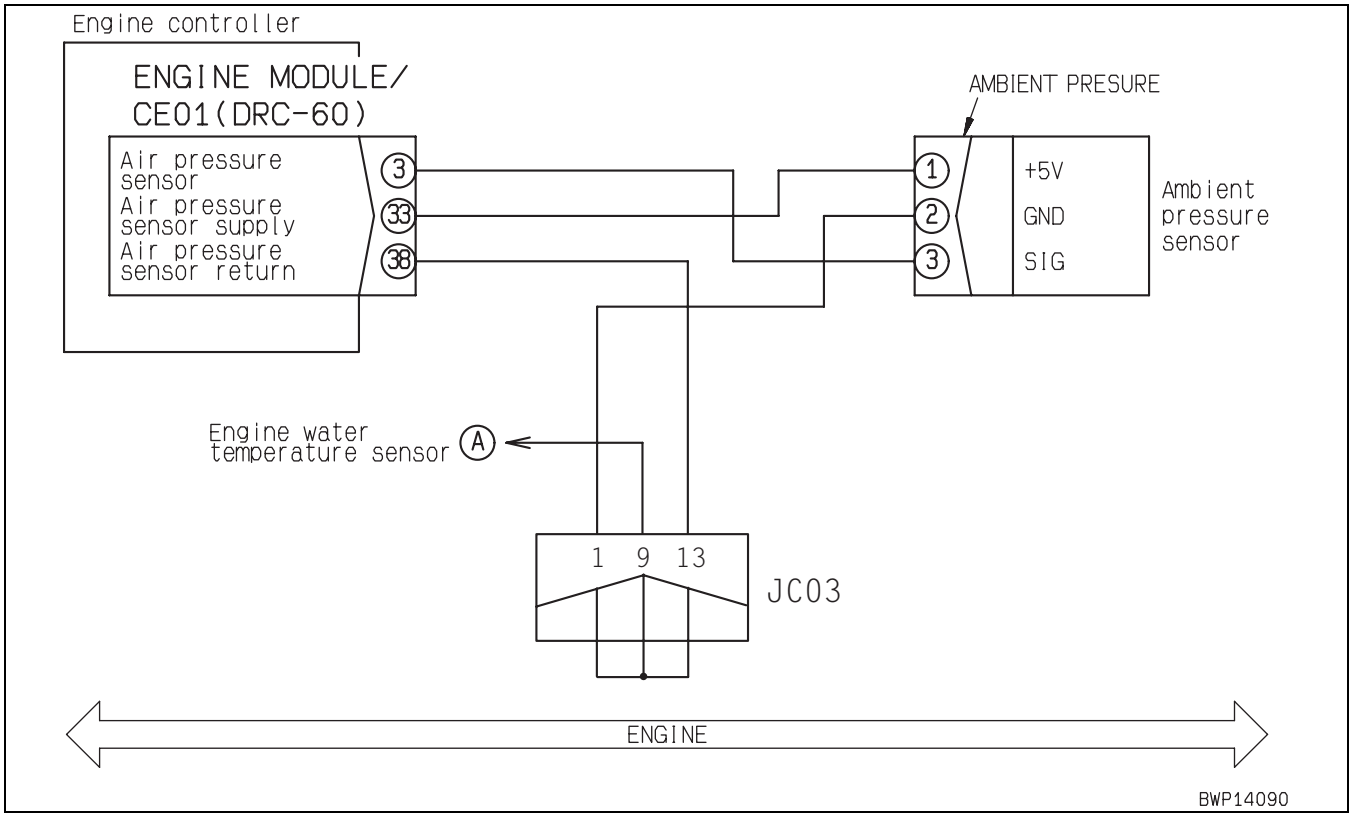


Failure code [CA386] Sens Supply 1 Volt High Error

User code	Failure code	Trouble	Sensor power supply 1 voltage high error (Engine controller system)
E15	**CA386**		
Contents of trouble	• High voltage was detected in sensor power supply 1 circuit.		
Action of controller	• Fixes ambient pressure value and continues operation.		
Problem that appears on machine	• Engine does not start easily. • Engine output lowers.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

		Cause	Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Defective wiring harness connector	Connecting parts between ambient pressure sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation
	2	Defective engine controller	If cause 1 is not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

Circuit diagram related to sensor power supply 1

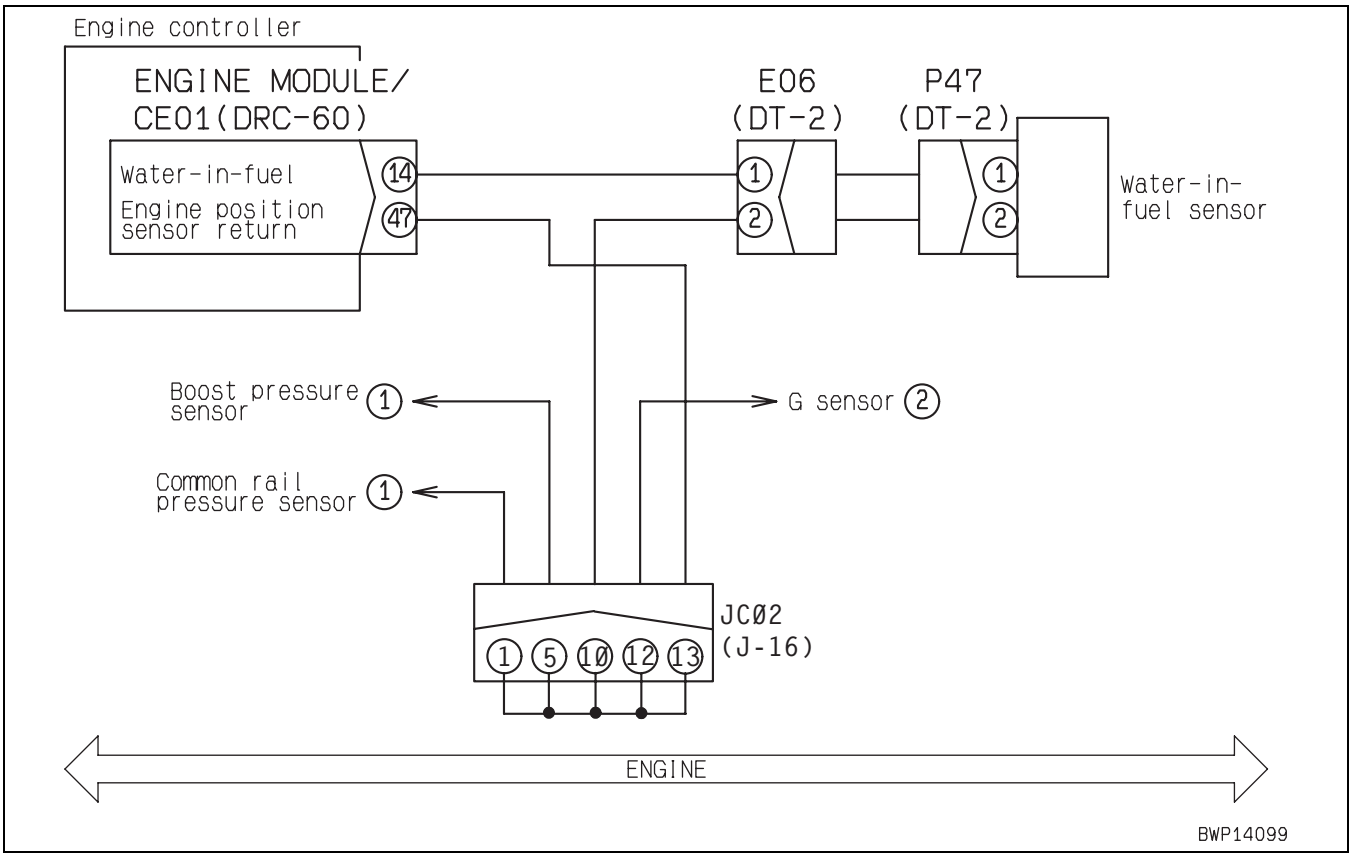


Failure code [CA428] Water in Fuel Sensor High Error

User code	Failure code	Trouble	Water-in-fuel sensor high error (Engine controller system)
E15	**CA428**		
Contents of trouble	• High voltage was detected in signal circuit of water-in-fuel sensor.		
Action of controller	• None in particular.		
Problem that appears on machine	• Water separator monitor does not display normally.		
Related information	• Condition water-in-fuel sensor signal can be checked with monitoring function. (Code: 18800 Condition of WIF sensor) • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective water-in-fuel sensor	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			P47 (female)	Resistance	
			Between (1) – (2)	Max. 10 Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (14) – P47 (male) (1)	Resistance	Max. 10 Ω
			Wiring harness between CE01 (female) (47) – JC02 – P47 (male) (2)	Resistance	Max. 10 Ω
	3	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (14) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts between water-in-fuel sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	5	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CE01 (female)	Resistance	
			Between (14) – (47)	Max. 10 Ω	

Circuit diagram related to water-in-fuel sensor

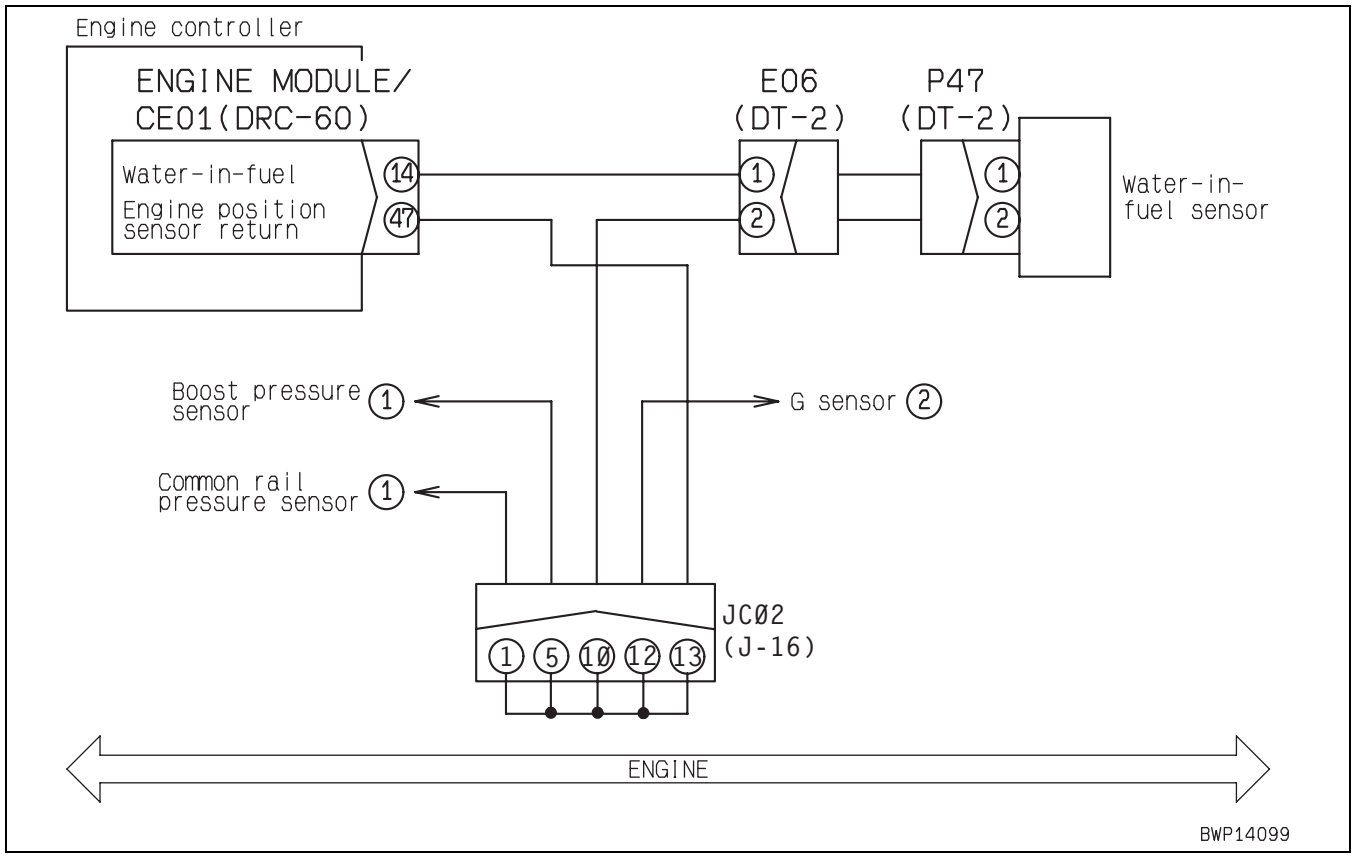


Failure code [CA429] Water in Fuel Sensor Low Error

User code	Failure code	Trouble	Water-in-fuel sensor low error (Engine controller system)
E15	**CA429**		
Contents of trouble	• Low voltage was detected in signal circuit of water-in-fuel sensor.		
Action of controller	• None in particular.		
Problem that appears on machine	• Water separator monitor does not display normally.		
Related information	• Condition water-in-fuel sensor signal can be checked with monitoring function. (Code: 18800 Condition of WIF sensor) • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective water-in-fuel sensor	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			P47 (female)	Resistance	
			Between (1) – (2)	Max. 10 Ω	
			Between (1) – chassis ground	Min. 100 kΩ	
	2	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (14) – P47 (male) (1)	Resistance	Min. 100 kΩ
	3	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (14) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts between water-in-fuel sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	5	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CE01 (female)	Resistance	
			Between (14) – (47)	Max. 10 Ω	
			Between (14) – chassis ground	Min. 100 kΩ	

Circuit diagram related to water-in-fuel sensor

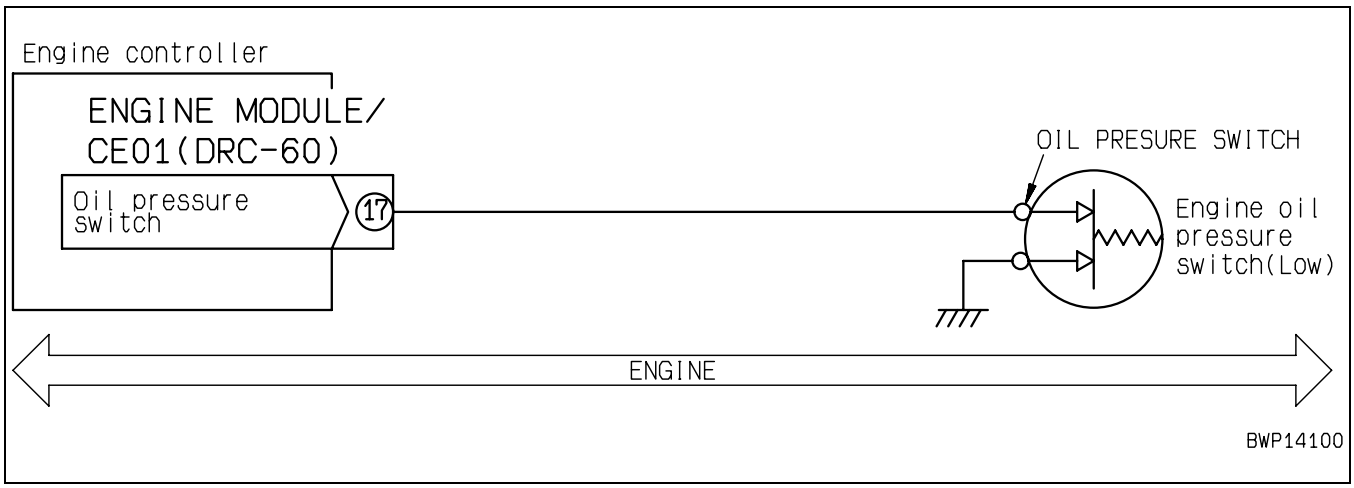


Failure code [CA435] Eng Oil Press Sw Error

User code	Failure code	Trouble	Engine oil pressure switch error (Engine controller system)
E15	**CA435**		
Contents of trouble	• There is error in signal circuit of engine oil pressure switch.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine protection function based on engine oil pressure does not work. • Engine oil pressure monitor does not display normally		
Related information	• Method of reproducing failure code: Turn starting switch ON or start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective engine oil pressure switch	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			OIL PRESSURE SWITCH (male)	Resistance	
			Between (1) – chassis ground	Max. 10 Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (17) – OIL PRESSURE SWITCH (male) (1)	Resistance	Max. 10 Ω
	3	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (17) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts between engine oil pressure switch – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	5	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CE01 (female)	Resistance	
			Between (17) – chassis ground	Max. 10 Ω	

Circuit diagram related to engine oil pressure switch



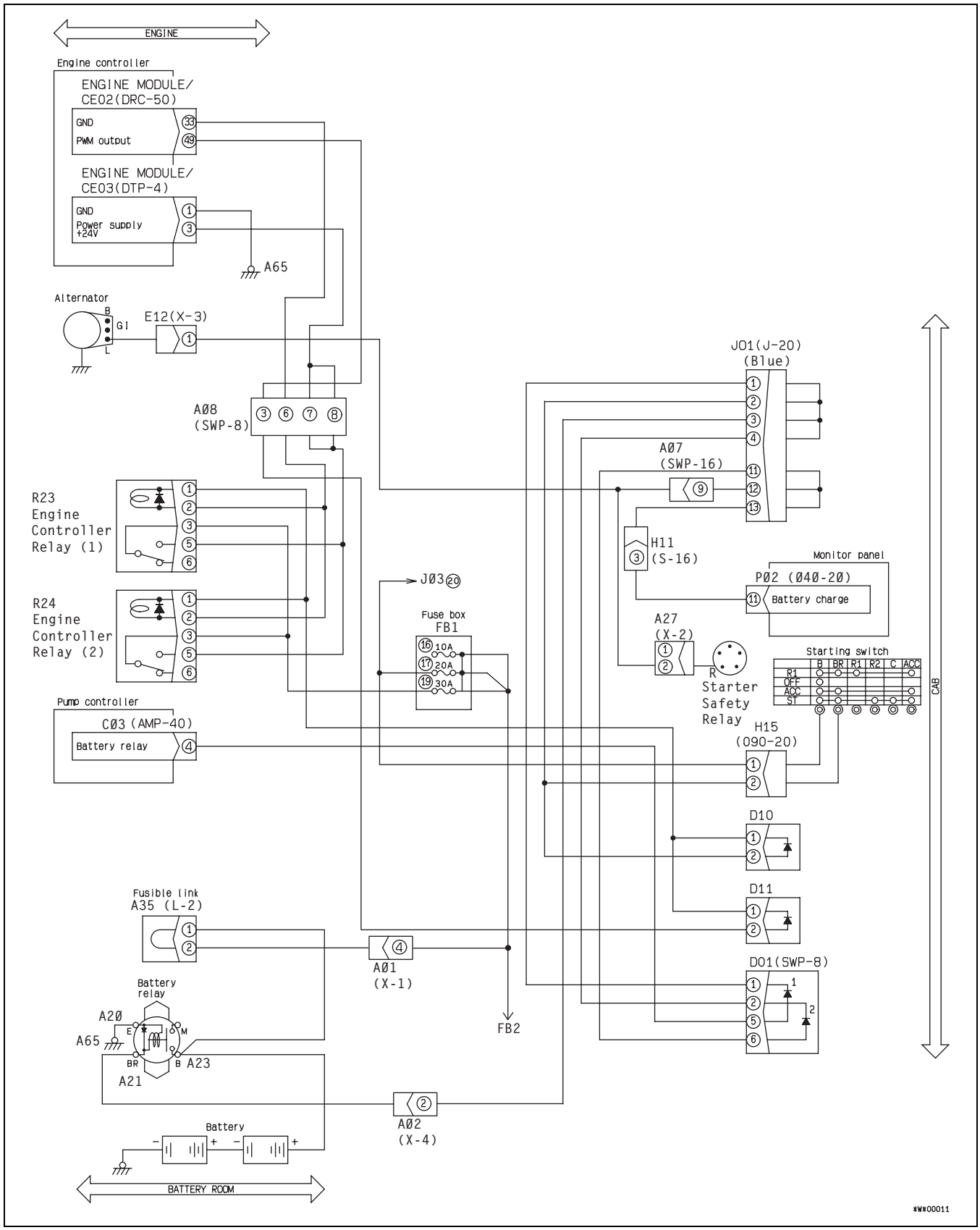
Failure code [CA441] Battery Voltage Low Error

User code	Failure code	Trouble	Battery voltage low error (Engine controller system)
E10	**CA441**		
Contents of trouble	• There is low voltage in controller power supply circuit.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine stops. • Engine does not start easily.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Looseness or corrosion of battery terminal	Battery terminal may be loosened or corroded. Check it directly.		
	2	Low battery voltage	a Prepare with starting switch OFF, then keep starting switch OFF and start engine and carry out troubleshooting in each case.		
			Battery (1 piece)	Starting switch	Voltage
			Between (+) – (–) terminals	OFF	Min. 12 V
				START	Min. 6.2 V
	3	Defective fuse No. 19	If fuse is broken, circuit probably has ground fault. (See Cause 6)		
	4	Defective relay for engine controller power supply	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Replace relay (R23, R24) for engine controller with another relay and perform reproducing operation. If "E" of failure code goes off at this time, replaced relay is defective.		
	5	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between FB1-19 – R23, R24 (female) (3)	Resistance	Max. 10 Ω
			Wiring harness between R23, R24 (female) (5) – CE03 (female) (3)	Resistance	Max. 10 Ω
			Wiring harness between CE03 (female) (1) – chassis ground (A65)	Resistance	Max. 10 Ω
	6	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between FB1-19 – R23, R24 (female) (3)	Resistance	Min. 100 kΩ
			Wiring harness between R23, R24 (female) (5) – CE03 (female) (3)	Resistance	Max. 10 Ω
	7	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE03 (female) (3) – CE03 (female) (1) pin (with battery terminal disconnected)	Resistance	Min. 100 kΩ
			Wiring harness between CE03 (female) (3) – each of CE02 (female) pins (With battery terminal disconnected)	Resistance	Min. 100 kΩ
			Wiring harness between CE03 (female) (1) – each of CE02 (female) pins (With battery terminal disconnected)	Resistance	Min. 100 kΩ

<table>
<tr><td rowspan="4">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="3">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>8</td><td>Defective wiring harness connector</td><td colspan="3">Connecting parts between fuse No. 19 – machine wiring harness – engine controller may be defective. Check them directly.
• Looseness of connector, breakage of lock, or breakage of seal
• Corrosion, bend, breakage, push-in, or expansion of pin
• Moisture or dirt in connector or defective insulation</td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">Defective engine controller</td><td colspan="3">a Prepare with starting switch OFF, then turn starting switch ON and start engine and carry out troubleshooting in each case.</td></tr>
<tr><td>CE03 (female)</td><td>Starting switch</td><td>Voltage</td></tr>
<tr><td rowspan="2">Between (3) – (1)</td><td>ON</td><td>Min. 24 V</td></tr>
<tr><td>START</td><td>Min. 12 V</td></tr>
</table>

Circuit diagram related to engine controller power supply

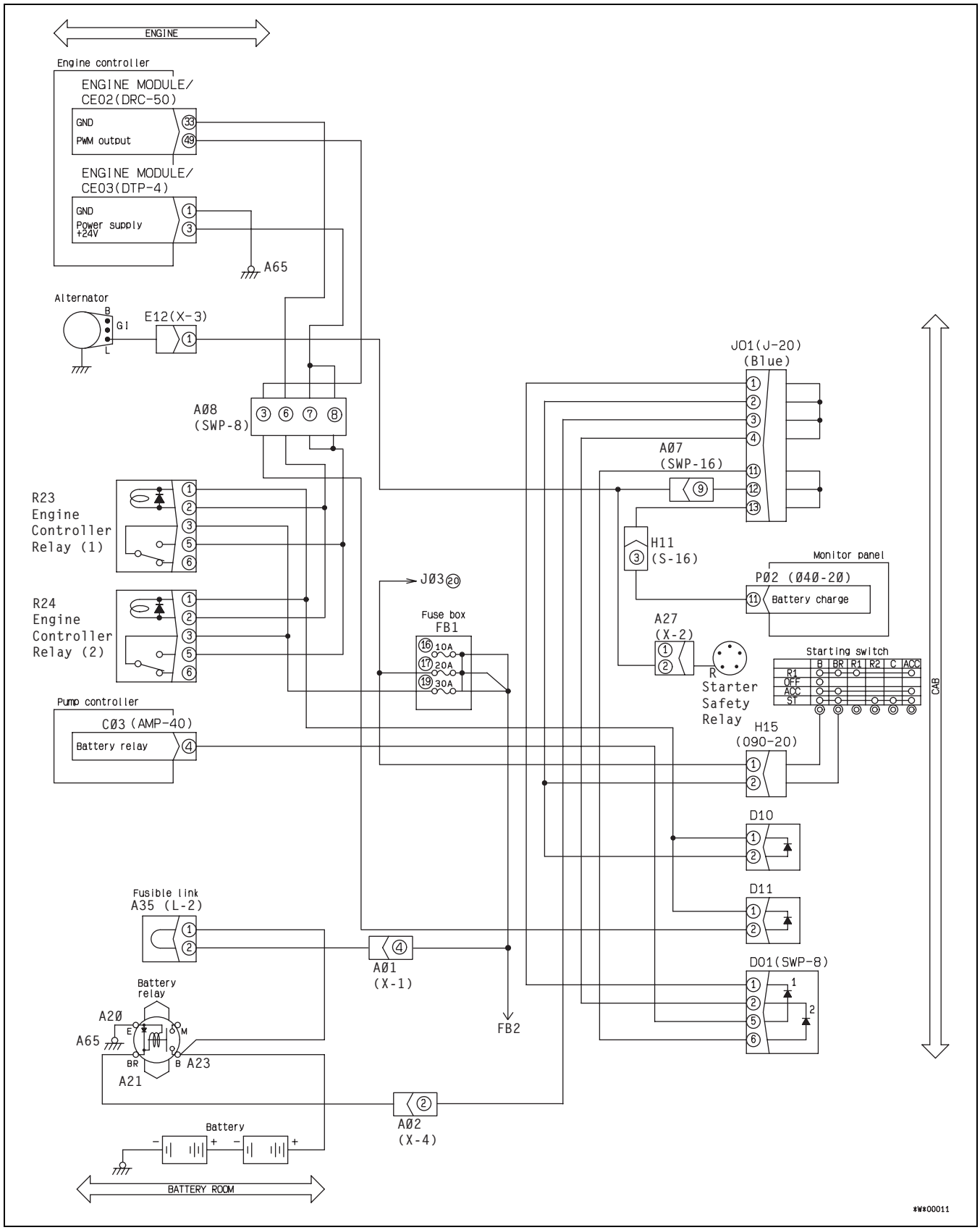


Failure code [CA442] Battery Voltage High Error

User code	Failure code	Trouble	Battery voltage high error (Engine controller system)
E10	**CA442**		
Contents of trouble	• There is high voltage (36 V or higher) in controller power supply circuit.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine may stop.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective battery voltage	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Battery		Voltage
			Between (+) – (–) terminals		Max. 32 V
	2	Defective alternator	a Prepare with starting switch OFF, then start engine and carry out troubleshooting.		
			E12 (male)	Engine speed	Voltage
			Between (1) – chassis ground	Medium or higher	27.5 – 29.5 V
	3	Defective engine controller	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			CE03 (female)		Voltage
			Between (3) – (1)		Max. 32 V

Circuit diagram related to engine controller power supply



Failure code [CA449] Rail Press Very High Error

User code	Failure code	Trouble	Common rail pressure very high error (Engine controller system)
E11	**CA449**		
Contents of trouble	• There is high pressure error in common rail circuit.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Engine sound becomes large when no or light load is applied. • Engine output lowers.		
Related information	• Common rail pressure can be checked with monitoring function. (Code: 36400 Common rail pressure) • Method of reproducing failure code: Start engine.		

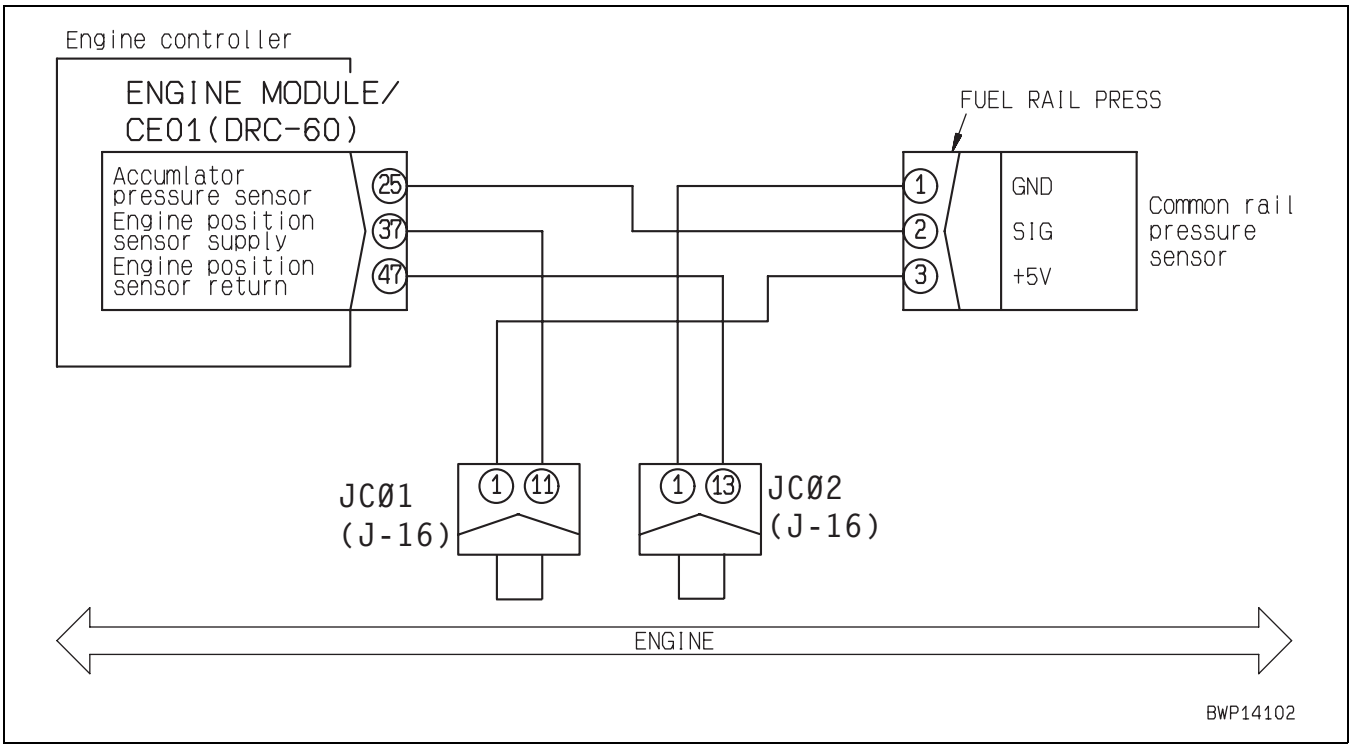
	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defect in related system	If another failure code is displayed, carry out troubleshooting for it.		
	2	Air in low pressure circuit	There may be air in low pressure circuit. Check it directly according to the following procedure. 1) Remove pressure pickup plug (outlet side) of fuel main filter. 2) Operate feed pump of fuel pre-filter. 3) Check pressure pickup plug for leakage of fuel and air.		
	3	Defect in fuel return circuit parts	a For check of fuel return circuit pressure, see Testing and adjusting, Checking fuel pressure.		
			Fuel return circuit pressure	Low idle running or cranking	Max. 0.02 MPa {Max. 0.19 kg/cm^2}
	4	Defective common rail pressure sensor	a Prepare with starting switch ON, then keep starting switch ON and carry out troubleshooting in each case.		
			Monitoring code (Machine monitor)	Monitoring information	
			36400 Common rail pressure	While engine is stopped	0 ± 0.39 MPa {0 ± 4 kg/cm^2}
	5	Defective pressure limiter	a For check of leakage through pressure limiter, see Testing and adjusting, Checking fuel return rate and leakage.		
			Leakage through pressure limiter	During low idle	0 cc (No leakage)
	6	Defective supply pump	If causes 1 – 5 are not detected, supply pump may be defective.		

Failure code [CA451] Rail Press Sensor High Error

User code	Failure code	Trouble	Common rail pressure sensor high error (Engine controller system)
E11	**CA451**		
Contents of trouble	• There is high voltage in signal circuit of common rail pressure sensor.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Engine does not start. • Engine speed or output lowers.		
Related information	• Signal voltage of common rail pressure sensor can be checked with monitoring function. (Code: 36401 Common rail pressure sensor voltage) • Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power supply 2 system	If failure code [**CA227**] is also displayed, carry out troubleshooting for it first.		
	2	Defective common rail pressure sensor	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			FUEL RAIL PRESS		Voltage
			Between (3) – (1)	Power supply	4.75 – 5.25 V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Hot short (Short circuit with 5V/24V circuit) in wiring harness	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between CE01 (female) (25) – FUEL RAIL PRESS (female) (2)	Voltage	Max. 1 V
	4	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (25) – FUEL RAIL PRESS (female) (2) and between CE01 (female) (37) – JC01 – FUEL RAIL PRESS (female) (3)	Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts between common rail pressure sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	6	Defective engine controller	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			CE01		Voltage
			Between (37) – (47)	Power supply	4.75 – 5.25 V

Circuit diagram related to common rail pressure sensor

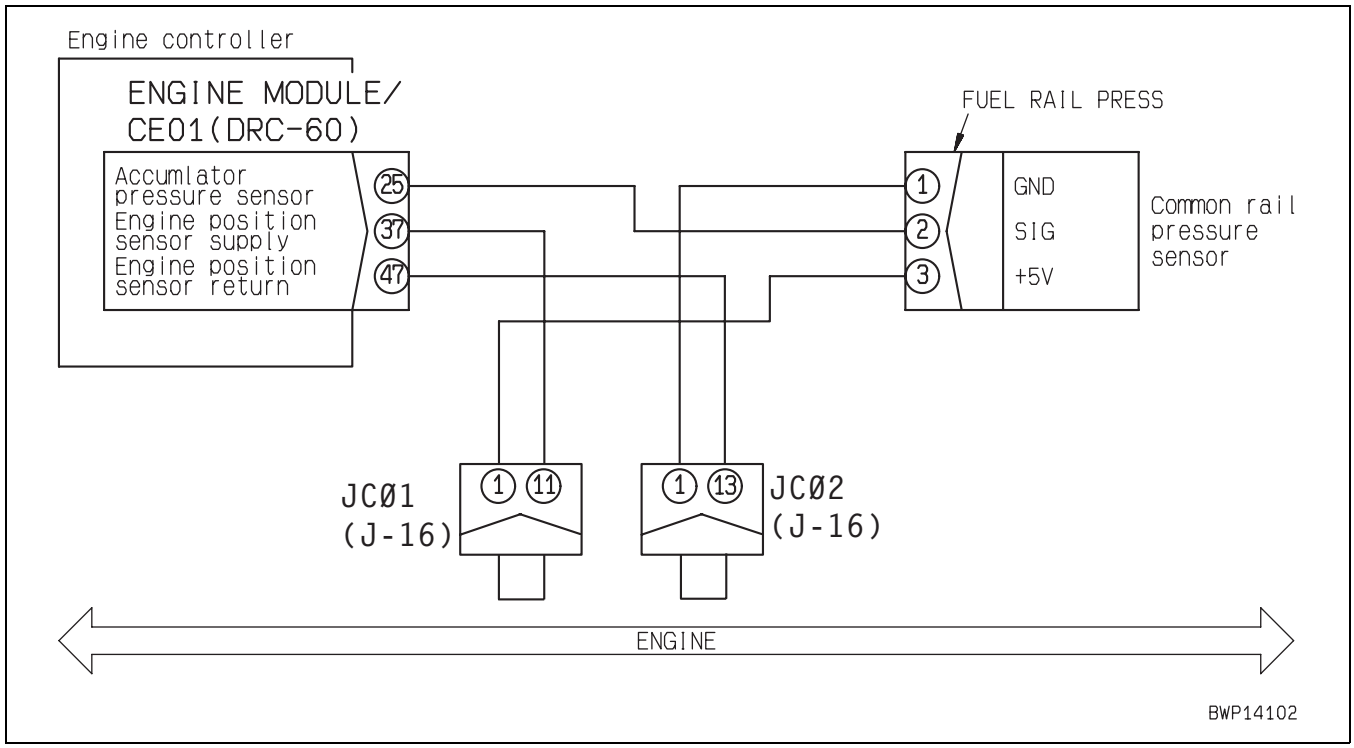


Failure code [CA452] Rail Press Sensor Low Error

Action code	Failure code	Trouble	Common rail pressure sensor low error (Engine controller system)
E11	**CA452**		
Contents of trouble	• There is low voltage in signal circuit of common rail pressure sensor.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Engine speed or output lowers. • Engine does not start.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective sensor power supply 2 system	If failure code [**CA187**] is also indicated, carry out troubleshooting for it first.			
	2	Defective common rail pressure sensor	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			FUEL RAIL PRESS		Voltage	
			Between (3) – (1)	Power supply	4.75 – 5.25 V	
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.			
	3	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Wiring harness between ENGINE (female) (25) – FUEL RAIL PRESS (female) (2) and chassis ground		Resistance	Min. 100 kΩ
	4	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between ENGINE (female) (25) – FUEL RAIL PRESS (female) (2) and between ENGINE (female) (47) – FUEL RAIL PRESS (female) (1)		Resistance	Min. 100 kΩ
	5	Defective wiring harness connector	Connecting parts between common rail pressure sensor – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	6	Defective engine controller	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			ENGINE		Voltage	
			Between (37) – (47)	Power supply	4.75 – 5.25 V	

Circuit diagram related to common rail pressure sensor



Failure code [CA488] Chg Air Temp High Torque Derate

User code	Failure code	Trouble	Charge air temperature high torque derate (Engine controller system)
E11	**CA488**		
Contents of trouble	• Temperature signal of boost pressure/temperature sensor exceeded control upper temperature limit.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Engine output lowers.		
Related information	• Boost temperature can be checked with monitoring function. (Code: 18500 Boost temperature) • Method of reproducing failure code: Start engine.		

		Cause	Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Lowering of cooling performance of aftercooler	Cooling performance of aftercooler may be low. Check following points directly. • Looseness and breakage of fan belt. • Insufficiency of cooling air • Clogging of aftercooler fins
	2	Abnormal rise of turbocharger outlet temperature	Outlet temperature of turbocharger may be abnormally high. Check related parts directly.
	3	Defective engine controller	If causes 1 – 2 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)

Failure code [CA553] Rail Press High Error

User code	Failure code	Trouble	Common rail pressure high error (Engine controller system)
E15	**CA553**		
Contents of trouble	• There is high pressure error in common rail circuit.		
Action of machine monitor	• None in particular.		
Problem that appears on machine	• Engine sound becomes large when no or light load is applied. • Engine output lowers.		
Related information	• Common rail pressure can be checked with monitoring function. (Code: 36400 Common rail pressure) • Method of reproducing failure code: Start engine.		

		Cause	Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Defect in related system	If another failure code is displayed, carry out troubleshooting for it.
	2	Defective connection of ground terminal	Ground terminal may be connected defectively. Check following terminals directly. • Ground terminal of machine ((–) terminal of battery) • Ground terminal of engine • Ground terminal of engine controller • Ground terminal of starting motor
	3	Breakage of O-ring of supply pump actuator	O-ring of supply pump actuator may be broken. Check it directly.

Failure code [CA559] Rail Press Low Error

Action code	Failure code	Trouble	Common rail pressure low error (Engine controller system)
E15	**CA559**		
Contents of trouble	• There is low pressure error (1) in common rail circuit.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine does not start at all or does not start easily. • Exhaust gas becomes black. • Engine output lowers.		
Related information	• Method of reproducing failure code: Start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Fuel leakage to outside	Fuel may be leaking to outside. Check it directly (Check visually while running engine at low idle).		
	2	Defect in low pressure circuit parts	a For check of pressure in fuel low pressure circuit, see Testing and adjusting, Checking fuel pressure. • Measured in fuel filter inlet side. • Cranking speed: Min. 150 rpm		
			Pressure in fuel low-pressure circuit	During cranking	Min. 0.14 MPa {Min. 1.4 kg/cm^2}
			a For check of pressure in fuel low pressure circuit, see Testing and adjusting, Checking fuel pressure. • Measured in fuel filter outlet side.		
			Pressure in fuel low-pressure circuit	During high idle	Min. 0.48 MPa {Min. 4.9 kg/cm^2}
			a For check of pressure in fuel low pressure circuit, see Testing and adjusting, Checking fuel pressure. • Measured in fuel filter inlet and outlet sides. • Pressure drop in fuel low-pressure circuit = Fuel filter inlet pressure — Fuel filter outlet pressure		
			Pressure drop in fuel low-pressure circuit	During high idle	Max. 0.14 MPa {Max. 1.4 kg/cm^2}
			a For check of fuel suction pressure, see Testing and adjusting, Checking fuel pressure. • Measured in gear pump fuel inlet side of supply pump.		
			Fuel suction circuit pressure (gear pump side)	During high idle	Max. 33.9 kPa {Max. 254 mmHg}
			a For check of fuel suction pressure, see Testing and adjusting, Checking fuel pressure. • Measured in fuel connector side.		
			Fuel suction circuit pressure (fuel connector side)	During high idle	Max. 27.1 kPa {Max. 203 mmHg}

<table>
<tr><td rowspan="8">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="3">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Defective injector (including high pressure piping in head)</td><td colspan="3">a For check of return rate from injector, see Testing and adjusting, Checking fuel return rate and leakage.</td></tr>
<tr><td rowspan="2">Return rate from injector</td><td>During cranking (if engine cannot be started)</td><td>Max. 100 cc/30 sec.</td></tr>
<tr><td>During low idle (if engine can be started)</td><td>Max. 300 cc/45 sec.</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Defective supply pump</td><td colspan="3">a For check of return rate from supply pump, see Testing and adjusting, Checking fuel return rate and leakage.</td></tr>
<tr><td rowspan="2">Return rate from supply pump</td><td>During cranking (if engine cannot be started)</td><td>Max. 100 cc/30 sec.</td></tr>
<tr><td>During low idle (if engine can be started)</td><td>Max. 300 cc/45 sec.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Defective pressure limiter</td><td colspan="3">a For check of leakage through pressure limiter, see Testing and adjusting, Checking fuel return rate and leakage.</td></tr>
<tr><td>Leakage through pressure limiter</td><td>During cranking</td><td>Max. 30 cc/min</td></tr>
<tr><td>6</td><td>Defective supply pump plunger</td><td colspan="3">a Remove the supply pump head, and directly check that the plunger is not damaged.</td></tr>
<tr><td>7</td><td>Air in low pressure circuit</td><td colspan="3">There may be air in low pressure circuit. Check it directly according to the following procedure.
1) Remove pressure pickup plug (outlet side) of fuel main filter.
2) Operate feed pump of fuel pre-filter.
3) Check pressure pickup plug for leakage of fuel and air.
• If this error occurs during air bleeding after the fuel filter was replaced, air may remain in the fuel circuit. Keep running the engine at low idle for about three minutes. As air is bled from the fuel circuit, the engine speed will be stabilized, erasing the error indication.</td></tr>
</table>

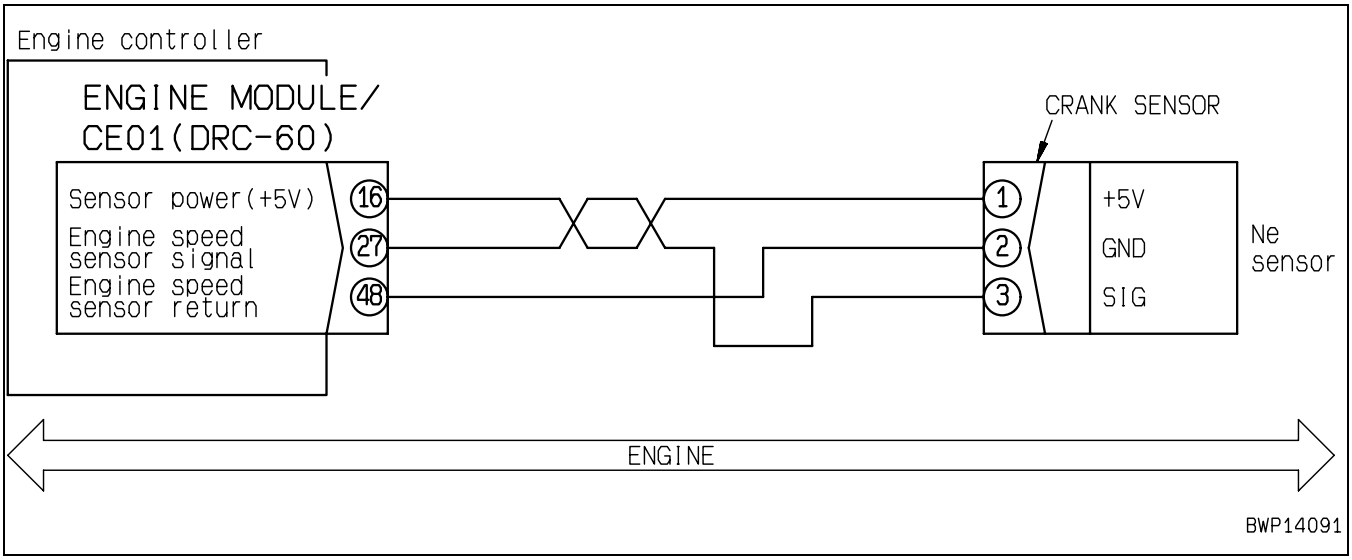
Failure code [CA689] Eng Ne Speed Sensor Error

User code	Failure code	Trouble	Engine Ne speed sensor error (Engine controller system)
E11	**CA689**		
Contents of trouble	• There is error in signal from engine Ne speed sensor.		
Action of controller	• Continues control with signal from engine Bkup speed sensor.		
Problem that appears on machine	• Engine hunts. • Engine does not start easily. • Engine output lowers.		
Related information	• Method of reproducing failure code: Start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective Ne speed sensor power supply system	If failure code [**CA238**] is also displayed, carry out troubleshooting for it first.		
	2	Defective engine Ne speed sensor	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			CRANK SENSOR		Voltage
			Between (1) – (2)	Power supply	4.75 – 5.25 V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Breakage or improper clearance of engine Ne speed sensor	Engine Ne speed sensor may be broken or may have improper clearance. Check it directly.		
	4	Breakage of rotation sensor wheel	Rotation sensor wheel may be broken. Check it directly.		
	5	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (27) – CRANK SENSOR (female) (3)	Resistance	Max. 10 Ω
	6	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (27) – CRANK SENSOR (female) (3)	Resistance	Min. 100 kΩ
	7	Hot short (Short circuit with 5V/24V circuit) in wiring harness	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between CE01 (female) (27) – CRANK SENSOR (female) (3)	Voltage	Max. 1 V
	8	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (27) – CRANK SENSOR (female) (3) or between CE01 (female) (16) – CRANK SENSOR (female) (1)	Resistance	Min. 100 kΩ
			Wiring harness between CE01 (female) (27) – CRANK SENSOR (female) (3) or between CE01 (female) (48) – CRANK SENSOR (female) (2)	Resistance	Min. 100 kΩ

<table>
<tr><td rowspan="4">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td>Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>9</td><td>Defective wiring harness connector</td><td>Connecting parts between engine Ne speed sensor – engine wiring harness – engine controller may be defective. Check them directly.
• Looseness of connector, breakage of lock, or breakage of seal
• Corrosion, bend, breakage, push-in, or expansion of pin
• Moisture or dirt in connector or defective insulation</td></tr>
<tr><td rowspan="2">10</td><td rowspan="2">Defective engine controller</td><td>a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.</td></tr>
<tr><td><table><tr><td>CE01</td><td></td><td>Voltage</td></tr><tr><td>Between (16) – (48)</td><td>Power supply</td><td>4.75 – 5.25 V</td></tr></table></td></tr>
</table>

Circuit diagram related to engine Ne speed sensor



Failure code [CA731] Eng Bkup Speed Sens Phase Error

User code	Failure code	Trouble	Engine G speed sensor phase error (Engine controller system)
E11	**CA731**		
Contents of trouble	• Phase error was detected in signals from engine Ne speed sensor and engine Bkup speed sensor		
Action of controller	• Continues control with signal from engine Ne speed sensor.		
Problem that appears on machine	• Engine does not start at all or does not start easily. • Idle speed is unstable. • Exhaust gas becomes black.		
Related information	• Method of reproducing failure code: Start engine.		

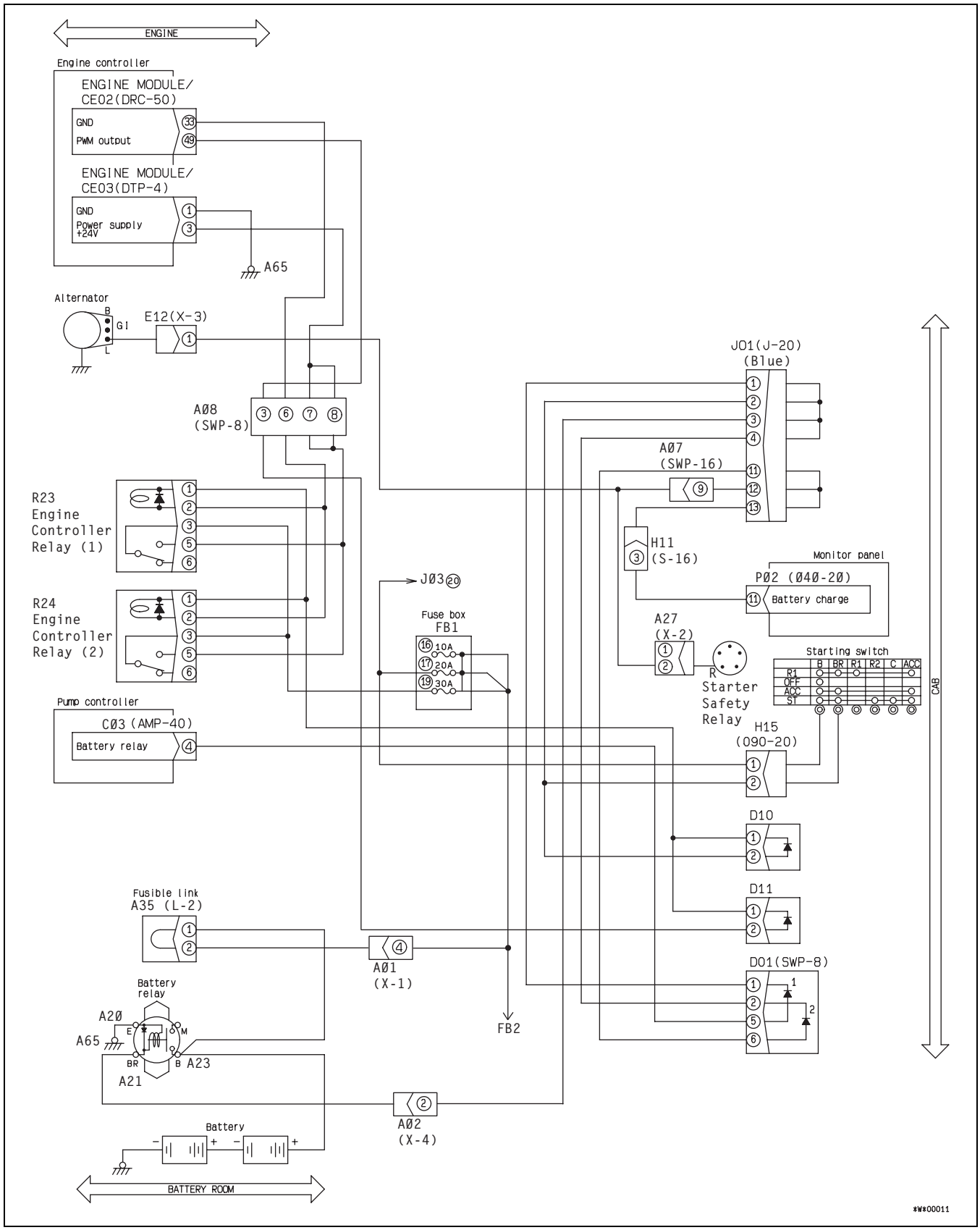
	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Breakage of engine Ne speed sensor	Engine Ne speed sensor may be broken. Check it directly.
	2	Breakage of engine G speed sensor	Engine G speed sensor may be broken. Check it directly.
	3	Defective installation or breakage of rotation sensor wheel on crankshaft side	Rotation sensor wheel on crankshaft side may be installed defectively or broken. Check it according to the following procedure. 1) Set No. 1 cylinder at compression top dead center (Match stamped mark). 2) If center of oblong hole of rotation sensor wheel is at tip of Ne speed sensor, rotation sensor wheel is installed normally.
	4	Defective installation or breakage of rotation sensor ring on camshaft side	Rotation sensor ring on camshaft side may be installed defectively or broken. Check it according to the following procedure. 1) Set No. 1 cylinder at compression top dead center (Match stamped mark). 2) Remove G speed sensor. 3) If 2 grooves (1 crest) of rotation sensor ring are seen through sensor mounting hole, rotation sensor ring is installed normally.
	5	Defective timing of crankshaft and camshaft	Timing of crankshaft and camshaft may be defective. Check it directly.
	6	Defective connection of ground terminal	Ground terminal may be connected defectively. Check following terminals directly. • Ground terminal of machine ((–) terminal of battery) • Ground terminal of engine • Ground terminal of engine controller • Ground terminal of starting motor

Failure code [CA757] All Continuous Data Lost Error

User code	Failure code	Trouble	All continuous data lost error (Engine controller system)
E10	**CA757**		
Contents of trouble	• All data in engine controller are lost.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine may stop and may not be started again. • Monitoring function of machine monitor (engine controller system) may not work normally.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defect in related system	If another failure code is displayed, carry out troubleshooting for it.			
	2	Looseness or corrosion of battery terminal	Battery terminal may be loosened or corroded. Check it directly.			
	3	Low battery voltage	a Prepare with starting switch OFF, then keep starting switch OFF and start engine and carry out troubleshooting in each case.			
			Battery (1 piece)	Starting switch	Voltage	
			Between (+) – (–) terminals	OFF	Min. 12 V	
				START	Min. 6.2 V	
	4	Defective fuse No. 19	If fuse is broken, circuit probably has ground fault.			
	5	Defective relay for engine controller power supply	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Replace relay (R23, R24) for engine controller with another relay and perform reproducing operation. If "E" of failure code goes off at this time, replaced relay is defective.			
	6	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between FB1-19 – R23, R24 (female) (3)	Resistance	Max. 10 Ω	
			Wiring harness between R23, R24 (female) (5) – CE03 (female) (3)	Resistance	Max. 10 Ω	
			Wiring harness between CE03 (female) (1) – chassis ground (T12)	Resistance	Max. 10 Ω	
	7	Defective wiring harness connector	Connecting parts between fuse No. 19 – machine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	8	Defective engine controller	a Prepare with starting switch OFF, then turn starting switch ON and start engine and carry out troubleshooting in each case.			
			CE03 (female)	Starting switch	Voltage	
			Between (3) – (1)	ON	Min. 24 V	
				START	Min. 12 V	

Circuit diagram related to engine controller power supply



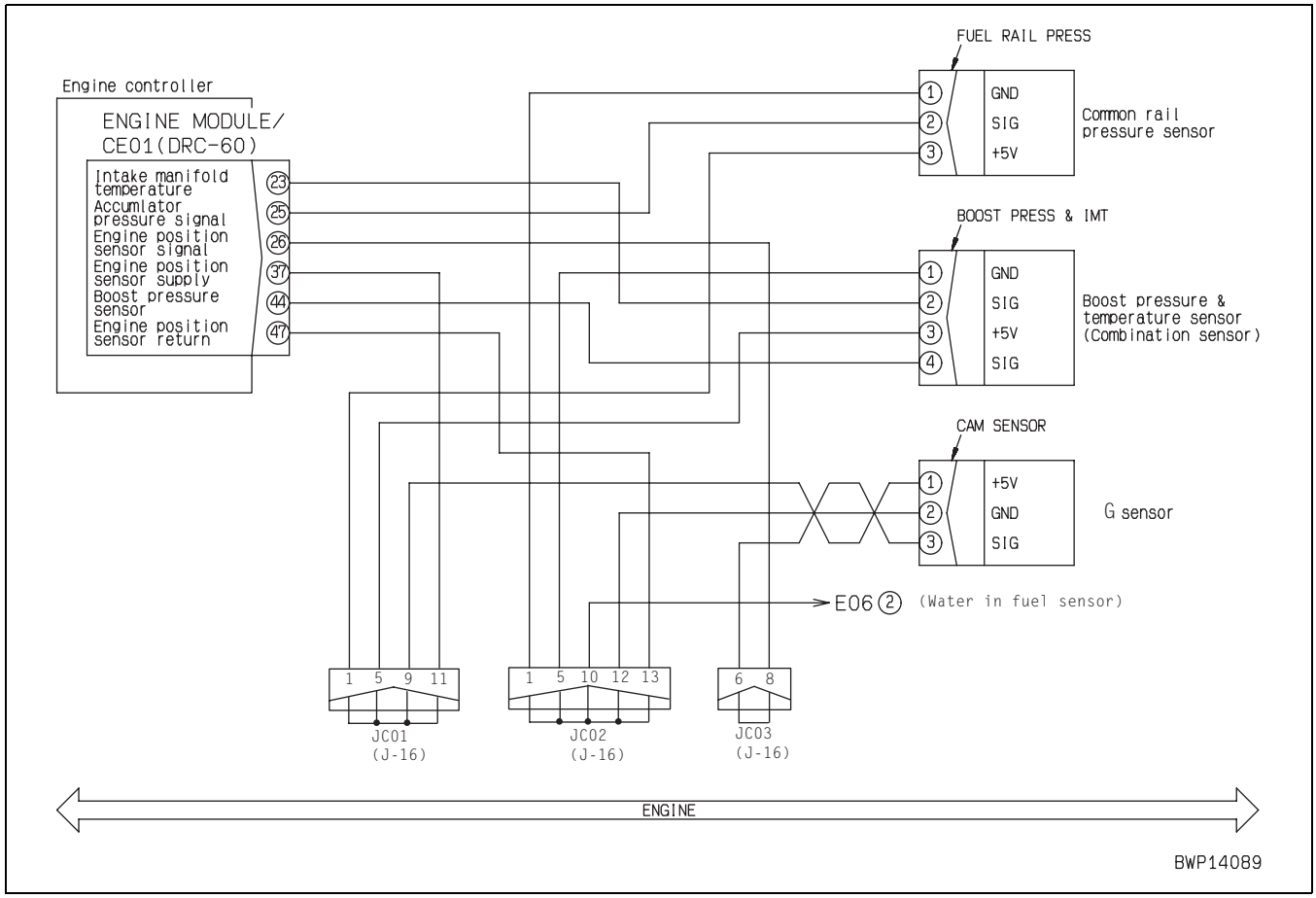
Failure code [CA778] Eng G Speed Sensor Error

User code	Failure code	Trouble	Engine G speed sensor error (Engine controller system)
E11	**CA778**		
Contents of trouble	• There is error in signal from engine G speed sensor.		
Action of controller	• Continues control with signal from engine Ne speed sensor.		
Problem that appears on machine	• Engine does not start easily. • Engine output lowers.		
Related information	• Method of reproducing failure code: Start engine.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective sensor power supply 2 system	If failure code [CA187] is also displayed, carry out troubleshooting for it first.		
	2	Defective engine G speed sensor	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			CAM SENSOR		Voltage
			Between (1) – (2)	Power supply	4.75 – 5.25 V
			Voltage is measured with wiring harness connected. Accordingly, if voltage is abnormal, check wiring harness and controller, too, for another cause of trouble, and then judge.		
	3	Breakage or improper clearance of engine G speed sensor	Engine G speed sensor may be broken or may have improper clearance. Check it directly.		
	4	Breakage of rotation sensor ring	Rotation sensor ring may be broken. Check it directly.		
	5	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (26) – JC03 – CAM SENSOR (female) (3)	Resistance	Max. 10 Ω
	6	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (26) – JC03 – CAM SENSOR (female) (3)	Resistance	Min. 100 kΩ
	7	Hot short (Short circuit with 5V/24V circuit) in wiring harness	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between CE01 (female) (26) – JC03 – CAM SENSOR (female) (3)	Voltage	Max. 1 V
	8	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE01 (female) (26) – JC03 – CAM SENSOR (female) (3) or between CE01 (female) (37) – JC01 – CAM SENSOR (female) (1)	Resistance	Min. 100 kΩ
			Wiring harness between CE01 (female) (26) – JC03 – CAM SENSOR (female) (3) or between CE01 (female) (47) – JC02 – CAM SENSOR (female) (2)	Resistance	Min. 100 kΩ

<table>
<tr><td rowspan="4">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="3">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>9</td><td>Defective wiring harness connector</td><td colspan="3">Connecting parts between engine G speed sensor – engine wiring harness – engine controller may be defective. Check them directly.
• Looseness of connector, breakage of lock, or breakage of seal
• Corrosion, bend, breakage, push-in, or expansion of pin
• Moisture or dirt in connector or defective insulation</td></tr>
<tr><td>10</td><td rowspan="3">Defective engine controller</td><td colspan="3">a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.</td></tr>
<tr><td colspan="2">CE01</td><td>Voltage</td></tr>
<tr><td>Between (37) – (47)</td><td>Power supply</td><td>4.75 – 5.25 V</td></tr>
</table>

Circuit diagram related to engine G speed sensor

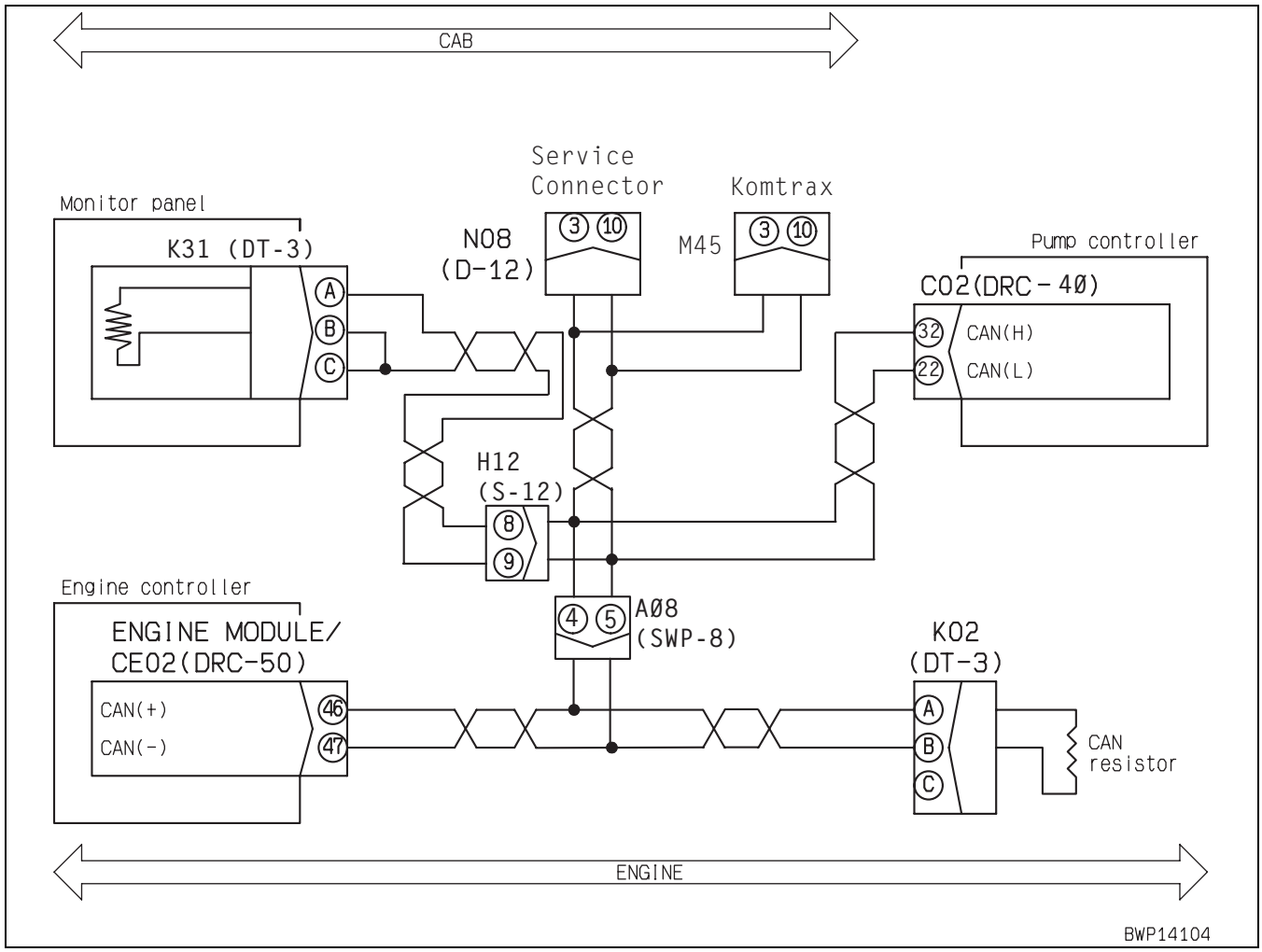


Failure code [CA1633] KOMNET Datalink Timeout Error

User code	Failure code	Trouble	KOMNET Datalink timeout error (Engine controller system)
E0E	**CA1633**		
Contents of trouble	• Engine controller detected communication error in KOMNET communication circuit between pump controller and machine monitor.		
Action of controller	• Continues operation in default mode. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• Information may not transmitted normally by KOMNET communication and machine may not operate normally. (Trouble phenomenon depends on failed section.)		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between K31 (female) (A)– C02 (female) (32), – CE02 (female) (46), – K02 (female) (A)	Resistance	Max. 1 Ω
			Wiring harness between K31 (female) (B)– C02 (female) (22), – CE02 (female) (47), – K02 (female) (B)	Resistance	Max. 1 Ω
	2	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between K31 (female) (A) – C02 (female) (32), – CE02 (female) (46), – K02 (female) (A), – N08 (male) (3)	Resistance	Min. 1 MΩ
			Wiring harness between K31 (female) (B) – C02 (female) (22), – CE02 (female) (47), – K02 (female) (B), – N08 (male) (10)	Resistance	Min. 1 MΩ
	3	Hot short (Short circuit with 24V circuit) in wiring harness	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between K31 (female) (A) – C02 (female) (32), – CE02 (female) (46), – K02 (female) (A), – N08 (male) (3)	Voltage	Max. 5.5 V
			Wiring harness between K31 (female) (B) – C02 (female) (22), – CE02 (female) (47), – K02 (female) (B), – N08 (male) (10)	Voltage	Max. 5.5 V
	4	Defective CAN terminal resistance (Internal short circuit or disconnection)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			K02 (male)	Resistance	
			Between (A) – (B)	120 ± 12 Ω	
	5	Defective pump controller	If causes 1 – 4 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to CAN communication

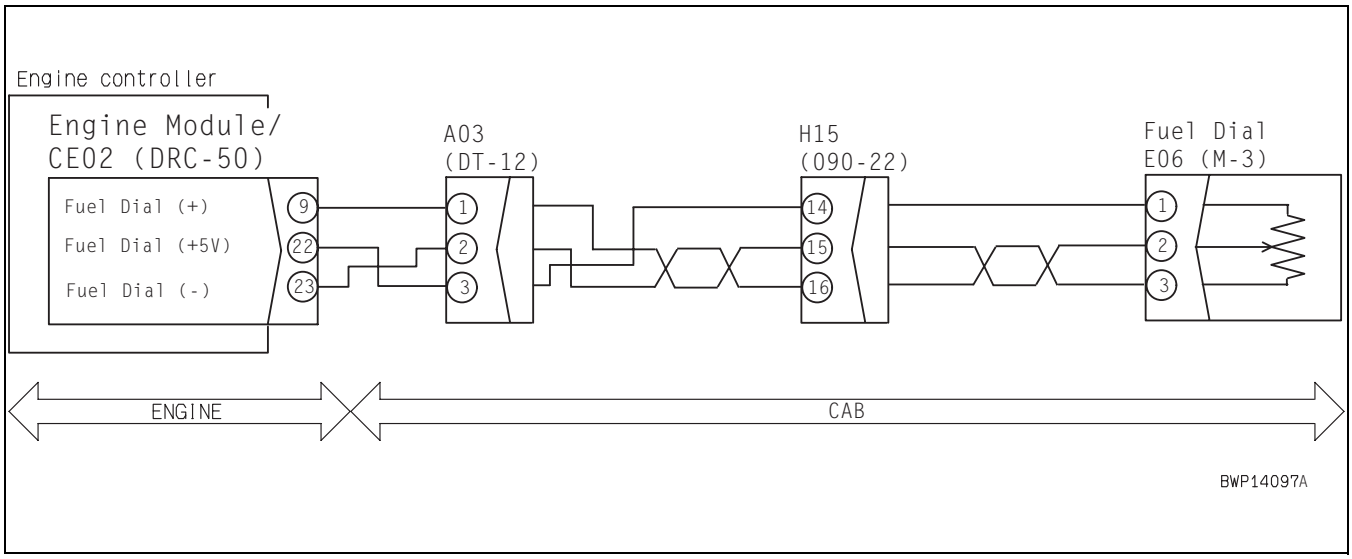


Failure code [CA2185] Throttle Sensor Supply Voltage High Error

User code	Failure code	Trouble	Throttle sensor supply voltage high error (Engine controller system)
E14	**CA2185**		
Contents of trouble	• High voltage (5.25 V or higher) was detected in throttle sensor power supply circuit.		
Action of controller	• If trouble occurs while starting switch is in ON position, controller fixes voltage value to level just before detection of trouble and continues operation. • If starting switch is turned ON while voltage is abnormally high, controller continues operation with voltage at 100% value.		
Problem that appears on machine	• Engine speed cannot be controlled with fuel control dial.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state			a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
	1	Short circuit in wiring harness (with another wiring harness)	Wiring harness between CE02 (female) (22) – each of CE02 (female) pins (With E06 disconnected)	Resistance	Min. 100 kΩ
			Wiring harness between CE02 (female) (22) – CE03 (female) (3) (With E06 disconnected)	Resistance	Min. 100 kΩ
	2	Defective wiring harness connector	Connecting parts between fuel control dial – machine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	3	Defective engine controller	If causes 1 – 2 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to fuel control dial

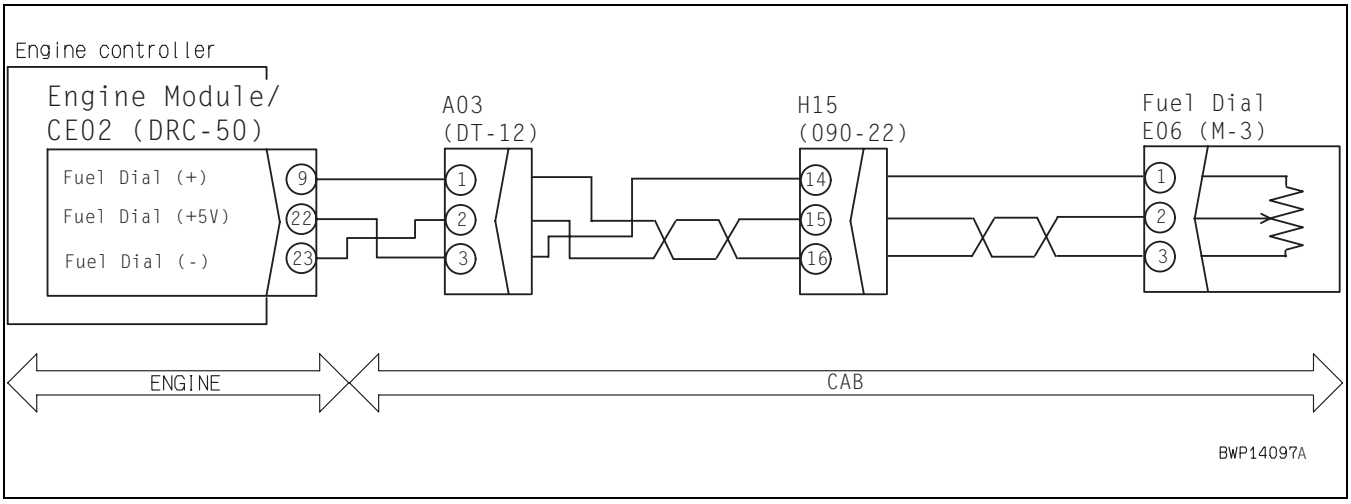


Failure code [CA2186] Throttle Sensor Supply Voltage Low Error

User code	Failure code	Trouble	Throttle sensor supply voltage low error (Engine controller system)
E14	**CA2186**		
Contents of trouble	• Low voltage was detected in throttle sensor power supply circuit.		
Action of controller	• If trouble occurs while starting switch is in ON position, controller fixes voltage value to level just before detection of trouble and continues operation. • If starting switch is turned ON while voltage is abnormally high, controller continues operation with voltage at 100% value.		
Problem that appears on machine	• Engine speed cannot be controlled with fuel control dial.		
Related information	• Method of reproducing failure code: Turn starting switch ON.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE02 (female) (22) – E06 (female) (1)	Resistance	Min. 100 kΩ
	2	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE02 (female) (9) – each of CE02 (female) pins (With E06 disconnected)	Resistance	Min. 100 kΩ
	3	Defective wiring harness connector	Connecting parts between fuel control dial – machine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	4	Defective engine controller	If causes 1 – 3 are not detected, engine controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to fuel control dial



Failure code [CA2249] Rail Press Very Low Error

User code	Failure code	Trouble	Common rail pressure very low error (Engine controller system)
E11	**CA2249**		
Contents of trouble	• There is low pressure error in common rail circuit.		
Action of controller	• Limits output and continues operation.		
Problem that appears on machine	• Engine does not start easily. • Exhaust gas becomes black. • Engine output lowers.		
Related information	• Common rail pressure can be checked with monitoring function. (Code: 36400 Common rail pressure) • Method of reproducing failure code: Start engine.		

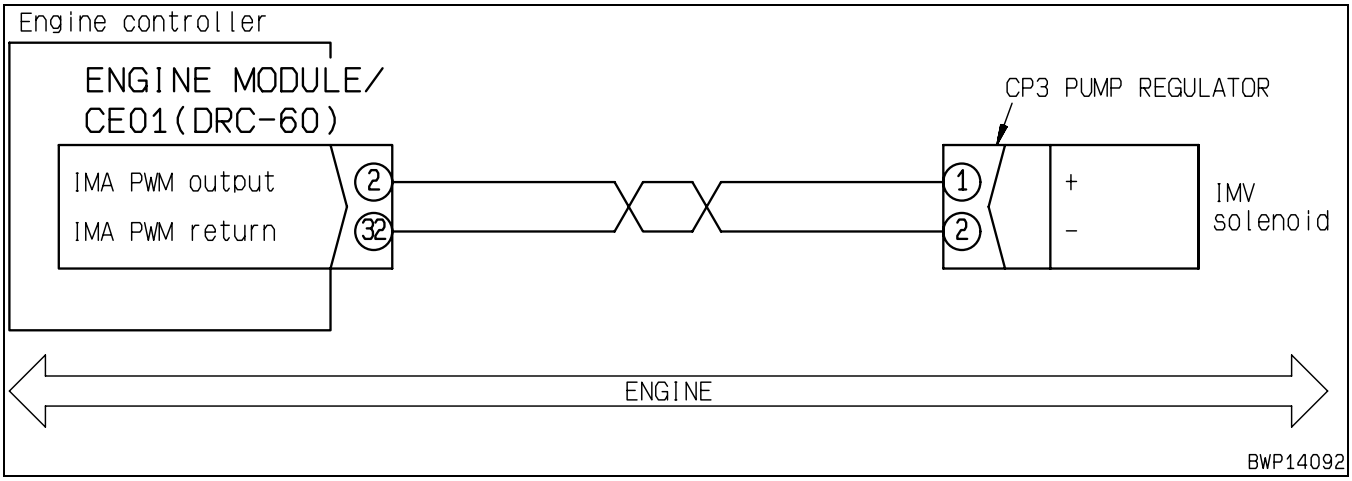
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Carry out troubleshooting for failure code [CA559].	

Failure code [CA2311] IMV Solenoid Error

User code	Failure code	Trouble	IMV solenoid error (Engine controller system)
E11	**CA2311**		
Contents of trouble	• Resistance of supply pump actuator circuit is abnormally high or low.		
Action of controller	• None in particular.		
Problem that appears on machine	• Engine output lowers.		
Related information	• Method of reproducing failure code: Start engine.		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting			
	1	Defect in related system	If another failure code is displayed, carry out troubleshooting for it.			
	2	Defective supply pump actuator	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CP3 PUMP REGULATOR (male)	Resistance		
			Between (1) – (2)	Max. 5 Ω		
			Between (1) – chassis ground	Min. 100 kΩ		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (2) – CP3 PUMP REGULATOR (female) (1)	Resistance	Max. 5 Ω	
			Wiring harness between CE01 (female) (32) – CP3 PUMP REGULATOR (female) (2)	Resistance	Max. 5 Ω	
	4	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (2) – CP3 PUMP REGULATOR (female) (1)	Resistance	Min. 100 kΩ	
	5	Defective wiring harness connector	Connecting parts between supply pump actuator – engine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	6	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CE01 (female)	Resistance		
			Between (2) – (32)	Max. 5 Ω		
			Between (2) – chassis ground	Min. 100 kΩ		

Circuit diagram related to supply pump actuator (metering unit)

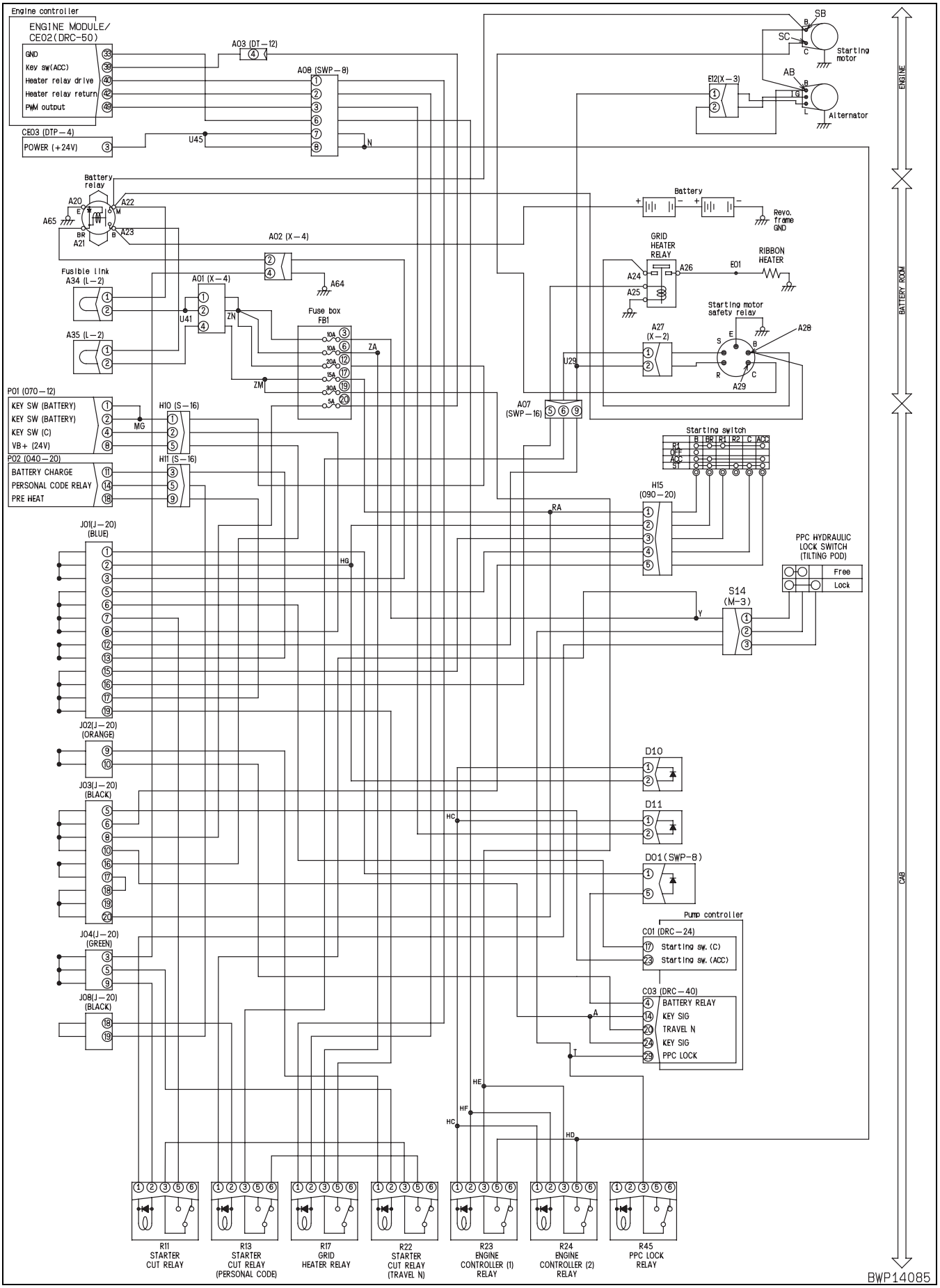


Failure code [CA2555] Grid Htr Relay Volt High Error

User code	Failure code	Trouble	Grid heater relay volt high error (Engine controller system)
E15	**CA2555**		
Contents of trouble	• Disconnection was detected in drive circuit of intake air heater relay.		
Action of controller	• None in particular.		
Problem that appears on machine	• Intake air heater does not work (Engine does not start easily and exhaust gas becomes white at low temperature).		
Related information	• Method of reproducing failure code: Turn starting switch ON when engine coolant temperature is below –4°C.		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective grid heater relay (Internal disconnection)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON. (Troubleshooting for relay unit)			
			R17 (male)	Resistance		
			Between (1) – (2)	300 – 600 Ω		
			a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting. (Troubleshooting by replacement)			
			Replace grid heater relay (R17) with another relay and perform reproducing operation. If "E" of failure code goes off at this time, replaced relay is defective.			
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE02 (female) (40) – R17 (female) (1)	Resistance	Max. 10 Ω	
			Wiring harness between CE02 (female) (42) – R17 (female) (2)	Resistance	Max. 10 Ω	
	3	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE02 (female) (40) – each of CE02 (female) pins (With R17 disconnected)	Resistance	Min. 100 kΩ	
	4	Defective wiring harness connector	Connecting parts between grid heater relay – machine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation			
	5	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			CE02 (female)	Resistance		
			Between (40) – (42)	300 – 600 Ω		

Circuit diagram related to engine preheater/starting motor/charging system

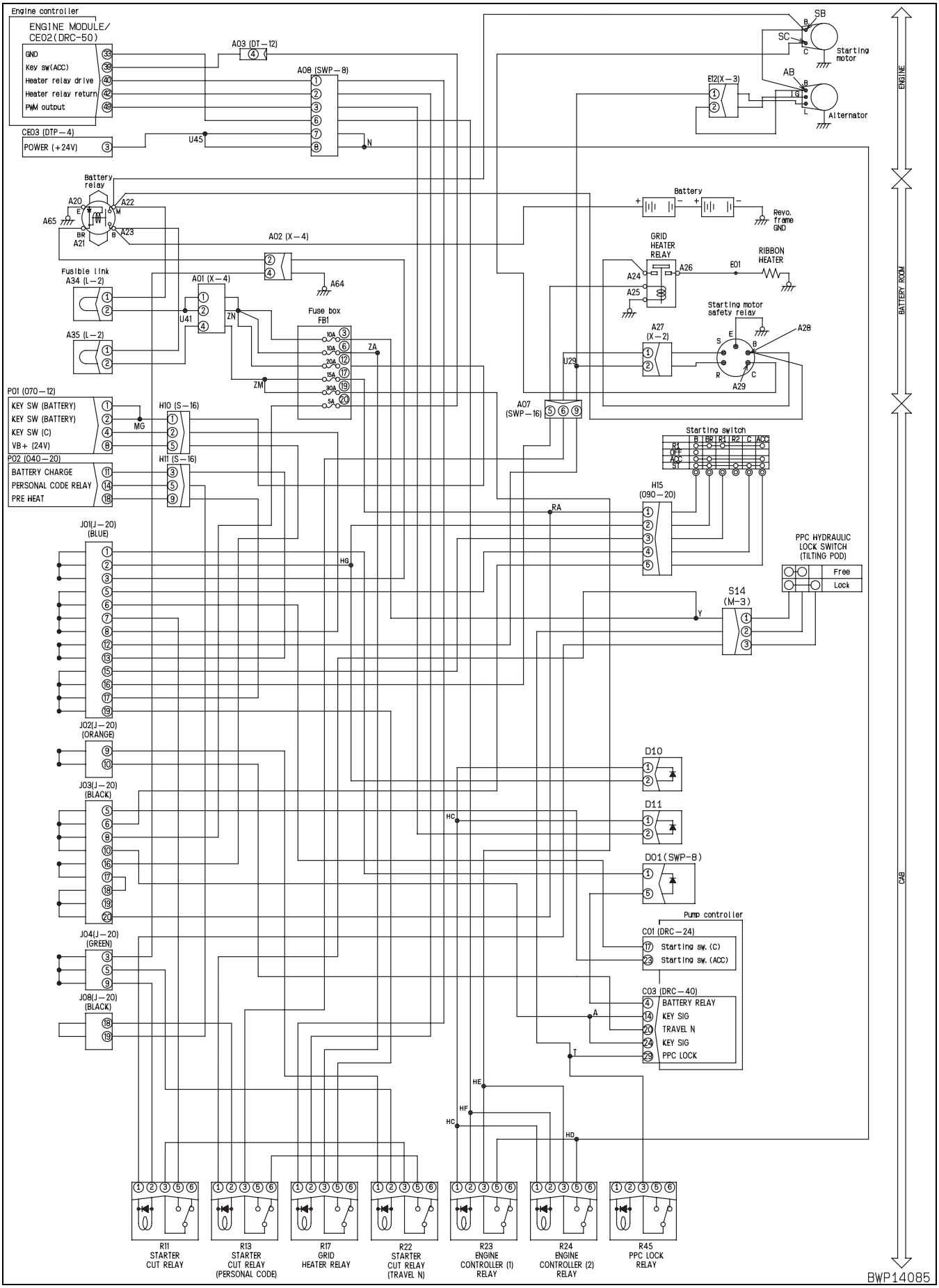


Failure code [CA2556] Grid Heater Relay Volt Low Error

User code	Failure code	Trouble	Grid heater relay volt low error (Engine controller system)
E15	**CA2556**		
Contents of trouble	• Short circuit was detected in drive circuit of intake air heater relay.		
Action of controller	• None in particular.		
Problem that appears on machine	• Intake air heater does not work (Engine does not start easily and exhaust gas becomes white at low temperature).		
Related information	• Method of reproducing failure code: Turn starting switch ON when engine coolant temperature is below –4°C.		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective grid heater relay (Internal disconnection)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON. (Troubleshooting for relay unit)		
			R17 (male)	Resistance	
			Between (1) – (2)	300 – 600 Ω	
			a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting. (Troubleshooting by replacement)		
			Replace grid heater relay (R17) with another relay and perform reproducing operation. If "E" of failure code goes off at this time, replaced relay is defective.		
	2	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE02 (female) (40) – R17 (female) (1)	Resistance	Min. 100 kΩ
	3	Short circuit in wiring harness (with another wiring harness)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between CE02 (female) (40) – each of CE02 (female) pins (With R17 disconnected)	Resistance	Min. 100 kΩ
	4	Defective wiring harness connector	Connecting parts between grid heater relay – machine wiring harness – engine controller may be defective. Check them directly. • Looseness of connector, breakage of lock, or breakage of seal • Corrosion, bend, breakage, push-in, or expansion of pin • Moisture or dirt in connector or defective insulation		
	5	Defective engine controller	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			CE02 (female)	Resistance	
			Between (40) – (42)	300 – 600 Ω	

Circuit diagram related to engine preheater/starting motor/charging system

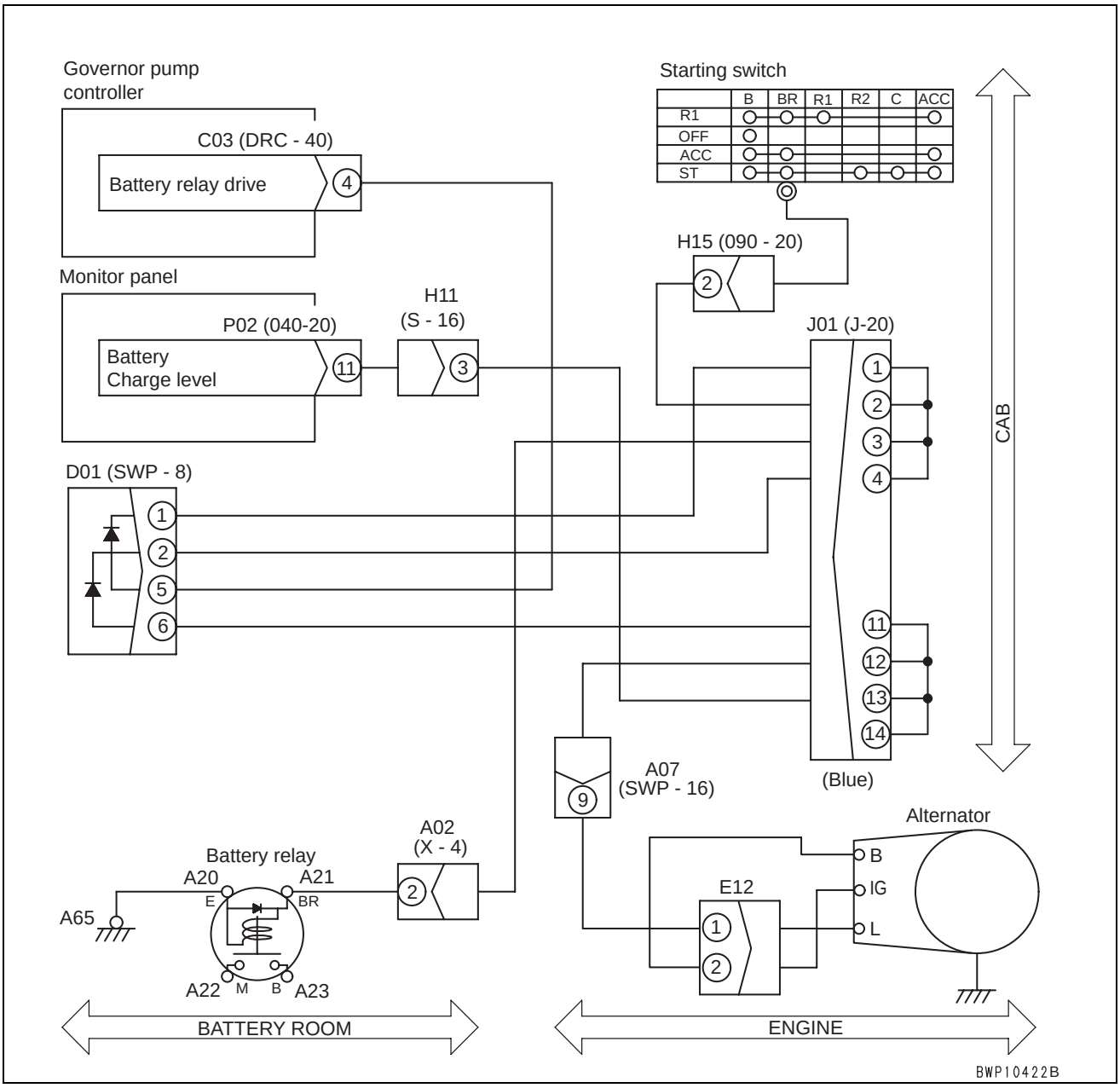


Failure Code [D110KB] (Short-circuiting in battery relay)

User Code	Failure Code	Failure phenomenon	Short-circuiting in battery relay (• pump controller)
—	**D110KB**		
Failure content	• Abnormal current flow to the battery relay drive circuit, when power was supplied to the circuit.		
Response from controller	• The controller turns OFF power to the battery drive circuit. • Even when the failure cause disappears, the relay does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• The engine does not stop.		
Relative information	• It can be confirmed in the monitor function how the battery relay works (ON or OFF). (Code No. 03700: Controller output)		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Battery relay defective (Internal failure)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Battery relay		Continuity & Resistance value	
			Between A21 (BR terminal) and A20 (E terminal)		100 Ω	
			Between A21 (BR terminal) and grounding		Above 1 MΩ	
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ④ to D01 to J01 to A02 to A21 (BR terminal) and grounding		Resistance value	Above 1 MΩ
	3	• Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C03 (female)	Engine starting switch OFF	Voltage	
			Between ④ and grounding	ON → OFF	20 – 30 V (for 4 to 7 seconds)	

Electrical Circuit Diagram for Battery Relay • Pump Controller

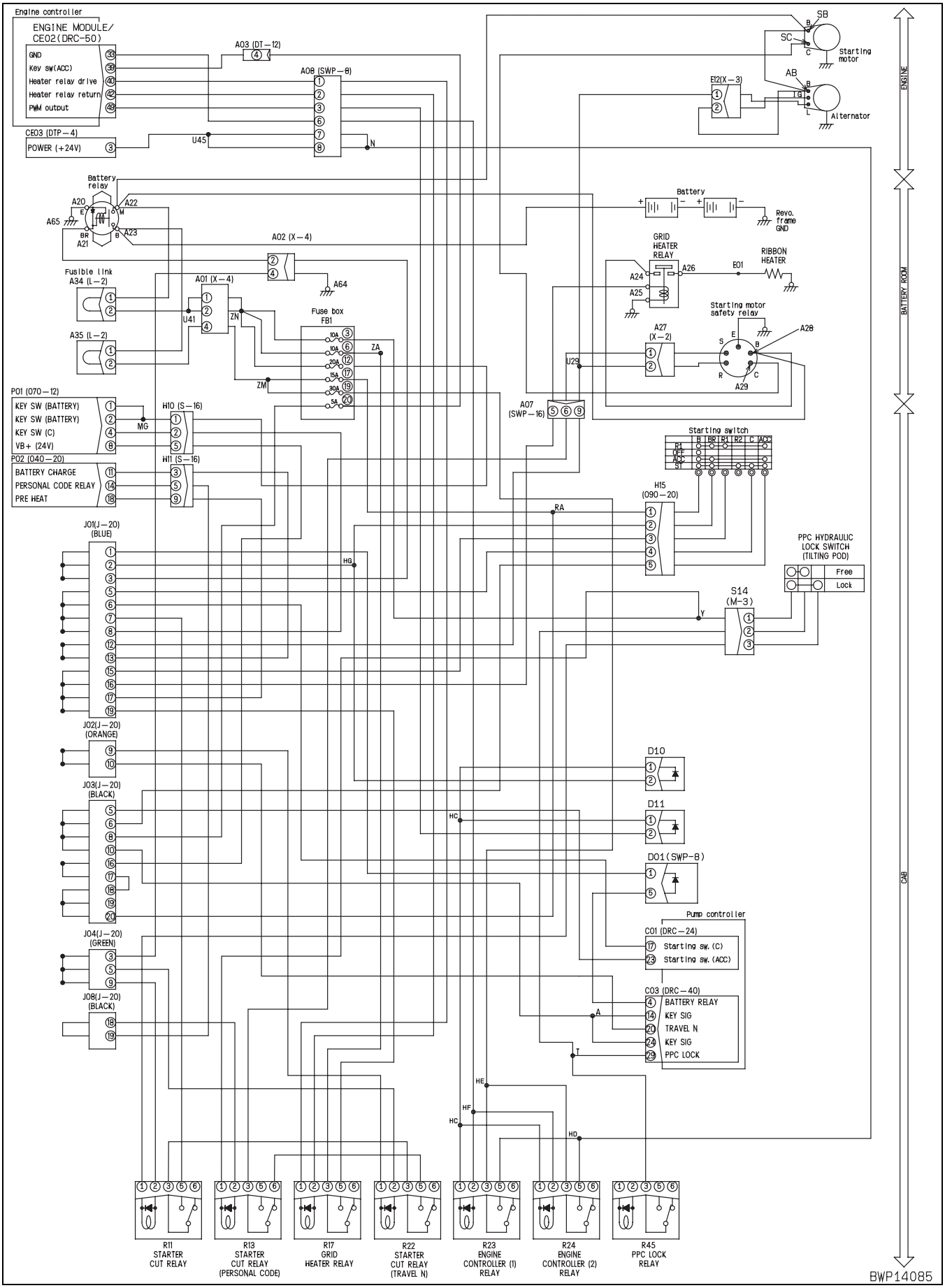


Failure code [D19JKZ] Personal Code Relay Abnormality

User code	Failure code	Trouble	Personal code relay abnormality
E01	**D19JKZ**		
Contents of trouble	• Disconnection or short circuit was detected in personal code relay circuit.		
Action of controller	• None in particular (when disconnection is detected). • Turns output to personal code relay OFF (when short circuit is detected). • If cause of failure disappears, system resets itself (when disconnection is detected). • Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine			
Related information	• Method of reproducing failure code: Turn starting switch ON (Disconnection). Trouble cannot be reproduced on machine (Short circuit).		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective fuse No. 3	If fuse is broken, circuit probably has ground fault (See cause 4).		
	2	Defective personal code relay (Internal disconnection or short circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON. (Troubleshooting for relay unit)		
			R13 (male)	Resistance	
			Between (1) – (2)	(300 – 600 Ω)	
			a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting. (Troubleshooting by replacement)		
			Replace personal code relay (R13) with another relay and perform reproducing operation. If "E" of failure code goes off at this time, replaced relay is defective.		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between FB1 (3) – R13 (female) (1)	Resistance	Max. 1 Ω
			Wiring harness between R13 (female) (2) – P02 (female) (14)	Resistance	Max. 1 Ω
	4	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between FB1 (3) – R13 (female) (1)	Resistance	Min. 1 MΩ
			Wiring harness between R13 (female) (2) – P02 (female) (14)	Resistance	Min. 1 MΩ
	5	Defective machine monitor	If causes 1 – 4 are not detected, machine monitor may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to engine preheater/starting motor/charging system

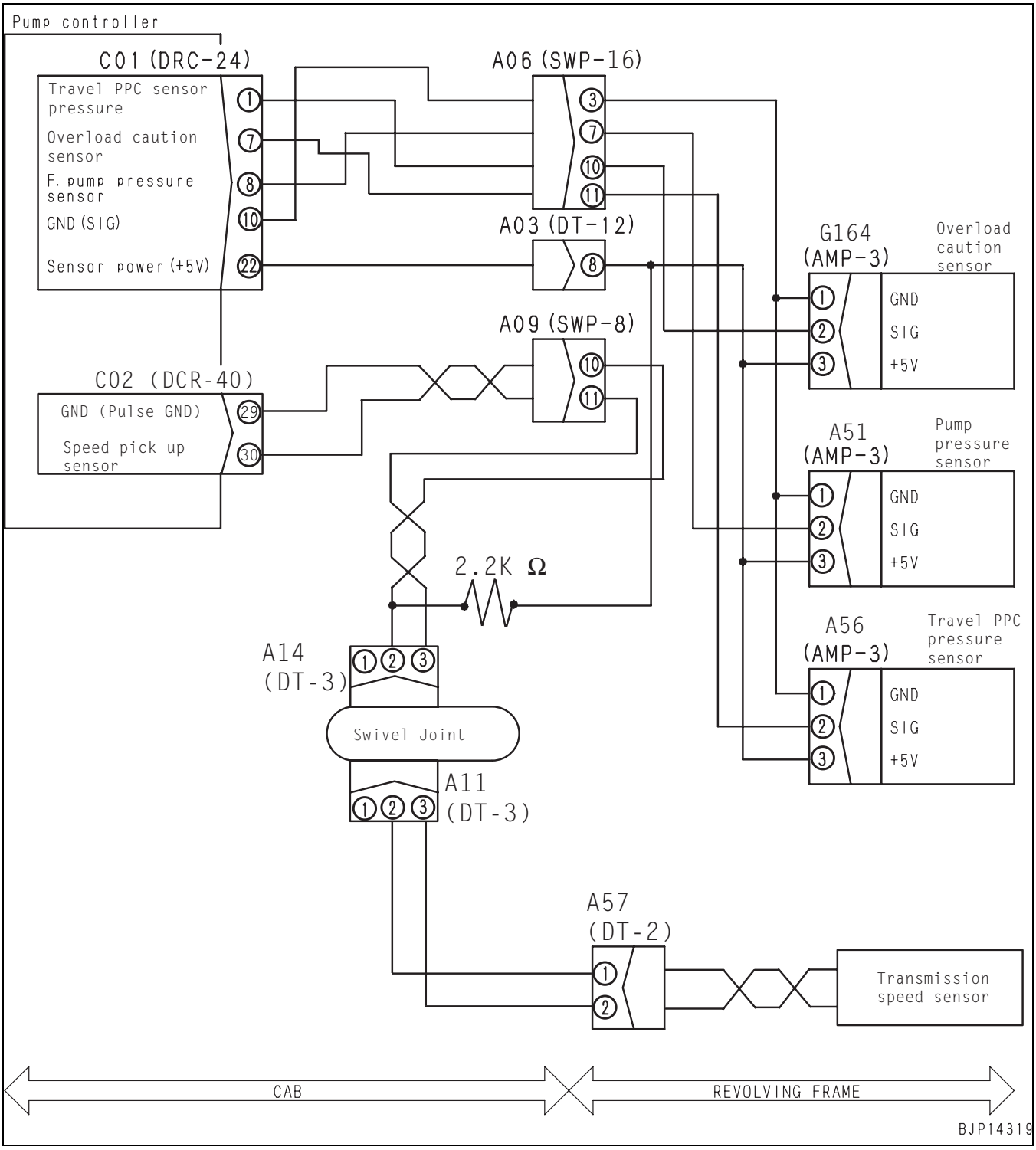


Failure code [DA25KP] Press. Sensor Power Abnormality

Action code	Failure code	Trouble	Pressure sensor power abnormality (Pump controller system)
E02	**DA25KP**		
Contents of trouble	• Abnormal current flowed in pressure sensor power supply (5V) circuit.		
Action of controller	• Turns output to power supply (5V) circuit OFF. • Even if phenomenon of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine	• Signal of pressure sensor is not input normally. • Pressure sensor failure code is displayed at the same time.		
Related information			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective pressure sensor (Internal short circuit)	a Disconnect connector with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Disconnect sensor and wiring harness at right in order. If no failure code is displayed, that sensor is defective.	Pump pressure sensor	A51 connector	
				Overload caution sensor	G164 connector	
				Travel PPC pressure sensor	A56 connector	
				Transmission speed sensor	A57 connector	
	2	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between C01 (female) (22) – A03 – A51 (female) (3) and chassis ground [F pump pressure sensor system]		Resistance	Min. 1 MΩ
			Wiring harness between C01 (female) (22) – A03 – G164 (female) (3) and chassis ground [R pump pressure sensor system]		Resistance	Min. 1 MΩ
			Wiring harness between C01 (female) (22) – A03 – A56 (female) (3) and chassis ground [Bucket CURL pressure sensor system]		Resistance	Min. 1 MΩ
			Wiring harness between C01 (female) (22) – A03 – A57 (female) (3) and chassis ground [Arm IN pressure sensor system]		Resistance	Min. 1 MΩ
	3	Defective pump controller	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			C01		Voltage	
			Between (22) – (10)		4.5 – 5.5 V	

Circuit diagram related to pressure sensor power supply of pump controller

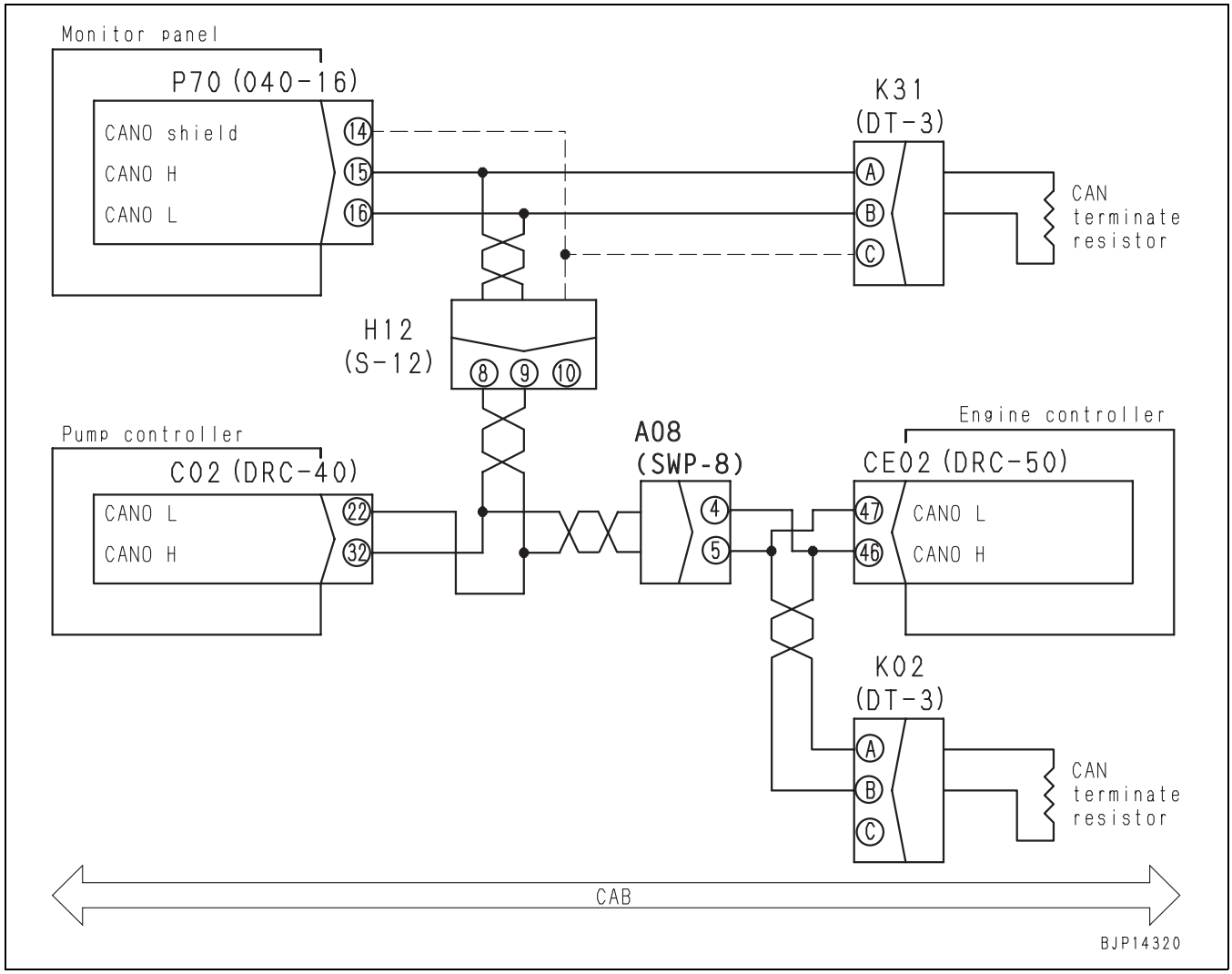


Failure code [DA2RMC] Pump Comm. Abnormality

Action code	Failure code	Trouble	Pump communication abnormality (Pump controller system)
E0E	**DA2RMC**		
Contents of trouble	• Pump controller detected communication error in CAN communication circuit between machine monitor and engine controller.		
Action of controller	• Fix engine output to E-mode, and limit pump absorption torque to about 80%. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• Output lowers. (Pump absorption torque decreases.) • As the working load increases, engine may stall.		
Related information			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between P70 (female) (16) – CE02 (female) (47), – C02 (female) (22)	Resistance	Max. 1 Ω
			Wiring harness between P70 (female) (15) – CE02 (female) (46), – C02 (female) (32)	Resistance	Max. 1 Ω
	2	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between P70 (female) (16) – CE02 (female) (47), – C02 (female) (22), – other related circuit and chassis ground	Resistance	Min. 1 MΩ
			Wiring harness between P70 (female) (15) – CE02 (female) (46), – C02 (female) (32), – other related circuit and chassis ground	Resistance	Min. 1 MΩ
	3	Hot short (Short circuit with 24V circuit) in wiring harness	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between P70 (female) (16) – CE02 (female) (47), – C02 (female) (22), – other related circuit and chassis ground	Voltage	Max. 1 V
			Wiring harness between P70 (female) (15) – CE02 (female) (46), – C02 (female) (32), – other related circuit and chassis ground	Voltage	Max. 1 V
	4	Defective CAN terminal resistance	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			K02 (male), K31 (male)	Resistance	
			Between (A) – (B)	40 – 80 Ω	
	5	Defective machine monitor, engine controller, or pump controller	If causes 1 – 4 are not detected, machine monitor, engine controller, or pump controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to CAN communication of pump controller



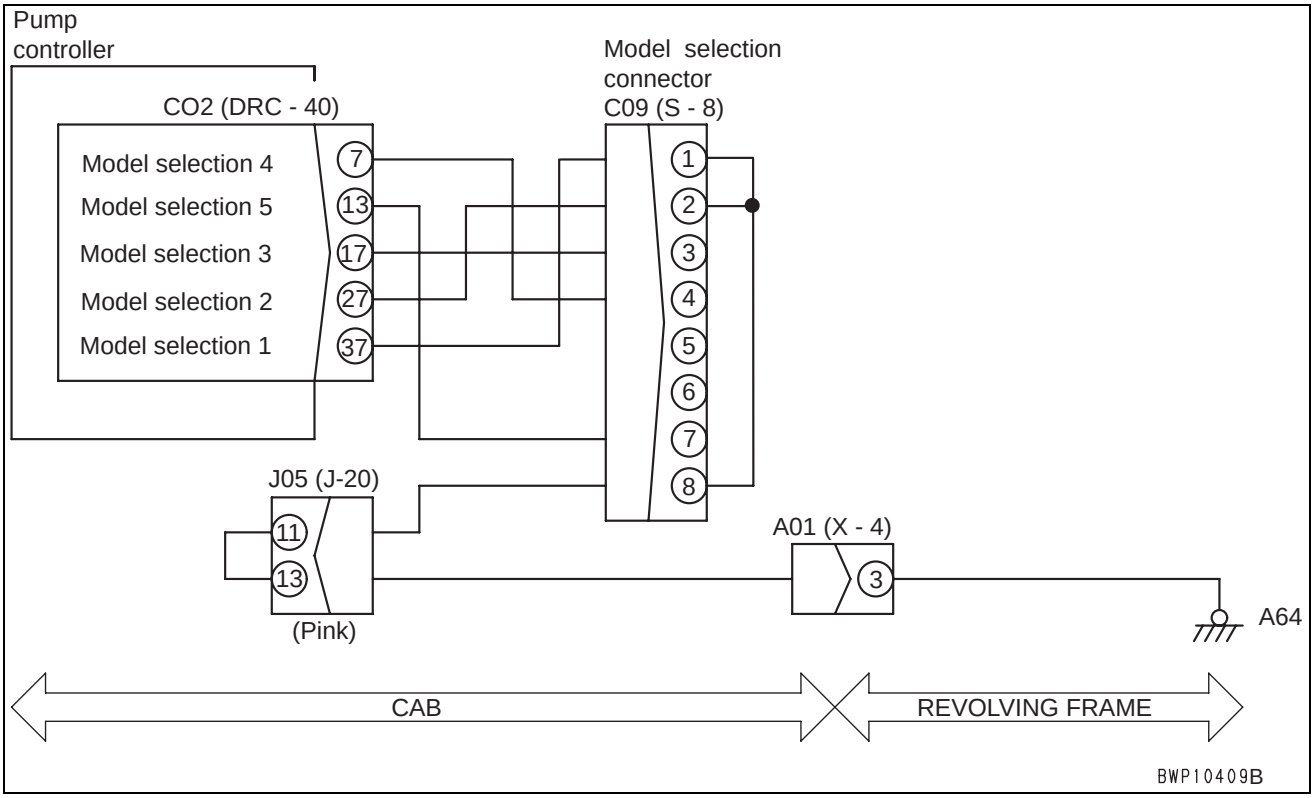
Failure Code [DA2SKQ] (Abnormality in inputting model code)

20/25kph

User Code	Failure Code	Failure phenomenon	Abnormality in inputting model code (in pump controller system)
—	**DA2SKQ**		
Failure content	• A model code signal was inputted which indicates another model that is not registered in the controller.		
Response from controller	• Even if the failure cause disappears of itself, the machine operation does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• Hunting may be experienced.		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting		
	1	Model selecting connector defective (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			C09 (female)	Resistance value	
			Between ①, ② and ⑧	Below 1 Ω	
			Between ③, ④, ⑤, ⑥ or ⑦ and ⑧	Above 1 MΩ	
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Wiring harness between C02 (female) ㉗ and C09 (male) ②	Resistance value	Below 1 Ω
			Between wiring harness C02 (female) ㊲ and C09 (male) ①	Resistance value	Below 1 Ω
			Wiring harness C09 (male) ⑧ and J05 and grounding	Resistance value	Below 1 Ω
	3	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Wiring harness between C02 (female) ⑦ and C09 (male) ④ and grounding	Resistance value	Above 1 MΩ
			Wiring harness C02 (female) ⑬ and C09 (male) ⑦ and grounding	Resistance value	Above 1 MΩ
			Wiring harness between C02 (female) ㉗ and C09 (male) ③ and grounding	Resistance value	Above 1 MΩ
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.		
			C02	Voltage	
			Between ⑦, ⑬ or ⑰ and grounding	20 – 30 V	
			Between ㉗, ㊲ and grounding	Below 1 V	

Electrical Circuit Diagram for Model Selecting Connector in Pump Controller
20/25kph



Failure Code [DA2SKQ] (Abnormality in inputting model code)

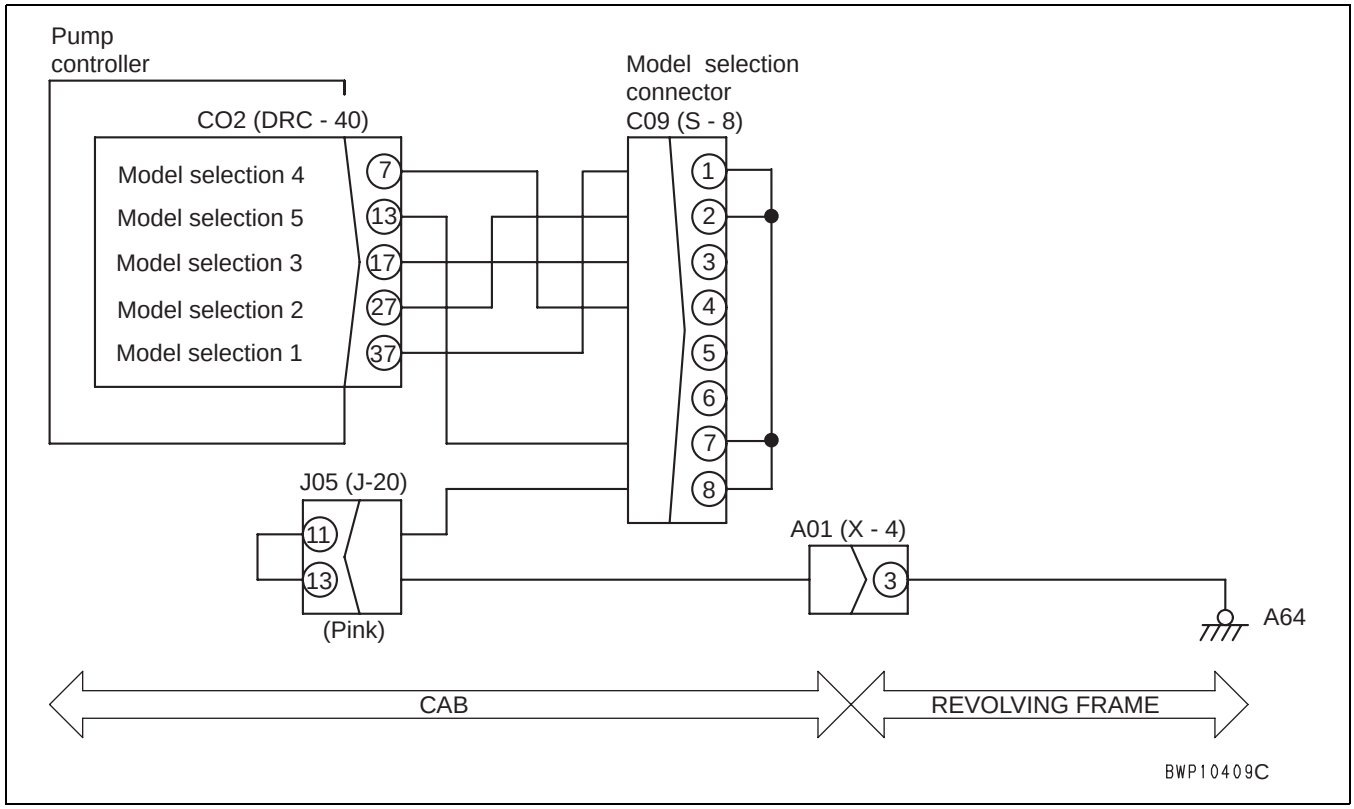
35kph

User Code	Failure Code	Failure phenomenon	Abnormality in inputting model code (pump controller system)
—	**DA2SKQ**		
Failure content	• A model code signal was inputted which indicates another model that is not registered in the controller.		
Response from controller	• Even if the failure cause disappears of itself, the machine operation does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• N/A		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Model selecting connector defective (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C09 (female)	Resistance value		
			Between ①, ②, ⑦ and ⑧	Below 1 Ω		
			Between ③, ④, ⑤, ⑥ or ⑧	Above 1 MΩ		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between C02 (female) ⑬ and C09 (male) ⑦	Resistance value	Below 1 Ω	
			Wiring harness between C02 (female) ㉗ and C09 (male) ②	Resistance value	Below 1 Ω	
			Between wiring harness C02 (female) ㊲ and C09 (male) ①.	Resistance value	Below 1 Ω	
			Between wiring harness C09 (male) ⑧ and J05 and grounding	Resistance value	Below 1 Ω	
	3	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness C02 (female) ⑦ and C09 (male) ③ and grounding	Resistance value	Above 1 MΩ	
			Between wiring harness C02 (female) ⑰ and C09 (male) ③ and grounding	Resistance value	Above 1 MΩ	
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C02	Voltage		
			Between ⑦ or ⑰ and grounding	20 – 30 V		
			Between ㊲, ㉗, ⑬ and grounding	Below 1 V		

Electrical Circuit Diagram for Model Selecting Connector in Pump Controller

35kph

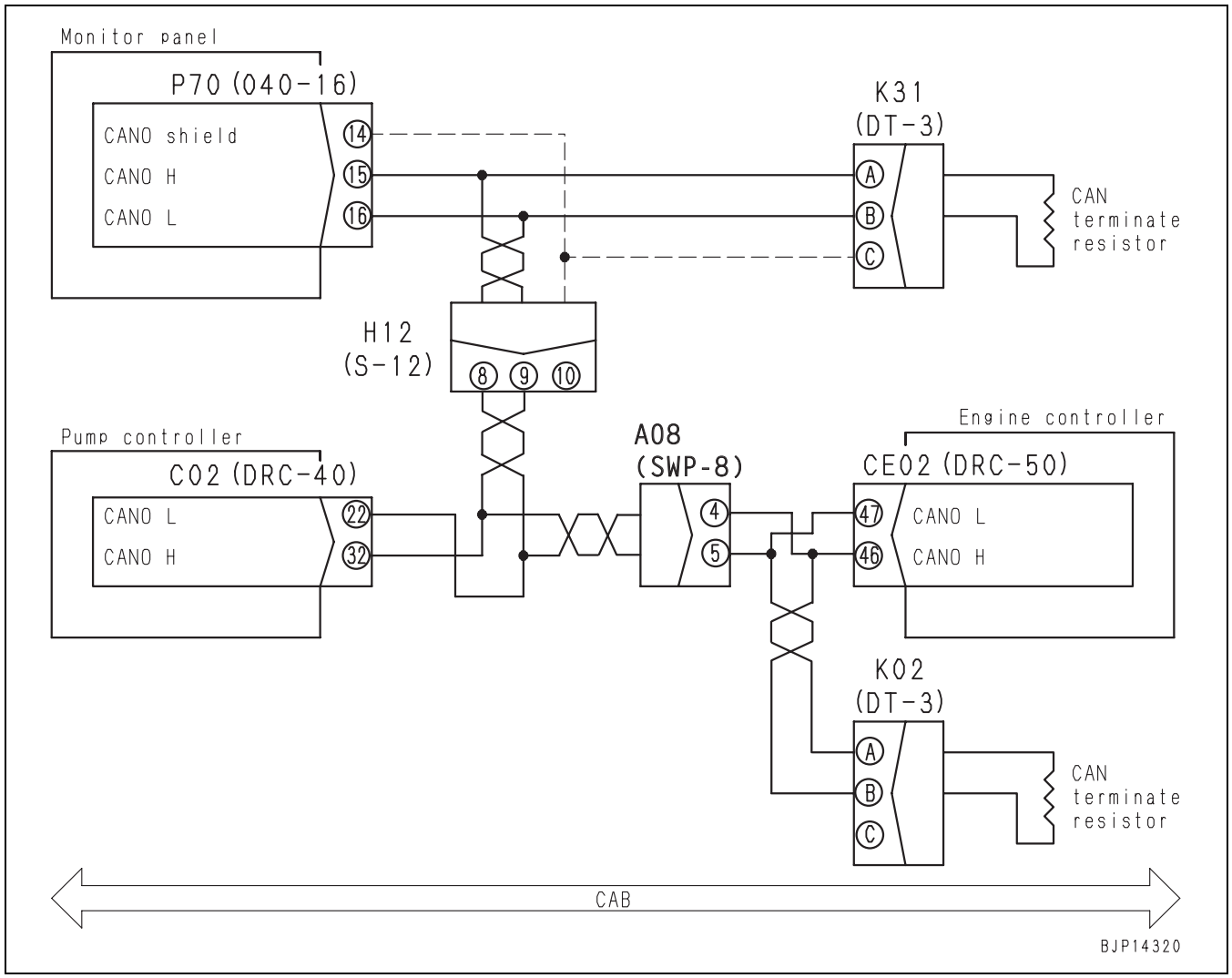


Failure code [DAFRMC] Monitor Comm. Abnormality

Action code	Failure code	Trouble	Monitor communication abnormality (Machine monitor)
E0E	**DAFRMC**		
Contents of trouble	• Machine monitor detected communication error in CAN communication circuit between pump controller and engine controller.		
Action of controller	• Fix engine output to E-mode, and limit pump absorption torque to about 80%. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• Output lowers. (Pump absorption torque decreases.) • As the working load increases, engine may stall.		
Related information			

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between P70 (female) (16) – CE02 (female) (47), – C02 (female) (22)	Resistance	Max. 1 Ω
			Wiring harness between P70 (female) (15) – CE02 (female) (46), – C02 (female) (32)	Resistance	Max. 1 Ω
	2	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between P70 (female) (16) – CE02 (female) (47), – C02 (female) (22), – other related circuit and chassis ground	Resistance	Min. 1 MΩ
			Wiring harness between P70 (female) (15) – CE02 (female) (46), – C02 (female) (32), – other related circuit and chassis ground	Resistance	Min. 1 MΩ
	3	Hot short (Short circuit with 24V circuit) in wiring harness	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			Wiring harness between P70 (female) (16) – CE02 (female) (47), – C02 (female) (22), – other related circuit and chassis ground	Voltage	Max. 1 V
			Wiring harness between P70 (female) (15) – CE02 (female) (46), – C02 (female) (32), – other related circuit and chassis ground	Voltage	Max. 1 V
	4	Defective CAN terminal resistance	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			K02 (male), K31 (male)	Resistance	
			Between (A) – (B)	40 – 80 Ω	
	5	Defective machine monitor, engine controller, or pump controller	If causes 1 – 4 are not detected, machine monitor, engine controller, or pump controller may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		

Circuit diagram related to CAN communication of machine monitor

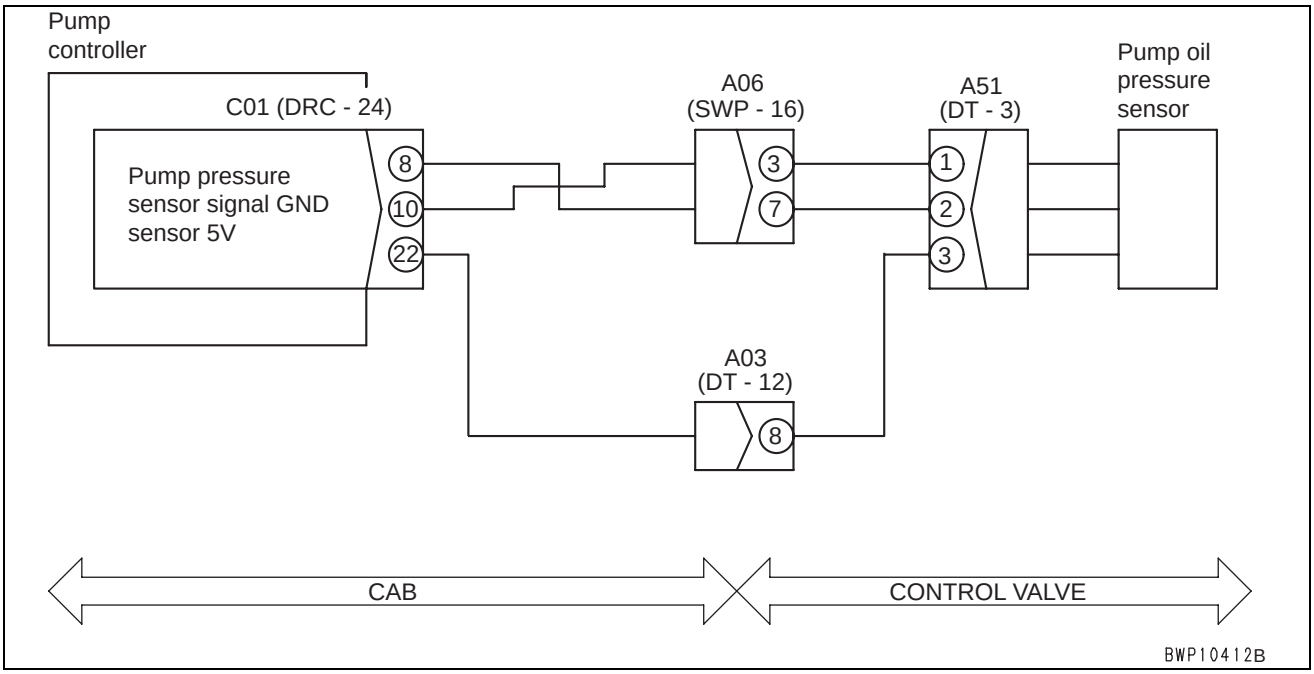


Failure Code [DDHPAKP] (Abnormality in pump pressure sensor)

User Code	Failure Code	Failure phenomenon	Abnormality in pump pressure sensor (pump controller system)
—	**DDHPAKP**		
Failure content	• Signal voltage from the pump pressure sensor dropped below 0.3 V or exceeded 4.72 V.		
Response from controller	• The controller controls the pump pressure at 0 MPa{0 kg/cm^2}. • If the failure cause disappears, the sensor returns to normal of itself.		
Phenomenon occurring on machine	• The travel speed does not shift automatically.		
Relative information	• Input from the pump pressure sensor (pressure) can be confirmed in the monitor function. (Code No. 01100: pump pressure)		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Pump pressure sensor defective (Internal failure)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
			A51	Voltage		
			Between ② and ①	4.5 – 5.5 V		
			Between ③ and ①	0.5 – 4.5 V		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C01 (female) ㉒ to A51 (female) ③		Resistance value	Below 1 Ω
			Wiring harness between C01 (female) ⑩ and A51 (female) ①		Resistance value	Below 1 Ω
			Wiring harness between C01 (female) ⑧ and A51 (female) ②		Resistance value	Below 1 Ω
	3	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness C01 (female) ⑧ and A51 (female) ② and grounding		Resistance value	Above 1 MΩ
	4	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness C01 (female) ㉒, A51 (female) ③ and grounding		Voltage	Below 1 V
			Between wiring harness C01 (female) ⑧ and A51 (female) ② and grounding		Voltage	Below 1 V
	5	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
			C01	Voltage		
			Between ㉒ and ⑩	4.5 – 5.5 V		
			Between ⑧ and ⑩	0.5 – 4.5 V		

Electrical Circuit Diagram for Pump Pressure Sensor Pump Controller

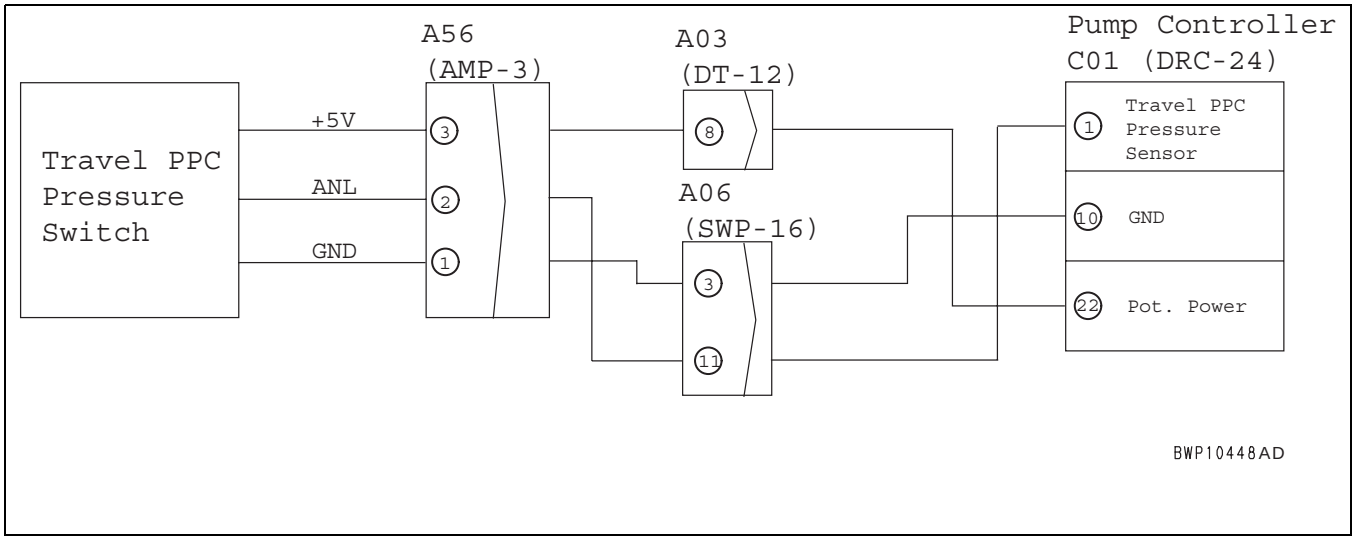


Failure Code [DDP4KX] (Abnormality in travel PPC pressure switch)

User Code	Failure Code	Failure phenomenon	Disconnection in travel PPC pressure switch (in pump controller system)
E20	**DDP4KX**		
Failure content	• Error code appears on monitor when travel pedal operated.		
Response from controller	• Defaults travel mode to 'N' (Neutral).		
Phenomenon occurring on machine	• Machine cannot travel		
Relative information	•		

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting		
	1	Pressure switch defective(Internal short circuiting or grounding).	• Turn starting switch OFF for the preparations, and hold it OFF during troubleshooting.		
			A56	Voltage	
			Between ① and ③	4.5 - 5.5V	
			Between ① and ②.	0.5 - 4.5V	
	2	Disconnection of wirirng harness (disconnection or deffective contact with connector)	• Turn starting switch OFF for the preparations, and hold it OFF during troubleshooting.		
			Between C01-1 and A56-2.	Resistance value	Below 1 Ω
			Between C01-10 and A56-1.		
			Between C01-22 and A56-3		

Electrical Circuit Diagram for Travel PPC Pressure Switch

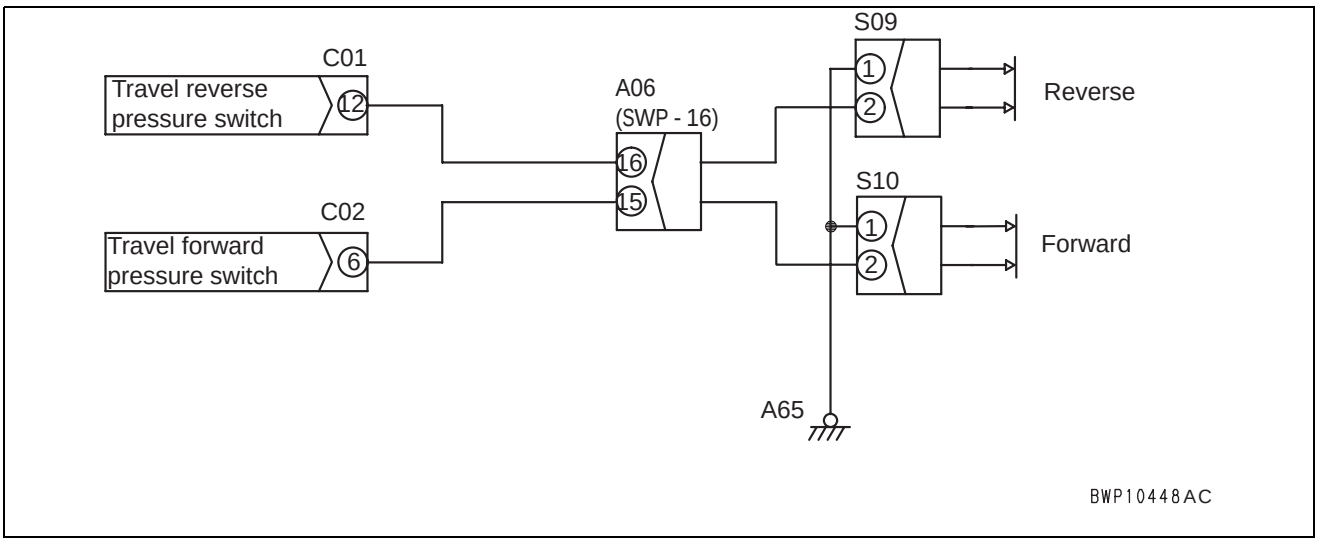


Failure Code [DDWCKZ] (Abnormality in travel direction control switch)

User Code	Failure Code	Failure phenomenon	Disconnection in direction control switches (in pump controller system)
E20	**DDWCKZ**		
Failure content	• Error code appears on monitor when travel pedal operated.		
Response from controller	• Defaults travel mode to 'N' (Neutral).		
Phenomenon occurring on machine	• Machine cannot travel		
Relative information	•		

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting		
	1	Pressure switch defective(Internal short circuiting or grounding).	• Turn starting switch OFF for the preparations, and hold it OFF during troubleshooting.		
			S09 and S10	Resistance value	
			Between ① and ② with oil pressure.	Above 1 Ω	
			Between ① and ② without oil pressure.	Less than 100 Ω	
	2	Disconnection of wirirng harness (disconnection or deffective contact with connector)	• Turn starting switch OFF for the preparations, and hold it OFF during troubleshooting.		
			Between C01-12 and S09-2.	Resistance value	Below 1 Ω
			Between C02-6 and S10-2.		

Electrical Circuit Diagram for Travel PPC Switch

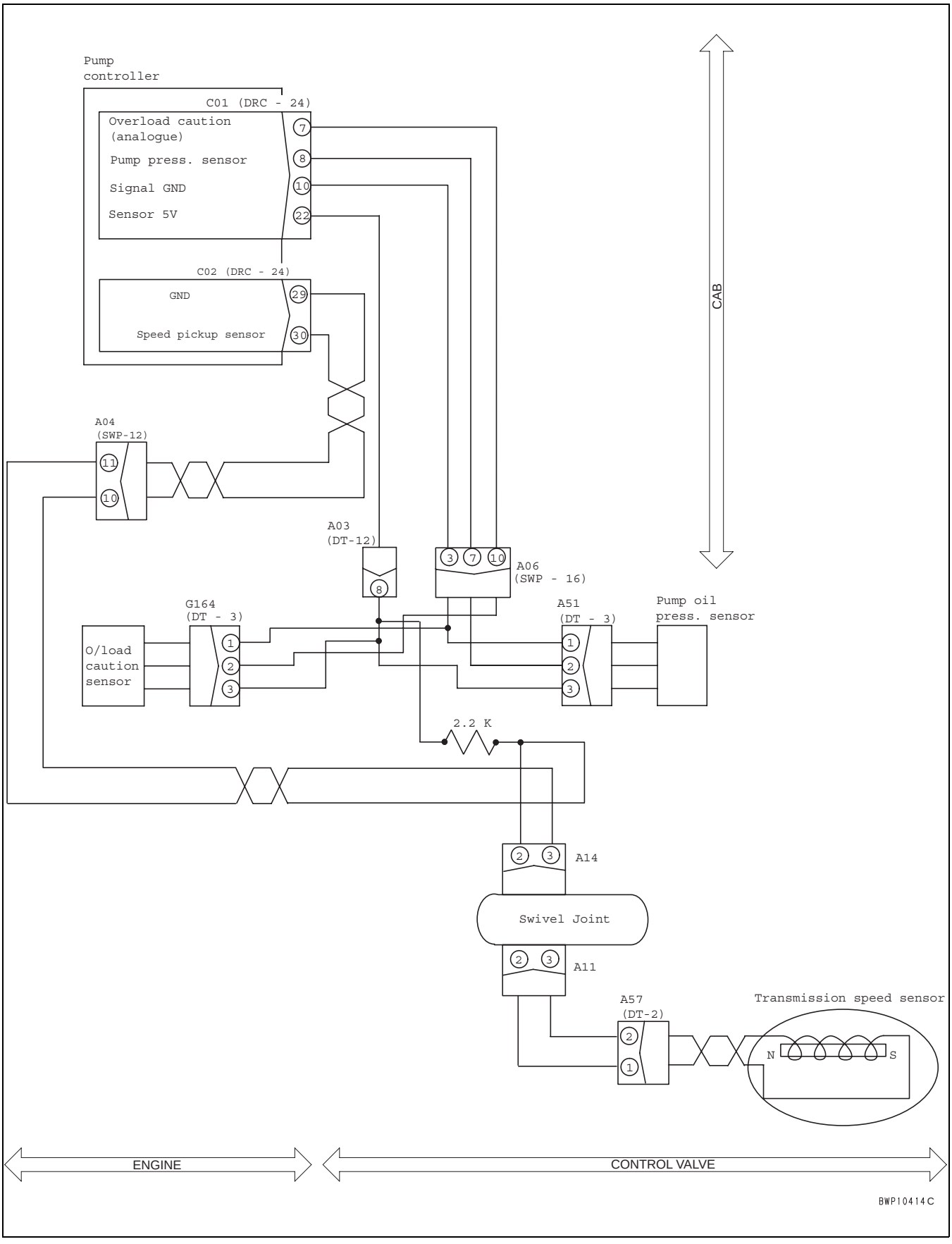


Failure Code [DH1OKS] (Abnormality in Pressure sensor power source)

User Code	Failure Code	Failure phenomenon	Abnormality in pressure sensor power source (in pump controller system)
—	**DH10KS**		
Failure content	• Abnormal current flow to the power source circuit (5 V) for the pressure sensors and potentiometer.		
Response from controller	• The controller turns OFF power supply to the power source circuit (5 V). • Even when the failure cause disappears of itself, the current does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• Signals from the pressure sensors and potentiometer are not inputted correctly. • The Service Code of "pressure sensor abnormal" and that of "potentiometer abnormal" are displayed at the same time.		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting		
	1	Pressure sensor or potentiometer defective (Internal short-circuit)	Disconnect the following equipment one by one. Equipment that shows no service code is defective, having an internal failure. • Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.		
			Speed sensor	A57 Connector	
			Pump pressure sensor	A51 Connector	
			Overload caution sensor	G164 Connector	
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Between wiring harness from C01 (female) ㉒ to A57 (female) ① and grounding [speed sensing system]	Resistance value	Above 1 MΩ
			Between wiring harness from C01 (female) ㉒ to A51 (female) ③ and grounding [Pump pressure sensor system]	Resistance value	Above 1 MΩ
			Between wiring harness C01 (female) ㉒ to G164 (female) ③ and grounding.	Resistance value	Above 1 MΩ
	3	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.		
			C01	Voltage	
			Between ㉒ and ⑩	4.5 – 5.5 V	

Electrical Circuit Diagram for Sensor Power Source in Pump Controller

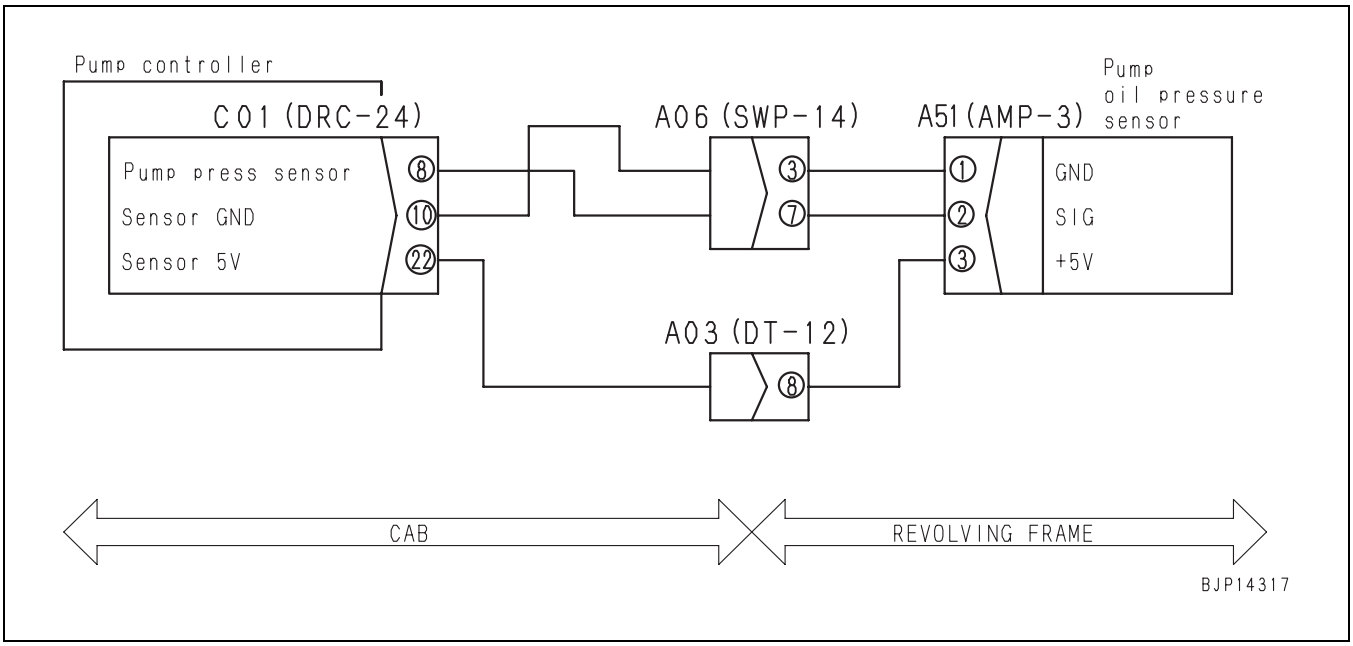


Failure code [DHPAMA] F Pump Press Sensor Abnormality

Action code	Failure code	Trouble	Pump press sensor abnormality (Pump controller system)
—	**DHPAMA**		
Contents of trouble	• Signal voltage from pump pressure sensor is below 0.3 V or above 4.42 V.		
Action of controller	• Fixes pump pressure at 0 MPa {0 kg/cm^2} and continues control. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• No automatic gear shifting		
Related information	a If 5V circuit (3) and ground circuit (1) of pressure sensor are connected inversely, pressure sensor will be broken. Accordingly, take extreme care when checking. • Input from pump pressure sensor (pressure) can be checked with monitoring function. (Code 01112: pump pressure		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective sensor power supply system	If failure code [**DA25KP**] is also displayed, carry out troubleshooting for it first.			
	2	Defective F pump pressure sensor (Internal defect)	a Prepare with starting switch OFF, then start engine and carry out troubleshooting.			
			A51	Voltage		
			Between (3) – (1)	4.5 – 5.5 V		
			Between (2) – (1)	0.5 – 4.5 V		
	3	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between C01 (female) (22) – A03 – A51 (female) (3)	Resistance	Max. 1 Ω	
			Wiring harness between C01 (female) (10) – A06 – A51 (female) (1)	Resistance	Max. 1 Ω	
			Wiring harness between C01 (female) (8) – A06 – A51 (female) (2)	Resistance	Max. 1 Ω	
	4	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between C01 (female) (8) – A06 – A51 (female) (2) and chassis ground	Resistance	Min. 1 MΩ	
	5	Hot short (Short circuit with 24V circuit) in wiring harness	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Wiring harness between C01 (female) (22) – A03 – A51 (female) (3) and chassis ground	Voltage	Max. 1 V	
			Wiring harness between C01 (female) (8) – A06 – A51 (female) (2) and chassis ground	Voltage	Max. 1 V	
	6	Defective pump controller	a Prepare with starting switch OFF, then start engine and carry out troubleshooting.			
			C01	Voltage		
			Between (22) – (10)	4.5 – 5.5 V		
			Between (8) – (10)	0.5 – 4.5 V		

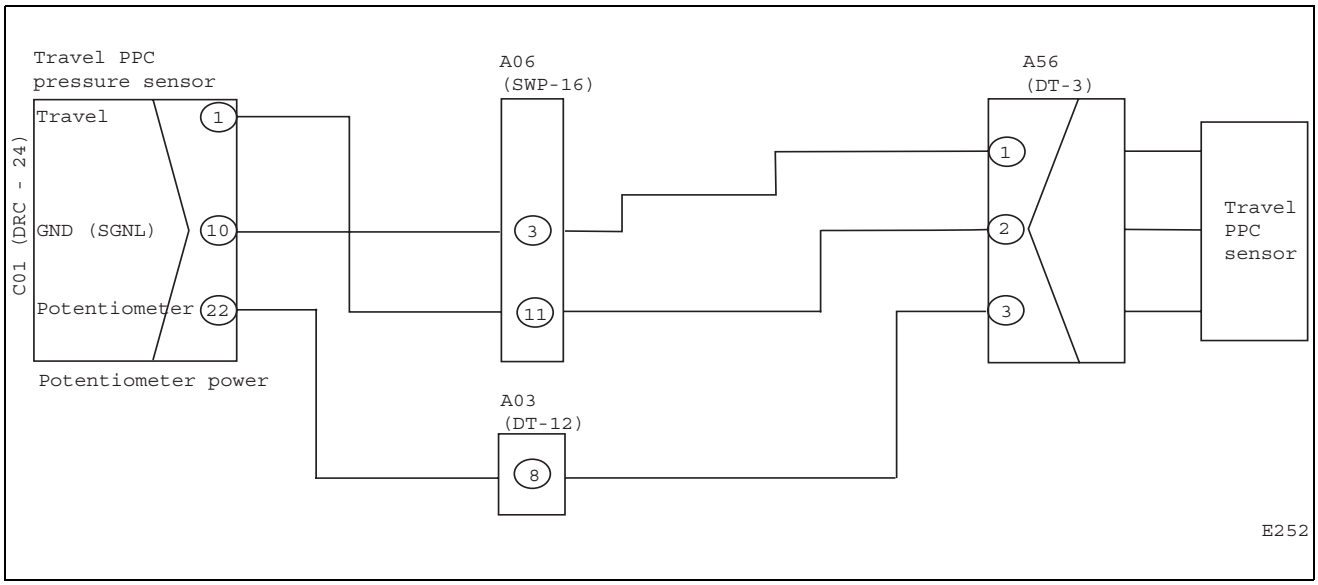
Circuit diagram related to pump pressure sensor of pump controller



Failure Code [DHS5KX] (Abnormality in travel PPC sensor)

User Code	Failure Code	Failure phenomenon	Abnormality in the travel PPC sensor (in pump controller system)
E20	**DHS5KX**		
Failure content	• A normal signal is not inputted to the signal circuit from the travel PPC sensor.		
Response from controller	• No control of engine speed via throttle pedal during travel operation. • If the failure cause disappears of itself, the signal input returns to normal.		
Phenomenon occurring on machine	• The machine lacks speed unless engine fuel dial is turned to 'Hi' position.		
Relative information			

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Travel PPC (Internal short-circuiting or disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			A56 (male)	Resistance value		
			Between ③ and ②	500 – 1,000 Ω		
			Between ③ and grounding	Above 1 MΩ		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between C01 (female) ㉒ and A56 (female) ③	Resistance value	Below 1 Ω	
			Wiring harness between C01 (female) ⑩ and A56 (female) ①	Resistance value	Below 1 Ω	
			Wiring harness between C01 (female) ① and A56 (female) ②	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Wiring harness between C01 (female) ㉒ and A56 (female) ① and grounding	Voltage	Below 1 V	
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C01 (female)	Resistance value		
			Between ㉒ and ⑩	500 – 1,000 Ω		
			Between ① and ⑩	Above 1 MΩ		

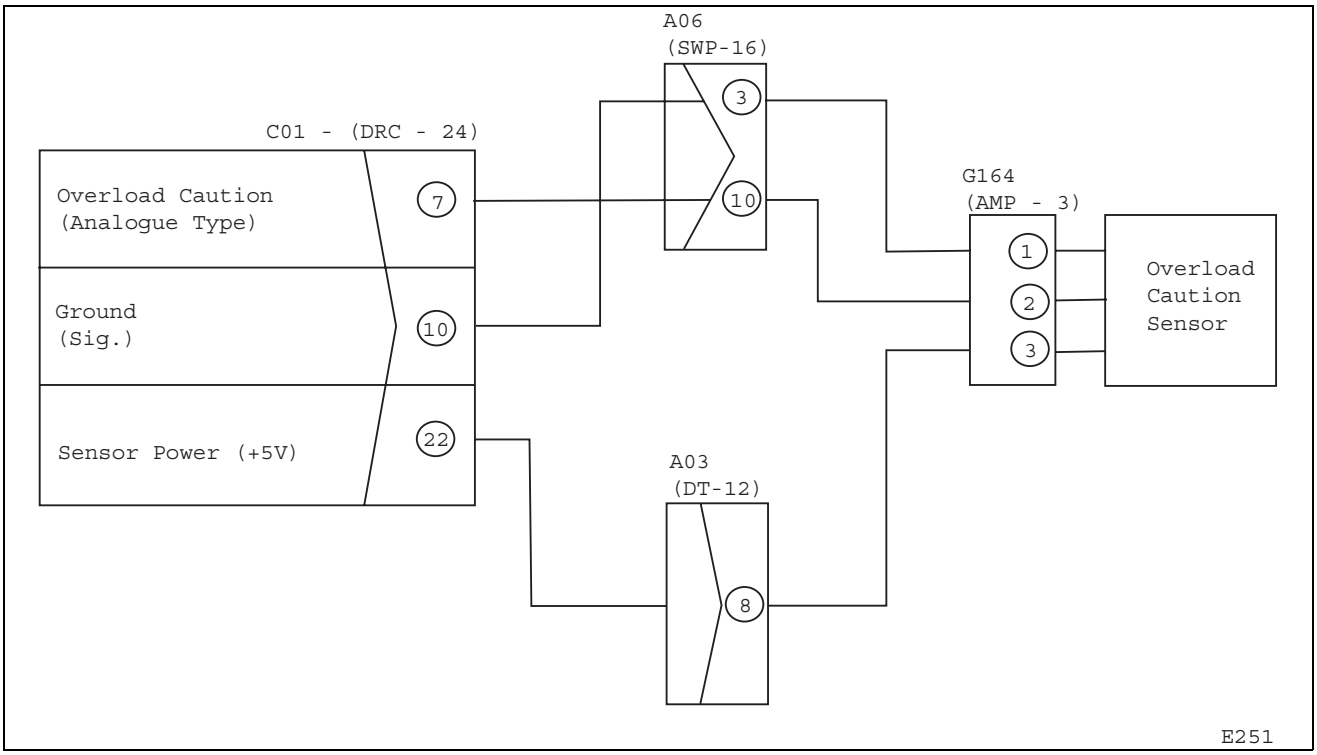


Failure Code [DHX1MA] (Abnormality in overload caution sensor)

User Code	Failure Code	Failure phenomenon	Abnormality in overload caution sensor (Pump controller system)
—	**DHX1MA**		
Failure content	• A normal pulse signal is not inputted to the signal circuit in the overload caution sensor.		
Response from controller	• The controller exercises a control equivalent to E mode. • If the failure cause disappears of itself, the signal input returns to normal.		
Phenomenon occurring on machine	• Caution may illuminate on monitor		
Relative information	• Warning buzzer may sound		

	Cause		Standard value in normal and references for troubleshooting			
Presumed cause and standard value in normal	1	Overload caution sensor fault (Internal short-circuiting or disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			G164 (male)	Resistance value		
			Between ① and ③	500 – 1,000 Ω		
			Between ① and ②	Above 1 MΩ		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between C01 (female) ⑦ and G164 (female) ②	Resistance value	Below 1 Ω	
			Wiring harness between C01 (female) ⑩ and G164 (female) ① Wiring harness between C01 (female) ㉒ and G164 (female) ③	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Wiring harness between C02 (female) ㉒ and G164 (female) ③ and grounding Wiring harness between C01 (female) ⑦ and G164 ② and grounding.	Voltage	Below 1 V	
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C01 (female)	Resistance value		
			Between ㉒ and ⑩	500 – 1,000 Ω		
			Between ㉒ and grounding	Above 1 MΩ		

Electrical Circuit Diagram for Overload Caution

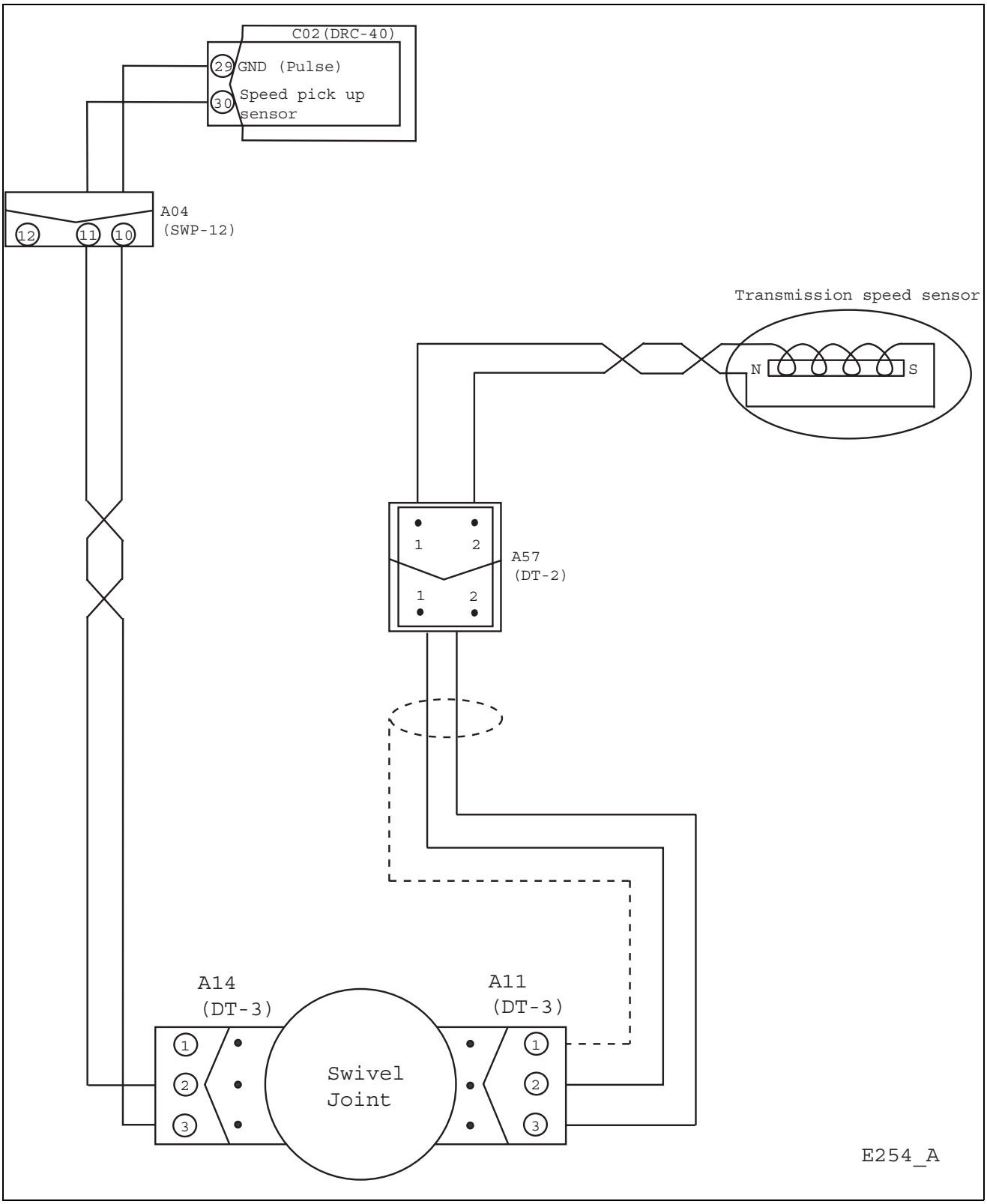


Failure Code [DLT4KA] (Disconnection in transmission speed sensor in pump controller system)

User Code	Failure Code	Failure phenomenon	Disconnection in transmission speed sensor (in pump controller system)
E20	**DLT4KA**		
Failure content	• A normal pulse signal is not inputted to the signal circuit in the transmission speed sensor.		
Response from controller	• The machine will default to 'Hi' travel speed only. • If the failure cause disappears of itself, the signal input returns to normal condition.		
Phenomenon occurring on machine	• The machine defaults to 'Hi' speed travel. • Monitor will not display travel speed.		
Relative information	• Input from the transmission speed sensor (rpm) can be confirmed in the monitor function.		

	Cause		Standard value in normalcy and references for troubleshooting			
Presumed cause and standard value in normal	1	Transmission speed sensor fault (Internal short-circuiting or disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			A57 (male)	Resistance value		
			Between ① and ②	500 – 1,000 Ω		
			Between ① and grounding	Above 1 MΩ		
	2	Transmission speed sensor adjustment improper	For the inspection and adjustment, refer to the section of "Adjusting Transmission speed Sensor" in this manual.			
	3	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between C02 (female) ㉚ and A57 (female) ①	Resistance value	Below 1 Ω	
			Between C02 (female) ㉙ and A57 ②.	Resistance value	Below 1 Ω	
	4	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Wiring harness between C02 (female) ㉚ and A57 (female) ② and grounding	Voltage	Below 1 V	
	5	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C02 (female)	Resistance value		
			Between C02 ㉚ and C02 ㉙	500 – 1,000 Ω		
			Between C02 ㉚ and grounding	Above 1 MΩ		

Electrical Circuit Diagram for Monitor Panel Power Source

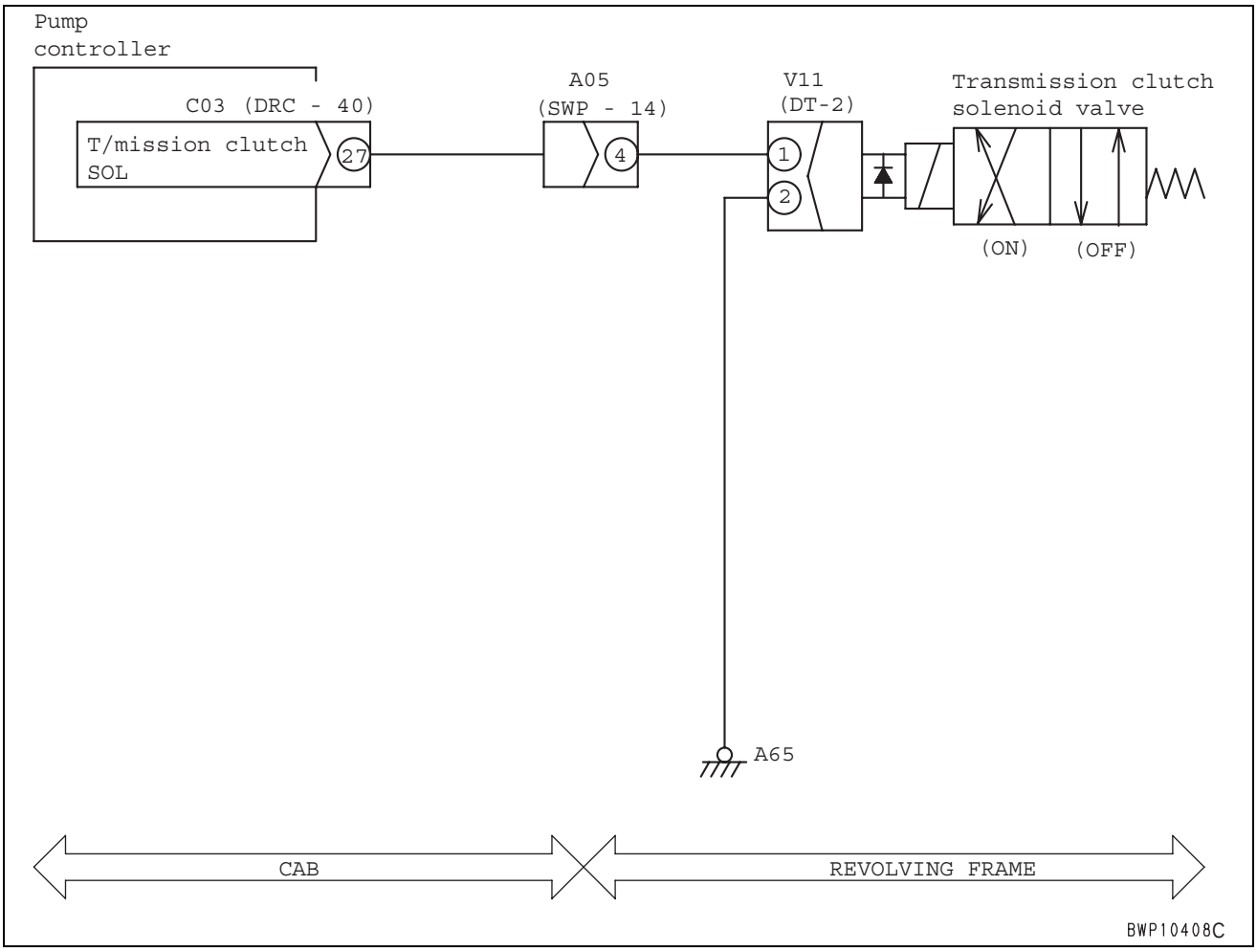


Failure Code [DW27KA] (Disconnection in Transmission Clutch solenoid)

User Code	Failure Code	Failure phenomenon	Disconnection in transmission clutch solenoid (in pump controller system)
E20	**DW27KA**		
Failure content	• No current flows to the transmission clutch solenoid circuit, when power is supplied to the circuit.		
Response from controller	• None in particular (The solenoid does not function as there is no current flowing to it) • When the failure cause disappears of itself, the machine operation returns to normal.		
Phenomenon occurring on machine	• The travel speed does not shift to Lo. (Machine defaults to Hi) (The display changes normally in the monitor panel)		
Relative information	• Operation of the transmission clutch solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02300: Solenoid valve 1) • The solenoid detects disconnection, when power is ON. Hence be sure to check it with power ON after the repairs.		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Transmission clutch solenoid defective (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V11 (male)	Resistance value		
			Between ① and ②	27 – 30 Ω at 20°C		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ㉗ to A05 to V11 (female) ①	Resistance value	Below 1 Ω	
			Wiring harness between V11 (female) ② and grounding	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Betwen wiring harness from C03 (female) ㉗ to A05 to V11 (female) ①.	Voltage	Below 1 V	
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ㉗ and grounding	20 – 60 Ω		

Electrical Circuit Diagram for Transmission Clutch Solenoid in Pump Controller

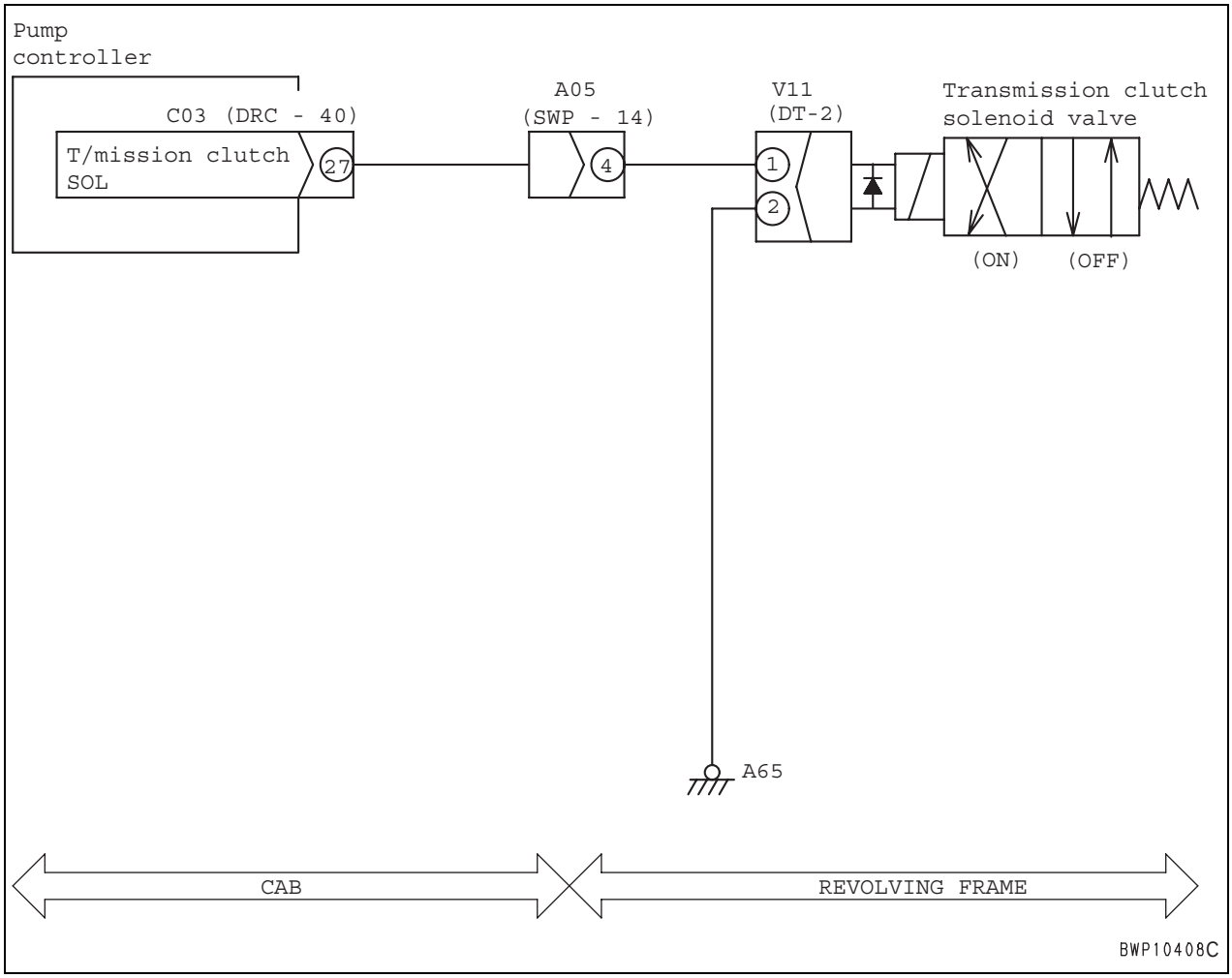


Failure Code [DW27KB] (Short-circuiting in Transmission Clutch solenoid)

User Code	Failure Code	Failure phenomenon	Disconnection in transmission clutch solenoid (in pump controller system)
E20	**DW27KB**		
Failure content	• Abnormal current flow to the transmission clutch solenoid, when power was supplied to the circuit.		
Response from controller	• Power supply to the transmission clutch solenoid circuit is switched OFF. • Even after the failure cause disappears of itself, the machine operation does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• The travel speed does not turn to Hi. (The display in the monitor panel changes correctly)		
Relative information	• Operation of the transmission clutch solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02300: Solenoid valve 1)		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Transmission clutch solenoid defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V11 (male)		Resistance value	
			Between ① and ②		27 – 30 Ω at 20°C	
			Between ① and grounding		Above 1 MΩ	
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ㉗ to A05 to V11 (female) ①.		Resistance value	Above 1 MΩ
	3	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it running during the troubleshooting.			
			C03	Travel speed	Voltage	
			Between ㉗ and grounding	Lo	Below 1 V	
				Hi + Travel operation	20 – 30 V	

Electrical Circuit Diagram for Transmission Clutch Solenoid

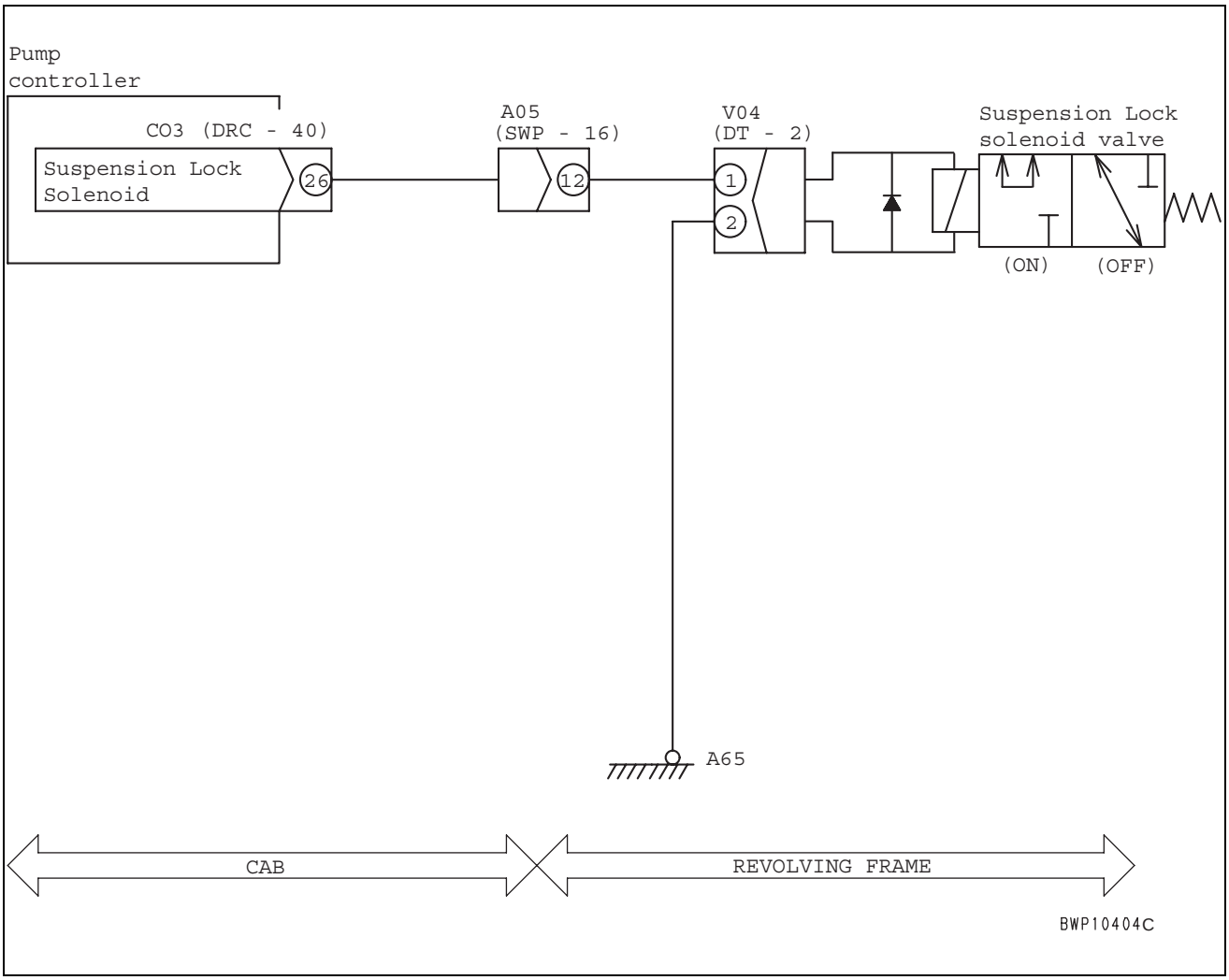


Failure Code DW4AKA (Disconnection in suspension lock solenoid)

User Code	Failure Code	Failure phenomenon	Disconnection in suspension lock solenoid (in pump controller system)
E20	**DW4AKA**		
Failure content	• No current flows to the suspension lock solenoid circuit, when power is supplied to the circuit.		
Response from controller	• None in particular (The solenoid does not function as there is current flowing to it) • When the failure cause disappears of itself, the machine operation returns to normal.		
Phenomenon occurring on machine	• The suspension lock cylinders which should hold the front axle solid do not lock. The axle is always free to oscillate.		
Relative information	• Operation of the suspension lock solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02301: Solenoid valve 2) • The solenoid detects disconnection, when power is ON. Hence be sure to check it with power ON after the repairs. (Operation of the suspension lock solenoid [ON or OFF] can be checked in the monitoring function [code 02301: solenoid valve 2]).		

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Suspension lock solenoid defective (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V04 (male)	Resistance value		
			Between ① and ②	27 – 30 Ω at 20°C		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ㉖ to A05 to V04 (female) ①	Resistance value	Below 1 Ω	
			Wiring harness between V04 (female) ② and grounding	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness from C03 (female) ㉖ to A05 to V04 (female) ①, or between wiring harness C03 (female) ㉖ and grounding	Voltage	Below 1 V	
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ㉖ and grounding	20 – 60 Ω		

Electrical Circuit Diagram for Suspension Lock Solenoid in Pump Controller

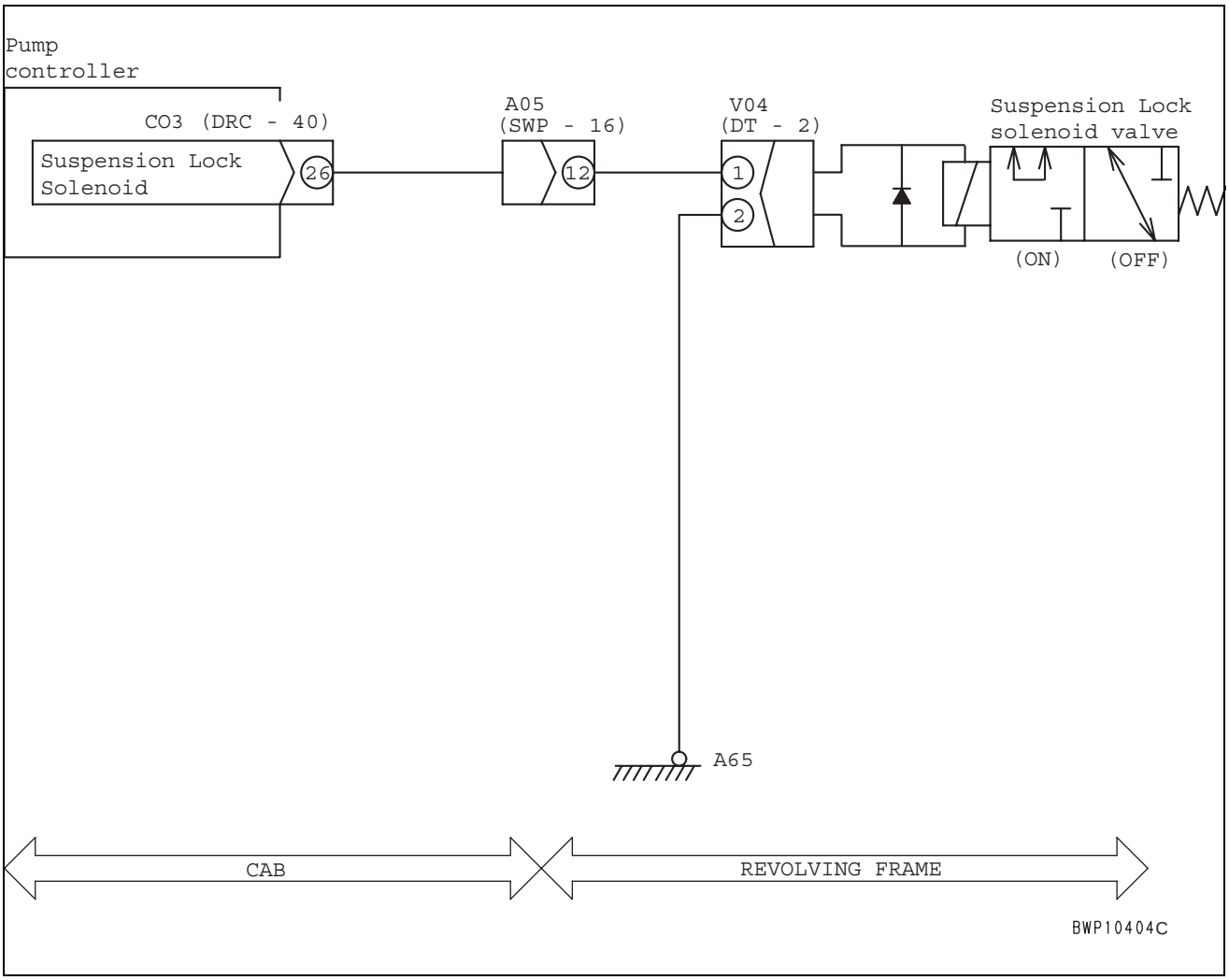


Failure Code [DW4AKB] (Short circuiting in suspension lock solenoid)

User Code	Failure Code	Failure phenomenon	Short circuit of suspension lock solenoid (in pump controller system)
E20	**DW4AKB**		
Failure content	• Abnormal current flew to the suspension lock solenoid circuit, when power was supplied to the circuit.		
Response from controller	• Power supply to the suspension lock solenoid circuit is switched OFF. • Even after the failure cause disappears of itself, the machine operation does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• The suspension lock cylinders which should hold the front axle solid do not lock. The axle is always free to oscillate.		
Relative information	• Operation of the suspension lock solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02301: Solenoid valve 2)		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Suspension lock solenoid defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V04(male)	Resistance value		
			Between ① and ②	27 – 30 Ω at 20°C		
			Between ① and grounding	Above 1 MΩ		
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ㉖ to A05 to V04 (female) ①.	Resistance value	Above 1 MΩ	
	3	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C03	Voltage		
			Between ㉖ and grounding	Below 1 V		
				20 – 30 V		

Electrical Circuit Diagram for Suspension Lock Solenoid in Pump Controller

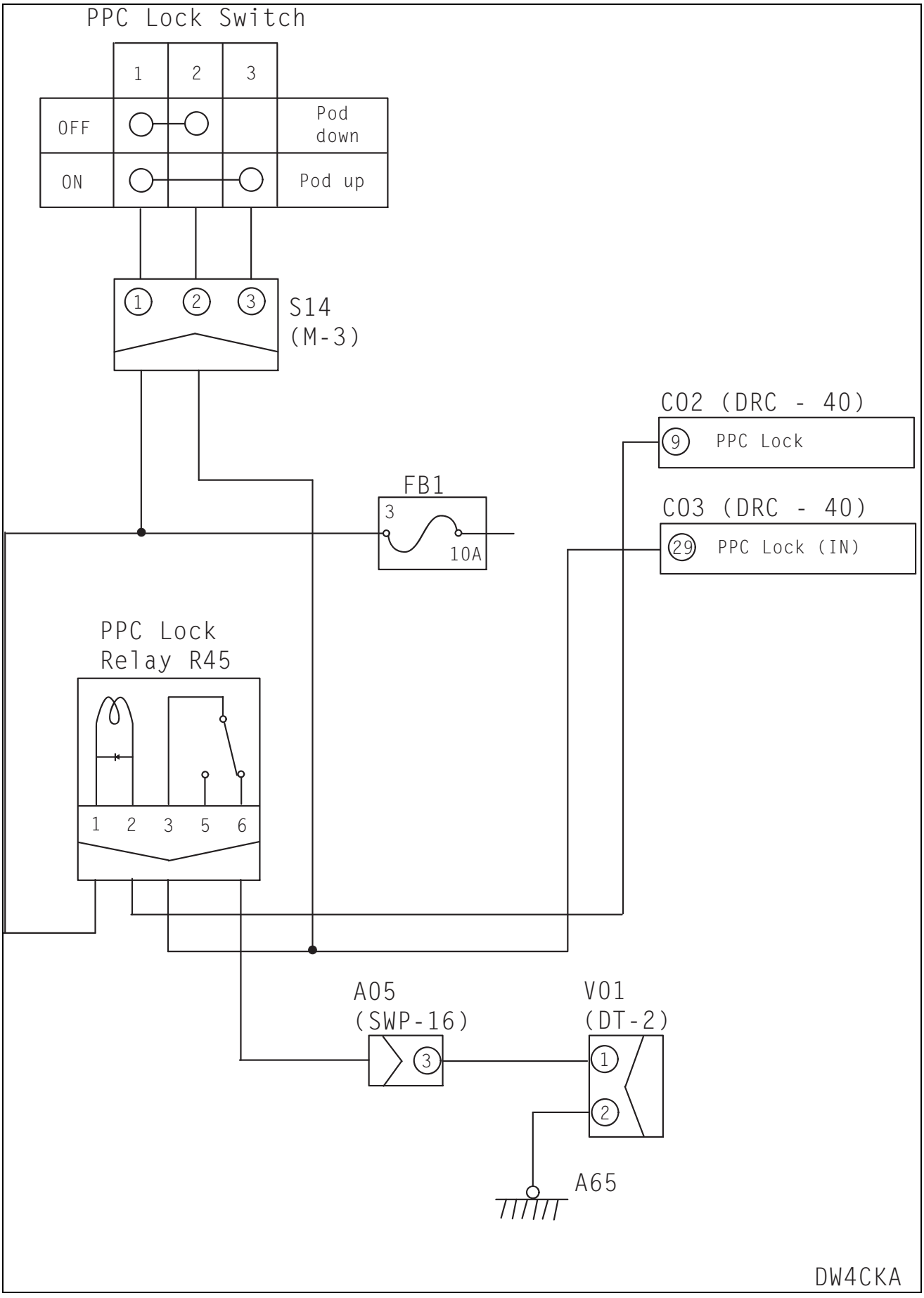


Failure Code [DW4CKA] (Disconnection in PPC lock solenoid)

User Code	Failure Code	Failure phenomenon	Disconnection in PPC lock solenoid (in pump controller system)
	DW4CKA		
Failure content	• No current flows to the PPC lock solenoid circuit, when power is supplied to the circuit.		
Response from controller	• None in particular (The solenoid does not function as there is no current flowing to it) • When the failure cause disappears of itself, the machine operation returns to normal.		
Phenomenon occurring on machine	• None of the machines work equipment functions operate.		
Relative information	• Operation of the PPC lock solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02300: Solenoid valve 1) • The solenoid detects disconnection, when power is ON. Hence be sure to check it with power ON after the repairs.		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting		
	1	PPC lock solenoid defective (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			V01 (male)	Resistance value	
			Between ① and ②	27 – 30 Ω at 20°C	
	2	Defective PPC lock relay (Internal disconnection)	R45 (Male)	Resistance value	
			Between (1) - (2)	300 - 600 Ω	
			• Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting. (Troubleshooting by replacemment)		
			• Replace PPC lock relay (R45) with another relay and perform reproducing operation. If "E" of failure code goes off at this time, replaced relay is defective.		
	3	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Wiring harness between C03 (female) ㉙ to R45 to A05 to V01 (female) ①	Resistance value	Below 1 Ω
			Between wiring harness from S14 (male) ② to R45 (female) ③	Resistance value	Below 1 Ω
			Between wiring harness from S14 (male) ① to FB1 (female) ③	Resistance value	Below 1 Ω
			Wiring harness between V01 (female) ② and grounding	Resistance value	Below 1 Ω
			Between wiring harness from S14 (male) ① to R45 ①	Resistance value	Below 1 Ω
			Between wiring harness from C02 (female) ⑨ to R45 ②	Resistance value	Below 1 Ω
	4	Short-circuiting of Wiring harness (Contact with 24V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.		
			Between wiring harness C03 (female) ㉙ and and R45 and A05 and V01 ① and grounding	Voltage	Below 1 V
	5	Defective PPC lock switch	• Prepare with starting switch OFF, with PPC lock switch OFF (LH pod down) then carry out troubleshooting without turning starting switch ON.		
			S14 (female)	Resistance	
			Between ① and ②	Below 1 Ω	
			Between ① and ③	Above 1 MΩ	
	6	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			C03 (female)	Resistance value	
			Between ㉙ and grounding	Below 1 Ω	

Electrical Circuit Diagram for PPC Lock Solenoid in Pump Controller

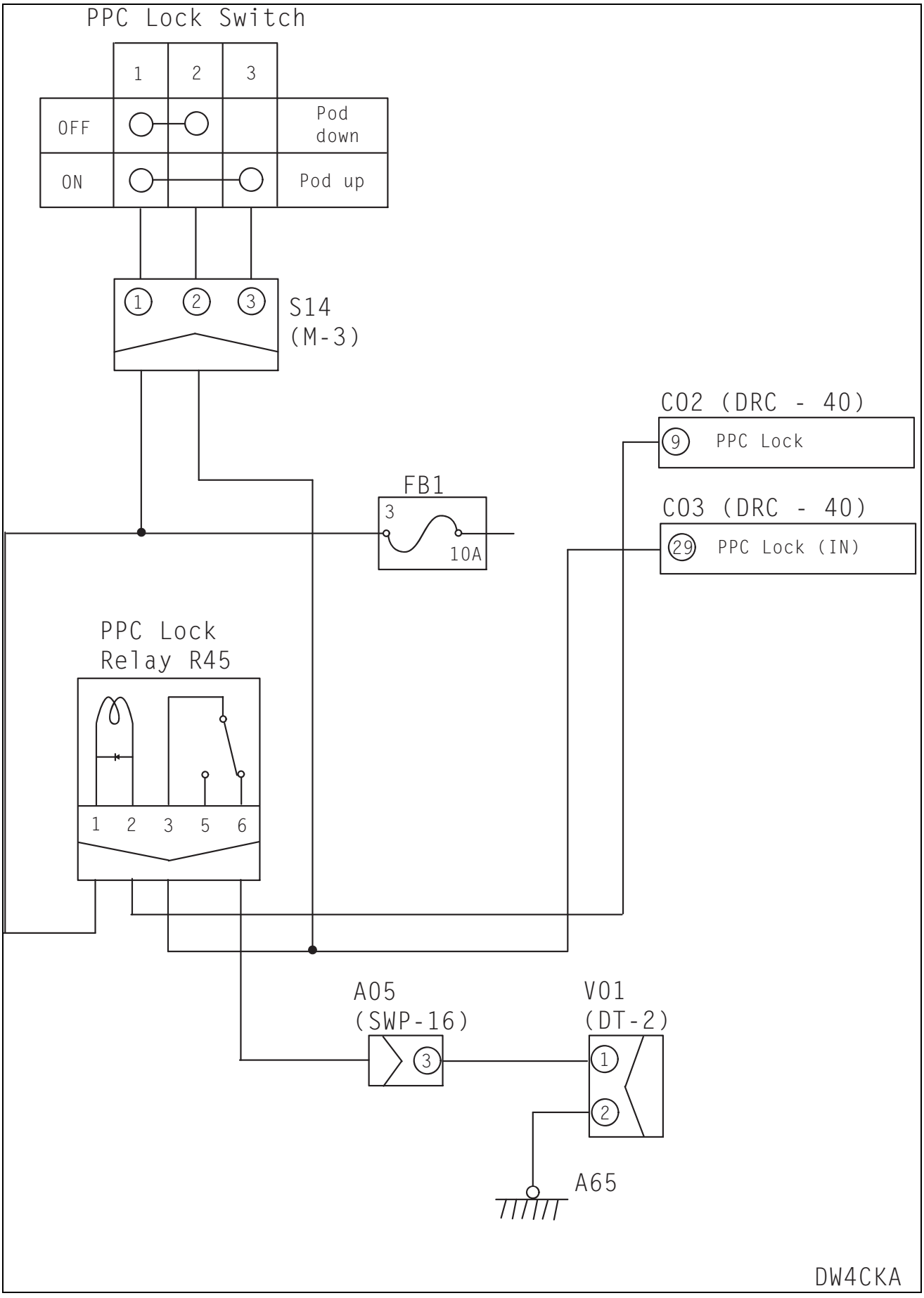


Failure code [DW4CKB] PPC Lock Sol. S/C

Action code	Failure code	Trouble	PPC lock solenoid short (Pump controller system)
	DW4CKB		
Contents of trouble	• Abnormal current flowed at output to PPC lock solenoid circuit.		
Response from controller	• None in particular (The solenoid does not function as there is no current flowing to it) • When the failure cause disappears of itself, the machine operation returns to normal.		
Problem that appears on machine	• None of the machines work equipment functions operate.		
Related information	• Operating condition of PPC lock solenoid (ON/OFF) can be checked with monitoring function. (Code 02301: Solenoid valve 1)		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective PPC lock solenoid (Internal short circuit or ground fault)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			V01 (male)	Resistance	
			Between ① – ②	27 – 30 Ω at 20°C	
			Between ① – chassis ground	Min. 1 MΩ	
	2	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between C03 (female) ㉙ – R45 – A05 – V01 (female) ① and chassis ground	Resistance	Min. 1 MΩ
			Wiring harness between V01 (female) ② and ground.	Resistance	Below 1 Ω
			Wiring harness between C03 (female) ㉙ - S14 (male) ② and ground.	Resistance	Min. 1 MΩ
			Wiring harness between S14 (male) ① - FB1 ③ and ground.	Resistance	Min. 1 MΩ
			Wiring harness between S14 (male) ① - R45 ① and ground.	Resistance	Min. 1 MΩ
			Wiring harness between R42 (female) ② - FB1 ③ and ground.	Resistance	Min. 1 MΩ
	3	Defective pump controller	a Prepare with starting switch OFF, then start engine and carry out troubleshooting.		
			C03	Voltage	
			Between ㉙ – chassis ground	20 – 30 V	

Circuit diagram related to swing holding brake solenoid of pump controller

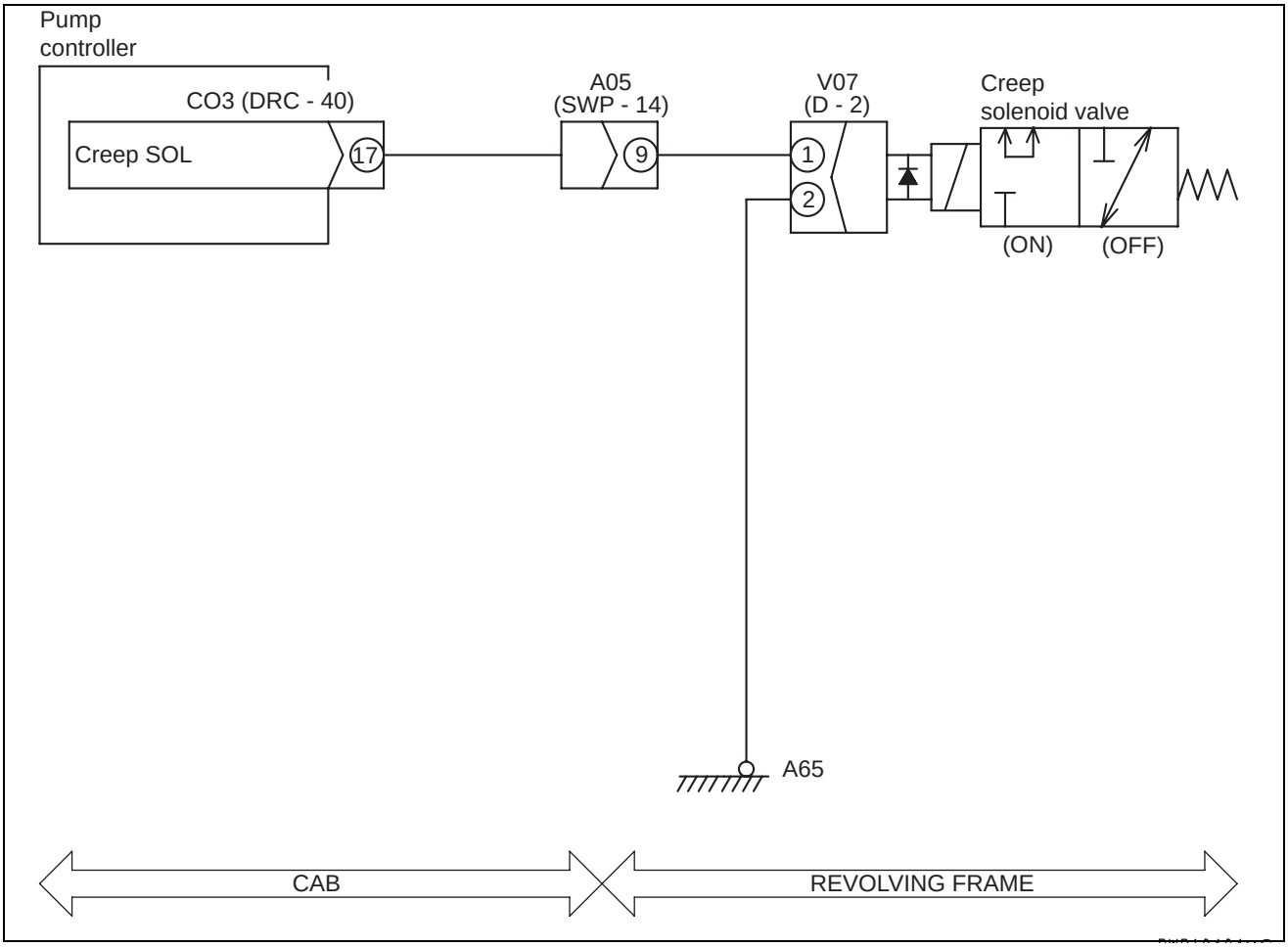


Failure Code [DW4MKA] (Disconnection in Creep solenoid)

User Code	Failure Code	Failure phenomenon	Disconnection in creep solenoid (in pump controller system)
E20	**DW4MKA**		
Failure content	• No current flows to the creep solenoid circuit, when power is supplied to the circuit.		
Response from controller	• None in particular (The solenoid does not function as there is current flowing to it) • When the failure cause disappears of itself, the machine operation returns to normal.		
Phenomenon occurring on machine	• The travel speed does not turn to Creep.		
Relative information	• Operation of the creep solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02300: Solenoid valve 1) • The solenoid detects disconnection, when power is ON. Hence be sure to check it with power ON after the repairs.		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting		
	1	Creep solenoid defective (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			V07 (male)	Resistance value	
			Between ① and ②	27 – 30 Ω at 20°C	
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Between wiring harness from C03 (female) ⑰ to A05 to V07 (female) ①	Resistance value	Below 1 Ω
			Wiring harness between V07 (female) ② and grounding	Resistance value	Below 1 Ω
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.		
			Between wiring harness from C03 (female) ⑰ to A05 to V07 (female) ①, or between wiring harness C03 (female) ⑰ and grounding	Voltage	Below 1 V

Electrical Circuit Diagram for Creep Solenoid in Pump Controller

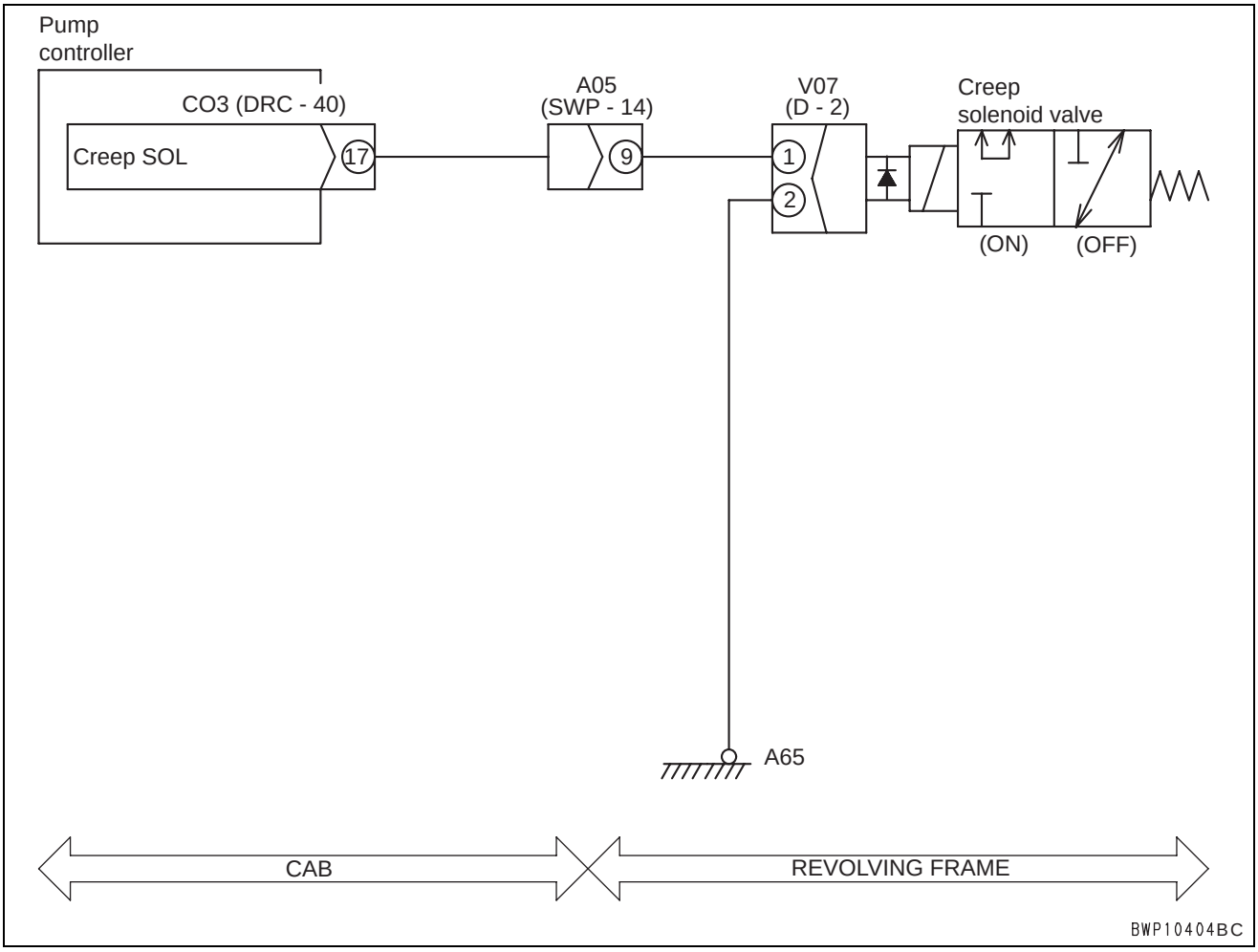


Failure Code [DW4MKB] (Short-circuiting in Creep solenoid)

User Code	Failure Code	Failure phenomenon	Short-circuit in creep solenoid (in pump controller system)
E20	**DW4MKB**		
Failure content	• Abnormal current flow to the creep solenoid, when power was supplied to the circuit.		
Response from controller	• Power supply to the creep solenoid circuit is switched OFF. • Even after the failure cause disappears of itself, the machine operation does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• The travel speed does not turn to Creep.		
Relative information	• Operation of the creep solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02300: Solenoid valve 1)		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Creep solenoid defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V07 (male)	Resistance value		
			Between ① and ②	27 – 30 Ω at 20°C		
			Between ① and grounding	Above 1 MΩ		
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ⑰ to A05 to V07 (female) ①.	Resistance value	Above 1 MΩ	
	3	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it running during the troubleshooting.			
			C03	Travel speed	Voltage	
			Between ⑰ and grounding	Lo	Below 1 V	
				Hi + Travel operation	20 – 30 V	

Electrical Circuit Diagram for Creep Solenoid in Pump Controller

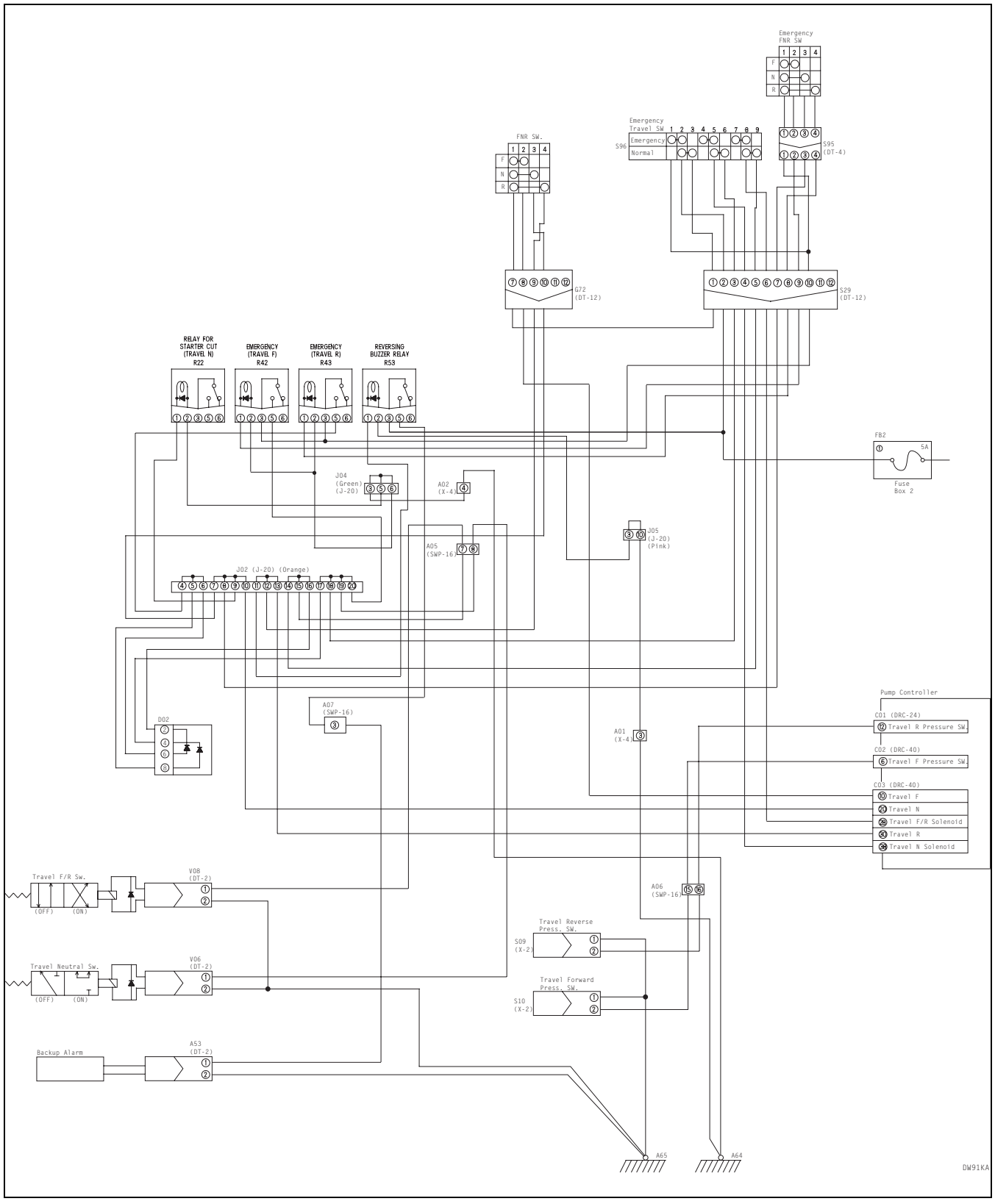


Failure Code [DW44KA] (Disconnection of Travel F/R solenoid)

User Code	Failure Code	Failure phenomenon	Disconnection in travel F/R solenoid (in pump controller system)
E20	**DW44KA**		
Failure content	• No current flows to the travel F/R solenoid circuit, when power is supplied to the circuit.		
Response from controller	• None in particular (The solenoid does not function as there is current flowing to it) • When the failure cause disappears of itself, the machine operation returns to normal.		
Phenomenon occurring on machine	• It is difficult to steer the machine while travelling.		
Relative information	• Operation of the travel F/R solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02301: Solenoid valve 2) • The solenoid detects disconnection, when power is ON. Hence be sure to check it with power ON after the repairs.		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Travel F/R solenoid defective (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V08 (male)	Resistance value		
			Between ① and ②	27 – 30 Ω at 20°C		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ㉘ - S29 ⑥ - S96 - S29 ⑤ - J02 ⑭ - J02 ⑮ - A05 ⑦ - V08 (female) ①.		Resistance value	Below 1 Ω
			Wiring harness between V08 (female) ② and grounding		Resistance value	Below 1 Ω
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness from C03 (female) ㉘ - S29 ⑥ - S96 - S29 ⑤ - J02 ⑭ - J02 ⑮ - A05 ⑦ - V08 (female) ①., or between wiring harness C03 (female) ㉘		Voltage	Below 1 V
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ㉘ and grounding	20 – 60 Ω		

Electrical Circuit Diagram for Travel F/R Solenoid

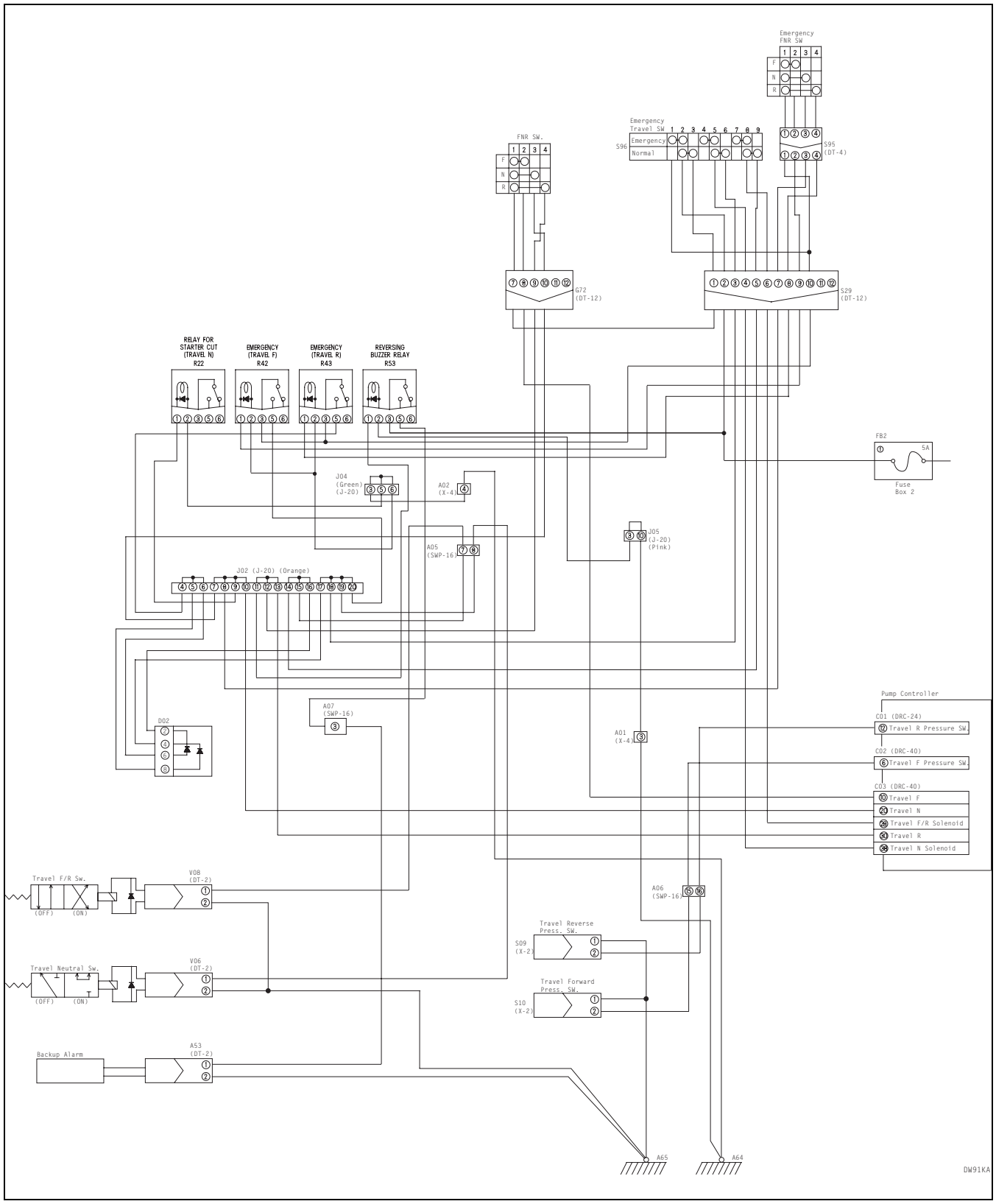


Failure Code [DW44KB] (Short-circuiting of Travel F/R solenoid)

User Code	Failure Code	Failure phenomenon	Short-circuiting in travel F/R solenoid (in pump controller system)
E20	**DW44KB**		
Failure content	• Abnormal current flow to the travel F/R solenoid circuit, when power was supplied to the circuit.		
Response from controller	• Power supply to the travel F/R solenoid circuit is switched OFF. • Even after the failure cause disappears of itself, the solenoid circuit does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• Machine will not reverse.		
Relative information	• Operation of the travel F/R solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02301: Solenoid valve 2)		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting		
	1	Swing and parking brake solenoid defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			V08 (male)	Resistance value	
			Between ① and ②	27 – 30 Ω at 20°C	
			Between ① and grounding	Above 1 MΩ	
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Between wiring harness from C03 (female) ㉘ - S29 ⑥ - S96 - S29 ⑤ - J02 ⑭ - J02 ⑮ - A05 ⑦ - V08 (female) ① and grounding	Resistance value	Above 1 MΩ

Electrical Circuit for Travel F/R Solenoid in Pump Controller

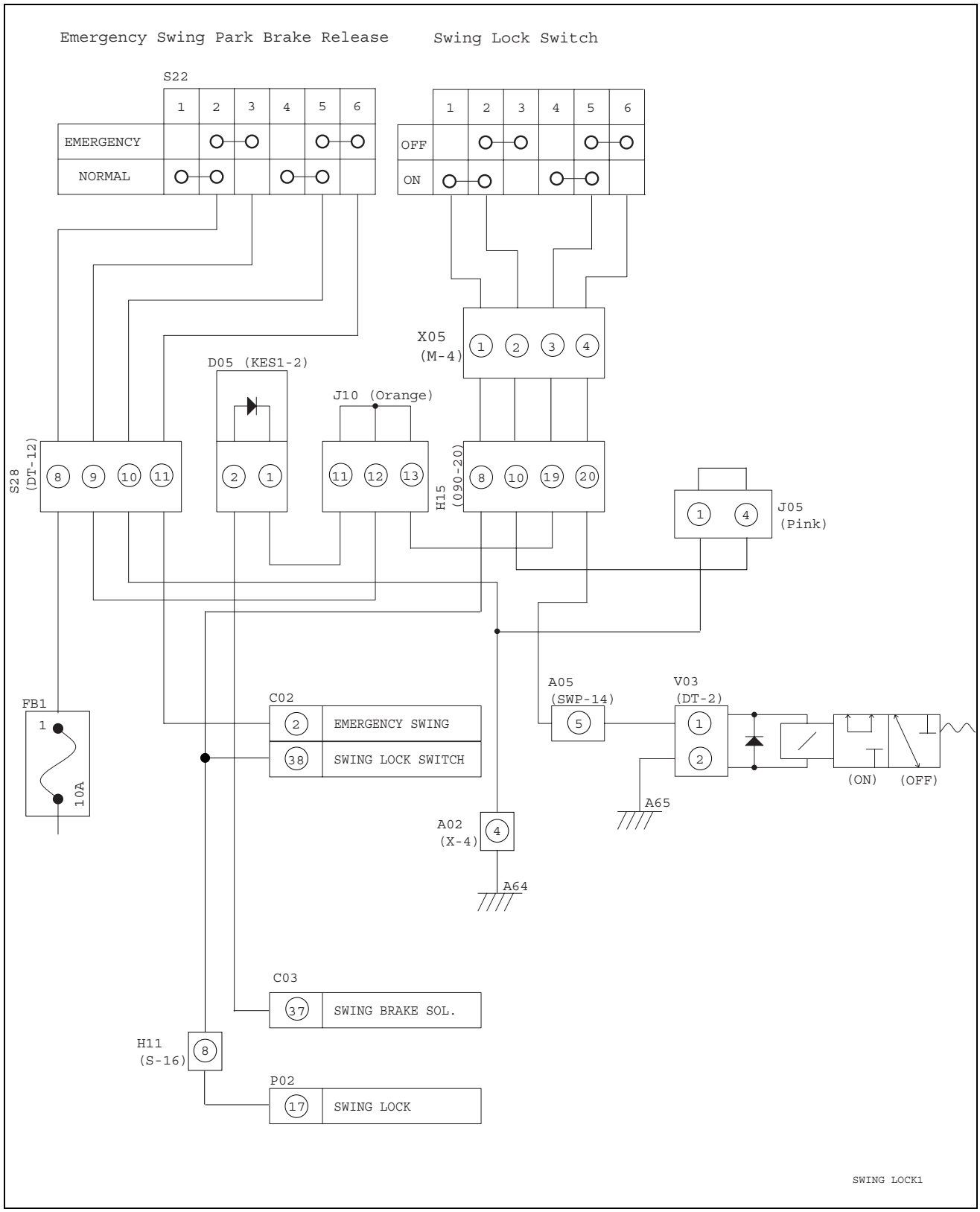


Failure Code [DW45KA] (Disconnection in Swing Parking Brake solenoid)

User Code	Failure Code	Failure phenomenon	Disconnection in swing and parking brake solenoid (in pump controller system)
E03	**DW45KA**		
Failure content	• No current flows to the swing parking brake solenoid circuit, when power is supplied to the circuit.		
Response from controller	• None in particular (The solenoid does not function as there is no current flowing to it) • When the failure cause disappears of itself, the machine operation returns to normal.		
Phenomenon occurring on machine	• The machine's upper structure does not swing.		
Relative information	• Operation of the swing parking brake solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02300: Solenoid valve 1) • If there is abnormality neither with the solenoid nor with wiring harnesses, the upper structure can swing by moving the emergency swing brake release switch to the FREE position. (In this case, however, the parking brake does not work, when stopping the machine) • While in troubleshooting, hold both the swing lock switch and the emergency swing release switch in the OFF position. • The solenoid detects disconnection, when power is ON. Hence be sure to check it with power ON after the repairs. (For how to turn power ON or OFF, refer to the troubleshooting under Failure Code [DW45KB])		

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Swing parking brake solenoid defective (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V03 (male)		Resistance value	
			Between ① and ②		27 – 30 Ω at 20°C	
	2	Swing lock switch defective (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			X05 (female)	Swing lock switch	Resistance value	
			Between ③ and ④	OFF	Below 1 Ω	
				ON	Above 1 MΩ	
	3	Defective assembled-type diode D05 (Internal Disconnection)	• Prepare with starting switch OFF, then carry out troubleshooting with turning starting switch.			
			D05 (male)	Digital circuit tester	Continuity	
			Between ① and ②.	Diode mode	There is continuity	
	4	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between C03 (female) ㊲ and D05 (female) ②		Resistance value	Below 1 Ω
			Between wiring harness from D05 (female) ① to J10 to H15 to X05 (female) ③		Resistance value	Below 1 Ω
			Between wiring harness from X05 (female) ④ to H15 to A05 to V03 (female) ①		Resistance value	Below 1 Ω
			Wiring harness between V03 (female) ② and grounding		Resistance value	Below 1 Ω
	5	Short-circuiting of Wiring harness (Contact with 24V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness C03 (female) ㊲ and D05 (female) ② and grounding		Voltage	Below 1 V
	6	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Disconnect D05 and connect pins ① and ② of the female side.	Resistance value	
			Between ㊲ and grounding		20 – 60 Ω	

Electrical Circuit Diagram for Swing and Parking Brake Solenoid in Pump Controller

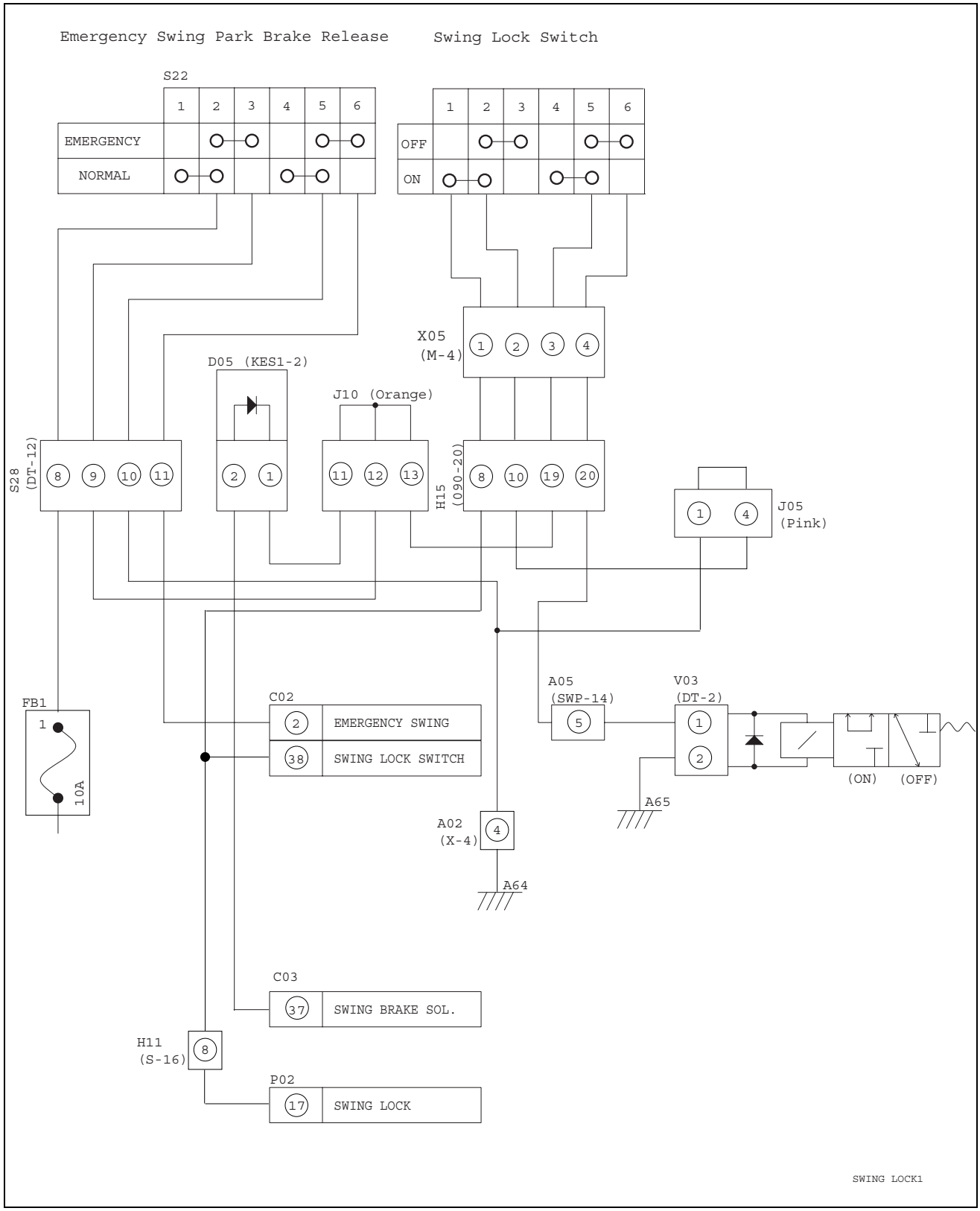


Failure code [DW45KB] Swing Brake Sol. S/C

Action code	Failure code	Trouble	Swing holding brake solenoid short (Pump controller system)
E03	**DW45KB**		
Contents of trouble	• Abnormal current flowed at output to swing holding brake solenoid circuit.		
Action of controller	• Turns output to swing holding brake solenoid circuit OFF. • Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine	• Machine cannot swing.		
Related information	• Operating condition of swing holding brake solenoid (ON/OFF) can be checked with monitoring function. (Code 02300: Solenoid valve 1) • If solenoid and wiring harness are normal, operator can swing machine by setting emergency swing brake release switch in release position (Swing holding brake does not work, however, when machine stops).		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective swing holding brake solenoid (Internal short circuit or ground fault)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			V03 (male)	Resistance		
			Between ① – ②	20 – 60 Ω		
			Between ① – chassis ground	Min. 1 MΩ		
	2	Defective assembled-type diode D01 (Internal short circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			D05 (male)	Resistance		
			Between ① – ②	Min. 1 MΩ		
	3	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between C03 (female) ㊲ – D01 – J10 – H15 – X05 (male) ③ and chassis ground	Resistance	Min. 1 MΩ	
			Wiring harness between V03 (female) ① – A05 – H15 – X05 (male) ④ and chassis ground	Resistance	Min. 1 MΩ	
	4	Defective pump controller	a Prepare with starting switch OFF, then start engine and carry out troubleshooting.			
			C03	Swing lever	Voltage	
			Between ㊲ – chassis ground	At neutral	Max. 1 V	
				At swing	20 – 30 V	

Circuit diagram related to swing holding brake solenoid of pump controller

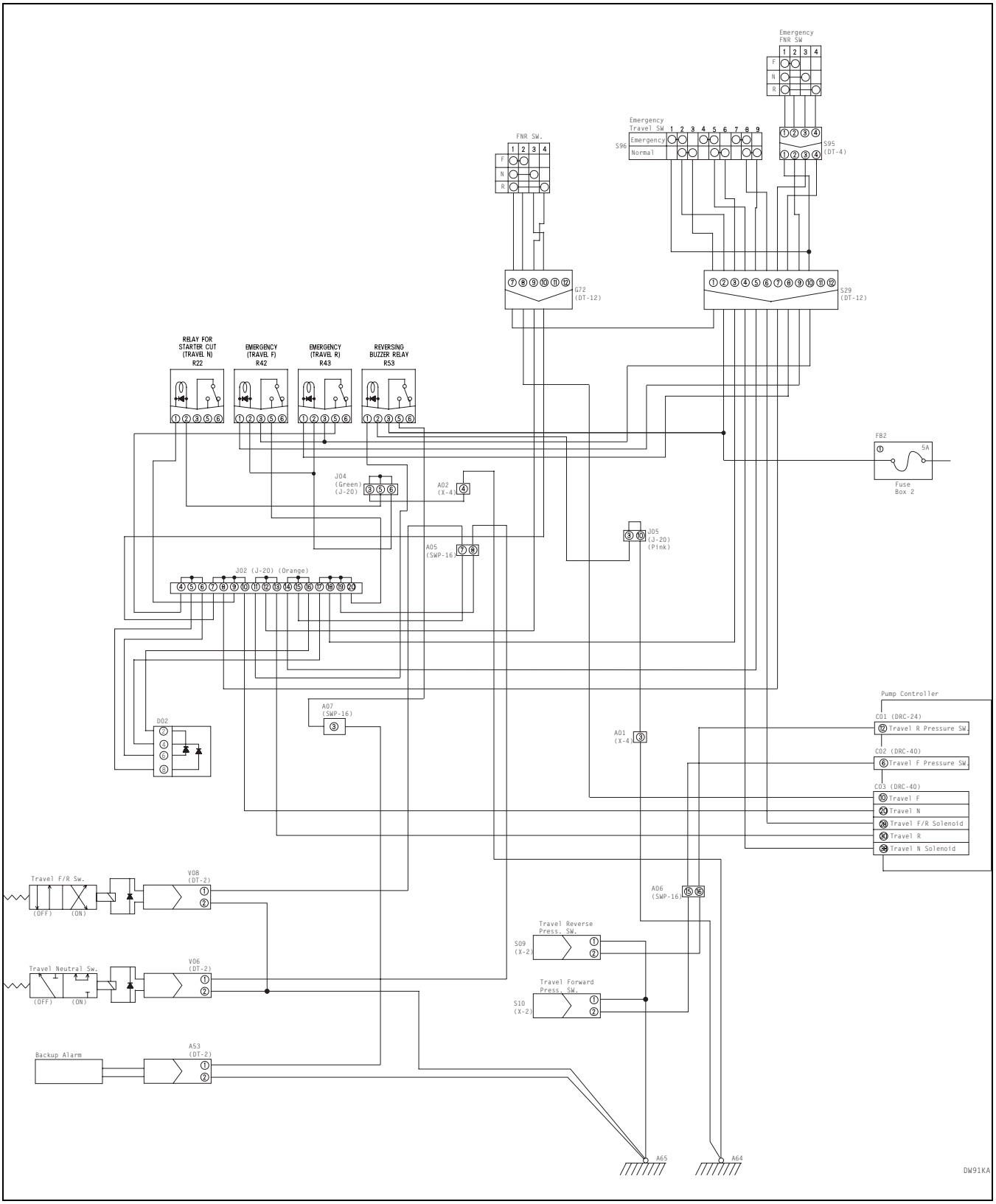


Failure Code [DW91KA] (Disconnection in Travel Neutral solenoid)

User Code	Failure Code	Failure phenomenon	Disconnection in travel neutral solenoid (in pump controller system)
E20	**DW91KA**		
Failure content	• No current flows to the travel neutral solenoid circuit, when power is supplied to the circuit.		
Response from controller	• None in particular (The solenoid does not function as there is current flowing to it) • When the failure cause disappears of itself, the machine operation returns to normal.		
Phenomenon occurring on machine	• Machine will not travel.		
Relative information	• Operation of the travel neutral solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02301: Solenoid valve 2) • The solenoid detects disconnection, when power is ON. Hence be sure to check it with power ON after the repairs. (For how to turn power ON or OFF, refer to the troubleshooting under Failure Code [DW91KB])		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Travel neutral solenoid defective (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V06 (male)	Resistance value		
			Between ① and ②	27 – 30 Ω at 20°C		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ㊳ to S29 ④ to S96 to S29 ③ to J02 to A05 to V06 (female) ①.	Resistance value	Below 1 Ω	
			Wiring harness between V02 (female) ② and grounding.	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness from C03 (female) ㊳ to S29 ④ to S96 to S29 ③ to J02 to A05 to V06 (female) ①, or between wiring harness C03 (female) ㊳ and grounding.	Voltage	Below 1 V	
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ㊳ and grounding	20 – 60 Ω		

Electrical Circuit Diagram for Travel Neutral Solenoid in Pump Controller

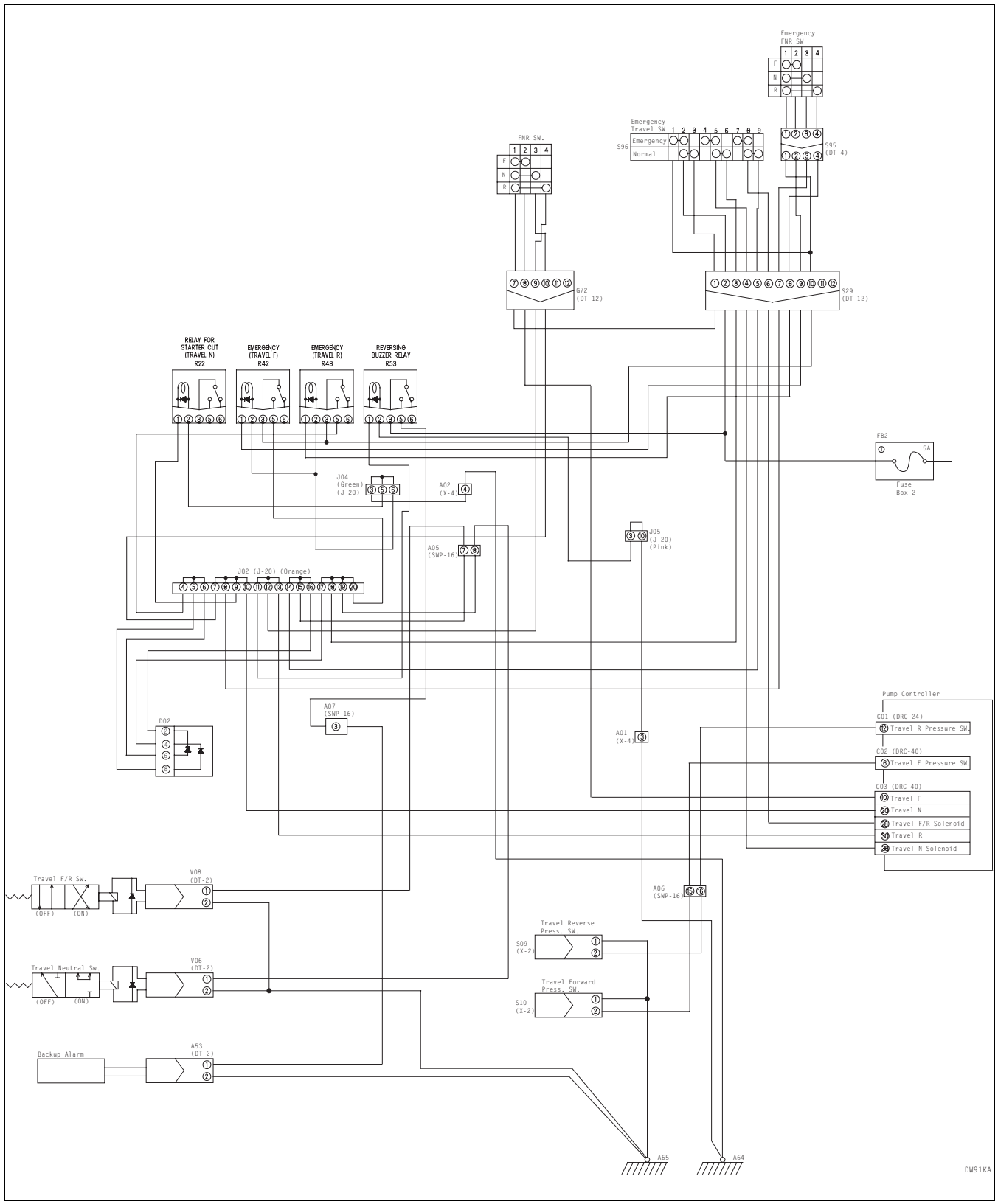


Failure Code [DW91KB] (Short-circuiting in Travel Neutral Solenoid)

User Code	Failure Code	Failure phenomenon	Short-circuiting in travel neutral solenoid (in pump controller system)
E20	**DW91KB**		
Failure content	• Abnormal current flow to the travel neutral solenoid circuit, when power was supplied to the circuit.		
Response from controller	• Power supply to the travel neutral solenoid circuit is switched OFF. • Even if the failure cause disappears of itself, the solenoid circuit does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• Machine will not drive.		
Relative information	• Operation of the travel neutral solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02301: Solenoid valve 2)		

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Travel neutral solenoid defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V06 (male)	Resistance value		
			Between ① and ②	27 – 30 Ω at 20°C		
			Between ① and grounding	Above 1 MΩ		
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ㊳ to S29 ④ to S96 to S29 ③ to J02 to A05 to V06 (Female) ① and grounding.		Resistance value	Above 1 MΩ

Electrical Circuit for Travel Neutral Solenoid in Pump Controller

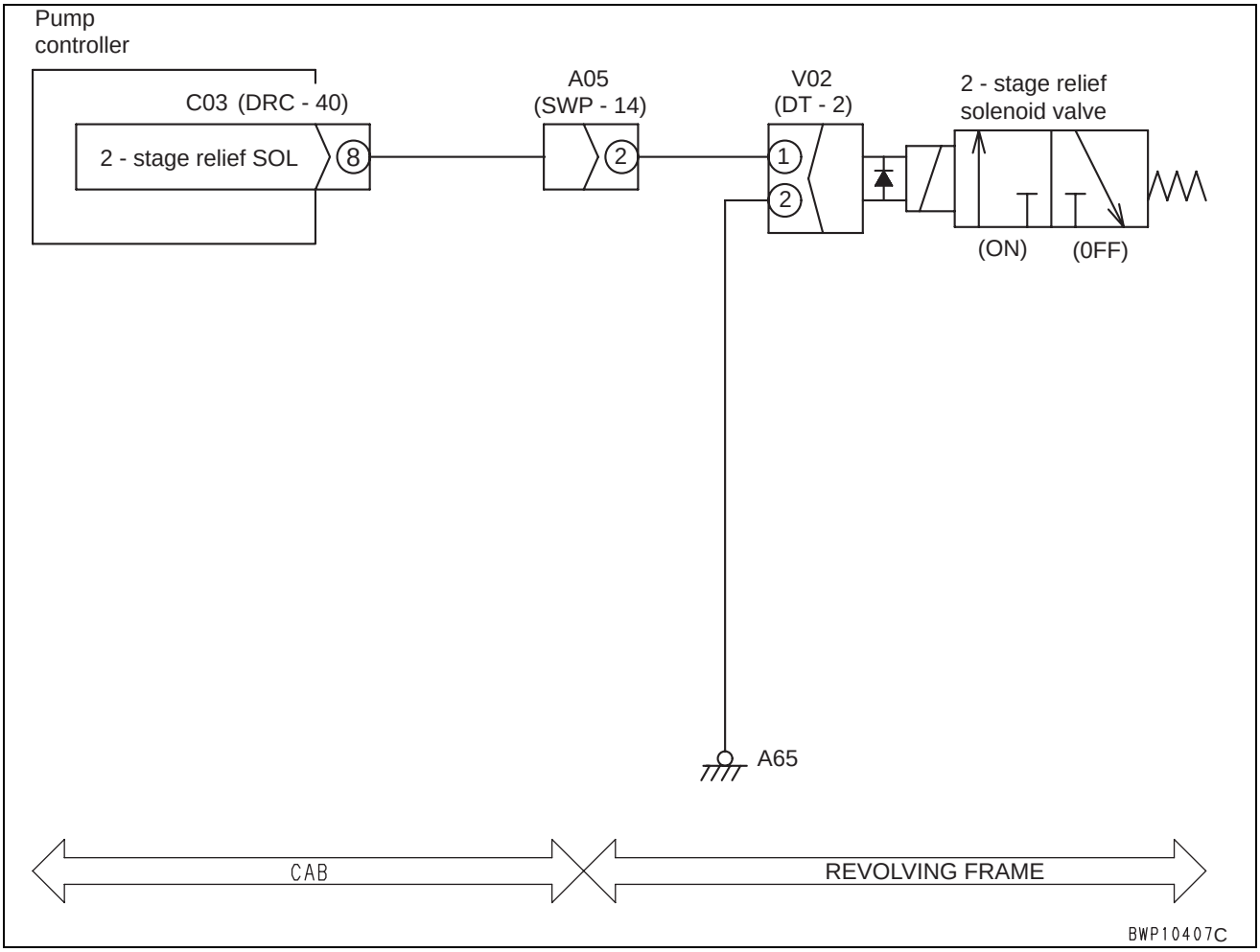


Failure Code [DWK0KA] (Disconnection in 2-stage Relief solenoid)

User Code	Failure Code	Failure phenomenon	Disconnection in 2-stage relief solenoid (in pump controller system)
—	**DWK0KA**		
Failure content	• No current flows to the 2-stage relief solenoid circuit, when power is supplied to the circuit.		
Response from controller	• None in particular (The solenoid does not function as there is no current flowing to it) • When the failure cause disappears of itself, the machine operation returns to normal.		
Phenomenon occurring on machine	• The one-touch power max. switch does not work.		
Relative information	• Operation of the 2-stage relief solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02300: Solenoid valve 1) • The solenoid detects disconnection, when power is ON. Hence be sure to check it with power ON after the repairs.		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	2-stage relief solenoid defective (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V02 (male)	Resistance value		
			Between ① and ②	27 – 30 Ω at 20°C		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ⑧ to A05 to V02 (female) ①	Resistance value	Below 1 Ω	
			Wiring harness between V02 (female) ② and grounding	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness from C03 (female) ⑧ to A05 to V06 (female) ①.	Voltage	Below 1 V	
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ⑧ and grounding	20 – 60 Ω		

Electrical Circuit Diagram for 2-stage Relief Solenoid in Pump Controller

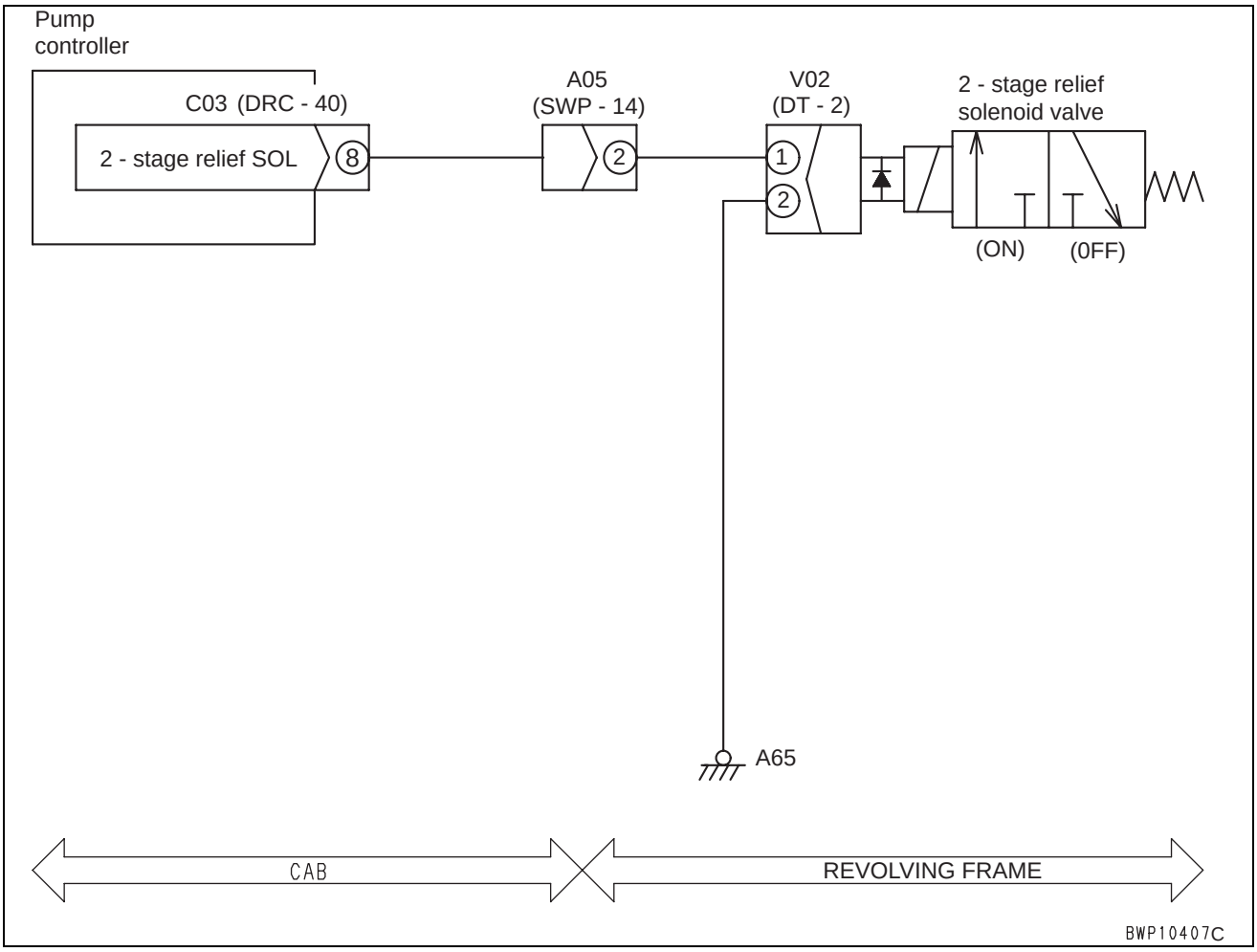


Failure Code [DWK0KB] (Short-circuiting in 2-Stage Relief Solenoid)

User Code	Failure Code	Failure phenomenon	Short-circuiting in 2-stage relief solenoid (in pump controller system)
—	**DWK0KB**		
Failure content	• Abnormal current flow to the 2-stage relief solenoid circuit, when power was supplied to the circuit.		
Response from controller	• Power supply to the 2-stage relief solenoid circuit is switched OFF. • Even after the failure cause disappears of itself, the machine operation does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• The one-touch power max. switch does not work.		
Relative information	• Operation of the 2-stage relief solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02300: Solenoid valve 1)		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	2-stage relief solenoid defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V02 (male)	Resistance value		
			Between ① and ②	27 – 30 Ω at 20°C		
			Between ① and grounding	Above 1 MΩ		
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ⑧ to A05 to V02 (female) ①.	Resistance value	Above 1 MΩ	
	3	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C03	Working mode	Voltage	
			Between ⑧ and grounding	Other than L mode	Below 1 V	
				L mode	20 – 30 V	

Electric Circuit Diagram for 2-stage Relief Solenoid in Pump Controller

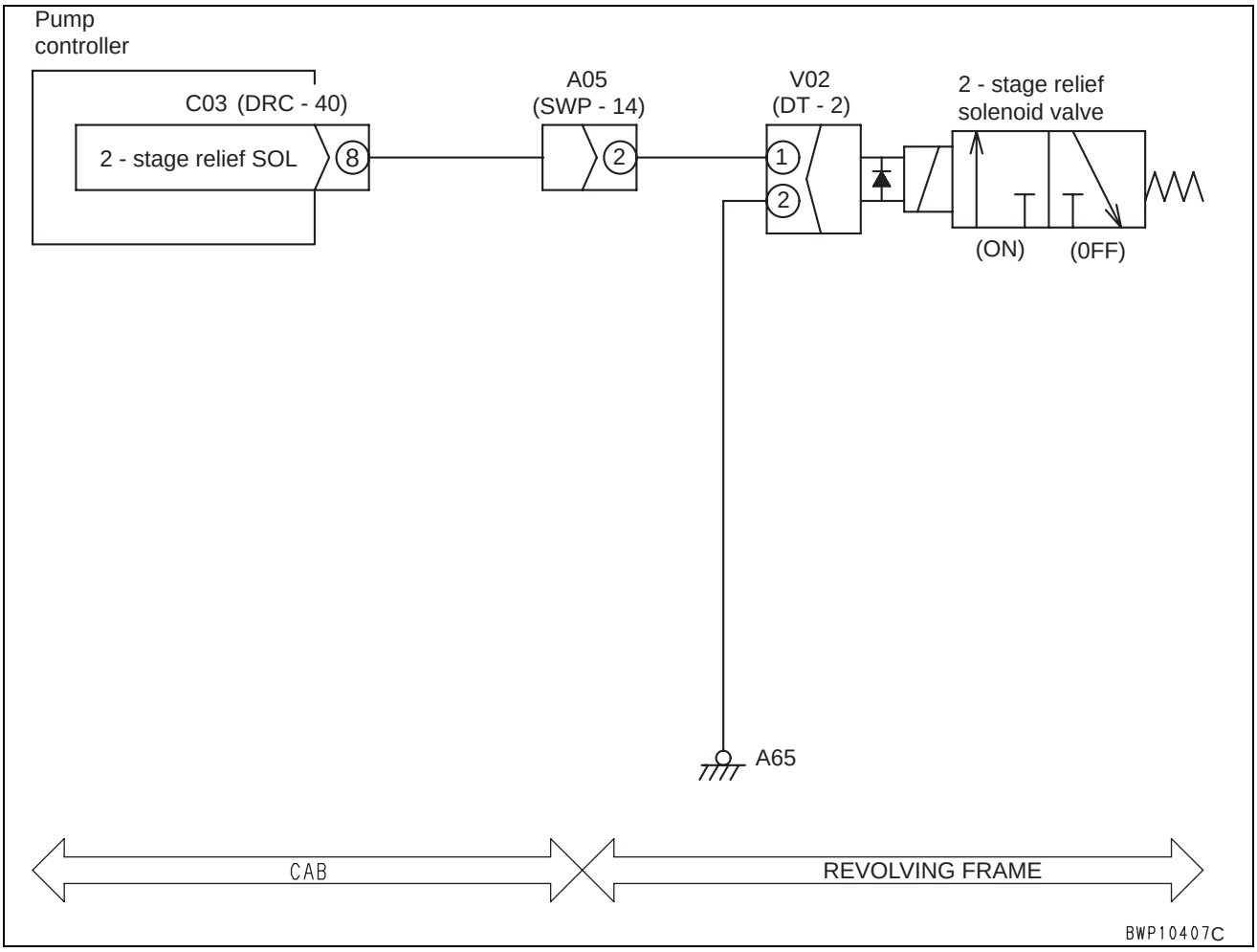


Failure Code [DWK2KA] (Disconnection in 2-stage Back Pressure solenoid)

User Code	Failure Code	Failure phenomenon	Disconnection in 2-stage back pressure solenoid (in pump controller system)
—	**DWK2KA**		
Failure content	• No current flows to the 2-stage back pressure solenoid circuit, when power is supplied to the circuit.		
Response from controller	• None in particular (The solenoid does not function as there is current flowing to it) • When the failure cause disappears of itself, the machine operation returns to normal.		
Phenomenon occurring on machine	• Travel may be uncomfortable due to excessive noise from travel motor.		
Relative information	• Operation of the 2-stage back pressure solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02301: Solenoid valve 2) • The solenoid detects disconnection, when power is ON. Hence be sure to check it with power ON after the repairs. (Operation of the 2 stage back pressure solenoid [ON or OFF] can be checked in the monitoring function [code 02301: solenoid valve 2]).		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	2-stage back pressure solenoid defective (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V15 (male)	Resistance value		
			Between ① and ②	27 – 30 Ω at 20°C		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ㊱ to A05 to V15 (female) ①	Resistance value	Below 1 Ω	
			Wiring harness between V15 (female) ② and grounding	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness from C03 (female) ㊱ to A05 to V15 (female) ①, or between wiring harness C03 (female) ㊱ and grounding	Voltage	Below 1 V	
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ㊱ and grounding	20 – 60 Ω		

Electrical Circuit Diagram for 2-stage Back Pressure Solenoid in Pump Controller

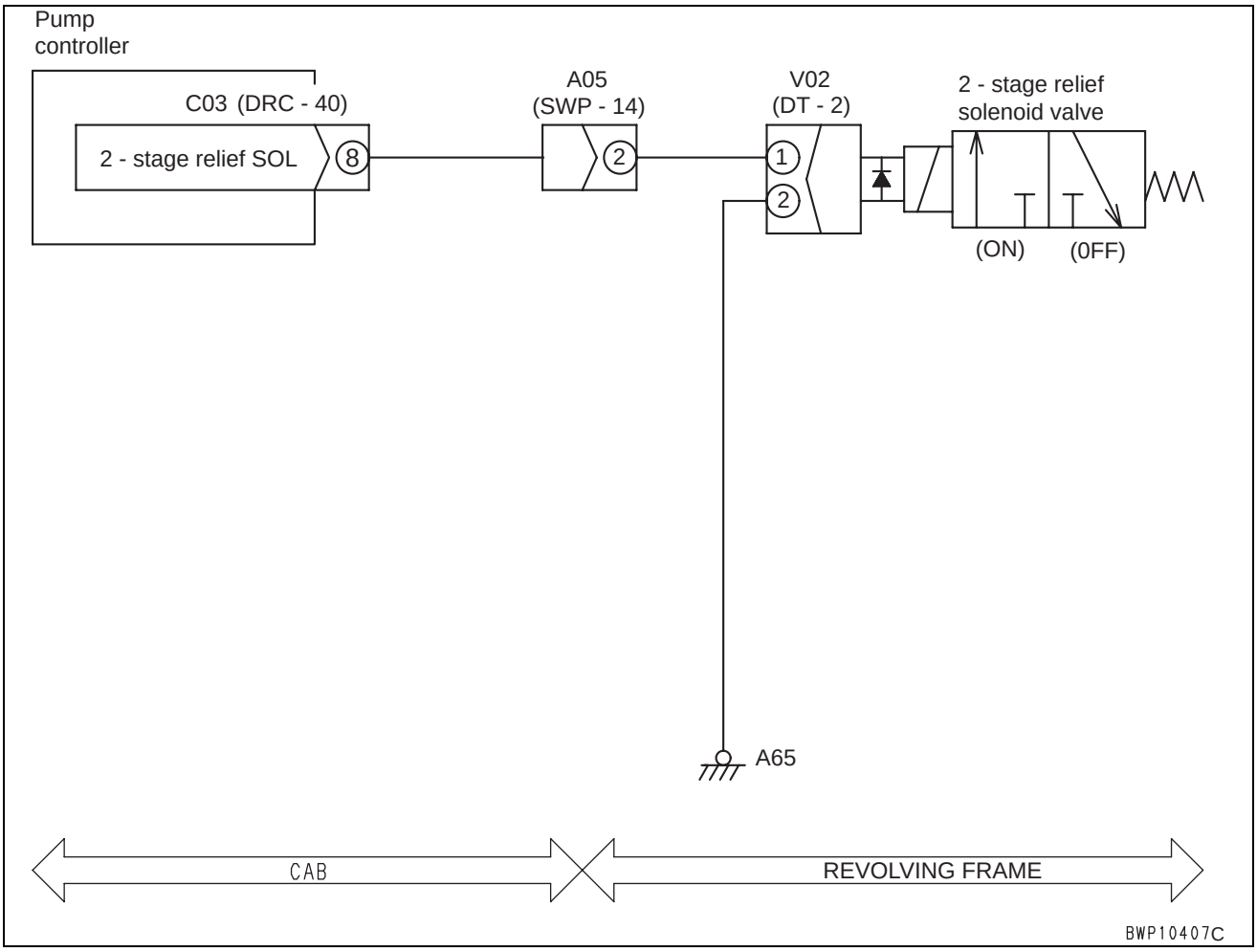


Failure Code [DWK2KB] (Short circuiting in 2-stage back pressure solenoid)

User Code	Failure Code	Failure phenomenon	Short circuit of 2-stage back pressure solenoid (in pump controller system)
—	**DWK2KB**		
Failure content	• Abnormal current flew to the 2-stage relief solenoid circuit, when power was supplied to the circuit.		
Response from controller	• Power supply to the 2-stage relief solenoid circuit is switched OFF. • Even after the failure cause disappears of itself, the machine operation does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• Travel may be uncomfortable due to excessive noise from travel motor.		
Relative information	• Operation of the 2-stage back pressure solenoid (ON or OFF) can be checked in the monitoring function. (Code No. 02301: Solenoid valve 2)		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	2-stage back pressure solenoid defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V15 (male)	Resistance value		
			Between ① and ②	27 – 30 Ω at 20°C		
			Between ① and grounding	Above 1 MΩ		
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ㊱ to A05 to V15 (female) ①.	Resistance value	Above 1 MΩ	
	3	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C03	Working mode	Voltage	
			Between ㊱ and grounding	Other than L mode	Below 1 V	
				L mode	20 – 30 V	

Electrical Circuit Diagram for 2-Stage Back Pressure Solenoid in Pump Controller

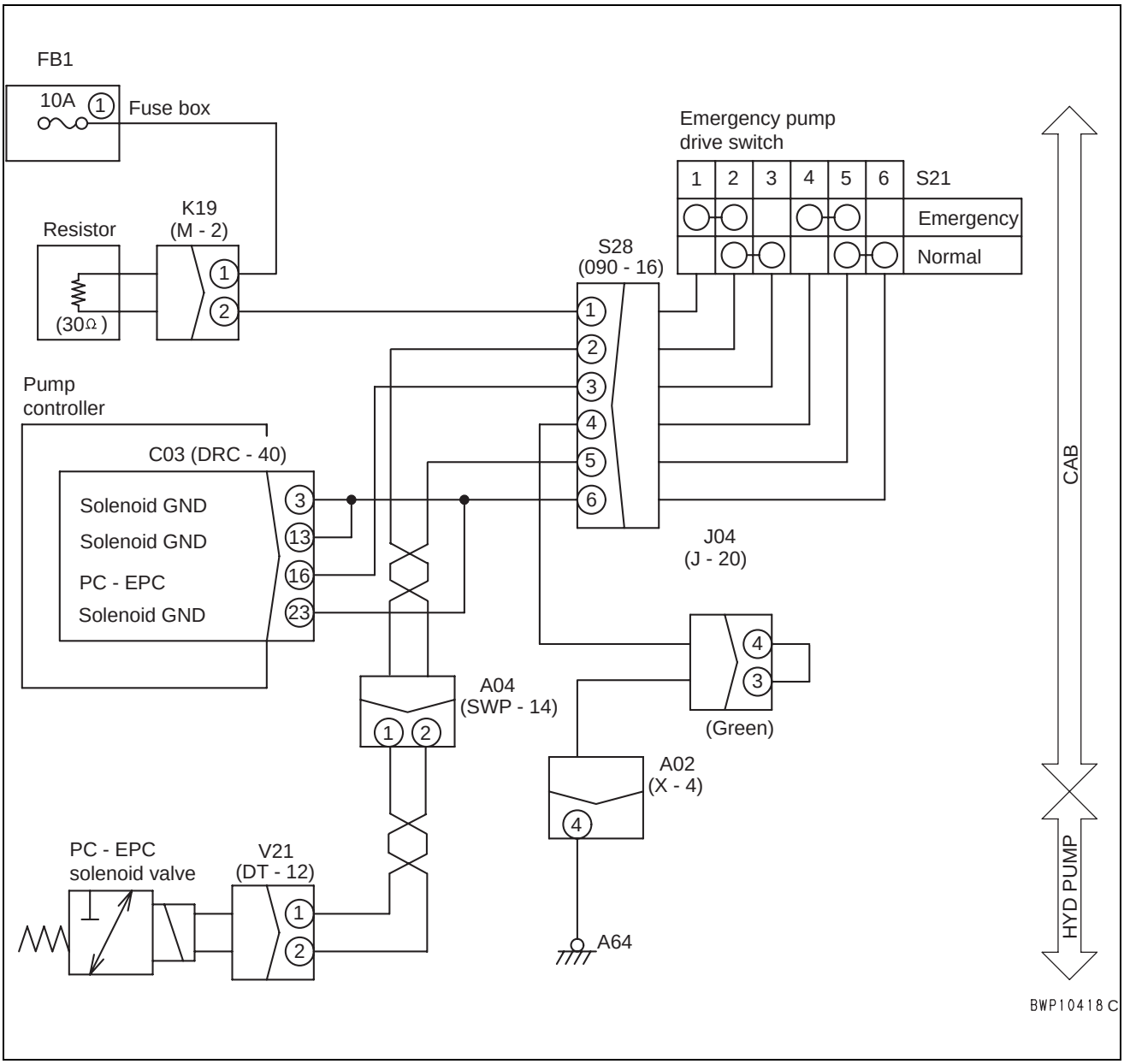


Failure Code [DXA0KA] (Disconnection in PC-EPC solenoid system)

User Code	Failure Code	Failure phenomenon	Disconnection in PC-EPC solenoid (in pump controller system)
E02	**DXA0KA**		
Failure content	• No current flows to the PC-EPC solenoid circuit.		
Response from controller	• None in particular (The solenoid does not function as there is no current flowing to it) • When the failure cause disappears of itself, the current returns to normal.		
Phenomenon occurring on machine	• As load to the pump increases, the engine rotation drops sharply and sometimes the engine stalls.		
Relative information	• Output to PC-EPC solenoid (ampere) can be confirmed in the monitor function. (Code No. 01300: PC-EPC solenoid current) • If there is no abnormality with the solenoid or any of the wiring harnesses, the machine can be operated in a working mode equivalent to E mode by turning the emergency driving switch ON. (At that time the monitor panel continues to display Failure Code No. [DXA0KA], but this is not abnormal)		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	PC-EPC solenoid defective (Internal short-circuiting)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V21 (male)		Resistance value	
			Between ① and ②		7 – 14 Ω	
	2	Emergency pump driving switch defective (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			S25	Switch	Resistance value	
			Between ② and ③	OFF	Below 1 Ω	
				ON	Above 1 MΩ	
			Between ⑤ and ⑥	OFF	Below 1 Ω	
				ON	Above 1 MΩ	
	3	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between C03 (female) ⑯ and S25 ③		Resistance value	Below 1 Ω
			Wiring harness between S25 ② and V21 (female) ①		Resistance value	Below 1 Ω
			Wiring harness between C03 (female) ③, ⑬, ㉓ and S25 ⑥		Resistance value	Below 1 Ω
			Wiring harness between S25 ⑤ and V21 (female) ②		Resistance value	Below 1 Ω
	4	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness C03 (female) ⑯ and S25 ③ and grounding		Voltage	Below 1 V
			Between wiring harness S25 ② and V21 (female) ① and grounding		Voltage	Below 1 V
	5	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)		Resistance value	
			Between ⑯ and ③, ⑬, ㉓.		7 – 14 Ω	

Electrical Circuit Diagram for PC-EPC Solenoid in Pump Controller

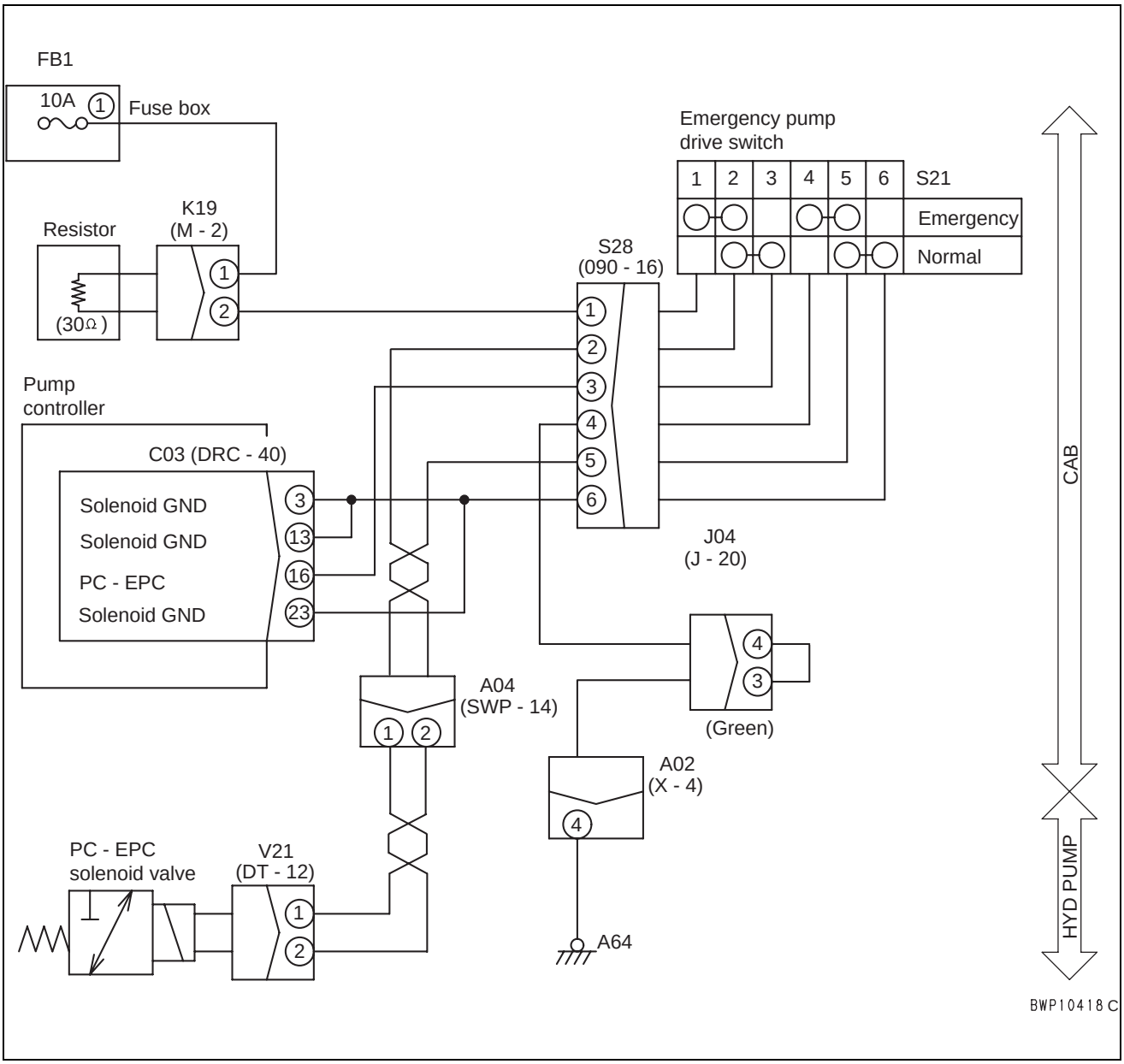


Failure Code [DXA0KB] (Short-circuiting in PC-EPC solenoid)

User Code	Failure Code	Failure phenomenon	Disconnection in PC-EPC solenoid (in pump controller system)
E02	**DXA0KB**		
Failure content	• Abnormal current flow to the PC-EPC solenoid circuit.		
Response from controller	• The controller reduces the output to the PC-EPC solenoid circuit to 0. • Even if the failure cause disappears, the current does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• As load to the pump increases, the engine rotation drops sharply and sometimes the engine stalls.		
Relative information	• Output to PC-EPC solenoid (ampere) can be confirmed in the monitor function. (Code No. 01300: PC-EPC solenoid current) • If there is no abnormality with the solenoid or any of the wiring harnesses, the machine can be operated in a working mode equivalent to E mode by turning the emergency drive switch ON. (At that time the monitor panel continues to display failure code [DXA0KB], but this is not abnormal) • Turn the emergency driving switch ON during the troubleshooting.		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	PC-EPC solenoid defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V21 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
			Between ① and grounding	Above 1 MΩ		
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ⑯ to S25 to A04 to V21 (female) ① and grounding	Resistance value	Above 1 MΩ	
	3	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ⑯ and ③ ⑬ ㉓	7 – 14 Ω		
			Between ⑯ and grounding	Above 1 MΩ		

Electrical Circuit Diagram for PC-EPC Solenoid in Pump Controller

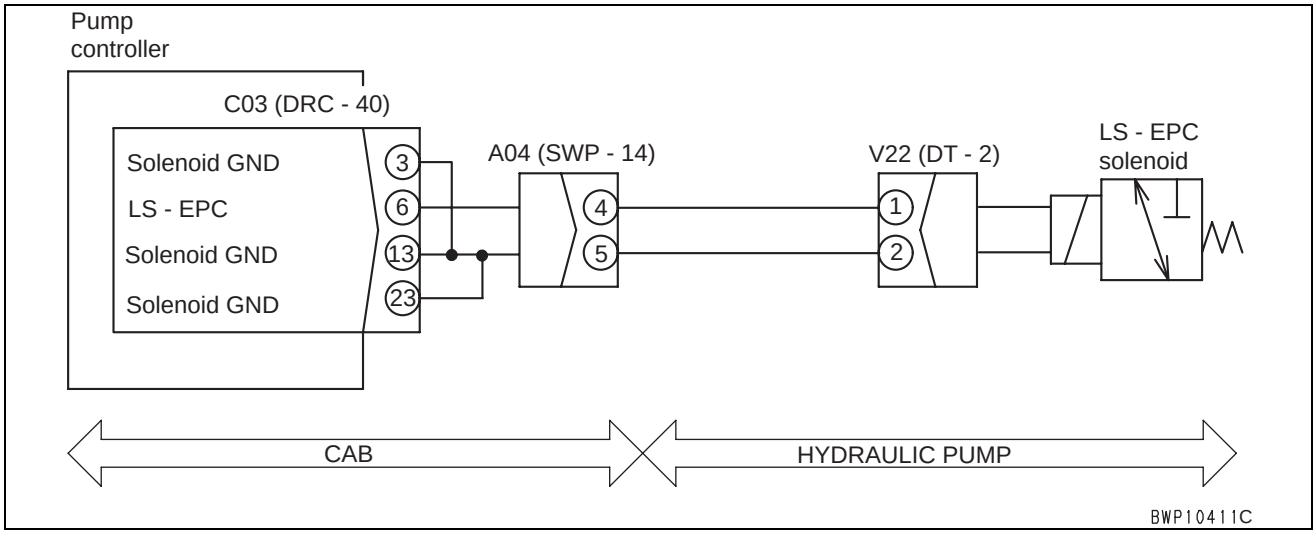


Failure Code [DXE0KA] (Disconnection in LS-EPC solenoid system)

User Code	Failure Code	Failure phenomenon	Disconnection in LS-EPC solenoid (in pump controller system)
—	**DXE0KA**		
Failure content	• No current flows to the LS-EPC solenoid circuit.		
Response from controller	• None in particular (The solenoid does not function as there is no current flowing to it) • When the failure cause disappears of itself, the machine operation returns to normal.		
Phenomenon occurring on machine	• The travel speed is slow at Lo. • In L mode, speeds of the work equipment and swing are too fast.		
Relative information	• Output to LS-EPC solenoid (ampere) can be confirmed in the monitor function. (Code No. 01500: LS-EPC solenoid current)		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	LS-EPC solenoid defective (Internal short-circuiting)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V22 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness C03 (female) ⑥ and V22 (female) ① and grounding	Resistance value	Below 1 Ω	
			Wiring harness between C03 (female) ③ ⑬ ㉓ and V22 (female) ②	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness C03 (female) ⑥ and V22 (female) ① and grounding	Voltage	Below 1 V	
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ⑥ and ③ ⑬ ㉓	7 – 14 Ω		

Electrical Circuit Diagram for LS-EPC Solenoid in Pump Controller

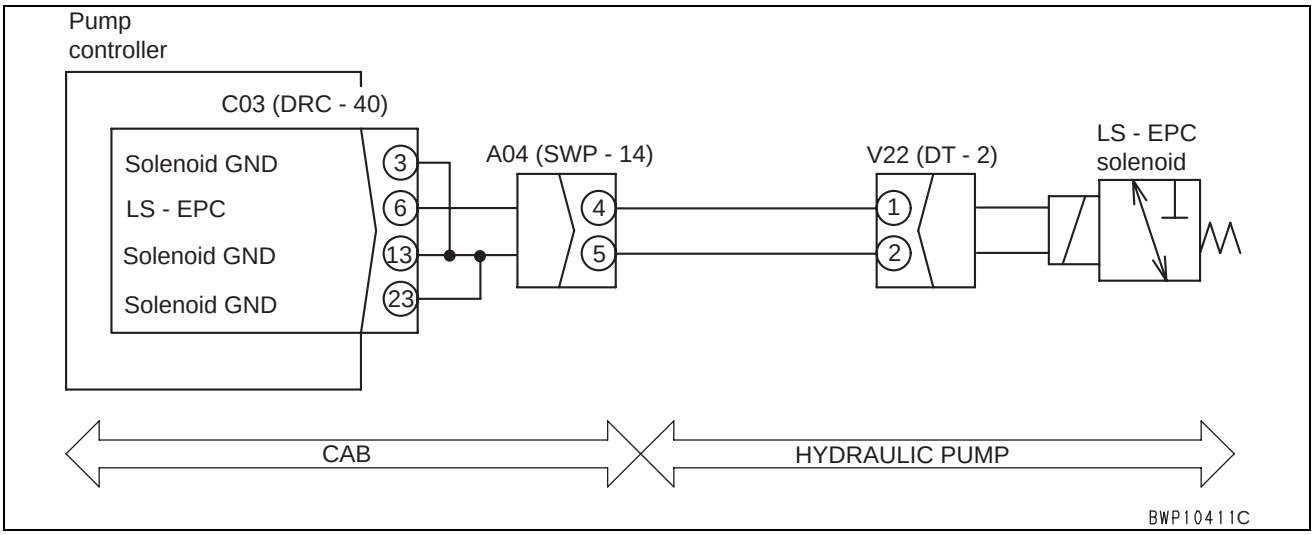


Failure Code [DXE0KB] (Short-circuiting in LS-EPC solenoid)

User Code	Failure Code	Failure phenomenon	Disconnection in LS-EPC solenoid (in pump controller system)
—	**DXE0KB**		
Failure content	• Abnormal current flow to the LS-EPC solenoid circuit.		
Response from controller	• The controller reduces the output to the LS-EPC solenoid circuit to 0. • Even if the failure cause disappears, the current does not return to normal, unless the engine starting switch is once turned OFF.		
Phenomenon occurring on machine	• The travel speed is slow at Lo. • In L mode, speeds of the work equipment and swing are too fast.		
Relative information	• Output to LS-EPC solenoid (ampere) can be confirmed in the monitor function. (Code No. 01500: LS-EPC solenoid current)		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	LS-EPC solenoid defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V22 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
			Between ① and grounding	Above 1 MΩ		
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness C03 (female) ⑥ and V22 (female) ① and grounding	Resistance value	Above 1 MΩ	
	3	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ⑥ and ③ ⑬ ㉓	7 – 14 Ω		
			Between ⑥ and grounding	Above 1 MΩ		

Electrical Circuit Diagram for LS-EPC Solenoid in Pump Controller



Failure Code [DXE4KA] (Disconnection in attachment oil flow rate adjusting EPC)

User Code	Failure Code	Failure phenomenon	Disconnection in attachment oil flow rate adjusting EPC (in pump controller system)
—	**DXE4KA**		

1st Service EPC Solenoid (Left Hand)

Failure content	• No current flew to the attachment oil flow rate adjusting EPC solenoid circuit.
Response from controller	• None in particular (The solenoid does not work, as there is no current flowing to it) • If the failure cause disappears, the EPC solenoid circuit returns to normal of itself.
Phenomenon occurring on machine	• The attachments do not move.
Relative information	• It can be confirmed in the monitor function how power (ampere) is supplied to the attachment oil flow rate adjusting EPC solenoid circuit. (Code No. 01700: Service solenoid current)

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Attachment oil flow rate adjusting EPC defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V23 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness C03 (female) ⑤ and V23 (male) ① and grounding		Resistance value	Below 1 Ω
			Between wiring harness C03 (female) ③ ⑬ ㉓ and V23 (male) ② and grounding		Resistance value	Below 1 Ω
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness C03 (female) ⑤ and V23 (female) ① and grounding		Voltage	Below 1 V
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ⑤ and ③, ⑬, ㉓.	7 – 14 Ω		

1st Service EPC Solenoid (Right Hand)

Failure content	• No current flew to the attachment oil flow rate adjusting EPC solenoid circuit.
Response from controller	• None in particular (The solenoid does not work, as there is no current flowing to it) • If the failure cause disappears, the EPC solenoid circuit returns to normal of itself.
Phenomenon occurring on machine	• The attachments do not move.
Relative information	• It can be confirmed in the monitor function how power (ampere) is supplied to the attachment oil flow rate adjusting EPC solenoid circuit. (Code No. 01701: Service solenoid current)

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Attachment oil flow rate adjusting EPC defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V24 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness C03 (female) ⑮ and V24 (male) ① and grounding	Resistance value	Below 1 Ω	
			Between wiring harness C03 (female) ③ ⑬ ㉓ and V24 (male) ② and grounding	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness C03 (female) ⑮ and V24 (female) ① and grounding	Voltage	Below 1 V	
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ⑮ and ③, ⑬, ㉓.	7 – 14 Ω		

2nd Service EPC Solenoid (Left Hand)

Failure content	• No current flew to the attachment oil flow rate adjusting EPC solenoid circuit.
Response from controller	• None in particular (The solenoid does not work, as there is no current flowing to it) • If the failure cause disappears, the EPC solenoid circuit returns to normal of itself.
Phenomenon occurring on machine	• The attachments do not move.
Relative information	• It can be confirmed in the monitor function how power (ampere) is supplied to the attachment oil flow rate adjusting EPC solenoid circuit. (Code No. 01702: Service solenoid current)

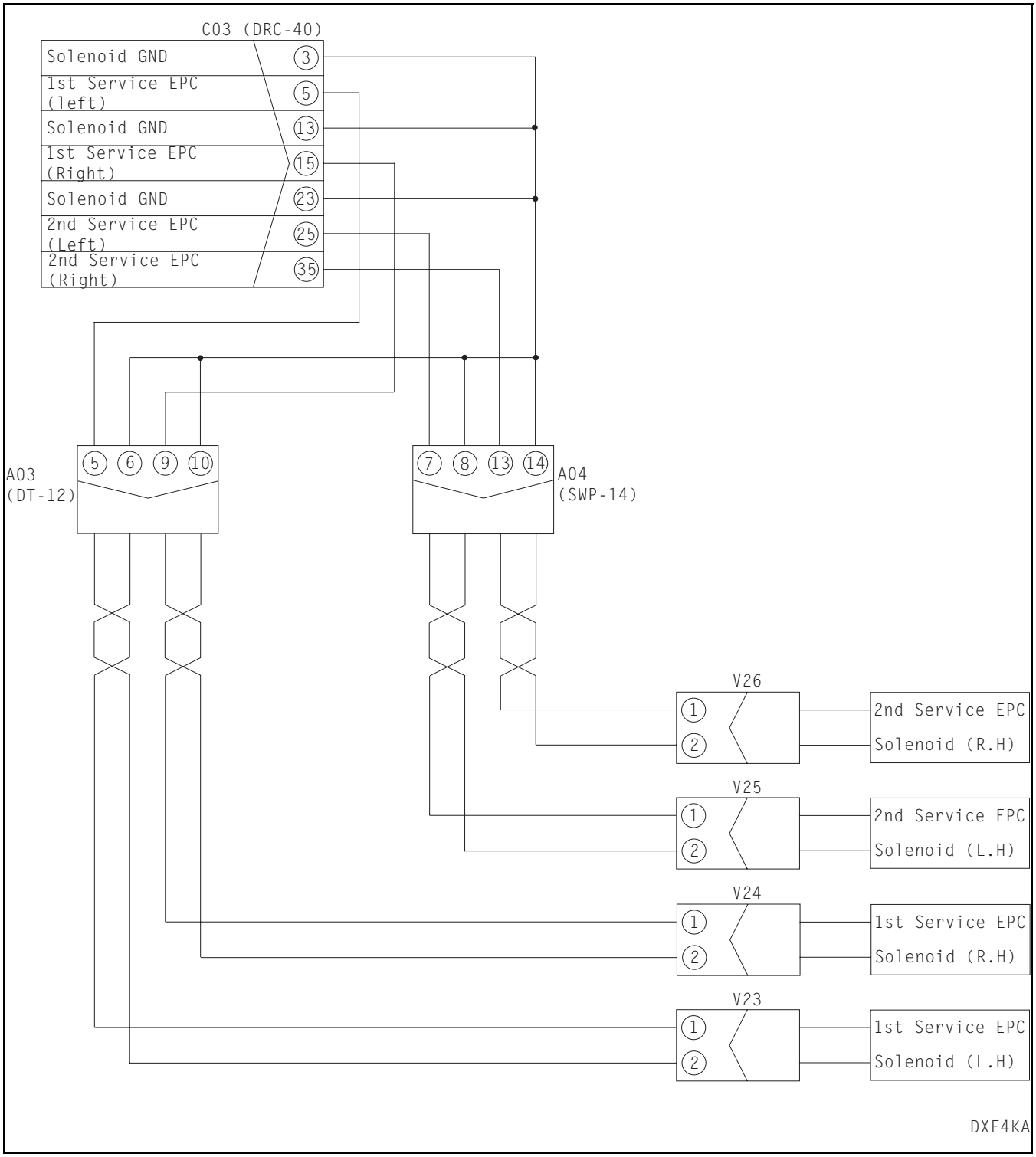
Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Attachment oil flow rate adjusting EPC defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V25 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness C03 (female) ㉕ and V25 (male) ① and grounding	Resistance value	Below 1 Ω	
			Between wiring harness C03 (female) ③ ⑬ ㉓ and V25 (male) ② and grounding	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness C03 (female) ㉕ and V25 (female) ① and grounding	Voltage	Below 1 V	
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ㉕ and ③, ⑬, ㉓.	7 – 14 Ω		

2nd Service EPC Solenoid (Right Hand)

Failure content	• No current flew to the attachment oil flow rate adjusting EPC solenoid circuit.
Response from controller	• None in particular (The solenoid does not work, as there is no current flowing to it) • If the failure cause disappears, the EPC solenoid circuit returns to normal of itself.
Phenomenon occurring on machine	• The attachments do not move.
Relative information	• It can be confirmed in the monitor function how power (ampere) is supplied to the attachment oil flow rate adjusting EPC solenoid circuit. (Code No. 01703: Service solenoid current)

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Attachment oil flow rate adjusting EPC defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V26 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness C03 (female) ㉟ and V26 (male) ① and grounding	Resistance value	Below 1 Ω	
			Between wiring harness C03 (female) ③ ⑬ ㉓ and V26 (male) ② and grounding	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness C03 (female) ㉟ and V26 (female) ① and grounding	Voltage	Below 1 V	
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ㉟ and ③, ⑬, ㉓.	7 – 14 Ω		

Circuit Diagram related to the 1st and 2nd Service EPC Solenoid.



Failure Code [DXE4KB] (Short-circuiting in attachment oil flow rate adjusting EPC)

User Code	Failure Code	Failure phenomenon	Short-circuiting in attachment oil flow rate adjusting EPC (in pump controller system)
—	**DXE4KB**		

1st Service EPC Solenoid (Left Hand)

Failure content	• Abnormal current flew to the attachment oil flow rate adjusting EPC solenoid circuit.
Response from controller	• The controller reduces to zero (0) power to the attachment oil flow rate adjusting EPC solenoid circuit. • Even when the failure cause disappears, the EPC solenoid circuit does not return to normal, unless the engine starting switch is once turned OFF.
Phenomenon occurring on machine	• The attachments do not move.
Relative information	• It can be confirmed in the monitor function how power (ampere) is supplied to the attachment oil flow rate adjusting EPC solenoid circuit. (Code No. 01700: Service solenoid current)

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Attachment oil flow rate adjusting EPC defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V23 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
			Between ① and grounding	Above 1 MΩ		
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness C03 (female) ⑤ and V23 (female) ① and grounding	Resistance value	Above 1 MΩ	
	3	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ⑤ and ③ ⑬ ㉓	7 – 14 Ω		
			Between ⑤ and grounding	Above 1 MΩ		

1st Service EPC Solenoid (Right Hand)

Failure content	• Abnormal current flew to the attachment oil flow rate adjusting EPC solenoid circuit.
Response from controller	• The controller reduces to zero (0) power to the attachment oil flow rate adjusting EPC solenoid circuit. • Even when the failure cause disappears, the EPC solenoid circuit does not return to normal, unless the engine starting switch is once turned OFF.
Phenomenon occurring on machine	• The attachments do not move.
Relative information	• It can be confirmed in the monitor function how power (ampere) is supplied to the attachment oil flow rate adjusting EPC solenoid circuit. (Code No. 01701: Service solenoid current)

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Attachment oil flow rate adjusting EPC defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V24 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
			Between ① and grounding	Above 1 MΩ		
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness C03 (female) ⑮ and V24 (female) ① and grounding	Resistance value	Above 1 MΩ	
	3	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ⑮ and ③ ⑬ ㉓	7 – 14 Ω		
			Between ⑮ and grounding	Above 1 MΩ		

2nd Service EPC Solenoid (Left Hand)

Failure content	• Abnormal current flew to the attachment oil flow rate adjusting EPC solenoid circuit.
Response from controller	• The controller reduces to zero (0) power to the attachment oil flow rate adjusting EPC solenoid circuit. • Even when the failure cause disappears, the EPC solenoid circuit does not return to normal, unless the engine starting switch is once turned OFF.
Phenomenon occurring on machine	• The attachments do not move.
Relative information	• It can be confirmed in the monitor function how power (ampere) is supplied to the attachment oil flow rate adjusting EPC solenoid circuit. (Code No. 01702: Service solenoid current)

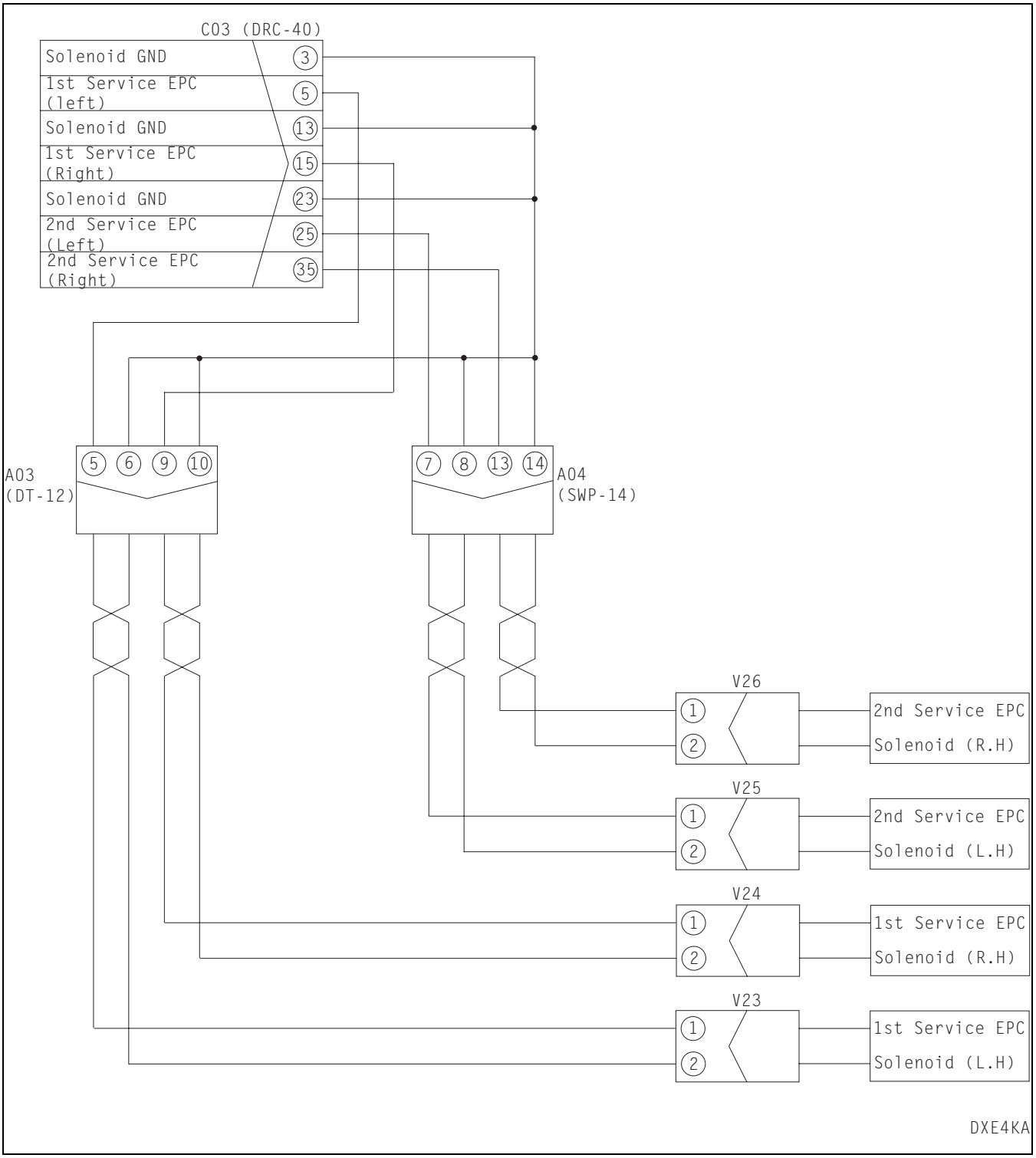
Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Attachment oil flow rate adjusting EPC defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V25 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
			Between ① and grounding	Above 1 MΩ		
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness C03 (female) ㉕ and V25 (female) ① and grounding	Resistance value	Above 1 MΩ	
	3	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ㉕ and ③ ⑬ ㉓	7 – 14 Ω		
			Between ㉕ and grounding	Above 1 MΩ		

2nd Service EPC Solenoid (Right Hand)

Failure content	• Abnormal current flew to the attachment oil flow rate adjusting EPC solenoid circuit.
Response from controller	• The controller reduces to zero (0) power to the attachment oil flow rate adjusting EPC solenoid circuit. • Even when the failure cause disappears, the EPC solenoid circuit does not return to normal, unless the engine starting switch is once turned OFF.
Phenomenon occurring on machine	• The attachments do not move.
Relative information	• It can be confirmed in the monitor function how power (ampere) is supplied to the attachment oil flow rate adjusting EPC solenoid circuit. (Code No. 01703: Service solenoid current)

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Attachment oil flow rate adjusting EPC defective (Internal short-circuiting or grounding fault)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V26 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
			Between ① and grounding	Above 1 MΩ		
	2	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness C03 (female) ㉟ and V26 (female) ① and grounding	Resistance value	Above 1 MΩ	
	3	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ㉟ and ③ ⑬ ㉓	7 – 14 Ω		
			Between ㉟ and grounding	Above 1 MΩ		

Circuit Diagram related to the 1st and 2nd Service EPC Solenoid.

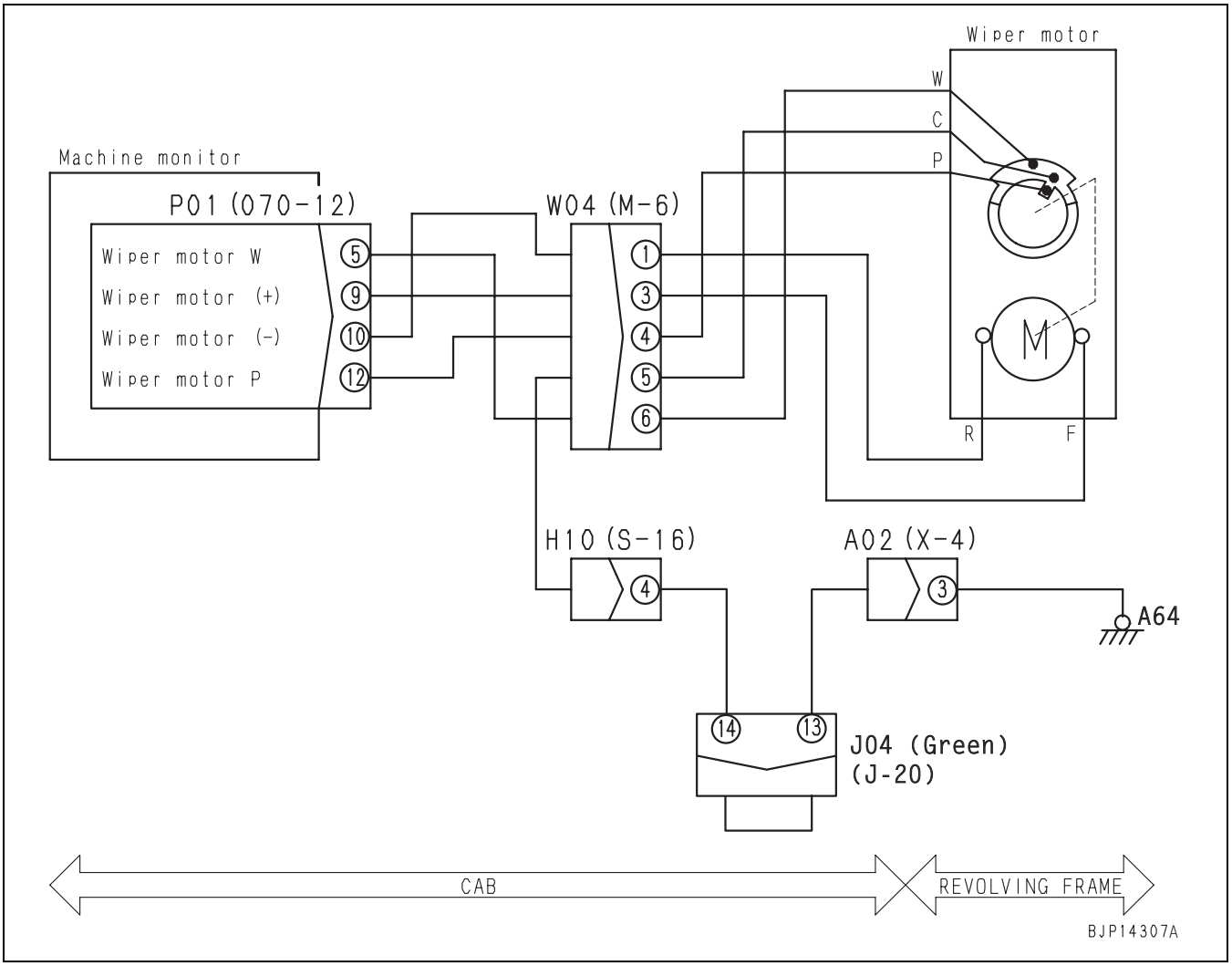


Failure code [DY20KA] Wiper Working Abnormality

Action code	Failure code	Trouble	Wiper working abnormality (Machine monitor system)
—	**DY20KA**		
Contents of trouble	• When windshield wiper works, W signal of working ends is not input.		
Action of monitor panel	• Turns working output to wiper motor OFF.		
Problem that appears on machine	• Windshield wiper does not operate.		
Related information	• Input of W signal in wiper working area (ON/OFF) can be checked with monitoring function. (Code 04502: Monitor Input 3)		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective wiper motor (Internal disconnection)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			W04 (female)	Wiper blade	Resistance	
			Between ⑥ – ⑤	Operating range top	Max. 1 Ω	
				Other than operating range top	Min. 1 MΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between P01 (female) ⑤ – W04 (male) ⑥		Resistance	Max. 1 Ω
			Wiring harness between W04 (male) ⑤ – chassis ground		Resistance	Max. 1 Ω
	3	Defective machine monitor	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			P01	Wiper blade	Voltage	
			Between ⑤ – chassis ground	Operating range top	Max. 1 V	
				Other than operating range top	20 – 30 V	

Circuit diagram related to wiper motor of machine monitor

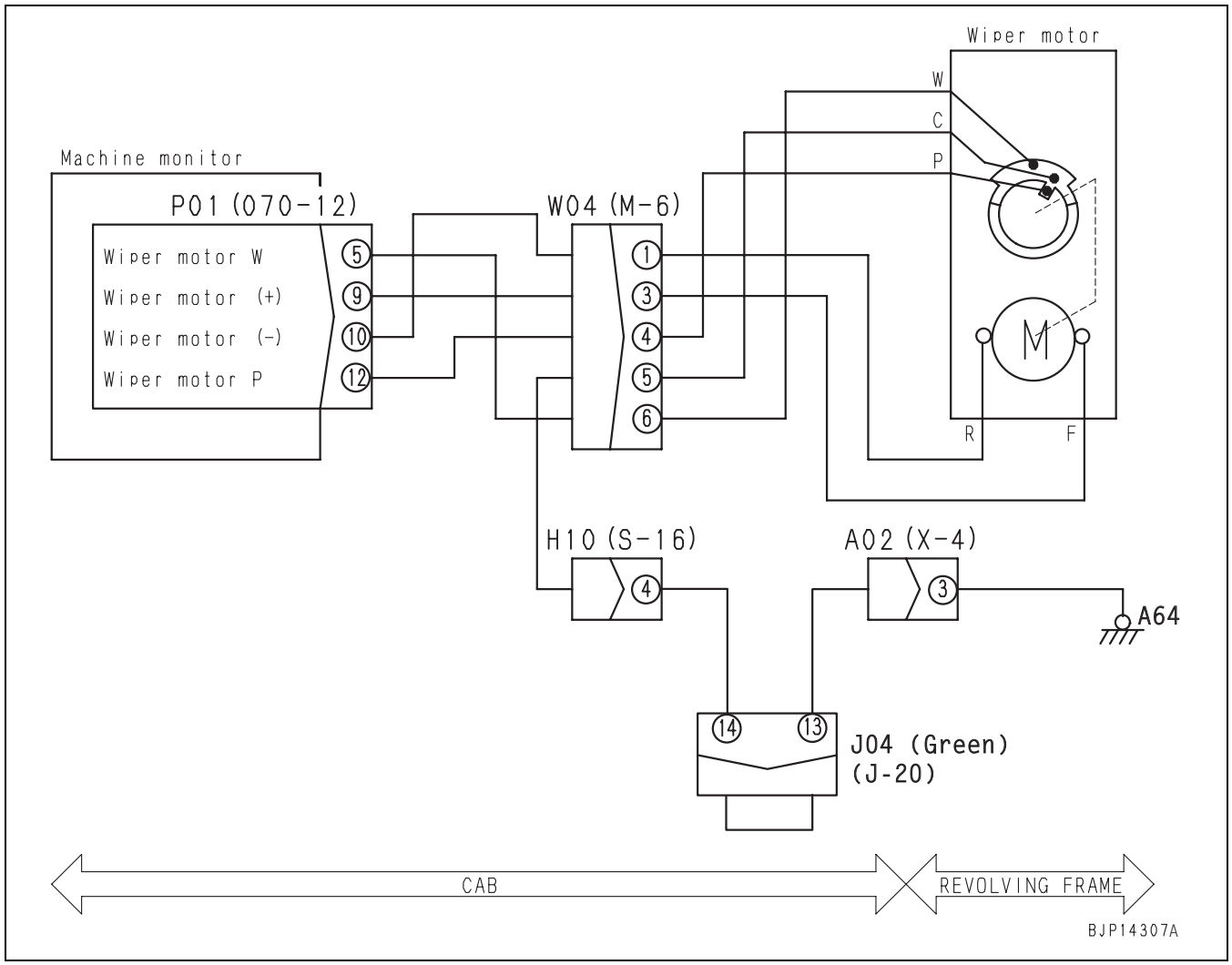


Failure code [DY20MA] Wiper Parking Abnormality

Action code	Failure code	Trouble	Wiper parking abnormality (Machine monitor system)
—	**DY20MA**		
Contents of trouble	• When windshield wiper parks, P signal of storage area is not input.		
Action of monitor panel	• Turns parking output to wiper motor OFF.		
Problem that appears on machine	• Windshield wiper does not park.		
Related information	• Input of P signal in wiper parking area (ON/OFF) can be checked with monitoring function. (Code 04502: Monitor Input 3)		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective wiper motor (Internal disconnection)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			W04 (female)	Wiper blade	Resistance	
			Between ④ – ⑤	Storage area	Max. 1 Ω	
				Working area	Min. 1 MΩ	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between P01 (female) ⑫ – W04 (male) ④		Resistance	Max. 1 Ω
			Wiring harness between W04 (female) ⑤ – chassis ground		Resistance	Max. 1 Ω
	3	Defective machine monitor	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			P01	Wiper blade	Voltage	
			Between ⑫ – chassis ground	Storage area	Max. 1 V	
				Working area	20 – 30 V	

Circuit diagram related to wiper motor of machine monitor

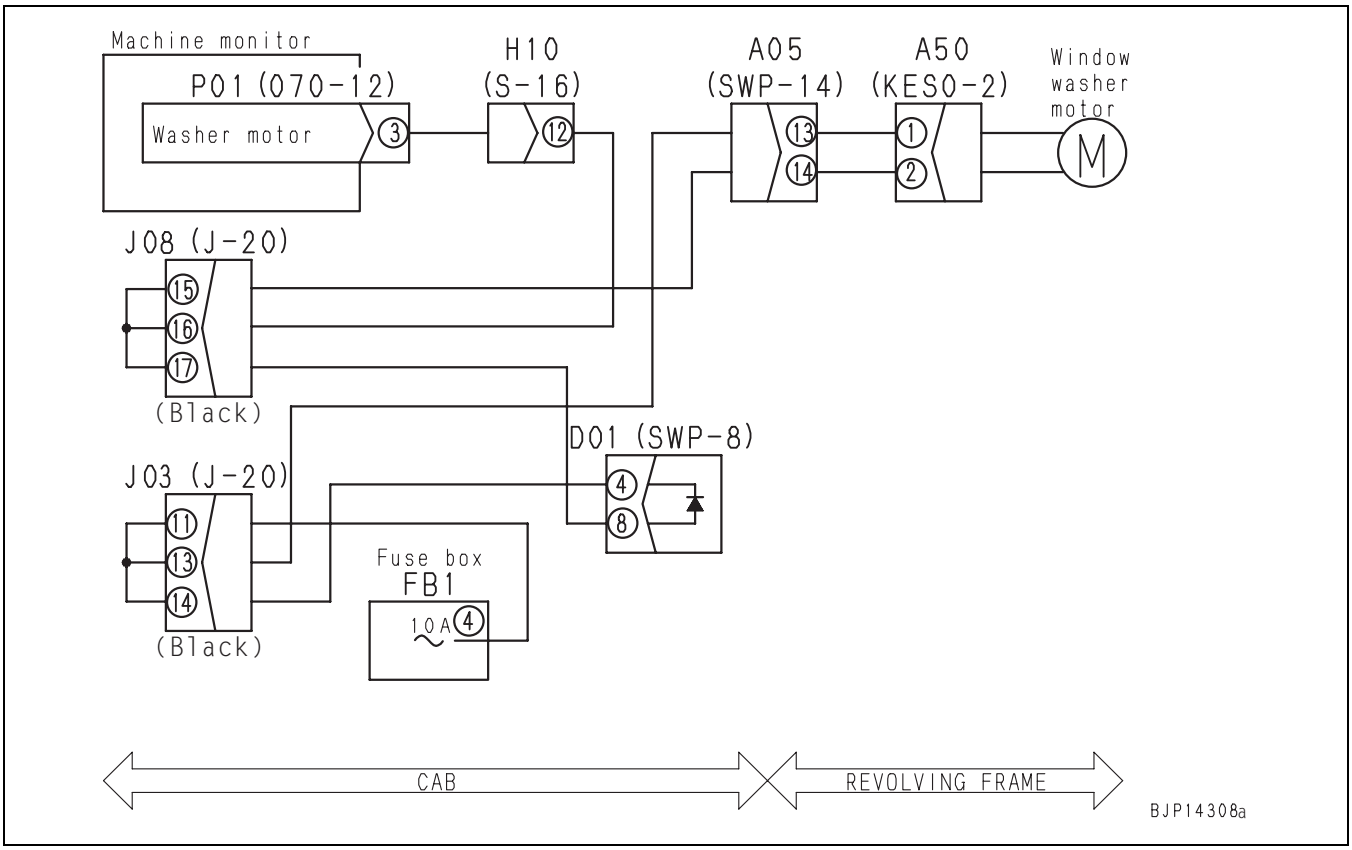


Failure code [DY2CKB] Washer Drive S/C

Action code	Failure code	Trouble	Window washer drive system short (Machine monitor system)
—	**DY2CKB**		
Contents of trouble	• When washer drive circuit was connected to GND (when output was turned ON), abnormal current flowed.		
Action of monitor panel	• Turns output to washer motor circuit OFF.		
Problem that appears on machine	• Window washer operation stops.		
Related information			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective washer motor (Internal short circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			A50 (male)		Resistance	
			Between ① – ②		5 – 20 Ω	
	2	Hot short (Short circuit with 24V circuit) in wiring harness	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			Wiring harnesses between P01 (female) ③ – J08 – A50 (female) ②, – D01 (female) ⑧ and chassis ground		Voltage	Max. 1 V
	3	Defective machine monitor	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			P01	Washer switch	Voltage	
			Between ③ – chassis ground	OFF	20 – 30 V	
				ON	Max. 1 V	

Circuit diagram related to window washer motor of machine monitor

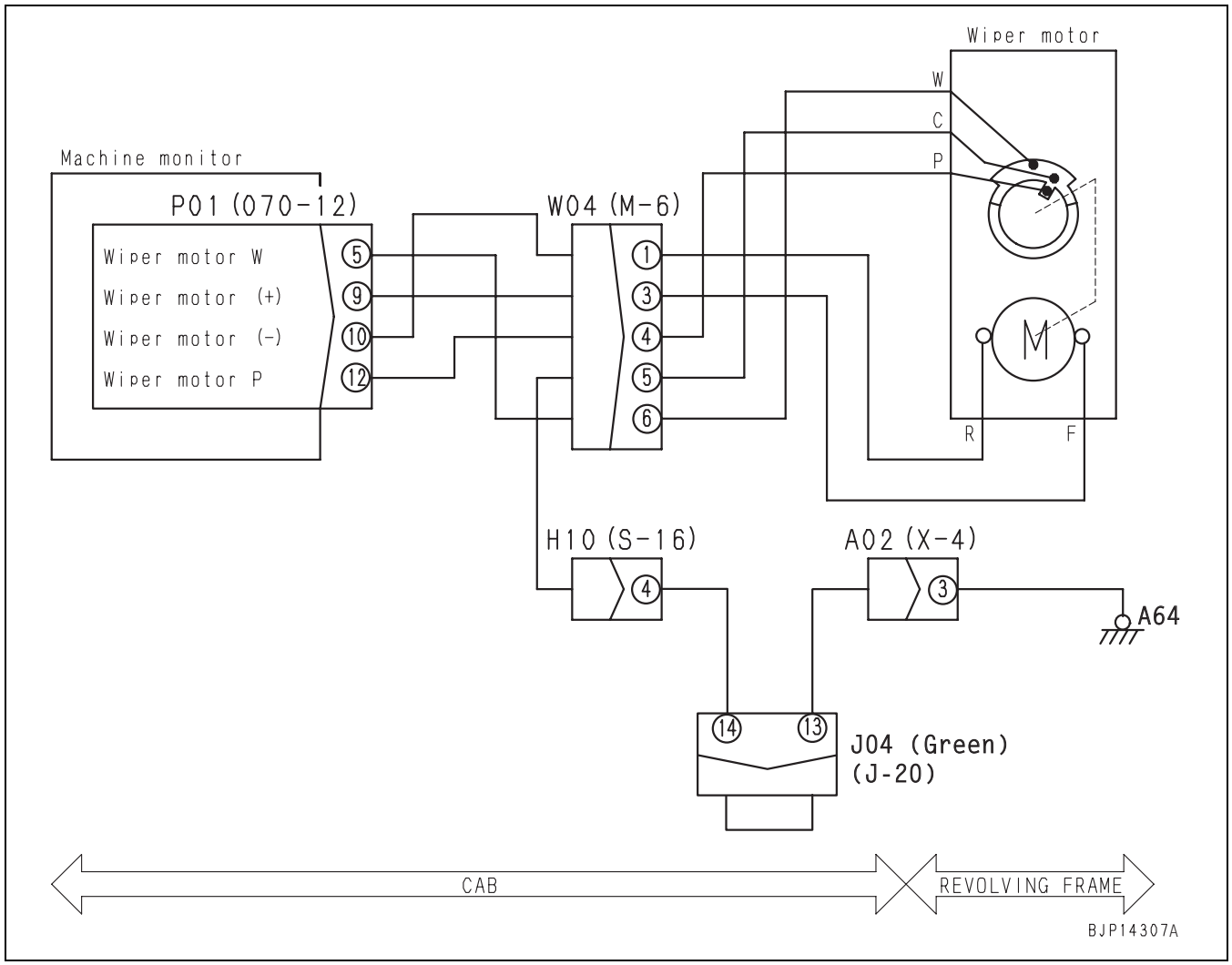


Failure code [DY2DKB] Wiper Drive (For) S/C

Action code	Failure code	Trouble	Wiper motor drive forward system short (Machine monitor system)
—	**DY2DKB**		
Contents of trouble	• Abnormal current flowed at output to wiper motor drive forward circuit.		
Action of monitor panel	• Turns output to wiper motor drive forward circuit OFF.		
Problem that appears on machine	• Window washer operation stops.		
Related information			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective wiper motor (Internal short circuit or ground fault)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			W04 (female)		Continuity/Resistance	
			Between ③ – ①		There is continuity	
			Between ③ – chassis ground		Min. 1 MΩ	
	2	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between P01 (female) ⑨ – W04 (male) ③ and chassis ground		Resistance	Min. 1 MΩ
	3	Defective machine monitor	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			P01	Wiper switch	Voltage	
			Between ⑨ – chassis ground	OFF	Max. 3 V	
				ON	Max. 3 V ⇔ 20 – 30 V (Constant cycle)	

Circuit diagram related to wiper motor of machine monitor

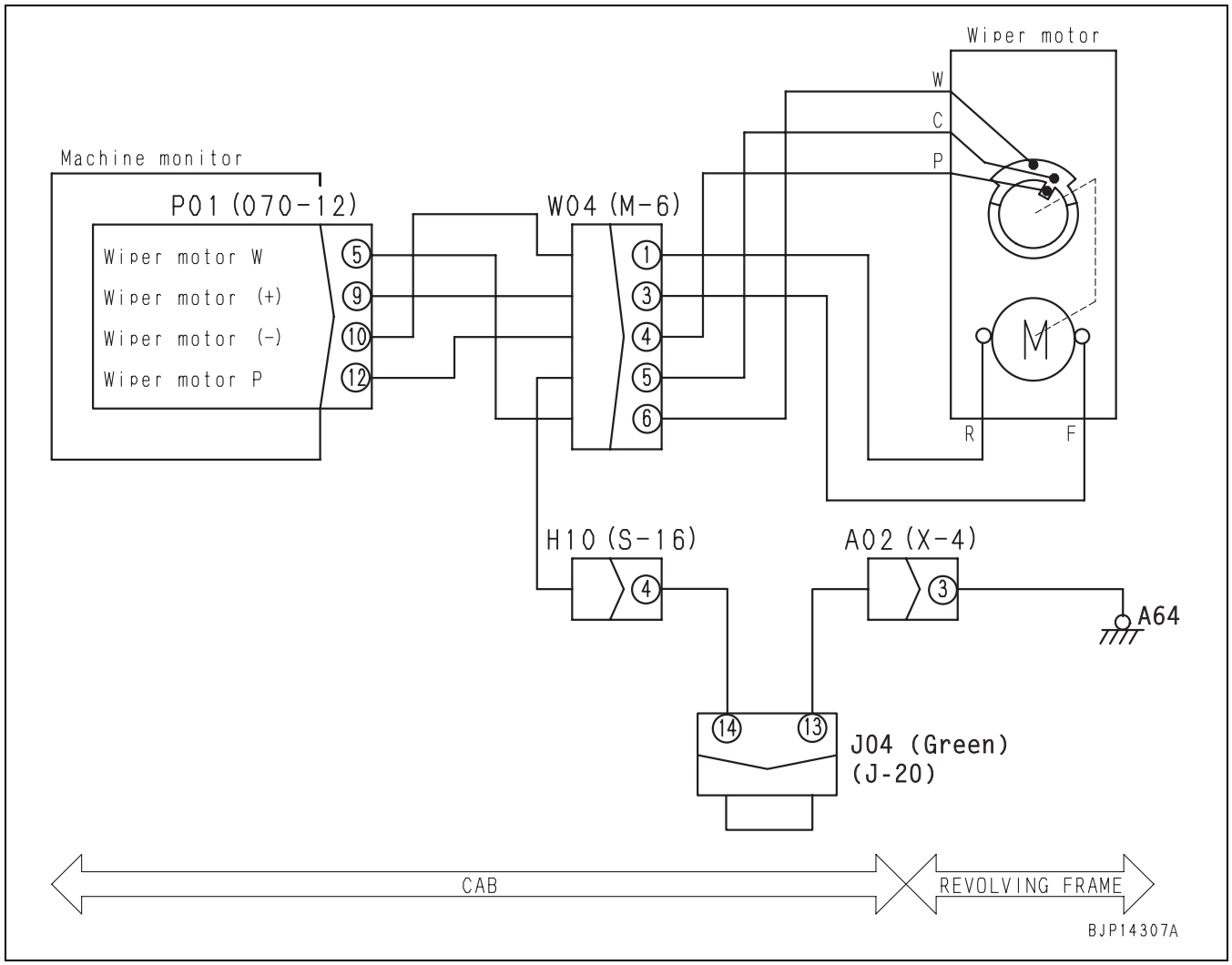


Failure code [DY2EKB] Wiper Drive (Rev) S/C

Action code	Failure code	Trouble	Wiper motor drive reverse system short (Machine monitor system)
—	**DY2EKB**		
Contents of trouble	• Abnormal current flowed at output to wiper motor drive reverse circuit.		
Action of monitor panel	• Turns output to wiper motor drive reverse circuit OFF.		
Problem that appears on machine	• Window washer operation stops.		
Related information			

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective wiper motor (Internal short circuit or ground fault)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			W04 (female)		Continuity/Resistance	
			Between ① – ③		There is continuity	
			Between ① – chassis ground		Min. 1 MΩ	
	2	Ground fault in wiring harness (Short circuit with GND circuit)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between P01 (female) ⑩ – W04 (male) ① and chassis ground		Resistance	Min. 1 MΩ
	3	Defective machine monitor	a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.			
			P01	Wiper switch	Voltage	
			Between ⑩ – chassis ground	OFF	Max. 3 V	
				ON	Max. 3 V ⇔ 20 – 30 V (Constant cycle)	

Circuit diagram related to wiper motor of machine monitor



TROUBLESHOOTING OF ELECTRICAL SYSTEM (E-MODE)

INFORMATION CONTAINED IN TROUBLESHOOTING TABLE. 20-502
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E-16 Fuel gauge does not display correctly 20-523
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E-18 When the monitor switch is operated, no display appears 20-526
E-19 Windshield wiper and window washer do not operate 20-528
E-20 Alarm buzzer cannot be stopped 20-530
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E-23 "Arm DIGGING" is not correctly displayed in monitor function 20-534
E-24 "Arm DUMPING" is not correctly displayed in monitor function 20-535
E-25 "Bucket DIGGING" is not correctly displayed in monitor function 20-536
E-26 "Bucket DUMPING" is not correctly displayed in monitor function 20-537
E-27 "SWING" is not correctly displayed in monitor function 20-538
E-28 "TRAVEL" is not correctly displayed in monitor function 20-540
E-29 "2 Piece Boom" is not correctly displayed in monitor function 20-542
E-30 Air Conditioner does not work 20-544
E-31 Travel reverse alarm does not sound 20-546
E-32 KOMTRAX system does not operate normally 20-548

INFORMATION CONTAINED IN TROUBLESHOOTING TABLE

- The following information are edited and contained in the "Information Contained in Troubleshooting Table". You are required to proceed with troubleshooting after fully grasping the contents.

Failure information	Phenomena occurring on machine
Relative information	Information on occurred failures and troubleshooting

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting
	1	Cause for presumed failure (The attached No. for filing and reference purpose only. It does not stand for any priority)	<Contents> • The standard values in normal by which to judge "good" or "no good" about presumed causes. • References for making judgement of "good" or "no good" <Phenomena of wiring harness fault> • Failure due to disconnection Defective contact with connector or disconnection of wiring harness has occurred. • Grounding fault A wiring harness that is not originally connected with a grounding circuit is in contact with it. • Failure due to short-circuiting A wiring harness that is not originally connected with a power source circuit (24 V) is in contact with it. <Points to remember in troubleshooting> 1. Connector denotation method and handling of T-adapters Insert or connect T-adapters in the following manner, unless specifically otherwise instructed. • If there is no indication of (male) or (female) in the connector No., pull off a connector and insert a T-adapter into both sides of male and female. • If there is an indication of (male) and (female) in the connection No., pull off a connector and insert a T-adapter into only one side of (male) or (female). 2. Description sequence of pin No. and handling of circuit tester leads Connect the positive lead (+) and negative lead (–) for troubleshooting in the following manner unless specifically otherwise instructed. • Connect the positive lead (+) to a pin No. marked at the front or wiring harness. • Connect the negative lead (–) to a pin No. marked at the rear or wiring harness.
	2		
	3		
	4		
	5		

Relative Electrical Circuit Diagram

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

- Connector No.: Indicates (Type - numbers of a pin) (color)
- Arrow: Roughly indicates the location in the machine where it is installed.

E-1 Engine does not start (Engine does not rotate)

Failure information	• The engine does not start (the engine does not rotate).
Relative information	• The following two engine start locking mechanisms are provided in the engine starting circuit. 1. Engine start locking by means of password in the monitor panel (※) 2. Engine start locking by means of safety lock lever

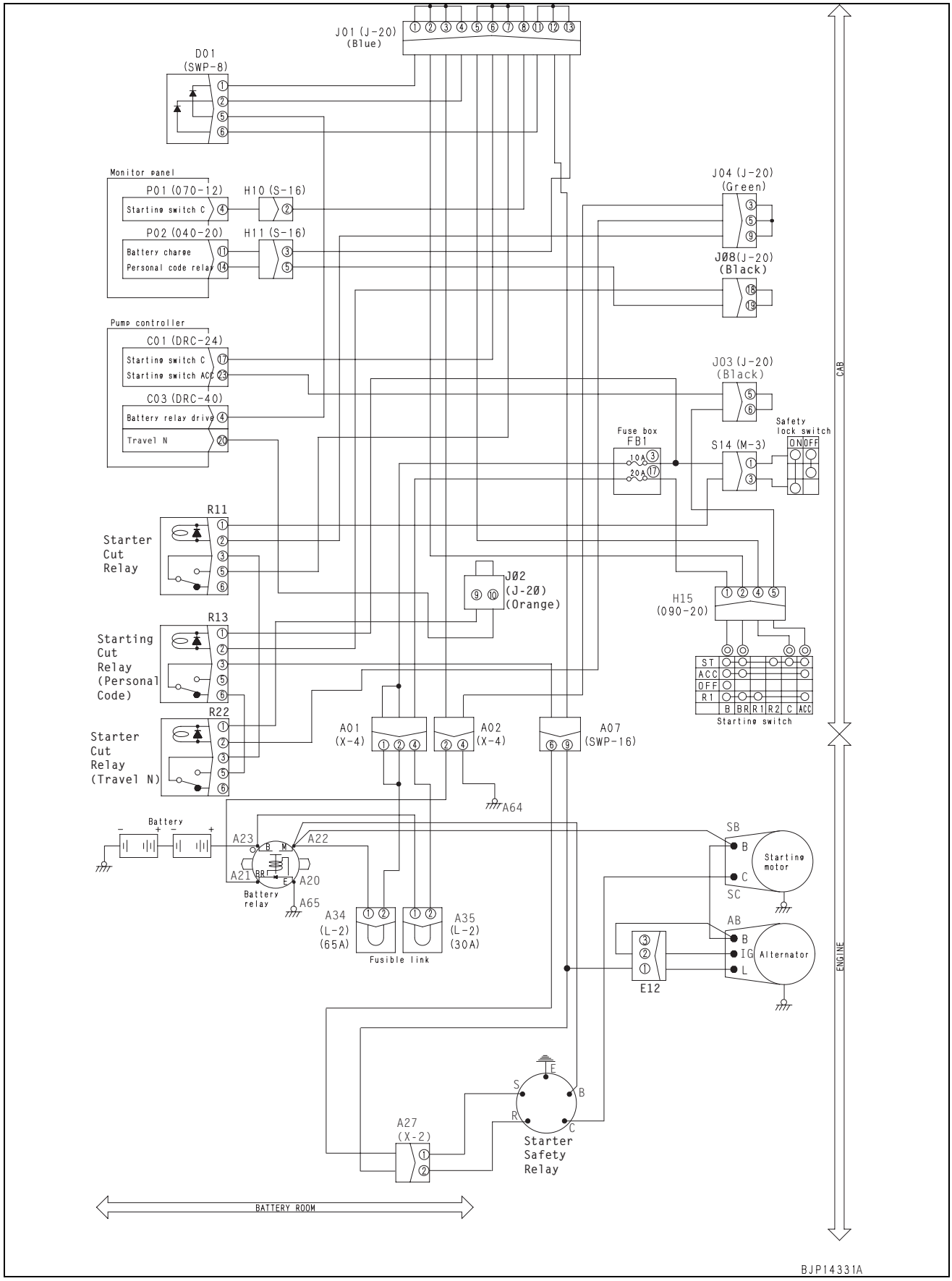
Presumed cause and standard value in normal

Cause		Standard value in normal and references for troubleshooting			
1	Shortage in battery capacity	Battery voltage	Battery electrolyte specific gravity		
		Above 24 V	Above 1.26		
2	Fuse box 1 nos. 3 and 17 and Fusible Links A34 and A35 fault	When a fuse or fusible link is blown, there is a big possibility that grounding fault occurred in the circuit. If a monitor lamp does not light up in the monitor panel, check the power source circuit between the battery and the specific fuse.			
3	Engine starting switch fault (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		H15 (male)	Position	Resistance value	
		Between ① and ④	OFF	Above 1 MΩ	
			Start	Below 1 Ω	
4	Safety lock switch fault (Internal short-circuiting)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		S14 (female)	Lock lever	Resistance value	
		Between ① and ③	FREE	Above 1 MΩ	
			LOCK	Below 1 Ω	
5	Engine starting motor cut relay, R11, R13 and R22 defective (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		R11 (male) & R13 (male) & R22 (male)	Resistance value		
		Between ① and ②	100 – 500 Ω		
		Between ③ and ⑤	Above 1 MΩ		
		Between ③ and ⑥	Below 1 Ω		
6	Engine starting motor fault (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting. (If all of the power source, grounding (GND), generation signal and engine start input are normal and yet the engine start output is not normal, the engine starting motor relay is defective)			
		Safety relay		Engine starting switch	Voltage
		Power source: Between B terminal and grounding		Start	20 – 30 V
		GND (grounding): Between E terminal and grounding			Connected
		Generation signal: Between R terminal (A27 ②) and grounding			Below 1 V
		Engine start input: Between C terminal and grounding			20 – 30 V
		Engine start output: Between S terminal (A27 ①) and grounding			20 – 30 V
7	Engine starting motor fault (Internal disconnection or damage)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting. (If all of the power source, grounding (GND), generation signal and engine start input are normal and yet the engine start output is not normal, the engine starting motor relay is defective)			
		Engine starting motor		Engine starting switch	Voltage
		Power source: B terminal and grounding		Start	20 – 30 V
		Engine start input: C terminal and grounding			20 – 30 V

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting		
	8	Alternator fault (Internal short-circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position or running during the troubleshooting.		
			E12 (male)	Voltage	
			Between ① and grounding	Below 1 V	
	9	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Wiring harness between FB1-17 outlet and H15 (female) ①	Resistance value	Below 1 Ω
			Wiring harness from H15 (female) ④ to J01 to R11 (female) ⑤	Resistance value	Below 1 Ω
			Wiring harness between R11 (female) ③ and R22 (female) ③	Resistance value	Below 1 Ω
			Wiring harness between R22 (female) ⑤ and R13 (female) ⑥	Resistance value	Below 1 Ω
			Wiring harness between R13 (female) ③ to A07 to A27 (female) ①.	Resistance value	Below 1 Ω
			Wiring harness between engine starting motor relay C terminal and engine starting motor C terminal	Resistance value	Below 1 Ω
			Wiring harness between FB1-3 and S14 (male) ①	Resistance value	Below 1 Ω
			Wiring harness between S14 (male) ③ and R11 (female) ①	Resistance value	Below 1 Ω
			Wiring harness between R11 (female) ② to J04 and R22 (female) ②	Resistance value	Below 1 Ω
			Wiring harness from R11 (female) ② to J04 to A02 (male) ④ to grounding	Resistance value	Below 1 Ω
	10	Grounding fault of wiring harness (Contact with grounding circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Between wiring harness from battery relay B terminal (A23) to A35 to A01 to FB1-17 and grounding	Resistance value	Above 1 MΩ
			Wiring harness between FB1-17 outlet and H15 (female) ① and grounding	Resistance value	Above 1 MΩ
			Between wiring harness from H15 (female) ④ to J01 to R11 (female) ⑤ and grounding	Resistance value	Above 1 MΩ
			Wiring harness between R11 (female) ③ and R22 (female) ③ and grounding	Resistance value	Above 1 MΩ
			Wiring harness between R22 (female) ⑤ and R13 (female) ⑥	Resistance value	Below 1 Ω
			Wiring harness between R13 (female) ③ to A07 to A27 (female) ①.	Resistance value	Above 1 MΩ
			Wiring harness between engine starting motor relay C terminal and engine starting motor C terminal and grounding	Resistance value	Above 1 MΩ
			Wiring harness between FB1-3 and S14 (female) ① and grounding	Resistance value	Above 1 MΩ
			Wiring harness between S14 (female) ③ and R11 (female) ① and grounding	Resistance value	Above 1 MΩ
			Between wiring harness from R13 (female) ② to J08 to H11 to P02 (female) ⑭ and grounding	Resistance value	Above 1 MΩ

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting		
	11	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.		
			Wiring harness between A27 (female) ② and E12 (female) ①, or wiring harness from A27 (female) ② to A07 to J01 to D01 (female) ⑥, or between wiring harness between A27 (female) ② to J01 to H11 to P02 (female) ⑪ and grounding.	Voltage	Below 1 V

Electrical Circuit Diagram for Engine Start, Stop and Battery Charging



E-5 Auto-decelerator does not work

Failure information	• The auto-deceleration does not work.
Relative information	• Rotation of the auto-deceleration is set at 1,400 rpm. If the fuel dial is not adjusted above this level, the auto-deceleration does not work. • Confirm the display on the monitor panel, when the engine is running.

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting		
	1	Boom RAISE signal fault	If the display on the monitor panel is not normal, proceed to section E-21 of this trouble-shooting chapter.		
			Monitoring code	Item	Normal display
			01900	Boom RAISE	Lever operation: ON Lever NEUTRAL: OFF
	2	Boom LOWER signal fault	If the display on the monitor panel is not normal, proceed to section E-22 of this trouble-shooting chapter.		
			Monitoring code	Item	Normal display
			01900	Boom LOWER	Lever operation: ON Lever NEUTRAL: OFF
	3	Arm DIGGING signal fault	If the display on the monitor panel is not normal, proceed to section E-23 of this trouble-shooting chapter.		
			Monitoring code	Item	Normal display
			01900	Arm DIGGING	Lever operation: ON Lever NEUTRAL: OFF
	4	Arm DUMPING signal fault	If the display on the monitor panel is not normal, proceed to section E-24 of this trouble-shooting chapter.		
			Monitoring code	Item	Normal display
			01900	Arm DUMPING	Lever operation: ON Lever NEUTRAL: OFF
	5	Bucket DIGGING signal fault	If the display on the monitor panel is not normal, proceed to section E-25 of this trouble-shooting chapter.		
			Monitoring code	Item	Normal display
			01901	Bucket DIGGING	Lever operation: ON Lever NEUTRAL: OFF
	6	Bucket DUMPING signal fault	If the display on the monitor panel is not normal, proceed to section E-26 of this trouble-shooting chapter.		
			Monitoring code	Item	Normal display
			01901	Bucket DUMPING	Lever operation: ON Lever NEUTRAL: OFF
	7	Swing signal fault	If the display on the monitor panel is not normal, proceed to section E-27 of this trouble-shooting chapter.		
			Monitoring code	Item	Normal display
			01900	Swing	Lever operation: ON Lever NEUTRAL: OFF
	8	Travel signal fault	If the display on the monitor panel is not normal, proceed to section E-28 of this trouble-shooting chapter.		
			Monitoring code	Item	Normal display
			01901	Travel	Lever operation: ON Lever NEUTRAL: OFF

<table>
<tr><td rowspan="4">Presumed cause and standard value in normal</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal and references for troubleshooting</td></tr>
<tr><td rowspan="3">9</td><td rowspan="3">Attachment signal fault</td><td colspan="4">If the display on the monitor panel is not normal, proceed to section E-29 of this trouble-shooting chapter.</td></tr>
<tr><td>Monitoring code</td><td>Item</td><td>Normal display</td></tr>
<tr><td>01901</td><td>Service</td><td>Lever operation: ON
Lever NEUTRAL: OFF</td></tr>
<tr><td>10</td><td>Pump controller defective</td><td colspan="4">As this is an internal failure, troubleshooting cannot be conducted. (If there is none of the causes listed in Item 1 through 9, the controller is judged as defective.</td></tr>
</table>

E-6 Auto engine warm-up device does not work

Failure information	• The auto engine warm-up device does not work.
Relative information	• The auto engine warm-up device is activated, when the engine cooling water temperature is below 30°C, and the engine speed is below 1,200 rpm. • The auto engine warm-up device is canceled by keeping the fuel dial opening at above 70% for more than 3 seconds, when the engine starting switch is in the ON position or after the engine is started.

<table>
<tr><td rowspan="4">Presumed cause and standard value in normal</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal and references for troubleshooting</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Engine cooling water temperature signal fault</td><td colspan="4">If the display on the monitor panel is not normal, proceed to section E-14 of this troubleshooting chapter.</td></tr>
<tr><td>Monitoring code</td><td>Item</td><td colspan="2">Normal display</td></tr>
<tr><td>2</td><td>Pump controller defective</td><td>04102</td><td>Engine cooling water temperature</td><td colspan="2">Compare with the actual engine cooling water temperature.</td></tr>
<tr><td colspan="5">As this is an internal failure, troubleshooting cannot be conducted.
(If the fault mentioned in the above item is not found, the pump controller is judged as defective)</td></tr>
</table>

E-7 Preheater does not operate

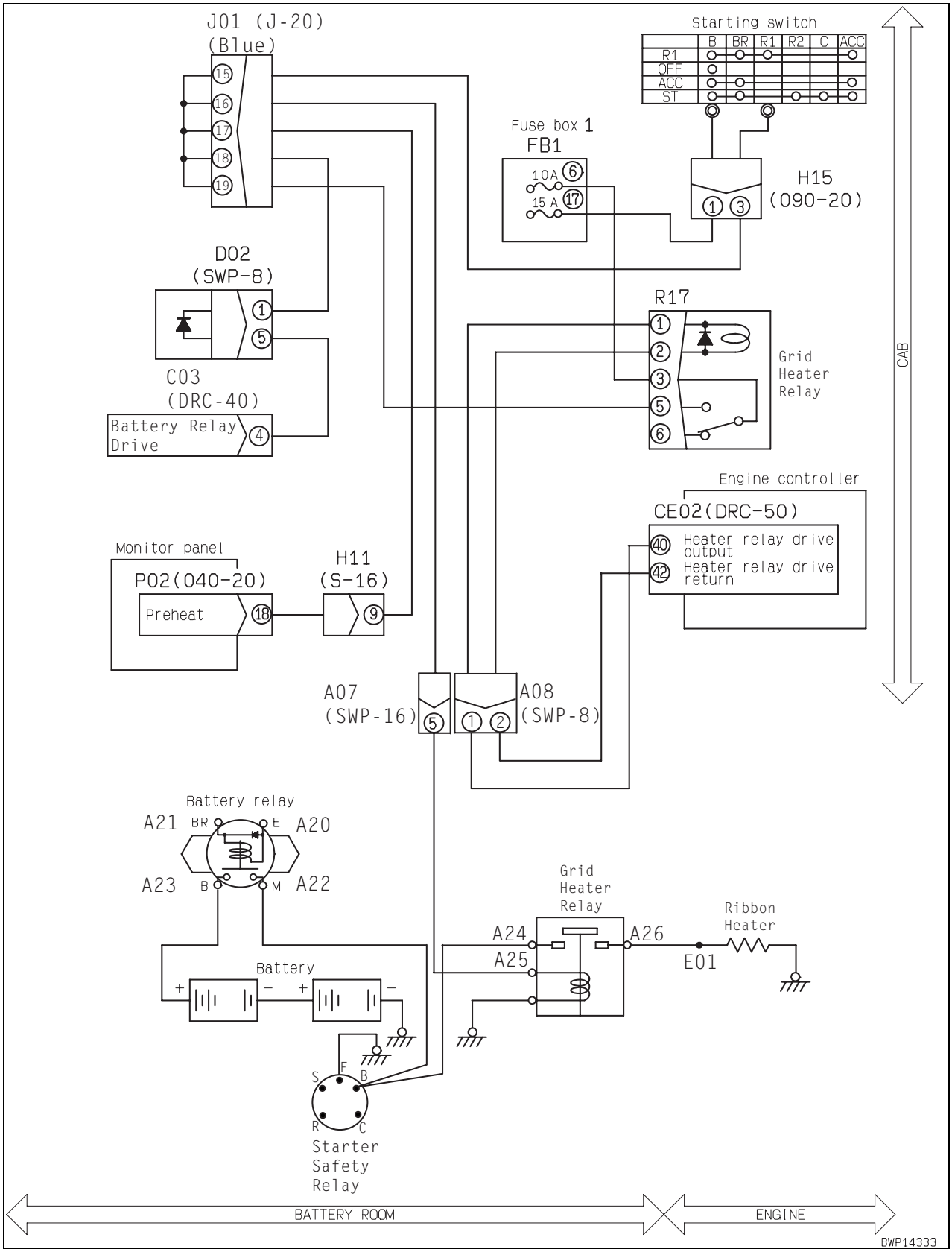
Trouble (1)	When starting switch is turned to HEAT position, preheating monitor does not light up.
Related information	Input of preheating signal (ON/OFF) can be checked with monitoring function. (Code 04500: Monitor Input 1)

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective starting switch system	If preheating fails to operate (the heater does not warm up), refer to Trouble (2)			
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between P02 (female) (18) – J02 (male) (17)		Resistance	Max. 1 Ω
	3	Defective machine monitor	a Prepare with starting switch OFF			
			P02	Starting switch	Voltage	
			Between (18) – chassis ground	OFF	Max. 1 V	
				HEAT	20 – 30 V	

Trouble (2)	• When starting switch is turned to HEAT position, preheater does not warm up.
Related information	• During low temperature (coolant temperature below 30°C), pump controller drives the heater relay for 100 sec. after engine start to automatically preheat.

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective starting switch (Internal disconnection)	a Prepare with starting switch OFF			
			H15 (male)	Starting switch	Resistance	
			Between (1) – (3)	OFF	Min. 1 MΩ	
				HEAT	Max. 1 Ω	
	2	Defective heater relay (Internal disconnection)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Heater relay		Resistance	
			Coil terminal – chassis ground			
			Between contact terminals		Min. 1 MΩ	
	3	Defective intake air heater (Internal disconnection).	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Between heater terminals		Normal if conductive	
	4	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between H15 (female) (3) – J02 – Heater relay terminal A25		Resistance	Max. 1 Ω
			Wiring harness between battery relay terminal M (A22) – Heater relay terminal A24.		Resistance	Max. 1 Ω

Circuit diagram related to engine preheater



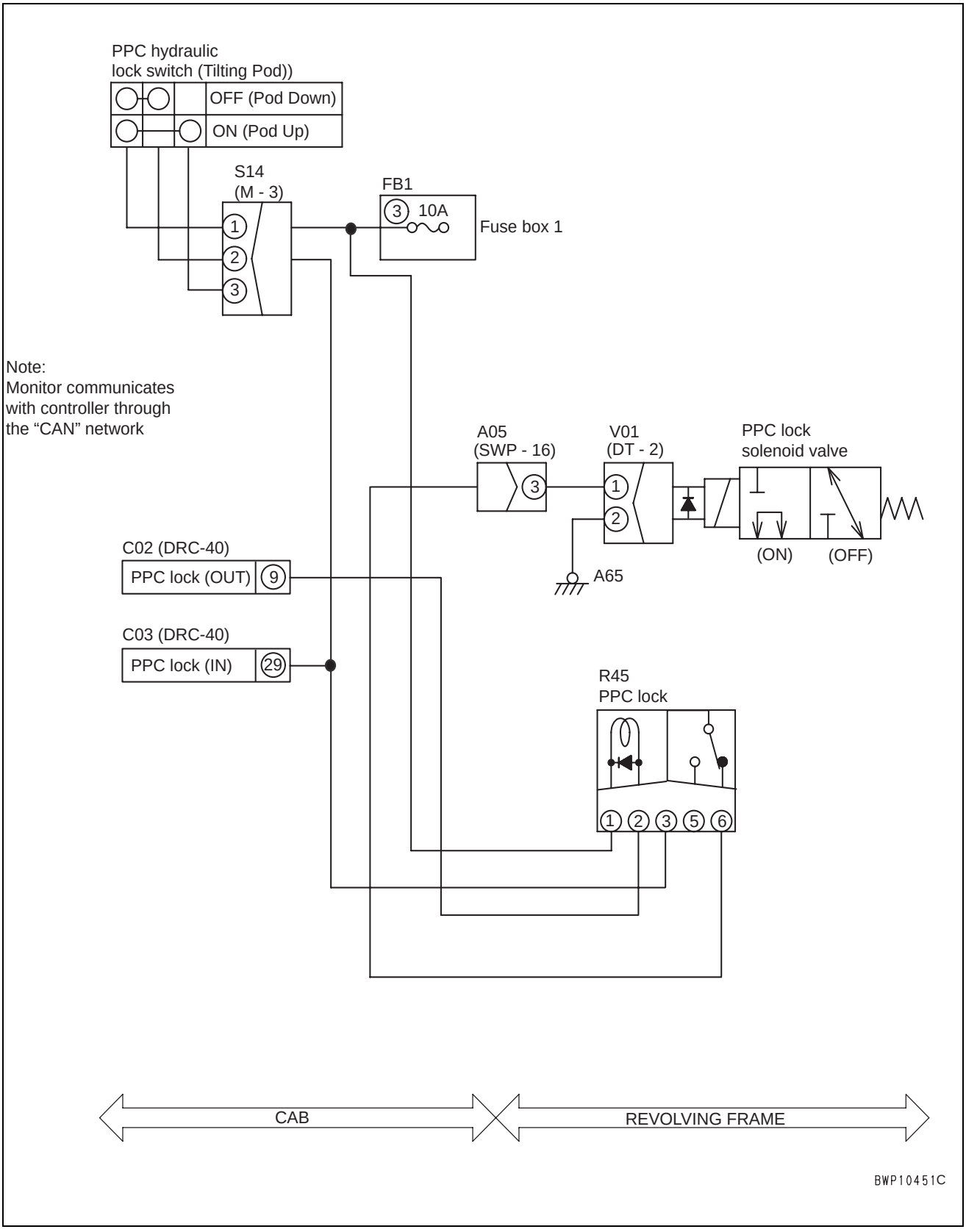
E-8 All work equipment, swing and travel do not move

Failure information	• All the work equipment, swing and travel do not move.
Relative information	—

Presumed cause and standard value in normal

Cause		Standard value in normal and references for troubleshooting			
1	Fuse No. 3 fault	If the fuse is blown, there is a big possibility that grounding fault occurred in the circuit.			
2	Safety switch lock defective (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		S14 (female)	Safety control lever	Resistance value	
		Between ① and ②	OFF	Above 1 MΩ	
			ON	Below 1 Ω	
3	PPC lock solenoid fault (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		V01 (male)	Resistance value		
		Between ① and ②	20 – 60 Ω		
		Between ① and grounding	Above 1 MΩ		
4	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between FB1 ③ outlet and S14 (male) ①	Resistance value	Below 1 Ω	
		Wiring harness from S14 (male) ② to R45 to A05 to V01 (female) ①	Resistance value	Below 1 Ω	
		Wiring harness between V01 (female) ② and grounding	Resistance value	Below 1 Ω	
5	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between FB1 ③ outlet and S14 (male) ① and grounding	Resistance value	Above 1 MΩ	
		Wiring harness from C02 (male) ⑨ to R45 ② to V01 (female) ①, or between wiring harness between C02 (male) ⑨ and R45 (female) ③ and grounding.	Resistance value	Above 1 MΩ	

Electrical Circuit Diagram for PPC Lock Solenoid

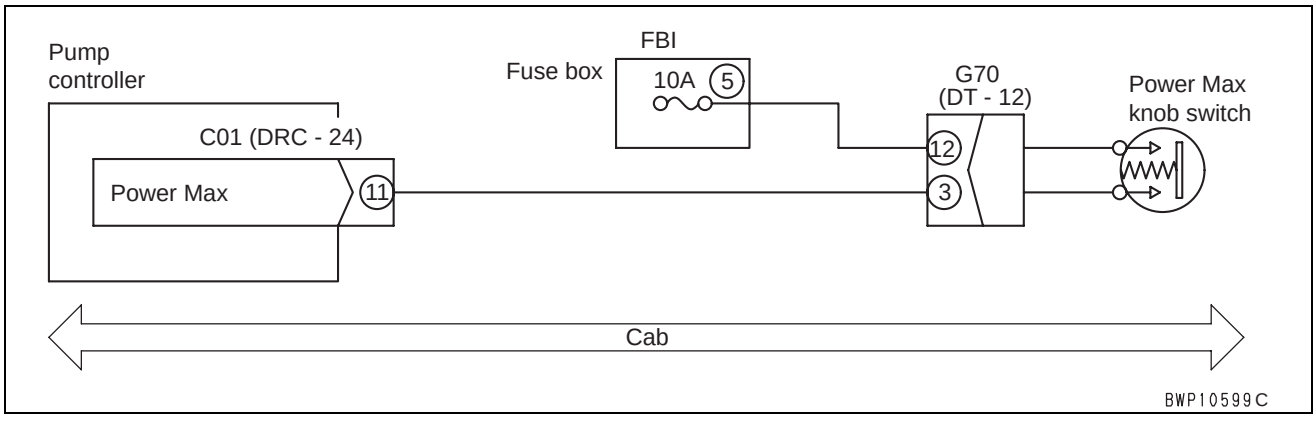


E-9 One-touch Power Max Switch does not work

Failure information	• The one-touch power max. switch does not work.
Relative information	• If the one touch-power max. switch is pressed (during work equipment operation) while the engine is running, the symbol mark is displayed in the monitor panel. • Input from the one-touch power max. switch (left knob switch) can be confirmed in the monitor function. (Code No. 02200: Switch input 1)

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Fuse No. 5 fault	If the fuse is blown, there is a big possibility that grounding fault occurred in the circuit.			
	2	One-touch power max. switch fault (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			G70 (male)	One-touch power max. switch	Resistance value	
			Between ③ and ⑫	Release	Above 1 MΩ	
				Depress	Below 1 Ω	
	3	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between FB1 ⑤ outlet and G70 (female) ⑫		Resistance value	Below 1 Ω
			Wiring harness between G70 (female) ③ and C01 (female) ⑪		Resistance value	Below 1 Ω
	4	Grounding fault of wiring harness (Contact with grounding [GND] circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between FB1 ⑤ outlet and G70 (female) ⑫ and grounding		Resistance value	Above 1 MΩ
			Wiring harness between G70 (female) ③ and C01 (female) ⑪ and grounding		Resistance value	Above 1 MΩ
	5	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C01	One-touch power max. switch	Voltage	
			Between ⑪ and grounding	Release	Below 1 V	
				Depress	20 – 30 V	

Electric Circuit Diagram for One-Touch Power Max. Switch

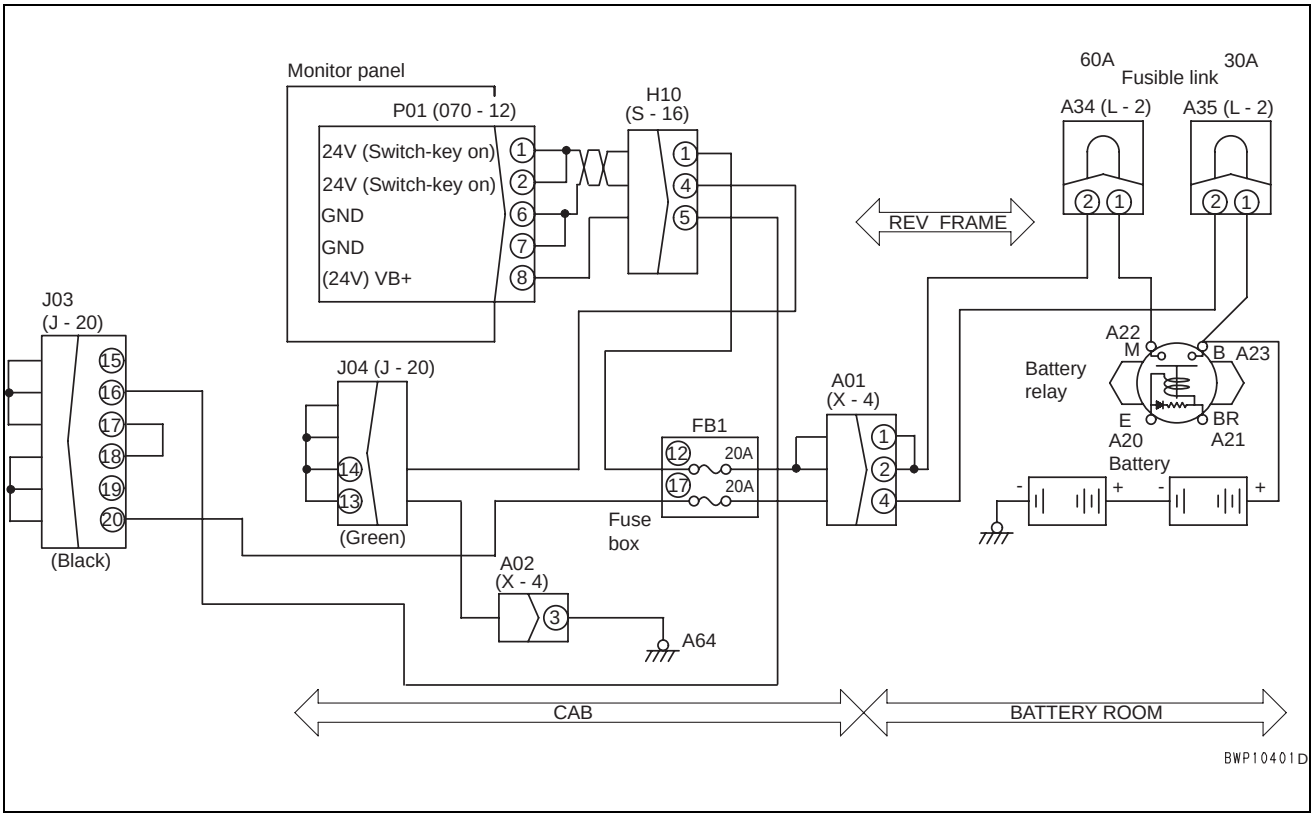


E-10 No display in monitor panel at all

Failure information	• When the engine starting switch is turned ON, there appears no display at all in the monitor panel.
Relative information	—

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting		
	1	Fuse No. 12 and 17 fault	If the fuse is blown, there is a big possibility that grounding fault occurred in the circuit.		
	2	Disconnection of wiring harness (Disconnection or defect contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Wiring harness from P01 (female) ① ② to H10 to FB1⑫	Resistance value	Below 1 Ω
			Wiring harness between P01 (female) ⑧ and grounding	Resistance value	Below 1 Ω
	3	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Between wiring harness from P01 (female) ① ② to FB1⑫ outlet and grounding	Resistance value	Above 1 MΩ
	4	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.		
			P01	Voltage and resistance value	
			Between ① ② and grounding	Voltage: 20 – 30 V	
			Between ⑥ ⑦ and grounding	Resistance value: Below 1 Ω	

Electrical Circuit Diagram for Power Source in Monitor Panel



E-11 Part of display on monitor panel is missing

Failure information	• Part of the display in the monitor panel is missing.
Relative information	—

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting
	1	Monitor panel LCD fault	If all the LCD in the monitor panel light up (i.e. the screen becomes totally white) by the following switching operation, then the monitor panel is normal. • Switching operation: [↩] + [A] (simultaneous switching operation)
	2	Monitor panel defective	As this is an internal failure, troubleshooting cannot be conducted. (If there is no problem with the above switching operation, the monitor panel is judged as defective)

E-12 Monitor panel displays contents irrelevant to the model

Failure information	• The monitor panels displays contents that have nothing to do with the model on which it is installed.
Relative information	—

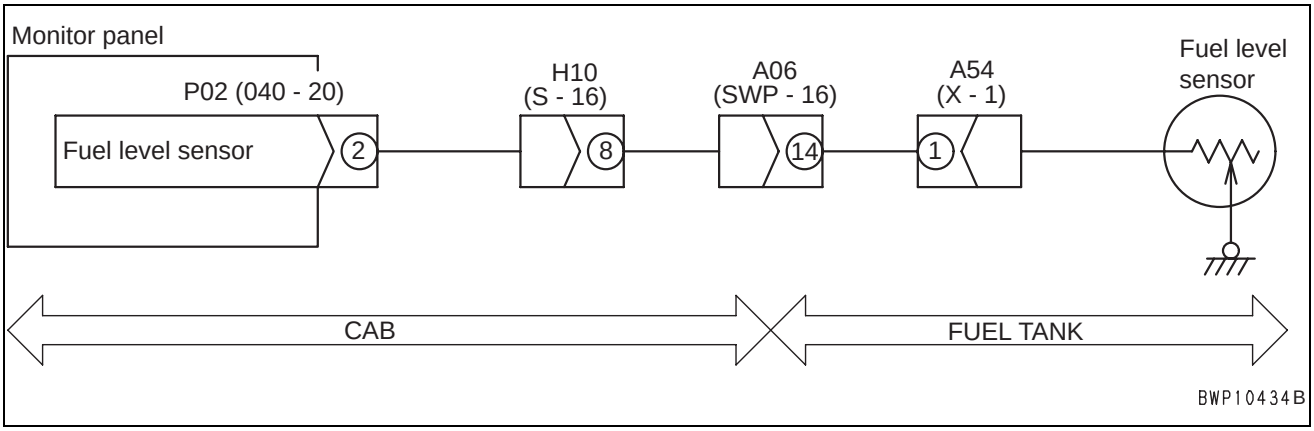
Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting		
	1	Model code signal fault (Internal failure)	If the display on the monitor panel is normal, proceed to Service Code [DA2SKQ].		
			Monitoring code	Item	Normal display
			00200	Controller model select	PW180
	2	Monitor panel defective	As this is an internal failure, troubleshooting cannot be conducted. (If there is no problem with the above, the monitor panel is judged as defective)		

E-13 Fuel level monitor red lamp lights up while engine is running

Failure information	• The fuel level monitor red lamp lighted up while the engine was running.
Relative information	• If the fuel gauge shows in a red range on the monitor panel, the fuel level monitor lamp lights up red. • Input signal from the fuel level sensor (voltage) can be confirmed in the monitor function. (Code No. 04200: Fuel level sensor)

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Fuel level lowered (system in normal condition)	• Refill fuel.			
	2	Fuel level sensor fault (Internal disconnection)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			A54 (male)	Fuel level	Resistance value	
			Between ① and grounding	FULL (Upper limit)	Approx. 12 Ω	
				EMPTY (Lower limit)	85 – 110 Ω	
	3	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between P02 (female) ② and A54 (female) ①		Resistance value	Below 1 Ω
	4	Governor • pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			P02 (female)	Fuel level	Resistance value	
			Between ② and grounding	FULL (Upper limit)	Approx. 12 Ω	
				EMPTY (Lower limit)	85 – 110 Ω	

Electrical Circuit Diagram for Fuel Level Sensor

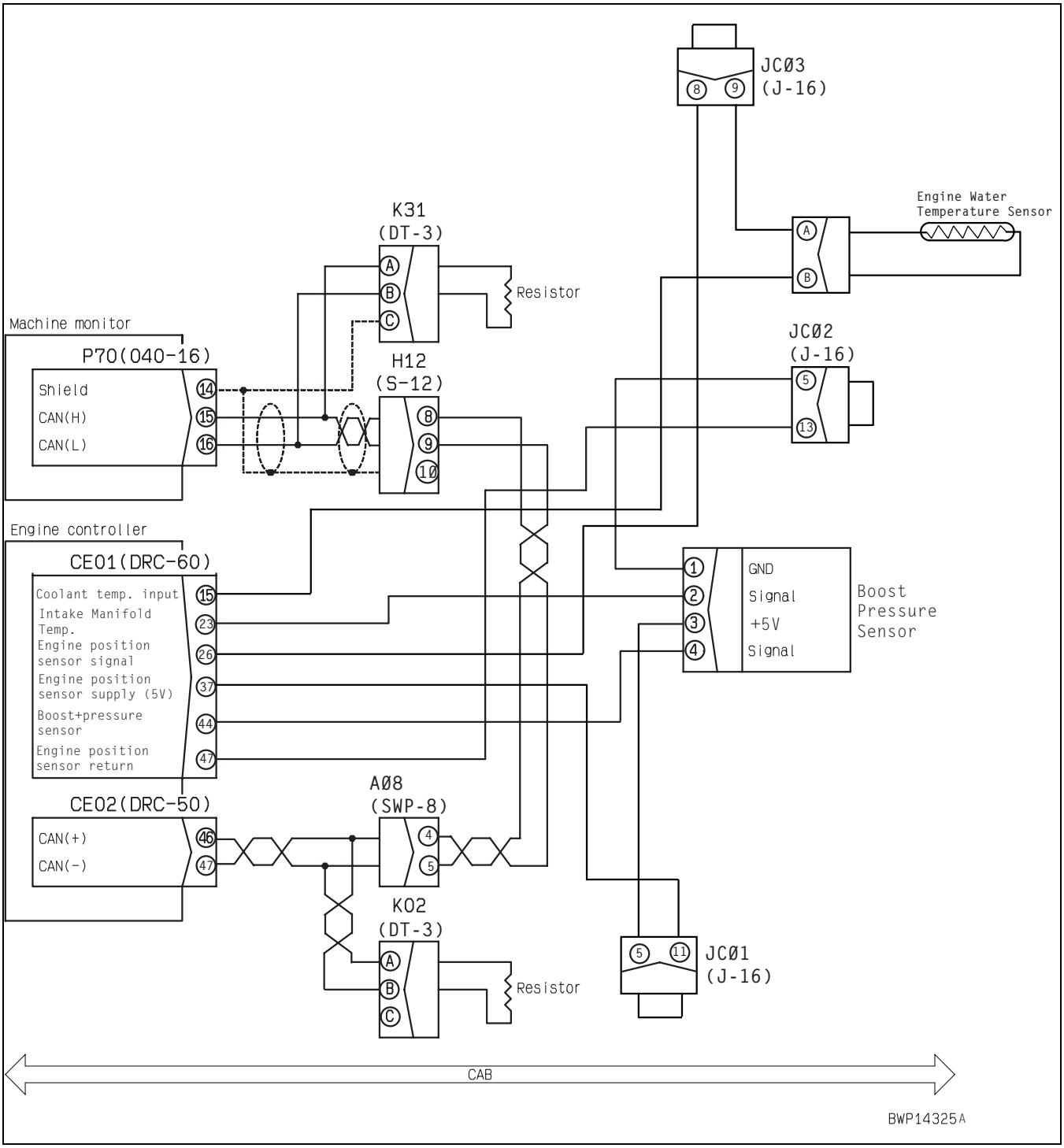


E14 Engine coolant temperature gauge does not indicate normally

Trouble	• While engine coolant temperature is rising normally, temperature gauge does not rise from white range (C). • While engine coolant temperature is stabilized normally, temperature gauge rises to red range (H).
Related information	• Input from the engine coolant temperature sensor (temperature) can be checked with monitoring function. (Code: 04105: Engine coolant temperature) • Check if failure code for abnormal communication (machine monitor) system [**DAFRMC**] is indicated (if yes, diagnose that failure first.)

<table>
<tr><td rowspan="15">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Defective coolant temperature sensor
(Internal disconnection or short circuit)</td><td colspan="4">a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td>Boost pressure sensor (male)</td><td>Engine coolant temperature</td><td colspan="2">Resistance</td></tr>
<tr><td>Between (2) – (1)</td><td rowspan="2">10 – 100°C</td><td colspan="2">90 – 3.5 kΩ</td></tr>
<tr><td>Between (2) – chassis ground</td><td colspan="2">Min. 1 MΩ</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Disconnection in wiring harness
(Disconnection in wiring or defective contact in connector)</td><td colspan="4">a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between CE01 (female) (15) –Boost pressure sensor (female) (2)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between boost pressure sensor (female) (1) – chassis ground</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Ground fault in wiring harness
(Short circuit with GND circuit)</td><td colspan="4">a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between CE01 (female) (15) – Boost pressure sensor (female) (2) and chassis ground</td><td>Resistance</td><td>Min. 1 MΩ</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Hot short (Short circuit with 24V circuit) in wiring harness</td><td colspan="4">a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.</td></tr>
<tr><td colspan="2">Wiring harness between CE01 (female) (15) – Boost pressure sensor (female) (2) and chassis ground</td><td>Voltage</td><td>Max. 1 V</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Defective engine controller</td><td colspan="4">a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td>CE01 (female)</td><td>Engine coolant temperature</td><td colspan="2">Resistance</td></tr>
<tr><td>Between (15) – chassis ground</td><td>10 – 100°C</td><td colspan="2">90 – 3.5 kΩ</td></tr>
</table>

Circuit diagram related to engine coolant temperature sensor

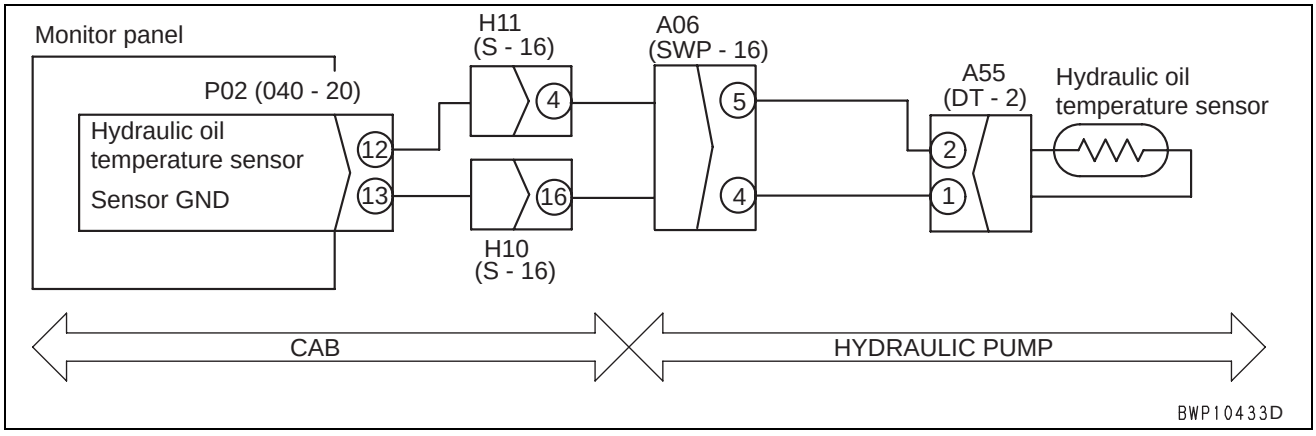


E-15 Hydraulic oil temperature gauge does not display correctly

Failure information	• Hydraulic oil temperature rises normally, but the display does not exceed the white range (C). • Hydraulic oil temperature remains stable, but the display rises up the red range (H).
Relative information	• Input from the hydraulic oil temperature sensor can be confirmed in the monitor function. (Code No. 04402: Hydraulic oil temperature)

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Hydraulic oil temperature sensor fault (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			A55	Engine cooling water temperature	Resistance value	
			Between ① and ②	10 – 100 °C	90 – 3.5 kΩ	
			Between ② and grounding		Above 1 MΩ	
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between P02 (female) ⑫ and A55 (female) ②		Resistance value	Below 1 Ω
			Wiring harness between P02 (female) ⑫ and A55 (female) ①		Resistance value	Between 1.9 and 38.2KΩ
	3	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between P02 (female) ⑫ and A55 (female) ② and grounding		Resistance value	Above 1 MΩ
	4	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness between P02 (female) ⑫ and A55 (female) ② and grounding		Voltage	Below 1 V
	5	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			P02	Engine cooling water temperature	Resistance value	
			Between ⑫ and ⑬	10 – 100 °C	90 – 3.5 kΩ	
			Between ⑫ and grounding		Above 1 MΩ	

Electrical Circuit Diagram for Hydraulic Oil Temperature Sensor

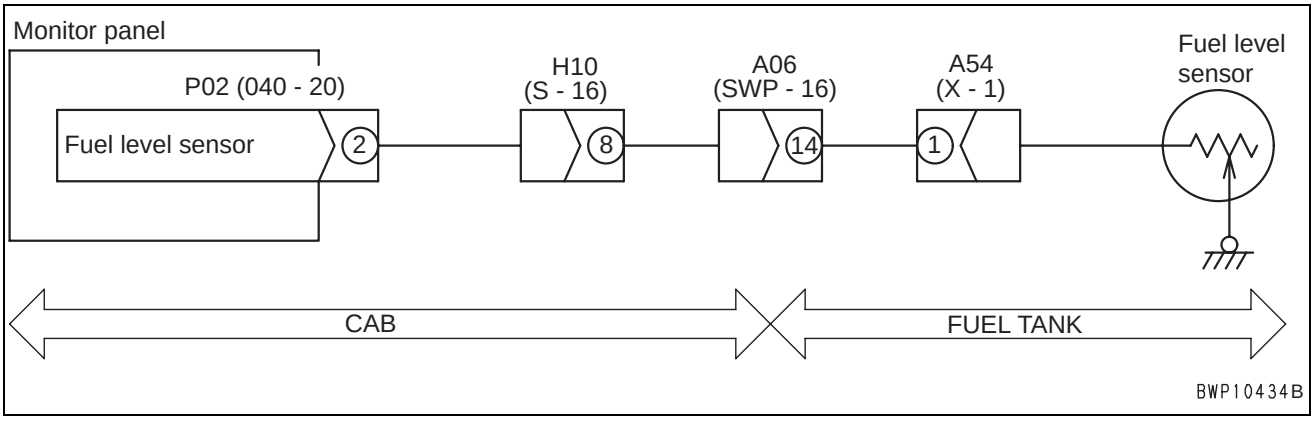


E-16 Fuel gauge does not display correctly

Failure information	• Though fuel was refilled, the display does not exceed the red range (E). • Though the remaining fuel level is low, the display does not drop below the green range (F).
Relative information	• Input from the fuel level sensor (voltage) can be confirmed in the monitor function. (Code No. 04200: Fuel sensor voltage)

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Fuel level sensor fault (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			A54 (male)	Fuel level	Resistance value	
			Between ① and grounding	FULL (Upper limit)	Approx. 12 Ω	
				EMPTY (Lower limit)	85 – 110 Ω	
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between P02 (female) ② and A54 (female) ①		Resistance value	Below 1 Ω
	3	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between P02 (female) ② and A54 (female) ① and grounding		Resistance value	Above 1 MΩ
	4	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			W iring harness between P02 (female) ② and A54 (female) ① and grounding		Voltage	Below 1 V
	5	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			P01	Fuel level	Resistance value	
			Between ② and grounding	FULL (Upper limit)	Approx. 12 Ω	
				EMPTY (Lower limit)	85 – 110 Ω	

Electrical Circuit Diagram for Fuel Level Sensor



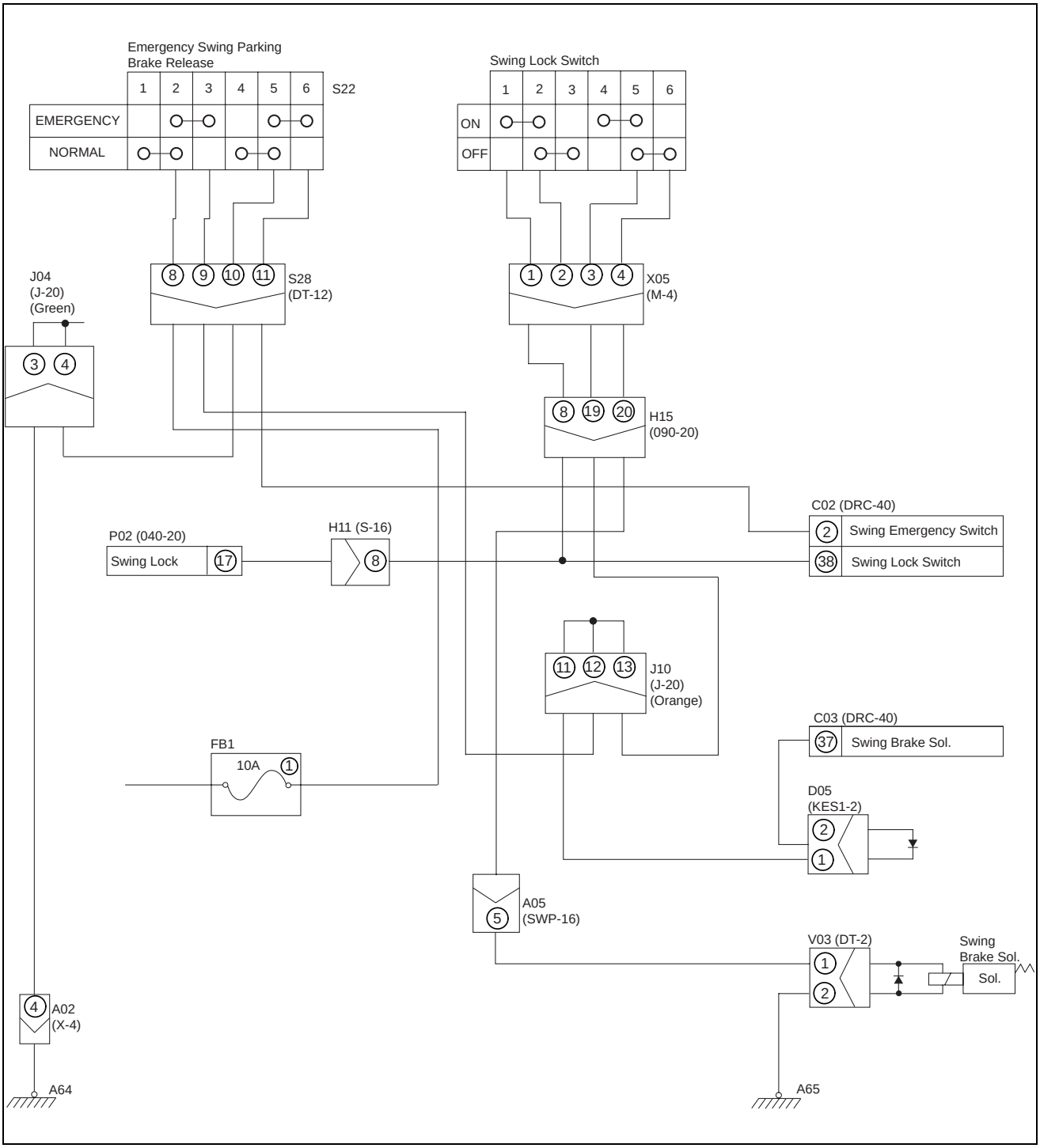
E-17 Swing lock monitor does not display correctly

Failure information	• Though the swing lock switch was turned ON, the swing lock monitor does not light up. • Though the swing lock switch was turned OFF, the swing lock monitor lights up.
Relative information	• Input from the swing lock switch (ON or OFF) can be confirmed in the monitor function. (Code No. 04502: Monitor input 3)

Presumed cause and standard value in normal

Cause		Standard value in normal and references for troubleshooting			
1	Swing lock switch fault (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		X05 (female)	Swing lock switch	Resistance value	
		Between ① and ②	OFF	Above 1 MΩ	
			ON	Below 1 Ω	
		Between ③ and ④	OFF	Below 1 Ω	
			ON	Above 1 MΩ	
2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness from P02 (female) ⑰ to H11 to H15 to X05 (female) ①		Resistance value	Below 1 Ω
		Wiring harness from X05 (female) ④ to grounding		Resistance value	Below 1 Ω
3	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Between wiring harness from P02 (female) ⑰ to H11 to H15 to X05 (male) ① and grounding		Resistance value	Above 1 MΩ
4	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		Between wiring harness from P02 (female) ⑰ to H11 to H15 to X05 (male) ① and grounding		Voltage	Below 1 V
5	Monitor panel defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		P02	Swing lock switch	Voltage	
		Between ⑰ and grounding	OFF	20 – 30 V	
			ON	Below 1 V	

Electrical Circuit Diagram for Swing Lock Switch



E-18 When the monitor switch is operated, no display appears

Failure information (1)	• When operating the working mode changing switch, the working mode monitor does not appear.
Relative information	—

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting
	1	Monitor panel defective	As this is an internal failure, troubleshooting cannot be conducted.

Failure information (2)	• When operating the auto-deceleration switch, the auto-deceleration monitor does not appear.
Relative information	• If the auto-deceleration itself does not work, either, proceed to section E-5 of this troubleshooting chapter.

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting
	1	Monitor panel defective	As this is an internal failure, troubleshooting cannot be conducted.

Failure information (3)	• When operating the travel speed shifting switch, the travel speed monitor does not appear.
Relative information	• If the travel speed does not actually change, proceed to section H-18 of this troubleshooting chapter.

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting
	1	Monitor panel defective	As this is an internal failure, troubleshooting cannot be conducted.

Failure information (4)	• When operating the windshield wiper switch, the windshield wiper monitor does not appear.
Relative information	• If the windshield wiper itself does not work, either, proceed to section E-19 of this troubleshooting chapter.

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting
	1	Monitor panel defective	As this is an internal failure, troubleshooting cannot be conducted.

Failure information (5)	• When operating the select switch, the adjustment display does not appear. • When operating the LCD monitor adjusting switch, the adjustment display does not appear. • When operating the maintenance switch, the item display does not appear.
Relative information	—

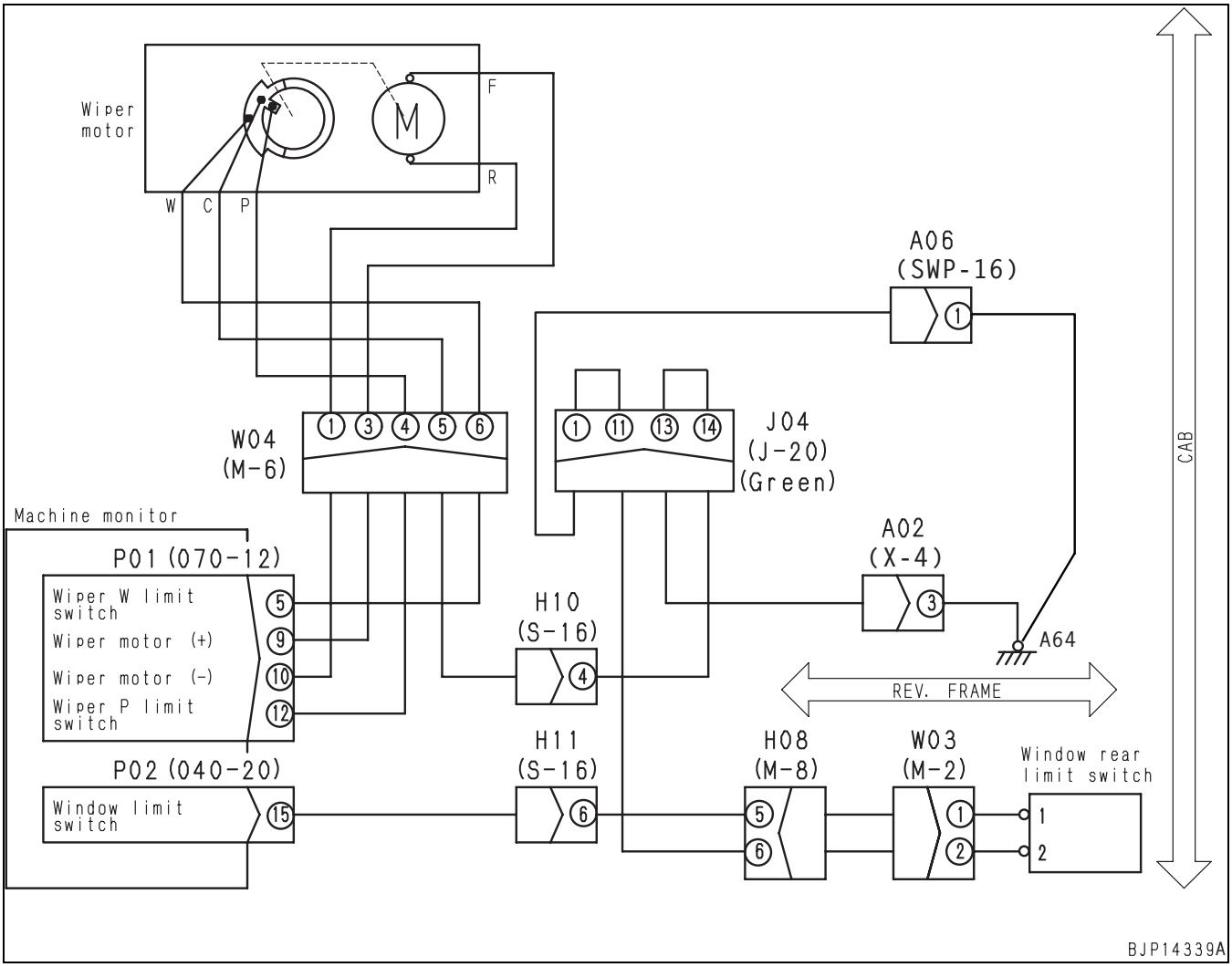
Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting
	1	Monitor panel defective	As this is an internal failure, troubleshooting cannot be conducted.

E-19 Windshield wiper and window washer do not operate

Trouble	• Windshield wiper and window washer do not operate	(1) Windshield wiper does not operate.
Related information	• Input from window limit switch (ON/OFF) can be checked with monitoring function. (Code 04502: Monitor Input 3)	

<table>
<tr><td rowspan="15">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="5">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Defective window rear limit switch
(Internal disconnection or short circuit)</td><td colspan="5">a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td>W03 (male)</td><td colspan="2">Front window</td><td colspan="2">Resistance</td></tr>
<tr><td rowspan="2">Between (1) – (2)</td><td colspan="2">When installed to front</td><td colspan="2">Min. 1 MΩ</td></tr>
<tr><td colspan="2">When retracted to rear</td><td colspan="2">Max. 1 Ω</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Defective wiper motor
(Internal disconnection or short circuit)</td><td colspan="5">a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="3">W04 (male)</td><td colspan="2">Resistance</td></tr>
<tr><td colspan="3">Between (3) – (1)</td><td colspan="2"></td></tr>
<tr><td colspan="3">Between (3), (1) – chassis ground</td><td colspan="2">Min. 1 MΩ</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Disconnection in wiring harness
(Disconnection in wiring or defective contact in connector)</td><td colspan="5">a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="3">Wiring harness between P01 (female) (9) – W04 (female) (3)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="3">Wiring harness between P01 (female) (10) – W04 (female) (1)</td><td>Resistance</td><td>Max. 1 Ω</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Ground fault in wiring harness
(Short circuit with GND circuit)</td><td colspan="5">a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="3">Wiring harness between P02 (female) (15) – W03 (male) (2) and chassis ground</td><td>Resistance</td><td>Min. 1 MΩ</td></tr>
<tr><td rowspan="5">5</td><td rowspan="3">Defective machine monitor (window limiter switch system)</td><td colspan="5">a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.</td></tr>
<tr><td>P01</td><td colspan="2">Front window</td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="2">Between (15) – chassis ground</td><td colspan="2">When installed to front</td><td colspan="2">20 – 30 V</td></tr>
<tr><td colspan="2">When retracted to rear</td><td colspan="2">Max. 1 V</td></tr>
<tr><td rowspan="4">Defective machine monitor (Wiper motor system)</td><td colspan="5">a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.</td></tr>
<tr><td>P01</td><td colspan="2">Wiper switch</td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="2">Between (9) – chassis ground
Between (10) – chassis ground</td><td colspan="2">OFF</td><td colspan="2">Max. 3 V</td></tr>
<tr><td colspan="2">ON</td><td colspan="2">Max. 3 V ⇔ 20 – 30 V (Constant cycle)</td></tr>
</table>

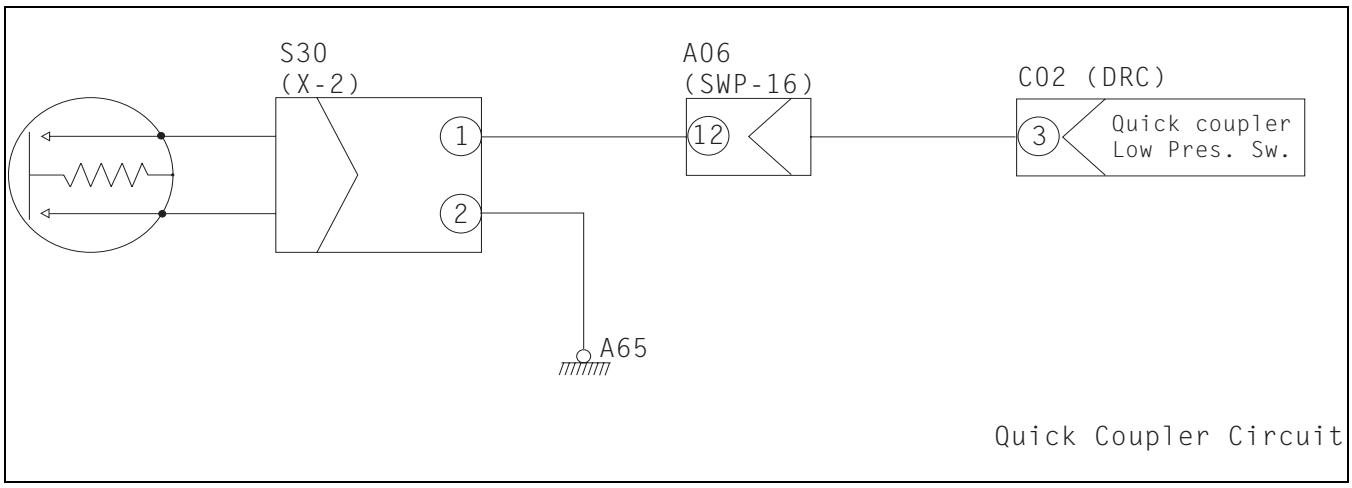
Circuit diagram related to windshield wiper motor



E-20 Alarm buzzer cannot be stopped

Trouble	• Alarm buzzer cannot be stopped.
Related information	-

Possible causes and standard value in normal state		Cause	Standard value in normal state/Remarks on troubleshooting		
	1	Defective machine monitor	Machine monitor may be defective. (Since trouble is in system, troubleshooting cannot be carried out.)		
	2	Quick coupler grounding fault of wiring harness (Contact with grounding [GND] circuit)	• Turn the engine starting switch OFF for the preparation and hold it in the OFF position during troubleshooting.		
			Wiring harness between C02 (female) ③ and S30 (female) ① and grounding.	Resistance Value	Above 1 MΩ



Quick Coupler Circuit

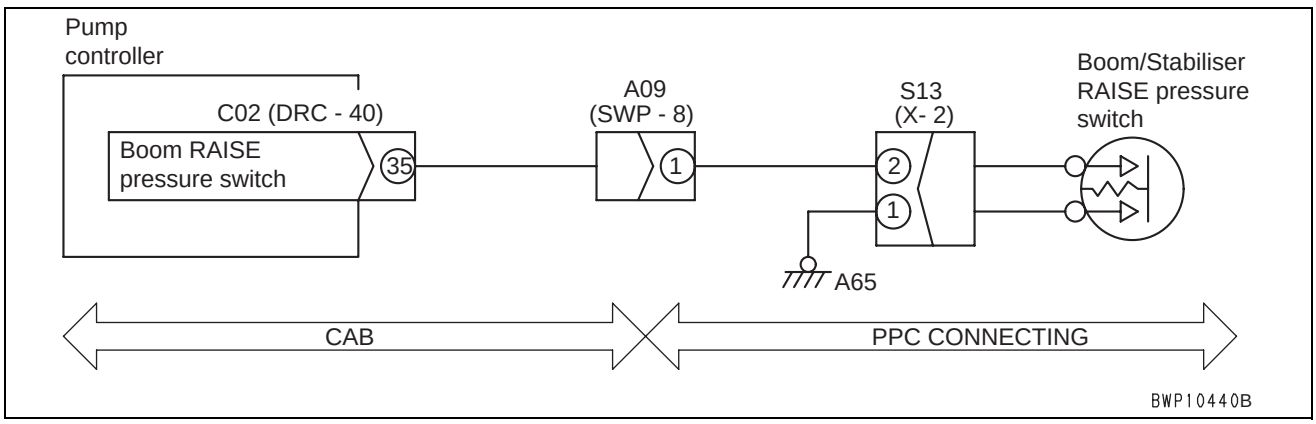
E-21 "Boom/Stabiliser RAISE" is not correctly displayed in monitor function

Failure information	• "Boom/Stabiliser RAISE" is not correctly displayed in the monitor function on the monitor panel.
Relative information	• Monitoring code: 01900 (Pressure switch 1)

Presumed cause and standard value in normal

Cause		Standard value in normal and references for troubleshooting			
1	Boom/Stabiliser RAISE PPC hydraulic switch fault (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
		S13 (male)	Boom control lever	Resistance value	
		Between ① and ②	NEUTRAL	Above 1 MΩ	
			RAISE	Below 1 Ω	
2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C02 (female) ㉟ and S13 (female) ②		Resistance value	Below 1 Ω
		Wiring harness between S13 (female) ① and grounding		Resistance value	Below 1 Ω
3	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C02 (female) ㉟ and S13 (female) ② and grounding		Resistance value	Above 1 MΩ
4	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		Wiring harness between C02 (female) ㉟ and S13 (female) ② and grounding		Voltage	Below 1 V
5	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		C02	Boom control lever	Voltage	
		Between ㉟ and grounding	NEUTRAL	20 – 30 V	
			RAISE	Below 1 V	

Electrical Circuit Diagram for Boom RAISE PPC Hydraulic Switch



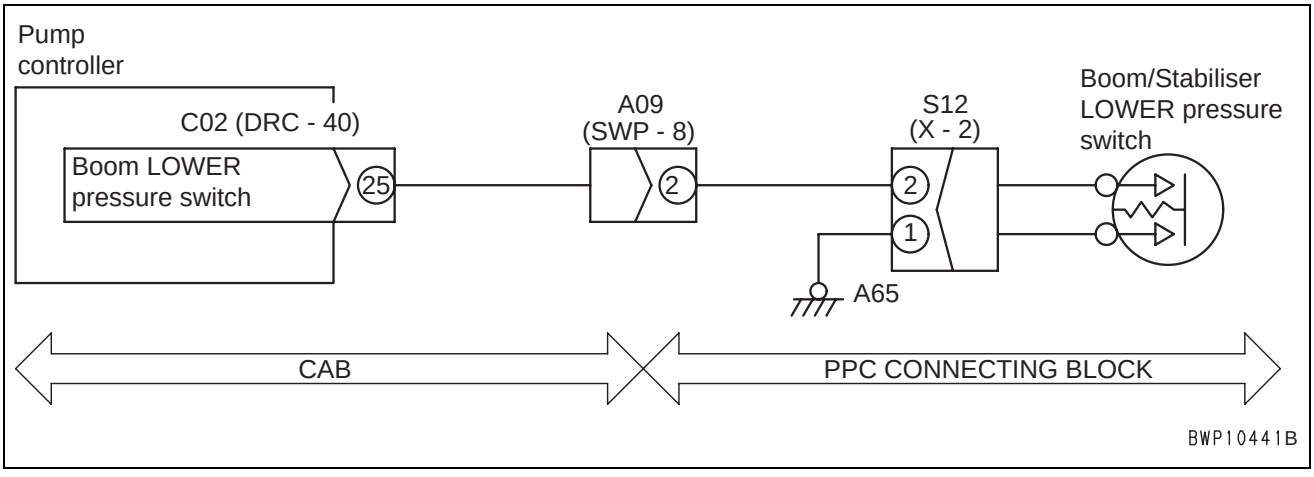
E-22 "Boom/Stabiliser LOWER" is not correctly displayed in monitor function

Failure information	• "Boom/Stabiliser LOWER" is not correctly displayed in the monitor function on the monitor panel.
Relative information	• Monitoring code: 01900 (Pressure switch 1)

Presumed cause and standard value in normal

	Cause	Standard value in normal and references for troubleshooting			
1	Boom/Stabiliser LOWER PPC hydraulic switch fault (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
		S12 (male)	Boom control lever	Resistance value	
		Between ① and ②	NEUTRAL	Above 1 MΩ	
			LOWER	Below 1 Ω	
2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C02 (female) ㉕ and S12 (female) ②		Resistance value	Below 1 Ω
		Wiring harness between S12 (female) ① and grounding		Resistance value	Below 1 Ω
3	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C02 (female) ㉕ and S12 (female) ② and grounding		Resistance value	Above 1 MΩ
4	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		Wiring harness between C02 (female) ㉕ and S12 (female) ② and grounding		Voltage	Below 1 V
5	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		C02	Boom control lever	Voltage	
		Between ㉕ and grounding	NEUTRAL	20 – 30 V	
			LOWER	Below 1 V	

Electrical Circuit Diagram for Boom LOWER PPC Hydraulic Switch



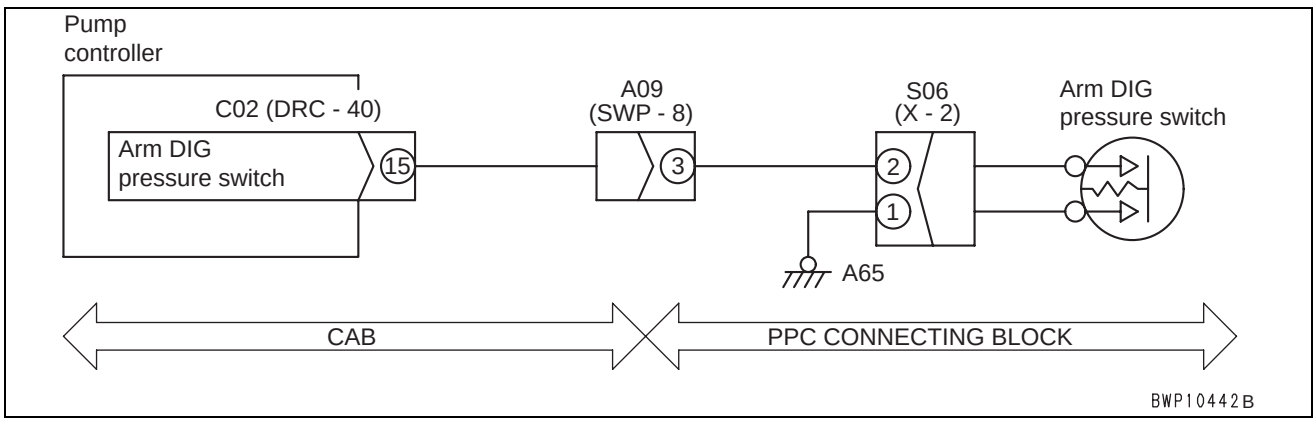
E-23 "Arm DIGGING" is not correctly displayed in monitor function

Failure information	• "Arm DIGGING" is not correctly displayed in the monitor function (special function) on the monitor panel.
Relative information	• Monitoring code: 01900 (Pressure switch 1)

Presumed cause and standard value in normal

Cause		Standard value in normal and references for troubleshooting			
1	Arm DIGGING PPC hydraulic switch fault (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
		S06 (male)	Arm control lever	Resistance value	
		Between ① and ②	NEUTRAL	Above 1 MΩ	
			DIGGING	Below 1 Ω	
2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C02 (female) ⑮ and S06 (female) ②		Resistance value	Below 1 Ω
		Wiring harness between S06 (female) ① and grounding		Resistance value	Below 1 Ω
3	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C02 (female) ⑮ and S06 (female) ② and grounding		Resistance value	Above 1 MΩ
4	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		Wiring harness between C02 (female) ⑮ and S06 (female) ② and grounding		Voltage	Below 1 V
5	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		C02	Arm control lever	Voltage	
		Between ⑮ and grounding	NEUTRAL	20 – 30 V	
			DIGGING	Below 1 V	

Electrical Circuit Diagram for Arm DIGGING PPC Hydraulic Switch

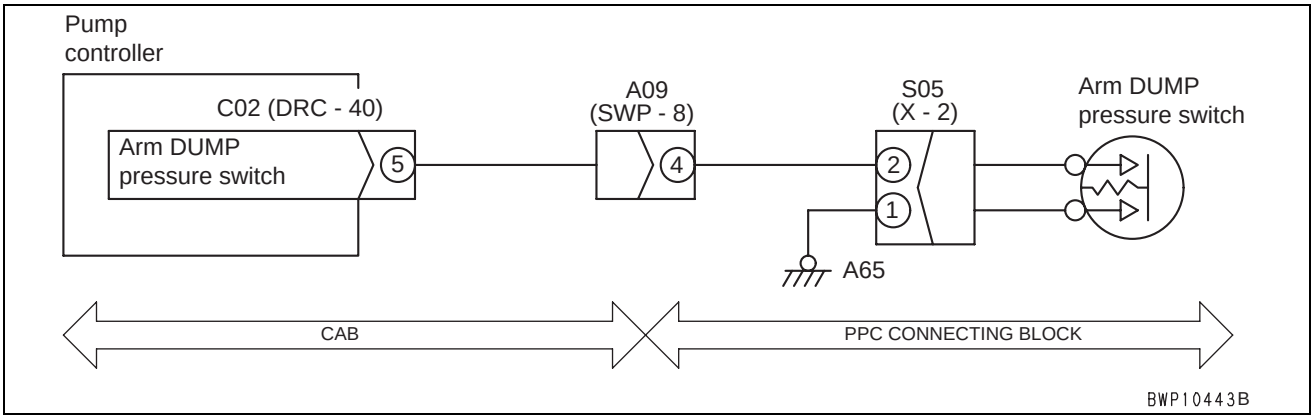


E-24 "Arm DUMPING" is not correctly displayed in monitor function

Failure information	• "Arm DUMPING" is not correctly displayed in the monitor function (special function) on the monitor panel.
Relative information	• Monitoring code: 01900 (Pressure switch 1)

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Arm DUMPING PPC hydraulic switch defect (Internal disconnection and short-circuiting)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
			S05 (male)	Arm control lever	Resistance value	
			Between ① and ②	NEUTRAL	Above 1 MΩ	
				DUMPING	Below 1 Ω	
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between C02 (female) ⑤ and S05 (female) ②		Resistance value	Below 1 Ω
			Wiring harness between S05 (female) ① and grounding		Resistance value	Below 1 Ω
	3	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between C02 (female) ⑤ and S05 (female) ② and grounding		Resistance value	Above 1 MΩ
	4	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Wiring harness between C02 (female) ⑤ and S05 (female) ② and grounding		Voltage	Below 1 V
	5	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C02	Arm control lever	Voltage	
			Between ⑤ and grounding	NEUTRAL	20 – 30 V	
				DUMPING	Below 1 V	

Electrical Circuit Diagram for Arm DUMPING PPC Hydraulic Switch



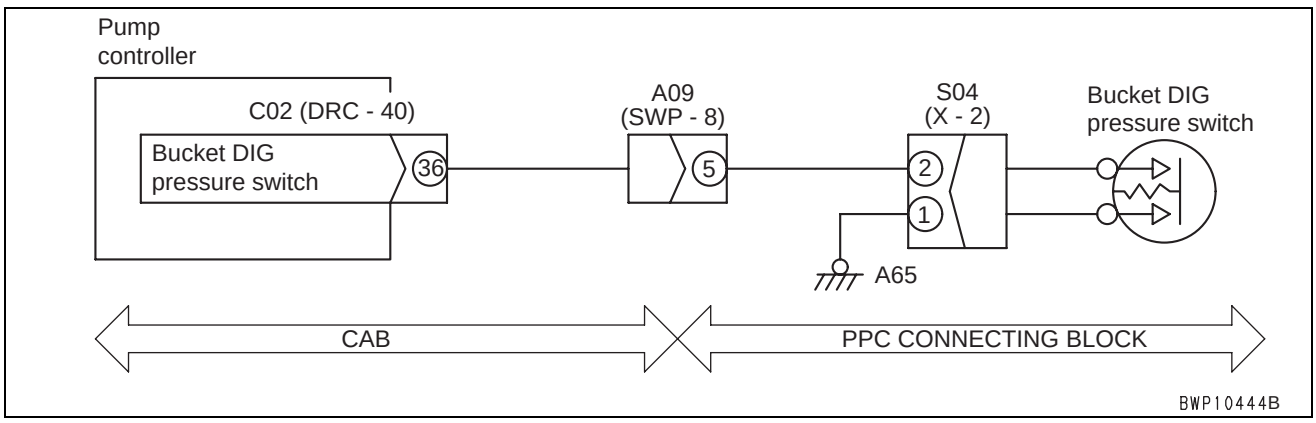
E-25 "Bucket DIGGING" is not correctly displayed in monitor function

Failure information	• "Bucket DIGGING" is not correctly displayed in the monitor function (special function) on the monitor panel.
Relative information	• Monitoring code: 01901 (Pressure switch 2)

Presumed cause and standard value in normal

	Cause	Standard value in normal and references for troubleshooting			
1	Bucket DIGGING PPC hydraulic switch fault (Internal disconnection and short-circuiting)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
		S04 (male)	Bucket control lever	Resistance value	
		Between ① and ②	NEUTRAL	Above 1 MΩ	
			DIGGING	Below 1 Ω	
2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C02 (female) ㊱ and S04 (female) ②		Resistance value	Below 1 Ω
		Wiring harness between S04 (female) ① and grounding		Resistance value	Below 1 Ω
3	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C02 (female) ㊱ and S04 (female) ② and grounding		Resistance value	Above 1 MΩ
4	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		Wiring harness between C02 (female) ㊱ and S04 (female) ② and grounding		Voltage	Below 1 V
5	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		C02	Bucket control lever	Voltage	
		Between ㊱ and grounding	NEUTRAL	20 – 30 V	
			DIGGING	Below 1 V	

Electrical Circuit Diagram for Bucket DIGGING PPC hydraulic Switch



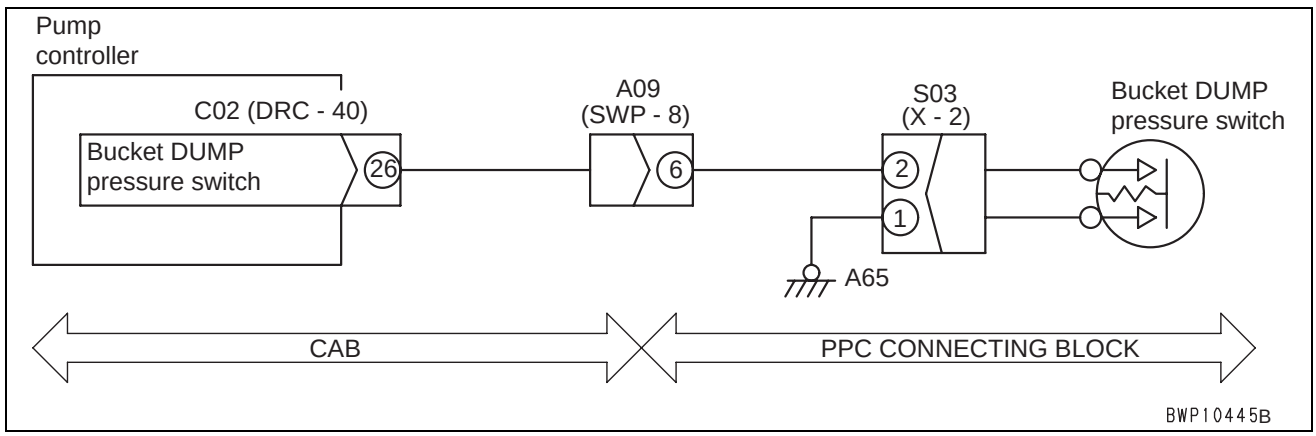
E-26 "Bucket DUMPING" is not correctly displayed in monitor function

Failure information	• "Bucket DUMPING" is not correctly displayed in the monitor function (special function) on the monitor panel.
Relative information	Monitoring code: 01901 (Pressure switch 2)

Presumed cause and standard value in normal

	Cause	Standard value in normal and references for troubleshooting			
1	Bucket DUMPING PPC hydraulic switch fault (Internal disconnection and short-circuiting)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
		S03 (male)	Bucket control lever	Resistance value	
		Between ① and ②	NEUTRAL	Above 1 MΩ	
			DUMPING	Below 1 Ω	
2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C02 (female) ㉖ and S03 (female) ②		Resistance value	Below 1 Ω
		Wiring harness between S03 (female) ① and grounding		Resistance value	Below 1 Ω
3	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C02 (female) ㉖ and S03 (female) ② and grounding		Resistance value	Above 1 MΩ
4	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		Wiring harness between C02 (female) ㉖ and S03 (female) ② and grounding		Voltage	Below 1 V
5	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		C02	Bucket control lever	Voltage	
		Between ㉖ and grounding	NEUTRAL	20 – 30 V	
			DUMPING	Below 1 V	

Electrical Circuit Diagram for Bucket DUMPING PPC hydraulic Switch



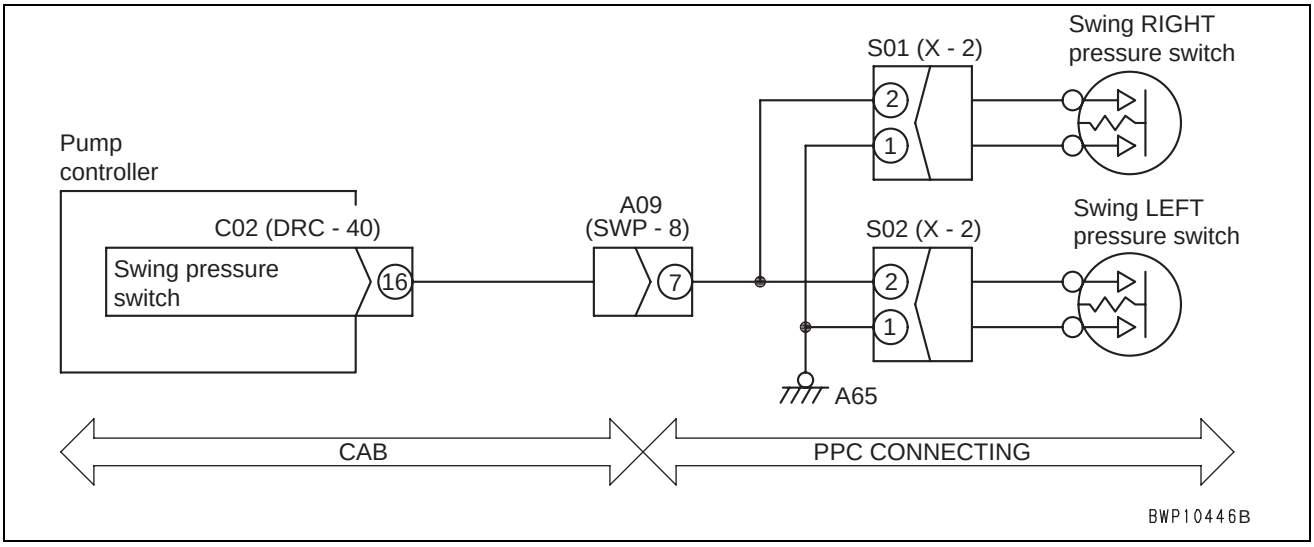
E-27 "SWING" is not correctly displayed in monitor function

Failure information	• "SWING" is not correctly displayed in the monitor function (special function) on the monitor panel.
Relative information	Monitoring code: 1900 (Pressure switch 1)

Presumed cause and standard value in normal

Cause		Standard value in normal and references for troubleshooting			
1	Swing PPC hydraulic switch, right, fault (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
		S01 (male)	Swing control lever	Resistance value	
		Between ① and ②	NEUTRAL	Above 1 MΩ	
			Right	Below 1 Ω	
2	Swing PPC hydraulic switch, left, fault (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
		S02 (male)	Swing control lever	Resistance value	
		Between ① and ②	NEUTRAL	Above 1 MΩ	
			Left	Below 1 Ω	
3	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C02 (female) ⑯ and S01 (female) ②, or wiring harness between C02 (female) ⑯ and S02 (female) ②		Resistance value	Below 1 Ω
		Wiring harness between S01 (female) ① and grounding		Resistance value	Below 1 Ω
		Wiring harness between S02 (female) ① and grounding		Resistance value	Below 1 Ω
4	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C02 (female) ⑯ and S01 (female) ②, or wiring harness between C02 (female) ⑯ and S02 (female) ② and grounding		Resistance value	Above 1 MΩ
5	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		Wiring harness between C02 (female) ⑯ and S01 (female) ②, or wiring harness between C02 (female) ⑯ and S02 (female) ② and grounding		Voltage	Below 1 V
6	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		C02	Swing control lever	Voltage	
		Between ⑯ and grounding	NEUTRAL	20 – 30 V	
			Right or left	Below 1 V	

Electrical Circuit Diagram for Right and Left Swing PPC hydraulic Switches

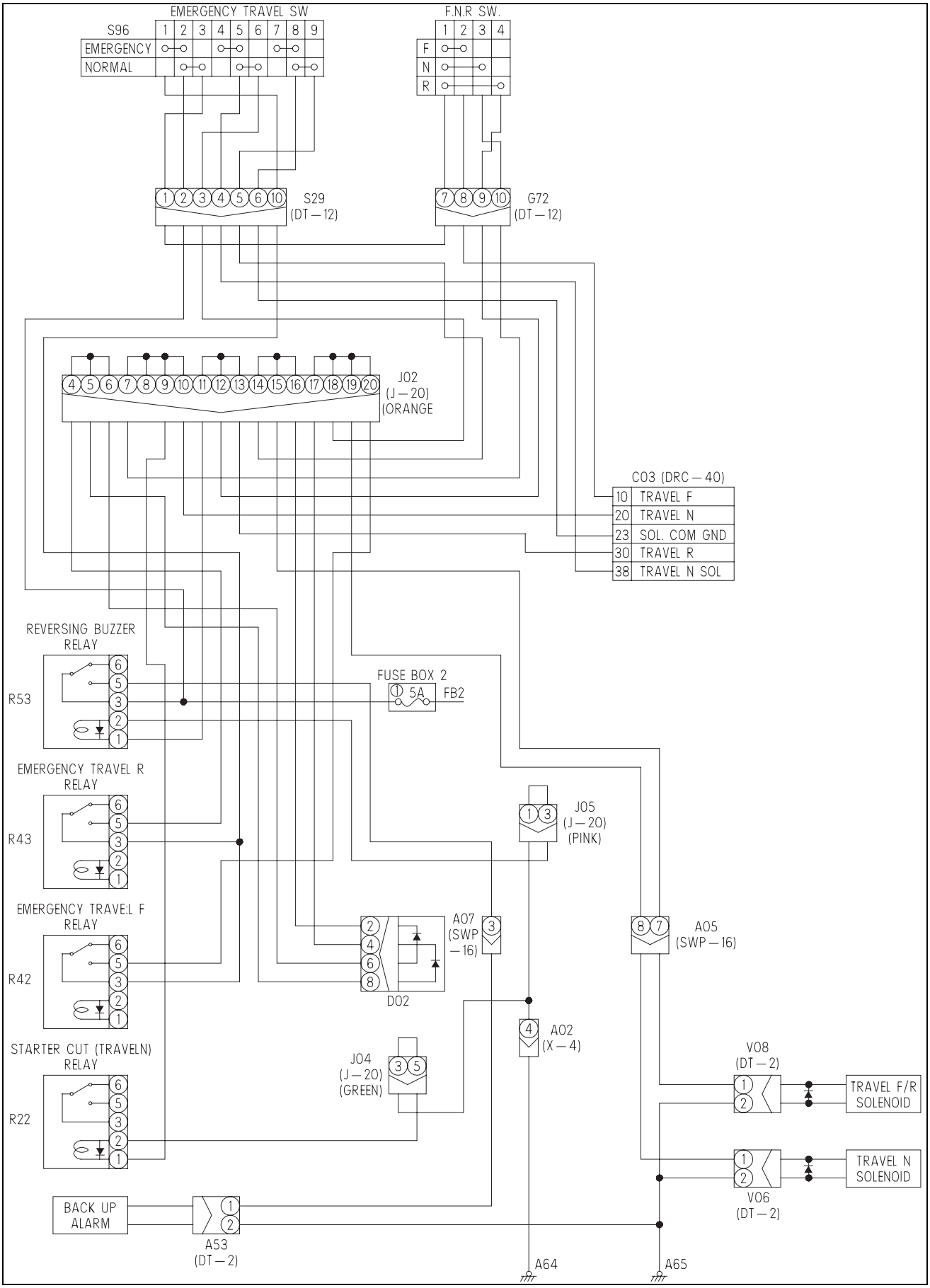


E-28 "TRAVEL" is not correctly displayed in monitor function

Failure information	• "TRAVEL" is not correctly displayed in the monitor function (special function) on the monitor panel.
Relative information	—Default travel indication is neutral

<table>
<tr><td rowspan="16">Presumed cause and standard value in normal</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal and references for troubleshooting</td></tr>
<tr><td rowspan="5">1</td><td rowspan="5">Travel PPC hydraulic switch fault (Internal disconnection or short-circuiting)</td><td colspan="4">• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.</td></tr>
<tr><td>G72 (male)</td><td>Travel control lever</td><td colspan="2">Resistance value</td></tr>
<tr><td rowspan="2">Between ⑦ and ⑧</td><td>NEUTRAL</td><td colspan="2">Above 1 MΩ</td></tr>
<tr><td>Forward</td><td colspan="2">Below 1 Ω</td></tr>
<tr><td rowspan="2">Between ⑦ and ⑨</td><td>NEUTRAL</td><td colspan="2">Above 1 MΩ</td></tr>
<tr><td>Reverse</td><td colspan="2">Below 1 Ω</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Disconnection of wiring harness (Disconnection or defective contact with connector)</td><td colspan="4">• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.</td></tr>
<tr><td colspan="2">Wiring harness from C03 (female) ⑩ to G72 (female) ⑧</td><td>Resistance value</td><td>Below 1 Ω</td></tr>
<tr><td colspan="2">Wiring harness from C03 (female) ⑳ to J02 to G72 (female) ⑩</td><td>Resistance value</td><td>Below 1 Ω</td></tr>
<tr><td colspan="2">Wiring harness from C03 (female) ㉚ to J02 to G72 ⑨</td><td>Resistance value</td><td>Below 1 Ω</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Grounding fault of wiring harness (Contact with grounding (GND) circuit)</td><td colspan="4">• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.</td></tr>
<tr><td colspan="2">Wiring harness from C03 (female) ⑩, or C03 ⑳, or between wiring harness between C03 (female) ㉚ and grounding</td><td>Resistance value</td><td>Above 1 MΩ</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Short-circuiting of wiring harness (Contact with 24 V circuit)</td><td colspan="4">• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.</td></tr>
<tr><td colspan="2">Wiring harness from C03 (female) ⑩, or C03 ⑳, or between wiring harness between C03 (female) ㉚ and grounding.</td><td>Voltage</td><td>Below 1 V</td></tr>
<tr><td rowspan="4">5</td><td rowspan="4">Pump controller defective</td><td colspan="4">• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.</td></tr>
<tr><td>C03</td><td>Travel control lever</td><td colspan="2">Voltage</td></tr>
<tr><td>Between ⑩ and grounding</td><td rowspan="2">NEUTRAL</td><td colspan="2" rowspan="2">20 – 30 V</td></tr>
<tr><td>Between ⑳ and grounding</td></tr>
<tr><td>Between ㉚ and grounding</td><td>Forward or backward</td><td colspan="2">Below 1 V</td></tr>
</table>

Electrical Circuit Diagram for Travel PPC hydraulic Switch and Travel Alarm



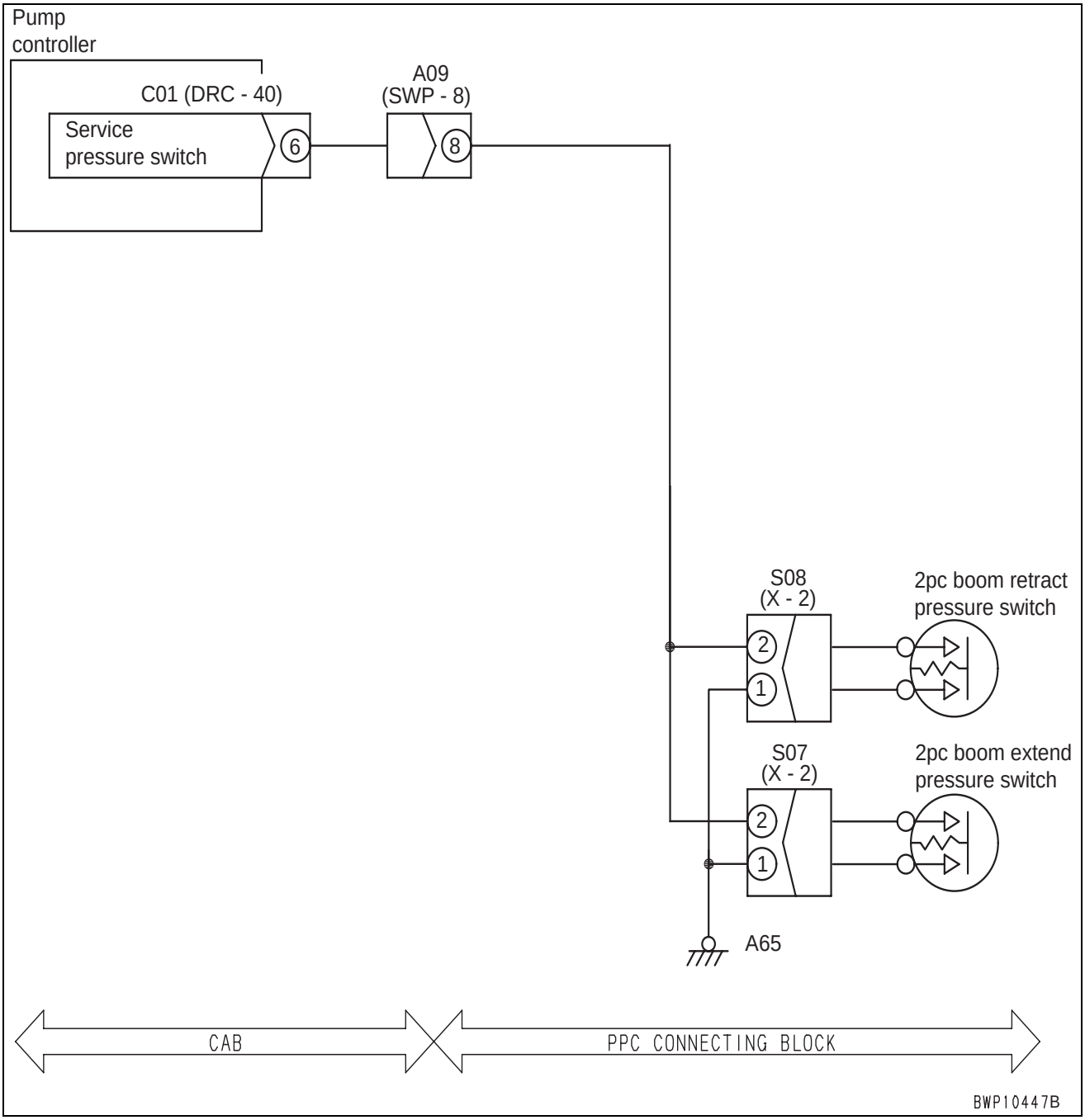
E-29 "2 Piece Boom" is not correctly displayed in monitor function

Failure information	• "2 Piece Boom" is not correctly displayed in the monitor function (special function) on the monitor panel.
Relative information	—

Presumed cause and standard value in normal

	Cause	Standard value in normal and references for troubleshooting			
1	2 Piece Boom (Extend) PPC hydraulic switch fault (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
		S07 (male)	Service pedal	Resistance value	
		Between ① and ②	NEUTRAL	Above 1 MΩ	
			Front	Below 1 Ω	
2	2 Piece Boom (Retract) PPC hydraulic switch fault (Internal disconnection or short-circuiting)	• Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
		S08 (male)	Service pedal	Resistance value	
		Between ① and ②	NEUTRAL	Above 1 MΩ	
			Rear	Below 1 Ω	
3	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C01 (female) ⑥ and S07 (female) ②, or wiring harness between C01 (female) ⑥ and S08 (female) ②		Resistance value	Below 1 Ω
		Wiring harness between S07 (female) ① and grounding or Wiring harness between S08 (female) ① and grounding		Resistance value	Below 1 Ω
4	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
		Wiring harness between C01 (female) ⑥ and S07 (female) ②, or between wiring harness between C01 (female) ⑥ and S08 (female) ② and grounding		Resistance value	Above 1 MΩ
5	Short-circuiting of wiring harness (Contact with 24 V circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		Wiring harness between C01 (female) ⑥ and S07 (female) ①, or between wiring harness between C01 (female) ⑥ and S08 (female) ① and grounding		Voltage	Below 1 V
6	Pump controller defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
		C01	Service pedal	Voltage	
		Between ⑥ and grounding	NEUTRAL	20 – 30 V	
			Front or rear	Below 1 V	

Electrical Circuit Diagram for 2 Pice Boom PPC hydraulic Switch

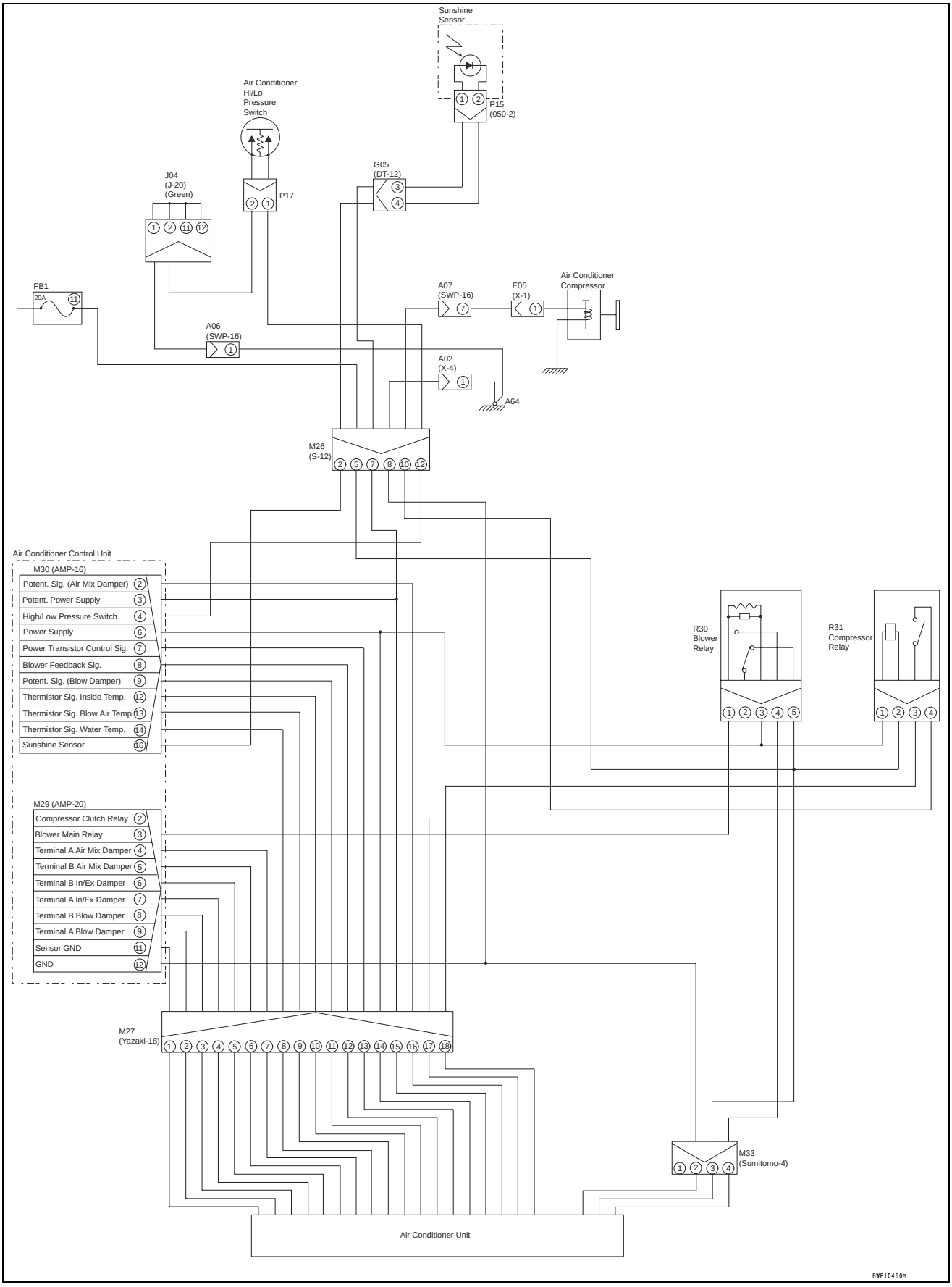


E-30 Air Conditioner does not work

Failure information	• The air conditioner does not work.
Relative information	• For the electrical circuit diagram inside the air conditioner unit, refer to the section of STRUCTURE AND FUNCTION - Air Conditioner in this manual.

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting		
	1	Fuse No. 11 fault	When the fuse is blown, there is a big possibility that grounding fault occurred in the circuit.		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Wiring harness between FB1⑪ outlet and M26 (male) ⑤	Resistance value	Below 1 Ω
			Wiring harness between M26 (male) ⑧ and grounding	Resistance value	Below 1 Ω
	3	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Between wiring harness between FB1⑪ outlet and M26 (male) ⑤ and grounding	Voltage	Above 1 MΩ
	4	Air conditioner unit defective	• Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.		
			M26	Voltage	
			Between ⑤ and ⑩	20 – 30 V	

Electrical Circuit Diagram for Air Conditioner

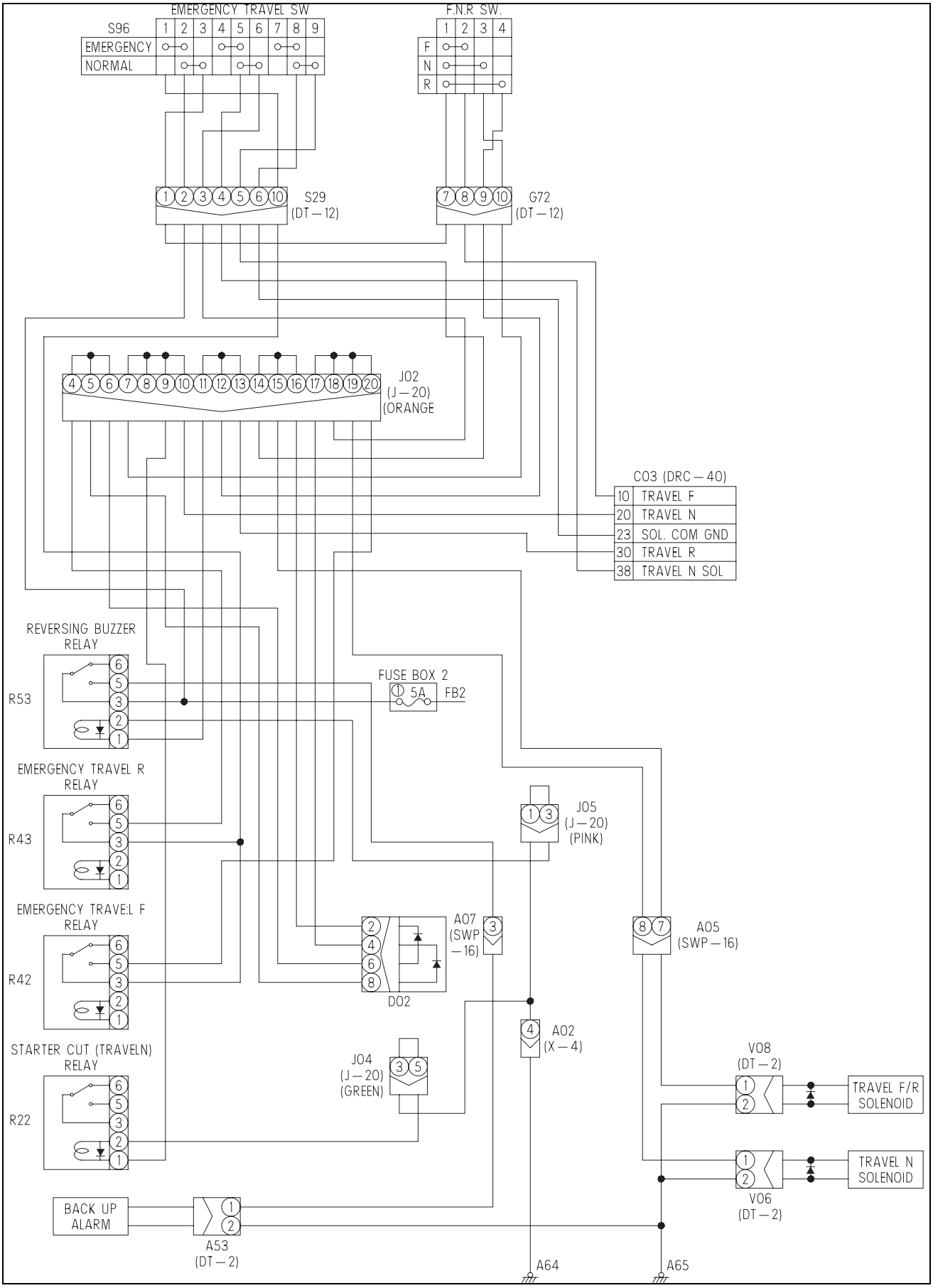


E-31 Travel reverse alarm does not sound

Failure information	• The travel alarm does not sound while the machine is travelling. • The alarm begins to sound when the machine is at a standstill.
Relative information	—

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Fuse box 2 - Fuse No. 1 fault	When the fuse is blown, there is a big possibility that grounding fault occurred in the circuit.			
	2	Travel signal fault	If the monitor display is not correct, proceed to section E-21 of this troubleshooting chapter.			
			Monitoring code	Item	Normal display	
			02200	Travel Reverse	Control lever operation: ON Control lever NEUTRAL: OFF	
	3	Disconnection of wiring harness (Disconnection or defective contact with connector)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting. Ensure FNR switch is in reverse position.			
			Wiring harness between FB2-1 outlet to R53 to A07 and A53 (female) ①		Resistance value	Below 1 MΩ
			Wiring harness between FB2-1 outlet to S29 to G72 to J02 to R53 to J05 and A02 (female) ④.		Resistance value	Below 1 Ω
			Wiring harness between FB2-1 outlet to S29 to G72 to J02 and C03 (female) ㉚.		Resistance value	Below 1 MΩ
	4	F.N.R switch defective (Internal disconnection or short-circuiting)	• Turn engine starting switch OFF for the preparations and hold it in the OFF position during the troubleshooting. Ensure FNR switch is in reverse position.			
			G72 (Male)		Resistance value	
			Between ⑦ and ⑧		Above 1 MΩ	
			Between ⑦ and ⑨		Below 1 Ω	
			Between ⑦ and ⑩		Above 1 MΩ	
	5	Reversing buzzer relay R53 defective (Internal disconnection or short-circuiting)	• Turn engine starting switch OFF for the preparations and hold it in the OFF position during the troubleshooting. Ensure FNR switch is in reverse position.			
			R53 (Male)		Resistance value	
			Between ① and ②		100 - 500 Ω	
			Between ③ and ⑤		Above 1 MΩ	
			Between ③ and ⑥		Below 1 Ω	
	6	Grounding fault of wiring harness (Contact with grounding (GND) circuit)	• Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting. Ensure FNR switch is in reverse position.			
			Between wiring harness between FB1-3 outlet to S25 to S23 to G72 to J02 to A07 and A53 (female) ① and grounding		Resistance value	Above 1 MΩ
	7	Travel alarm fault	As this is an internal failure, troubleshooting cannot be conducted. (If none of the causes listed in Item 1 through 4 above is found, the travel alarm is judged as defective)			

Electrical Circuit Diagram for Travel Reverse Alarm System



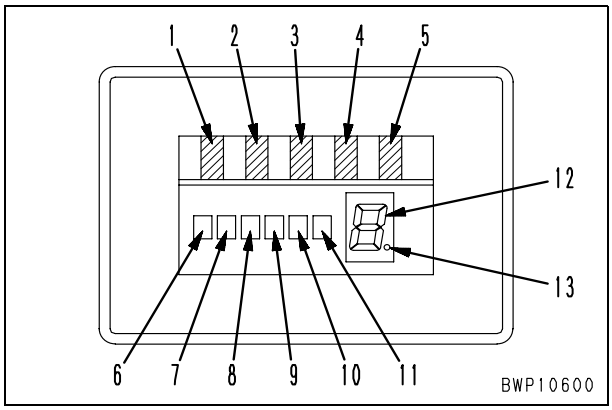
E-32 KOMTRAX system does not operate normally

Trouble	• KOMTRAX system does not operate normally.
Related information	• If KOMTRAX system administrator makes request for checking system on machine side for trouble, carry out following troubleshooting. • Even if KOMTRAX system has trouble, it does not particularly appear on machine.

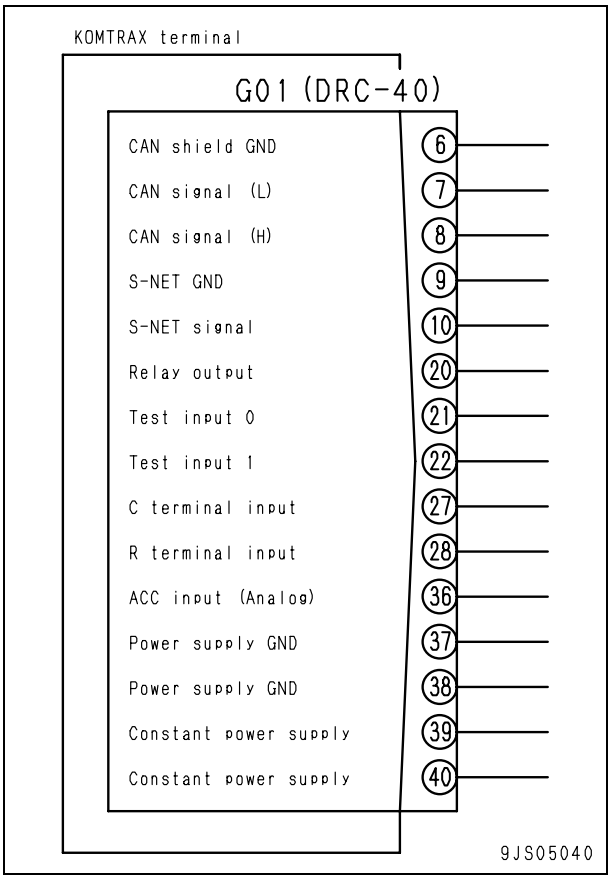
	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective power supply	a Turn starting switch OFF, then carry out troubleshooting.		
			LED (1)	Normal state	
			LED-A1	Lighted up	
			a Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			G01	Signal	Voltage
			Between (39), (40) – (37), (38)	Constant power supply	20 – 30 V
	2	Defective GPS	a Turn starting switch ON and carry out troubleshooting.		
			LED (2)	Normal state	
			LED-A2	Lighted up	
	3	Defective starting switch ACC signal and alternator R signal	a Start engine and carry out troubleshooting.		
			LED (6)	Normal state	
			LED-C1	Lighted up	
			a Prepare with starting switch OFF, then start engine and carry out troubleshooting.		
			G01	Signal	Voltage
			Between (36) – (37), (38)	Starting switch ACC	20 – 30 V
			Between (28) – (37), (38)	Alternator R	20 – 30 V
	4	Defective S-NET connection and starting switch C signal	a Turn starting switch ON and carry out troubleshooting.		
			LED (8)	Normal state	
			LED-C3	Lighted up	
			a Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.		
			G01	Signal	Voltage
			Between (10) – (9)	S-NET	6 – 9 V
			Between (27) – (37), (38)	Starting switch C	Max. 1 V
	5	State of CAN connection	a Turn starting switch ON and carry out troubleshooting.		
			LED (9)	Normal state	
			LED-C4	Lighted up	
			a Prepare with starting switch OFF and carry out troubleshooting.		
			G01	Signal	Resistance
			Between (7) – (8)	CAN	40 – 80 Ω

	Cause		Standard value in normal state/Remarks on troubleshooting	
Possible causes and standard value in normal state	6	Number of mails not transmitted yet	a Turn starting switch ON and carry out troubleshooting.	
			LED (12)	Normal state
			7-segment	0 – 9
	7	State of positioning with GPS	a Turn starting switch ON and carry out troubleshooting (See *)	
			LED (13)	Normal state
			Dot	ON
			* In an outdoor location within radio waves' penetration range, it sometimes takes more than a minute from turning on of the starting switch to completion of the positioning.	

LED display unit



G01 connector



TROUBLESHOOTING OF ELECTRICAL SYSTEM (Error checking of items without Monitor codes)

- This troubleshooting is carried out when there is still an abnormality
- Before carrying out any troubleshooting check all related connectors are properly inserted.
- Always connect any disconnected connectors before moving on to next step.

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INFORMATION CONTAINED IN TROUBLESHOOTING TABLE

- The following information are edited and contained in the "Information Contained in Troubleshooting Table". You are required to proceed with troubleshooting after fully grasping the contents.

Failure information	Phenomena occurring on machine
Relative information	Information on occurred failures and troubleshooting

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting
	1	Cause for presumed failure (The attached No. for filing and reference purpose only. It does not stand for any priority)	<Contents> • The standard values in normal by which to judge "good" or "no good" about presumed causes. • References for making judgement of "good" or "no good" <Phenomena of wiring harness fault> • Failure due to disconnection Defective contact with connector or disconnection of wiring harness has occurred. • Grounding fault A wiring harness that is not originally connected with a grounding circuit is in contact with it. • Failure due to short-circuiting A wiring harness that is not originally connected with a power source circuit (24 V) is in contact with it. <Points to remember in troubleshooting> 1. Connector denotation method and handling of T-adapters Insert or connect T-adapters in the following manner, unless specifically otherwise instructed. • If there is no indication of (male) or (female) in the connector No., pull off a connector and insert a T-adapter into both sides of male and female. • If there is an indication of (male9 and (female) in the connection No., pull off a connector and insert a T-adapter into only one side of (male) or (female). 2. Description sequence of pin No. and handling of circuit tester leads Connect the positive lead (+) and negative lead (–) for troubleshooting in the following manner unless specifically otherwise instructed. • Connect the positive lead (+) to a pin No. marked at the front or wiring harness. • Connect the negative lead (–) to a pin No. marked at the rear or wiring harness.
	2		
	3		
	4		
	5		

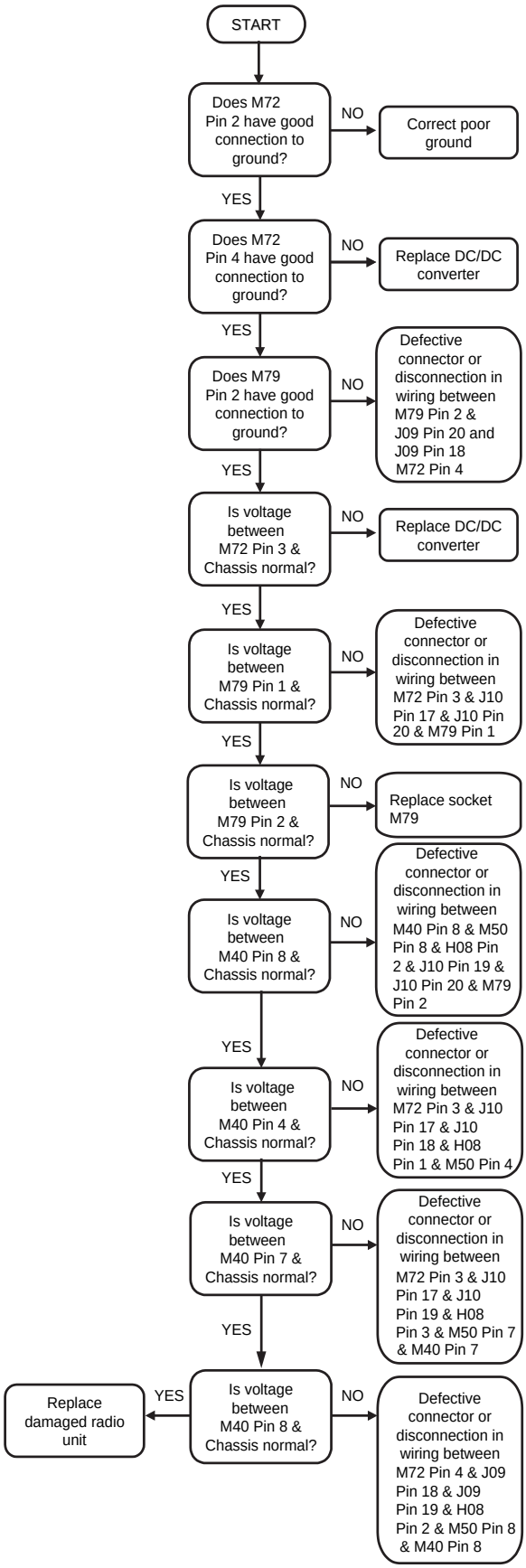
Relative Electrical Circuit Diagram

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

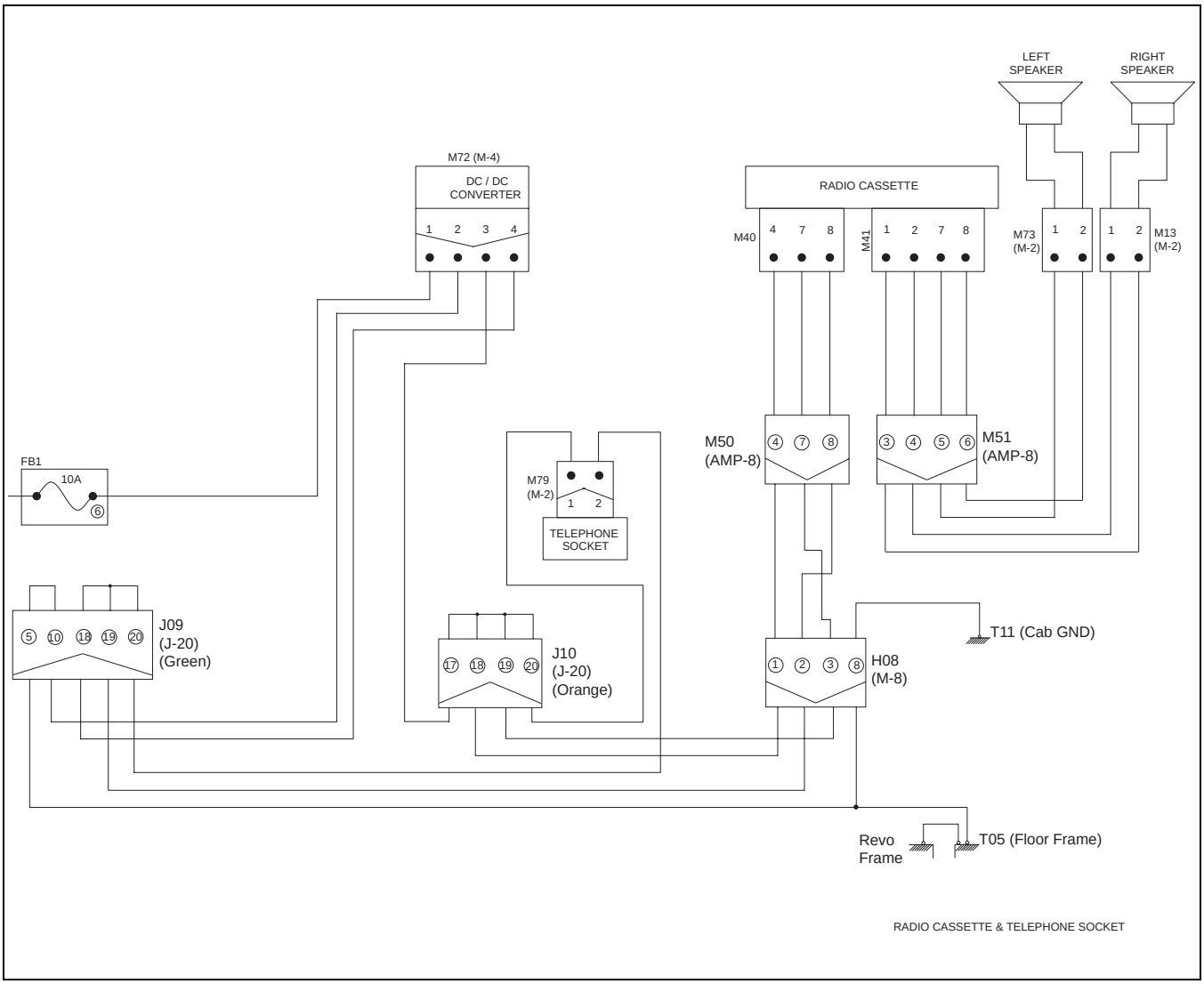
- Connector No.: Indicates (Type - numbers of a pin) (color)
- Arrow: Roughly indicates the location in the machine where it is installed.

Radio Cassette & Telephone Socket

*When fuse no.6 (Fuse box 1) is not blown



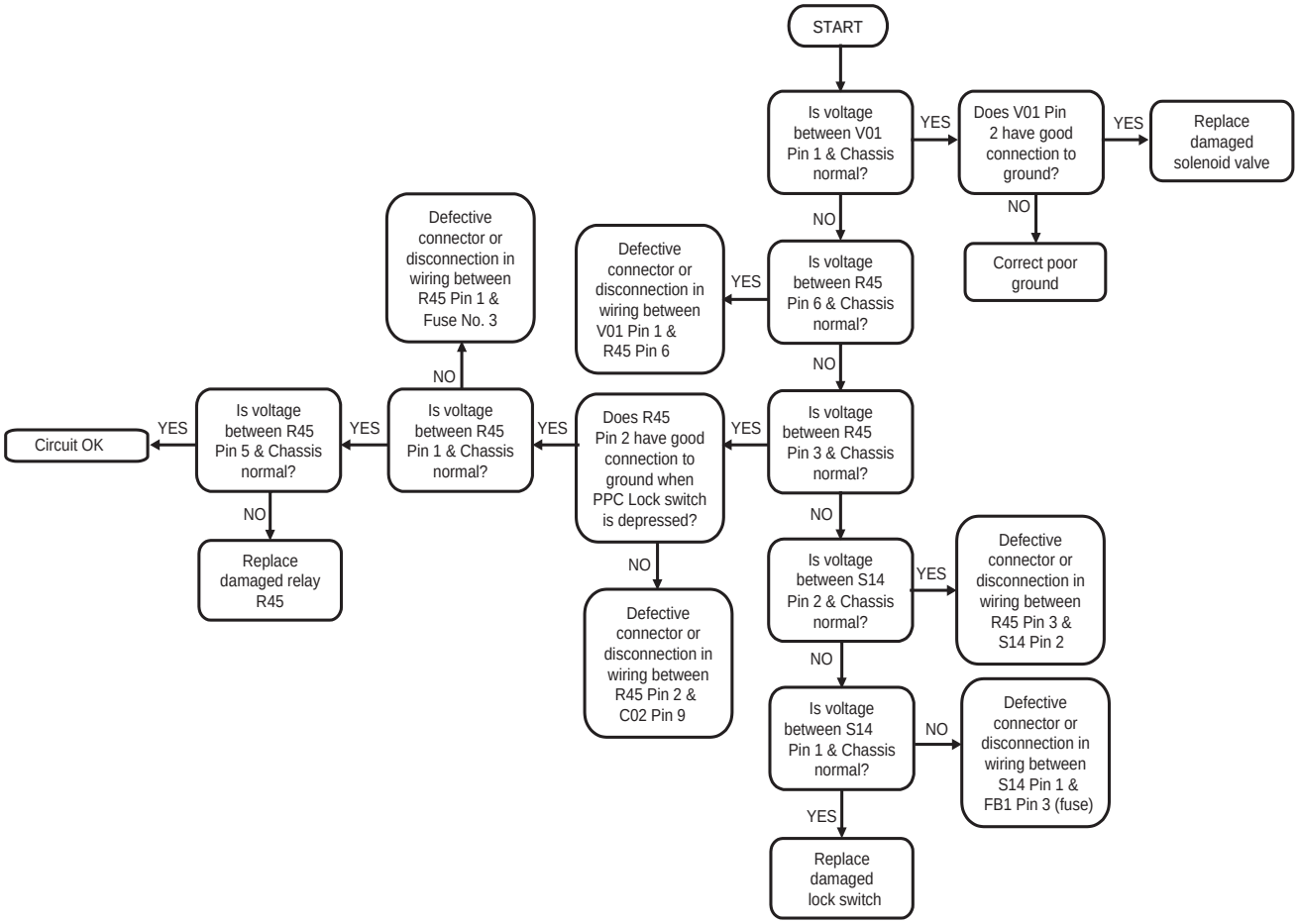
Electrical Circuit Diagram For Radio Cassette & Telephone Socket



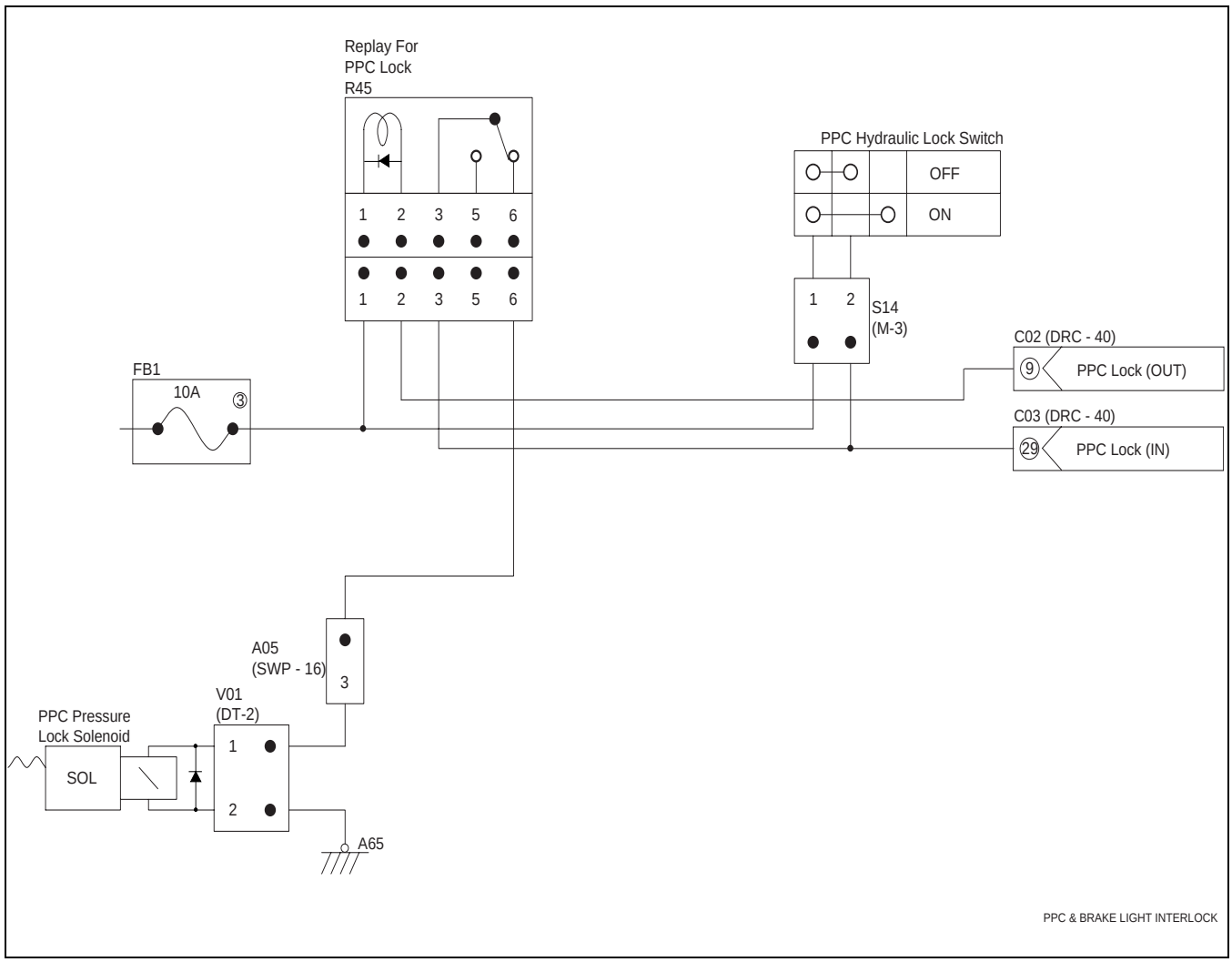
PPC Lock Circuit

*When Fuse No.3 (Fuse box 1) is not blown

*When bulbs are fitted correctly & fully functional



Circuit Diagram for PPC Lock Circuit

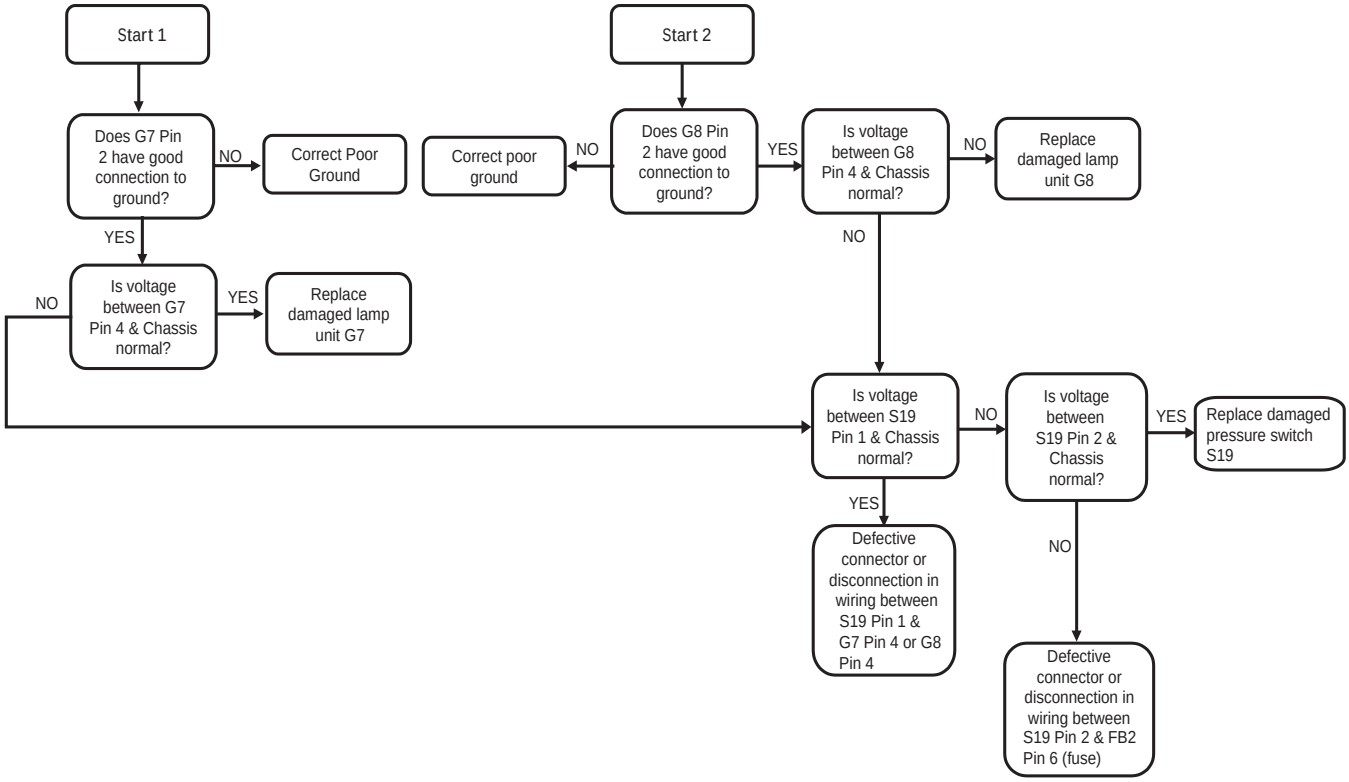


Brake Light Circuit

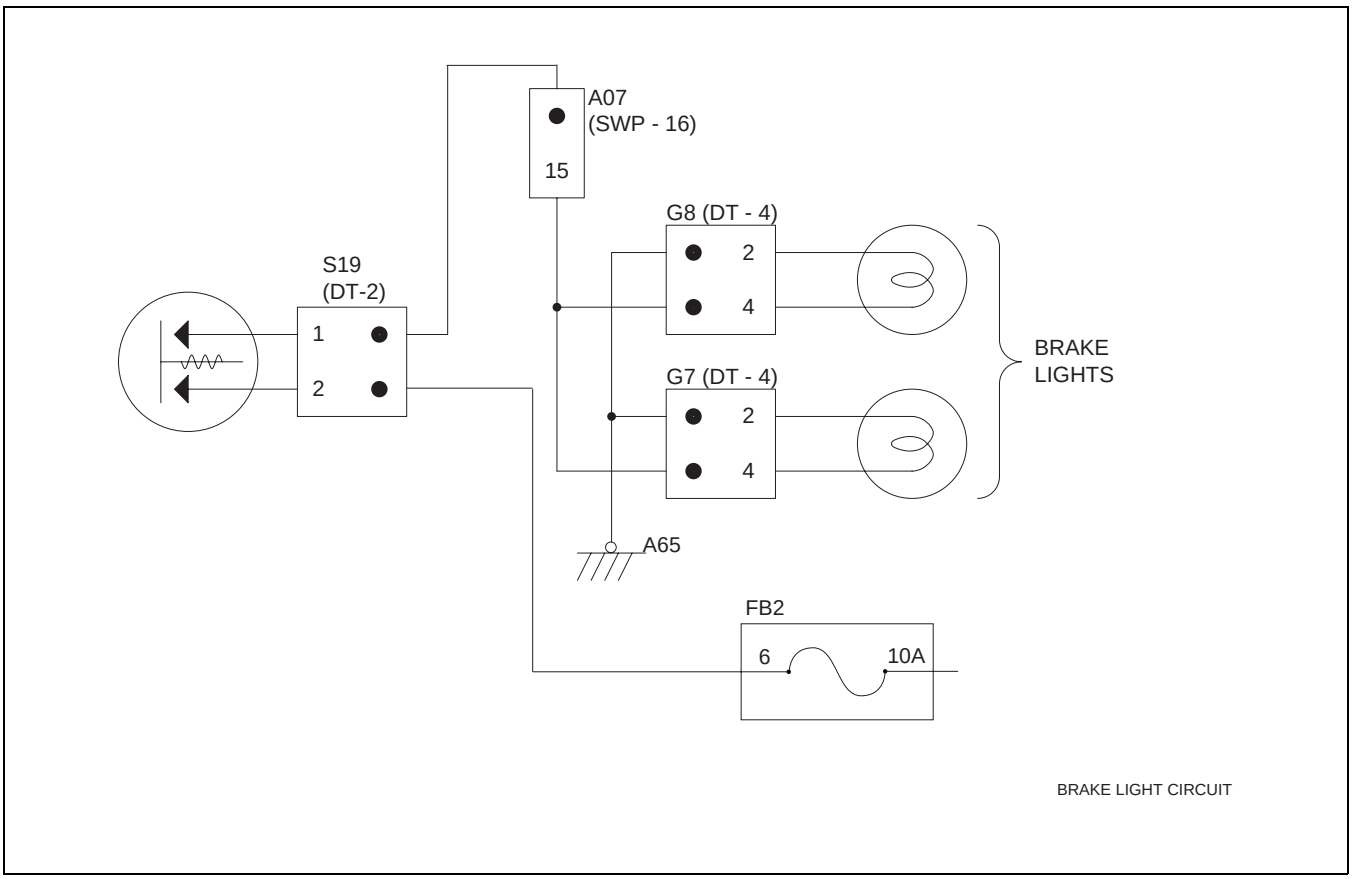
*When Fuse No.6 (Fuse box 2) is not blown

*When bulbs are fitted correctly & fully functional

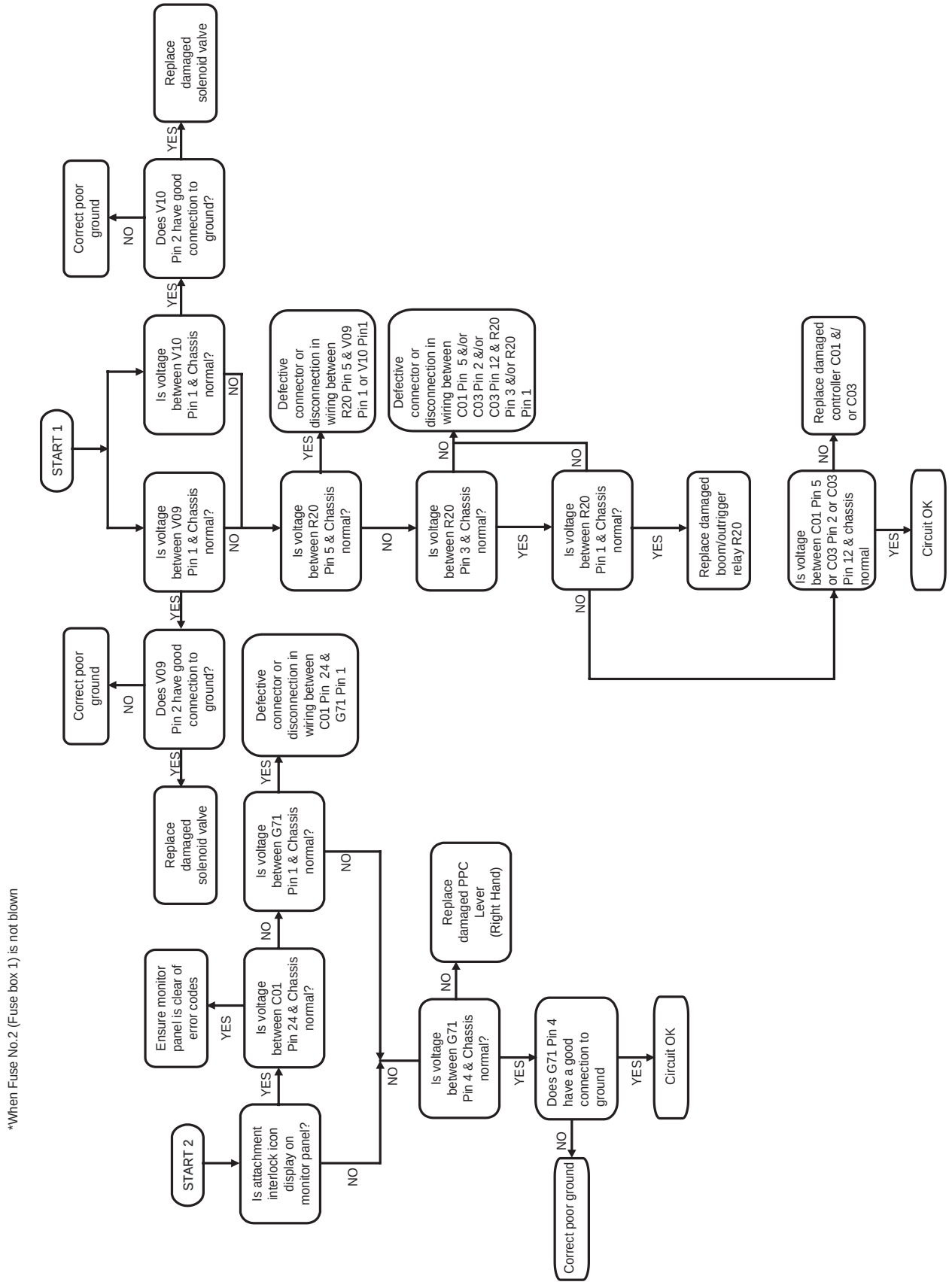
*When brake pedal is depressed



Circuit Diagram for Brake Light Circuit

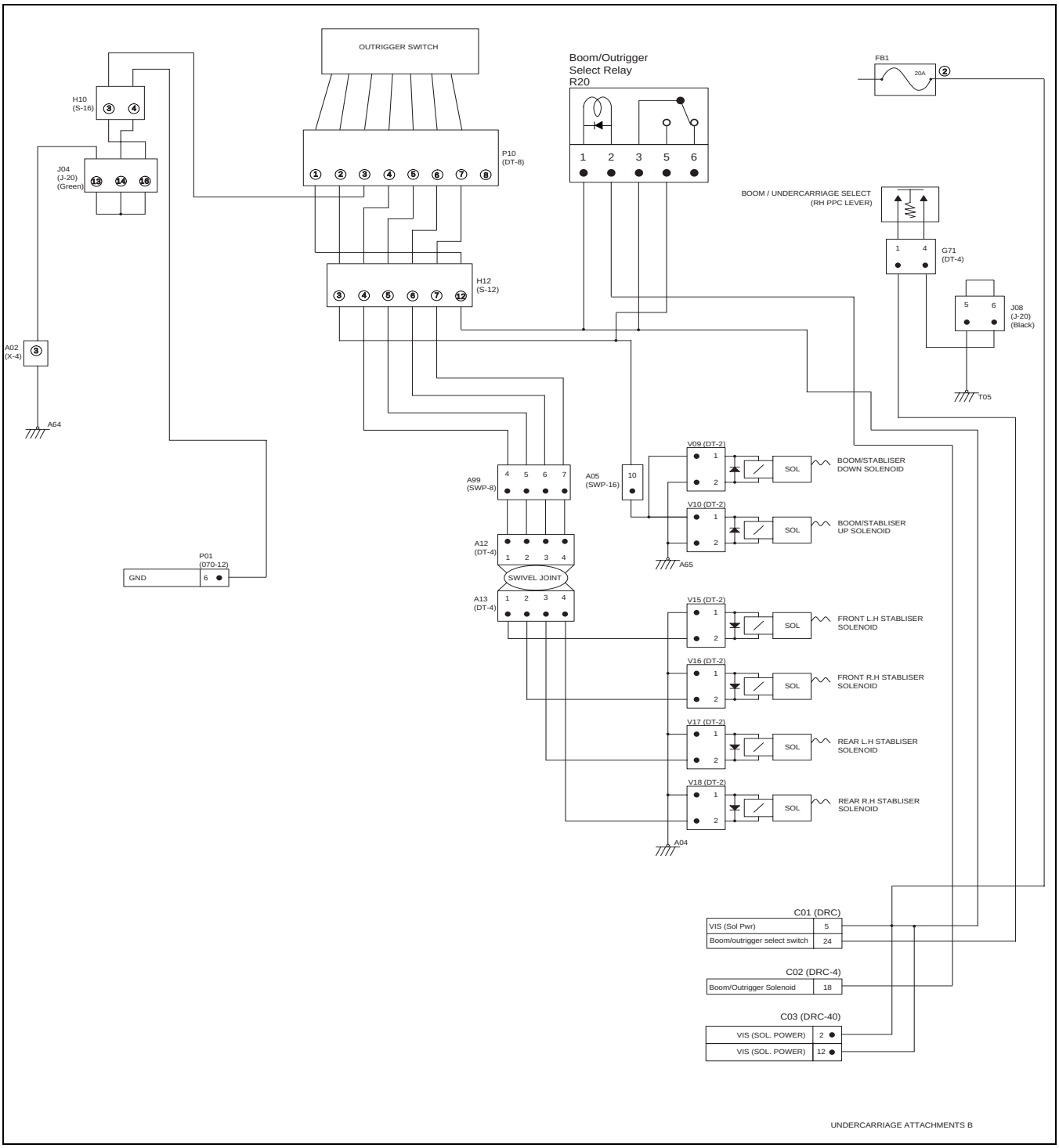


Undercarriage Attachments - Mode Selection



*When Fuse No.2 (Fuse box 1) is not blown

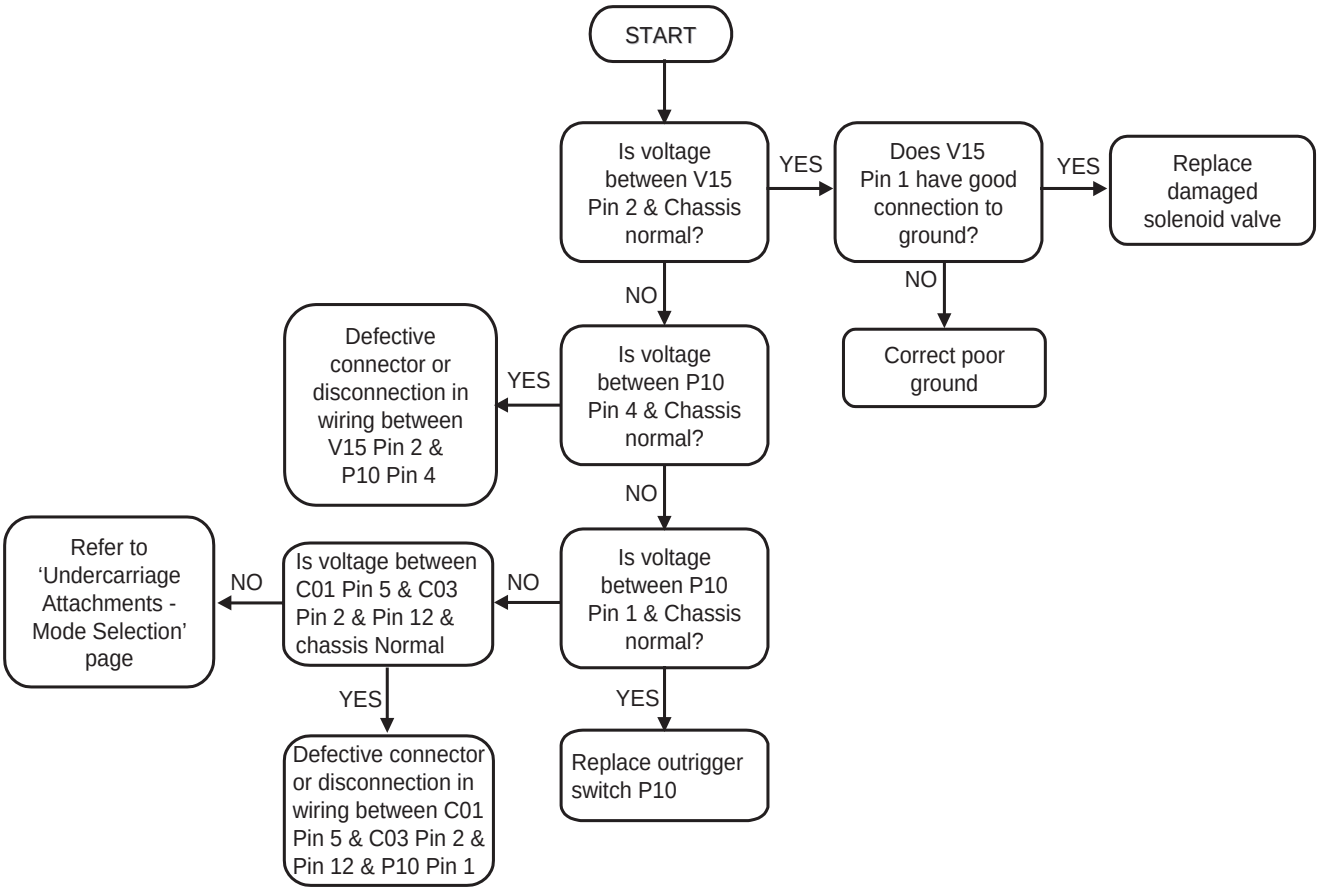
Circuit Diagram for Undercarriage Attachments - Mode Selection



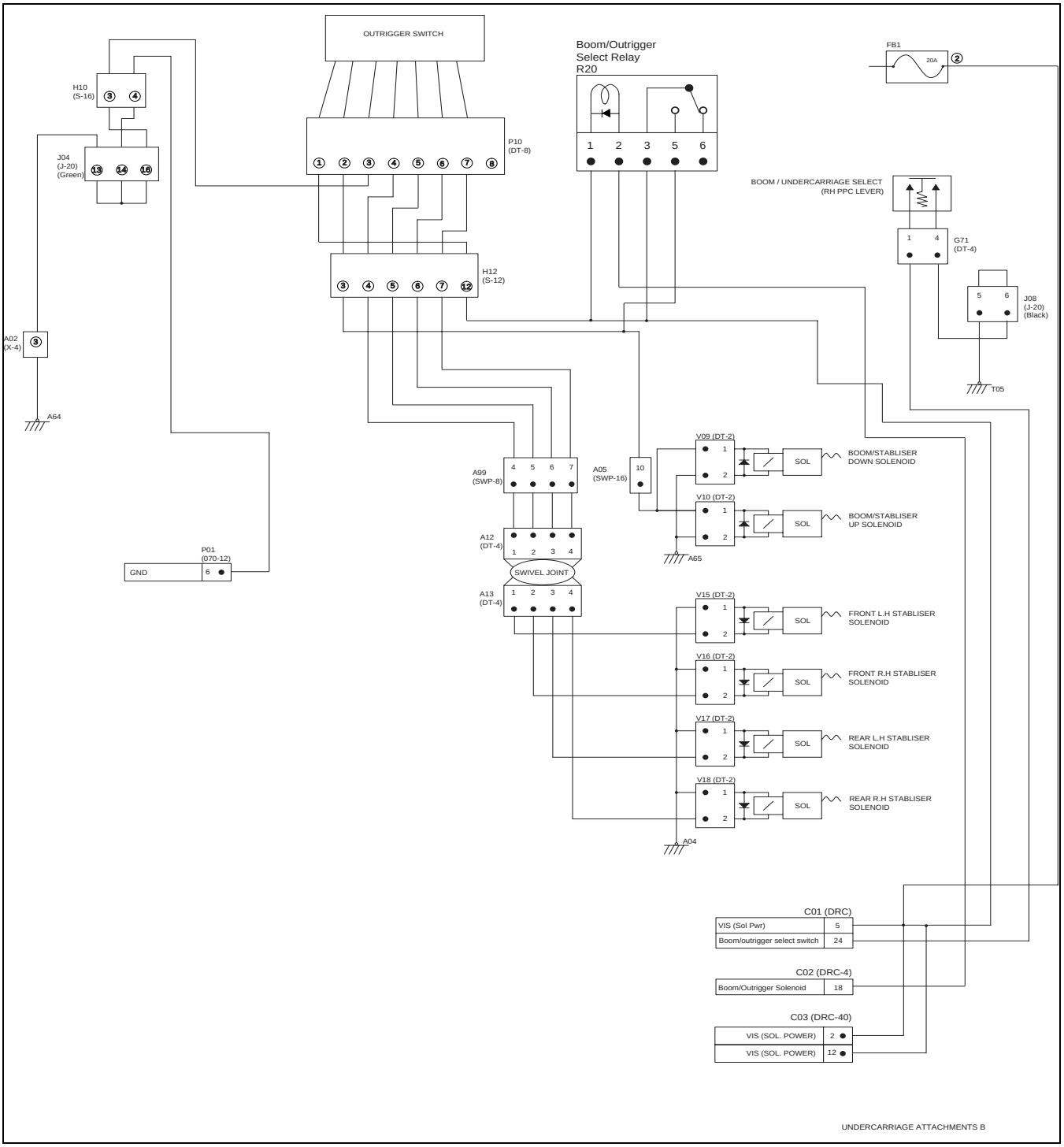
Undercarriage Attachments - Front Left Outrigger

*When Fuse No.2 (Fuse box 1) is not blown

*When attachment 'Mode Select' circuit is fully functional



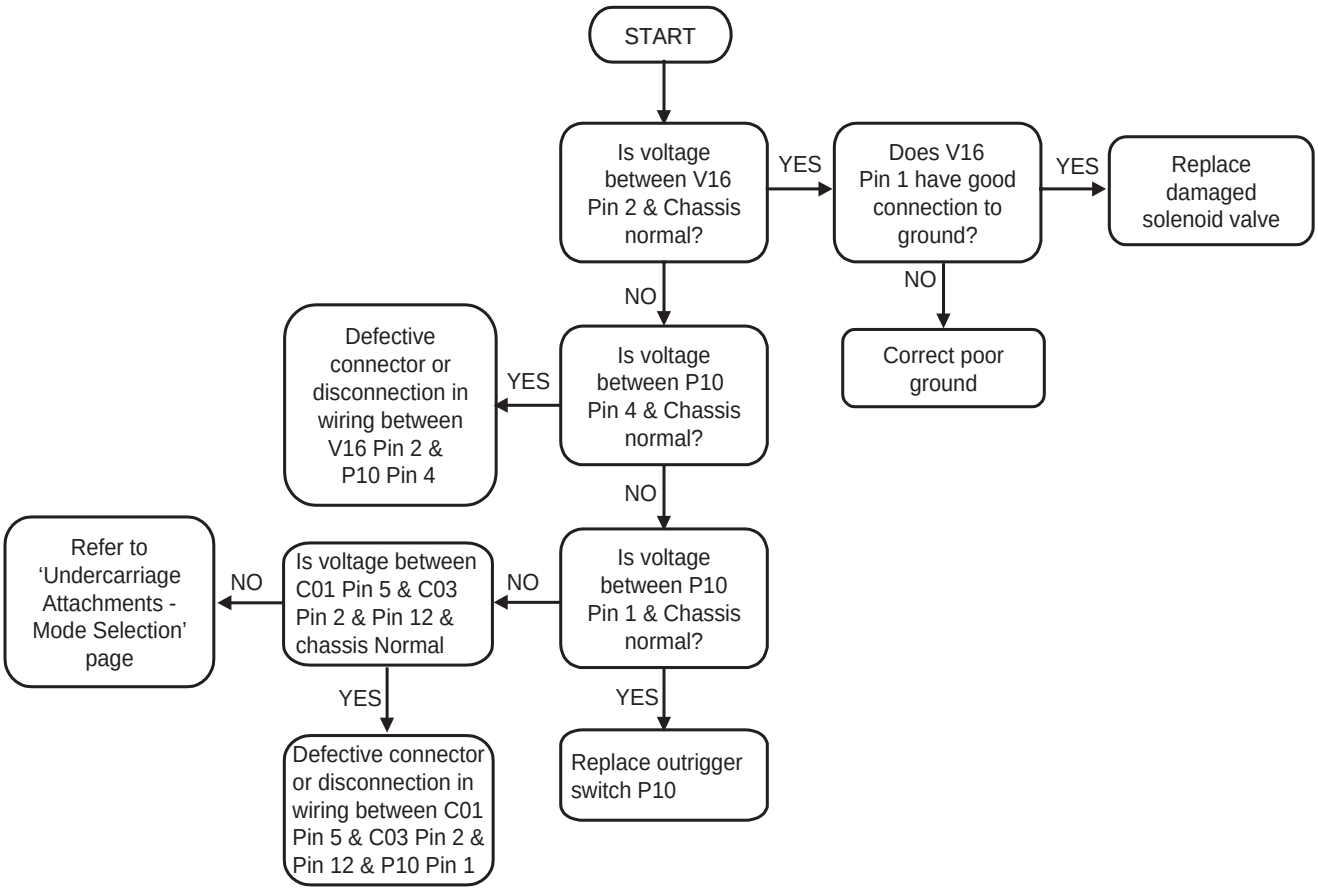
Circuit Diagram for Undercarriage Attachments - Front Left Outrigger



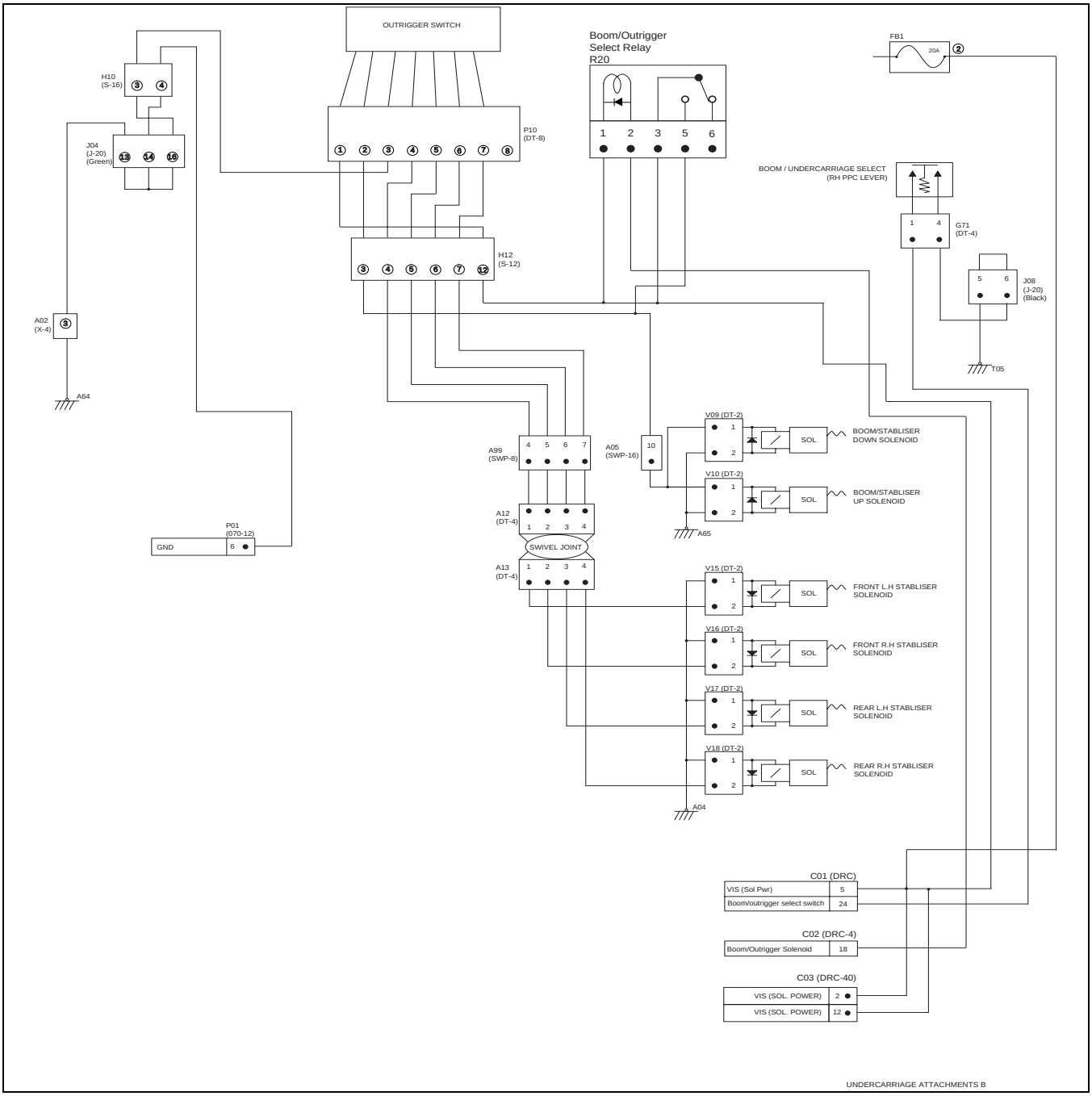
Undercarriage Attacments - Front Right Outrigger

*When Fuse No.2 (Fuse box 1) is not blown

*When attachment 'Mode Select' circuit is fully functional



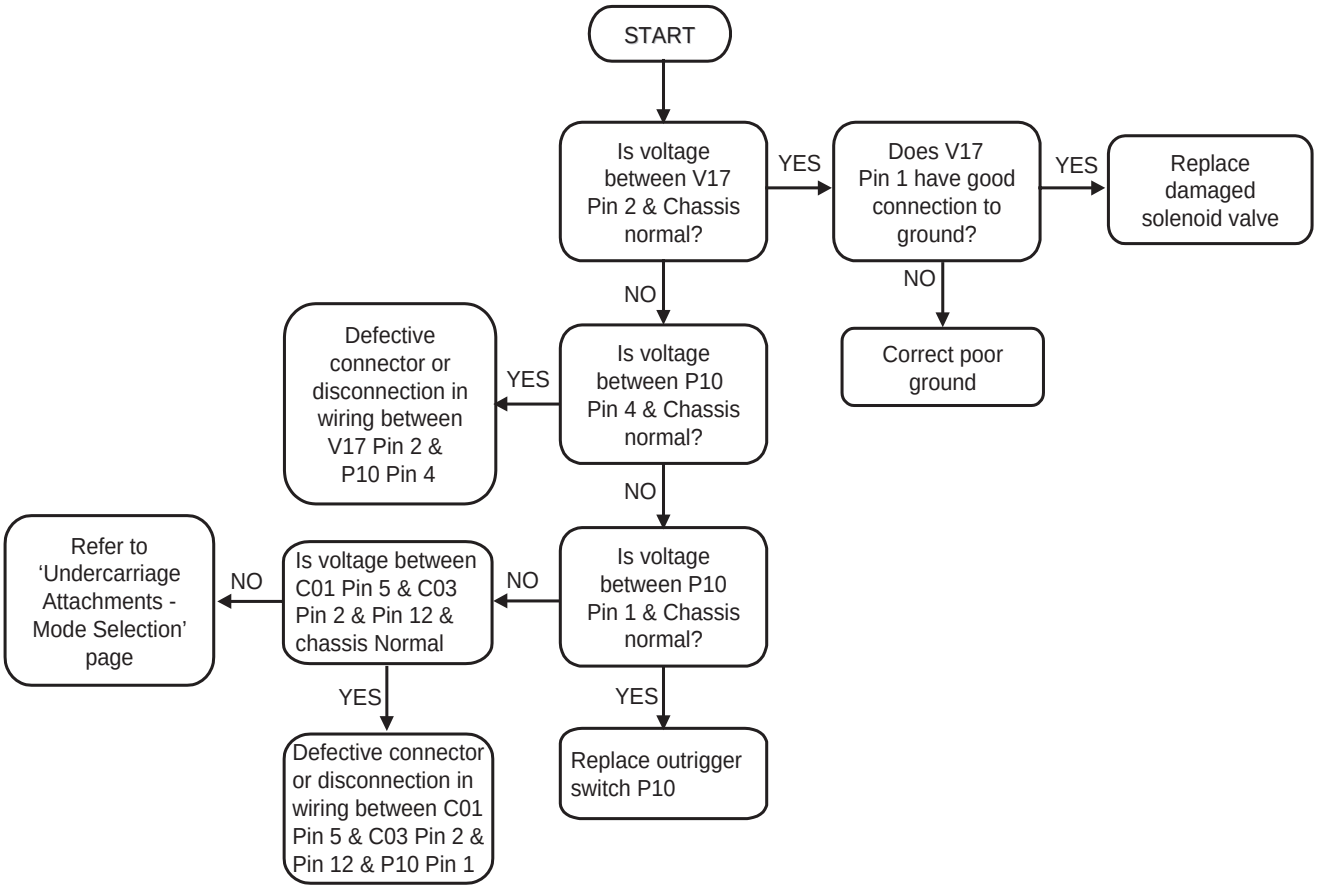
Circuit Diagram for Undercarriage Attachments - Front Right Outrigger



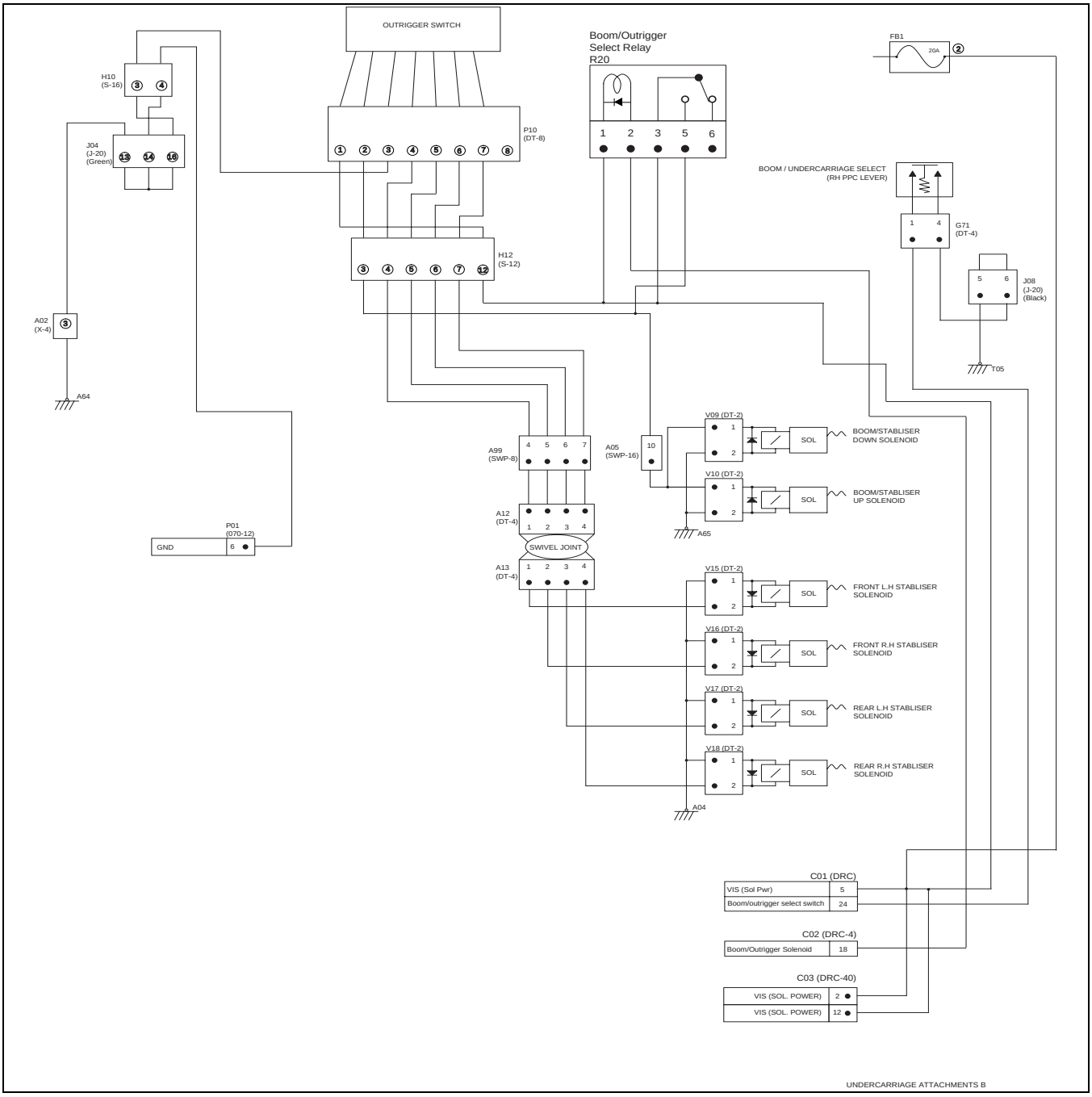
Undercariage Attachments - Rear Left Outrigger

*When Fuse No.2 (Fuse box 1) is not blown

*When attachment 'Mode Select' circuit is fully functional



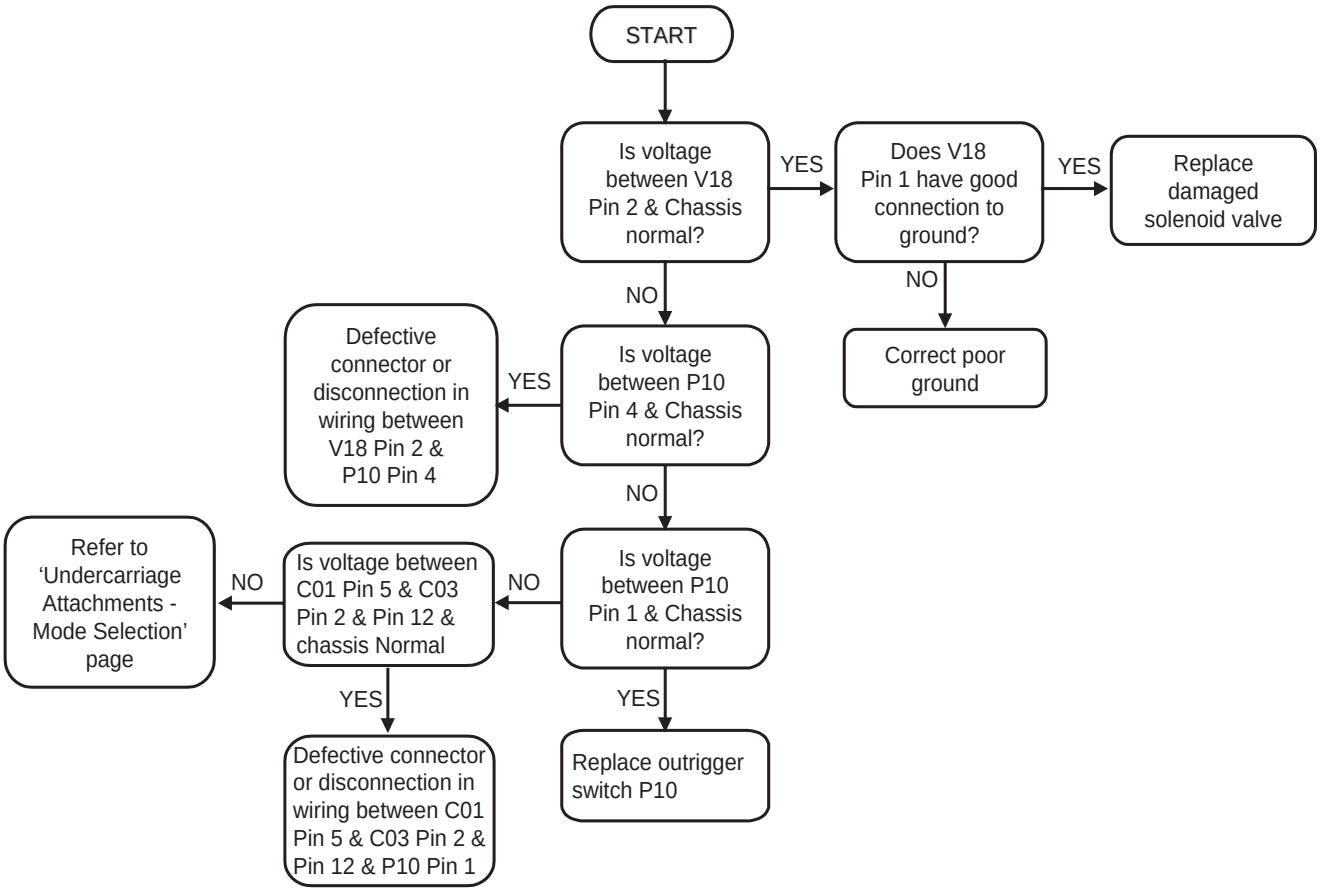
Circuit Diagram for Undercarriage Attachments - Rear left outrigger



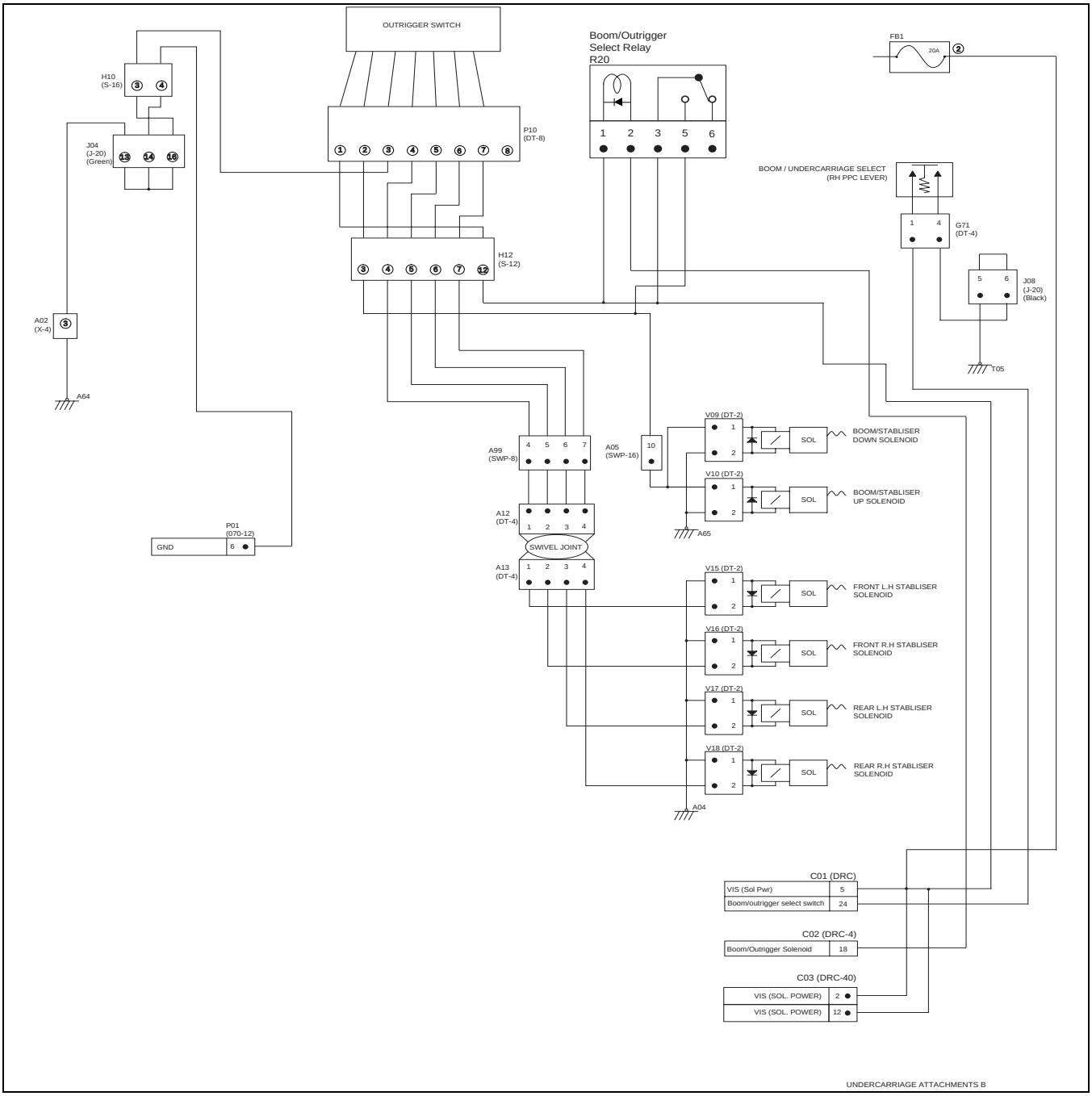
Undercarriage Attachments - Rear Right Outrigger

*When Fuse No.2 (Fuse box 1) is not blown

*When attachment 'Mode Select' circuit is fully functional

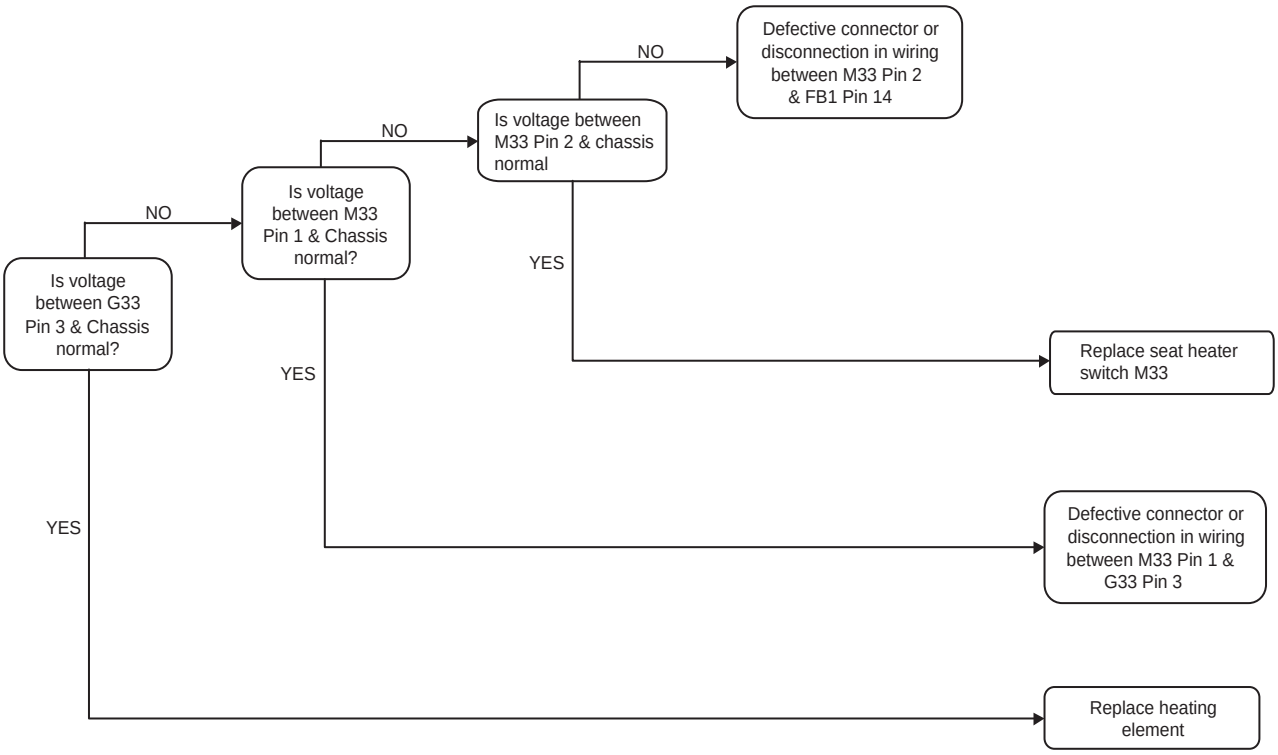


Circuit Diagram for Undercarriage Attachments - Rear Right Outrigger

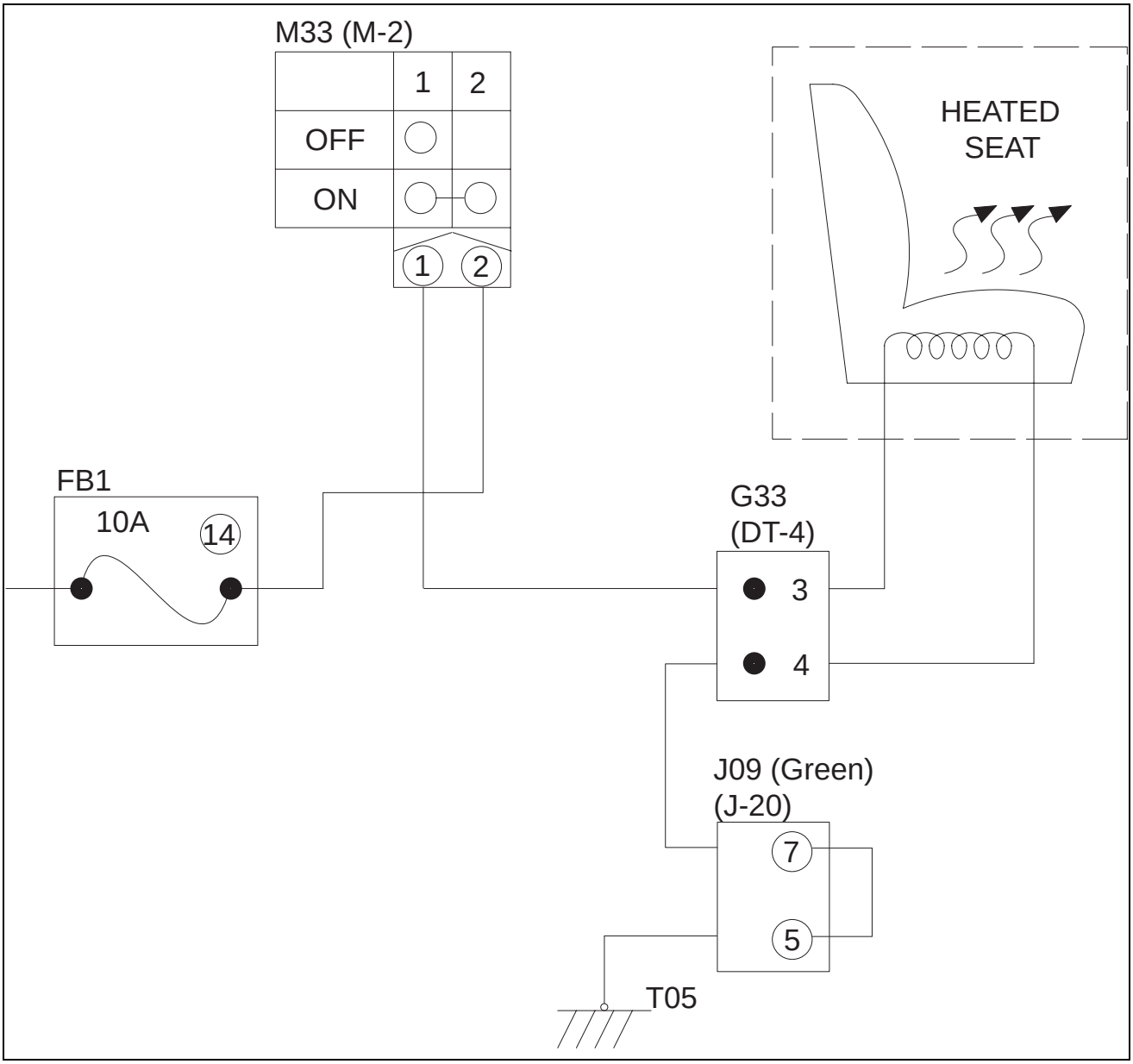


Heated Seat Does Not Warm Up

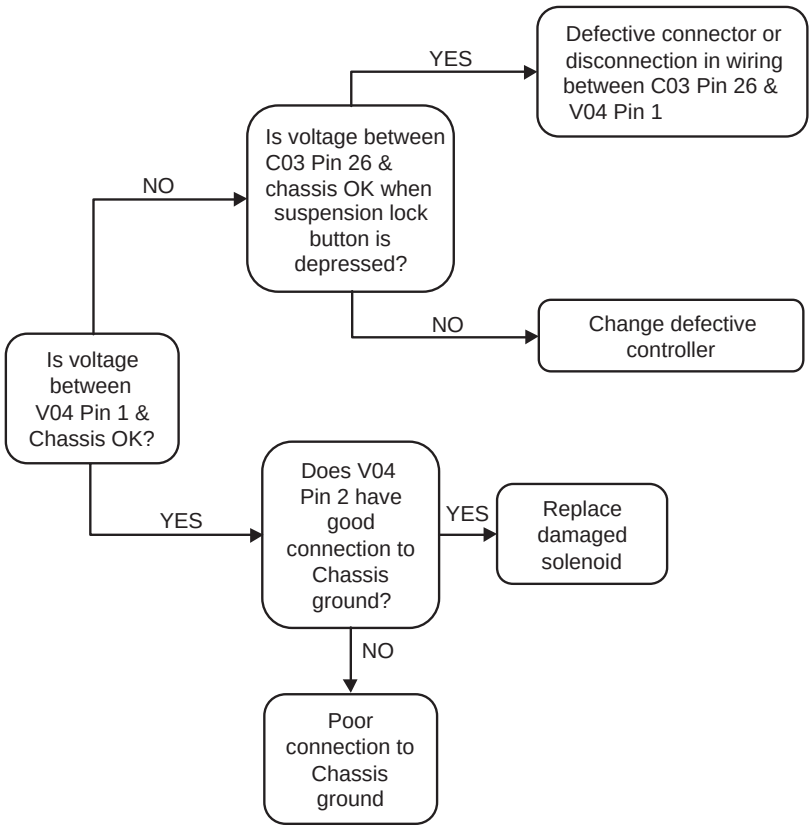
*When Fuse No.14 (Fuse box 1) is not blown



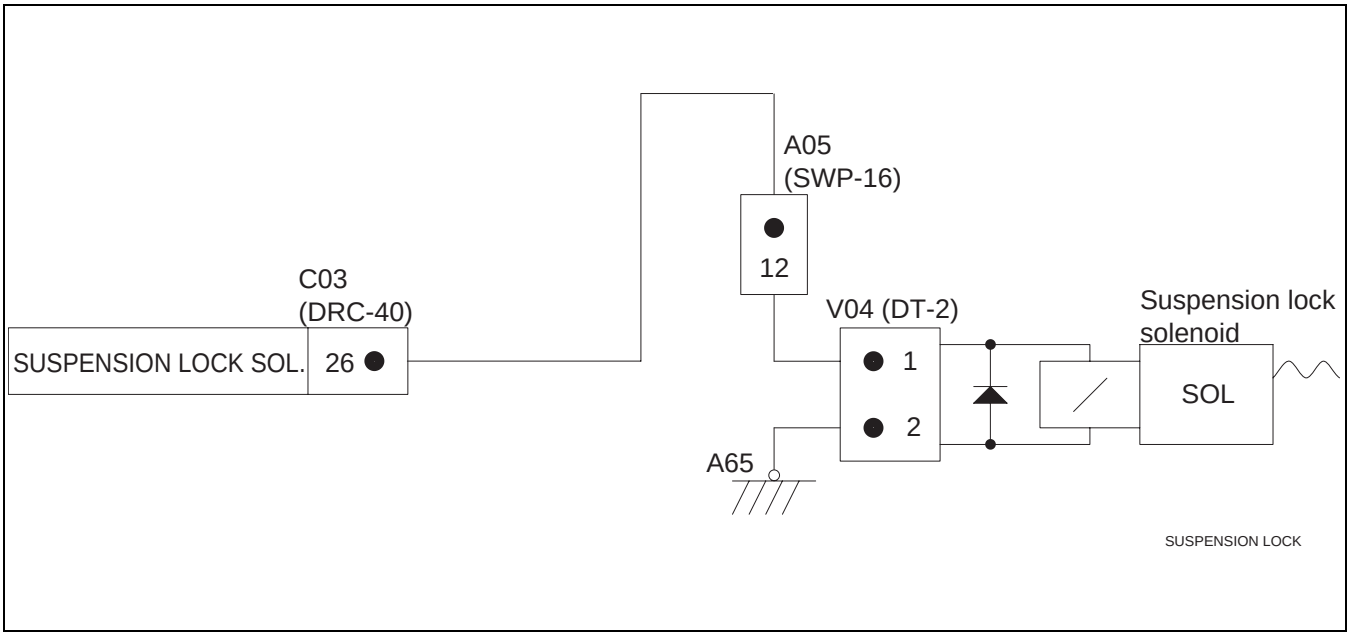
Circuit Diagram for the Heated Seat



Suspension Lock

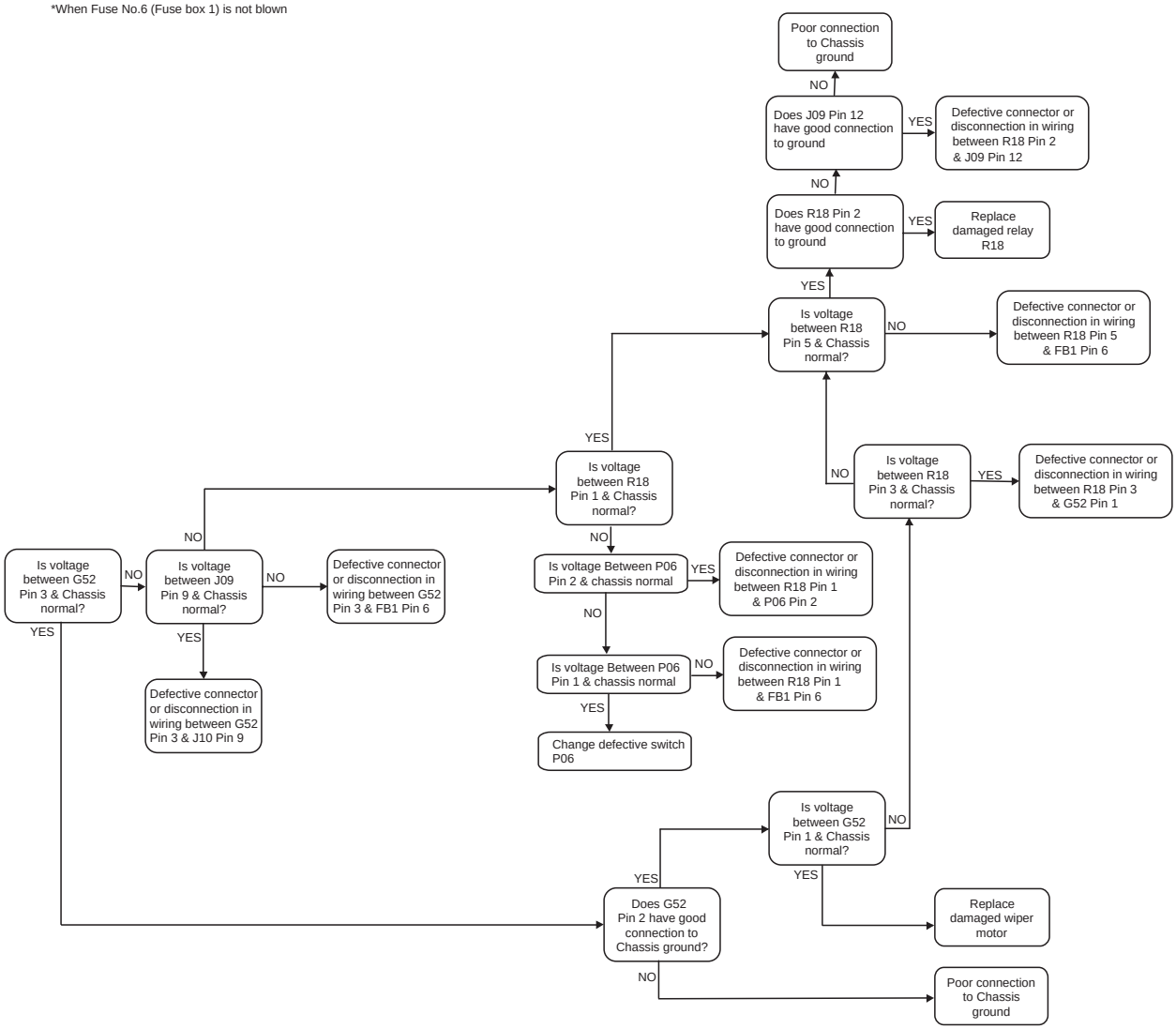


Circuit Diagram for Suspension Lock

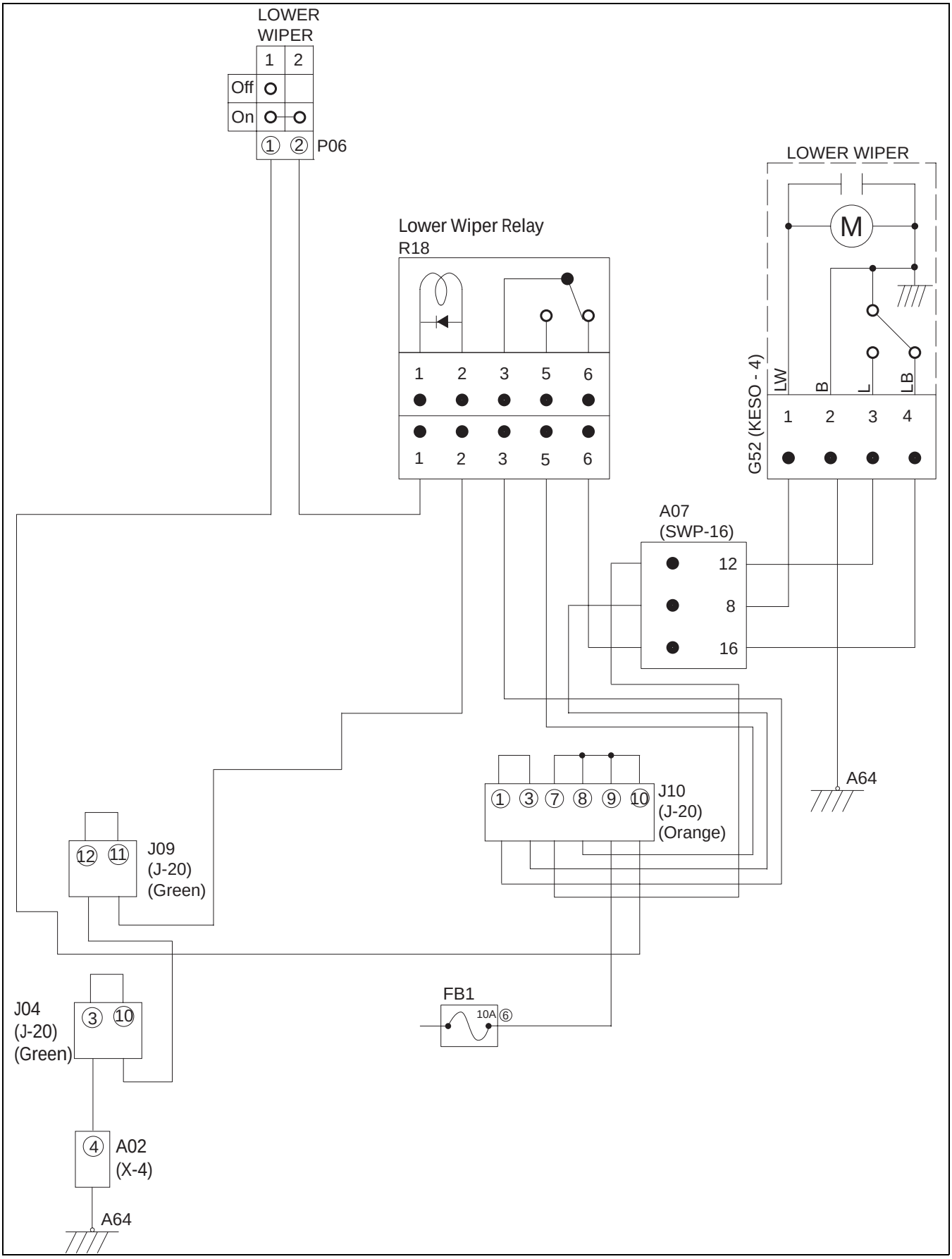


Lower Wiper Does Not Work (Optional Fitment)

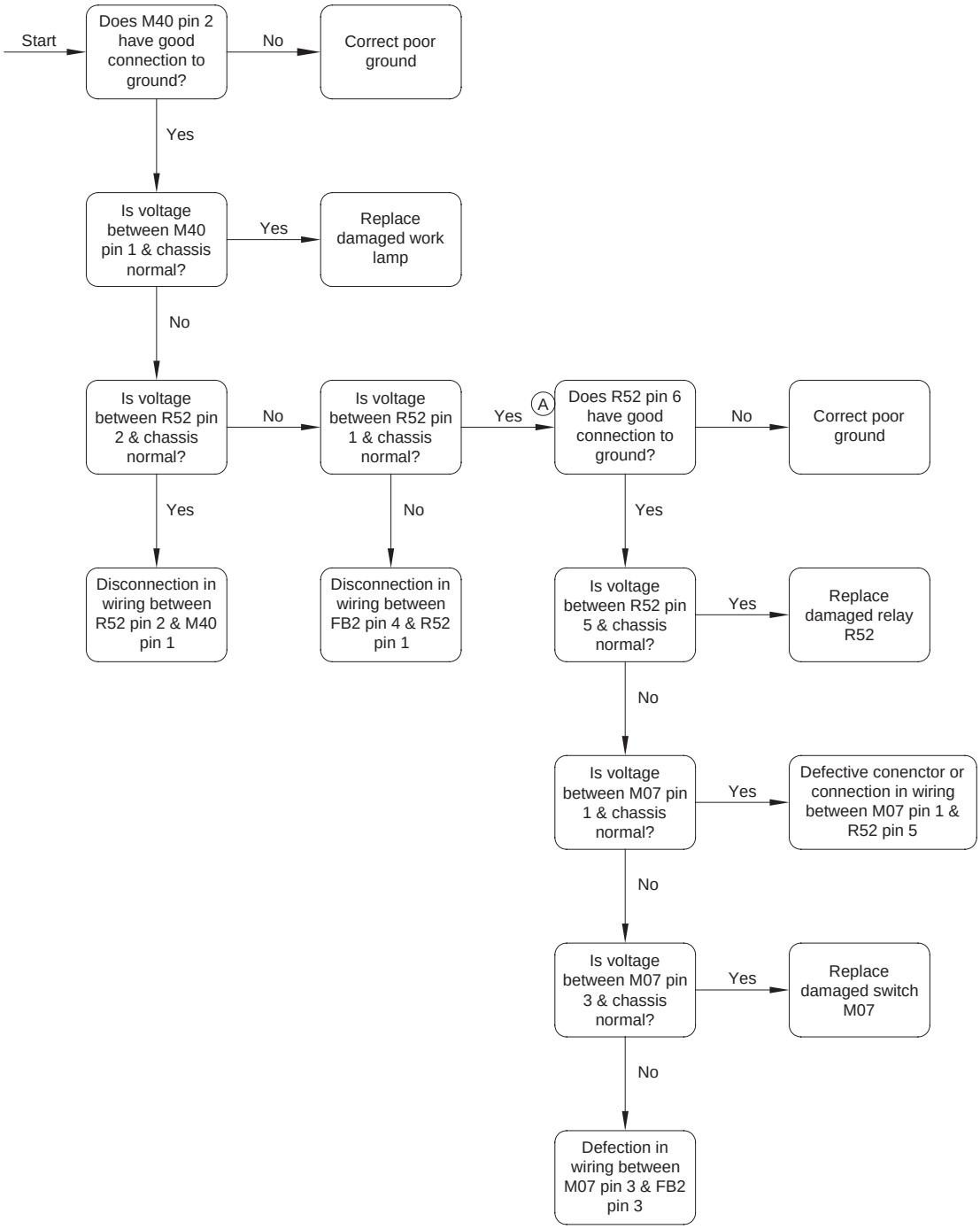
*When Fuse No.6 (Fuse box 1) is not blown



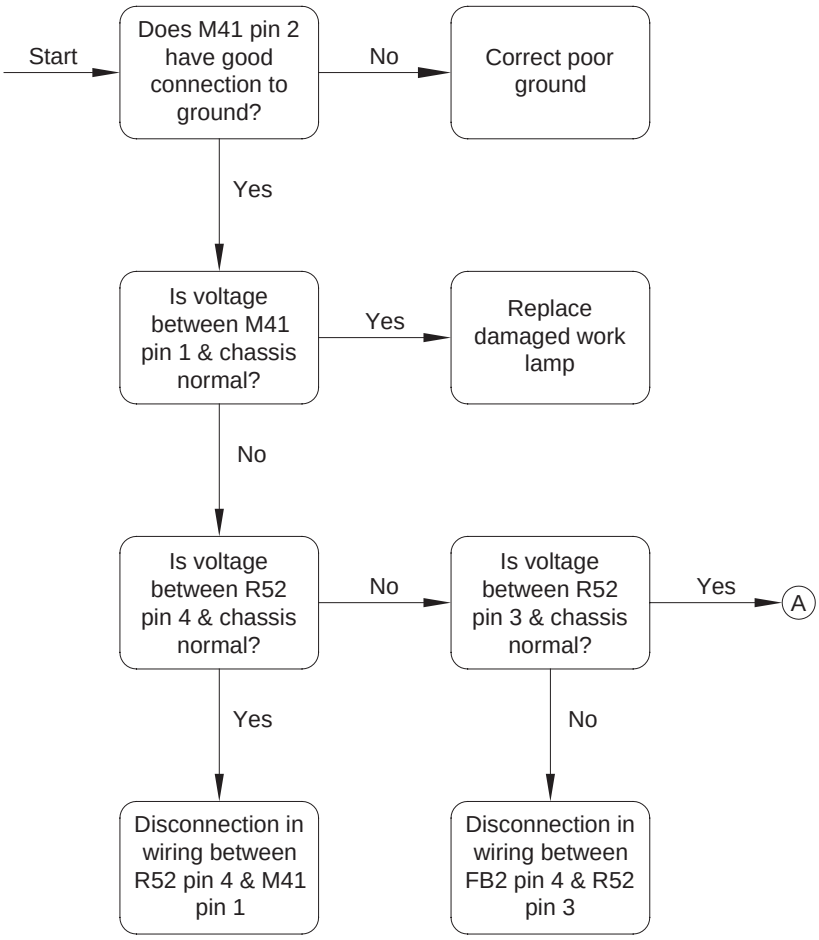
Circuit Diagram for Lower Wiper



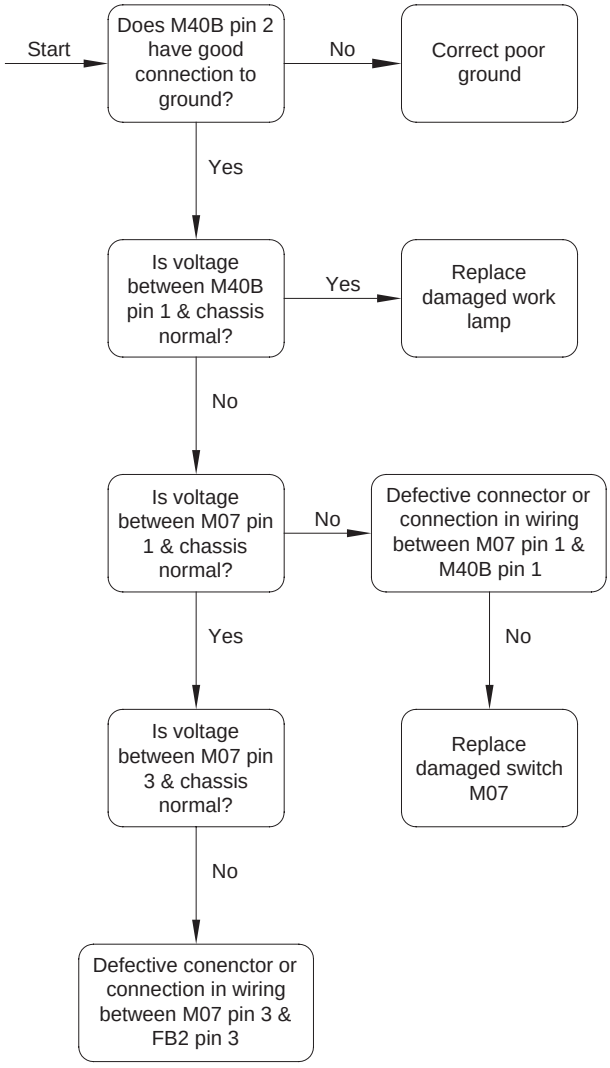
Work Lights (Operator Cab Front Left)



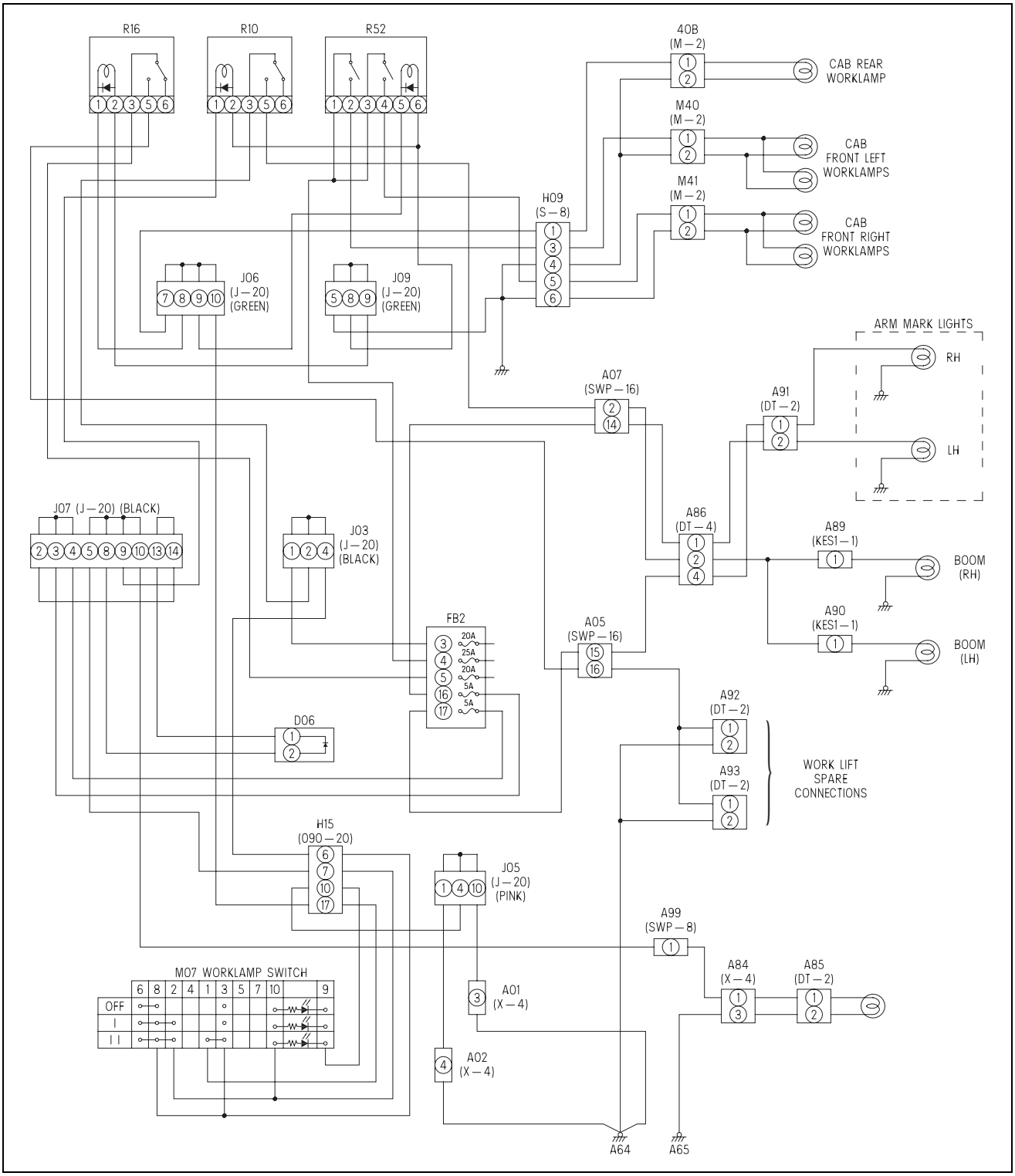
Work Lights (Operator Cab Front Right)



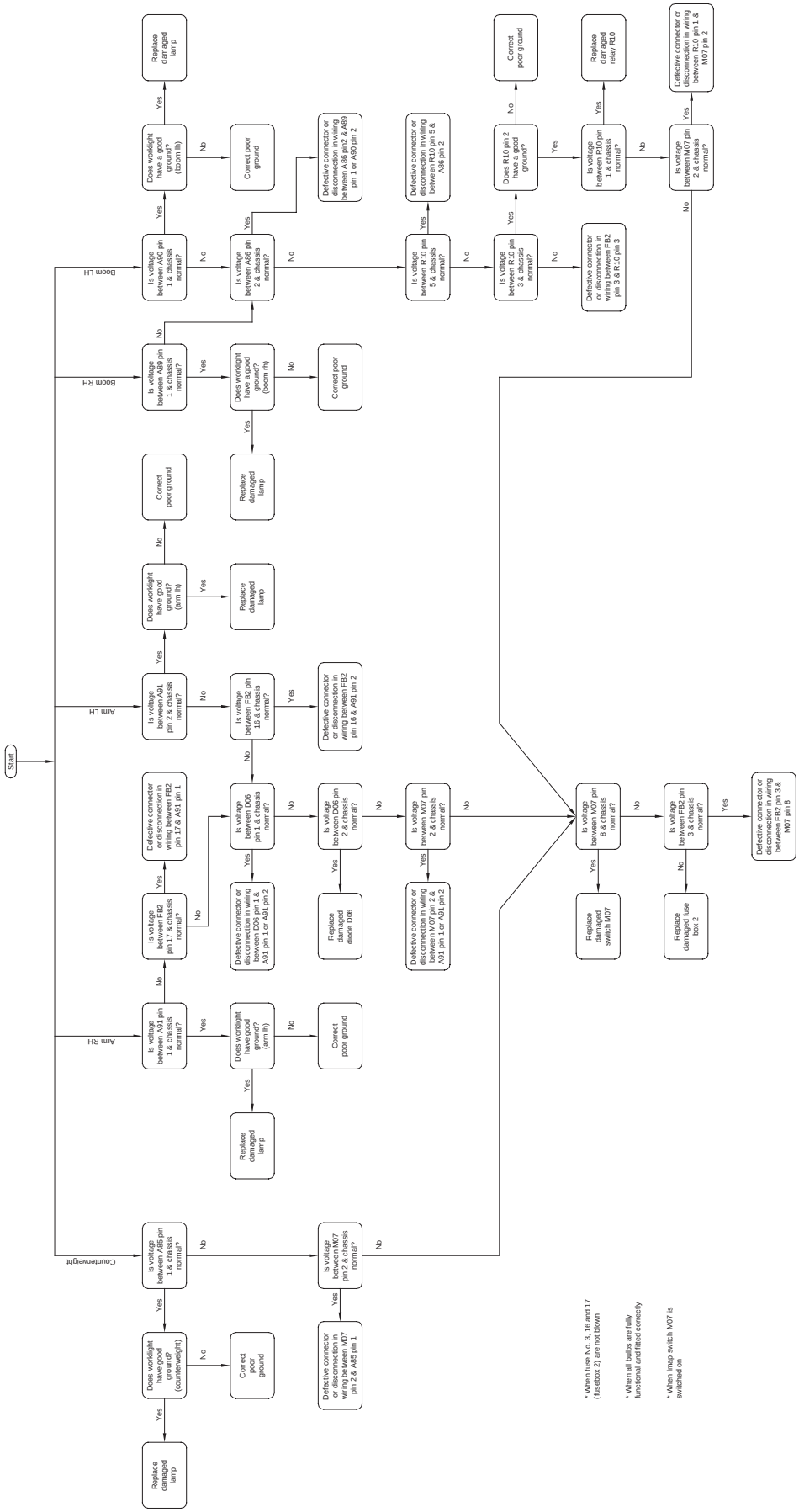
Work Lights (Operator Cab Rear)



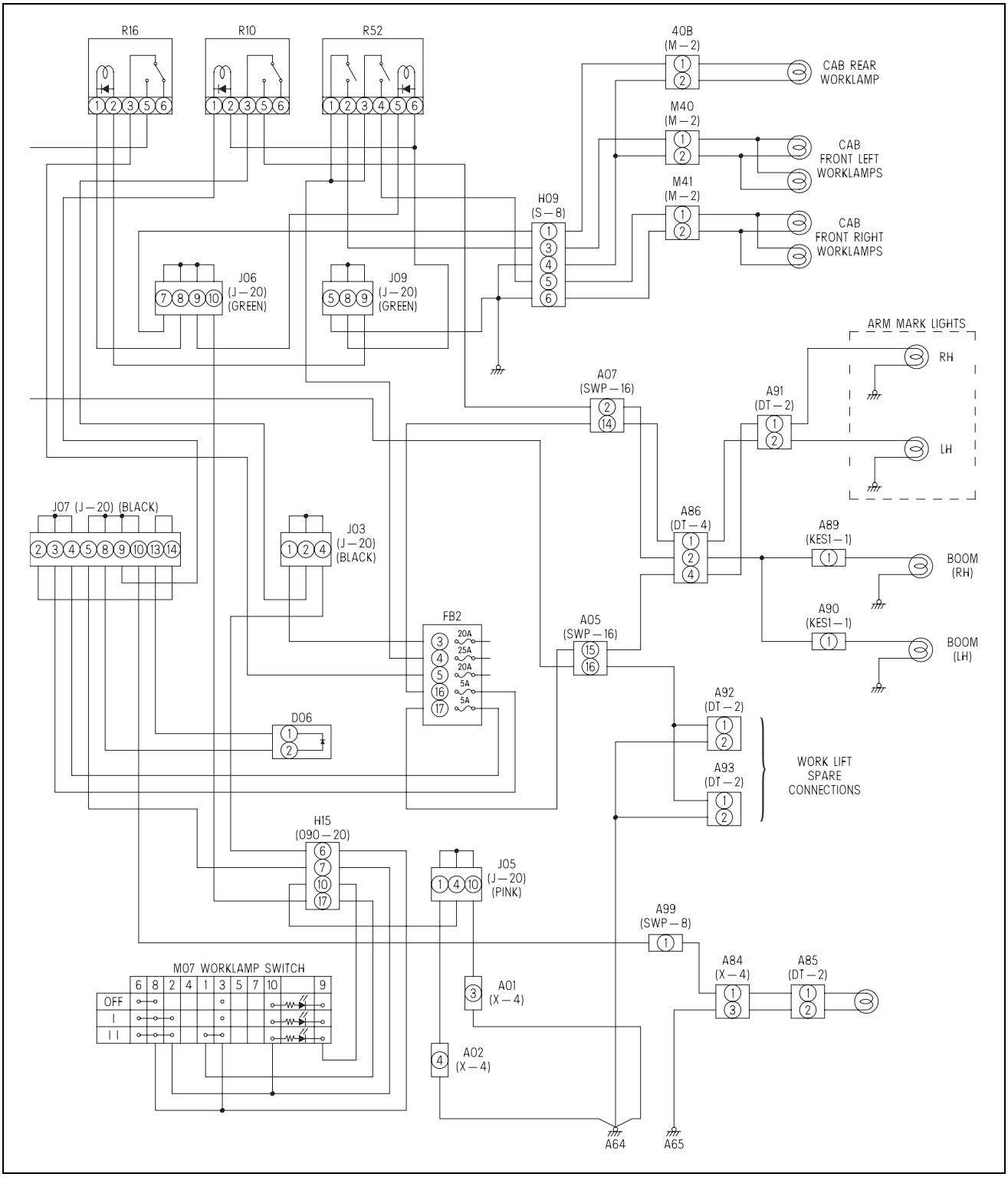
Circuit Diagram for Work Lights



Worklights (Boom, Arm & Counterweight)



Circuit Diagram for Worklights (Boom & Counterweight)

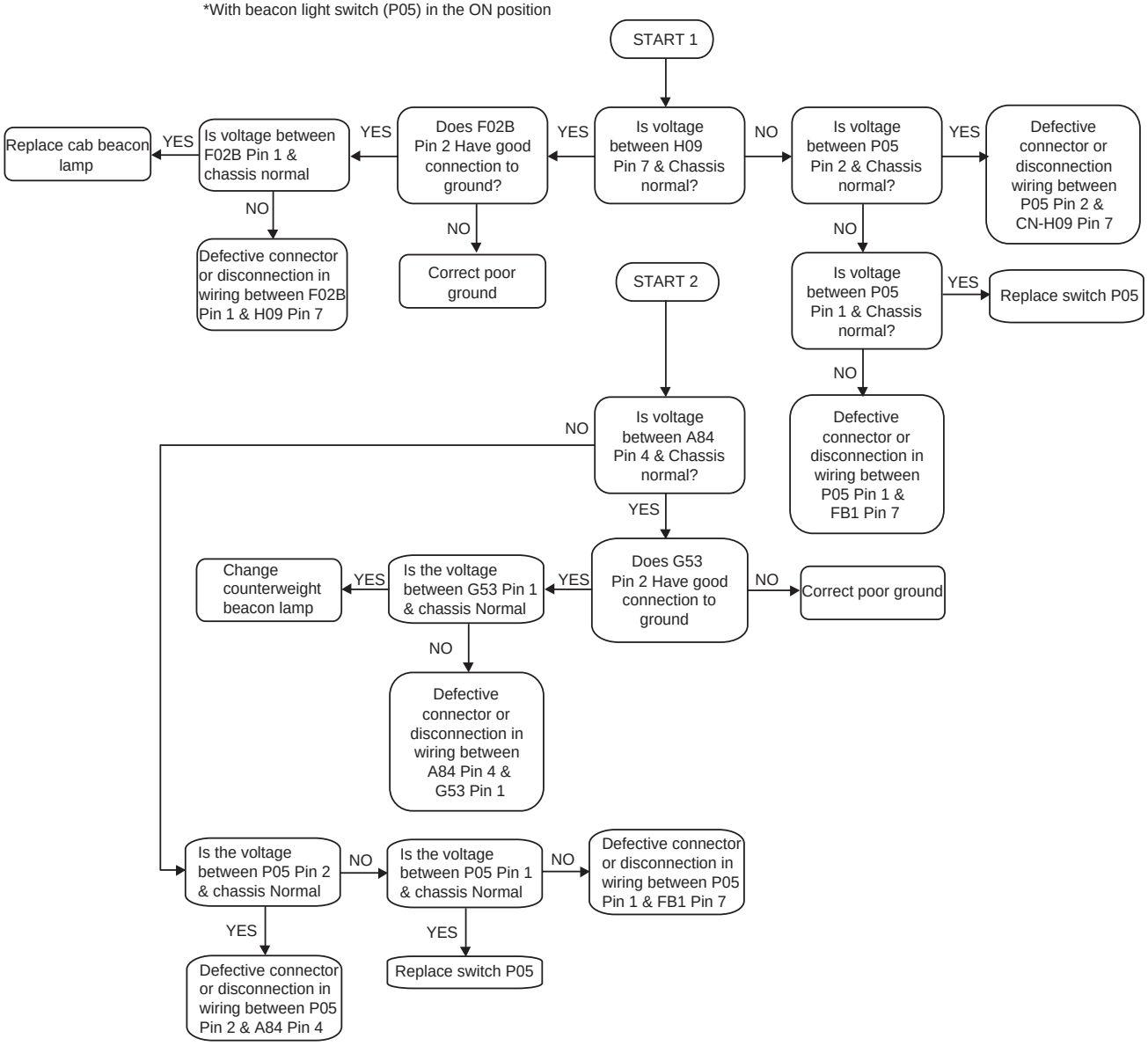


Cab and Counterweight Beacon Light

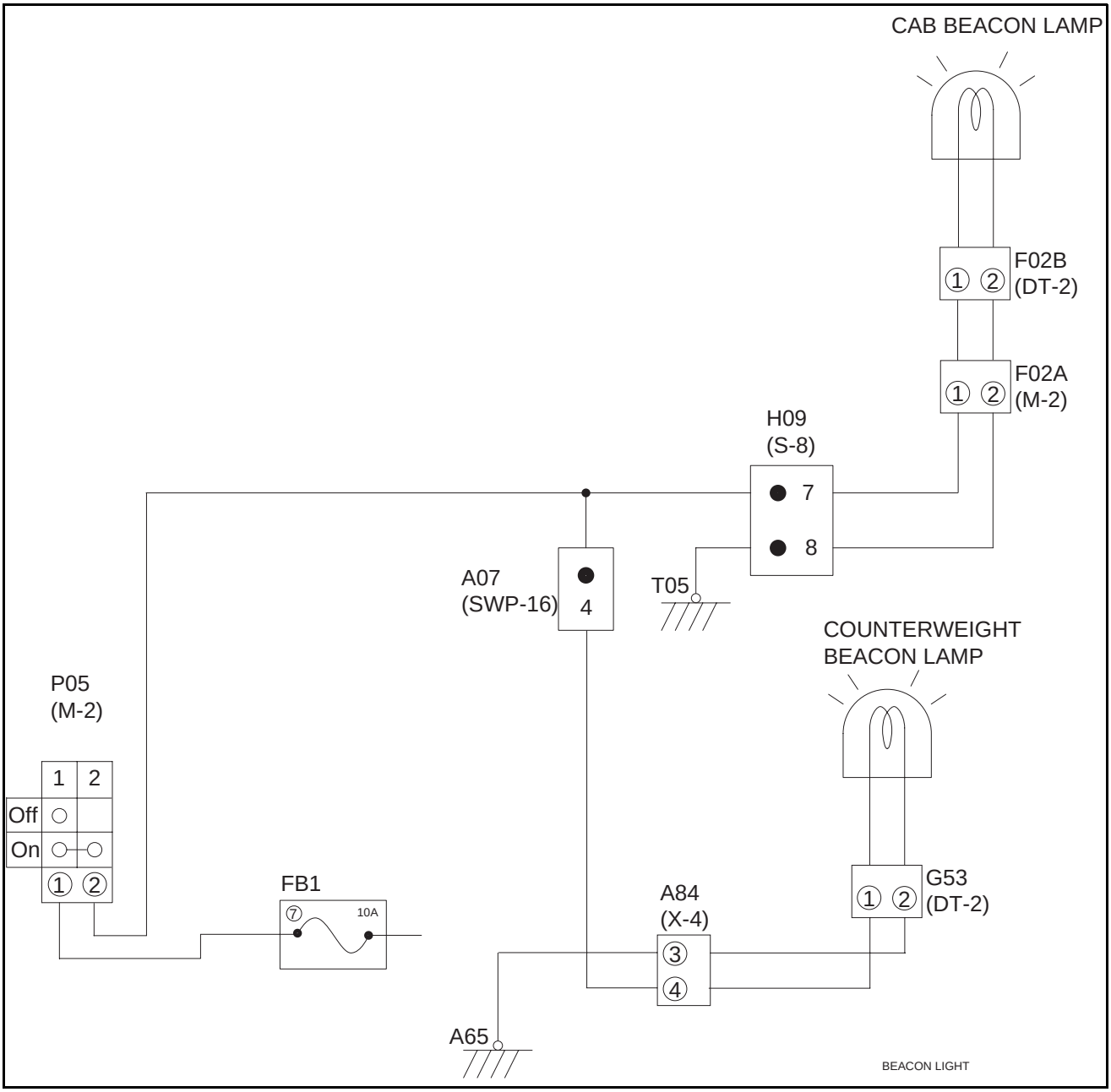
*When Fuse No.7 (Fuse box 1) is not blown

*When bulb is fitted correctly and fully functional

*With beacon light switch (P05) in the ON position

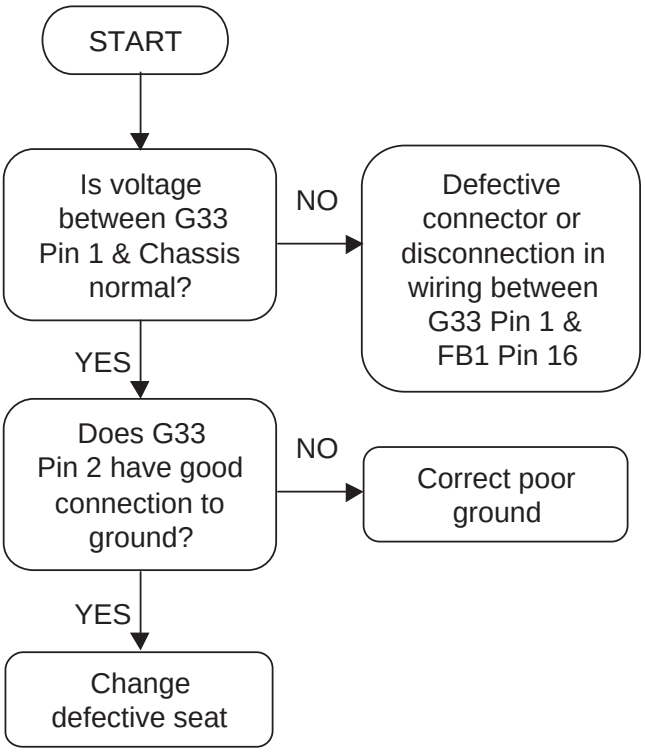


Circuit Diagram for Cab & Counterweight Beacon Light

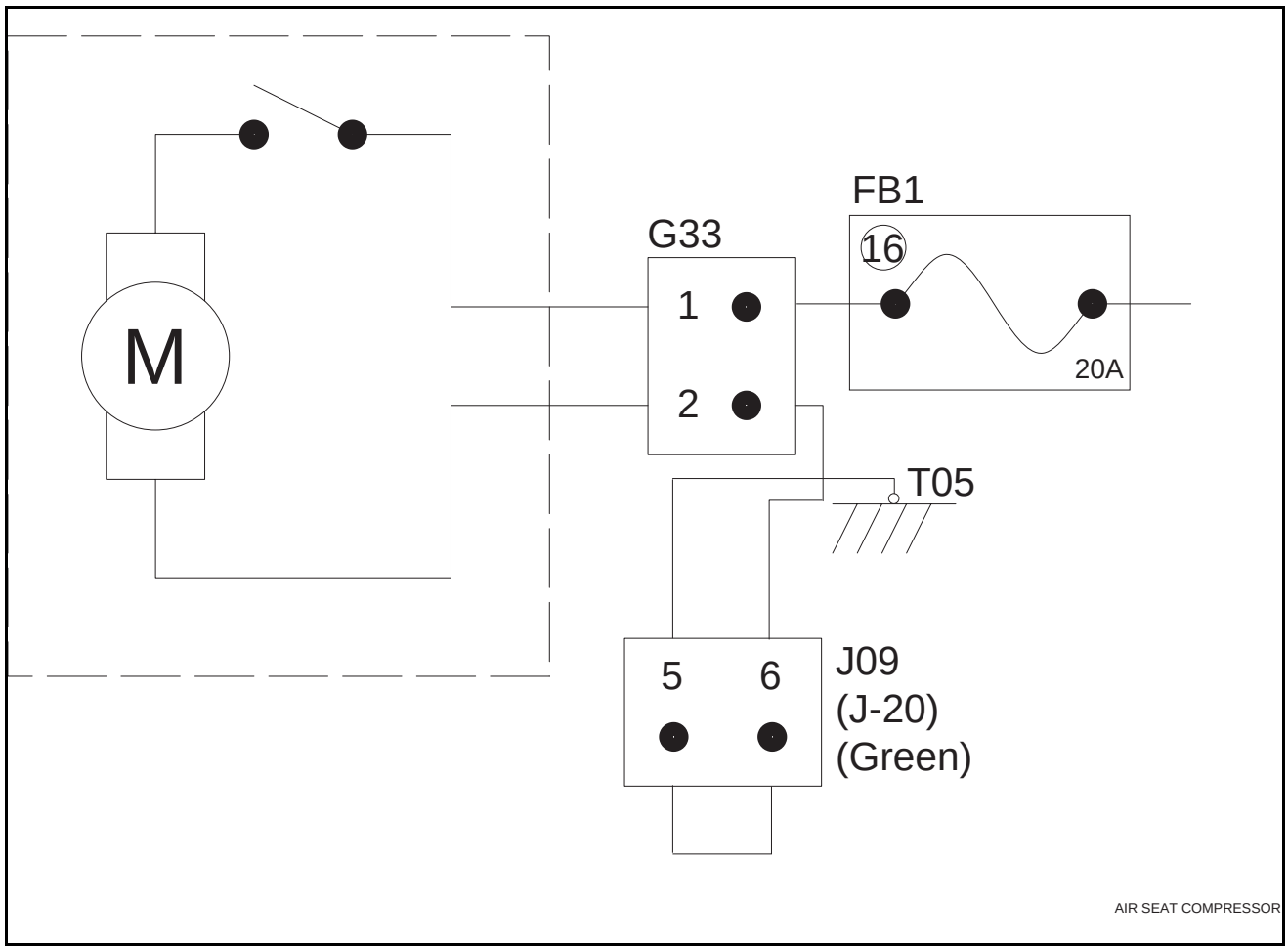


Air Seat Compressor (Option - Air Suspension Seat)

*When Fuse No.16 (Fuse box 1) is not blown



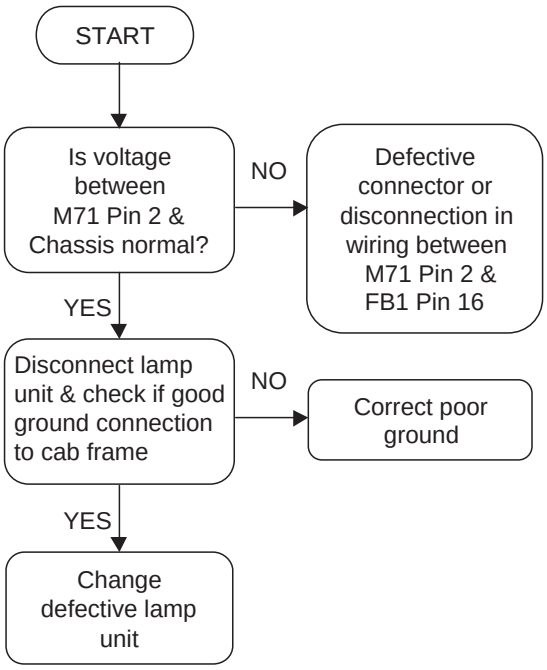
Circuit Diagram for Air Seat Compressor (Option - Air Suspension Seat)



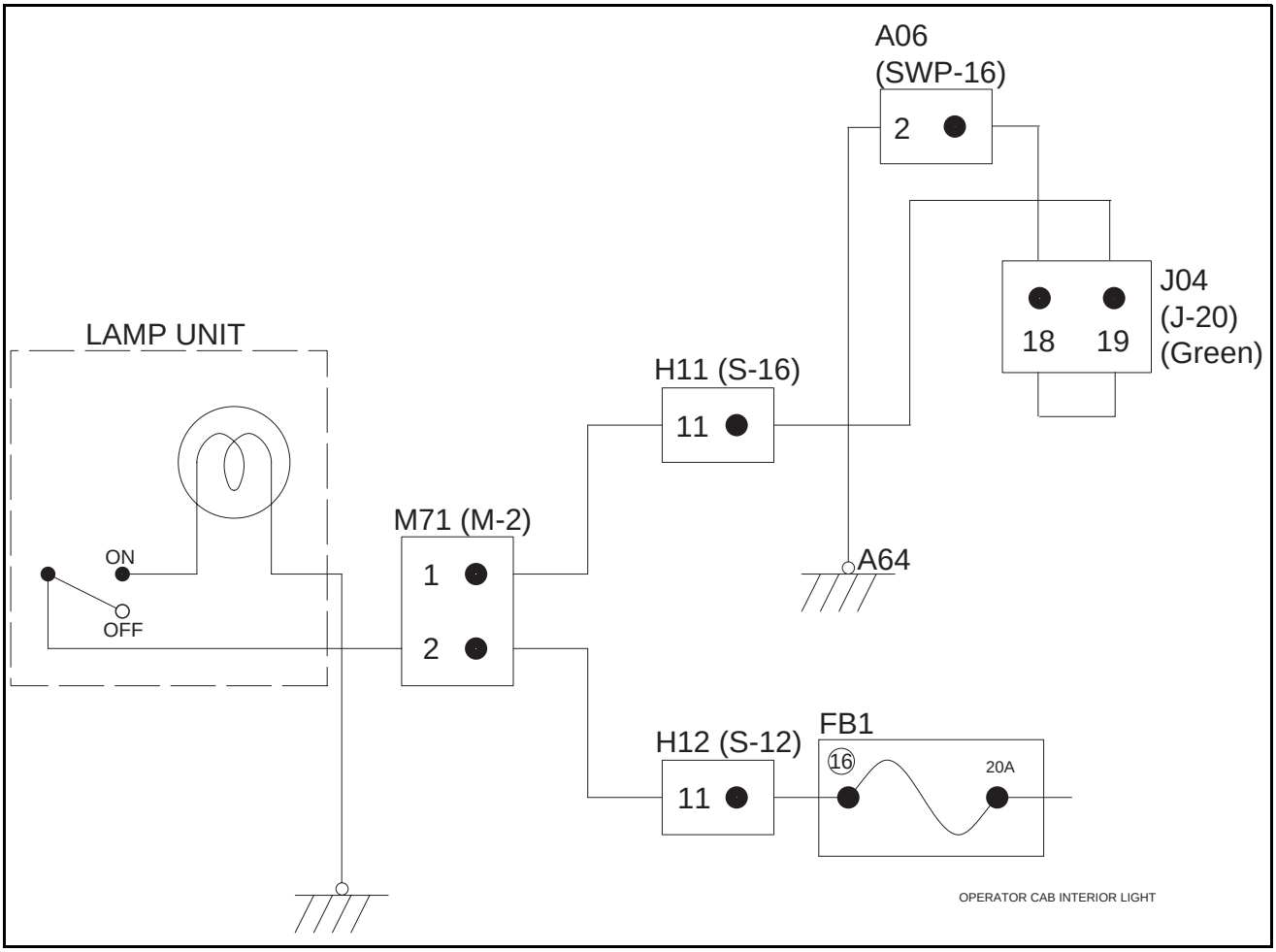
Operator Cab Interior Light

*When Fuse No.16 (Fuse box 1) is not blown

*When bulb is fully functional & fitted correctly

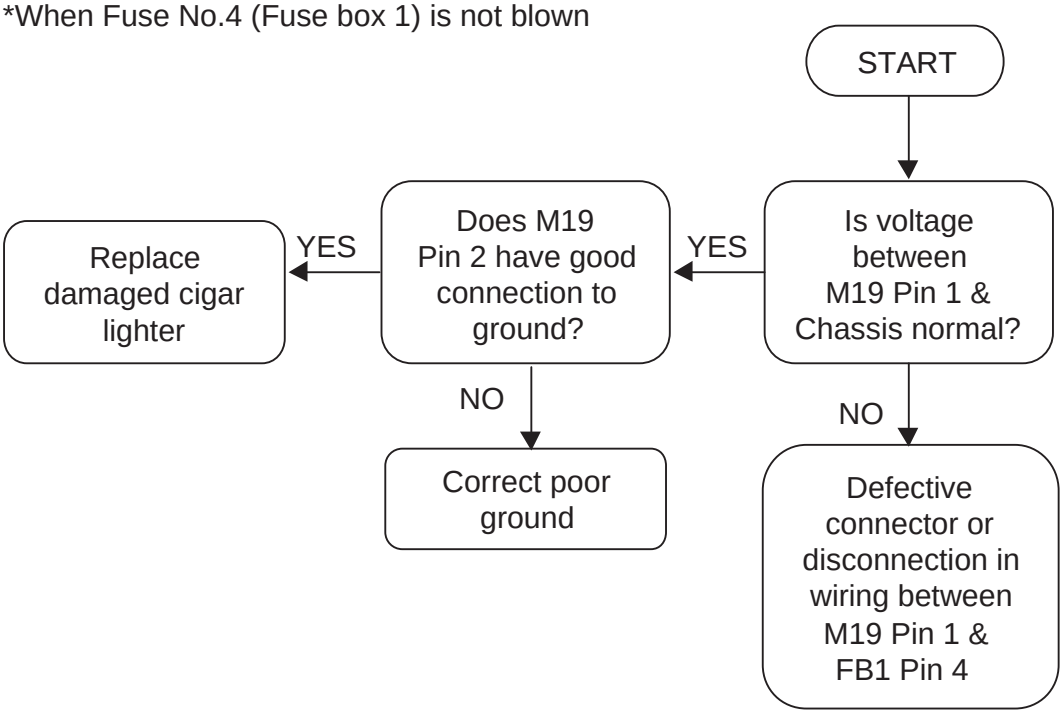


Circuit Diagram for Operator Cab Interior Light

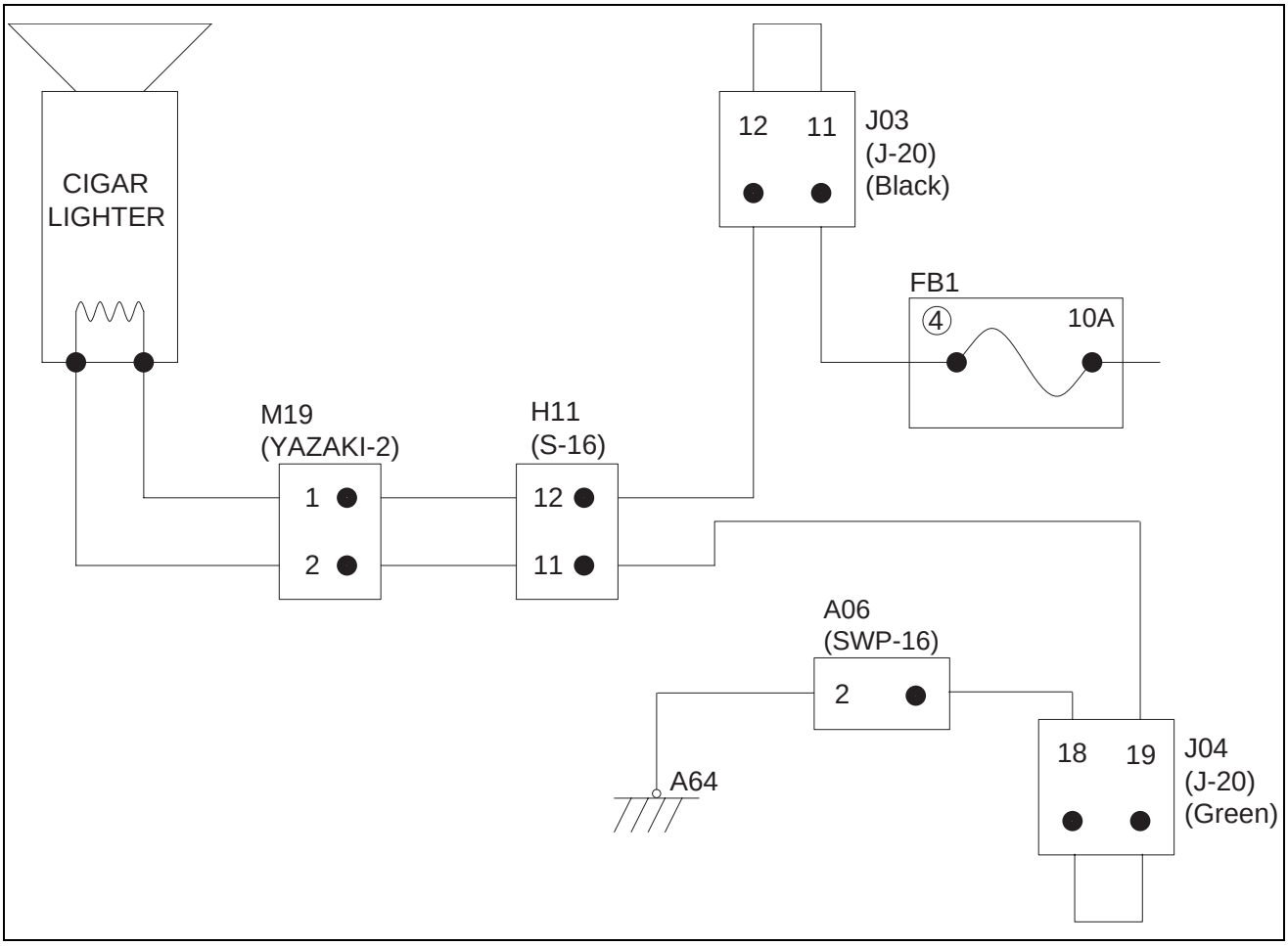


Cigar Lighter

*When Fuse No.4 (Fuse box 1) is not blown

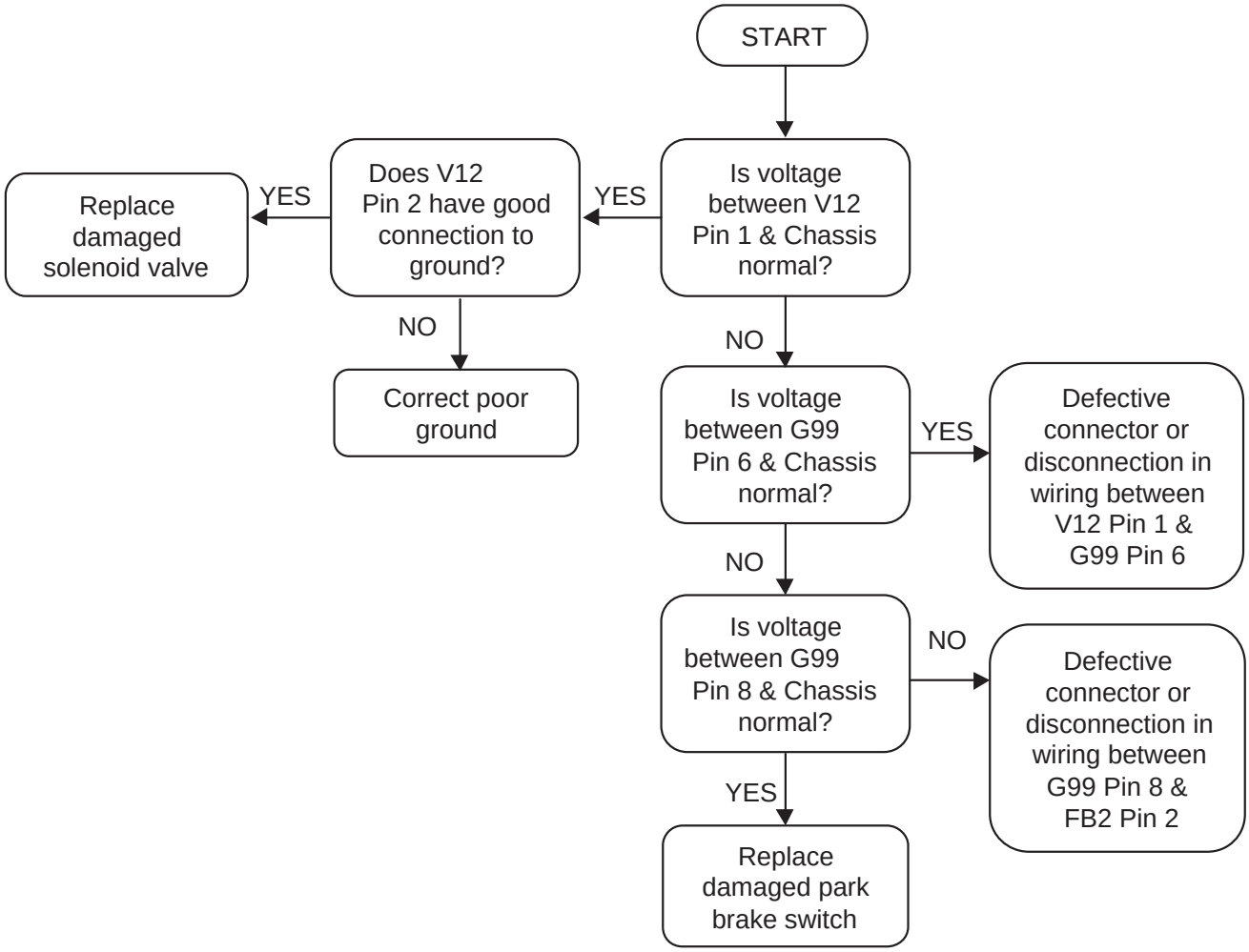


Circuit Diagram for Cigar Lighter

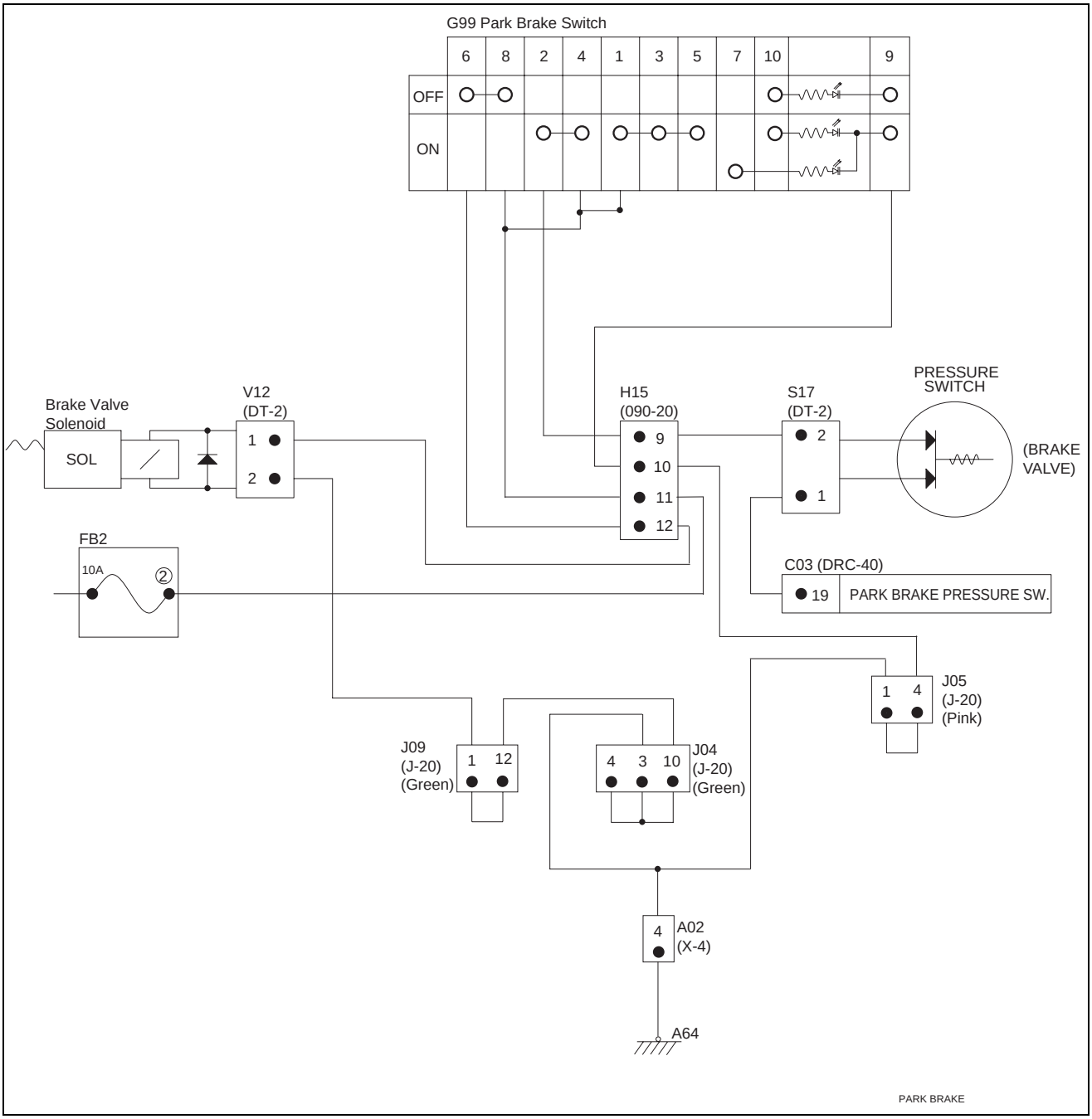


Park Brake (Not Activating)

*When Fuse No.2 (Fuse box 2) is not blown

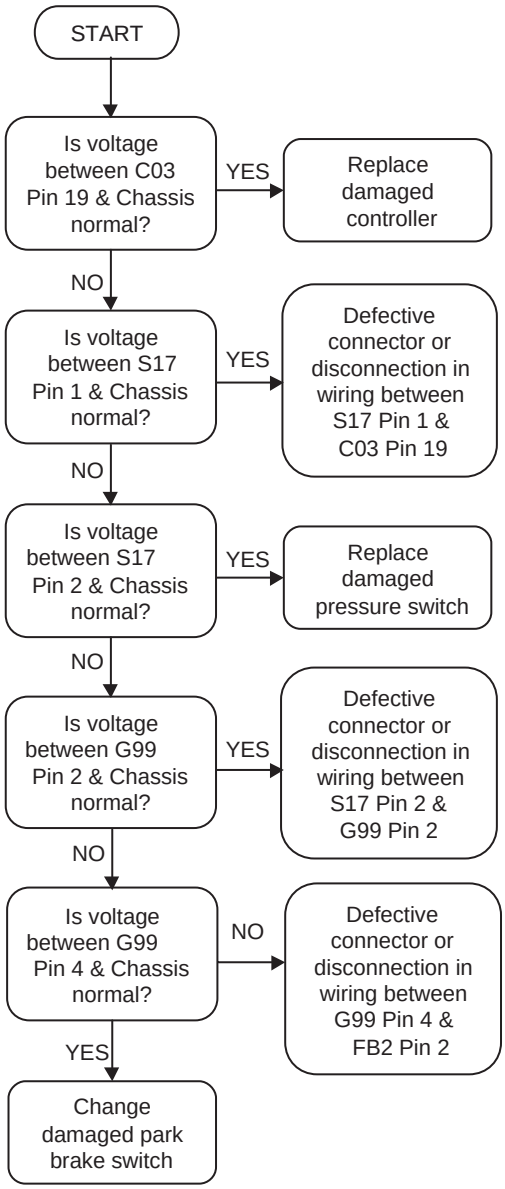


Circuit Diagram for Park Brake

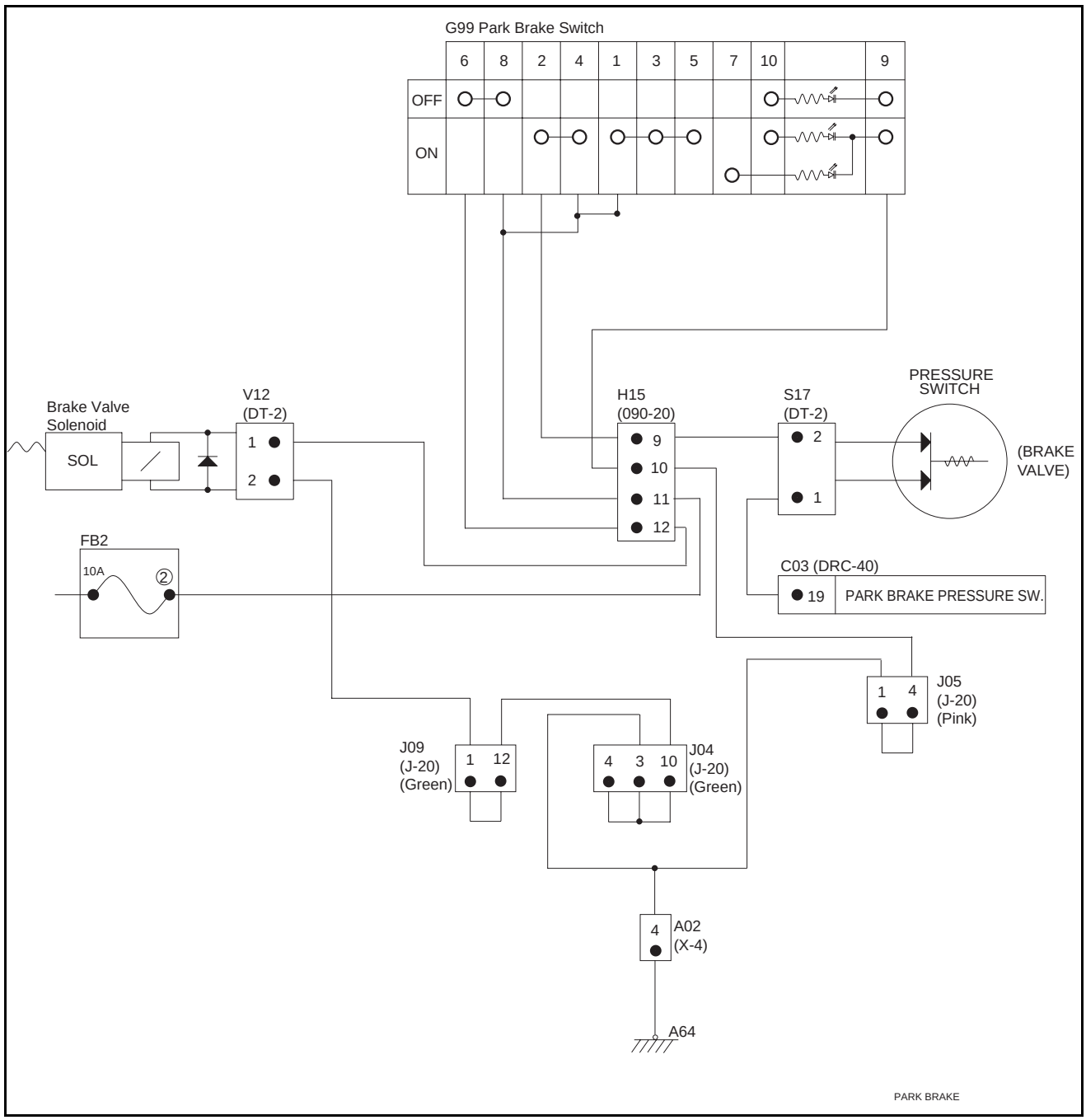


Park Brake (Displayed Symbol)

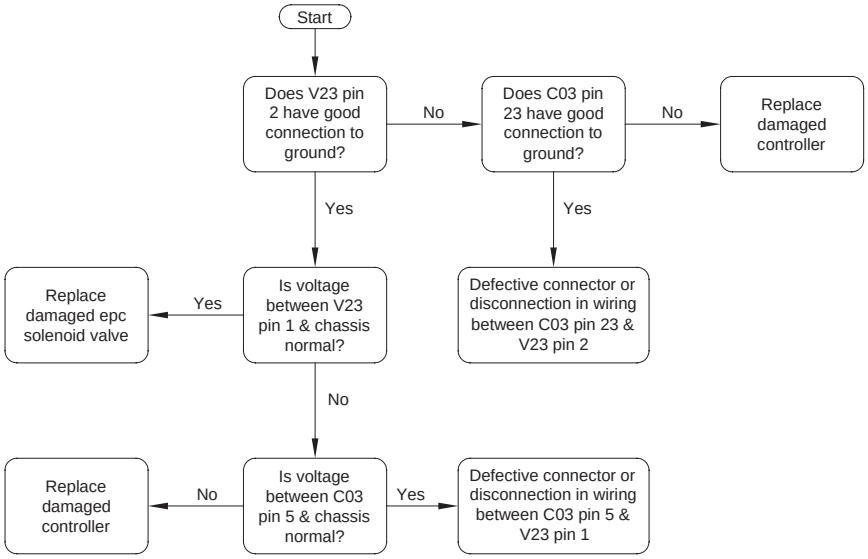
*When Fuse No.2 (Fuse Box 2) is not blown



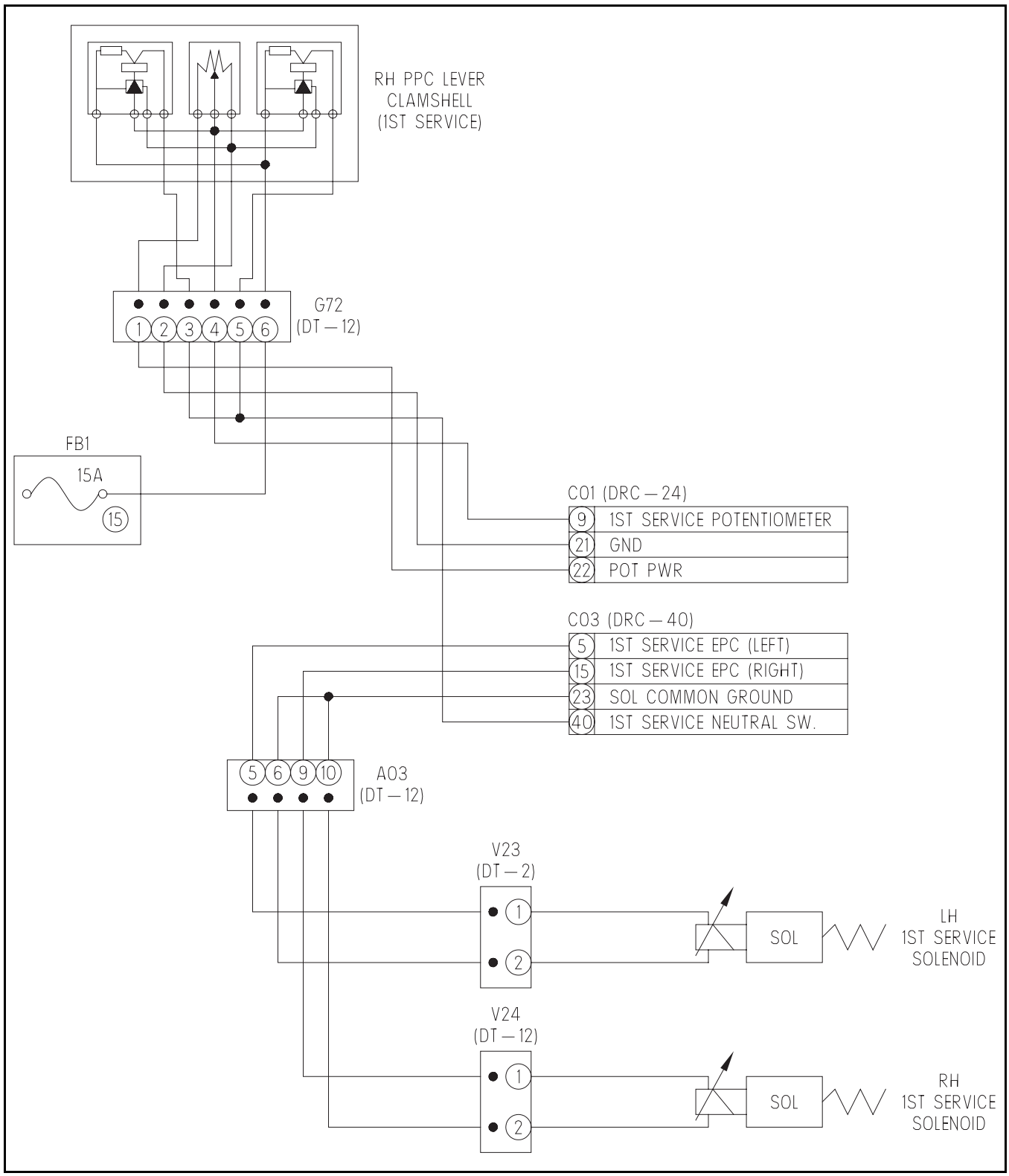
Circuit Diagram for Park Brake



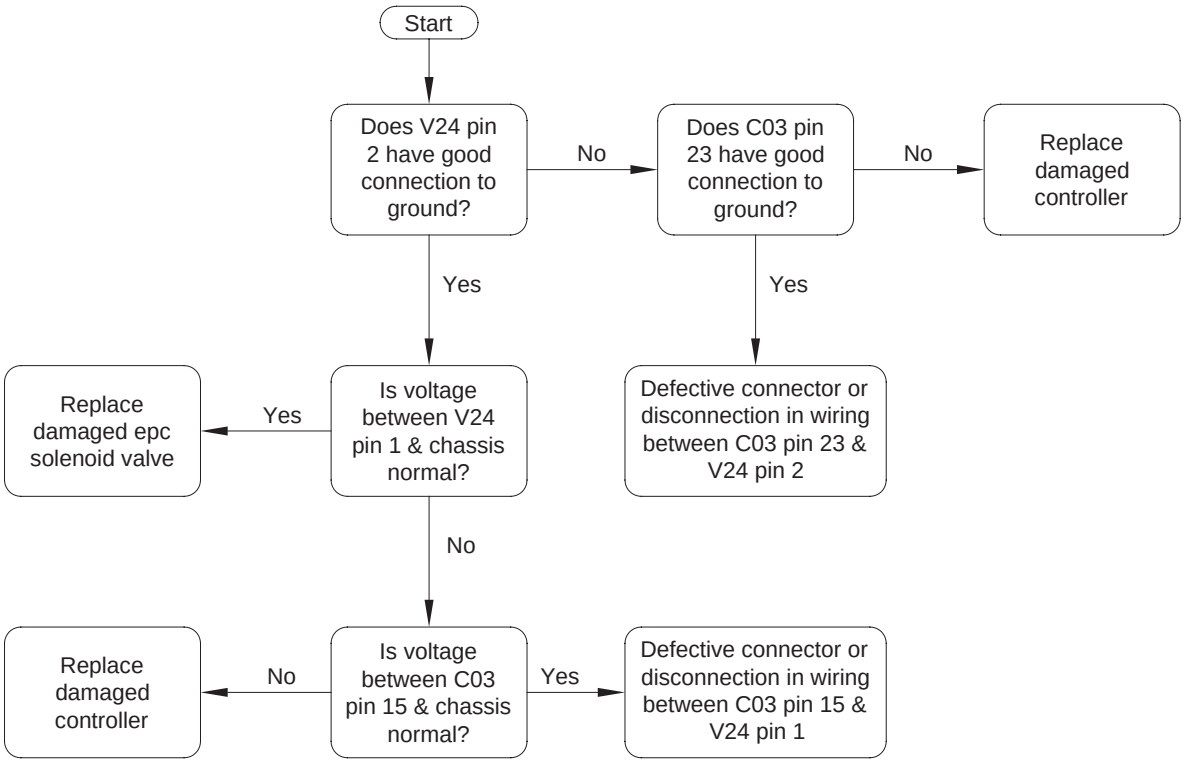
RH PPC Lever Clamshell Roller Switch Pushed to the LH Position



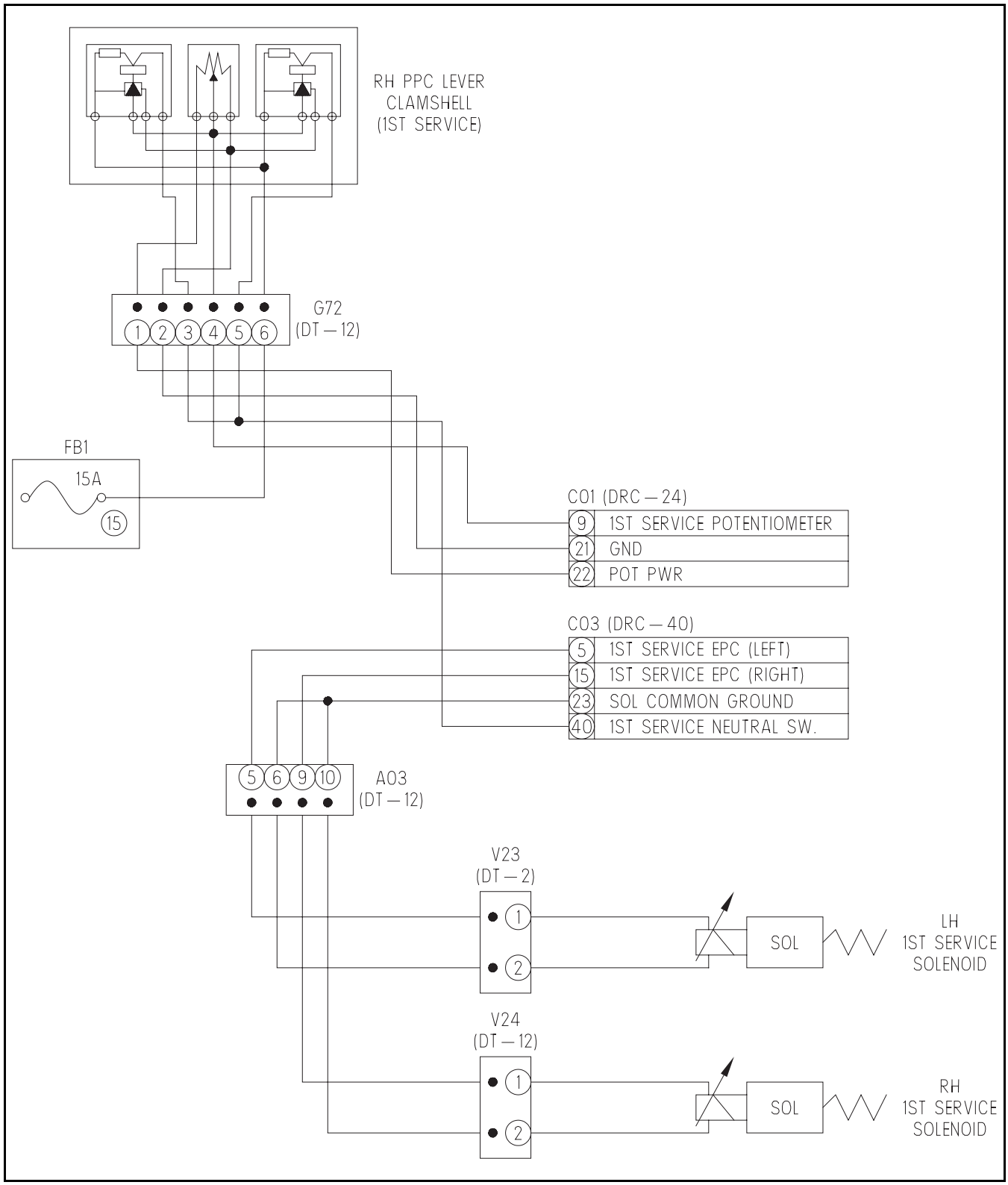
Circuit Diagram for Clamshell Control



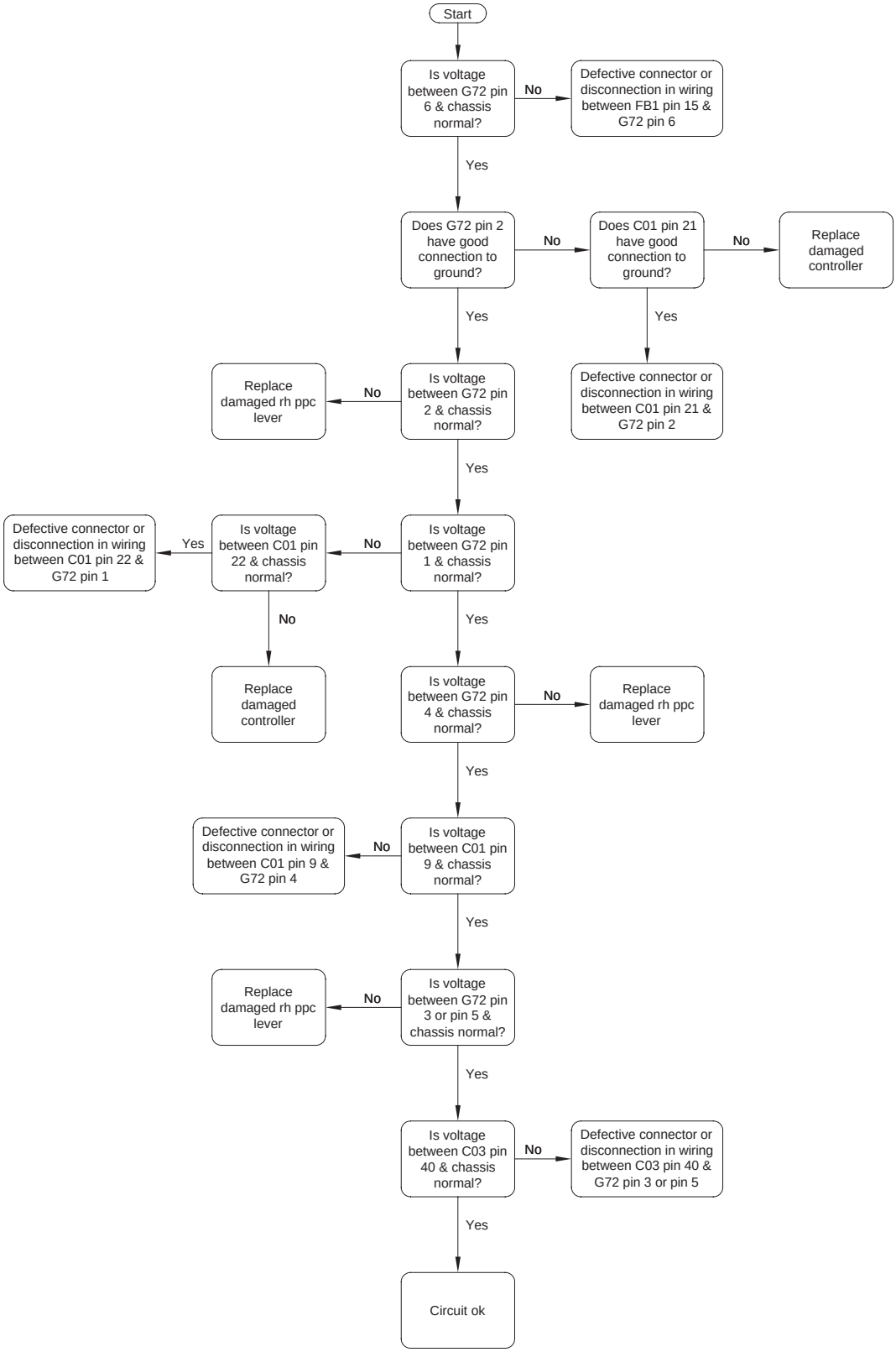
RH PPC Lever Clamshell Roller Switch Pushed to the RH Position



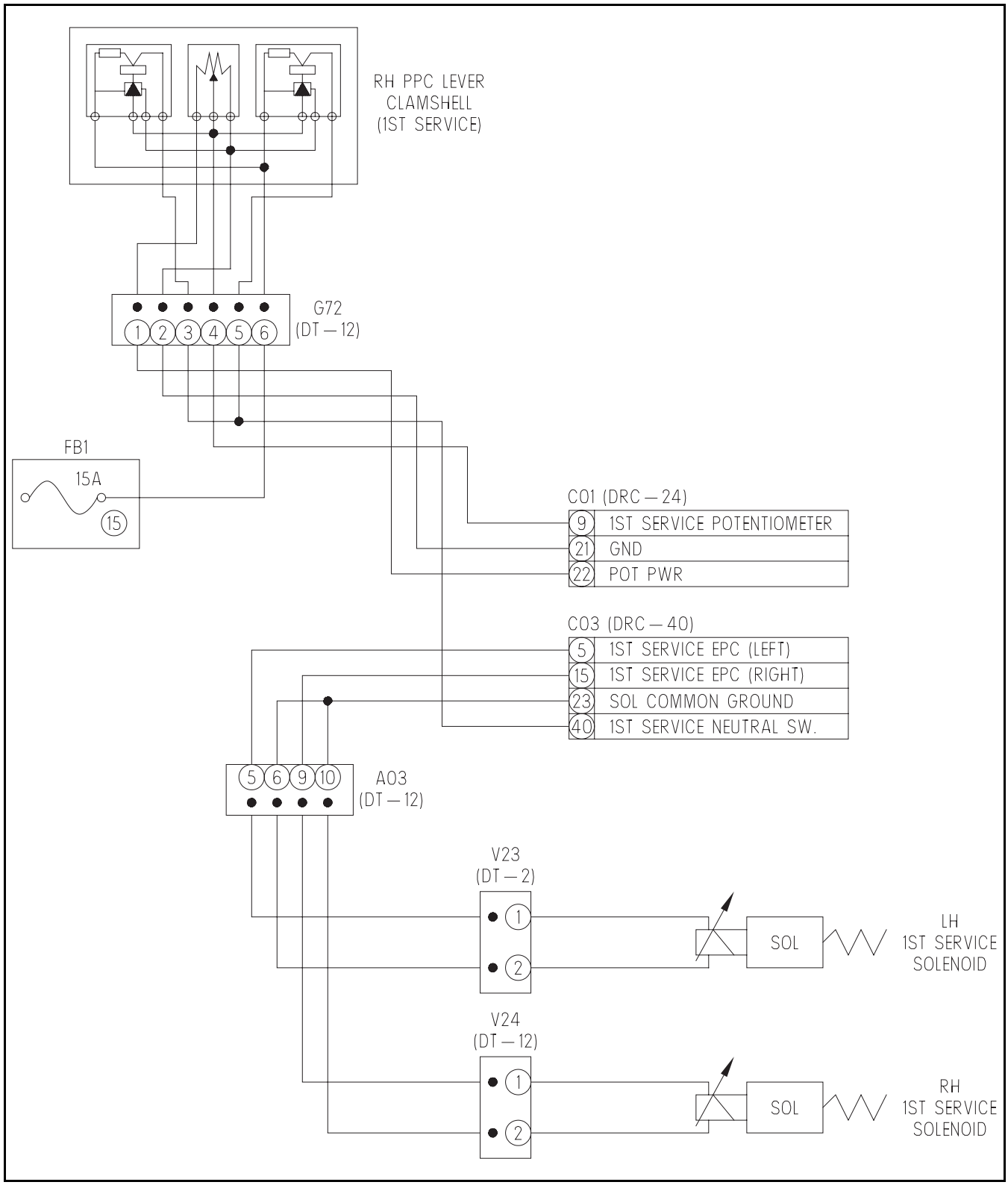
Circuit Diagram for Clamshell Control



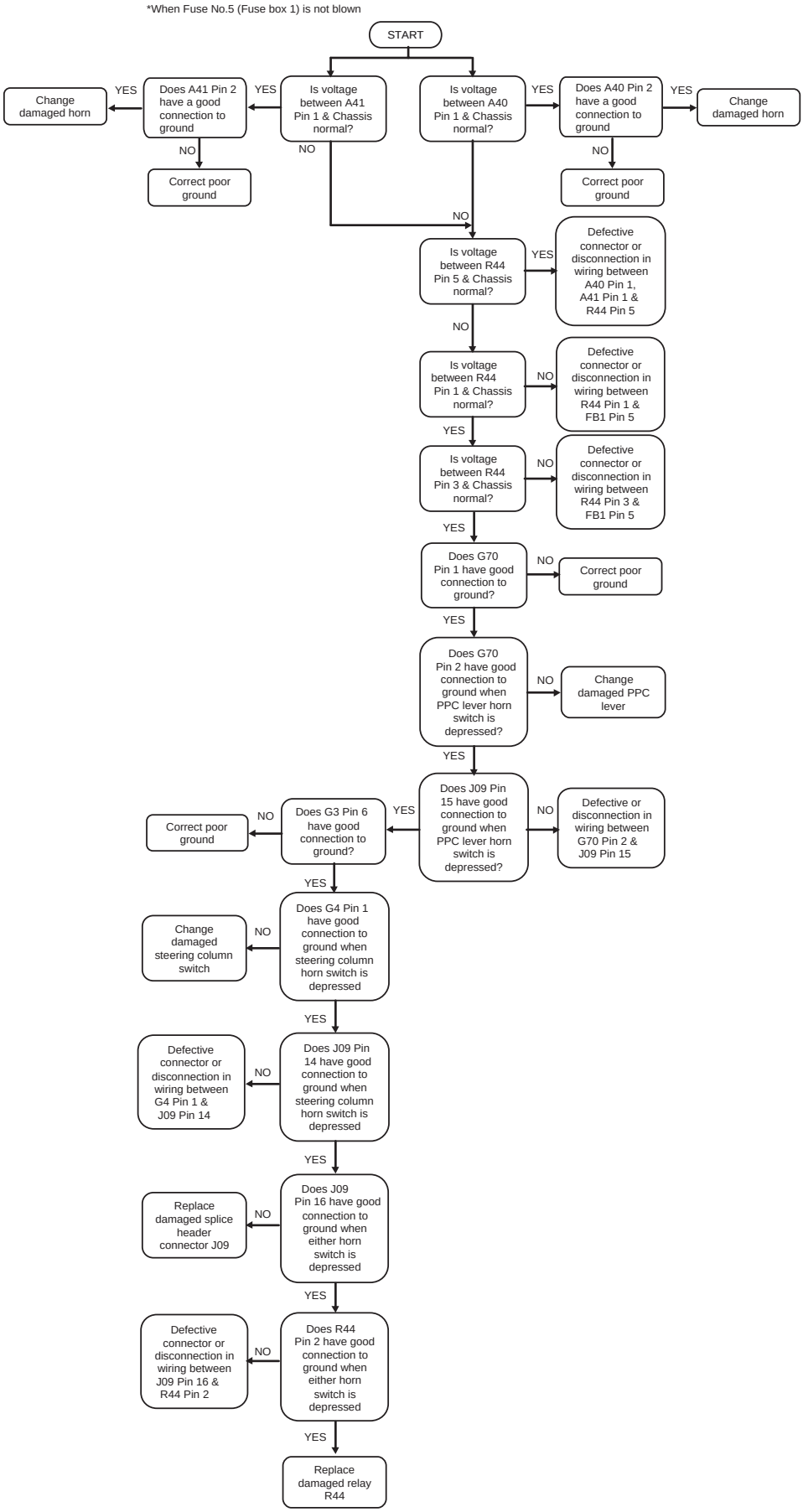
RH PPC Lever Clamshell Roller Switched Pushed to the RH or LH



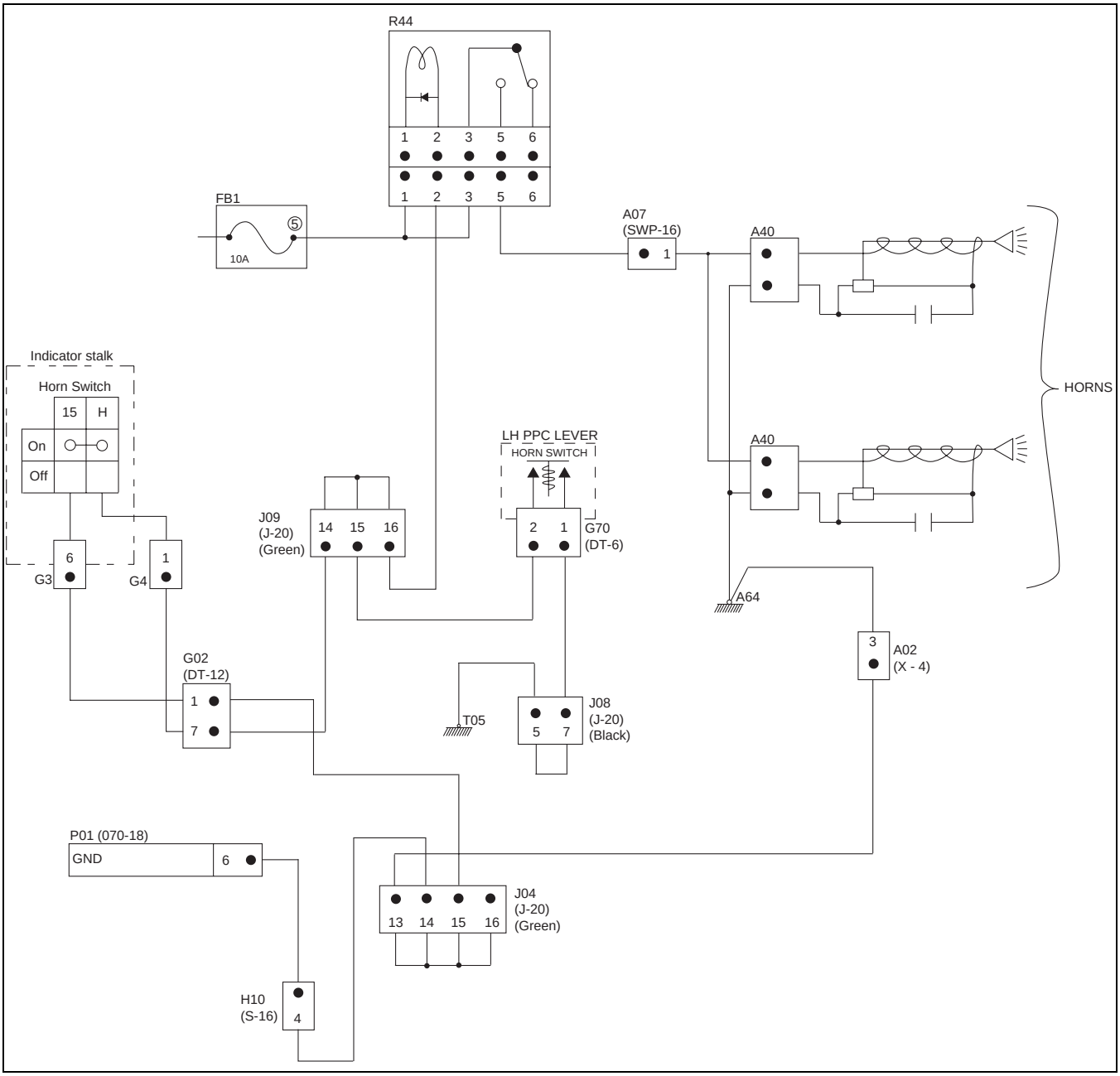
Circuit Diagram for Clamshell Control



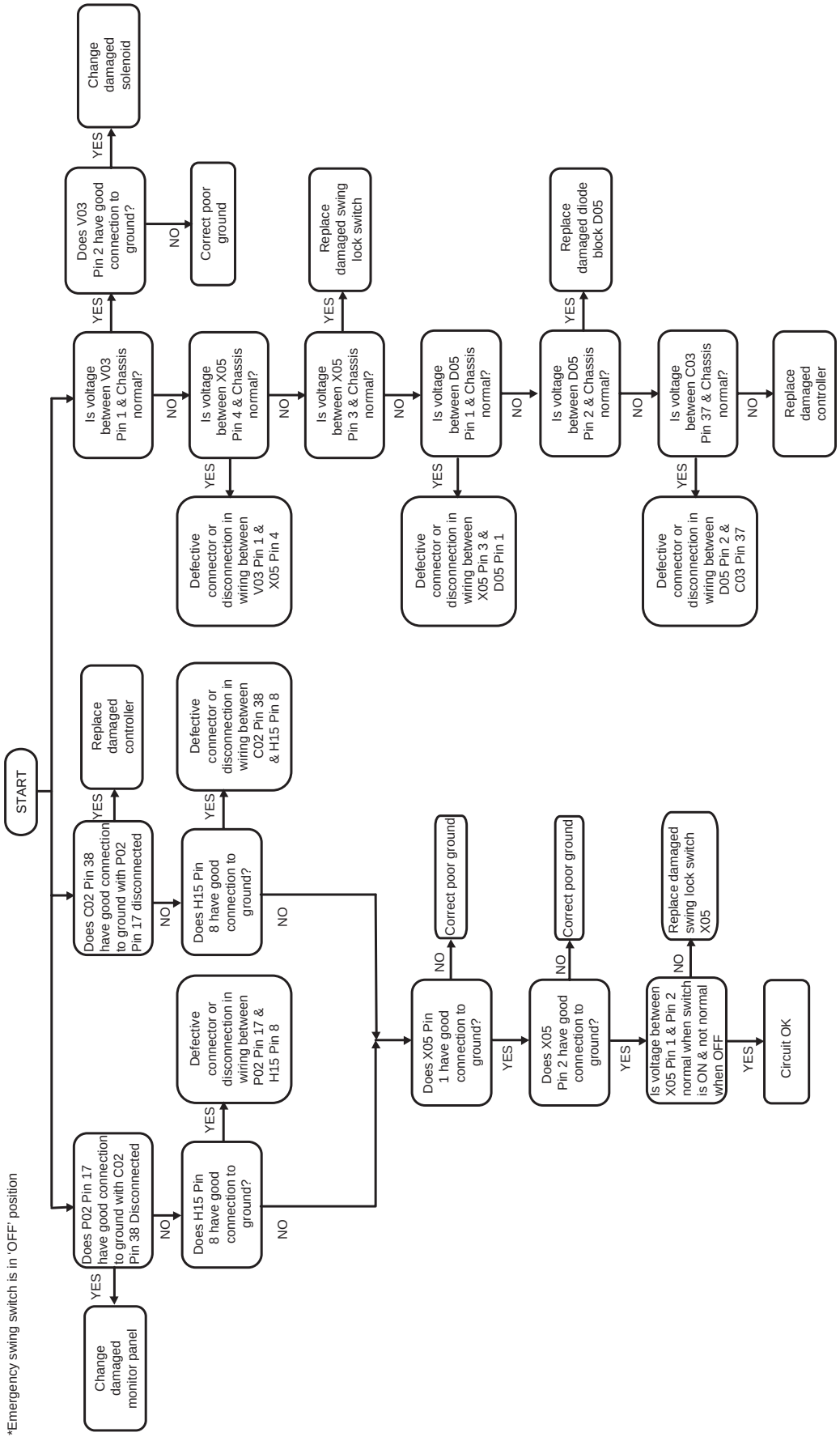
Horns


*When Fuse No.5 (Fuse box 1) is not blown
START
Is voltage between A41 Pin 1 & Chassis normal?
Does A41 Pin 2 have a good connection to ground
Change damaged horn
Correct poor ground
Is voltage between A40 Pin 1 & Chassis normal?
Does A40 Pin 2 have a good connection to ground
Change damaged horn
Correct poor ground
Is voltage between R44 Pin 5 & Chassis normal?
Defective connector or disconnection in wiring between A40 Pin 1, A41 Pin 1 & R44 Pin 5
Is voltage between R44 Pin 1 & Chassis normal?
Defective connector or disconnection in wiring between R44 Pin 1 & FB1 Pin 5
Is voltage between R44 Pin 3 & Chassis normal?
Defective connector or disconnection in wiring between R44 Pin 3 & FB1 Pin 5
Does G70 Pin 1 have good connection to ground?
Correct poor ground
Does G70 Pin 2 have good connection to ground when PPC lever horn switch is depressed?
Change damaged PPC lever
Does J09 Pin 15 have good connection to ground when PPC lever horn switch is depressed?
Defective or disconnection in wiring between G70 Pin 2 & J09 Pin 15
Does G3 Pin 6 have good connection to ground?
Correct poor ground
Does G4 Pin 1 have good connection to ground when steering column horn switch is depressed
Change damaged steering column switch
Does J09 Pin 14 have good connection to ground when steering column horn switch is depressed
Defective connector or disconnection in wiring between G4 Pin 1 & J09 Pin 14
Does J09 Pin 16 have good connection to ground when either horn switch is depressed
Replace damaged splice header connector J09
Does R44 Pin 2 have good connection to ground when either horn switch is depressed
Defective connector or disconnection in wiring between J09 Pin 16 & R44 Pin 2
Replace damaged relay R44
YES
NO

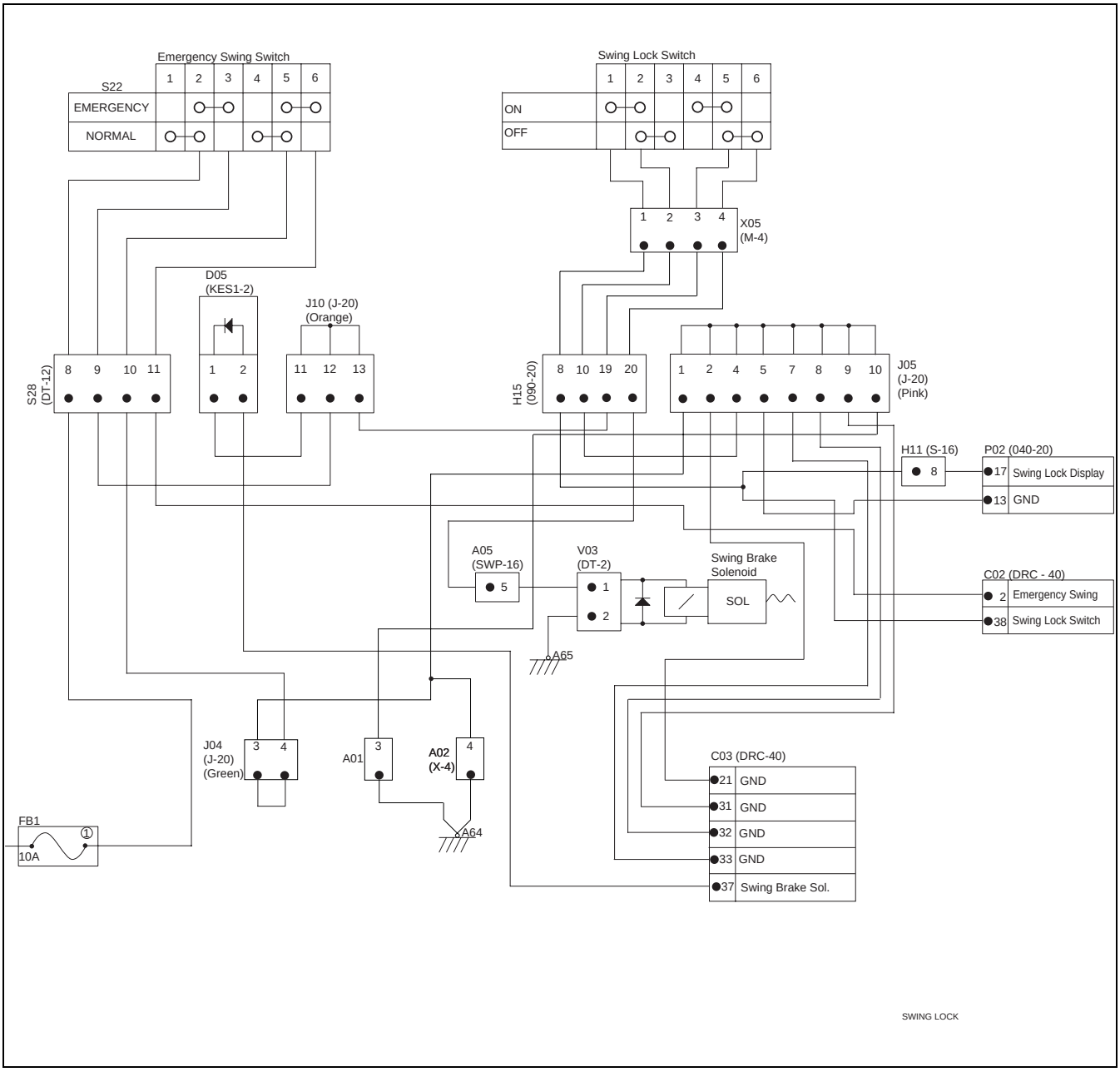
Circuit Diagram for Horn



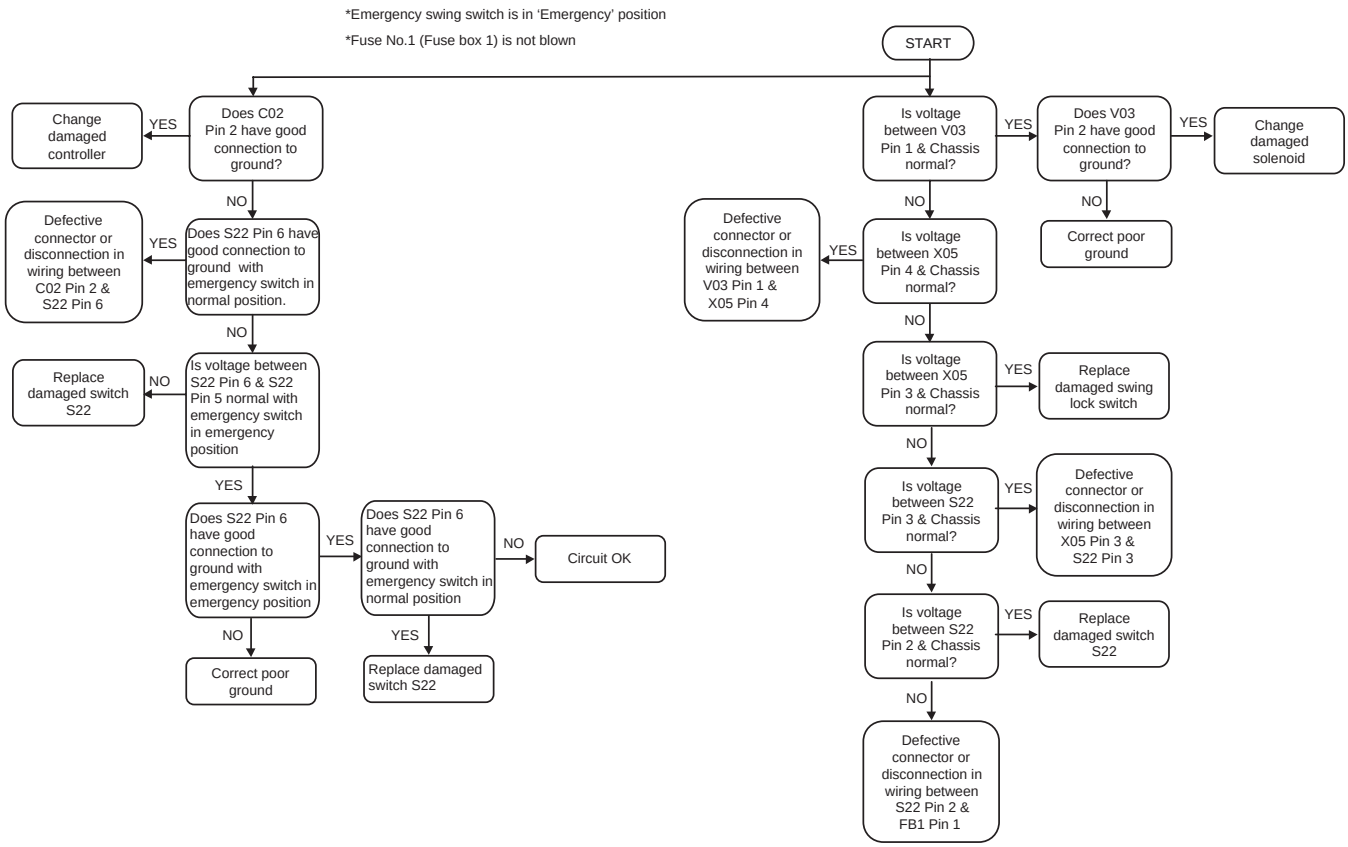
Swing Lock - Normal Operation



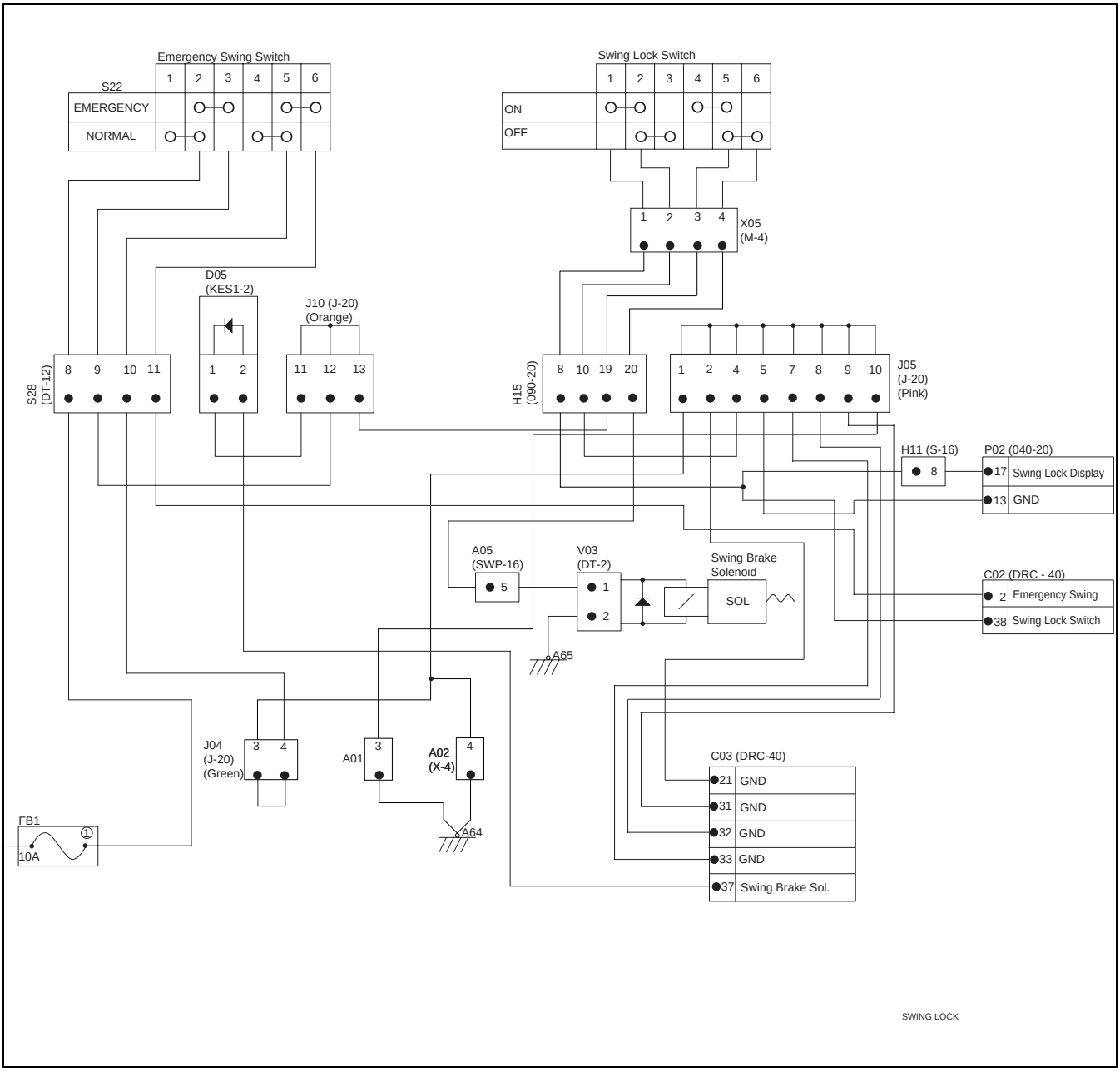
Circuit Diagram for Swing Lock



Swing Lock - Emergency Operation

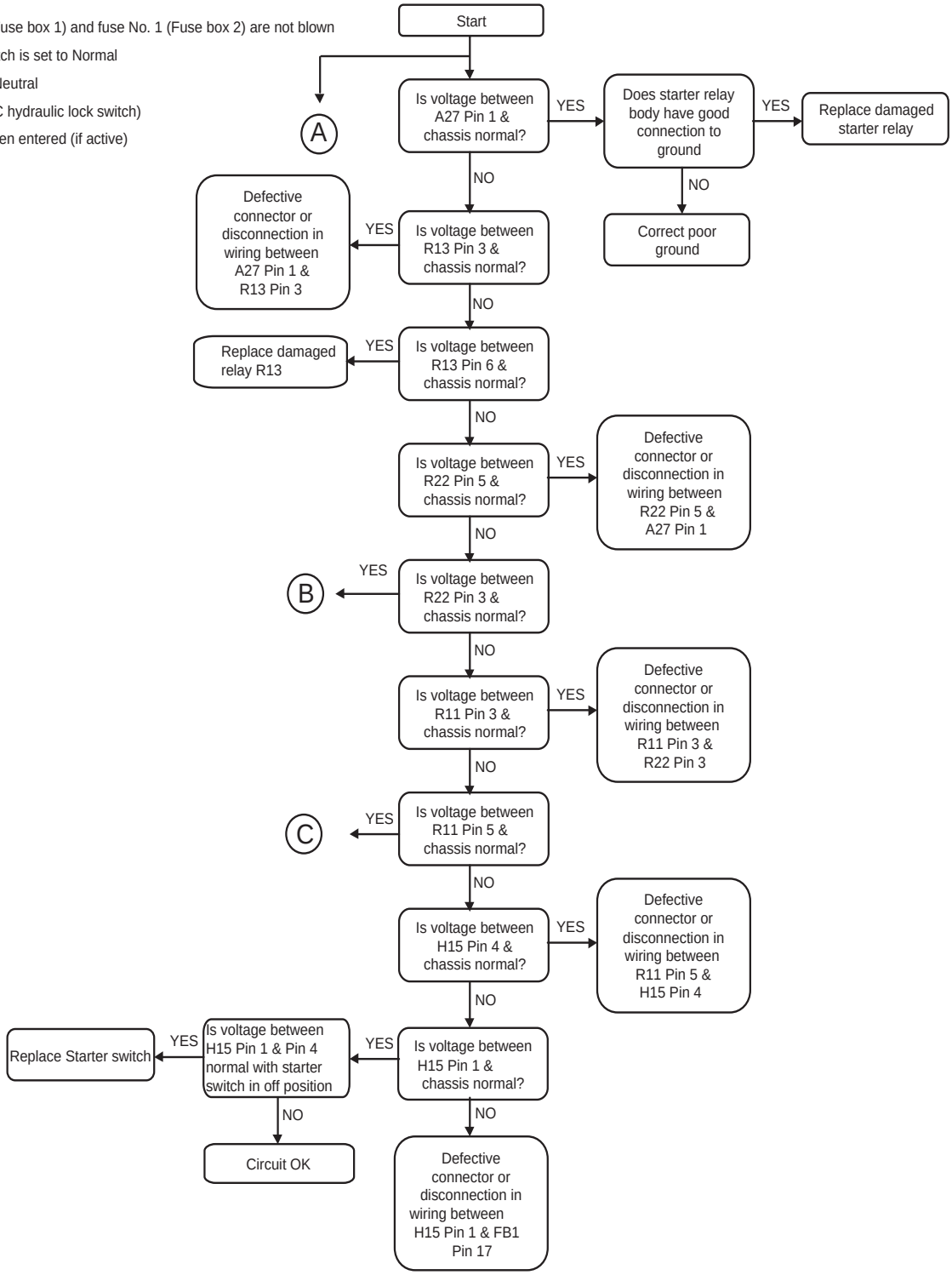


Circuit Diagram for Swing Lock - Emergency Operation

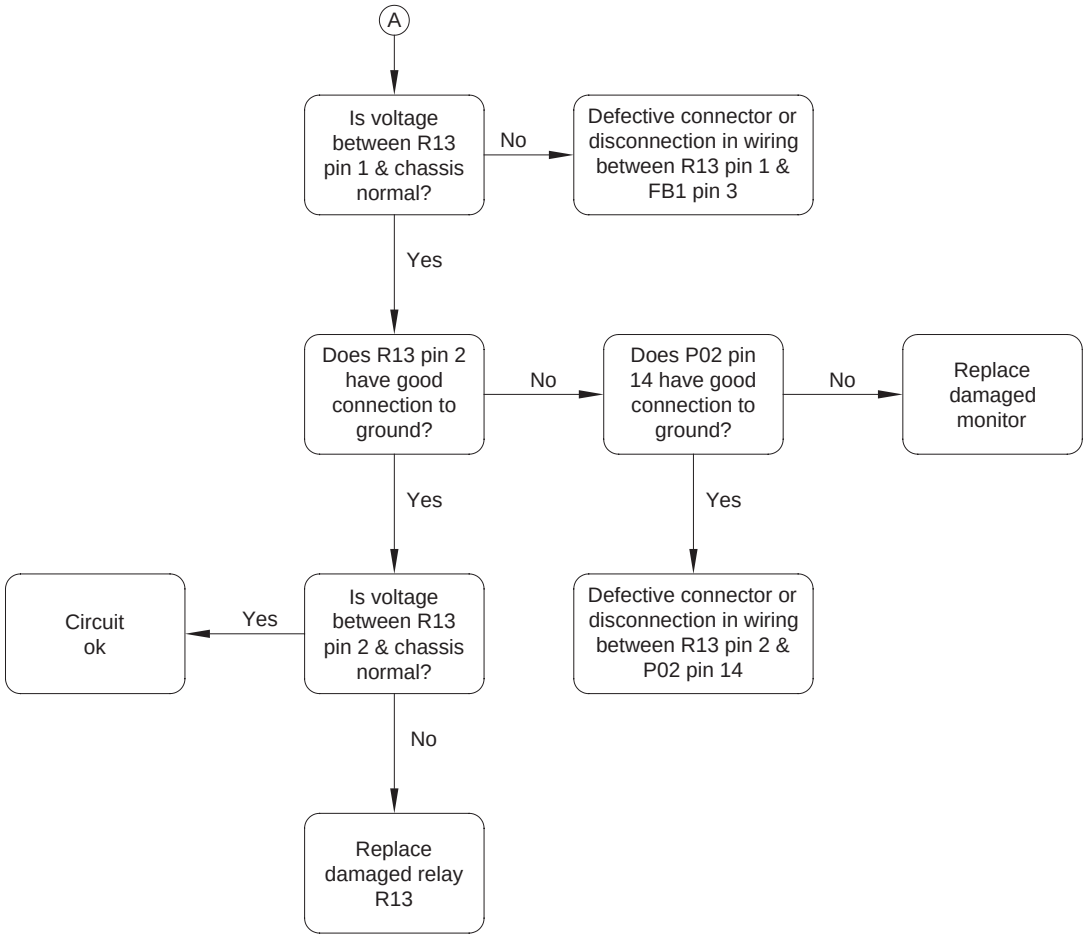


Neutral Start (Engine)

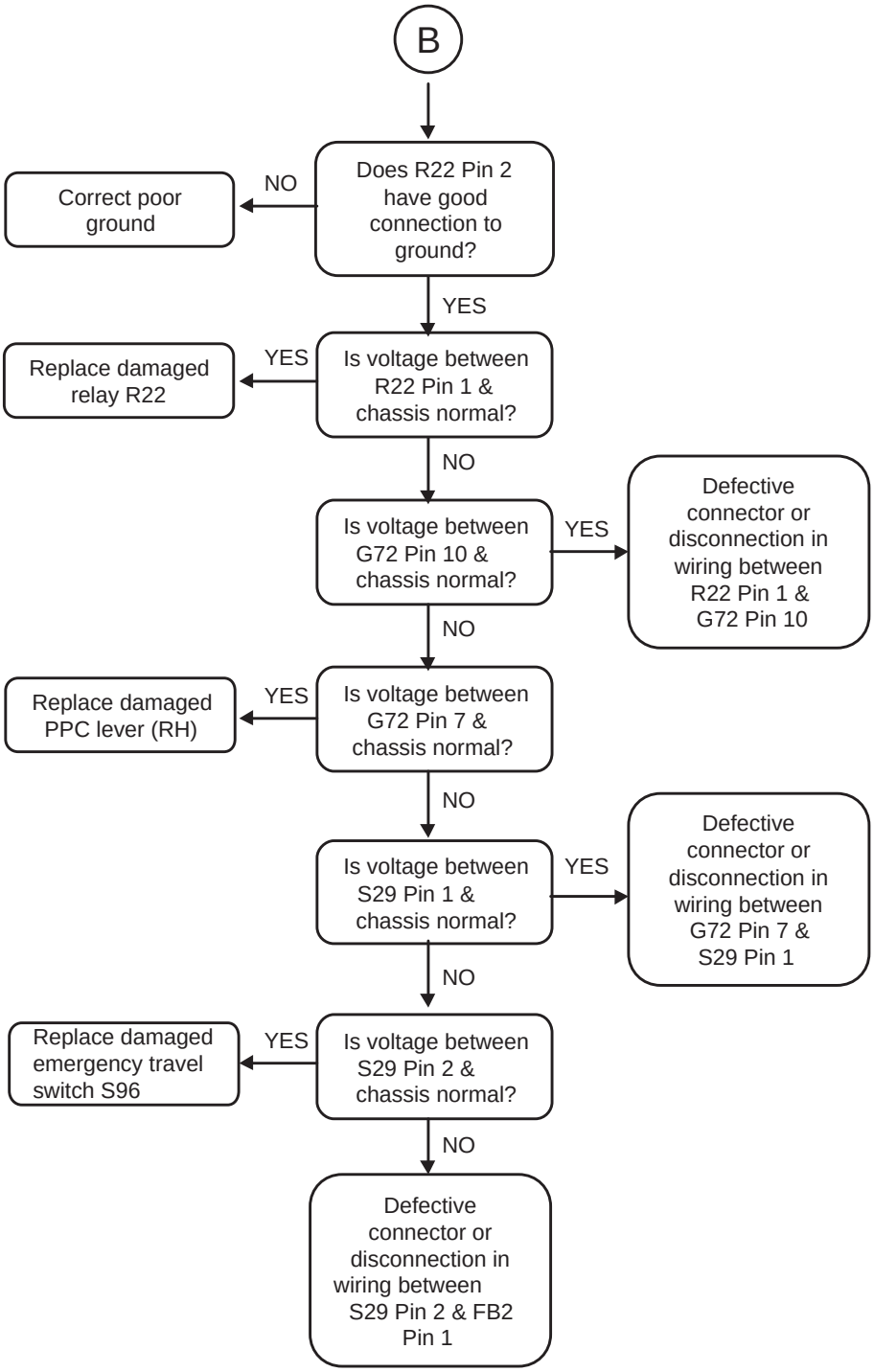
*When Fuses No.3, 15, 17 (Fuse box 1) and fuse No. 1 (Fuse box 2) are not blown
*When travel emergency switch is set to Normal
*When FNR switch is set to Neutral
*When LH pod is raised (PPC hydraulic lock switch)
*When personal code has been entered (if active)



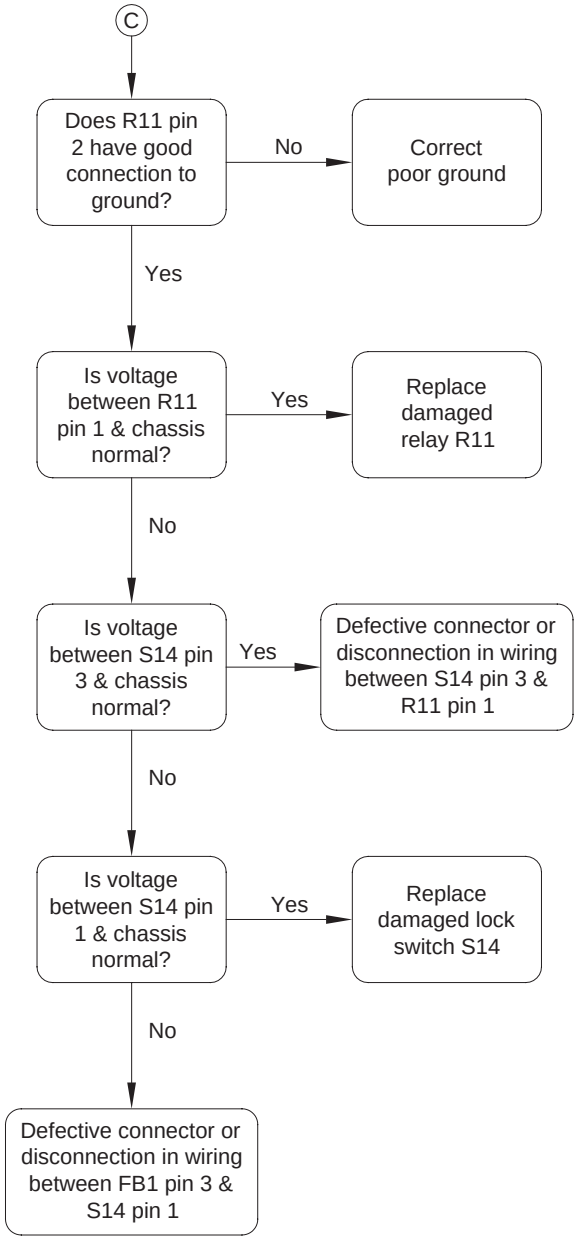
Neutral Start (Engine) cont'd (A)



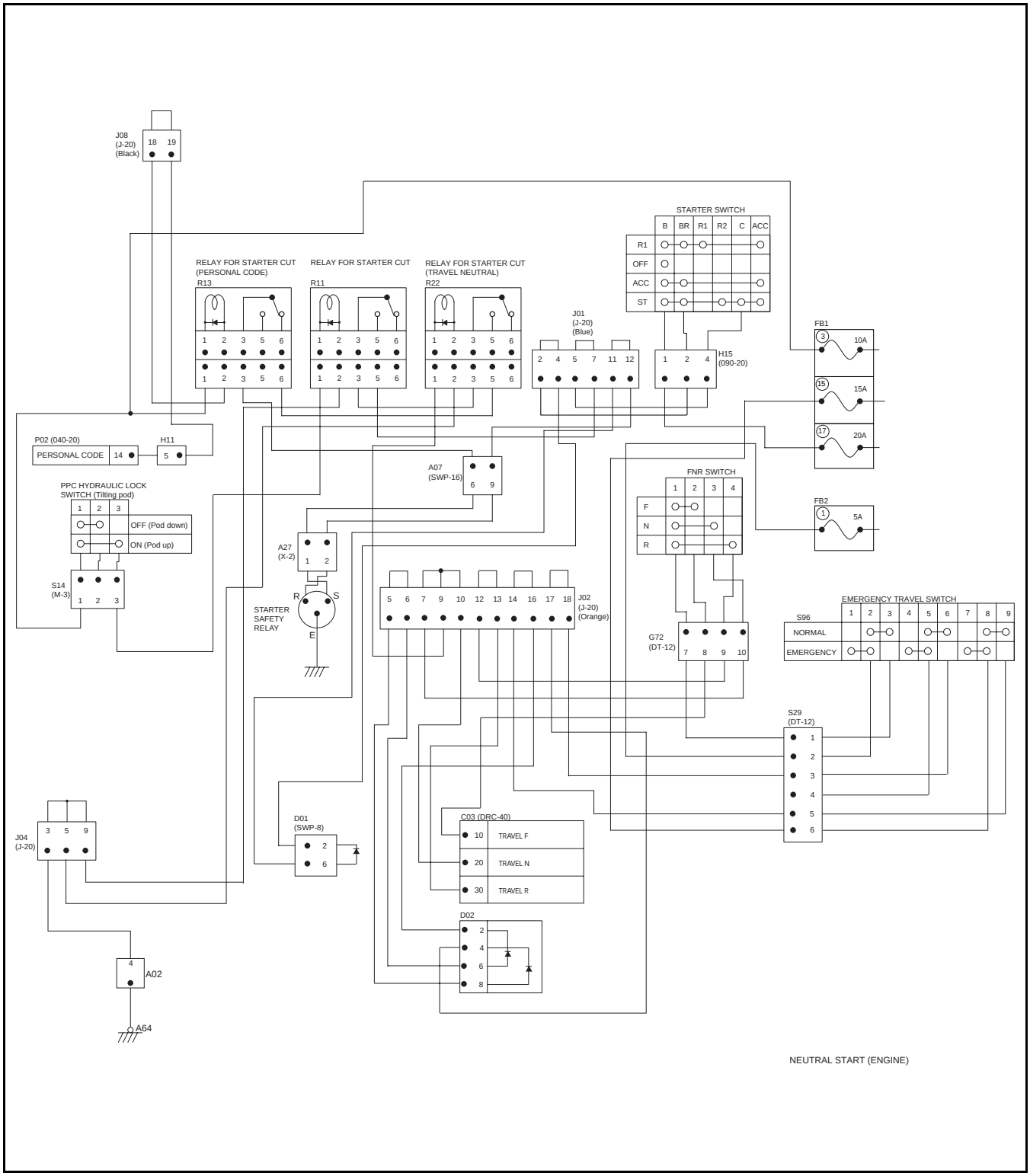
Neutral Start (Engine) cont'd (B)



Neutral Start (Engine) cont'd (C)



Circuit Diagram for Neutral Start (Engine)

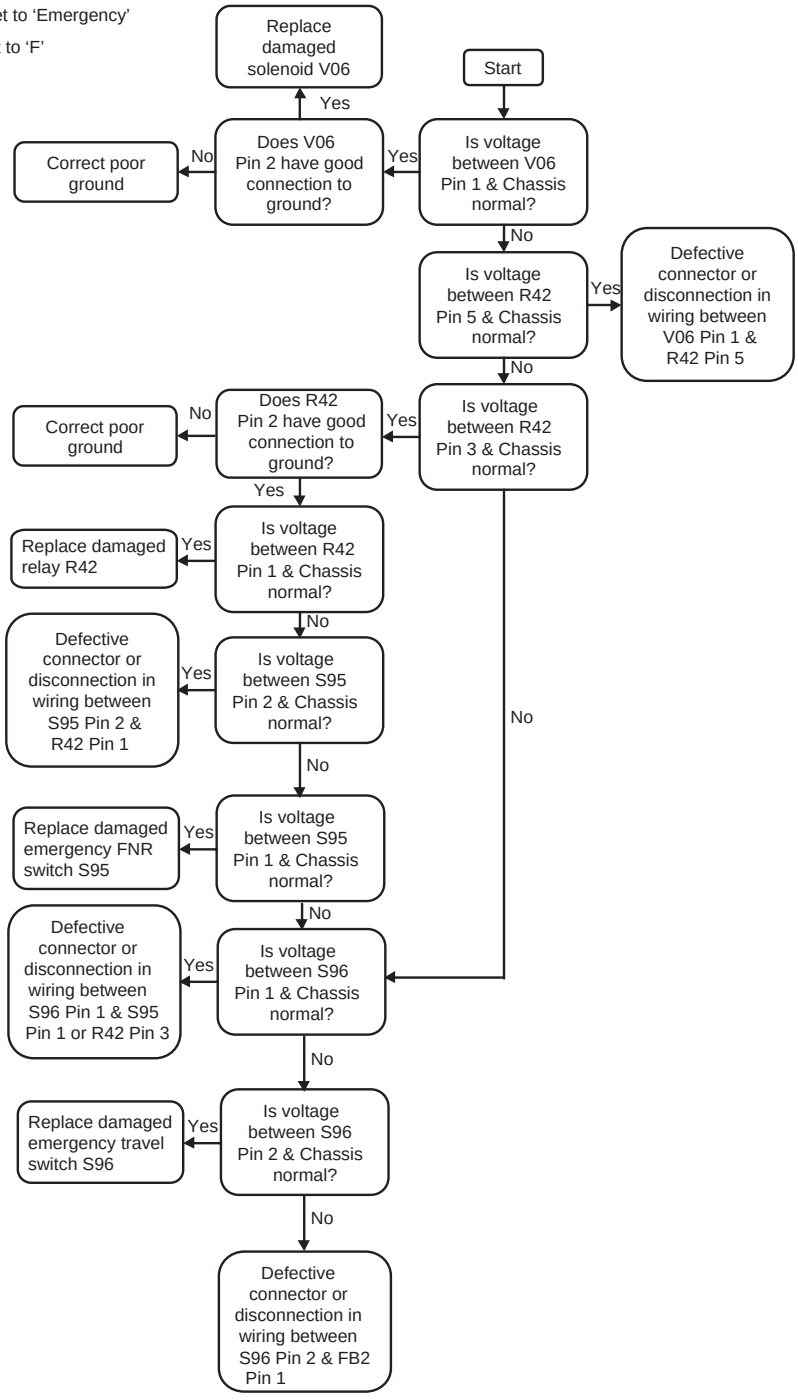


Emergency Travel Control - Forward

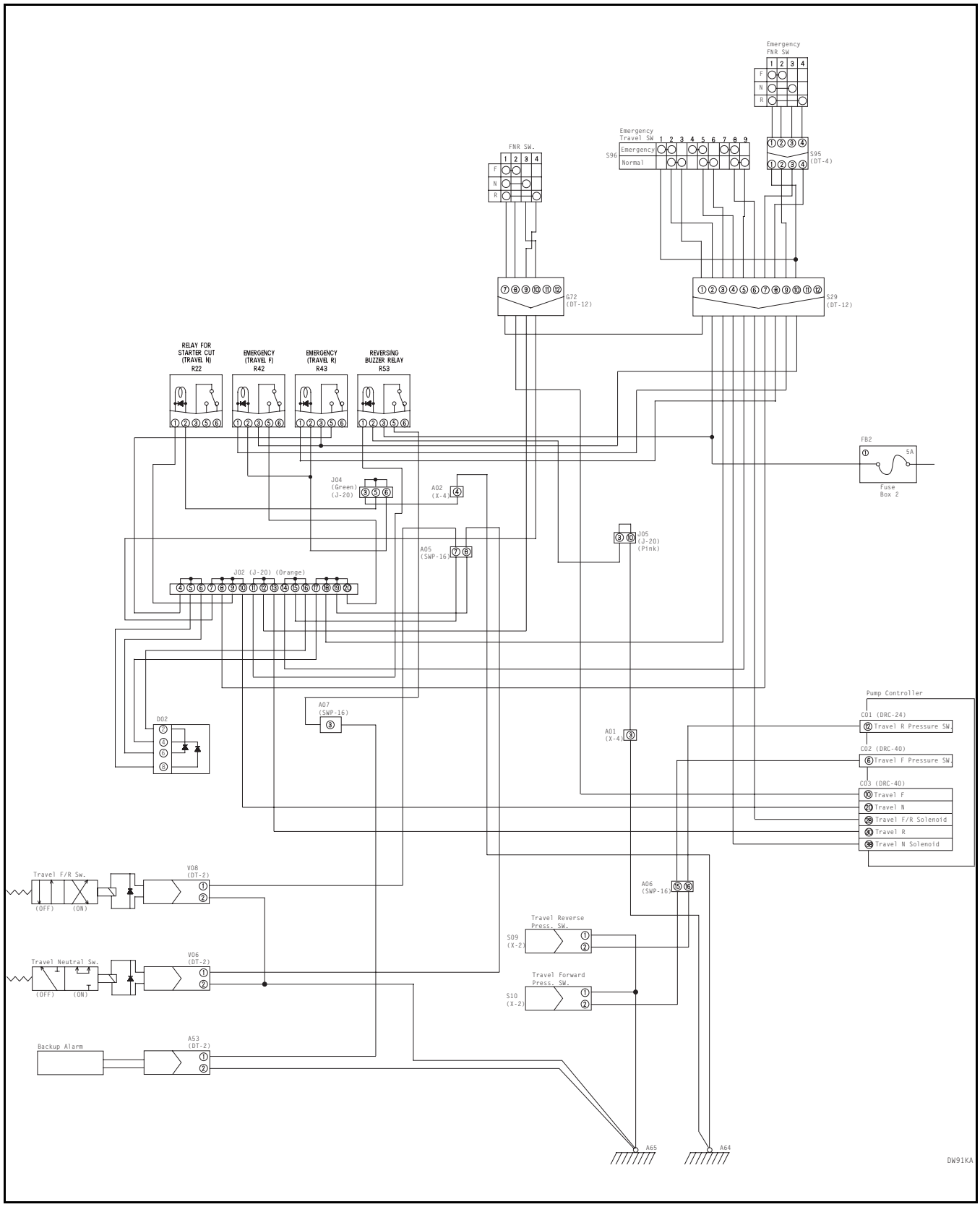
*When Fuse No. 1 (Fuse box 2) is not blown

*When emergency travel switch is set to 'Emergency'

*When emergency FNR switch is set to 'F'



Circuit Diagram for Travel Direction Control

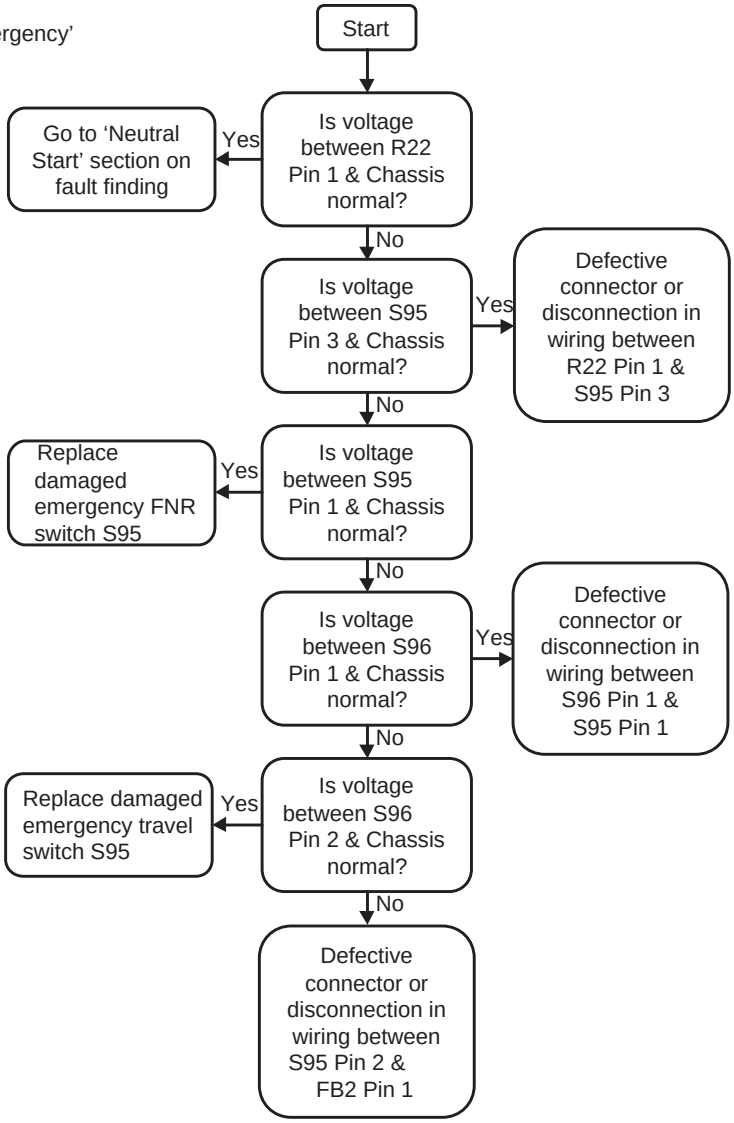


Emergency Travel Control - Neutral

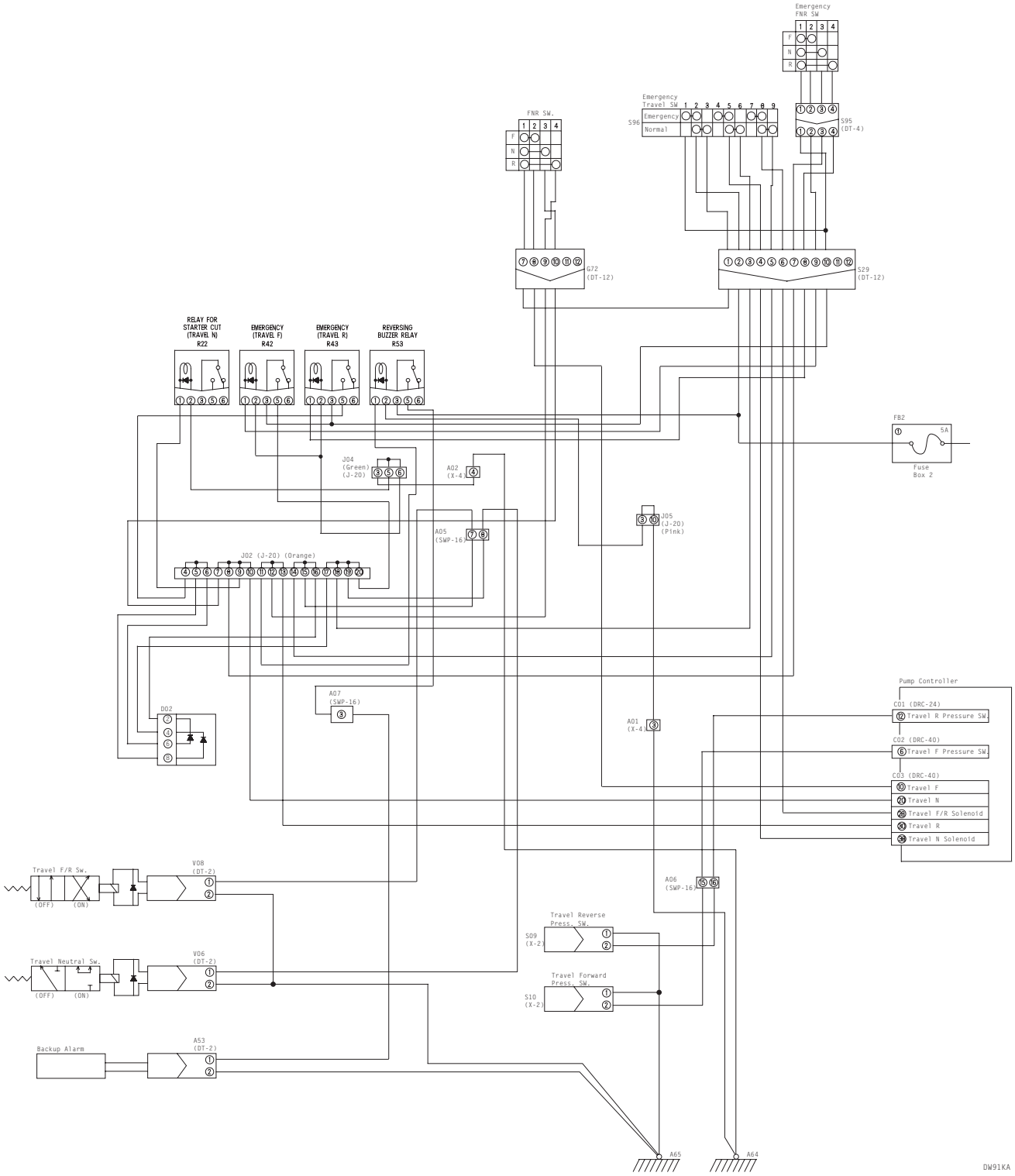
*When Fuse No. 1 (Fuse box 2) is not blown

When emergency travel switch is set to ‘Emergency’

*When emergency FNR switch is set to ‘N’



Circuit Diagram for Travel Direction Control

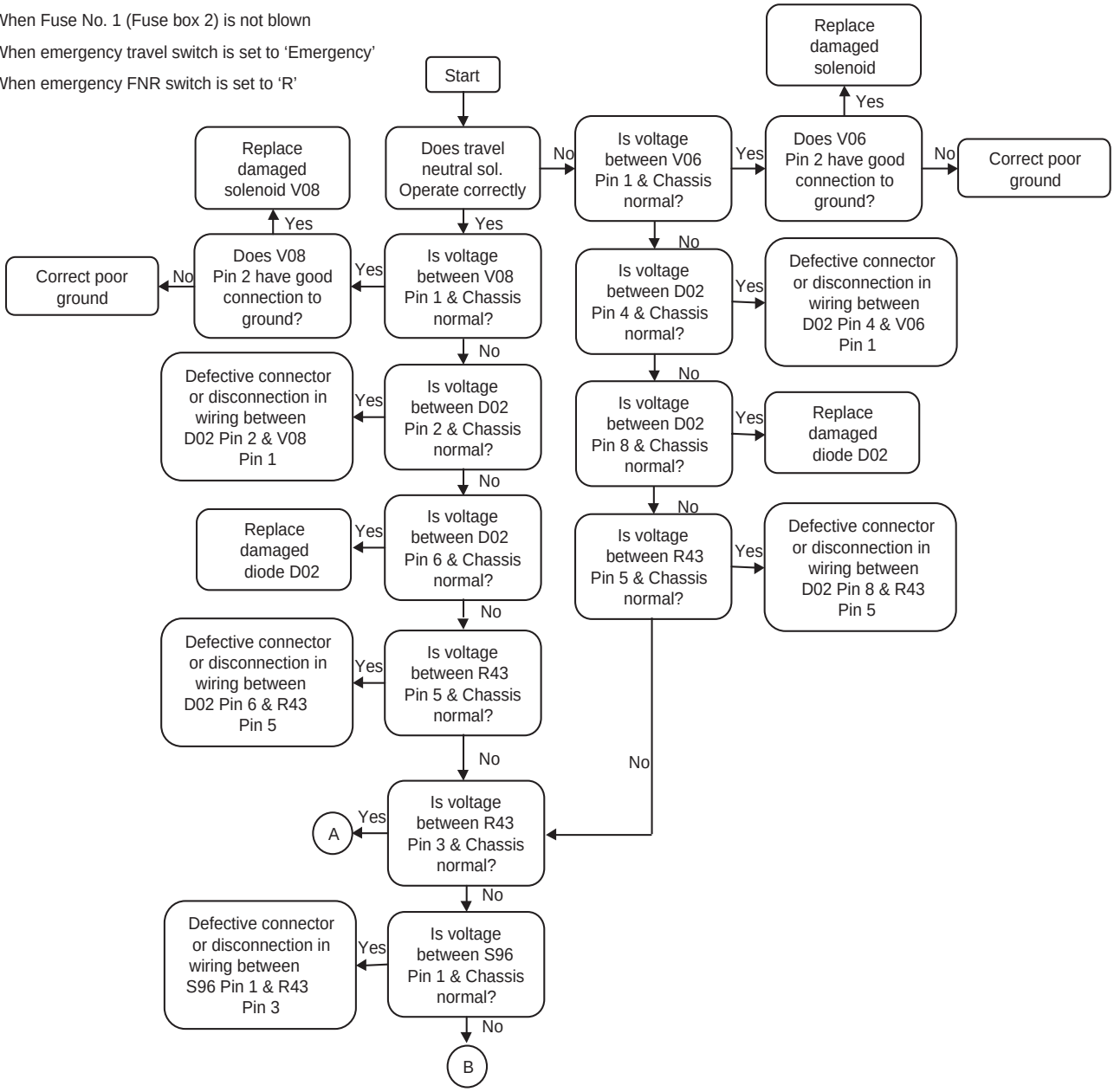


Emergency Travel Control - Reverse

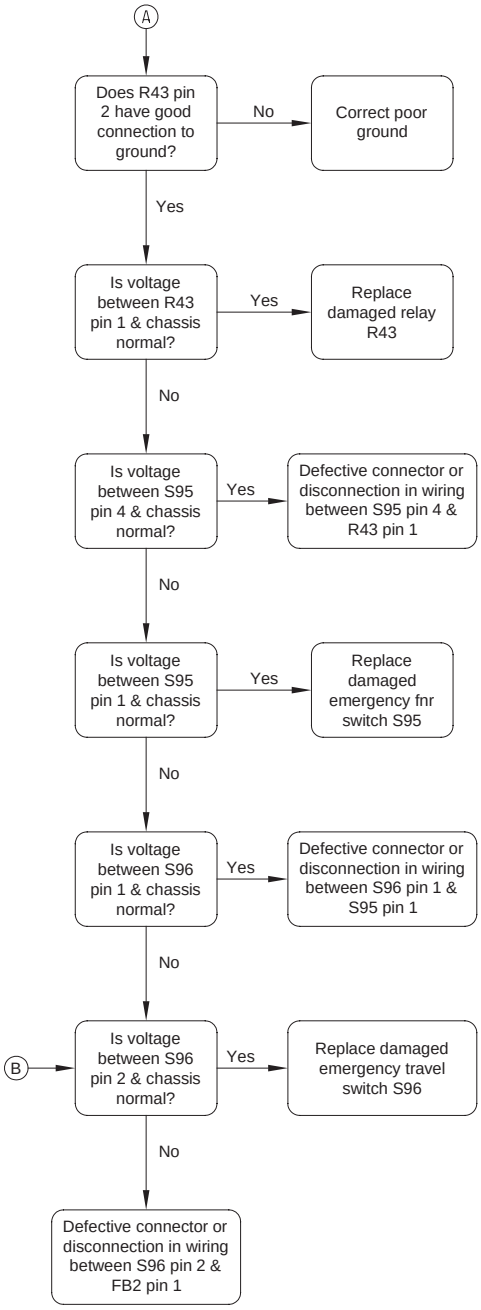
*When Fuse No. 1 (Fuse box 2) is not blown

*When emergency travel switch is set to 'Emergency'

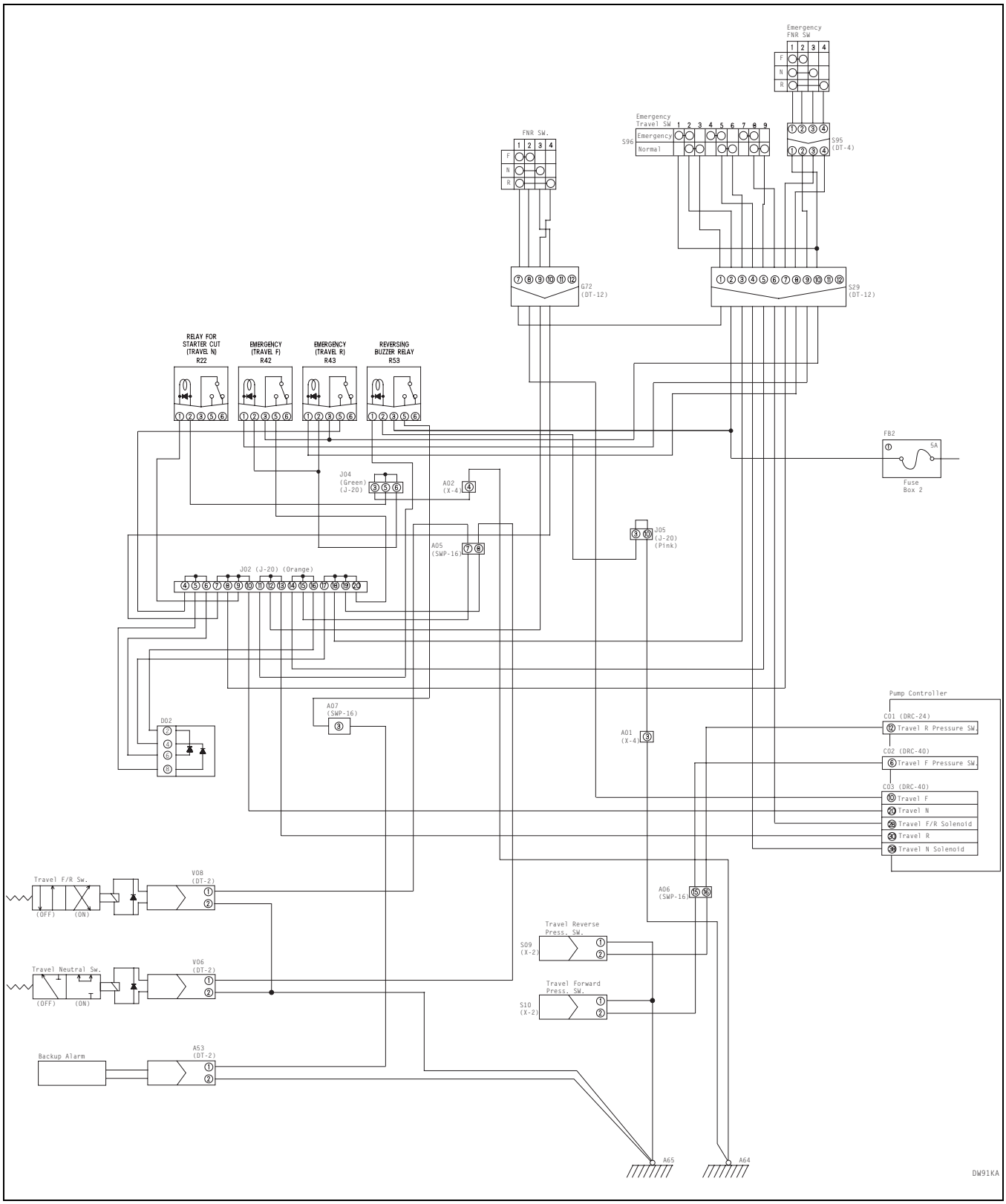
*When emergency FNR switch is set to 'R'



Emergency Travel Control - Reverse cont'd



Circuit Diagram for Travel Direction Control

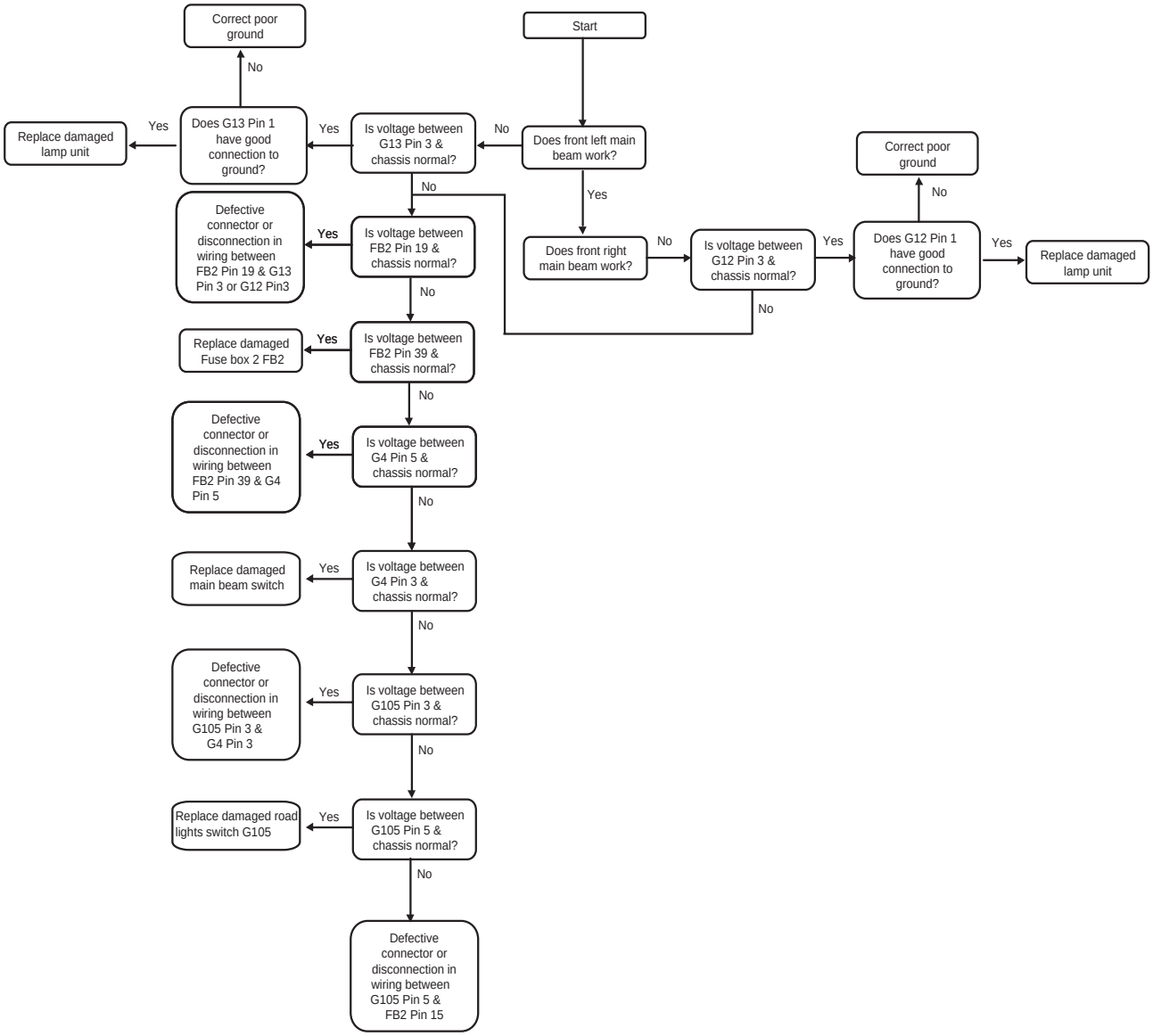


Driving Lights - Main Beam

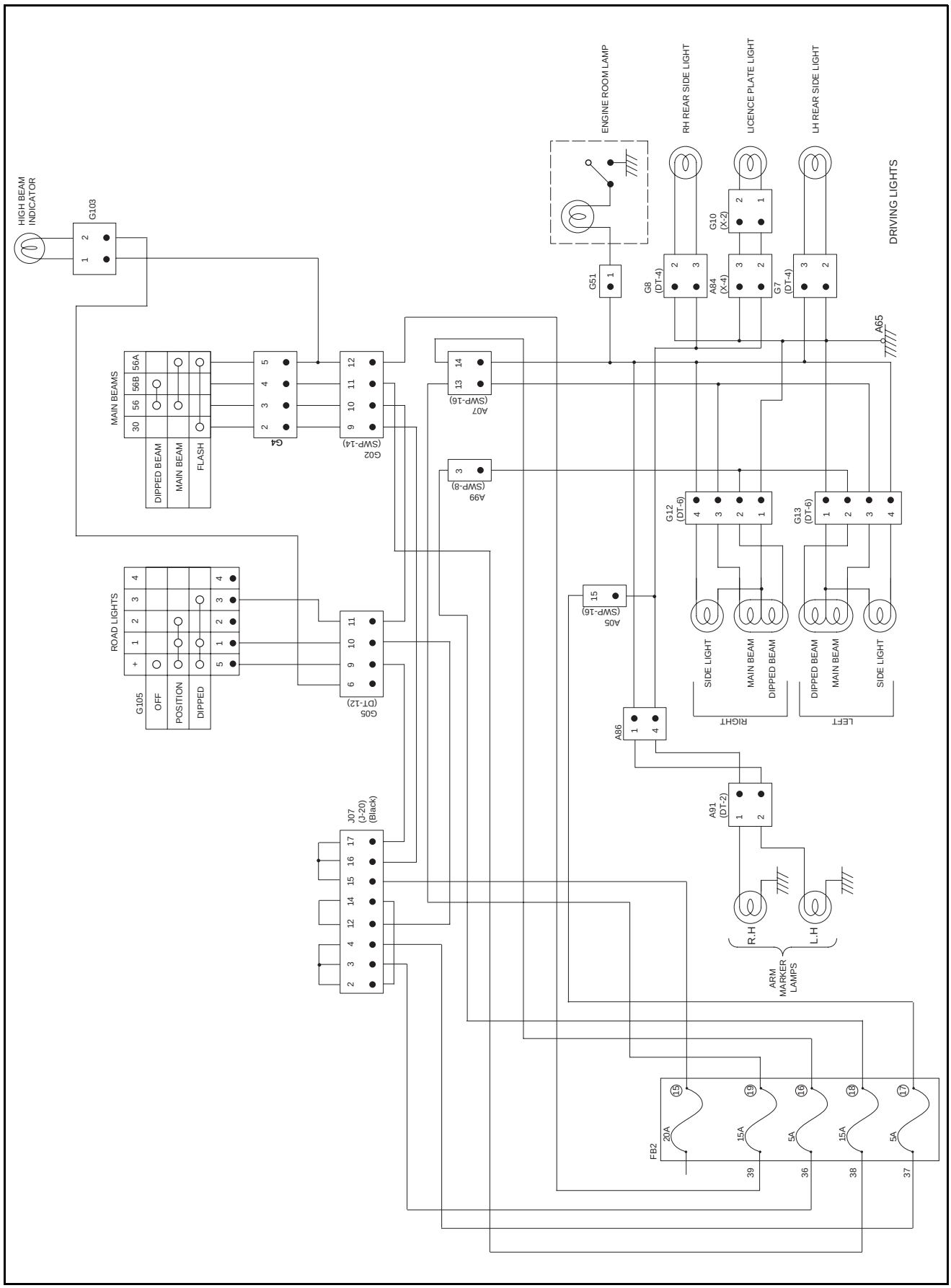
*Standard notes

*When fuse No.15 & 19 (Fuse box 2) are not blown

*When bulbs are fitted correctly and fully functional



Circuit Diagram for Driving Lights

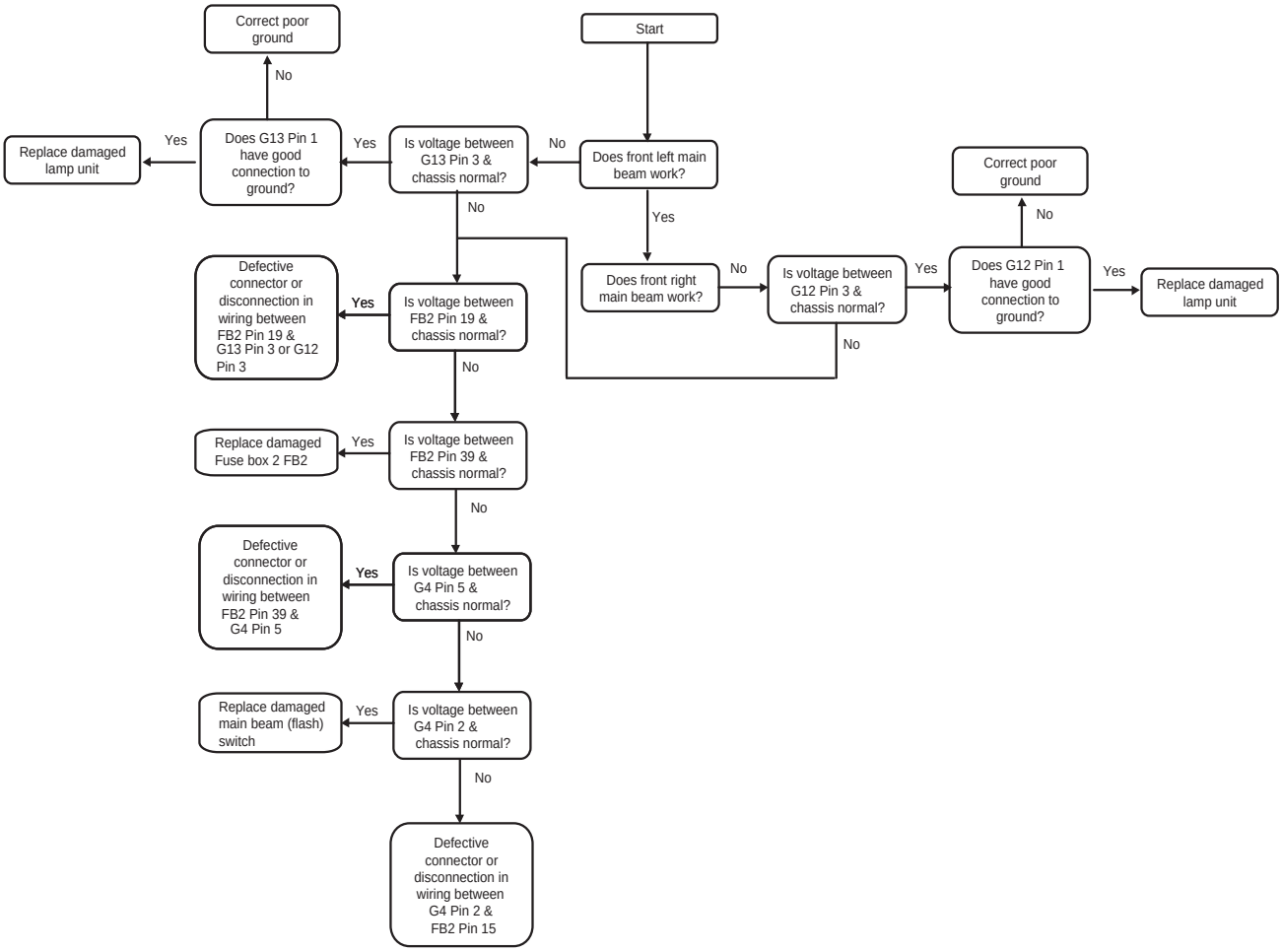


Driving Lights - Main Beam Flash

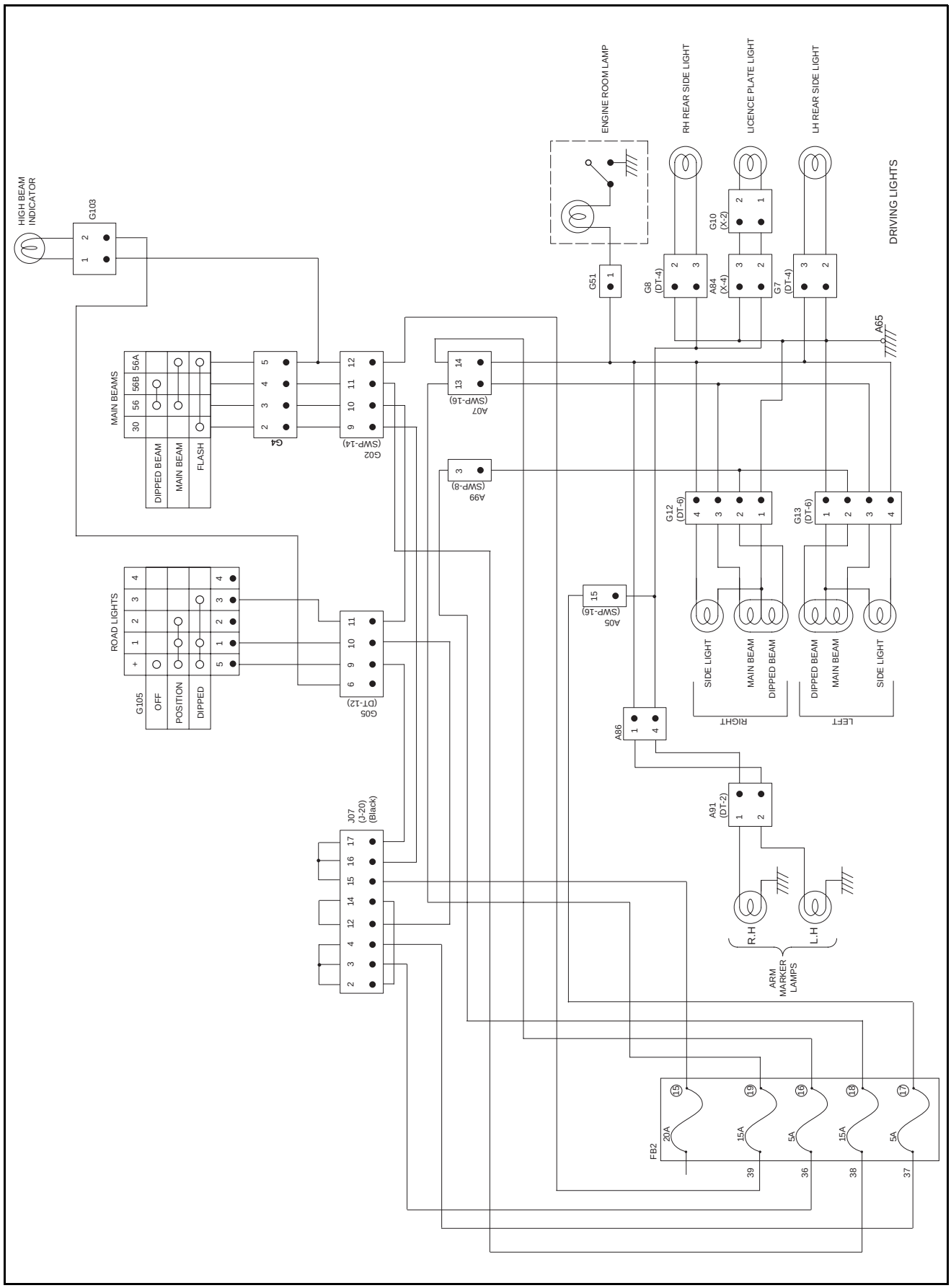
*Standard notes

*When fuse No.15 & 19 (Fuse box 2) are not blown

*When bulbs are fitted correctly and fully functional



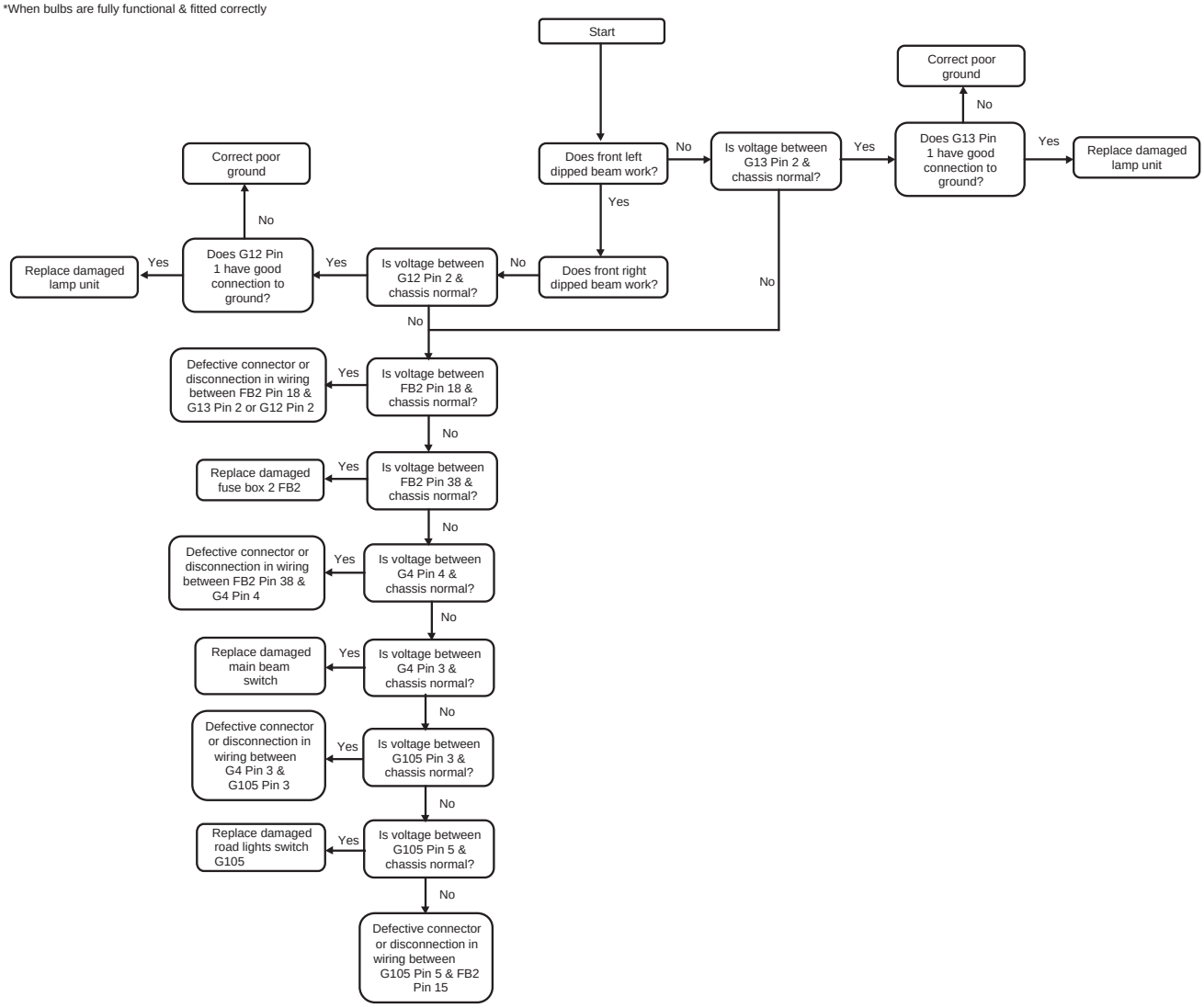
Circuit Diagram for Driving Lights



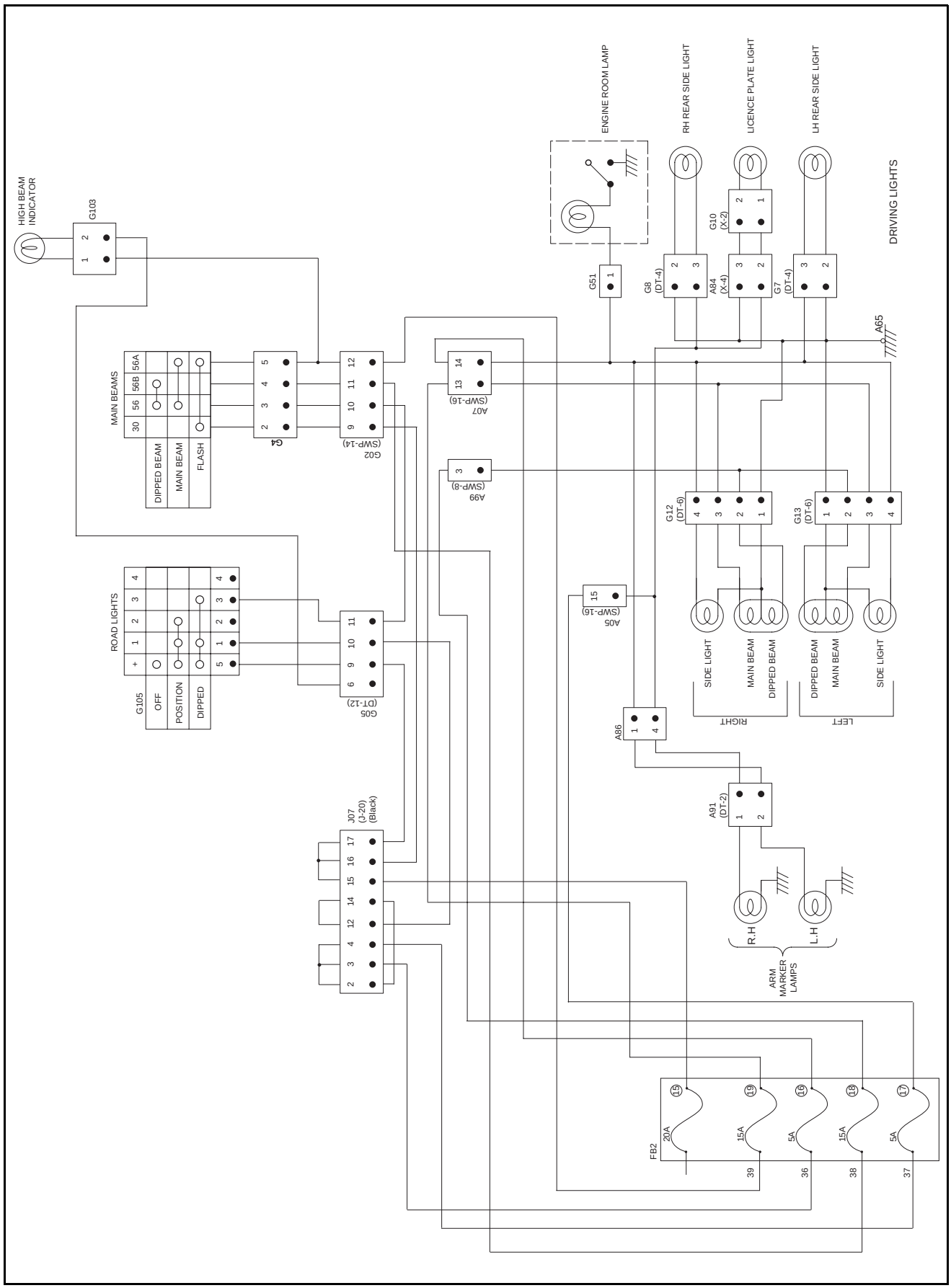
Driving Lights - Main Beam Dipped

*When Fuse No.15 & 18 (Fuse box 2) are not blown

*When bulbs are fully functional & fitted correctly



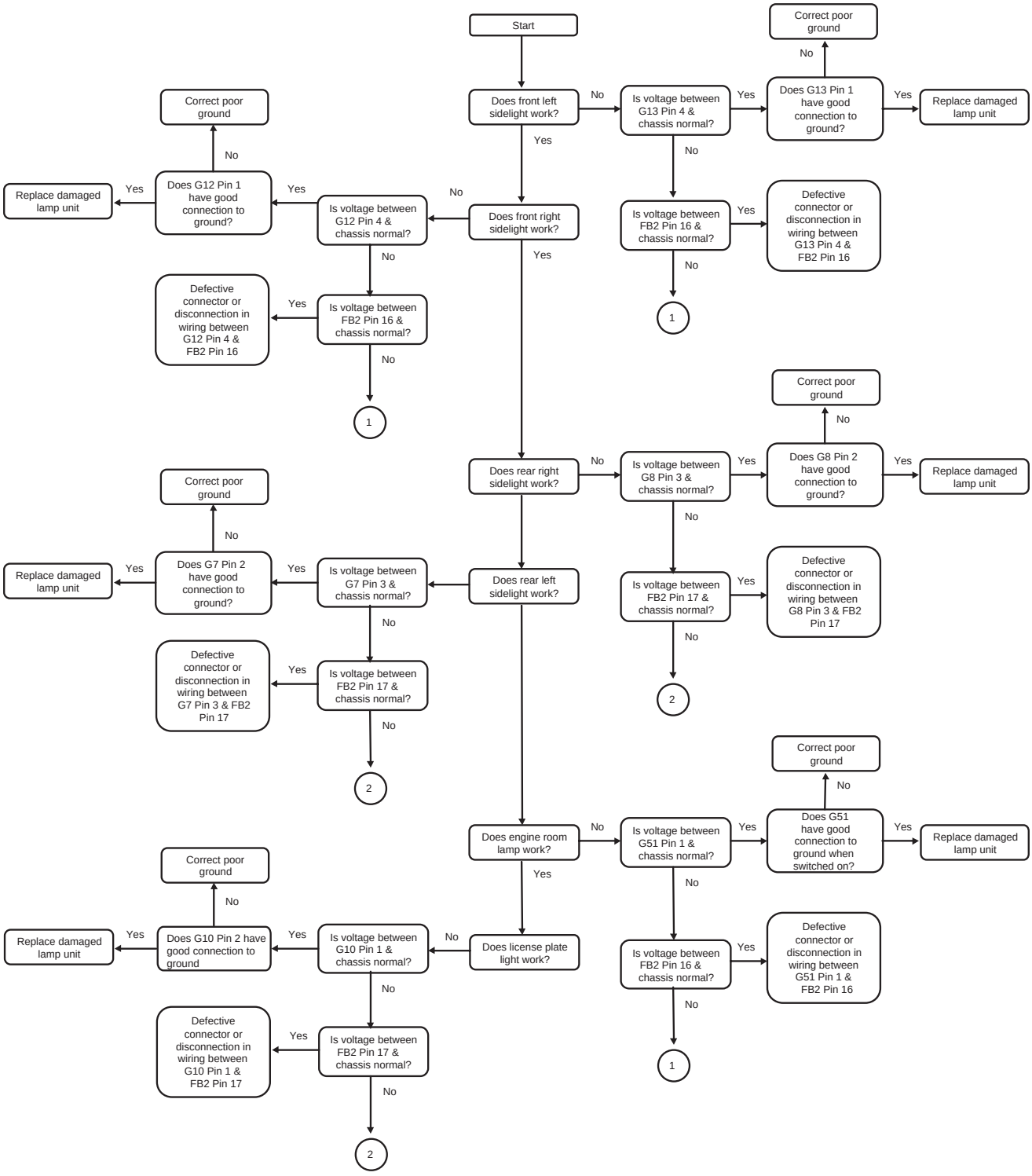
Circuit Diagram for Driving Lights



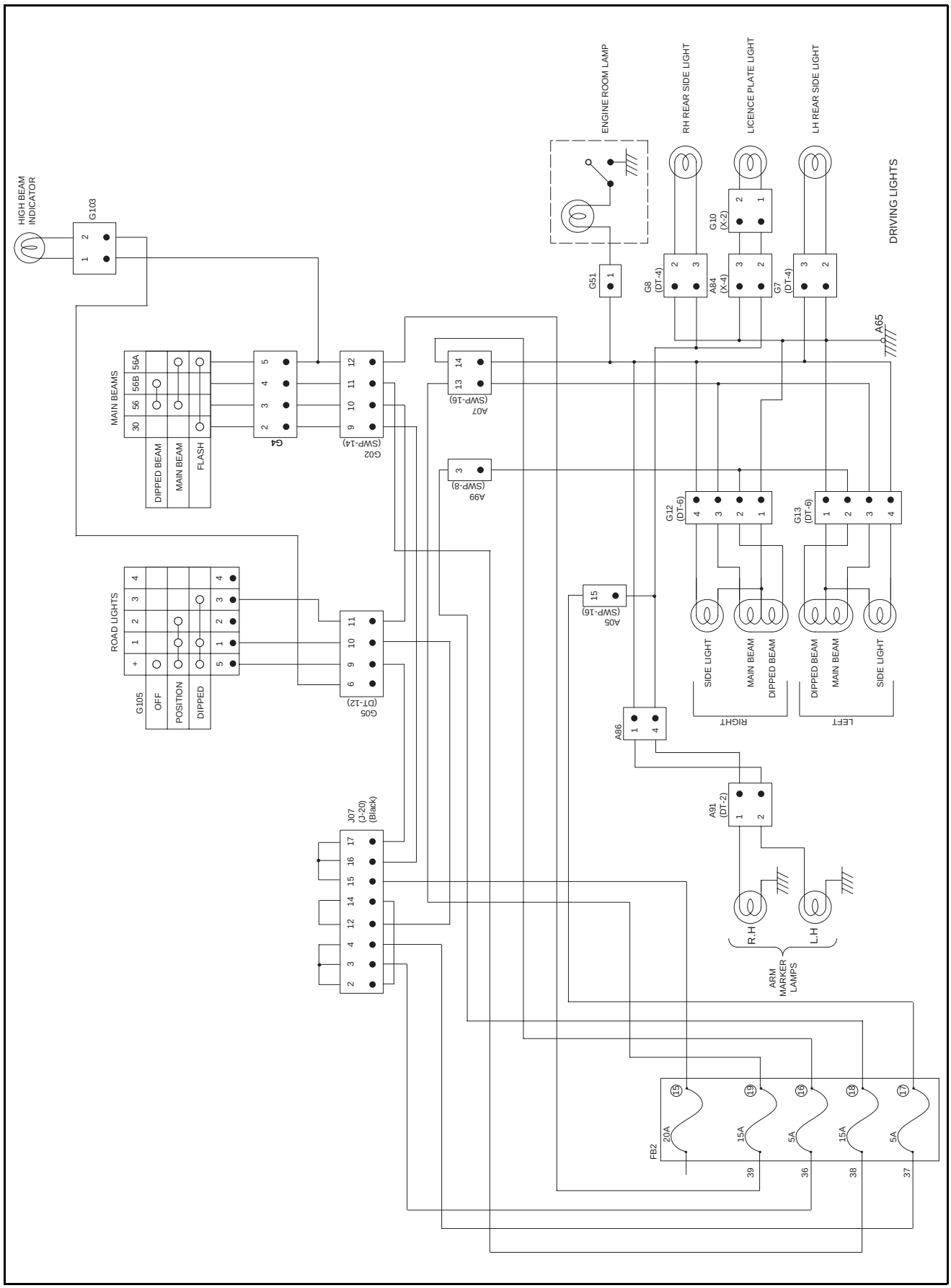
Driving Lights - Position Lights

*When fuse No.15 & 16 (Fuse box 2) are not blown

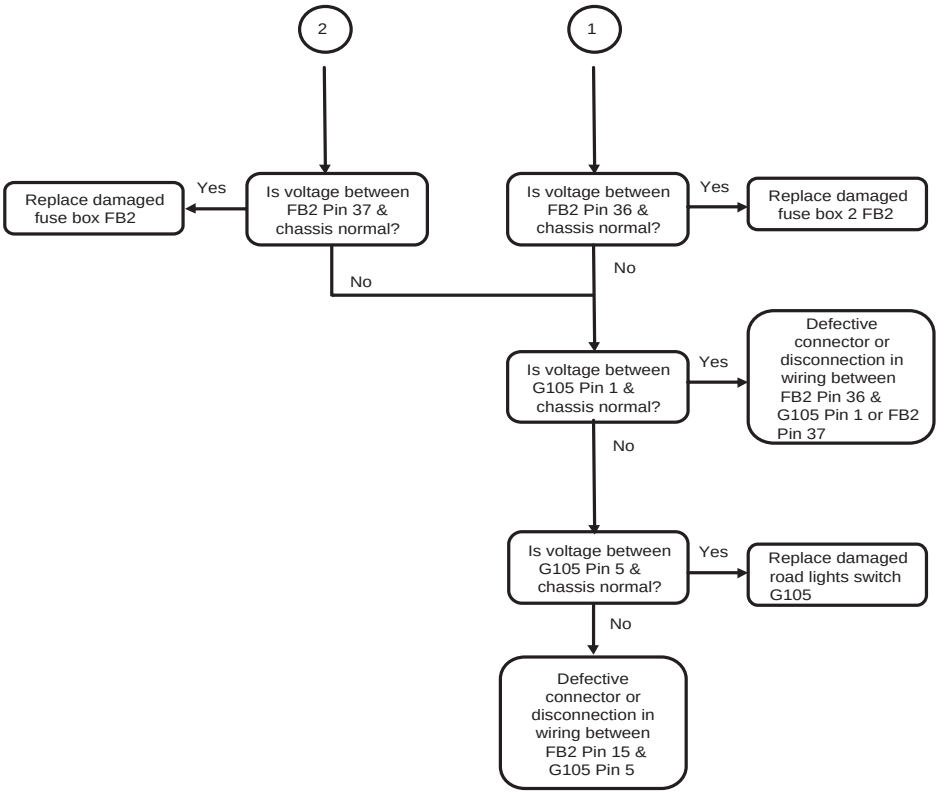
*When bulbs are fitted correctly and fully functional



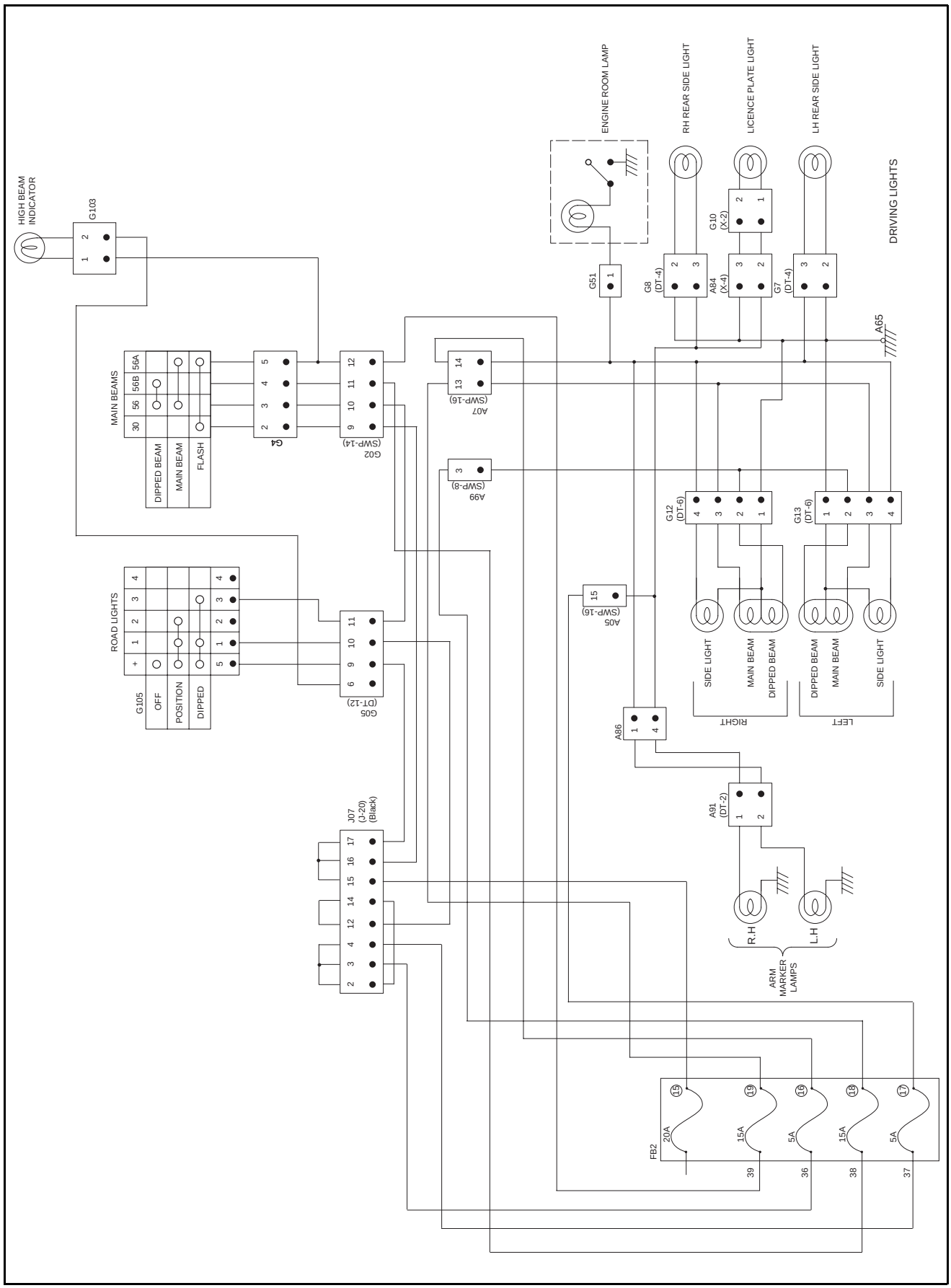
Circuit Diagram for Driving Lights



Driving Lights - Position Lights cont'd (1) and (2)



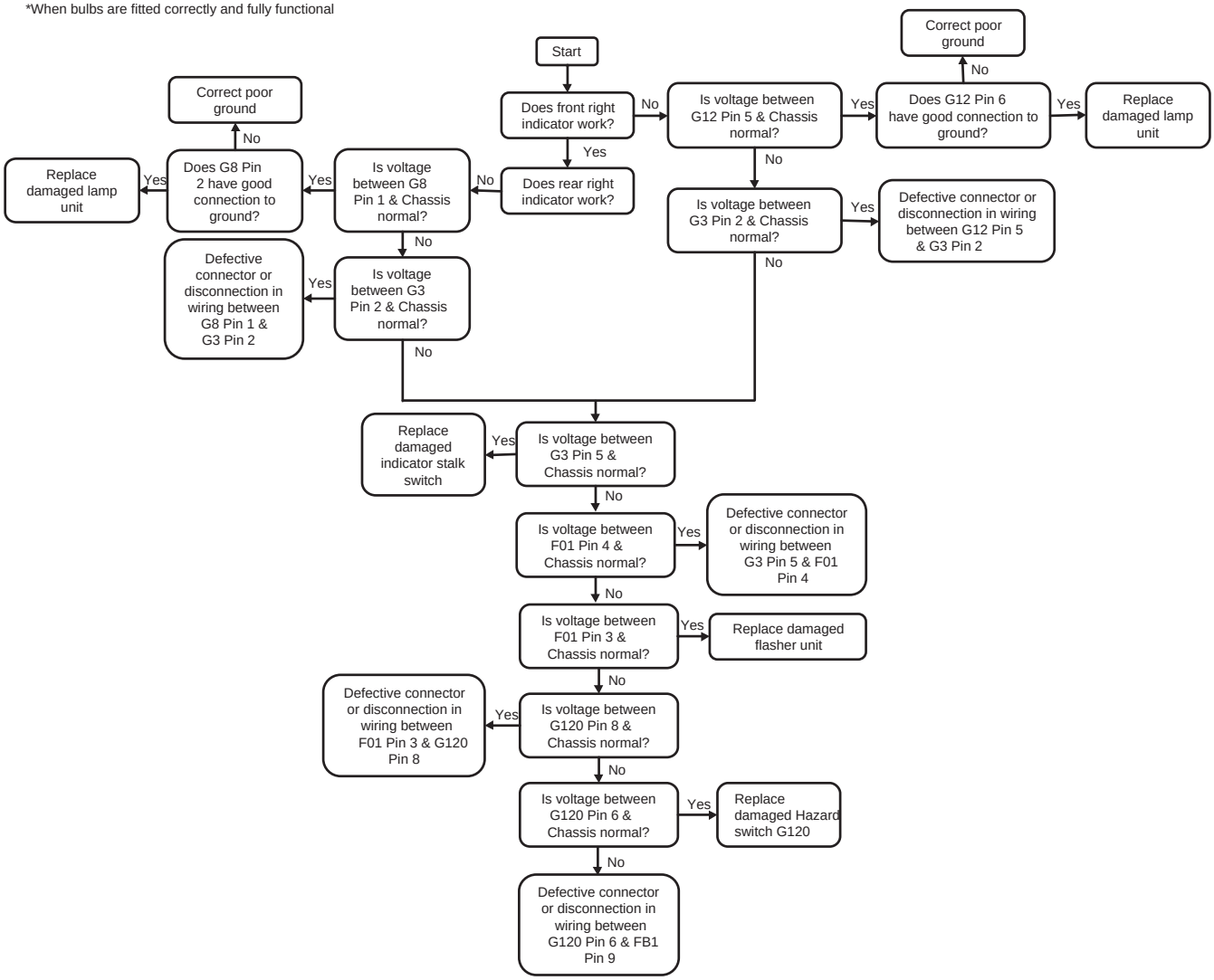
Circuit Diagram for Driving Lights



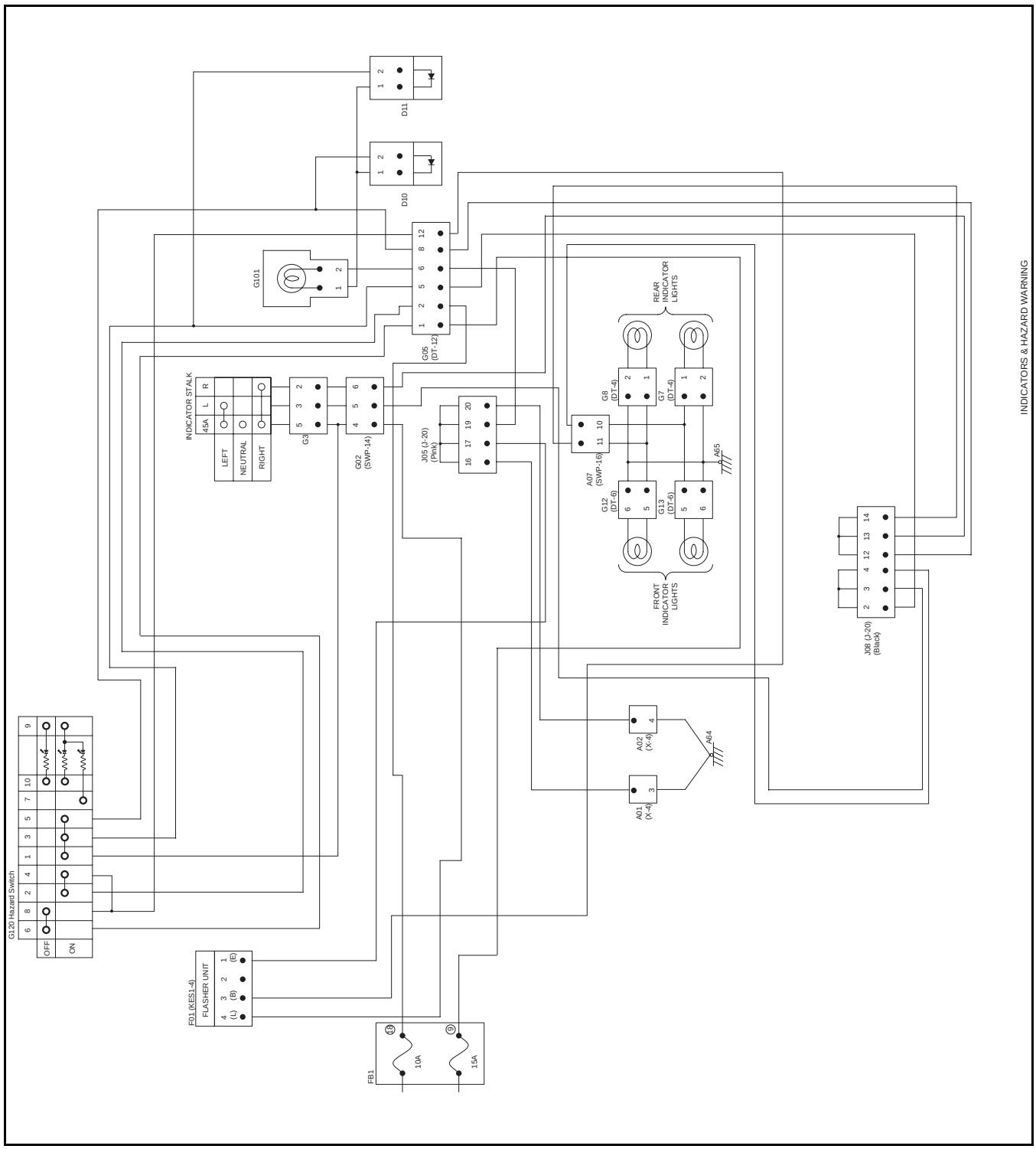
Indicators - Right Hand

*When Fuse No. 9 (Fuse box 1) is not blown

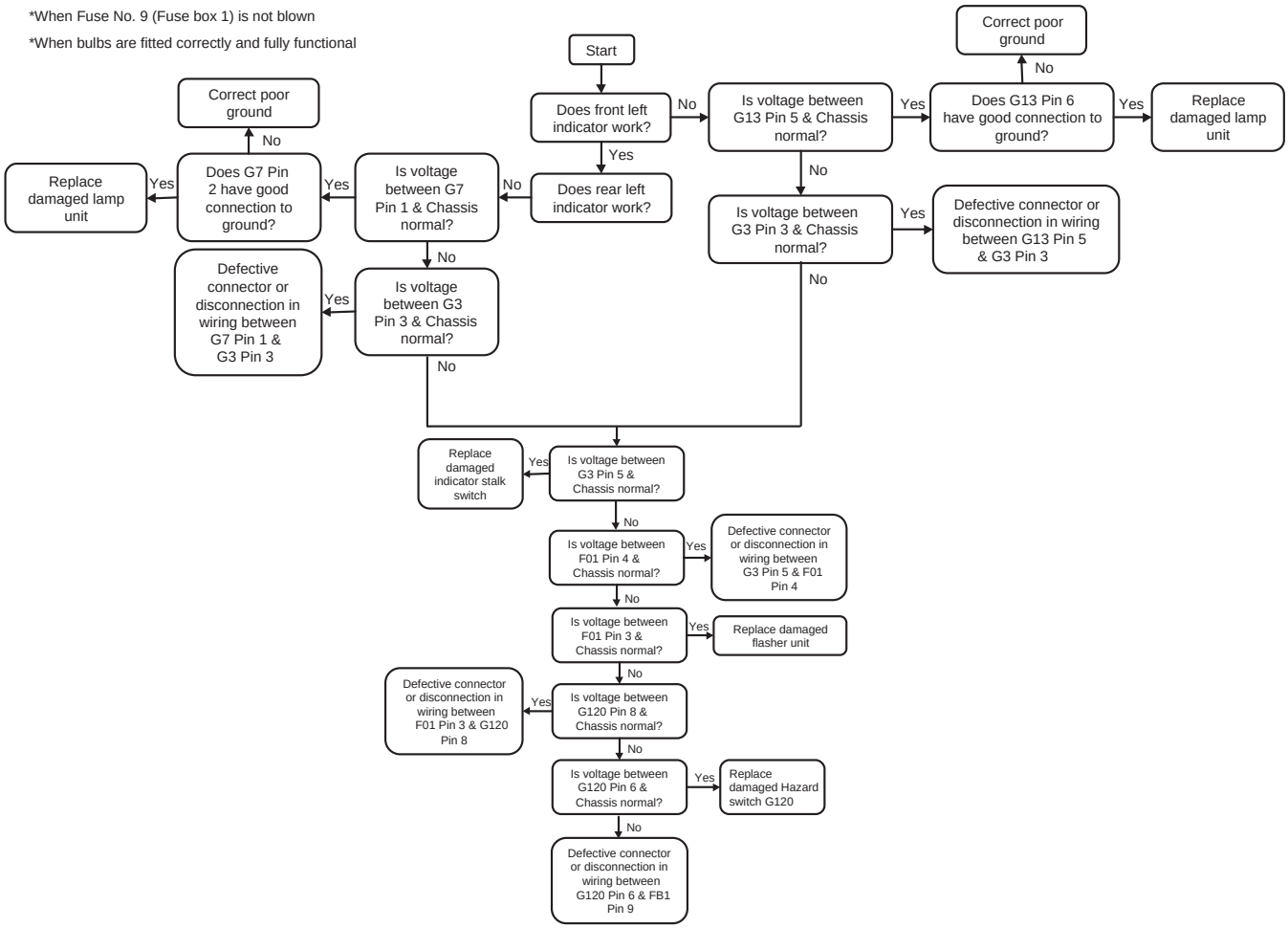
*When bulbs are fitted correctly and fully functional



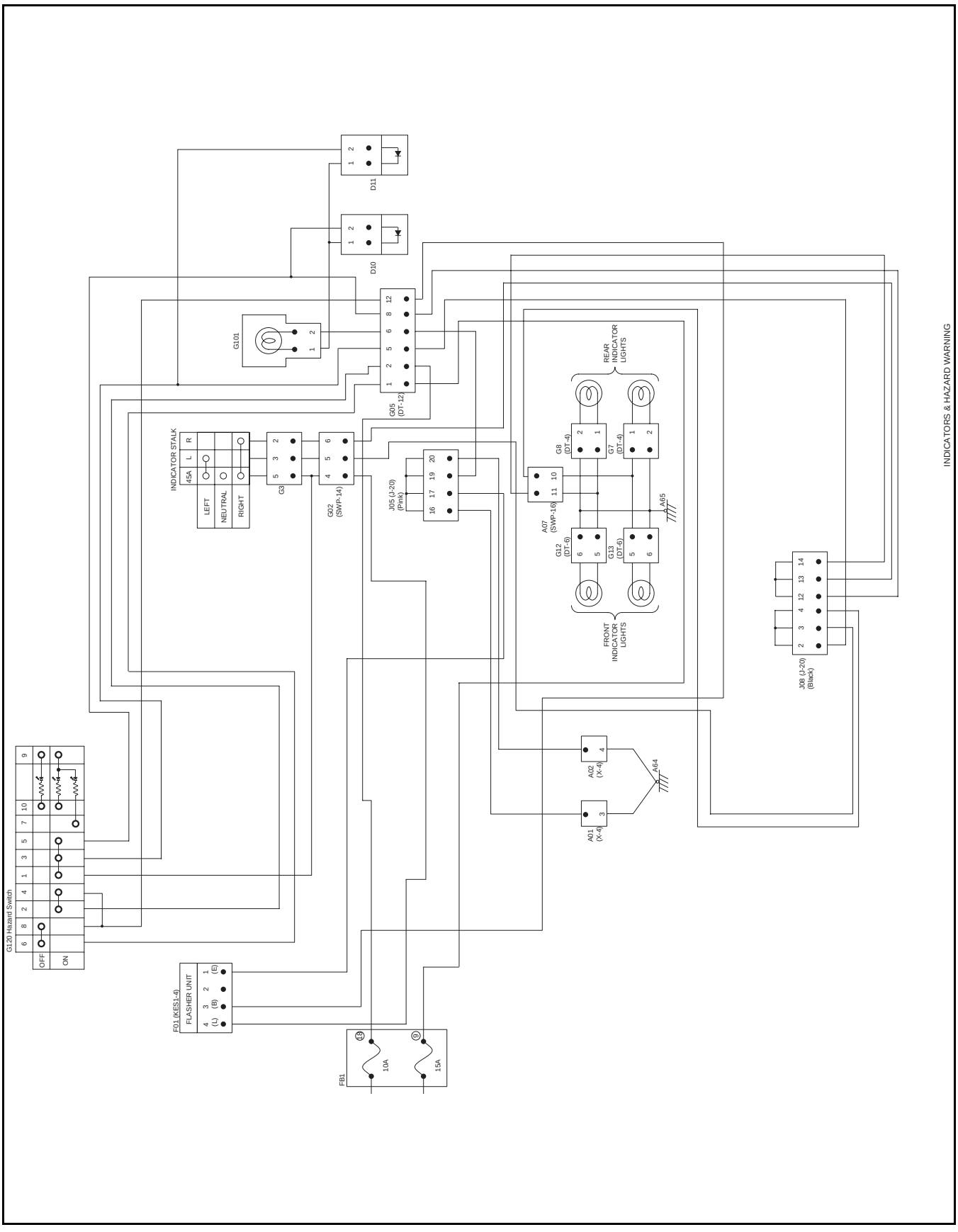
Circuit Diagram for Indicators & Hazard Warning



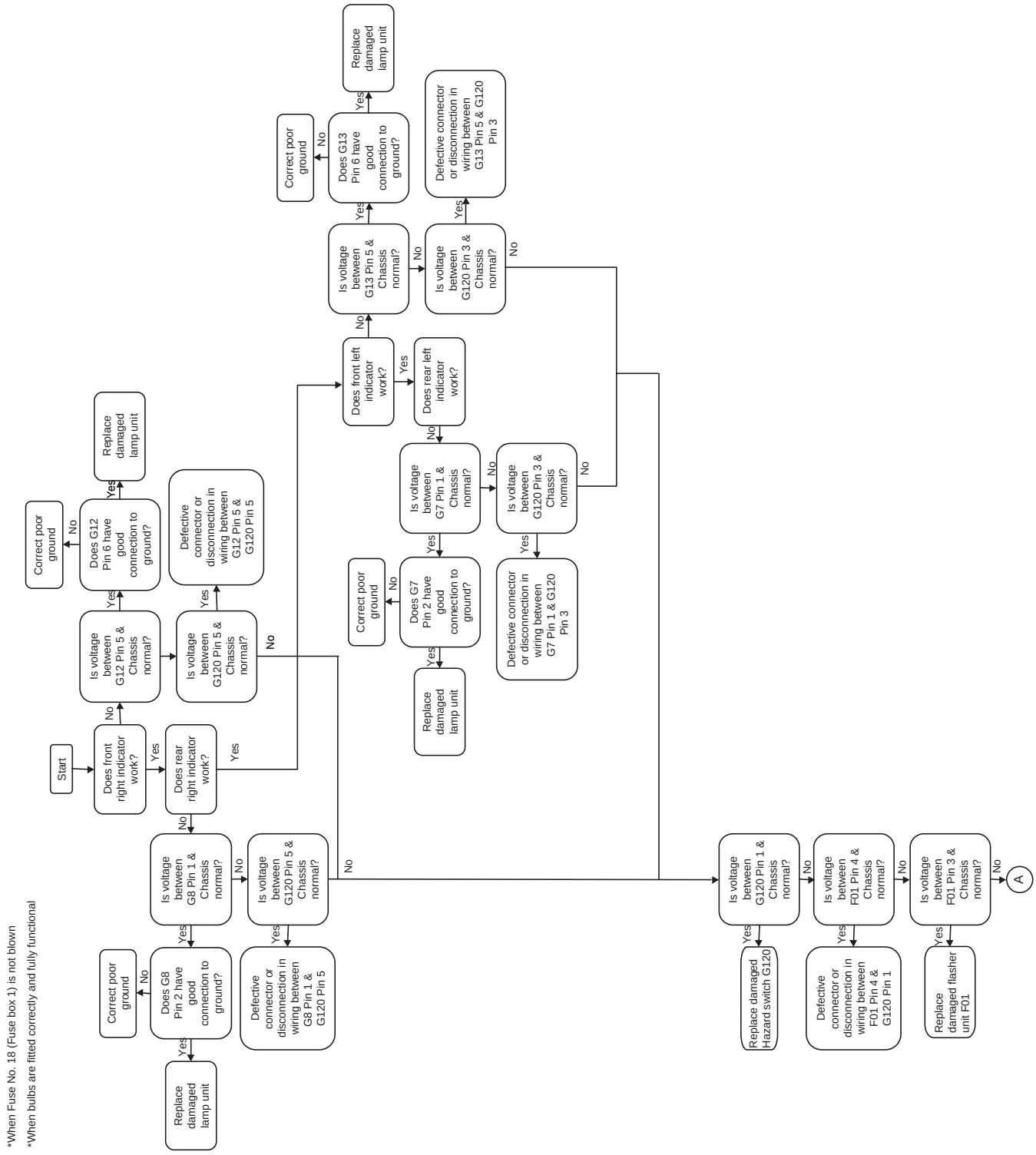
Indicators - Left Hand



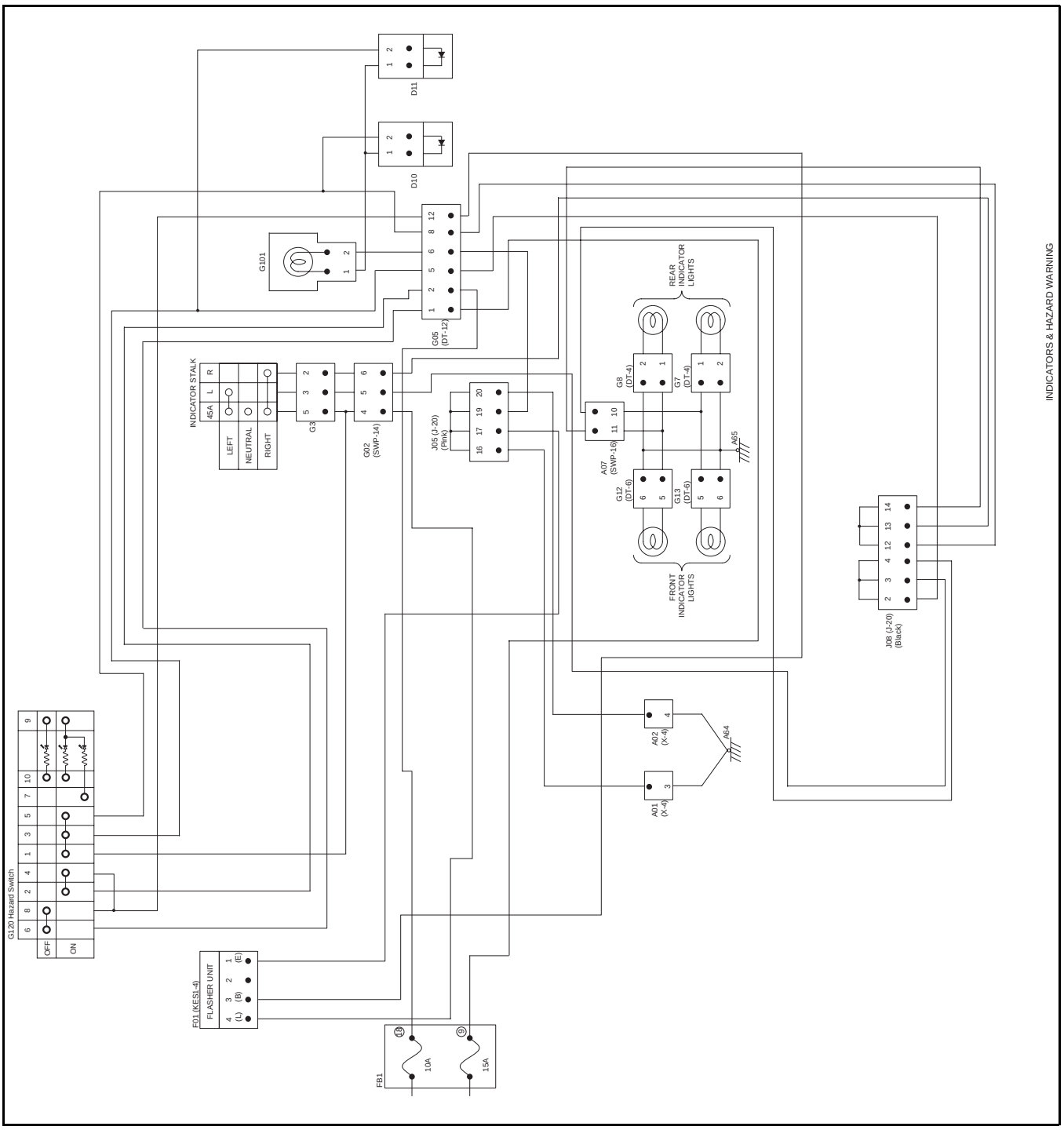
Circuit Diagram for Indicators & Hazard Warning



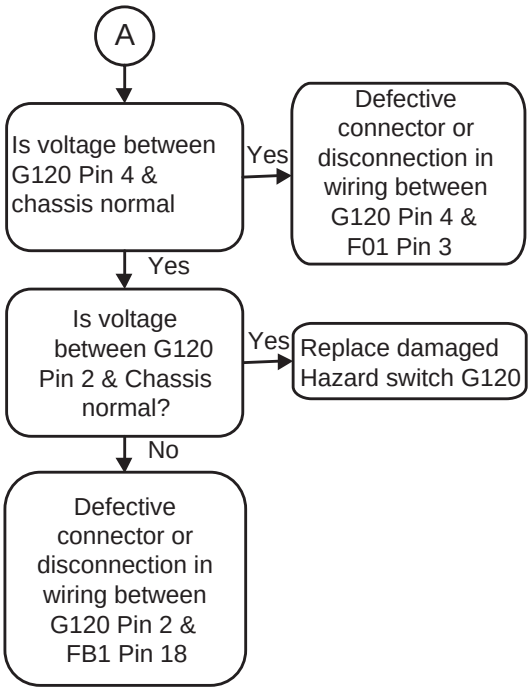
Hazard Warning Lights



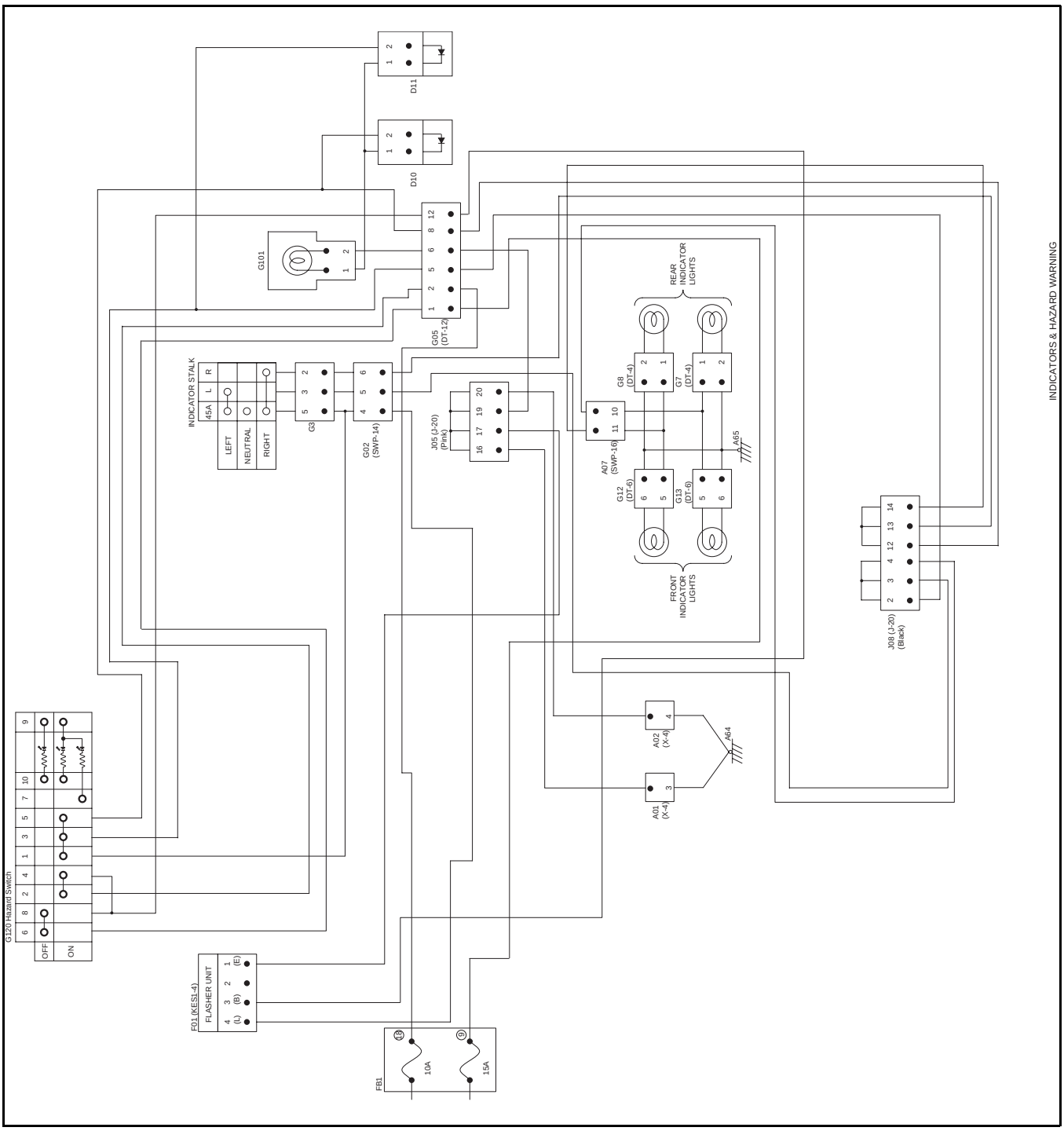
Circuit Diagram for Indicators & Hazard Warning



Hazard Warning Lights cont'd (A)

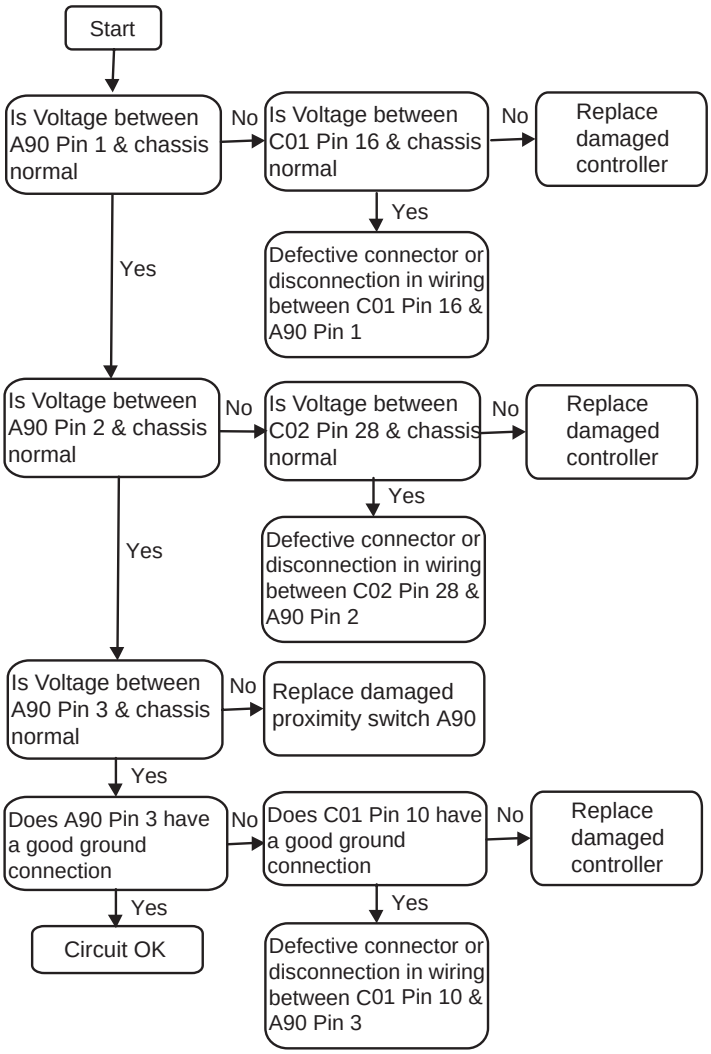


Circuit Diagram for Indicators & Hazard Warning

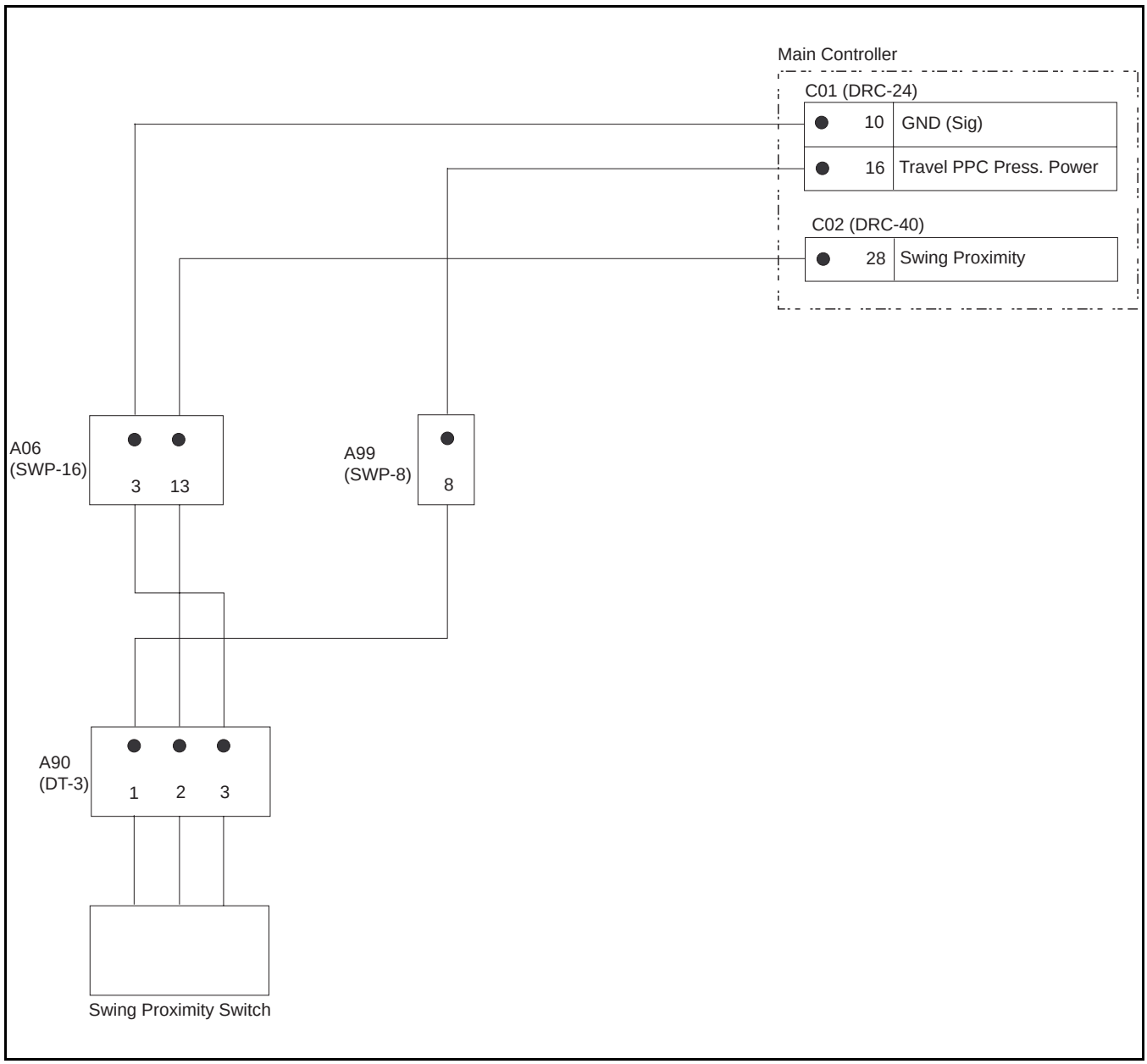


Swing Lock Proximity Switch

*With machine upper structure locked in the travel position



Brake and Swing Lock Proximity Switches

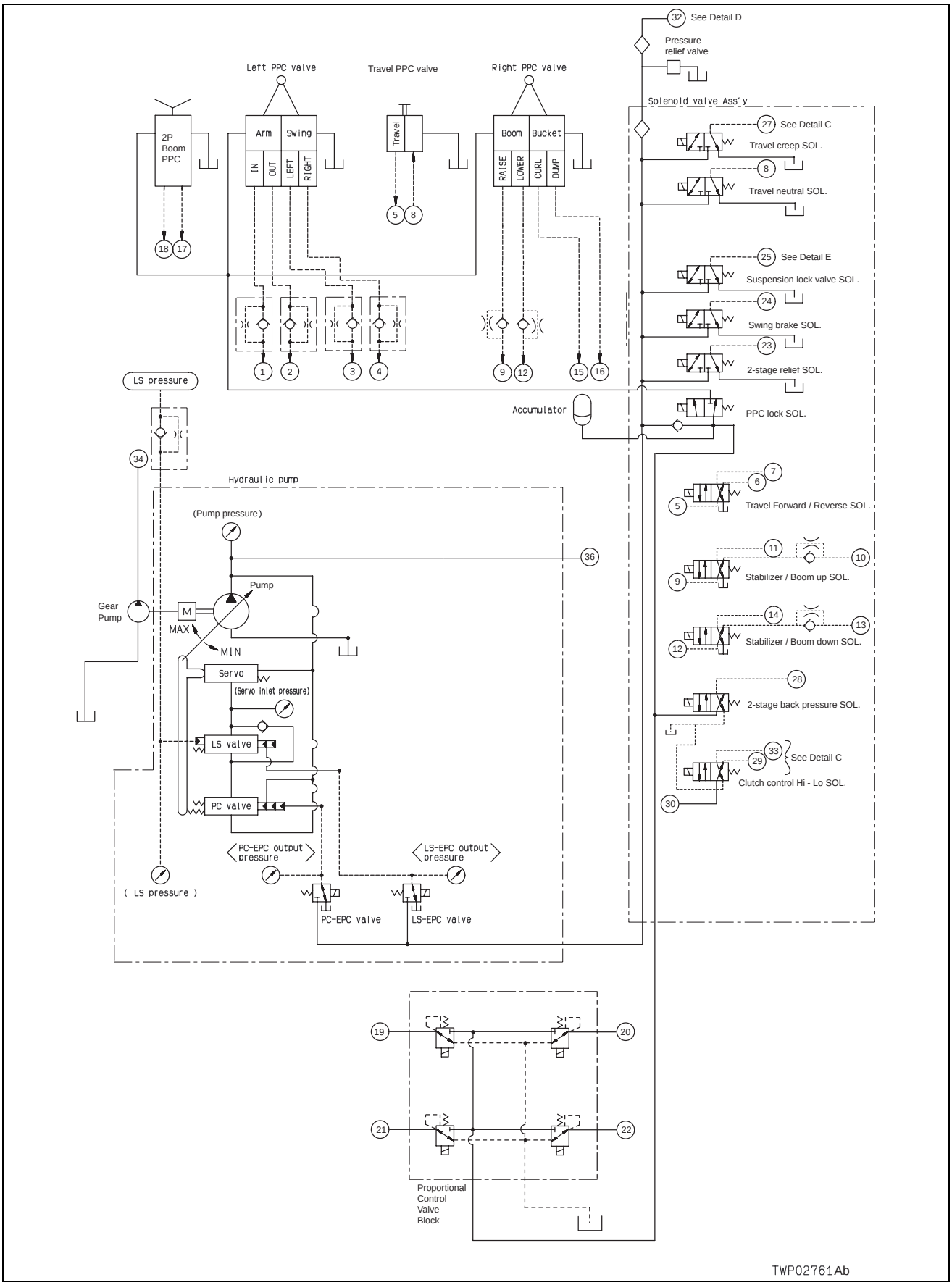


TROUBLESHOOTING OF HYDRAULIC AND MECHANICAL SYSTEM (H-MODE)

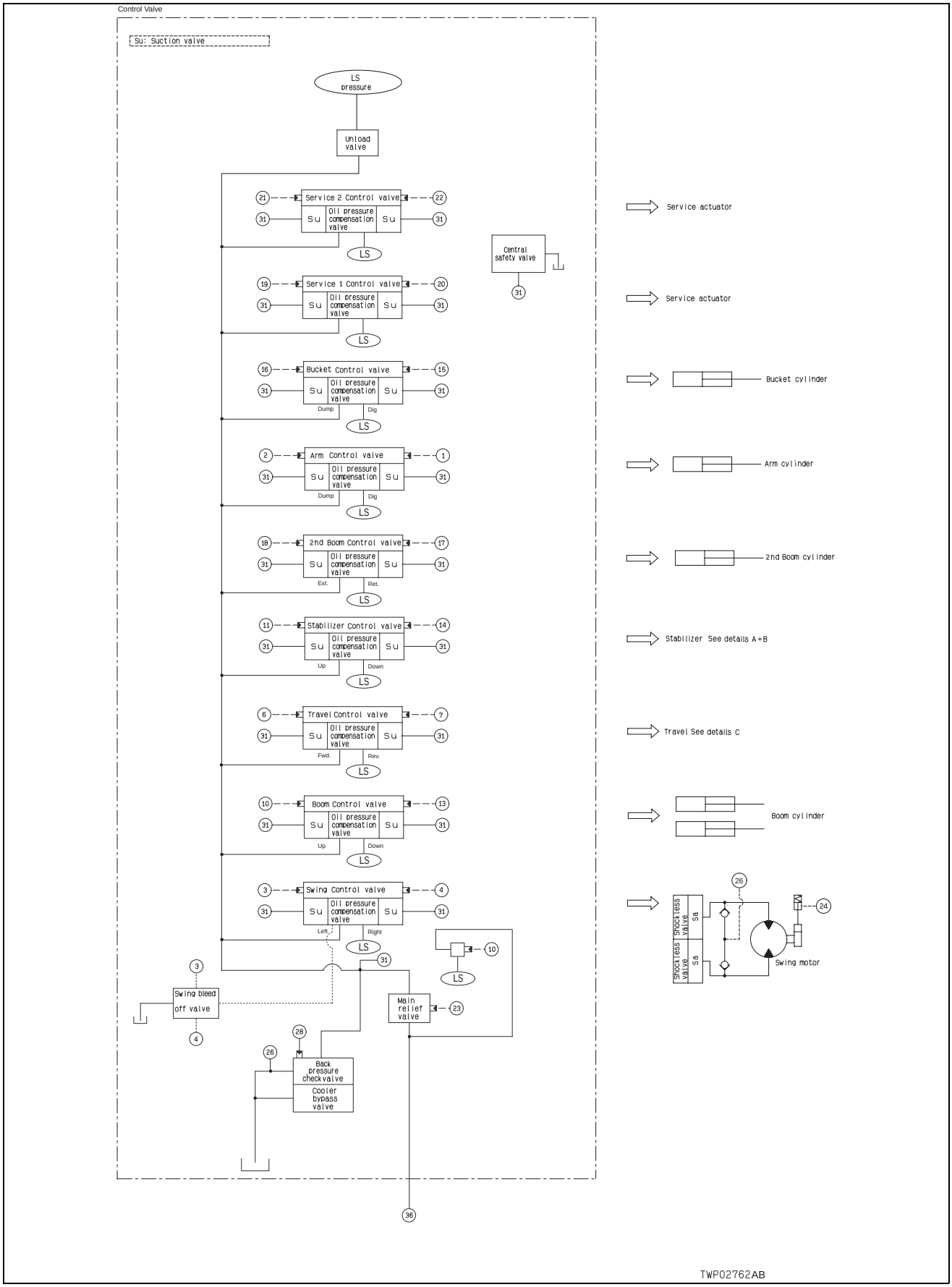
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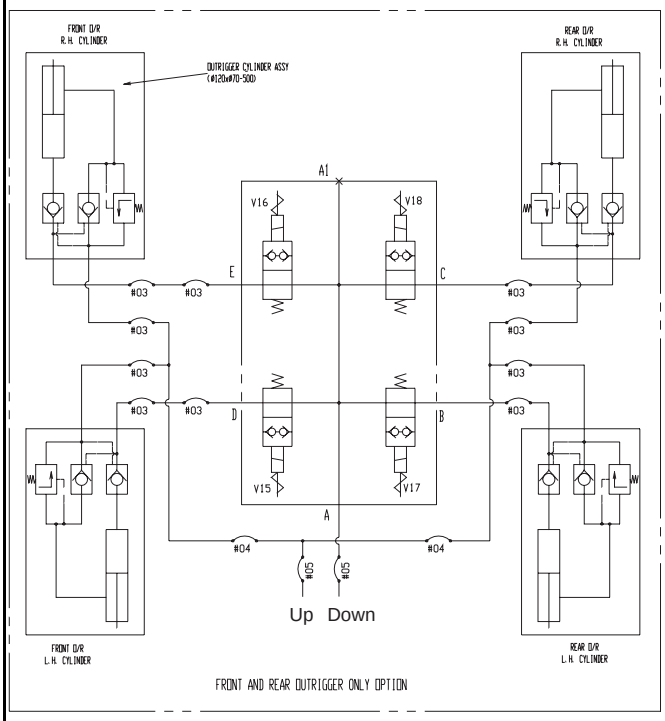
SYSTEM CHART FOR HYDRAULIC AND MECHANICAL SYSTEMS



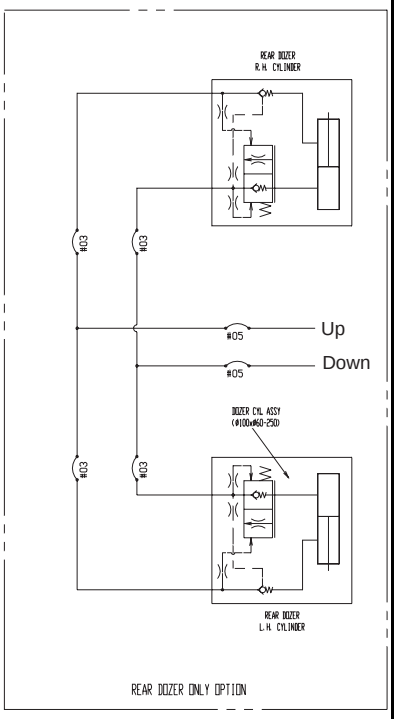
- This is a system chart that has been drawn up by simplifying the whole hydraulic circuit chart. Use it as a reference material when troubleshooting the hydraulic and mechanical systems.



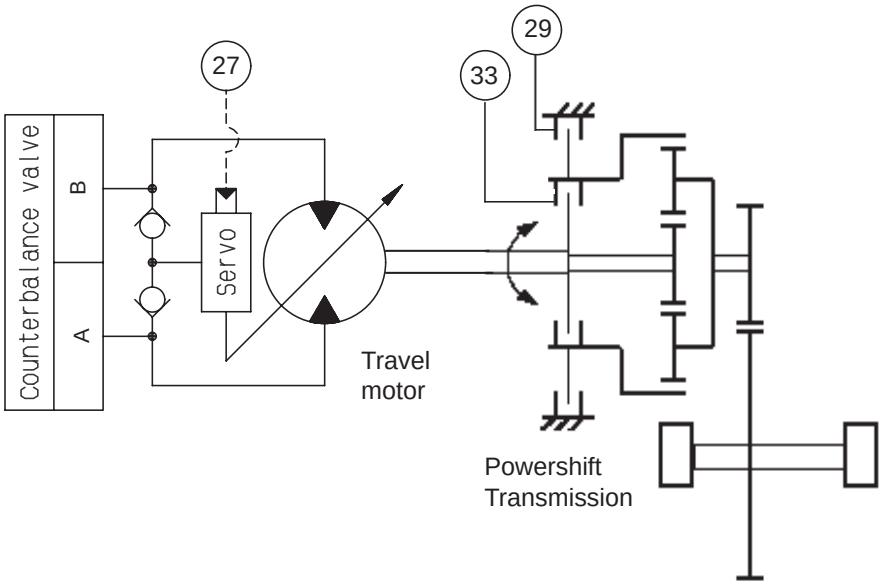
Detail A

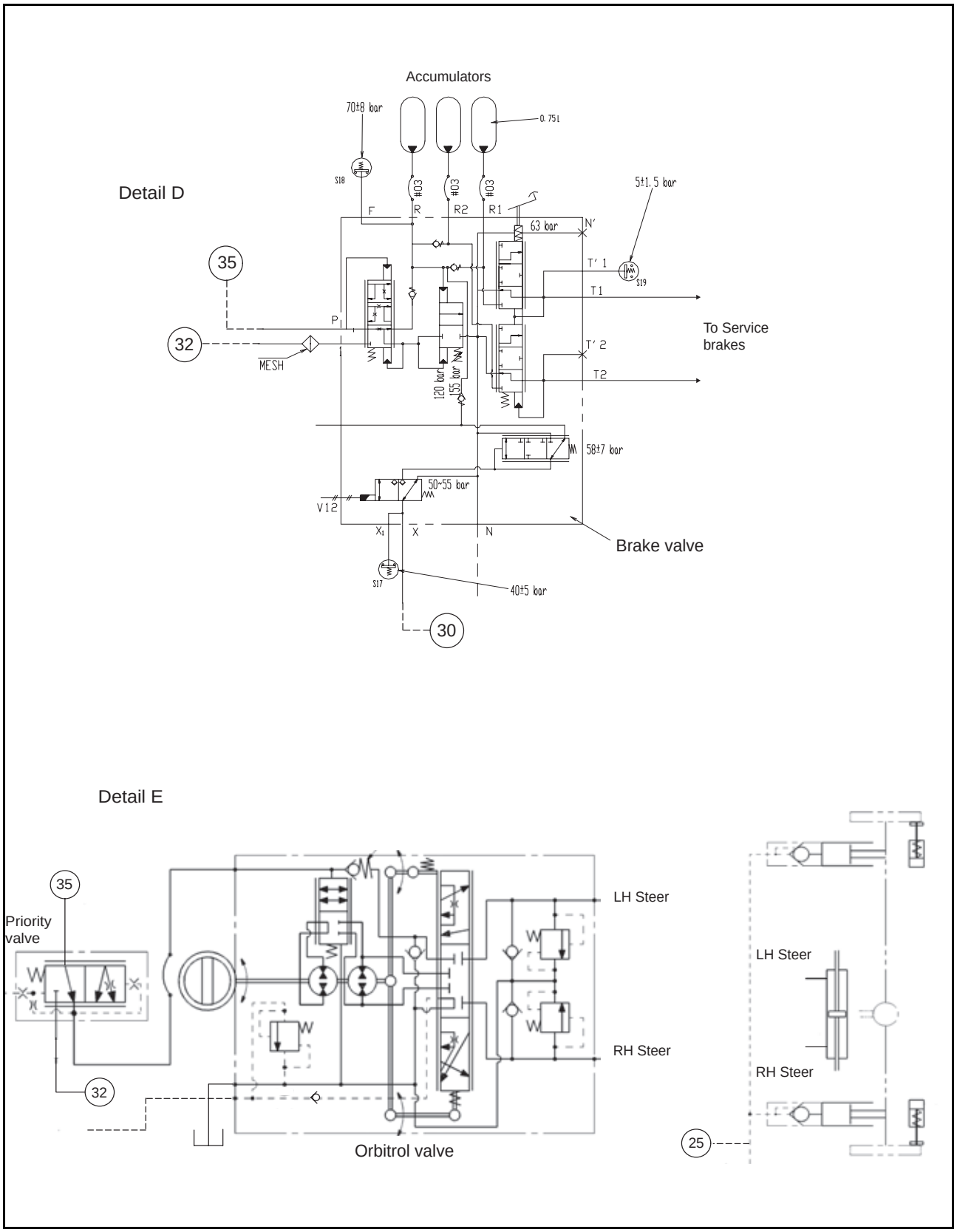


Detail B



Detail C




Accumulators
70±8 bar
0.75ℓ
S18
#03
#03
#03
F
R
R2
R1
5±1.5 bar
63 bar
N'
T' 1
S19
T1
To Service brakes
T' 2
T2
35
32
P
MESH
120 bar
155 bar
58±7 bar
50~55 bar
V12
X1
X
N
Brake valve
S17
40±5 bar
30
Detail D
Detail E
35
Priority valve
32
LH Steer
RH Steer
Orbitrol valve
LH Steer
RH Steer
25

INFORMATION CONTAINED IN TROUBLESHOOTING TABLE

- Troubleshooting Table and Related Circuit Diagram collectively carry the following information. Carry out troubleshooting work after fully grasping their contents.

Failure information	Phenomena occurring on machine
Relative information	Information on occurred failures and troubleshooting

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting
	1	Cause for presumed failure (The attached No. for filing and reference purpose only. It does not stand for any priority)	<Contents> • The standard values in normal condition by which to judge "good" or "no good" about presumed causes. • References for making judgement of "good" or "no good"
	2		
	3		
	4		
	5		

H-1 All work equipment lacks power, or travel and swing speeds are slow

Failure information	• All the work equipment lacks power, or their travel and swing speeds are slow.
Relative information	• Set the working mode at P mode for troubleshooting.

Presumed cause and standard value in normal condition

Cause		Standard value in normal condition and references for troubleshooting
1	Malfunctioning of unload valve	• Stop engine for preparations. Start troubleshooting at engine high idling. Control lever: All control levers in NEUTRAL Unload pressure: 3.38 ± 1.0 MPa {34.5 ± 10kg/cm^2}
2	Improper adjustment or malfunctioning of main relief valve	• Stop engine for preparations. Start troubleshooting at engine high idling. Control lever: Arm, DIGGING Main relief pressure: 34.8 – 37.3 MPa {355 – 380kg/cm^2} If the pressure does not return to normal condition even after the adjustment, malfunctioning of main relief valve or its internal failure is suspected. In that case, check the valve itself.
3	Malfunctioning of relief valve on solenoid block	• Stop engine for preparations. Start troubleshooting at engine high idling. Control lever: All control levers in NEUTRAL Control circuit source pressure: 3.5 – 3.8 MPa {35.7 – 38.8kg/cm^2}
4	Improper adjustment or malfunctioning of PC valve	• Stop engine for preparations. Start troubleshooting at engine high idling. Measurement condition: Swing lock: ON, Arm digging relief Pump delivery pressure: 1 PC valve output pressure: Approx. 0.6 (3/5) If the oil pressure does not return to normal condition even after the adjustment, malfunctioning of PC valve or its internal failure is suspected. In that case, check the valve itself.
5	Malfunctioning of LS-EPC valve	• Stop engine for preparations. Start troubleshooting at engine high idling. Travel mode: NEUTRAL Lo: 3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2} Hi: Travel F/R lever: 0{0}
6	Improper adjustment or malfunctioning of LS valve	• Stop engine for preparations. Start troubleshooting at engine high idling. Oil pressure to be measured: NEUTRAL Oil pressure ratio: Travel without load travel pedal held at half stroke Pump delivery pressure: 1 LS valve output pressure: Approx. 0.6 (3/5) Nearly equal pressure If the oil pressure does not return to normal condition even after the adjustment, malfunctioning of LS valve or its internal failure is suspected. In that case, check the valve itself.
7	Malfunctioning of servo piston	Malfunctioning of servo piston is suspected. Check the piston itself.
8	Piston pump defective	If none of the above listed causes is detected, the piston pump is suspected of deteriorated performance, malfunctioning or internal failure.

H-2 Engine speed sharply drops or engine stalls

Failure information	• The engine speed sharply drops or the engine stalls.
Relative information	• Relative Information

Presumed cause and standard value in normal condition

	Cause	Standard value in normal condition and references for troubleshooting
1	Improper adjustment or malfunctioning of main relief valve	• Stop engine for preparations. Start troubleshooting at engine high idling. Control lever: Arm, DIGGING — Main relief pressure: 34.8 – 37.3 MPa {355 – 380kg/cm^2} If the oil pressure does not return to normal condition even after the adjustment, malfunctioning of the main relief valve or its internal failure is suspected. In that case, check the valve itself.
2	Improper adjustment or malfunctioning of PC valve	• Stop engine for preparations. Start troubleshooting at engine high idling. Oil pressure to be measured: Pump delivery pressure — Measurement condition: Swing lock: ON, Arm digging relief — Oil pressure ratio: 1 Oil pressure to be measured: PC valve output pressure — Measurement condition: Swing lock: ON, Arm digging relief — Oil pressure ratio: Approx. 0.6 (3/5) If the oil pressure does not return to normal condition even after the adjustment, malfunctioning of the PC valve or its internal failure is suspected. In that case, check the valve itself.
3	Improper adjustment or malfunctioning of LS valve	• Stop engine for preparations. Start troubleshooting at engine high idling. Oil pressure to be measured: Pump delivery pressure — Oil pressure ratio: Travel NEUTRAL: Nearly equal pressure — Travel without load (travel pedal held at half stroke): 1 Oil pressure to be measured: LS valve output pressure — Oil pressure ratio: Travel NEUTRAL: Nearly equal pressure — Travel without load (travel pedal held at half stroke): Approx. 0.6 (3/5) If the oil pressure does not return to normal condition even after the adjustment, malfunctioning of the LS valve or its internal failure is suspected. In that case, check the valve itself.
4	Orifice or filter in servo equipment clogged	The orifice or filter in the pump servo equipment is suspected of clogging. Check the equipment itself.
5	Malfunction of servo piston	The servo piston is suspected of malfunction. Check the piston itself.

H-3 No work equipment, travel or swing move

Failure information	• No work equipment or travel and swing functions can be set in motion.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting	
	1	Malfunctioning of PPC lock solenoid valve	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Safety lock lever	Main relief pressure
			Locked	0{0}
			Released	3.5 – 3.8 MPa {35.7 – 38.8kg/cm^2}
	2	Malfunction of relief valve in solenoid valve block.	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Control lever	Control circuit source pressure
			All control levers in NEUTRAL position	3.5 – 3.8 MPa {35.7 – 38.8kg/cm^2}
	3	Piston pump defective	The piston pump is suspected of malfunctioning or an internal failure. Diagnose it in the following manner. • Remove the oil pressure measurement plug and crank the engine. If oil flows out, it is in normal condition.	
	4	Damper defective	It is presumed that the pump shaft does not rotate due to some internal failure of the damper. Check the damper itself.	

H-4 Abnormal noise is heard from around hydraulic pump

Failure information	• An abnormal noise is heard from around the hydraulic pump.
Relative information	—

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting
	1	Hydraulic oil level lowered	Make a visual check.
	2	Quality of hydraulic oil bad	Air may have mixed with the oil. Make a visual check.
	3	Hydraulic tank cap breather clogged	It is presumed that the breather in the cap of hydraulic tanks is clogged, thereby causing negative pressure inside the tank. Make a visual check.
	4	Hydraulic tank strainer clogged	It is presumed that the strainer in the hydraulic tank is clogged, thereby causing negative pressure in the suction circuit. Make a visual check.
	5	Piston pump defective	The piston pump is suspected of an internal failure. Check the pump itself.

H-5 Auto-decelerator does not work

Failure information	• The auto-decelerator does not work.
Relative information	• This troubleshooting mode is applied when the auto-decelerator does not work, while operating the travel control pedal. (A shuttle valve is provided between PPC valve and the hydraulic switch only in the travel circuit -actually located inside PPC valve) • Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting	
	1	Malfunctioning of travel PPC (solenoid valve)	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Travel mode	PPC valve output pressure
			NEUTRAL	0{0}
			Operation	3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}

H-6 Fine control mode does not function

Failure information	• The fine control mode poorly functions or its response is slow.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting		
	1	Malfunctioning of LS-EPC valve	• Stop engine for preparations. Start troubleshooting at engine high idling.		
			Travel speed	Travel mode	LS-EPC valve output pressure
			Lo	NEUTRAL	3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}
			Hi	F/R	0{0}
	2	Orifice in LS circuit clogged	The orifice in the LS circuit is presumed to be clogged. Check the orifice itself.		
	3	Improper adjustment or malfunctioning of LS valve	• Stop engine for preparations. Start troubleshooting at engine high idling.		
			Oil pressure to be measured	Oil pressure ratio	
				TRAVEL NEUTRAL	Travel without load (travel pedal held at half stroke)
			Pump delivery pressure	Nearly equal oil pressure	1
			LS valve output pressure		Approx. 0.6 (3/5)
			If the oil pressure does not return to normal condition even after the adjustment, malfunctioning of the LS valve or its internal failure is suspected. In that case, check the valve itself.		
	4	Malfunctioning of servo piston	Malfunctioning of the servo piston is suspected. Check the piston itself.		

H-7 Boom moves slowly or lacks power

Failure information	• The boom moves slowly or lacks power
Relative information	• Set the working mode at P mode for the troubleshooting.

<table>
<tr><td rowspan="11">Presumed cause and standard value in normal condition</td><td colspan="2">Cause</td><td colspan="2">Standard value in normal condition and references for troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunctioning of right PPC valve (in boom circuit)</td><td colspan="2">• Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td>Boom lever</td><td>PPC valve output pressure</td></tr>
<tr><td>NEUTRAL</td><td>0{0}</td></tr>
<tr><td>RAISE or LOWER</td><td>3.5 - 3.8 MPa
{35.7 - 38.8 kg/cm^2}</td></tr>
<tr><td>2</td><td>Malfunctioning of boom control valve (spool)</td><td colspan="2">The spool in the boom control valve is presumed to malfunction. Check the valve itself.</td></tr>
<tr><td>3</td><td>Malfunctioning of boom control valve (pressure compensation valve)</td><td colspan="2">The pressure compensation valve in the boom control valve is presumed to malfunction. Check the valve itself.</td></tr>
<tr><td>4</td><td>Malfunctioning of boom control valve (regeneration valve)</td><td colspan="2">The regeneration valve in the boom control valve or the seal is presumed to malfunction. Check the valve itself.</td></tr>
<tr><td>5</td><td>Malfunctioning of safety valve or seal defective</td><td colspan="2">The safety valve is presumed to malfunction, or the seal is suspected to be defective. Check the valve itself.</td></tr>
<tr><td>6</td><td>Malfunctioning of boom control valve (suction valve) or seal defective</td><td colspan="2">The suction valve in the boom control valve is presumed to malfunction, or the seal is suspected to be defective.</td></tr>
<tr><td>7</td><td>Malfunctioning of boom control valve (safety and suction valves) or seal defective</td><td colspan="2">The safety and suction valves in the boom control valve are presumed to malfunction, or the seal is suspected to be defective. Check those valves themselves.</td></tr>
<tr><td rowspan="3">8</td><td rowspan="3">Boom cylinder defective</td><td colspan="2">• Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td>Boom lever</td><td>Amount oil leakage from cylinder</td></tr>
<tr><td>Raise relief</td><td>20 cc/min</td></tr>
</table>

H-8 Arm moves slowly or lacks power

Failure information	• The arm moves slowly, or lacks power.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition		Cause	Standard value in normal condition and references for troubleshooting	
	1	Malfunctioning of left PPC valve (arm circuit)	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Arm lever	PPC valve output pressure
			NEUTRAL	0{0}
			DIGGING or DUMPING	3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}
	2	Malfunctioning of arm control valve (spool)	The spool in the arm control valve is presumed to malfunction. Check the valve itself.	
	3	Malfunctioning of arm control valve (pressure compensation valve)	The pressure compensation valve in the arm control valve is presumed to malfunction. Check the valve itself.	
	4	Malfunctioning of arm control valve (regeneration valve)	The generation valve in the arm control valve is presumed to malfunction, or the seal is suspected to be defective. Check the valve itself.	
	5	Malfunctioning of arm control valve (safety and suction valves) or seal defective	The safety and suction valves in the arm control valve are presumed to malfunction, or the seal is suspected of defect. Check those valves themselves.	
	6	Arm cylinder defective	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Arm lever	Amount oil leakage from cylinder
			Digging relief	20 cc/min

H-9 Bucket moves slowly or lacks power

Failure information	• The bucket moves slowly, or lacks power.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting	
	1	Malfunctioning of right PPC valve (bucket circuit)	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Bucket lever	PPC valve output pressure
			NEUTRAL	0{0}
			DIGGING or DUMPING	3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}
	2	Malfunctioning of bucket control valve (spool)	The spool in the bucket control valve is presumed to malfunction. Check the valve itself.	
	3	Malfunctioning of bucket control valve (pressure compensation valve)	The pressure compensation valve in the bucket control valve is presumed to malfunction. Check the valve itself.	
	4	Malfunctioning of bucket control valve (safety and suction valves) or seal defective	The safety and suction valves in the bucket control valve are presumed to malfunction, or the seal is suspected to be defective. Check those valves themselves.	
	5	Bucket cylinder defective	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Bucket lever	Amount oil leakage from cylinder
			Digging relief	20 cc/min

H-10 Work equipment does not move in its single operation

Failure information	• The boom does not move when operated independently. • The arm does not move when operated independently. • The bucket does not move when operated independently.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting	
	1	Malfunctioning of PPC valve	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Work equipment control lever	PPC valve output pressure
			NEUTRAL	0{0}
			Operation	3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}
	2	Malfunctioning of work equipment control valve (spool)	The spool in the work equipment control valve is presumed to malfunction. Check the valve itself.	

H-11 Work equipment hydraulic drift is too fast

Failure information (1)	• Hydraulic drift of the boom is a bit too fast.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition		Cause	Standard value in normal condition and references for troubleshooting	
	1	Boom cylinder defective	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Boom control lever	Amount oil leakage from cylinder
			Raise relief	20 cc/min
	2	Boom control lever (lock valve) seal defective	The seal at lock valve in the boom control lever is suspected to be defective. Check the valve itself.	
	3	Seal at safety valve for lock valve defective	The seal at the safety valve in the lock valve is suspected to be defective. Check the valve itself.	

Failure information (2)	• Hydraulic drift of the arm is a bit too fast.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition		Cause	Standard value in normal condition and references for troubleshooting	
	1	Arm cylinder defective	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Arm control lever	Amount oil leakage from cylinder
			Digging relief	20 cc/min
	2	Arm control valve (safety and suction valves) seal defective	The seal for safety and suction valves in the arm control valve is suspected to be defective. Check the valve itself. • Whether the seal is defective or not may well be determined by changing for other safety and suction valves. (Do not attempt to change them for the safety and suction valves for the boom LOWER and the lock valve, because the set pressure differs)	
	3	Arm control valve (spool) seal defective	The seal for spool in the arm control valve is suspected to be defective. Check the seal itself.	
	4	Arm control valve (pressure compensation valve) seal defective	The seal for pressure compensation valve in the arm control valve is suspected to be defective. Check the seal itself.	

Failure information (3)	• Hydraulic drift of the bucket is a bit too fast.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition		Cause	Standard value in normal condition and references for troubleshooting	
	1	Bucket cylinder defective	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Bucket control lever	Amount oil leakage from cylinder
			Digging relief	20 cc/min
	2	Bucket control valve (safety and suction valves) seal defective	The seal for the safety and suction valves in the bucket control lever is suspected to be defective. Check the seal itself. • Whether the seal is defective or not may well be determined by changing for other safety and suction valves. (Do not attempt to change them for the safety and suction valves for the boom LOWER and the lock valve, because the set pressure differs)	
	3	Bucket control valve (spool) seal defective	The seal for spool in the bucket control valve is suspected to be defective. Check the seal itself.	
	4	Bucket control valve (pressure compensation valve) seal defective	The seal for pressure compensation valve in the bucket control valve is suspected to be defective. Check the seal itself.	

H-12 Work equipment has big time lag

Failure information	• The work equipment has a big time lag.
Relative information	• Set the working mode at P mode for the troubleshooting.

<table>
<tr><th rowspan="6">Presumed cause and standard value in normal condition</th><th colspan="2">Cause</th><th colspan="3">Standard value in normal condition and references for troubleshooting</th></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Malfunctioning of LS-EPC valve</td><td colspan="3">• Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td>Travel speed</td><td>Travel mode</td><td>LS-EPC valve output pressure</td></tr>
<tr><td>Lo</td><td>NEUTRAL</td><td>3.5 - 3.8 MPa
{35.7 - 38.8 kg/cm^2}</td></tr>
<tr><td>Hi</td><td>Operation</td><td>0{0}</td></tr>
<tr><td>2</td><td>Malfunctioning of control valve (regeneration valve) - with boom and arm only</td><td colspan="3">The regeneration valve in the control valve is presumed to malfunction. Check the valve itself.</td></tr>
<tr><td>3</td><td>Malfunctioning of control valves (safety & suction valve)</td><td colspan="3">The safety and suction valves of the control valve are presumed to malfunction. Check those valves themselves directly.
• For the arm and boom, whether they are defective or not may well be determined by changing them for other safety and suction valves. (Do not attempt to change them for the safety and suction valves for the boom LOWER and the lock valve, because each set pressure differs)</td></tr>
<tr><td>4</td><td>Malfunctioning of control valve (pressure compensation valve)</td><td colspan="3">The pressure compensation valve of the control valve is presumed to malfunction. Check the valve itself directly.</td></tr>
</table>

H-13 Other work equipment moves when relieving single circuit

Failure information	• Other work equipment moves when relieving the single circuit of specific work equipment.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting
	1	Control valve (pressure compensation valve) seal defective	The seal for pressure compression valve in the control valve is suspected to be defective. Check the seal itself.

H-14 One-touch power max. switch does not operate

Failure information	• The one-touch power max. switch does not operate.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting	
	1	Malfunctioning of 2-stage solenoid valve	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Swing lock switch	Solenoid valve output pressure
			OFF	0{0}
			ON	3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}
	2	Malfunctioning of main relief valve	The main relief valve is presumed to malfunction. Check the valve itself.	

H-15 In compound operation, work equipment with larger load moves slowly

Failure information	• In a compound operation, work equipment with larger load tends to move slowly.
Relative information	—

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting	
	1	Malfunctioning of pressure compensation valve for work equipment with larger load	The pressure compensation valve for the work equipment with larger load is presumed to malfunction. Check the valve itself.	
			Combination of compound operation	Work equipment with larger load
			Boom RAISE + arm DIGGING	Boom RAISE
			Boom RAISE + arm DUMPING	Arm DUMPING
			Boom RAISE + bucket DIGGING	Boom RAISE
			Arm DUMPING + bucket DIGGING	Arm DUMPING
			Boom LOWER + arm DUMPING	Arm DUMPING

H-16 In swing + boom RAISE operation, boom moves slowly

Failure information	• In a compound operation of swing + boom RAISE, the boom tends to move slowly.
Relative information	• If the boom moves slowly in the single operation of boom RAISE, carry out the "Boom moves slowly or lacks power" checks first see page 20-712.

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting
	1	Malfunctioning of swing & boom control valves or seal defective	The swing & boom control valves are presumed to malfunction, or the seal is suspected to be defective. Check the valves and seals.

H-17 In swing + travel, travel speed drops sharply

Failure information	• In a compound operation of swing + travel, the travel speed drops sharply.
Relative information	• If the travel speed is slow in the single operation of travel, carry out the "Travel speed does not shift or it is too slow or fast" checks first see page 20-720.

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting
	1	Malfunctioning of travel and swing control valves.	The travel & swing control valves are presumed to malfunction. Check both of them directly.

H-18 Travel speed does not switch

Failure information	• The machine's travel speed is slow.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition

	Cause	Standard value in normal condition and references for troubleshooting
1	Malfunctioning of travel PPC valve	• Stop engine for preparations. Start troubleshooting at engine high idling. Travel control lever: Forward or reverse PPC valve output pressure: 3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}
2	Malfunctioning of self-pressure decompression valve	• Stop engine for preparations. Start troubleshooting at engine high idling. Control lever: All control levers and pedals in NEUTRAL Control circuit source pressure: 3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}
3	Malfunctioning of LS-EPC valve	• Stop engine for preparations. Start troubleshooting at engine high idling. Lo: Travel speed; NEUTRAL: Travel control pedal; Approx. 2.9 MPa {approx. 30 kg/cm^2}: LS-EPC valve output pressure Hi: Travel speed; Travel control pedal: Travel control pedal; 0 {0}: LS-EPC valve output pressure
4	Malfunction of travel control valve (spool)	The spool in the travel control valve is presumed to malfunction. Check the spool itself.
5	Malfunctioning of travel control valve (pressure compensation valve)	The pressure compensation valve in the travel control valve is presumed to malfunction. Check the valve itself.
6	Malfunctioning of travel control valve (suction valve)	The suction valve in the travel control valve is presumed to malfunction. Check the valve itself.
7	Malfunction of travel motor	• Stop engine for preparations. Start troubleshooting at engine high idling. Travel control pedal: Travel relief Amount of oil leakage from travel motor: 6 l/min
8	Travel speed does not switch	Malfunction of speed sensing system

H-19 Travel speed does not shift, or it is too slow or fast.

Failure information	• Travel speed does not shift, or it is either too fast or slow.
Relative information	• Set the working mode at P mode for the troubleshooting.

<table>
<tr><td rowspan="13">Presumed cause and standard value in normal condition</td><td colspan="2">Cause</td><td colspan="3">Standard value in normal condition and references for troubleshooting</td></tr>
<tr><td rowspan="9">1</td><td rowspan="9">Malfunctioning of LS-EPC valve</td><td colspan="3">• Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td>Travel speed</td><td>Travel control pedal</td><td>Monitoring [15]</td></tr>
<tr><td>Lo</td><td rowspan="3">Fine control
(to the extent that the decelerator is released)</td><td>940 mA</td></tr>
<tr><td>Creep</td><td>583 mA</td></tr>
<tr><td>Hi</td><td>0 mA</td></tr>
<tr><td colspan="3">• Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td>Travel speed</td><td>Travel control pedal</td><td>LS-EPC valve output pressure</td></tr>
<tr><td>Lo</td><td>NEUTRAL</td><td>3.5 - 3.8 MPa
{35.7 - 38.8 kg/cm^2}</td></tr>
<tr><td>Hi</td><td>Operation</td><td>0 {0}</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Malfunctioning of transmission clutch control solenoid valve</td><td colspan="3">• Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td>Travel speed</td><td>Park brake valve</td><td>Transmission clutch control solenoid feed</td></tr>
<tr><td rowspan="2">Lo or Hi</td><td>ON</td><td>0 {0}</td></tr>
<tr><td>OFF</td><td>5 - 5.5 MPa
{51 - 56 kg/cm^2}</td></tr>
<tr><td>3</td><td>Malfunctioning of travel motor (speed shifting)</td><td colspan="3">The travel motor is presumed to malfunction when shifting speed. Check the speed shifting portion directly.</td></tr>
</table>

H-20 Machine does not swing

Failure information (1)	• The machine swings neither to the right nor to the left.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition

	Cause	Standard value in normal condition and references for troubleshooting
1	Malfunctioning of swing parking brake solenoid valve	• Stop engine for preparations. Start troubleshooting at engine high idling.

Swing	Solenoid valve
NEUTRAL	0 {0}
Operation	3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}

2	Malfunctioning of swing motor (parking brake)	The parking brake portion of the swing motor is presumed to malfunction. Check it directly.
3	Improper adjustment or malfunctioning of swing motor (safety valve)	• Stop engine for preparations. Start troubleshooting at engine high idling.

Swing lock switch	Swing control lever	Swing relief pressure
ON	Swing relief	28.4 – 28.9 MPa {290 – 295 kg/cm^2}

If the oil pressure does not return to normal condition even after the adjustment, the safety valve is presumed to malfunction, or suspected of an internal failure. Check the valve itself.

4	Swing motor defective	• Stop engine for preparations. Start troubleshooting at engine high idling.

Swing control lever	Amount of oil leakage from swing motor
Swing relief	Below 21 cc/min

5	Swing machinery defective	The swing machinery is suspected of an internal failure. Check the inside of the swing machinery directly. • A failure inside the swing machinery may well be determined by an abnormal noise from within, abnormal heat generated or metal dust or chips contained in the drained oil.

Failure information (2)	• The machine does not swing in one direction.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition

	Cause	Standard value in normal condition and references for troubleshooting
1	Malfunctioning of PPC valve	• Stop engine for preparations. Start troubleshooting at engine high idling.

Left control lever	PPC valve output pressure
NEUTRAL	0 {0}
Swing operation	3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}

2	Malfunctioning of swing control valve (spool)	The spool in the swing control valve is presumed to malfunction. Check the spool itself.
3	Swing motor (suction valve) seal defective	The seal in the suction valve of the swing motor is suspected of defect. Check the seal itself. • Whether the seal is defective or not may well be determined by swapping the right and left suction valves and watching if there is any change.
4	Swing motor (check valve) seal defective	The seal in the check valve of the swing motor is suspected of defect. Check the seal itself. • Whether the seal is defective or not may well be determined by swapping the right and left check valves and watching the result.

H-21 Swing acceleration is poor, or swing speed is slow

Failure information (1)	• Swing acceleration is poor, or swing speed is slow.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition

	Cause	Standard value in normal condition and references for troubleshooting
1	Malfunctioning of LS shuttle valve	The LS shuttle valves for all the control valves are presumed to malfunction. Check them directly.
2	Malfunctioning of swing motor (parking brake)	The parking brake portion of the swing motor is presumed to malfunction. Check it directly.
3	Improper adjustment or malfunctioning of swing motor (safety valve)	• Stop engine for preparations. Start troubleshooting at engine high idling.

Swing lock switch	Swing control lever	Swing relief pressure
ON	Swing relief	28.4 – 28.9 MPa {290 – 295 kg/cm^2}

If the oil pressure does not return to normal condition even after the adjustment, the safety valve is presumed to malfunction, or suspected of an internal failure. Check the valve itself.

4	Swing motor defective	• Stop engine for preparations. Start troubleshooting at engine high idling.

Swing control lever	Amount of oil leakage from swing motor
Swing relief	Below 21 cc/min

Failure information (2)	• Swing acceleration is poor only on one side, or swing speed is slow.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition

	Cause	Standard value in normal condition and references for troubleshooting
1	Malfunctioning of PPC valve	• Stop engine for preparations. Start troubleshooting at engine high idling.

Swing control lever	PPC valve output pressure
NEUTRAL	0 {0}
Left or right	3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}

2	Malfunctioning of swing control valve (spool)	• The spool in the swing control valve is presumed to malfunction. Check the valve itself.
3	Malfunctioning of swing motor (pressure compensation valve)	• The pressure compensation valve in the swing motor is presumed to malfunction. Check the valve itself.
4	Swing motor (suction valve) seal defective	The seal in the suction valve of the swing motor is suspected of defect. Check the seal itself. • Whether the seal is defective or not may well be determined by swapping the right and left suction valves and watching the result.
5	Swing motor (check valve) seal defective	The seal in the check valve of the swing motor is suspected of defect. Check the seal itself. • Whether the seal is defective or not may well be determined by swapping the right and left check valves and watching the result.

H-22 Excessive overrun when stopping swing

Failure information (1)	• The work equipment overruns excessively when stopping swing.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition		Cause	Standard value in normal condition and references for troubleshooting
	1	Improper adjustment or malfunctioning of swing motor (safety valve)	• Stop engine for preparations. Start troubleshooting at engine high idling.
			Swing lock switch: ON; Swing control lever: Swing relief; Swing relief pressure: 28.4 – 28.9 MPa {290 – 295 kg/cm^2}
			If the oil pressure does not return to normal condition even after the adjustment, the safety valve is presumed to malfunction, or suspected of an internal failure. Check the valve itself.
	2	Swing motor defective	• Stop engine for preparations. Start troubleshooting at engine high idling.
			Control lever: Swing relief; Amount of oil leakage from swing motor: Below 21 cc/min

Failure information (2)	• Swing acceleration is poor only on one side, or swing speed is slow.
Relative information	• Set the working mode at P mode for the troubleshooting.

Presumed cause and standard value in normal condition		Cause	Standard value in normal condition and references for troubleshooting
	1	Malfunctioning of PPC valve	★Stop engine for preparations. Start troubleshooting at engine high idling.
			Swing control lever: NEUTRAL; PPC valve output pressure: 0 {0}
			Swing control lever: Left or right; PPC valve output pressure: 3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}
	2	Swing PPC slow return valve clogged	The PPC slow return valve is suspected of clogging. Check the valve itself. • Whether the valve is clogged or not may well be determined by swapping the right and left valves and watching the result.
	3	Malfunctioning of swing control valve (spool)	The spool in the swing control valve is resumed to malfunction. Check the valve itself.
	4	Swing motor (suction valve) seal defective	The seal in the suction valve of the swing motor is suspected of defect. Check the seal itself. • Whether the seal is defective or not may well be determined by swapping the right and left suction valves and watching the result.
	5	Swing motor (check valve) seal defective	The seal in the check valve of the swing motor is suspected of defect. Check the seal itself. • Whether the seal is defective or not may well be determined by swapping the right and left check valves and watching the result.

H-23 There is big shock when stopping swing

Failure information	• There is a big shock caused when stopping a swing motion.
Relative information	• Set the working mode at P mode for the troubleshooting.

	Cause		Standard value in normal condition and references for troubleshooting	
Presumed cause and standard value in normal condition	1	Malfunctioning of swing PPC valve	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Swing control lever	PPC valve output pressure
			NEUTRAL	0 {0}
			Left or right	3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}
	2	Malfunctioning of swing PPC slow return valve	The swing PPC slow return valve is presumed to malfunction. Check the valve itself. • Whether the valve malfunctions or not may well be determined by swapping the right and left valves and watching the result.	

H-24 There is loud abnormal noise caused when stopping swing

Failure information	• There is a loud abnormal noise caused when stopping a swing motion.
Relative information	• Set the working mode at P mode for the troubleshooting.

	Cause		Standard value in normal condition and references for troubleshooting
Presumed cause and standard value in normal condition	1	Malfunctioning of back pressure valve	The backpressure valve is presumed to malfunction. Check the valve itself.
	2	Malfunction of swing motor (safety valve)	The safety valve in the swing motor is presumed to malfunction. Check the valve itself.
	3	Malfunction of swing motor (suction valve)	The seal in suction valve of the swing motor is suspected of defect. Check the seal itself. • Whether the seal is defective or not may well be determined by swapping the right and left valves and watching the result.
	4	Swing machinery defective	The swing machinery is suspected of an internal failure. Check the inside of the machinery itself. • A failure inside the swing machinery may well be determined by monitoring abnormal noise, abnormal heat generated or metal dust or chips contained in the drained oil.

H-25 Swing natural drift is too big

Failure information (1)	• Natural drift of the swing is too big (when the parking brake is activated).
Relative information	• When the emergency swing release switch is in the OFF position (this is a normal condition), the swing and parking brake is activated and the swing is fixed with a disc brake.

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting	
	1	Swing and parking brake solenoid valve malfunctioned	• Stop engine for preparations. Start troubleshooting at engine high idling.	
			Swing control lever	Solenoid valve output pressure
			NEUTRAL	0 {0}
			Left or right	3.5 - 3.8 MPa {35.7 - 38.8 kg/cm^2}
	2	Swing motor (parking brake portion) malfunctioned	The parking portion of the swing motor is suspected of malfunctioning and interior failure. Check that portion directly.	

Failure information (2)	• Natural drift of the swing is too big (when the parking brake is released).
Relative information	• When the emergency swing release switch is in the ON condition (this is an emergent condition), the swing and parking brake is released and the swing is retained only hydraulically.

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting
	1	Swing control valve (spool) malfunctioned	The seal in the spool of the swing control valve is suspected of defect. Check the spool itself directly.
	2	Swing control valve (pressure compensation valve) malfunctioned	The pressure compensation valve seal in the swing control valve is suspected of defect. Check the valve itself directly.
	3	Swing motor (safety valve) defective	The safety valve seal in the swing motor is suspected of defect. Check the valve itself directly.
	4	Swing motor (suction valve) defective	The suction valve seal in the swing motor is suspected of defect. Check the valve itself directly.
	5	Swing motor (check valve) defective	The check valve seal in the swing motor is suspected of defect. Check the valve itself directly.

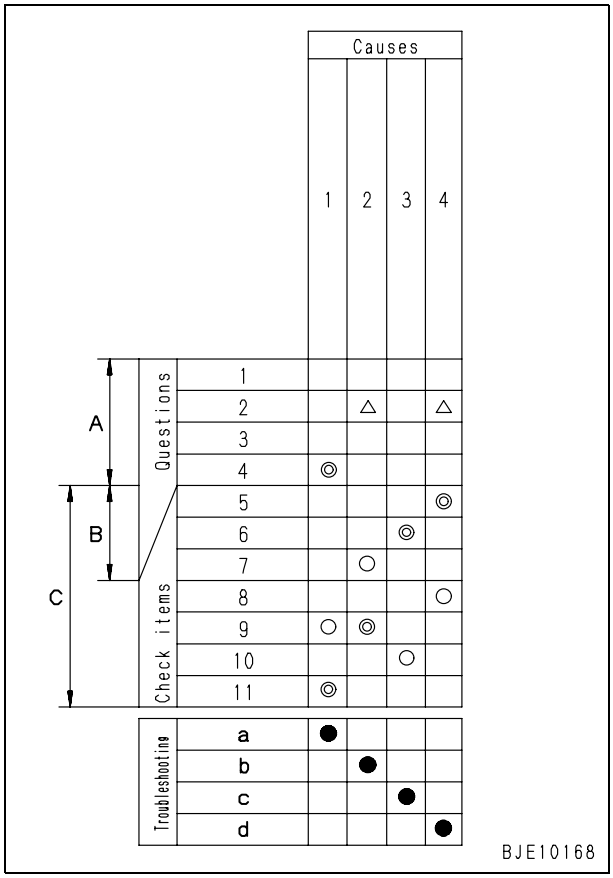
H-26 Swing speed is faster than specified swing speed

Failure information (1)	• Swing speed is greater than specified speed.
Relative information	• When operating the swing system.

Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting
	1	Operation of LS valve defective.	Is output of the LS-EPC solenoid valve normal.
	2	Defective LS-EPC solenoid.	Output pressure of the LS-EPC solenoid valve is abnormal. Correct or replace the LS-EPC solenoid.

Troubleshooting of engine (S-mode)

Method of using troubleshooting chart



The troubleshooting chart consists of the "questions", "check items", "causes", and "troubleshooting" blocks.

The questions and check items are used to pinpoint high probability causes by simple inspection or from phenomena without using troubleshooting tools.

Next, troubleshooting tools or direct inspection are applied to check the narrowed causes in order from the most probable one to make final confirmation according to the troubleshooting procedure.

[Questions]

Items to be drawn from the user or operator. They correspond to **A** and **B** in the chart on the right. The items in **A** are basic ones. The items in **B** can be drawn from the user or operator, depending on their level.

[Check items]

Simple check items used by the serviceman to narrow the causes. They correspond to **C** in the chart on the right.

[Causes]

Items to be narrowed from the questions and check items. The serviceman narrows down the probable causes from **A**, **B**, and **C**.

[Troubleshooting]

Items used to find out the true cause by verifying the narrowed causes finally in order from the most probable one by applying troubleshooting tools or direct inspection.

Items listed in the [Questions] and [Check items] and related to the [Causes] are marked with △, ○, and ◎.

△: Causes to be referred to for questions and check items

○: Causes related to questions and check items

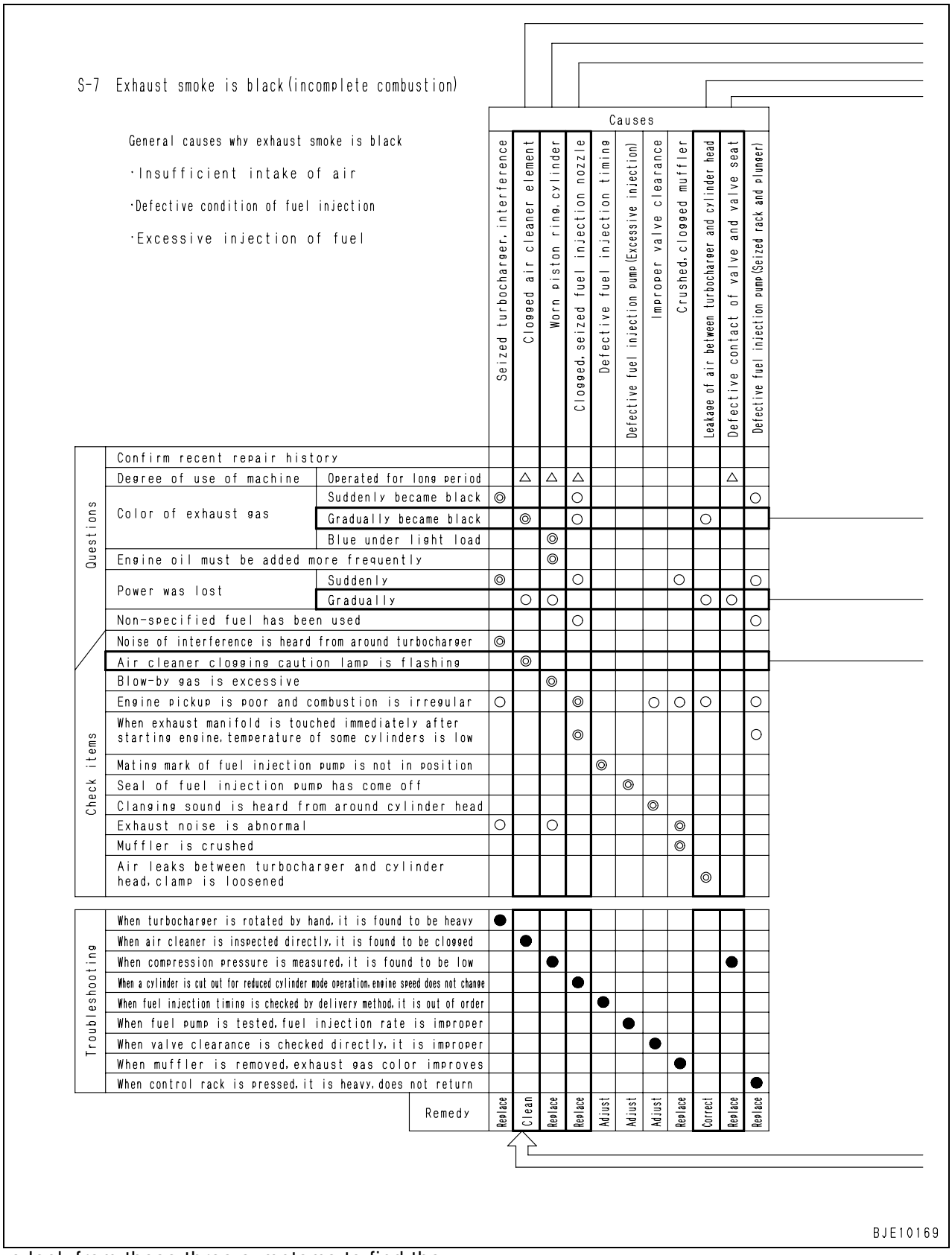
◎: Causes highly probable among ones marked with ○

- When narrowing the "causes", apply the items marked with ◎ before those marked with ○.

  When narrowing the causes, do not apply the items marked with △. (If no items have other marks and the causes cannot be narrowed, however, you may apply them.)

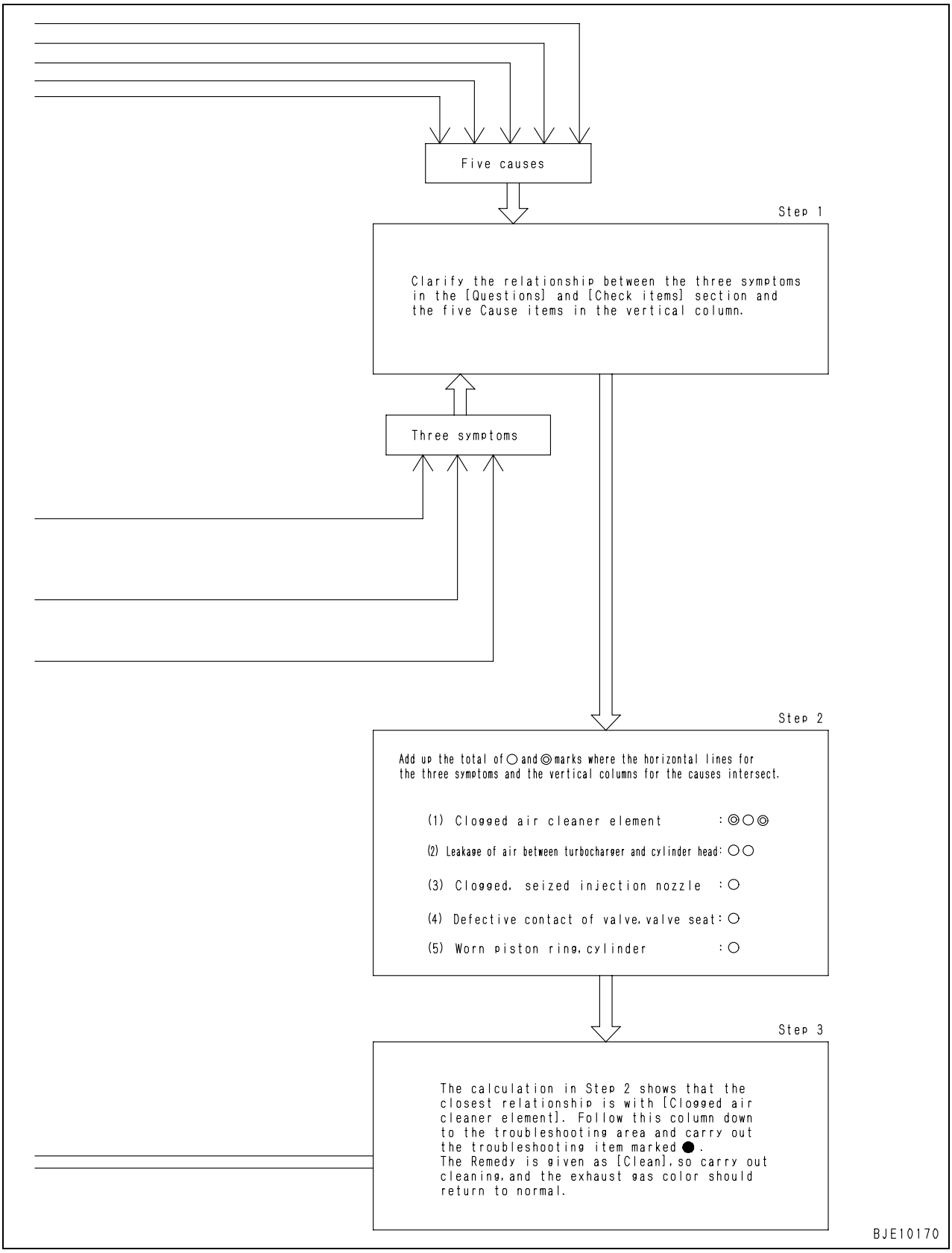
<Example of troubleshooting> Exhaust gas is black

Let us assume that [Clogged air cleaner] is taken to be the cause of black exhaust gas. Three symptoms have causal relationship with this problem: [Exhaust gas slowly became black], [Power slowly became weaker], and [Air cleaner clogging caution lamp is flashing].



If we look from these three symptoms to find the causes, we find that there is a relationship with five causes.

Let us explain here the method of using this causal relationship to pinpoint the most probable cause.



S-1 Starting performance is poor

General causes why starting performance is poor
- Defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel
- The common rail fuel injection system (CRI) recognizes the fuel injection timing electrically. Accordingly, even if the starting operation is carried out, the engine may not start until the crankshaft revolves 2 turns at maximum. This phenomenon does not indicate a trouble, however.

			Causes											
			Clogged air cleaner element	Defective contact of valve, vale seat	Worn piston ring, cylinder	Clogged air breather hole of fuel tank cap	Leaking or clogged fuel piping, entry of air	Clogged fuel filter, element	Stuck, seized supply pump plunger	Defective injector	Defective intake air heater system	Defective alternator (regulator section)	Defective alternator (generator section)	Defective, deteriorated battery
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period	△					△						△
	Starting performance	Became worse gradually	○	◎	◎			○						
		Engine starts easily when warm									◎			◎
	Non-specified fuel is being used							○	○	○				
	Replacement of filters has not been carried out according to Operation and Maintenance Manual		◎					◎	○	○				
	Engine oil must be added more frequently				◎									
	When engine is preheated or when temperature is low, preheating monitor does not indicate normally										◎			
	During operation, charge level monitor indicates abnormal charge											◎	◎	
Check items	Dust indicator is red		◎											
	Air breather hole of fuel tank cap is clogged					◎								
	Fuel is leaking from fuel piping						◎		○					
	When priming pump is operated, it makes no reaction or it is heavy						◎	○						
	Starting motor cranks engine slowly													◎
	While engine is cranked with starting motor	If air bleeding plug of fuel filter is removed, fuel does not flow out						◎						
		If spill hose from injector is disconnected, little fuel spills							◎					
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low									◎				
	Engine does not pick up smoothly and combustion is irregular			○	○					◎				
	There is hunting from engine (rotation is irregular)					○	◎	○						
	Blow-by gas is excessive				◎									
Troubleshooting	Inspect air cleaner directly		●											
	When compression pressure is measured, it is found to be low			●	●									
	When air is bled from fuel system, air comes out						●							
	Inspect fuel filter, strainer directly							●						
	Carry out troubleshooting according to "Rail Press (Very) Low Error (*1)" indicated by code								●					
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change									●				
	When starting switch is turned to HEAT, intake air heater mount does not become warm										●			
	Is voltage 20 – 30 V between alternator terminal B and terminal E with engine at low idle?	Yes										●		
		No											●	
	When specific gravity of electrolyte and voltage of battery are measured, they are low													●
		Remedy	Clean	Replace	Replace	Clean	correct	Clean	Replace	Replace	Replace	Replace	Replace	Replace

*1: Displayed failure codes [CA559] and [CA2249]

S-2 Engine does not start

a) Engine does not turn

General causes why engine does not turn

- Internal parts of engine seized
  - ✔ See "S-4 Engine stops during operations
- Defective electrical system
- Problem in drive devices on applicable machine side
  - ✔ Carry out troubleshooting for devices on applicable machine

			Causes							
			Broken flywheel ring gear	Defective or deteriorated battery	Defective connection of battery terminal	Defective battery relay	Defective starting switch	Defective safety relay	Defective starting motor (motor section)	Defective starting circuit wiring
Questions	Confirm recent repair history									
	Degree of use of machine	Operated for long period	△	△						
	Condition of horn when starting switch is turned ON	Horn does not sound			○		○			◎
		Horn volume is low		◎						
Check items	Battery electrolyte is low			◎						
	Battery terminal is loose				◎					
	When starting switch is turned ON, there is no operating sound from battery relay			○		◎				
	When starting switch is turned to START, starting pinion does not move out			○			○			◎
	When starting switch is turned to START, starting pinion moves out, but	Speed of rotation is low		◎						
		Makes grating noise	◎						◎	
		Soon disengages again						◎		
		Makes rattling noise and does not turn		○				○	○	
Troubleshooting	Inspect flywheel ring gear directly		●							Carry out troubleshooting on applicable machine side
	When specific gravity of electrolyte and voltage of battery are measured, they are low			●						
	Turn starting switch OFF, connect cord, and carry out troubleshooting at ON	There is not voltage (20 – 30 V) between battery relay terminal B and terminal E				●				
		When terminal B and terminal C of starting switch are connected, engine starts					●			
		When terminal B and terminal C at safety relay outlet are connected, engine starts						●		
		Even if terminal B and terminal C at safety relay outlet are connected, engine does not start							●	
		When safety switch terminal and terminal B of starting motor are connected, engine starts							●	
		Remedy	Replace	Replace	Correct	Replace	Replace	Replace	Replace	—

b) Engine turns but no exhaust smoke comes out

General causes why engine turns but no exhaust smoke comes out

- q Fuel is not being supplied
- q Supply of fuel is extremely small
- q Improper selection of fuel (particularly in winter)

			Causes												
			Use of improper fuel	Insufficient fuel in tank	Clogged air breather hole of fuel tank cap	Leaking or clogged fuel piping, entry of air	Clogged fuel filter element	Seized, abnormally worn feed pump	Broken supply pump shaft	Stuck, seized supply pump plunger	Defective supply pump MPROP	Defective operation of overflow valve (Does not close)	Defective common rail pressure limiter	Defective fuel injector
Questions / Check items	Confirm recent repair history													
	Degree of use of machine	Operated for long period				△	△							
	Exhaust smoke suddenly stopped coming out (when starting again)							◎	○	◎	◎			△
	Replacement of filters has not been carried out according to Operation and Maintenance Manual						◎			△				○
	When fuel tank is inspected, it is found to be empty			◎										
	Air breather hole of fuel tank cap is clogged			○	◎									
	Rust and water are found when fuel tank is drained						○	△		△	△			
	When fuel filter is removed, there is not fuel in it		◎			◎								
	Fuel is leaking from fuel piping					◎								
	When priming pump is operated, it makes no reaction or it is heavy					◎	○							
	While engine is cranked with starting motor	If air bleeding plug of fuel filter is removed, fuel does not flow out		○		○		◎	○					
		If spill hose from injector is disconnected, little fuel spills				○			◎	◎	◎			○
Troubleshooting	When air is bled from fuel system, air comes out					●								
	Inspect fuel filter directly						●							
	Inspect feed pump directly							●						
	Carry out troubleshooting according to "Rail Press (Very) Low Error (*1)" indicated by code								●	●				
	Carry out troubleshooting according to "IMV/PCV1 Short (Open) Error (*2)" indicated by code										●			
	Inspect overflow valve directly											●		
	Engine can be started in reduced cylinder mode.													●
	If pressure limiter return pipe is disconnected, fuel flows out												●	
		Remedy	Replace	Add	Correct	Correct	Replace	Replace	Replace	Replace	Replace	Replace	Replace	Replace

*1: Displayed failure codes [CA559] and [CA2249]
*2: Displayed failure codes [CA271] and [CA272]

c) Exhaust smoke comes but engine does not start (fuel is being injected)

General causes why exhaust smoke comes out but engine does not start

- q Lack of rotating force due to defective electrical system
- q Insufficient supply of fuel
- q Insufficient intake of air
- q Improper selection of fuel

			Causes											
			Clogged air cleaner element	Worn dynamic valve system (Valve, rocker lever, etc.)	Worn piston ring, cylinder liner	Use of improper fuel	Clogged air breather hole of fuel tank cap	Leaking or clogged fuel system, entry of air	Clogged fuel filter	Stuck, seized supply pump plunger	Clogged injector, defective spray	Defective, deteriorated battery	Defective coolant temperature sensor, wiring harness	Defective intake air heater system
Questions / Check items	Confirm recent repair history													
	Degree of use of machine	Operated for long period			△				△		△			
	Suddenly failed to start			◎						◎			○	
	Non-specified fuel is being used									○	○			
	Replacement of filters has not been carried out according to Operation and Maintenance Manual		◎						◎					
	Engine oil must be added more frequently				◎									
	When engine is preheated or when temperature is low, preheating monitor does not indicate normally													◎
	Dust indicator is red		◎											
	Air breather hole of fuel tank cap is clogged						○							
	Rust and water are found when fuel tank is drained								◎					
	When fuel filter is removed, there is not fuel in it					◎								
	Fuel is leaking from fuel piping							◎						
	When priming pump is operated, it makes no reaction or it is heavy							◎	○					
	Starting motor cranks engine slowly											◎		
	When engine is cranked, abnormal sound is generated around cylinder head			◎										
	While engine is cranked with starting motor,	If air bleeding plug of fuel filter is removed, fuel does not flow out				○			◎					
		If spill hose from injector is disconnected, little fuel spills								◎				
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low										◎			
Troubleshooting	Inspect air cleaner directly		●											
	Inspect dynamic valve system directly			●										
	When compression pressure is measured, it is found to be low				●									
	When air is bled from fuel system, air comes out							●						
	Inspect fuel filter directly								●					
	Carry out troubleshooting according to "Rail Press (Very) Low Error (*1)" indicated by code									●				
	Engine can be started in reduced cylinder mode.										●			
	When specific gravity of electrolyte and voltage of battery are measured, they are low											●		
	Coolant temperature gauge does not indicate normally												●	
	When starting switch is turned to HEAT, intake air heater mount does not become warm													●
		Remedy	Clean	Replace	Replace	Replace	Clean	Correct	Clean	Replace	Replace	Replace	Replace	Replace

*1: Displayed failure codes [CA559] and [CA2249]

S-3 Engine does not pick up smoothly

General causes why engine does not pick up smoothly
- q Insufficient intake of air
- q Insufficient supply of fuel
- q Defective condition of fuel spray
- q Improper selection of fuel
- q Controller is controlling in derate mode (limiting injection rate (output) because of an error in electrical system)

			Causes										
			Clogged air cleaner element	Defective contact of valve and valve seat	Improper valve clearance	Seized turbocharger, interference of turbocharger	Worn piston ring, cylinder liner	Clogged air breather hole of fuel tank cap	Leaking or clogged fuel piping, entry of air	Clogged fuel filter	Stuck, seized supply pump plunger	Clogged injector, defective spray
Questions	Confirm recent repair history											
	Degree of use of machine	Operated for long period	△	△			△			△		
	Engine pick-up suddenly became worse					◎		○	○			○
	Non-specified fuel is being used									◎	◎	◎
	Replacement of filters has not been carried out according to Operation and Maintenance Manual		◎							◎		
	Oil must be added more frequently						◎					
Check items	Dust indicator is red		◎									
	Air breather hole of fuel tank cap is clogged							◎				
	Rust and water are found when fuel tank is drained									◎		
	Fuel is leaking from fuel piping								◎			
	When priming pump is operated, it makes no reaction or it is heavy								◎	○		
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low										○	◎
	Color of exhaust gas	Blue under light load					◎					
		Black	◎	○		◎						◎
	When engine is cranked, abnormal sound is generated around cylinder head				◎							
	When engine is cranked, interference sound is generated around turbocharger					◎						
	High idle speed under no load is normal, but speed suddenly drops when load is applied							○		◎		
	There is hunting from engine (rotation is irregular)							○		○		○
	Blow-by gas is excessive						◎					
Troubleshooting	Inspect air cleaner directly		●									
	When compression pressure is measured, it is found to be low			●			●					
	Inspect valve clearance directly				●							
	When turbocharger is rotated by hand, it is found to be heavy					●						
	When air is bled from fuel system, air comes out								●			
	Inspect fuel filter, strainer directly									●		
	Carry out troubleshooting according to "Rail Press (Very) Low Error (*1)" indicated by code										●	
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change											●
		Remedy	Clean	Replace	Adjust	Replace	Replace	Clean	Correct	Clean	Replace	Replace

*1: Displayed failure codes [CA559] and [CA2249]

S-4 Engine stops during operations

General causes why engine stops during operations
- Seized parts inside engine
- Insufficient supply of fuel
- There is overheating
- Problem in drive devices on applicable machine side
  ✔Carry out troubleshooting for devices on applicable machine

			Causes													
			Broken dynamic valve system (valve, rocker arm, etc.)	Broken, seized piston, connecting rod	Broken, seized crankshaft bearing	Broken, seized gear train	Insufficient fuel in tank	Clogged air breather hole of fuel tank cap	Leaking, clogged fuel piping	Clogged fuel filter	Broken, seized feed pump	Broken supply pump shaft	Stuck, seized supply pump plunger	Broken auxiliary equipment (pump, compressor, etc.)	Problem in drive devices on applicable machine side
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period								△					
	Condition when engine stopped	Abnormal noise was heard and engine stopped suddenly	◎	◎	◎	◎					○	◎	○	◎	◎
		Engine overheated and stopped		◎	○									○	
		Engine stopped slowly					◎			○					
		There was hunting and engine stopped					◎	○		○	○				
	Non-specified fuel is being used									○	○		○		
	Replacement of filters has not been carried out according to Operation and Maintenance Manual									◎					
	Fuel level monitor indicates low level (if monitor is installed)						◎								
Check items	When fuel tank is inspected, it is found to be empty						◎								
	Air breather hole of fuel tank cap is clogged							◎							
	Fuel is leaking from fuel piping								◎						
	When priming pump is operated, it makes no reaction or it is heavy								◎	○					
	Rust and water are found when fuel tank is drained									◎					
	Metal particles are found when oil is drained		◎	◎	◎						○				
	When engine is cranked by hand	Does not turn at all		◎	◎										
		Turns in opposite direction	◎												
		Moves by amount of gear backlash				◎								◎	
		Supply pump shaft does not turn										◎			
	Engine turns, but stops when load is applied to machine														◎
Troubleshooting	Inspect dynamic valve system directly		●												Carry out troubleshooting on applicable machine
	Inspect piston, connecting rod directly			●											
	Inspect crankshaft bearing directly				●										
	Inspect gear train directly					●									
	Inspect fuel filter, strainer directly									●					
	Inspect feed pump directly										●				
	Carry out troubleshooting according to "Rail Press (Very) Low Error (*1)" indicated by code											●	●		
	Engine rotates when pump auxiliary equipment (pump, compressor, etc.) is removed													●	
		Remedy	Replace	Replace	Replace	Replace	Add	Clean	Correct	Clean	Replace	Replace	Replace	Replace	—

*1: Displayed failure codes [CA559] and [CA2249]

S-5 Engine does not rotate smoothly

General causes why engine does not rotate smoothly

- Air in fuel system
- Defective speed sensor (Error at degree that it is not indicated)

			Causes							
			Insufficient fuel in tank	Clogged air breather hole of fuel tank cap	Leaking or clogged fuel piping, entry of air	Clogged fuel filter	Clogged injector, defective spray (dirt in injector)	Defective Ne speed sensor, wiring harness	Defective Bkup speed sensor, wiring harness
Questions	Confirm recent repair history								
	Degree of use of machine	Operated for long period				△			
	Condition of hunting	Occurs at a certain speed range						○	○
		Occurs at low idle			○	○	○	○	○
		Occurs even when speed is raised		○				○	○
		Occurs on slopes	◎						
	Replacement of filters has not been carried out according to Operation and Maintenance Manual					◎			
Check items	When fuel tank is inspected, it is found to be empty		◎						
	Air breather hole of fuel tank cap is clogged			◎					
	Rust and water are found when fuel tank is drained					○			
	Fuel is leaking from fuel piping				◎				
	When priming pump is operated, it makes no reaction or it is heavy				◎	○			
Troubleshooting	When air is bled from fuel system, air comes out				●				
	Inspect fuel filter, strainer directly					●			
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change						●		
	Carry out troubleshooting according to "Eng Ne Speed Sensor Error (*1)" indicated by code							●	
	Carry out troubleshooting according to "Eng Bkup Speed Sensor Error (*2)" indicated by code								●
		Remedy	Add	Clean	Replace	Replace	Replace	Replace	Replace

*1: Displayed failure codes [CA689]
*2: Displayed failure code [CA778]

S-6 Engine lack output (or lacks power)

General causes why engine lacks output
- Insufficient intake of air
- Insufficient supply of fuel
- Defective spray condition of fuel
- Improper selection of fuel
- There is overheating
  ✔See "S-14 Coolant temperature becomes too high (Overheating)".
- Controller is controlling in derate mode (limiting injection rate (output) because of an error in electrical system)

			Causes																
			Clogged air cleaner element	Air leakage from air intake piping	Seized turbocharger, interference of turbocharger	Defective contact of valve and valve seat	Improper valve clearance	Worn piston ring, cylinder liner	Clogged air breather hole of fuel tank cap	Leaking, clogged fuel piping	Clogged fuel filter	Stuck, seized supply pump plunger	Clogged injector, defective spray (dirt in injector)	Defective drive of injector (signal, solenoid)	Defective installation of boost pressure sensor (air leakage)	Defective boost pressure sensor, wiring harness	Clogged spill piping
Questions	Confirm recent repair history																
	Degree of use of machine	Operated for long period	△			△		△			△						
	Power was lost	Suddenly		○	◎									○	○	○	○
		Gradually	○			○		○			○		○		○		
	Non-specified fuel is being used										○	○	○				
	Replacement of filters has not been carried out according to Operation and Maintenance Manual		◎								◎						
	Engine oil must be added more frequently					○		○									
	Dust indicator is red		◎	◎													
	Air breather hole of fuel tank cap is clogged				◎				◎								
	Fuel is leaking from fuel piping									◎							
	Output becomes insufficient after short stop of operation			◎													
	Color of exhaust gas	Black			◎		◎										
		Blue under light load						◎									
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low												◎	◎			
Check items	When engine is cranked, interference sound is generated around turbocharger				◎												
	When engine is cranked, abnormal sound is generated around cylinder head						◎										
	High idle speed is too high													○			
	High idle speed under no load is normal, but speed suddenly drops when load is applied								○		◎	○	○				
	Engine does not pick up smoothly and combustion is irregular			◎	◎				○	○			◎				
	There is hunting from engine (rotation is irregular)								○	○	○		○	○			
	Blow-by gas is excessive				◎			◎									
Troubleshooting	Inspect air cleaner directly		●														
	Inspect air intake piping directly			●													
	When boost pressure is measured, it is found to be low		●	●	●												
	When compression pressure is measured, it is found to be low					●		●									
	Inspect valve clearance directly						●										
	Inspect fuel piping									●							
	Inspect fuel filter, strainer directly										●						
	Inspect spill port check valve directly																●
	Carry out troubleshooting according to "Rail Press (Very) Low Error (*1)" indicated by code											●					
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change												●	●			
	Inspect boost pressure sensor mount directly														●		
	Carry out troubleshooting according to "Chg Air Press Sensor High (Low) Error (*2)" indicated by code															●	
		Remedy	Clean	Correct	Replace	Replace	Adjust	Replace	Clean	Correct	Replace	Replace	Replace	Replace	Correct	Replace	Replace

*1: Displayed failure codes [CA559] and [CA2249]

*2: Displayed failure codes [CA122] and [CA123]

S-7 Exhaust smoke is black (incomplete combustion)

General causes why exhaust smoke is black
- Insufficient intake of air
- Defective condition of fuel injection
- Improper selection of fuel
- There is overheating
  ✔See "S-14 Coolant temperature becomes too high (Overheating)".
- Controller is controlling in derate mode (limiting injection rate (output) because of an error in electrical system)

			Causes													
			Clogged air cleaner element	Seized turbocharger, interference of turbocharger	Defective contact of valve and valve seat	Improper valve clearance	Leakage of air between turbocharger and cylinder head	Crushed, clogged muffler	Worn piston ring, cylinder liner	Stuck, seized supply pump plunger	Clogged, seized injector	Abnormally worn injector	Improper fuel injection timing	Improper fuel injection pressure	Defective coolant temperature sensor, wiring harness
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period	△		△				△		△				
	Color of exhaust gas	Suddenly became black		◎			◎			○	○	○			
		Gradually became black	◎				○				○				
		Blue under light load							◎						
	Non-specified fuel is being used									○	○				
	Oil must be added more frequently								◎						
	Power was lost	Suddenly		◎				○		○	○				
		Gradually	○		○		○		○						
Check items	Dust indicator is red		◎												
	Muffler is crushed							◎							
	Air leaks between turbocharger and cylinder head, clamp is loosened						◎								
	Engine is operated in low-temperature mode at normal temperature												○	○	○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low									○	◎				
	When engine is cranked, interference sound is generated around turbocharger		◎												
	When engine is cranked, abnormal sound is generated around cylinder head				◎										
	Pump relief speed is high (Fuel is injected excessively)										○				
	Exhaust noise is abnormal		○				◎								
	Engine does not pick up smoothly and combustion is irregular		○		○	○	○		○	◎					
	Blow-by gas is excessive							◎							
	If spill hose from injector is disconnected, abnormally much fuel spills										◎				
Troubleshooting	Inspect air cleaner directly		●												
	When turbocharger is rotated by hand, it is found to be heavy			●											
	When compression pressure is measured, it is found to be low				●				●						
	Inspect valve clearance directly					●									
	When muffler is removed, exhaust sound improves							●							
	Carry out troubleshooting according to "Rail Press (Very) Low Error (*1)" indicated by code									●		●			
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change										●				
	Carry out troubleshooting according to "Coolant Temp Sens High (Low) Error (*2)" indicated by code														●
	Check with monitoring function												●	●	
		Remedy	Clean	Replace	Replace	Adjust	Correct	Replace	Replace	Replace	Replace	Replace	Replace	Replace	Replace

*1: Displayed failure codes [CA559] and [CA2249]

*2: Displayed failure codes [CA144] and [CA145]

S-8 Oil consumption is excessive (or exhaust smoke is blue)

General causes why oil consumption is excessive
- Abnormal consumption of oil
- Long-time operation of engine at low idle or high idle (Do not run engine at idle for more than 20 minutes continuously)
- External leakage of oil
- Wear of pats in lubrication system

			Causes														
			Dust sucked in from intake system	Worn, damaged valve (stem, guide, seal)	Turbocharger: Worn seal at turbocharger end	Turbocharger: Worn seal at blower end	Clogged breather, breather hose	Broken piston ring	Worn piston ring, cylinder liner	Worn, damaged rear oil seal	Broken oil cooler	Oil leakage from oil cooler	Oil leakage from oil filter	Oil leakage from oil piping	Oil leakage from oil drain plug	Oil leakage from oil pan, cylinder head, etc.
Questions	Confirm recent repair history																
	Degree of use of machine	Operated for long period		△	△	△			△								
	Oil consumption suddenly increased							◎			○						
	Oil must be added more frequently								◎		○						
	Oil becomes contaminated quickly						○	○	◎								
Check items	Outside of engine is dirty with oil											◎	◎	◎	◎	◎
	There are loose piping clamps in intake system		◎														
	Inside of turbocharger intake outlet pipe is dirty with oil					◎											
	Inside of turbocharger exhaust outlet pipe is dirty with oil			○	◎												
	There is oil in coolant										◎						
	Oil level in damper chamber of applicable machine is high									◎							
	Exhaust smoke is blue under light load							◎	◎								
	Amount of blow-by gas	Excessive		○		○		◎	◎								
		None					◎										
Troubleshooting	When intake manifold is removed, dust is found inside		●														
	When intake manifold is removed, inside is found to be dirty abnormally			●													
	Excessive play of turbocharger shaft				●	●											
	Check breather and breather hose directly						●										
	When compression pressure is measured, it is found to be low							●	●								
	Inspect rear oil seal directly									●							
	Pressure-tightness test of oil cooler shows there is leakage										●	●					
	There is external leakage of oil from engine												●	●	●	●	
		Remedy	Correct	Correct	Replace	Replace	Clean	Replace	Replace	Correct	Replace	Replace	Correct	Correct	Correct	Correct	

S-9 Oil becomes contaminated quickly

General causes why oil becomes contaminated quickly
- Entry of exhaust gas into oil due to internal wear
- Clogging of lubrication passage
- Use of improper fuel
- Use of improper oil
- Operation under excessive load

			Causes									
			Defective seal at turbocharger turbine end	Worn valve, valve guide	Worn piston ring, cylinder liner	Clogged breather, breather hose	Clogged oil cooler	Clogged oil filter	Defective oil filter safety valve	Clogged turbocharger lubrication drain tube	Exhaust smoke is bad
Questions / Check items	Confirm recent repair history										
	Degree of use of machine	Operated for long period	△	△	△						
	Non-specified fuel is being used				○			○			
	Engine oil must be added more frequently				◎						
	Metal particles are found when oil is drained			○	○			◎			
	Inside of exhaust pipe is dirty with oil			◎							
	Engine oil temperature rises quickly						◎				
	Color of exhaust gas color	Blue under light load			◎						
		Black									◎
	Amount of blow-by gas	Excessive	○	○	◎					○	
		None				◎					
Troubleshooting	Excessive play of turbocharger shaft		●								See S-7
	When compression pressure is measured, it is found to be low			●	●						
	Check breather and breather hose directly					●					
	Inspect oil cooler directly						●				
	Inspect oil filter directly							●			
	Spring of oil filter safety valve is hitched or broken								●		
	Inspect turbocharger lubrication drain tube directly									●	
		Remedy	Replace	Replace	Replace	Clean	Clean	Replace	Replace	Clean	—

S-10 Fuel consumption is excessive

General causes why fuel consumption is excessive
- Leakage of fuel
- Defective condition of fuel injection (fuel pressure, injection timing)
- Excessive injection of fuel

			Causes									
			Fuel leakage inside head cover	Fuel leakage from fuel filter, piping, etc.	Defective feed pump oil seal	Defective supply pump plunger	Defective common rail pressure	Defective spray by injector	Defective operation of injector	Improper fuel injection timing	Defective coolant temperature sensor, wiring harness
Questions	Confirm recent repair history										
	Degree of use of machine	Operated for long period			△	△		△			
	Condition of fuel consumption	More than for other machines of same model					○		○	○	○
		Gradually increased				○		○			
		Suddenly increased	○	○							
Check items	There is external leakage of fuel from engine			◎							
	Combustion is irregular							◎			
	Engine oil level rises and oil smells of diesel fuel		◎		◎						
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low							◎			
	Low idle speed is high								○		
	Pump relief speed is high								○		
	Exhaust smoke color	Black					○	○		○	○
		White	○								
Troubleshooting	Remove and inspect head cover directly		●								
	Inspect feed pump oil seal directly				●						
	Carry out troubleshooting according to "Rail Press (Very) Low Error (*1)" indicated by code					●					
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change							●			
	If spill hose from injector is disconnected, much fuel spills								●		
	Carry out troubleshooting according to "Coolant Temp Sens High (Low) Error (*2)" indicated by code										●
	Check with monitoring function						●			●	
		Remedy	Correct	Correct	Replace	Replace	Correct	Replace	Replace	Replace	Replace

*1: Displayed failure codes [CA559] and [CA2249]

*2: Displayed failure codes [CA144] and [CA145]

S-11 Oil is in coolant (or coolant spurts back or coolant level goes down)

General causes why oil is in coolant
- Internal leakage in lubrication system
- Internal leakage in cooling system

			Causes				
			Broken cylinder head, head gasket	Internal cracks in cylinder block	Holes caused by pitting	Broken oil cooler core, O-ring	Broken hydraulic oil cooler on applicable machine side
Questions	Confirm recent repair history						
	Degree of use of machine	Operated for long period			△	△	
	Oil level	Suddenly increased	○			○	○
		Gradually increased		○	○		
	Hard water is being used as coolant				○	○	
	Oil level has risen, oil is milky			○	○	◎	
Check items	There are excessive air bubbles in radiator, coolant spurts back		◎				
	Hydraulic oil on applicable machine side is milky						◎
	When hydraulic oil on applicable machine side is drained, water is found						◎

Trouble-shooting	Pressure-tightness test of cylinder head shows there is leakage		●				Carry out troubleshooting on applicable machine side
	Inspect cylinder block, liner directly			●	●		
	Pressure-tightness test of oil cooler shows there is leakage					●	
		Remedy	Replace	Replace	Replace	Replace	—

S-12 Oil pressure drops

General causes why oil pressure drops
- Leakage, clogging, wear of lubrication system
- Defective oil pressure control
- Improper selection of fuel (improper viscosity)
- Deterioration of oil due to overheating

			Causes									
			Worn journal of bearing	Lack of oil in oil pan	Coolant, fuel in oil	Clogged strainer in oil pan	Clogged, broken pipe in oil pan	Defective oil pump	Defective regulator valve	Clogged oil filter	Leaking, crushed, clogged hydraulic piping	Defective oil level sensor, wiring harness
Questions	Confirm recent repair history											
	Degree of use of machine	Operated for long period	△					△		△		
	Oil pressure monitor indicates low oil pressure								○	◎		
	Non-specified oil is being used		○							○		
	Replacement of filters has not been carried out according to Operation and Maintenance Manual									◎		
Check items	Oil pressure monitor (if installed)	Indicates pressure drop at low idle	◎									
		Indicates pressure drop at low, high idle		○		◎	◎	◎	○			
		Indicates pressure drop on slopes		◎								
		Sometimes indicates pressure drop							◎			○
	Oil level monitor indicates oil level drop			◎								◎
	Oil level in oil pan is low			◎								
	External hydraulic piping is leaking, crushed										◎	
	Oil is milky or smells of diesel oil				◎							
	Metal particles are found when oil pan is drained		◎									
	Metal particles are found when oil filter is drained		◎					○				
Troubleshooting	Metal particles are found in oil filter		●		See S-13							
	Inspect oil pan strainer, pipe directly					●	●					
	Oil pump rotation is heavy, there is play in oil pump							●				
	Valve spring of regulator valve is fatigued, damaged								●			
	Inspect oil filter directly									●		
	If oil level sensor is replaced, oil pressure monitor indicates normally											●
		Remedy	Clean	Add	—	Clean	Clean	Replace	Adjust	Clean	Correct	Replace

S-13 Oil level rises (Entry of coolant/fuel)

General causes why oil level rises
- Coolant in oil (milky)
- Fuel in oil (smells diluted diesel fuel)
- If oil is in coolant, carry out troubleshooting for "S-11 Oil is in coolant"

			Causes							
			Broken cylinder head, head gasket	Broken injector O-ring	Cracks inside cylinder block	Holes caused by pitting	Worn, damaged rear oil seal	Broken oil cooler core, O-ring	Defects in supply pump	Defective seal of auxiliary equipment (pump, compressor)
Questions	Confirm recent repair history									
	Degree of use of machine	Operated for long period		△		△	△			△
	Fuel must be added more frequently			◎					◎	
	Coolant must be added more frequently		○		○					
Check items	There is oil in coolant		○	○	○	○		◎		
	Oil smells of diesel fuel			◎					◎	
	Oil is milky		○			○				
	When engine is started, drops of water come from muffler		○							
	When radiator cap is removed and engine is run at low idle, an abnormal number of bubbles appear, or coolant spurts back		◎			○				
	Exhaust smoke is white			○						
	Oil level in damper chamber of applicable machine is low						◎			
	Oil level in hydraulic tank of applicable machine is low									◎
Troubleshooting	When compression pressure is measured, it is found to be low		●							
	Remove injector and inspect O-ring			●						
	Inspect cylinder block, liner directly				●	●				
	Inspect rear oil seal directly						●			
	Pressure-tightness test of oil cooler shows there is leakage							●		
	Remove and inspect supply pump directly								●	
	Inspect seal of auxiliary equipment directly									●
		Remedy	Replace	Correct	Replace	Replace	Correct	Replace	Replace	Replace

S-14 Coolant temperature becomes too high (overheating)

General causes why coolant temperature becomes too high
- Lack of cooling air (deformation, damage of fan)
- Drop in heat dissipation efficiency
- Problem in coolant circulation system
- Rise in oil temperature in power train

✔Carry out troubleshooting for machine

			Causes											
			Broken cylinder head, head gasket	Holes caused by pitting	Clogged, broken oil cooler	Lack of coolant	Broken water pump	Defective operation of thermostat	Clogged, crushed radiator fins	Clogged radiator core	Defective radiator cap (pressure valve)	Slipping fan belt, worn fan pulley	Defective coolant temperature gauge	Rise of hydraulic oil temperature on applicable machine side
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period	△	△					△	△				
	Condition of overheating	Sudden overheated				○	◎					○		
		Always tends to overheat						○	◎	◎		○		
	Coolant temperature gauge (if installed)	Rises quickly				○		◎						
		Does not go down from red range											◎	
Check items	Radiator coolant level monitor indicates drop of coolant level (if monitor is installed)					◎								
	Engine oil level has risen and oil is milky			◎	○									
	Fan belt tension is low											◎		
	When fan belt is turned, it has play						◎							
	Milky oil is floating on coolant				◎									
	There are excessive air bubbles in radiator, coolant spurts back		◎											
	When light bulb is held behind radiator core, no light passes through								◎					
	Radiator shroud, inside of underguard on applicable machine side are clogged with dirt or mud								◎			◎		
	Coolant is leaking because of cracks in hose or loose clamps					◎								
	Coolant flows out from radiator overflow hose										◎			
	Fan belt whines under sudden acceleration											◎		
	Hydraulic oil temperature enters red range faster than engine coolant temperature													◎
Troubleshooting	When compression pressure is measured, it is found to be low		●											Carry out troubleshooting on applicable machine side
	Inspect cylinder liner directly			●										
	Inspect oil cooler directly				●									
	Temperature difference between upper and lower tanks of radiator is large						●							
	When operation of thermostat is carried out, it does not open at cracking temperature							●						
	Temperature difference between upper and lower tanks of radiator is slight								●					
	Inspect radiator core directly									●				
	When operation of radiator cap is carried out, its cracking pressure is low										●			
	Inspect fan belt, pulley directly											●		
	When coolant temperature is measured, it is fount to be normal												●	
		Remedy	Replace	Replace	Replace	Add	Replace	Replace	Correct	Correct	Replace	Correct	Replace	—

S-15 Abnormal noise is made

General causes why abnormal noise is made
- Abnormality due to defective parts
- Abnormal combustion
- Air sucked in from intake system
- Judge if the noise is an internal noise or an external noise before starting troubleshooting.
- The engine is operated in the low-temperature mode while it is not warmed up sufficiently. Accordingly, the engine sound becomes a little larger. This does not indicate abnormality, however.
- When the engine is accelerated, it is operated in the acceleration mode and its sound becomes a little larger for up to about 3 seconds. This does not indicate abnormality, however.

			Causes												
			Leakage of air between turbocharger and cylinder head	Interference of turbocharger, seized turbocharger	Broken dynamic valve system (valve, rocker lever)	Defective inside of muffler (dividing board out of position)	Improper valve clearance	Excessive wear of piston ring, cylinder liner	Improper gear train backlash	Removed, seized bushing	Deformed cooling fan, loose fan belt, interference of fan belt	Clogged, seized injector	Dirt caught in injector	Improper fuel injection timing (abnormality in coolant low temperature sensor, boost temperature sensor)
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period						△						
	Condition of abnormal noise	Gradually occurred						○			○			
		Sudden occurred		○	○					○				
	Non-specified fuel is being used											○		
	Oil must be added more frequently							◎						
Check items	Metal particles are found when oil filter is drained							◎		◎				
	Air leaks between turbocharger and cylinder head		◎											
	When engine is cranked, interference sound is generated around turbocharger			◎										
	When engine is cranked, abnormal sound is generated around cylinder head				◎		◎							
	When engine is cranked, beat noise is generated around muffler					◎								
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											◎	○	
	Color of exhaust gas	Blue under light load						◎						
		Black	○	◎			○							
	Engine does not pick up smoothly and combustion is irregular											◎		
	Abnormal noise is loud when engine is accelerated						○		○		○	○		
	Blow-by gas is excessive							◎						
Troubleshooting	When turbocharger is rotated by hand, it is fount to be heavy			●										
	Inspect dynamic valve system directly				●									
	When muffler is removed, abnormal noise disappears					●								
	Inspect valve clearance directly						●							
	When compression pressure is measured, it is found to be low							●						
	Inspect gear train directly								●	●				
	Inspect fan and fan belt directly										●			
	When a cylinder is cut out for reduced cylinder mode operation, engine speed does not change											●	●	
	Abnormal noise is heard only when engine is started												●	
	Confirm with INSITE or monitoring function on applicable machine side													●
		Remedy	Replace	Replace	Correct	Replace	Replace	Replace	Replace	Replace	Correct	Replace	Replace	Replace

S-16 Vibration is excessive

General causes why vibration is excessive
- Defective parts (abnormal wear, breakage)
- Misalignment between engine and chassis
- Abnormal combustion
- If abnormal noise is made and vibration is excessive, carry out trouble-shooting for "S-15 Abnormal noise is made", too.

			Causes								
			Stuck dynamic valve system (valve, rocker lever)	Worn main bearing, connecting rod bearing	Improper gear train backlash	Worn camshaft bushing	Improper injection timing (Abnormality in coolant temperature sensor, boost temperature sensor)	Loose engine mounting bolts, broken cushions	Misalignment between engine and devices on applicable machine side	Broken output shaft, parts in damper on applicable machine side
Questions / Check items	Confirm recent repair history									
	Degree of use of machine	Operated for long period		△		△		△		
	Condition of vibration	Suddenly increased	○							○
		Gradually increased		○		○		○		
	Non-specified oil is being used			○		○				
	Metal particles are found when oil filter is drained			◎		◎				
	Metal particles are found when oil pan is drained			◎		◎				
	Oil pressure is low at low idle			○		○				
	Vibration occurs at mid-range speed							○		○
	Vibration follows engine speed				○			○	○	○
	Exhaust smoke is black		◎				○			
Troubleshooting	Inspect dynamic valve system directly		●							
	Inspect main bearing and connecting rod bearing directly			●						
	Inspect gear train directly				●					
	Inspect camshaft bushing directly					●				
	Check with monitoring function						●			
	Inspect engine mounting bolts and cushions directly							●		
	When alignment is checked, radial runout or facial runout is detected								●	
	Inspect inside of damper directly									●
		Remedy	Replace	Replace	Replace	Replace	Replace	Replace	Adjust	Replace

30 DISASSEMBLY AND ASSEMBLY

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HOW TO READ THIS MANUAL

REMOVAL AND INSTALLATION OF ASSEMBLIES

SPECIAL TOOLS

- Special tools that are deemed necessary for removal or installation of parts are listed.
- List of the special tools contains the following kind of information.
  1) Necessity
     ■: Special tools which cannot be substituted, should always be used.
     ●: Special tools which are very useful if available, can be substituted with commercially available tools.
  2) Distinction of new and existing special tools
     N: Tools with new part numbers, newly developed for this model.
     R: Tools with upgraded part numbers, remodeled from already available tools for other models.

  Blank: Tools already available for other models, used without any modification.
  3) Circle mark (O) in sketch column:
     A circle mark means that a sketch of the special tool is presented in the section of Sketches for Special Tools.

★ Part No. of special tools starting with 79*T means that they are locally made parts and as such not interchangeable with those made by Komatsu in Japan e.g. 79*T--- xxx --- xxxx.

REMOVAL OF PARTS

- The REMOVAL Section contains procedures, precautions and the amount of oil or water to be drained.
- Various symbols used in the REMOVAL Section are explained and listed below.

 This mark indicates safety-related precautions which must be followed when doing the work.

★ This mark gives guidance or precautions when doing the procedure.

 This mark shows that there are instructions or precautions for installing parts.

 This mark shows oil or water to be drained.

INSTALLATION OF PARTS

- Except where otherwise instructed, install parts is the reverse order of removal.
- Instructions and precautions for installing parts are shown with  mark in the INSTALLATION Section, identifying which step the instructions are intended for.
- Marks shown in the INSTALLATION Section stand for the following.

 This mark indicates safety-related precautions which must be followed when doing the work.

★ This mark gives guidance or precautions when doing the procedure.

 This mark stands for a specific coating agent to be used.

 This mark indicates the specified torque.

 This mark indicates an amount of oil or water to be added.

SKETCHES OF SPECIAL TOOLS

- Various special tools are illustrated for the convenience of local manufacture.

DISASSEMBLY AND ASSEMBLY OF ASSEMBLIES

SPECIAL TOOLS

- Special tools which are deemed necessary for disassembly and assembly are listed in this section.
- List of the special tools contains the following kind of information.
  1) Necessity
     ■: Special tools which cannot be substituted, should always be used.
     ●: Special tools which are very useful if available, can be substituted with commercially available tools.
  2) Distinction of new and existing special tools
     N: Tools with new part numbers, newly developed for this model.
     R: Tools with upgraded part numbers, remodeled from already available tools for other models.

  Blank: Tools already available for other models, used without any modification.
  3) Circle mark (○) in sketch column:
     A circle mark means that a sketch of the special tool is presented in the section of Sketches for Special Tools.
  4) Part No. of special tools starting with 79*T means that they are locally made parts and as such not interchangeable with those made by Komatsu in Japan e.g. 79*T--- xxx --- xxxx.

DISASSEMBLY

- The DISASSEMBLY Section contains procedures, precautions and the amount of oil or water to be drained.
- Various symbols used in the DISASSEMBLY Section are explained and listed below.

 This mark indicates safety-related precautions which must be followed when doing the work.

★ This mark gives guidance or precautions when doing the procedure.

 This mark shows that there are instructions or precautions for installing parts.

 This mark shows oil or water to be drained.

ASSEMBLY

- Section titled ASSEMBLY contain procedures, precautions and the know-how for the work, as well as the amount of oil or water to be added.
- Various symbols used in the ASSEMBLY Section are explained and listed below.

 This mark indicates safety-related precautions which must be followed when doing the work.

★ This mark gives guidance or precautions when doing the procedure.

 This mark stands for a specific coating agent to be used.

 This mark indicates the specified torque.

 This mark indicates an amount of oil or water to be added.

SKETCHES OF SPECIAL TOOLS

1) Various special tools are illustrated for the convenience of local manufacture.

Coating materials list

- The recommended coating materials such as adhesives, gasket sealants, and greases used for disassembly and assembly are listed below.
- For coating materials not listed below, use the equivalent of products shown in this manual.

Category	Komatsu code	Part number	Q'ty	Container	Main features and applications
Adhesive	LT-1A	790-129-9030	150 g	Tube	• Used to prevent rubber gaskets, rubber cushions, and cork plugs from coming out.
	LT-1B	790-129-9050	20 g (2 pcs.)	Polyethylene container	• Used for plastic (except polyethylene, polypropylene, tetrafluoroethylene and vinyl chloride), rubber, metal, and non-metal parts which require immediate and strong adhesion.
	LT-2	09940-00030	50 g	Polyethylene container	• Features: Resistance to heat and chemicals. • Used to fix and seal bolts and plugs.
	LT-3	790-129-9060 (Set of adhesive and hardener)	Adhesive: 1 kg Hardener: 500 g	Can	• Used to stick and seal metal, glass, and plastics.
	LT-4	790-129-9040	250 g	Polyethylene container	• Used to seal plugs.
	Holtz MH 705	790-129-9120	75 g	Tube	• Heat-resistant seal used to repair engines.
	ThreeBond 1735	790-129-9140	50 g	Polyethylene container	• Quick-setting adhesive. • Setting time: Within 5 sec. to 3 min. • Used mainly to stick metals, rubbers, plastics, and woods.
	Aron-alpha 201	790-129-9130	2 g	Polyethylene container	• Quick-setting adhesive. • Quick-setting type. (max. strength is obtained after 30 minutes) • Used mainly to stick rubbers, plastics, and metals.
	Loctite 648-50	79A-129-9110	50 cc	Polyethylene container	• Features: Resistance to heat and chemicals. • Used for fitted portions used at high temperatures.
Gasket sealant	LG-1	790-129-9010	200 g	Tube	• Used to stick or seal gaskets and packing of power train case, etc.
	LG-5	790-129-9080	1 kg	Polyethylene container	• Used to seal various threaded portions, pipe joints, and flanges. • Used to seal tapered plugs, elbows, and nipples of hydraulic piping.
	LG-6	790-129-9020	200 g	Tube	• Features: Silicon-based heat and cold-resistant sealant. • Used to seal flange surfaces and threaded portions. • Used to seal oil pan, final drive case, etc.
	LG-7	790-129-9070	1 kg	Tube	• Features: Silicon-based quick-setting sealant. • Used to seal flywheel housing, intake manifold, oil pan, thermostat housing, etc.
	ThreeBond 1211	790-129-9090	100 g	Tube	• Gasket sealant used to repair engine.
	ThreeBond 1207B	419-15-18131	100 g	Tube	• Features: Silicon-based, heat and cold-resistant, vibration-resistant, impact-resistant sealant. • Used to seal transfer case, etc.

Category	Komatsu code	Part number	Q'ty	Container	Main features and applications
Molybdenum disulfide lubricant	LM-G	09940-00051	60 g	Can	• Used to lubricate sliding portions. (to prevent squeaking)
	LM-P	09940-00040	200 g	Tube	• Used to prevent scuffing and seizure of press-fitted portions, shrink-fitted portions, and threaded portions. • Used to lubricate linkages, bearings, etc.
Grease	G2-LI	SYG2-400LI SYG2-350LI SYG2-400LI-A SYG2-160LI SYGA-160CNLI	Various	Various	• General purpose type.
	G2-CA	SYG2-400CA SYG2-350CA SYG2-400CA-A SYG2-160CA SYGA-160CNCA	Various	Various	• Used for bearings used at normal temperature under light load in contact with water or steam.
	Molybdenum disulfide grease LM-G (G2-M)	SYG2-400M SYG2-400M-A SYGA-16CNM	400 g x 10 400 g x 20 16 kg	Bellows-type container Can	• Used for parts under heavy load.
	Hyper White Grease G2-T, G0-T (*) *: For cold district	SYG2-400T-A SYG2-16CNT SYG0-400T-A (*) SYG0-16CNT (*)	400 g 16 kg	Bellows-type container Can	• Seizure resistance and heat resistance higher than molybdenum disulfide grease. • Not conspicuous on machine since color is white.
	Bio-grease G2-B, G2-BT (*) *: For use at high temperature and under high load	SYG2-400B SYGA-16CNB SYG2-400BT (*) SYGA-16CNBT (*)	400 g 16 kg	Bellows-type container Can	• Since this grease is decomposed by natural bacteria in short period, it has less effects on micro-organisms, animals, and plants.
Primer	SUNSTAR PAINT PRIMER 580 SUPER	417-926-3910	20 ml	Glass container	Adhesive for cab glass: • Used as primer for cab side. (Using limit: 4 months after date of manufacture)
	SUNSTAR GLASS PRIMER 580 SUPER		20 ml	Glass container	Adhesive for cab glass: • Used as primer for glass side. (Using limit: 4 months after date of manufacture)
	SUNSTAR PAINT PRIMER 435-95	22M-54-27230	20 ml	Glass container	Adhesive for cab glass: • Used as primer for painted surface on cab side. (Using limit: 4 months after date of manufacture)
	SUNSTAR GLASS PRIMER 435-41	22M-54-27240	150 ml	Can	Adhesive for cab glass: • Used as primer for black ceramic-coated surface on glass side and for hard polycarbonate-coated surface. (Using limit: 4 months after date of manufacture)
	SUNSTAR SASH PRIMER GP-402	22M-54-27250	20 ml	Glass container	Adhesive for cab glass: • Used as primer for sash (Almite). (Using limit: 4 months after date of manufacture)

Cate-gory	Komatsu code	Part number	Q'ty	Container	Main features and applications	
Adhesive	SUNSTAR PENGUINE SEAL 580 SUPER "S" or "W"	417-926-3910	320 ml	Polyethylene container	Adhesive for cab glass	• "S" is used for high-temperature season and "W" for low-temperature season as adhesive for glass. (Using limit: 4 months after date of manufacture)
	Sika Japan, Sikaflex 256HV	20Y-54-39850	310 ml	Polyethylene container		• Used as adhesive for glass. (Using limit: 6 months after date of manufacture)
	SUNSTAR PENGUINE SUPER 560	22M-54-27210	320 ml	Ecocart (Special container)		• Used as adhesive for glass. (Using limit: 6 months after date of manufacture)
Caulking material	SUNSTAR PENGUINE SEAL No. 2505	417-926-3920	320 ml	Polyethylene container		• Used to seal joints of glass parts. (Using limit: 4 months after date of manufacture)
	SEKISUI SILICONE SEALANT	20Y-54-55130	333 ml	Polyethylene container		• Used to seal front window. (Using limit: 6 months after date of manufacture)
	GE TOSHIBA SILICONES TOSSEAL 381	22M-54-27220	333 ml	Cartridge		• Used to seal joint of glasses. Translucent white seal. (Using limit: 12 months after date of manufacture)

Special tools list

Component	Symbol		Part number	Part name	Nature of work, remarks
Engine front seal	A	1	795-799-6400	Seal puller	Installation of engine front seal
Engine rear seal		2	795-799-6500	Seal puller	Installation of engine rear seal
Cylinder head assembly, fuel injector assembly		3	795-799-6700	Primer	Removal of fuel injector
		4	795-799-1131	Gear	Positioning with 3RD and 4TH cylinder Top
		5	795-799-8150	Remover	Removal of inlet connector
Cylinder head assembly		6	790-331-1120	Wrench (Angle)	Angle tightening of bolt
		7	795-790-4510	Gauge	Judgment of cylinder head bolt length
Engine and hydraulic pump assembly		8	796T-401-1110	Plate	Removal and installation of engine and hydraulic pump assembly
		9	795-790-9300	Lifting tool	
Hydraulic pump assembly, Engine and hydraulic pump assembly, Control valve assembly, Center swivel joint assembly		10	796-460-1210	Oil stopper	Stopping oil
		11	796-770-1320	Adaptor	
Swing motor and swing machinery assembly	E	1	796T-626-1110	Push tool	Press fitting of bearing
		3	790-201-2480	Push tool	Press fitting of bearing
		4	790-101-5401	Push tool kit	Press fitting of oil seal
			790-101-5521	• Plate	
			790-101-5421	• Grip	
			01010-51240	• Bolt	
		5	793T-815-1110	Push tool	Press fitting of bearing
Center swivel joint assembly	L		790-101-2501	Push puller	Disassembly and assembly of center swivel joint assembly
			790-101-2510	• Block	
			790-101-2520	• Screw	
			791-112-1180	• Nut	
			790-101-2540	• Washer	
			790-101-2630	• Leg	
			790-101-2570	• Plate	
			790-101-2560	• Nut	
			790-101-2650	• Adapter	

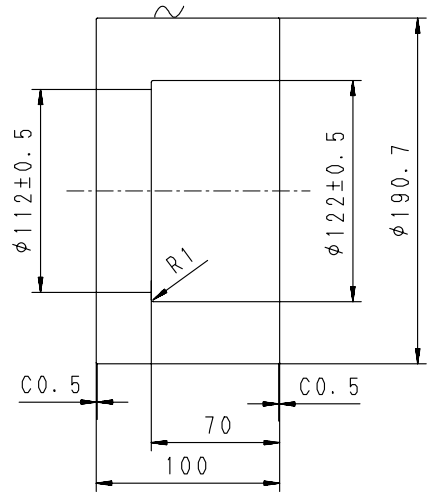
Component	Symbol		Part number	Part name	Nature of work, remarks
Control valve assembly	M	1	796-946-1310	Guide	Replacement of pressure compensation valve seal
			(For 723-46-40100, 723-46-40601)		
			796-946-1810	Guide	
			(For 723-46-43100, 723-46-43400)		
			796-946-2110	Guide	
			(For 723-46-44100)		
			796-946-2210	Guide	
			(For 723-46-45100)		
		2	796-946-1320	Guide	
			(For 723-46-40100, 723-46-40601)		
			796-946-1820	Guide	
			(For 723-46-43100, 723-46-43400)		
			796-946-2120	Guide	
			(For 723-46-44100)		
			796-946-2220	Guide	
			(For 723-46-45100)		
			796-946-1420	Guide	
			(For 723-46-42800)		
		3	796-946-1330	Sleeve	
			(For 723-46-40100, 723-46-40601)		
			796-946-1830	Sleeve	
			(For 723-46-43100, 723-46-43400)		
			796-946-2130	Sleeve	
			(For 723-46-44100)		
			796-946-2230	Sleeve	
			(For 723-46-45100)		
			796-946-1430	Sleeve	
			(For 723-46-42800)		

Component	Symbol		Part number	Part name	Nature of work, remarks
Hydraulic cylinder assembly	N	1	790-502-1003	Cylinder repair stand	Disassembly and assembly of hydraulic cylinder assembly
		2	790-102-4300	Wrench assembly	Removal and installation of piston assembly
			790-102-4310	Pin	
		3	790-720-1000	Expander	Installation of bearing
		4	796-720-1680	Ring	
			07281-01589	Clamp	
		5	790-201-1702	Push tool kit	Press fitting of bushing
			790-201-1851	Push tool (for bucket and boom)	
			790-201-1861	Push tool (for arm)	
			790-101-5021	Grip	
			01010-50816	Bolt	
		6	790-201-1500	Push tool kit	Press fitting of dust seal
			790-101-5021	Grip	
			01010-50816	Bolt	
			790-201-1660	Push tool (for boom and bucket)	
			790-201-1670	Plate (for arm)	Removal of foot pin
Work equipment assembly	P		796-670-1100	Remover	
			796-670-1110	• Sleeve	
			796-670-1120	• Plate	
			796-670-1130	• Screw	
			791-775-1150	• Adapter	
			01643-33080	• Washer	
			01803-13034	• Nut	
			790-101-4000	Puller (490 kN {50 t} long)	
			790-101-1102	Pump (294 kN {30 t})	
Air conditioner assembly	Q		799-703-1200	Service tool kit	Refilling of gas for air conditioner
			799-703-1100	Vacuum pump (100 V)	
			799-703-1111	Vacuum pump (220 V)	
			799-703-1121	Vacuum pump (240 V)	
			799-703-1401	Gas leak detector	
Operator's cab glass	Y	1	793-498-1210	Lifter (Suction cup)	Removal and installation of operator's cab glass
		2	20Y-54-13180	Adapter	

Sketches of special tools

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

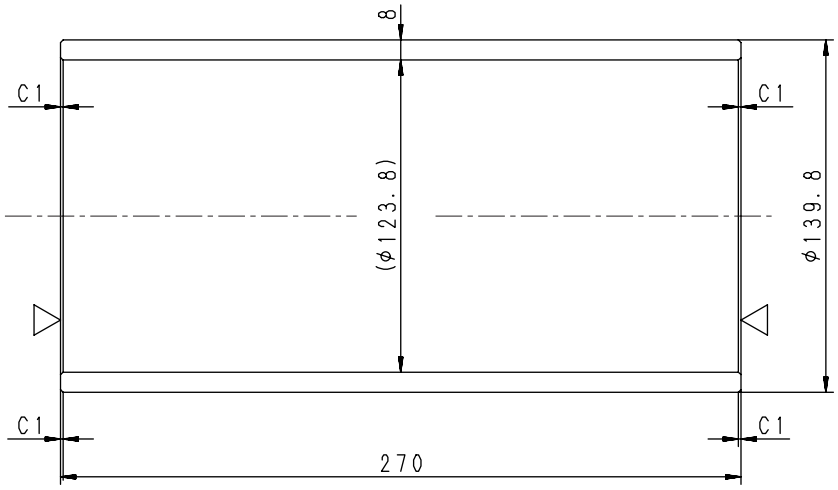
E1 push tool



CDP00506

HEAT TREATMENT	MATERIAL
----	STKM13A
PART NAME	Q'TY
PUSH TOOL	1
796T-626-1110 △	

E5 push tool



CWW03075

HEAT TREATMENT	MATERIAL
----	STKM13A
PART NAME	QTY
PUSH TOOL	----
793T-815-1110 △	

LIST OF TOOLS

Part Number	Part Name	Area Used on Machine
799-203-8001	Multi Tachometer	Setting of engine revs
799-201-2202	Boost Gauge Kit	Air boost pressure
799-101-5210	Fitting (PT 1/4)	Air boost pressure
799-201-9000	Handy Smoke Checker	Measurement of exhaust colour
795-799-1131	Gear	Adjustment of valve clearance
795-799-1900	Pin Assembly	Adjustment of valve clearance
799-201-1504	Blow By Kit	Measurement of blow by
795-790-1950	Tool (Nozzle)	Measurement of blow by
795-799-1131	Gear	Adjustment of fuel injection timing
795-799-1900	Pin Assembly	Adjustment of fuel injection timing
795-799-1950	Lock Pin	Adjustment of fuel injection timing
799-101-5002	Hydraulic Tester	Measurement of engine oil pressure
790-261-1203	Digital Type Hydraulic Tester	Measurement of engine oil pressure
799-401-2320	Hydraulic Tester	Measurement of engine oil pressure
673-281-3170	Joint	Measurement of engine oil pressure
621-581-9710	O-Ring	Measurement of engine oil pressure
796-627-1130	Wear Gauge	Inspection of wear on the sprocket
799-101-5220	Nipple (10 x 1.25mm)	Hydraulic testing
799-101-1340	Differential Pressure Gauge	Hydraulic testing
799-401-2910	Nipple (Size 02)	Solenoid valve output
799-401-2920	Nipple (Size 03)	Measurement of solenoid valve output
795-502-1205	Compression Gauge	Cylinder compression
795-502-1700	Adapter	Cylinder compression

PRECAUTIONS WHEN PERFORMING OPERATION

Be sure to follow the general precautions given below when performing removal or installation (disassembly or assembly) of units.

1. Precautions when performing removal work

- If the engine coolant water contains antifreeze, dispose of it correctly.
- After disconnecting hoses or tubes, cover them or install blind plugs to prevent dirt or dust from entering.
- When draining oil, prepare a container of adequate size to catch the oil.
- Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
- To avoid loosening any wire contacts, do not pull on the wires. In-order to prevent excessive force to the wiring, hold onto the connectors when disconnecting them.
- Fasten tags to wires and hoses to identify and show their installation position and help prevent any mistakes when re-installing.
- Count and check the number and thickness of the shims, and keep them in a safe place.
- When raising or lifting components, be sure to use proper lifting equipment of ample strength and safety.
- When using forcing screws to remove any components, tighten the forcing screws uniformly in turn.
- Before removing any unit, clean the surrounding area and install a cover to prevent any dust or dirt from entering after removal.

★ **Precautions when handling piping during disassembling**

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

A. Hoses and tubes using sleeve nuts

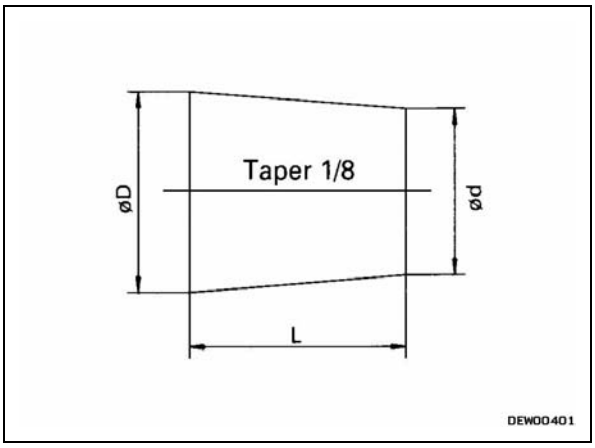
Nominal number	Plug (nut end)	Sleeve nut (elbow end) Use the two items below as a set
02	07376-50210	07221-20210 (Nut), 07222-00210 (Plug)
03	07376-50315	07221-20315 (Nut), 07222-00312 (Plug)
04	07376-50422	07221-20422 (Nut), 07222-00414 (Plug)
05	07376-50522	07221-20522 (Nut), 07222-00515 (Plug)
06	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)

B. Split flange type hoses and tubes

Nominal number	Flange (hose end)	Sleeve head (tube end)	Split flange
04	07379-00400	07378-10400	07371-30400
05	07379-00500	07378-10500	07371-30500

C. If the part is not under hydraulic pressure, the following corks can be used:

Nominal number	Part Number	Dimensions		
		D	d	L
06	07049-00608	6	5	8
08	07049-00811	8	6.5	11
10	07049-01012	10	8.5	12
12	07049-01215	12	10	15
14	07049-01418	14	11.5	18
16	07049-01620	16	13.5	20
18	07049-01822	18	15	22
20	07049-02025	20	17	25
22	07049-02228	22	18.5	28
24	07049-02430	24	20	30
27	07049-02734	27	22.5	34



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 pin or lock plate securely.
   - When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with two or three drops of adhesive.
   - When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
   - Clean all parts, and correct any damage, dents, burrs, or rust.
   - Coat rotating parts and sliding parts with engine oil.
   - When press-fitting parts, coat the surface with anti-friction compound (LM-P).
   - After installing snap rings, check that the snap ring is installed securely in the ring groove.
   - When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
   - When using eye bolts, 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, bleed the air as follows:

1) Start the engine and run it at low idle.
2) Operate the work equipment control lever to operate the hydraulic cylinders, 4 - 5 times, stopping the cylinders 100 mm from the end of their stroke.
3) Next operate the hydraulic cylinder 3 - 4 times to the end of its stroke.
4) After doing this run the engine at normal speed.

★ When using the machine for the first time after repair or long storage, follow the same procedure.

3. Precautions when completing the operations
   - If the engine coolant water has been drained, tighten the drain valve, and add coolant water to the specified level. Run the engine to circulate the coolant water through the system. Then check the coolant water level again.
   - If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
   - If the piping or hydraulic equipment, have been removed for repair, Bleed the air from the system after reassembling the parts.

   ★ For details, see TESTING AND ADJUSTING, Bleeding air.

   - Add the specified amount of grease (molybdenum disulphide grease) to the work equipment related parts.

Removal and installation of fuel supply pump assembly

Removal

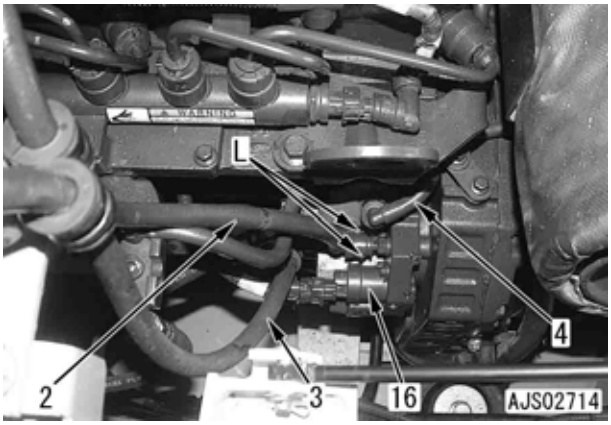
⚠ WARNING

Disconnect the negative terminal (–) of the battery before starting with the work.

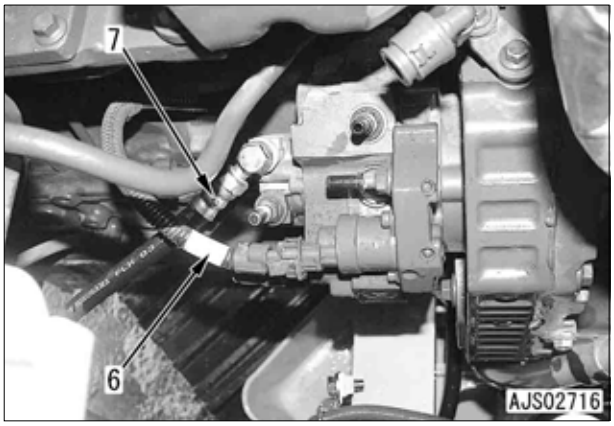
1. Turn the upper structure by 90 degrees.
2. Close the fuel stop valve.
3. Remove cover (1).



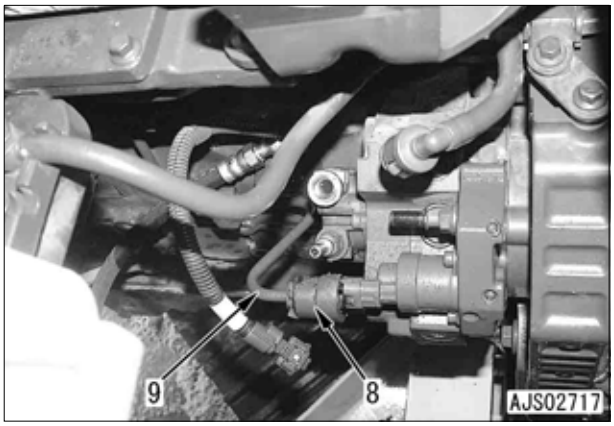
4. Open the engine hood.
5. Disconnect fuel filter hoses (2) and (3) from fuel supply pump (16).
   - ✕ Remove dirt on the connector in advance. (Because dirt sometimes makes lock (L) fit tight.)
   - ✕ Pull out the hose while pushing lock (L) from both sides.
   - ✕ When disconnecting the hoses, oil will flow out. Stop the flow by inserting plugs into the mouthpieces.
   - ✕ Wooden plugs should not be used because wood chips may get into the fuel line.
6. Disconnect fuel return hose (4).



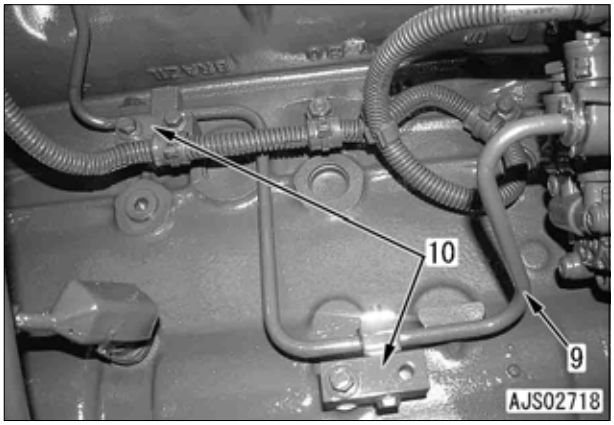
7. Disconnect connector CP3 (6).
8. Disconnect fuel supply hose (7).



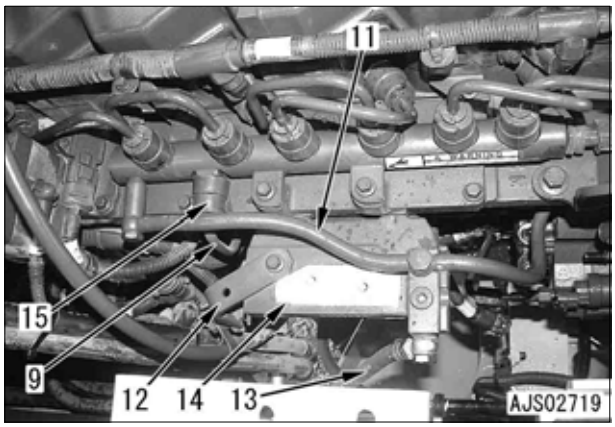
9. Remove bellows (8). [*1]
10. Disconnect high-pressure pipe (9). [*1]



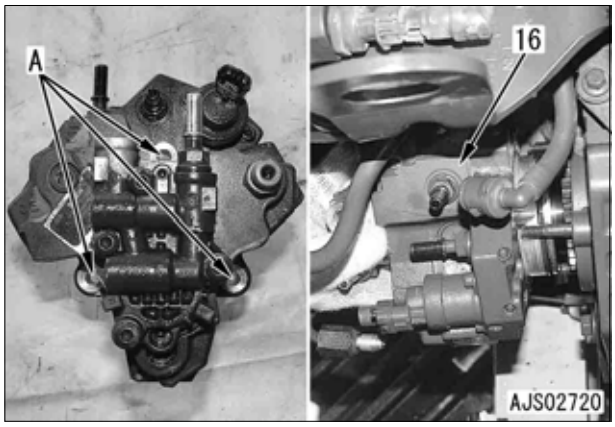
11. Disconnect two tube clamps (10). [*1]



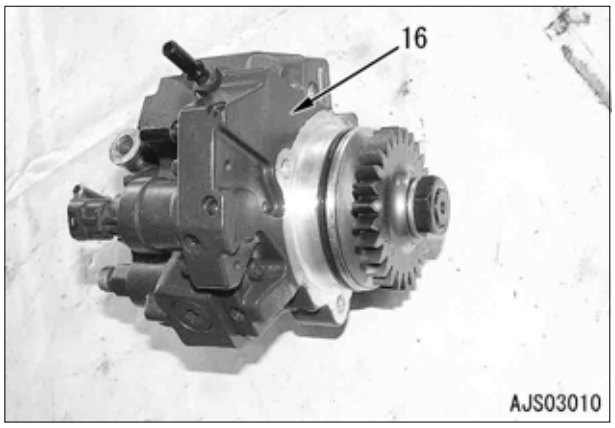
12. Disconnect fuel return tube (11). [*2]
13. Disconnect bracket (12).
14. Disconnect fuel return hose (13).
15. Remove fuel block (14). [*3]
16. Remove bellows (15).
17. Disconnect tube (9). [*1]



18. Remove three nuts (A parts) and remove fuel injection pump assembly (16). [*4]



- Fuel injection pump assembly (16) comes off in one piece with the gear. No treatment (tooth thinning etc.) has been given to the gear teeth for aligning the 1st and 6th cylinder tops.



Installation

- Installation is done in the reverse order of removal.
- Figure: Refer to **Removal**.

[*1]

- How to install high-pressure pipe (9)

1. Tighten the sleeve nuts by hand. (both sides)
2. Tighten the sleeve nuts in the order of firstly the pump side, then the common rail side.

N·m Sleeve nut:
35 ± 3.5 Nm {3.57 ± 0.36 kgm}

3. Install two tube clamps (10)
   .

N·m Clamp mounting bolt:
24 ± 4 Nm {2.45 ± 0.41 kgm}

4. Install bellows (8) and (15).
   - Set the slits of each bellows out and down.
   - The bellows are installed so that fuel will not spout over the hot parts of the engine and catch fire when it leaks for some reason.

[*2]

N·m Fuel return tube (11) mounting bolt:
24 ± 4 Nm {2.45 ± 0.41 kgm}

[*3]

N·m Fuel block mounting bolt:
32 ± 4 Nm {3.26 ± 0.41 kgm}

[*4]

N·m Fuel supply pump mounting nut:
24 ± 4 Nm {2.45 ± 0.41 kgm}

- **Air bleeding**
  Bleed air from the fuel injection system.
- Refer to the Testing and adjustment chapter.

Removal and installation of fuel injector assembly

Special tools

Symbol		Part number	Part name
A	3	795-799-6700	Primer
	4	795-799-1131	Gear
	5	795-799-8150	Remover

Removal

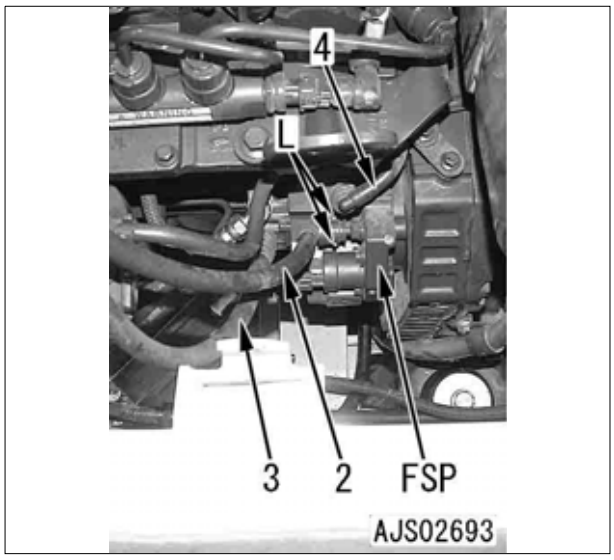
⚠ WARNING

Disconnect the negative terminal (–) of the battery before starting with the work.

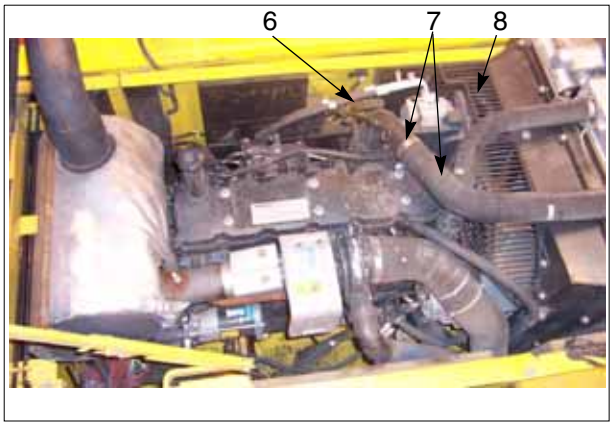
1. Remove cover (1).

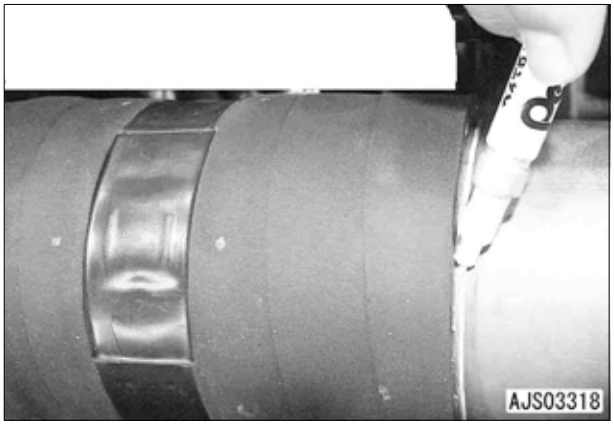


2. Disconnect fuel filter hoses (2) and (3) from fuel supply pump (FSP).
   - ✔ Pull out the hose while pushing lock (L) from both sides.
3. Disconnect fuel return hose (4).

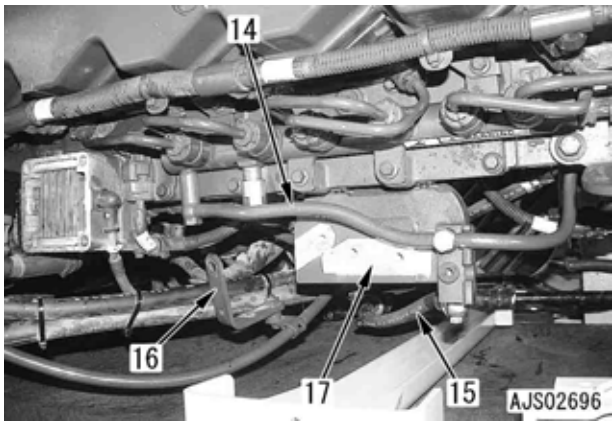


4. Disconnect dipstick bracket (6). [*1]
5. Remove hose, tube and air intake connector assembly (7). [*2]
   - ✔ Remove it without separating from the bracket.
   - ✔ Mark the hose edge and tube to show the original hose installation positions. (See figure below.)
   - ✔ When removing the cylinder head cover only, it is not necessary to remove hose, tube and air intake connector assembly (7).
6. Remove fan guard (8).
   - ✔ Remove it for checking the 3rd and 4th cylinder tops.





   - ✔ (9) – (13): Unused numbers
7. Disconnect fuel return hose (14). [*3]
8. Disconnect fuel return hose (15).
9. Disconnect bracket (16). [*4]
10. Remove fuel block (17). [*5]

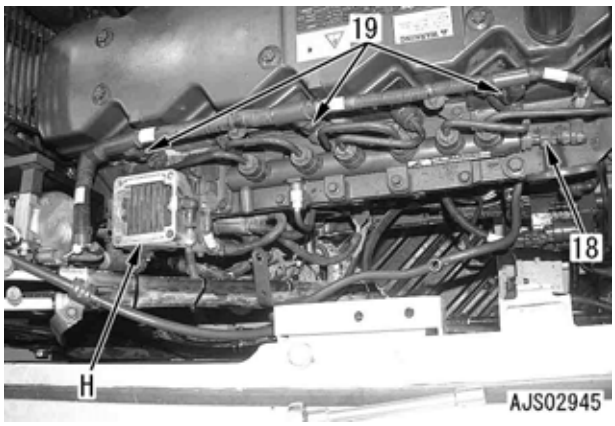


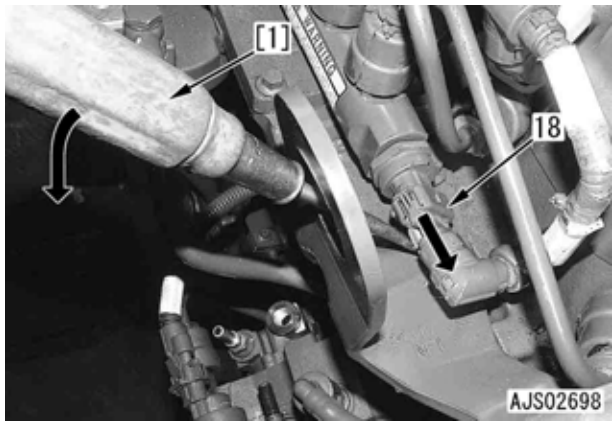
11. Disconnect connector (18).
    - ✔ Pull out connector (18) in the direction of the arrow while pushing up its lock with flat-head screwdriver [1].
12. Disconnect connectors (19).
    - ✔ As you cannot hold the connector, remove it as follows, using two flat-head screwdrivers.

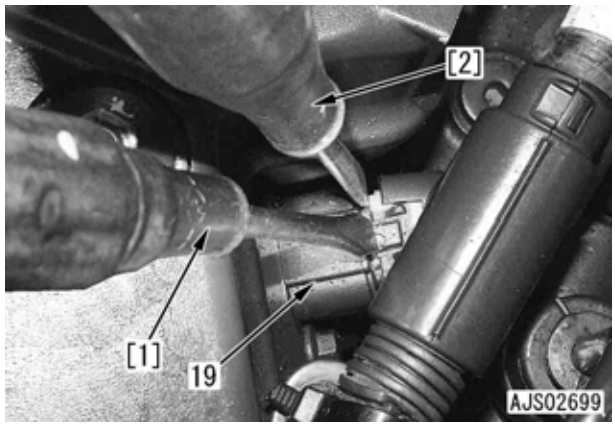
12.1. Keep pushing the lock of connector (19) with flat-had screwdriver [1].

12.2. Insert flat-head screwdriver [2] to the gap between the left or right side of the lock and the connector. Then twist the screwdriver from side to side gently to remove the connector gradually.

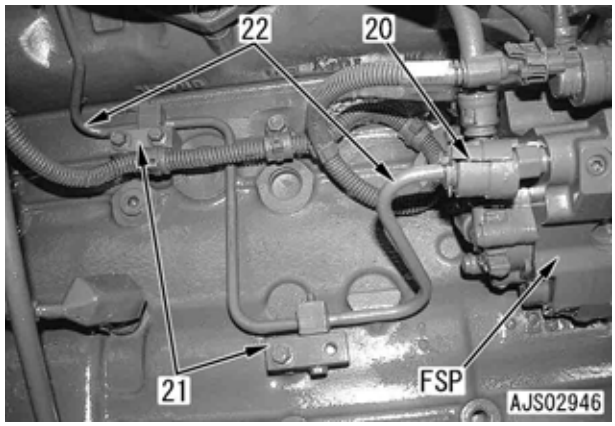
- ✔ Keep electrical intake air heater (H) drawn to the counterweight side.
- ✔ Keep the harness drawn to the counterweight side. [*6]

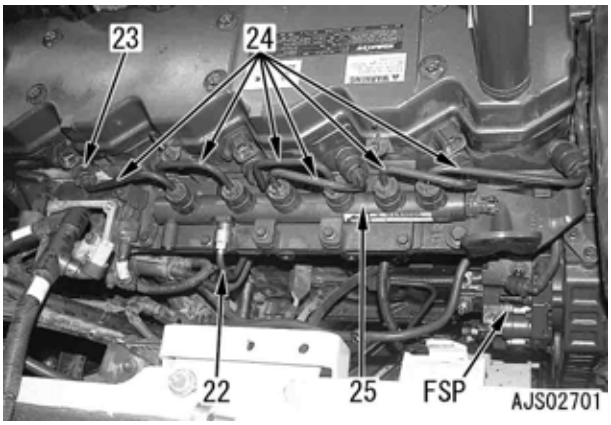




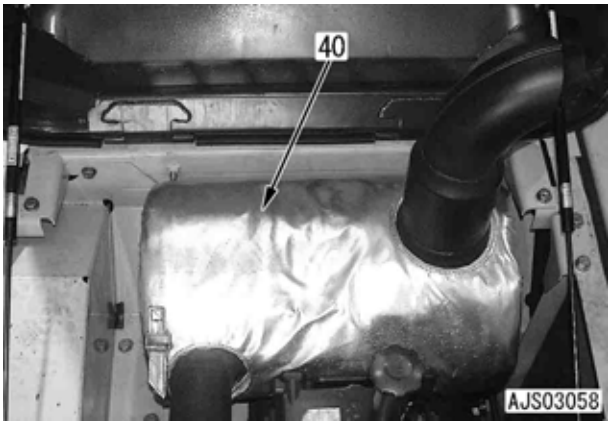


13. Remove bellows (20). [*7]
14. Remove clamp (21) from the cylinder block and disconnect fuel supply tube (22). [*8]
    - ✔ FSP: Fuel supply pump
15. Remove six bellows (23). [*9]
    - ✔ Cylinder head side only
16. Disconnect six high-pressure pipes (24) at the cylinder head side. [*10]
17. Remove common rail and high-pressure pipe assembly (25). [*11]

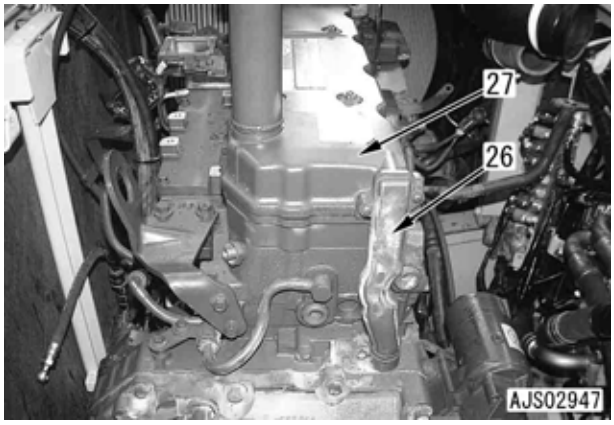




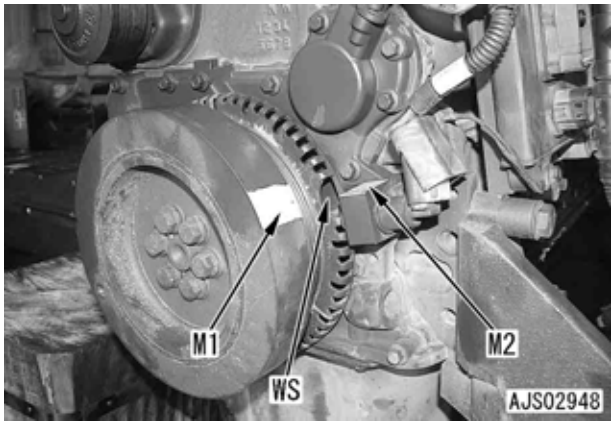
18. Remove muffler heat insulation cover (40).
    - ✔ Secure space to remove blow-by duct (26).



19. Remove blow-by duct (26). [*12]
20. Remove head cover (27). [*13]



21. By cranking, align mark 1 (M1) at the damper side with mark 2 (M2) at the engine speed sensor side.
    - ✔ Be careful that the aligning position is not the 1st and 6th cylinder top position but the 3rd and 4th cylinder top position.
    - ✔ Mark 1 (M1) corresponds to wide-width slit (WS).
    - ✔ Refer to the Adjusting of Valve Clearance section in the Testing and adjusting chapter of this manual.
    - ✔ Use tool **A4** (refer to the tool list) for cranking.



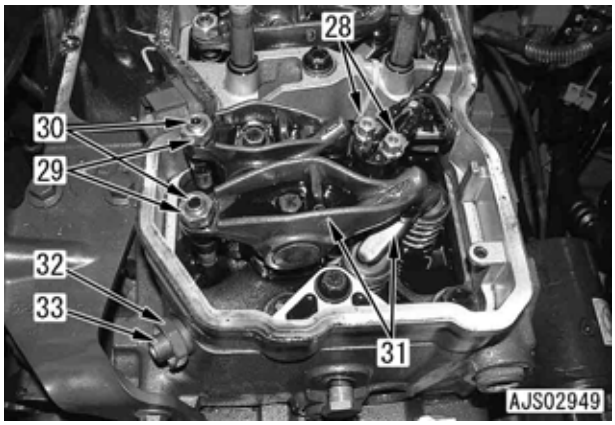
22. Remove nuts (28) for the harnesses from the injector. [*14]

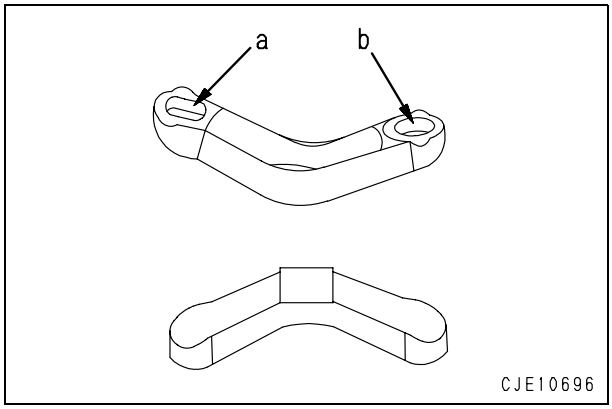
Harness color	Cylinder No.
White	1, 3, 5
Black	2, 4, 6

23. Remove 12 mounting bolts and remove six rocker arm and crosshead assemblies (31).
    - ✔ Loosen locknut (29) and then loosen adjustment screw (30) a few turns so that excessive force is not put on the push rod when the rocker arm is installed.

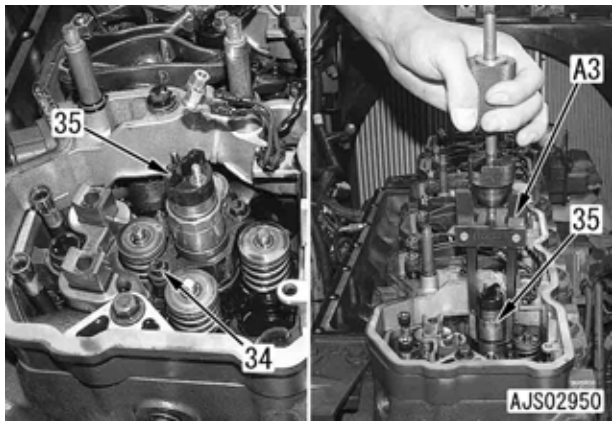
- Keep records of installation position and direction of the crosshead (hole shape of **a** and **b** parts) (Install it in the same direction when reinstalling.)

24. Remove retainers (32) and then remove six inlet connectors (33).
    - Remove and flush dirt etc., off the surrounding area in advance to prevent them from entering the connector holes.
    - Tool **A5**: remover is adopted for removing inlet connectors (33). (Refer to the tool list.)





25. Remove two mounting bolts (34) for fuel injector assembly (35).
26. Remove fuel injector assembly (35) using tool **A3**.
    - Be careful not to let any dust or foreign materials enter the fuel injector assembly mounting portion.



Installation

1. Fuel injector assembly

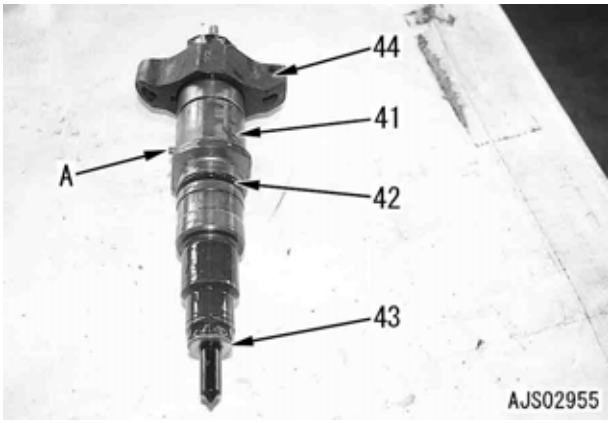
   ✔ Check that there is no damage or dust on the fuel injector sleeve.

1.1. Install O-ring (42) and gasket (43) to fuel injector (41).

1.2. Coat O-ring (42) and the head side of fuel injector (41) with engine oil (EO15W-40).

O-ring (42) and the head side of fuel injector (41):
engine oil (EO15W-40)

1.3. Install holder (44) to fuel injector (41) with concavity and convexity (A) fitted together.

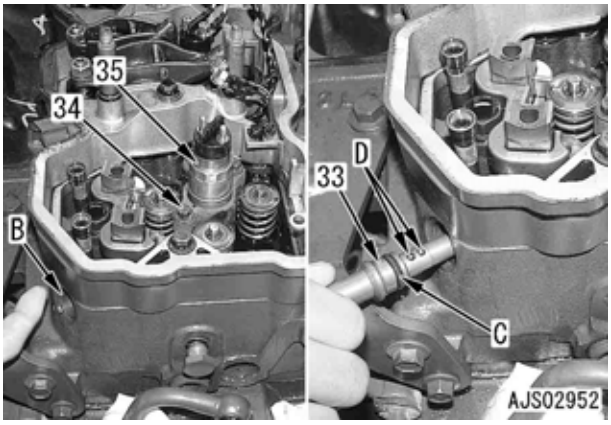


1.4. Assemble fuel injector assembly (35) to the cylinder head with its fuel inlet hole facing the intake manifold side.

1.5. Tighten bolts (34) three or four turns.

1.6. Coat the head side (B part) of inlet connector (33) with engine oil (EO15W-40).

1.7. Coat O-ring (C) of inlet connector (33) with engine oil (EO15W-40). Then insert inlet connector (33) completely, aligning (D part) with the side groove of the head.



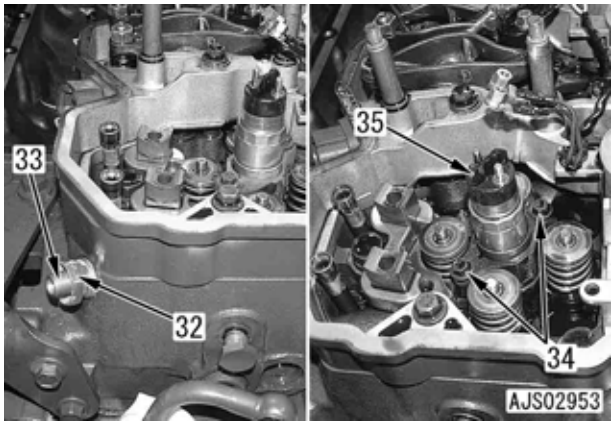
1.8. Tighten inlet connector (33) with retainer (32) by hand. (Push it into the injector hole.)

1.9. Tighten mounting bolts (34) for fuel injector assembly (35) alternately.

Bolt: **8 ± 0.8 Nm {0.81 ± 0.08 kgm}**

1.10. Tighten retainer (32).

Retainer:
50 ± 5 Nm {5.1 ± 0.5 kgm}



2. Rocker arm and crosshead assembly

2.1. Install rocker arm and crosshead assembly (31).

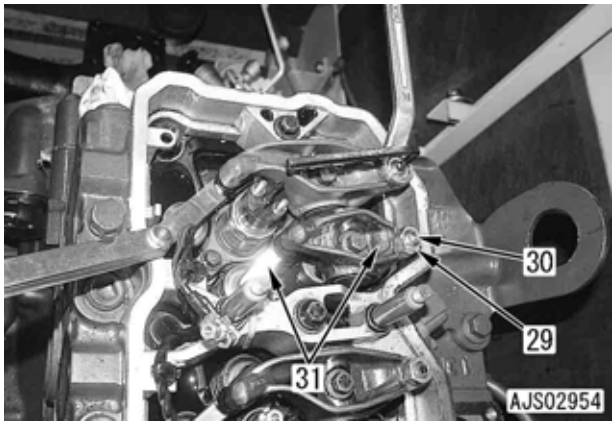
- When reusing the crosshead, install the same intake and exhaust valves in the same direction because the shapes of its holes **a** and **b** are different,
- Tighten the mounting bolt after checking that the ball portion of adjustment screw (30) is well seated in the push rod socket.

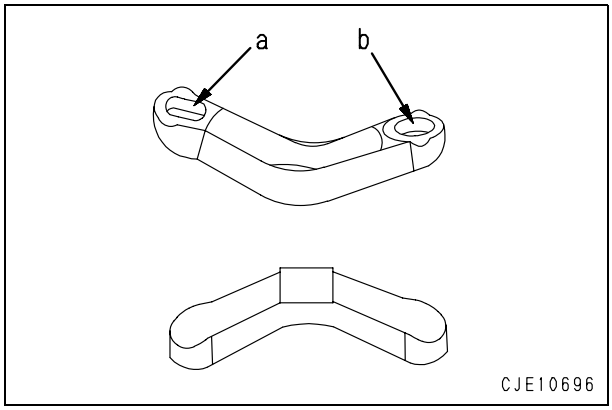
N·m Mounting bolt:
36 ± 5 Nm {3.7 ± 0.5 kgm}

2.2. Adjust the valve clearances.

- Refer to the Adjusting of Valve Clearance section in the Testing and adjusting chapter of this manual.

N·m Locknut (29):
24 ± 4 Nm {2.4 ± 0.4 kgm}





- Carry out the rest of installation in the reverse order to removal.

[*1]

N·m Bracket mounting bolt:
43 ± 6 Nm {4.4 ± 0.6 kgm}

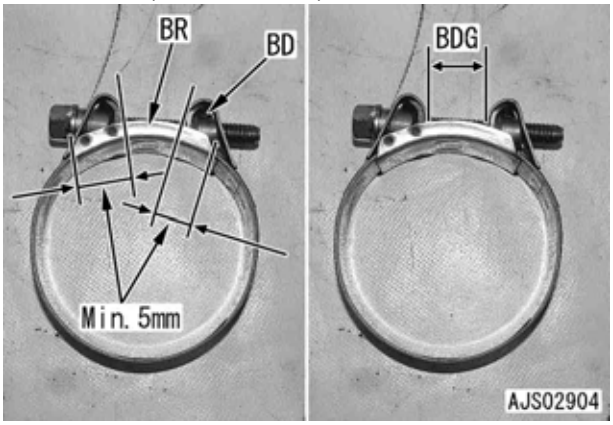
[*2]

N·m Air intake connector mounting bolt:
24 ± 4 Nm {2.4 ± 0.4 kgm}

- MIKALOR clamp
- Use a new clamp.
- Align the hose to the original position (marking position).
- Reference
- Depth of insertion: 60mm (aftercooler side)
- Set bridge (BR) under the clamp tightening bolt as the lap with band (BR) is Min.5mm.
- Align the clamp to the original position.
- Impact wrench is not applicable to use.

N·m Clamp: **16 – 18 Nm {1.6 – 1.8 kgm}**

- When the tightening torque force is less than 16Nm{1.6kgm}, tighten it until the hand gap is adhered (BDG size is 0).



[*3]

N·m Joint bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

[*4]

N·m Mounting bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

[*5]

N·m Fuel block mounting bolt:
32 ± 4 Nm {3.3 ± 0.4 kgm}

[*6]

⚠ WARNING

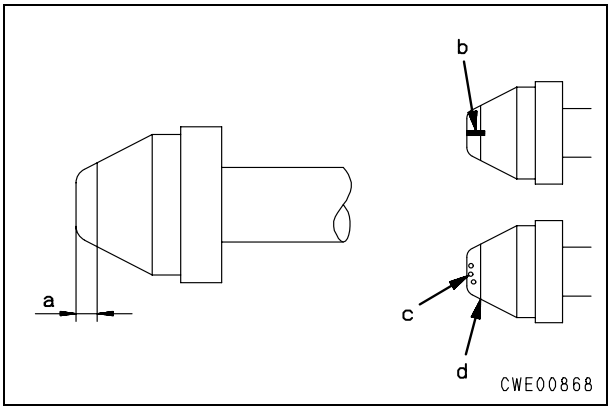
When installing, keep the distance of more than 10 mm between the high-pressure pipe and the harness.

[*7], [*8], [*9], [*10], [*11]
✔ **High-pressure pipes and common rail**

⚠ WARNING

- **Do not use high-pressure pipes with bending modification.**
- **Be sure to use a genuine high-pressure pipe fixing clamp and observe strictly the tightening torque.**

✔ A high-pressure pipe which has depressions such as visible vertical slit scar (b), patchy scars (c) etc. on the taper seal section of its connector ((a) part: within 2mm from the tip), or a high-pressure pipe whose (d) part (end of the taper seal section: 2mm from the tip) catches on a finger nail due to fatigue, may cause fuel leakage. In these cases, replace the high-pressure pipe.



2.3. Assemble common rail (25) and high-pressure pipes (51) -(56) temporarily.

N·m Sleeve nut and mounting bolt: **0.2 – 0.8 Nm {0.02 – 0.08 kgm}**

2.4. Tighten high-pressure pipes (51) - (56) according to the following procedure.

N·m Sleeve nut: **35 ± 3.5 Nm {3.6 ± 0.4 kgm}**

2.4.1 Head side of high-pressure pipes (51) and (56)
2.4.2 Common rail (25) side of high-pressure pipes (51) and (56)
2.4.3 Head side of high-pressure pipes (52), (53), (54) and (55)
2.4.4 Common rail (25) side of high-pressure pipes (52), (53), (54) and (55)

2.5. Tighten the sleeve nut of high-pressure pipe (22) temporarily.

2.6. Tighten high-pressure pipe (22) in the order of firstly pump (FSP) side, then common rail (25) side.

N·m Sleeve nut: **35 ± 3.5 Nm {3.6 ± 0.4 kgm}**

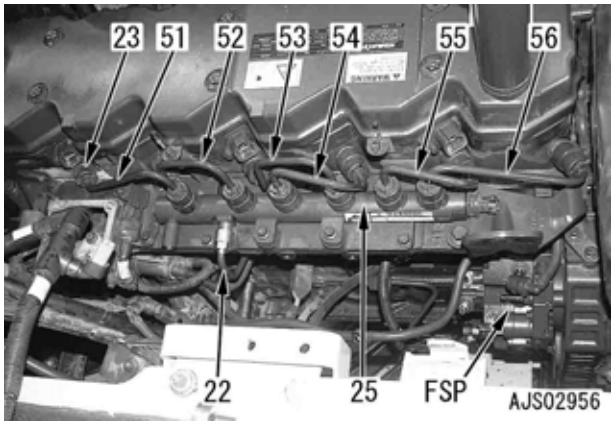
2.7. Tighten clamp (21) of high-pressure pipe (22).

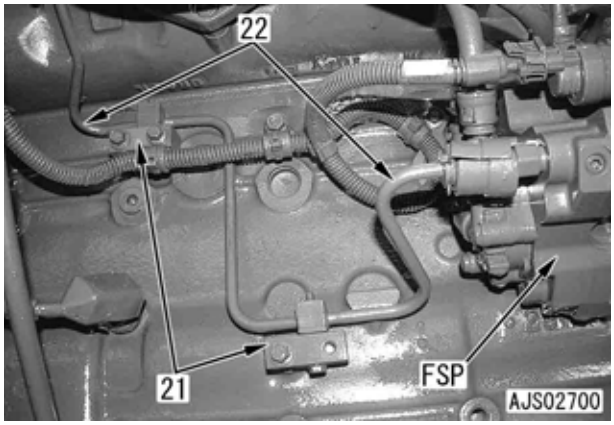
N·m Mounting bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

2.8. Tighten common rail (25) with four bolts.
✔ Coat the two bolt threads on the inner side of the engine with sealant (LG-7).

N·m Mounting bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

2.9. Install bellows (23) to each high-pressure pipe. (14 pieces)
✔ Set the slits of each bellows out and down.
✔ The bellows are installed so that fuel will not spout over the hot parts of the engine and catch fire when it leaks for some reason.
✔ FSP: Fuel supply pump





[*12]

N·m Blow-by duct mounting bolt: **10 ± 2 Nm {1.0 ± 0.2 kgm}**

[*13]

N·m Head cover mounting nut: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

[*14]

a Harness installation position

Harness color	Cylinder No.
White	1, 3, 5
Black	2, 4, 6



Harness mounting nut:
1.5 ± 0.25 Nm {0.15 ± 0.03 kgm}

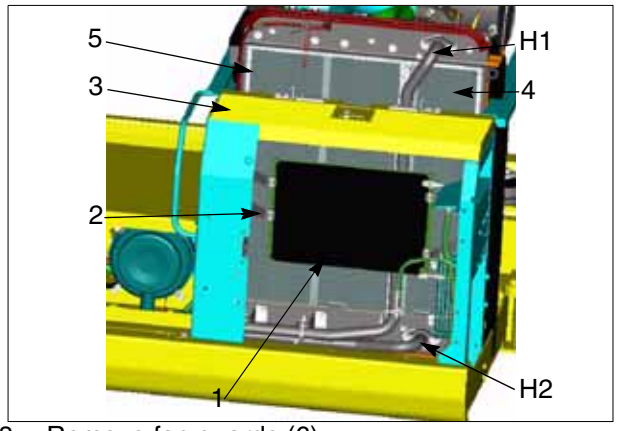
Removal and installation of engine front seal

Special tools

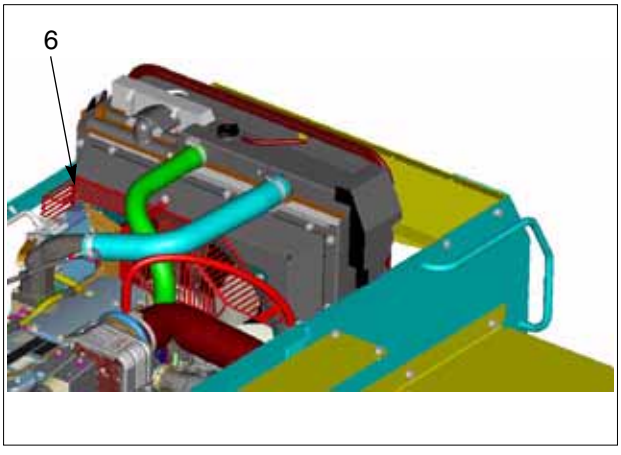
Symbol		Part number	Part name
A	1	795-799-6400	Seal puller
	6	790-331-1120	Wrench (Angle)

Removal

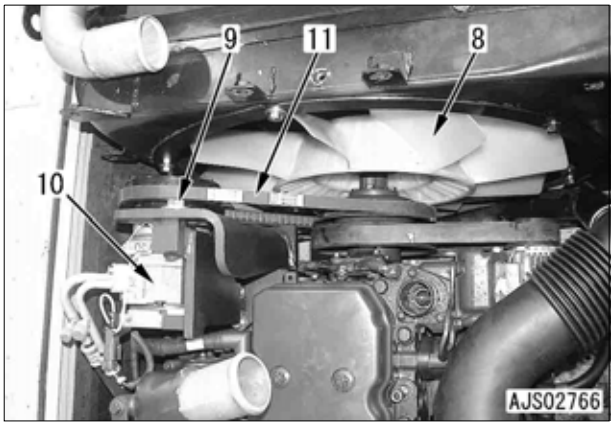
1. Remove the radiator assembly referring to the section of Removing Radiator Assembly.
2. Remove the hydraulic oil cooler assembly referring to the section of Removing Hydraulic Oil Cooler Assembly.
3. Remove the aftercooler assembly referring to the section of Removing Aftercooler Assembly.
4. Remove mounting bolts for air conditioner condenser (1) and put aside air conditioner condenser (1).
5. Remove bracket (2).
6. Remove cover (3).
7. Remove nets (4) and (5).
   - ✔ Hydraulic oil cooler hoses **H1** and **H2** have already been removed with removal of oil cooler.



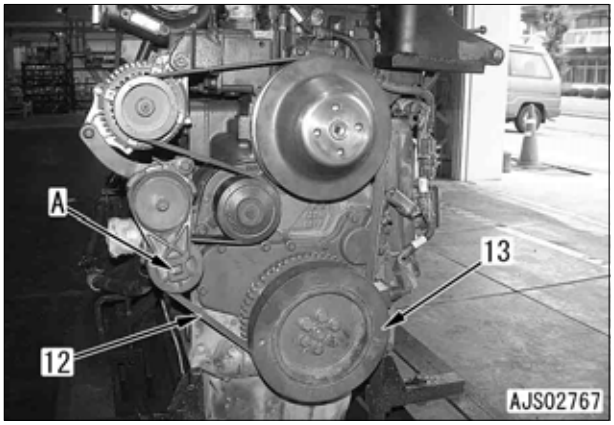
8. Remove fan guards (6).



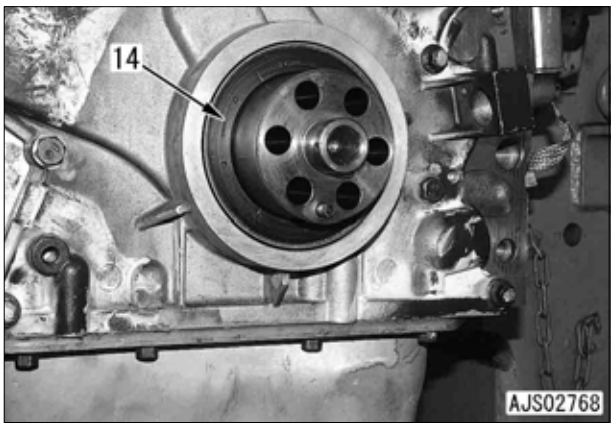
9. Remove fan (8). [*1]
10. Loosen air conditioner compressor bracket adjustment bolts (9).
    - ✔ There is another bolt behind.
11. Move air conditioner compressor assembly (10).
12. Remove air conditioner compressor drive belt (11). [*2]



13. Loosen tension by inserting a wrench to **A** part, and remove alternator belt (12).
14. Remove six mounting bolts and remove vibration damper (13).



15. Remove seal (14).

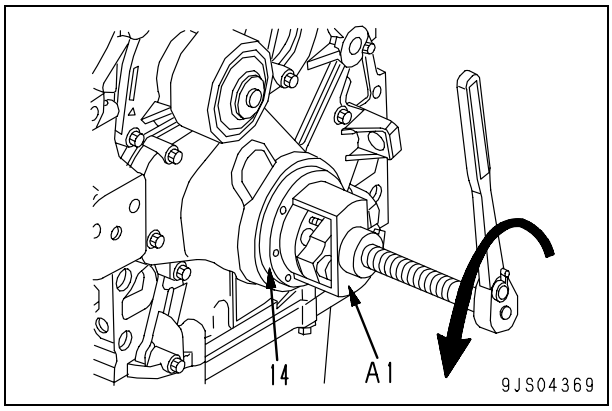


Installation

1. Install front seal (14) using tool **A1**.

   ✔ Before installing the seal, check that the end corners and lip sliding surfaces of the crankshaft are free from flaw, burr, and rust of the housing.

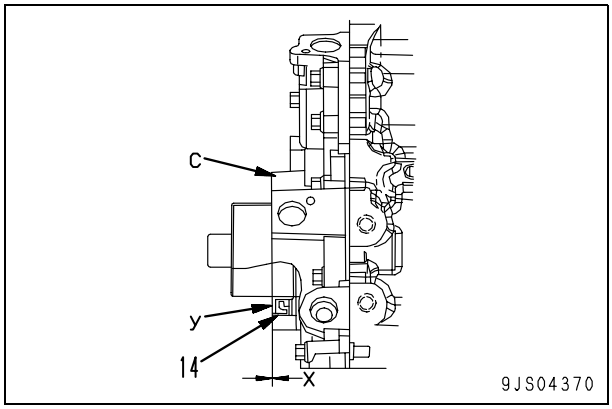
   ✔ When installing the seal, do not coat the shaft and seal lip with oil, grease etc. Also, wipe off grease from the shaft completely.



   ✔ From cover (C) of seal (14)

   • Extrusion **x**: **less than 0.38 mm**

   • Facial run out (TIR: total indicator reading) **y**: **less than 0.25 mm**



2. Vibration damper

2.1. Install vibration damper (13), aligning its dowel hole with dowel pin **a** of the crankshaft.

2.2. Tightening procedure of bolts (15)

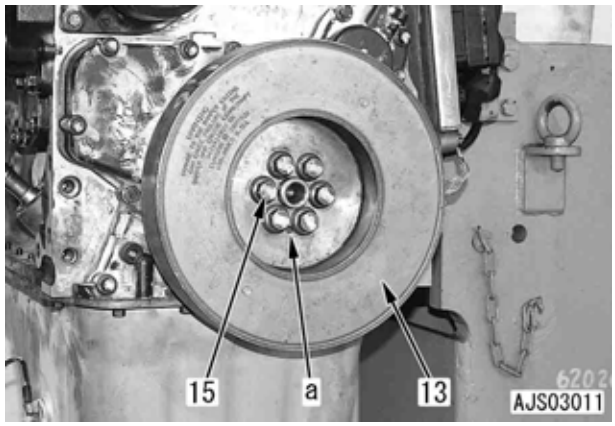
2.2.1 Tighten to a torque of 55 ± 5 Nm {5.6 ± 0.5 kgm} in diagonal order.

2.2.2 Loosen the bolts 180°.

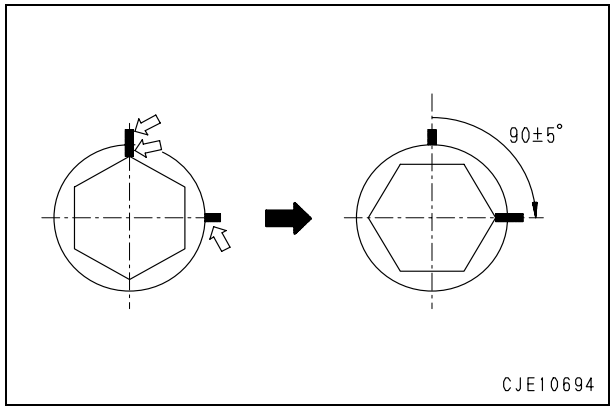
2.2.3 Tighten to a torque of 55 ± 5 Nm {5.6 ± 0.5 kgm} in diagonal order.

2.2.4 90° ± 5°

   ✔ Tool **A6**: wrench is adopted for angle tightening. (Refer to the tool list.) (Refer to the tool list.)



   ✔ When an angle tightening tool is not used:
   Put marks on the vibration damper and bolts with a felt-tip pen, and then tighten the bolts an additional **90° ± 5°**.



   ✔ Carry out the rest of installation in the reverse order to removal.

[*1]

N·m Fan mounting bolt:
43 ± 6 Nm {4.4 ± 0.6 kgm}

[*2]

a Refer to the Inspection and Adjustment of Air Compressor Belt Tension section in the Testing and adjusting chapter in this manual.

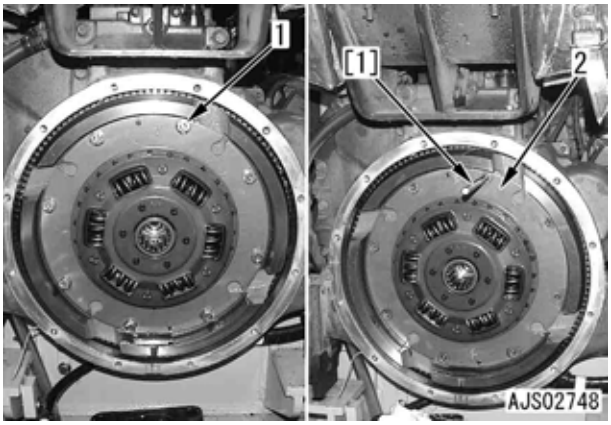
Removal and installation of engine rear seal

Special tools

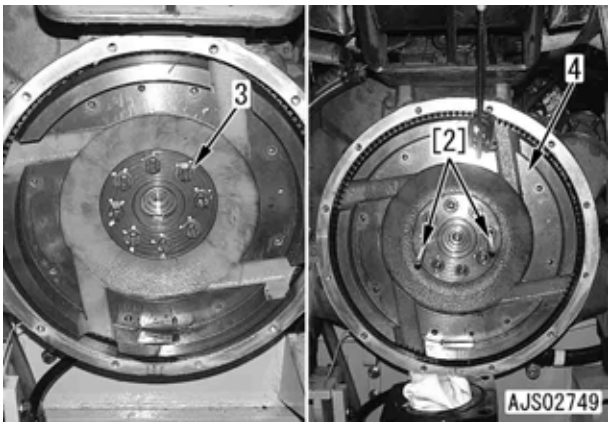
Symbol		Part number	Part name
A	2	795-799-6500	Seal puller

Removal

1. Remove the hydraulic pump assembly referring to the section of Removing Hydraulic Pump Assembly.
2. Remove mounting bolt (1) and set guide bolt [1].
3. Remove damper assembly (2).

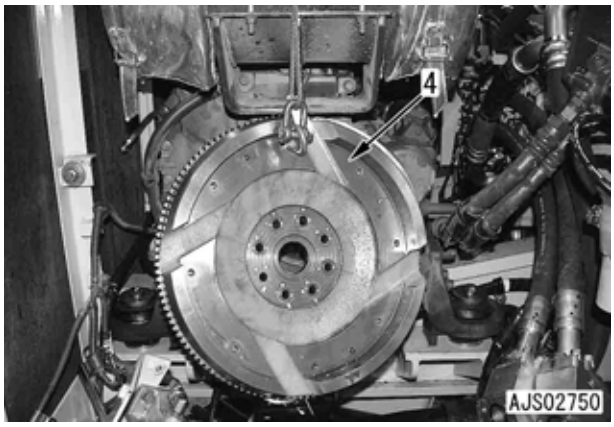


4. Remove mounting bolt (3) and insert guide bolts [2]. [*1]
   - ✔ Width across flats: 18 mm
5. Lift temporarily flywheel assembly (4) and pull out flywheel assembly (4).
   - ✔ Be careful not to let the guide bolts drop out.

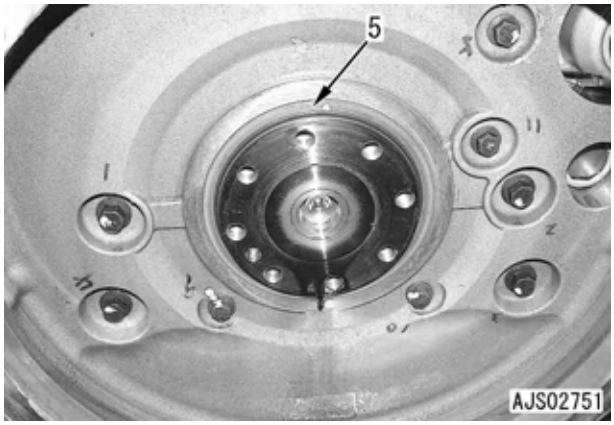


6. Lift off flywheel assembly (4) to remove it.

kg Flywheel assembly: **35 kg**

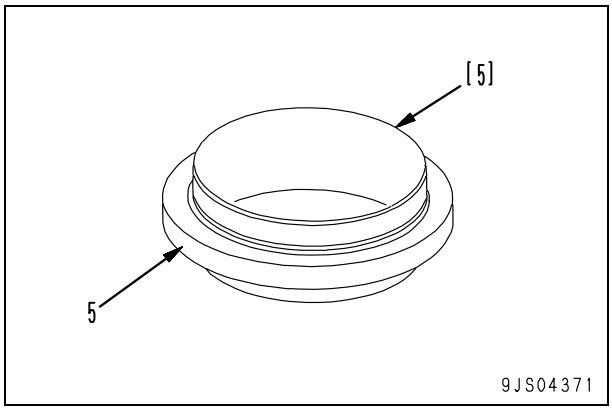


7. Remove seal (5) as follows.
   - ✔ Use care in the removal so that the crank shaft may not be damaged.

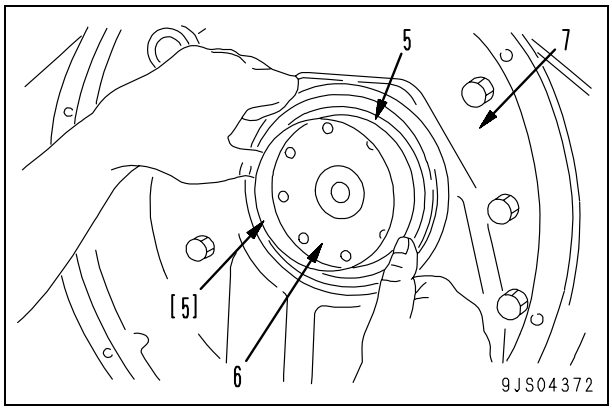


Installation

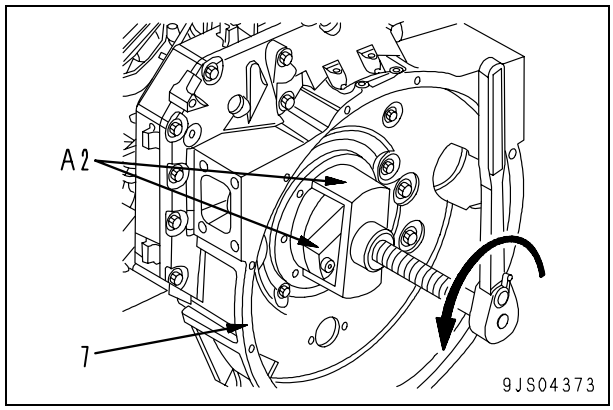
1. Install the oil seal according to the following procedure.
   - ✔ Do not remove pilot [5] which is attached to oil seal (5) until oil seal (5) is inserted to the crankshaft.
   - ✔ Before installing the oil seal, de-grease, clean and dry the crankshaft sealing face and the seal lip face to prevent oil leakage.

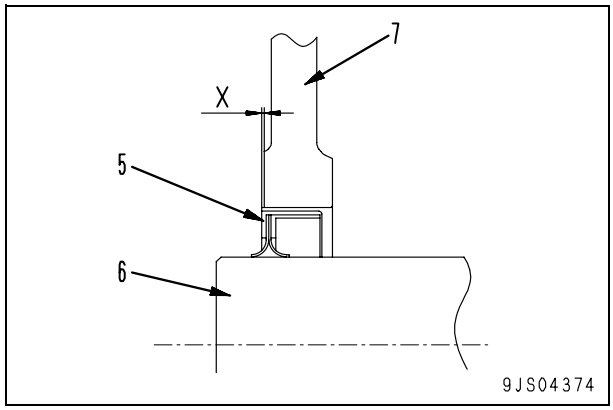


2. Insert pilot [5] to crankshaft (6) and push oil seal (5) into flywheel housing (7).
3. Push in oil seal (5) further and pull out pilot [5].



4. Install oil seal (5) on flywheel housing (7) to the proper depth by using tool **A2**.
   - ✔ Push in oil seal (5) taking care that there are no bend etc. on it.
   - ✔ Extrusion of oil seal (5) from flywheel housing (7)
     X: less than 0.38 mm



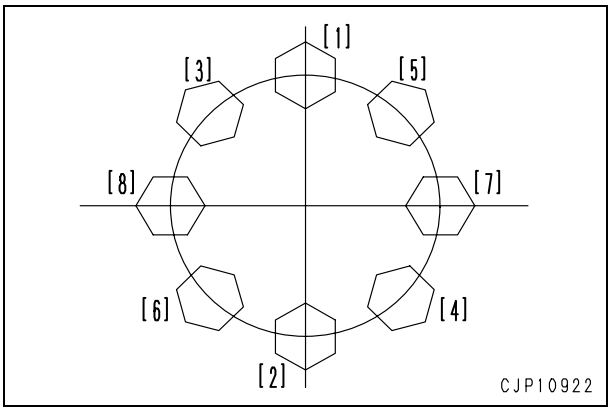


✔ Carry out the rest of installation in the reverse order to removal.

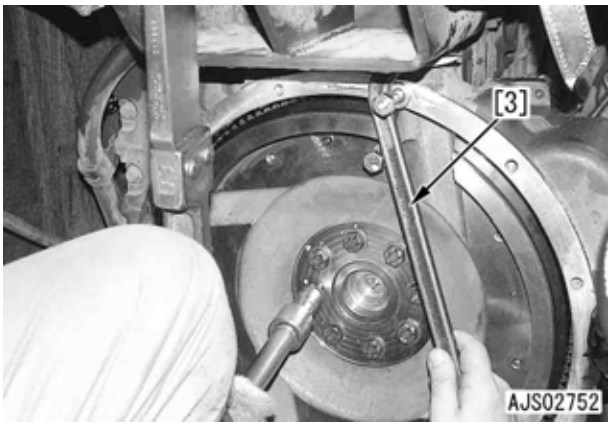
[*1]

✔ Tighten the eight flywheel mounting bolts in the order of (1) through (8) as shown in the figure below.

N·m Flywheel assembly mounting bolt:
137 ± 7 Nm {13.97 ± 0.71 kgm}



✔ Tighten the bolts using bar [3] for preventing rotation of the flywheel assembly.



✔ Measurement of radial run out

✔ Radial run out: less than **0.13 mm**

4.1. Set dial gauge [4] to the stand, and set it to flywheel housing (7).

4.2. Bring the dial gauge probe into contact with faucet joint portion **a** or the outer perimeter surface of the flywheel at a right angle.

4.3. Rotate the flywheel 360°and measure the difference of the maximum swing of the dial gauge indicator.

✔ Check that the dial gauge indicator is back in the original position after the flywheel is rotated 360°.

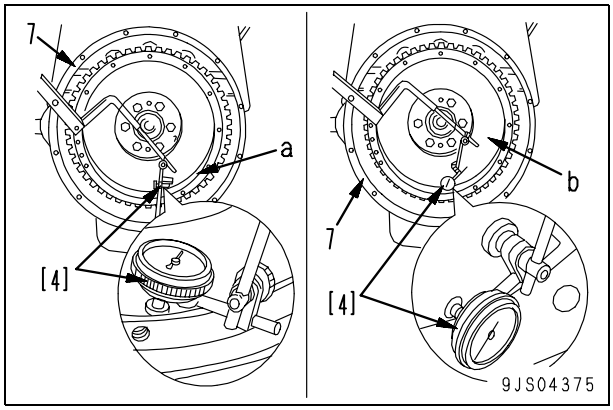
✔ Measurement of facial run out

✔ Facial run out: less than **0.20 mm**

4.4. As in the case of measurement of radial run out, bring the dial gauge probe into contact with end surface **b** near the outer perimeter of the flywheel at a right angle.

✔ Conduct measurement pulling the crankshaft to either the front or rear side to prevent errors caused by shakiness.

4.5. Rotate the flywheel 360° and measure the difference of the maximum swing of the dial gauge indicator.



Removal and installation of cylinder head assembly

Special tools

Symbol		Part number	Part name
A	3	795-799-6700	Primer
	4	795-799-1131	Gear
	5	795-799-8150	Remover
	6	790-331-1120	Wrench (Angle)
	7	795-790-4510	Gauge

Removal

WARNING

Disconnect the negative terminal (–) of the battery before starting with the work.

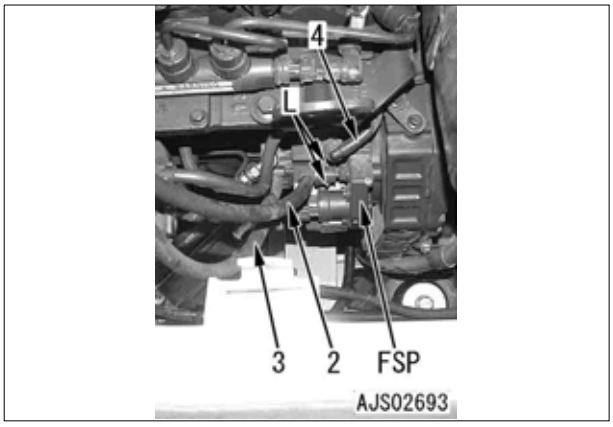
1. Remove cover (1).



2. Drain the engine cooling water.

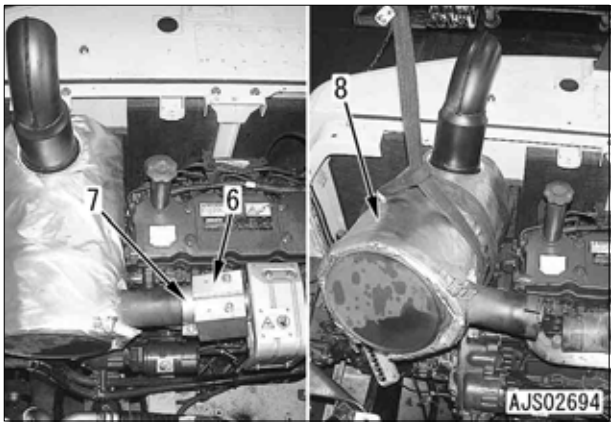
Coolant: Approx. 17.6ℓ

3. Remove the following referring to the section of Removing Engine and Hydraulic Pump Assembly.
   - Engine hood
   - Top cover on control valve
   - Remove muffler guard plate.
   - Centre partition between control valve and engine
4. Disconnect fuel filter hoses (2) and (3) from fuel supply pump (FSP).
   - Remove dirt on the connector in advance. (Because dirt sometimes makes lock (L) fit tight.)
   - Pull out the hose while pushing lock (L) from both sides.
5. Disconnect fuel return hose (4).

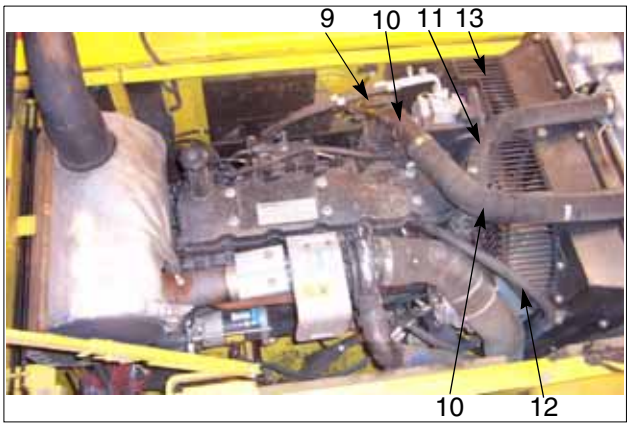


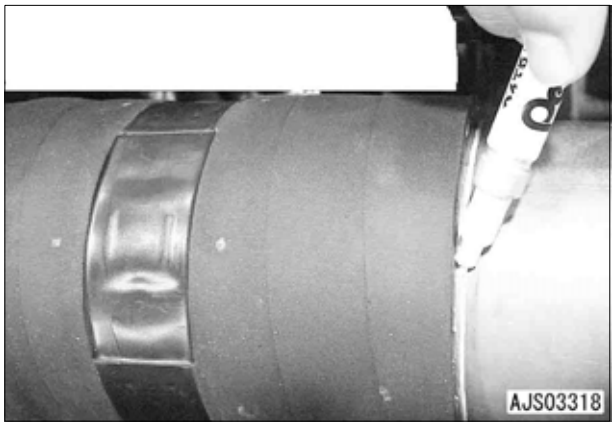
6. Remove cover (6).
7. Remove clamp (7).
8. Remove the mounting bolt and lift off muffler assembly (8) to remove it. [*1]
   - Space for winding the lifting tool is small.

kg Muffler assembly: **35 kg**

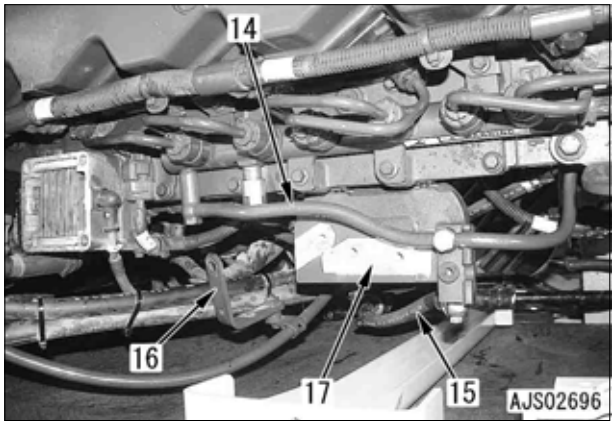


9. Disconnect dipstick bracket (9). [*2]
10. Remove hose, tube and air intake connector assembly (10). [*3]
    - ✗ Remove it without separating from the bracket.
    - ✗ Mark the hose edge and tube to show the original hose installation positions. (See figure below.)





11. Disconnect radiator hose (11). [*4]
12. Disconnect heater hose (12).
13. Remove fan guard (13).
14. Disconnect fuel return hose (14). [*5]
15. Disconnect fuel return hose (15).
16. Disconnect bracket (16). [*6]
17. Remove fuel block (17). [*7]

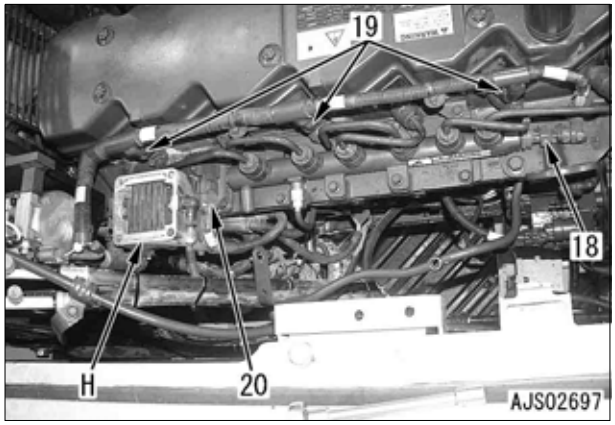


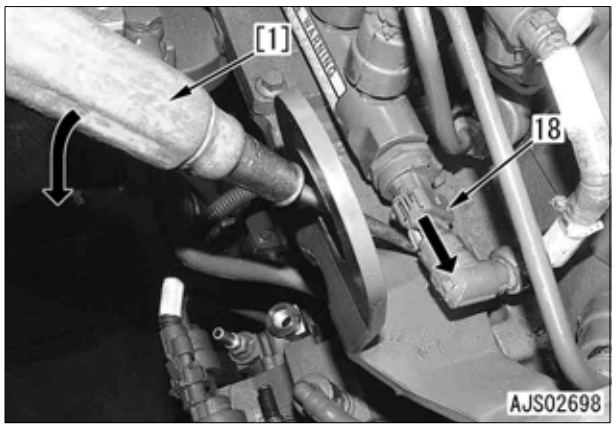
18. Disconnect connector (18).
    - ✗ Pull out connector (18) in the direction of the arrow while pushing up its lock with flat-head screwdriver [1].
19. Disconnect connector (19).
    - ✗ As you cannot hold the connector, remove it as follows, using two flat-head screwdrivers.

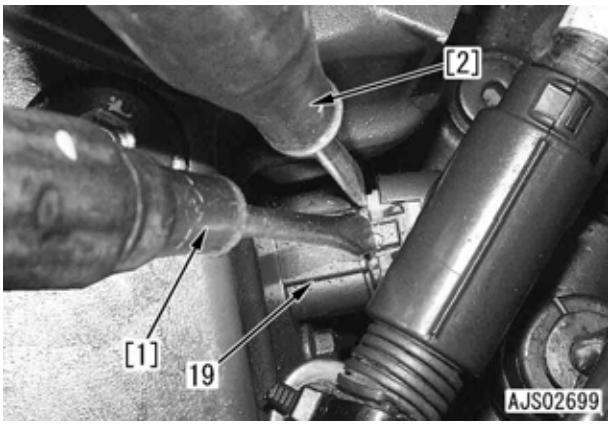
19.1. Keep pushing the lock of connector (19) with flat-had screwdriver [1].

19.2. Insert flat-head screwdriver [2] to the gap between the left or right side of the lock and the connector. Then twist the screwdriver from side to side gently to remove the connector gradually.

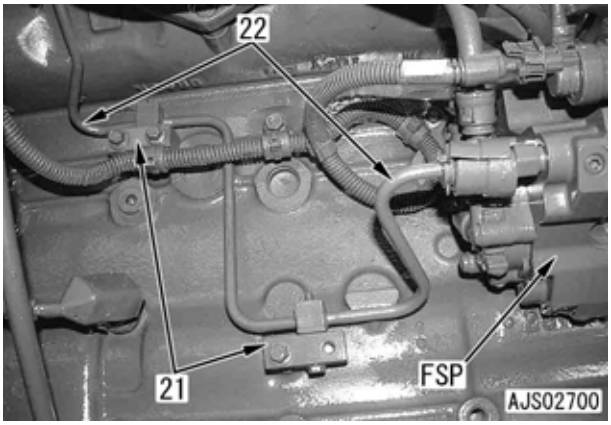
20. Disconnect connector with boost pressure and intake air temperature sensor (20).
    - ✗ Keep electrical intake air heater (H) drawn to the counterweight side.
    - ✗ Keep the harness drawn to the counterweight side. [*8]

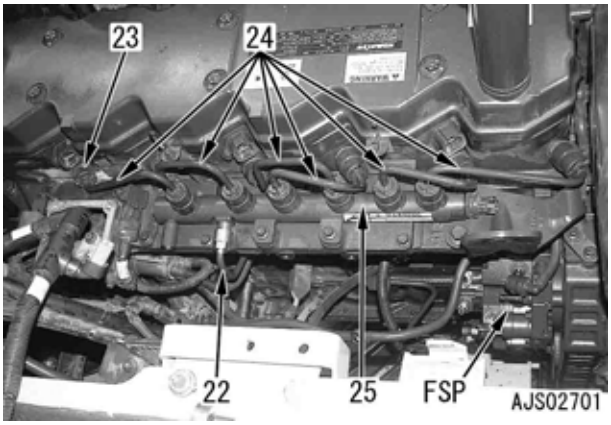




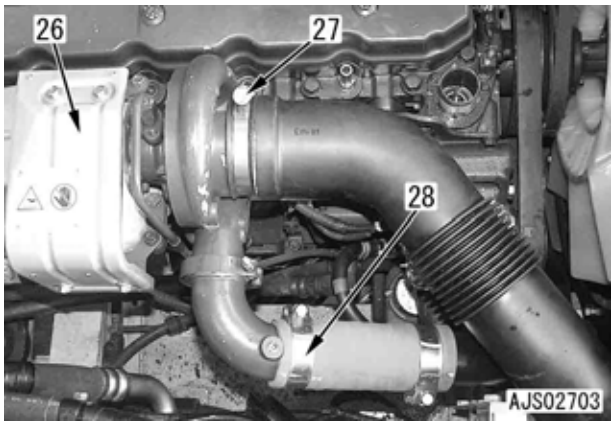


21. Remove clamp (21) from the cylinder block and disconnect high-pressure pipe (22). [*9]
    - ✔ FSP: Fuel supply pump
    - ✔ Remove the bellows from the sleeve nut portions.
22. Remove six bellows (23).
    - ✔ Cylinder head side only
23. Disconnect six high-pressure pipes (24) at the cylinder head side. [*9]
24. Remove common rail and high-pressure pipe assembly (25). [*10]

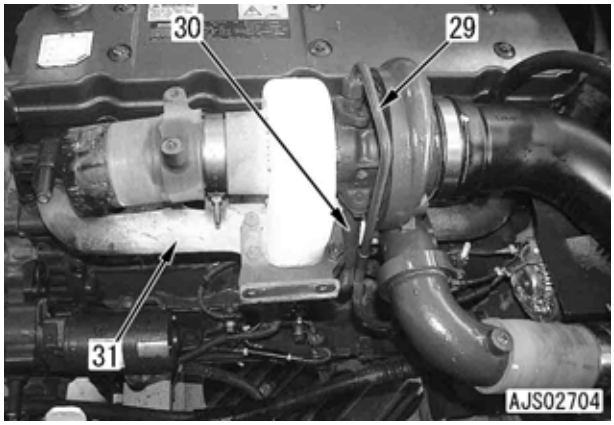




25. Remove protection cover (26).
26. Loosen air tube clamp (27). [*11]
27. Loosen hose clamp (28). [*12]

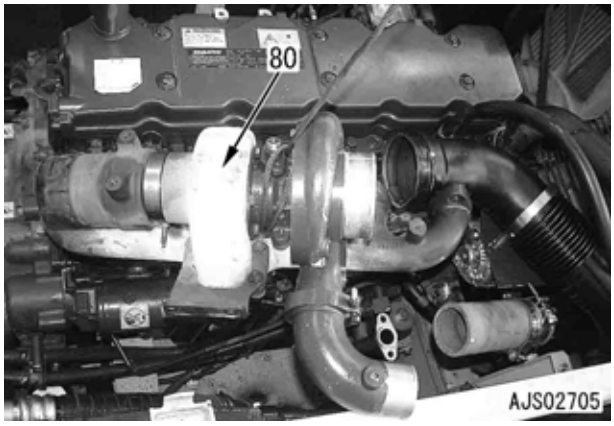


28. Disconnect lubrication inlet hose (29) and lubrication outlet hose (30).[*13]
29. Remove all the mounting bolts for exhaust manifold (31) except a few pieces. [*14]

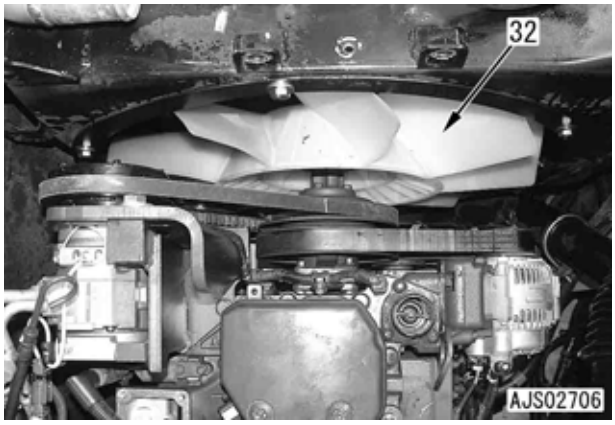


30. Lift temporarily exhaust manifold and turbo charger assembly (80), and remove the remaining mounting bolts. [*14]
31. Lift off exhaust manifold and turbo charger assembly (80) to remove it.

kg Exhaust manifold and turbo charger assembly: **25 kg**

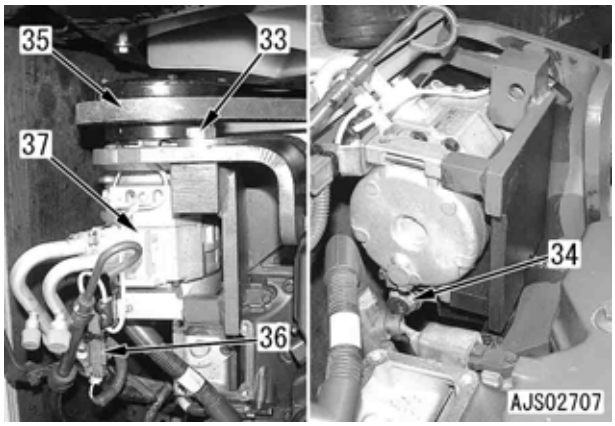


32. Remove fan (32).[*15]
    - ✔ Keep the fan dropped down.

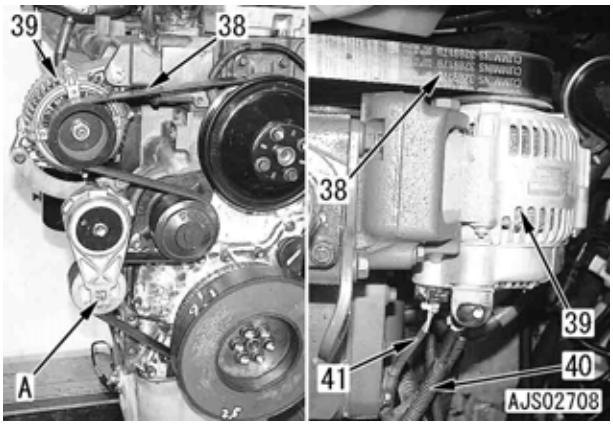


33. Loosen air conditioner compressor bracket mounting bolts (33) and (34).
34. Remove air conditioner compressor drive belt (35). [*16]

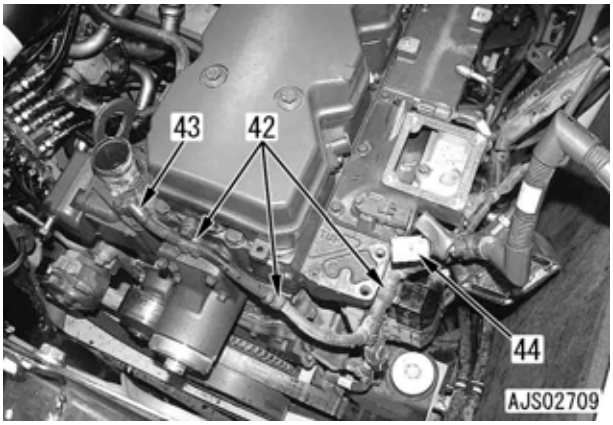
35. Disconnect connector E05 (36).
36. Remove air conditioner compressor assembly (37).
    - ✔ Remove air conditioner compressor assembly in one piece with the bracket and put them on the counter weight.

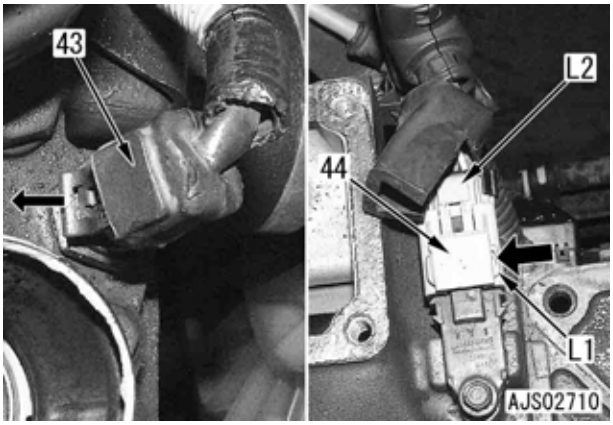


37. Insert a wrench to **A** part and remove fan belt (38) from alternator (39).
38. Disconnect connectors AB (40) and E12 (41).
39. Remove alternator (39).

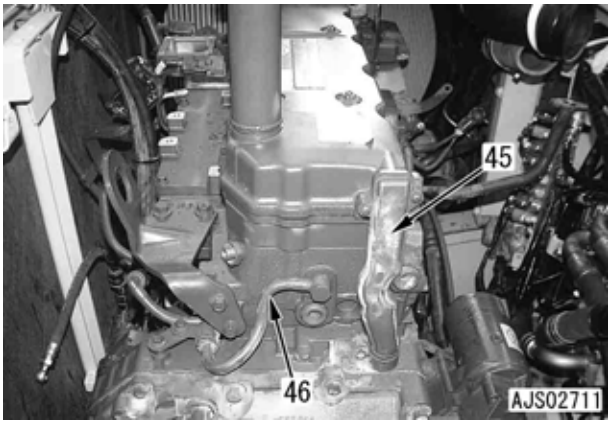


40. Disconnect clamp (42).
41. Disconnect connector with water temperature sensor (43) and air intake pressure sensor (44).
    - ✔ Connector with water temperature sensor (43)
      Pull the lock (female side) to the outside.
    - ✔ Air intake pressure sensor (44):
      1) Push lock (L1) and slide it.
      2) Pull out the connector while pushing lock (L2).

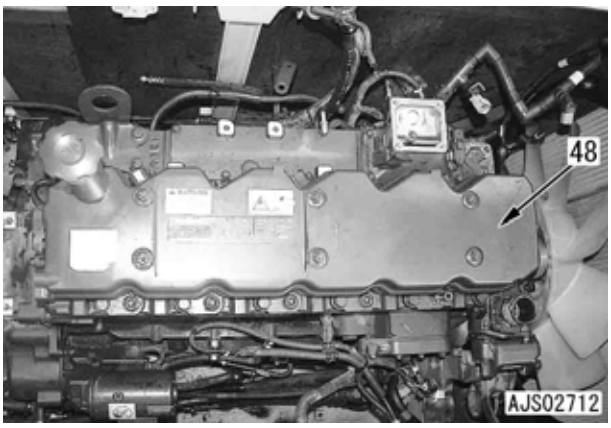




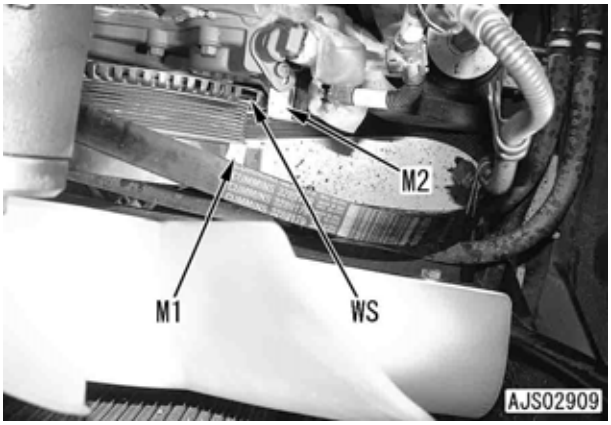
42. Remove blow-by duct (45).
43. Disconnect fuel return tube (46).



44. Remove head cover (48).



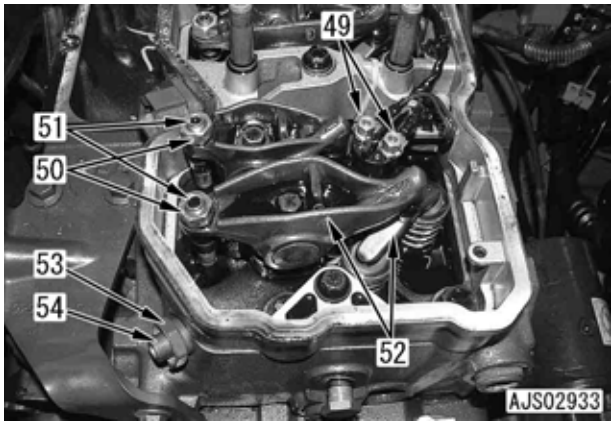
45. By cranking, align mark 1 (M1) at the damper side with mark 2 (M2) at the engine speed sensor side.
    - ✔ Be careful that the aligning position is not the 1st and 6th cylinder top position but the 3rd and 4th cylinder top position.
    - ✔ Mark 1 (M1) corresponds to wide-width slit (WS).
    - ✔ Refer to the Adjusting of Valve Clearance section in the Testing and adjusting chapter of this manual.
    - ✔ Use tool **A4** (refer to the tool list) for cranking.

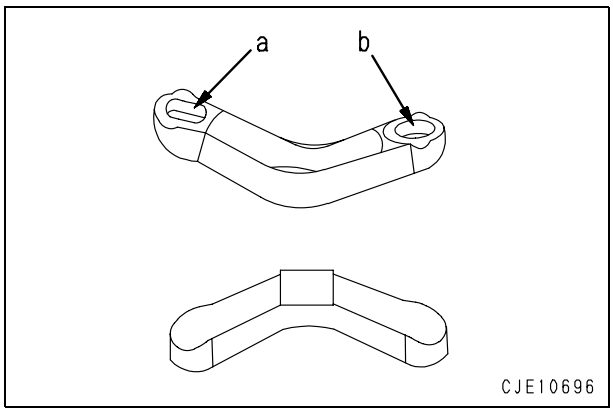


46. Remove nuts (49) for the harnesses from the injector.

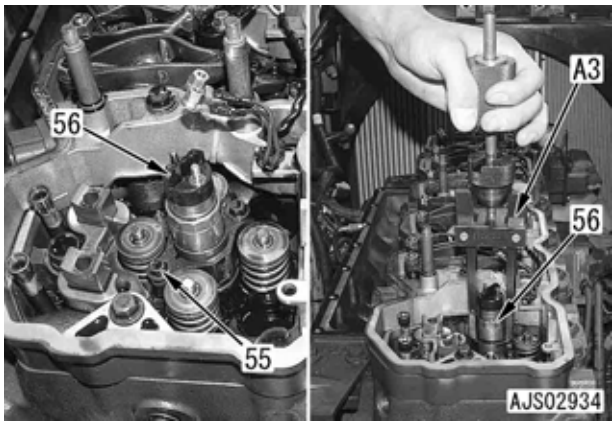
Harness color	Cylinder No.
White	1, 3, 5
Black	2, 4, 6

47. Remove 12 mounting bolts and remove six rocker arm and crosshead assemblies (52).
    - ✔ Loosen locknut (50) and then loosen adjustment screw (51) a few turns so that excessive force is not put on the push rod when the rocker arm is installed.
    - ✔ Keep records of installation position and direction of the crosshead (hole shape of **a** and **b** parts) (Install it in the same direction when reinstalling.)
48. Remove retainers (53) and then remove six inlet connectors (54).
    - ✔ Remove and flush dirt etc., off the surrounding area in advance to prevent them from entering the connector holes.
    - ✔ Tool **A5**: remover is adopted for removing inlet connectors (54). (Refer to the tool list.)

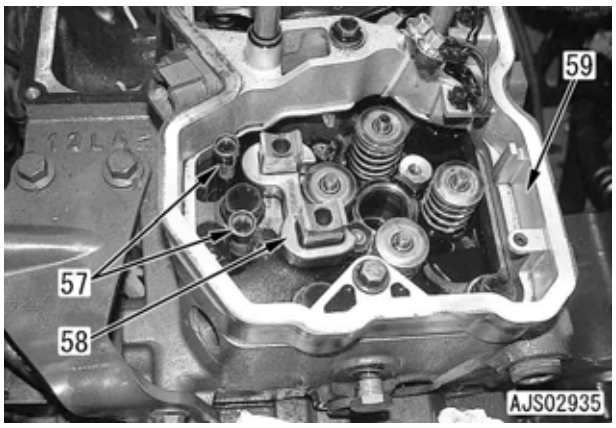




49. Remove two mounting bolts (55) for injector assembly (56).
50. Remove injector assembly (56) using tool **A3**.
    - ✔ Be careful not to let any dust or foreign materials enter the fuel injector assembly mounting portion.



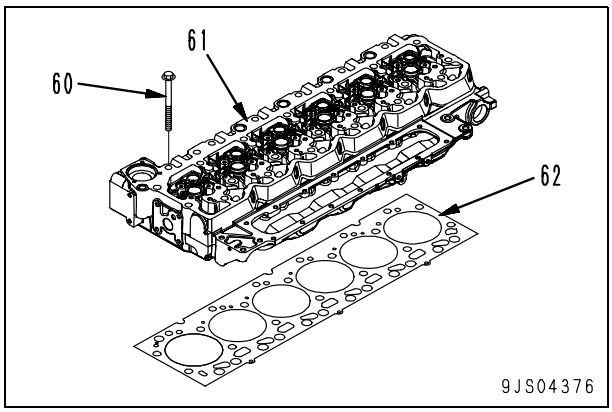
51. Remove push rods (57).
52. Remove rocker arm support (58).
53. Remove rocker housing assembly (59).



54. Remove 26 mounting bolts (60) and lift off cylinder head assembly (61) to remove it.

kg Cylinder head assembly: **75 kg**

55. Remove cylinder head gasket (62).

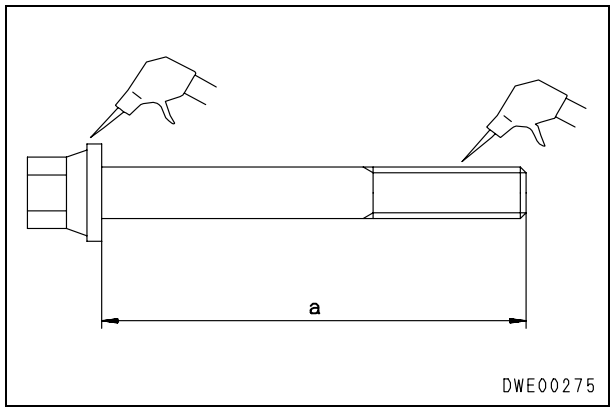


Installation

1. Cylinder head assembly

1.1. Measure under head length **a** of all the cylinder head mounting bolts to check that they are within the length limit.

- ✔ Bolt length limit: **less than 132.1 mm**
- ✔ If a bolt is longer than the using limit, do not reuse it but replace it.
- ✔ Tool **A7**: gauge is adopted for the measurement. (Refer to the tool list.)

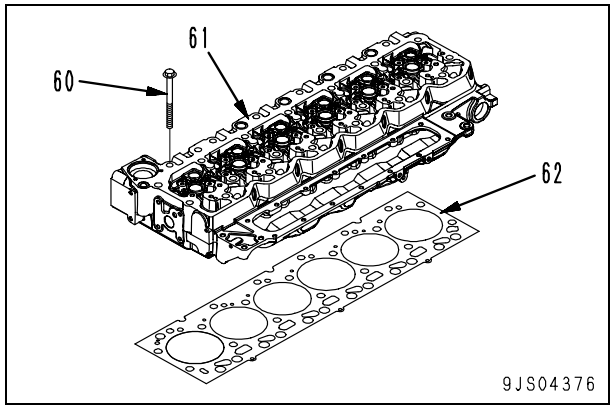


1.2. Set head cylinder gasket (62) after checking that there is no dust or foreign material on the cylinder head mounting face and inside the cylinders.

- ✔ Check that the gasket is properly matched with the cylinder head holes.

1.3. Set cylinder head assembly (61) on the cylinder block, screw in mounting bolts (60) by hand a few turns, and tighten them according to the following procedure.

Coat the threads and seat surface of the mounting bolts with **engine oil (EO15W-40)**.



✔ How to tighten mounting bolts (60)

✔ Tighten the bolts in the order shown below.

1]

N·m **90 ± 3 Nm {9.2 ± 0.3 kgm}**

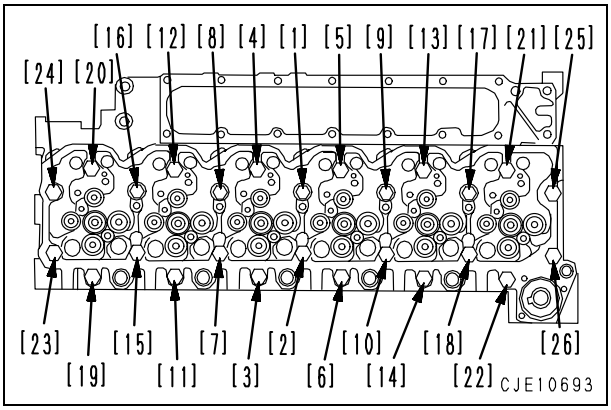
2] .

N·m Recheck the torque:
90 ± 3 Nm {9.2 ± 0.3 kgm}

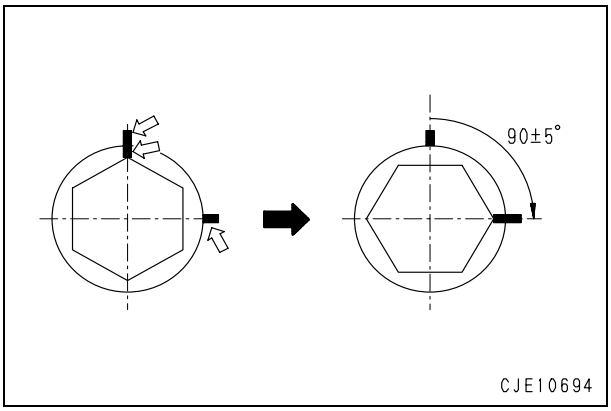
3]

N·m **90° ± 5°** (Tighten with an angle tightening tool.)

a Tool **A6**: wrench is adopted for angle tightening. (Refer to the tool list.) (Refer to the tool list.)



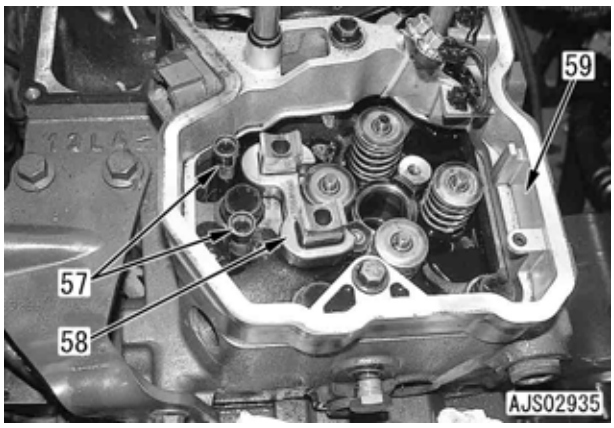
- When an angle tightening tool is not used:
  Put marks on the cylinder head and bolts with a felt-tip pen, and then tighten the bolts an additional **90° ± 5°**.



2. Install rocker housing assembly (59).

N·m Mounting bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

3. Install push rods (57).
4. Install rocker arm support (58).



5. Fuel injector assembly

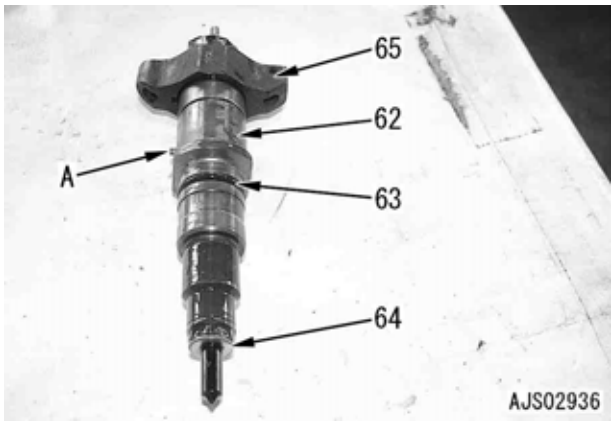
✔ Check that there is no damage or dust on the fuel injector sleeve.

5.1. Install O-ring (63) and gasket (64) to fuel injector (62).

5.2. Coat O-ring (63) and the head side of fuel injector (62) with engine oil (EO15W-40).

O-ring (63) and the head side of fuel injector (62): **engine oil (EO15W-40)**

5.3. Install holder (65) to fuel injector (62) with concavity and convexity (A) fitted together.

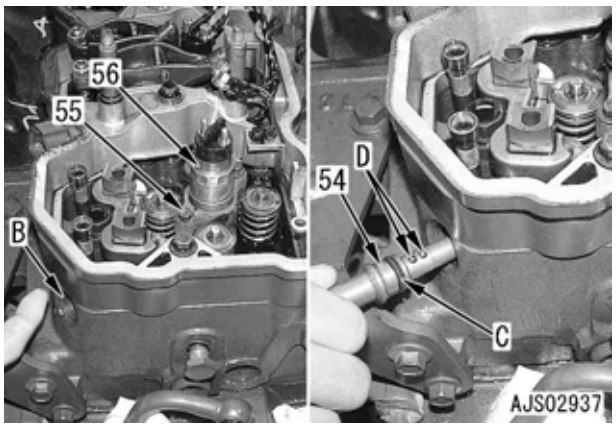


5.4. Assemble fuel injector assembly (56) to the cylinder head with its fuel inlet hole facing the intake manifold side.

5.5. Tighten bolts (55) three or four turns.

5.6. Coat the head side (B part) of inlet connector (54) with engine oil (EO15W-40).

5.7. Coat O-ring (C) of inlet connector (54) with engine oil (EO15W-40). Then insert inlet connector (54) completely, aligning (D part) with the side groove of the head.



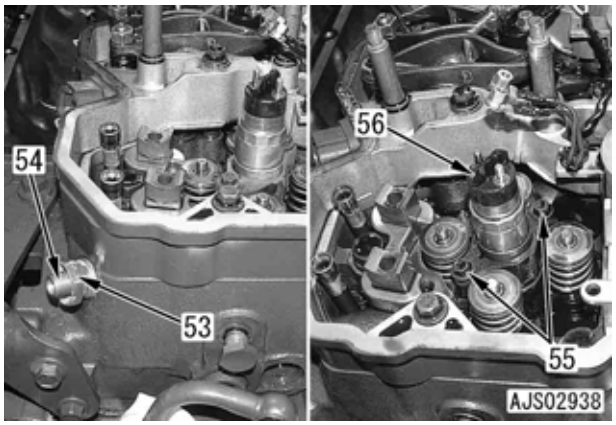
5.8. Tighten inlet connector (54) with retainer (53) by hand. (Push it into the injector hole.)

5.9. Tighten mounting bolts (55) for fuel injector assembly (56) alternately.

N·m Bolt: **8 ± 0.8 Nm {0.81 ± 0.08 kgm}**

5.10. Tighten retainer (53).

N·m Retainer: **50 ± 5 Nm {5.1 ± 0.5 kgm}**



6. Rocker arm and crosshead assembly

6.1. Install rocker arm and crosshead assembly (52).

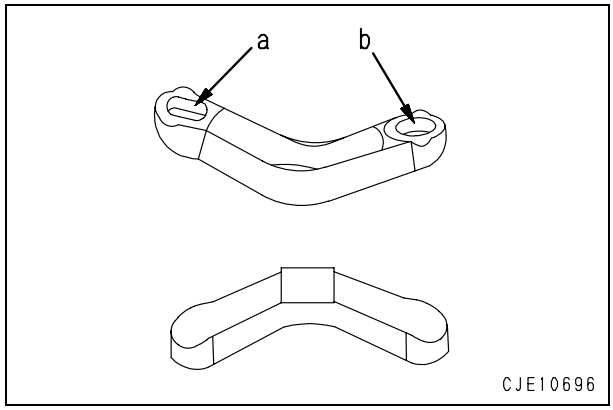
- When reusing the crosshead, install the same intake and exhaust valves in the same direction because the shapes of its holes **a** and **b** are different,
- Tighten the mounting bolt after checking that the ball portion of adjustment screw (51) is well seated in the push rod socket.

N·m Mounting bolt: **36 ± 5 Nm {3.7 ± 0.5 kgm}**

6.2. Adjust the valve clearances.

a Refer to the Adjusting of Valve Clearance section in the TESTING AND ADJUSTING chapter of this manual.

N·m Locknut (50): **24 ± 4 Nm {2.4 ± 0.4 kgm}**

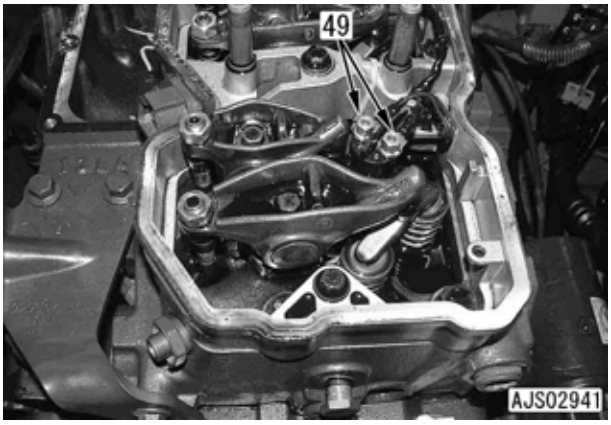




7. Install harnesses (49).
   ✔ Harness installation position

Harness color	Cylinder No.
White	1, 3, 5
Black	2, 4, 6

N·m Mounting nut: **1.5 ± 0.25 Nm {0.15 ± 0.03 kgm}**



8. Fit the O-ring and install head cover (48).

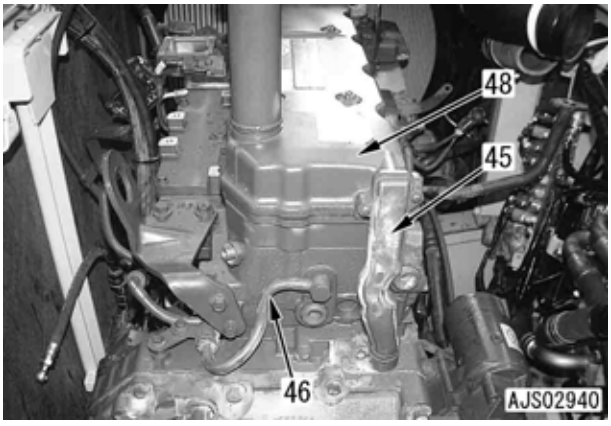
N·m Mounting nut: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

9. Install blow-by duct (45).

N·m Blow-by duct mounting bolt:
10 ± 2 Nm {1.0 ± 0.2 kgm}

10. Install fuel drain hose (46).

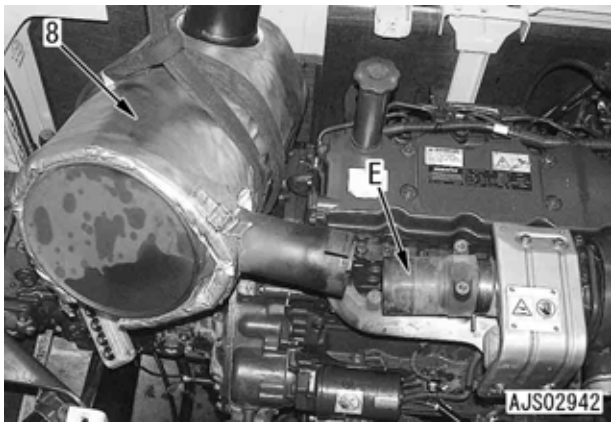
N·m Joint bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**



✔ Carry out the following installation in the reverse order to removal.

[*1]
Install muffler (8) after coating it with thermosetting sealant.

Entire perimeter of E section: thermosetting sealant (equivalent of **Holts Firegum**)



[*2]

N·m Bracket mounting bolt:
43 ± 6 Nm {4.4 ± 0.6 kgm}

[*3]

N·m Air intake connector mounting bolt:
24 ± 4 Nm {2.4 ± 0.4 kgm}

✔ MIKALOR clamp

✔ Use a new clamp.

✔ Align the hose to the original position (marking position).

✔ Reference
Depth of insertion: 60mm (aftercooler side)

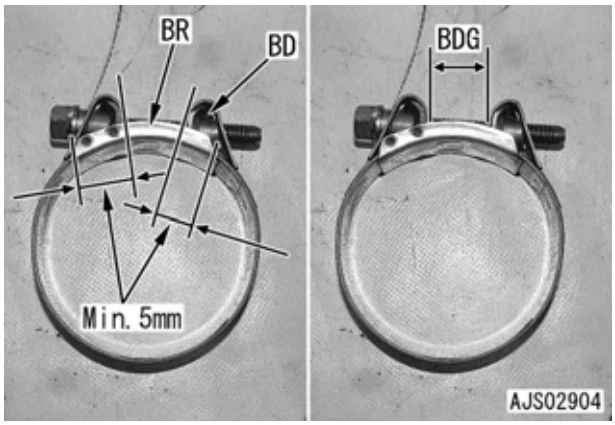
✔ Set bridge (BR) under the clamp tightening bolt as the lap with band (BR) is Min.5mm.

✔ Align the clamp to the original position.

✔ Impact wrench is not applicable to use.

N·m Clamp: **16 – 18 Nm {1.6 – 1.8 kgm}**

✔ When the tightening torque force is less than 16 Nm {1.6 kgm}, tighten it until the hand gap is adhered (BDG size is 0).



[*4]

N·m Radiator hose clamp:
10.8 – 11.8 Nm {1.1 – 1.2 kgm}

[*5]

N·m Joint bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

[*6]

N·m Mounting bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

[*7]

N·m Fuel block mounting bolt:
32 ± 4 Nm {3.3 ± 0.4 kgm}

[*8]

⚠ WARNING

When installing, keep the distance of more than 10 mm between the high-pressure pipe and the harness.

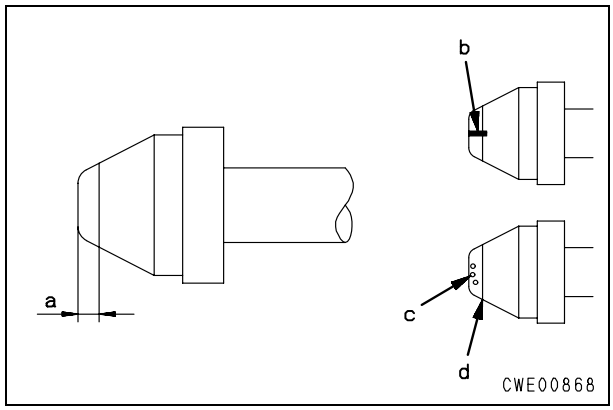
[*9], [*10]

✔ High-pressure pipes and common rail

⚠ WARNING

- **Do not use high-pressure pipes with bending modification.**
- **Be sure to use a genuine high-pressure pipe fixing clamp and observe strictly the tightening torque.**

✔ A high-pressure pipe which has depressions such as visible vertical slit scar (b), patchy scars (c) etc. on the taper seal section of its connector ((a) part: within 2 mm from the tip), or a high-pressure pipe whose (d) part (end of the taper seal section: 2 mm from the tip) catches on a finger nail due to fatigue, may cause fuel leakage. In these cases, replace the high-pressure pipe.



10.1. Assemble common rail (25) and high-pressure pipes (71) – (76) temporarily.

N·m Sleeve nut and mounting bolt:
0.2 – 0.8 Nm {0.02 – 0.08 kgm}

10.2. Tighten high-pressure pipes (71) – (76) according to the following procedure.

N·m Sleeve nut: **35 ± 3.5 Nm {3.6 ± 0.4 kgm}**

10.2.1 Head side of high-pressure pipes (71) and (76)

10.2.2 Common rail side of high-pressure pipes (76) and (71)

10.2.3 Head side of high-pressure pipes (72), (73), (74) and (75)

10.2.4 Common rail side of high-pressure pipes (72), (73), (74) and (75)

10.3. Tighten the sleeve nut of high-pressure pipe (22) temporarily.

10.4. Tighten high-pressure pipe (22) in the order of firstly pump (FSP) side, then common rail (25) side.

N·m Sleeve nut: **35 ± 3.5 Nm {3.6 ± 0.4 kgm}**

10.5. Tighten clamp (21) of high-pressure pipe (22).

N·m Mounting bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

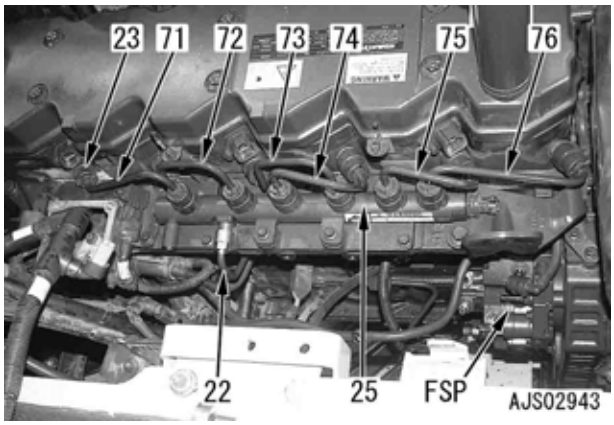
10.6. Tighten common rail (25) with four bolts.

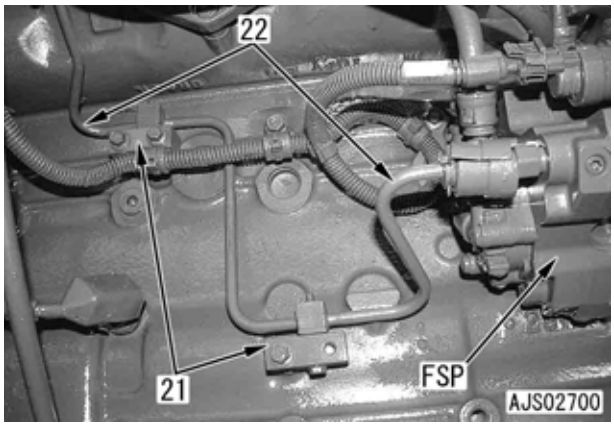
- Coat the two bolt threads on the inner side of the engine with sealant (LG-7).

N·m Mounting bolt: **24 ± 4 Nm {2.4 ± 0.4 kgm}**

10.7. Install bellows (23) to each high-pressure pipe. (14 pieces)

- Set the slits of each bellows out and down.
- The bellows are installed so that fuel will not spout over the hot parts of the engine and catch fire when it leaks for some reason.
- FSP: Fuel supply pump





[*11]

N·m Air tube clamp:
10.0 – 11.0 Nm {1.02 – 1.12 kgm}

[*12]

- MIKALOR clamp
- Reference
- Length of insertion: 40 mm (turbocharger side)
- Refer to [*3].

[*13]

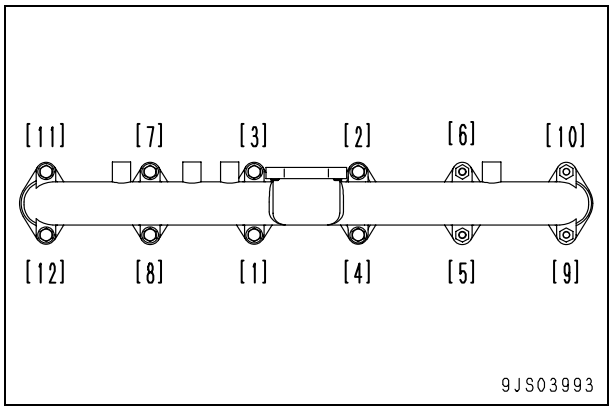
N·m Lubrication inlet hose tightening nut:
35 ± 5 Nm {3.5 ± 0.5 kgm}

N·m Lubrication outlet hose mounting bolt:
24 ± 4 Nm {2.4 ± 0.4 kgm}

[*14]

✔ Tighten the bolts in the order shown below.

Exhaust manifold mounting bolt:
First time:in the order of [1] – [12]
Tighten to a torque of
24 ± 4 Nm {2.4 ± 0.4 kgm}.
Second time:in the order of [2] – [12]
Tighten to a torque of
53 ± 6 Nm {5.4 ± 0.6 kgm}.
Third time:in the order of [1] – [4]
Tighten to a torque of
53 ± 6 Nm {5.4 ± 0.6 kgm}.



[*15]

Fan mounting bolt:
43 ± 6 Nm {4.4 ± 0.6 kgm}

[*16]

✔ Refer to the Inspection and Adjustment of Air Compressor Belt Tension section in the Testing and adjusting chapter of this manual.

✔ Refilling engine coolant
Refill water through the water filler port up to the specified level. Start the engine and circulate the water, and then check the water level.

Coolant: **Approx. 21.4ℓ**

Removal and installation of combination cooler assembly

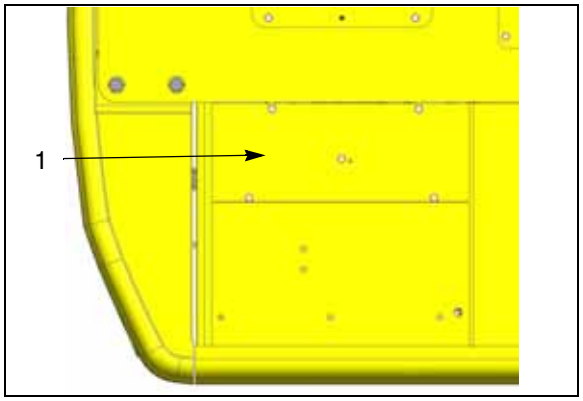
Removal

WARNING

Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filter cap slowly to release the pressure inside the hydraulic tank.

- Remove the hydraulic tank strainer, and using tool B stop the oil.
- When not using tool B, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

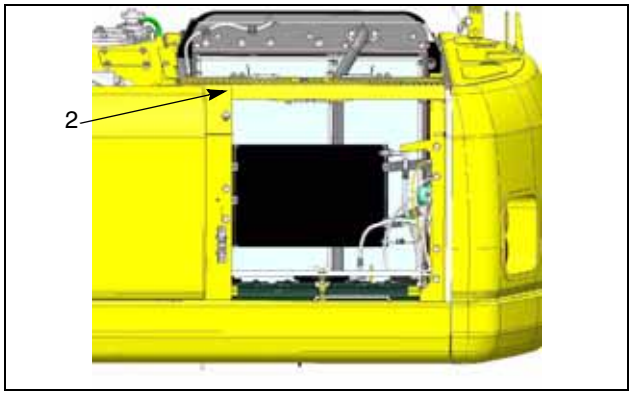
1. Remove cover (1).



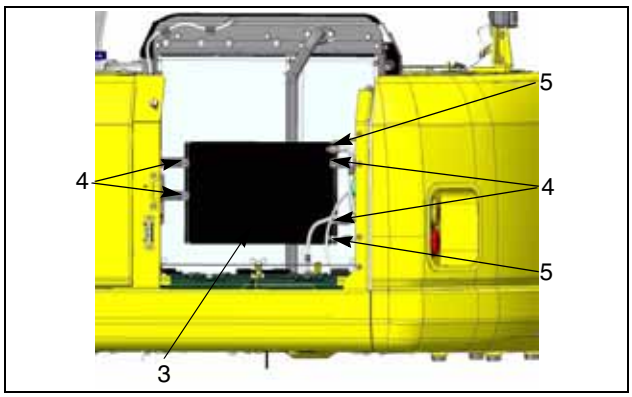
2. Drain the engine cooling water.

Engine cooling water: Approx. 17.6 ℓ

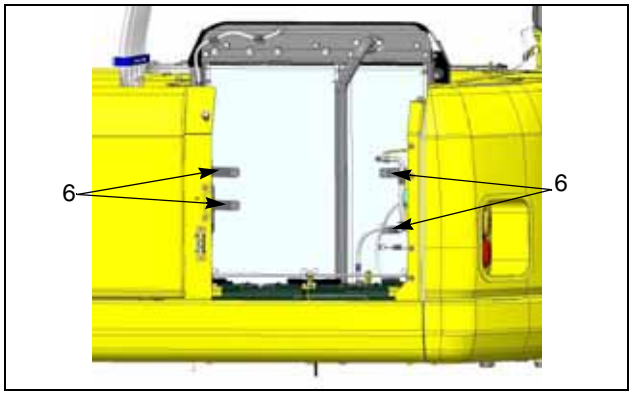
3. Open up the engine hood and remove (see page page 30-50).
4. Remove radiator top cover (2).



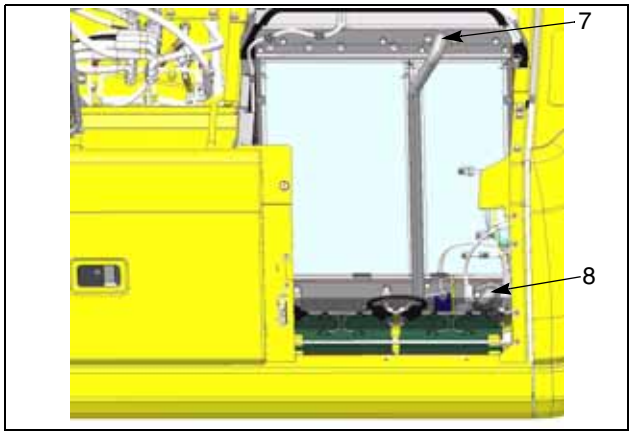
5. Remove condenser (3) by removing 8 bolts (4). Be sure to disconnect hoses (5).



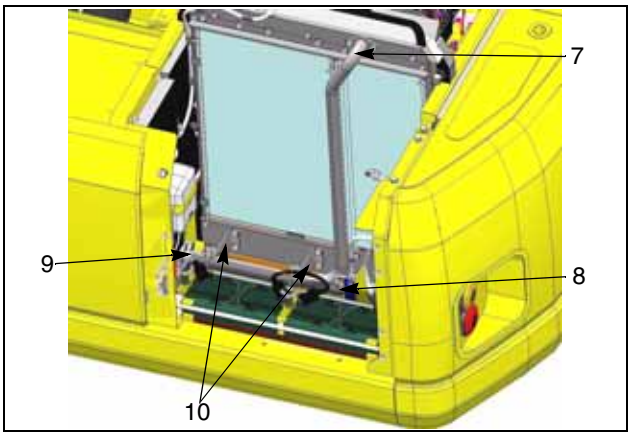
6. Remove brackets (6).



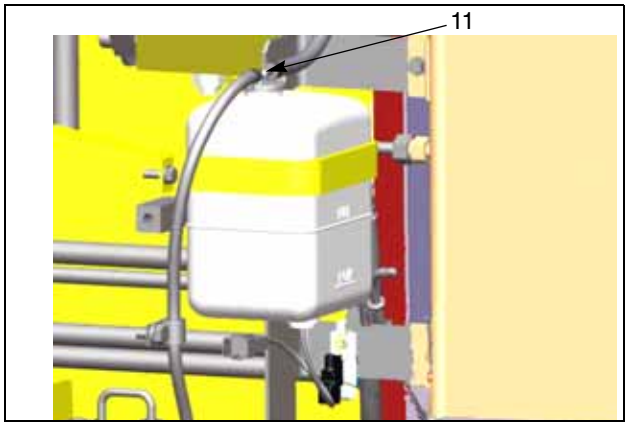
7. Disconnect oil cooler inlet (7) and outlet (8) pipes.



8. Disconnect pipes (7) and (8) at point (9), also remove brackets (10).

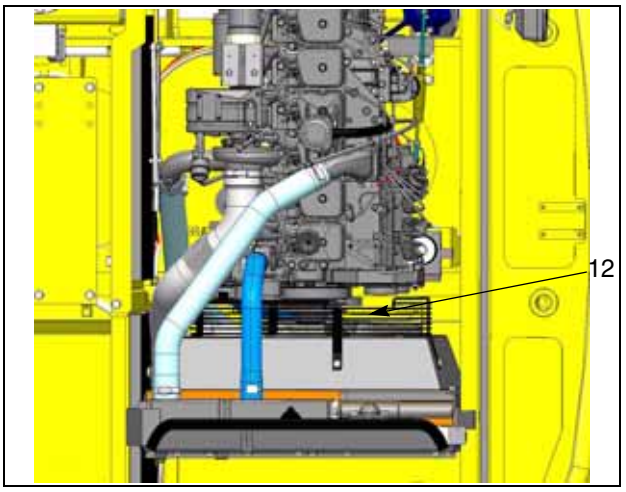


9. Disconnect and remove fuel cooler. (see page 30-49)
10. Disconnect reservoir tank (11).

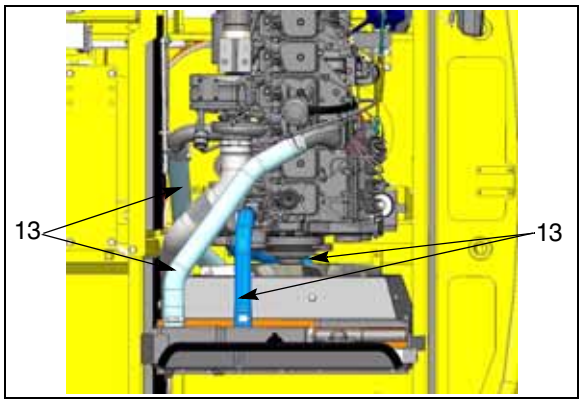


11. Remove fan guard (12).

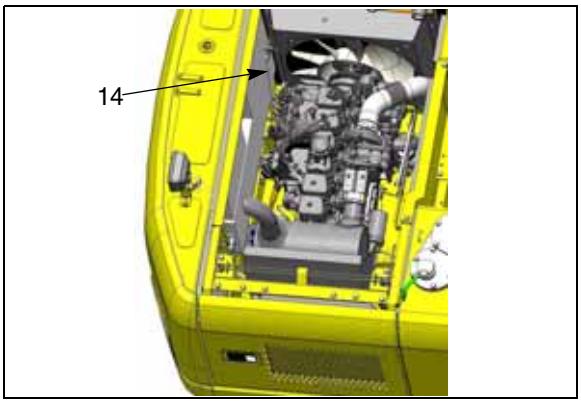
.



12. Remove 4 hoses (13).



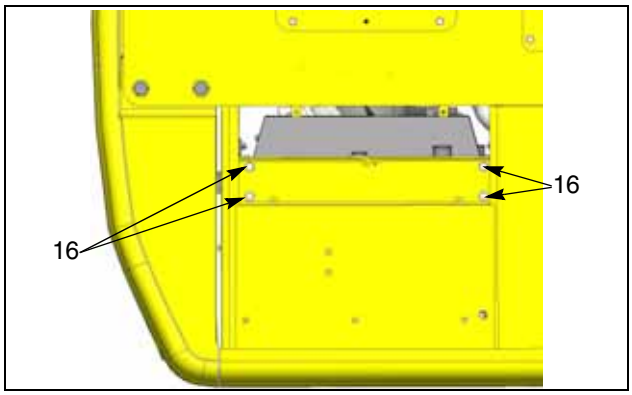
13. Remove support bars (14). (Either side of the cooler assembly)



14. Sling radiator assembly with two lifting hooks. **(But do not lift!)**



15. Remove 4 mounting bolts (16) and lift radiator assembly out.



Installation

✔ Install in reverse order of removal.

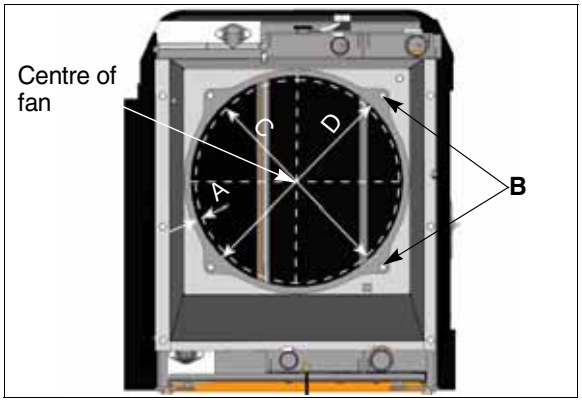
Radiator hose clamp bolt:
0.55 - 0.65 kgm

✔ To maintain the heat balance, make sure that sponge sheets are assembled in the original position.

✔ Adjust clearance **A** between the cooling fan circumference and the shroud, adjuster ring using oblong hole **B** for mounting the bell mouth shroud, adjuster ring so that the clearance may be even all around the circumference.

✔ Check that clearance **A** shows the following value, measured at four points on the right, left, top and bottom sides.

- ✔ Standard clearance **A** (on all the circumference): More than 10 mm
- ✔ Fan diameter **C**: ∅545
- ✔ Shroud inner diameter **D**: ∅580



- Refilling engine cooling water
  Refill engine cooling water through the water filler port up to the specified level. Let the water circulate to release any air pockets by starting the engine. Check the water level again.

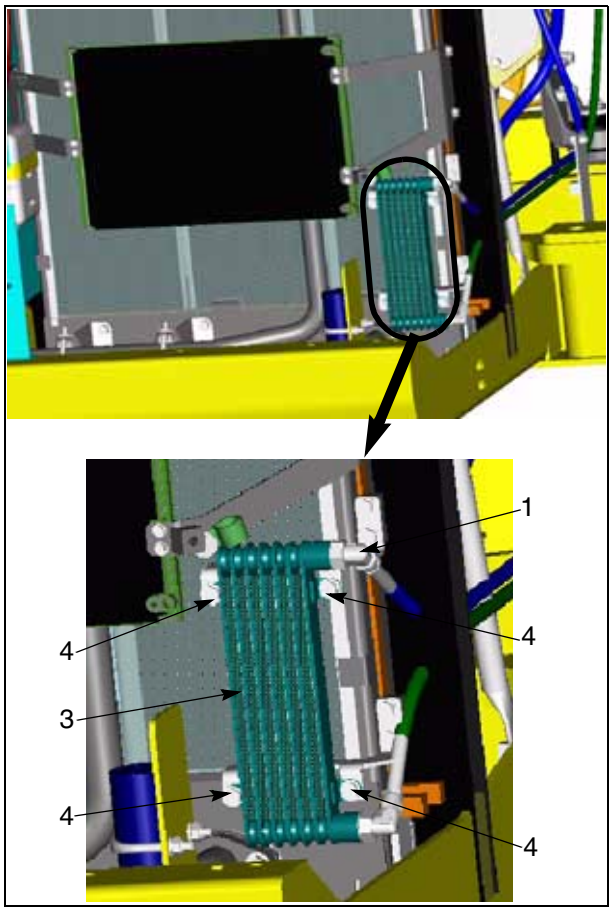
Engine cooling water: Approx. 17.6 ℓ

Removal and installation of fuel cooler assembly

Removal

✔ If the fuel is too much, drain the fuel in order to stop the fuel flow from the fuel tank return hose.

1. Disconnect fuel hose (1) and (2) with the precaution described below.
   - ✔ To prevent undue force being exerted on the fuel cooler, use two wrenches to disconnect the hoses. One to hold the elbow the other to disconnect the hose.
   - ✔ Be sure to use the two wrenches, otherwise the force is loaded to the cooler body and the weld portion (M) may be separated.
2. Remove fuel cooler assembly (3) by removing 4 bolts (4).



Installation

- Installation is done in the reverse order of removal.

Removal and installation of engine and hydraulic pump assemblies

Special tools

Mark	Part No.	Part Name
D	796-460-1210	Oil Stopper

Removal

⚠ WARNING

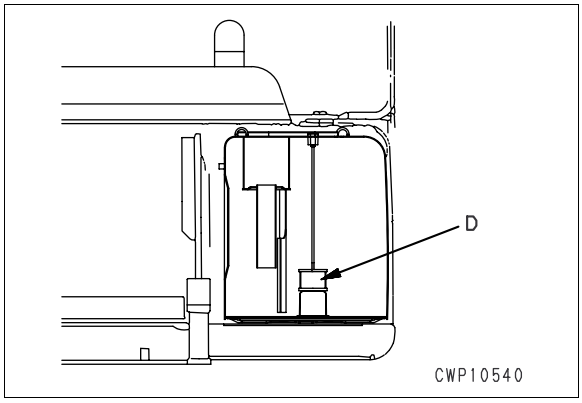
- **Lower the work equipment to the ground for safety and stop the engine. Disconnect the cable from the negative terminal (-) of the battery.**
- **To release the internal pressure, gradually loosen the oil filler cap on the hydraulic tank.**

✔ Attach an identification tag to each pipe. This will avoid a possible mistake when reinstalling.

1. Remove the hydraulic tank strainer and stop the flow of oil, using Tool **D**.

✔ When not using tool **D**, remove the drain plug to drain oil from the hydraulic tank and piping.

Hydraulic tank: Approx. 160 ℓ



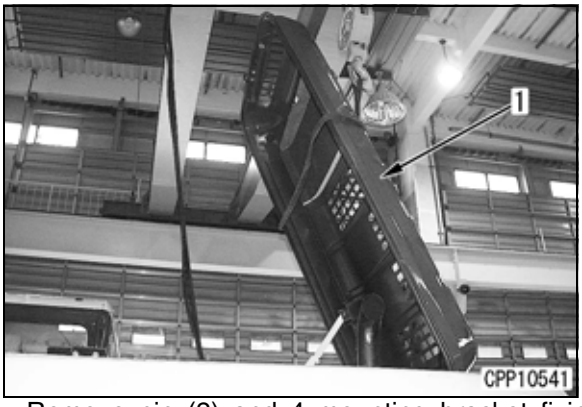
2. Drain engine cooling water.

Engine cooling water: Approx. 17.6 ℓ

3. Lift up engine hood (1).

⚠ WARNING

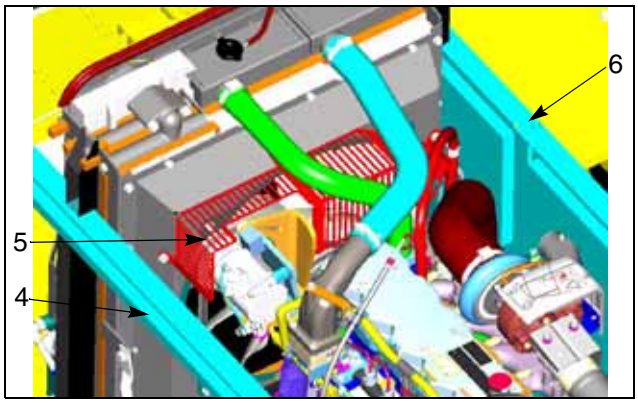
Support the engine hood with an appropriate strap and lifting device.



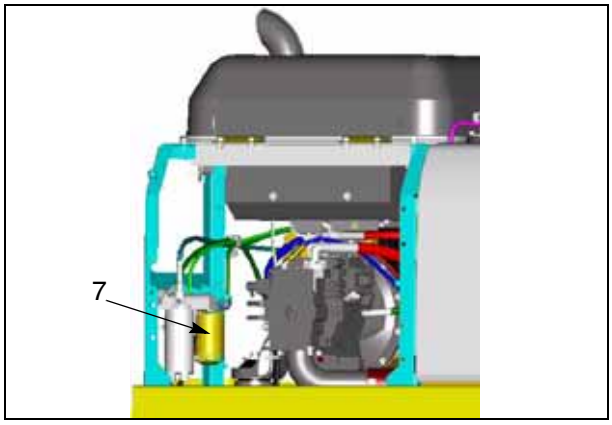
4. Remove pin (2) and 4 mounting bracket fixing bolts (3). Lift off the hood and mounting bracket and set them aside.



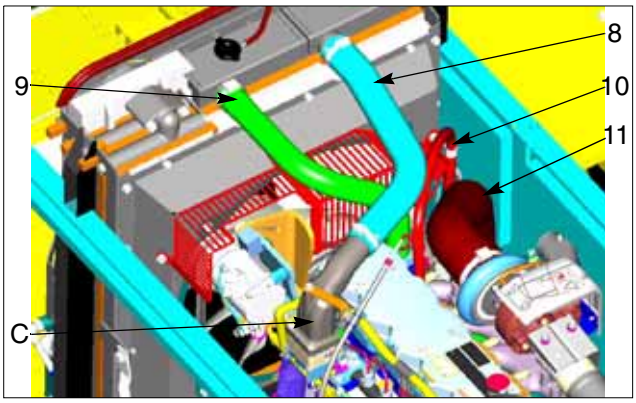
5. Remove angle (4).
6. Remove radiator fan guards (5).
7. Remove centre partition (6).

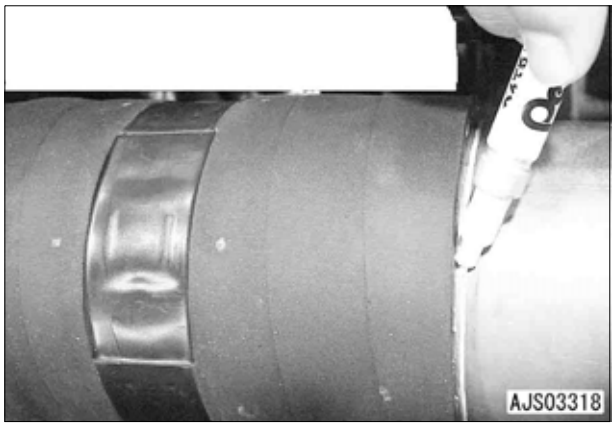


8. Remove fuel filter and bracket assembly (7).
   - Put it on the engine.

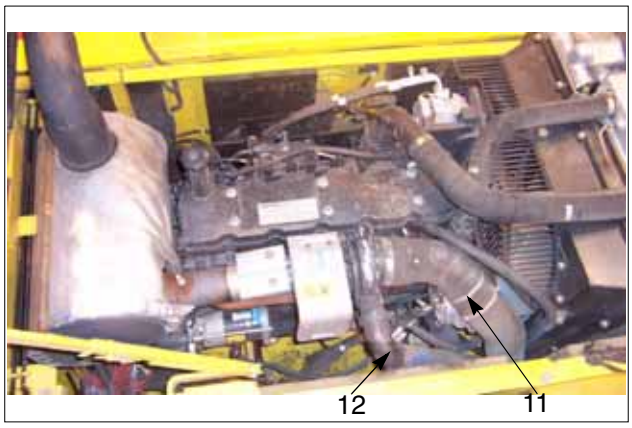


9. Remove hose and tube assembly (8).
   - Mark the hose edge and tube to show the original hose installation positions. (See figure below.)
   - If disconnecting air intake connector (C), replace the gasket.
10. Disconnect radiator hose (9). [*1]
    - Mark the hose edge and tube to show the original hose installation positions.
11. Disconnect heater hose (10).

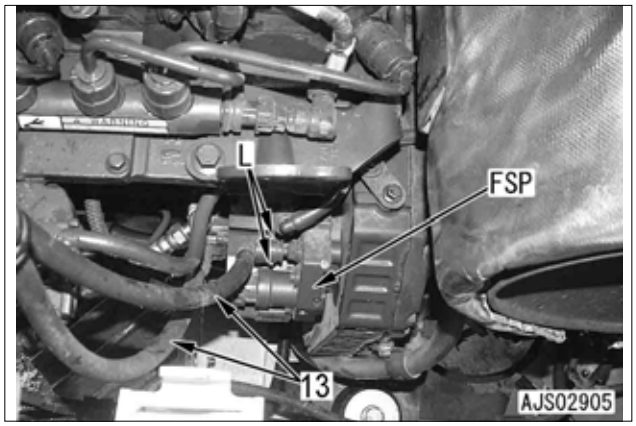




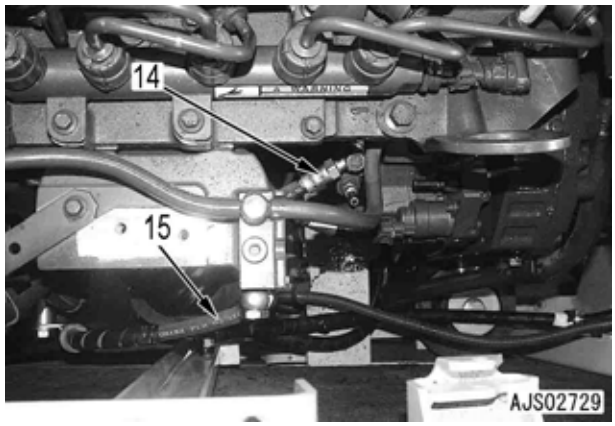
12. Disconnect air cleaner tube (11). [*2]
13. Remove after cooler hose and tube assembly (35).
    - Mark the hose edge and tube to show the original hose installation positions. (See figure below.)



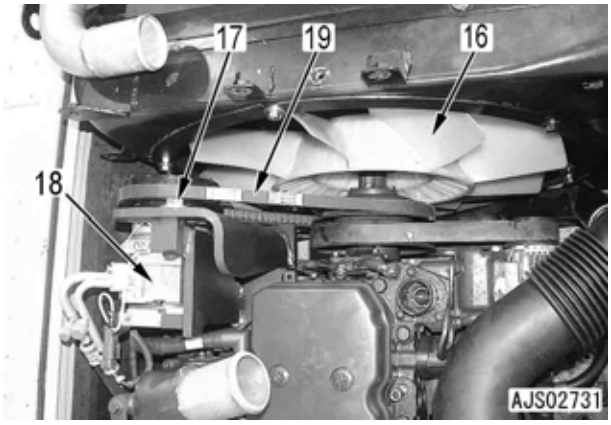
14. Disconnect fuel filter hose (13) from fuel supply pump (FSP).
    - The fuel filter hose can be disconnected by pushing locks (L) at both sides.



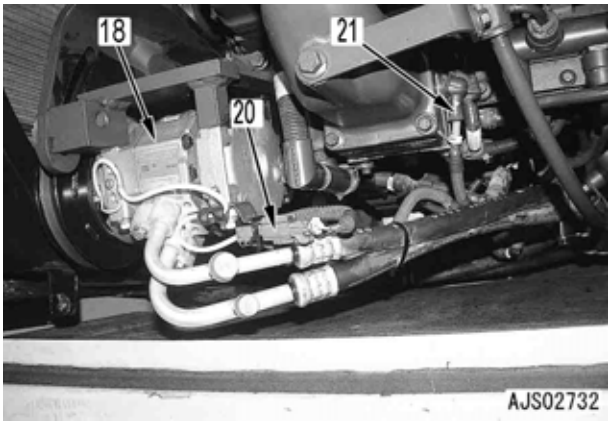
15. Disconnect fuel supply hose (14).
16. Disconnect fuel return hose (15).
    - Disconnect the clamp.



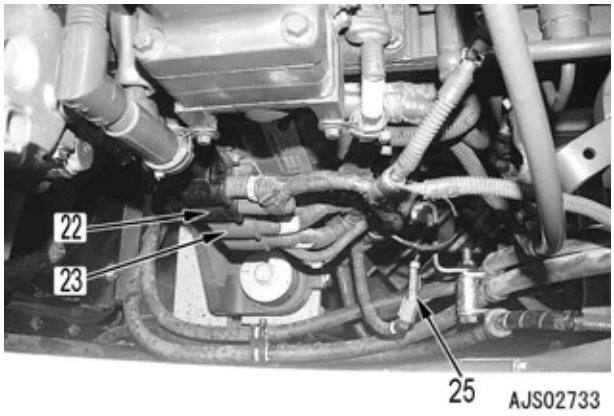
17. Remove fan (16). [*3]
18. Loosen air conditioner compressor bracket adjusting bolt (17).
    - ✔ There is another bolt behind.
19. Move air conditioner compressor assembly (18). [*4]
20. Remove fan belt (19).

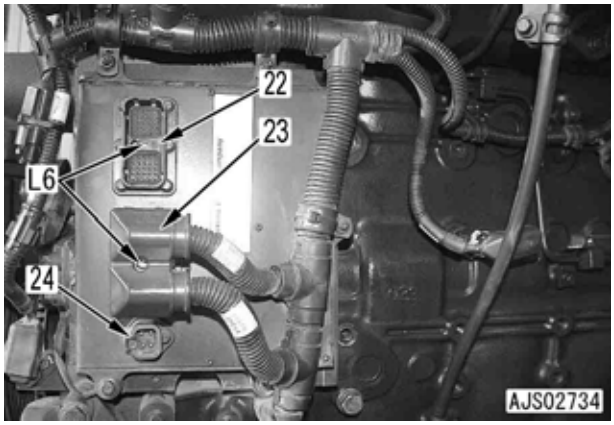


21. Disconnect connector AC02 (20).
22. Remove air conditioner compressor assembly (18).
    - ✔ Remove air conditioner compressor assembly in one piece with the bracket and put them on the counter weight.
23. Disconnect ribbon heater connector E01 (21).

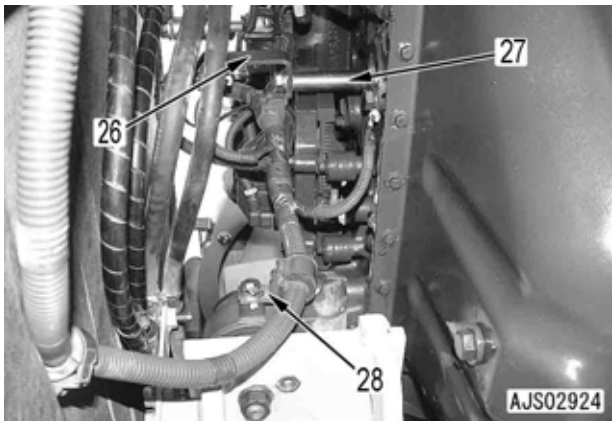


24. Disconnect connectors CE02 (22) and (23) from the engine controller.
    - ✔ The connector is locked with the inside hex head bolt L6 (4 mm).
    - ✔ Connector (23) is attached at the engine side, however it needs to be removed not to be obstructive in removing the engine mounting bolts.
25. Disconnect connector (24) from the engine controller by pushing the lock.
26. Disconnect connector E06 (25).

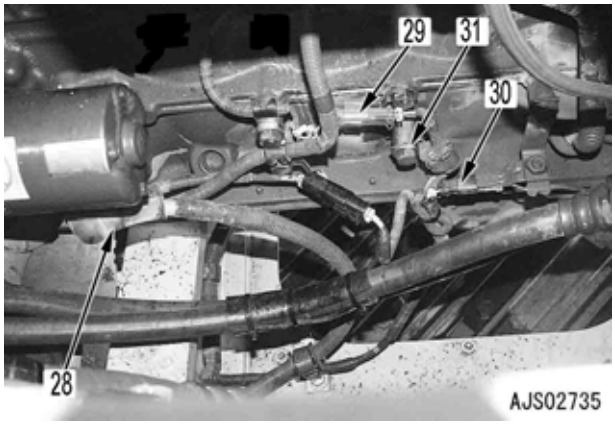




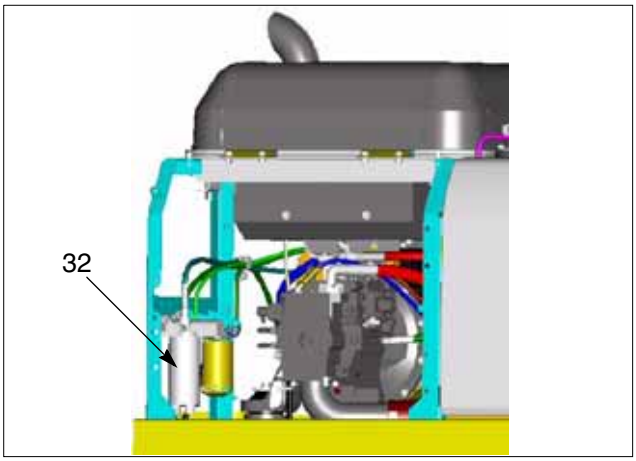
27. Disconnect bracket (26) and remove spacer (27).



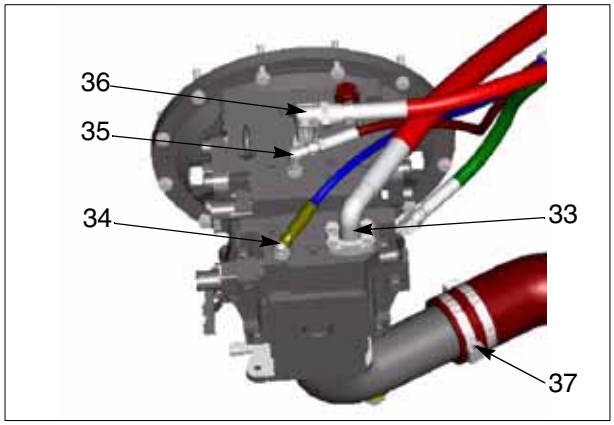
28. Disconnect terminals (28) from the starter B and C.
29. Disconnect connectors E12 and alternator terminal'B' (29) and E03 (30).
30. Disconnect clamp (31).



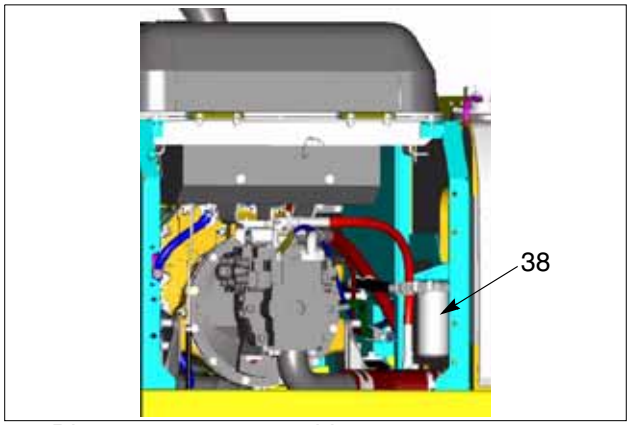
31. Remove filter and bracket assembly (32).



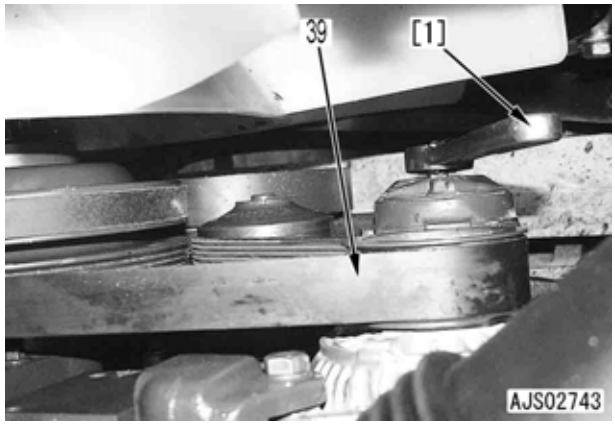
32. Disconnect four hoses.
    - q (33): Pump delivery hose
    - q (34): EPC basic pressure port hose
    - q (35): Pump pressure input port hose
    - q (36): Drain port hose
33. Disconnect suction elbow (37).



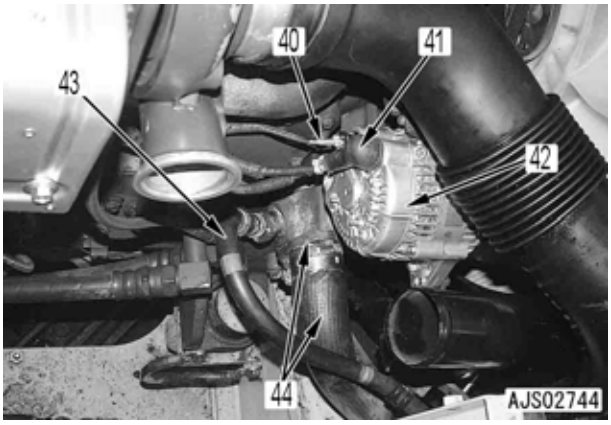
34. Disconnect remote oil filter from frame (38).



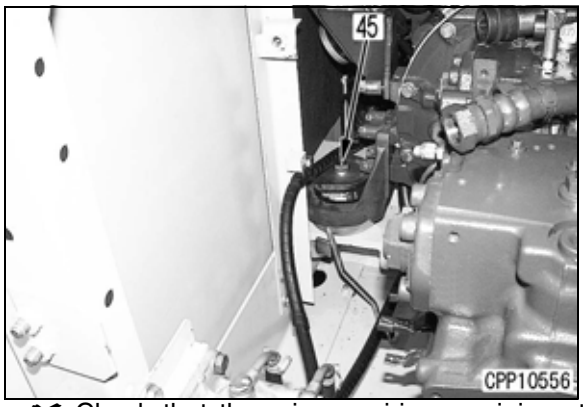
35. Disconnect pump wiring connectors at two points.
    - q V21 PC-EPC solenoid valve
    - q A55 hydraulic oil temperature
    - q V22 LS-EPC solenoid valve
36. Remove fan belt (39) from the alternator with wrench [1].



37. Disconnect connectors AB (40) and E12 (41).
38. Remove alternator (42).
39. Disconnect heater hose (43).
40. Remove three bolts and disconnect radiator hose and flange assembly (44). [*5]



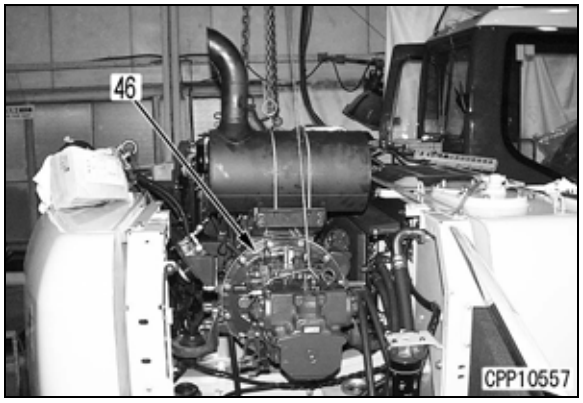
41. Disconnect engine ground.
42. Remove four engine mounting bolts (45) at the front and rear. ⊠6



✔ Check that there is no wiring or piping still connected.

43. Lift out engine and hydraulic pump assembly (46).

kg Engine and hydraulic pump assembly: 800 kg



Installation

✔ Installation is done in the reverse order of removal.

[*1]

a Align the hose to the original position (marking position).

a Align the clamp to the original position.

N·m Radiator hose clamp: **10.8 – 11.8 Nm {1.1 – 1.2 kgm}**

[*2]

N·m Tube clamp: **10.0 – 11.0 Nm {1.02 – 1.12 kgm}**

[*3]

N·m Fan mounting bolt: **43 ± 6 Nm {4.4 ± 0.6 kgm}**

[*4]

✔ Refer to the Inspection and Adjustment of Air Compressor Belt Tension section in the Testing and adjusting chapter in this manual.

[*5]

N·m Flange mounting bolt: **43 ± 6 Nm {4.4 ± 0.6 kgm}**

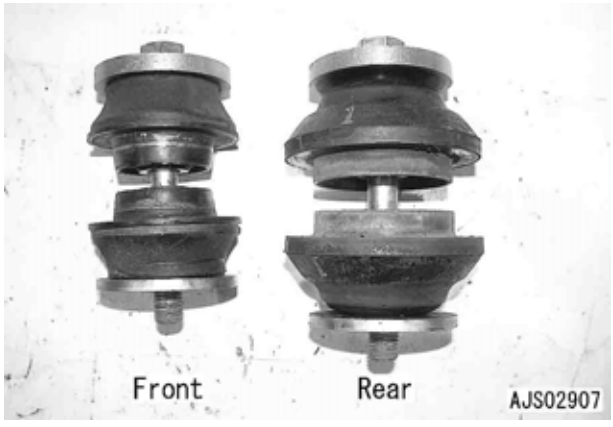
✔ Reference
Inserted radiator hose length: **40 mm**

N·m Radiator hose clamp: **10.8 – 11.8 Nm {1.1 – 1.2 kgm}**

[*6]

a The bolt length of the engine front side is shorter than that of rear side.

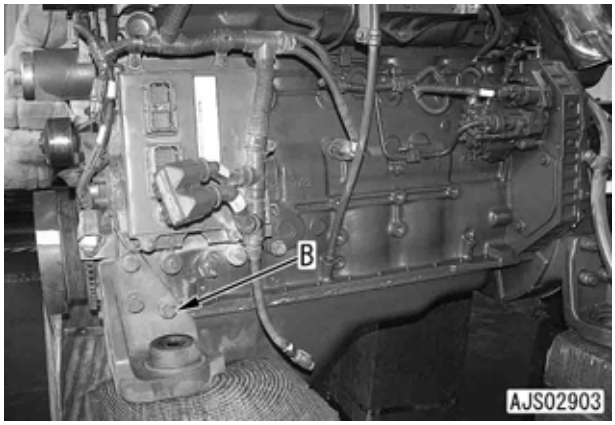
a The engine mounting rubber size of the engine front side is smaller than that of rear side.



N·m Engine mounting bolt (4 points): **245 – 308.9 Nm {25 – 31.5 kgm}**

✔ Reference

Engine mounting bracket (4 points) bolts:
122.5 – 147 Nm {12.5 – 15 kgm}



- **Refilling engine coolant**
  Refill water through the water filler port up to the specified level. Start the engine and circulate the water, and then check the water level.

Coolant:**Approx. 17.6ℓ**

- **Refilling with oil (hydraulic tank)**
  Refill hydraulic oil through the oil filler port to the specified level. Let the oil circulate in the hydraulic system by starting the engine. Then check the oil level again.

Hydraulic tank:**Approx. 160ℓ**

Hydraulic tank drain plug:
58.8 – 78.5 Nm {6.0 – 8.0 kgm}

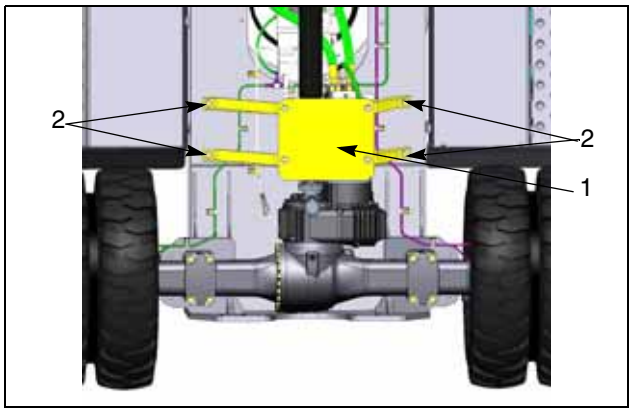
- **Air bleeding**
  Bleed the air from the circuit between the valve and the hydraulic cylinder. For details, see Testing and adjusting, Air Bleeding of Various Parts.

Removal and installation of travel motor assembly

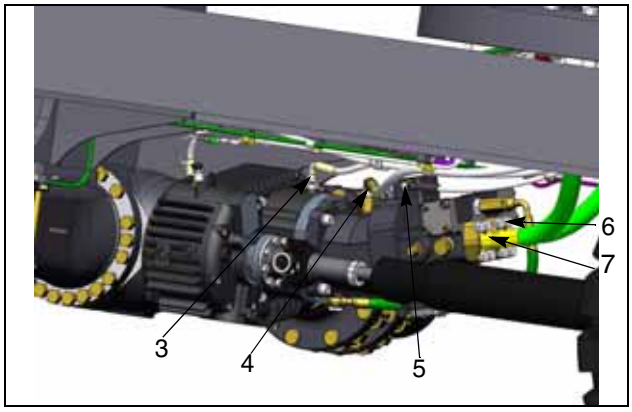
Removal

Blanking Kit			
Description	Part Number	Qty	Where Used
Cap Plug O-ring	07376-70422 02896-11012	1 1	Top Drain Hose
Cap Plug O-ring	07376-70210 02896-11008	1 1	Top Pilot Pressure Hose
Flange O-ring Bolt Washer	07379-01260 07000-13038 01010-51245 01643-51032	2 2 8 8	Front Main Travel Hoses

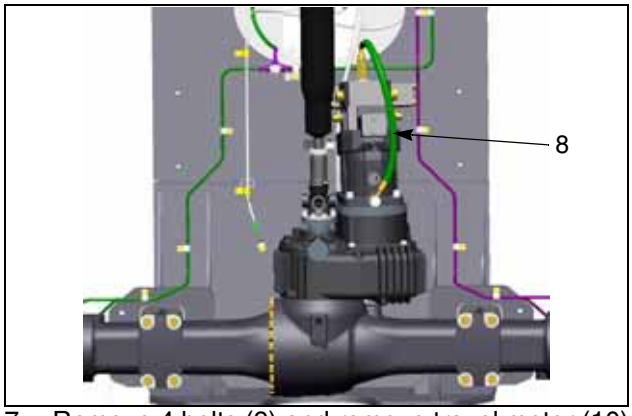
1. Remove cover (1) by removing bolts (2).



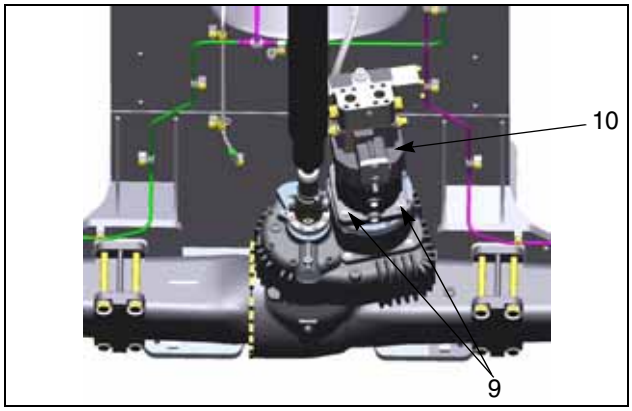
2. Drain oil out of transmission and travel motor.
3. Attach an identification tag to hoses to avoid incorrect connection during re-assembly.
4. Attach vacuum pump to hydraulic tank.
5. Disconnect each hose individually and plug with blank/plug and O-ring from blanking kit to prevent oil spillage and contamination (3 through 7).



6. Remove drain hose (8).



7. Remove 4 bolts (9) and remove travel motor (10) in direction shown to disengage the splined shaft. (Weight approx. 66 kg).

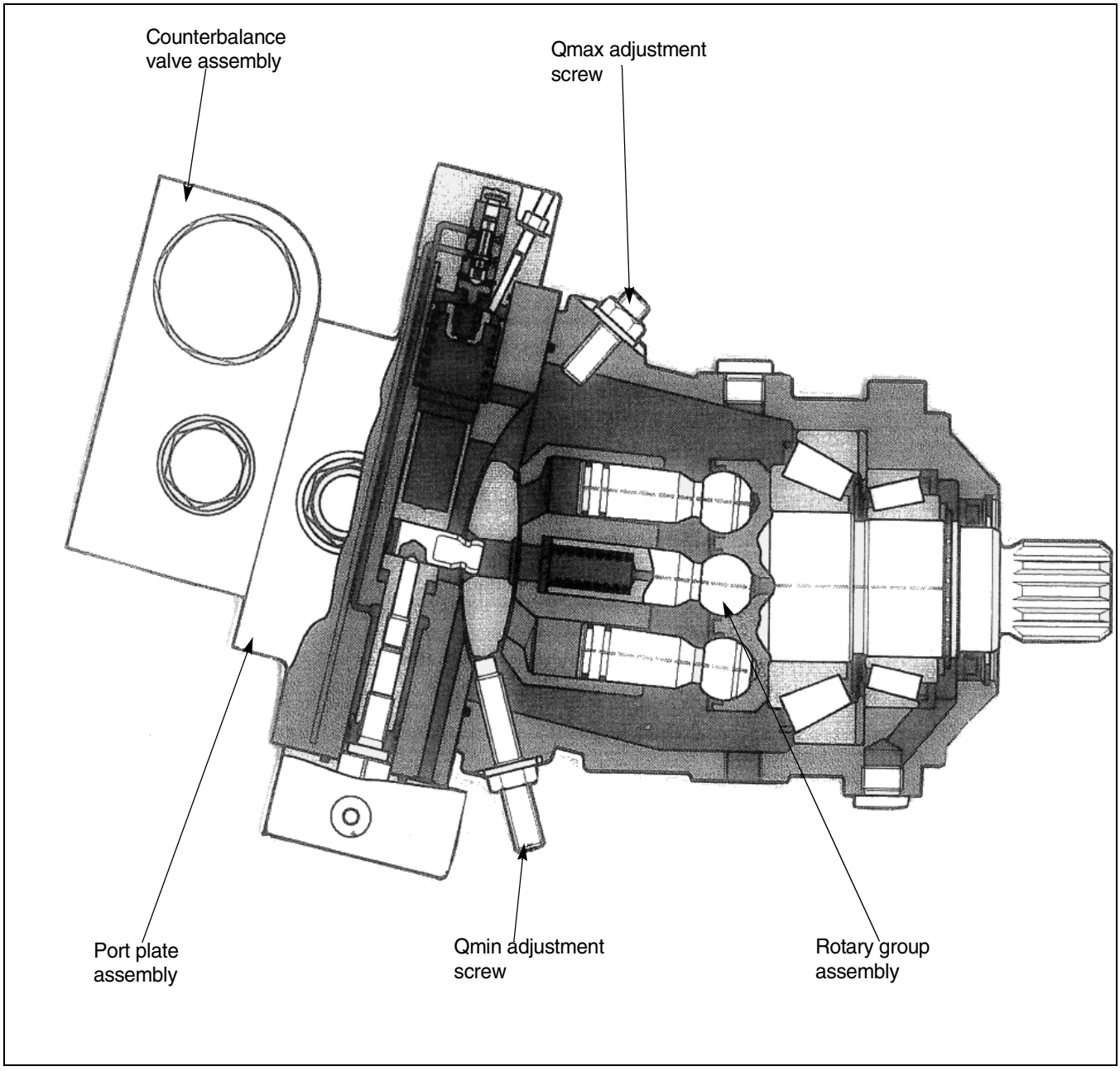


Installation

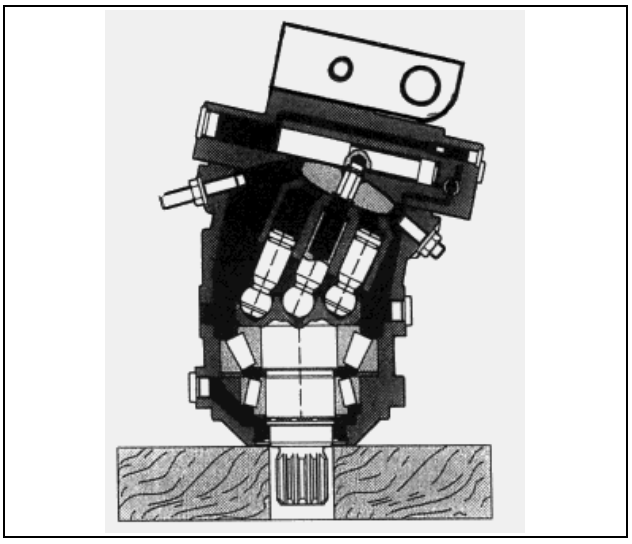
- Install in reverse order of removal.
- Tightening torque for propshaft nuts is: 25 - 31.5 kgf-m
- Refill the transmission oil to the required level (4.85 litres).
- Top up hydraulic through oil filler port to the specified level and let the oil circulate in the hydraulic system by starting the engine. Then check oil again.
- Air bleeding
  Refer to the Air Bleeding of Various Part section in the TESTING AND ADJUSTING chapter of this manual.

Disassembly and assembly of travel motor assembly

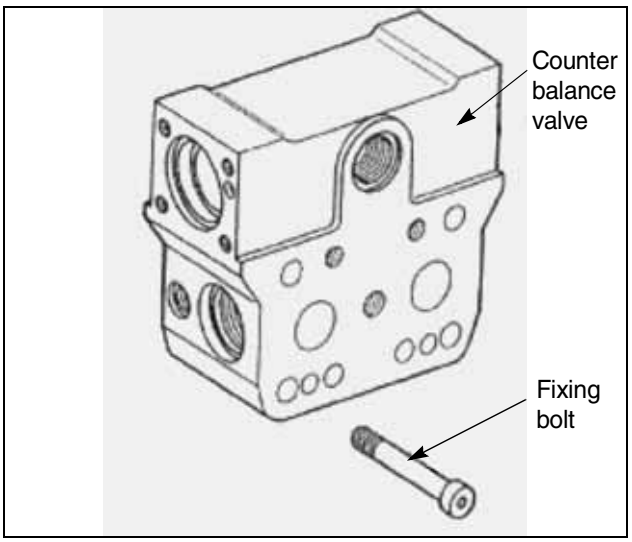
Disassembly



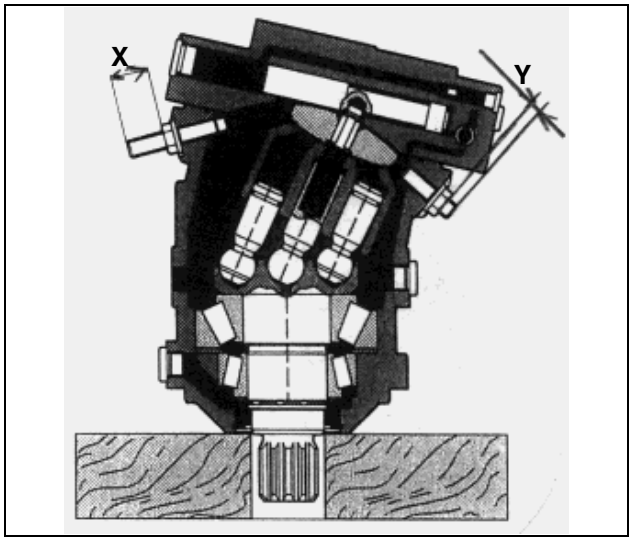
1. Put the unit in a bench with a hole or place it on a fixture for assembly.



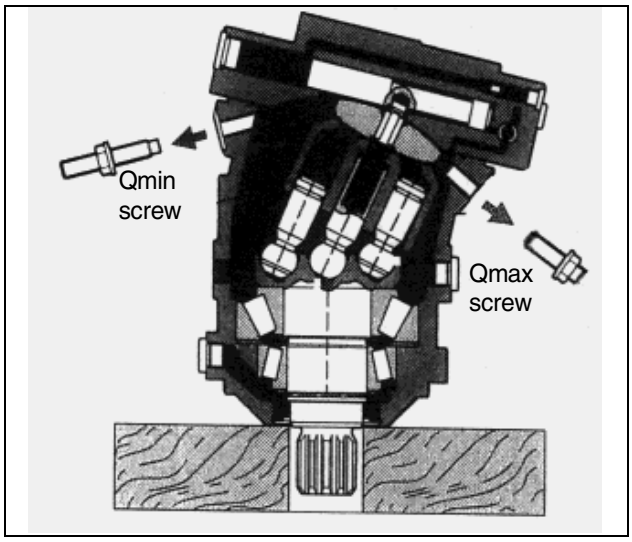
2. Remove the counterbalance valve by loosening the six fixing bolts.



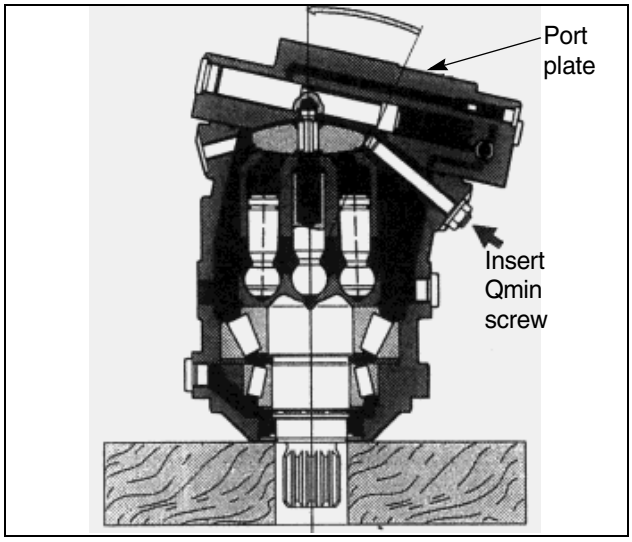
3. Before removing the port plate measure and record dimension **X** of the Qmin adjustment screw and dimension **Y** of the Qmax adjustment screw.



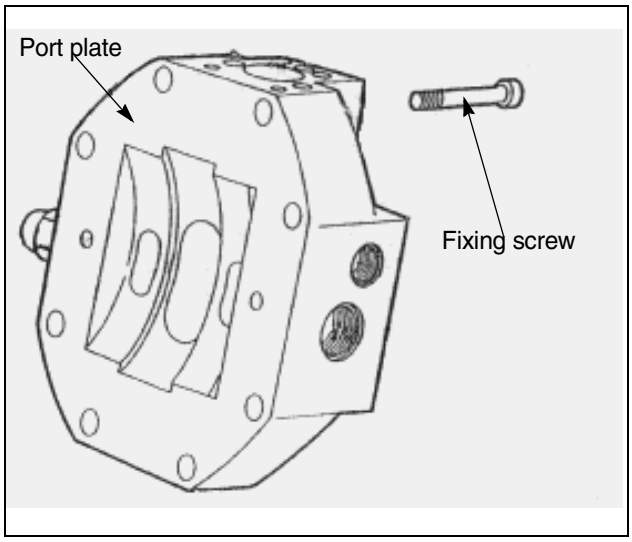
4. Remove the adjustment screws completely from the motor casing.



5. Insert the Qmin adjustment screw into the Qmax threaded hole and turn screw until the rotary group is at the zero displacement position (should be vertical).

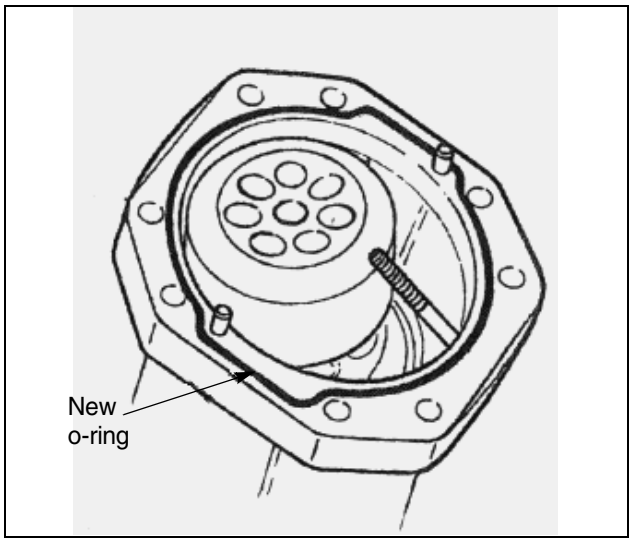


6. Remove the port plate by loosen the eight fixing bolts.

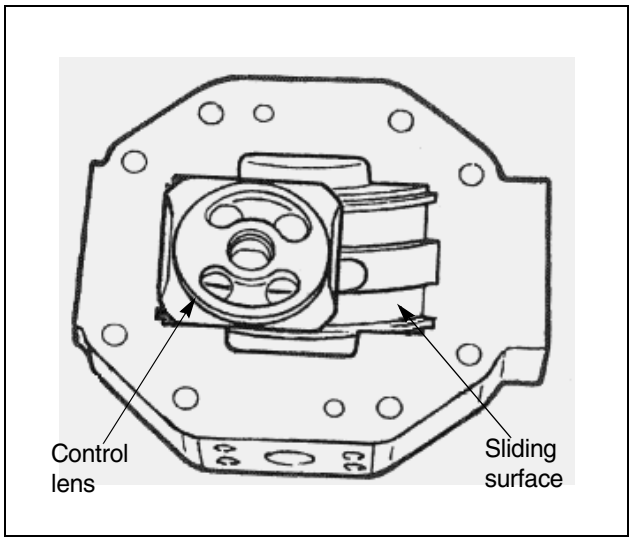


Assembly

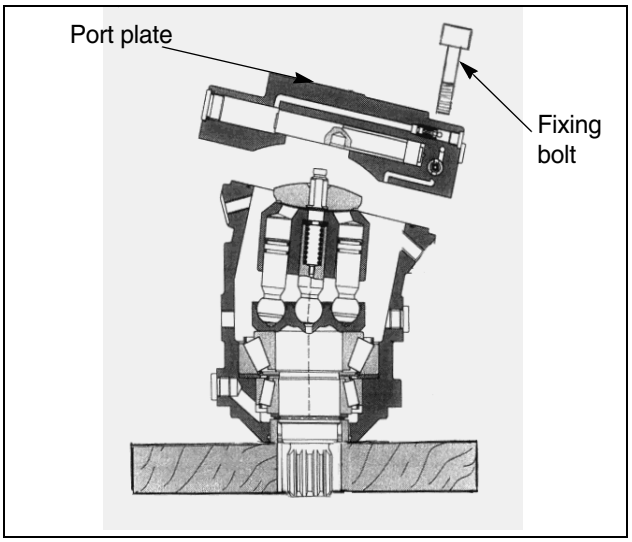
1. Do not remove rotary group from casing, just check for signs of damage or wear.
   Replace O-ring and install into position using grease.



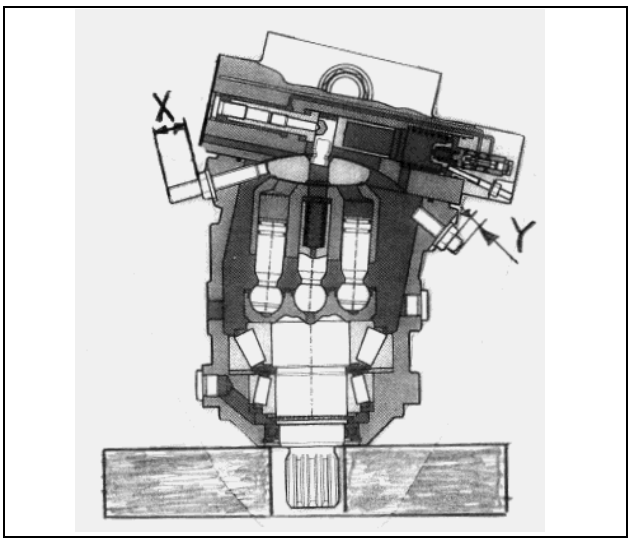
2. Apply grease to control lens sliding surface.



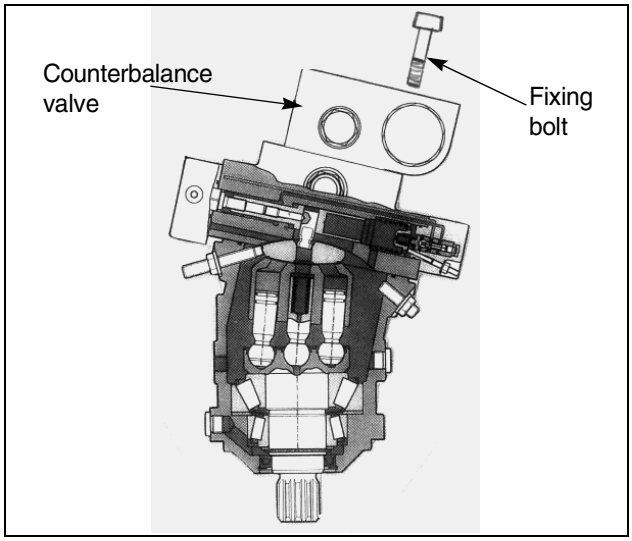
3. Assemble the port plate by locating the lens plate onto the rotary group.
   Secure the port plate by tightening the eight fixing bolts.
   Tightening torque - 310 Nm



4. Insert the Qmin and Qmax adjustment screws and set at dimensions **X** and **Y** which were recorded during the disassembly procedure.



5. Assemble the counterbalance valve assembly using the six fixing bolts.
   Tightening torque - 205 Nm.



Removal and installation of swing motor and swing machinery

Removal

⚠ WARNING

Release the residual pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Release of residual pressure from hydraulic circuit.
Lower the work equipment to the ground in a stable position and set the safety lock lever to the LOCK position.

1. Disconnect 6 hoses (1) – (5).

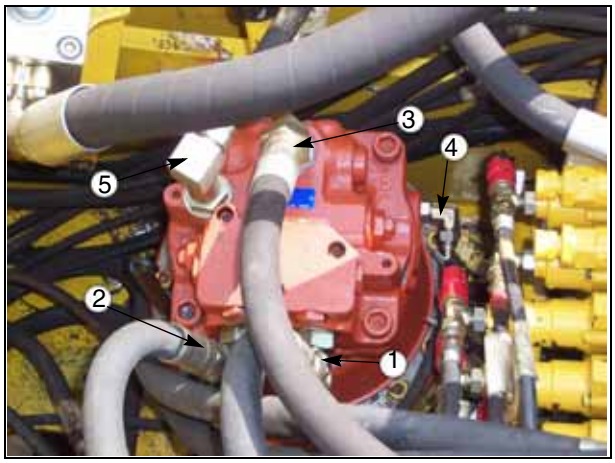
1.1. Between swing motor and control valve (Port MA)

1.2. Between swing motor and control valve (Port MB)

1.3. Suction hose (Port S)

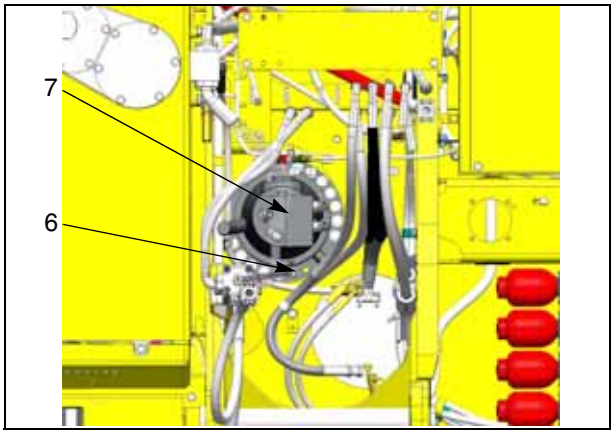
1.4. Drain hose between swing motor and swivel joint (Port DB)

1.5. Drain hose between swing motor and hydraulic tank (Port DB)



2. Remove 13 mounting bolts. Using forcing screws (6) {one located on opposite side}, lift off swing motor and swing machinery assembly (7).
   ✕ Take care that the assembly will not interfere with the hoses around it.

kg Swing motor and swing machinery assembly: **170 kg**



Installation

✔ Carry out installation in the reverse order to removal.

- **Refilling with oil**

  ✔ Add oil through the oil filler to the specified level. Run the engine to circulate the oil through the system. Then, check the oil level again.

- **Bleeding air**

  ✔ For details, see TESTING AND ADJUSTING, Bleeding air from each part.

Disassembly and assembly of swing machinery

Special tools

Symbol		Part No.	Part name
G	1	KBATZ080080	Wrench
	2	KBATZ030190	Adapter
	3	KBATZ060400	Stopper

Disassembly

1. Draining oil
   Loosen the drain plug and drain the oil from the swing machinery case.

Swing machinery case: **4.5** ℓ

2. Swing motor assembly

2.1. Set the swing motor and swing machinery assembly on blocks.

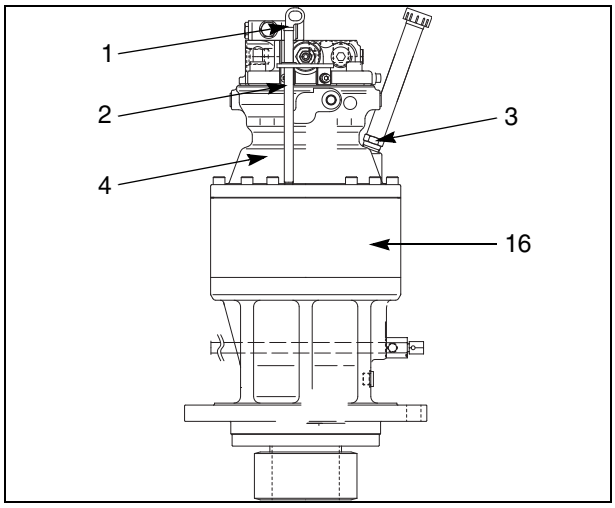
2.2. Pull out level gauge (1) and remove pipe (2) and bracket.

✔ Turn and remove pipe (2).

2.3. Loosen the mounting nut of pipe (3) and remove the pipe and bracket together.

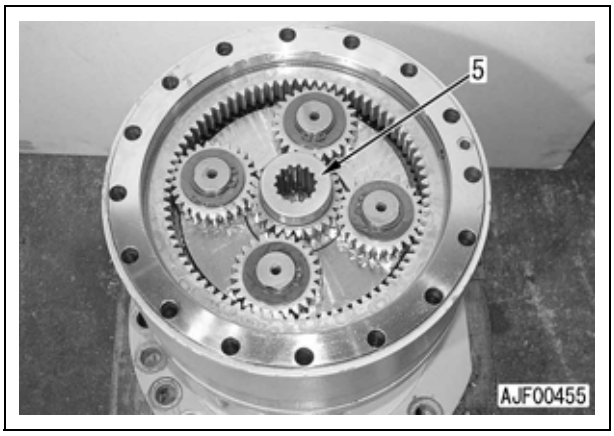
2.4. Lift off swing motor assembly (4).

✔ Make match marks on the swing motor case and cover (16) for reassembly.



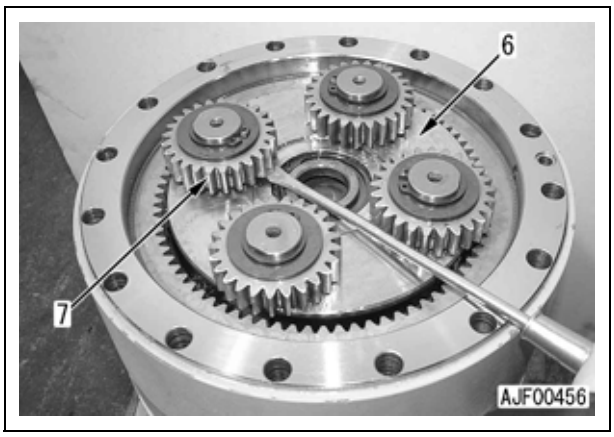
3. No. 1 carrier assembly

3.1. Remove No. 1 sun gear (5).



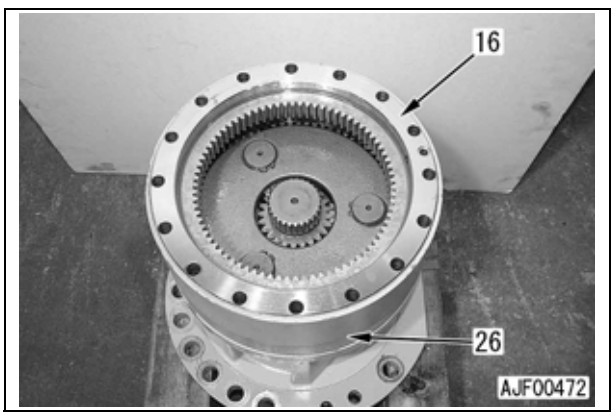
3.2. Remove No. 1 carrier assembly (6).

✔ Insert a flat-head screwdriver, etc. under planetary gear (7) to float and remove the planetary gear.



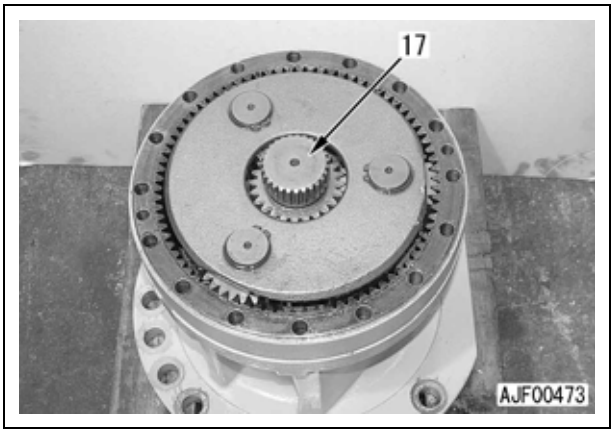
4. Cover
   Remove cover (16).

✔ Make match marks on cover (16) and ring gear (26) for reassembly.

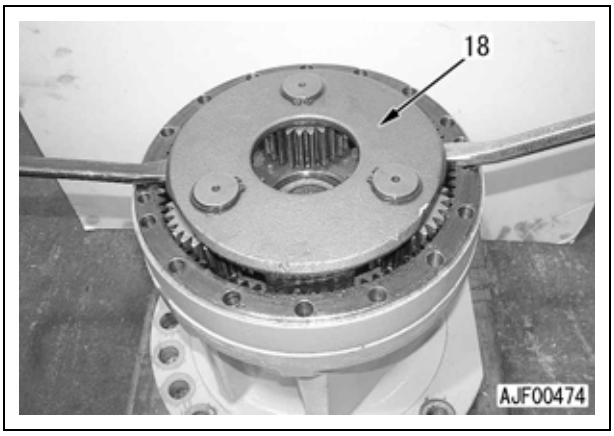


5. No. 2 carrier assembly

5.1. Remove No. 2 sun gear (17).

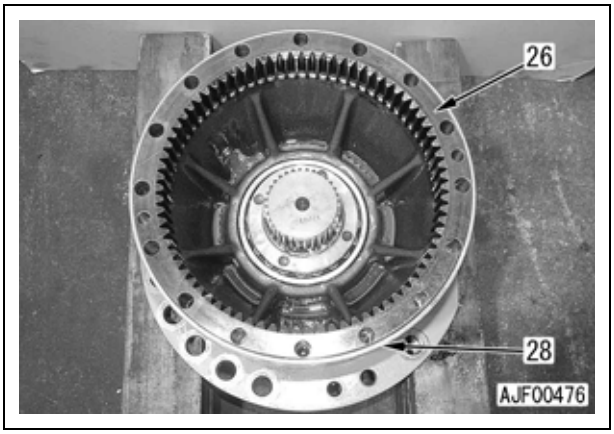


5.2. Using a bar, etc., float and remove No. 2 carrier assembly (18).



6. Ring gear
Remove ring gear (26).

✔ Make match marks on ring gear (26) and housing (28) for reassembly.



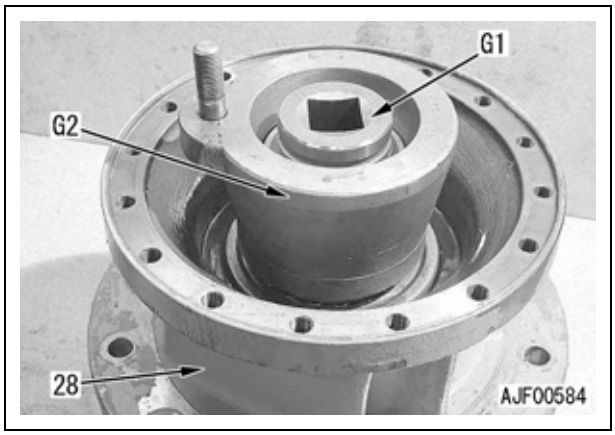
7. Ring nut

7.1. Using punch [1], etc., straighten the bent parts (3 places) of ring nut (27) around the pinion shaft spline.



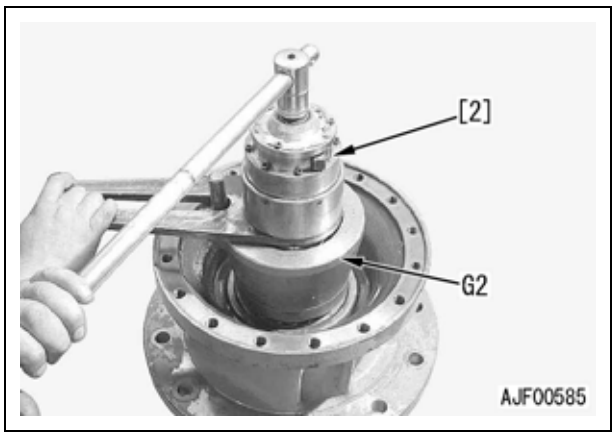
7.2. Place the flange of housing (28) on a block and float the pinion shaft at the center.

7.3. Install tool **G1** to the pinion shaft and install tool **G2** to the ring nut.

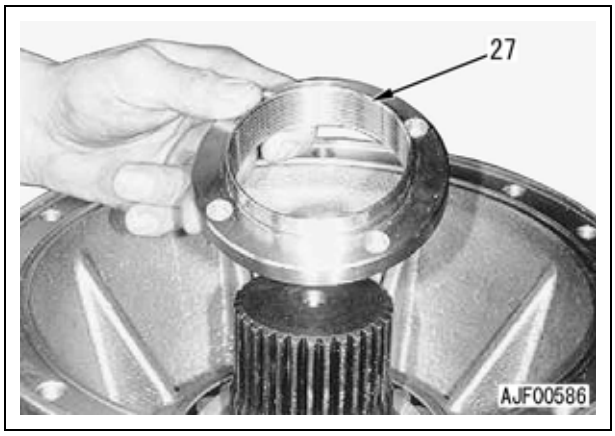


7.4. Fix tool **G2**. Using power wrench (25-time power) [2], turn tool **G1** to loosen the ring nut.

N·m Ring nut (Reference):
1100 – 1200 Nm {112.2 – 122.3 kgm}

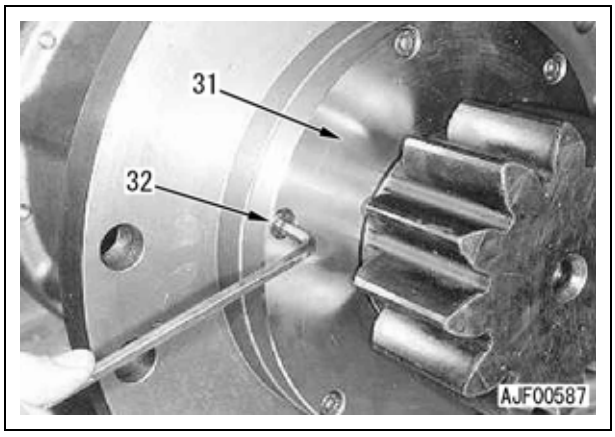


7.5. Remove ring nut (27).

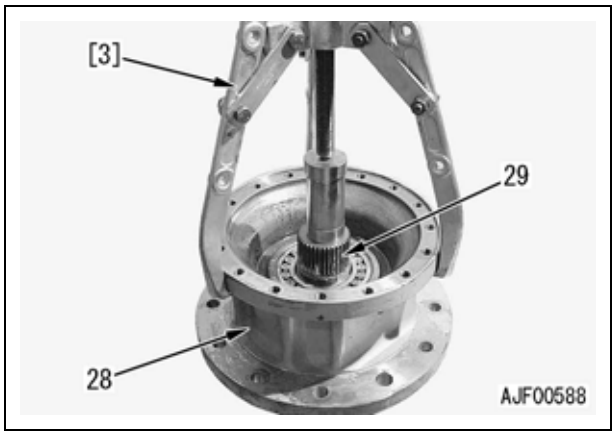


8. Housing and pinion shaft

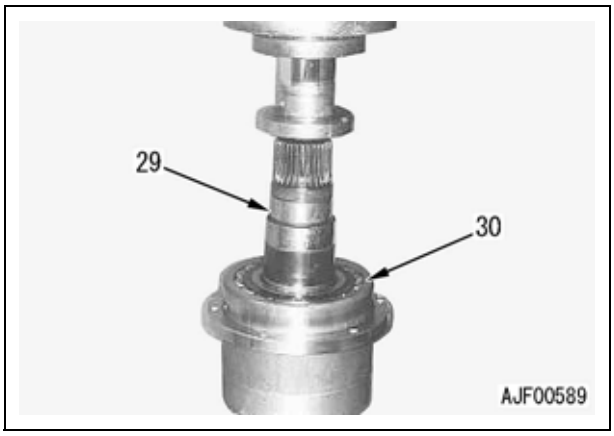
8.1. Remove 6 mounting screws (32) of front cover (31).



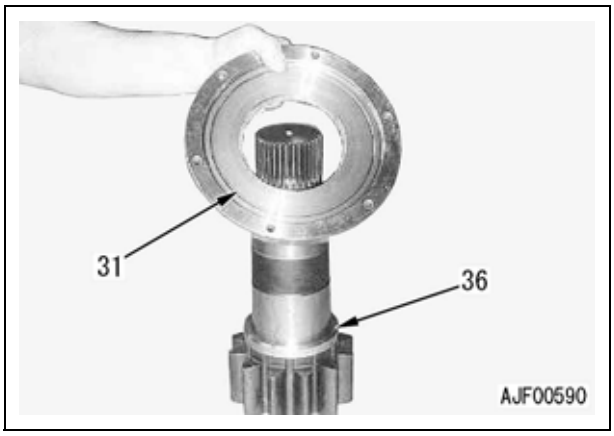
8.2. Using puller [3], separate housing (28) and pinion shaft assembly (29).



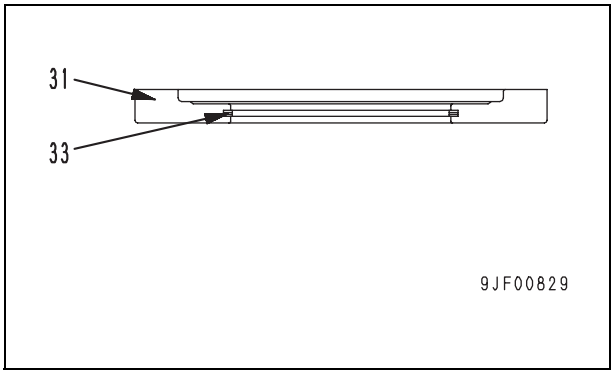
8.3. Using a press, separate pinion shaft assembly (29) and bearing (30).



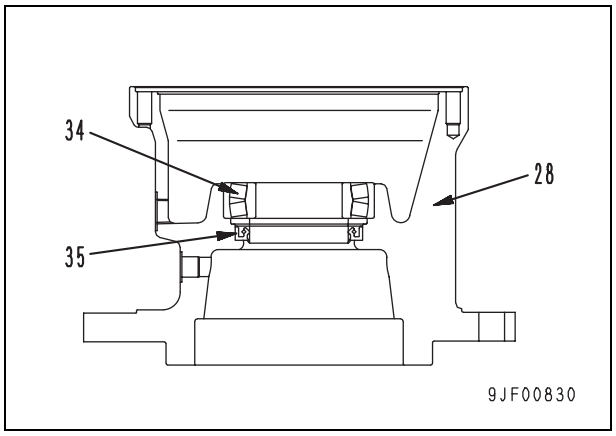
8.4. Remove front cover (31) and spacer (36).



8.5. Remove seal ring (33) from front cover (31).



8.6. Remove bearing (34) and oil seal (35) from housing (28).

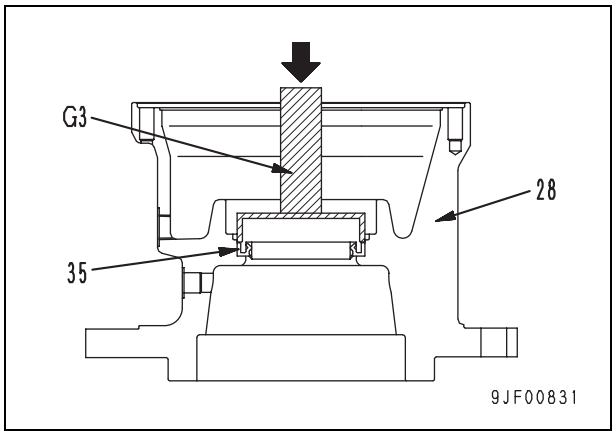


Assembly

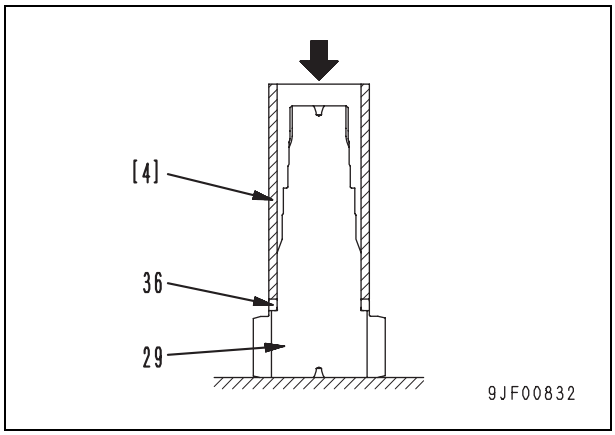
1. Housing and pinion shaft

1.1. Using tool **G3**, install oil seal (35) to housing (28) as shown in the following figure.

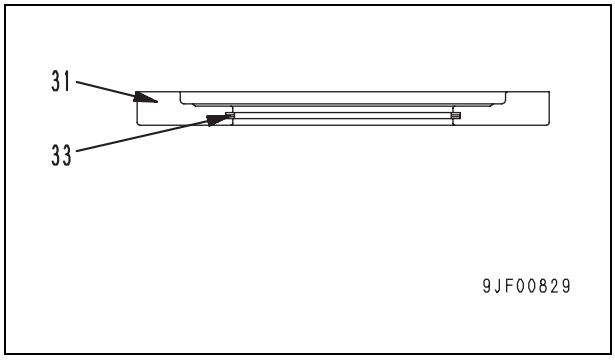
✔ Press fit the oil seal until its end reaches the housing end.



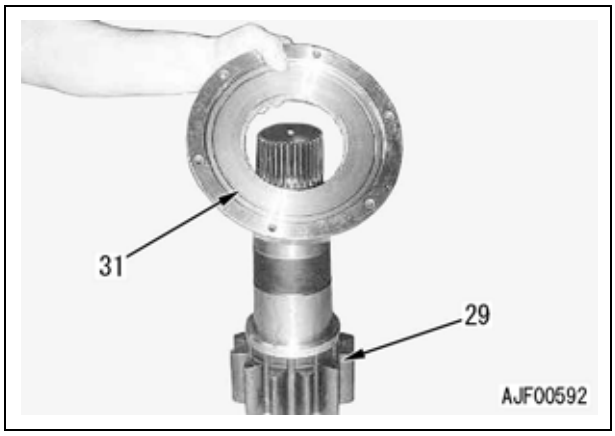
1.2. Using push tool [4], press fit spacer (36) to pinion shaft (29).



1.3. Install seal ring (33) to front cover (31).



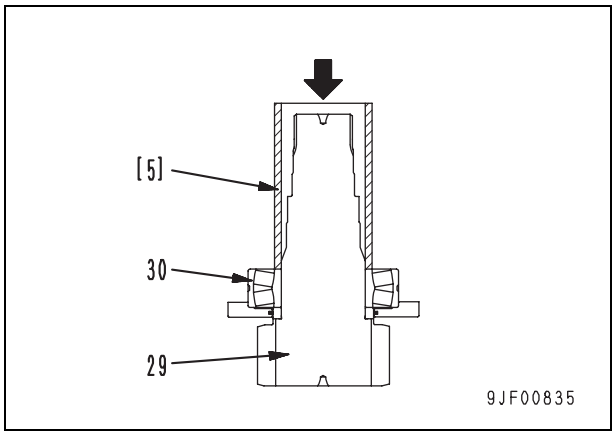
1.4. Set front cover (31) to pinion shaft (29).



1.5. Using push tool [5], press fit bearing (30) to pinion shaft (29).

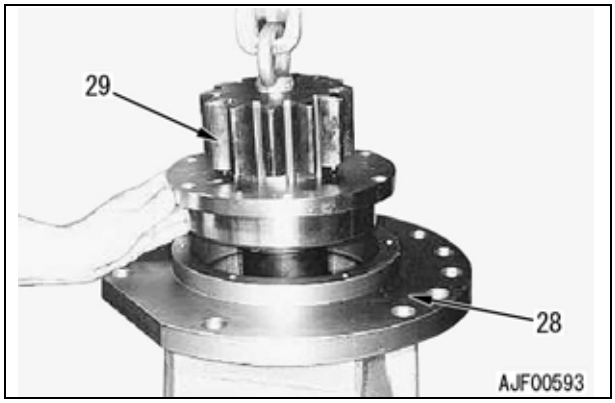
✔ Press fit the bearing until the inner race end reaches the spacer.

Bearing: Grease
(SHELL RETINAX HD-2 or equivalent)



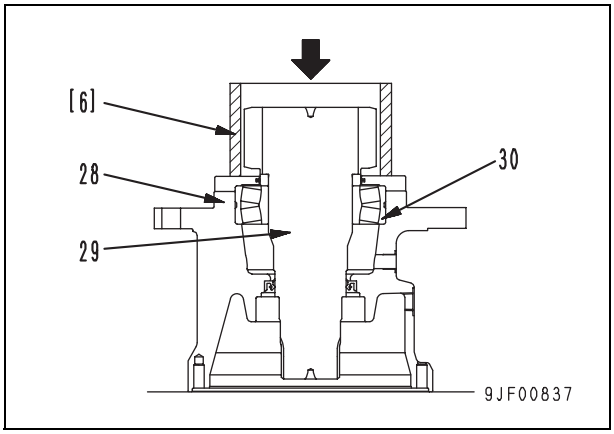
1.6. Set pinion shaft assembly (29) to housing (28).

Housing: Grease
(SHELL RETINAX HD-2 or equivalent)



1.7. Using push tool [6], press fit pinion shaft assembly (29) to housing (28).

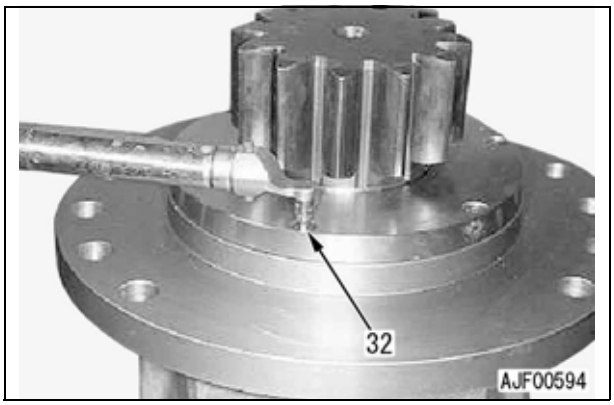
✔ Press fit the bearing until the end of bearing (30) reaches the end of housing (28).



1.8. Tighten 6 front cover mounting screws (32).

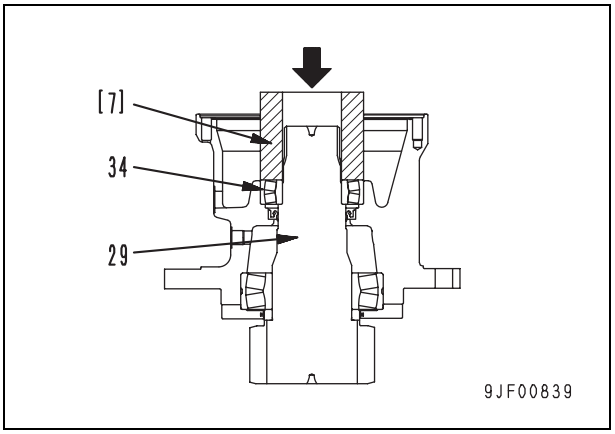
Mounting screw:
Loctite® 243 or equivalent

N·m Mounting screw: 25 Nm {2.5 kgm}



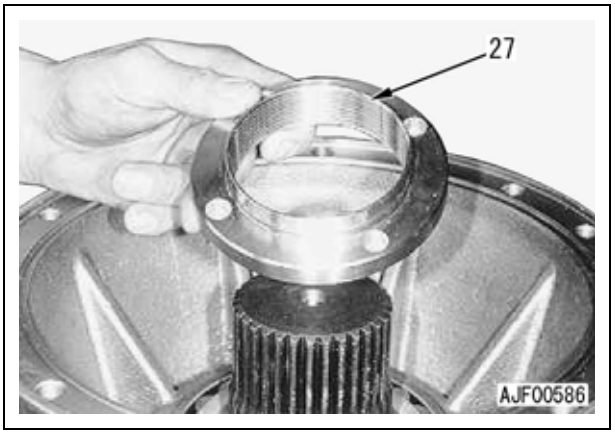
1.9. Using push tool [7], press fit bearing (34).

✔ Press fit bearing (34) until its end reaches the shoulder of pinion shaft (29).



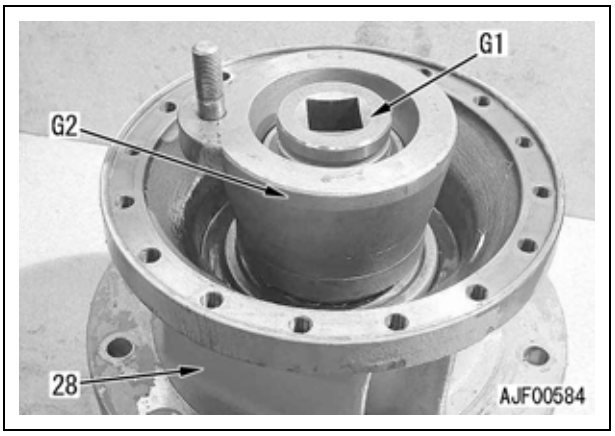
2. Ring nut

2.1. Install ring nut (27) to the pinion shaft.



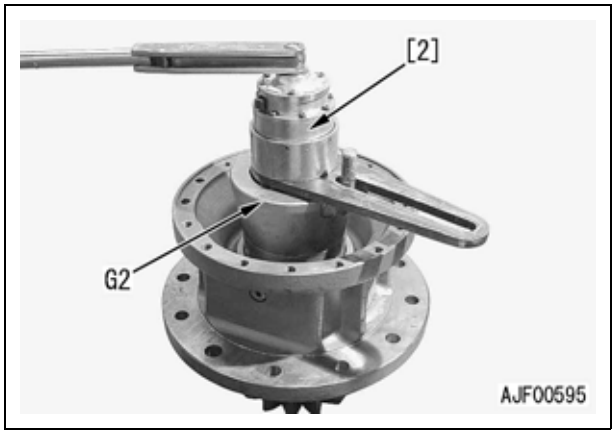
2.2. Place the flange of housing (28) on blocks and float the pinion shaft at the center.

2.3. Install tool **G1** to the pinion shaft and install tool **G2** to the ring nut.



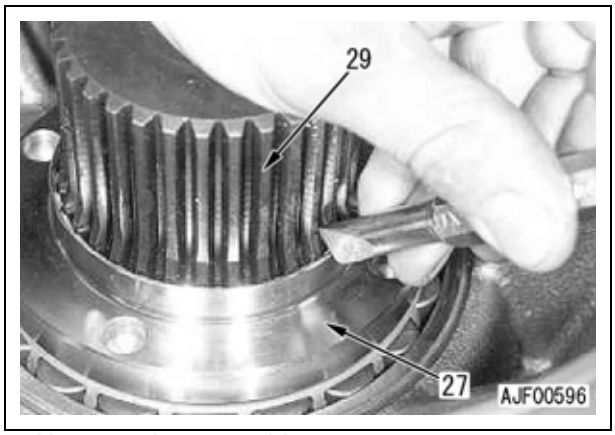
2.4. Fix tool **G2**. Using power wrench (25-time power) [2], turn tool **G1** to tighten the ring nut.

N·m Ring nut:
1100 – 1200 Nm {112.2 – 122.3 kgm}



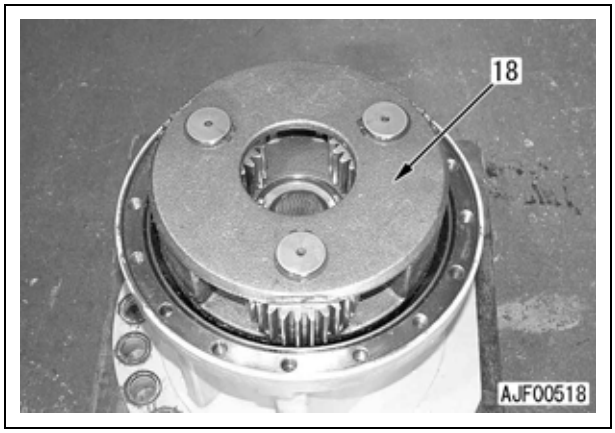
2.5. Using a punch, etc., bend the inside parts of ring nut (27) toward the spline of pinion shaft (29).

- Bend 3 parts at intervals of 120°.

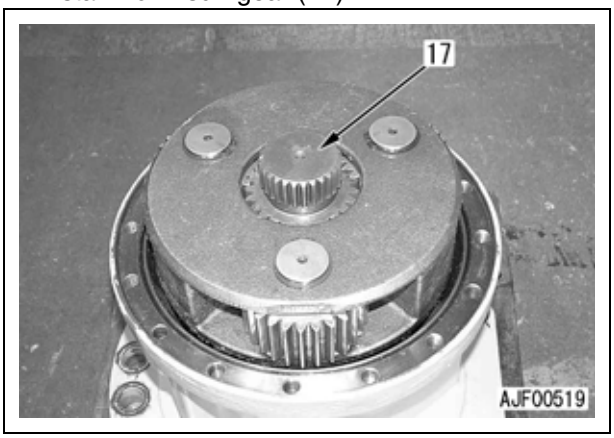


3. No. 2 carrier assembly

3.1. Install No. 2 carrier assembly (18).



3.2. Install No. 2 sun gear (17).

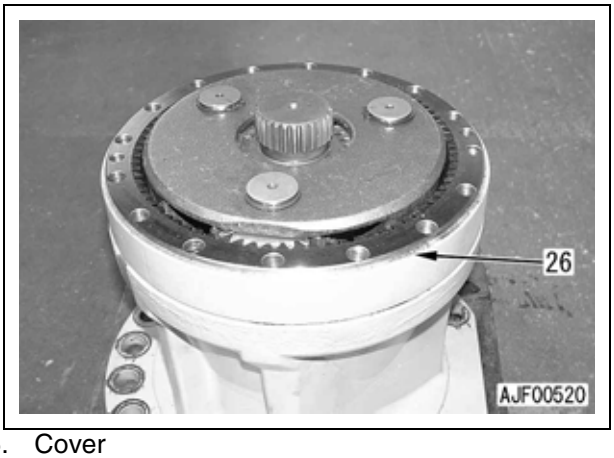


4. Ring gear

4.1. Fit the O-ring to the housing.

4.2. Install ring gear (26).

✔ Match the match marks made when the ring gear was removed.

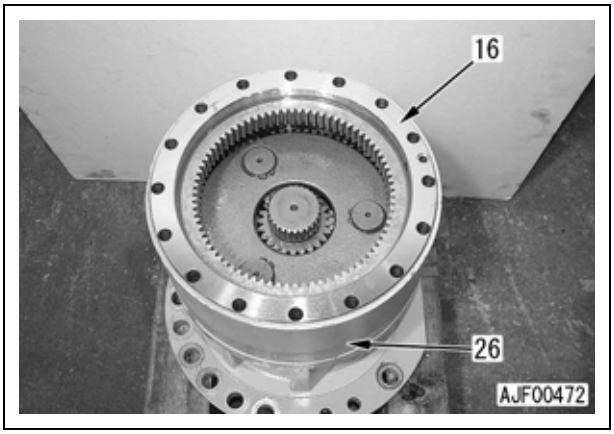


5. Cover

5.1. Fit the O-ring to the ring gear mounting face of cover (16).

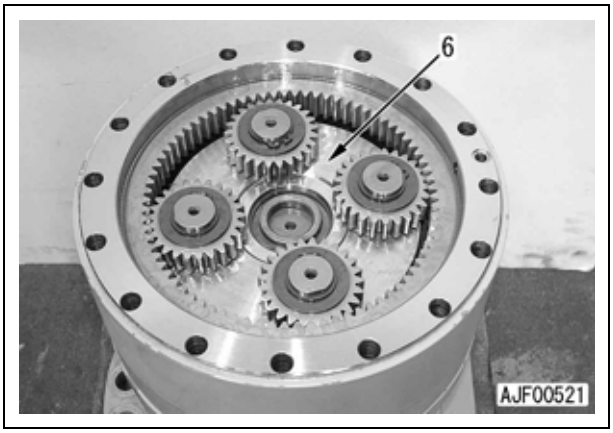
5.2. Install cover (16).

✔ Match the match marks made when the cover was removed.

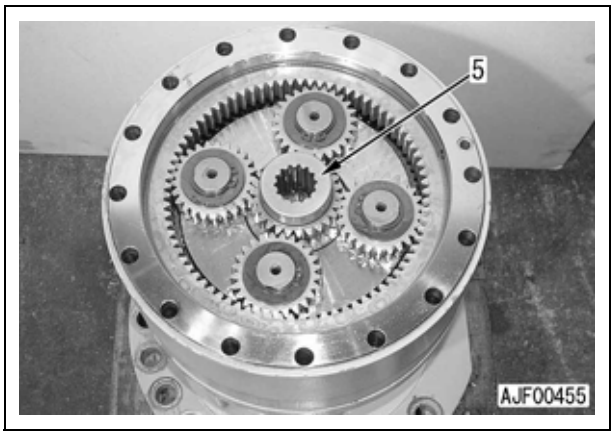


6. No. 1 carrier assembly

6.1. Install No. 1 carrier assembly (6).

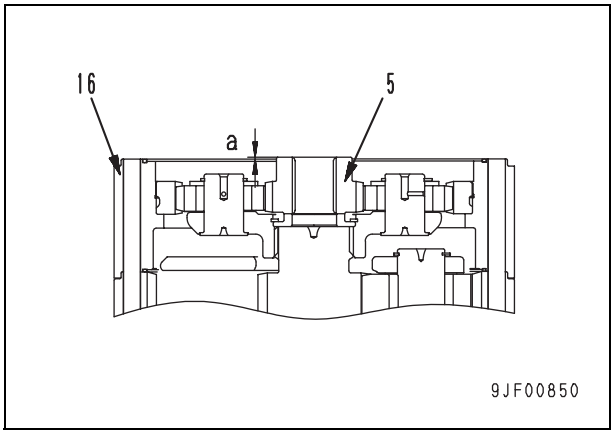


6.2. Install No. 1 sun gear (5).



6.3. Check that dimension **a** from the end of cover (16) to the end of No. 1 sun gear (5) is as follows.

✔ Dimension **a** = $\mathbf{1.5}^{0}_{-0.5}$ **mm**



7. Swing motor assembly

7.1. Install swing motor assembly (4).

✔ Match the match marks made when the swing motor assembly was removed.

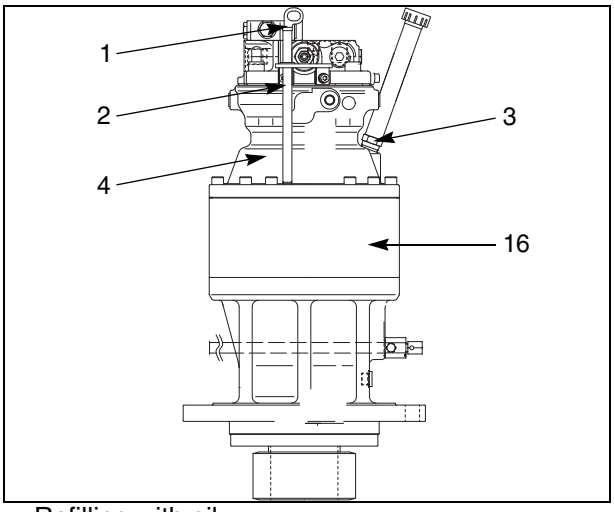
N·m Mounting bolt:
85 ± 4.3 Nm {8.7 ± 0.44 kgm}

7.2. Install pipe (3) and bracket.

N·m Pipe mounting nut (2 places):
56.4 ± 7.3 Nm {5.8 ± 0.74 kgm}

7.3. Install pipe (2) and bracket and insert level gauge (1).

N·m Pipe: **12.3 ± 2.5 Nm {1.25 ± 0.25 kgm}**



8. Refilling with oil

Swing machinery case: **4.5 ℓ (EO30-CD)**

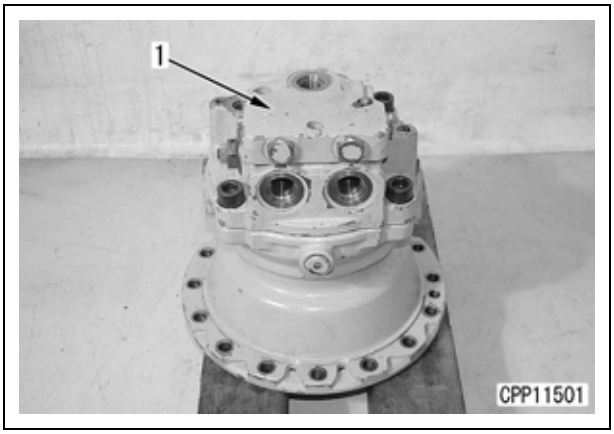
Disassembly and assembly of swing motor assembly

Special tools

Symbol	Part No.	Part name
D1	799-301-1600	Oil leak tester kit

Disassembly

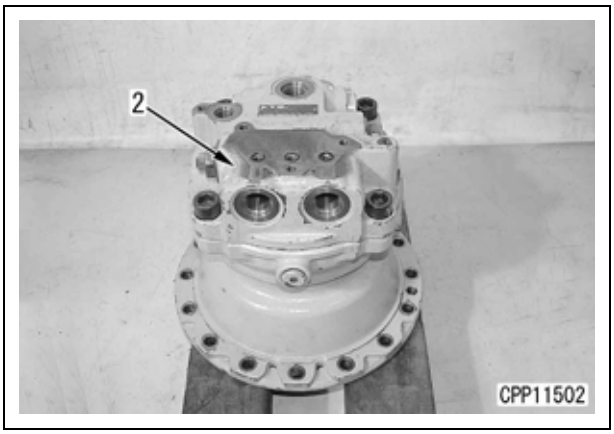
1. Set the swing motor and swing machinery assembly on blocks.
2. Reverse prevention valve assembly
   Remove reverse prevention valve assembly (1).



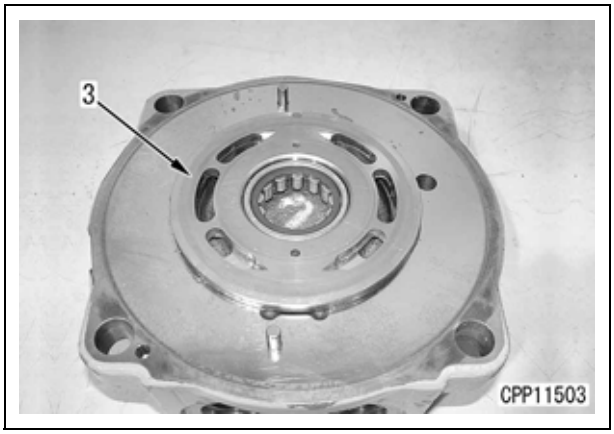
3. Cover assembly

3.1. Remove cover assembly (2).

- Note that the valve plate may fall from the cover assembly.



3.2. Remove valve plate (3) from the cover assembly.

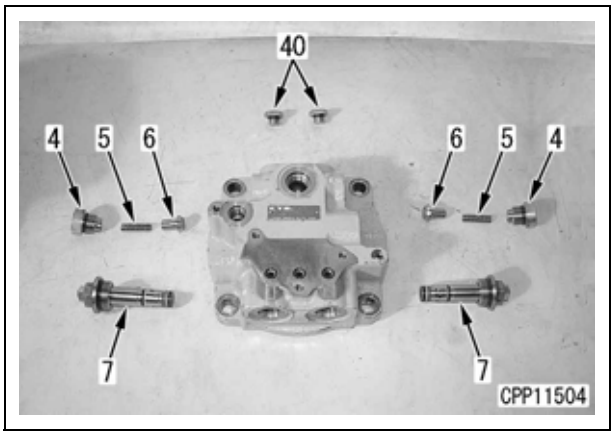


3.3. Remove 2 plugs (4), 2 springs (5), and 2 poppets (6).

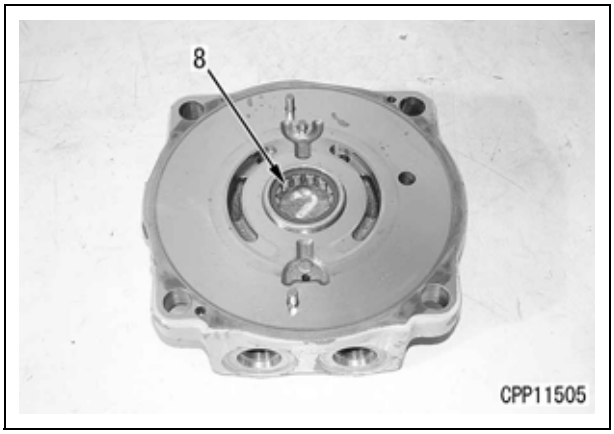
3.4. Remove relief valve assembly (7).

- Do not disassemble the relief valve assembly.
- Note that the poppet seat at the relief valve end may be left in the cover.

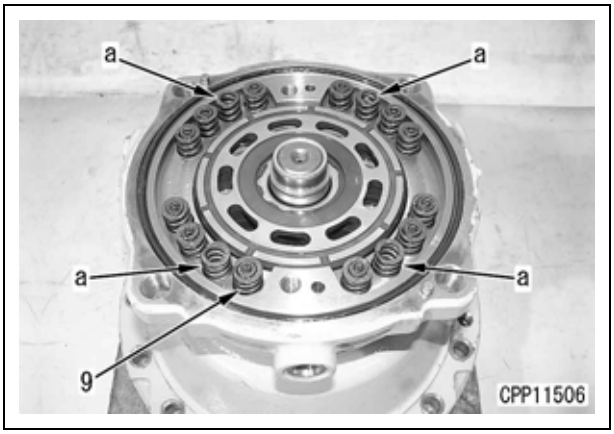
3.5. Remove 2 plugs (40).



3.6. Remove bearing outer race (8).



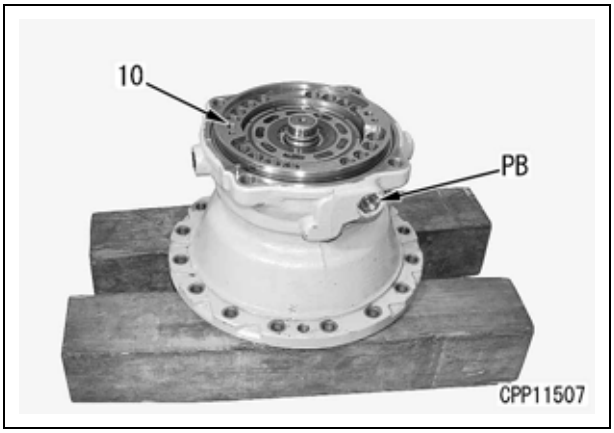
4. Springs
Remove 16 springs (9).
✔ There are outer springs (large) and inner springs (small). Only the outer springs (large) are installed to 4 places **a**.



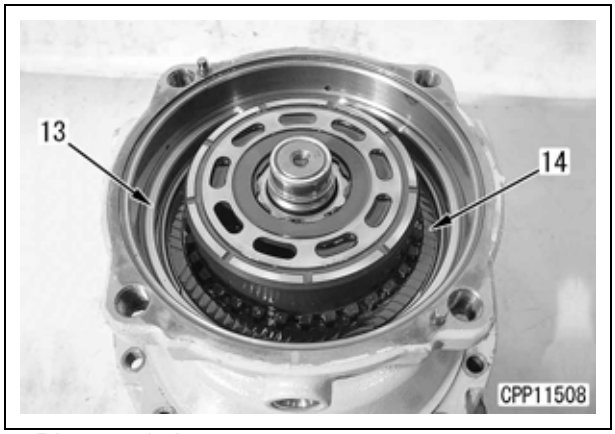
5. Brake piston
Using tool **D1**, supply compressed air to port **PB** of the case to float and remove brake piston (10).
✔ When installing the cover, make match marks on the brake piston and case so that the dowel pin of the cover will not shift from the dowel pin hole of the brake piston.

⚠ WARNING

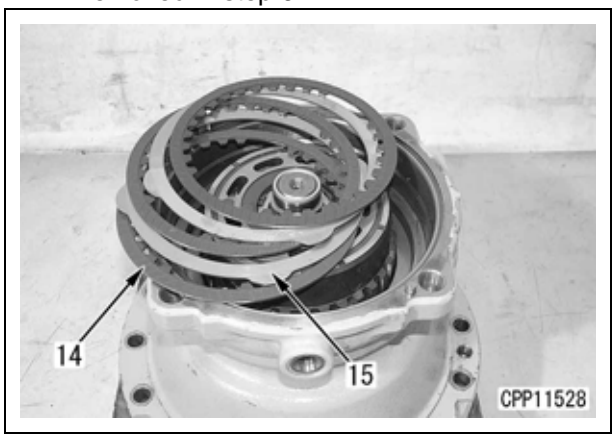
If high-pressure air is supplied, the brake piston jumps out. Accordingly, supply very low-pressure air at first and check the movement of the brake piston, and then adjust the air pressure.



6. Collar
Using a puller, etc., remove collar (13).
✔ Remove 1 disc (14) so that you can remove the collar easily.



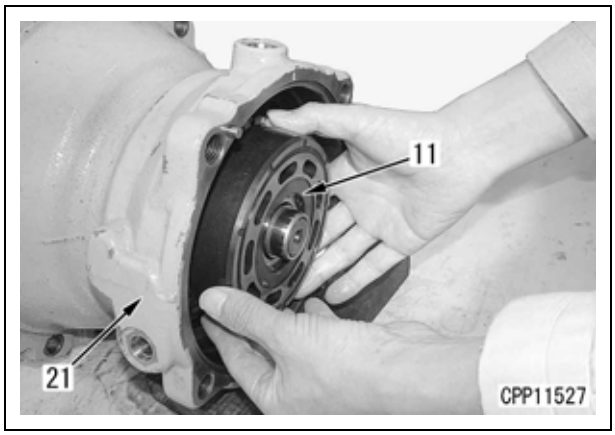
7. Discs and plates
Remove 3 discs (14) and 2 plates (15).
✔ The number of the discs includes the one removed in step 6.



8. Cylinder block assembly

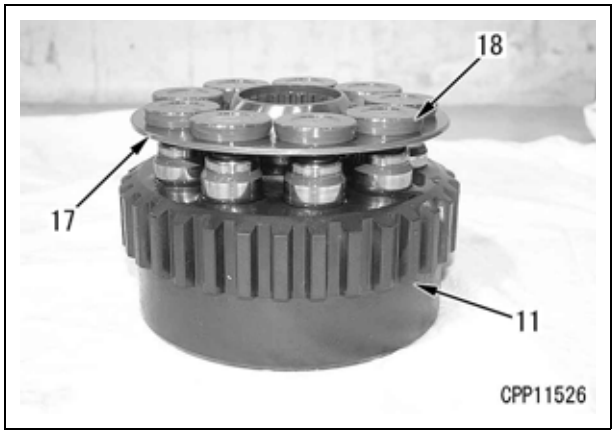
8.1. Place case (21) on its side.

8.2. Pull out cylinder block assembly (11).
✔ When removing the cylinder block assembly, slant the case down a little so that the internal parts (piston, retainer holder, and pin) will not be left in the case.

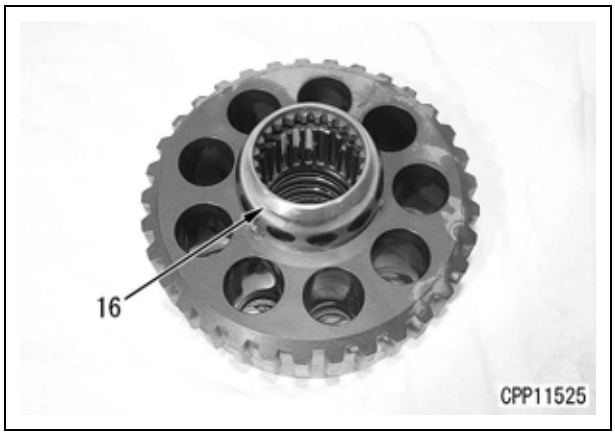


8.3. Lift up retainer plate (17) and remove it and piston (18) together from cylinder block (11).

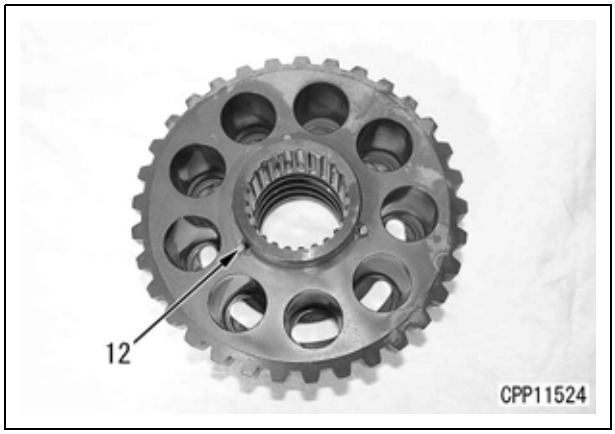
8.4. Separate retainer plate (17) and piston (18).



8.5. Remove retainer holder (16).

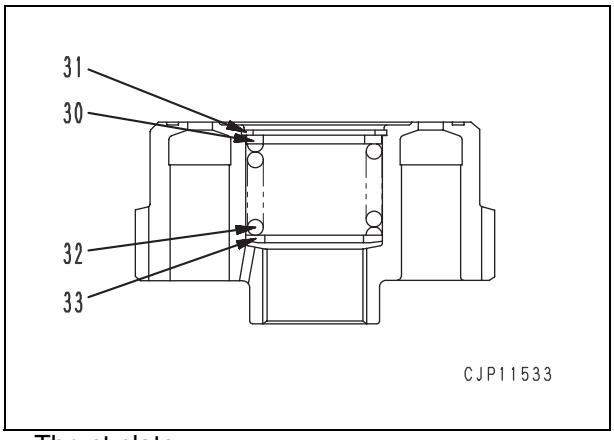


8.6. Remove 3 pins (12).

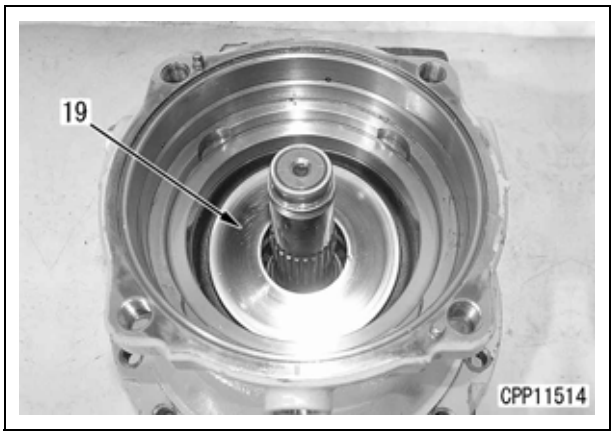


8.7. Press down collar (30) with a press, etc. and remove snap ring (31).

8.8. Remove collar (30), spring (32), and collar (33).

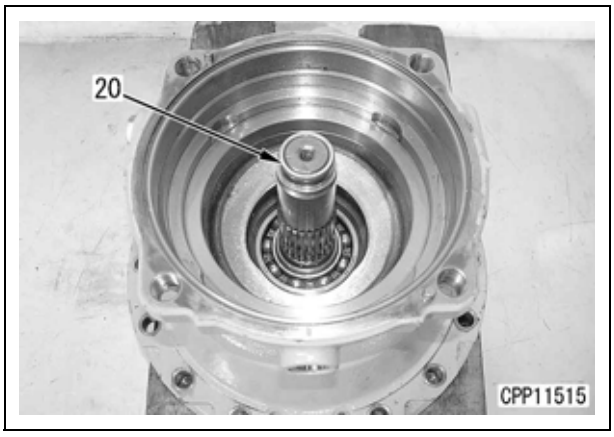


9. Thrust plate
Remove thrust plate (19).



10. Shaft and case

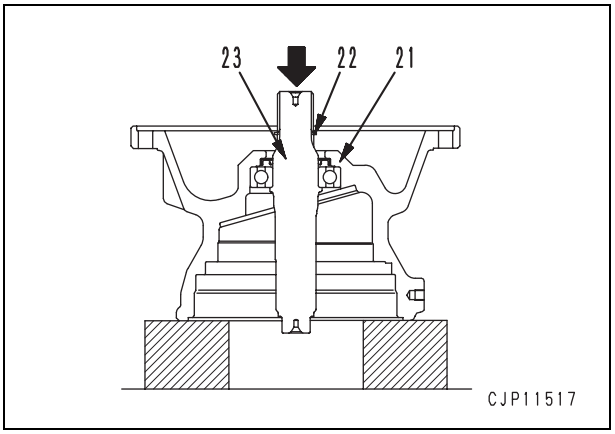
10.1. Remove bearing inner race (20).



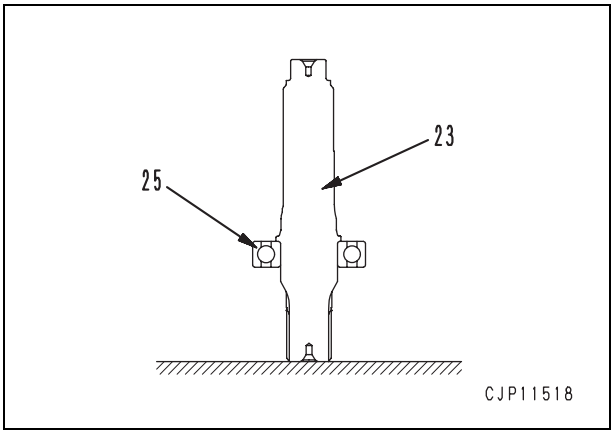
10.2. Turn over case (21) and set it on blocks.

10.3. Remove snap ring (22).

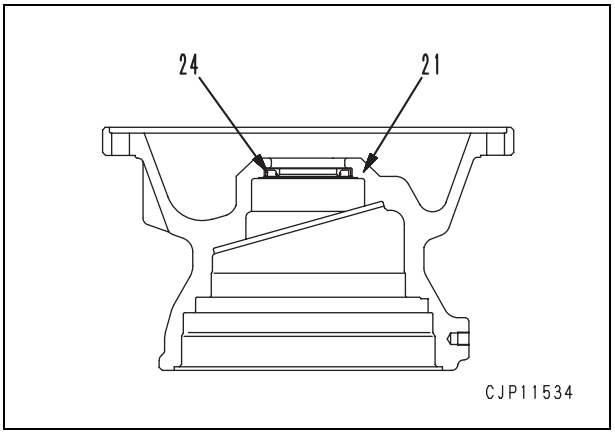
10.4. Press the end of shaft (23) with a press, etc. to remove the shaft.



10.5. Remove bearing (25) from shaft (23).



10.6. Remove oil seal (24) from case (21).



Assembly

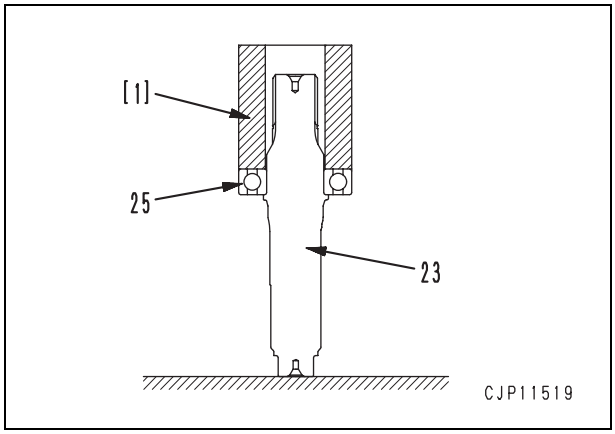
✔ Clean the all parts and check them for dirt or damage.

✔ Coat the sliding surfaces of each part with engine oil (EO10-CD).

1. Shaft and case

1.1. Using push tool [1], press fit bearing (25) to shaft (23).

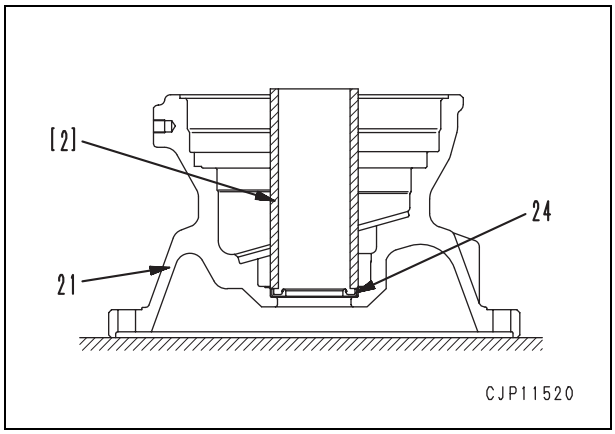
✔ Press fit the bearing until the end of its inner race reaches the shoulder of the shaft.



1.2. Using push tool [2], press fit oil seal (24) to case (21) as shown in the following figure.

✔ Press fit the oil seal until its end reaches the case end.

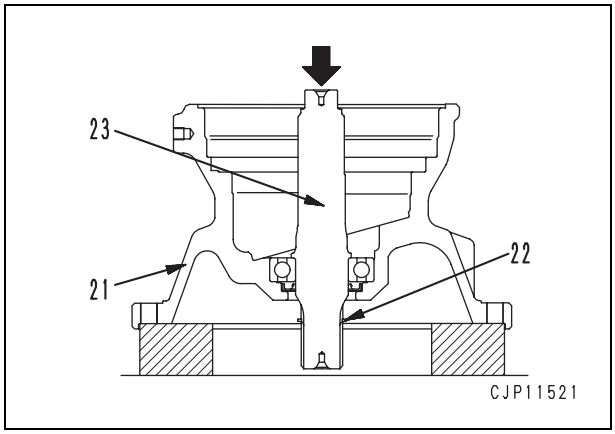
 Lip surface of oil seal: Grease (G2-LI)



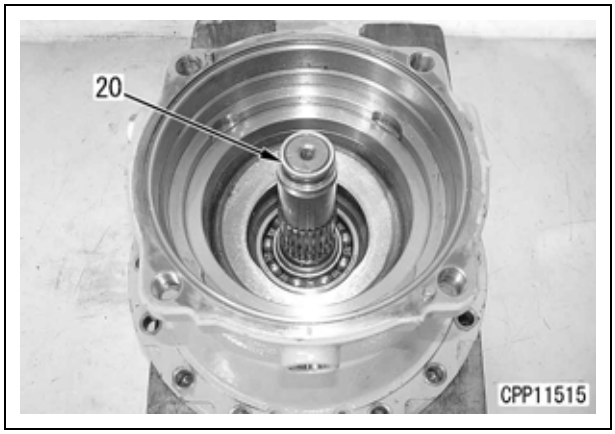
1.3. Press the end of shaft (23) with a press, etc. to press fit it to case (21).

✔ Press fit the shaft until the end of the bearing outer race reaches the case end.

1.4. Install snap ring (22).

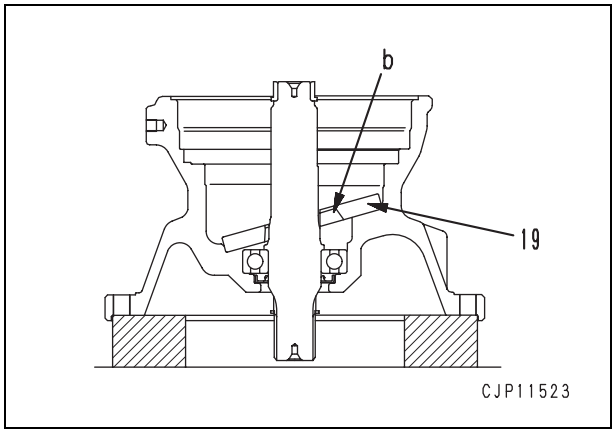


1.5. Install inner race (20).



2. Thrust plate
Install thrust plate (19).

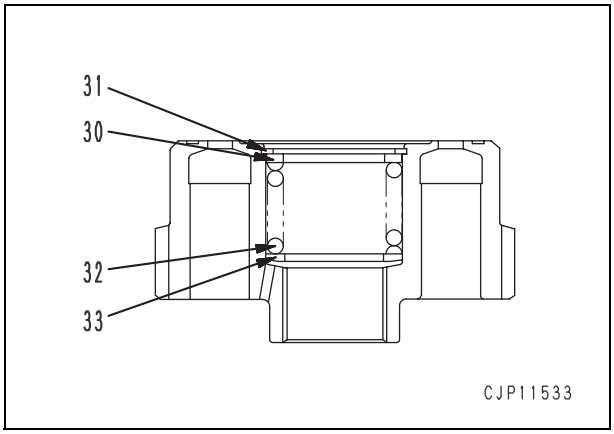
✔ Install the thrust plate with small hole side **b** up.



3. Cylinder block assembly

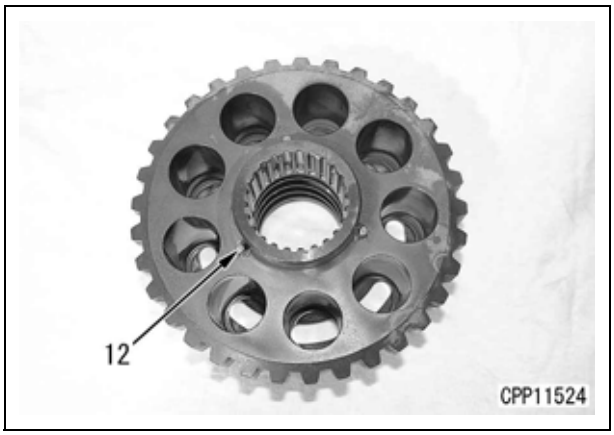
3.1. Install collar (33), spring (32), and collar (30).

3.2. Press down collar (30) with a press, etc., and install snap ring (31).

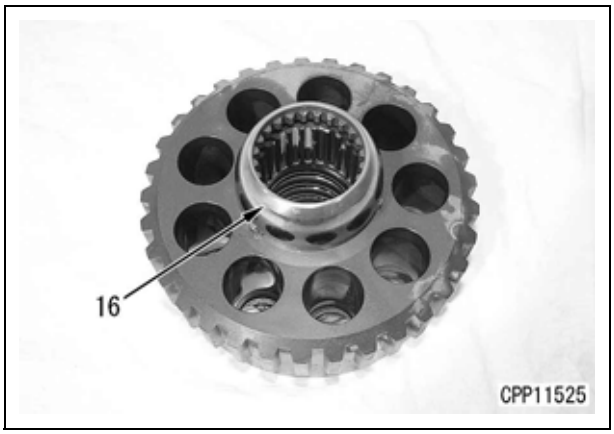


3.3. Install 3 pins (12).

✔ Apply grease (G2-LI) to the pins so that they will not fall when the cylinder block assembly is installed.



3.4. Install retainer holder (16).

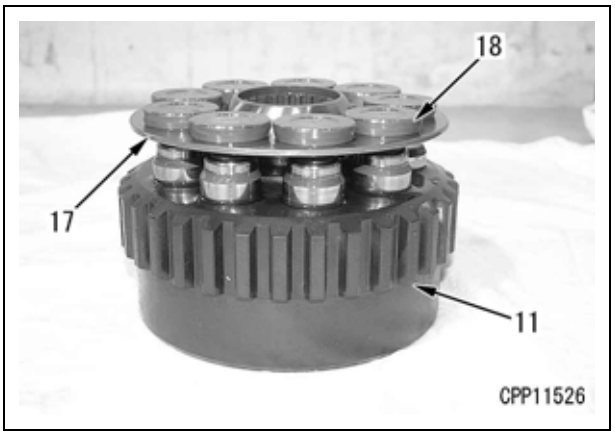


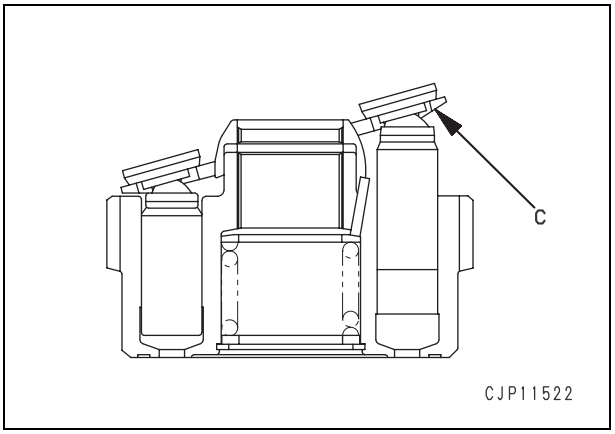
3.5. Install piston (18) to retainer plate (17).

✔ Set chamfered periphery **c** of retainer plate (17) toward the cylinder block side.

3.6. Install the retainer plate and piston assembly to the cylinder block assembly (11).

✔ Apply engine oil (EO10-CD) fully to the sliding surfaces of the piston and cylinder block.

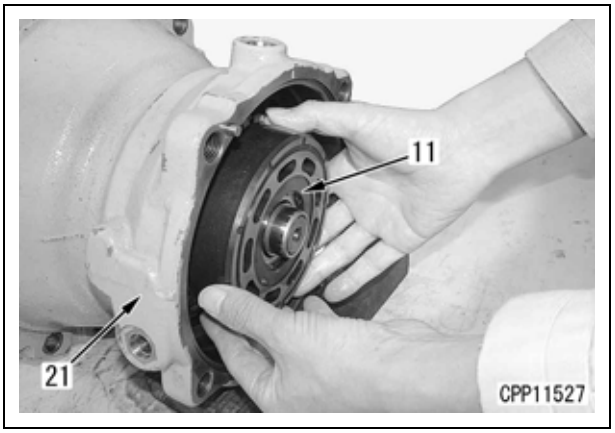




3.7. Place case (21) on its side.

3.8. Install cylinder block assembly (11) to the case.

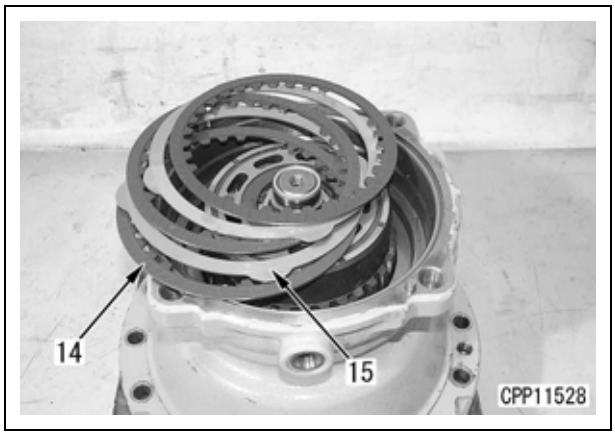
✔ Take care that the piston will not come out of the cylinder block.

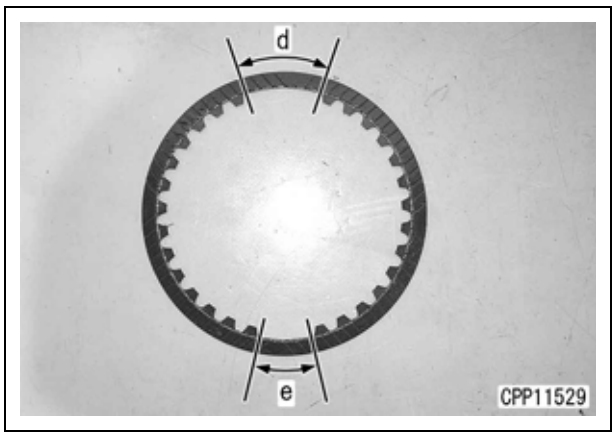


4. Discs and plates
Install 3 discs (14) and 2 plates (15) alternately.

✔ When installing discs, set their wider no-spline teeth sides **d** and narrower no-spline teeth sides **e** to each other respectively.

✔ The wider and narrower no-spline teeth sides may be installed in any direction of the cylinder block.



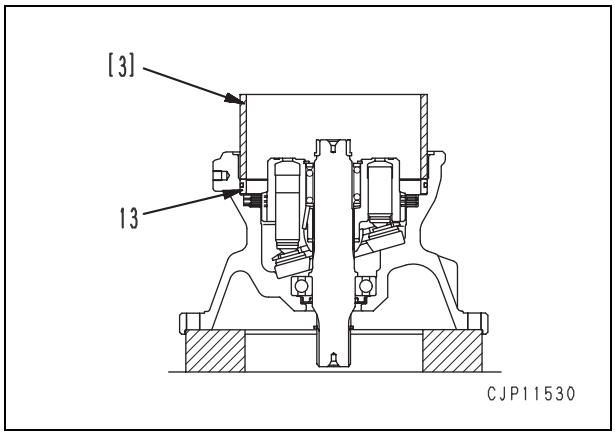


5. Collar

5.1. Fit the O-ring to collar (13).

Periphery of O-ring: **Grease (G2-LI)**

5.2. Using push tool [3], press fit collar (13) evenly.



6. Brake piston

6.1. Fit the O-ring to brake piston (10).

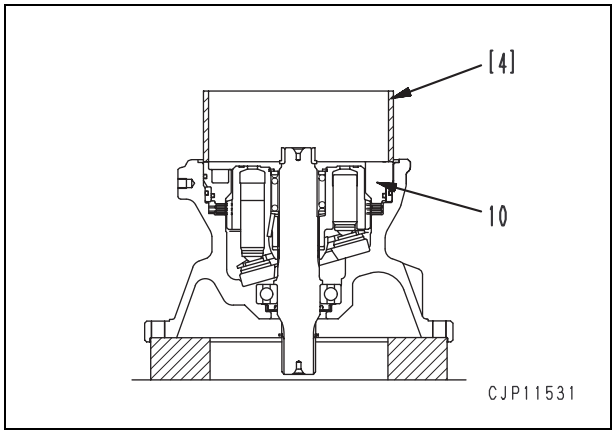
Periphery of O-ring: **Grease (G2-LI)**

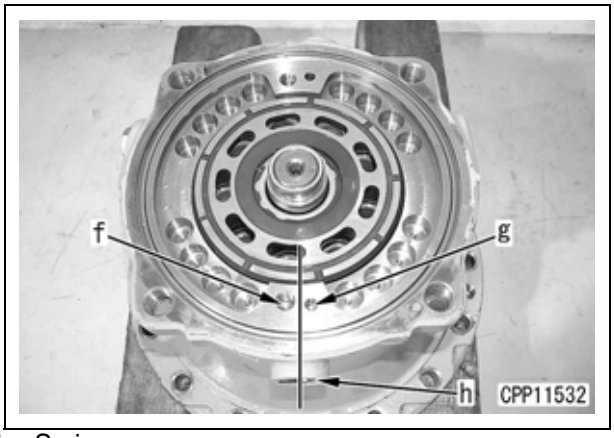
6.2. Using push tool [4], press fit brake piston (10) evenly.

✔ When press fitting the brake piston, align the intermediate point between tap hole (f) of the brake piston and dowel pin hole (g) with the center of port (h) of the case so that the dowel pin of the cover will be aligned with the dowel pin hole of the brake piston when the cover is installed (in step 8). (Match the match marks made when the brake piston was removed.)

6.3. Fit the O-ring to the case.

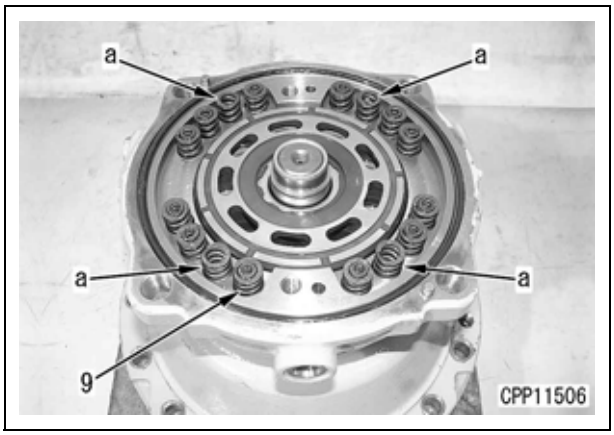
Periphery of O-ring: **Grease (G2-LI)**





7. Springs
Install 16 springs (9).

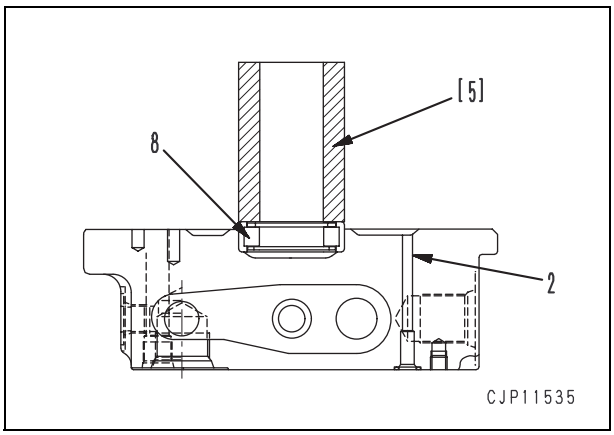
✔ There are outer springs (large) and inner springs (small). Install only the outer springs (large) to 4 places **a**.



8. Cover assembly

8.1. Using push tool [5], press fit bearing outer race (8) to cover (2).

✔ Press fit the bearing outer race until its end reaches the cover end.



8.2. Install 2 plugs (40).

Periphery of O-ring: **Grease (G2-LI)**

Plug: **46 ± 0.98 Nm {4.7 ± 0.1 kgm}**

8.3. Fit the backup ring and O-ring and install 2 relief valve assemblies (7).

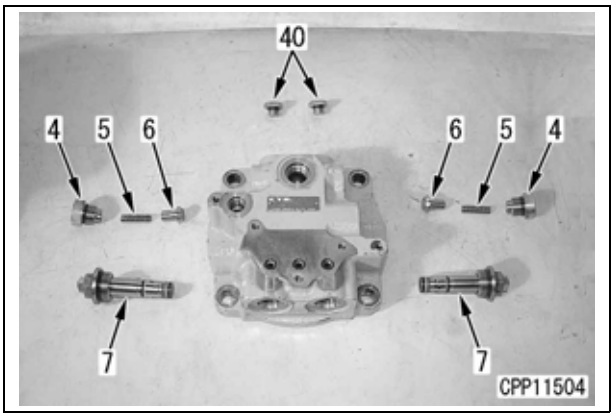
Periphery of backup ring and O-ring: **Grease (G2-LI)**

Relief valve assembly:
373 ± 20 Nm {38.0 ± 2.0 kgm}

8.4. Install 2 poppets (6), 2 springs (5), and plugs (4).

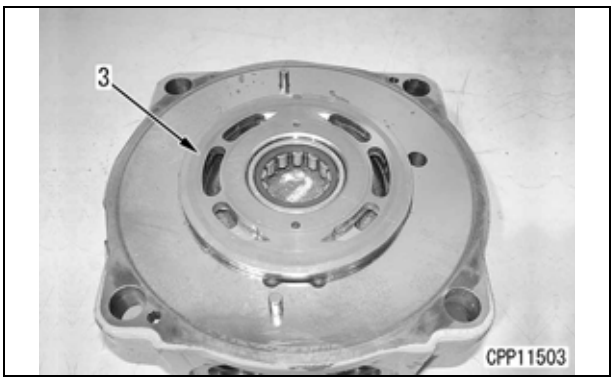
Periphery of O-ring: **Grease (G2-LI)**

Plug: **157 ± 10 Nm {16.0 ± 1.0 kgm}**



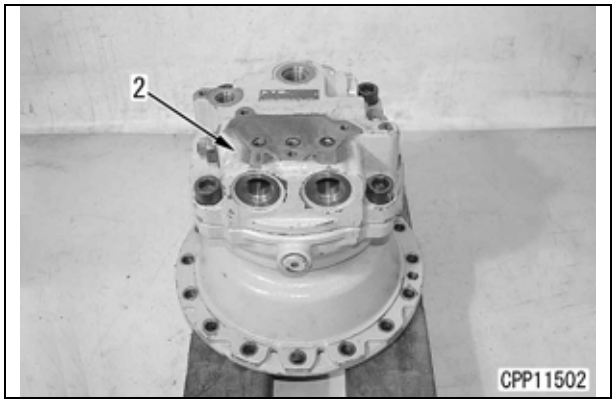
8.5. Install valve plate (3).

- When installing the valve plate, set its circularly grooved side toward the cover and match the cut on its periphery to the dowel pin.
- Apply grease (G2-LI) to the cover mounting face so that the valve plate will not fall when the cover assembly is installed.



8.6. Install cover assembly (2).

- When installing the cover assembly, match the dowel pin on the cover side to the dowel pin hole on the brake piston side.
- Do not apply an impact to the cover assembly. If it is applied, the valve plate may fall.

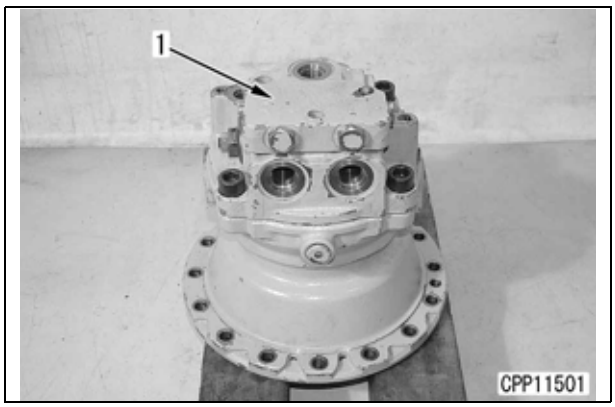


8.7. Tighten the mounting bolts.

Mounting bolt:
294 ± 20 Nm {29.9 ± 2.0 kgm}

9. Reverse prevention valve assembly
Install reverse prevention valve assembly (1).

Mounting bolt:
32.4 ± 2.0 Nm {3.3 ± 0.2 kgm}



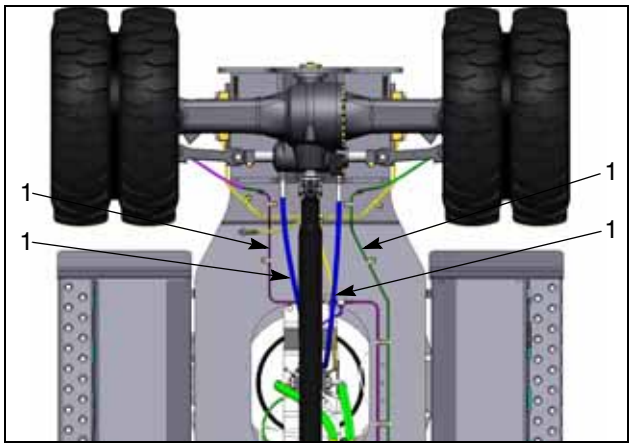
Removal and installation of front axle assembly

Removal

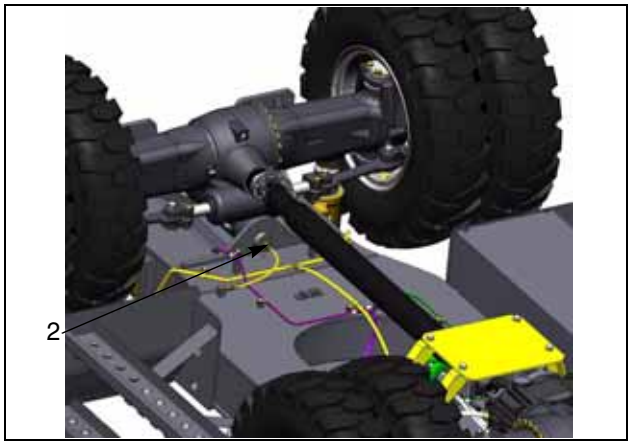
1. Drain oil out of front axle and hubs.

Front Axle: Approx.: **11.5 Litres**
Hubs: Approx.: **2.5 Litres (Each)**

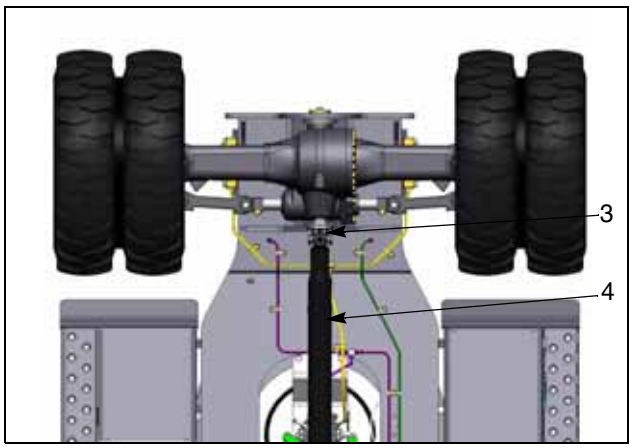
2. Retract front attachment fully.
3. Remove 4 hoses (1).



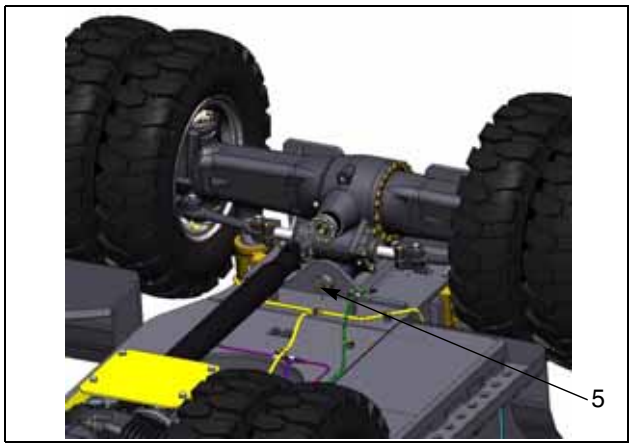
4. Remove hose (2).



5. Support propshaft weight with suitable equipmant.
6. Remove all nuts (3) from propshaft (4), then retract propshaft (4).



7. Remove pin (5).



8. Use work equipment to lift undercarriage above the axle.



9. Roll axle out on wheels.
10. Place supports in place of axle.

Installation

- Install in reverse order of removal.
- Grease all cylinders before installation



Propshaft nuts (3): **58.8 - 73.5 Nm.**

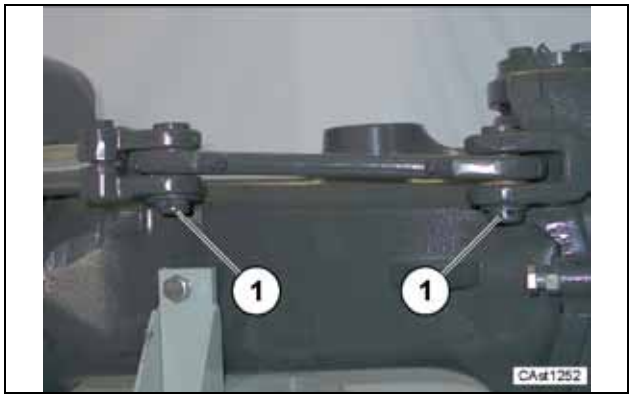
Disassembly and assembly of front axle

Disassembly of steering cylinder

1. Remove the safety split pins (1).

⚠ WARNING

Reject the used split pins.



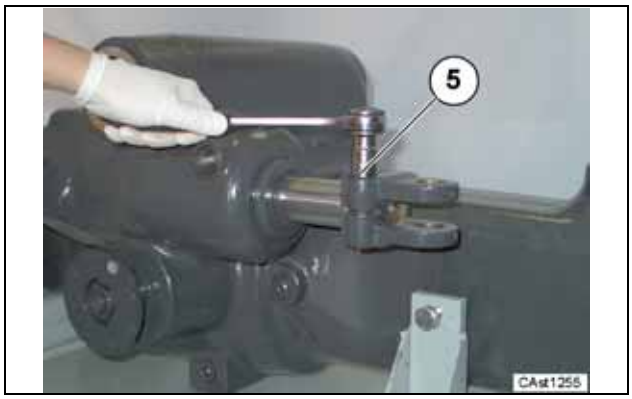
2. Remove the joint pivots (2) and the thicknesses (4).



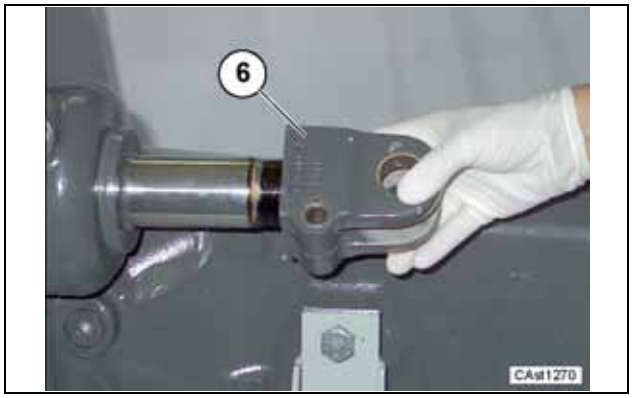
3. Remove the steering bars (3).



4. Remove the screws (5).



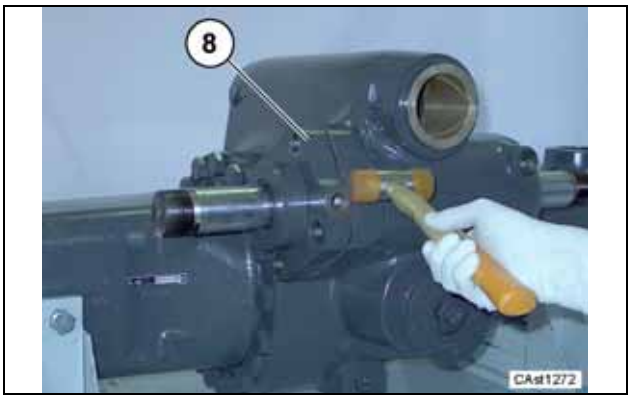
5. Unscrew the heads of the steering cylinder (6).



6. Remove the screws (7) of the steering cylinder.



7. Remove the head of the cylinder (8). Strike by means of a plastic hammer.



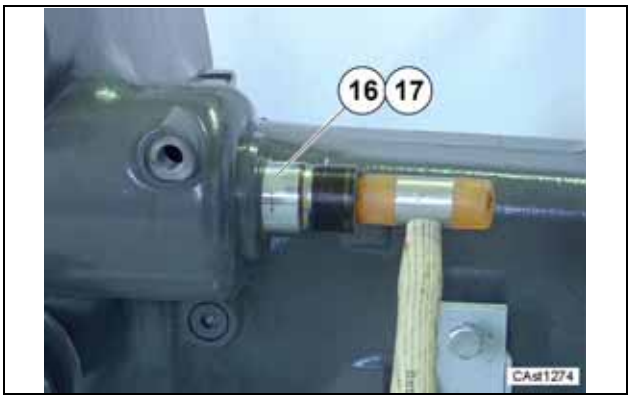
8. Remove the gaskets (11), (12) and the scraper ring.



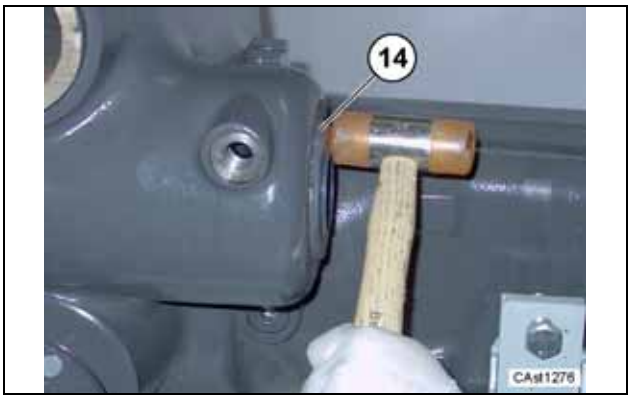
9. Remove the O-rings (9) and (10).



10. Remove the rod complete with cylinder (16) and cylinder liner (17).



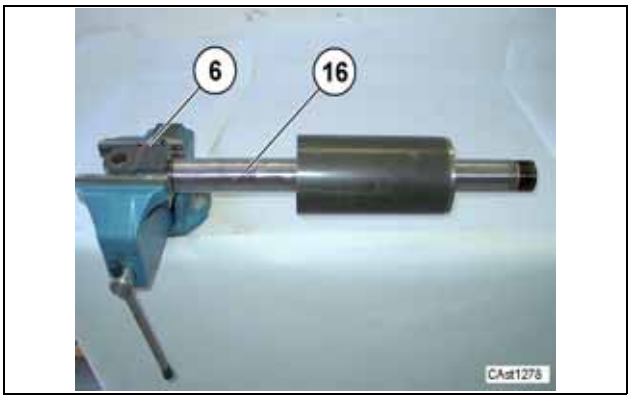
11. Remove the head of the cylinder (14).



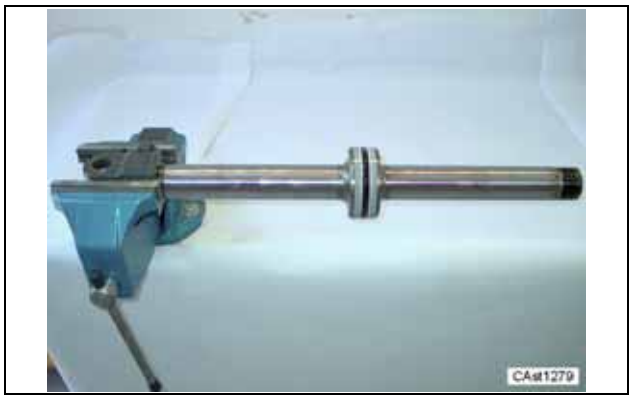
12. Remove O-ring (15).



13. Lock the rod of the cylinder (16) on a vice after having screwed the head (6).



14. Remove the cylinder liner (17).



15. Remove the O-ring (20) and the setting thicknesses (24).



16. Remove the gaskets (21), (22) and the scraper ring (23).



Assembly of steering cylinder

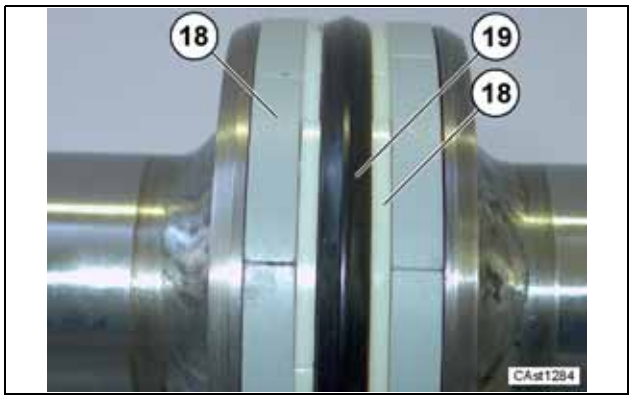
1. Fit the gaskets (21) and (22) and the scraper ring.



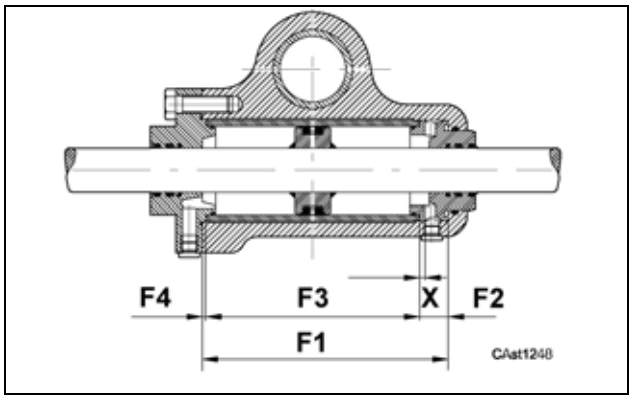
2. Fit the piston gaskets (18) and (19).

WARNING

The gasket cuts (18) should not coincide.



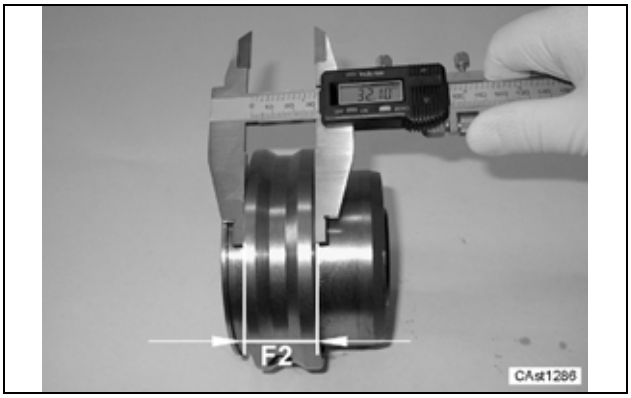
3. Thicknesses to be fitted.



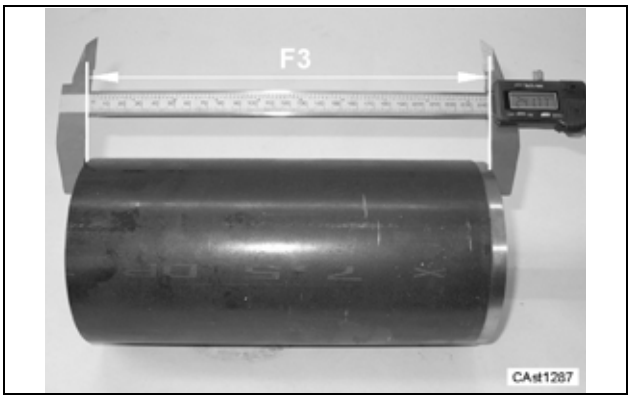
4. Measuring of value **F1.**



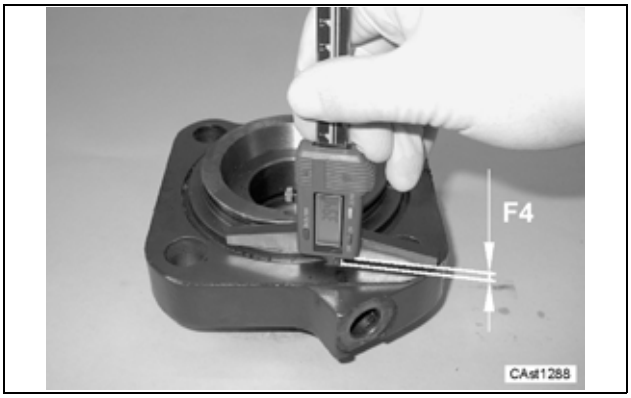
5. Measuring of value **F2.**



6. Measuring of value **F3.**



7. Measuring of value **F4.**



8. Assemble the thicknesses x (24) and the O-ring (20).



9. Assemble the O-rings (9) and (10).



10. Assemble the gaskets (11), (12) and the scraper ring (13).



11. Assemble the O-ring (15).



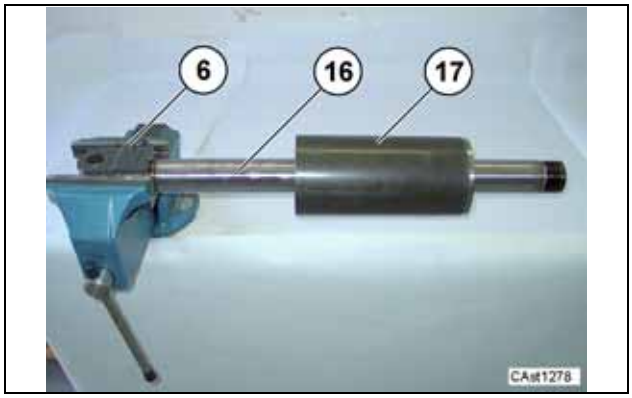
12. Lubricate with grease the contact surface.



13. Assemble the head of the cylinder (14).



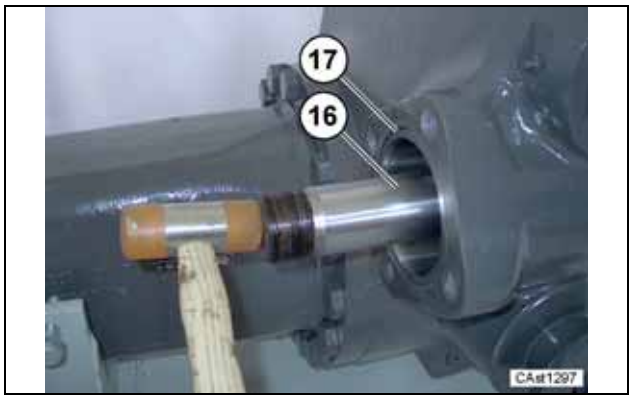
14. Lock the rod of the cylinder (16) on a vice after having screwed the head (6) and assemble the cylinder liner (17).



15. Lubricate with grease the gaskets of the right cylinder rod.



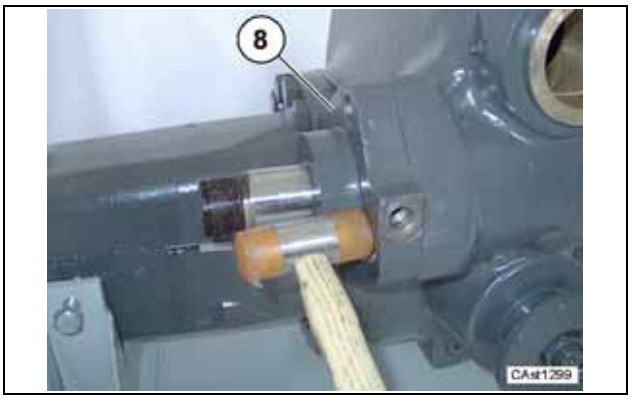
16. Assemble the rod complete with cylinder (16) and the cylinder liner (17).



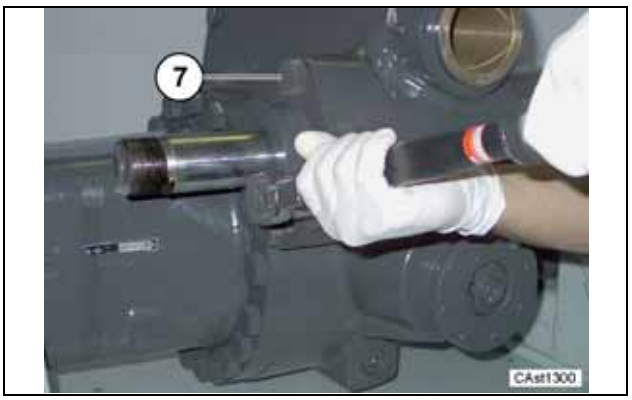
17. Lubricate with grease the gaskets of the left cylinder rod.



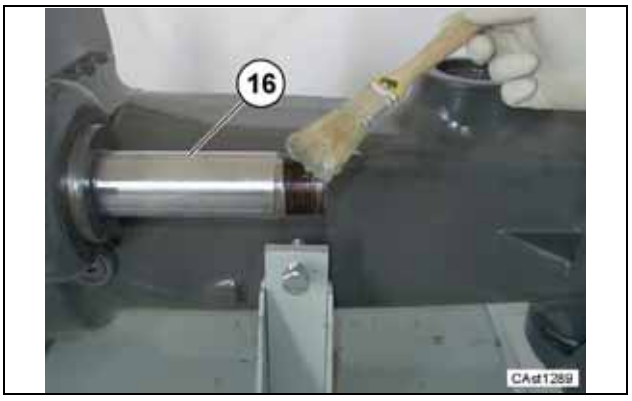
18. Assemble head of cylinder (8). Strike by means of a plastic hammer. Apply Loctite® 510.



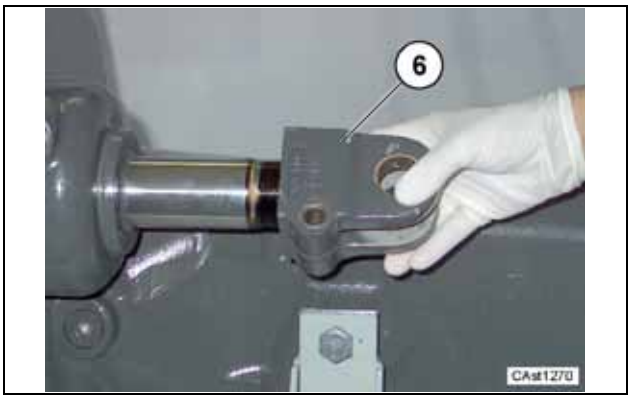
19. Assemble screws (7) of steering cylinder. Torque = **560Nm (57.1 kgf-m)** Apply Loctite® 242.



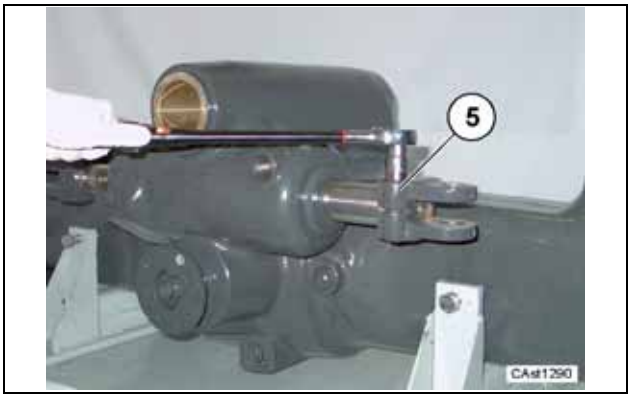
20. Lubricate the threads of the steering cylinder with grease.



21. Screw heads of steering cylinder (6).



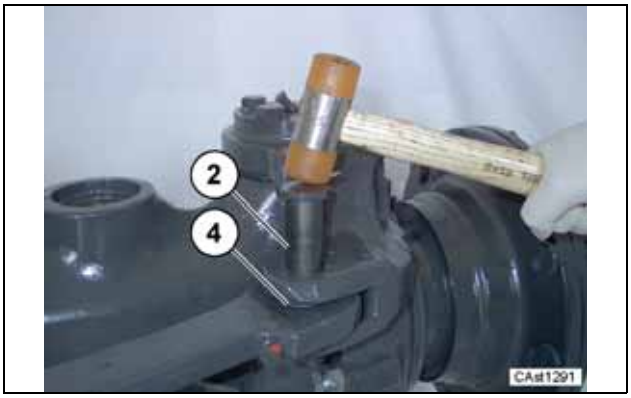
22. Fit screws (5). Torque = **117Nm (12 kgf-m)**



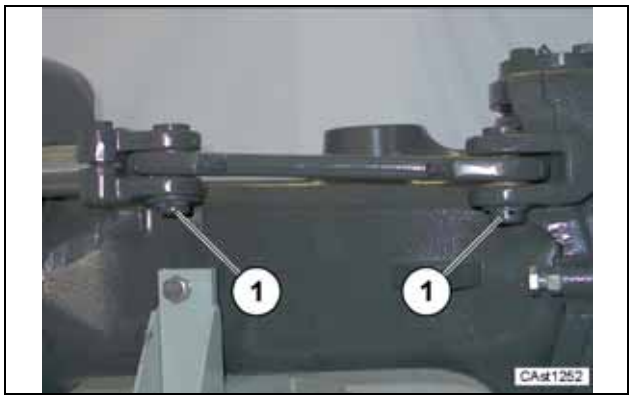
23. Assemble steering bars (3).



24. Assemble joint pivots (2) and thicknesses (4).

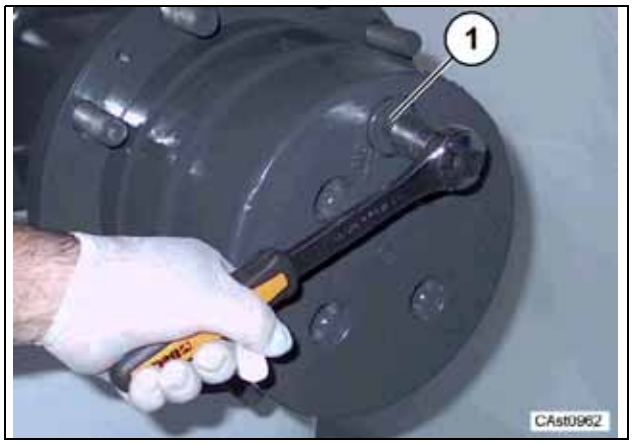


25. Assemble safety split pins (1).

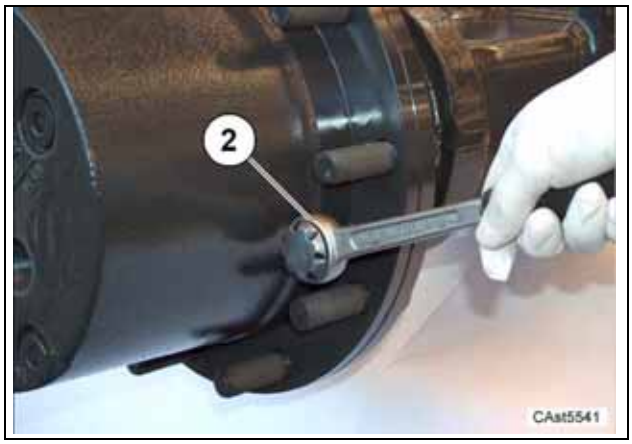


Disassembly of epicyclic reduction gear and brake

1. Before draining the oil, position the wheel hub (1) with the plug on the upper part and loosen it off some turns in order to eliminate any possible inner pressure, then remove it completely. Turn the wheel hub upside down till the hole is in the lowest point.
   Drain the oil completely.



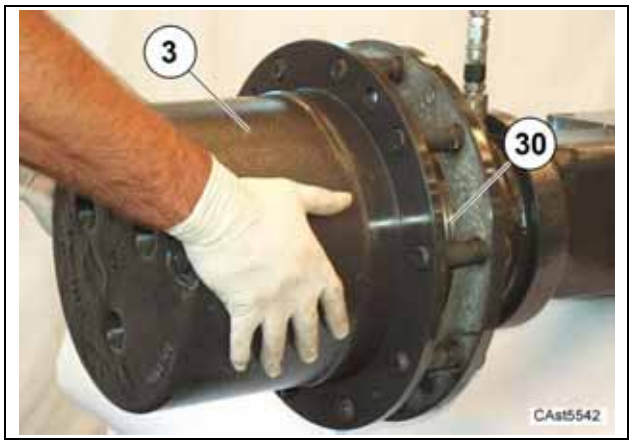
2. Remove fastening screws (2) from the cover of the planetary gears carrier.



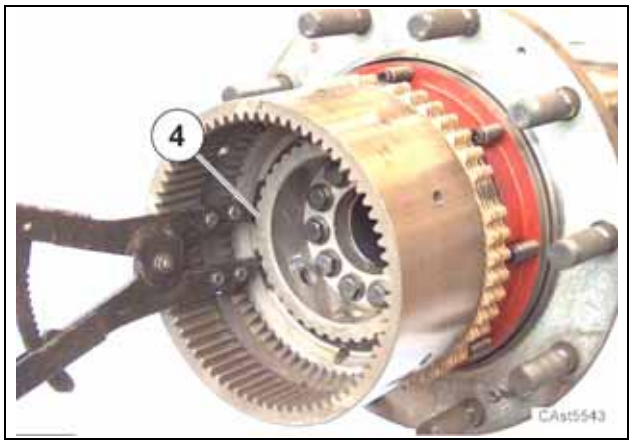
3. Use the levers inside the preset slots to detach the planetary gear carrier cover.



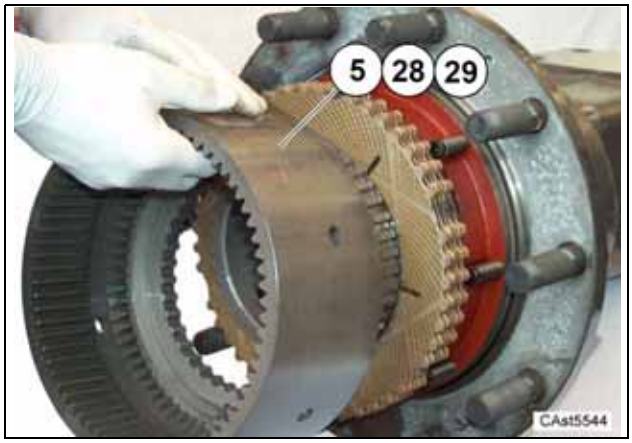
4. Remove the planetary gear carrier cover (3) and O-ring (30).



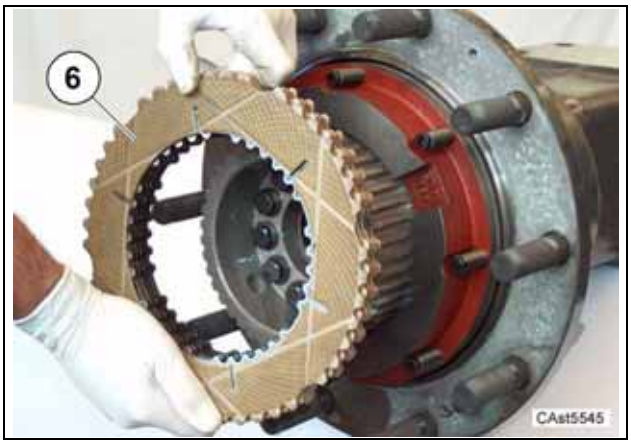
5. Remove split ring (4).



6. Remove ring bevel gear (5) complete with carrier (28) and split ring (29).



7. Remove brake discs (6).



8. Remove fastening screws of piston (7) and springs (15).



9. Remove piston (8).



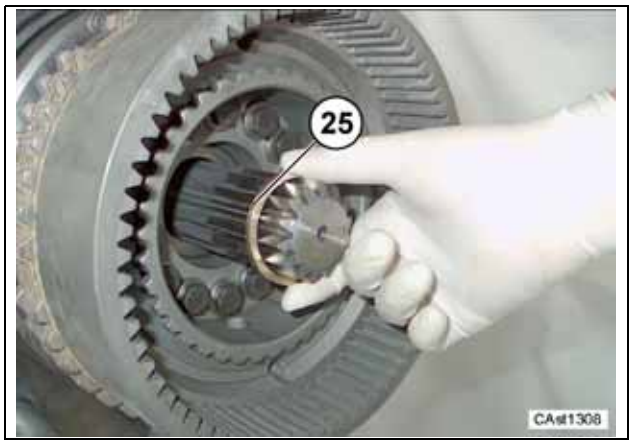
10. Remove seal rings (9) and (10) from piston (8).



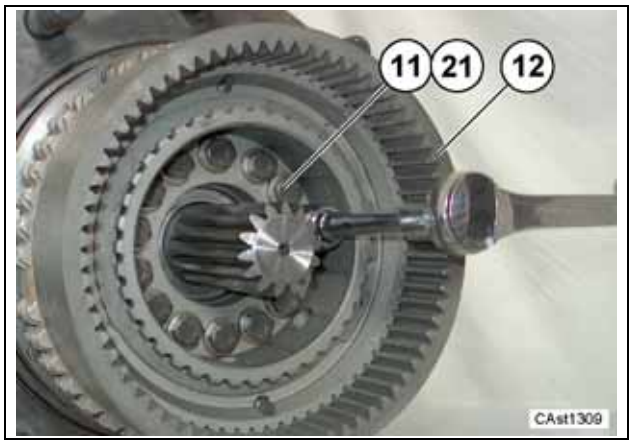
11. Remove snap ring (24).



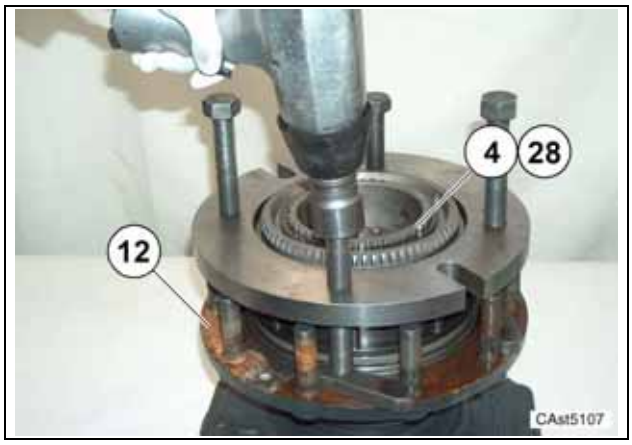
12. Remove spacer (25).



13. Remove screws (11) and washers (21) from brake carrier (12).



14. Assemble carrier (28) and split ring (4). Remove brake carrier (12).



15. Remove bushes (22).



16. Remove seal rings (13) and (14) from brake carrier (12).



17. Remove shims (26).



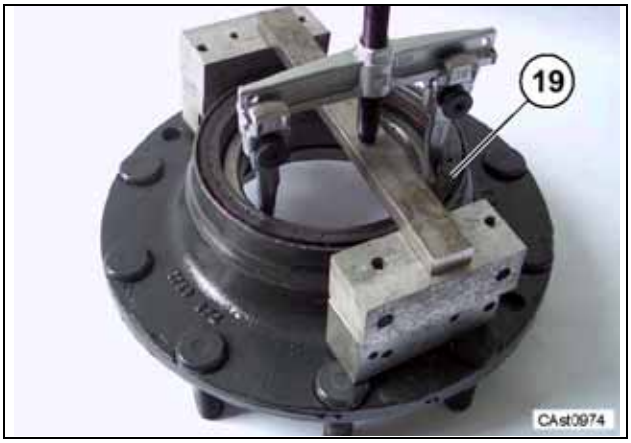
18. Remove wheel hub (16) with bearings (19) and (20) and seal ring (19).



19. Remove the drain valve (17).



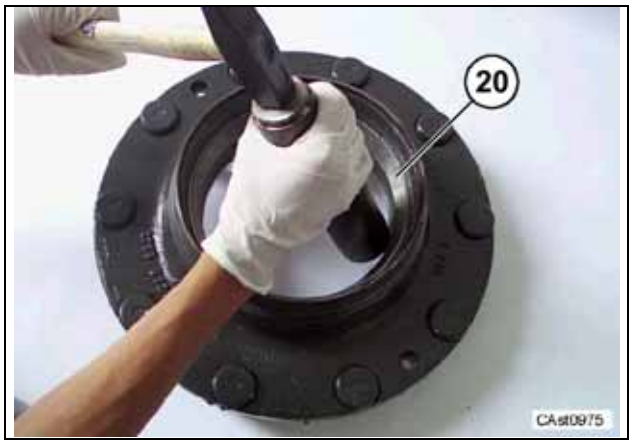
20. Remove seal ring (19).



21. Remove inner cup of bearing (18).



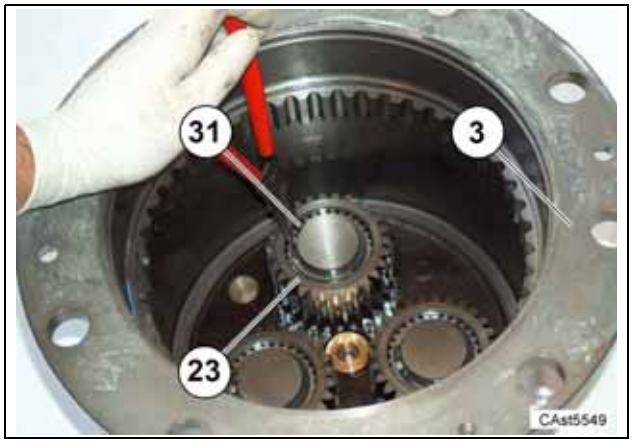
22. Remove outer cup of bearing (20).



23. Remove outer cup of bearing (18).



24. Remove snap ring (31). Remove planetary gears (23) from planetary gear carrier cover (3).



Assembly of Epicylic Reduction Gear and Brake

1. Fit outer cup of bearing (18) wheel hub (16).



2. Fit outer cup of bearing (20) wheel hub (16).



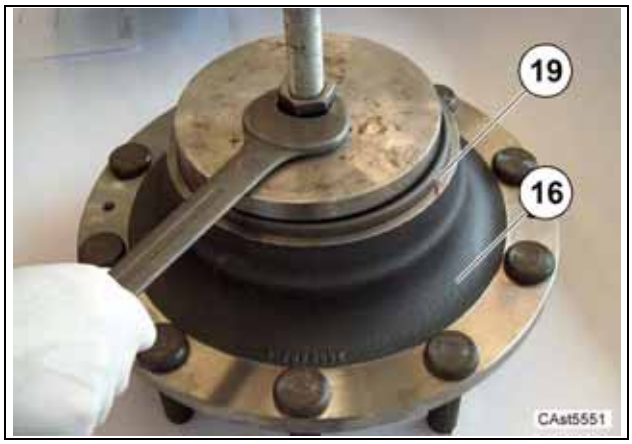
3. fit the remaining part of bearing 18) on wheel hub (16).



4. Apply Loctite® 510 on seal ring (19).



5. Fill seal ring (19) on wheel hub (16). Use tool 2897003.



6. Lubricate axle shaft to assemble the wheel hub.

⚠ WARNING

Polish hub and oil holes.



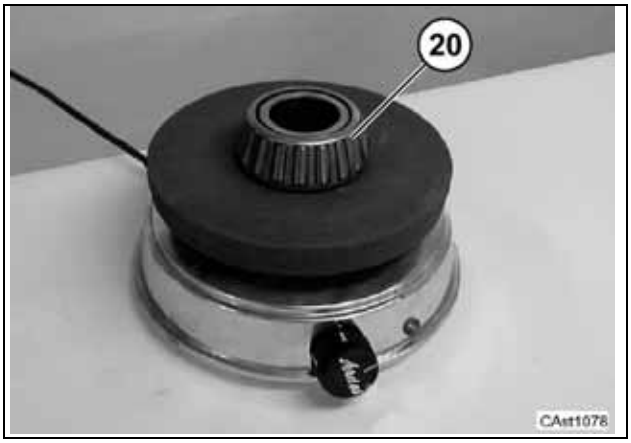
7. Assemble the whole wheel hub (16). Alternately strike bearings (18).

⚠ WARNING

The roller bearing should be rested on the beam trumpet.



8. Preheat bearing (20) on proper plate up to 100°C.



9. Fit bearing (20) inside beam trumpet.

⚠ WARNING

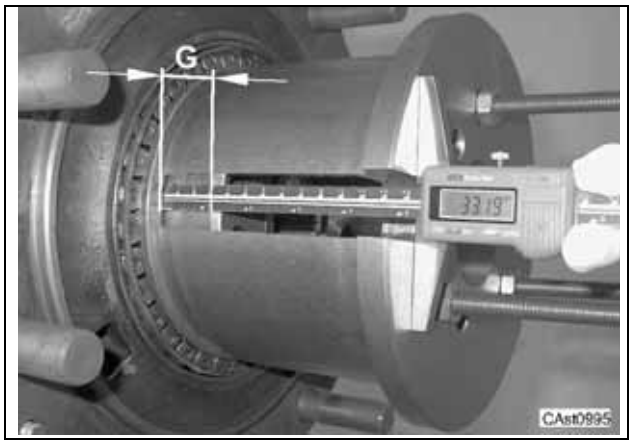
Wear gloves to avoid getting burnt.



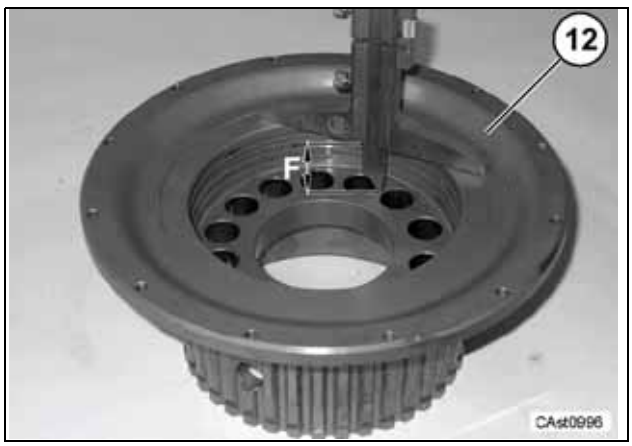
10. Assemble the tool 2897013, 3 draw plates M10 x 285 and 3 nuts M10.



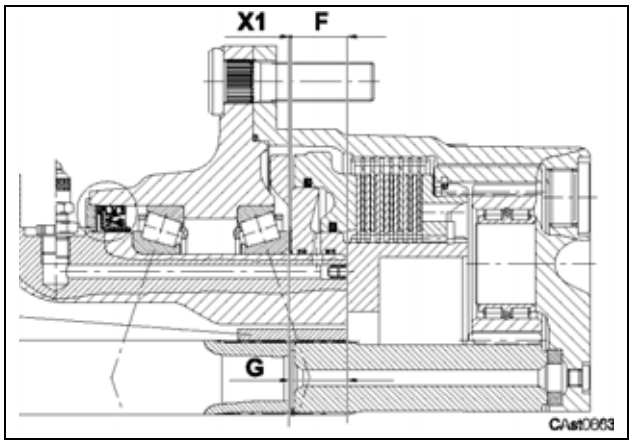
11. Use a depth gauge to measure dimension (g) of wheel hub.



12. Use a depth gauge to measure dimension F of brake carrier (12).



13. Calculate shims X1 of adjustment shims by using the following procedure: X1 (G-F) + 0.05.



14. Assemble previously calculated shims (26) X1.



15. Assemble O-rings (9) and (10) on piston (8).



16. Assemble O-rings (13) and (14) on brake carrier (12).



17. Fit piston (8) on brake carrier (12) with springs (15) and screws (7). Apply Loctite® 638 on the screws (7).



18. Fit the whole unit of the brake carrier on wheel hub.

⚠ WARNING

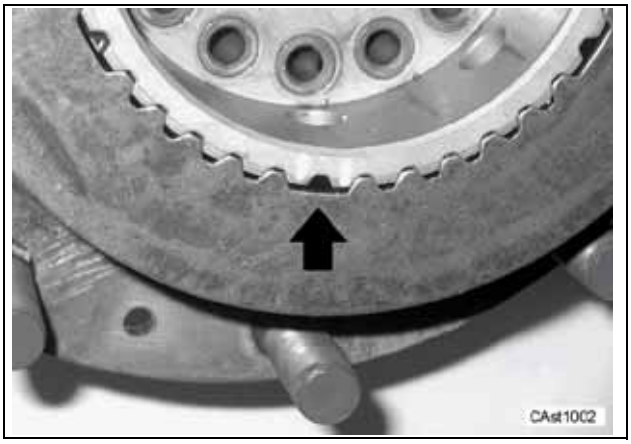
The brake carrier and beam trumpet holes should coincide.



19. Assemble brake discs (6).

WARNING

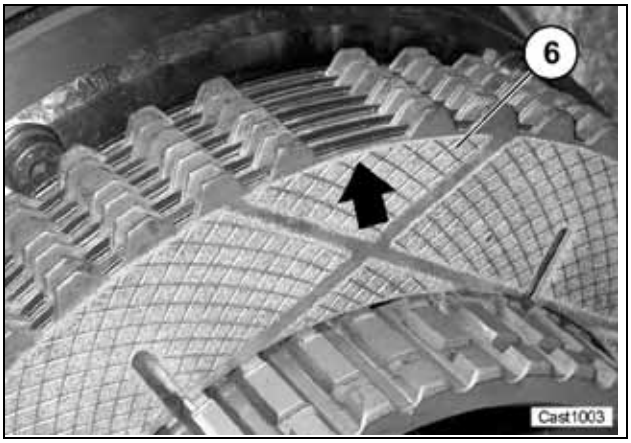
During assembly operations all the inner disc slots should coincide.



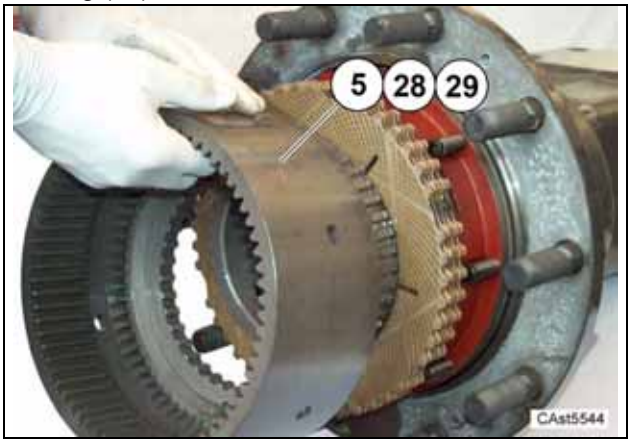
20. Assemble brake discs (6).

WARNING

Warning: During assembly operations all the outer disc slots should coincide.



21. Fit ring bevel gear (5) with carrier (28) and split ring (29).



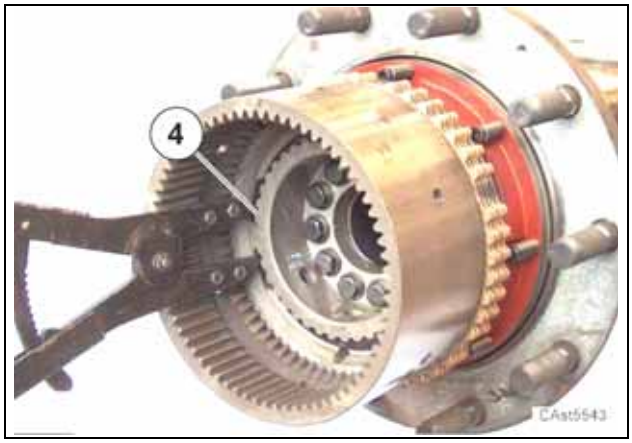
22. Test the brake by temporarily fitting two screws (11).

WARNING

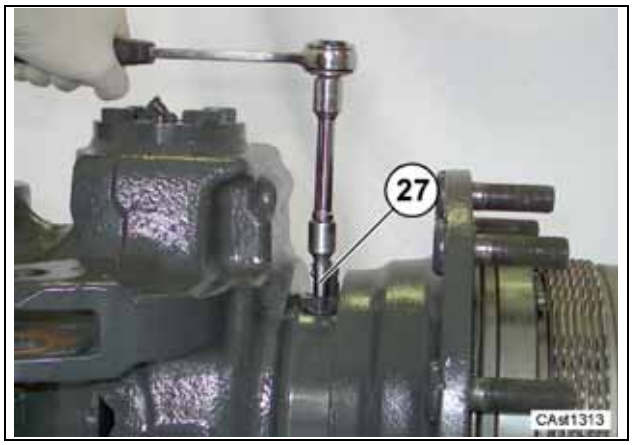
Warning: Do not assemble bushes (22).



23. Fit snap ring (4).



24. Remove plug (27).



25. Fit an adapter instead of the plug.



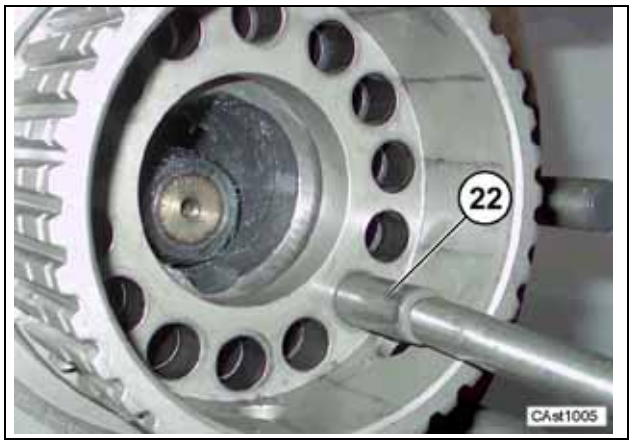
26. Test the brakes by considering that pressure should be 100^{0}_{-5} bar for about one minute.



27. Fit bushes (22).

WARNING

Pay attention to the assembly direction of bushes.



28. Apply Loctite® 242 inside slots.



29. Fit screws (11) and shims (21).

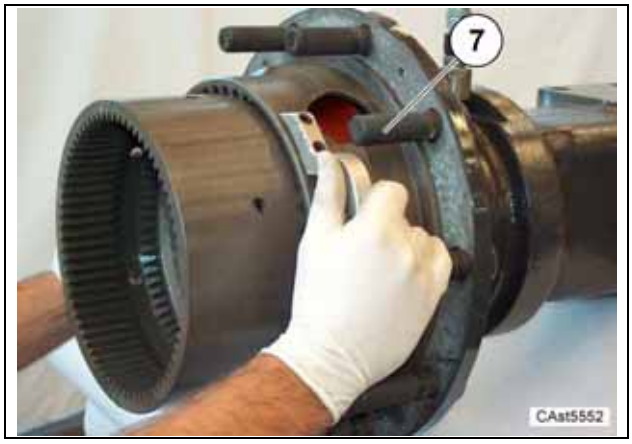
N•m Screws (11) tightening torque: **68Nm**



30. Line up brake discs. Use tool 2897014.

WARNING

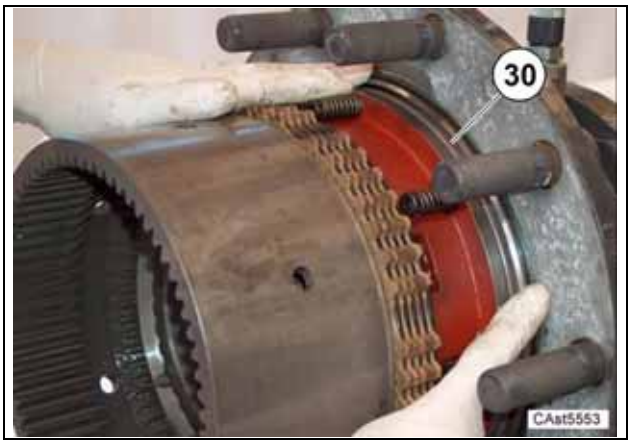
A tooth should coincide with a brake fastening screw (7).



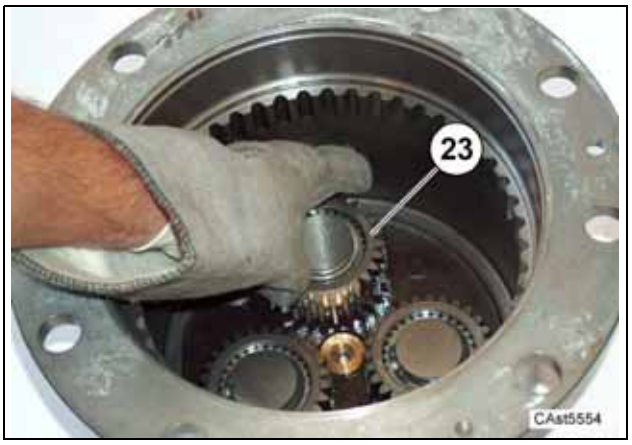
31. Put brakes under pressure to avoid outer disc misalignment.



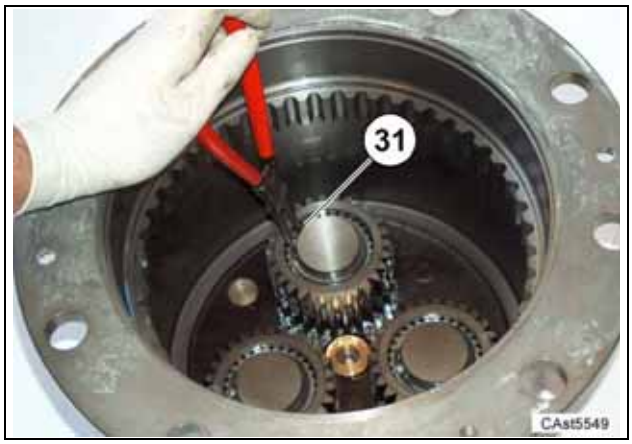
32. Lubricate with grease and fit O-ring (30).



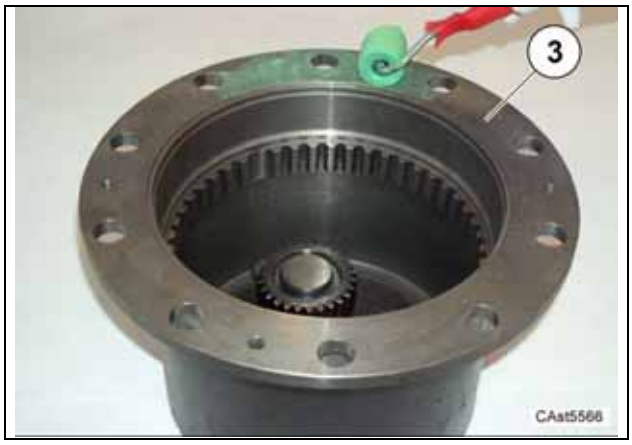
33. Heat the planetary gear bearing at 110°C. Assemble planetary gear.



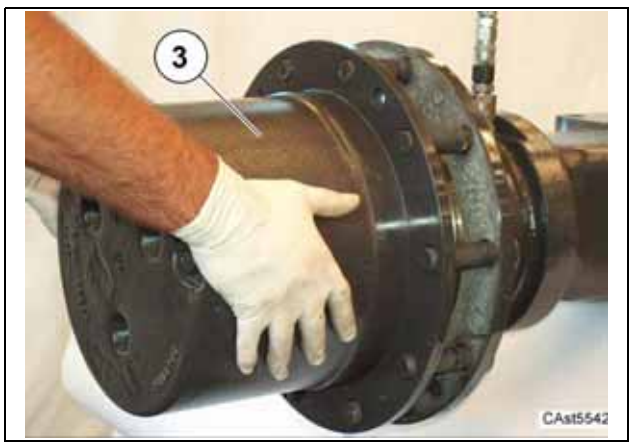
34. Assemble snap ring.



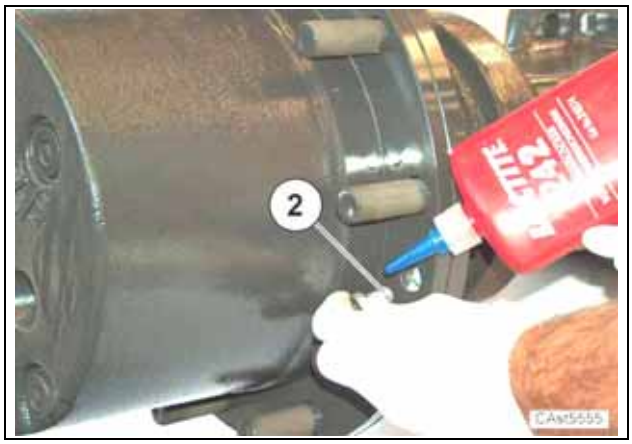
35. Lubricate with grease the contact surface of planetary gear cover (3). Apply Loctite® 510 in the holes.



36. Fit the planetary gear cover (3) and discharge pressure from the hydraulic pump.



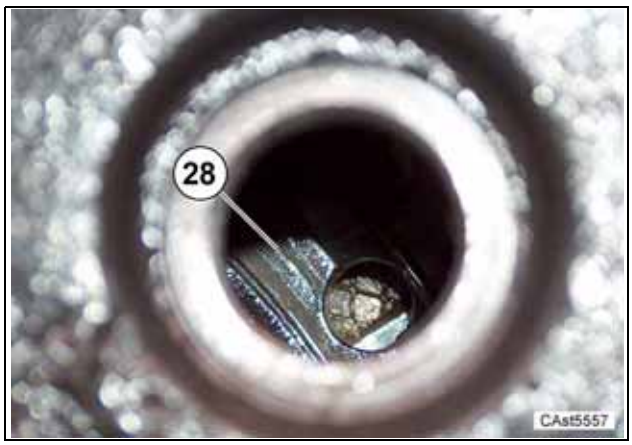
37. Apply Loctite® 242 on screw.



38. Fit screws (2) according to the proper tightening torque (48Nm).



39. Remove oil drain plug and turn the final drive up to meeting item (28) hole.

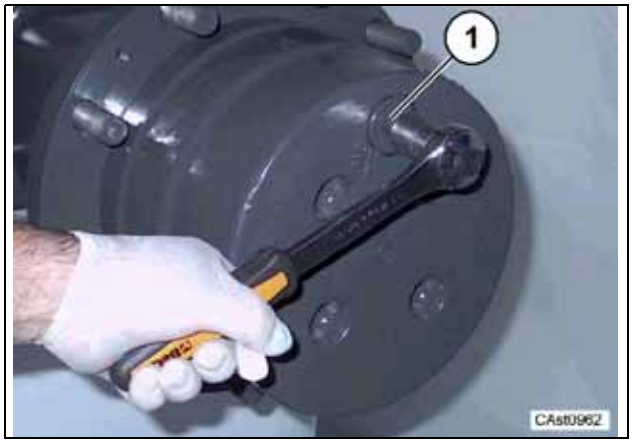


40. Apply pressure of 45-50 bar and check the distance between brake locking and unlocking (Min: 1.7mm; Max: 3.8 mm)

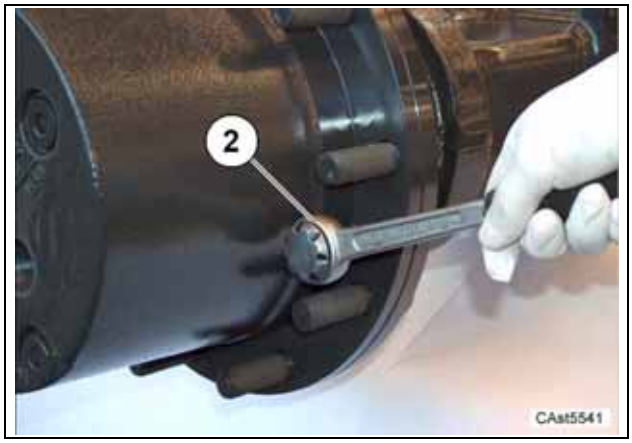


Disassembly of joint box

1. Before draining the oil, position the wheel hub (1) with the plug on the upper part and loosen it off some turns in order to eliminate any possible inner pressure, then remove it completely. Turn the wheel hub upside down till the hole is in the lowest point.
   Drain the oil completely.



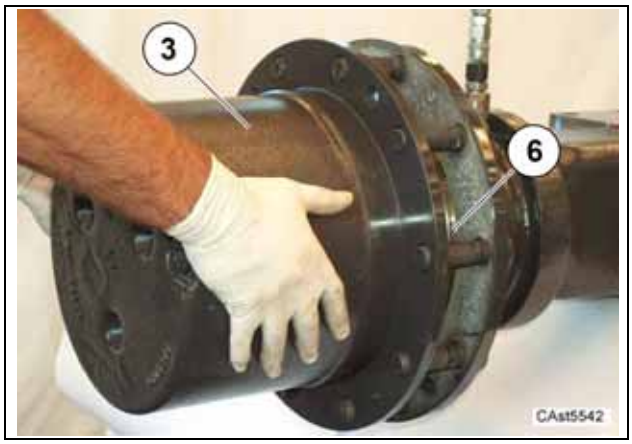
2. Remove fastening screws (2) from the cover of the planetary gears carrier.



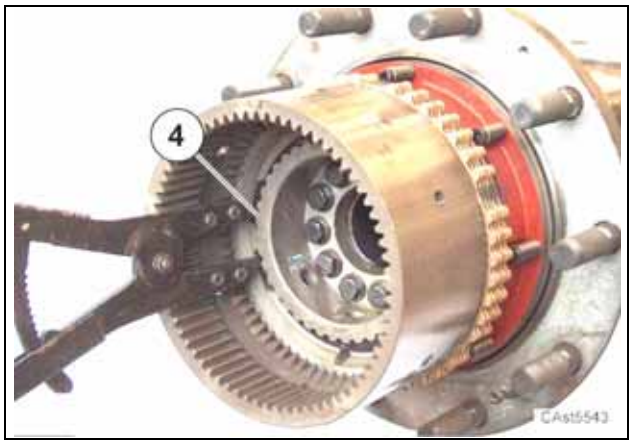
3. Use the levers inside the preset slots to detach the planetary gear carrier cover.



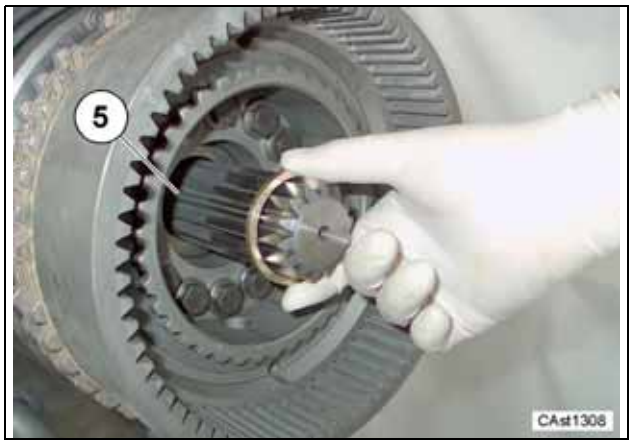
4. Remove the planetary gear carrier cover (3) and O-ring (6).



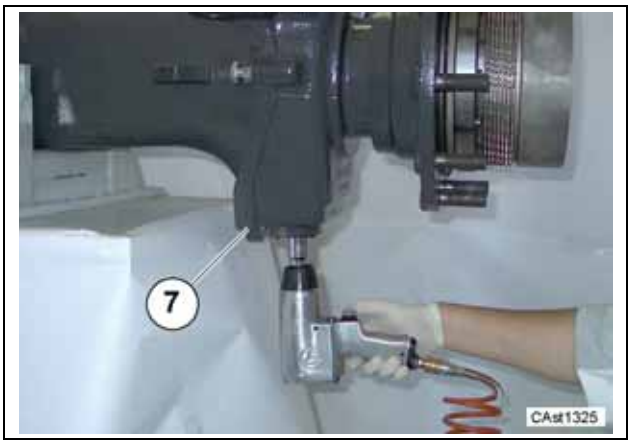
5. Remove split ring.



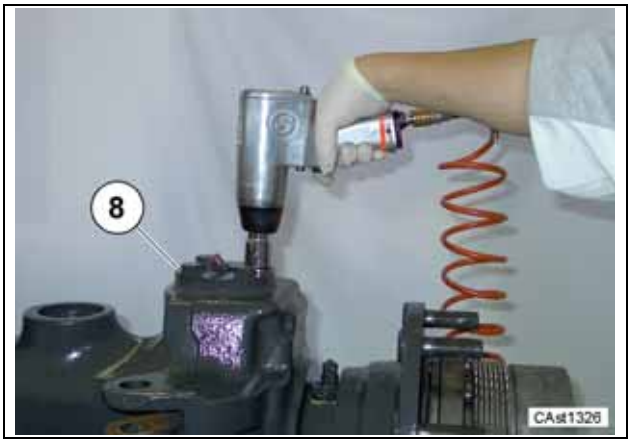
6. Remove spacer (5).



7. Remove the screw (7).



8. Remove the screw (8).



9. Secure the joint box to a hoisting equipment.



10. Screw two screws M12 x 100 and remove the pivot.



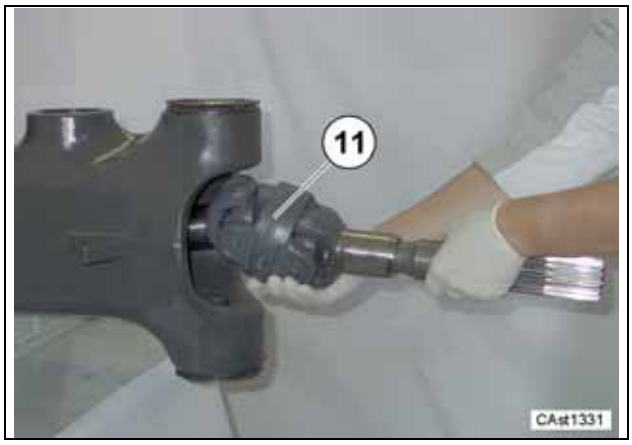
11. Screw screws M12 x 100 and remove the pivot.



12. Remove the complete joint group.



13. Remove the complete joint (11).



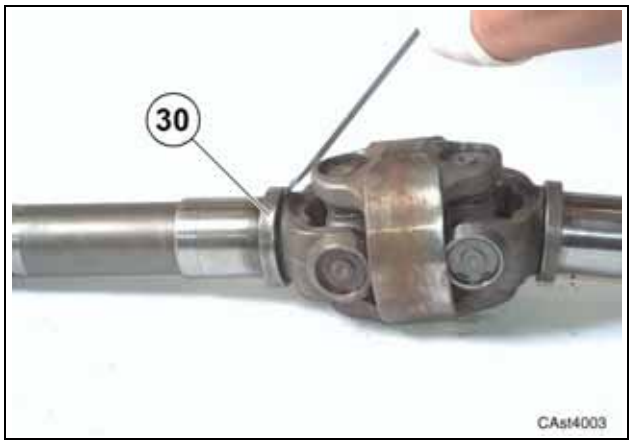
14. Remove the gasket (12).



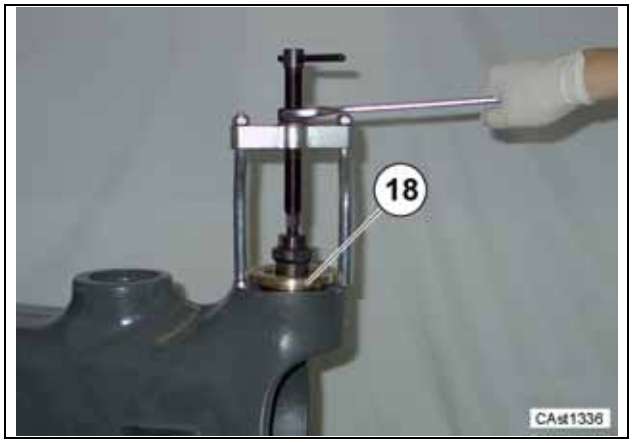
15. Remove the gasket (13).



16. Remove gasket (30).



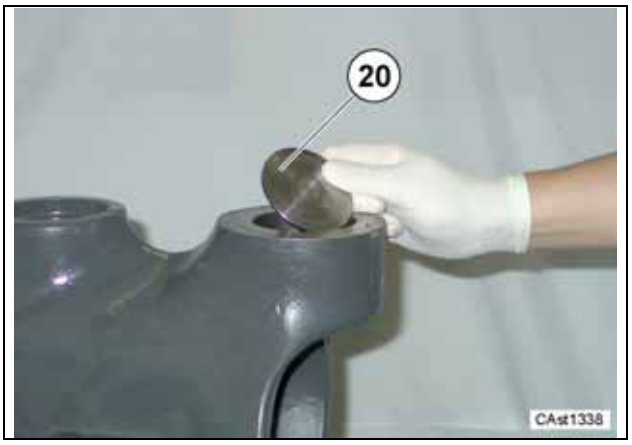
17. Use an extractor to remove bush (18).



18. Remove the O-ring (20).



19. Remove the disk (20).



20. Remove the bush (21).



21. Remove the O-ring (22) and the disk (23).



22. Remove the gasket (24).



23. Remove the bush (25).



24. Remove pins (26).



25. Remove the spacer (27).



26. Remove gaskets (28).



27. Remove the bush (29).



Assembly of joint box

1. Assemble the disk (20).
   Pay attention to assembling direction.



2. Assemble the O-ring (19).



3. Assemble the bush (18).
   Use tool 2897017.



4. Assemble the O-ring (22) and the disk (23). Pay attention to assembling direction.



5. Assemble the bush (21).
Use tool 2897017.



6. Assemble the bush (25).
Use tool 2897017.



7. Apply Loctite® 510 on the gasket (24).



8. Assemble the gasket (24).
Use tool 2897017.



9. Assemble the bush (29).
Use tool 2897016.



10. Apply Loctite® 510 on the gasket (28).



11. Assemble the gasket (28).
Use tool 2897017.



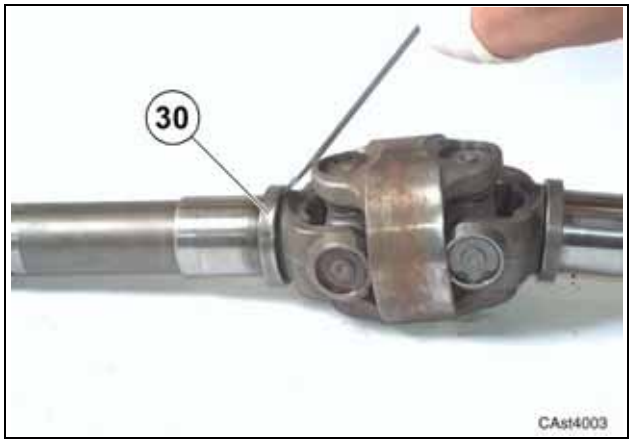
12. Assemble the pins (26).



13. Grease and assemble the spacer (27).



14. Assemble gasket (30).



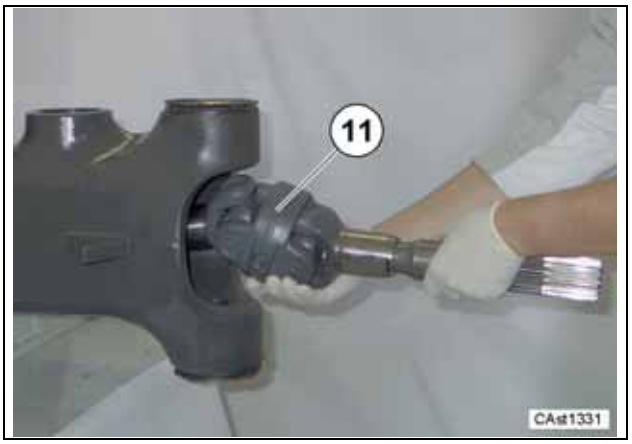
15. Assemble the gasket (12). Pay attention to assembling direction.



16. Assemble the gasket (13). Pay attention to assembling direction.



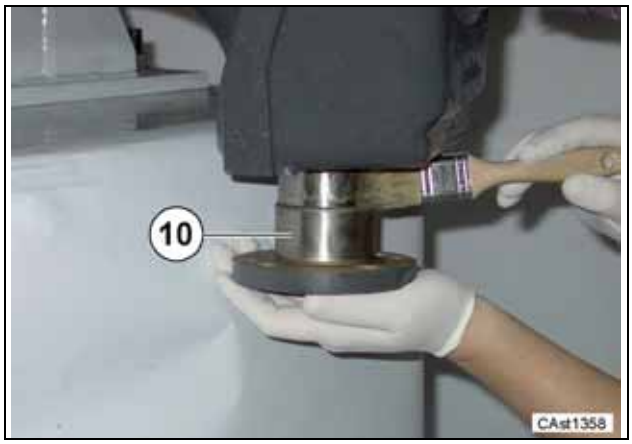
17. Assemble the complete joint (11).



18. Grease tabs of the joint group and assemble.



19. Lubricate and assemble the pivot.



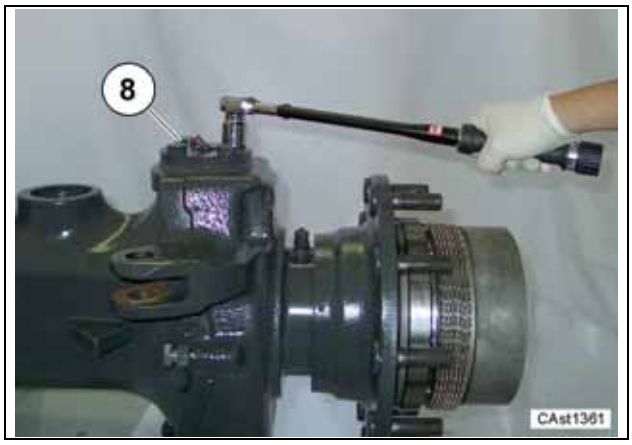
20. Lubricate and assemble the pivot (9).



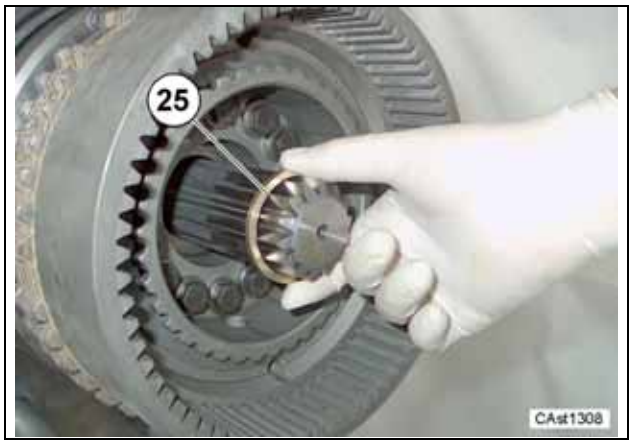
21. Apply Loctite® 242 and assemble the screw (7). Torque - **285Nm (29 kgf-m)**



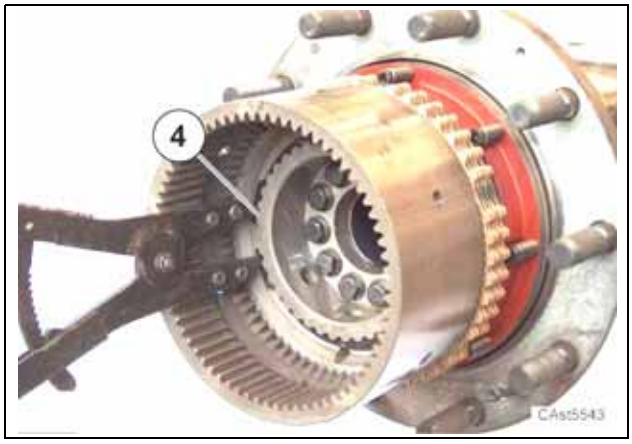
22. Apply Loctite® 242 and assemble the screw (8). Torque - **285 (29kgf-m)**



23. Assemble the snap ring (4).



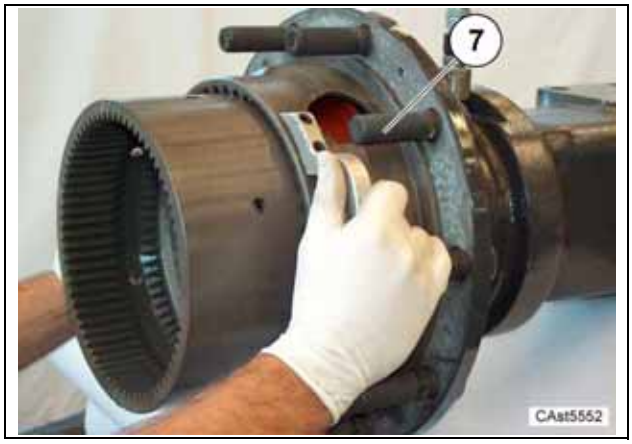
24. Assemble the snap ring (4).



25. Line up brake discs. Use tool 2897014.

⚠ WARNING

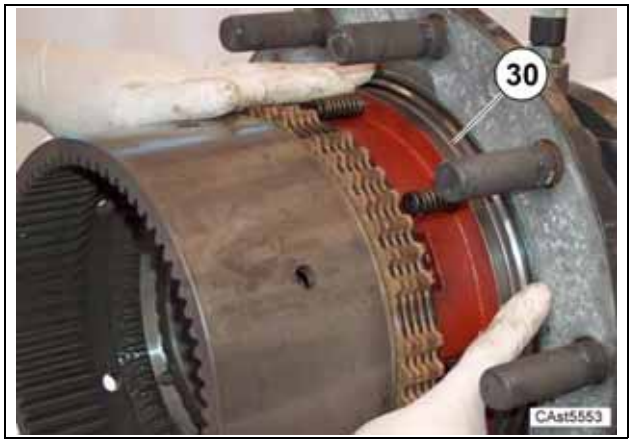
A tooth should coincide with a brake fastening screw (7)



26. Put brakes under pressure to avoid outer discs misalignment.



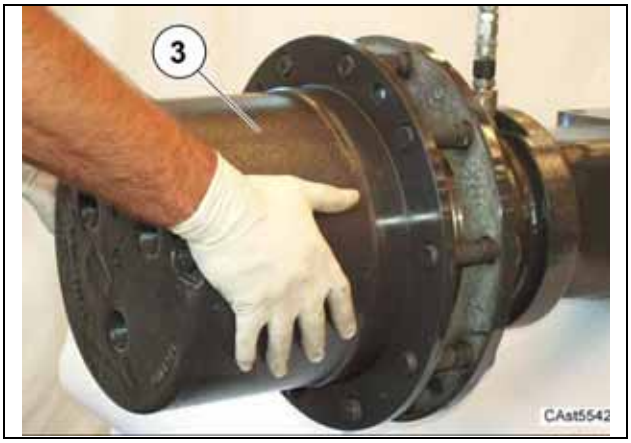
27. Lubricate with grease and fit O-ring (30).



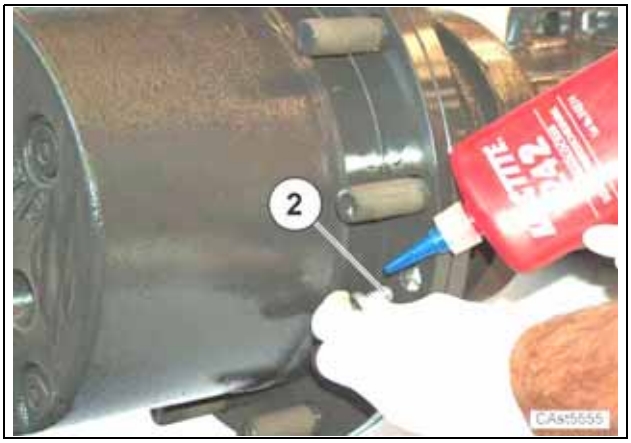
28. Lubricate with grease the contact surface of planetary gear cover (3).
    Apply Loctite® 510 in the holes.



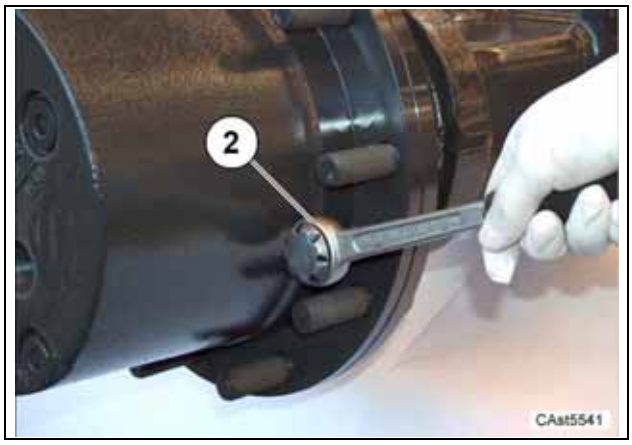
29. Fit the planetary gear cover (3) and discharge pressure from the hydraulic pump.



30. Apply Loctite® 242 on screw (2).



31. Fit screws (2).
    Torque - **55 Nm (6 kgf-m)**



Disassembly of beam trumpet and differential unit

1. Remove the axle unit. Sling and slightly tension the rope. Turn and then fix it in vertical position.



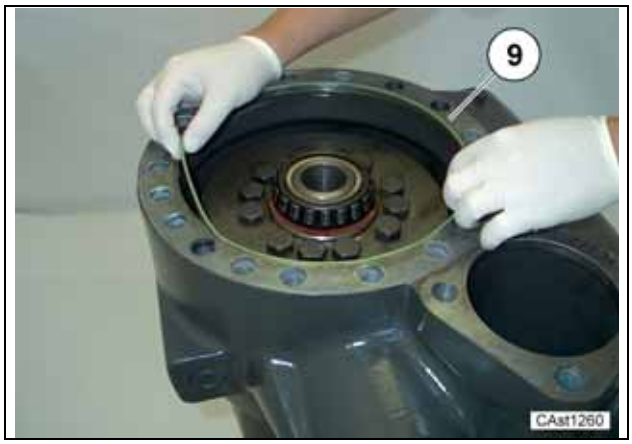
2. Loosen and remove screws (1) with washers (27).



3. Sling the beam trumpet (3) and slightly lift it.



4. Remove O-ring (9).



5. Lift the whole differential unit.



6. Use an extractor and remove from housing (4) the outer cup of bearing (5).



7. Remove shims (6).



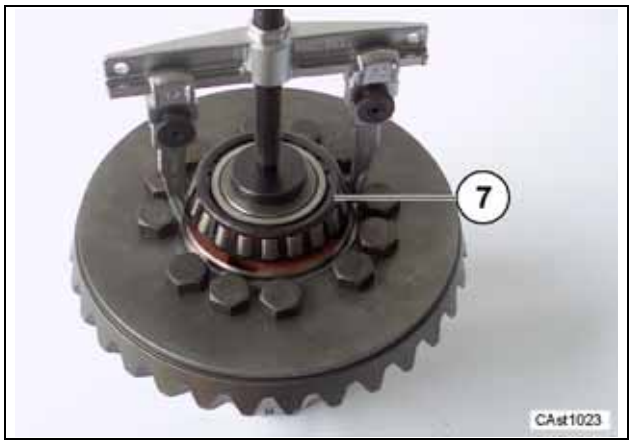
8. Use an extractor and remove from housing (3) the outer cup of bearing (7).



9. Remove shims (8).



10. Use an extractor to remove bearing (7) from differential unit.



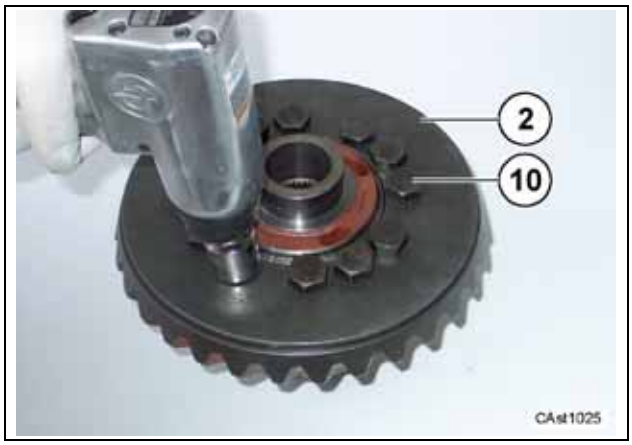
11. Use an extractor to remove bearing (5) from differential unit.



12. Unscrew all fastening screws (10) of bevel gear crown (2).

⚠ WARNING

This operation makes both differential half boxes free, so take care not to drop the inner components.



13. Remove ring bevel gear (2) by means a mallet.



14. Check marking points (11) and (12) that will be useful during the assembly.

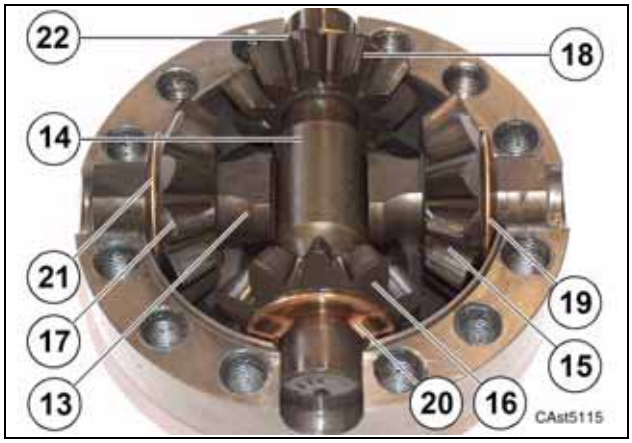


NOTE: Without differential torque limiter.

15. Remove planetary gear (23) and shim (25).



16. Remove differential pins (13 and (14), planetary gears (15), (16), (17) and (18) and spheric washers (19), (20), (21), and (22).

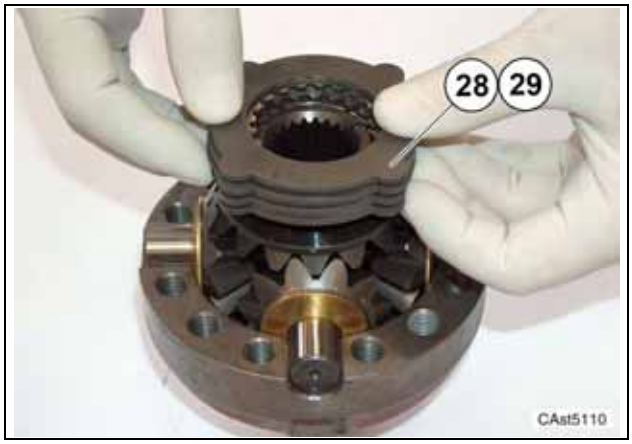


17. Remove planetary gear (24) and shim (26).

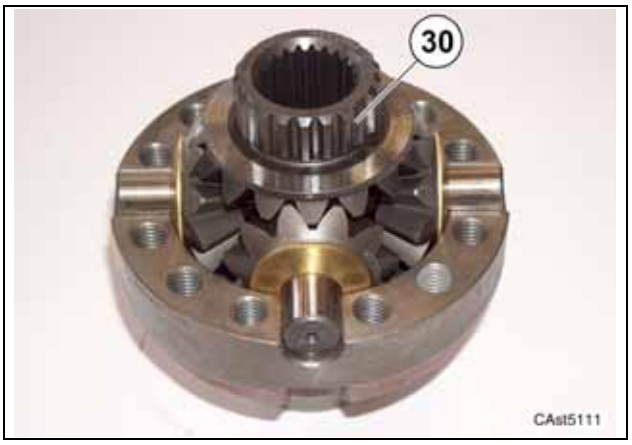


NOTE: With differential torque limiter.

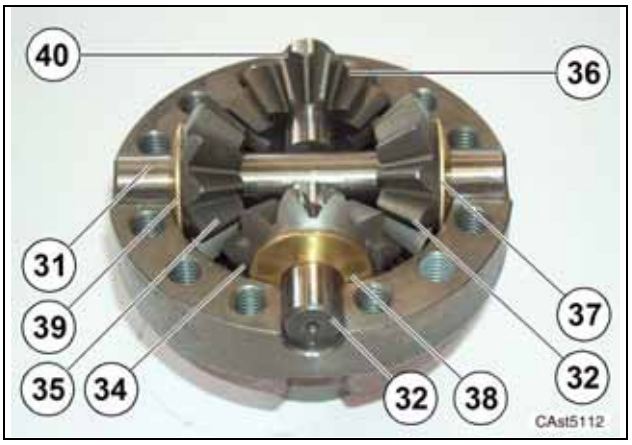
18. Remove discs (28) and (29).



19. Remove planetary gear (30).



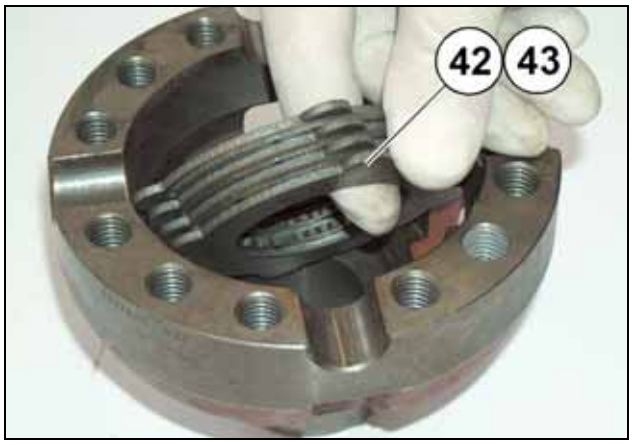
20. Remove differential pins (31 and (32), planetary gears (33), (34), (35) and (36) and spheric washers (37), (38), (39), and (40).



21. Remove planetary gear (41).



22. Remove discs (42) and (43).

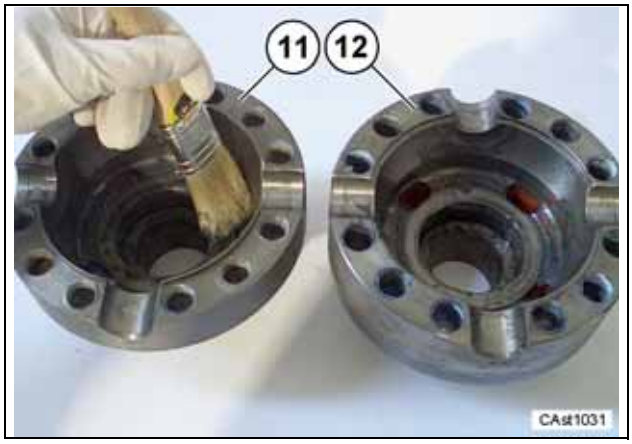


Assembly of beam trumpet and differential unit.
NOTE: Without differential torque limiter.

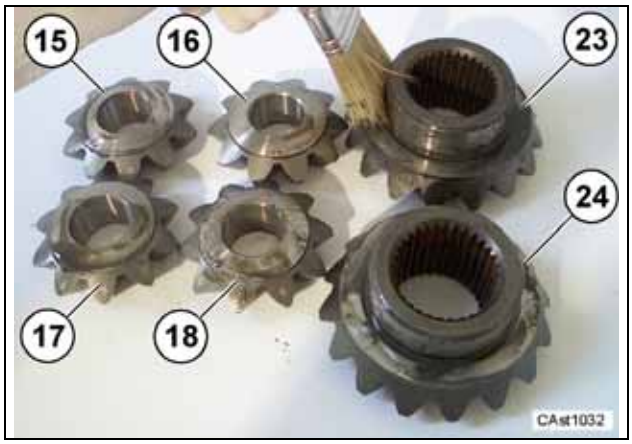
1. Apply a thin layer of molicote G-n plus paste on half boxes of differential (11) and (12).

⚠ WARNING

Remove rests do dope.



2. Apply a thin layer of molicote G-n plus paste on planetary gears (15), (16), (17) and (18) and on crown wheels (23) and (24).



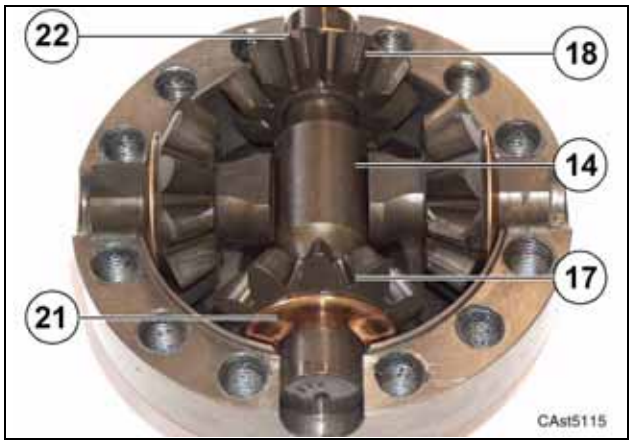
3. Set crown Wheel (24) and washer (26).



4. Fit the differential unit pin (13) and planetary gears (15) and (16) and washers (19) and (20).



5. Fit the differential unit pin (14) and planetary gears (17) and (18) and washers (21) and (22).



6. Fit ring bevel gear (23) and washer (25).

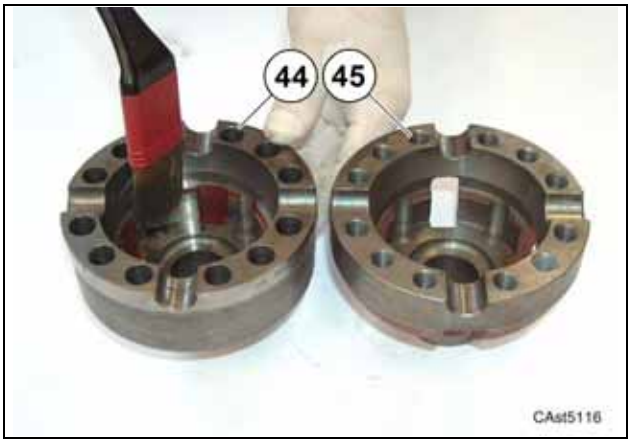


NOTE: With differential torque limiter.

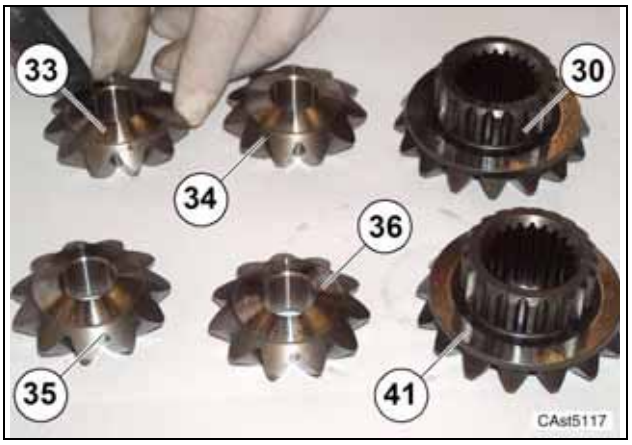
7. Apply a thin layer of Molicote G-n plus paste on half boxes of differential (44) and (45).

⚠ WARNING

Remove rests of dope.



8. Apply a thin layer of Molicote G-n plus paste on planetary gears (33), (34), (36) and on crown wheels (30) and (41).



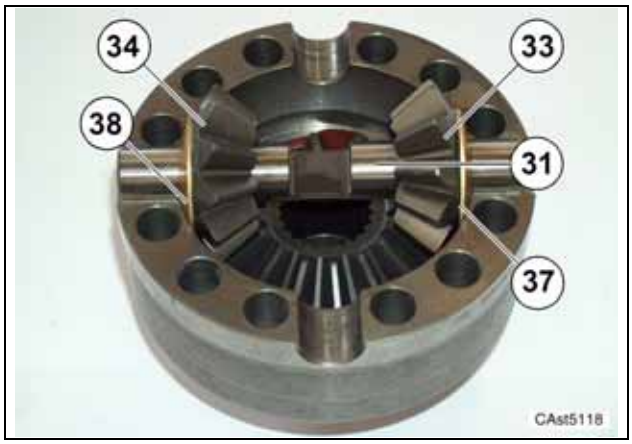
9. Assemble discs (42) and (43).



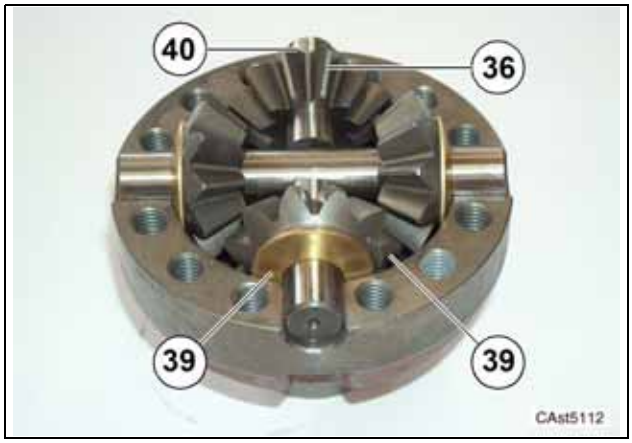
10. Assemble planetary gears (41).



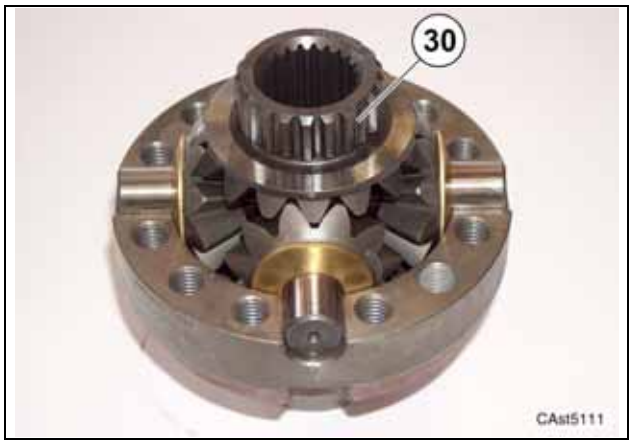
11. Fit the differential unit pin (31) and planetary gears (33), (34) and washers (37) and (38).



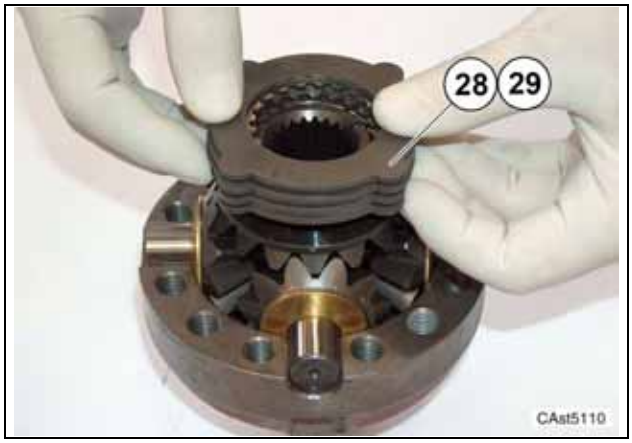
12. Fit differential unit pin (32) and planetary gears (35), (36) and washers (39) and (40).



13. Assemble planetary gears (30).



14. Assemble discs (28) and (29).



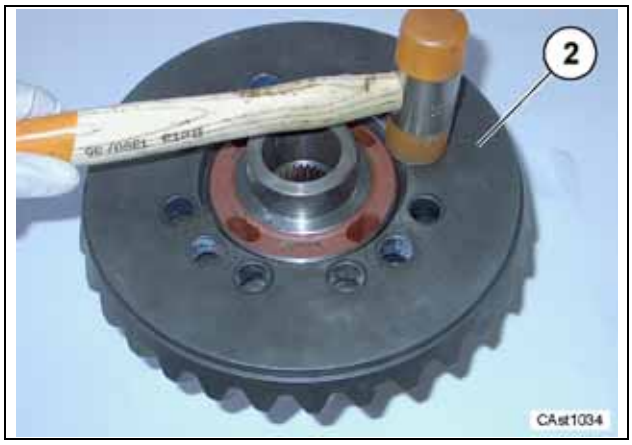
15. Fit the two half boxes of differential unit (11) and (12).

⚠ WARNING

Carefully check that the marks of both differential half boxes coincide.



16. Fit ring bevel gear (2) by using a hammer.



17. Apply Loctite® 242 on thread of screws (10).



18. Tighten screws (10)
    Torque - **205 Nm (21 kgf-m)**

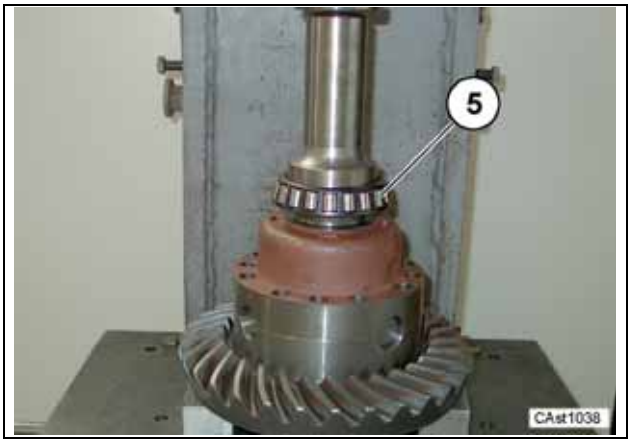
NOTE: Fix differential housing in the vice.



19. Press bearing (7) or assemble after preheating.



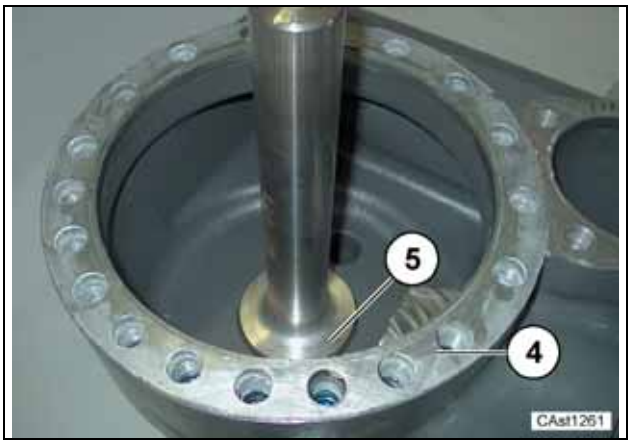
20. Press bearing (5) assemble after the preheating.
‘



21. Fit adjustment shims (6) **X1** = 1.8 on beam trumpet (4).



22. Use tool 2897004 to fit bearing washer (5) on beam trumpet (4).



23. Fit O-ring (9) on beam trumpet (3). Lubricate O-ring (9)with grease.



24. Position adjusting shims (8) **X2** on beam trumpet (3).



25. Use tool 2897004 to fit the bearing outer washer (7) on beam trumpet (3).



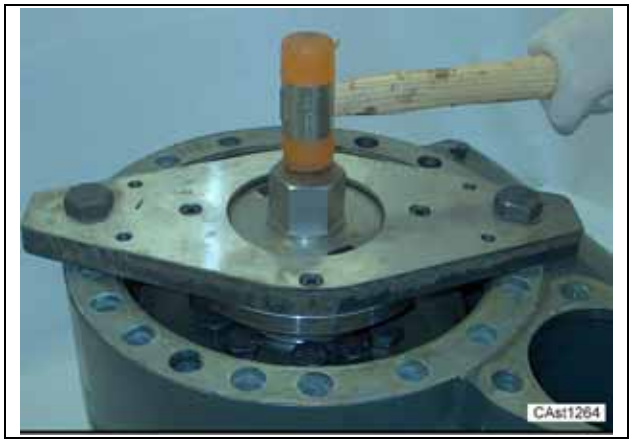
26. Position the differential unit beam trumpet (4).



27. Position tool 2897001 for 20K-23-31000. Position tool 2897002 for 20K-23-32000. Assemble half bearing (7) inside tool.



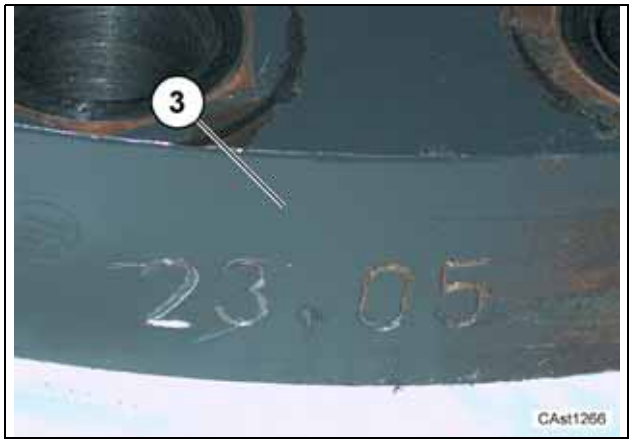
28. While Screwing the tool nut until the value of 10Nm has been reached turn the ring bevel gear and strike it with a hammer to fix whole unit.



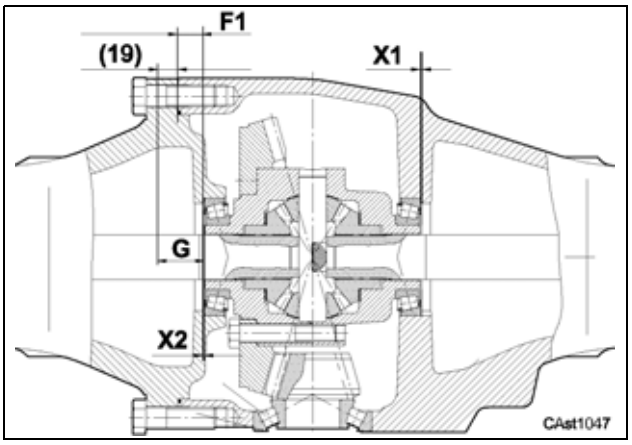
29. Measuring of value **G.**



30. Value written on beam trumpet (3) **F1**



31. Drawing used to determine backlashes between the bevel gear pair teeth for 20K-23-31000.
X1 = 1.8
Check adjusting shims **X2** through the suggested procedure for 20K-23-31000 axles
X2 = G - (19 + F1) + 0.15 / 0.1
F1 = addition of the dimensions printed on the housings 19 + 0.1 / 0.15 is the bearing pre-loading



32. Move alternately the pinion tag and take note of the backlash between pinion and ring bevel gear (detected through a compactor). Make sure that the feeler touches the screw head mounted on the flange and is located at 90 degrees. Check if the value of the detected backlash is within the preset field: 0.15/0.25 mm.
Should the backlash be insufficient or excessive, adjust shim **X1**=1.8 by increasing or decreasing.



33. Apply Loctite® 510 on contact surface of beam trumpet (4).

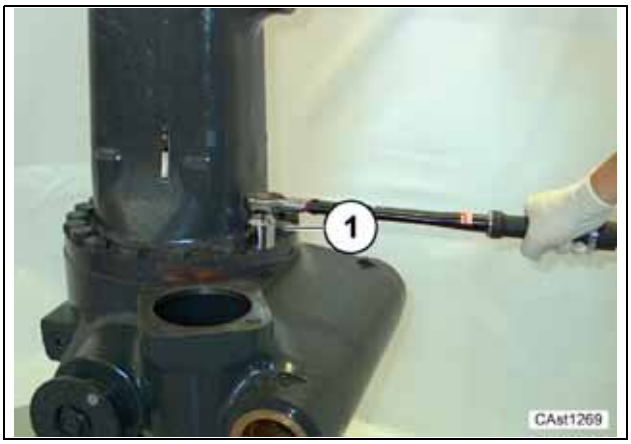


34. Apply Loctite® 242 on screws (1).



35. Assemble screws (1).

N·m Screws (1) - **560Nm (57 kgf-m)**



Disassembly of pinion group

1. Remove the axle unit. Sling and slightly tension the rope. Turn and then fix it in vertical position.



2. Loosen and remove screws (1) with washers (14).



3. Sling the beam trumpet (3) and slightly lift it.



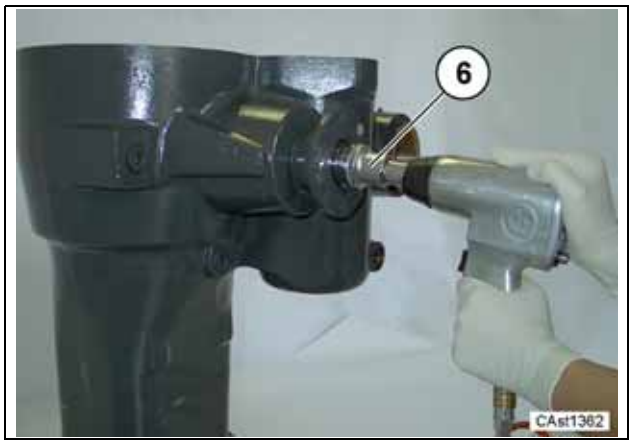
4. Remove O-ring (5).



5. Lift the whole differential unit.



6. Loosen the nut (6).



7. Remove the nut (6) and the flange (10).



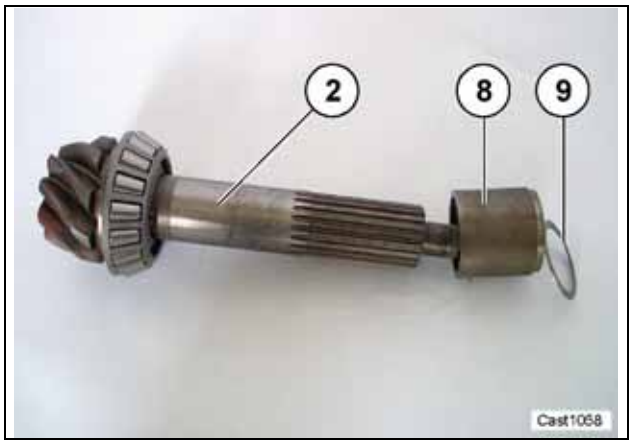
8. Remove the gasket (7).



9. Take the bevel pinion out of its housing, by beating with hammer made of soft material on the splined end.



10. Once the bevel pinion (2) has been removed, collect shims (9) and spacer (8).



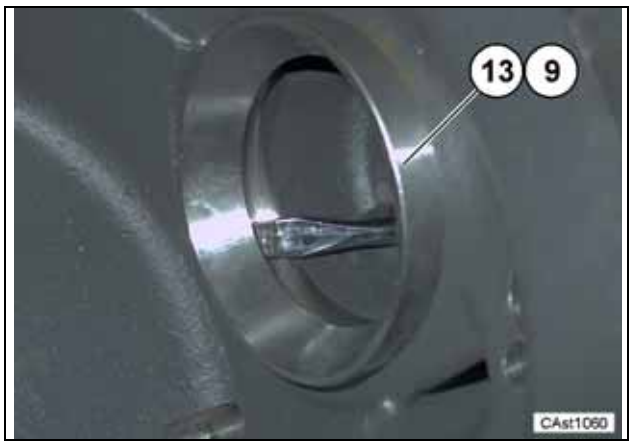
11. Take the bearing cone (13) out of the bevel pinion end, using a suitable extractor.



12. Take the cup of the taper roller bearing (11) out of the central body, using a chisel and hammer.



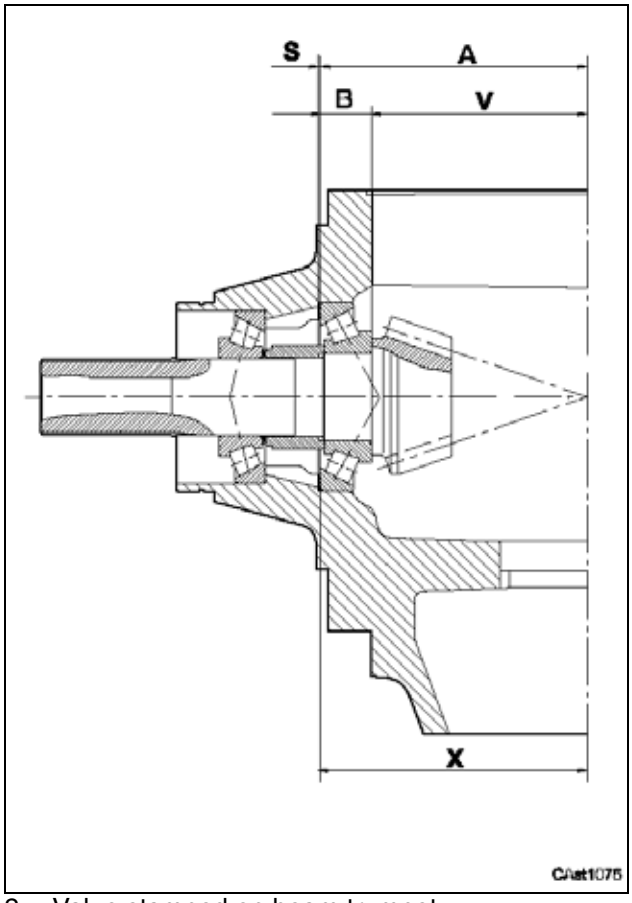
13. Remove the outer cup of the taper roller bearing (13) and shims (9) from the central body. Use a chisel and a hammer.



Assembly of pinion group

1. Bevel pinion adjustment for 20K-23-31000.

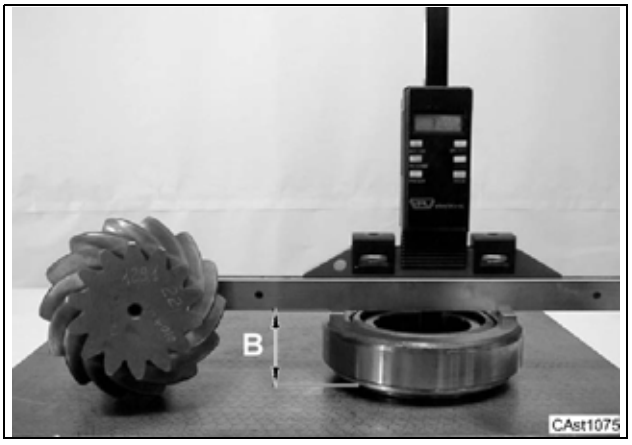
X	155.50	155.50	155.70
B	29.25	29.45	29.45
V	125.00	125.20	124.80
A	154.25	154.65	154.05
S	1.25	0.85	1.65



2. Value stamped on beam trumpet.



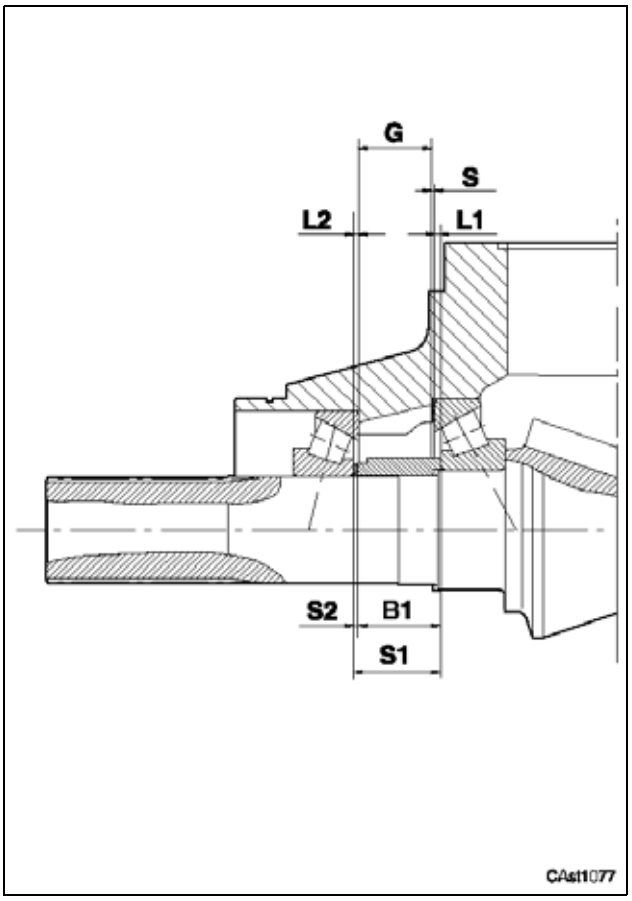
3. To determine shim (**S**) between pinion and bearing it is enough to add value (**V**) printed on pinion head (**V** = prescribed conical distance) to value **B** - bearing width - and subtract **X** from the value printed on beam
   S = X - (V+B)
   Example:shim **S** = 163.6 - (132.80 + 29.25) =1.55 mm



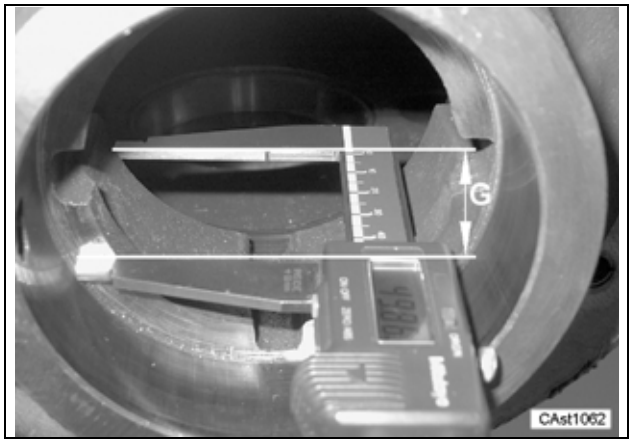
4. Bearings adjustment.

G	30.50	30.00	30.60
S	1.25	0.85	1.65
L1	2.25	2.25	2.57
L2	2.25	2.25	2.57
S1	36.25	35.35	37.39
B1	34.40	34.50	34.40
S2	1.85	0.85	2.99

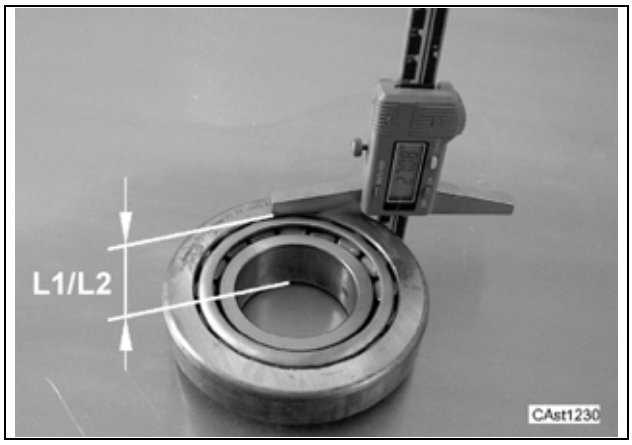
Pre-loading reduction ca. 0.02 - 0.04 for a 2-3 Nm torque.



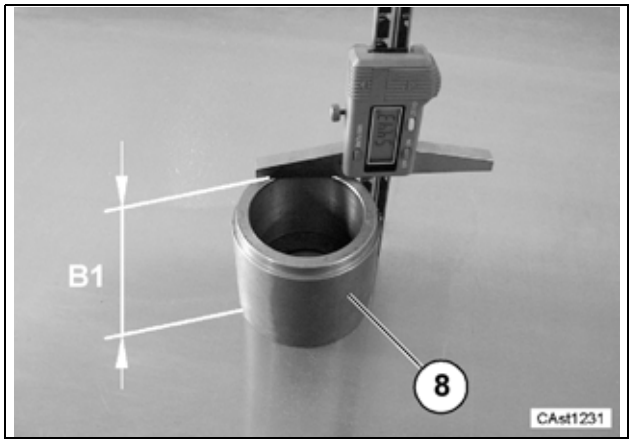
5. To determine shim **S2.**
   S2 = B1 - (L1 - S - G - L2)
   S = previously detected shims
   G = beam value



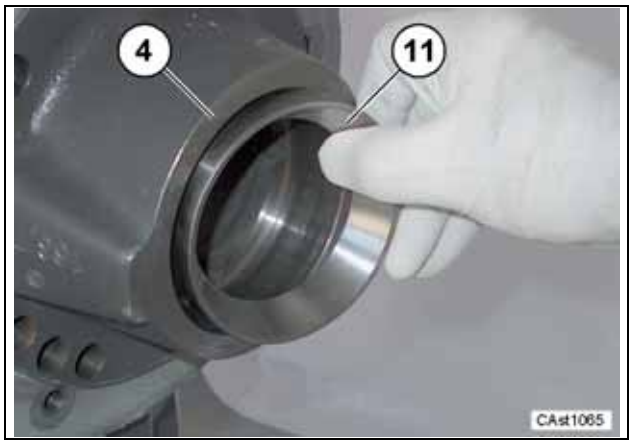
6. **B1** = spacer eight (8).
   Alternative procedure, use starting spacer **S** = 1.5.



7. **B1** = spacer eight (8).
   Alternative procedure, use starting spacer **S** = 1.5.



8. Position half bearing (11) on beam trumpet (4).



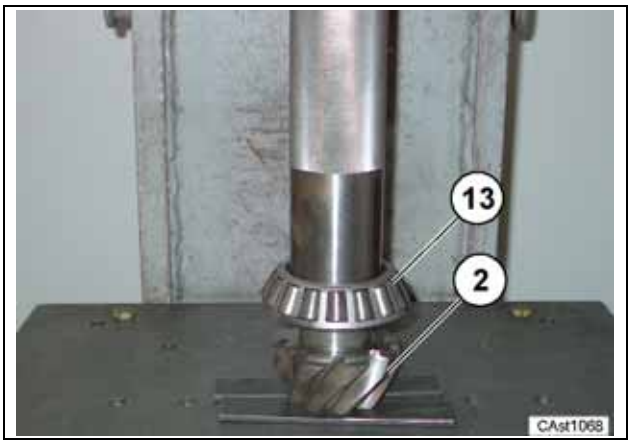
9. Position adjusting shims (9) and inner bearing washer (13) on beam trumpet (4).



10. Insert the cups of the taper roller bearings on their housings using the special tools included on the kit 2897006 (20K-23-31000) 25897007 (20K-23-32000).



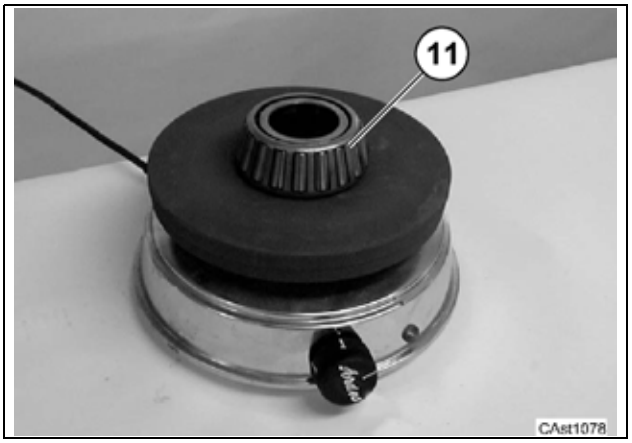
11. Press inner bearing (13) on pinion (2).
Use tool 2897009.



12. Fit the whole pinion of the bearing on beam trumpet (4) spacer (8) and shims (12).



13. Preheat bearing (11) on proper plate up to 100ºC.



14. Fit bearing (11) in relevant housing on beam trumpet (4).

⚠ WARNING

Use a special glove to protect from scorching.



15. Grease shaft pinion (2).



16. Fit oil seal (7) inside tool 2897015.
Apply Loctite® 510 on the oil seal outer edge.



17. Assemble the oil seal by slightly striking with a plastic hammer.

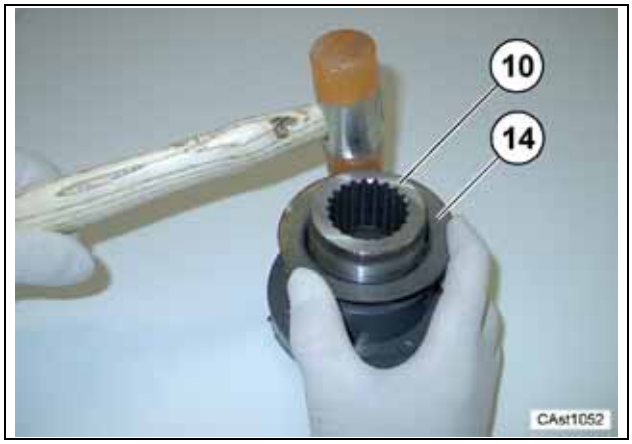
NOTE: Clean the box with a rolling brush.



18. Apply Loctite® 242 on nut (6).



19. Use a hammer to assemble flange (10) together with guard (14).



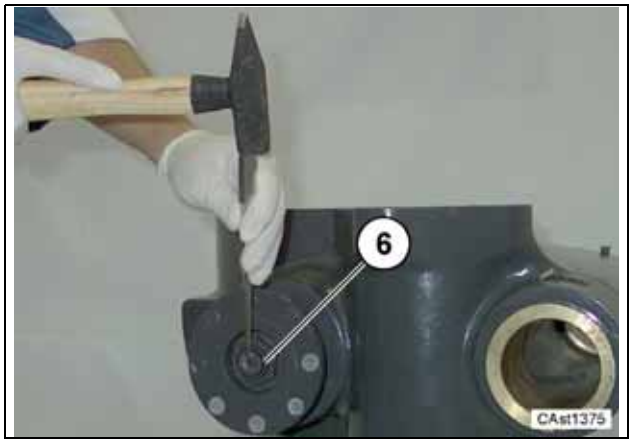
20. Assemble the flange (10) and the nut (6).



21. Apply tool 2987001.
Torque - **340 Nm (35 kgf-m)**



22. Drive the nut (6) with a tool.



23. Carry out the pre-loading measurement (**P**) of the pinion taper roller using a dynamometer whose cord is wound on the flange diameter. The adjustment is performed by gradually increasing shims (12) mounted under bearing (11).

⚠ WARNING

All pre-loadings should be measured without the seal ring.
P = 2/3 Nm



24. Assemble the whole differential unit.



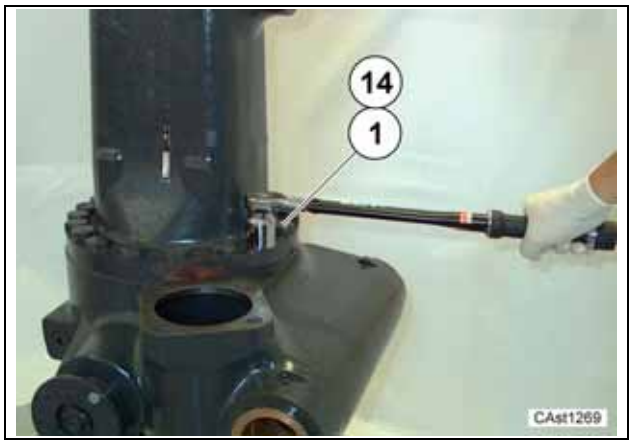
25. Assemble O-ring (5) on beam trumpet (3). Grease the O-ring (5)



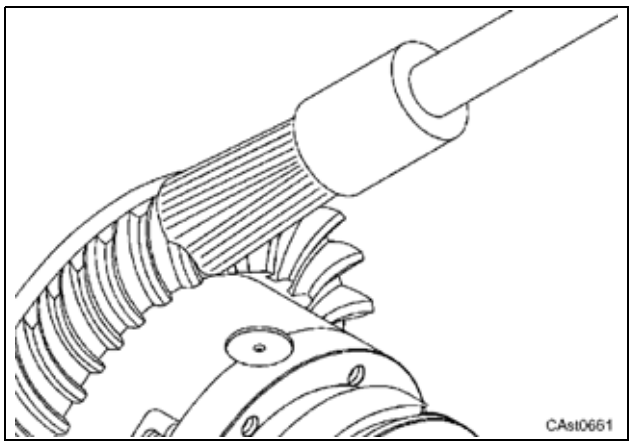
26. Apply Loctite® 510 on contact surface of beam trumpet (4).



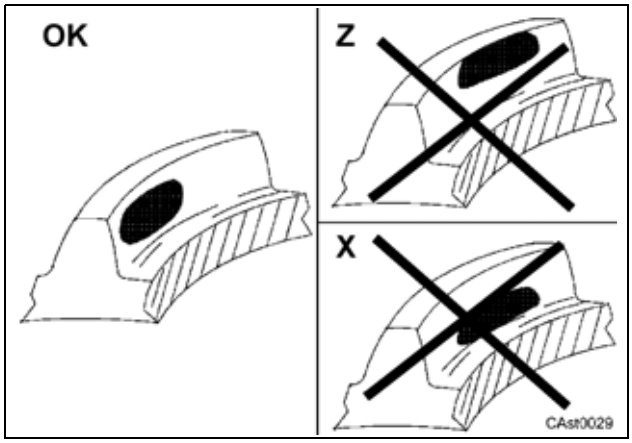
27. Fit screws (1) and tighten.
Torque - **205 Nm (21 kgf-m)**



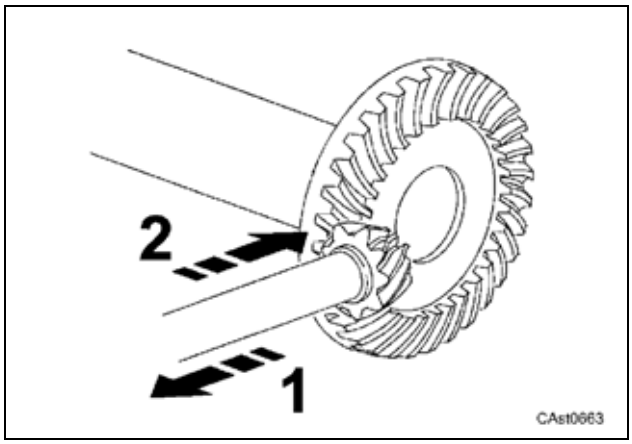
28. To test the marks of the bevel gear teeth, paint the ring gear with red lead paint and detect the contact. The marking test should be **always** carried out on the ring bevel gear teeth and on both sides.



29. **OK** - Correct contact.
    If the bevel gear is well adjusted, the mark on the teeth surfaces will be regular
    Z - Excessive contact on the tooth tip
    Approach the pinion to the ring bevel gear and then move the ring bevel gear away from the pinion in order to adjust the backlash.
    X - Excessive contact at the tooth base
    Move the pinion away from the ring bevel gear and then approach the ring bevel gear to the pinion in order to adjust the backlash.



30. Movements to correct
    1 - Move the pinion for type **X** contact adjustment.
    2 - Move the pinion for type **Z** contact adjustment.

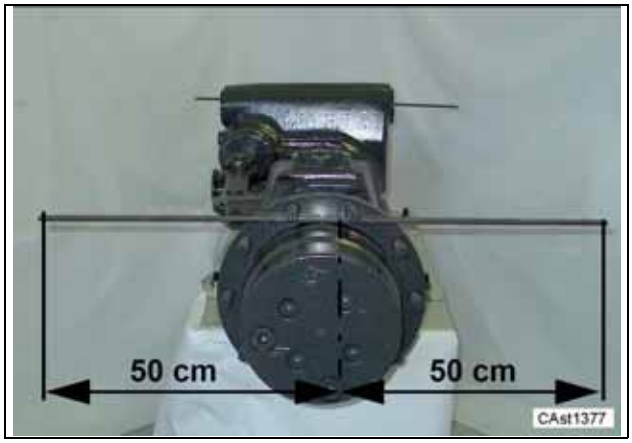


Toe-in adjustment

1. Put 2 equal one meter long linear bars on the wheel sides and lock them with two nuts on the wheel hub stud bolt.

WARNING

The 2 bars should be fixed on their middle so that they are perpendicular to the supporting surface and parallel to the pinion shaft. Align the 2 bars.



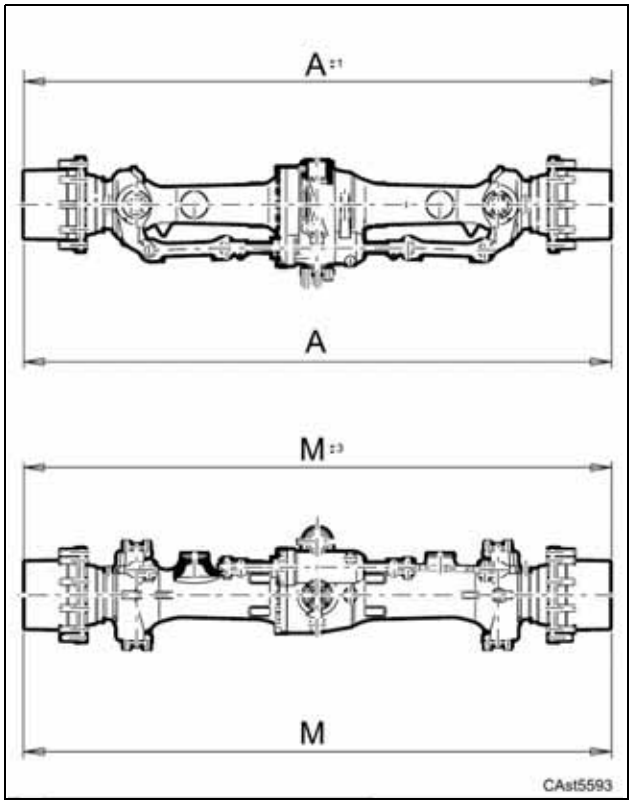
2. Measure the distance in mm between the bar ends with a tapeline (M).

NOTE: Keep the minimum value, swinging the measurement point.



3. Check that the difference of the measurements between the wheel hubs diameters ends is within the requested tolerance range (Tolerance = 0)
   The nominal toe-in (A) value is referred to the external diameter of the wheel hubs flange, therefore the measured toe-in value (M) at the bars ends must be related to the ratio between length of the bar and flange diameter.

Nominal toe-in	**Measured**
(Tolerance = 0) = A±1	**Toe-in = M±3**



4. If toe-in is incorrect, remove the pivots of the steering cylinder heads, screw them in and out equally till the toe-in is within the requested tolerance.



5. After adjusting, screw in the lock nuts. (Tightening torque = **117Nm**)



Steering angle adjustment

1. Use the same bars assembled for the toe-in adjustment and a long bar perfectly balanced over the machined part of the central body (pinion side), so that the 2 bars form an acute angle at the maximum steering.



2. Adjust a goniometer to the to the requested angle 32º/26.2º (inner/outer) and position it on the long bar.
   Move a wheel side till it forms with the 2 bars, the angle fixed by the goniometer.



3. Adjust the steering mechanical retainer, screwing in or out the right screw on the bar body, locking it with a locknut. (Tightening torque - **150Nm**)



4. Steer completely towards the other side and repeat the previous operations.

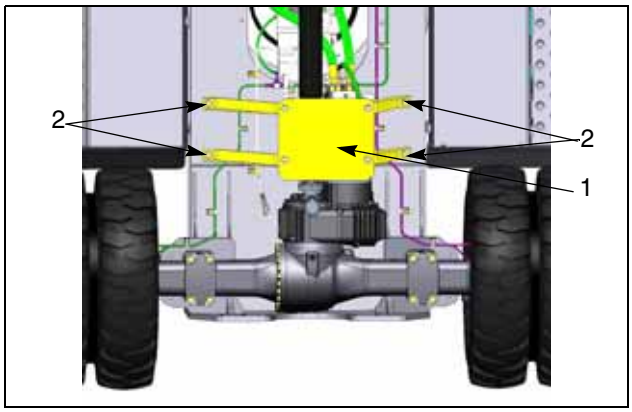


Removal and installation of rear axle and transmission

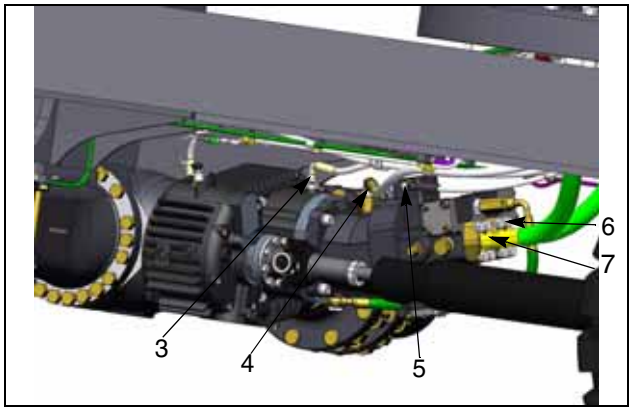
Removal

Blanking Kit			
Description	Part Number	Qty	Where Used
Cap Plug O-ring	07376-70422 02896-11012	1 1	Top Drain Hose
Cap Plug O-ring	07376-70210 02896-11008	1 1	Top Pilot Pressure Hose
Flange O-ring Bolt Washer	07379-01260 07000-13038 01010-51245 01643-51032	2 2 8 8	Front Main Travel Hoses

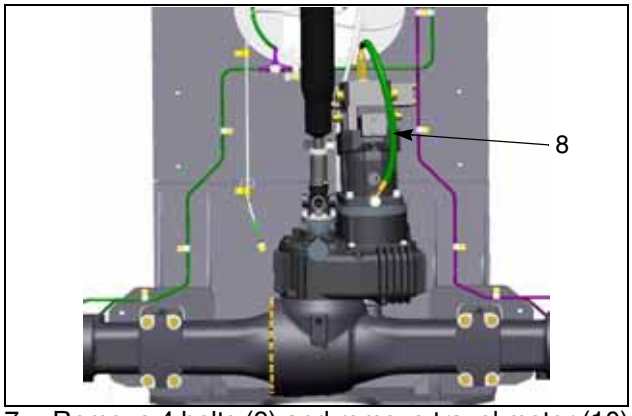
1. Remove cover (1) by removing bolts (2).



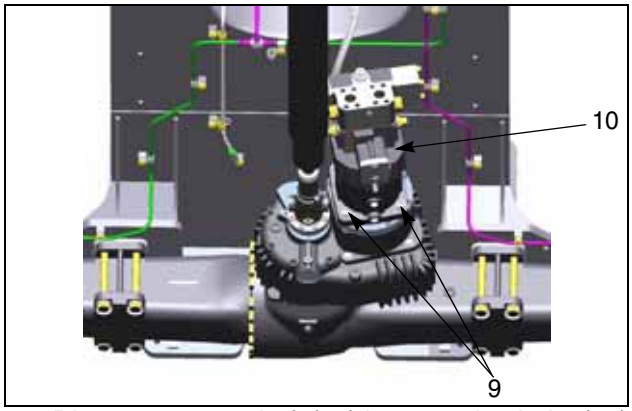
2. Drain oil out of transmission and travel motor.
3. Attach an identification tag to hoses to avoid incorrect connection during re-assembly.
4. Attach vacuum pump to hydraulic tank.
5. Disconnect each hose individually and plug with blank/plug and O-ring from blanking kit to prevent oil spillage and contamination (3 through 7).



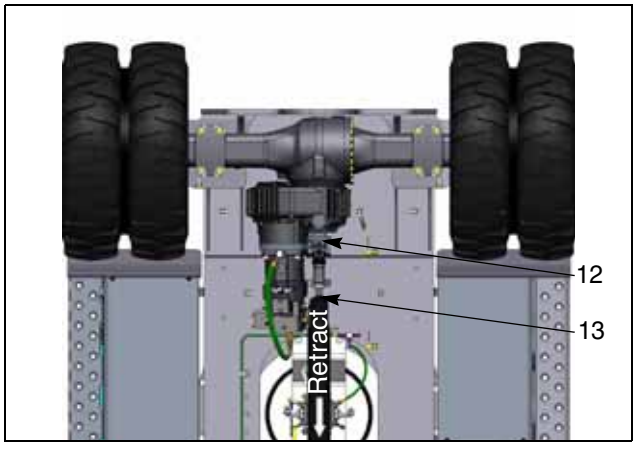
6. Remove drain hose (8).



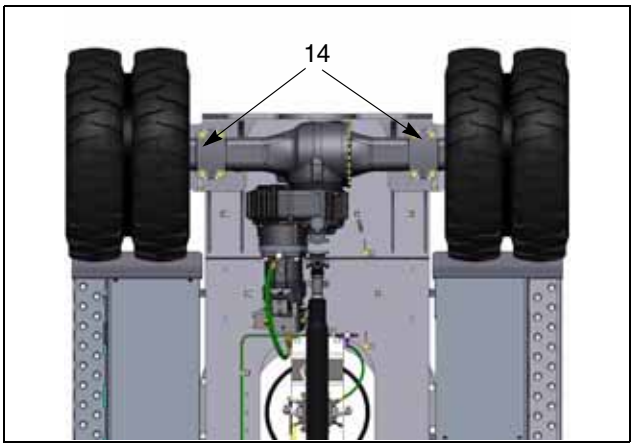
7. Remove 4 bolts (9) and remove travel motor (10) in direction shown to disengage the splined shaft. (Weight approx. 66 kg).



8. Disconnect propshaft (12) by removing bolts (13) and retracting propshaft in direction shown.



9. Remove bolts(14).

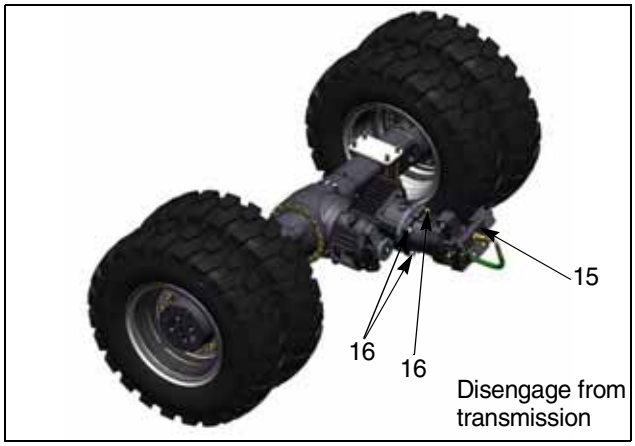


10. Use work equipment to lift undercarriage above the axle.



11. Roll axle and wheels clear of machine making sure the transmission and travel motor are kept clear of the ground.
12. Position supports in place of axle.

13. To remove travel motor (15) {option} remove 4 bolts (16) and extract motor in direction shown to disengage splined shaft.



Installation

- Install in reverse order of removal.
- Grease all cylinders before installation.

Axle mounting bolts (14): **662.-828.5 Nm.**

Propshaft nuts (13): **58.8-73.5 Nm.**

Travel motor bolts (16): **25-31.5 kgf-m.**

Refill oil in transmission: **(4.85litres)**.

Refill oil in rear axle: **(9.5 litres).**

- Top up hydraulic through oil filler port to the specified level and let the oil circulate in the hydraulic system by starting the engine. Then check oil again.
- Air bleeding see section on air bleeding in the TESTING AND ADJUSTING section of the manual.

Disassembly and assembly of rear axle assembly

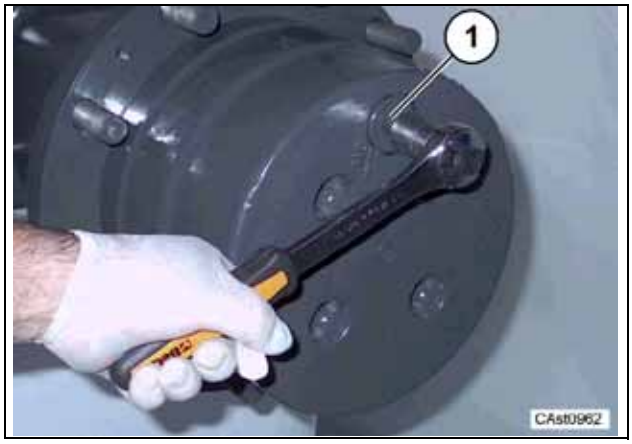
Special tools

Part Number	Part Name	Quantity
2897002	Toque control device	1
2897003	Chuck for bushings	1
2897004	Chuck for bushings	1
2897007	Assemle pin	1
2897009	Pin	1
2897012	Assemble device	1
2897014	Brake centring	1
2897015	Assemble pin	1
2897039	Assemble pin	1

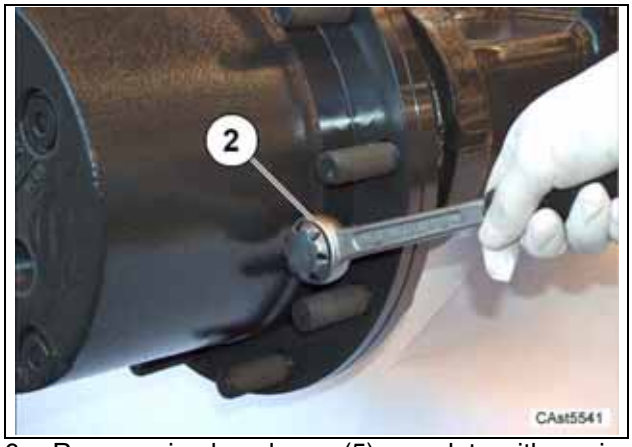
Disassembly

Removal of Epicyclic Reduction Gear and Brake

1. Before draining the oil, position the wheel hub (1) with the plug on the upper part and loosen it off some turns in order to eliminate any possible inner pressure, then remove it completely. Turn the wheel hub upside down till the hole is in the lowest point.
   Drain the oil completely.

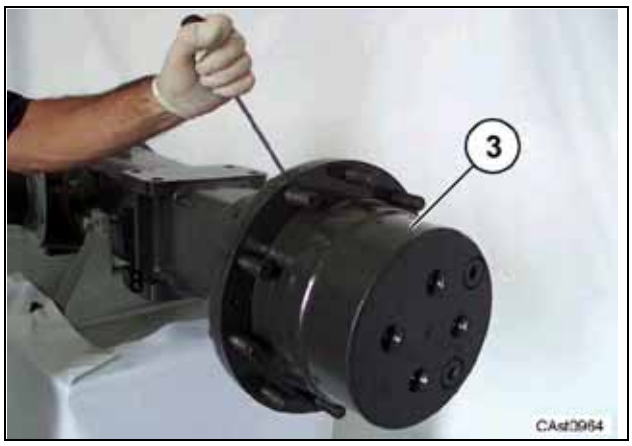


2. Remove fastening screws (2) from the cover of the planetary gears carrier.

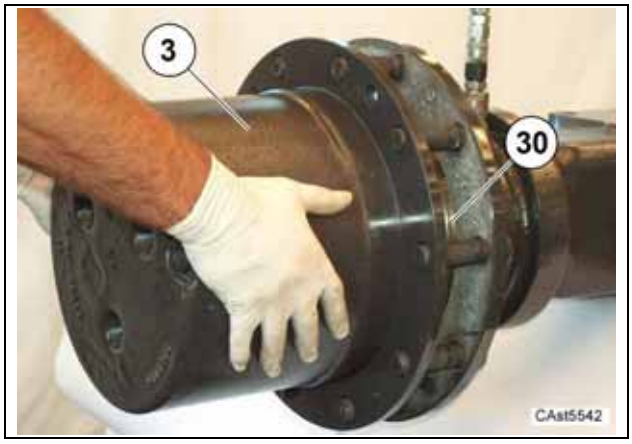


6. Remove ring bevel gear (5) complete with carrier (28) and split ring (29).

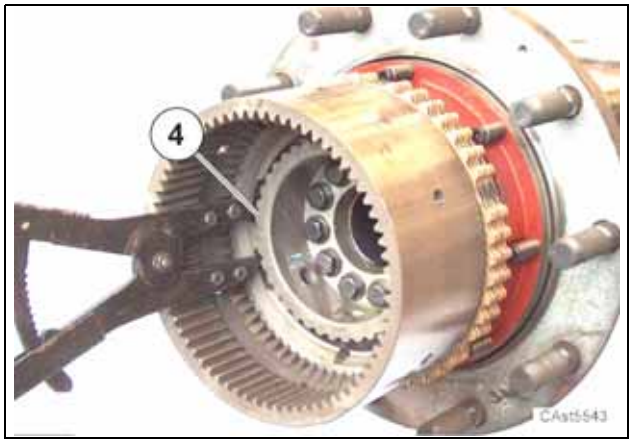
3. Use the levers inside the preset slots to detach the planetary gear carrier cover.

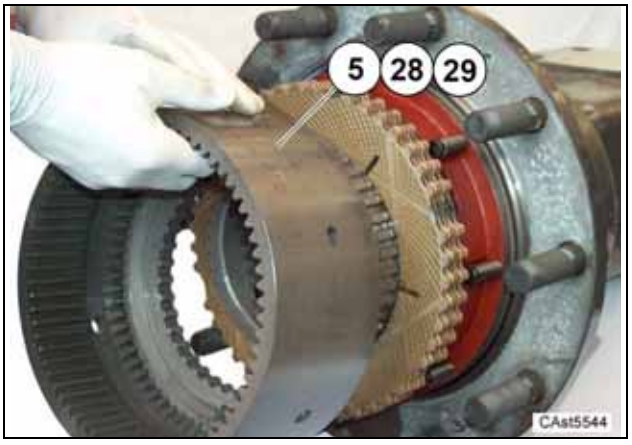


4. Remove the planetary gear carrier cover (3) and O-ring (30).

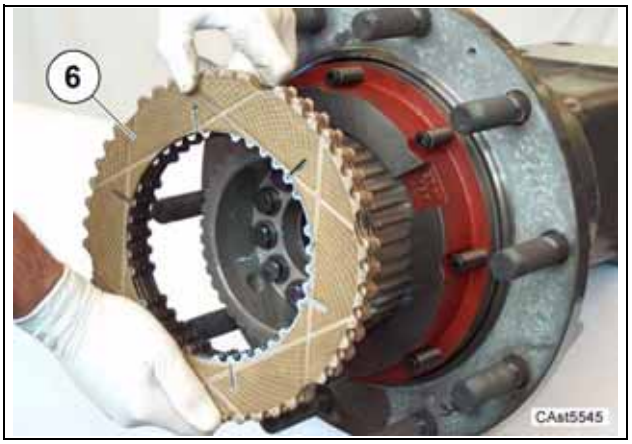


5. Remove split ring (4).





7. Remove brake discs (6).



8. Remove fastening screws of piston (7) and springs (15).



12. Assemble carrier (28) and split ring (4). Remove brake carrier (12).

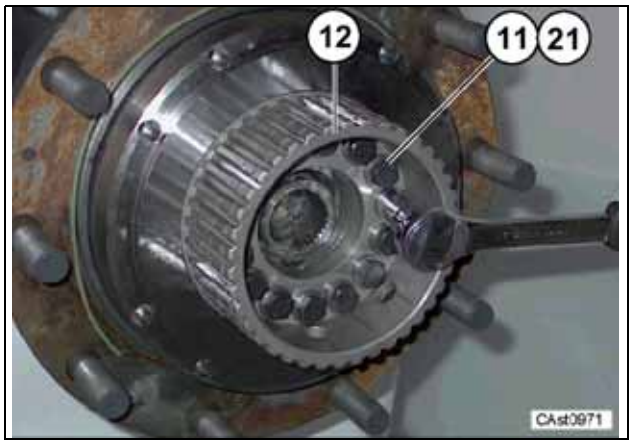
9. Remove piston (8).

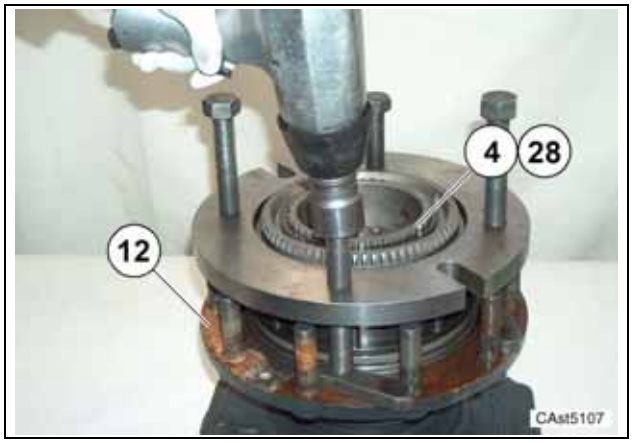


10. Remove seal rings (9) and (10) from piston (8).



11. Remove screws (11) and washers (21) from brake carrier (12).





13. Remove bushes (22).



14. Remove seal rings (13) and (14) from brake carrier (12).



15. Remove shims (26).



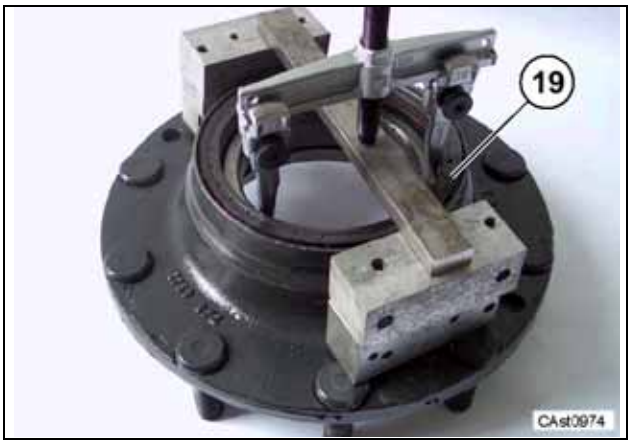
16. Remove wheel hub (16) with bearings (19) and (20) and seal ring (19).



17. Remove the drain valve (17).



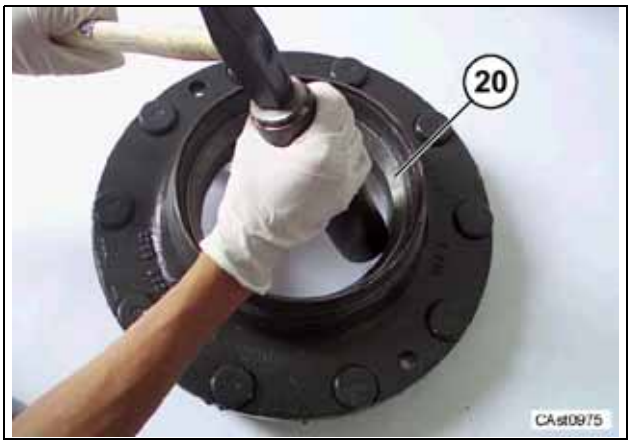
18. Remove seal ring (19).



19. Remove inner cup of bearing (18).



20. Remove outer cup of bearing (20).



21. Remove outer cup of bearing (18).



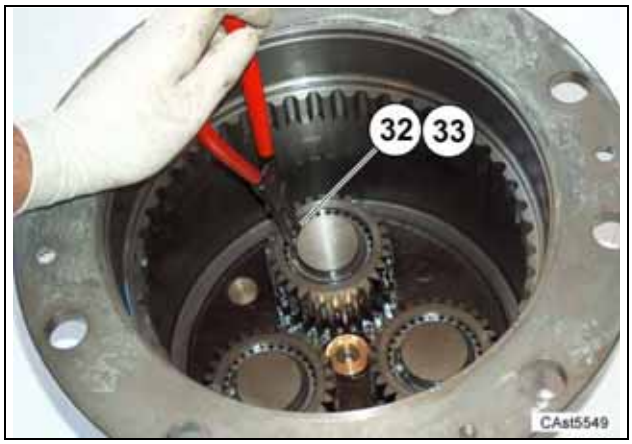
22. Remove sleeve (25).



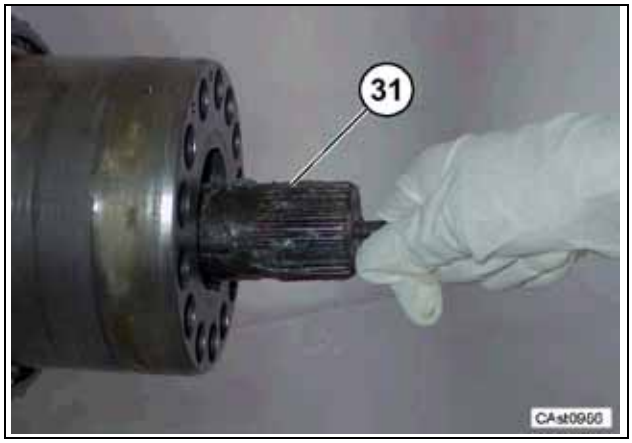
23. Remove shaft and pinion (24).



24. Remove snap ring (32) planetary gears (33).

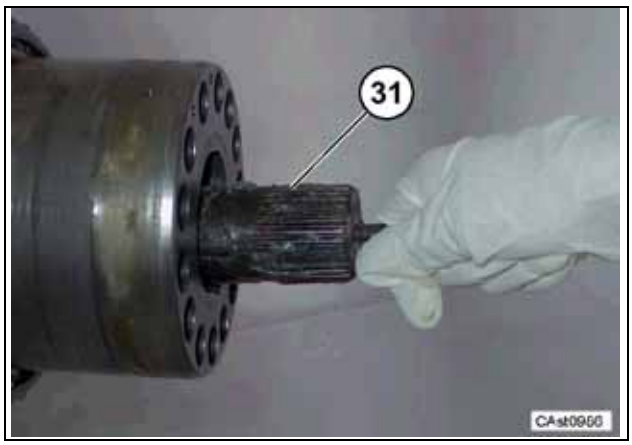


25. Remove universal joint (31).



Installation of Epicylic Reduction Gear and Brake

1. Assemble universal joint (31).



2. Fit outer cup of bearing (18) wheel hub (16).



3. Fit outer cup of bearing (20) wheel hub (16).



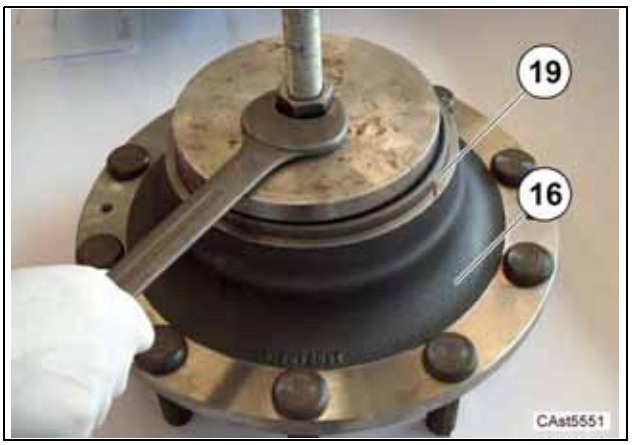
4. fit the remaining part of bearing 18) on wheel hub (16).



5. Apply Loctite® 510 on seal ring (19).



6. Fit seal ring (19) on wheel hub (16). Use tool 2897003.



7. Lubricate axle shaft to assemble the wheel hub

⚠ WARNING

Polish hub and oil holes.



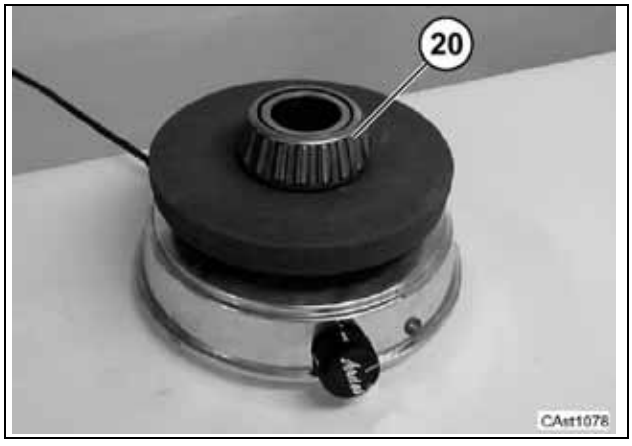
8. Assemble the whole wheel hub (16). Alternately strike bearings (18).

⚠ WARNING

The roller bearing should be rested on the beam trumpet.



9. Preheat bearing (20) on proper plate up to 100°C.



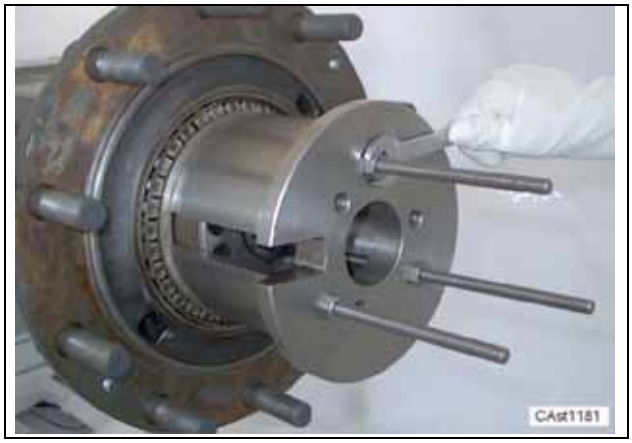
10. Fit bearing (20) inside beam trumpet.

⚠ WARNING

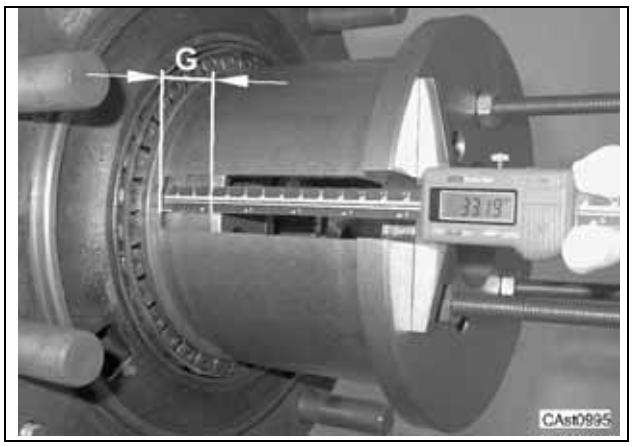
Wear gloves to avoid getting burnt.



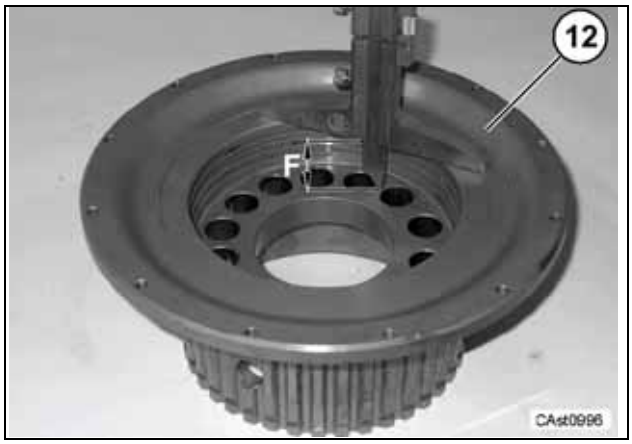
11. Assemble the tool 2897012, 3 draw plates M10 x 285 and 3 nuts M10.



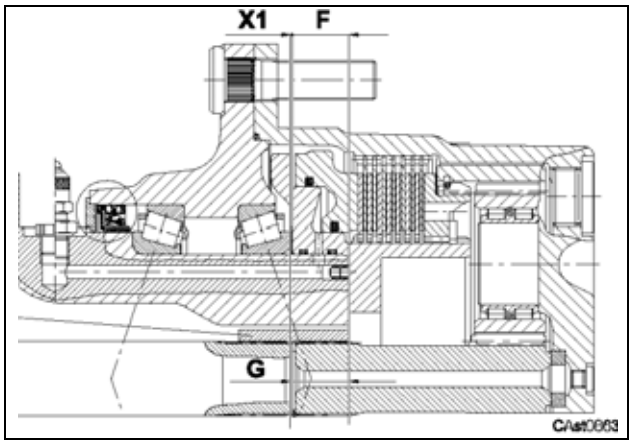
12. Use a depth gauge to measure dimension (g) of wheel hub.



13. Use a depth gauge to measure dimension F of brake carrier (12).



14. Calculate shims X1 of adjustment shims by using the following procedure: X1 (G-F) + 0.05.



15. Assemble previously calculated shims (26) X1.



16. Assemble O-rings (9) and (10) on piston (8).



17. Assemble O-rings (13) and (14) on brake carrier (12).



18. Fit piston (8) on brake carrier (12) with springs (15) and screws (7). Apply Loctite® 638 on the screws (7).



19. Fit the whole unit of the brake carrier on wheel hub.

⚠ WARNING

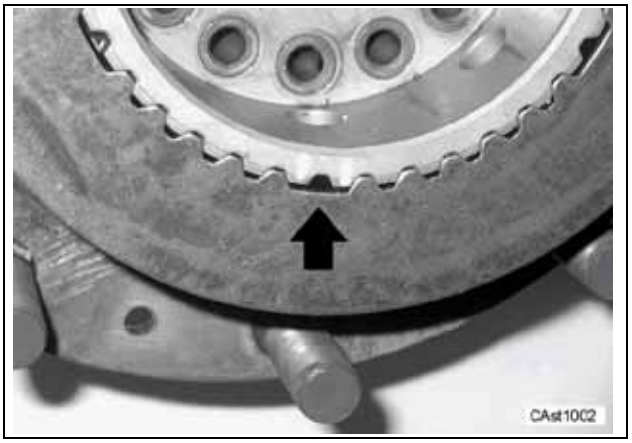
The brake carrier and beam trumpet holes should coincide.



20. Assemble brake discs (6).

⚠ WARNING

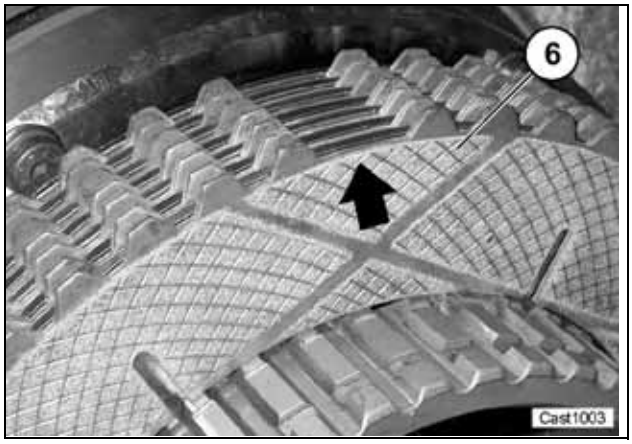
During assembly operations all the inner disc slots should coincide.



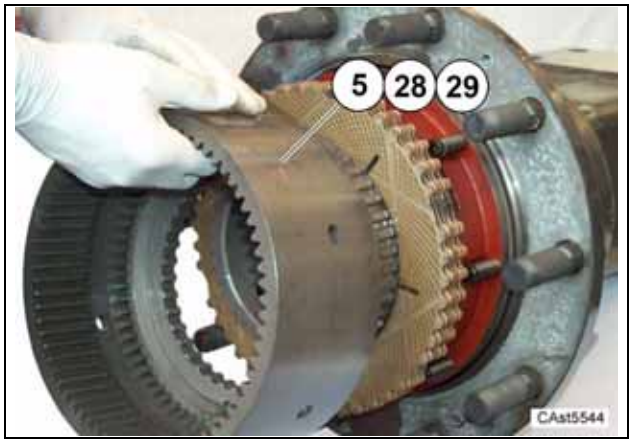
21. Assemble brake discs (6).

WARNING

Warning: During assembly operations all the outer disc slots should coincide.



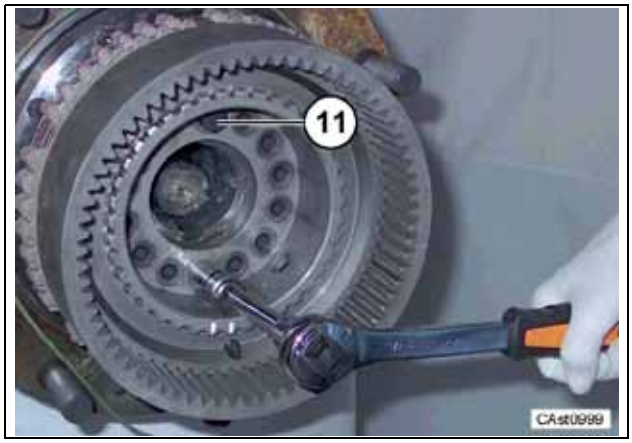
22. Fit ring bevel gear (5) with carrier (28) and split ring (29).



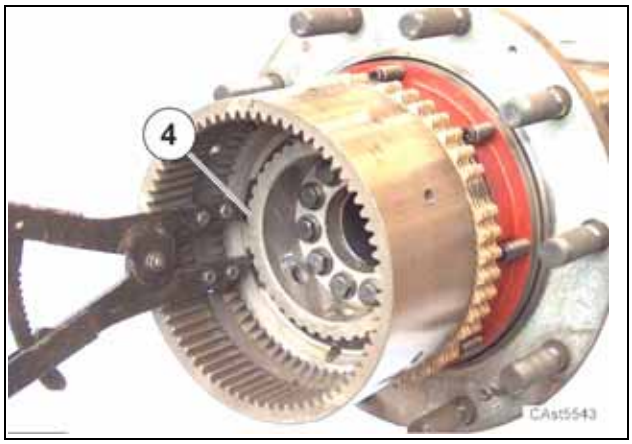
23. Test the brake by temporarily fitting two screws (11).

WARNING

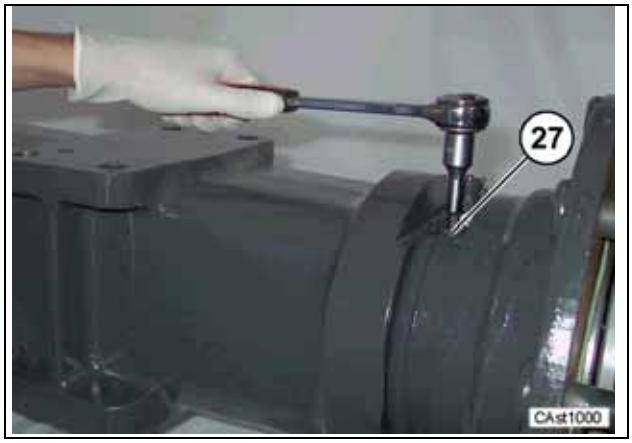
Do not assemble bushes (22).



24. Fit snap ring (4).



25. Remove plug (27).



26. Fit an adapter instead of the plug.



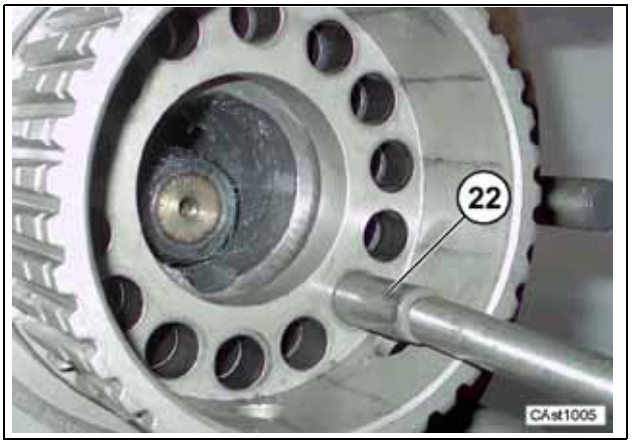
27. Test the brakes by considering that pressure should be 100^{0}_{-5} bar for about one minute.



28. Fit bushes (22).

⚠ WARNING

Pay attention to the assembly direction of bushes.

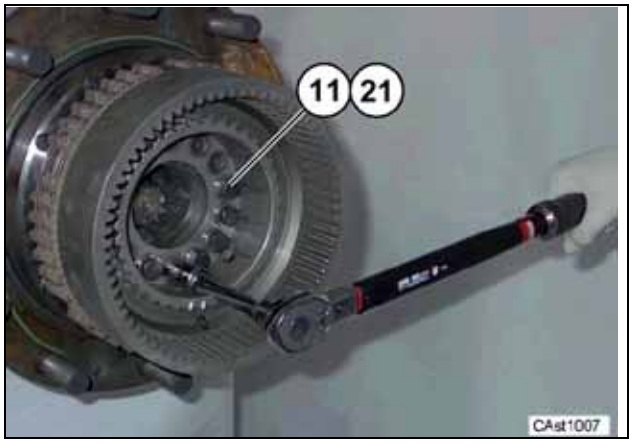


29. Apply Loctite® 242 inside slots.



30. Fit screws (11) and shims (21).

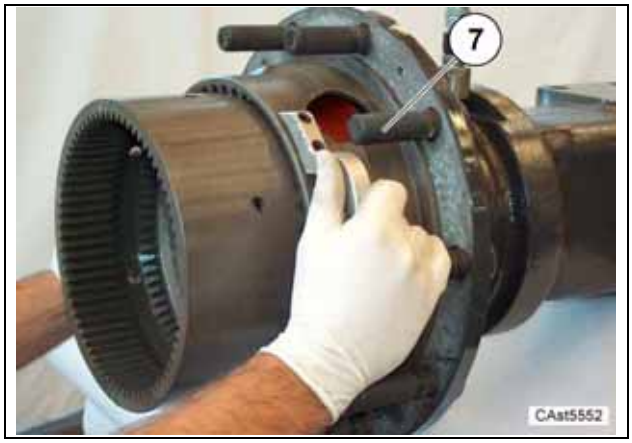
N·m Screws (11) - **68Nm**



31. Line up brake discs. Use tool 2897014.

⚠ WARNING

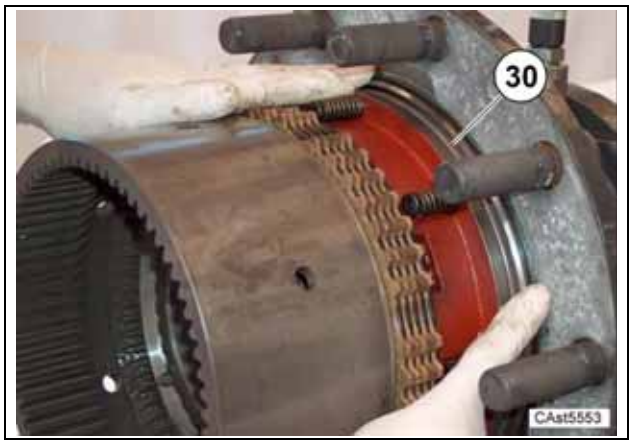
A tooth should coincide with a brake fastening screw (7).



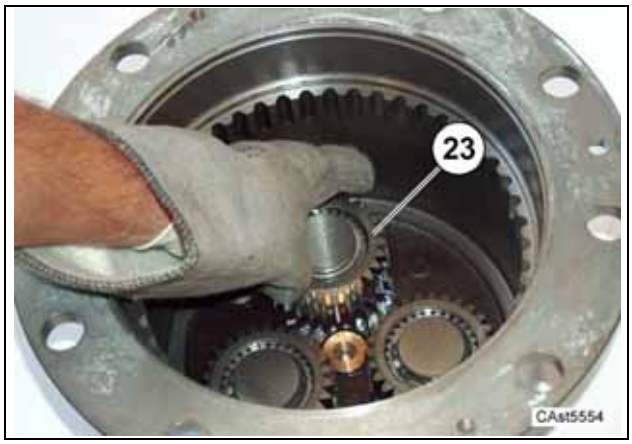
32. Put brakes under pressure to avoid outer disc misalignment.



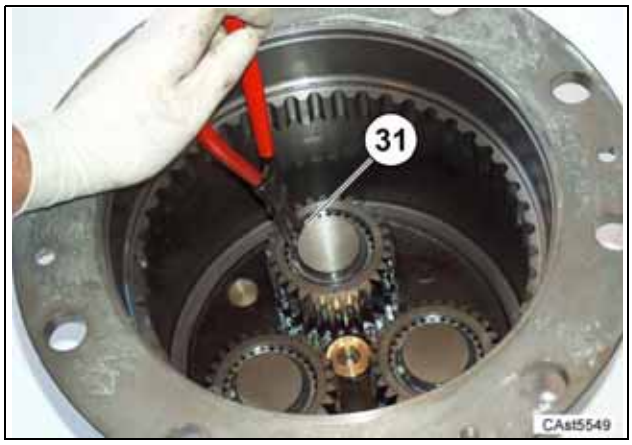
33. Lubricate with grease and fit O-ring (30).



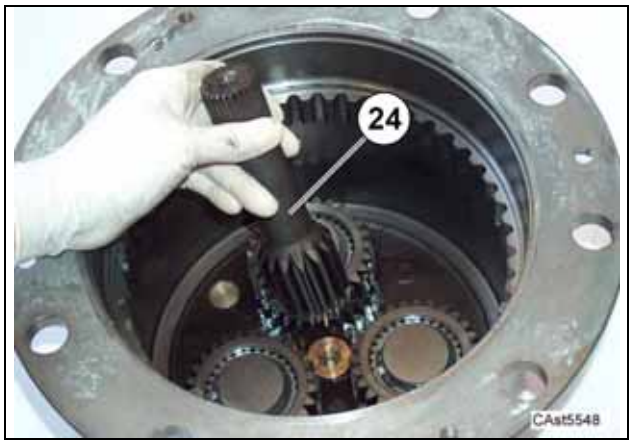
34. Heat planetary gear bearing at 110ºC. Assemble planetary gear (23).



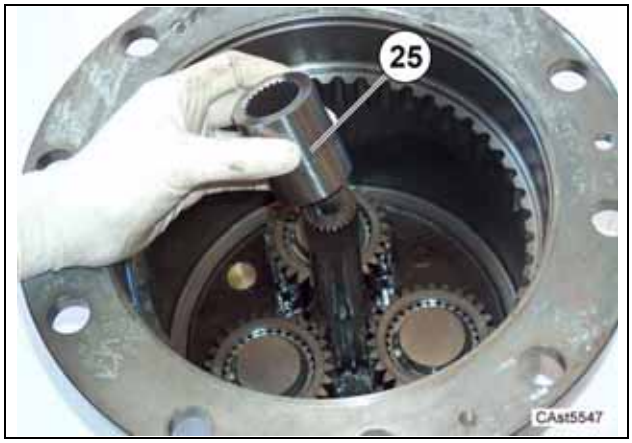
35. Assemble snap ring (32).



36. Fit pinion shaft (24).



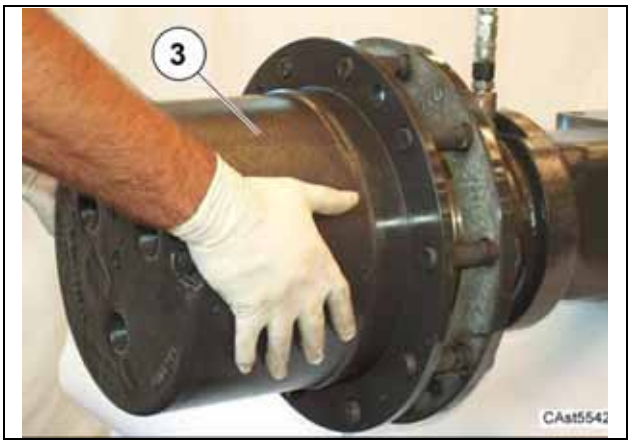
37. Fit sleeve (25).



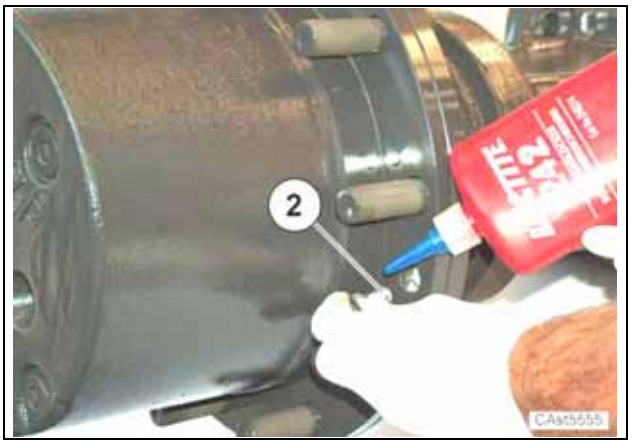
38. Lubricate with grease the contact surface of planetary gear cover (3). Apply Loctite® 510 in the holes.



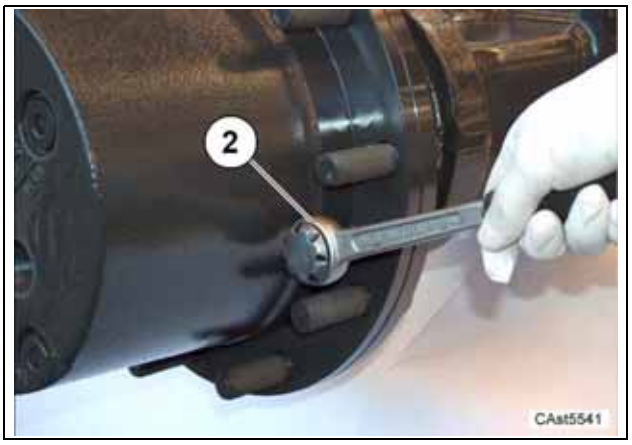
39. Fit the planetary gear cover (3) and discharge pressure from the hydraulic pump.



40. Apply Loctite® 242 on screw (2).

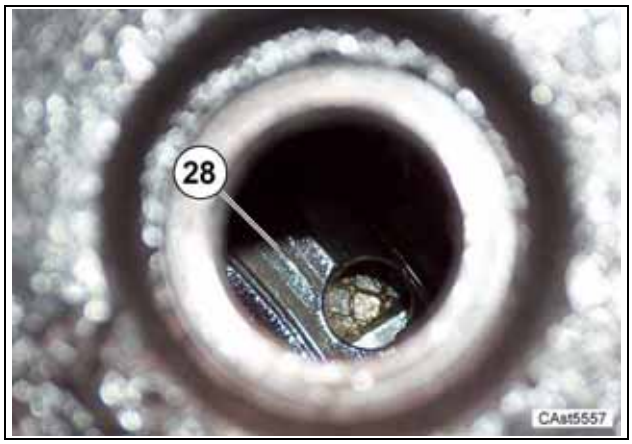


41. Assemble screws(2). (Tightening torque - 46Nm)



42. Remove oil drain plug and turn the final drive up to meeting the item (28) hole.

Note: Brakes wear check.



43. Apply a pressure of 45-50 bar and check the distance between brake locking and unlocking (MIN: 1.7mm, MAX: 3.8mm).

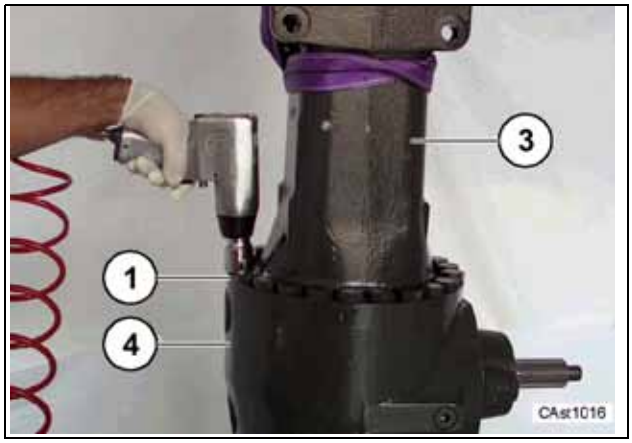


Disassembly of Beam Trumpet and Differential Unit

1. Remove the axle unit. Sling and slightly tension the rope. Turn and then fix it in vertical position.



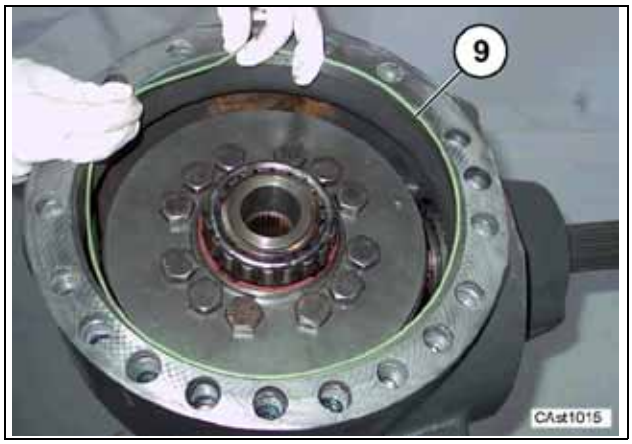
2. Loosen and remove screws (1) fixing beam trumpet (3) to the body (4).



3. Sling the beam trumpet (3) and slightly lift it.



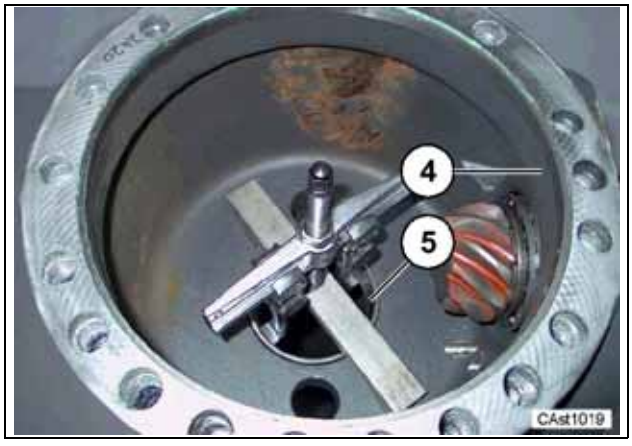
4. Remove O-ring (9).



5. Lift the whole differential unit.



6. Use an extractor and remove from housing (4) the outer cup of bearing (5).



7. Remove shims (6).



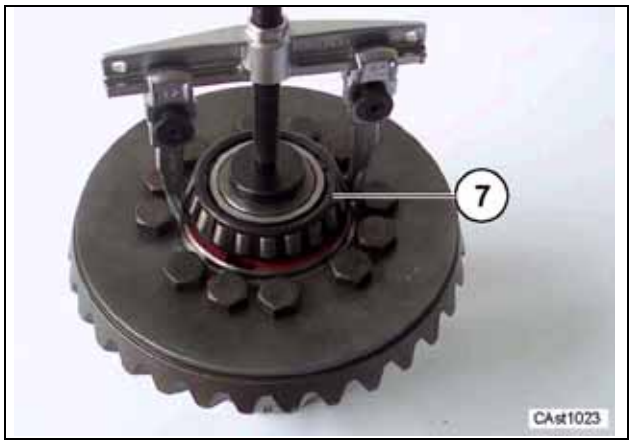
8. Use an extractor and remove from housing (3) the outer cup of bearing (7).



9. Remove shims (8).



10. Use and extractor to remove bearing (7) from differential unit.



11. Use an extractor to remove bearing (5) from differential unit.



12. Unscrew all fastening screws (10) of bevel gear crown (2).

⚠ WARNING

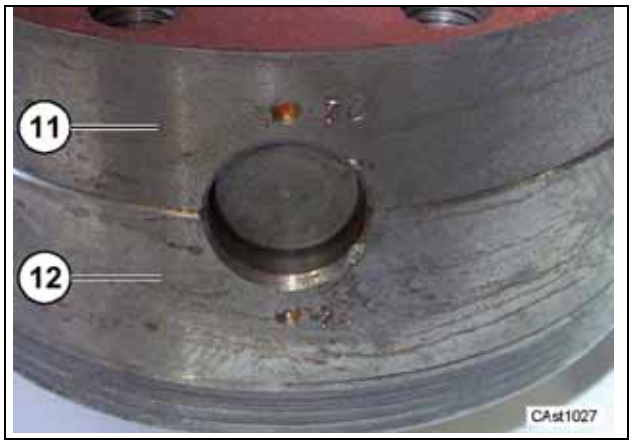
This operation makes both differential half boxes free, so take care not to drop the inner components.



13. Remove ring bevel gear (2) by means of a mallet.

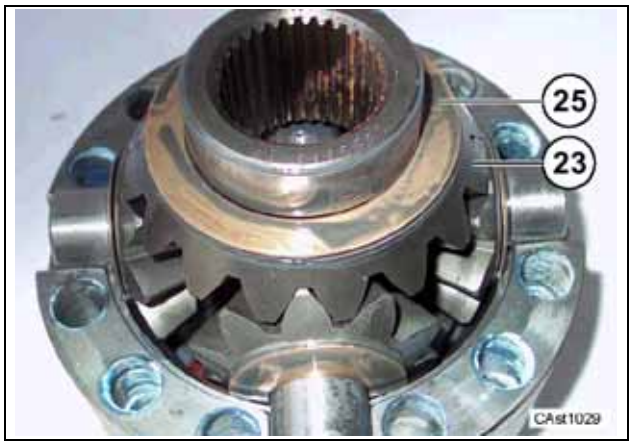


14. Check marking points (11) and (12) that will be useful during the assemblage.



NOTE: Without differential torque limiter

15. Remove planetary gear (23) and shim (25).



16. Remove differential pins (13) and (14), planetary gears (15), (16), (17) and (18) and spheric washers (19), (20), (21) and (22).

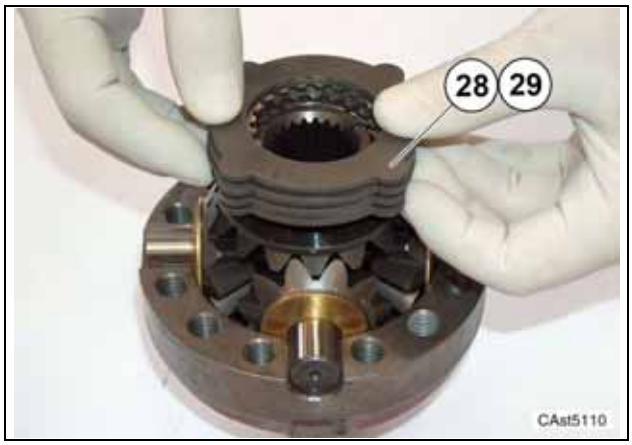


17. Remove planetary gear (24) and shim (26).

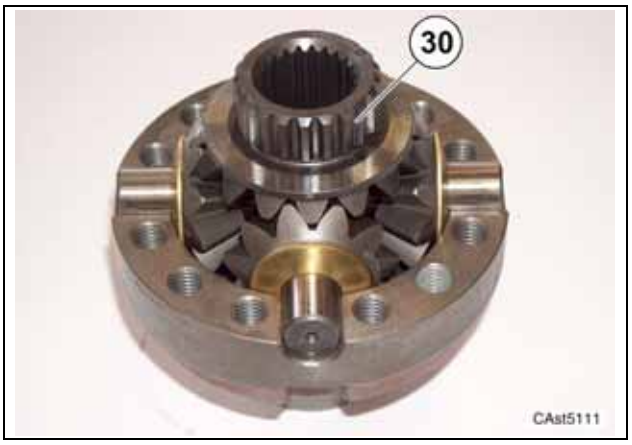


NOTE: With differential torque limiter

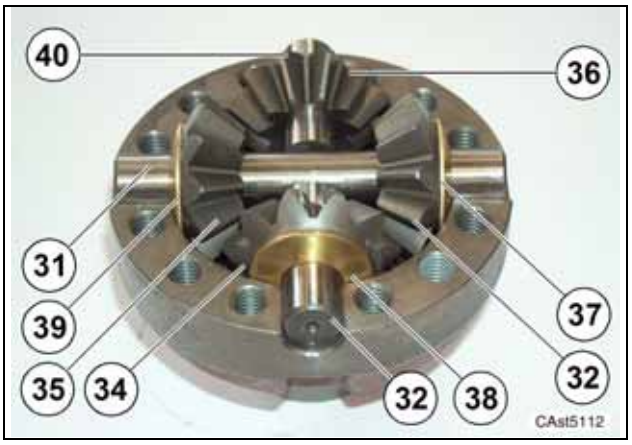
18. Remove discs (28) and (29).



19. Remove planetary gear (30).



20. Remove differential pins (31), (32), planetary gears (33), (34), (35) and spheric washers (37), (38), (39) and (40).



21. Remove planetary gear (41).



22. Remove discs (42) and (43).



Installation of Beam Trumpet and Differential Unit

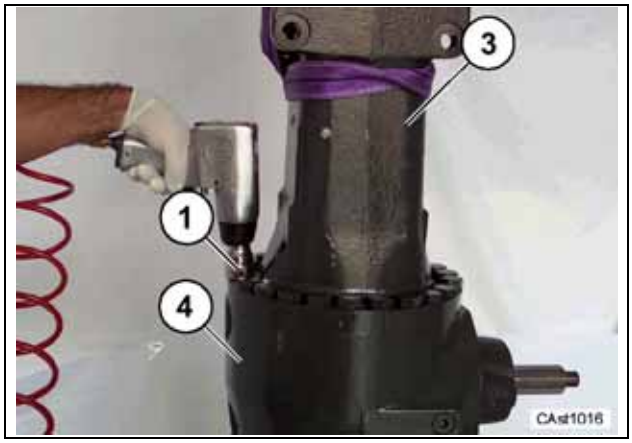
- Install in reverse order to removal.
- When installing screws apply Loctite® 242.
- Apply a thin layer of Molicote G-n plus paste on all planetary gears, crown wheels and half boxes of differential unit.

Disassembly of Pinion Group

1. Remove the axle unit. Sling and slightly tension the rope. Turn and then fix it in vertical position.



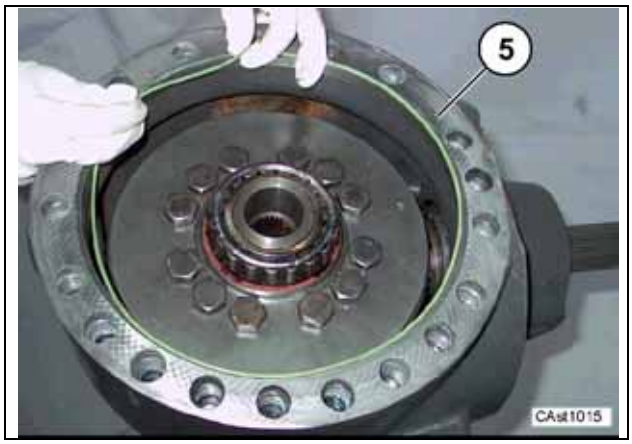
2. Loosen and remove screws (1) fixing beam trumpet (3) to the body (4).



3. Sling the beam trumpet (3) and slightly lift it.



4. Remove O-ring (5).



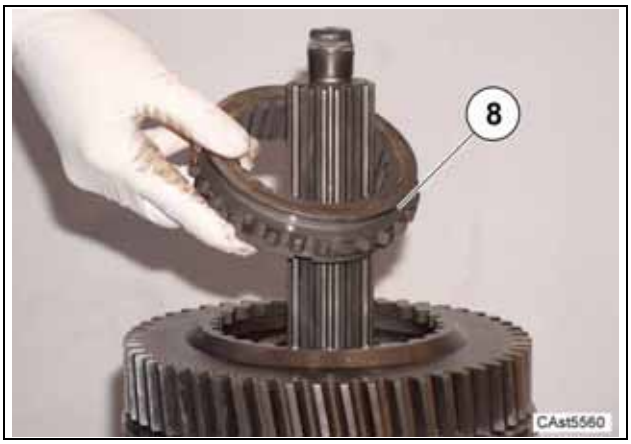
5. Lift the whole differential unit.



6. Remove bush (7).



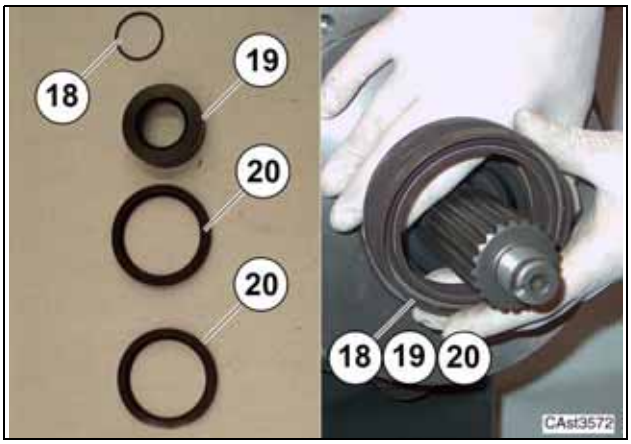
7. Remove sleeve (8).



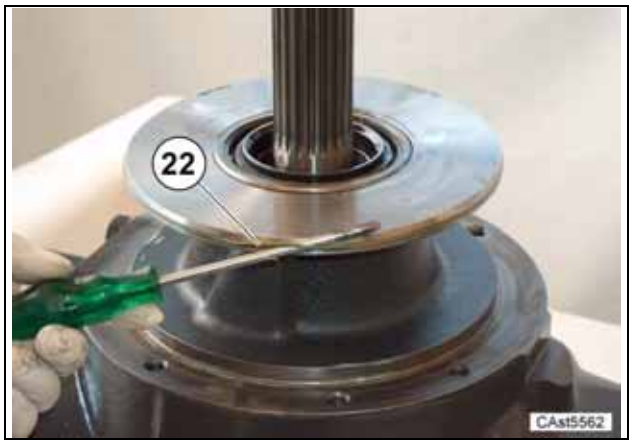
8. Remove gear wheel (9).



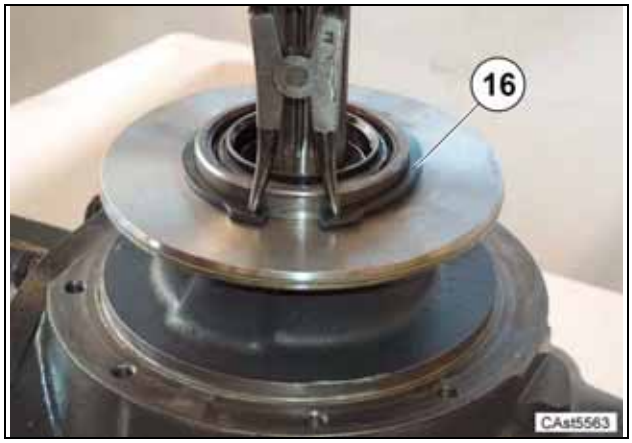
9. Remove O-ring (18), ring (19) and seal (20).



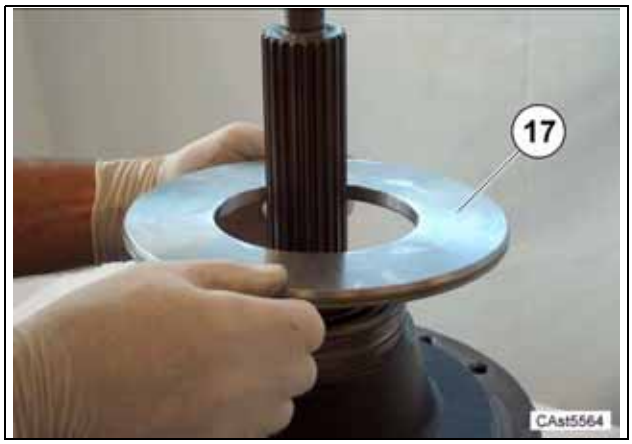
10. Remove O-ring (22).



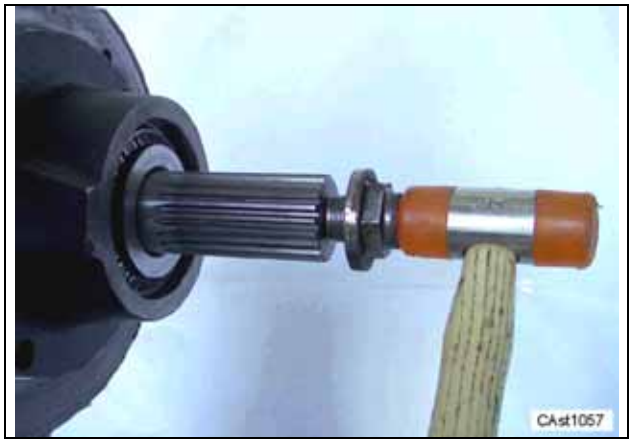
11. Remove snap ring (16).



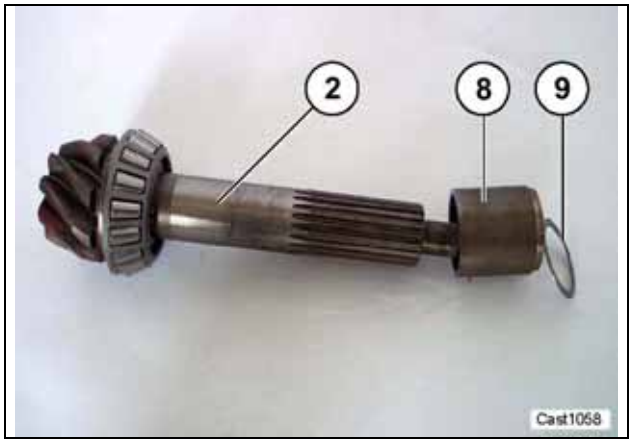
12. Remove the disc (17).



13. Take the bevel pinion out of its housing, by beating with a hammer made of soft material on the splined end.



14. Once the bevel pinion (2) has been removed, collect shims (9) and spacer (8).



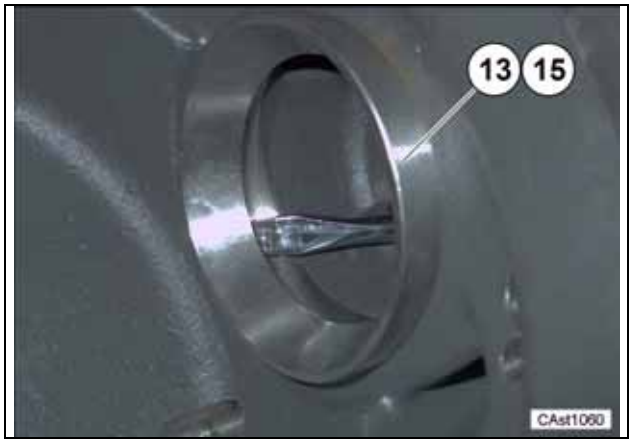
15. Take the bearing cone (13) out of the bevel pinion end, using a suitable extractor.



16. Take the cup of the taper roller bearing (11) out of the central body using a chisel and hammer.



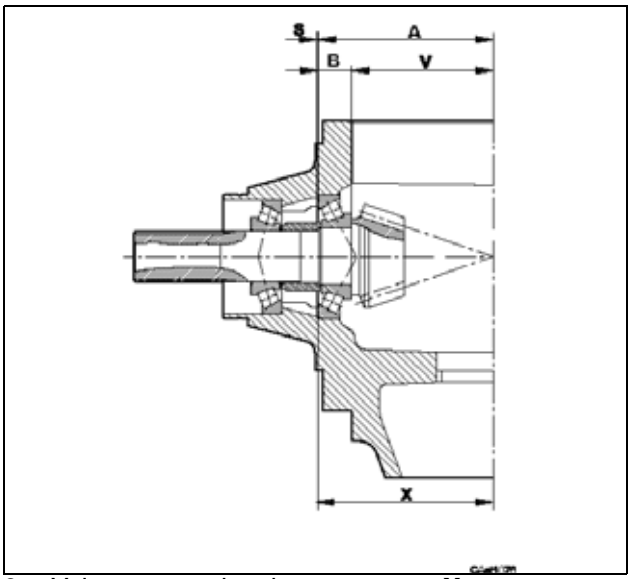
17. Remove the outer cup of the taper roller bearing (13) and shims (15) from the central body. Use a chisel and hammer.



Installation of Pinion Group

1. Bevel pinion adjustment.

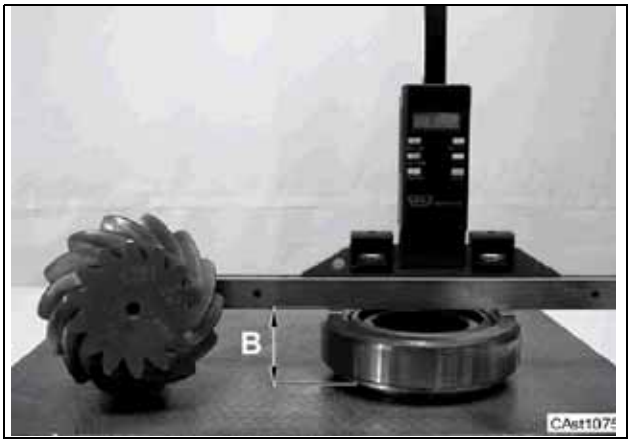
X	163.50	163.50	163.70
B	29.25	29.45	29.25
V	133.00	133.20	132.80
A	162.25	162.65	162.05
S	1.25	0.85	1.65



2. Value stamped on beam trumpet **X.**



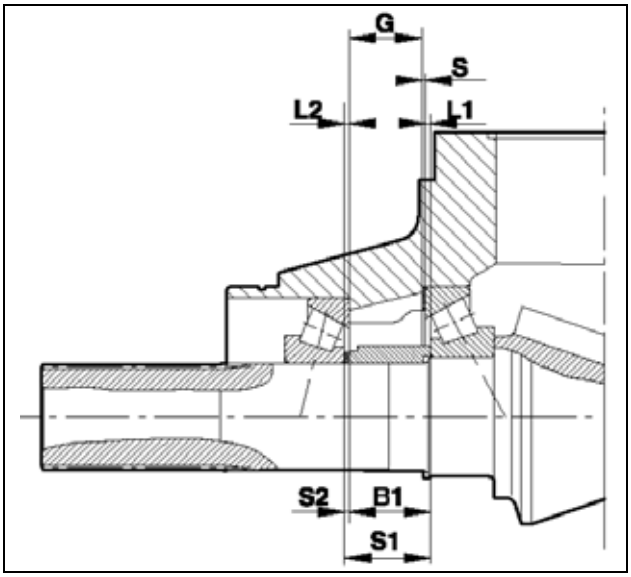
3. To determine shim (**S**) between pinion and bearing it is enough to add value (**V**) printed on pinion head (**V** = prescribed conical distance) to value **B** - bearing width - and subtract **X** from the value printed on beam.
S=X - (V+B)
Example: shim **S** = 163.6 - (132.80 + 29.25) = 1.55mm.



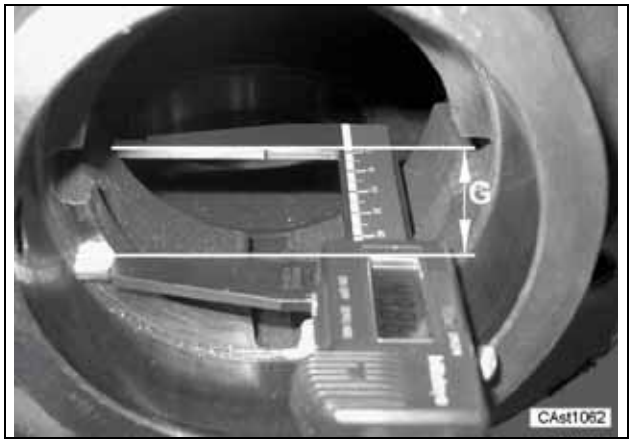
4. Bearings adjustment.

G	49.50	49.30	49.80
S	1.25	0.85	1.65
L_1	2.25	2.25	2.57
L_2	2.25	2.25	2.57
S_1	55.25	54.65	56.59
B_1	54.50	54.50	54.40
S_2	0.75	0.15	2.19

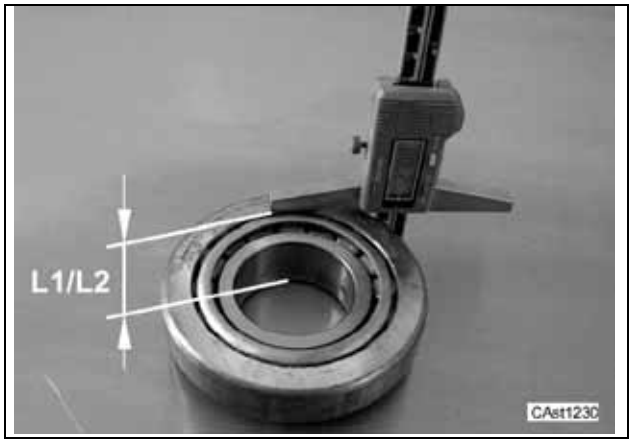
Pre-loading reduction ca. 0.02 - 0.04mm for a 2-3 Nm torque.



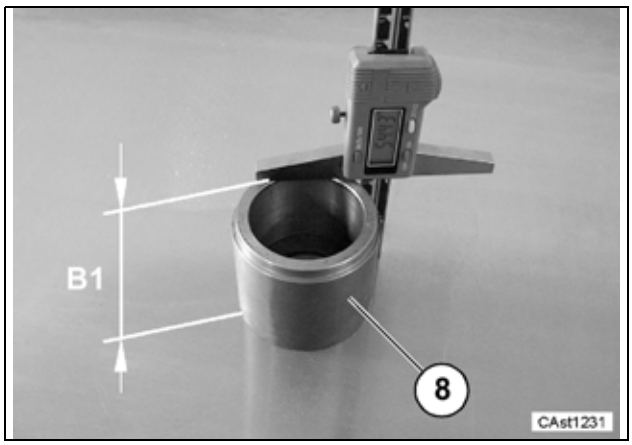
5. To determine shim **S2**
   S2 = B1 - (L1 - S - G - L2)
   S = previously detected shims
   G = beam value



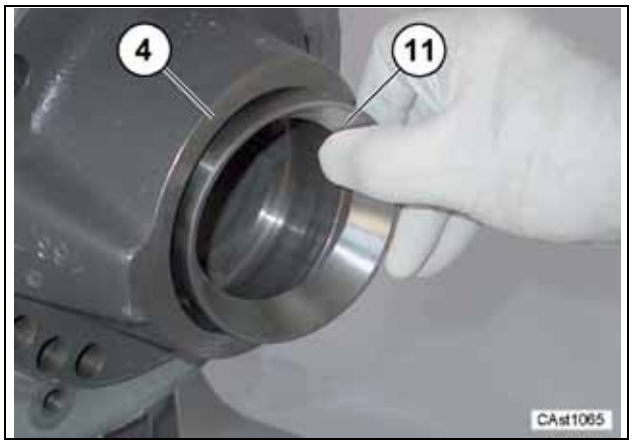
6. L1 = bearing height
   L2 = bearing height



7. **B1**= spacer (8) height.
   Alternative procedure, use starting spacer S= 1.5.



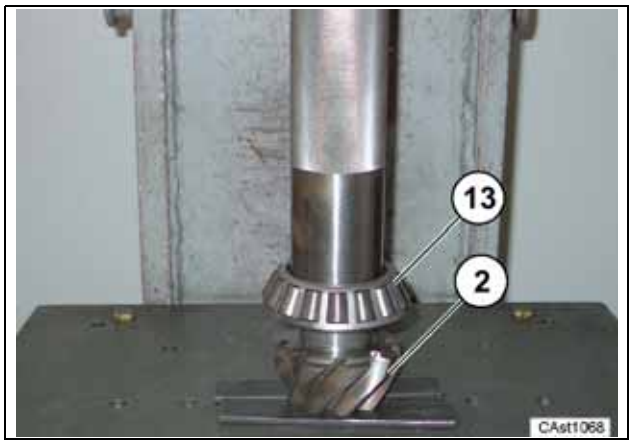
8. Position half bearing (11) on beam trumpet (4).



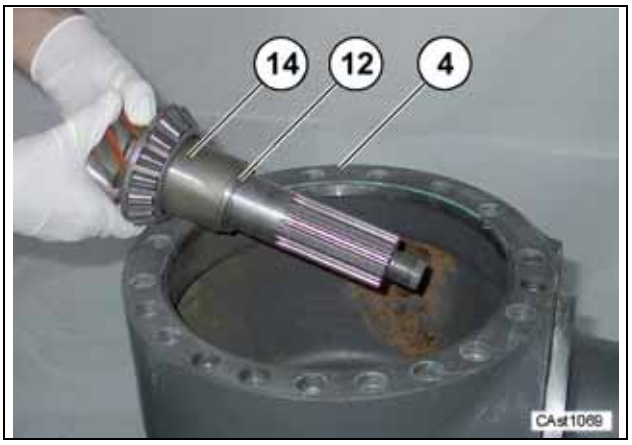
9. Position adjusting shims (9) and inner bearing washer (13) on beam trumpet (4).



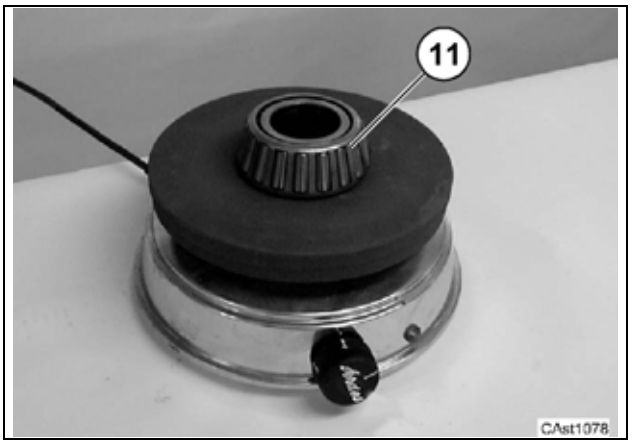
10. Press inner bearing (13) on pinion (2).



11. Fit the whole pinion of bearing on beam trumpet (4), spacer (14) and shims (12).



12. Preheat bearing (11) on proper plate up to 100°C.



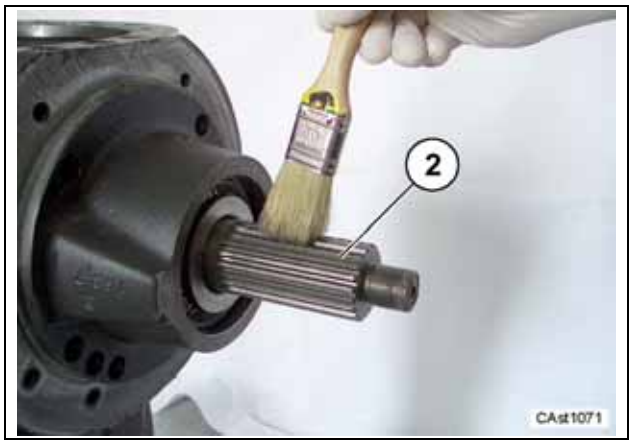
13. Fit bearing (11) in relevant housing on beam trumpet (4).

⚠ WARNING

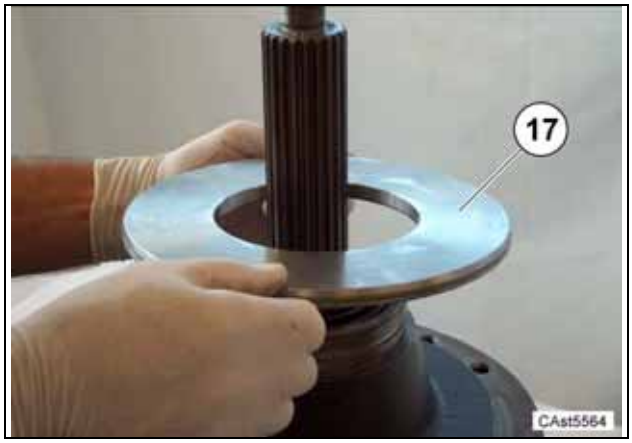
Use a special glove to protect from scorching.



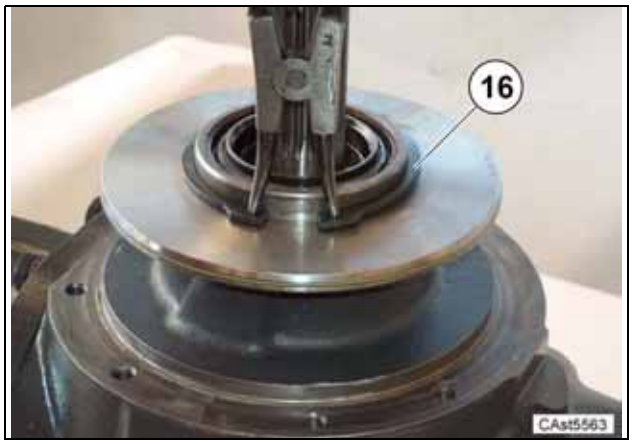
14. Grease bevel pinion.



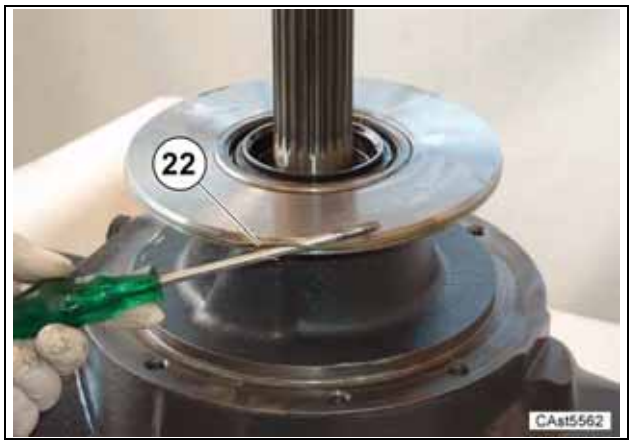
15. Assemble the disc (17).



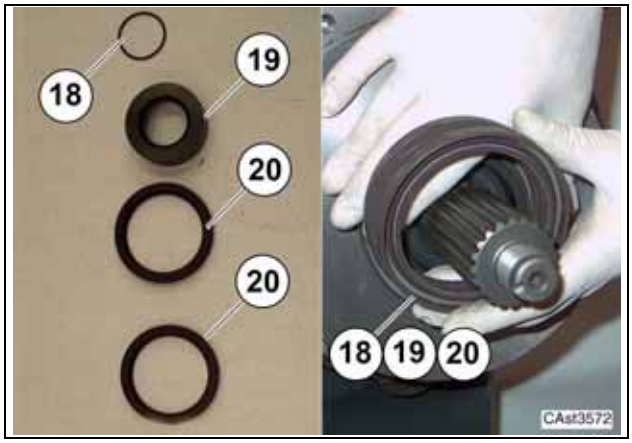
16. Assemble snap ring (16).



17. Assemble O-ring (22).



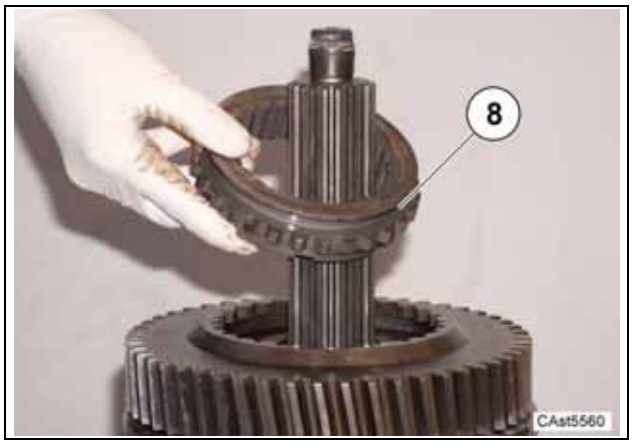
18. Assemble O-ring (18), ring (19) and seal (20).



19. Grease gear wheel (9) and assemble.



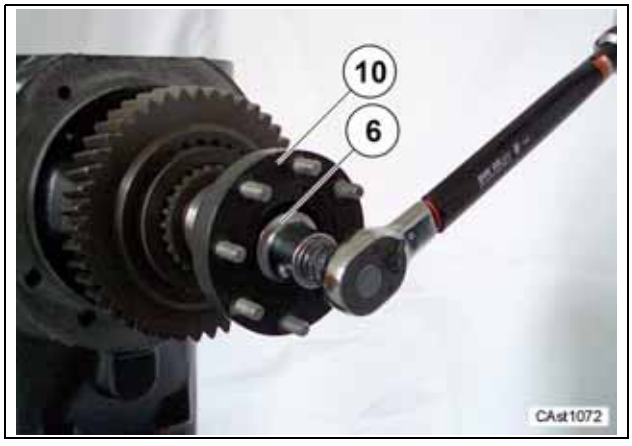
20. Assemble the bush (8).



21. Assemble sleeve (7) and grease surface.



22. Assemble flange (10) and nut (6). (Tightening torque - **400Nm**).



23. Carry out the pre-loading measurement (P) of pinion taper roller using a dynamometer whose cord is wound on the flange diameter. The adjustment is performed by gradually increasing shims mounted under bearing.

⚠ WARNING

Warning: All pre-loadings should be measured without the seal ring.
P = 2 / 3 Nm



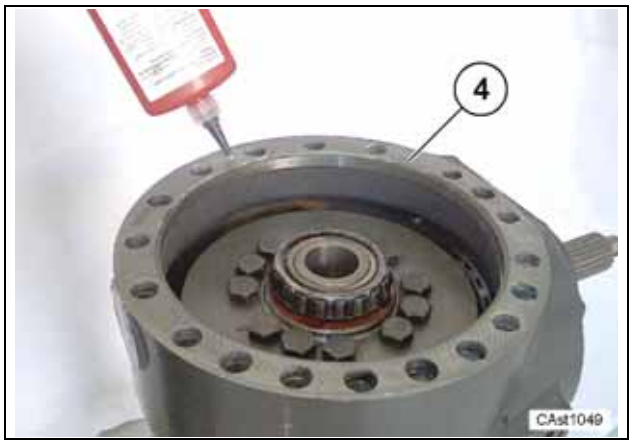
24. Assemble whole differential unit.



25. Assemble the O-ring (5) on beam trumpet (3). Grease the O-ring (5).



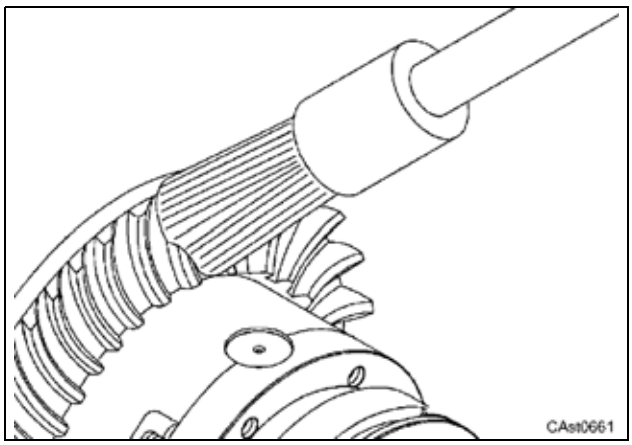
26. Apply Loctite® 510 on contact surface of beam trumpet (4).



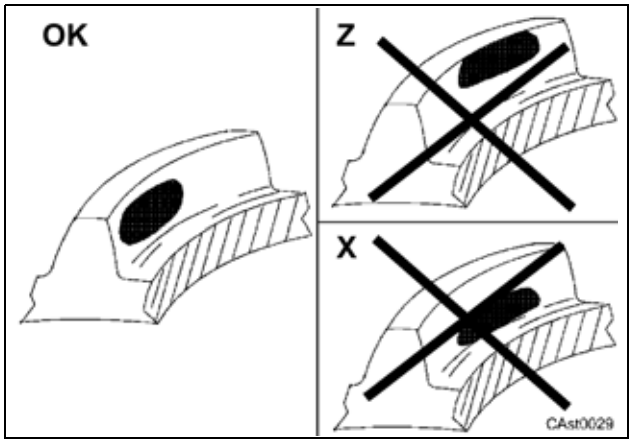
27. Fit screws (1) and tighten according to the prescribed torque: 285 Nm.



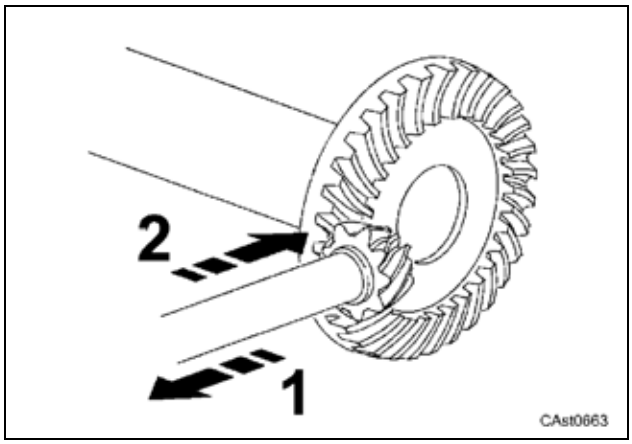
28. Note: To test the marks of the bevel gear teeth, paint the ring gear with red lead paint and detect the contact.
The marking test should be **ALWAYS** carried out on the ring bevel gear teeth and on both sides.



29. **OK** - Correct contact
    If bevel gear is well adjusted, the mark on teeth surfaces will be regular.
    Z - Excessive contact on the tooth tip.
    Approach the pinion to the ring bevel gear and then move the ring bevel gear away from the pinion in order to adjust the backlash.
    X - Excessive contact at the tooth base.
    Move the pinion away from the ring bevel gear and then approach the ring gear to the pinion in order to adjust the backlash.



30. Movements to correct.
    1 - Move the pinion for type **X** contact adjustment.
    2 - Move the pinion for type **Z** contact adjustment.



Disassembly and assembly of transmission

Special tools

Part Number	Part Name	Quantity
2897005	Seal Assembly	1
2897008	Snap Ring Assembly	1
2897039	Handle	1

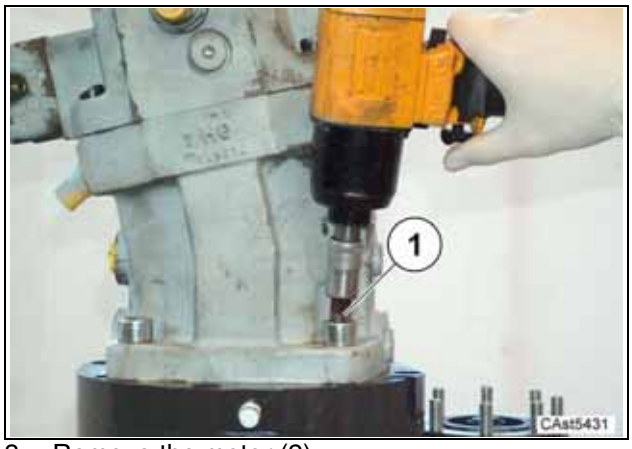
Disassembly

Removal of Travel Motor and Flange

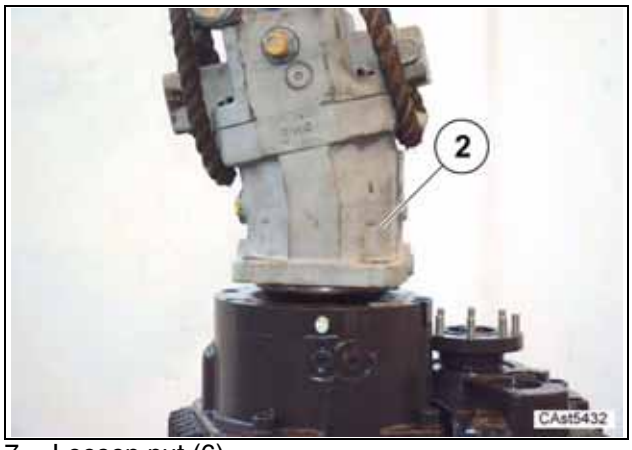
1. Remove drain plug and drain oil from transmission and travel motor.

Transmission: **Approx. 4.85 ℓ**

2. Remove screws (1).

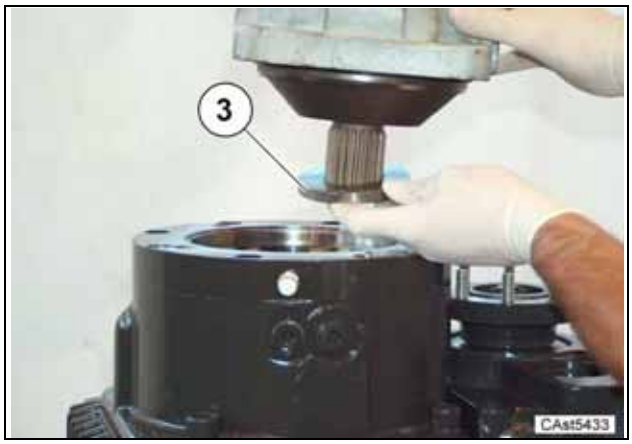


3. Remove the motor (2).

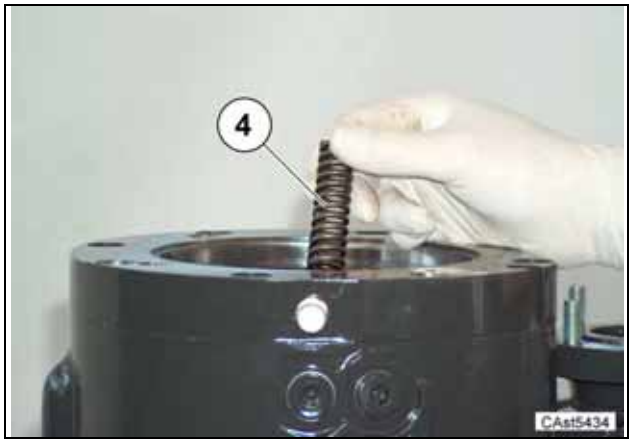


7. Loosen nut (6).

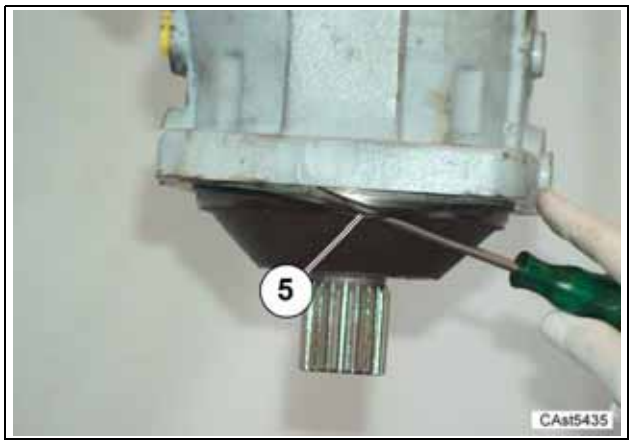
4. Remove disc (3).

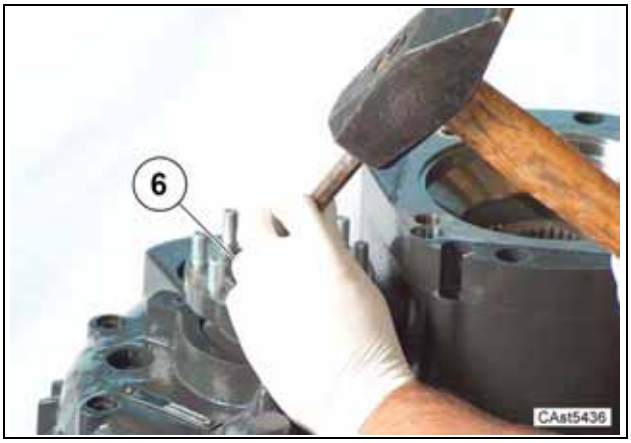


5. Remove spring (4).



6. Remove O-ring (5).

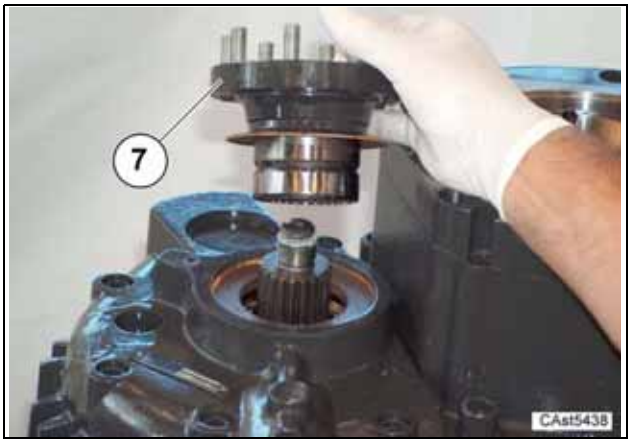




8. Remove nut (6).

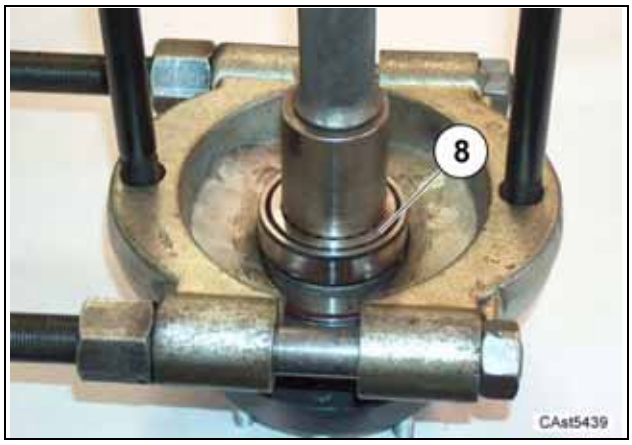


9. Remove flange (7).



13. Remove hydraulic motor flange (11) and O-ring (12).

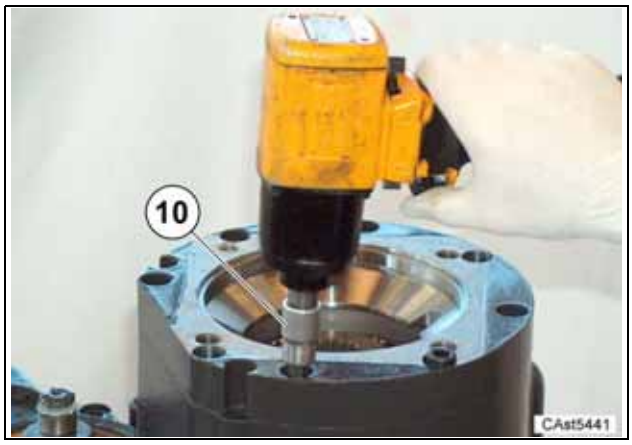
10. Use an extractor to remove the inner ring of the bearing (8).

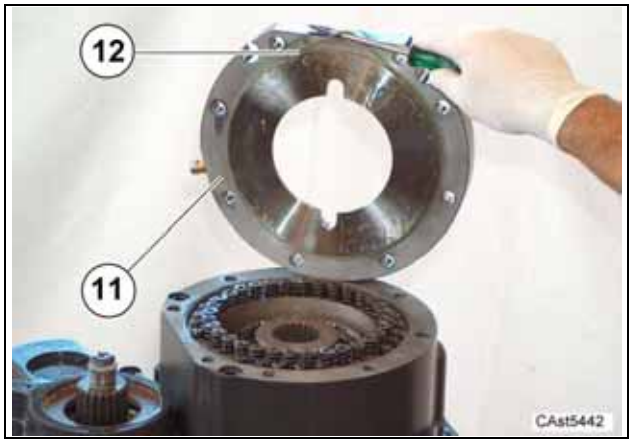


11. Remove flange protection (9).



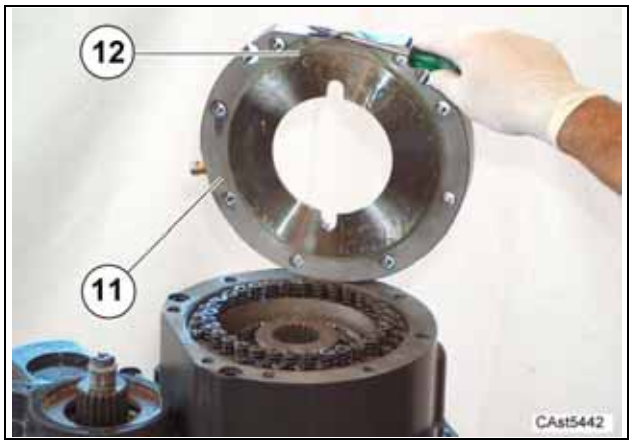
12. Loosen and remove screws (10).





Installation of Travel Motor

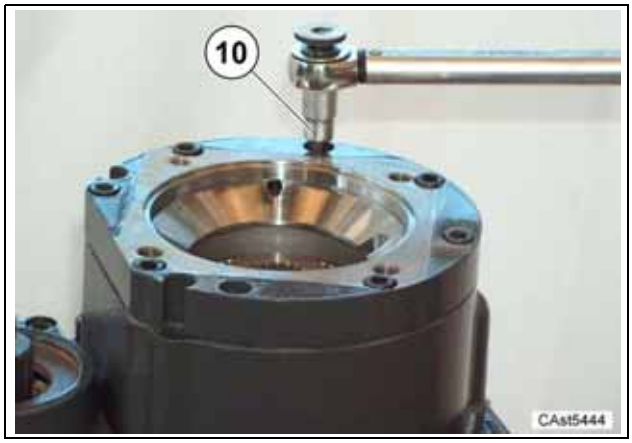
1. Assemble flange (11) and O-ring (12).



2. Apply Loctite® 242 on screws (10).



3. Assemble screw (10). (Tightening torque - **117Nm**)



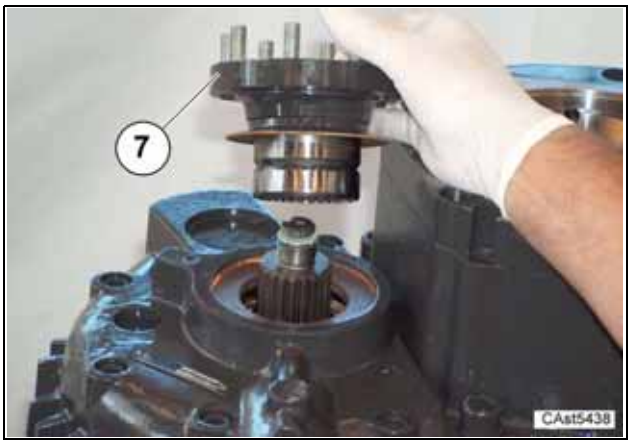
4. Assemble flange protection (9) on flange (7).



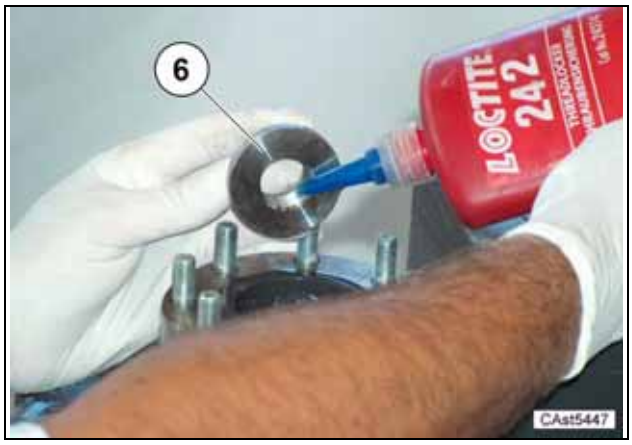
5. Assemble inner ring (8) of the bearing.



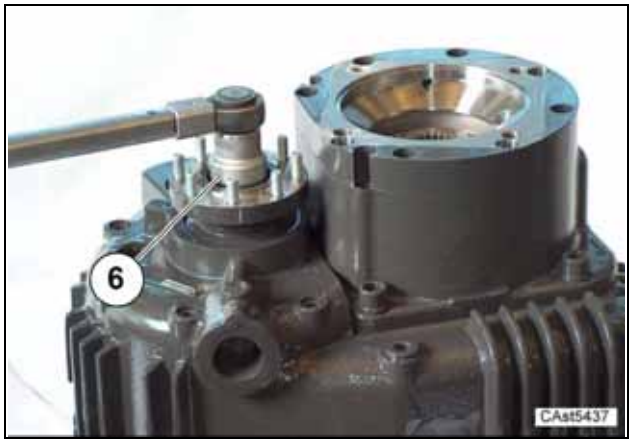
6. Assemble the flange (7).



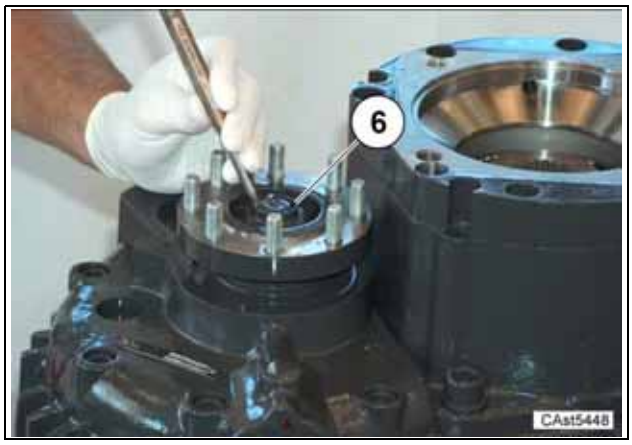
7. Apply Loctite® 242 on nut (6).



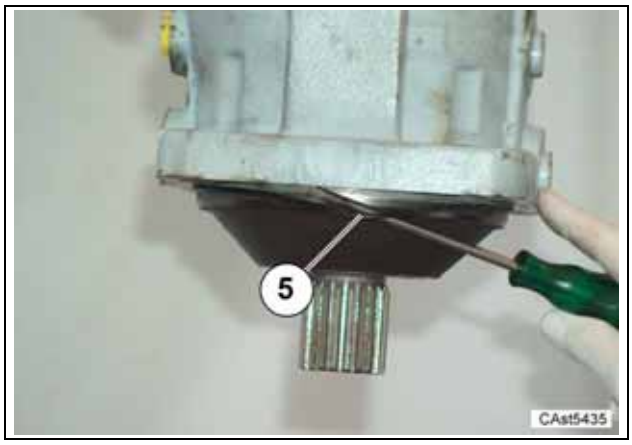
8. Assemble nut (6).



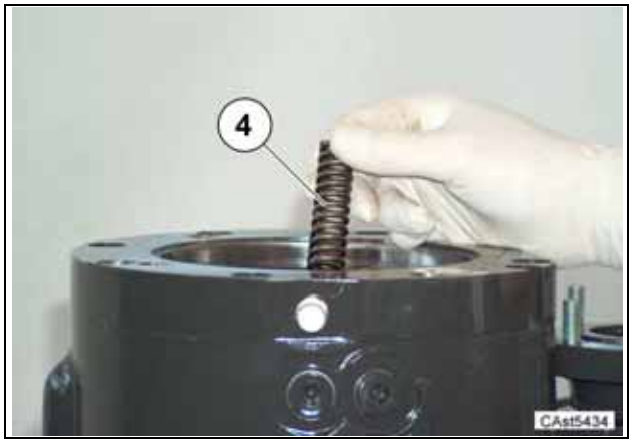
9. Carry out caulking on nut (6).



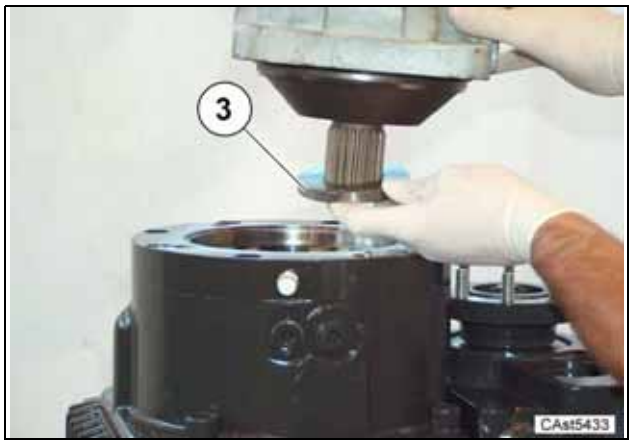
10. Assemble O-ring (5).



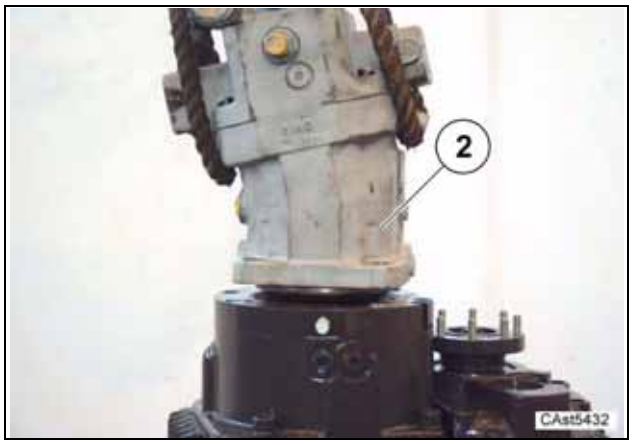
11. Assemble spring (4).



12. Assemble disc (3).



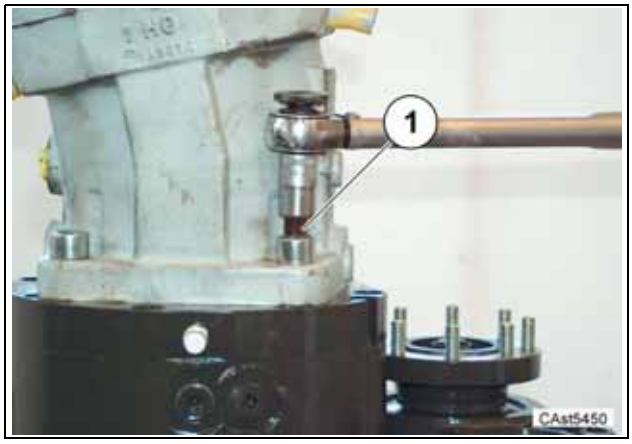
13. Assemble the travel motor (2).



14. Apply Loctite® 242 on screws (1).



15. Assemble screws (1). (Tightening torque - **285Nm**)



Removal of Transmission Box

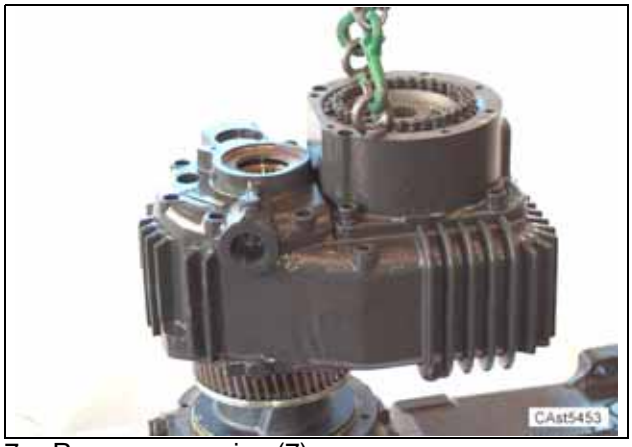
1. Remove screws (1).



2. Remove screws (2).

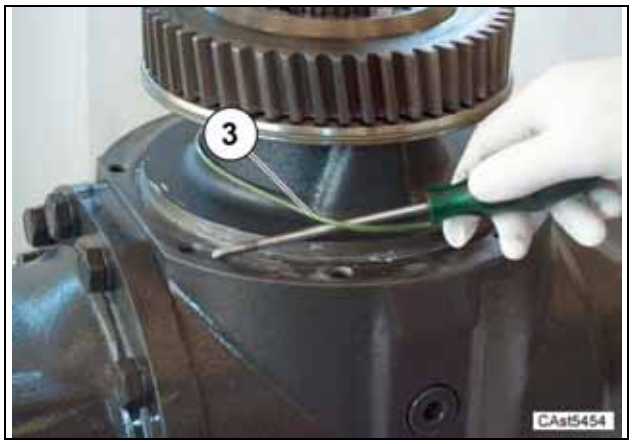


3. Remove transmission box.

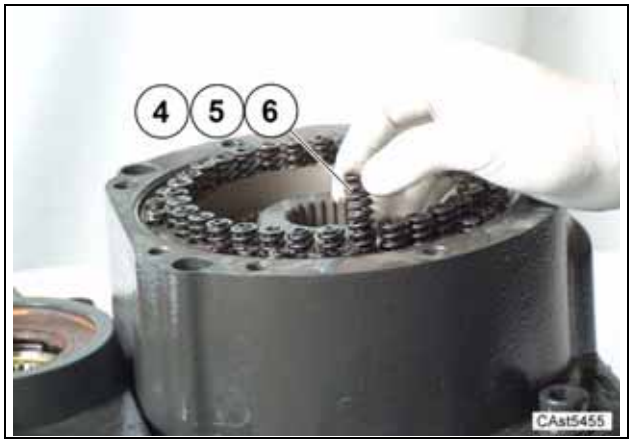


7. Remove snap ring (7).

4. Remove the O-ring (3).

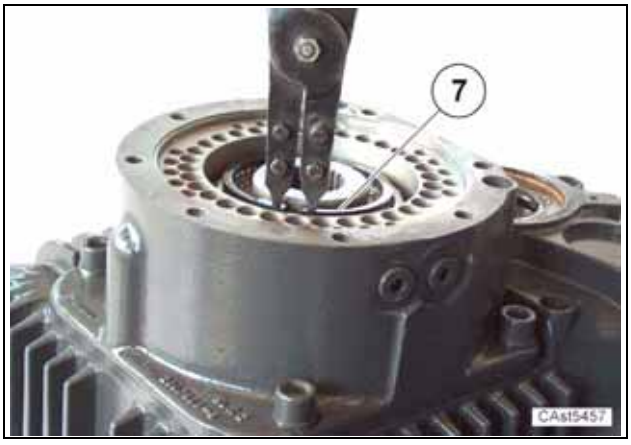


5. Remove springs (4), (5) and (6).

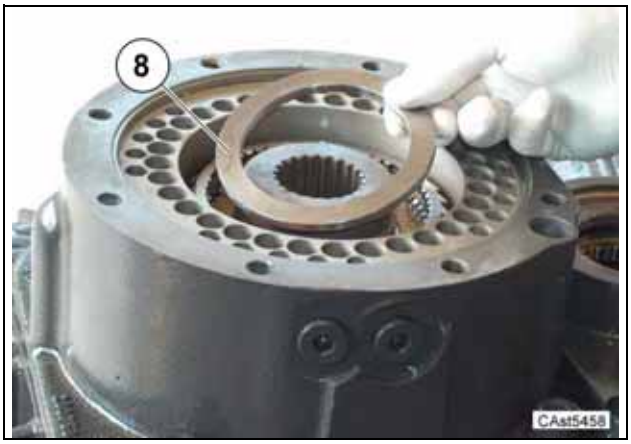


6. Unlock the clutch by pressing with 50-100 bar, through gearbox hole.

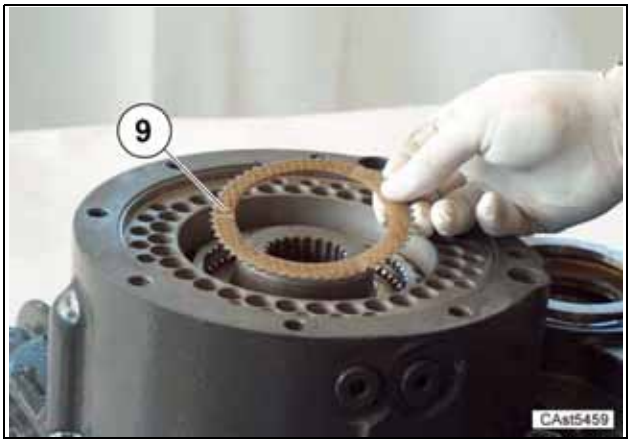




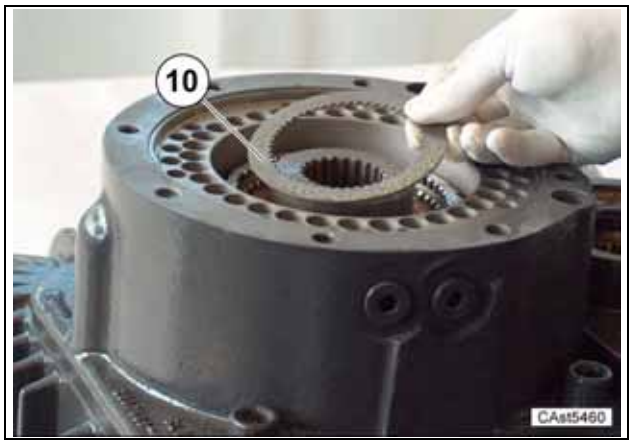
8. Remove ring (8).



9. Remove discs (9).



10. Remove disc (10).



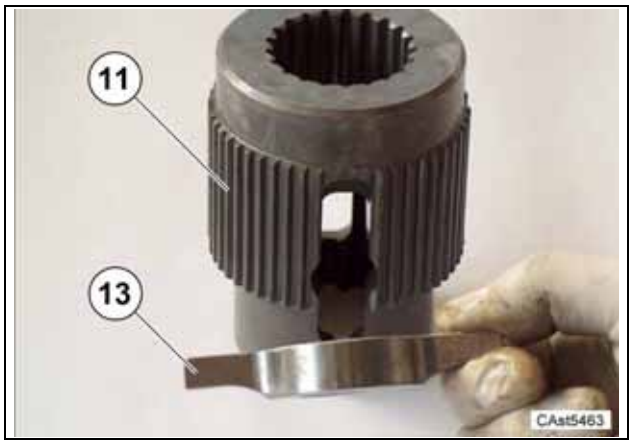
11. Remove bush assembly.



12. Remove the thrust ring (12).



13. Remove thrust plate (13) from bush (11).



14. Remove screws (14).



15. Remove the box assembly.



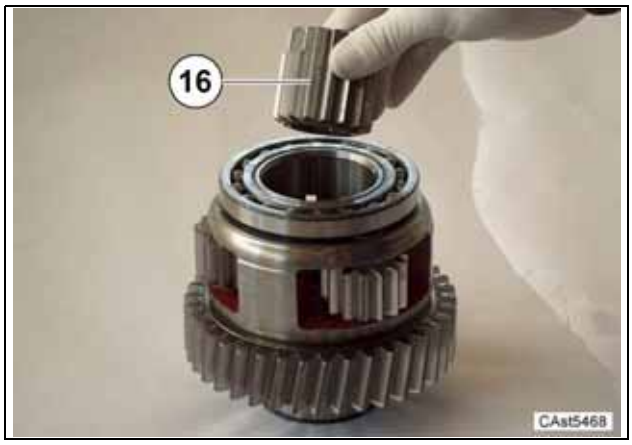
16. Remove complete planetary gears carrier.



17. Remove shaft (15).



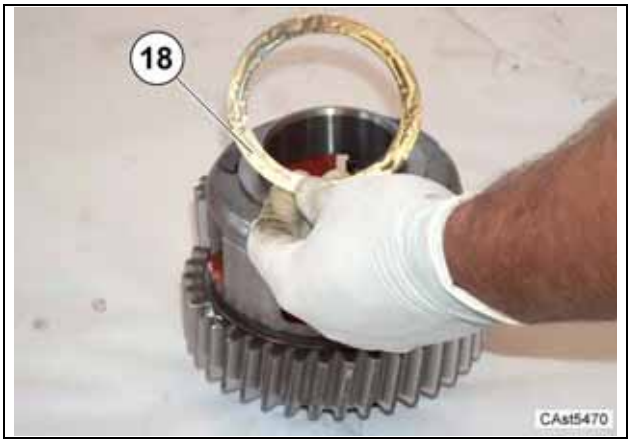
18. Remove gear (16).



19. Use an extractor to remove the bearing (17).



20. Remove shims(18).



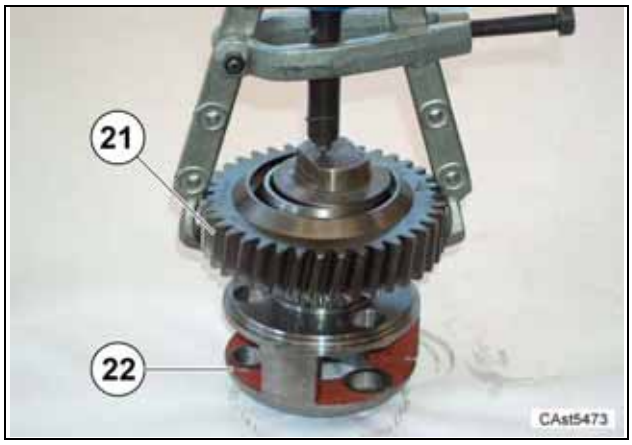
21. Remove ring (19).



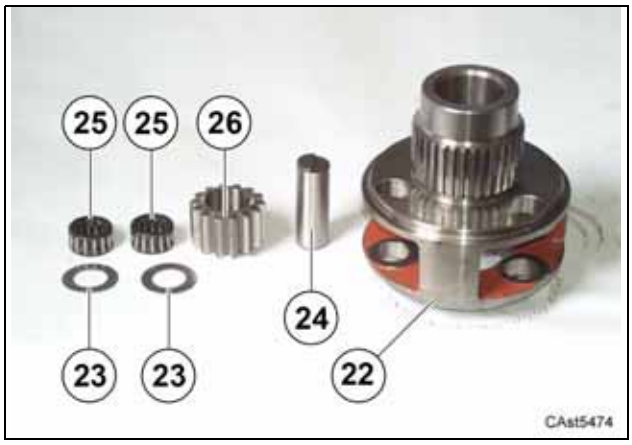
22. Use an extractor to remove bering inner cup (20).



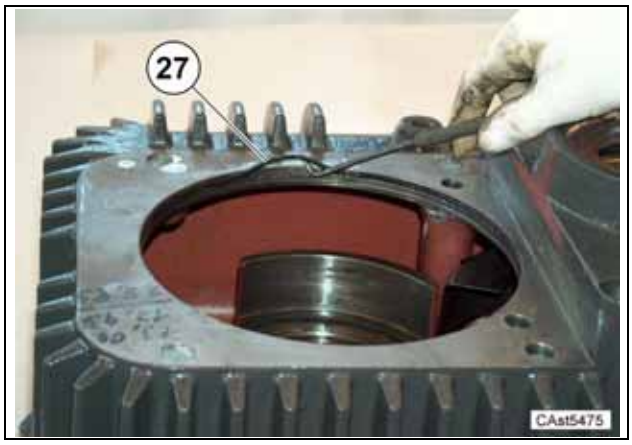
23. Use an extractor to remove gearwheel (21) from planetary gears carrier (22).



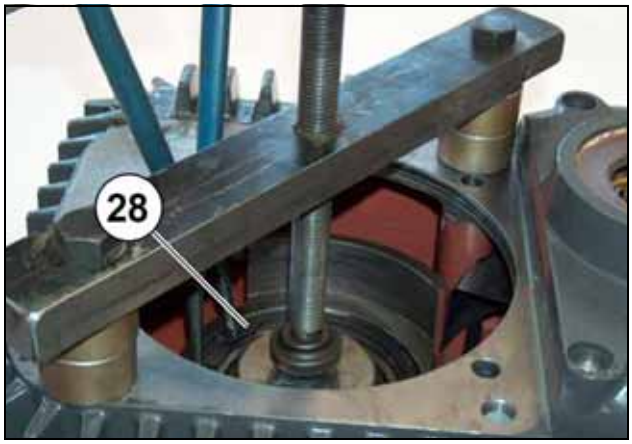
24. Remove washers (23), pins (24), bearings (25), and gears (26) from the planetary gears carrier (22).



25. Remove O-ring (27).



26. Remove snap ring (28).
Use tool 2897008



27. Remove bearing (20).



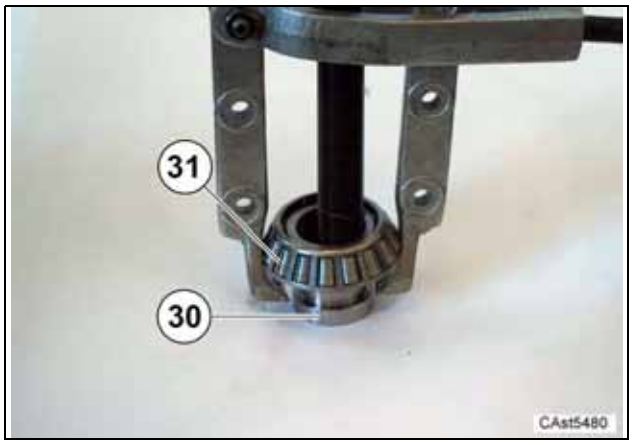
28. Remove ring (29).



29. Remove spin assembly.



30. Remove pin (30) from bearing (31).



31. Remove bearing outer cup (31).



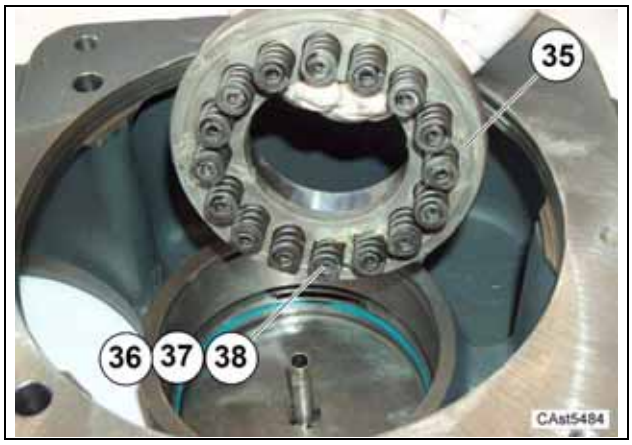
32. Remove piston (32).



33. Remove gasket (33) and O-ring (34).



34. Remove piston (35) and springs (36), (37).



35. Remove bearing cup (38).



36. Remove gasket (39).



37. Remove O-ring (40.



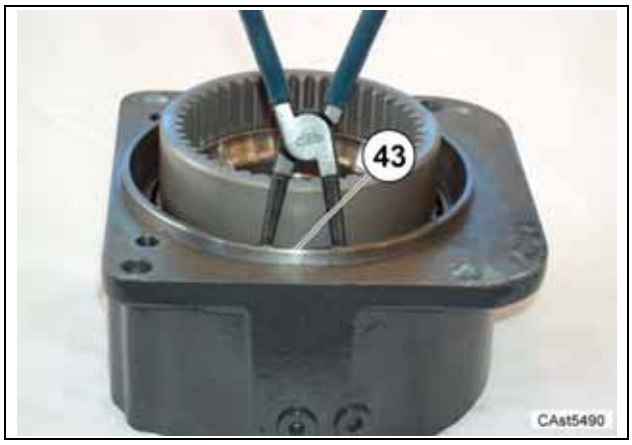
38. Remove disc (41).



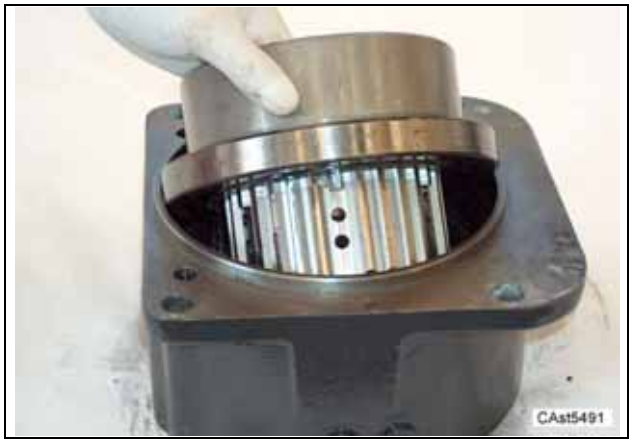
39. Remove the pin (42).



40. Remove snap ring (43).



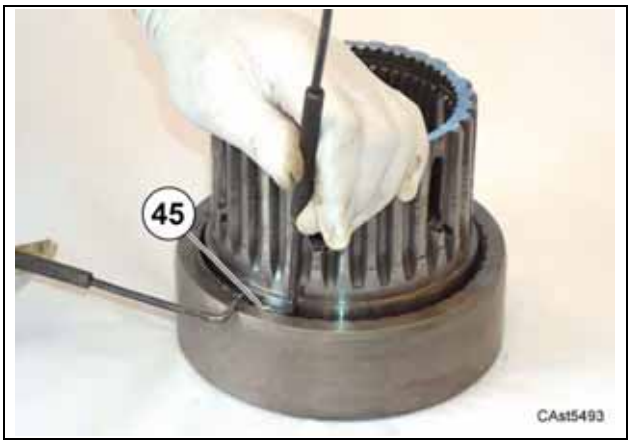
41. Remove hollow wheel assembly.



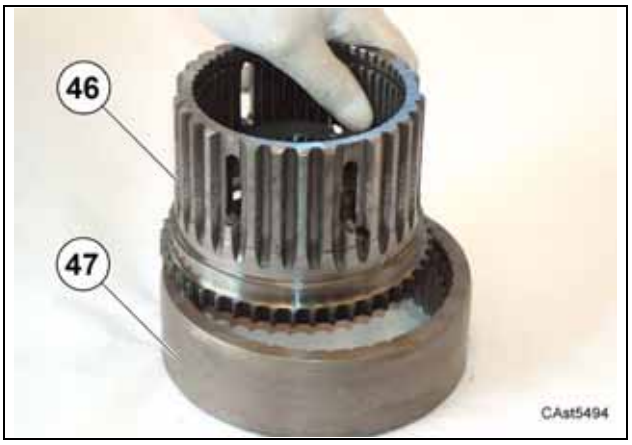
42. Remove bearing (44).



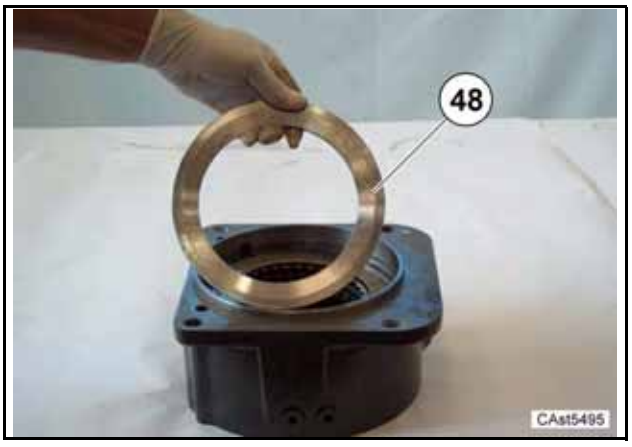
43. Remove snap ring (45).



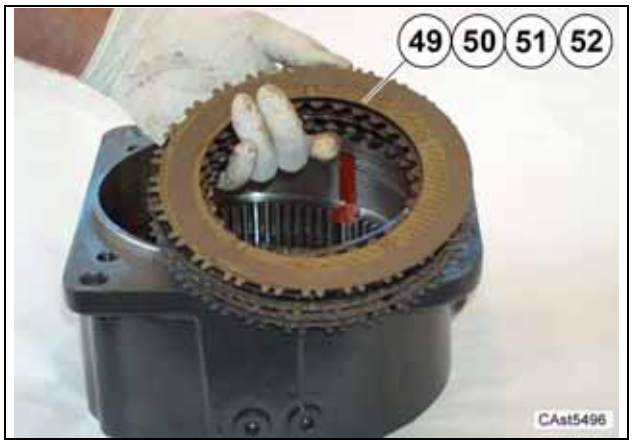
44. Remove external geared wheel (46) from hollow wheel (47).



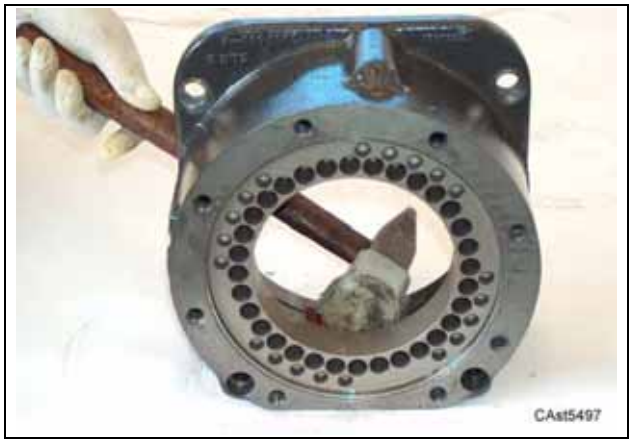
45. Remove disc (48).



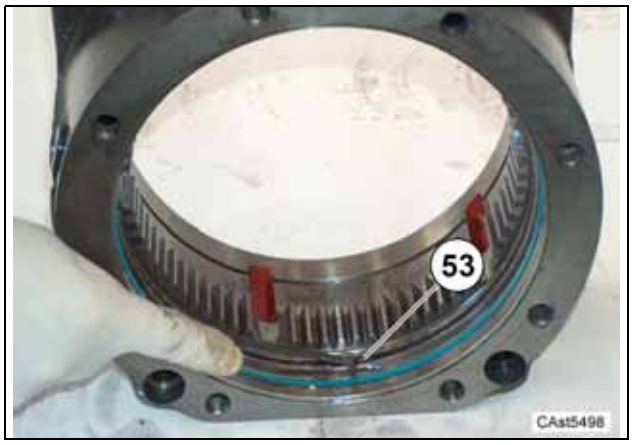
46. Remove discs (49), (50), (51) and (52).



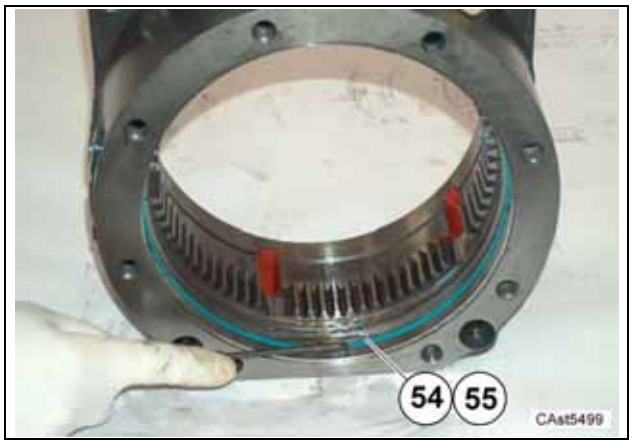
47. Remove piston assembly.



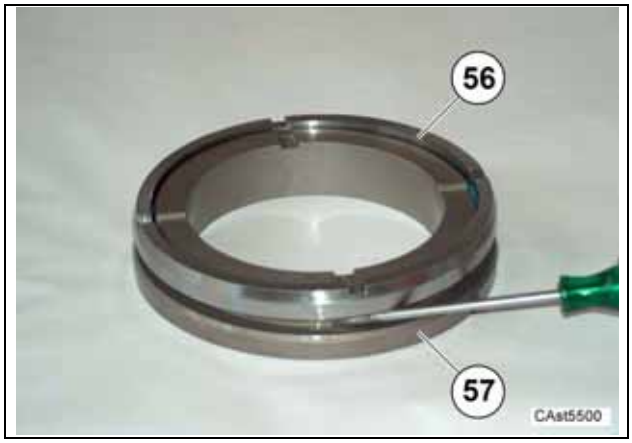
48. Remove O-ring (53).



49. Remove piston gasket (54) and O-ring (55).



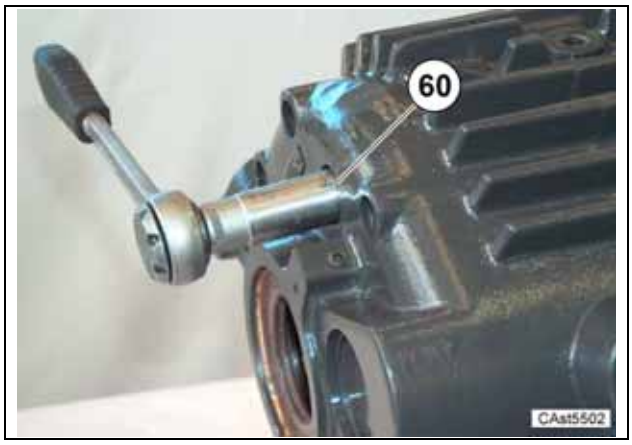
50. Remove outer ring (56) from piston (57).



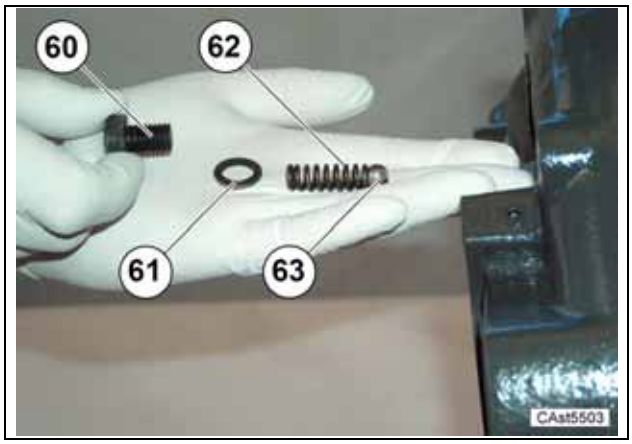
51. Remove gasket (58) and O-ring (59) from seat.



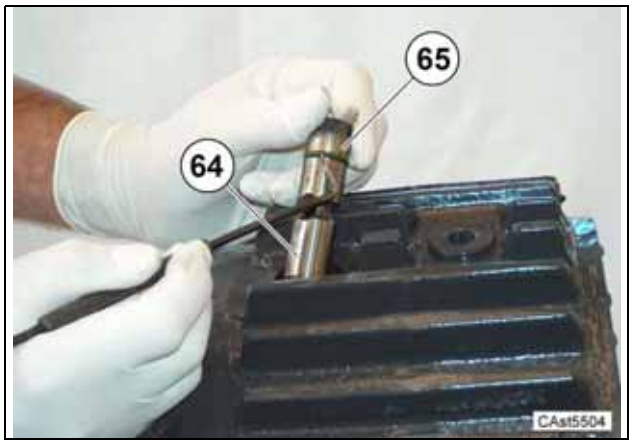
52. Loosen screw (60).



53. Remove screw (60), washer (61), spring (62), and ball (63).



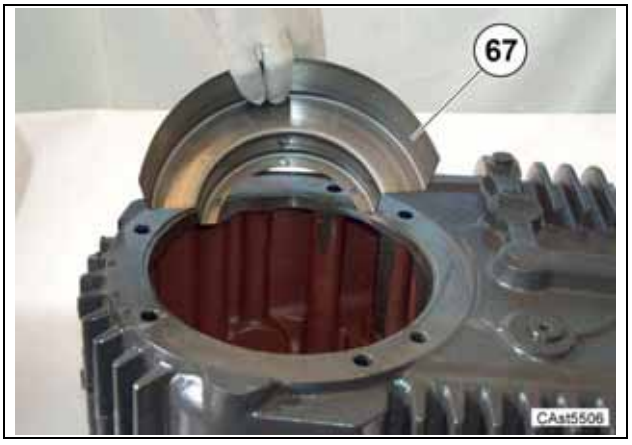
54. Remove pin (64) and O-ring (65).



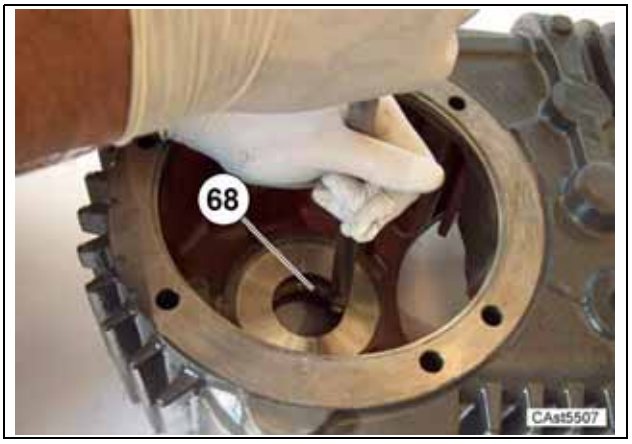
55. Remove screws (66).



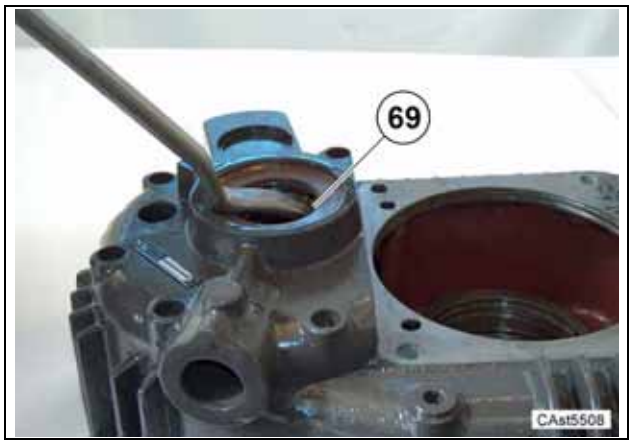
56. Remove the cover (67).



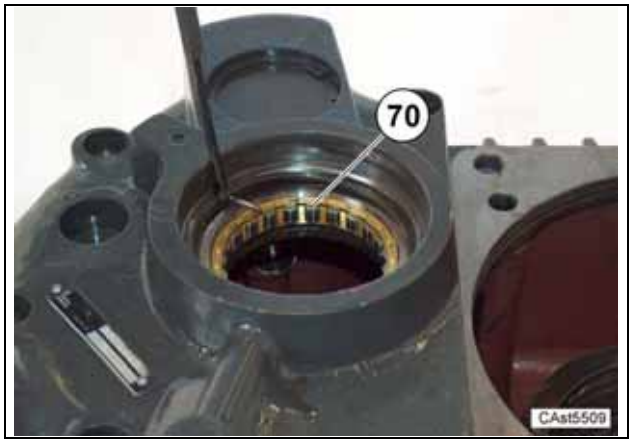
57. Remove disc (68).



58. Remove gasket (69).



59. Remove snap ring (70).



60. Remove bearing (71).



Installation of Transmission Box

1. Assemble bearing (71).



2. Assemble snap ring (70).

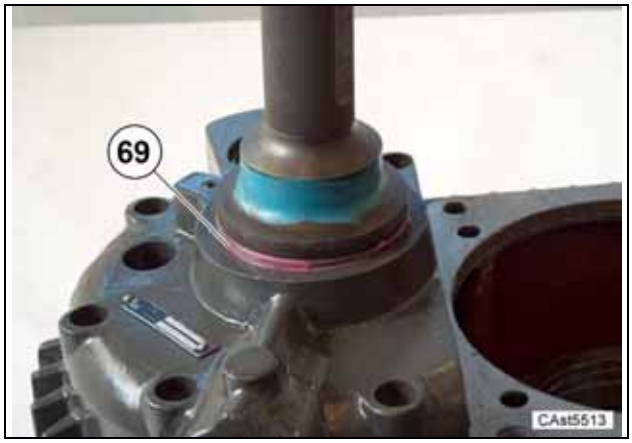


3. Install oil seal ring (69) inside tool 2897005. Apply Loctite® 510 on seal ring outer edge.

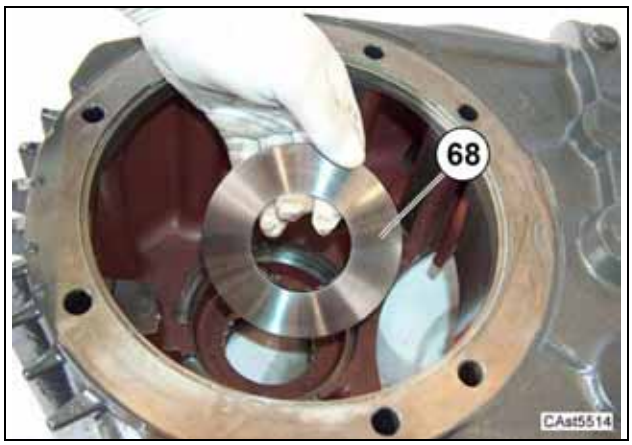


4. Assemble oil seal (69) on tool 2897005.

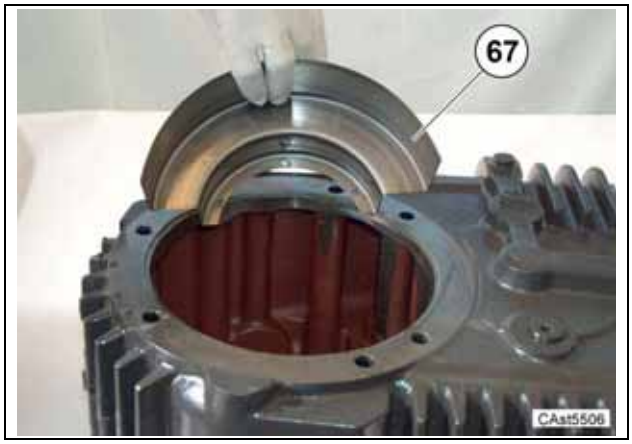
NOTE: Clean the box with a rolling brush.



5. Assemble disc (68).



6. Install cover (67).



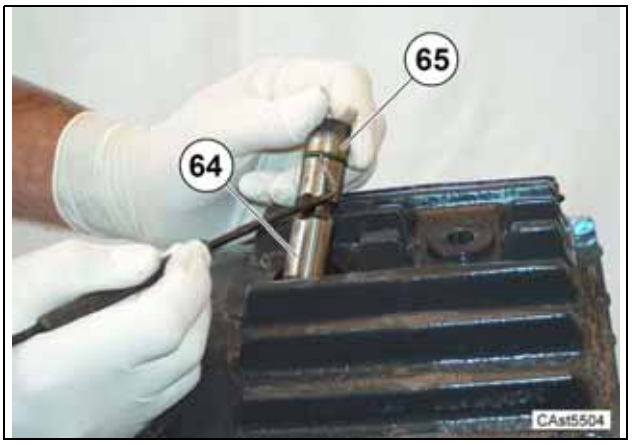
7. Apply Loctite® 242 on screws (66).



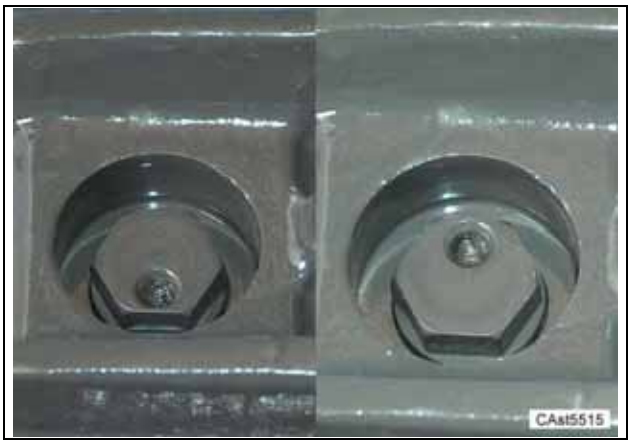
8. Fix cover (67) with screws (68).



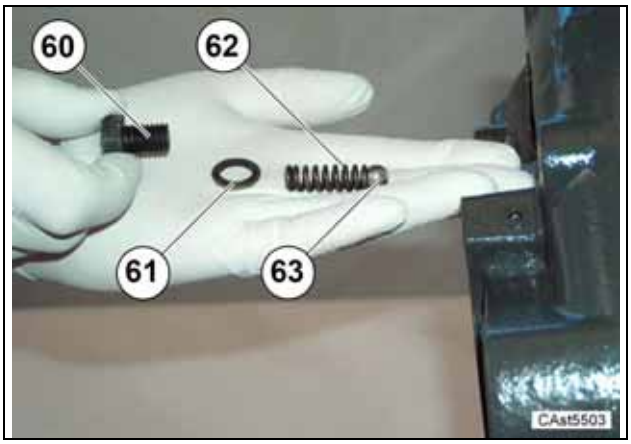
9. Assemble O-ring (65) on the pin (64) and apply a light layer of grease. Assemble the pin.



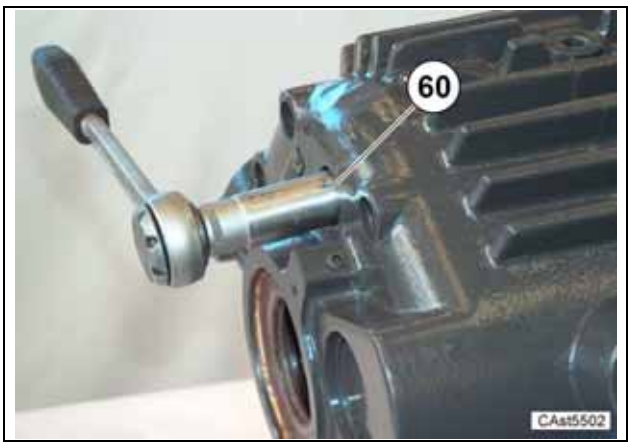
NOTE: To unlock the transmission in case of need, turn the eccentric pin 180° (notch upward).



10. Assemble ball (63), spring (62), washer (61) and screw (60).



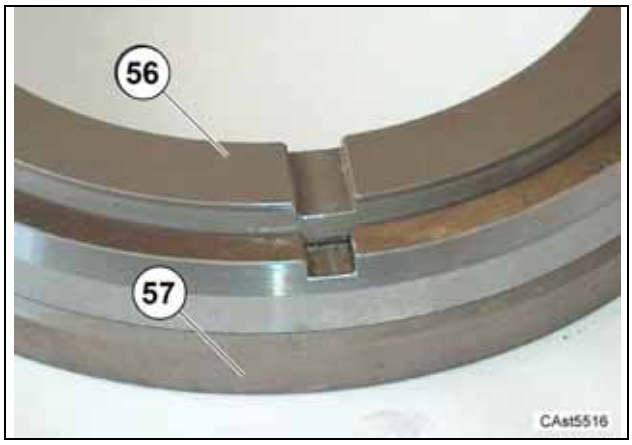
11. Tighten screw (60). (Tightening torque - **400Nm**)



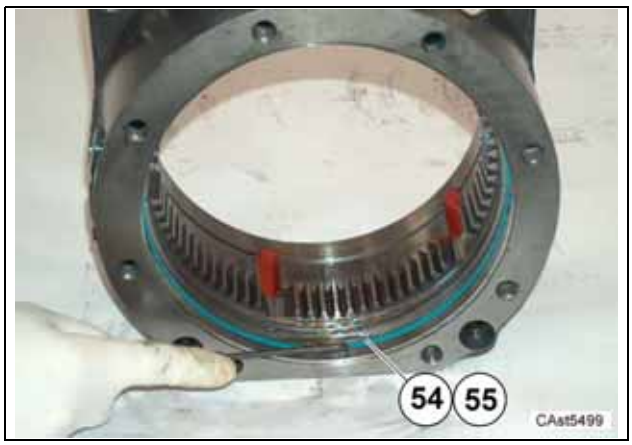
12. Assemble gasket (58) and O-ring (59) in the ring (56).



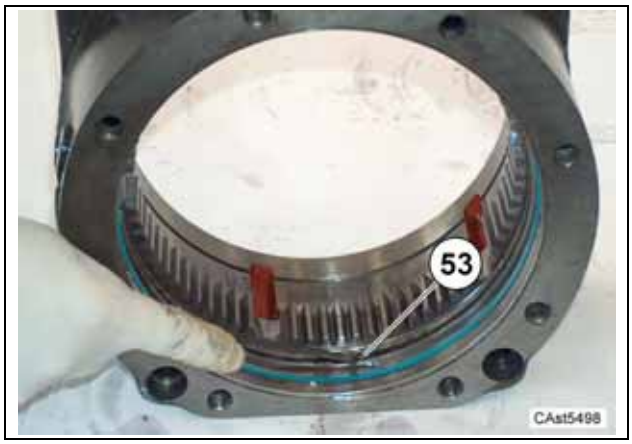
13. Assemble outer ring (56) on piston (57) making the notches match.



14. Assemble gasket (54) and O-ring (55).



15. Assemble O-ring (53).



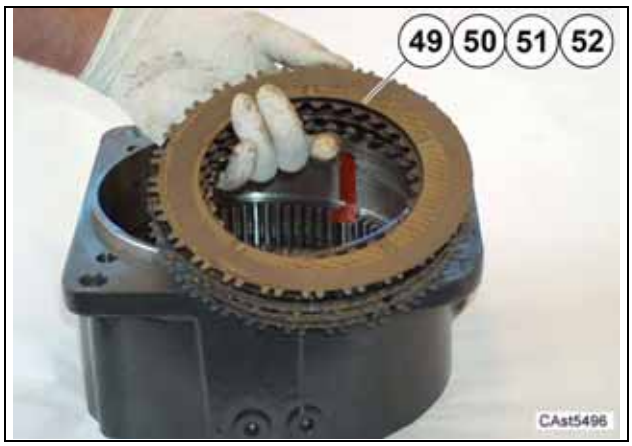
16. lubricate and install piston using tool 1743047. Make sure that the oil groove coincides with the toothed disc grooves.

WARNING

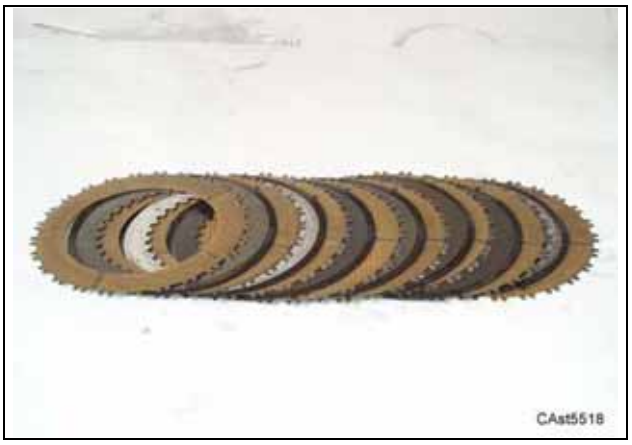
Make sure that the piston does not key.



17. Assemble discs (49), (50), (51) and (52).



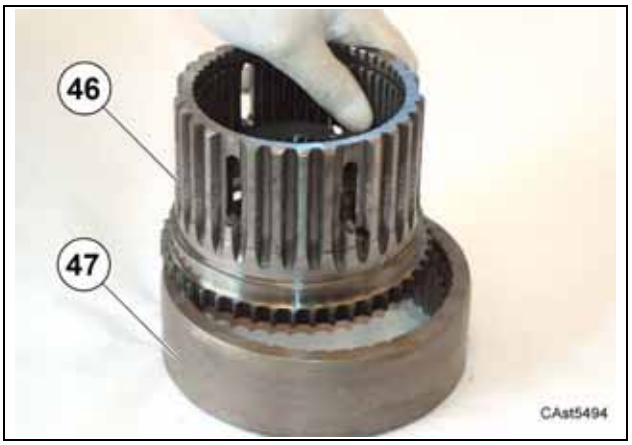
NOTE: Check the sequence of discs.



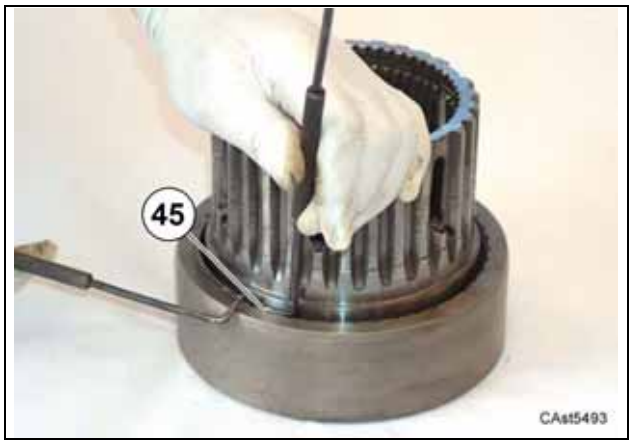
18. Assemble disc (48).



19. Assemble external geared wheel (46) on the hollow wheel (47).



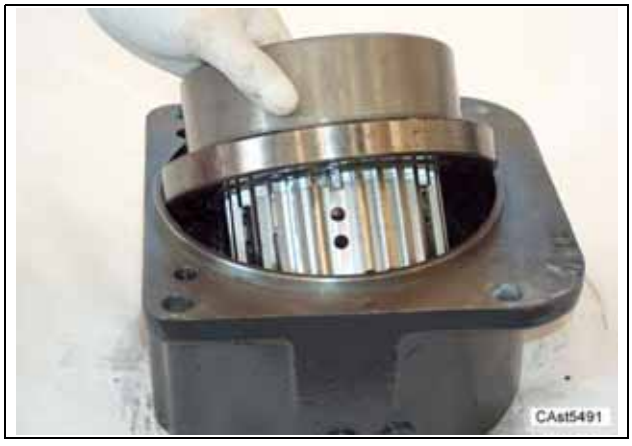
20. Assemble snap ring (45).



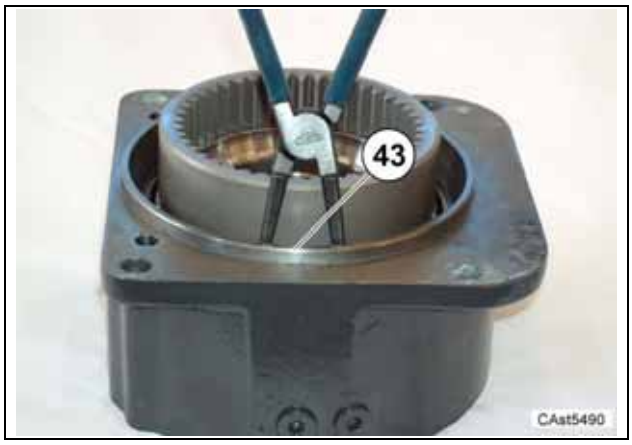
21. Assemble bearing (44) on hollow wheel assembly.



22. Assemble hollow wheel assembly.



23. Assemble snap ring (43).



24. Assemble pin (42).



25. Assemble disc (41).



26. Assemble O-ring (40).



27. Assemble gasket (39).



28. Assemble O-ring (38).



29. Install O-ring (38) and gasket (39).
Use tool 2912484.



30. Apply grease on piston (35) to prevent springs from falling and insert springs (36), (37) and (38).

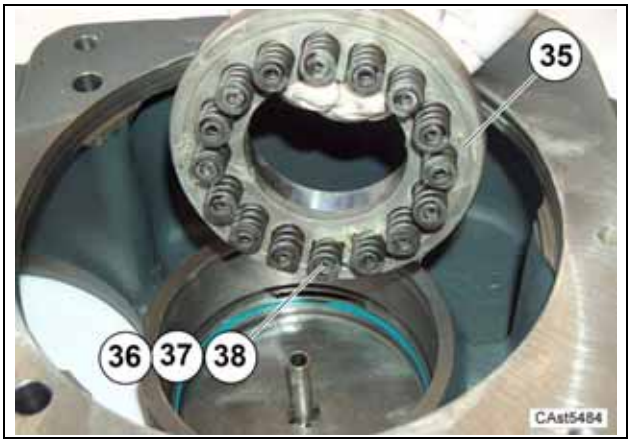


⚠ WARNING

Springs are assembled as follows:
N.1 series with 1 spring;
N.1 series with 2 spring;
N.1 series with 1 spring;
N.3 series with 2 spring;
N.1 series with 1 spring;
N.1 series with 2 spring.
Repeat this operation twice.



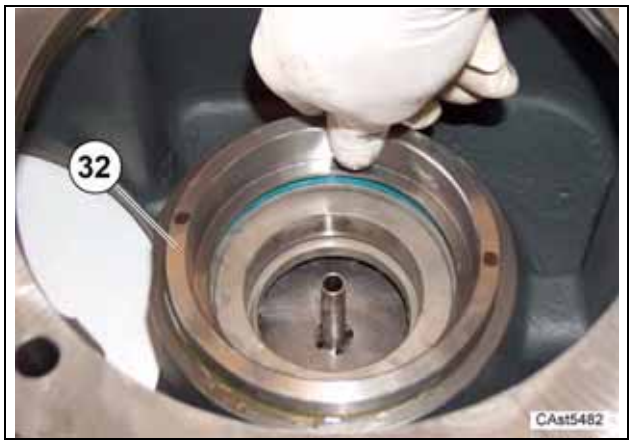
31. Assemble piston assembly



32. Assemble O-ring (34) and gasket (33).



33. Assemble piston (32).



34. Assemble cup of bearing (31).



35. Assemble bearing (31).



36. Assemble pin (30).



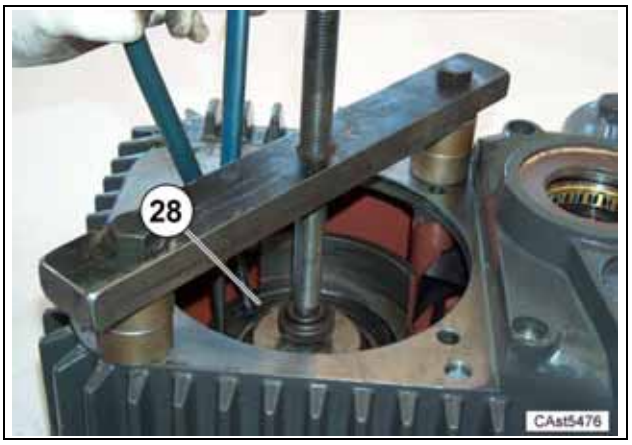
37. Assemble ring (29).



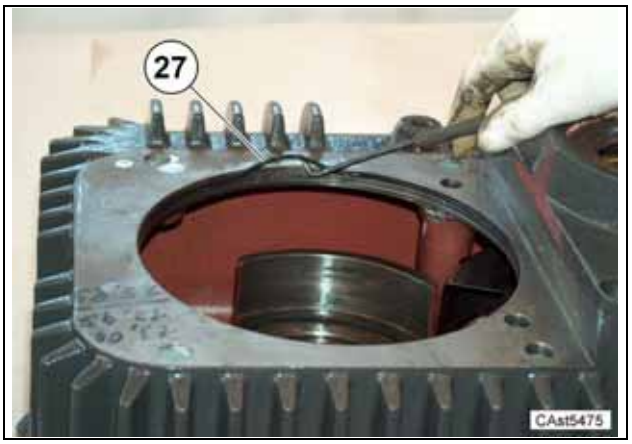
38. Assemble bearing outer cup (20).



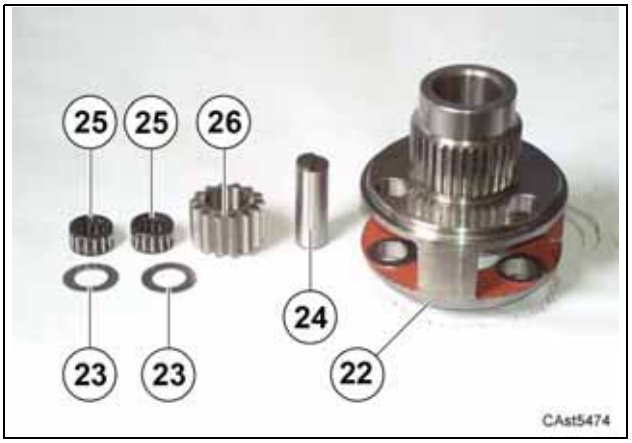
39. Assemble snap ring (28).
Use tool 2897008.



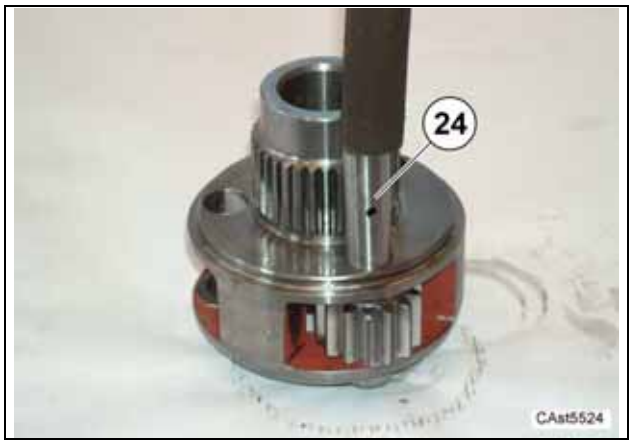
40. Assemble O-ring (27).



41. Assemble gears (26), bearings (25), pins(24) and washers (23) on the planetary gears carrier (22).



42. Assemble pins (24).



43. Assemble gear wheel (21) on planetary gears carrier (22).



44. Align the holes of the wheel (21) with the holes of the planetary gears carrier (22).



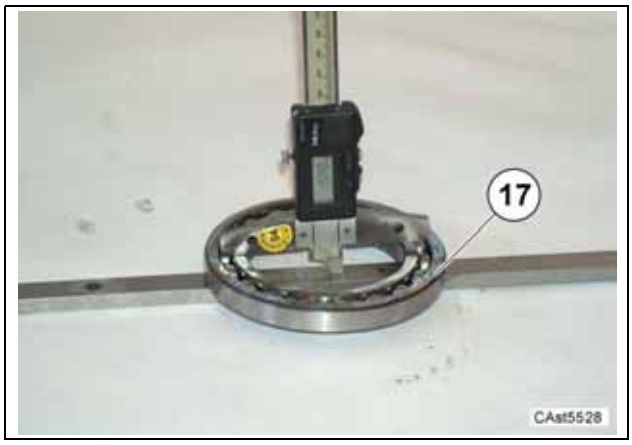
45. Apply Loctite® 638 on inner race of bearing(20)



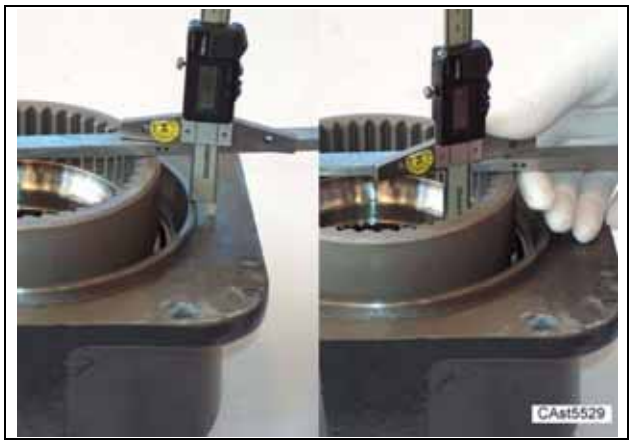
46. Assemble the ring (19).



47. Measure shim (S) of bearing (17).



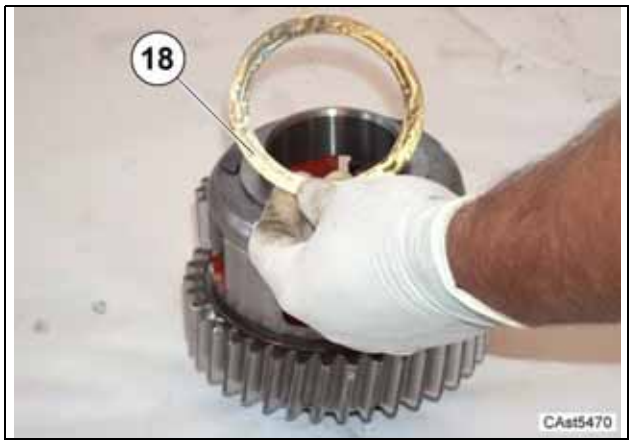
48. Measure the distance (A) between supporting plate and the bearing detent (17).



49. Measure the distance (B) between the case supporting plate and the upper detent of the bearing(17).



50. The dimension X= A-(B+S) determines the value of the shims (18) to be fitted, with a tolerance of 0.5 - 0.7.



51. Apply Loctite® 638 on inner race of bearing (17) and assemble it.



52. Assemble gear (16).



53. Assemble shaft (15).

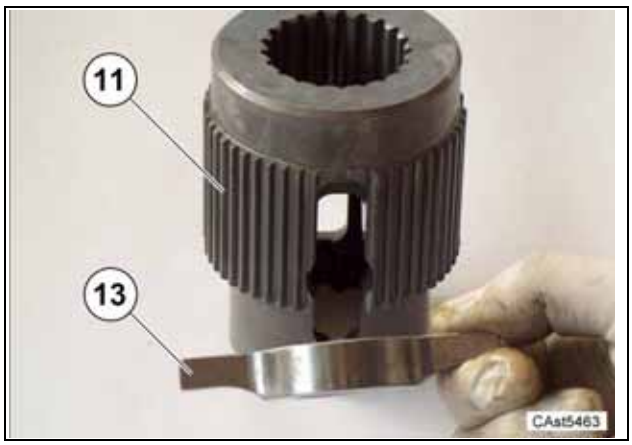


54. Assemble the planetary gears carrier.



55. Assemble bush (11) and thrust plate (13).

NOTE: Pay attention to assembly direction.



56. Install thrust ring (12).



57. Assemble the complete box.



58. Assemble the complete bush.

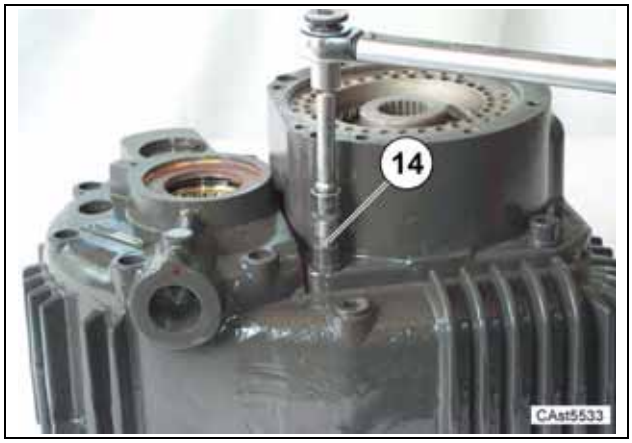


59. Apply Loctite® 242 on screws (14).

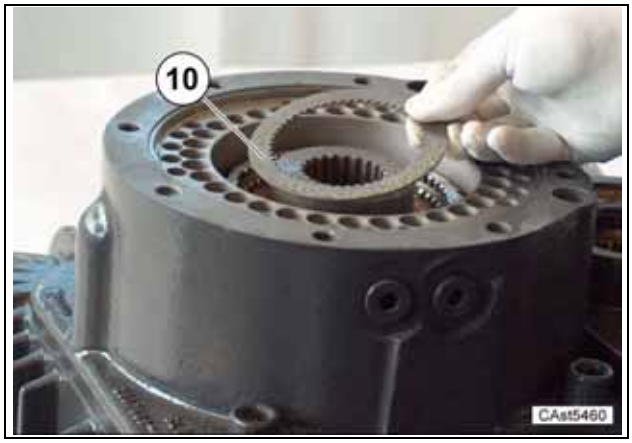


60. Assemble screws (14).

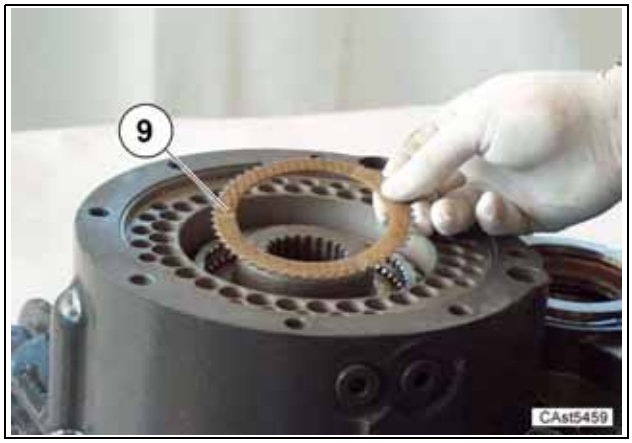
N•m Screw (14) - **117Nm**



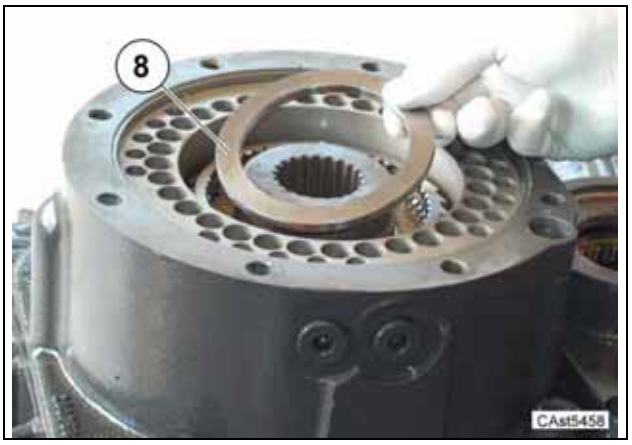
61. Assemble disc (10).



62. Assemble disc (9).



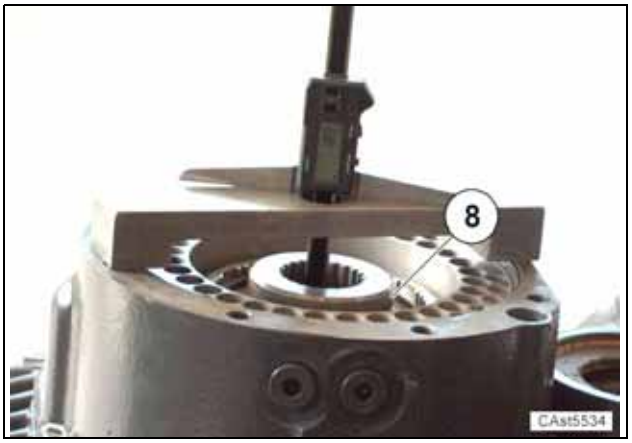
63. Assemble the ring (8).



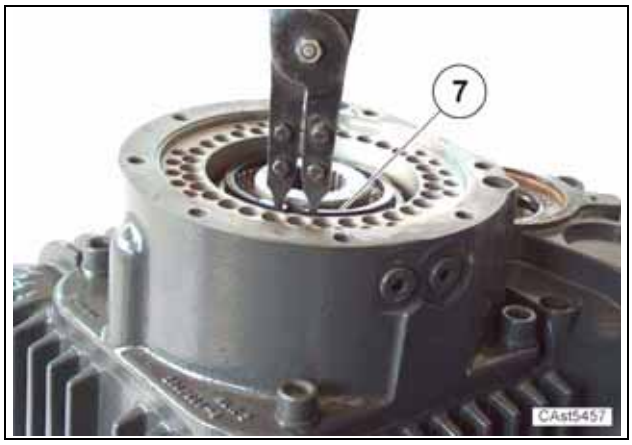
64. Unlock the clutch by pressing 50 - 100 bar.



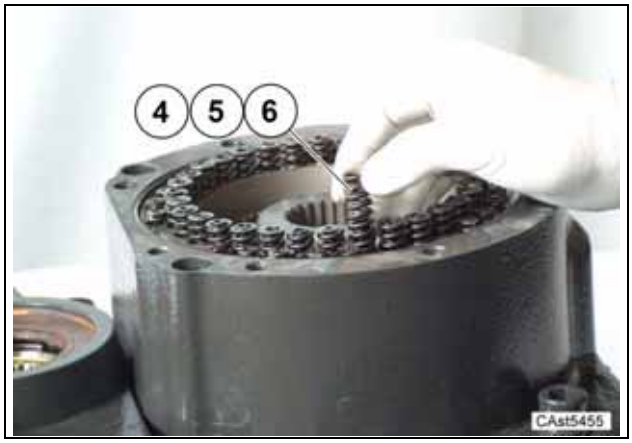
65. Measure the lowering of the discs using a digital gauge. the stroke should be between 1.7 and 1.9 mm. Otherwise replace the ring (8) with one of different thickness.



66. Assemble snap ring (7).



67. Assemble springs (4), (5) and (6).



68. Assemble O-ring (3).
Apply Loctite® 510.



69. Assemble transmission box.

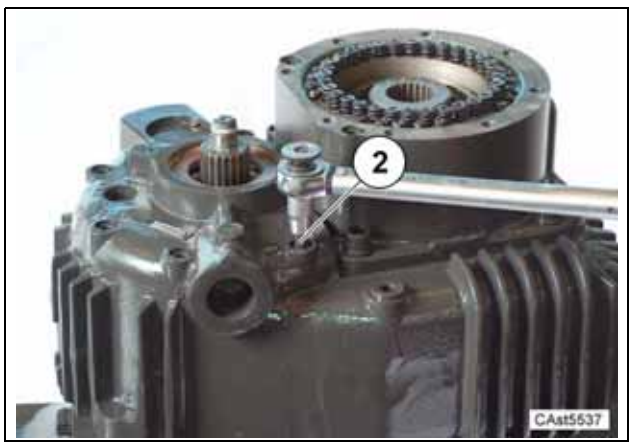


70. Apply Loctite® 242 on screws (2).

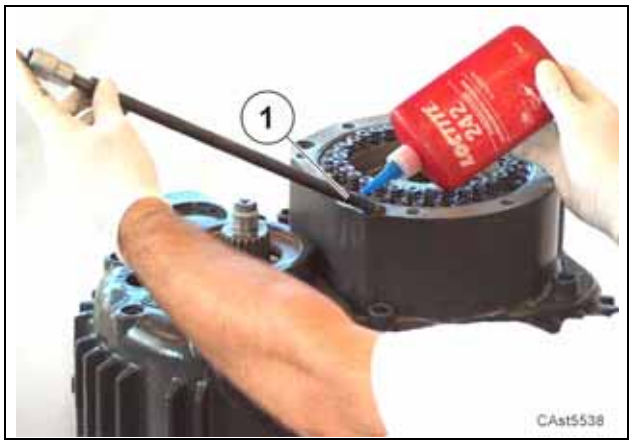


71. Assemble screws (2).

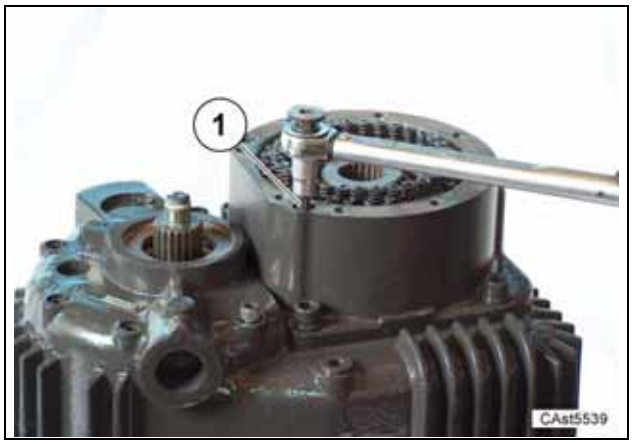
N·m Screw (2) - **70Nm**



72. Apply Loctite® 242 on screws (1).



73. Assemble screws (2).
(Tightening torque - **285Nm)**



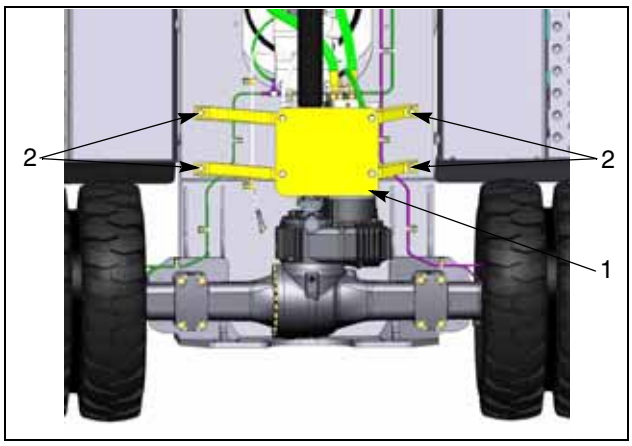
74. Drain clutch by pressing with 50 - 100 bar. Measure the lowering of discs using a digital gauge. The stroke should be between 2.2 and 2.4 mm.



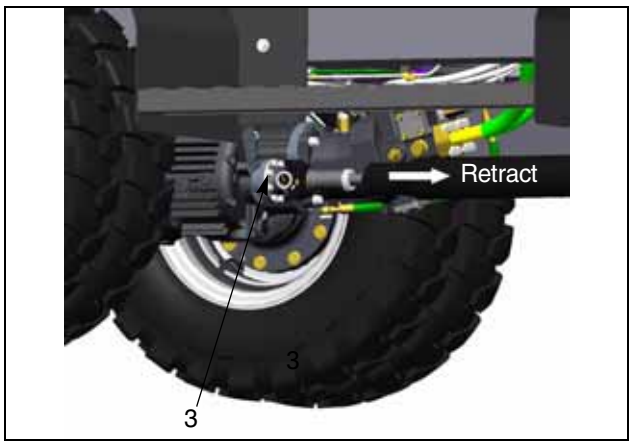
Removal and installation of propshaft assembly

Removal

1. Remove cover (1) by removing 4 bolts (2).

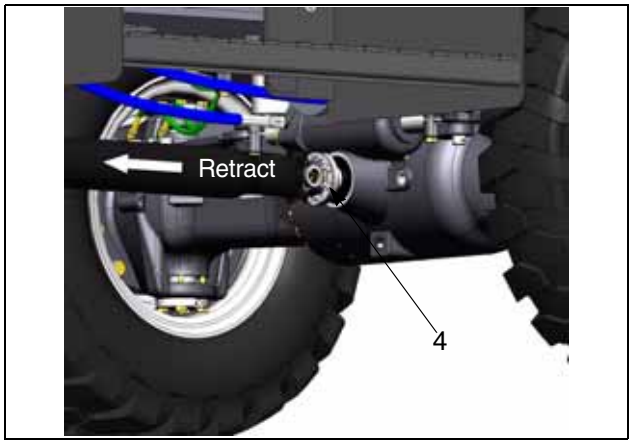


2. Support propshaft in 2 places with suitable equipment.
3. Remove nuts (3), then retract the propshaft clear of studs on transmission housing.



4. Ensure propshaft is supported safely.
5. Remove nuts (4), then retract from the studs on the axle housing.

.



6. Carefully lift propshaft away.

kg Propshaft Assembly: **17.1Kg**

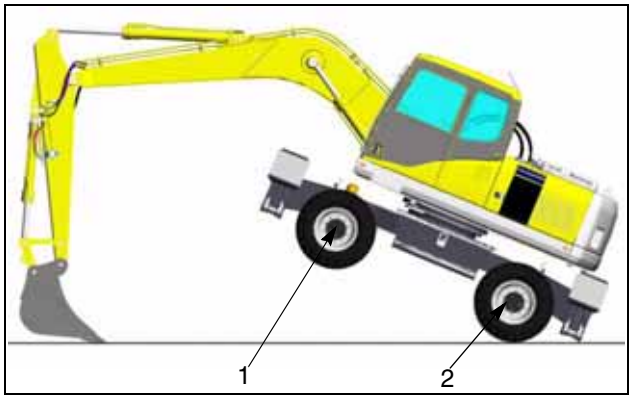
Installation

- Install in reverse order of removal.
- Tightening torque of propshaft nuts **(58.8-73.5 Nm)**.

Removal and installation of wheel assembly

Removal

1. Stop engine and ensure brake pedal is engaged.
2. Raise the chassis with the boom so that the tyres are raised above the ground. Then, place axle stands below the front (1) and rear (2) axles.



3. Lower onto stands and deflate tyre completely by removing valve (3) with appropriate tool.

WARNING

Always stand to the side while deflating the tyre.



4. Release 8 of the wheel retaining nuts leaving 2 diagonally opposite each other remaining (1+2). Once you have checked there is no pressure on the remaining 2 nuts remove these as well.



Installation

✔ Install in reverse order of removal.

✔ When inflating tyres, inflate to:

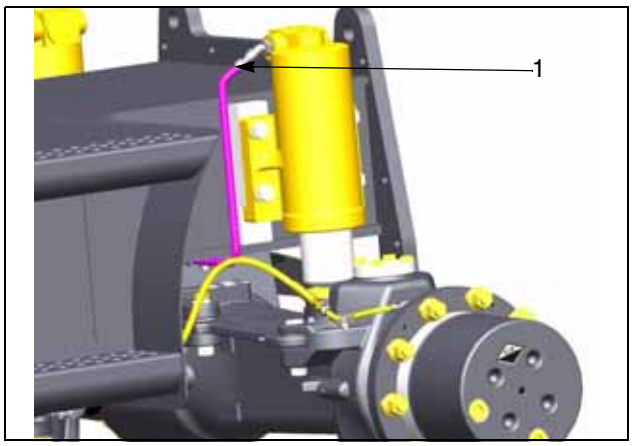
Tyre	Tyre Pressure (bar)
10.00 - 20 16 ply	7.25
11.00 - 20 16 ply	7.00

✔ Check there is no damage to wheel and rims.

Removal and installation of suspension lock cylinder assembly

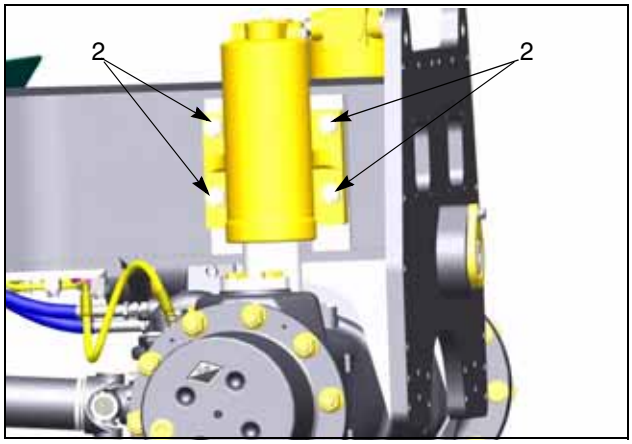
Removal

1. Remove front wheels see “Removal and installation of wheel assembly” on page 20- 200.
2. Remove tube (1).



3. Remove the 4 bolts (2) attaching the suspension lock cylinders to the chassis.

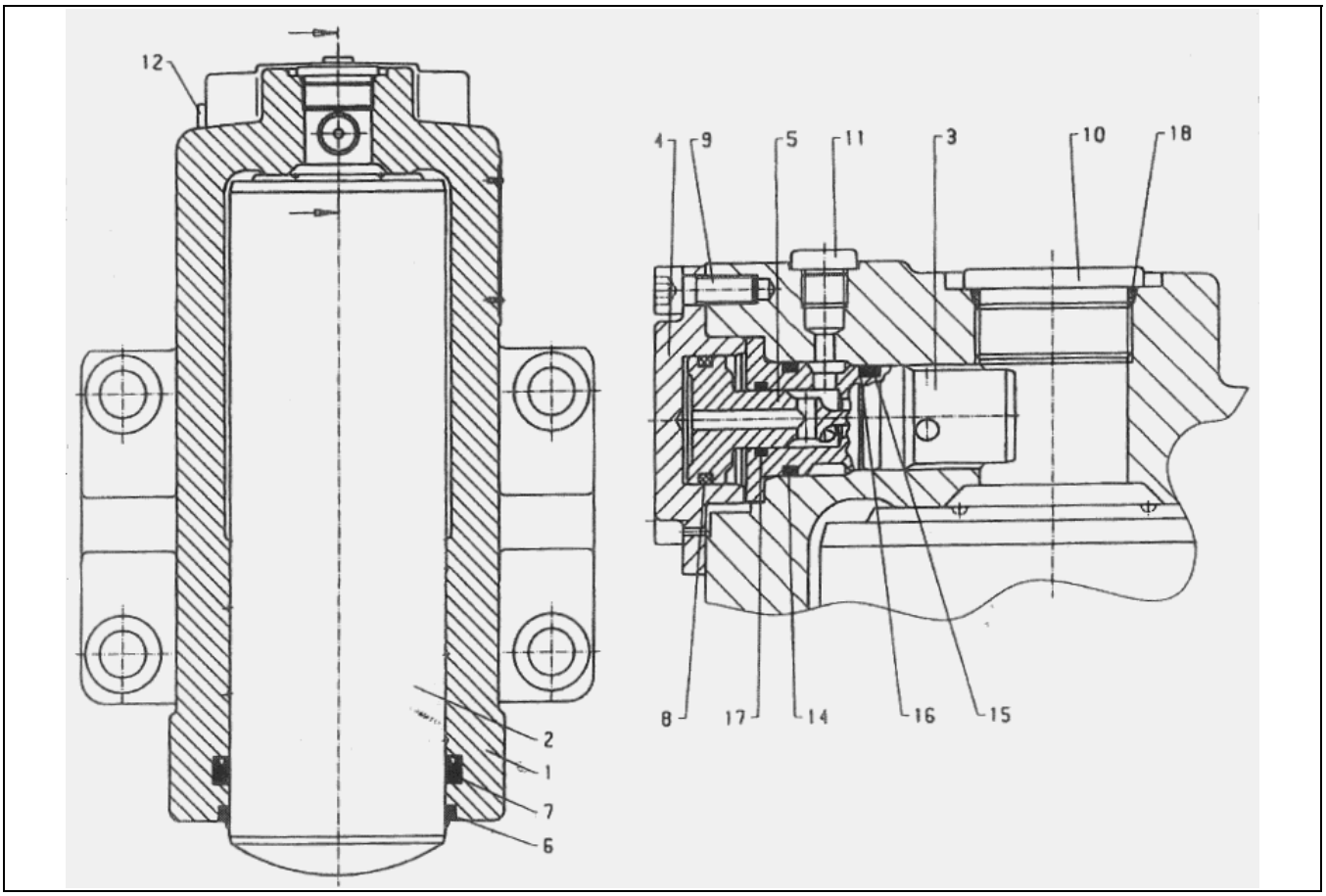
kg Suspension cylinder assembly: **57Kg**



Installation

- Install in reverse order of removal.
- Be sure to grease axle pads when installing cylinders.

Disassembly and assembly of suspension lock cylinder



Change Rod Seal

1. Remove screw plug position 10.
2. Press rod position 2 downwards.

WARNING

Do not damage rod surface!

3. Take out U - ring position 7 using a tool without sharp edges.

WARNING

Do not damage groove!

4. Insert new U -ring in a reniform squeezed state and press it into the groove ensuring that there are no kinks.
5. Investigate wiper ring position 6 with respect to damages, if necessary replace it.
6. Grease the seals.
7. Mount the rod.

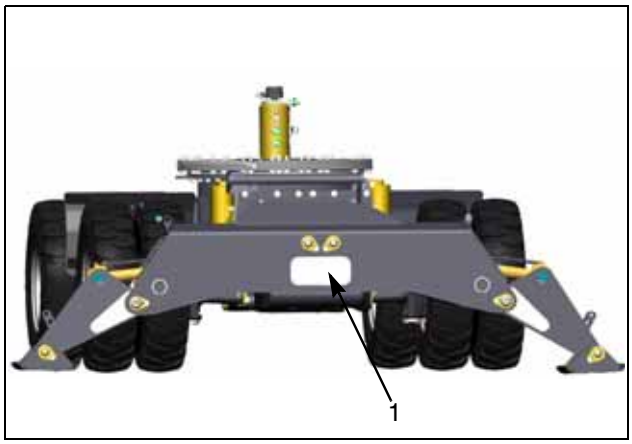
WARNING

With all repairs pay attention to extreme cleanliness!

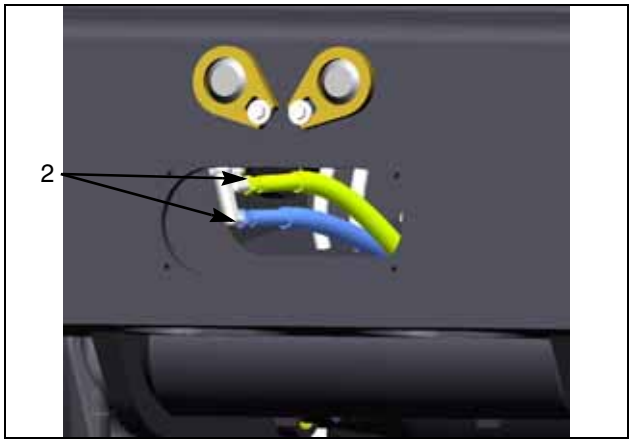
Removal and installation of outrigger assembly

Removal

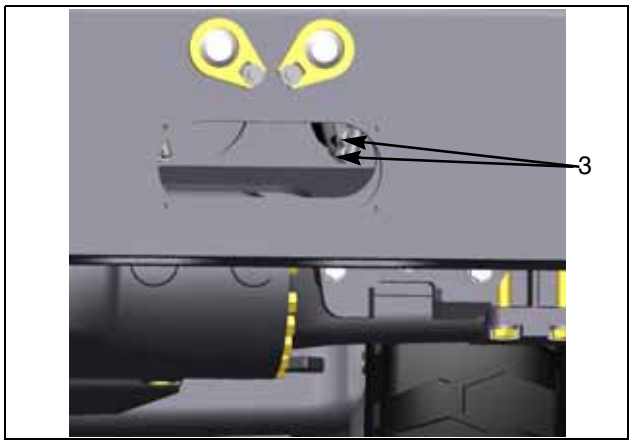
1. Lower outriggers until they just touch the ground but do not take any of the weight of the machine.
2. Turn off engine.
3. Depressurise the outrigger hydraulic circuit.
4. Remove cover (1).



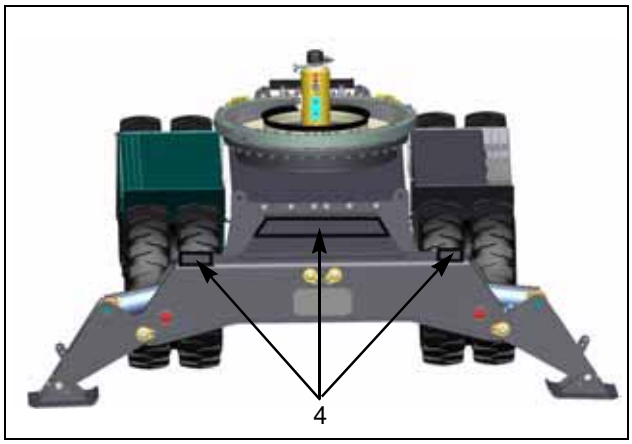
5. Remove 2 pipes (2).



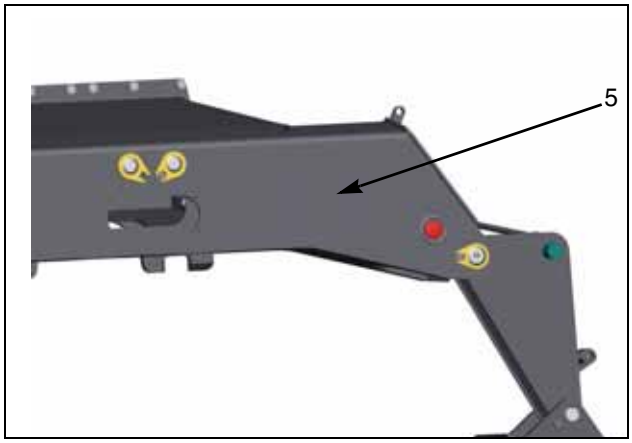
6. Remove 2 pipes (3).



7. Sling outrigger assembly at points marked (4).



8. Remove all bolts (5) and remove outriggers.



Installation

- Install in reverse order of removal.
- Grease all pins and cylinders before installing.

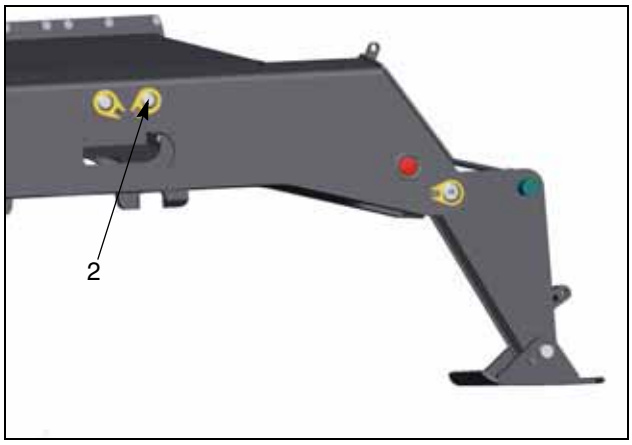
Disassembly and assembly of outriggers

Disassembly

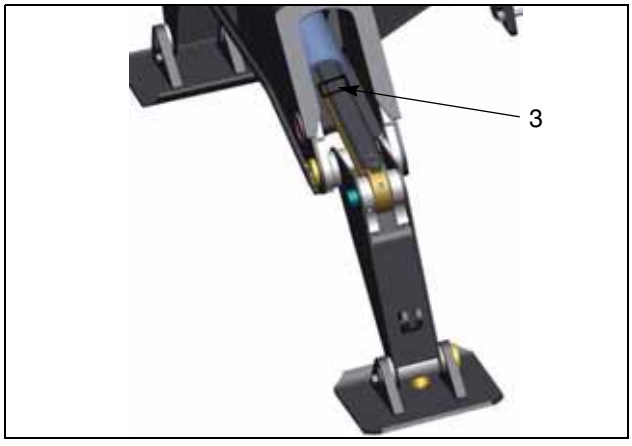
1. Insert plugs into oil connectors to prevent dirt blocking connectors.
2. Insert support block below cylinder at (1).



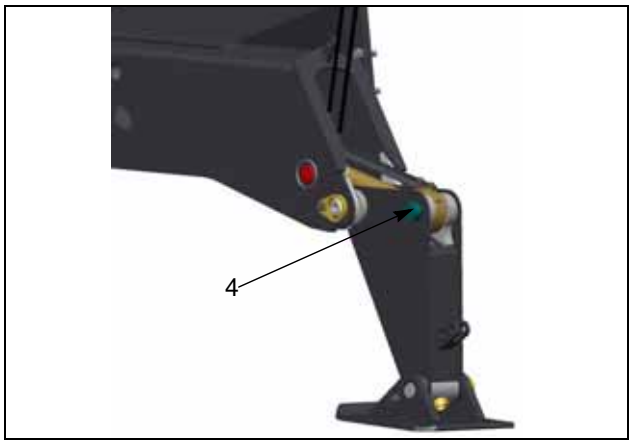
3. Remove pin (2).



4. Attach sling to cylinder at location (3).



5. Remove pin (4).



6. Slowly sling cylinder and remove from outrigger.

Assembly

- Install in reverse order of removal.
- Grease all pins and cylinders before installing.
- Grease bearing points after assembly.

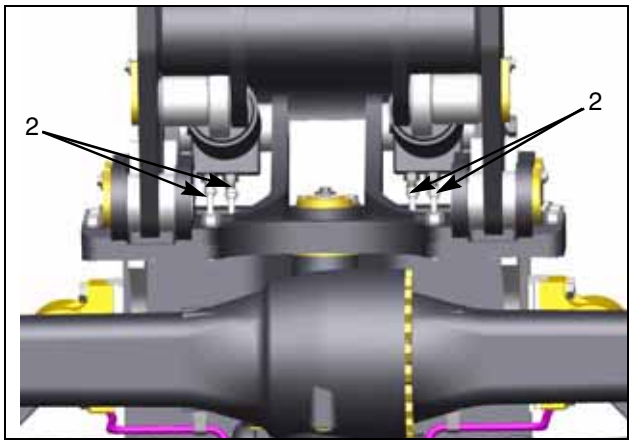
Removal and installation of dozer blade assembly

Removal

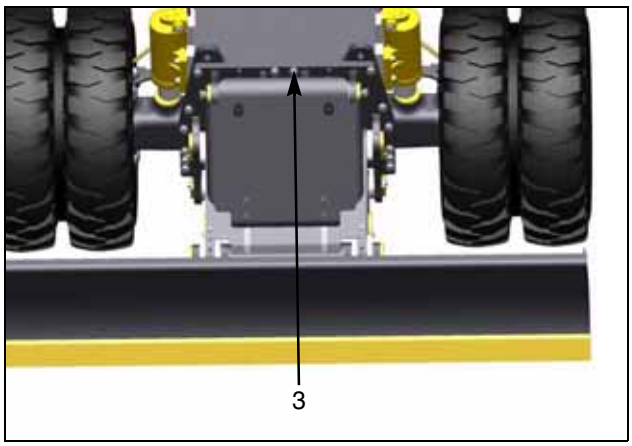
1. Sling at shown points (1).



2. Lower dozer blade until it just touches the ground, but don't take any of the weight of the machine.
3. Turn off engine.
4. Depressurise dozer blade circuit.
5. Remove 4 pipes (2).



6. Attach lifting tackle.
7. Remove bolts (3) and remove dozer blade assembly.



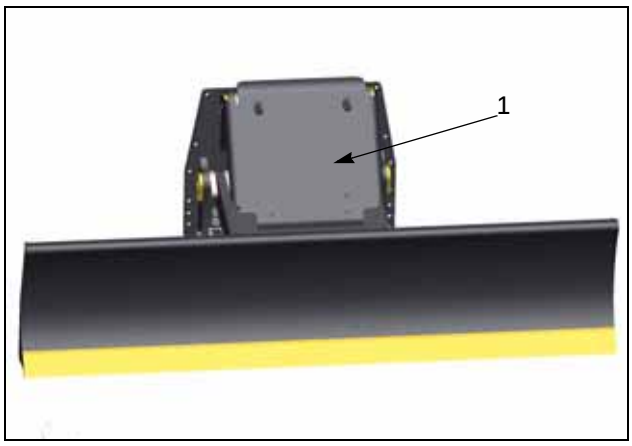
Installation

- Install in reverse order to removal.
- Grease all pins and cylinders.

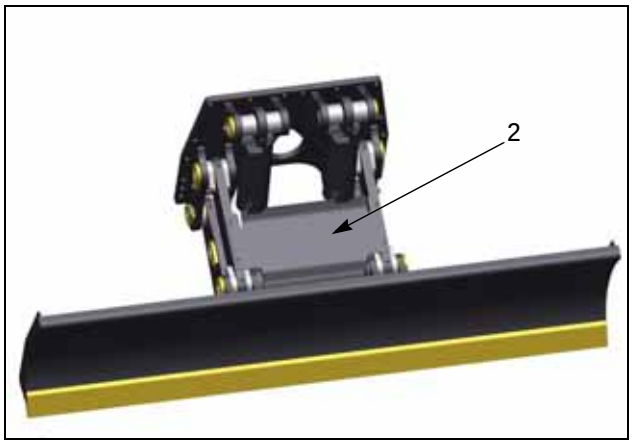
Disassembly and assembly of dozer blade

Disassembly

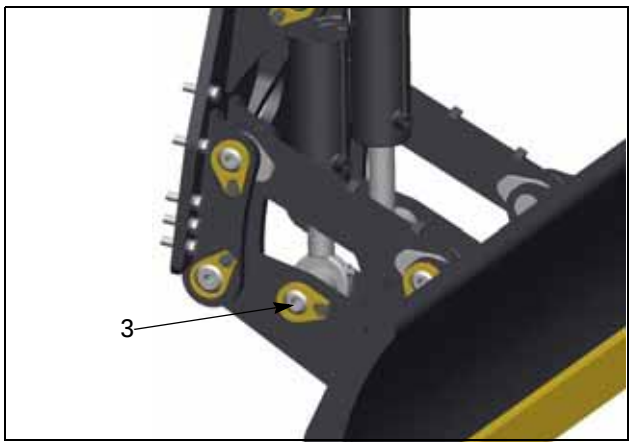
1. Remove plate (1).



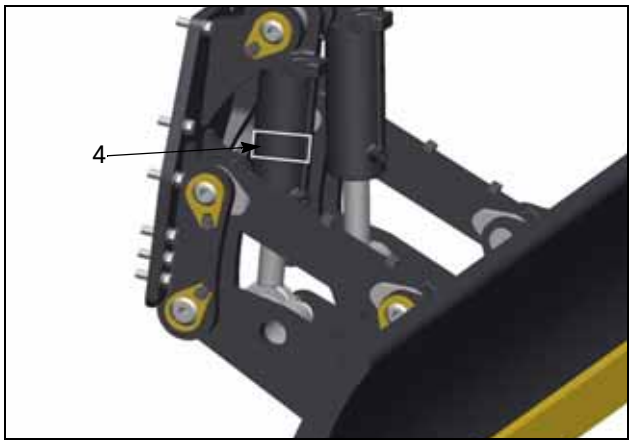
2. Remove plate (2).



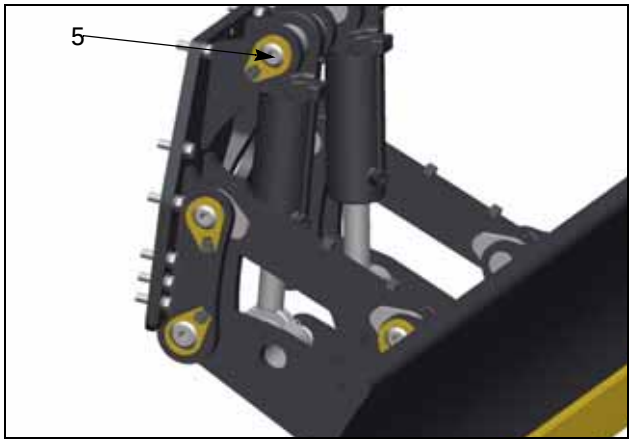
3. Remove pin (3).



4. Attach lifting tackle to cylinder at location (4).



5. Remove pin (5).



6. Slowly sling cylinder and remove from dozer.

Assembly

- Install in reverse order of removal.
- Grease all pins and cylinders before installing.
- Grease bearing points after assembly.

Removal and installation of swing circle assembly

Removal

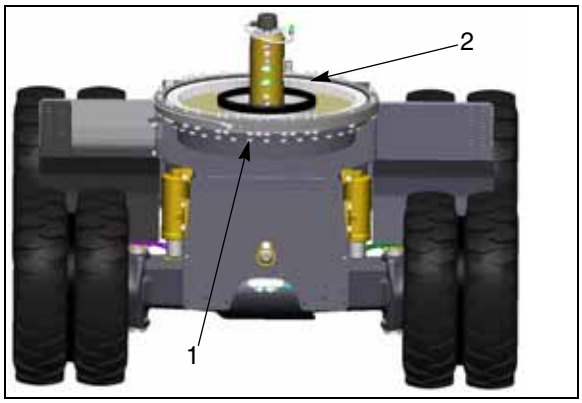
1. Remove revolving frame assembly. For details, see REMOVAL OF REVOLVING FRAME ASSEMBLY.
2. Remove 36 mounting bolts (1) to remove the swing circle assembly.

※1

3. Lift off swing circle assembly (2).

※2

kg Swing circle assembly: **207.3 kg**





Installation

✔ Install in reverse order of removal.

※1

Thread of swing circle mounting bolt: **Thread tightener (LT-2)**

N·m Swing circle mounting bolt:

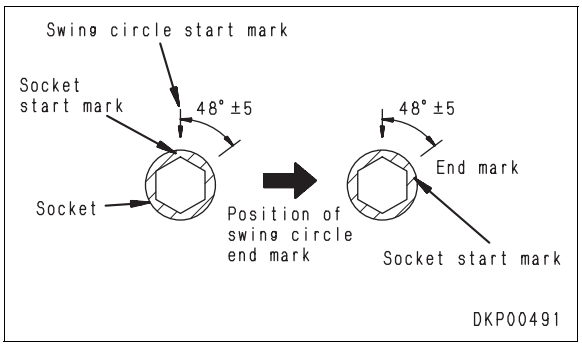
1st pass:

Tighten to 191.2 ± 19.6 Nm

{19.5 ± 2 kgm}

2nd pass:

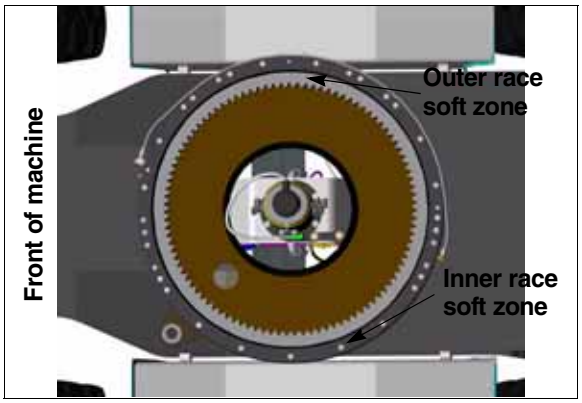
1. Using the angle of the bolt head as the base, make start marks on the swing circle and socket.
2. Make an end mark at a point (on swing circle) 48 ± 5° from the start mark.
3. Tighten so that the start mark on the socket is aligned with the end mark on the swing circle at the 48 ± 5° position.



※2

✔ Set the soft zone **S** mark on the inside ring of the inner race facing the right side as shown in the diagram. Then install to the chassis.

Swing circle: **Grease (G2-L1) 14.6 l**



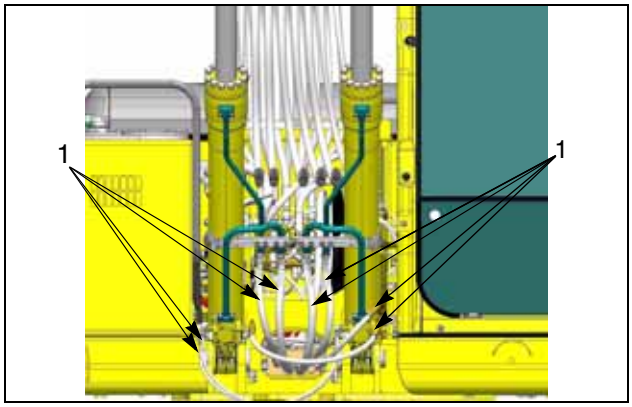
Removal and installation of revolving frame assembly

Removal

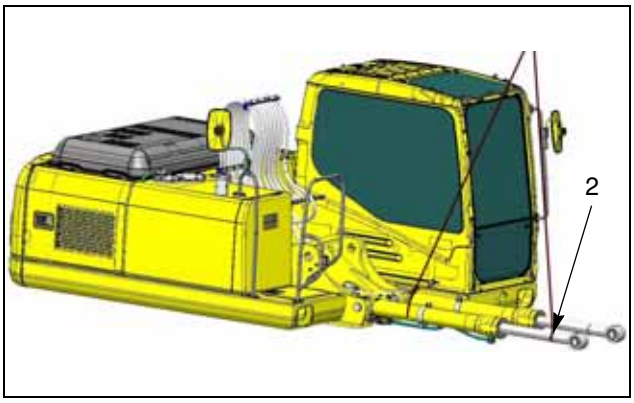
WARNING

Extend the arm and bucket fully, then lower the work equipment to the ground and move the safety lock lever to the LOCK position.

1. Drain oil from hydraulic system.
2. Attach identification tags to the hoses to avoid incorrect connection during re-assembly
3. Remove work equipment assembly so refer to either see “Removal and installation of mono-boom work equipment” on page 30- 250. or see “Removal and installation of 2 piece boom work equipment” on page 30- 254.
4. Remove the counter weight. see “Removal and installation of counterweight” on page 20- 262.
5. Disconnect boom cylinder hoses (1) and plug the hoses to prevent flow of oil.

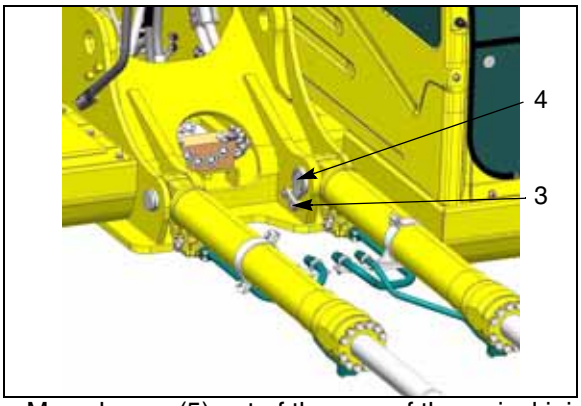


6. Sling boom cylinders (2).

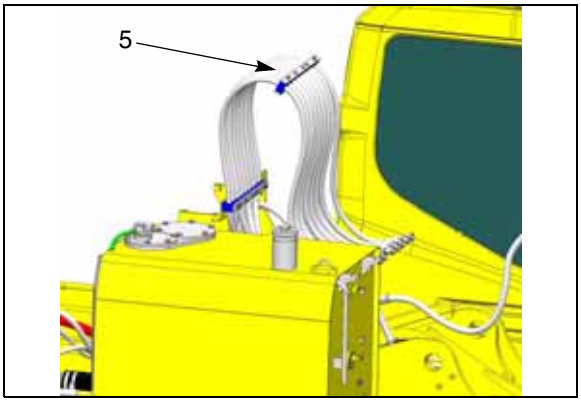


7. Remove plate (3) and pin (4) and lift off boom cylinder assembly (2) to remove it.
   - ✔ Remove the boom cylinder assembly on the opposite side in the same manner.

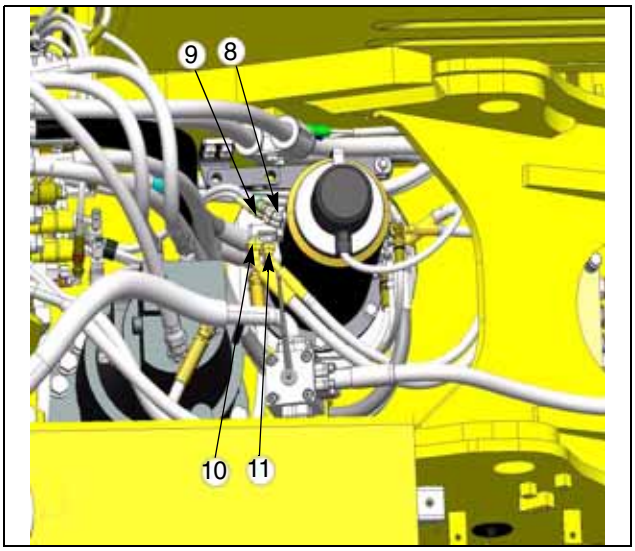
kg Boom cylinder assembly: **180 kg**

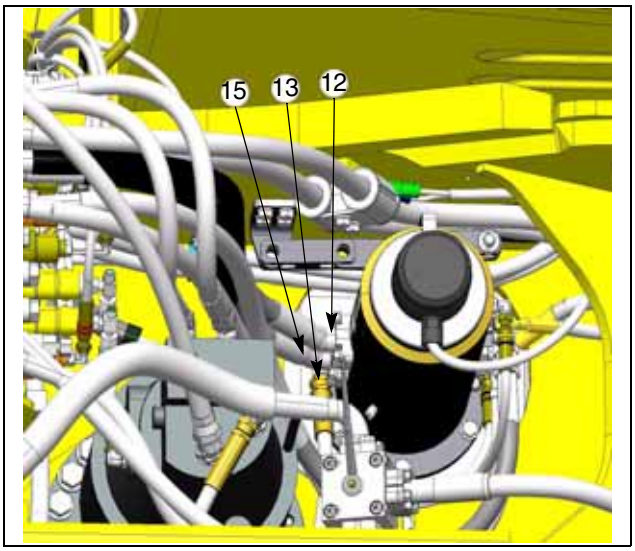


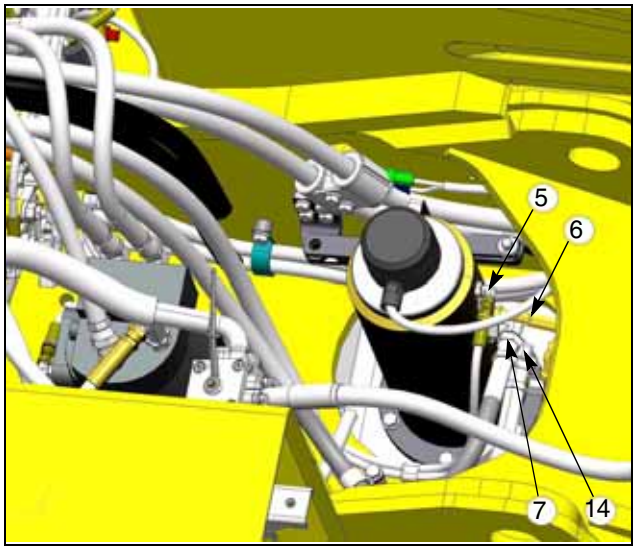
8. Move hoses (5) out of the way of the swivel joint.

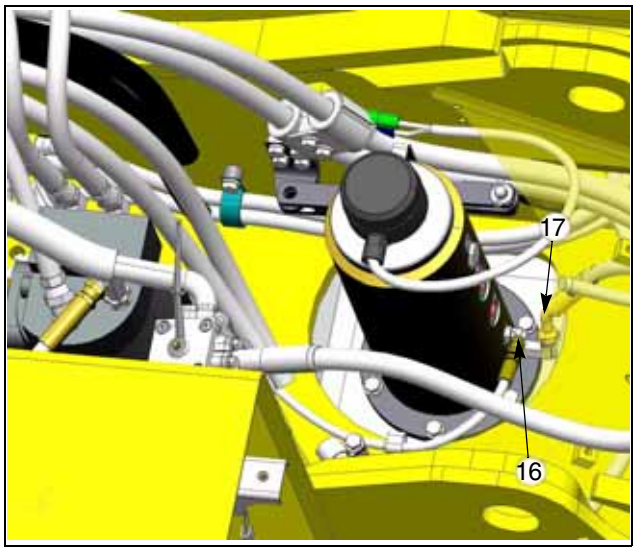


9. Disconnect the 13 hoses on the swivel joint assembly at the swivel joint side.
   (5): Suspension lock
   (6): Brake 2
   (7): Attachment bottom
   (8): 2nd clutch
   (9): 1st clutch
   (10): Steer right
   (11): Brake 1
   (12): Travel B
   (13): Travel A
   (14): Attachment Head
   (15): Drain
   (16): Motor volume pilot
   (17): Steer left

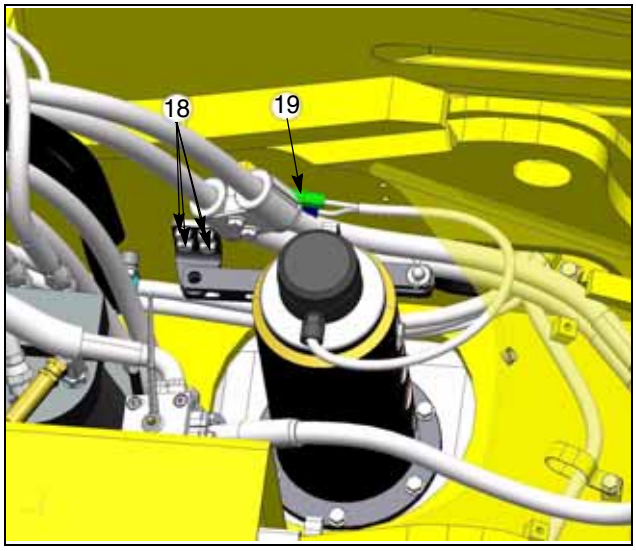








10. Remove 4 bolts (18) from revolving frame.
11. Disconnect connector (19).

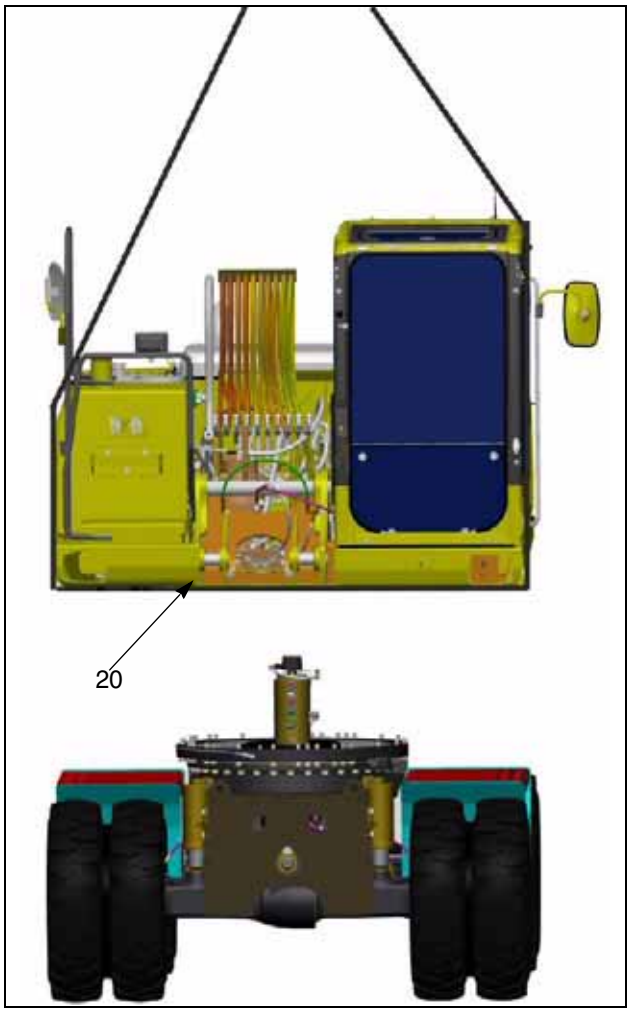


12. Remove the 34 revolving frame mounting bolts and remove revolving frame assembly (20) by lifting it off. ※2

✔ Attain fore and aft balance and right and left balance of the revolving frame assembly without two mounting bolts at the front and rear being removed and using a lever block. Only when the right balance is obtained, remove the remaining two bolts.

⚠ WARNING

When removing the revolving frame assembly, take care so that it does not hit the swivel joint assembly.



kg Revolving frame assembly

	Assembly	Revolving frame only (Reference value)
PW180-7E0	8,226 kg	1,516 kg

Installation

✔ Install in reverse order of removal.

N·m Air intake hose clamp screw:
5.4 - 6.4 Nm (0.55 - 0.65 kgm)

Swivel circle mating surface:
Gasket sealant (LG-1)

Threads of revolving frame mounting bolt:
Adhesive compound (LT-2)

N·m Revolving frame mounting bolt
1st step: **294.2 ± 29.4 Nm (30 ± 3 kgm)**
2nd step: **Retightening by 60° or 588 - 677 Nm (60 - 69 kgm)**

✔ Refilling hydraulic oil
Refill hydraulic oil through the oil filler port to the specified level, and let the oil circulate in the hydraulic system by starting the engine. Then check the level again.

✔ Air bleeding
Bleed air from the travel motor, refer to the Air Bleeding of Various Parts section in the TESTING AND ADJUSTING chapter of this manual.

Removal and installation of centre swivel joint

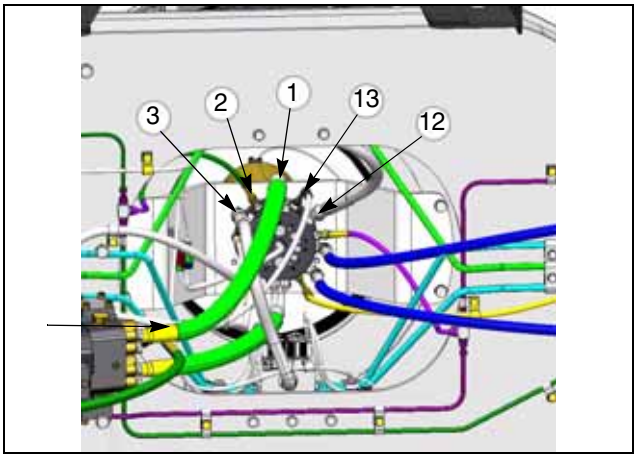
Removal

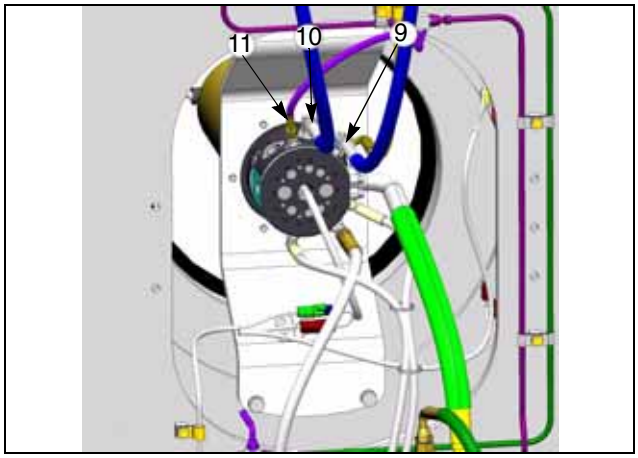
WARNING

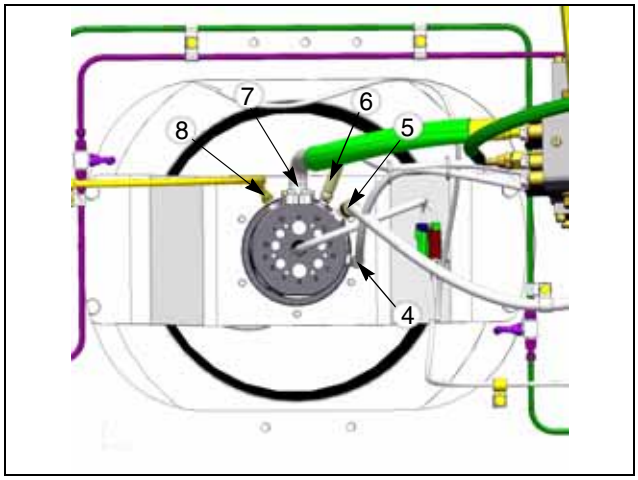
Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, release of remaining pressure in hydraulic circuit.

1. Remove oil from hydraulic tank and drain oil from system.
2. Attach identification tags to the hoses to avoid incorrect connection during re-assembly
3. Disconnect 14 hoses (1) through (13).
   - ✗ When removing hoses mark all hoses with tags to prevent mistakes when installing.

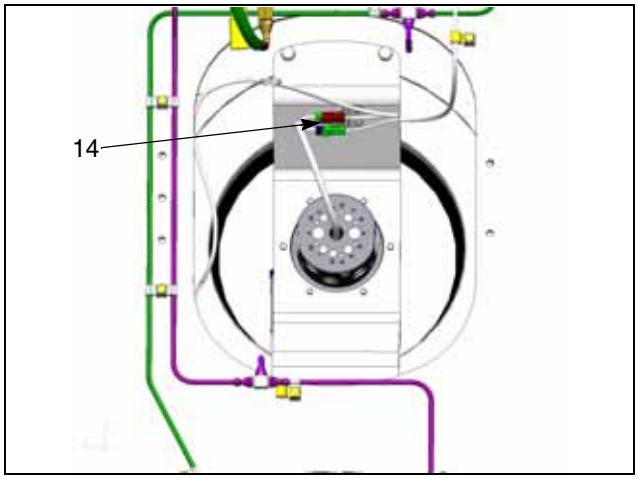
- ✗ (1): Travel B
- ✗ (2): Brake 1
- ✗ (3): Attachment bottom
- ✗ (4): 1st clutch
- ✗ (5): Drain
- ✗ (6): 2nd clutch
- ✗ (7): Travel A
- ✗ (8): Suspension lock
- ✗ (9): Steer left
- ✗ (10): Steer right
- ✗ (11): Brake 2
- ✗ (12): Attachment head
- ✗ (13): Motor volume pilot





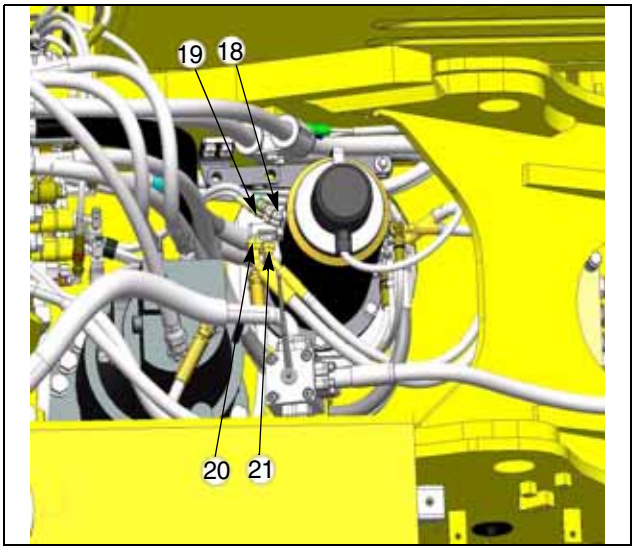


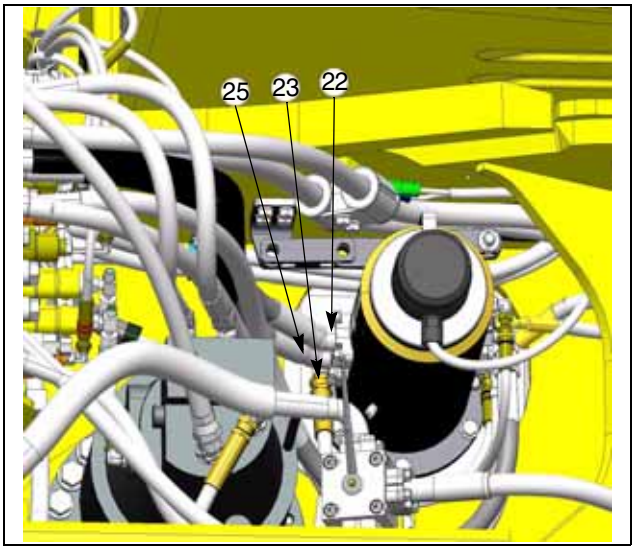
4. Disconnect connector (14)

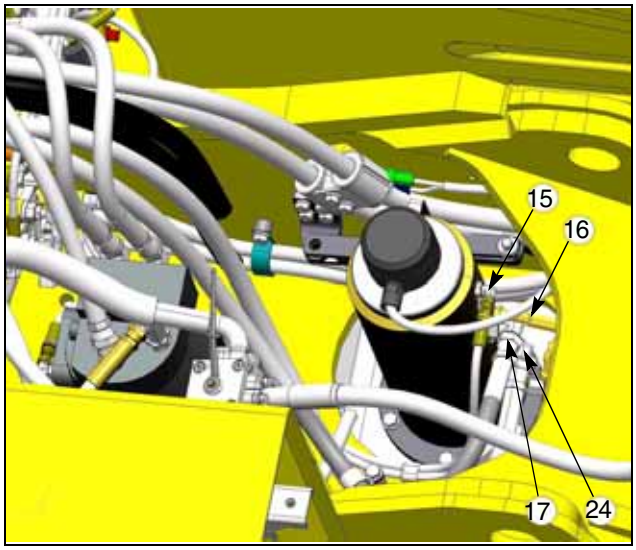


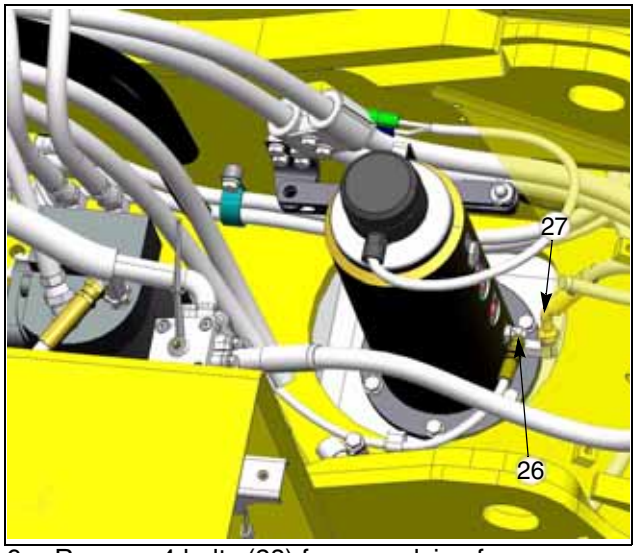
5. Disconnect the 13 hoses on the swivel joint assembly at the swivel joint side.

   (15): Suspension lock
   (16): Brake 2
   (17): Attachment bottom
   (18): 2nd clutch
   (19): 1st clutch
   (20): Steer right
   (21): Brake 1
   (22): Travel B
   (23): Travel A
   (24): Attachment Head
   (25): Drain
   (26): Motor volume pilot
   (27): Steer left

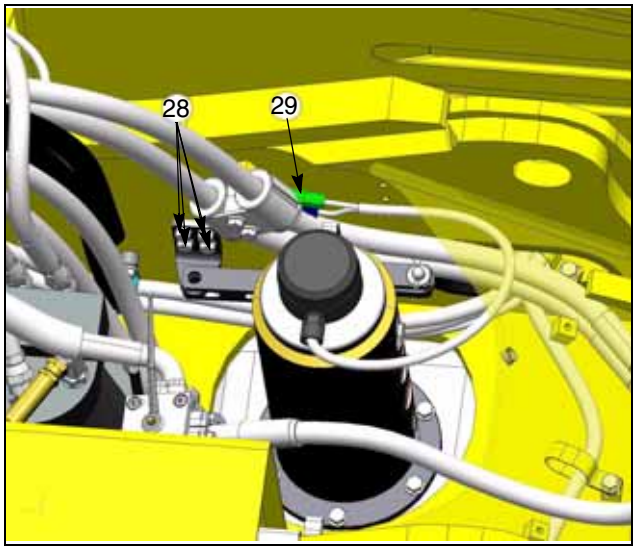




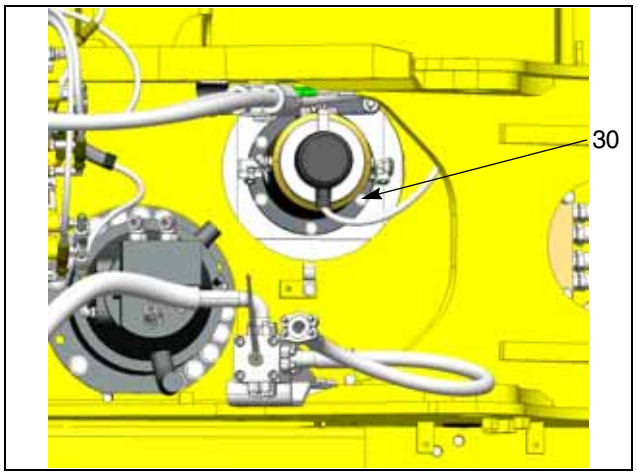




6. Remove 4 bolts (28) from revolving frame.
7. Disconnect connector (29).



8. Remove 4 of the 6 mounting bolts (30).

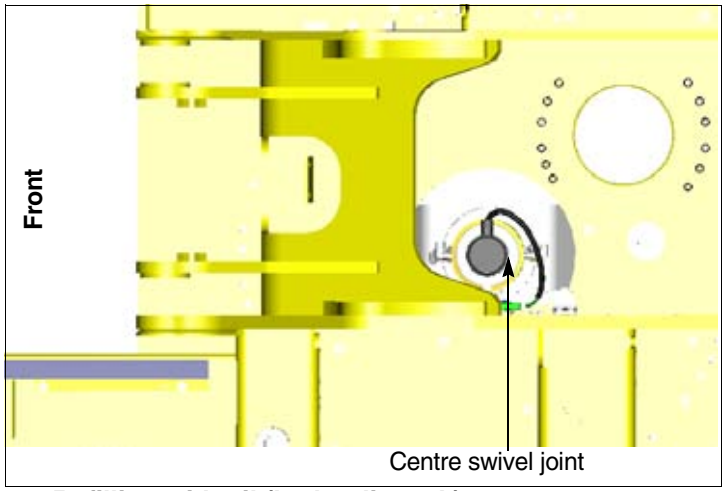


9. Sling centre swivel joint then remove 2 remaining mounting bolts (30) and remove.

kg Center swivel joint assembly: **95 kg**

Installation

✔ Install in reverse order of removal.
Install the center swivel joint facing in the direction shown in the diagram.
(The diagram shows the machine as seen from above)



✔ **Refilling with oil (hydraulic tank)**

✔ Add oil through the oil filter to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

✔ **Bleeding air**

✔ Bleed the air from the travel motor. For details see TESTING AND ADJUSTING, Air Bleeding of Various Parts.

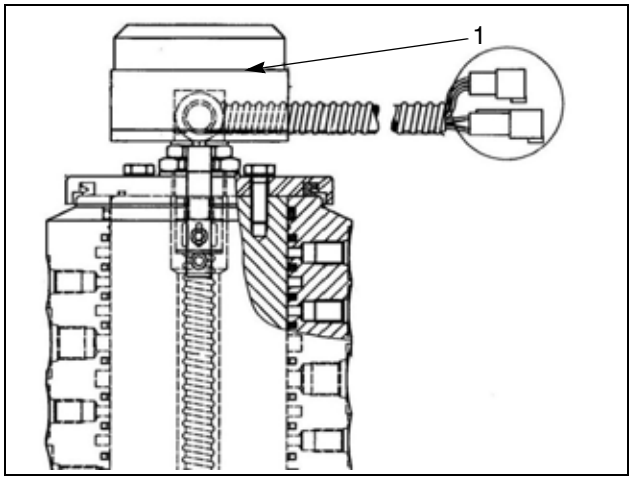
Disassembly and assembly of centre swivel joint assembly

Special tools

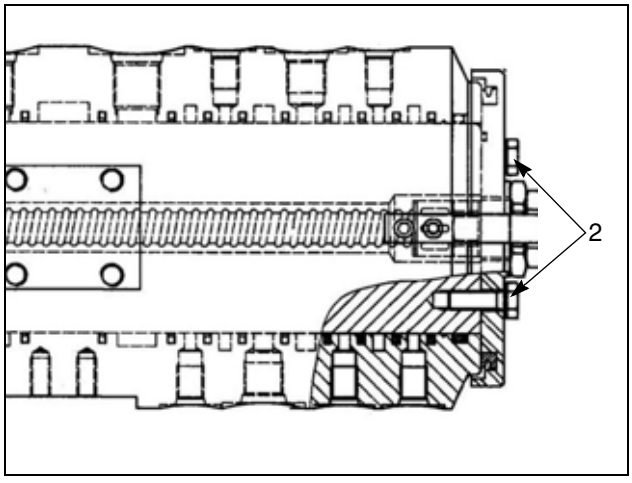
Mark		Part No.	Part Name
E		790-101-2501	Push puller
		• 790-101-2510	• Block
		• 790-101-2520	• Screw
		• 791-112-1180	• Nut
		• 790-101-2540	• Washer
		• 790-101-2630	• Leg
		• 790-101-2570	• Plate
		• 790-101-2560	• Nut
		• 790-101-2650	• Adapter

Disassembly

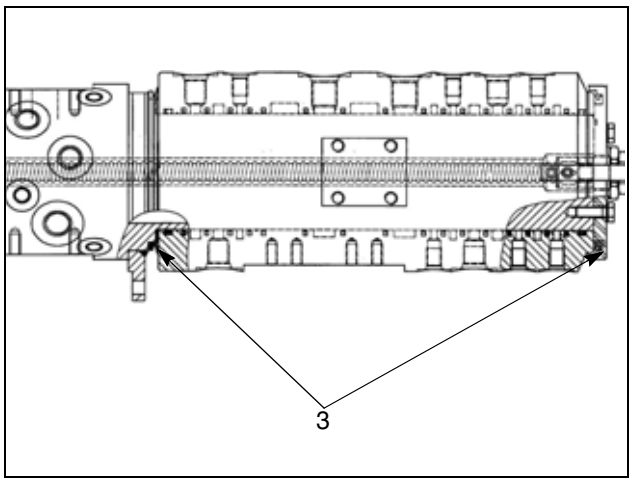
1. Remove the electric slip-ring (1) on the enclosure flange.



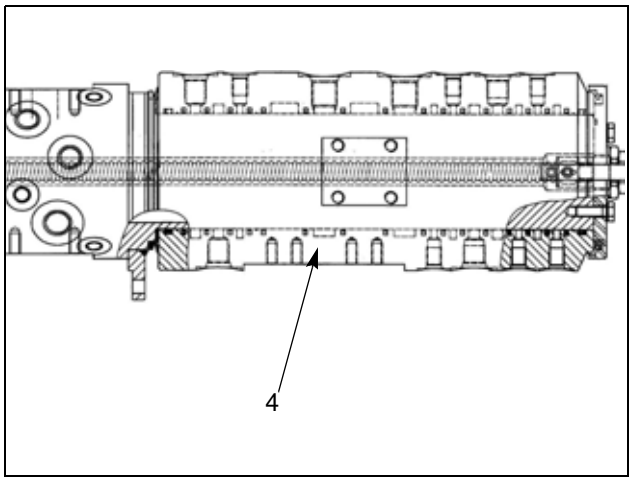
2. Remove all 4 screws (2) TE M10 x 30 on enclosure flange.



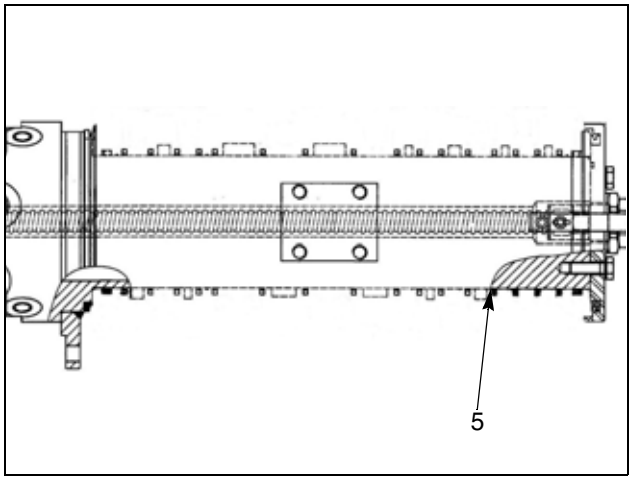
3. Remove the end cover and protection seal (3) VA130.



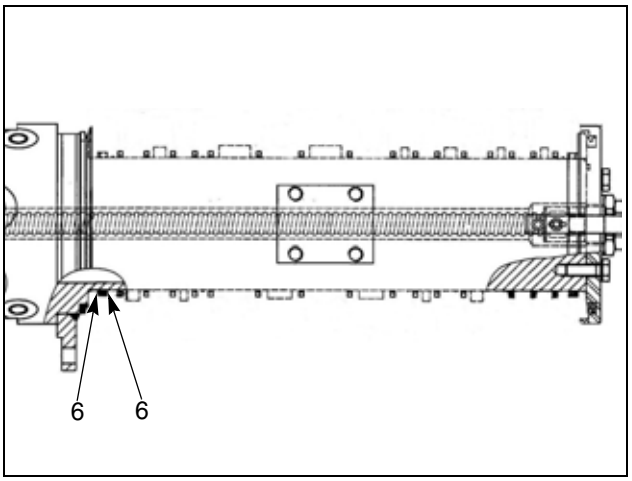
4. Remove housing (4) with appropriate tools.



5. Prevent any possibility of damage on chromium plated surface of spool.
6. Remove all of the wearing (5) seals from the grove of housing.



7. Remove the seals (6) from the end and top grove of housing.



Assembly

- Assemble in reverse order of disassembly.
- Replace any seals that have been removed.

Removal and installation of fuel tank assembly

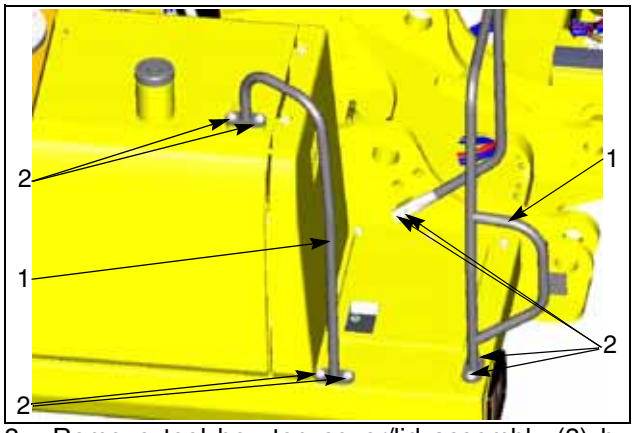
Removal

1. Drain fuel tank.

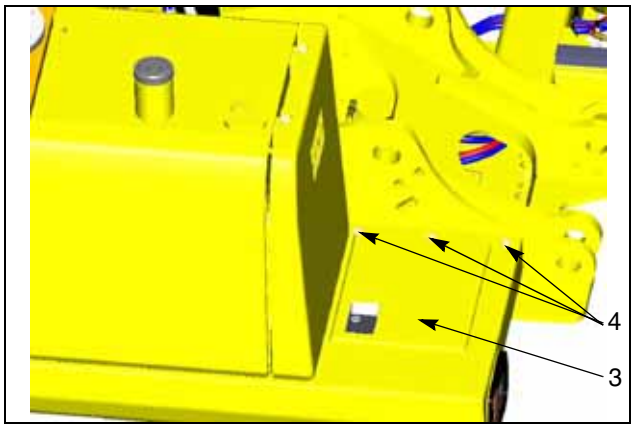
※1

Fuel: **325 l**

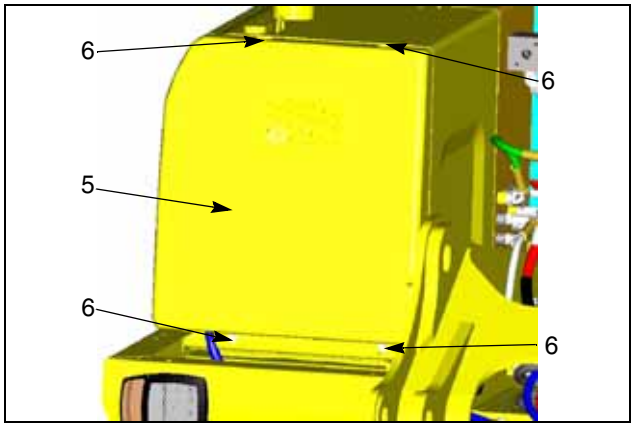
2. Remove handrail (1) by removing 8 bolts (2).



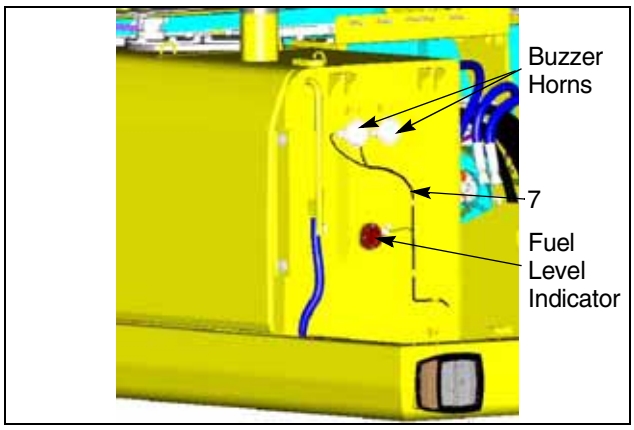
3. Remove tool box top cover/lid assembly (3) by removing 3 bolts (4).



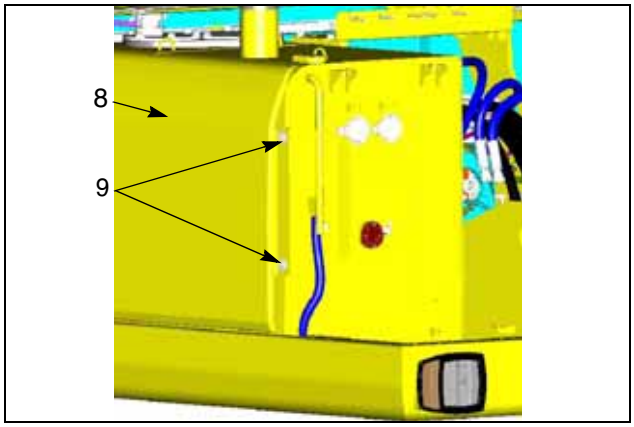
4. Remove front cover (5) by removing 4 bolts (6).

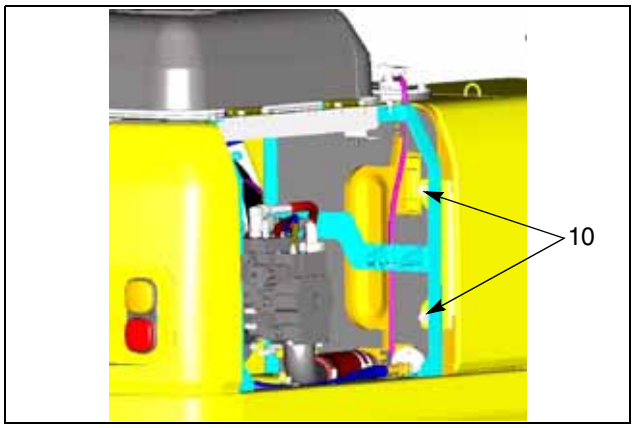


5. Disconnect wiring harness (7) from horn buzzers and fuel level indicator.

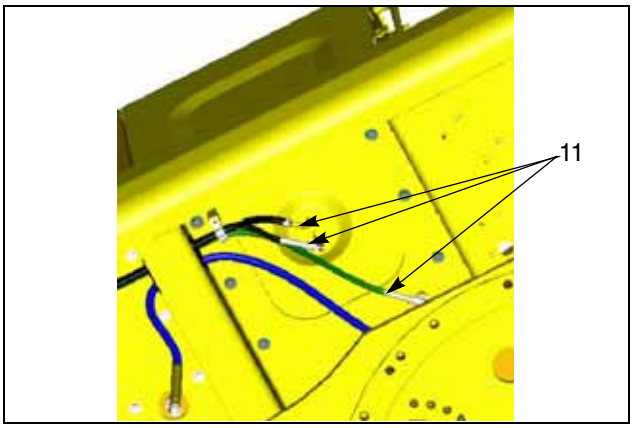


6. Remove tank side cover (8) by removing 4 bolts (9) and (10).

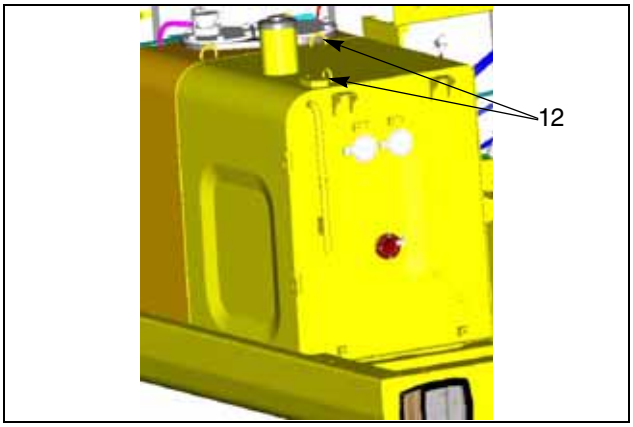




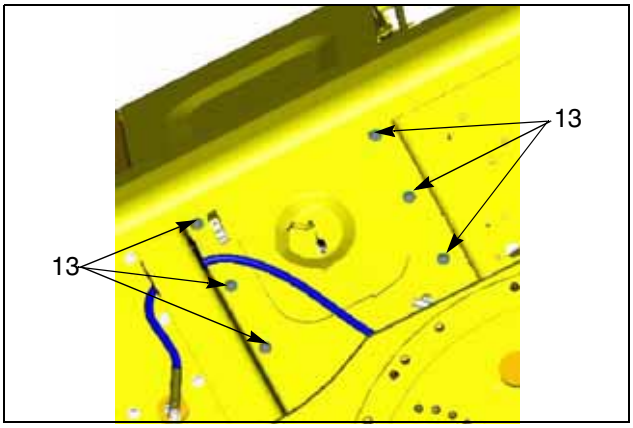
7. Disconnect hoses (11) from fuel tank.



8. Attach lifting hooks to tank at points (12).



9. Loosen 6 mounting bolts (13).



10. Ensure lifting equipment takes the weight of the fuel tank.
11. Once the lifting equipment has taken the weight remove mounting bolts (13).
12. Remove fuel tank.

kg Fuel tank assembly: **120 kg**

Installation

✔ Install in reverse order of removal.

1

N·m Fuel tank drain plug: **58.8 - 78.5 Nm {6.0 - 8.0 kgm}**

✔ **Refilling with fuel tank**

Adding Fuel

✔ Add fuel through the fuel filler to the specified level

Fuel: **325 ℓ**

✔ **Bleeding air**

✔ Bleed the air.
For details, see TESTING AND ADJUSTING. Air Bleeding of Various Parts.

Removal and installation of hydraulic tank assembly

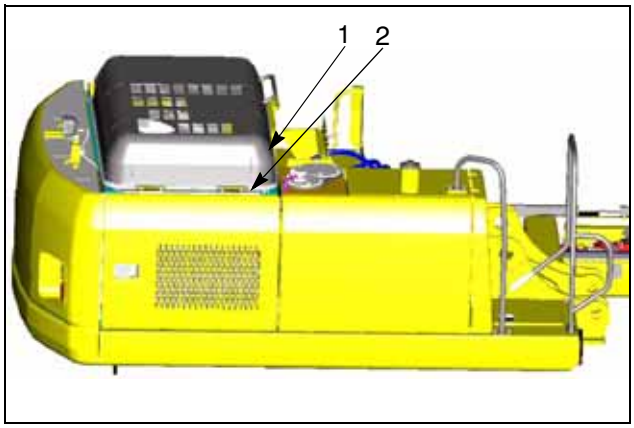
Removal

1. Drain hydraulic tank.

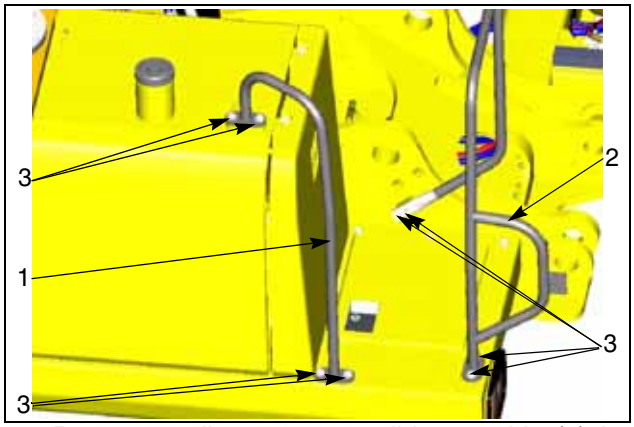
※1

Hydraulic oil: **160 ℓ**

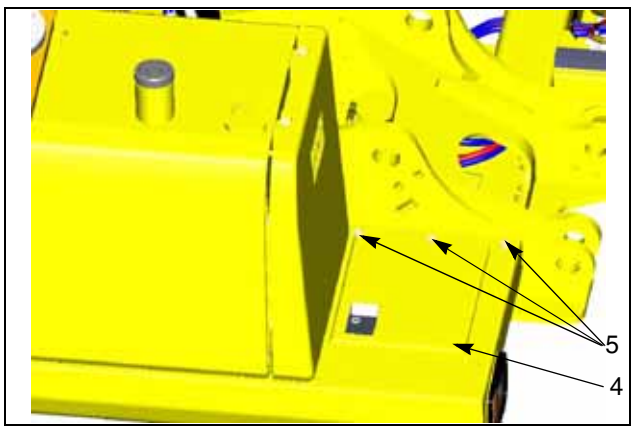
2. Open up the engine hood.
3. Remove engine hood (1) (see page 30-50) and mounting bracket (2).



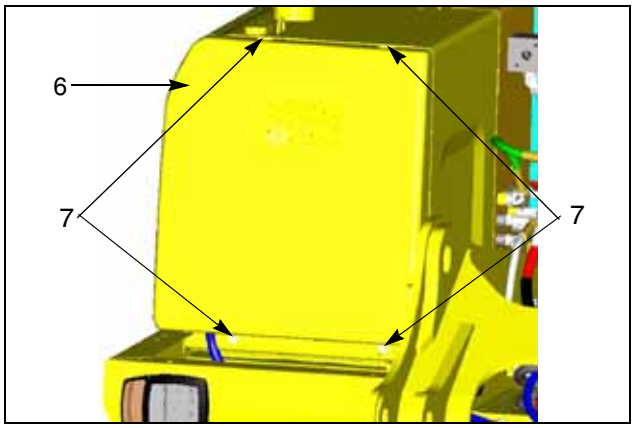
4. Remove handrail (2) by removing 8 bolts (3).



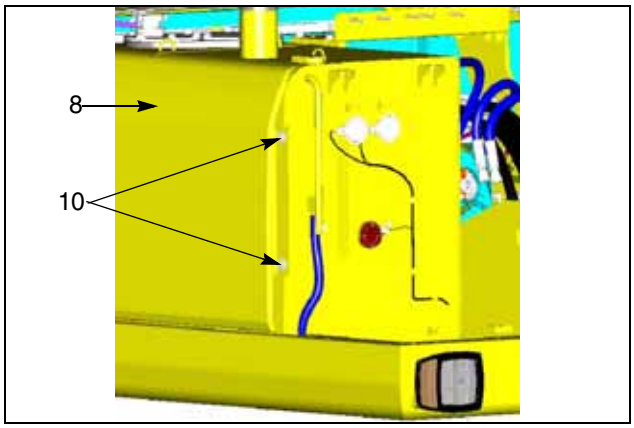
5. Remove toolbox top cover lid assembly (4) by removing 3 bolts (5).

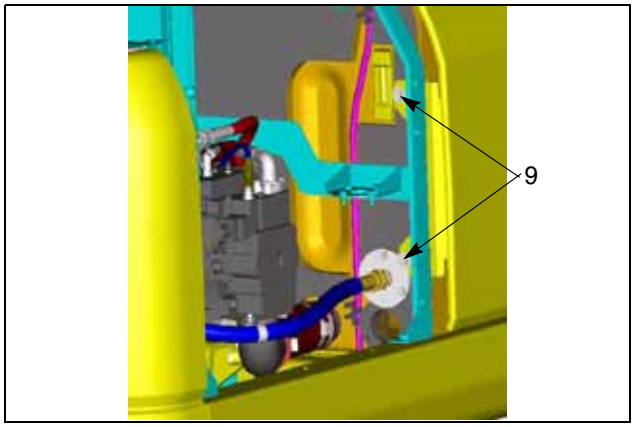


6. Remove front cover (6) by removing 4 bolts (7).

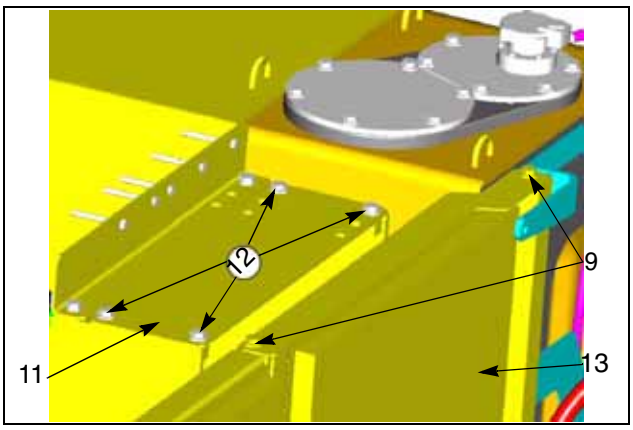


7. Remove tank side cover (8) by removing 4 bolts (9) and (10).

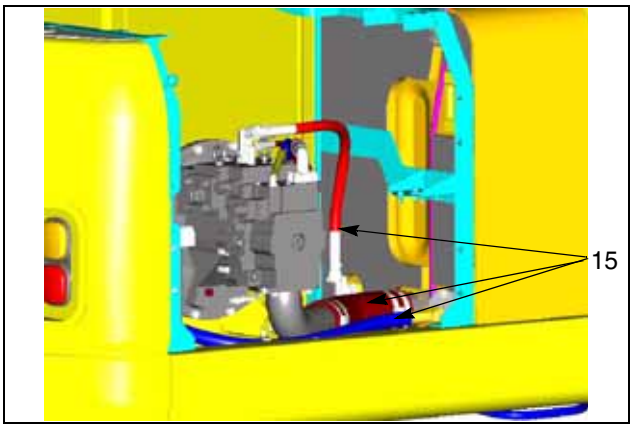




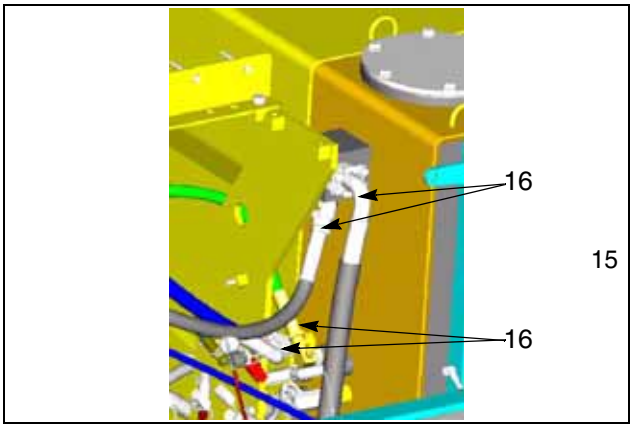
8. Remove main valve cover plate (11) by removing 4 bolts (12).
9. Remove centre partition (13) by removing 2 bolts (14).



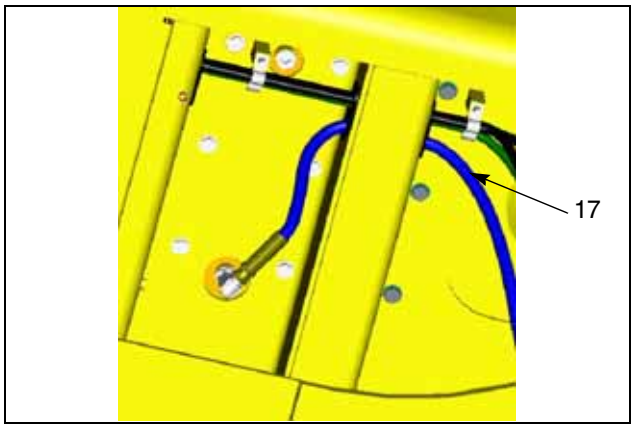
10. Disconnect hydraulic tank hoses (15) from pump compartment. ※2



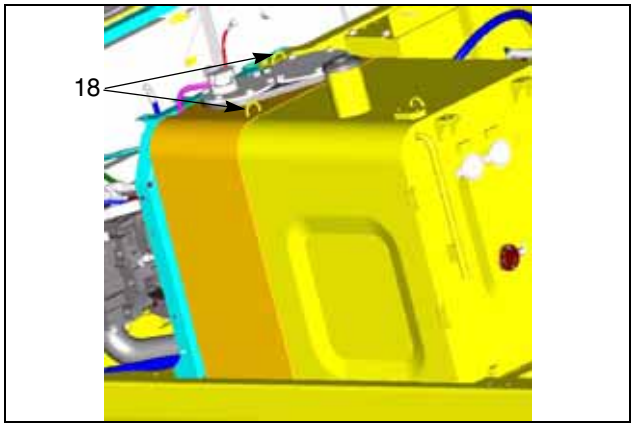
11. Disconnect all hoses (16) on hydraulic main valve side of tank.



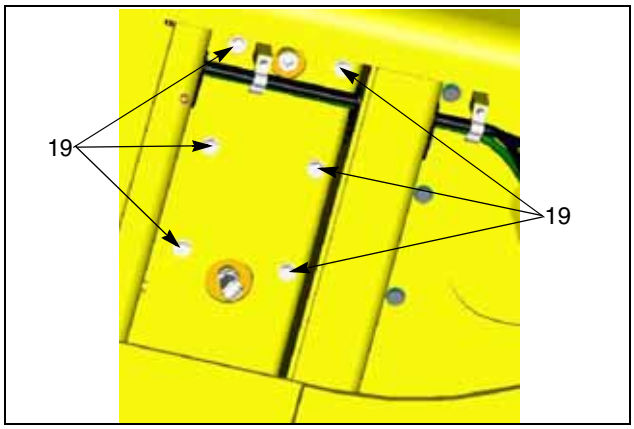
12. Disconnect hose (17) from hydraulic tank.



13. Attach lifting hooks to tank at points (18).



14. Loosen 6 mounting bolts (19). ※1



15. Ensure lifting equipment takes the weight of the hydraulic tank.
16. Once the lifting equipment has taken the weight remove mounting bolts (19).
17. Remove hydraulic tank.

kg Hydraulic tank assembly: **122 kg**

Installation

✔ Install in reverse order of removal.

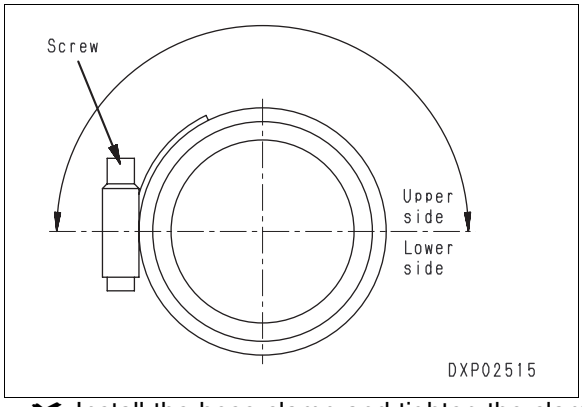
※1

Hydraulic tank drain plug: **58.8 - 78.5 Nm {6.0 - 8.0 kgm}**

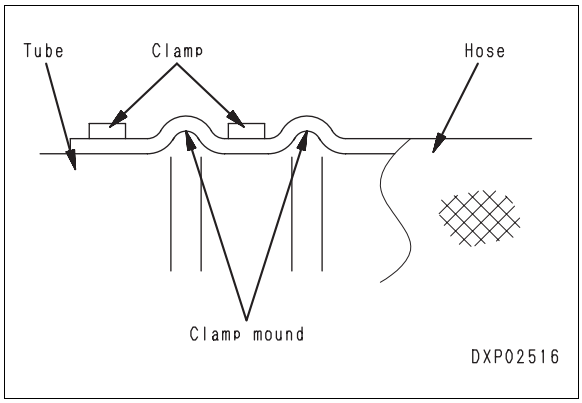
※2

✔ After tightening the suction hose clamp screw, check that the screw is located within the range shown in the diagram.

Hose clamp screw: **8.8 ± 0.5 Nm {90 ± 5 kgm}**



✔ Install the hose clamp and tighten the clamp screw as shown in the diagram below.



✔ **Refilling with hydraulic tank**

Adding oil

✔ Add oil through the oil filler to the specified level.
Run the engine to circulate the oil through the system. Then check the oil level again.l

Hydraulic oil: **160 ℓ**

✔ **Bleeding air**

✔ Bleed the air.
For details, see TESTING AND ADJUSTING. Air Bleeding of Various Parts.

Removal and installation of control valve assembly

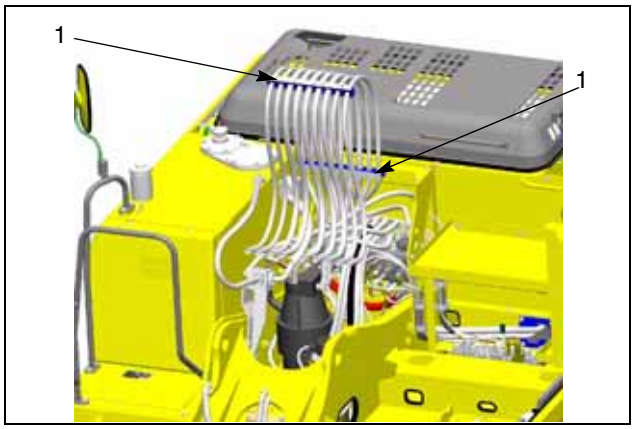
Removal

WARNING

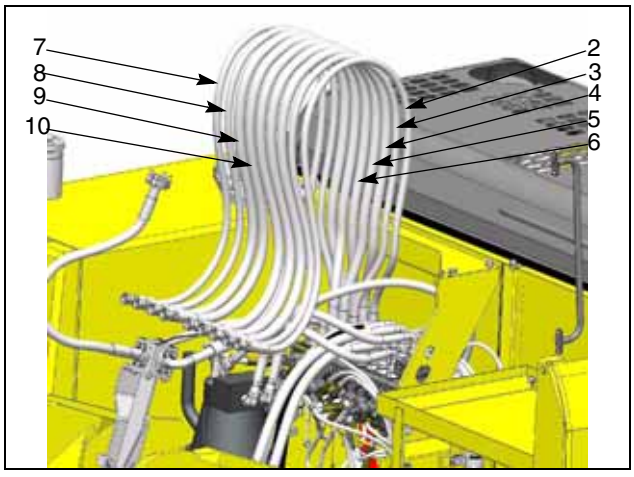
Lower the work equipment to the ground for safety and stop the engine. Unscrew the oil filler cap on the hydraulic tank slowly to release pressure inside the tank. Then move the safety lock lever to the LOCK position.

✔ Remove pressure from all circuits.

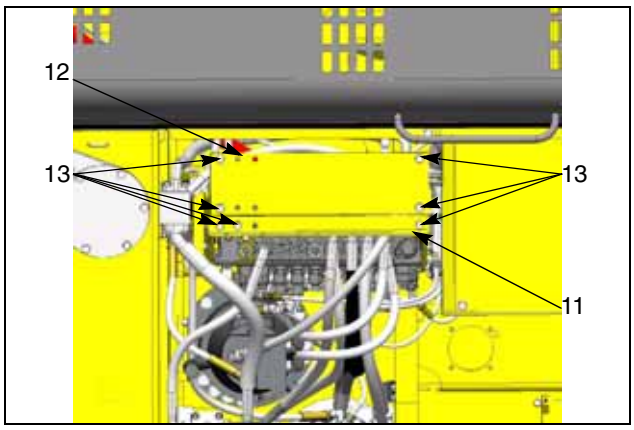
1. Drain oil from the hydraulic tank and then drain oil out of the system.
2. Attach an identification tag to pipe/hose to avoid incorrect connection during re-assembly.
3. Repeat for electrical connections.
4. Remove pipe clamps (1).



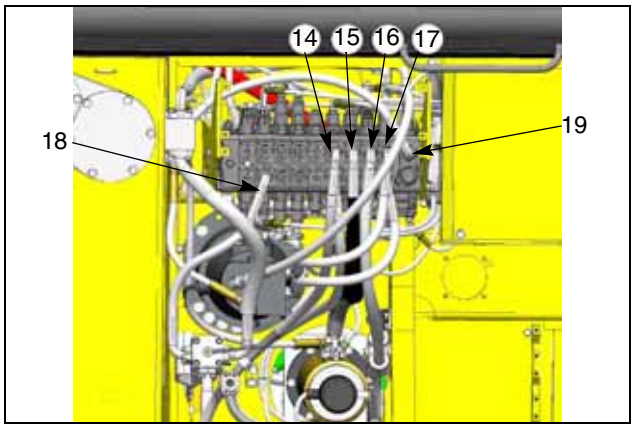
5. Disconnect hoses 2 through 10. (Hoses 2, 3, 7 and 8 are options)



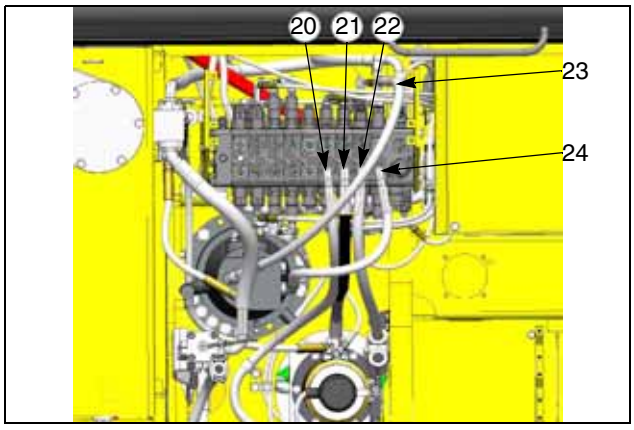
6. Remove 2 plates (11 and 12) by removing 7 bolts (13).



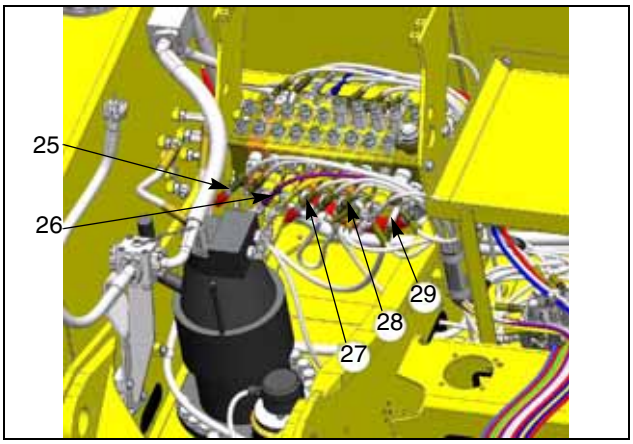
7. Disconnect hoses (14 through 19) from top of control valve.



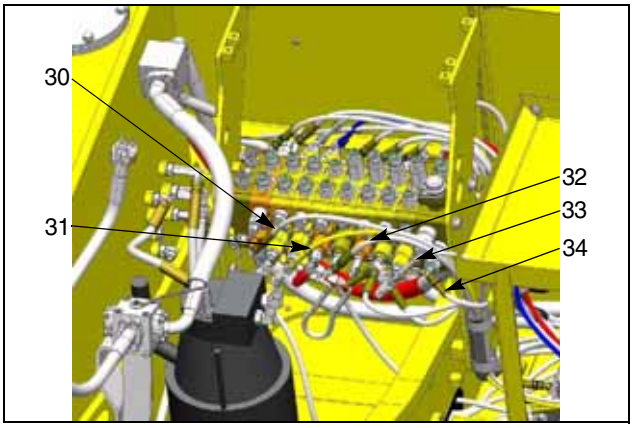
8. Disconnect hoses (20 through 24) from top of control valve.
9. Also disconnect hoses (23 and 24) from swing machinery to aid removal of control valve and improve accessibility.



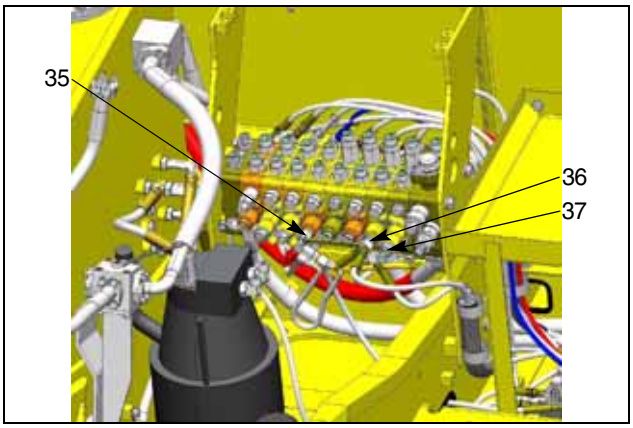
10. Disconnect hoses (25 through 29).



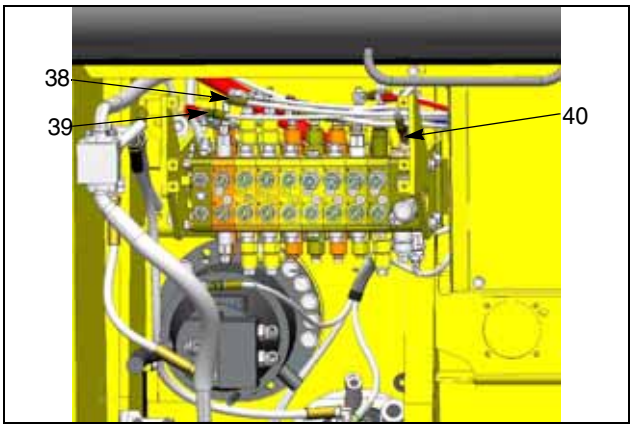
11. Disconnect hoses (30 through 34).



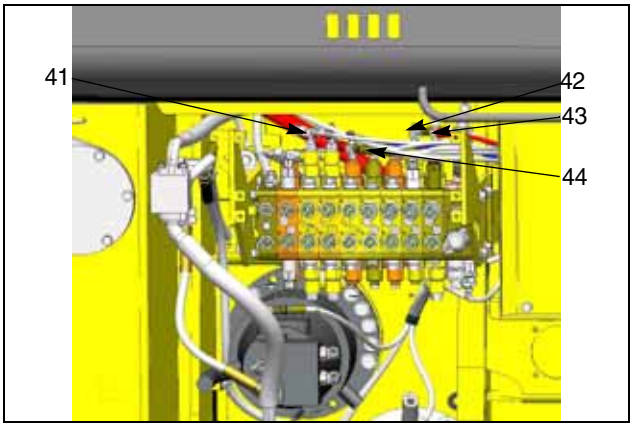
12. Disconnect hoses (35 through 37).



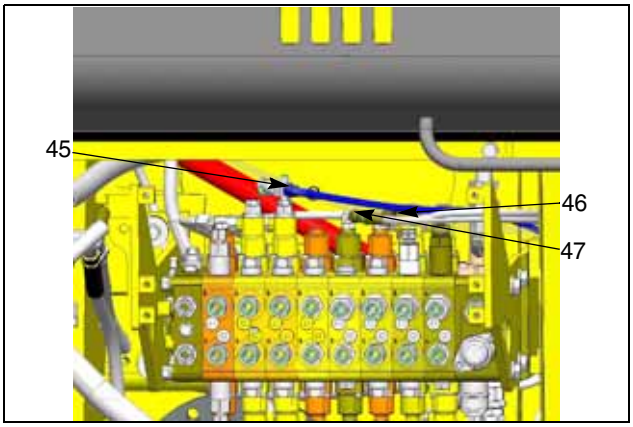
13. Disconnect hoses (38 through 42).



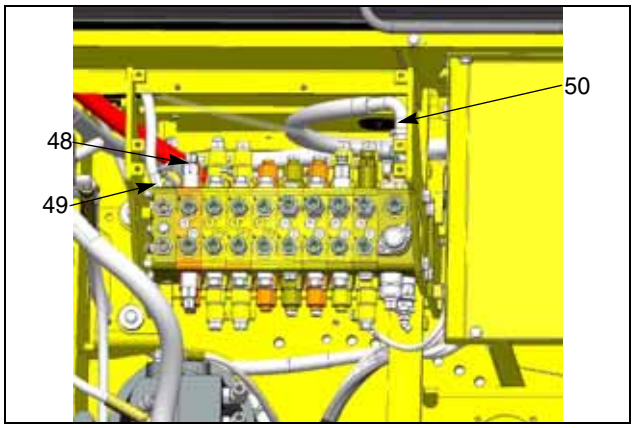
14. Disconnect hoses (41 through 44).



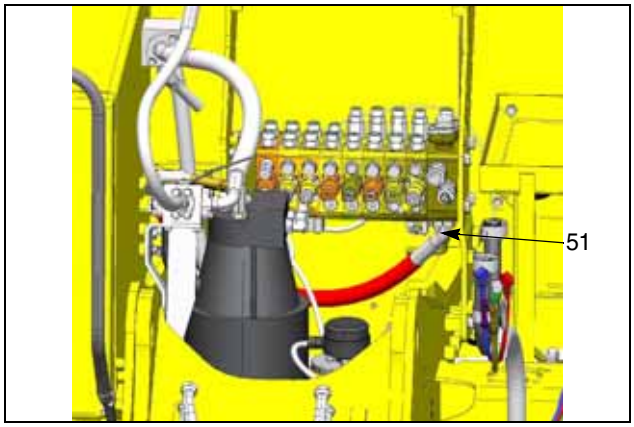
15. Disconnect hoses (45 through 47).



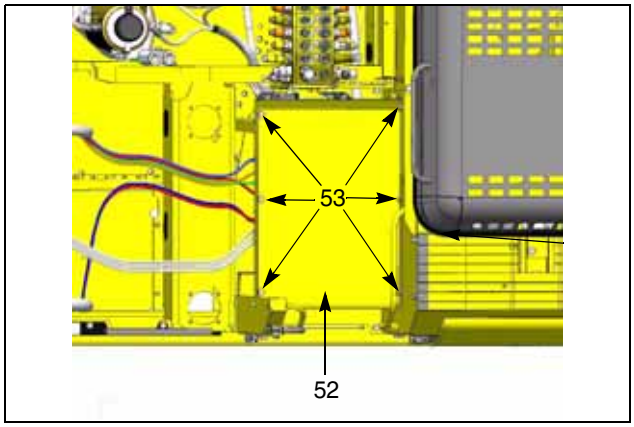
16. Disconnect hoses (48 through 50).



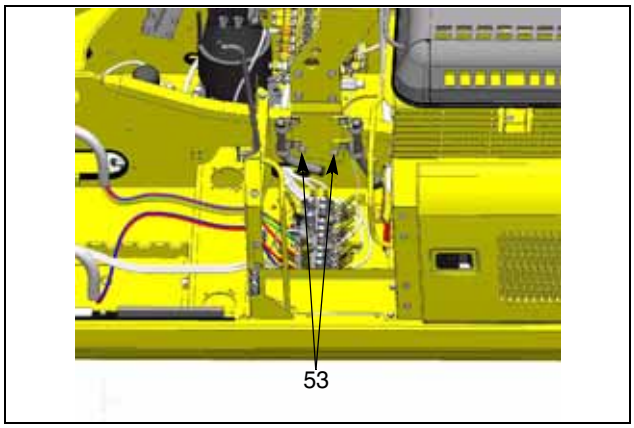
17. Disconnect hose (51).

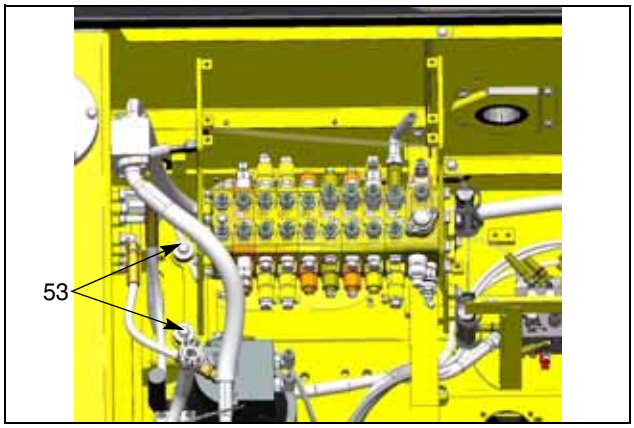


18. Remove the step (52) by removing 6 bolts (53).

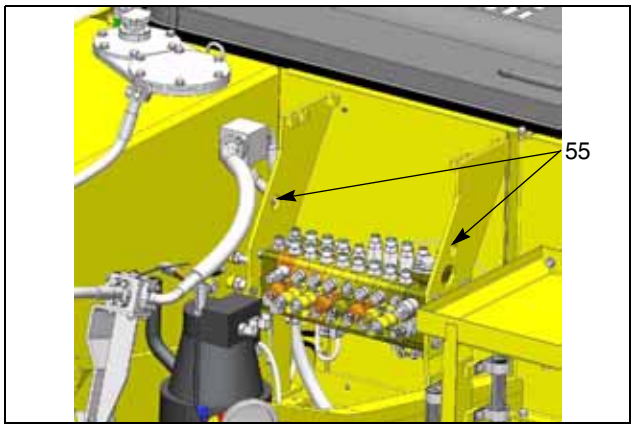


19. Loosen off mounting bolts (54).



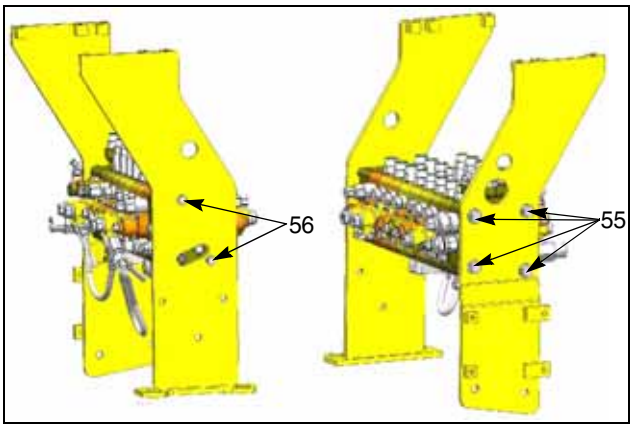


20. Sling bracket assembly by points (55) and take the weight of the assembly.



21. Remove mounting bolts (54)
22. Remove control valve.

23. To remove the control valve from bracket remove bolts (55 and 56).



kg Control valve assembly with bracket: **154kg**
Control valve assembly: **117 kg**

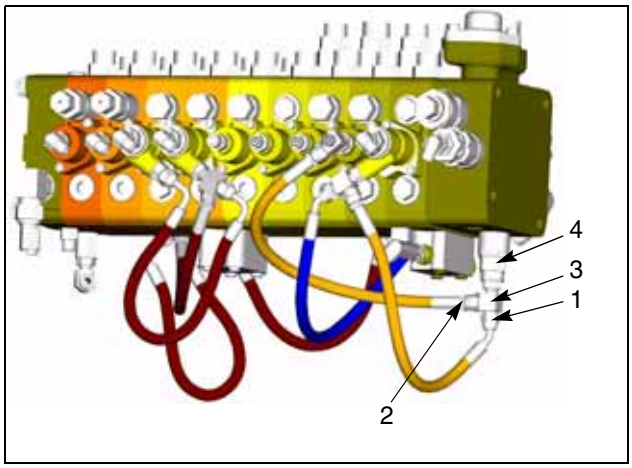
Installation

- Install in reverse order of removal.
- **Refilling with oil (hydraulic tank)**
  - Add oil through the oil filler to the specified level.
    Run the engine to circulate the oil through the system. Then check the oil level again.
- **Bleeding air**
  - Bleed the air from the circuit between the valve and the hydraulic cylinder.
    For details, see TESTING AND ADJUSTING, Air Bleeding of Various Parts.

Removal and installation of LS separation valve assembly

Removal

1. Remove hoses (1 and 2).
2. Remove Tee piece (3) if required.
3. Remove LS separation valve (4) from control valve.



Installation

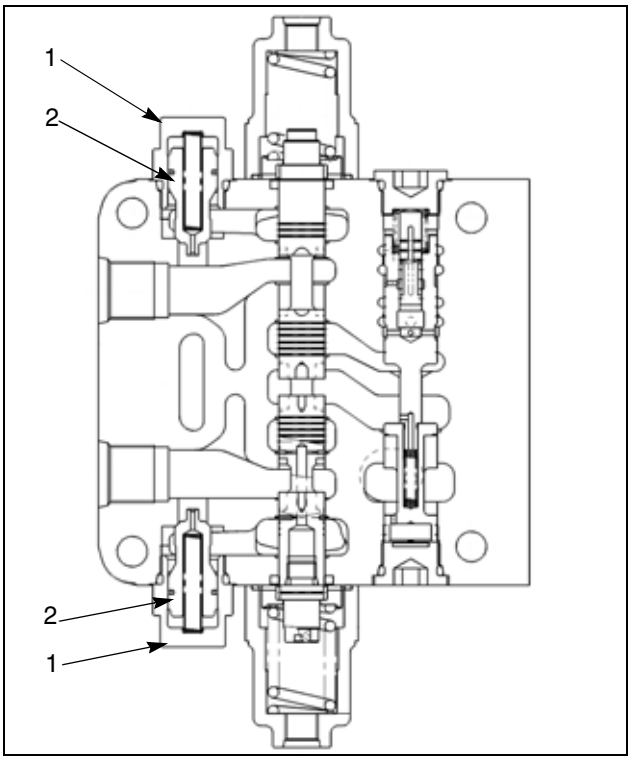
✔ Install in reverse order of removal.

N·m LS separation valve (4): **108 - 147 Nm**

Removal and installation of pressure compensation valve assembly

Removal

1. Remove any hoses that interfere with the removal of pressure compensation valve.
2. Remove cap (1).
3. Remove pressure compensation valve (2).



Installation

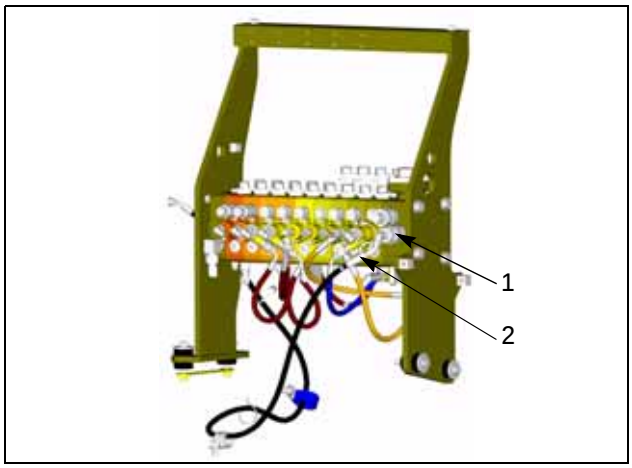
✔ Install in reverse order of removal.

N·m Cap (1): **137 - 157Nm**

Removal and installation of main relief valve assembly

Removal

1. Remove hose (2).
2. Remove main relief valve (1).



Installation

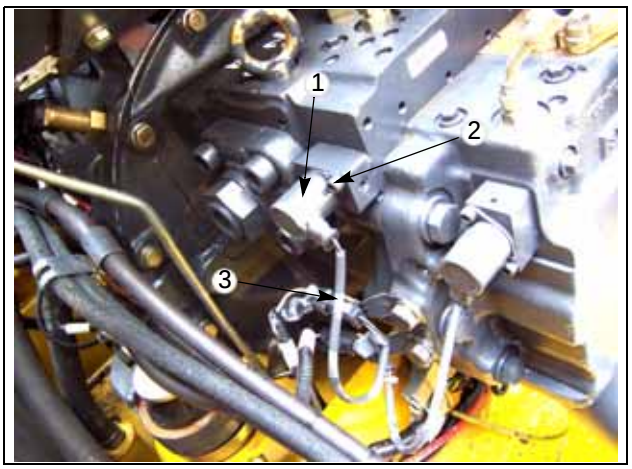
✔ Install in reverse order to removal.

N·m Main relief valve (1): **88.3 - 107.9Nm**

Removal and installation of LS control EPC valve

Removal

1. Remove bolts (1). (2 off).
2. Carefully remove LS control EPC valve (2), do not bend or pull harness (3) with more than 4.9N.



Installation

✔ Install in reverse order of removal.

N·m LS control EPC valve bolts (1): **11.8 - 14.7 Nm**

Removal and installation of EPC solenoid valve assembly

Removal

1. Remove bolts (1).
2. Carefully remove EPC solenoid valve (2), do not bend or pull harness (3) with more than 4.9N.



Installation

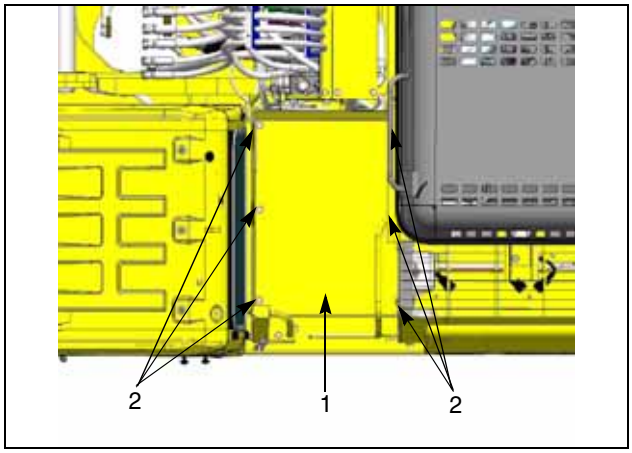
✔ Install in reverse order of removal.

N·m EPC solenoid valve bolts (1): **11.8 - 14.7 Nm**

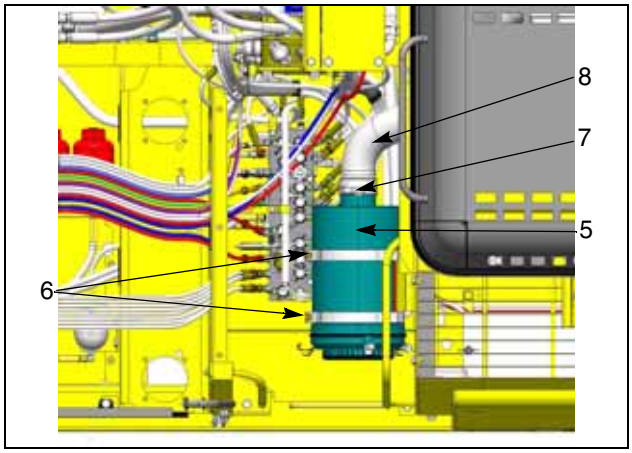
Removal and installation of PPC solenoid valve block assembly

Removal

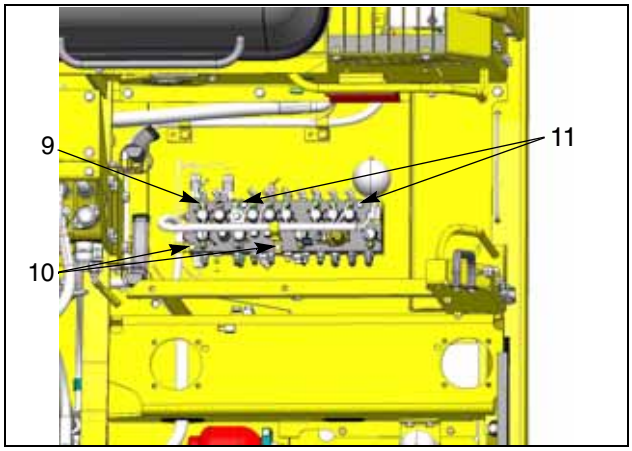
1. Remove step (1), by removing 6 bolts (2) and lifting step out.



2. Attach an identification tag to hoses and electrical connections to avoid incorrect connection during re-assembly.
3. Removal of the air cleaner (5), by slackening clips (6 and 7) and disconnecting hose (8). Disconnect electrical connection from the underside air cleaner.



4. Remove all hoses from the solenoid valve.
5. Disconnect electrical connectors (9) from solenoid valve then remove bolts (10).
6. Ensure all hoses and electrical connectors have identification tags attached to them to avoid incorrect connection during re-assembly.
7. Remove 2 securing bolts (11).



8. Lift out solenoid assembly.

kg Solenoid Valve: **22.5kg**

Installation

✔ Install in reverse order of removal.



Solenoid mounting bolts (10) and (11):
59 - 74Nm (6 - 7.5 Kgm)

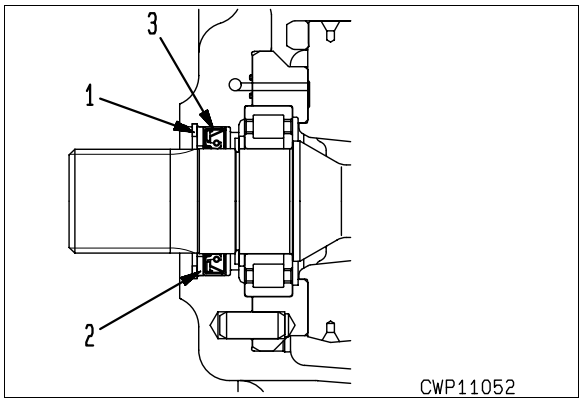
Removal and installation of oil seal in hydraulic pump input shaft

Special tools

Mark	Part No.	Part Name
N	790-201-2000	Push tool
	790-201-2740	Spacer

Removal

1. Remove the hydraulic pump assembly. Refer to see “Removal and installation of engine and hydraulic pump assemblies” on page 30- 50.
2. Remove snap ring (1) and then remove spacer (2).
3. Pry off oil seal (3) with a screwdriver. ※1
   - ✔ When attempting to pry off the seal, do not damage the shaft.



Installation

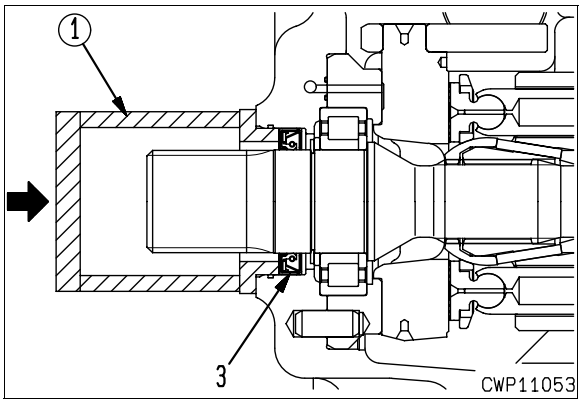
✔ Install in reverse order of removal.

※1

Oil seal lip portion: **Grease (G2-LI)**

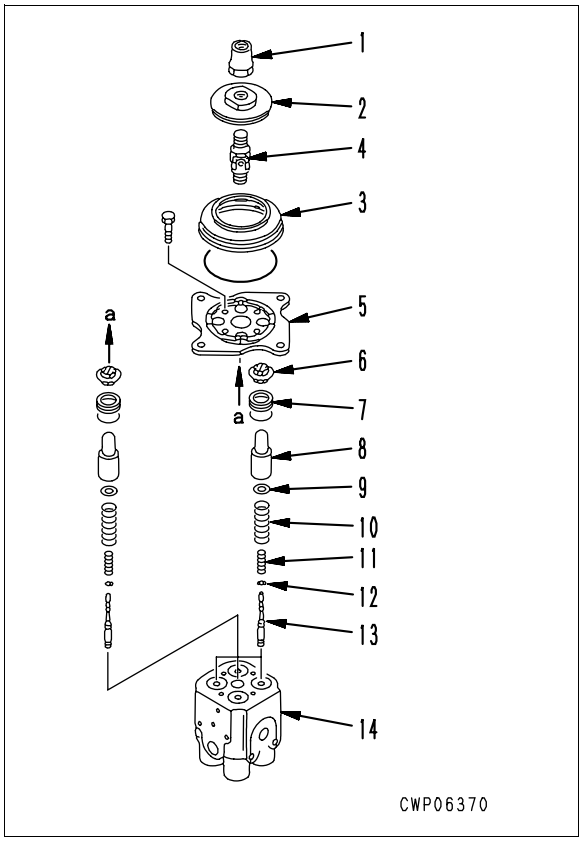
Oil seal outer circumference: **Grease (G2-LI)**

- ✔ Coat the oil seal outer circumference thinly with grease.
- ✔ Press-fit oil seal (3), using tool **N**.



Disassembly and assembly of work equipment PPC valve

✔ This section deals with only precautions to be followed when reassembling the PPC valve assembly for work equipment.



Assembly

✔ Reassembling work equipment PPC valve reassembly

✔ Install spring (11) so that the end surface of smaller end coil diameter (inner diameter) will face the shim (12) side.

✔ Springs (10) in use differ in the number of turns according to hydraulic ports as classified in the table below. Hence take care when installing one.

Port location	Spring free length
P1, P2	44.4 mm
P3, P4	42.4 mm

✔ The location of each port is stamped in the lower part of the valve body.

Piston (8): **Grease (G2-LI)**

✔ When assembling piston (8), coat the piston outer periphery and body hole inner periphery with grease.

N·m Plate (5) mounting bolt:
11.8 - 14.7 Nm (1.2 -1.5 kgm)

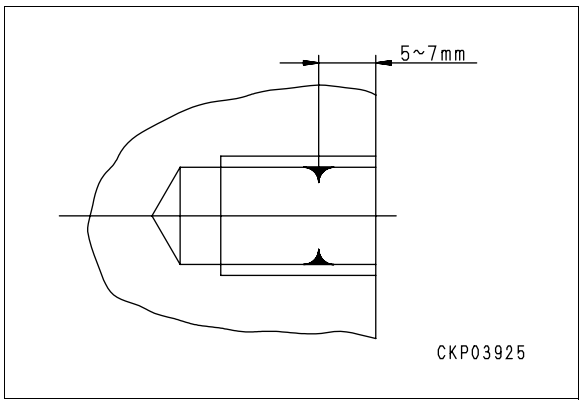
Joint (4) sliding surface:
Grease 2 - 4 cc (G2-LI)

Body female screw portion:
Adhesive compound (LT-2)

✔ Coat the female screw body with Loctite® at two spots as shown in the diagram below. Each spot is to be coated with a drop (approx. 0.02 g).

N·m Joint (4): **39 - 49 Nm (4 - 5 kgm)**

✔ Strictly follow the specified torque for the joint.



Contact surfaces of piston and disc (2):
Grease 0.3 - 0.8 cc (G2-LI)

N·m Nut (1): **98 - 127 Nm (10 - 13 kgm)**

✔ After assembling the disc, refer to the Adjustment of Work Equipment and Swing PPC Valve section of the TESTING AND ADJUSTING chapter of this manual.

Disassembly and assembly of hydraulic cylinder

Special tools

Mark		Part No.	Part Name
Q	1	790-502-1003	Cylinder repair stand
		790-101-1102	Pump
	2	790-102-4300	Wrench Assembly
		790-102-4310	Pin
	3	790-720-1000	Expander
	4	796-720-1670	Rubber Band (for boom and arm)
		07281-01279	Clamp
		796-720-1660	Rubber band (for bucket)
		07281-01159	Clamp
	5	790-201-1702	Push tool kit
		• 790-201-1830	Push tool (for bucket)
		• 790-201-1930	Push tool (for arm)
		• 790-201-1940	Push tool (for boom)
		• 790-101-5021	Grip
		• 01010-50816	Bolt
	6	790-201-1500	Push tool kit (for bucket)
		• 790-201-1640	Push tool
		• 790-101-5021	Grip
		• 01010-50816	bolt
		790-201-1980	Plate (for boom)
		790-201-1990	Plate (for arm)
		790-101-5021	Grip
		01010-50816	Bolt

Disassembly

Arm and bucket cylinders

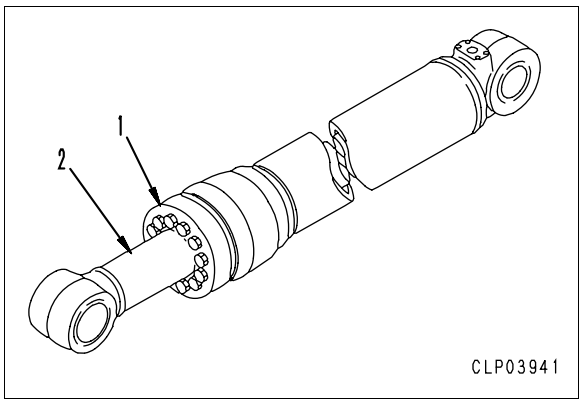
1. Piston rod assembly

1.1. Remove piping from cylinder assembly.

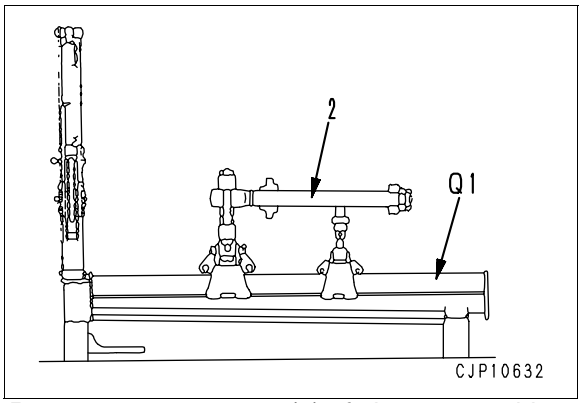
1.2. Remove mounting bolts and disconnect head assembly (1).

1.3. Pull out piston rod assembly (2).

✔ Place a container under the cylinder to catch the oil.

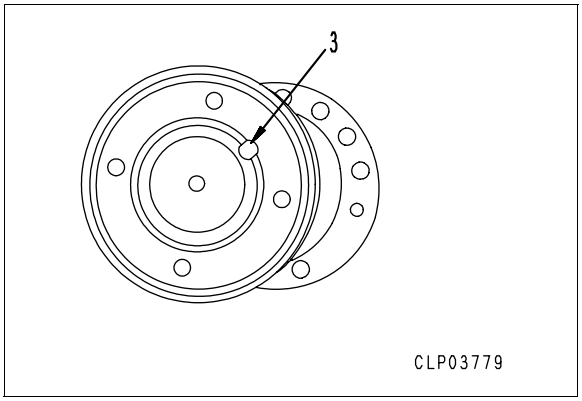


1.4. Disassemble piston rod assembly as follows.
Set piston rod assembly (2) in tool **Q1.**

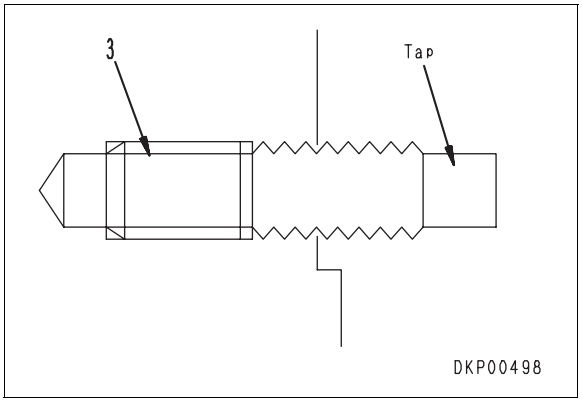


Remove stopper screw (3) of piston assembly.

✔ Common screw size for boom, arm, and bucket cylinder: M12 x Pitch 1.75.

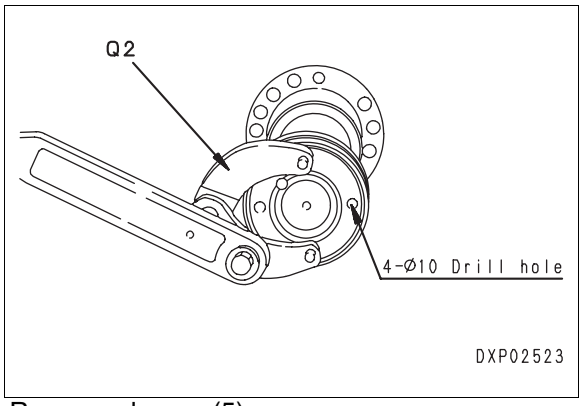


✔ If the caulking of screw (3) is too strong and it cannot be removed, tighten the screw fully, then fit a tap to the thread and remove the screw.



Using tool **Q2**, remove piston assembly (4).

✔ When not using tool **Q2**, use the drill holes (∅ 10, 4 places) and loosen the piston assembly.



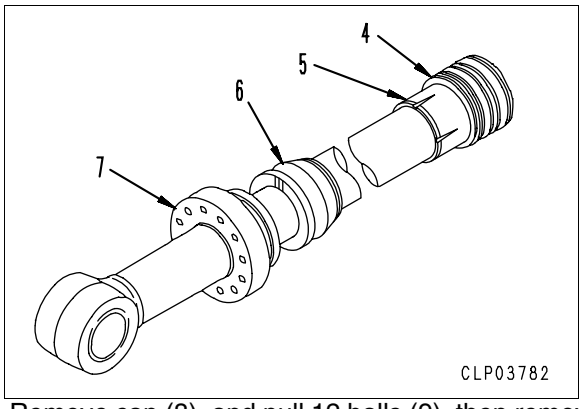
Remove plunger (5).

✔ Boom and arm cylinder only

Remove collar (6).

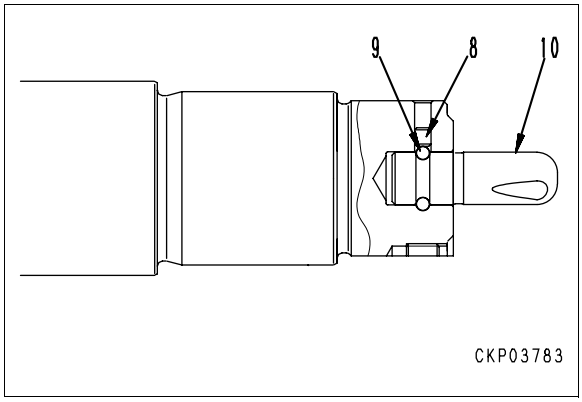
✔ Boom and arm cylinder only

Remove head assembly (7).



Remove cap (8), and pull 12 balls (9), then remove plunger (10).

✔ Arm cylinder only



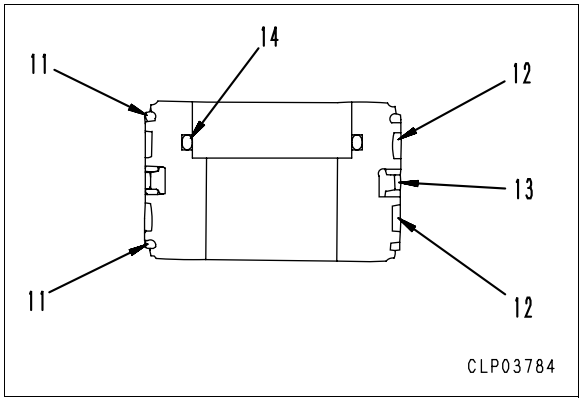
2. Disassembly of piston assembly

2.1. Remove rings (11).

2.2. Remove wear rings (12).

2.3. Remove piston ring (13).

2.4. Remove O-ring and backup ring (14).



3. Disassembly of cylinder head assembly

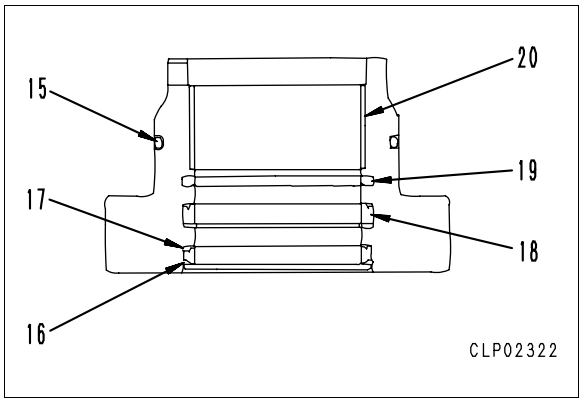
3.1. Remove O-ring and backup ring (15).

3.2. Remove snap ring (16), then remove dust seal (17).

3.3. Remove rod packing (18).

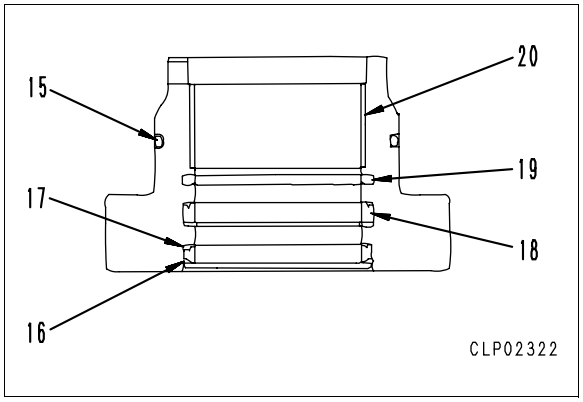
3.4. Remove buffer ring (19).

3.5. Remove busing (20).



Assembly

- Be careful not to damage the packing, dust seals, and O-rings.
- Clean each part, then cover the piping ports and pin-inserting hole to prevent dust from entering them.
- Do not try to force the backup ring into position. Warm it in warm water (50 - 60°C) before installing it.



1. Assembly of head assembly

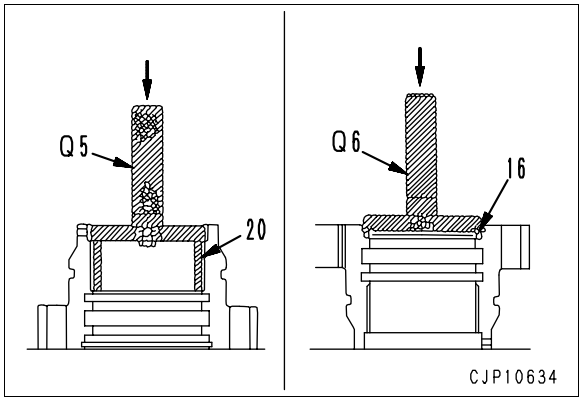
1.1. Using tool **Q5**, press fit bushing (20).

1.2. Assemble buffer ring (19).

1.3. Assemble rod packing (18).

1.4. Using tool **Q6**, install dust seal (17), and secure with snap ring (16).

1.5. Install backup ring and O-ring (15).

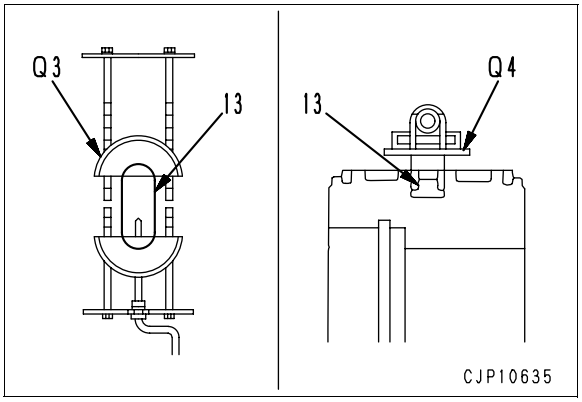


2. Assembly of piston assembly

2.1. Using tool **Q3**, expand piston ring (13).

- Set the piston ring on tool **Q3**, and turn the handle 8 - 10 times to expand the ring.

2.2. Set tool **Q4** in position, and compress piston ring (13).



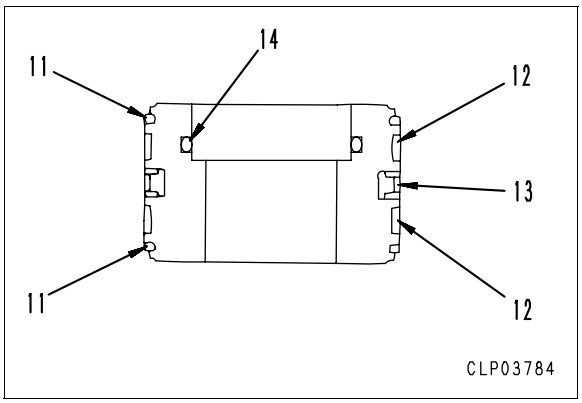
2.3. Install backup ring and O-ring (14).

2.4. Assemble wear ring (12).

2.5. Assemble ring (11).

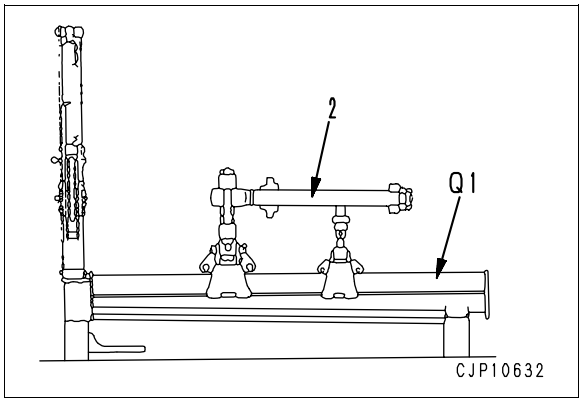
- Be careful not to open the end gap of the ring too wide.

Ring grove: **Grease (G2-L1)**



3. Piston rod assembly

3.1. Set piston rod assembly (2) to tool **Q1**.



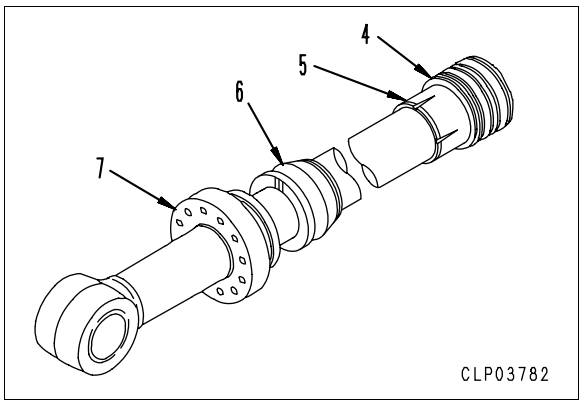
3.2. Assemble head assembly (7).

3.3. Fit O-ring and backup ring to collar (6), then assemble.

✔ Boom and arm cylinder only

3.4. Assemble plunger (5).

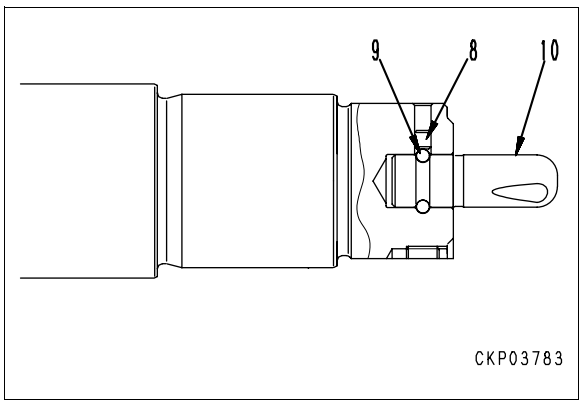
✔ Boom and arm cylinder only



3.5. Set cushion plunger (10) to piston rod, then assemble 12 balls (9) and secure with cap (8).

✔ Check that there is a small amount of play at the tip of the plunger.

✔ Arm cylinder only



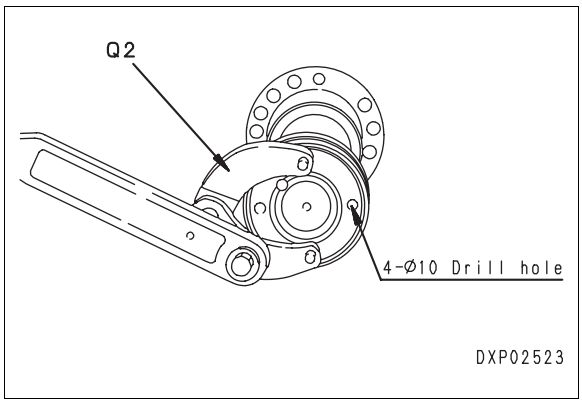
3.6. Assemble piston assembly (4) as follows.

✔ When using rod piston (2) again:

✔ Wash thoroughly and remove all metal particles and dirt.

3.6.1 Screw in piston assembly (4), then use tool **Q2** to tighten piston assembly (2) so the position of the screw thread hole matches

✔ Remove all burrs and flashes with a file.

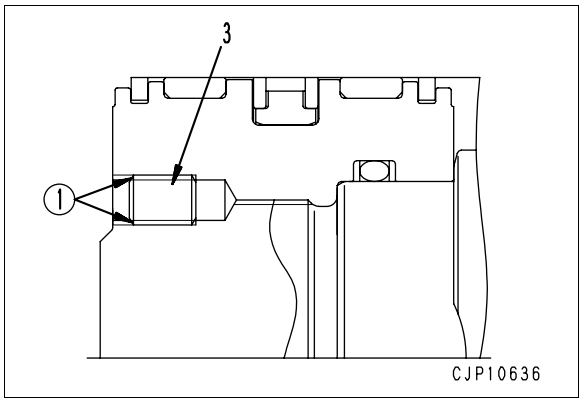


3.6.2 Tighten screw (3).

Screw thread: **Loctite® No. 262**

Screw: **58.9 - 73.6 Nm {6 - 7.5 kgm}**

3.6.3 Caulk thread at 2 places with punch.



✔ When using a new part for either or both of rod piston assembly (2)

✔ For the rod with bottom cushion, mark the cushion plug position on the end of the rod.

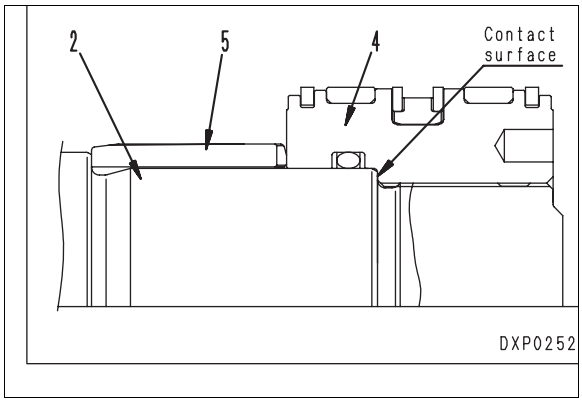
✔ Arm cylinder only

A. Screw in until piston assembly (4) contacts end face of rod, then use tool to tighten.

N·m Piston assembly: **294 ± 29.4 Nm {30 ± 3.0 kgm)**

✔ After tightening the piston, check that there is play in plunger (5).

✔ Boom, arm cylinder only



B. Machine one of the holes used to install screw (3).

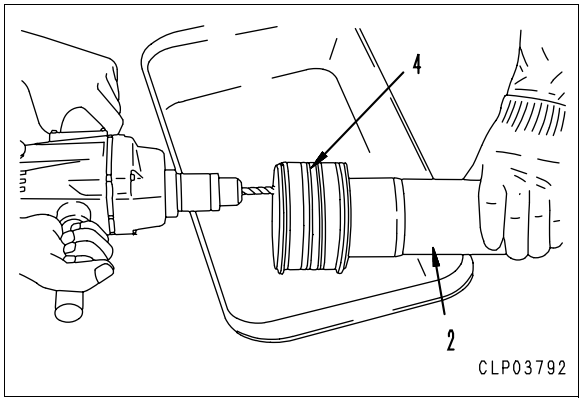
✔ Align a drill horizontal with the V-groove of the thread of rod (2) and piston (4), then carry out machining.

✔ For the cylinder with bottom cushion (arm cylinder), avoid the cushion plug position when machining.

✔ Screw machining dimension (mm)

Drill diameter	Bottom hole depth	Tap used	Tap depth
10.3	27	12 x 1.75	20

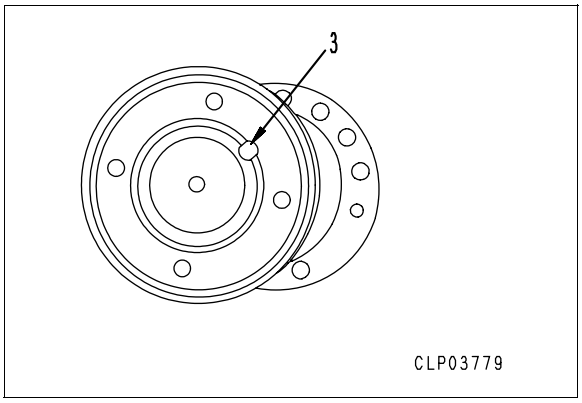
C. After machining, wash thoroughly to remove all metal particles and dust.



D. Tighten screw (3).

N·m Screw: **58.9 - 73.6 Nm {6 - 7 kgm}**

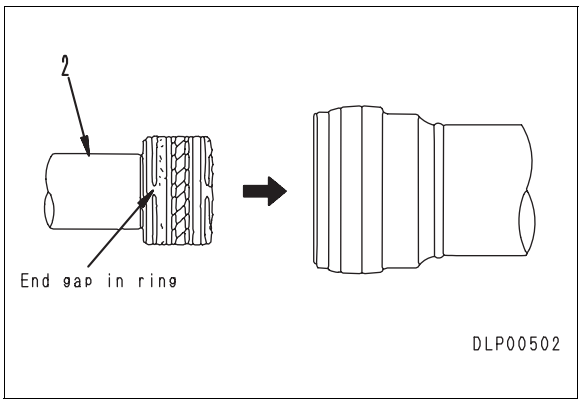
E. Caulk thread at 4 places with punch.



3.7. Assemble piston rod assembly (2).

★ Set the end gap of the ring horizontally (at the side position), align axial center of cylinder tube, then insert.

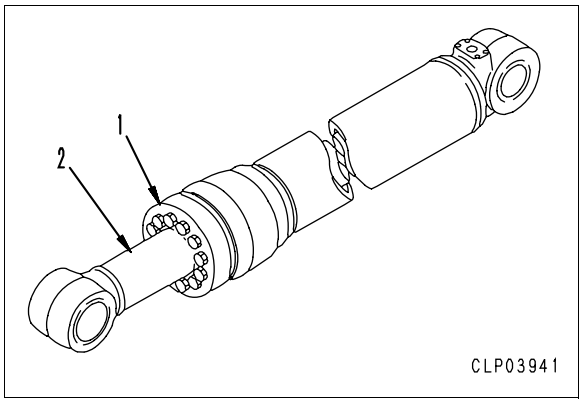
★ After inserting, check that the ring is not broken and has not come out, then push in fully.



3.8. Tighten head assembly (1) with mounting bolts.

N·m Mounting bolt:

Cylinder	Tightening torque
Bucket	**270 ± 39 Nm {27.5 ± 4.0 kgm}**
Arm	**373 ± 54 Nm {38.0 ± 5.5 kgm}**
Boom	**270 ± 39 Nm {27.5 ± 4.0 kgm}**



3.9. Install piping.

Removal and installation of monoboom work equipment

Special tools

Mark	Part No.	Part Name
R	796-900-1200	Remover
	790-101-4000	Puller (490 kN 50-T-long)
	790-101-1102	Pump (294 kN 30 T)

Removal

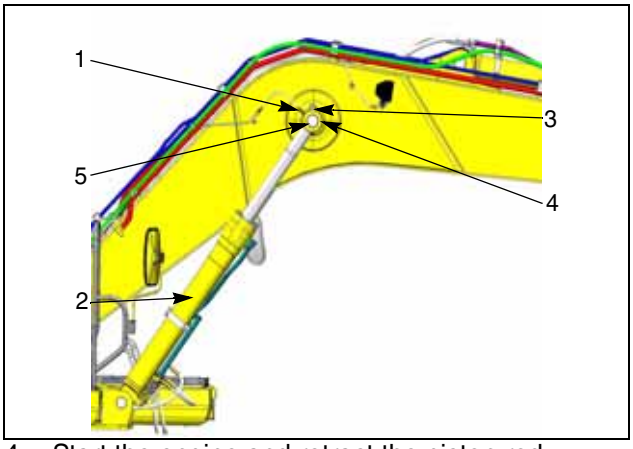
⚠ WARNING

- **Extend the arm and bucket fully. Lower the work equipment to the ground and set the safety lock lever to the lock position**
- **Release the residual pressure in the hydraulic circuit. Refer to the Release of Remaining Pressure in Hydraulic Circuit section in the TESTING AND ADJUSTING chapter of this manual**

1. Disconnect grease hose (1).
2. Sling boom cylinder assembly (2), and remove lock bolt (3).
3. Remove plate (4), then remove head pin (5).

※1

✔ There are shims installed, so check the number and thickness, and keep them in a safe place.



4. Start the engine and retract the piston rod.

✔ Fasten the piston rod with wire so that it will not slip out and lower the cylinder onto a stand, or place a support under the bottom of the cylinder to support it. In the latter case, remove the grease fitting on the bottom side first.

✔ Remove the boom cylinder on the other side in the same manner.

5. Disconnect stabilizer hoses (6), arm cylinder hoses (7), boom cylinder hoses (8) two for each.

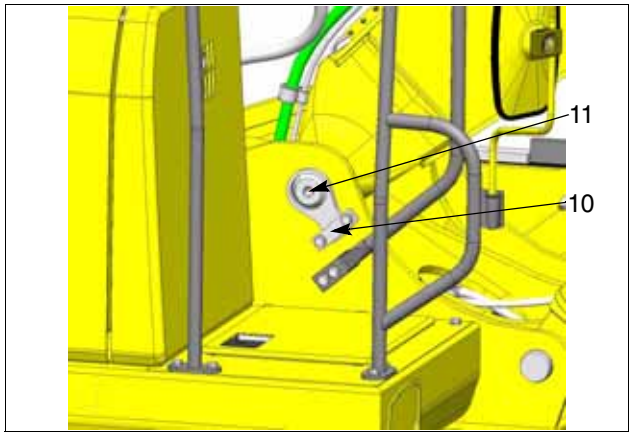
✔ Plug the hoses to prevent oil flow-out, and fasten them on the valve side.

6. Disconnect intermediate connector A86 (9) for a working lamp.

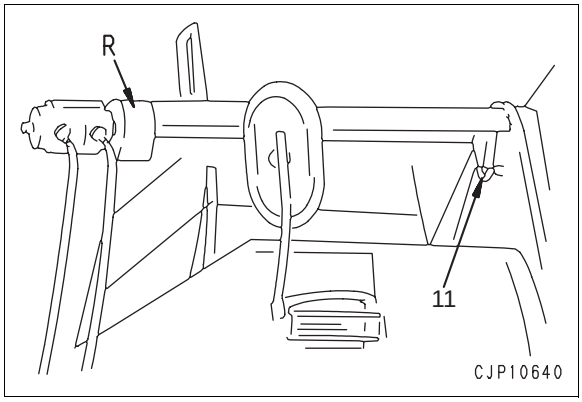


7. Lift off the work equipment and remove plate (10) and then pin (11) at the foot.

※2



- When removing them, first remove plate (10) and then remove pin (11) at the foot, using Tool **R**.
- Shims are installed, so do not forget to check their number and each location of installation.



8. Lift off work equipment assembly (12) and disassemble it.

kg Work equipment assembly: **1,742 kg**

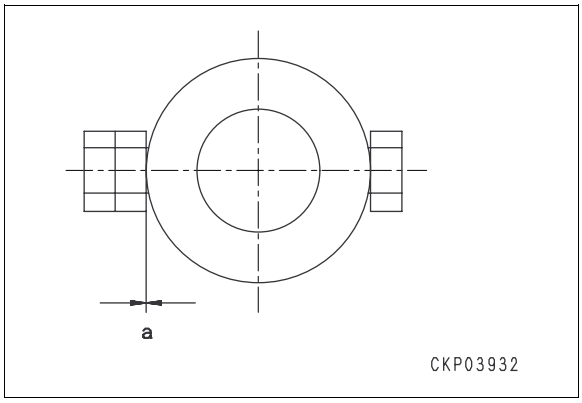


Installation

- Install in reverse order of removal.

1

- When tightening the locknut, tighten so that clearance **a** between the plate and nut is 0.5 - 1.5 mm.



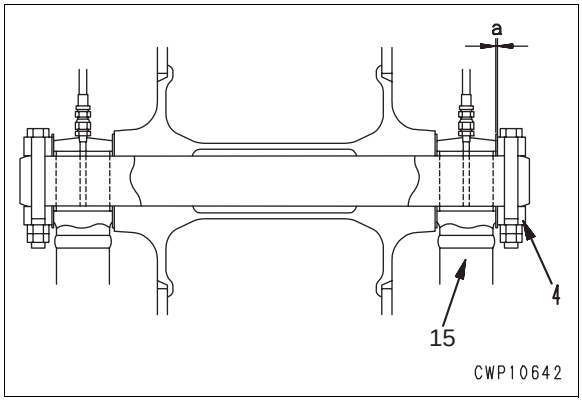
Inside surface of bushing when assembling pin: **Anti-friction compound (LM-P)**

Grease after assembling pin: **Grease (LM-G)**

WARNING

When aligning the position of the pin hole, never insert your fingers into the pin hole.

- Adjust the shim thickness so that clearance **a** between cylinder rod (13) and plate (4) is below 1 mm.
- Standard shim thickness: 1.0 mm and 2.0 mm.




Inside surface of bushing when assembling pin: **Anti-friction compound (LM-P)**


Grease after assembling pin: **Grease (LM-G)**

⚠ WARNING

When aligning the position of the pin hole, never insert your fingers into the pin hole.

- **Bleeding air**
  - Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Air Bleeding of Various Parts.
- **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 and installation of 2 piece boom work equipment

Special tools

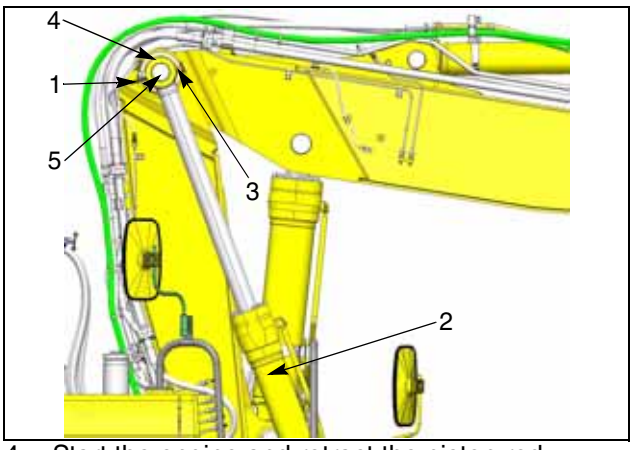
Mark	Part No.	Part Name
R	796-900-1200	Remover
	790-101-4000	Puller (490 kN 50-T-long)
	790-101-1102	Pump (294 kN 30 T)

Removal

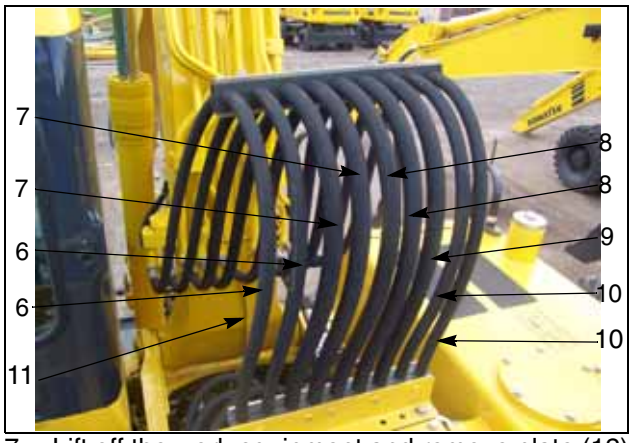
⚠ WARNING

- **Extend the arm and bucket fully. Lower the work equipment to the ground and set the safety lock lever to the lock position.**
- **Release the residual pressure in the hydraulic circuit. Refer to the Release of Remaining Pressure in Hydraulic Circuit section in the TESTING AND ADJUSTING chapter of this manual.**

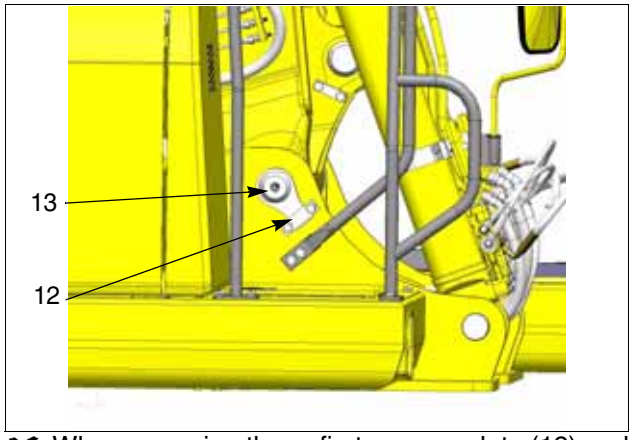
1. Disconnect grease hose (1).
2. Sling boom cylinder assembly (2), and remove lock bolt (3).
3. Remove plate (4), then remove head pin (5). ※1
   - ✔ There are shims installed, so check the number and thickness, and keep them in a safe place.



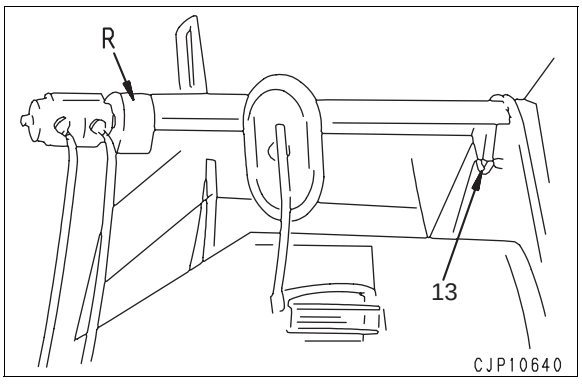
4. Start the engine and retract the piston rod.
   - ✔ Fasten the piston rod with wire so that it will not slip out and lower the cylinder onto a stand, or place a support under the bottom of the cylinder to support it. In the latter case, remove the grease fitting on the bottom side first.
   - ✔ Remove the boom cylinder on the other side in the same manner.
5. Disconnect 2 piece boom cylinder hoses (6), arm cylinder hoses (7), bucket cylinder hoses (8), service 1 hose (9) and service 2 hose (10).
   - ✔ Plug the hoses to prevent oil flow-out, and fasten them on the valve side.
6. Disconnect intermediate connector A86 (11) for a working lamp.



7. Lift off the work equipment and remove plate (12) and then pin (13) at the foot. ※2



   - ✔ When removing them, first remove plate (12) and then remove pin (13) at the foot, using Tool **R**.
   - ✔ Shims are installed, so do not forget to check their number and each location of installation.



8. Lift off work equipment assembly (14) and disassemble it.

kg Work equipment assembly: **1,926 kg**

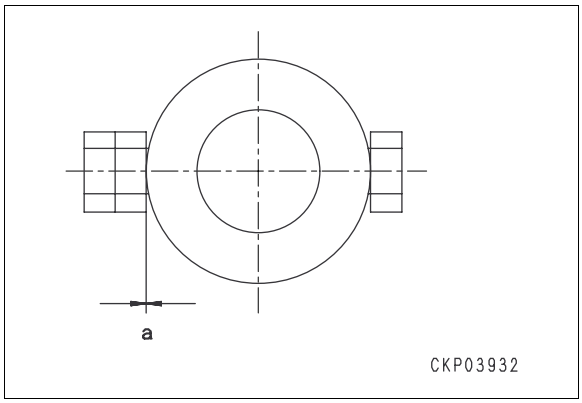


Installation

- Install in reverse order of removal.

※1

★ When tightening the locknut, tighten so that clearance **a** between the plate and nut is 0.5 - 1.5 mm.



Inside surface of bushing when assembling pin: **Anti-friction compound (LM-P)**

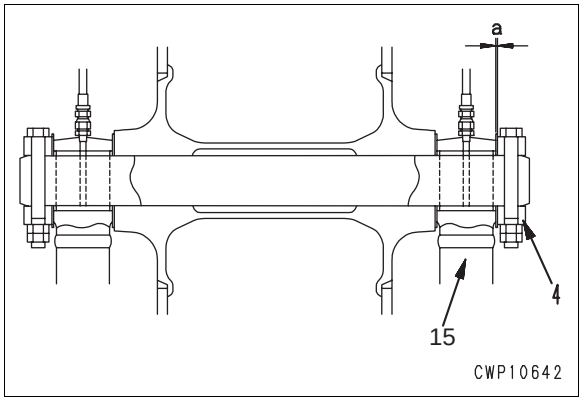
Grease after assembling pin: **Grease (LM-G)**

⚠ WARNING

When aligning the position of the pin hole, never insert your fingers into the pin hole.

✕ Adjust the shim thickness so that clearance **a** between cylinder rod (15) and plate (4) is below 1 mm.

✕ Standard shim thickness: 1.0 mm and 2.0 mm.




Inside surface of bushing when assembling pin:
Anti-friction compound (LM-P)


Grease after assembling pin:
Grease (LM-G)

⚠ WARNING

When aligning the position of the pin hole, never insert your fingers into the pin hole.

✕ Bleeding air

- ✕ Bleed the air from the cylinder. For details, see TESTING AND ADJUSTING, Air Bleeding of Various Parts.

✕ 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 and installation of air conditioner unit

Special tools

Mark	Part No.	Part Name
S	799-703-1200	Service tool kit
	799-703-1100	Vacuum Pump (100 V)
	799-703-1110	Vacuum Pump (220 V)
	799-703-1120	Vacuum Pump (240 V)
	799-703-1400	Gas leak tester

Removal

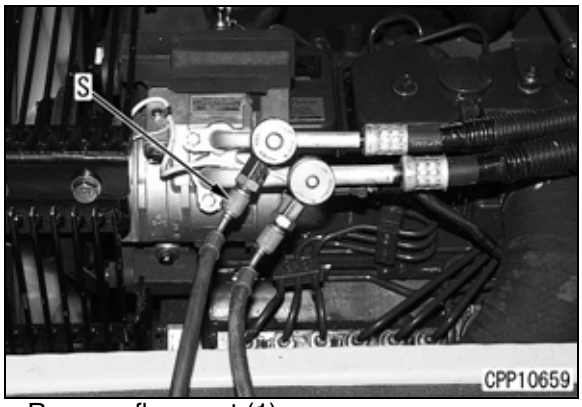
⚠ WARNING

First, disconnect the cable from the negative terminal (-) of the battery.

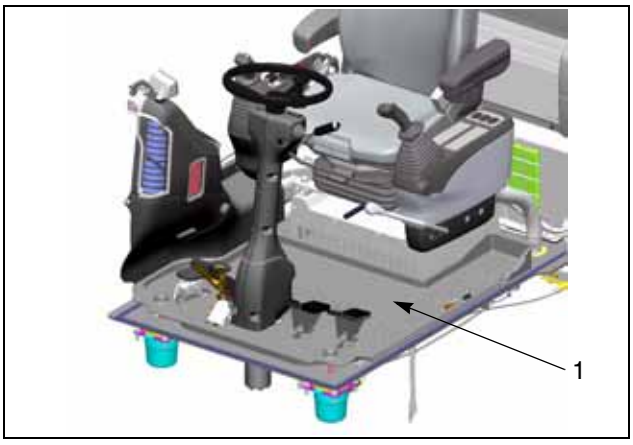
1. Drain cooling water.

Cooling water: **Approx. 22.8 ℓ**

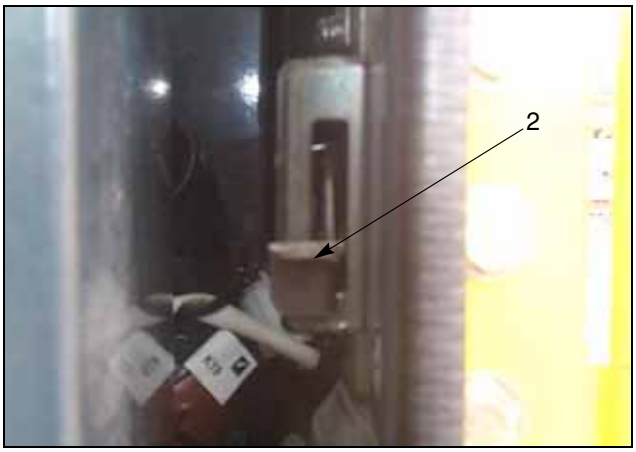
2. Bleed gas from the air conditioner, using tool **S**.



3. Remove floor mat (1).



4. Pull down outside air filter cover opening-closing lever (2).

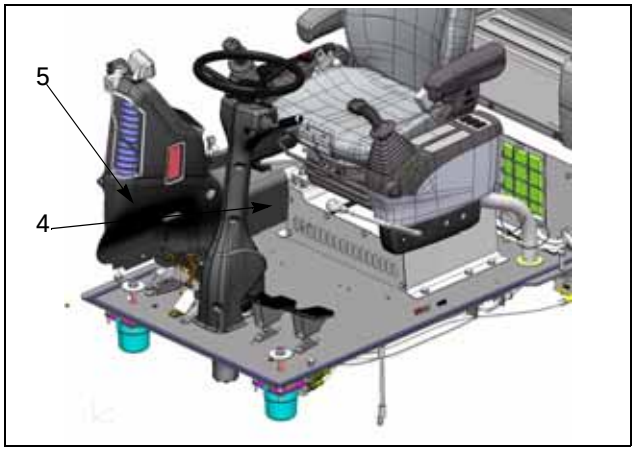


5. Remove outside air filter (3).

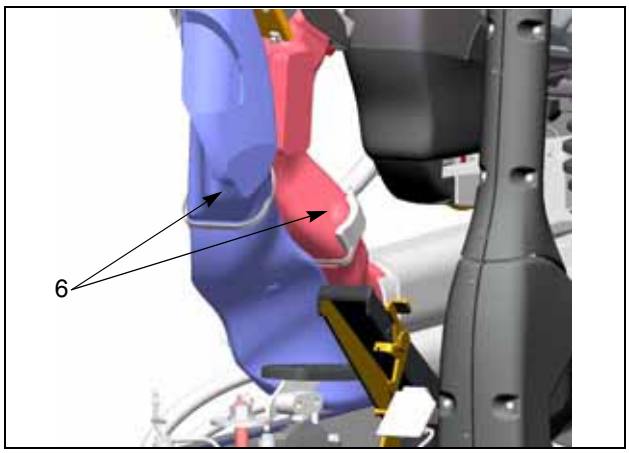


6. Remove monitor panel lower covers (4) and (5).

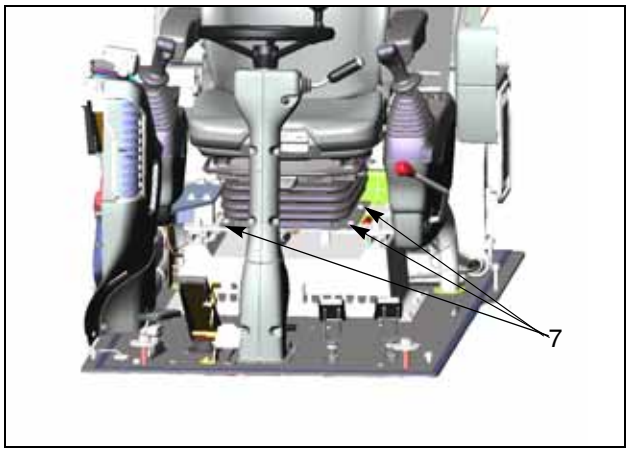
✔ When removing cover (4), first remove the M19 wiring for cigarette lighter.



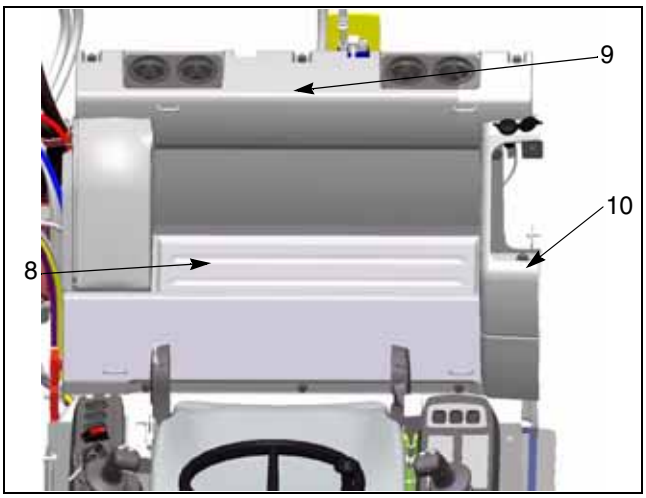
7. Remove duct (6) on the right side.



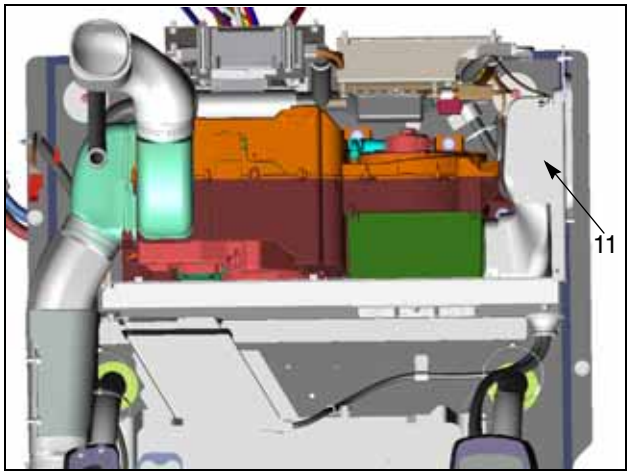
8. Remove operator seat by removing 4 mounting bolts (7). When removing the seat be sure to disconnect connector G33 (if fitted), then remove carefully.



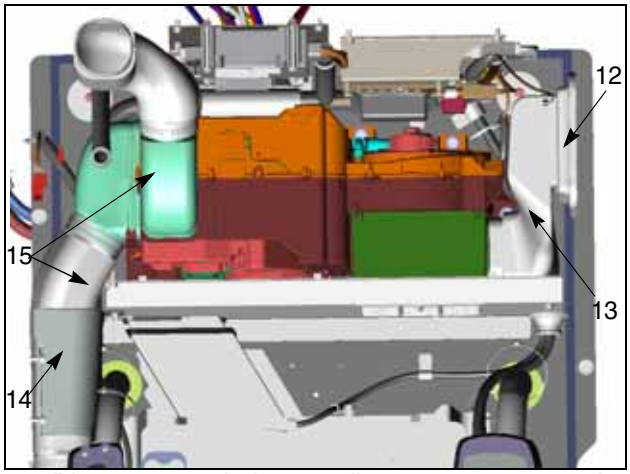
9. Remove rear covers (8), (9) and (10).



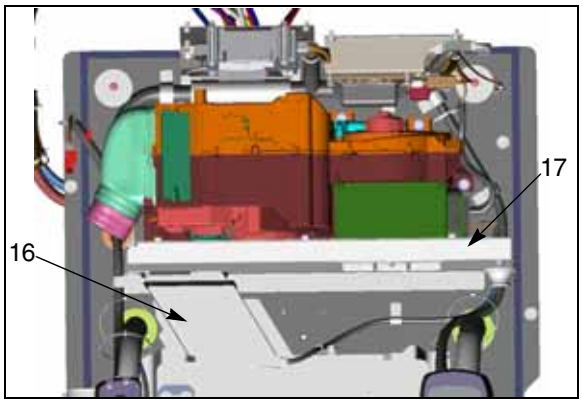
10. Remove plate (11).



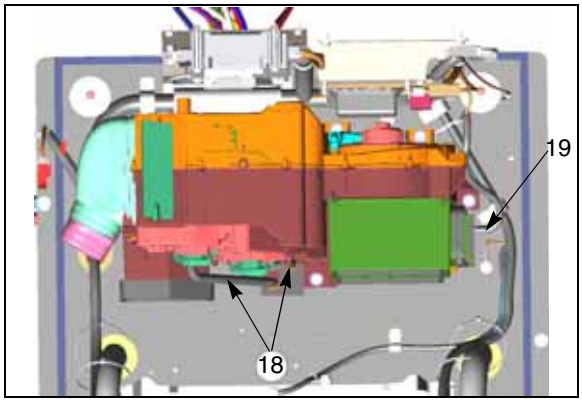
11. Remove plate (12) and then remove duct (13).
12. Remove plate (14) and right duct (15).



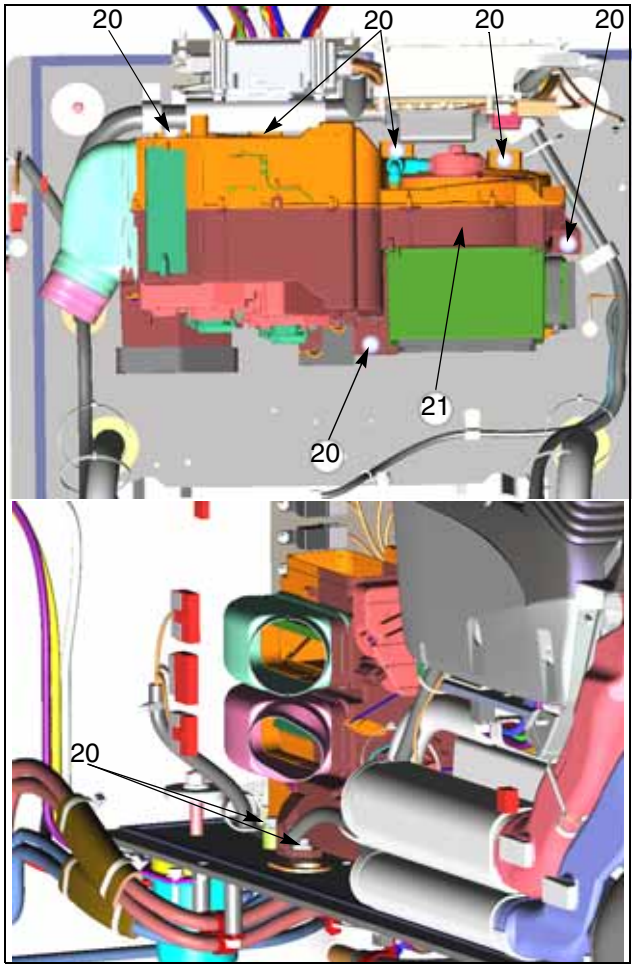
13. Disconnect cab intermediate connectors at the following two points. (Refer to TROUBLESHOOTING section on “CONNECTOR LOCATION CHART AND ELECTRICAL CIRCUIT DIAGRAM BY SYSTEM” on page 221)
    - H09: Upper side
    - H08: Lower side
14. Remove duct (16).
15. Remove cover (17).



16. Disconnect connectors at the following seven points. (Refer to TROUBLESHOOTING section on “CONNECTOR LOCATION CHART AND ELECTRICAL CIRCUIT DIAGRAM BY SYSTEM” on page 221)
    - ✔ D01 (Assembled-type diode connector)
    - ✔ D02 (Assembled-type diode connector)
    - ✔ C09 (Model selection switch connector)
    - ✔ Air conditioner unit connector From top to bottom, M26, M27, M28 and M33 option power source connector
17. Remove 2 hoses (18) and remove connector (19).



18. Remove the 8 mounting bolts (20) and remove air conditioner unit assembly (21) carefully.
    - ✔ When removing the air conditioner unit assembly, do not forget to disconnect the two air conditioner hoses connected to the bottom.



Installation

- Install in reverse order of removal.
- Install hoses in the air conditioner circuit with care so that dirt, dust, water, etc. may not enter them.
- Install air conditioner hoses only after checking that an O-ring is in place at the connecting part.
- Check that there is no damage on O-rings, or that they have not deteriorated.

※1

- Coat the threads of the refrigerant piping at the connecting part with compressor oil (ND-OIL8), and then tighten the piping with a double-ended spanner.

N·m Hose clamp screw:
8.83 - 14.7 Nm (0.9 - 1.5 kgm)

N·m Hose screw M16 x 1.5:
11.8 - 14.7 Nm (1.2 - 1.5 kgm)

N·m Hose screw M24 x 1.5:
29.4 - 34.3 Nm (3.0 - 3.5 kgm)

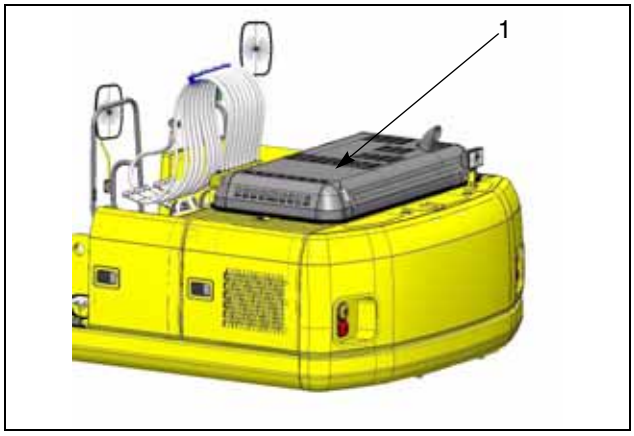
- Filling air conditioner gas
  Fill the air conditioner circuit with air conditioner gas (R134a), using tool **S**.

Removal and installation of counterweight

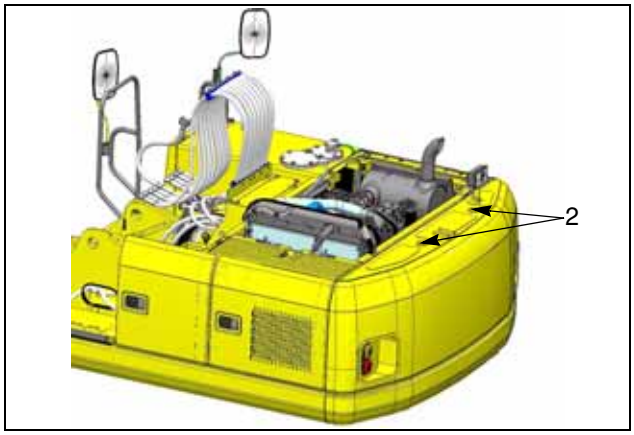
- Before beginning with removal of all the counterweight make sure all electrical connectors are disconnected.
- Attach tags to all wires to avoid confusion when installing counterweight.

Removal

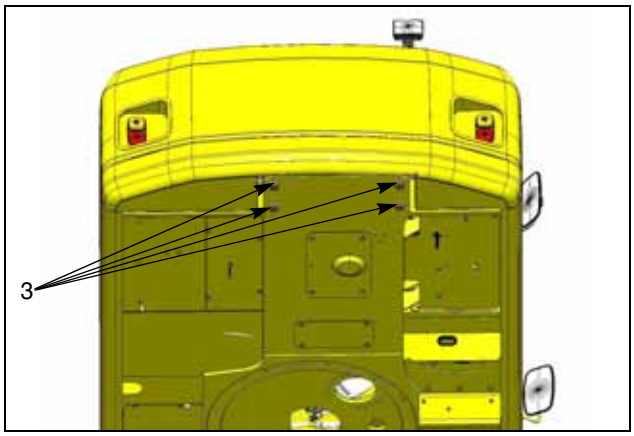
1. Open hood (1) and remove (see page page 30-50).



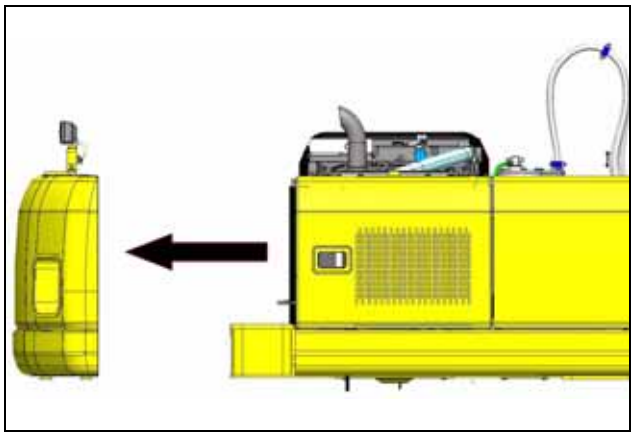
2. Remove caps (2) from counterweight.



3. Insert lifting eye's into holes. The lifting eye's you require are:
   Thread - 48x3
   Must have safe working load of - 3,500 Kg
4. Loosen 4 bolts (3).



5. Ensure lifting equipment is supporting the weight of the counterweight.
6. Remove mounting bolts (3).
7. Remove counterweight in the direction shown.



- Be careful not to hit the engine or cooler.

kg Counterweight assembly: **3,500 kg**

Installation

✔ Install in reverse order of removal.

Thread of counterweight mounting bolt:
Thread tightener (LT-2)

Counterweight mounting bolt:
1,180 - 1,470 Nm {120 - 150 kgm}

※2

✔ Installing and adjusting counterweight.

Sling counterweight with crane and place in position on the frame.

Push counterweight, install mounting bolts, and adjust to the following dimensions.

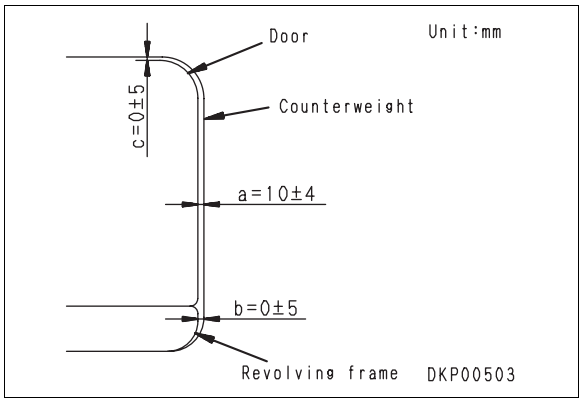
✔ Clearance from revolving frame:
10 ± 5 mm (left and right)

✔ Clearance from bodywork door:
10 ± 5 mm (left and right)

✔ Stepped difference **b** from revolving frame in left- to right direction: Max. 5 mm

✔ Stepped difference **a** from bodywork door in left- to right direction: 10 ± 4

✔ Stepped difference **c** from bodywork top cover in up-down right direction: Max. 5 mm



Removal and installation of operator cab assembly

Removal

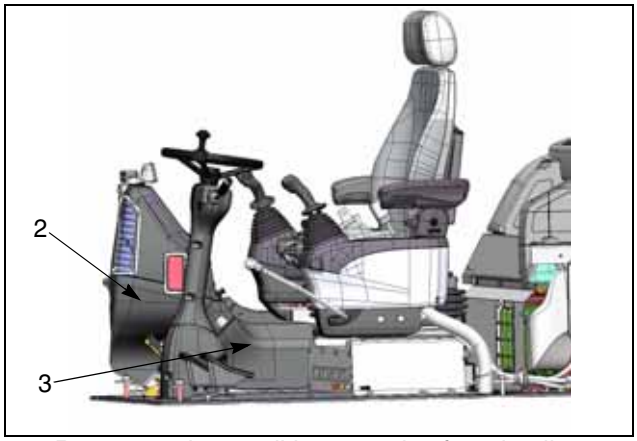
⚠ WARNING

- **First, disconnect the cable from the negative terminal (-) of the battery.**
- **Release the residual pressure in the hydraulic circuit. Refer to the Release of Remaining Pressure in Hydraulic Circuit section in the TESTING AND ADJUSTING chapter of this manual.**

1. Remove floor mat (1).

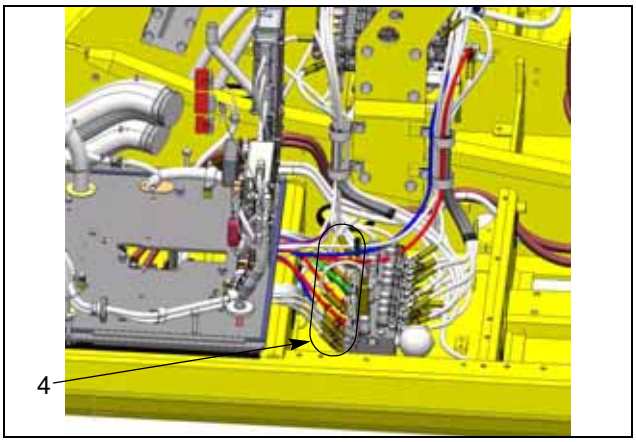


2. Remove covers (2) and (3) under the monitor panel.
   - ✔ When removing cover (2), first disconnect the M19 wiring for cigarette lighter.

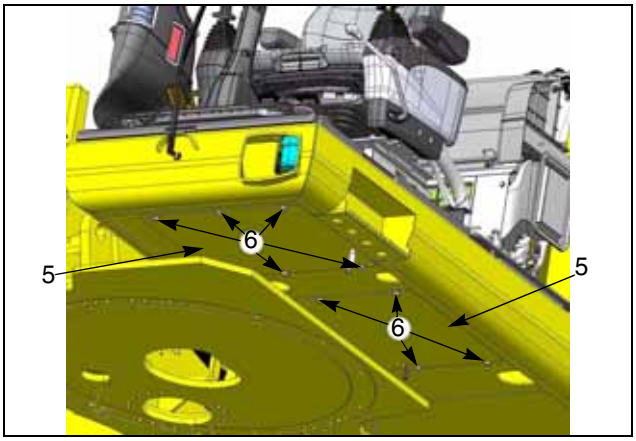


3. Remove air conditioner unit, for details see “Removal and installation of air conditioner unit” on page 30- 258.

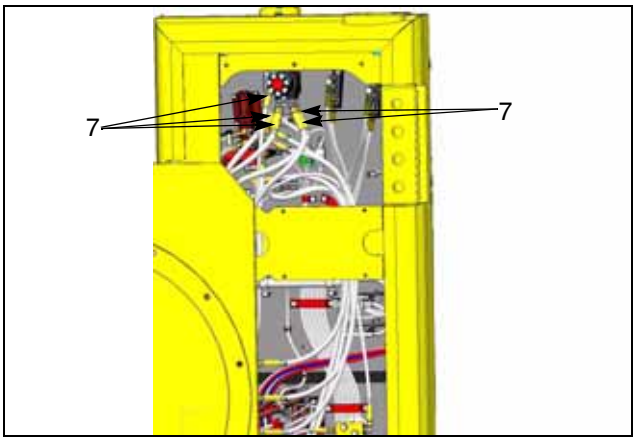
4. Disconnect all hoses at (4).



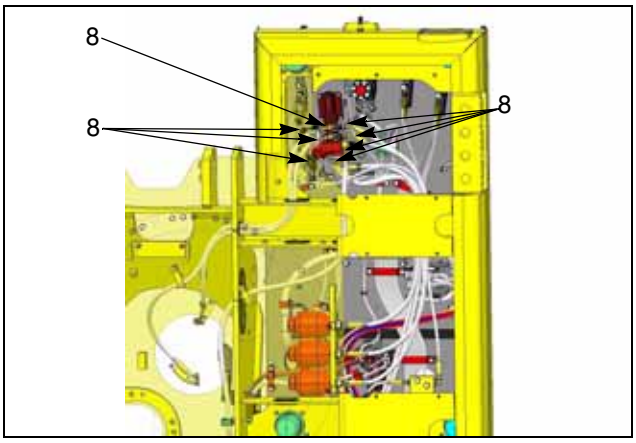
5. Remove plate (5) by removing bolts (6).



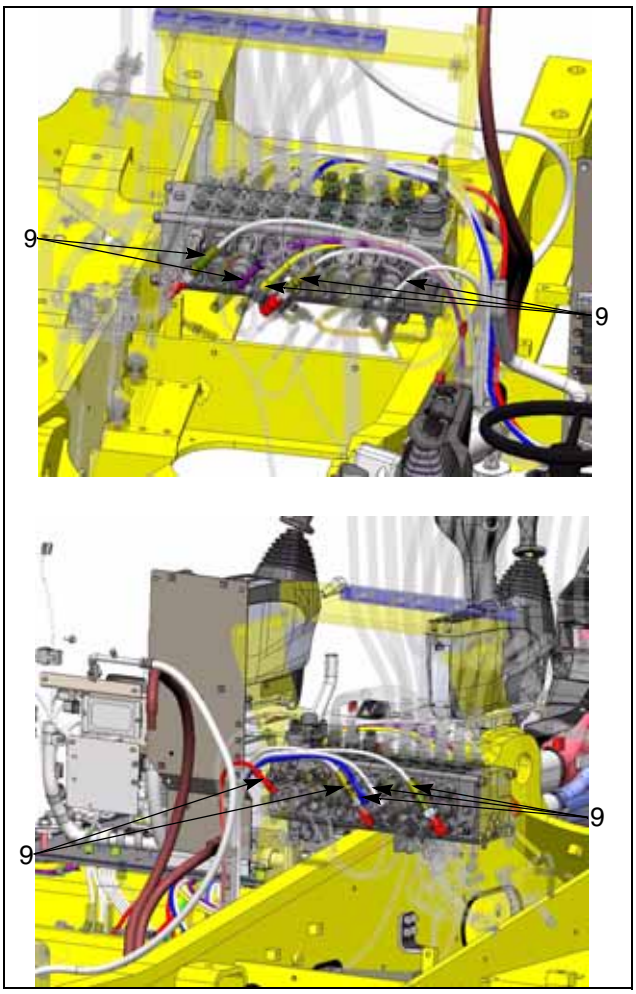
6. Disconnect hoses (7) from orbitrol valve.



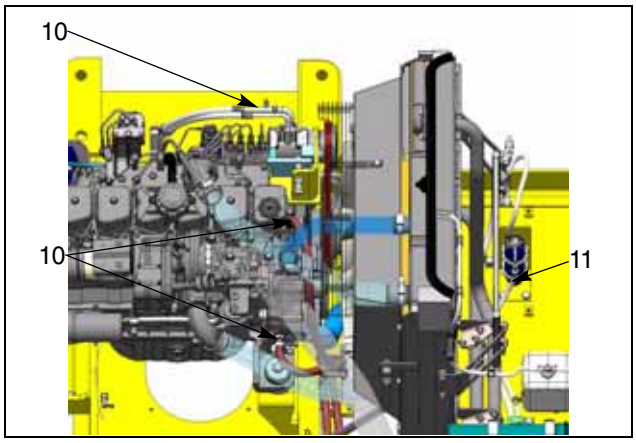
7. Disconnect hoses (8) from brake valve.



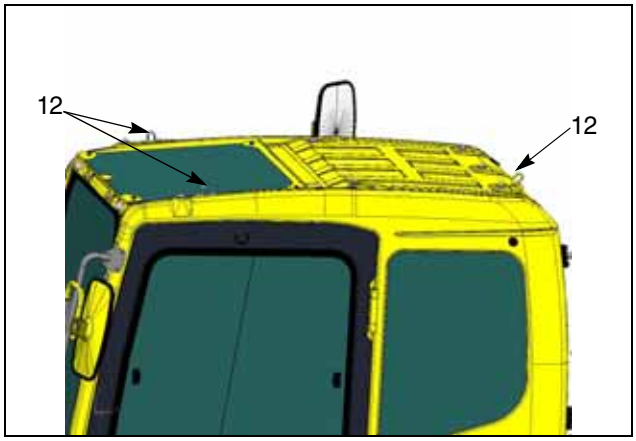
8. Remove 10 hoses from control valve (9).



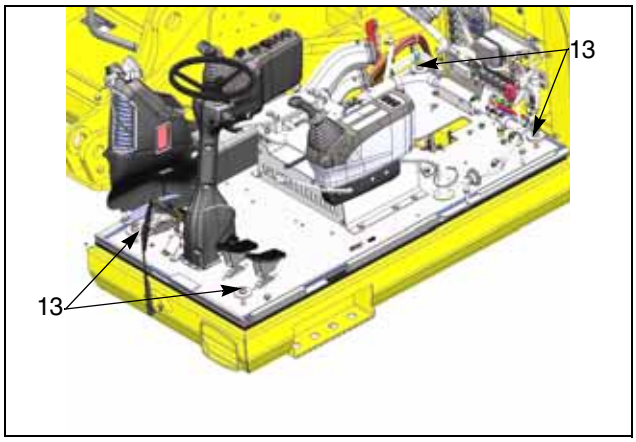
9. Remove 3 hoses (10) from engine and 1 hose from the dryer (11).



10. Ensure cab door is securely fastened.
11. Ensure all hoses are loose and all clips have been removed.
12. Attach lifting equipment at points (12).



13. Loosen off 4 mounting bolts (13) inside the cab.



14. Have lifting equipment take the weight of the operator cab.

15. Remove mounting bolts (13) and lift operator cab off.



Operator cab assembly: **662 kg**

Installation

✔ Install in reverse order of removal.

Removal and installation of monitor assembly

Removal

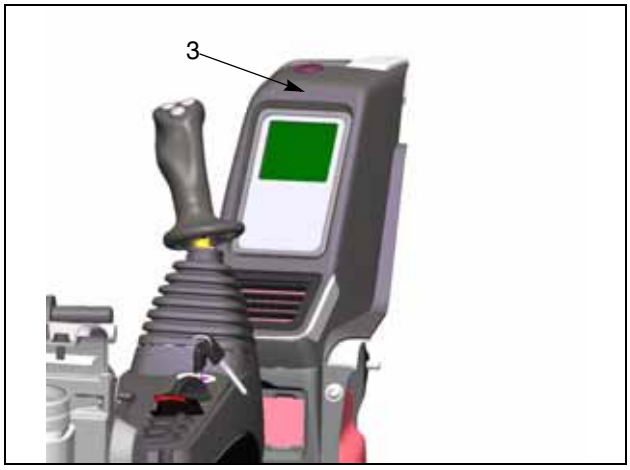
WARNING

First, disconnect the cable from the negative terminal (-) of the battery.

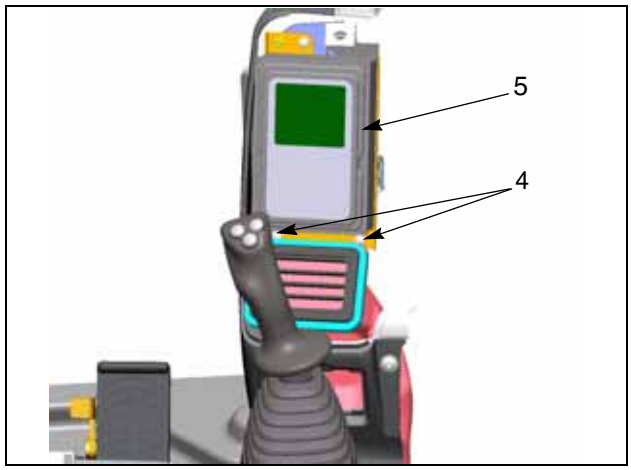
1. Remove 2 bolts (1) from cab wall to remove monitor assembly (2).



2. Remove cover (3).
   - To remove cover just lift the top of the cover to unclip.



3. Remove 2 bolts (4) then slide monitor panel (5) down to remove from bracket. Remove 3 connectors from the back of the monitor panel assembly (5) to completely remove monitor panel assembly (5).



Installation

- Install in reverse order of removal.

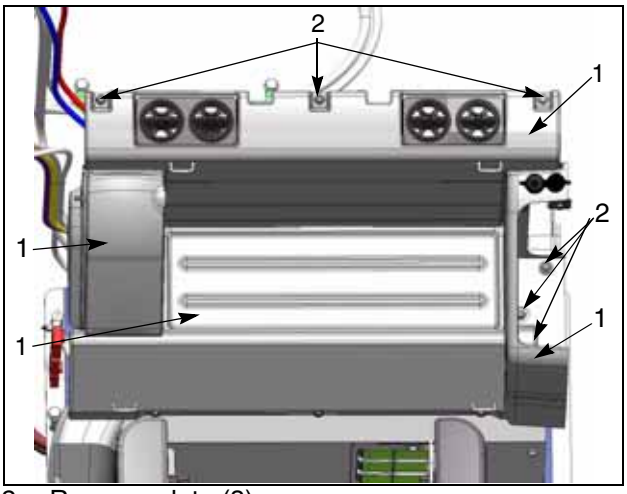
Removal and installation of pump controller assembly

Removal

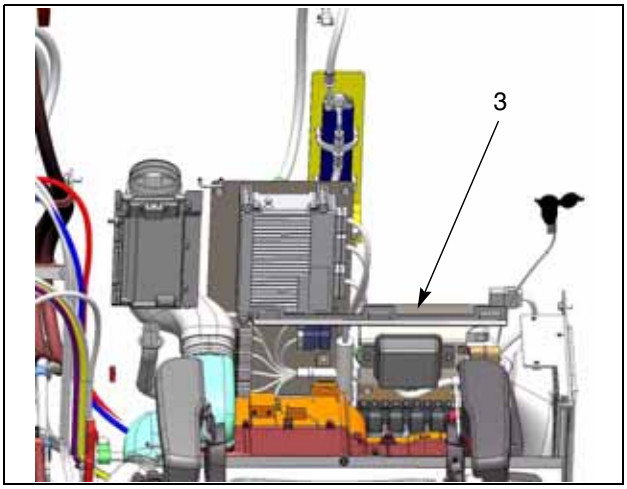
WARNING

First, disconnect the cable from the negative terminal (-) of the battery. Then disconnect the cable from positive terminal (+) of the battery.

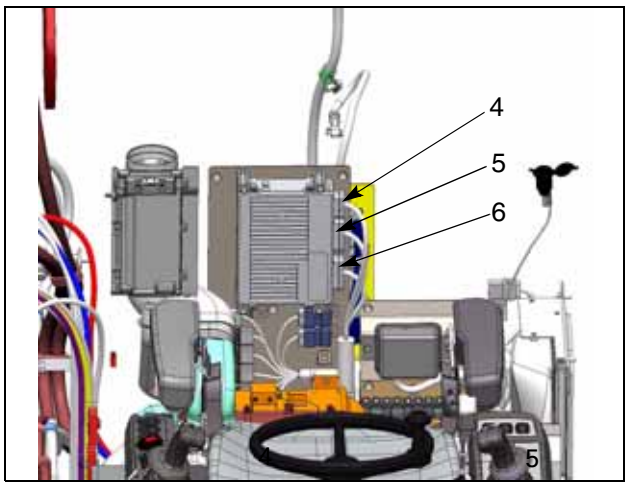
1. Remove covers (1) by removing bolts (2).



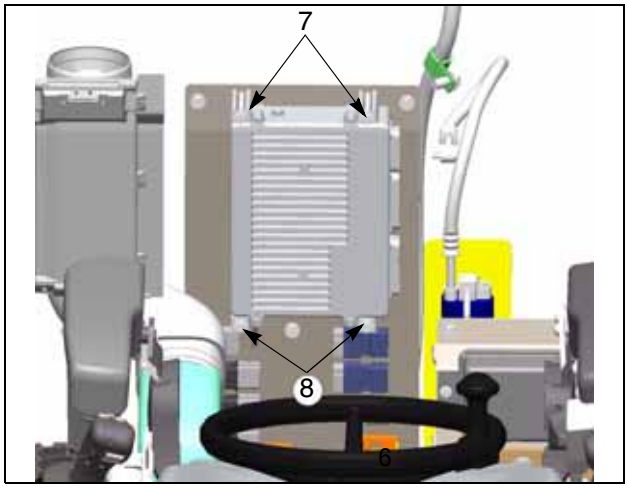
2. Remove plate (3).



3. Disconnect 3 electrical connectors C01 (4), C02 (5), C03 (6).



4. Make sure controller is fully supported.
5. Remove bolts (7) then remove bolts (8).



6. Carefully remove controller from cab.

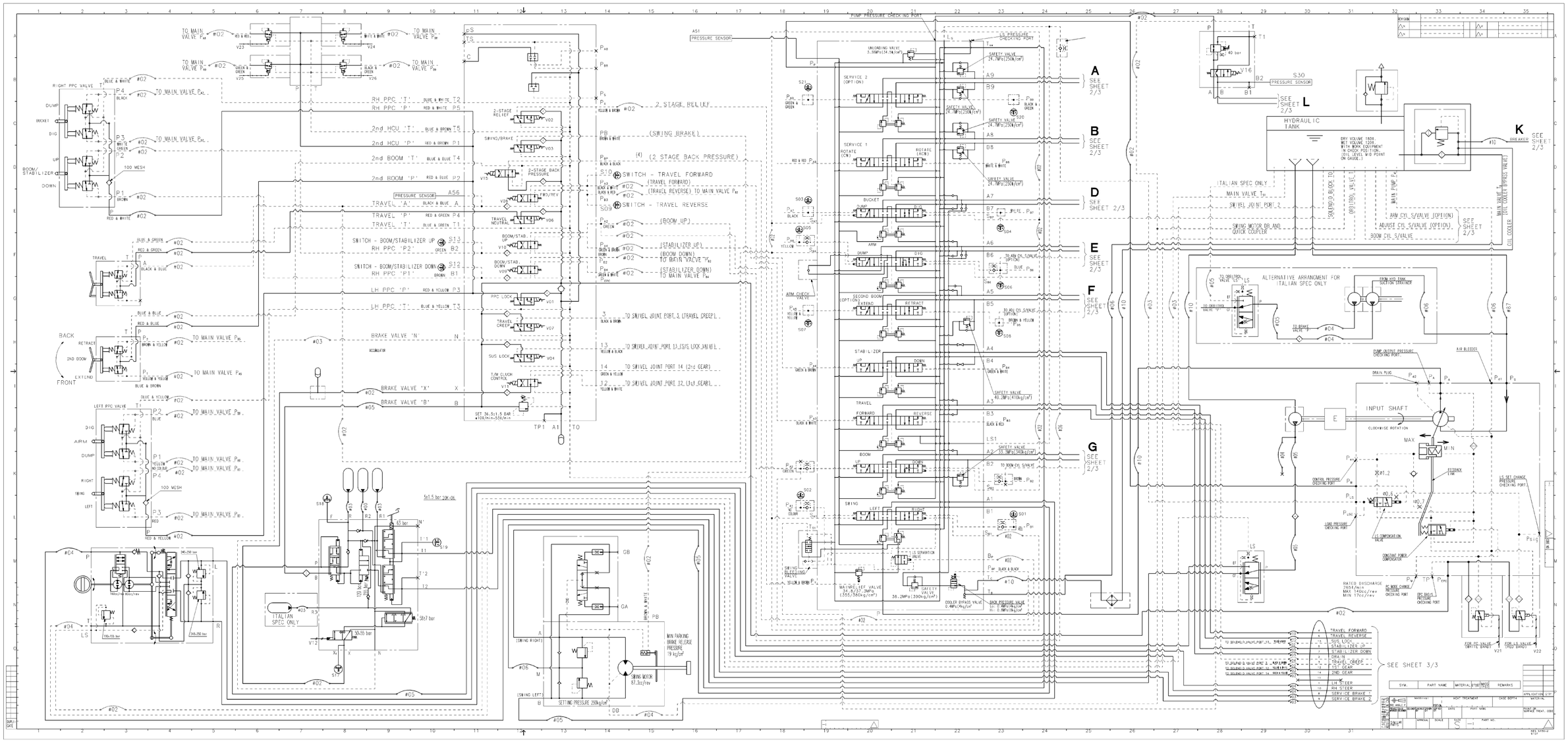
Installation

✔ Install in reverse order of removal.

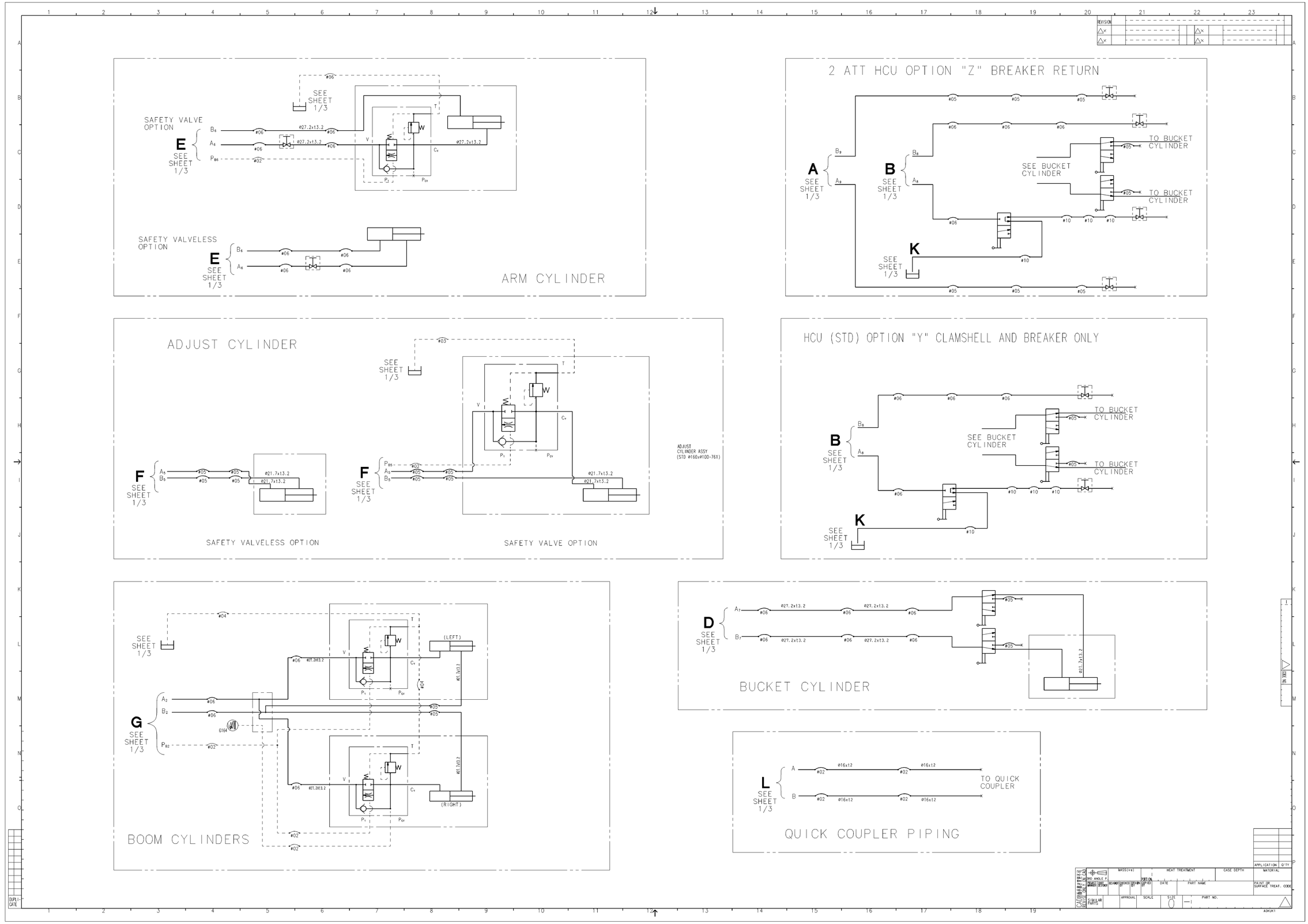
90 OTHER

Hydraulic Circuit Diagram (1/3) 90- 3
Hydraulic Circuit Diagram (2/3) 90- 5
Hydraulic Circuit Diagram (3/3) 90- 7
Electrical Circuit Diagram (1/5) 90- 9
Electrical Circuit Diagram (2/5) 90- 11
Electrical Circuit Diagram (3/5) 90- 13

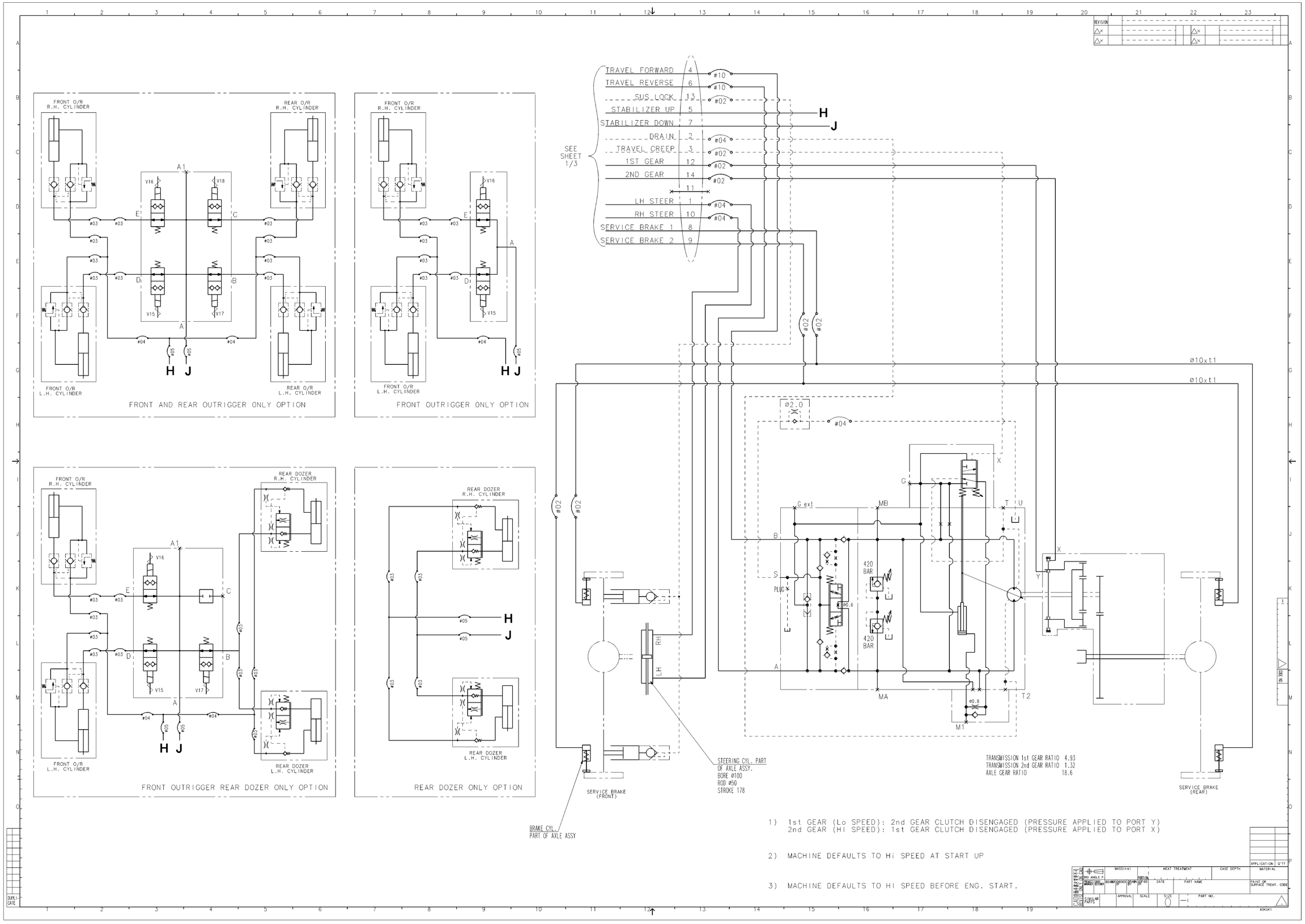
HYDRAULIC CIRCUIT DIAGRAM (1/3)



HYDRAULIC CIRCUIT DIAGRAM (2/3)

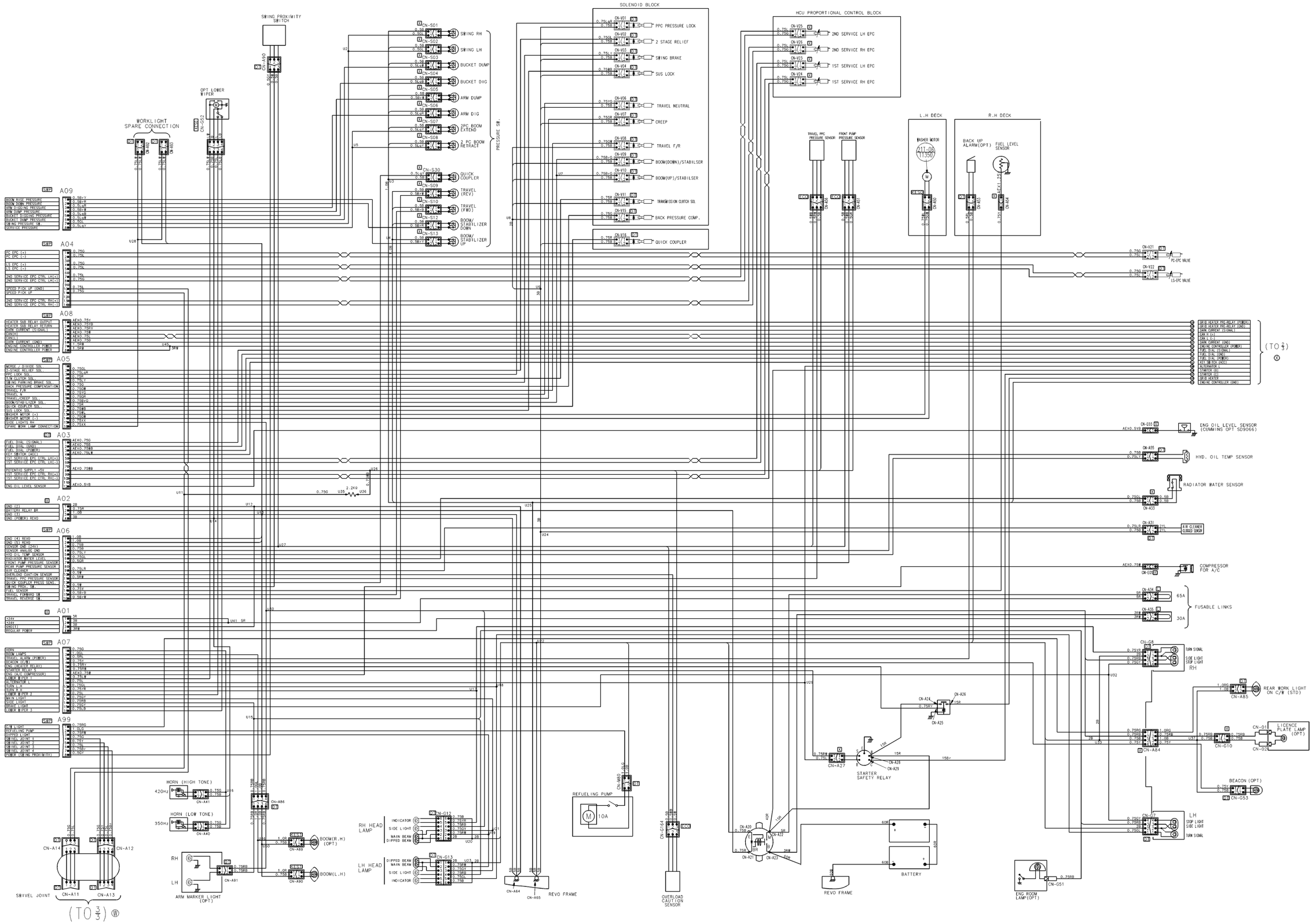


HYDRAULIC CIRCUIT DIAGRAM (3/3)



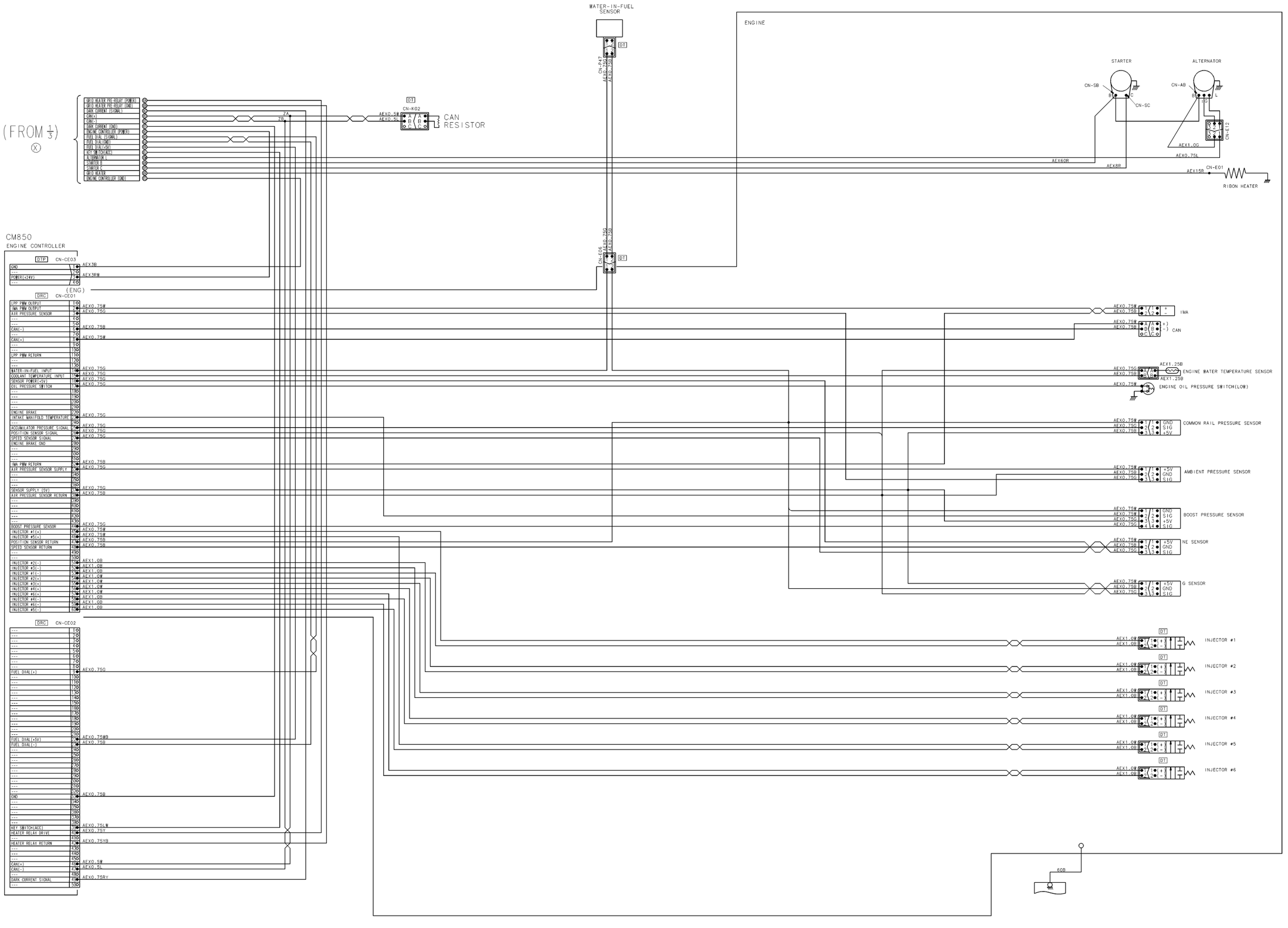
ELECTRICAL CIRCUIT DIAGRAM (1/3)

FOR MULTI MONITOR



ELECTRICAL CIRCUIT DIAGRAM (2/3)

FOR MULTI MONITOR



ELECTRICAL CIRCUIT DIAGRAM (3/3)

FOR MULTI MONITOR

CHASSIS ATTACHMENT CONFIGURATION OPTIONS FOR MACHINE

