VEBM395100

SHOP MANUAL

KOMATSU

PW160-7E0

MACHINE MODEL
PW160-7E0

SERIAL NUMBER
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.
- PW160-7E0 mount the SAA4D107E-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.

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.

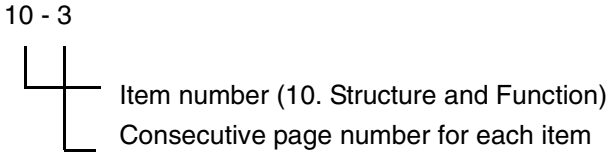
DISTRIBUTION AND UPDATING

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

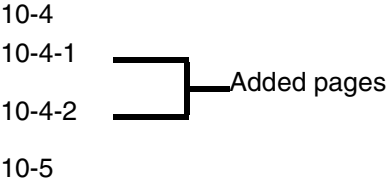
1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number:

Example:



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.

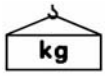
Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work.
★	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire 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

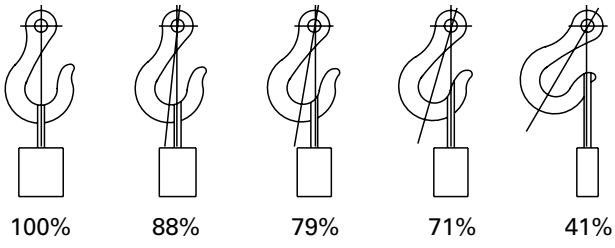
3. Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

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.

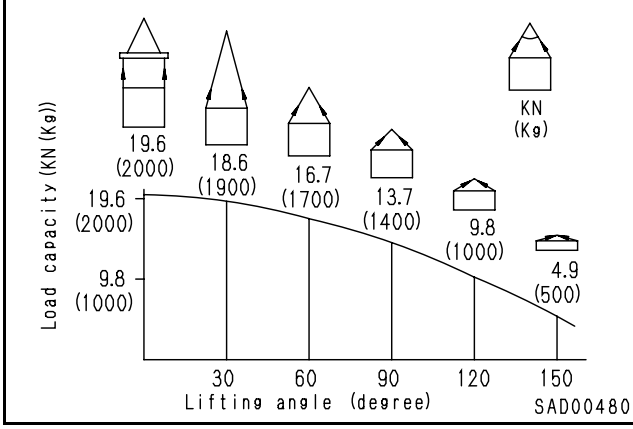


5. Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.

⚠ 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}

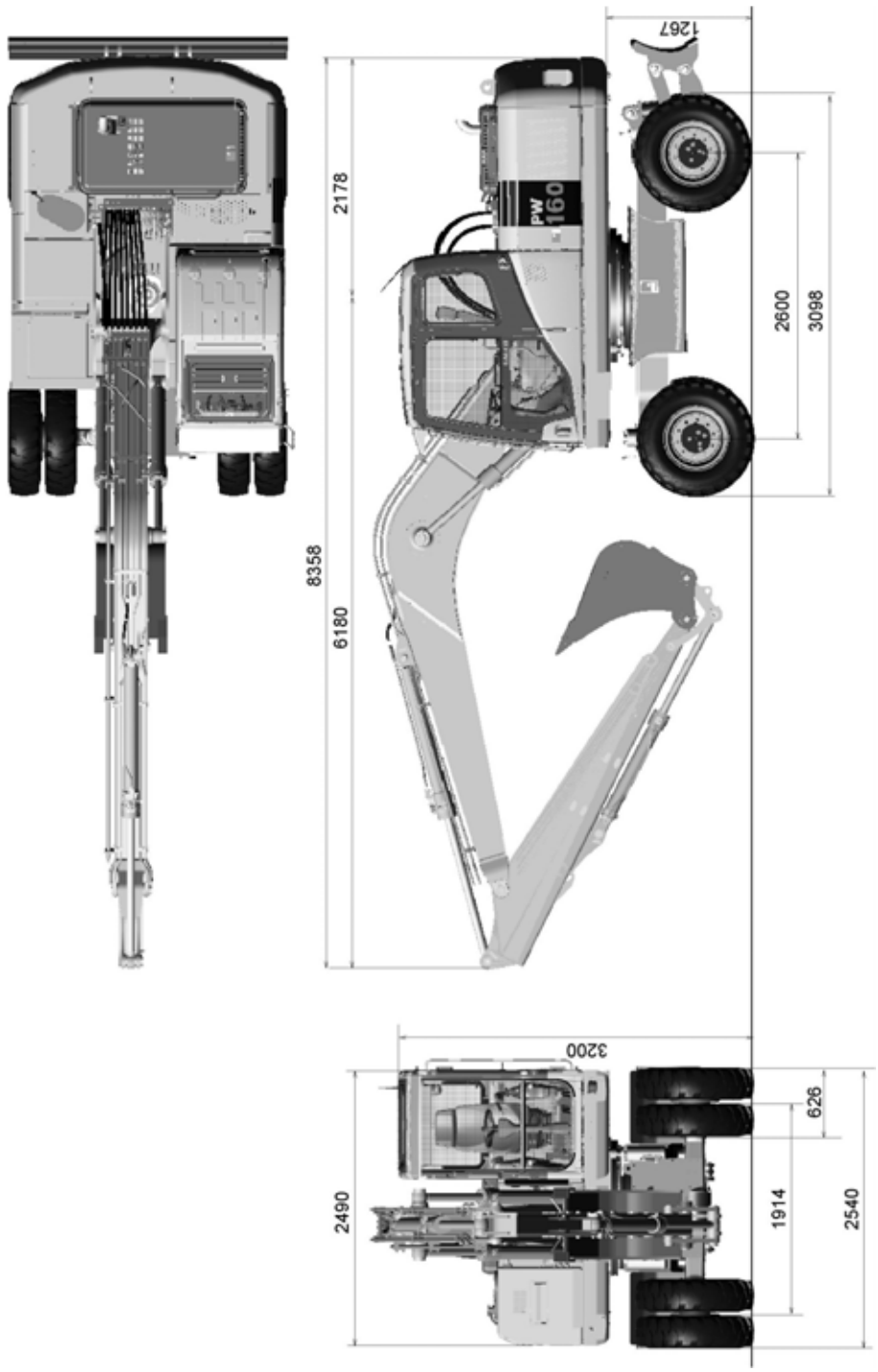
01 GENERAL

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SPECIFICATION DIMENSION DRAWINGS

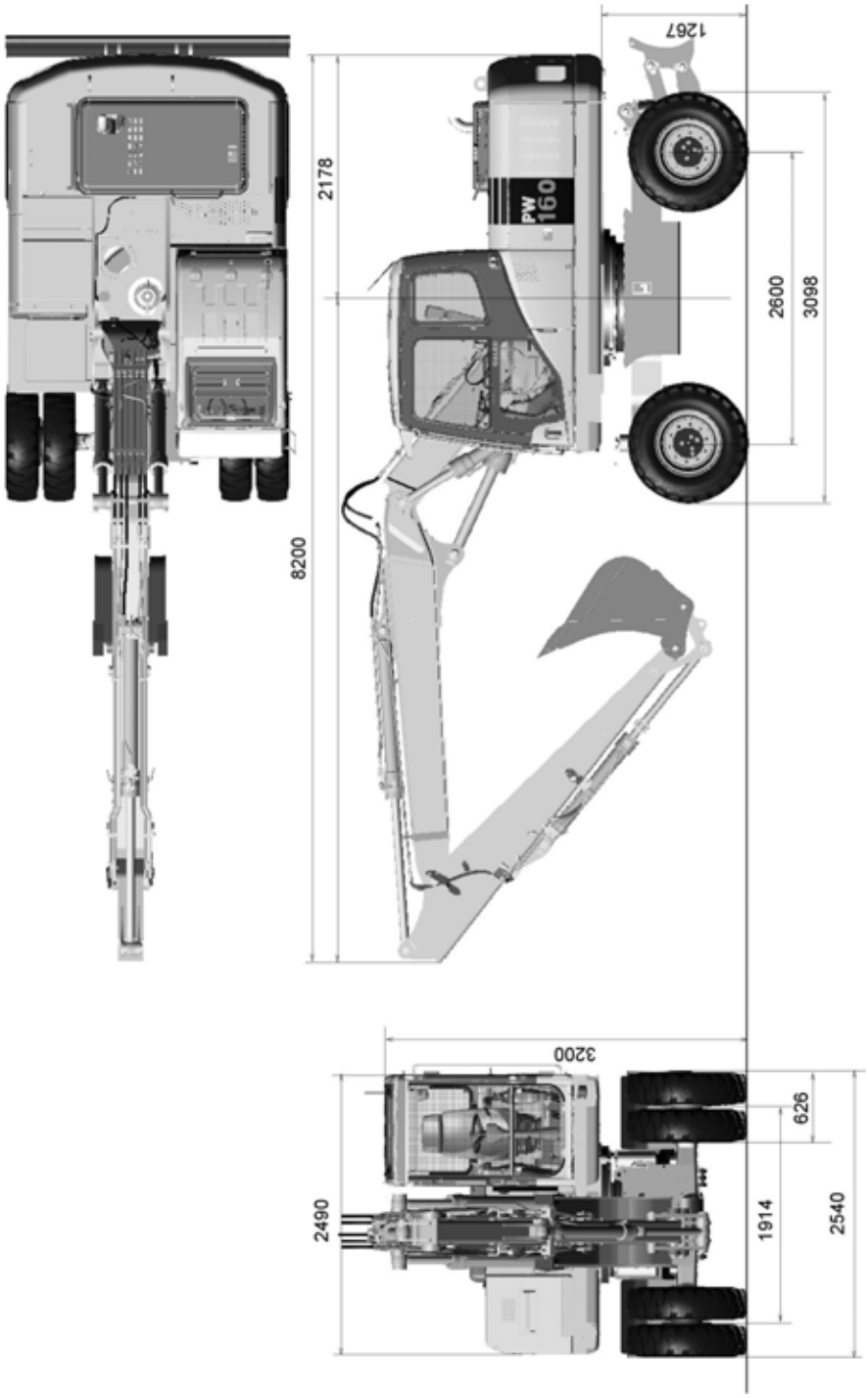
DIMENSIONS

1 PIECE BOOM



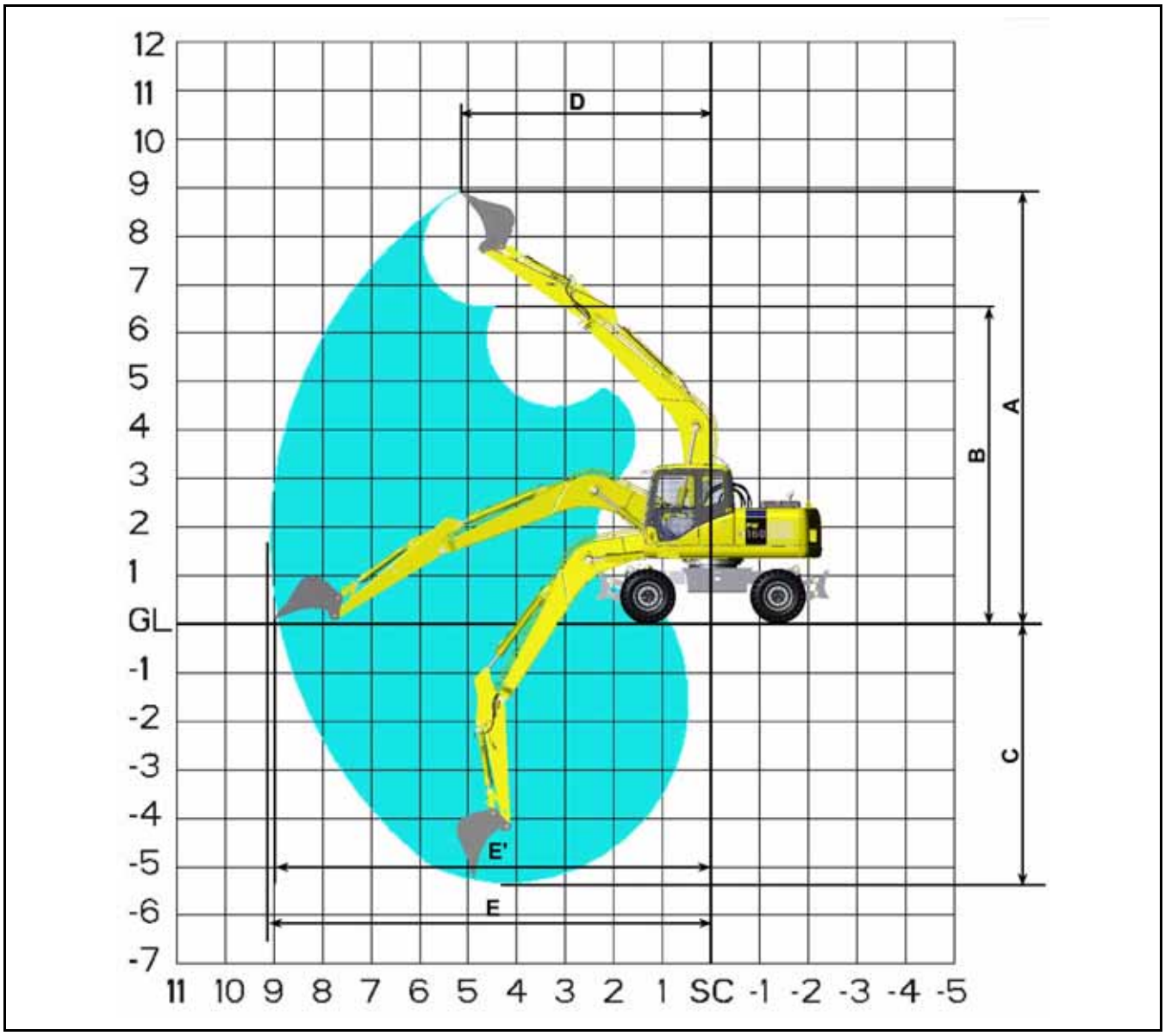
DIMENSIONS

2 PIECE BOOM



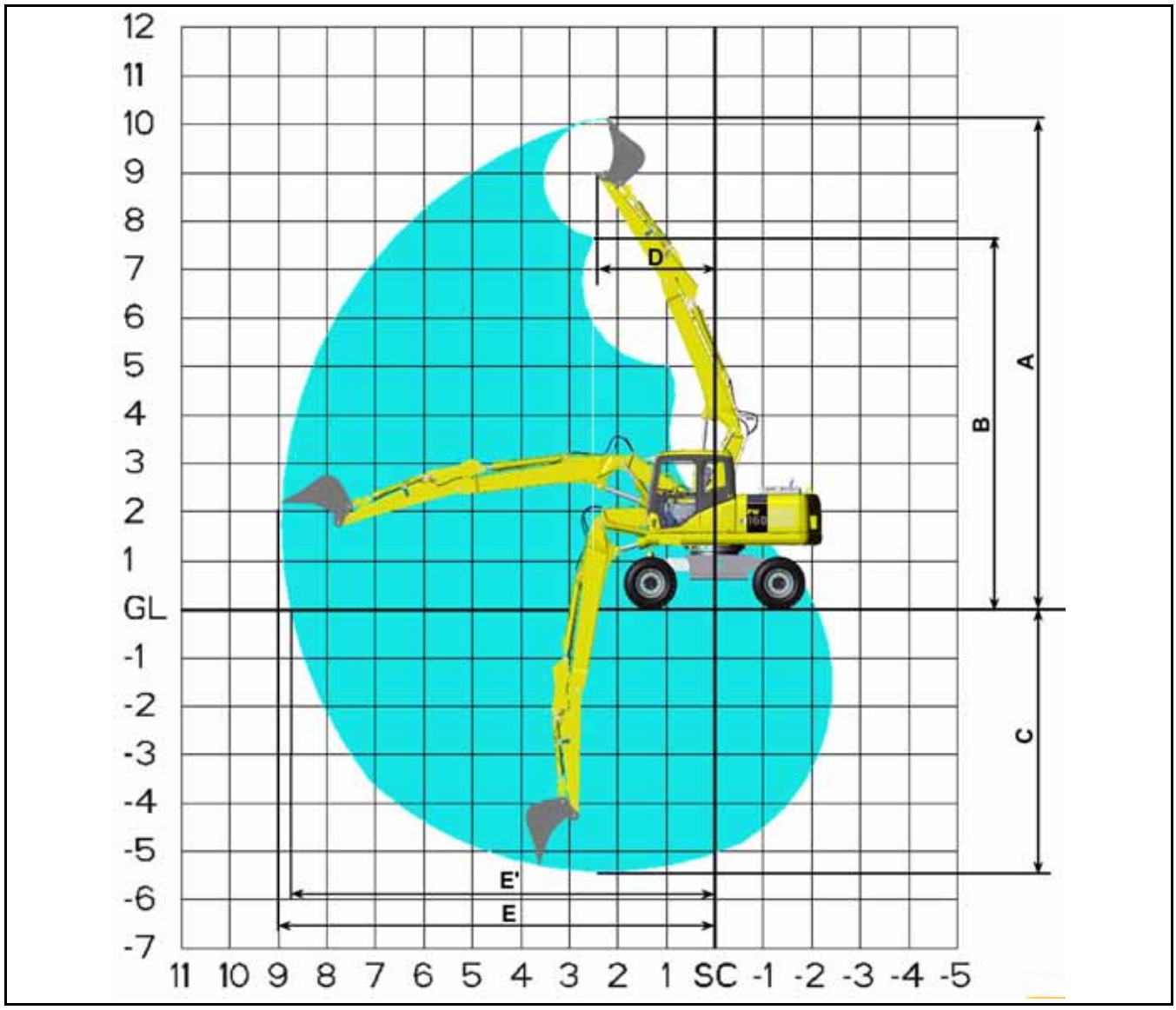
WORKING RANGES

1 PIECE BOOM



Arm length mm (Tt/In)		2100	2500	3000
A	Max. digging height	8730	8930	9285
B	Max. dumping height	6335	6555	6911
C	Max. digging depth	4925	5320	5600
D	Min. swing radius	3205	3160	3180
E'	Max. digging reach ay GL	8620	8885	9315
E	Max. digging reach	8640	9070	9485

2 PIECE BOOM



Arm length mm (Tt/In)		2100	2500	3000
A	Max.digging height	9745	10118	10575
B	Max.dumping height	7285	7655	8117
C	Max digging depth	4960	5465	5770
D	Min. swing radius	2215	2385	2590
E’	Max. digging reach ay GL	8310	8745	9225
E	Max. digging reach	8505	8930	9410

SPECIFICATIONS

Machine model				PW160-7E0
Serial Number				H55051 and up
Bucket capacity		Arm size (m)	m^3	0.55
Operating weight			kg	15,800*
Performance	Max. digging force (using power max. function)	2.1	kN {kg}	102.0 {10,400}
		2.5		
		3.0		
	Swing speed		rpm	11.5
	Swing max. slope angle		deg.	21.5
	Travel speed		km/h	Cr : 0-2.5 Lo : 0-10 Hi : 10-35 (Germany :10-20)
	Gradeability		deg. kPa {kg cm^2}	35 36.3 {0.37}
	Standard Tyre Width		mm	10.00 - 20

* Weight will vary depending on specification.

Machine model							PW160-7E0	
Serial Number							H55051 and up	
Engine	Model Type No. of cylinders - bore x stroke Piston displacement				mm l {cc}		SAA4D107E-1 4-cycle, water-cooled, in-line, vertical, direct injection, with turbo charger 4 - 107 x 124 4.5 {4500}	
	Performance	Flywheel horsepower Max. torque Max. speed at no load Min. speed at no load			kW/rpm Nm/rpm rpm rpm		96.9/2200 471/1500 2,450 1040	
	Starting motor Alternator Battery						24V, 4.5 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 308 x 1 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					A6VM107 HAXT/63W-VAB380A-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: Double acting piston	Arm: Double acting piston	Bucket: 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		110 75 960 2,660 1,700	115 80 1,175 2,877 1,702	105 70 885 2,263 1,378
	Hydraulic cylinder 2 Pice Boom	Type				Adjust	Boom: L.H / R.H: Double acting piston	Arm: Double acting piston	Bucket: 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	160 100 702 1,900 1,198	115 75 996 2,509 1,527	115 80 1,175 2,877 1,702	105 70 885 2,263 1,378
	Hydraulic tank Hydraulic filter Hydraulic cooler						Closed box type Tank return side Air cooled		

WEIGHT TABLE

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

Unit: kg

Machine model		PW160-7E0
Serial Number		H55051 and up
Engine assembly • Engine • Damper • Hydraulic pump		505.5 390 6.0 114
Radiator oil cooler assembly		107
Hydraulic tank, filter assembly (excluding hydraulic oil)		125
Fuel tank (excluding fuel)		120
Revolving frame		1,490
Operator's cab		286
Operator's seat	Mechanical	38
	Air Suspension	42
Counterweight		3,100
Swing machinery		170
Control valve		117
Travel motor		67
Center swivel joint		95

1 PIECE BOOM

Unit: kg

Machine model		PW160-7E0
Serial Number		H55051 and up
Boom assembly		1010
Arm assembly	2.1m	288.5
	2.5m	326
	3.0m	458
Bucket assembly		460
Lift cylinder	Left Hand	140.5
	Right Hand	140.5
Arm cylinder assembly		146.9
Bucket cylinder assembly	2.1m	90
	2.5m	
	3.0m	
Link / pins assembly		124.5
Boom pin		6.3 + 12 + 19.5
Arm pin		12

2 PIECE BOOM

Unit: kg

Machine model		PW160-7E0
Serial Number		H55051 and up
Boom assembly	1st Boom	467.5
	2nd Boom	660
Arm assembly	2.1m	288.5
	2.5m	326
	3.0m	458
Bucket assembly		460
Lift cylinder	Left Hand	131.3
	Right Hand	131.95
Adjust cylinder		190.8
Arm cylinder assembly		146.9
Bucket cylinder assembly	2.1m	90
	2.5m	
	3.0m	
Link / pins assembly		124.5
Boom pin	1st Boom	33.1
	2nd Boom	12
Arm pin		12

FUEL, COOLANT AND LUBRICANTS

Reservoir		Kind of fluid	AMBIENT TEMPERATURE		Type of oil	CAPACITY	
			Min.	Max		Specified	Refill
Engine oil pan		Engine oil	-30° C	30° C	Komatsu EOS0W30	17 litre	17 litre
			-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		Engine oil	-20° C	40° C	SAE 30	4.5 litre	4.5 litre
PTO gear case						0.75 litre	0.75 litre
Hydraulic system		Bio-oil	-20° C	30° C	Panolin HLP synth 46	167 litre	120 litre
		Hydr-oil	-20° C	50° C	Komatsu H046-HM		
		Engine oil	-25° C	40° C	Komatsu EOS5W40		
			-20° C	40° C	Komatsu EO10W30DH		
			-15° C	40° C	Komatsu EO15W40DH		
Grease fitting		Hyper grease	-20° C	50° C	G2-T, G2-TE		
		Lithium EP grease	-20° C	50° C	G2-LI		
Fuel tank		Diesel fuel	-10° C -30° C	40° C -10° C	ASTM D975 No. 2 ASTM D975 No 1 (for winter use)	300 litre	
Cooling system		Supercoolant AF-NAC	-30° C	50° C	AF-NAC (density: between 30% and 68%)	18 litre	
Axles	Front	Multi oil	-30° C	40° C	Fuchs titan hydra 20W-40	10.5 litre	
	Rear					9.5 litre	
Transmission + clutch					BP tractran 8	4.85 litre	4.85 litre
Hubs	Front		-20° C	40° C	Fuchs titan hydra 20W-40	2.5 litre	
	Rear					2.0 litre	

REMARK

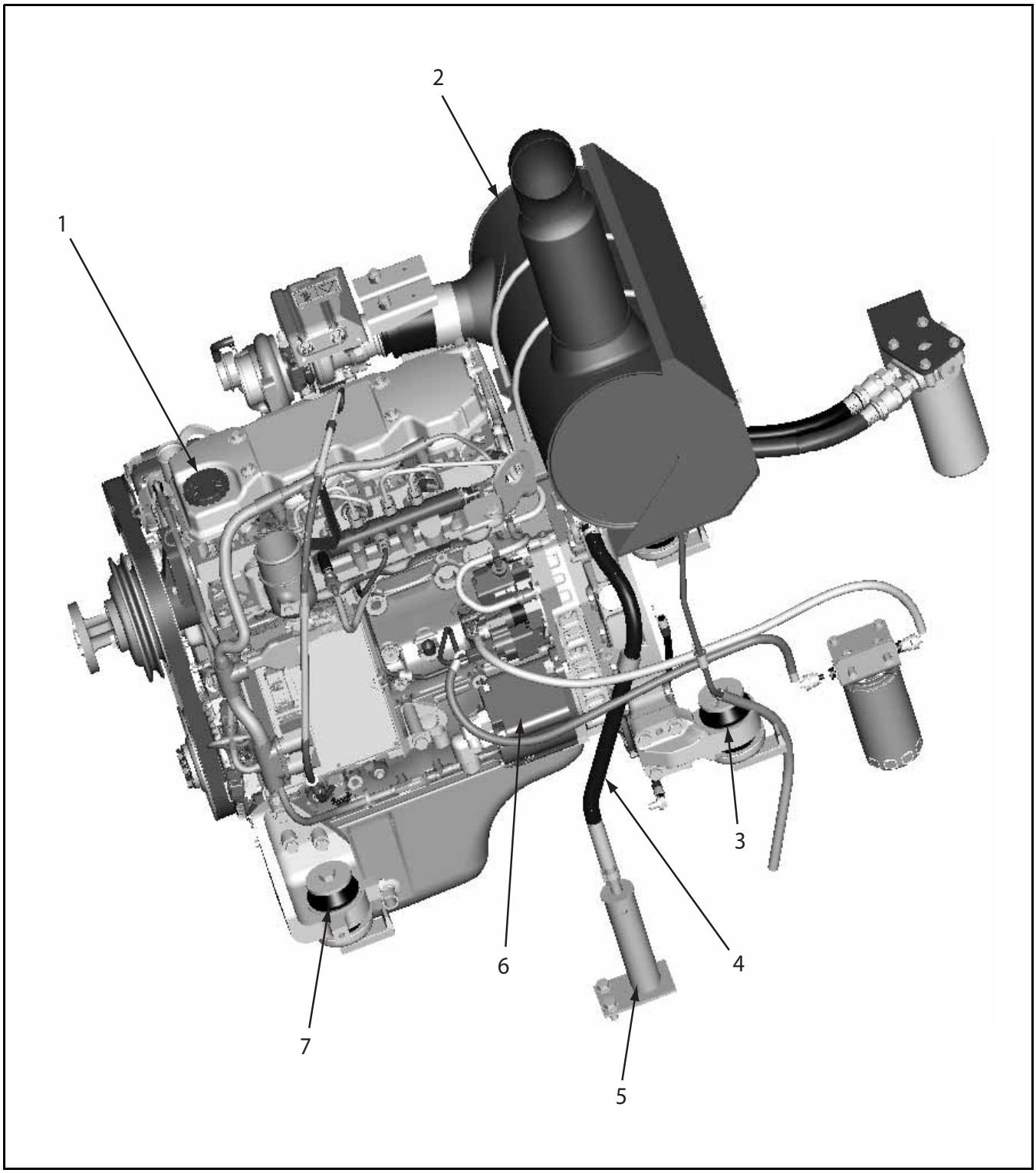
- We recommend Komatsu genuine oil which has been specifically formulated and approved for use in engine and hydraulic work equipment applications.
- Only use high quality oils which meet internationally recognized specifications.

Blank for technical reason

STRUCTURE, FUNCTION AND MAINTENANCE STANDARD

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ENGINE RELATED PARTS

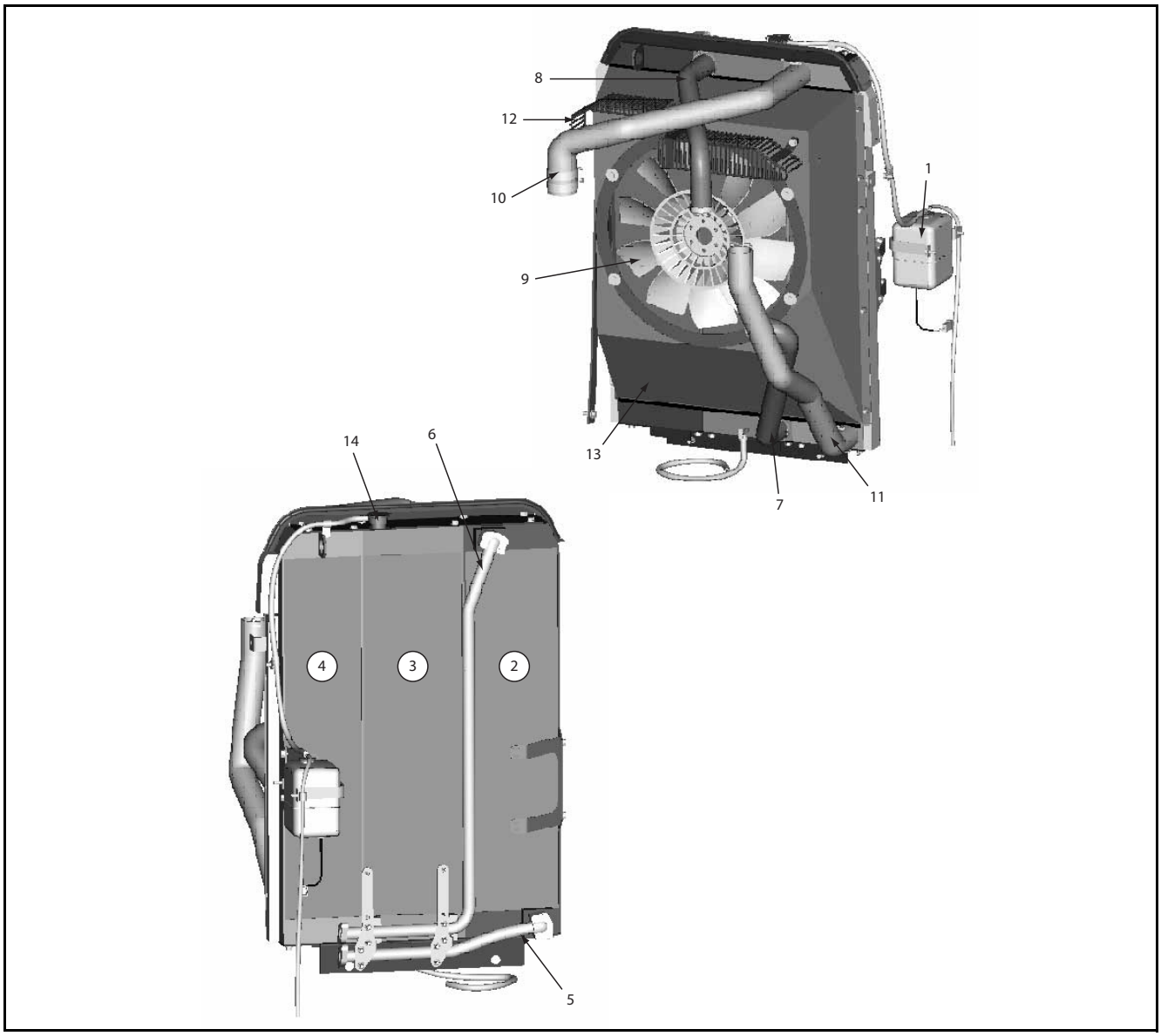


1. Breather cap
2. Muffler
3. Rear engine mount
4. Breather hose
5. Oil catcher tube
6. Brake/Steer pump
7. Front engine mount

OUTLINE

- The damper assembly is a wet type.

RADIATOR • OIL COOLER • CHARGE AIR COOLER



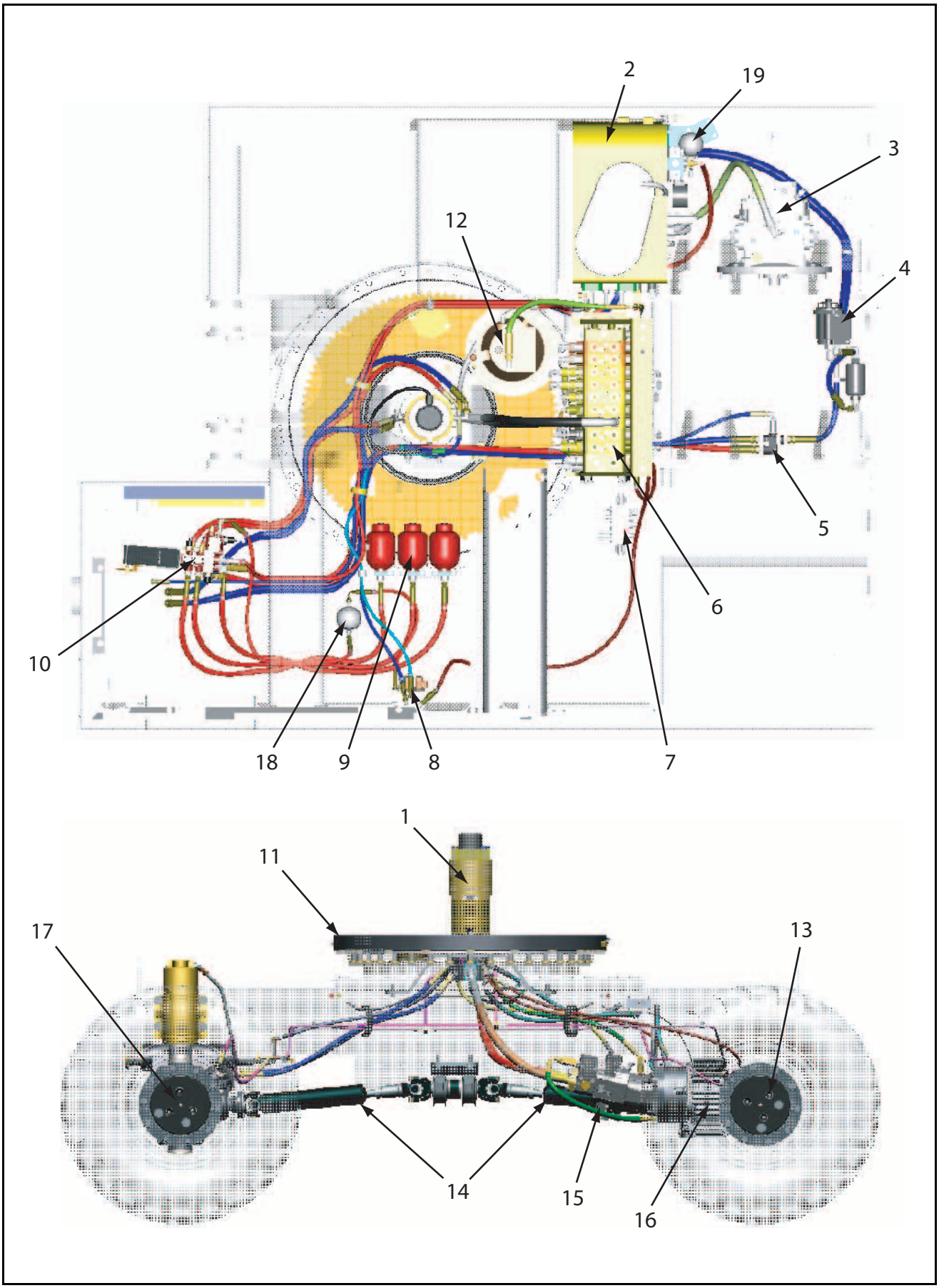
1. Reservoir tank
2. Oil cooler
3. Radiator
4. Charge Air Cooler
5. Oil Cooler outlet tube
6. Oil Cooler inlet tube
7. Radiator outlet hose
8. Radiator inlet hose
9. Fan
10. Charge Air Oil Cooler outlet hose
11. Charge Air Oil Cooler inlet hose
12. Net
13. Shroud
14. Radiator Cap

SPECIFICATIONS:

Combination Cooler

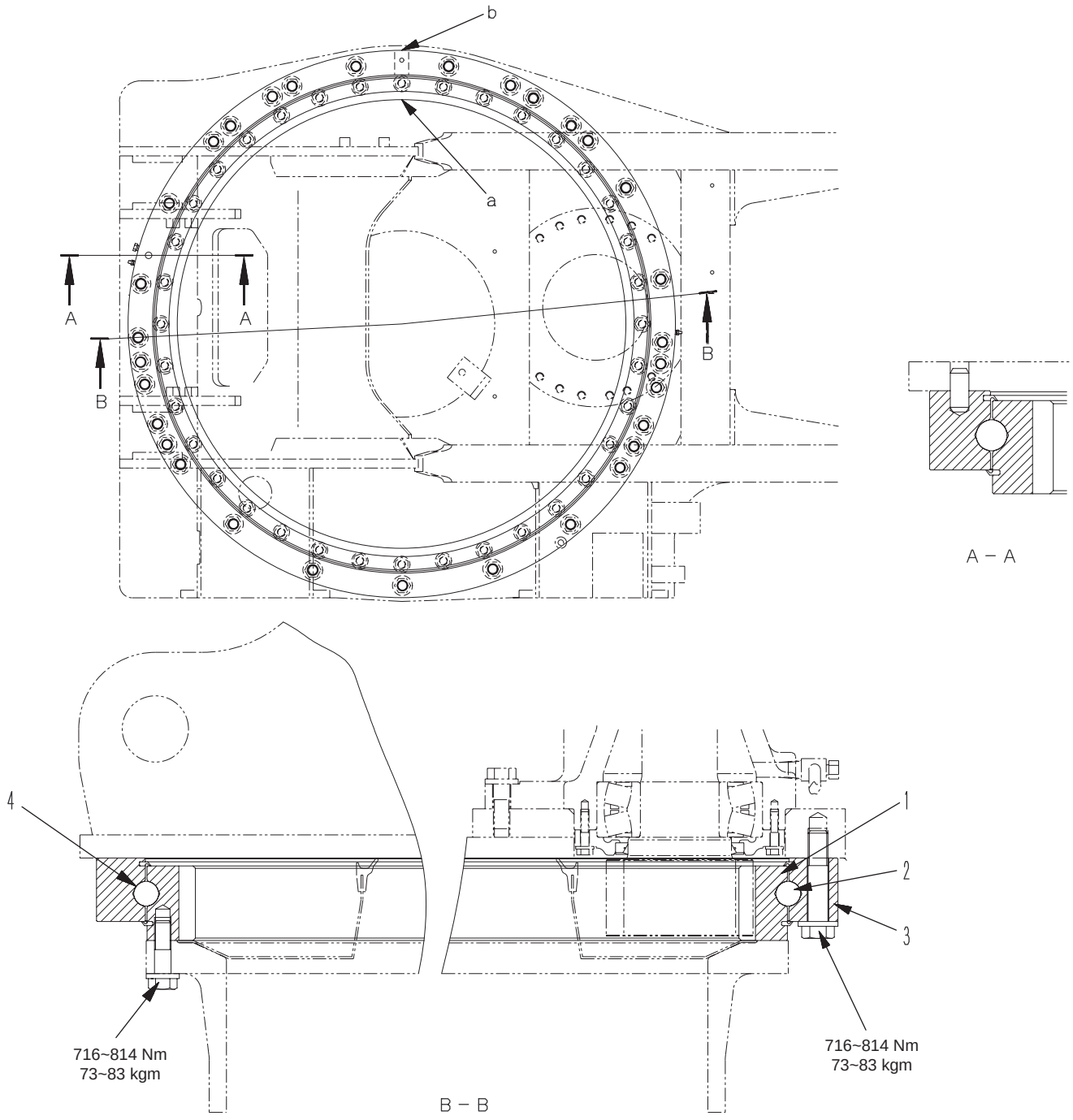
	Oil	Coolant	Air
Max working pressure. bar	10	0.6	1.7
Max working temperature ^{o}C	100	100	75
Cooler volume l.	6.5	7	7.6

POWER TRAIN



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

SWING CIRCLE



SJP09097A

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

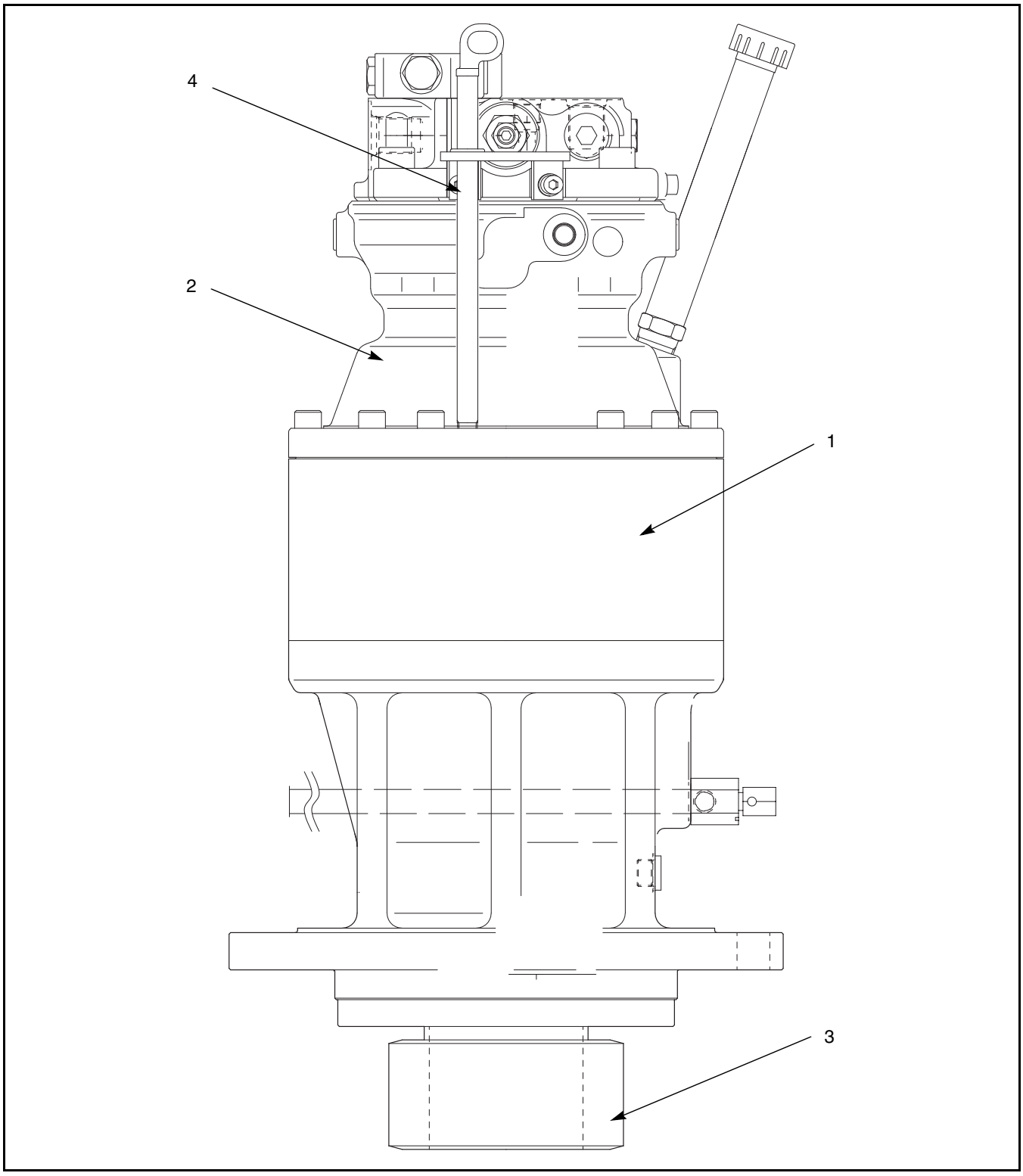
Reduction ratio:

$$\frac{92}{13} = 7.615$$

Amount of grease: 10.5 litres

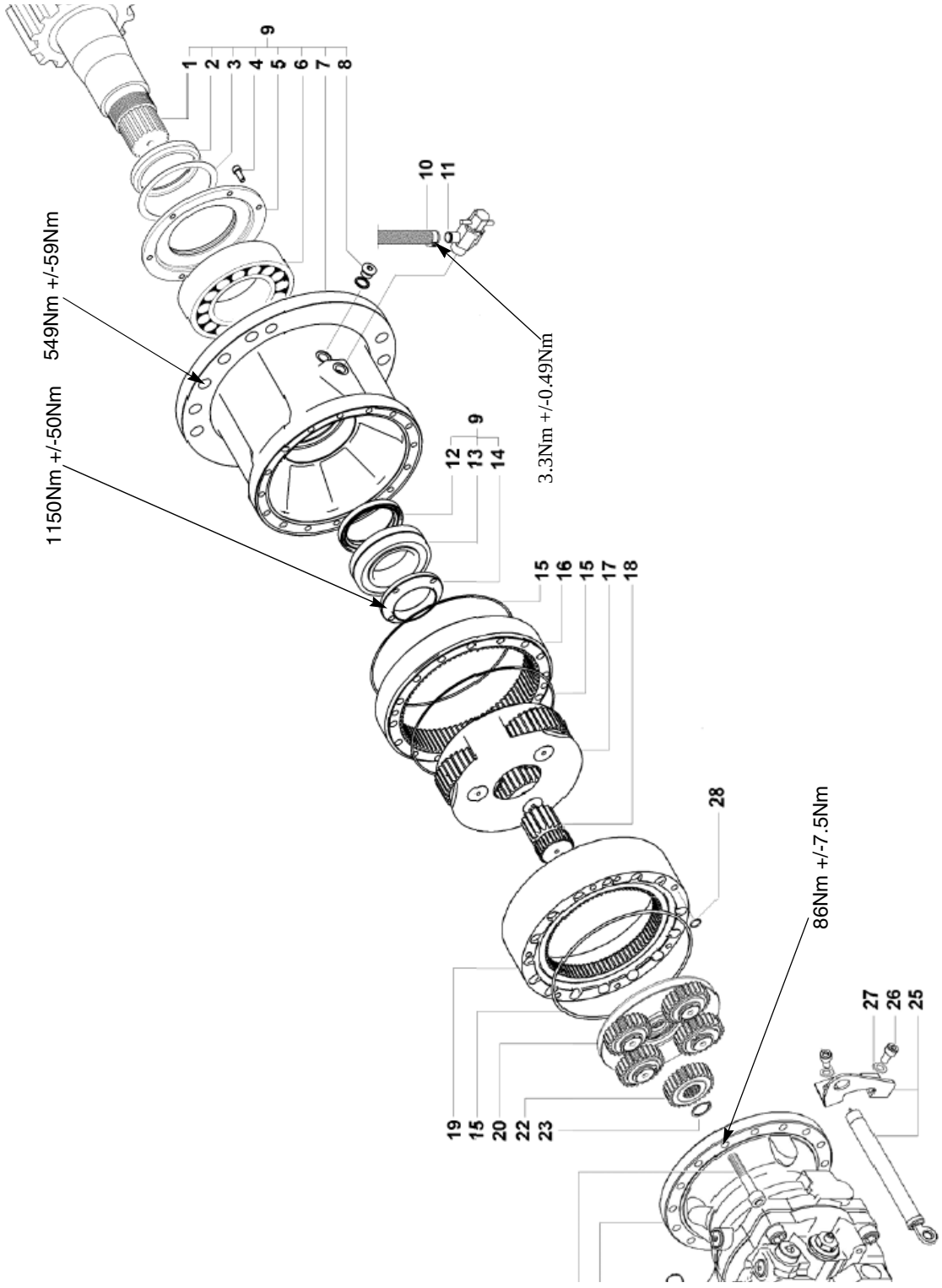
No	Check item	Criteria		Remedy
4	Axial clearance of bearing	Standard clearance	Clearance limit	Replace
	(when mounted on chassis)	0.5-1.6	3.2	

SWING MACHINERY & MOTOR



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

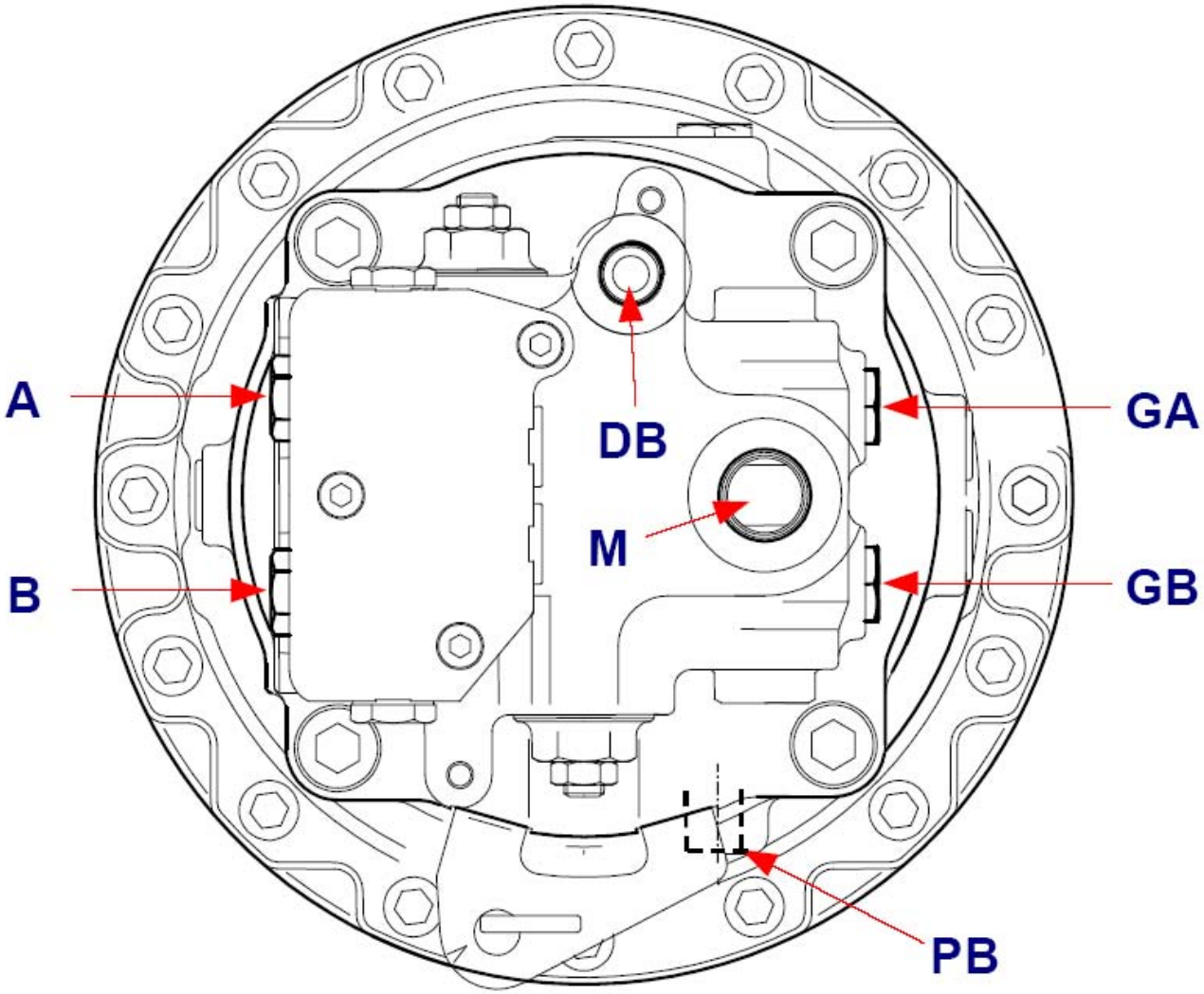
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549Nm +/-59Nm
1150Nm +/-50Nm
3.3Nm +/-0.49Nm
86Nm +/-7.5Nm
1
2
3
4
5
6
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9
10
11
12
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28

1.	Pinion shaft	16.	Toothed ring
2.	Spacer	17.	Reduction assembly
3.	Sealing	18.	Sun gear
4.	Screw	19	Cover
5.	Cover	20.	Reduction assembly
6.	Bearing	21.	Screw
7.	Gearbox housing	22.	Sun gear
8.	Plug	23.	Circlip
9.	Output assembly	24.	Lubrication kit
10.	Lubrication kit	25.	Lubrication kit
11.	Cock	26.	Screw
12.	Seal ring	27.	Washer
13.	Bearing	28.	O-ring
14.	Nut	29.	Hydraulic motor
15.	O-ring		

SWING MOTOR

MSF 85P

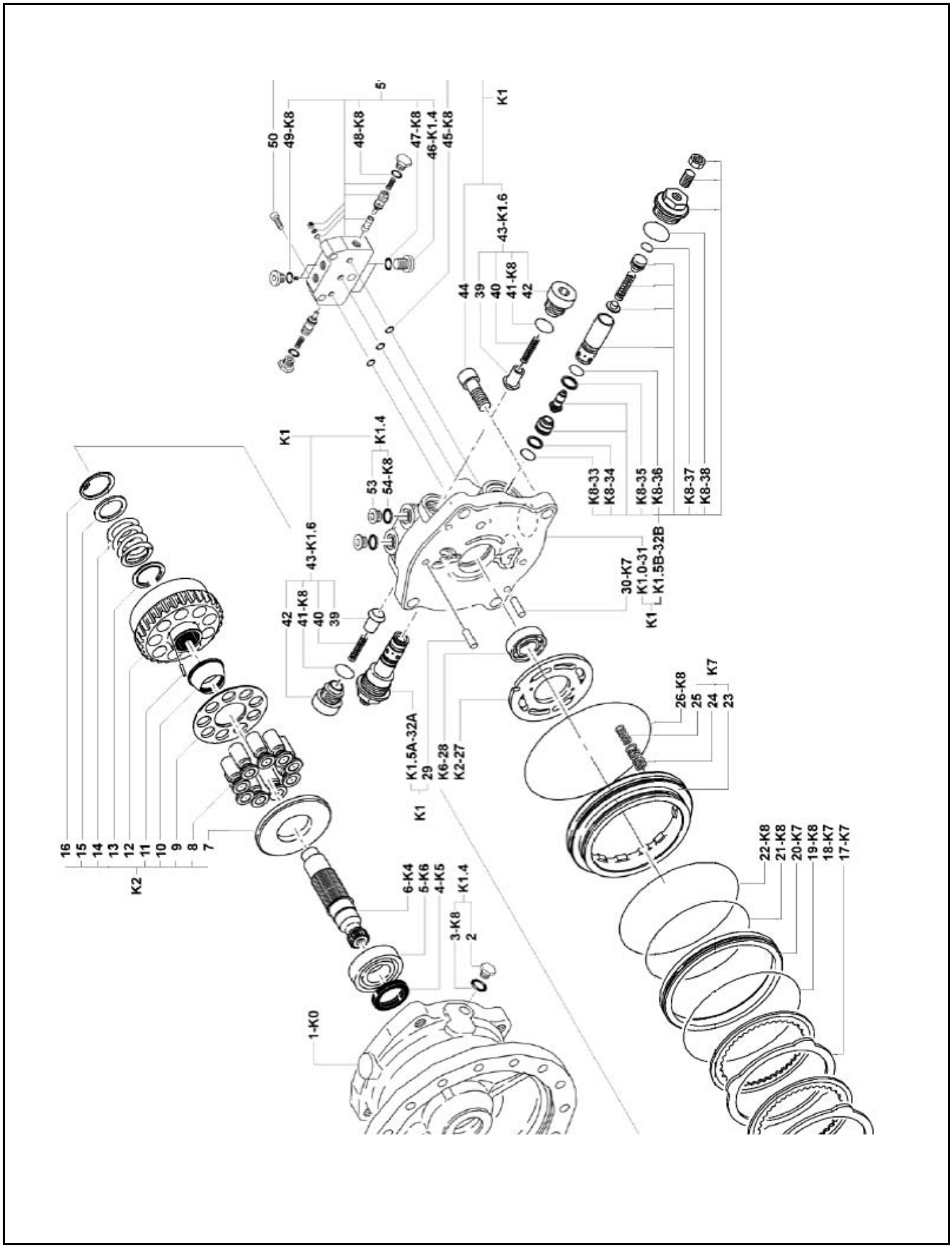


A B	Service ports
M	Anti-cavitation
DB	Drain port
GA GB	Pressure gauge ports
PB	Brake port

SPECIFICATIONS

	PW160-7E0
Model	MSF85P
Theoretical displacement	87.3 cm^3/rev
Safety valve set pressure	19.6 MPa {200 kg/cm^2}
Rated revolving speed	1,553 rpm
Brake release pressure	1.9 MPa {19 kg/cm^2}

Blank for technical reason


50
49-K8
48-K8
47-K8
46-K1.4
45-K8
K1
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 L K1.5B-32B
K1.5A-32A
29
K6-28
K2-27
K1
26-K8
25
24
23
K7
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

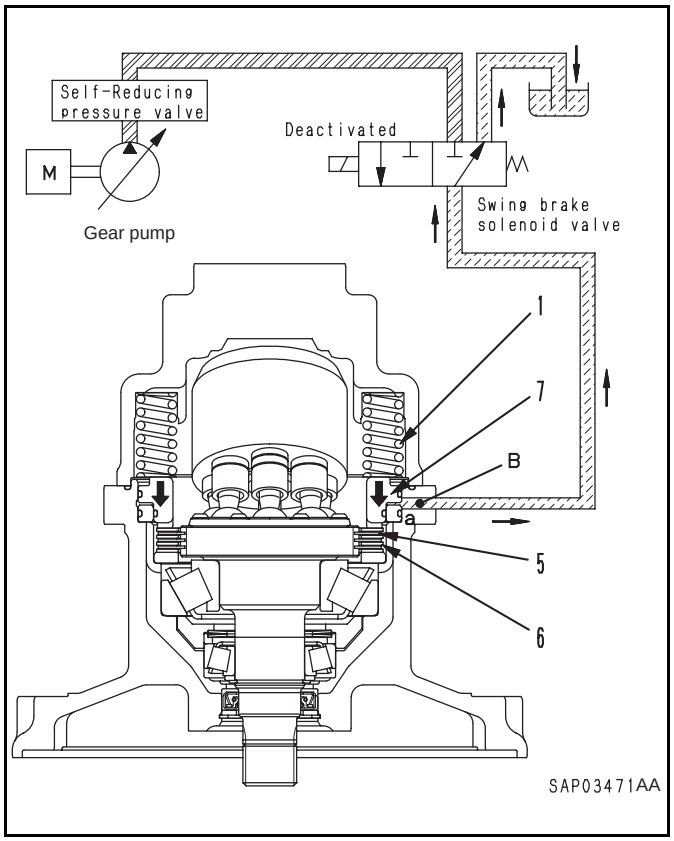
Kit	Ref. No.	Description	Kit	Ref. No.	Description
K0	1	Motor housing kit	K2	13	Collar
K1		Base plate assembly		14	Spring
	29	Pin		15	Collar washer
	31	Base plate		16	Circlip
	32A	Relief valve		27	Valve plate
	32B	Relief valve	K4	6	Motor shaft assembly
	43	Anti-cavitation valve assembly	K5	4	Motor seal 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.

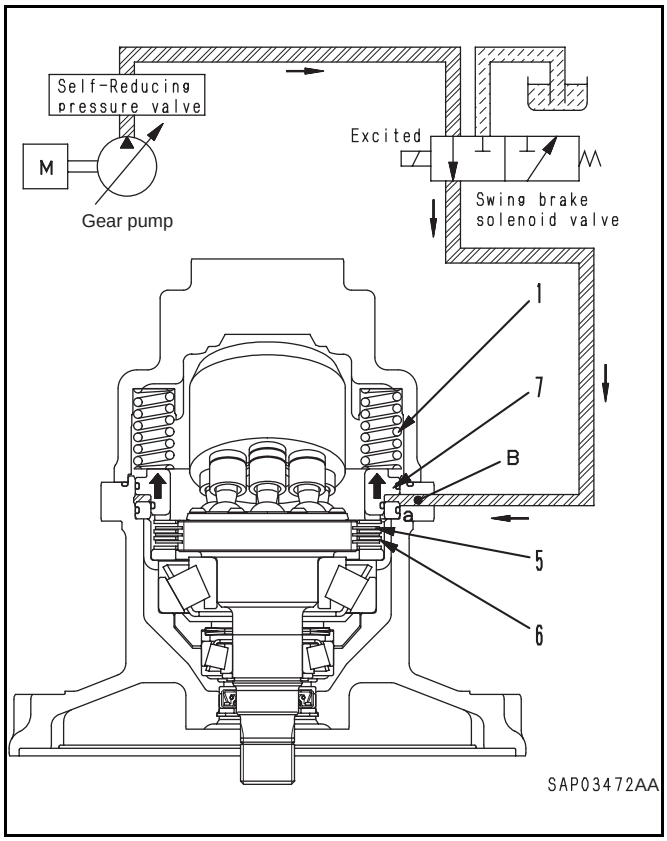
As a result, brake piston (7) is pushed down by brake spring (1), discs (5) and plates (6) are pushed together, and the brake is applied.



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

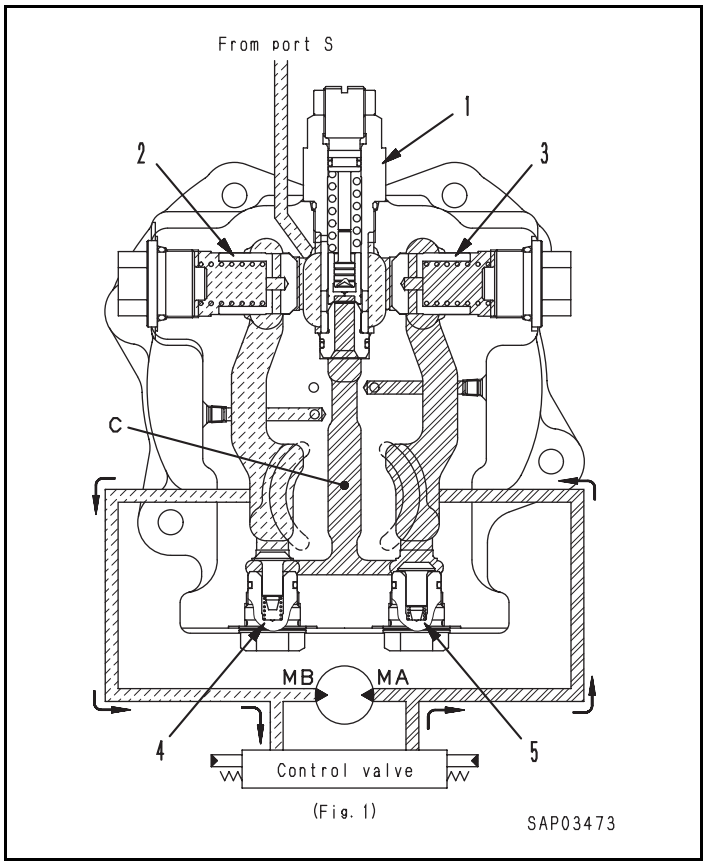
When the swing control lever is operated to swing right, the pressure oil from the pump passes through the control valve and is supplied to port MA. As a result, the pressure at port MA rises, the starting torque is generated in the motor, and the motor starts to rotate. The oil from the outlet port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

2. When stopping swing

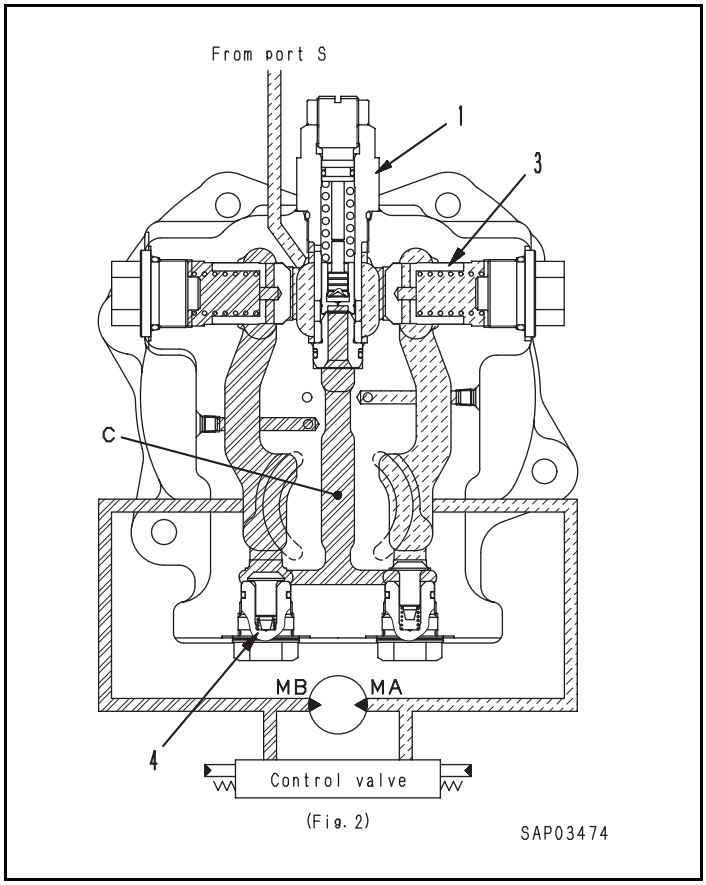
When the swing control lever is returned to neutral, the supply of pressure oil from the pump to port MA is stopped. With the oil from the outlet port of the motor, the return circuit to the tank is closed by the control valve, so the pressure at port MB rises. As a result, rotation resistance is generated 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**.

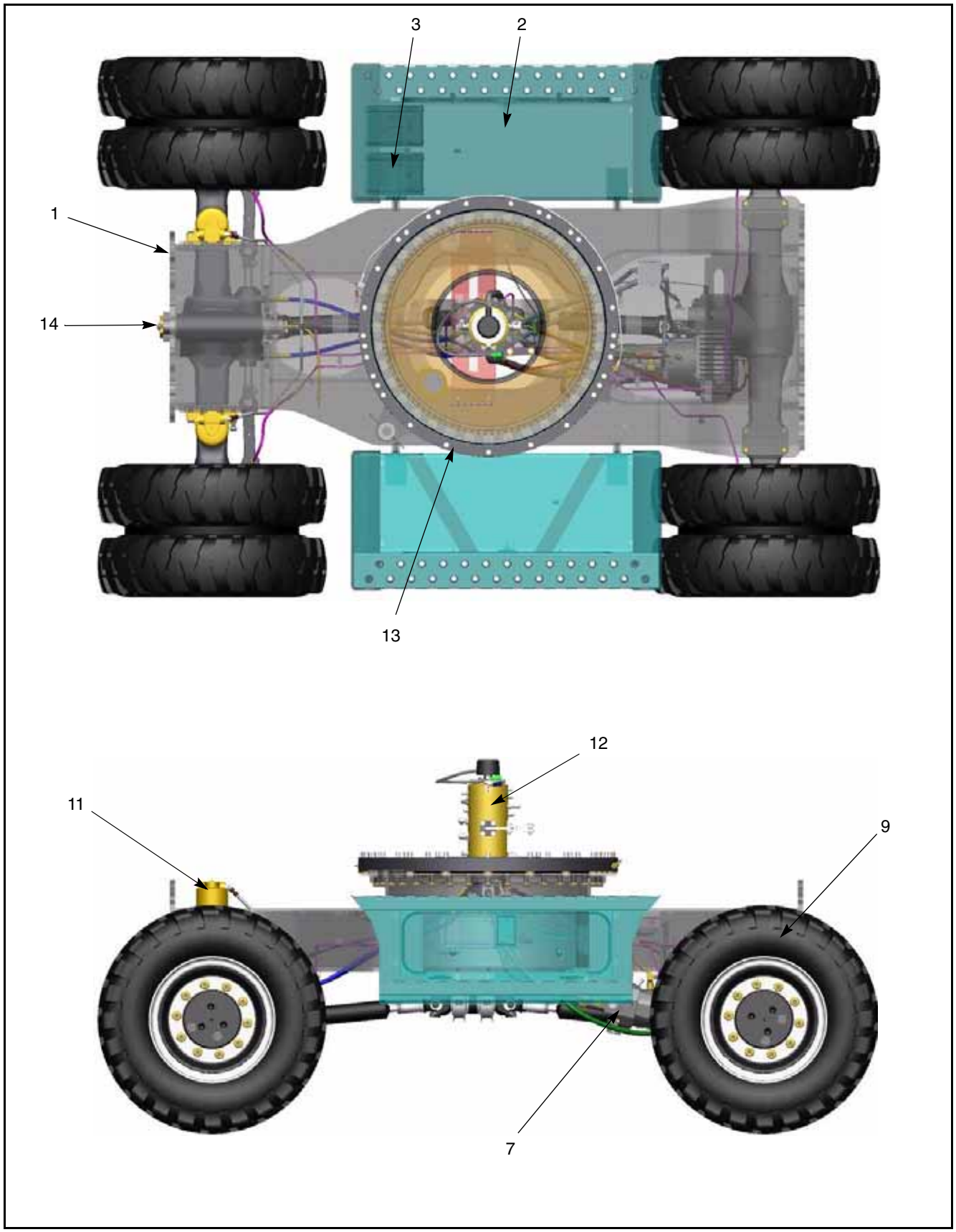


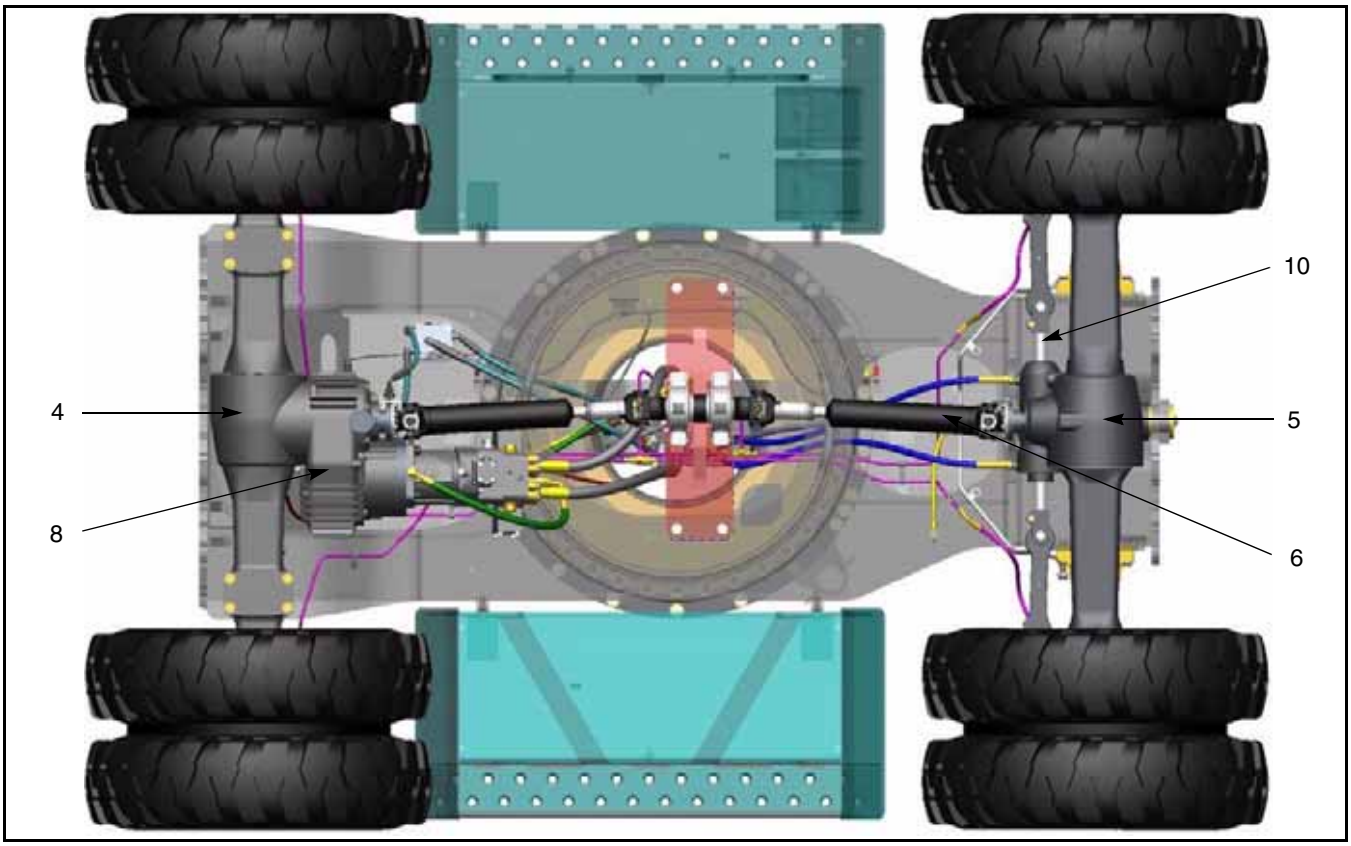
(Fig. 1)



(Fig. 2)

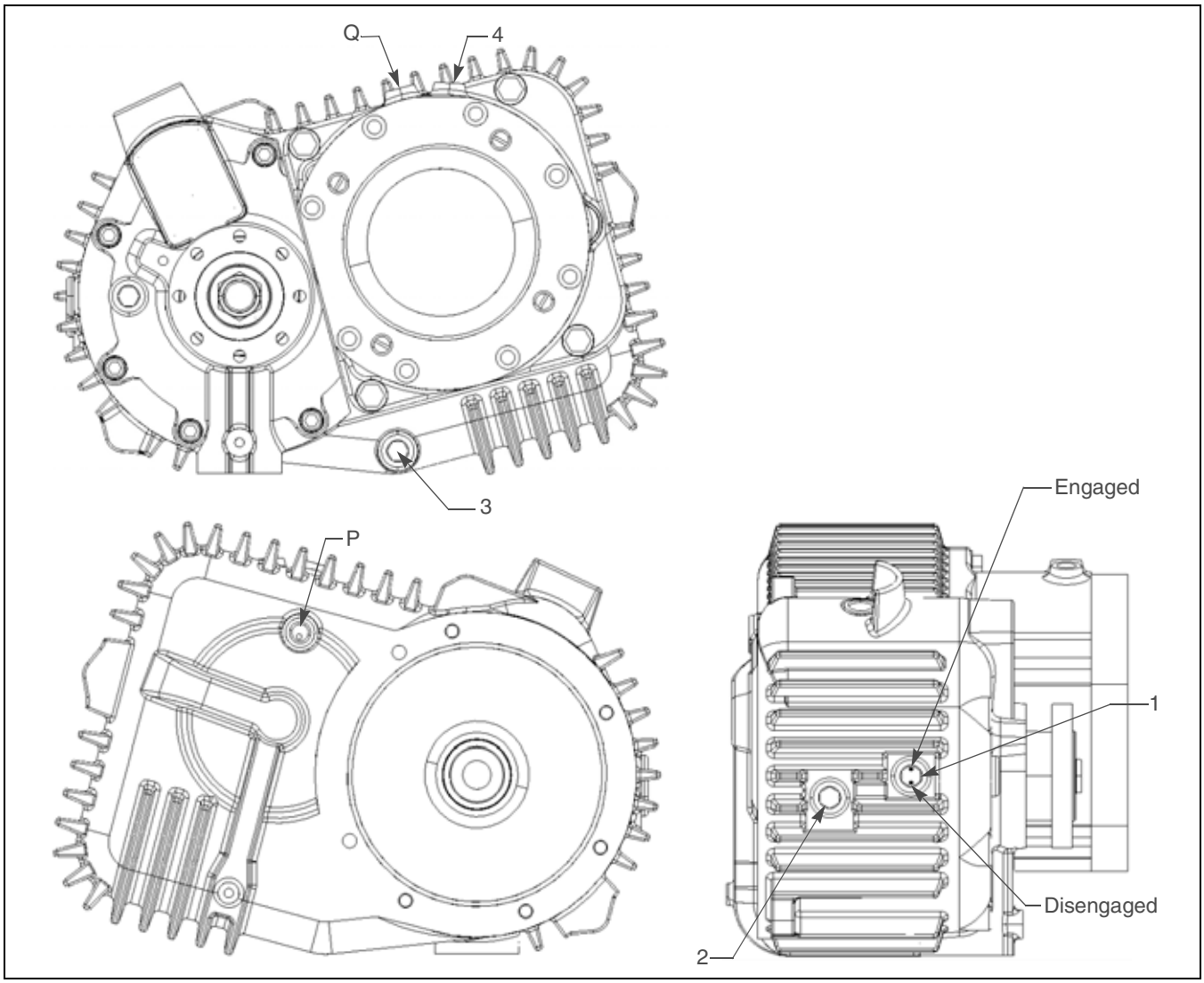
UNDERCARRIAGE





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

TRANSMISSION



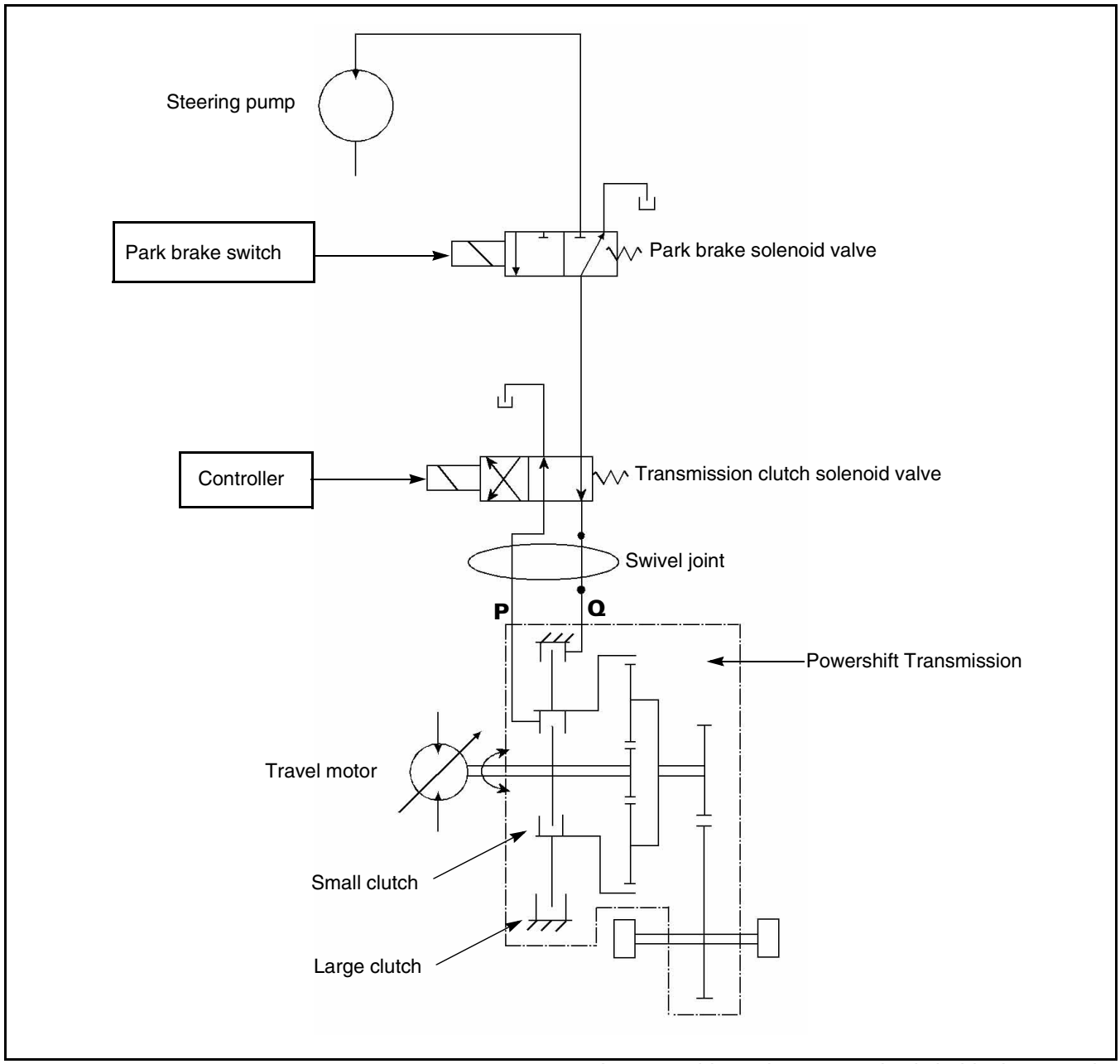
1. Transmission disengagement pin (for towing)
2. Oil filler plug
3. Oil drain plug
4. Breather

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

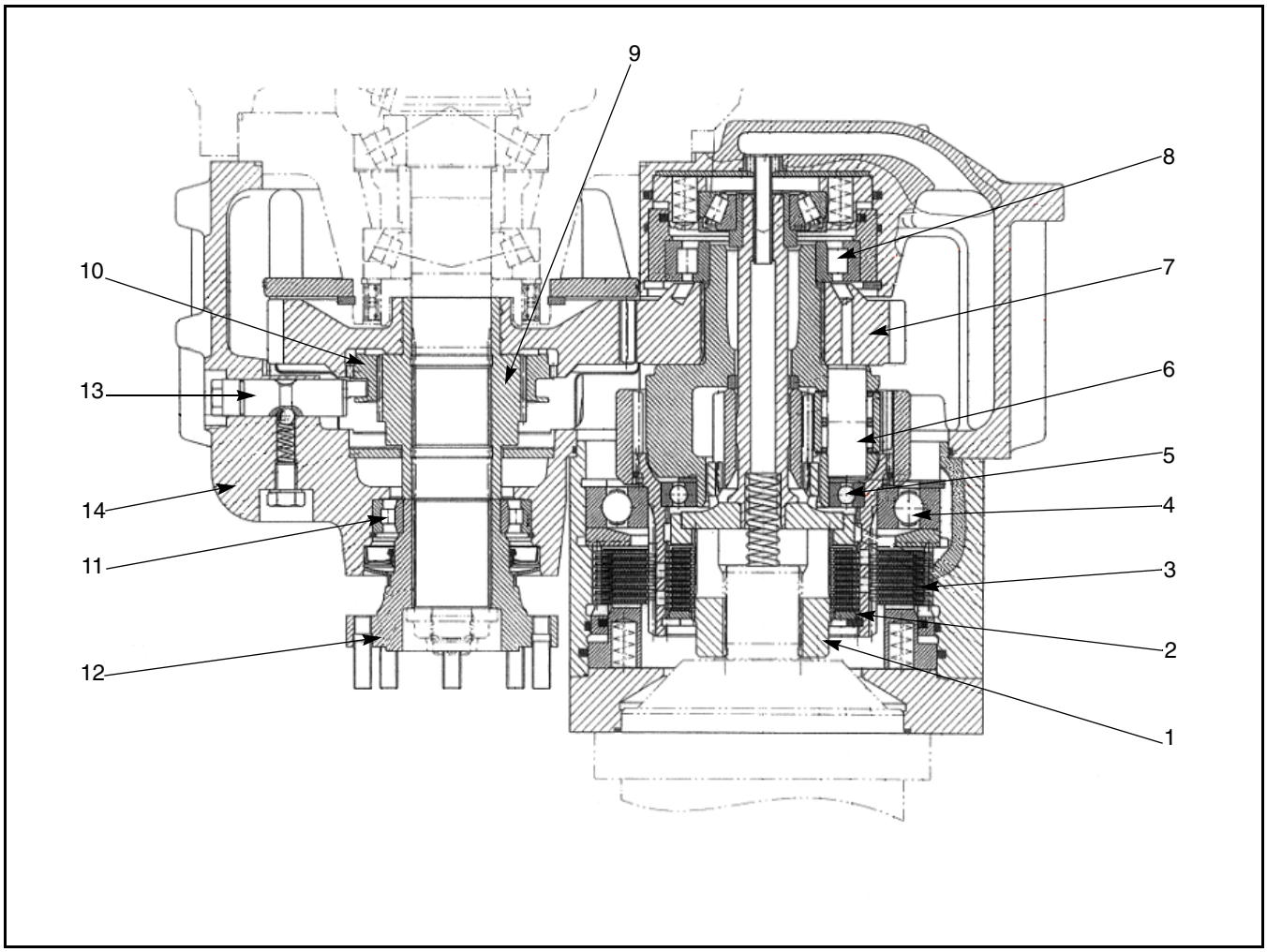
FUNCTION

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.



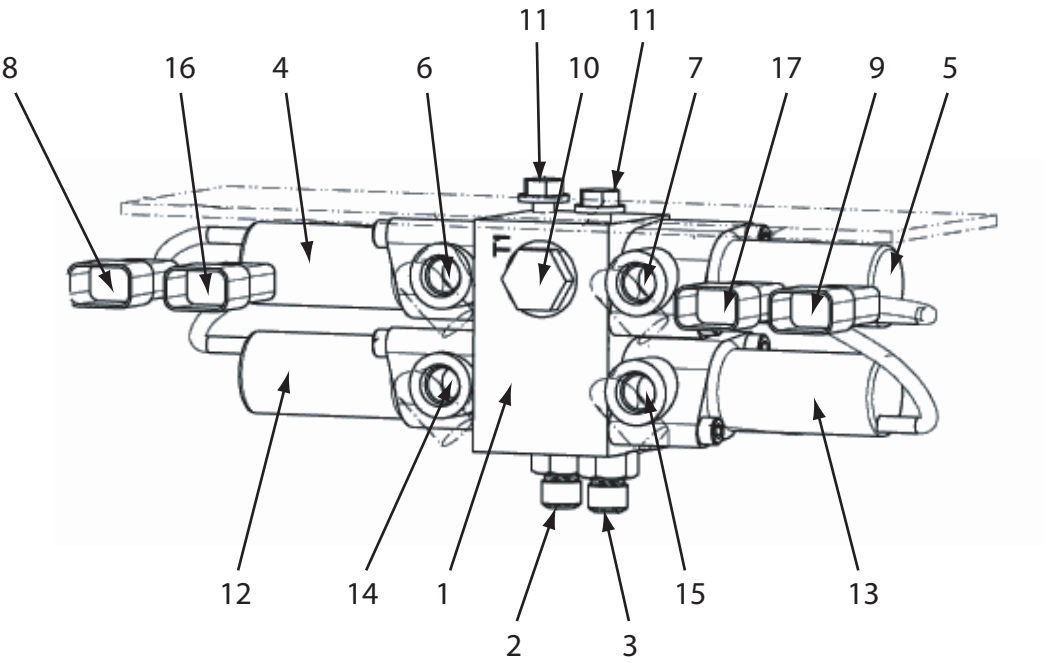
Hi = sun + planets locked together, planetary drive = (1.32 : 1)

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



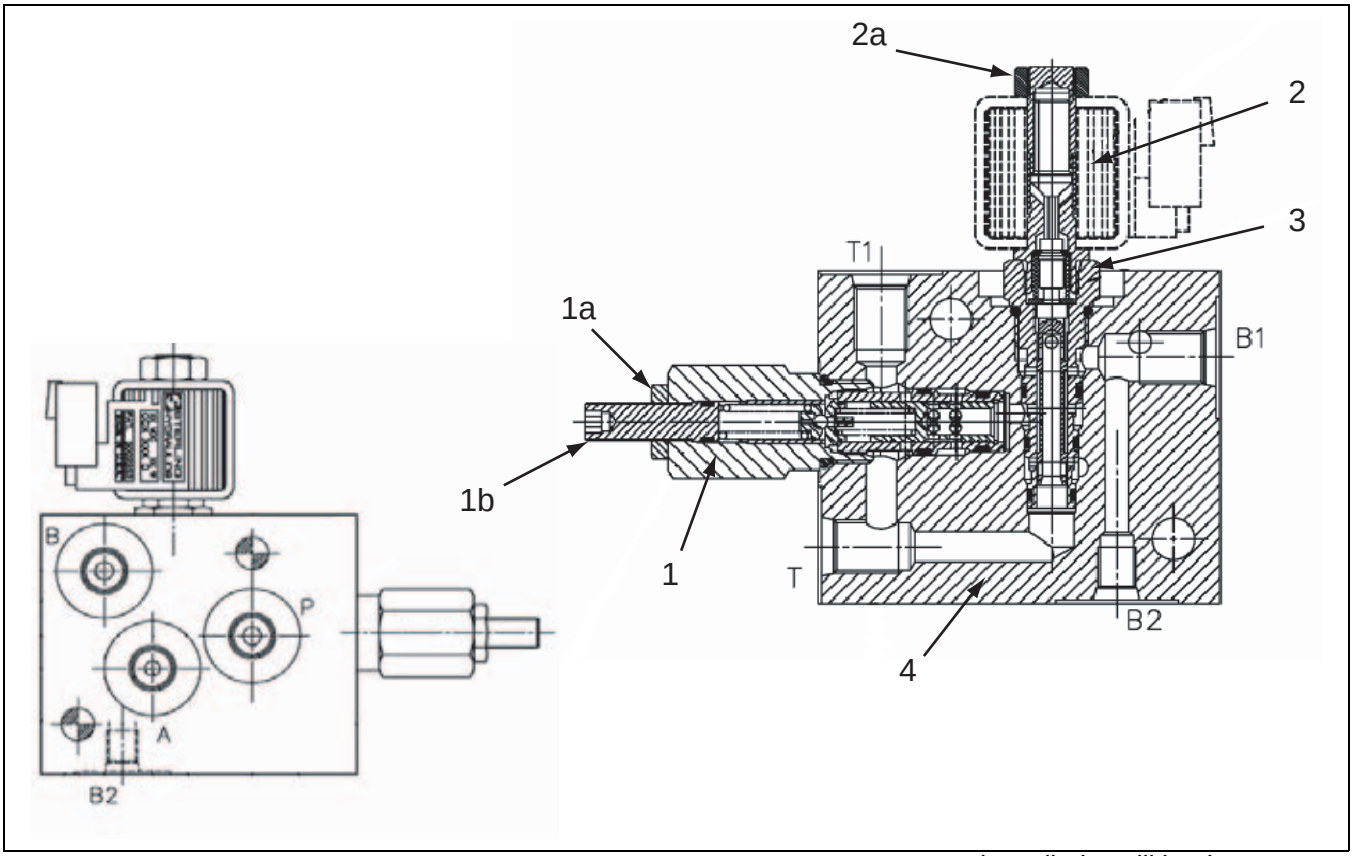
1.	Sleeve	8.	Roller Bearing
2.	Small clutch pack (high gear)	9.	Spur Gear
3.	Large clutch pack (low gear)	10.	Coupling
4.	Ball Bearing	11.	Bearing
5.	Bearing	12.	Flange
6.	Epicyclic Gearbox	13.	Pin
7.	Spur Gear	14.	Casing

ATT EPC VALVE ASSEMBLY



3) Valve Manifold
4) Port 'P'
5) Port 'T'
6) 1 Att EPC Valve
7) 1 Att EPC Valve
8) To Main Valve Port PA8
9) To Main Valve Port PB8
10) 1 Att EPC Valve Connector V24
11) 1 Att EPC Valve Connector V23
12) Blanking Plug
13) Mounting Bolts
14) 2 Att EPC Valve
15) 2 Att EPC Valve
16) To Main Valve Port PA9
17) To Main Valve Port PB9
18) 2 Att EPC Valve Connector V26
19) 2 Att EPC Valve Connector V25
20)

QUICK COUPLER CONTROL VALVE



1	Pressure regulating valve
1a	Lock nut
1b	Adjustment screw
2	Solenoid
2a	Nut
3	Directional control valve
4	Block

Specification

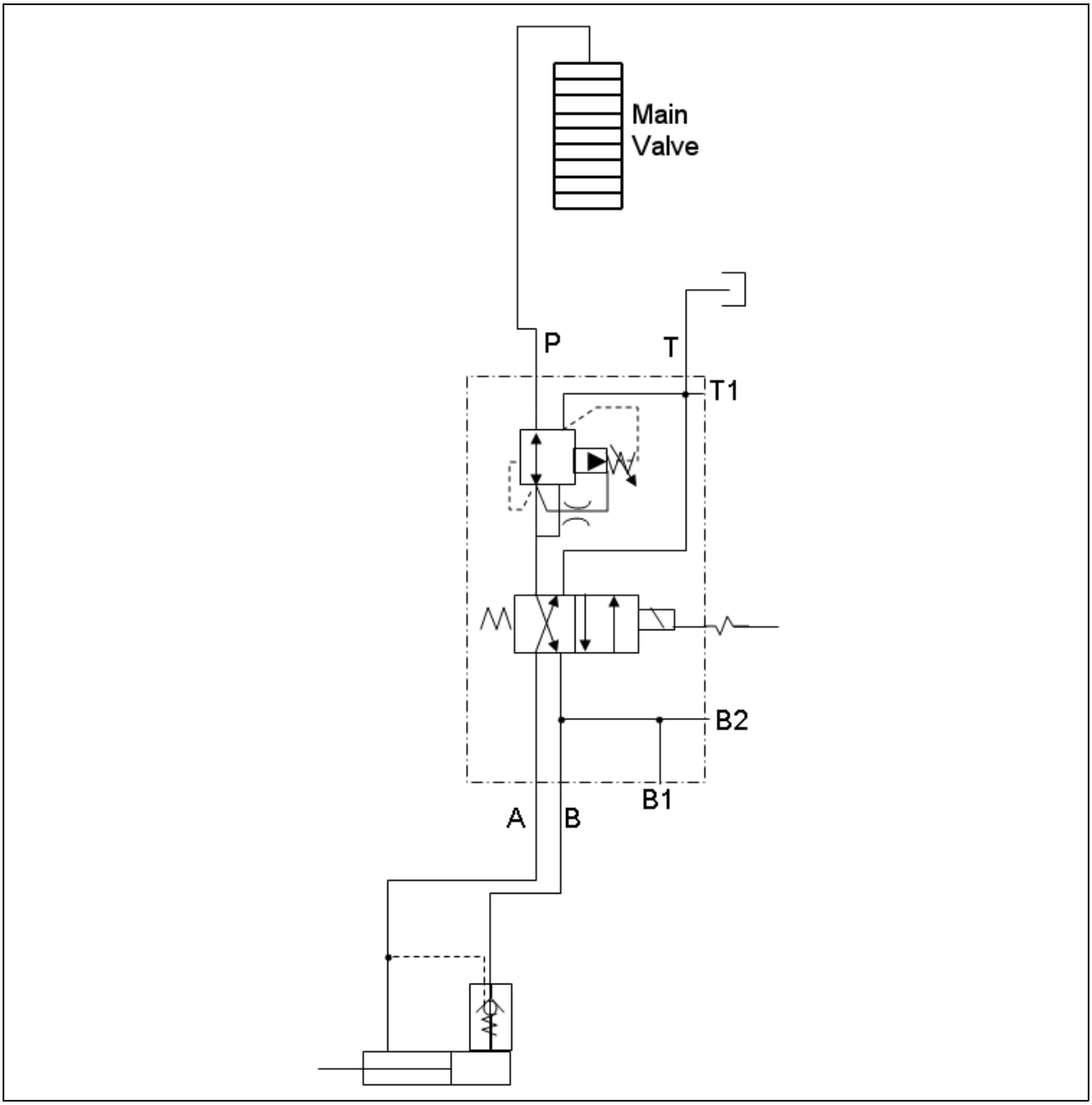
Min set pressure: 1MPa (10.2 kg/cm²).
Max set pressure 30+/-5 Mpa (306+/-51kg/cm²)
Flow: 120l/min.

Operation

1. When solenoid is switched OFF
   - Since the signal from the operation switch (Op Cab RHS Console) is off, solenoid (2) is deenergised. For this reason, directional control valve (3) is in the default position and oil will flow from port P to port B.
   - Oil returning from the quick coupler will flow from port A to port T.
   - The setting of the pressure regulating valve (1) will determine the maximum pressure at port B. When the stroke end of the quick coupler cylinder is reached the pressure at the cylinder will be the set pressure of the regulating valve(1).
   - The pressure regulating valve can be adjusted according to the specification of the coupler. The minimum setting is 1MPa and the maximum setting is 30+-5MPa.

2. When solenoid is switched ON
   - When the switch (Op Cab RHS Console)is on current will flow to the solenoid (2) energising it. Accordingly, the directional control valve (3) will move upwards and oil will flow from port P to port A.
   - Oil returning from the quick coupler will flow from port B to port T.
   - The setting of the pressure regulating valve (1) will determine the maximum pressure at port A. When the stroke end of the quick coupler is reached the pressure at the cylinder will be the set pressure of the regulating valve (1).

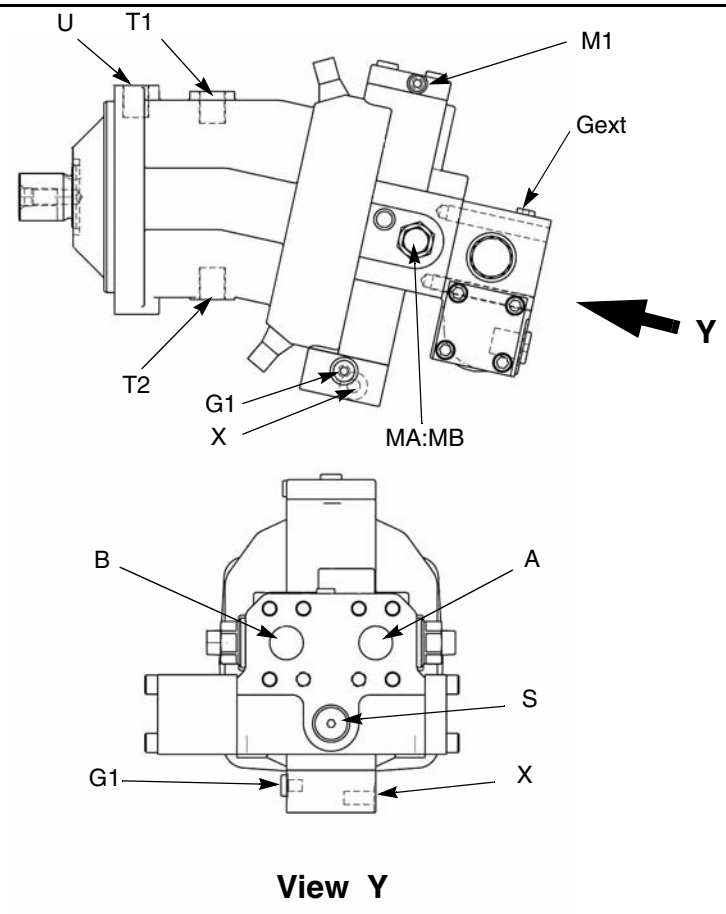
Schematic



P Supply pressure from main valve
T To tank
B Supply to quick coupler - lock and hold direction
B1 Pressure checking port for B line
B2 Spare
A Supply to quick coupler - unlock direction

TRAVEL MOTOR

A6VM107 HAXT/63W-VAB380A-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	107cc unit
Min. displacement setting	29cc/rev
Brake relief valve setting	420 bar
Counterbalance valve pressure setting	7 bar

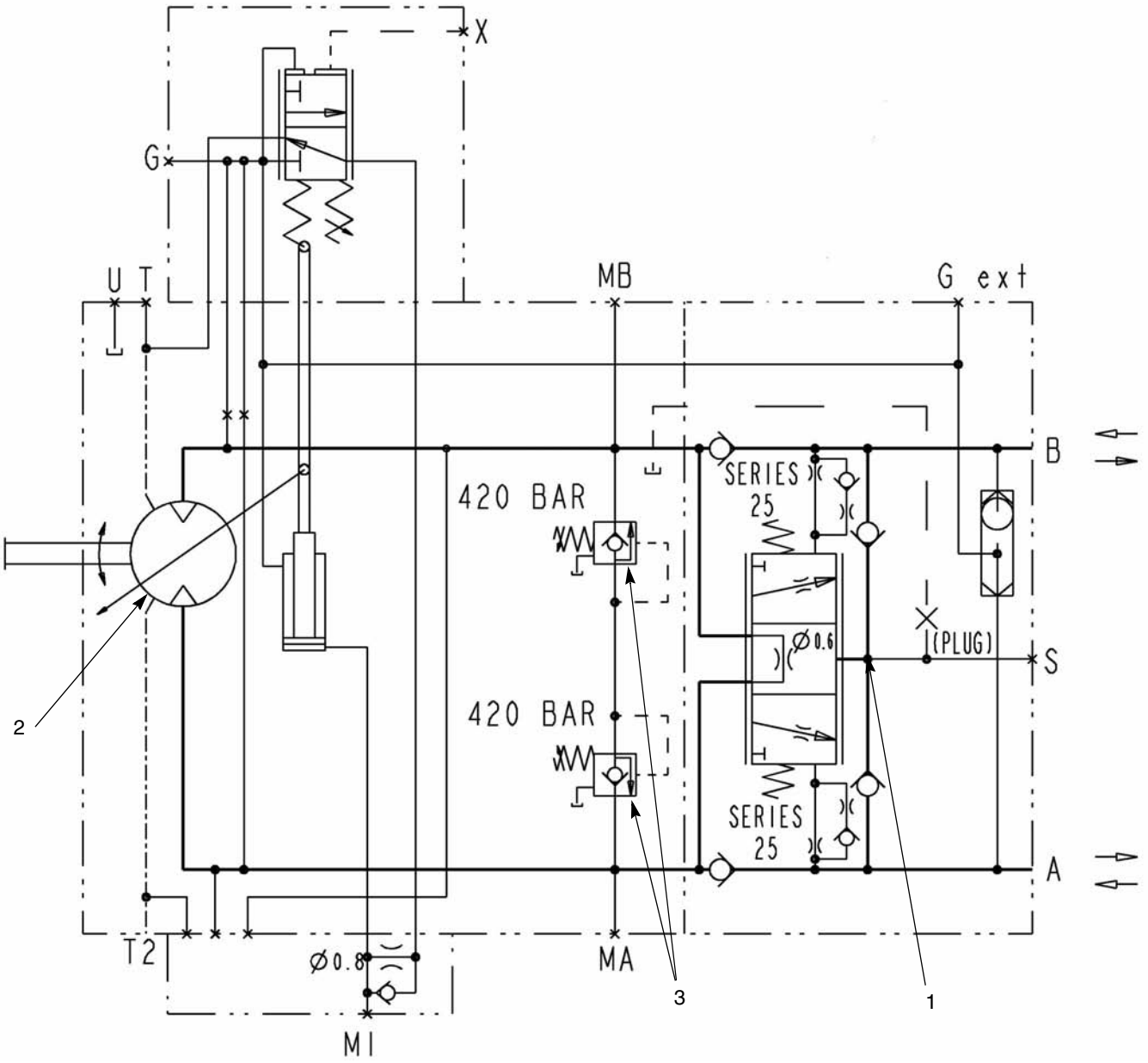
FUNCTION

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.

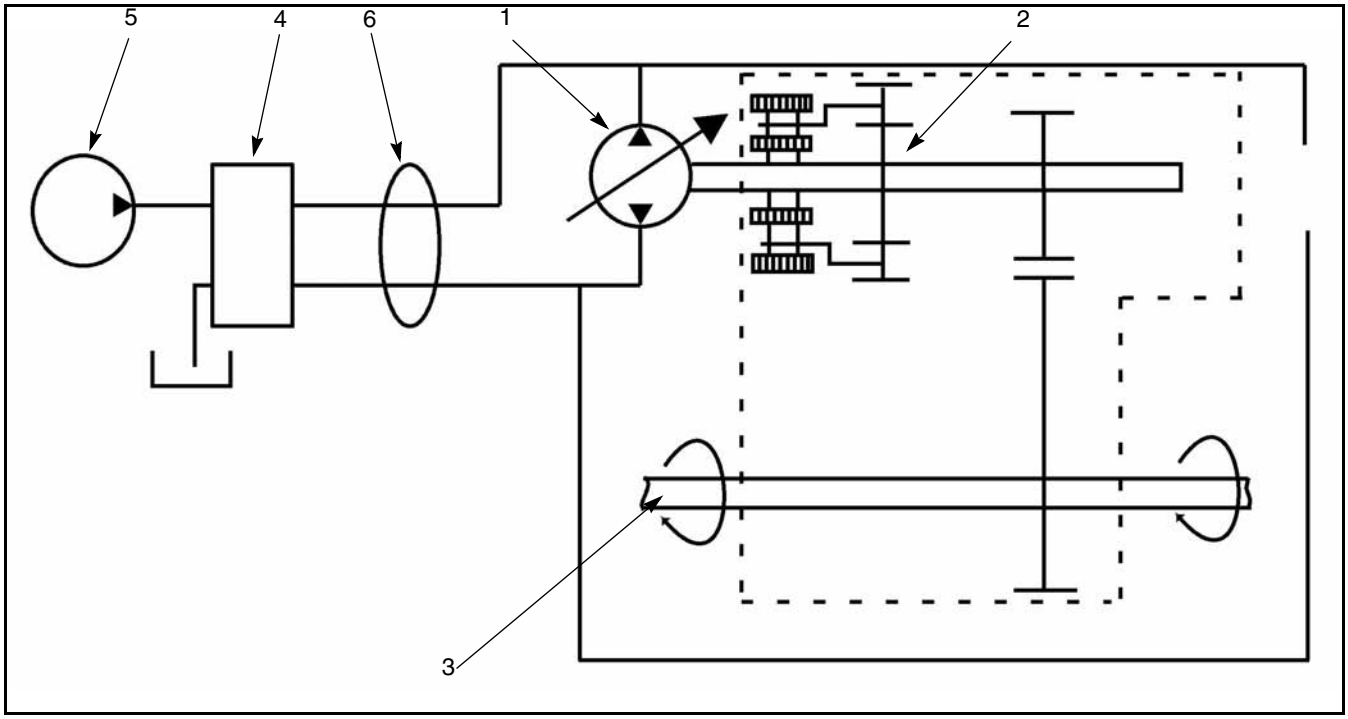
Travel Motor



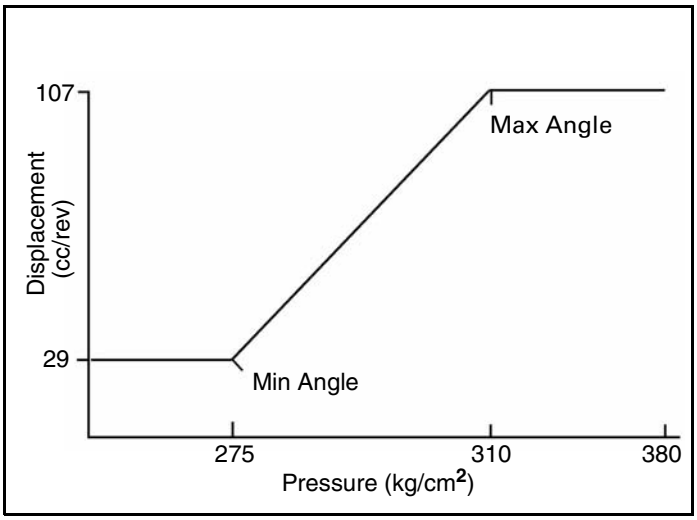
1. Counterbalance valve
2. Motor
3. Relief valve

OPERATION OF TRAVEL MOTOR

1. During normal travel

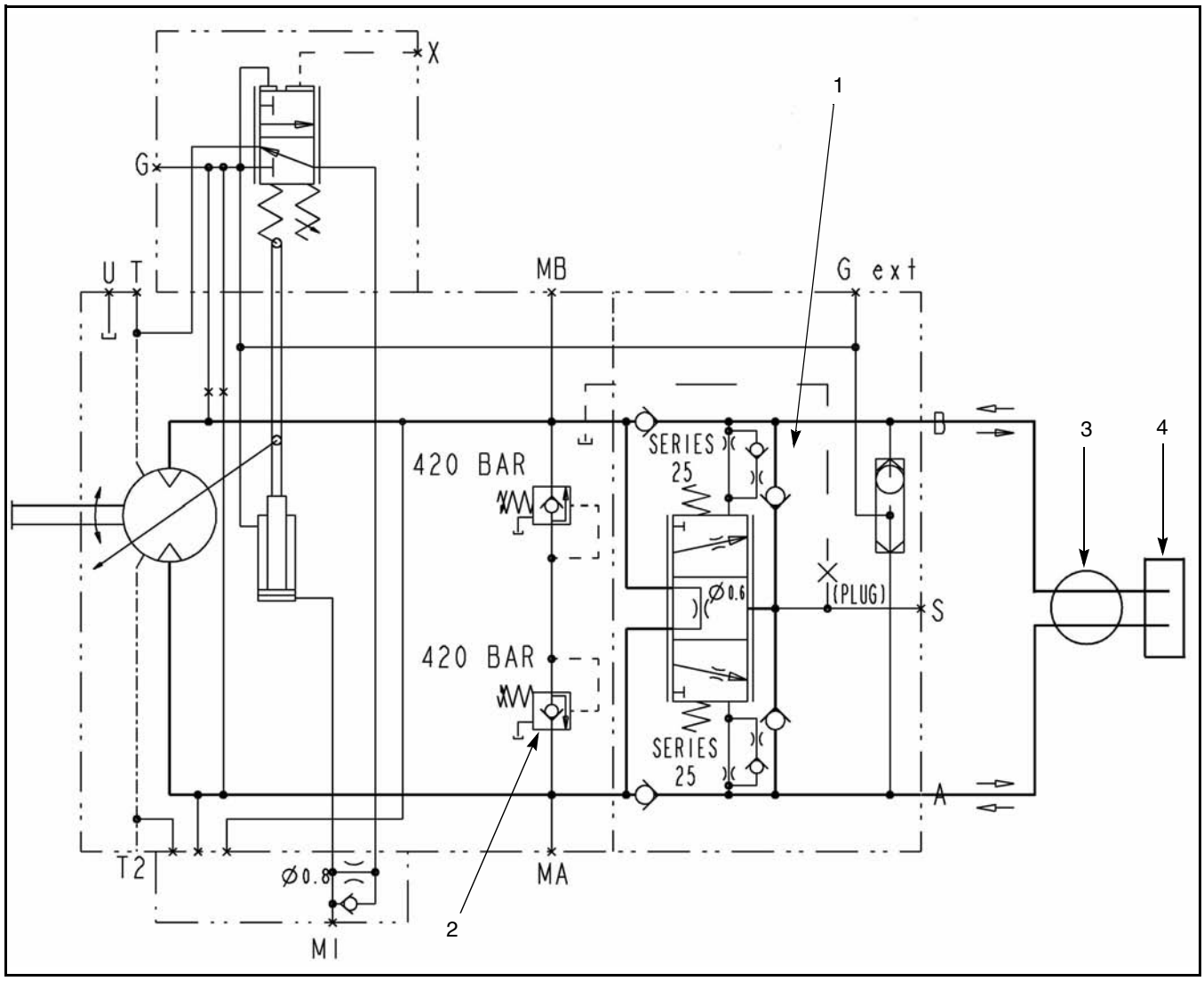


1. Travel motor
2. Transmission and clutch
3. Drive shafts
4. Main control valve
5. Main pump
6. Swivel joint



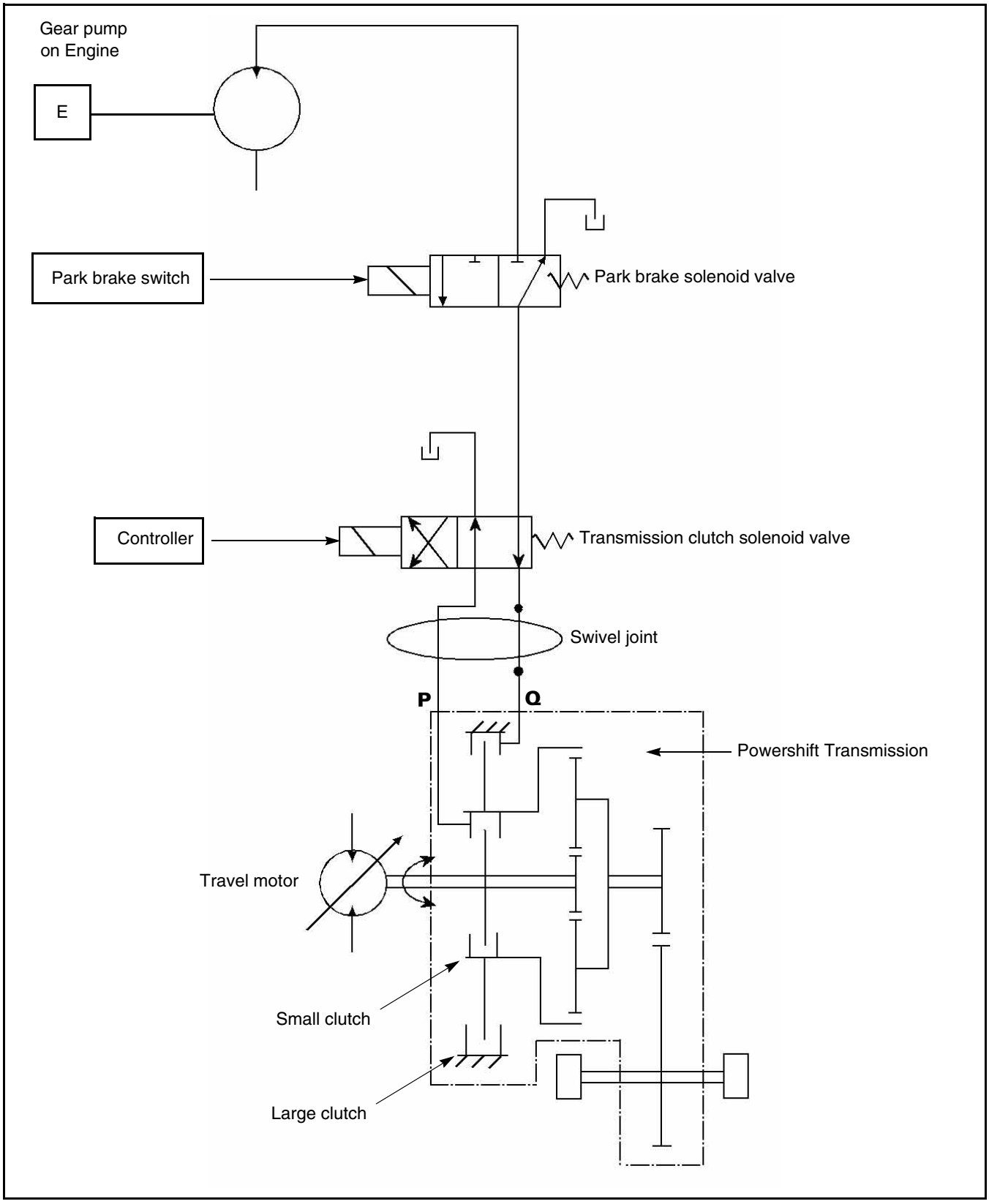
- Oil is supplied to the travel motor from the control valve by the travel spool. When the spool is opened the machine accelerates from the stationary the pressure at the travel motor rises to maximum. This high pressure is used to set the displacement of the travel motor to maximum to give maximum torque.
- 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.

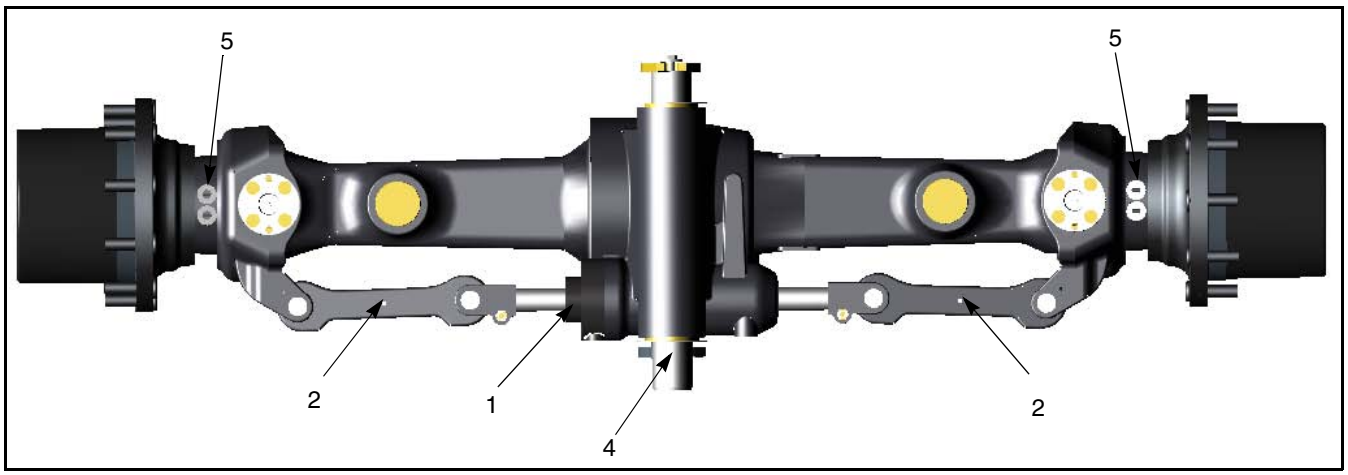
1. Pressure applied to transmission port 'P' disengages the high speed clutch pack meaning the low speed clutch pack is engaged - low speed has been selected.
2. Pressure applied to transmission port 'Q' disengages the low speed clutch pack meaning the high speed clutch pack is engaged - high speed has 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.

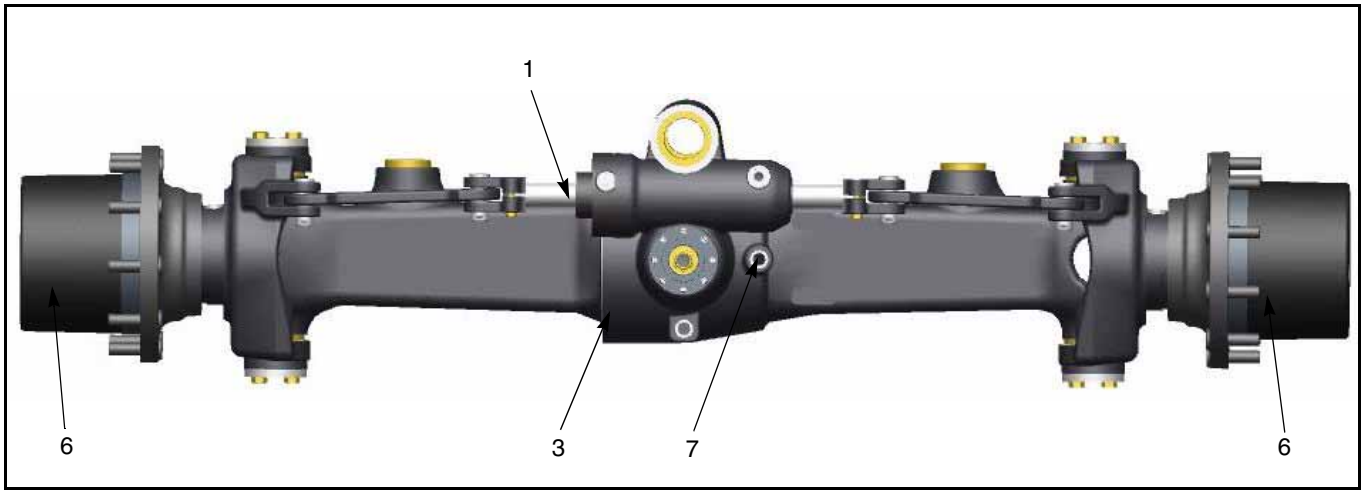
AXLE

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.

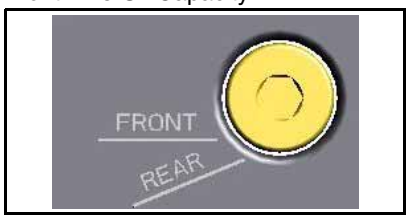
FRONT AXLE





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

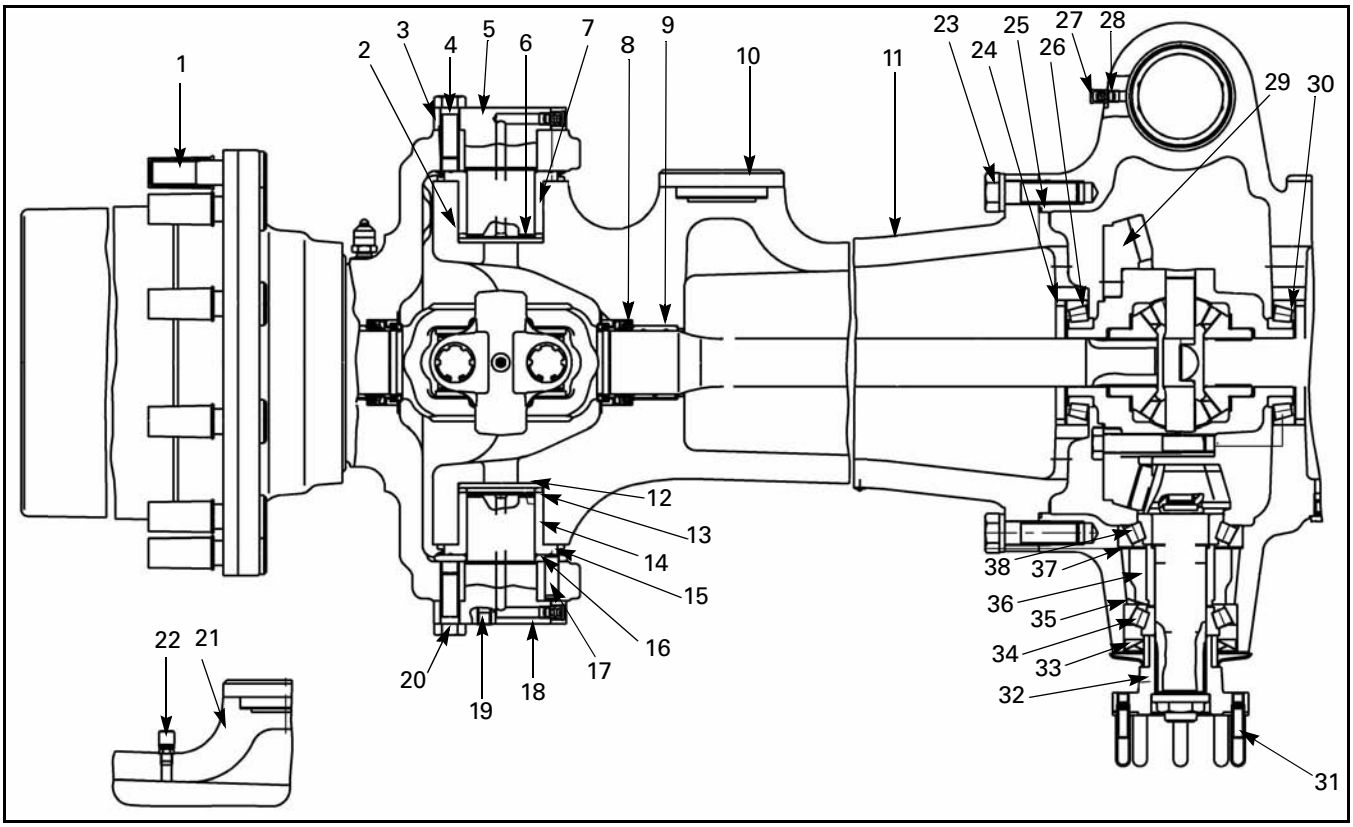


PW160	10.5 Litres

Front Hub Oil Capacity

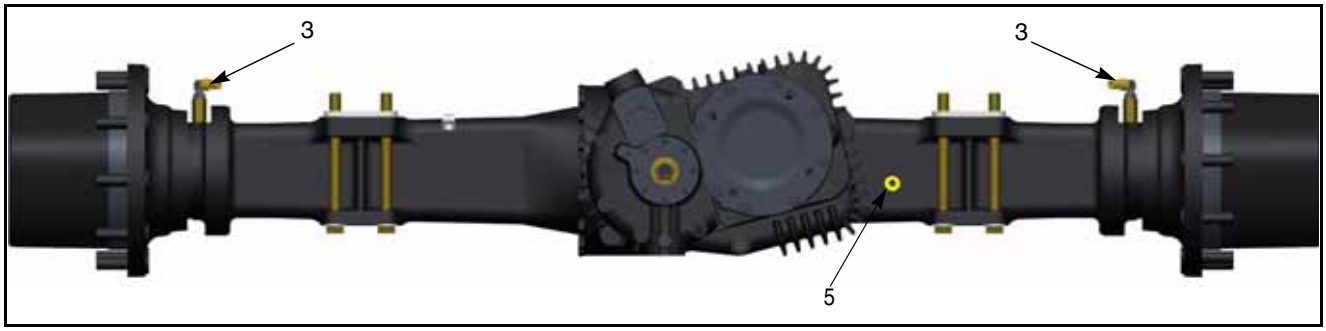


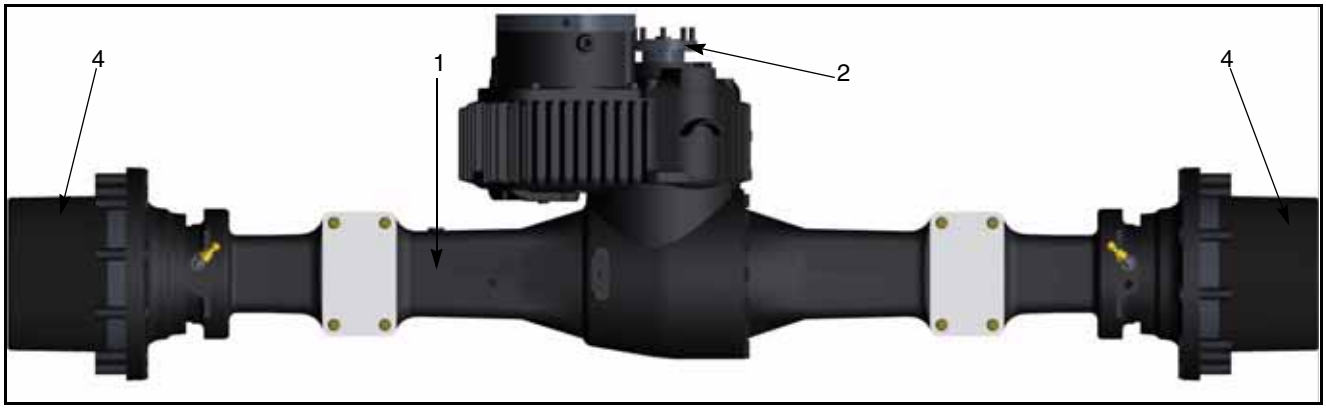
PW160	2.5 Litres



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





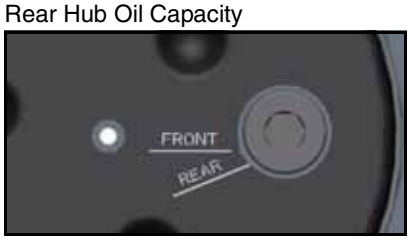
1. Axle housing
2. Drive shaft input
3. Brake line input
4. Wheel hub
5 Oil level plug

Rear Axle Oil Capacity

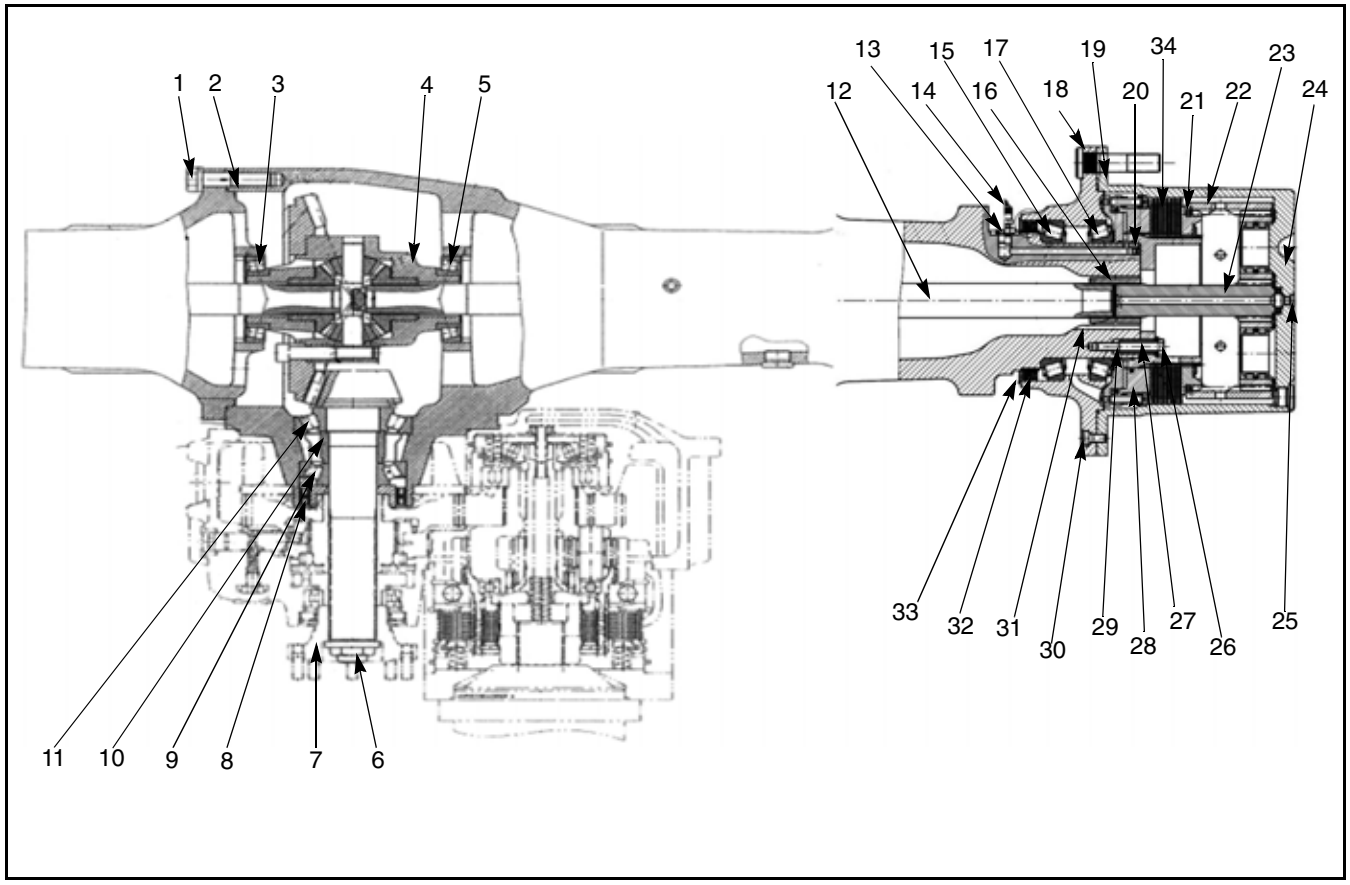


PW160 2.5m Axle	9.5 Litres

Rear Hub Oil Capacity



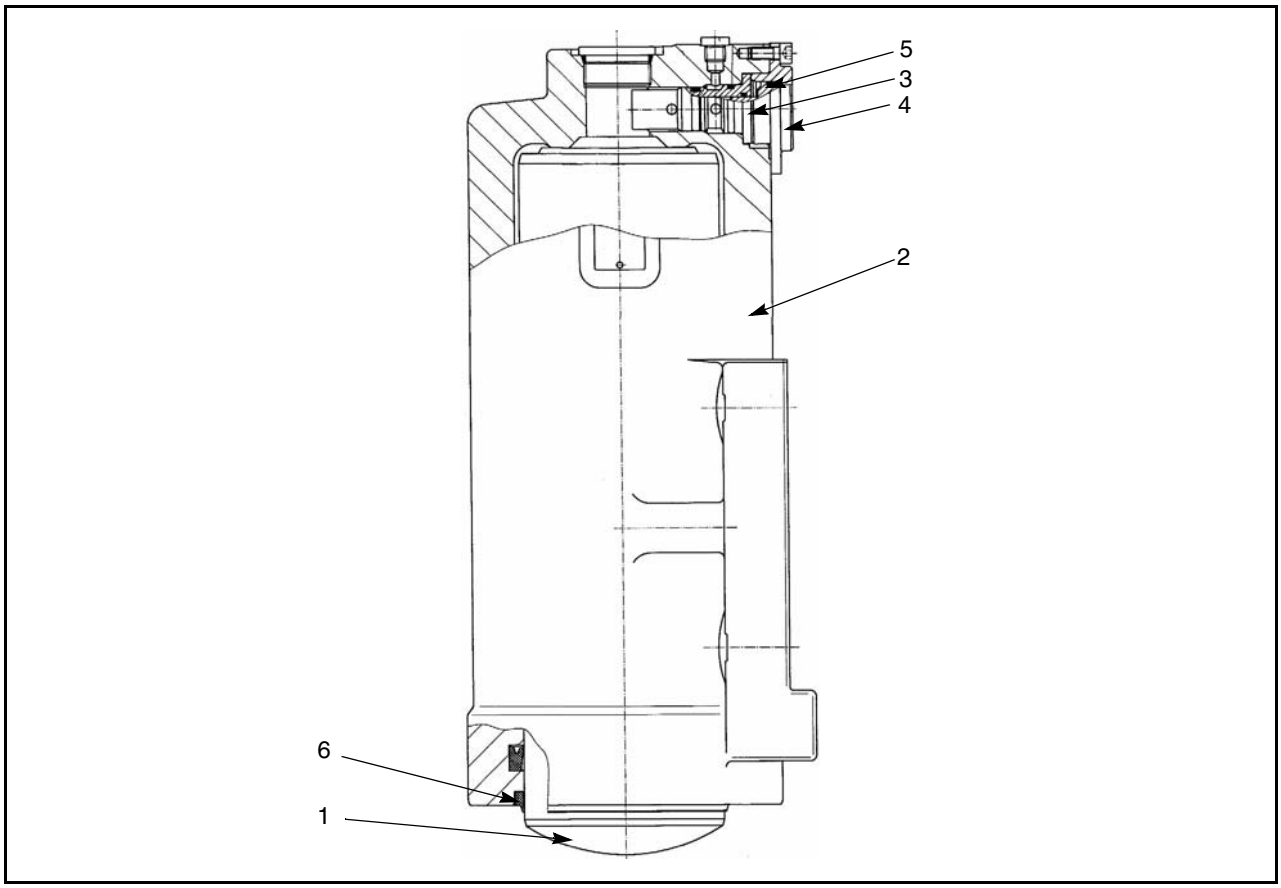
PW160	2 Litres



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

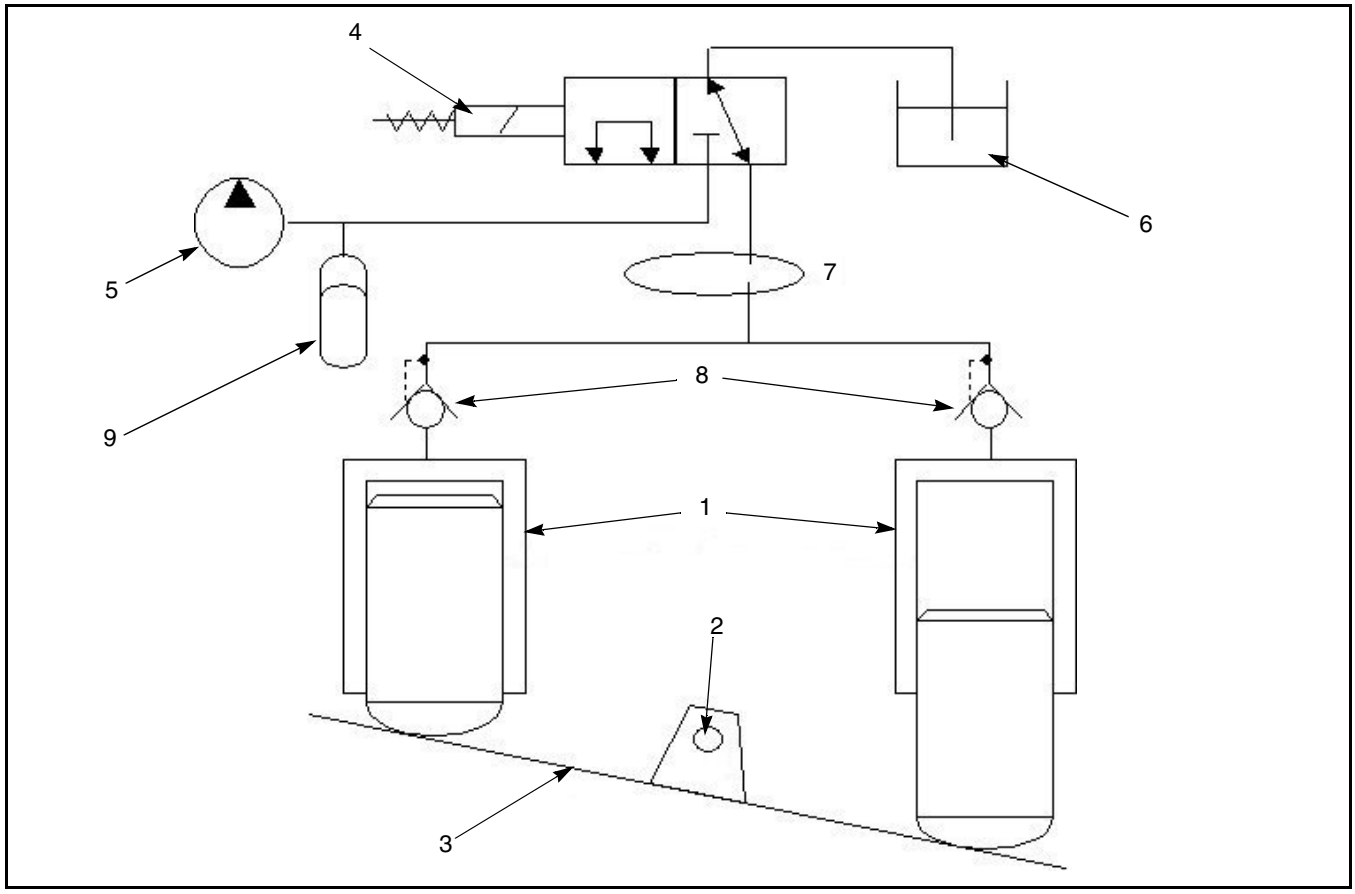
Purpose

The undercarriage of wheeled hydraulic excavators has one of the two driven axles oscillating mounted. This makes it possible to fully utilize 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 block the axle during digging or lifting work.

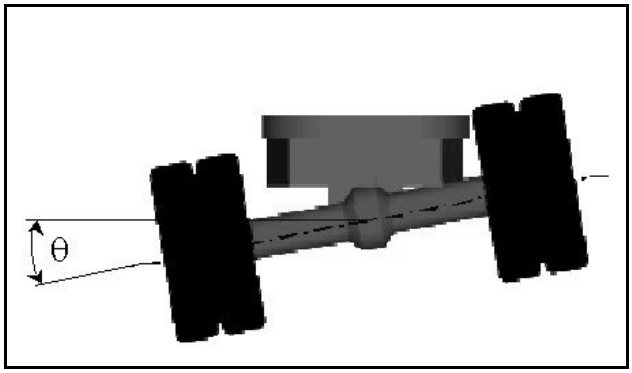
Blocking the axle increases the excavators stability.

The oscillating axle (3) is mounted on axle mount pin (2) in the middle 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 energised 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. PPC pressure reducing valve
6. Hydraulic tank
7. Swivel joint
8. PPC operated check valve
9. Accumulator

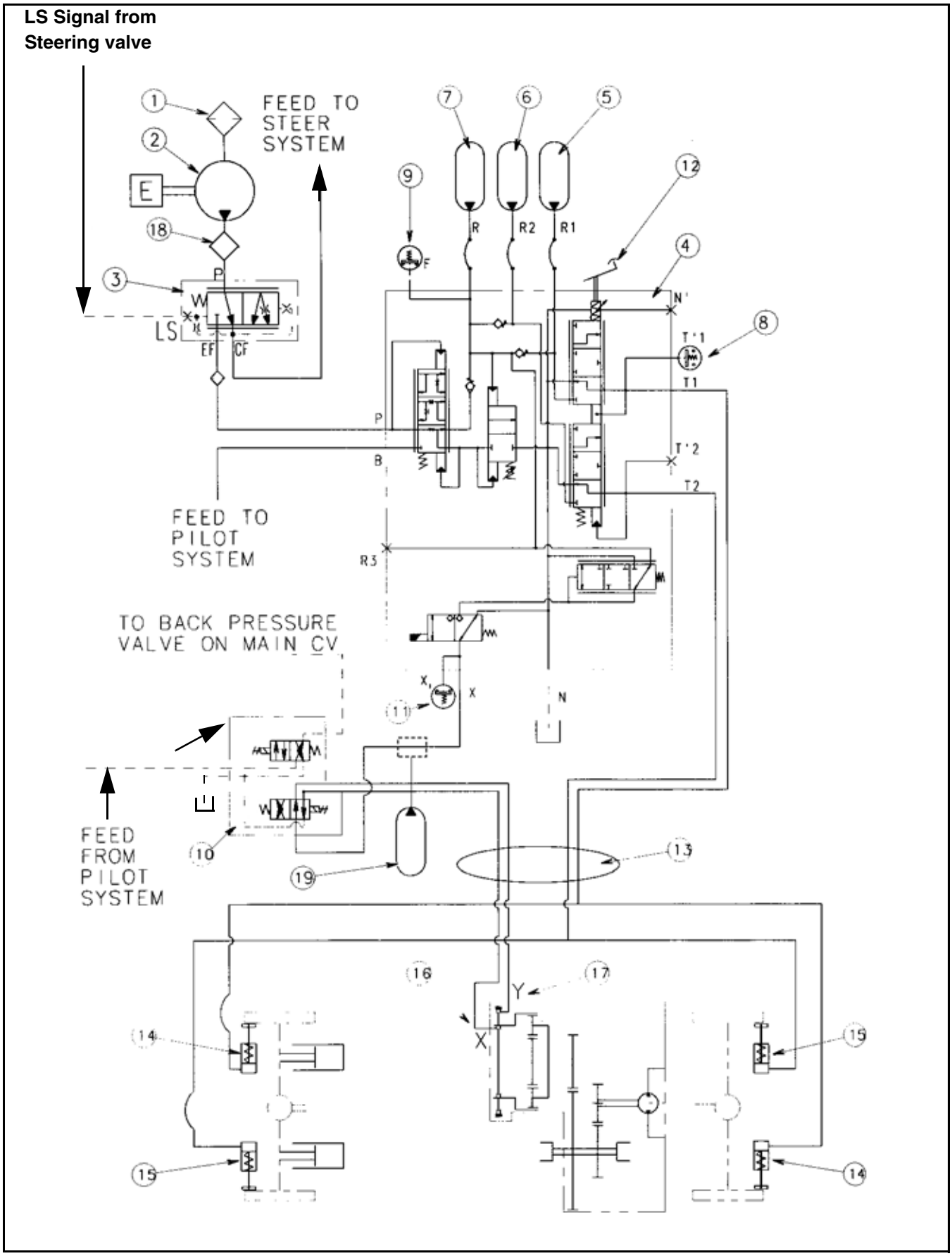


AXLE OSCILLATION

Axle oscillation: $= 10^{o}$

Minimum turning radius PW160 = 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 +/- 8 bar)
10. Two stage 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
18. In line filter (cartridge type)
19. Accumulator (0.3 l.)

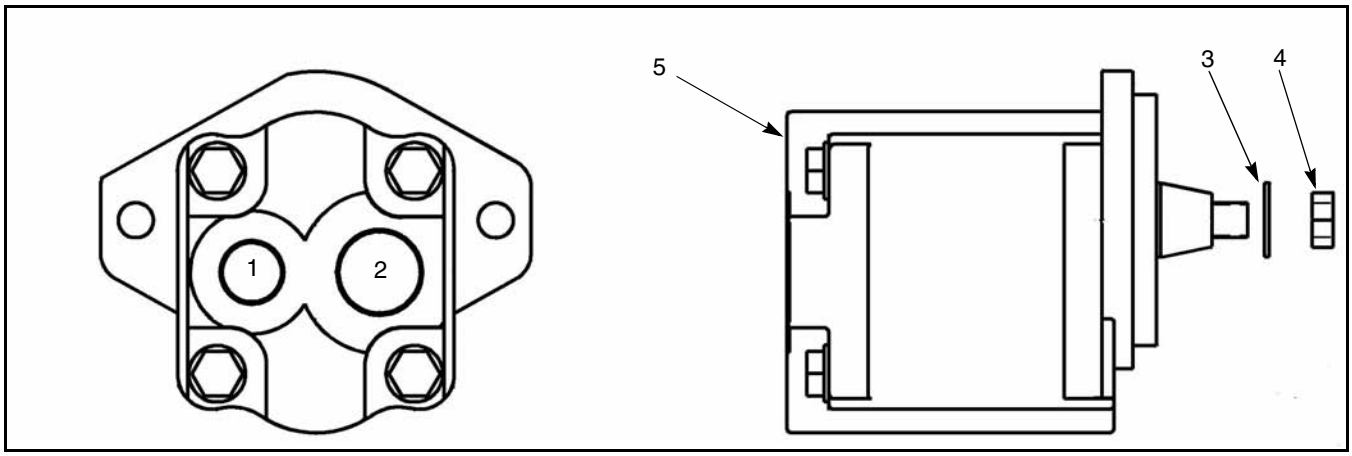
Structure and Function

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. 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.

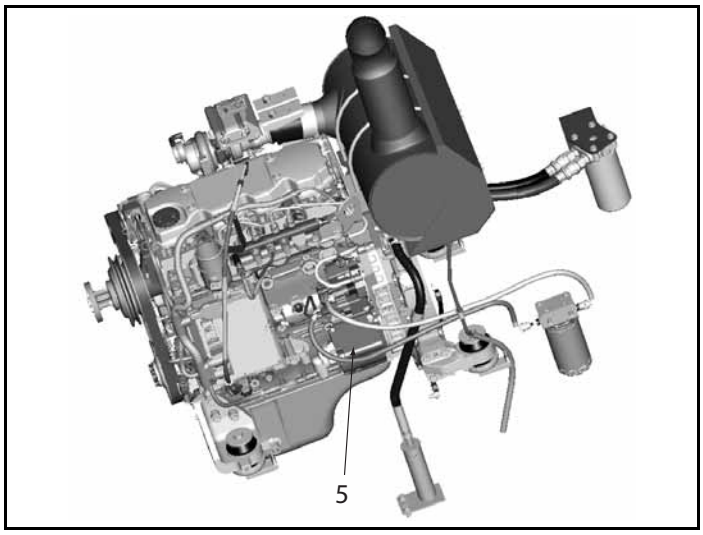
A parking brake is provided which is operated by selecting park brake switch in cab. This de-energises both high and low gear signals and locks the transmission gears.

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	19cc/REV
Rated pressure	250 bar
Rotation	Anti Clockwise

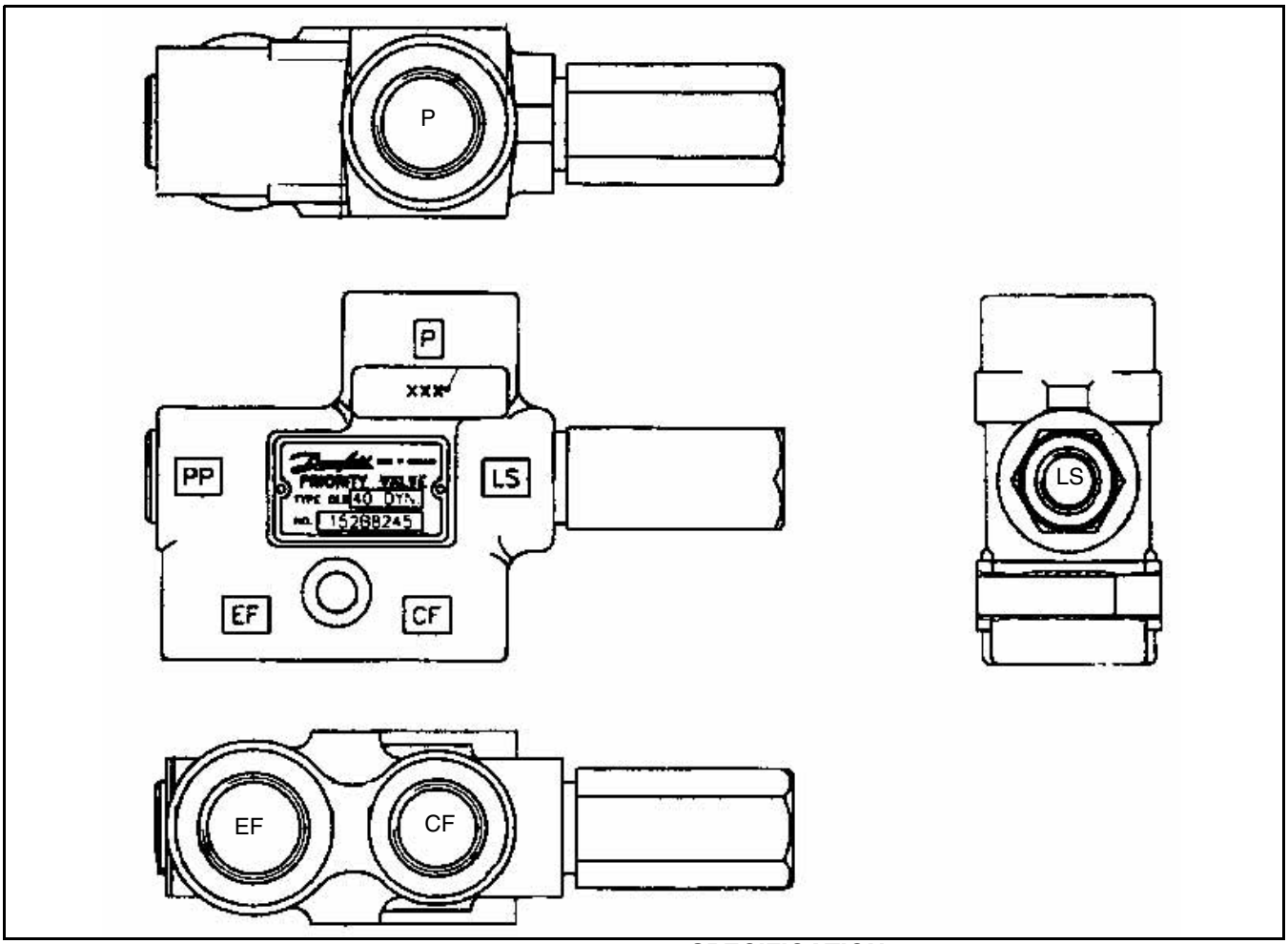
* Rotation direction when viewed on shaft

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 ancilliary 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

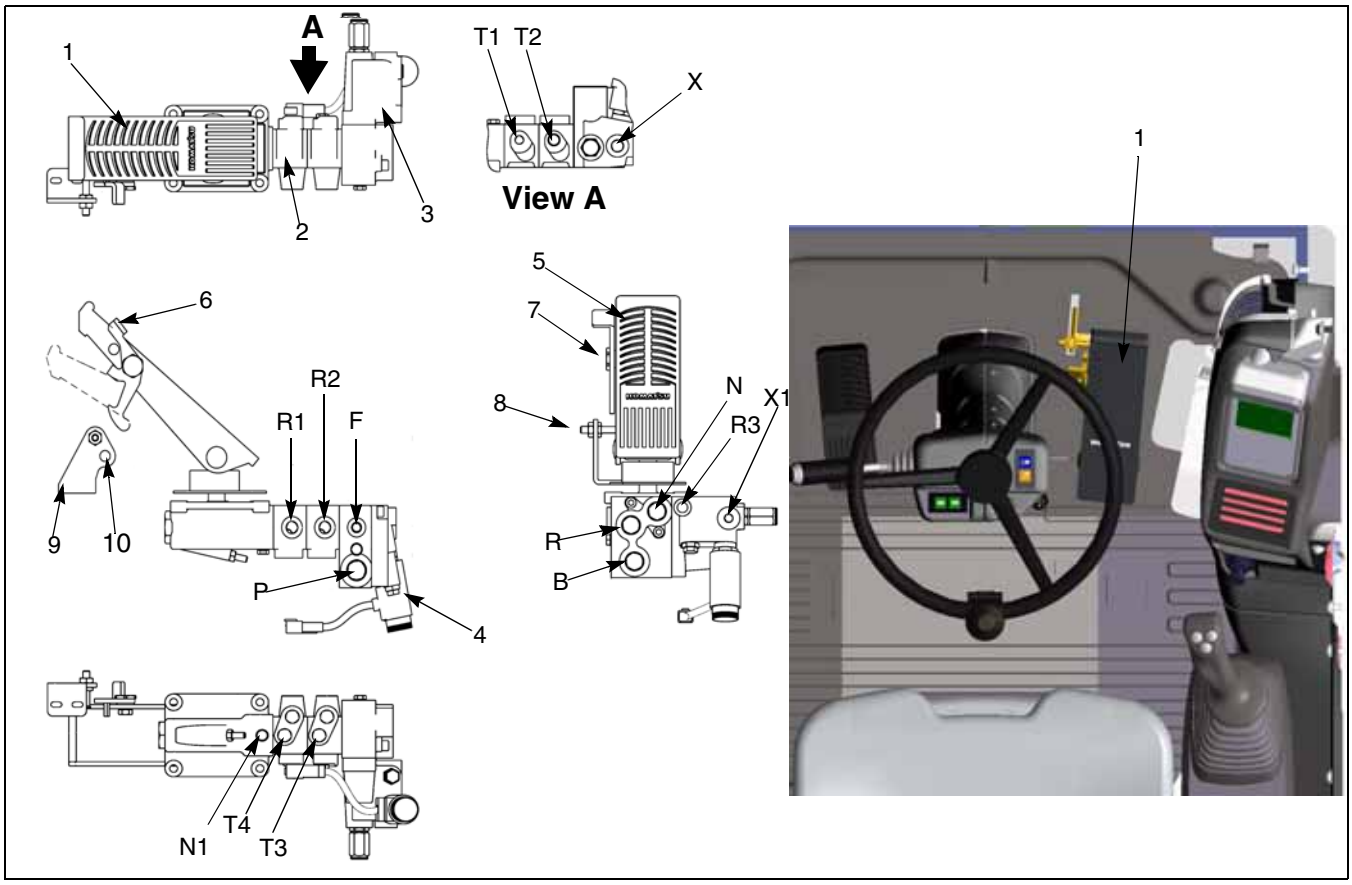
When the steering wheel is turned, the oil flow is distributed in such a way that the oil flow necessary for steering is led to the steering unit through the CF connection.

The remaining oil flow is available for the working hydraulics 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)	N1	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	T3	Service brake		
8	Latch pin	T4	Service brake		
9	Latch pin stirrup	X	Parking brake		
10	Brake proximity switch mounting hole	X1	Parking brake pressure switch		

SPECIFICATIONS

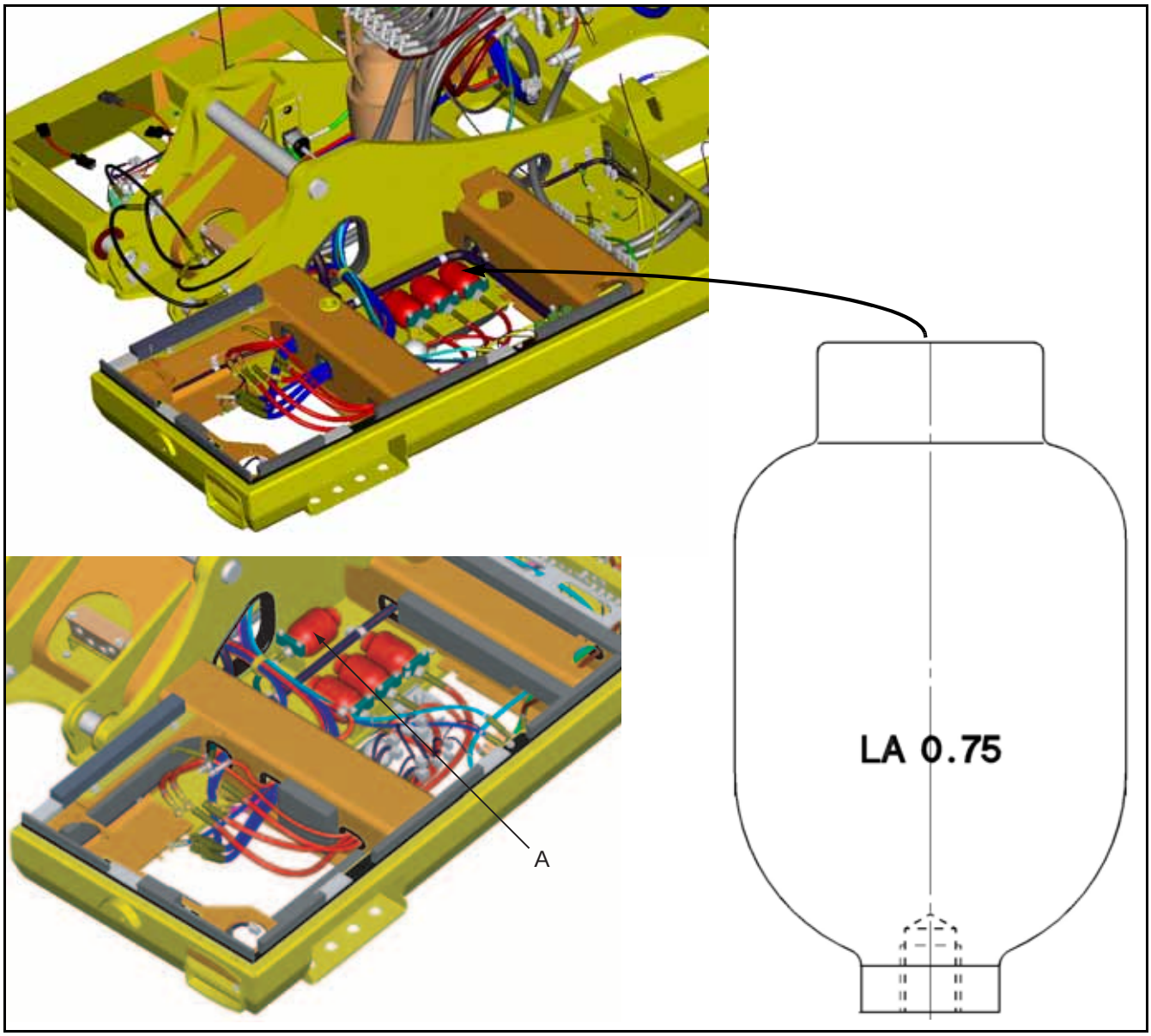
Accumulator charge pressure	(cut in) = 120 $^{+}/_{-}$ 5 bar
	(cut out) = 155 $^{+0}/_{-2}$ bar
Service brake pressure	63 bar
Park brake pressure	58 $^{+}/_{-}$ 7 bar

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 SYSTEM



SPECIFICATIONS

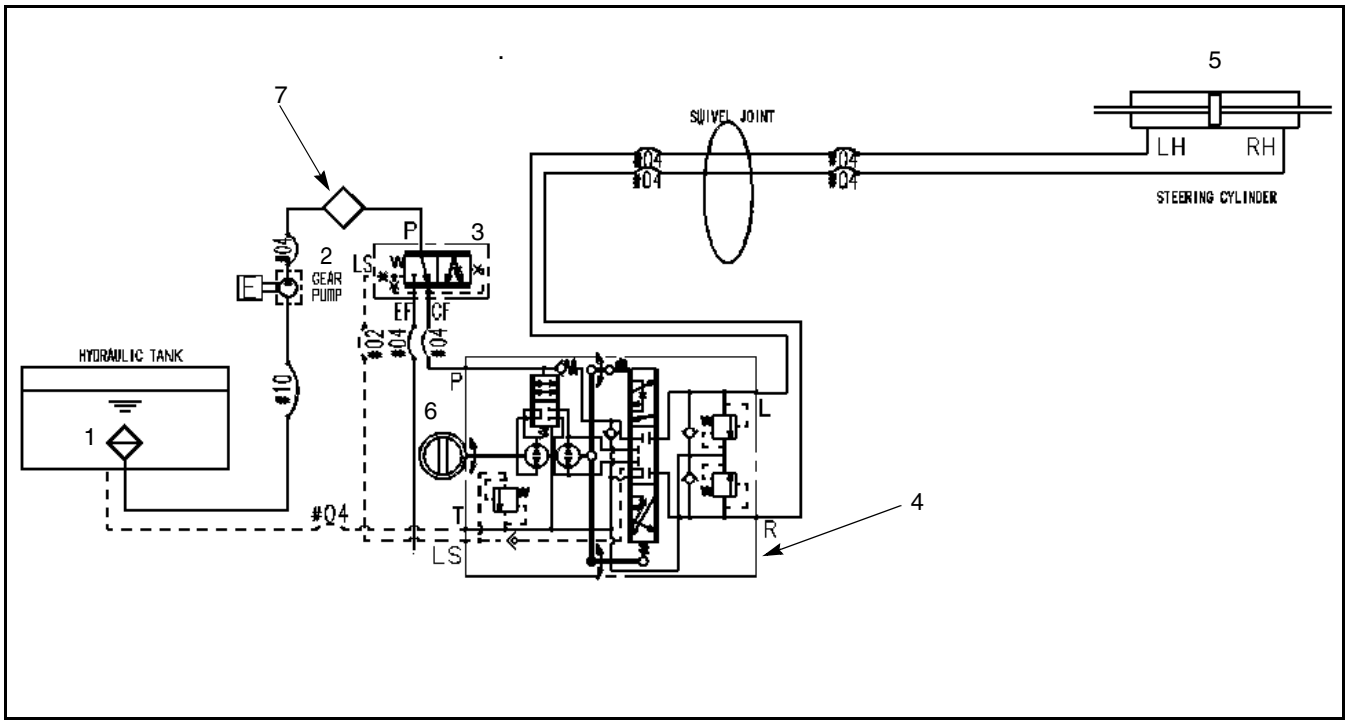
1.	Nominal capacity	0.75L
2.	Max working pressure	210 bar
3.	Max p dynamic	175 bar
4.	Working temperature	- 30° to 125° C
5.	Diaphragm	NBR
6.	Fluid	Mineral oil
7.	Body	Forged steel
8.	Surface finish	Rust preventative coating
9.	Pre-charge gas	Nitrogen
10.	Pre-charge Pressure	50 bar

Structure and Function

- The accumulators are installed below the operators cab accessible from the undercovers.
- 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 for Italian Specification machine.

STEERING SYSTEM



1.	Hydraulic filter	4.	Steering valve	7.	In-line filter
2.	Brake/steer pump	5.	Steering cylinder		
3.	Priority valve	6.	Steering wheel		

Structure and Function

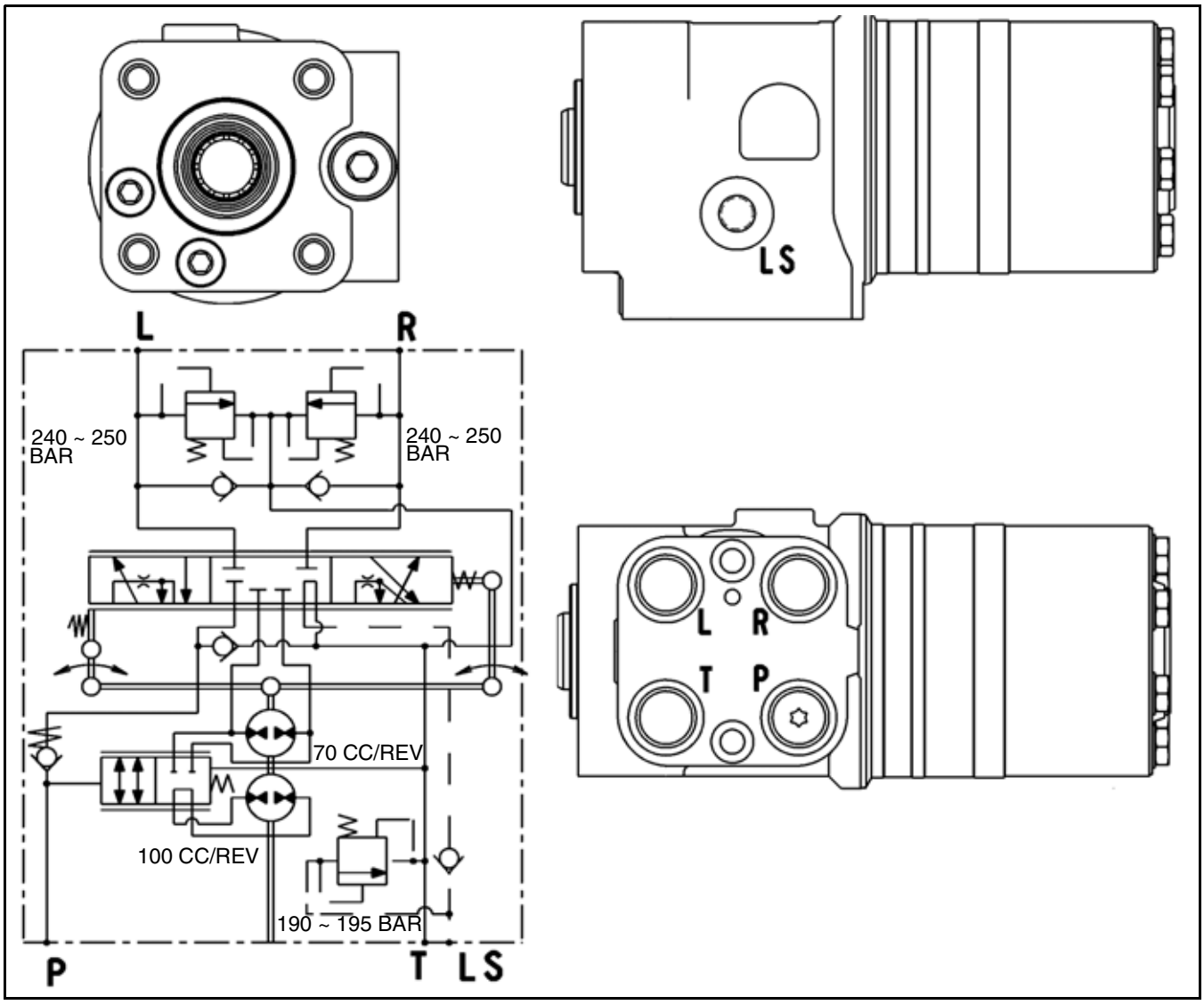
- The steering is fully hydraulic. The oil sent by the brake/steer pump (2) mounted on the PTO at the front of the engine, flows via the priority valve (3) to the steering valve (4). From here it is passed through swivel joint to steering cylinder (5). the steering cylinder then extends or retracts to 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)	170cc/rev
Nominal displacement (emergency operation)	70cc/rev
Relief valve setting	190_{-0}^{+5} bar

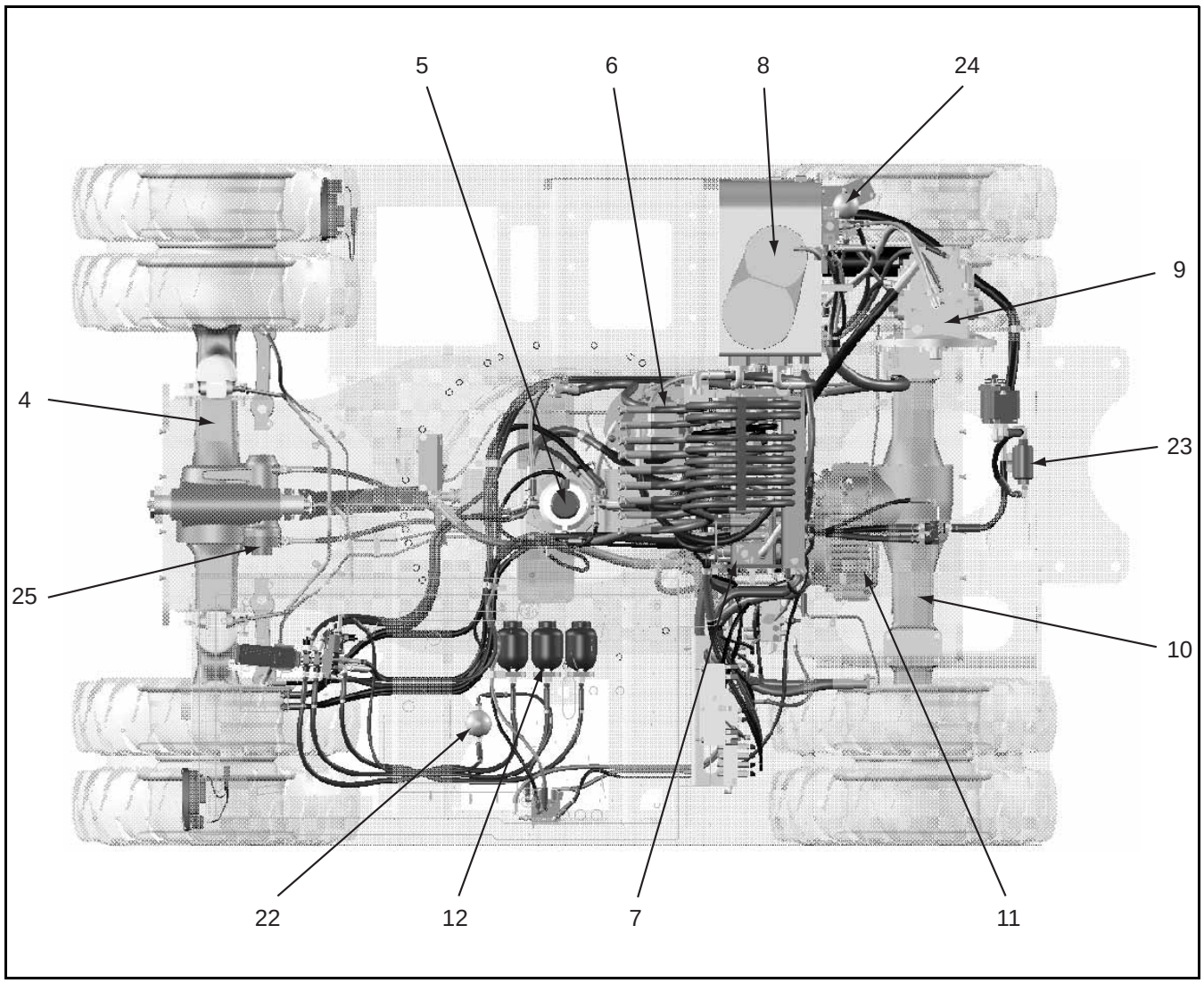
Structure and Function

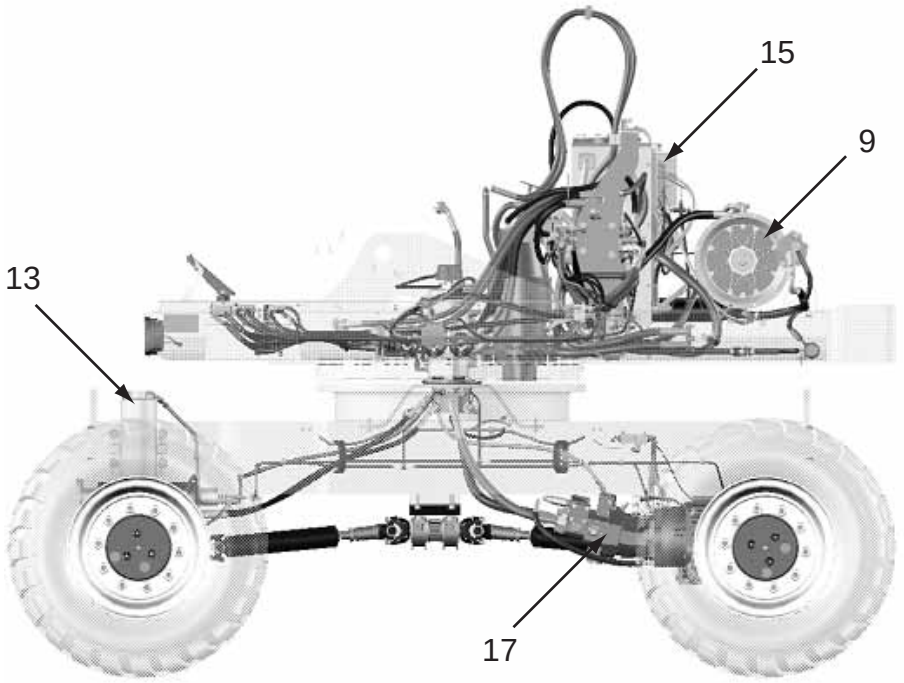
- The steering is fully hydraulic, the oil sent by the brake/steer pump on the front of the engine flows via the priority valve to the orbitrol valve, and finally to the steering cylinder which controls, extends or retracts the tie rod on the axle to steer the machine.

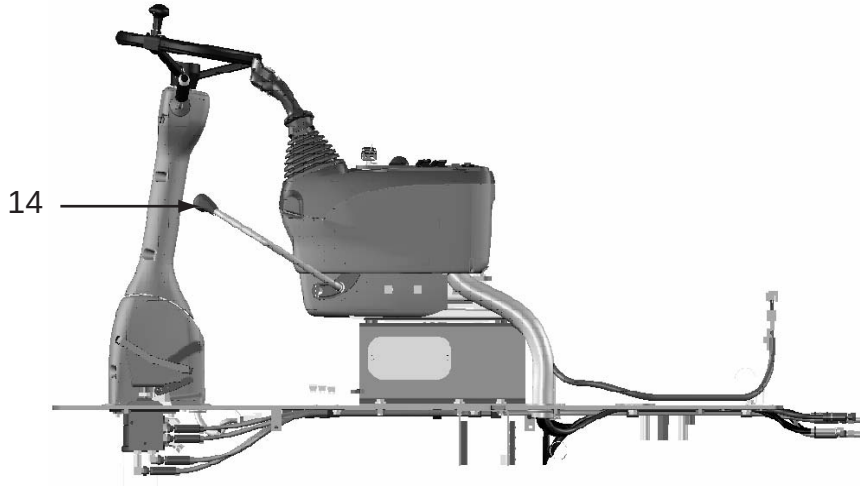
  In the event of failure of the power supply the machine can be steered by 'Emergency steering', the steering valve acts as a pump to send oil to the steering cylinders.

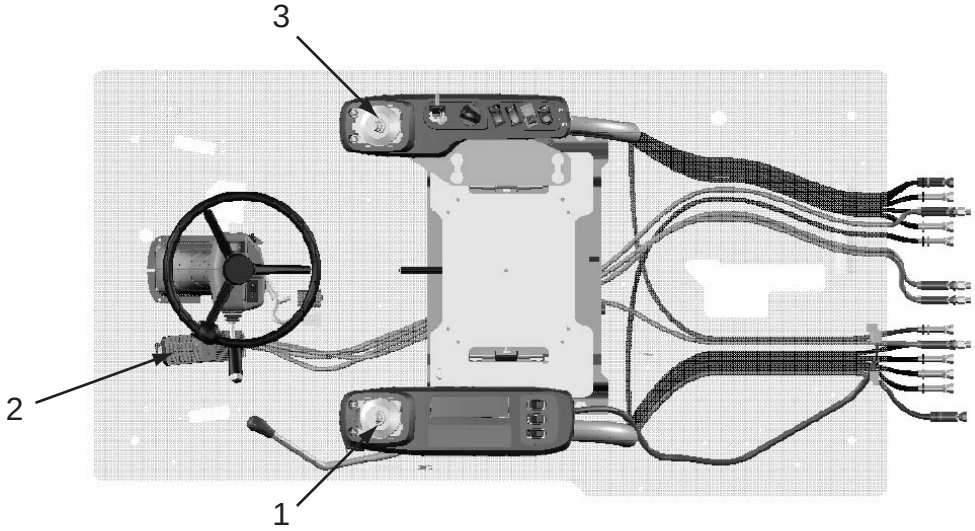
HYDRAULIC EQUIPMENT LAYOUT DRAWINGS

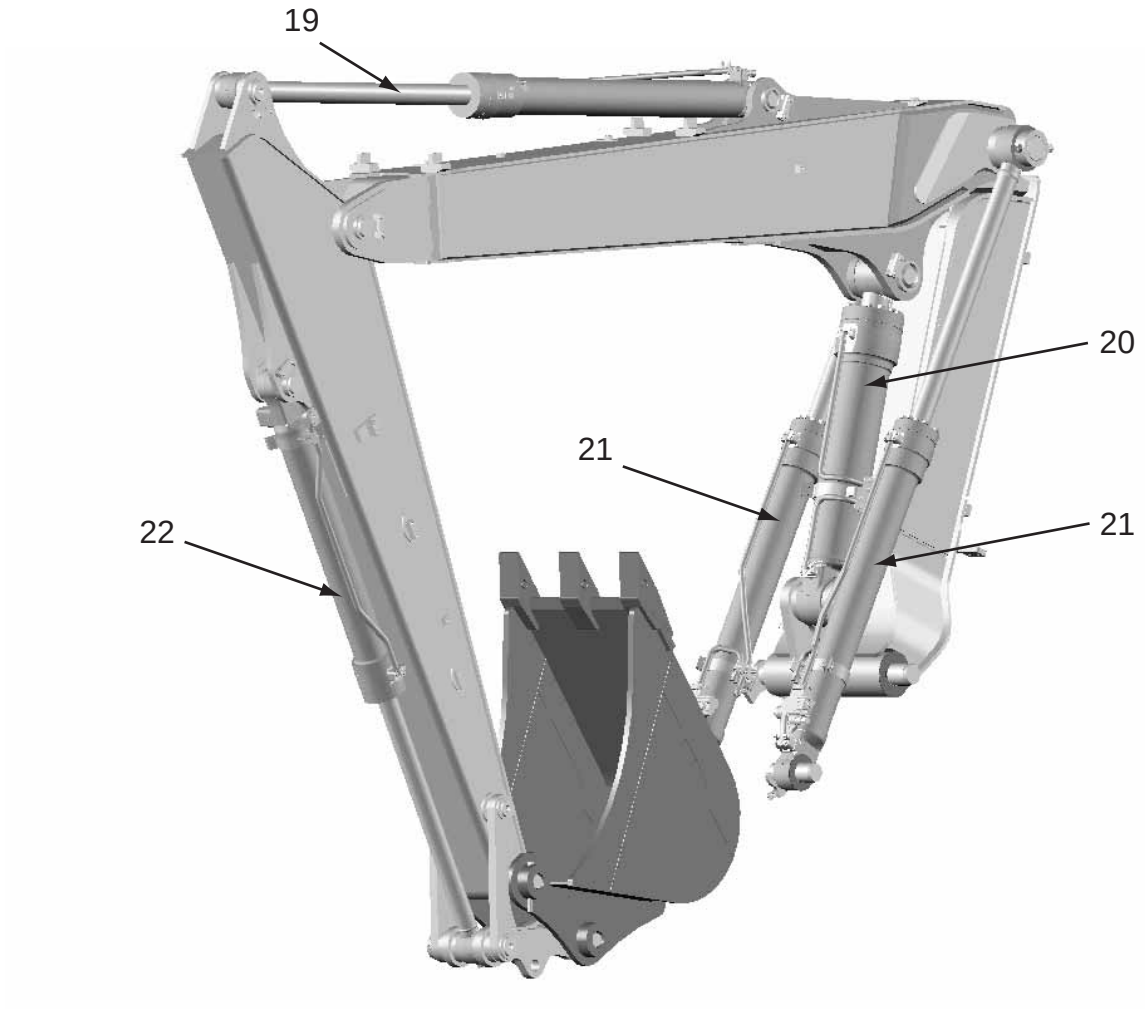
1.	L.H PPC valve	12.	Brake accumulators	23.	Inline Filter
2.	Boom adjust pedal	13.	Suspension cylinder	24.	PPC Accumulator
3.	R.H PPC valve	14.	Safety lock lever	25.	Steering Cylinder
4.	Front axle	15.	Hydraulic tank		
5.	Swivel joint	16.	Combination cooler (Not Shown)		
6.	Swing motor	17.	Travel motor		
7.	Control valve	18.	Arm cylinder		
8.	Hydraulic filter	19.	2nd boom adjust cylinder		
9	Main pump	20.	1st boom cylinder		
10	Rear axle	21.	Bucket cylinder		
11	Transmission	22.	Clutch Accumulator		




15
9
13
17


14

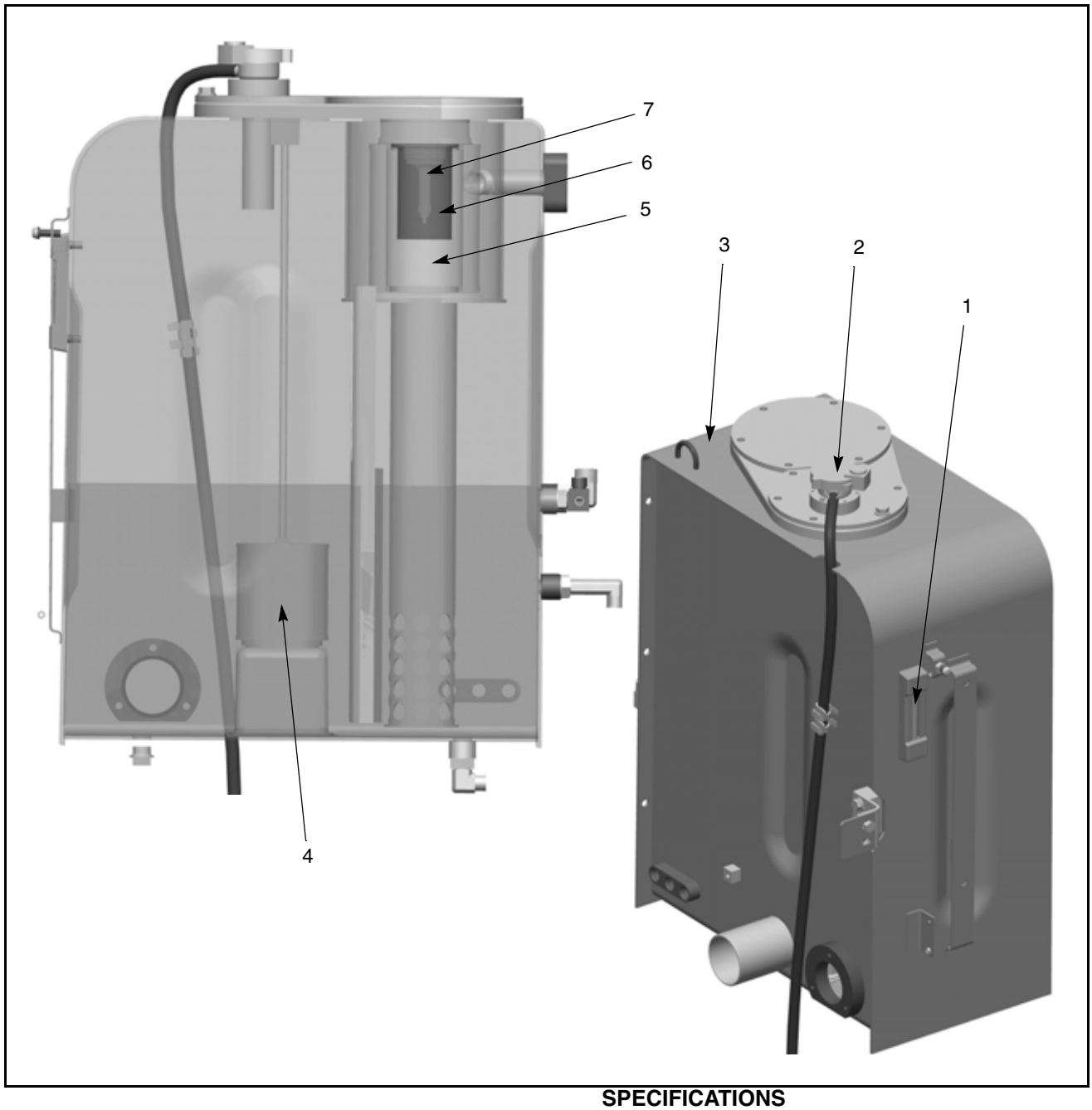

3
2
1


19
20
21
21
22

HYDRAULIC CIRCUIT DIAGRAM

(Please refer to Section 90)

HYDRAULIC TANK



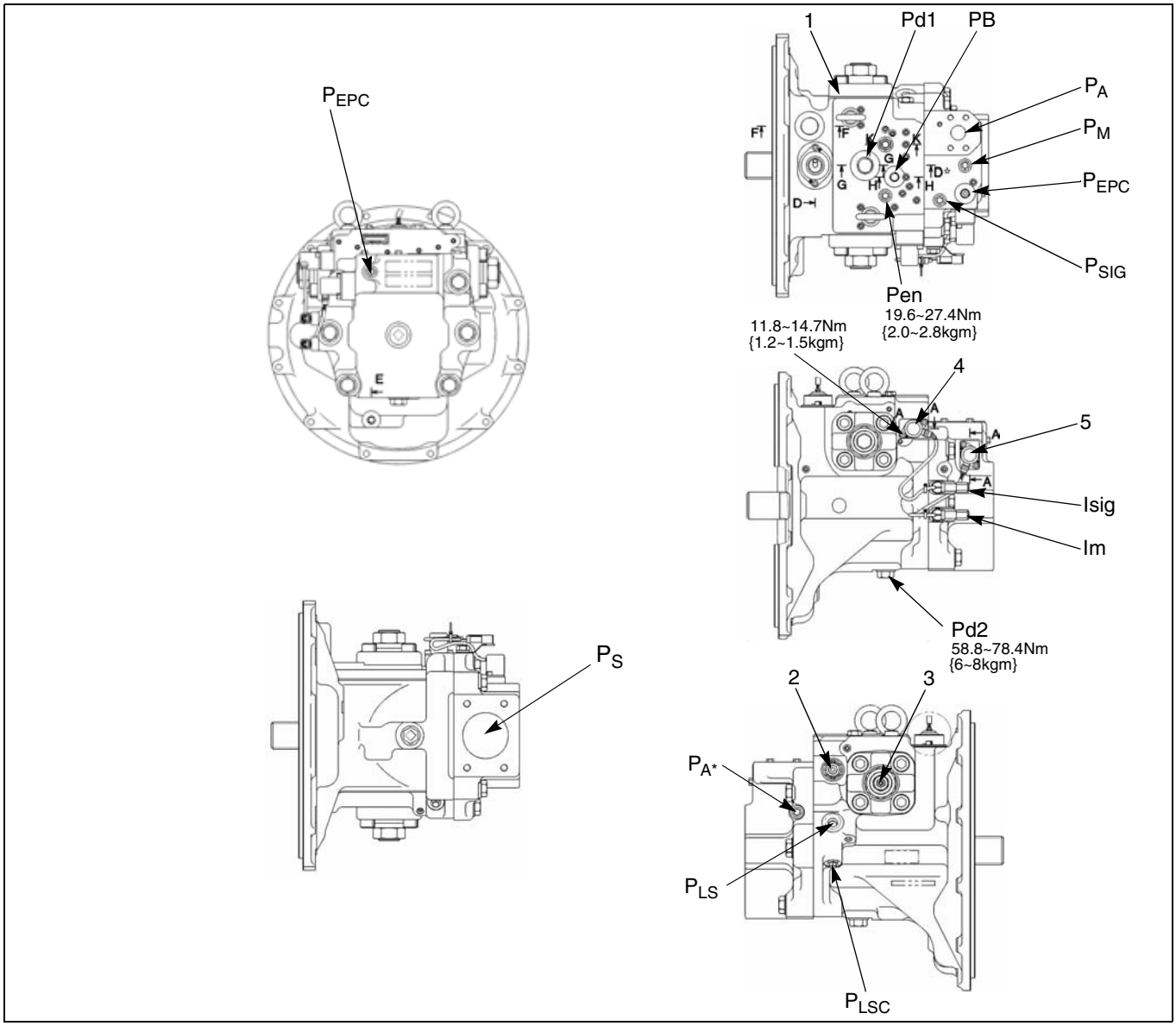
1. Sight gauge
2. Oil filler cap
3. Hydraulic tank
4. Suction strainer
5. Filter element
6. Strainer
7. Bypass valve

SPECIFICATIONS

Tank	166 l
Amount of oil inside tank	120 l
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



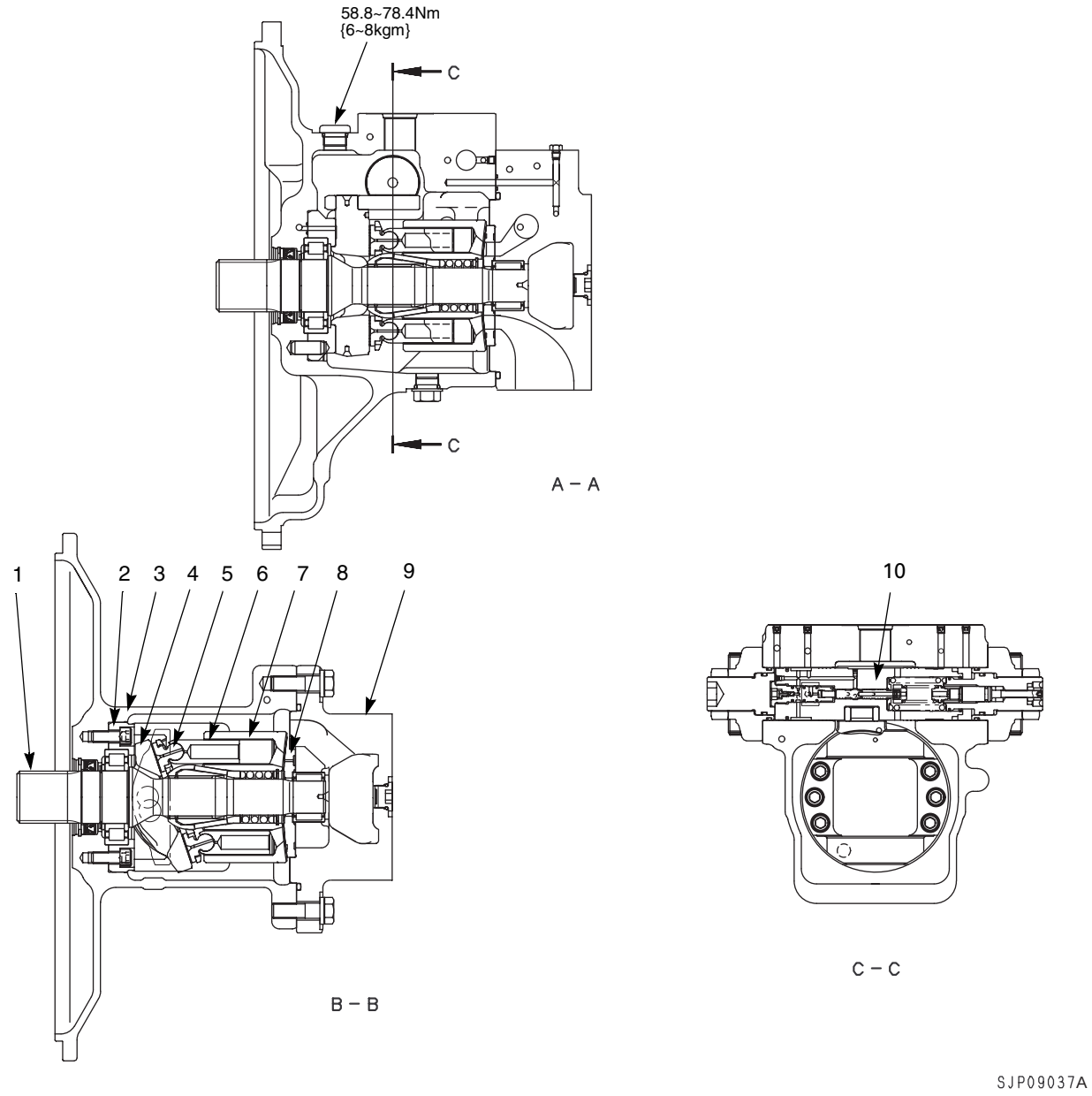
1. Main pump
2. LS valve
3. PC valve
4. LS-EPC valve
5. PC-EPC valve

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

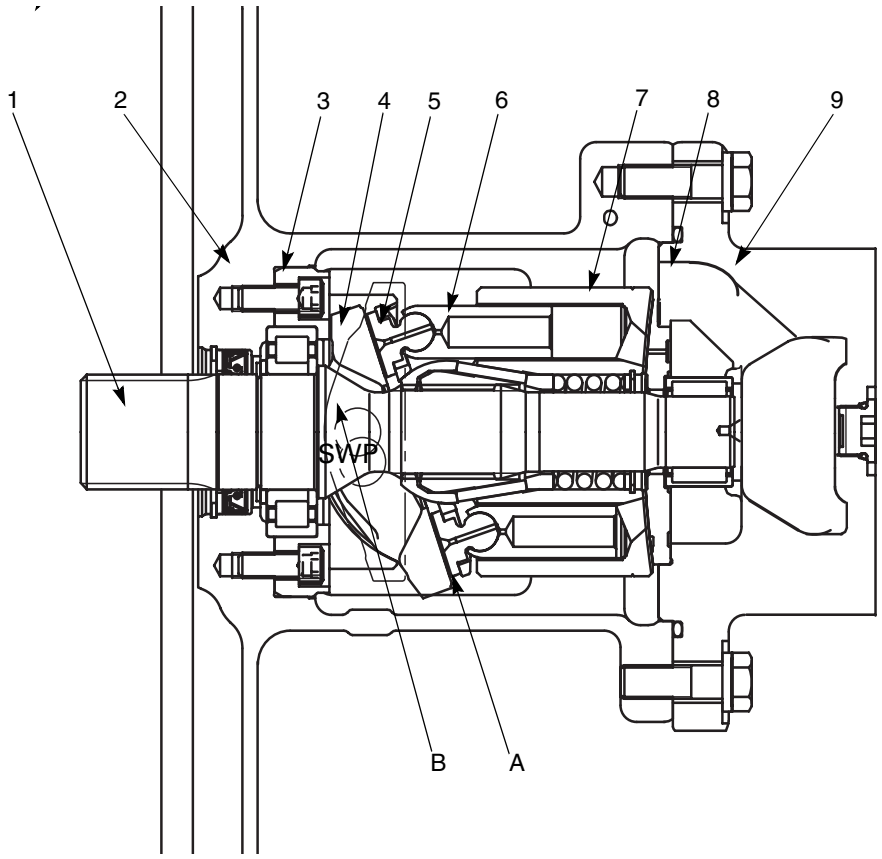
P_{LS} :Load pressure input port
P_{LSC} :Load pressure detection port
P_S :Pump suction port
P_{LSC}:LS set selector pressure detection port
P_M :PC set selector pressure detection port
P_{EPC}:EPC basic pressure input port
P_{EPC} :EPC basic pressure checking port
P_{SIG} :LS set change pressure checking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

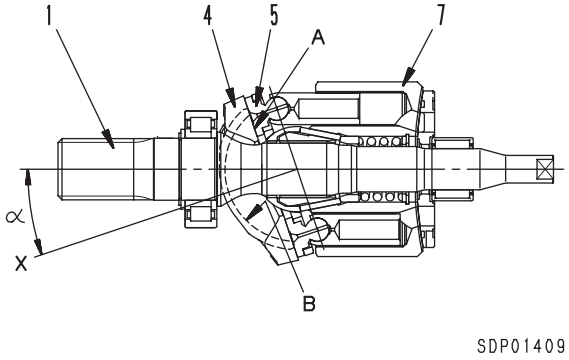
Structure

- 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).

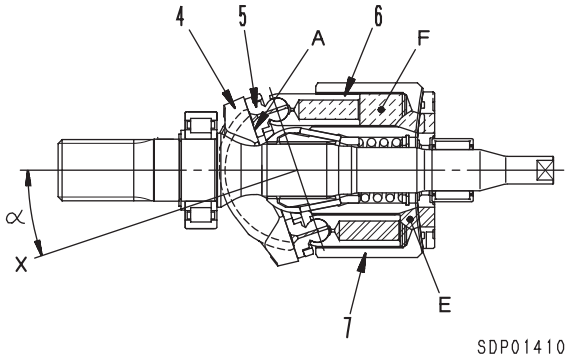
Operation

1) Operation of pump

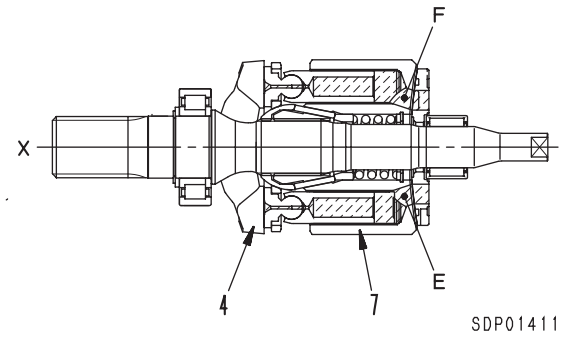
- Cylinder block (7) rotates together with shaft (1), and shoe (5) slides on flat surface **A**.
- When this happens, rocker cam (4) moves along cylindrical surface **B**, so angle α between center line **X** of rocker cam (4) and the axial direction of cylinder block (7) changes. (Angle α is called 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.)



SDP01409



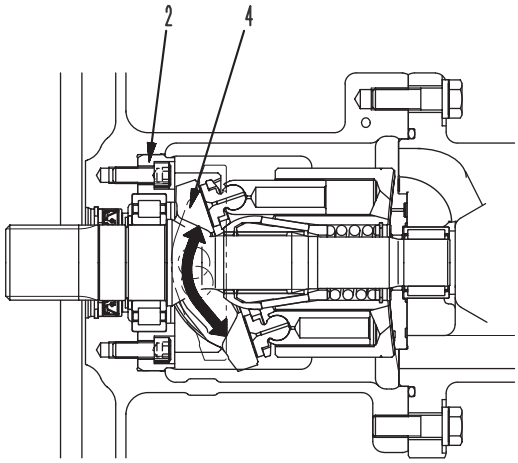
SDP01410



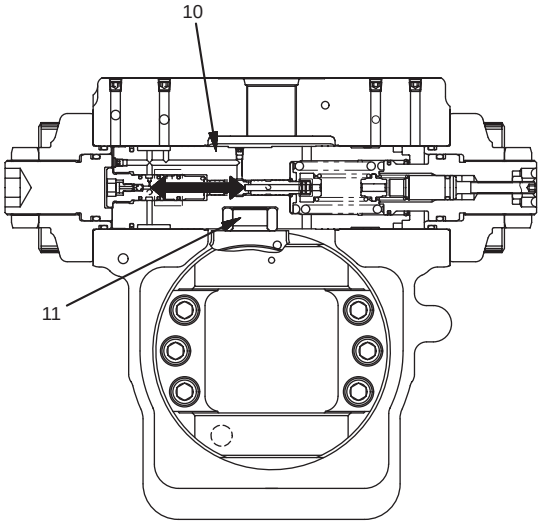
SDP01411

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 (10).
- 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 (12), 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 (12).

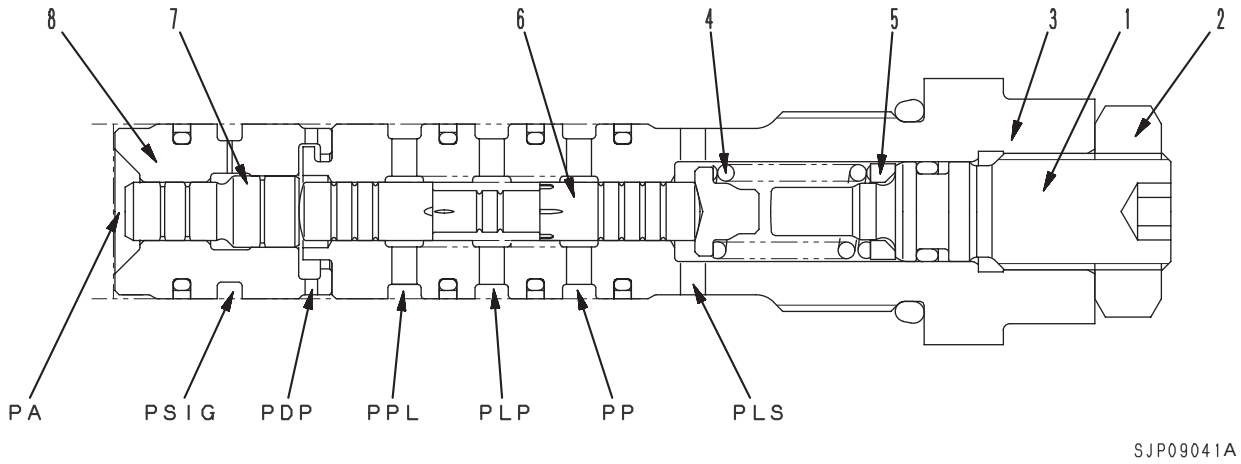


SJP09039A



SJP09040A

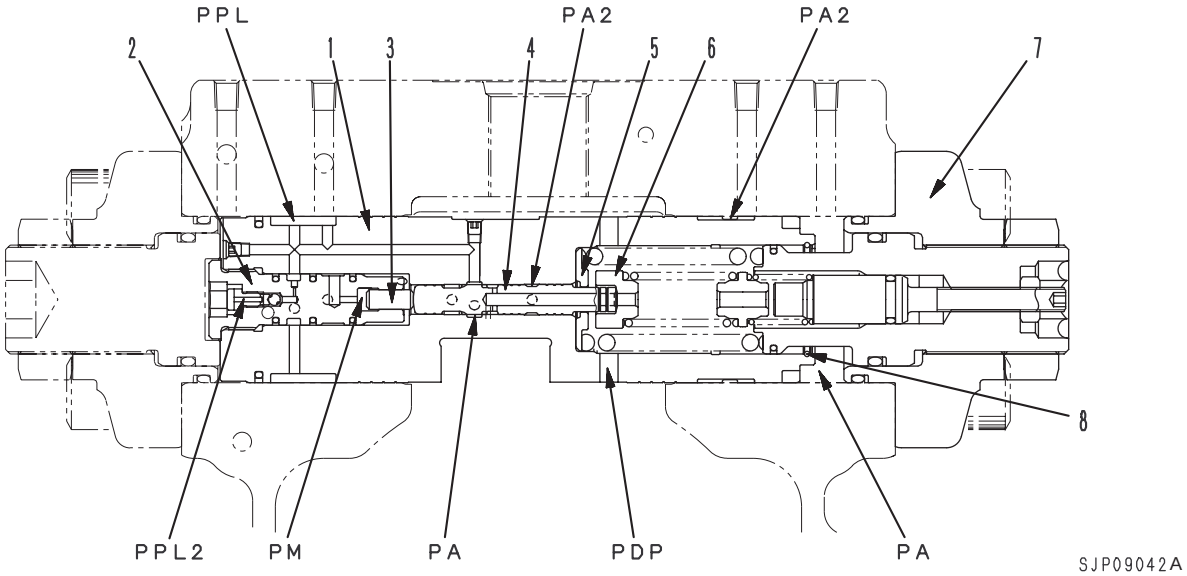
LS VALVE



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



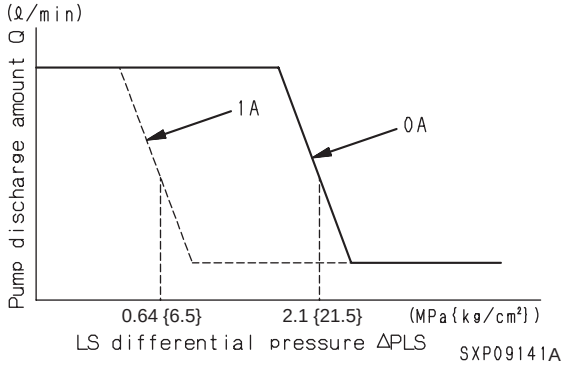
1) Servo piston assembly
2) Plug
3) Pin
4) Spool
5) Retainer
6) Seat
7) Cover
8) Wiring

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

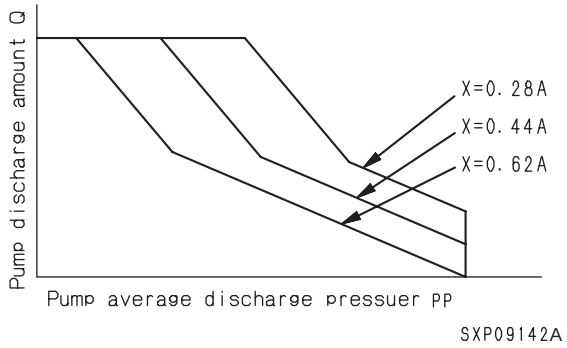
(1) LS valve

- 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}.

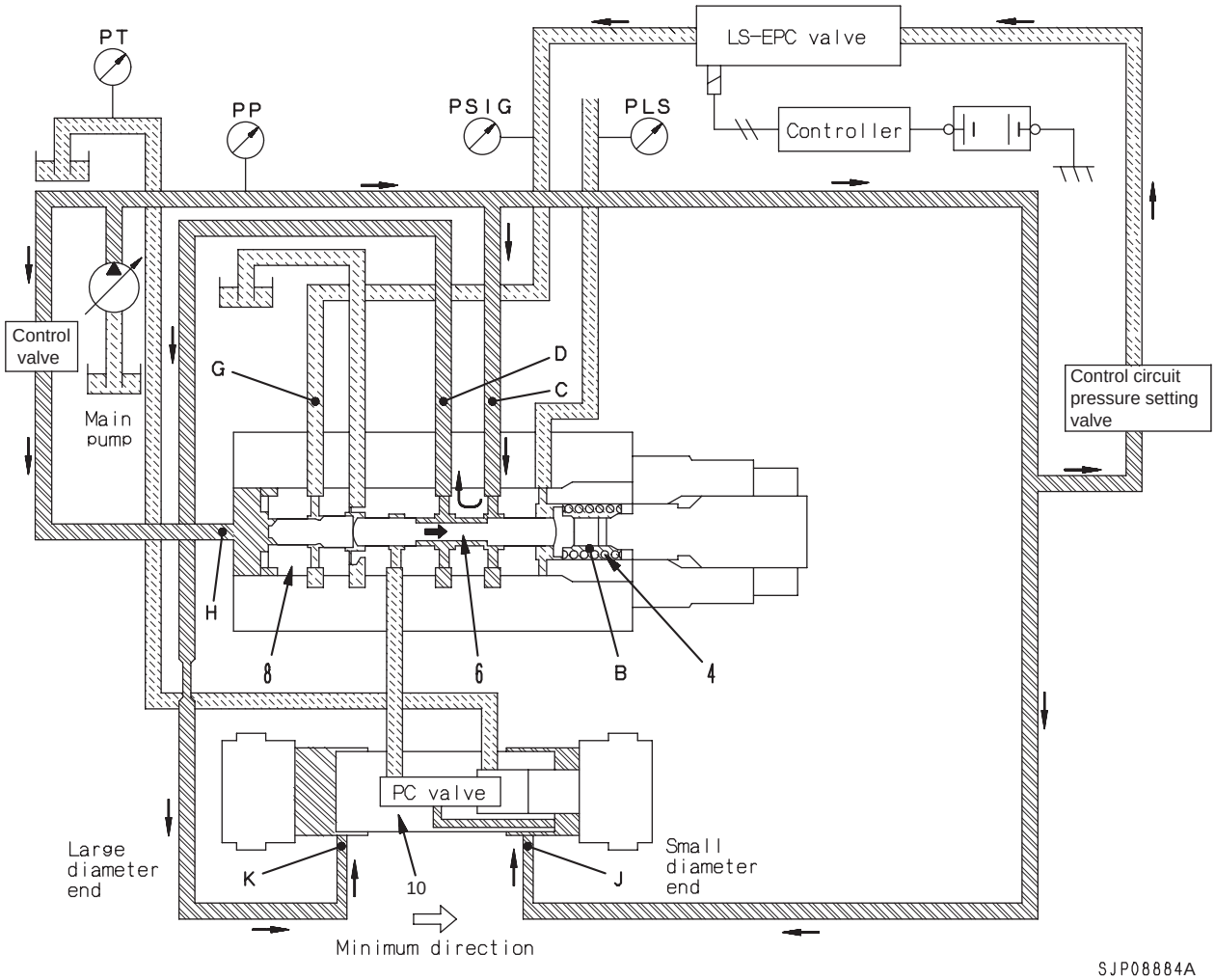


(2) PC valve

- 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



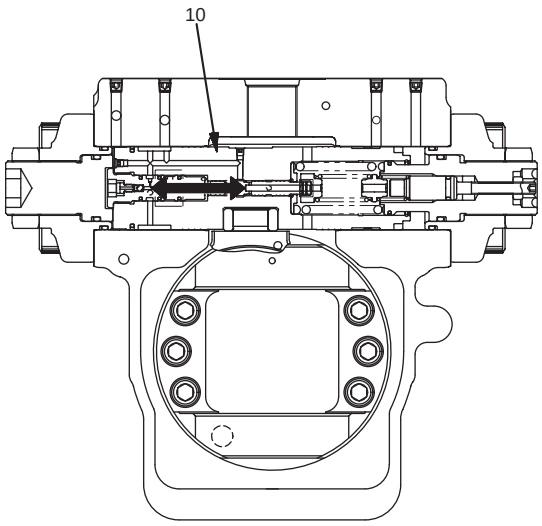
SJP08884A

(1) LS valve

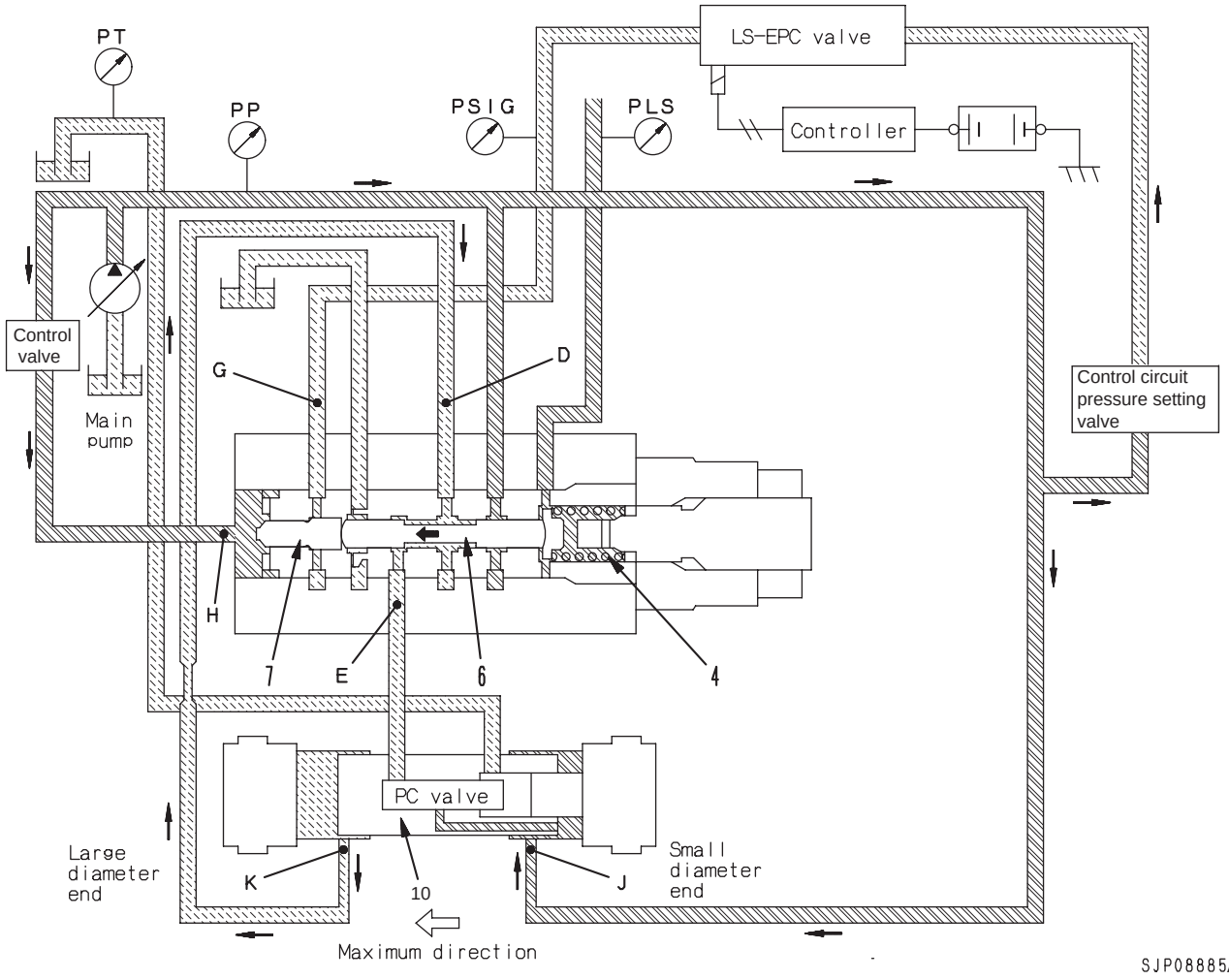
1) When control valve is at neutral position

- The LS valve is a three-way selector valve, with pressure **PLS** (LS pressure) from the 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 (ic) 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).

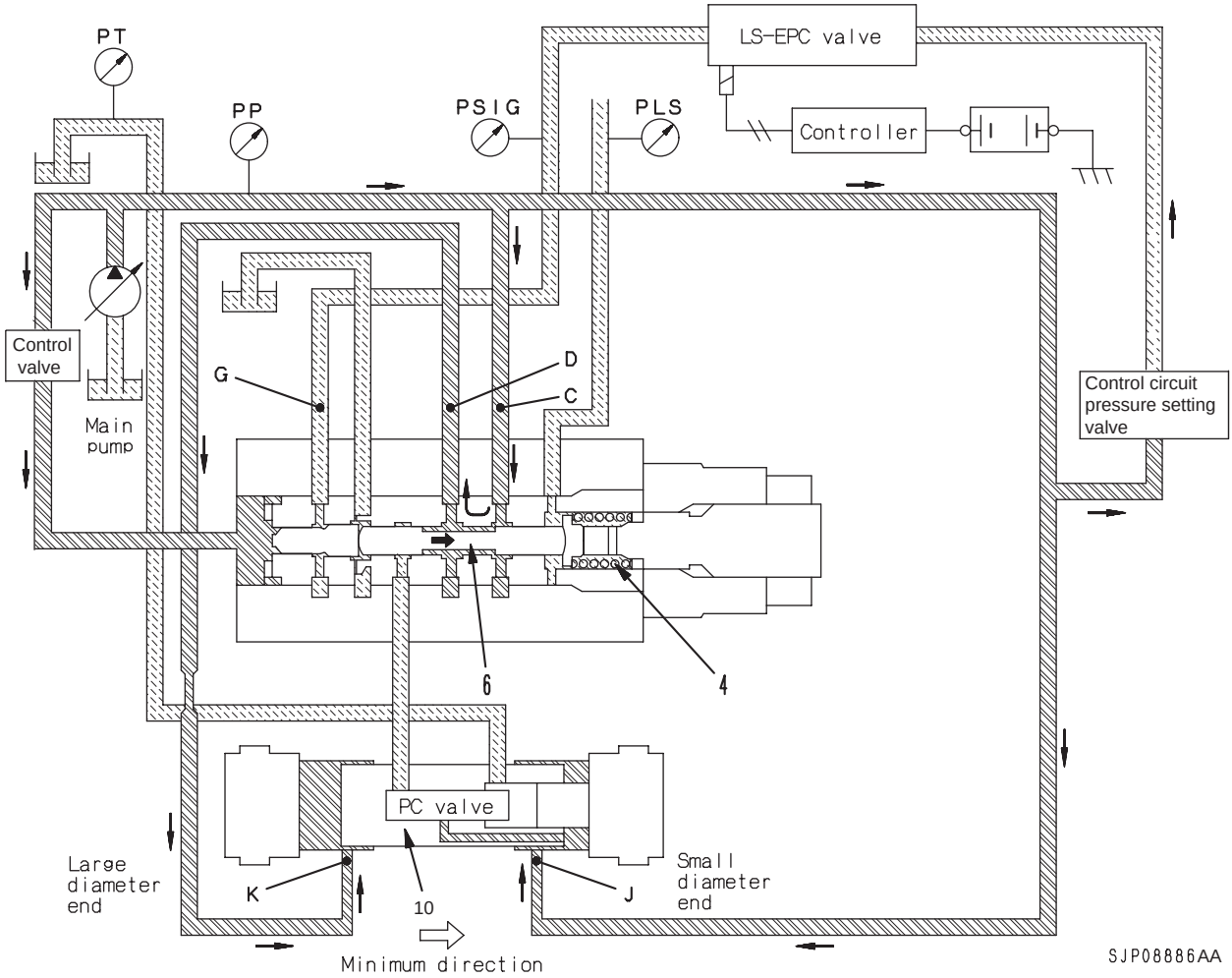


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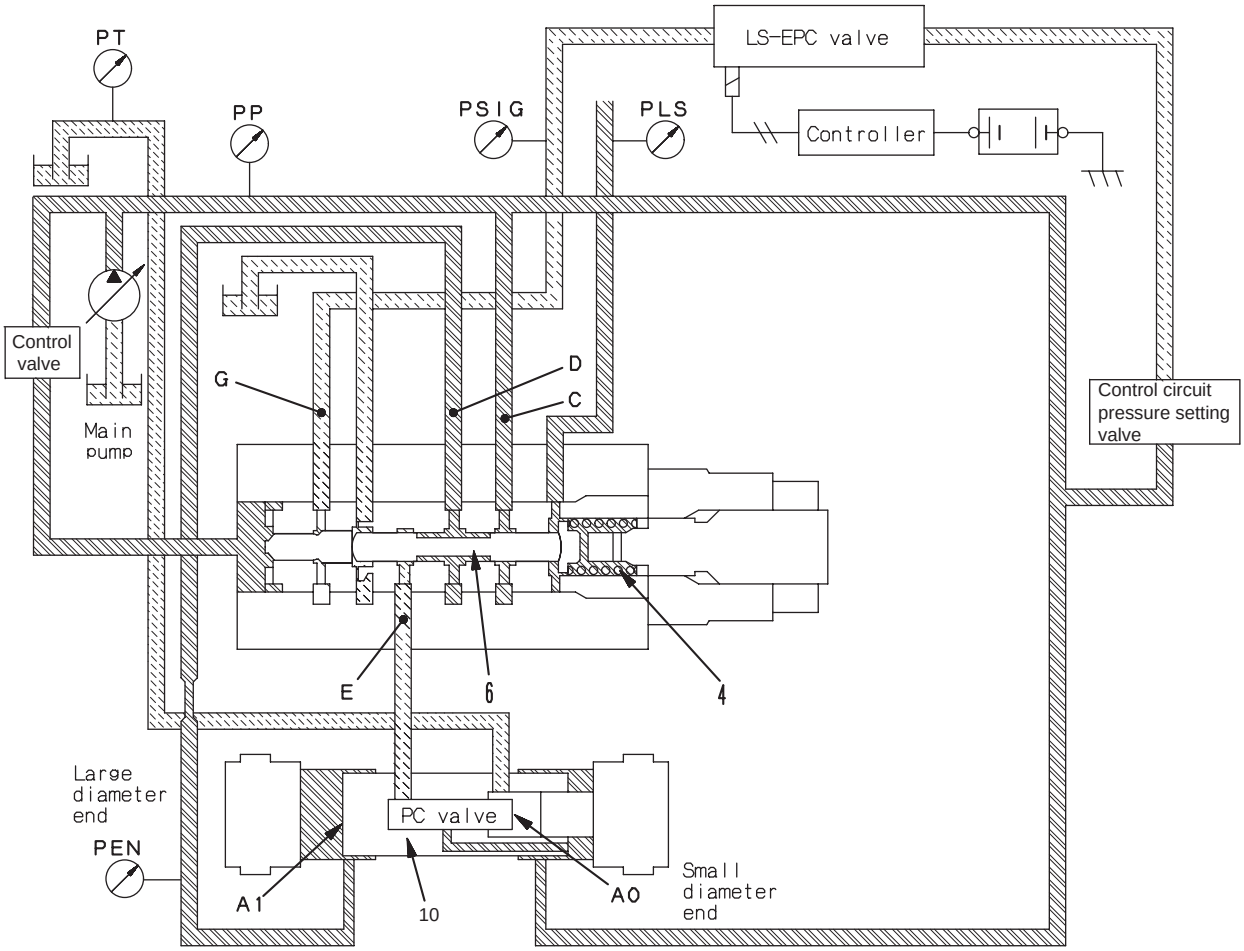
2. Operation in increase direction for pump discharge amount

- 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.



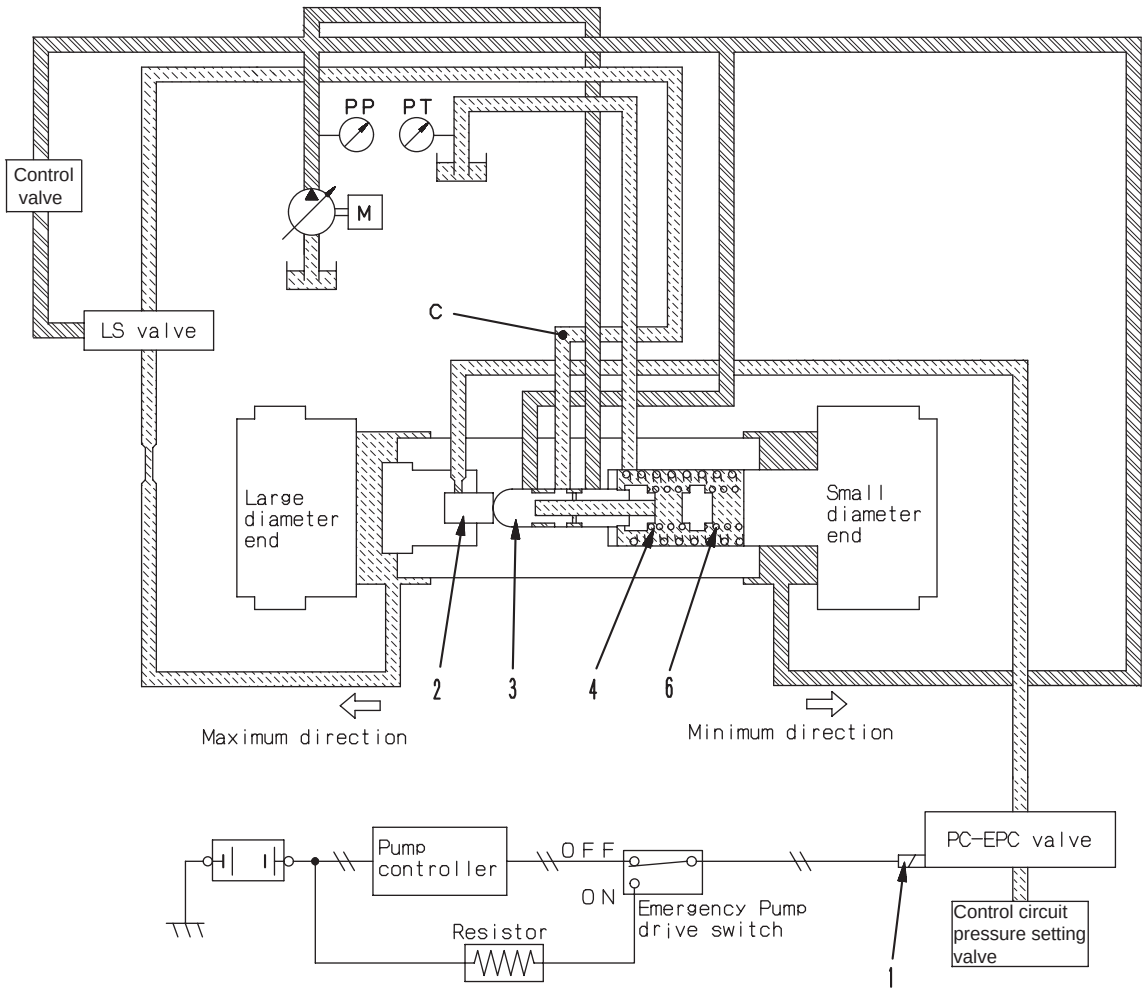
3. Operation in decrease direction for pump discharge amount

- 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.



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}.



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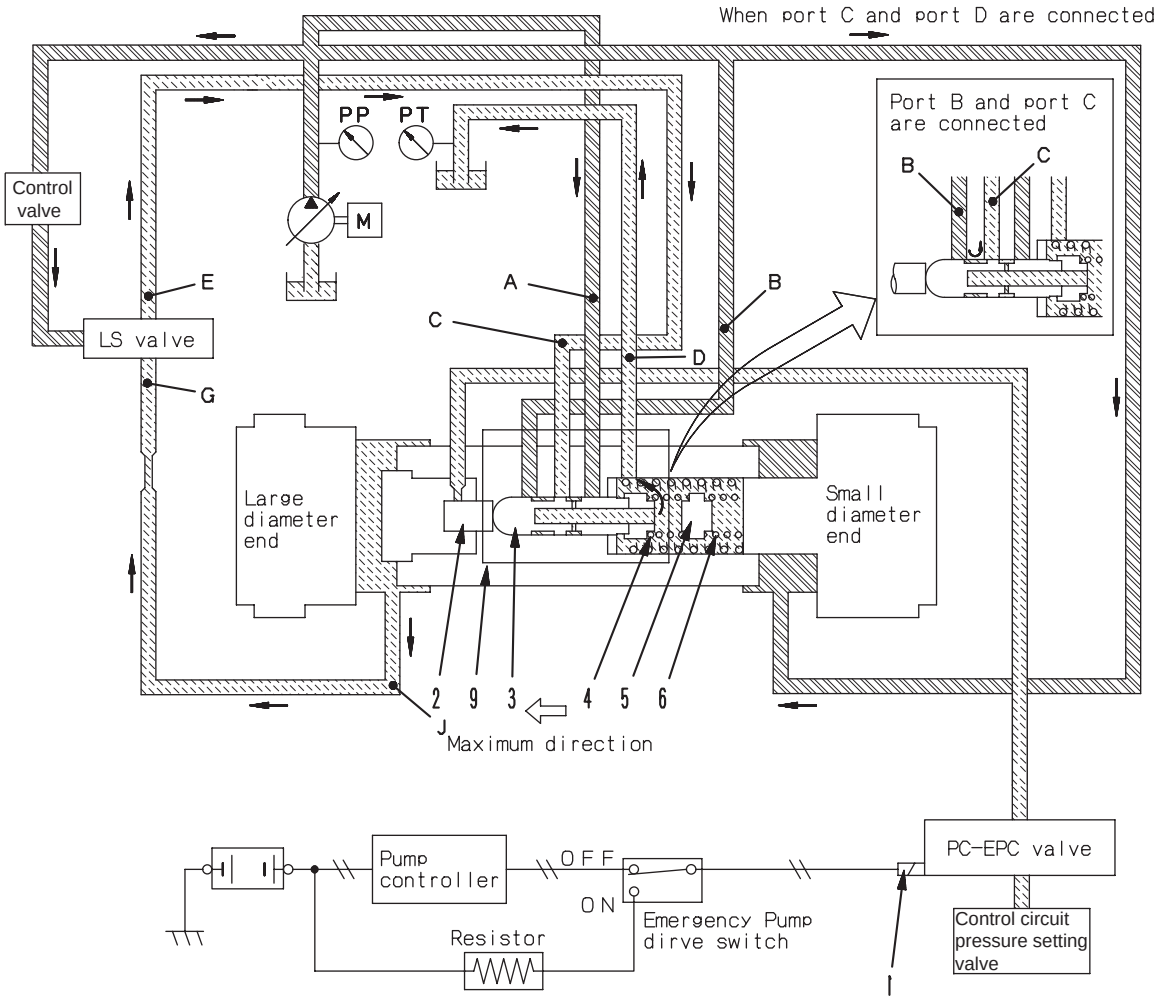
(2) PC Valve

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.

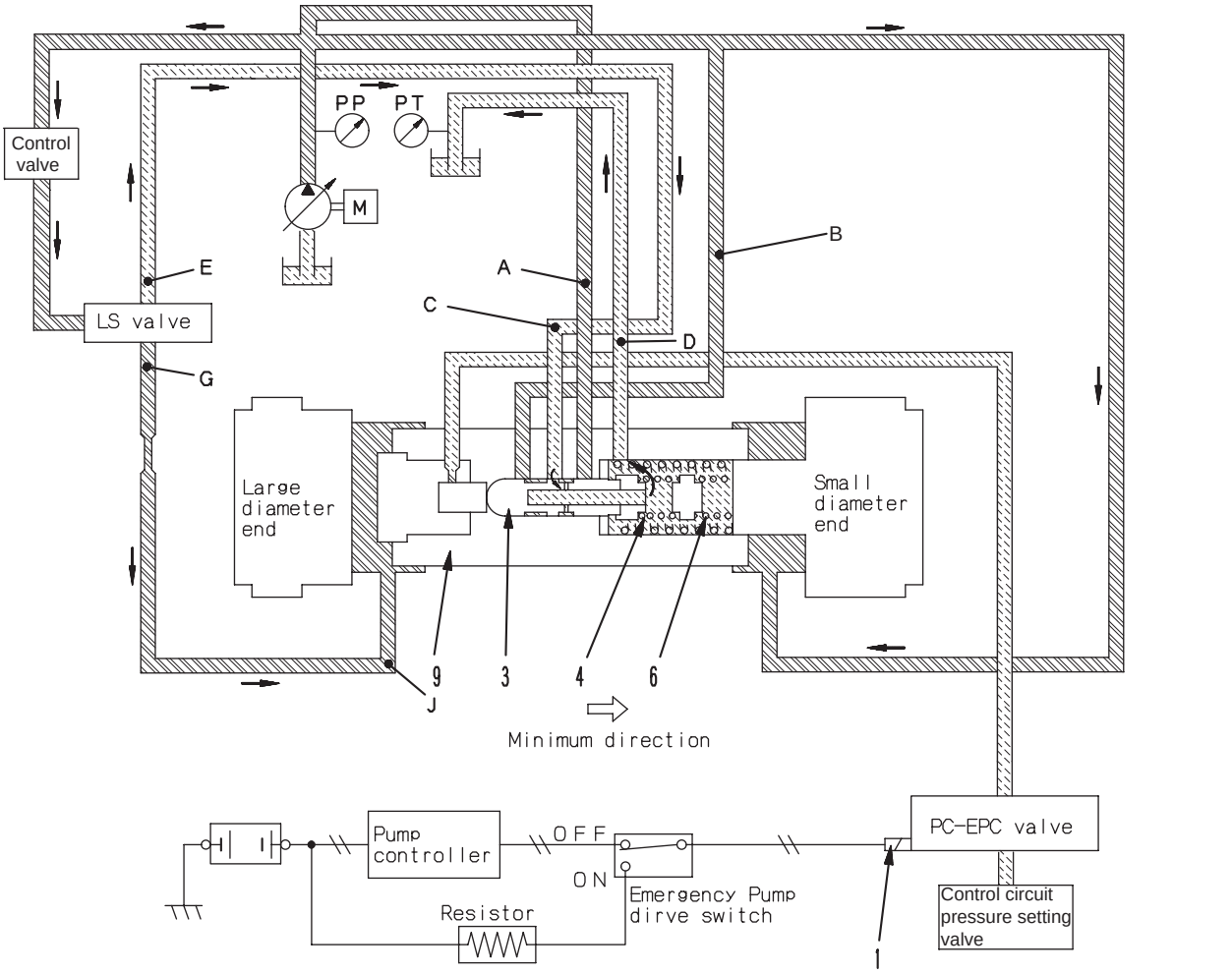


SXP09144AA

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.

- 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.

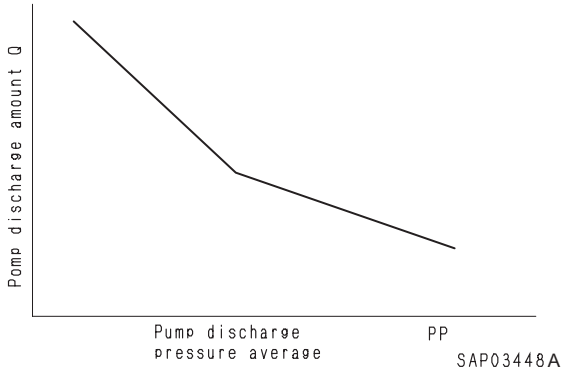


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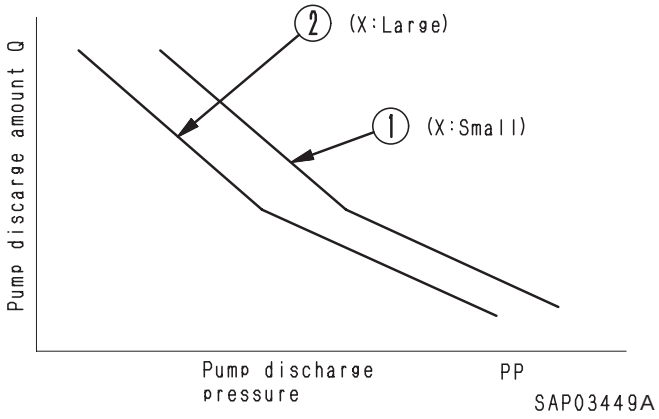
b). When load on actuator is large and pump discharge pressure is high

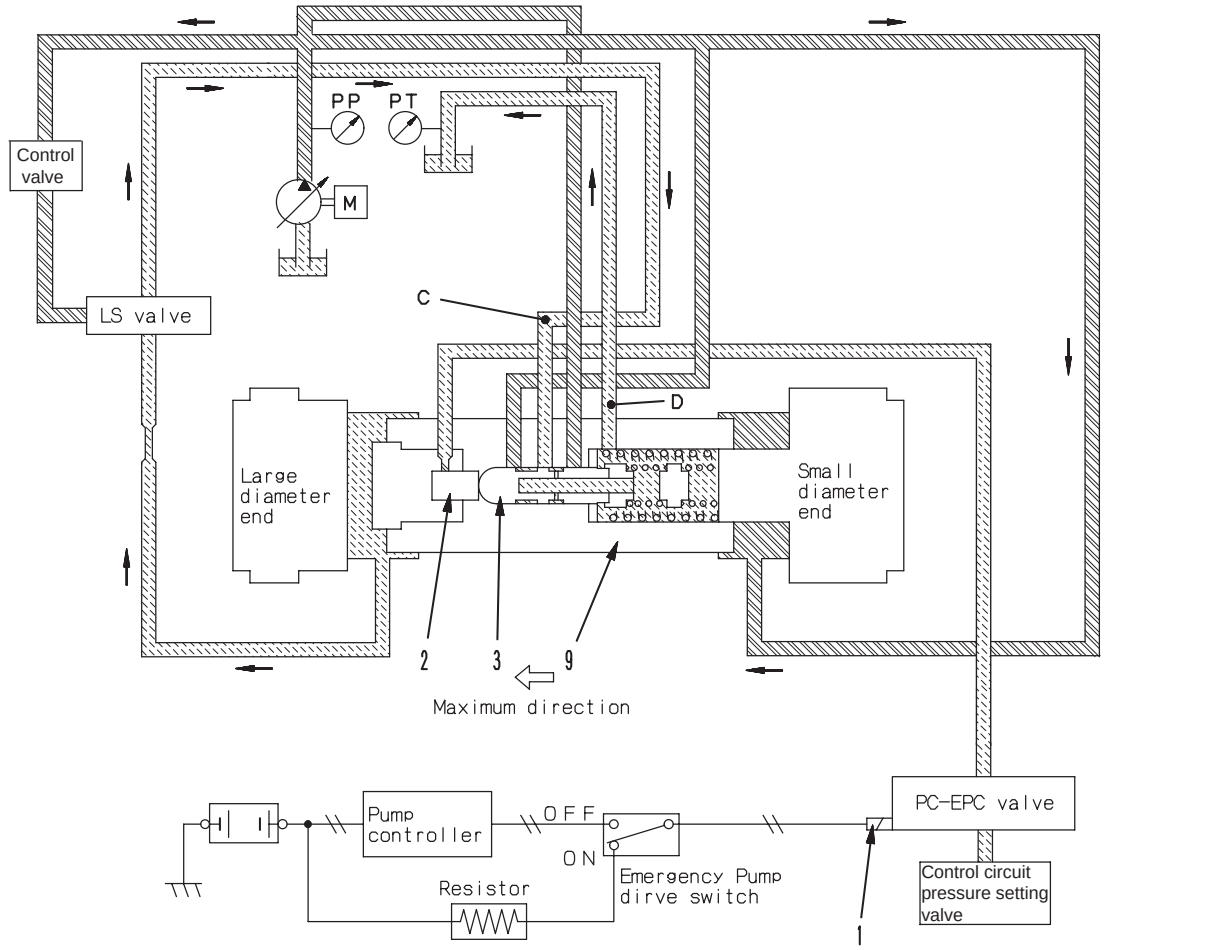
- When the load is large and pump discharge pressure **PP** is high, the force pushing servo piston (9) to the left becomes larger and spool (3) moves to the position in the diagram above. When this happens, as shown in the diagram above, part of the pressurized oil from port **B** flows out through 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 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 figure at the right.



- If command voltage **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**.



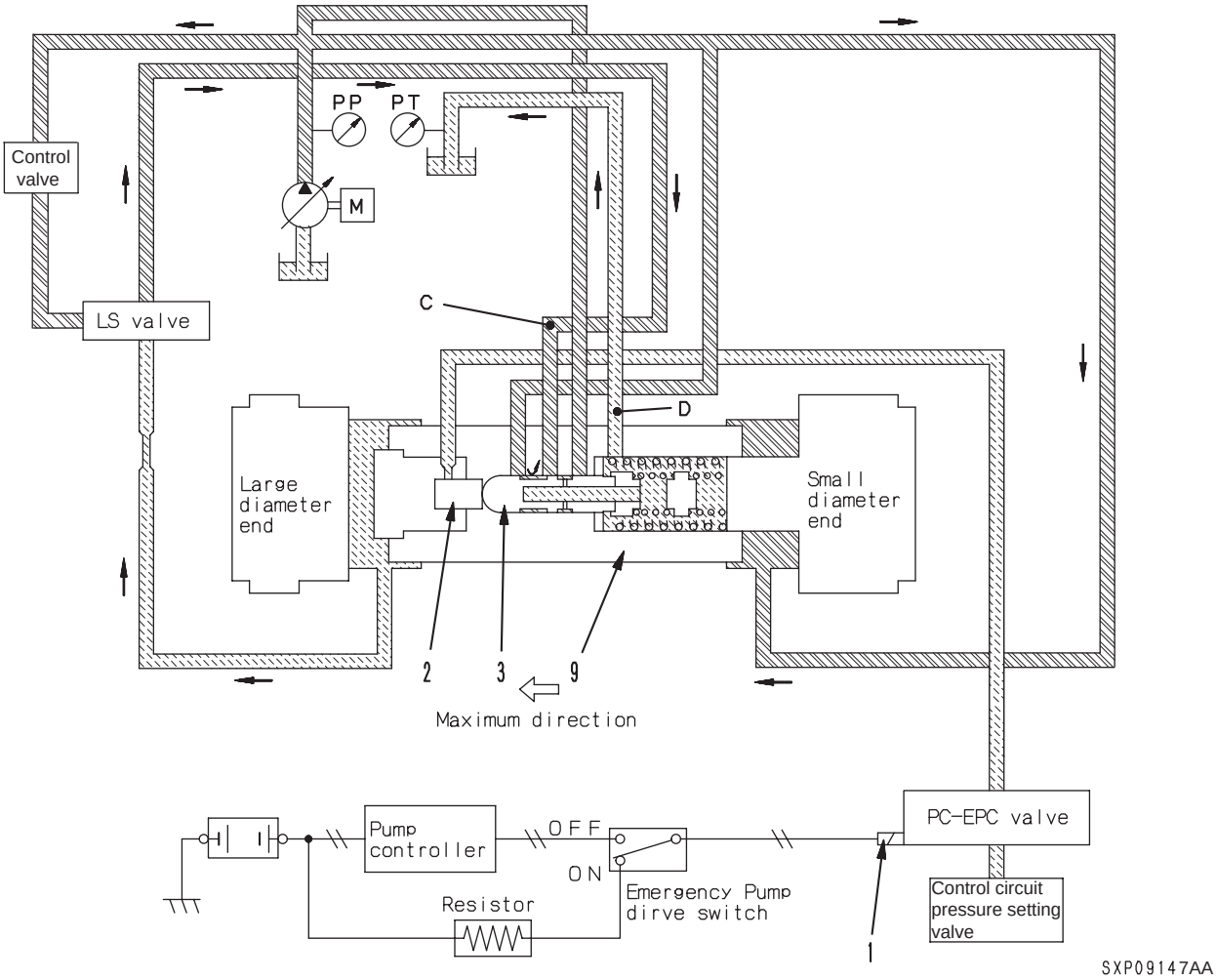


SXP09146AA

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

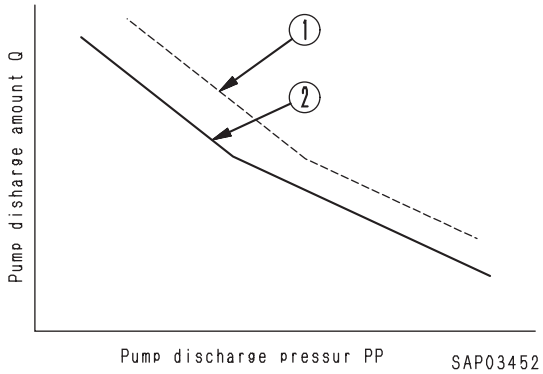
a. When load on main pump is light

- 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** are low, the combined force of the pump pressure and the force of PC-EPC valve solenoid (1) is weaker than the spring set force, so spool (3) is balanced at a position to the left.
- At this point, port **C** is connected to the drain pressure of port **D**, and the large diameter end of the piston of 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.

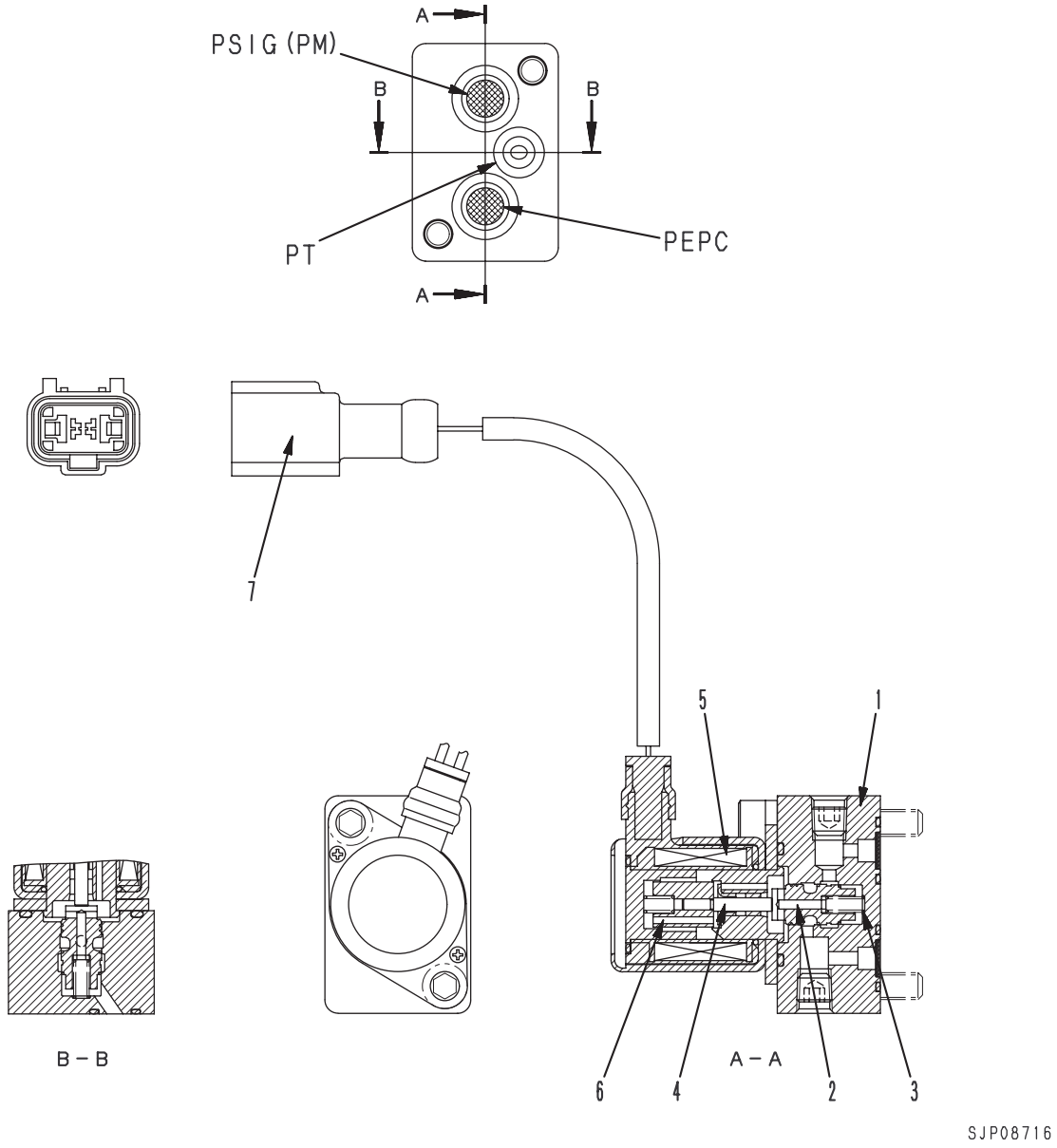


b. When main pump load is heavy

- 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, spool (3) moves further to the right than when the main pump load is light, and is balanced at the position in the diagram above.
- In this case, the pressure from port **B** flows to port **C**, so servo piston (9) moves to the right (to make the discharge amount smaller) by the same mechanism as explained in item 2)-b, and stops at a position to the right 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 PC prolix 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

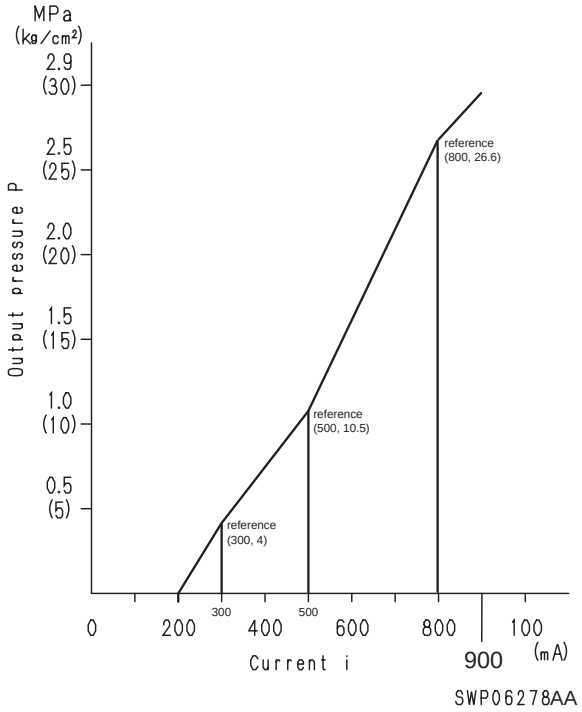


1) Body
2) Spool
3) Spring
4) Rod
5) Coil
6) Plunger
7) Connector

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.

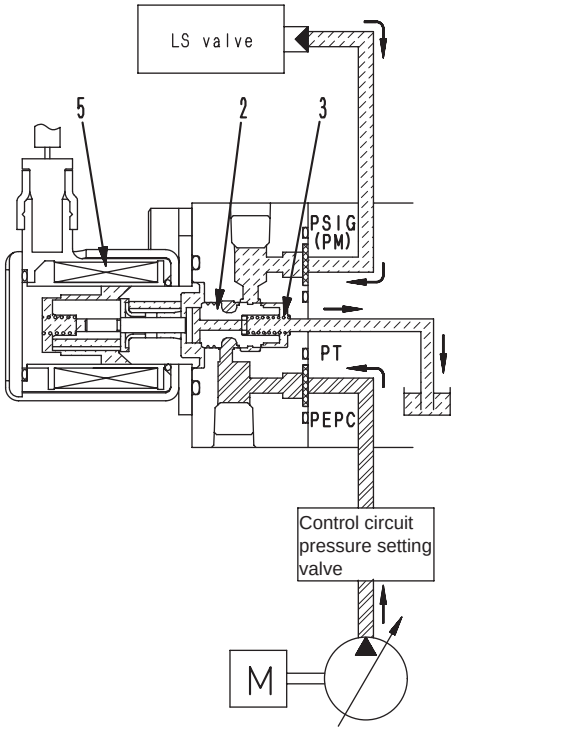


SWP06278AA

Operation

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

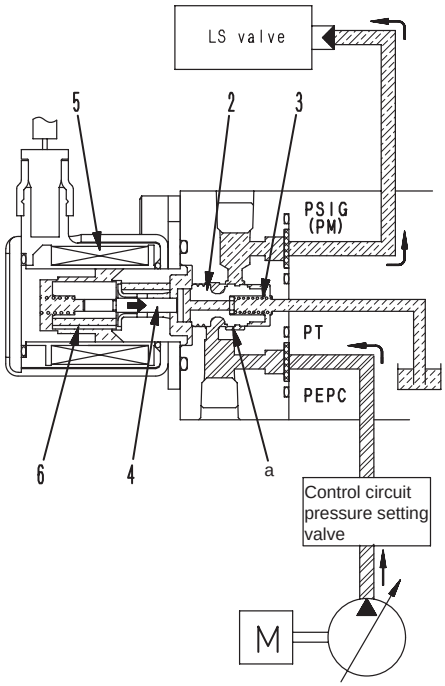
- When there is no signal current flowing from the controller to coil (5), coil (5) is de-energized.
- For this reason, spool (2) is pushed to the left in the direction of the arrow by spring (3).
- As a result, port **PEPC** closes and the pressurized oil from the main pump does not flow to the LS (PC)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



SJP08890AA

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

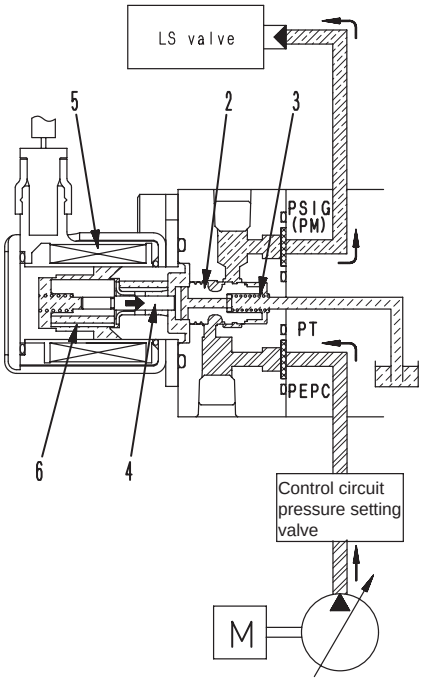
- When a very small signal current flows to coil (5), coil (5) is energized, and a propulsion force is generated which pushes plunger (6) to the right.
- Push pin (4) pushes spool (2) to the right, and pressurized oil flows from port **PEPC** to port **PSIG(PM)**.
- When the pressure at port **PSIG(PM)** 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.



SJP08891AA

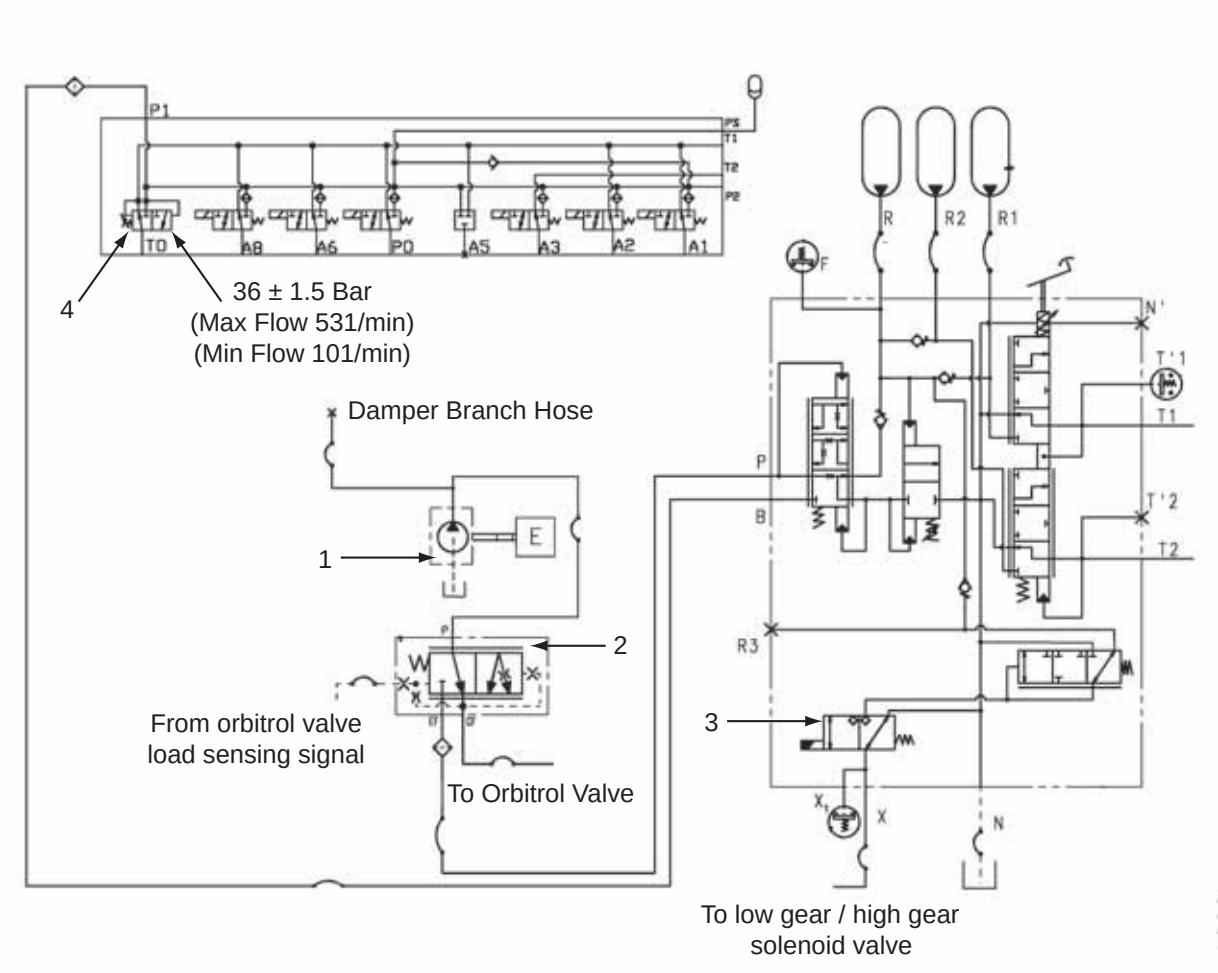
3. When signal current is maximum (coil energized)

- 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.



SJP08892AA

PILOT PRESSURE CONTROL (PPC) SYSTEM



1. Gear Pump
2. Steering/Braking priority valve
3. Power Brake Valve
4. Pressure Regulating 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 pumpless 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

PW160-7E0

OUTLINE

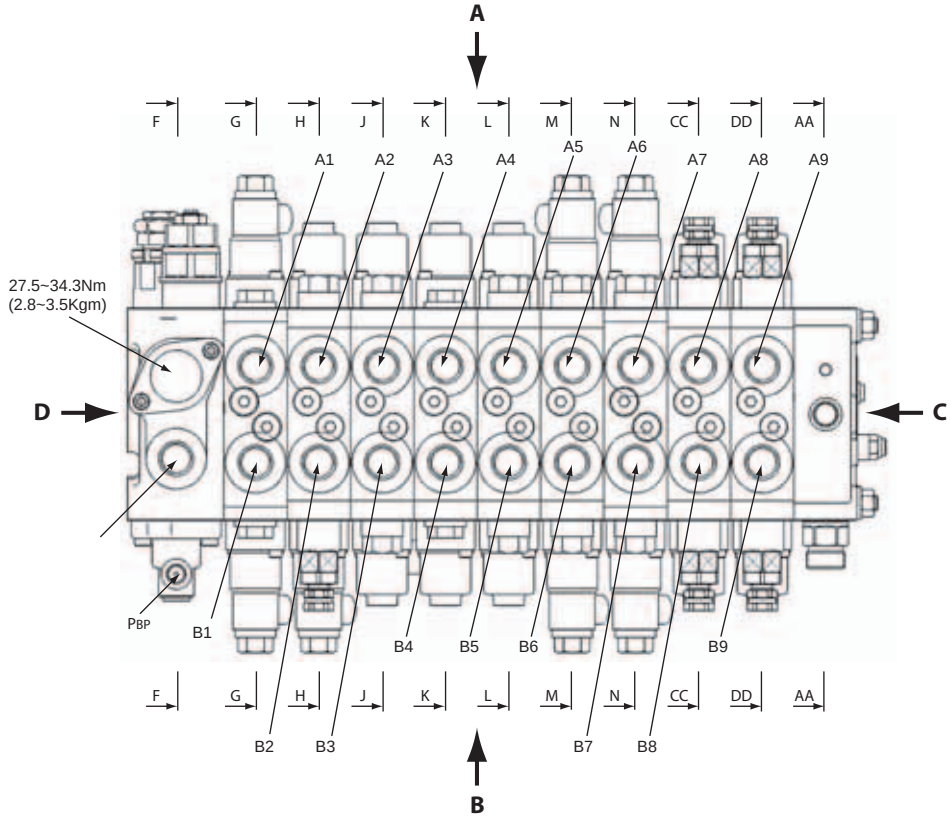
The following four types of control valve are set.

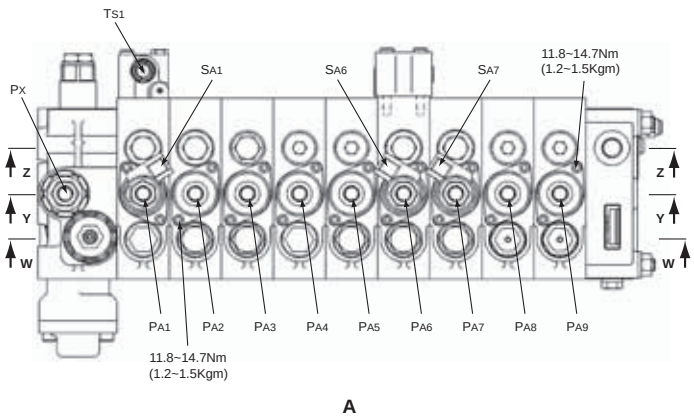
- 7-spool (monoboom + service valve)
- 8-spool (monoboom + two service valve)
- 8-spool (2P boom + service valve + 2nd boom cylinder valve)
- 9-spool (2P boom + two service valve + 2nd boom cylinder valve)

H 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)

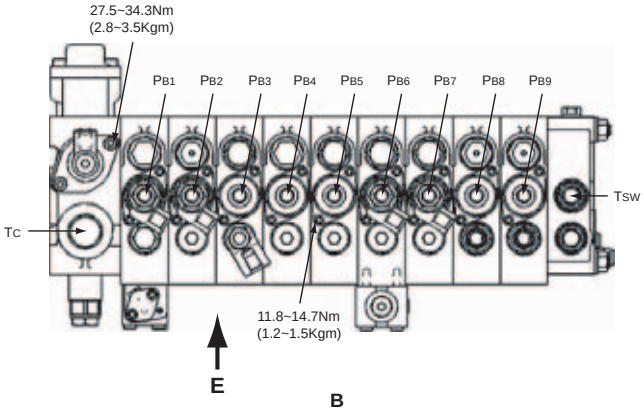
An explanation of the external appearance and the cross section is given only for the 9-spool valve (2P boom + two service valve + 2nd boom cylinder valve)

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 OUT	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 IN	L_S.	to pump LS valve
B7.	To bucket cyl bott	P_{B7}.	From bucket cyl PPC valve CURL	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		

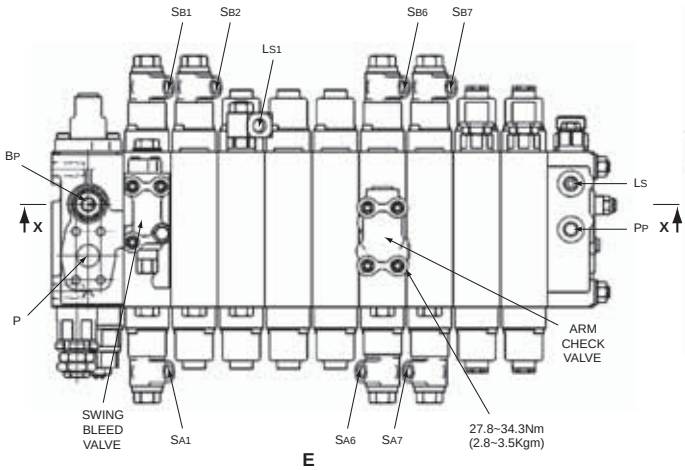

A
F
G
H
J
K
L
M
N
CC
DD
AA
A1
A2
A3
A4
A5
A6
A7
A8
A9
27.5~34.3Nm
(2.8~3.5Kgm)
D
C
PBP
B1
B2
B3
B4
B5
B6
B7
B8
B9
B


TS1
PX
SA1
SA6
SA7
11.8~14.7Nm
(1.2~1.5Kgm)
Z
Y
W
PA1
PA2
PA3
PA4
PA5
PA6
PA7
PA8
PA9
11.8~14.7Nm
(1.2~1.5Kgm)

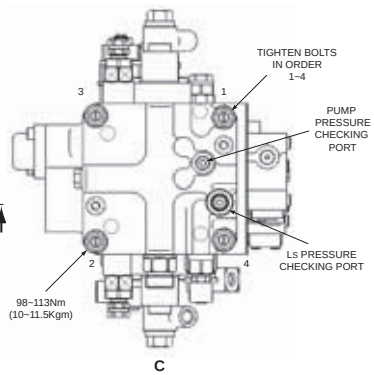
A


27.5~34.3Nm
(2.8~3.5Kgm)
PB1
PB2
PB3
PB4
PB5
PB6
PB7
PB8
PB9
TSW
TC
11.8~14.7Nm
(1.2~1.5Kgm)
E

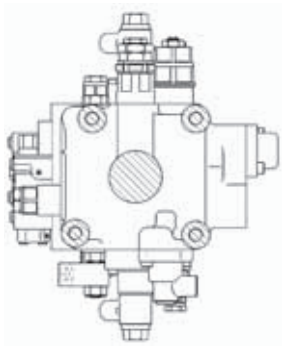
B


SB1
SB2
LS1
SB6
SB7
BP
X
P
LS
PP
ARM
CHECK
VALVE
SWING
BLEED
VALVE
SA1
SA6
SA7
27.8~34.3Nm
(2.8~3.5Kgm)

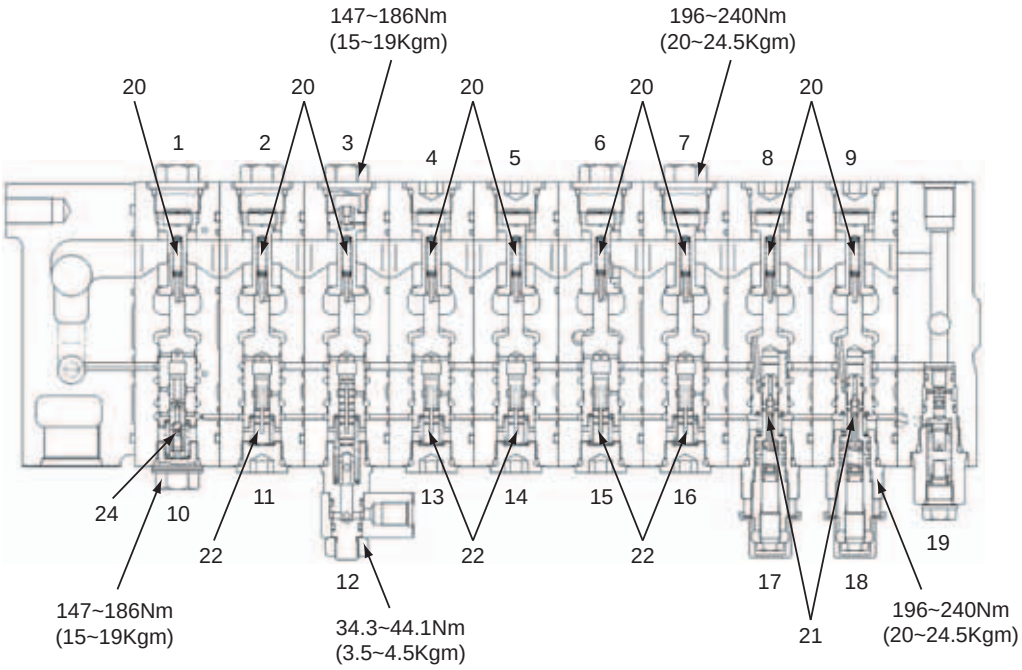
E


TIGHTEN BOLTS
IN ORDER
1~4
3
1
PUMP
PRESSURE
CHECKING
PORT
LS PRESSURE
CHECKING PORT
2
4
98~113Nm
(10~11.5Kgm)

C



D



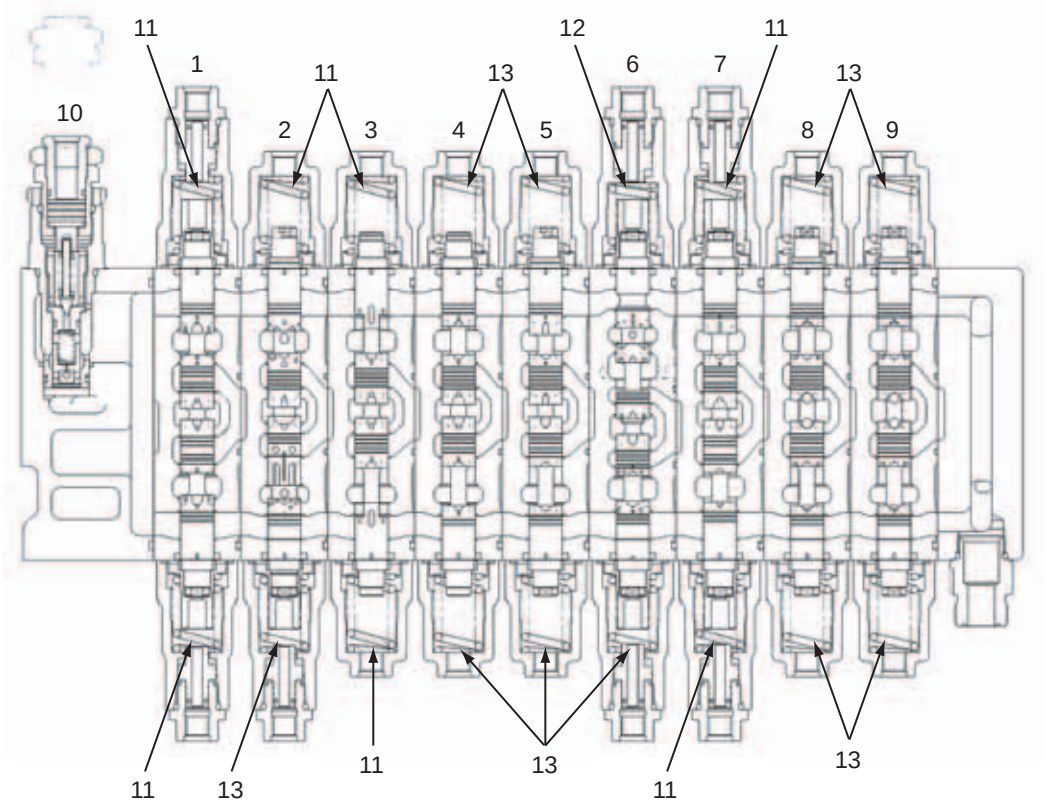
Z-Z

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

H The letters F and R refer to the following valves.
F: Flow control valve R: Reducing 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	
20.	Flow control valve spring	36.2 x 5.3	23.5	29.4N (3kg)		23.5N (2.4kg)	If damaged or deformed, replace spring
21.	Reducing valve spring	24.5 x 15	14.5	9.8N (1kg)		7.8N (0.8kg)	
22.	Reducing valve spring	27.5 x 14.2	18	17.6N (1.8kg)		14N (1.4kg)	
23.	Reducing valve spring	74.8 x 14.2	40	66.4N (6.8kg)		53.1N (5.4kg)	
24.	Reducing valve spring	32.5 x 14.2	23	17.6N (1.8kg)		14N (1.4kg)	

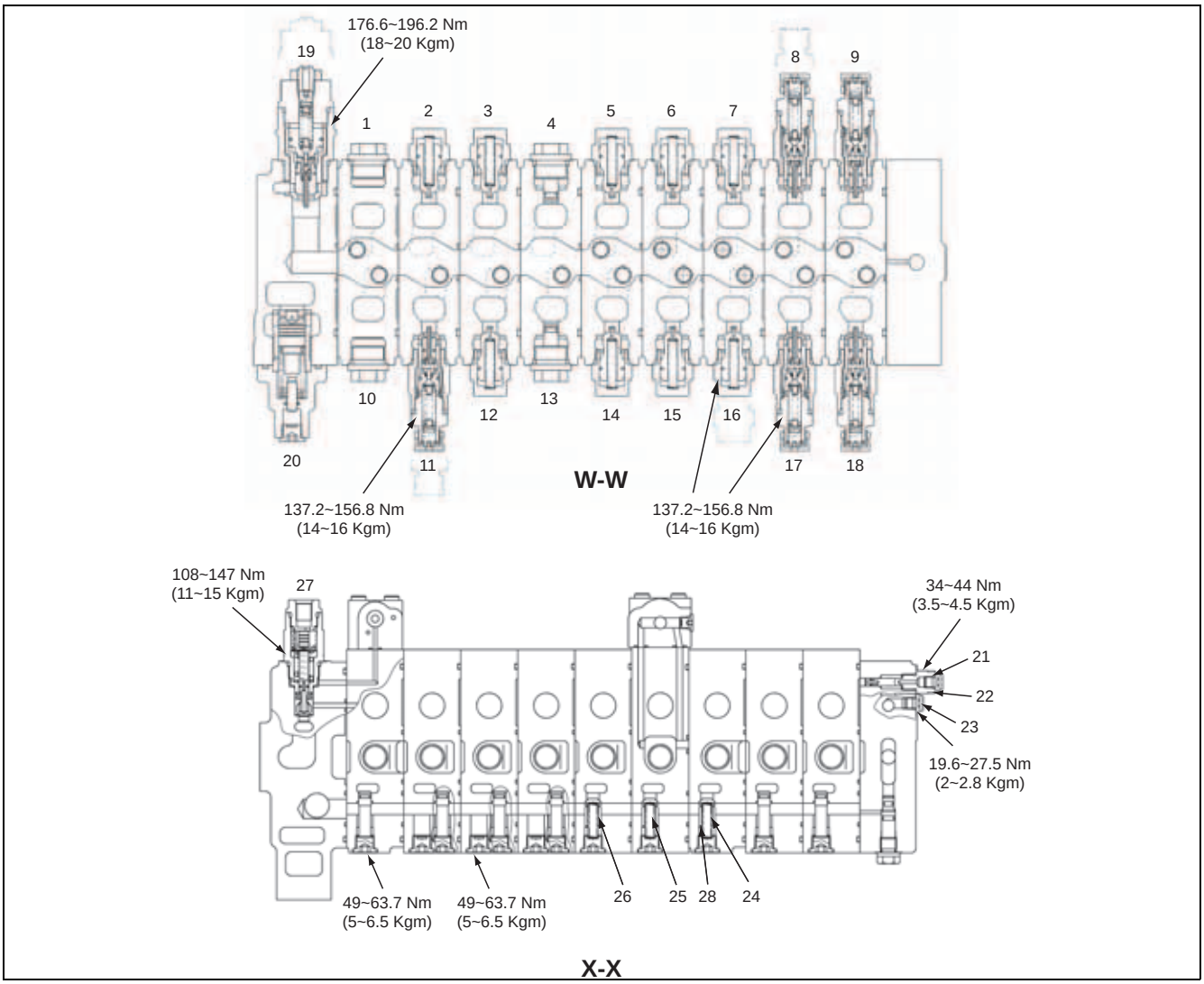


Y-Y

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

Unit:mm

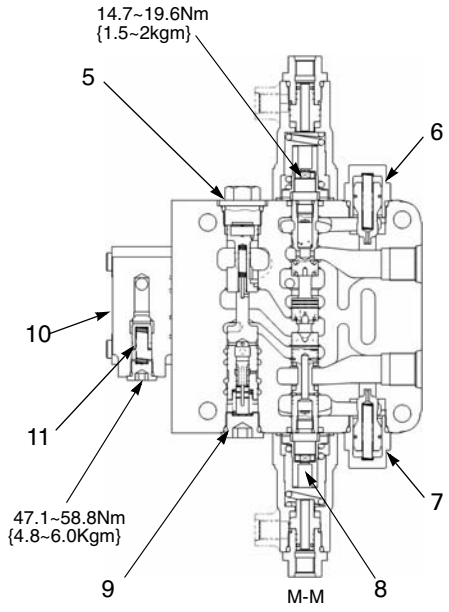
No	Check Item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Out-side diameter	Installed length	Installed load	Free length	Installed load	
11.	Spool return spring	45.7 x 28	45	55.9N (5.7kg)		44.7N (4.6kg)	If damaged or deformed, replace spring
12.	Spool return spring	42.4 x 28	41	92.2N (9.4kg)		73.8N (7.5kg)	
13.	Spool return spring	45.6 x 28	45	53.5N (5.46kg)		42.8N (4.4kg)	



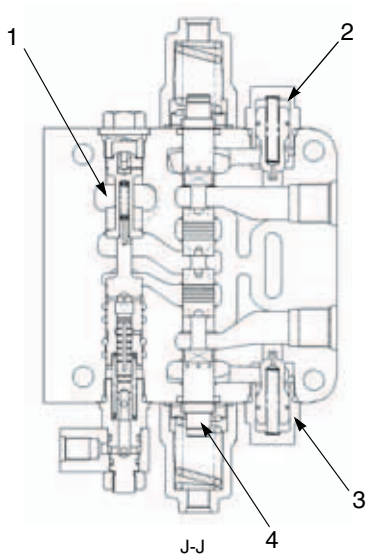
1. N/A
2. Suction valve (Boom Raise)
3. Suction valve (Travel Forward)
4. N/A
5. Suction valve (2PBoom Extend)
6. Suction valve (Arm Dump)
7. Suction valve (Bucket Dump)
8. Variable safety suction valve (Service)
9. Variable safety suction valve (Service)
10. N/A
11. Suction valve (Boom Lower)
12. Suction 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	5.9N (0.6kg)		4.7N (0.48kg)	



Arm control valve

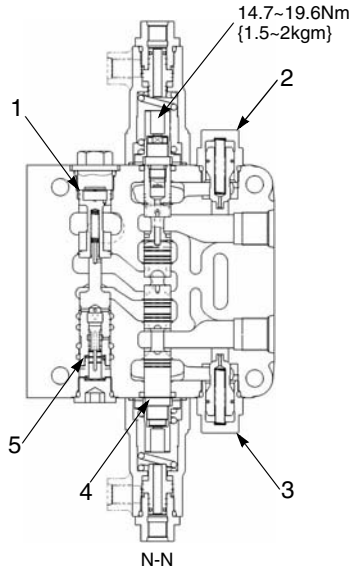


Travel control valve

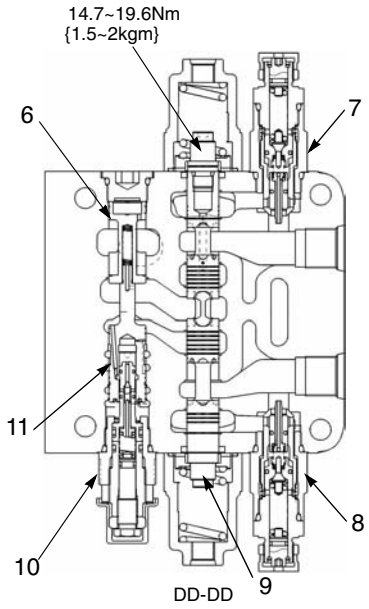
1.	Pressure compensation valve	6.	Suction valve
2.	Suction valve	7.	Suction valve
3.	Suction valve	8.	Spool (Arm)
4.	Spool (Travel)	9.	Pressure compensation valve R
5.	Pressure compensation valve F	10.	Arm regeneration valve

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
11	Check valve spring	41.5 x 8.5	26.5	8.8N (0.9kg)		7N (0.7kg)	



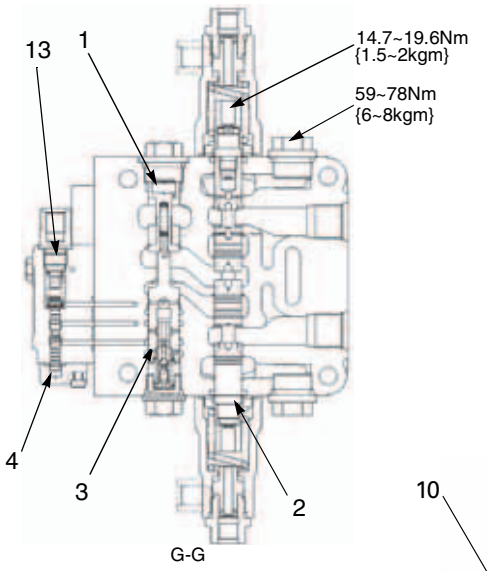
Bucket control valve

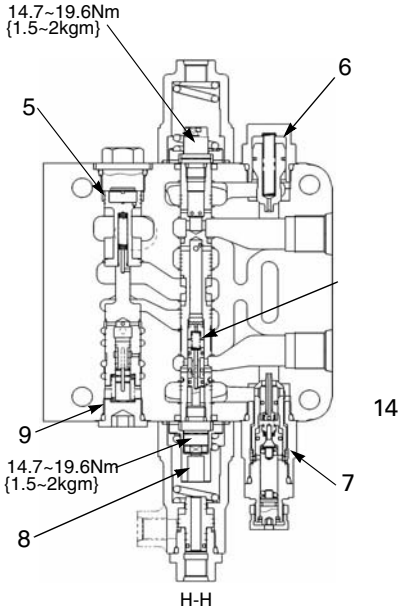


Service control valve

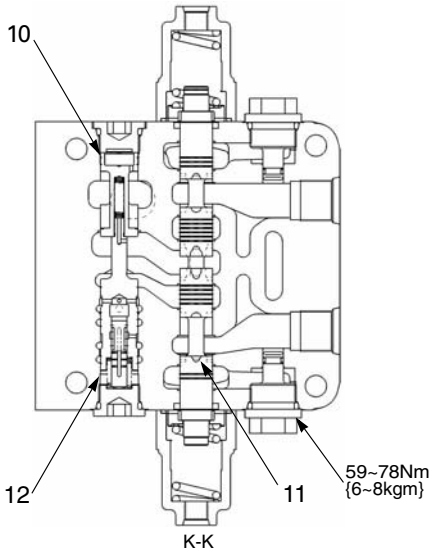
1. Pressure compensation valve F
2. Safety suction valve
3. Safety suction valve
4. Spool (Bucket)
5. Pressure compensation valve R
6. Pressure compensation valve F
7. Safety suction valve mount
8. Safety suction valve mount
9. Spool (service)
10. Variable pressure compensation valve
11. Pressure compensation valve R

Swing control valve





Boom control valve



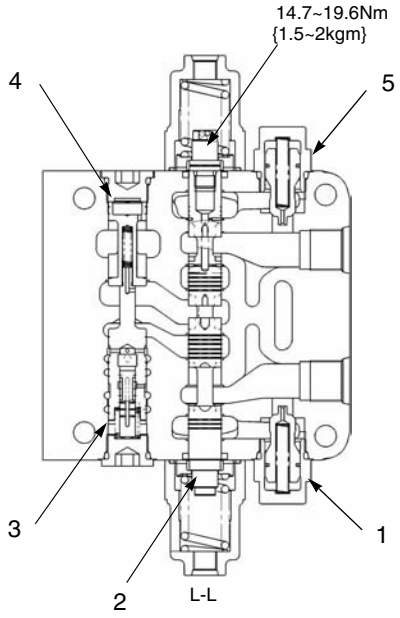
Stabilizer control valve

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

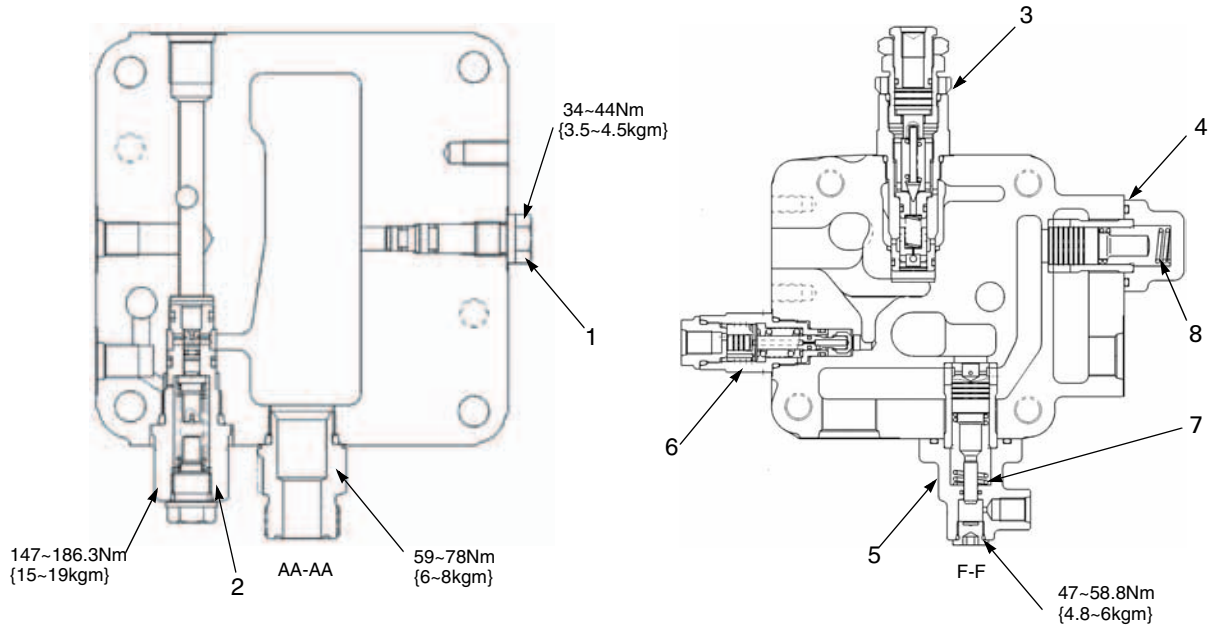
Unit:mm

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
13.	Bleed spool return spring	23.3 x 12.5	23	3.9Nm (0.4kgm)		2.9Nm 0.3kgm)	

Second boom control valve



1. Suction valve
2. Spool (2nd Boom)
3. Pressure compensation valve R
4. Pressure compensation valve F
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. select 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

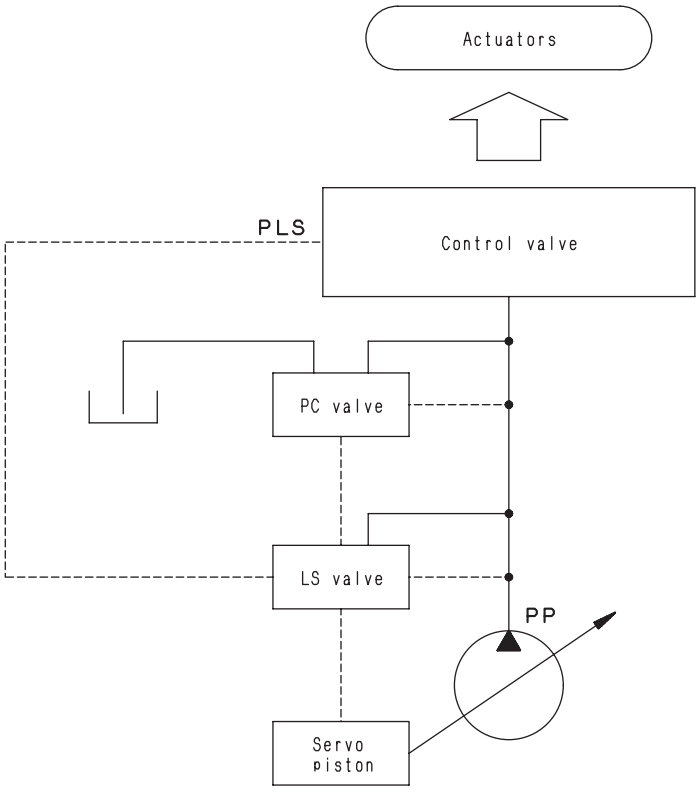
FEATURES

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.

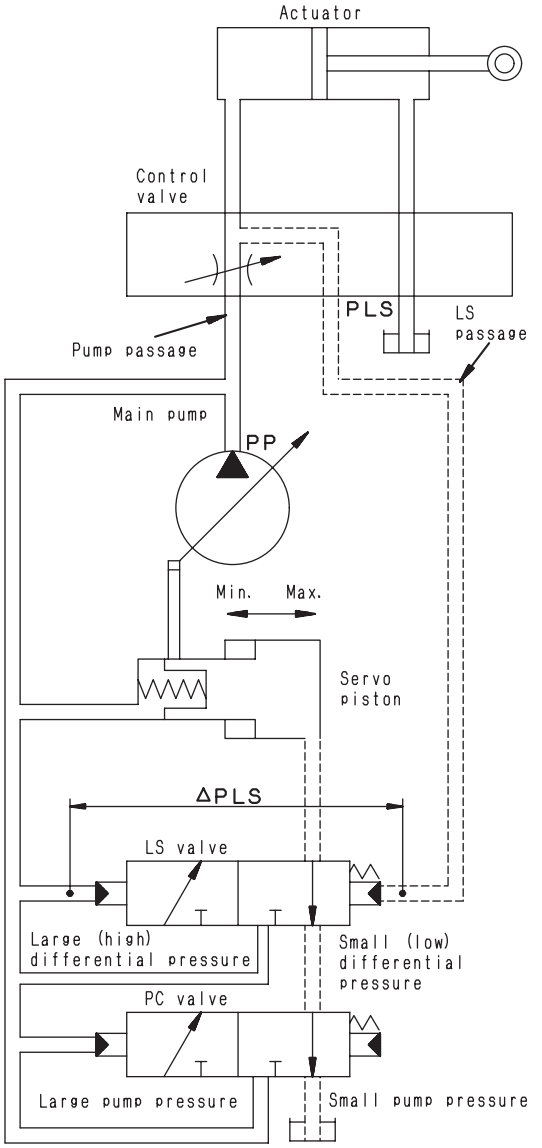


SJP07975

BASIC PRINCIPLE

1. Control of pump swash plate angle

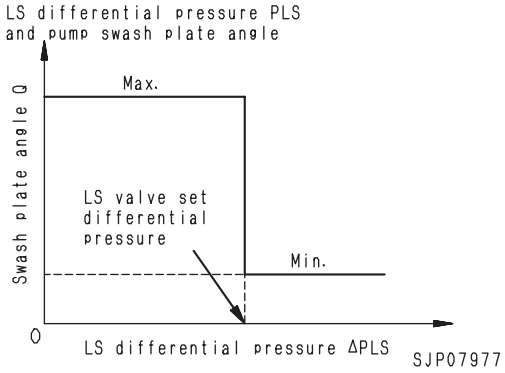
- The pump swash plate angle (pump discharge amount) is controlled so that LS differential pressure ∆**PLS** (the difference between pump (discharge) pressure **PP** and control valve outlet port LS pressure **PLS**) load pressure of actuator) is constant.
  (LS pressure ∆**PLS**=Pump discharge pressure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



SJP07976

- 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.

H For details of the operation, see HYDRAULIC PUMP.

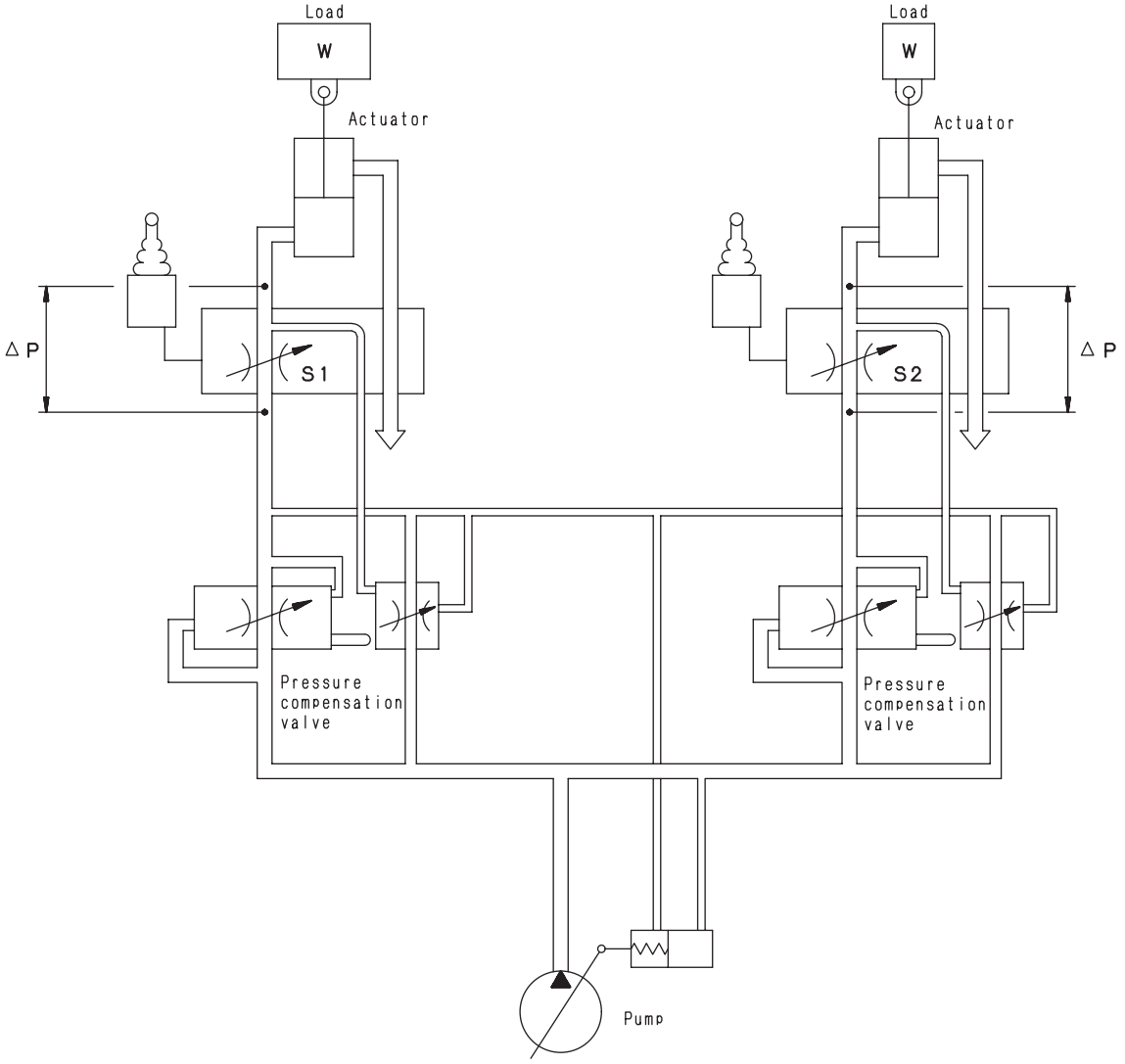


SJP07977

2. Pressure compensation control

- A pressure compensation valve is installed to the inlet port side of the control valve spool to balance the load.

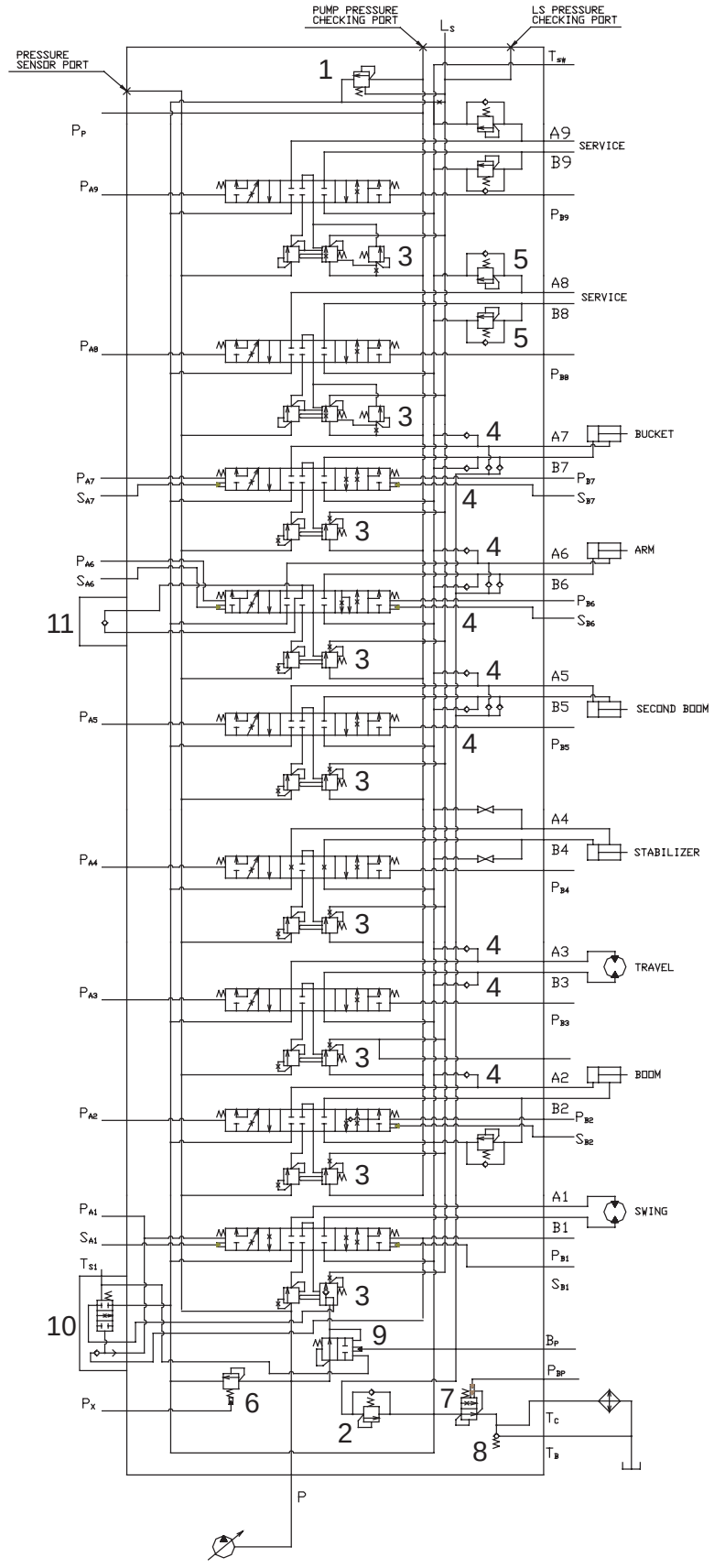
When to actuators are operated together, this valve acts to make pressure difference ∆**P** between the upstream (inlet port) and downstream (outlet port) the same, regardless of the size of the load (pressure). In this way, the flow of oil from the pump is divided (compensated) in proportion to the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



SJP07978

OPERATION FOR EACH FUNCTION AND VALVE

Hydraulic circuit diagram and name of valves



1. Unload valve
   Set pressure: 3.38 MPa {34.5 kg/cm^2}

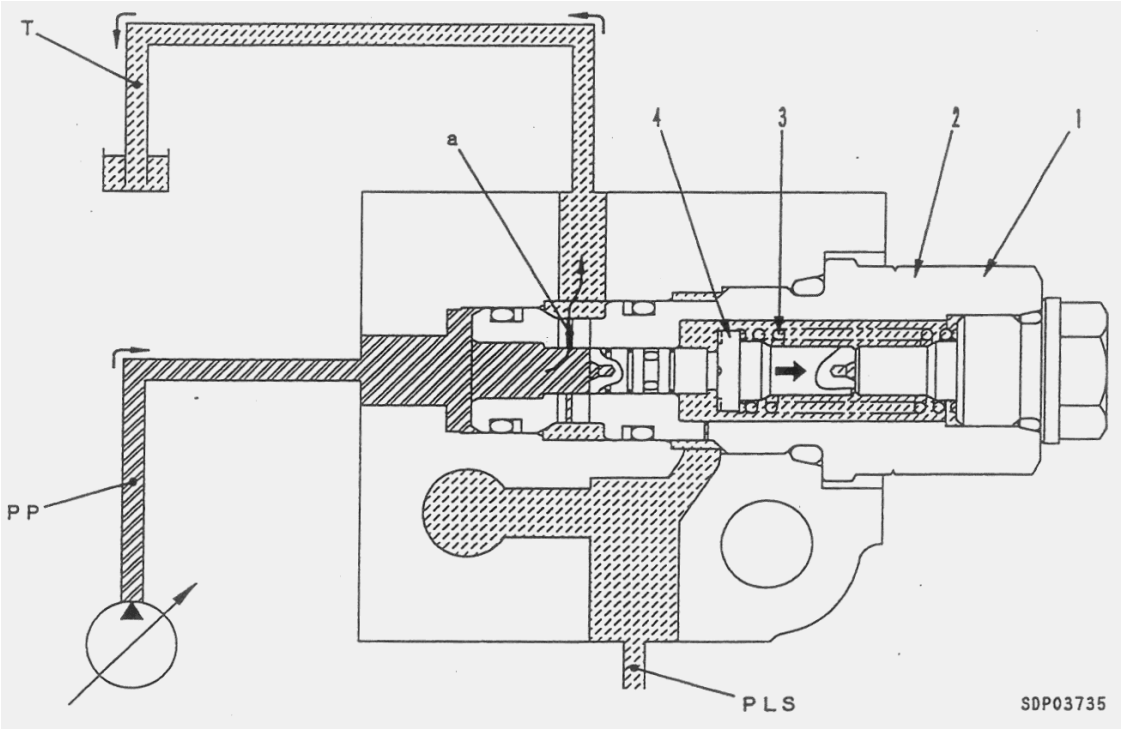
7. Lift check valve

2. Safety-suction valve
   Set pressure: 38.2 MPa {390 kg/cm^2}
3. Pressure compensation valve
4. Suction valve
5. Safety-suction valve
   Set pressure: 24.7 MPa {250 kg/cm^2}
6. Main relief valve
   Set pressure: Normal: 34.8 MPa {355 kg/cm^2}
   When rising: 37.3 MPa {380 kg/cm^2}
8. Cooler bypass valve
9. LS select valve
10. Swing bleed plug
11. Arm check valve

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 2.45 MPa {25 kg/cm^2} by spring (3) inside the valve. (LS pressure **PLS** : 0 MPa {0 kg/cm^2})



Operation

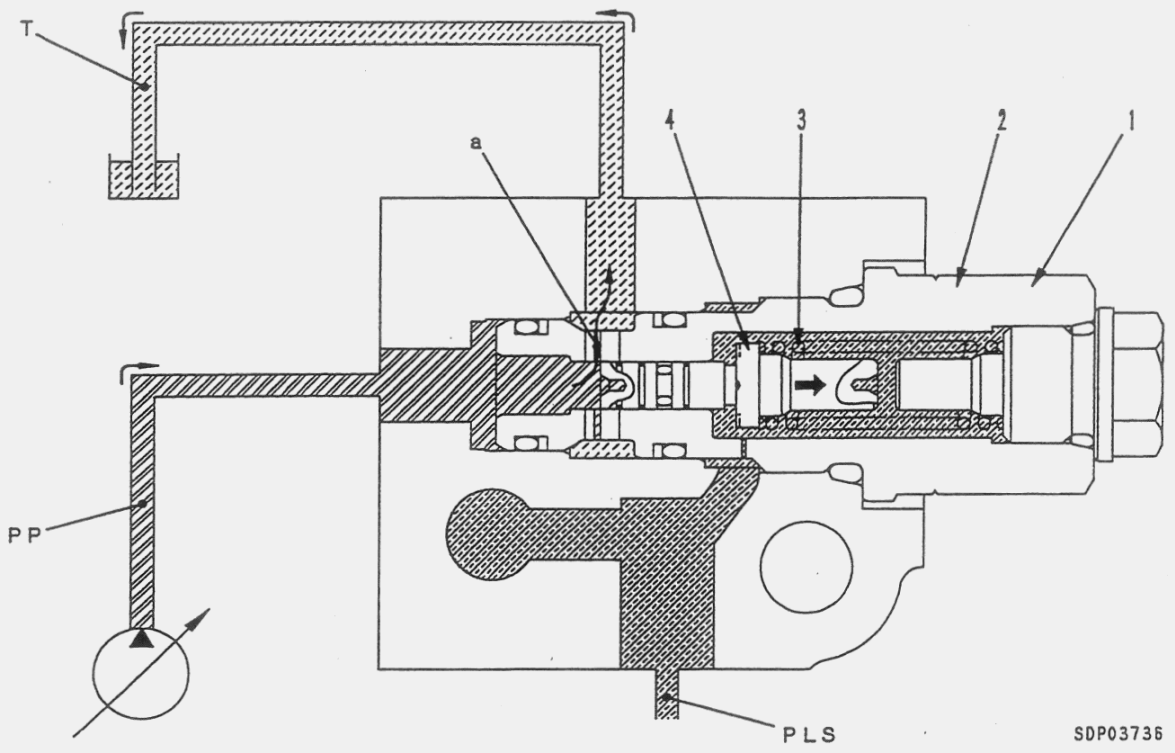
When control valve is neutral

- 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), (2.45MPa {25kg/cm^2})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 2.45MPa {25kg/cm^2}

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** + 2.45MPa {25kg/cm^2}.
   When the differential pressure between the pump discharge pressure **PP** and LS pressure **PLS** reaches the load of spring (3) (2.45MPa {25kg/cm^2}),the unload valve opens, so LS differential pressure **PLS** becomes 2.45MPa {25kg/cm^2}.



Operation

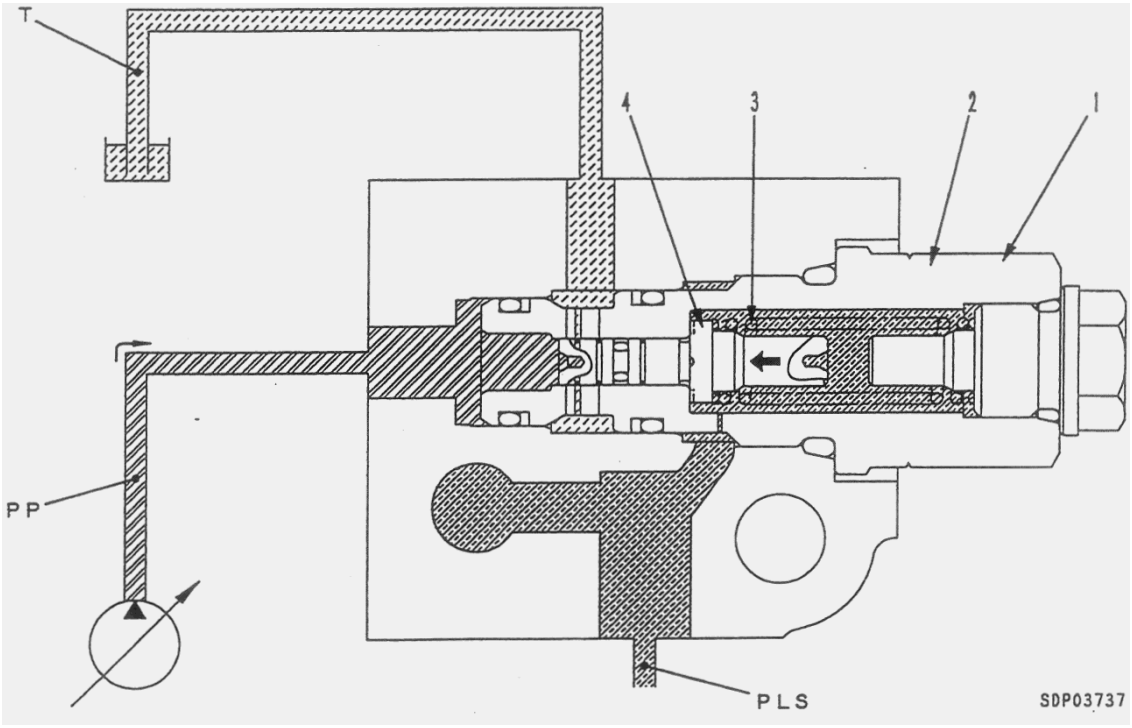
Fine control of control valve

- 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) (2.45MPa {25kg/cm^2}), 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 (2.45MPa {25kg/cm^2}) + LS pressure PLS, and LS differential pressure PLS becomes 2.45MPa {25kg/cm^2}.

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

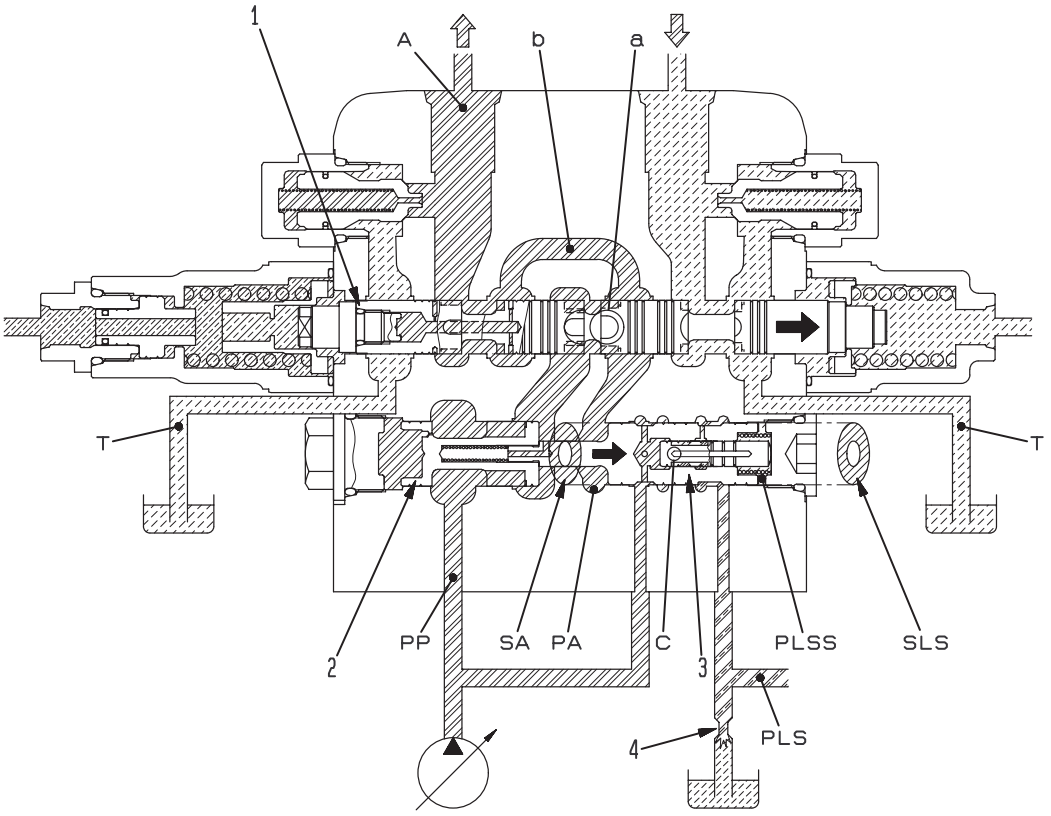
PP: Pump circuit (pressure)

PLS: LS circuit (pressure)

T: Tank circuit (pressure)

2. Introduction of LS pressure

Work equipment valve



9JY01515

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**.

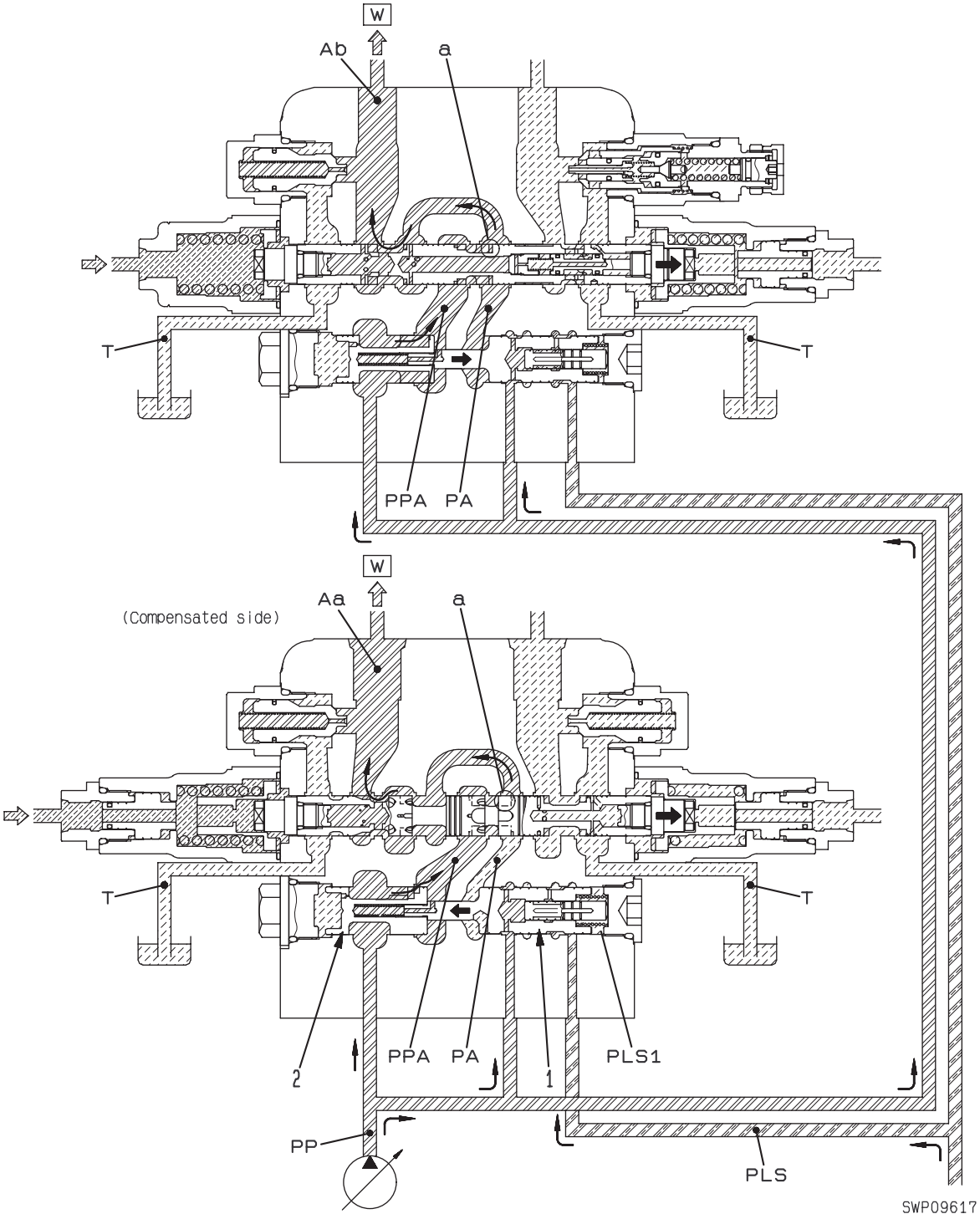
Operation

- 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. 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**.

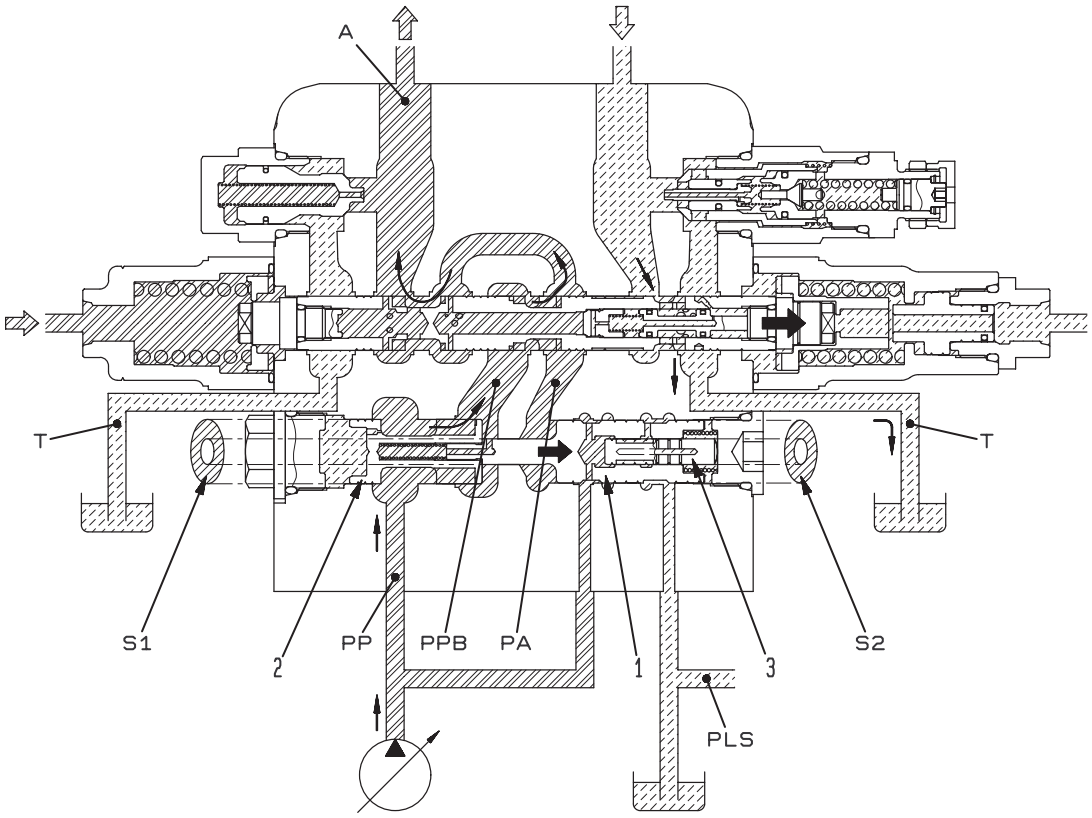
4. Area ratio of pressure compensation valve

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)



9JY01519

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.

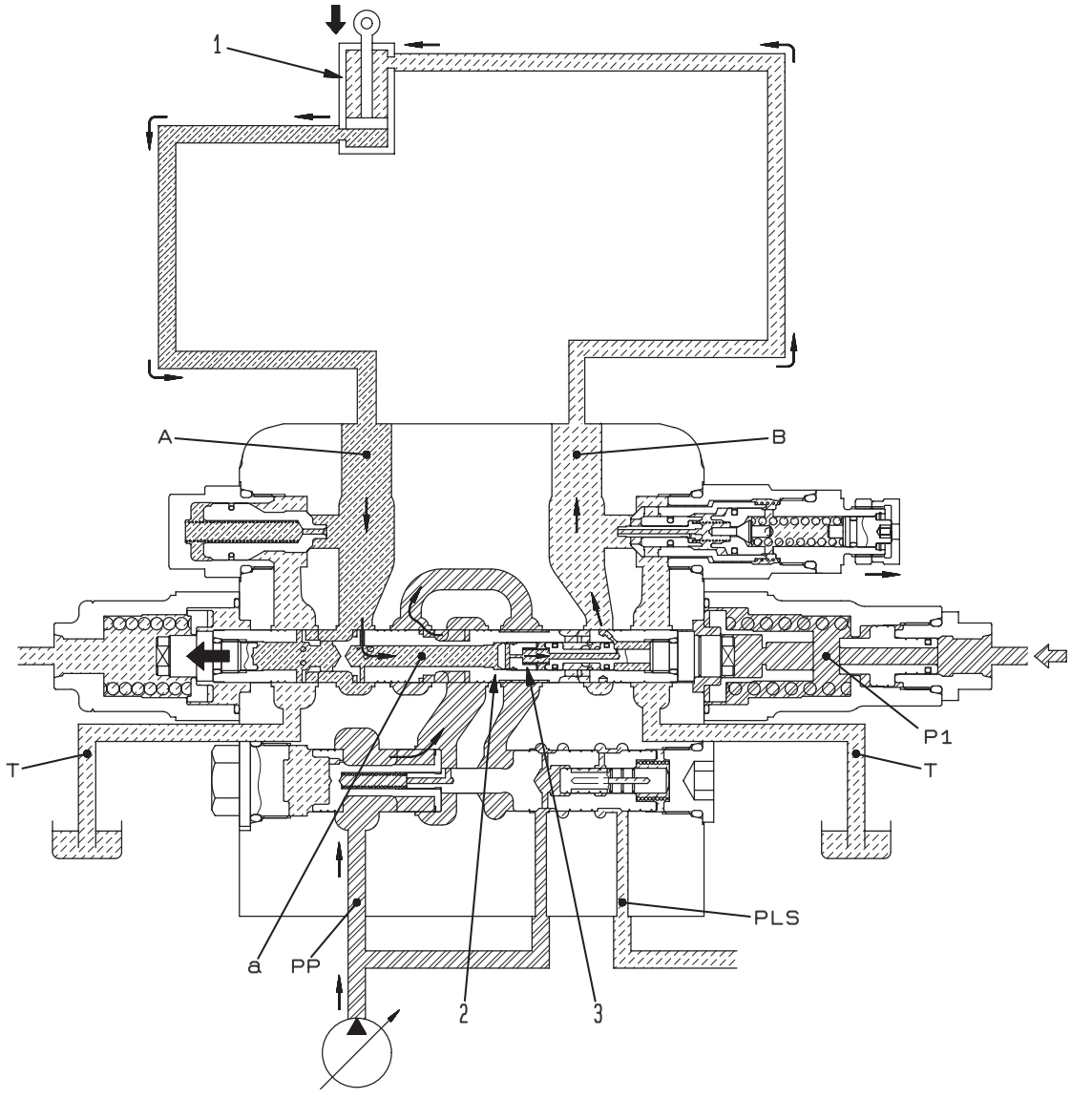
Blank for technical reason

5. Boom regeneration circuit

1. At 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.
- This increases the boom lower speed.



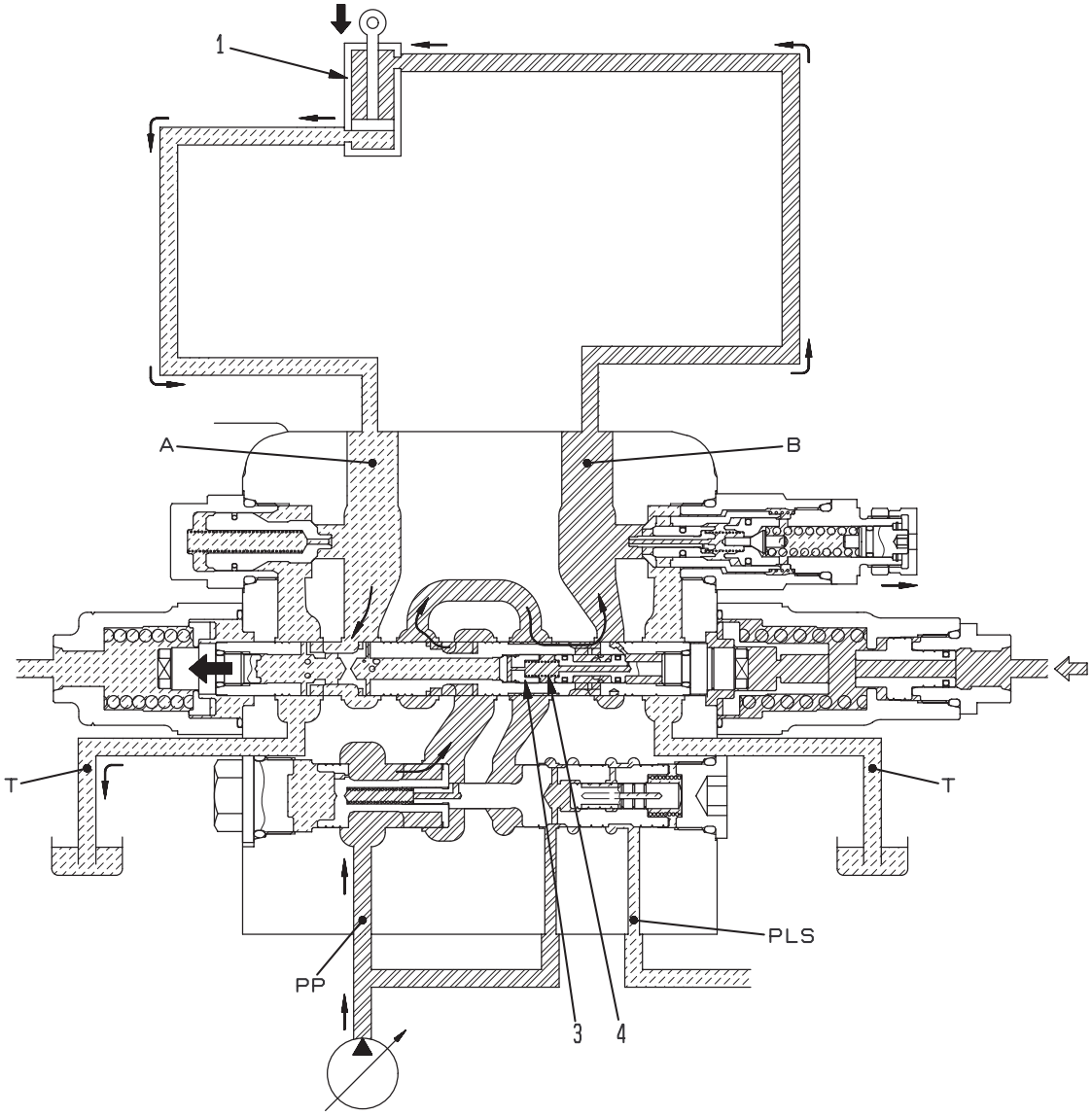
Operation

- 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.

2. At 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.



9JY01522 A

Operation

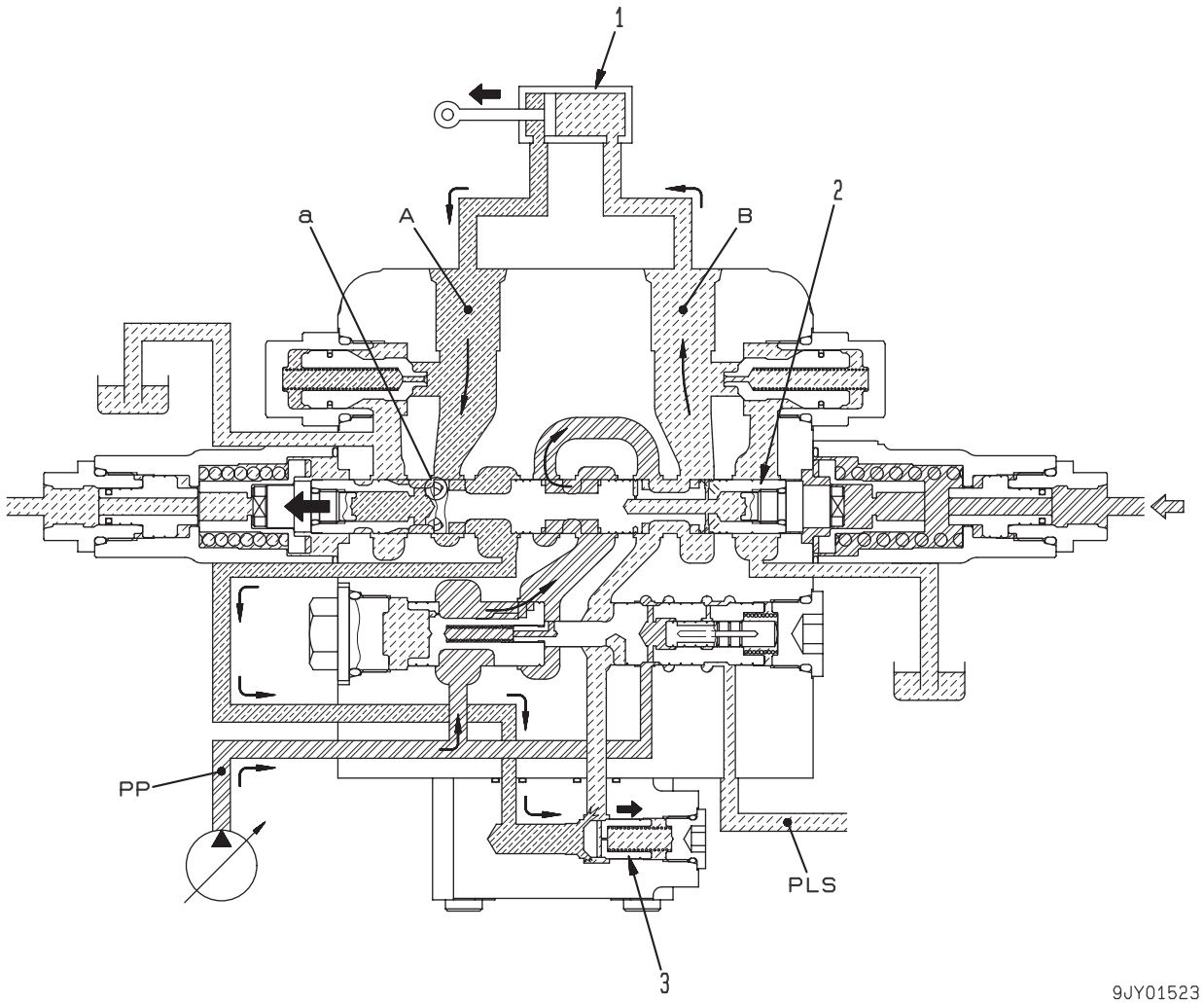
- When the boom is lowered and is in the load process, the head side pressure **B** of the boom cylinder (1) rises above the bottom side pressure **A**
- At the time, the head side pressure **B** and the spring (4) close the check valve (3), and the circuits on the head side and the bottom side are interrupted.

6. Arm regeneration circuit

1. At boom 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 a 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)

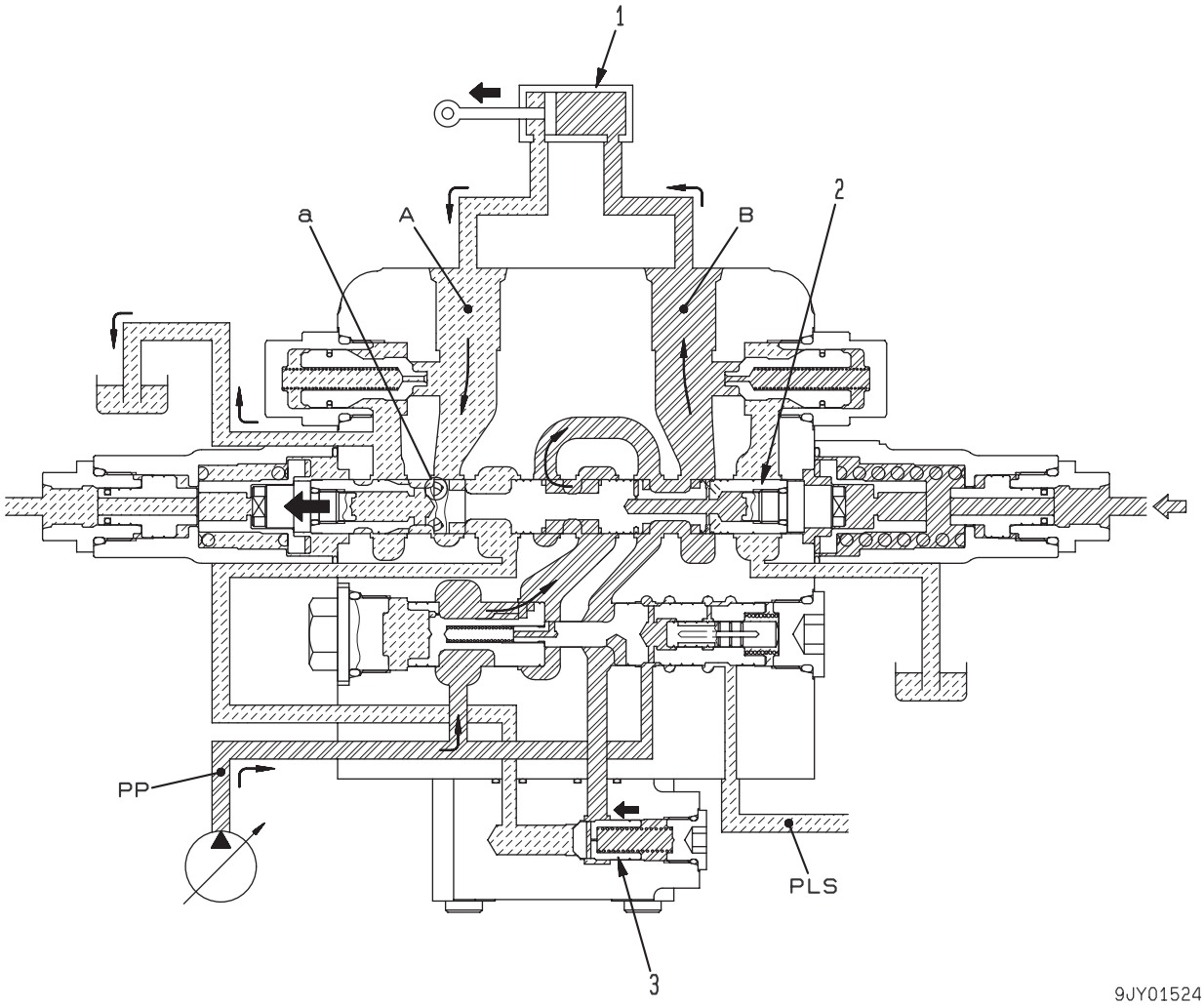
B: Bottom circuit (pressure)

PP: Pump circuit (pressure)

2. At arm in 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)

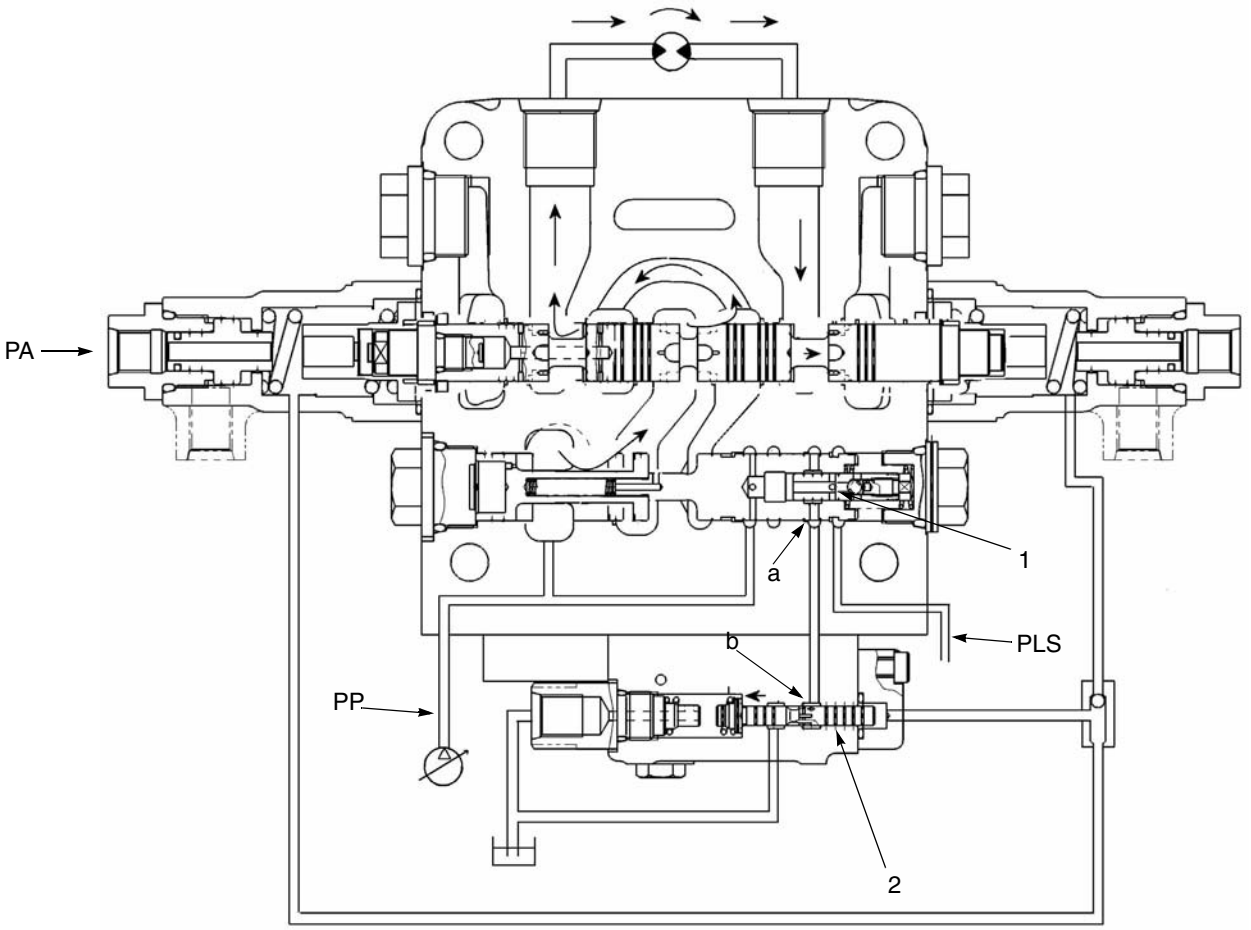
B: Bottom circuit (pressure)

PP: Pump circuit (pressure)

7. 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)

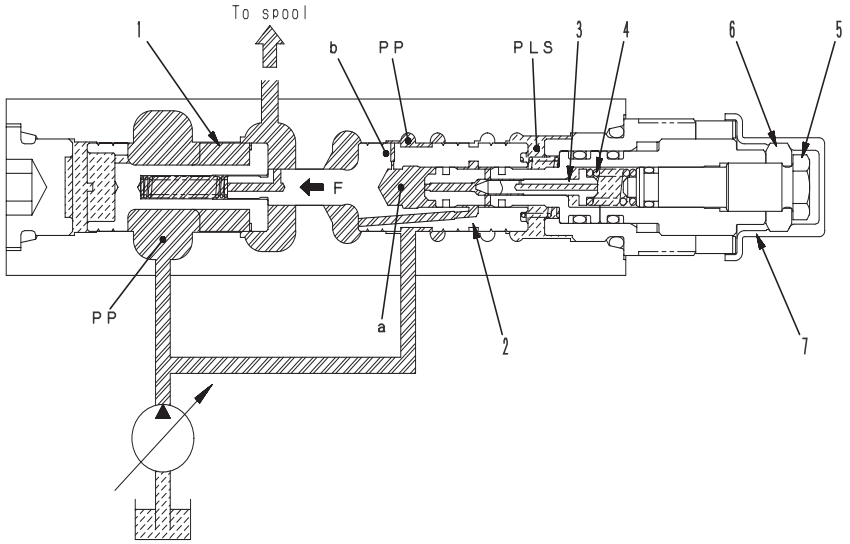
- The pressure reducing valve moves to the right and notch **a** connects to the LS circuit. As a result, pump circuit **PP**, bleed-off circuit, and Ls circuit are connected through piston (1).
- Bleeding spool (2) moves to the left in proportion as swing **PPC** pressure **PA** rises. In the fine control 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. Piston
2. Pressure Compensation Valve

8. 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) is 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).



SJP07620

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

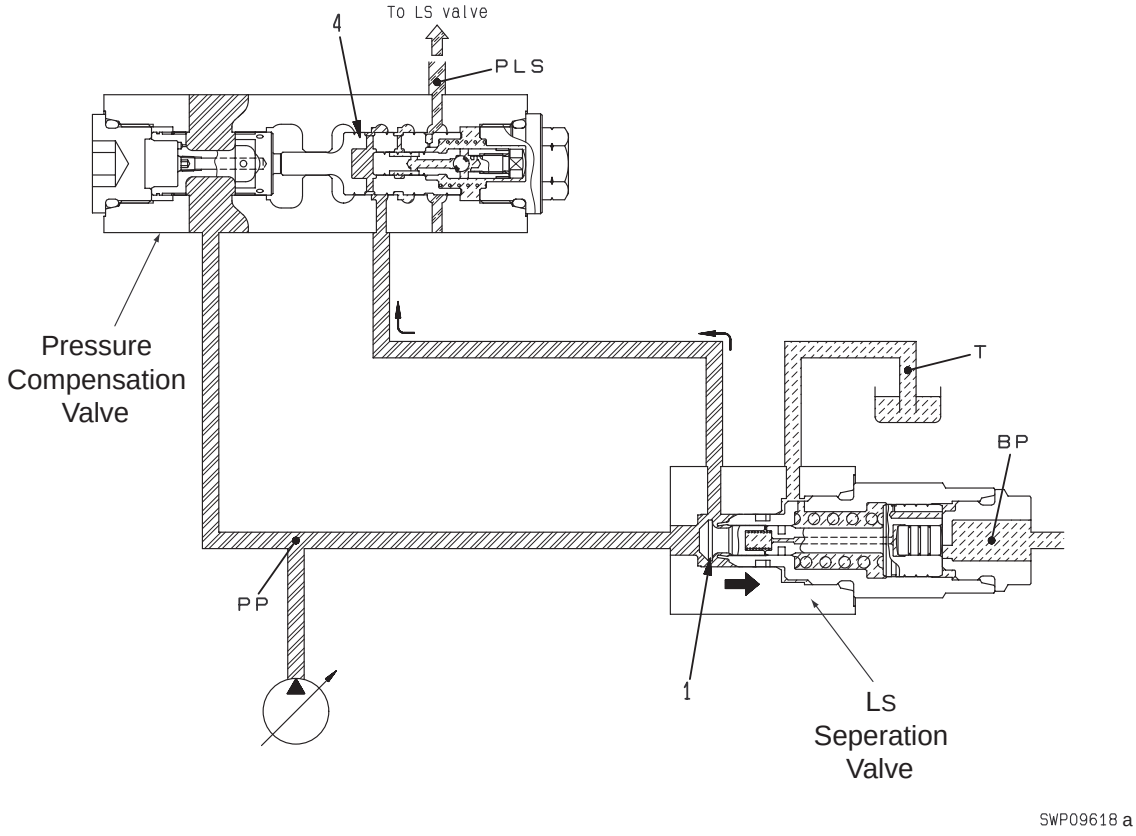
- Pump pressure **PP** and LS pressure **PLS** are determined by other work equipment.
- When the pressure in chamber **a** reaches the set pressure of spring (4), poppet (3) opens and the pressure in chamber **a** is maintained at a pressure lower than the pump pressure at throttle **b**.
- As a result, 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

9. LS select valve (LS Seperation 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

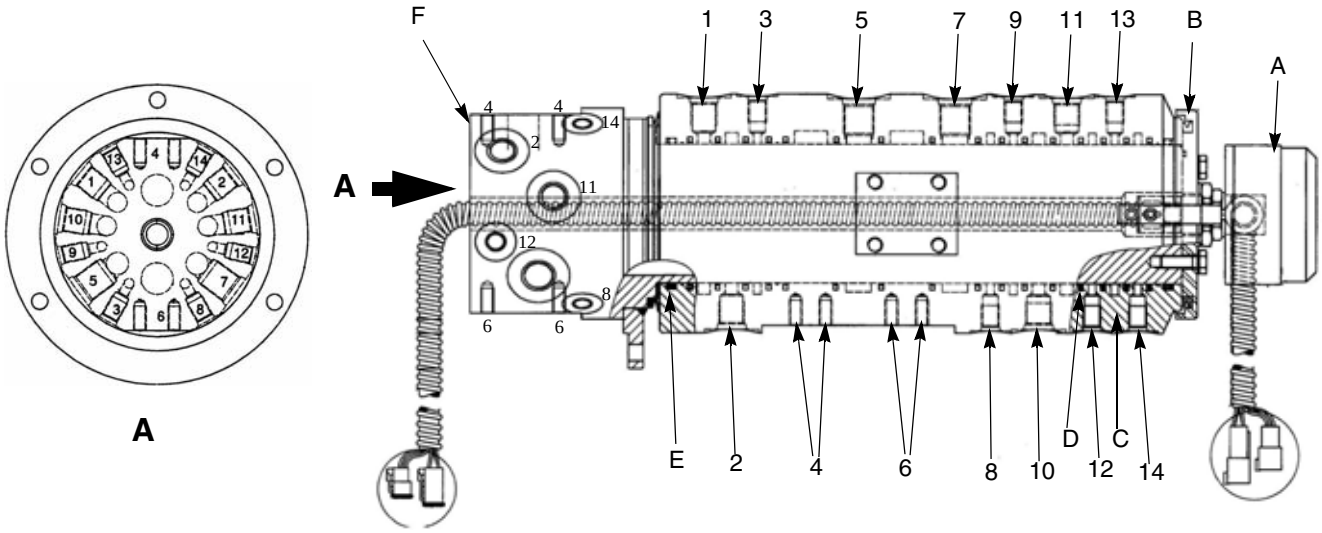


Operation

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



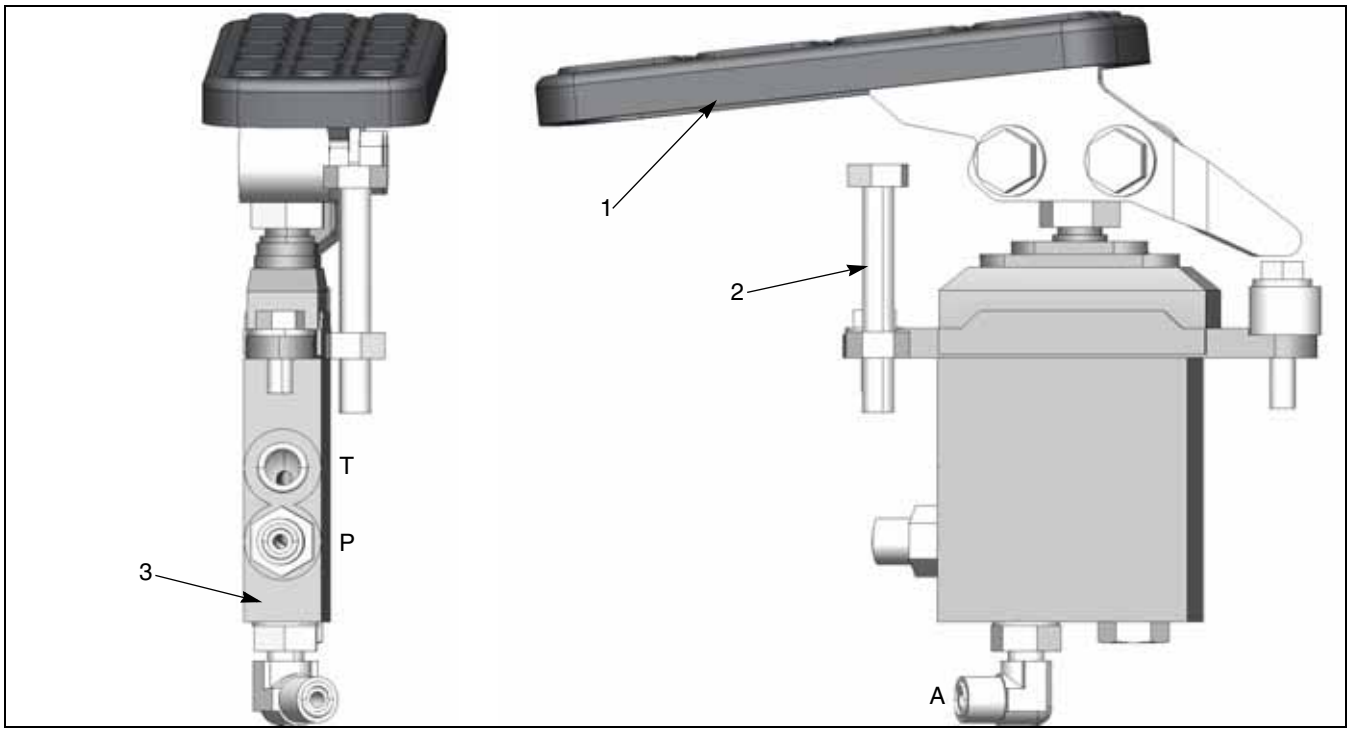
1. Steering left
2. Drain
3. Motor volume pilot
4. Travel motor A
5. Undercarriage attachment cylinder head
6. Travel motor B
7. Undercarriage attachment cylinder bottom
8. Service brake-1
9. Service brake-2
10. Steering right
11. Blanked off
12. Transmission large clutch
13. Suspension lock
14. Transmission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

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

Unit: mm

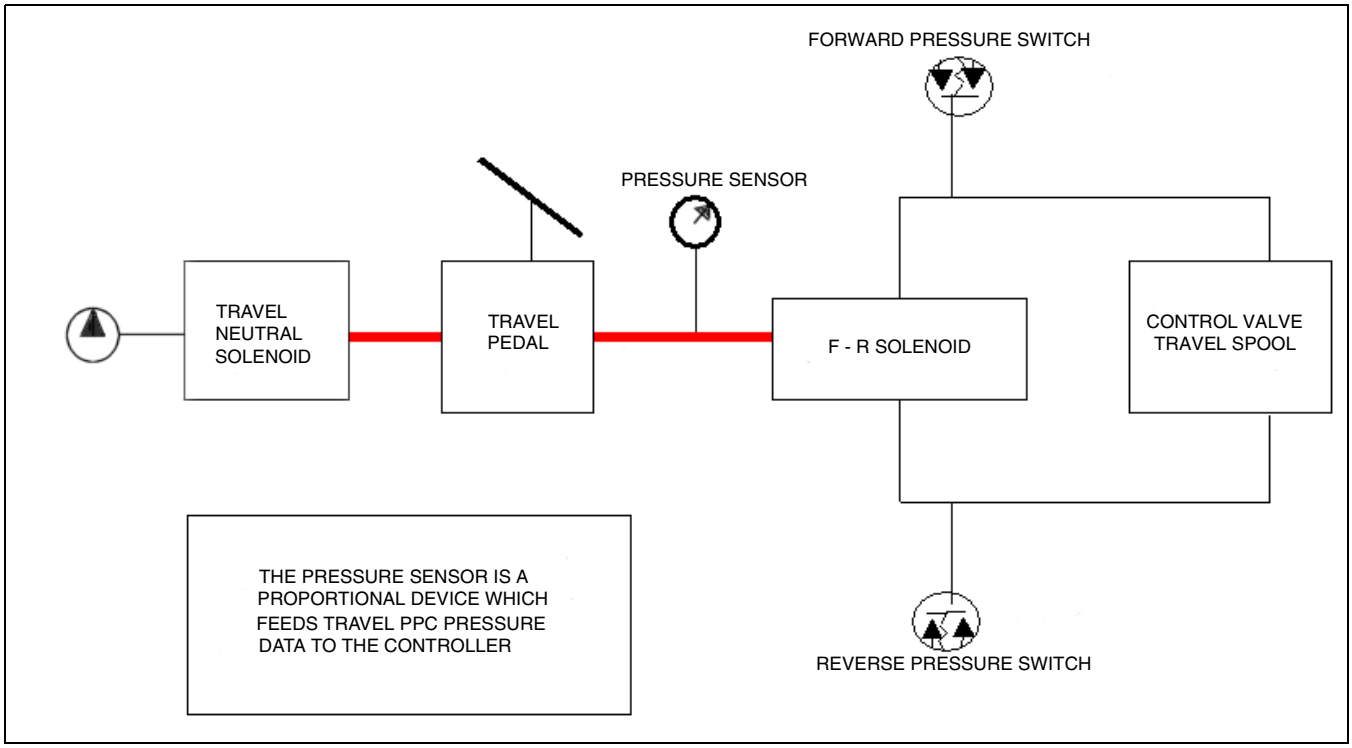
No.	Check Item	Criteria			Remedy
		Standard Size	Standard clearance	Repair limit	
1	Internal shaft	$110^{-0.02}_{-0.06}$	Max.=0.21 Min.=0.12	>=0.26	Replace
2	External rotor	$110^{0.15}_{0.10}$			

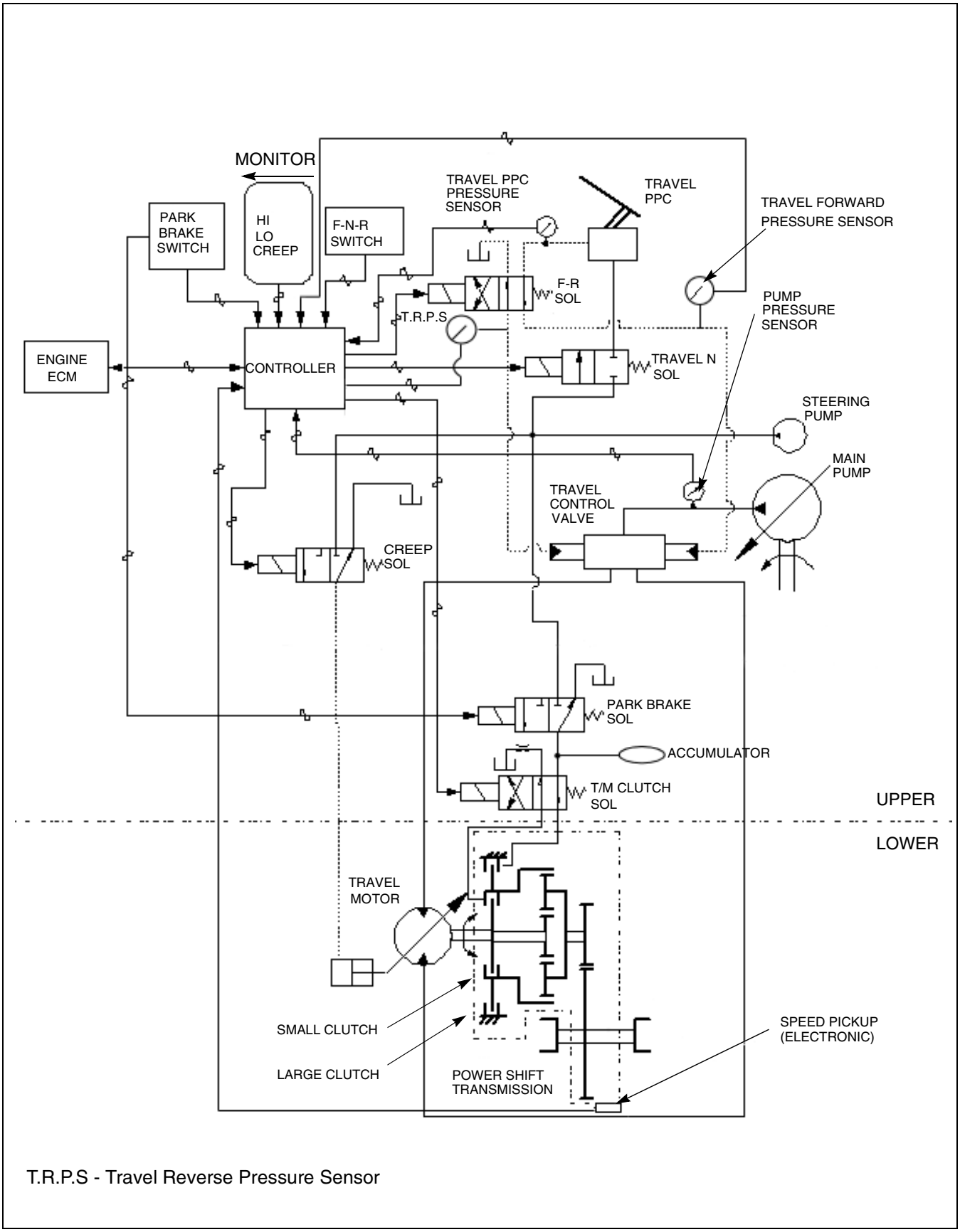
TRAVEL PPC PEDAL



1. Pedal
2. Pedal Adjuster
3. Valve

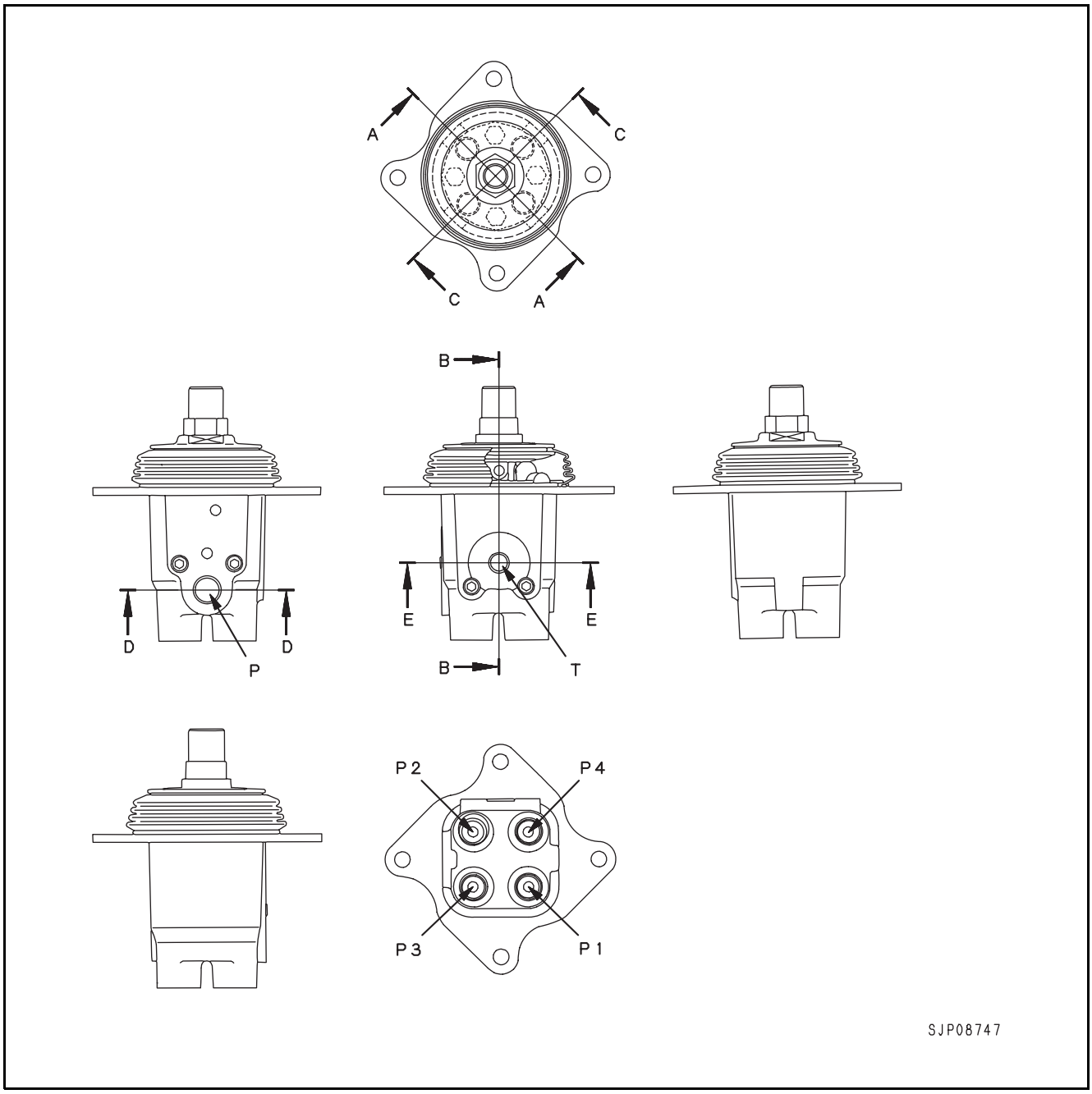
A. To forward-reverse solenoid
P. To travel neutral solenoid
T. To tank





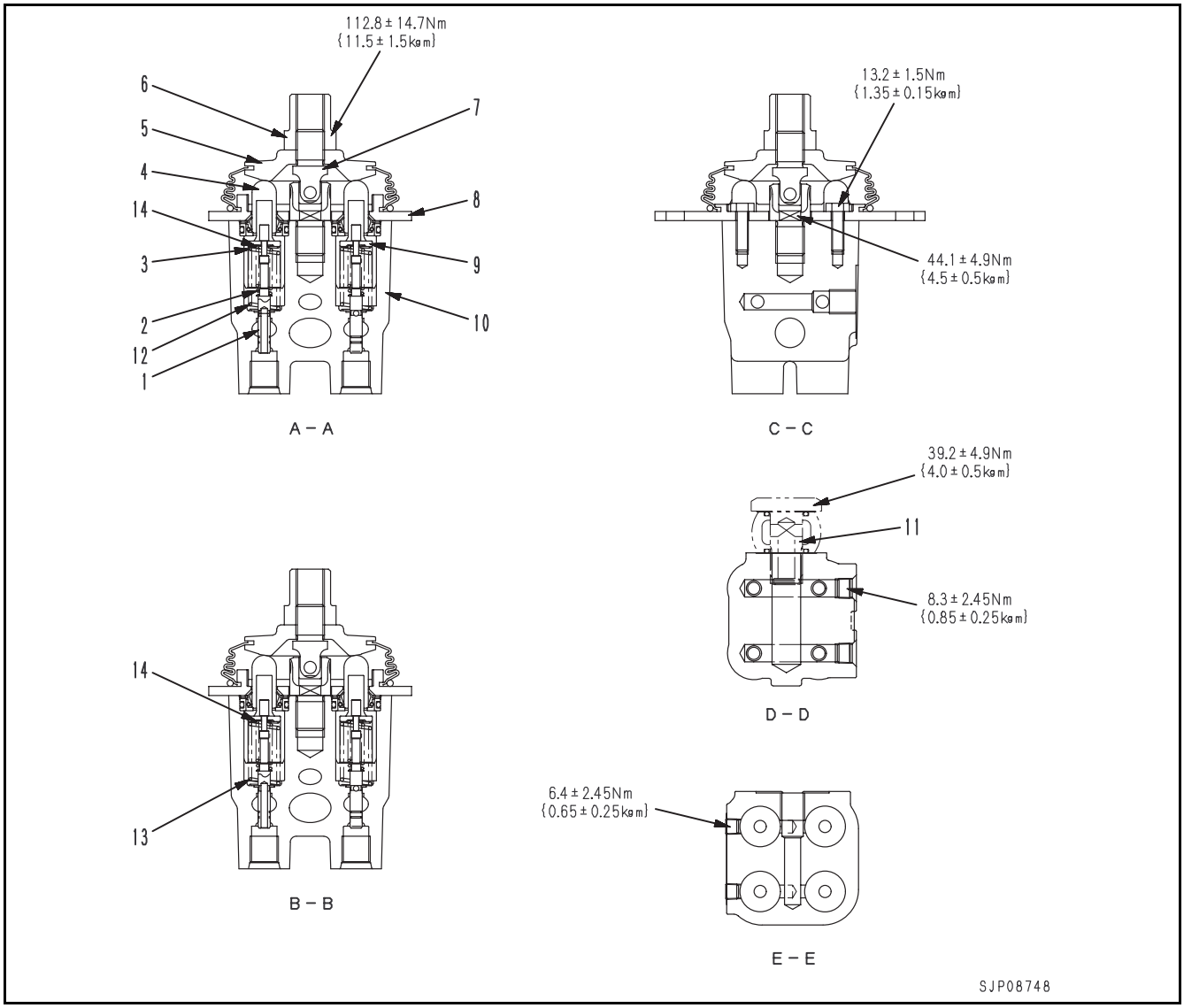
T.R.P.S - Travel Reverse Pressure Sensor

WORK EQUIPMENT • SWING PPC VALVE



P. From main pump
T. To tank

P1. Left: Arm OUT / Right: Boom LOWER
P2. Left: Arm IN / Right: Boom RAISE
P3. Left: Swing RIGHT / Right: Bucket CURL
P4. Left: SwingLEFT / 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

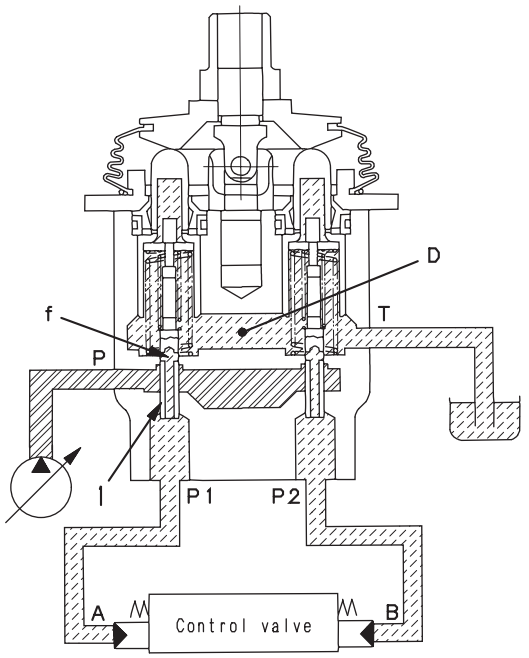
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
12	Centering spring (For P3 and P4)	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}	If damaged or deformed, replace spring
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

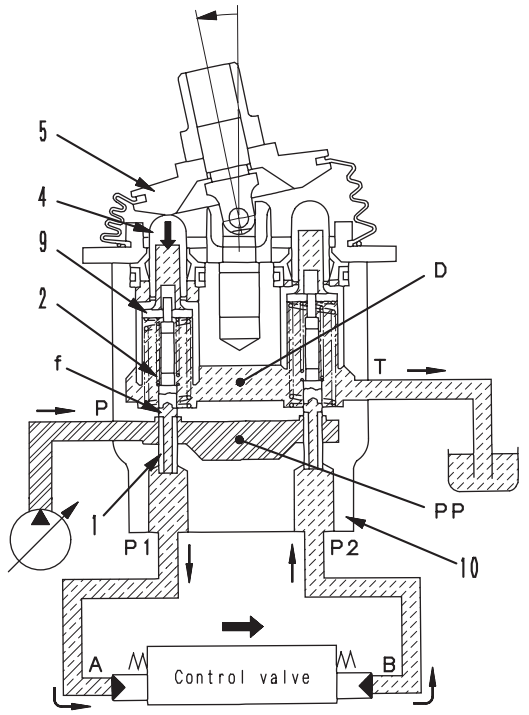
2. During fine control (neutral → fine control)

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

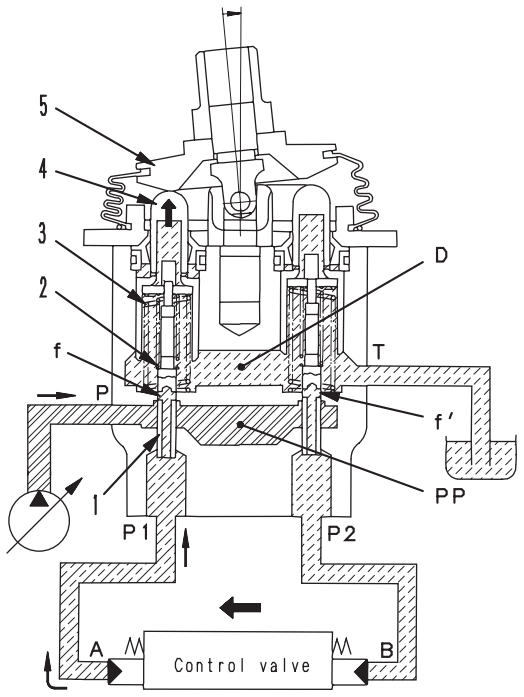
3. During fine control (when control lever is returned)

- 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)



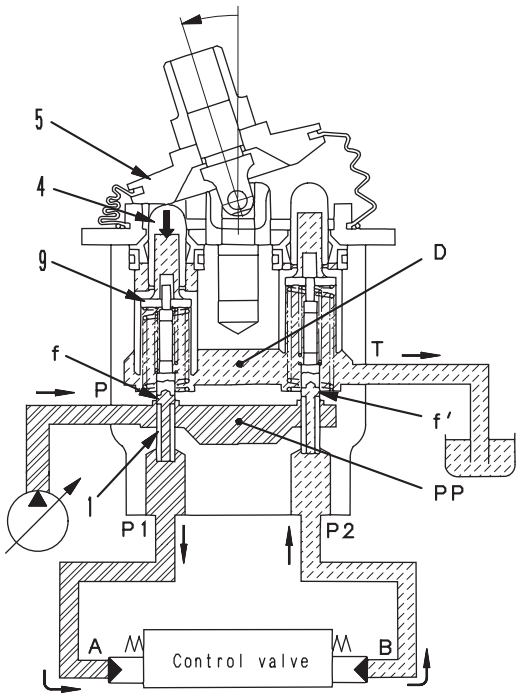
(Fig. 3)

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 MANIFOLD

6-stage manifold block:

PPC lock, 2-stage relief, swing brake, suspension lock, merge flow, travel neutral, travel creep solenoid valves.(see page 10-230)

4-stage manifold block:

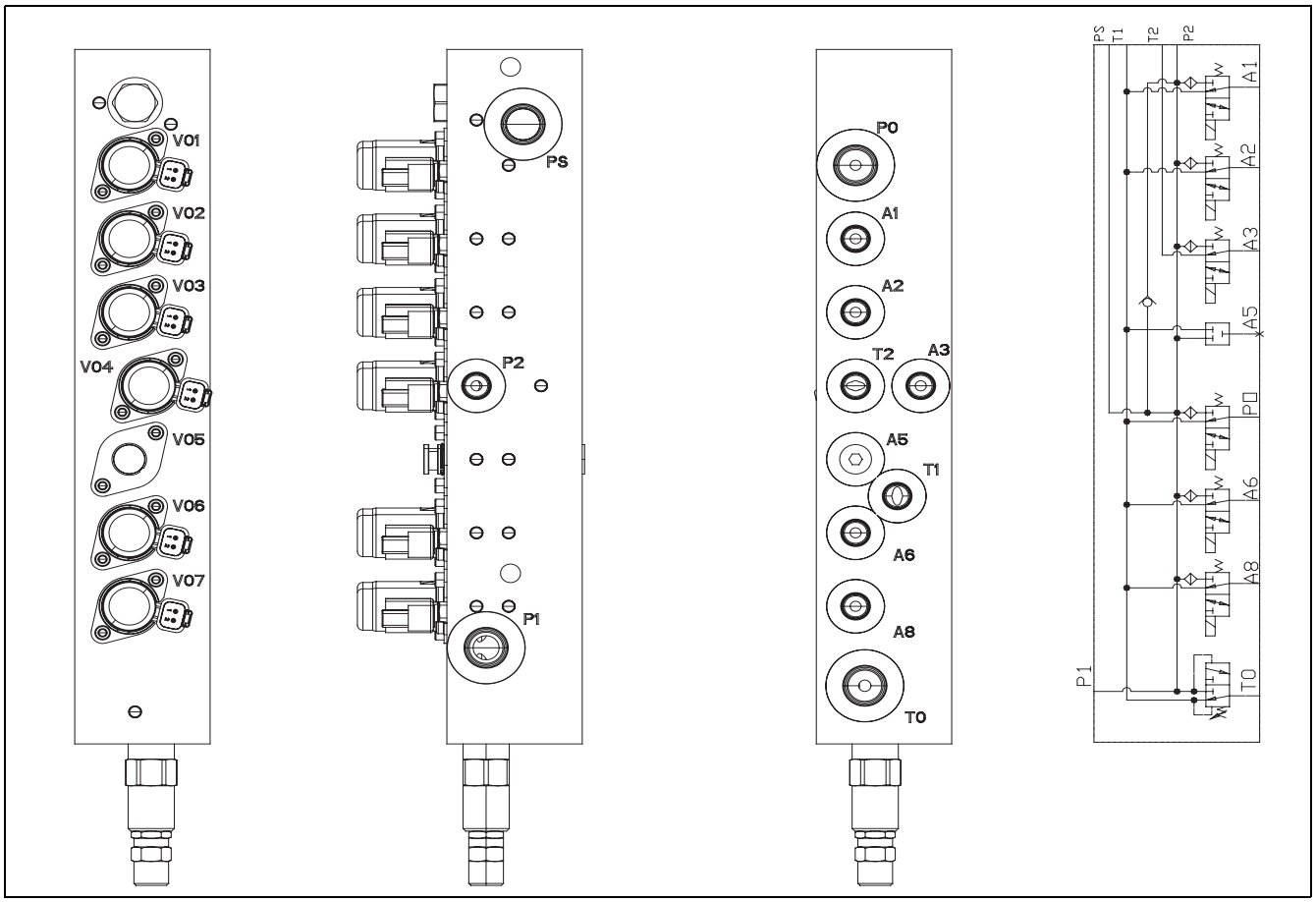
Travel forward / reverse, stabilizer / boom down, stabilizer / boom up, rotate CW / ACW solenoid valves.

(see page 10-230)

2-stage manifold:

Hi-lo (see page 10-227),

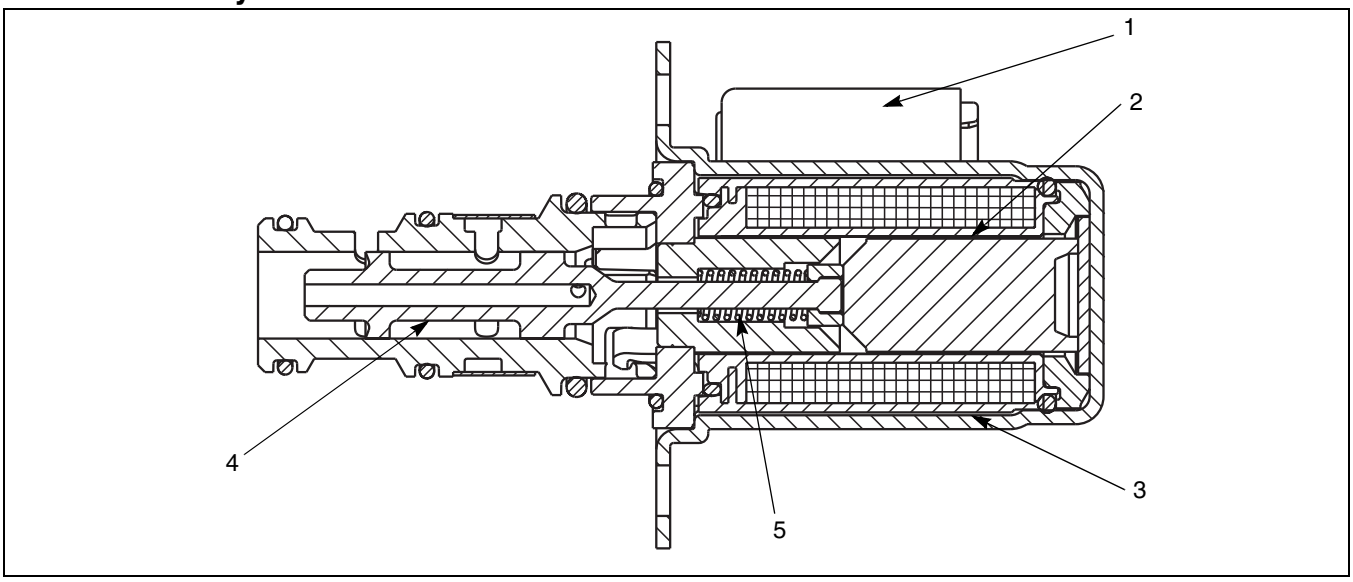
2-stage back pressure (see page 10-228) solenoid valves.



TO.	To tank	A1.	2 stage relief	V01	PPC hyd press lock sol
T1.	To tank	A2.	Swing brake	V02	2-stage relief sol
P1.	From brake valve	A3.	Suspension lock valve	V03	Swing brake sol
P2.	To : main valve, 2 stage back pressure valve, EPC valve in main pump	A5.	N/A	V04	Sus lock sol
PS.	To : accumulator, manifold valve block, 2 stage back pressure lock	A6.	Travel neutral	V06	Travel neutral sol
P0.	PPC hydraulic pressure lock	A8.	Travel creep (motor volume pilot)	V07	Travel creep sol

SOLENOID VALVE BLOCK

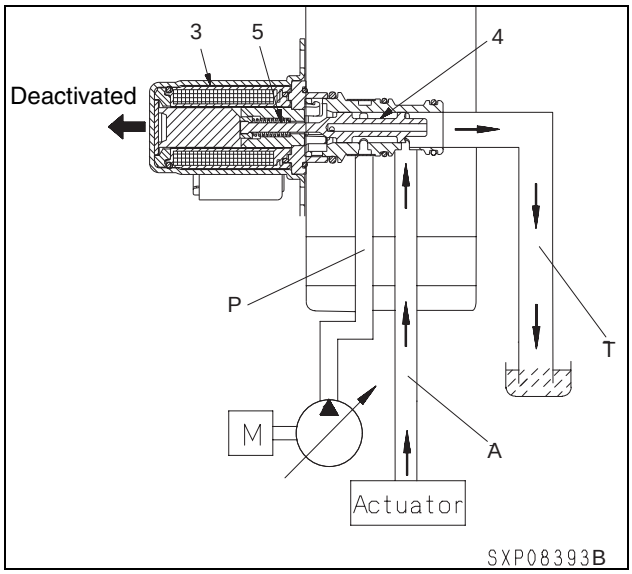
2 Position 3 way valve



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



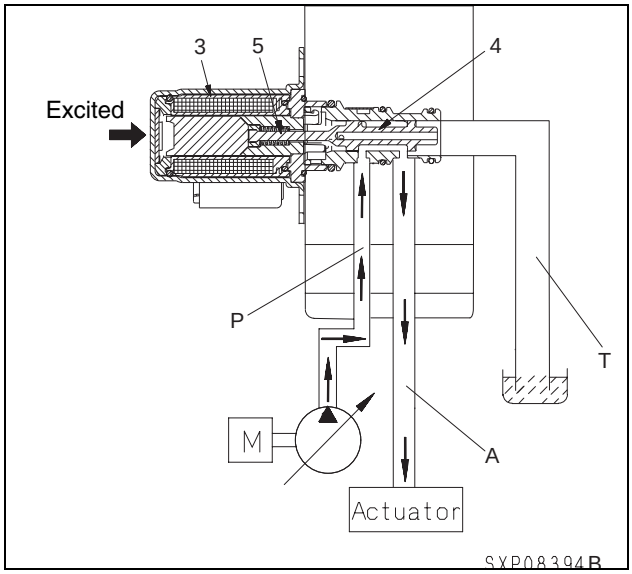
OPERATION

When solenoid is deactivated

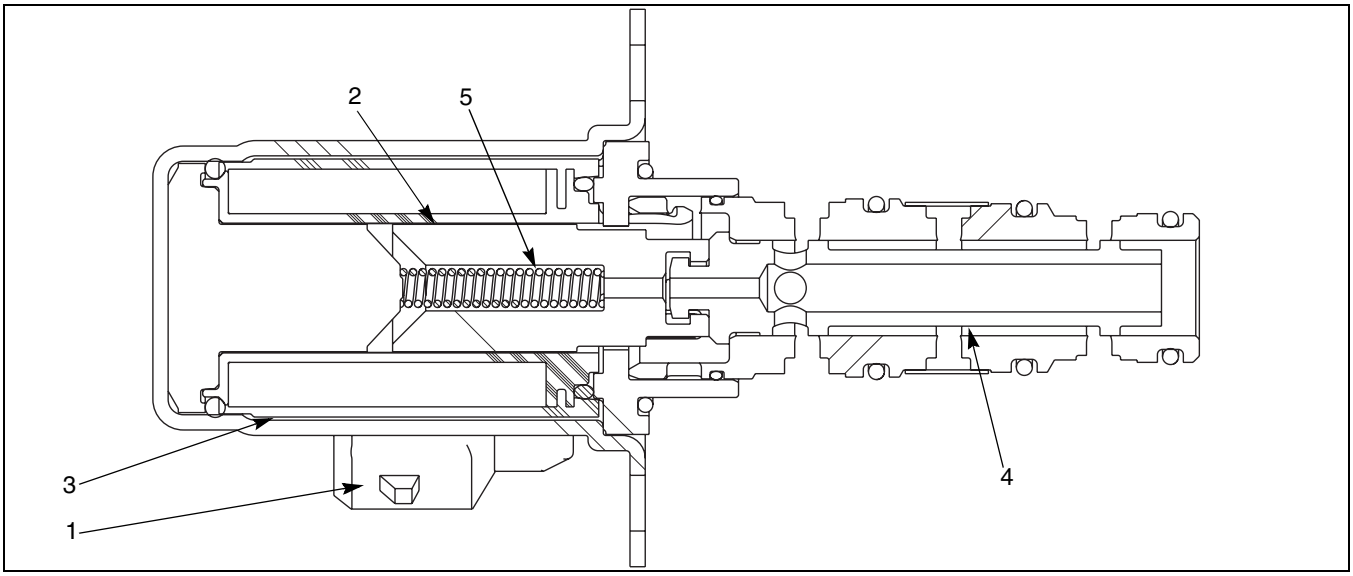
- Since the signal current does not flow from the controller, coil (3) is turned off
  Accordingly, spool (4) is pressed by spring (5) against the left side.
  By this operation, the passage from **P** to **A** is closed and the hydraulic oil from the control circuit does not flow into the actuator.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



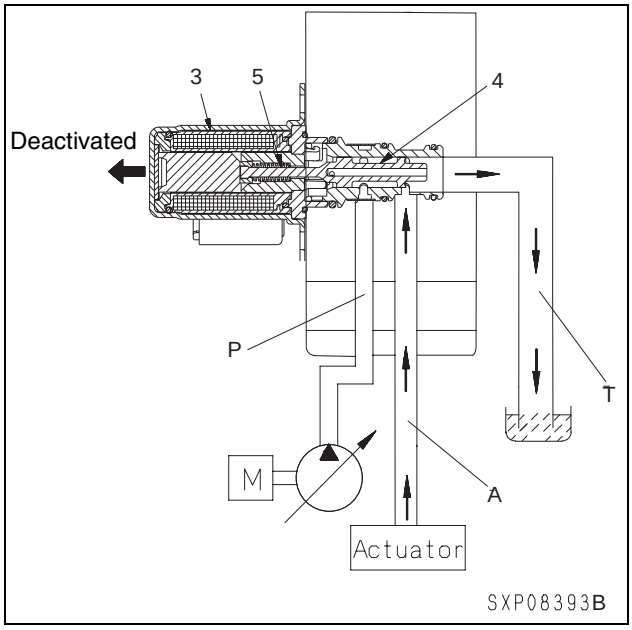
2 Position 4 way valve



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



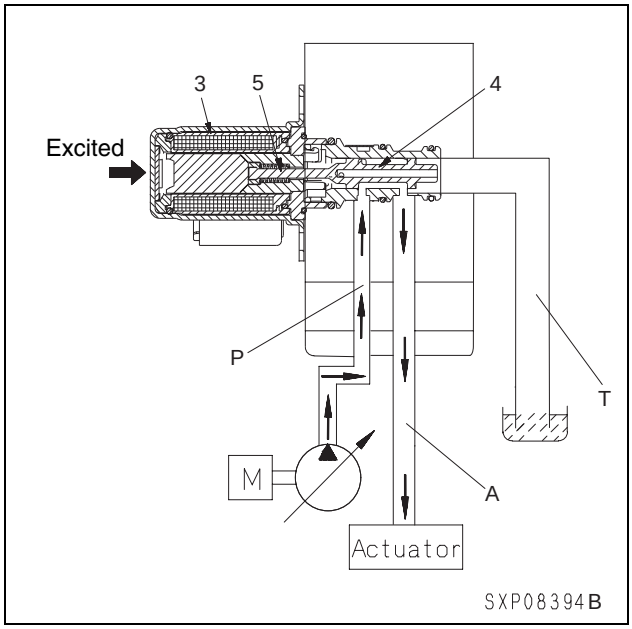
OPERATION

When solenoid is deactivated

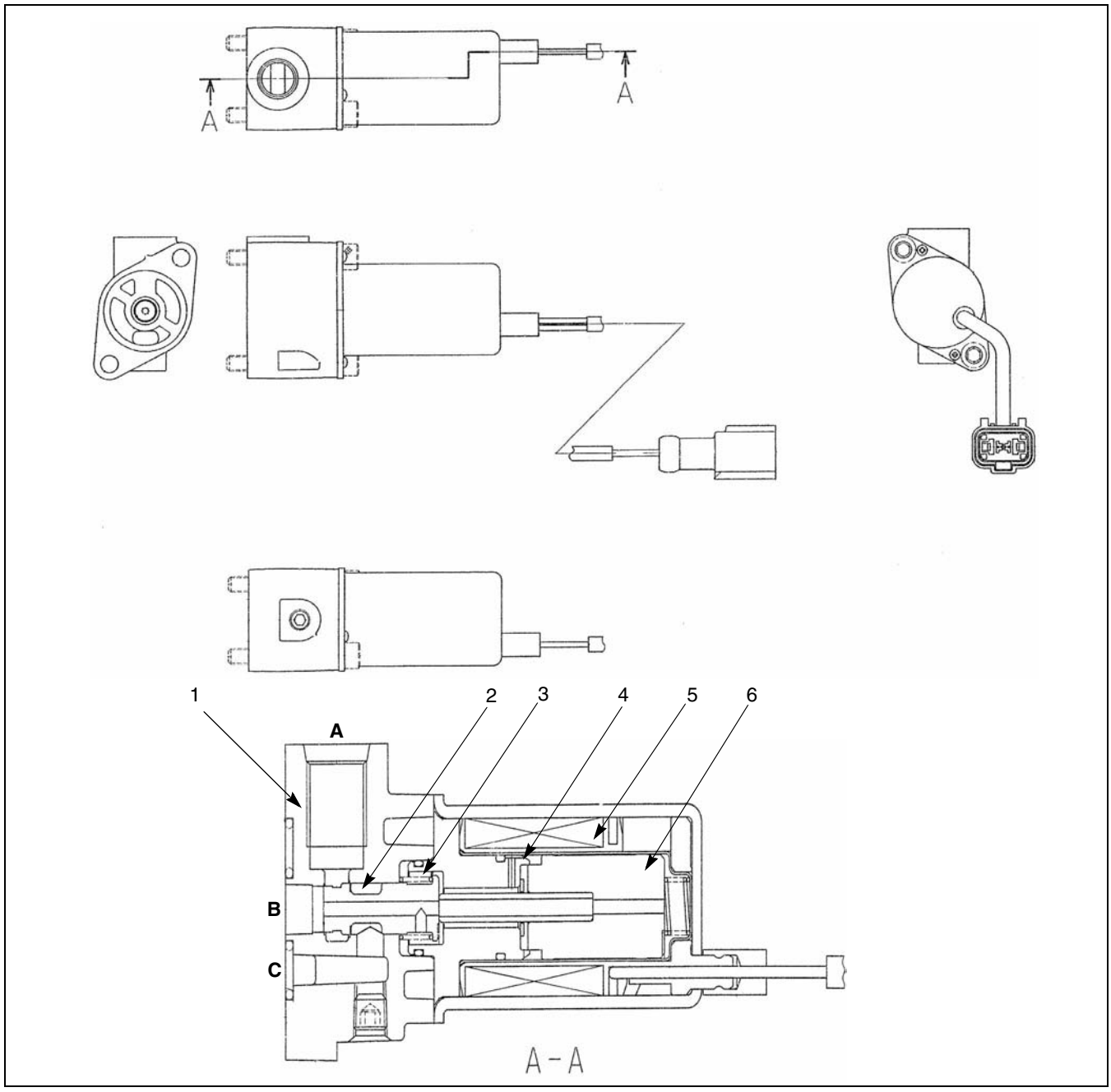
- Since the signal current does not flow from the controller, coil (3) is turned off
  Accordingly, spool (4) is pressed by spring (5) against the left side.
  By this operation, the passage from **P** to **A** is closed and the hydraulic oil from the control circuit does not flow into the actuator.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

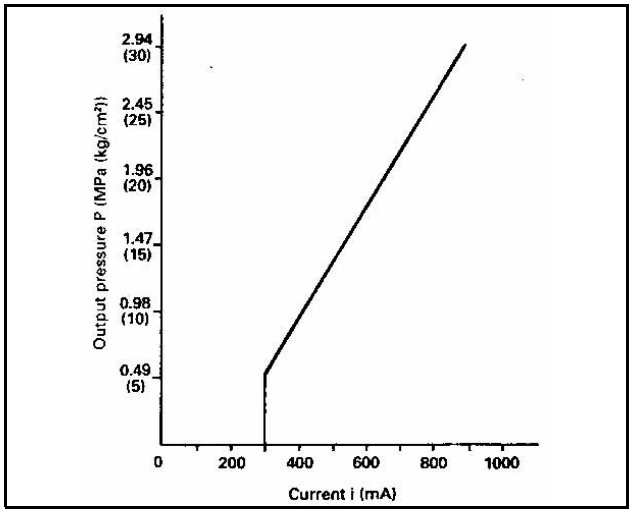


A. Port C (to LS valve)
B. Port T (to tank)
C. Port P (from PPC pressure reducing valve)

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

Function

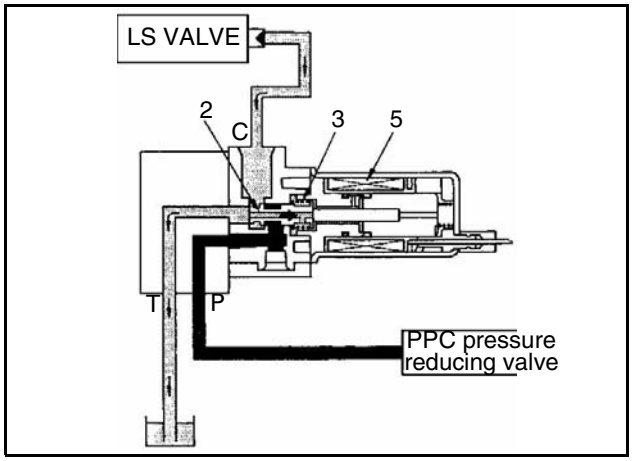
- The EPC valve consists of the proportional solenoid portion and the hydraulic valve portion.
- When it receivers signal current **i** from the pump controller, it generates EPC output pressure **P** in proportion to the size of the signal, and outputs it to the control valve.
- Therefore, the circuit pressure between the EPC valve and the Att pedal is controlled in proportion to the size of the signal current.



Operation

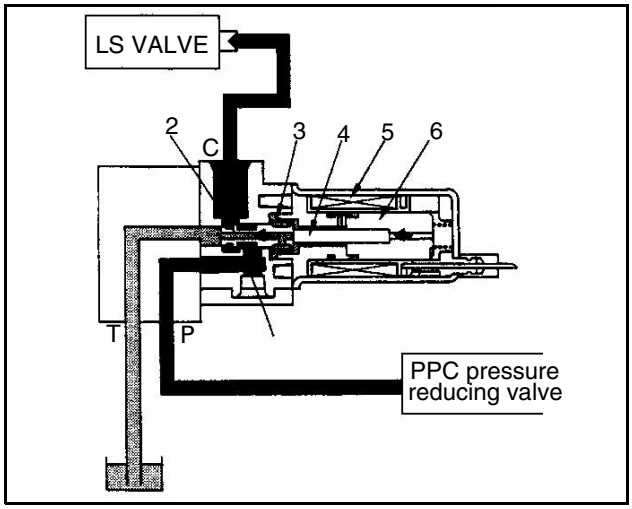
1) When signal current is 0 (coil deactivated)

- 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.



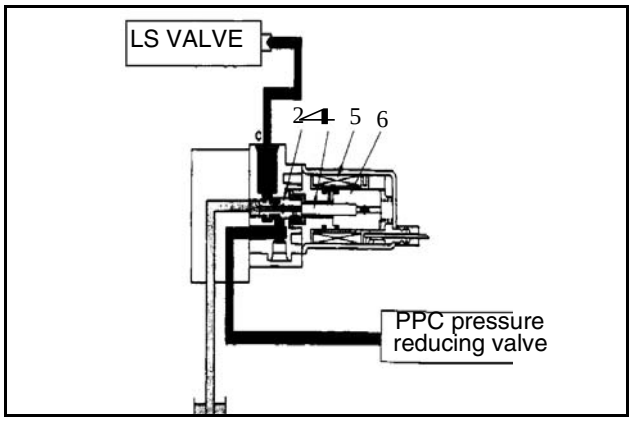
2. When signal current is very small (coil excited)

- 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 in the direction of the arrow. 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.**

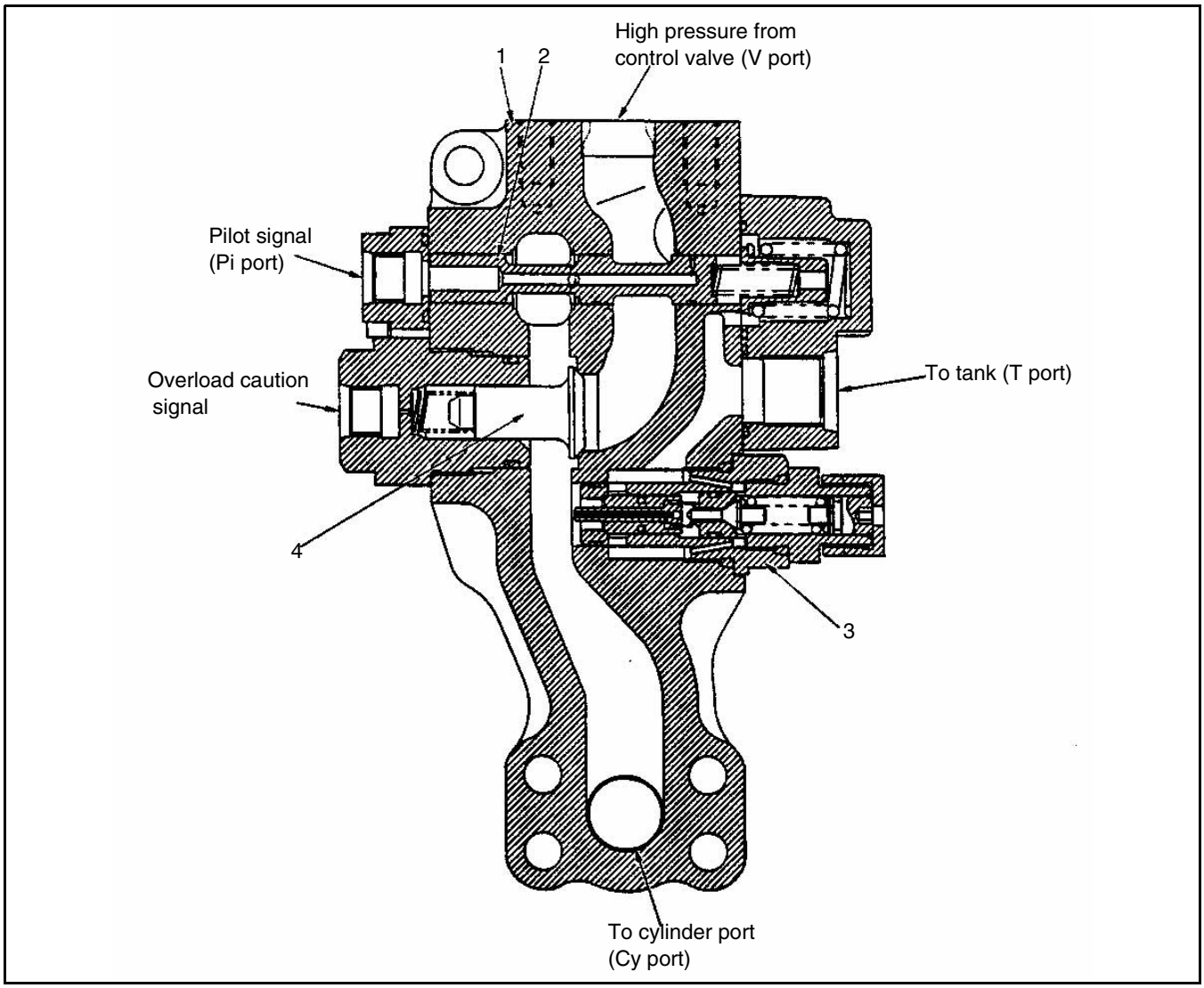


3. When signal current is maximum (coil excited)

- 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.



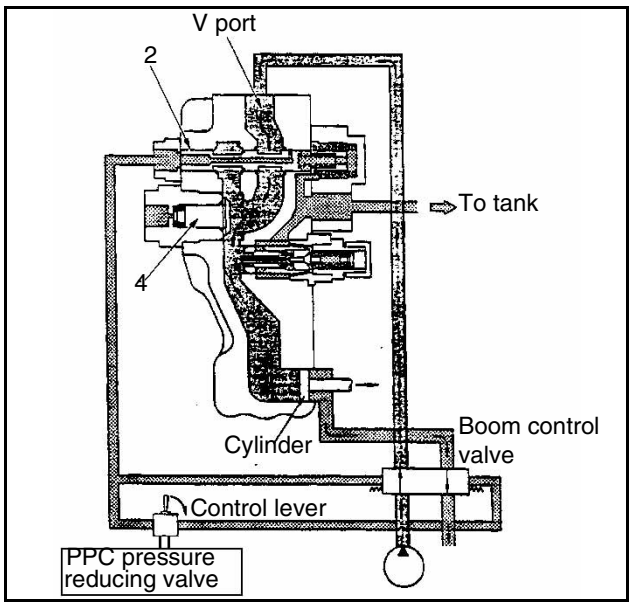
BOOM SAFETY VALVE



Operation

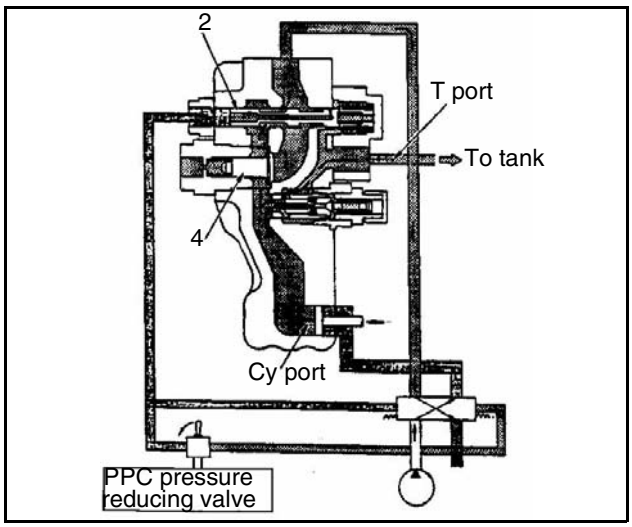
Boom Raise

- 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 room.



Boom Lower

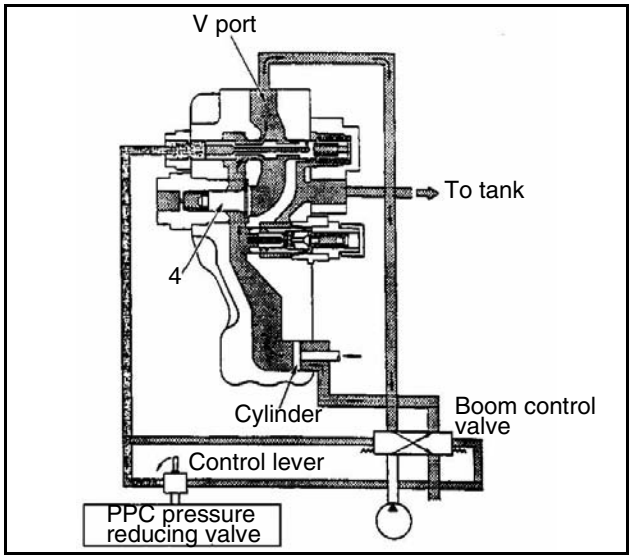
- During boom lowering the pilot signal reverses the flow through the control valve spool. High pressure oil flows to the head side of the cylinder. Oil in the bottom side of the cylinder flows through the port **Cy** of the valve. The pilot signal also opens the spool (2) of the hose burst valve and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



When hose burst occurs

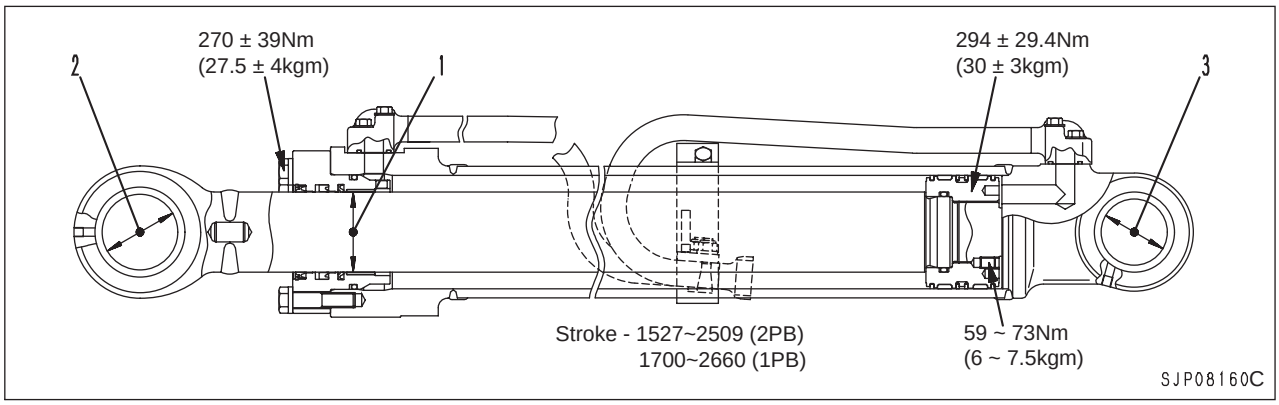
(operation to lower safety)

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

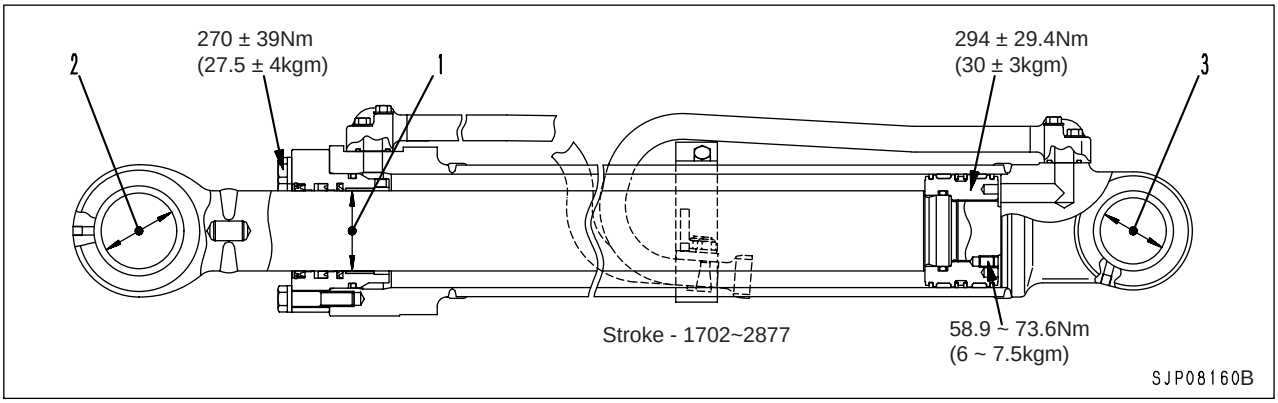

V port
To tank
4
Cylinder
Boom control valve
Control lever
PPC pressure reducing valve

HYDRAULIC CYLINDER

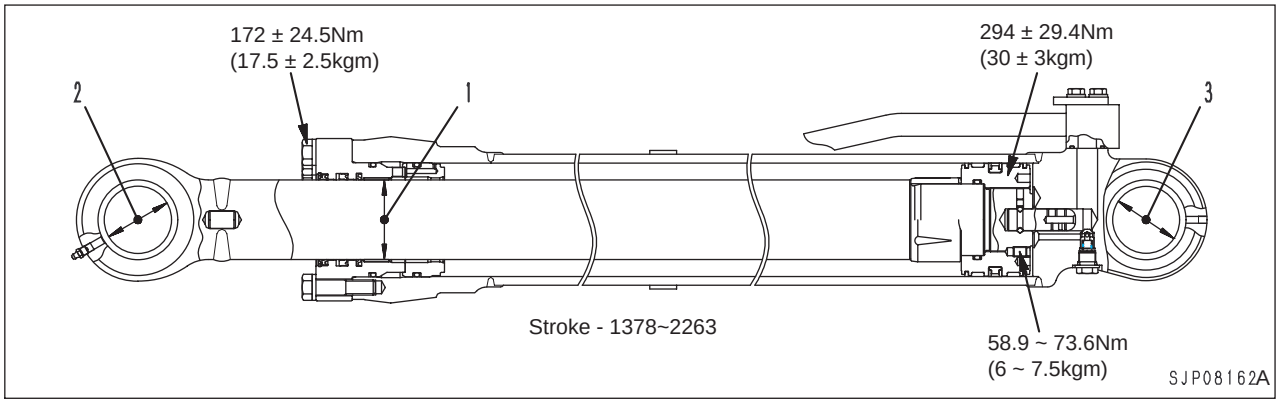
BOOM CYLINDER



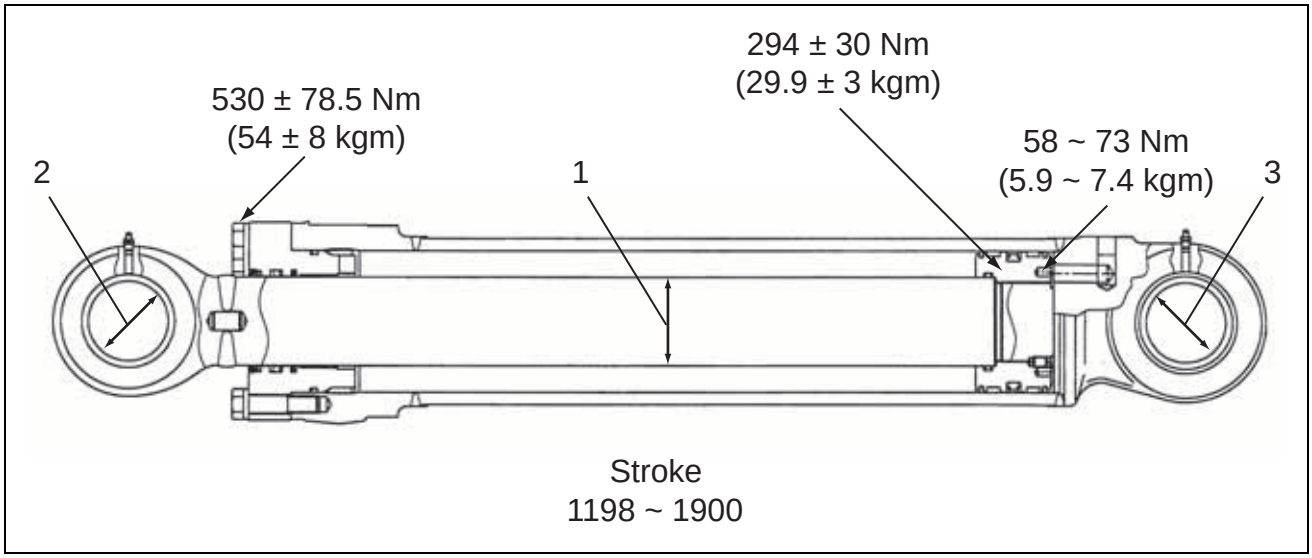
ARM CYLINDER



BUCKET CYLINDER



ADJUST CYLINDER

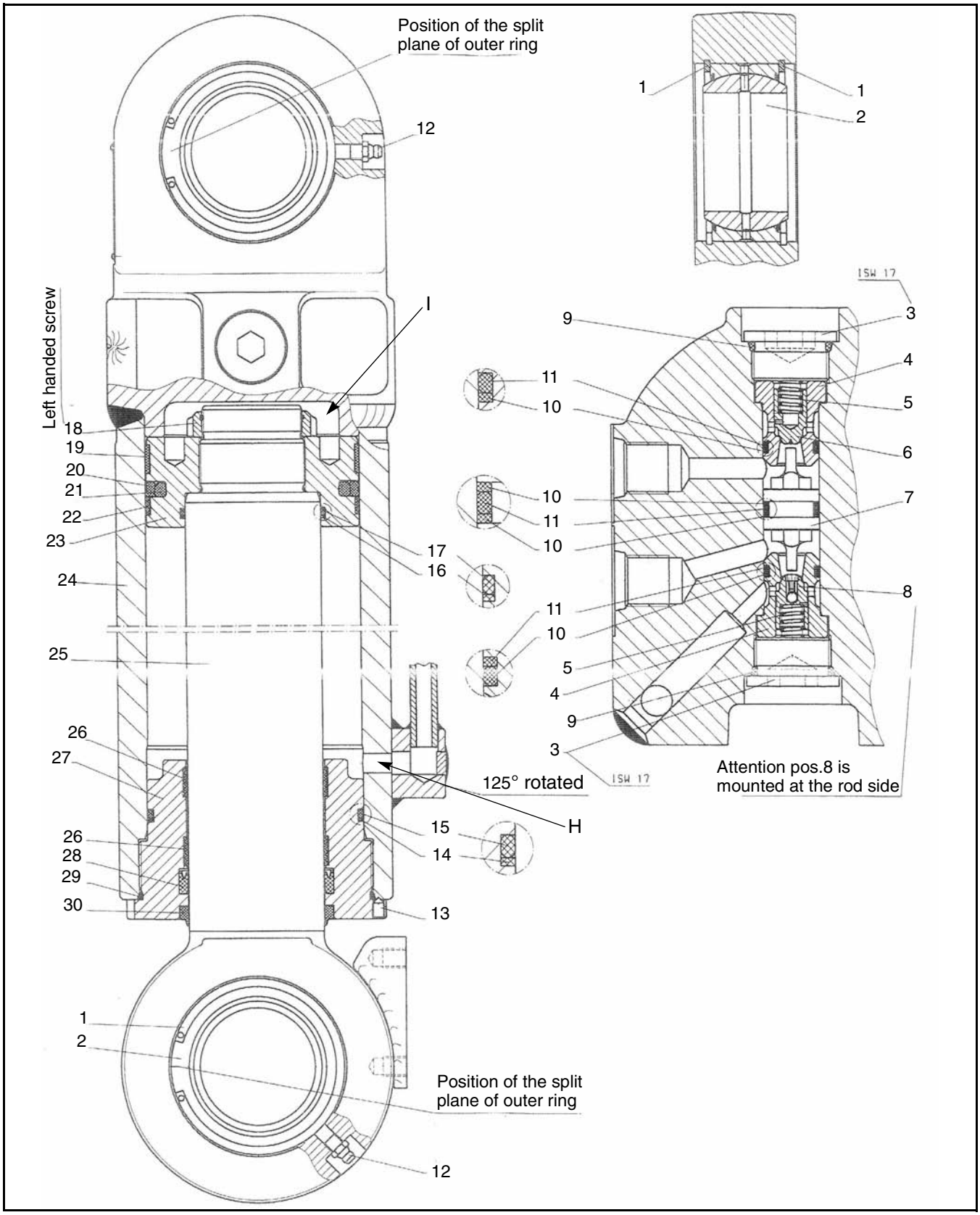


Unit: mm

No.	Check item		Criteria					Remedy
		Cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
-1	Clearance between piston rod and bushing	2 piece boom	75	-0.025 -0.076	+0.279 +0.085	0.110 ~ 0.355		Replace bushing
		Arm	80	-0.025 -0.076	+0.258 +0.048	0.073 ~ 0.334		
		Bucket	70	-0.025 -0.076	+0.259 +0.083	0.108 ~ 0.335		
		Adjust	100	-0.035 -0.091	+0.257 +0.047	0.082 ~ 0.348		
		1 Piece boom	75	-0.025 -0.076	+0.279 +0.055	0.080 ~ 0.355		

2	Clearance between piston rod support pin and bushing	2 piece boom	90	-0.030 -0.060	+0.190 +0.070	0.100 ~ 0.250	---	Replace pin or bushing
		Arm	70	-0.030 -0.100	+0.198 +0.124	0.154 ~ 0.298	---	
		Bucket	70	-0.030 -0.080	+0.198 +0.124	0.154 ~ 0.278	---	
		Adjust	90	-0.030 -0.076	+0.457 +0.370	0.400 ~ 0.533	---	
		1 Piece boom	70	-0.030 -0.100	+0.190 +0.070	0.100 ~ 0.290	---	
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	---	
		Arm	70	-0.030 -0.100	+0.198 +0.124	0.154 ~ 0.298	---	
		Bucket	70	-0.030 -0.104	+0.198 +0.124	0.154 ~ 0.302	---	
		Adjust	90	-0.030 -0.076	+0.457 +0.370	0.400 ~ 0.533	---	
		1 Piece boom-	70	-0.030 -0.060	+0.190 +0.070	0.100 ~ 0.250	---	

OUTRIGGER CYLINDER



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

Function

Cylinder head (27) guides the piston rod (25) which is sealed by seal (28). Seal (28) is protected against dirt by wiper (30).

When oil flows through port **I** to the piston side of the cylinder the piston rod (25) extends out of the cylinder (24).

The piston is guided in the cylinder (24) by the piston guide ring (23). It is sealed by the piston ring (14). The cylinder head is sealed against the cylinder by O-ring (21).

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.

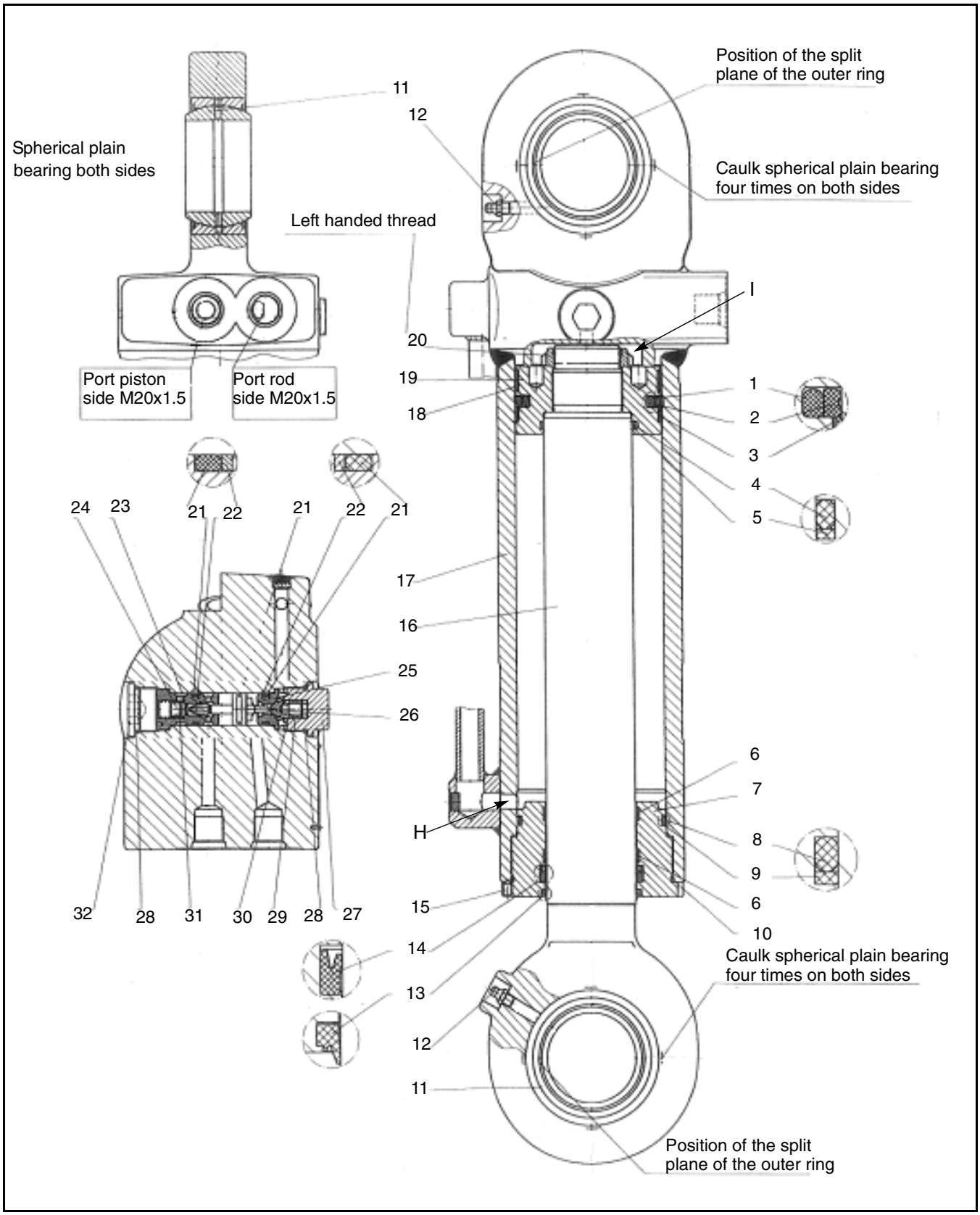
The built in check valve also holds hydraulic pressure within the cylinder when the hydraulic hoses are removed from the cylinder.

Depressurise the cylinder before opening

To depressurise the cylinder, loosen the plug (3) carefully using an allen key 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. Uncut backup ring
6. Rod wearing
7. Cylinder head
8. O-ring
9. Uncut 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. Guide
20. Self locking groove nut
21. O-ring
22. Uncut 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

Cylinder head (7) guides the piston rod (16) which is sealed by seal (14). Seal (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 (19). It is sealed by the piston ring (18). The cylinder head is sealed against the cylinder by O-ring (8).

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.

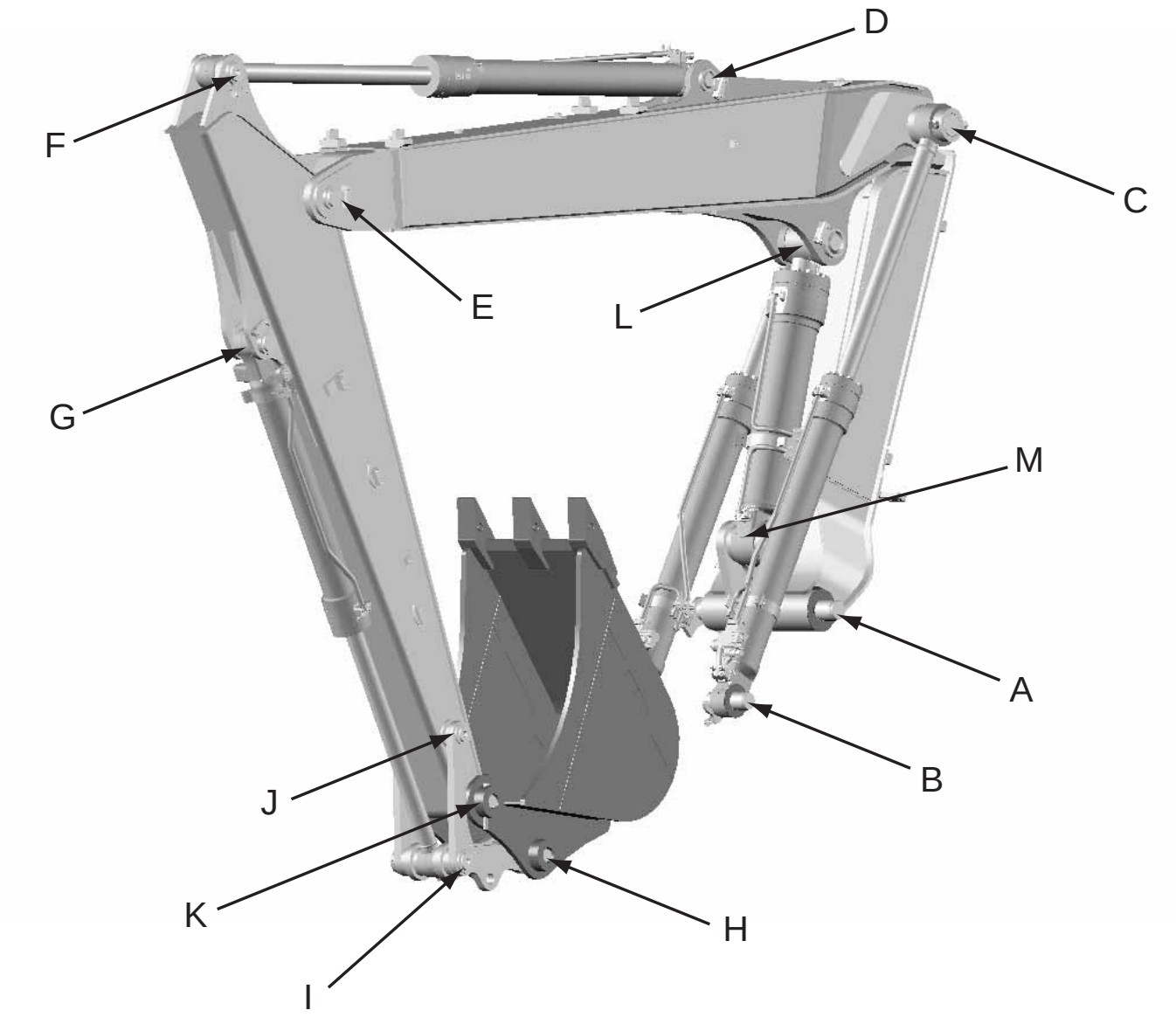
The built in check valve also holds hydraulic pressure within the cylinder when the hydraulic hoses are removed from the cylinder.

Depressurise the cylinder before opening

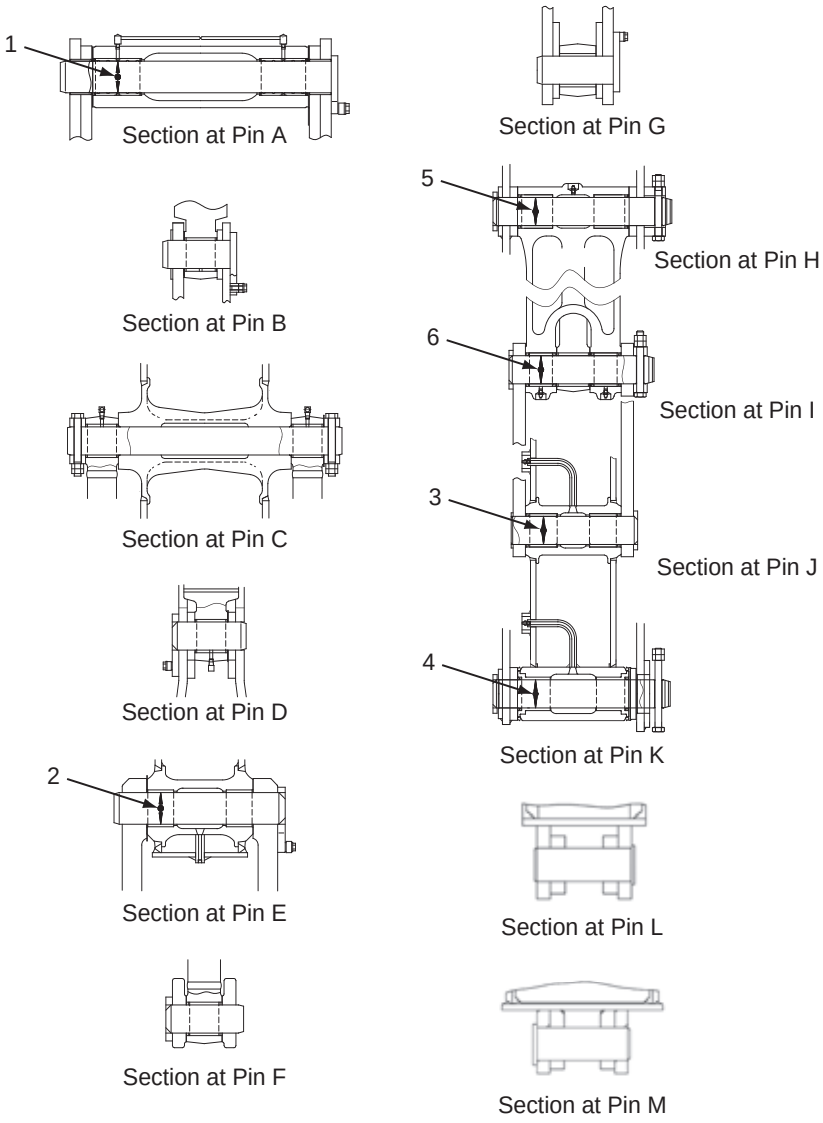
To depressurise the cylinder, loosen the plug (32) carefully using an allen key and wait until the pressure has been released.

To be absolutely sure the plug can be completely removed.

WORK EQUIPMENT



Work Equipment

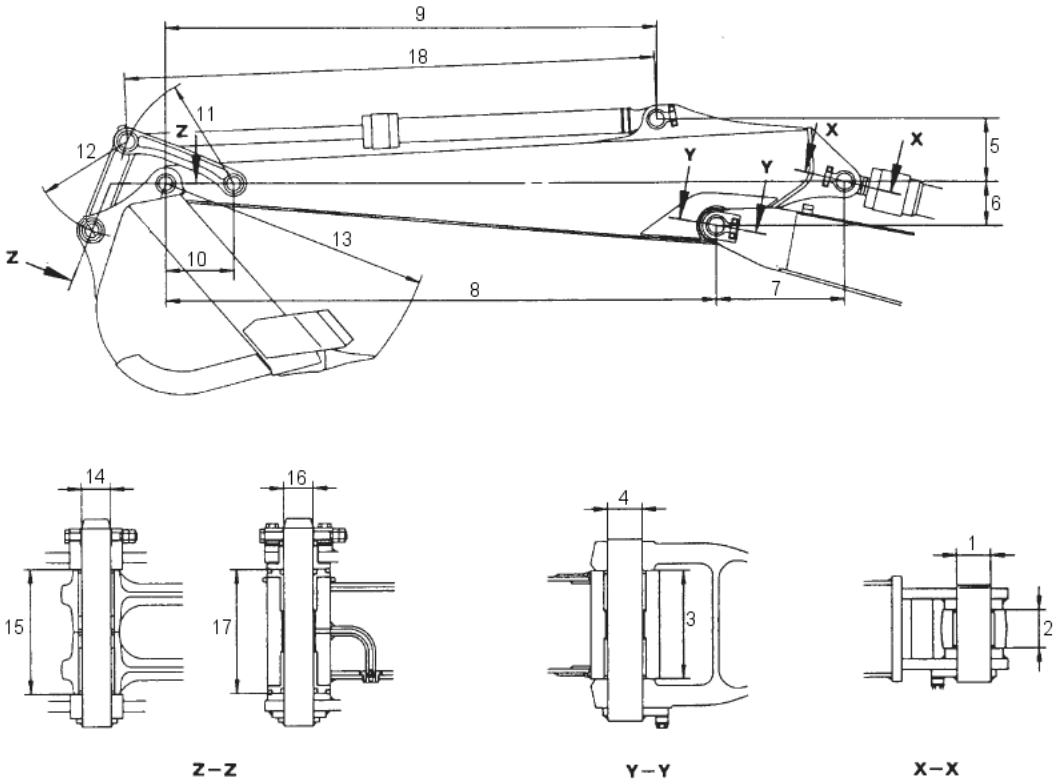


Unit: mm

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	+0.106 +0.045	0.105 ~ 0.136	1.0	Replace
2	Clearance between connecting pin and bushing of boom and arm	70	-0.030 -0.060	+0.104 +0.043	0.103 ~ 0.134	1.0	
3	Clearance between connecting pin and bushing of arm and link	60	-0.030 -0.080	+0.135 +0.074	0.154 ~ 0.165	1.0	
4	Clearance between connecting pin and bushing of arm and bucket	60	-0.030 -0.080	+0.129 +0.074	0.154 ~ 0.159	1.0	
5	Clearance between connecting pin and bushing of link and bucket	60	-0.030 -0.080	+0.130 +0.074	0.154 ~ 0.160	1.0	
6	Clearance between connecting pin and bushing of link and link	70	-0.030 -0.080	+0.331 +0.270	0.350 ~ 0.361	1.0	

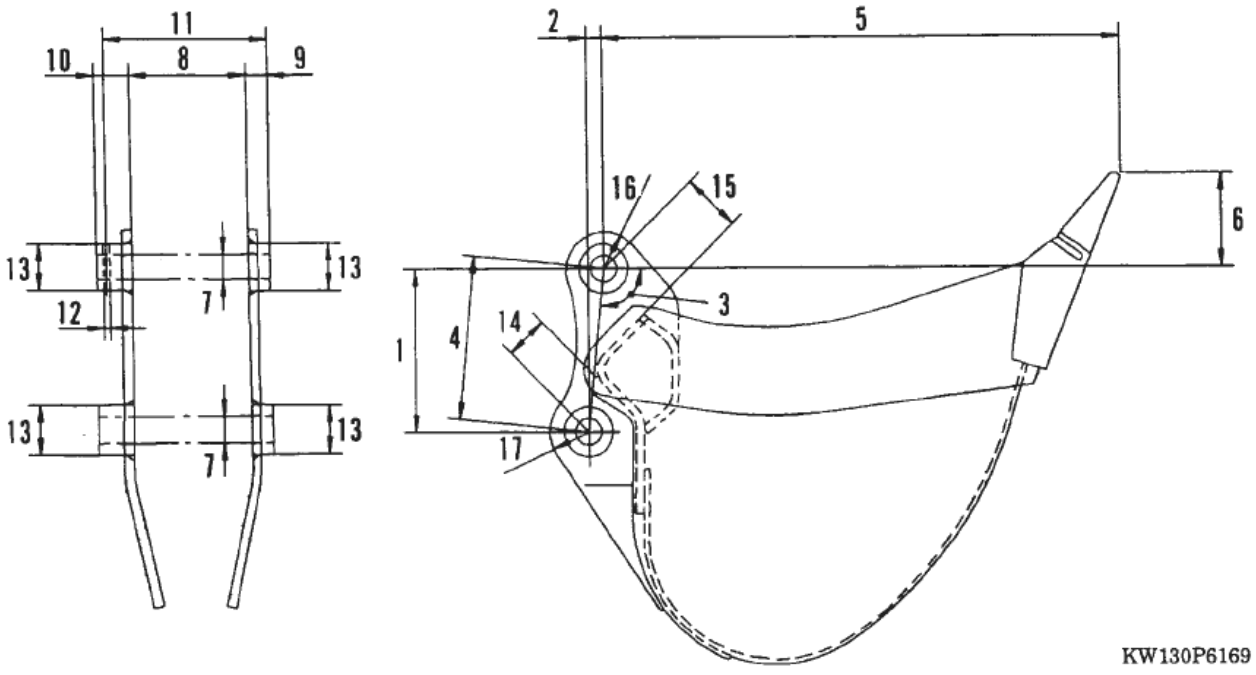
1. DIMENSION OF ARM



Unit: mm

Model No.		PW160-7E0 Arm Size (M)		
		2.1	2.5	3.0
1		∅ 70 $^{+0.1}_{0}$		
2		81.5 $^{+1.0}_{0}$		
3		226 $^{0.2}_{-0.7}$		
4		∅ 70 $^{-0.03}_{-0.06}$		
5		293.9 ±2	275.7 ±2	291.8 ±2
6		199.7 ±1	199.7 ±1	219.6 ±1
7		635.0 ±0.5	635.0 ±0.5	631.9 ±1
8		2,089.8	2,492.2	2,991.9
9		2,100 ±1.5	2,100.2 ±1.5	2,100 ±1.5
10		290 ±0.5		
11		493 ±0.2		
12		422 ±0.5		
13		1,202		
14		∅ 60		
15		261 ±1		
16		∅ 60		
17	When pressfitting bushing	260		
18	Min.	1,378		
	Max.	2,263		

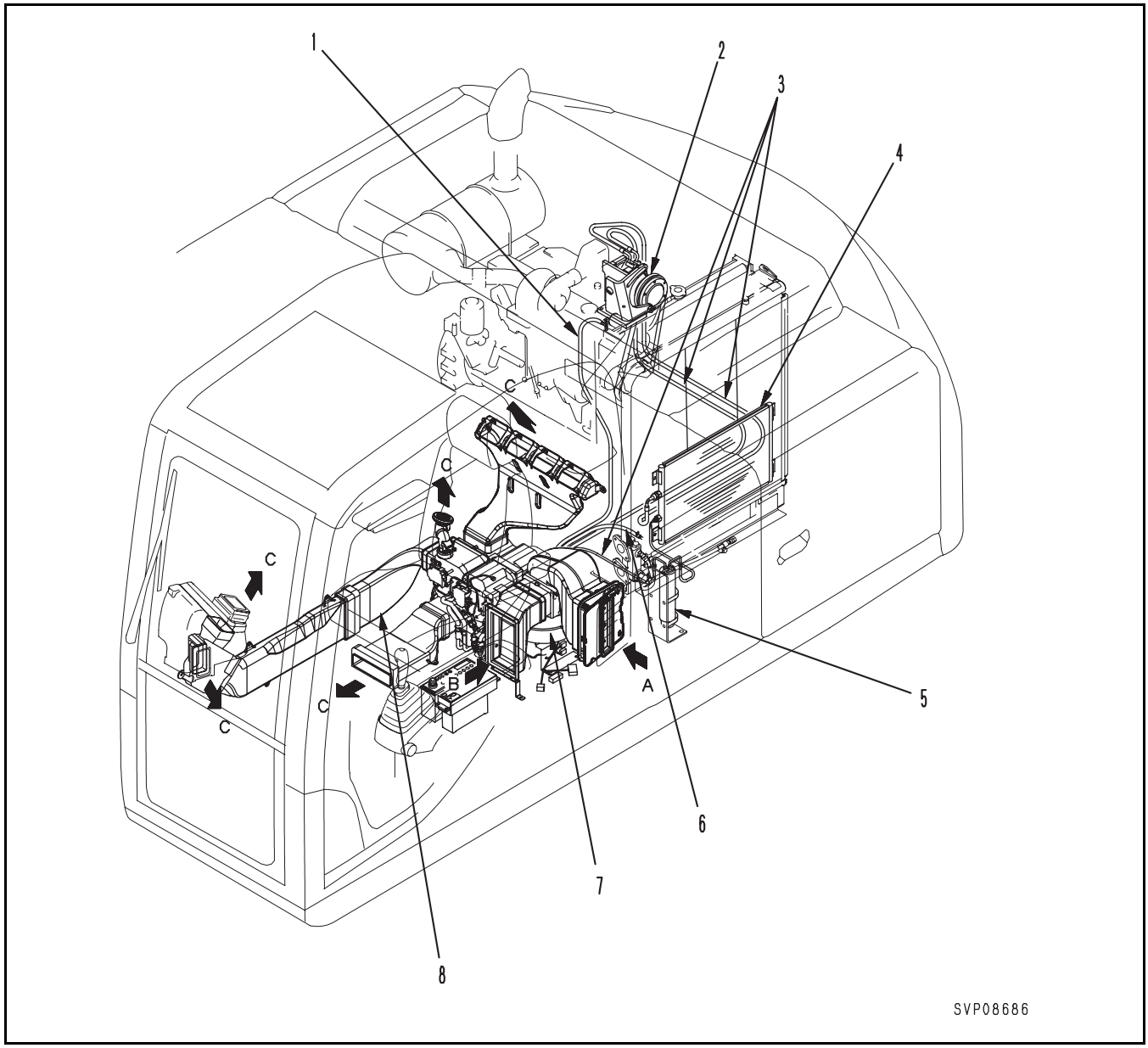
2.DIMENSION OF BUCKET



Model No.	Size (mm)	Model No.	Size (mm)
1.	373	10.	85
2.	38	11.	380
3.	95.80	12.	∅ 16
4.	374.9	13.	∅ 110
5.	1,197	14.	101.5
6.	222	15.	138
7.	∅ 60	16.	85
8.	260	17.	85
9.	50		

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

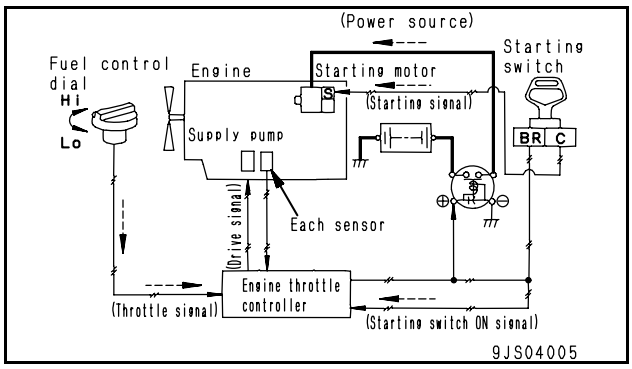
Engine Control

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.

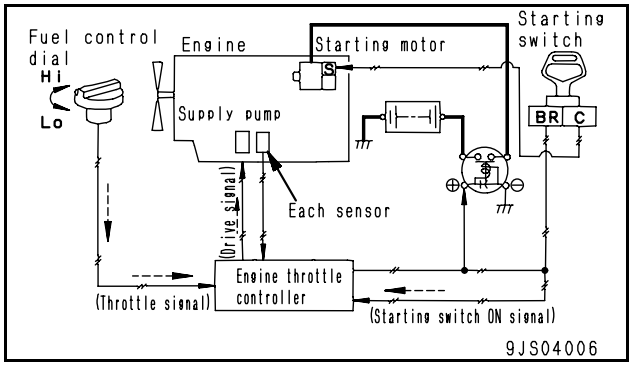
  When it happens, the engine controller checks the signal voltage from the fuel control dial and sets the engine speed to the speed set by the fuel control dial.



Engine speed control

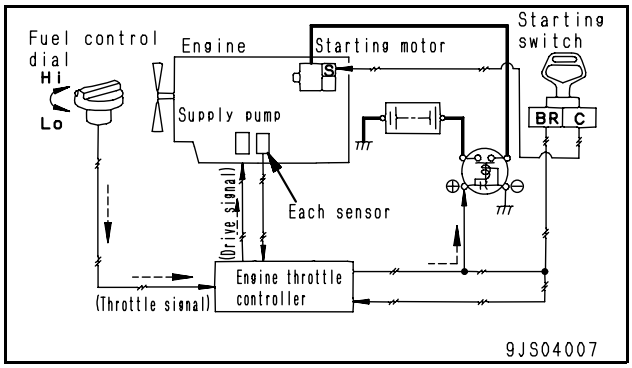
- The fuel control dial sends a signal voltage corresponding to the rotation angle to the engine

  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.



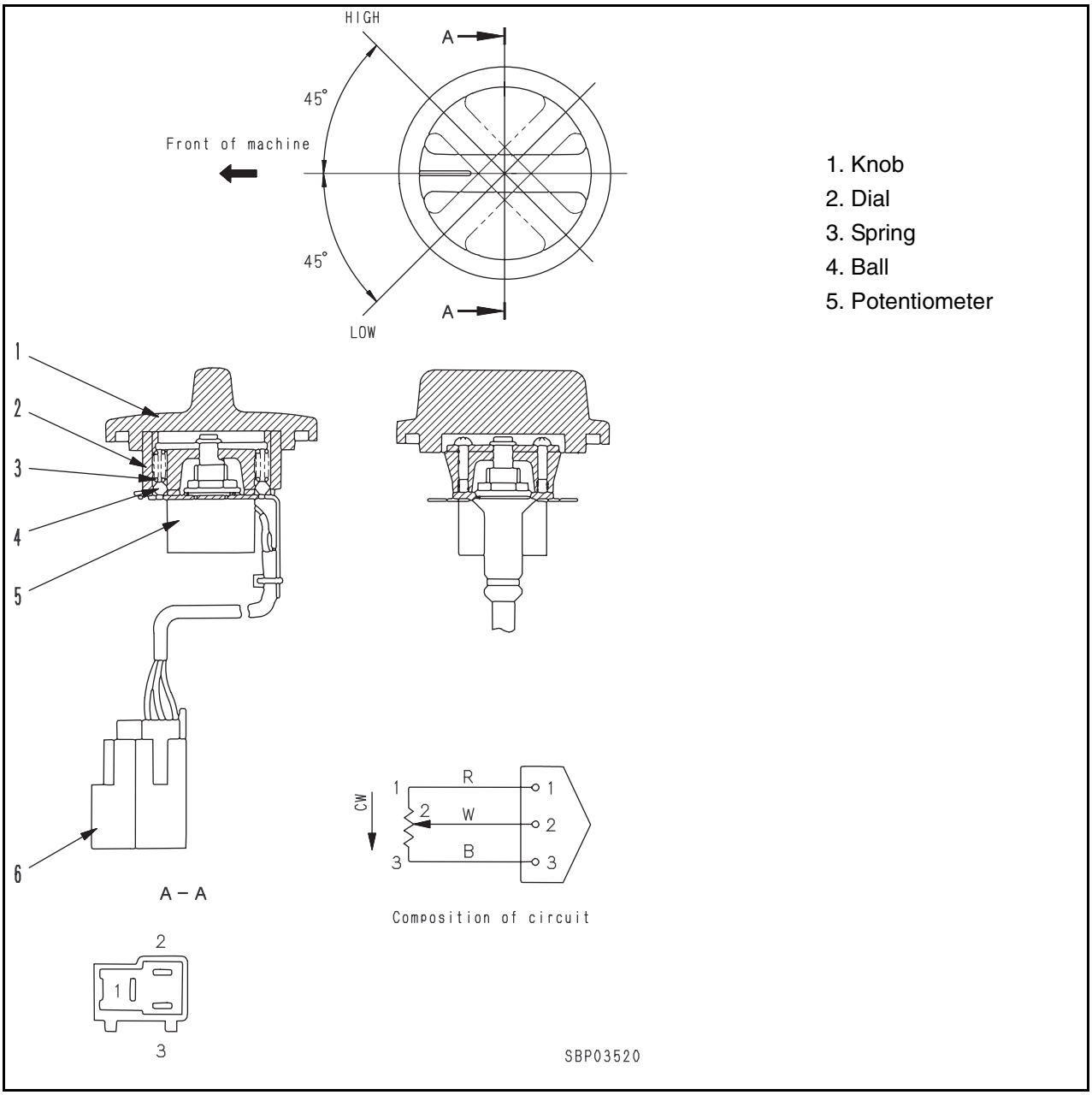
Stopping engine

- 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

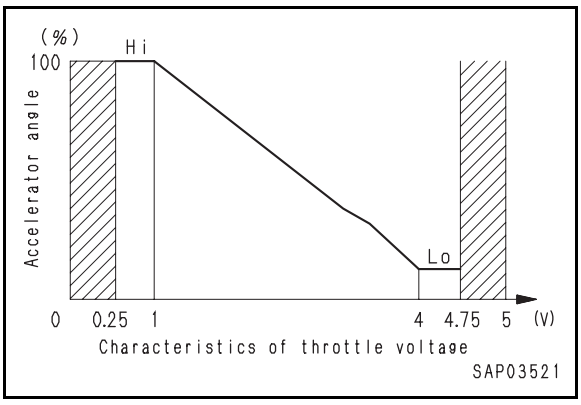
Fuel control dial



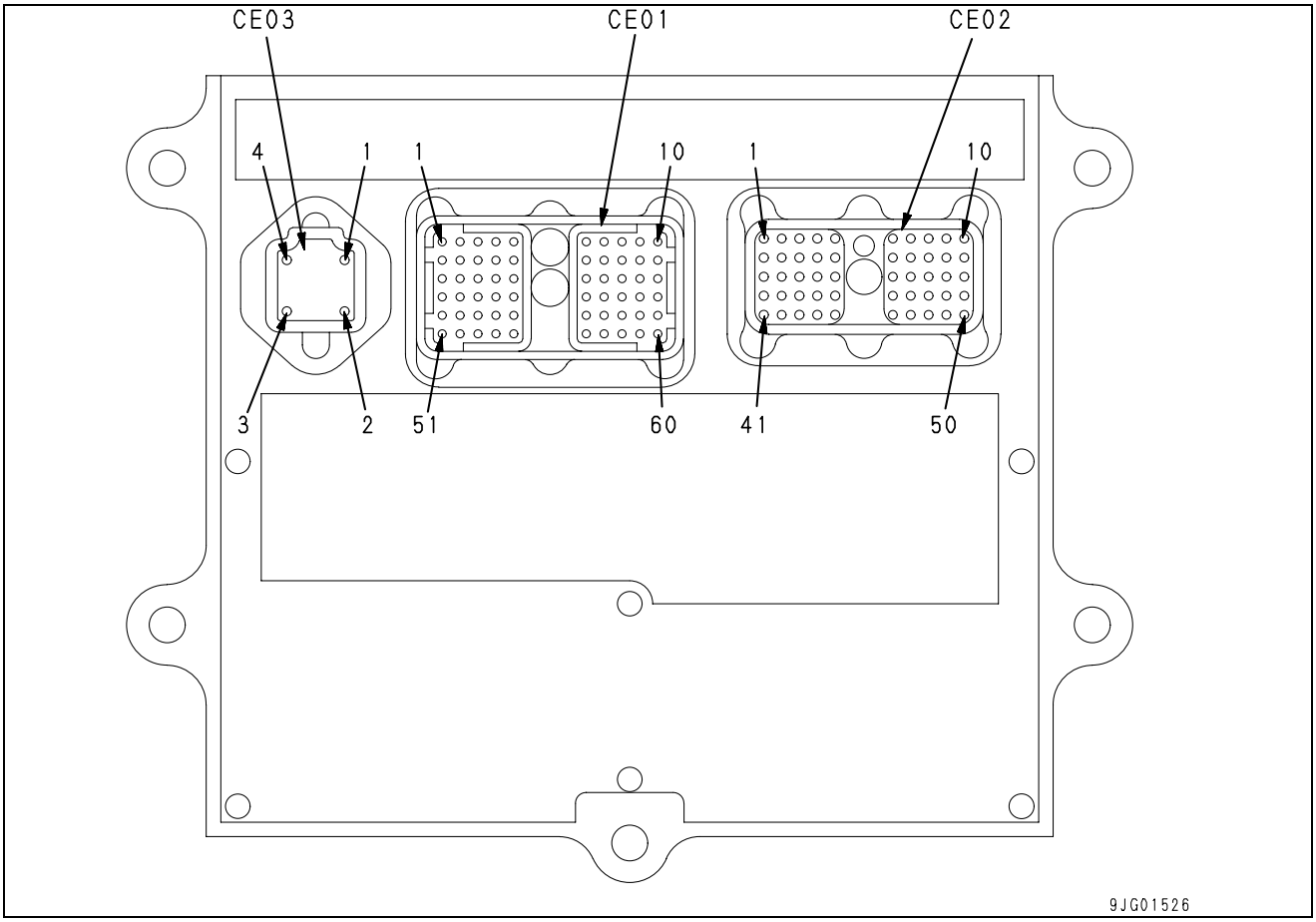
1. Knob
2. Dial
3. Spring
4. Ball
5. Potentiometer

Function

- The fuel control dial is installed near the monitor panel, and a potentiometer is installed under the knob. The potentiometer shaft is turned by turning the knob.
- 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 throttle and pump 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	NC (*)		18	NC (*)	
2	Electric power supply for IMA		19	NC (*)	
3	Atmosphere sensor		20	NC (*)	
4	NC (*)		21	NC (*)	
5	NC (*)		22	NC (*)	
6	CAN (-)		23	Intake manifold temperature	
7	NC (*)		24	NC (*)	
8	CAN (+)		25	Accumulator pressure signal	
9	NC (*)		26	Position sensor signal	B
10	NC (*)		27	Speed sensor signal	
11	NC (*)		28	NC (*)	
12	NC (*)		29	NC (*)	
13	NC (*)		30	NC (*)	
14	Water-in-fuel input		31	NC (*)	
15	Coolant temperature sensor		32	IMA return	
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 (*)	
36	NC (*)	
37	5V electric power supply for sensor	
38	Air pressure sensor return	
39	NC (*)	
40	NC (*)	
41	NC (*)	
42	NC (*)	
43	NC (*)	
44	Boost pressure sensor	
45	Injector #1 (+)	
46	Injector #3 (+)	
47	Position sensor return	
48	Speed sensor return	
49	NC (*)	
50	NC (*)	
51	NC (*)	
52	Injector #4 (-)	
53	Injector #1 (-)	
54		
55	Injector #4 (+)	
56		
57	Injector #2 (+)	
58		
59	Injector #2 (-)	
60	Injector #3 (-)	

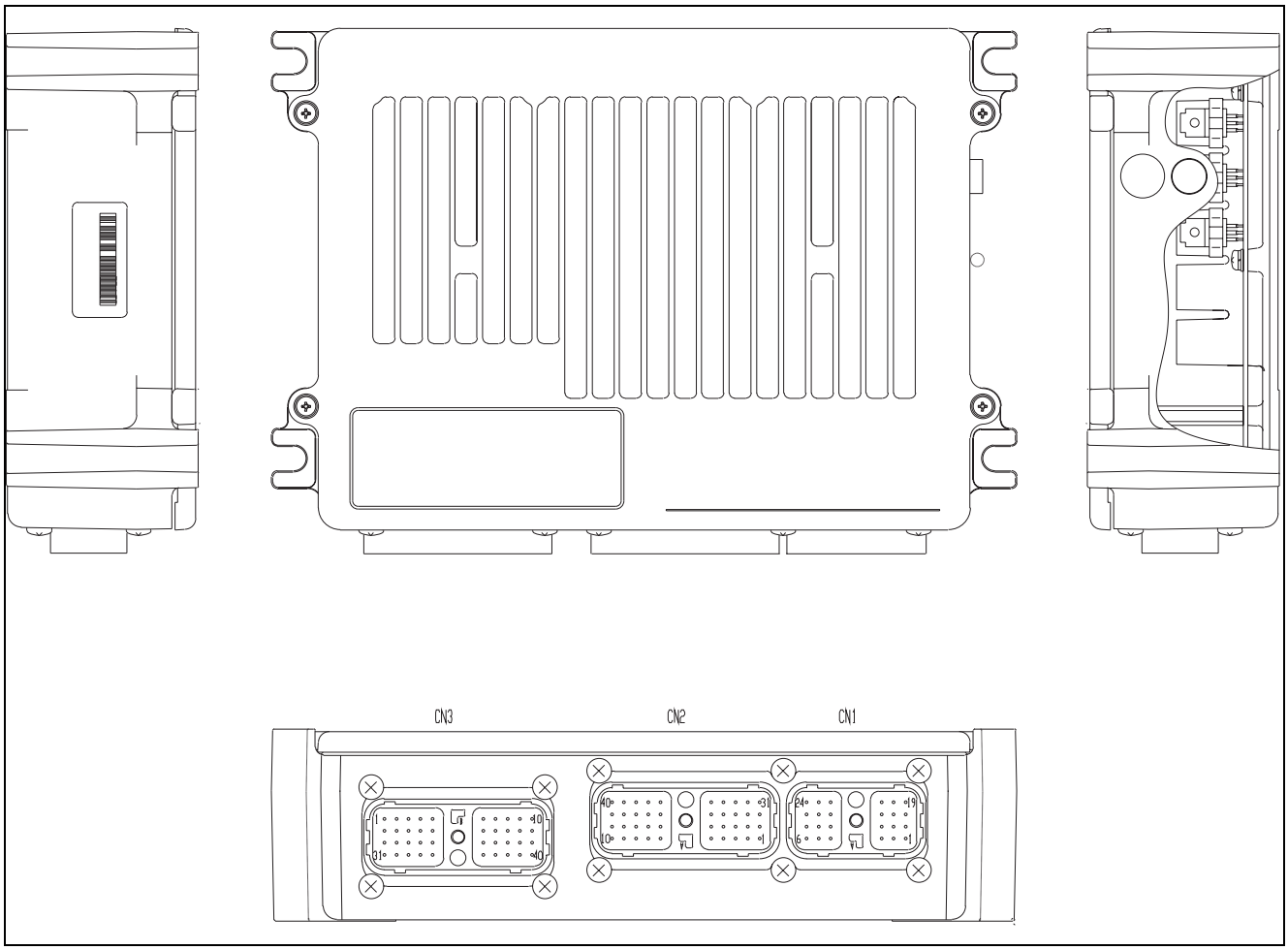
CN-CE02 (*: Never connect to NC as malfunctions and errors occur)

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 (*)	
Pin No.	Signal name	Input/ Output
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


CN3
CN2
CN1

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 portion	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 paternity	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

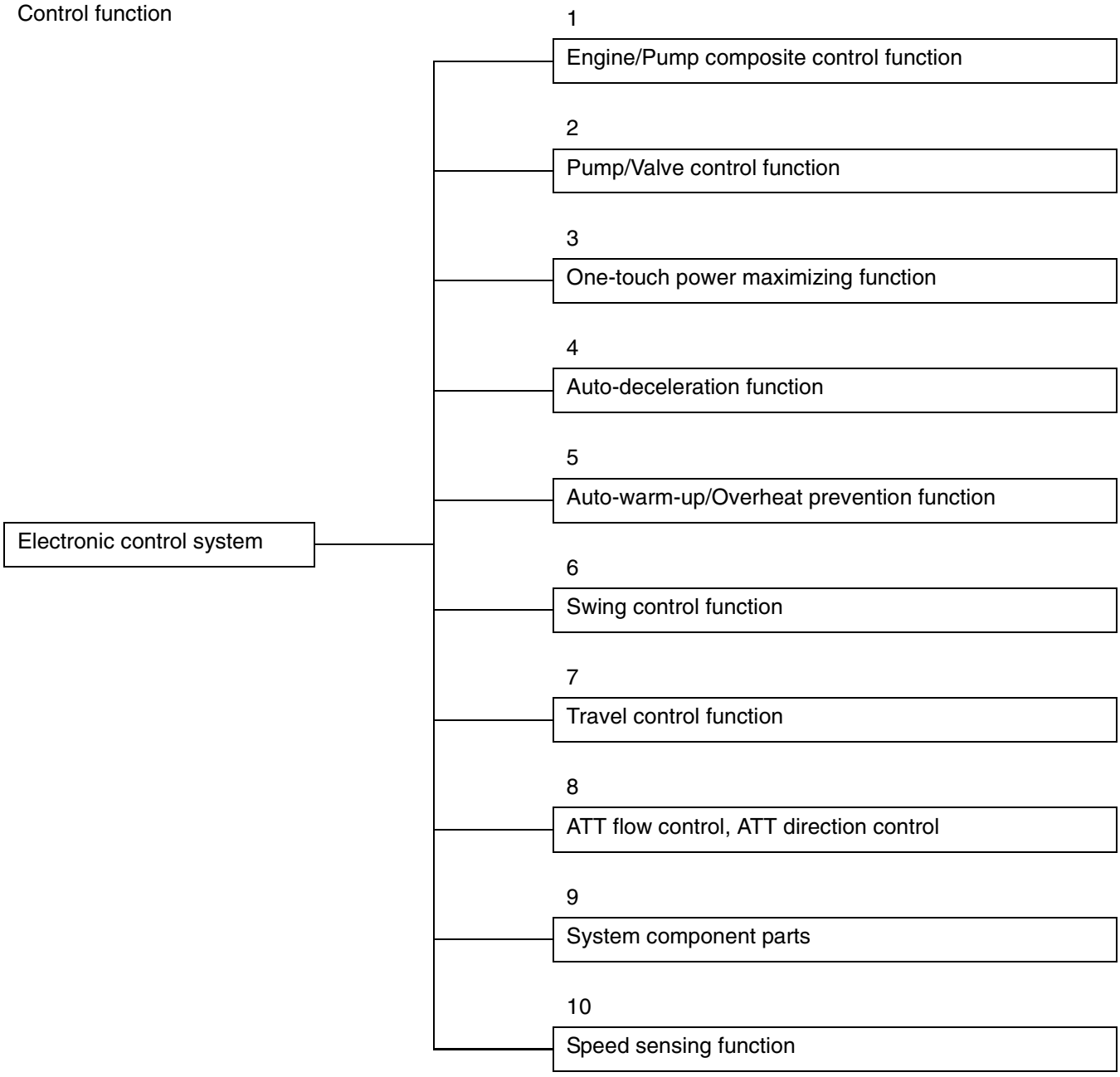
CN-2

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

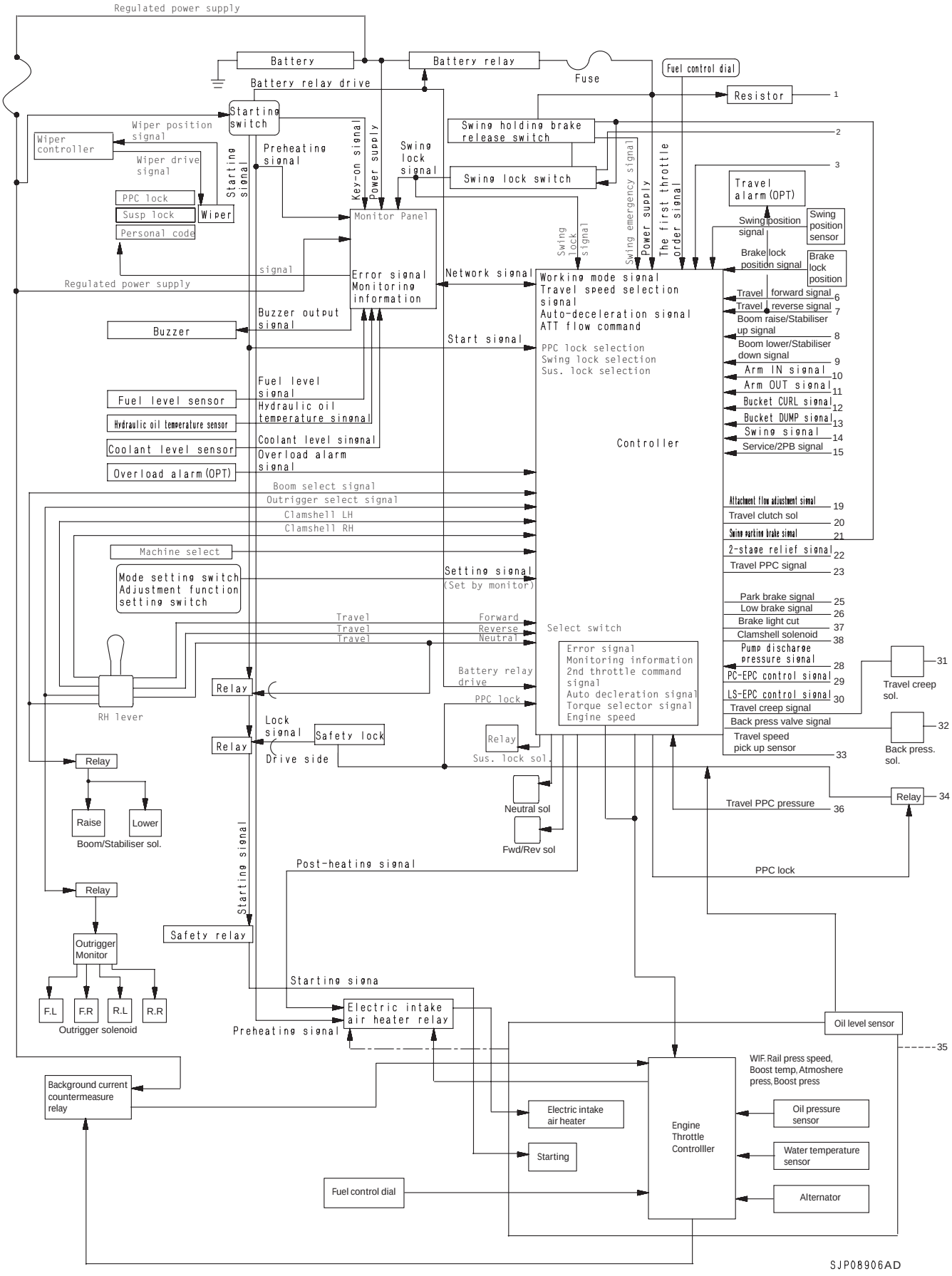
Pin	Signal name	Input/
1	VB (controller power)	Input
2	VIS (solenoid power)	Input
3	SOL_COM (solenoid com-	
4	Battery relay drive signal	Output
5	1st service LH flow control EPC	Output
6	LS-EPC solenoid	Output
7	Merge/Flow divider solenoid	Output
8	2 stage relief solenoid	Output
9	2nd service neutral 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

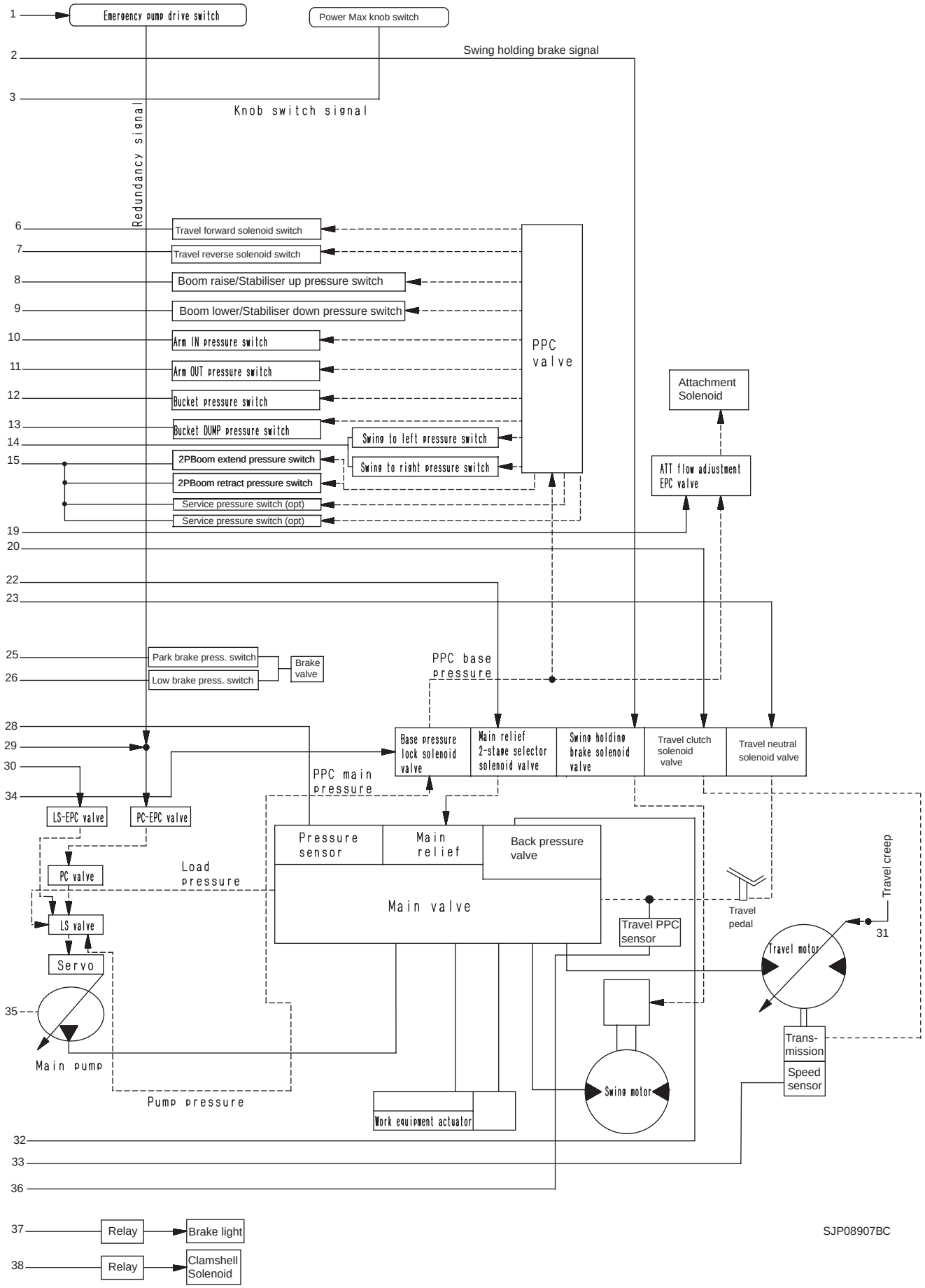
ELECTRONIC CONTROL SYSTEM



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

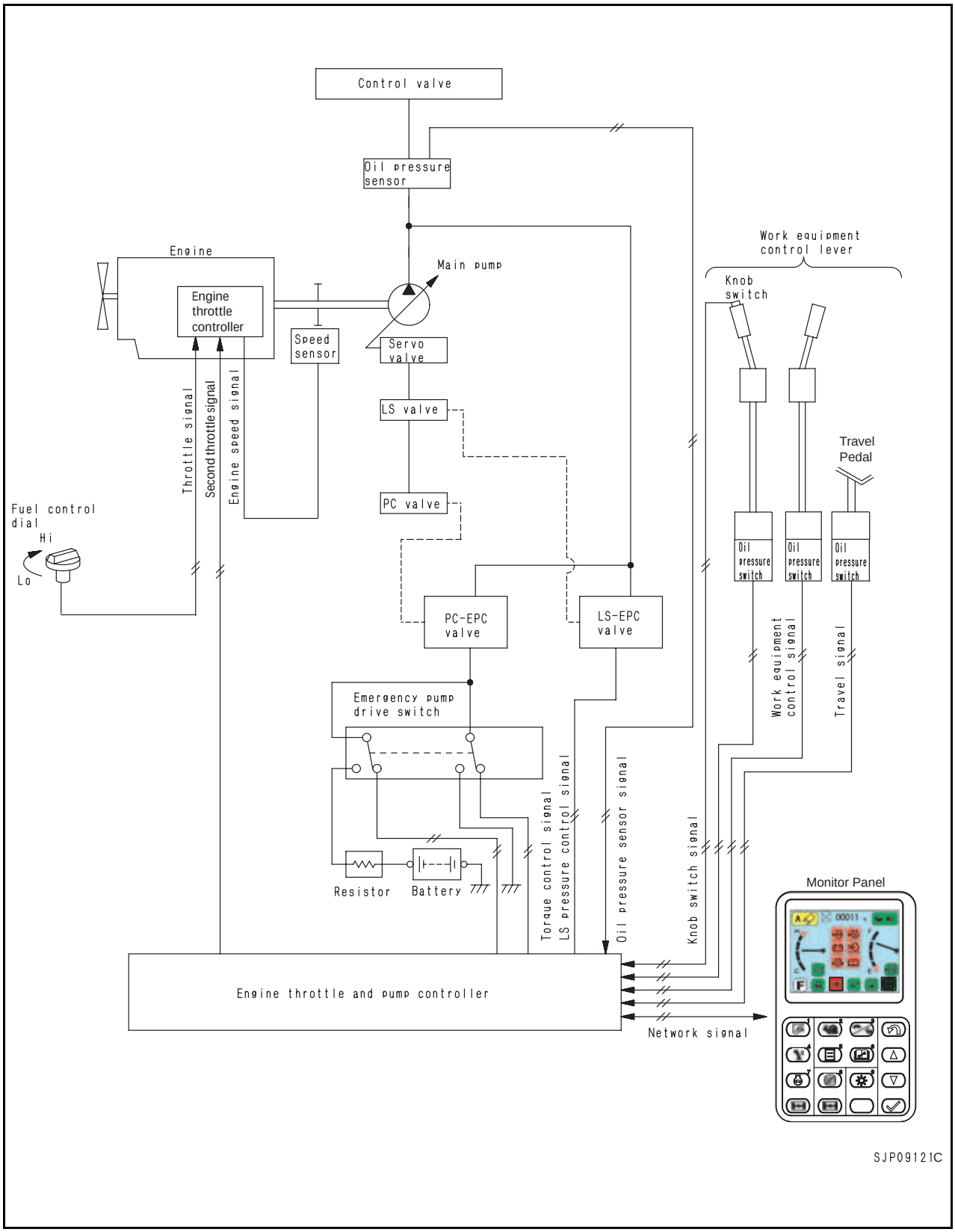
MACHINE CONTROL SYSTEM DIAGRAM




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 pedal
Travel creep
31
Travel PPC sensor
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

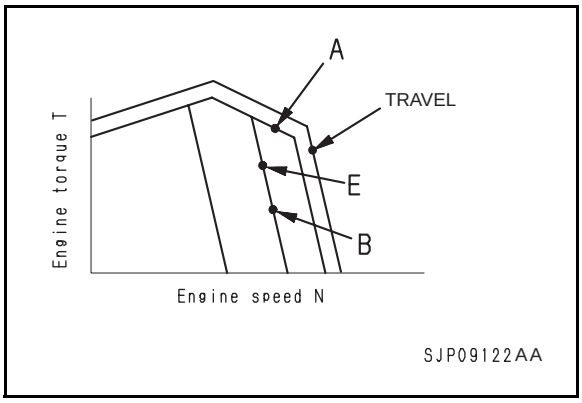
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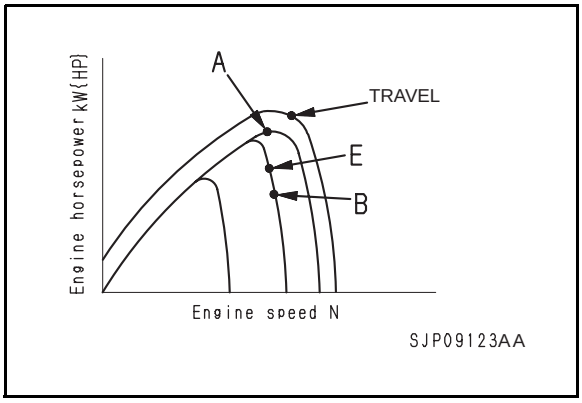
1. Engine and Pump control function

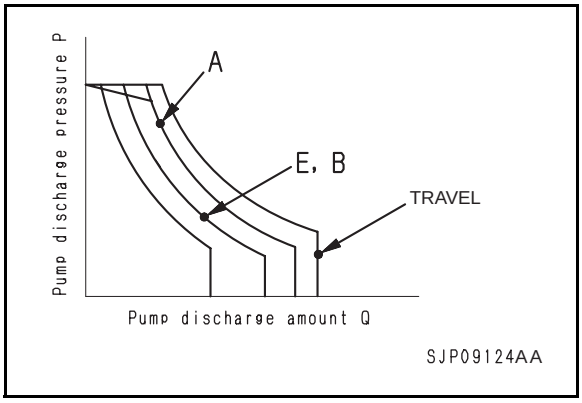


FUNCTION

- The operator can set the work mode switch on the monitor panel to mode A, E, or 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.







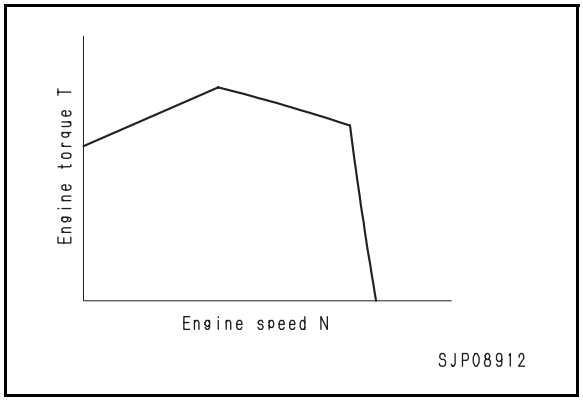
1) Control method in each mode

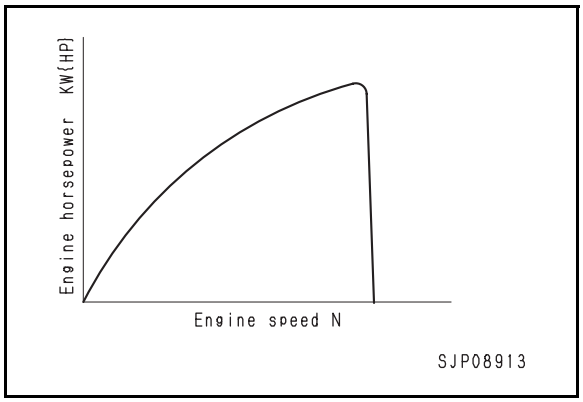
Mode P

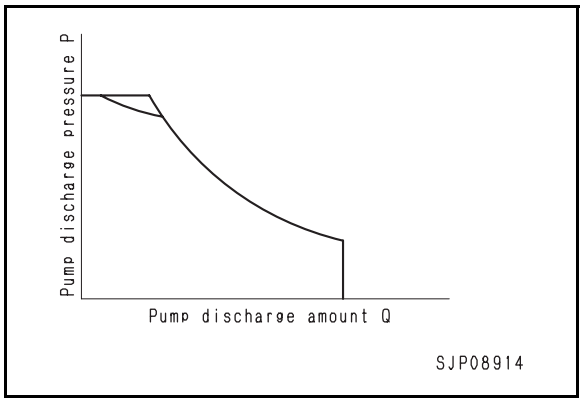
- Matching point in mode P: Rated speed

Model	PW160-7E0
Mode P Working	2,150 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.



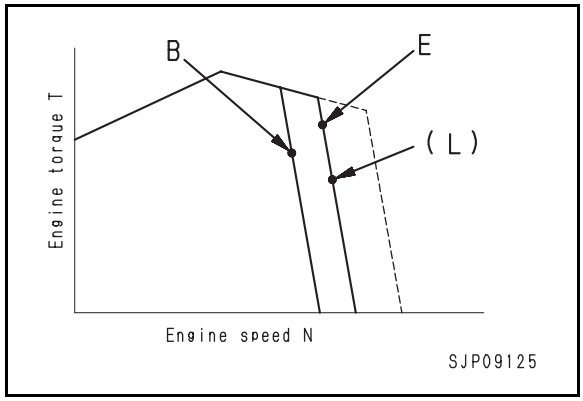




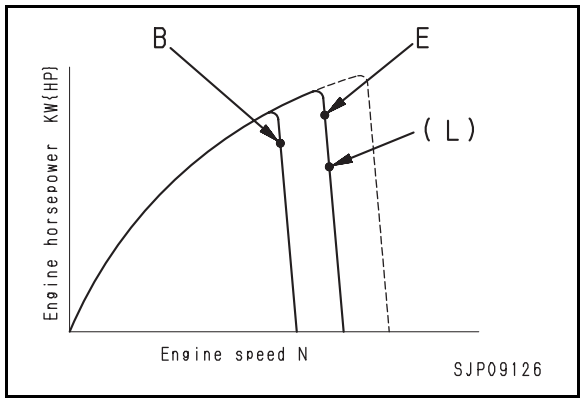
Mode E / Mode B / Mode L

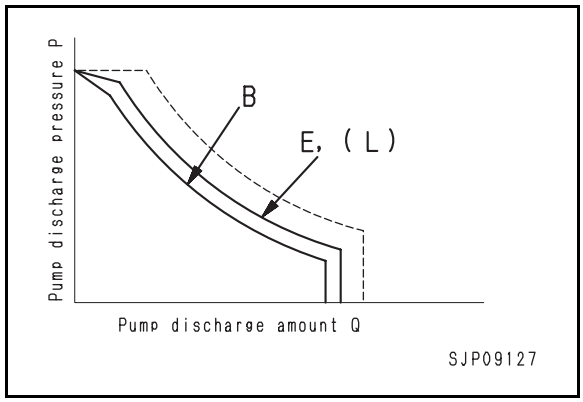
Mode	Digging	Breaker	Finishing
Partial output point	85%	75%	70%

Mode	PW160-7E0
Mode E	1,950 RPM
Mode B	1,990 RPM
Mode L	1,715 RPM

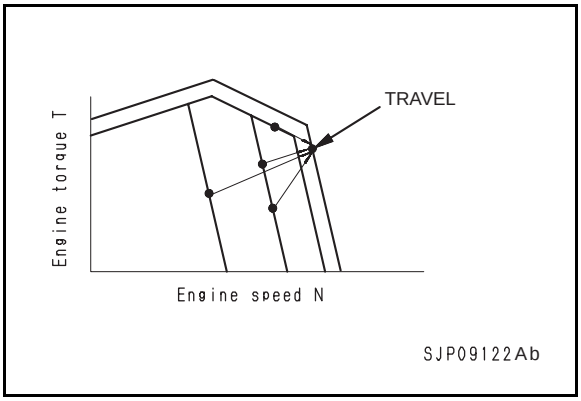


- At this time, the controller keeps the pump absorption torque along the constant horsepower curve and lower the engine speed by the composite control of the engine and pump.
  By this method, the engine is used in the low fuel consumption area.





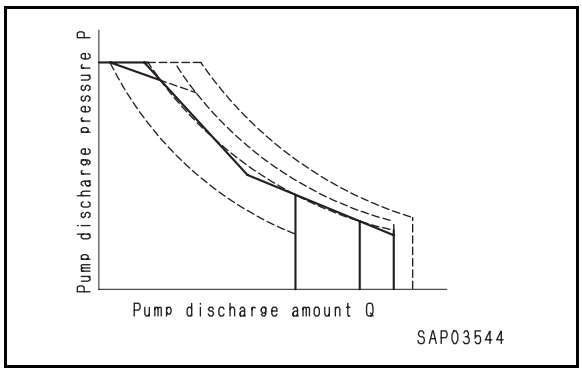
- When travel is activated in each mode matching point changes to travel matching point.



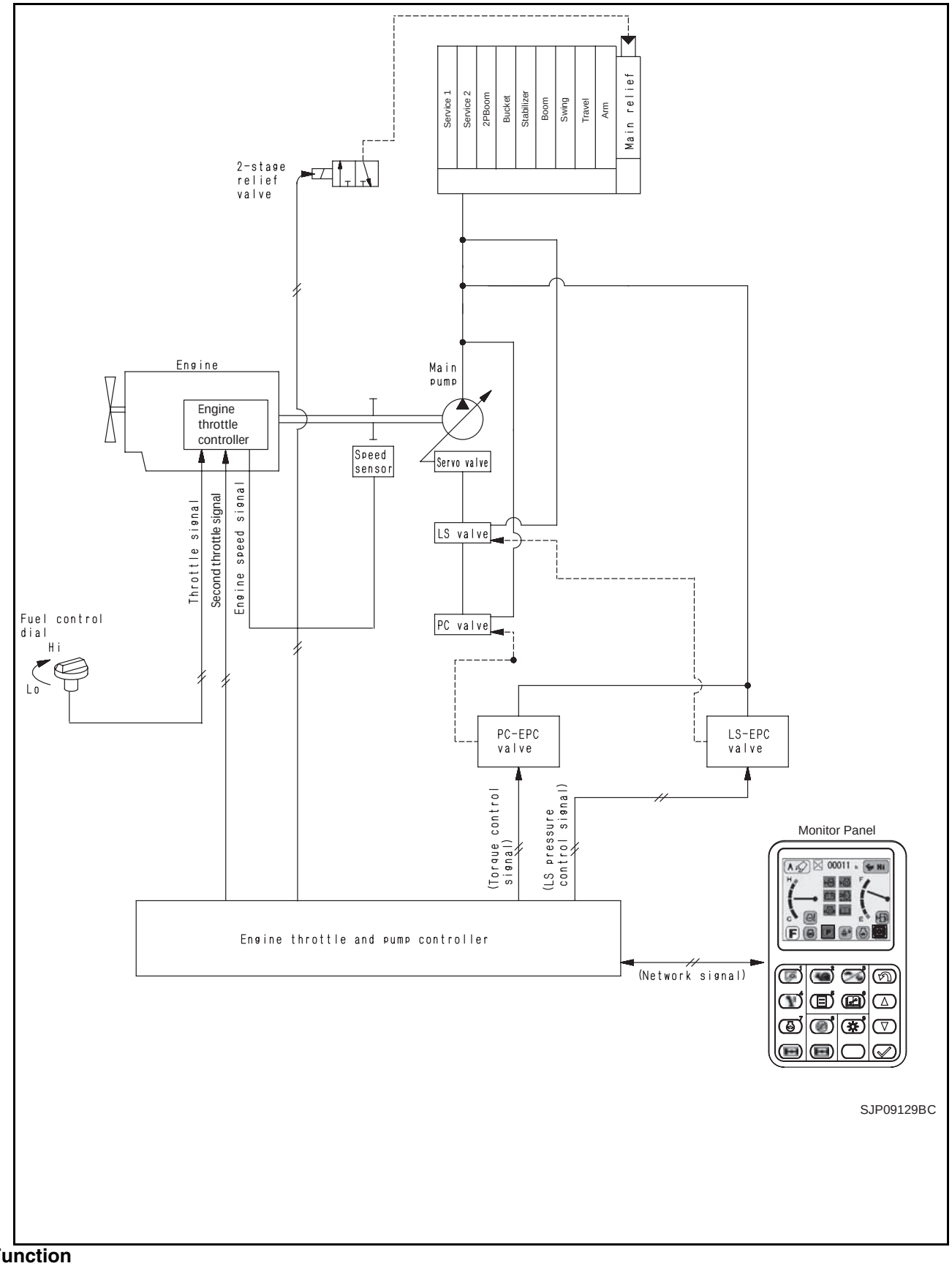
2. Function to control when emergency pump drive switch is turned ON

- 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

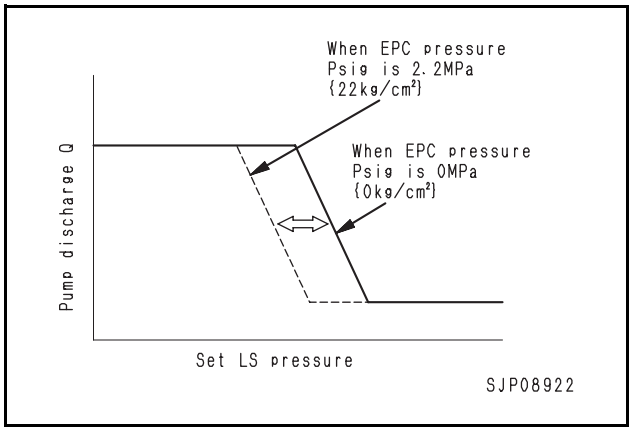


Function

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

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.

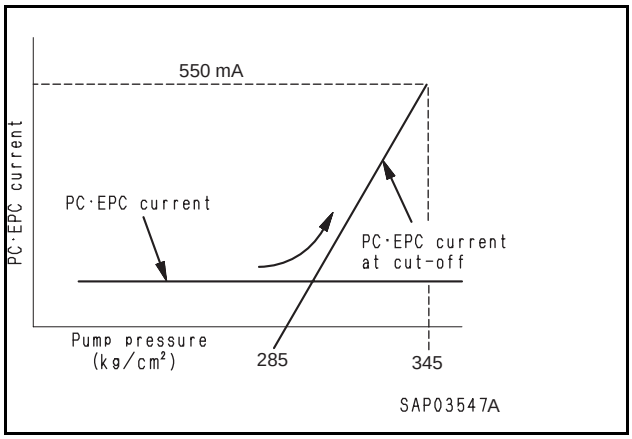


2. Cut-off function

- 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.

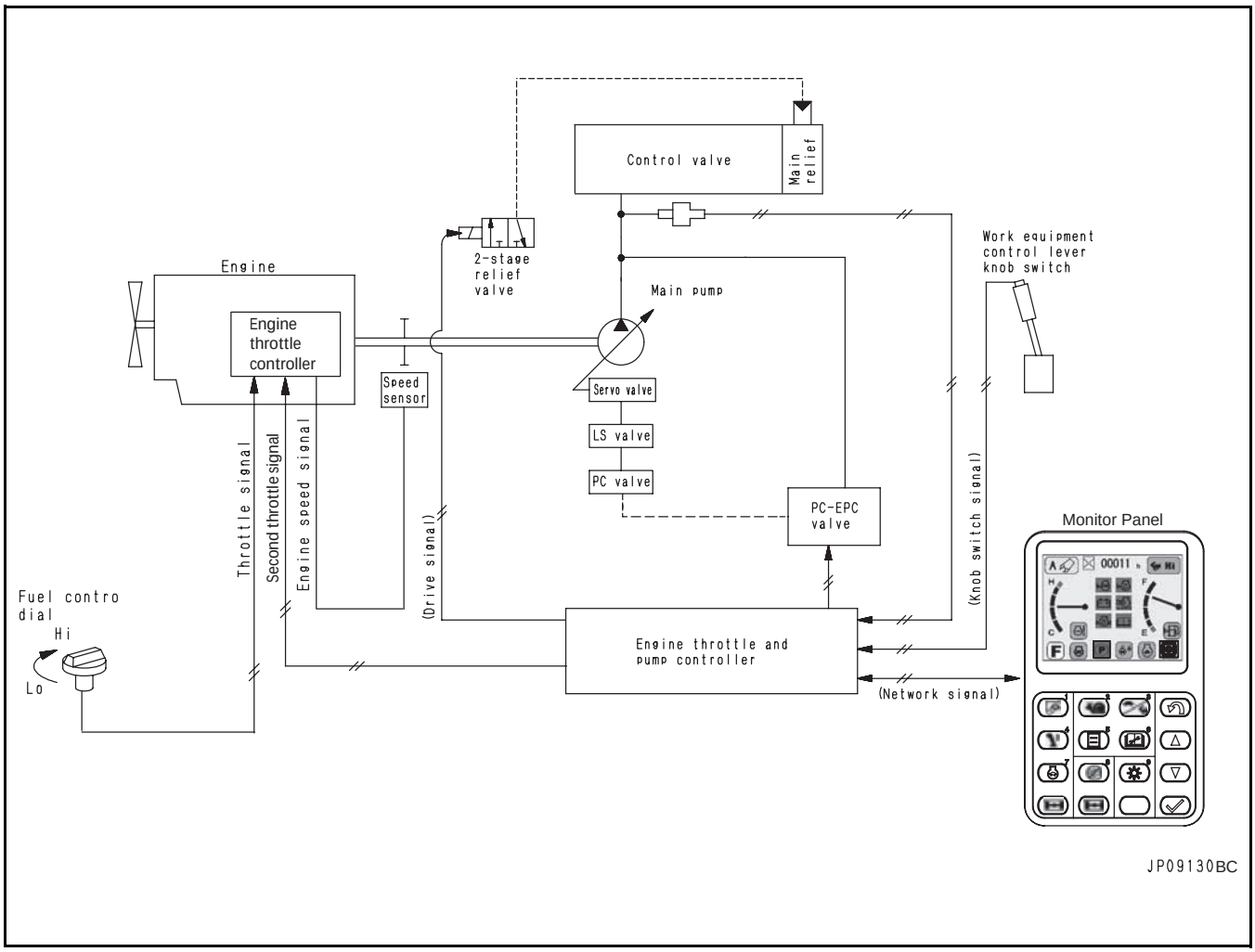
3. 2-stage relief function

- 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 maximizing 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 "A" and "E" working modes only.

1) One-touch power maximizing function

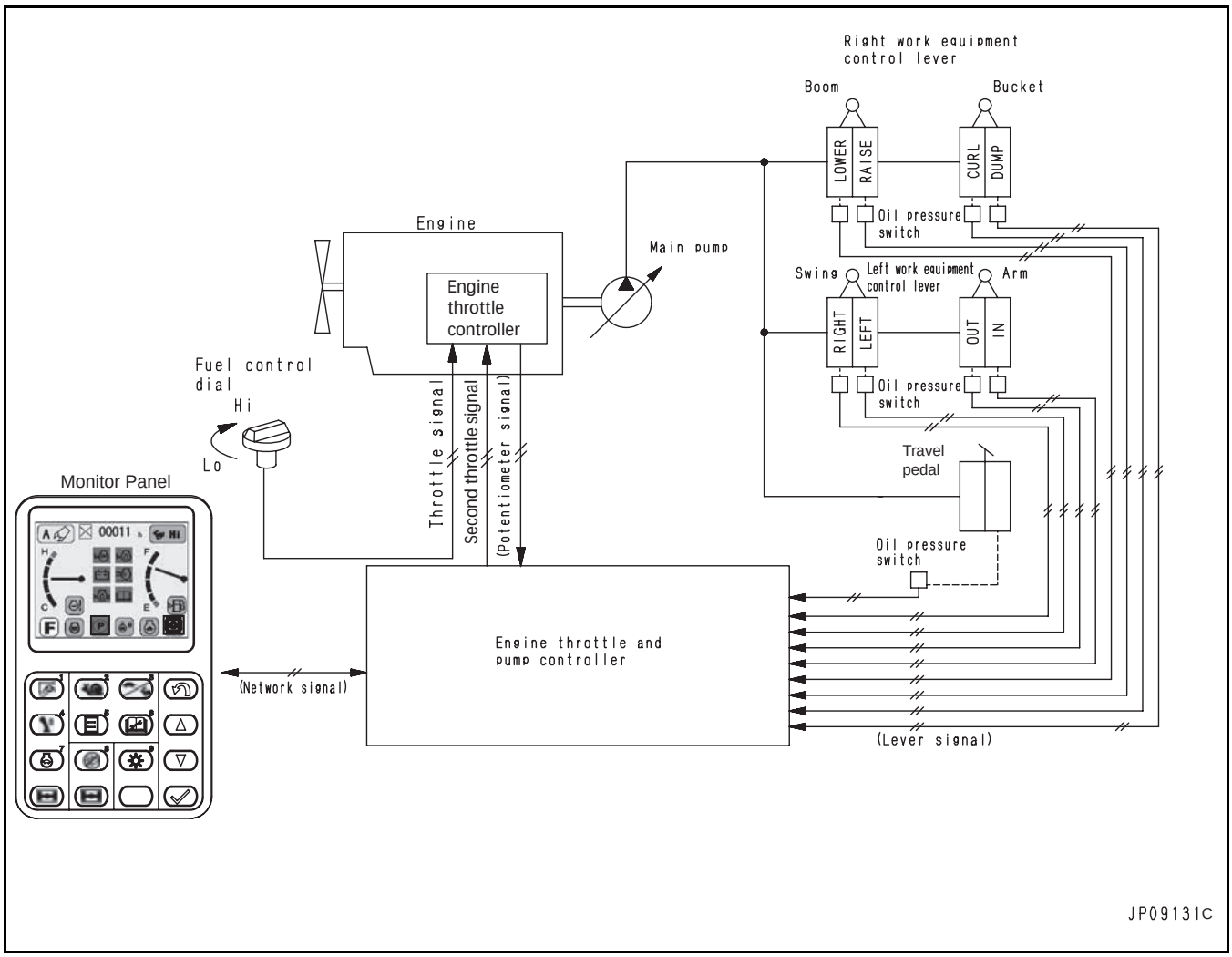
- When the operator needs more digging force to dig up a large rock, etc., if the left knob switch is pressed, the hydraulic force is increased about 7% to increase the digging force.
- If the left knob switch is turned on in working mode "P" or "E", each function is set automatically as shown below.

⇓

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.

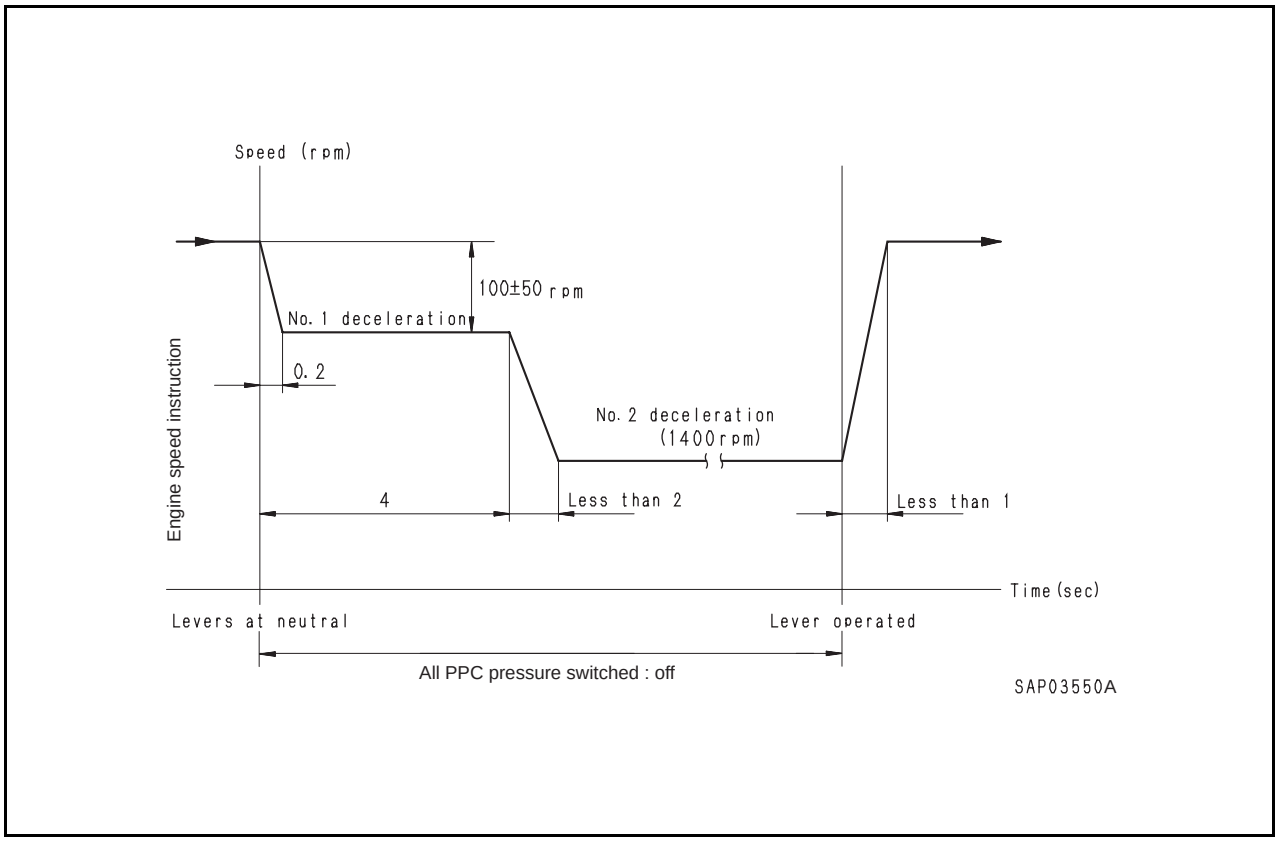
OPERATION

WHEN CONTROL LEVERS ARE SET IN NEUTRAL

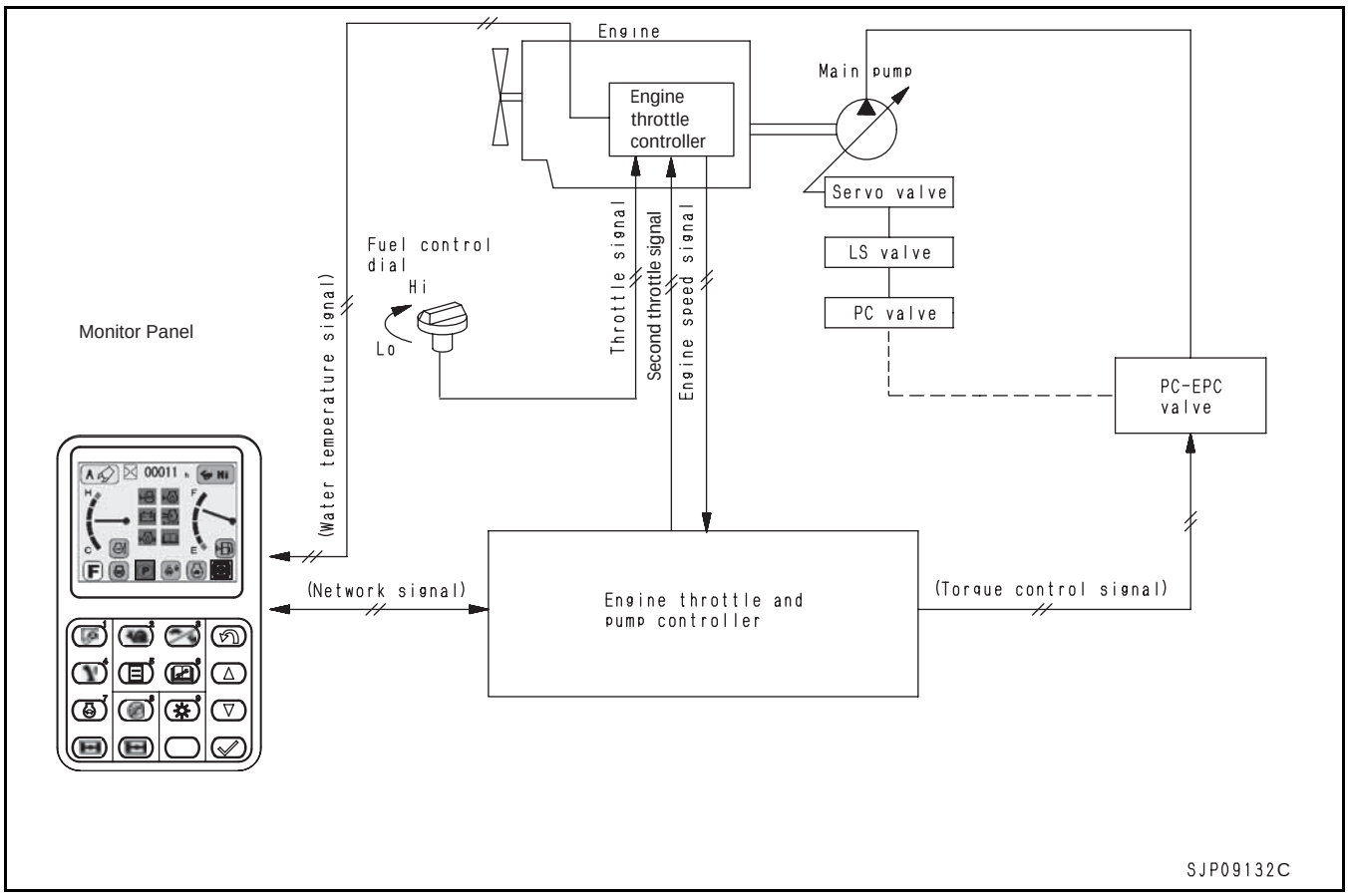
- If all the control levers are set in NEUTRAL while the engine speed is above the decelerator operation level (about 1,400 rpm), the engine speed lowers instantly to the first deceleration level about 100 rpm lower than the set speed.
- If 4 more seconds pass, the engine speed lowers to the second deceleration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

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

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 95°C.

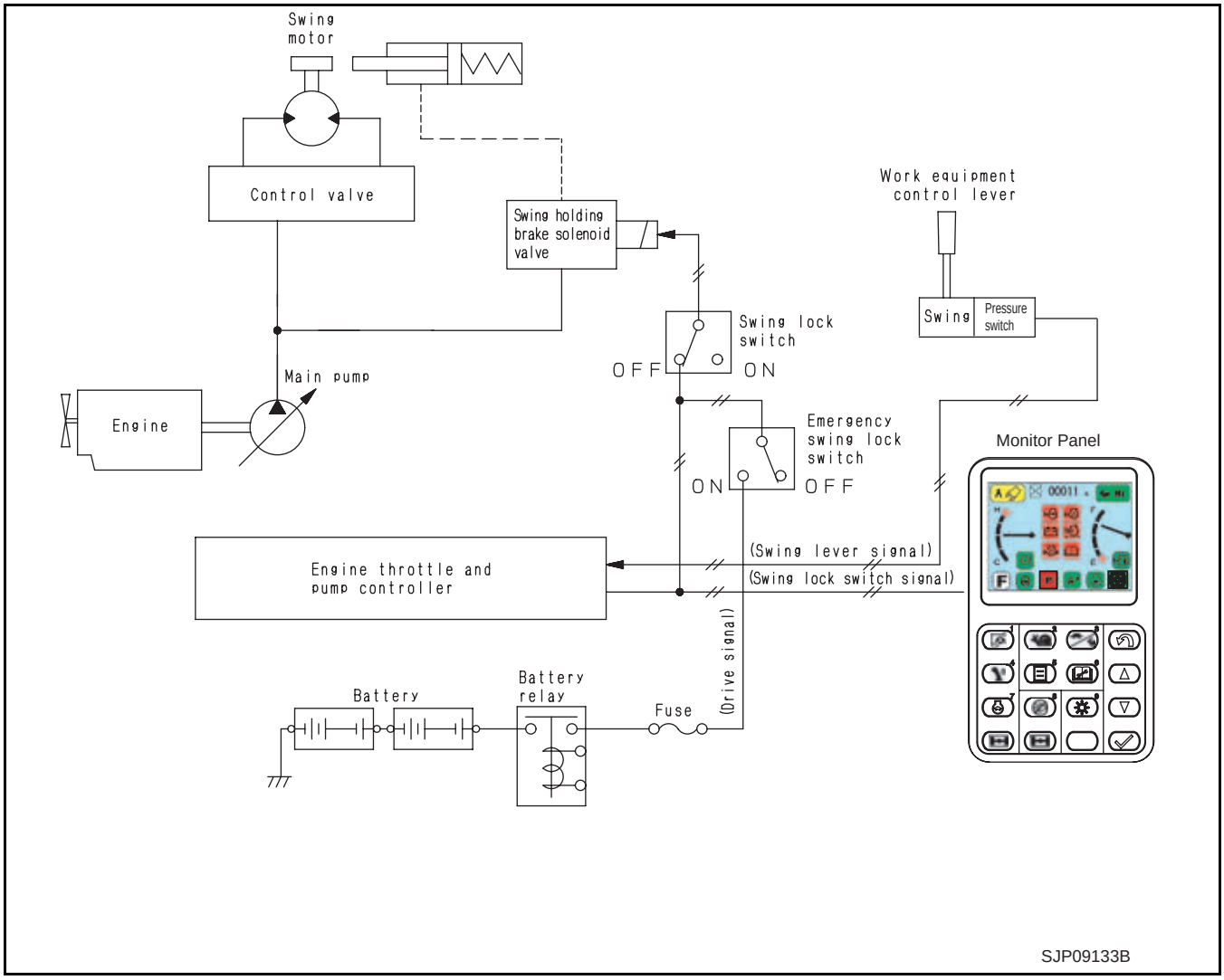
Operating condition	Operation/Remedy	Resetting condition
Water temperature: Above 105°C	Work mode: Any mode Engine speed: Low idle Monitor alarm lamp: Lights up Alarm buzzer: Sounds	Water temperature: Below 105°C Fuel control dial: Return to low idle position once. • Under above condition, controller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

Operating condition	Operation/Remedy	Resetting condition
Water temperature: Above 102°C	Work mode: Mode A, E, OR B Engine speed: Keep as is. Monitor alarm lamp: Lights up. Lower pump discharge.	Water 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°C	Work mode: Mode A Engine speed: Keep as is. Lower pump discharge.	Water temperature: Below 100°C • Under above condition, controller is set to condition before operation of function. (Automatic reset)

Operating condition	Operation/Remedy	Resetting condition
Water temperature: Above 95°C	Work mode: Travel Engine speed: Keep as is. Lower travel speed.	Water 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.

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

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.

※Operation of swing holding brake release switch

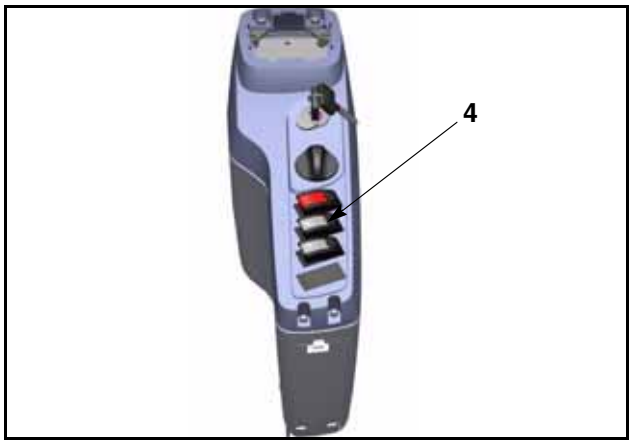
- If the controller, etc. has a problem, the swing holding brake does not work normally, and the machine cannot swing, the swing lock can be reset with the swing holding brake release switch.

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.

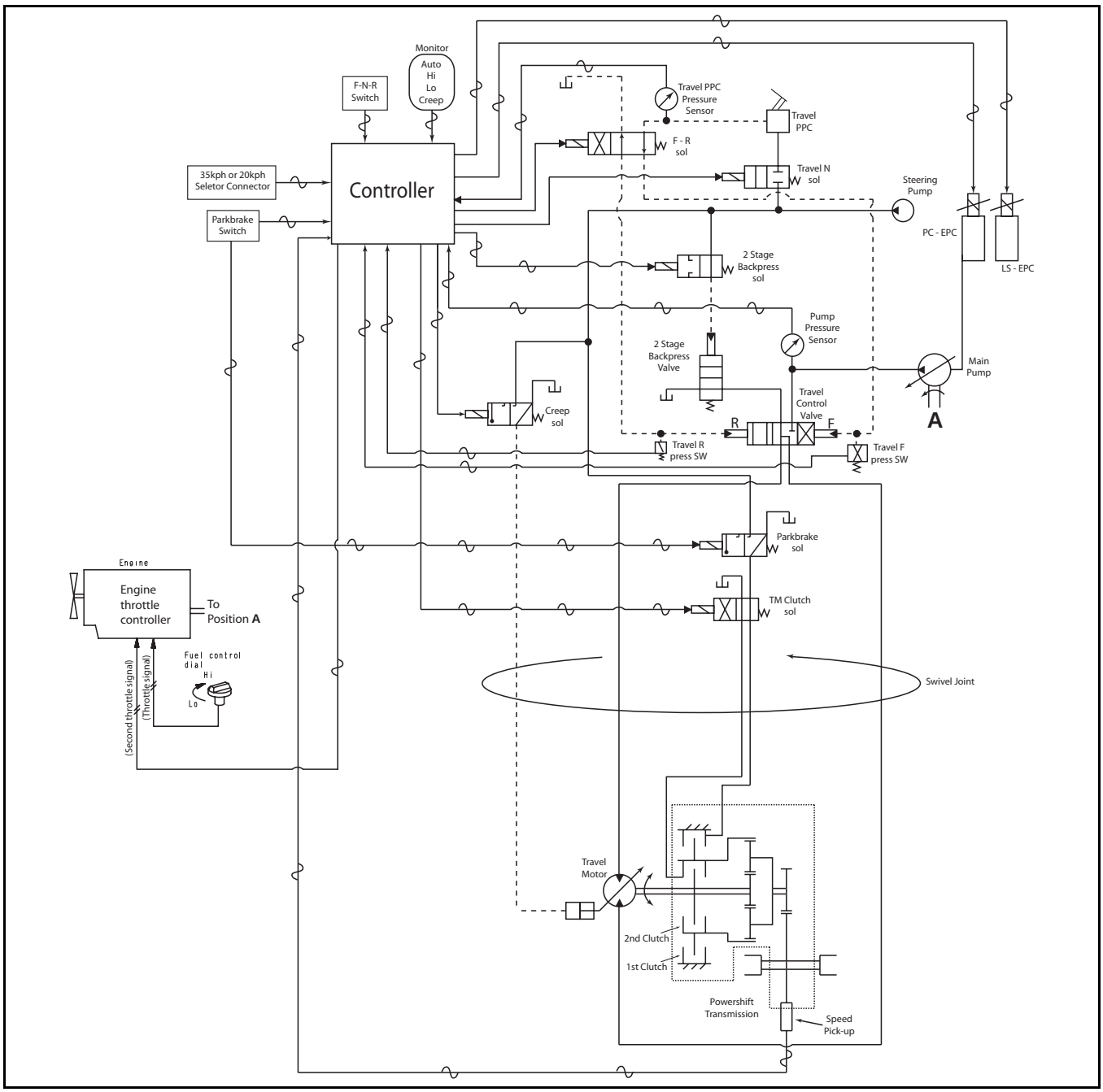
- Even if the swing holding brake release switch is turned on, if the swing lock switch is turned on, the swing brake is not released.
- If the swing lock is reset, swinging is stopped by only the hydraulic brake of the safety valve. Accordingly, if swinging is stopped on a slope, the upper structure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

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.

1) Pump control function during travel

- If the machine travels in a work mode other than mode A, the work mode and the engine speed remain unchanged and the pump absorption torque is increased.

H For details, see ENGINE/PUMP COMPOSITE CONTROL FUNCTION.

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 at right to change the travel speed. (See engine speed table, right).

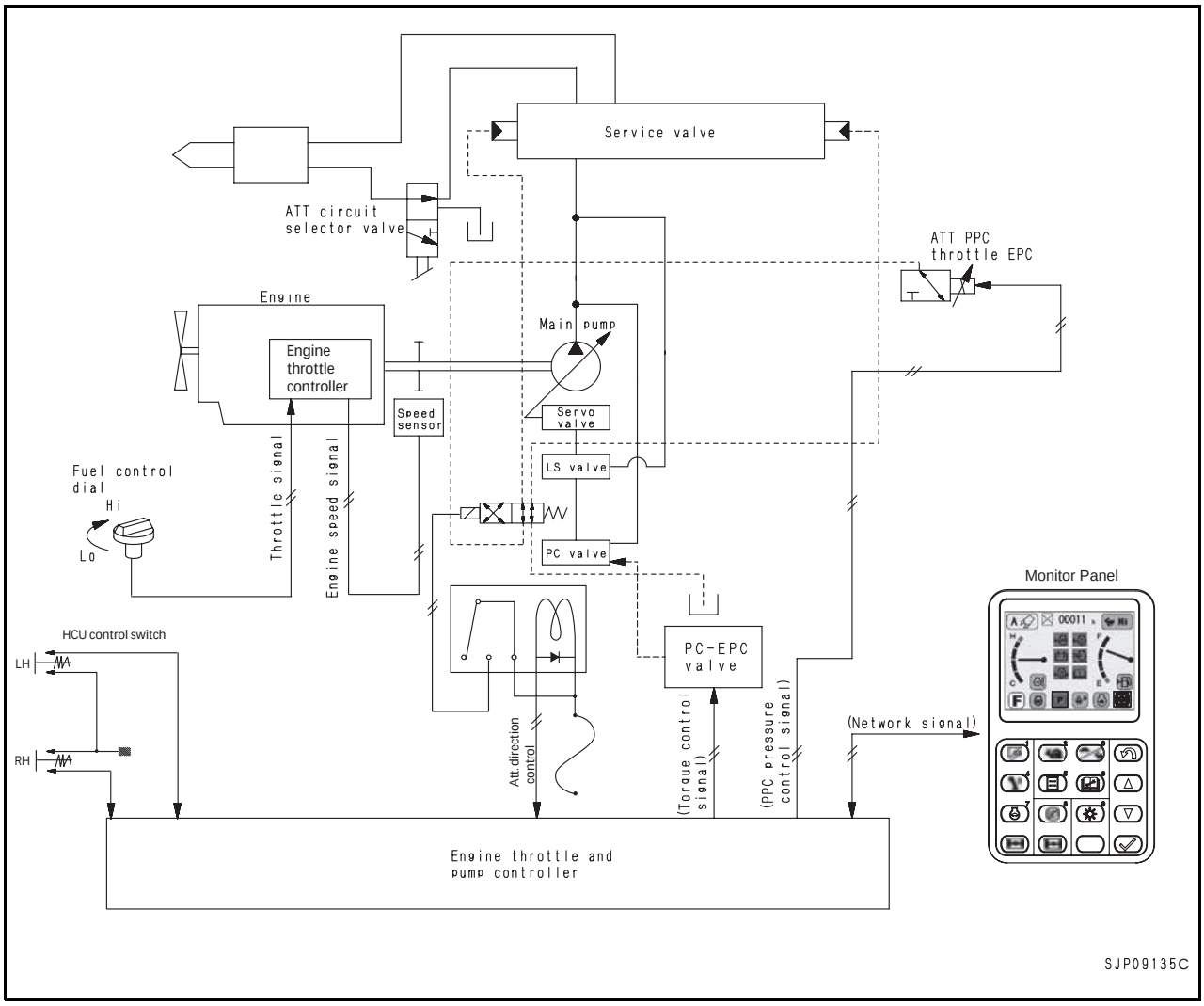
Travel speed switch	CREEP	LO	HI	AUTO (LO~HI)
Pump capacity (%)	60	100	100	
Motor capacity	Max.	Min~Max	Min~Max	Min~Max
Travel speed (km/h)	2.5	0 ~9.5	0 - 35 0 - 20	0 - 35 0 - 20

- Automatic change by engine speed.
- If the engine speed is lowered to 1,500 rpm or less with the fuel control dial during travel the travel speed does not change even if the travel speed switch is changed from CREEP, LO to Hi.
- 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 2450 rpm.

Maximum engine speed:

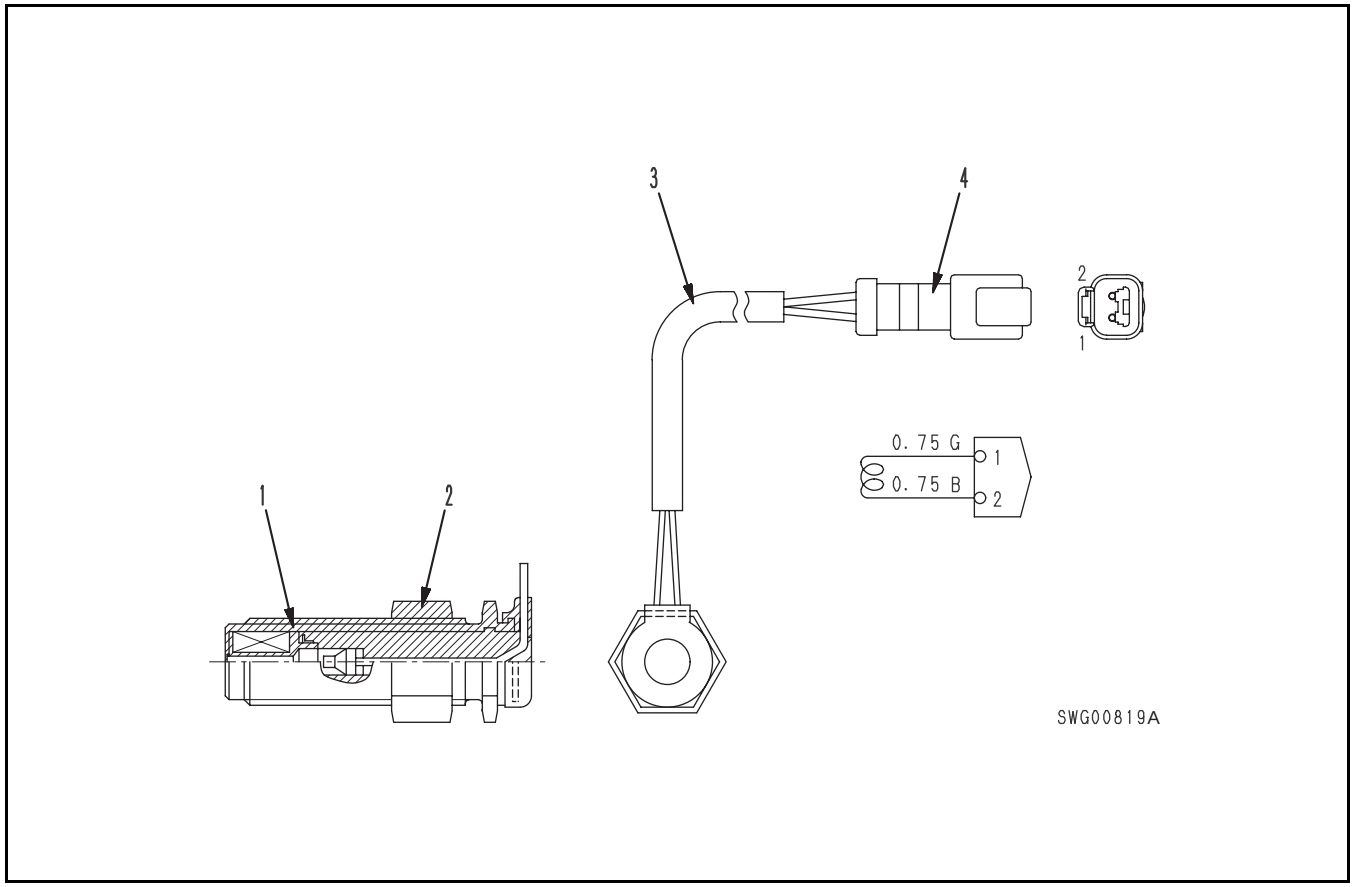
Max. Engine speed	
Travel	2442 rpm
P Mode	2150 rpm
E Mode	1950 rpm
L Mode	1715 rpm
B Mode	1990 rpm

8 . ATT flow control, circuit selector function (option)



9 . System component parts

1) Engine revolution sensor

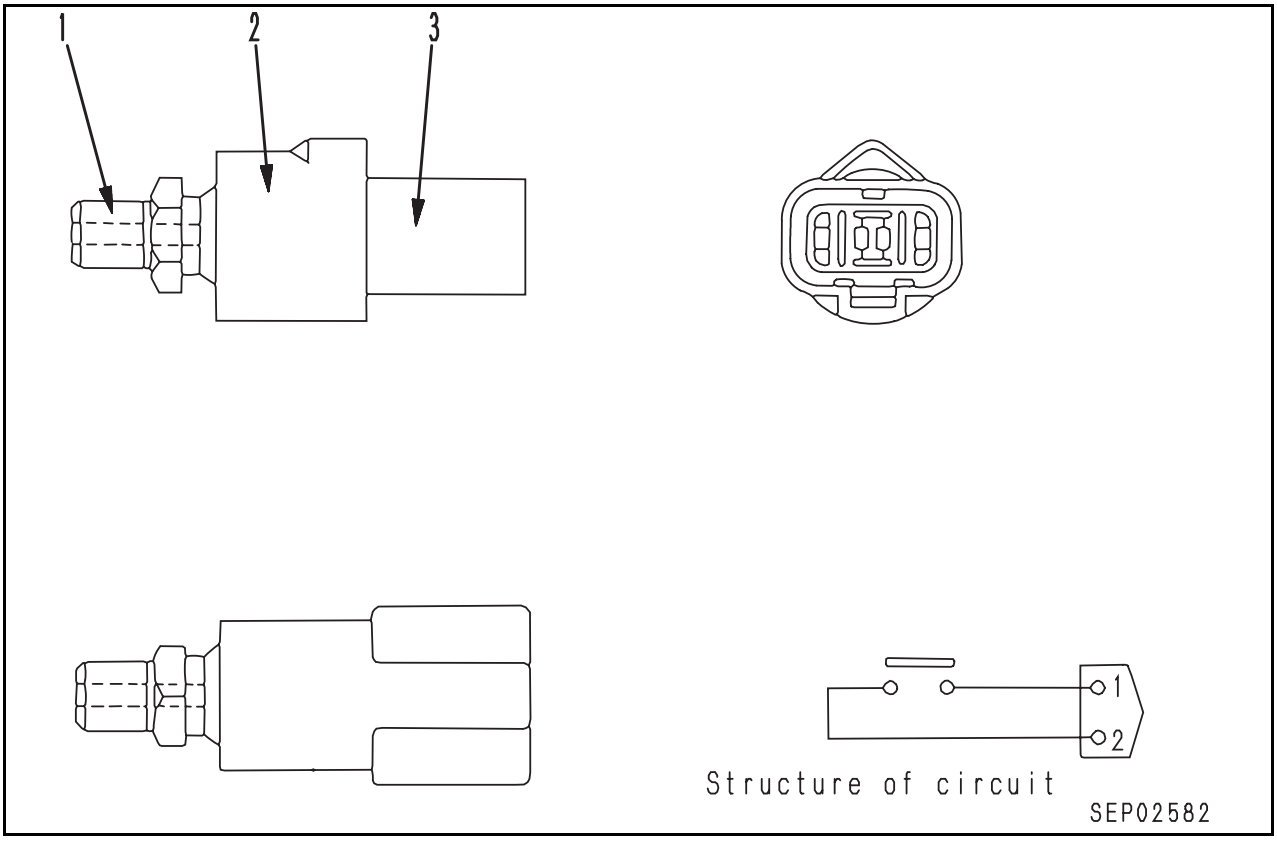


1. Sensor
2. Locknut
3. Wiring harness
4. Connector

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.

2. PPC oil pressure switch



1. Plug
2. Switch
3. Connector

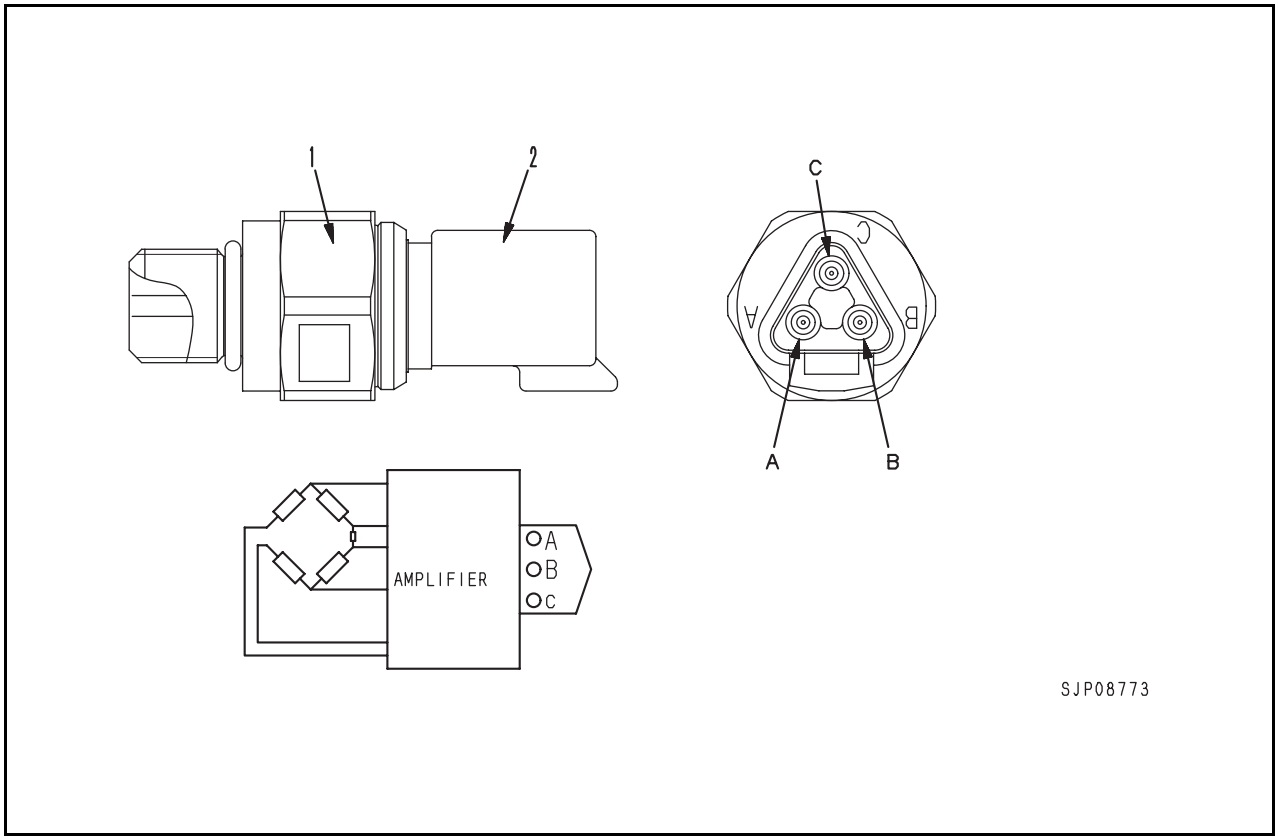
SPECIFICATIONS

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 junction block has 10 pressure switches, the 4-stage solenoid block has 2 pressure switches which check the operating condition of each actuator by the PPC pressure and transmit it to the governor/pump controller.

3. Pump pressure sensor



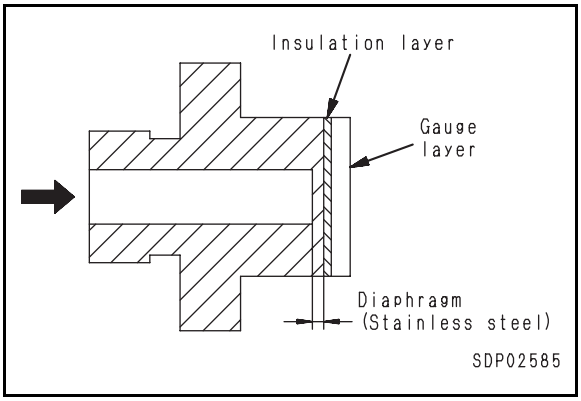
1. Sensor
2. Connector

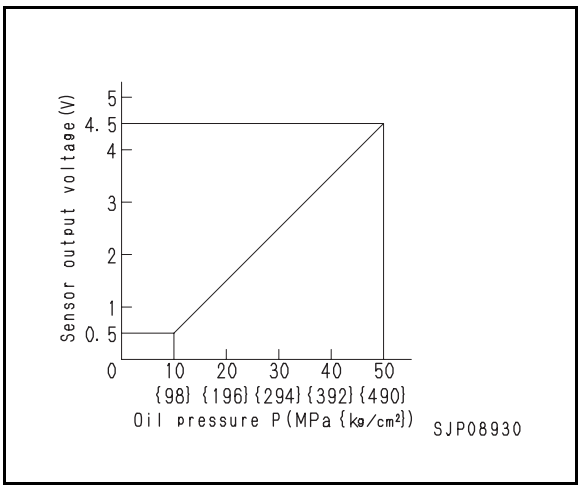
FUNCTION

- 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.

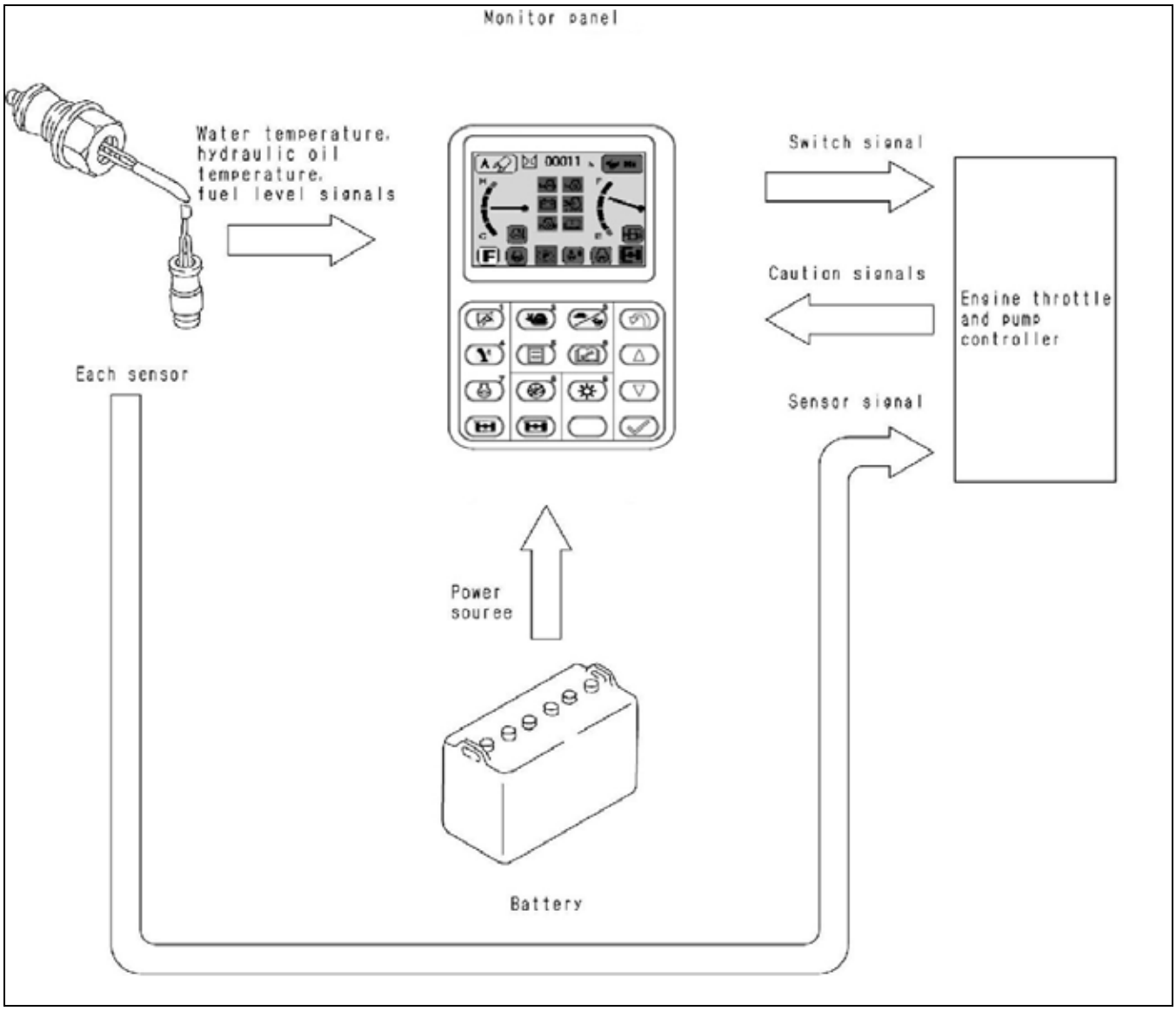
OPERATION

- 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





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.

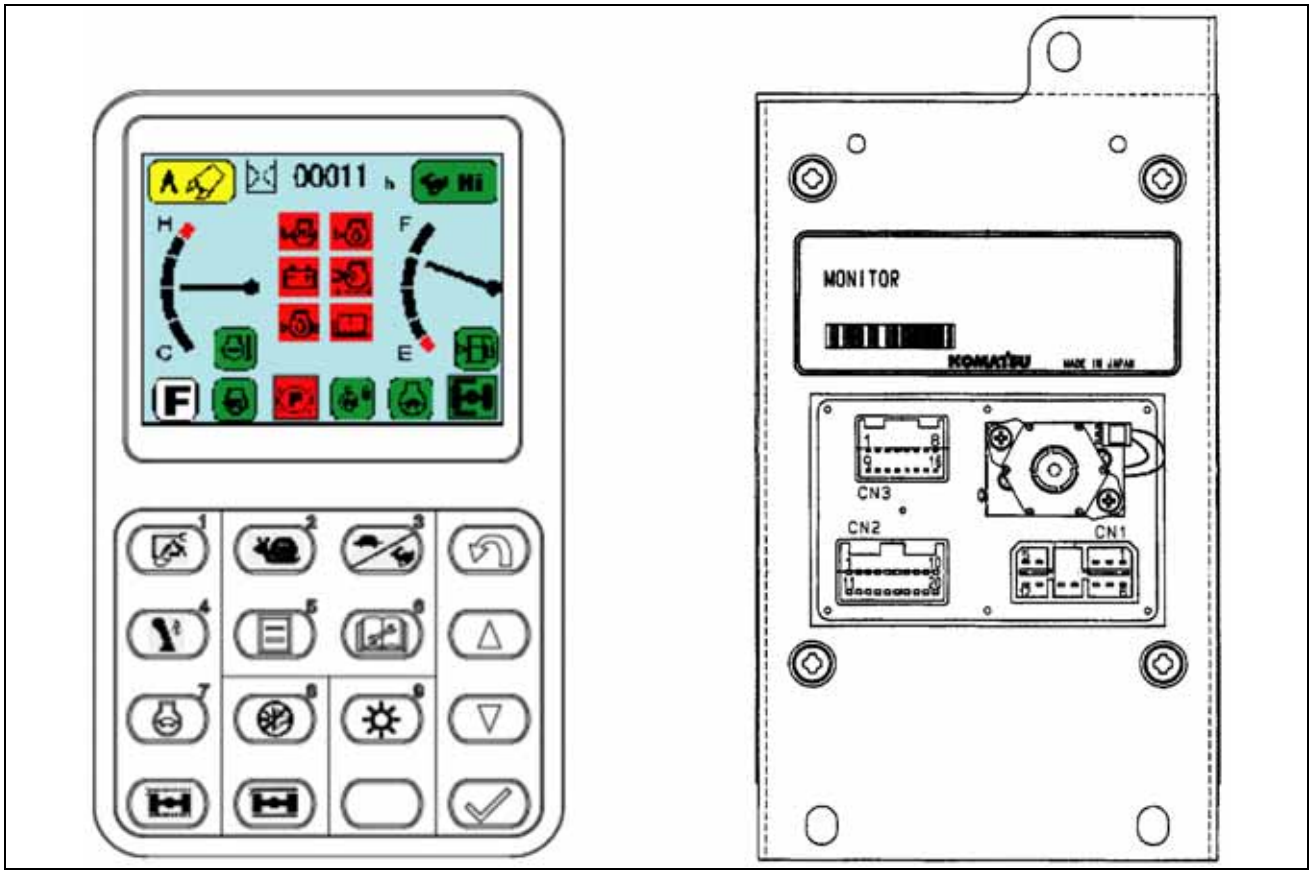
1. Monitor section to output alarms when the machine has troubles

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.

Blank for technical reason

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

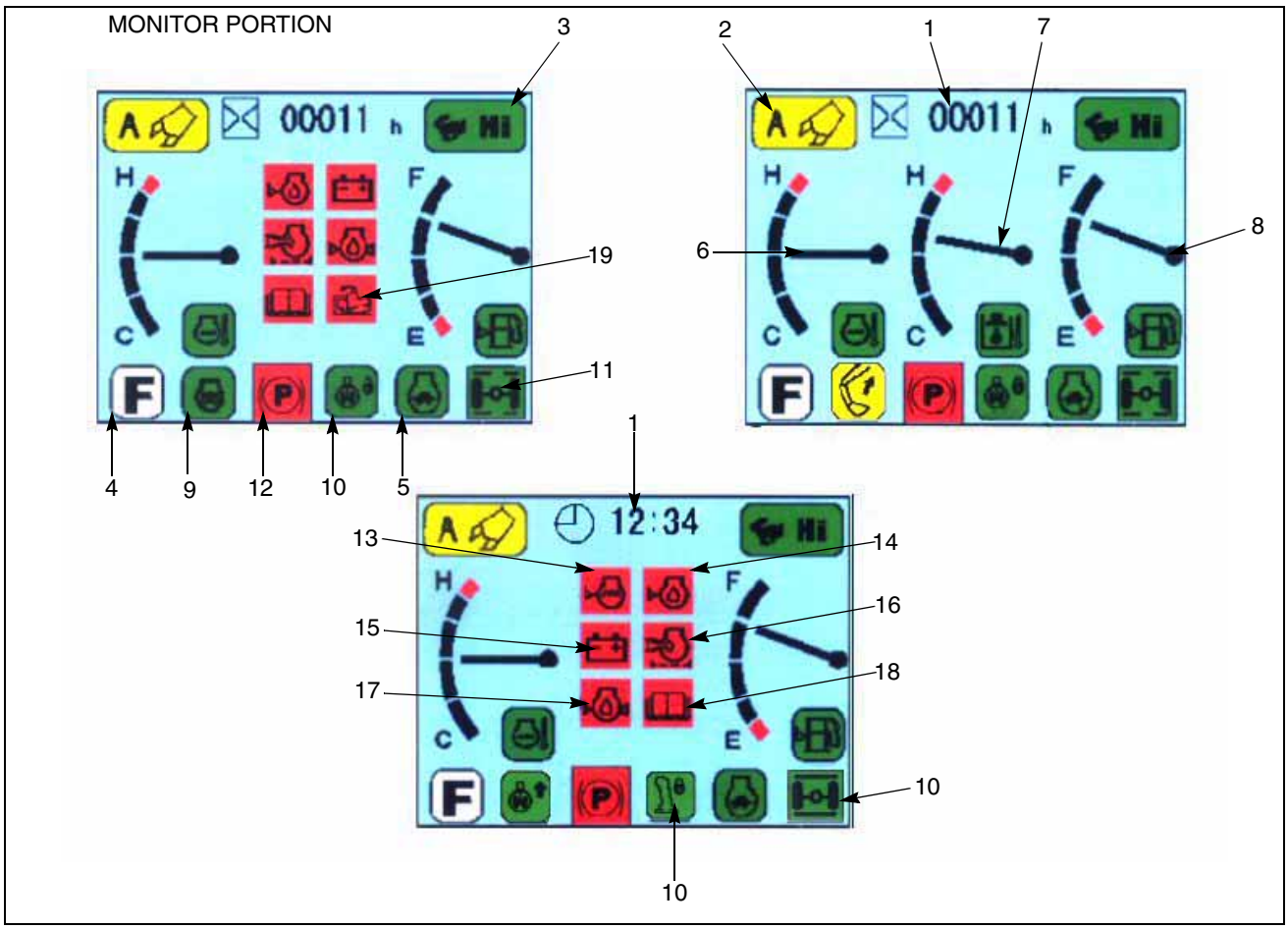
CN2

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

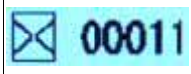
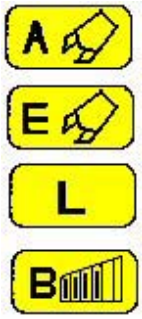
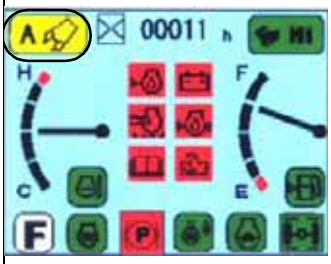
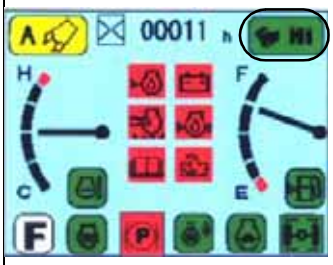
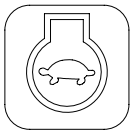
Pin No.	Signal name	Input/ Output
1		Input
2		Input
3		Input
4		Input
5		Input
6		Input
7	Serial CTS signal	Input
8	Serial RTS signal	Input
9	Serial TXD signal	Input/ Output
10	Serial RXD signal	Input/ Output
11	Boot switch	Input
12		Input
13	GND	-
14	CAN (Shield)	Input
15	CAN (+)	Input
16	CAN(-)	Input

MONITOR CONTROL, DISPLAY PORTION



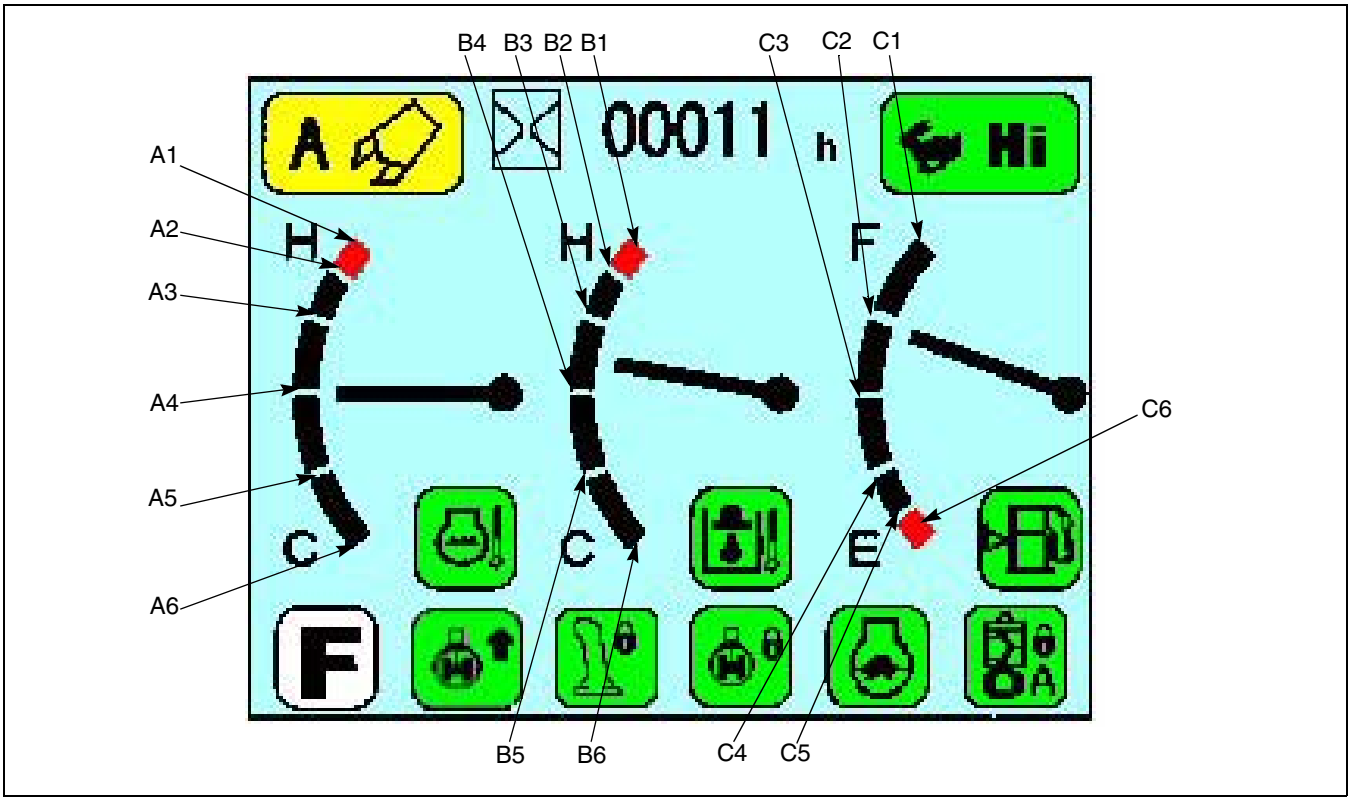
1.	Hour meter / Clock	11.	Suspension lock (Manual) / Suspension lock (Auto)
2.	Working mode	12.	Parking brake
3.	Travel modes	13.	Radiator level caution
4.	Travel direction	14.	Engine oil level caution
5.	Auto-deceleration	15.	Battery charge caution
6.	Engine water temperature gauge	16.	Air filter caution
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

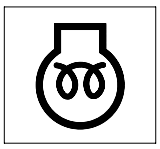
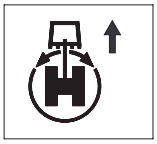
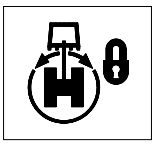
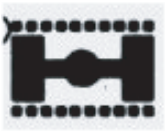
Item No.	Symbol	Display item	Display method	
1.		Service meter indicator	When service meter is	Lights up when service meter is working, engine not running and ignition is on.
		Clock	Other than above, clock is shown	
2.		Working mode	Displays set mode in top left hand corner of monitor as shown in diagram 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 177.	

Item No.	Symbol	Display item	Display method
7.		Hydraulic oil temperature gauge	See “Monitor Gauge Displays” on page 177.
8.		Fuel gauge	

Monitor Gauge Displays

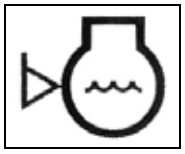
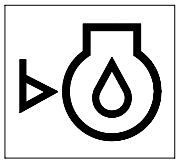
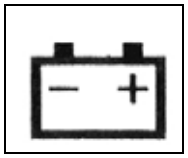
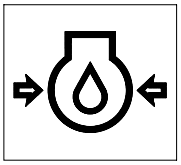
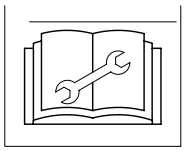


Gauge	Range	Temperature, volume	Indicator	Buzzer sound
Engine water temperature (°C)	A1	105	Red	Yes
	A2	102	Red	No
	A3	100	Green	No
	A4	80	Green	No
	A5	60	Green	No
	A6	30	White	No
Hydraulic oil temperature (°C)	B1	105	Red	Yes
	B2	102	Red	No
	B3	100	Green	No
	B4	80	Green	No
	B5	40	Green	No
	B6	20	White	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

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

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.

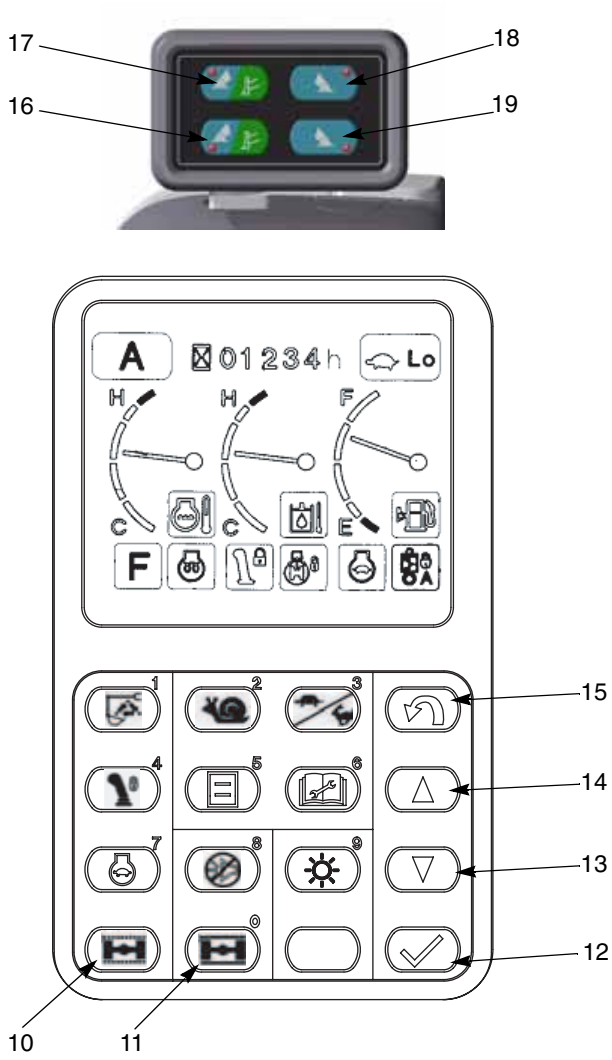
Item No.	Symbol	Display item	Check before starting item	When engine is stopped	When engine is running
13.		Radiator water level	Yes	Lights up when abnormal	When abnormal, lights up and buzzer sounds
14.		Engine oil level	Yes	Lights up when abnormal	--
15.		Battery charge	Yes	--	Lights up when abnormal
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.

A mode: For heavy-load operations

E mode: For operations with emphasis on fuel economy

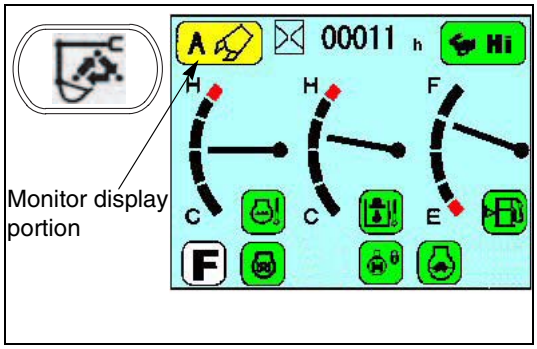
L mode: For fine-control operations and lifting

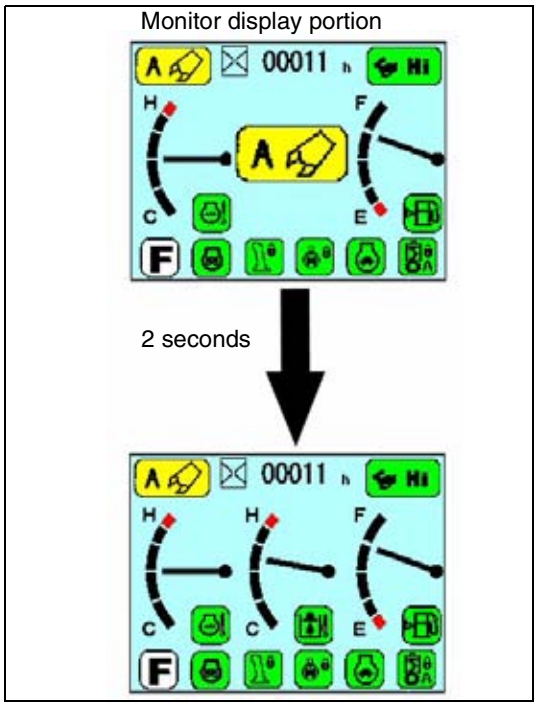
B mode: For breaker operations

- When the engine is started, the working mode is set automatically to A 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 'A mode' please consult your Komatsu distributor or dealership to have the setting amended.

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 A mode.)

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





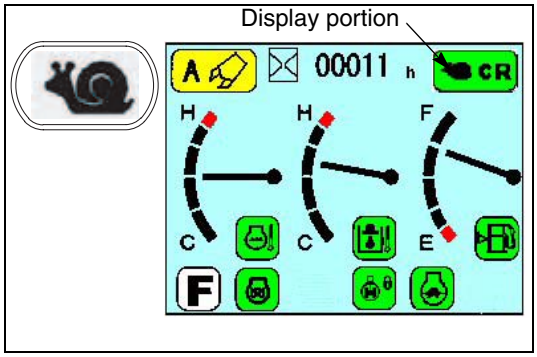
2. CREEP SPEED SELECTOR SWITCH

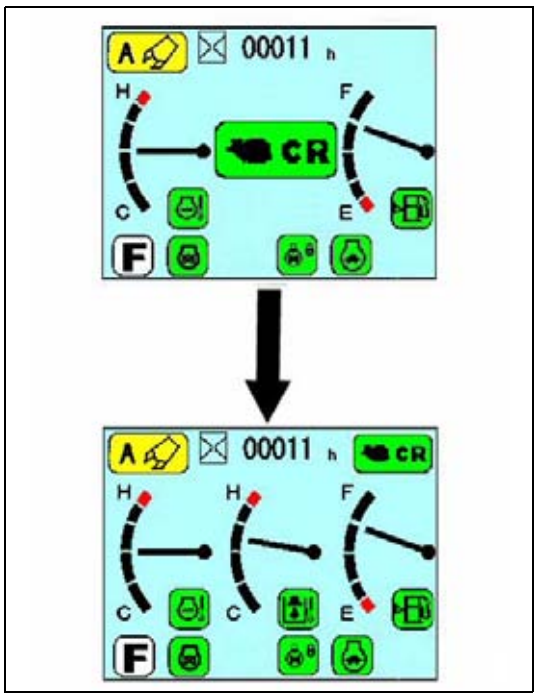
This switch (2) is used to set the travel mode to creep.

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

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

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

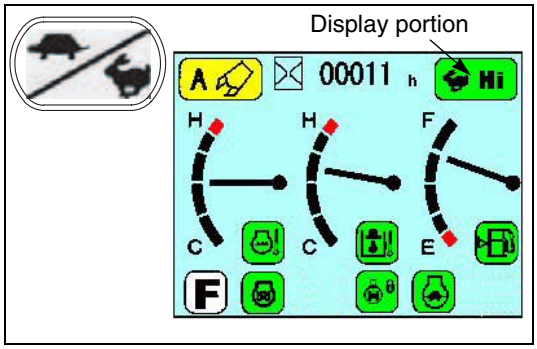
When the engine is started, the speed is automatically set to the last value before engine was stopped.

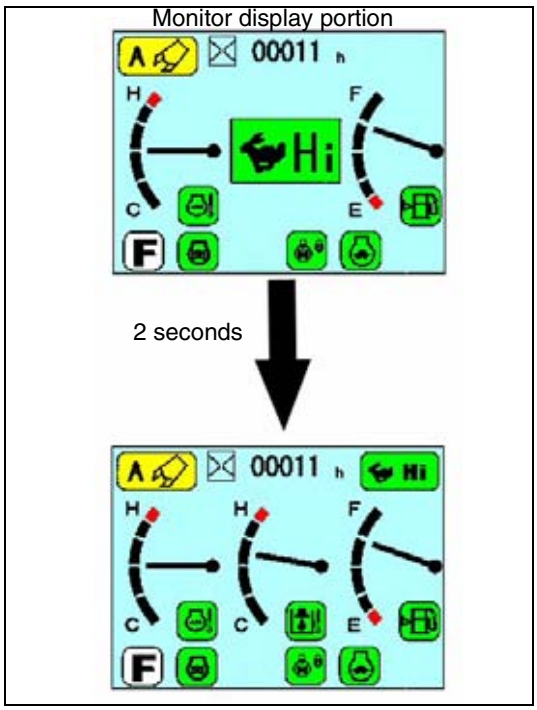
Each time that the switch is pressed, the display changes Lo→Hi→At→Lo in turn.

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.

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.

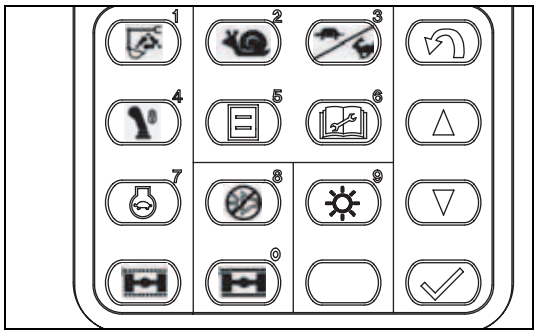




4. CONTROL LEVER LOCK SWITCH

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.

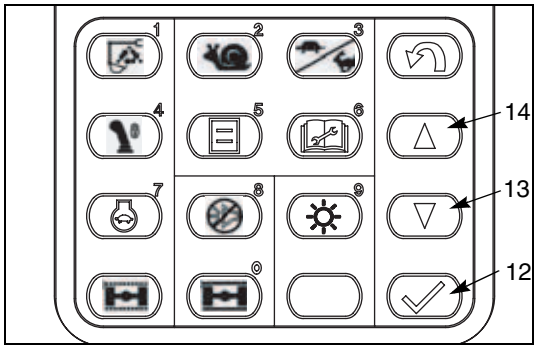
The display will illuminate on the monitor when active.



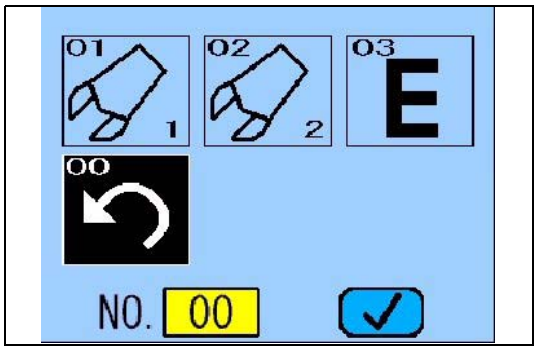
5. MENU SELECT SWITCH

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.

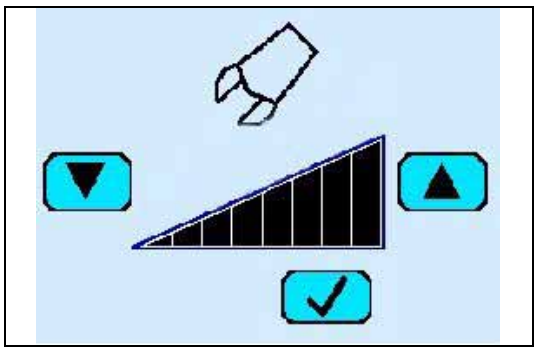


4. Select 01 from the screen and the monitor display changes to the flow setting screen shown on the right (Full flow). By pressing down switch (13) the flow can be reduced.



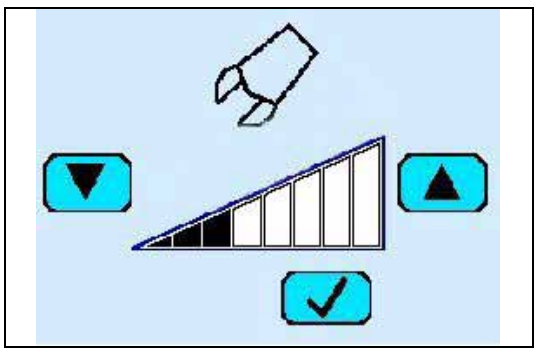
OR

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.

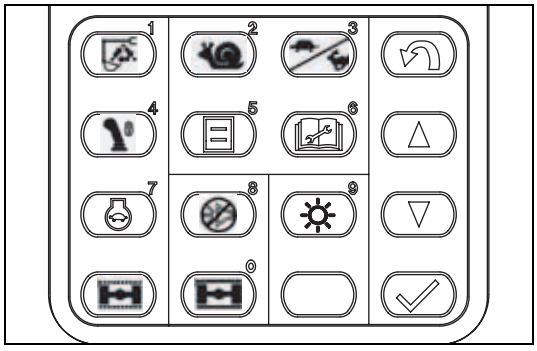


5. After completing the flow setting, press input confirmation switch (12).
   The monitor display will return to the normal screen.

The flow can be adjusted for the attachment installed.



6 . SERVICE MENU SWITCH



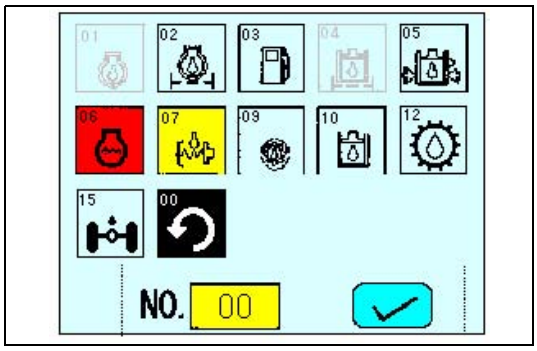
- This switch (6) is used to check the time remaining to maintenance.
- When this switch (6) is pressed, the screen on the monitor display changes to the maintenance screen shown in the diagram below right.

  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

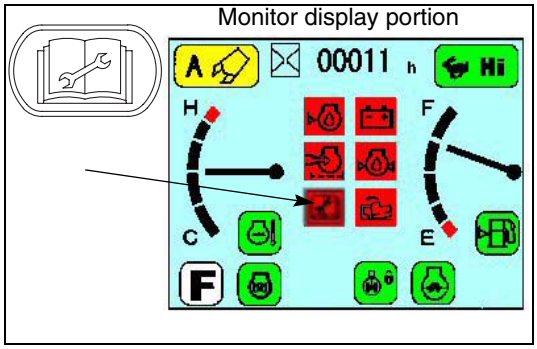


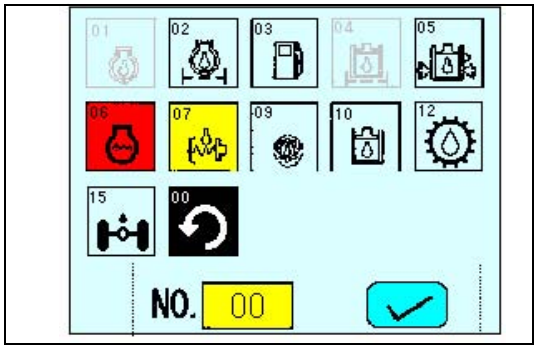
- **If the monitor display changes to the maintenance warning screen when the engine is started or when the machine is being operated, stop operations immediately. When this happens, the monitor corresponding to the maintenance warning screen will light up red.**

- **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.**

Monitor display portion





- 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)

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

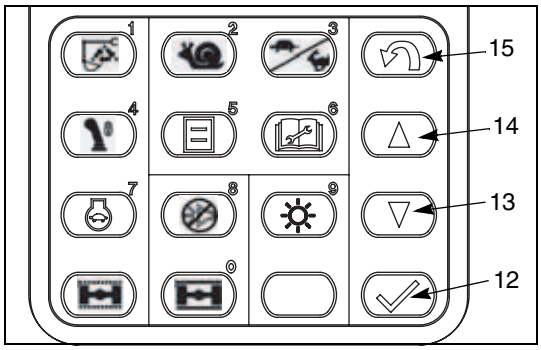
When only checking the time remaining to maintenance, press back switch (15) twice.

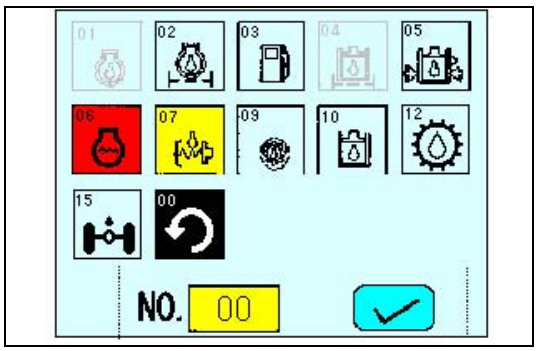
The screen will return to the normal operation monitor screen.

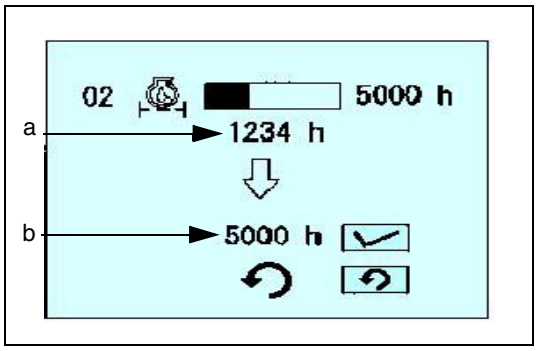
When canceling the time remaining to maintenance and returning to the default time setting, press input confirmation switch (12). The screen will switch to the default setting screen.

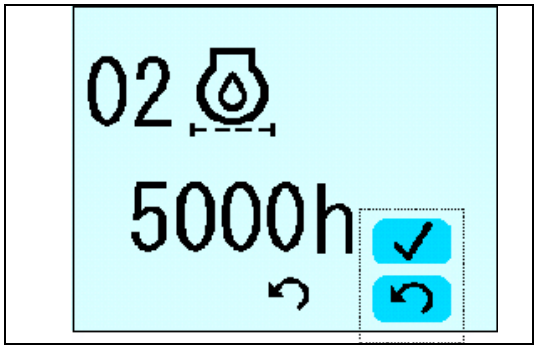
4. After checking the time on the default setting screen, press input confirmation switch (12). The screen will return to the maintenance screen.

(Press back switch (15) to return to the previous screen.)









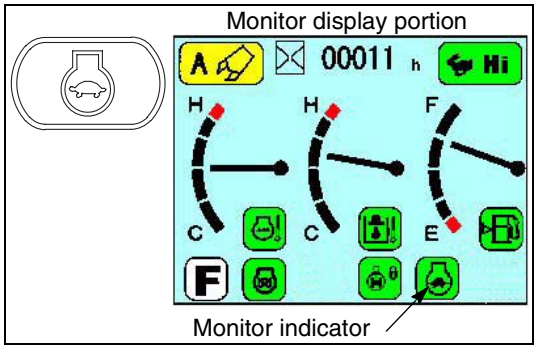
7 . AUTO-DECELERATION SWITCH

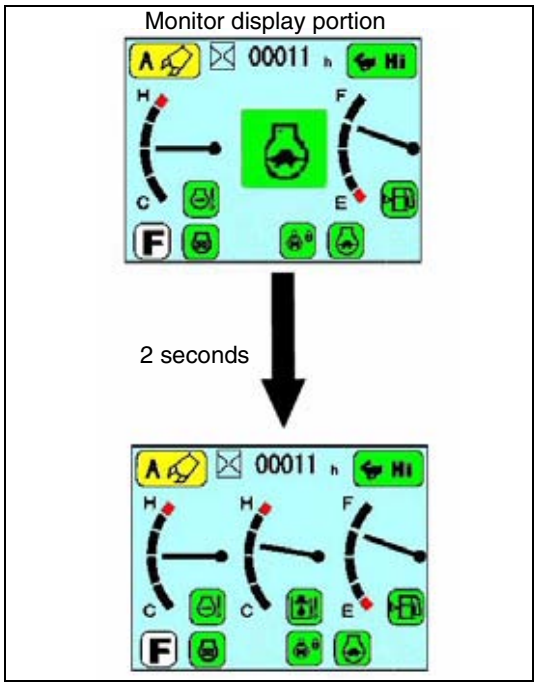
When this auto-deceleration switch (7) is depressed, the auto-deceleration is actuated. If the control levers and foot pedals are in the neutral position, the engine speed is automatically lowered to reduce fuel consumption.

Monitor display ON: Auto-deceleration actuated.

Monitor display OFF: Auto-deceleration cancelled.

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.



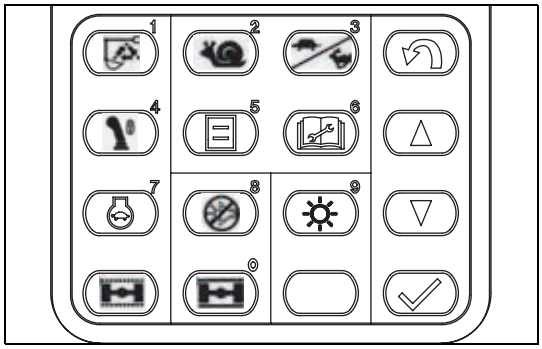


8. BUZZER CANCEL SWITCH

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 191.

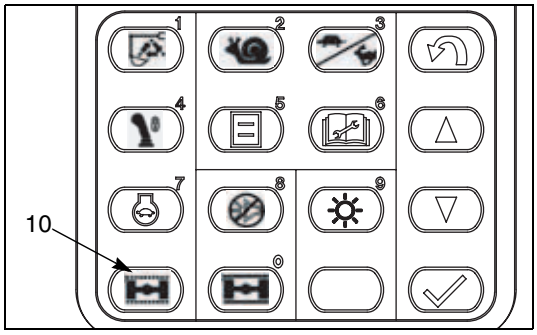


10. AUTOMATIC SUSPENSION LOCK SWITCH

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

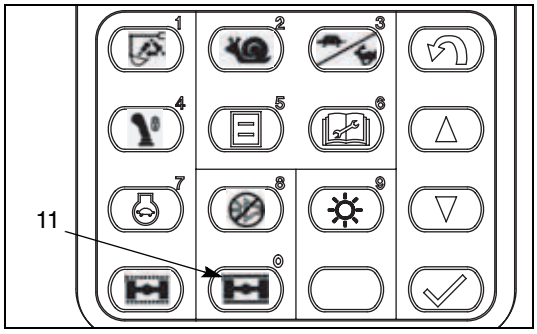
Take care when using undercarriage attachments to stabilize the machine, and suspension lock simultaneously, as locked front axle may suddenly become free.

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

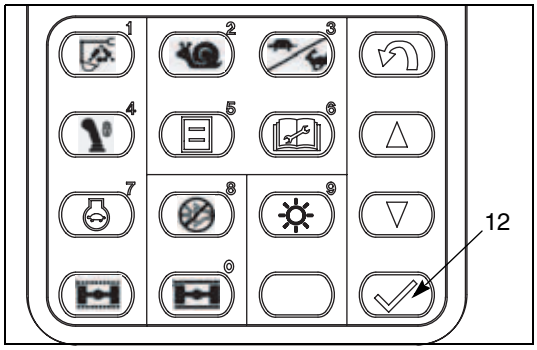
Press switch (11) in order to engage permanent front axle lock. Front axle will be fixed in place when engaged, the permanent suspension lock indicator will illuminate. To disengage lock, press switch (11) again.

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

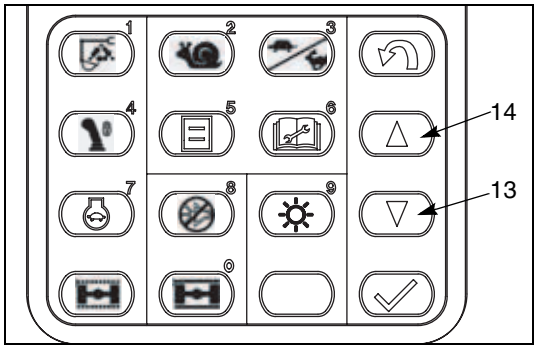
Press this switch (12) to confirm the selected mode when in the maintenance mode, brightness/contrast adjustment mode, or select mode.



13. SCROLL DOWN
14. SCROLL UP

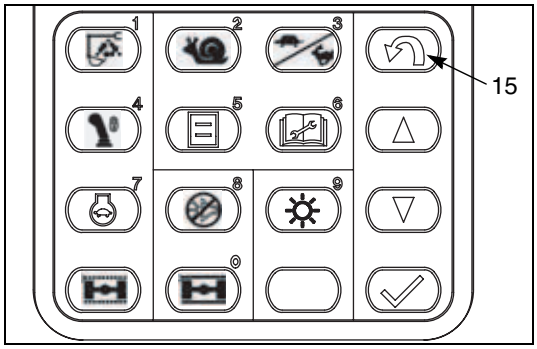
Press up switch (14) or down switch (13) when in the menu screens will allow you to move up and down the menu options.

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

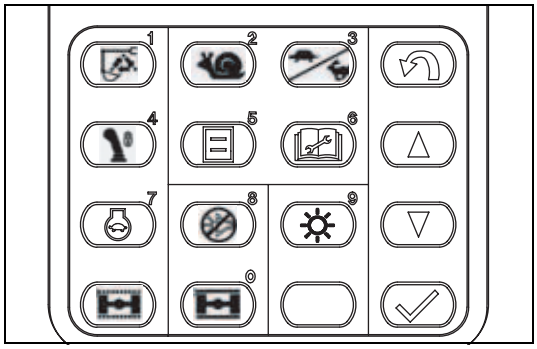
Allows operation of rear right outrigger.

Light on switch illuminates when activated.



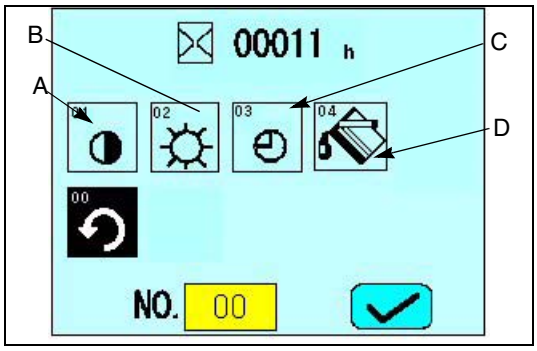
LIQUID CRYSTAL MONITOR ADJUSTMENT SWITCH

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

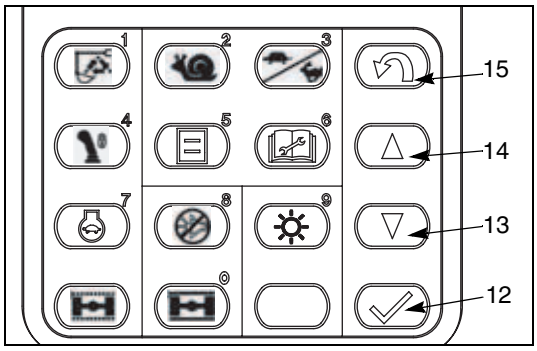
- (A).Adjusting contrast

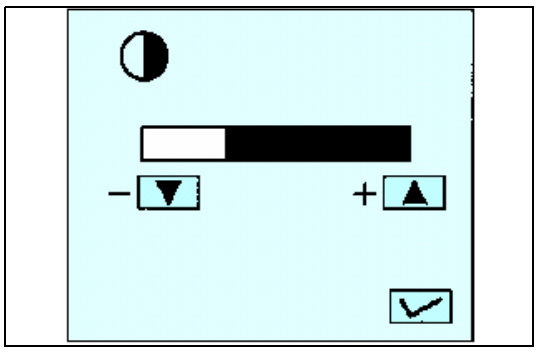
  1. Use the brightness/contrast screen and press up switch (14) or down switch (13) to select the contrast monitor.
  (The selected monitor is inverted to black.)

  2. When the screen changes to the contrast adjustment screen, press up switch (14) or down switch (13) to adjust the contrast.

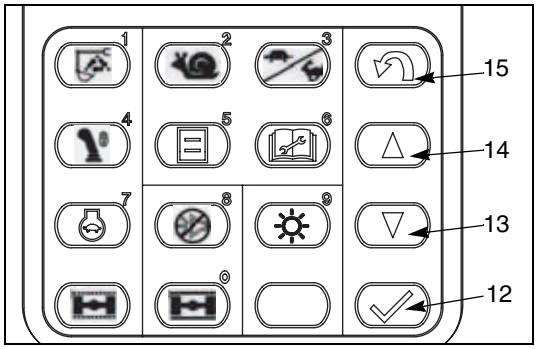
  3. After completing adjustment of the contrast, press input confirmation switch (12). This will store the new setting and return you to the adjustment menu.

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



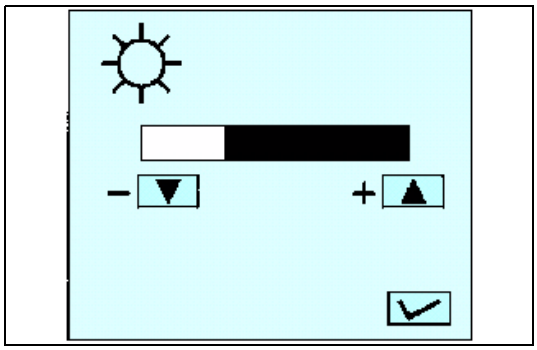


- (B). Adjusting brightness



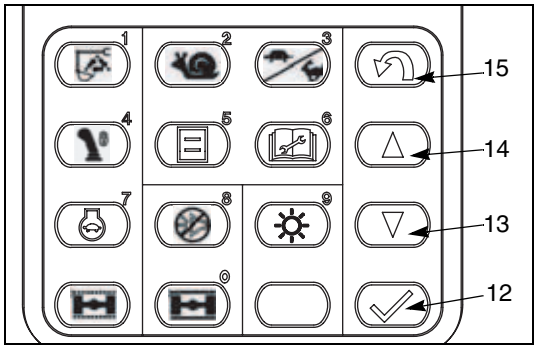
1. Use the adjustment screen and press up switch (14) or down switch (13) to select the brightness monitor.
(The selected monitor is inverted to black.)

2. When the screen changes to the brightness adjustment screen, press up switch (14) or down switch (13) to adjust the brightness.



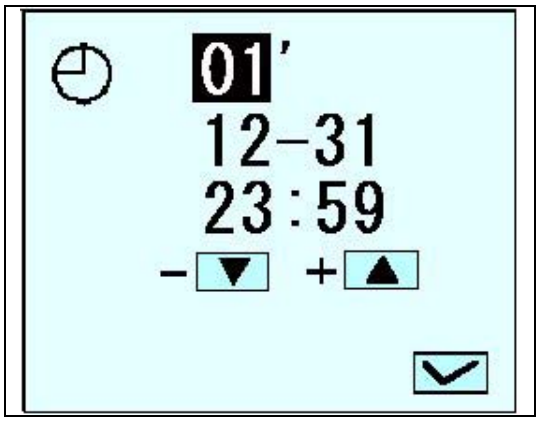
3. After completing adjustment of the brightness, press input confirmation switch (12). This will return you to the above menu and store the new setting.

- (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.

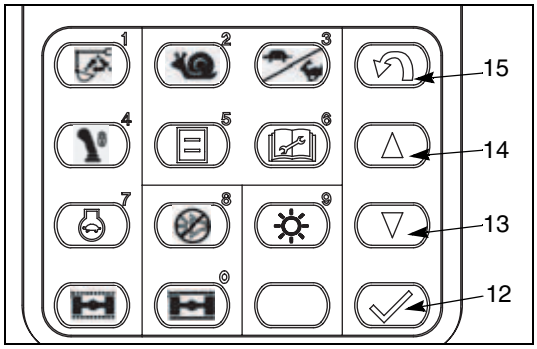
- (D). Adjusting background colour

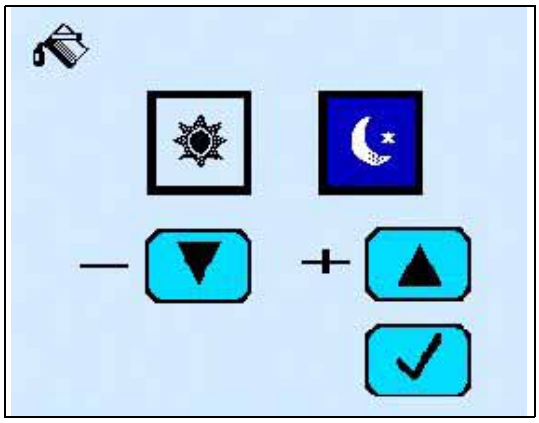
  1. Use the adjustment screen and press up switch (14) or down switch (13) to select the background colour monitor.
  (The selected monitor is inverted to black.)

  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.

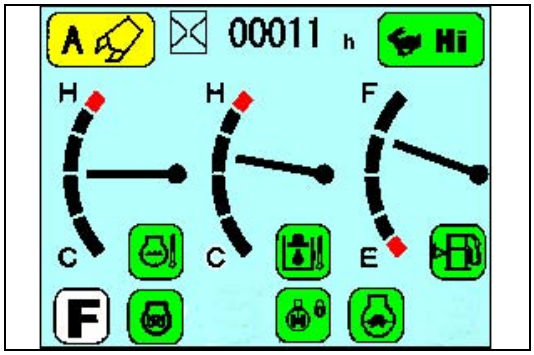




PASSWORD FUNCTION

- 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.

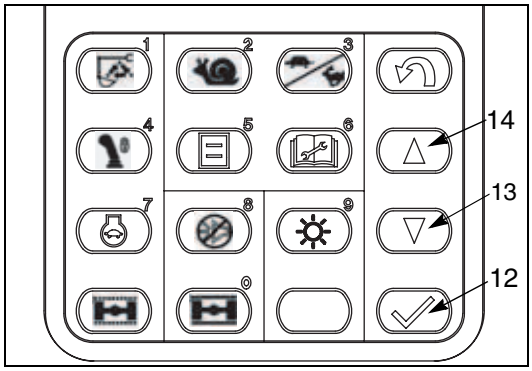
  This becomes possible 10 minutes after the starting switch is turned ON and the monitor screen has changed to the normal screen.

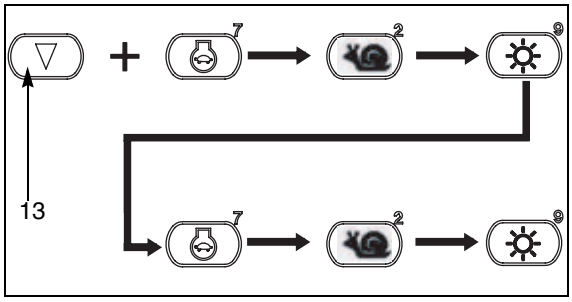


METHOD OF SETTING, CHANGING PASSWORD

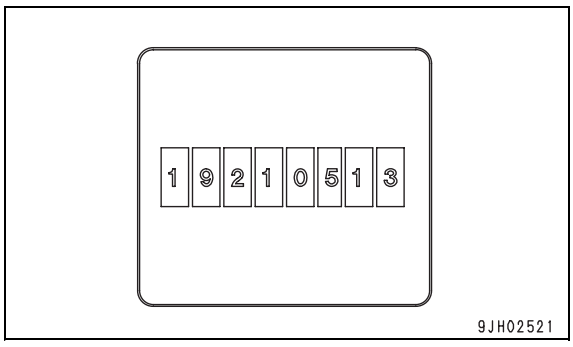
1. Turn Starter key switch to 'on' position (wait 10 minutes). Press and hold down switch (13). Using the 10 digit key pad, input the following number sequence: 7->2->9->7->2->9

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



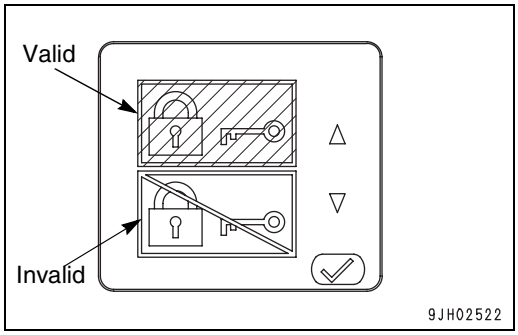


2. On the input screen, use the 10-key pad to input an 8-digit number [19210513]. When the final digit [number 3] is input, the screen will change to the Valid/Invalid screen for the password function.



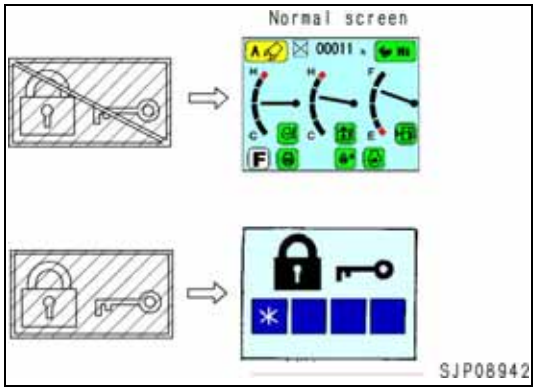
3. Press control switch (14) or (13) to set to Valid/ Invalid.

   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.



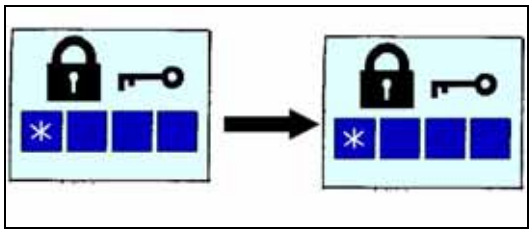
4. Input a 4-digit number on the input screen (the lock and key symbol are displayed), then press input confirmation switch (12).

   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.

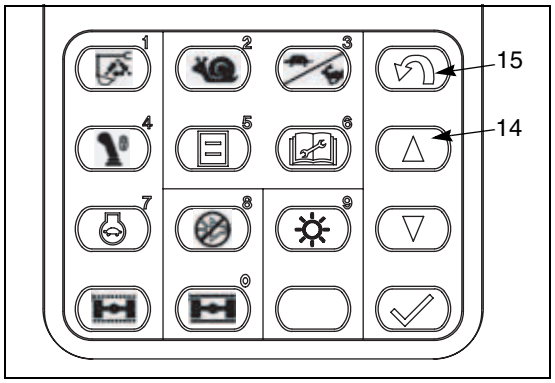
   NOTE: If the number input the second time is different from the number input the first time, the password will not be confirmed and the screen will return to the first screen, so input the same 4-digit password 2 times in succession.



SERVICE METER CHECK FUNCTION

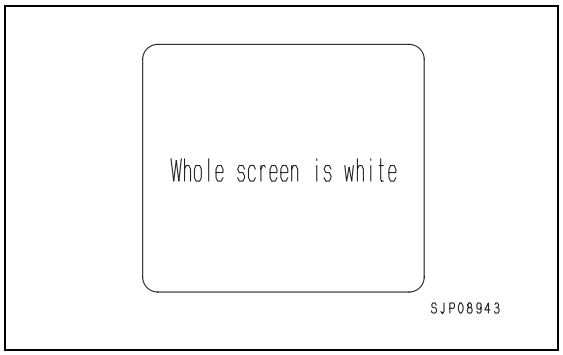
- When the starting switch is in the OFF position, press return switch (15) and control switch (14) of the monitor at the same time, and the service meter will be shown on the display.
- This display is shown only while the two switches are being pressed. When the switches are released, the display goes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

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



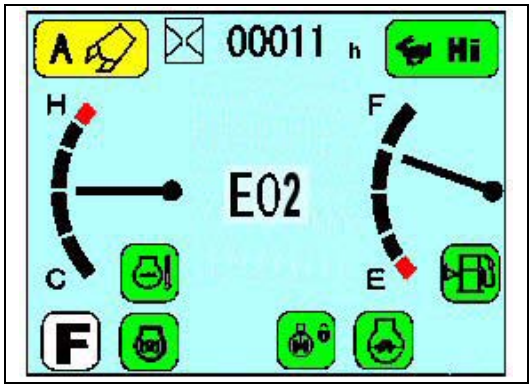
DISPLAY LCD CHECK FUNCTION

- 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.

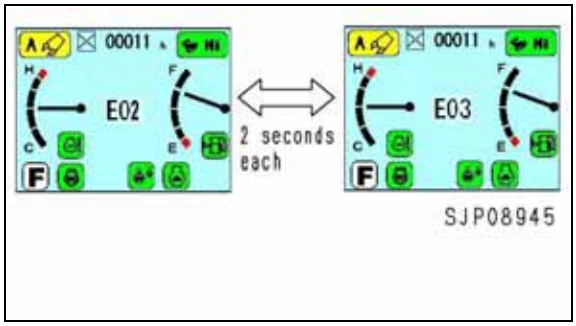


USER CODE DISPLAY FUNCTION

- 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.



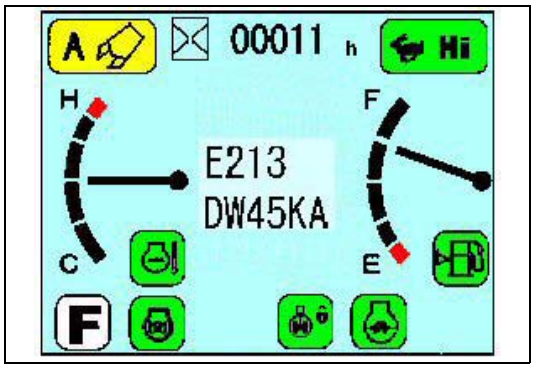
- If more than one user code is generated at the same time, the user codes are displayed in turn for 2 seconds each to display all the user codes.

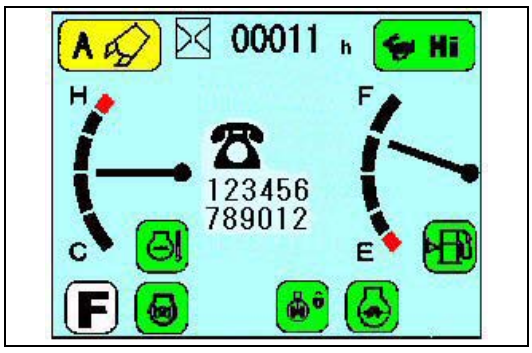


- While the user code is being displayed, if the input confirmation switch is pressed, the service code and failure code can be displayed.
- If there is more than one service code or failure code, the display switches every 2 seconds and displays all the service codes/failure codes that caused the user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

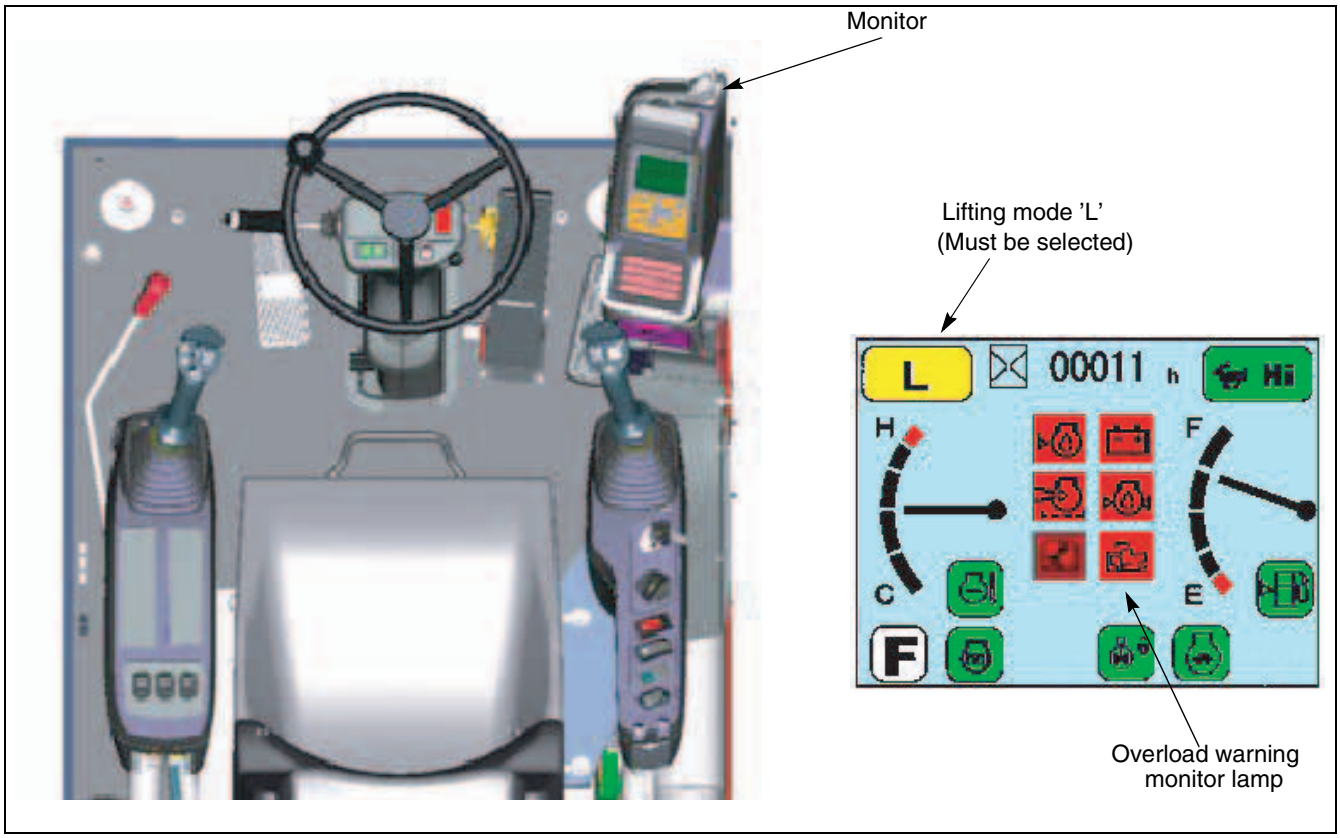
FUNCTION

- 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.

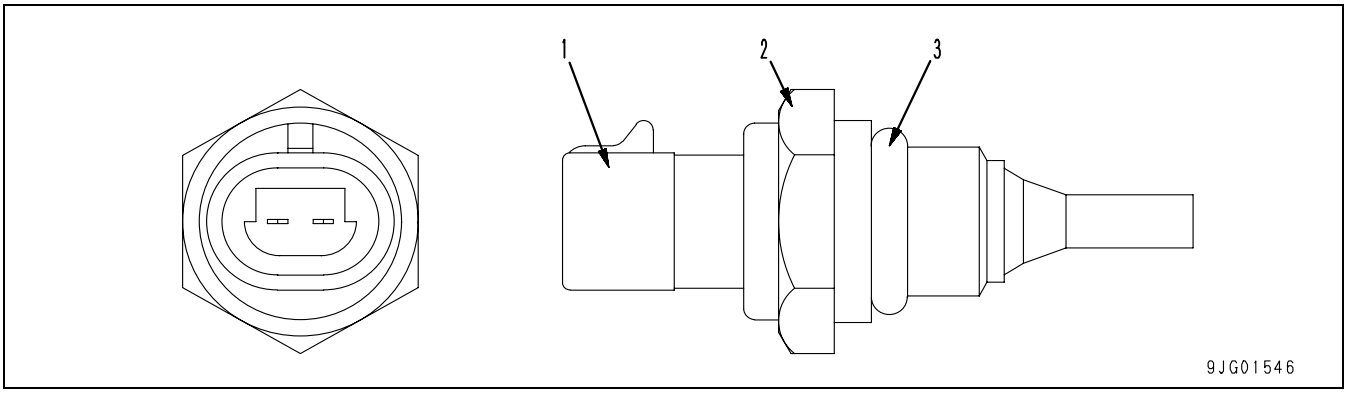


SENSOR

- 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

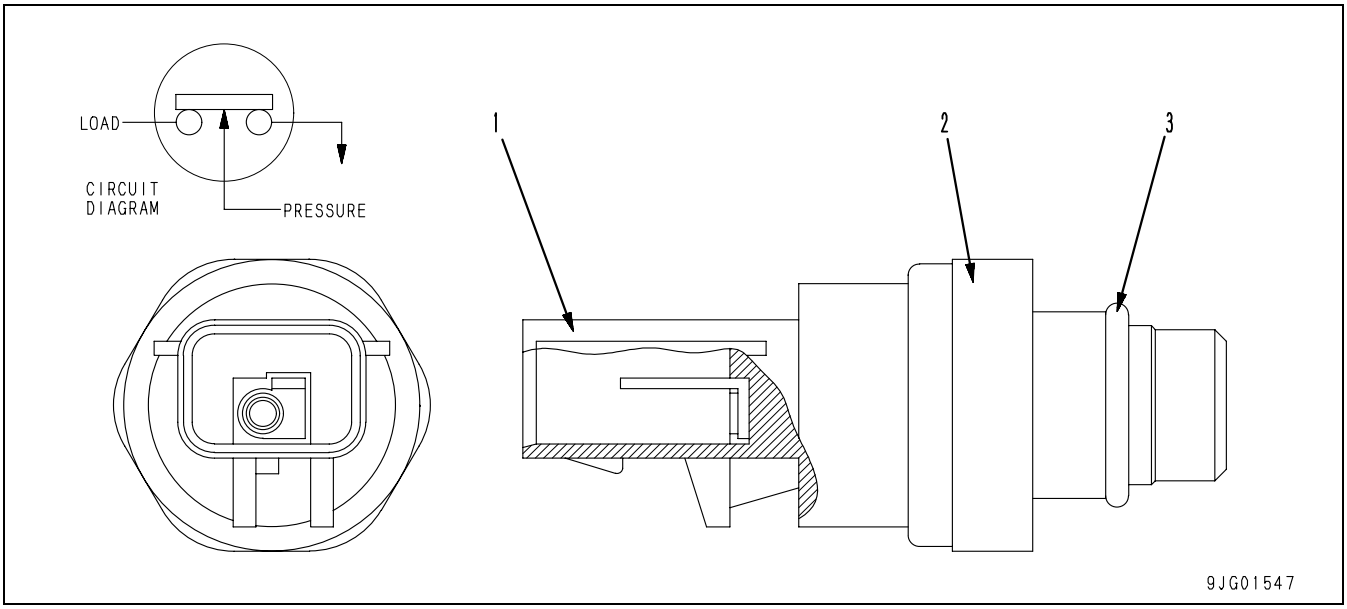
Sensor name	Type of sensor	When normal	When abnormal	Input controller
Coolant level	Contact	ON (Closed)	OFF (Open)	Monitor
Engine oil level	Contact	ON (Closed)	OFF (Open)	
Engine oil pressure	Contact	ON (Open)	OFF (Closed)	Engine controller
Coolant temperature	Resistance	—	—	
Fuel level	Resistance	—	—	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



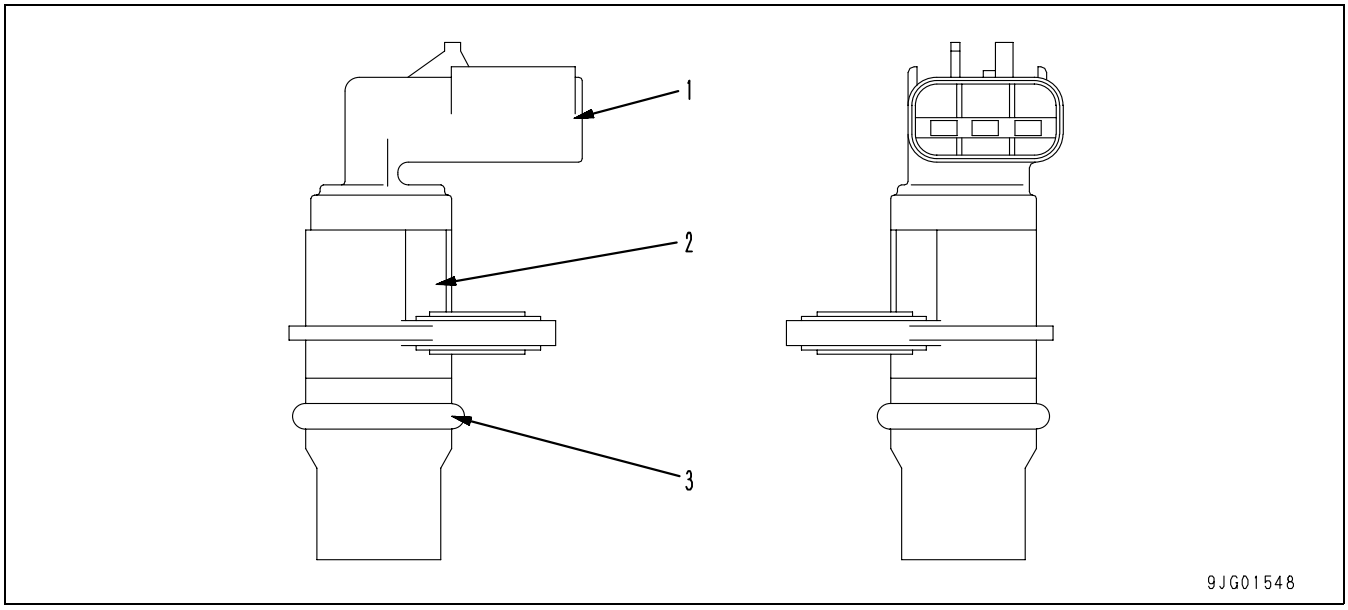
1. Sensor
2. O-ring
3. Connector

Oil pressure switch



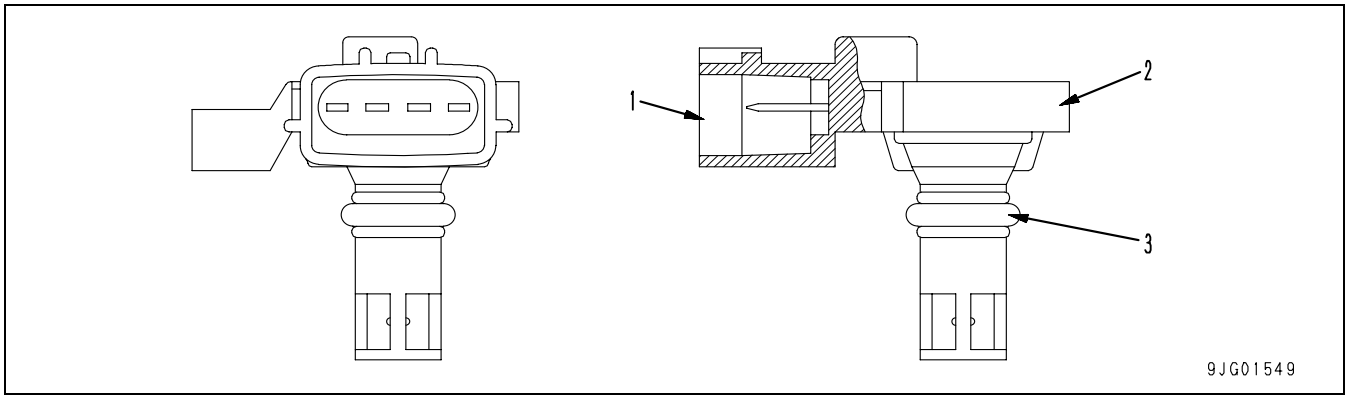
1. Connector
2. Sensor
3. O-ring

Rotation sensor



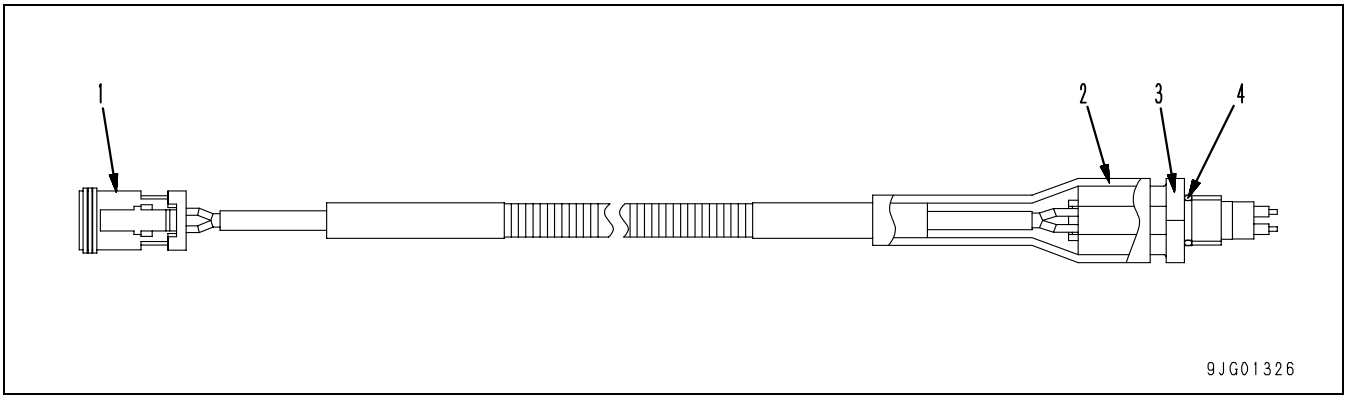
1. Connector
2. Sensor
3. O-ring

Boost pressure and temperature sensor



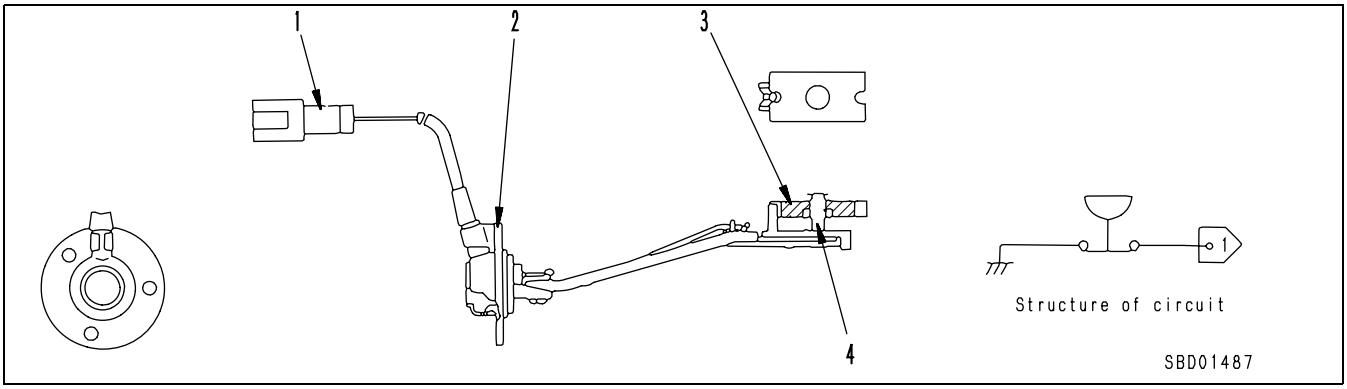
1. Connector
2. Sensor
3. O-ring

WIF (Water-In-Fuel detection) sensor



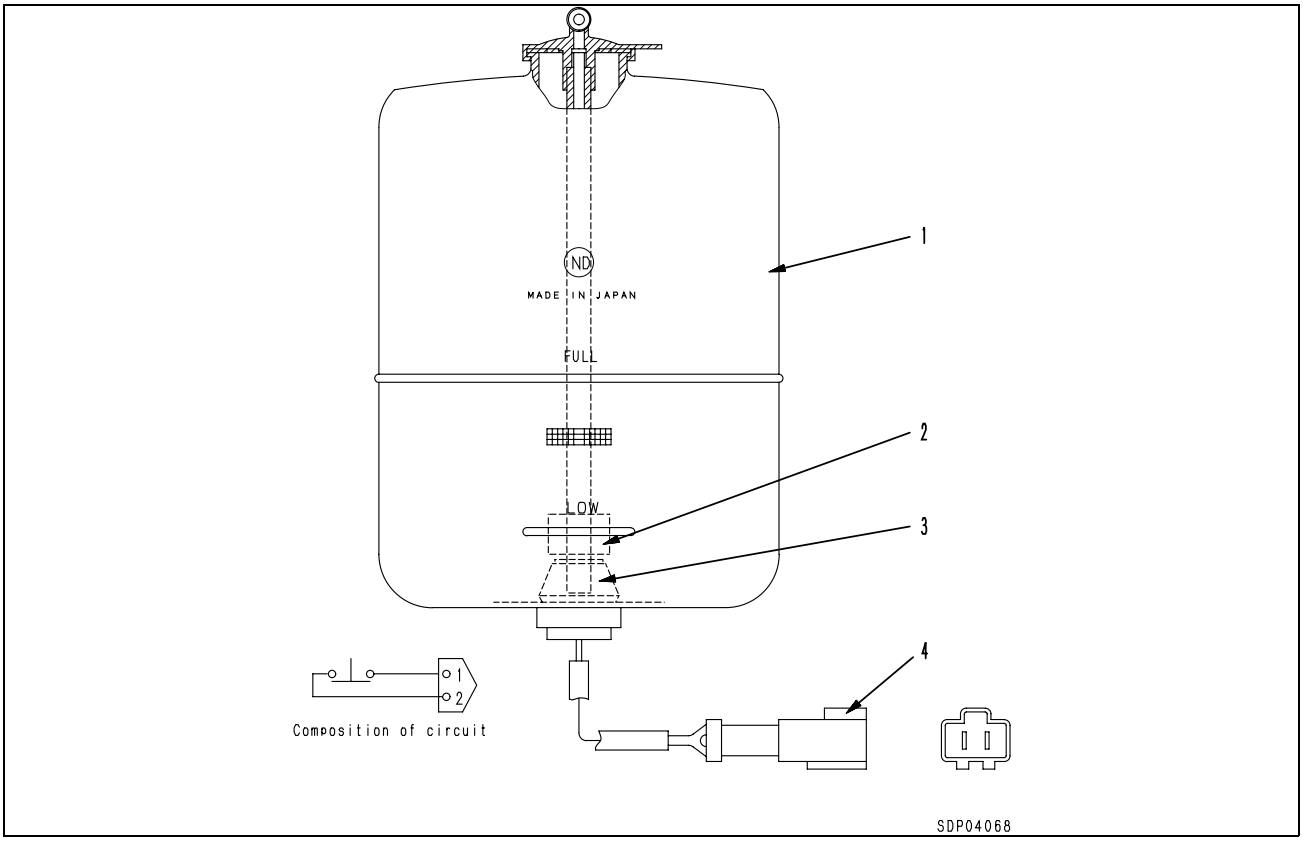
1. Connector
2. Tube
3. Sensor
4. O-ring

Engine oil level sensor



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

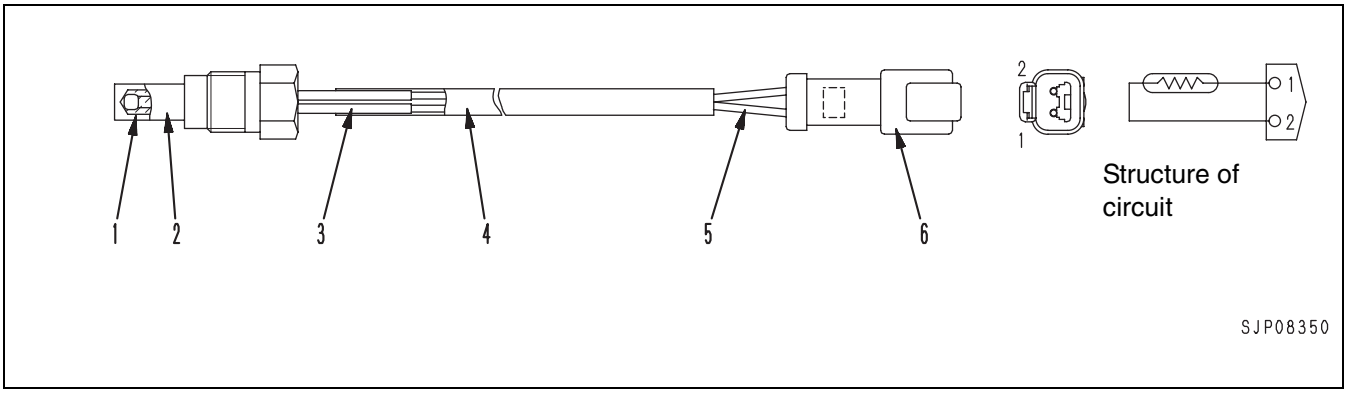
Coolant level sensor



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

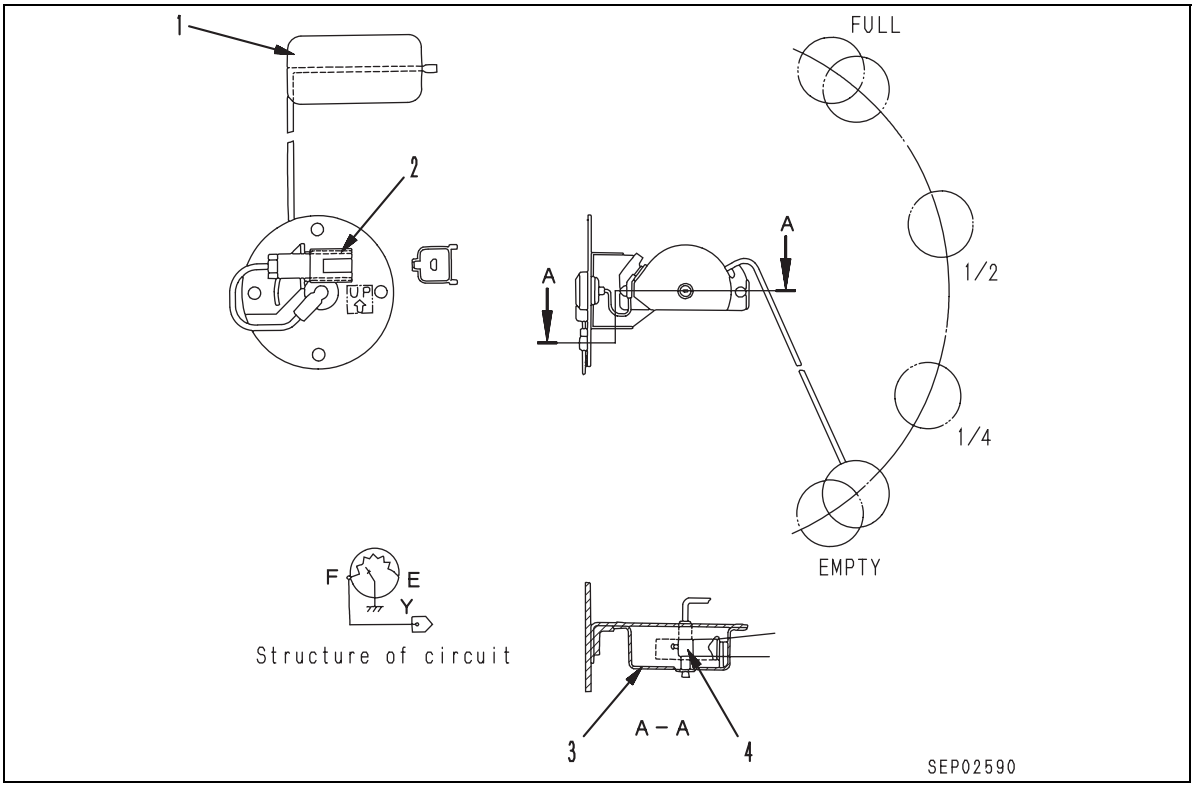
Coolant temperature sensor

Hydraulic oil temperature sensor



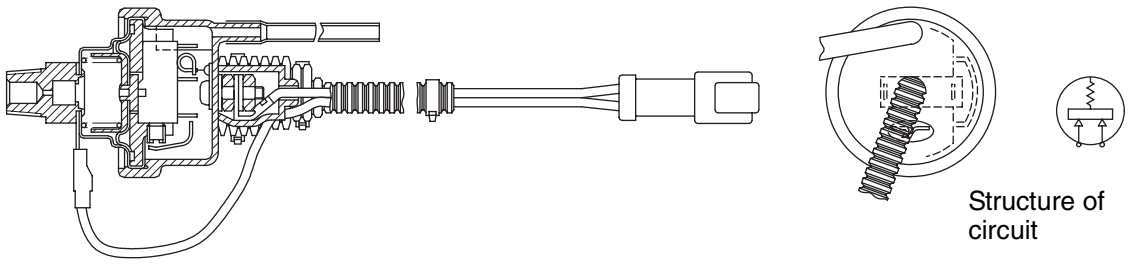
1. Thermistor
2. Body
3. Tube
4. Tube
5. Wire
6. Connector

Fuel level sensor

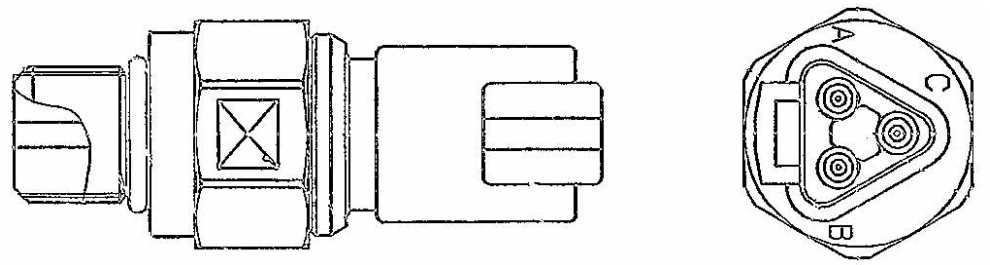


1. Float
2. Connector
3. Cover
4. Variable resistor

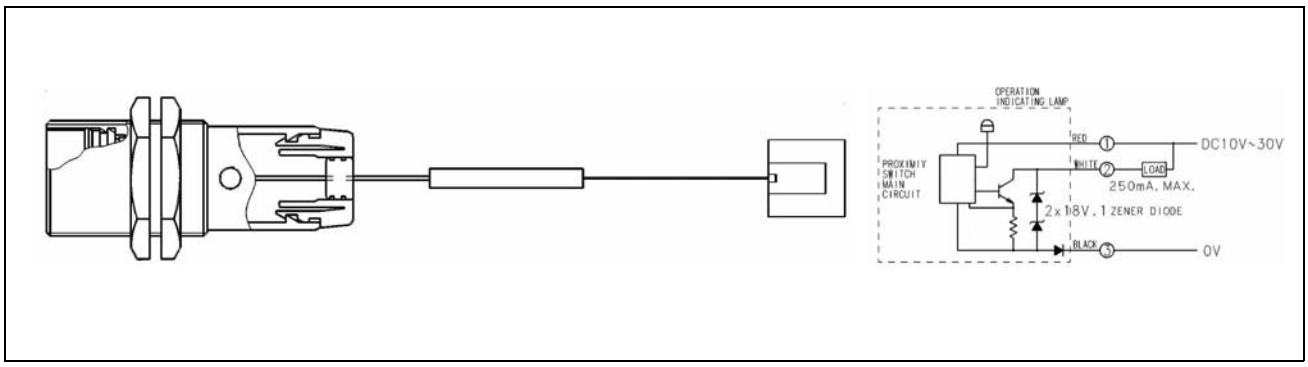
Air cleaner clogging sensor



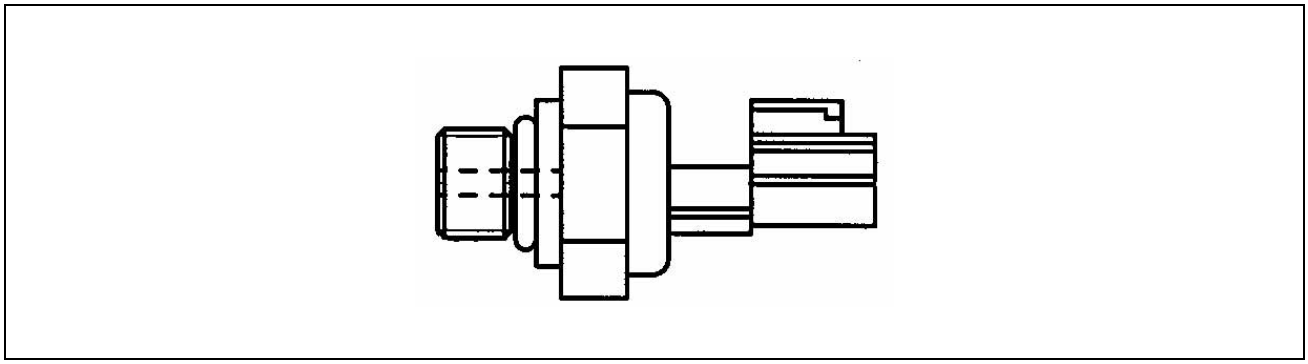
Overload Caution sensor



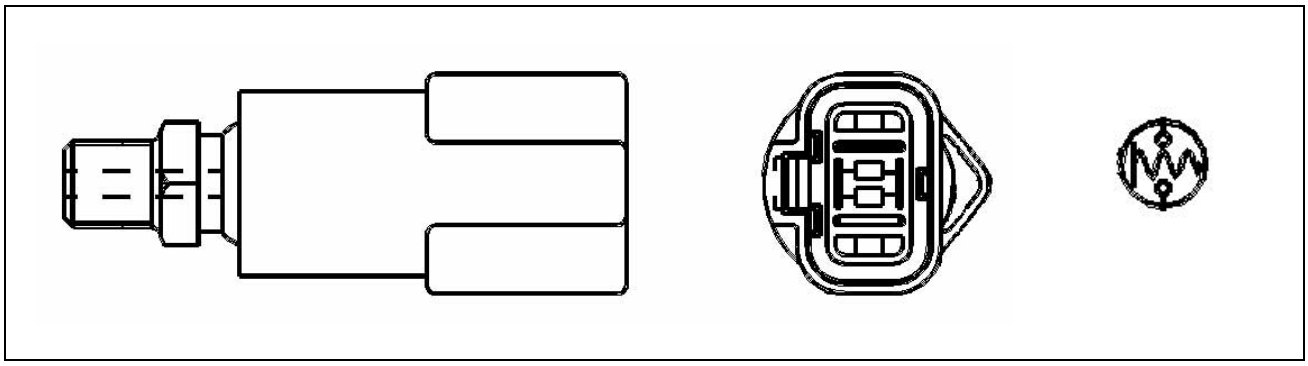
Swing proximity sensor



Travel PPC sensor

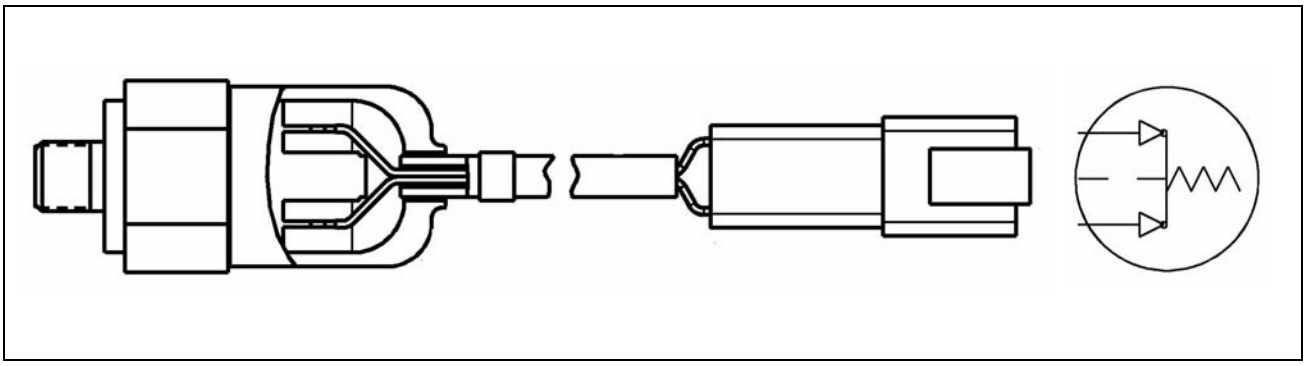


PPC pressure sensor

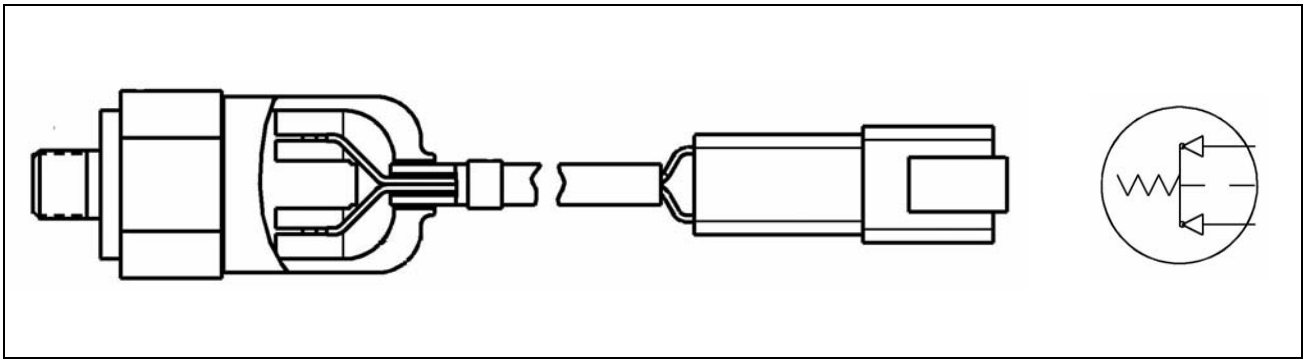


Park brake pressure sensor

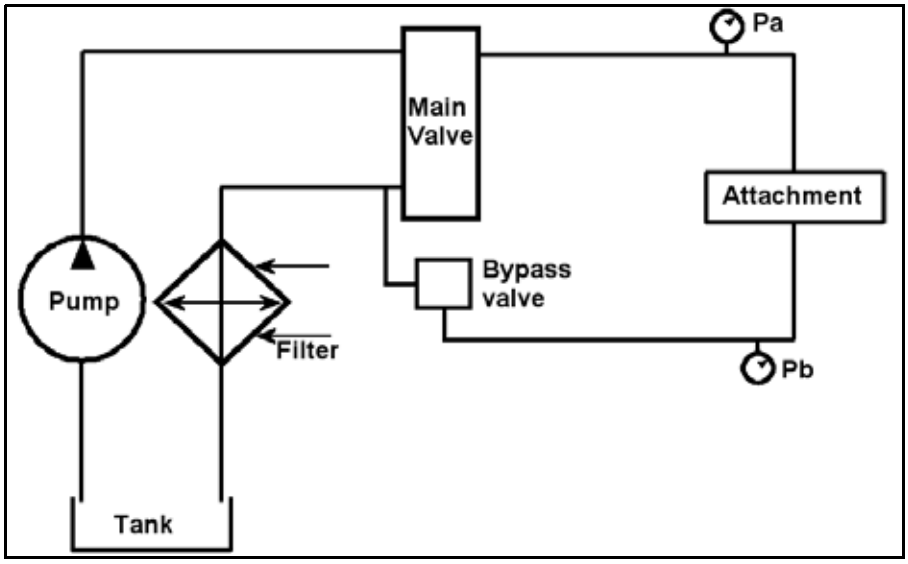
Brake accumulator low pressure sensor



Brake stop light sensor



1st ATTACHMENT CIRCUIT HYDRAULIC PERFORMANCE (MAIN VALVE BYPASSED)

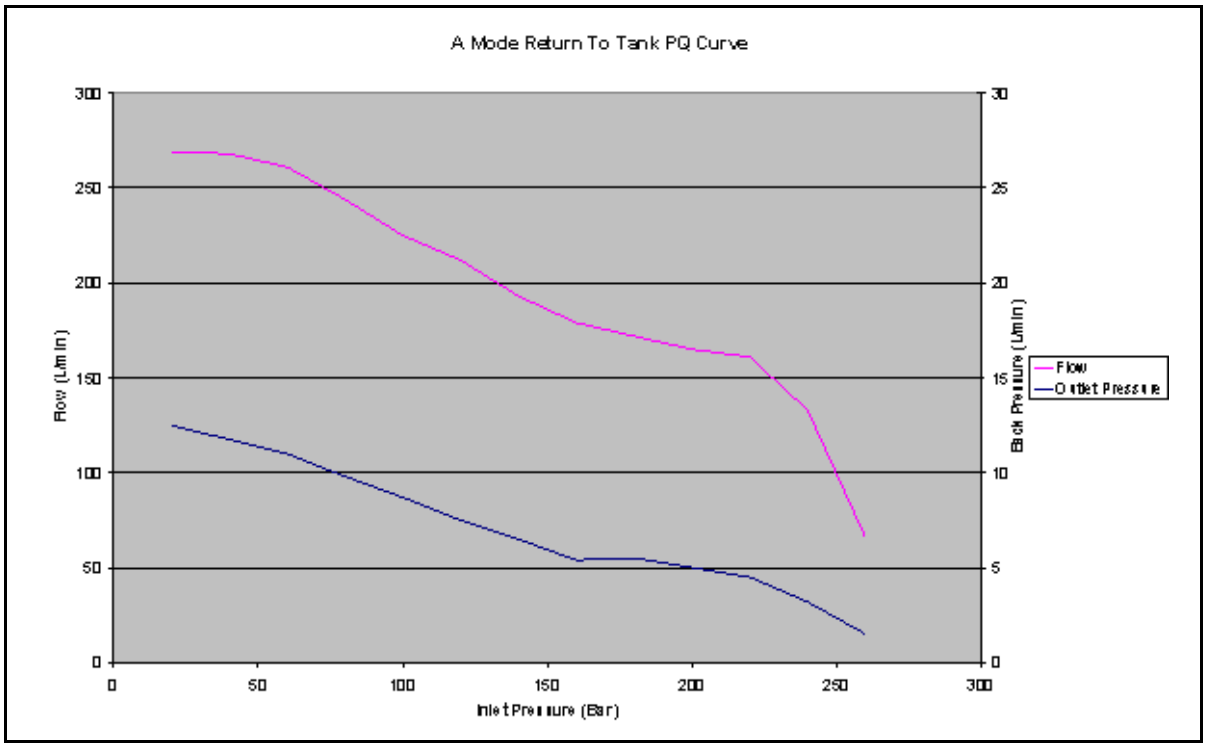


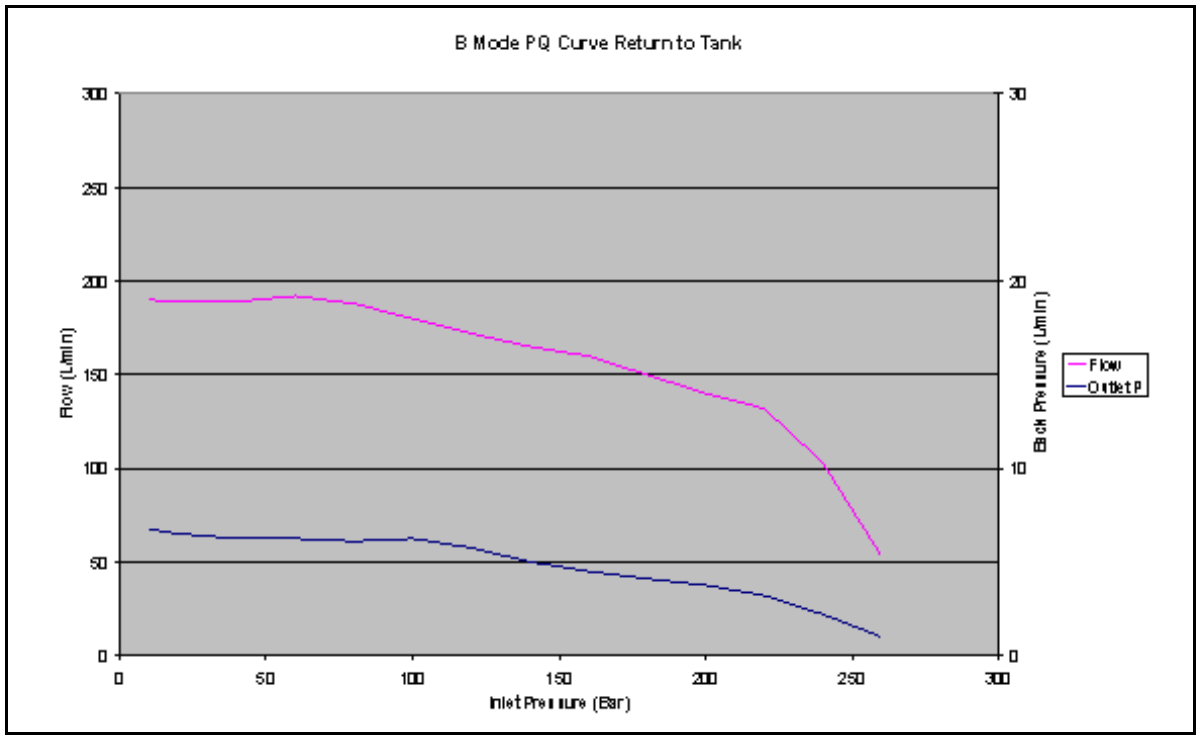
The performance of the hydraulic system when operating the 1st attachment circuit is shown below.

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 A and **Pb** for varying flow through the attachment in A mode, E mode & B mode.

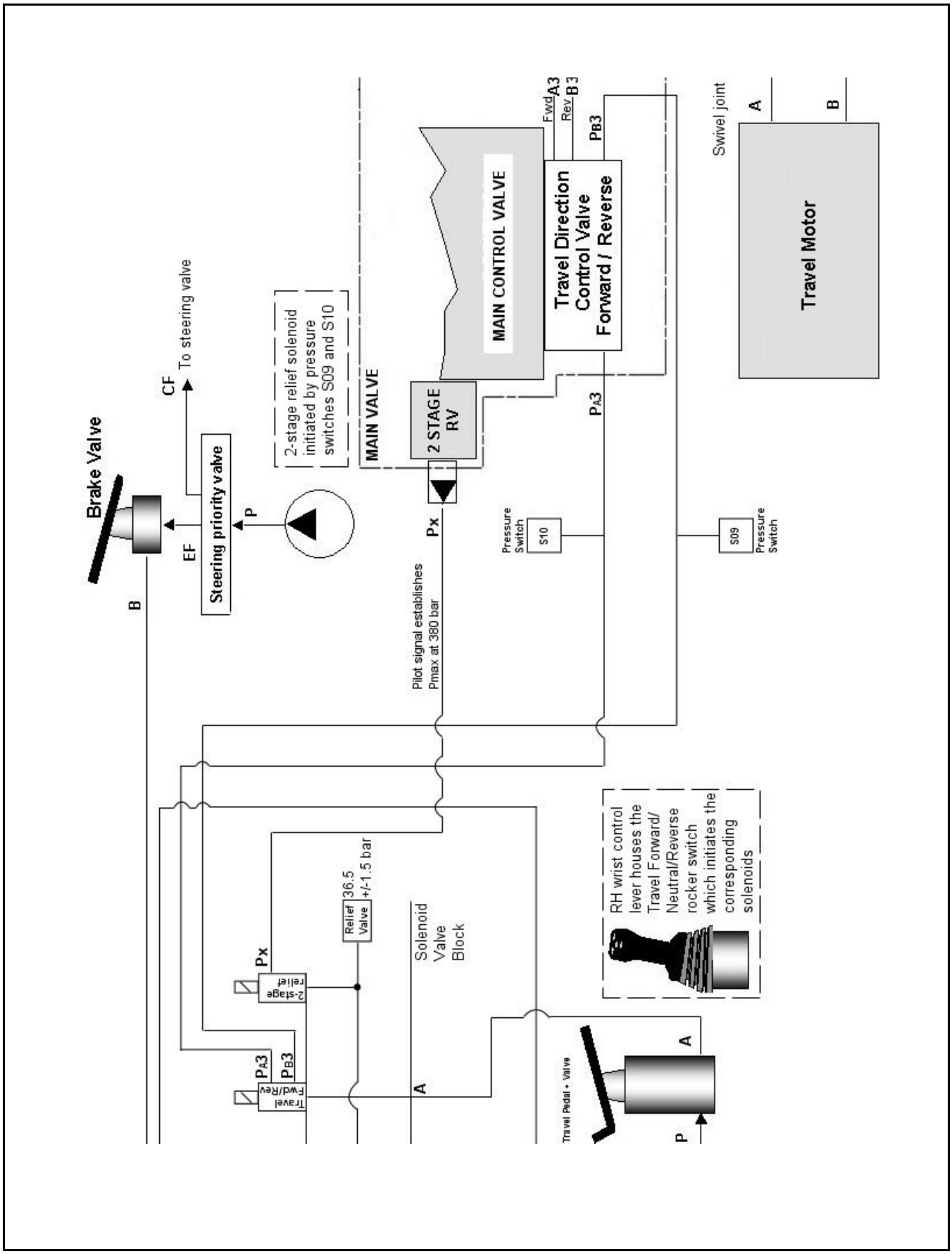




NOTE: The data given here is intended as a guide only. This is because the data is typical for an excavator of this type therefore there will be variation from one machine to another.

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)

Operator's Input via travel mode switch

H 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.

H 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.

- 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:

H 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.

H 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 Px1 and Px2. This action raises the pressure of the 2 stage relief valves 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)

In both of these operating modes, w/hen the motor pressure reaches 280 bar this represents the cracking pressure of the torque / speed control valve.

The valve has a switching range of 38 +0/-3 bar. This gives a progressive increase in motor displacement, resulting in a controlled increased rate of traction force and corresponding reduction in motor speed per litre of fluid supplied.

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

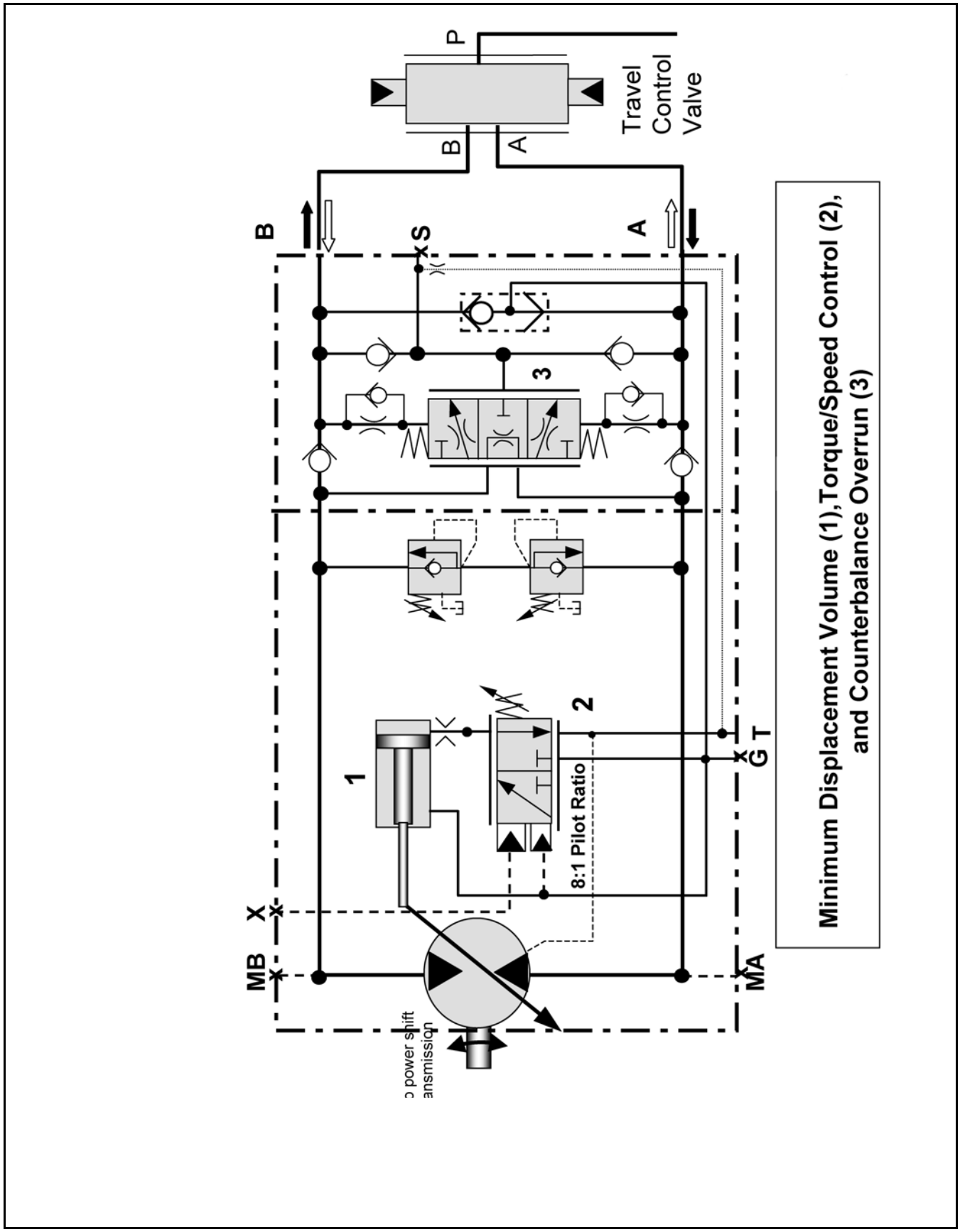
motor return side thereby providing a braking force and controlled vehicle movement.

Operational and Control features (4)

- To prevent cavitation of the travel motor a 2 stage back -pressure valve is incorporated in the main return line. This valve is part of the main control valve. (Set at 4 bar. This is raised to 8 bar during travel.)
- Operation of this valve is initiated via the speed control of the machine.
- If the travel speed exceeds 1.5 kph the back pressure valve is supplied with a signal pressure of 38 +0/-3 bar. This pressure based upon the applied area of the pilot creates a return line back pressure of 8 bar. The normal pressure is 4 bar.

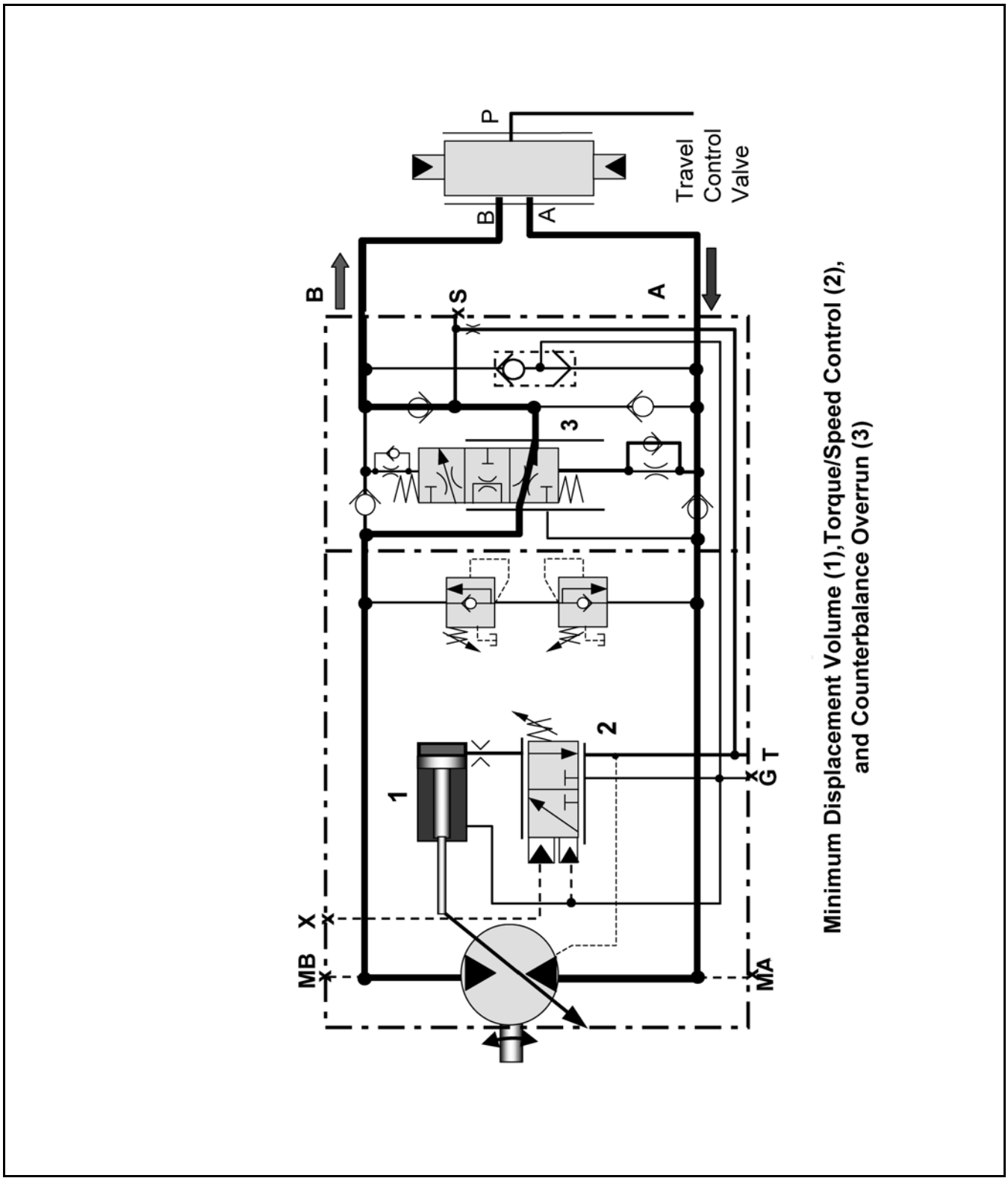
1. Travel Motor.

1.1 Shown in the neutral position.



1. Travel Motor.

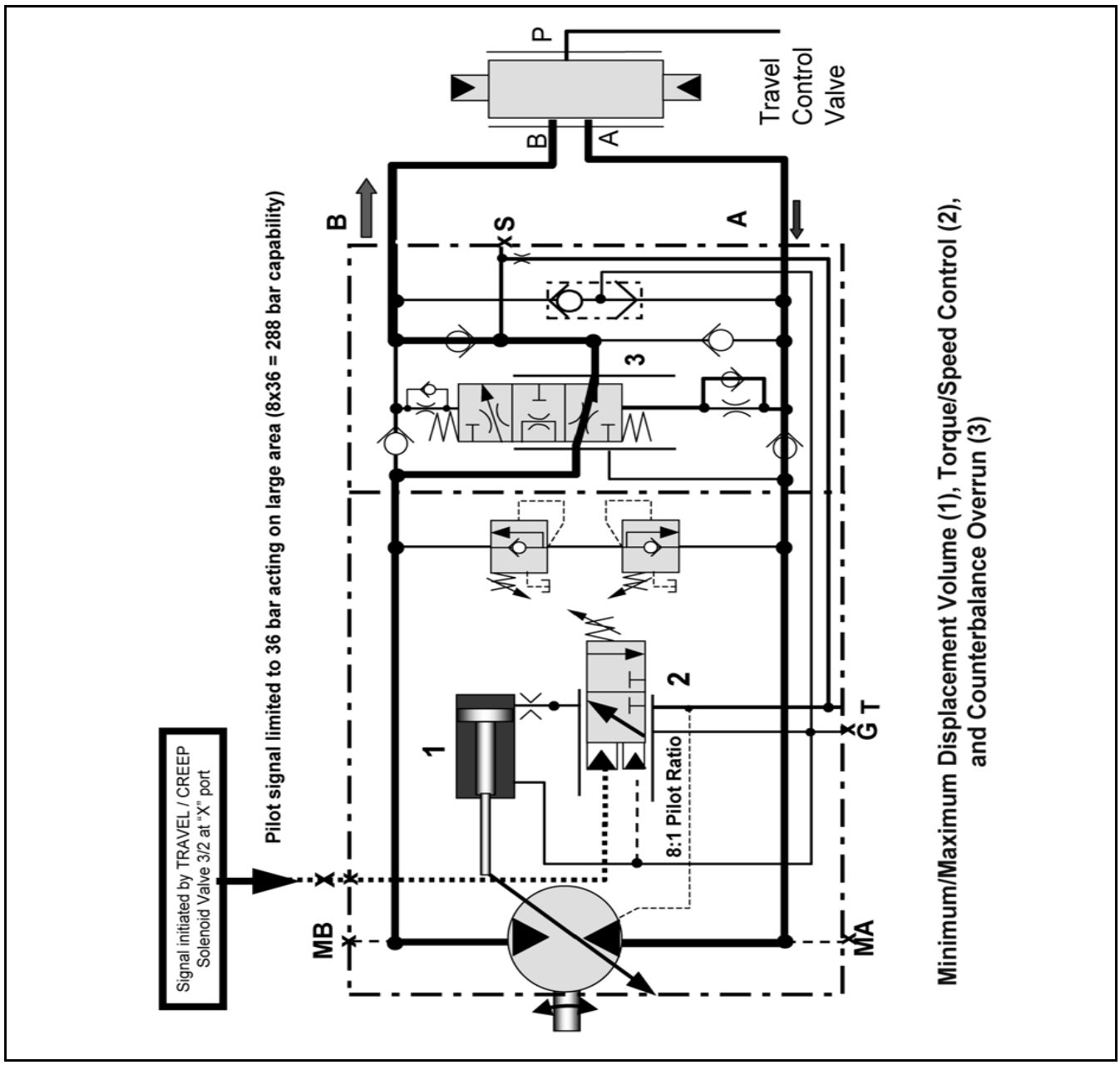
1.2 Flow path representing: Low Torque - High speed with counterbalance taking up an active position. (Default for Travel)
The counterbalance valve (3) is activated which allows a constant flow of oil around the circuit. From port A through to port B the motor displacement is at minimum pending maximum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



1. Travel Motor

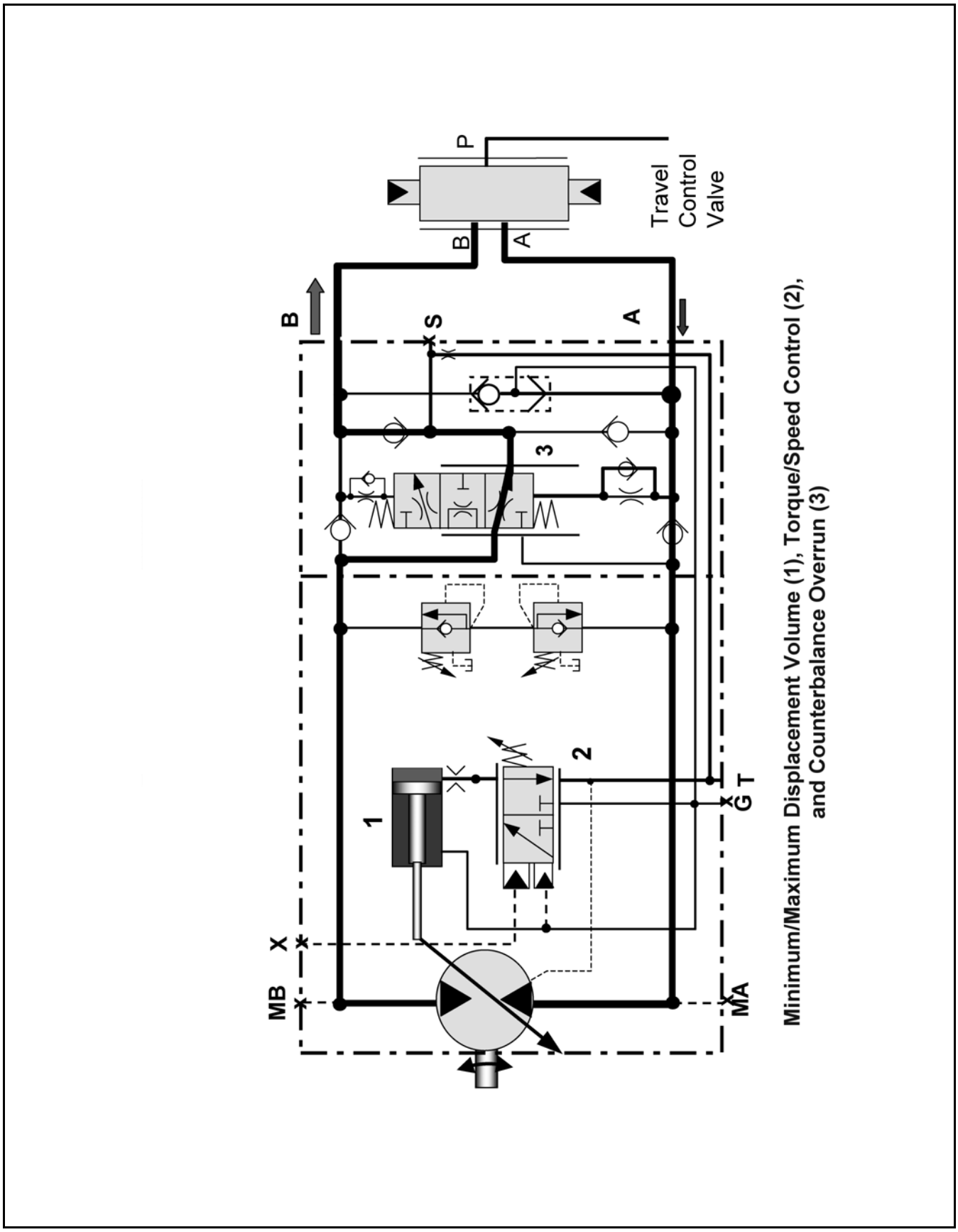
1.3 Introduction of Creep control: High Torque - Low Speed.

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



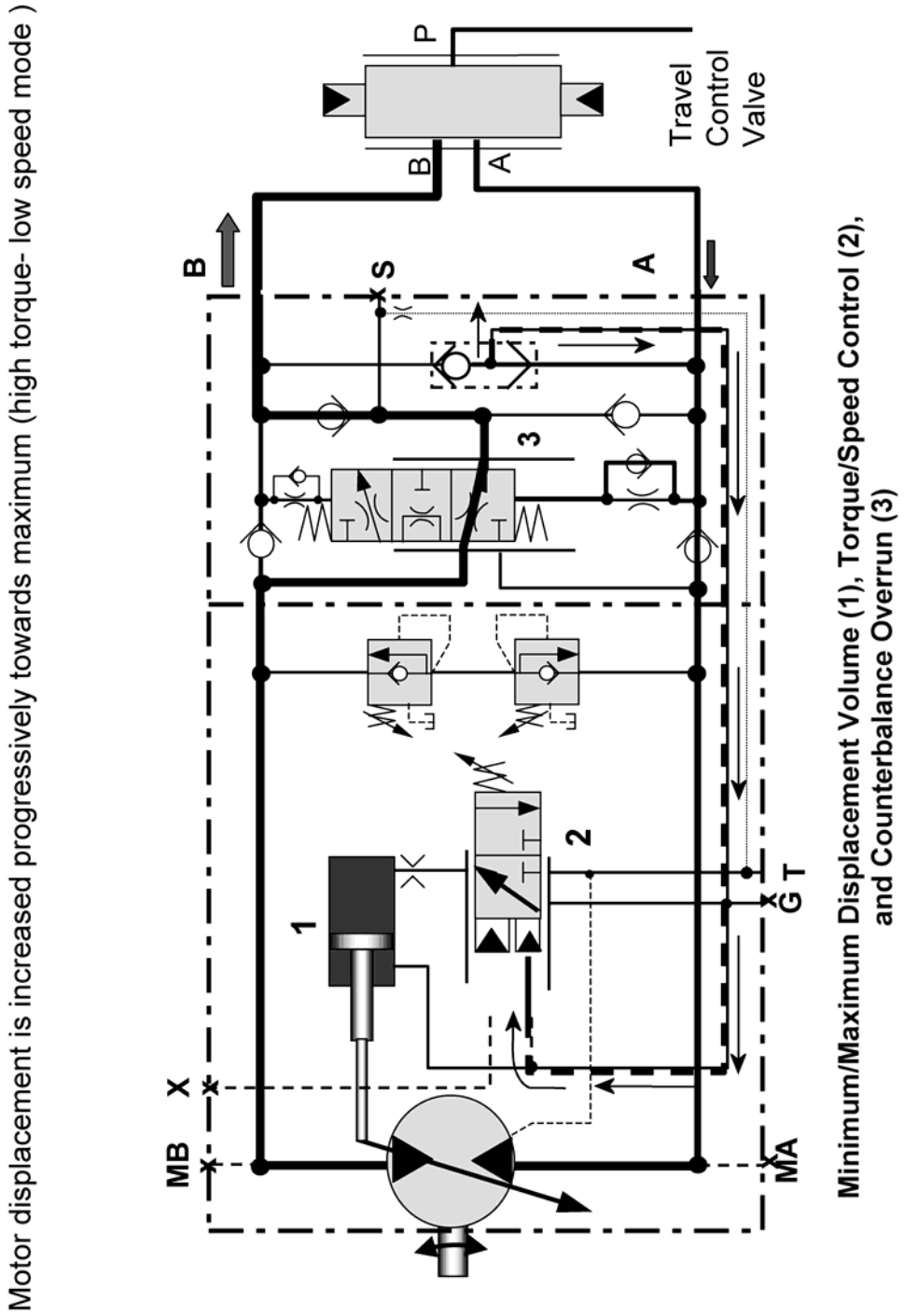
1. Travel Motor

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



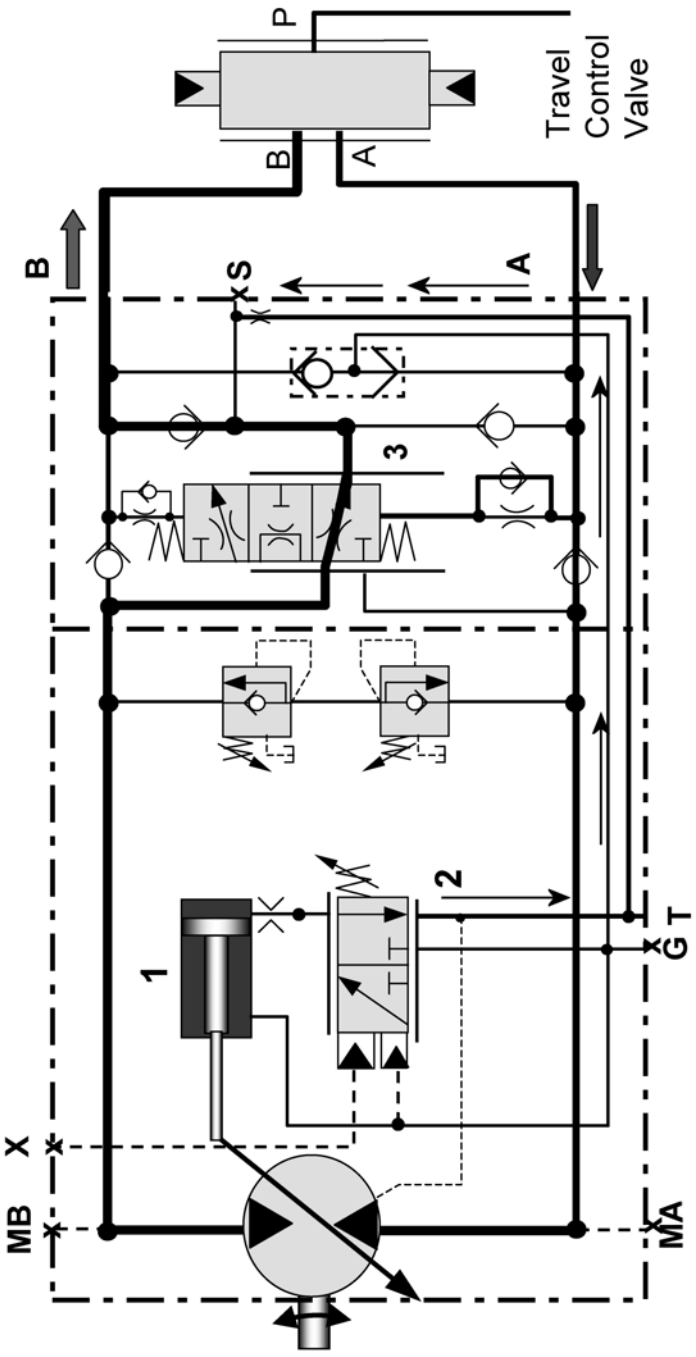
1. Travel Motor.

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. Travel Motor.

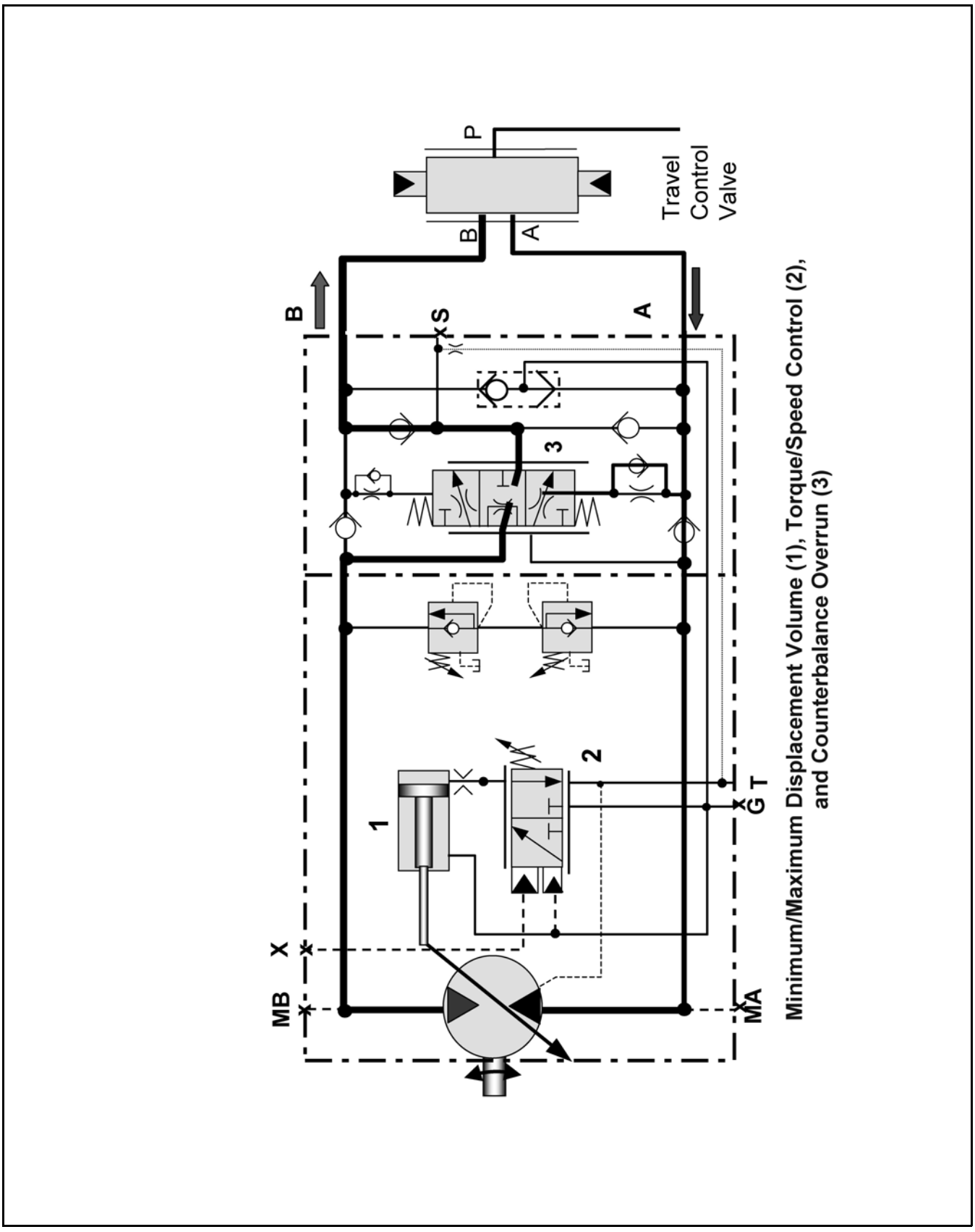
1.5 Motor begins to overrun and pressure falls on supply side: This causes counterbalance valve to begin to close and throttle return flow from motor.



Minimum/Maximum Displacement Volume (1), Torque/Speed Control (2), and Counterbalance Overrun (3)

1. Travel Motor.

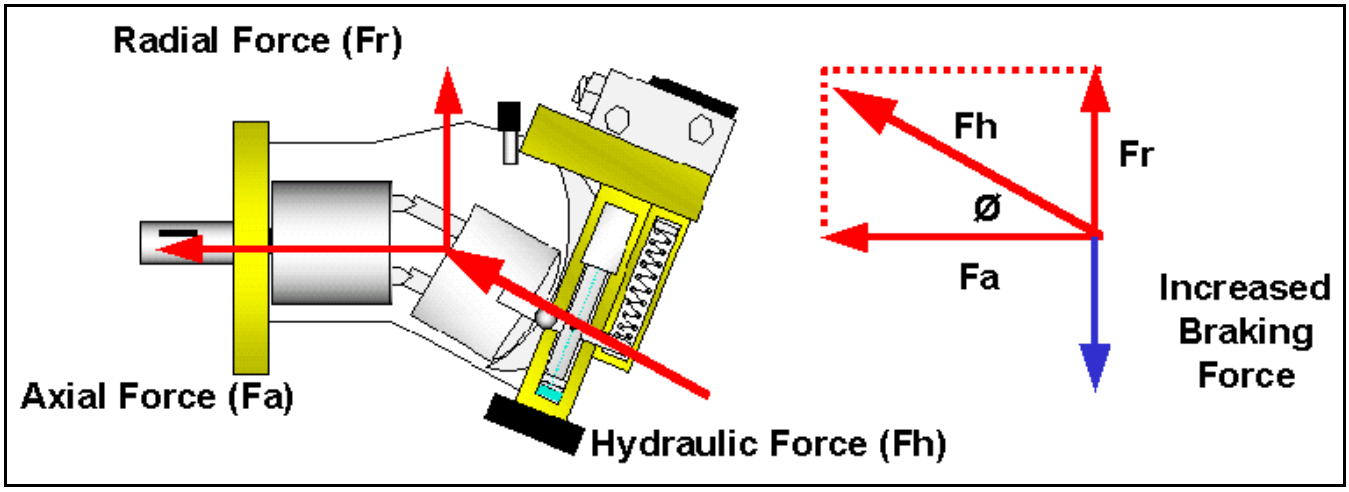
1.6 Motor begins to overrun and pressure falls on supply side: This causes counterbalance valve to begin to close and throttle return to flow motor. Pressure line in return line rises providing a braking torque.



1. Travel Motor.

1.7 Travel Motor Performance.

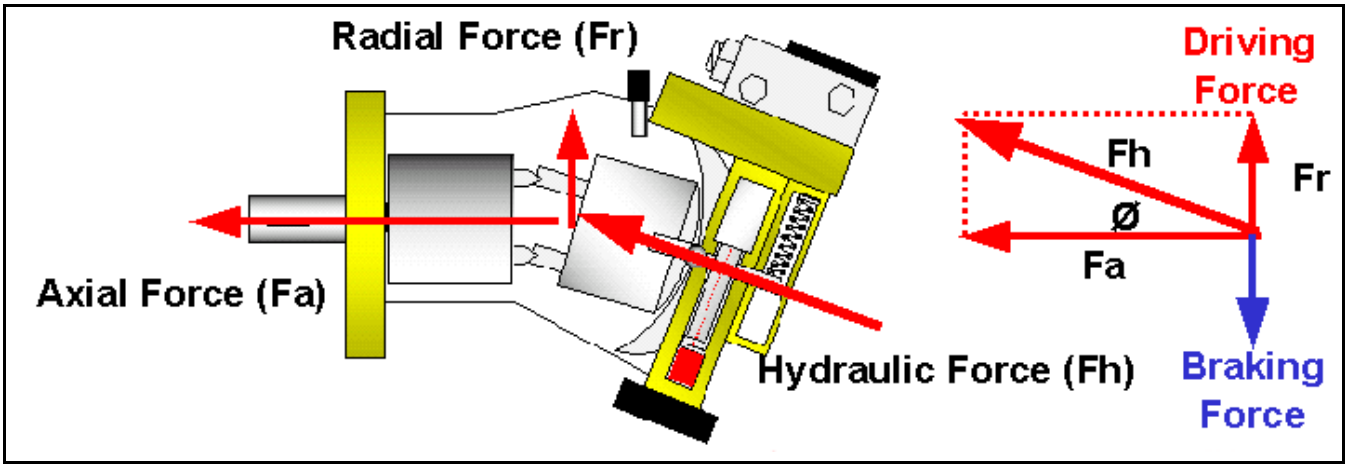
1.7.1 High Torque - Low Speed.



- 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. Travel Motor.

1.7.2 Low Torque - High Speed.

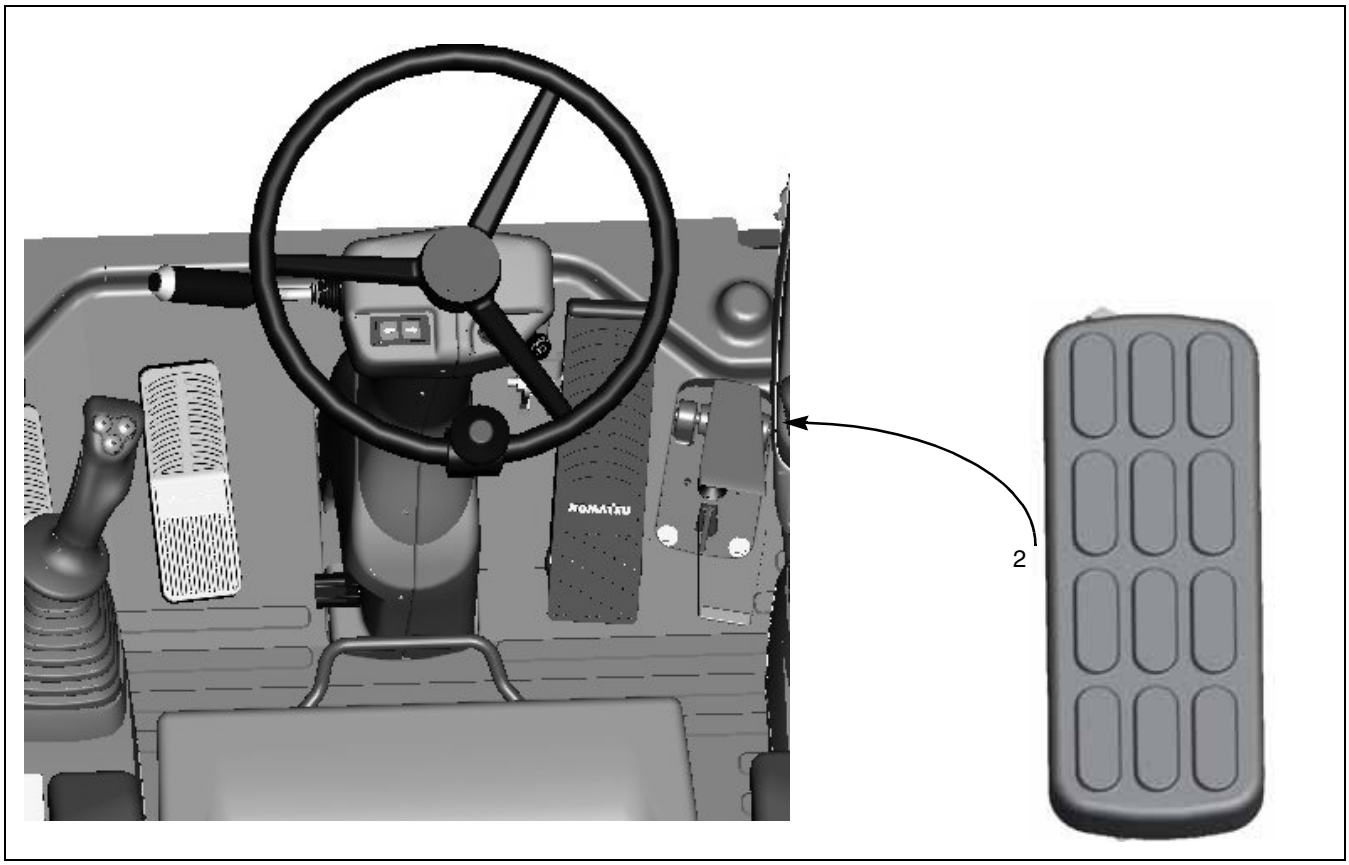


- Ø represents motor minimum displacement angle (usually about 5 to 7°). Fr represents the radial force developed by the hydraulic oil pressure which in turn develops the corresponding driving or braking torque.

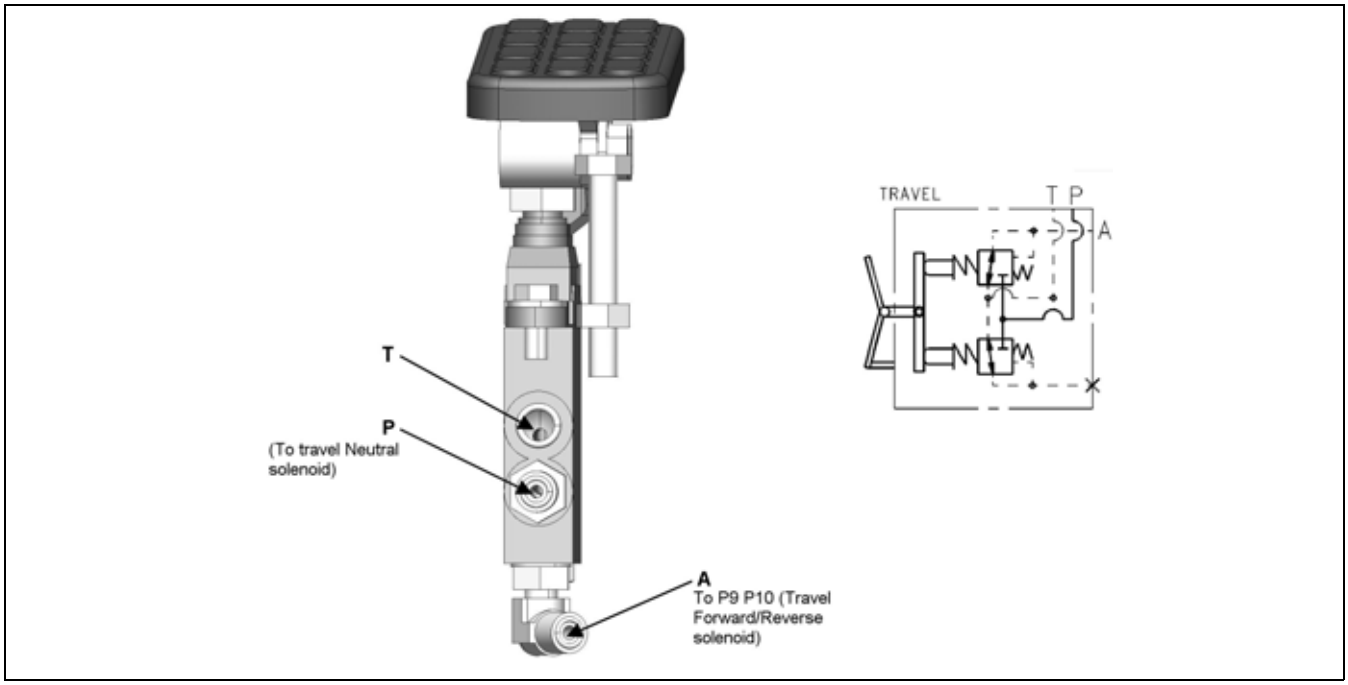
Motor size:

29 - 107cm^3 / rev for machines rated at 35 kph.

2. Travel Pedal

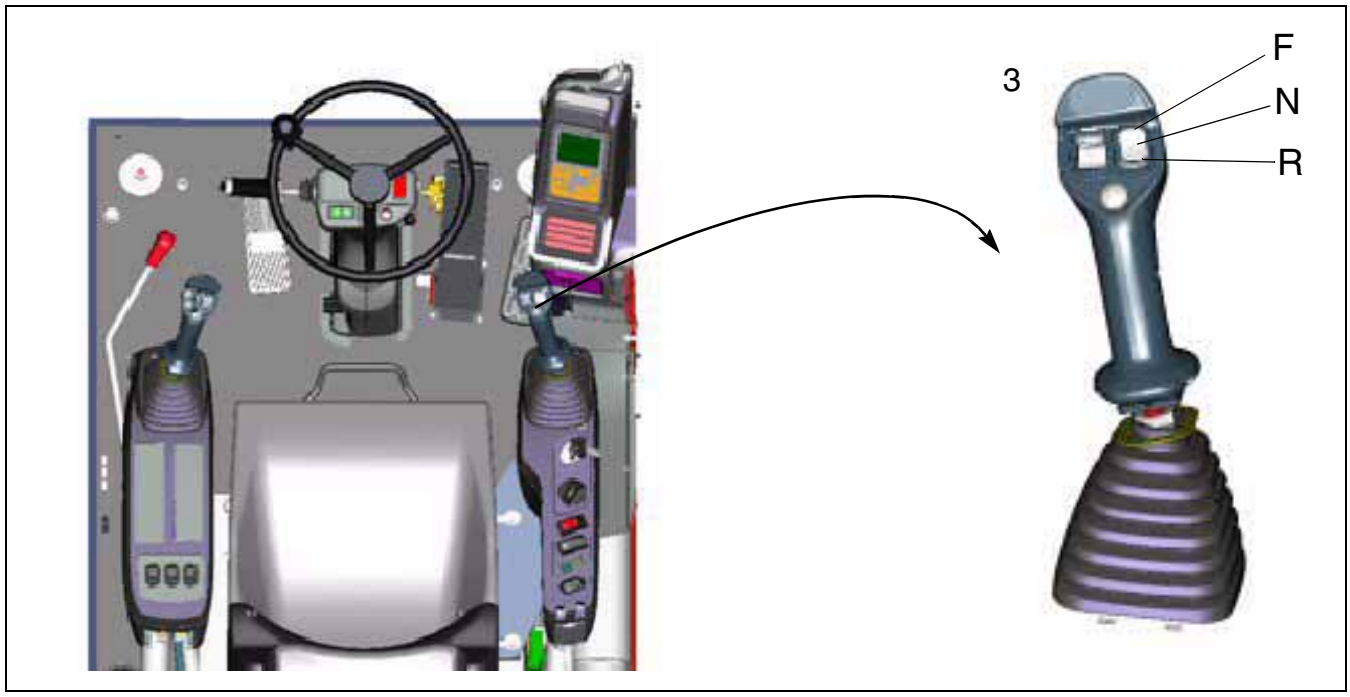


2.1. Travel Pedal Schematic.

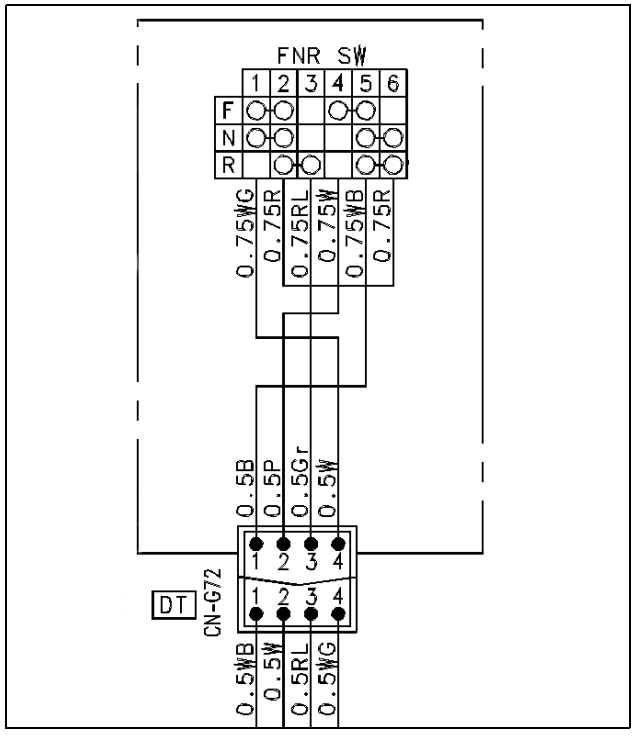


2.2. Travel Pedal: Located to the extreme right of the steering column on the floor of the Operators cab, a proportional valve when activated controls the flow of oil to the travel motor.

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.

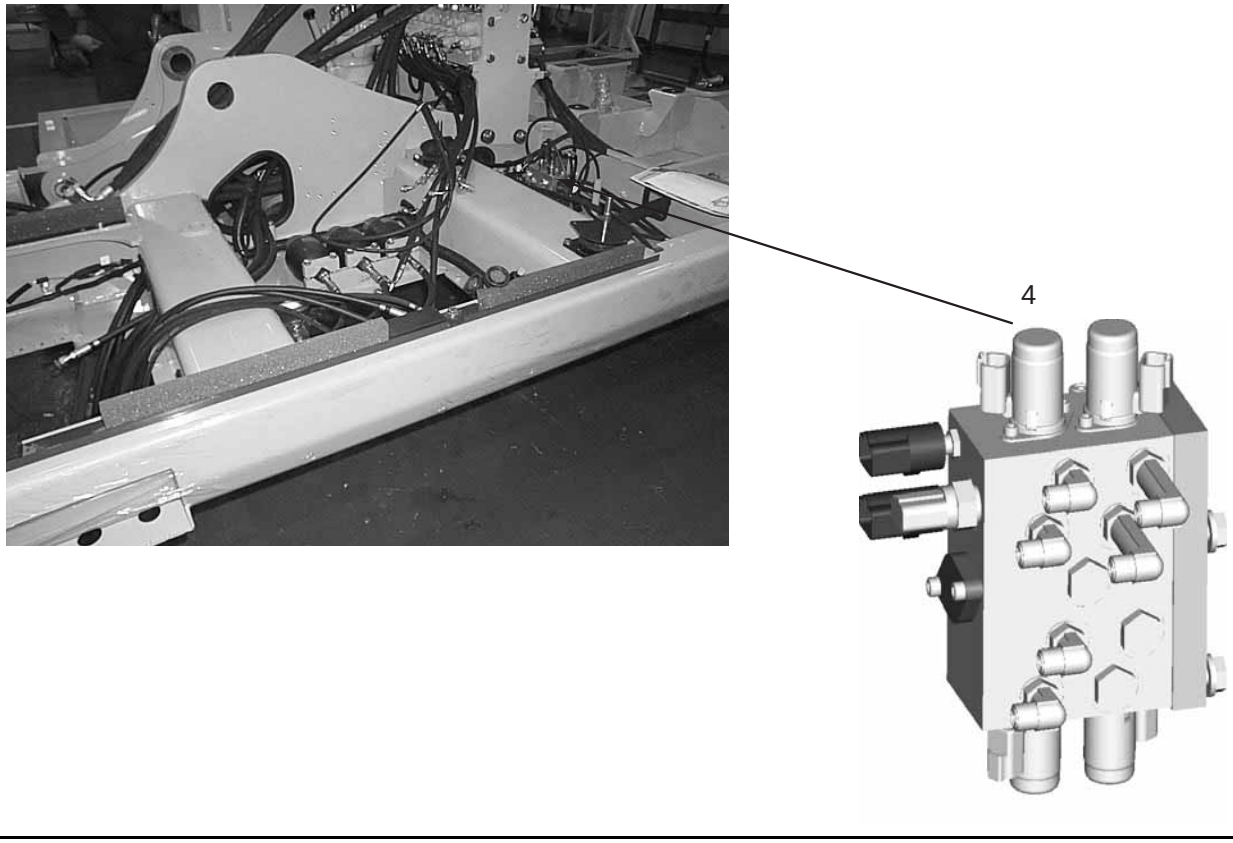
NOTE: Machine cannot be started unless the switch is in the neutral position.

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

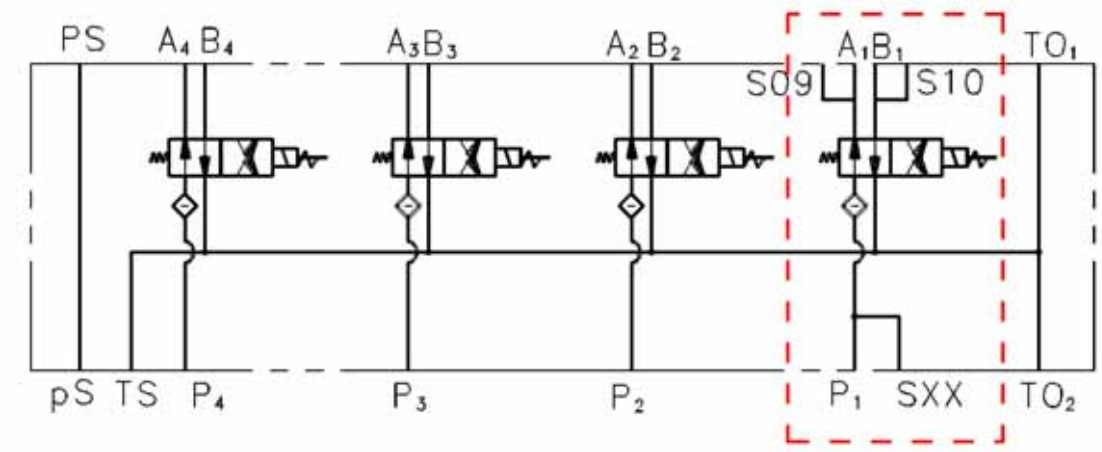
F/N/R Status Table

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

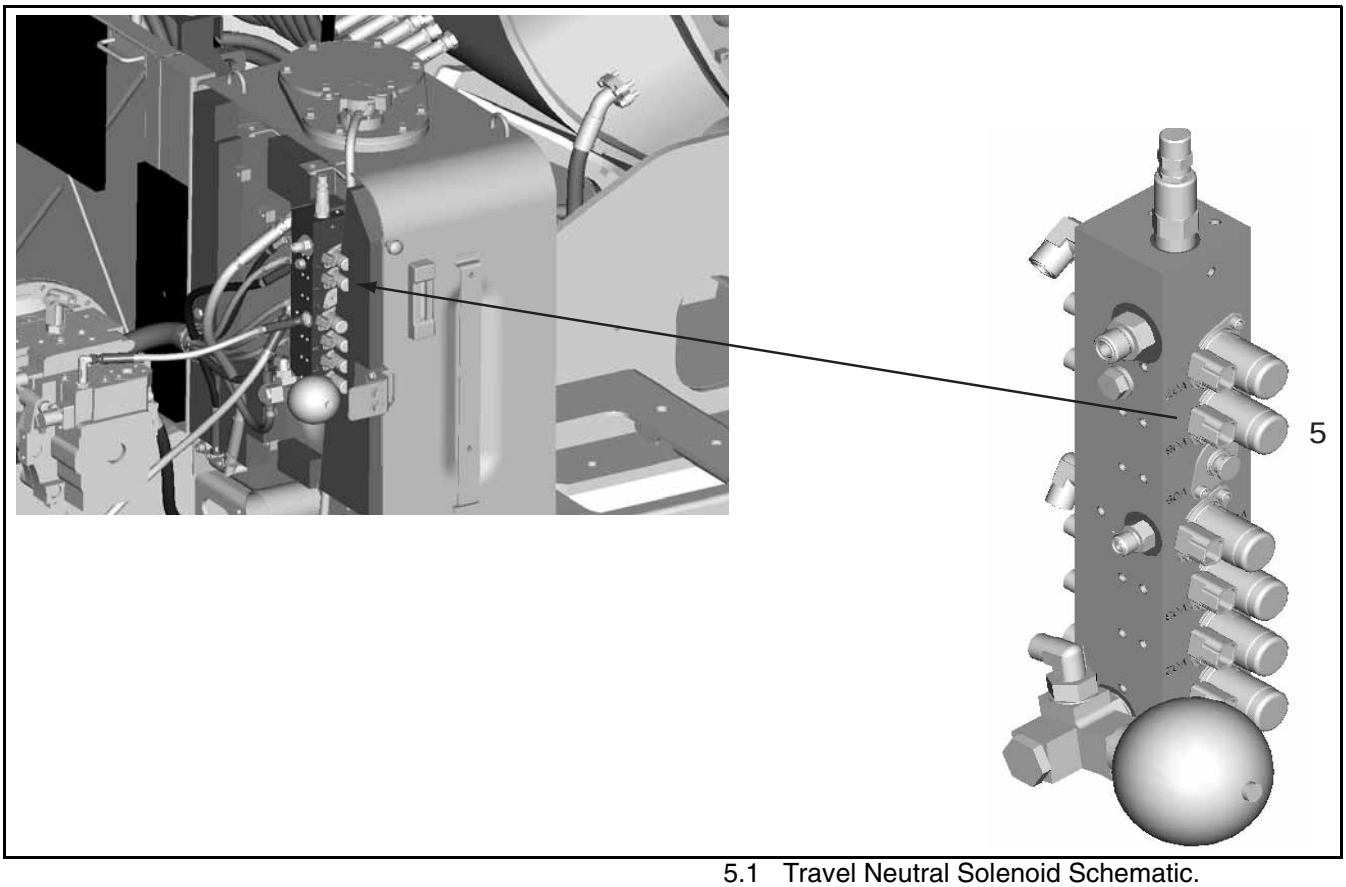


4.1 Forward / Reverse Travel Solenoid Schematic

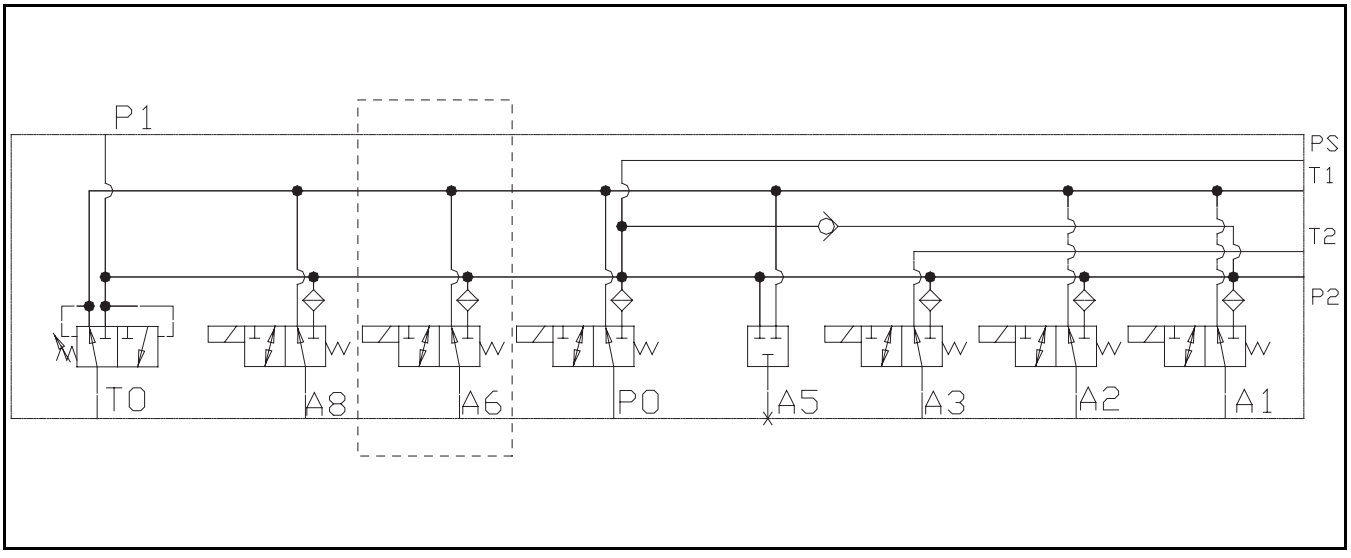


4.2 Forward / Reverse Travel Solenoid: Located on the 4-stage solenoid block in the service compartment at the rear of the operators cab. This device controls the travel motor direction (forward or reverse) by a signal from the F-N-R switch. Solenoid energised ~Forward or Reverse. Travel is engaged, 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.

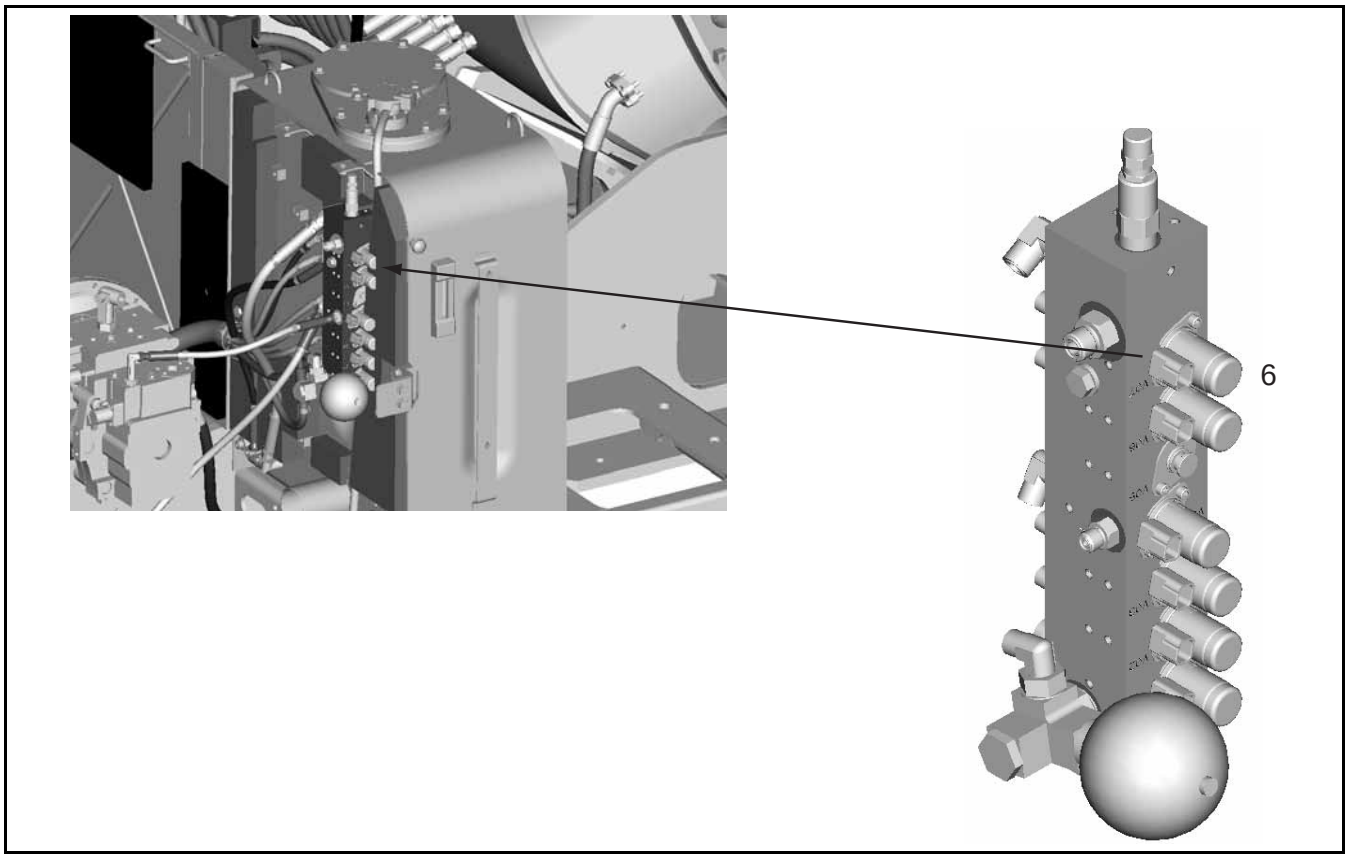


5.1 Travel Neutral Solenoid Schematic.

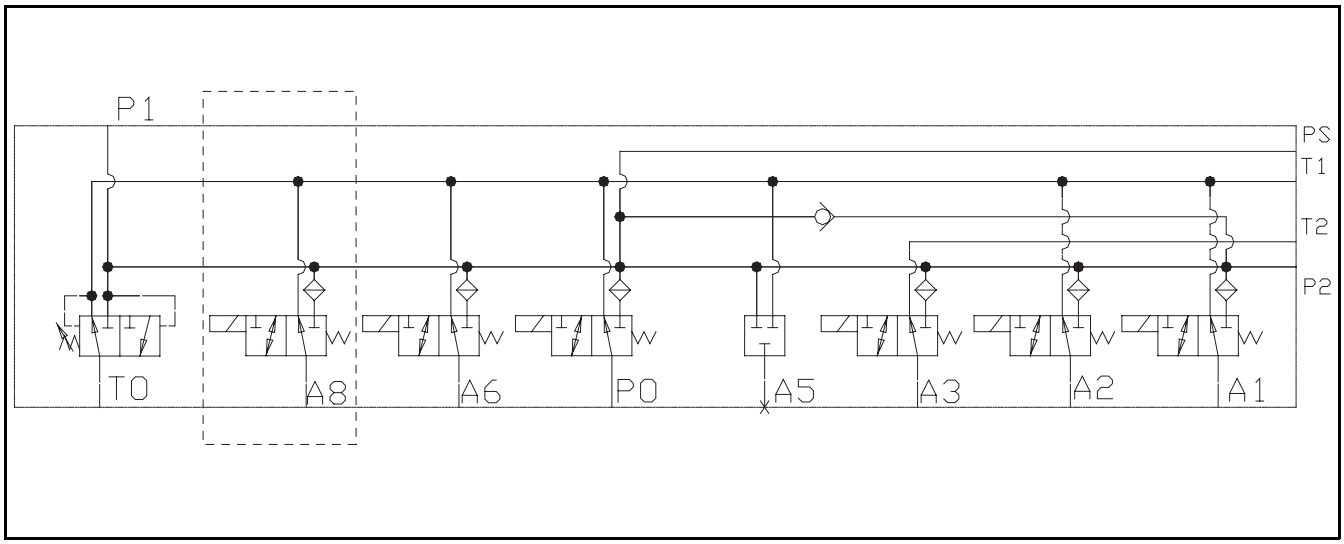


5.2Travel Neutral Solenoid: Located on the 7-stage solenoid manifold in the service compartment at the rear of the operators cab. This device interlocks with the forward / reverse solenoid to give supply pressure to the foot pedal control valve.
Solenoid active - PPC pressure to foot valve
Solenoid inactive - 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.



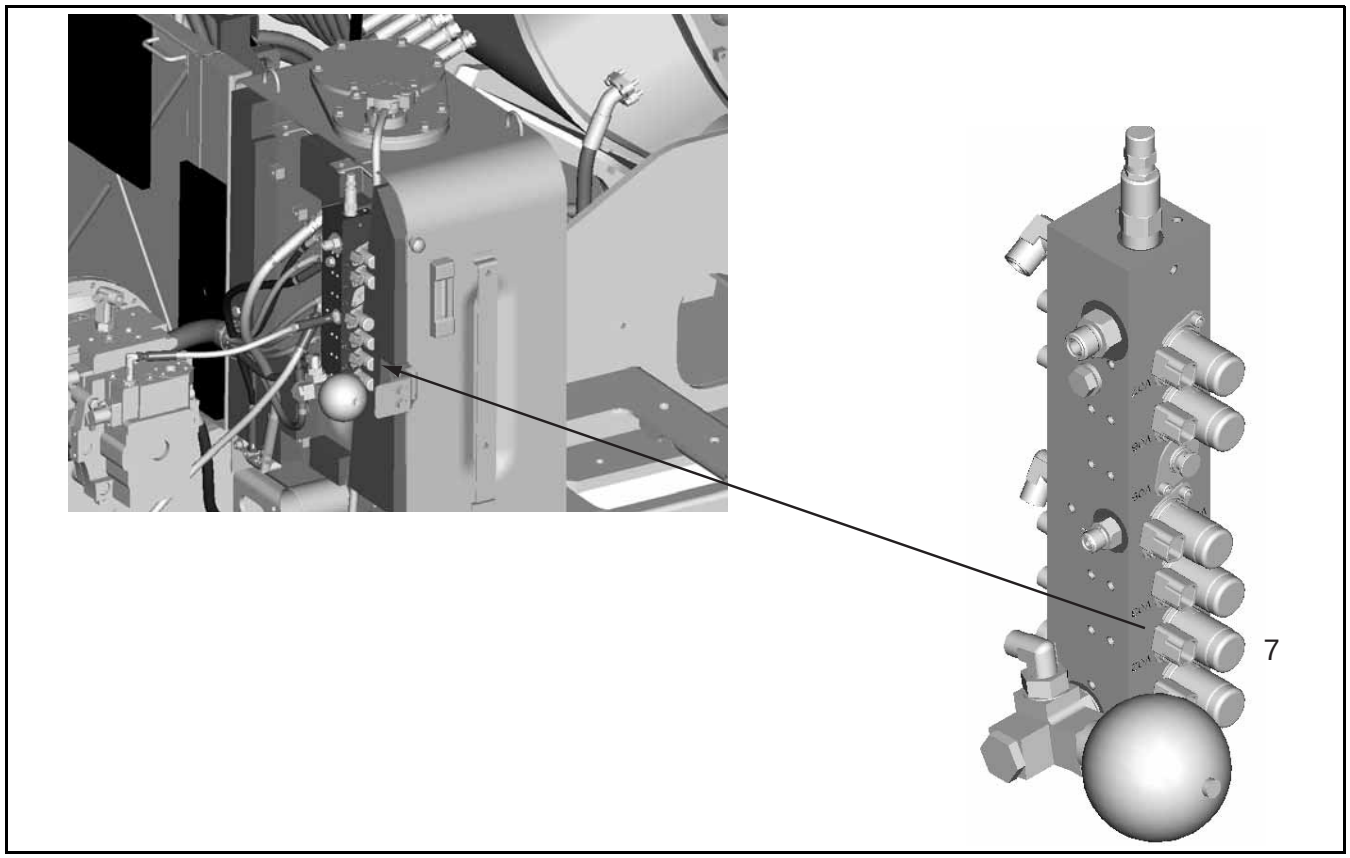
6.1 Travel Creep Solenoid Schematic.



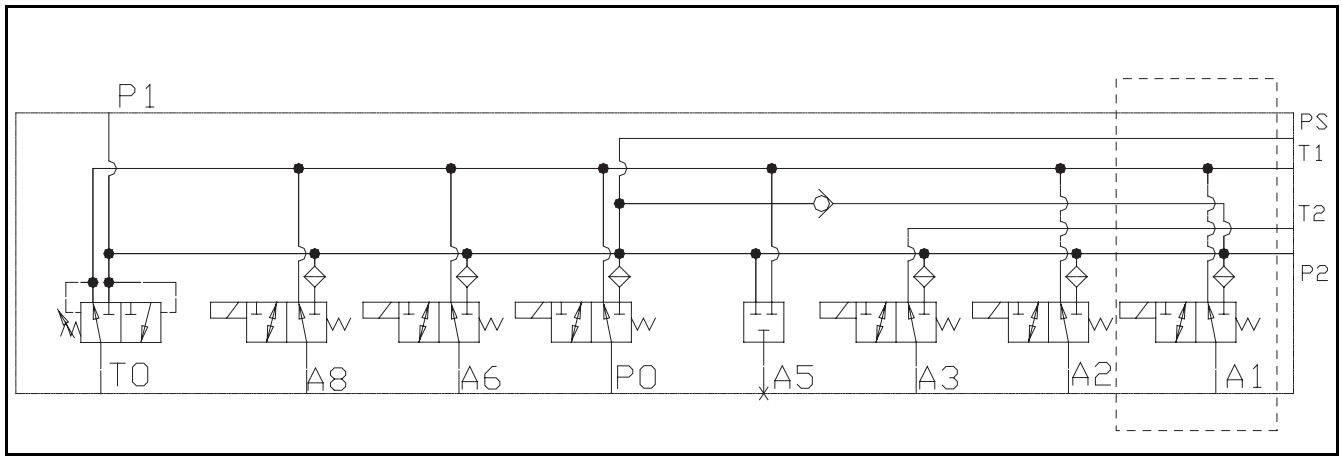
6.2 Travel Creep Solenoid: Located on the 7-stage solenoid manifold in the service compartment at the rear of the operators cab. When this device is activated 'CREEP' mode is selected and travel speed, sends PPC pressure to port X on travel motor ensure travel motor stays at maximum displacement.

Creep Solenoid	Travel Mode Selected	Travel Speed (kph)
On	Creep	0 - 2.5
Off	Low	0 - 9
Off	High	0 - 35
Off	Auto	0 - 35

7. 2-Stage Relief Solenoid.



7.1 2-Stage Relief Solenoid Schematic.

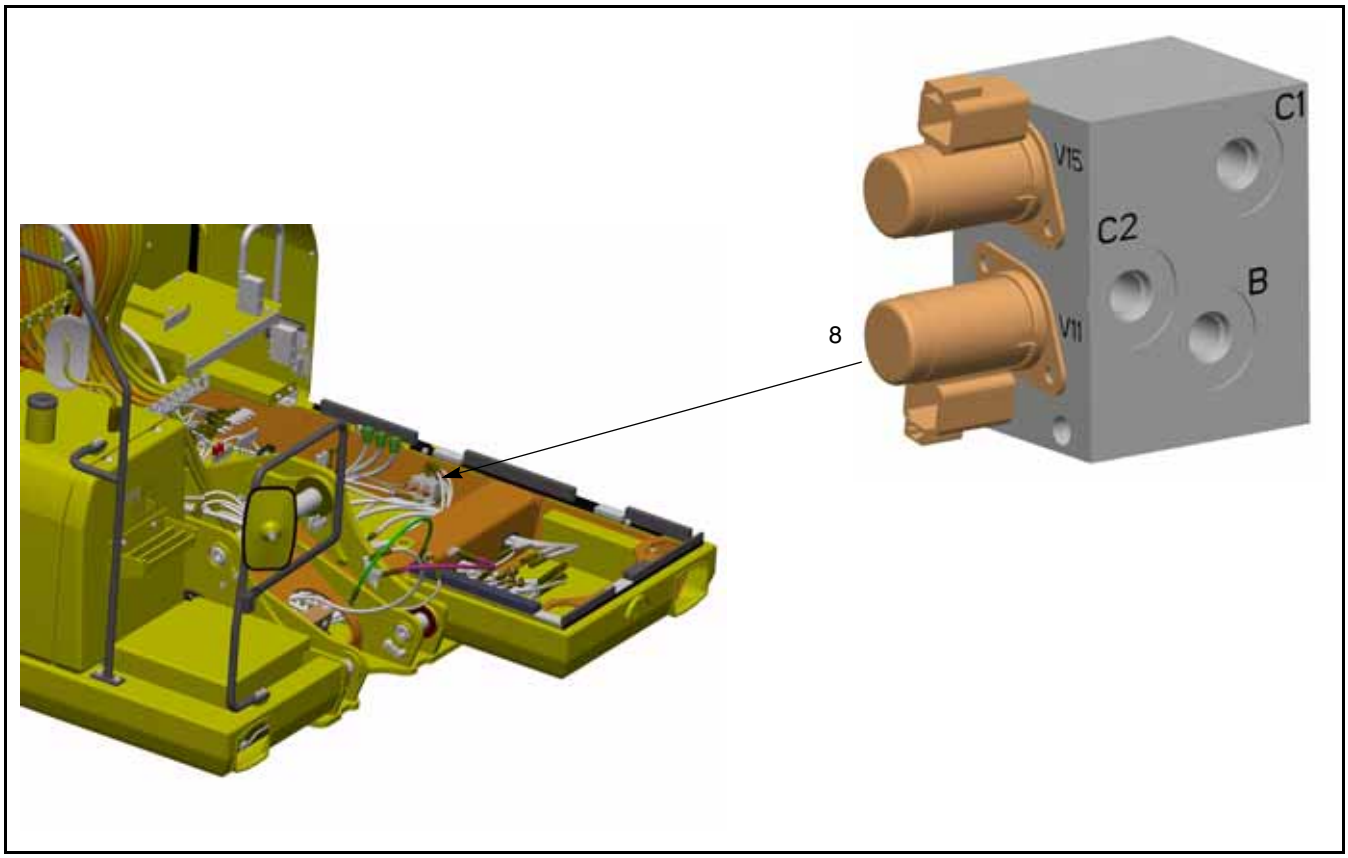


7.2 2-Stage Relief Solenoid: Located on the 7-stage solenoid manifold in the service compartment at the rear of the operators cab. This device is activated when the forward / reverse travel solenoid is selected.

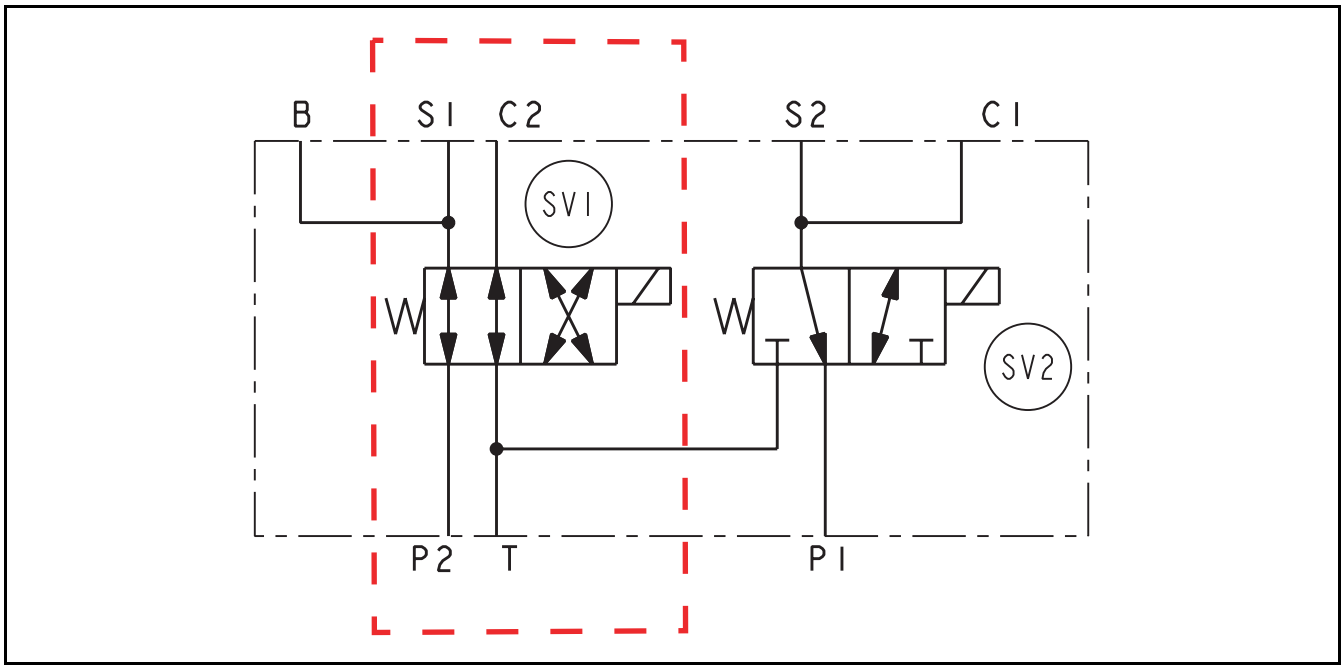
- The relief pressure in the normal working mode is 34.8 Mpa (355 kg/cm^2). If the 2-stage relief function is turned on, however, the relief pressure rises to about 37.2 MPa (380 kg/cm^2).
  By this operation, the hydraulic force is increased further
- Operating condition for turning on 2-stage relief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

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

8. Transmission Clutch Control Valve



8.1 Transmission Clutch Control Valve Schematic.

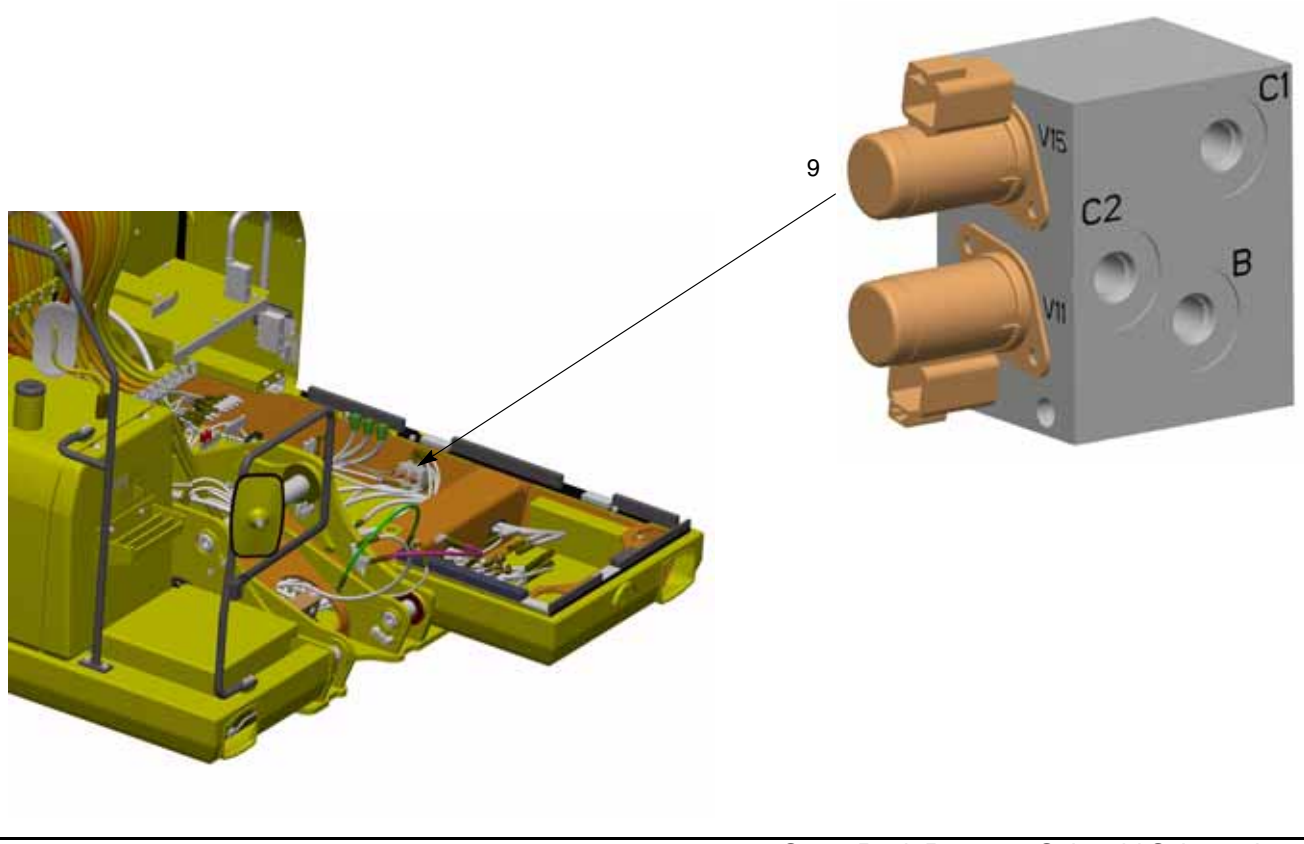


8.2 Hi / Lo Solenoid Valve: Located on the 2-stage solenoid block in the service compartment at the rear of the operators cab. This device is activated-when 'HI or 'LO' speeds are selected.

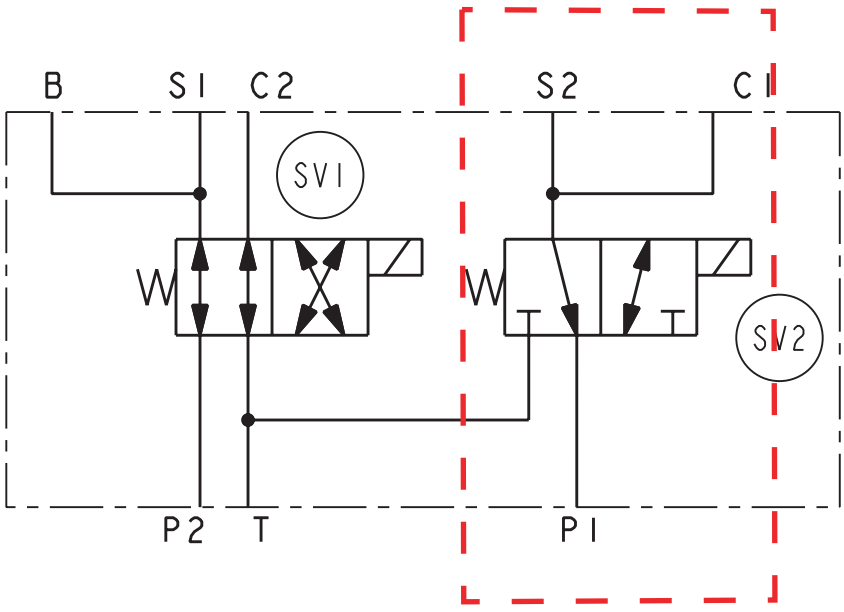
Solenoid On	Lo	0 - 9 kph
Solenoid Off	Hi	0 - 35 kph *

* : To max speed

9. 2 Stage Back Pressure Solenoid.



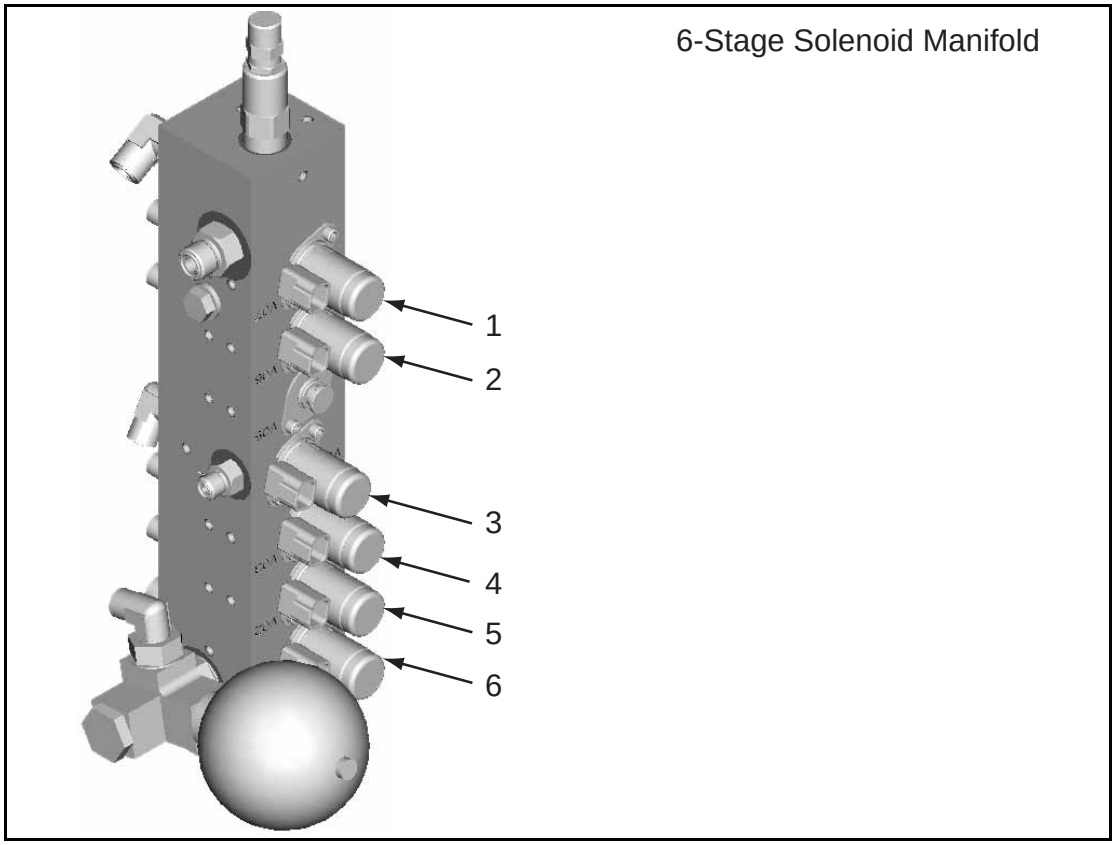
9.1 2 Stage Back Pressure Solenoid Schematic.



9.2 2-Stage Back Pressure Solenoid: Located on the solenoid block in the service compartment at the rear of the operators cab. This device enables the back pressure valve to supply pressure thus preventing cavitation to the travel motor.

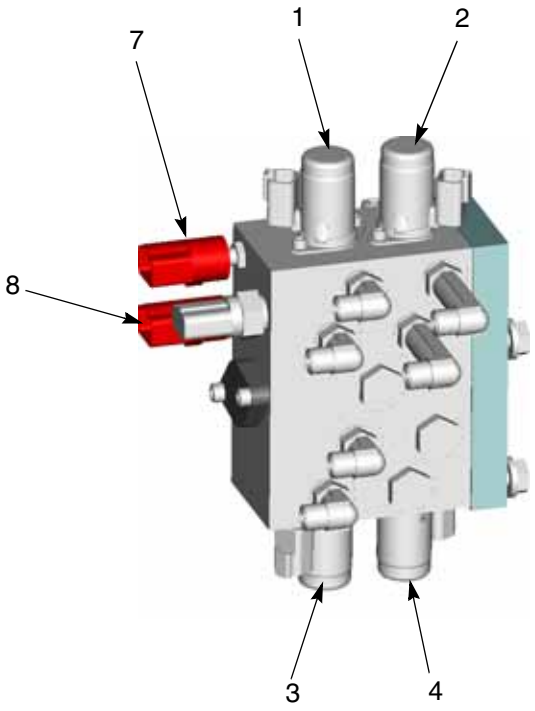
Solenoid Off	8 Bar
Solenoid On	4 Bar

10. Solenoid Valves & Pressure Switches

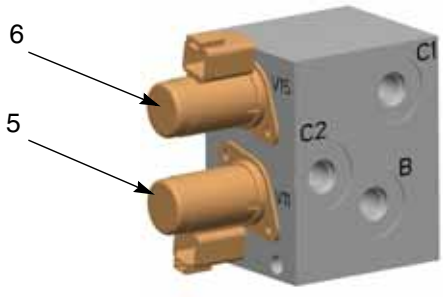


Solenoid Valves			
1	Travel Creep (see page 10-226)	4	Swing Brake
2	Travel Neutral (see page 10-225)	5	2 Stage Relief (see page 10-227)
3	Suspension Lock Valve	6	PPC Hyd Pressure Lock

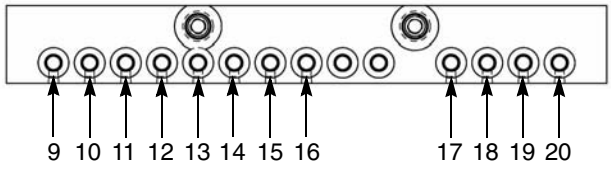
4-Stage solenoid manifold



2-Stage solenoid manifold



PPC manifold



Solenoid Valves		Pressure Switches	
1	Forward / Reverse Travel	7	Travel Reverse
2	Boom / Stabilizer Down	8	Travel Forward
3	Boom / Stabilizer Up	9	Left swing - P_{21*}
4	Rotate - CW / ACW	10	Arm dump - P_{61*}
5	Hi / Lo	11	Arm dig - P_{51*}
6	2-Stage Back pressure	12	Right swing - P_{11*}
		13	2nd HCU - PA_{11**}
		14	2nd HCU - PA_{9**}
		15	Adjust cylinder retract - P_{81***}
		16	Adjust cylinder extend - P_{71***}
		17	Bucket dig - P_{31*}
		18	Boom down - PA_{7*}
		19	Bucket dump P_{41*}
		20	Boom raise - PA_{5*}

* Pressure switch fitted to this port

** Pressure switch fitted to this port if 2 attachment fitted

*** Pressure switch fitted to this port if 2 piece boom fitted

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 'A' and the service port 'B' 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.

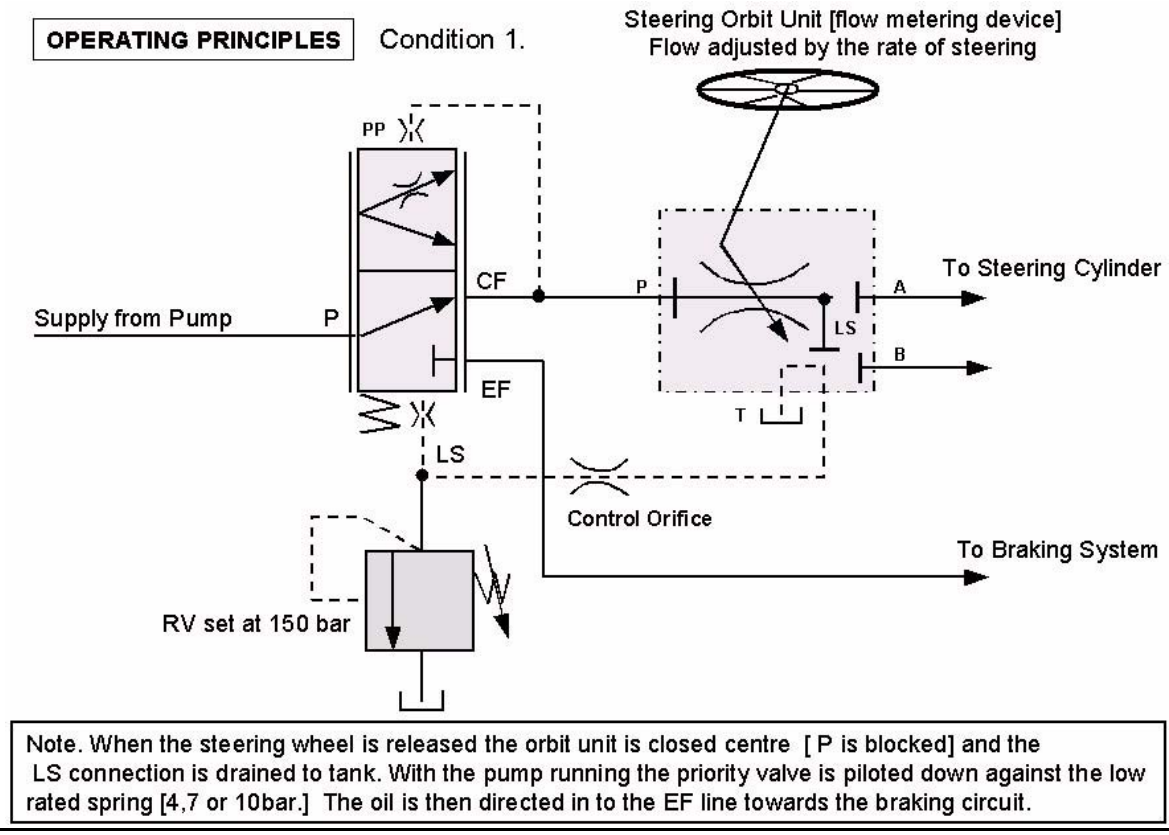
In the static LS system the LS chamber is filled with oil from the LS port in the steering unit.

2 - stage principle

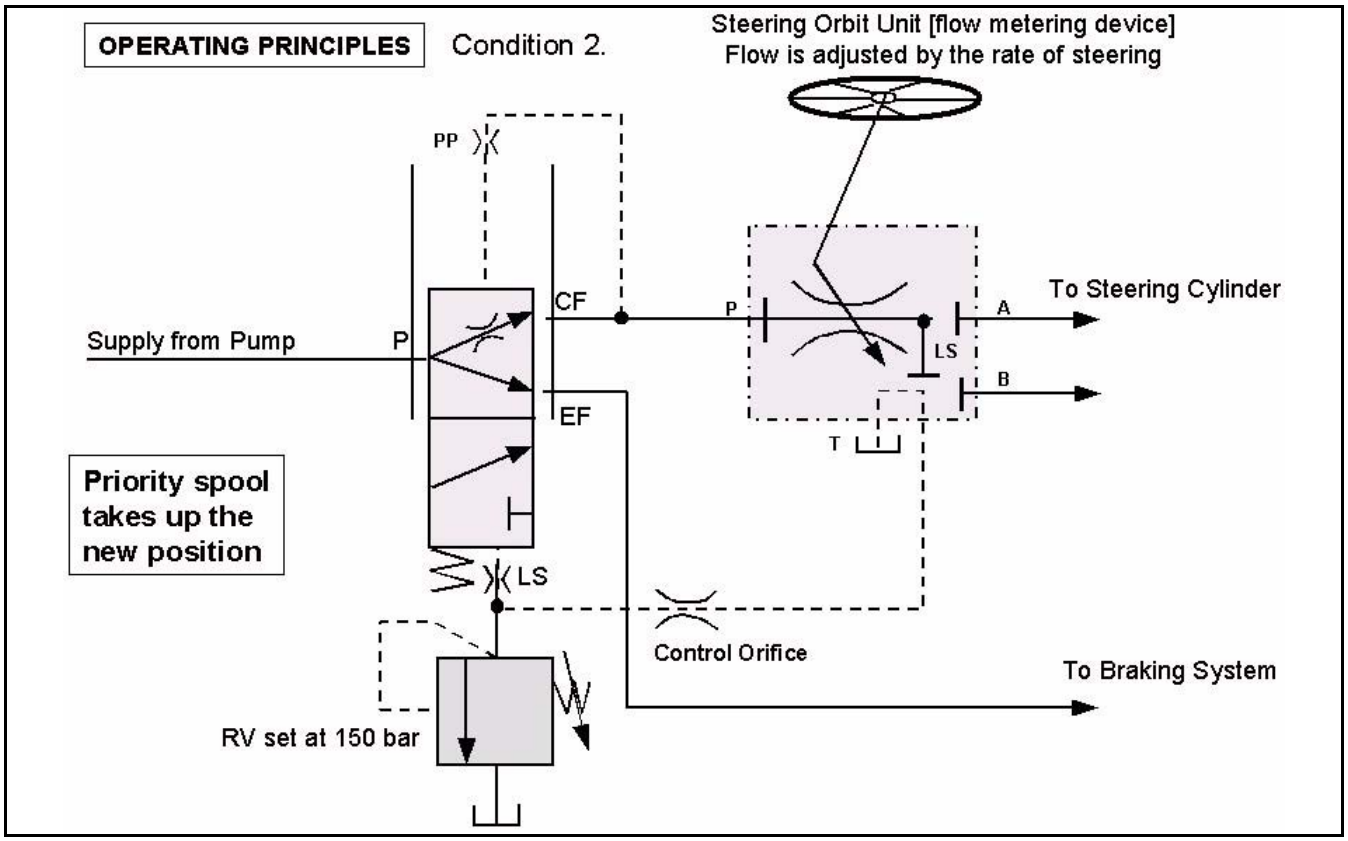
Any valve operation in which the main stage is controlled by a pilot stage and involves the application of a control orifice to create a pressure differential between the ends of the main stage to offset the effect of the main stage spring is operating on the 2-stage principle.

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

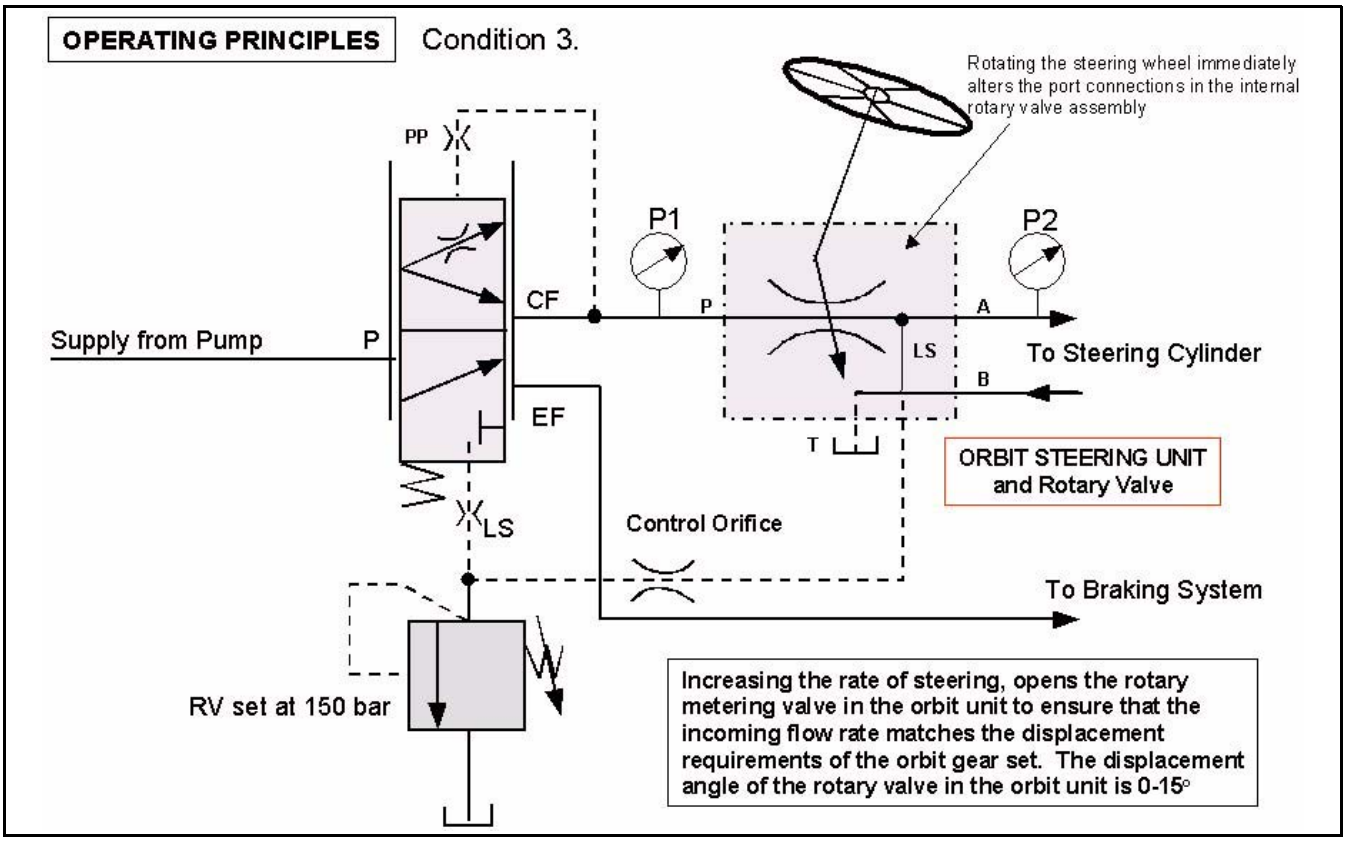
1. Condition 1.



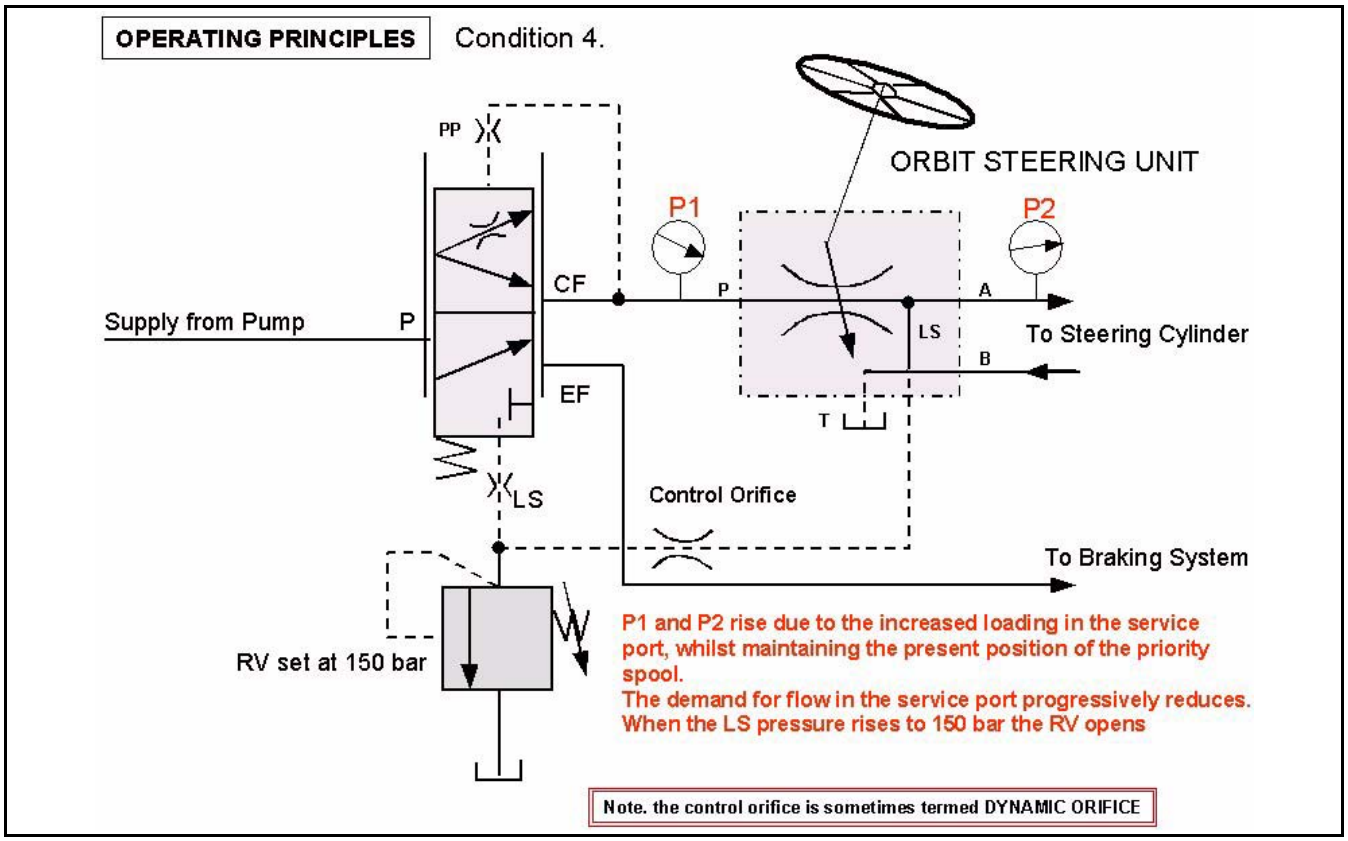
2. Condition 2.



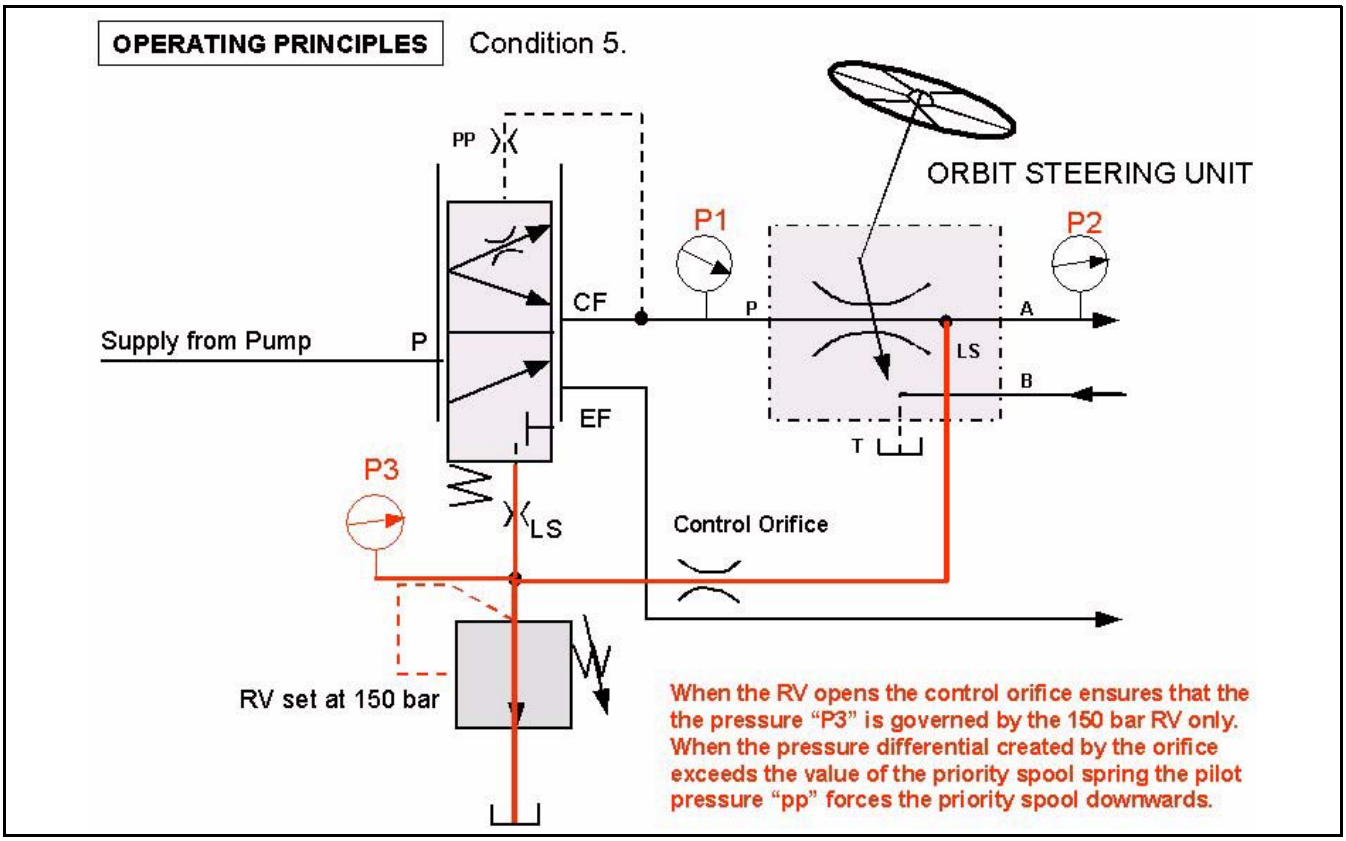
3. Condition 3.



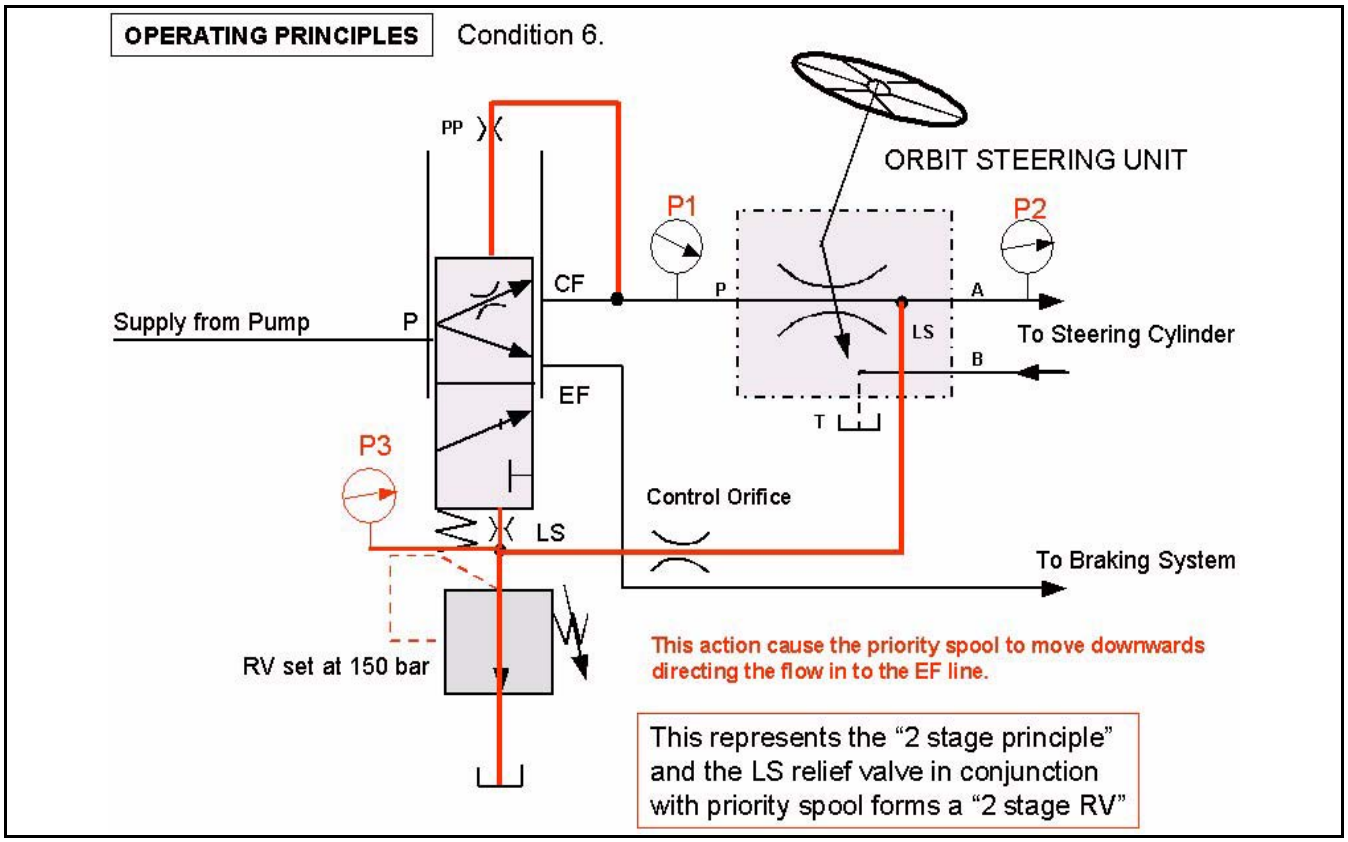
4. Condition 4.



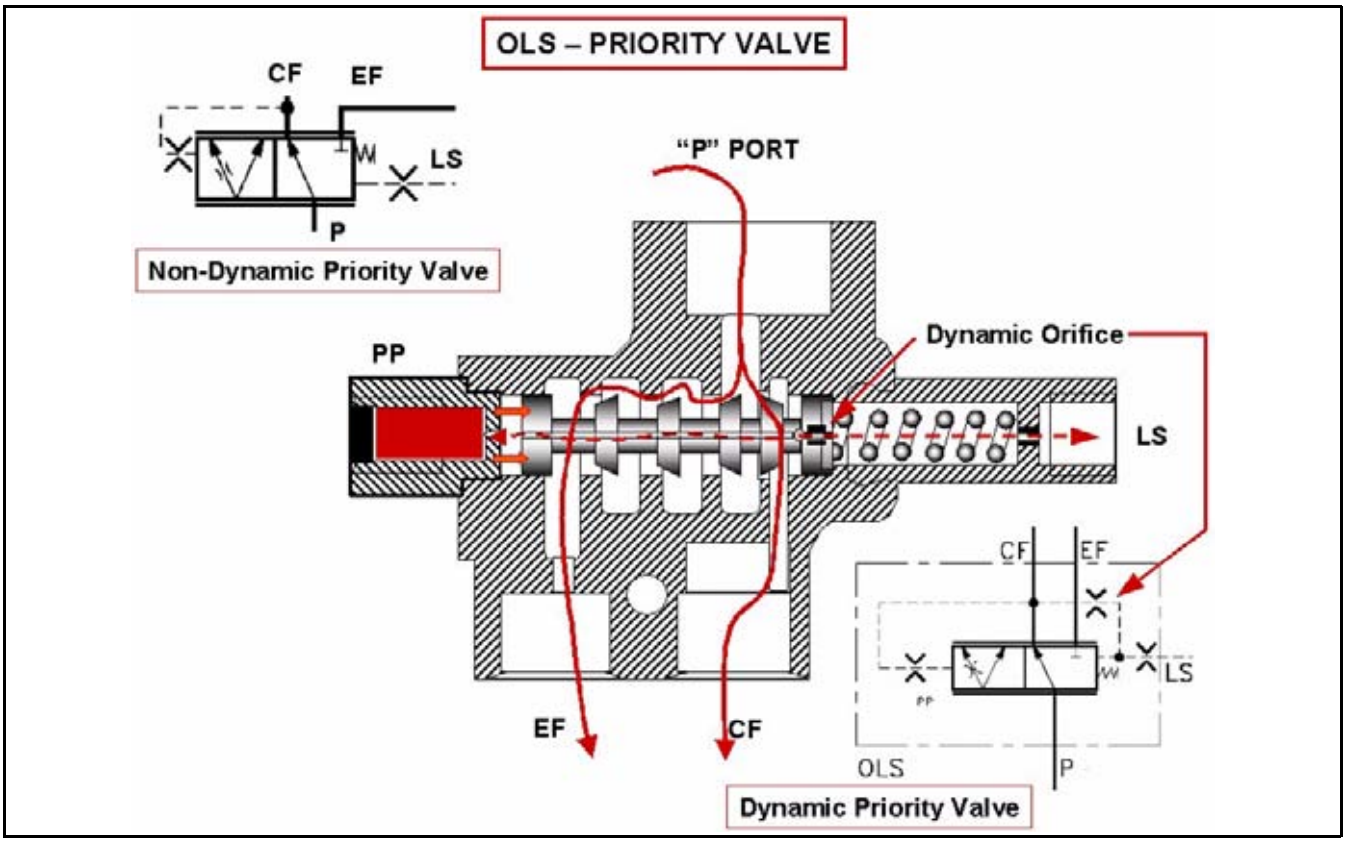
5. Condition 5.



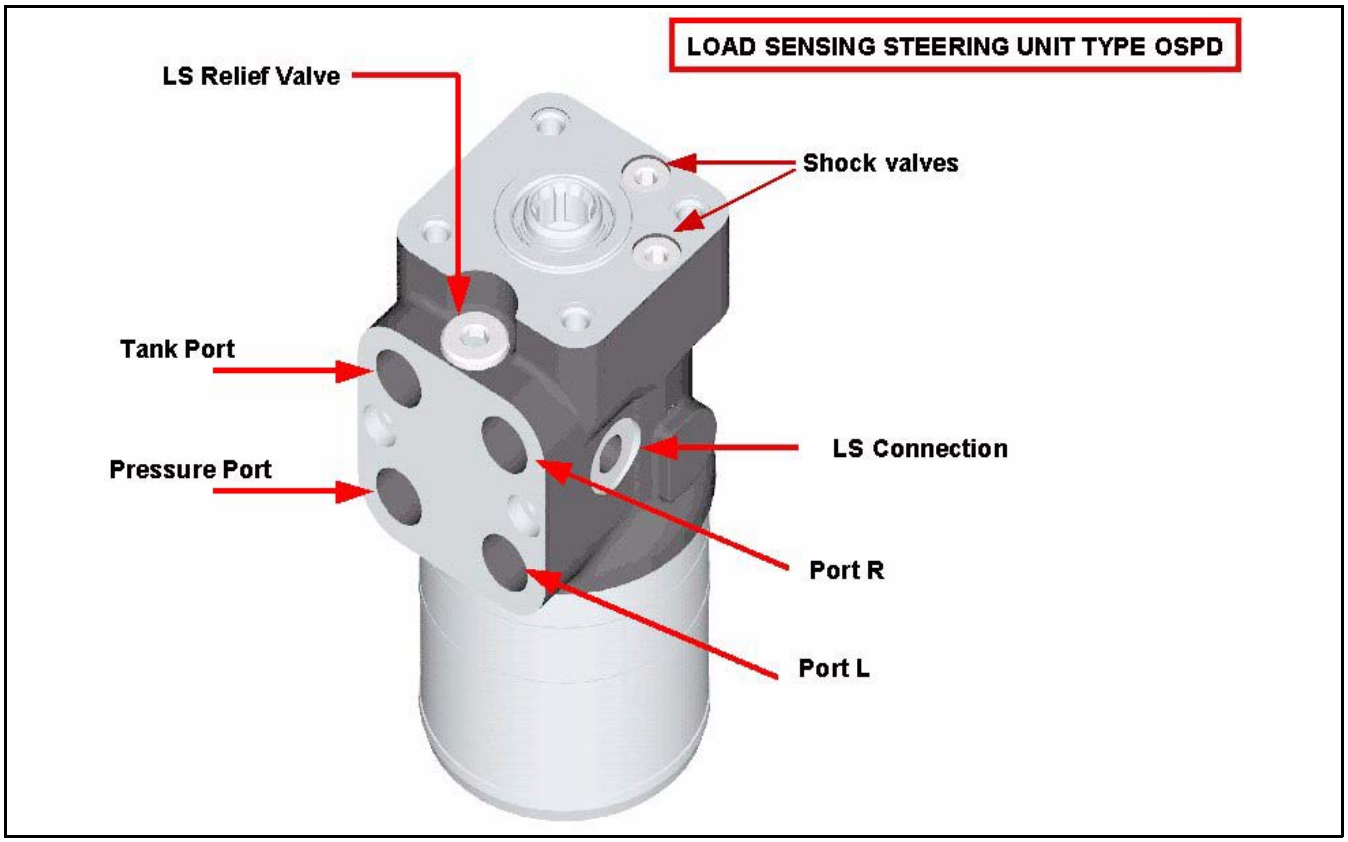
6. Condition 6.



7. OLS Priority Valve.



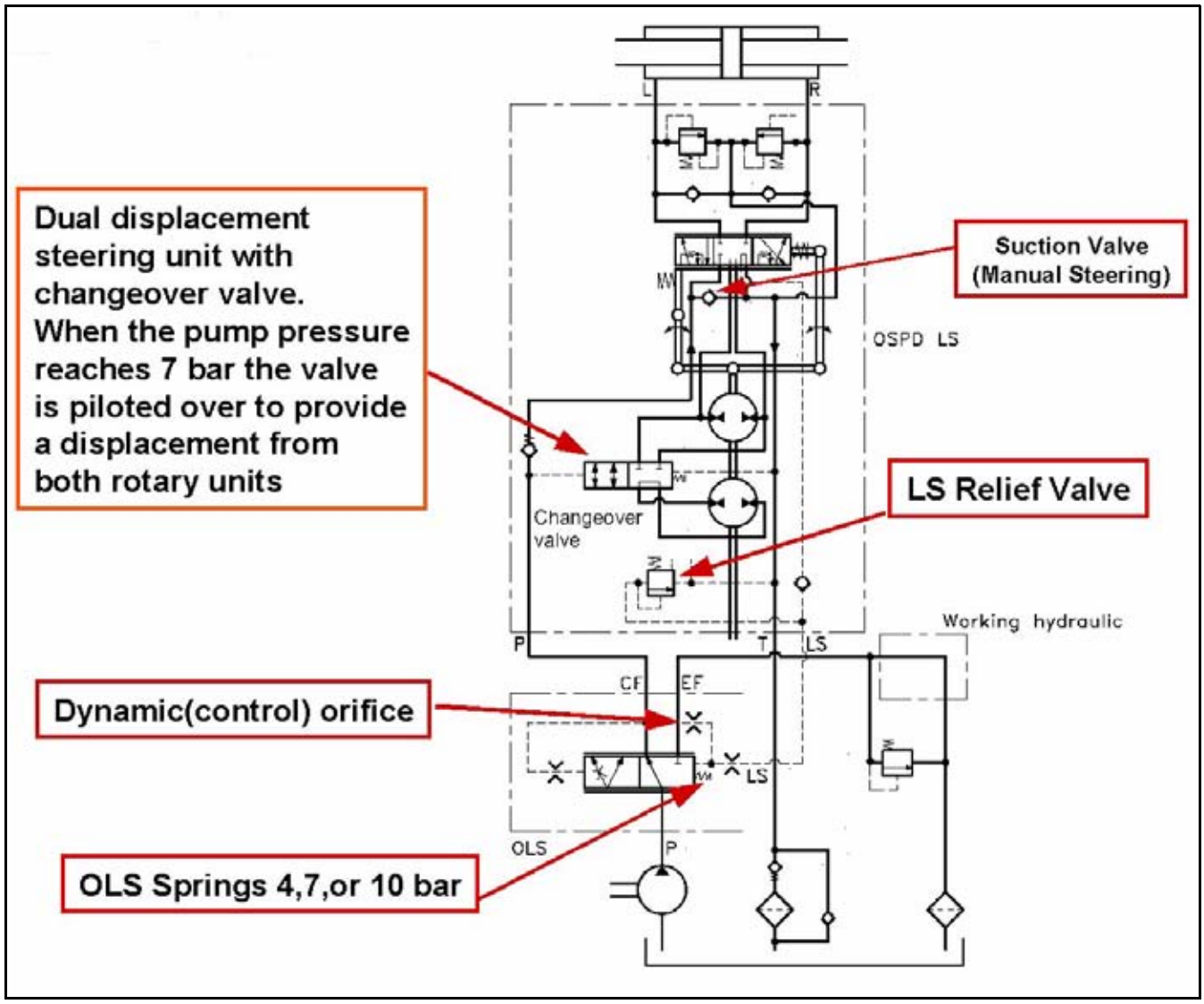
8. Load sensing steering unit

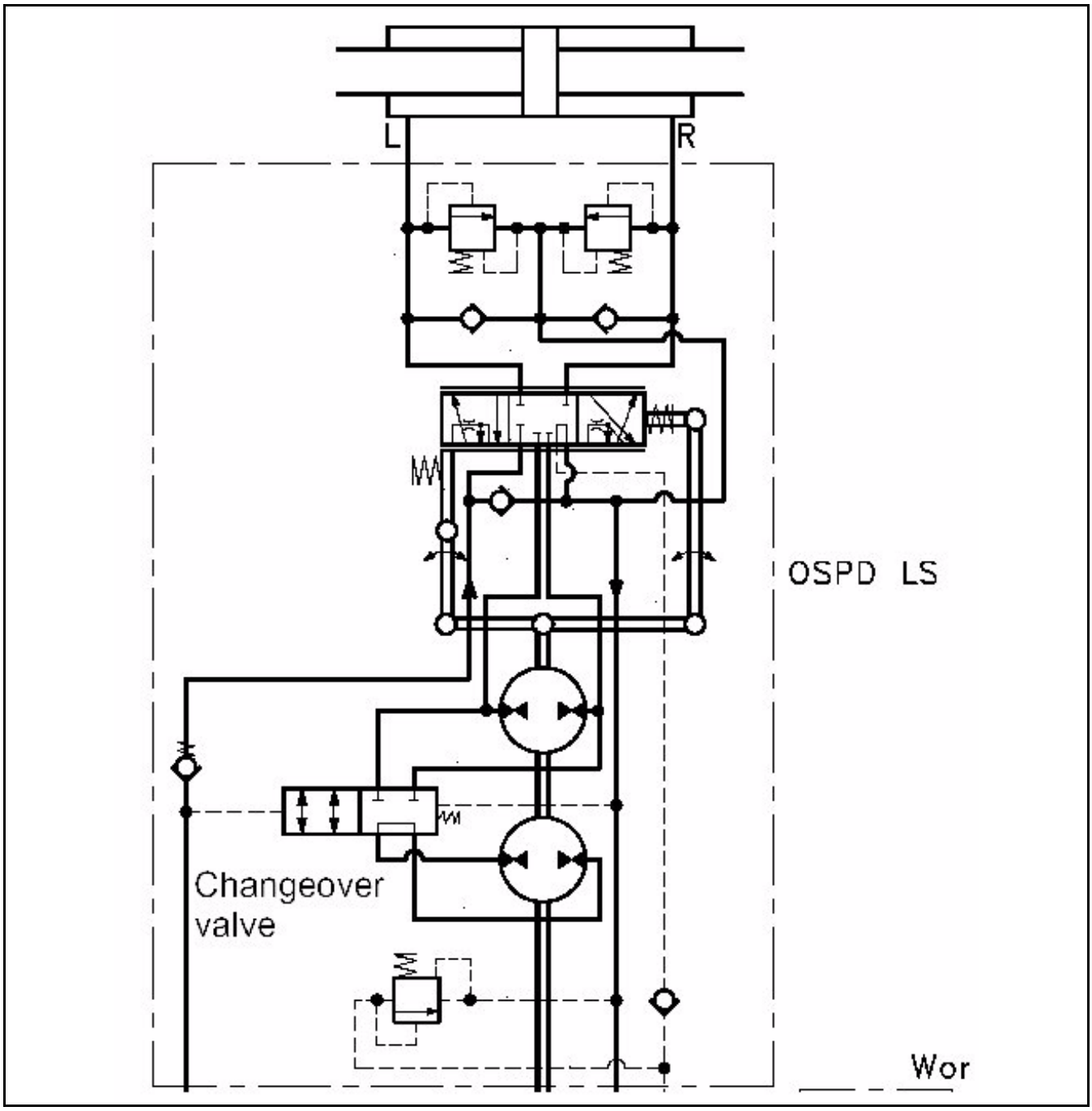


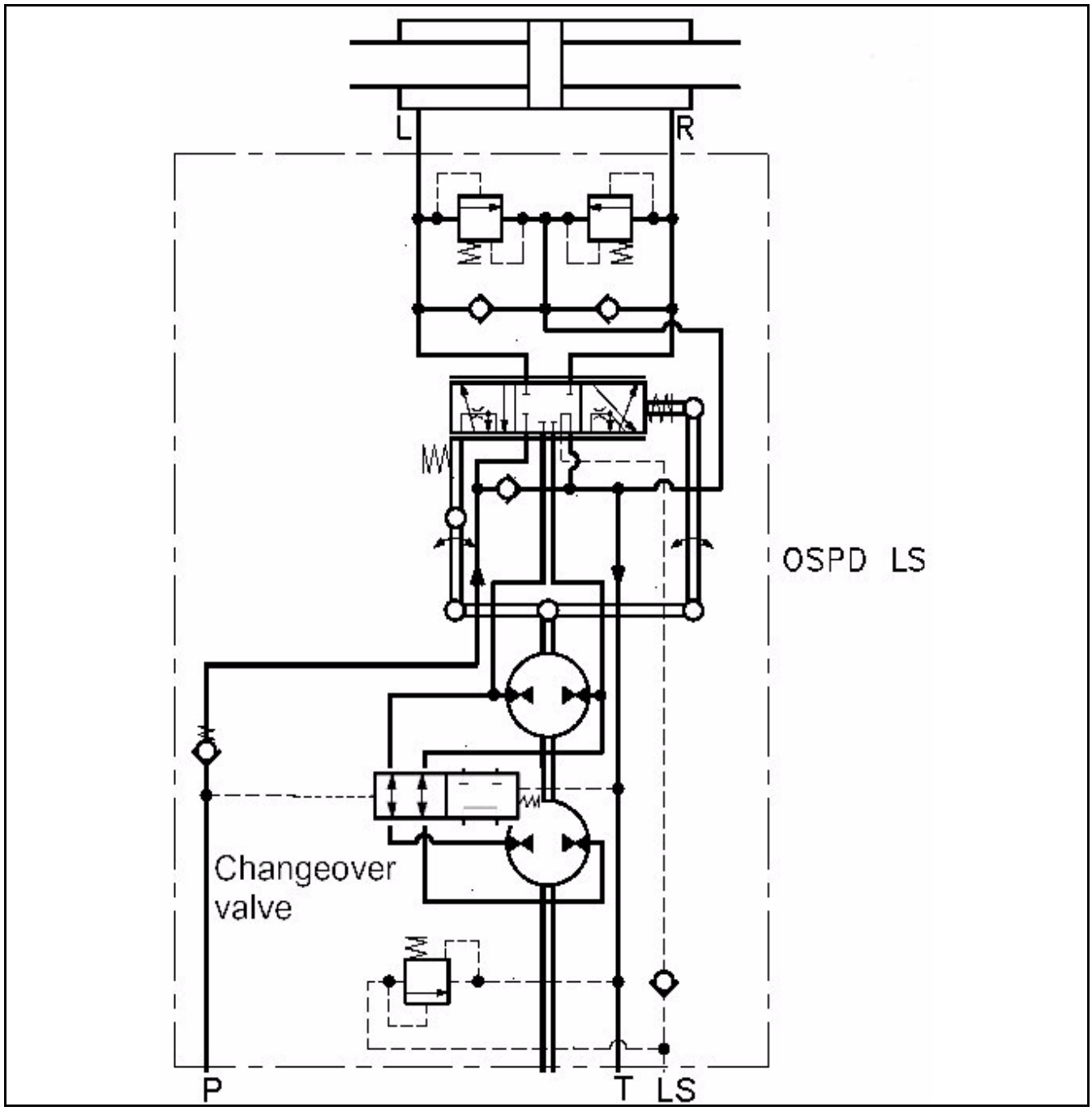
Technical data			
Displacement	Small gear wheel set	70 cc/rev.	
	Large gear wheel set	100 cc/rev.	
	OSPD 70/170	Small gear set	70 cc/rev.
		Large gear set	170 cc/rev.

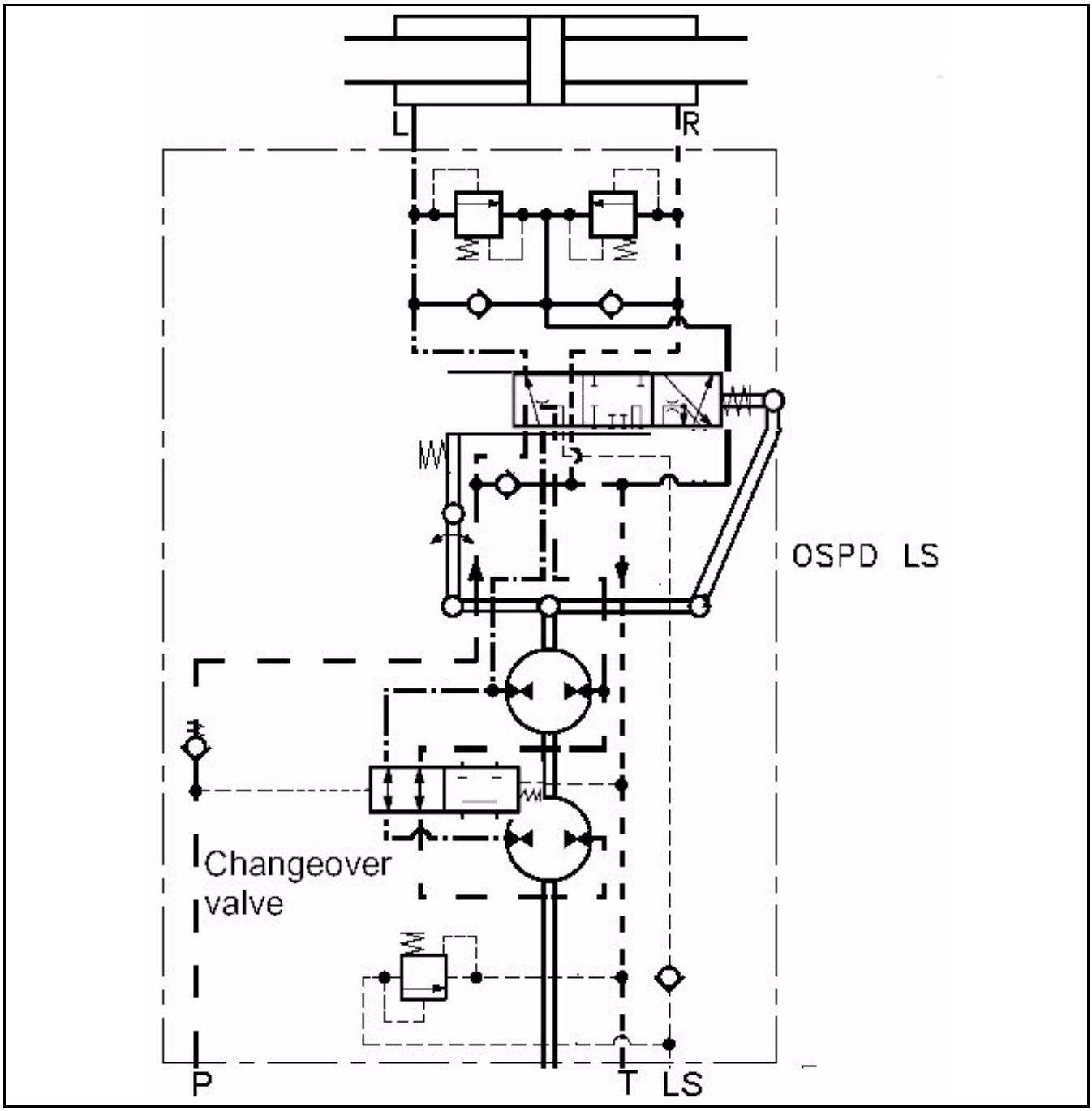
Valve functions	Pilot pressure relief valve
	Shock valves
	Suction valves
	Check valves in LS-connection
	Check valves in P connection

Pressure	Max. pressure in P - port	205 bar
	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
OSPD LS
Changeover valve
Working hydraulic
L
R
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

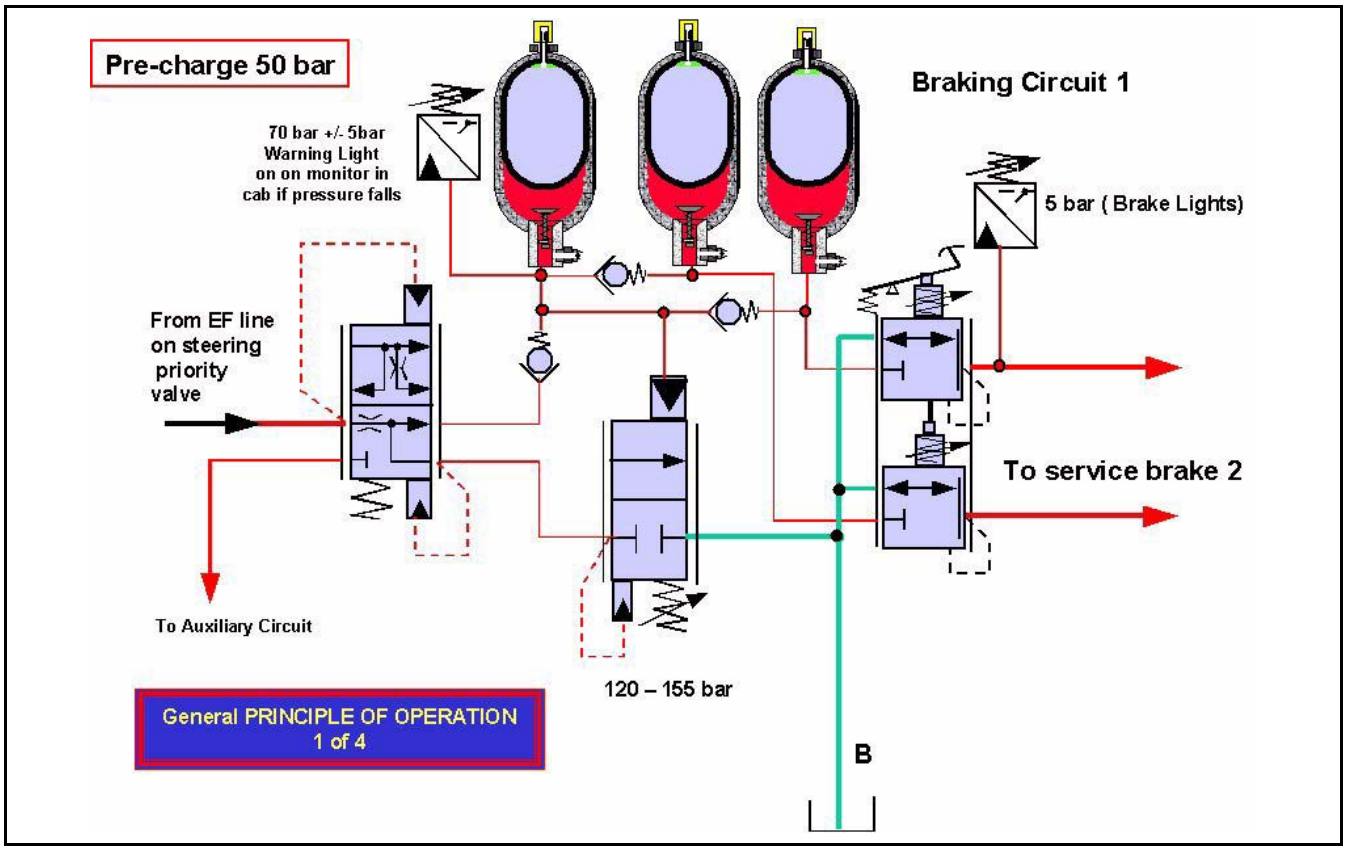
The hydraulic braking system unit contains the following services.

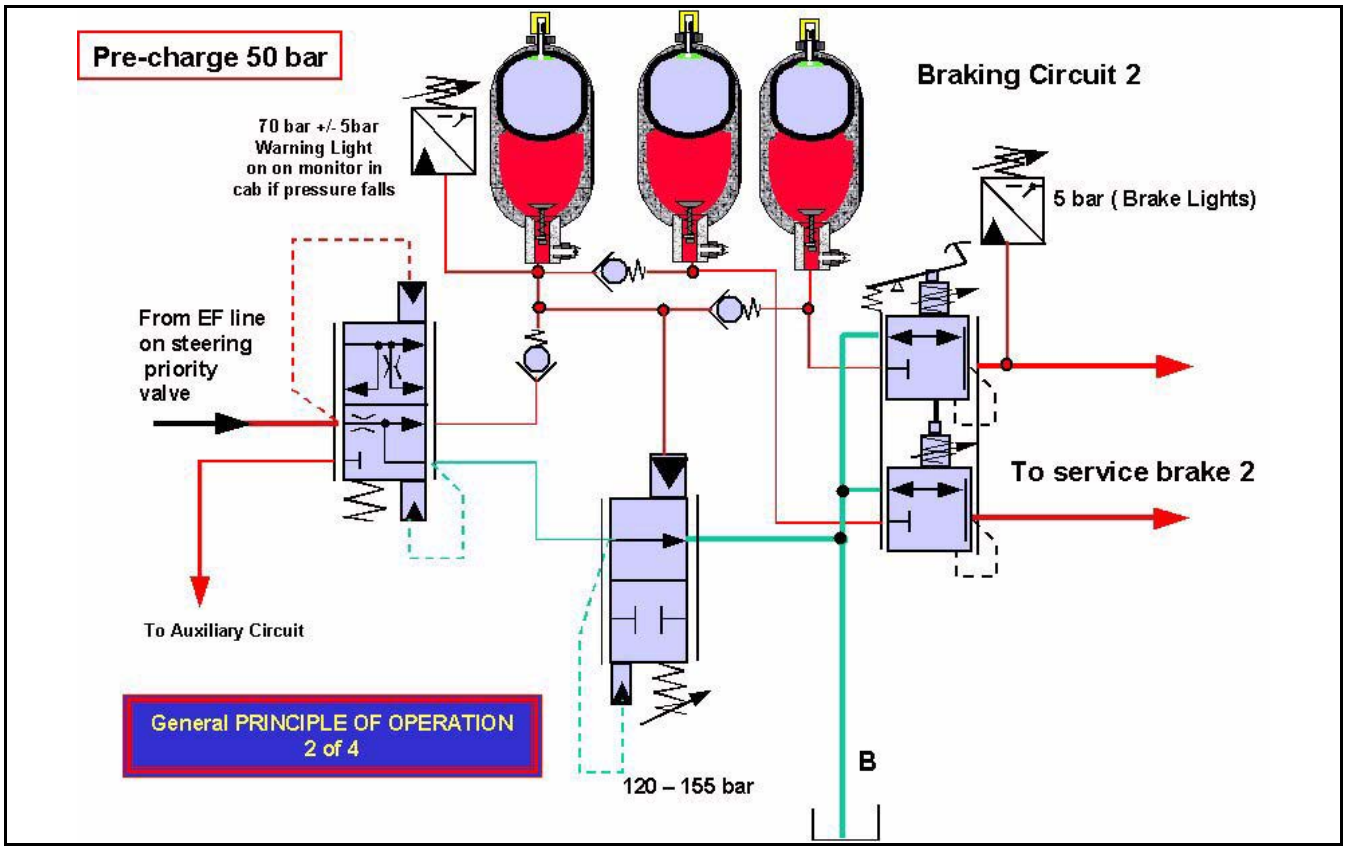
- Inlet Bypass Valve:
  distributing flow to other services when braking demand is low or not required.

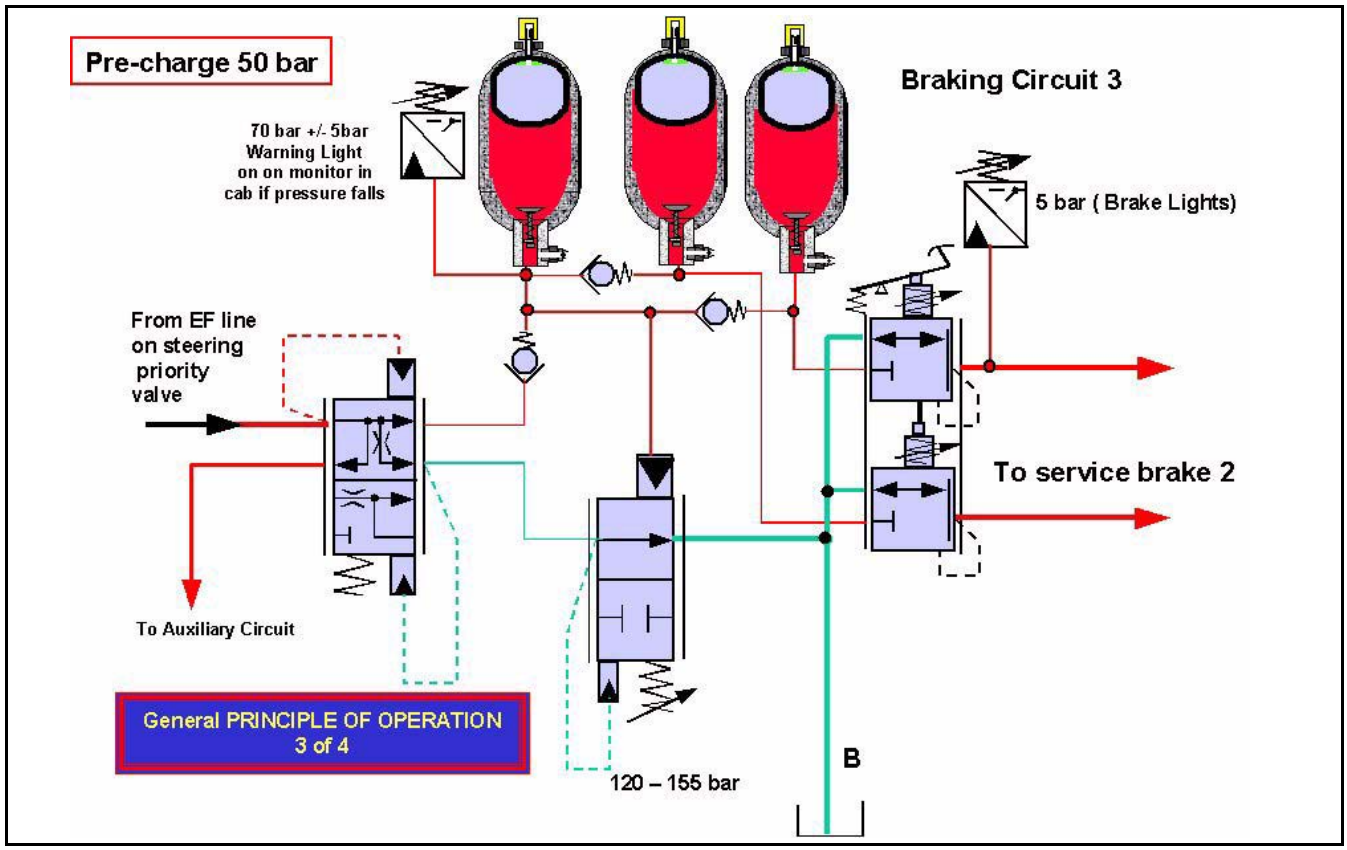
- Accumulators:
  for fluid storage providing a number of brake operations (usually 5 ~ 8 operations depending upon accumulator capacity)

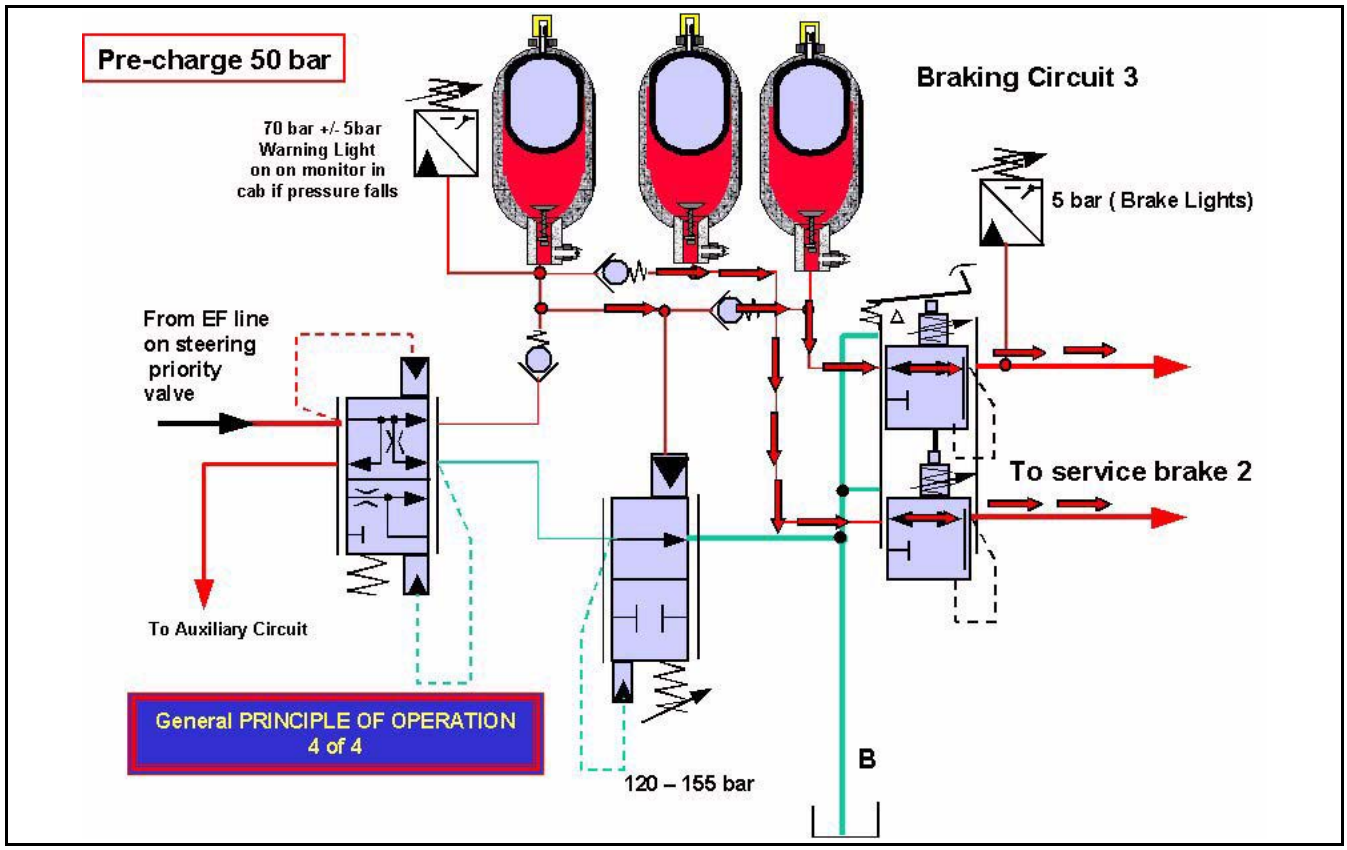
- Check Valves:
  to isolate the inlet supply from the charged accumulators and isolate individually charged accumulators from each other, thereby allowing individual brake circuits to be controlled.
  NOTE: Service brakes1 and 2 are individually supplied but simultaneously applied.

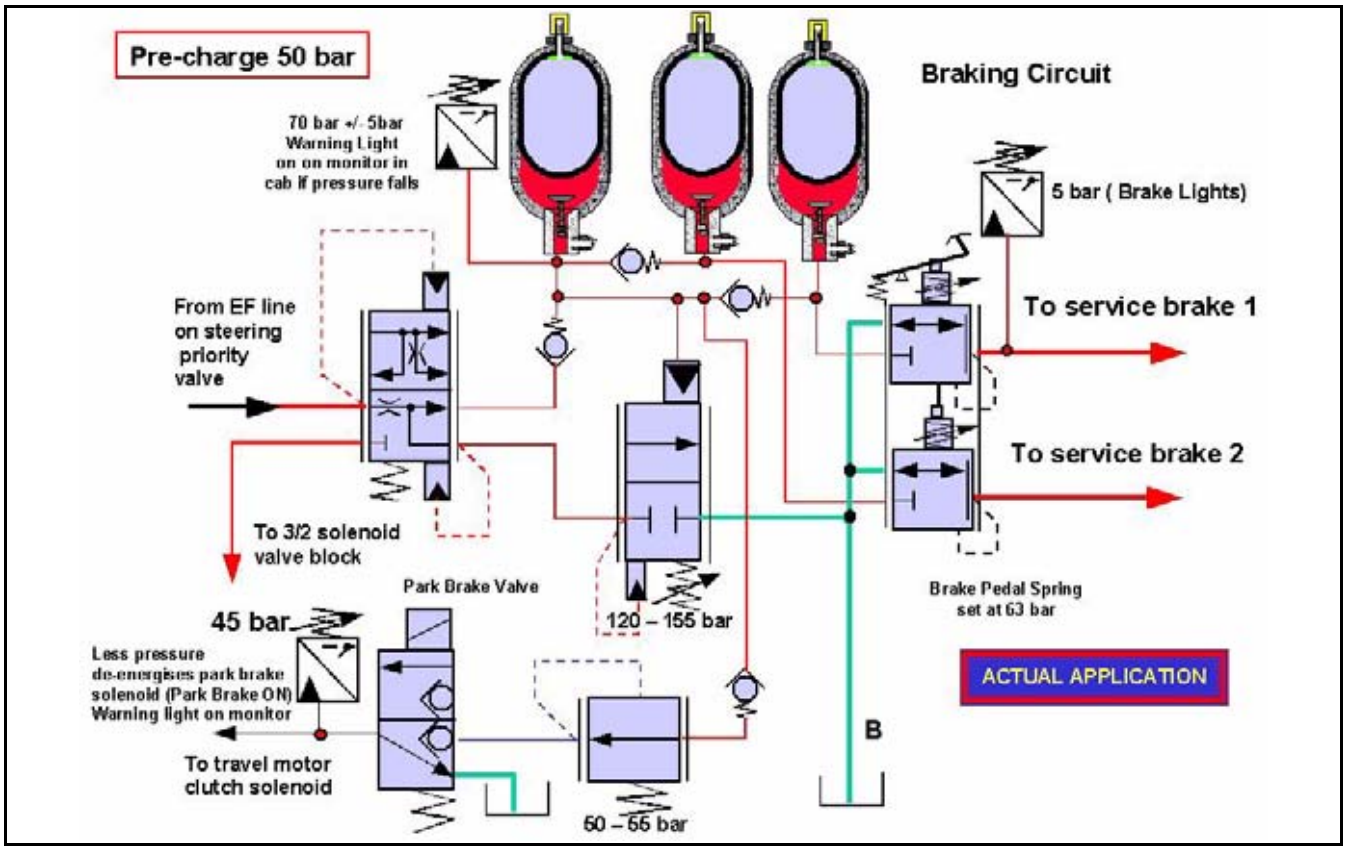
- Pressure Limiting Valve:
  to control the maximum pressure in the accumulators. This valve provides relief valve protection and diverts the fluid via its unloaded valve action.


Pre-charge 50 bar
Braking Circuit 1
70 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
70 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
2 of 4
B


Pre-charge 50 bar
70 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
70 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

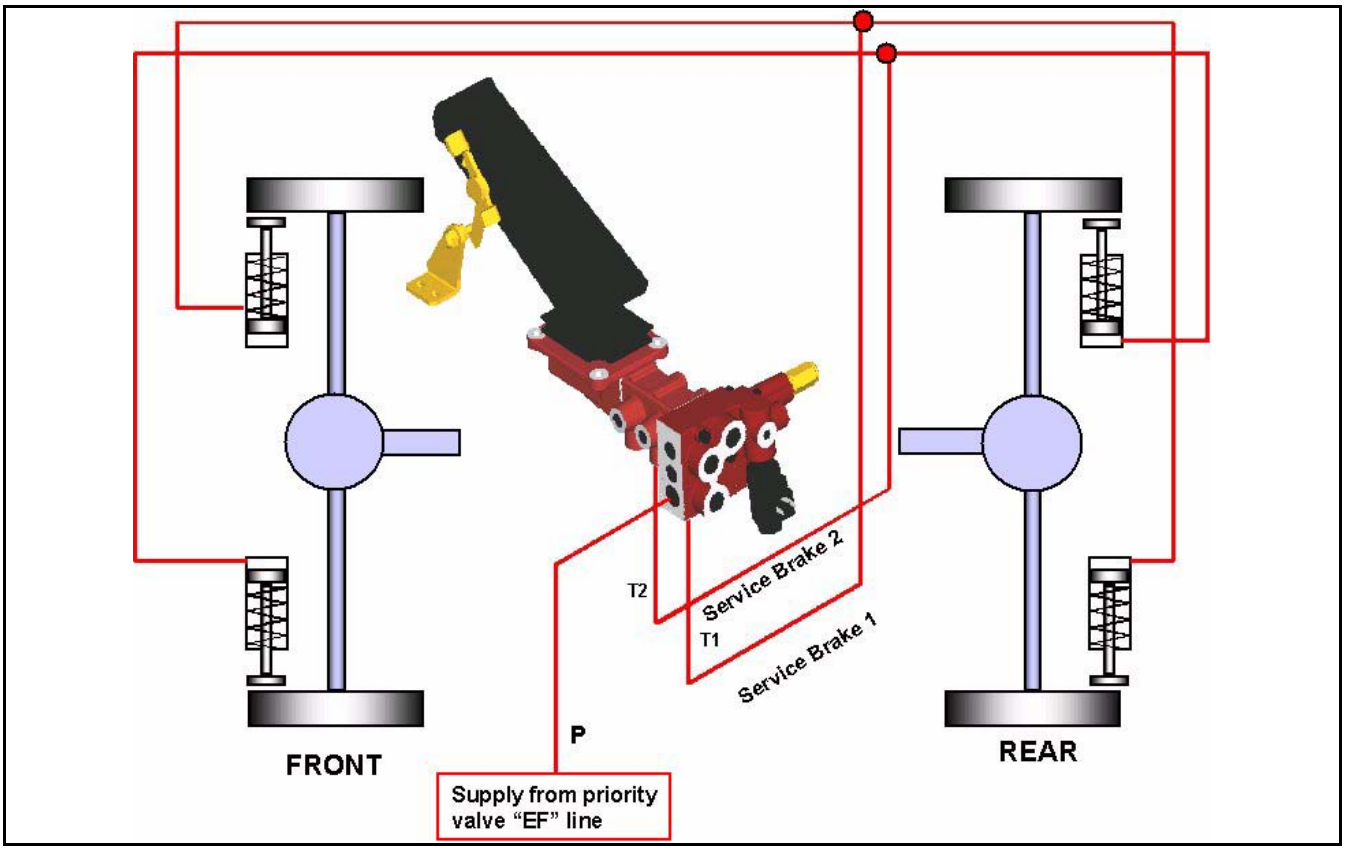
- Oil from the steering priority valve passes at a controlled rate to charge the accumulators. The inlet bypass valve is spring biased into the position shown and hydraulically balanced.
- When the oil pressure in the accumulators reach the cracking pressure of the pressure limiting valve it begins to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

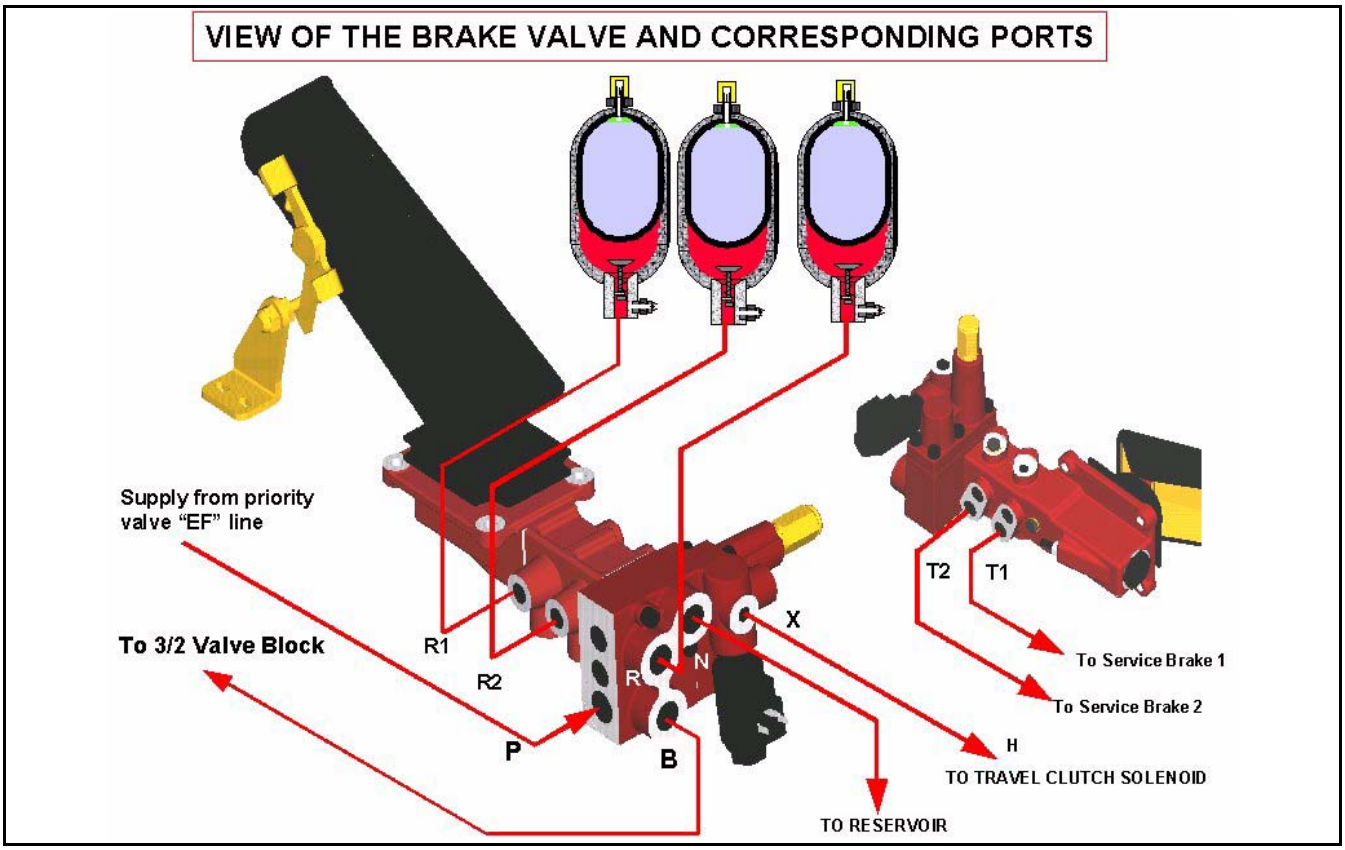
  Between 120 and 155 bar the accumulators continue to charge until the bottom pilot signal on the inlet bypass valve is diverted to tank, allowing the inlet bypass valve to move downwards thereby diverting all the incoming flow to the auxiliary circuit.

  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.

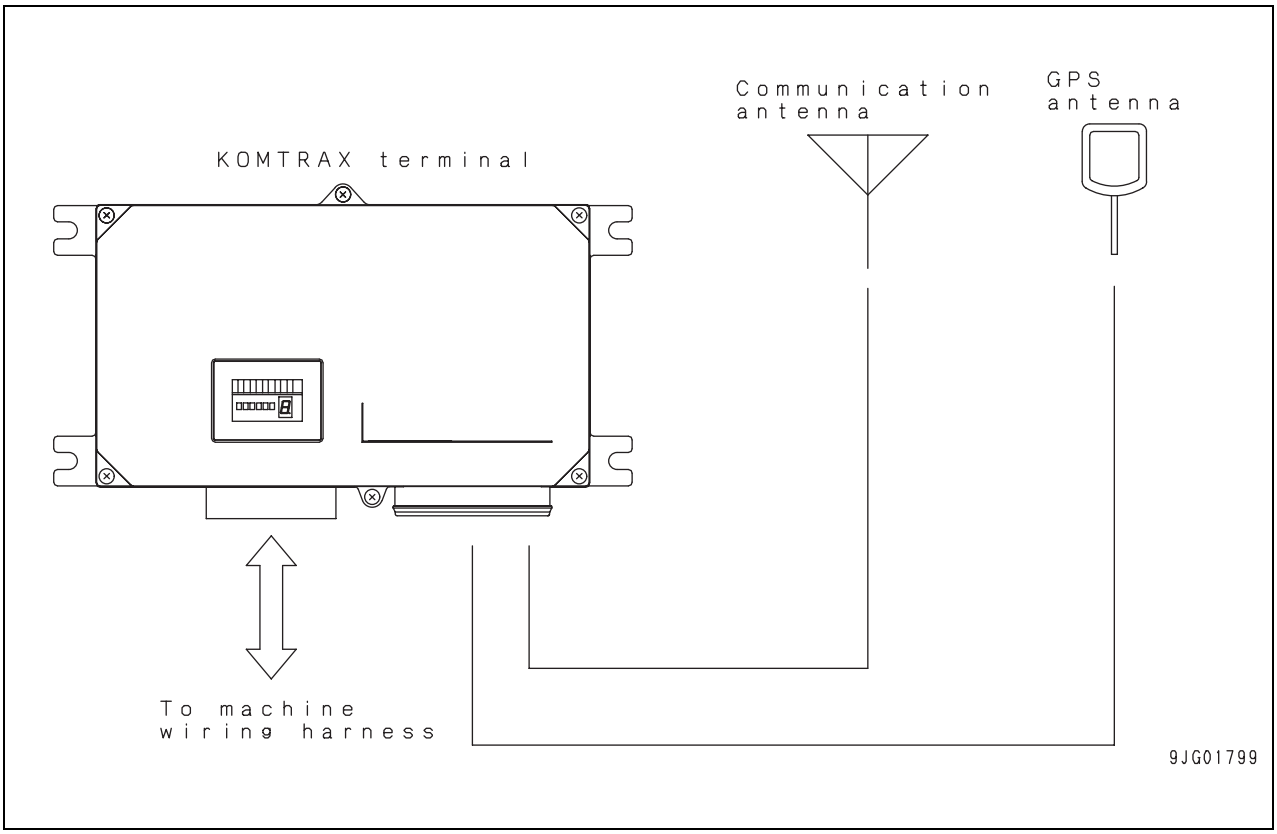
  As the brakes are applied the accumulator volumes and associated pressure will fall. This action will allow the pressure limiting valve to gradually close as the pressure falls below 155 bar.

  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
TO TRAVEL CLUTCH SOLENOID
TO RESERVOIR
T2
T1
To Service Brake 1
To Service Brake 2

KOMTRAX TERMINAL SYSTEM



- The KOMTRAX terminal system transmits various kinds of machine information wirelessly. Persons to operate the KOMTRAX can refer to the information at office to provide various kinds of services for customers.
- Information transmittable from the KOMTRAX terminal system includes the following.

  1.Operation map

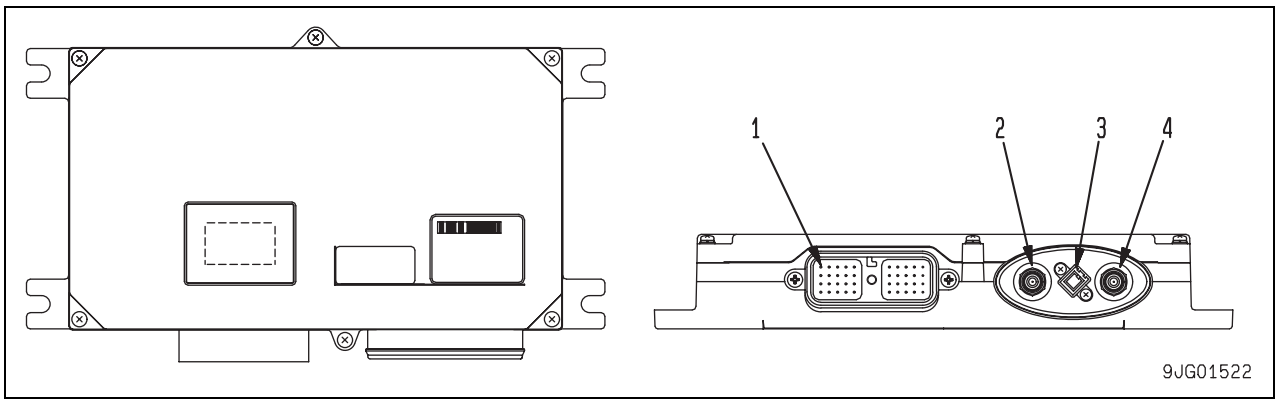
  2.Service meter

  3.Position information

  4.Error history

  and others.

KOMTRAX terminal



1. DRC connector connection (40 poles)
2. (Do not connect any cable)
3. GPS antenna connection
4. Film antenna connection

- The KOMTRAX terminal obtains various kinds of machine information from the network signals and input signals in the machine and transmits them via the wireless communication antenna. It contains a CPU (Central Processing Unit) and has wireless communication function and GPS function.
- This terminal has an LED lamp unit and a 7-segment display lamp unit used for inspection and troubleshooting.

Input and output signals

DRC conector

Pin No.	Signal name	Input/output
1	—	—
2	—	—
3	—	—
4	—	—
5	—	—
6	CAN shield GND	—
7	CAN signal (L)	Input/output
8	CAN signal (H)	Input/output
9	S-NET shield GND	—
10	S-NET signal	Input/output
11	—	—
12	—	—
13	—	—
14	—	—
15	—	—
16	—	—
17	—	—
18	—	—
19	—	—
20	Relay output	output
21	Input for check	Input
22	Input for check	Input
23	—	—
24	—	—
25	—	—

*1: Never connect to NC or malfunctions or failures will occur.

DRC conector

Pin No.	Signal name	Input/output
26	—	—
27	C-terminal input (Hi side)	Input
28	R-terminal input	Input
29	—	—
30	—	—
31	—	—
32	—	—
33	—	—
34	—	—
35	—	—
36	ACC input (analog)	Input
37	Power GND	—
38	Power GND	—
39	Regular power	Input
40	Regular power	Input

*1: Never connect to NC or malfunctions or failures will occur.

Blank for technical reason

20 TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR ENGINE RELATED PARTS 20-2
STANDARD VALUE TABLE FOR CHASSIS RELATED PARTS 20-3
TESTING AND ADJUSTING 20-101
TROUBLESHOOTING 20-205
TROUBLESHOOTING WHEN FAILURE CODE IS INDICATED 20-301
TROUBLESHOOTING OF ELECTRICAL SYSTEM (E-MODE) 20-519
TROUBLESHOOTING OF ELECTRICAL SYSTEM (Error checking of items without Monitor codes) 20-601
TROUBLESHOOTING OF HYDRAULIC AND MECHANICAL SYSTEM (H-MODE) 20-701

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

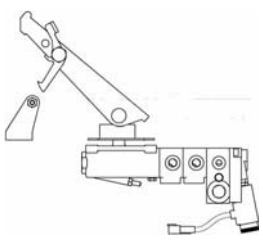
1. The standard value for a new machine given in the table is the value used when shipping the machine from the factory and is given for reference. It is used as a guideline for judging the progress of wear after the machine has been operated, and as a reference value when carrying out repairs.
2. The 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				PW160-7E0	
Engine				SAA4D107E-1	
Item	Measurement condition		Unit	Standard value for new machine	Service limit value
Engine speed	High idling		rpm	2,450 ±50	
	Low idling			1,040 ±50	
	Rated speed			2,200 ±20	
Exhaust gas colour	At sudden acceleration LO idle - HI idle		Bosch index	Max. 1.2	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
Compression pressure	Oil temperature: 40–60ºC Engine speed: 250rpm ~ 280rpm		MPa {kg/cm^2}	Min. 2.4 {Min. 24.6}	1.69 {17.2}
Blow-by pressure	2500rpm full load with 0.221 inch orifice		KPa {mm H_2O}	1.0 {100}	2.49 {250}
Oil pressure	• SAE0W30E0S, SAE5W40E0S, SAE10W30DH, SAE15W40DH, SAE30DH engine oil • Coolant temperature: Within operating range	High Idle	MPa {kg/cm^2}	Min. 0.29 {Min. 3.0}	0.25 {2.5}
		Low Idle	MPa {kg/cm^2}	Min. 0.10 {Min. 1.0}	0.07 {0.7}
Oil temperature	Whole speed range (inside oil pan)		ºC	80 ~ 110	120
Fuel injection timing				Electronic	
Fan belt tension	Deflection when pressed with finger force of approx. 58.8 N{6 kg}		mm	Auto Tension	Auto Tension
Air conditioner compressor belt tension			mm	5–8	

STANDARD VALUE TABLE FOR CHASSIS RELATED PARTS

Applicable model				PW160-7E0	
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 • Swing lock off	rpm	2,030 ±100	2,030 ±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 • Swing lock off		1,980 ±100	1,980 ±100
	Speed when auto-deceleration is operated	• Engine at high idling • Auto-deceleration switch in ON condition • All control levers in NEUTRAL condition		1,380 ±100	1,380 ±100
Spool stroke	Boom control valve		mm	9.5 ±0.5	9.5 ±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 centre 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 centre 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					PW160-7E0 (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: A 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: A 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} (37.3 ±1.0 {380 ±10})	33.3–36.8 {340–375} (36.3–39.2 {370–400})
	Arm					
	Bucket					
	Swing				30.9 ±1.5 {315 ±15}	28.9–32.9 {295–335}
	Travel				38.2 ±1.0 {390 ±10}	3.5-3.8 35.7-38.7
	Stabiliser					
	Control circuit source pressure	• Hydraulic oil temperature: Within operation range • Engine running at high idling • Control circuit pressure setting valve input (7 station solenoid valve block port P_1)			3.65 ± 0.15 37.2 ± 1.5	3.5–3.8 {35.7–38.7}
	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		2.2 ±0.1 {22 ±1}	2.2 ±0.1 {22 ±1}
Swing	Swing brake angle	 • Hydraulic oil temperature: Within operation range • Engine running at high idling • Working mode: P mode • Swing circle misalignment amount when stopping after one turn		deg (mm)	Max. 100 (–)	Max. 130 (–)
	Time taken to swing from start	 • Hydraulic oil temperature: Within operation range • Engine running at high idling • Working mode: P mode • Time required for passing points 90 and 180 degrees from starting point • Speeds quoted are with rated bucket (1440kg)	90°	sec	3.4 ±0.3	Max. 4.0
			180°		4.9 ±0.4	Max. 5.7

Applicable model				PW160-7E0	
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	

<table>
<tr><td colspan="5">Applicable model</td><td colspan="2">PW160-7E0</td></tr>
<tr><td>Category</td><td>Item</td><td colspan="3">Measurement Condition</td><td>Unit</td><td>Standard value</td><td>Permissible value</td></tr>
<tr><td rowspan="4">Travel</td><td rowspan="3">Travel speed (1)</td><td rowspan="3"> 
• Machine in road travel posture
• Engine running at high idle
• Hydraulic oil temperature 45~55ºC
• 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</td><td>CR</td><td>2.5km/h</td><td rowspan="4">sec.</td><td colspan="2">72±10%</td></tr>
<tr><td>LO</td><td>9.5km/h</td><td colspan="2">$18^{+2}/_{-0}$</td></tr>
<tr><td rowspan="2">Hi</td><td>20km/h</td><td colspan="2">$9^{+1}/_{-0}$</td></tr>
<tr><td>35km/h</td><td colspan="2">$5.1^{+0.5}/_{-0}$</td></tr>
<tr><td>Travel speed (2)</td><td> 
• 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 45~55ºC. Within operation range</td><td colspan="2">CR</td><td>rpm</td><td colspan="2">230 ±5%</td></tr>
<tr><td colspan="2">LO</td><td>rpm</td><td colspan="2">930±5%</td></tr>
</table>

Applicable model					PW160-7E0	
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 45~55ºC. 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 bucket mass) • 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. 600	Max. 900
		Boom cylinder (cylinder retraction amount)			Max. 18	Max. 27
		Arm cylinder (cylinder extension amount)			Max. 160	Max. 240
		Bucket cylinder (cylinder retraction amount)			Max. 40	Max. 58
		Second Boom adjust cylinder (Cyl retraction amount)			Max. 20	Max. 30

Applicable model						PW160-7E0	
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: P • Time required from raise stroke end till bucket touches ground	RAISE	sec	4.0 ±0.4	Max. 4.6
				LOWER		3.8 ±0.5	Max. 3.5
		Two piece boom 1st boom lift	 • Hydraulic oil temperature: Within operation range • Engine running at high idle • Working mode: P • Time required from raise stroke end till bucket touches ground	RAISE		4.5 ±0.4	Max. 5.3
				LOWER		3.8 ±0.3	Max. 4.4
		Two piece boom 2nd boom adjust	 • Hydraulic oil temperature: Within operation range • Engine running at high idle • Working mode: P • Time required from raise stroke end till lower stroke end	RAISE		5.8 ±0.5	Max. 6.3
				LOWER		5.8 ±0.5	Max. 6.3

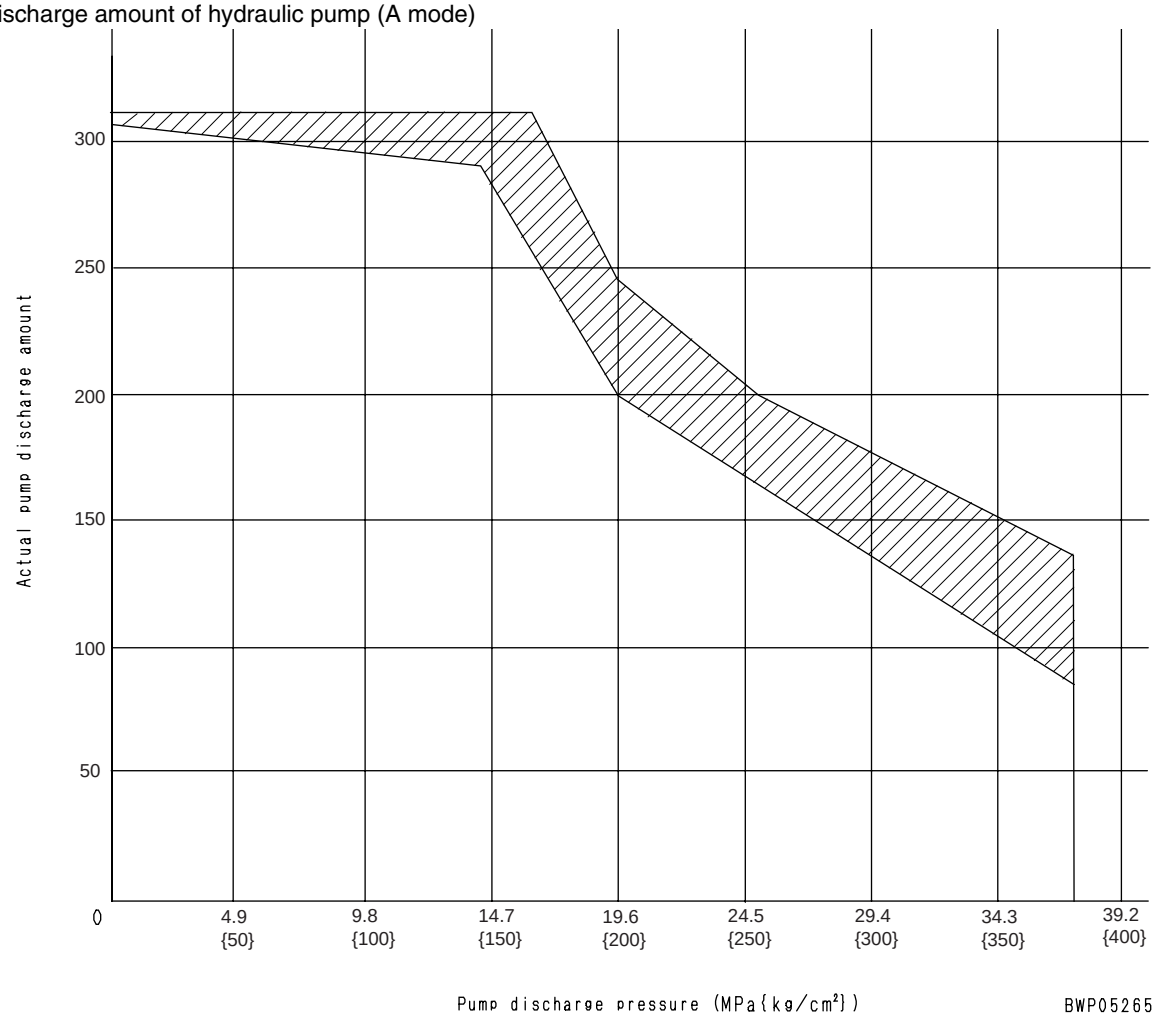
Applicable model						PW160-7E0	
Category	Item		Measurement Condition		Unit	Standard value	Permissible value
		Outrigger	• Hydraulic oil temperature: Within operation range • Engine running at high idle • Working mode: P • Time required for 1 outrigger raise stroke end to lower stroke end.	RAISE		4.0 ± 0.4	Max. 4.5
				LOWER		4.0 ± 0.4	Max. 4.7
		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. 2.7
				LOWER		2.0 ± 0.3	Max. 2.7

Applicable model						PW160-7E0	
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: A mode • Time required from dumping stroke end to digging stroke end	DIG		3.2 ± 0.4	Max. 3.9
				DUMP		2.9 ± 0.3	Max. 3.6
		Bucket	 • Hydraulic oil temperature: Within operation range • Engine running at high idling • Working mode: A mode • Time required from dumping stroke end to digging stroke end	CURL		3.1 ± 0.3	Max. 3.4
				DUMP		2.8 ± 0.3	Max. 3.2
	Time lag	Monoboom boom lift	 • Hydraulic oil temperature: Within operation range • Engine running at low idling • Working mode: A 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.		sec	Max. 1.0	Max. 1.2

Applicable model					PW160-7E0	
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: A 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: A 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
		Centre swivel joint			10	50
	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

Applicable model					PW160-7E0	
Cate-gory	Item		Measurement Condition	Unit	Standard value	Permissible value
Work equipment	Time lag	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	/min.	See next page	

Applicable model				PW160-7E0	
Cate-gory	Item	Measurement Condition	Unit	Standard value	Permissible value
Performance of hydraulic pump	Discharge amount of hydraulic pump (A mode)				



• Pump speed: At 1,950 rpm, PC current 310 mA

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				PW160-7E0 (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: A 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 4.4 ±0.4 Two piece boom 5.0 ±0.4

TESTING AND ADJUSTING

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MEASURING INTAKE AIR PRESSURE (BOOST PRESSURE) 20-104
MEASUREMENT OF EXHAUST GAS COLOUR 20-105
ADJUSTING VALVE CLEARANCE 20-107
MEASURING COMPRESSION PRESSURE 20-109
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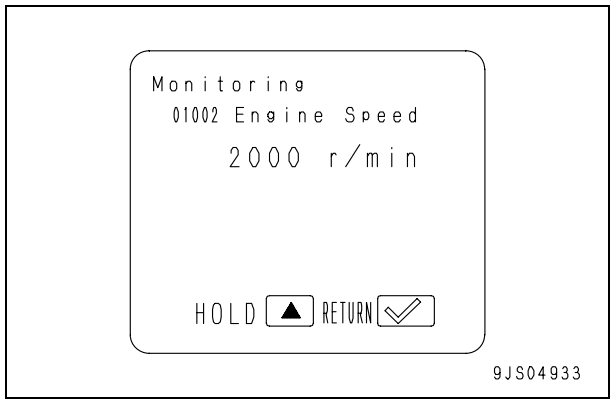
Measuring engine speed

★ 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 functions of machine monitor".
★ Monitoring code: 01002 Engine speed



2. Measuring low idle speed

1) Start the engine and set the fuel control dial to the low idle (MIN) position.
2) Set all the control levers and pedals for work equipment, swing and travel to the neutral and measure the engine speed.

3. Measuring high idle speed

1) Start the engine and set the fuel control dial to the high idle (MAX) position.
2) Set the working mode in the power mode (P) and turn the auto-decelerator OFF.
3) While operating the left work equipment control lever to move the arm slightly at the IN stroke end by avoiding overload on the arm, 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 being depressed. Thus measurement of the engine speed must be completed within that period.

4. **Measuring the engine speed when pump is relieved**
   1) Start the engine and set the arm cylinder to the dump stroke end.
   2) Set the fuel control dial in the high idle (MAX) position and set the working mode in the power mode (P).
   3) Operate the left work equipment control lever to relieve the arm circuit at the dump stroke end and measure the engine speed.

5. **Measuring** the engine speed at **pump relief and power maximizing (near rated speed)**
   1) Start the engine and set the arm cylinder to the dump stroke end.
   2) Set the fuel control dial in the high idle (MAX) position and set the working mode in the power mode (P).
   3) While operating the left work equipment control lever to relieve the arm at the dump 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 being depressed. Thus measurement of the engine speed must be completed within that period.

6. **Measuring** the speed when **auto-deceleration speed is in operation**
   1) Start the engine, set the fuel control dial in the high idle position (MAX), and turn the auto-decelerator ON.
   2) Set all the control levers and pedals for work equipment, swing and travel to neutral and measure the engine speed when the auto-decelerator is operated.
      ★ The engine speed is slowed down to a certain level in about 5 seconds from setting all the control levers and pedals to the neutral. This level is the engine speed when operation of the auto-deceleration is turned on.

Measuring intake air pressure (boost pressure)

★ Measuring tools for intake air pressure (boost pressure)

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

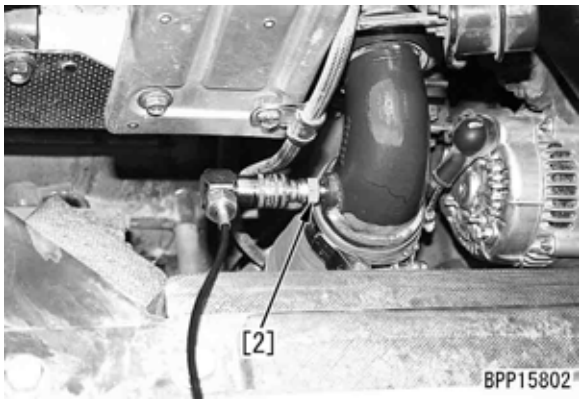
⚠ **Stop the machine on a level ground and lower the work equipment to the ground.**

★ 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 pick-up plug (1) (R1/8) from the intake air connector.



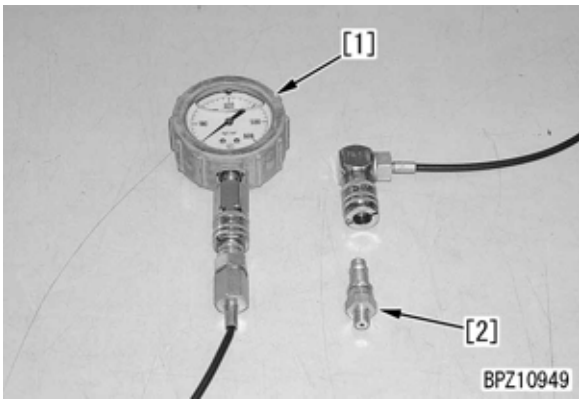
2. Install nipple [2] of boost gauge kit **A** and connect it to gauge [1].



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 at the IN 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**.

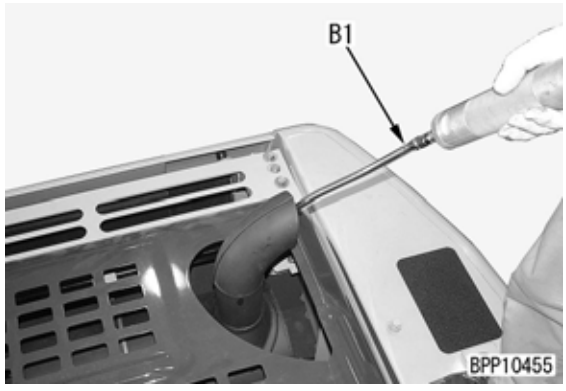
1. Measurement with Handy Smoke Checker **B1**.

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.

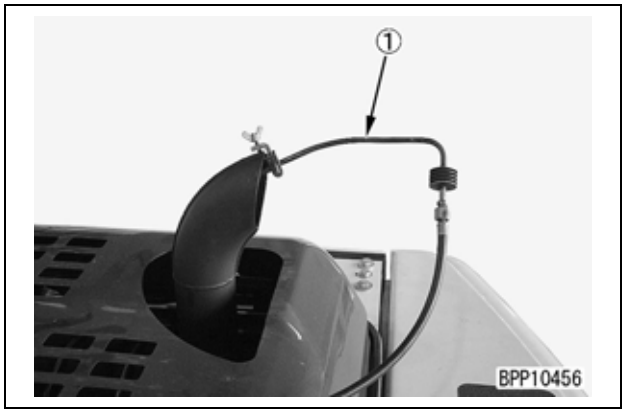


1.5. Take out the filtering paper and compare it with the attached scale for judgement.

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}.

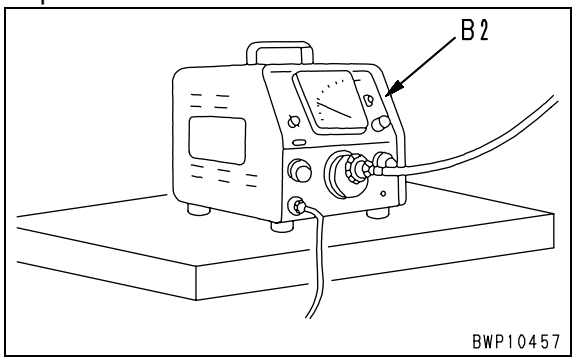
2.3. Connect the power cable to an outlet of AC100V.

- 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

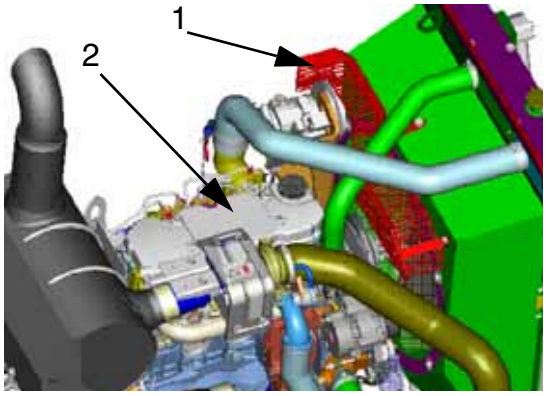
Symbol		Part No.	Part name
C	1	795-799-1131	Gear
	2	Commercially available	Clearance gauge

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

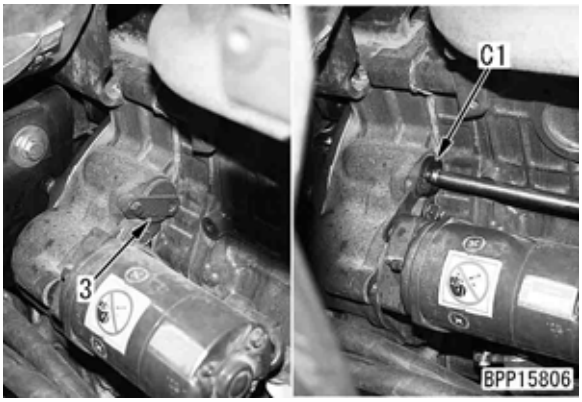
★ Measure the valve clearance under the following condition.
- Engine coolant temperature: Normal temperature

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

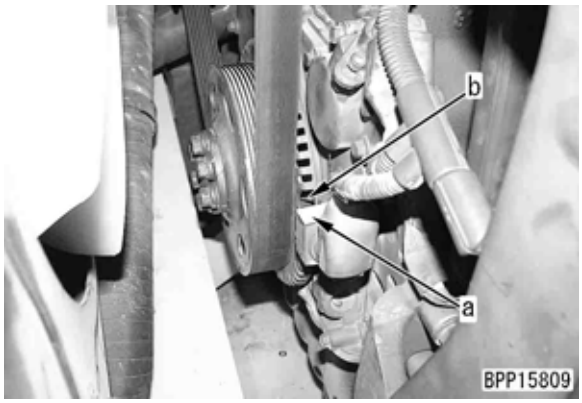
2. Remove cylinder head cover (2).



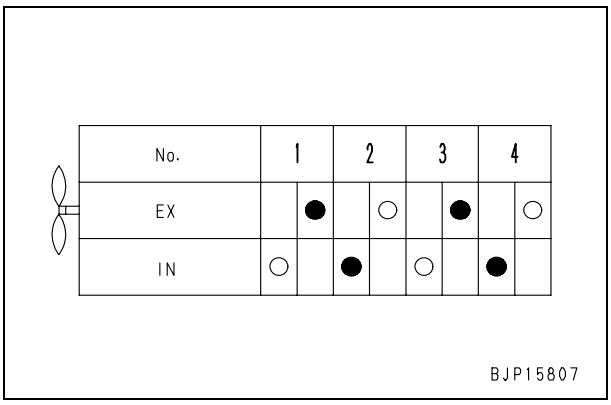
3. Remove plug (3) from the top of the starting motor and insert gear **C1**.



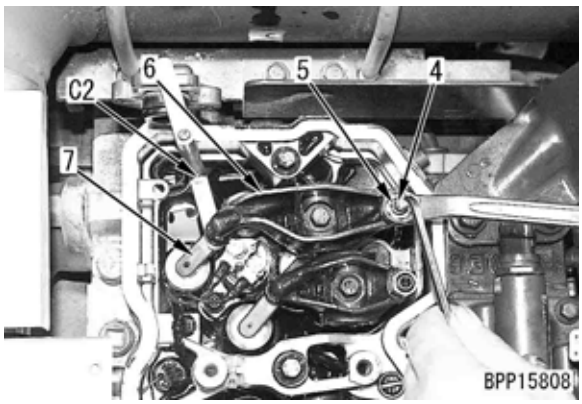
4. Rotate the crankshaft forward with gear **C1** and set wide slit (b) of the rotation sensor ring to projection top (a) of front cover.
   ★ Projection top (a) must be within the range of wide slit (b) when it is seen from the air conditioner compressor side.
   ★ If you can see the yellow marks of projection top (a) and wide slit (b), you may set them to each other.
   ⚠ **When the crankshaft is set as above, the piston in the No. 1 or No. 4 cylinder is not set to the compression top dead centre (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 exhaust valves (EX) with the hand by the valve clearance, adjust the valves marked with ● in the valve arrangement drawing.
   ★ If you can not 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.
   1) While fixing adjustment screw (4), loosen lock nut (5).
   2) Insert thickness gauge **C2** in the clearance between rocker arm (6) and cross head (7) and adjust the valve clearance with adjustment screw (4).
      ★ With the clearance gauge inserted, turn the adjustment screw to a degree that you can move the clearance gauge lightly.
   3) While fixing adjustment screw (4), tighten lock nut (5).
      3 Lock nut:
      24 ± 4 Nm {2.45 ± 0.41 kgm}
      ★ After tightening the lock nut, 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.
   Remove gear C1 without fail.
   Cylinder head cover mounting nut:
   24 ± 4 Nm {2.45 ± 0.41 kgm}

Measuring compression pressure

★ Measuring tools for compression pressure

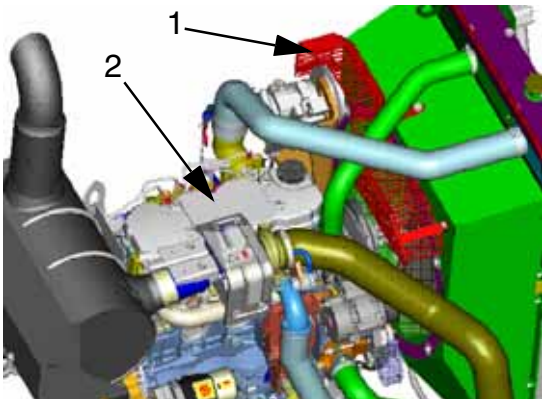
Symbol		Part No.	Part name
D	1	795-502-1590	Compression gauge
	2	795-799-6700	Puller
	3	795-790-4410	Adapter
		6754-11-3130	Gasket

⚠ 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 belt guard (1) from the top of the air conditioner compressor.

2. Remove cylinder head cover (2).



3. Remove the mounting bolts of rocker arm assembly (3) on the exhaust side, and then remove rocker arm assembly (3).
   ★ When removing the injector, you do not need to remove the rocker arm assembly on the intake side.

4. Remove fuel tube (4), and then remove inlet connector (7) in the cylinder head.
   ★ The inlet connector is connecting the fuel tube to the injector.



5. Disconnect injector wiring harness. Using tool **D2**, remove injector (5).

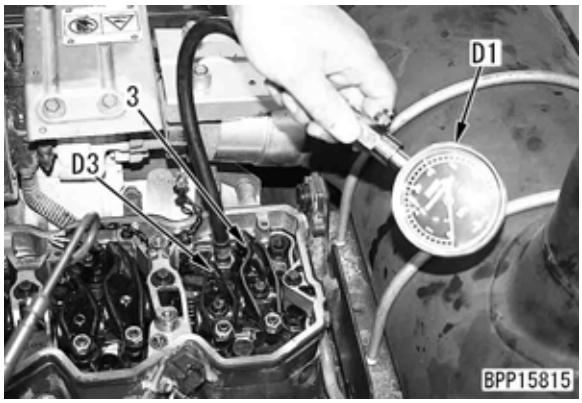


6. Install adapter **D3** to the injector mounting part with the injector holder and connect compression gauge **D1**.
   ★ Install the gasket to the adapter end without fail.
   ★ Tighten the holder mounting bolts alternately.

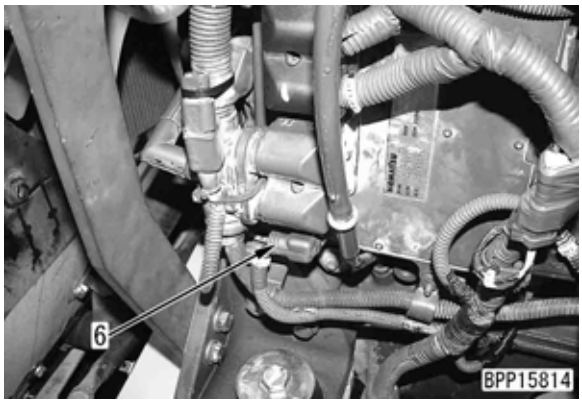
   Injector holder mounting bolt:
   8 ± 0.8 Nm {0.8 ± 0.08 kgm}

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

7. Install rocker arm assembly (3) on the exhaust side and adjust the valve clearance.
   Rocker arm assembly mounting bolt:
   36 ± 5 Nm {3.67 ± 0.5 kgm}
   ★ See "Adjusting valve clearance".

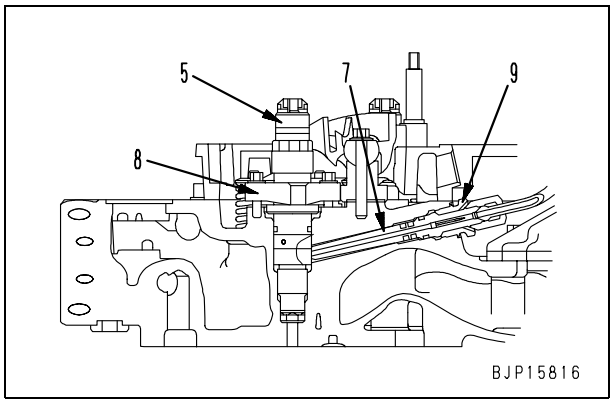


8. Disconnect **CE03** connector (6) of the engine controller.
   If the connector is not disconnected, the engine will start during measurement and it will be dangerous.
   Since the CE03 connector is a part of the power supply circuit of the engine controller, cover the connector on the machine side with a vinyl sheet, etc. to prevent electric leakage and ground fault.



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

10. After finishing measurement, remove the measuring tools and return the removed parts.
   ★ Install the injector and inlet connector according to the following procedure.
   1) Apply new engine oil (SAE15W-40) to the O-ring of injector (5) and cylinder head.
   2) Install injector (5) with the fuel inlet hole directed to the air intake manifold.
   3) Install injector holder (8) and tighten the mounting bolt by 3 – 4 threads.
   4) Install inlet connector (7) and tighten inlet connector retainer (9) temporarily.
   5) Tighten the mounting bolt of injector holder (8) securely.
      3 Injector holder mounting bolt:
      8 ± 0.8 Nm {0.8 ± 0.08 kgm}
   6) Tighten inlet connector retainer (9) securely.
      3 Inlet connector retainer:
      50 ± 5 Nm {5.1 ± 0.5 kgm}



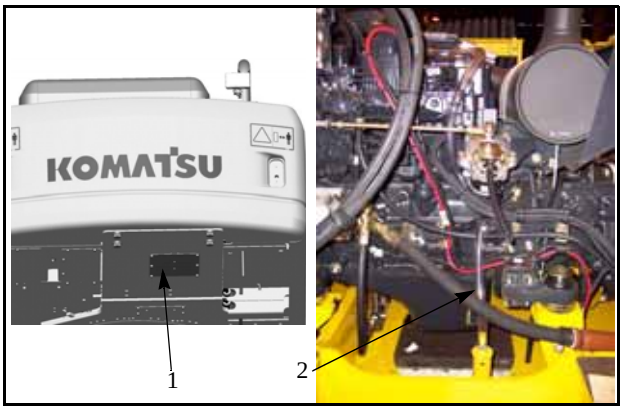
   ★ Tighten the bolts and nuts other than the injector and inlet connector to the following torque.
   Injector wiring harness nut:
   1.5 ± 0.25 Nm {0.15 ± 0.026 kgm}
   Fuel tube sleeve nut:
   35 ± 3.5 Nm {3.6 ± 0.4 kgm}
   Rocker arm assembly mounting bolt:
   36 ± 6 Nm {3.7 ± 0.6 kgm}
   ★ Adjust the valve clearance. For details, see "Adjusting valve clearance".
   Cylinder head cover mounting nut:
   24 ± 4 Nm {2.45 ± 0.41 kgm}

MEASUREMENT OF BLOW-BY PRESSURE

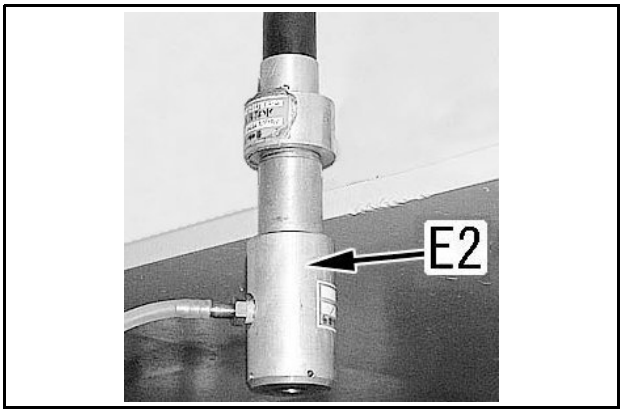
★ Blow-by pressure measurement tools

Mark		Part No.	Part Name
E	1	799-201-1504	Blow-by Kit
	2	795-790-1950	Tool (Nozzle)

1. Remove undercover (1), remove breather tube (2) from oil catcher

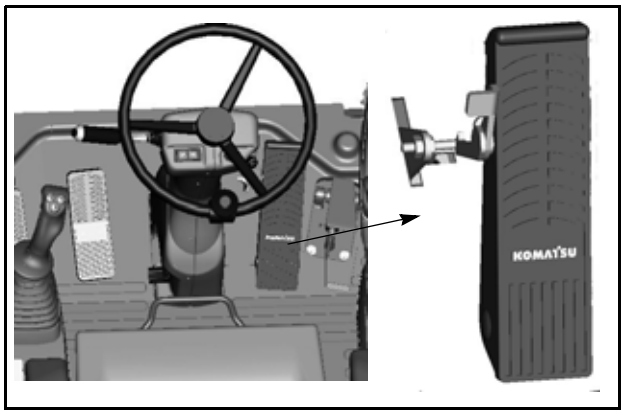


2. Fit tool **E2** to blow-by hose and connect it with gauge ① of blow-by kit **E1**.



3. Keep engine running until the engine cooling water temperature rises to the operating range.

4. Ensure machine is on level ground and service brake is applied to prevent travel, start the engine, select forward or reverse travel in Hi or Lo speed not creep



5. Measure the blow-by pressure at high idling and under the following conditions.
   - Working mode: A mode
   - Work equipment, swing and travel:
   - Service brake applied, travel in relief.

Travel relief

★ Read off the blow-by pressure value, when the needle of the gauge steadies itself.



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

Measuring engine oil pressure

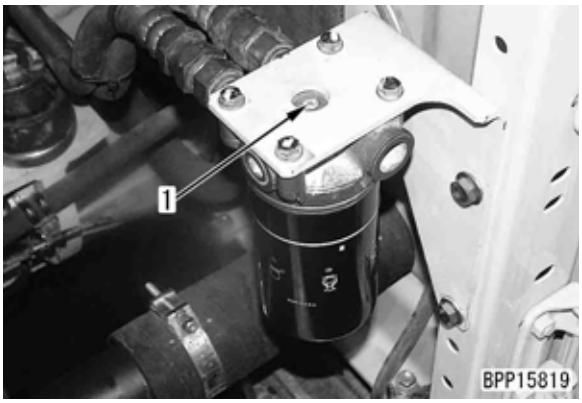
★ Measuring tools for engine oil pressure

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

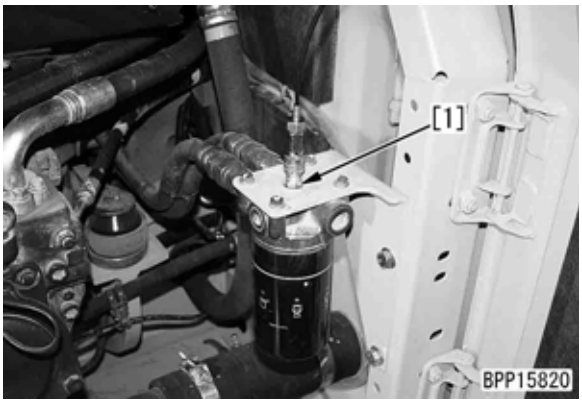
⚠ **Stop the machine on a level ground and lower the work equipment to the ground.**

★ 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 pick-up plug (1) (R1/8) from the engine oil filter.

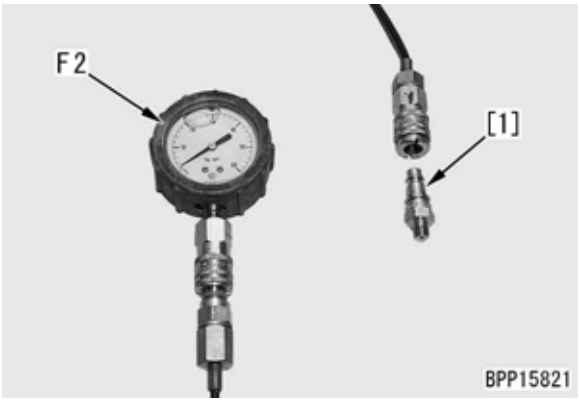


2. Install nipple [1] of hydraulic tester **F1** and connect hydraulic tester **F2**.



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.

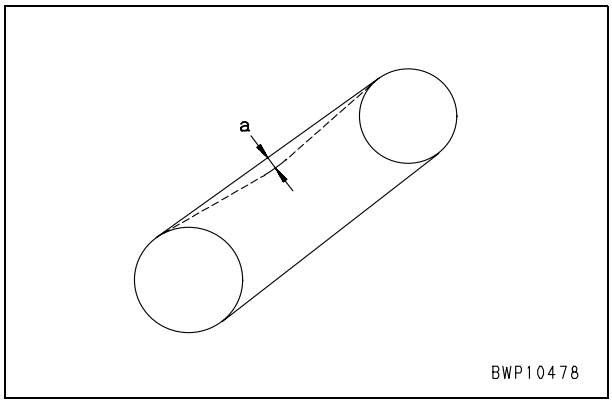
CHECKING AND ADJUSTING AIR CONDITIONER COMPRESSOR BELT TENSION

⚠ 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: 58.8 N {6 kg}



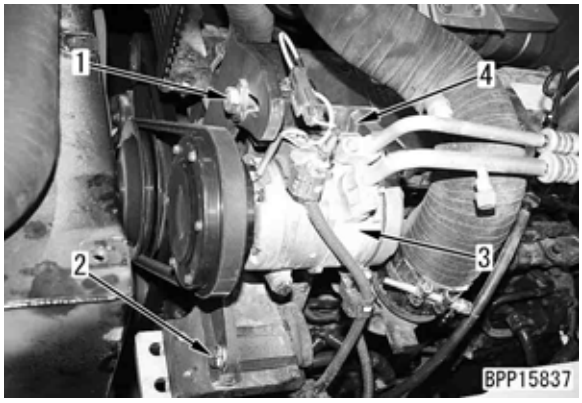
Adjusting

★ 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 checking procedure.



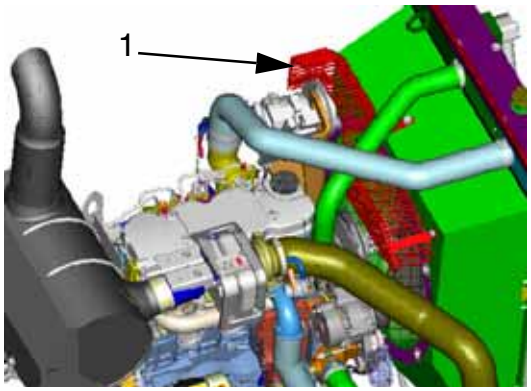
4. After finishing measurement, return the removed parts.

Replacing the fan belt

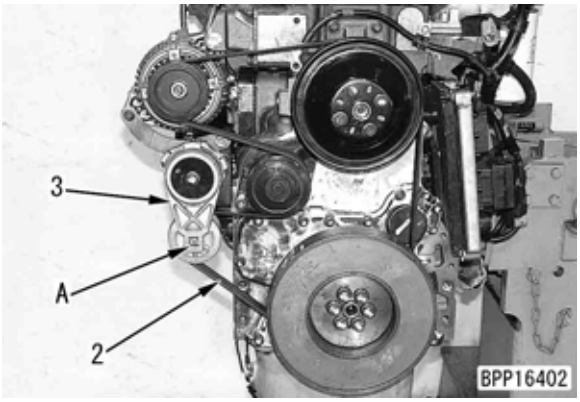
★ The auto-tensioner is provided for the fan belt. Thus, testing and adjustment of the belt is usually not necessary.
★ Disconnect air conditioner compressor belt before replacing the fan belt.

⚠ Parking the machine in a level ground and lower the work equipment to the ground.

1. Open engine hood and remove fan belt cover (1).



2. Insert a wrench to the portion (A) (width across flats □12.7 mm) of the tensioner assembly (3), and rotate it to the opposite to the winding-up direction to decrease the fan belt (2) tension.
   ⚠ Make sure that the wrench is secured at the portion (A) of the tensioner assembly (3) before rotating it. (The spring of the tensioner assembly (3) is strong. If the wrench is loosely inserted, the wrench may accidentally come off while being rotated and it is extremely dangerous.)
   ⚠ After removing the fan belt (2), return the tensioner assembly (3) slowly with care.
   ⚠ Be careful not to get your fingers caught between the pulley and fan belt (2) during work.



3. Replace the fan belt (2).
   - Check each pulley for breakage and crack.

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.

⚠ **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
G	1	799-101-5002	Hydraulic tester
		790-261-1204	Digital hydraulic tester
	2	795-790-4430	Adapter (10 × 1.0 mm ✕ R1/8)
		6215-81-9710	O-ring
	3	795-790-5200	Fuel pressure gauge adapter kit
	4	799-401-2320	Hydraulic tester

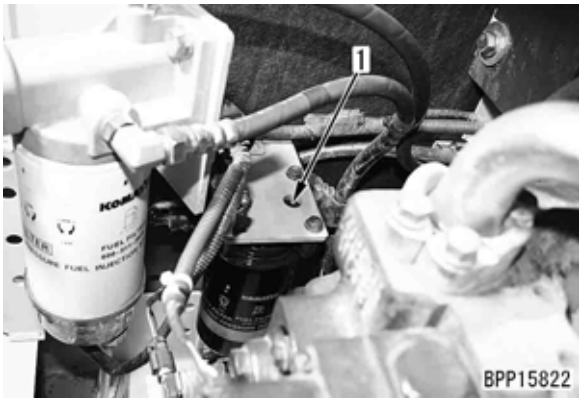
⚠ **Stop the machine on a level ground and lower the work equipment to the ground.**

★ 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.

⚠ **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.**

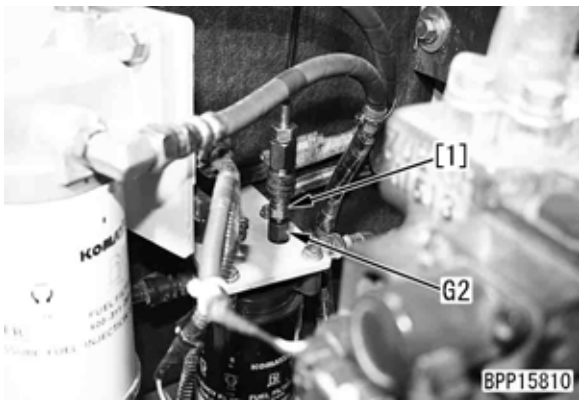
1. Measuring pressure in fuel low-pressure circuit

1) Open the side cover of the pump room and remove fuel pressure pick-up plug (fuel inlet side) (1) from the fuel main filter.



2) Install adapter **G2** and nipple [1] of hydraulic tester **G1** and connect them to oil pressure gauge [2].

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

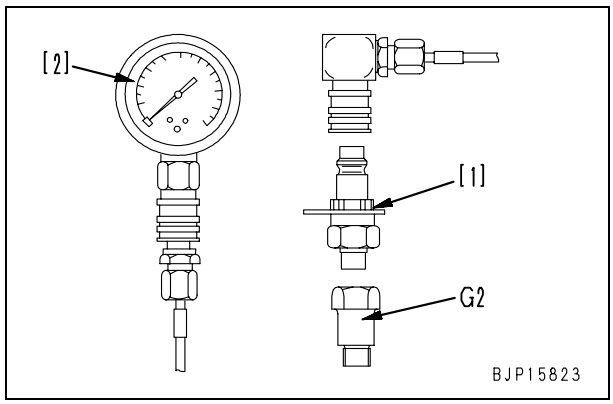


3) Run the engine at low idle and measure the pressure in the fuel low-pressure circuit.

★ 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}

⚠ **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.**

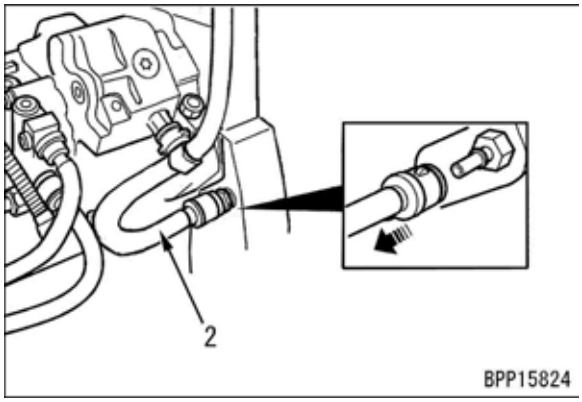


4) After finishing measurement, remove the measuring tools and return the removed parts.

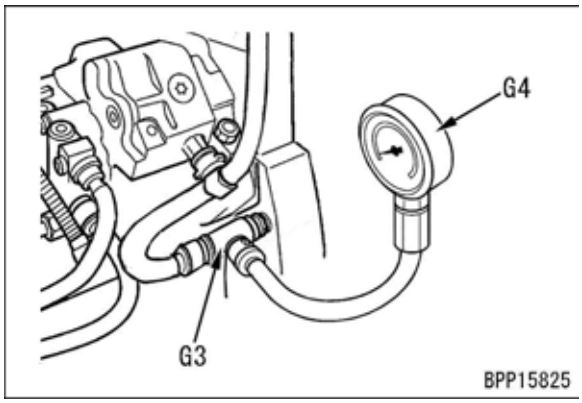
3 Fuel pressure pickup plug:
10 ± 2 Nm {1 ± 0.2 kgm}

2. Measuring pressure in fuel return circuit

1) Disconnect fuel return hose (2).



2) Install fuel pressure gauge adapter kit **G3** and connect it to hydraulic tester **G4**.



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 {Max. 0.19 kg/cm^2}
During cranking	

⚠ **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.**

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

Measuring fuel discharge, return and leakage

★ Measuring tools for fuel discharge, return and leakage

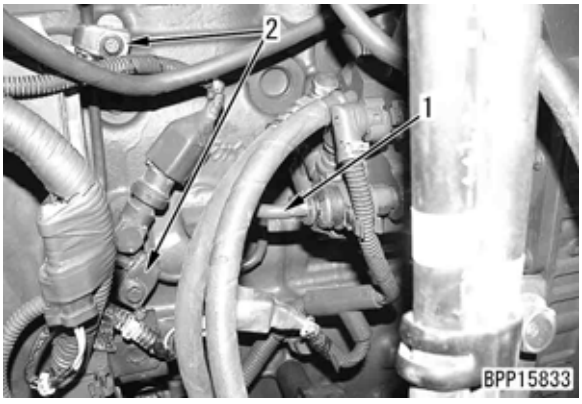
Symbol		Part No.	Part name
H	1	Commercially available	Hose (Internal dimension: ø14 mm)
	2	795-790-4700	Tester kit
	3	795-790-6700	Adapter
	4	6754-71-5340	Connector
		6754-71-5350	Washer
	5	Commercially available	Measuring cylinder
	6	Commercially available	Stopwatch
	7	Commercially available	Hose (Internal dimension: ø12 mm)

★ Since some fuel flows out during check, prepare an oil (receiving) pan of about 20 ℓ.

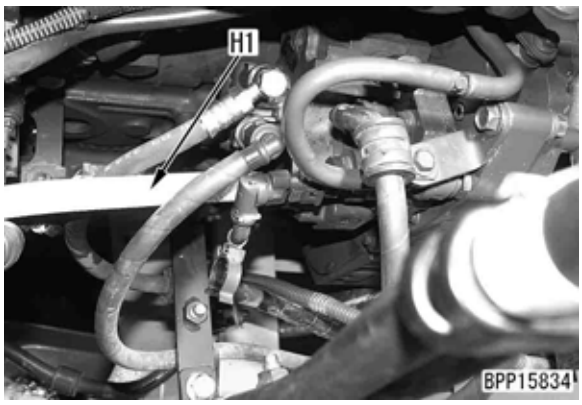
⚠ **Stop the machine on a level ground and lower the work equipment to the ground.**

1. Measuring discharge from supply pump

1) Open the engine hood, loosen 2 clamps (2) from discharge side tube (1) of the supply pump, and disconnect tube (1).

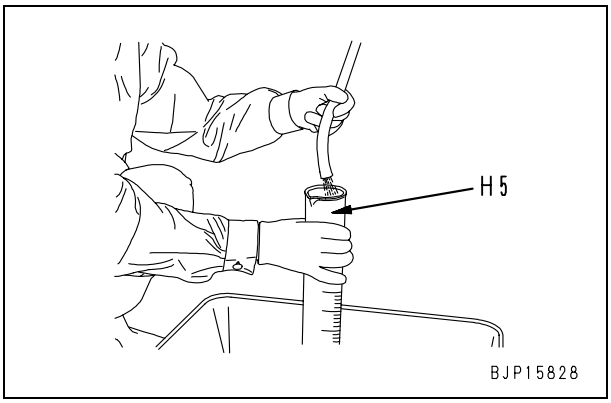


2) Install measuring hose **H1** to the discharge side nipple of the supply pump.
   ★ Fix the hose using a wire to prevent the hose from coming off.
   ★ Adjust the rout inspection hose so that there is no slack, and insert its end to the oil pan.



3) Crank the engine for 30 seconds and measure the discharge with measuring cylinder **H5**.
   ★ In order to protect the starter motor, it is prohibited to continue cranking for more than 30 seconds for any other purpose than this measurement.
   ★ If the discharge from the supply pump is in the following range, it is normal.

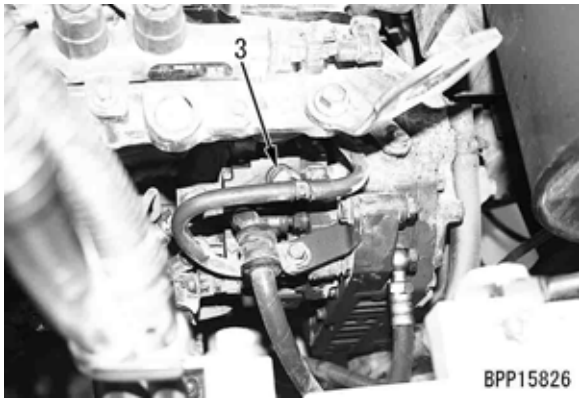
Engine Speed	Discharge
125 rpm	Min. 75 cc
150 rpm	Min. 90 cc



4) After finishing checking, remove the measuring tools and return the removed parts.
   3 Tube sleeve nut:
   35 ± 3.5 Nm {3.6 ± 0.4 kgm}
   3 Clamp mounting bolt:
   24 ± 4 Nm {2.45 ± 0.4 kgm}

2. Measuring return rate from supply pump

1) Open the engine hood and disconnect return hose (3) of the supply pump.
   ★ The return hose is connected by a quick coupler.

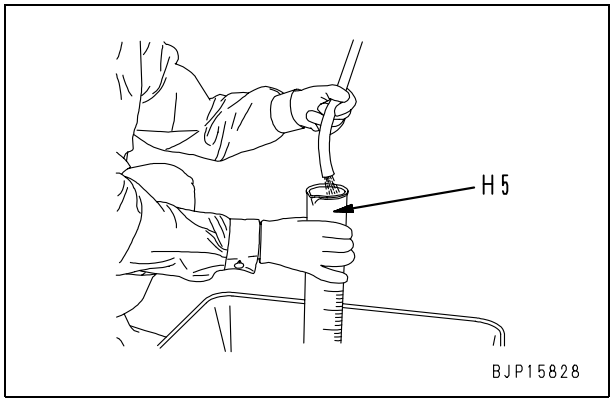


2) Install connector **H4** and the cap nut of tester kit **H2** to stop the fuel from flowing out.
3) Connect test hose [1] of tester kit **H2** to the supply pump.
   ★ Lay the test hose so that it will not slacken and put its end in the oil (receiving) pan.



4) Run the engine at low idle and measure the return rate for 25 seconds with measuring cylinder **H5**.
   ★ If the return rate from the supply pump is in the following range, it is normal.

At low idle (750 rpm)	Max. 400 cc



5) After finishing measurement, remove the measuring tools and return the removed parts.
   ★ When measuring the leakage from the pressure limiter or finishing the measurement: Return the removed parts to their original positions.
   ★ When measuring the leakage from the injector: Leave the removed parts as they are and keep the hose end in the oil pan.

3. Measuring leakage from pressure limiter

1) Open the engine hood and disconnect return hose (4) of the pressure limiter.

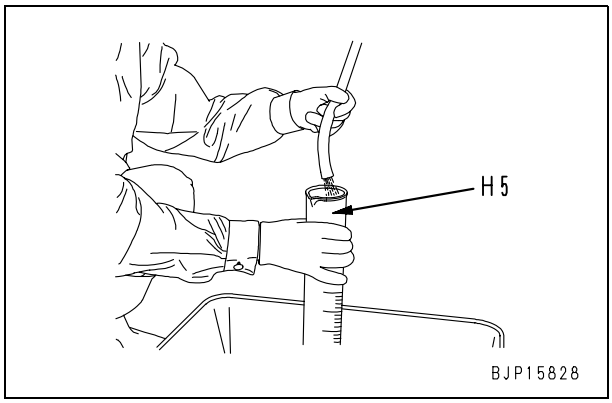


2) Install connector **H4** and the cap nut of tester kit **H2** to the return hose side, to stop the fuel from flowing out.
3) Connect the measuring hose [1] of tester kit **H2** to the common rail side.
   ★ Lay the test hose so that it will not slacken and put its end in the oil (receiving) pan.



4) Run the engine at low idle and measure the return rate in 1 minute with measuring cylinder **H5**.
   ★ If the leakage from the pressure limiter is in the following range, it is normal.

At low idle	0 cc (No leakage)

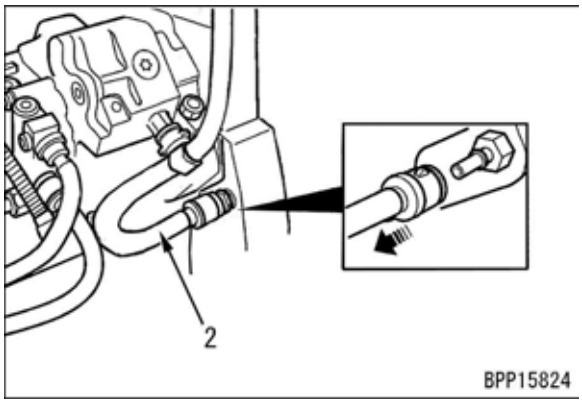


5) After finishing measurement, remove the measuring tools and return the removed parts.

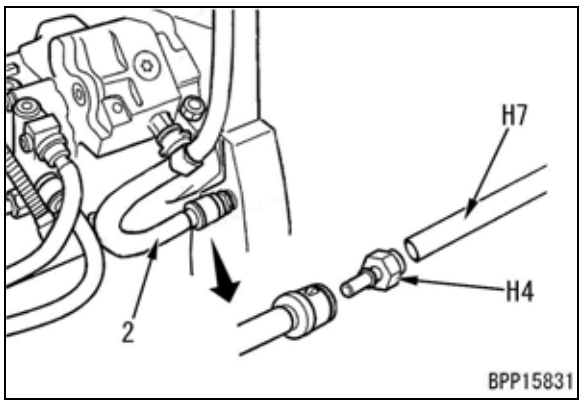
4. Measuring return rate from injector

★ The leakage from the injector is measured while the return hose of the pressure limiter is connected. Accordingly, before measuring the leakage from the injector, check that the leakage from the pressure limiter is normal.

1) Referring to "Measuring return rate from supply pump", set the supply pump for testing.
   ⚠ **The fuel returning from the supply pump flows out during measurement of the return rate from the injector. Accordingly, keep the test hose end in the oil pan.**
2) Disconnect return hose (2) of the manifold part.



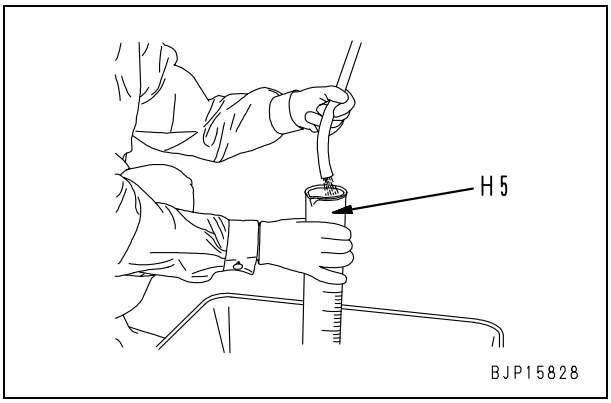
3) Install connector **H4** to hose (2), and connect it to hose **H7**.
   ★ Fix the hose using a wire to prevent the hose from coming off.
   ★ Lay the test hose so that it will not slacken and put its end in the oil (receiving) pan.



4) Run the engine at low idle and measure the return rate in 1 minute with measuring cylinder **H5**.
   ★ If the return rate from the injector is in the following range, it is normal.

At low idle	Max. 120 cc/min
During cranking	Max. 90 cc/min

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.



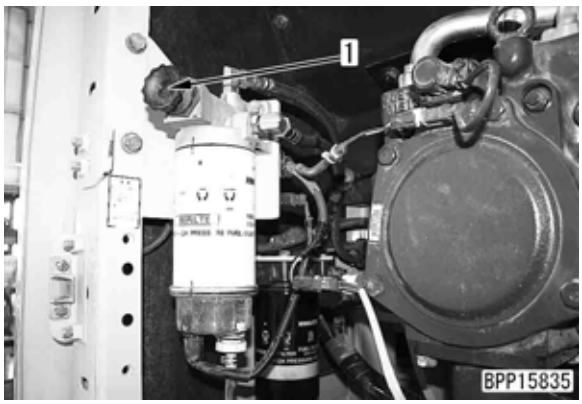
5) After finishing measurement, remove the measuring tools and return the removed parts.
   3 Joint bolt:
   19.6 – 29.4 Nm {2.0 – 3.0 kgm}

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.

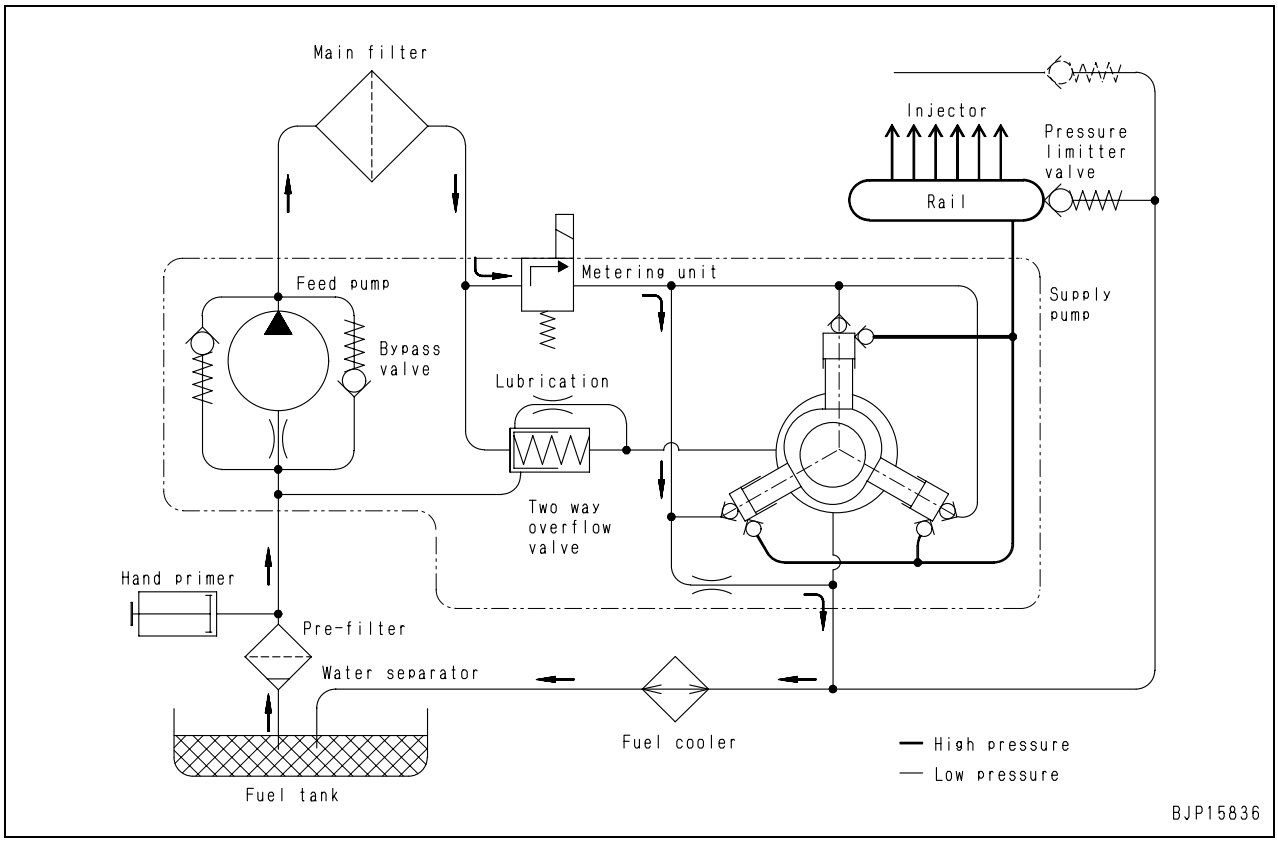
⚠ **Stop the machine on a level ground and lower the work equipment to the ground.**

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

⚠ **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 de-grease the engine and the parts around it in advance so that you can check it easily for fuel leakage.

1. Spray colour 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 colour 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 colour 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 colour 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.
   ★ Check mainly around the high-pressure circuit parts coated with the colour checker for fuel leakage.
   ★ If any fuel leakage is detected, repair it and check again from step 2.
   ★ If no fuel leakage is detected, check is completed.

MEASUREMENT OF CLEARANCE IN SWING CIRCLE BEARINGS

★ Swing circle bearing clearance measurement tools

Mark	Part No.	Part Name
H	Commercial Product	Dial Gauge

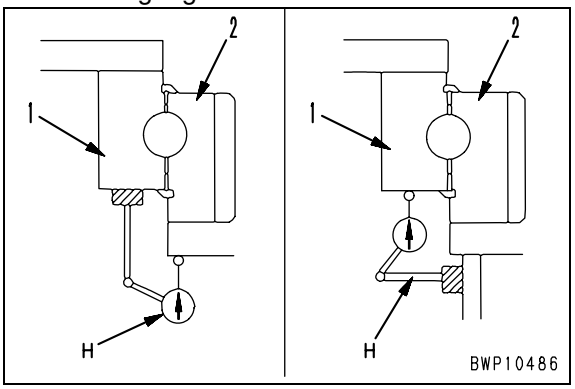
★ Follow the steps explained below, when measuring clearance in the swing circle bearing in the actual machine.

⚠ CAUTION

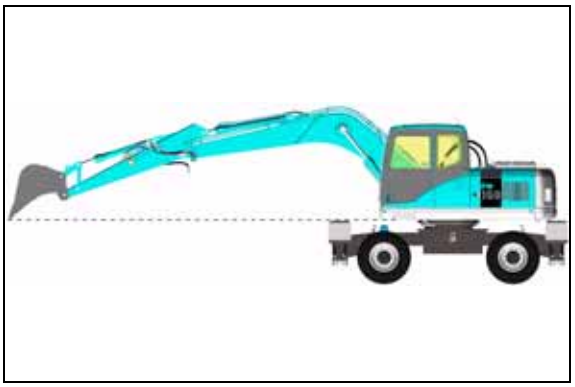
Be careful not to put a hand or foot under the undercarriage, while taking measurement.

1. Fasten dial gauge **H** to swing circle outer race (1) or inner race (2), and contact the probe with the end surface of inner race (2) or outer race (1) on the opposite side.

   ★ 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 that time.

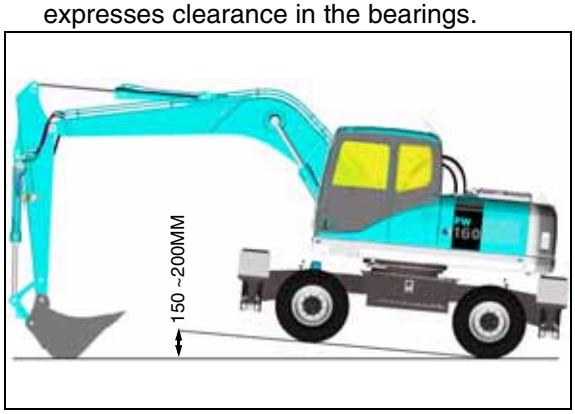
3. Set dial gauge **H** at zero point.

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 that 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 for hydraulic oil pressure in hydraulic circuit for work equipment, swing and travel

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

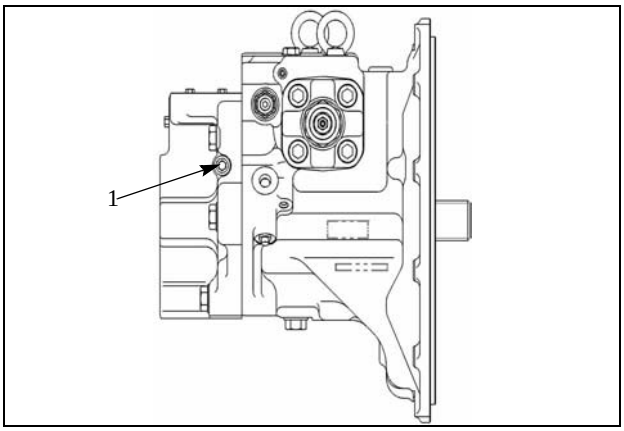
★ Hydraulic oil pressure in the hydraulic circuit for work equipment, swing and travel (hydraulic pump output pressure) may be also confirmed with a monitoring function in the monitor panel (special function of monitor panel).

MEASUREMENT

1. Pre-measurement work

Lower the work equipment to the ground, then release the remaining pressure in the piping by operating the control lever several times after stopping the engine, and release the pressure inside the hydraulic tank by gradually loosening the oil filler cap. Ignition switch must be in the 'ON' position.

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



2) Fit fitting **J2** and connect it to oil pressure gauge ① of hydraulic tester **J1**.

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



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



2. Measurement of Unload Pressure

1) Start the engine.
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

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

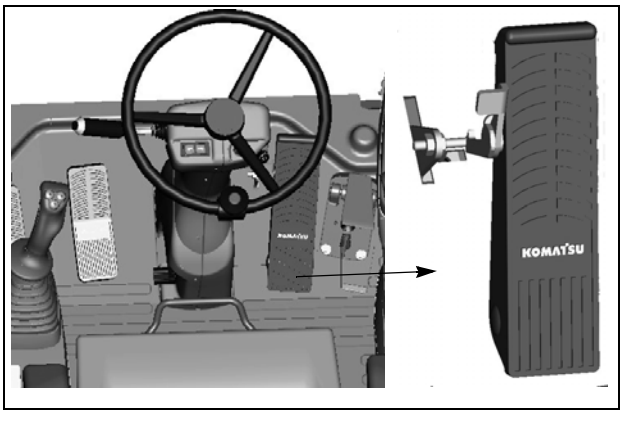
1) Start the engine and move the swing lock switch to the ON position.
2) Measure hydraulic oil pressure when the engine is running at high idling and the swing circuit is relieved.

★ 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

1) Start the engine and apply service brake to prevent travel, select forward or reverse travel.



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.

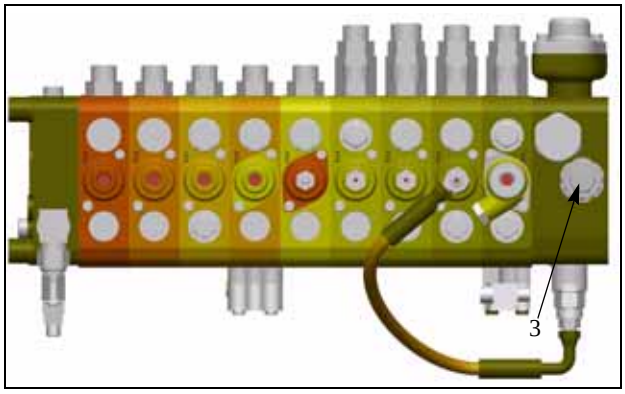
ADJUSTMENT

★ 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).

★ The high pressure setting is the state in which the 2 stage relief solenoid valve is turned ON and the pilot pressure is applied.

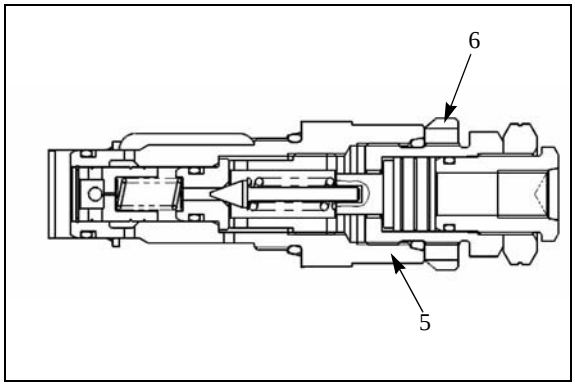


1) Disconnect the pilot hose.
2) Loosen lock nut (5) and adjust the pressure by turning holder (6).

★ 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**



3) Check the pressure again after the adjustment, following the aforementioned steps for measurement.

★ When measuring the pressure, connect 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.

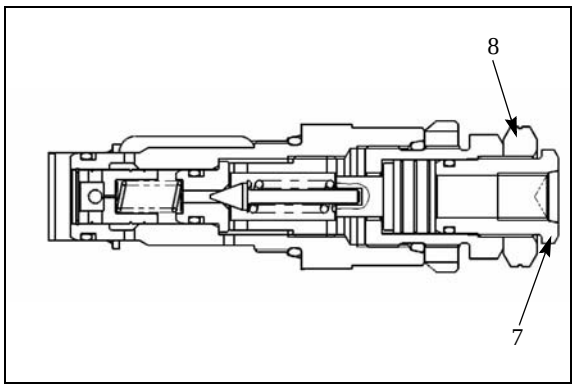
★ The high pressure setting is in the state in which the 2-stage relief solenoid is turned OFF and NO pilot pressure is applied to the change over port.

1) Disconnect pilot hose.
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}**

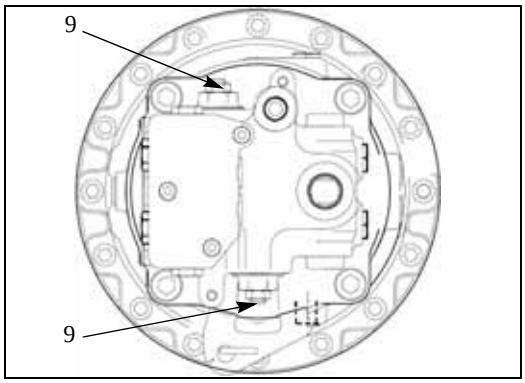


3) Check the pressure again after the adjustment, following the aforementioned steps for measurement.

★ When measuring the pressure, connect 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.



1) Hold screw (9), loosen lock nut (10).

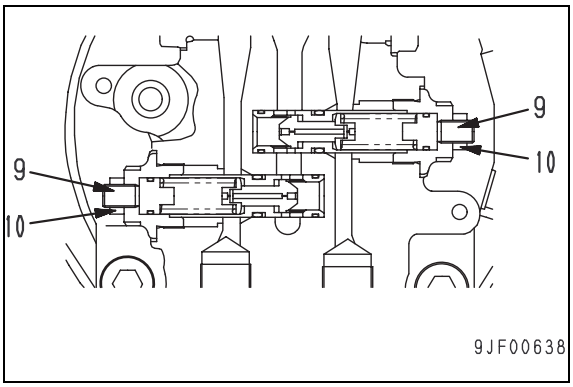
★ Fix the screw with a hexagonal wrench.

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}**



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

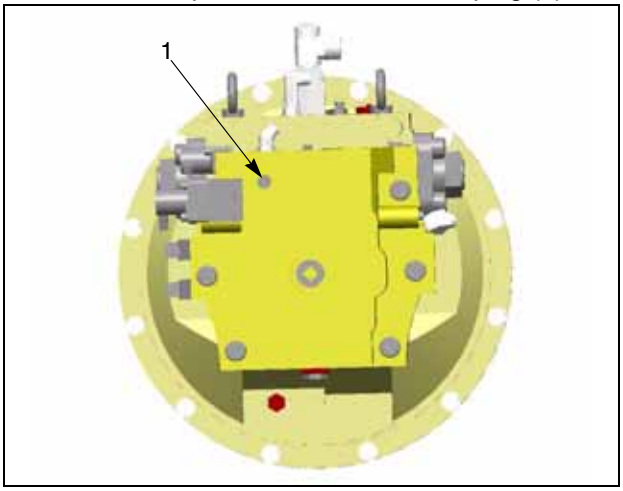
Mark		Part No.	Part Name
J	1	799-101-5002	Hydraulic Tester
		790-261-1203	Digital Type Hydraulic Tester
	2	799-101-5220	Grease Fitting (14 x 1.5 mm)
		07002-11023	O-ring

MEASUREMENT

⚠ CAUTION

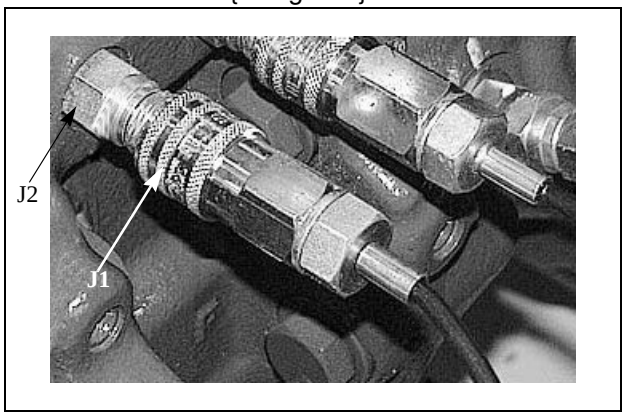
Lower the work equipment to the ground and stop the engine. After the engine stops, operate the control lever several times to release the remaining pressure in the piping. Then loosen the oil filler cap to release the pressure inside the hydraulic tank.

1. Remove oil pressure measurement plug (1).



2. Fit fitting **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.

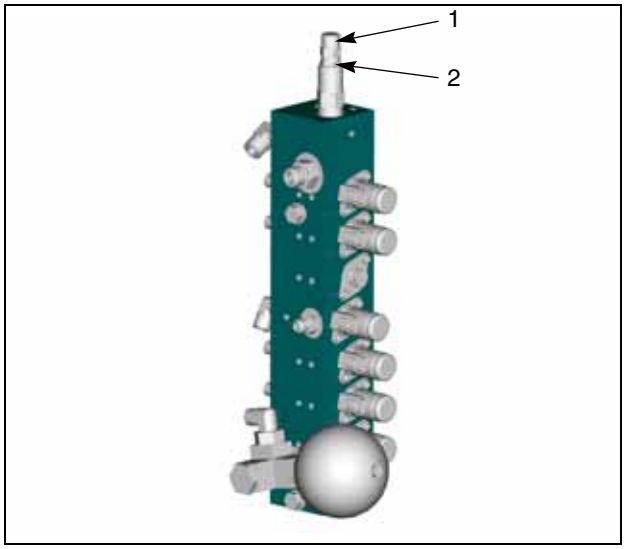
4. Measure oil pressure with the engine running at high idling and all the control levers in the NEUTRAL position.

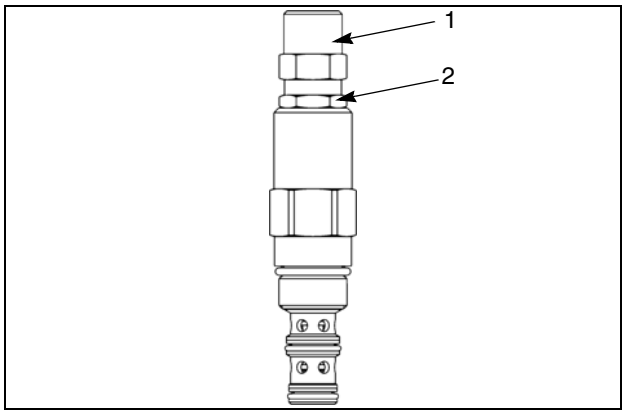


5. Detach all the measurement tools after the measurement, and make sure that the machine is back to normal condition.

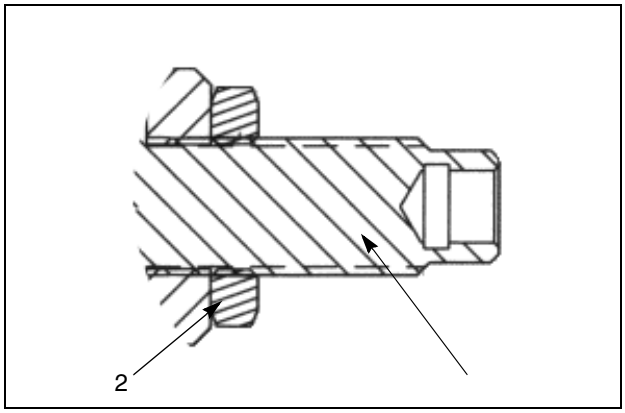
Procedure for pressure reducing adjustment

1. Remove dust cap (1).
2. Loosen off adjusting screw nut (2).





3. Tighten adjusting screw (3) to increase pressure and loosen to decrease pressure.



4. When at correct pressure tighten adjusting screw 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
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

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.

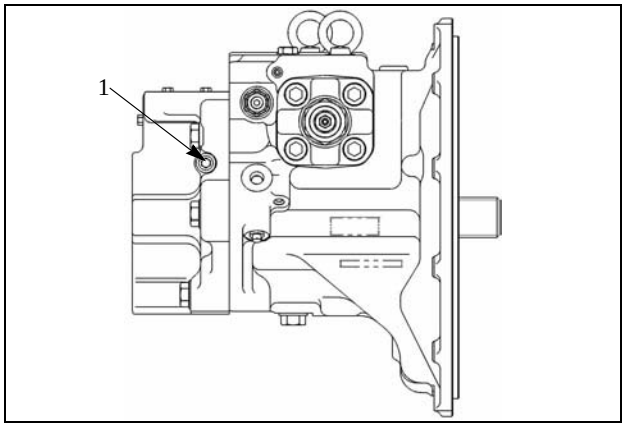
⚠ CAUTION

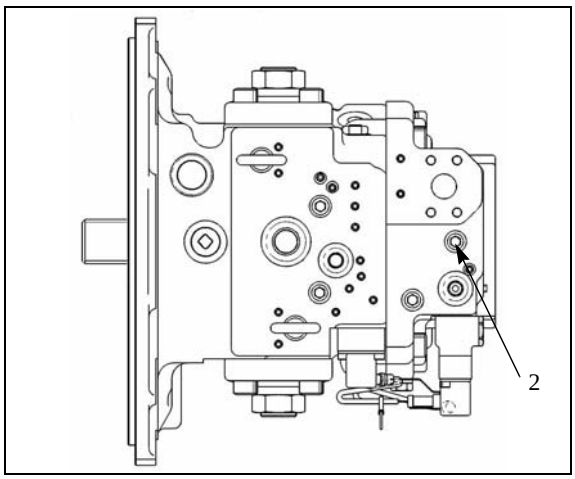
Lower the work equipment to the ground and stop the engine. After the engine stops, operate the control lever several times to release the remaining pressure in the piping. Then loosen the oil filler cap to release the pressure inside the hydraulic tank. Ignition switch must be in the 'ON' position.

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) 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





2) Fit fitting **J2** and connect to oil pressure gauge ① of hydraulic tester **J1**.

★ Use an oil pressure gauge with the capacity of 58.8 MPa{600 kg/cm^2}





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



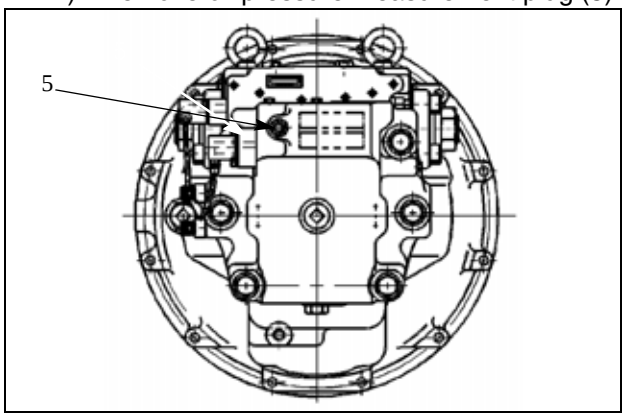
4) Measure the pump delivery pressure and PC valve output pressure (servo piston inlet pressure) together with the engine running at high idling, after setting the machine at the following conditions.
   - Working mode: A mode
   - Swing lock switch: ON (switched to high pressure relief with 2-stage 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. Measurement of PC-EPC output pressure
   1) Remove oil pressure measurement plug (5).



   2) Fit fitting **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 pressure rises to the operating range.



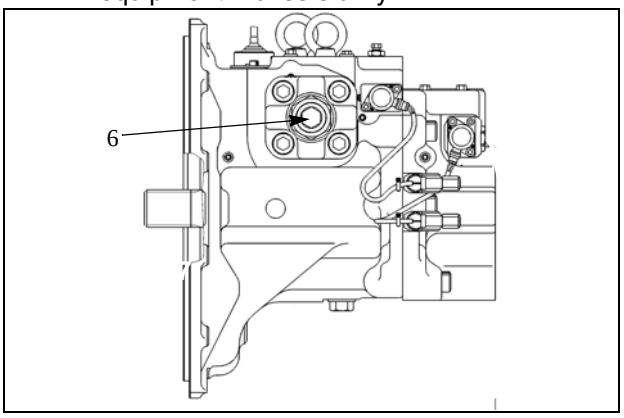
4) Measure the hydraulic oil pressure with all the control levers kept in the NEUTRAL position and the engine running at high idling and at low idling.

★ If PC-EPC valve output pressure changes to the following values, it is judged normal.

Engine speed	Control lever	Hydraulic oil pressure
Low idling	Neutral	2.9 MPa {30 kg/cm^2}
High idling		0{0}

ADJUSTMENT

★ If any of the phenomena mentioned below occurs and PC valve malfunctioning is suspected, adjust PC valves (6) .
- As workload increases, the engine rpm sharply drops.
- While the engine rpm is normal, the work equipment moves slowly.

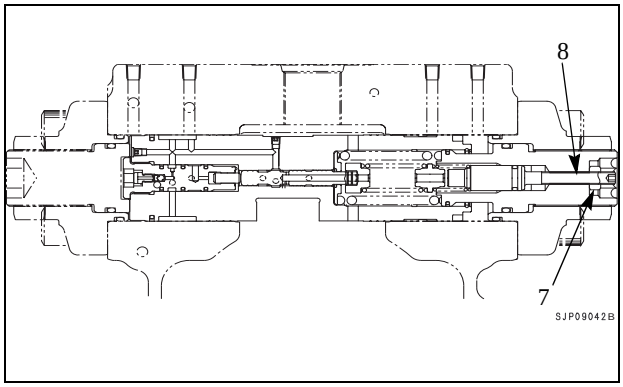


1. Loosen lock nut (7) and make adjustment, turning adjusting screw (8).

★ 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)

N·m Lock nut: **27.50–34.3Nm{2.8–3.5kgm}**



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
K	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
	3	799-401-1340	Differential Pressure Gauge

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.

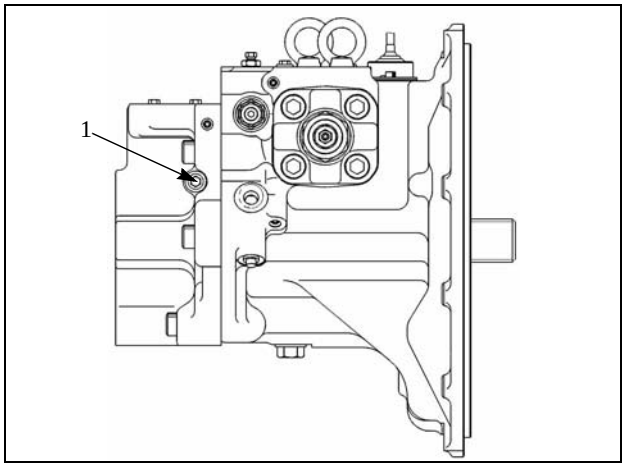
⚠ CAUTION

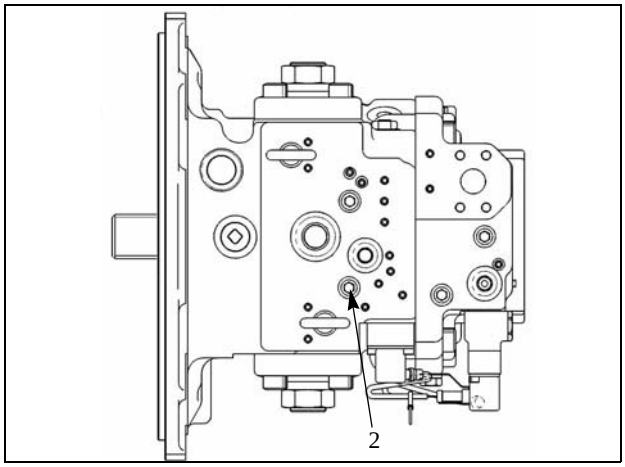
Lower the work equipment to the ground and stop the engine. After the engine stops, operate the control lever several times to release the remaining pressure in the piping. Then loosen the oil filler cap to release the pressure inside the hydraulic tank. Ignition switch must be in the 'ON' position.

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) 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





2) Fit test fittings K2 connected to oil pressure gauge ① of hydraulic tester **K1**, to both ports 1 and 2.

★ Use an oil pressure gauge with the capacity of 58.5 MPa{600 kg/cm^2}.

3) Start the engine and keep it running until the hydraulic oil temperature rises to the operating range.
   - Fuel dial : Full
   - 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.



4) Measure pump delivery pressure and LS valve output pressure (servo piston inlet pressure).

★ 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.

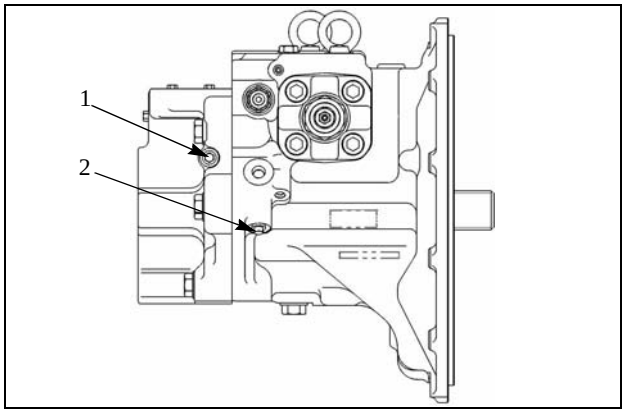
Oil pressure to be measured	Oil pressure ratio	
	All control levers in NEUTRAL	During test.
Pump delivery pressure	Nearly equal pressure	1
LS valve delivery pressure		Approx. 3/5

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.

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) Fit fitting **K2** and connect it to oil pressure gauge ① of hydraulic tester **K1** or differential pressure gauge **K3, to both ports 1 and 2**.

★ 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.



3) Start the engine and keep it running until the hydraulic oil temperature rises to the operating range.
   - Fuel dial : Full
   - 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.



4) Measure pump delivery pressure and LS pressure (actuator loaded pressure). attention to the surroundings for safety.

★ Calculation of LS differential pressure:
LS differential pressure = Pump delivery pressure – LS pressure

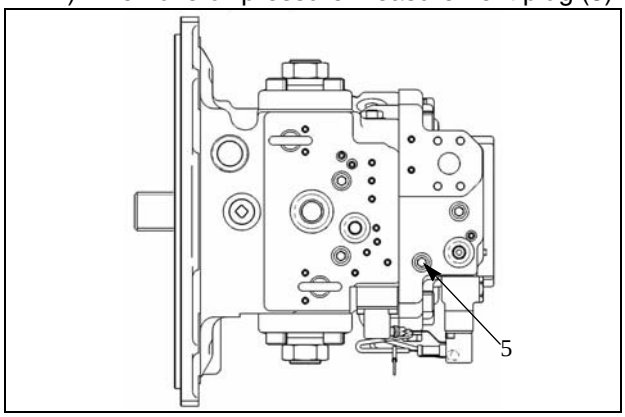
★ If LS differential pressure is in the following conditions, it is judged normal.

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)

5) Detach all the measurement tools after the measurement, and make sure that the machine is back to normal condition.

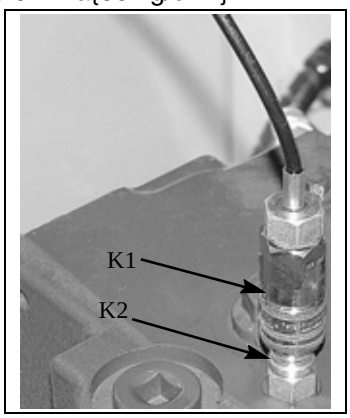
3. Measurement of LS-EPC valve output pressure

1) Remove oil pressure measurement plug (5).



2) Fit fitting **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) Start the engine and keep it running until the hydraulic oil temperature rises to the operating range.



4) Measure the oil pressure under the following conditions:
   - Fuel dial : Full
   - Auto decel : Off.
   - One touch power max : Off.

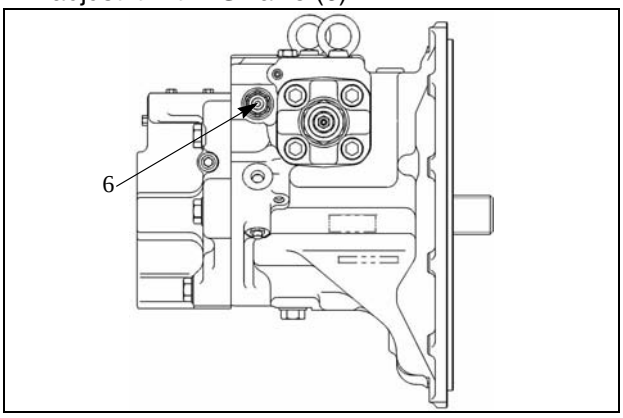
l.

Working Mode	Work Equipt. Operation	Travel Pedal	Hydraulic Pressure
A	Neutral	Neutral	{30} 900 mA
L	Arm dump relief	Pump relieved	{16} 580 mA

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).



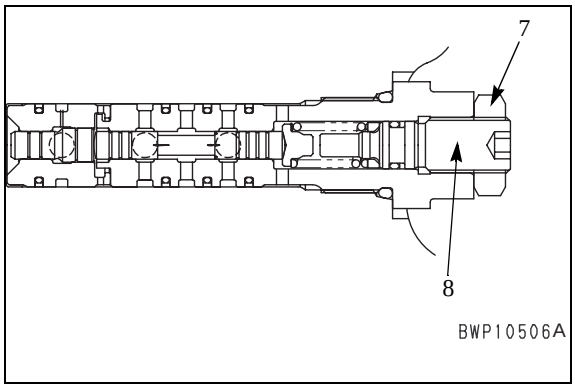
1. Loosen lock nut (7) and adjust the pressure by turning adjusting screw (8).

   ★ 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, 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 stops, operate the control lever several times to release the remaining pressure in the piping. Then loosen the oil filler cap to release the pressure inside the hydraulic tank. Switch must be in the 'ON' position.

1. Disconnect the hoses of solenoid valve to be measured at the outlet side.

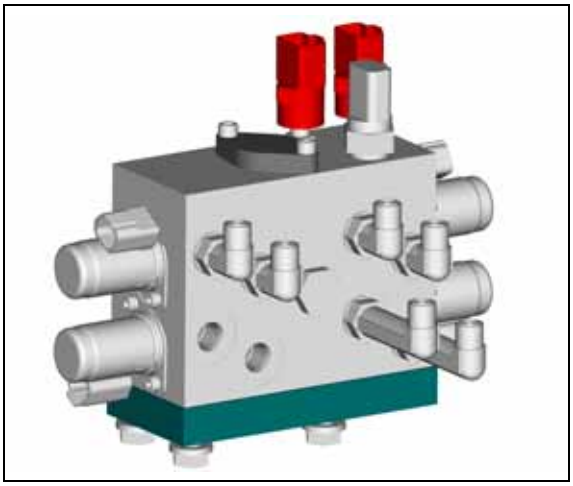
No.	Solenoid valve to be measured
PO	PPC hydraulic pressure lock solenoid valve
A1	2 stage relief solenoid valve
A2	Swing brake solenoid valve
A3	Suspension lock solenoid valve
A5	Blanked
A6	Travel neutral solenoid valve
A8	Travel creep solenoid valve

★ Hoses to outlet ports (1 ~ 7) of the 6-station manifold within the pump compartment.



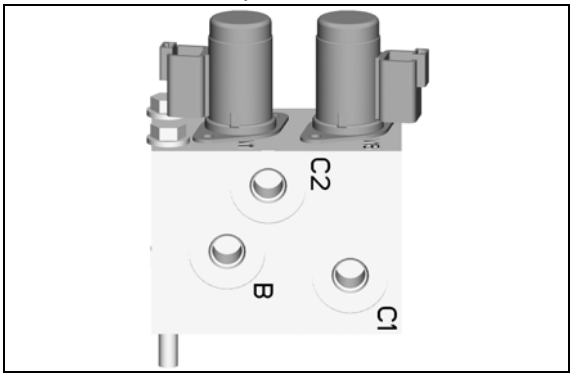
No.	Solenoid valve to be measured
A1	Travel solenoid valve - forward
B1	Travel solenoid valve - reverse
A2	Boom / Stabilizer solenoid valve - Boom down
B2	Boom / Stabilizer solenoid valve - Stabilizer down
A3	Boom / Stabilizer solenoid valve - Boom up
B3	Boom / Stabilizer solenoid valve - Stabilizer up

★ Hoses to outlet ports (8 ~ 11) of the 4-station manifold in the service area at the rear of operator's cab.



No.	Solenoid valve to be measured
C1	2 stage back pressure solenoid valve
C2	Hi / Lo solenoid valve - hi gear
B	Hi / Lo solenoid valve - lo gear

★ Hoses to outlet ports (C1), (C2) and (B) of the 2-station manifold in the service area underneath the operator's cab.



2. Connect fitting **L2** to outlet port to be measured.

3. Fit fitting 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.

6 - Stage solenoid block

Table for Functioning Conditions - PPC lock solenoid valve.

Functioning Condition		Functioning
Safety lock lever	Locked	OFF
	Released	ON

Table for Functioning Conditions - 2 stage relief solenoid valve.

<table>
<tr><td colspan="3">Functioning Condition</td><td>Functioning</td></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>

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 - 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 - 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 - Travel creep solenoid valve.

Functioning Condition		Functioning
Travel Creep	Creep selected	On
	Creep not selected	Off
	Stationary	On

4 - Stage solenoid block

Table for Functioning Conditions - Travel solenoid valve. (forward / reverse)

Functioning Condition	Functioning
Forward (Default)	OFF
Reverse	ON

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 - Boom / Stabilizer solenoid valve. (boom / stabilizer UP)

Functioning Condition	Functioning
Boom up (Default)	OFF
Stab up	ON

2 - Stage solenoid block

Table for Functioning Conditions - Hi / Lo 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 - 2 Stage back pressure solenoid valve - Not prepared for PW160-7

Functioning Condition	Functioning
Back pressure	OFF
No back pressure	ON

MEASUREMENT OF PPC VALVE OUTPUT PRESSURE

- PPC valve output pressure measurement tools

Mark		Part No.	Part Name
M	1	799-101-5002	Hydraulic Tester
	2	790-261-1203	Digital Type Hydraulic Tester
P	2	799-401-3100	Adapter (Size 02)

Stop the machine on a level ground and lower the work equipment to the ground. Then, release the residual pressure from the hydraulic circuit. For details, see "Releasing residual pressure from hydraulic circuit".

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

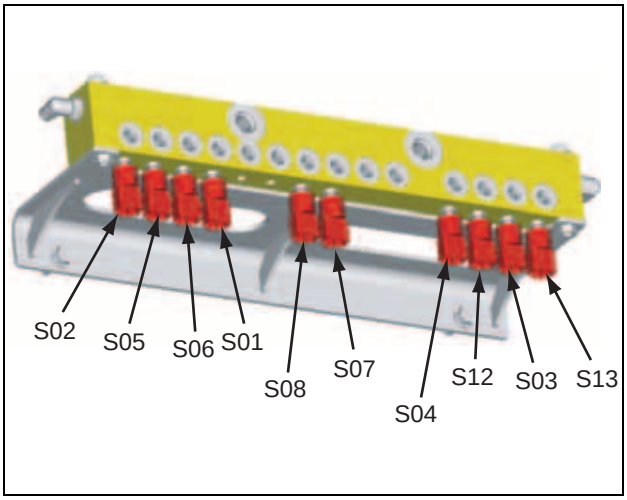
★ Measure the solenoid valve output pressure under the following condition.

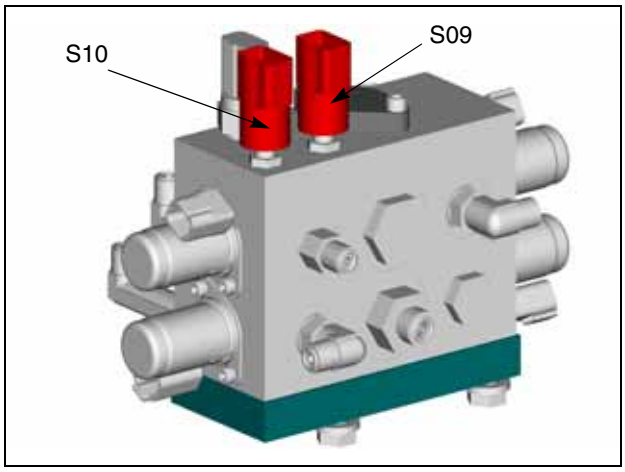
- Hydraulic oil temperature: Within operating range

1) Remove PPC oil pressure switches in the hydraulic circuits to be measured.

No.	Circuit to be measured	Location
S01	Swing right	Manifold Block
S02	Swing Left	Manifold Block
S03	Bucket Dump	Manifold Block
S04	Bucket Dig	Manifold Block
S05	Arm Dump	Manifold Block
S06	Arm Dig	Manifold Block
S07	2nd Boom Extend *	Manifold Block
S08	2nd boom Retract *	Manifold Block
S09	Travel Reverse	Solenoid Valve Block
S10	Travel Forward	Solenoid Valve Block
S12	Boom/Stabiliser Down	Manifold Block
S13	Boom/Stabiliser Up	Manifold Block

* Pressure switch fitted to this port if 2 piece boom fitted





2) Attach fitting (1) of hydraulic tester M and connect oil pressure gauge (2).
   - Use an oil pressure gauge with capacity of 5-9 MPa (60kg/cm^3)

3) Start the engine and set the working mode in the power mode (P).

4) Run the engine at high idle and measure the oil pressure with the control switch in neutral and moved to the max position.



★ If the output pressure is as follows, the PPC valve is normal.

Operation of lever	Output pressure
Neutral	0 MPa {0 kg/cm^2}
Max Position	Almost same as control circuit basic pressure (See standard values table)

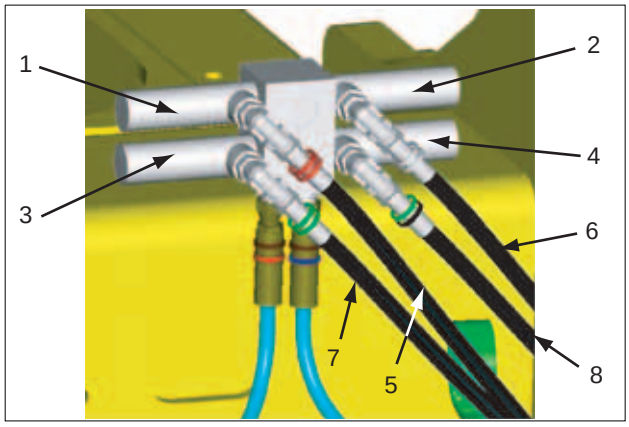
5) After finishing measurement, remove the measuring tools and return the removed parts.

CHECKING PROPORTIONAL CONTROL PPC CIRCUIT

1) Disconnect the hose of the Proportional Control PPC circuit to be measured.

2) Install adapter **P2** and connect the disconnected hose again.

3) Install nipple of hydraulic tester **M1** into adaptor **P2** and connect it to oil pressure gauge [2].
   ★ Use the oil pressure gauge of 5.9 MPa {60 kg/cm^2}.



1. LH 1 Att EPC Valve
2. RH 1 Att EPC Valve
3. LH 2 Att EPC Valve
4. RH 2 Att EPC Valve
5. 1 Att 1st Service Spool
6. 1 Att 2nd Service Spool
7. 2 Att 1st Service Spool
8. 2 Att 2nd Service Spool

4) Start the engine and set the working mode in the power mode (P).

5) Run the engine at high idle and measure the oil pressure with the control switch in neutral and moved to the max position.



   ★ If the output pressure is as follows, the PPC valve is normal.

Operation of lever	Output pressure
Neutral	0 MPa {0 kg/cm^2}
Max Position	Almost same as control circuit basic pressure (See standard values table)

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

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. Remove work equipment and swing PPC valve ass'y.

2. Take off boot (1).

3. Loosen lock nut (2) and screw in disc (3) until it contacts the heads of four pistons (4).

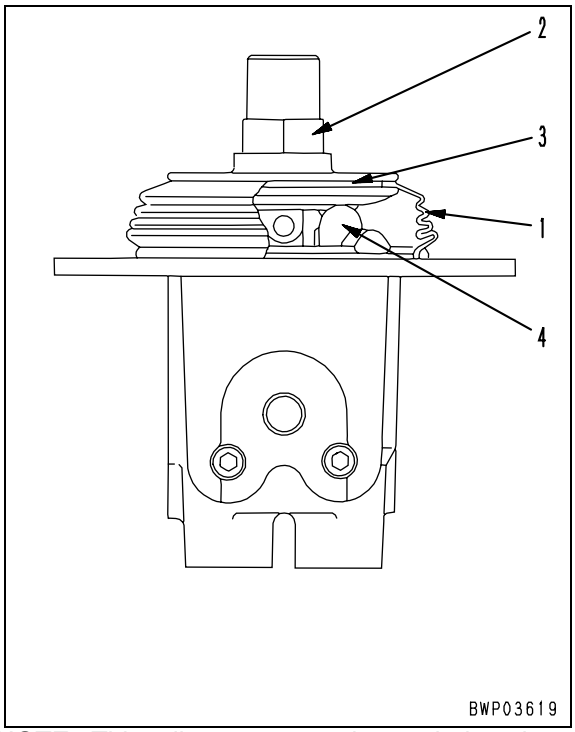
   ★ Do not move the piston while doing this work.

4. 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}**

5. Install boot (1).

6. Install work equipment and swing PPC valve ass'y.



NOTE: This adjustment must be carried out in a clean environment. Do not allow dirt particles under the boot.

Measuring and adjusting quick coupler control valve output pressure

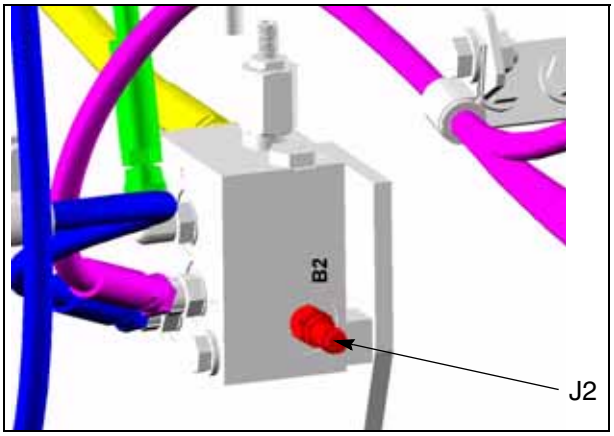
★ Measuring and adjusting tools for oil pressure in quick coupler circuit.

Symbol		Part No.	Part name
J	1	799-101-5002	Hydraulic tester
		790-261-1204	Digital hydraulic tester
	2	799-101-5220	Nipple (10 × 1.25 mm)
		07002-11023	O-ring

Stop the machine on a level ground and lower the work equipment to the ground. Then, release the residual pressure from the hydraulic circuit. For details, see "Releasing residual pressure from hydraulic circuit".

Measuring

- Measure quick coupler control valve output pressure after checking that work equipment, swing and travel circuit pressures are normal.
- Fit nipple J2 to port B2 and connect it to oil pressure gauge of hydraulic tester.



- Use an oil pressure gauge with the capacity of 59MPa (600kg/cm²)
- Start the engine. In order to raise the pressure to the set pressure of the pressure regulating valve it will be necessary to operate one of the main control circuits. Set the swing lock to ON and operate the swing lever.

NOTE: When delivered from the factory the regulated pressure is set to 4MPa (41kg/cm².

Adjustment

If the regulated pressure is not suitable for the quick coupler to be installed adjust the pressure of the regulating valve as follows:

1. Loosen the locknut (1a). (using a 17mm spanner).



2. Turn the adjustment screw (1b) to adjust the pressure. (Using a 5mm hexagon key).
   - If the screw is turned to the right the pressure increases.
   - If the screw is turned to the left the pressure reduces.
   - Quantity of adjustment per turn of the screw: Approx 5.5MPa.



3. After required pressure is achieved, hold adjustment screw (1b) and tighten the lock nut (1a). (Torque of lock nut (1a) 12+/-2Nm)

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.

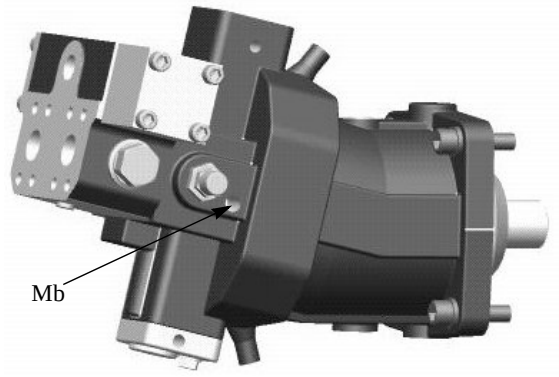
★ Test the machine on a downhill slope with a smooth surface and long enough to allow the pressure to stabilize. If the slope is steep (more than 5 degrees) test in LOW mode, otherwise test in HIGH mode.

★ 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 rewards travel (Mb side) of the motor.

★ Remove seal and cap from the valve.

★ Loosen locking nut.

★ Turn adjustment screw clockwise to increase, and counter clockwise to decrease the pressure.

★ Tighten lock nut.

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

Propshaft speed in RPM

Oil temperature 45 ~ 50°C

Check Item		Unit	Standard	Remarks
Travel Speed - CREEP	P Mode	rpm	230 +/-5%	If too high check travel EPC valve.
Travel Speed - LO	P 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 Q is connected to tank (i.e. no pressure) and port P 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 P is connected to tank and port Q 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. With the park brake valve de-energised, both clutches are engaged and the park brake is engaged.

1. Measuring clutch actuation pressure

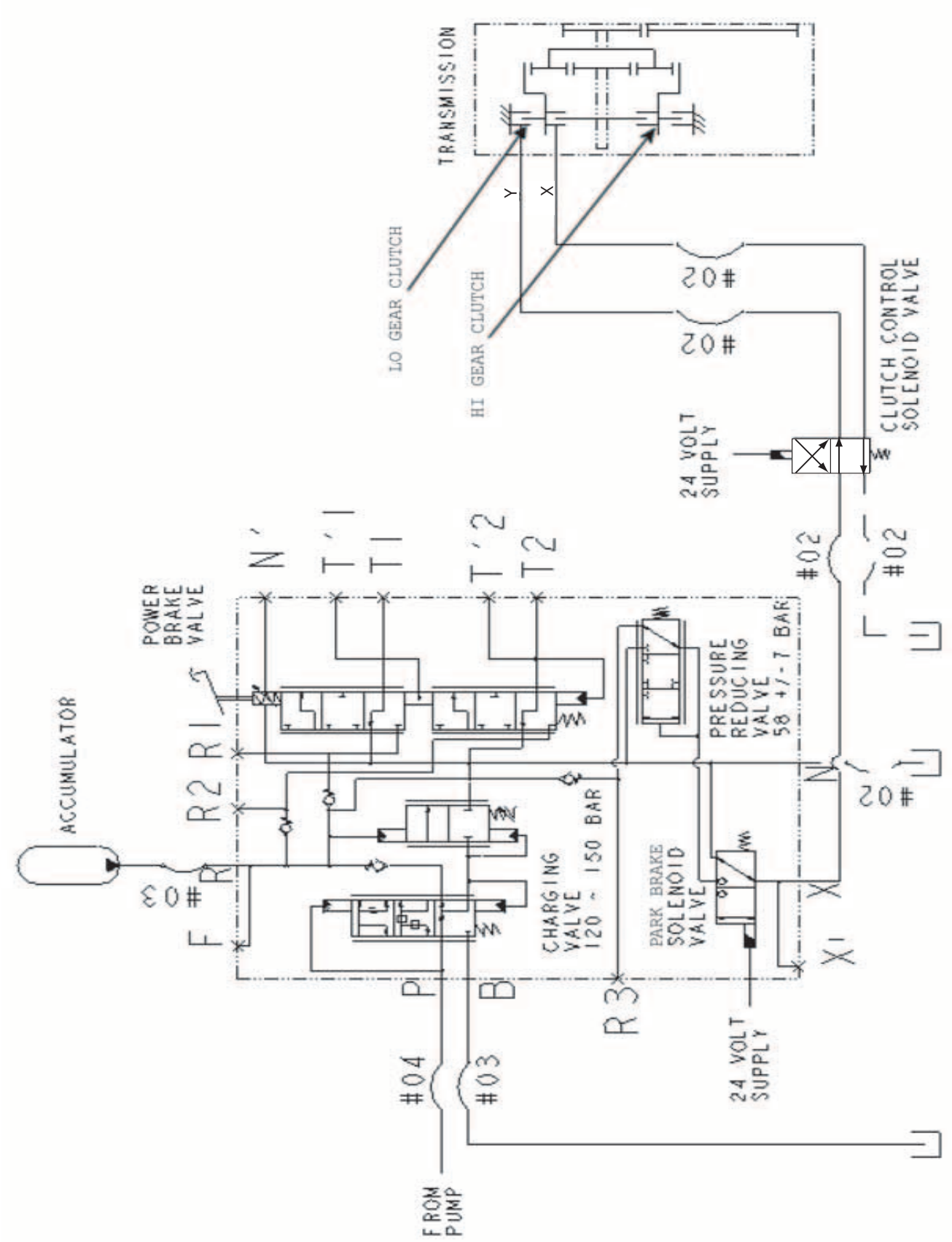
Oil temperature 45 ~ 55°C

Fit the connectors to clutch ports P and Q on the transmission. Fit a 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 P and Q.

★ Judgement table

Travel mode	Pressure MPa (kg/cm^2)	
	Port P	Port Q
HI	0	5.8 $^+$ / $^-$ 0.7 (59 $^+$ / $^-$ 7)
LO	5.8 $^+$ / $^-$ 0.7 (59 $^+$ / $^-$ 7)	0
CREEP	5.8 $^+$ / $^-$ 0.7 (59 $^+$ / $^-$ 7)	0
PARK BRAKE	0	0

If the pressure is low or high then the power brake valve must be exchanged (the pressure reducing valve is not adjustable).If the pressure is 0, check flow to power brake valve and accumulator charge pressure.


TRANSMISSION
LO GEAR CLUTCH
HI GEAR CLUTCH
Y
X
20#
20#
CLUTCH CONTROL SOLENOID VALVE
24 VOLT SUPPLY
N'
T'1
T1
T'2
T2
#02
#02
POWER BRAKE VALVE
PRESSURE REDUCING VALVE 58 +/- 7 BAR
ACCUMULATOR
R2
R1
20#
CHARGING VALVE 120 - 150 BAR
PARK BRAKE SOLENOID VALVE
F
R
P1
B1
R3
X1
#04
#03
24 VOLT SUPPLY
FROM PUMP

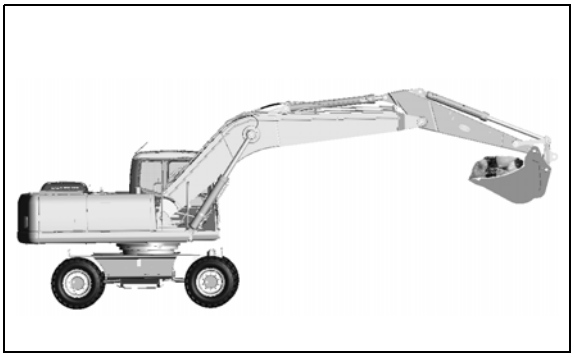
INSPECTION OF LOCATIONS OF HYDRAULIC DRIFT OF WORK EQUIPMENT

★ 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) 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.



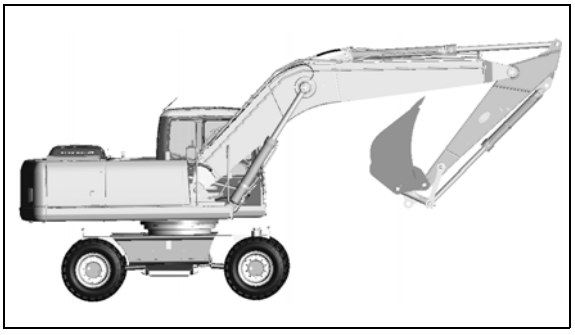
2) Operate the control lever to the RAISE position or the bucket control lever to the CURL position.
   - If the lowering speed increases, the cylinder packing is defective.
   - If there is no change, the control valve is defective.

★ 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

1) Operate the arm cylinder to move the arm to the position 100 mm before the digging stroke end, and stop the engine.



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.

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 small 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) 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.
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 AMOUNT

1. Measurement of oil leakage amount from boom cylinder

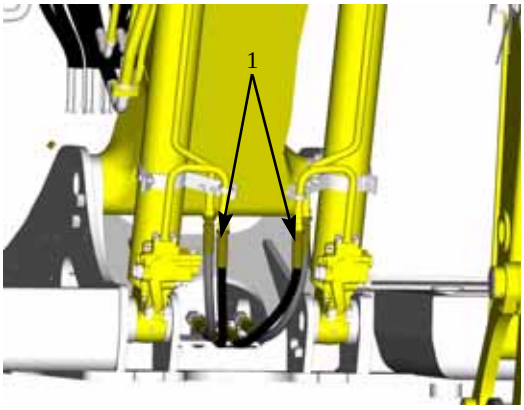
1) Start the engine and keep it running until the hydraulic oil temperature rises to the operating range. Then extend the boom cylinder to the stroke end.

Release the pressure remaining in the piping, referring to the foregoing section of "Release of Remaining Pressure in Hydraulic Circuit".

2) Disconnect hose (1) at the cylinder head end and block the hose end with a plug.

Be careful not to disconnect the hose at the cylinder bottom end.

3) Start the engine and apply the relief pressure to the bottom end of the cylinder with the engine running at high idling.
4) Continue this condition for 30 seconds, then measure the oil leakage amount for one minute.



5) After the measurement, make sure that the machine is back to normal condition.

2. Measurement of oil leakage amount from arm cylinder

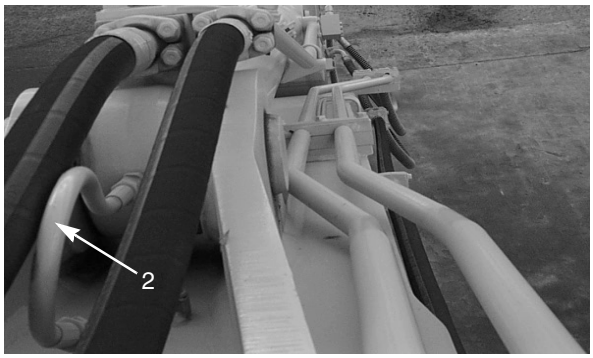
1) Start the engine and keep it running until the hydraulic oil temperature rises to the operating range. Then extend the arm cylinder to the digging stroke end.

Release the pressure remaining in the piping, referring to the foregoing section of "Release of Remaining Pressure in Hydraulic Circuit".

2) Disconnect hose (2) on the cylinder head end and block the hose end with a plate.

Be careful not to disconnect the hose at the cylinder bottom end.

3) Start the engine and apply the relief pressure to the bottom end of the cylinder with the engine running at high idling.
4) Continue this condition for 30 seconds, then measure the oil leakage amount for one minute.



5) After the measurement, make sure that the machine is back to normal condition.

3. Measurement of oil leakage amount from bucket cylinder

1) Start the engine and keep it running until the hydraulic oil temperature rises to the operating range. Then extend the bucket cylinder to the digging stroke end.

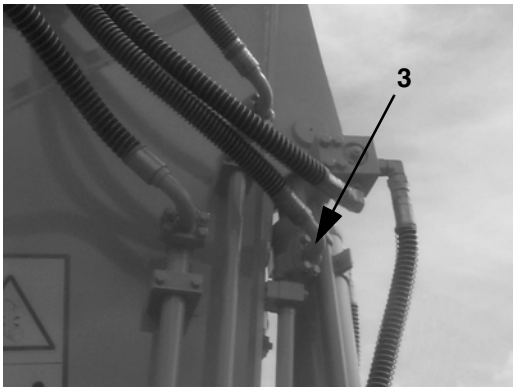
Release the pressure remaining in the piping, referring to the foregoing section of "Release of Remaining Pressure in Hydraulic Circuit".

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) Start the engine and apply the relief pressure to the bottom end of the cylinder with the engine running at high idling.
4) Continue this condition for 30 seconds, then measure the oil leakage amount for one minute.



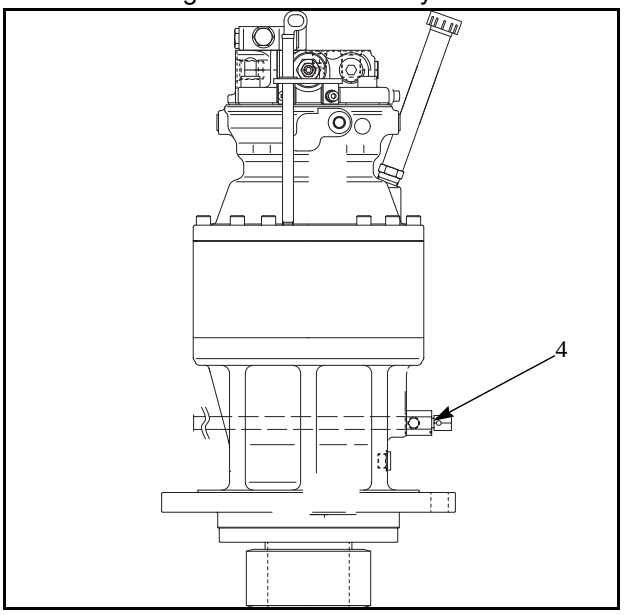
5) After the measurement, make sure that the machine is back to normal condition.

4. Measurement of oil leakage amount from swing motor

1) Disconnect drain hose (4) and fit a blind plug in the hose.
2) Turn the swing lock switch to the ON position.
3) Start the engine. Apply the swing relief pressure with the engine running at high idling and measure an oil leakage amount under such conditions.

★ After keeping the conditions in 3) above for 30 seconds, measure the oil leakage amount for one minute.

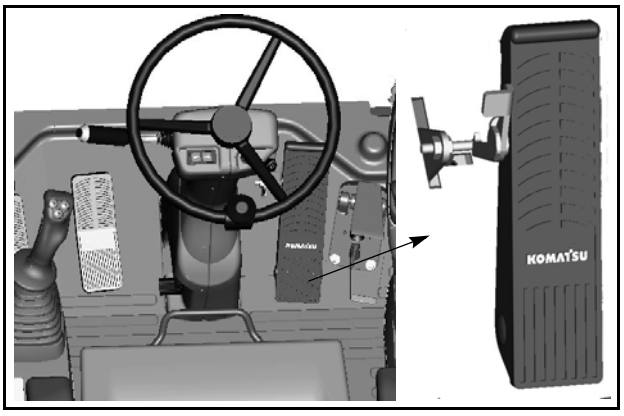
★ After the first measurement, turn the upper structure by 180 degrees and take measurement again in the same way.



4) After the measurement, make sure that the machine is back to normal condition.

5. Measurement of oil leakage amount from travel motor

1) Start the engine run at high idle and apply the service brake to prevent travel. Hydraulic oil temp 40 ~ 50°C



2) Disconnect flushing hose (1) of the travel motor and fit a blind plug in the hose end.
3) Lock travel pedal so that rotary group cannot rotate.
4) Port A or B are set under pressure above the setting of relief valves (i.e. 380 bar)

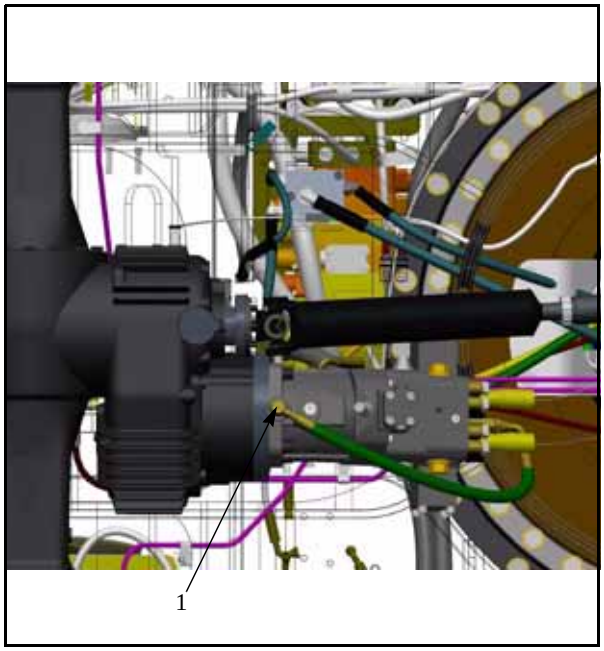
⚠ CAUTION

In this measurement, an erroneous operation of the control lever will likely lead to a serious accident. Make sure that all the signals and confirmations are followed without fail.

★ After keeping the conditions in 4) above for 30 seconds, measure the oil leakage amount for one minute.

★ Repeat the measurement several times, slightly rotating the motor, i.e. shifting the position of valve plate and cylinder, and the position of cylinder and piston, and take measurement several times

.



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	Air bleeding procedure					
	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 ● Removal of 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 ● Removal of travel motor piping		●	→	→	●	●
● Replacement or repair of swivel joint ● Removal of swivel joint piping		●	→	→	→	●

NOTE: Bleed air from the swing motor and travel motor only when oil in the casing is drained.

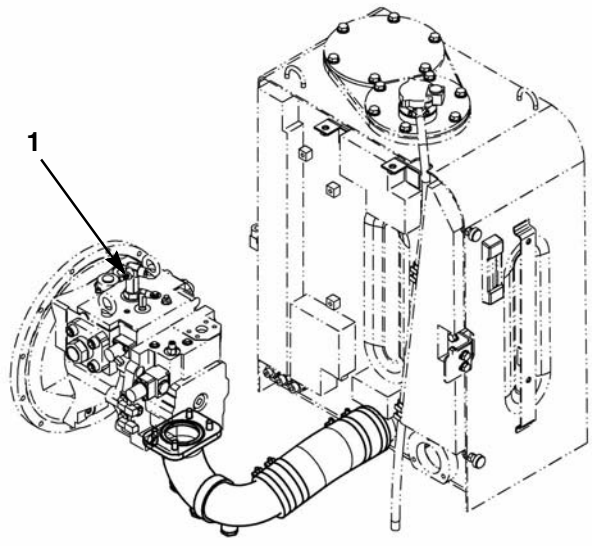
1. Air bleeding from hydraulic pump

1) Loosen air bleeding plug (1) and confirm that oil seeps out from the plug.
2) If the oil seepage is confirmed, tighten air bleeding plug (1).

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

★ Precautions for starting engine
When starting the engine after the air bleeding work explained above, run the engine at low idling for 10 minutes.
If the engine cooling water temperature is low and an automatic engine warming-up function is relied on, use the fuel dial, when it becomes necessary to cancel it

.



2. Air bleeding from hydraulic cylinder

1) Start the engine and kept it running at low idling for 5 minutes.
2) Raise and lower the boom 4 to 5 times with the engine running at low idling.

★ Be careful not to apply the relief pressure, stopping the piston rod approx. 100 mm before its stroke end.

3) Repeat the steps in Item 2) above, but this time with the engine running at high idling.
4) Apply the relief pressure by extending the piston rod to its stroke end and with the engine running at low idling.
5) For bleeding air from the arm cylinder and bucket cylinder, follow the same steps explained in Item 2) through 4) above.

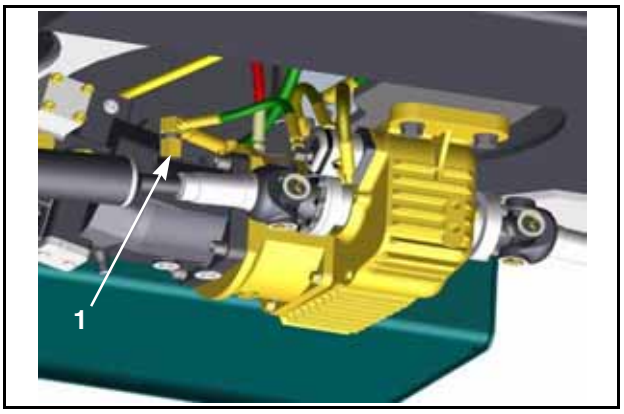
★ In case a cylinder is replaced with new one, it is advised to bleed air from the new one before mounting the work equipment. It is especially so with the boom cylinder, because its rod does not extend to the stroke end of LOWER side, after the work equipment is mounted.

3. Air bleeding from swing motor

1) Start the engine and run it at low idling.
2) Bleed air from the motor by swinging the upper structure slowly.

4. Air bleeding from travel motor

1) Start the engine and run it at low idling.
2) Loosen motor drain hose fitting (1) and confirm that oil seeps out from nipple.
3) If the oil seepage is confirmed, tighten fitting (1).

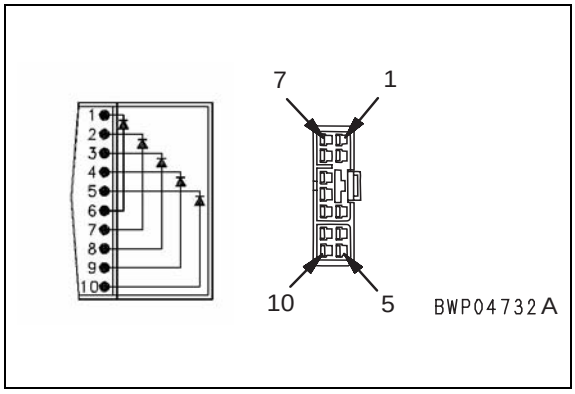


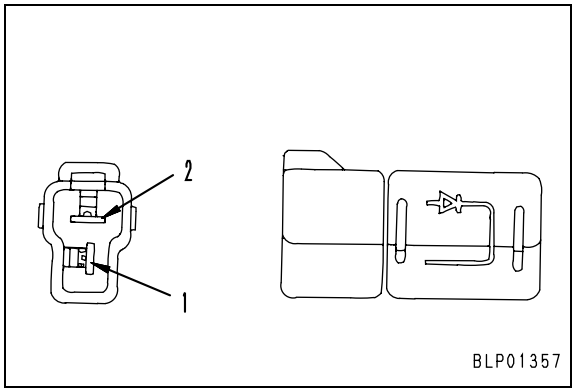
INSPECTION PROCEDURES FOR DIODE

★ 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.

★ The continuity direction of a single diode is shown on the diode surface.





1. When using digital type circuit tester

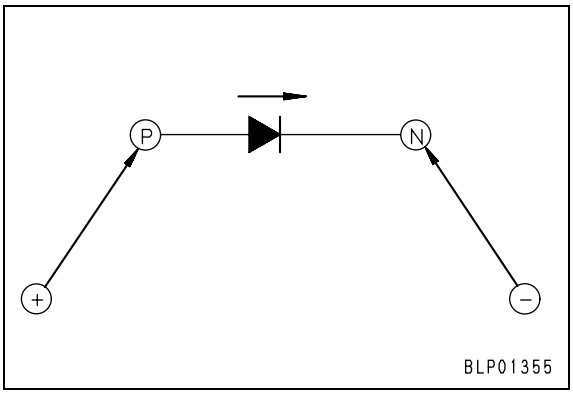
1) Switch the testing mode to diode range and confirm the indicated value.

★ Voltage of the battery inside is displayed with conventional circuit testers.

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.

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

1) Switch the testing mode to resistance range.
2) Check the needle swing in case of the following connections.

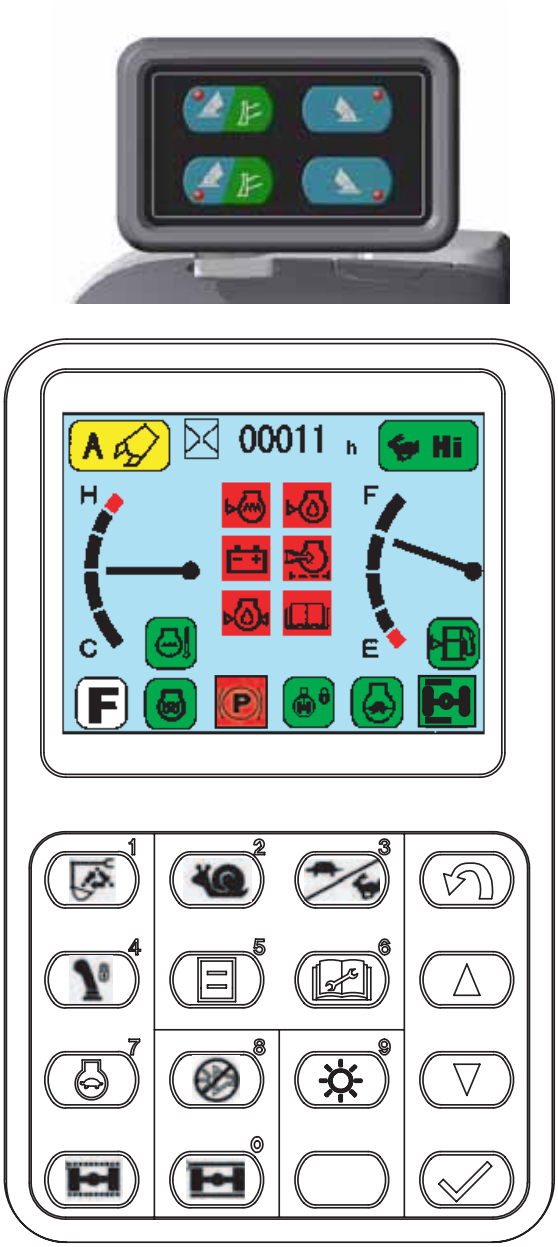
a. Put the red probe (+) of the test lead to the anode (P) and the black probe (–) to the cathode (N) of diode.

b. Put the red probe (+) of the test lead to the cathode (N) and the black probe (–) to the anode (P) of diode.

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 20-163.
2	Function for showing Komatsu's logo, see page 20-163.
3	Function for machine inspection before starting day's work, see page 20-163.
4	Function for showing machine maintenance, see page 20-163.
5	Function for showing precaution items, see page 20-164.
6	Function for confirming working mode and travel speed, see page 20-164.
7	Function for display of ordinary items, see page 20-164.
8	Function for adjusting display luminance and contrast, colour and clock see page 20-164.
9	Function for adjusting breaker and attachment flow rate, see page 20-165.
10	Function for confirming maintenance information, see page 20-168.
11	Function for showing service meter reading or clock, see page 20-168.
12	Function for showing occurrence of caution item, see page 20-168.
13	Function for showing users' code No., see page 20-168.
14	Function for showing service code No. and failure code No., see page 20-169.

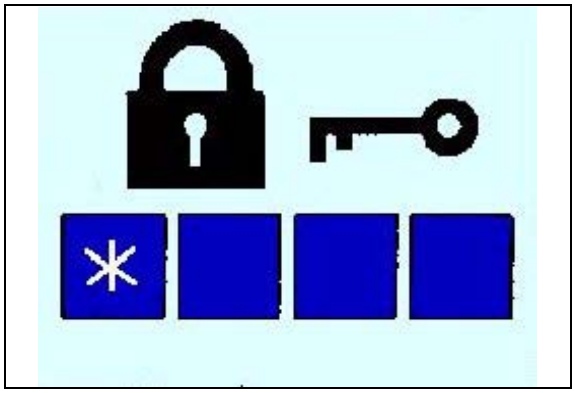
2. Special function: Service Menu

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

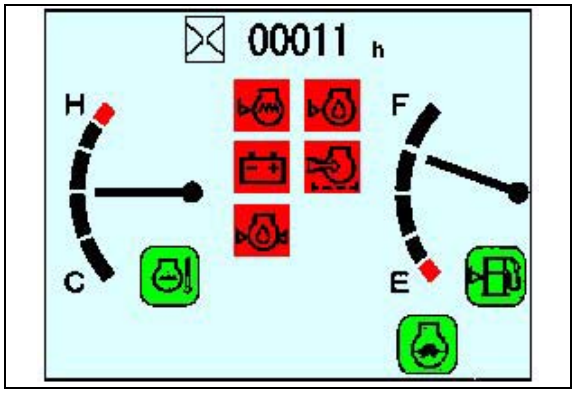
When the engine starting switch is turned ON, the password inputting display is shown.

- This display is shown only when a password is registered.



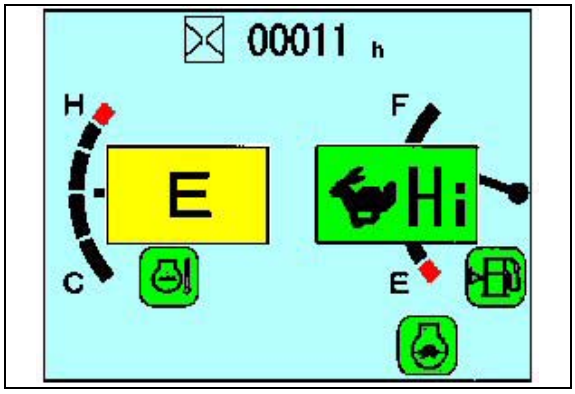
2. Function for showing KOMATSU logo

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.



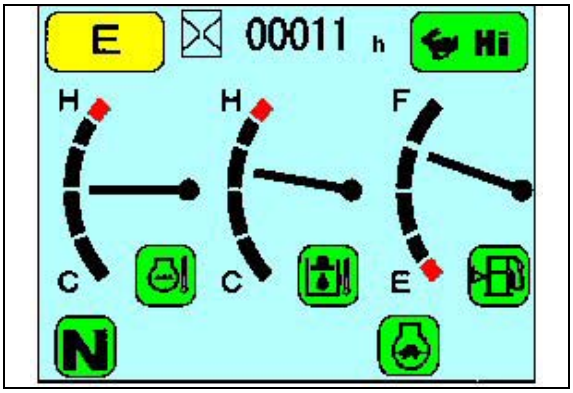
4. Function for machine maintenance

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.

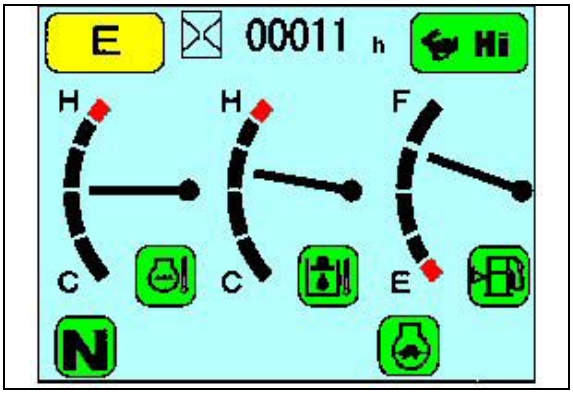


6. Function for confirming working mode and travel speed

7. Function for display of ordinary items

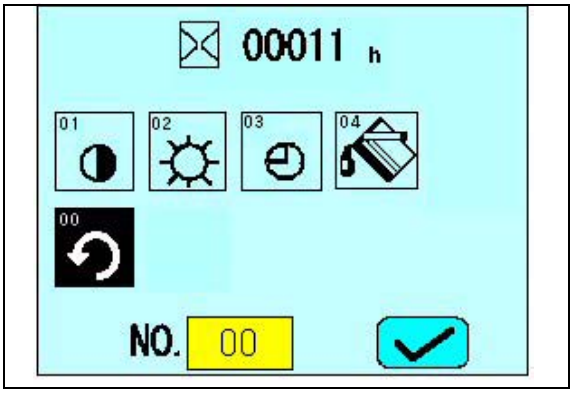
The display of confirming working mode and travel speed is switched to this display of ordinary items.

- 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.

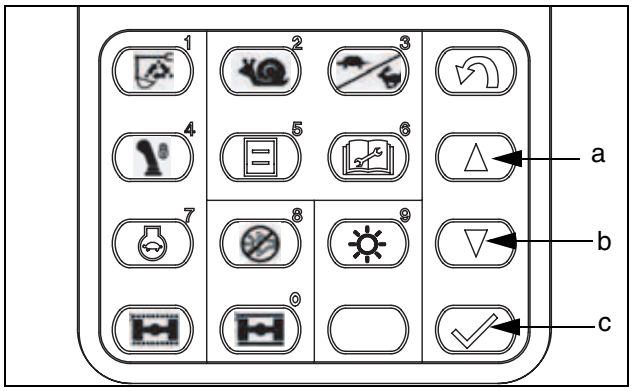


9. Function for adjusting breaker and attachment flow rate (For machines equipped with breaker attachment)

When a breaker or other attachments are used, hydraulic pump flow rate can be adjusted by operating the select switch.

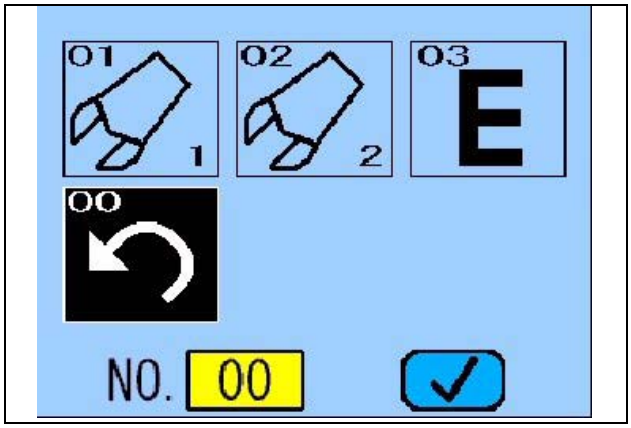
- Note that the symbol mark and contents of display partially differ between the breaker

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

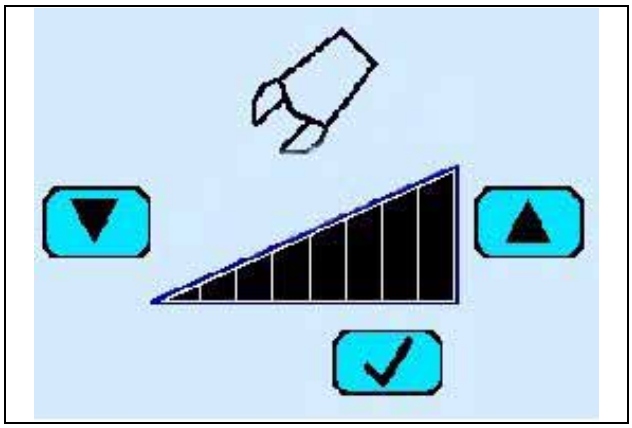


9.1. When the working mode is P or E

9.1.1 Press switch (5) and normal screen on monitor display changes to the screen shown in the diagram on the right

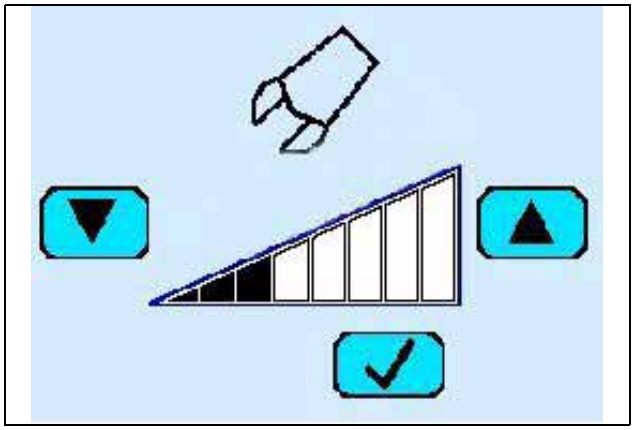


9.1.2 Select 01 from the screen and the monitor display changes to the flow setting screen shown on the right (Full Flow). By pressing down switch (b) the flow can be reduced.



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.

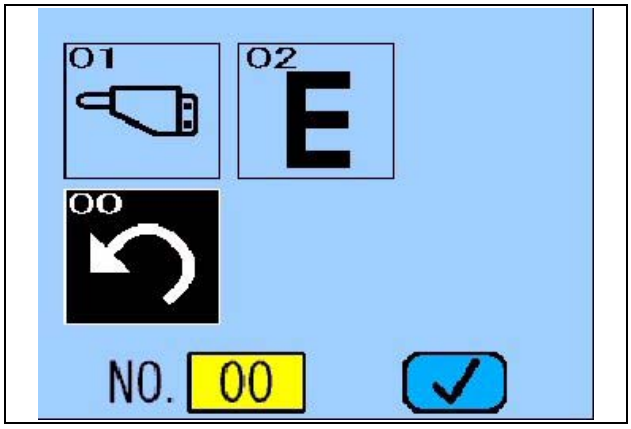


9.1.3 After completing the flow setting, press input confirmation switch (c).
The monitor display will return to the normal screen.

The flow can be adjusted for the attachment installed.

9.2. When working mode is B mode.

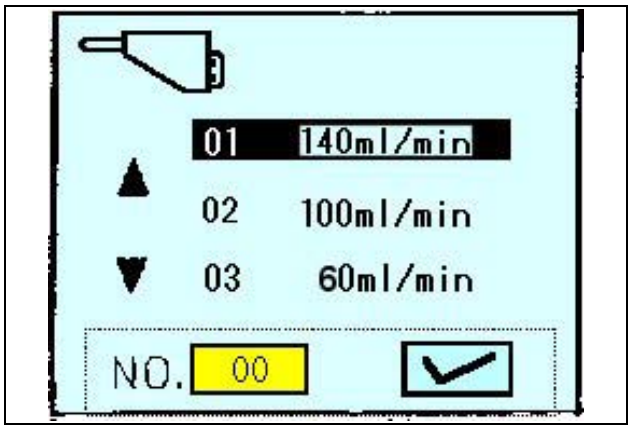
9.2.1 Press menu select switch (5) and the normal screen on the monitor display changes to the screen shown in the diagram on the right.



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.

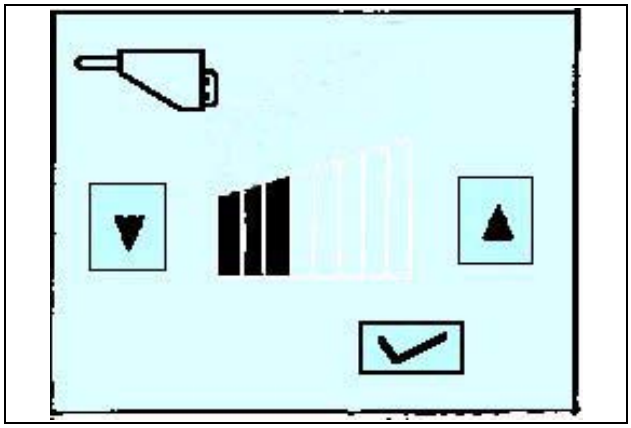
9.2.4 After completing the flow setting, press input confirmation switch (c).

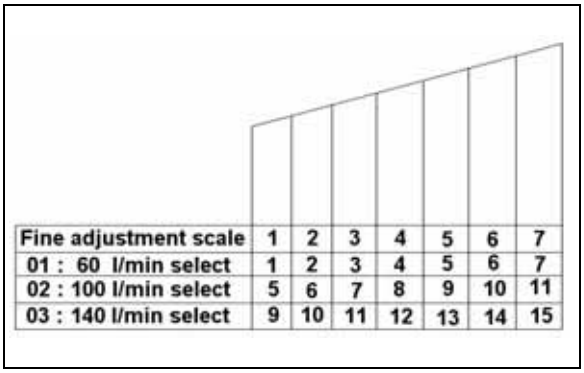


9.2.5 With the operation in step 3, the flow setting screen changes to the fine flow adjustment screen shown in the diagram on the right.

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

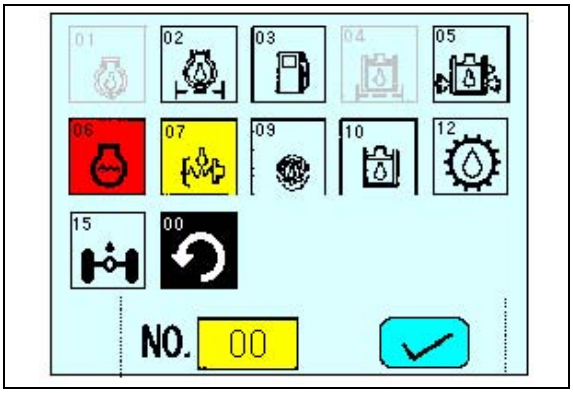
For approximate flow rate setting look at flow rate table below.

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.



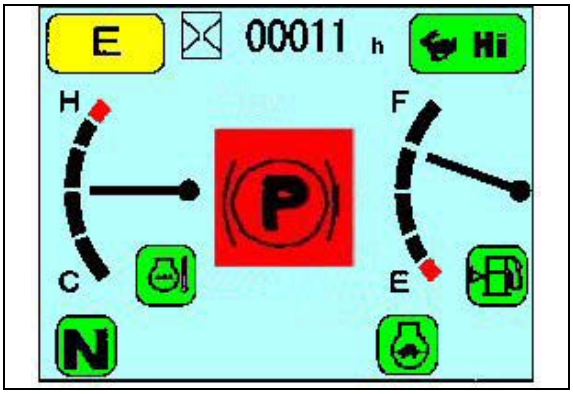
11. Function for showing service meter reading or clock

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.

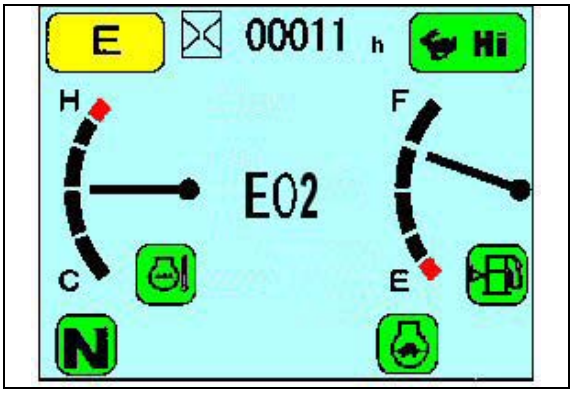
A. Park brake
B. Low Brake Pressure
C. Undercarriage Attach Select.



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

⇩

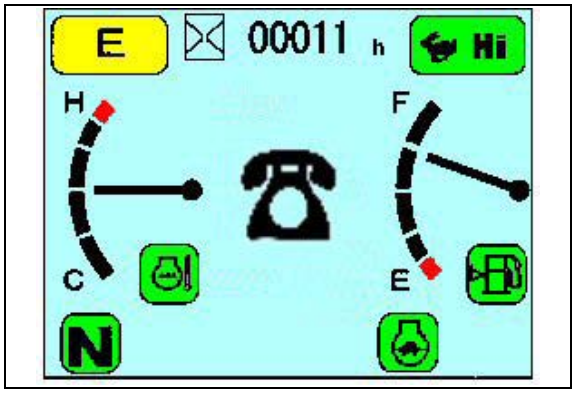
② Telephone No.

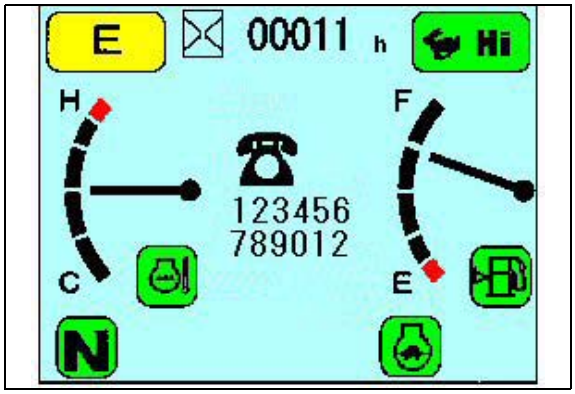
⇩

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.





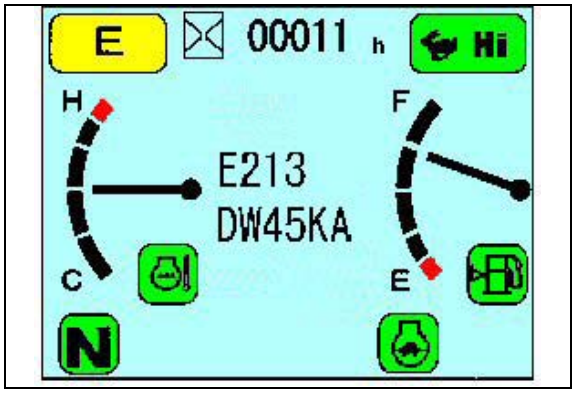


TABLE FOR FAILURE CODE NO.

User code	Failure code	Trouble (Displayed on screen)	Alarm buzzer	Component in charge	Category of record
	6B2JMA	Travel Hydraulic Abnormality		PUMP	Electrical 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
E15	**CA144**	Coolant Temp Sens High Error	●	ENG	Electrical system
E15	**CA145**	Coolant Temp Sens Low 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
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	**CA324**	Inj #3 (L#3) 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
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
E15	**CA559**	Rail Press Low Error	●	ENG	Electrical system
E15	**CA689**	Eng Ne Speed Sensor Error	●	ENG	Electrical system
E15	**CA731**	Eng Bkup Speed Sens Phase Error	●	ENG	Electrical system
E10	**CA757**	All Persistent Data Lost Error	●	ENG	Electrical system
E15	**CA778**	Eng Bkup Speed Sensor Error	●	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
	DA22KK	Abnormality in Pump Pressure		PUMP	Electrical system
E02	**DA25KP**	Pressure Sensor Power Abnormality		PUMP	Electrical system
E0E	**DA2RMC**	CAN Discon (Pump Con Detected)	●	PUMP	Electrical system

User code	Failure code	Trouble (Displayed on screen)	Alarm buzzer	Component in charge	Category of record
	DA2SKQ	Model Selection Abnormality		PUMP	Electrical system
E0E	**DAFRMC**	CAN Discon (Monitor Detected)	●	MON	Electrical system
E20	**DDC3KZ**	Outrigger Switch Select Abnormality		PUMP	Electrical system
	DDP4KX	Travel PPC Pressure Switch Abnormality		PUMP	Electrical system
E20	**DDWCKZ**	Direction Switch Abnormality		PUMP	Electrical system
	DFB1KZ	Service Lever Pot. 1 Abnormality		PUMP	Electrical system
	DFB2KZ	Service Lever Pot. 2 Abnormality		PUMP	Electrical system
	DFB5KZ	Service Lever Spot. 1 Abnormality		PUMP	Electrical system
	DFB6KZ	Service Lever Spot. 2 Abnormality		PUMP	Electrical system
	DFB3L8	Service Lever 1 Potentio Error		PUMP	Electrical system
	DFB4L8	Service Lever 2 Potentio Error		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**	Suspension 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
	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	**DXA0KA**	PC-EPC Sol Discon	●	PUMP	Electrical system
E02	**DXA0KB**	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 1 Open Circuit		PUMP	Electrical system
	DXE4KB	Service Current EPC 1 Open Circuit		PUMP	Electrical system
	DXE7KA	Service Current EPC 2 Open Circuit		PUMP	Electrical system
	DXE7KB	Service Current EPC 2 Open Circuit		PUMP	Electrical system
	DXE8KA	Service Current EPC 3 Open Circuit		PUMP	Electrical system
	DXE8KB	Service Current EPC 3 Open Circuit		PUMP	Electrical system
	DXE9KA	Service Current EPC 4 Open Circuit		PUMP	Electrical system
	DXE9KB	Service Current EPC 4 Open Circuit		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.

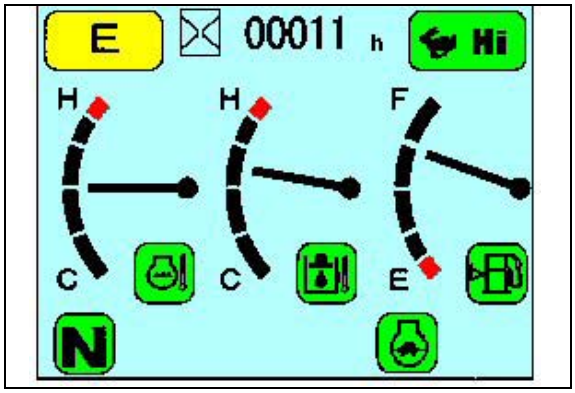
- Category of record

  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

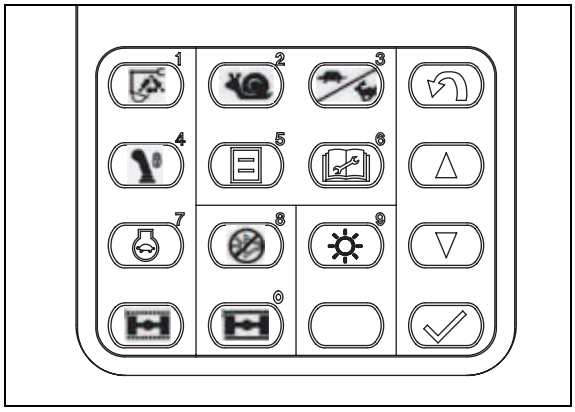
   Confirm that the display of ordinary items is shown (Normally engine stopped).

   - Changing to Service Menu cannot be made from displays other than this.

2. Switch operation

   Operate the switch as instructed below.

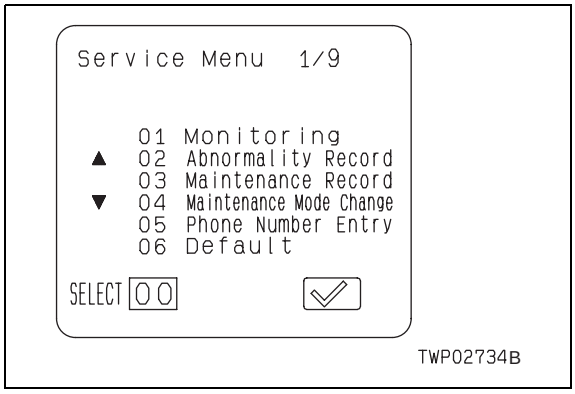
   - Switch operation: [▲] + [1] › [2] › [3]



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.

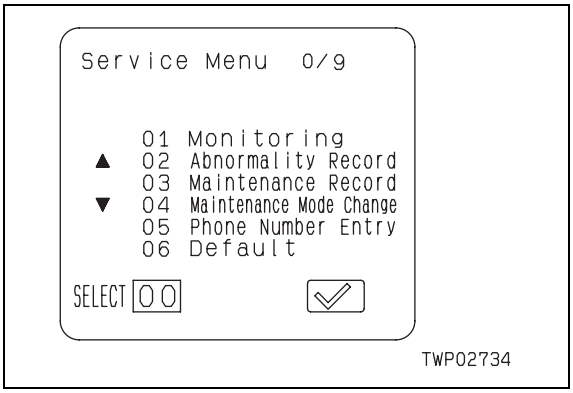
   ①Depress [↩] switch. (This method may be used for terminating any display)

   ②If "Return" switch is shown, depress it.

   ③If "Return" menu is shown, call that menu and depress [✓] switch.

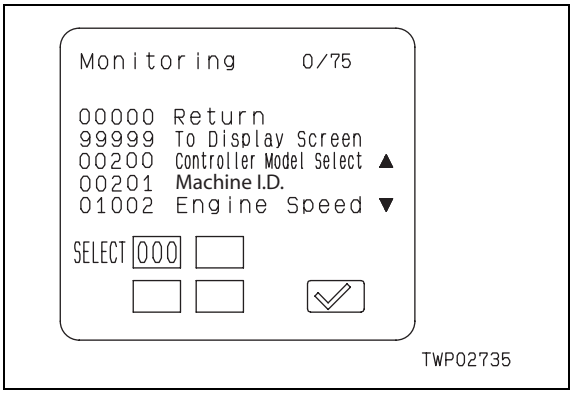
1. Function of Monitoring [01]

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

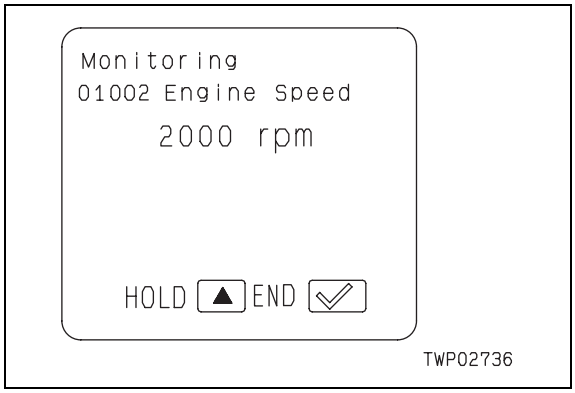
Select or register an item to be monitored through the following switch operation.

- [▲] 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 registerable 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.

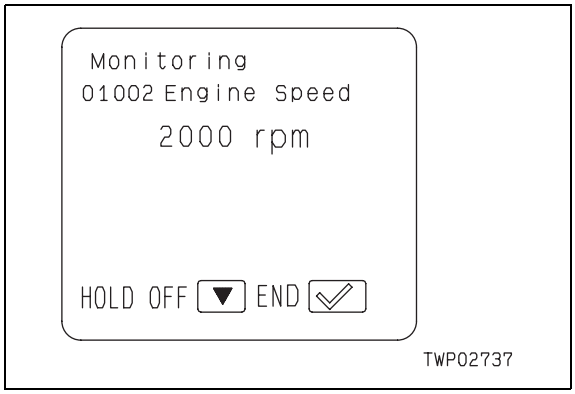
1.3. Monitoring operation

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.

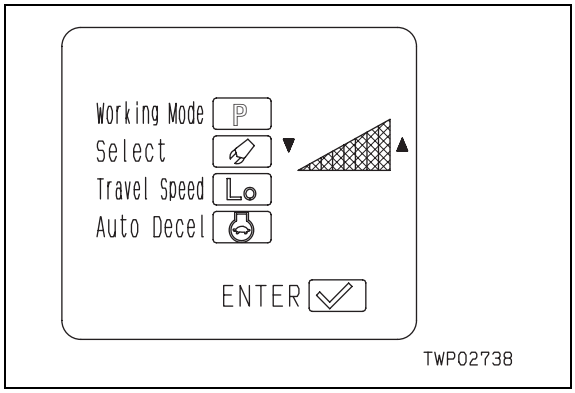


Table for Monitoring Items

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	
01701	Service Solenoid 1 Curr.	mA	mA	mA	PUMP	
01702	Service Solenoid 2 Curr.	mA	mA	mA	PUMP	
01703	Service Solenoid 3 Curr.	mA	mA	mA	PUMP	
01704	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	

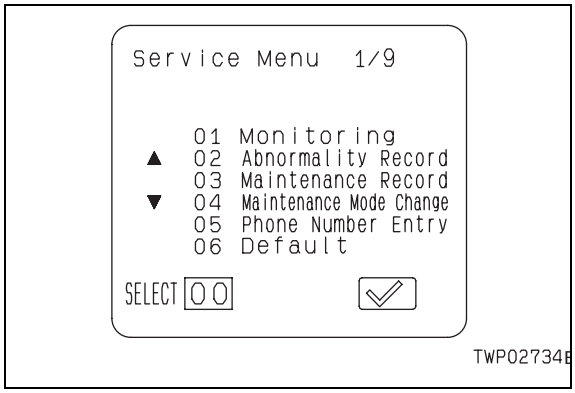
Code No.	Monitoring item (Display on screen)		Unit (Initial setting: ISO)			Component in charge	Remarks
			ISO	meter	inch		
01900	Pressure Switch 1	Swing	ON•OFF			PUMP	
		Boom Lower	ON•OFF			PUMP	
		Boom Raise	ON•OFF			PUMP	
		Arm Curl	ON•OFF			PUMP	
		Arm Dump	ON•OFF			PUMP	
01901	Pressure Switch 2	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	
		Quick Coupler	ON•OFF			MON	
04502	Monitor Input 3	Swing Brake Sw.	ON•OFF			MON	
04503	Monitor Function Switches	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	
42008	Lever Potentio 1 Volts (Main)		V	V	V	PUMP	
42009	Lever Potentio 1 Volts (Sub)		V	V	V	PUMP	
42010	Lever Potentio 2 Volts (Main)		V	V	V	PUMP	
42011	Lever Potentio 2 Volts (Sub)		V	V	V	PUMP	
42012	Lever Potentio 1 Stroke		%	%	%	PUMP	
42013	Lever Potentio 1 Stroke		%	%	%	PUMP	

- Select the most favourite 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

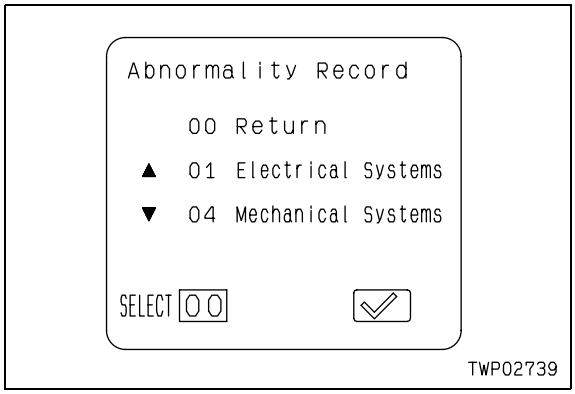
2. Function for Abnormality Record [02]

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

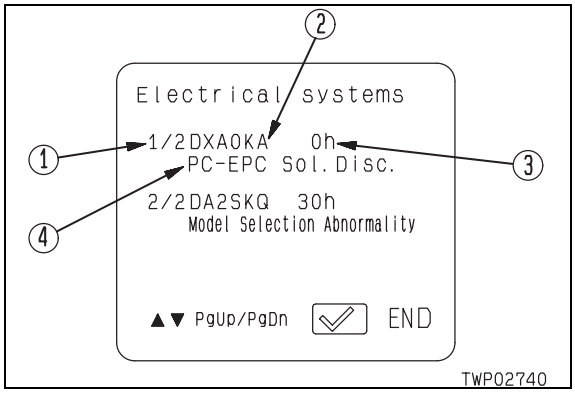
Select 02 Abnormality Record in the initial display of Service Menu and depress [√] switch.



2.2. Selection of Sub menu

Select an appropriate item from Sub menu in the Abnormality Record display and depress [√] switch.

No.	Abnormality Record Sub menu
00	Return (termination of Abnormality Record)
01	Electrical System
02	Mechanical Systems

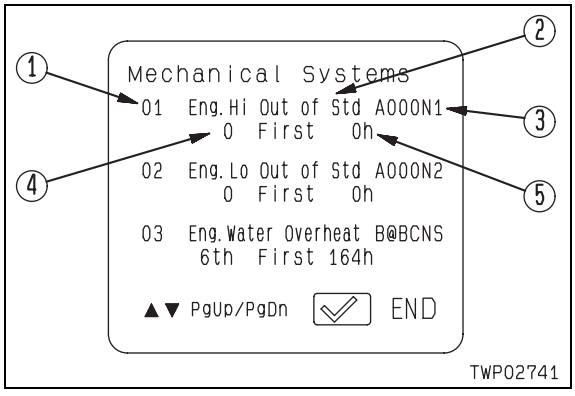


2.3. Information shown in display of Abnormality Record in the electrical system

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 170.



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 170.

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.

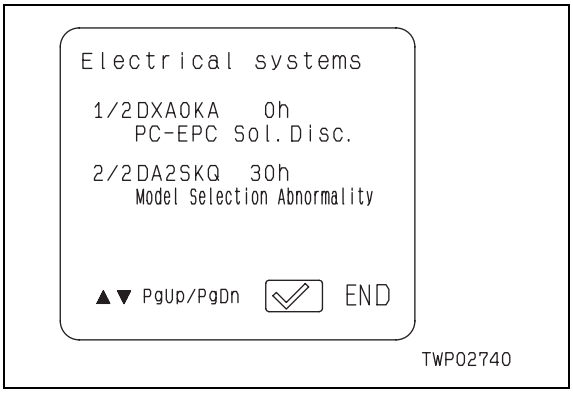
- Switch operation:

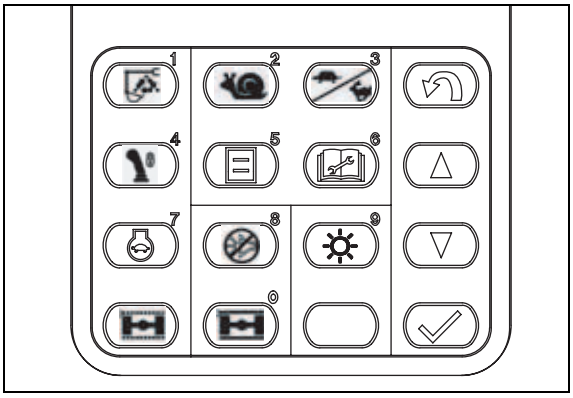
  [▲] +[1] › [2] › [3]

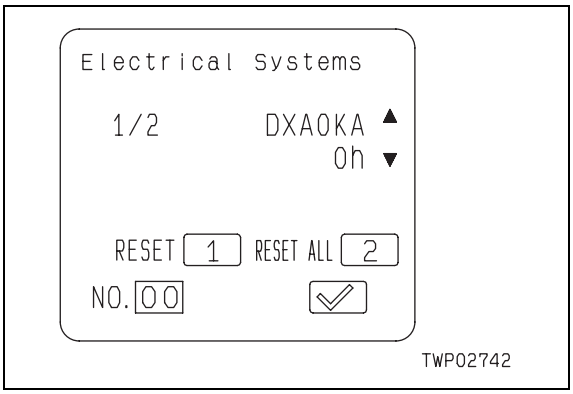
- This is the same switch operation in changing the display to Service Menu.

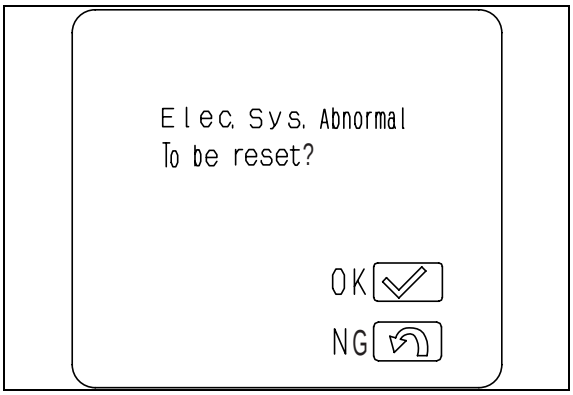
B. Operate the switch, following the instructions shown in the resetting display.

- 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.







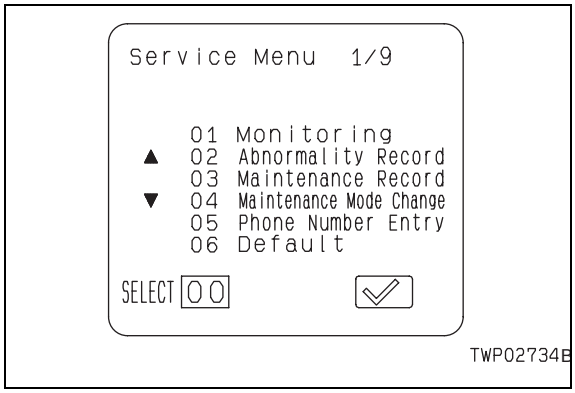


3. Function for Maintenance Record [03]

The monitor panel records information on the maintenance of filters and oils. The stored information can be displayed through the following switch operation.

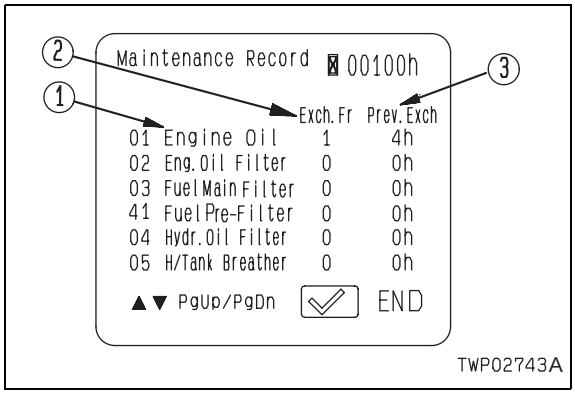
3.1. Selection of menu

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	Engine Oil Filter
03	Fuel Main Filter
41	Fuel Pre-Filter
04	Hydraulic Oil Filter
05	Hydraulic Tank Breather
06	Corrosion Resistor
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

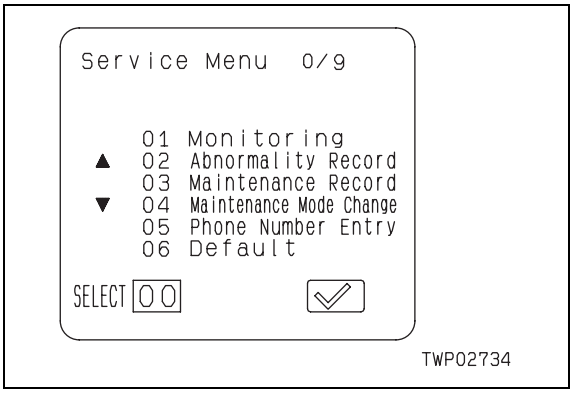
Select an item to be changed in the display of Maintenance Mode Change Selecting Menu.

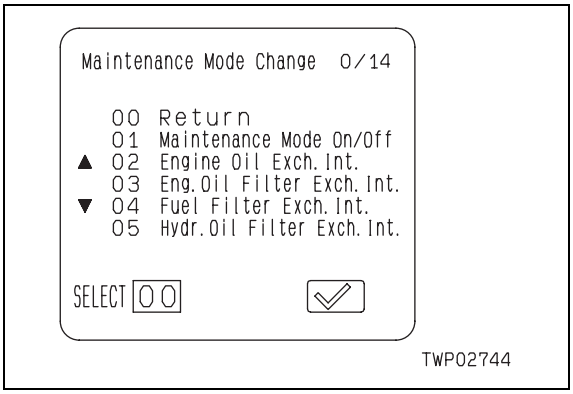
No.	Maintenance mode change item
00	Return
01	Maintenance Mode On/Off
02	Engine Oil Exch. Int.
03	Engine Oil Filter Exch. Int.
04	Fuel Main Filter Exch. Int.
05	Fuel Pre-Filter Exch. Int.
06	Hydr. Oil Filter Exch. Int.
07	H/Tank Breather Exch. Int.
08	Corro. Resis. Exch. Int.
09	PTO Oil Service Int.
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

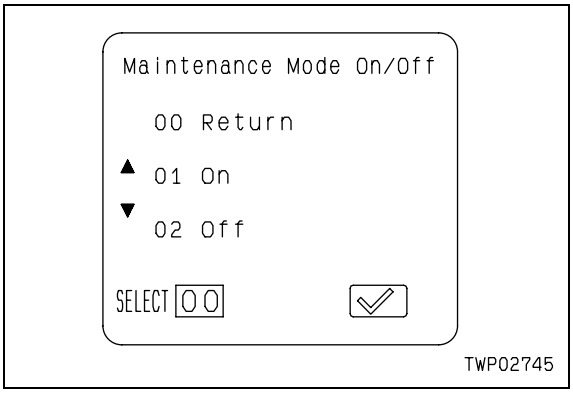
- 01 and 14 menus are provided for setting the whole maintenance mode, while those from 02 through 13 are for setting individual items.

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)

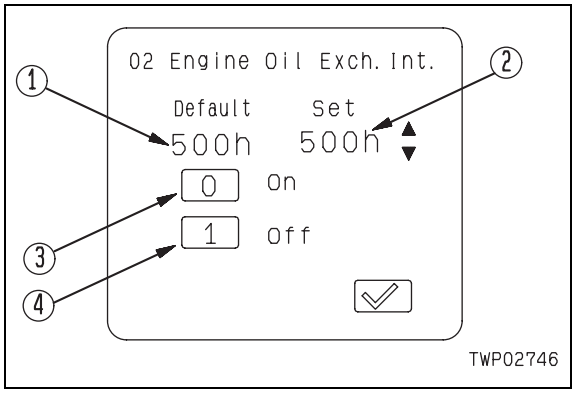
③:On: Maintenance display function with this instruction becomes effectual.

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.

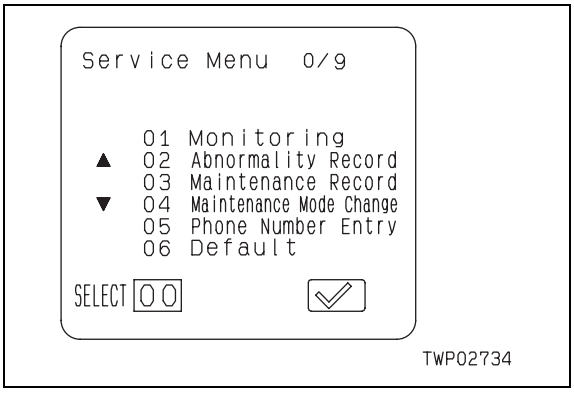
5.3. Entry and setting Phone number

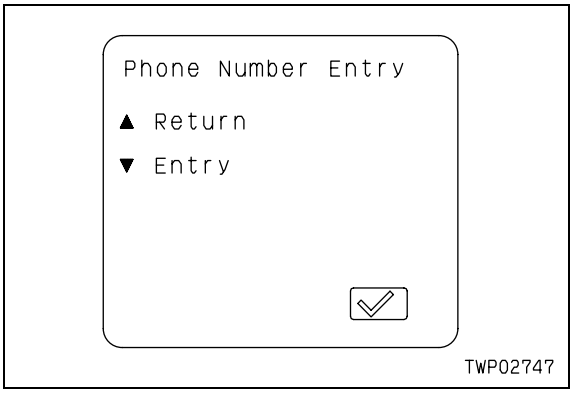
Follow the method explained below, enter a Phone number in the Phone Number Entry display. (Entry automatically begins with a cursor at the left end)

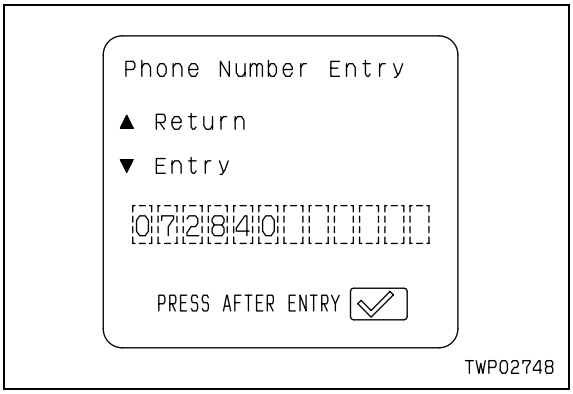
A. Enter a number into a cursor at the left end (using characters 0-9).

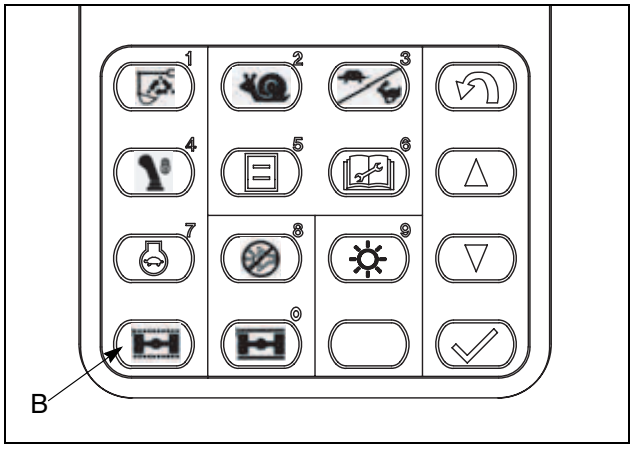
B. Depress [✓] switch when all the numbers have been entered.

- 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.

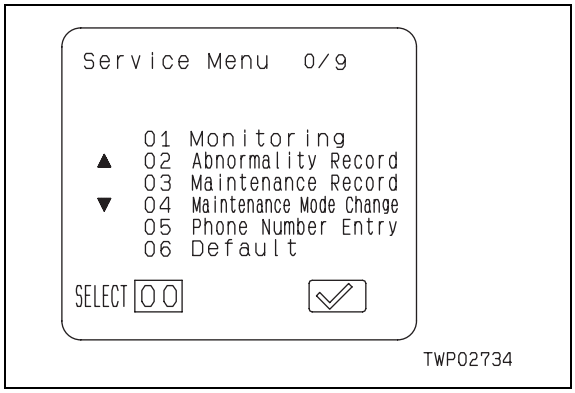
6.1. Selection of menu

Select 06 "Default menu" in the initial display of Service Menu, and depress [✓] switch.

6.2. Selection of sub menu

Select an item to change from the sub menu, and depress [√] switch.

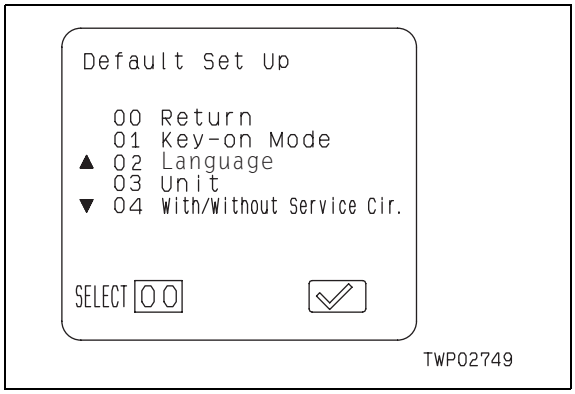
No.	Default sub menu
00	Return (Termination of Default)
01	Key-on Mode
02	Language
03	Unit
04	With/Without Service Circuit

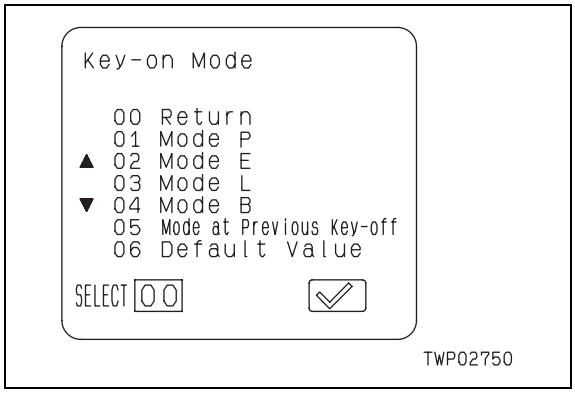


6.3. Function for Key-on Mode

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.

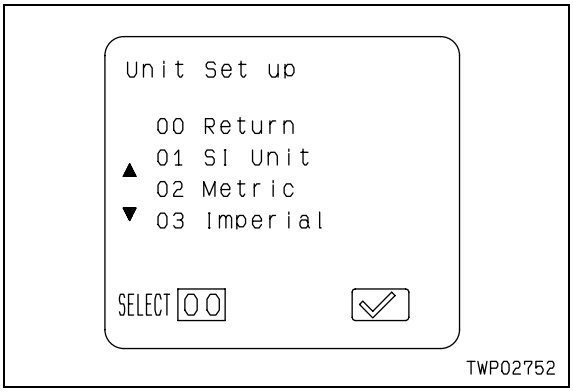




6.4. Function for unit selection

As the unit to be used in the monitoring function display of Service Menu, three kinds of unit are provided.

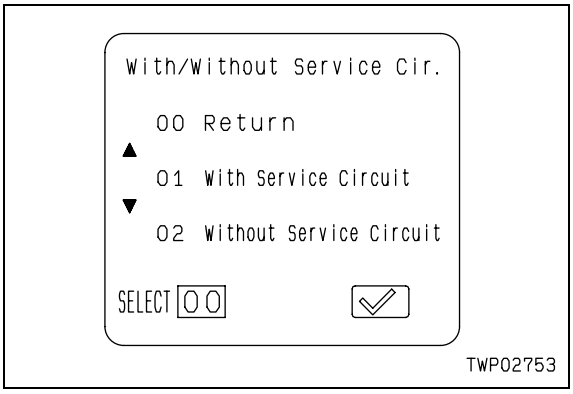
- Unit used for default setting in the monitor panel is SI, i.e. International System of Units.



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.

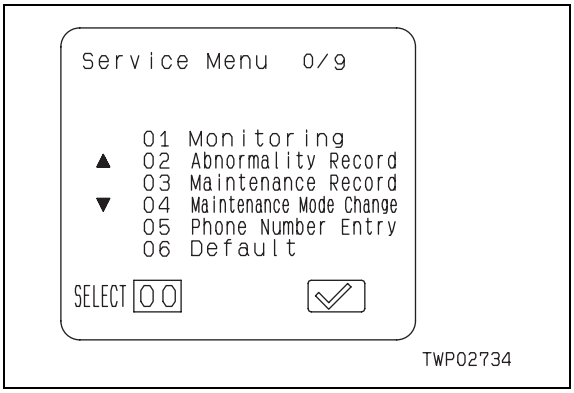


7. Function for Adjustment [07]

The monitor panel has a function of making various adjustments of the machine.

7.1. Selection of menu

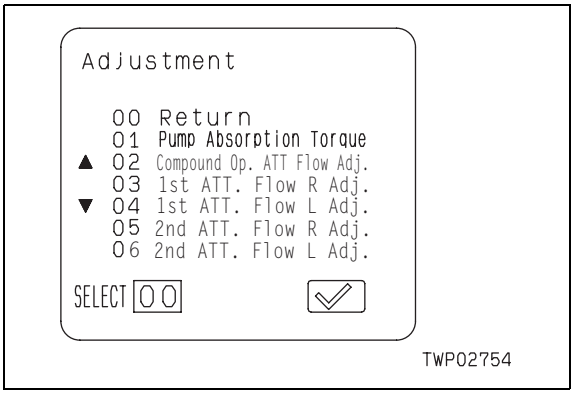
Select 07 adjustment in the initial display of Service Menu, and depress [√] switch.



7.2. Selection of sub menu

Select an item to change from the sub menu and depress [√] switch.

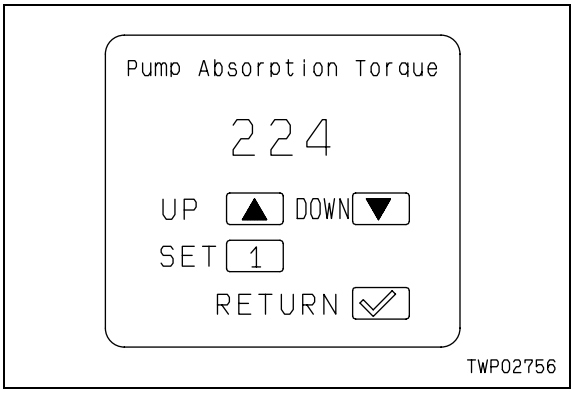
No.	Adjustment sub menu
00	Return (termination of adjustment)
01	Pump Absorbtion Torque
02	Compound Op. ATT. Flow Adj.
03	1st ATT. Flow R Adj.
04	1st ATT. Flow L Adj.
05	2nd ATT. Flow R Adj.
06	2nd ATT. Flow L Adj.



7.3. Function for Pump Absorption Torque adjustment.

The pump absorption torque can be adjusted within the range shown in the table below.

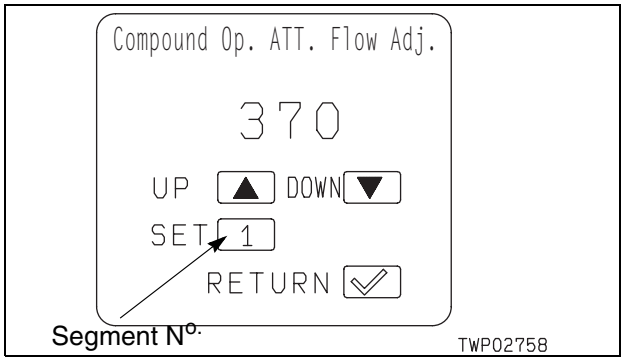
Adjustment value	Torque adjustment value
220	+4.0 kgm
221	+3.0 kgm
222	+2.0 kgm
223	+1.0 kgm
224	0.0 kgm
225	–1.0 kgm
226	–2.0 kgm
227	–3.0 kgm
228	–4.0 kgm

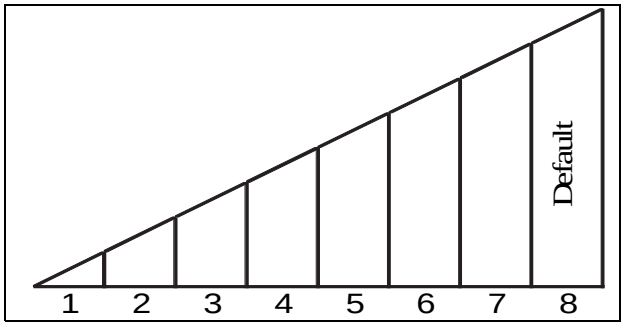


7.4. Function for ATT. Flow Adjust.

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 reduce 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).

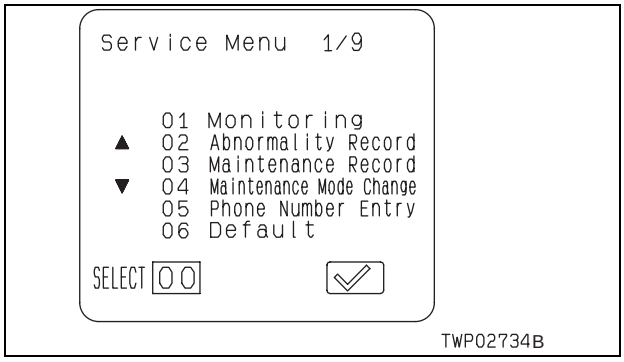
8.1. Selecting menu.
On the initial screen of the service menu, select "09 cylinder cut out mode operation" and press the [✓] switch.

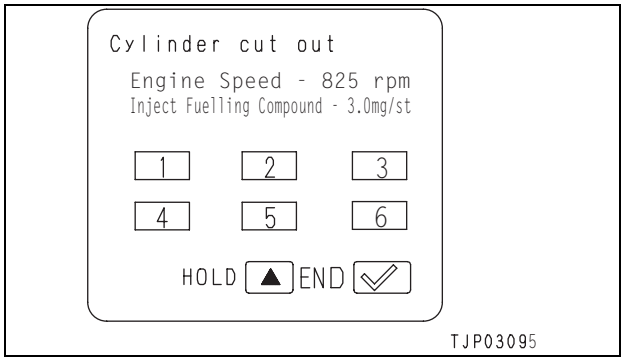
8.2. Setting cylinders to be disabled.
Press switches [1] - [6] on the monitor panel corresponding to the cylinder No. to be disabled.

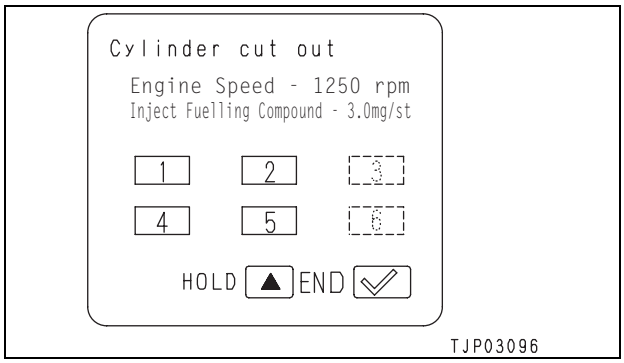
- After a switch is pressed, if the cylinder No. corresponding to it on the monitor panel is displayed in a white frame, the cylinder is disabled (If setting is wrong, press the same switch again).
- Only one or more cylinders can be disabled for the reduced cylinder mode operation.

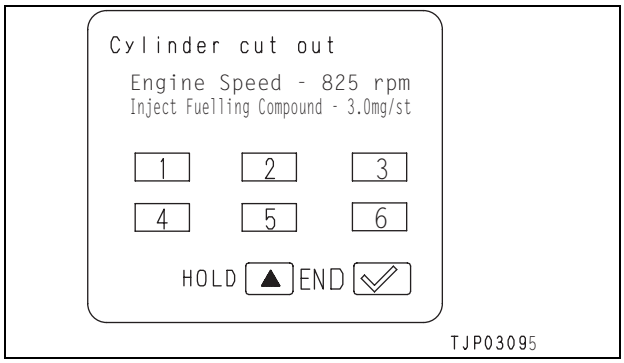
8.3. Cancellation of disabled cylinders.
Press switches [1] - [6] on the monitor panel corresponding to the disabled cylinder No. to cancel disabling of those cylinders.

- 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.

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 cancellation of the cylinder cut out mode. Accordingly, a defective 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.

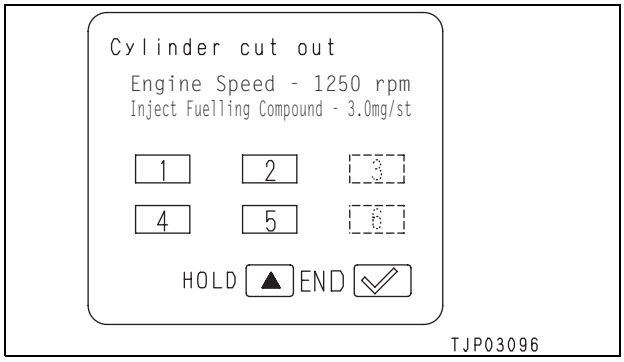
8.4.2 Disable a cylinder to be checked.

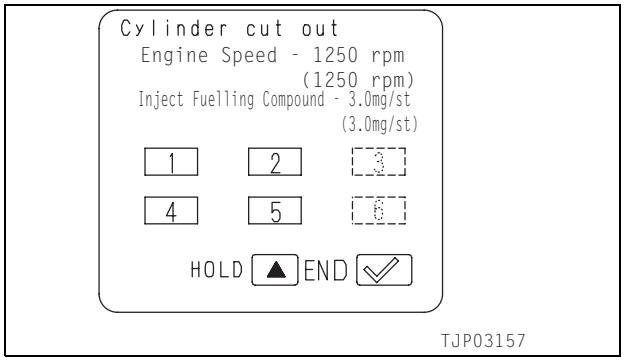
8.4.3 Run the engine under the same condition as normal operation in step (1) and compare the engine speed at this time with the held engine speed.

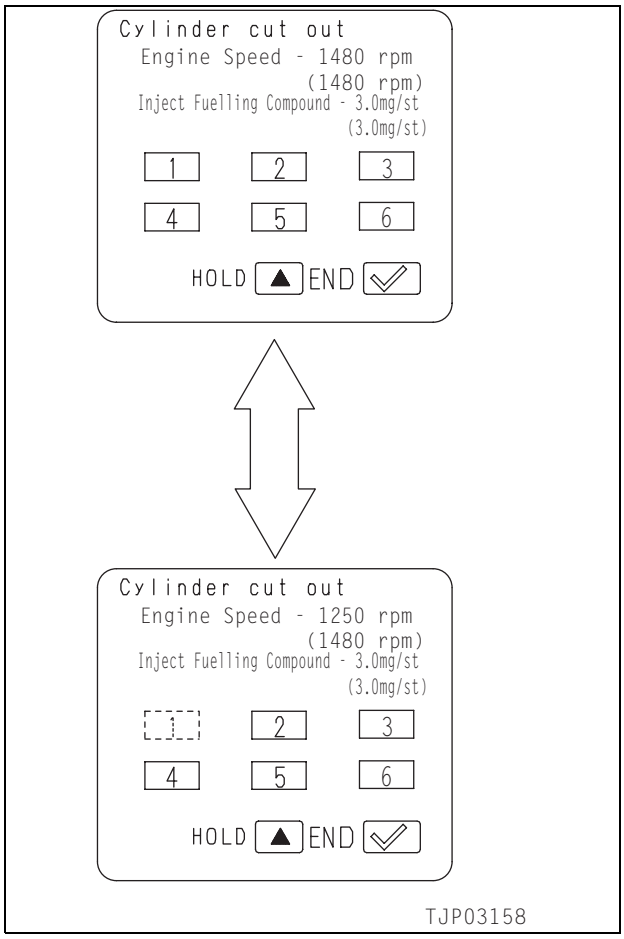
8.4.4 Cancel the cylinder cut out mode, regardless of the change of the engine speed.

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.





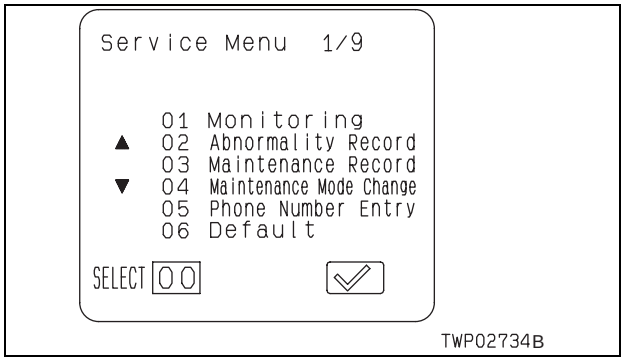


9. Function of no injection cranking [09]

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.

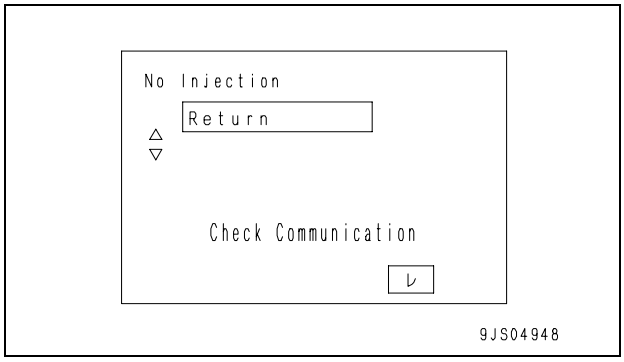
- This setting must be done after stopping the engine.

9.1. Selecting menu
Select “09 No Injection Cranking” from the service menu initial screen and press [✓] switch.

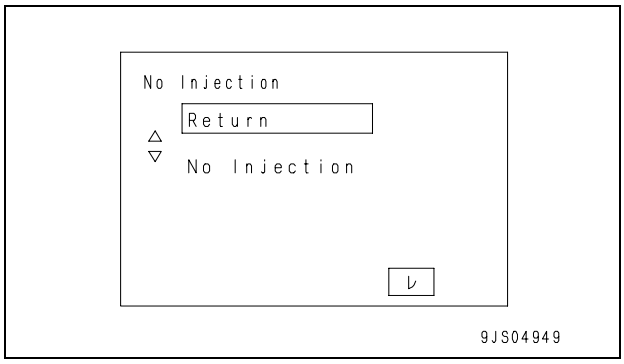


9.2. The initial screen for the no injection cranking will appear.

- “Check Communication” will be displayed in red.

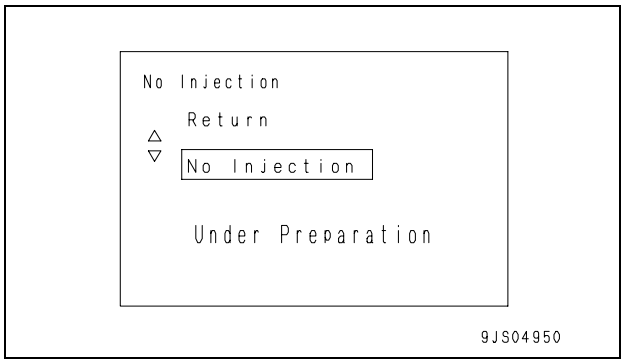


9.3. As the checkup is over, following screen appears.



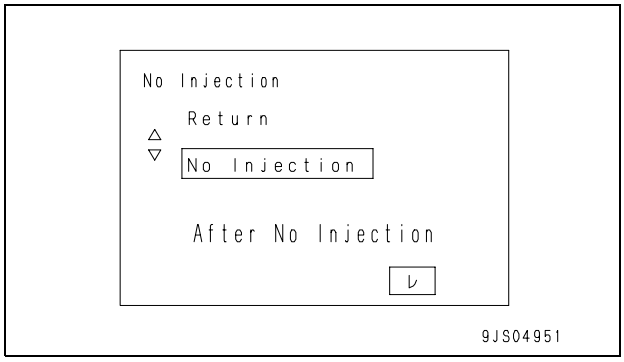
9.4. Select “No Injection” and press [✓] switch.
“Under Preparation” will be displayed on the screen.

- The letters “Under Preparation” are displayed in red.



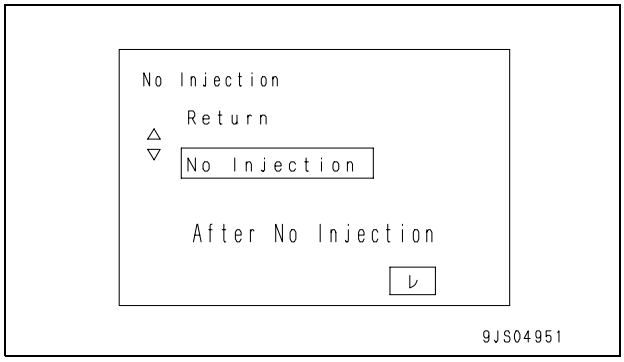
9.5. As the preparation for no injection cranking is completed, display of “Under Preparation” is replaced with “After No Injection”.

- The letters “After No Injection” are displayed in green.



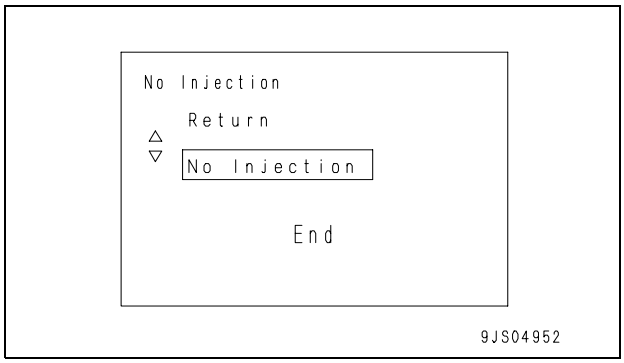
9.6. From this state, crank the engine using the starting motor.

- Limit the cranking time to 20 seconds to protect the starting motor.



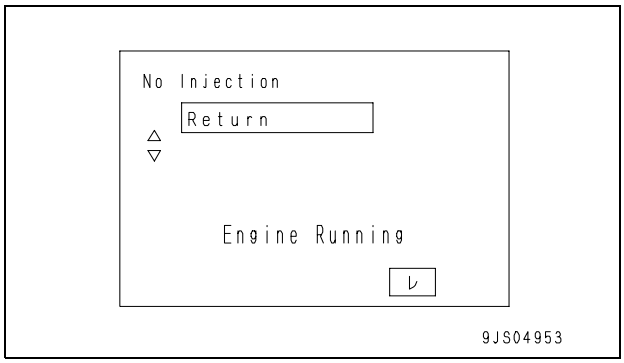
9.7. After the no injection cranking is over, press [✓] switch from the previous screen and the letters “End” will be displayed for 3 seconds.

- 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.



Procedure for turning on KOMTRAX terminal

When the machine is delivered, KOMTRAX terminal is installed:

★ When the machine is delivered, KOMTRAX terminal is installed (machine with the standard equipment), implement the following procedure.

1. Reporting of machine model, model number and serial number

Report the machine model, model number and serial number to the person responsible to operation of KOMTRAX.

2. Registration of KOMTRAX terminal

The person responsible to operation of KOMTRAX shall register the subject terminal using the KOMTRAX client PC.

★ See “KOMTRAX administrator manual” for the procedure.

★ Above completes the necessary operations.

When installing KOMTRAX terminal after the machine is delivered:

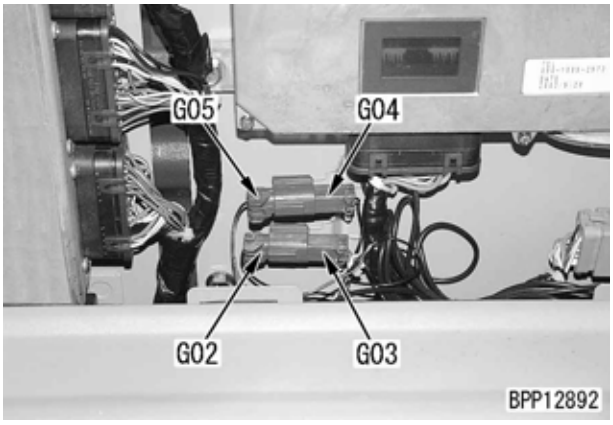
★ When installing KOMTRAX terminal after the machine is delivered (machine with the retrospective equipment), implement the following procedure.

1. Station opening inspection

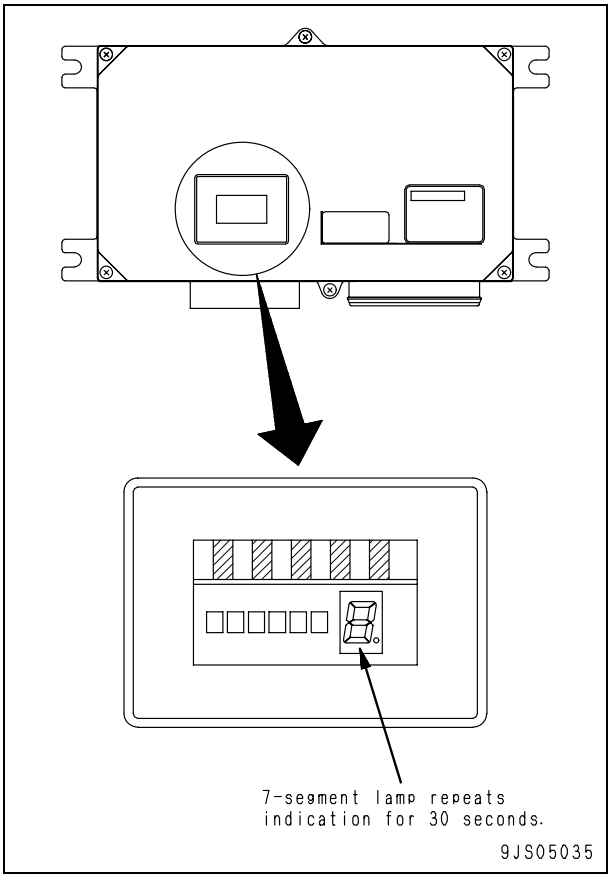
★ Referencing “Preparation work for troubleshooting of electrical system”, confirm the position of KOMTRAX terminal and the inspecting connector (the inspecting connector is provided at the bottom of KOMTRAX terminal).

★ Finish the operations of steps 4) to 7) within 30 seconds.

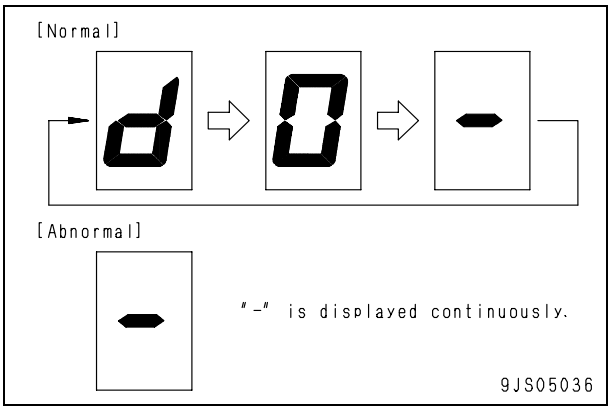
1) Turn OFF the starting switch and then, after making sure 5 seconds have elapsed, proceed to the next step.
2) Make sure visually that the inspecting connectors 1 and 2 are connected.
   - Inspecting connector 1: **G02** (female) and **G03** (male)
   - Inspecting connector 2: **G04** (female) and **G05** (male)



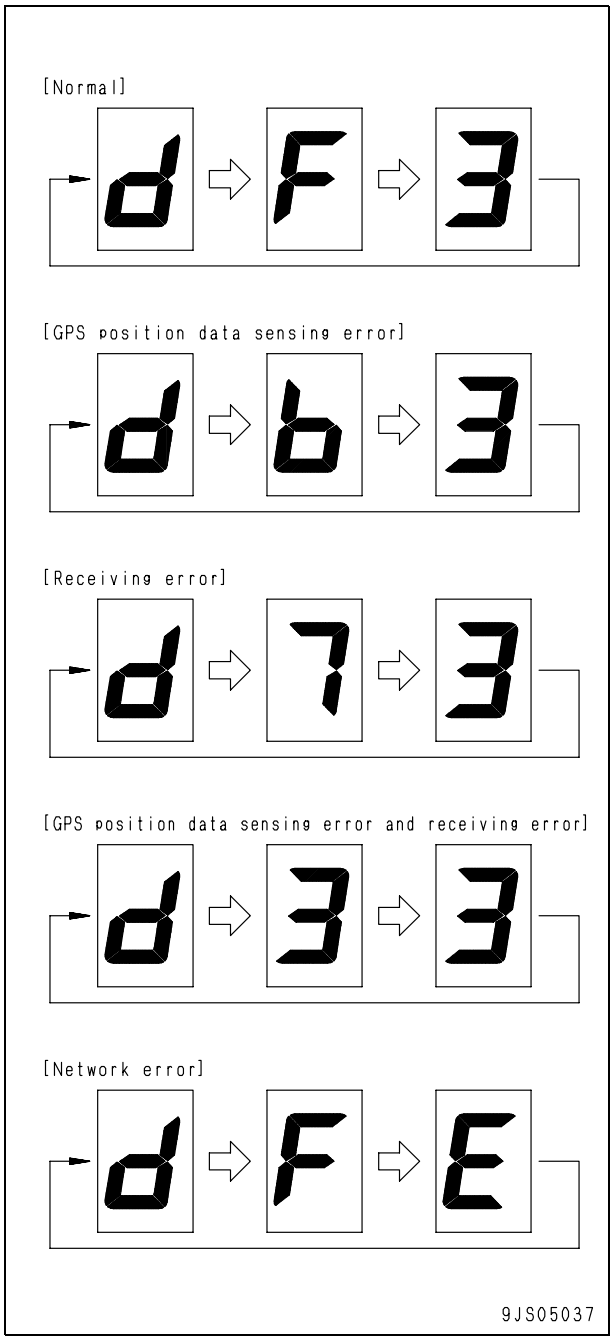
3) Disconnect the inspecting connector 1 and maintain that state for 5 seconds.
4) Turn ON the starting switch and maintain that state for 5 seconds.
5) Disconnect the inspecting connector 2 and maintain that state for 5 seconds.
6) Connect the inspecting connector 1 again and maintain that state for 5 seconds.
7) Connect the inspecting connector 2 again and maintain that state for 5 seconds.
8) Make sure that the KOMTRAX terminal 7-segment indicator lamp is normally turned on.



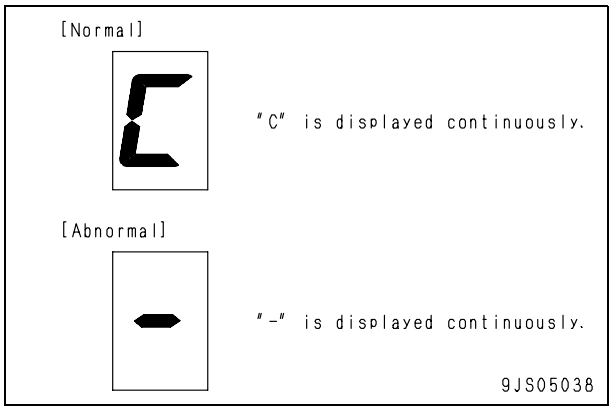
★ As [Normal] is indicated, proceed to the next step.
★ If [Abnormal] is indicated, repeat the procedure from step 1).



9) Set the starting switch to START position and maintain it in that state for 5 seconds. Make sure the engine is not started.
★ If the engine is started, repeat the procedure from step 1).
10) Return the starting switch to ON position and maintain that state for 5 seconds.
★ Don't return it to OFF position.
11) Set the starting switch to START position again and make sure the engine is started.
12) Make sure that the KOMTRAX terminal indicator lamps are normally turned on.
Note: The third number on the display can be "2" or "3" though "3" is displayed in above figure (both for the normal state and when trouble is present).
★ As [Normal] is confirmed, proceed to the next step (it will take 90 seconds to 15 minutes until normal display is restored).
★ If [GPS position data sensing error] were displayed, check the GPS antenna and cable for external troubles. If any, repair the trouble and repeat the procedure from step 1).
★ If [Receiving error] were displayed, check the communication antenna and cable for external troubles. If any, repair the trouble and repeat the procedure from step 1).
★ If [GPS position data sensing error and Receiving error] were displayed, check the GPS antenna and cable as well as the communication antenna and cable for external troubles. If any, repair the trouble and repeat the procedure from step 1).
★ If [Network error] were displayed, check the indication of [LED-C4] referencing "KOMTRAX terminal lamp indications". (When CAN is not recognized, check KOMTRAX terminal CAN harness for troubles. If any, repair the trouble and repeat the procedure from step 1)).



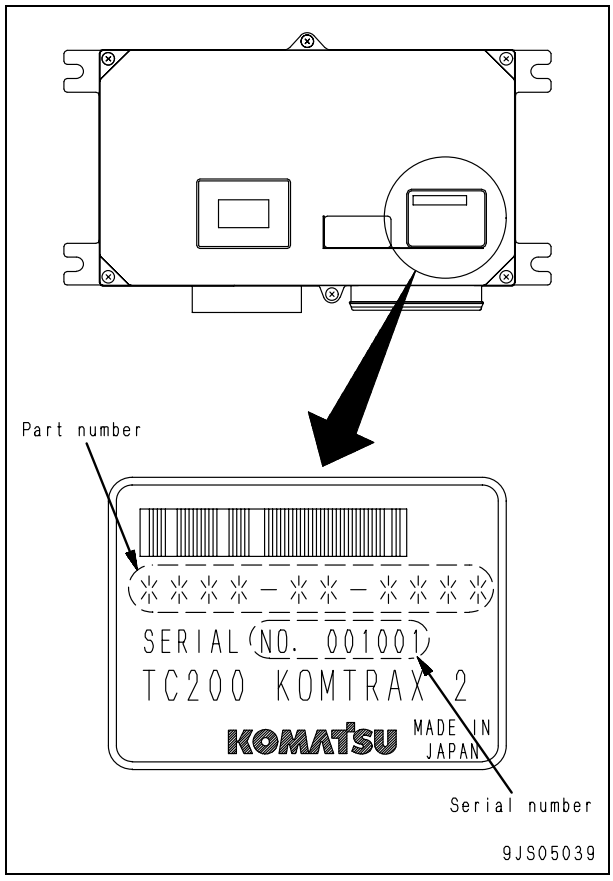
13) Turn the starting switch OFF.
14) Make sure that the 7-segment indicator lamp (a) comes on normally in 10 seconds.
    ★ As [Normal] is displayed, the station opening inspection is complete.
    ★ If [Abnormal] is displayed, the inspection is incomplete and must be repeated from step 1).



2. Application for start of use

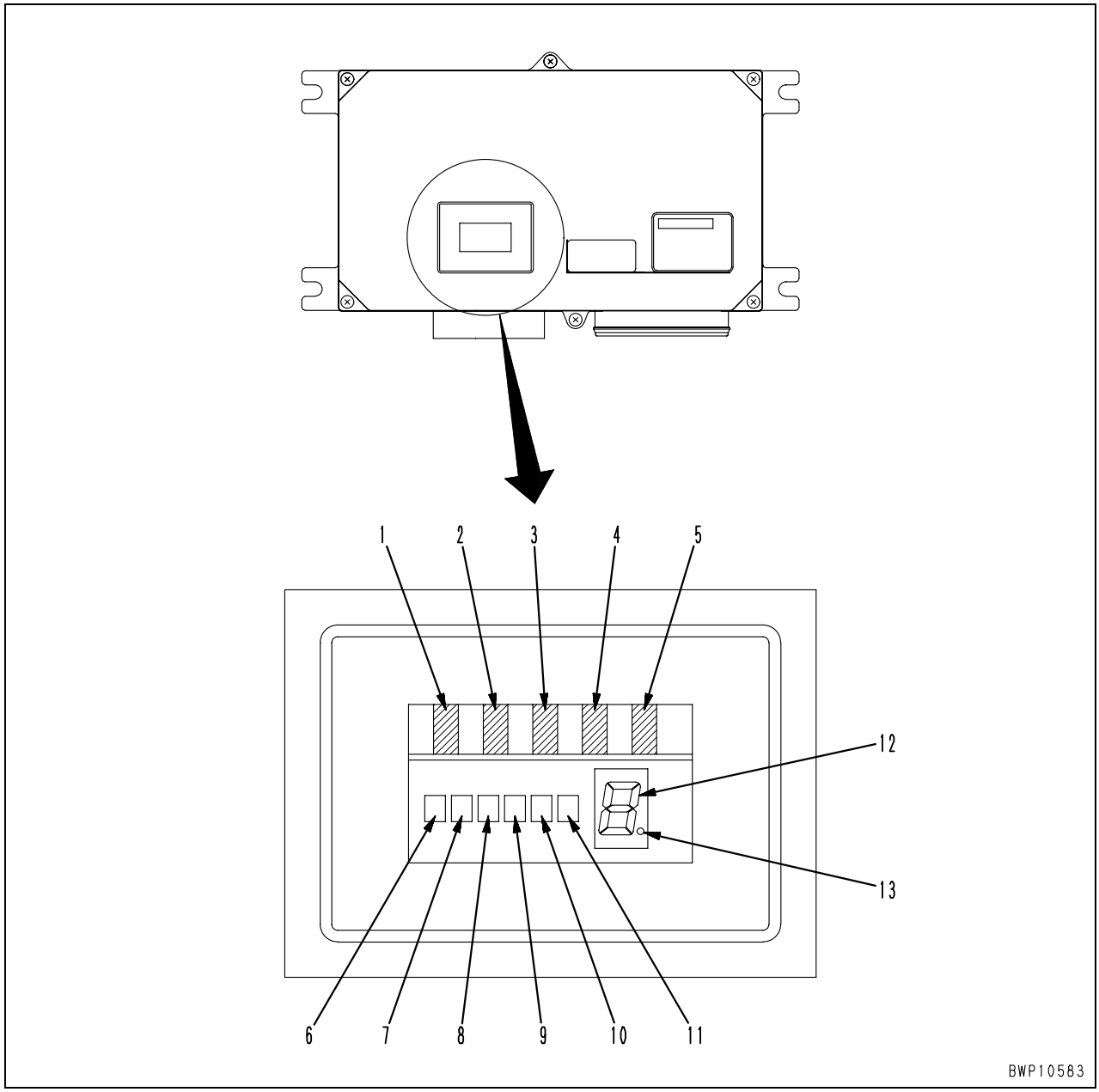
★ The application for start of use is allowed only after the terminal station opening inspection has been successfully ended.

1) Concerning the machine body for which the station opening inspection has been completed, report the following information to the person responsible to operation of KOMTRAX.
    (1) Information of the machine body for which the station opening inspection has been completed (machine model, model number and serial number)
    (2) Part number and serial number of KOMTRAX terminal
    (3) The service meter reading when KOMTRAX terminal was installed (in 0.1 h unit)



2) The person responsible to operation of KOMTRAX shall register the machine body using the KOMTRAX client PC.
    ★ See “KOMTRAX administrator manual” for the procedure.
    ★ Above completes the necessary operations.

KOMTRAX terminal lamp indications



LED for communication module

1. LED-A1 (Power lamp)
2. LED-A2 (Within communication range lamp)
3. LED-A2 (Communication in progress lamp)
4. LED-A2 (Internal transmitting lamp)
5. LED-A2 (Internal receiving lamp)

LED for CPU

6. LED-C1 (R signal and ACC signal)
7. LED-C2 (Initial output state)
8. LED-C3 (S-NET and C signal state)
9. LED-C4 (CAN state)
10. LED-C5 (Download writing state)
11. LED-C6 (Download writing state)

7-segment and dot for CPU

12. 7-segment (Number of mails not transmitted yet)
13. Dot (GPS positioning state)

KOMTRAX system displays various information in the system as well as contents of information processing on the LED display unit located at the top of KOMTRAX terminal. Thus, when a failure on the system is suspected, implement the following checkups.

- Checking antennas
- Checking terminal LED display

Before using KOMTRAX, the application for start of use and the machine side station opening inspection must be completed.

When above is not completed, all LEDs for the communication module are turned off. It does not indicate the machine trouble.

Checking antennas

★ Before inspecting display of LED, check the communication antenna and its vicinity as well as GPS antenna and its vicinity for any trouble.

- The communication antenna shall not be disconnected or damaged.
- The communication antenna cable shall not be broken and shall be appropriately connected to KOMTRAX terminal.
- GPS antenna shall not be disconnected or damaged.
- GPS antenna cable shall not be broken and shall be appropriately connected to KOMTRAX terminal.

Checking terminal LED indication

1. Display contents of LED for communication module

★ Turn ON the starting switch prior to inspection of LED display.

No.	LED	Name and function	Display	Contents of display
1	LED-A1	Power lamp	ON OFF	LED stays turned on as long as power is supplied normally
2	LED-A2	Within communication range lamp	ON OFF	LED comes on as the machine body moves inside the communication range of KOMTRAX system.
3	LED-A3	Communication in progress lamp	ON OFF	LED stays turned on as long as KOMTRAX terminal is connected to KOMTRAX server. (Connection is made only needed)
4	LED-A4	Internal transmitting lamp	ON OFF	LED stays turned on as long as data transmission is continued from CPU to the communication module. (Transmission is made only needed)
5	LED-A5	Internal receiving lamp	ON OFF	LED stays turned on as long as the communication module is receiving data from CPU. (Receiving is made only needed)

2. Display contents of LED for CPU

★ Turn ON, START the starting switch or the engine prior to inspection of LED display.

No.	LED	Name and function	Display	Contents of display
6	LED-C1	State of starting switch ACC signal, alternator R signal	ON	Starting switch ACC signal: ON, Alternator R signal: ON
			Quick flashing	Starting switch ACC signal: ON, Alternator R signal: OFF
			Slow flashing	Starting switch ACC signal: OFF, Alternator R signal: ON
			OFF	Starting switch ACC signal: OFF, Alternator R signal: OFF
7	LED-C2	State of engine control signal	ON	Engine control signal: ON
			OFF	Engine control signal: OFF
8	LED-C3	State of S-NET connection and starting switch C signal	ON	S-NET: Connection and starting switch C signal: OFF
			Quick flashing	Starting switch C signal: ON
			Slow flashing	(Not used)
			OFF	S-NET: Non-connection and starting switch C signal: OFF
9	LED-C4	State of CAN connection	ON	CAN: Present (Fuel sensor: Absent)
			Quick flashing	CAN: Present (Fuel sensor: Present)
			Slow flashing	CAN: Absent (Fuel sensor: Present)
			OFF	CAN: Absent (Fuel sensor: Absent)
10	LED-C5	Download writing state	Single side ON	Download writing mode (Special function for system administrator)
11	LED-C6		Both sides OFF	Normal working mode

★ Types of flashing and flashing duration
Quick flashing: Flashing of approximately 1 second cycle
Slow flashing: Flashing of approximately 4 seconds cycle

3. Display contents of 7-segment and dots for CPU

★ Turn ON the starting switch prior to inspection of LED display.

No.	Display unit	Name and function	Display	Contents of display
12	7-segment	Number of mails not transmitted yet	0 – 9	Number of mails not transmitted yet
13	Dot	State of positioning with GPS	ON	Positioning with GPS complete (Position is recognized See * mark)
			OFF	Positioning with GPS incomplete (Position is not recognized See * mark)

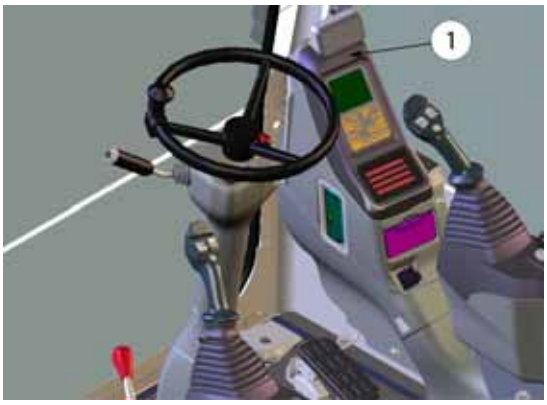
* In a outdoor location within radio waves penetration range, it sometimes takes more than a minute from turning on of the starting switch to completion of the positioning.
Positioning is not available in a location where radio waves are extremely weak or unreachable.

Preparation work for troubleshooting of electrical system

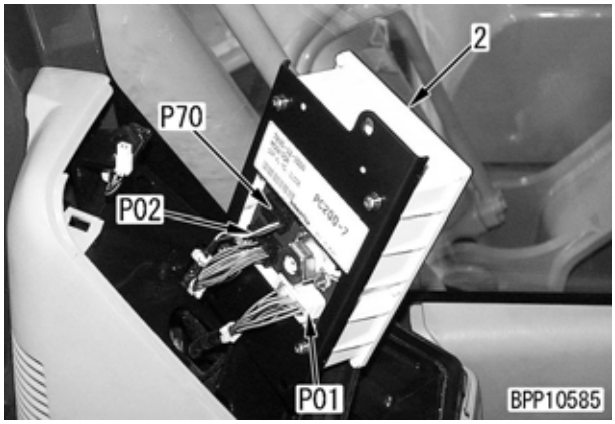
★ When troubleshooting the electric circuit related to the machine monitor, pump controller, engine controller or KOMTRAX terminal, expose the related connectors according to the following procedure.

1. Machine monitor

1) Take off cover (1).
   ★ The cover is fixed with two upper and lower clips. Pull it up for the removal.
   ★ If the sunlight sensor is equipped for an air conditioner, disconnect **P15** connector at the cover rear side.

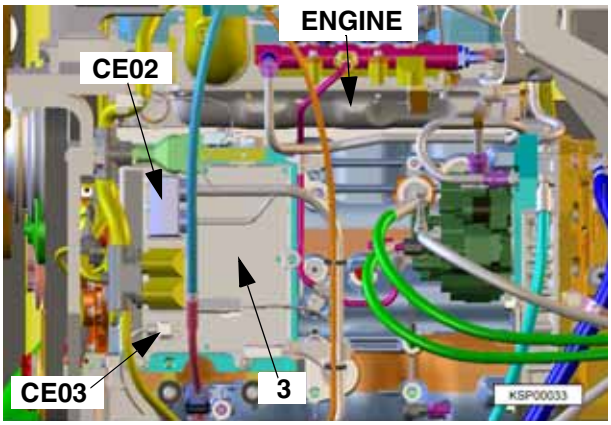


2) Remove the 3 mounting screws to disconnect machine monitor (2) from the mount.
   ★ Use care so that the screws may not fall into the console.
3) Insert or connect troubleshooting T-adapter in or to connectors **P01**, **P02**, and **P70** of machine monitor.



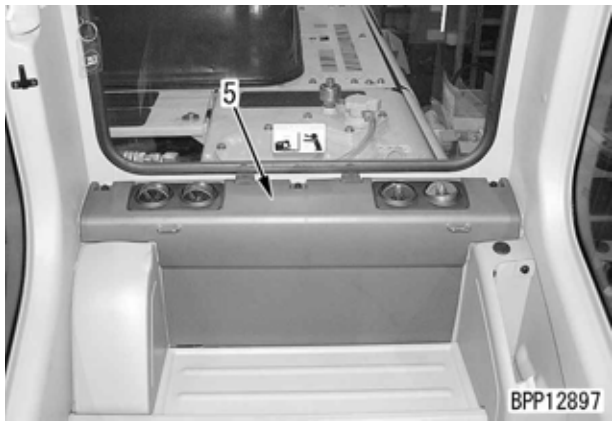
2. Engine controller

★ The engine controller is installed in the left side of the engine.
1) Open the engine hood.
2) Insert or connect troubleshooting T-adapter in or to connectors ENGINE, CE02 and CE03 of engine controller (3).
   ★ Connectors are fixed with screw. Loosen the screws before disconnecting them.
   ★ When returning the connectors back to their position, tighten them to the specified torque.
   3 Screw: **2.82 Nm {0.288 kgm}**

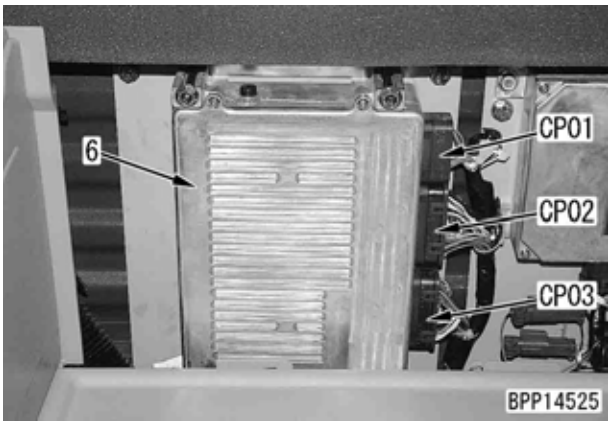


3. Pump controller

★ The engine throttle and pump controller are installed in the cover situated in the rear side of the operator seat.
1) Remove cover (5).



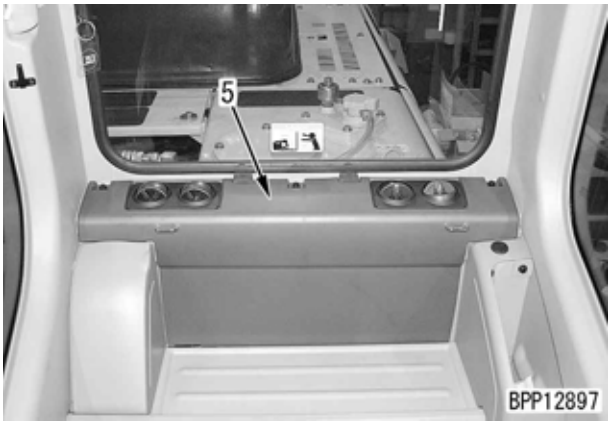
2) Insert or connect troubleshooting T-adapter in or to connectors **CP01**, **CP02** and **CP03** of pump controller (6).
   ★ Connectors are fixed with screws. Loosen the screws before disconnecting them.
   ★ When returning the connectors back to their position, tighten them to the specified torque.
   3 Screw: **2.82 Nm {0.288 kgm}**



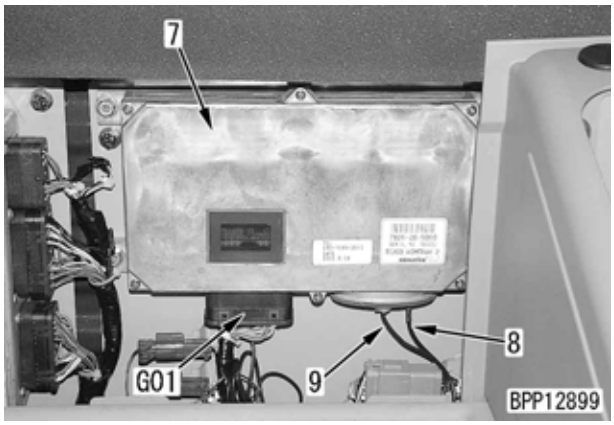
4. KOMTRAX terminal

★ KOMTRAX terminal is installed in the cover situated in the rear side of the operator seat.

1) Remove cover (5).

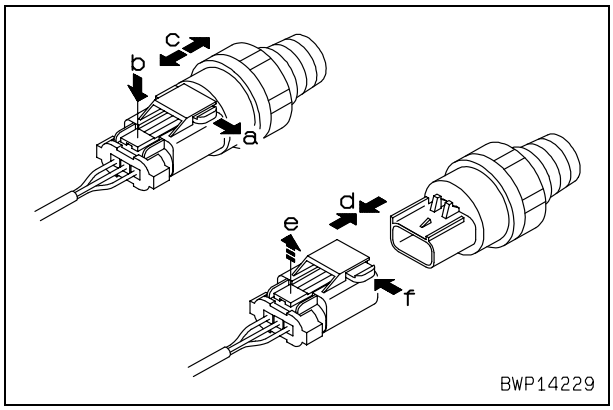


2) Insert or connect troubleshooting T-adapter in or to connector **G01** of KOMTRAX terminal (7).
   ★ The connectors are fixed with screws. Loosen the screws before disconnecting them.
   ★ When returning the connectors to their original positions, fix them by tightening the screws with the specified torque.
   3 Screw: **2.82 Nm {0.288 kgm}**
   ★ Cable (8) is used for the communication antenna (2 systems).
   ★ Cable (9) is used for the GPS antenna.



5. Removing and installing the atmospheric pressure and temperature sensor, the engine oil pressure switch, and position sensor (cam and crank)

- Removal
  Shift the lever in the arrowhead direction (a) and pull it out while pushing lock (b).
- Installation
  Insert the connector and then shift the lever in the arrowhead direction (f).



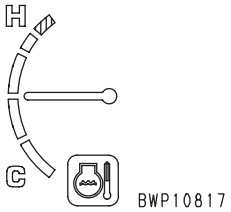
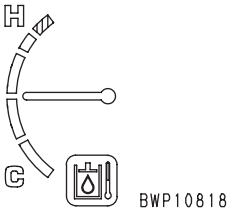
Pm - Tune up Service (PW160-7E0)

Model	Serial No.	Service meter reading
☐ PW160		h

User's name	Implemented on:	Inspected by:
	/ /	

Specifications		
Work equipment	Attachment	
Boom ☐ Standard ☐ ( )	☐	☐
Arm ☐ Standard ☐ ( )	☐	☐
Bucket ☐ Standard ☐ ( )		☐

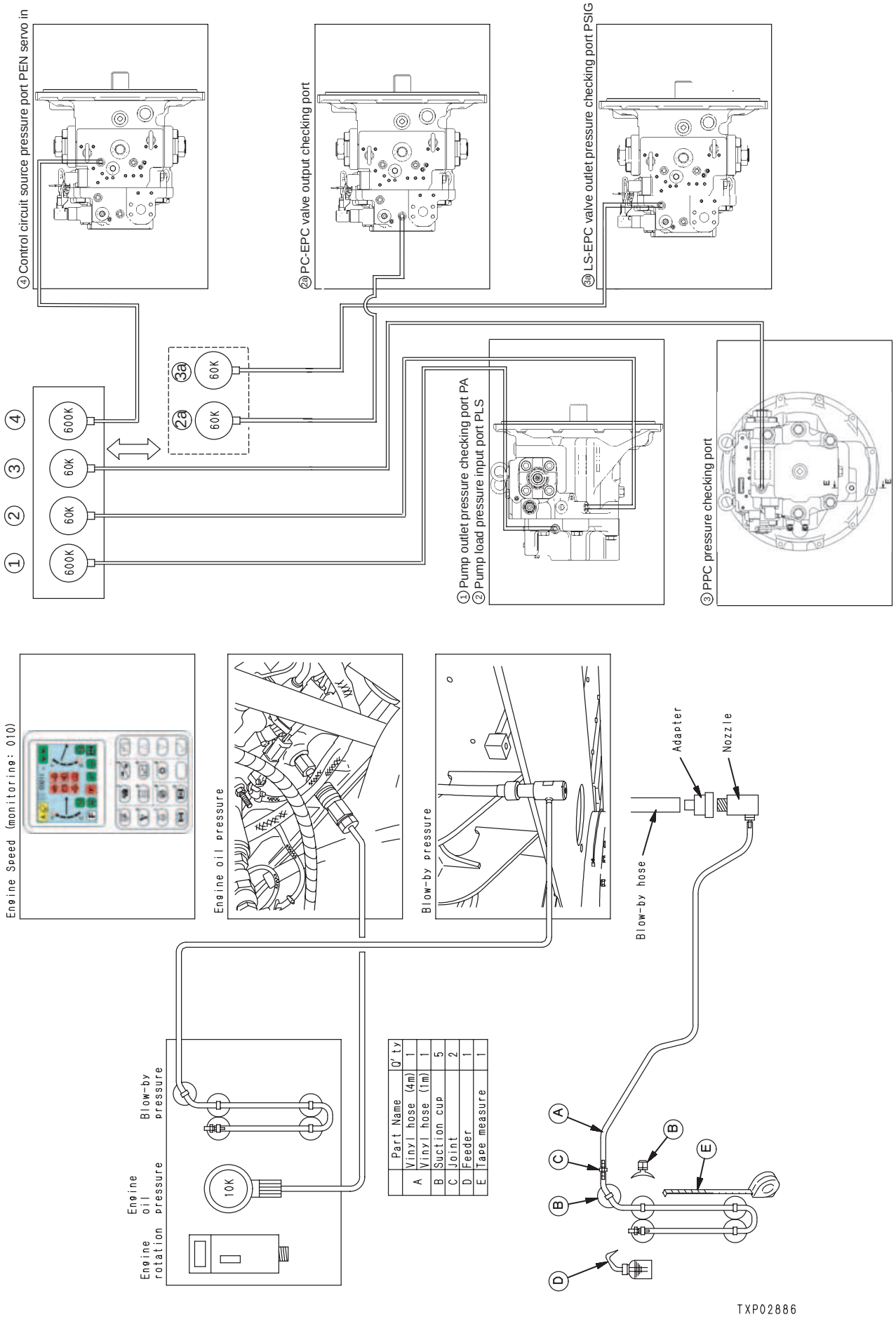
Oil and cooling water level check		
☐ Radiator water	As required	
☐ Engine oil	☐ Machinery case oil	☐
☐ Hydraulic oil		☐

Max. range of engine cooling water temperature	Max. range of hydraulic oil temperature	Ambient temperature
 BWP10817	 BWP10818	˚C
		Elevation
		m

Operator's comment

Result of visual check

Failure code history			
Electrical system		Mechanical system	
			Frequency / SMR at initial occurrence
h		A000N1 Engine rotation at high idling out of rate	
Content:		A000N2 Engine rotation at low idling out of rate	
h		B@BCNS Engine cooling water overheated	
Content:		B@BAZG Engine oil pressure abnormally low	
h		B@BAZK Engine oil level abnormally low	
Content:		B@HANS Hydraulic oil overheated	
h		B@BCZK Radiator water level abnormally low	
Content:		AA10NX Air cleaner clogged	
h		AB00KE Charging voltage abnormally low	
Content:		DA80MA Auto-lubrication system abnormal	
h			
Content:			


④ Control circuit source pressure port PEN servo in
2a PC-EPC valve output checking port
3a LS-EPC valve outlet pressure checking port PSIG
600K
60K
3a
2a
① Pump outlet pressure checking port PA
② Pump load pressure input port PLS
③ PPC pressure checking port
Engine Speed (monitoring: 010)
Engine oil pressure
Blow-by pressure
Adapter
Nozzle
Blow-by hose
Engine oil pressure
Blow-by pressure
Engine rotation pressure
10K
Part Name
Q'ty
A Vinyl hose (4m) 1
Vinyl hose (1m) 1
B Suction cup 5
C Joint 2
D Feeder 1
E Tape measure 1
A
B
C
D
E
TXP02886

Model	Serial No.	Service meter reading	Client user's name	Implemented on	Inspected by

1 Engine (PW160-7E0)

No	Condition setting: Fuel Dial	Working mode	Auto decelerator	One-touch power max switch	Work equipment operation	Measurement item	Unit	Standard value: New machine	Standard value: Failure judgement	Measured value	Judgement
1	Full	A	OFF	OFF	All control levers in NEUTRAL	Engine rotation	rpm	2050 - 2250	2050 - 2250		Good / No good
2						Engine oil pressure	Mpa{kg/cm^2}	0.39 ~ 0.64 {4.0 ~ 6.5}	0.25 {2.6}		Good / No good
3	Low					Engine rotation	rpm	950 ~ 1050	950 ~ 1050		Good / No good
4						Engine oil pressure	Mpa{kg/cm^2}	Min 0.21 {Min 2.1}	Min 0.09 {Min 0.9}		Good / No good
5	Full			OFF (Hi travel mode)	Travel relief (Apply service brake)	Engine rotation	rpm	2100 - 2300	2100 - 2300		Good / No good
6						Blow-by pressure	kPa{mmH$_2$O}	Max 7.6 {Max 76.2}	Max 3.2 {Max 330.2}		Good / No good
7			ON	OFF	All control levers in NEUTRAL	Engine rotation	rpm	1300 ~ 1500	1300 ~ 1500		Good / No good

2 Work Equipment Speed (PW160-7E0)

Hydraulic oil temperature: {45 ~ 55° C}

No	Condition Setting: Fuel Dial	Working mode	Work equipment posture	Measurement item		Unit	Standard Value PW160-7E0: Monoboom Nom Value	Monoboom Tolerance	Two Piece Boom Nom Value	Two Piece Boom Tolerance	Measured value PW160-7E0 Monoboom / Two Piece Boom*	Judgement
1	Full	A	No load, fully extended	1st Boom RAISE		s	3.8	3.4 ~ 4.2	4.5	4.1 ~ 4.9		Good/No good
2			No load, 1st Boom max extend	2nd Boom RAISE					5.0	4.5 ~ 5.5		Good/No good
3			Boom held level	Arm DUMP			3.0	2.7 ~ 3.3	3.0	2.7 ~ 3.3		Good/No good
4		E		Arm DIG			3.1	2.7 ~ 3.5	3.1	2.7 ~ 3.5		Good/No good
5		(L)										Good/No good
6		A	Boom & Arm held level	Bucket DIG			2.9	2.5 ~ 3.1	2.9	2.5 ~ 3.1		Good/No good
7			Fully extended	Swing (5 turns)	right		26	23.5 ~ 28.5	26	23.5 ~ 28.5		Good/No good
					left		26	23.5 ~ 28.5	26	23.5 ~ 28.5		Good/No good
8				Time to start swing (empty bucket)	90°		3.4	3.1 ~ 3.7	3.4	3.1 ~ 3.7		Good/No good
					180°		4.9	4.5 ~ 5.3	4.9	4.5 ~ 5.3		Good/No good
9			Travel	Lo	road speed	km/h	10	9.1 ~ 10	10	9.1 ~ 10		Good/No good
					prop speed	rpm	930	885 ~ 975	930	885 ~ 975		Good/No good
10			Chassis attachments up	Single Outrigger	lower	s						Good/No good
					raise							Good/No good
11				Dozer Blade	lower		2.1	1.8 ~ 2.4	2.1	1.8 ~ 2.4		Good/No good
					raise		2.1	1.8 ~ 2.4	2.1	1.8 ~ 2.4		Good/No good

* delete as applicable to machine under inspection

3 Work Equipment Hydraulic Drift Amount (PW160-7E0)

Hydraulic oil temperature: {45 ~ 55° C}

No	Condition Setting: Fuel Dial	Working mode	Work equipment posture	Measurement item	Unit	Standard Value: Mono Boom New model	Mono Boom Failure judgement	Two Piece Boom New model	Two Piece Boom Failure judgement	Measured value	Judgement
1	Engine stop		Boom and Arm held level, Bucket loaded	Hydraulic drift amount at bucket tooth tip (15min)	mm	Max 300	Max 300	Max 300	Max 300		Good/No good

4 Inspection of hydraulic circuit

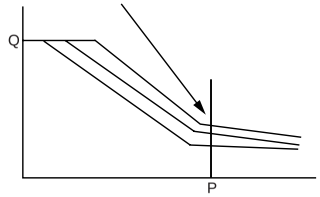
No	Part to be checked	Condition Setting: Fuel Dial	Working mode	Auto decelerator	One-touch power max switch	Work equipment operation		① kg/cm² main pump	② kg/cm² main pump LS	③ kg/cm² Control circuit pressure	④ kg/cm² main pump servo	Remarks
1	PPC circuit	Full	A	OFF	OFF	Arm dumping relief						Circuit pressure 3.8 +/- 0.2MPa (38 +/- 2.0kg/cm²)
2	Main relief valve											34.8 +/- 0.5MPa (355 +/- 5kg/cm²)
3	(When power increased)				ON							37.2 +/- 0.5MPa (380 +/- 5kg/cm²)
4	LS valve (LS differential pressure valve)				OFF	Neutral						Main - LS = 3.38 +/- 1.0MPa (34.5 +/- 10kg/cm²)
												LS differential pressure = Unload pressure
						Raise road wheels clear of ground using work equipment & chassis attachments. Select LO travel speed. Fully depress travel pedal.						Main - LS = 2.2 +/- 0.1 MPa (22 +/- 1kg/cm²)
5	Swing safety valve					Swing lock switch ON	Right relief					30.9 +/- 1.5MPa (315 +/- 15kg/cm²)
							Left relief					
6	Main relief valve, Travel safety valve,					Travel relief	Forward					38.2 +/- 1.0MPa (390 +/- 10kg/cm²)
							Reverse					

Connection to be changed at hoses ③

No	Part to be checked	Condition Setting: Fuel Dial	Working mode	Auto decelerator	One-touch power max switch	Work equipment operation	① kg/cm² main pump	② kg/cm² main pump LS	③ kg/cm² Control circuit pressure	④ kg/cm² main pump servo	Remarks
7	Servo	Full	A	OFF	OFF	Arm dumping relief					Main servo balance pressure balance ③ / ① = 3/5

Connection to be changed at hoses 2A and 3A, and guage to be replaced with one with 60K capacity

No	Part to be checked	Condition Setting: Fuel Dial	Working mode	Auto decelerator	One-touch power max switch	Work equipment operation	① kg/cm² main pump	2A kg/cm² PC EPC	3A kg/cm² LS EPC		Remarks < Reference value : kg/cm² >
8	PC - EPC valve	Low	A	OFF	OFF	Neutral					<34> Delivery variance by switching mode>
		Full									<3>
			E								<14>
											<21>
			B								<16>
9	LS - EPC valve	Full	A			Neutral					At neutral : MPa (kg/cm²)
						Arm dumping relief					When pump relieved : 1. 6MPa (16 kg/cm²)



TROUBLESHOOTING

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SEQUENCE OF EVENTS IN TROUBLESHOOTING 20-207
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TROUBLESHOOTING OF ELECTRICAL SYSTEM (E-MODE) 20-519
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TROUBLESHOOTING OF HYDRAULIC AND MECHANICAL SYSTEM (H-MODE) 20-701

POINTS TO REMEMBER WHEN TROUBLESHOOTING

⚠ Stop the machine in a level place, and check that the safety pin, blocks, and parking brake are securely fitted.
⚠ When carrying out the operation with two or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.
⚠ If the radiator cap is removed when the engine is hot, hot water may spurt out and cause burns, so wait for the engine to cool down before starting troubleshooting.
⚠ Be extremely careful not to touch any hot parts or to get caught in any rotating parts.
⚠ When disconnecting wiring, always disconnect the negative (–) terminal of the battery first.
⚠ When removing the plug or cap from a location which is under pressure from oil, water, or air, always release the internal pressure first. When installing measuring equipment, be sure to connect it properly.

The aim of troubleshooting is to pinpoint the basic cause of the failure, to carry out repairs swiftly, and to prevent recurrence 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 man-hours, parts, or oil or grease, and at the same time, will also lose the confidence of the user or operator.
For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.

2. Points to ask user or operator
1) Have any other problems occurred apart from the problem that has been reported?
2) Was there anything strange about the machine before the failure occurred?
3) Did the failure occur suddenly, or were there problems with the machine condition before this?
4) Under what conditions did the failure occur?
5) Had any repairs been carried out before the failure?
When were these repairs carried out?
6) Has the same kind of failure occurred before?

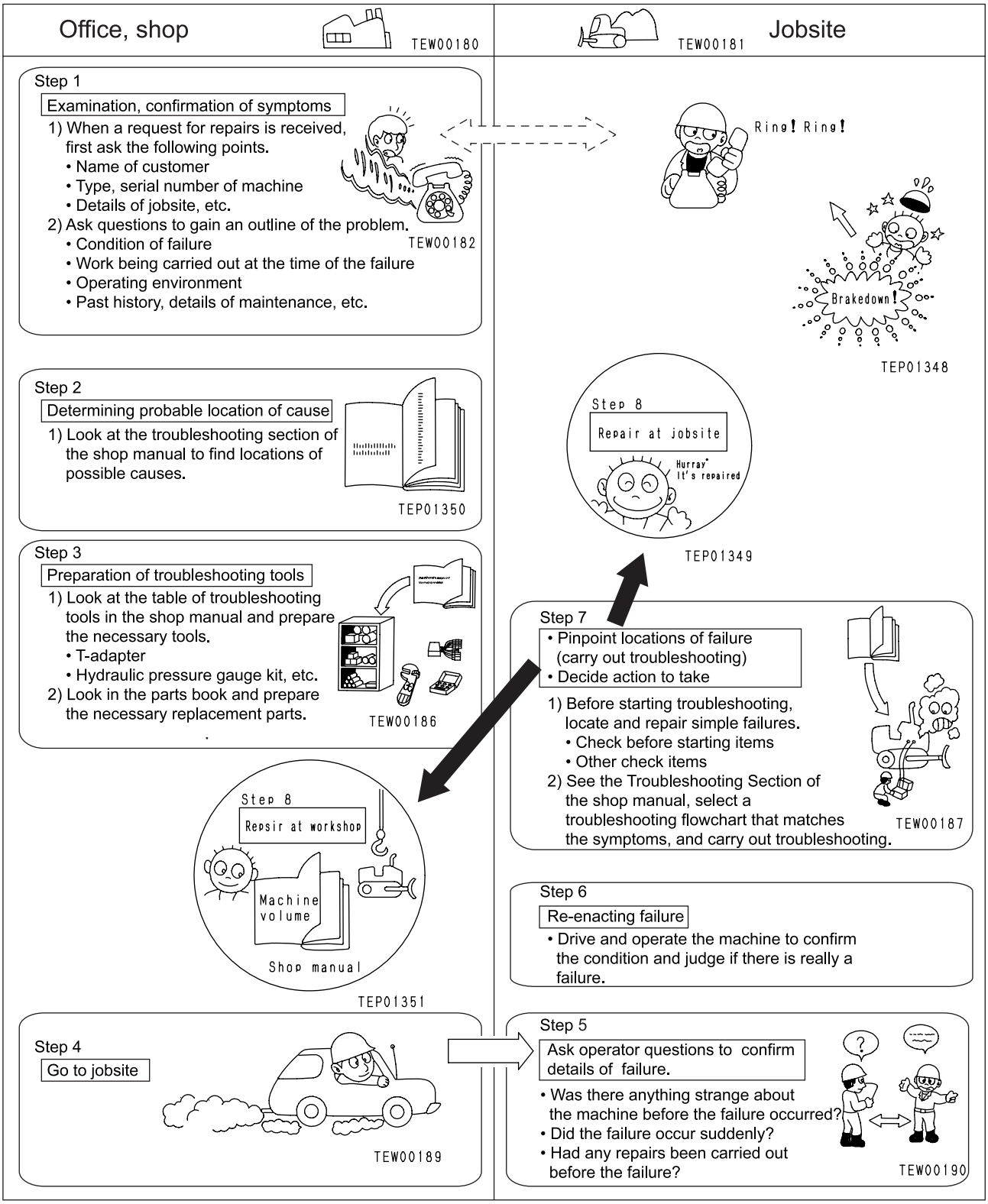
3. Check before troubleshooting
1) Check the oil level
2) Check for any external leakage of oil from the piping or hydraulic equipment.
3) Check the travel of the control levers.
4) Check the stroke of the control valve spool.
5) Other maintenance items can be checked externally, so check any item that is considered to be necessary.

4. Confirming failure
- Confirm the extent of the failure yourself, and judge whether to handle it as a real failure or as a problem with the method of operation, etc.
  - ★ When operating the machine to 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.
    1)Start from the simple points.
    2)Start from the most likely points.
    3)Investigate other related parts or information.

6. Measures to remove root cause of failure
- Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occur again.
To prevent this, always investigate why the problem occurred. Then, remove the root cause.

SEQUENCE OF EVENTS IN TROUBLESHOOTING



POINTS TO REMEMBER WHEN CARRYING OUT MAINTENANCE

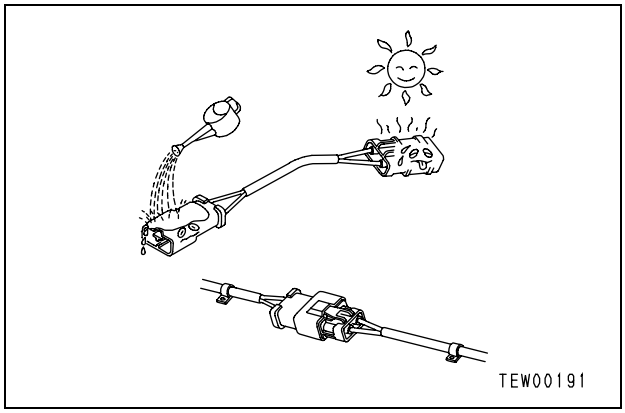
TO MAINTAIN THE PERFORMANCE OF THE MACHINE OVER A LONG PERIOD, AND TO PREVENT FAILURES OR OTHER TROUBLES BEFORE THEY OCCUR, CORRECT OPERATION, MAINTENANCE AND INSPECTION, TROUBLESHOOTING, AND REPAIRS MUST BE CARRIED OUT. THIS SECTION DEALS PARTICULARLY WITH CORRECT REPAIR PROCEDURES FOR MECHATRONICS AND IS AIMED AT IMPROVING THE QUALITY OF REPAIRS. FOR THIS PURPOSE, IT GIVES SECTIONS ON "HANDLING ELECTRIC EQUIPMENT" AND "HANDLING HYDRAULIC EQUIPMENT" (PARTICULARLY GEAR OIL AND HYDRAULIC OIL).

1. Points to remember when handling electric equipment

1) Handling wiring harnesses and connectors

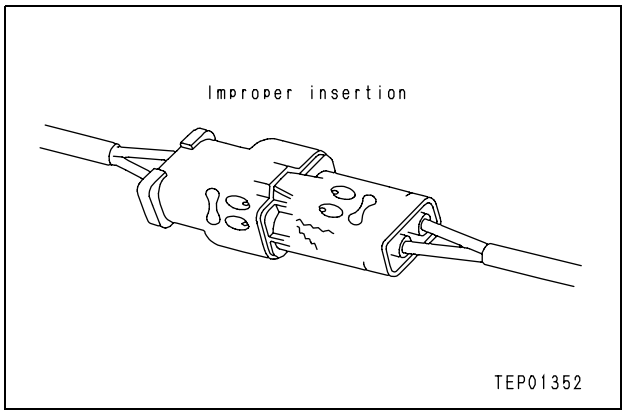
Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protectors or tubes used for protecting the wiring.

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

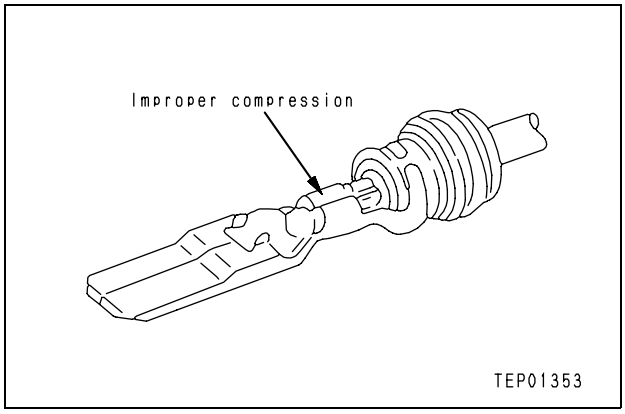


Main failures occurring in wiring harness

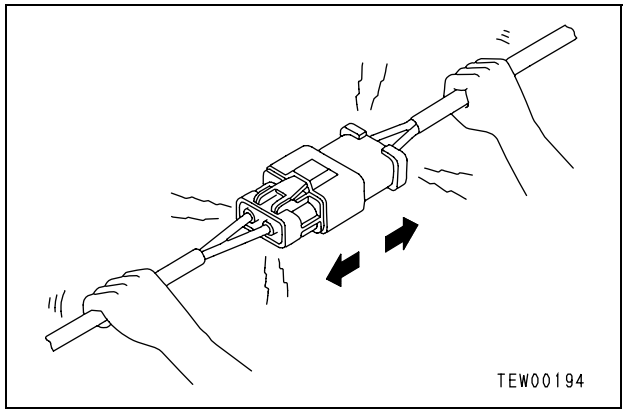
1) Defective contact of connectors (defective contact between male and female)
   Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned,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



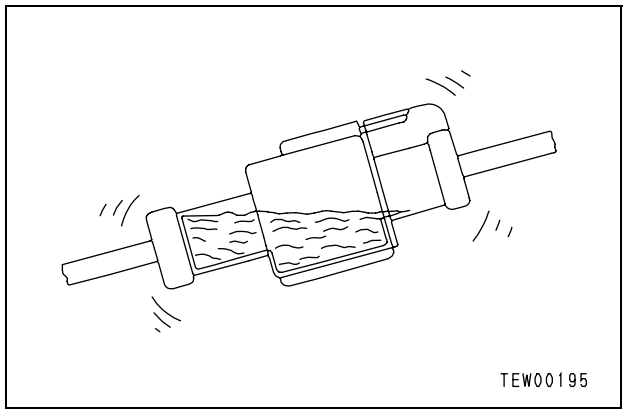
2) Defective crimping or soldering of connectors
   The pins of the male and female connectors are in contact at the crimped terminal or soldered portion, but if there is excessive force brought to bear on the wiring, the plating at the joint will peel and cause improper connection or breakage.



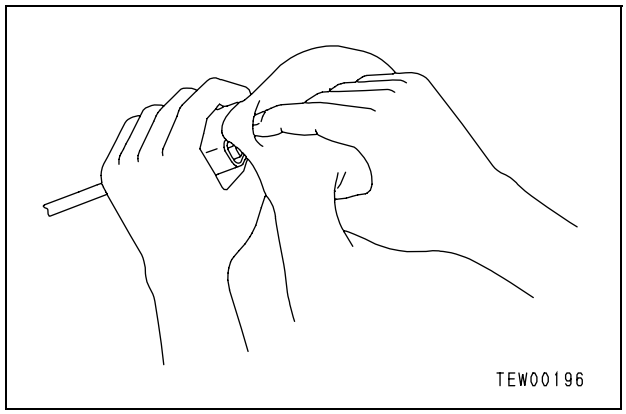
3) Disconnection in wiring
If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping of the connector may separate, or the soldering may be damaged, or the wiring may be broken.



4) High-pressure water entering connector
The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector, depending on the direction of the water jet.
As already said, the connector is designed to prevent water from entering, but at the same time, if water does enter, it is difficult for it to be drained. Therefore, if water should get into the connector, the pins will be short-circuited by the water, so if any water gets in, immediately dry the connector or take other appropriate action before passing electricity through it.

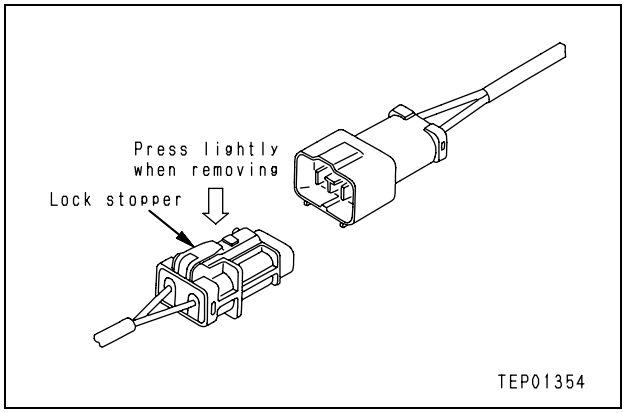


5) Oil or dirt stuck to connector
If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact.
If there is oil or grease stuck to the connector, wipe it off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

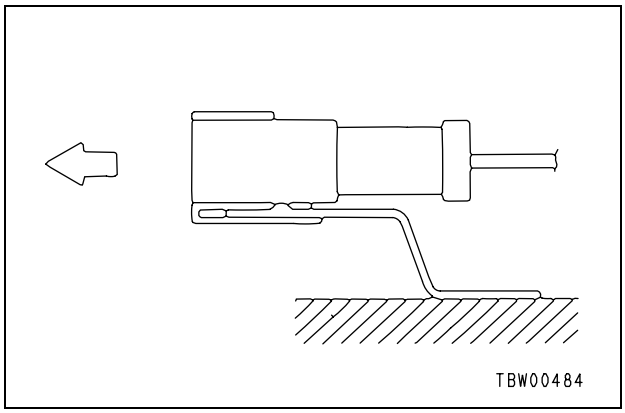


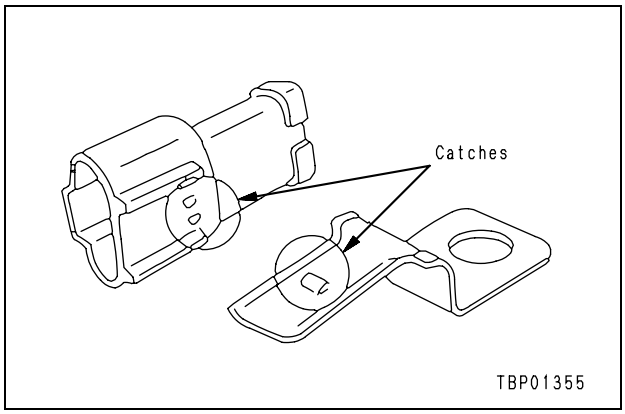
2) Removing, installing, and drying connectors and wiring harnesses

- **Disconnecting connectors**
  1) Hold the connectors when disconnecting.
     When disconnecting the connectors, hold the connectors and not the wires. For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.
     ★ Never pull with one hand.

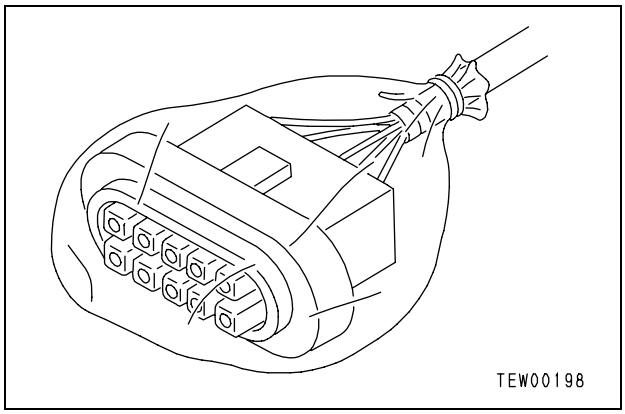


  2) When removing from clips
     When removing a connector from a clip, pull the connector in a parallel direction to the clip.
     ★ If the connector is twisted up and down or to the left or right, the housing may break.





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



- **Connecting connectors**
  1) Check the connector visually.
     1) Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).
     2) Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.
     3) Check that there is no damage or breakage to the outside of the connector.

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

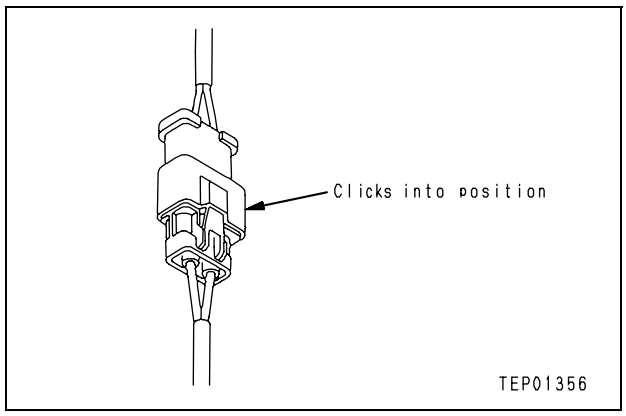
     ★ If there is any damage or breakage, replace the connector.

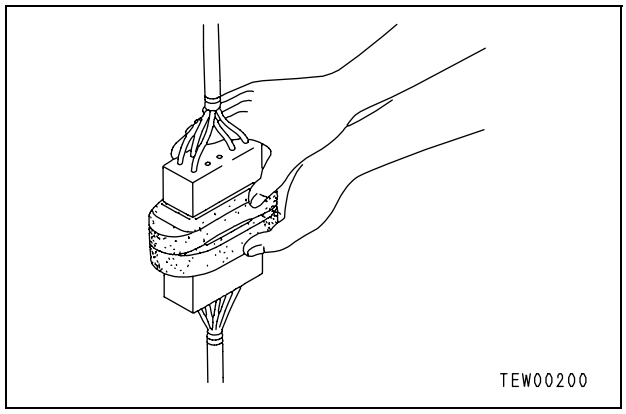
  2) Fix the connector securely.
     Align the position of the connector correctly, then insert it securely.
     For connectors with lock stopper, push in the connector until the stopper clicks into position.

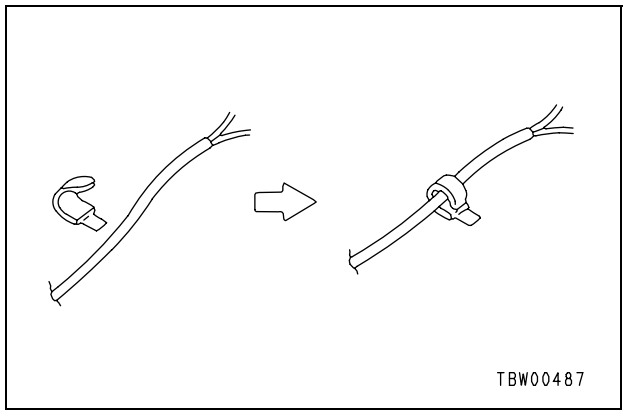
  3) Correct any protrusion of the boot and any misalignment of the wiring harness
     For connectors fitted with boots, correct any protrusion of the boot. In addition, if the wiring harness is misaligned, or the clamp is out of position, adjust it to its correct position.

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

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

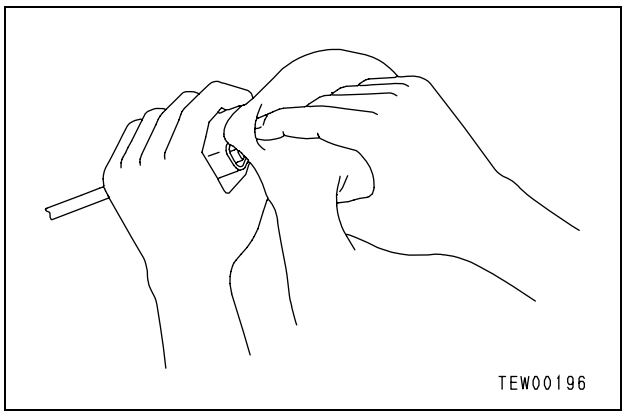




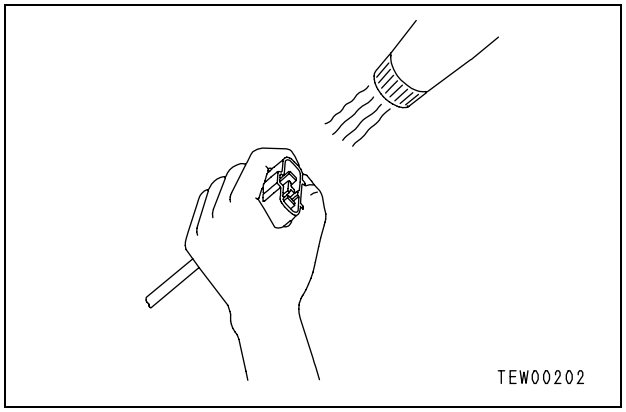


- **Drying wiring harness**
  If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high-pressure water or steam directly on the wiring harness.

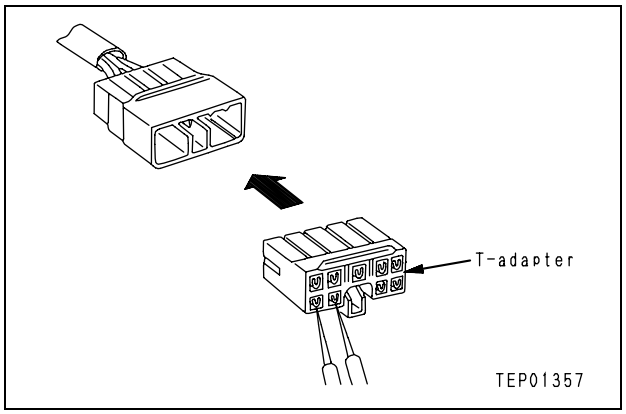
  If water gets directly on the connector, do as follows.
  1) Disconnect the connector and wipe off the water with a dry cloth.
     ★ If the connector is blown dry with compressed air, there is the risk that oil in the air may cause defective contact, so remove all oil and water from the compressed air before blowing with air.



  2) Dry the inside of the connector with a dryer.
     If water gets inside the connector, use a dryer to dry the connector.
     ★ Hot air from the dryer can be used, but regulate the time that the hot air is used in order not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.

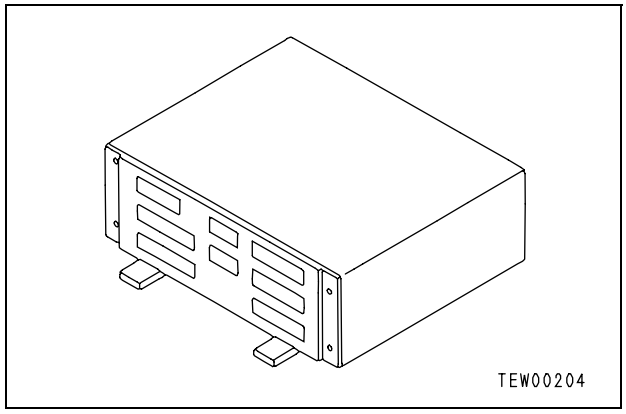


  3) Carry out a continuity test on the connector.
     After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.
     ★ After completely drying the connector, blow it with contact restorer and reassemble.

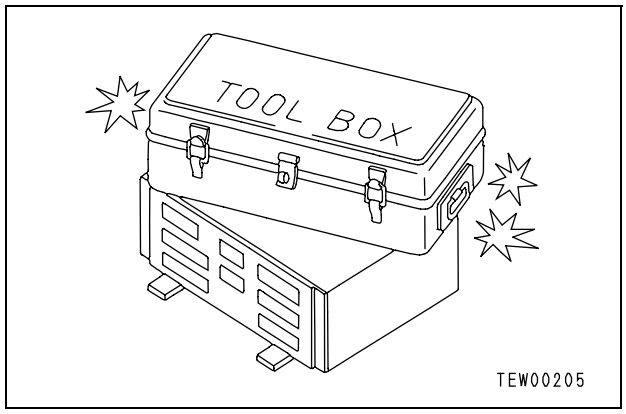


3) Handling control box

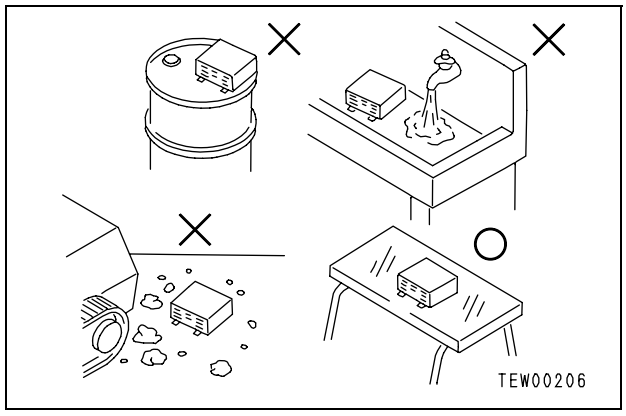
1) The control box contains a microcomputer and electronic control circuits. These control all of the electronic circuits on the machine, so be extremely careful when handling the control box.
2) Do not open the cover of the control box unless necessary.



3) Do not place objects on top of the control box.
4) Cover the control connectors with tape or a vinyl bag.
   Never touch the connector contacts with your hand.
5) During rainy weather, do not leave the control box in a place where it is exposed to rain.



6) Do not place the control box on oil, water, or soil, or in any hot place, even for a short time.
   (Place it on a suitable dry stand).
7) Precautions when carrying out arc welding
   When carrying out arc welding on the body, disconnect all wiring harness connectors connected to the control box. Fit an arc welding ground close to the welding point.



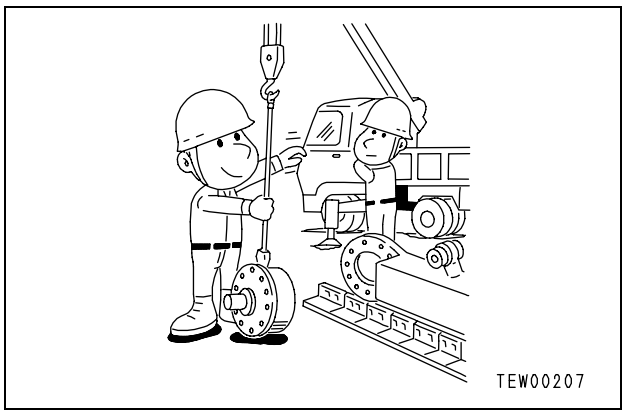
2. Points to remember when troubleshooting electric circuits

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

3. Points to remember when handling hydraulic equipment

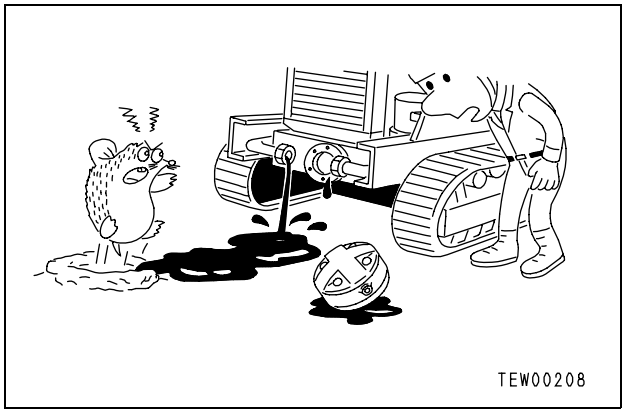
WITH THE INCREASE IN PRESSURE AND PRECISION OF HYDRAULIC EQUIPMENT, THE MOST COMMON CAUSE OF FAILURE IS DIRT (FOREIGN MATERIAL) IN THE HYDRAULIC CIRCUIT. WHEN ADDING HYDRAULIC OIL, OR WHEN DISASSEMBLING OR ASSEMBLING HYDRAULIC EQUIPMENT, IT IS NECESSARY TO BE PARTICULARLY CAREFUL.

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

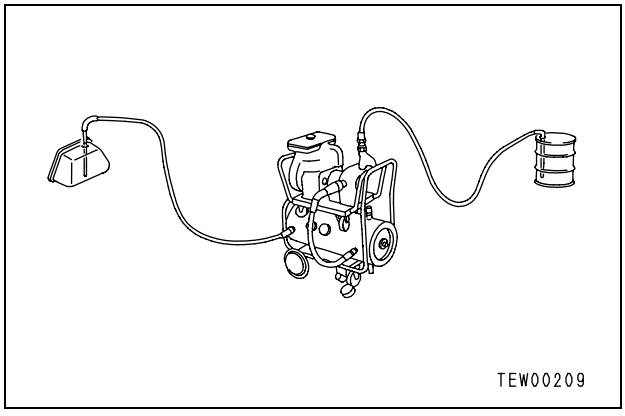


2) Disassembly and maintenance work in the field
If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to confirm the performance after repairs, so it is desirable to use unit exchange. Disassembly and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

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



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



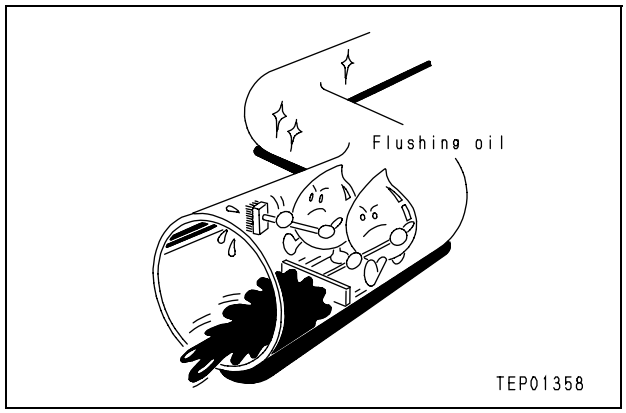
5) Change hydraulic oil when the temperature is high.

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

6) Flushing operations

After disassembling and assembling the equipment, or changing the oil, use flushing oil to remove the contaminants, sludge, and old oil from the hydraulic circuit.

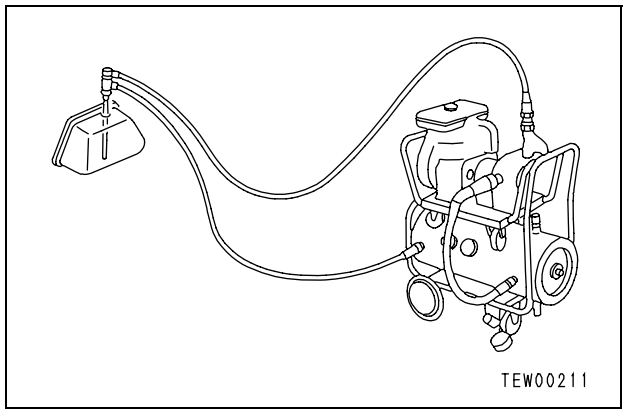
Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.



7) Cleaning operations

After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, carry out oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit.

The oil cleaning equipment is used to remove the ultrafine (about 3μ) particles that the filter built into the hydraulic equipment cannot remove, so it is an extremely effective device.



CHECKS BEFORE TROUBLESHOOTING

	Item	Judgement value	Action
Lubricating oil, coolant	1. Check fuel level, type of fuel	—	Add fuel
	2. Check for impurities in fuel	—	Clean, drain
	3. Check hydraulic oil level	—	Add oil
	4. Check 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 equipment	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 discoloured, 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 pick-up 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	Colour of exhaust gas is too dark. (Incomplete combustion)					S-7
13	Excessive engine oil consumption, or colour 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 over runs 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 start-up inspection, radiator water level caution symbol is displayed on the monitor panel, when the engine is running	B@BCZK			
54	In start-up inspection, engine oil level caution symbol is displayed, when the engine is stopped (with the starting key in the ON position)	B@BAZK			

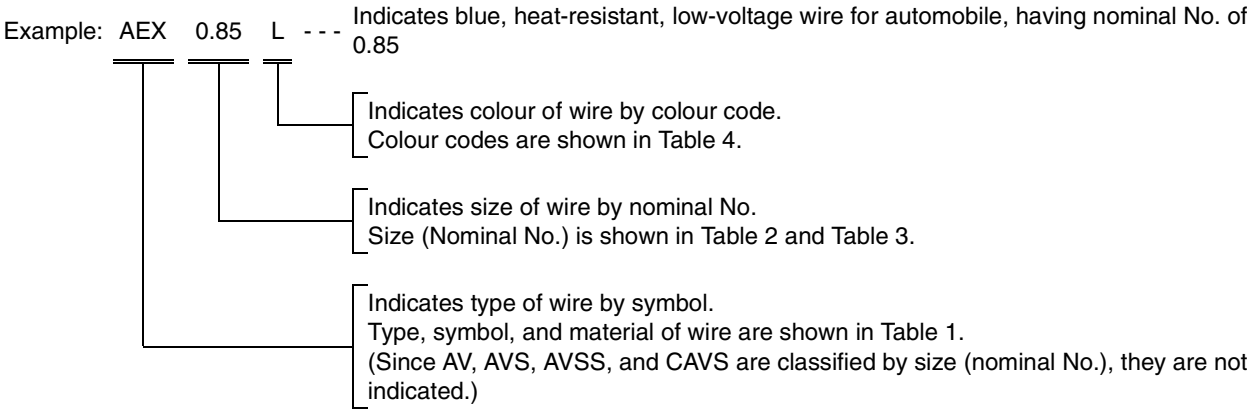
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No.	Failure-looking phenomenon	Troubleshooting			
		Code display	User code	H mode	(Engine)
55	In start-up inspection, maintenance hour monitor lamp lights up red	Refer to Operation and Maintenance Manual			
56	While engine is running, battery charging 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 displayed in red range	B@BCNS			
60	While engine is running, hydraulic oil temperature gauge is displayed 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		
Phenomena related to KOMTRAX					
79	KOMTRAX system does not operate normally		E-32		

How to read electric wire code

- In this section, electric wire codes specific to PW160-7E0 are explained.

IN THE ELECTRIC CIRCUIT DIAGRAM, THE MATERIAL, THICKNESS, AND COLOUR OF EACH ELECTRIC WIRE ARE INDICATED BY SYMBOLS. THE ELECTRIC WIRE CODE IS HELPFUL IN UNDERSTANDING THE ELECTRIC CIRCUIT DIAGRAM.



1. Type, symbol, and material

AV, 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	—	—	—

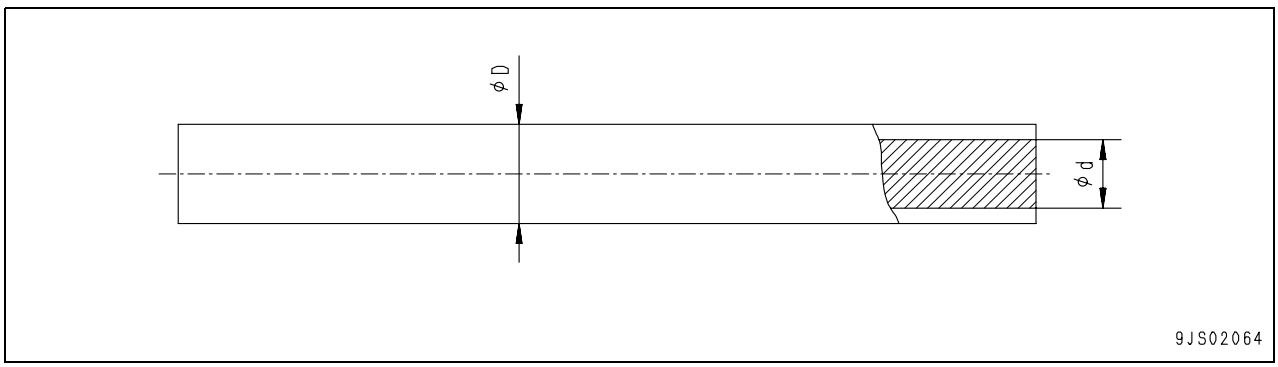
Nominal No.			8	15	20	30	40	50	60	85	100
Conductor		Number of strands/Diameter of strand	50/0.45	84/0.45	41/0.80	70/0.80	85/0.80	108/0.80	127/0.80	169/0.80	217/0.80
		Sectional area (mm^2)	7.95	13.36	20.61	35.19	42.73	54.29	63.84	84.96	109.1
		d (Approx.)	3.7	4.8	6.0	8.0	8.6	9.8	10.4	12.0	13.6
Cover 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. Colour codes table

(Table 4)

Colour Code	Colour 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

Colour Code	Colour 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 colour code consisting of 2 colours, the first colour is the colour of the background and the second colour is the colour of the marking.
Example: “GW” means that the background is Green and marking is White.

4. Types of circuits and colour 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-5
A02	X	4	Intermediate Connector	H-5
A03	DT	12	Intermediate Connector	H-5
A04	SWP	14	Intermediate Connector	H-5
A04	Terminal	1	Ground (Chassis)	DL-6
A05	SWP	16	Intermediated connector	H-4
A06	SWP	16	Intermediated connector	H-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	DL-5
A12	DT	4	Swivel Joint Connector	AA-2
A13	DT	4	Swivel Joint Connector	DL-5
A14	DT	3	Swivel Joint Connector	AA-2
A20	Terminal	1	Battery Relay (E Terminal)	Y-7
A21	Terminal	1	Battery Relay (BR Terminal)	Z-7
A22	Terminal	1	Battery Relay (M Terminal)	Y-8
A23	Terminal	1	Battery Relay (B Terminal)	Z-8
A24	Terminal	1	Heater relay (Contact)	X-8
A25	Terminal	1	Heater Relay (Contact)	X-7
A26	Terminal	1	Heater relay (contact)	X-7
A27	X	2	Starter Safety Relay (S & R Terminals).	Y-7
A28	Terminal	1	Starter Safety Relay (B Terminal)	Y-8
A29	Terminal	1	Starter Safety Relay (C Terminal).	Y-8
A31	DT	2	Air cleaner clogging system	M-6
A33	X	2	Radiator Water Level sensor	O-5
A34	L	2	Fusible Link (60A)	Y-8
A35	M	2	Fusible Link (30A)	X-8
A40	Spade	1	Alarm Horn (low tone)	X-5
A41	Spade	1	Alarm Horn (high tone)	X-5
A42	Spade	1	Horn (-)	X-5
A43	Spade	1	Horn (-)	X-5
A50	Spade	1	Washer Motor Connector	AJ-4

Connector No.	Type	No.of Pin	Name of Device	Address
A51	DT	3	Pump hydraulic oil pressure sensor	AC-3
A53	Bullet	1	Back up alarm (OPT)	K-7
A54	X	1	Fuel Level Sensor	X-4
A55	DT	2	Hydraulic Oil Temperature Sensor	AD-4
A56	DT	3	Travel PPC oil pressure sensor	L-5
A57	DT	2	Transmission Speed Sensor	DK-5
A59	Spade	1	Washer motor	AJ-4
A64	Terminal	1	Revolving Frame Grounding	N-2
A65	Terminal	1	Revolving Frame Grounding	N-2
A84	X	4	Rear Work light harness conn	AF-5
A85	X	1	Rear Work Light on Counter weight	AF-8
A86	DT	2	Work Equipment Lights	Z-2 + 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	H-6
A91	DT	2	Arm Marker Light (OPT)	EB-7
A92	DT	2	Lights	W-9
A93	DT	2	Lights	W-9
A99	SWP	8	Intermediated connector	I-5
AS1	DT	3	Angle sensor (Japan spec.)	BL-2
AB	Terminal	2	Alternator (B)	DF-3
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	DE-7
CE03	DTP	4	Engine controller	DE-7
CR1	M	2	Op cab front work lamps	AQ1 + AS2
CR2	M	2	Op cab front work lamps	AR2 + AS2
CR3	M	2	Op cab front work lamps	AR2
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	DA-3 + CE-5
D11	KES1	2	Assembled type diode	DA-3 + CE-5

Connector No.	Type	No.of Pin	Name of Device	Address
E01	Terminal	1	Ribbon heater	DF-8
E03	DT	2	Engine oil level sensor	DE-2
E05	X	1	Compressor for air conditioner	DE-8
E06	M	3	Fuel dial	BP-8
E06	DT	2	Water in fuel sensor	DE-7
E12	Connector	3	Alternator (IG + L)	DF-3
F01	KES1	4	Flasher unit	CK-5
F02	Yazaki	2	Operator cab beacon	AQ-7
FB1	-	20	Fuse box	BJ-5
FB2	-	20	Fuse box	BJ-3
G02	DT	14	Steering Column	DB-2 + BU-5
G3	AMP	7	Steering Column switch assy	DA-4
G4	AMP	7	Steering Column switch assy	DA-4
G05	DT	12	Steering Column	BU-5 + DB-2
G7	DT	4	Rear Lights L.H	AK-6
G8	DT	4	Rear Lights R.H	AE-6
G10	X	2	Harness for licence No. plate	AG-5
G12	DT	6	Front light connector (R.H)	V-2
G13	DT	6	Front light connector (L.H)	C-3
G33	DT	4	Heated seat (OPT)	BL-4
G51	Bullet	1	Engine compartment lamp (OPT)	AE-6
G52	KES0	4	Lower wiper (OPT)	B-3
G53	DT	2	Beacon	AG-6
G70	DT	12	LH Wrist control lever switch	BI-4
G71	DT	4	RH Wrist control lever switch	BP-7
G72	DT	12	Proportional control / F.N.R switches	BP-7
G73	DT	2	Lever opt.	BJ-4
G99	Britax	10	Park Brake	BQ-3
G101	Britax	2	Indicator Switch	DA-7
G103	Britax	2	High beam indicator	DA-7
G105	Britax	5	Road lights switch	DA-7
G120	Britax	10	Hazard switch	DA-7
G164	DT	3	Overload Caution Sensor	Y-2
H08	M	8	Intermediate Connector	AR-4 + AY-5
H09	S	8	Intermediate Connector	AR-4 + AY-5
H10	S	16	Intermediate Connector	CB-5

Connector No.	Type	No.of Pin	Name of Device	Address
H11	S	16	Intermediate Connector	CB-6
H12	S	12	Intermediate Connector	CB-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
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	DE-7
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	BC-6
M26	S	12	Air Con Unit	CO-4
M27	Yazaki	18	Air Con Unit	CO-4
M29	AMP	20	Air Con control panel	BJ-5
M30	AMP	16	Air Con control panel	BJ-5
M31	M	4	Power supply	CE-4
M33	Sumitomo	4	Air Con Unit	CO-5
M33	M	2	Heated seat switch	BJ-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	DT	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

Connector No.	Type	No.of Pin	Name of Device	Address
M73	M	2	Speaker (left)	AR-6
M79	M	2	12V elec. equip. socket (Phone Socket)	CE-7
M80	DT	2	Refueling pump connection	AD-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)	BJ-5
P06	M	2	Lower Wiper (Option)	BJ-5
P10	DT	8	Outrigger Switch	CX-5
P15	YOSO	2	Air Conditioner Sunlight sensor	DA-7
P17	Sumiomo	2	Air Con Hi/Lo pressure sw.	BY-4
P47	X	1	Water in fuel sensor	AD-6
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	BJ-4
RT3	DT	6	Roto tilt connector	BX-5
S01	X	2	Swing RH oil pressure switch	M-3

Connector No.	Type	No.of Pin	Name of Device	Address
S02	X	2	Swing LH oil pressure switch	N-3
S03	X	2	Bucket dumping oil pressure switch	L-4
S04	X	2	Bucket digging oil pressure switch	L-4
S05	X	2	Arm dump oil pressure switch	N-3
S06	X	2	Arm digging oil pressure switch	N-3
S07	X	2	2PB extend oil pressure switch	M-4
S08	X	2	2PB retract oil pressure switch	M-4
S09	X	2	Travel reverse oil pressure switch	M-5
S10	X	2	Travel forward oil pressure switch	M-5
S12	X	2	Stabilizer + boom down oil pressure switch	L-4
S13	X	2	Stabilizer + boom up oil pressure switch	L-4
S14	M	3	PPC hydraulic lock switch	BI-4
S17	DT	2	Park brake oil pressure switch	BU-5
S18	DT	2	Low brake oil pressure 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	AC-4
S95	DT	4	Intermediate connector	BR-5 + CB-4
S96	OTAX	9	Emergency travel switch (Ref. 20E-06-31540)	BQ-2
SB	Terminal	1	Starter	DE-2
SC	Terminal	1	Starter	DE-2
T05	Terminal	1	Earth to floor frame	CE-4
T11	Terminal	1	Earth	AR-4
V01	DT	2	PPC Pressure Lock Solenoid	R-5
V02	DT	2	2 Stage Relief Solenoid	R-6
V03	DT	2	Swing Brake Sol	R-6
V04	DT	2	Suspension Lock Solenoid	R-6
V06	DT	2	Travel Neutral Solenoid	R-6
V07	DT	2	Creep solenoid	R-7
V08	DT	2	Travel F/R solenoid	M-5
V09	DT	2	Boom / Stabilizer down solenoid	M-4
V10	DT	2	Boom / Stabilizer up solenoid	L-6

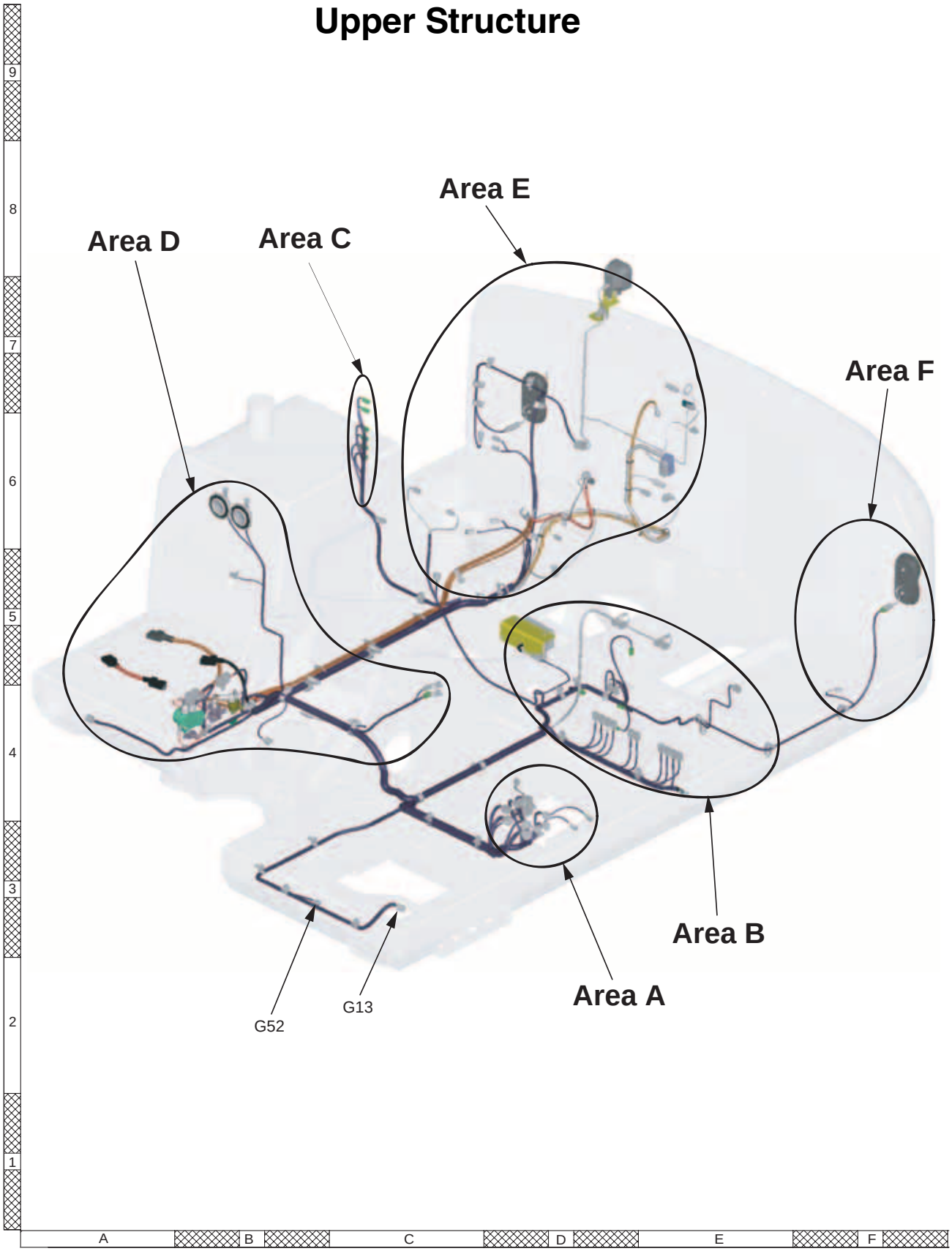
Connector No.	Type	No.of Pin	Name of Device	Address
V11	DT	2	Transmission clutch solenoid	J-5
V12	DT	2	Park brake solenoid valve	BU-4
V15	DT	2	Transmission back pressure solenoid	I-5
V15	DT	2	Front attachment solenoid (LHS)	DJ-6
V16	DT	2	Front attachment solenoid (RHS)	DJ-6
V16	DT	2	Quick coupler solenoid	AB-4
V17	DT	2	Rear attachment solenoid (LHS)	DN-5
V18	DT	2	Rear attachment solenoid (RHS)	DN-5
V21	DT	2	PC-EPC solenoid valve	AD-6
V22	DT	2	LS-EPC solenoid valve	AD-5
V23	X	2	1st service LH EPC	M-6
V24	X	2	1st service RH EPC	M-7
V25	X	2	2nd Service LH EPC	M-6
V26	X	2	2nd Service RH EPC	M-7
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

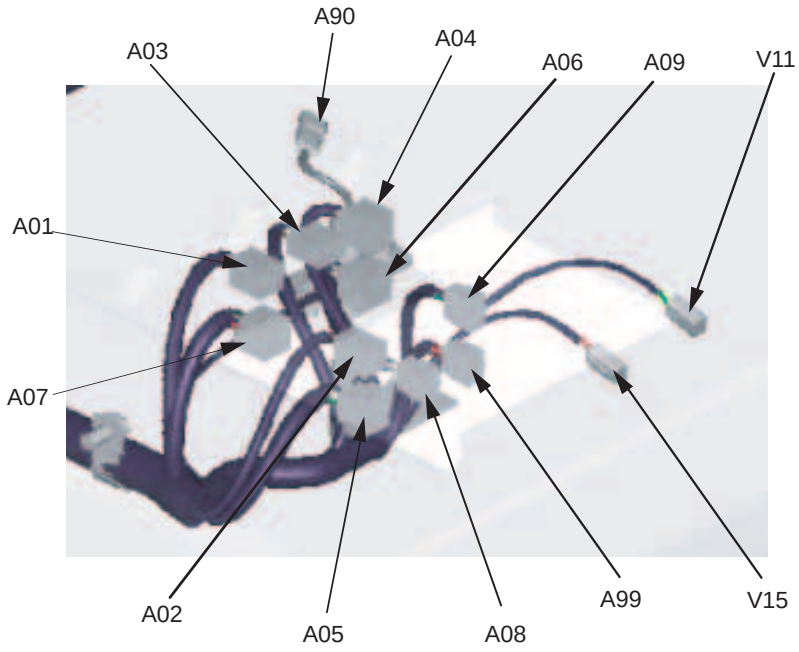
Connector No.	Detailed information
DENSO	Product of DENSO (Japan)
Sumitomo	Sumitomo made connector
JDK	Product of JIDSHA DENKI KOGYO

*AN AFFILIATED COMPANY OF MITSUBISHI
CABLE INDUSTRIES, LTD.

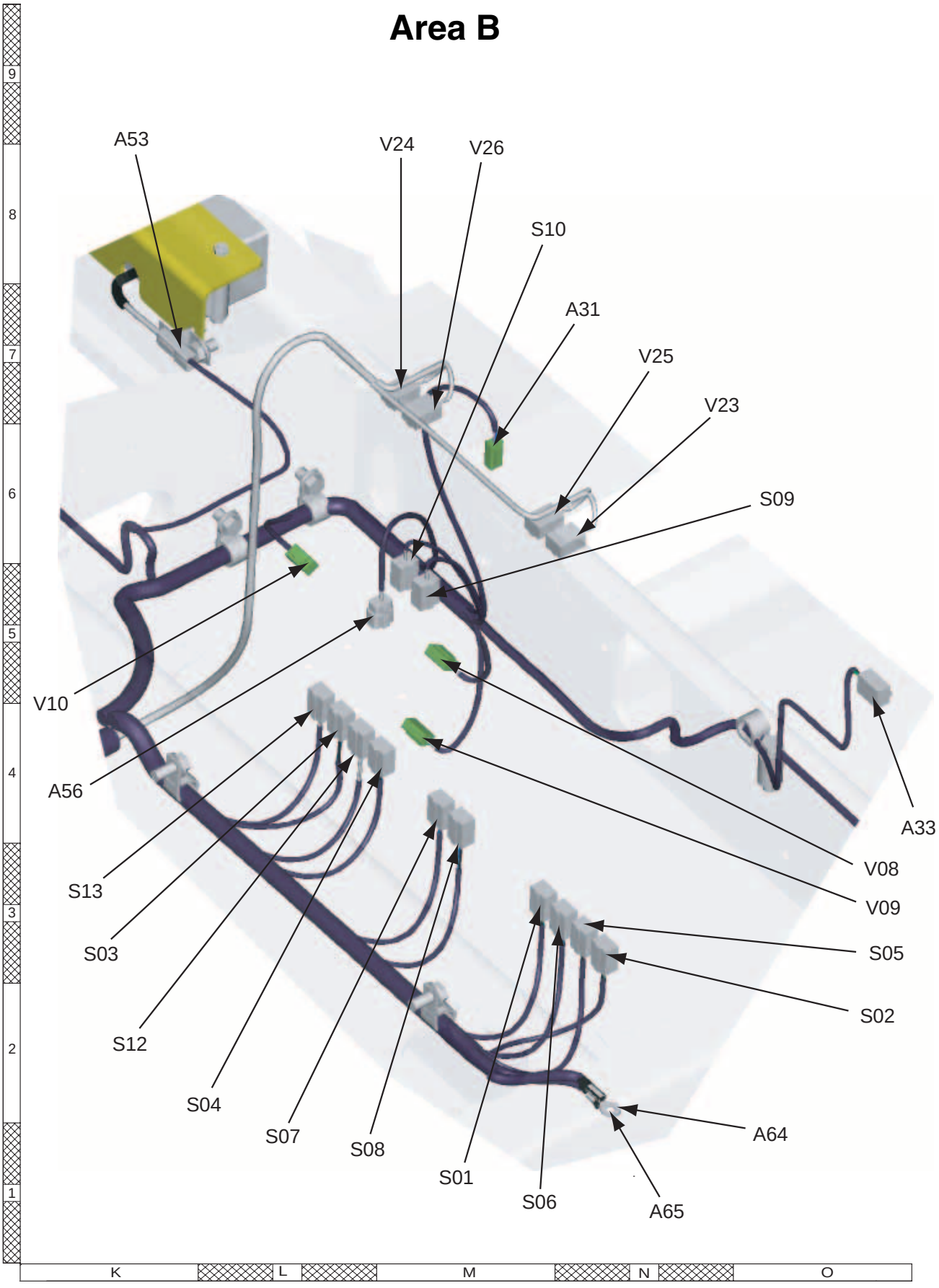
CONNECTOR LOCATIONS



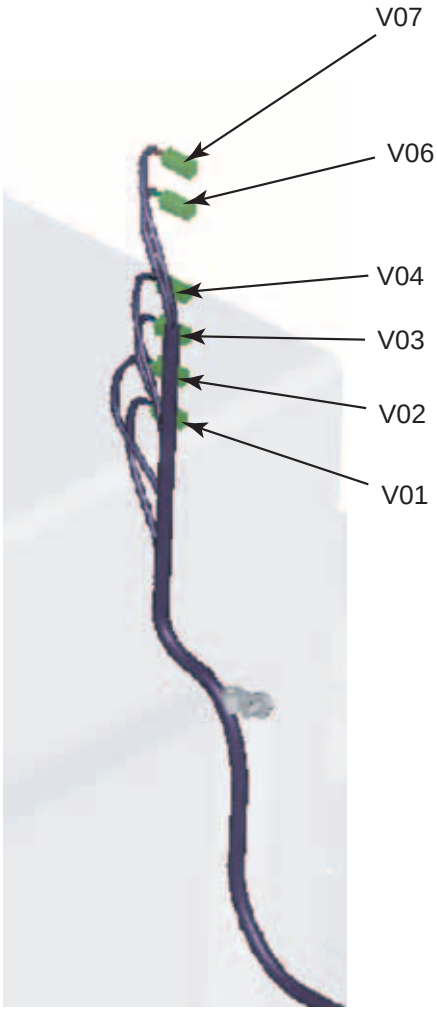
Area A

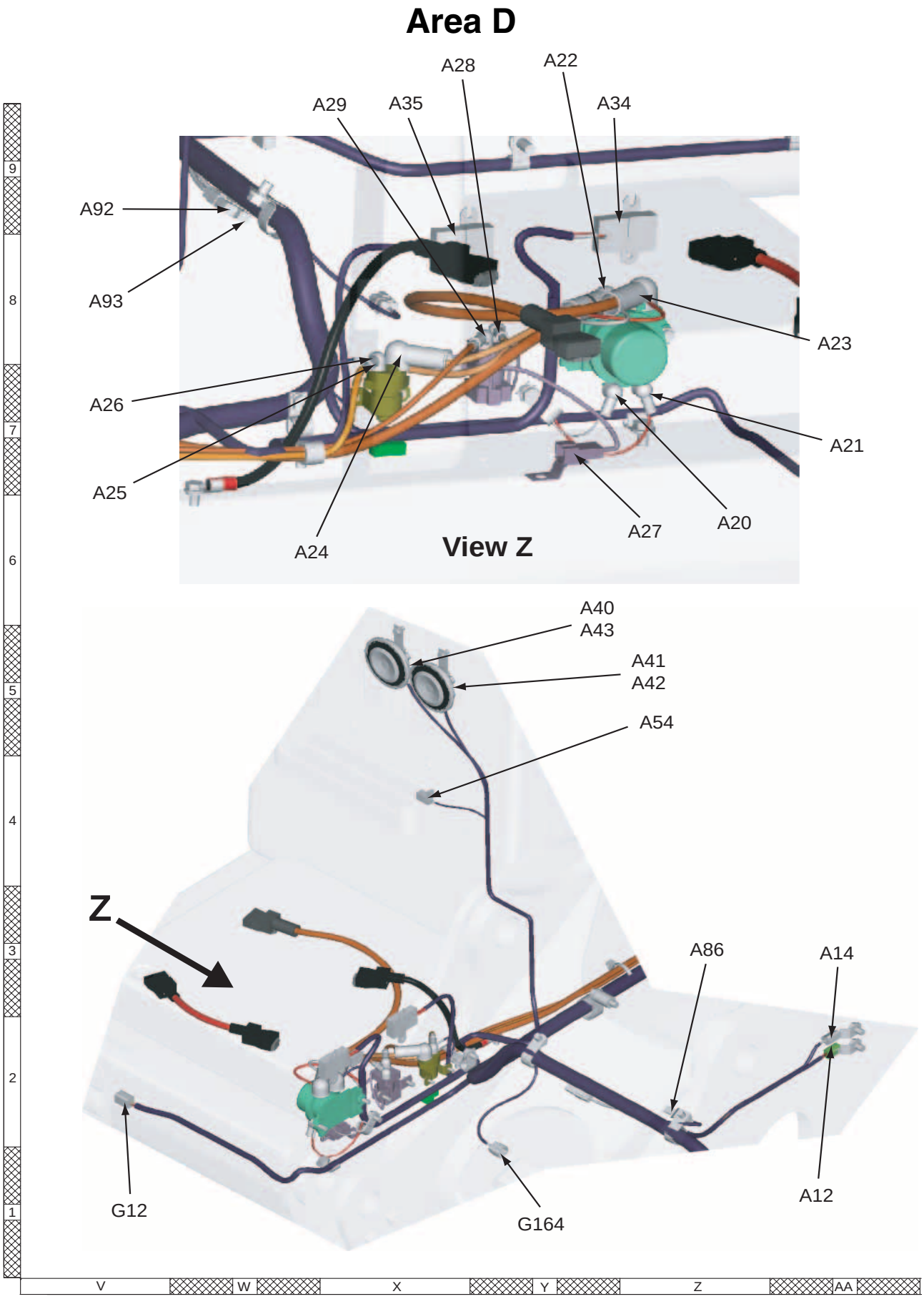


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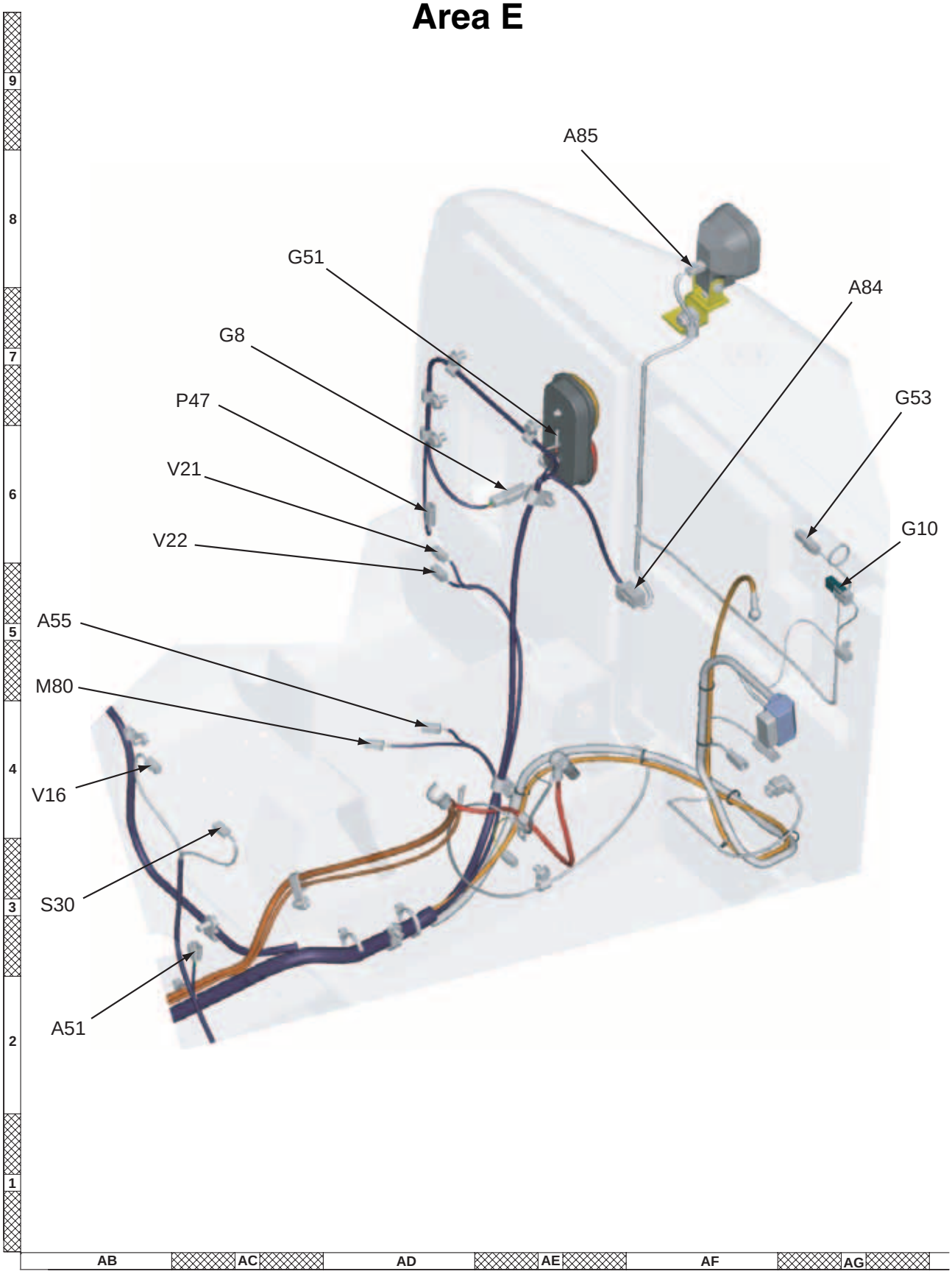

A53
V24
V26
S10
A31
V25
V23
S09
V10
A56
S13
S03
S12
S04
S07
S08
S01
S06
A65
A64
S02
S05
V09
V08
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O

Area C

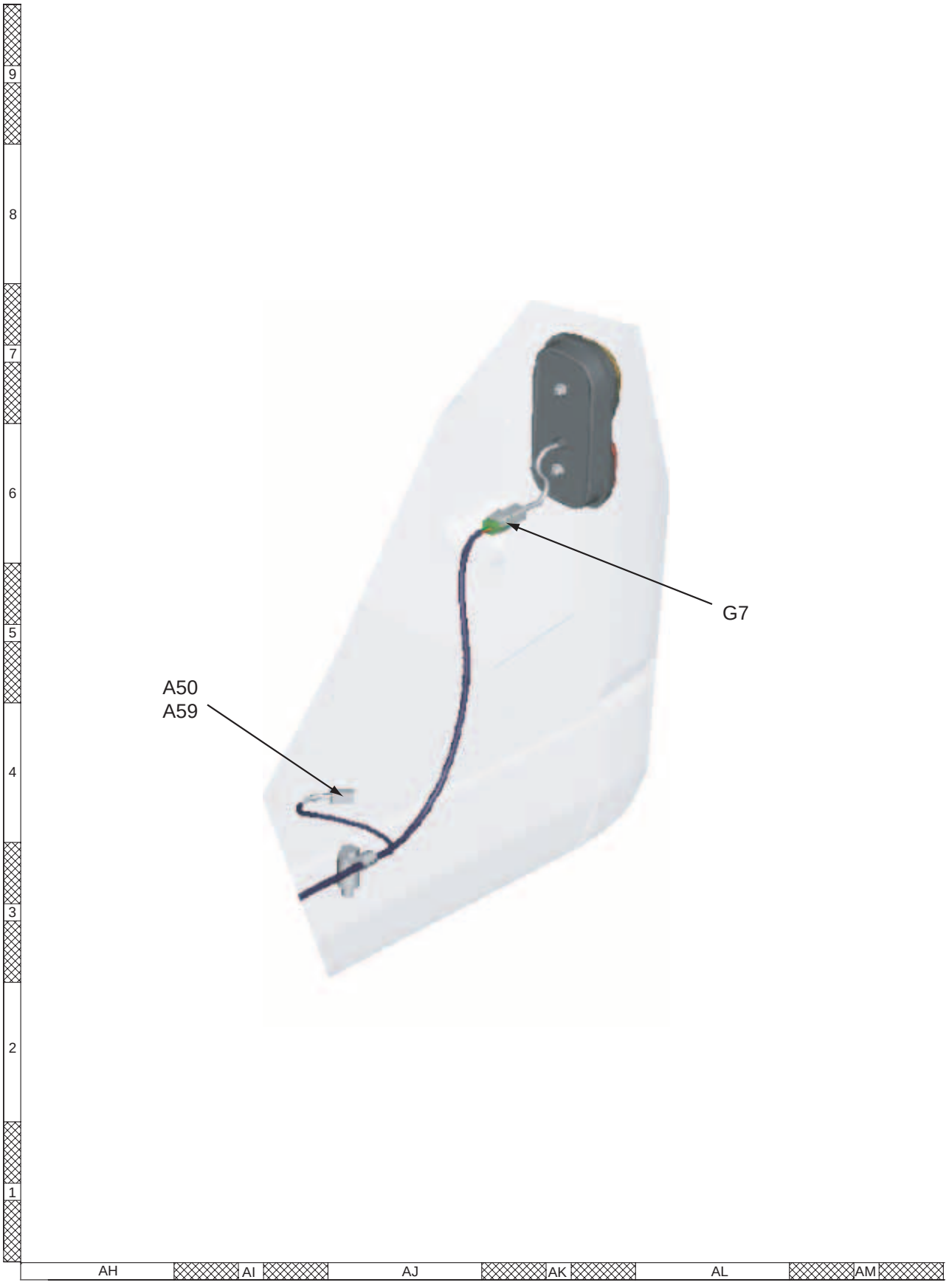



Area D
A28
A22
A29
A35
A34
A92
A93
A23
A26
A21
A25
A27
A20
A24
View Z
A40
A43
A41
A42
A54
Z
A86
A14
G12
G164
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7
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3
2
1
V
W
X
Y
Z
AA

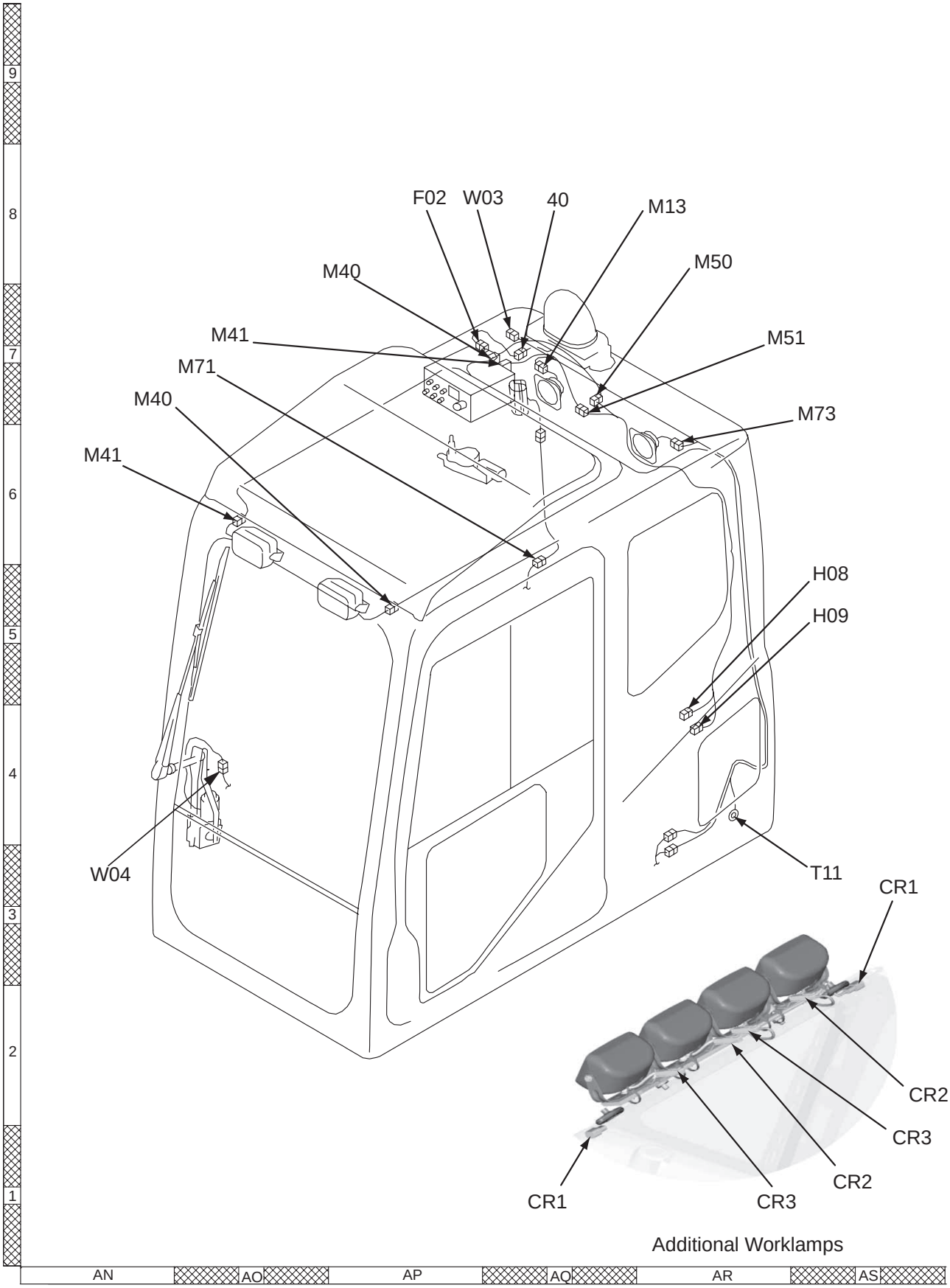
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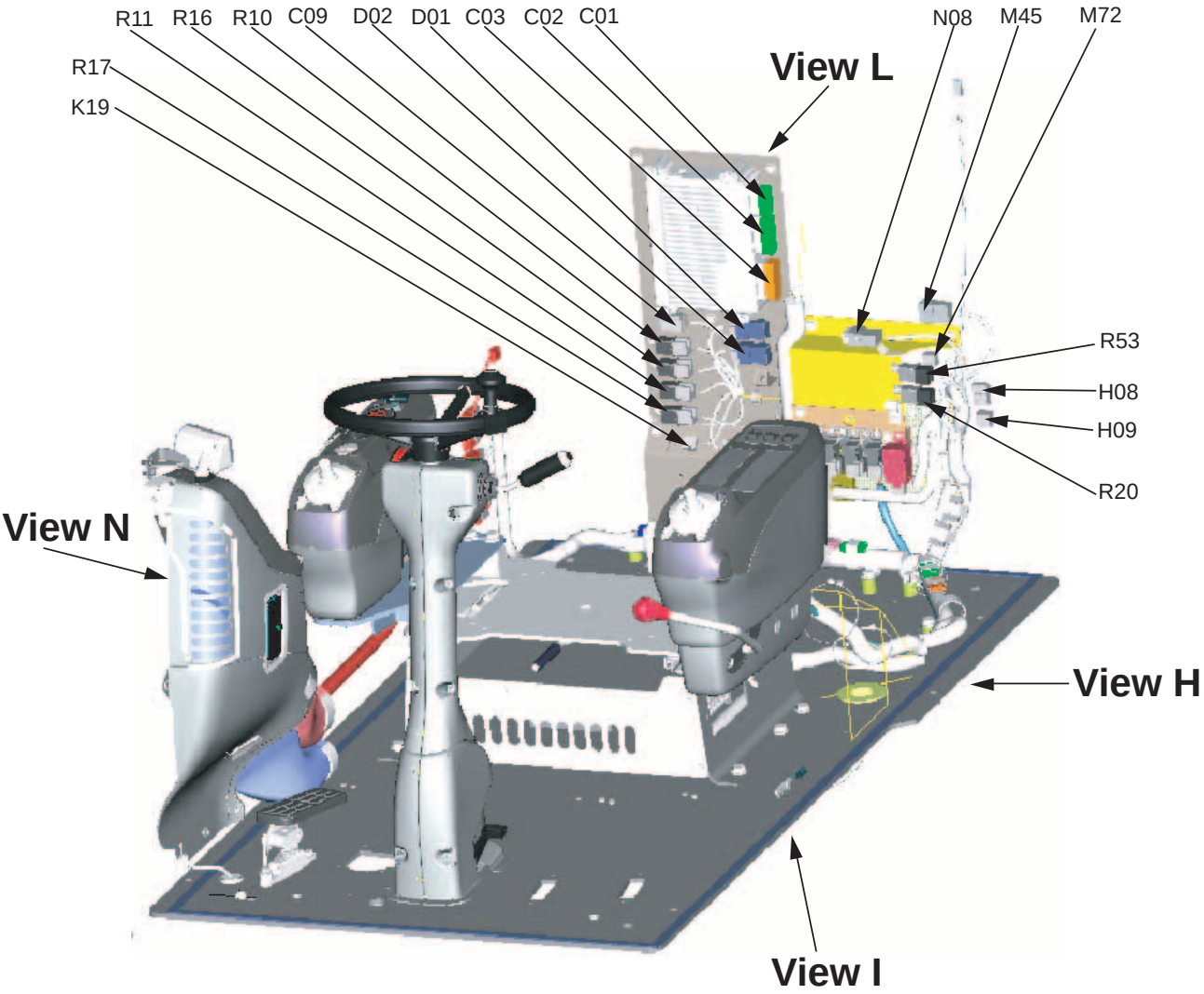

A85
G51
A84
G8
G53
P47
V21
G10
V22
A55
M80
V16
S30
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AB
AC
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AG

Area F

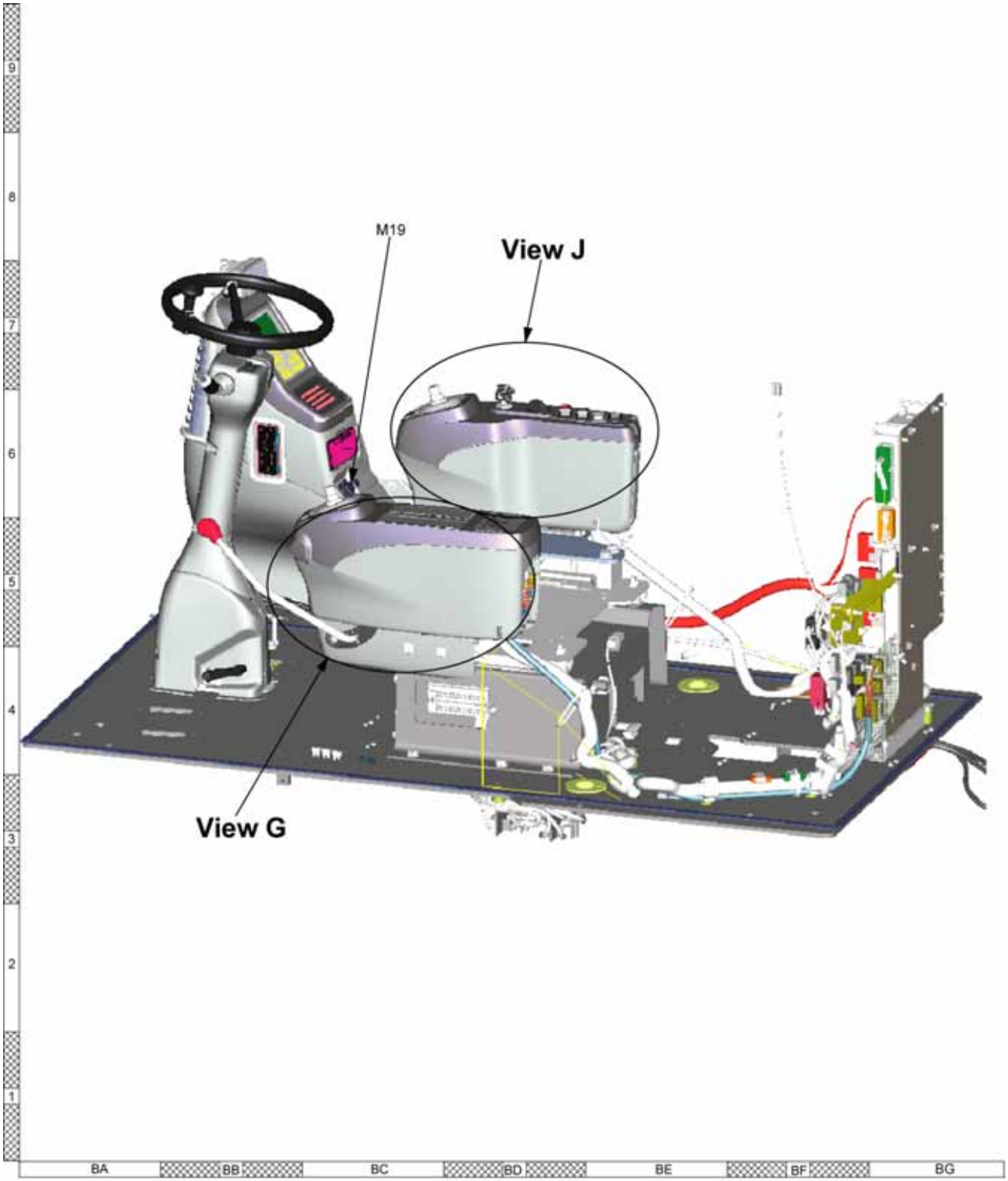


Operator Cab

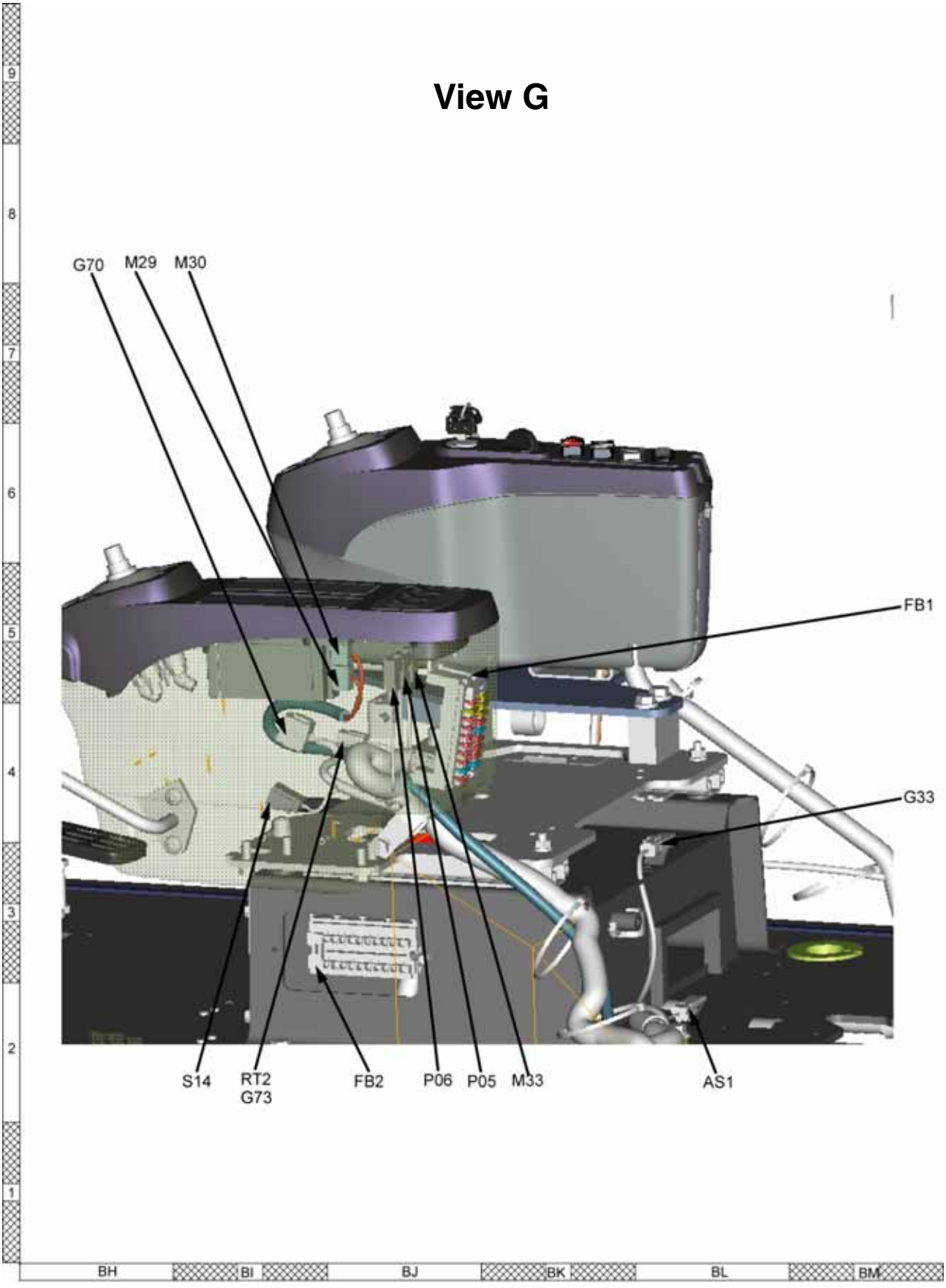



R11
R16
R10
C09
D02
D01
C03
C02
C01
R17
K19
N08
M45
M72
View L
R53
H08
H09
R20
View N
View H
View I

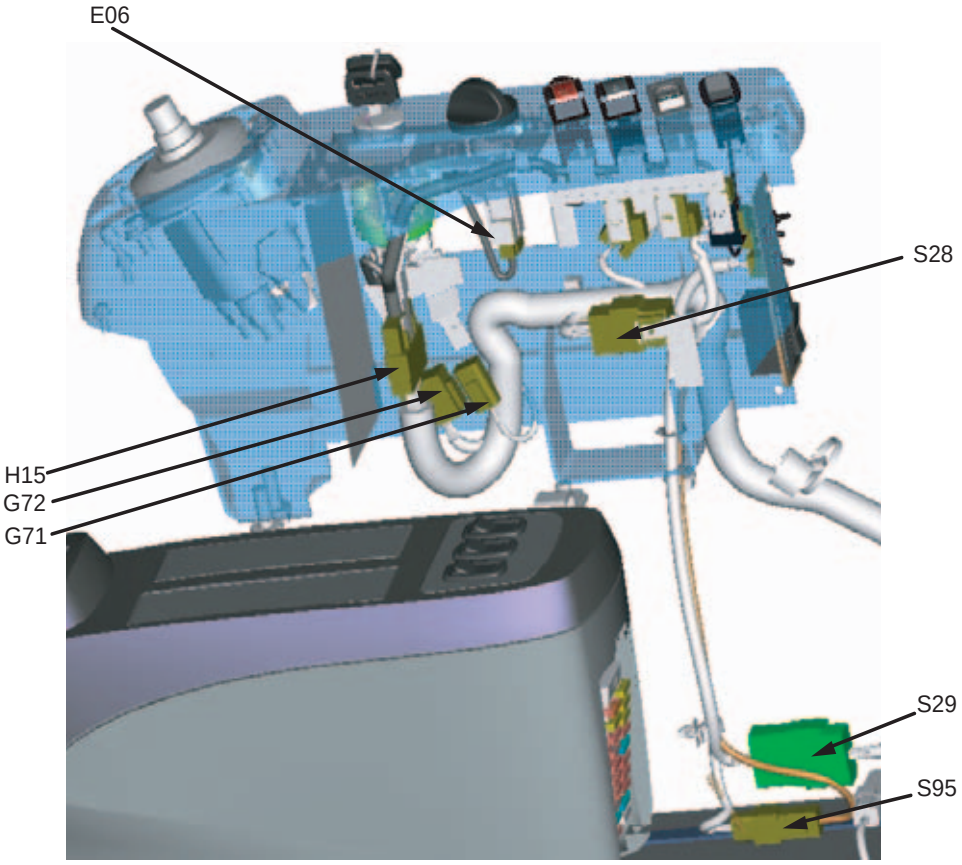
View H

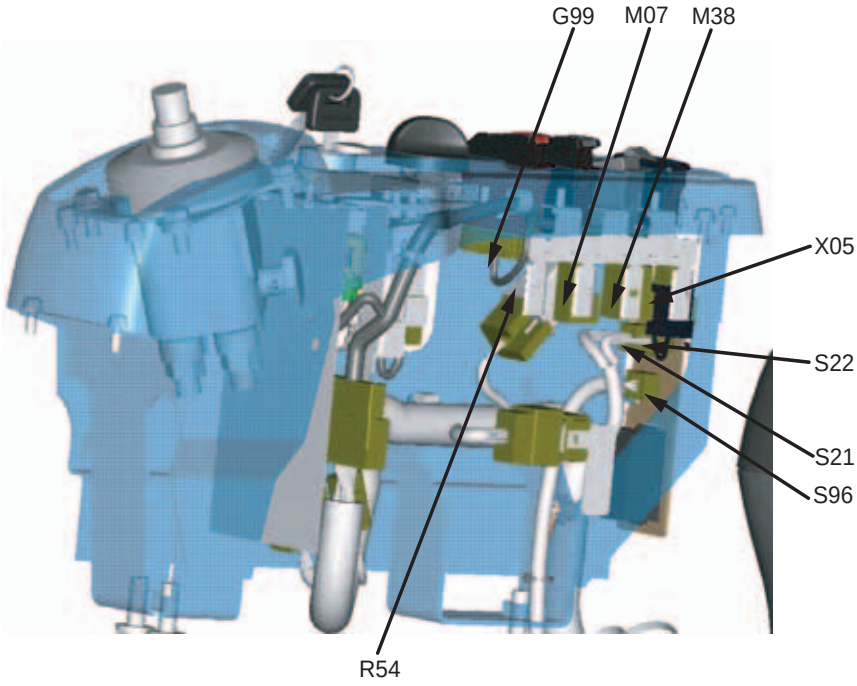


View G

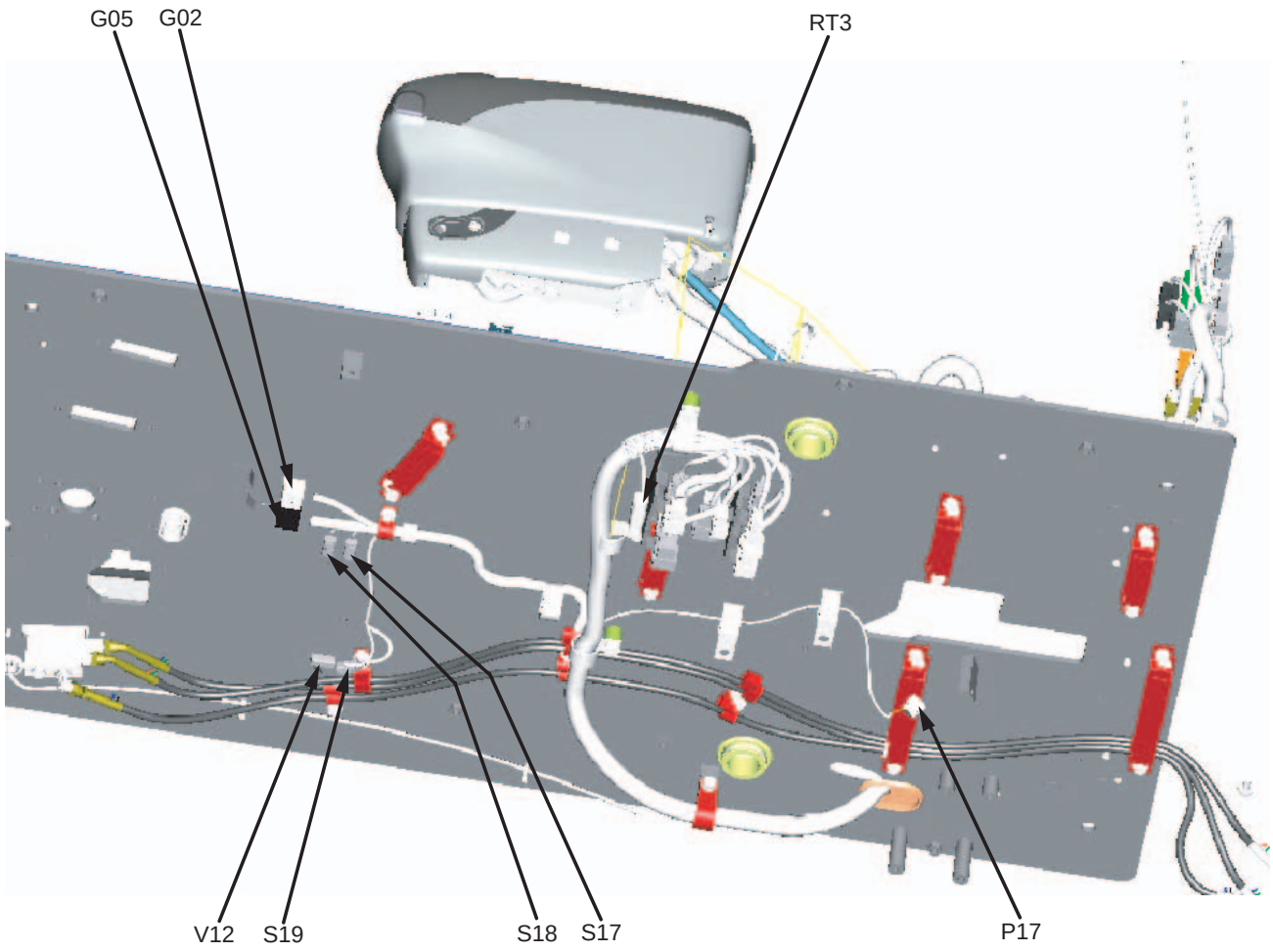

G70
M29
M30
FB1
G33
S14
RT2
G73
FB2
P06
P05
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BH
BI
BJ
BK
BL
BM

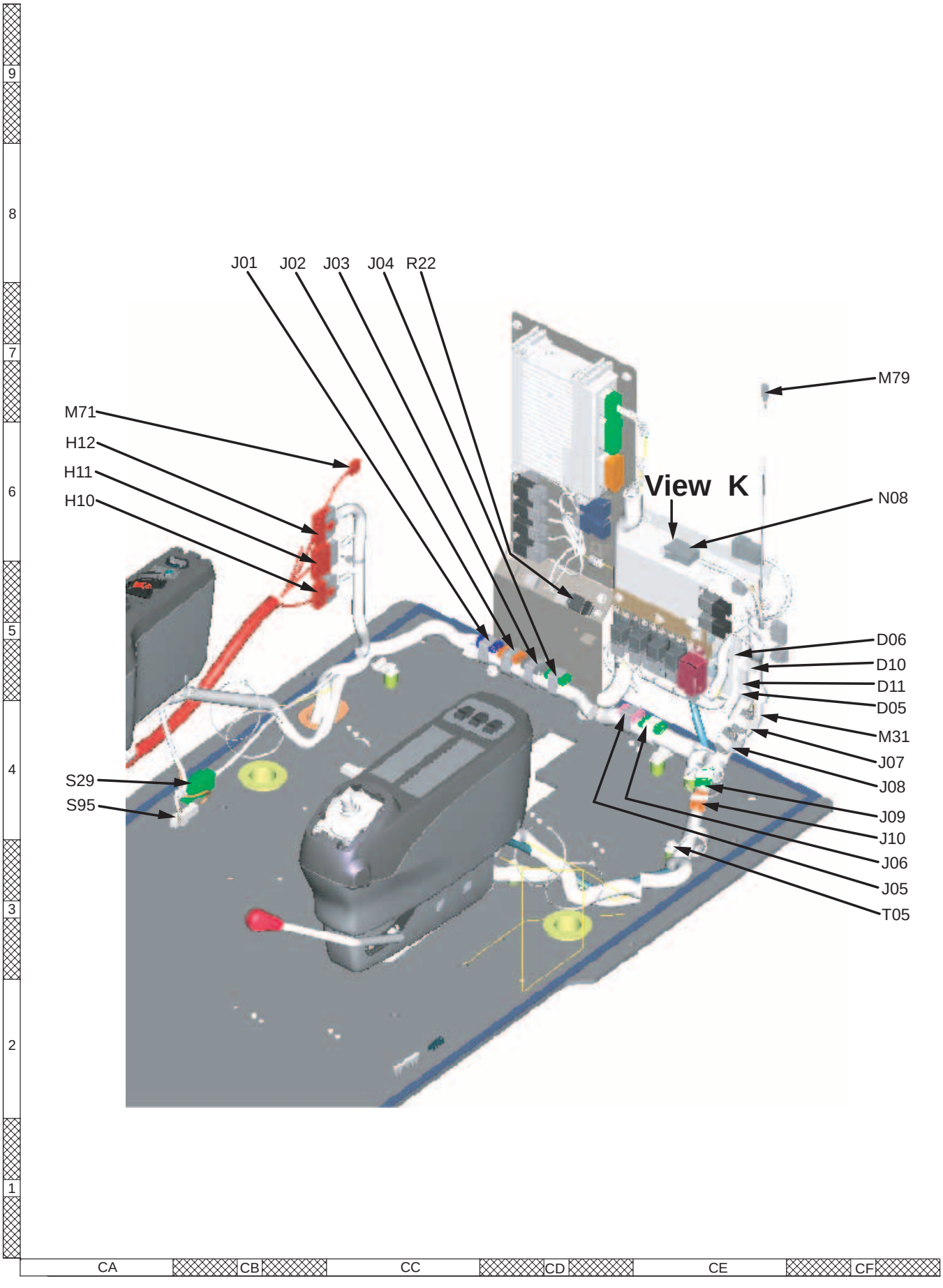
View J



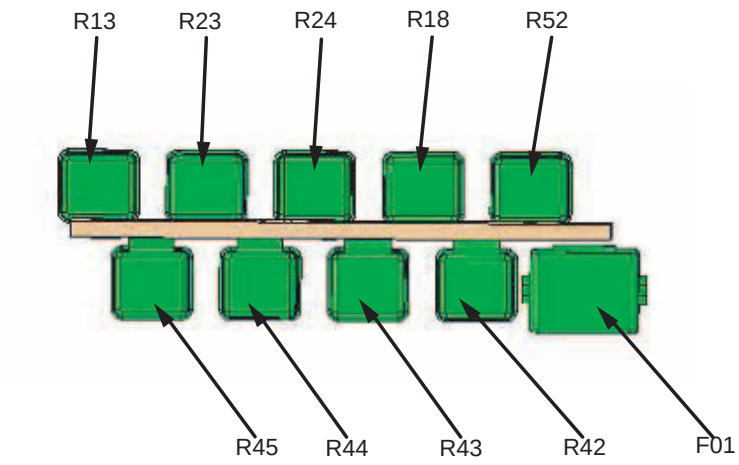


View I

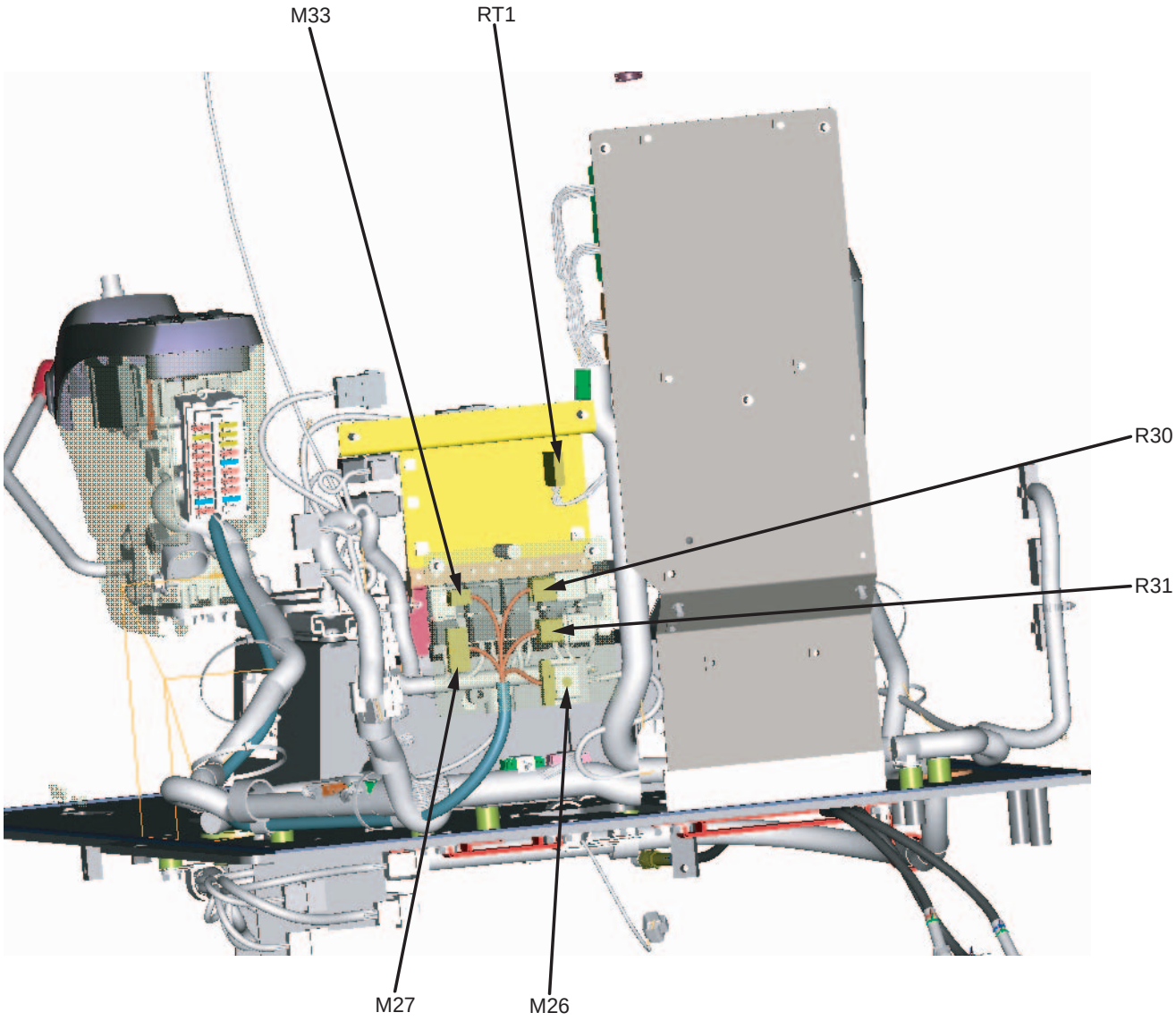



J01
J02
J03
J04
R22
M79
M71
H12
H11
H10
View K
N08
D06
D10
D11
D05
M31
J07
J08
J09
J10
J06
J05
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CB
CC
CD
CE
CF

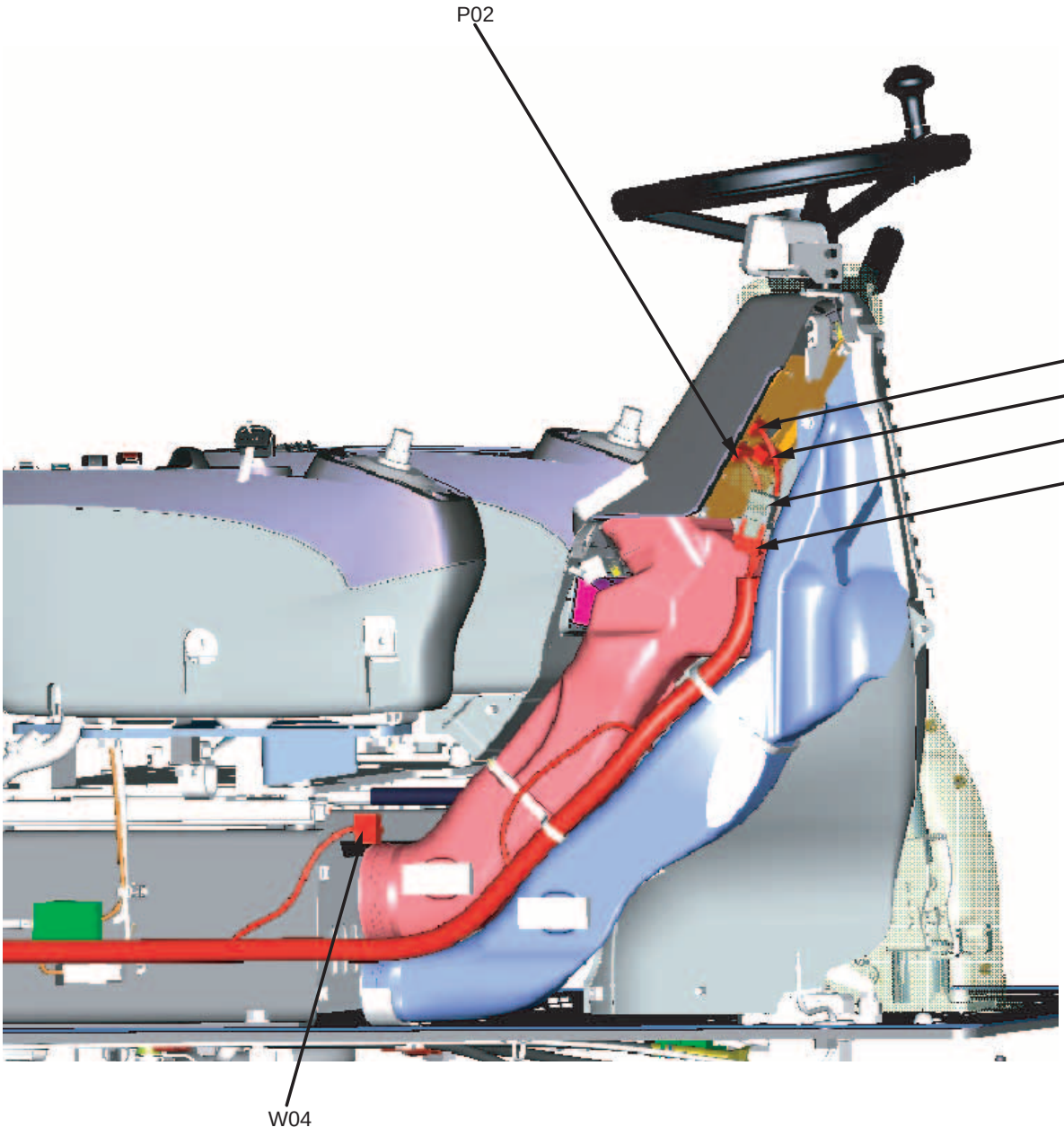
View K



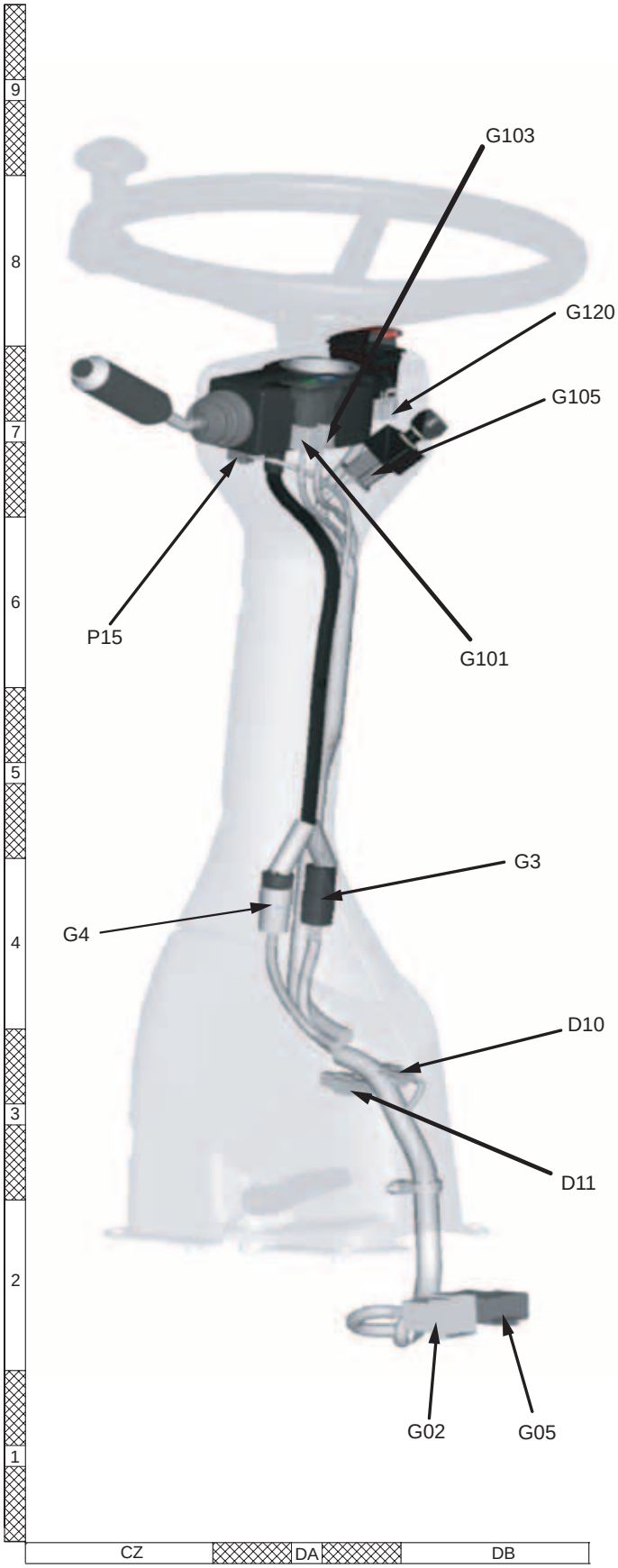
View L



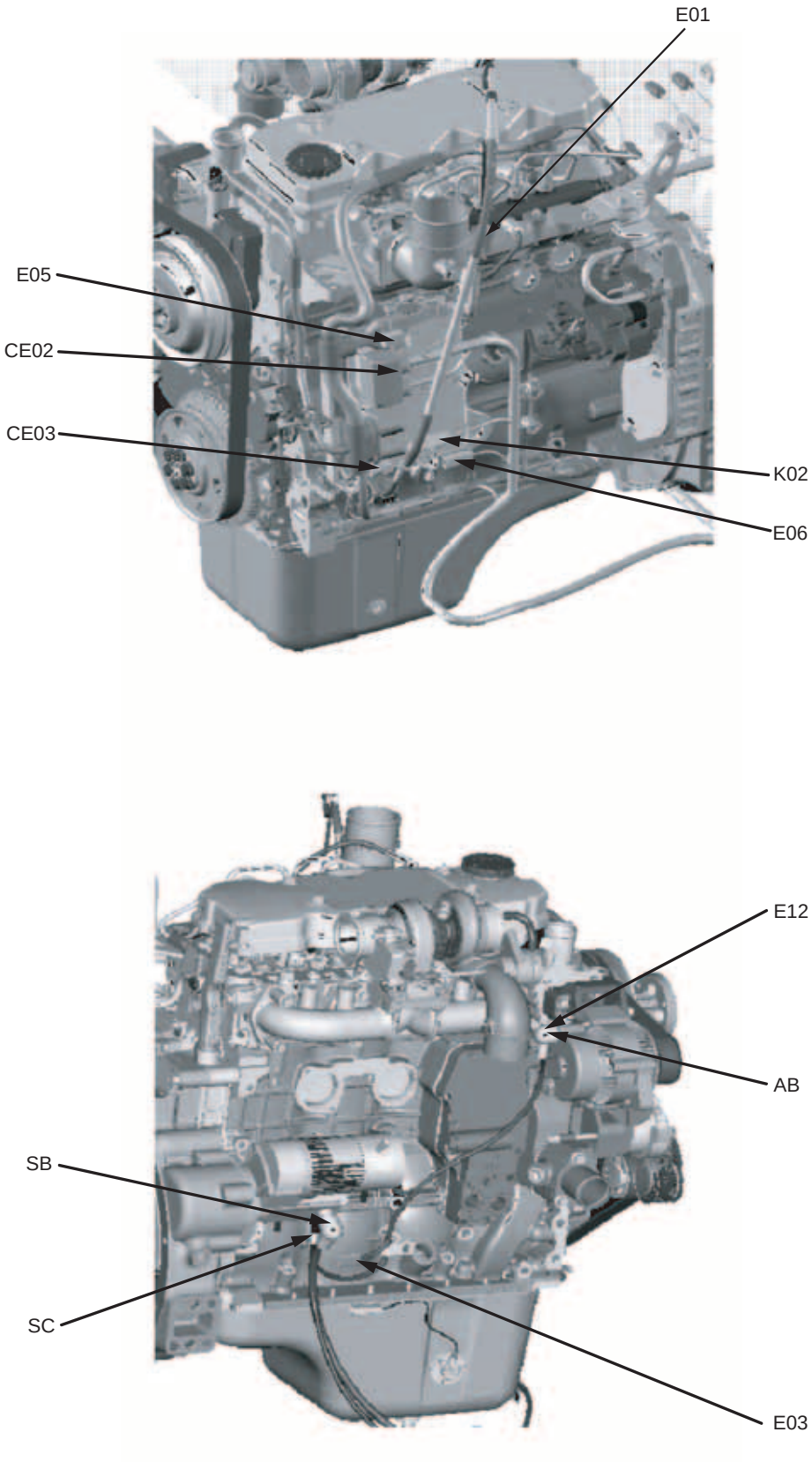
View N



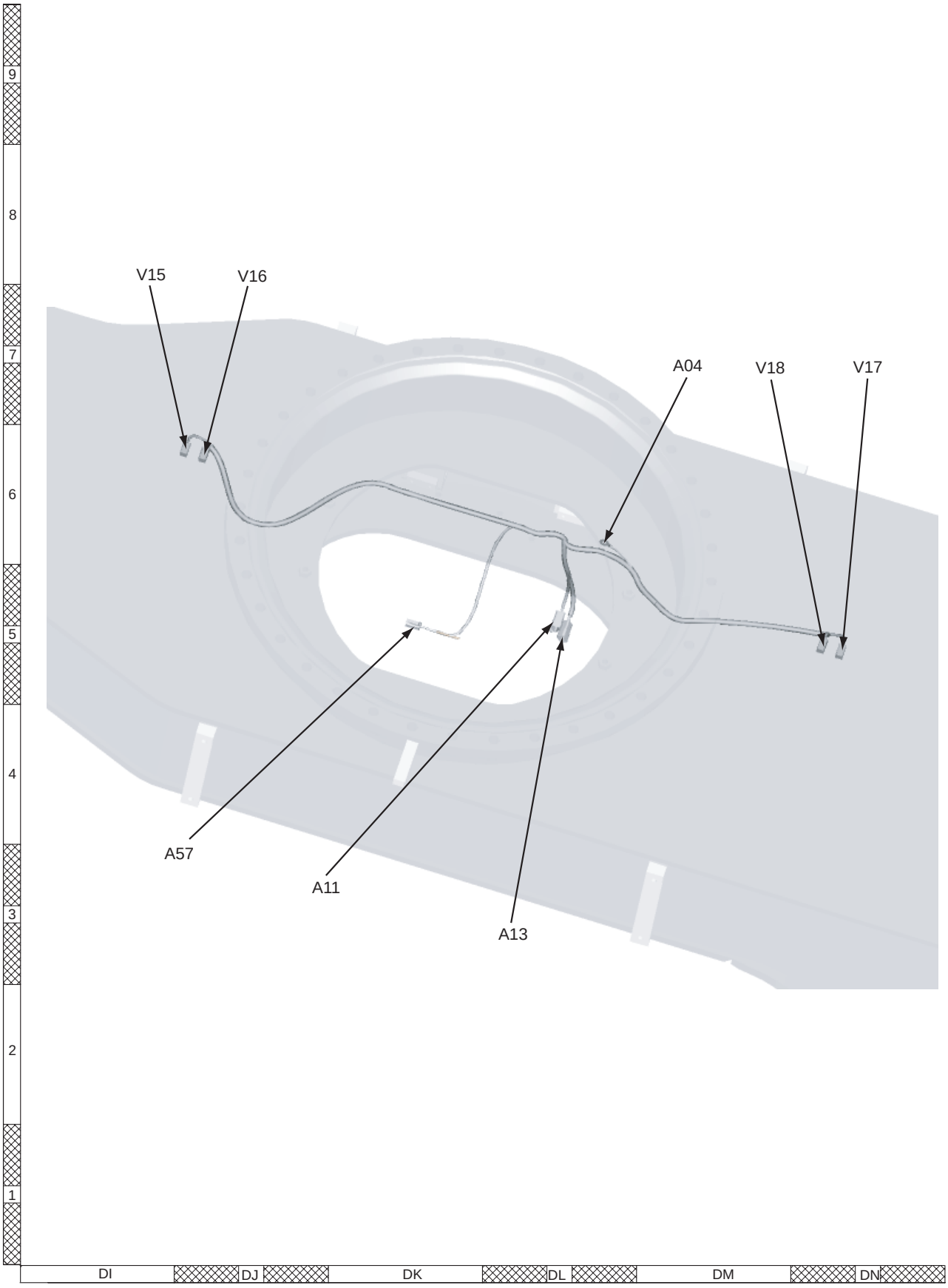
Steering Column



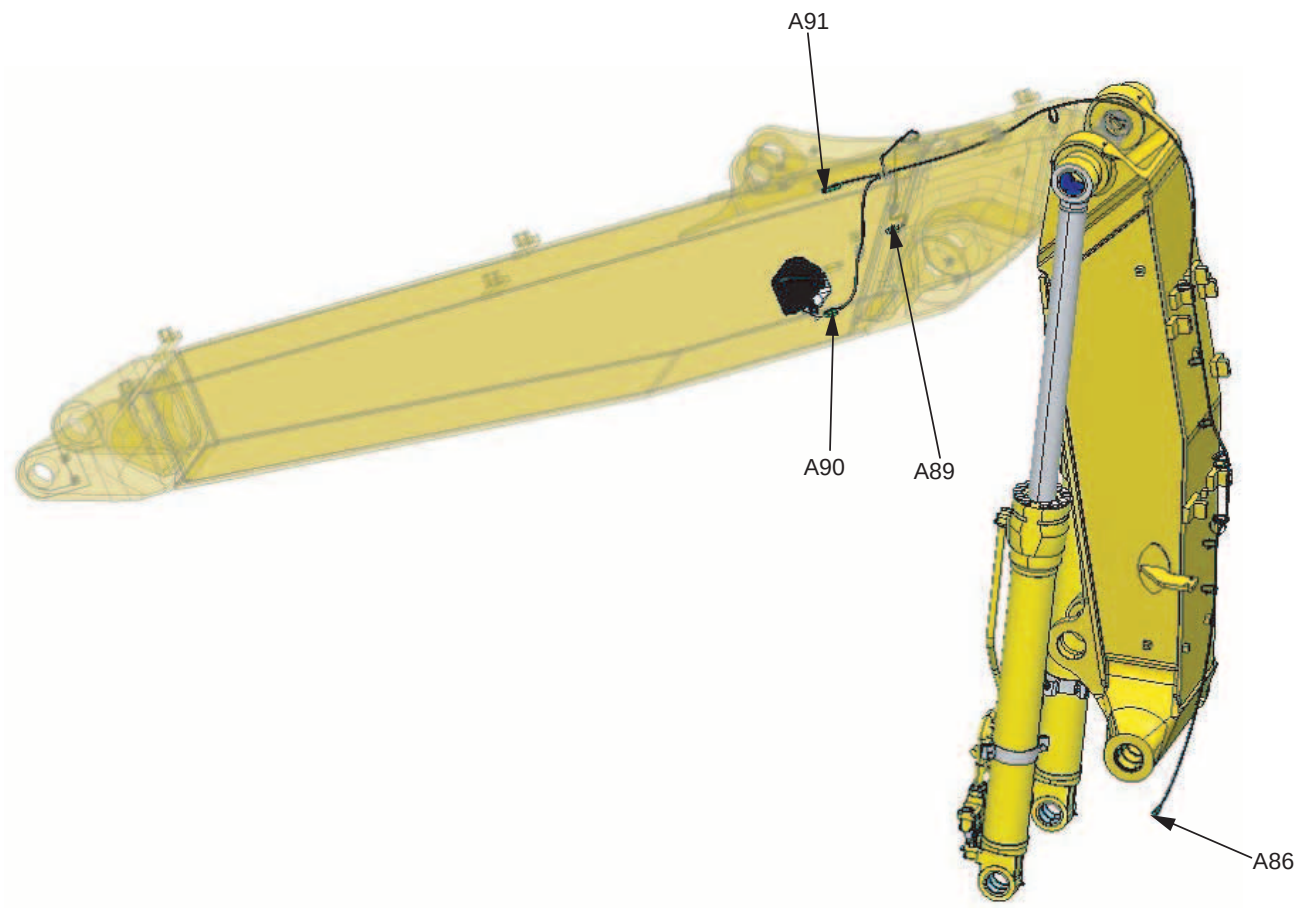
Engine



Undercarriage

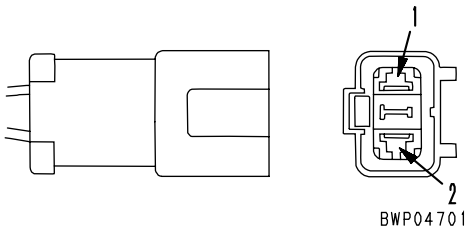
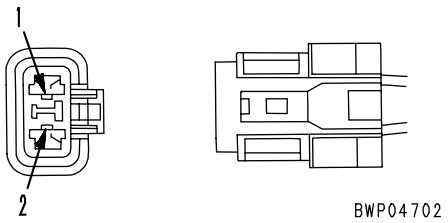
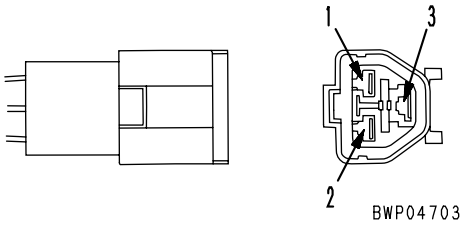
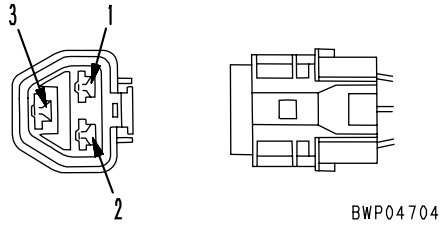
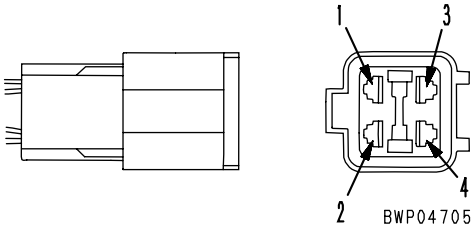
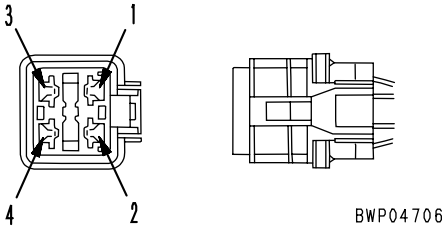


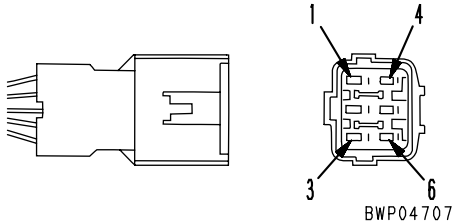
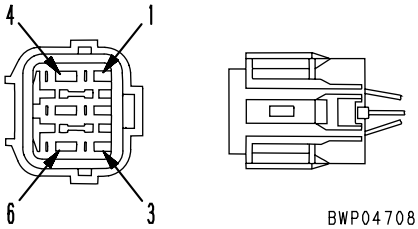
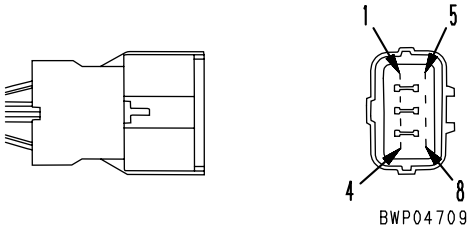
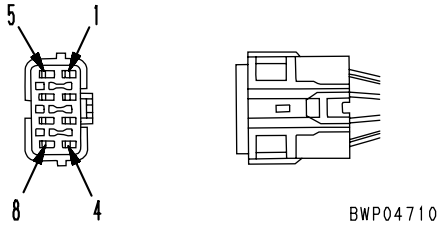
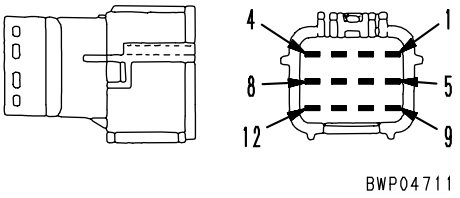
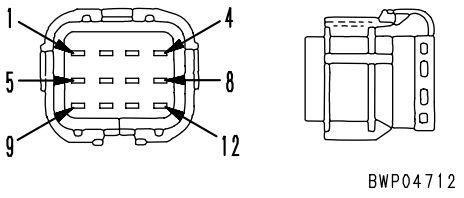
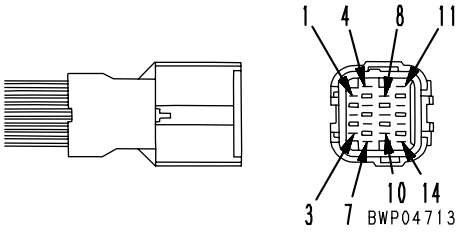
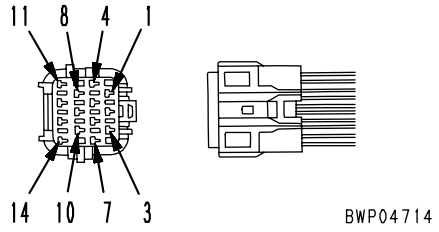
Work Equipment

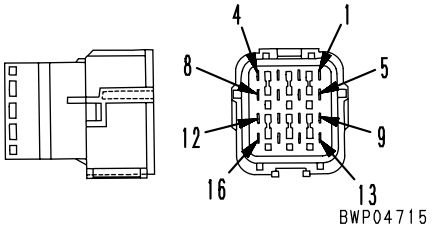
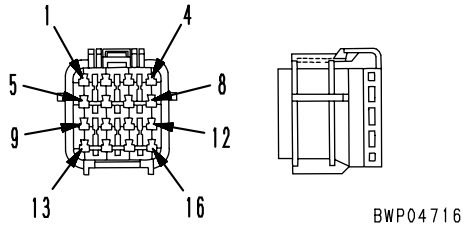


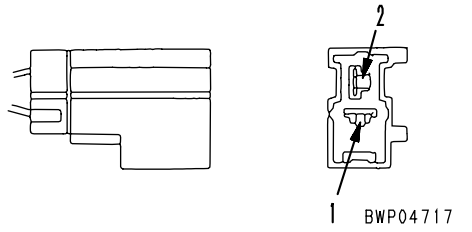
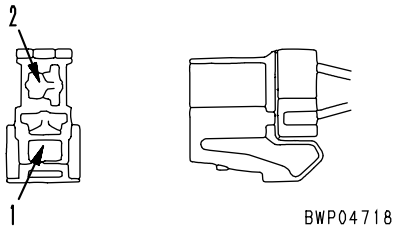
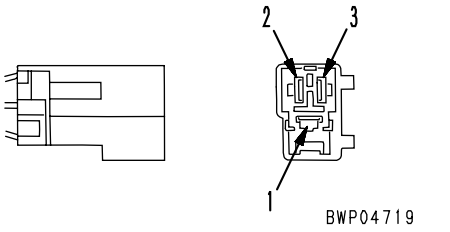
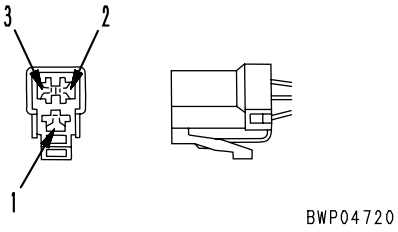
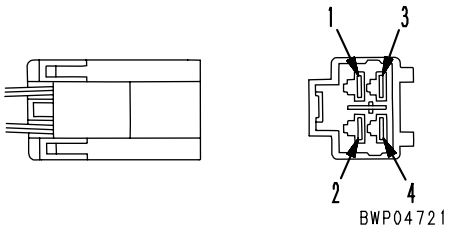
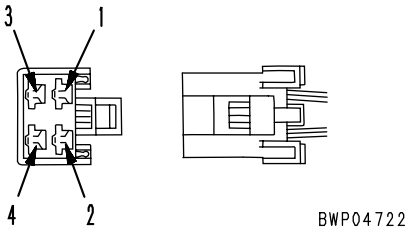
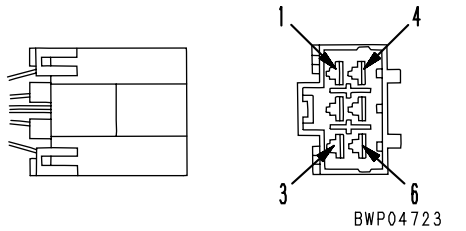
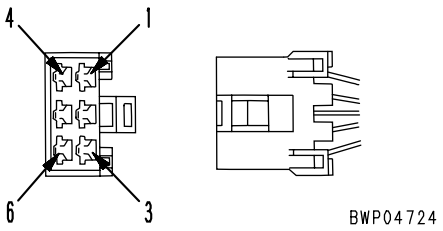
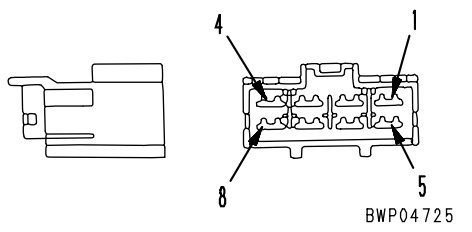
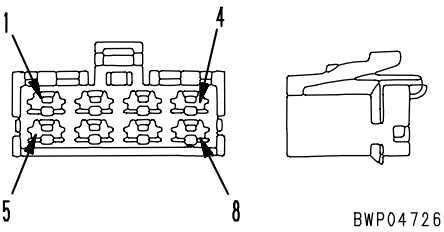
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

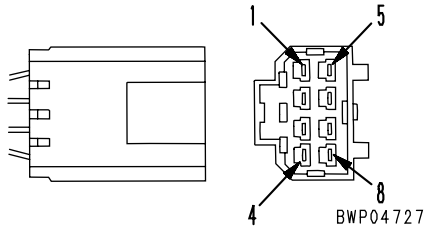
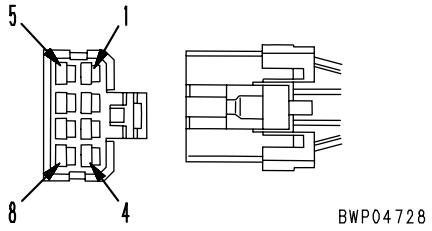
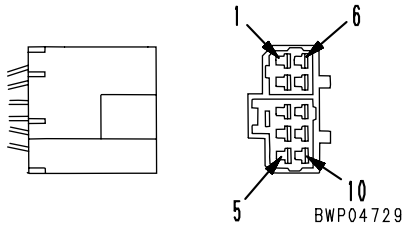
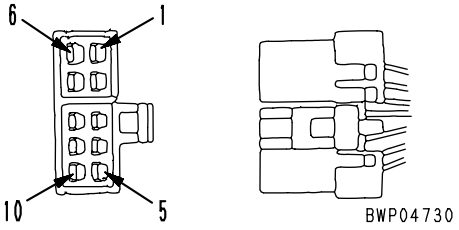
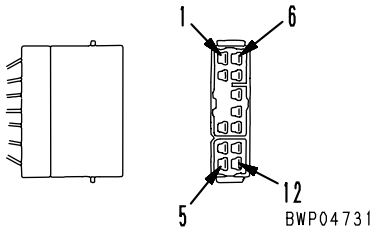
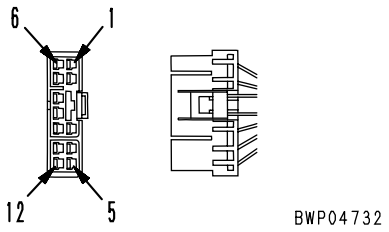
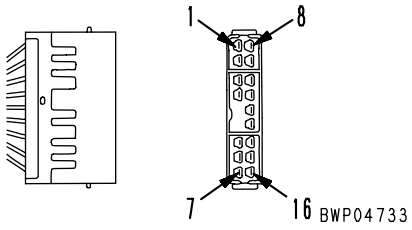
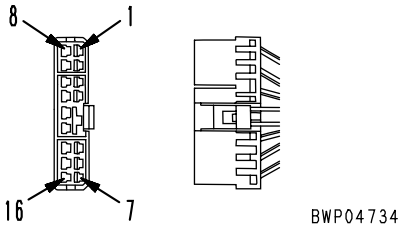
★ The terms male and female refer to the pins, while the terms male housing and female housing refer to the mating portion of the housing.

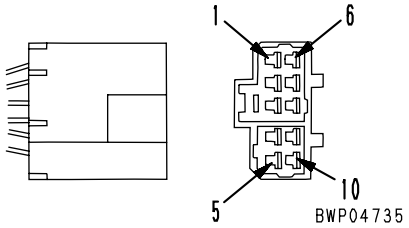
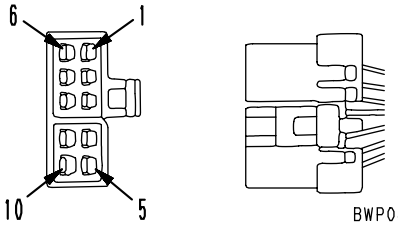
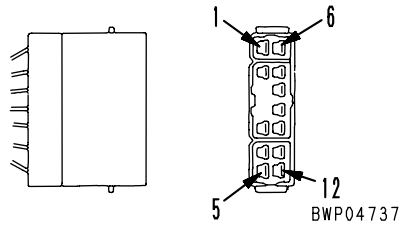
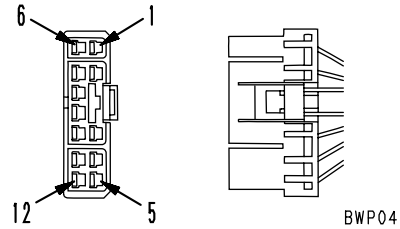
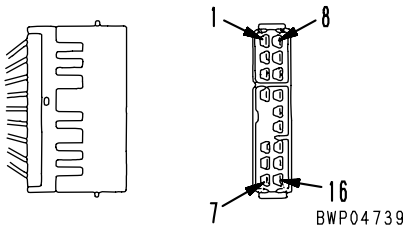
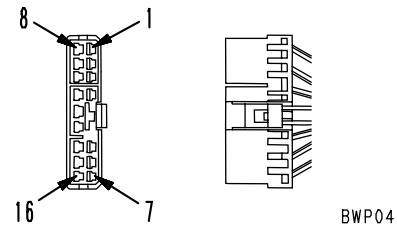
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<tr><td>Male (female housing)</td><td>Female (male housing)</td></tr>
<tr><td>1</td><td>Part No.: 08055-00181</td><td>Part No.: 08055-00191</td><td>799-601-7010</td></tr>
<tr><td rowspan="2">2</td><td> 
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</td><td rowspan="2">799-601-7020</td></tr>
<tr><td>Part No.: 08055-00282</td><td>Part No.: 08055-00292</td></tr>
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</td><td rowspan="2">799-601-7030</td></tr>
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</td><td rowspan="2">799-601-7040</td></tr>
<tr><td>Part No.: 08055-00481</td><td>Part No.: 08055-00491</td></tr>
<tr><td>—</td><td>Terminal part No.: 79A-222-3370
• Electric wire size: 0.85
• Grommet: Black
• Q’ty: 20</td><td>Terminal part No.: 79A-222-3390
• Electric wire size: 0.85
• Grommet: Black
• Q’ty : 20</td><td>—</td></tr>
<tr><td>—</td><td>Terminal part No.: 79A-222-3380
• Electric wire size: 2.0
• Grommet: Red
• Q’ty: 20</td><td>Terminal part No.: 79A-222-3410
• Electric wire size: 2.0
• Grommet: Red
• Q’ty: 20</td><td>—</td></tr>
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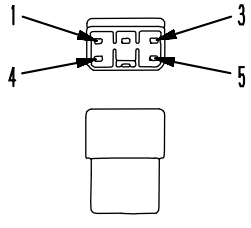
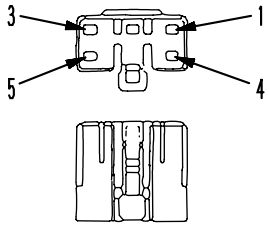
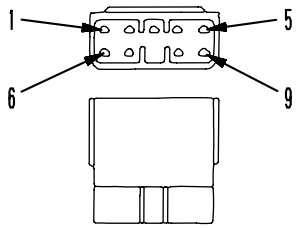
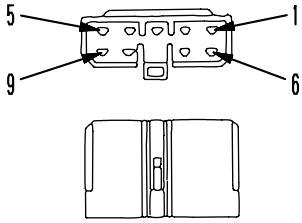
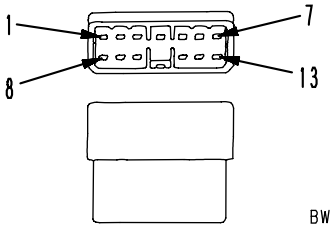
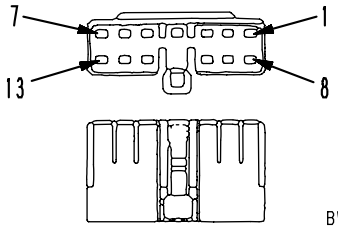
No.of pins	SWP type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
6			799-601-7050
	Part No.: 08055-10681	Part No.: 08055-10691	
8			799-601-7060
	Part No.: 08055-10881	Part No.: 08055-10891	
12			799-601-7310
	Part No.: 08055-11281	Part No.: 08055-11291	
14			799-601-7070
	Part No.: 08055-11481	Part No.: 08055-11491	

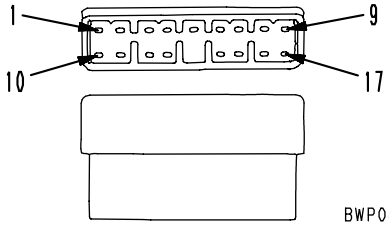
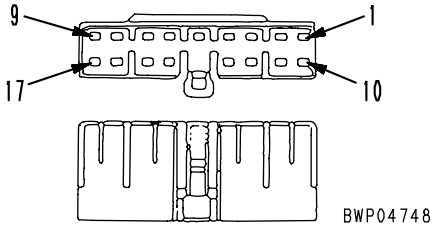
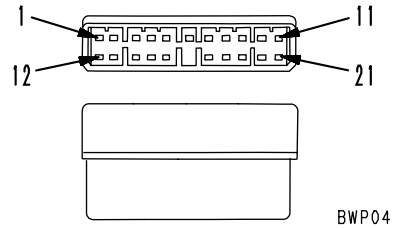
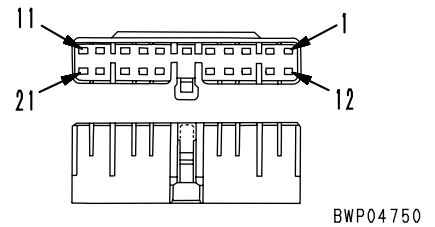
No. of pins	SWP type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
16			799-601-7320
	Part No.: 08055-11681	Part No.: 08055-11691	
—	Terminal part No.: • Electric wire size: 0.85 • Grommet: Black • Q'ty: 20	Terminal part No.: • Electric wire size: 0.85 • Grommet: Black •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

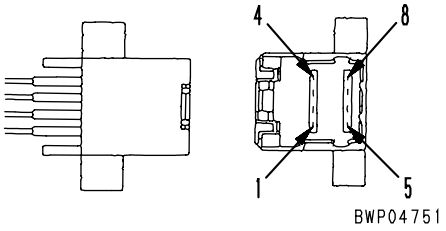
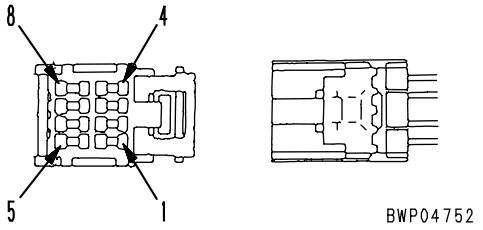
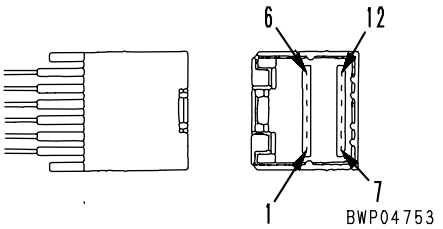
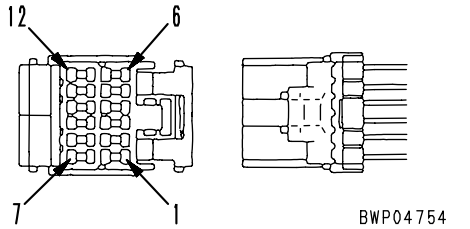
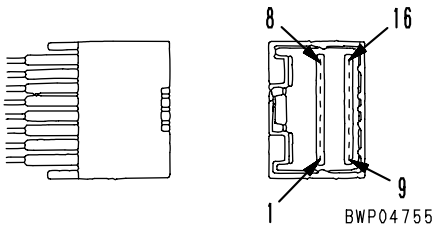
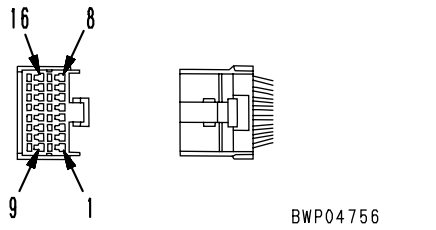
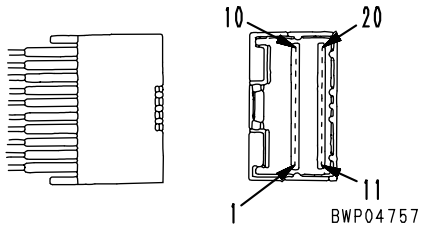
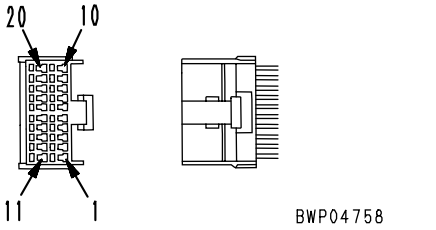
No.of pins	M type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
1	Part No.: 08056-00171	Part No.: 08056-00181	799-601-7080
2			799-601-7090
	Part No.: 08056-00271	Part No.: 08056-00281	
3			799-601-7110
	Part No.: 08056-00371	Part No.: 08056-00381	
4			799-601-7120
	Part No.: 08056-00471	Part No.: 08056-00481	
6			799-601-7130
	Part No.: 08056-00671	Part No.: 08056-00681	
8			799-601-7390
	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	

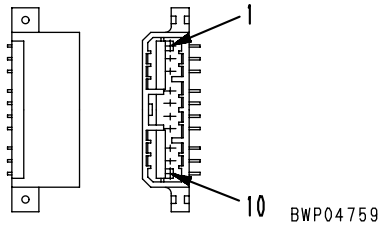
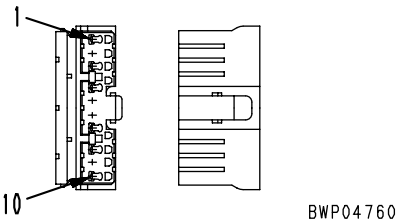
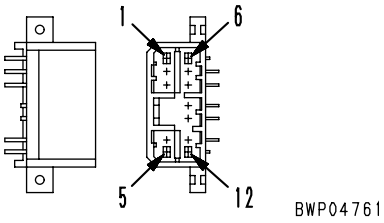
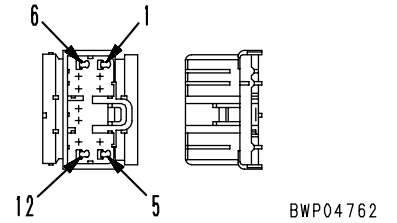
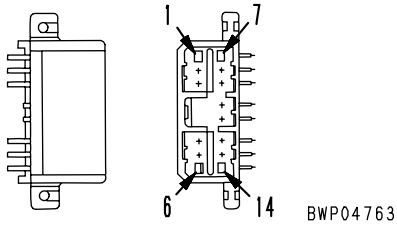
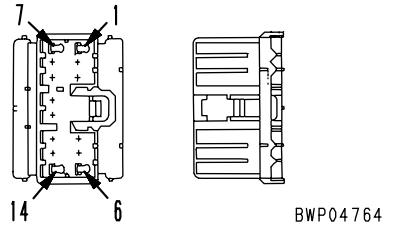
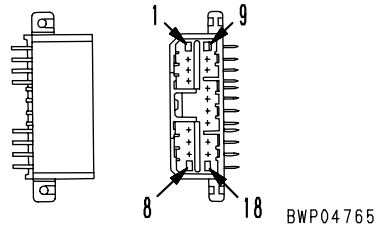
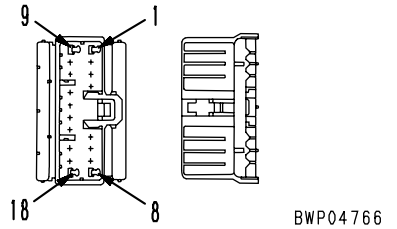
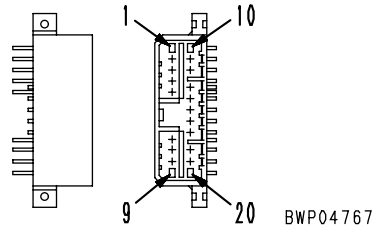
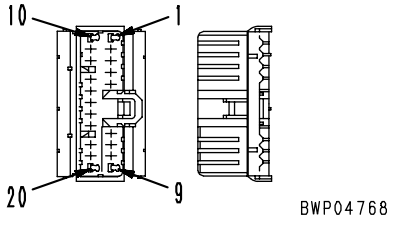
No.of pins	S type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10 (Blue)			—
	—	—	
12 (Blue)			799-601-7160
	Part No.: 08056-11272	Part No.: 08056-11282	
16 (Blue)			799-601-7170
	Part No.: 08056-11672	Part No.: 08056-11682	

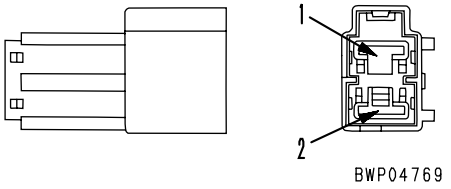
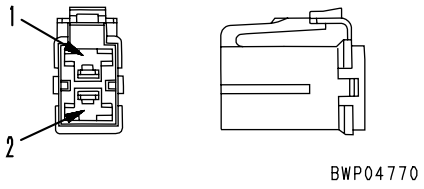
No.of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
7	Body part No.: 79A-222-2640 (Q'ty: 5)	Body part No.: 79A-222-2630 (Q'ty: 5)	—
11	Body part No.: 79A-222-2680 (Q'ty: 5)	Body part No.: 79A-222-2670 (Q'ty: 5)	—
5	 BWP04741	 BWP04742	799-601-2710
	Body part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

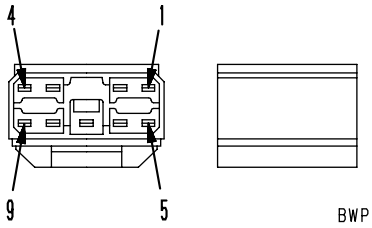
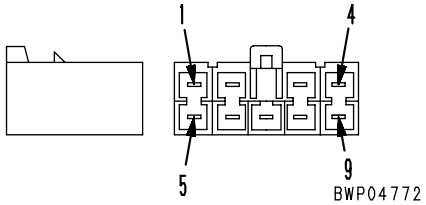
No.of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
17			799-601-2730
	Body part No.: 79A-222-2730 (Q'ty: 2)	Body part No.: 79A-222-2720 (Q'ty: 2)	
21			799-601-2740
	Body part No.: 79A-222-2750 (Q'ty: 2)	Body part No.: 79A-222-2740 (Q'ty: 2)	
	Terminal part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

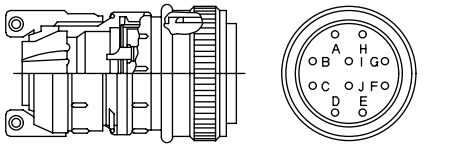
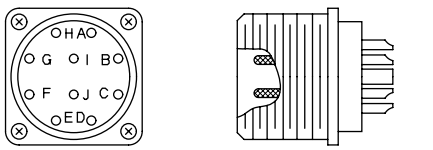
No.of pins	AMP040 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8			799-601-7180
	—	Housing part No.: 79A-222-3430 (Q'ty: 5)	
12			799-601-7190
	—	Housing part No.: 79A-222-3440 (Q'ty: 5)	
16			799-601-7210
	—	Housing part No.: 79A-222-3450 (Q'ty: 5)	
20			799-601-7220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

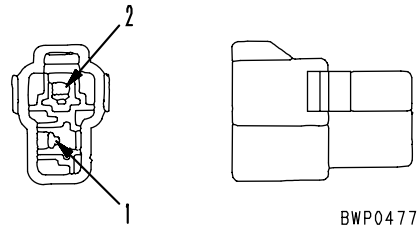
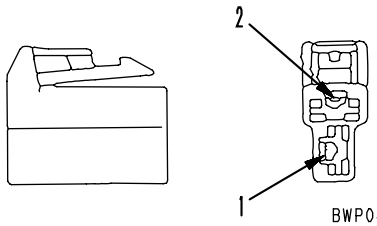
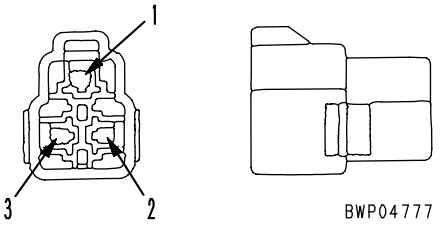
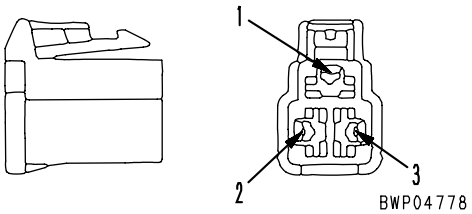
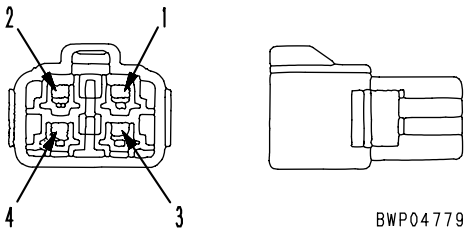
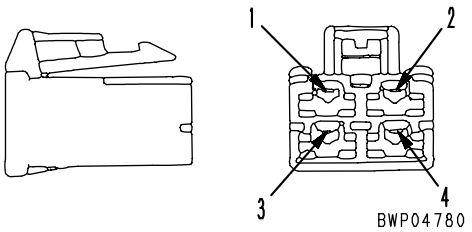
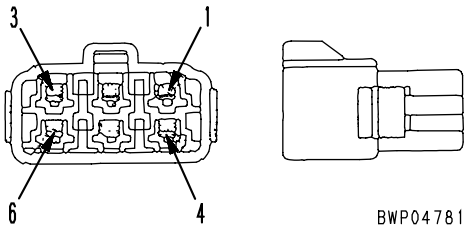
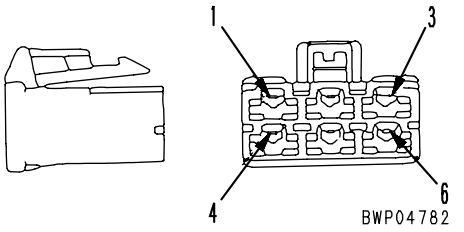
H Terminal part No.: 79A-222-3470 (No relation with number of pins)

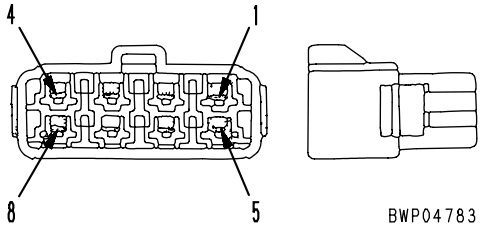
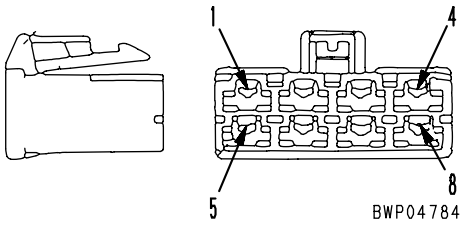
No.of pins	AMP070 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10			799-601-7510
	—	Part No.: 08195-10210	
12			799-601-7520
	—	Part No.: 08195-12210	
14			799-601-7530
	—	Part No.: 08195-14210	
18			799-601-7540
	—	Part No.: 08195-18210	
20			799-601-7550
	—	Part No.: 08195-20210	

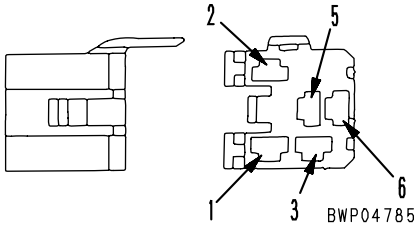
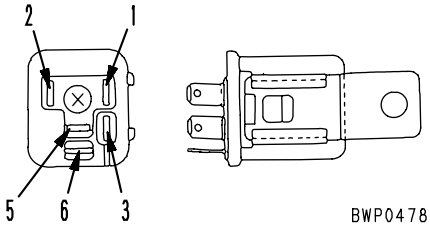
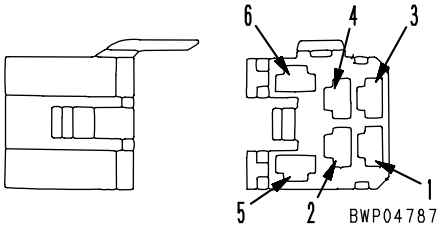
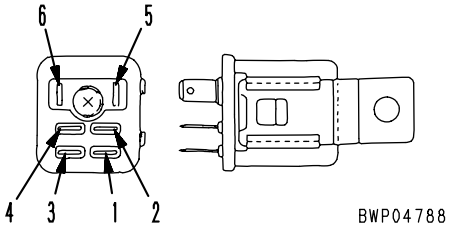
No.of pins	L type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2	 BWP04769	 BWP04770	—
	—	—	

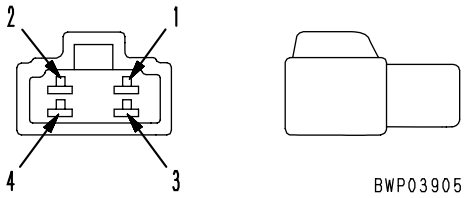
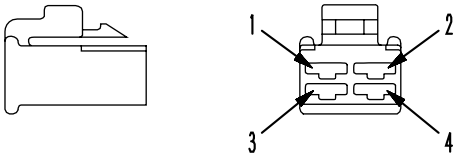
No.of pins	Connector for PA		
	Male (female housing)	Female (male housing)	T-adapter Part No.
9	 BWP04771	 BWP04772	—
	—	—	

No.of pins	Bendix MS connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10	 BWP04773	 BWP04774	799-601-3460
	—	—	

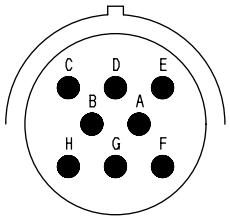
No.of pins	KES 1 (Automobile) connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2			—
	Part No.: 08027-10210 (Natural colour) 08027-10220 (Black)	Part No.: 08027-10260 (Natural colour) 08027-10270 (Black)	
3			—
	Part No.:08027-10310	Part No.:08027-10360	
4			—
	Part No.: 08027-10410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

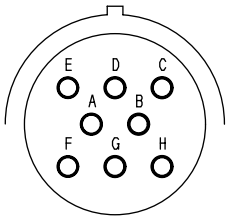
No.of pins	KES 1 (Automobile) connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8			—
	Part No.: 08027-10810 (Natural colour) 08027-10820 (Black)	Part No.: 08027-10860 (Natural colour) 08027-10870 (Black)	

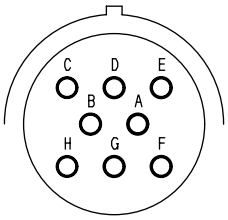
No.of pins	Connector for relay (Socket type)		
	Male (female housing)	Female (male housing)	T-adapter Part No.
5			799-601-7360
	—	—	
6			799-601-7370
	—	—	

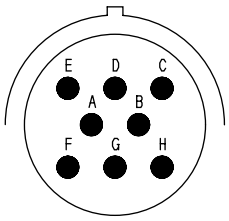
No.of pins	F type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
4	 BWP03905	 BWP03906	—
	—	—	

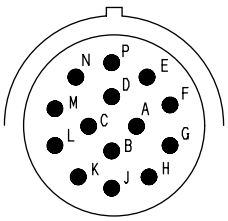
[THE PIN NO. IS ALSO MARKED ON THE CONNECTOR (ELECTRIC WIRE INSERTION END)]

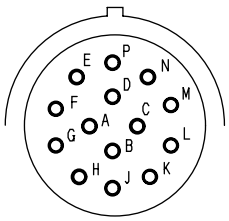
<table>
<tr><td rowspan="2">Type (shell size code)</td><td colspan="2">HD30 Series connector</td><td rowspan="2">T-adapter Part No.</td></tr>
<tr><td>Body (plug)</td><td>Body (receptacle)</td></tr>
<tr><td rowspan="4">18-8 (1)</td><td>Pin (male terminal)</td><td>Pin (female terminal)</td><td rowspan="2">799-601-9210</td></tr>
<tr><td> 

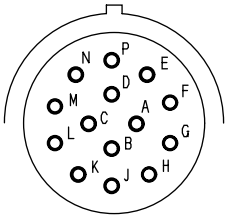
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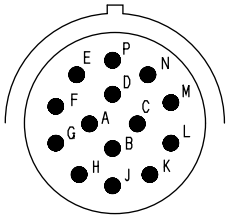
BWP05002</td></tr>
<tr><td>Part No.: 08191-11201, 08191-11202, 08191-11205, 08191-11206</td><td>Part No.: 08191-14101, 08191-14102, 08191-14105, 08191-14106</td></tr>
<tr><td>Pin (female terminal)</td><td>Pin (male terminal)</td><td rowspan="2">799-601-9210</td></tr>
<tr><td> 

BWP05003</td><td> 

BWP05004</td></tr>
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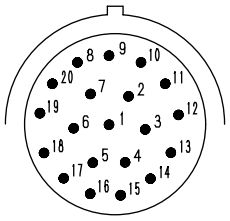
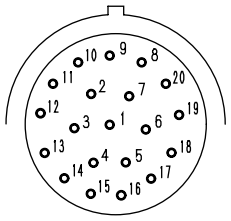
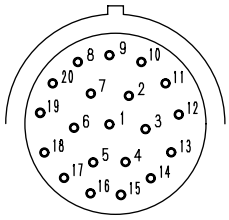
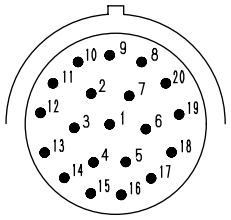
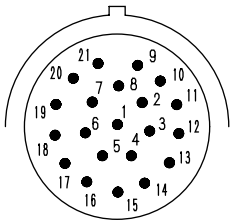
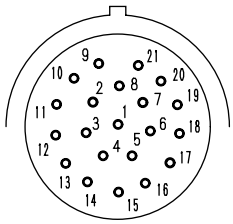
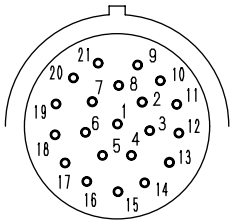
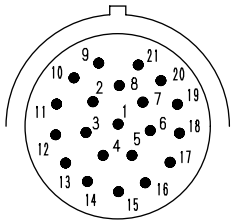
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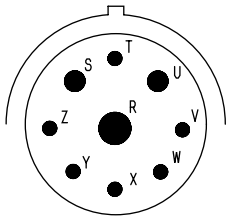
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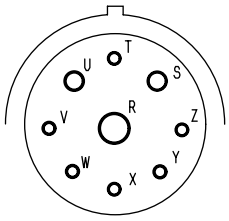
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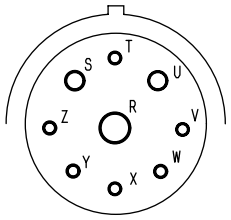
[THE PIN NO. IS ALSO MARKED ON THE CONNECTOR (ELECTRIC WIRE INSERTION END)]

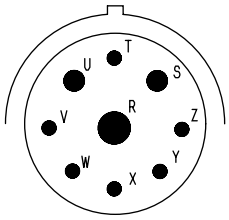
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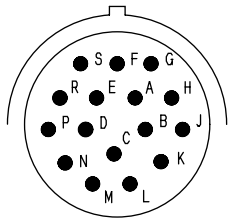
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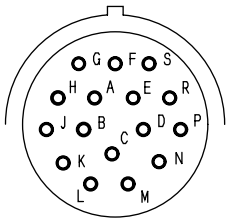
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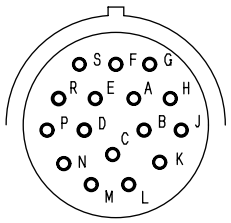
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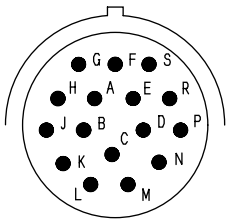
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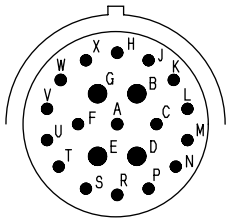
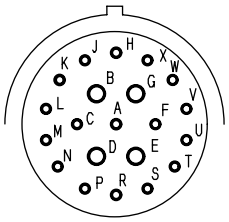
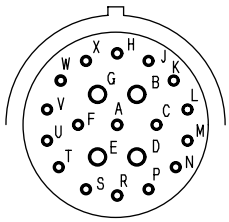
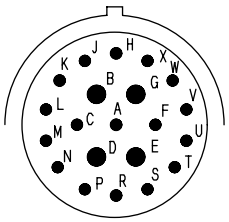
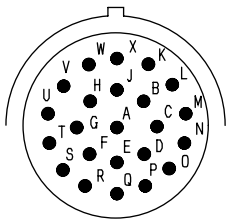
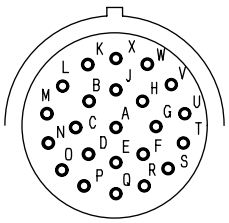
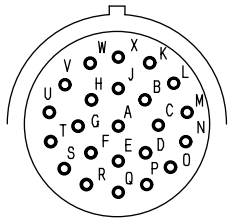
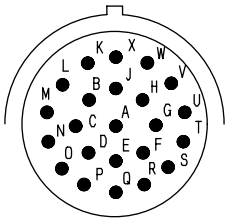
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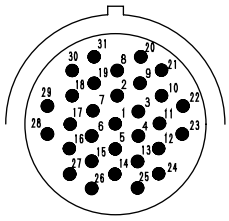
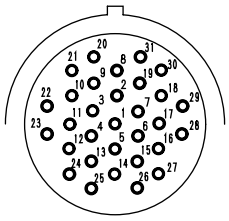
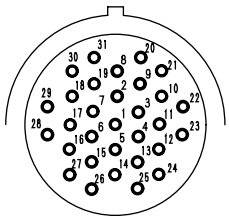
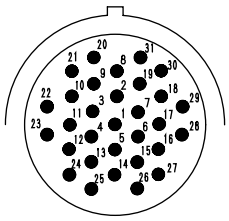
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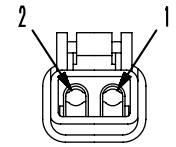
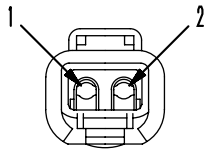
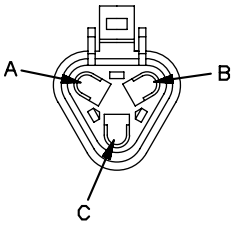
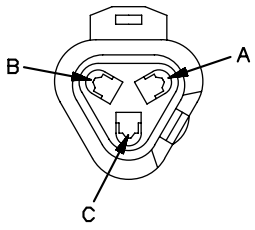
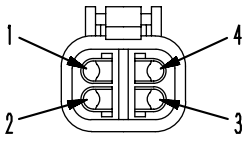
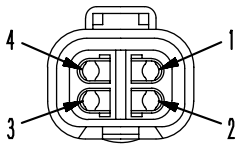
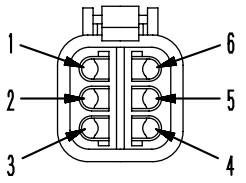
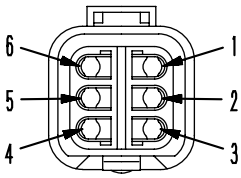
[THE PIN NO. IS ALSO MARKED ON THE CONNECTOR (ELECTRIC WIRE INSERTION END)]

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<tr><td>Body (plug)</td><td>Body (receptacle)</td></tr>
<tr><td rowspan="5">24-21 (7)</td><td>Pin (male terminal)</td><td>Pin (female terminal)</td><td rowspan="3">799-601-9270</td></tr>
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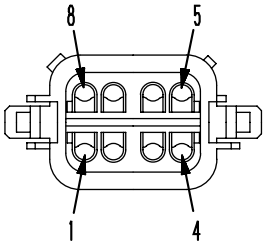
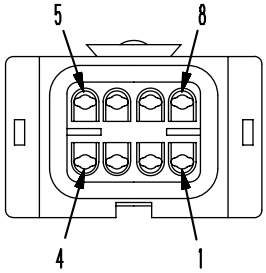
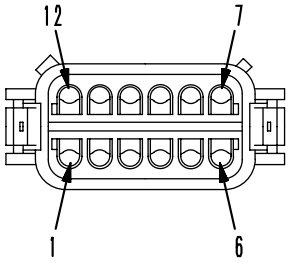
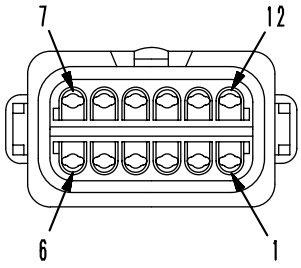
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<tr><td>Part No.: 08191-92203, 08191-92204, 08191-92205, 08191-92206</td><td>Part No.: 08191-93103, 08191-93104, 08191-93105, 08191-93106</td></tr>
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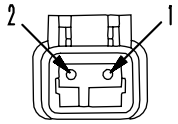
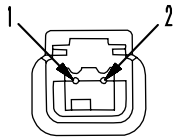
[THE PIN NO. IS ALSO MARKED ON THE CONNECTOR (ELECTRIC WIRE INSERTION END)]

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)	

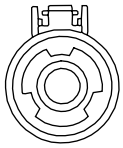
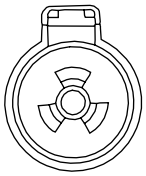
[THE PIN NO. IS ALSO MARKED ON THE CONNECTOR (ELECTRIC WIRE INSERTION END)]

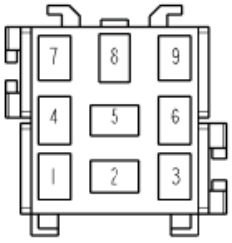
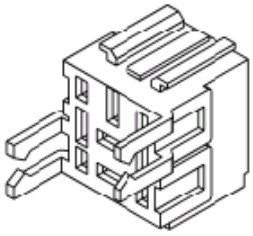
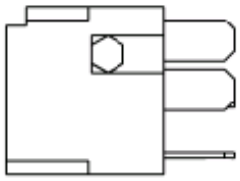
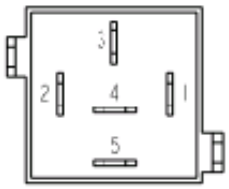
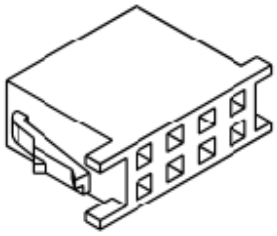
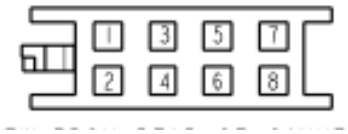
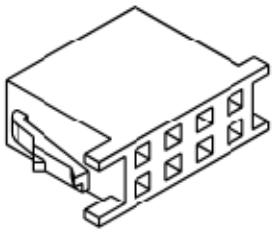
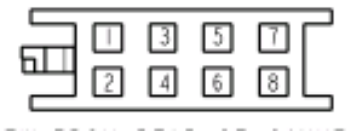
No.of pins	DT Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
8	 BWP05045	 BWP05046	8GR: 799-601-9060 8B: 799-601-9070 8G: 799-601-9080 8BR: 799-601-9090
	Part No.: 08192-1820☐ (normal type) 08192-2820☐ (fine wire type)	Part No.: 08192-1810☐ (normal type) 08192-2810☐ (fine wire type)	
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)	

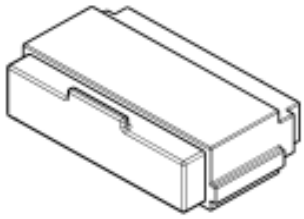
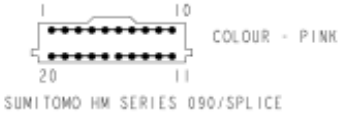
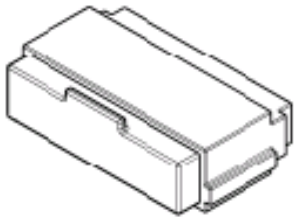
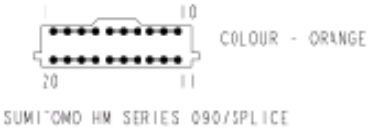
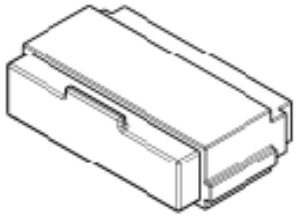
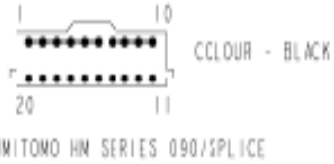
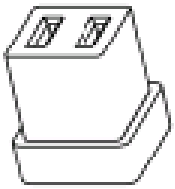
[THE PIN NO. IS ALSO MARKED ON THE CONNECTOR (ELECTRIC WIRE INSERTION END)]

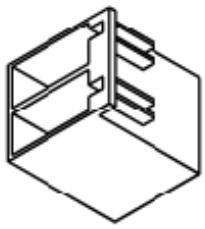
No.of pins	DTM Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2	 BWP05049	 BWP05050	799-601-9010
	Part No.: 08192-02200	Part No.: 08192-02100	

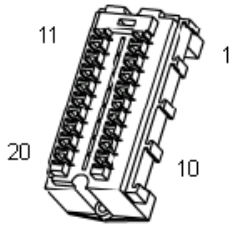
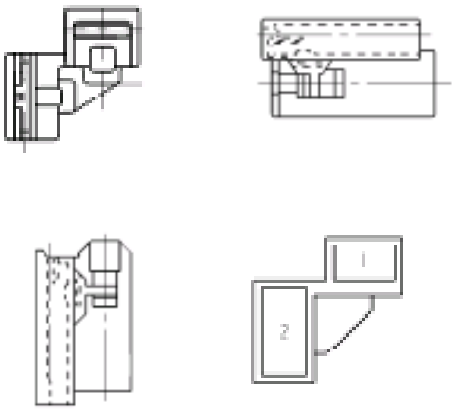
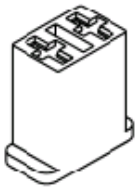
[THE PIN NO. IS ALSO MARKED ON THE CONNECTOR (ELECTRIC WIRE INSERTION END)]

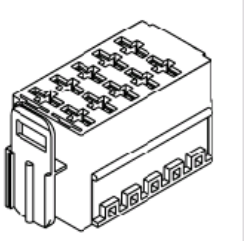
No.of pins	DTHD Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2	 BWP05051	 BWP05052	—
	Part No.: 08192-31200 (Contact size#12) 08192-41200 (Contact size #8) 08192-51200 (Contact size #4)	Part No.: 08192-31100 (Contact size#12) 08192-41100 (Contact size #8) 08192-51100 (Contact size #4)	

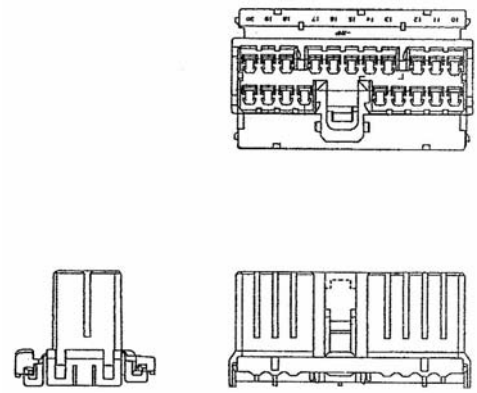
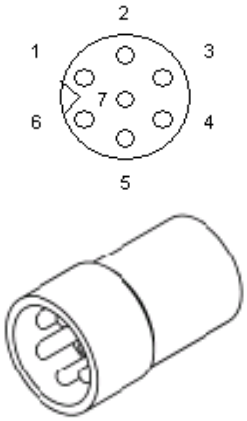
No.of pins	Miscellaneous connectors	
	Body (plug)	Body (receptacle)
9		
	Part No.: 20K-06-31960	Part No.:
5		
	Part No.: 20K-06-32130	Part No.:
8		
	Part No.: 20K-06-32170	Part No.:
8		
	Part No.: 20K-06-K32160	Part No.:

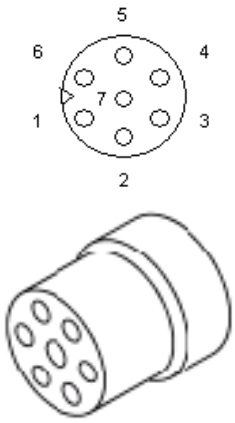
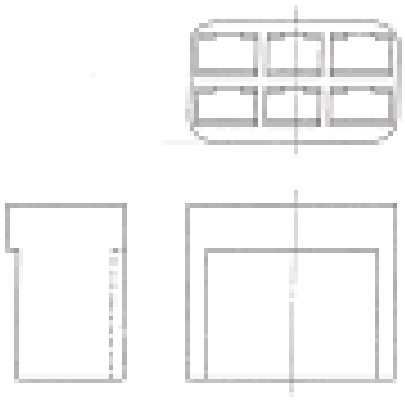
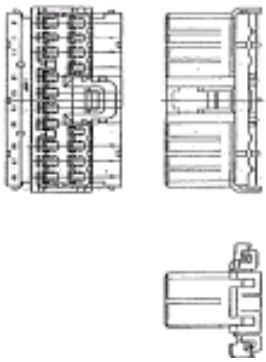
No.of pins	Miscellaneous connectors	
	Body (plug)	Body (receptacle)
20		
	Part No.: 20K-06-31460	Part No.:
20		
	Part No.: 20K-06-31470	Part No.:
20		
	Part No.: 20K-06-31450	Part No.:
2		
	Part No.:	Part No.:

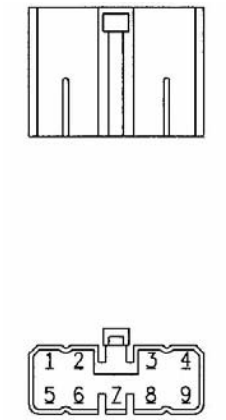
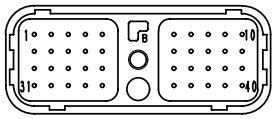
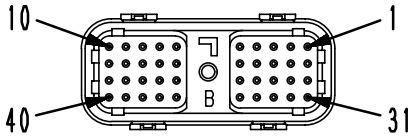
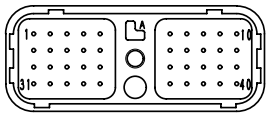
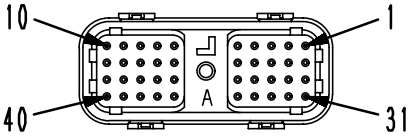
2		
	Part No.: 20K-06-32380	Part No.:

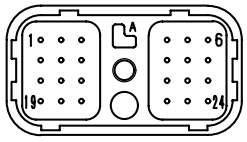
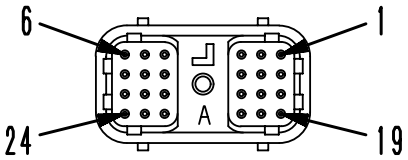
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	Part No.: 20K-06-32230	Part No.:
		
	Part No.: 198-Z11-2650	Part No.:
2		
	Part No.: 20K-06-31820	Part No.:

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.:

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.: 7821-93-3120	

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		●		●	●						●	●		●					
799-601-3100	T-box (for MS)	37						●													
799-601-3200	T-box (for MS)	37						●													
799-601-3300	T-box (for ECONO)	24								●											
799-601-3360	• Plate for MS (24-pin)									●											
799-601-3370	• Plate for MS (17-pin)									●											
799-601-3380	• Plate for MS (14-pin)									●											
799-601-3410	Adapter for BENDIX (MS)	24	MS-24P							●	●										
799-601-3420	Adapter for BENDIX (MS)	24	MS-24P							●	●										
799-601-3430	Adapter for BENDIX (MS)	17	MS-17P							●	●										
799-601-3440	Adapter for BENDIX (MS)	17	MS-17P							●	●										
799-601-3450	Adapter for BENDIX (MS)	5	MS-5P						●	●											
799-601-3460	Adapter for BENDIX (MS)	10	MS-10P							●	●										
799-601-3510	Adapter for BENDIX (MS)	5	MS-5S						●	●											
799-601-3520	Adapter for BENDIX (MS)	17	MS-17P						●	●											
799-601-3530	Adapter for BENDIX (MS)	19	MS-19P							●	●										
799-601-2910	Adapter for BENDIX (MS)	14	MS-14P						●	●											
799-601-3470	Case									●											
799-601-2710	Adapter for MIC	5	MIC-5P	●	●		●							●							
799-601-2720	Adapter for MIC	13	MIC-13P	●	●		●							●							
799-601-2730	Adapter for MIC	17	MIC-17P	●	●	●	●						●	●		●					
799-601-2740	Adapter for MIC	21	MIC-21P	●	●	●	●						●	●		●					
799-601-2950	Adapter for MIC	9	MIC-9P									●	●	●		●					
799-601-2750	Adapter for ECONO	2	ECONO2P	●	●																
799-601-2760	Adapter for ECONO	3	ECONO13P	●	●																
799-601-2770	Adapter for ECONO	4	ECONO4P	●	●																
799-601-2780	Adapter for ECONO	8	ECONO8P	●	●																
799-601-2790	Adapter for ECONO	12	ECONO12P	●	●																
799-601-2810	Adapter for DLI	8	DLI-8P	●	●																
799-601-2820	Adapter for DLI	12	DLI-12P	●	●																
799-601-2830	Adapter for DLI	16	DLI-16P	●	●																
799-601-2840	Extension cable (ECONO type)	12	ECONO12P	●	●									●							
799-601-2850	Case			●																	
799-601-4210	Adapter for DRC	50	DRC50																		●
799-601-7010	Adapter for X (T-adapter)	1												●		●					
799-601-7020	Adapter for X	2	X2P									●	●	●		●					
799-601-7030	Adapter for X	3	X3P									●	●	●		●					

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	
799-601-7040	Adapter for X	4	X4P									●	●	●		●					
799-601-7050	Adapter for SWP	6	SW6P									●	●	●							
799-601-7060	Adapter for SWP	8	SW8P									●	●	●							
799-601-7310	Adapter for SWP	12	SW12P																		●
799-601-7070	Adapter for SWP	14	SW14P											●		●					
799-601-7320	Adapter for SWP	16	SW16P																		●
799-601-7080	Adapter for M (T-adapter)	1												●		●					
799-601-7090	Adapter for M	2	M2P									●	●	●		●					
799-601-7110	Adapter for M	3	M3P									●	●	●		●					
799-601-7120	Adapter for M	4	M4P									●	●	●		●					
799-601-7130	Adapter for M	6	M6P									●	●	●		●					
799-601-7340	Adapter for M	8	M8P																		●
799-601-7140	Adapter for S	8	S8P									●	●	●		●					
799-601-7150	Adapter for S (White)	10	S10P									●	●	●		●					
799-601-7160	Adapter for S (Blue)	12	S12P									●	●	●							
799-601-7170	Adapter for S (Blue)	16	S16P									●	●	●		●					
799-601-7330	Adapter for S (White)	16	S16PW													●					
799-601-7350	Adapter for S (White)	12	S12PW																		●
799-601-7180	Adapter for AMP040	8	A8P											●							
799-601-7190	Adapter for AMP040	12	A12P											●		●					
799-601-7210	Adapter for AMP040	16	A16P									●	●	●		●					
799-601-7220	Adapter for AMP040	20	A20P									●	●	●		●					
799-601-7230	Short connector for X	2										●	●	●		●					
799-601-7240	Case											●	●								
799-601-7270	Case													●							
799-601-7510	Adapter for 070	10	07-10												●						
799-601-7520	Adapter for 070	12	07-12												●						
799-601-7530	Adapter for 070	14	07-14												●						
799-601-7540	Adapter for 070	18	07-18												●						
799-601-7550	Adapter for 070	20	07-20												●						
799-601-7360	Adapter for relay	5	REL-5P																		●
799-601-7370	Adapter for relay	6	REL-6P																		●
799-601-7380	Adapter for JFC	2																			●
799-601-9010	Adapter for DTM	2	DTM2														●		●		
799-601-9020	Adapter for DT	2	DT2														●		●		
799-601-9030	Adapter for DT	3	DT3														●		●		
799-601-9040	Adapter for DT	4	DT4														●		●		
799-601-9050	Adapter for DT	6	DT6														●		●		
799-601-9060	Adapter for DT (Gray)	8	DT8GR														●		●		
799-601-9070	Adapter for DT (Black)	8	DT8B														●		●		
799-601-9080	Adapter for DT (Green)	8	DT8G														●		●		
799-601-9090	Adapter for DT (Brown)	8	DT8BR														●		●		

Part No.	Part name	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	
799-601-9110	Adapter for DT (Gray)	12	DT12GR														●		●		
799-601-9120	Adapter for DT (Black)	12	DT12B														●		●		
799-601-9130	Adapter for DT (Green)	12	DT12G														●		●		
799-601-9140	Adapter for DT	12	DT12BR														●		●		
799-601-9210	Adapter for HD30-18	8	D18-8														●	●			
799-601-9220	Adapter for HD30-18	14	D18-14														●	●			
799-601-9230	Adapter for HD30-18	20	D18-20														●	●			
799-601-9240	Adapter for HD30-18	21	D18-21														●	●			
799-601-9250	Adapter for HD30-24	9	D24-9														●	●			
799-601-9260	Adapter for HD30-24	16	D24-16														●	●			
799-601-9270	Adapter for HD30-24	21	D24-21														●	●			
799-601-9280	Adapter for HD30-24	23	D24-23														●	●			
799-601-9290	Adapter for HD30-24	31	D24-31														●	●			
799-601-9310	Plate for HD30 (24-pin)																●	●		●	
799-601-9320	T-box (for DT/HD)	12															●	●		●	
799-601-9330	Case																●				
799-601-9340	Case																	●			
799-601-9350	Adapter for DRC	40	DRC-40																	●	
799-601-9360	Adapter for DRC	24	DRC-24																	●	
799-601-9410	Adapter for engine (CRI-T2)	2	G																		●
799-601-9420	Adapter for engine (CRI-T2) Adapter for engine (CRI-T3)	3	A3																		●
799-601-9430	Adapter for engine (CRI-T2) Adapter for engine (CRI-T3)	2	P																		●
799-601-9440	Adapter for engine (CRI-T2)	3	1,2,3																		●
795-799-5520	Adapter for engine (HPI-T2)	2	S																		●
795-799-5530	Adapter for engine (HPI-T2) Adapter for engine (CRI-T3)	2	C																		●
795-799-5540	Adapter for engine (HPI-T2) Adapter for engine (CRI-T3)	2	A																		●
795-799-5460	Adapter for engine (HPI-T2)	3																			●
795-799-5470	Adapter for engine (HPI-T2)	3																			●
795-799-5480	Adapter for engine (HPI-T2)	3																			●
799-601-4160	Adapter for engine (CRI-T3)	2	OIL																		●
799-601-4340	Adapter for engine (CRI-T3)	2	1,2,3																		●
799-601-4130	Adapter for engine (CRI-T3)	3	FCIN																		●
799-601-4140	Adapter for engine (CRI-T3)	3	FCIG																		●
799-601-4150	Adapter for engine (CRI-T3)	3	FCIB																		●
799-601-4180	Adapter for engine (CRI-T3)	3	FCIP3																		●
799-601-4190	Adapter for engine (CRI-T3)	3	1,2,3																		●
799-601-4240	Adapter for engine (CRI-T3)	3	1,2,3																		●
799-601-4250	Adapter for engine (CRI-T3)	3	1,2,3																		●
799-601-4330	Adapter for engine (CRI-T3)	3	1,2,3																		●

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	
799-601-4230	Adapter for engine (CRI-T3)	4	1,2,3,4																		●
799-601-4260	Adapter for controller (ENG)	4	DTP4																		●
799-601-4210	Adapter for controller (ENG)	50	DRC50																		●
799-601-4220	Adapter for controller (ENG)	60	DRC60																		●
799-601-4280	Box for controller (PUMP)	12 1																			●
799-601-9720	Adapter for controller (HST)	16	HST16A																		●
799-601-9710	Adapter for controller (HST)	16	HST16B																		●
799-601-9370	Adapter for controller (HST)	26	HST26A																		●

Blank for technical reason

TROUBLESHOOTING WHEN FAILURE CODE IS INDICATED

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Before carrying out troubleshooting when failure code is displayed

Connection table of fuse box

★ This connection table shows the devices to which each power supply of the fuse box supplies power (A switch power supply is a device which supplies power while the starting switch is in the ON position and a constant power supply is a device which supplies power while the starting switch is in the OFF and ON positions).

★ When carrying out troubleshooting related to the electrical system, you should check the fuses and fusible links to see if the power is supplied normally.

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		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting
	1	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.
	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) (colour)

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			

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	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.		

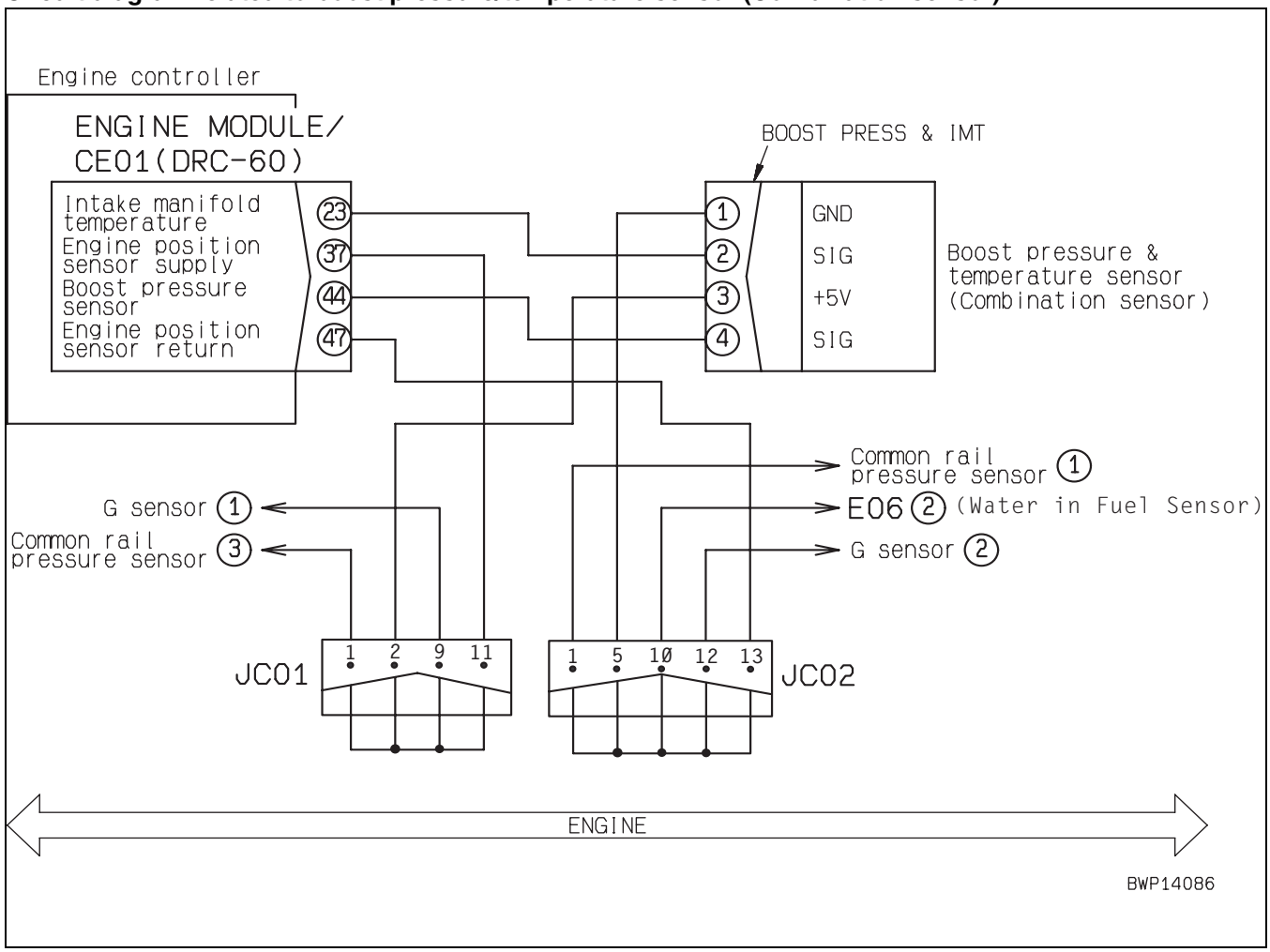
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defective connection of sensor connector	Connectors of Neutral speed sensor and Backup speed sensor may be connected defectively (or connected to wrong parts). Check them directly.

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]	★ 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	★ 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)	★ 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	★ 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)

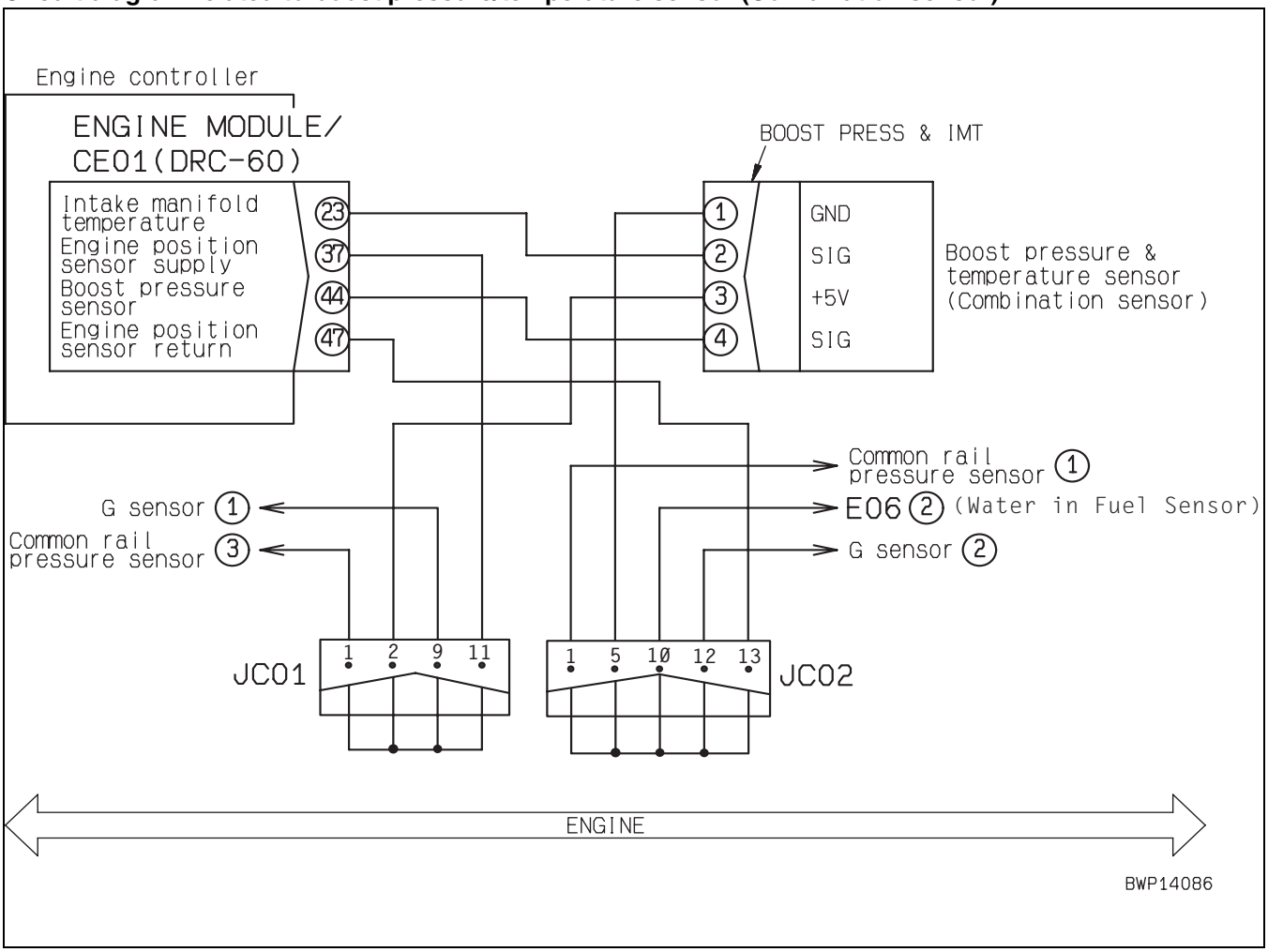


Failure code [CA123] Chg Air Press Sensor Low Error

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]	★ 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)	★ 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)	★ 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	★ 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)

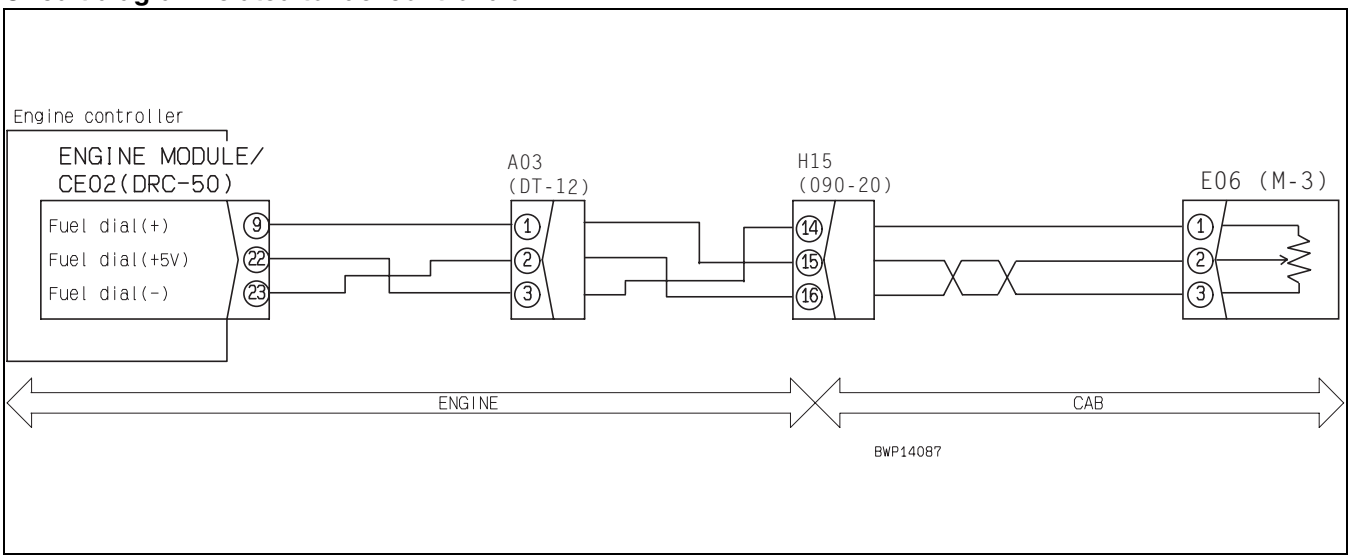


Failure code [CA131] Throttle Sensor High Error

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	★ 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	★ 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)	★ 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	★ 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	

Circuit diagram related to fuel control dial

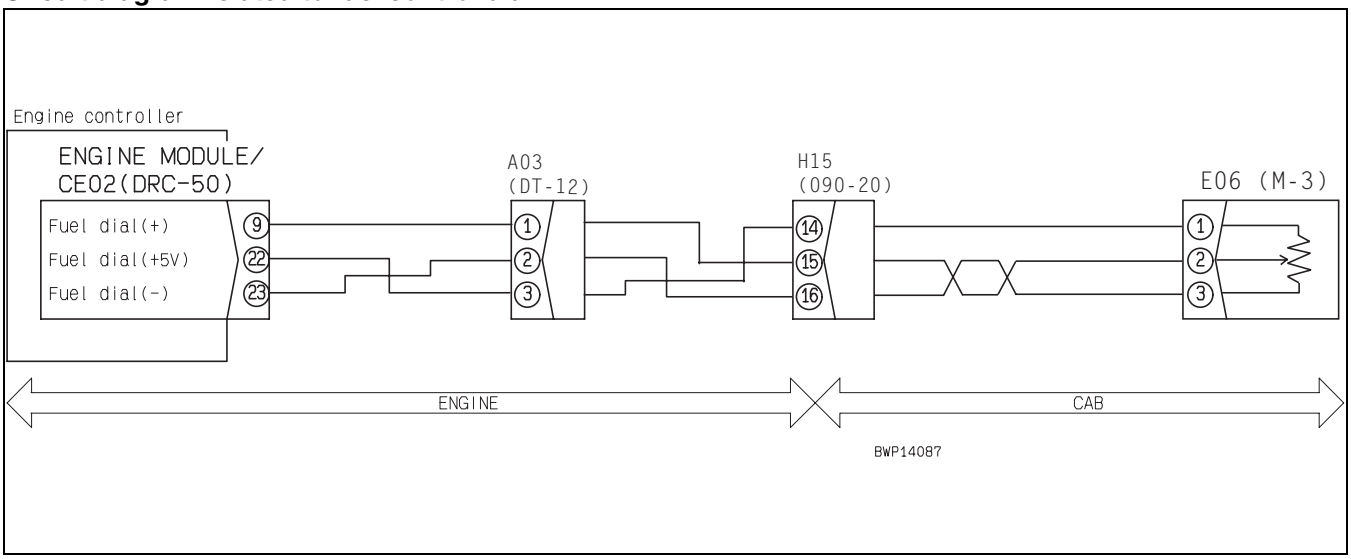


Failure code [CA132] Throttle Sensor Low Error

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	★ 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)	★ 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)	★ 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	★ 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	

Circuit diagram related to fuel control dial

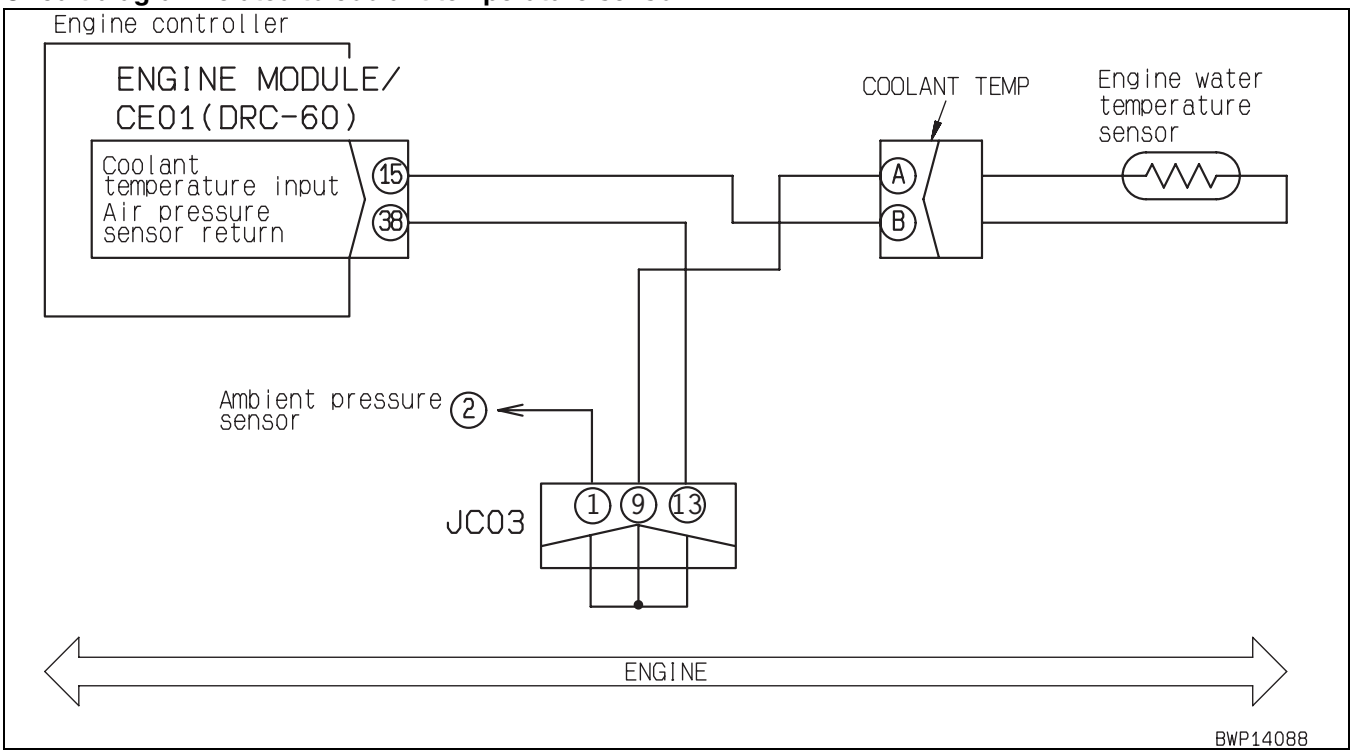


Failure code [CA144] Coolant Temp Sens High Error

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	★ 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)	★ 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)	★ 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	★ 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

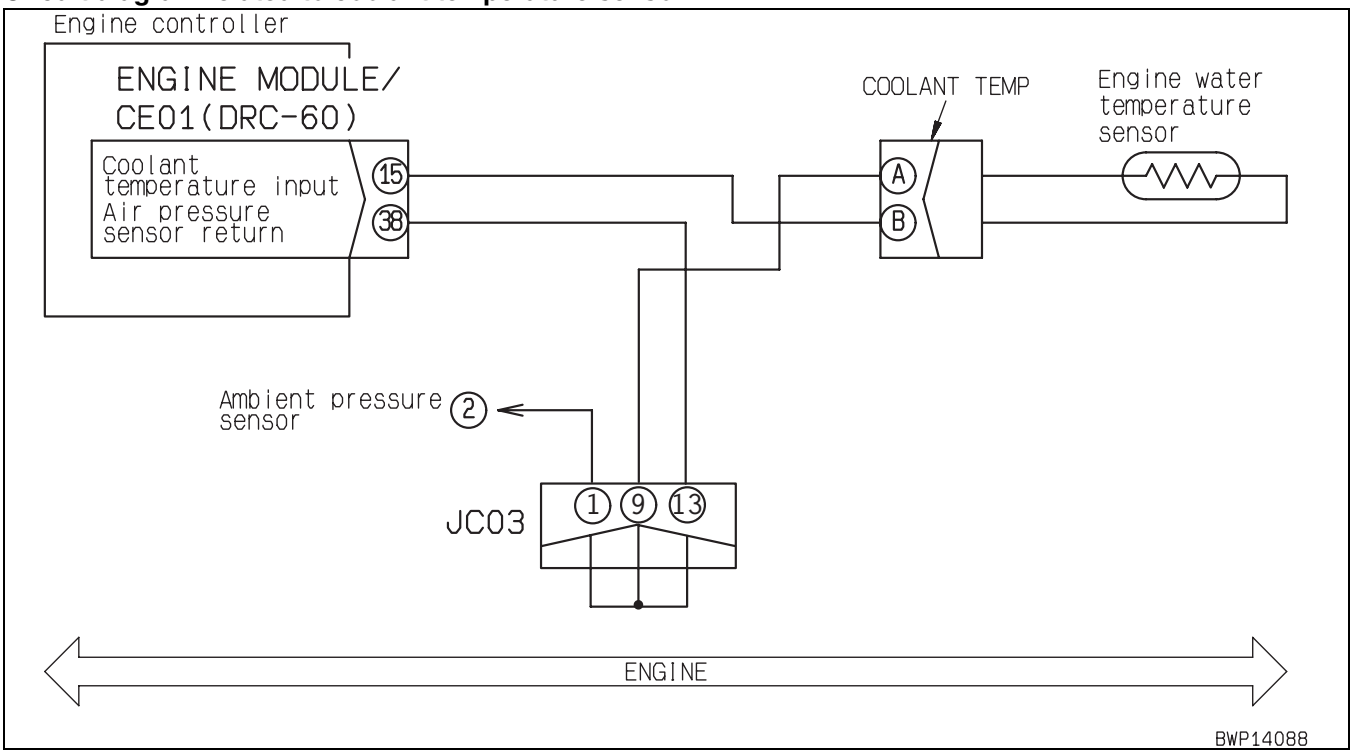


Failure code [CA145] Coolant Temp Sens Low Error

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	★ 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)	★ 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)	★ 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	★ 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

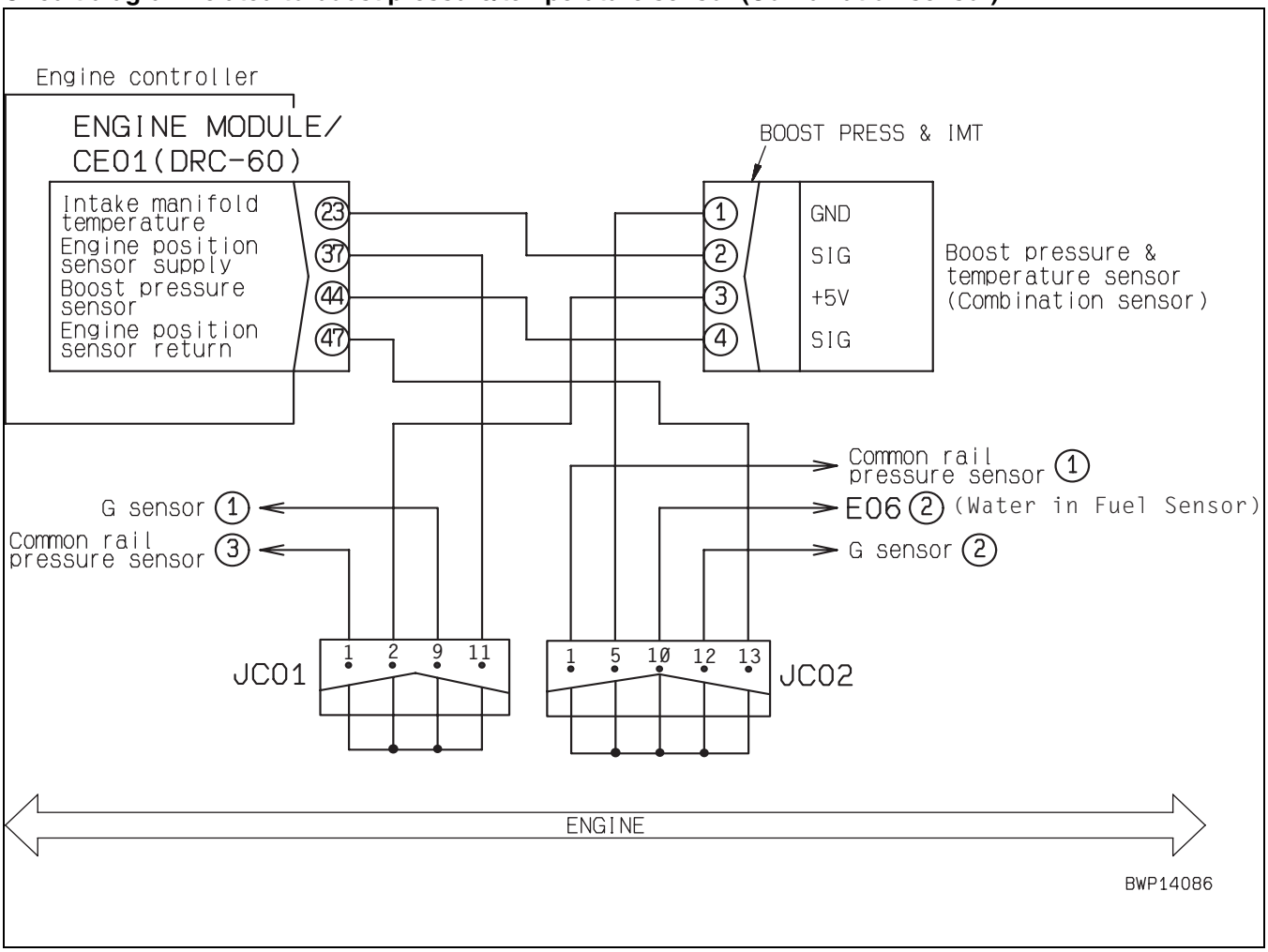


Failure code [CA153] Chg Air Temp Sensor High Error

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]	★ 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)	★ 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)	★ 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	★ 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)

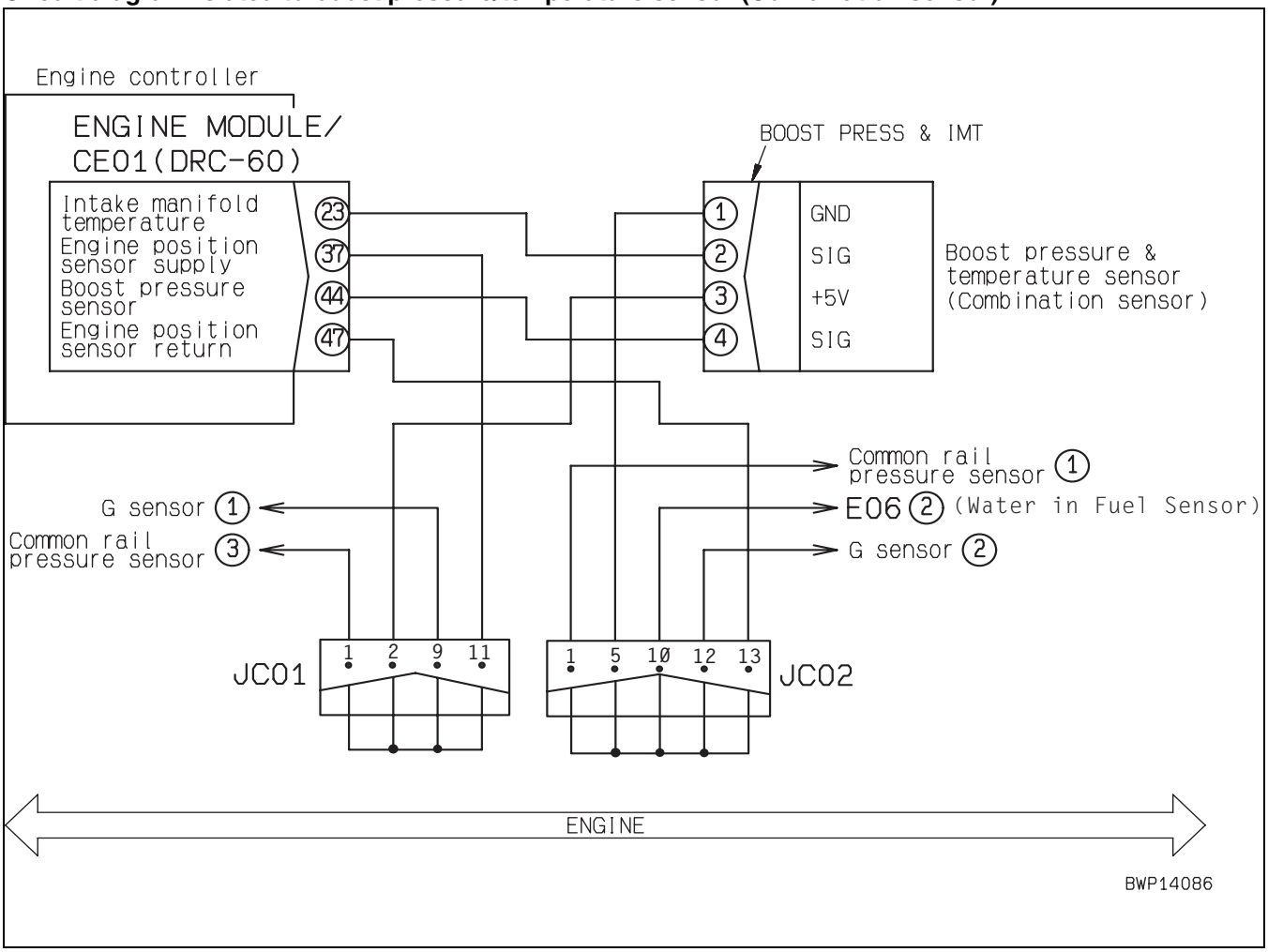


Failure code [CA154] Chg Air Temp Sensor Low Error

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]	★ 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)	★ 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)	★ 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	★ 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 after cooler	Cooling performance of after cooler may be low. Check following points directly. • Looseness and breakage of fan belt. • Insufficiency of cooling air • Clogging of after cooler 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.)

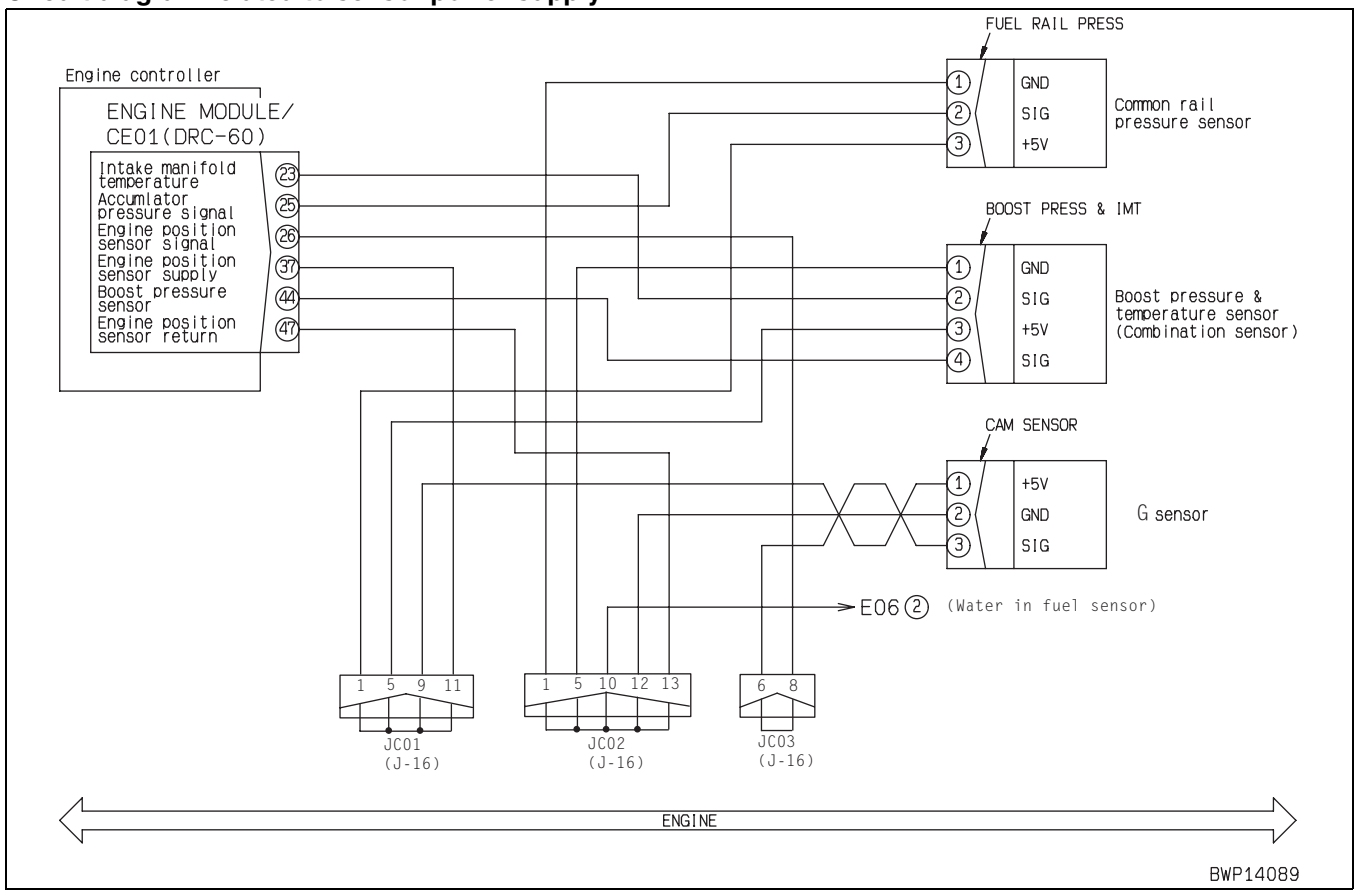
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Failure code [CA187] Sens Supply 2 Volt Low Error

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	★ 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	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

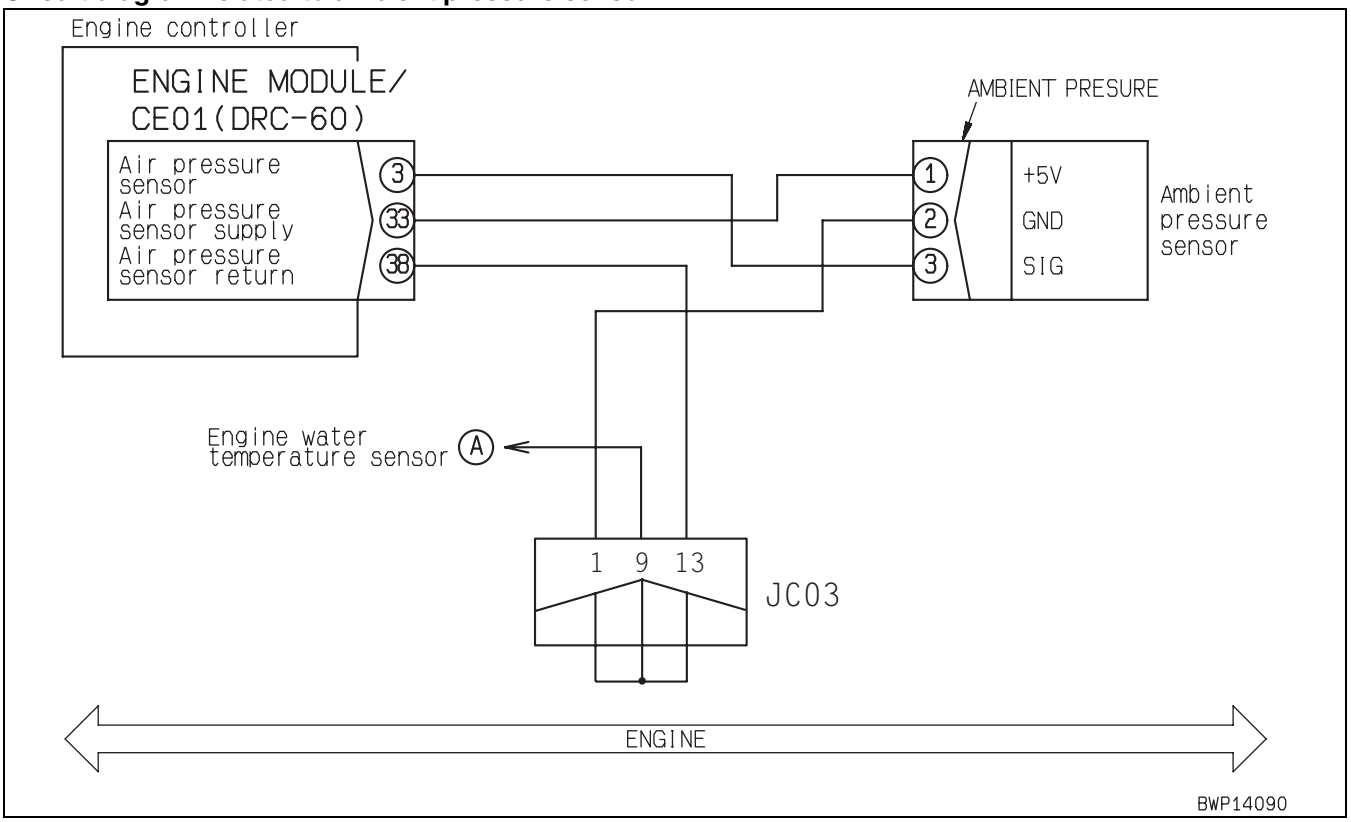


Failure code [CA221] Ambient Press Sens High Error

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	★ 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	★ 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)	★ 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	★ 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

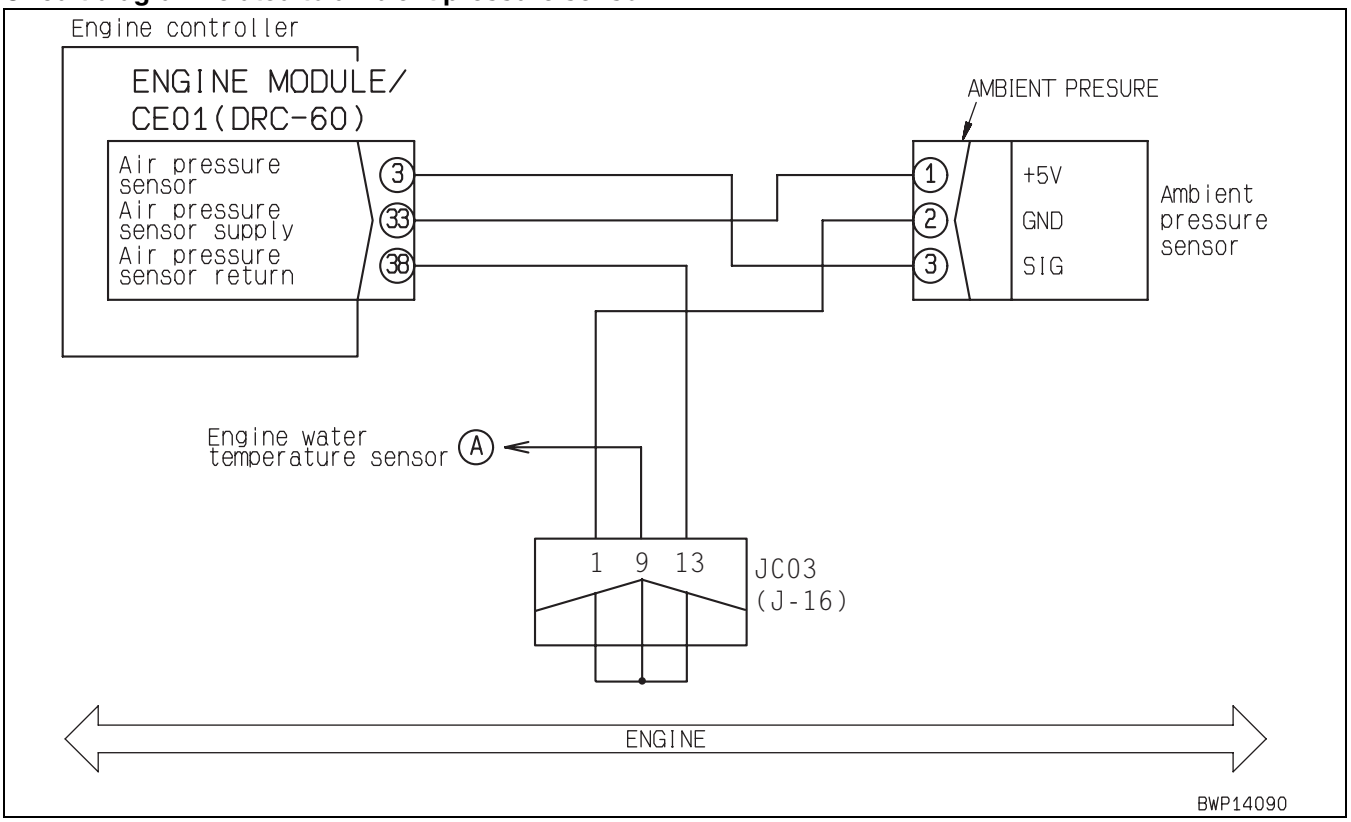


Failure code [CA222] Ambient Press Sens Low Error

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	★ 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)	★ 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)	★ 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	★ 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

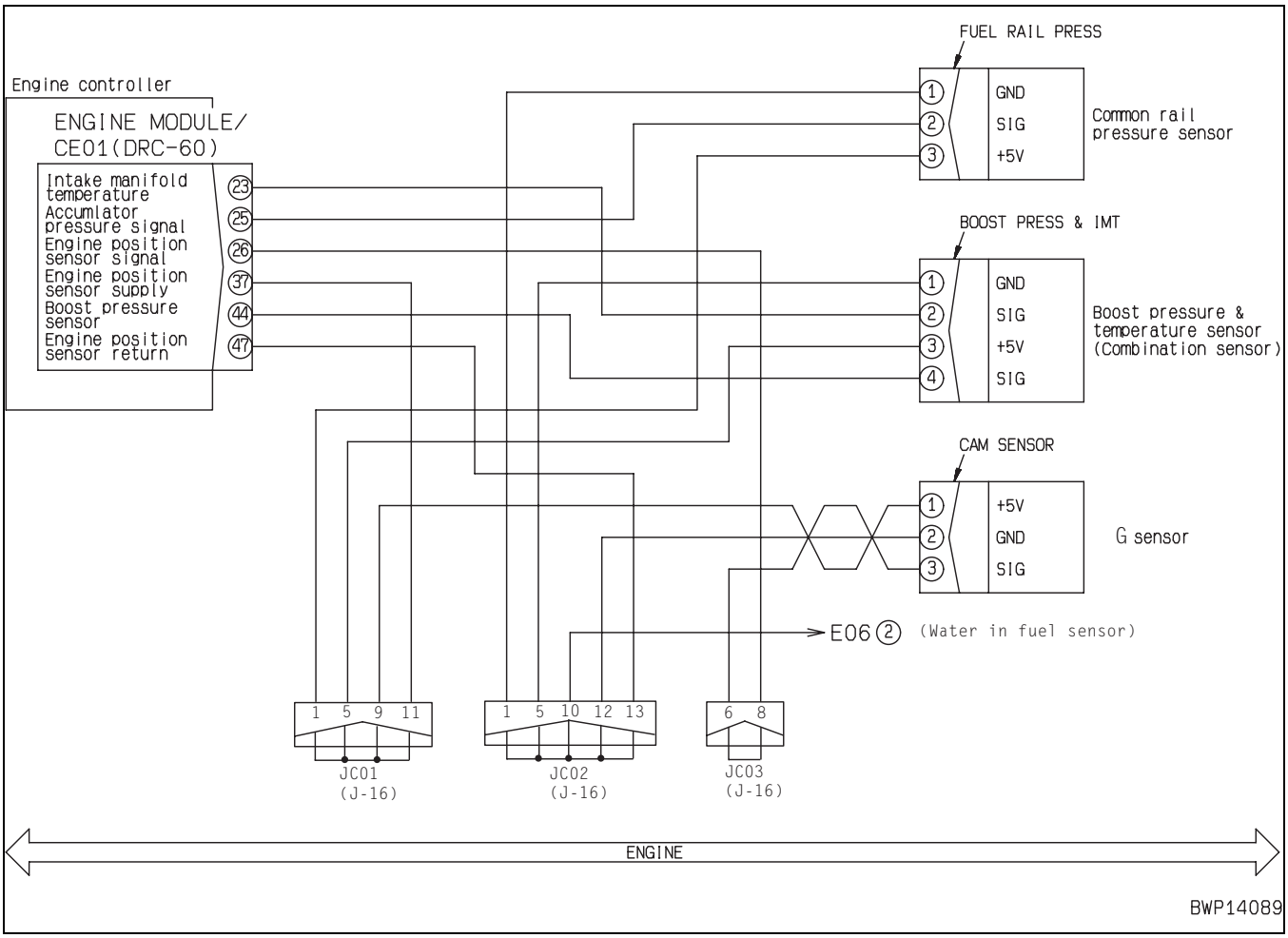


Failure code [CA227] Sens Supply 2 Volt High Error

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

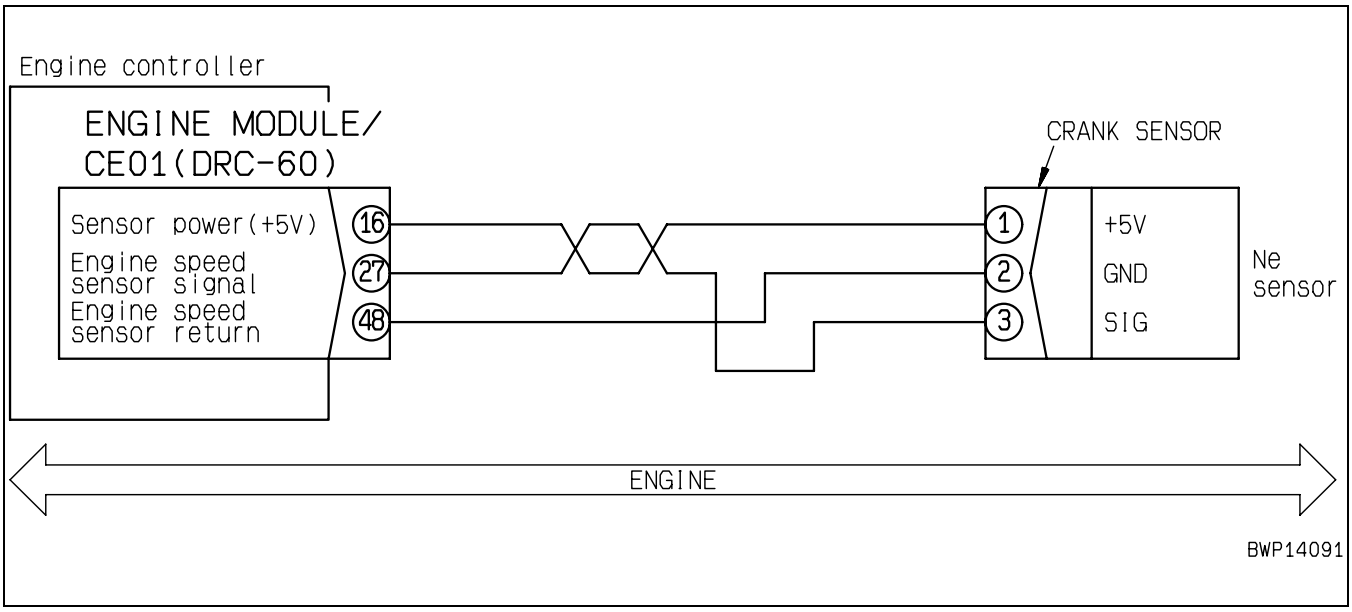


Failure code [CA238] Ne Speed Sens Supply Volt Error

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 Backup 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	★ 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	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

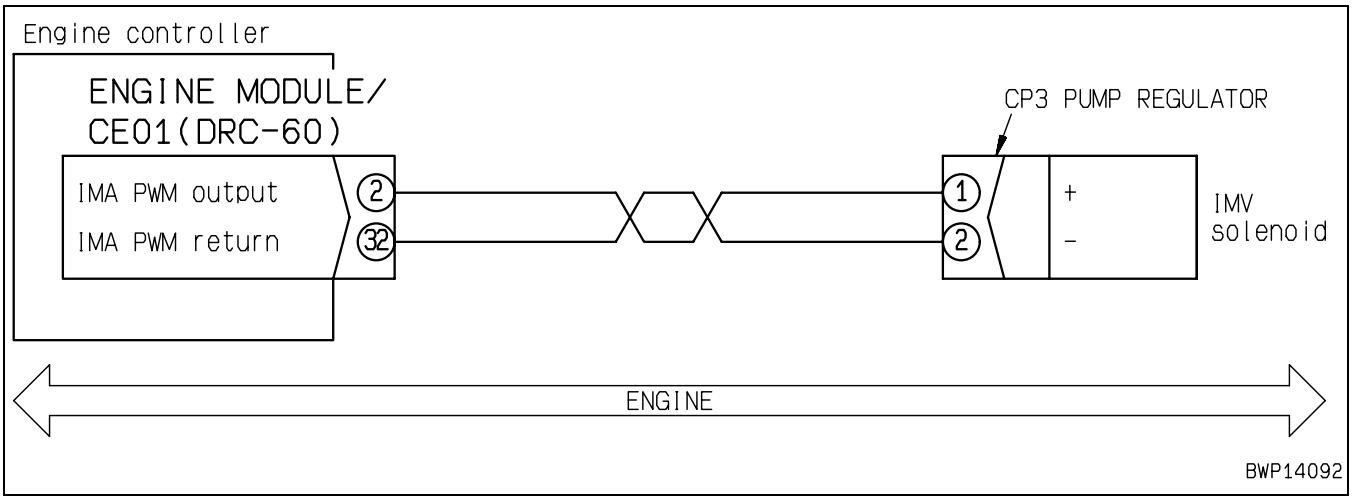


Failure code [CA271] IMV/PCV1 Short Error

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	★ 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)	★ 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)	★ 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	★ 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)

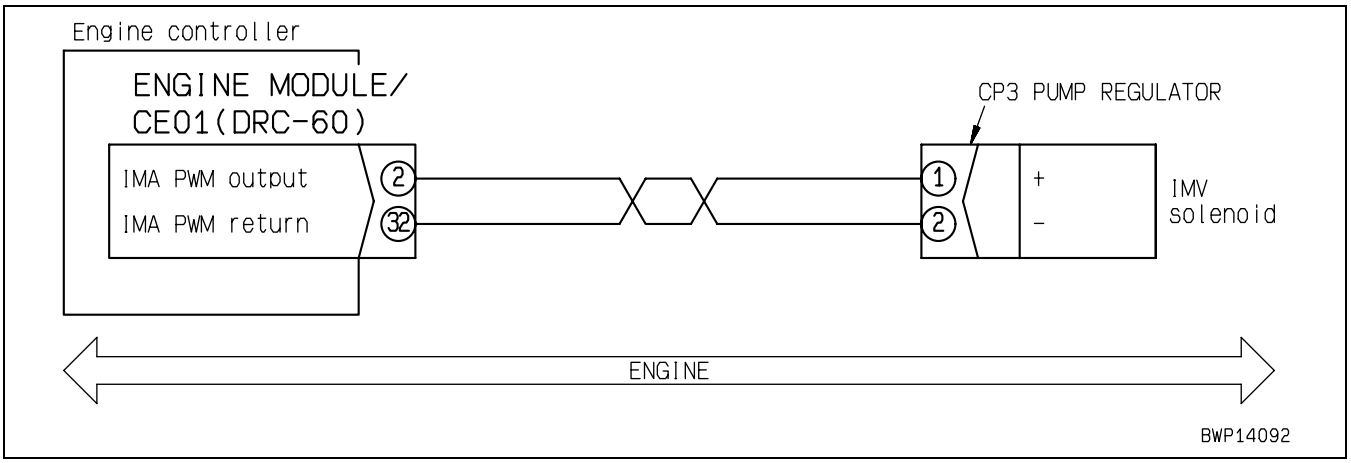


Failure code [CA272] IMV/PCV1 Open Error

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	★ 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)	★ 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	★ 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)	★ 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	★ 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)

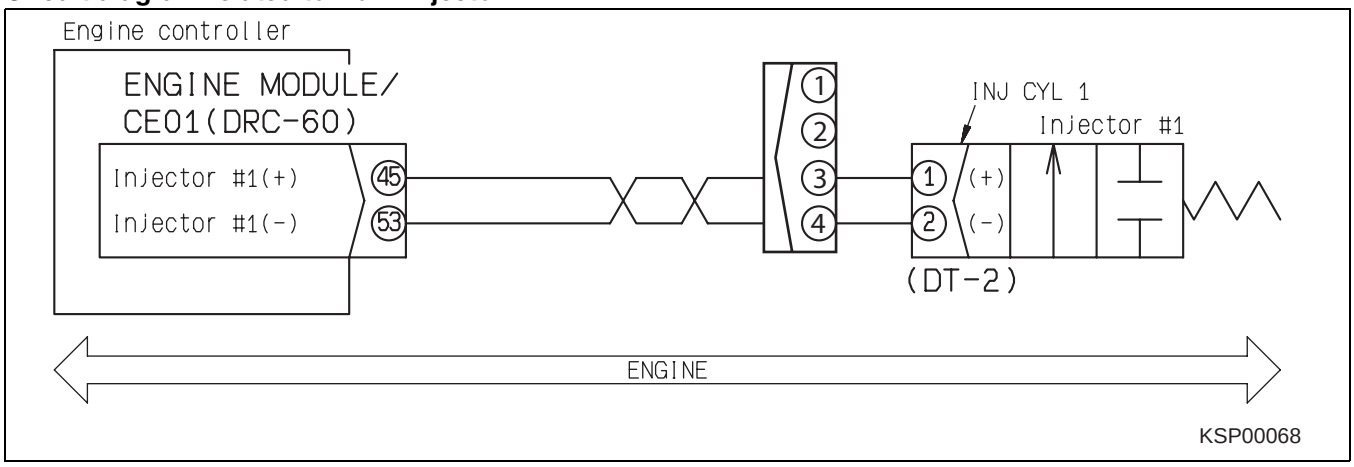


Failure code [CA322] Inj #1 (L#1) Open/Short Error

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.		

<table>
<tr><td rowspan="16">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>1</td><td>Defective engine controller</td><td colspan="4">If following failure codes are also displayed, trouble is in engine controller. [CA322], [CA324], [CA331]</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Defective No. 1 injector</td><td colspan="4">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">INJ CYL 1 (male)</td><td colspan="2">Resistance</td></tr>
<tr><td colspan="2">Between (1) – (2)</td><td colspan="2">Max. 2 Ω</td></tr>
<tr><td colspan="2">Between (1) – chassis ground</td><td colspan="2">Min. 100 kΩ</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="4">★ 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) (45) – INJ CYL 1 (female) (1)</td><td>Resistance</td><td>Max. 2 Ω</td></tr>
<tr><td colspan="2">Wiring harness between CE01 (female) (53) – INJ CYL 1 (female) (2)</td><td>Resistance</td><td>Max. 2 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="4">★ 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) (45) – INJ CYL 1 (female) (1)</td><td>Resistance</td><td>Max. 2 Ω</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Short circuit in wiring harness (with another wiring harness)</td><td colspan="4">★ 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) (45) – each of CE01 (female) pins (With all wiring harness connectors disconnected)</td><td>Resistance</td><td>Min. 100 kΩ</td></tr>
<tr><td colspan="2">Wiring harness between CE01 (female) (53) – each of CE01 (female) pins (With all wiring harness connectors disconnected)</td><td>Resistance</td><td>Min. 100 kΩ</td></tr>
<tr><td>6</td><td>Defective wiring harness connector</td><td colspan="4">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</td></tr>
<tr><td rowspan="4">7</td><td rowspan="4">Defective engine controller</td><td colspan="4">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">CE01 (female)</td><td colspan="2">Resistance</td></tr>
<tr><td colspan="2">Between (45) – (53)</td><td colspan="2">Max. 2 Ω</td></tr>
<tr><td colspan="2">Between (45) – chassis ground</td><td colspan="2">Min. 100 kΩ</td></tr>
</table>

Circuit diagram related to No. 1 injector

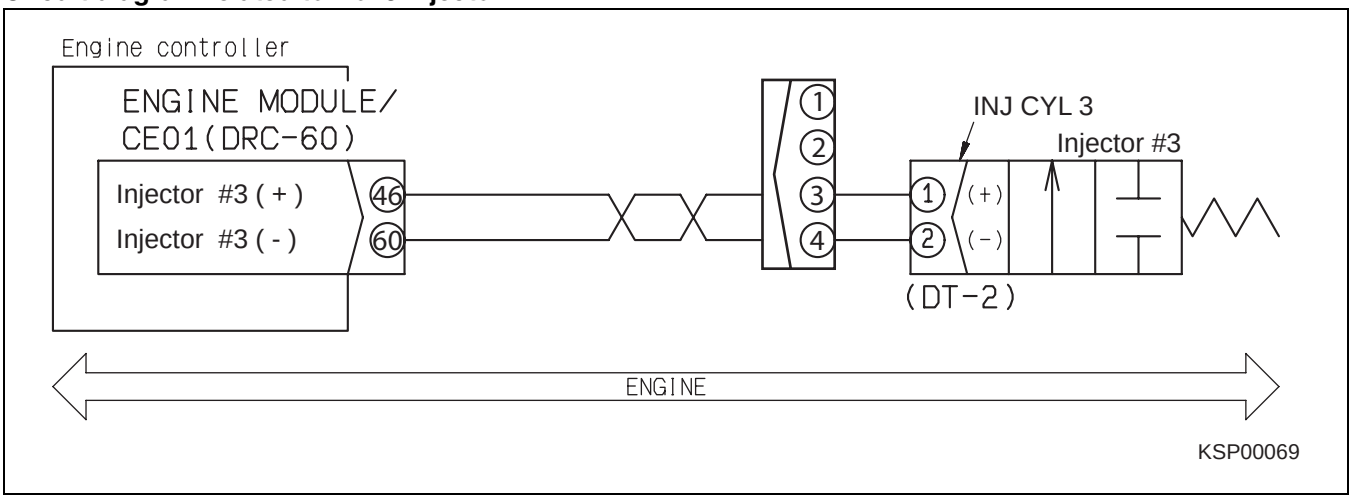


Failure code [CA324] Inj #3 (L#3) Open/Short Error

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	★ 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)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (46) – INJ CYL 3 (female) (1)	Resistance	Max. 2 Ω	
			Wiring harness between CE01 (female) (60) – INJ CYL 3 (female) (2)	Resistance	Max. 2 Ω	
	4	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (46) – INJ CYL 3 (female) (1)	Resistance	Max. 2 Ω	
	5	Short circuit in wiring harness (with another wiring harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (60) – each of CE01 (female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 100 kΩ	
			Wiring harness between CE01 (female) (46) – 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	★ 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. 3 injector

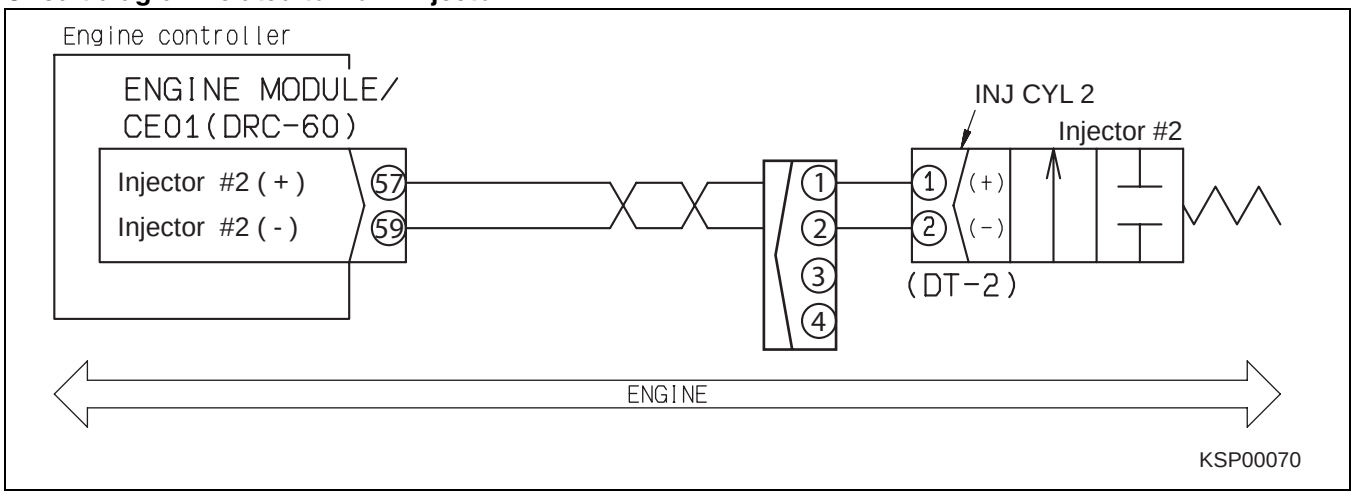


Failure code [CA331] Inj #2 (L#2) Open/Short Error

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.		

<table>
<tr><td rowspan="19">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>1</td><td>Defective engine controller</td><td colspan="4">If following failure codes are also displayed, trouble is in engine controller. [CA322], [CA324], [CA331]</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Defective No. 2 injector</td><td colspan="4">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td>INJ CYL 2 (male)</td><td colspan="3">Resistance</td></tr>
<tr><td>Between (1) – (2)</td><td colspan="3">Max. 2 Ω</td></tr>
<tr><td>Between (1) – chassis ground</td><td colspan="3">Min. 100 kΩ</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="4">★ 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) (57) – INJ CYL 2 (female) (1)</td><td>Resistance</td><td>Max. 2 Ω</td></tr>
<tr><td colspan="2">Wiring harness between CE01 (female) (59) – INJ CYL 2 (female) (2)</td><td>Resistance</td><td>Max. 2 Ω</td></tr>
<tr><td rowspan="3">4</td><td rowspan="3">Ground fault in wiring harness (Short circuit with GND circuit)</td><td colspan="4">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between CE01 (female) (57) – INJ CYL 2 (female) (1)</td><td>Resistance</td><td>Max. 2 Ω</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Short circuit in wiring harness (with another wiring harness)</td><td colspan="4">★ 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) (57) – each of CE01 (female) pins (With all wiring harness connectors disconnected)</td><td>Resistance</td><td>Min. 100 kΩ</td></tr>
<tr><td colspan="2">Wiring harness between CE01 (female) (59) – each of CE01 (female) pins (With all wiring harness connectors disconnected)</td><td>Resistance</td><td>Min. 100 kΩ</td></tr>
<tr><td>6</td><td>Defective wiring harness connector</td><td colspan="4">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</td></tr>
<tr><td rowspan="4">7</td><td rowspan="4">Defective engine controller</td><td colspan="4">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td>CE01 (female)</td><td colspan="3">Resistance</td></tr>
<tr><td>Between (57) – (59)</td><td colspan="3">Max. 2 Ω</td></tr>
<tr><td>Between (57) – chassis ground</td><td colspan="3">Min. 100 kΩ</td></tr>
</table>

Circuit diagram related to No. 2 injector

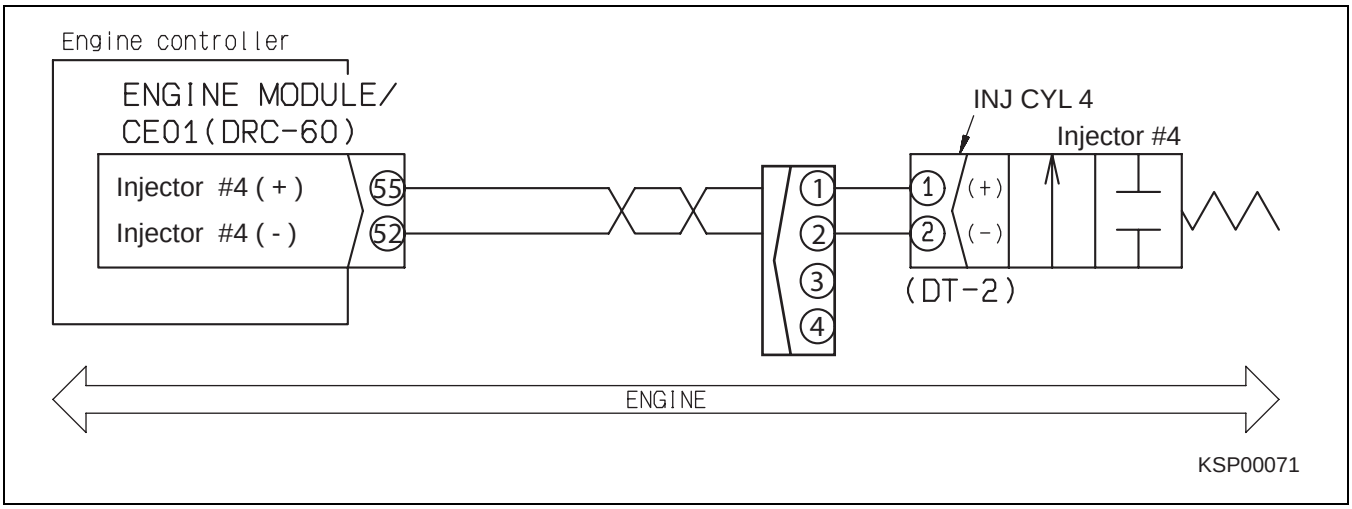


Failure code [CA332] Inj #4 (L#4) Open/Short Error

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	★ 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)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (55) – INJ CYL 4 (female) (1)	Resistance	Max. 2 Ω	
			Wiring harness between CE01 (female) (52) – INJ CYL 4 (female) (2)	Resistance	Max. 2 Ω	
	4	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between CE01 (female) (55) – INJ CYL 4 (female) (1)	Resistance	Max. 2 Ω	
	5	Short circuit in wiring harness (with another wiring harness)	★ 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. 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	★ 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. 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.		

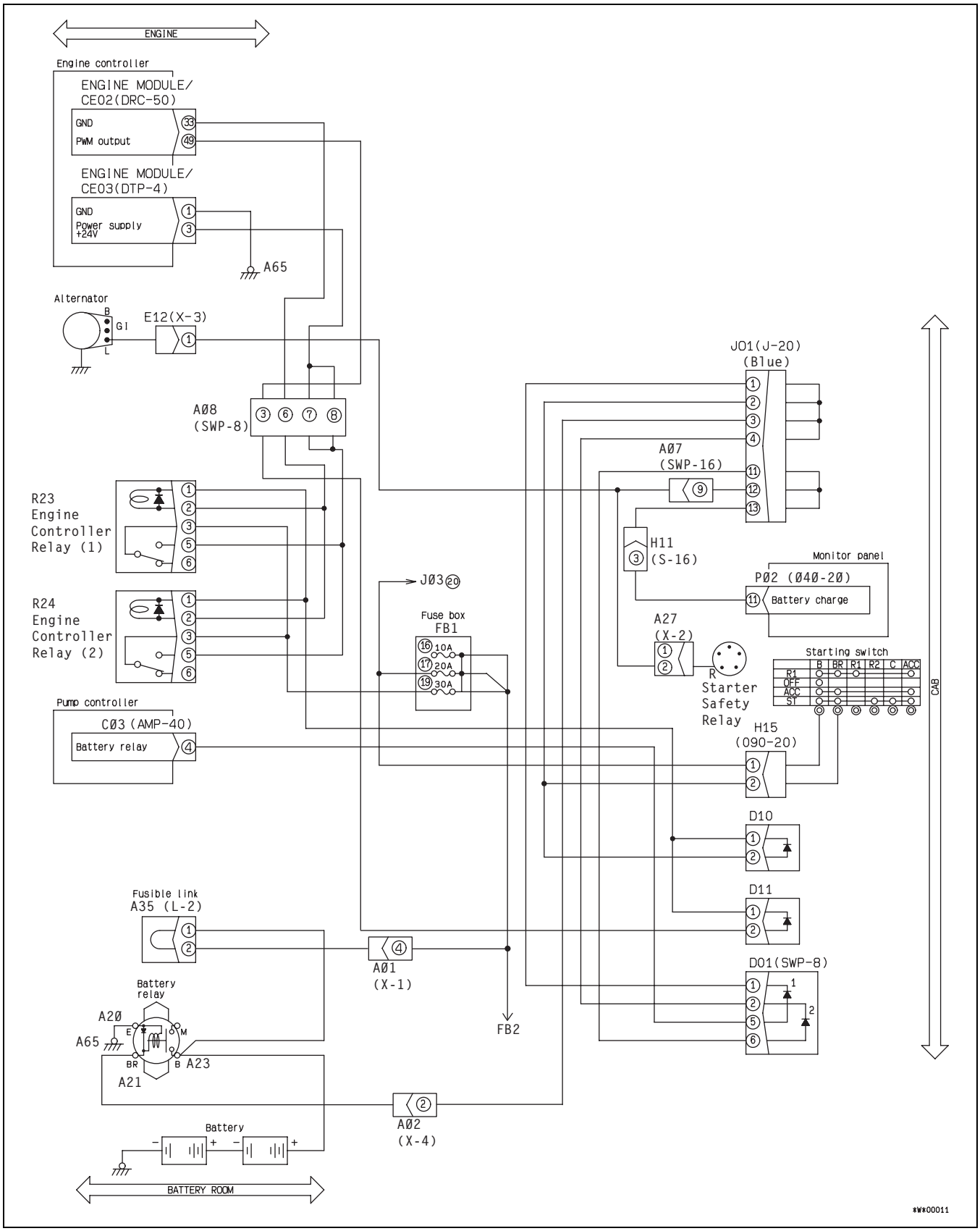
Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Defect in related system	If another failure code is displayed, carry out troubleshooting for it.
	2	Defective engine controller	Engine controller may be defective. (Troubleshooting cannot 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	★ 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)	★ 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



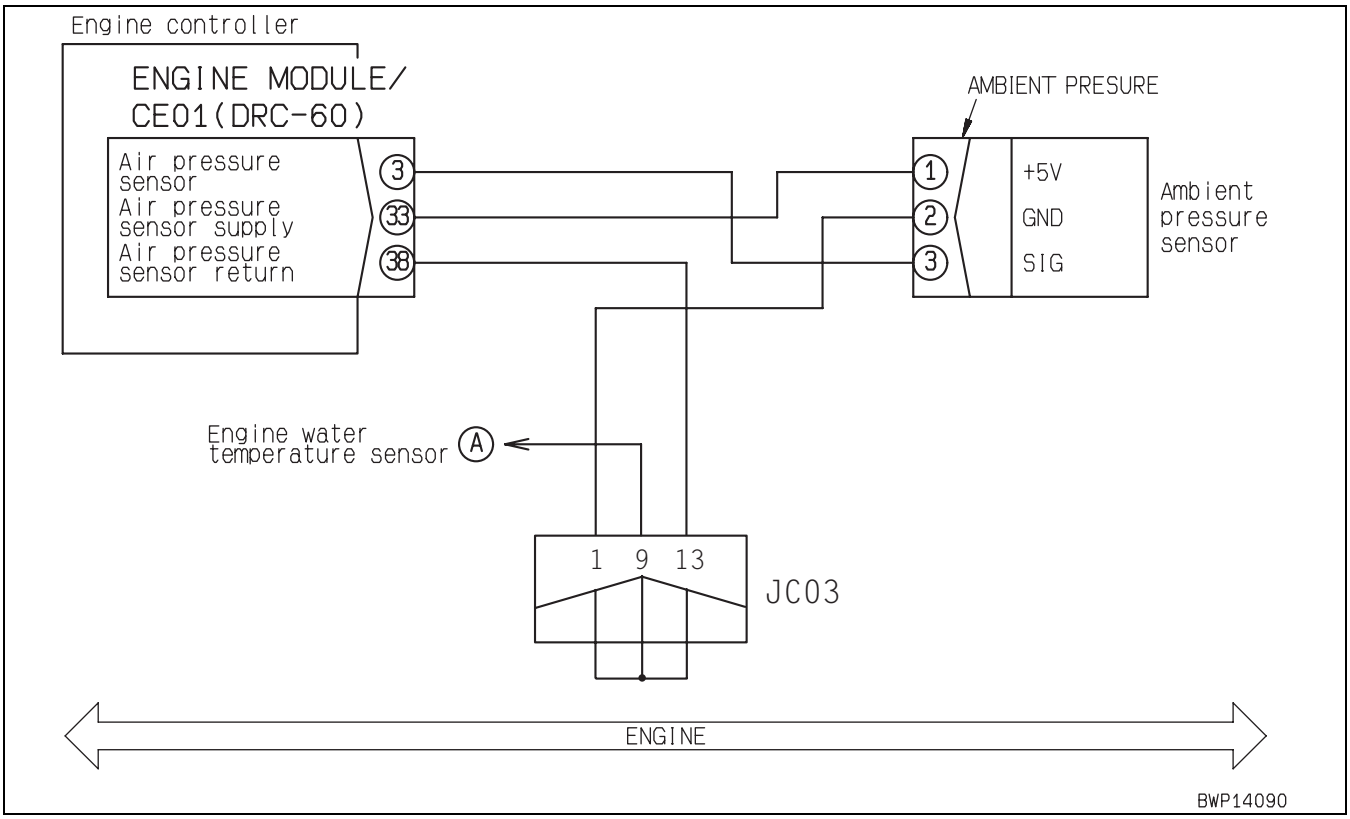
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Failure code [CA352] Sensor Supply 1 Volt Low Error

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	★ 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	Ambient pressure sensor	AMBIENT PRESSURE
				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

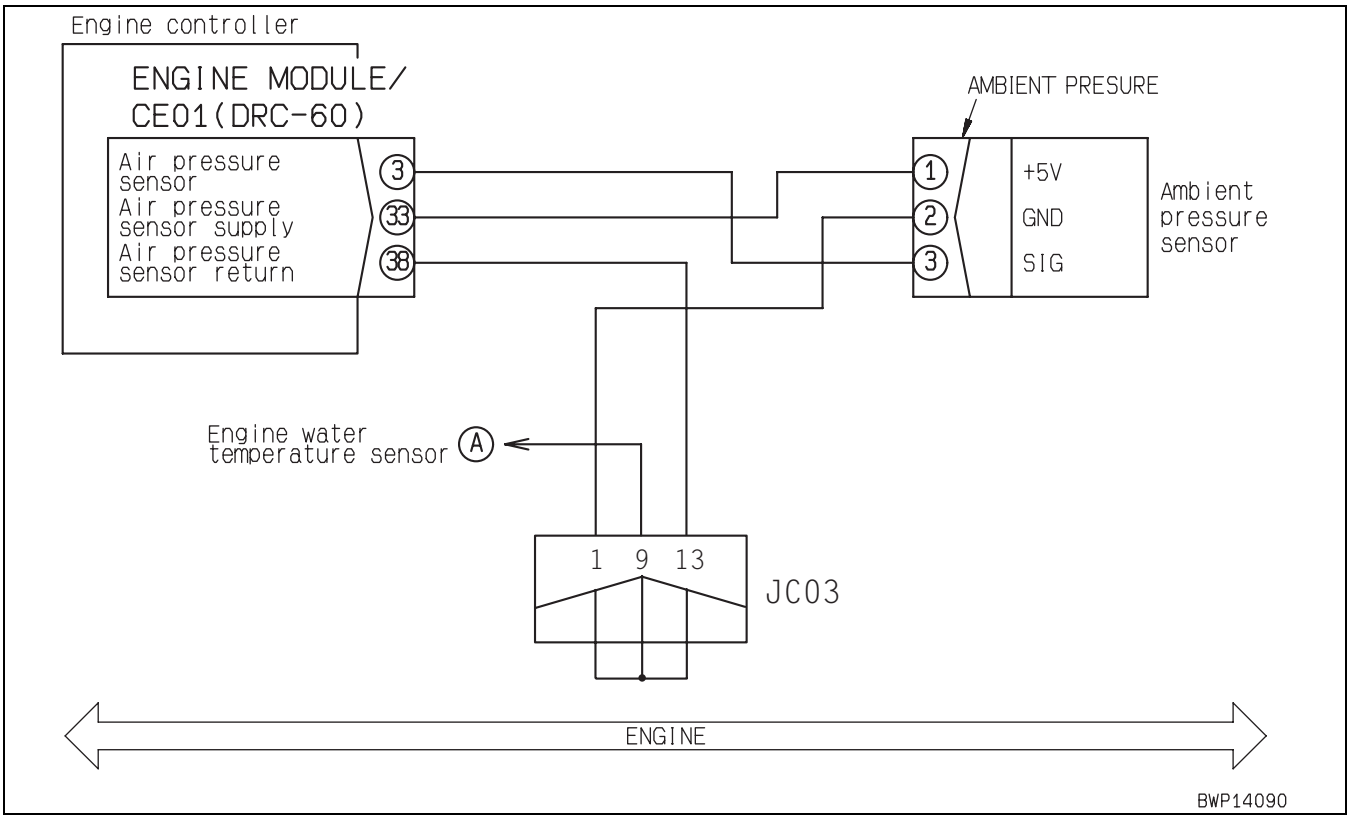


Failure code [CA386] Sens Supply 1 Volt High Error

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

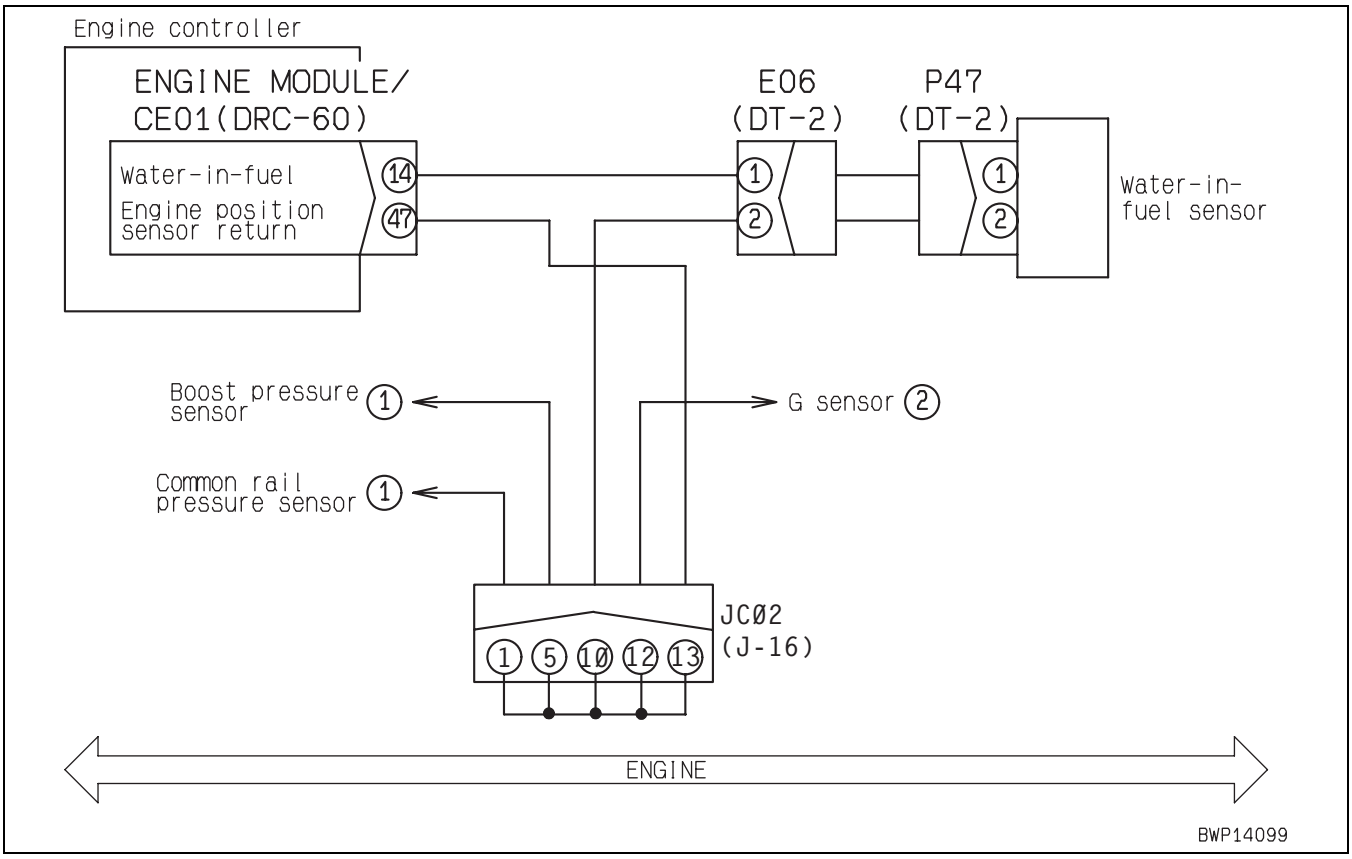


Failure code [CA428] Water in Fuel Sensor High Error

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	★ 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)	★ 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)	★ 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	★ 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

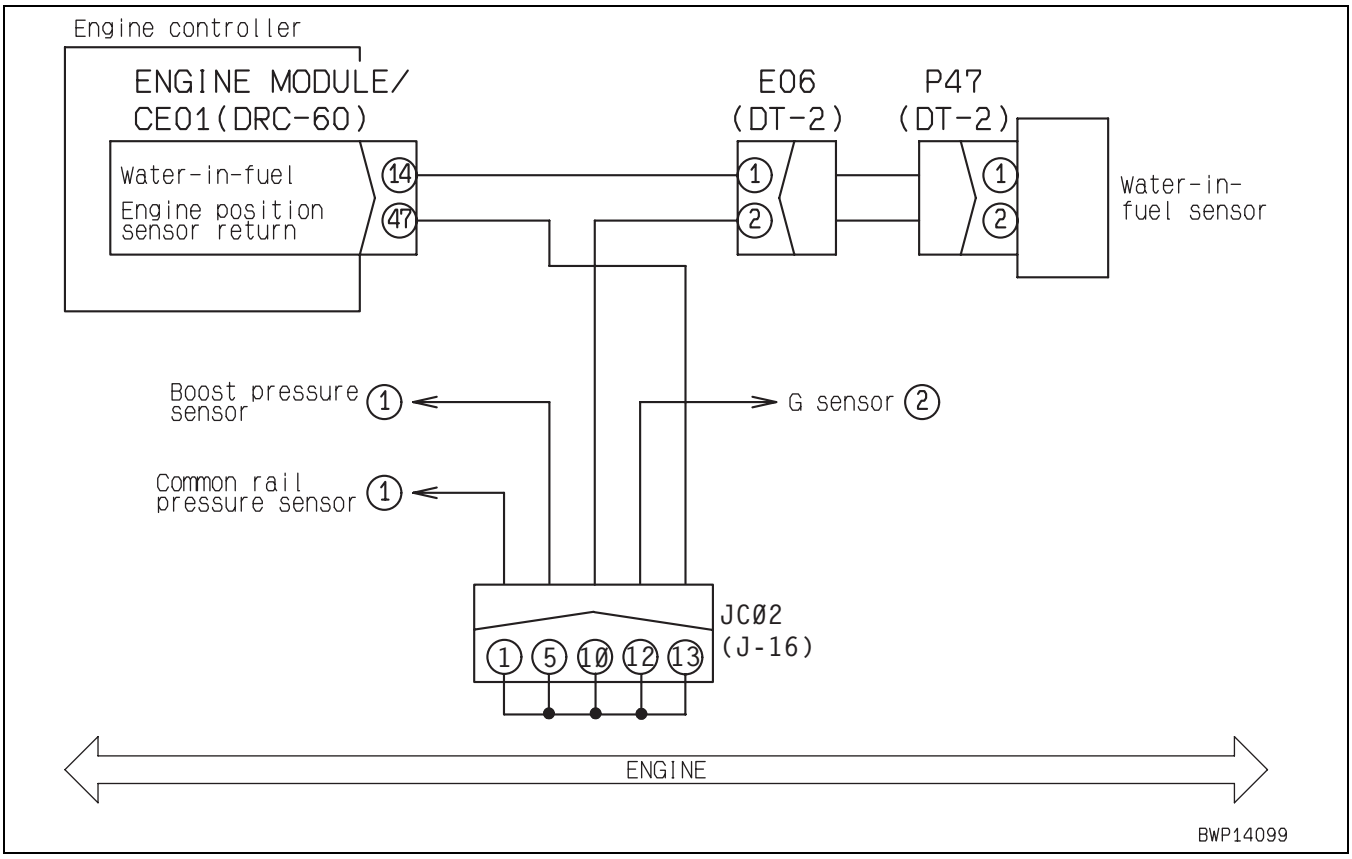


Failure code [CA429] Water in Fuel Sensor Low Error

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	★ 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)	★ 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)	★ 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	★ 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

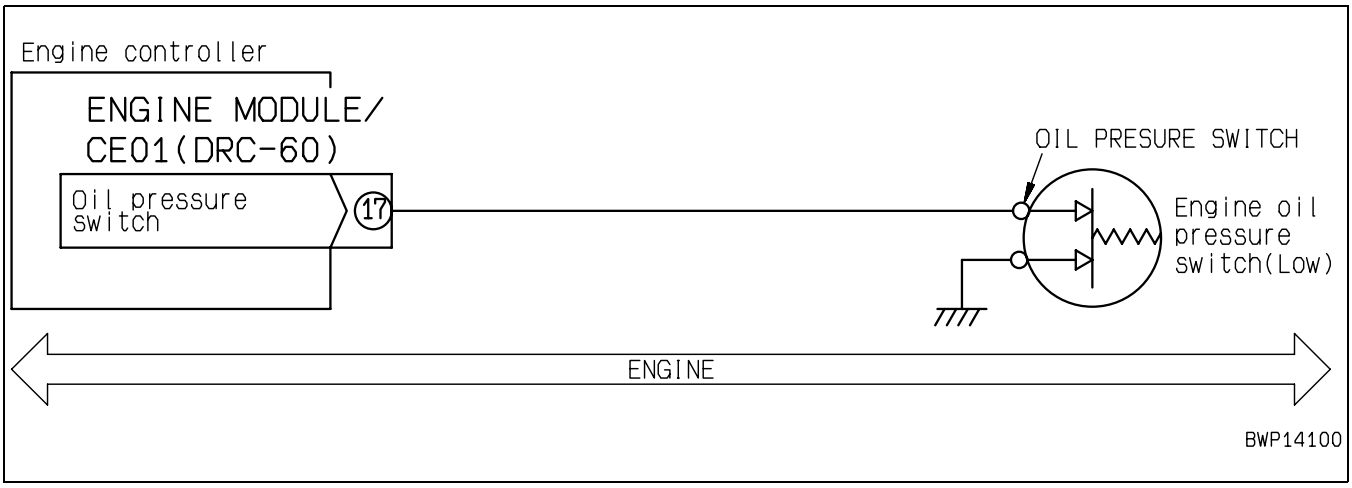


Failure code [CA435] Eng Oil Press Sw Error

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	★ 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)	★ 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)	★ 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	★ 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

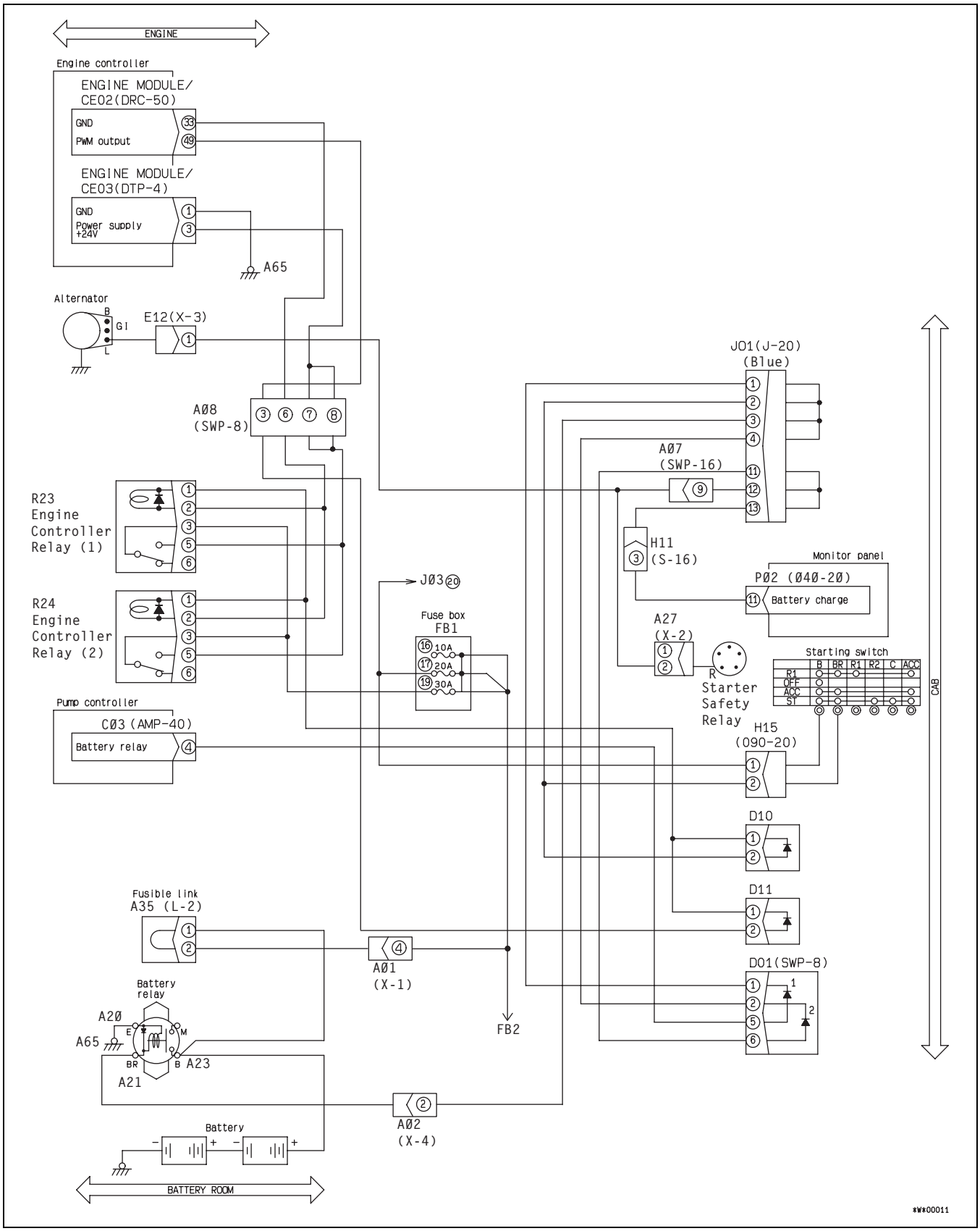


Failure code [CA441] Battery Voltage Low Error

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.		

<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>1</td><td>Looseness or corrosion of battery terminal</td><td colspan="5">Battery terminal may be loosened or corroded. Check it directly.</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Low battery voltage</td><td colspan="5">★ Prepare with starting switch OFF, then keep starting switch OFF and start engine and carry out troubleshooting in each case.</td></tr>
<tr><td>Battery (1 piece)</td><td colspan="2">Starting switch</td><td colspan="2">Voltage</td></tr>
<tr><td>Between (+) – (–) terminals</td><td colspan="2">OFF</td><td colspan="2">Min. 12 V</td></tr>
<tr><td></td><td colspan="2">START</td><td colspan="2">Min. 6.2 V</td></tr>
<tr><td>3</td><td>Defective fuse No. 19</td><td colspan="5">If fuse is broken, circuit probably has ground fault. (See Cause 6)</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Defective relay for engine controller power supply</td><td colspan="5">★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.</td></tr>
<tr><td colspan="5">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.</td></tr>
<tr><td rowspan="4">5</td><td rowspan="4">Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)</td><td colspan="5">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="3">Wiring harness between FB1-19 – R23, R24 (female) (3)</td><td>Resistance</td><td>Max. 10 Ω</td></tr>
<tr><td colspan="3">Wiring harness between R23, R24 (female) (5) – CE03 (female) (3)</td><td>Resistance</td><td>Max. 10 Ω</td></tr>
<tr><td colspan="3">Wiring harness between CE03 (female) (1) – chassis ground (A65)</td><td>Resistance</td><td>Max. 10 Ω</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Ground fault in wiring harness (Short circuit with GND circuit)</td><td colspan="5">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="3">Wiring harness between FB1-19 – R23, R24 (female) (3)</td><td>Resistance</td><td>Min. 100 kΩ</td></tr>
<tr><td colspan="3">Wiring harness between R23, R24 (female) (5) – CE03 (female) (3)</td><td>Resistance</td><td>Max. 10 Ω</td></tr>
<tr><td rowspan="4">7</td><td rowspan="4">Short circuit in wiring harness (with another wiring harness)</td><td colspan="5">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="3">Wiring harness between CE03 (female) (3) – CE03 (female) (1) pin (with battery terminal disconnected)</td><td>Resistance</td><td>Min. 100 kΩ</td></tr>
<tr><td colspan="3">Wiring harness between CE03 (female) (3) – each of CE02 (female) pins (With battery terminal disconnected)</td><td>Resistance</td><td>Min. 100 kΩ</td></tr>
<tr><td colspan="3">Wiring harness between CE03 (female) (1) – each of CE02 (female) pins (With battery terminal disconnected)</td><td>Resistance</td><td>Min. 100 kΩ</td></tr>
<tr><td rowspan="6">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>8</td><td>Defective wiring harness connector</td><td colspan="5">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="4">9</td><td rowspan="4">Defective engine controller</td><td colspan="5">★ 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 colspan="2">Starting switch</td><td colspan="2">Voltage</td></tr>
<tr><td rowspan="2">Between (3) – (1)</td><td colspan="2">ON</td><td colspan="2">Min. 24 V</td></tr>
<tr><td colspan="2">START</td><td colspan="2">Min. 12 V</td></tr>
</table>

Circuit diagram related to engine controller power supply

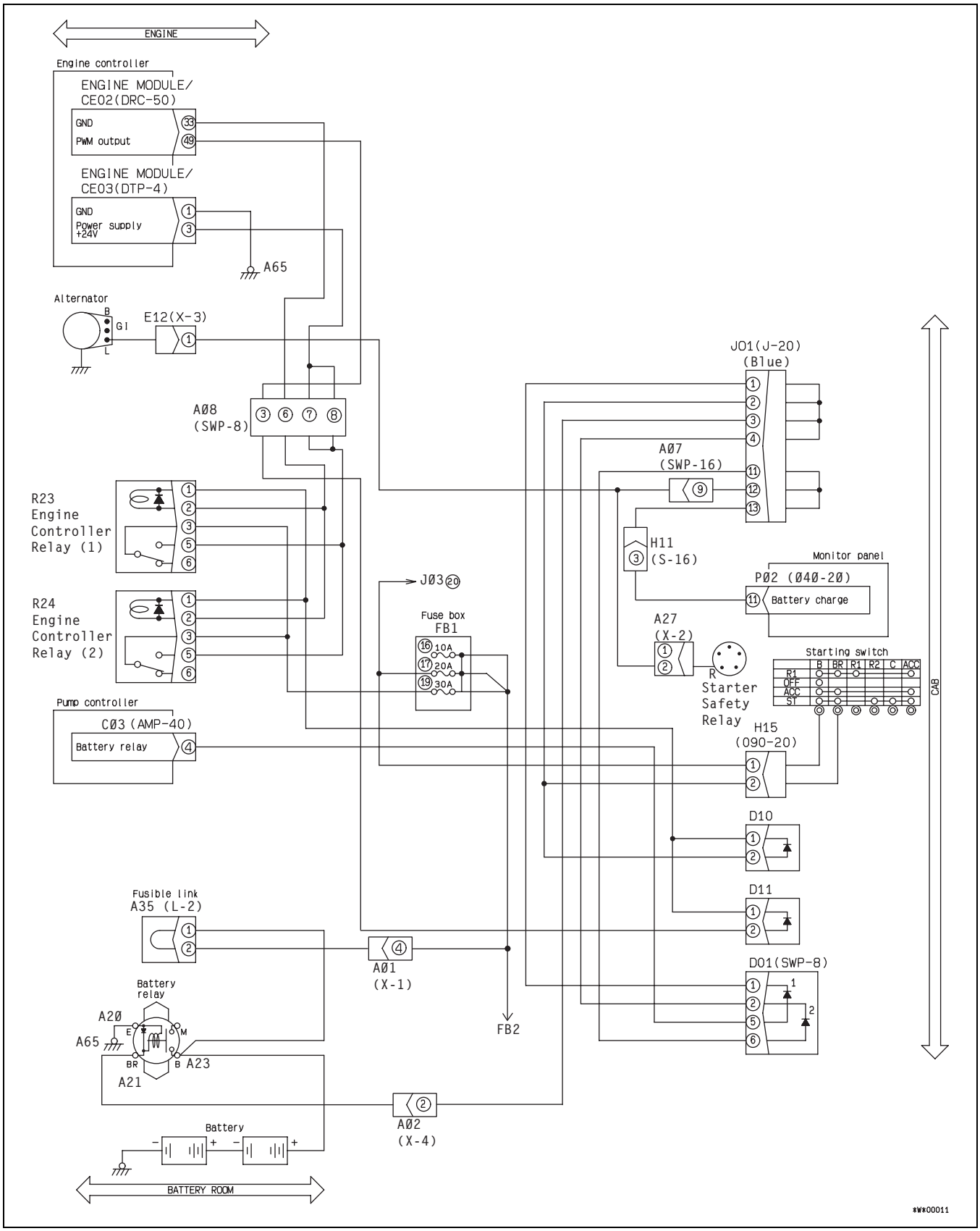


Failure code [CA442] Battery Voltage High Error

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	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Battery		Voltage
			Between (+) – (–) terminals		Max. 32 V
	2	Defective alternator	★ 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	★ 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.		

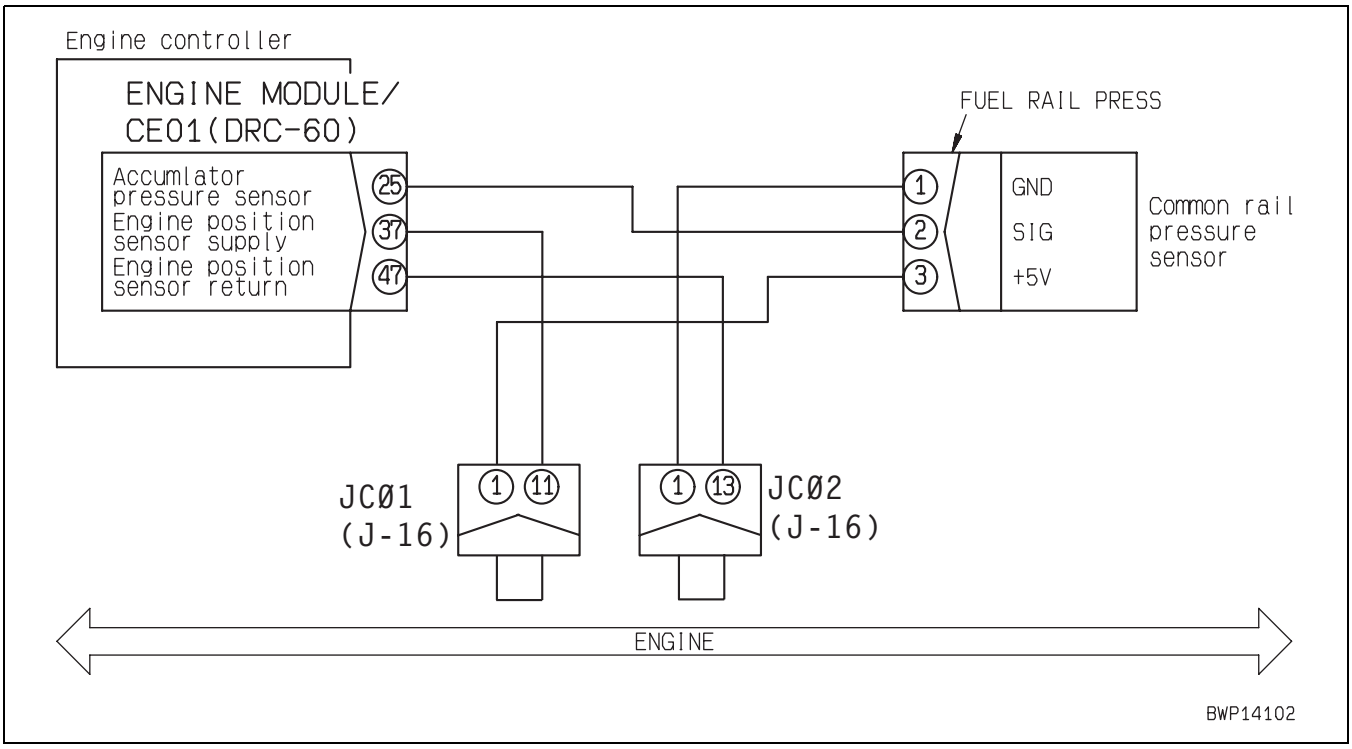
	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defect in related system	If another failure code is displayed, carry out troubleshooting for it.		
	2	Air in low pressure circuit	There may be air in low pressure circuit. Check it directly according to the following procedure. 1) Remove pressure pick-up plug (outlet side) of fuel main filter. 2) Operate feed pump of fuel pre-filter. 3) Check pressure pick-up plug for leakage of fuel and air.		
	3	Defect in fuel return circuit parts	★ 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	★ 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	★ 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	★ 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	★ 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)	★ 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	★ 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

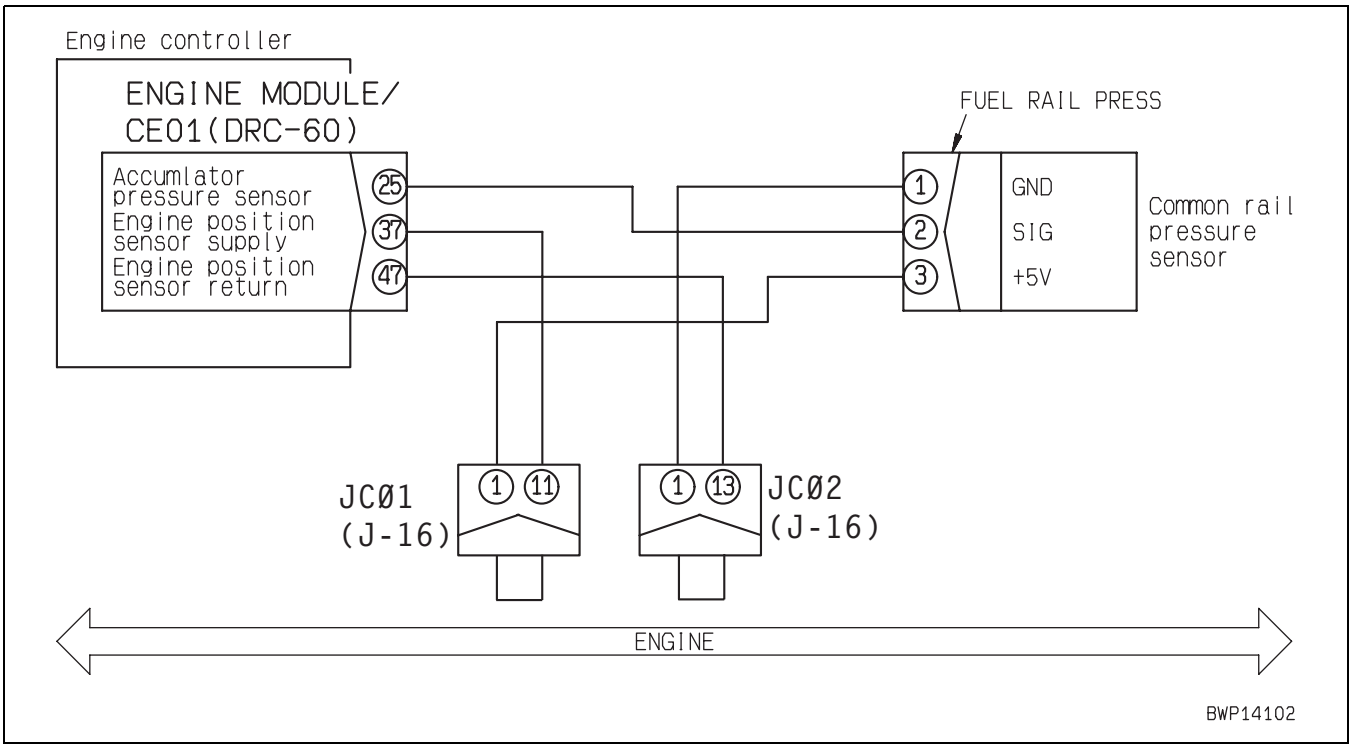


Failure code [CA452] Rail Press Sensor Low Error

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	★ 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)	★ 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)	★ 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	★ 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 after cooler	Cooling performance of after cooler may be low. Check following points directly. • Looseness and breakage of fan belt. • Insufficiency of cooling air • Clogging of after cooler 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	★ 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}
			★ 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}
			★ 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}
			★ 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}
			★ 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="11">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="3">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Defective injector (including high pressure piping in head)</td><td colspan="3">★ 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">★ 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">★ 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">★ 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 pick-up plug (outlet side) of fuel main filter.
2) Operate feed pump of fuel pre-filter.
3) Check pressure pick-up 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>

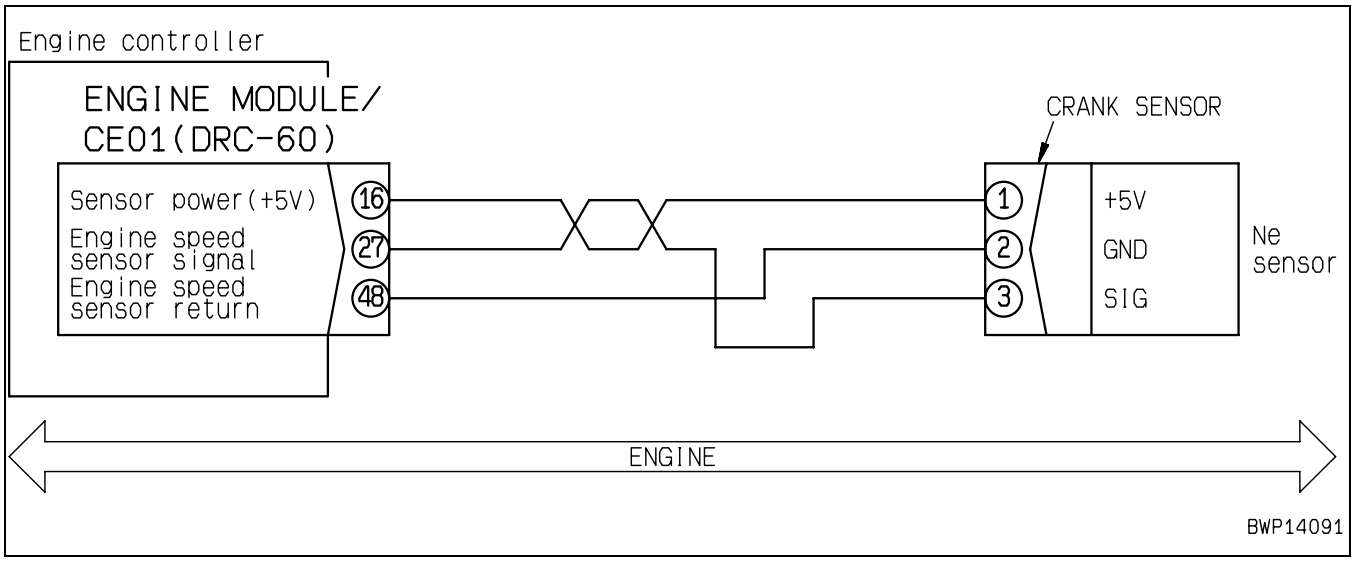
Failure code [CA689] Eng Ne Speed Sensor Error

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 Backup 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	★ 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)	★ 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)	★ 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	★ 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)	★ 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 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 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="3">10</td><td rowspan="3">Defective engine controller</td><td colspan="3">★ 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 (16) – (48)</td><td>Power supply</td><td>4.75 – 5.25 V</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.		

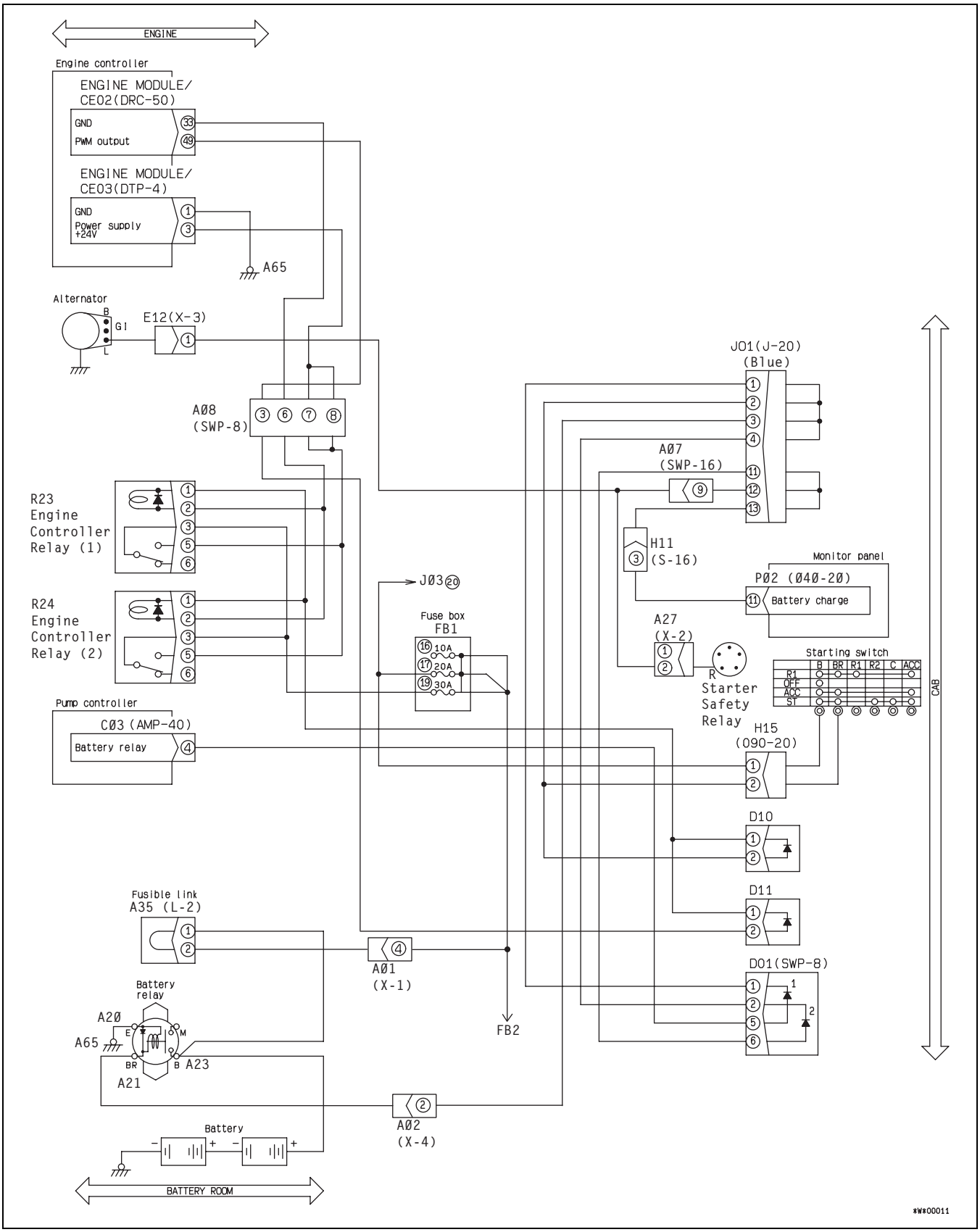
	Cause		Standard value in normal state/Remarks on troubleshooting
Possible causes and standard value in normal state	1	Breakage of engine Ne speed sensor	Engine Ne speed sensor may be broken. Check it directly.
	2	Breakage of engine G speed sensor	Engine G speed sensor may be broken. Check it directly.
	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 centre (Match stamped mark). 2) If centre 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 centre (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	★ 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	★ 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)	★ 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	★ 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

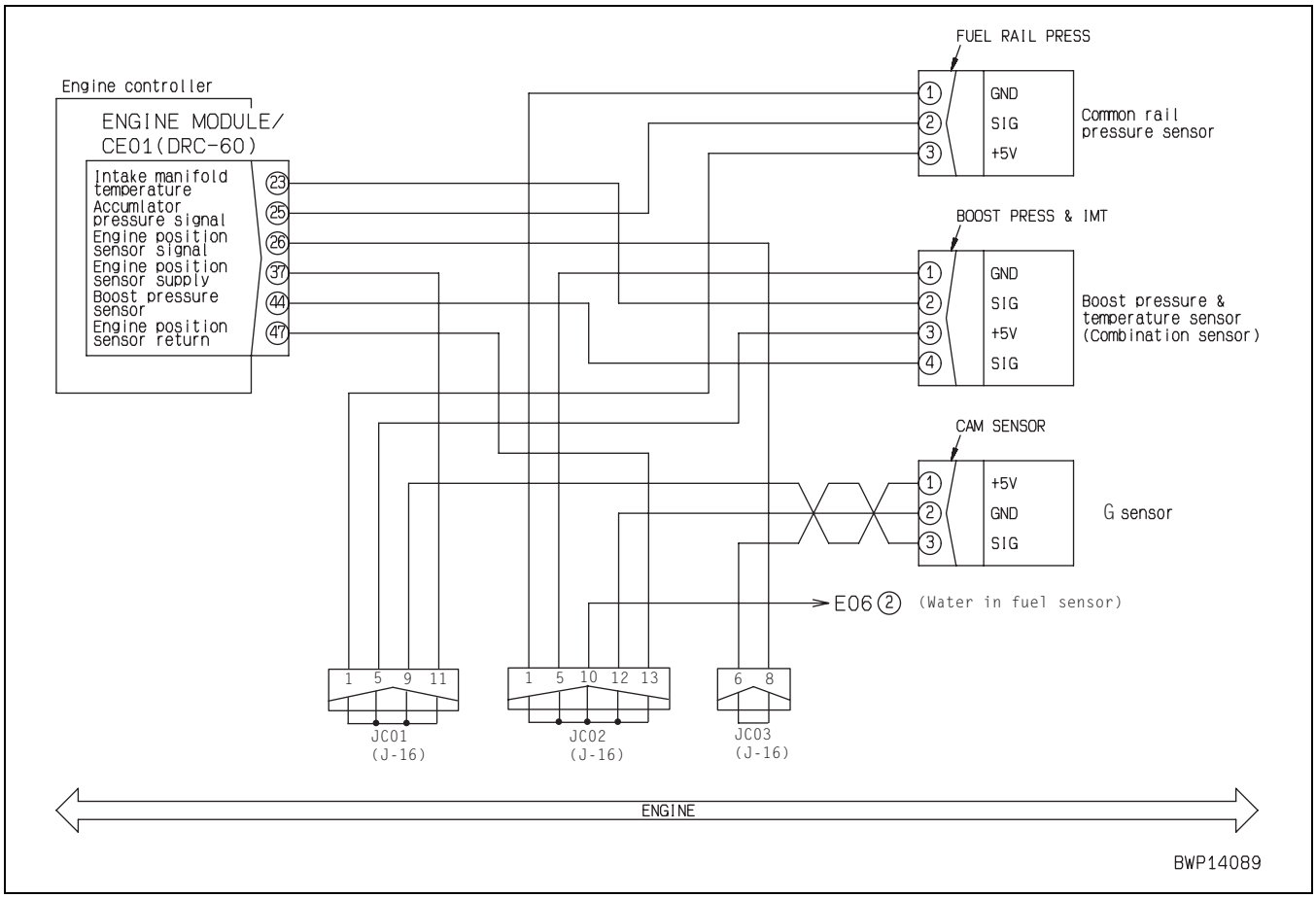


Failure code [CA778] Eng G Speed Sensor Error

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.		

<table>
<tr><td rowspan="14">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td>1</td><td>Defective sensor power supply 2 system</td><td colspan="4">If failure code [CA187] is also displayed, carry out troubleshooting for it first.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Defective engine G speed sensor</td><td colspan="4">★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.</td></tr>
<tr><td colspan="2">CAM SENSOR</td><td colspan="2">Voltage</td></tr>
<tr><td>Between (1) – (2)</td><td>Power supply</td><td colspan="2">4.75 – 5.25 V</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td>3</td><td>Breakage or improper clearance of engine G speed sensor</td><td colspan="4">Engine G speed sensor may be broken or may have improper clearance. Check it directly.</td></tr>
<tr><td>4</td><td>Breakage of rotation sensor ring</td><td colspan="4">Rotation sensor ring may be broken. Check it directly.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)</td><td colspan="4">★ 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) (26) – JC03 – CAM SENSOR (female) (3)</td><td>Resistance</td><td>Max. 10 Ω</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Ground fault in wiring harness (Short circuit with GND circuit)</td><td colspan="4">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between CE01 (female) (26) – JC03 – CAM SENSOR (female) (3)</td><td>Resistance</td><td>Min. 100 kΩ</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Hot short (Short circuit with 5V/24V circuit) in wiring harness</td><td colspan="4">★ 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) (26) – JC03 – CAM SENSOR (female) (3)</td><td>Voltage</td><td>Max. 1 V</td></tr>
<tr><td rowspan="3">8</td><td rowspan="3">Short circuit in wiring harness (with another wiring harness)</td><td colspan="4">★ 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) (26) – JC03 – CAM SENSOR (female) (3) or between CE01 (female) (37) – JC01 – CAM SENSOR (female) (1)</td><td>Resistance</td><td>Min. 100 kΩ</td></tr>
<tr><td colspan="2">Wiring harness between CE01 (female) (26) – JC03 – CAM SENSOR (female) (3) or between CE01 (female) (47) – JC02 – CAM SENSOR (female) (2)</td><td>Resistance</td><td>Min. 100 kΩ</td></tr>
<tr><td rowspan="6">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>9</td><td>Defective wiring harness connector</td><td colspan="4">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 rowspan="4">10</td><td rowspan="4">Defective engine controller</td><td colspan="4">★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.</td></tr>
<tr><td colspan="2">CE01</td><td colspan="2">Voltage</td></tr>
<tr><td>Between (37) – (47)</td><td>Power supply</td><td colspan="2">4.75 – 5.25 V</td></tr>
<tr><td colspan="4"></td></tr>
</table>

Circuit diagram related to engine G speed sensor



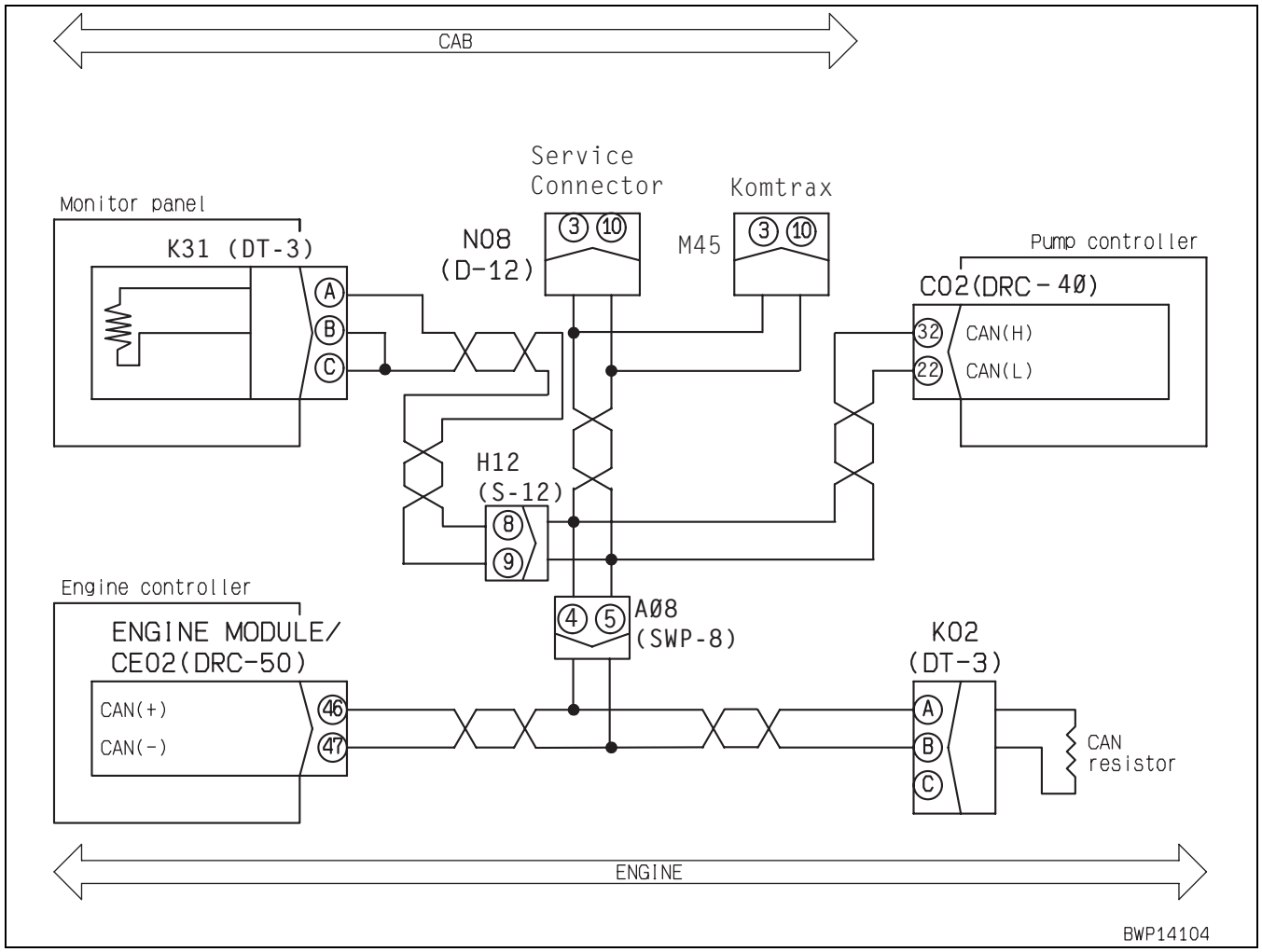
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Failure code [CA1633] KOMNET Datalink Timeout Error

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)	★ 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)	★ 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	★ 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)	★ 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

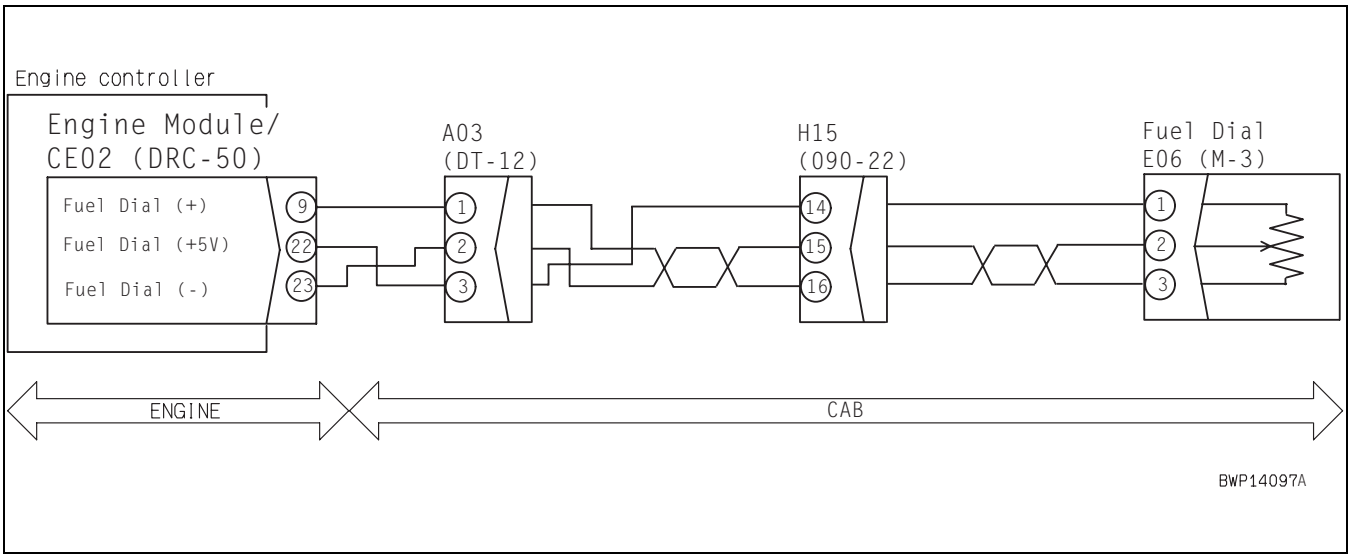


Failure code [CA2185] Throttle Sensor Supply Voltage High Error

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			★ 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

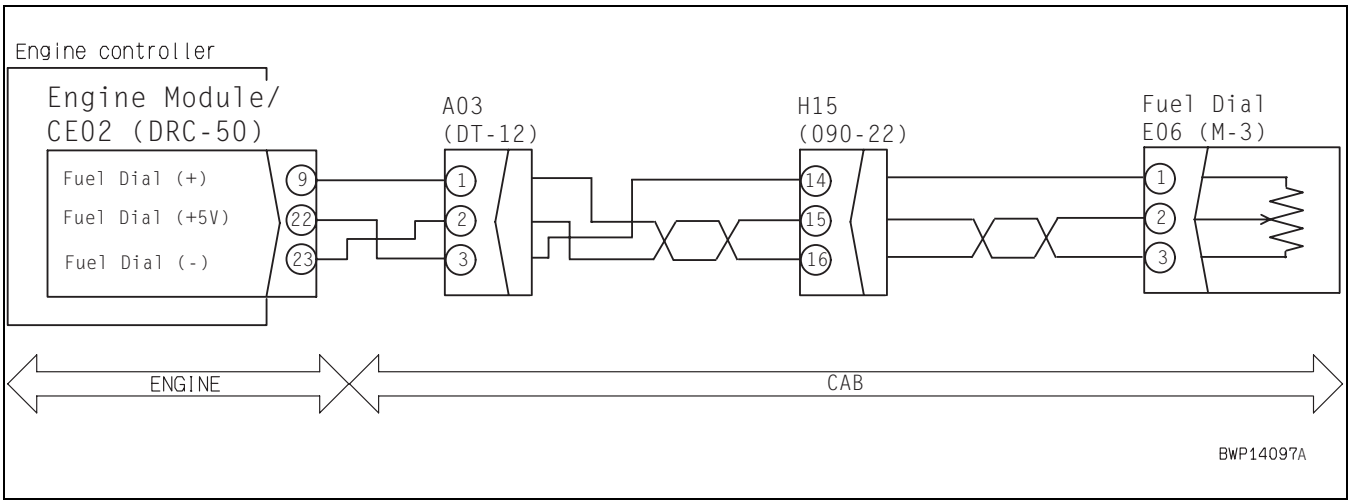


Failure code [CA2186] Throttle Sensor Supply Voltage Low Error

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)	★ 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)	★ 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].	

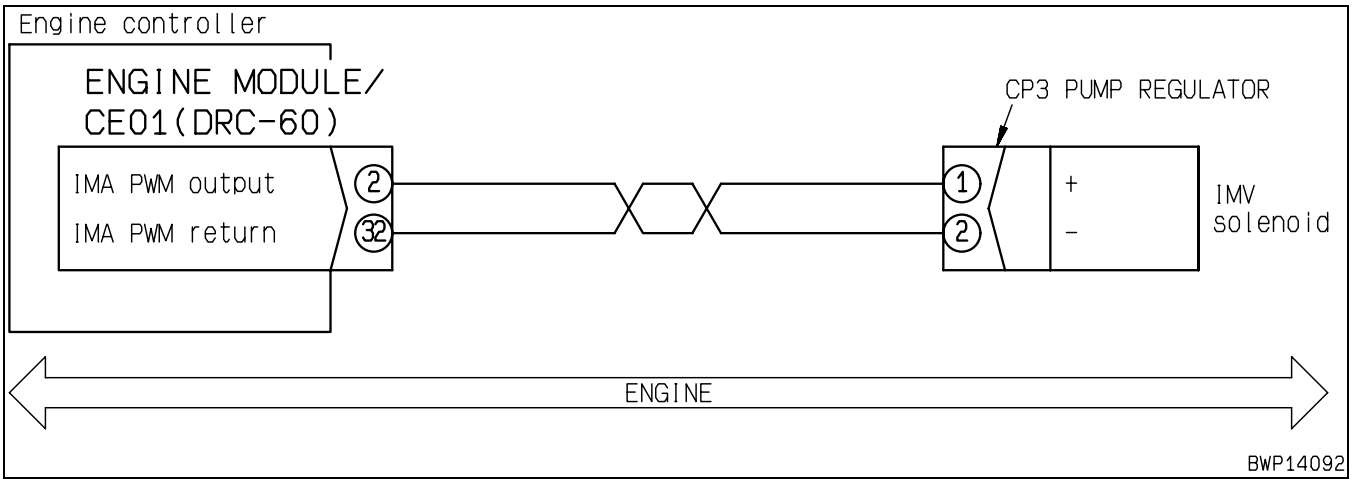
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Failure code [CA2311] IMV Solenoid Error

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.		

	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 supply pump actuator	★ 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)	★ 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)	★ 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	★ 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)

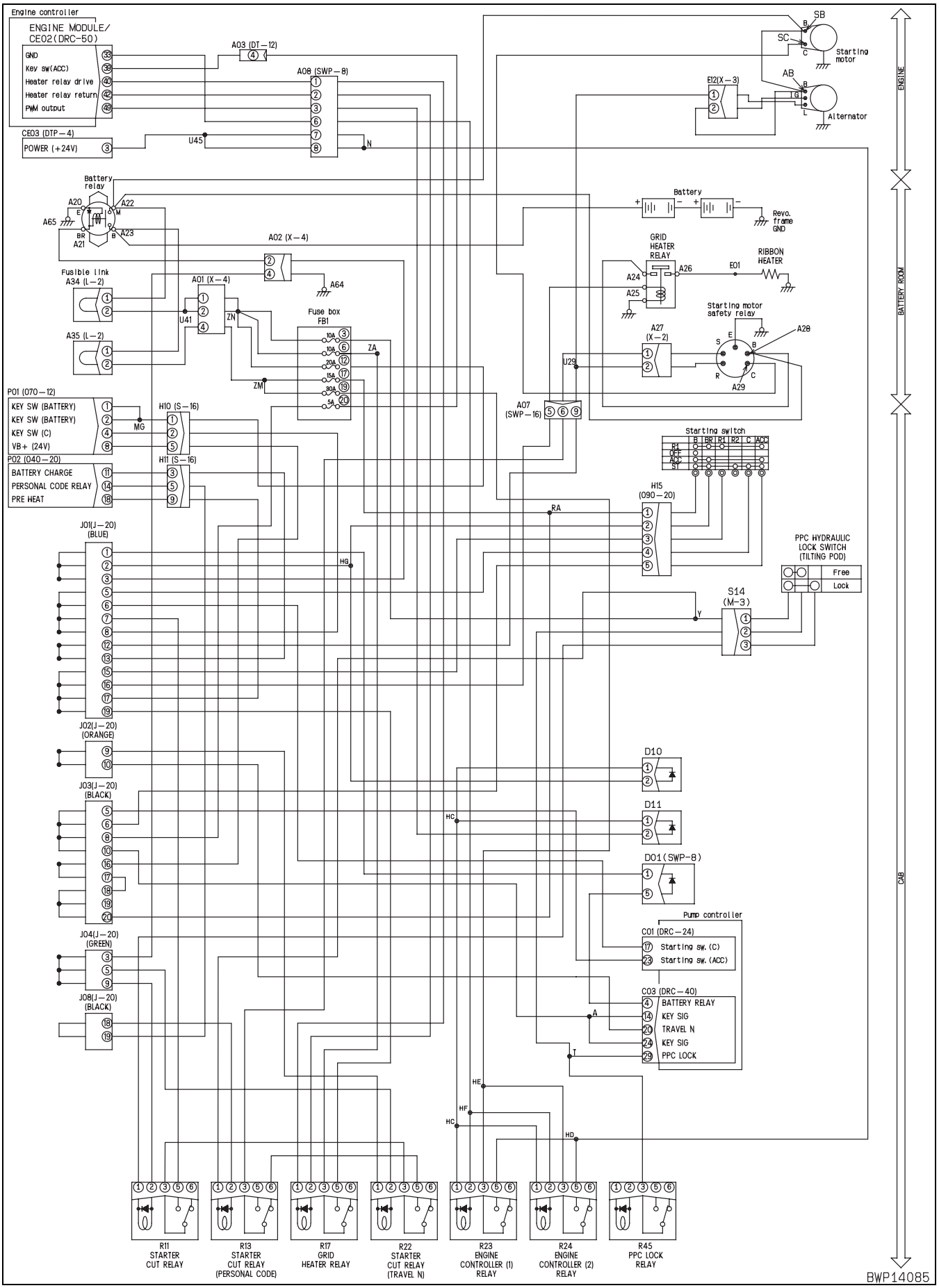


Failure code [CA2555] Grid Htr Relay Volt High Error

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)	★ 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	
			★ 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)	★ 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)	★ 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	★ 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

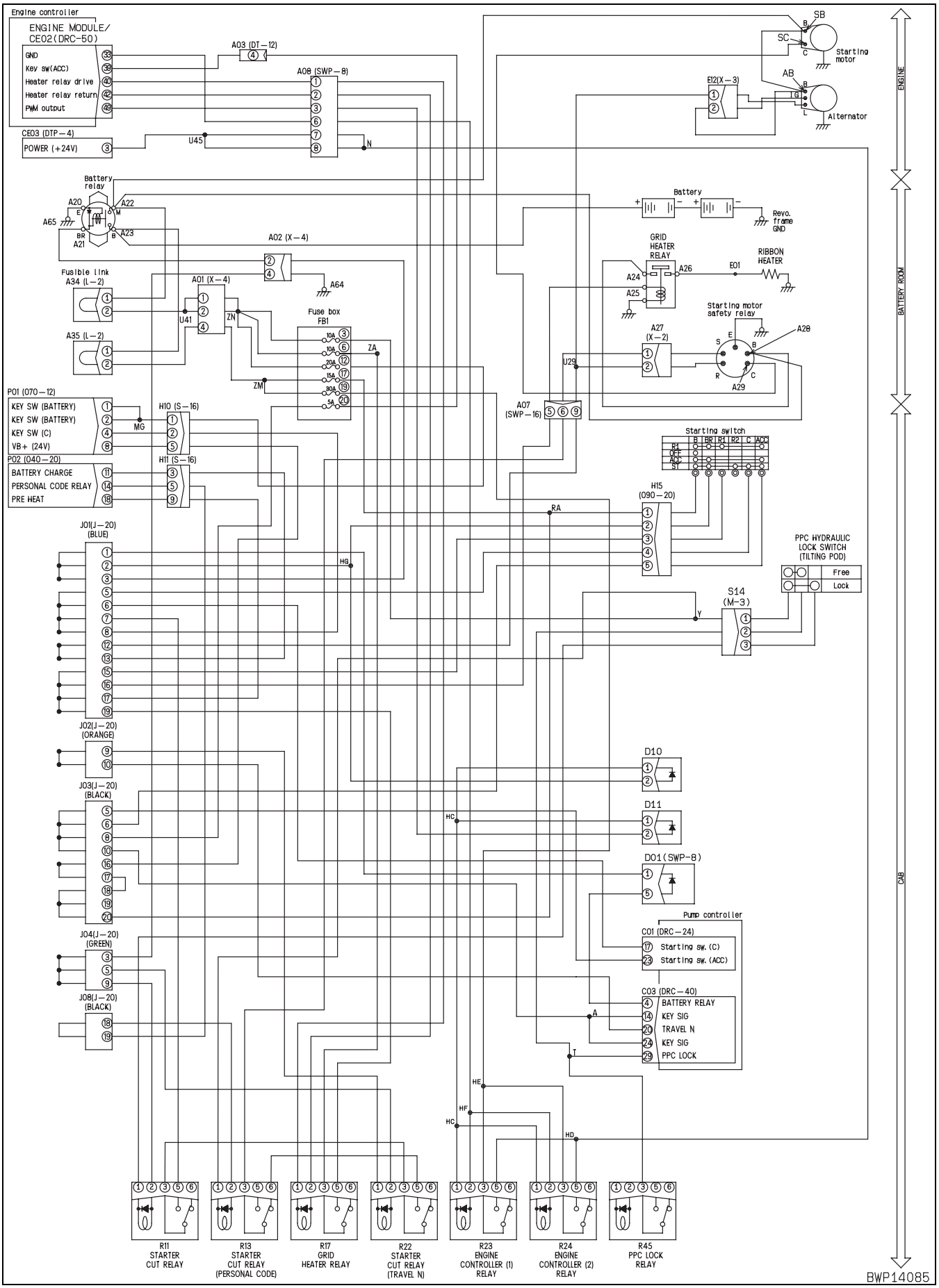


Failure code [CA2556] Grid Heater Relay Volt Low Error

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)	★ 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	
			★ 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)	★ 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)	★ 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	★ 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

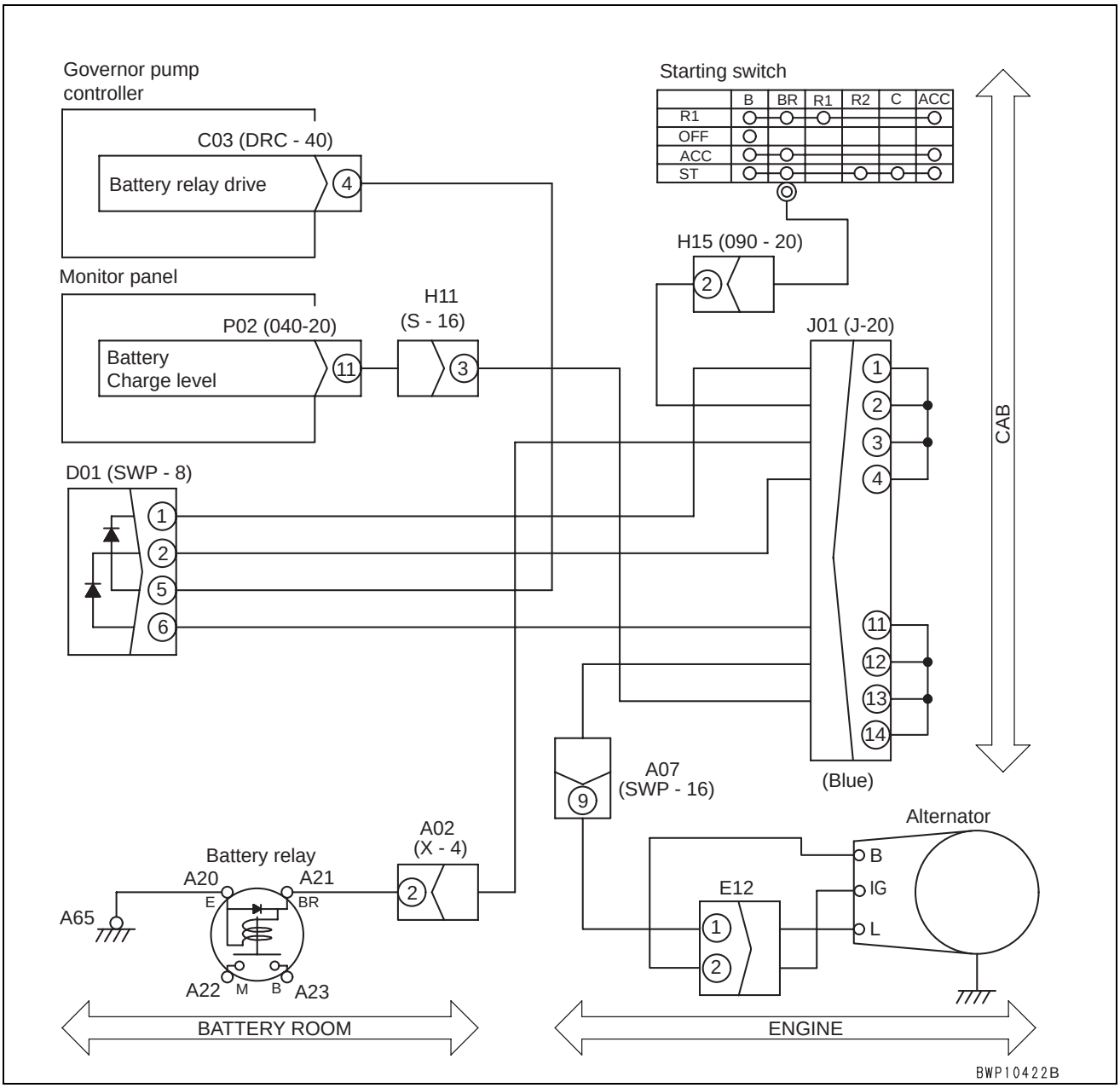


Failure Code [D110KB] (Short-circuiting in battery relay)

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

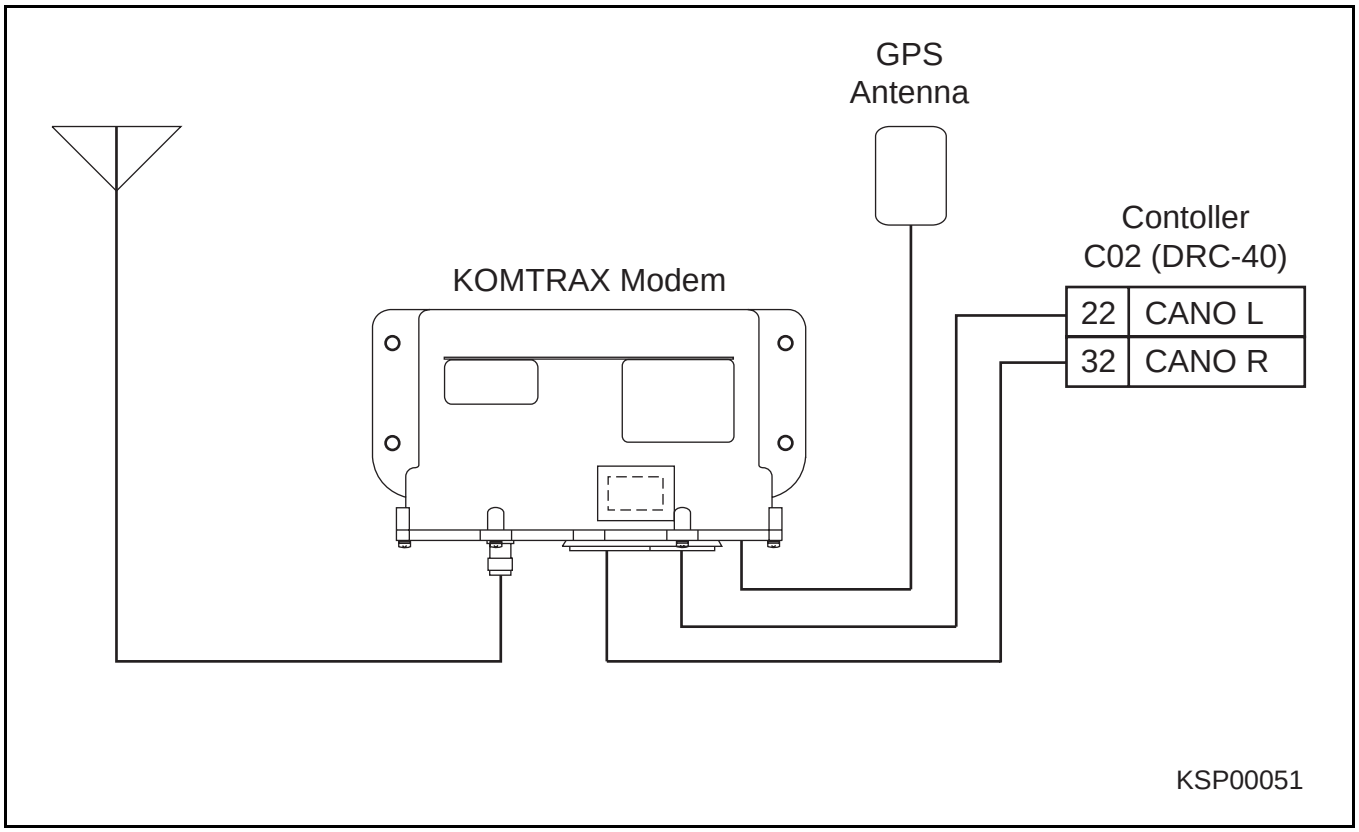


Failure code [D862KA] GPS Antenna Disconnection

User code	Failure code	Trouble	GPS antenna disconnection (KOMTRAX system in machine monitor)
—	**D862KA**		
Contents of trouble	• Disconnection was detected in GPS antenna circuit.		
Action of controller	• None in particular. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• GPS cannot measure position.		
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	Defective GPS antenna or antenna cable	GPS antenna may be defective and antenna cable may be disconnected or shorted and antenna cable may be connected defectively.

Configuration diagram of KOMTRAX system



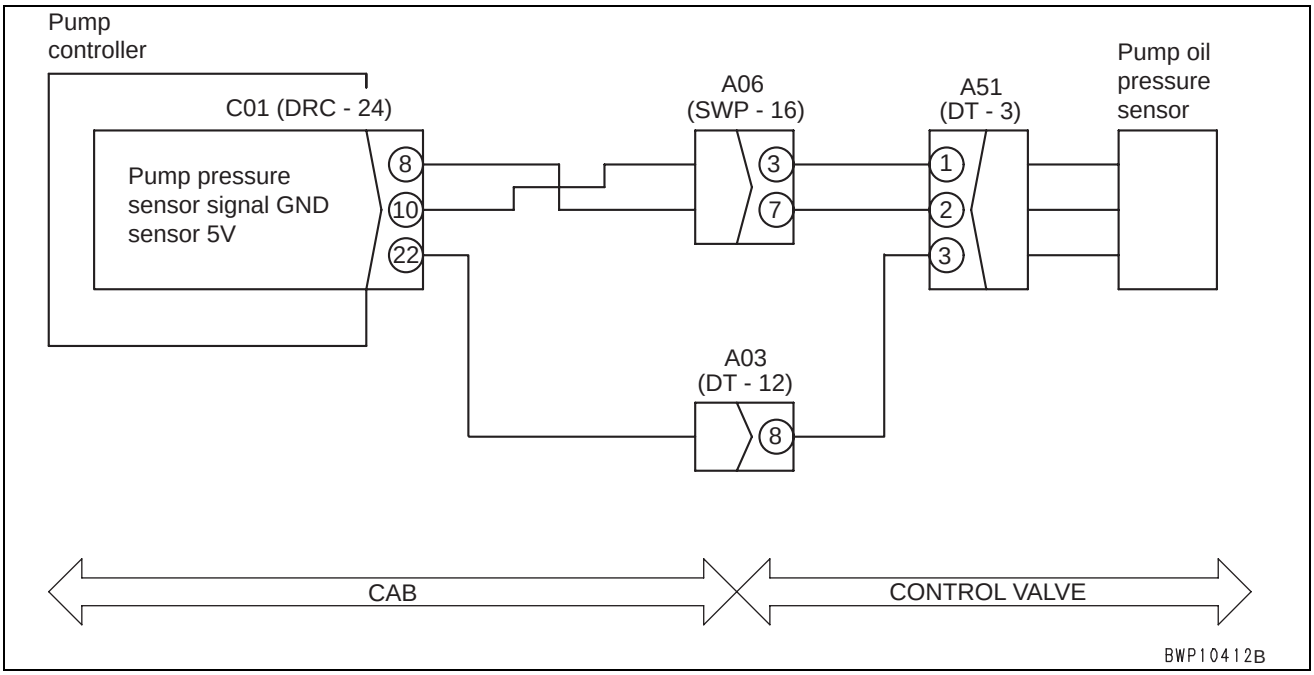
Blank for technical reason

Failure Code [DA22KK] (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

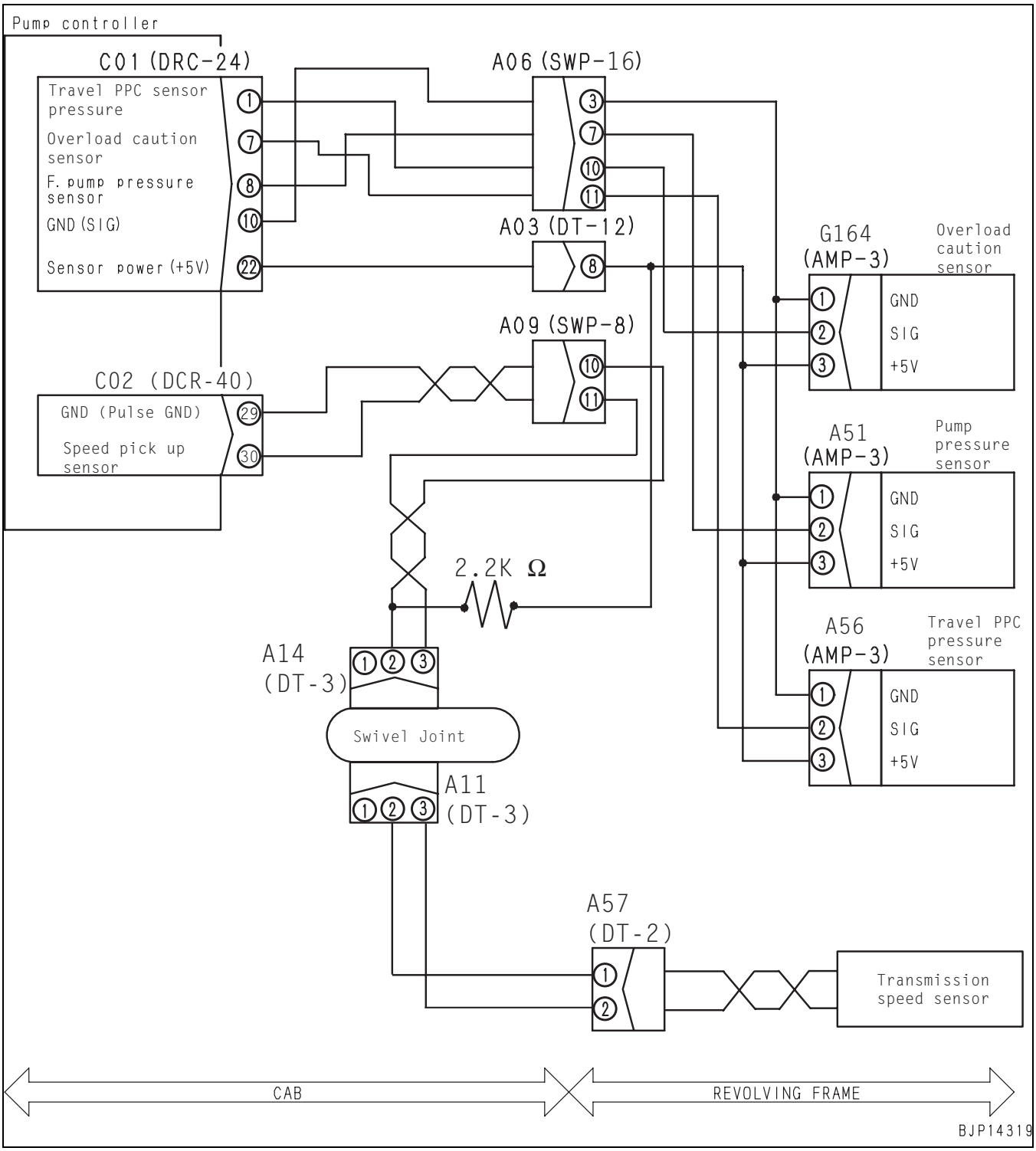


Failure code [DA25KP] Press. Sensor Power Abnormality

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)	★ 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)	★ 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	★ 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

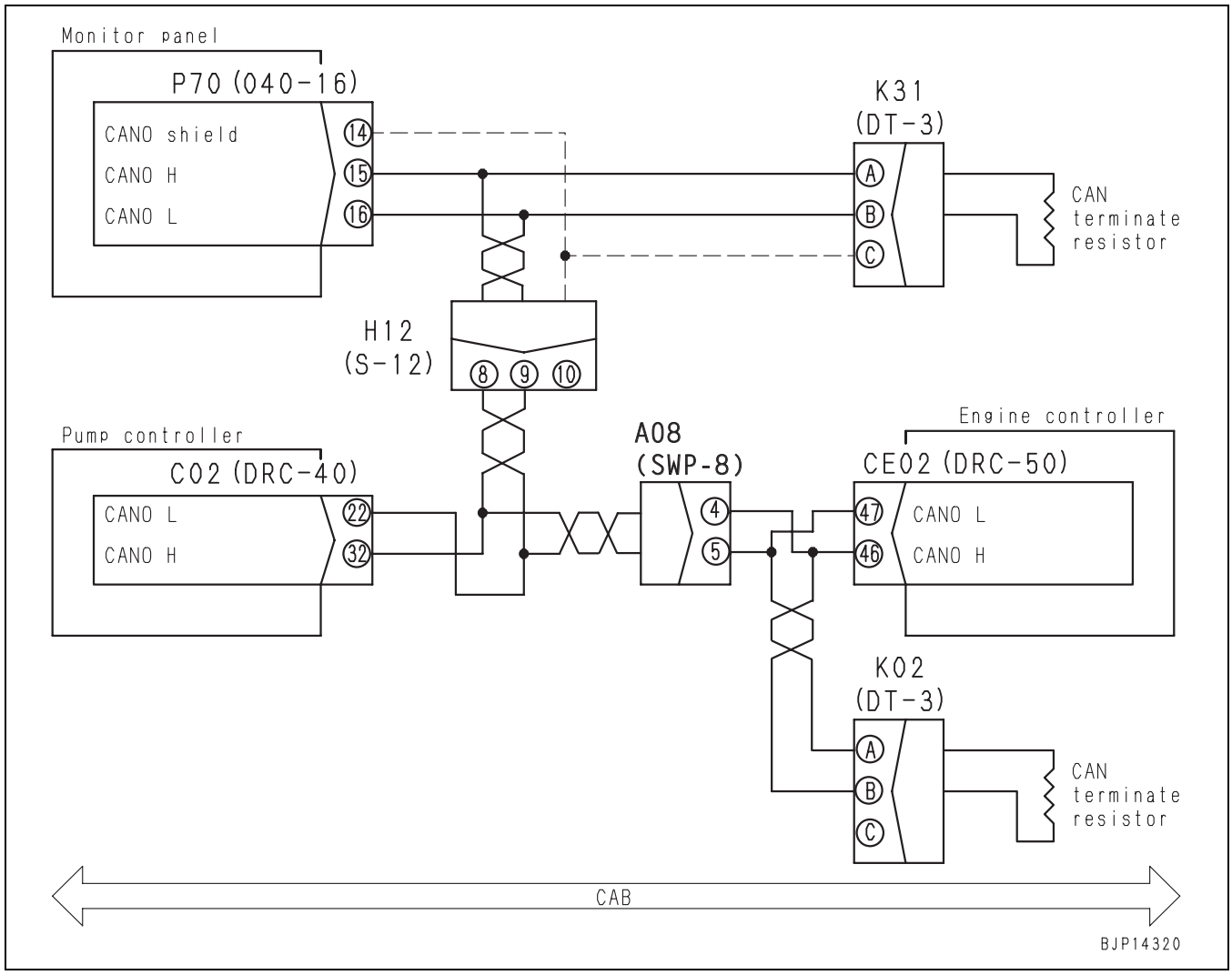


Failure code [DA2RMC] Pump Comm. Abnormality

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)	★ 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)	★ 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	★ 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	★ 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



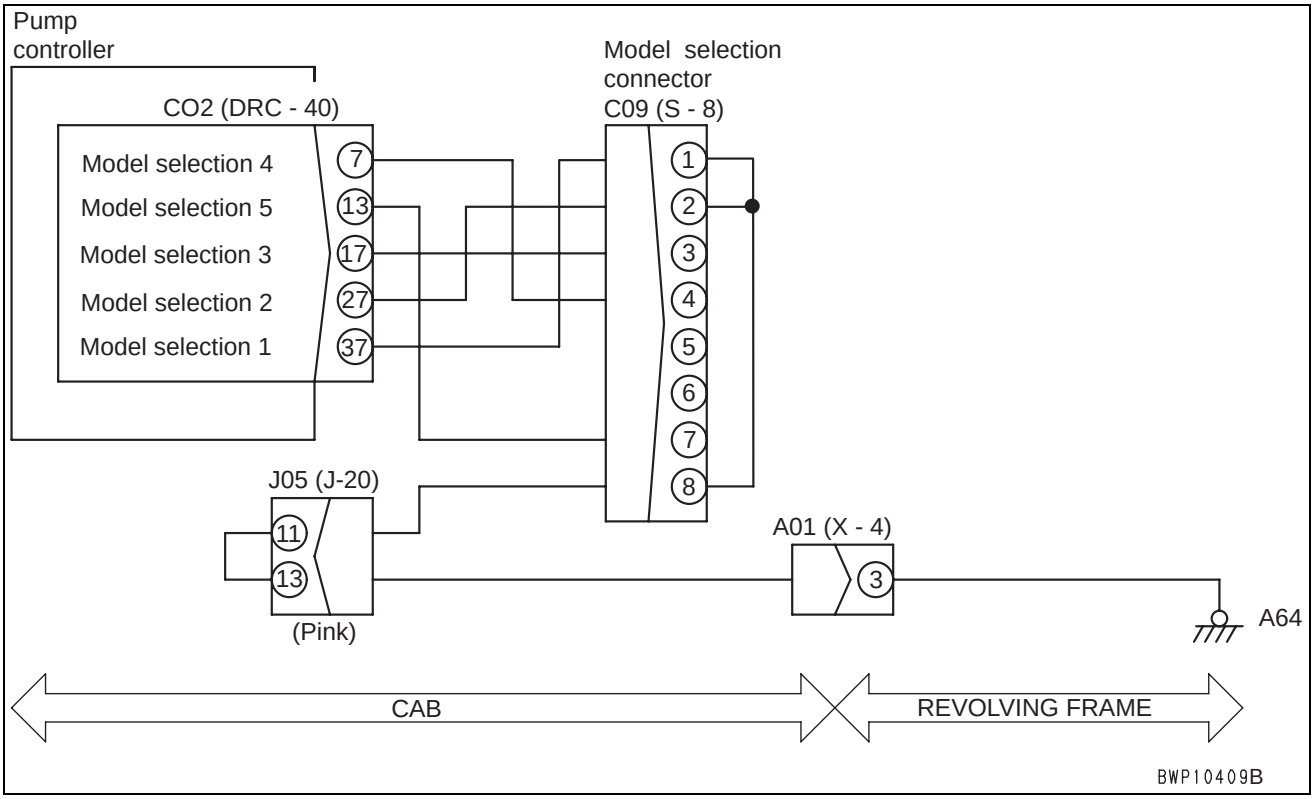
Failure Code [DA2SKQ] (Abnormality in inputting model code)

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.		

	Cause		Standard value in normal and references for troubleshooting			
Presumed cause and standard value in normal	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



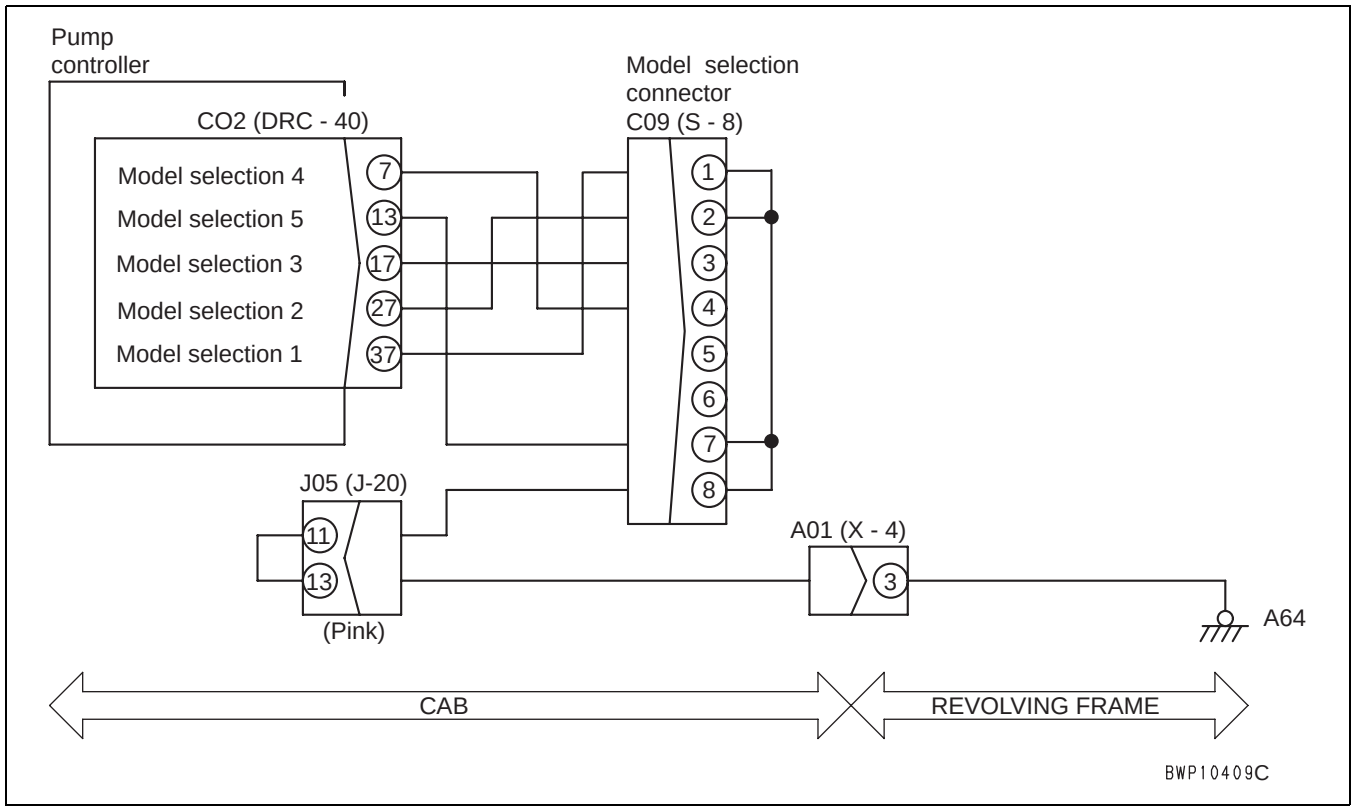
Failure Code [DA2SKQ] (Abnormality in inputting model code)

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		

	Cause		Standard value in normal and references for troubleshooting		
Presumed cause and standard value in normal	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

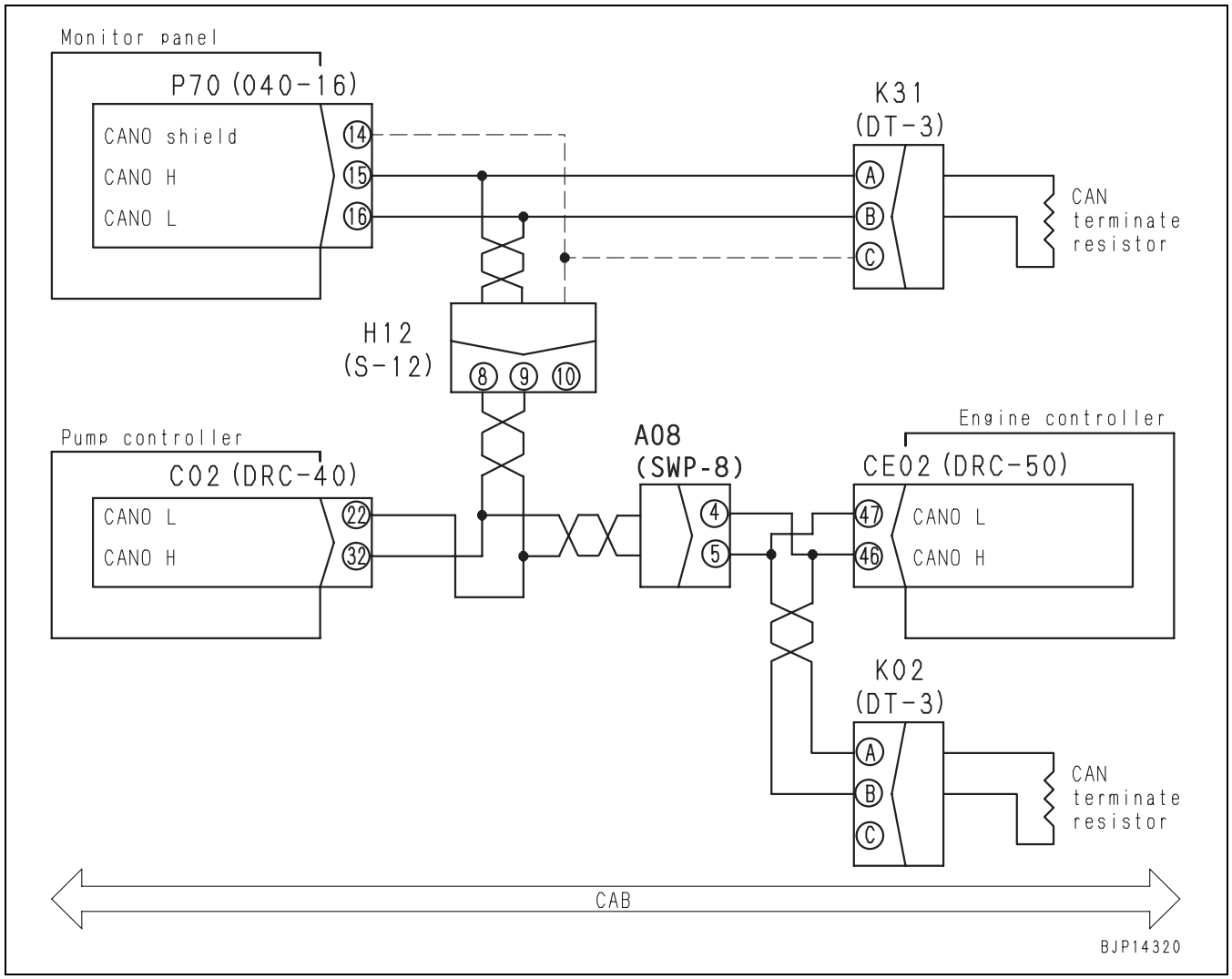


Failure code [DAFRMC] Monitor Comm. Abnormality

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)	★ 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)	★ 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	★ 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	★ 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

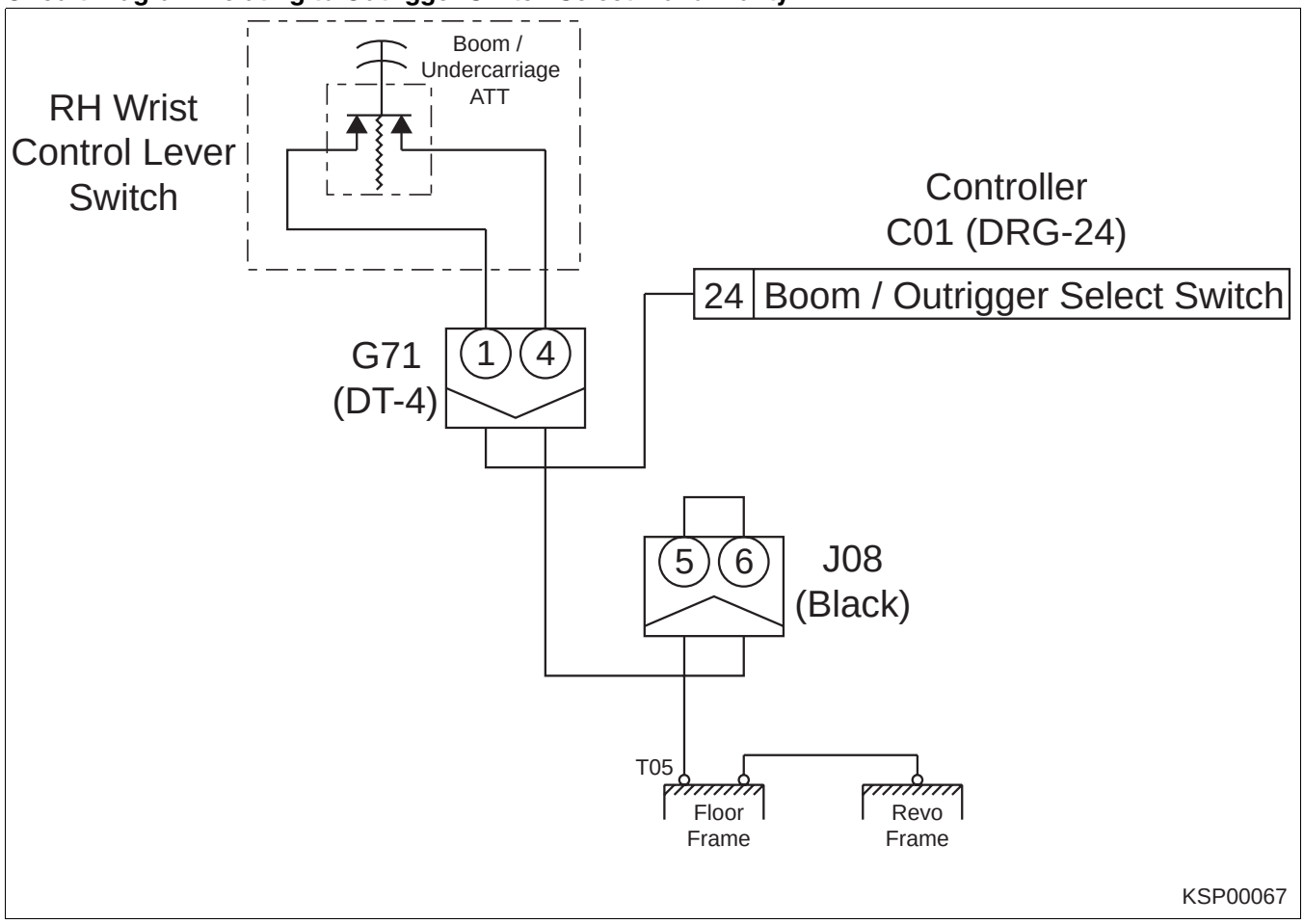


Failure code [DDC3KZ] Outrigger Switch Select Abnormality

User code	Failure code	Trouble	Outrigger Select Switch Abnormality
E20	**DDC3KZ**		
Contents of trouble	• Ground fault connection.		
Action of controller	• None in particular.		
Problem that appears on machine	• Control cannot be switched from boom to outrigger. OR • Control cannot be switched from outrigger to boom.		
Related information	• Outrigger select switch signal can be checked with monitoring function. (Code: 02301 Condition of Outrigger Select Switch) • 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 Boom/Undercarriage ATT Switch	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			G71 (Male)	Resistance with Button	
				Pressed	Not Pressed
			Between (1)-(4)	Max. 1Ω	Min. 1MΩ
	2	Disconnection in Wiring/ Harness (Disconnection in Wiring or Defective Contacting Connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between G71 (Female) (1) – C01 (Female) (24)	Resistance	Max. 1Ω
			Connecting ports between Boom/Undercarriage ATT Switch - Controller - Ground may be defective. Check them directly. • Looseness of connector, breakage of lock or breakage of steel. • Corrosion, bend, breakage, push-in or expansion of pin. • Moisture or dirt in connector or defective insulation.		
	3	Short Circuit in Wiring Harness (with another Wiring Harness)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between C01 (Female) (24) – each of C01 (Female) pins (With all wiring harness connectors disconnected)	Resistance	Min. 1MΩ
	4	Grounding Fault of Wiring Harness (Contact with Grounding Circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between C01 (Female) (24) - G71 (Female) (1) - ground.	Resistance	Min. 1MΩ
			Wiring harness between G71 (Female) (4) and ground.	Resistance	Max. 1Ω
	5	Pump Controller Defective.	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			C01 (Female)	Resistance	
			Between (24) and ground.	20 - 60 Ω	

Circuit Diagram Relating to Outrigger Switch Select Abnormality

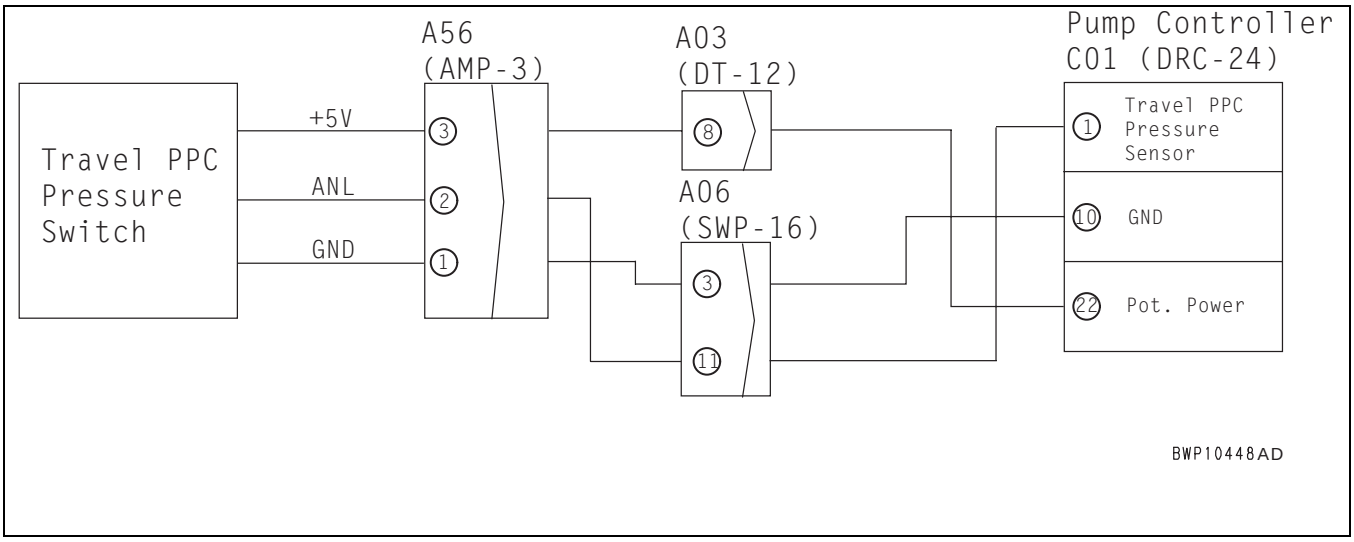


Failure Code [DDP4KX] (Abnormality in travel PPC pressure switch)

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 wiring 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

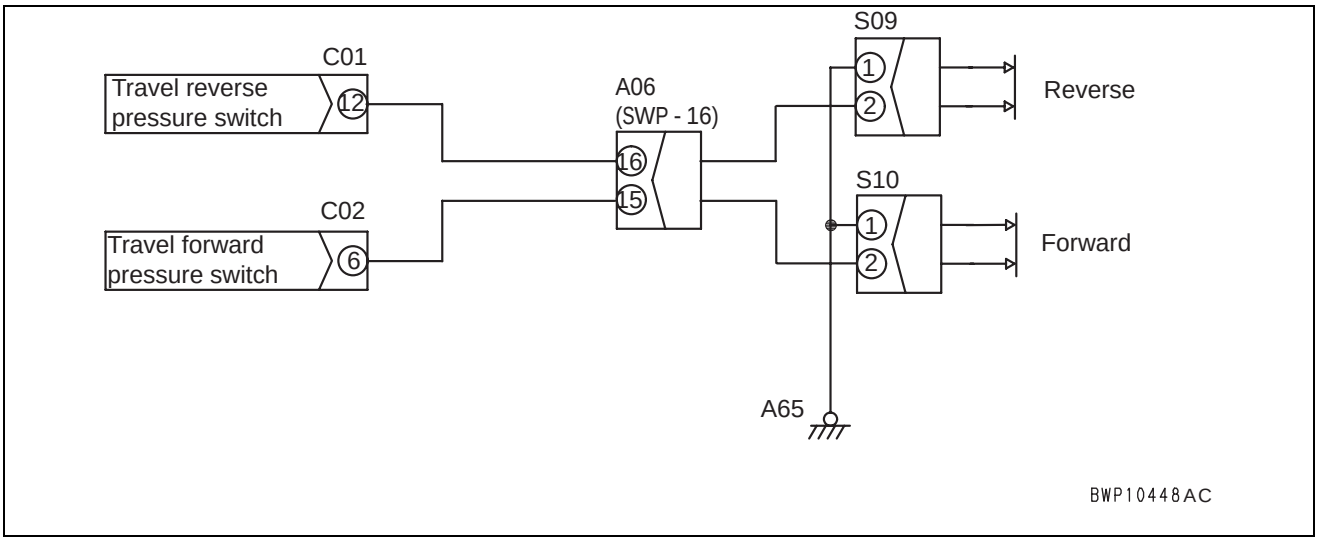


Failure Code [DDWCKZ] (Abnormality in travel direction control switch)

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 wiring 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.		

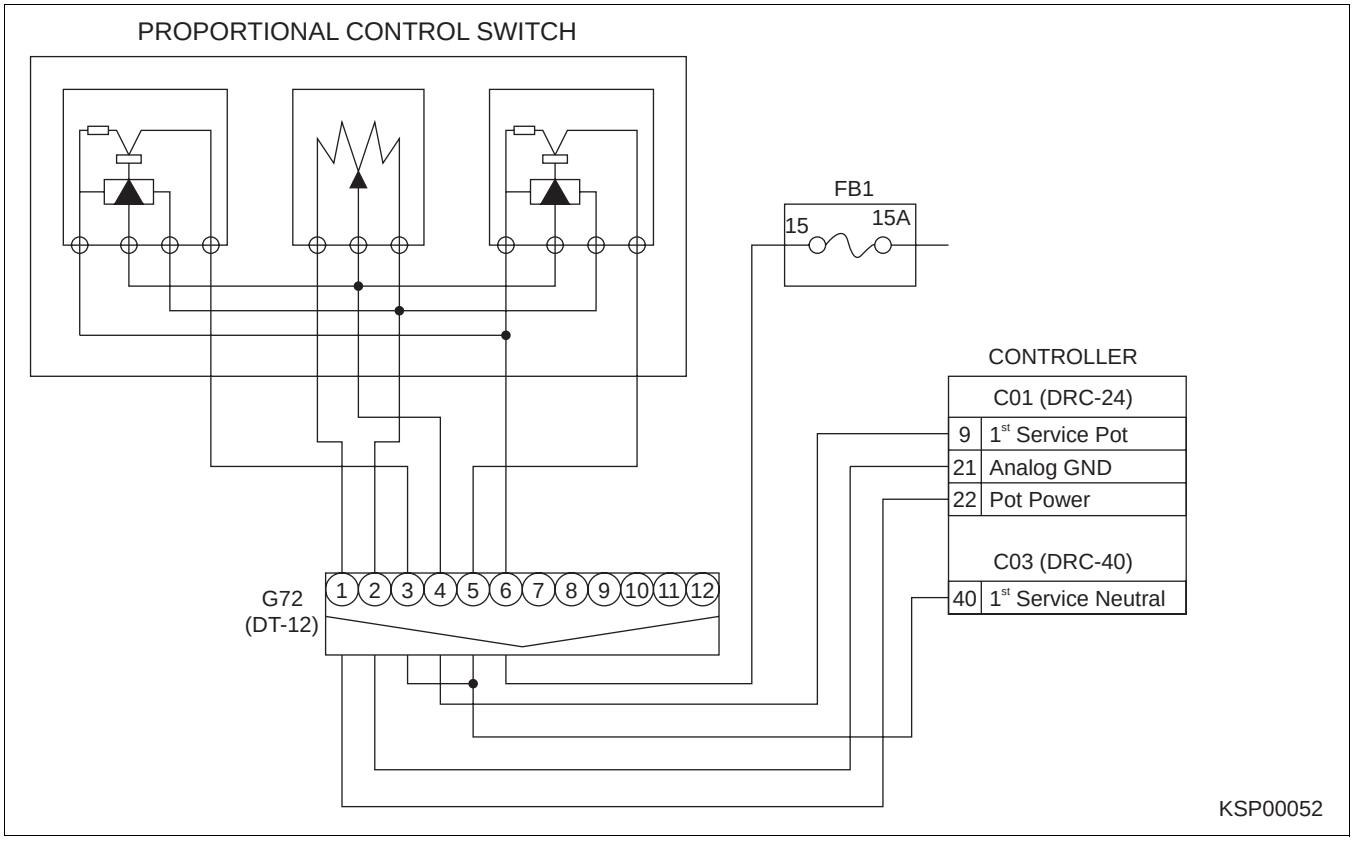
Electrical Circuit Diagram for Travel PPC Switch



Failure code [DFB1KZ] Service Lever Potentio 1 Abnormality

User code	Failure code	Trouble	RH Lever main potentiometer (for 1st Att.) has failure
—	**DFB1KZ**		
Contents of trouble	• Potentiometer's output voltage is out of range (below 0.4 volts or above 4.6 volts)		
Action of controller	• Turns output to service EPC solenoids (EPC1 & EPC2) OFF. • Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine	• 1st Attachment does not operate.		
Related information	• Main potentio output voltage can be checked with monitoring function. (Code: 42008 Lever potentio 1 volt (Main)) • Sub potentio output voltage can be checked with monitoring function. (Code 42009 Lever potentio 1 volt (Sub)) • Potentiometer stroke can be checked with monitoring function. (Code 42012 Lever potentio 1 stroke) • Method of reproducing failure code : Turn starting switch to ON + set in attachment mode (ATT)..		

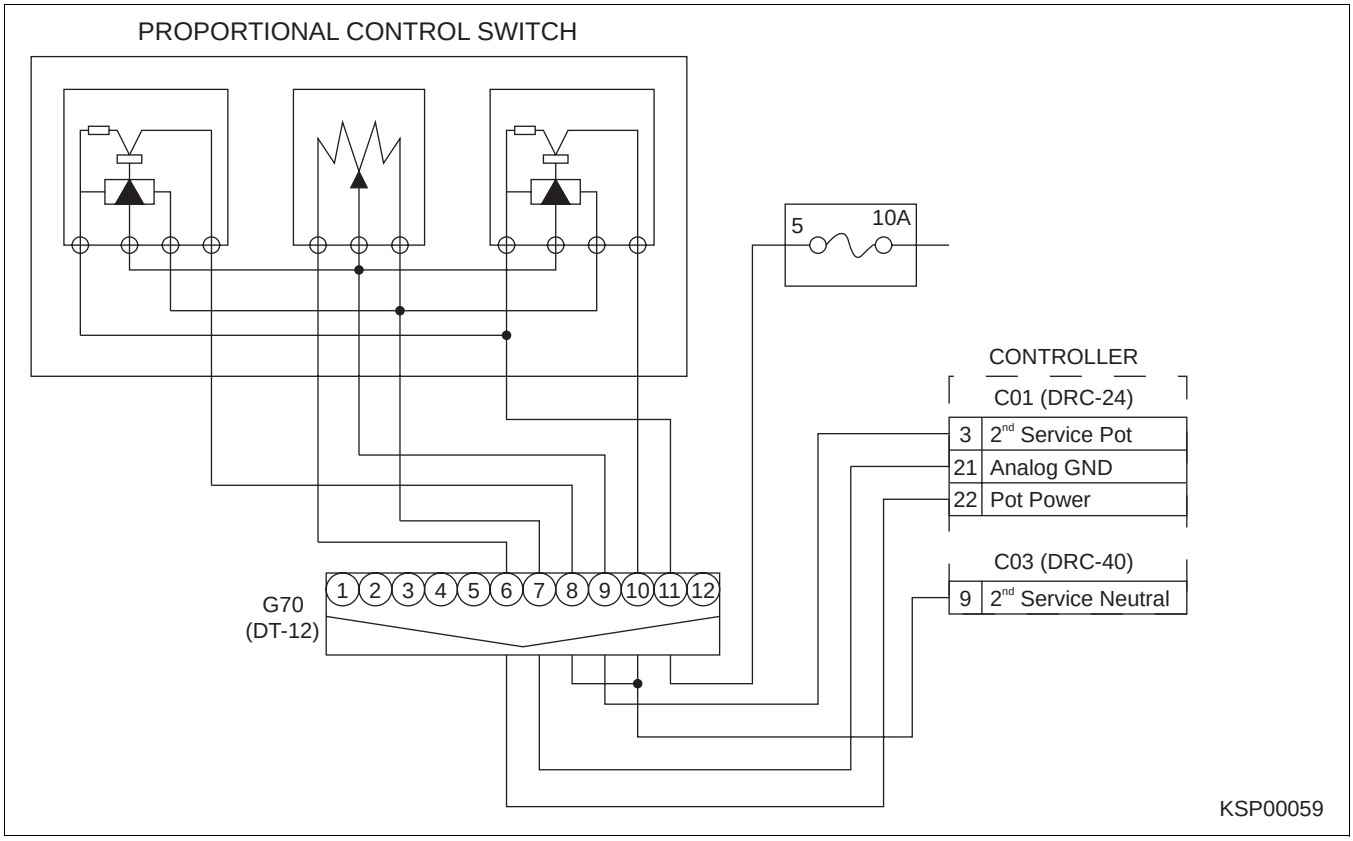
<table>
<tr><td rowspan="15">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="9">1</td><td rowspan="9">Defective RH lever assembly</td><td colspan="4">★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.</td></tr>
<tr><td rowspan="4">Monitoring function code
: 42008
Lever potentio 1
Volt (Main)</td><td colspan="2">Lever slide sw Neutral</td><td>2.5 ± 0.3 V</td></tr>
<tr><td colspan="2">Lever slide sw Upper max.</td><td>4.0 ~ 4.6 V</td></tr>
<tr><td colspan="2">Lever slide sw Lower max.</td><td>0.4 ~ 1.0 V</td></tr>
<tr><td colspan="3">If voltage is 0V and no movement, disconnection or ground short may be the cause.
If voltage is 5V and no movement, hot short may be the cause.</td></tr>
<tr><td colspan="2">G72 (female)</td><td>Voltage</td></tr>
<tr><td>Between (1) - (2)</td><td>Potentio 5V supply</td><td>4.5 ~ 5.5 V</td></tr>
<tr><td rowspan="3">Between (4) - (2)
Potentio output</td><td>Lever slide sw Neutral</td><td>2.5 ± 0.3 V</td></tr>
<tr><td>Lever slide sw Upper max.</td><td>4.0 ~ 4.6 V</td></tr>
<tr><td>Lever slide sw Lower max.</td><td>0.4 ~ 1.0 V</td></tr>
<tr><td colspan="4">If G72 (1) - (2) voltage 0V, disconnection may be the cause.</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">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between G72 (female) (1) - C01 (female) (22)</td><td>Resistance</td><td>Max.1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between G72 (female) (2) - C01 (female) (21)</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">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between G72 (female) (1) - C01 (female) (22)</td><td>Resistance</td><td>Min.100 kΩ</td></tr>
<tr><td colspan="2">Wiring harness between G72 (female) (4) - C01 (female) (9)</td><td>Resistance</td><td>Min.100 kΩ</td></tr>
<tr><td rowspan="7">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Hot short (Short circuit with 5 Volts circuit) in wiring harness.</td><td colspan="4">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between G72 (female) (4) - G72 (female) (1).
(Measure it disconnecting G72 connector).</td><td>Resistance</td><td>Min.100 kΩ</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Ground fault in wiring harness . (No secure GND from pump controller).</td><td colspan="4">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between G72 (female (2) - chassis GND</td><td>Resistance</td><td>Max.30 Ω</td></tr>
<tr><td>6</td><td>Defective pump controller.</td><td colspan="4">If cause 1 -5 are not detected, pump controller may be defective.
(Since trouble is in system, troubleshooting cannot be carried out).</td></tr>
</table>


PROPORTIONAL CONTROL SWITCH
FB1
15
15A
CONTROLLER
C01 (DRC-24)
9 1st Service Pot
21 Analog GND
22 Pot Power
C03 (DRC-40)
40 1st Service Neutral
G72
(DT-12)
1 2 3 4 5 6 7 8 9 10 11 12
KSP00052

Failure code [DFB2KZ] Service Lever Potentio 2 Abnormality

User code	Failure code	Trouble	LH Lever main potentiometer (for 2nd Att.) has failure
—	**DFB2KZ**		
Contents of trouble	• Potentiometer's output voltage is out of range (below 0.4 volts or above 4.6 volts)		
Action of controller	• Turns output to service EPC solenoids (EPC3 & EPC4) OFF. • Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine	• 2nd Attachment does not operate.		
Related information	• Main potentio output voltage can be checked with monitoring function. (Code: 42010 Lever potentio 2 volt (Main)) • Sub potentio output voltage can be checked with monitoring function. (Code 42011 Lever potentio 2 volt (Sub)) • Potentiometer stroke can be checked with monitoring function. (Code 42013 Lever potentio 2 stroke) • Method of reproducing failure code : Turn starting switch to ON + set in attachment mode (ATT)..		

<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="11">1</td><td rowspan="11">Defective LH lever assembly</td><td colspan="4">★ Prepare with starting switch OFF, then turn starting switch ON and carry out troubleshooting.</td></tr>
<tr><td rowspan="3">Monitoring function code : 42010
Lever potentio 2 Volt (Main)</td><td>Lever slide sw Neutral</td><td colspan="2">2.5 ± 0.3 V</td></tr>
<tr><td>Lever slide sw Upper max.</td><td colspan="2">4.0 ~ 4.6 V</td></tr>
<tr><td>Lever slide sw Lower max.</td><td colspan="2">0.4 ~ 1.0 V</td></tr>
<tr><td colspan="3">If voltage is 0V and no movement, disconnection or ground short may be the cause.
If voltage is 5V and no movement, hot short may be the cause.</td></tr>
<tr><td colspan="2">G70 (female)</td><td colspan="2">Voltage</td></tr>
<tr><td>Between (7) - (9)</td><td>Potentio 5V supply</td><td colspan="2">4.5 ~ 5.5 V</td></tr>
<tr><td rowspan="3">Between (9) - (17) Potentio output</td><td>Lever slide sw Neutral</td><td colspan="2">2.5 ± 0.3 V</td></tr>
<tr><td>Lever slide sw Upper max.</td><td colspan="2">4.0 ~ 4.6 V</td></tr>
<tr><td>Lever slide sw Lower max.</td><td colspan="2">0.4 ~ 1.0 V</td></tr>
<tr><td colspan="4">If G70 (6) - (7) voltage 0V, disconnection may be the cause.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Disconnection in wiring harness. (Disconnection in wiring or defective contact in connector).</td><td colspan="4">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between G70 (female) (6) - C01 (female) (22)</td><td>Resistance</td><td>Max.1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between G70 (female) (7) - C01 (female) (21)</td><td>Resistance</td><td>Max.1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between G70 (female) (9) - C01 (female) (3)</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">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between G70 (female) (6) - C01 (female) (22)</td><td>Resistance</td><td>Min.100 kΩ</td></tr>
<tr><td colspan="2">Wiring harness between M23 (female) (9) - C01 (female) (3)</td><td>Resistance</td><td>Min.100 kΩ</td></tr>
<tr><td rowspan="8">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Hot short (Short circuit with 5 Volts circuit) in wiring harness.</td><td colspan="4">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between G70 (female) (9) - G70 (female) (6).
(Measure it disconnecting G70 connector).</td><td>Resistance</td><td>Min.100 kΩ</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Ground fault in wiring harness . (No secure GND from pump controller).</td><td colspan="4">★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.</td></tr>
<tr><td colspan="2">Wiring harness between G70 (female (7) - chassis GND</td><td>Resistance</td><td>Max.30 Ω</td></tr>
<tr><td>6</td><td>Defective pump controller.</td><td colspan="4">If cause 1 -5 are not detected, pump controller may be defective.
(Since trouble is in system, troubleshooting cannot be carried out).</td></tr>
</table>


PROPORTIONAL CONTROL SWITCH
5
10A
CONTROLLER
C01 (DRC-24)
3 2nd Service Pot
21 Analog GND
22 Pot Power
C03 (DRC-40)
9 2nd Service Neutral
G70
(DT-12)
1 2 3 4 5 6 7 8 9 10 11 12
KSP00059

Failure code [DFB3L8] Service Lever 1 Potentio Error

User code	Failure code	Trouble	RH Lever main potentiometer (for 1st Att.) has failure
—	**DFB3L8**		
Contents of trouble	• Summation of Potentiometer's output voltage is out of range (below 4.5 volts or above 5.5 volts)		
Action of controller	• Turns output to service EPC solenoids (EPC1 & EPC2) OFF. • Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine	• 1st Attachment does not operate.		
Related information	• Main potentio output voltage can be checked with monitoring function. (Code: 42008 Lever potentio 1 volt (Main)) • Sub potentio output voltage can be checked with monitoring function. (Code 42009 Lever potentio 1 volt (Sub)) • Potentiometer stroke can be checked with monitoring function. (Code 42012 Lever potentio 1 stroke) • Method of reproducing failure code : Turn starting switch to ON + set in attachment mode (ATT)..		

- For troubleshooting, carry out [DFB1KZ].

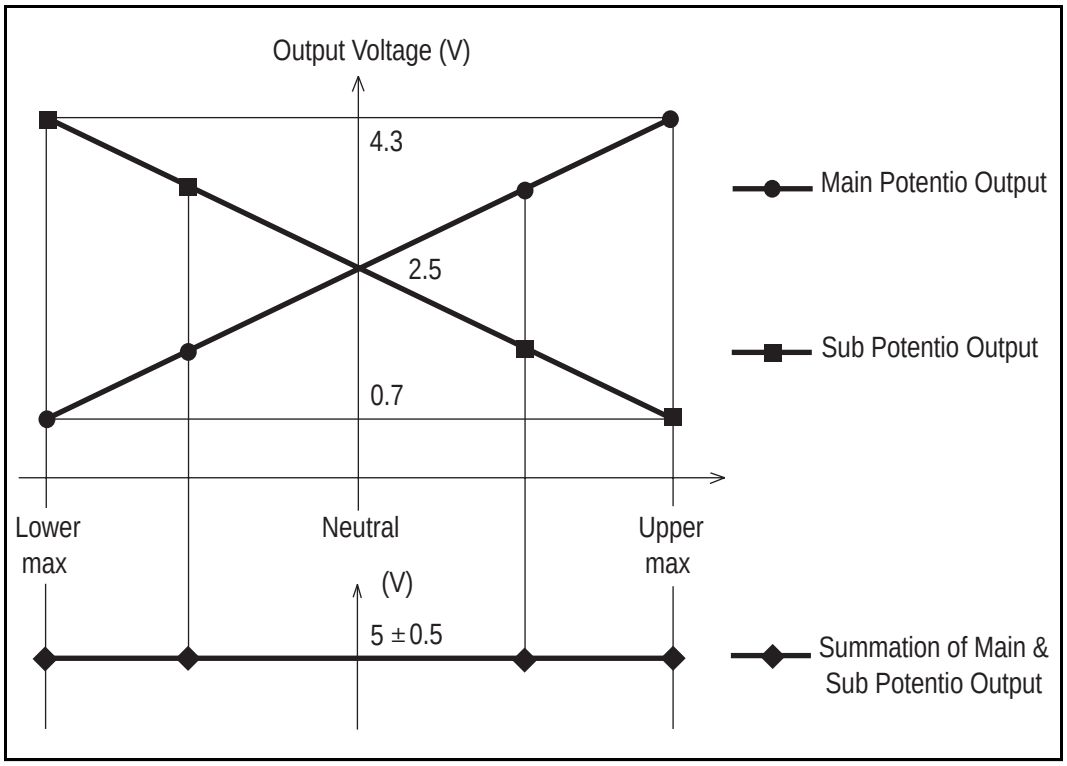
- Information

<Potentiometer's output voltage>

As shown below, summation of Main and Sub Potentiometer output to be constant.

If this value exceeded 5 ± 0.5 V, this Failure code [DFB3L8] is displayed.

The cause to be Main or Sub potentiometer's output error, so need to carry out troubleshooting in [DFB1KZ].



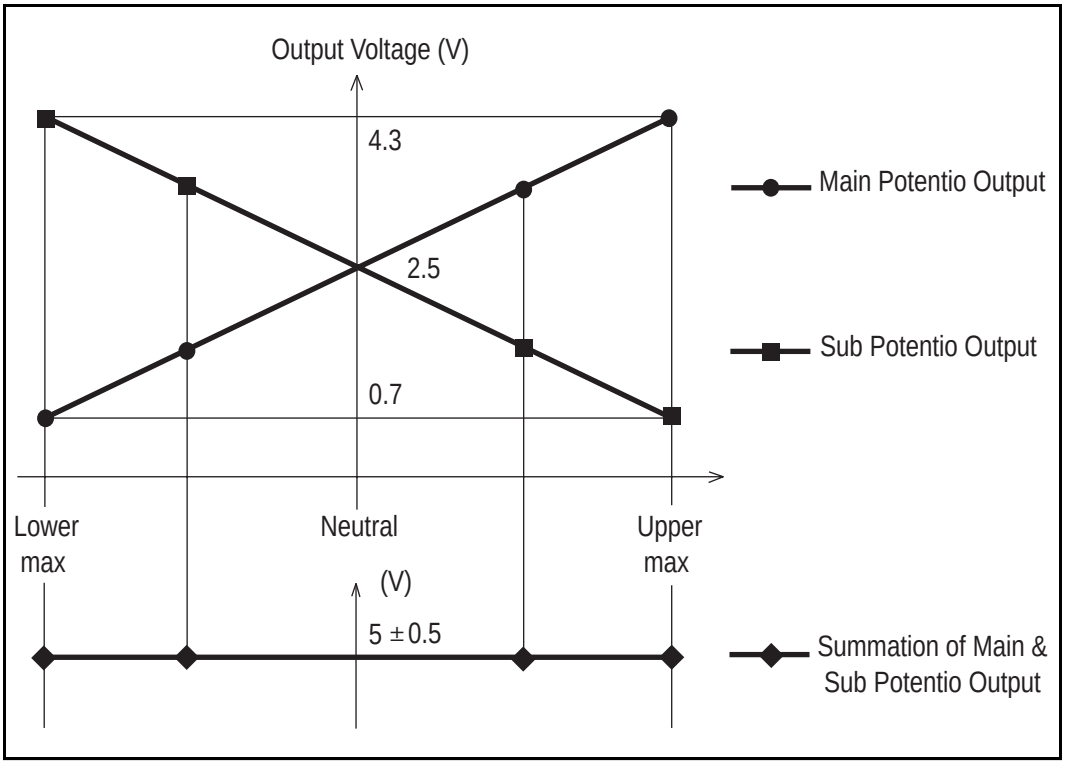
Failure code [DFB4L8] Service Lever 2 Potentio Error

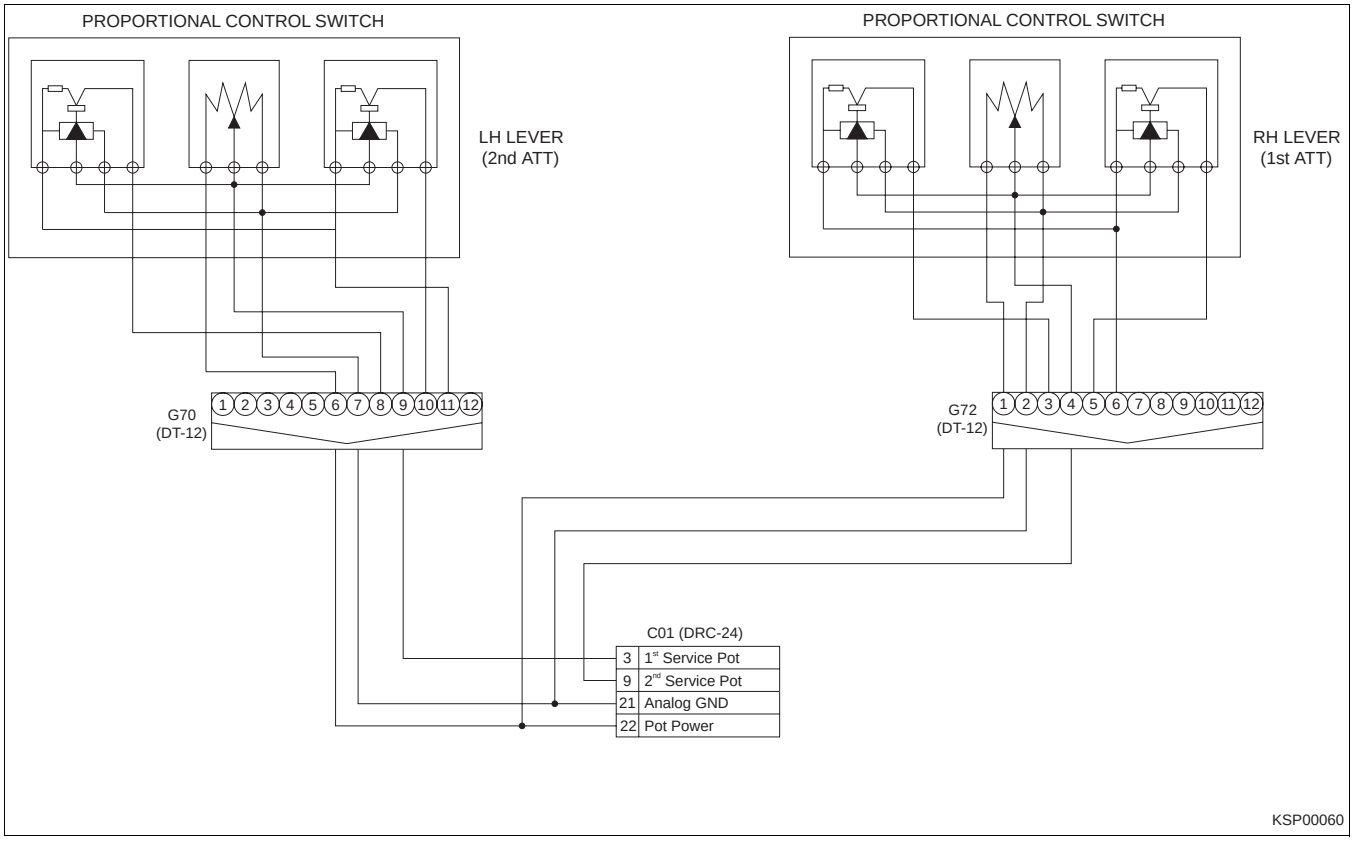
User code	Failure code	Trouble	LH Lever main potentiometer (for 2nd Att.) has failure
—	**DFB4L8**		
Contents of trouble	• Summation of Potentiometer's output voltage is out of range (below 4.5 volts or above 5.5 volts)		
Action of controller	• Turns output to service EPC solenoids (EPC3 & EPC4) OFF. • Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine	• 2nd Attachment does not operate.		
Related information	• Main potentio output voltage can be checked with monitoring function. (Code: 42010 Lever potentio 2 volt (Main)) • Sub potentio output voltage can be checked with monitoring function. (Code 42011 Lever potentio 2 volt (Sub)) • Potentiometer stroke can be checked with monitoring function. (Code 42013 Lever potentio 2 stroke) • Method of reproducing failure code : Turn starting switch to ON + set in attachment mode (ATT)..		

- For troubleshooting, carry out [DFB2KZ].

- Information

<Potentiometer's output voltage>
As shown below, summation of Main and Sub Potentiometer output to be constant.
If this value exceeded 5 ± 0.5 V, this Failure code [DFB4L8] is displayed.
The cause to be Main or Sub potentiometer's output error, so need to carry out troubleshooting in [DFB2KZ].



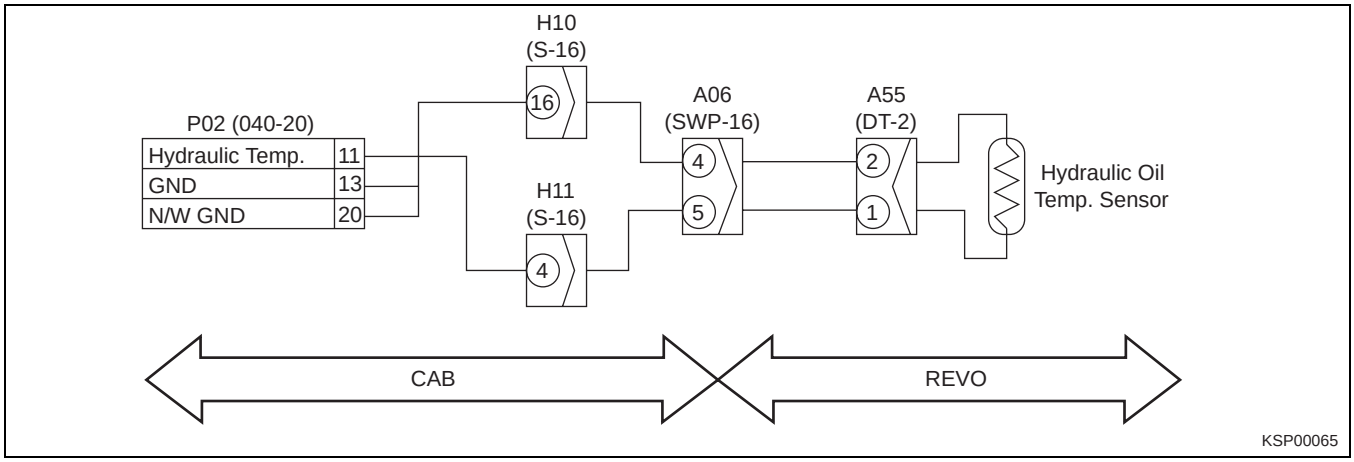

PROPORTIONAL CONTROL SWITCH
LH LEVER
(2nd ATT)
PROPORTIONAL CONTROL SWITCH
RH LEVER
(1st ATT)
G70
(DT-12)
1 2 3 4 5 6 7 8 9 10 11 12
G72
(DT-12)
1 2 3 4 5 6 7 8 9 10 11 12
C01 (DRC-24)
3 1st Service Pot
9 2nd Service Pot
21 Analog GND
22 Pot Power
KSP00060

Failure code [DGH2KB] Hydr Oil Sensor Short

User code	Failure code	Trouble	Hydraulic oil temperature sensor short (Pump controller system)
—	**DGH2KB**		
Contents of trouble	• Ground fault was detected in hydraulic oil temperature sensor circuit.		
Action of controller	• Fixes hydraulic oil temperature value at 40°C and continues operation. • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• While hydraulic oil temperature rises normally, hydraulic oil temperature gauge does not move from top of white range (bottom of green range).		
Related information	• Signal voltage of hydraulic oil temperature sensor can be checked with monitoring function. (Code: 04402 Hydraulic oil temperature sensor voltage) • 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 hydraulic oil temperature sensor (Internal disconnection or short circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			A55 (male)	Resistance	
			Between (1) – (2)	3.5 – 90 kΩ	
			Between (1) – chassis ground	Min. 1 MΩ	
	2	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between P02 (female) (11) – A55 (female) (1)	Resistance	Min. 1 MΩ
	3	Defective Monitor	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			P02 (female)	Resistance	
			Between (11) - (13) or (11) - (20)	3.5 – 90 kΩ	
			Between (11) – chassis ground	Min. 1 MΩ	

Circuit diagram related to hydraulic oil temperature sensor

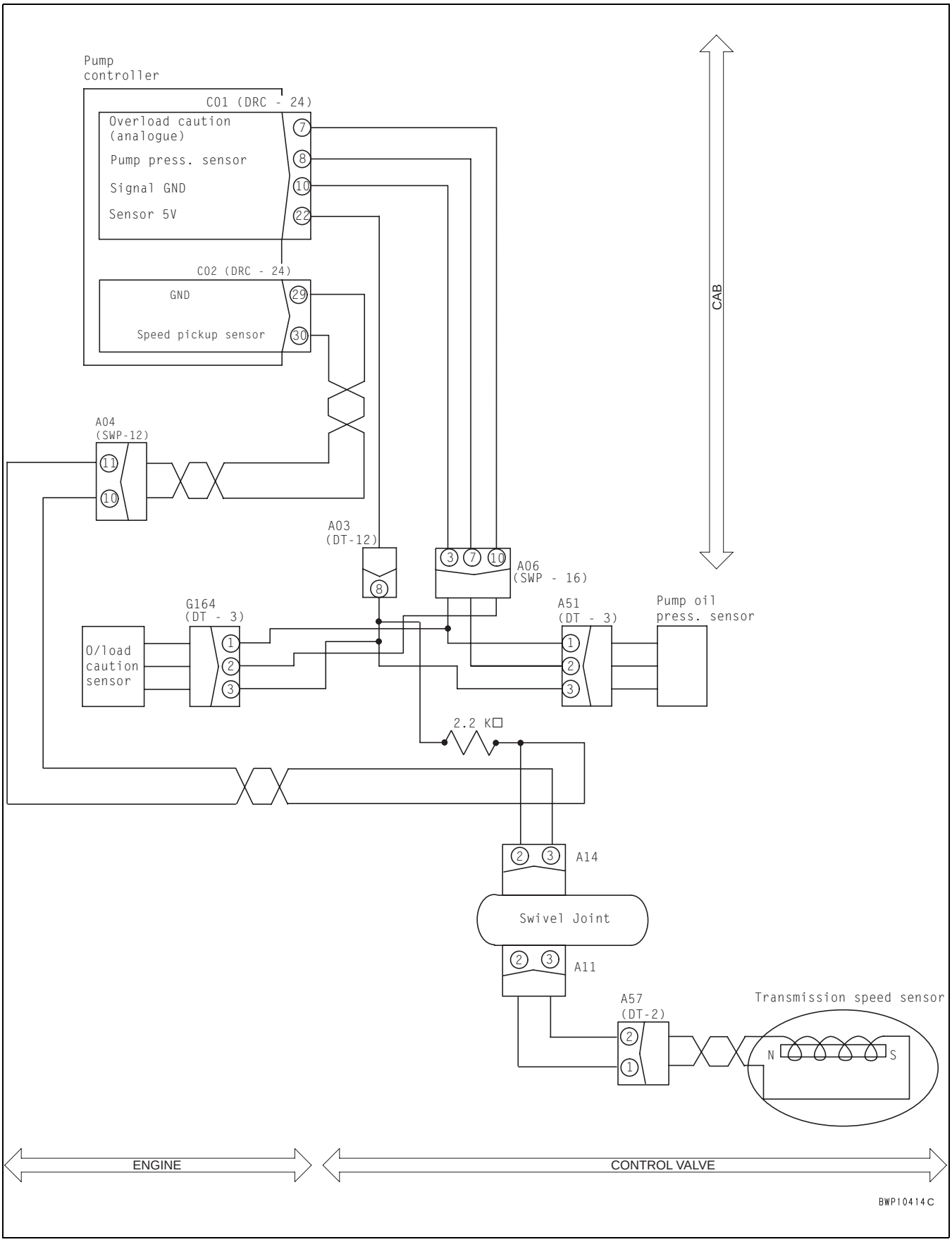


Failure Code [DH1OKS] (Abnormality in Pressure sensor power source)

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

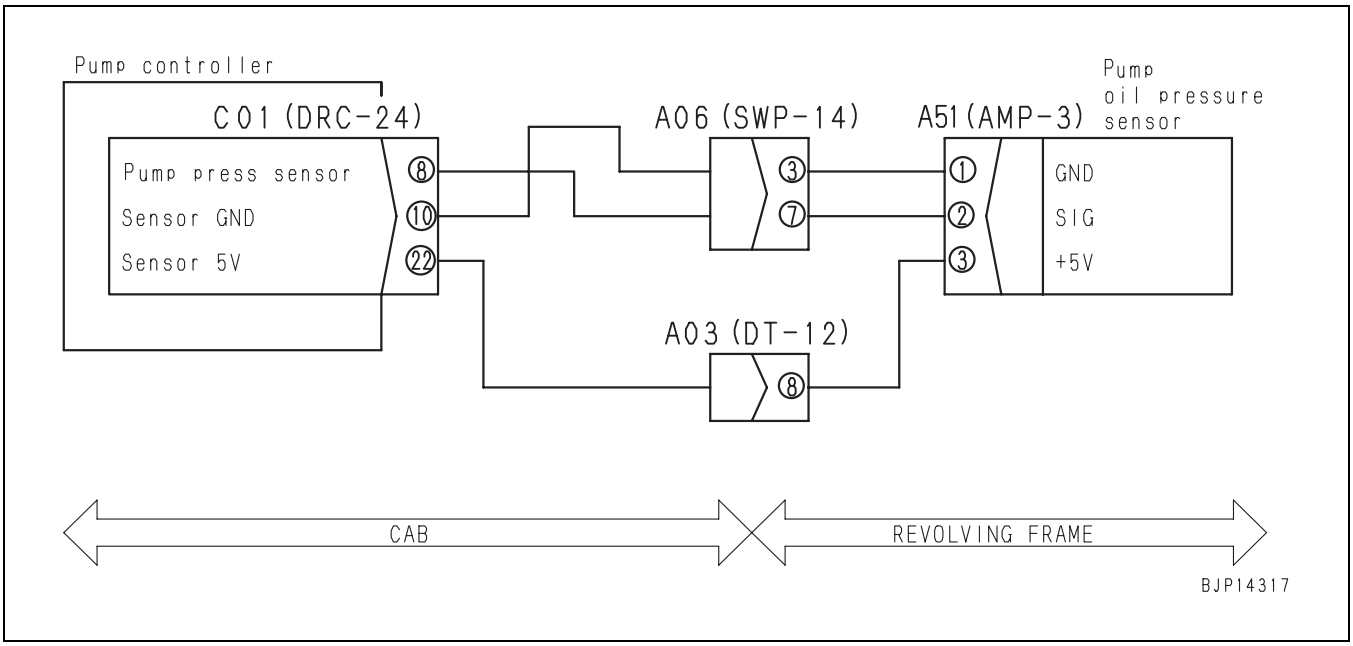


Failure code [DHPAMA] F Pump Press Sensor Abnormality

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	★ 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)	★ 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)	★ 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)	★ 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	★ 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	★ 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		

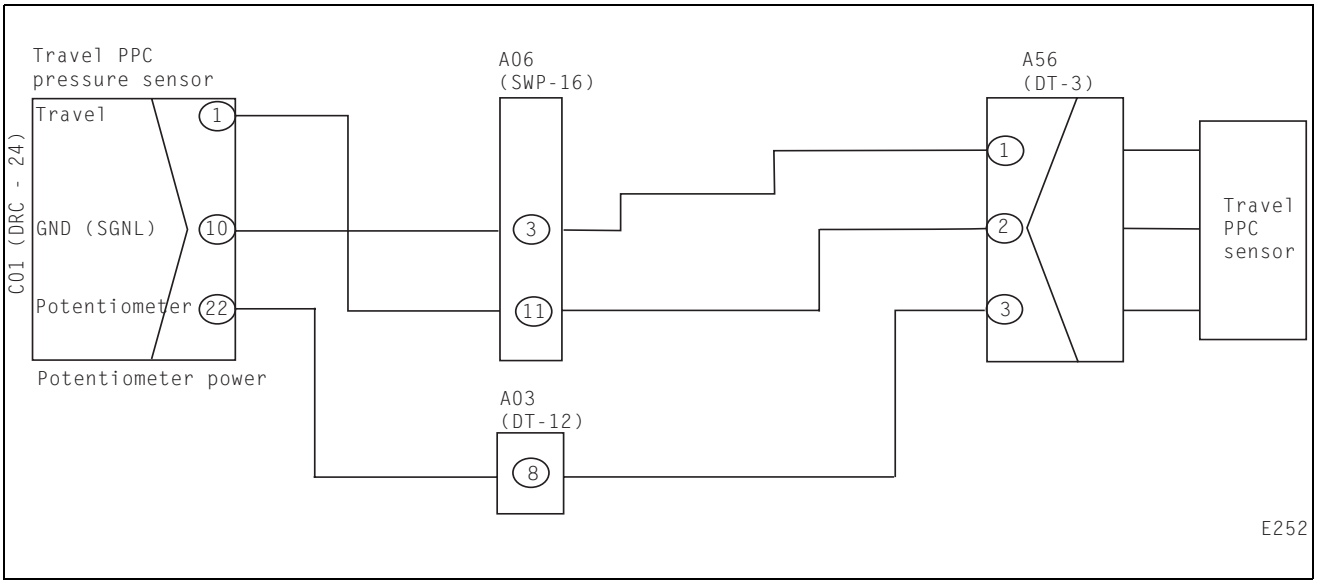
Circuit diagram related to pump pressure sensor of pump controller



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		

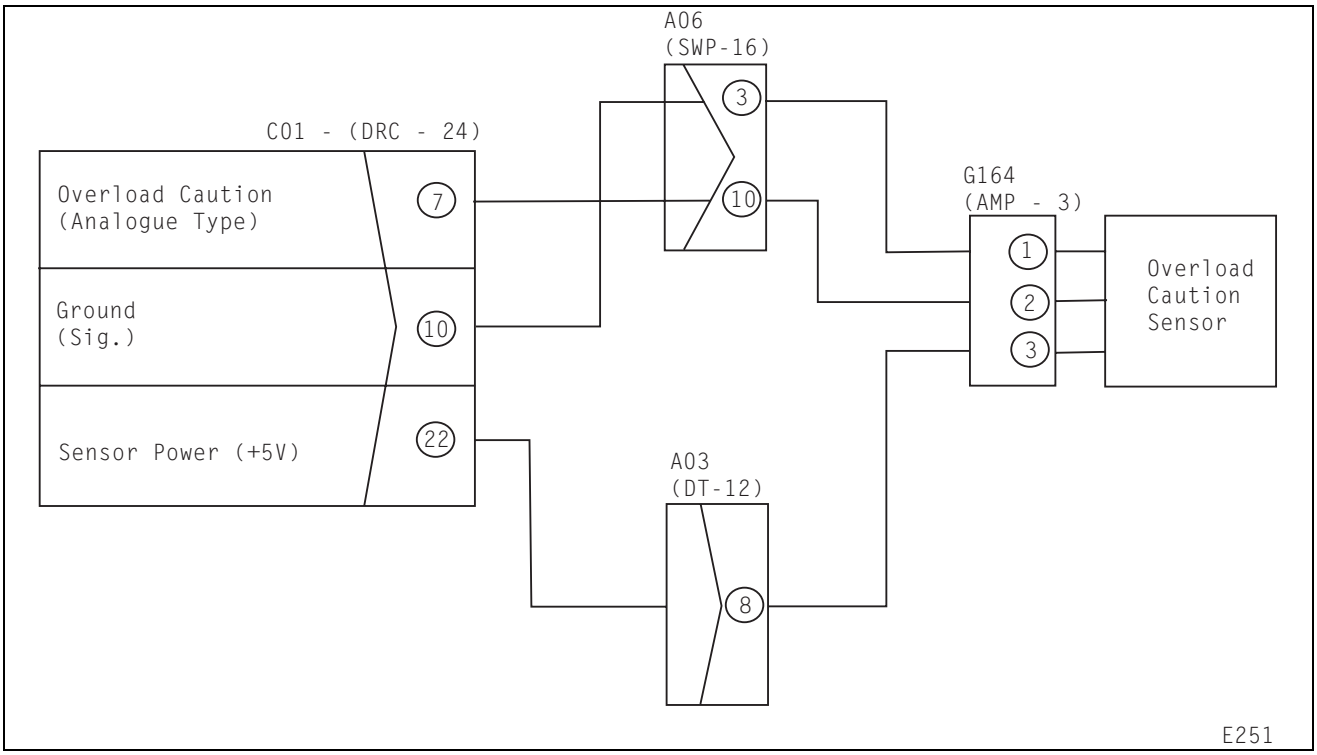

Travel PPC
pressure sensor
C01 (DRC - 24)
Travel
1
GND (SGNL)
10
Potentiometer
22
Potentiometer power
A06
(SWP-16)
3
11
A03
(DT-12)
8
A56
(DT-3)
1
2
3
Travel
PPC
sensor
E252

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		

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	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

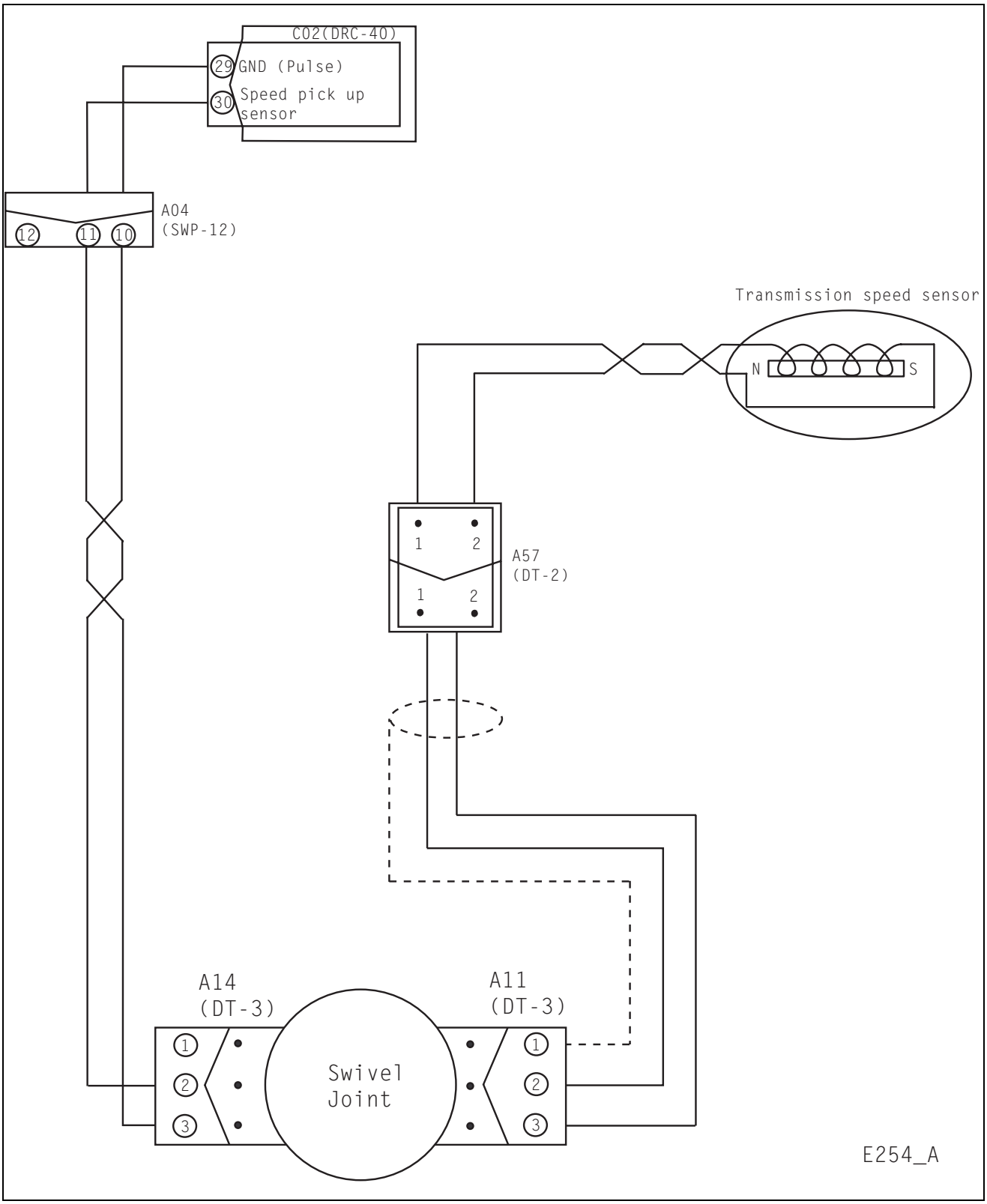


Failure Code [DLT4KA] (Disconnection in transmission speed sensor in pump controller system)

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.		

Presumed cause and standard value in normal		Cause	Standard value in normalcy and references for troubleshooting			
	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

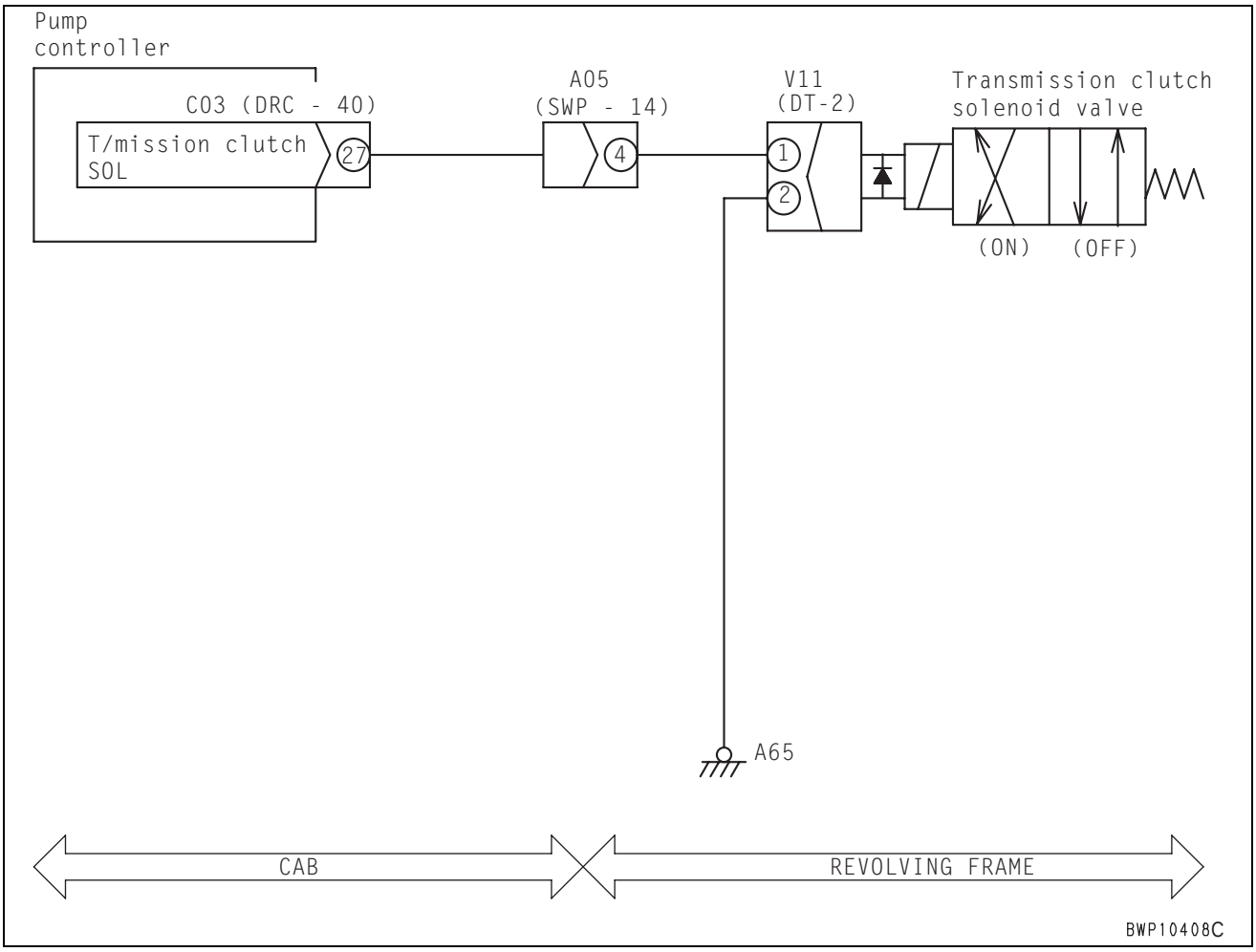


Failure Code [DW27KA] (Disconnection in Transmission Clutch solenoid)

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.			
			Between 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



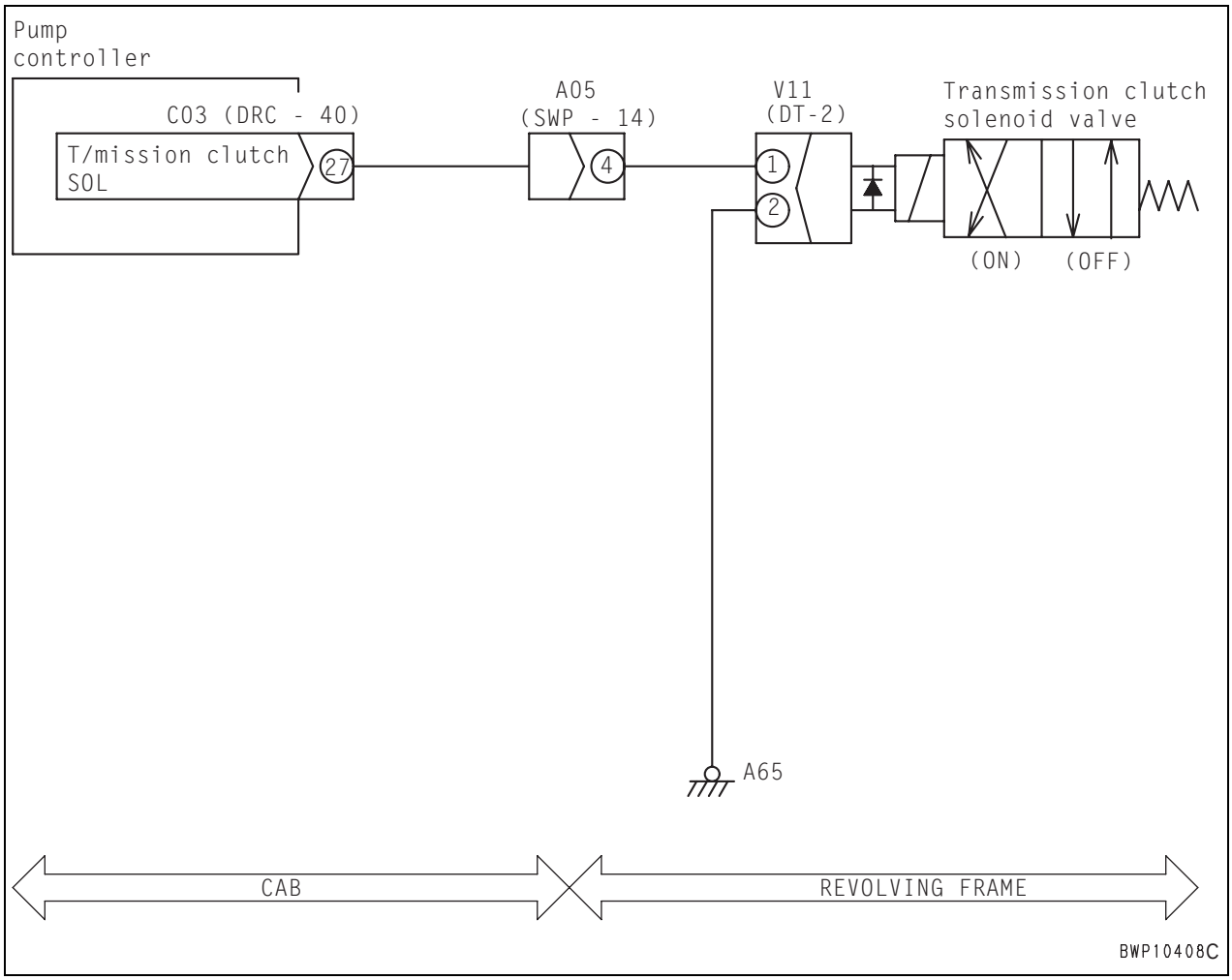
Failure Code [DW27KB] (Short-circuiting in Transmission Clutch solenoid)

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

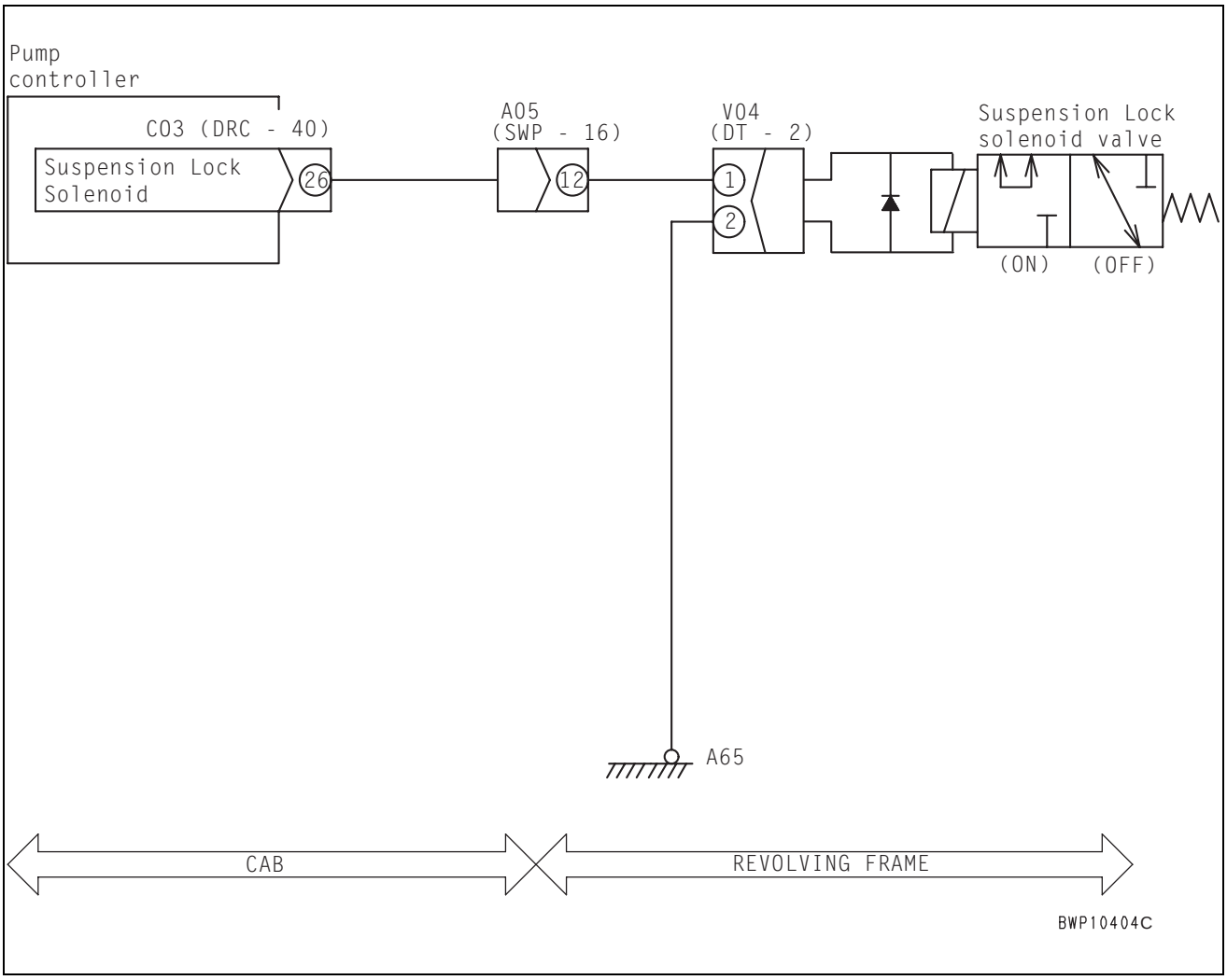


Failure Code DW4AKA (Disconnection in suspension lock solenoid)

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

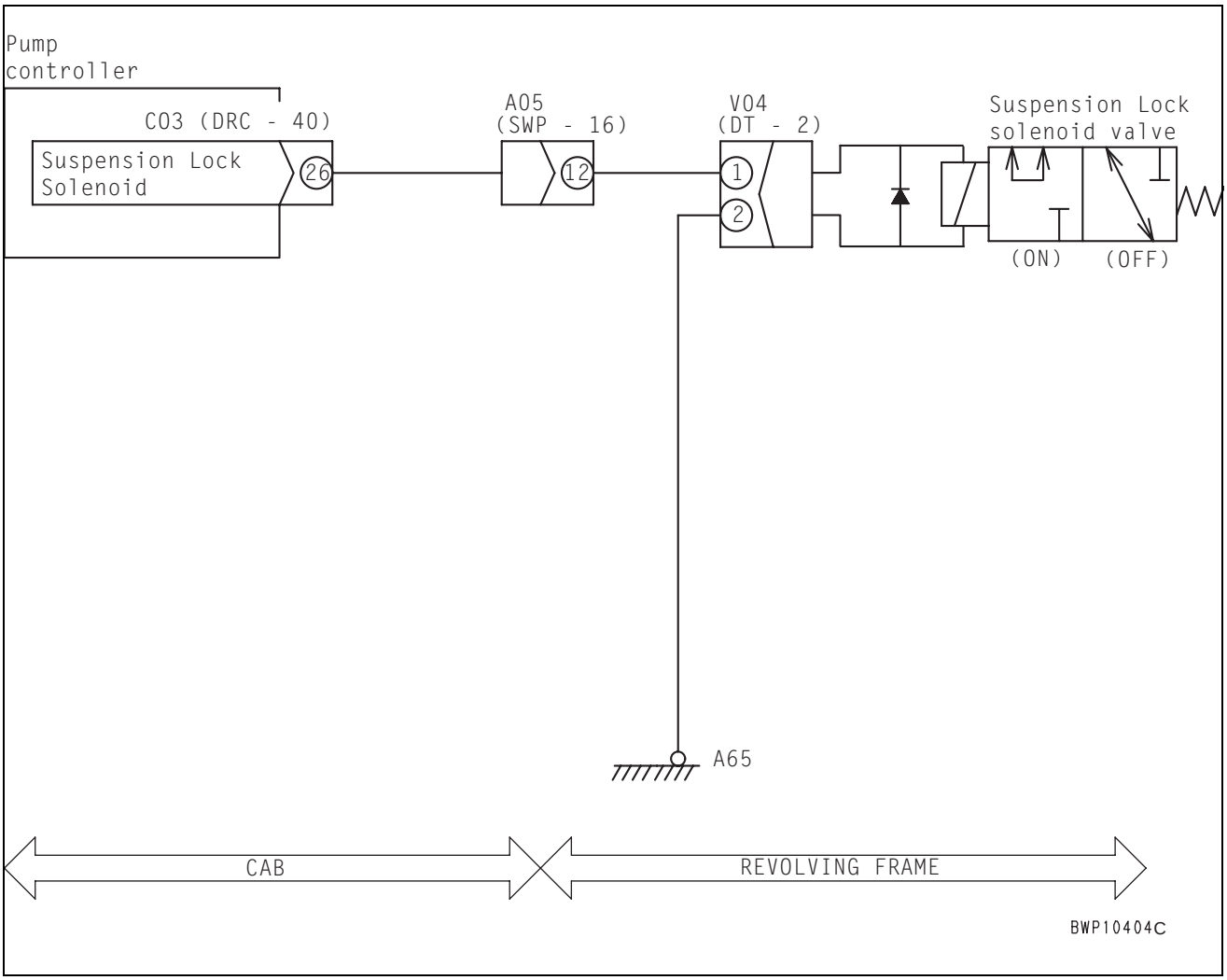


Failure Code [DW4AKB] (Short circuiting in suspension lock solenoid)

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

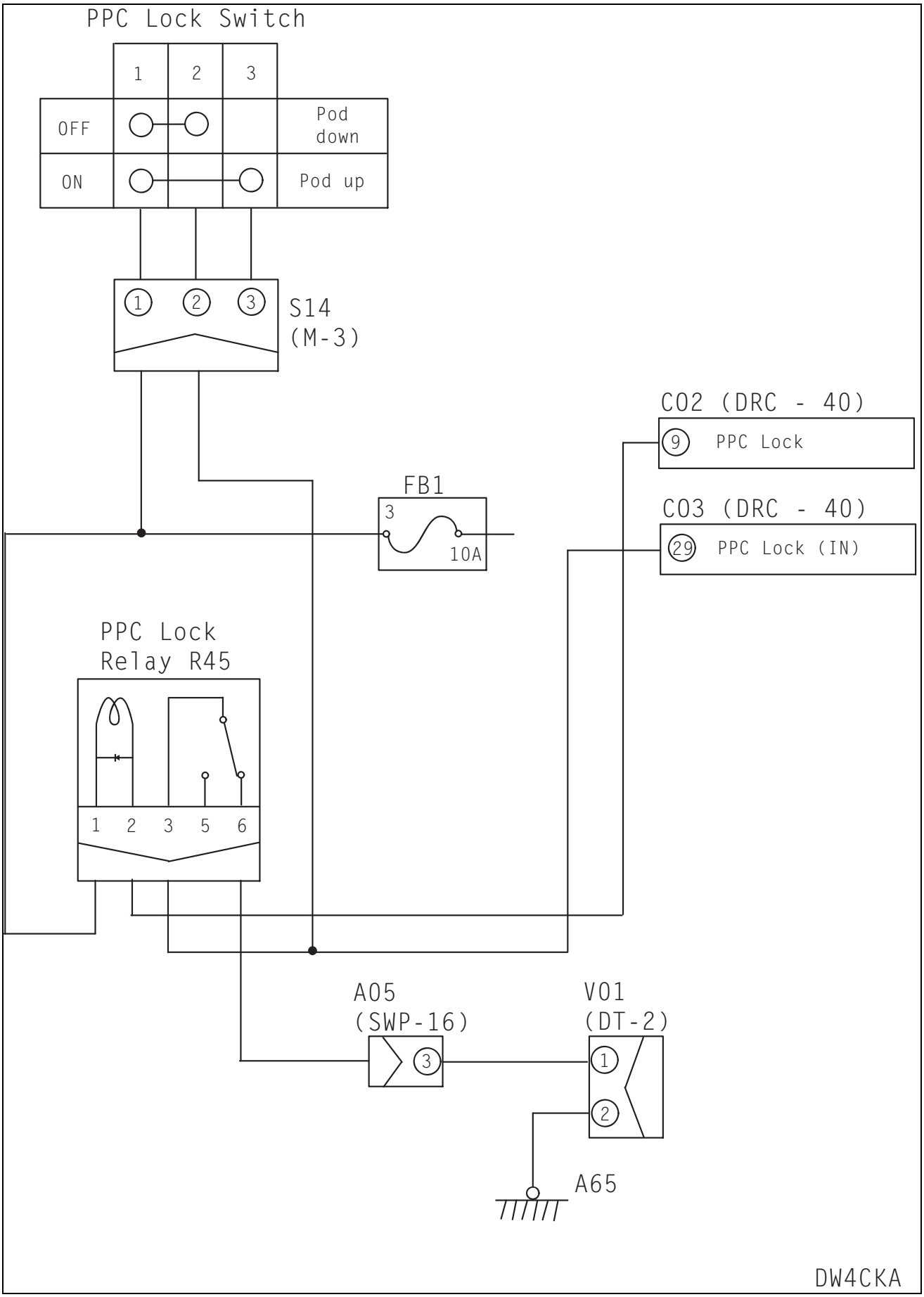


Failure Code [DW4CKA] (Disconnection in PPC lock solenoid)

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 replacement)		
			• 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 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

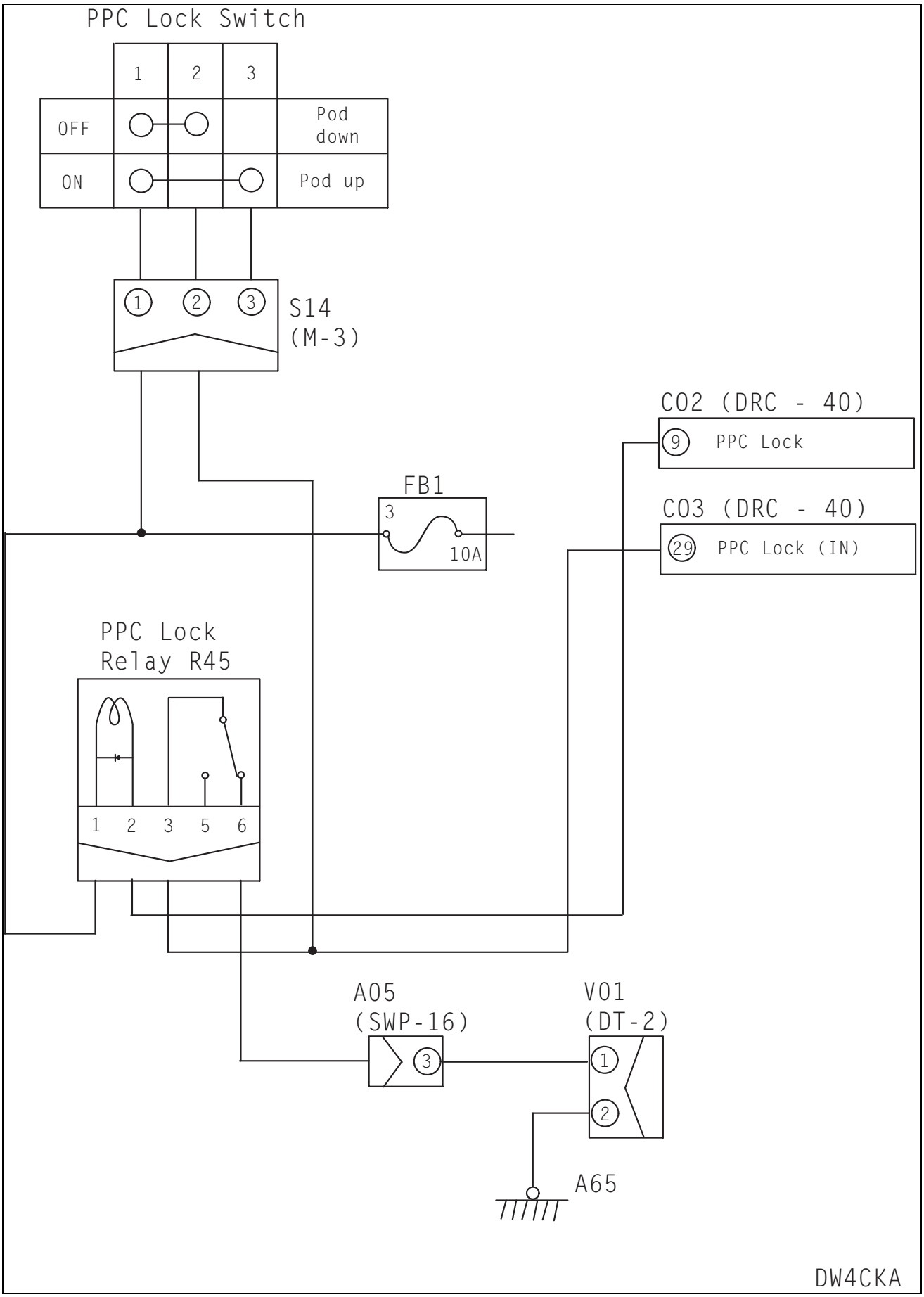


Failure code [DW4CKB] PPC Lock Sol. S/C

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)	★ 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)	★ 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	★ 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

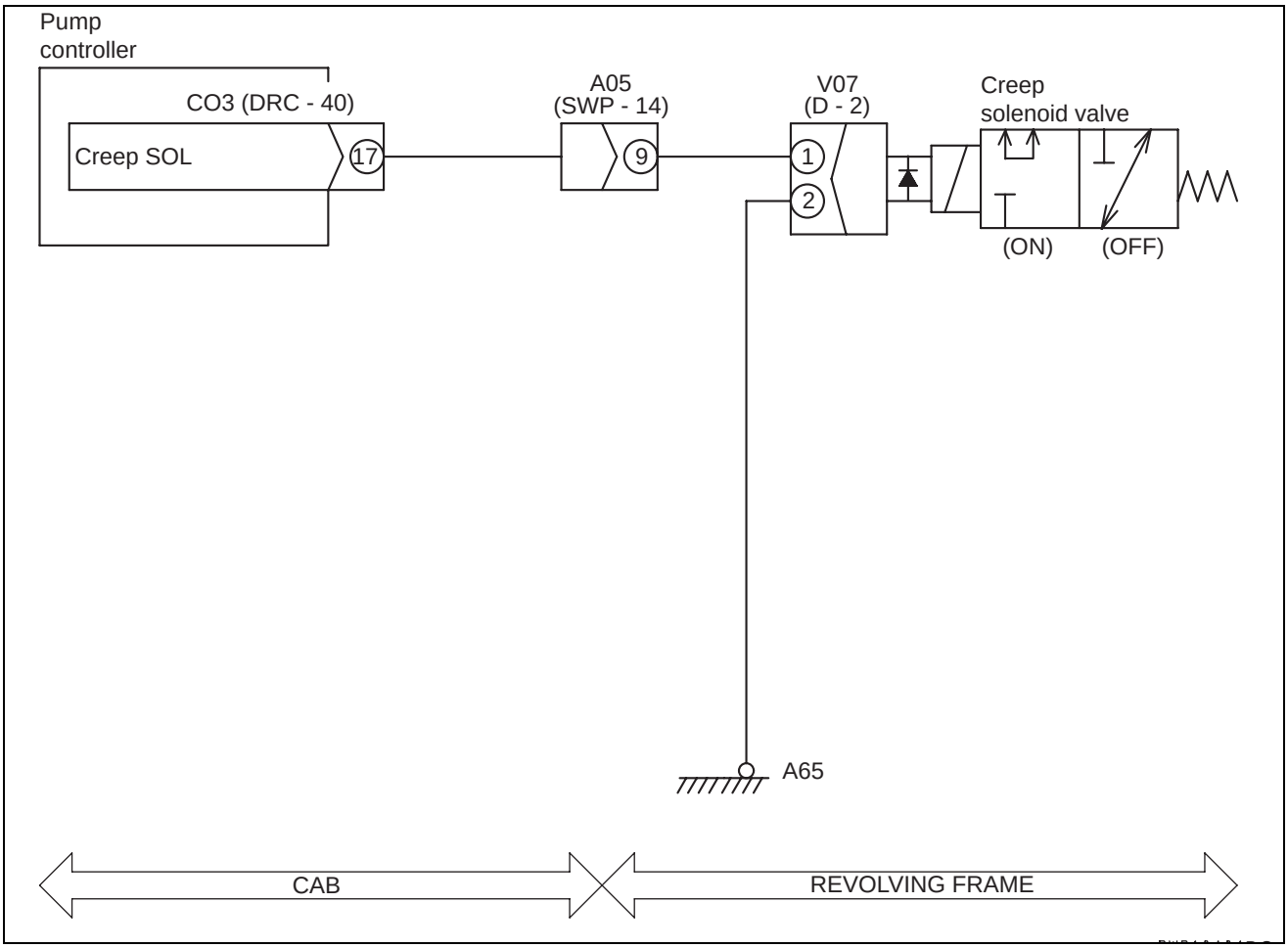


Failure Code [DW4MKA] (Disconnection in Creep solenoid)

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

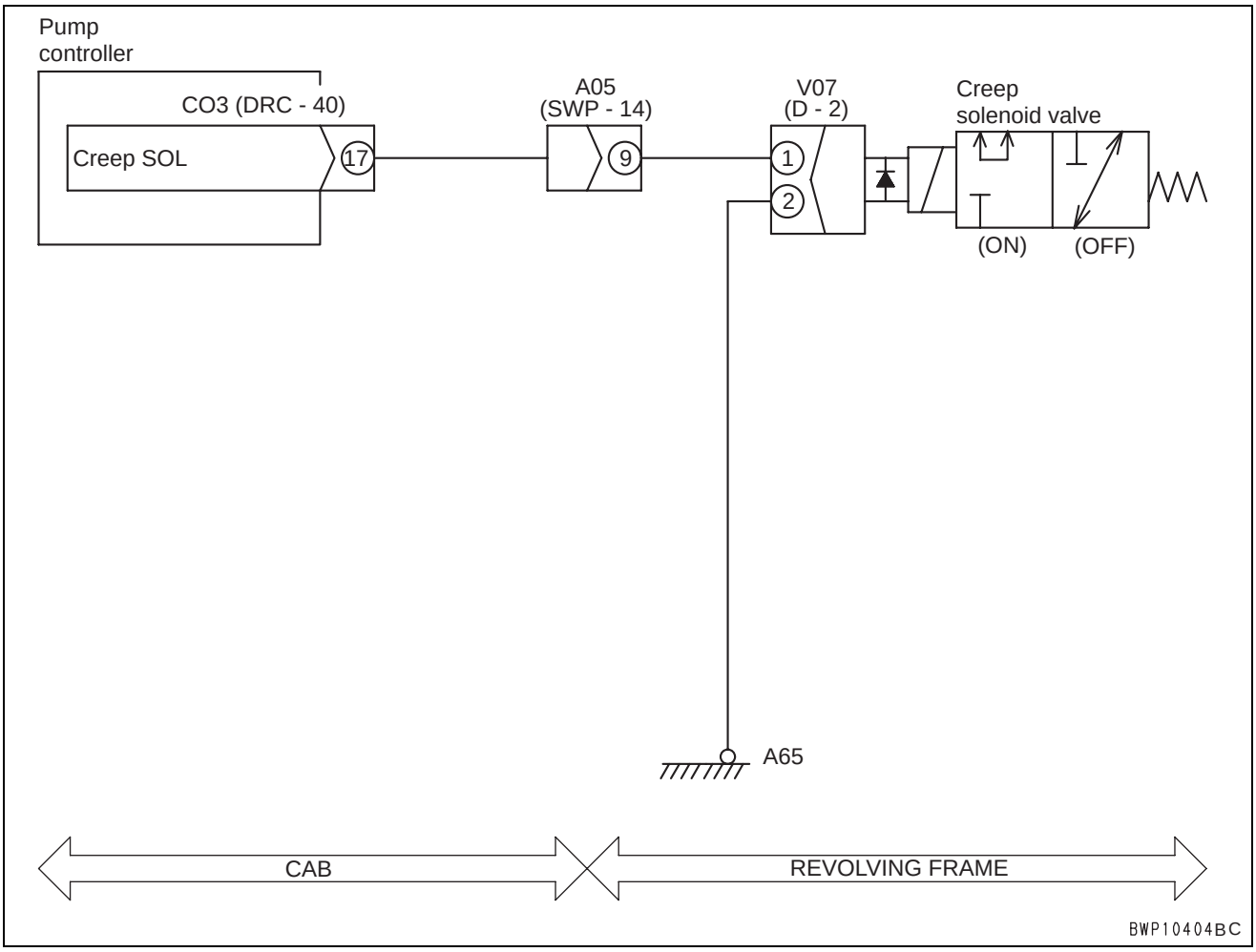


Failure Code [DW4MKB] (Short-circuiting in Creep solenoid)

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

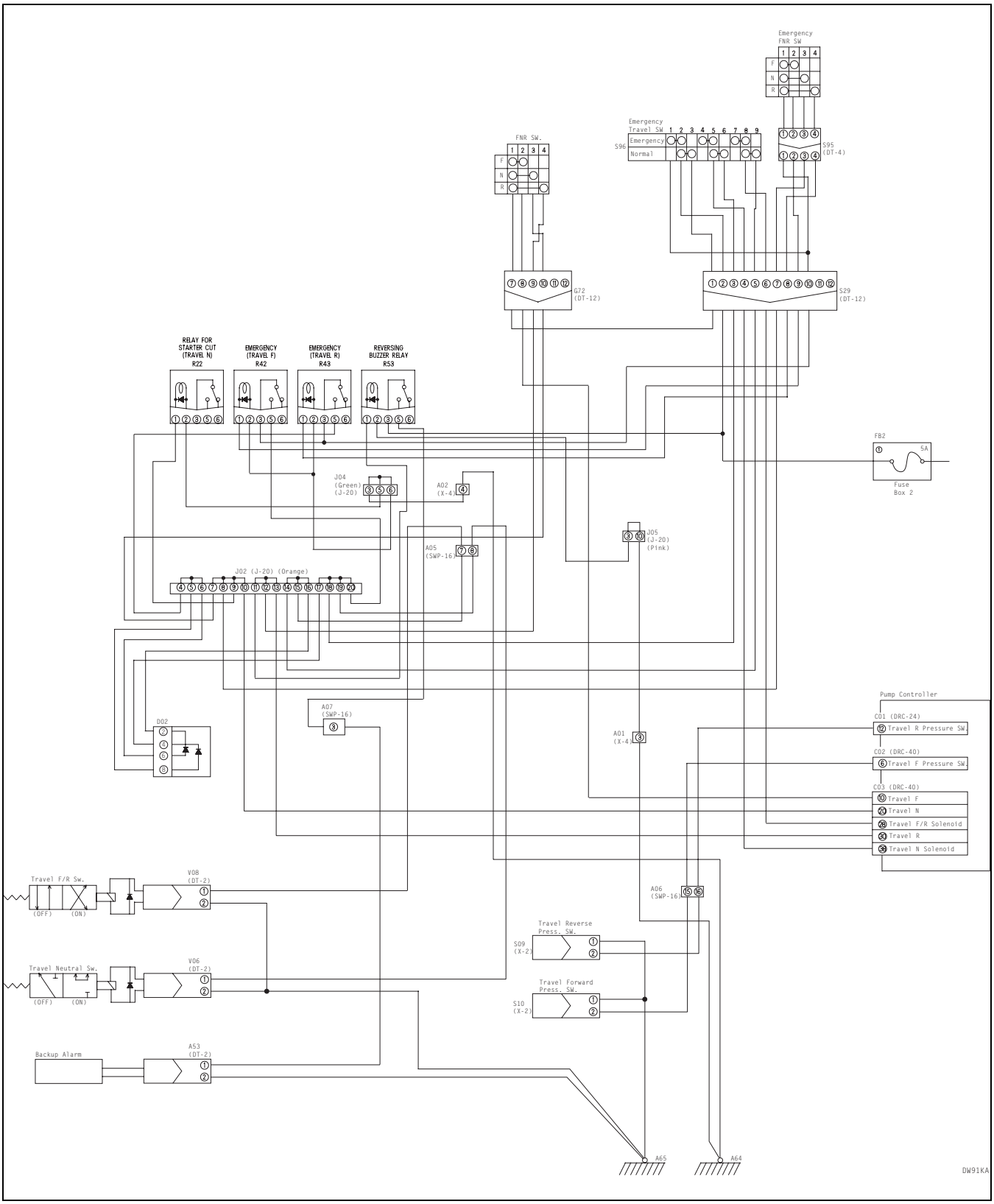


Failure Code [DW44KA] (Disconnection of Travel F/R solenoid)

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

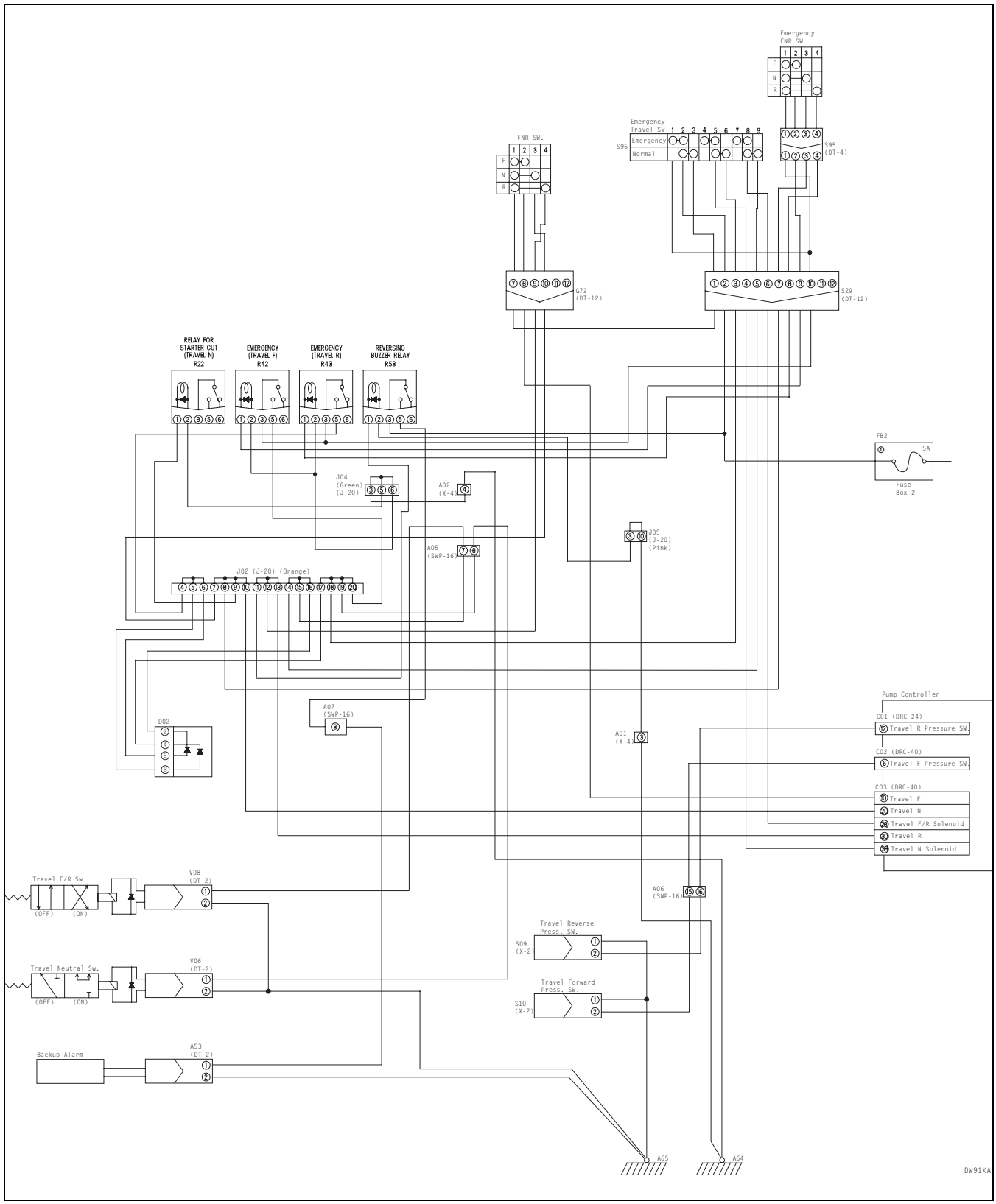


Failure Code [DW44KB] (Short-circuiting of Travel F/R solenoid)

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

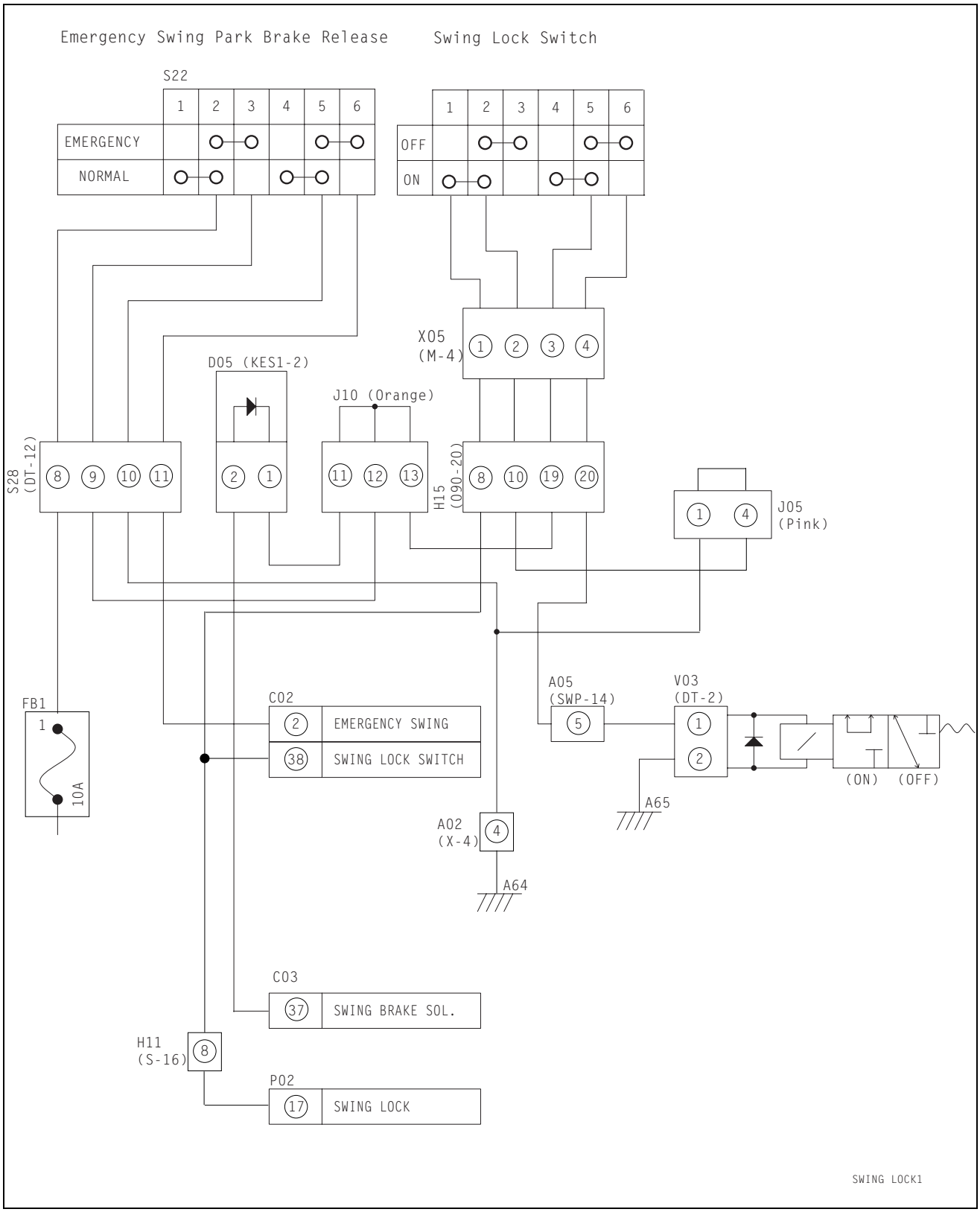


Failure Code [DW45KA] (Disconnection in Swing Parking Brake solenoid)

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



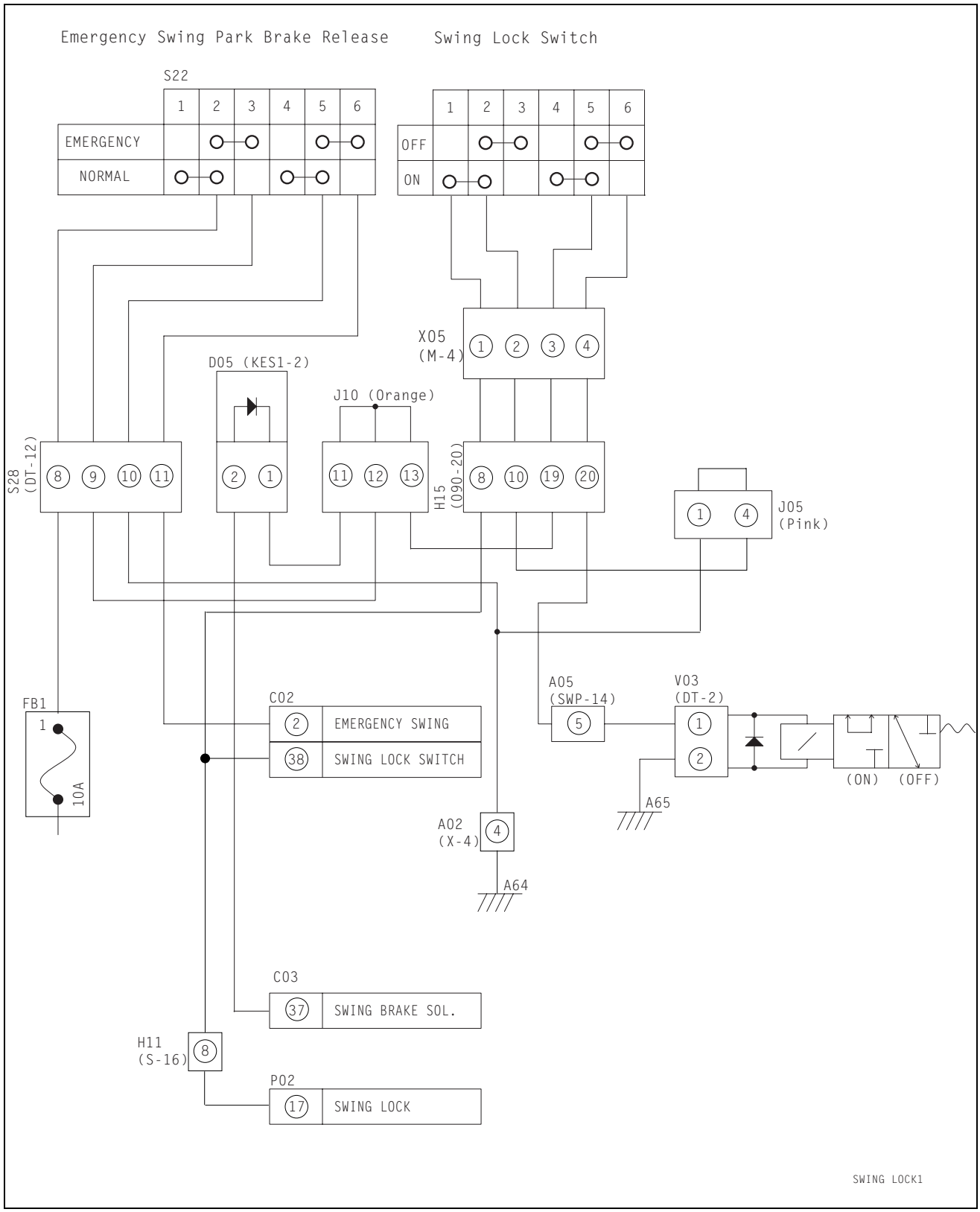
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Failure code [DW45KB] Swing Brake Sol. S/C

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)	★ 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)	★ 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)	★ 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	★ 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

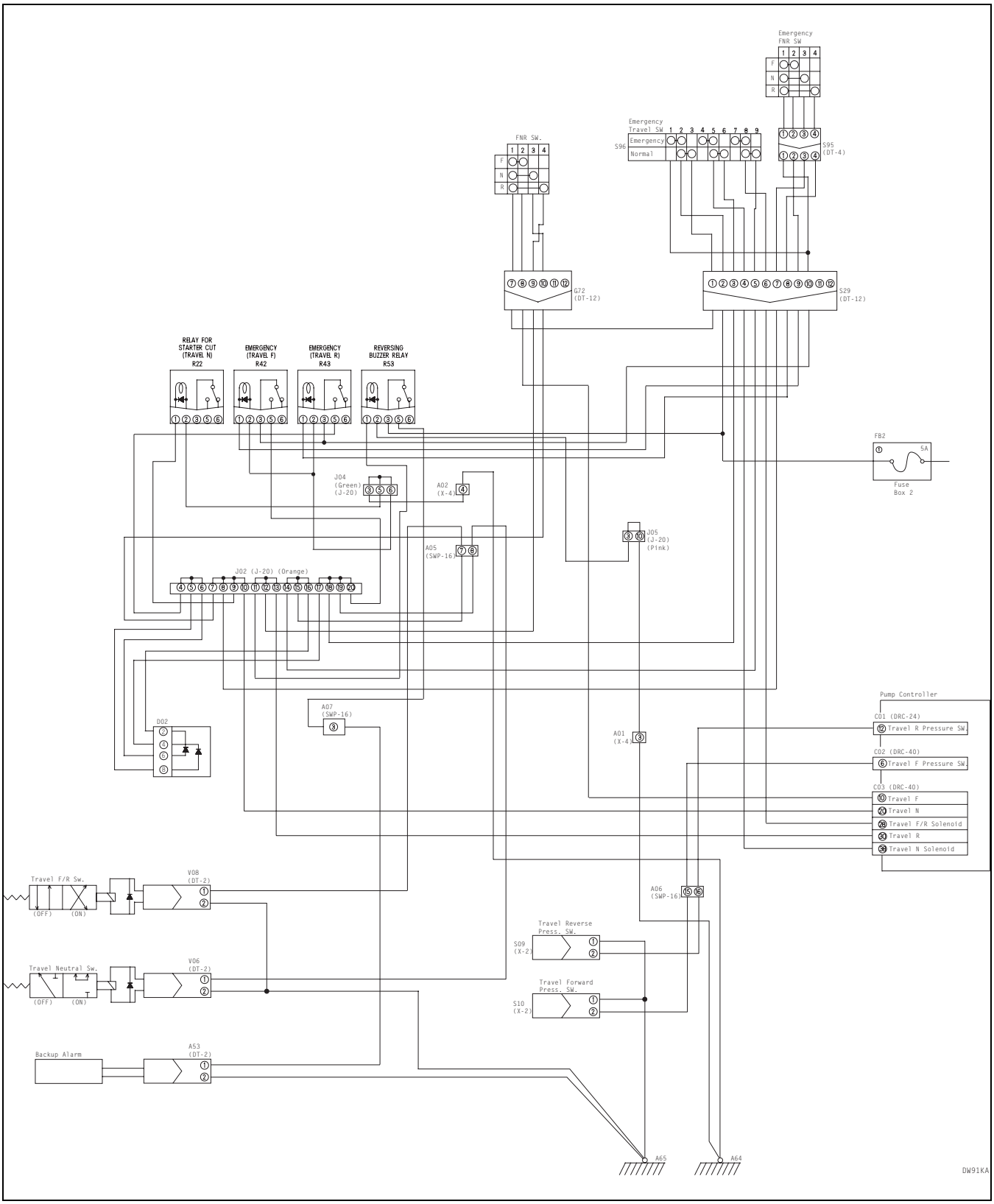


Failure Code [DW91KA] (Disconnection in Travel Neutral solenoid)

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

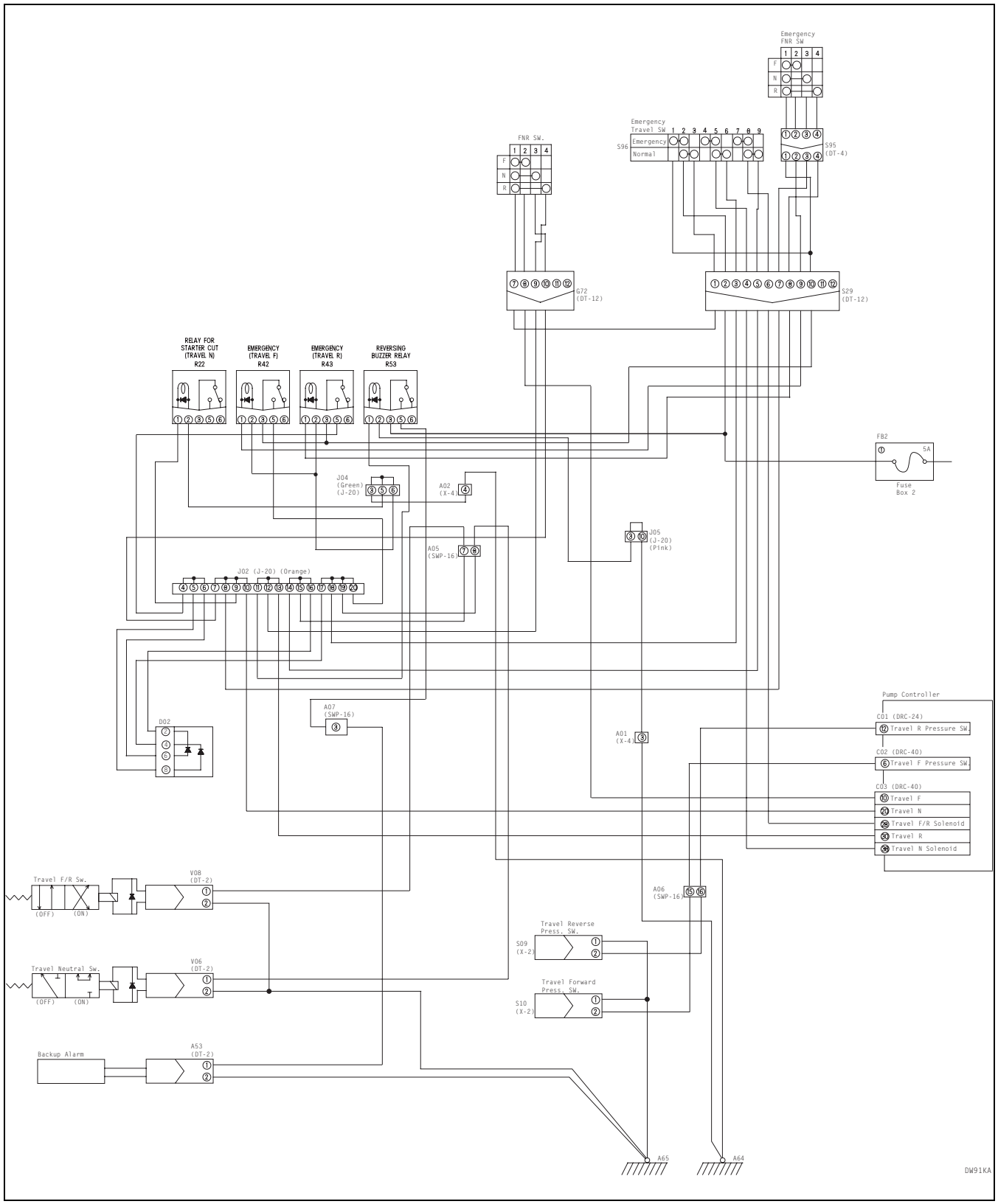


Failure Code [DW91KB] (Short-circuiting in Travel Neutral Solenoid)

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

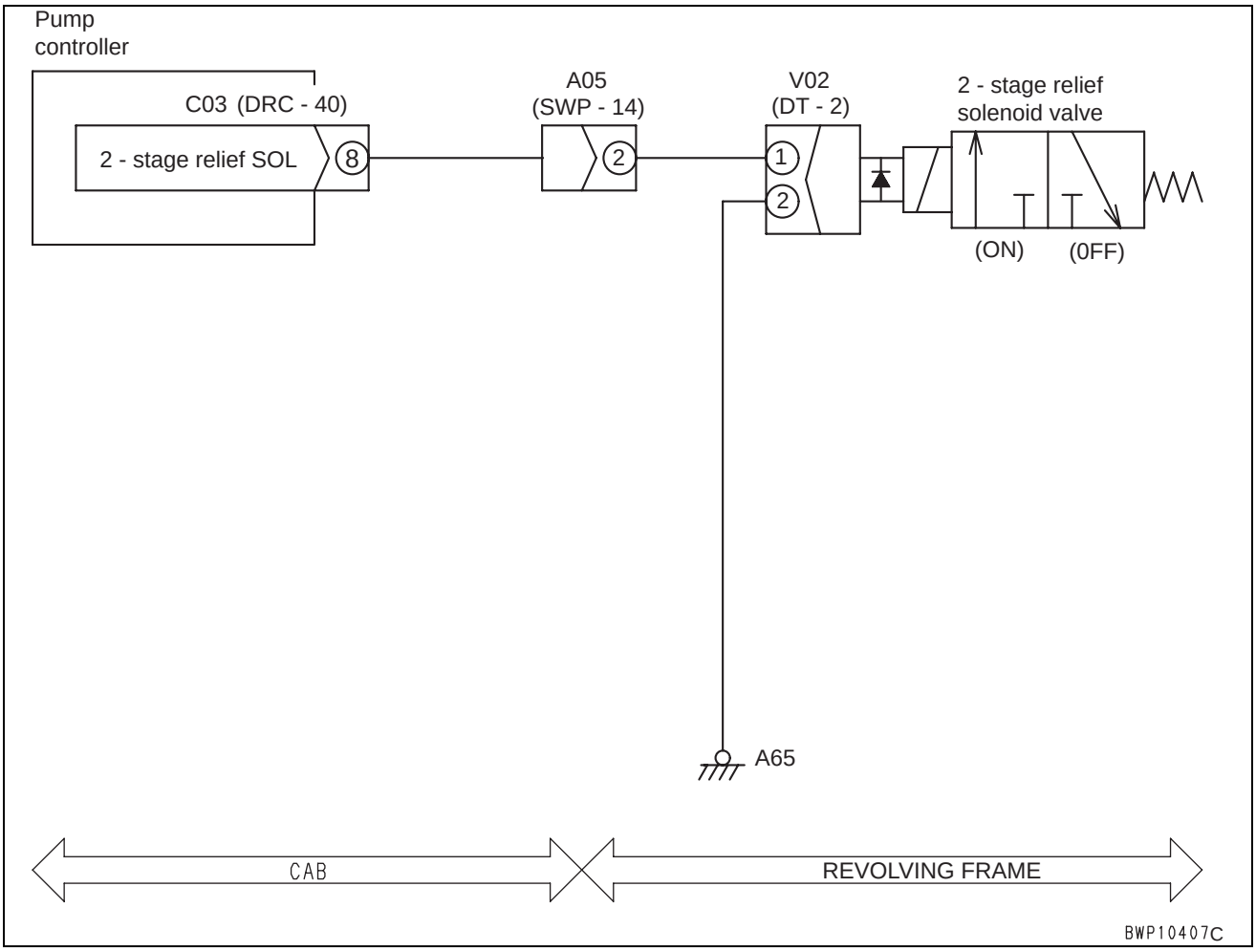


Failure Code [DWK0KA] (Disconnection in 2-stage Relief solenoid)

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



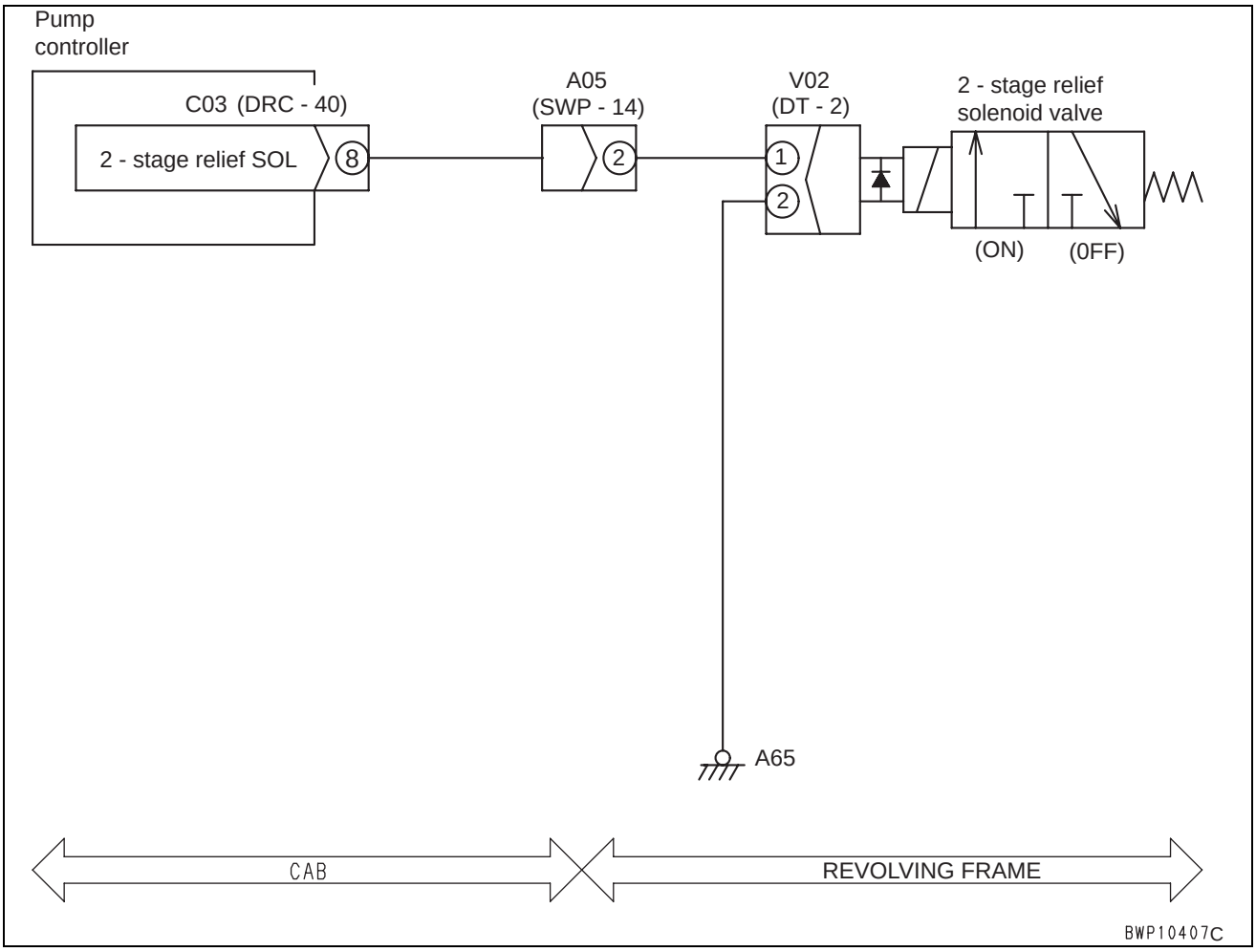
Failure Code [DWK0KB] (Short-circuiting in 2-Stage Relief Solenoid)

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

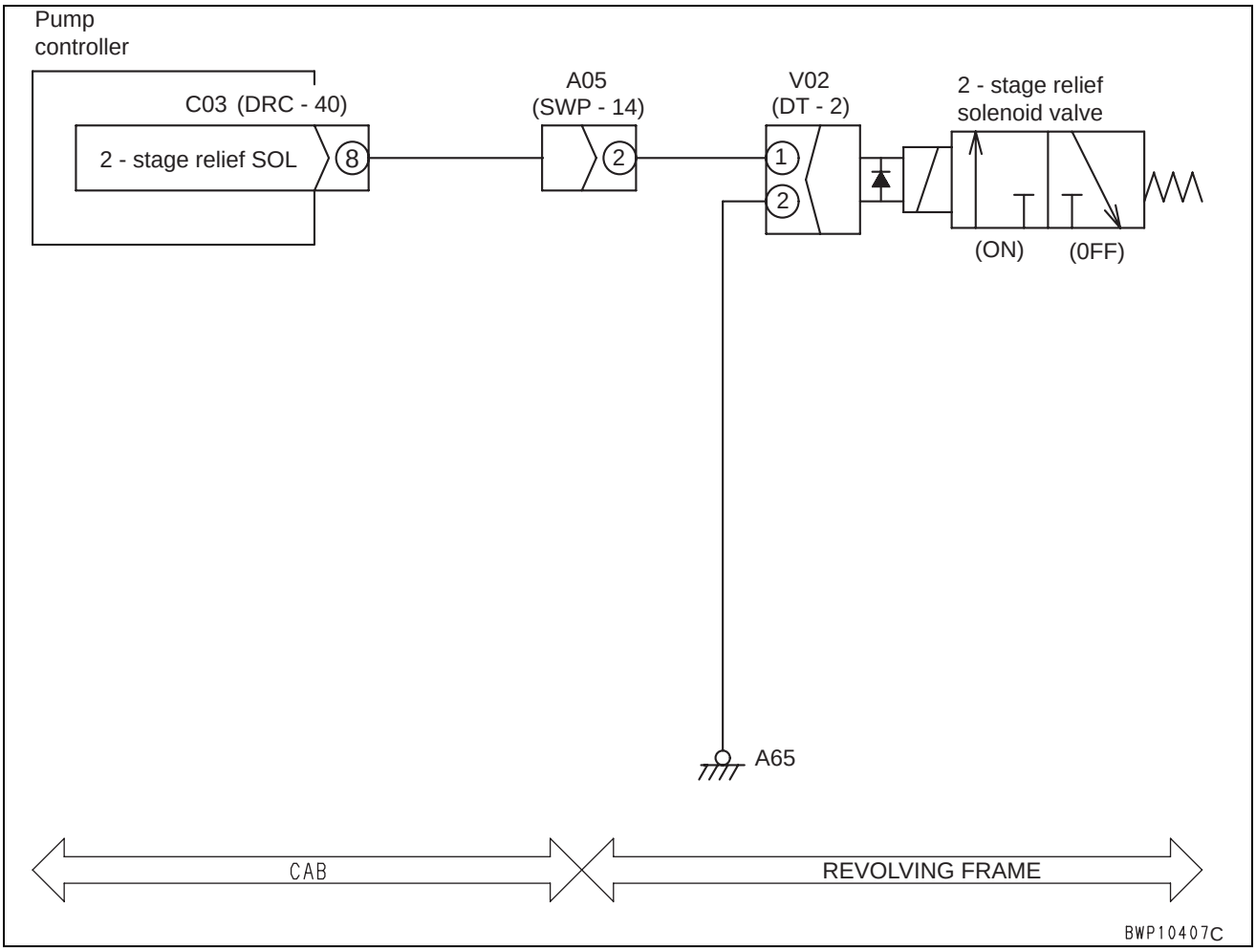


Failure Code [DWK2KA] (Disconnection in 2-stage Back Pressure solenoid)

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

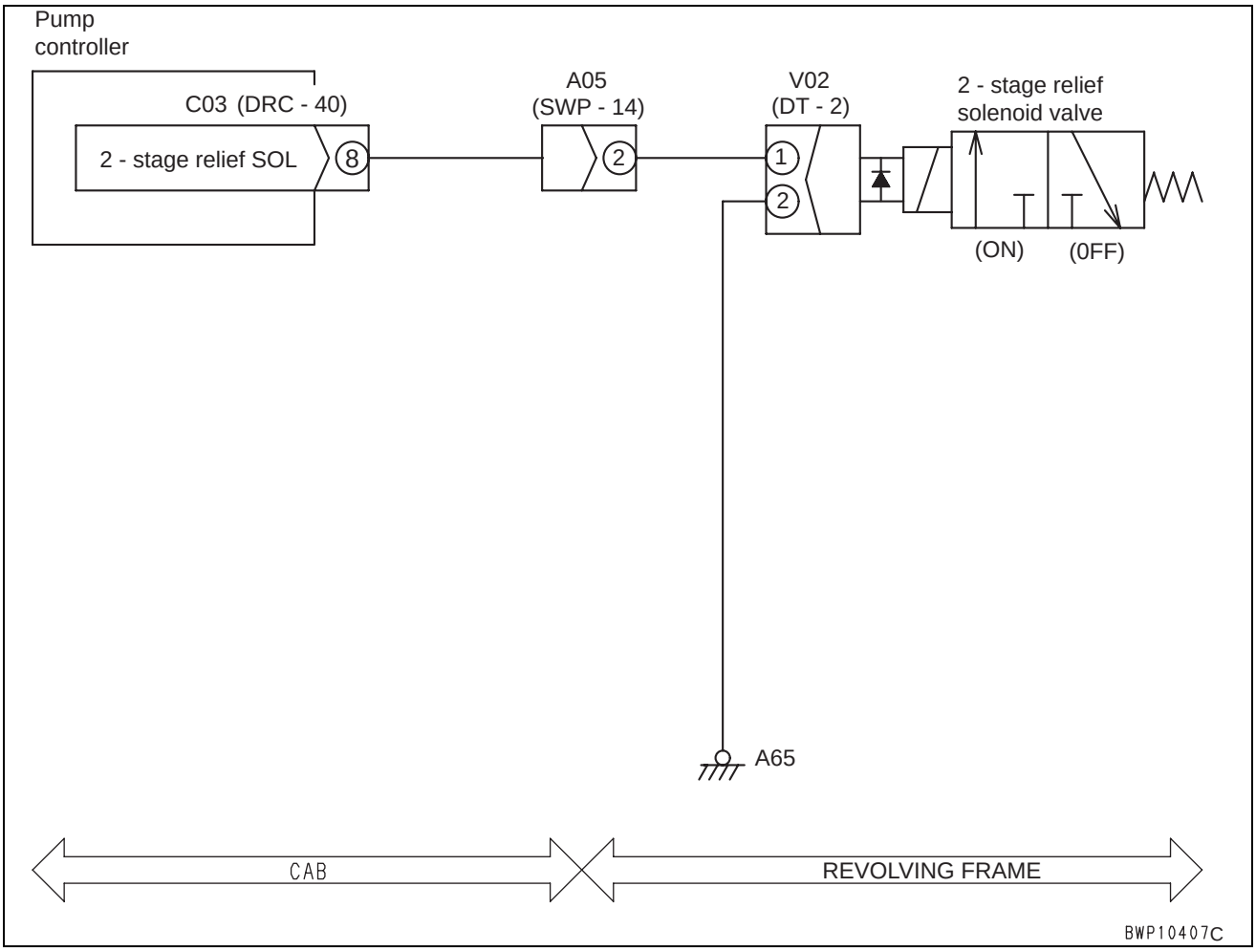


Failure Code [DWK2KB] (Short circuiting in 2-stage back pressure solenoid)

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

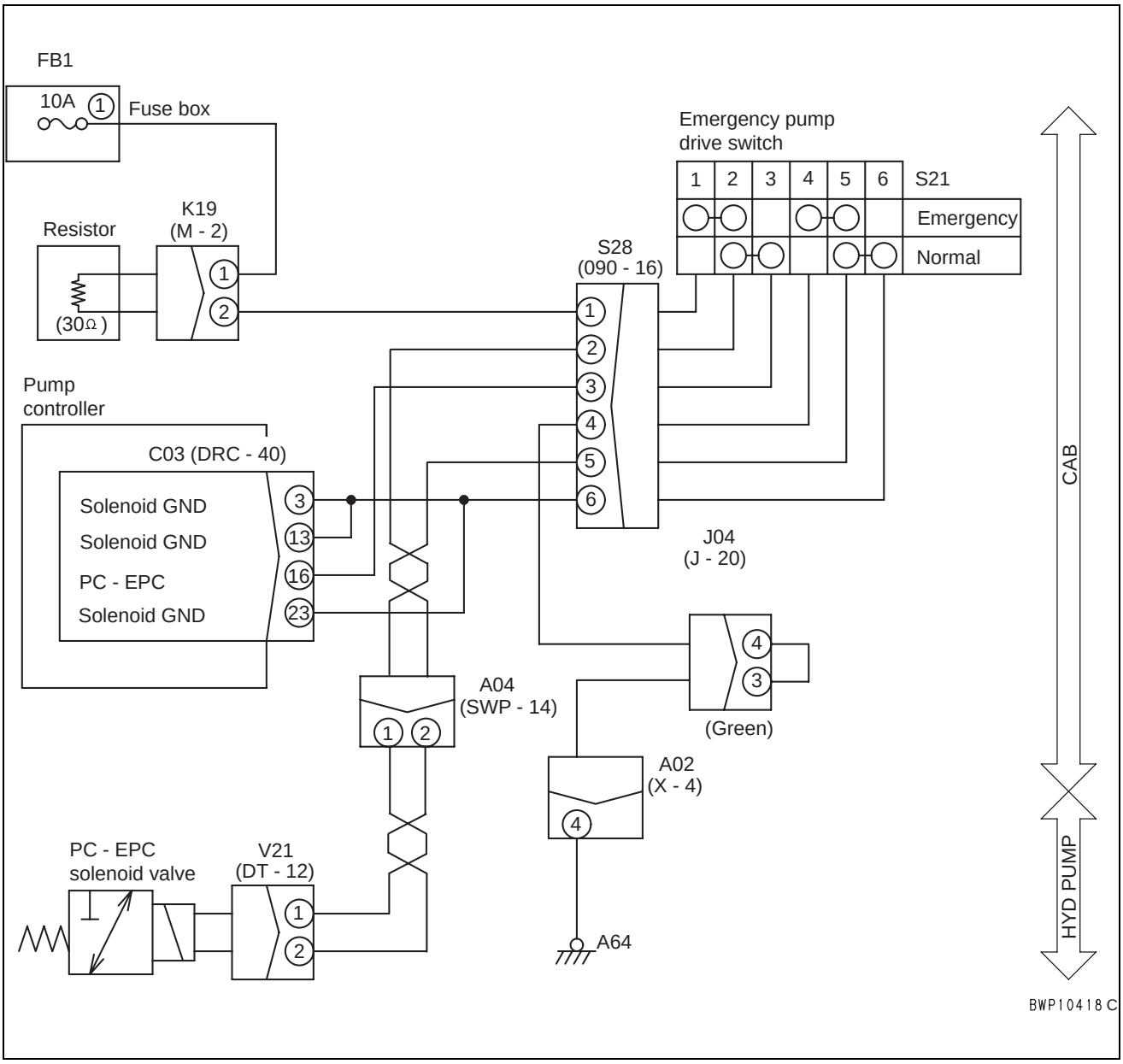


Failure Code [DXA0KA] (Disconnection in PC-EPC solenoid system)

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.			
			S28	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 S28 ③		Resistance value	Below 1 Ω
			Wiring harness between S28 ② and V21 (female) ①		Resistance value	Below 1 Ω
			Wiring harness between C03 (female) ③, ⑬, ㉓ and S28 ⑥		Resistance value	Below 1 Ω
			Wiring harness between S28 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 S28 ③ and grounding		Voltage	Below 1 V
			Between wiring harness S28 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

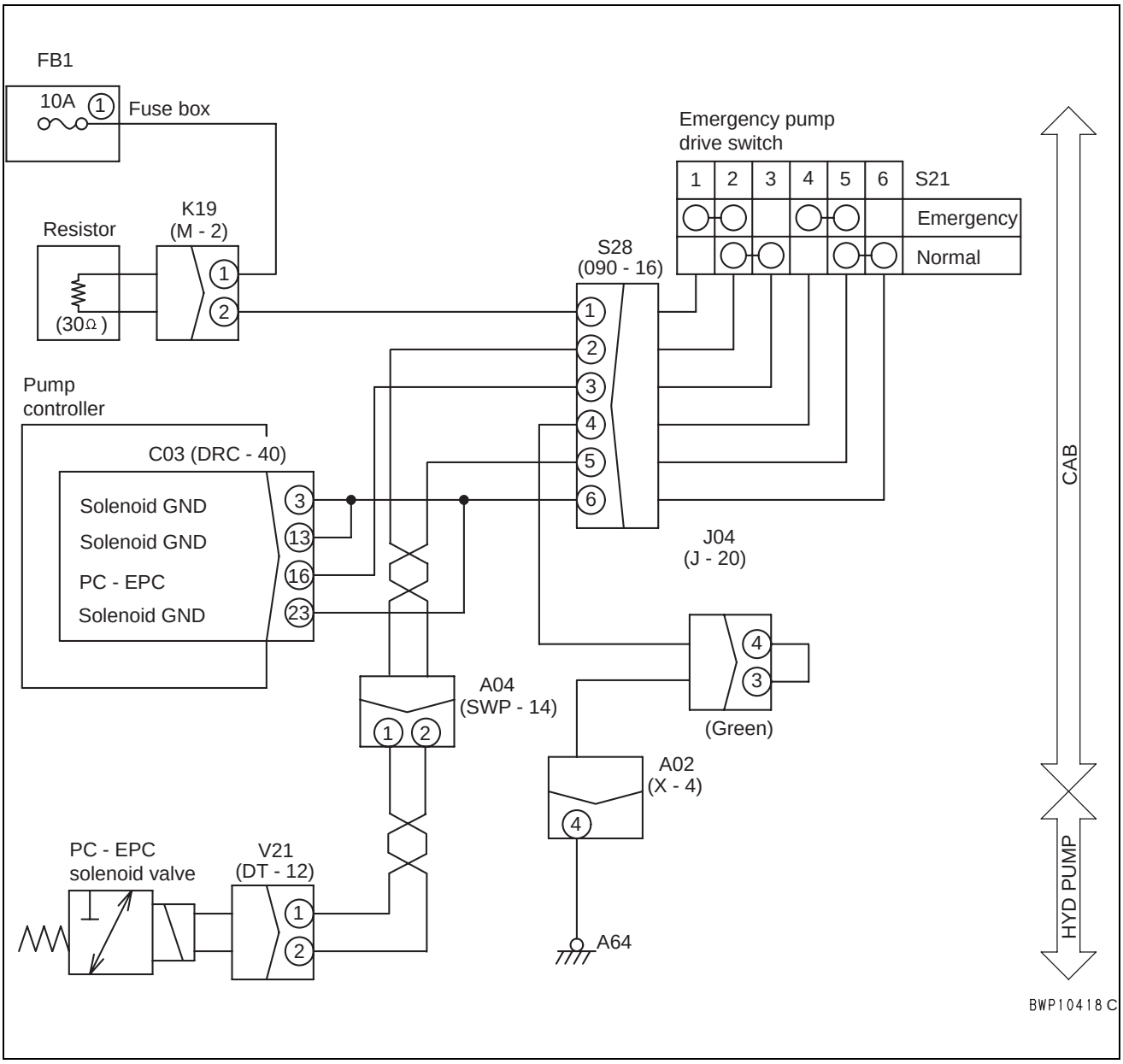


Failure Code [DXA0KB] (Short-circuiting in PC-EPC solenoid)

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 S28 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

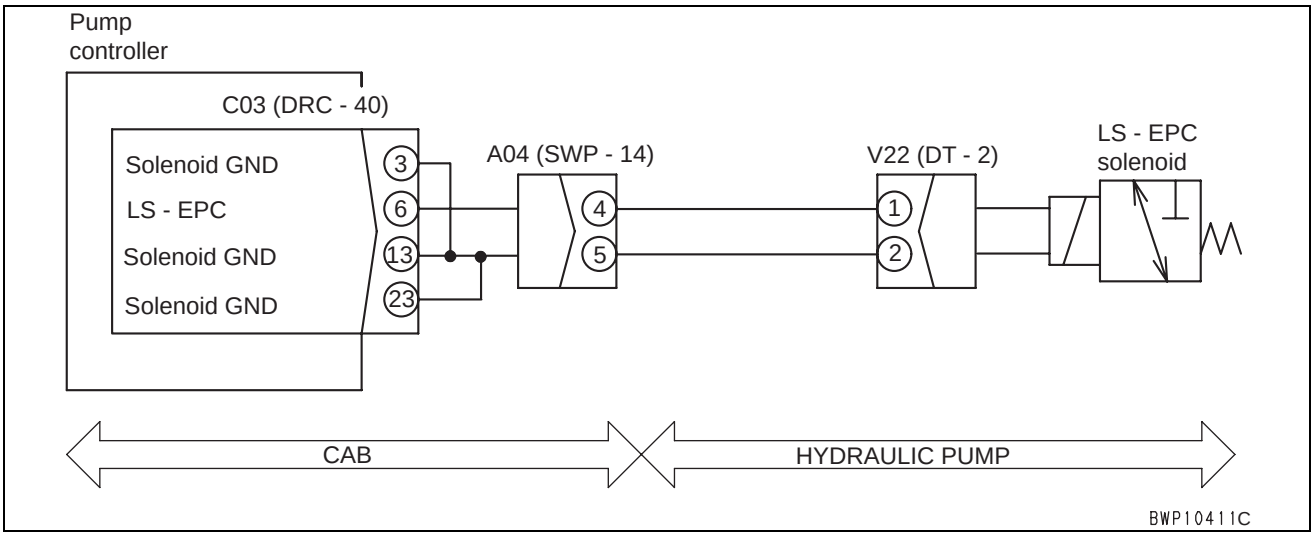


Failure Code [DXE0KA] (Disconnection in LS-EPC solenoid system)

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

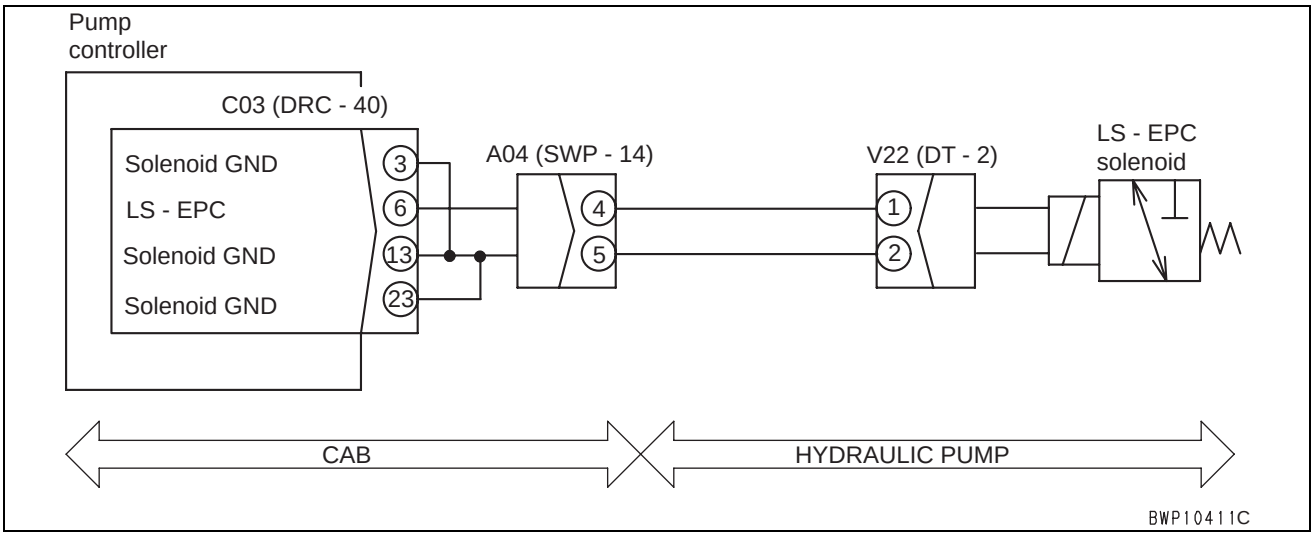


Failure Code [DXE0KB] (Short-circuiting in LS-EPC solenoid)

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

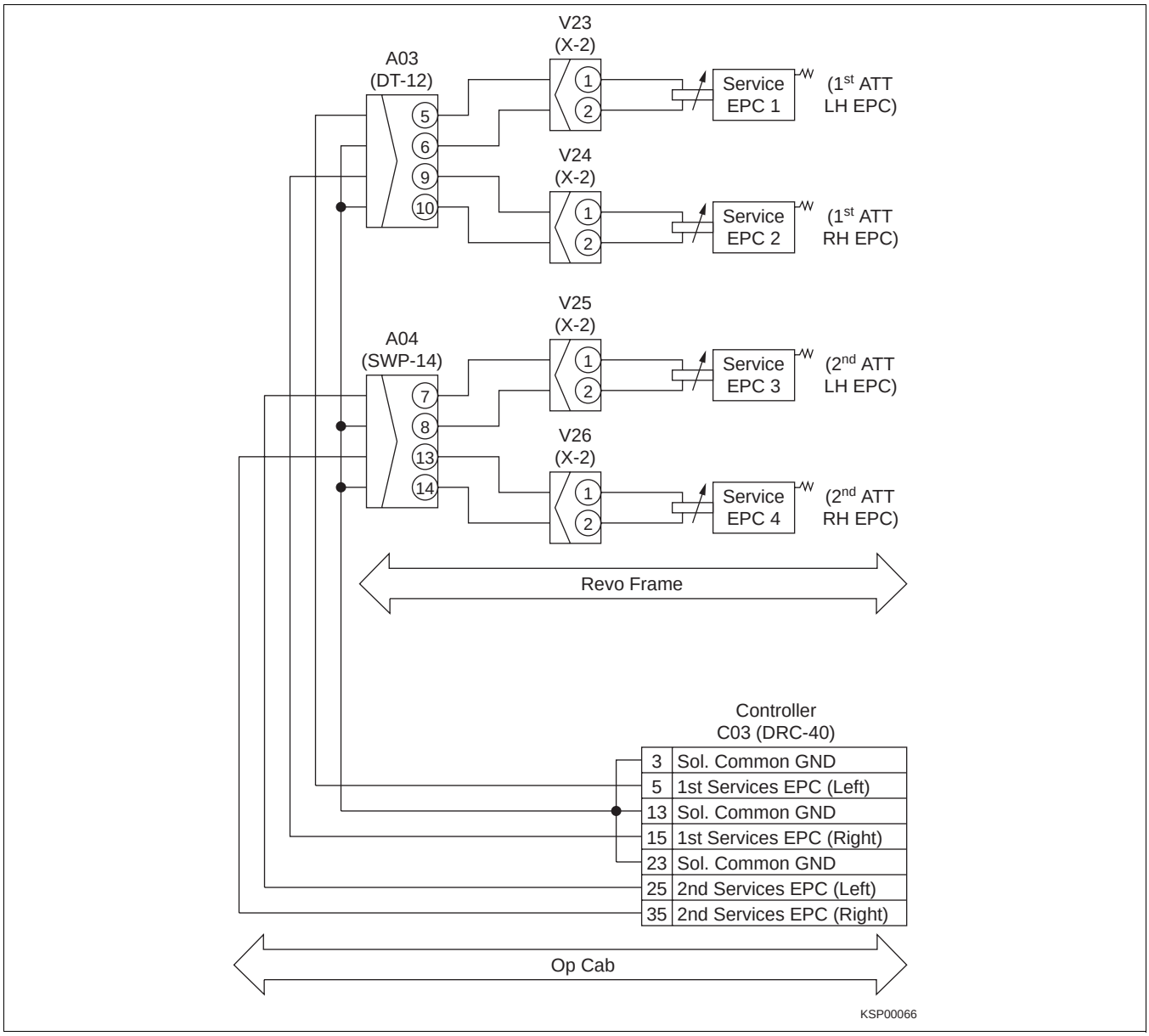


Failure code [DXE4KA] Service Current EPC1 Discon

User code	Failure code	Trouble	Service current EPC1 solenoid disconnection (Pump controller system)
—	**DXEAKA**		
Contents of trouble	• When service EPC1 solenoid was driven, disconnection was detected in circuit.		
Action of controller	• None in particular (Since no current flows, solenoid does not operate). • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• Attachment does not operate.		
Related information	• Drive current of service EPC1 solenoid can be checked with monitoring function. (Code: 01701 service solenoid current) • Method of reproducing failure code: Turn starting switch ON + Set in attachment mode (ATT).		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective service EPC solenoid (Internal disconnection)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			V23 (male)	Resistance		
			Between (1) – (2)	7 – 14 Ω		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between C03 (female) (5) – V23 (female) (1)	Resistance	Max. 1 Ω	
			Wiring harness between C03 (female) (3), (13), (23) – V23 (female) (2)	Resistance	Max. 1 Ω	
	3	Defective pump controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			C03 (female)	Resistance		
			Between (5) – (3), (13), (23)	7 – 14 Ω		

Circuit Diagram of Service EPC Solenoids

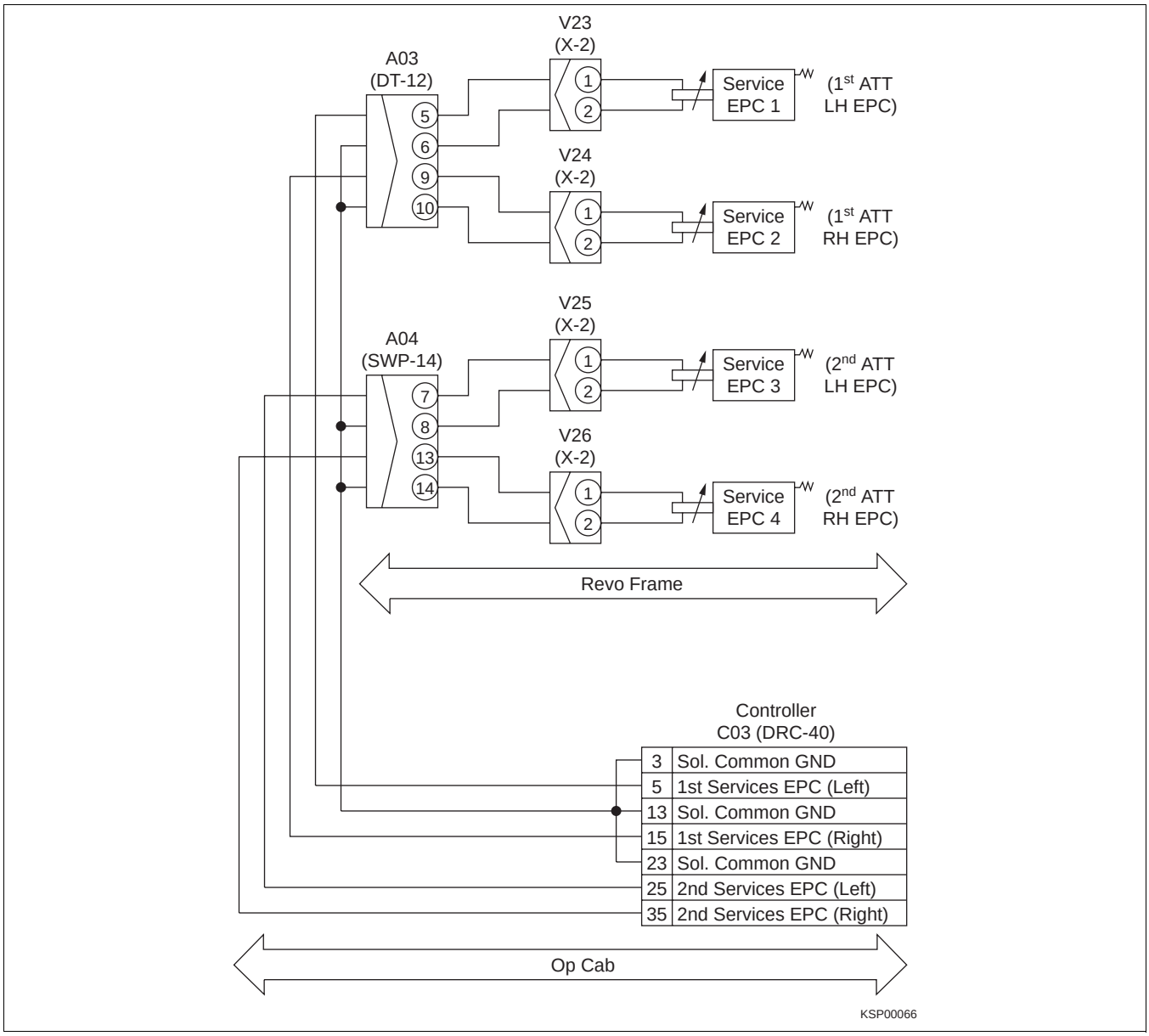


Failure code [DXE4KB] Service Current EPC1 Short

User code	Failure code	Trouble	Service current EPC1 solenoid short (Pump controller system)
—	**DXEAKB**		
Contents of trouble	• When service EPC1 solenoid was driven, short circuit was detected in circuit.		
Action of controller	• Turns output to service EPC1 solenoid OFF. • Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine	• Attachment does not operate.		
Related information	• Drive current of service EPC solenoid can be checked with monitoring function. (Code: 01701 service EPC solenoid current) • Method of reproducing failure code: Turn starting switch ON + Set in attachment mode (ATT).		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective service EPC solenoid (Internal short circuit or ground fault)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			V23 (male)	Resistance	
			Between (1) – (2)	7 – 14 Ω	
			Between (1) – chassis ground	Min. 1 MΩ	
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between C03 (female) (95) – V91 (female) (1)	Resistance	Min. 1 MΩ
	4	Defective pump controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			C02 (female)	Resistance	
			Between (3) – (5), (13), (23)	7 – 14 Ω	
			Between (5) – chassis ground	Min. 1 MΩ	

Circuit Diagram of Service EPC Solenoids

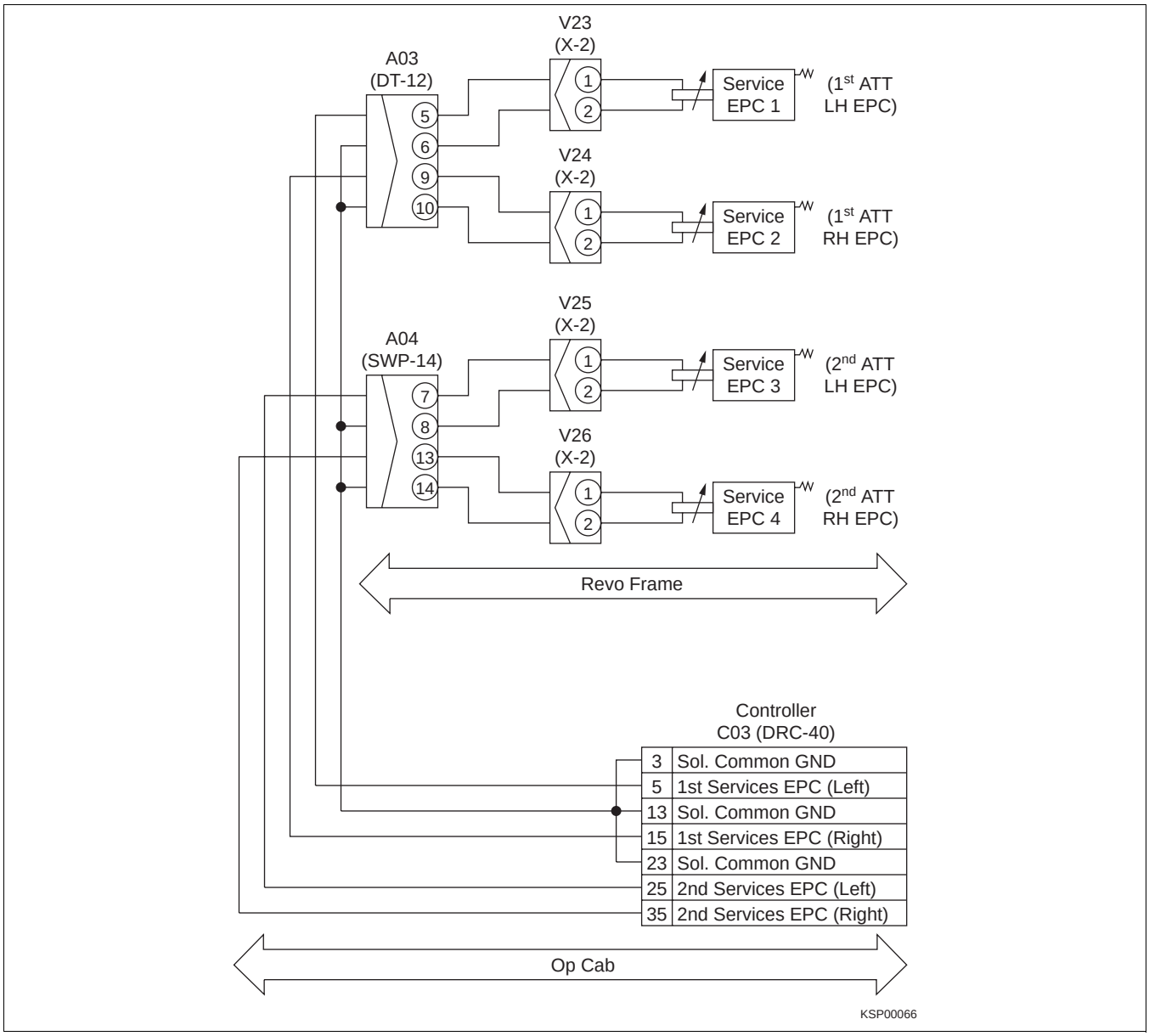


Failure code [DXE7KA] Service Current EPC2 Discon

User code	Failure code	Trouble	Service current EPC2 solenoid disconnection (Pump controller system)
—	**DXE7KA**		
Contents of trouble	• When service EPC2 solenoid was driven, disconnection was detected in circuit.		
Action of controller	• None in particular (Since no current flows, solenoid does not operate). • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• Attachment does not operate.		
Related information	• Drive current of service EPC2 solenoid can be checked with monitoring function. (Code: 01702 service solenoid current) • Method of reproducing failure code: Turn starting switch ON + Set in attachment mode (ATT).		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective service EPC solenoid (Internal disconnection)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			V24 (male)	Resistance	
			Between (1) – (2)	7 – 14 Ω	
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between C03 (female) (15) – V24 (female) (1)	Resistance	Max. 1 Ω
			Wiring harness between C03 (female) (3), (13), (23) – V24 (female) (2)	Resistance	Max. 1 Ω
	3	Defective pump controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			C03 (female)	Resistance	
			Between (15) – (3), (13), (23)	7 – 14 Ω	

Circuit Diagram of Service EPC Solenoids

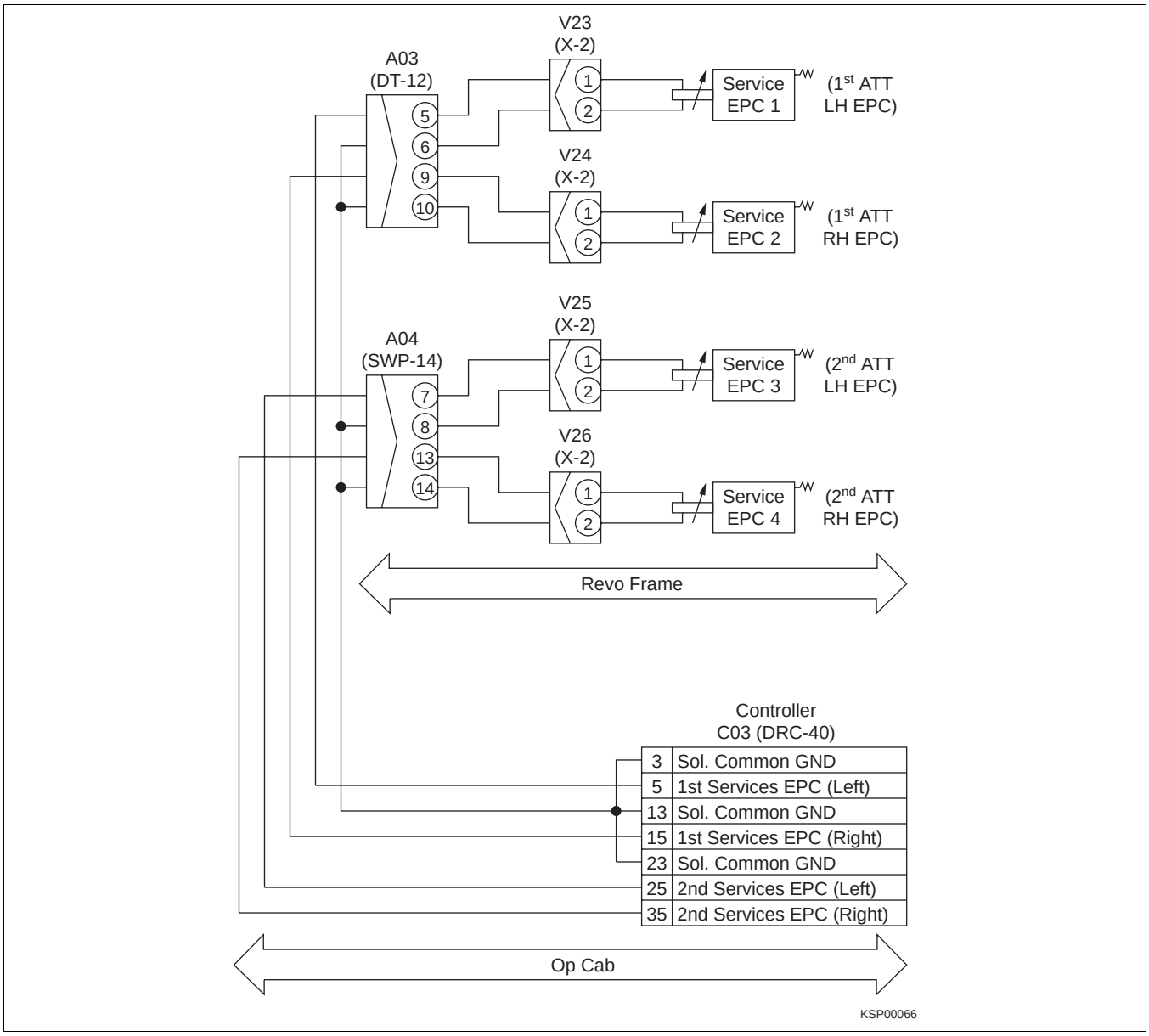


Failure code [DXE7KB] Service Current EPC2 Short

User code	Failure code	Trouble	Service current EPC2 solenoid short (Pump controller system)
—	**DXE7KB**		
Contents of trouble	• When service EPC2 solenoid was driven, short circuit was detected in circuit.		
Action of controller	• Turns output to service EPC2 solenoid OFF. • Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine	• Attachment does not operate.		
Related information	• Drive current of service EPC2 solenoid can be checked with monitoring function. (Code: 01702 service EPC solenoid current) • Method of reproducing failure code: Turn starting switch ON + Set in attachment mode (ATT).		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective service EPC solenoid (Internal short circuit or ground fault)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			V24 (male)	Resistance	
			Between (1) – (2)	7 – 14 Ω	
			Between (1) – chassis ground	Min. 1 MΩ	
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between C03 (female) (15) – V24 (female) (1)	Resistance	Min. 1 MΩ
	4	Defective pump controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			C03 (female)	Resistance	
			Between (15) – (3), (13), (20)	7 – 14 Ω	
			Between (15) – chassis ground	Min. 1 MΩ	

Circuit Diagram of Service EPC Solenoids

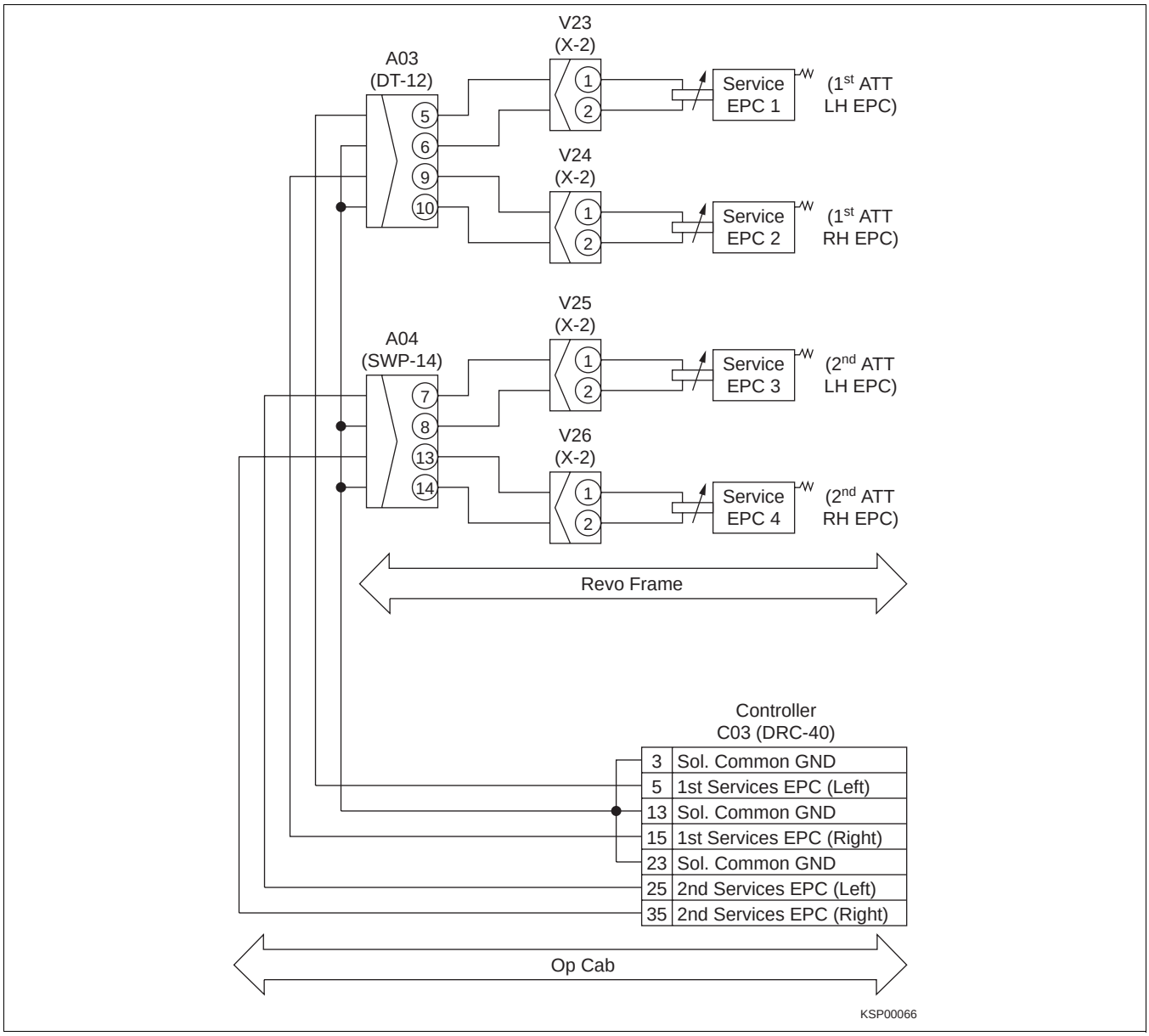


Failure code [DXE8KA] Service Current EPC3 Discon

User code	Failure code	Trouble	Service current EPC3 solenoid disconnection (Pump controller system)
—	**DXE8KA**		
Contents of trouble	• When service EPC3 solenoid was driven, disconnection was detected in circuit.		
Action of controller	• None in particular (Since no current flows, solenoid does not operate). • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• Attachment does not operate.		
Related information	• Drive current of service EPC3 solenoid can be checked with monitoring function. (Code: 01703 service solenoid current) • Method of reproducing failure code: Turn starting switch ON + Set in attachment mode (ATT).		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective service EPC solenoid (Internal disconnection)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			V25 (male)	Resistance		
			Between (1) – (2)	7 – 14 Ω		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between C03 (female) (25) – V25 (female) (1)	Resistance	Max. 1 Ω	
			Wiring harness between C03 (female) (3), (13), (23) – V25 (female) (2)	Resistance	Max. 1 Ω	
	3	Defective pump controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			C03 (female)	Resistance		
			Between (25) – (3), (13), (23)	7 – 14 Ω		

Circuit Diagram of Service EPC Solenoids

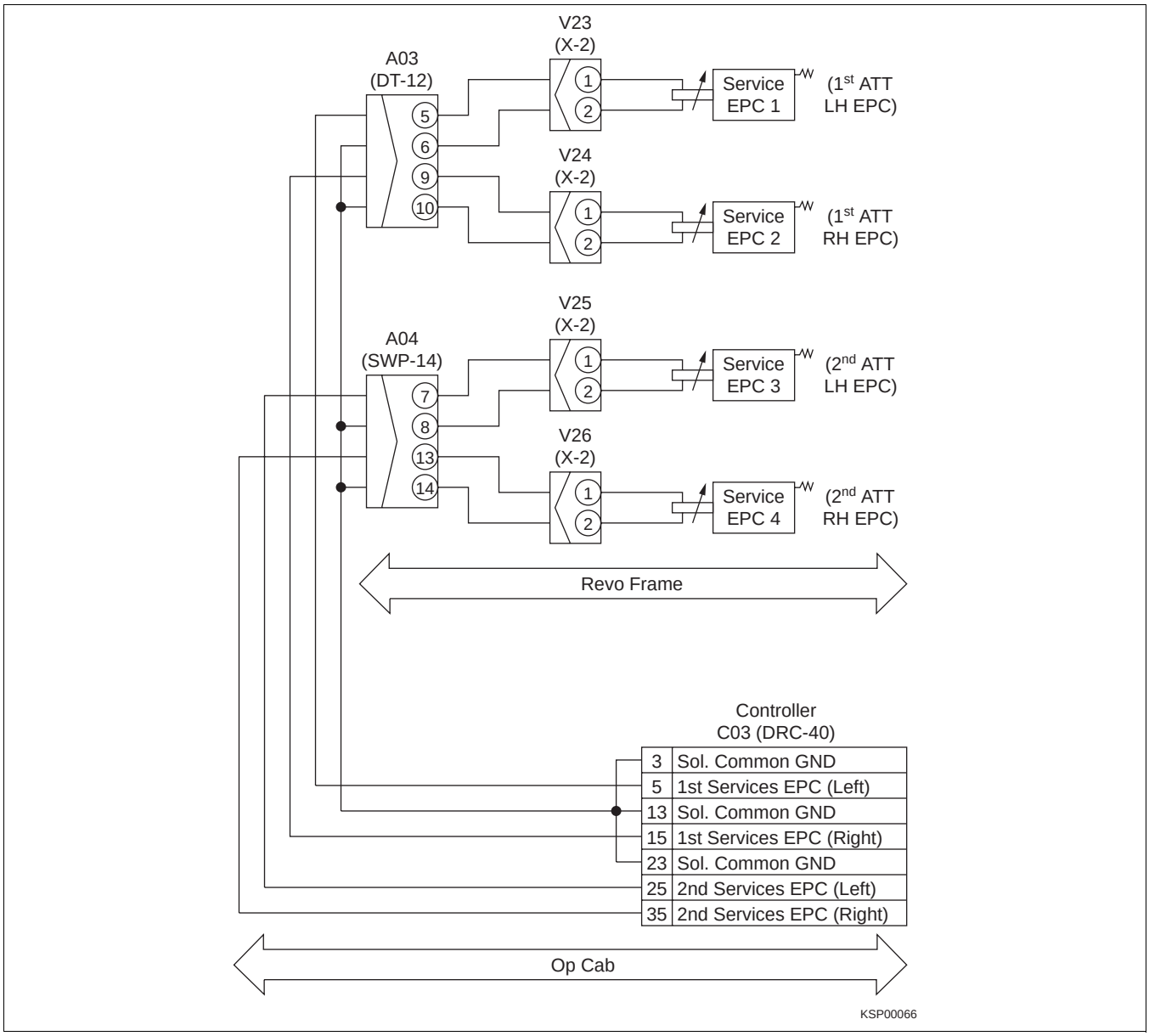


Failure code [DXE8KB] Service Current EPC3 Short

User code	Failure code	Trouble	Service current EPC3 solenoid short (Pump controller system)
—	**DXE8KB**		
Contents of trouble	• When service EPC3 solenoid was driven, short circuit was detected in circuit.		
Action of controller	• Turns output to service EPC3 solenoid OFF. • Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine	• Attachment does not operate.		
Related information	• Drive current of service EPC3 solenoid can be checked with monitoring function. (Code: 01703 service EPC solenoid current) • Method of reproducing failure code: Turn starting switch ON + Set in attachment mode (ATT).		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective service EPC solenoid (Internal short circuit or ground fault)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			V25 (male)	Resistance	
			Between (1) – (2)	7 – 14 Ω	
			Between (1) – chassis ground	Min. 1 MΩ	
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between C03 (female) (25) – V25 (female) (1)	Resistance	Min. 1 MΩ
	4	Defective pump controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			C03 (female)	Resistance	
			Between (25) – (3), (13), (23)	7 – 14 Ω	
			Between (25) – chassis ground	Min. 1 MΩ	

Circuit Diagram of Service EPC Solenoids

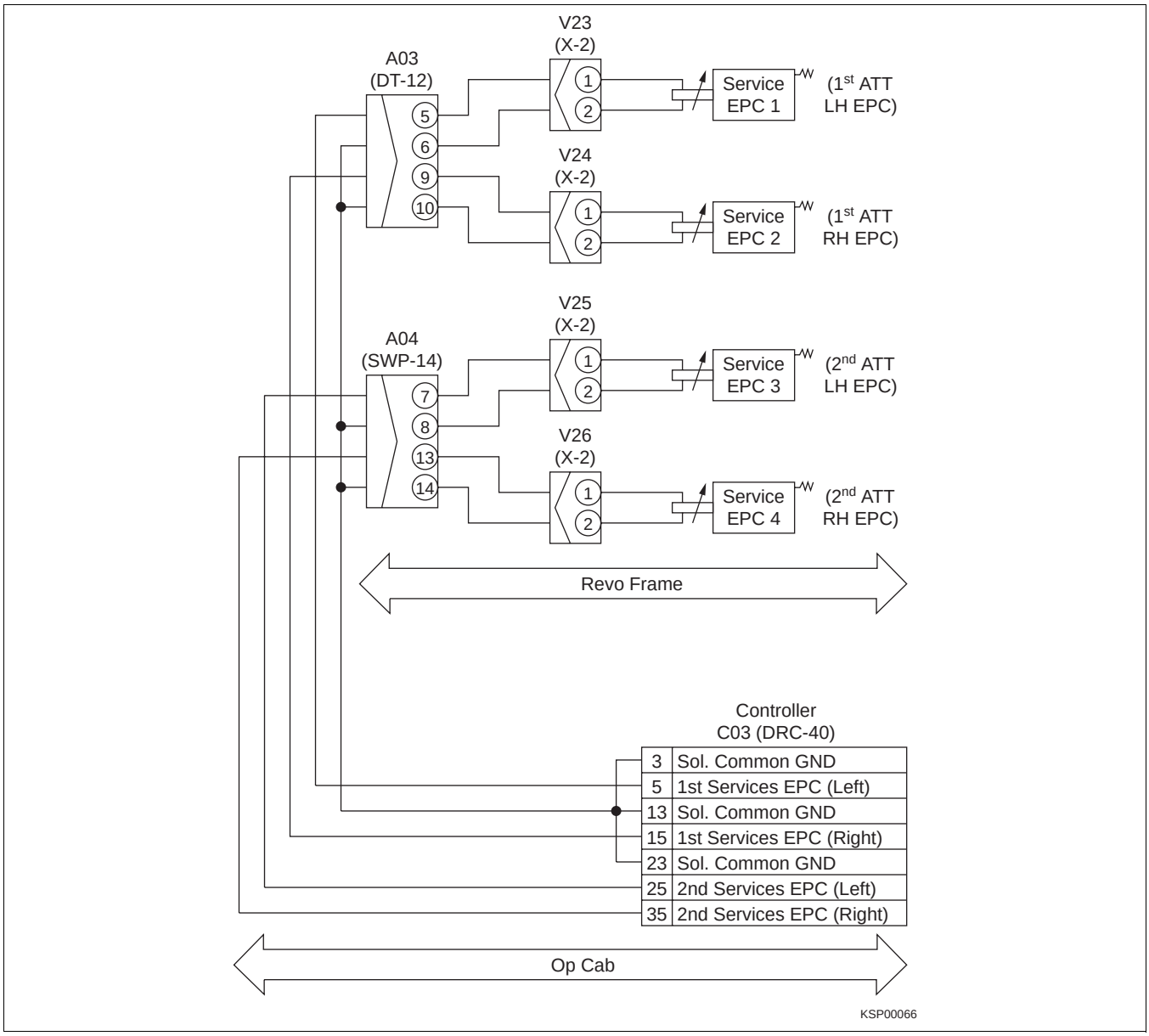


Failure code [DXE9KA] Service Current EPC4 Discon

User code	Failure code	Trouble	Service current EPC4 solenoid disconnection (Pump controller system)
—	**DXE9KA**		
Contents of trouble	• When service EPC4 solenoid was driven, disconnection was detected in circuit.		
Action of controller	• None in particular (Since no current flows, solenoid does not operate). • If cause of failure disappears, system resets itself.		
Problem that appears on machine	• Attachment does not operate.		
Related information	• Drive current of service EPC4 solenoid can be checked with monitoring function. (Code: 01704 service solenoid current) • Method of reproducing failure code: Turn starting switch ON + Set in attachment mode (ATT).		

	Cause		Standard value in normal state/Remarks on troubleshooting			
Possible causes and standard value in normal state	1	Defective service EPC solenoid (Internal disconnection)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			V26 (male)	Resistance		
			Between (1) – (2)	7 – 14 Ω		
	2	Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			Wiring harness between C03 (female) (35) – V94 (female) (1)	Resistance	Max. 1 Ω	
			Wiring harness between C03 (female) (3), (13), (23) – V26 (female) (2)	Resistance	Max. 1 Ω	
	3	Defective pump controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.			
			C03 (female)	Resistance		
			Between (35) – (3), (13), (23)	7 – 14 Ω		

Circuit Diagram of Service EPC Solenoids

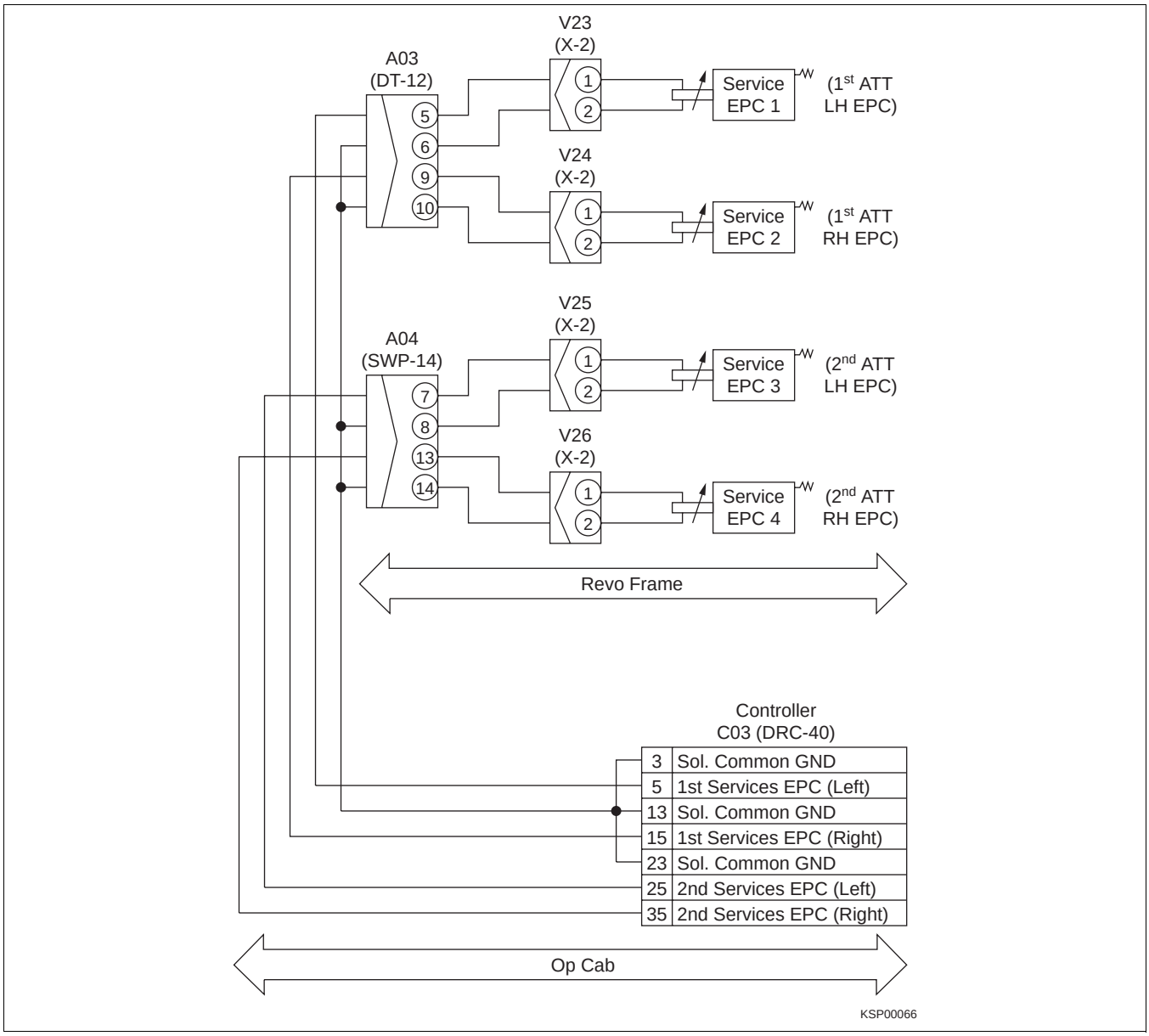


Failure code [DXE9KB] Service Current EPC4 Short

User code	Failure code	Trouble	Service current EPC4 solenoid short (Pump controller system)
—	**DXE9KB**		
Contents of trouble	• When service EPC4 solenoid was driven, short circuit was detected in circuit.		
Action of controller	• Turns output to service EPC4 solenoid OFF. • Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF.		
Problem that appears on machine	• Attachment does not operate.		
Related information	• Drive current of service EPC4 solenoid can be checked with monitoring function. (Code: 01704 service EPC solenoid current) • Method of reproducing failure code: Turn starting switch ON + Set in attachment mode (ATT).		

	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective service EPC solenoid (Internal short circuit or ground fault)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			V26 (male)	Resistance	
			Between (1) – (2)	7 – 14 Ω	
			Between (1) – chassis ground	Min. 1 MΩ	
	3	Ground fault in wiring harness (Short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			Wiring harness between C03 (female) (35) – V26 (female) (1)	Resistance	Min. 1 MΩ
	4	Defective pump controller	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			C03 (female)	Resistance	
			Between (35) – (3), (13), (23)	7 – 14 Ω	
			Between (35) – chassis ground	Min. 1 MΩ	

Circuit Diagram of Service EPC Solenoids

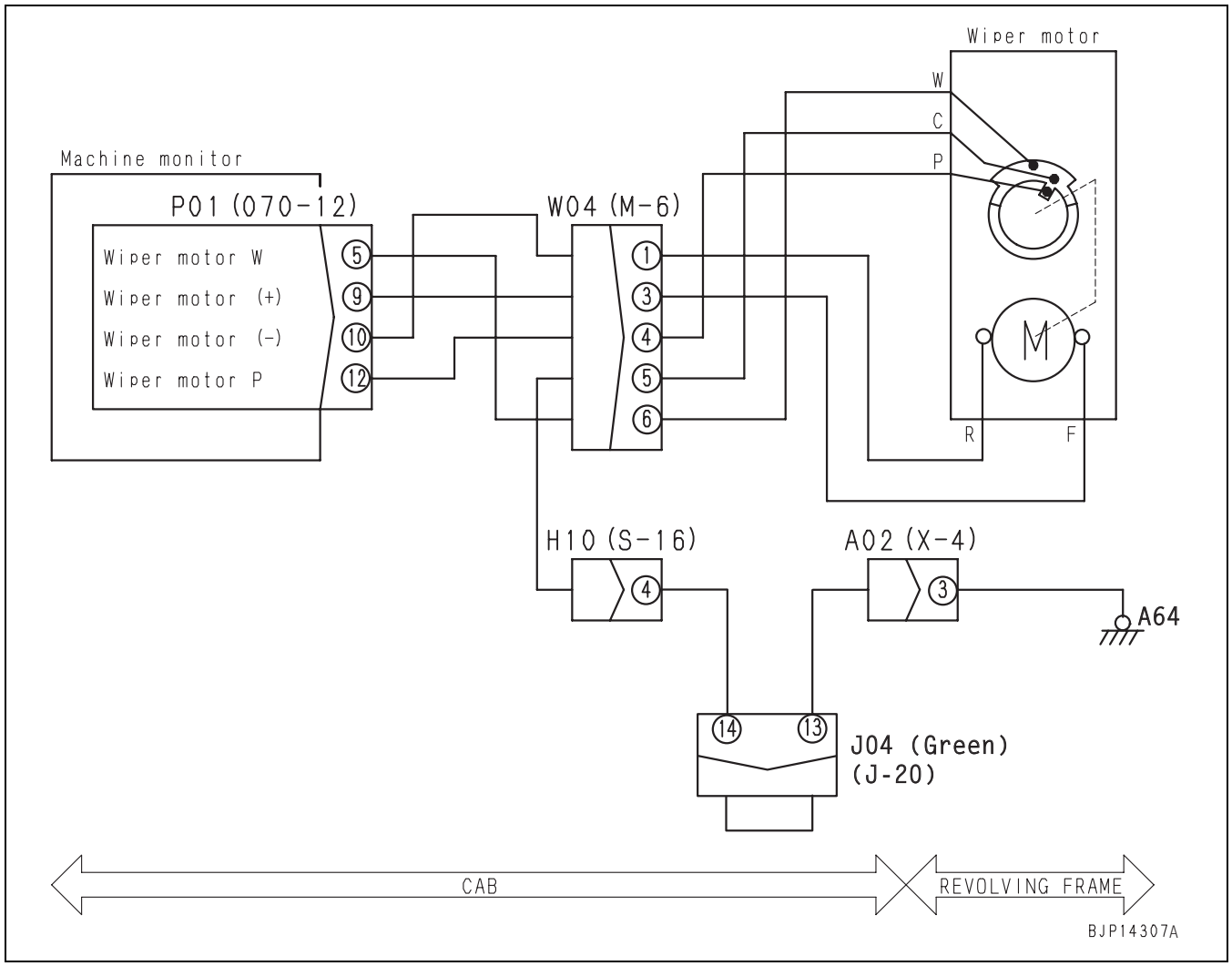


Failure code [DY20KA] Wiper Working Abnormality

Action code	Failure code	Trouble	Wiper working abnormality (Machine monitor system)
—	**DY20KA**		
Contents of trouble	• When wind shield 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)	★ 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)	★ 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	★ 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

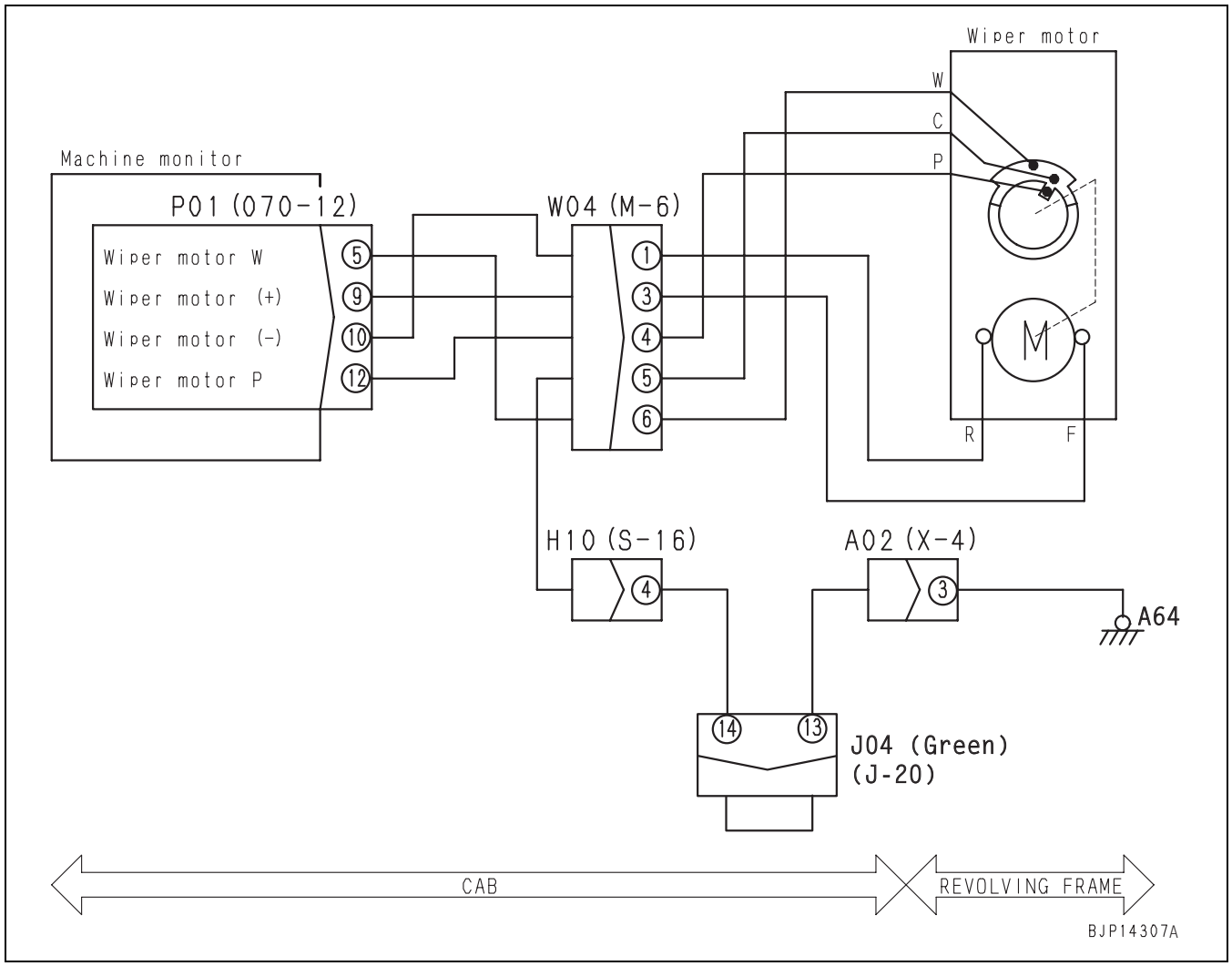


Failure code [DY20MA] Wiper Parking Abnormality

Action code	Failure code	Trouble	Wiper parking abnormality (Machine monitor system)
—	**DY20MA**		
Contents of trouble	• When wind shield 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)	★ 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)	★ 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	★ 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

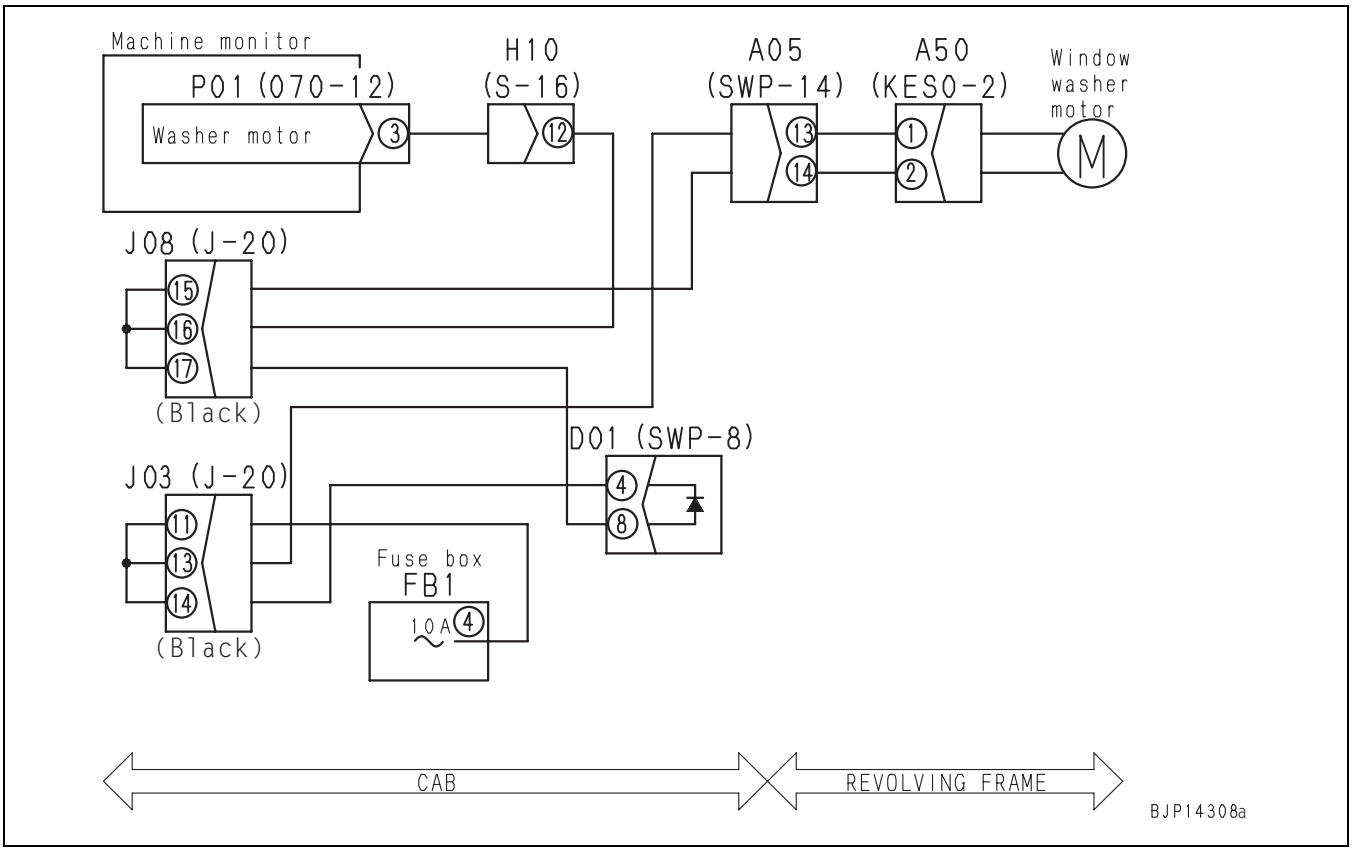


Failure code [DY2CKB] Washer Drive S/C

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)	★ 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	★ 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	★ 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

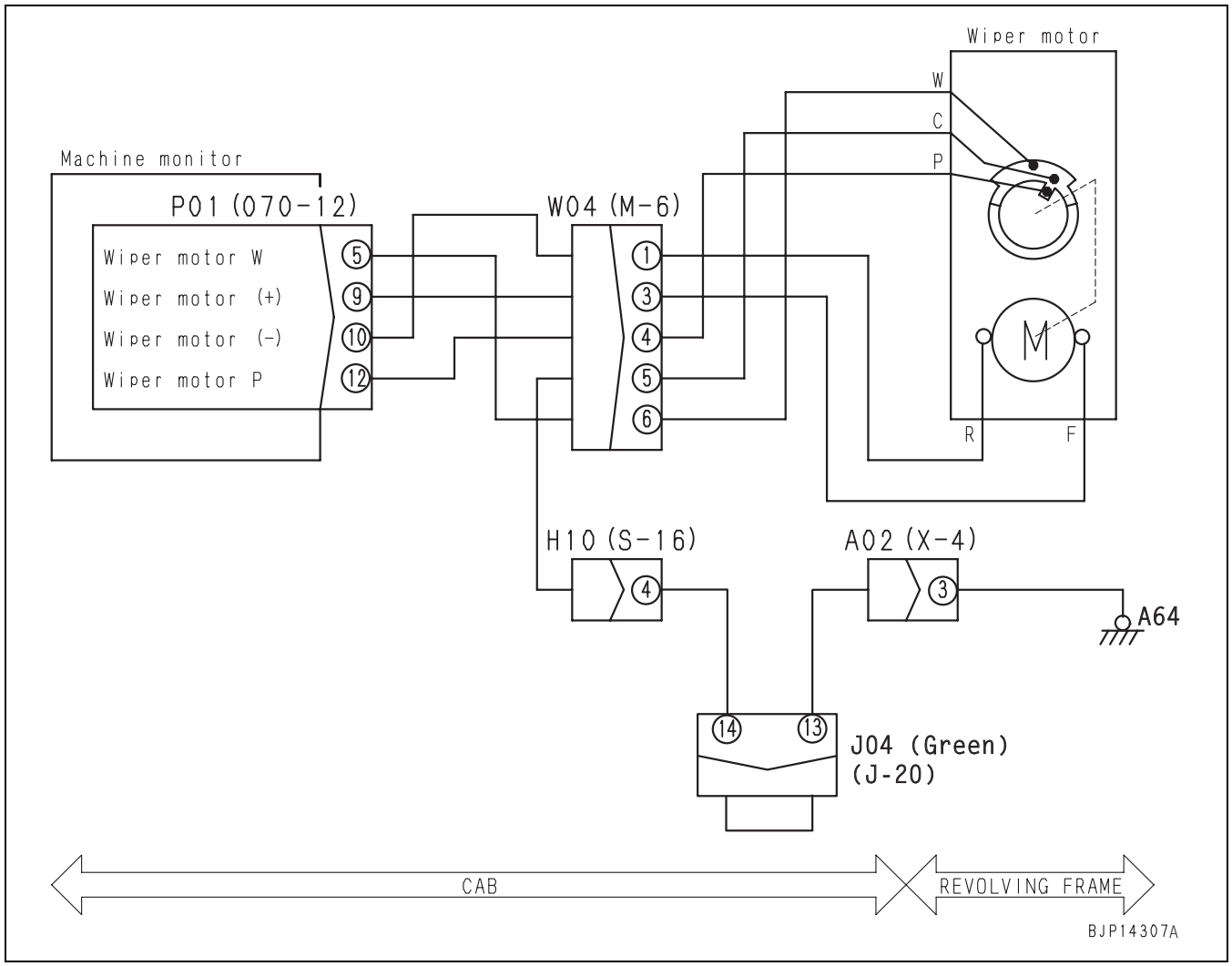


Failure code [DY2DKB] Wiper Drive (For) S/C

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)	★ 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)	★ 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	★ 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

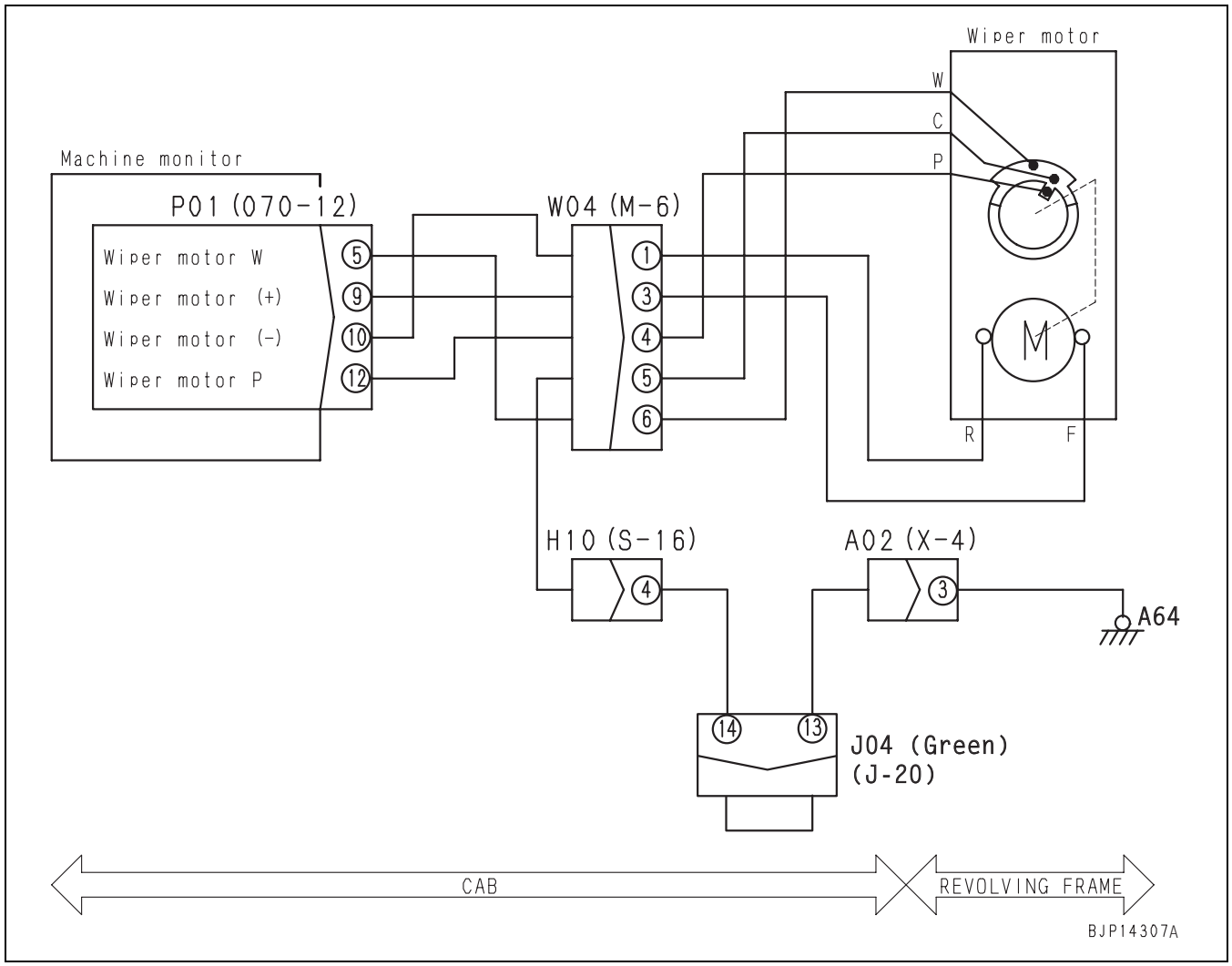


Failure code [DY2EKB] Wiper Drive (Rev) S/C

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)	★ 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)	★ 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	★ 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



Blank for technical reason

TROUBLESHOOTING OF ELECTRICAL SYSTEM (E-MODE)

INFORMATION CONTAINED IN TROUBLESHOOTING TABLE 20-520
E-1 Engine does not start (Engine does not rotate) 20-522
E-5 Auto-decelerator does not work 20-527
E-6 Auto engine warm-up device does not work 20-529
E-7 Preheater does not operate 20-530
E-8 All work equipment, swing and travel do not move 20-532
E-9 One-touch Power Max Switch does not work 20-534
E-10 No display in monitor panel at all 20-535
E-11 Part of display on monitor panel is missing 20-536
E-12 Monitor panel displays contents irrelevant to the model 20-536
E-13 Fuel level monitor red lamp lights up while engine is running 20-537
E-14 Engine coolant temperature gauge does not indicate normally 20-538
E-15 Hydraulic oil temperature gauge does not display correctly 20-540
E-16 Fuel gauge does not display correctly 20-541
E-17 Swing lock monitor does not display correctly 20-542
E-18 When the monitor switch is operated, no display appears 20-544
E-19 Windshield wiper and window washer do not operate 20-545
E-20 Alarm buzzer cannot be stopped 20-547
E-21 "Boom/Stabiliser RAISE" is not correctly displayed in monitor function 20-548
E-22 "Boom/Stabiliser LOWER" is not correctly displayed in monitor function 20-549
E-23 "Arm DIGGING" is not correctly displayed in monitor function 20-550
E-24 "Arm DUMPING" is not correctly displayed in monitor function 20-551
E-25 "Bucket DIGGING" is not correctly displayed in monitor function 20-552
E-26 "Bucket DUMPING" is not correctly displayed in monitor function 20-553
E-27 "SWING" is not correctly displayed in monitor function 20-554
E-28 "TRAVEL" is not correctly displayed in monitor function 20-556
E-29 "2 Piece Boom" is not correctly displayed in monitor function 20-558
E-30 Air Conditioner does not work 20-560
E-31 Travel reverse alarm does not sound 20-562
E-32 KOMTRAX system does not operate normally 20-564

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)

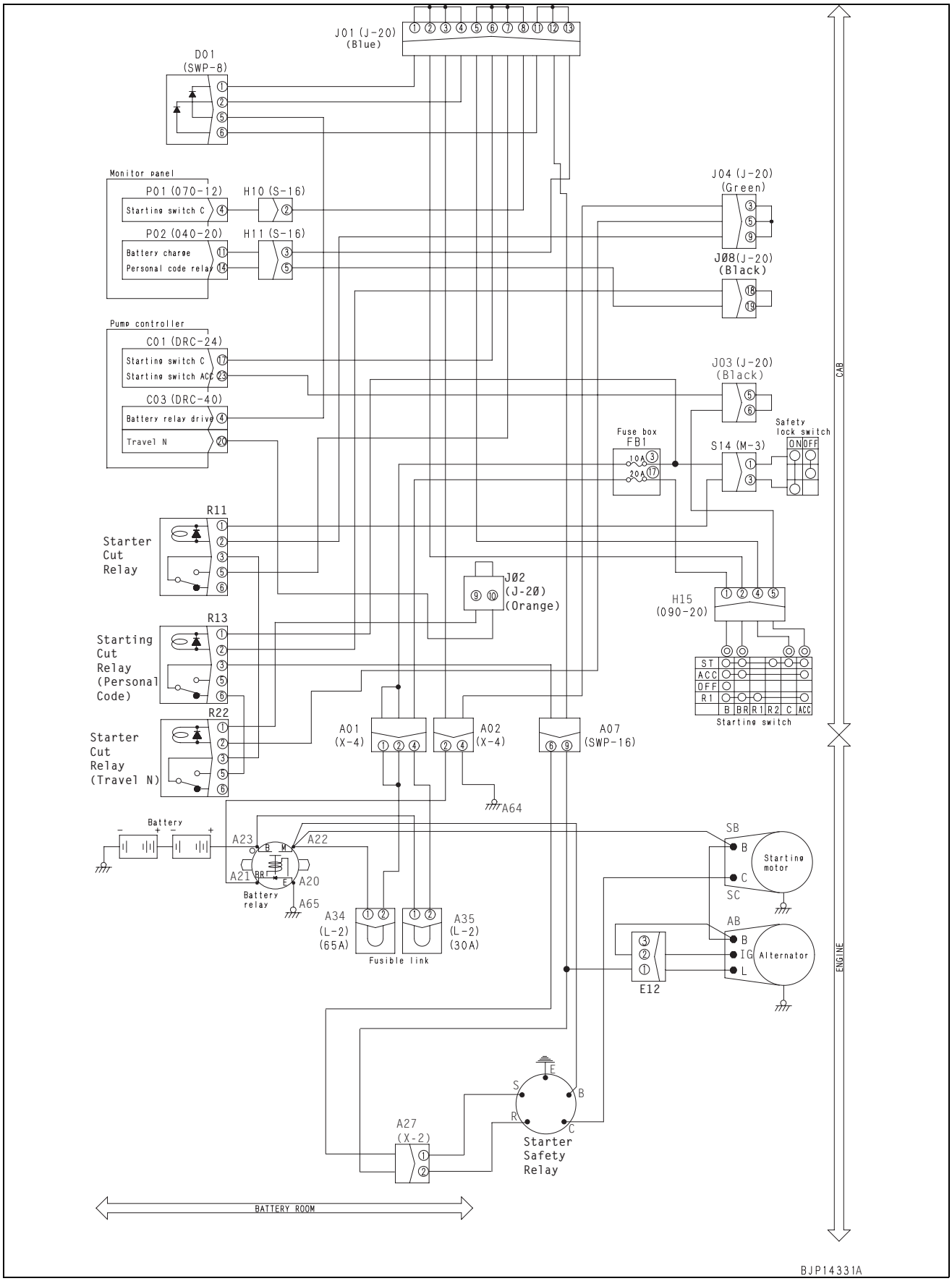
Failure information	• The engine does not start (the engine does not rotate).
Relative information	• The following two engine start locking mechanisms are provided in the engine starting circuit. 1. Engine start locking by means of password in the monitor panel (※) 2. Engine start locking by means of safety lock lever

<table>
<tr><td rowspan="19">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">Shortage in battery capacity</td><td>Battery voltage</td><td colspan="3">Battery electrolyte specific gravity</td></tr>
<tr><td>Above 24 V</td><td colspan="3">Above 1.26</td></tr>
<tr><td>2</td><td>Fuse box 1 nos. 3 and 17 and Fusible Links A34 and A35 fault</td><td colspan="4">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.</td></tr>
<tr><td rowspan="4">3</td><td rowspan="4">Engine starting switch fault (Internal disconnection)</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>H15 (male)</td><td>Position</td><td colspan="2">Resistance value</td></tr>
<tr><td rowspan="2">Between ① and ④</td><td>OFF</td><td colspan="2">Above 1 MΩ</td></tr>
<tr><td>Start</td><td colspan="2">Below 1 Ω</td></tr>
<tr><td rowspan="4">4</td><td rowspan="4">Safety lock switch fault (Internal short-circuiting)</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>S14 (female)</td><td>Lock lever</td><td colspan="2">Resistance value</td></tr>
<tr><td rowspan="2">Between ① and ③</td><td>FREE</td><td colspan="2">Above 1 MΩ</td></tr>
<tr><td>LOCK</td><td colspan="2">Below 1 Ω</td></tr>
<tr><td rowspan="5">5</td><td rowspan="5">Engine starting motor cut relay, R11, R13 and R22 defective (Internal disconnection or short-circuiting)</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">R11 (male) & R13 (male) & R22 (male)</td><td colspan="2">Resistance value</td></tr>
<tr><td colspan="2">Between ① and ②</td><td colspan="2">100 – 500 Ω</td></tr>
<tr><td colspan="2">Between ③ and ⑤</td><td colspan="2">Above 1 MΩ</td></tr>
<tr><td colspan="2">Between ③ and ⑥</td><td colspan="2">Below 1 Ω</td></tr>
<tr><td rowspan="7">6</td><td rowspan="7">Engine starting motor 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. (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)</td></tr>
<tr><td colspan="2">Safety relay</td><td>Engine starting switch</td><td>Voltage</td></tr>
<tr><td colspan="2">Power source: Between B terminal and grounding</td><td rowspan="5">Start</td><td>20 – 30 V</td></tr>
<tr><td colspan="2">GND (grounding): Between E terminal and grounding</td><td>Connected</td></tr>
<tr><td colspan="2">Generation signal: Between R terminal (A27 ②) and grounding</td><td>Below 1 V</td></tr>
<tr><td colspan="2">Engine start input: Between C terminal and grounding</td><td>20 – 30 V</td></tr>
<tr><td colspan="2">Engine start output: Between S terminal (A27 ①) and grounding</td><td>20 – 30 V</td></tr>
<tr><td rowspan="4">7</td><td rowspan="4">Engine starting motor fault (Internal disconnection or damage)</td><td colspan="4">• 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)</td></tr>
<tr><td colspan="2">Engine starting motor</td><td>Engine starting switch</td><td>Voltage</td></tr>
<tr><td colspan="2">Power source: B terminal and grounding</td><td rowspan="2">Start</td><td>20 – 30 V</td></tr>
<tr><td colspan="2">Engine start input: C terminal and grounding</td><td>20 – 30 V</td></tr>
</table>

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 cancelled 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="3">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="3">If the display on the monitor panel is not normal, proceed to section E-14 of this trouble-shooting chapter.</td></tr>
<tr><td>Monitoring code</td><td>Item</td><td>Normal display</td></tr>
<tr><td>2</td><td>Pump controller defective</td><td>04102</td><td>Engine cooling water temperature</td><td>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

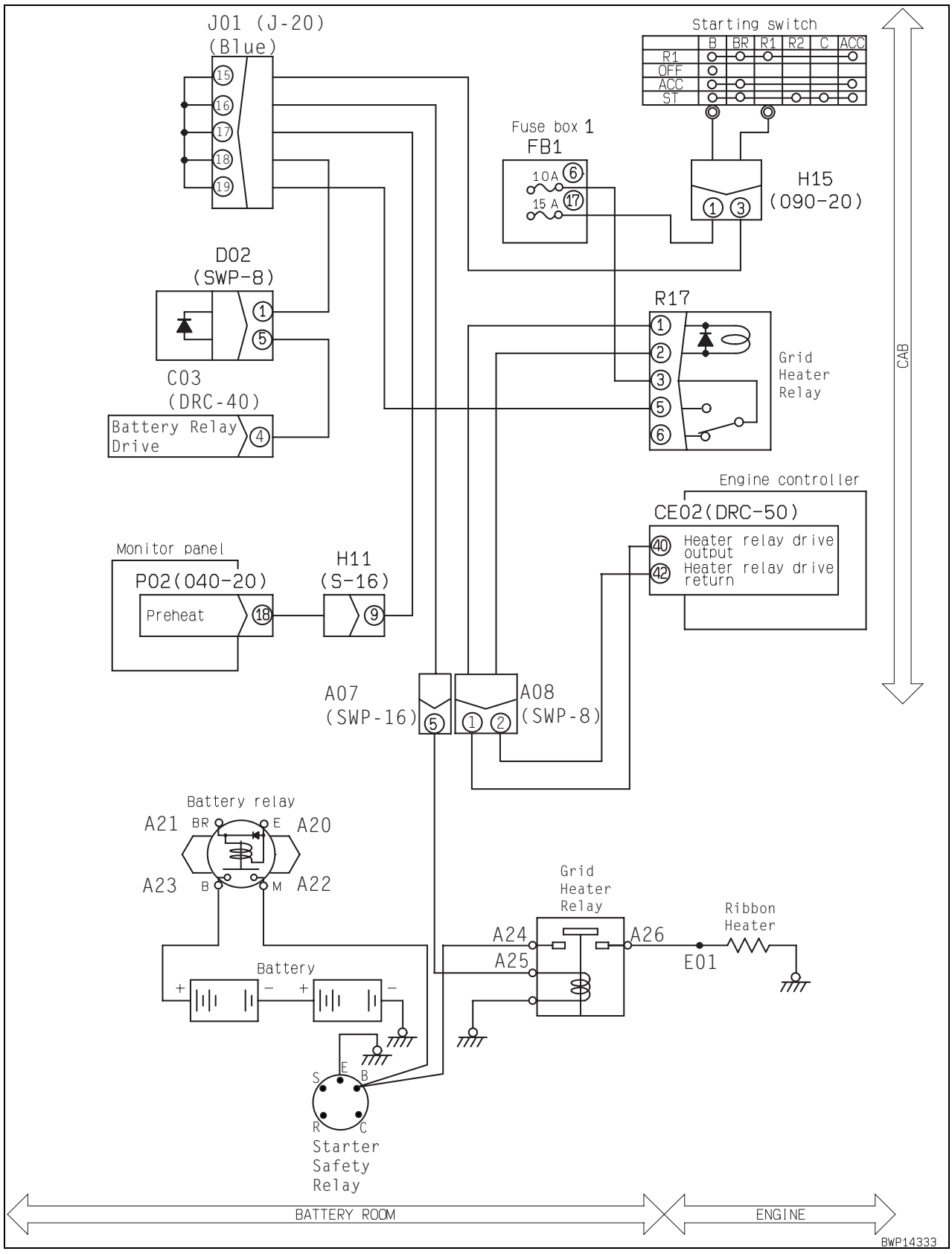
Trouble (1)	When starting switch is turned to HEAT position, preheating monitor does not light up.
Related information	Input of preheating signal (ON/OFF) can be checked with monitoring function. (Code 04500: Monitor Input 1)

	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)	★ 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	★ 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)	★ 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)	★ 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).	★ 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)	★ 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



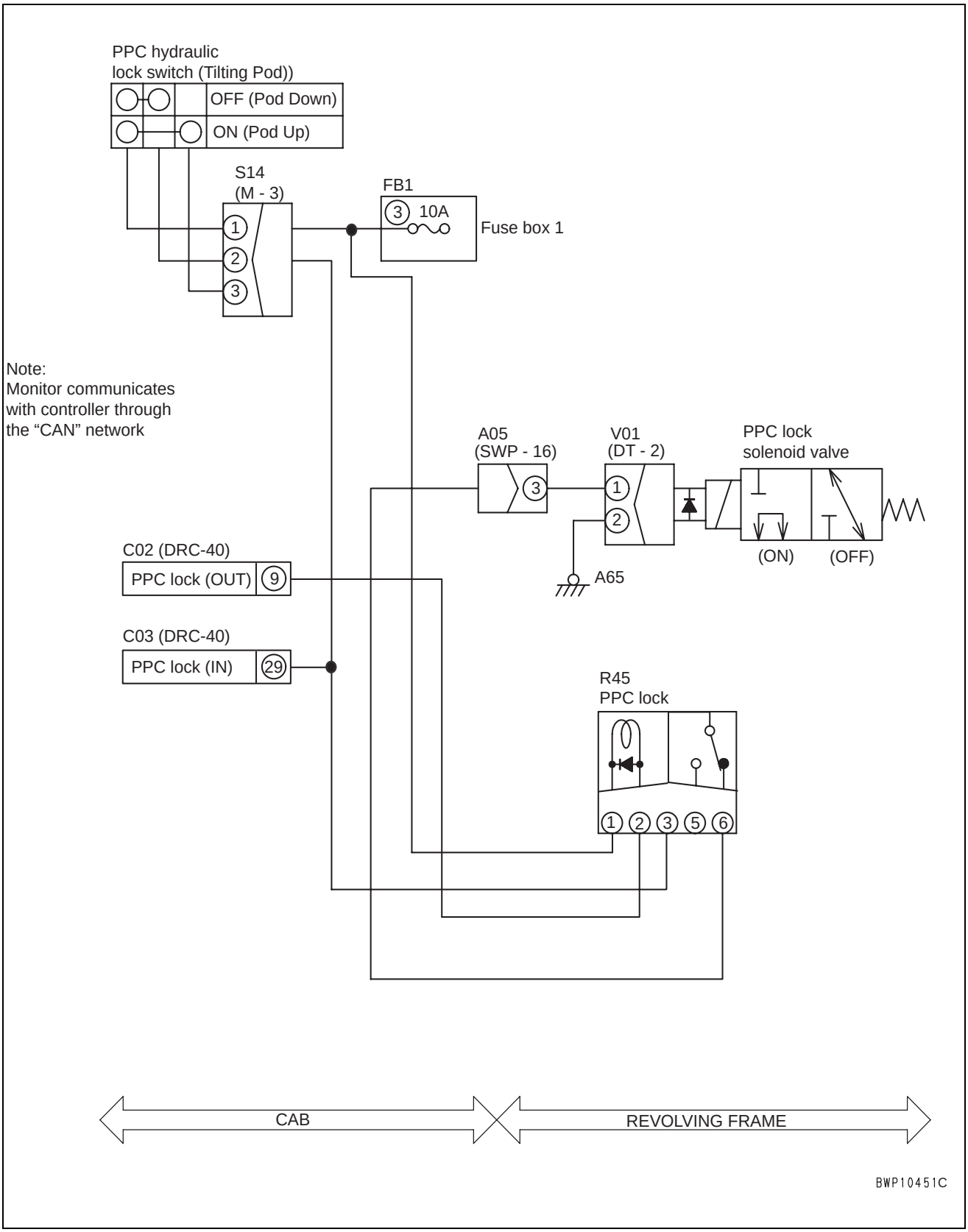
E-8 All work equipment, swing and travel do not move

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



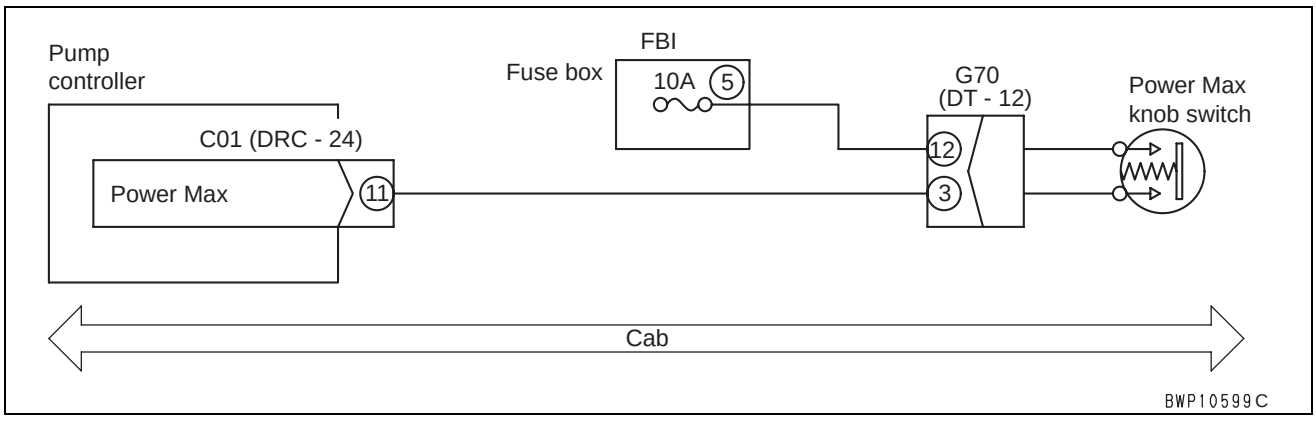
E-9 One-touch Power Max Switch does not work

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

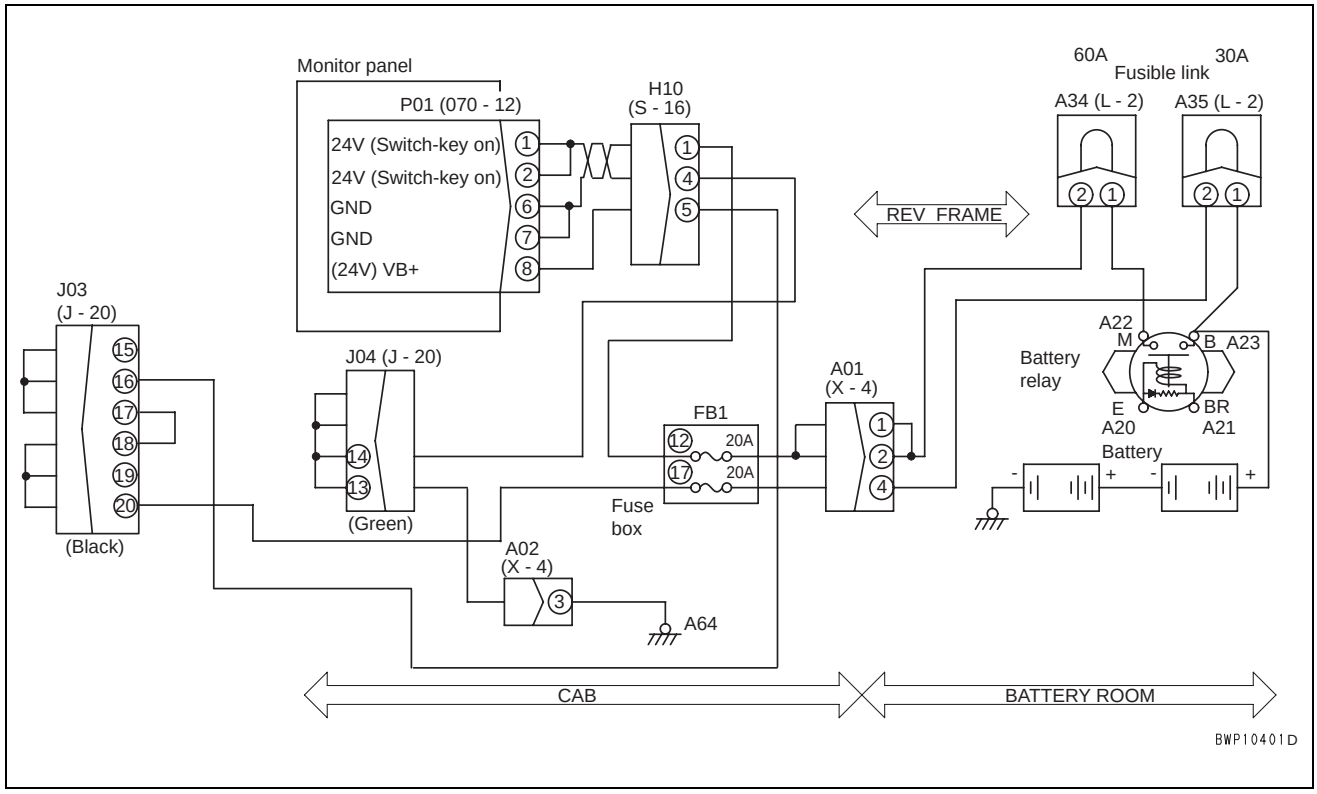


E-10 No display in monitor panel at all

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	—

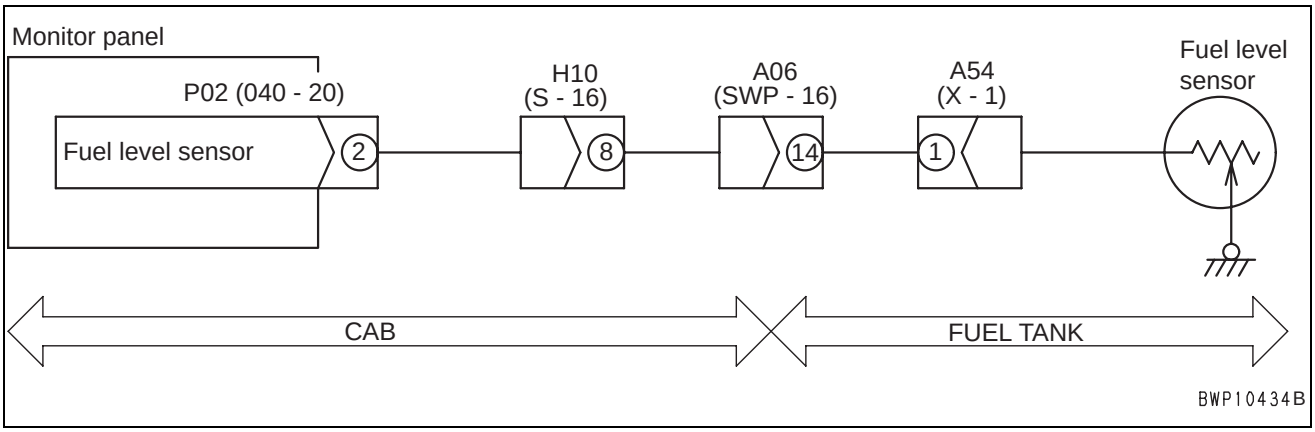
<table>
<tr><th rowspan="4">Presumed cause and standard value in normal</th><th colspan="2">Cause</th><th colspan="3">Standard value in normal and references for troubleshooting</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Model code signal fault
(Internal failure)</td><td colspan="3">If the display on the monitor panel is normal, proceed to Service Code [DA2SKQ].</td></tr>
<tr><td>Monitoring code</td><td>Item</td><td>Normal display</td></tr>
<tr><td>00200</td><td>Controller model select</td><td>PW180</td></tr>
<tr><td>2</td><td>Monitor panel defective</td><td colspan="3">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)</td></tr>
</table>

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

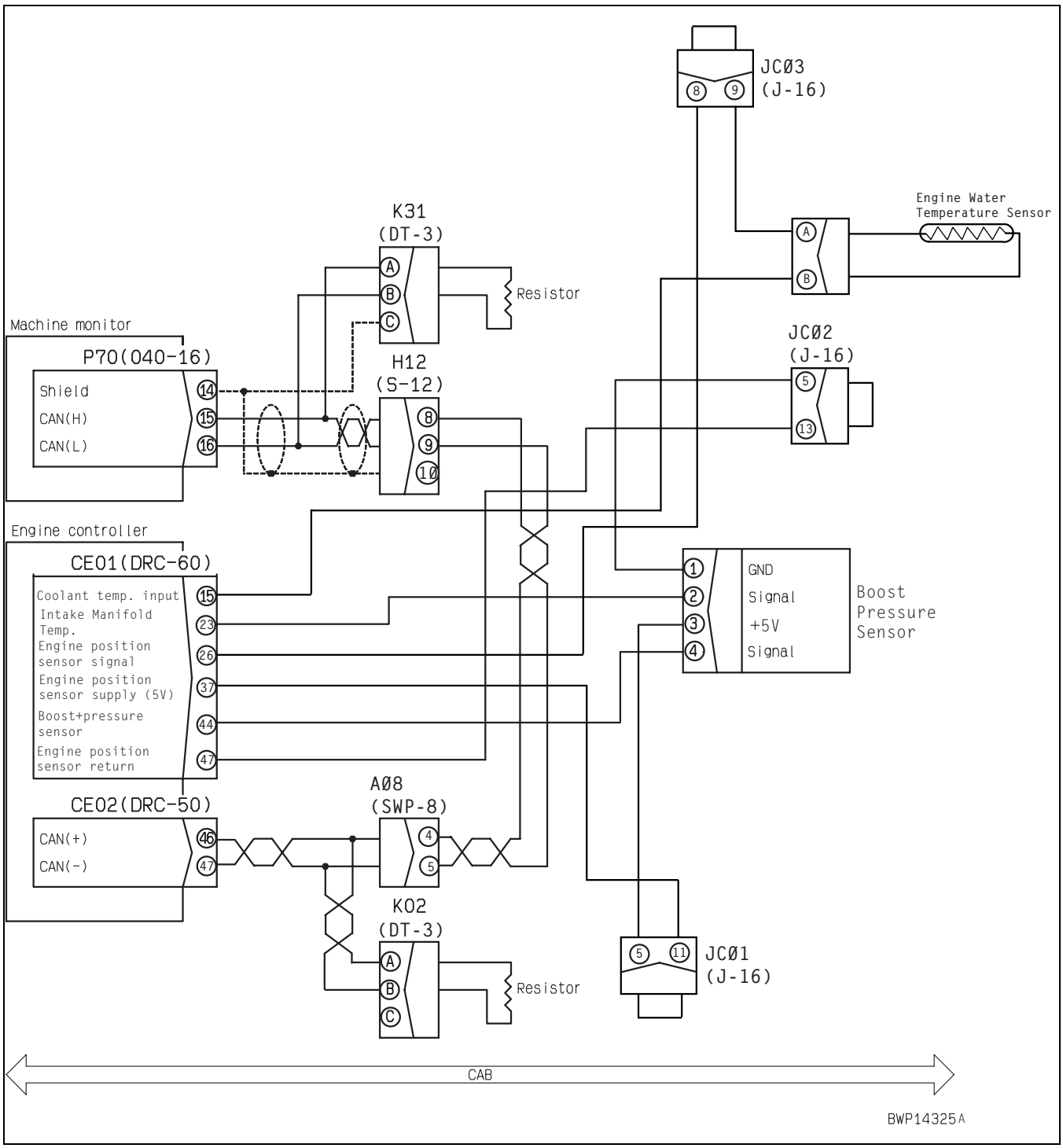


E-14 Engine coolant temperature gauge does not indicate normally

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="16">Possible causes and standard value in normal state</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal state/Remarks on troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Defective coolant temperature sensor
(Internal disconnection or short circuit)</td><td colspan="4">★ 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">★ 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">★ 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">★ 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">★ 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



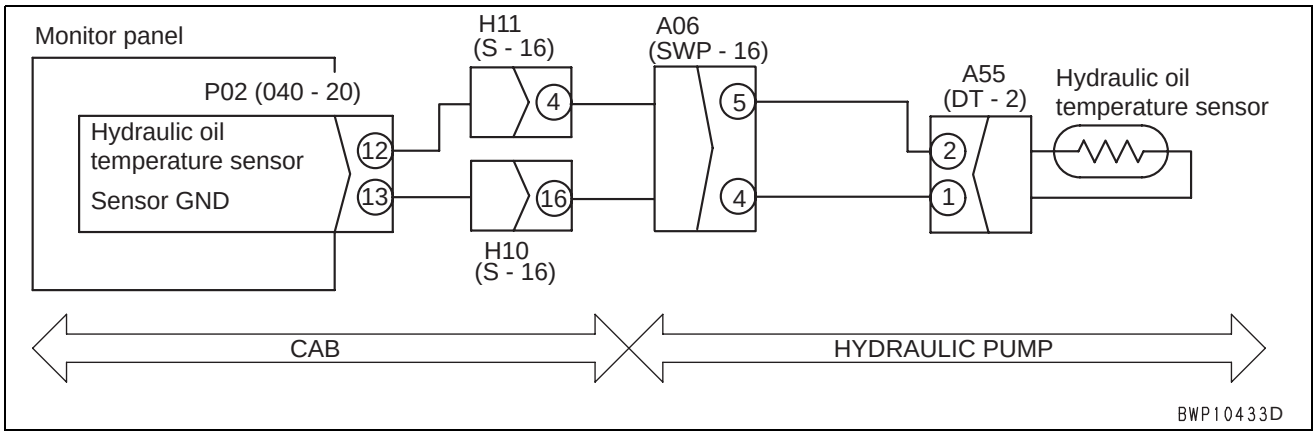
E-15 Hydraulic oil temperature gauge does not display correctly

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



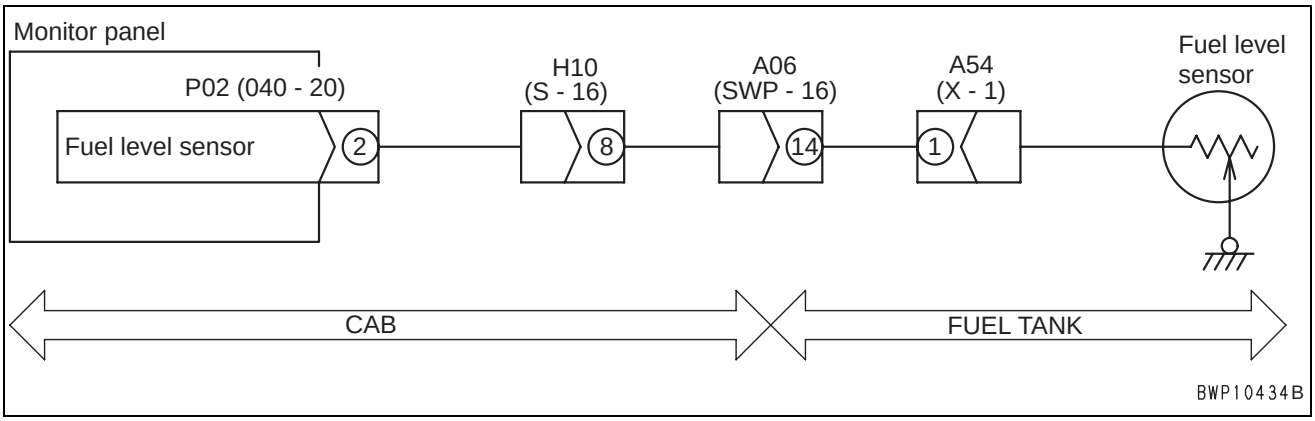
E-16 Fuel gauge does not display correctly

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.		
		Wiring 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



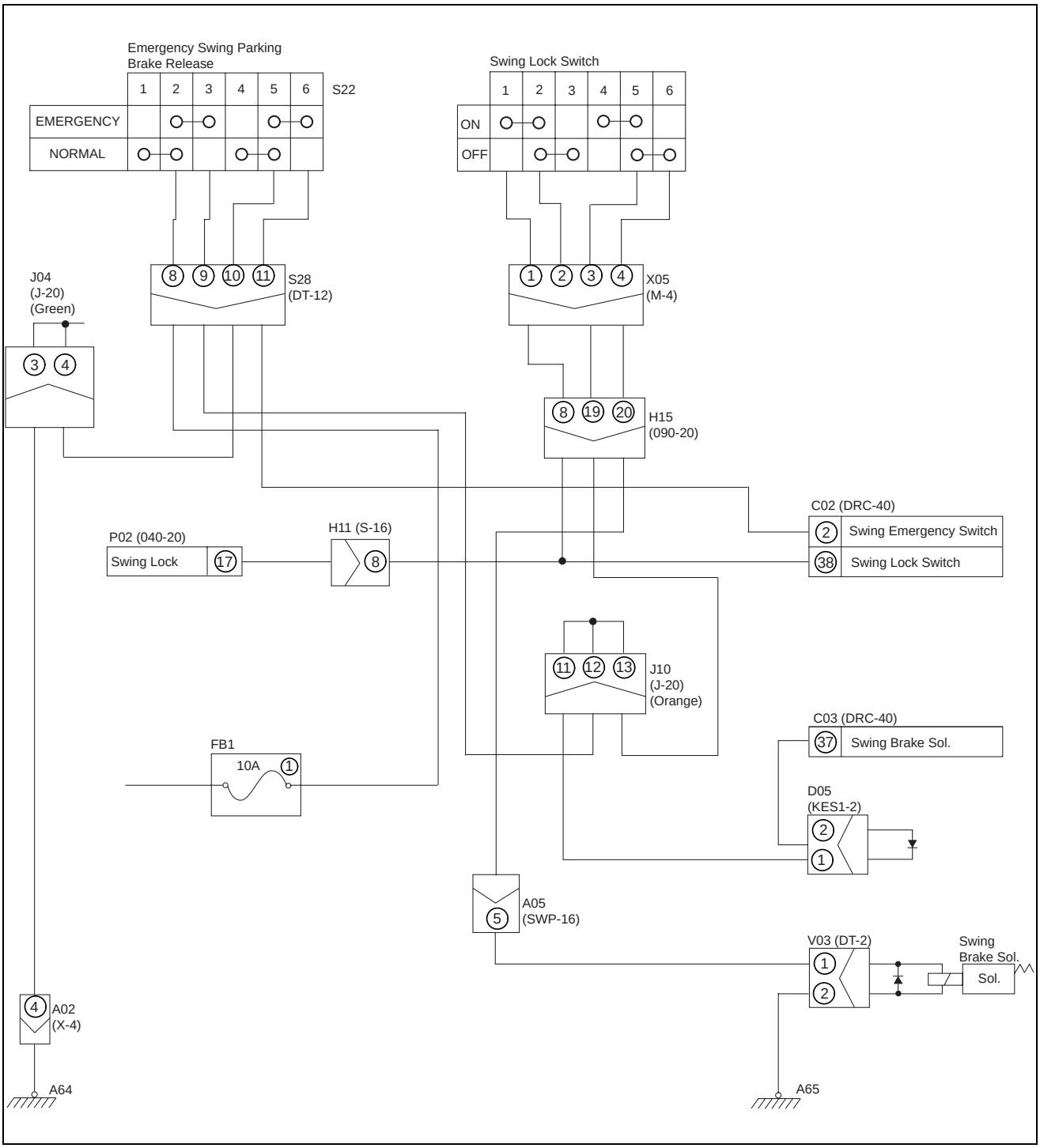
E-17 Swing lock monitor does not display correctly

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 wind shield wiper switch, the wind shield wiper monitor does not appear.
Relative information	• If the wind shield 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	—

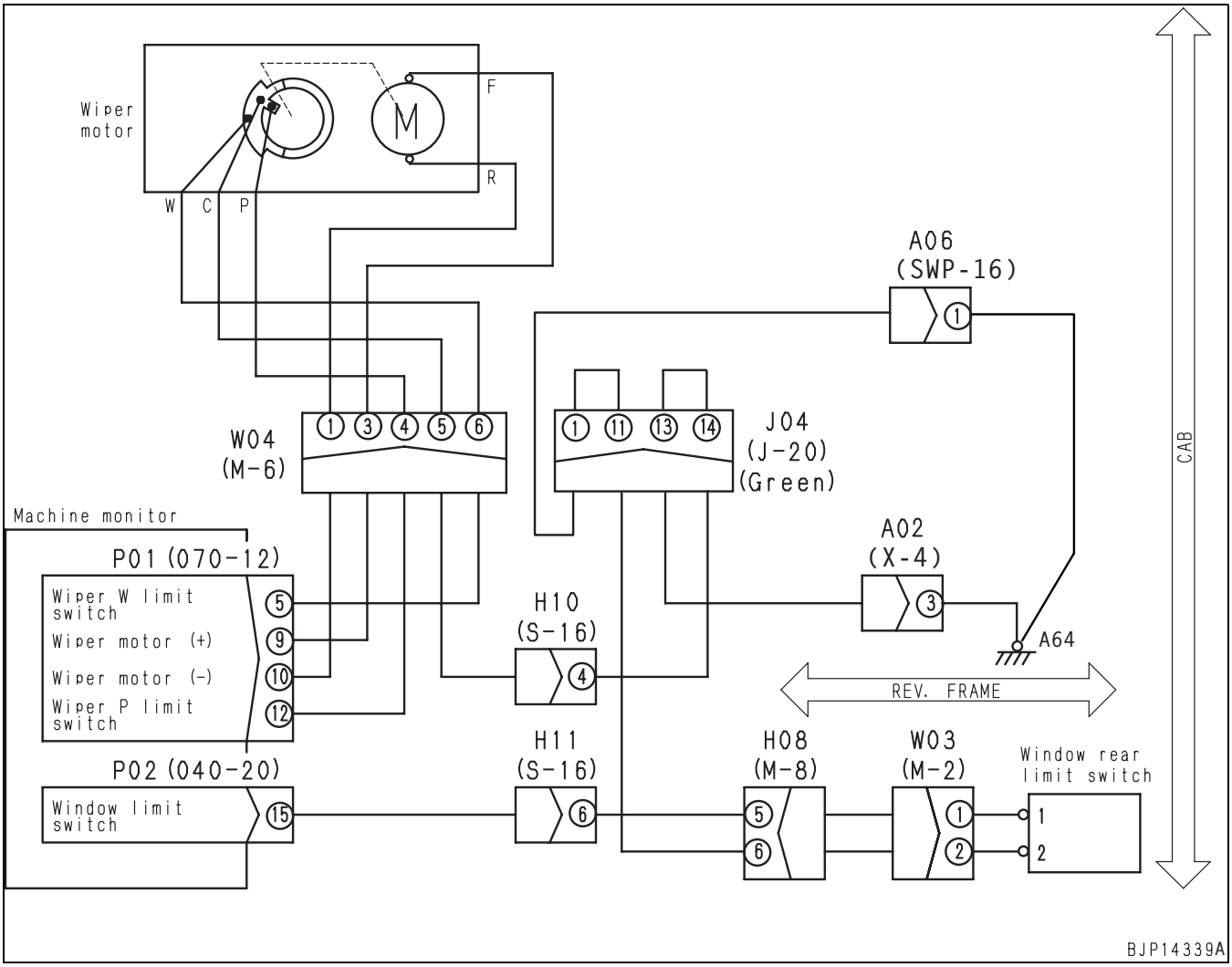
Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting
	1	Monitor panel defective	As this is an internal failure, troubleshooting cannot be conducted.

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="20">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">★ 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">★ 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">★ 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="3">4</td><td rowspan="3">Ground fault in wiring harness
(Short circuit with GND circuit)</td><td colspan="5">★ 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">★ 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="3">Defective machine monitor (Wiper motor system)</td><td colspan="5">★ 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>

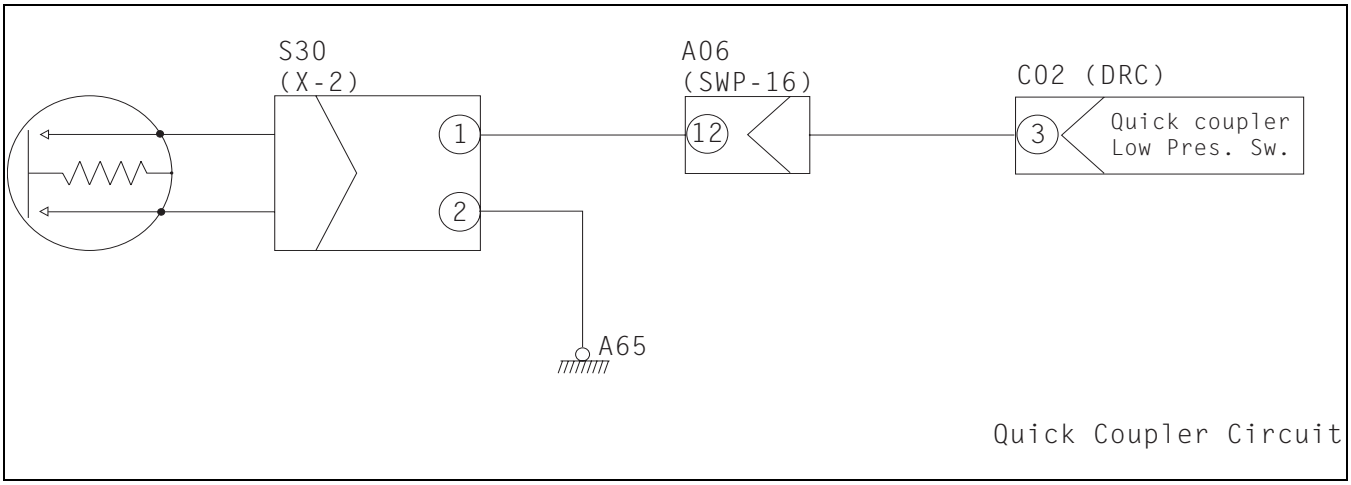
Circuit diagram related to wind shield wiper motor



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

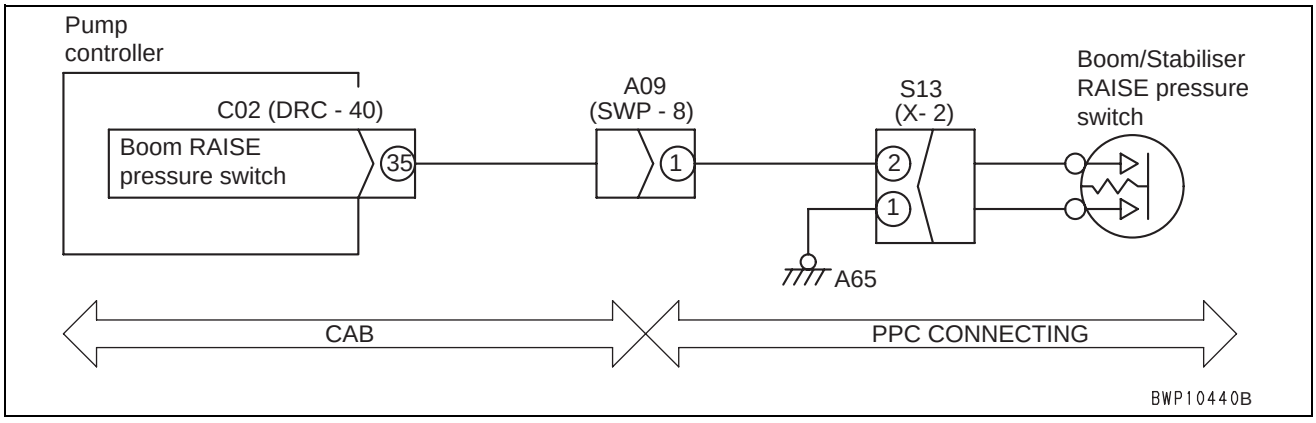
E-21 "Boom/Stabiliser RAISE" is not correctly displayed in monitor function

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

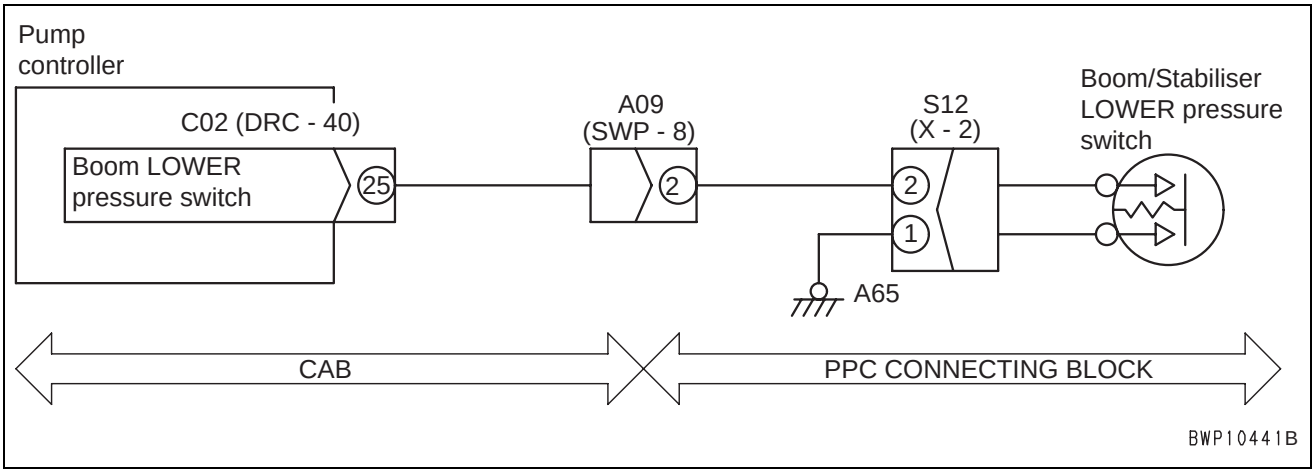


E-22 "Boom/Stabiliser LOWER" is not correctly displayed in monitor function

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



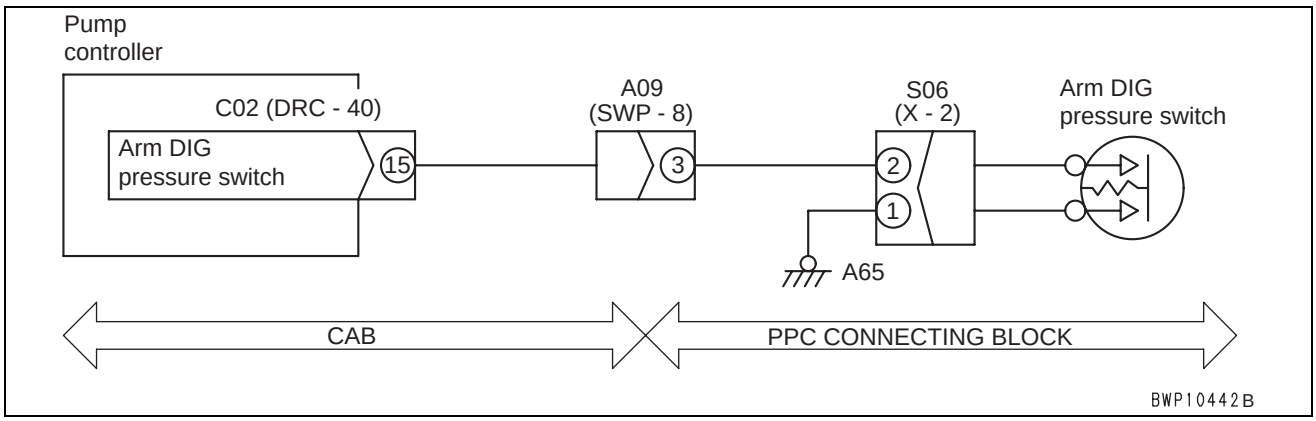
E-23 "Arm DIGGING" is not correctly displayed in monitor function

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



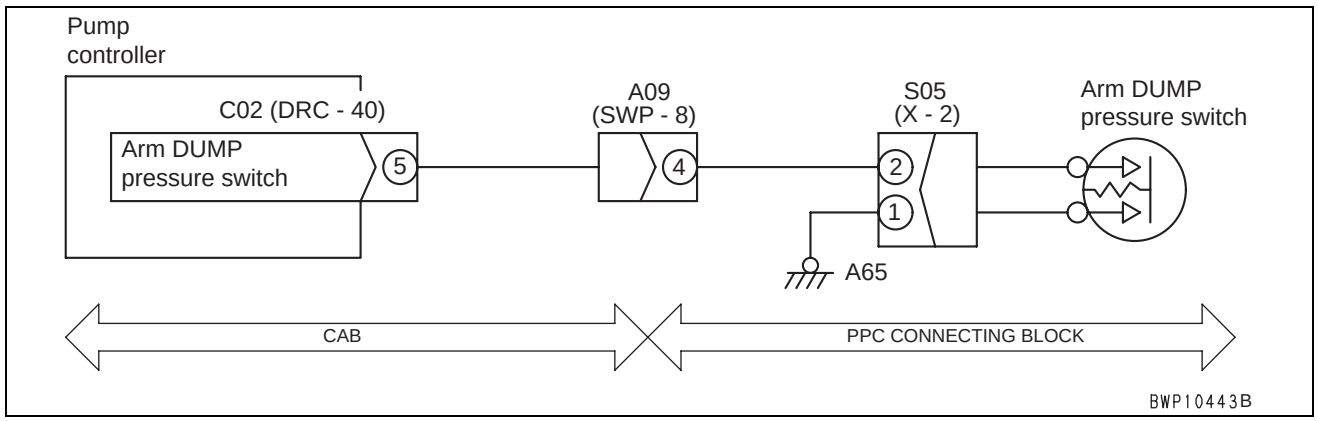
E-24 "Arm DUMPING" is not correctly displayed in monitor function

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

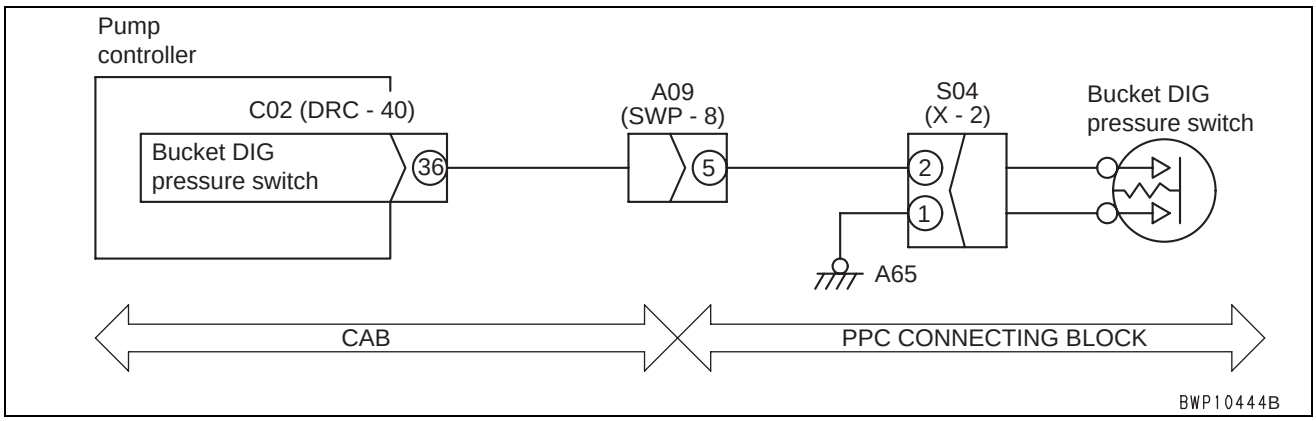


E-25 "Bucket DIGGING" is not correctly displayed in monitor function

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



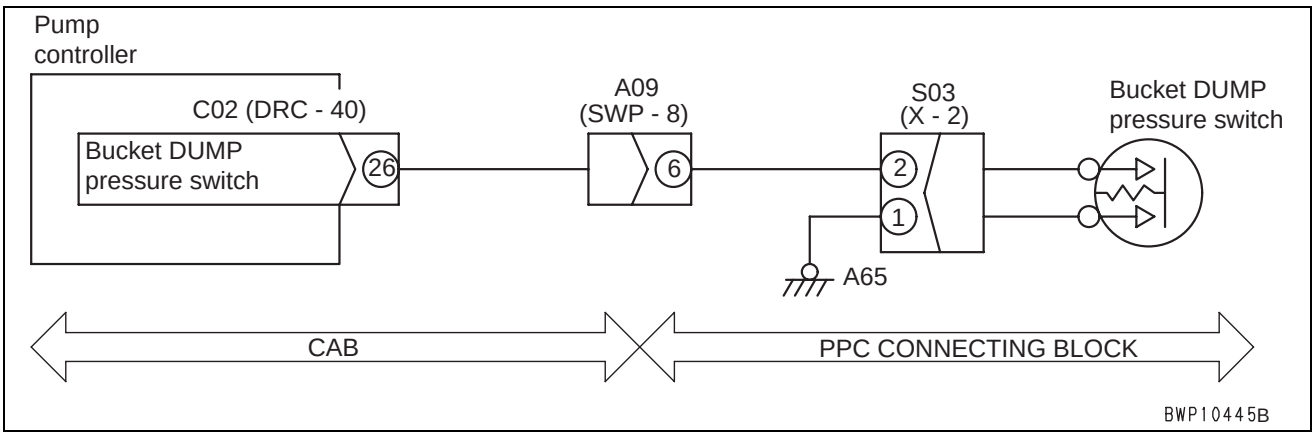
E-26 "Bucket DUMPING" is not correctly displayed in monitor function

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



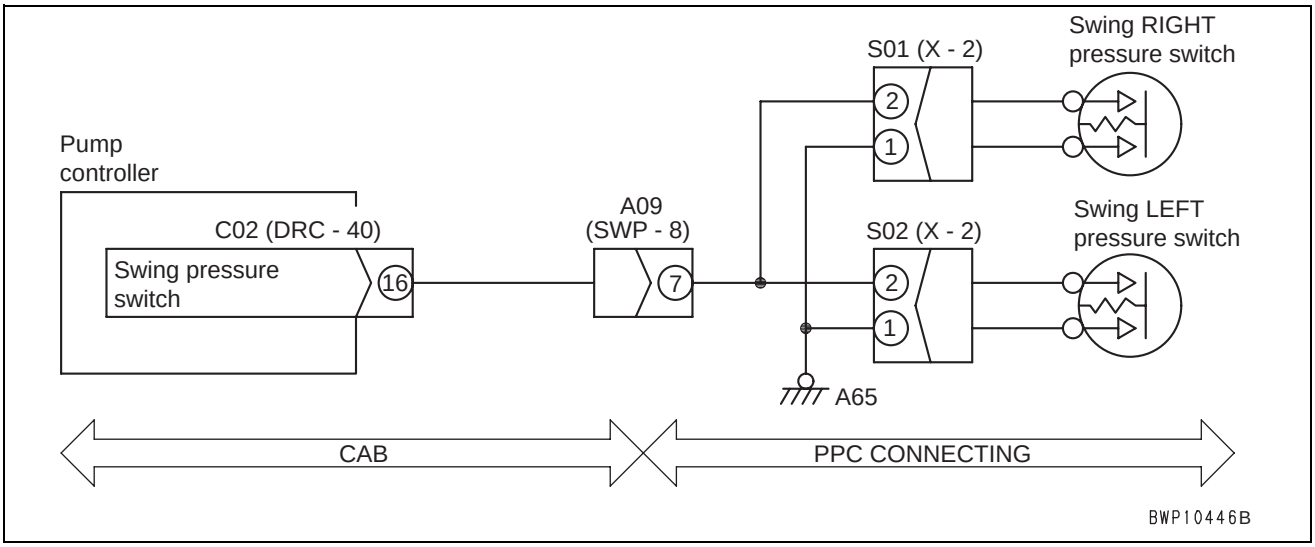
E-27 "SWING" is not correctly displayed in monitor function

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



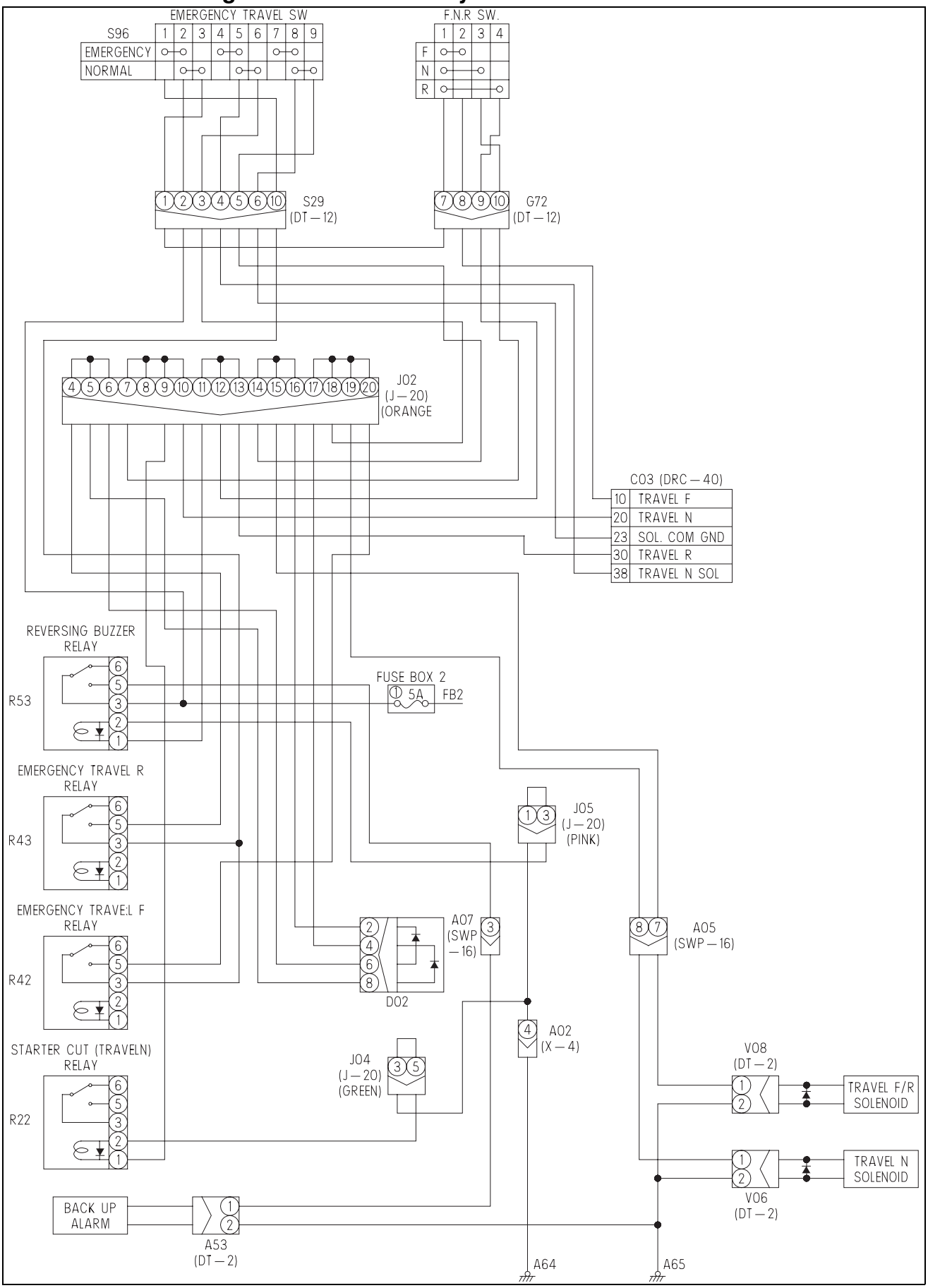
E-28 "TRAVEL" is not correctly displayed in monitor function

Failure information	• "TRAVEL" is not correctly displayed in the monitor function (special function) on the monitor panel.
Relative information	—Default travel indication is neutral

Presumed cause and standard value in normal

	Cause	Standard value in normal and references for troubleshooting			
1	Travel 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.			
		G72 (male)	Travel control lever	Resistance value	
		Between ⑦ and ⑧	NEUTRAL	Above 1 MΩ	
			Forward	Below 1 Ω	
		Between ⑦ and ⑨	NEUTRAL	Above 1 MΩ	
			Reverse	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 from C03 (female) ⑩ to G72 (female) ⑧		Resistance value	Below 1 Ω
		Wiring harness from C03 (female) ⑳ to J02 to G72 (female) ⑩		Resistance value	Below 1 Ω
		Wiring harness from C03 (female) ㉚ to J02 to G72 ⑨		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 from C03 (female) ⑩, or C03 ⑳, or between wiring harness between C03 (female) ㉚ 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 from C03 (female) ⑩, or C03 ⑳, or between wiring harness between C03 (female) ㉚ 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.			
		C03	Travel control lever	Voltage	
		Between ⑩ and grounding	NEUTRAL	20 – 30 V	
		Between ⑳ and grounding			
		Between ㉚ and grounding	Forward or backward	Below 1 V	

Electrical Circuit Diagram for Travel PPC hydraulic Switch and Travel Alarm



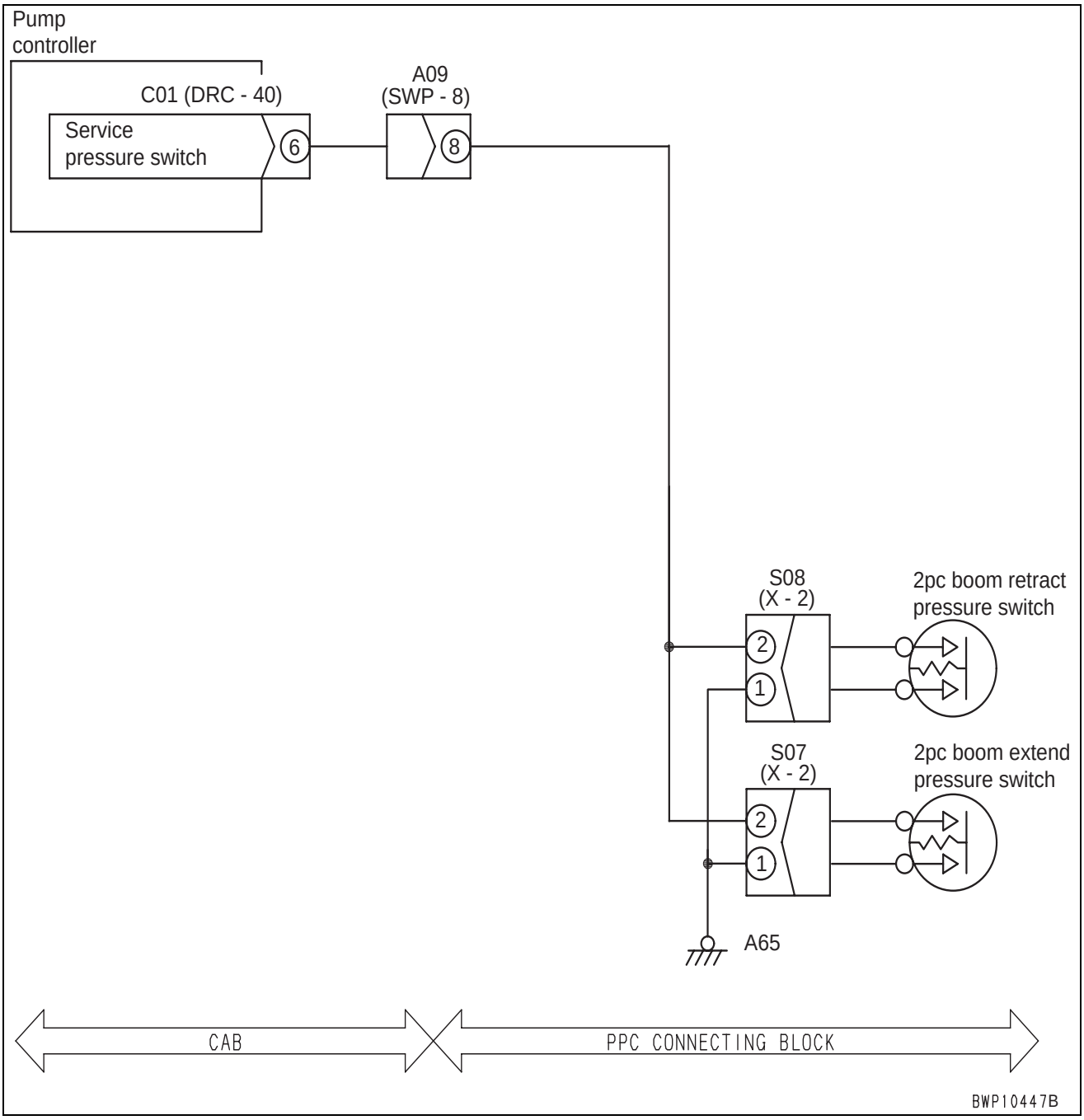
E-29 "2 Piece Boom" is not correctly displayed in monitor function

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 Piece Boom PPC hydraulic Switch

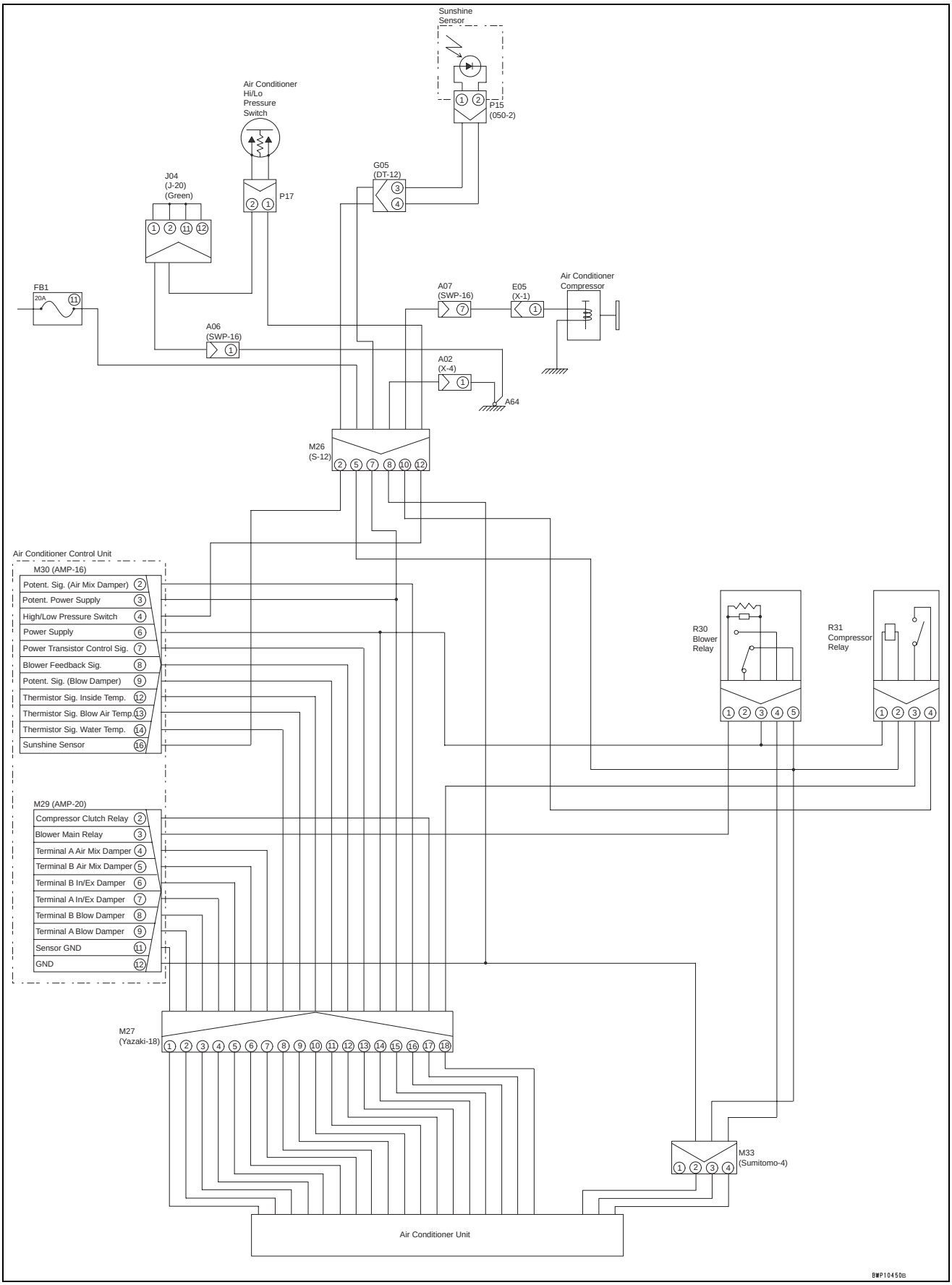


E-30 Air Conditioner does not work

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



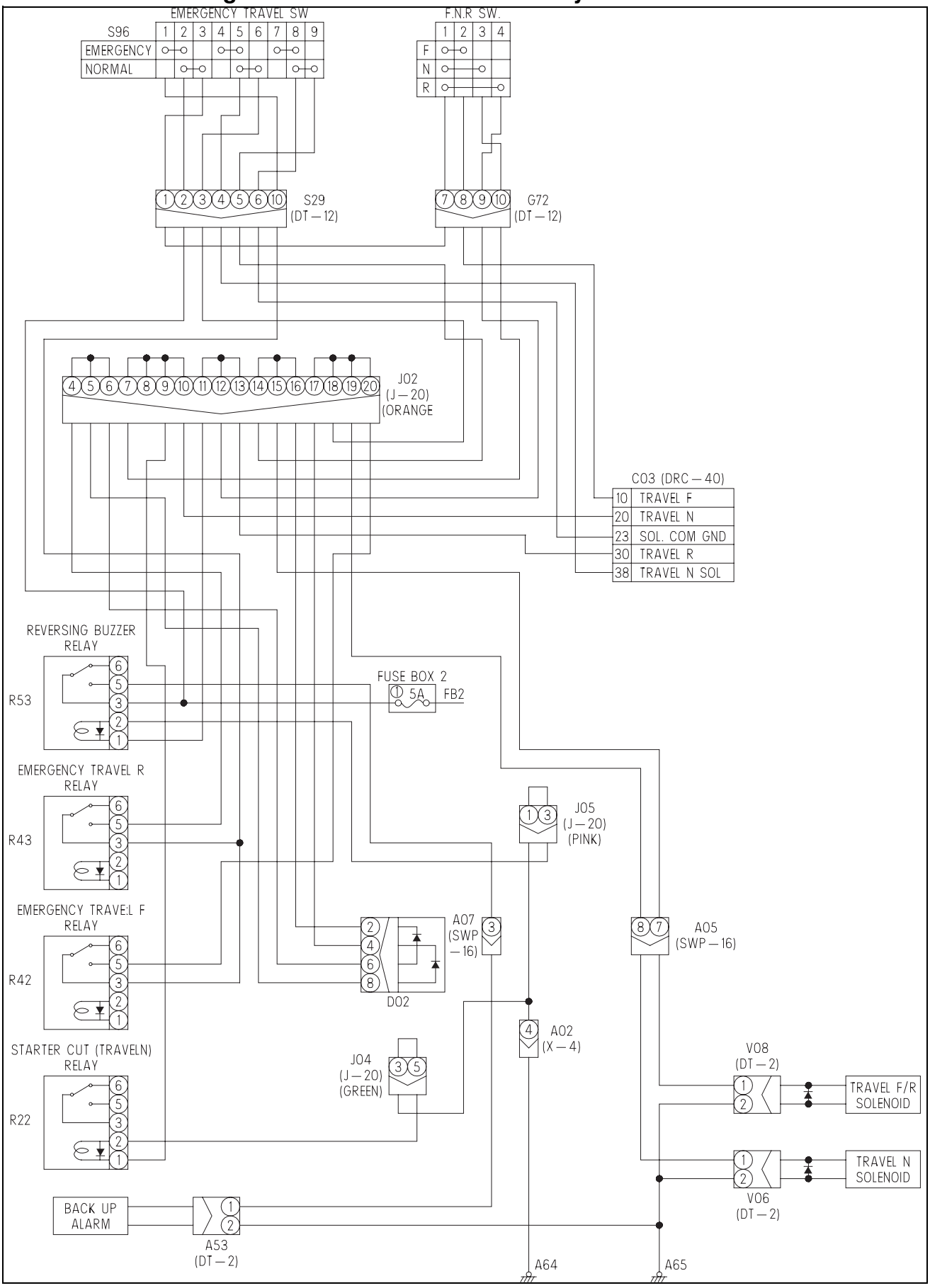
E-31 Travel reverse alarm does not sound

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



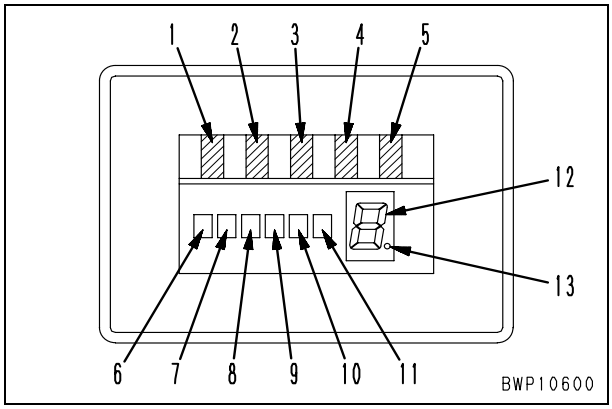
E-32 KOMTRAX system does not operate normally

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.

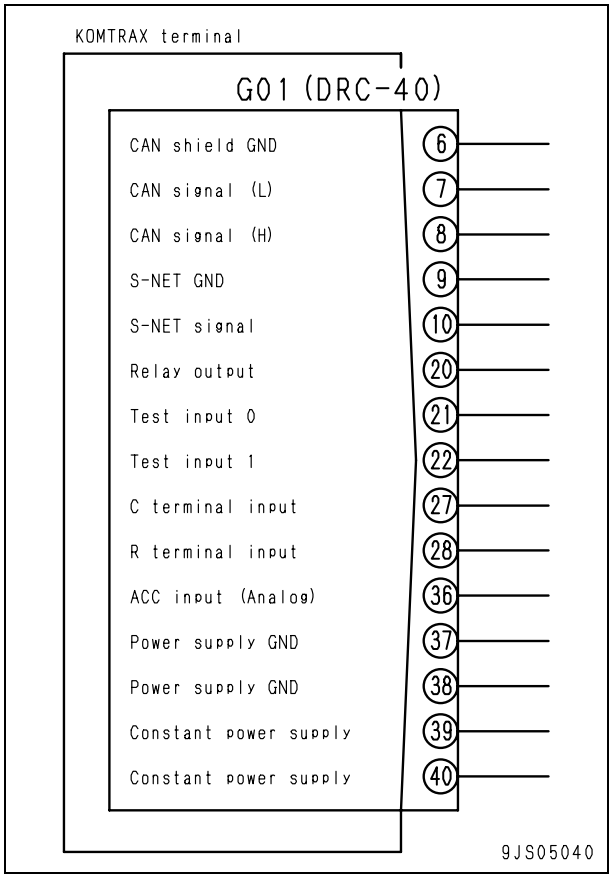
	Cause		Standard value in normal state/Remarks on troubleshooting		
Possible causes and standard value in normal state	1	Defective power supply	★ Turn starting switch OFF, then carry out troubleshooting.		
			LED (1)	Normal state	
			LED-A1	Lighted up	
			★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.		
			G01	Signal	Voltage
			Between (39), (40) – (37), (38)	Constant power supply	20 – 30 V
	2	Defective GPS	★ 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	★ Start engine and carry out troubleshooting.		
			LED (6)	Normal state	
			LED-C1	Lighted up	
			★ 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	★ Turn starting switch ON and carry out troubleshooting.		
			LED (8)	Normal state	
			LED-C3	Lighted up	
			★ 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	★ Turn starting switch ON and carry out troubleshooting.		
			LED (9)	Normal state	
			LED-C4	Lighted up	
			★ 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	★ Turn starting switch ON and carry out troubleshooting.	
			LED (12)	Normal state
			7-segment	0 – 9
	7	State of positioning with GPS	★ 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



Blank for technical reason

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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Brake Light Circuit 20-608
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RH PPC Lever Clamshell Roller Switch Pushed to the RH Position 20-646
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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		

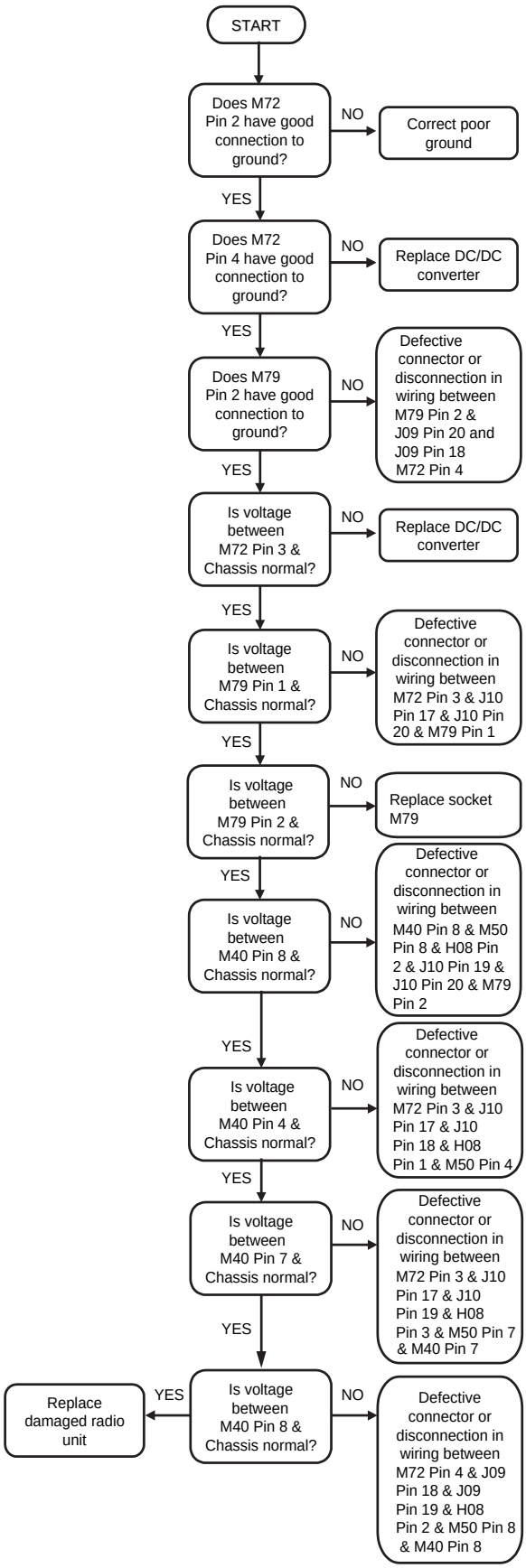
Relative Electrical Circuit Diagram

This is part of the electrical circuit diagram which shows the portion where the failure occurred.

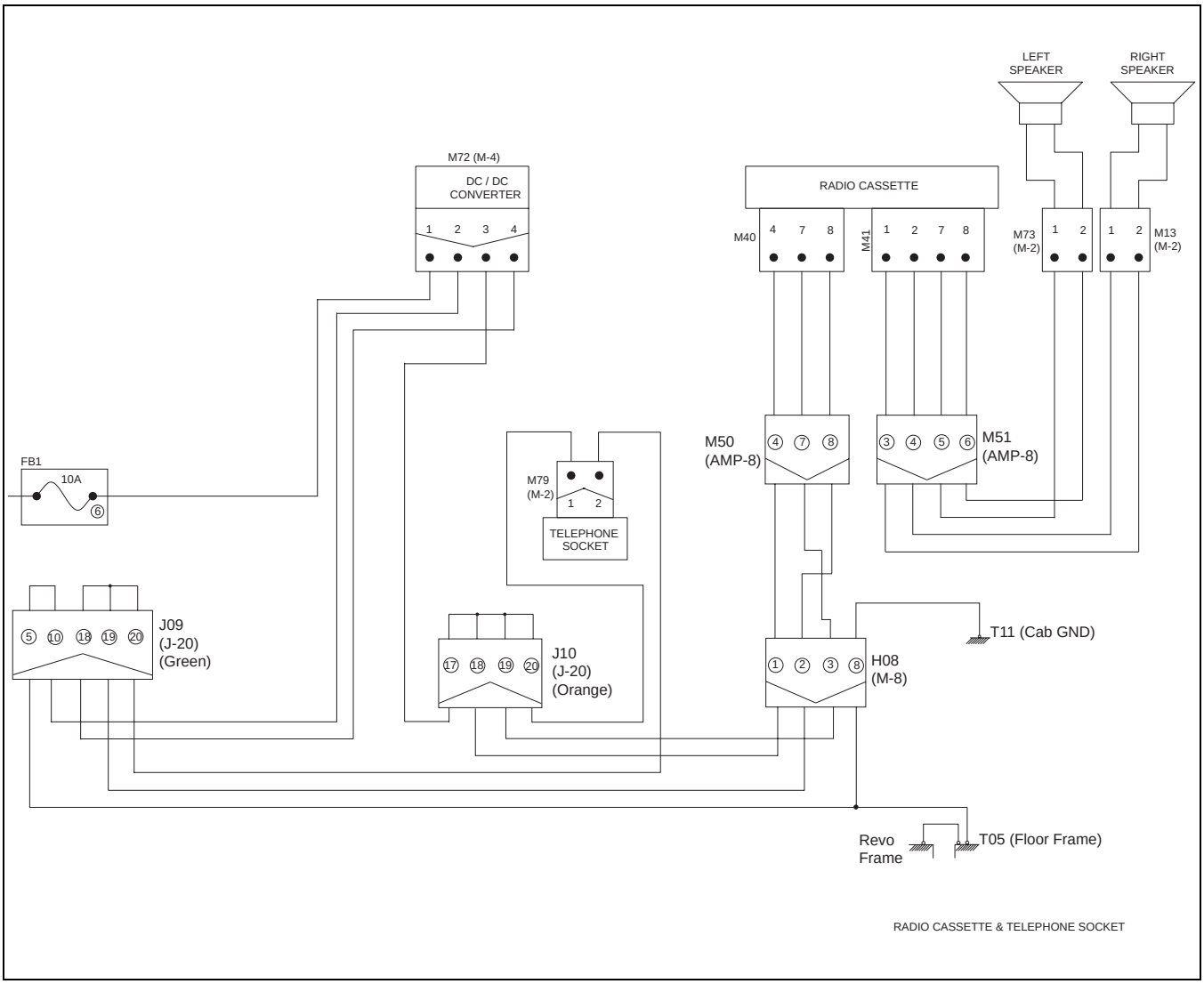
- Connector No.: Indicates (Type - numbers of a pin) (colour)
- Arrow: Roughly indicates the location in the machine where it is installed.

Radio Cassette & Telephone Socket

*When fuse no.6 (Fuse box 1) is not blown



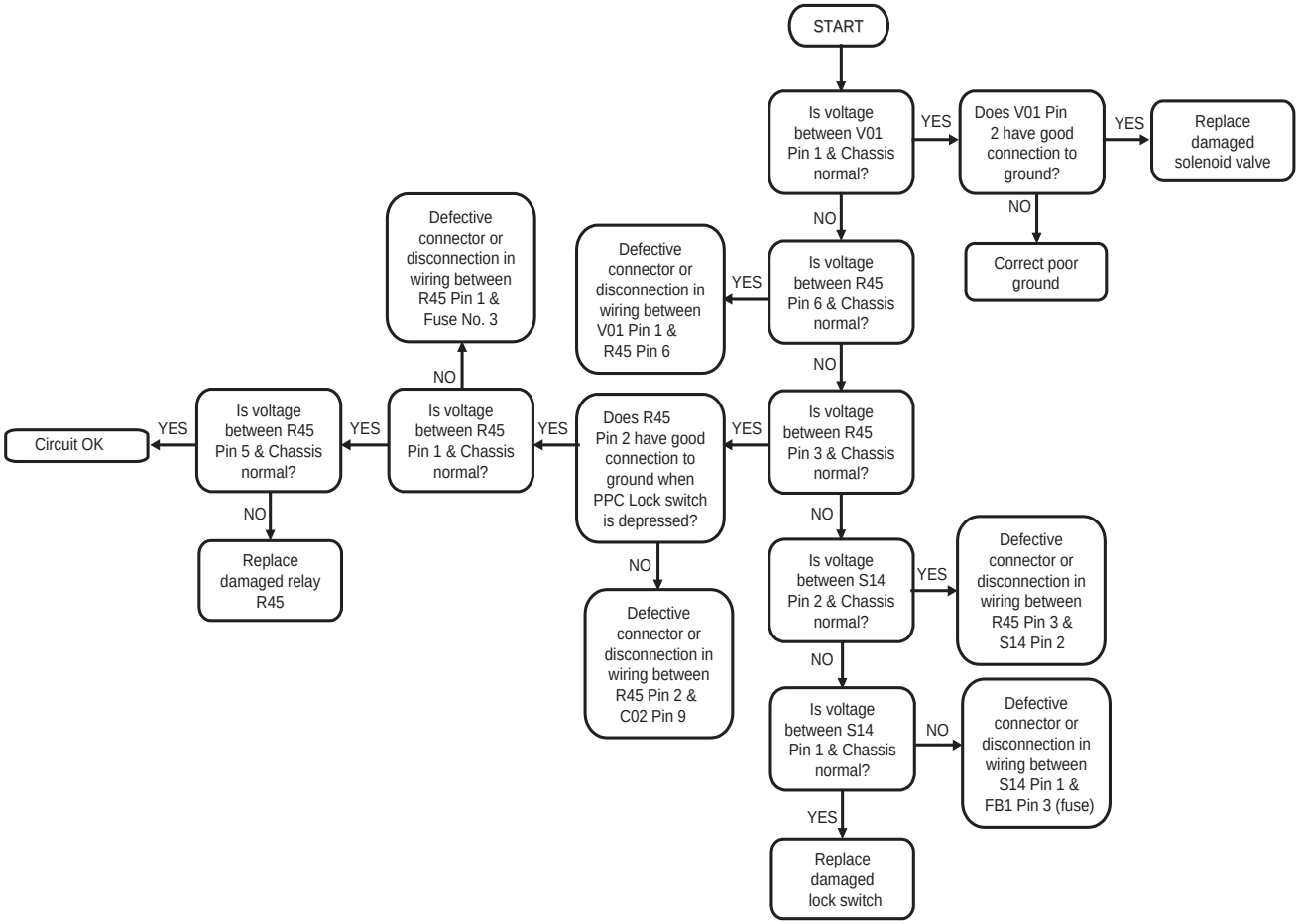
Electrical Circuit Diagram For Radio Cassette & Telephone Socket



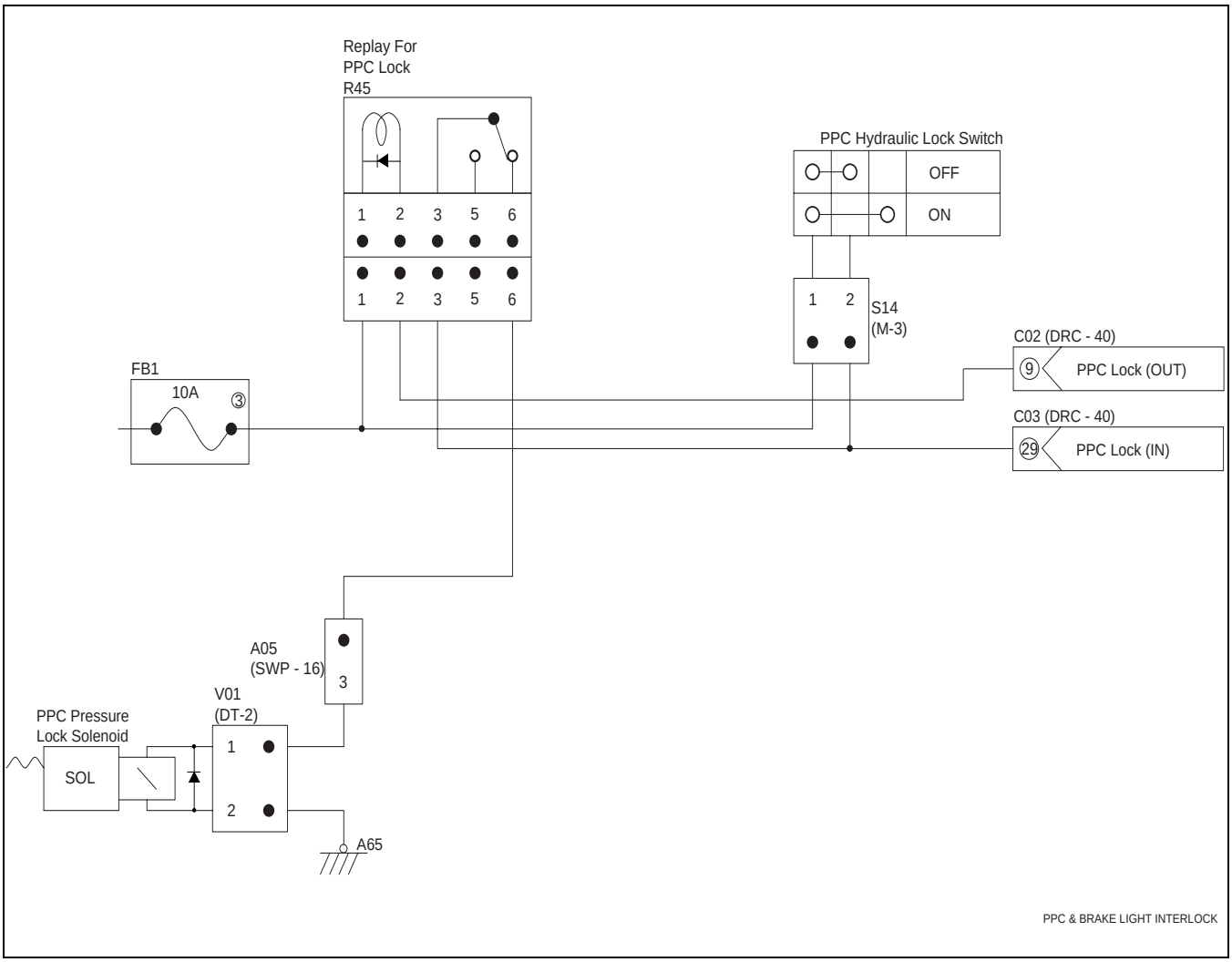
PPC Lock Circuit

*When Fuse No.3 (Fuse box 1) is not blown

*When bulbs are fitted correctly & fully functional



Circuit Diagram for PPC Lock Circuit

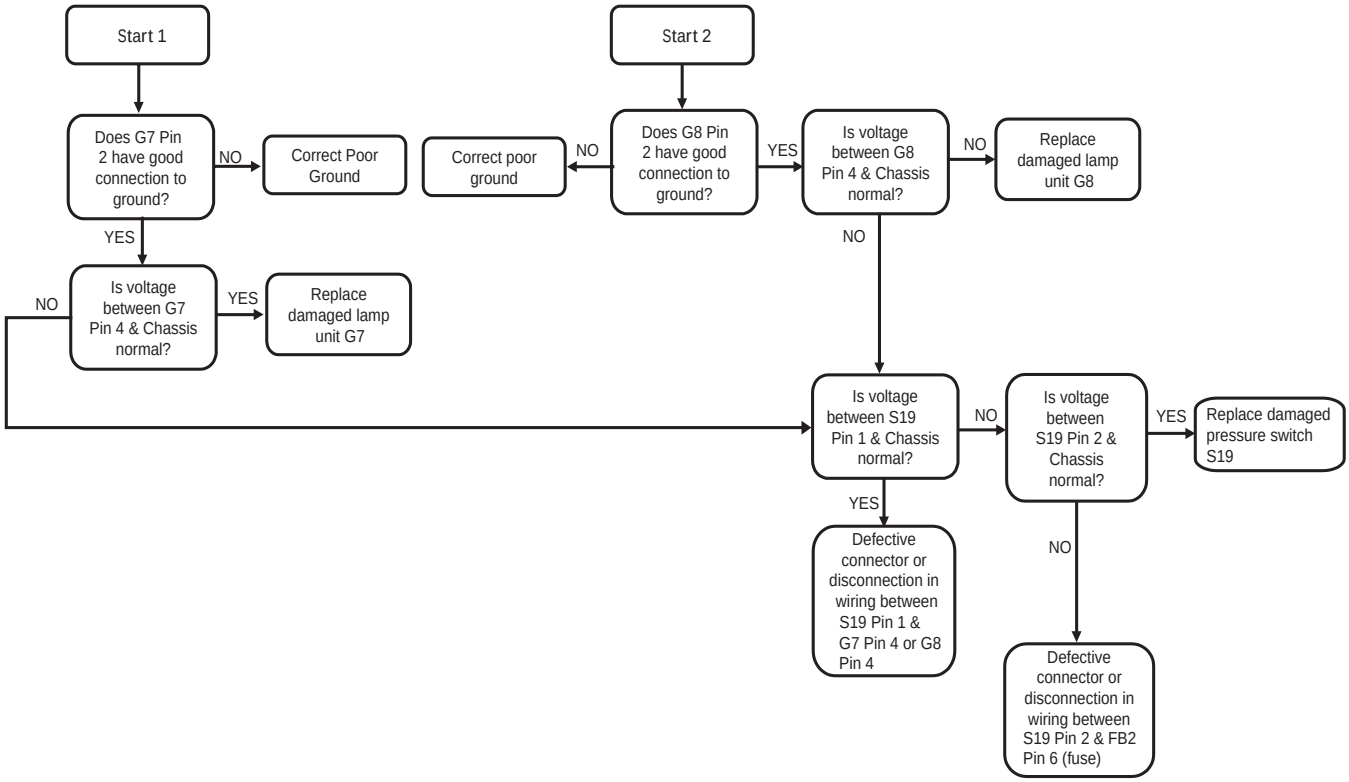


Brake Light Circuit

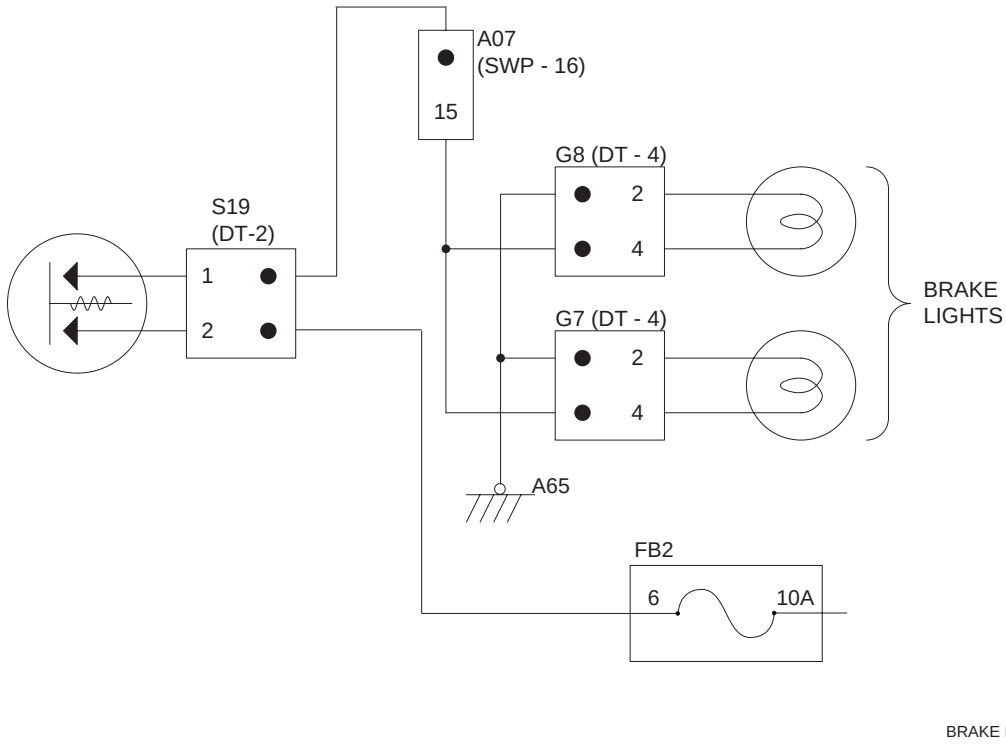
*When Fuse No.6 (Fuse box 2) is not blown

*When bulbs are fitted correctly & fully functional

*When brake pedal is depressed

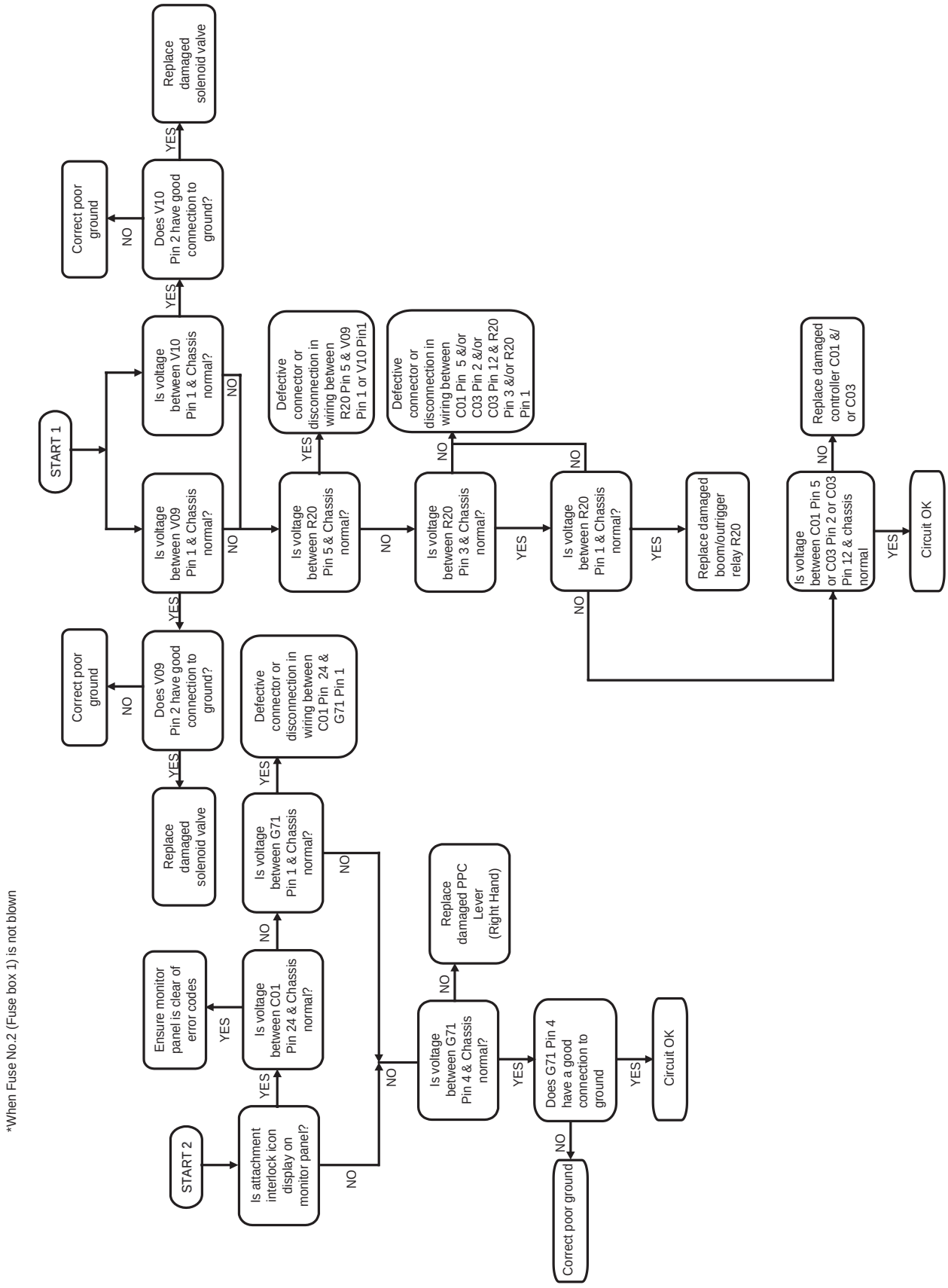


Circuit Diagram for Brake Light Circuit

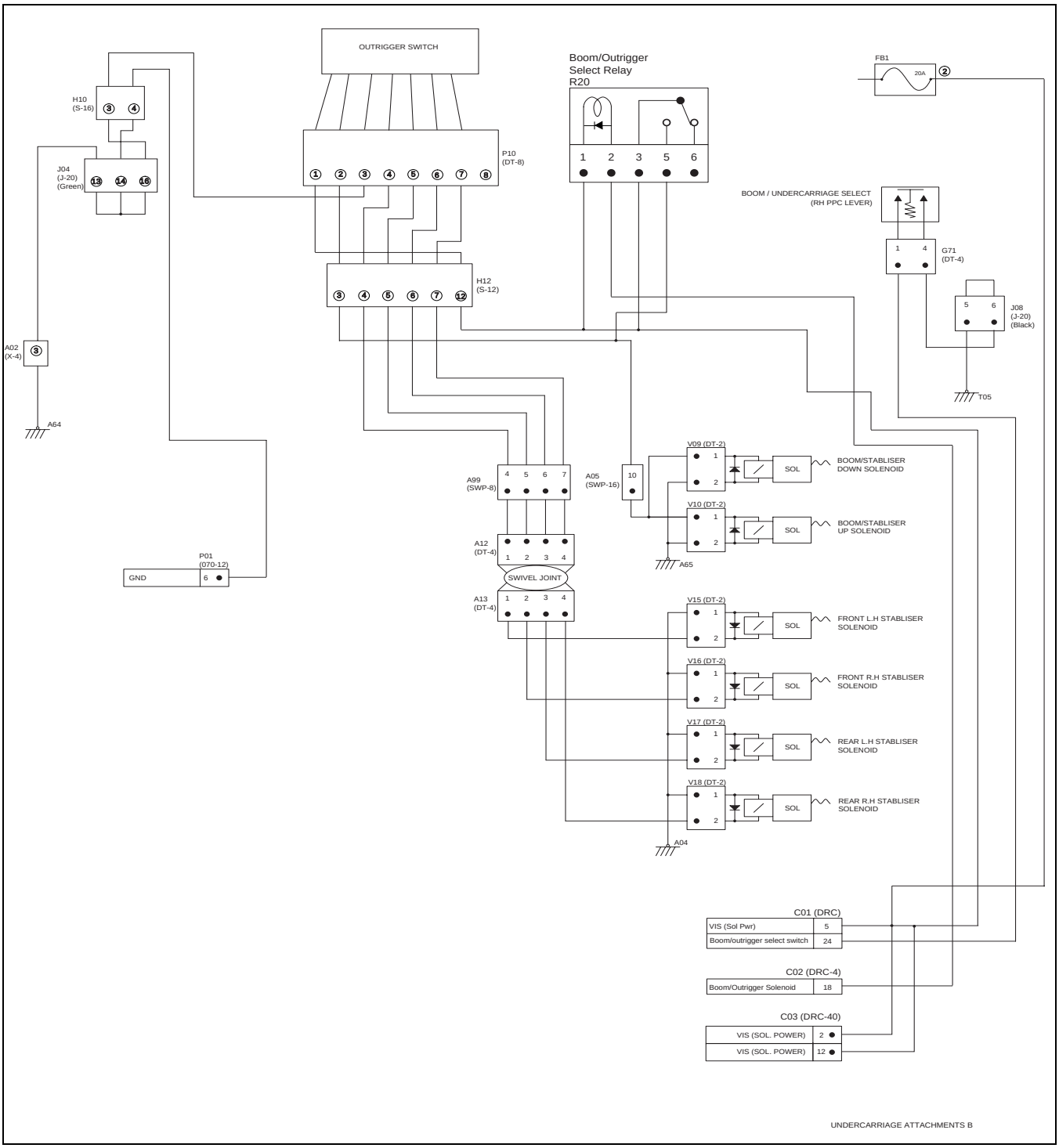


BRAKE LIGHT CIRCUIT

Undercarriage Attachments - Mode Selection



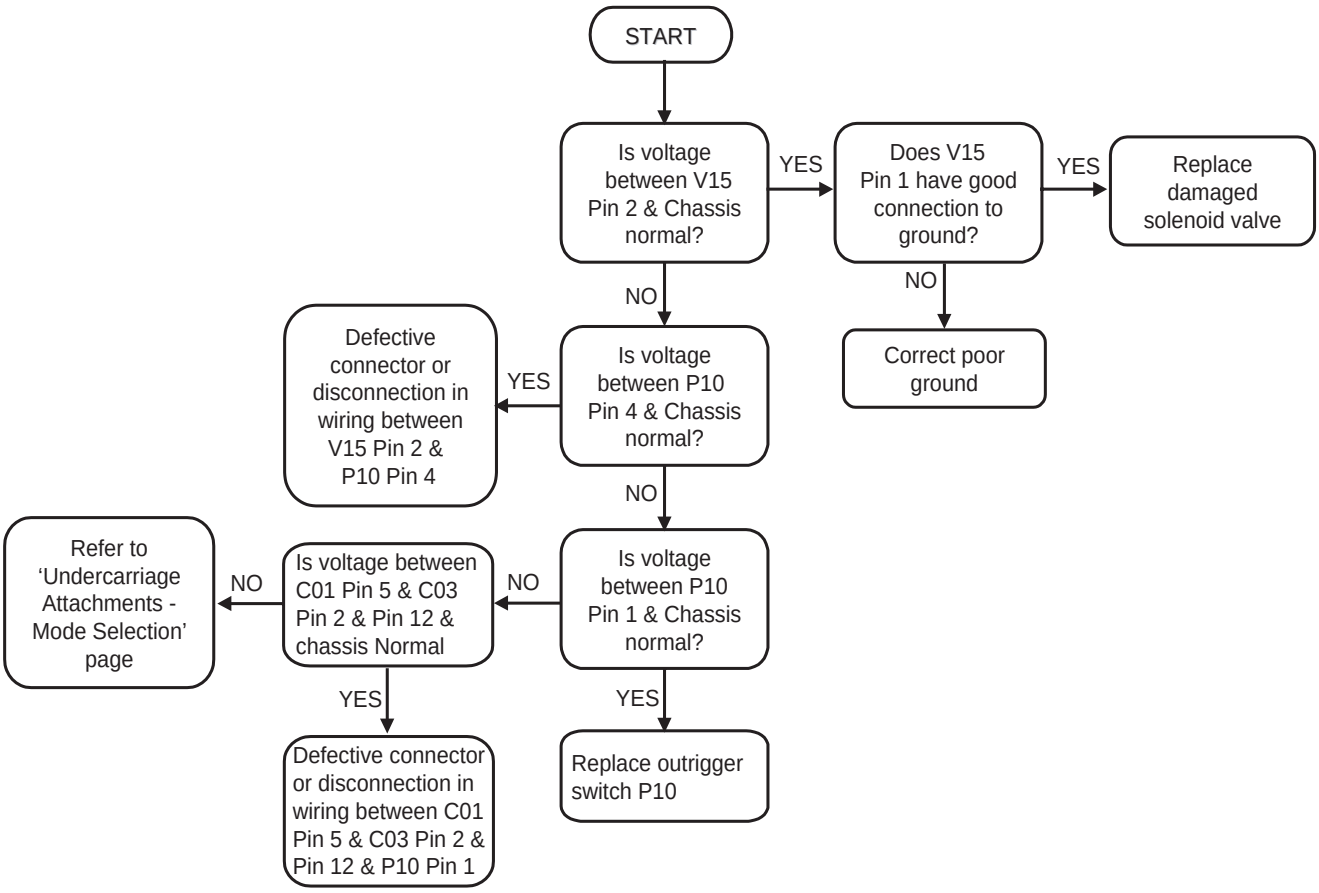
Circuit Diagram for Undercarriage Attachments - Mode Selection



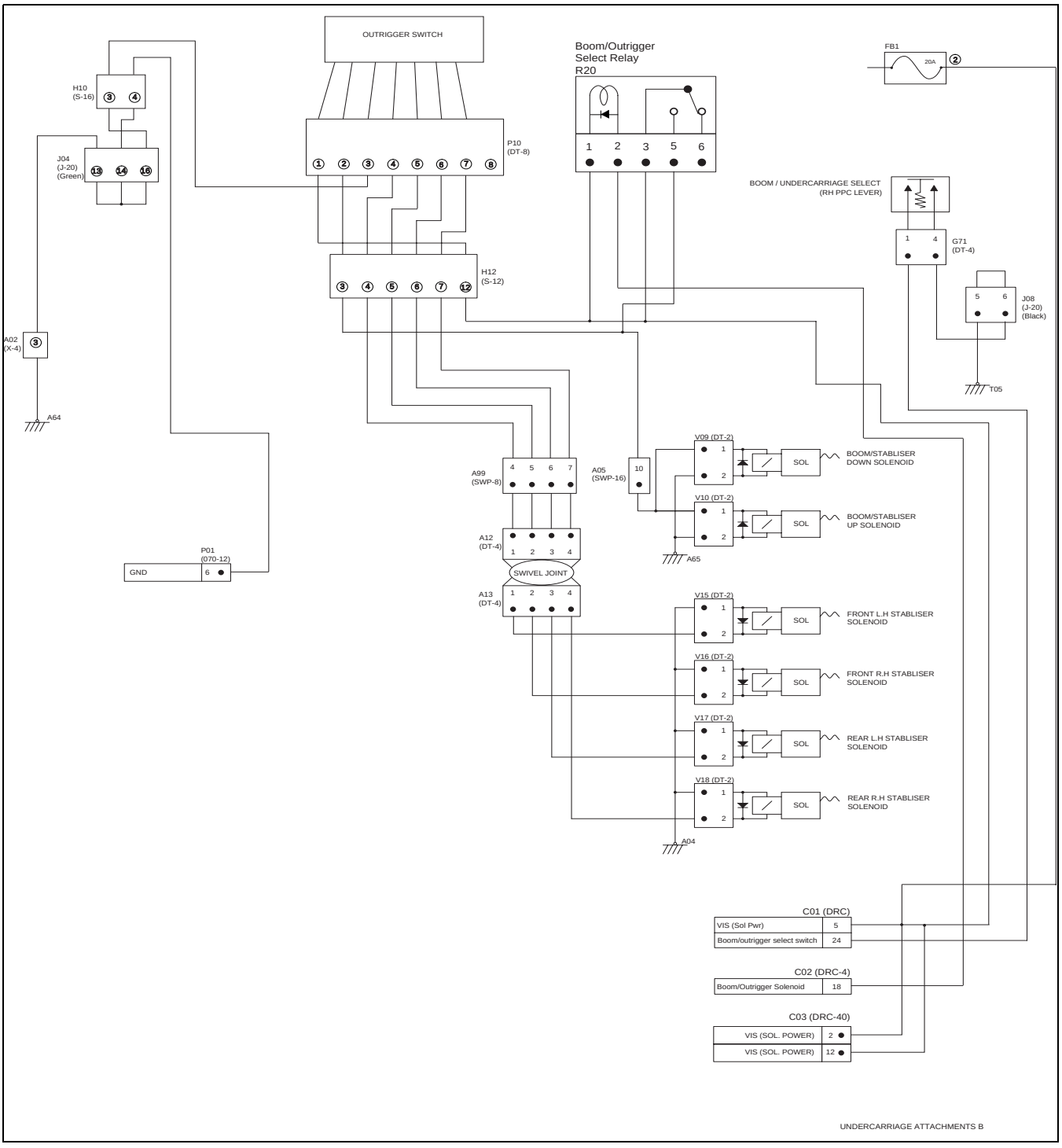
Undercarriage Attachments - Front Left Outrigger

*When Fuse No.2 (Fuse box 1) is not blown

*When attachment 'Mode Select' circuit is fully functional



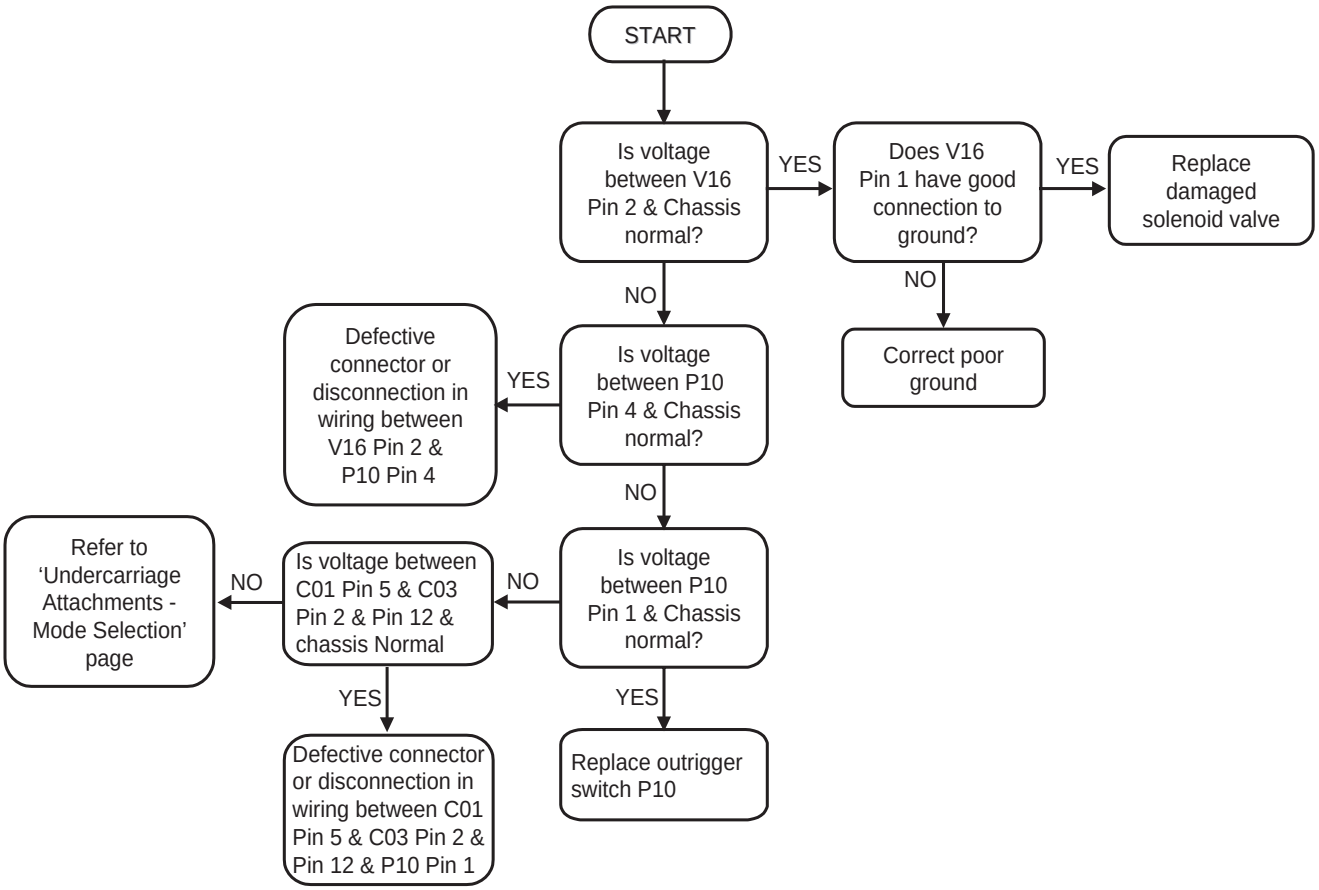
Circuit Diagram for Undercarriage Attachments - Front Left Outrigger



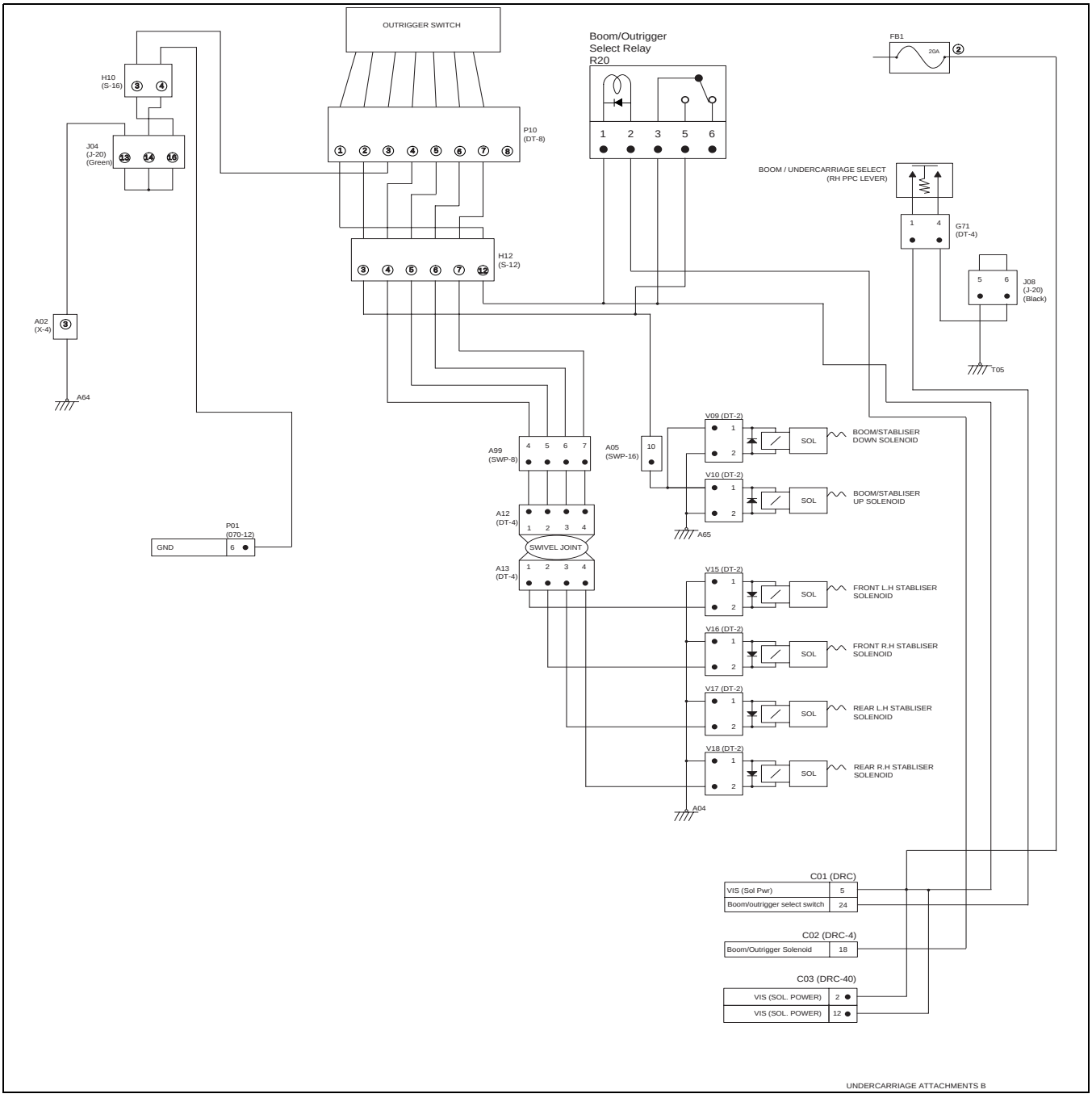
Undercarriage Attachments - Front Right Outrigger

*When Fuse No.2 (Fuse box 1) is not blown

*When attachment 'Mode Select' circuit is fully functional



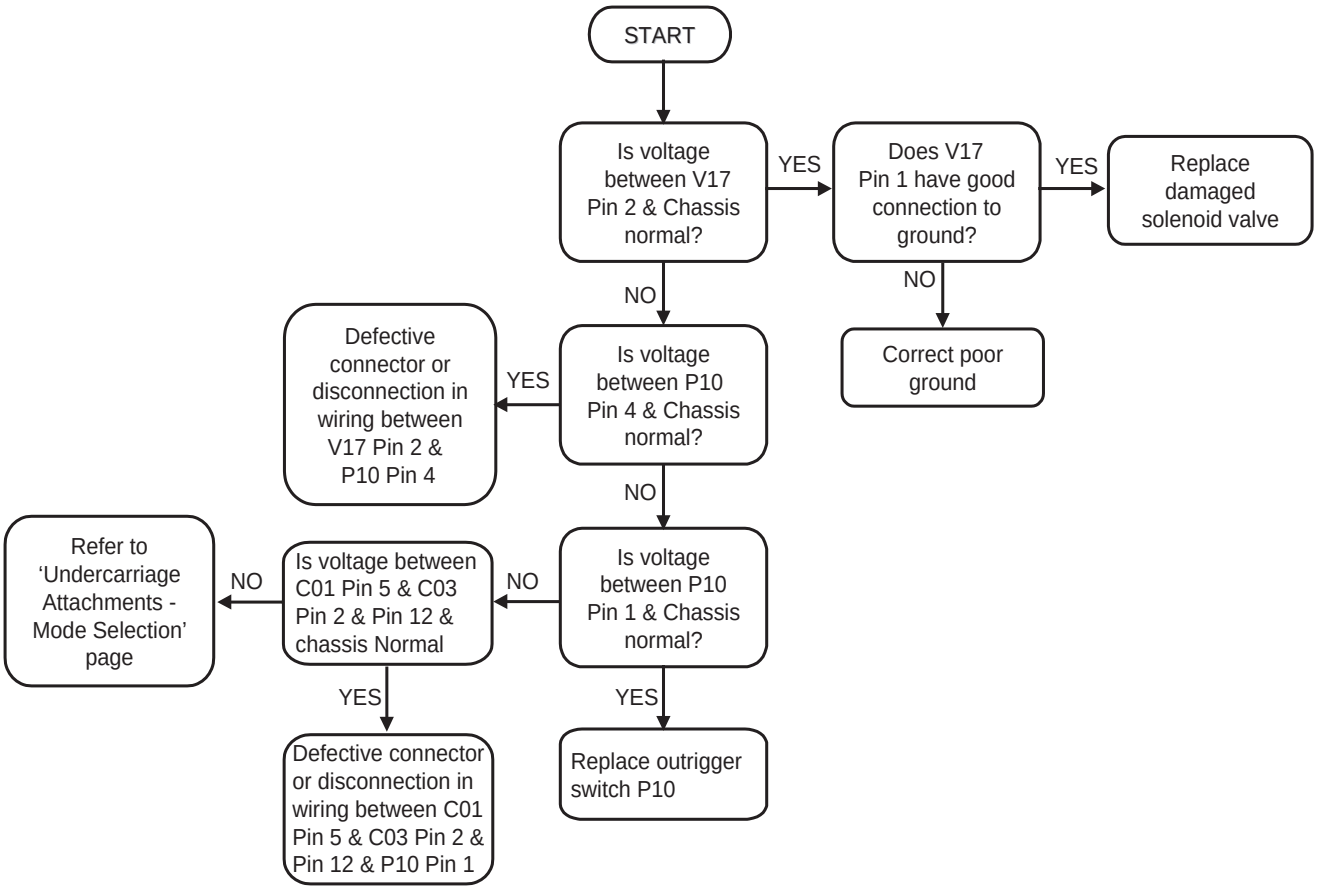
Circuit Diagram for Undercarriage Attachments - Front Right Outrigger



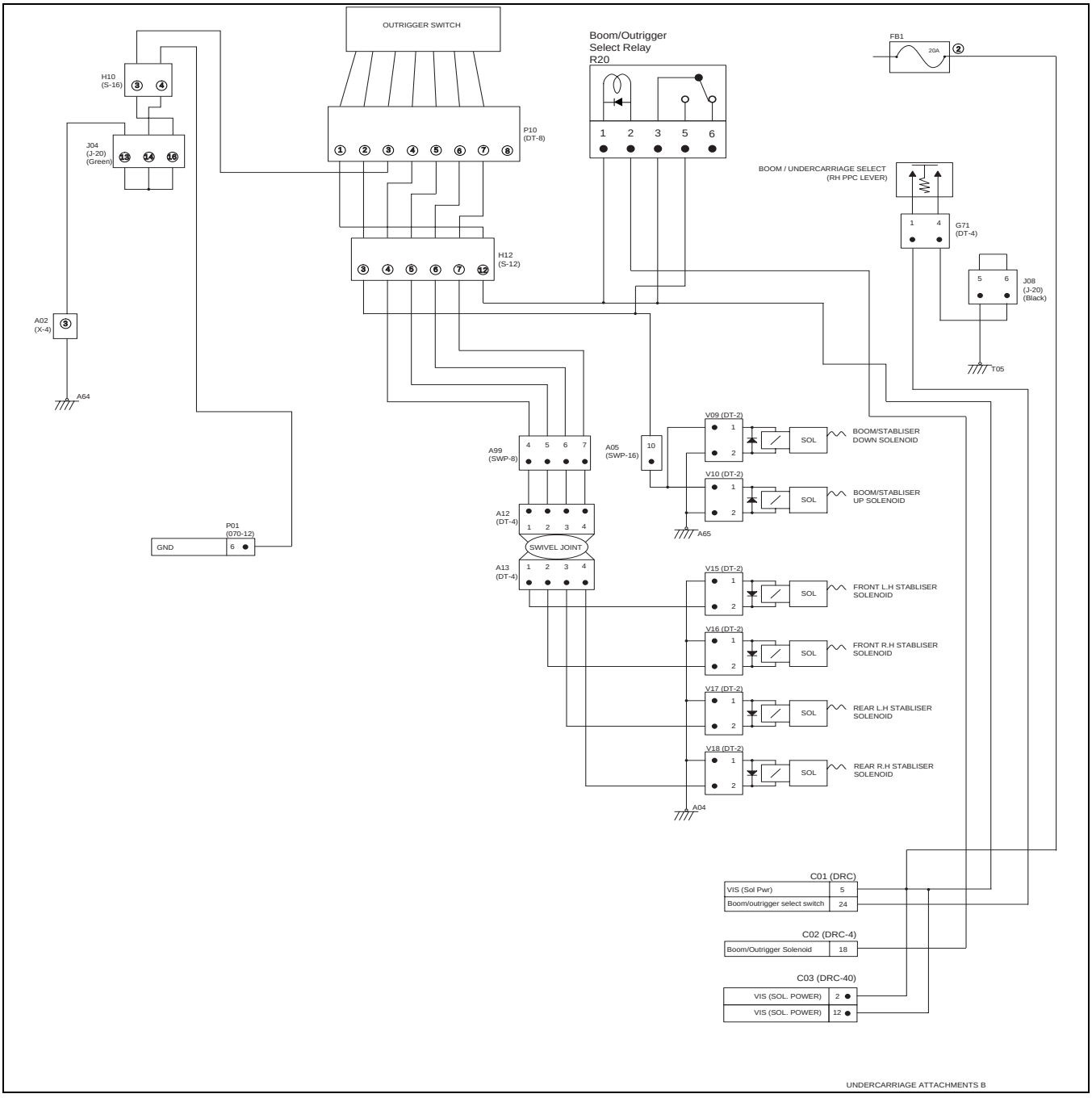
Undercarriage Attachments - Rear Left Outrigger

*When Fuse No.2 (Fuse box 1) is not blown

*When attachment 'Mode Select' circuit is fully functional



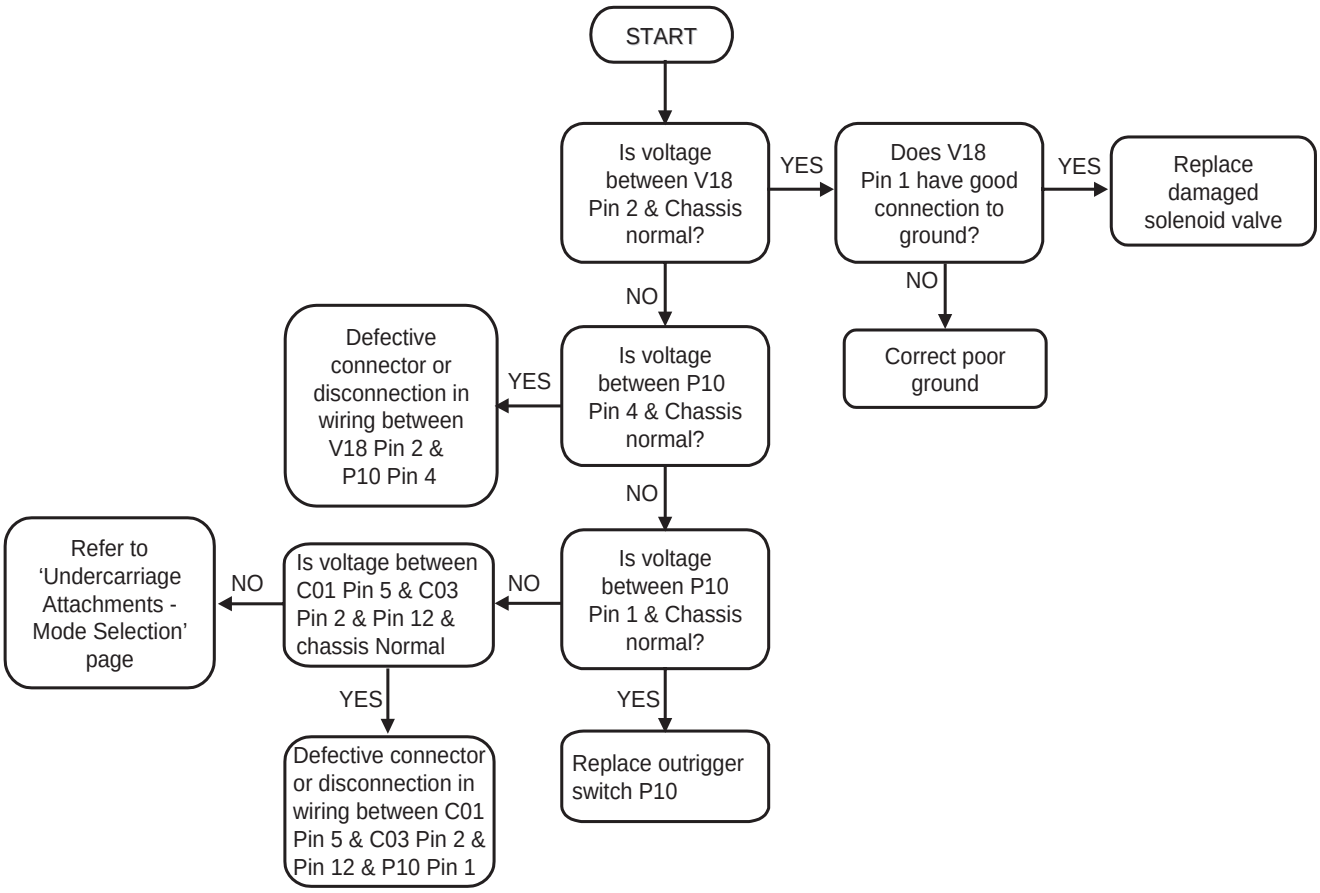
Circuit Diagram for Undercarriage Attachments - Rear left outrigger



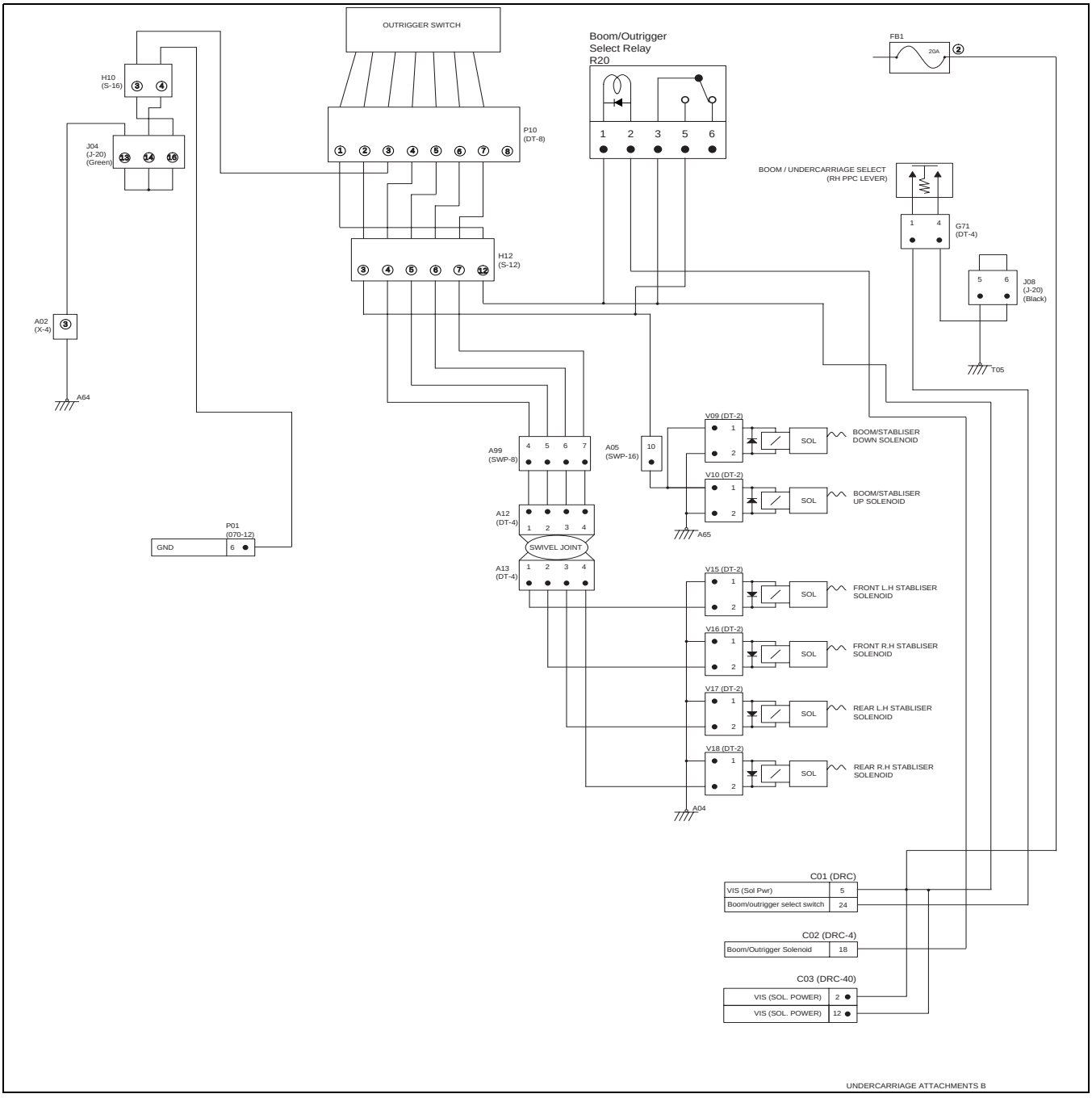
Undercarriage Attachments - Rear Right Outrigger

*When Fuse No.2 (Fuse box 1) is not blown

*When attachment 'Mode Select' circuit is fully functional

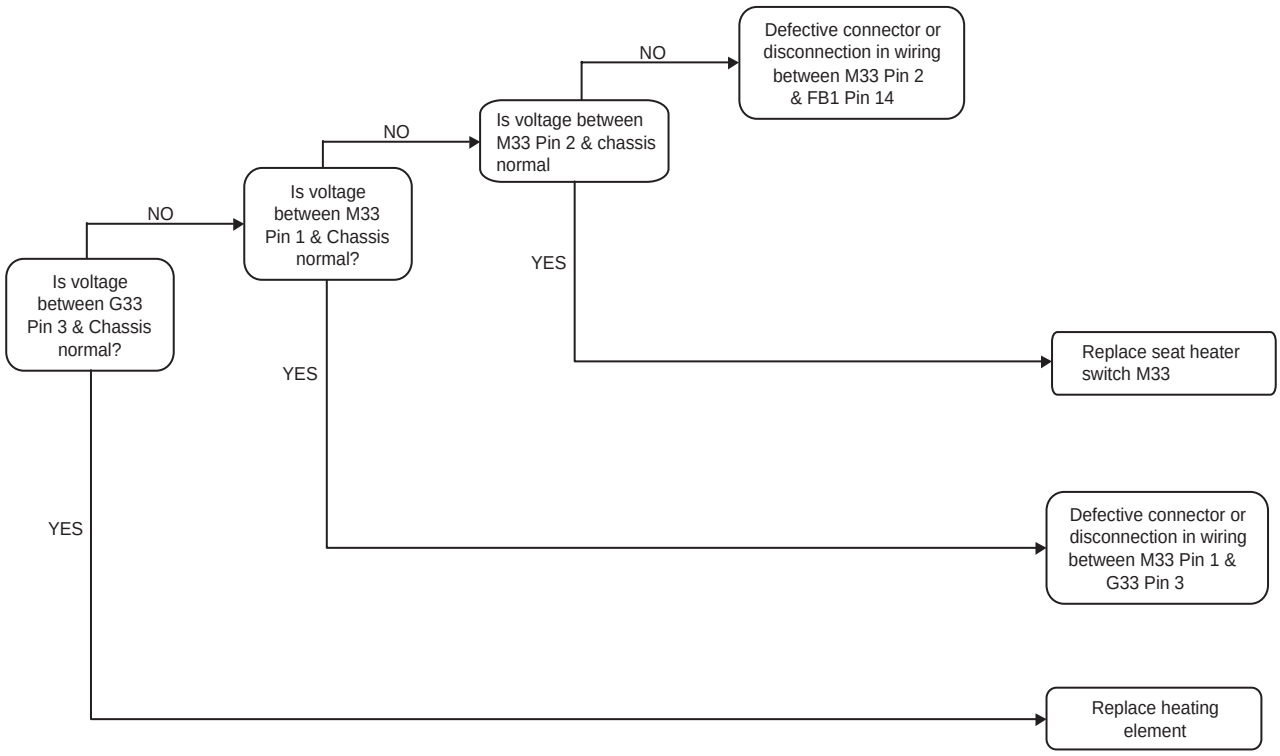


Circuit Diagram for Undercarriage Attachments - Rear Right Outrigger

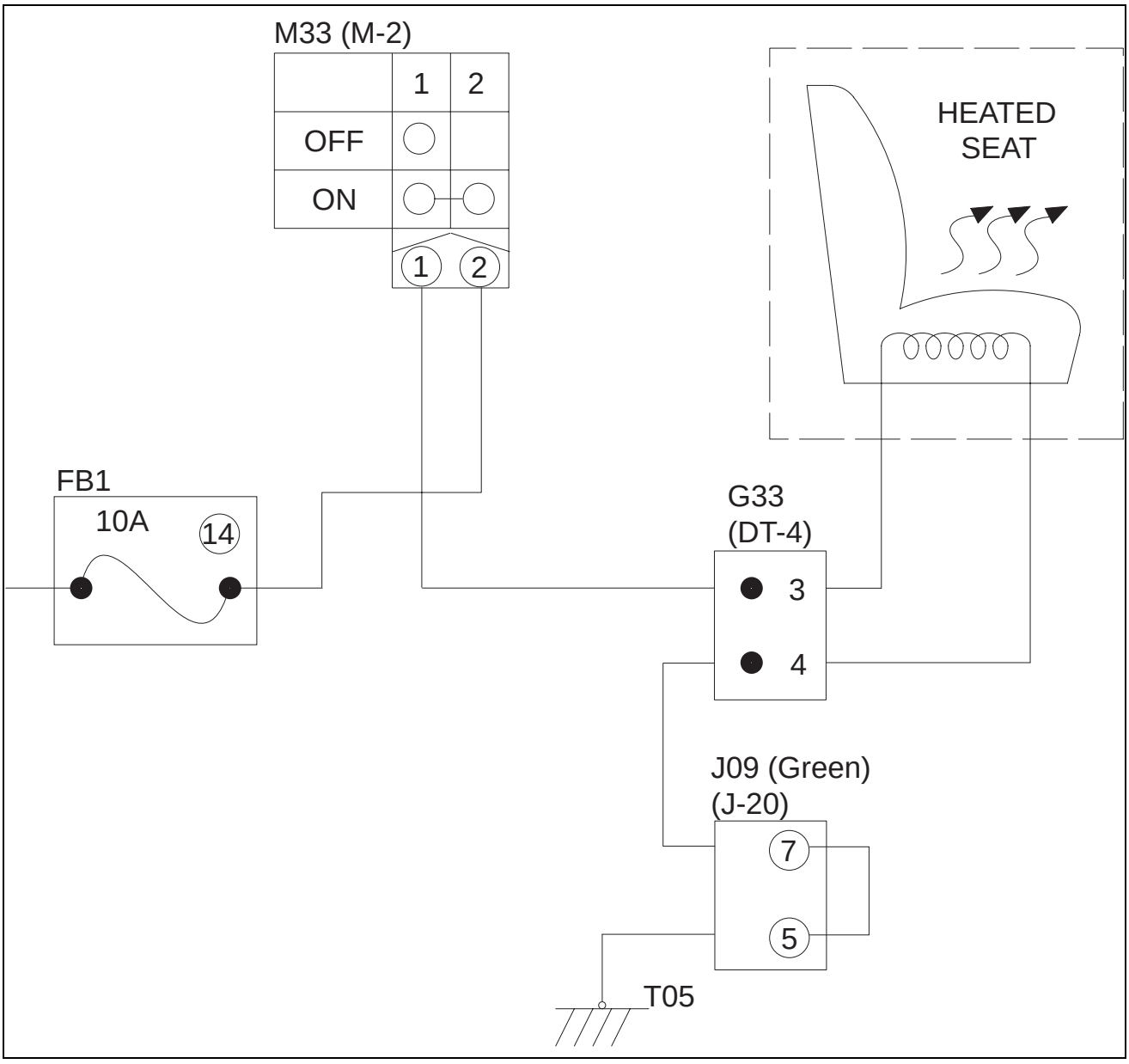


Heated Seat Does Not Warm Up

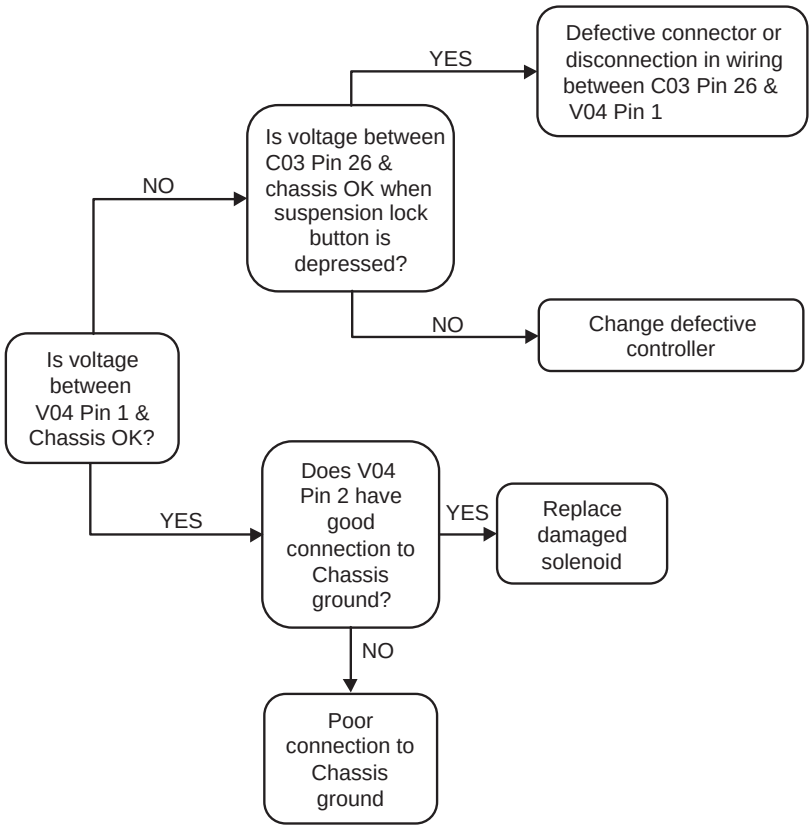
*When Fuse No.14 (Fuse box 1) is not blown



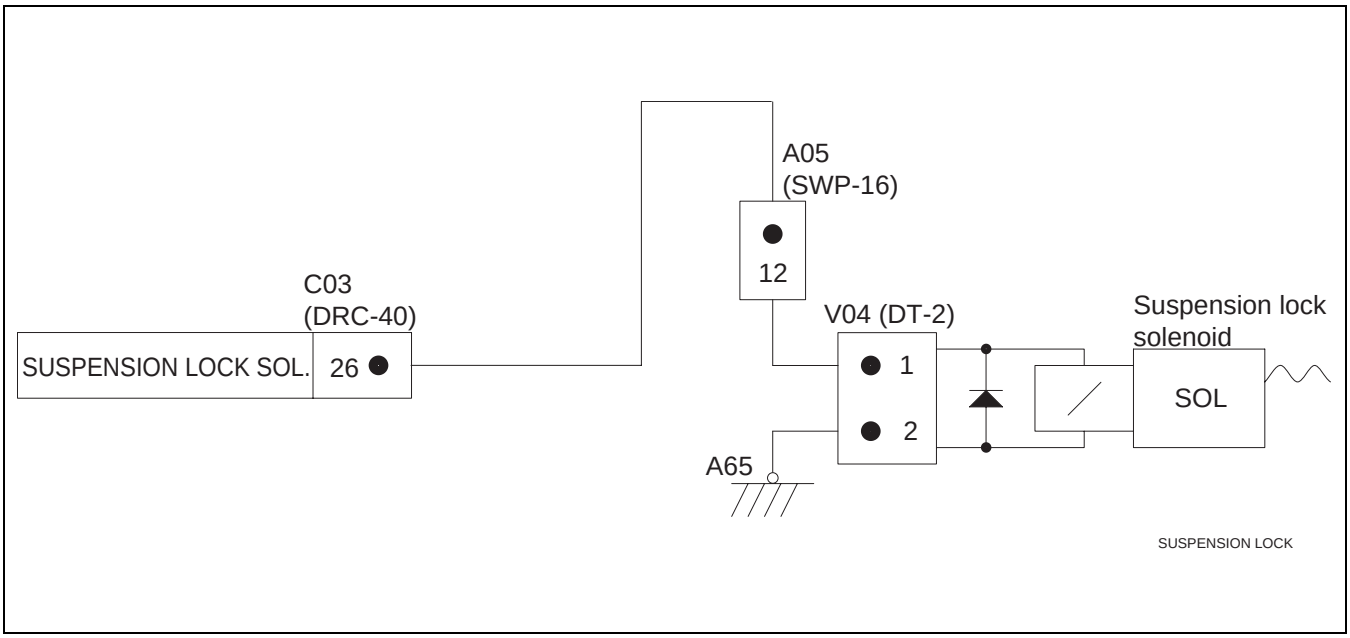
Circuit Diagram for the Heated Seat



Suspension Lock

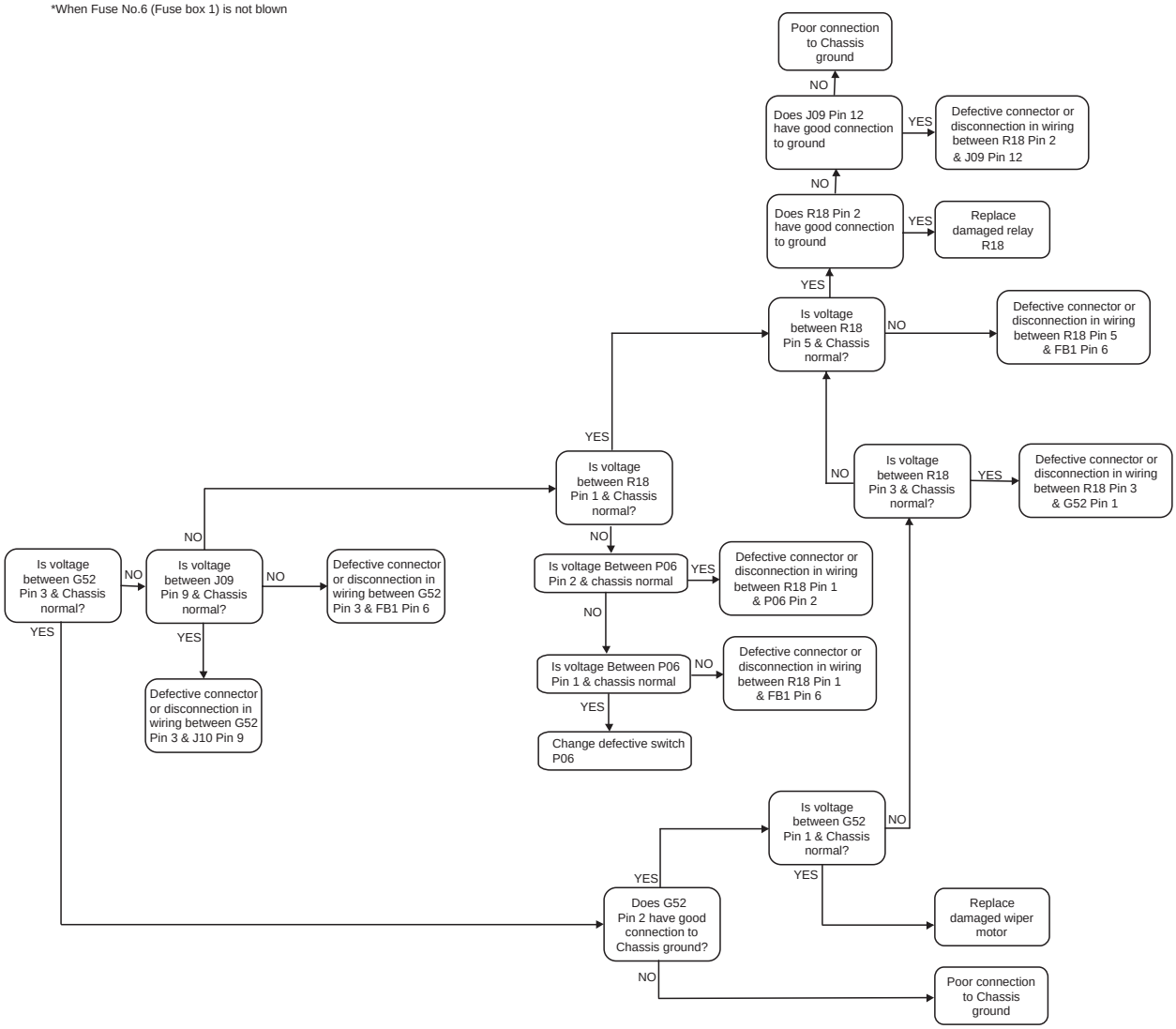


Circuit Diagram for Suspension Lock

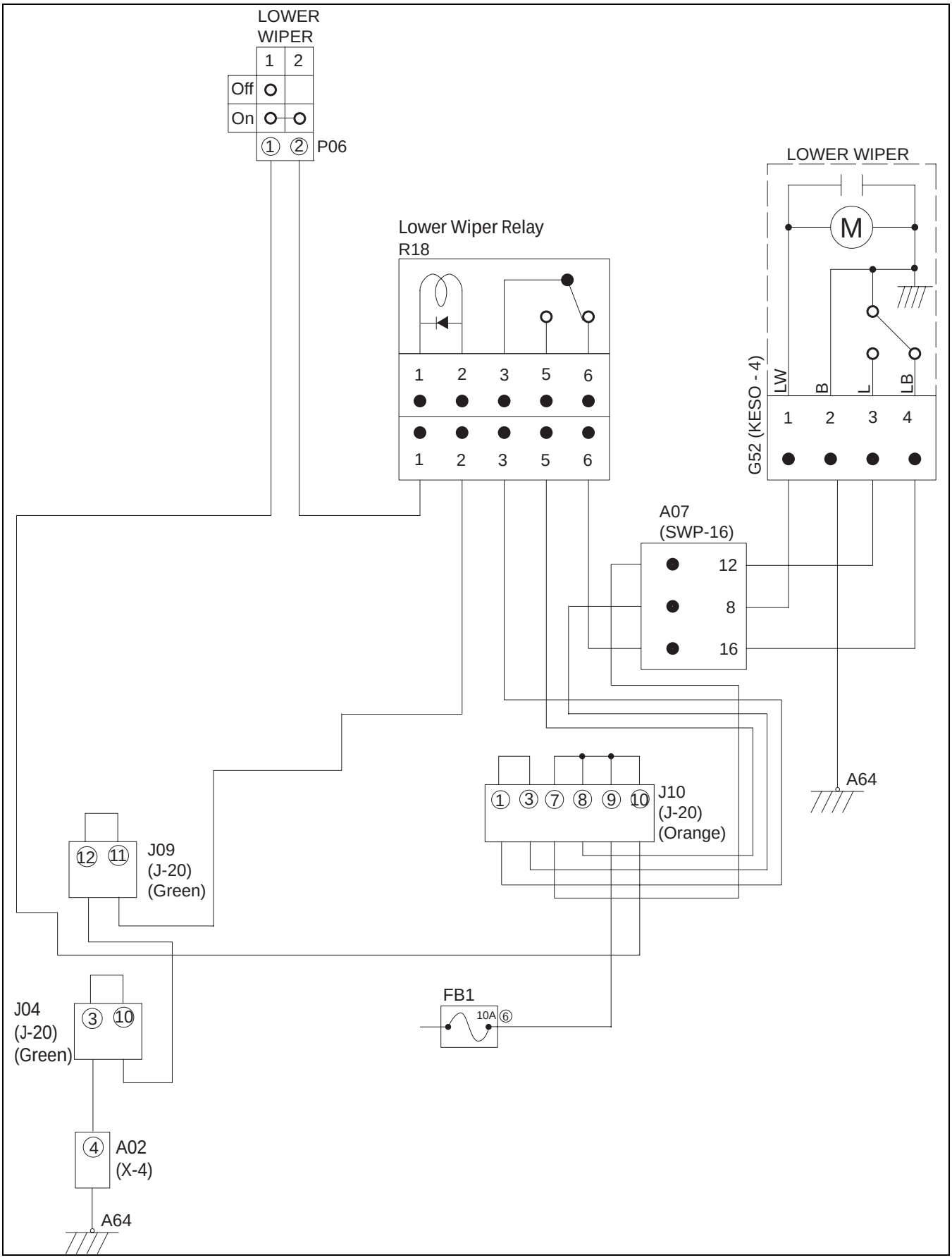


Lower Wiper Does Not Work (Optional Fitment)

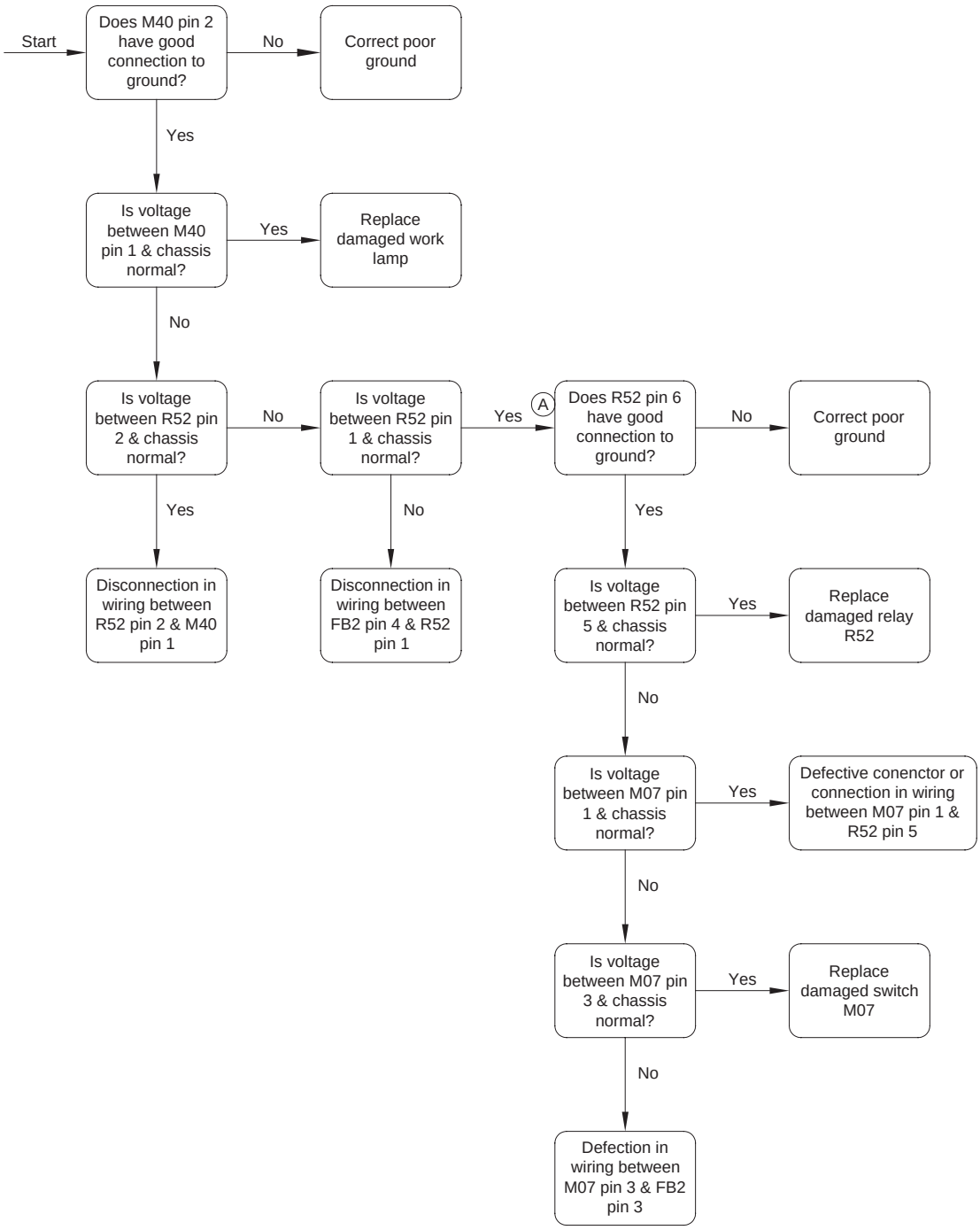
*When Fuse No.6 (Fuse box 1) is not blown



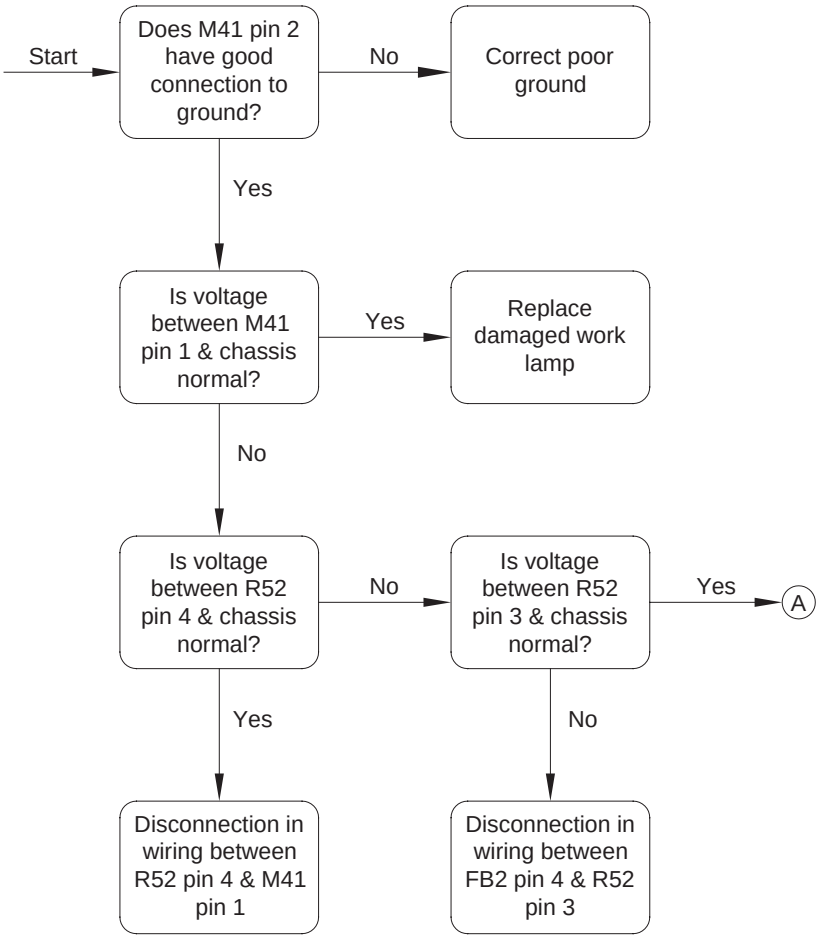
Circuit Diagram for Lower Wiper



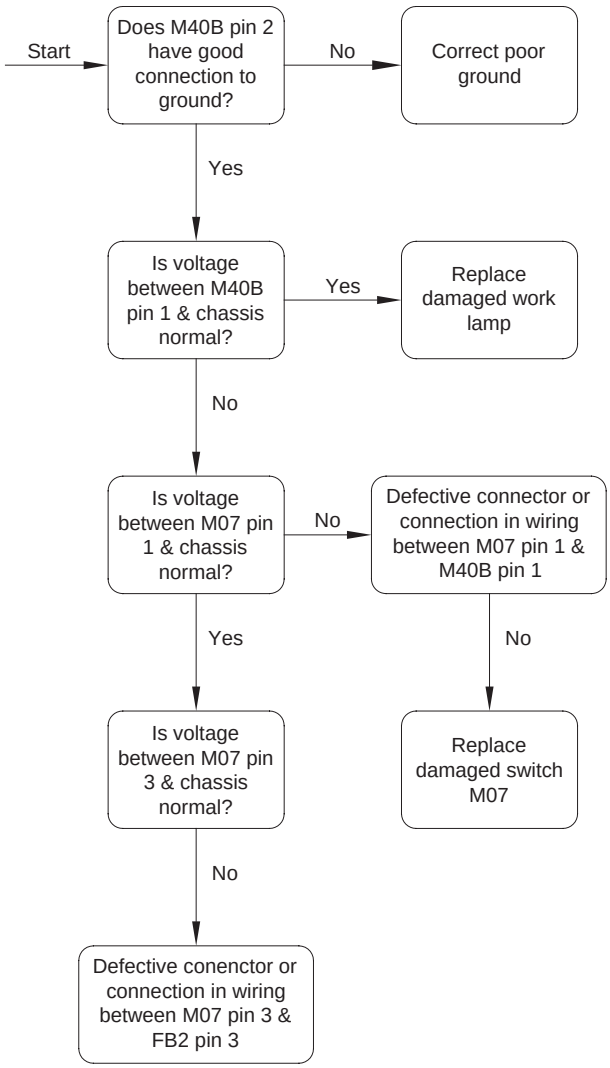
Work Lights (Operator Cab Front Left)



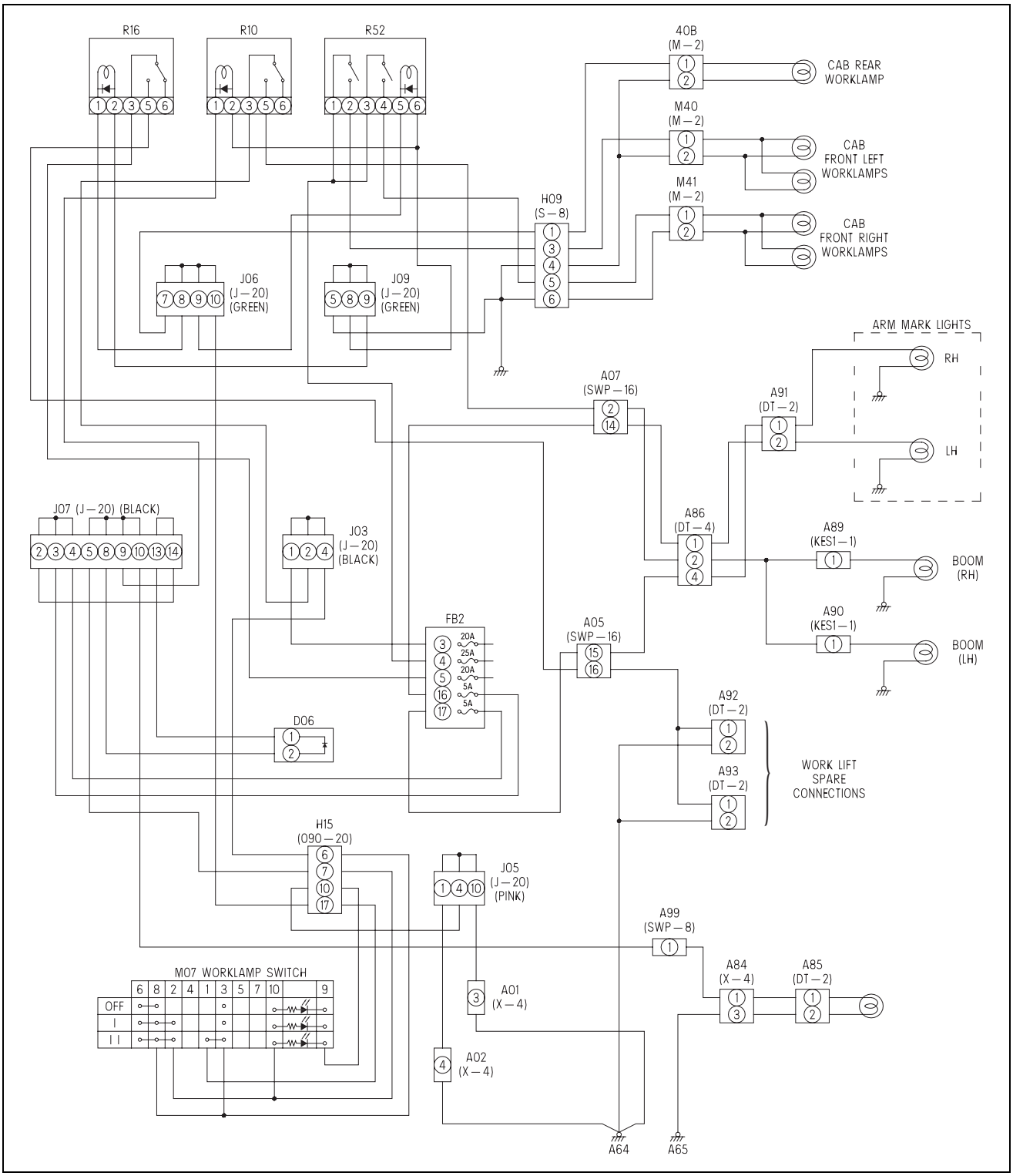
Work Lights (Operator Cab Front Right)



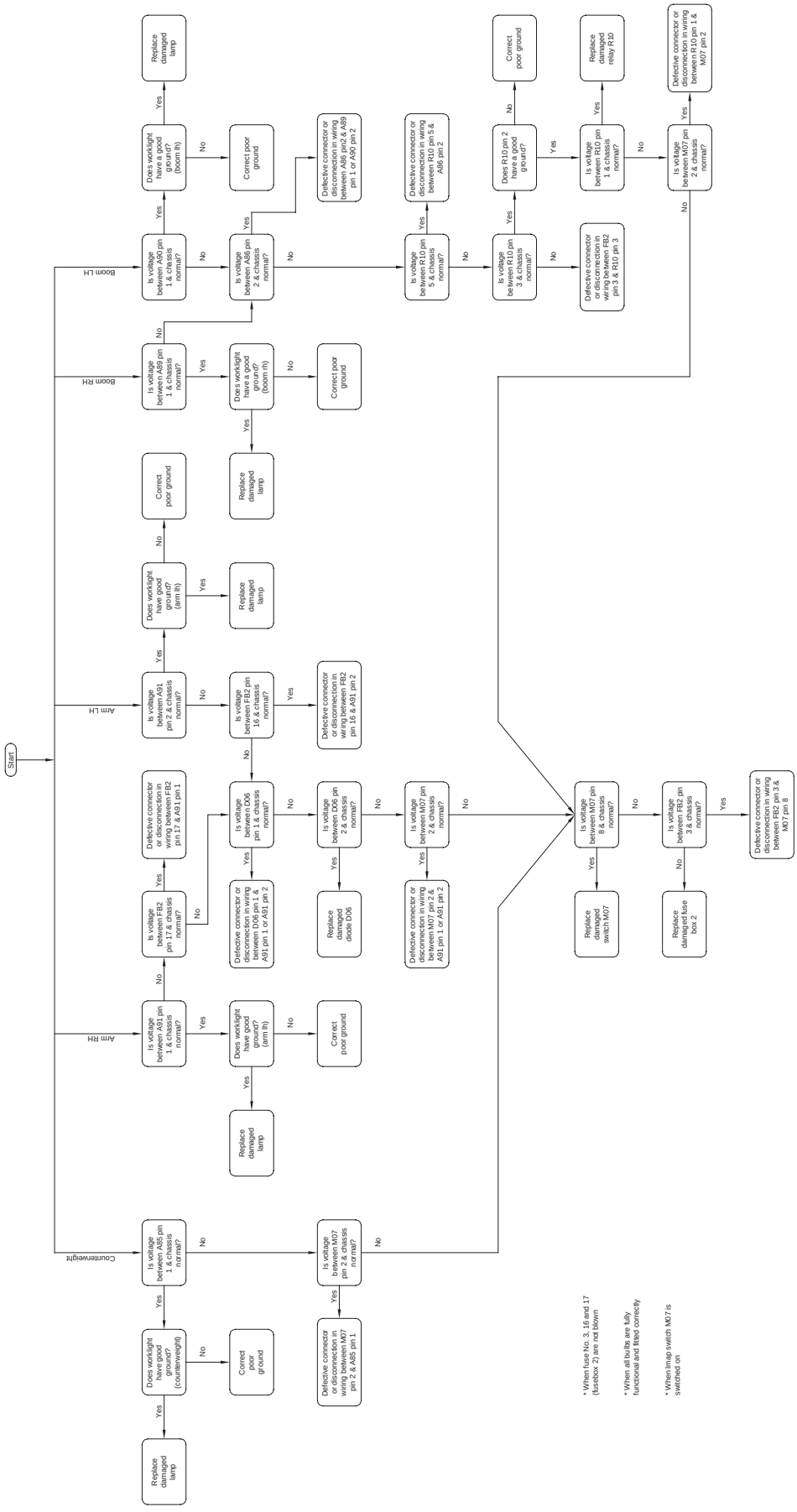
Work Lights (Operator Cab Rear)



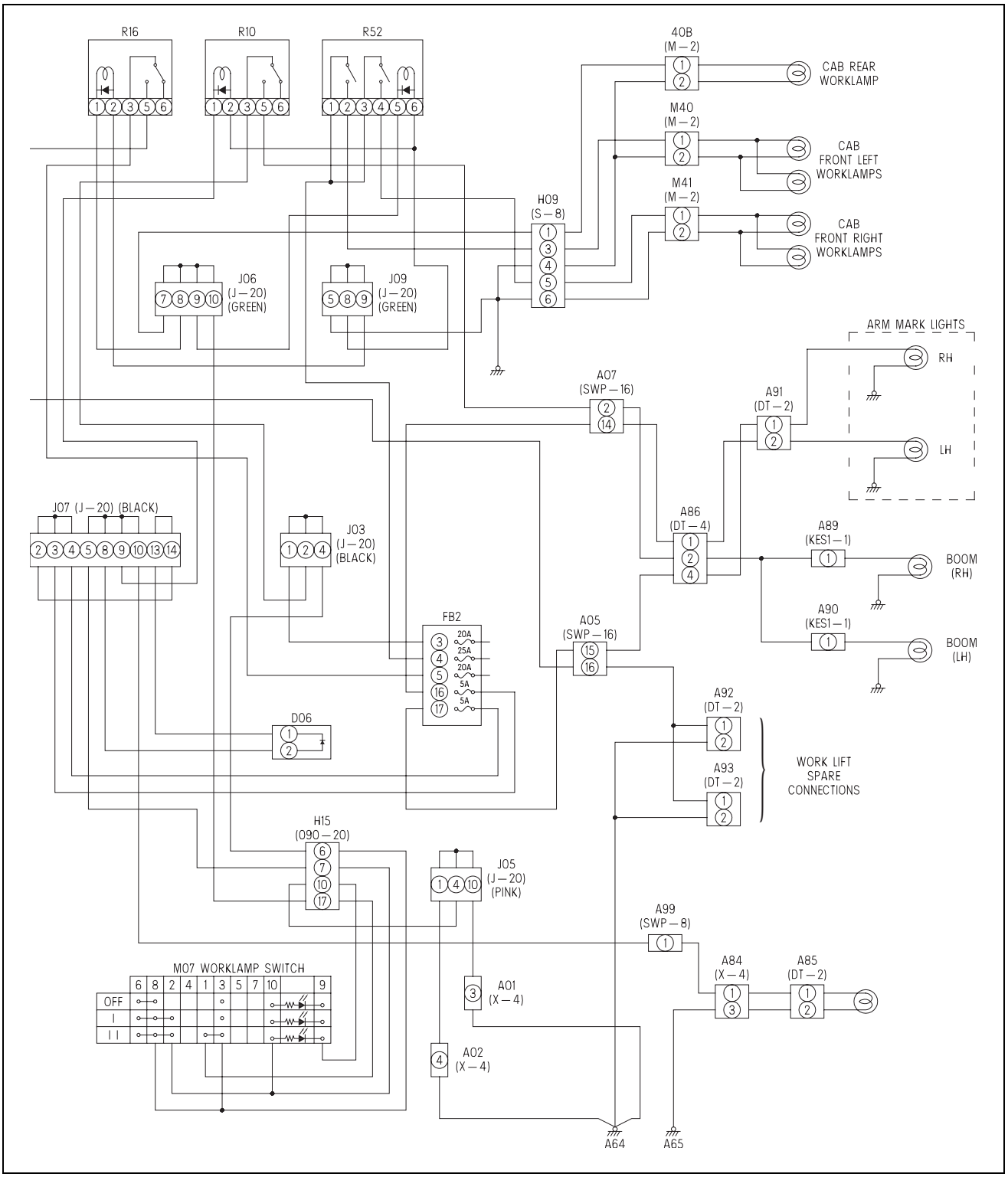
Circuit Diagram for Work Lights



Worklights (Boom, Arm & Counterweight)



Circuit Diagram for Worklights (Boom & Counterweight)

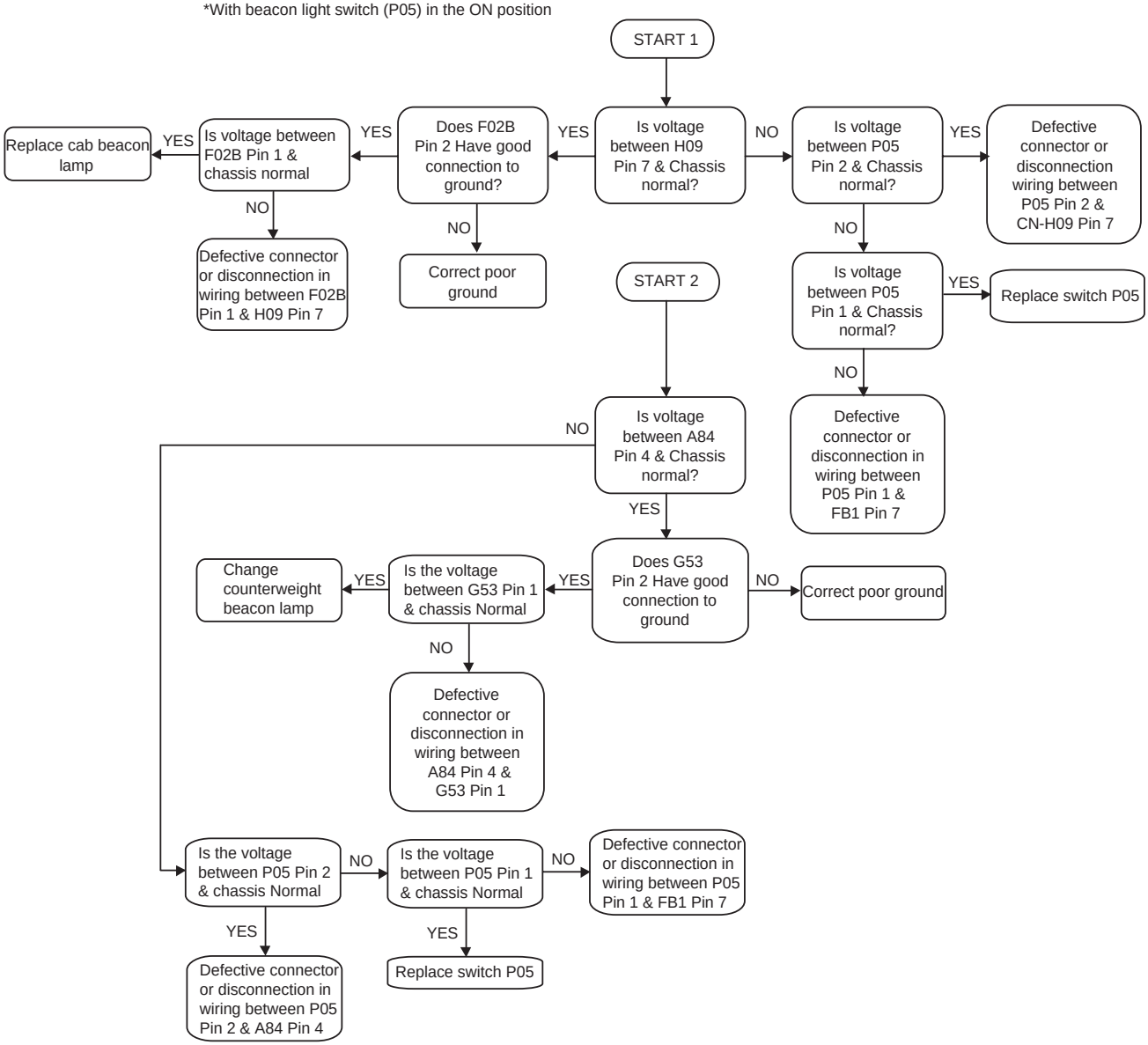


Cab and Counterweight Beacon Light

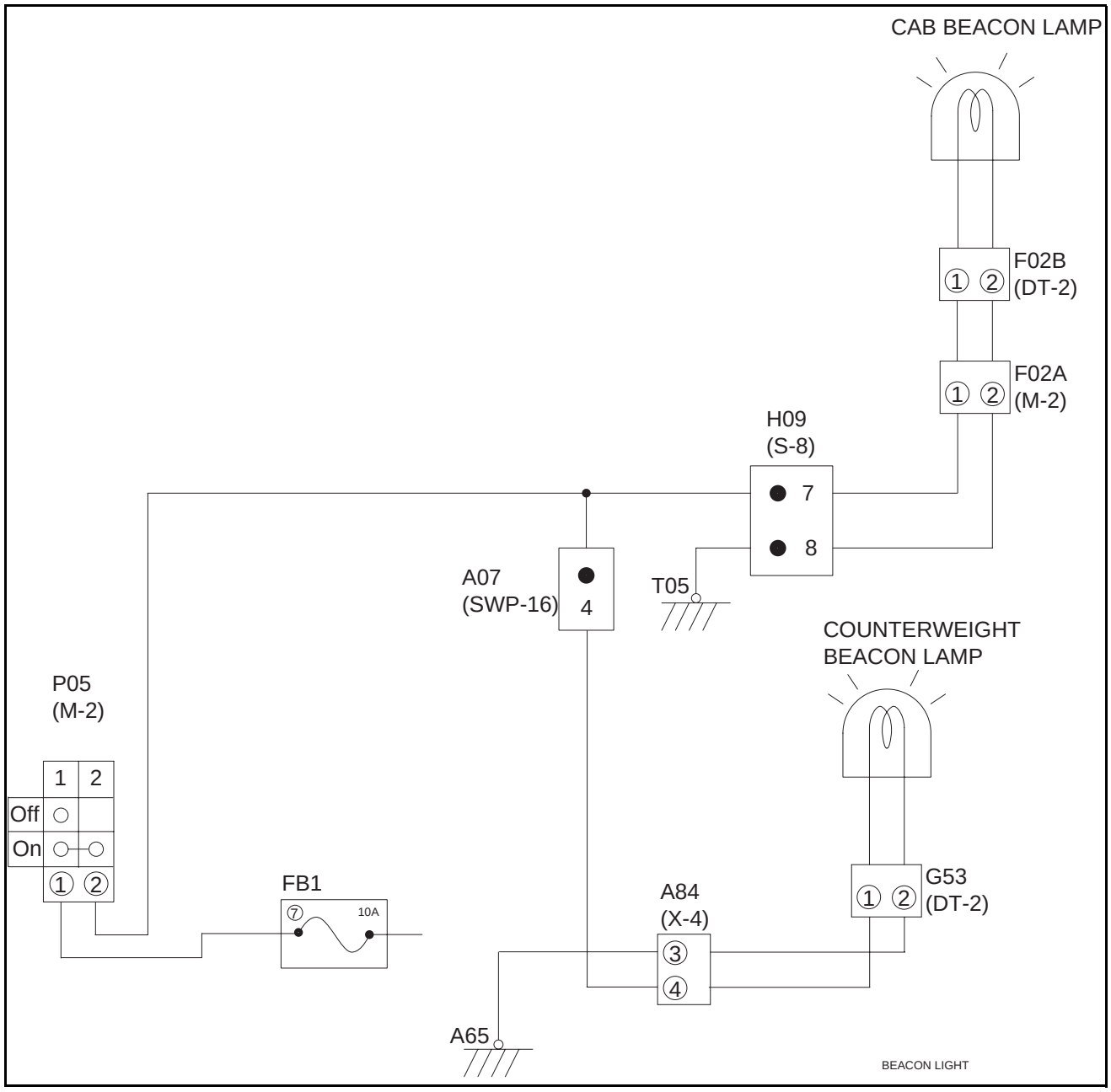
*When Fuse No.7 (Fuse box 1) is not blown

*When bulb is fitted correctly and fully functional

*With beacon light switch (P05) in the ON position

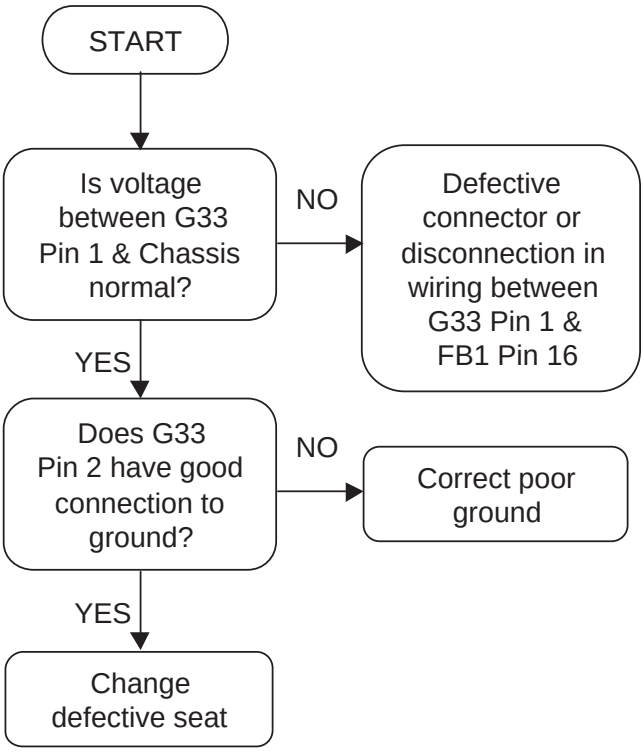


Circuit Diagram for Cab & Counterweight Beacon Light

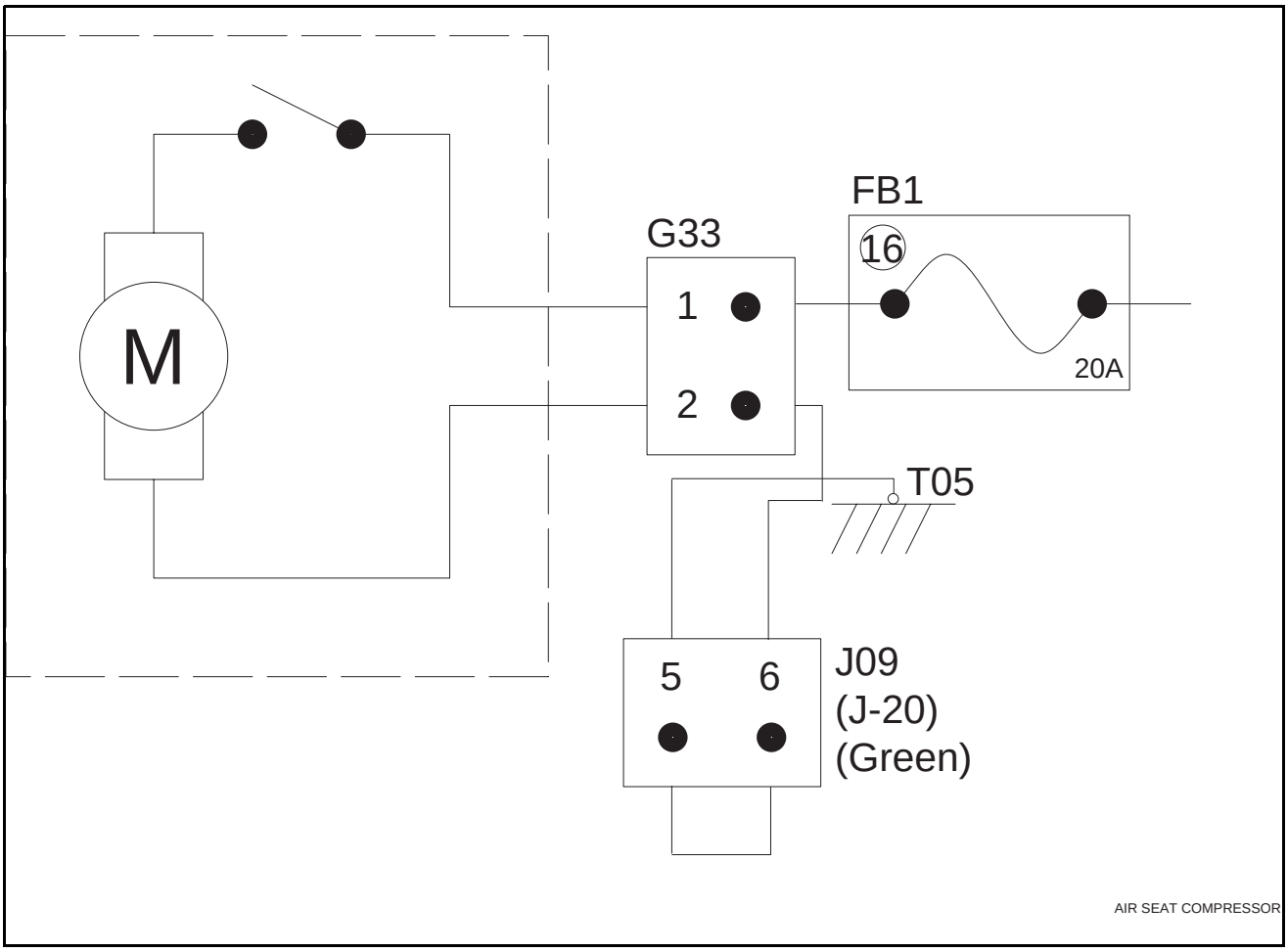


Air Seat Compressor (Option - Air Suspension Seat)

*When Fuse No.16 (Fuse box 1) is not blown



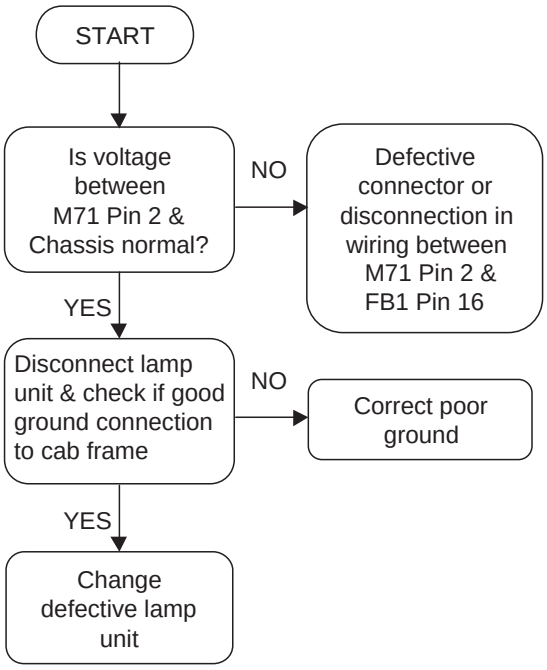
Circuit Diagram for Air Seat Compressor (Option - Air Suspension Seat)



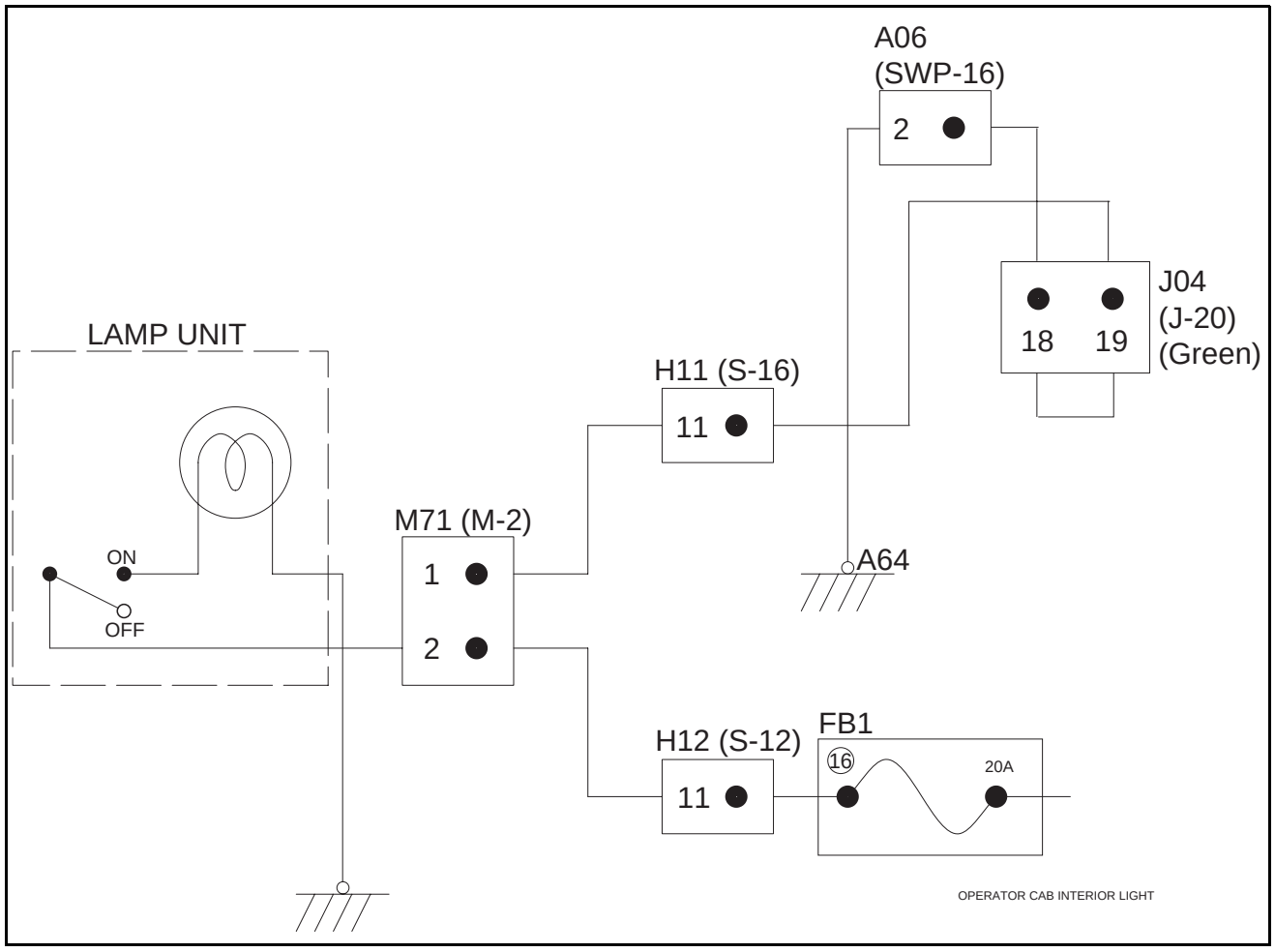
Operator Cab Interior Light

*When Fuse No.16 (Fuse box 1) is not blown

*When bulb is fully functional & fitted correctly

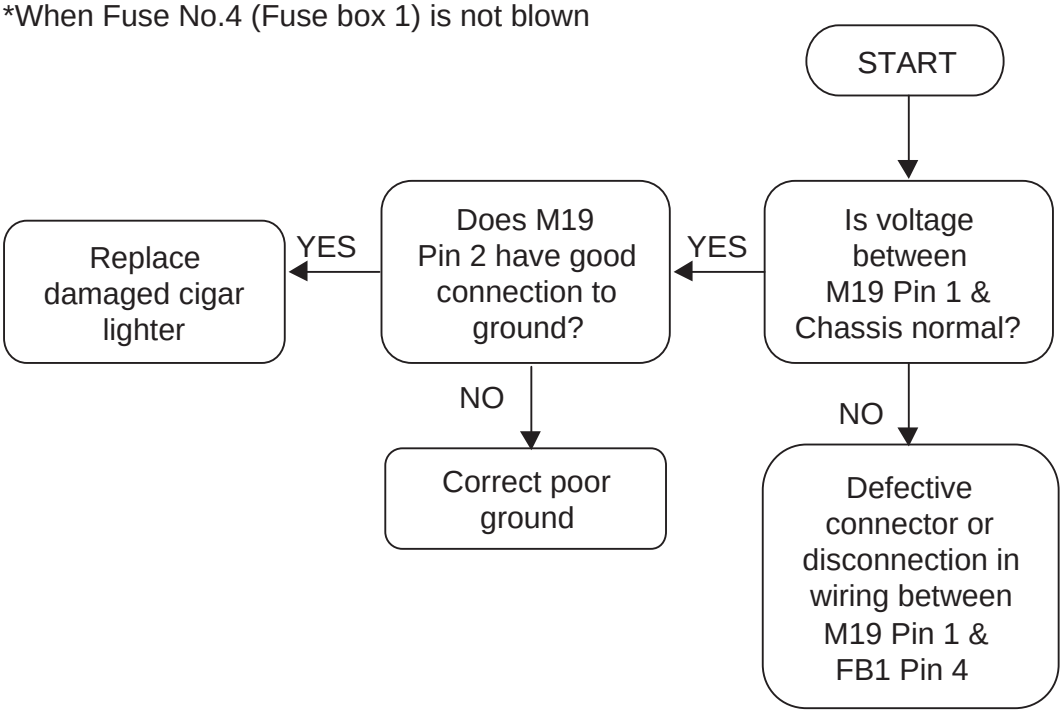


Circuit Diagram for Operator Cab Interior Light

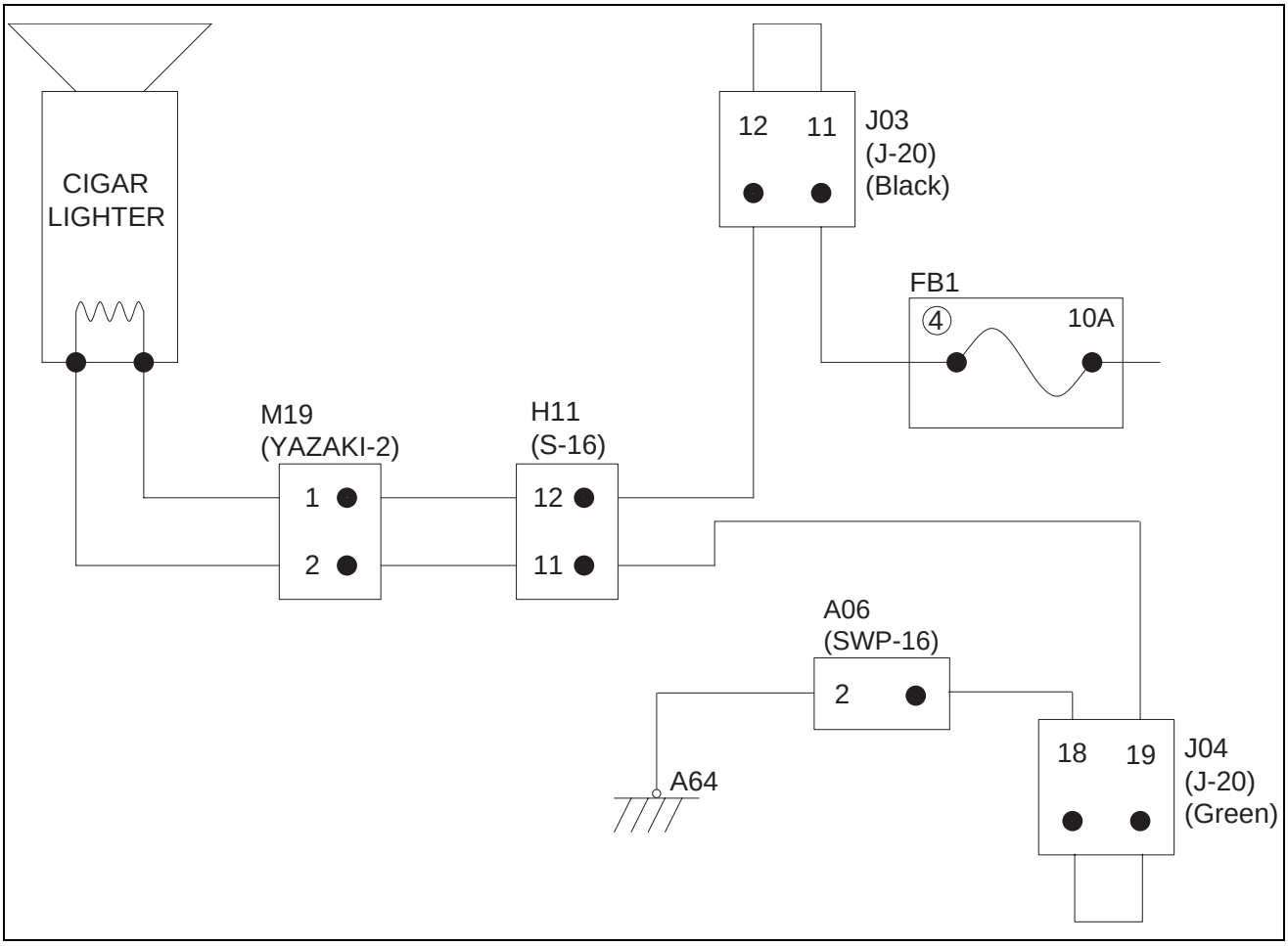


Cigar Lighter

*When Fuse No.4 (Fuse box 1) is not blown

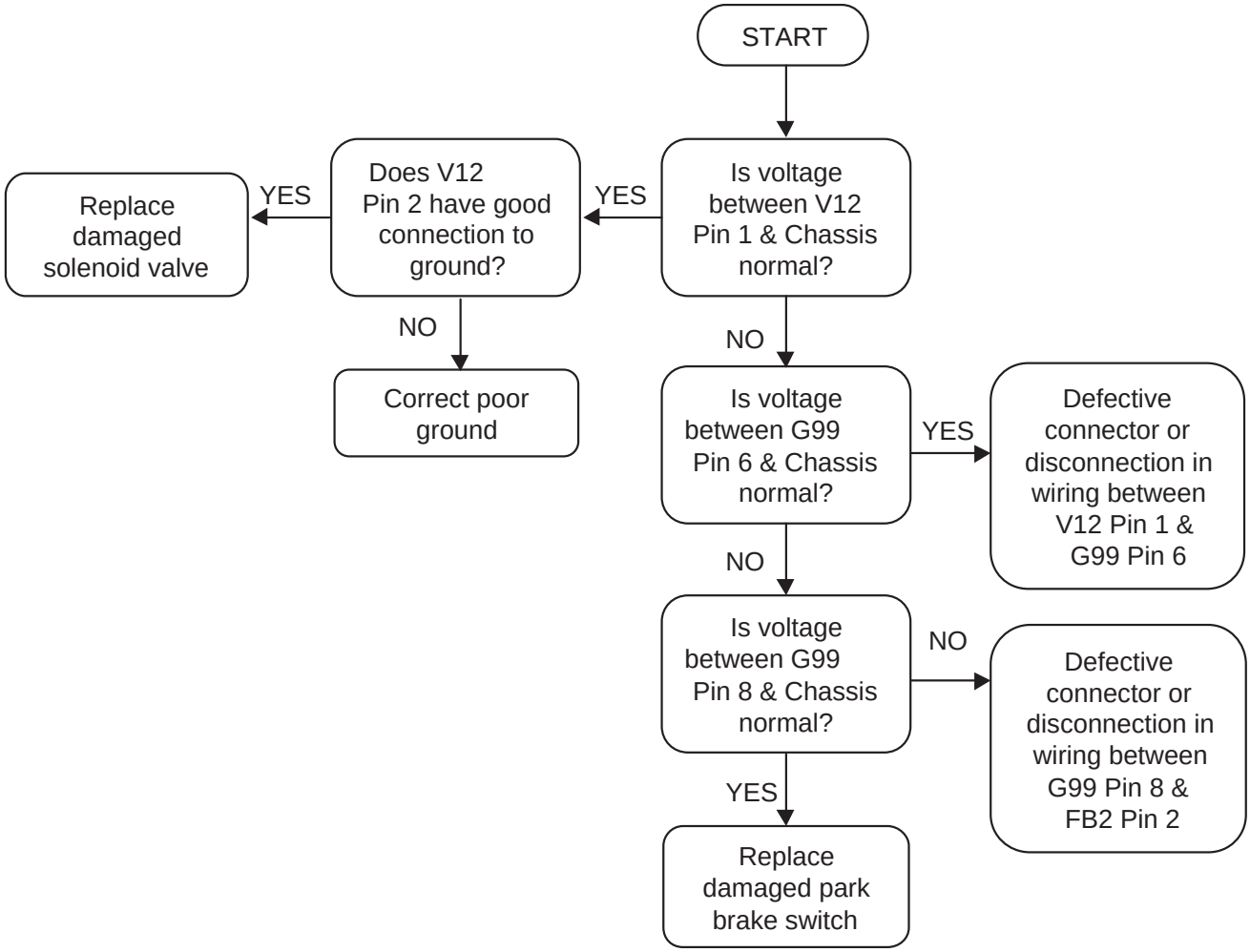


Circuit Diagram for Cigar Lighter

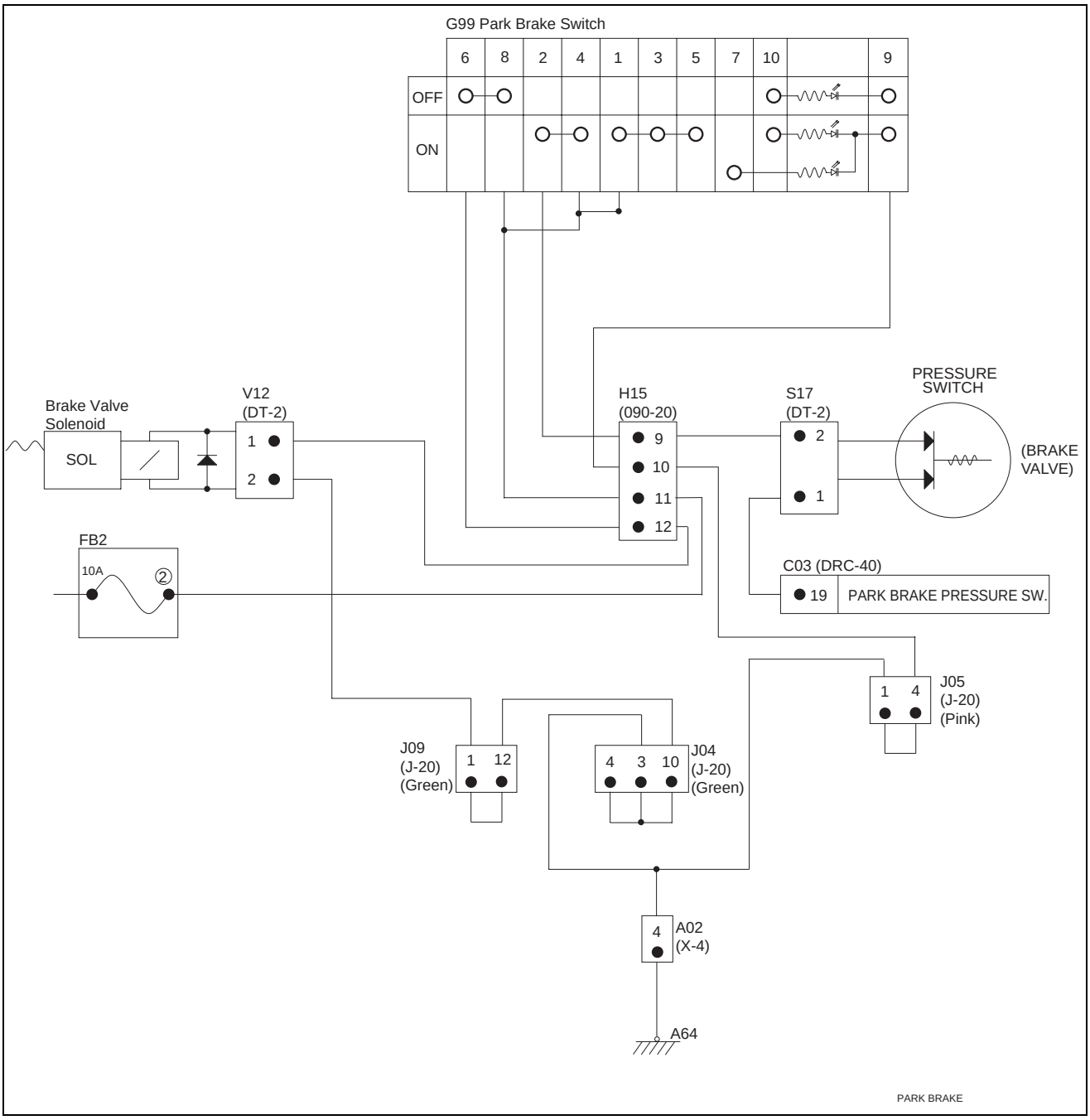


Park Brake (Not Activating)

*When Fuse No.2 (Fuse box 2) is not blown

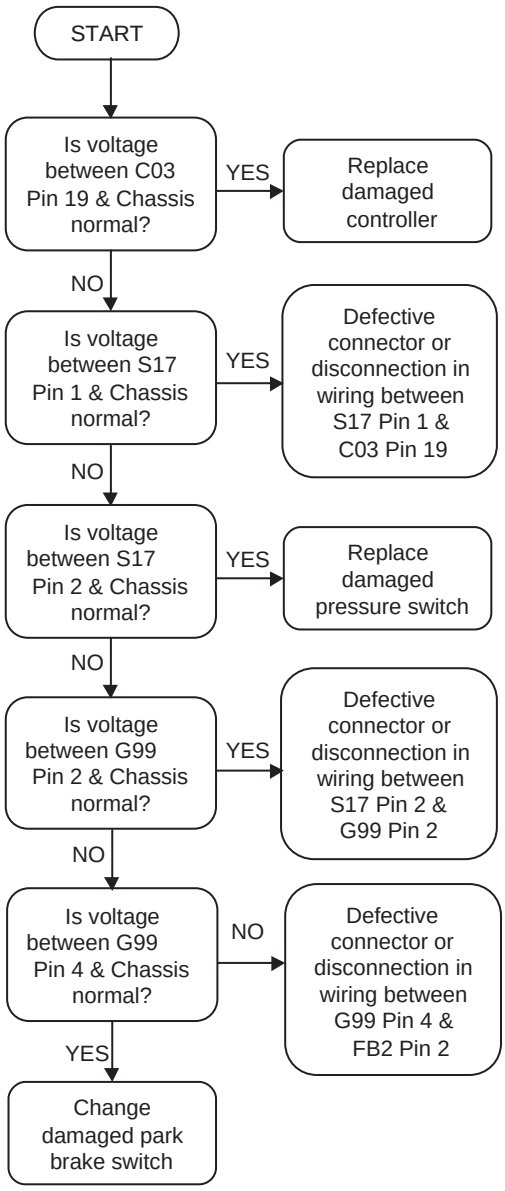


Circuit Diagram for Park Brake

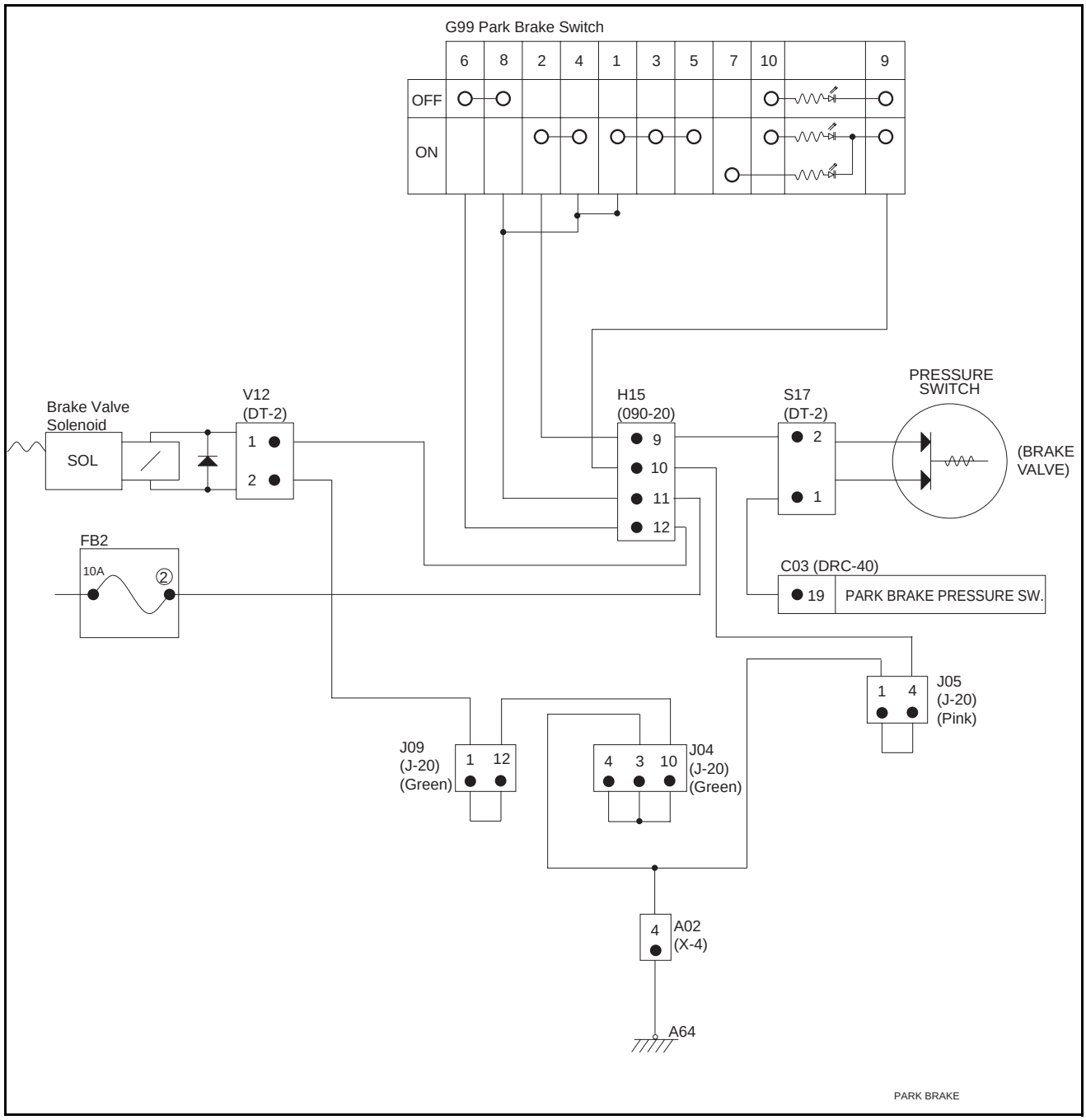


Park Brake (Displayed Symbol)

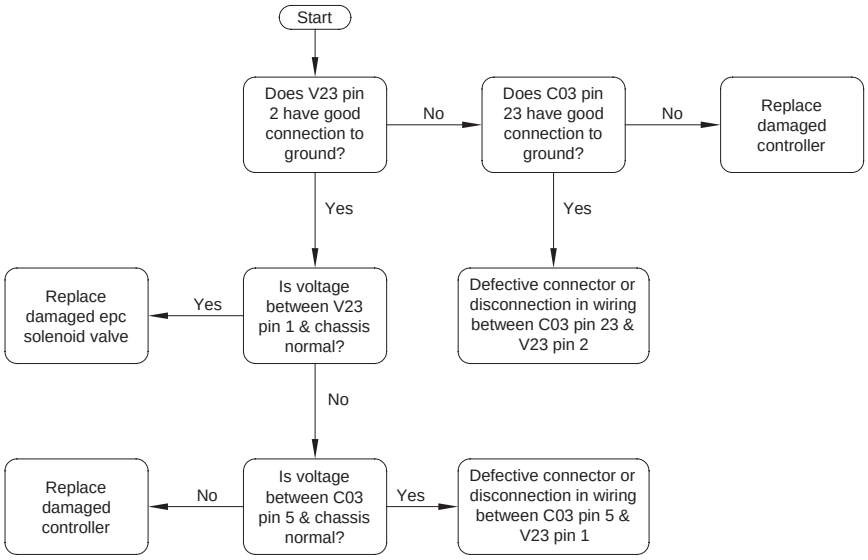
*When Fuse No.2 (Fuse Box 2) is not blown



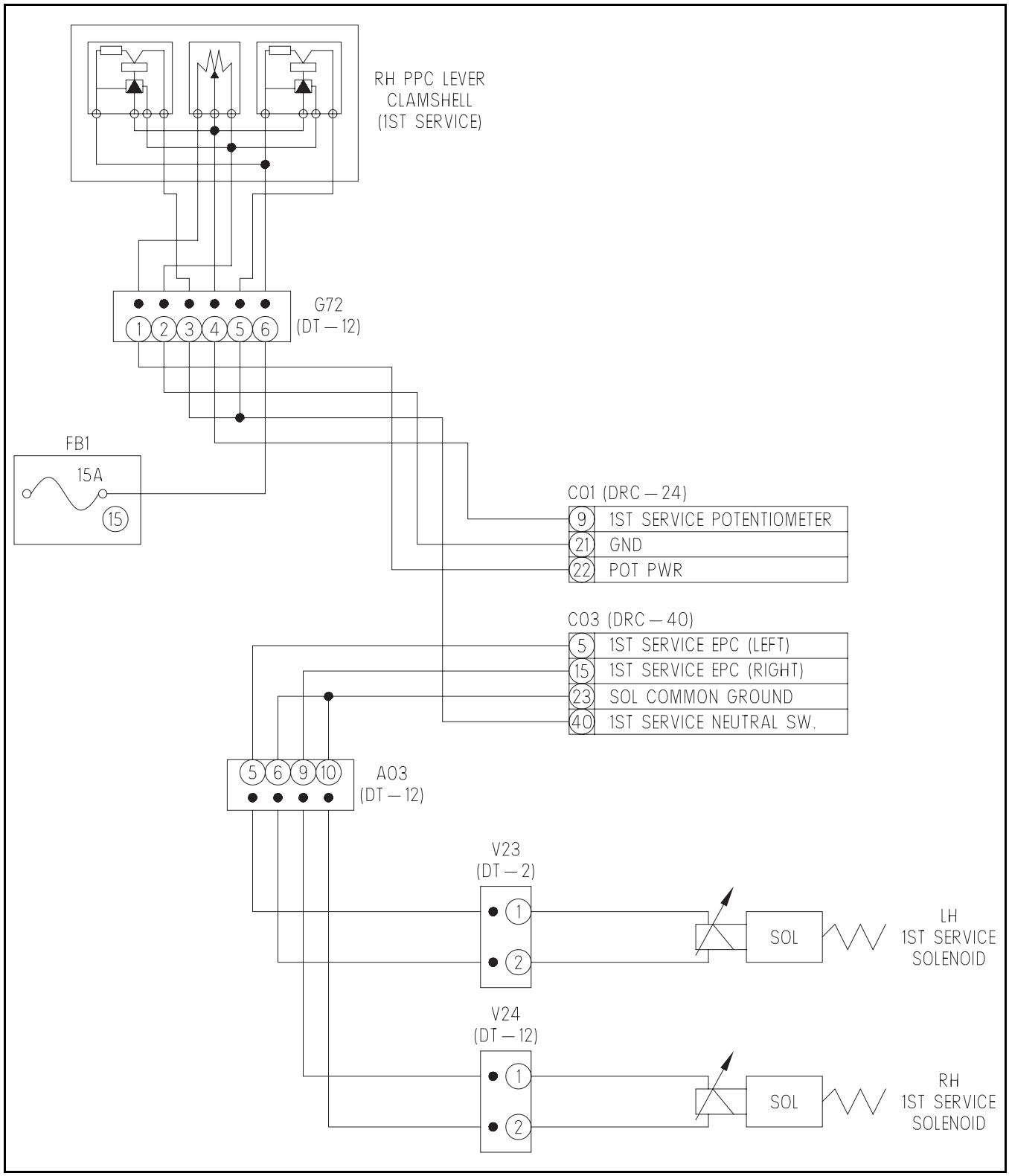
Circuit Diagram for Park Brake



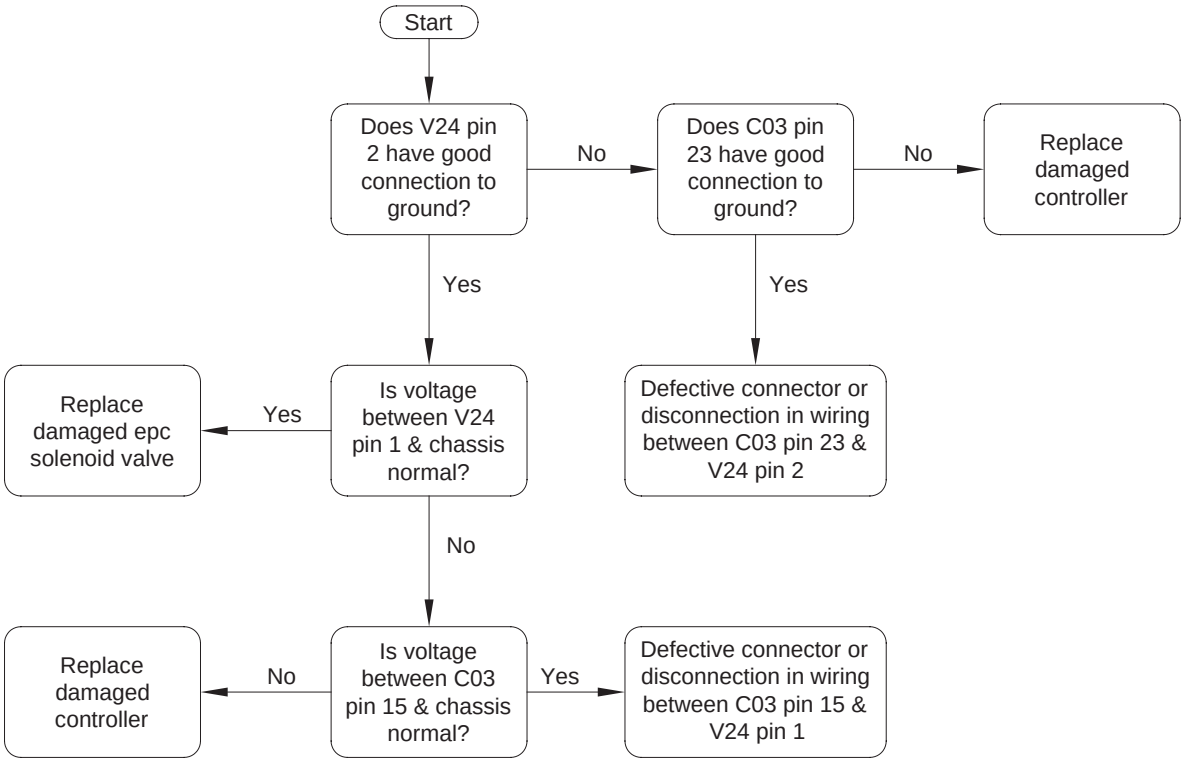
RH PPC Lever Clamshell Roller Switch Pushed to the LH Position



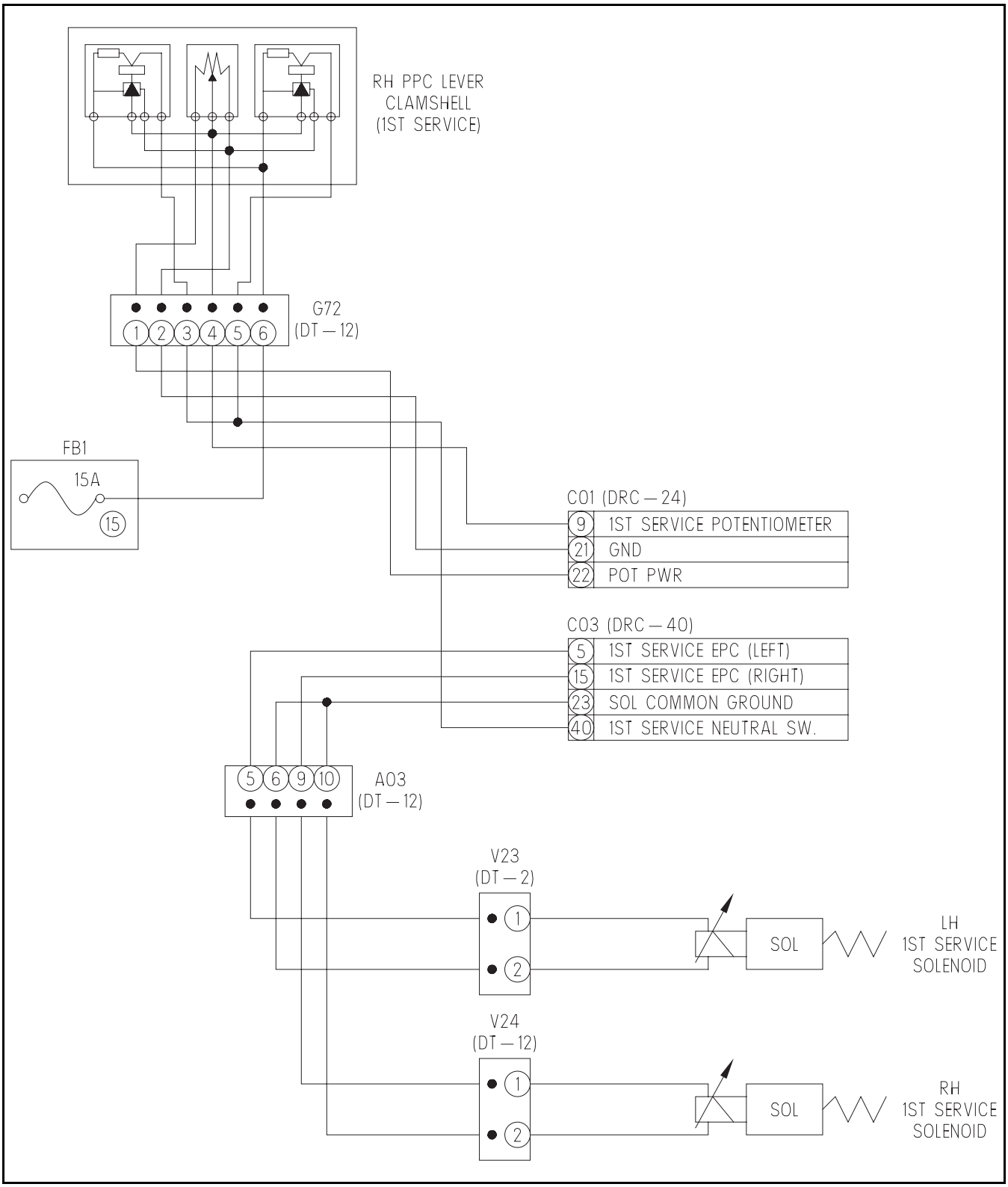
Circuit Diagram for Clamshell Control



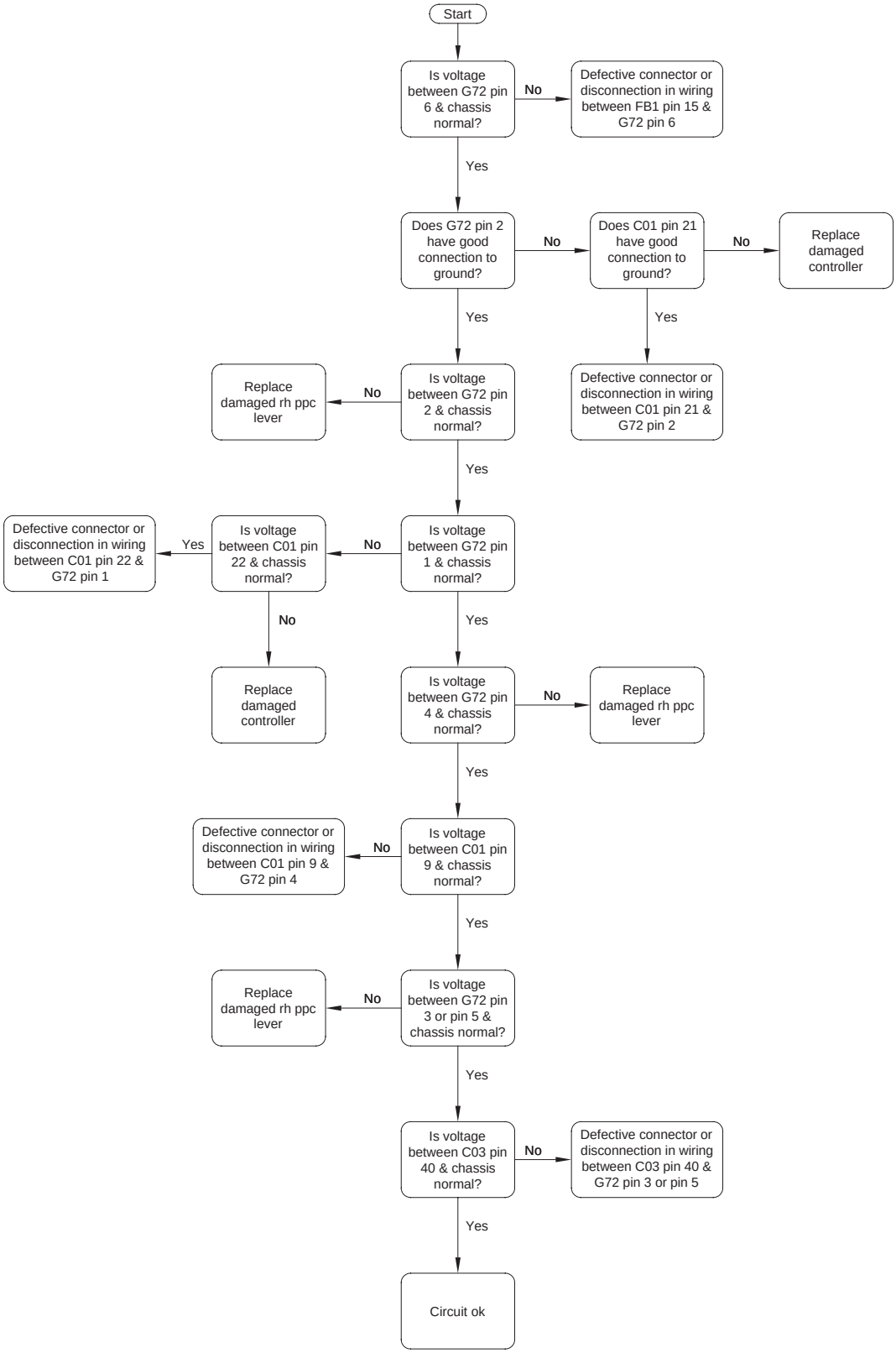
RH PPC Lever Clamshell Roller Switch Pushed to the RH Position



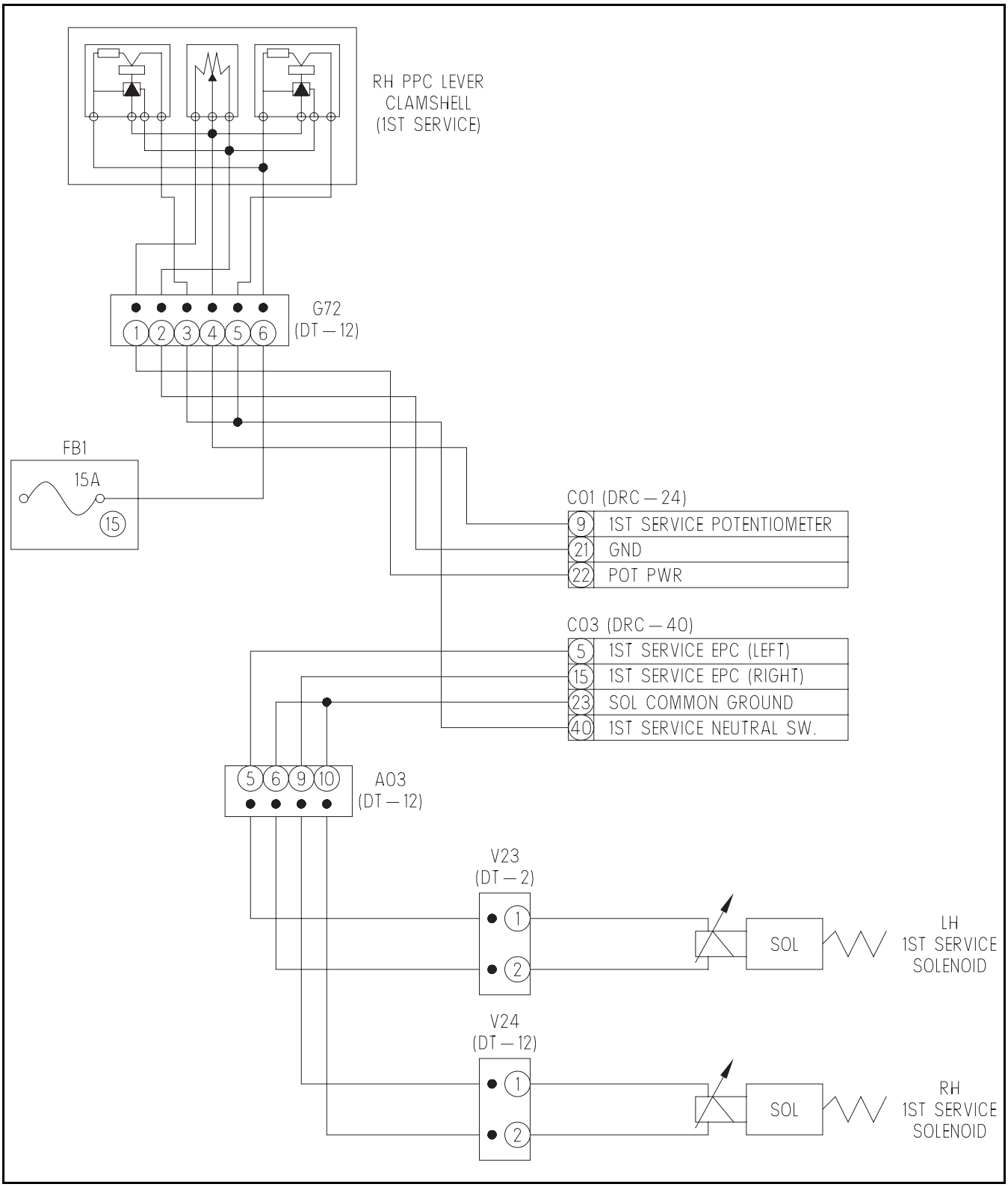
Circuit Diagram for Clamshell Control



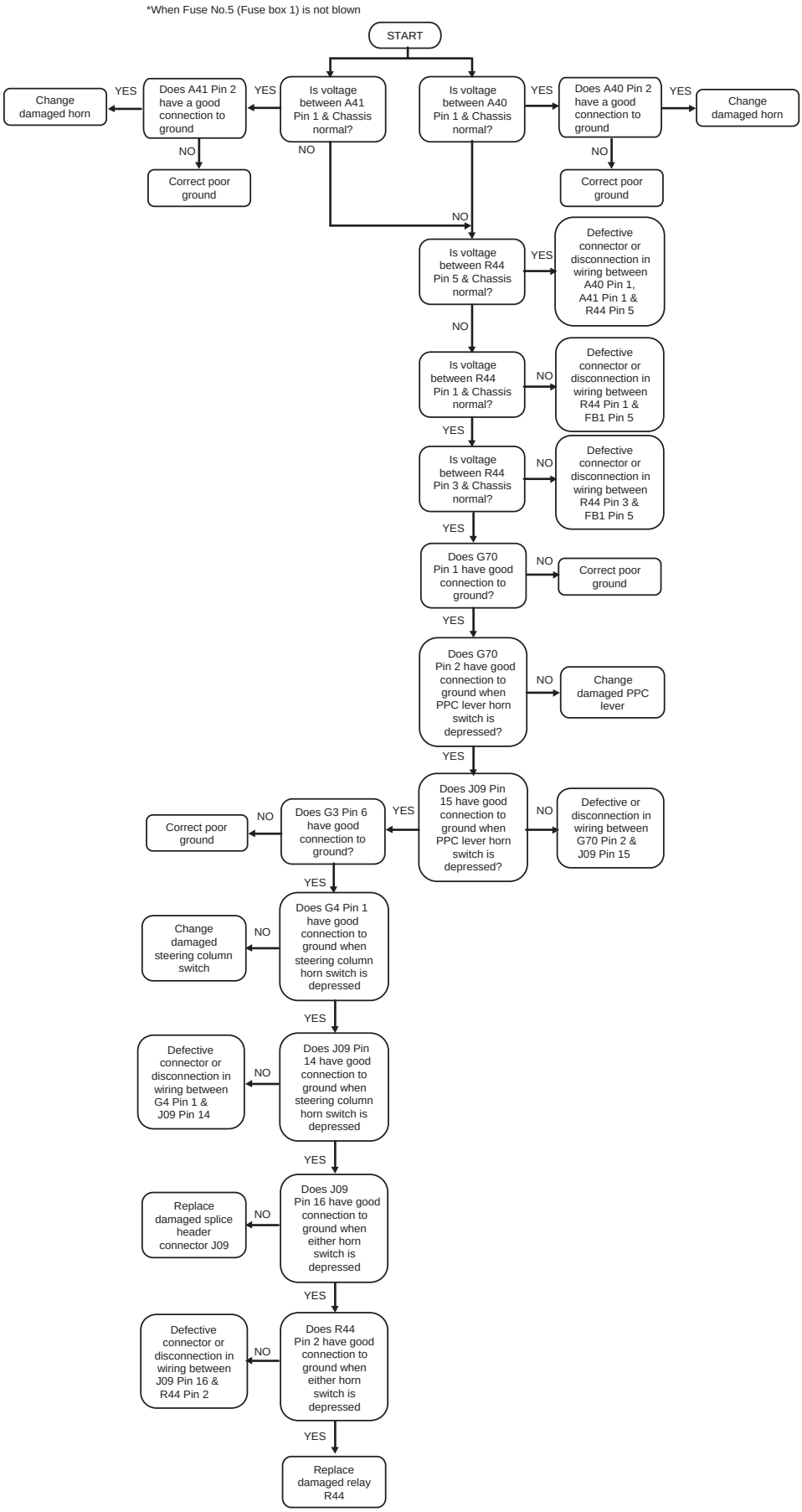
RH PPC Lever Clamshell Roller Switched Pushed to the RH or LH



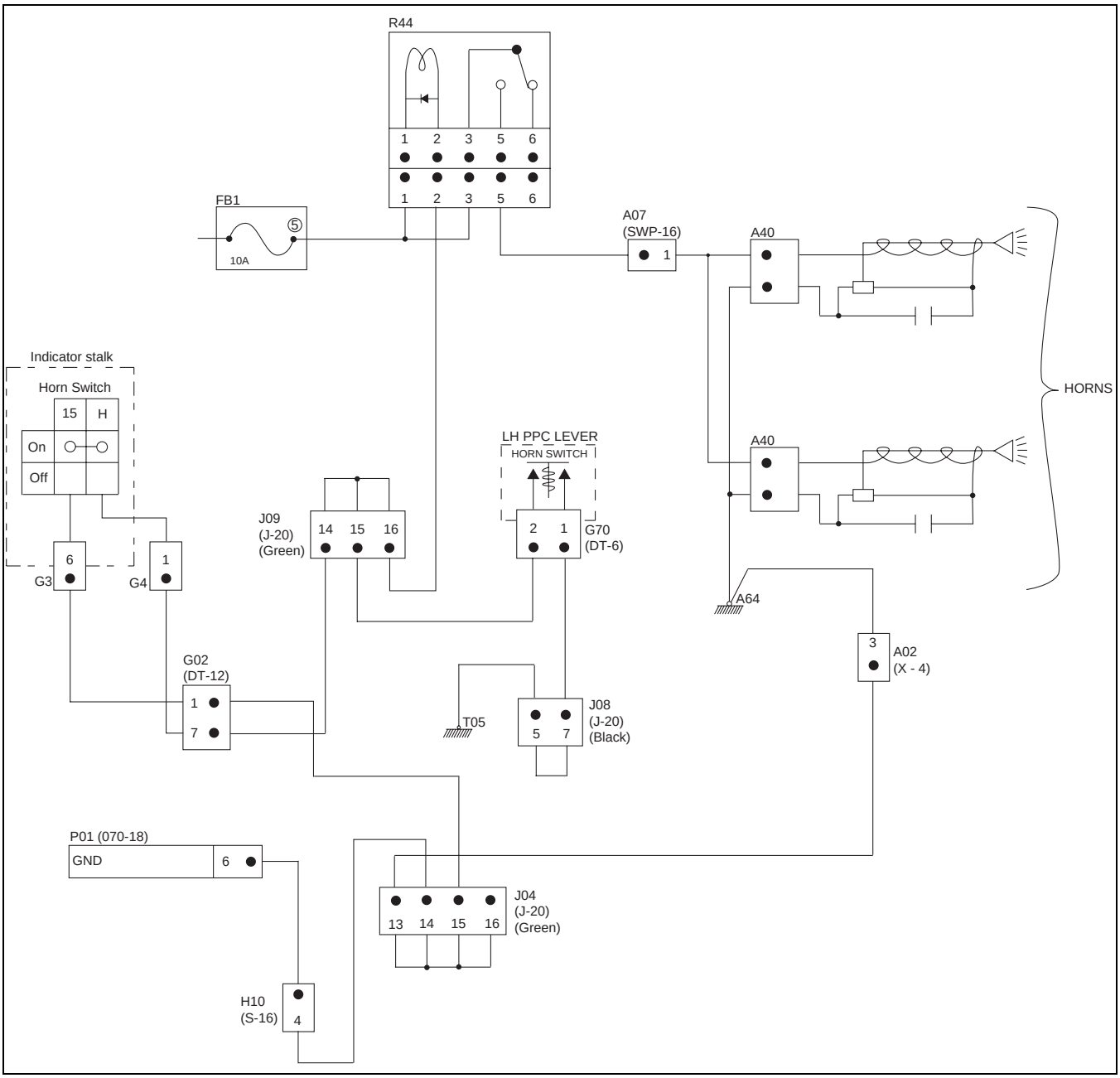
Circuit Diagram for Clamshell Control



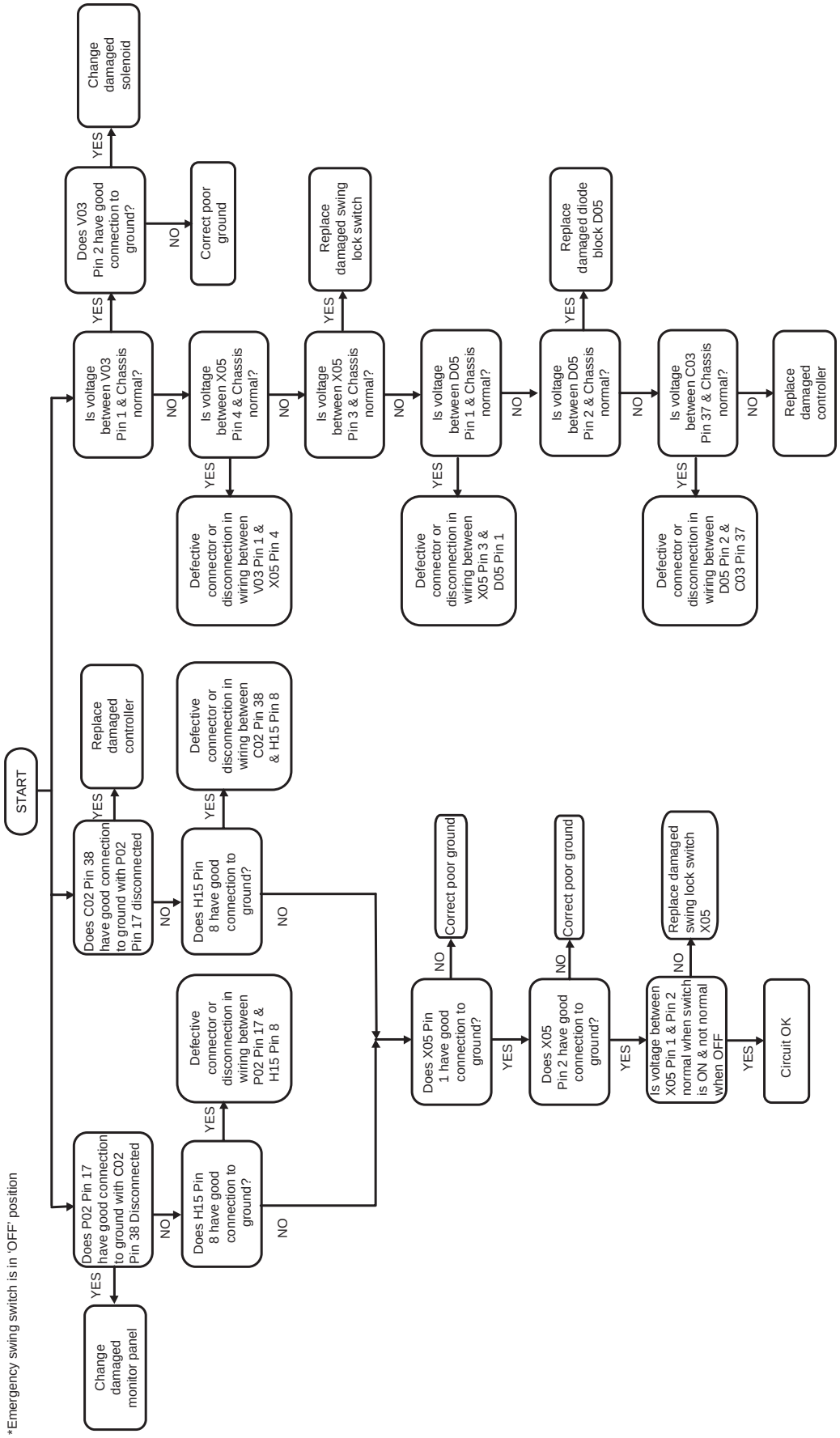
Horns


*When Fuse No.5 (Fuse box 1) is not blown
START
Is voltage between A41 Pin 1 & Chassis normal?
YES
Does A41 Pin 2 have a good connection to ground
YES
Change damaged horn
NO
Correct poor ground
NO
Is voltage between A40 Pin 1 & Chassis normal?
YES
Does A40 Pin 2 have a good connection to ground
YES
Change damaged horn
NO
Correct poor ground
NO
Is voltage between R44 Pin 5 & Chassis normal?
YES
Defective connector or disconnection in wiring between A40 Pin 1, A41 Pin 1 & R44 Pin 5
NO
Is voltage between R44 Pin 1 & Chassis normal?
NO
Defective connector or disconnection in wiring between R44 Pin 1 & FB1 Pin 5
YES
Is voltage between R44 Pin 3 & Chassis normal?
NO
Defective connector or disconnection in wiring between R44 Pin 3 & FB1 Pin 5
YES
Does G70 Pin 1 have good connection to ground?
NO
Correct poor ground
YES
Does G70 Pin 2 have good connection to ground when PPC lever horn switch is depressed?
NO
Change damaged PPC lever
YES
Does J09 Pin 15 have good connection to ground when PPC lever horn switch is depressed?
NO
Defective or disconnection in wiring between G70 Pin 2 & J09 Pin 15
YES
Does G3 Pin 6 have good connection to ground?
NO
Correct poor ground
YES
Does G4 Pin 1 have good connection to ground when steering column horn switch is depressed
NO
Change damaged steering column switch
YES
Does J09 Pin 14 have good connection to ground when steering column horn switch is depressed
NO
Defective connector or disconnection in wiring between G4 Pin 1 & J09 Pin 14
YES
Does J09 Pin 16 have good connection to ground when either horn switch is depressed
NO
Replace damaged splice header connector J09
YES
Does R44 Pin 2 have good connection to ground when either horn switch is depressed
NO
Defective connector or disconnection in wiring between J09 Pin 16 & R44 Pin 2
YES
Replace damaged relay R44

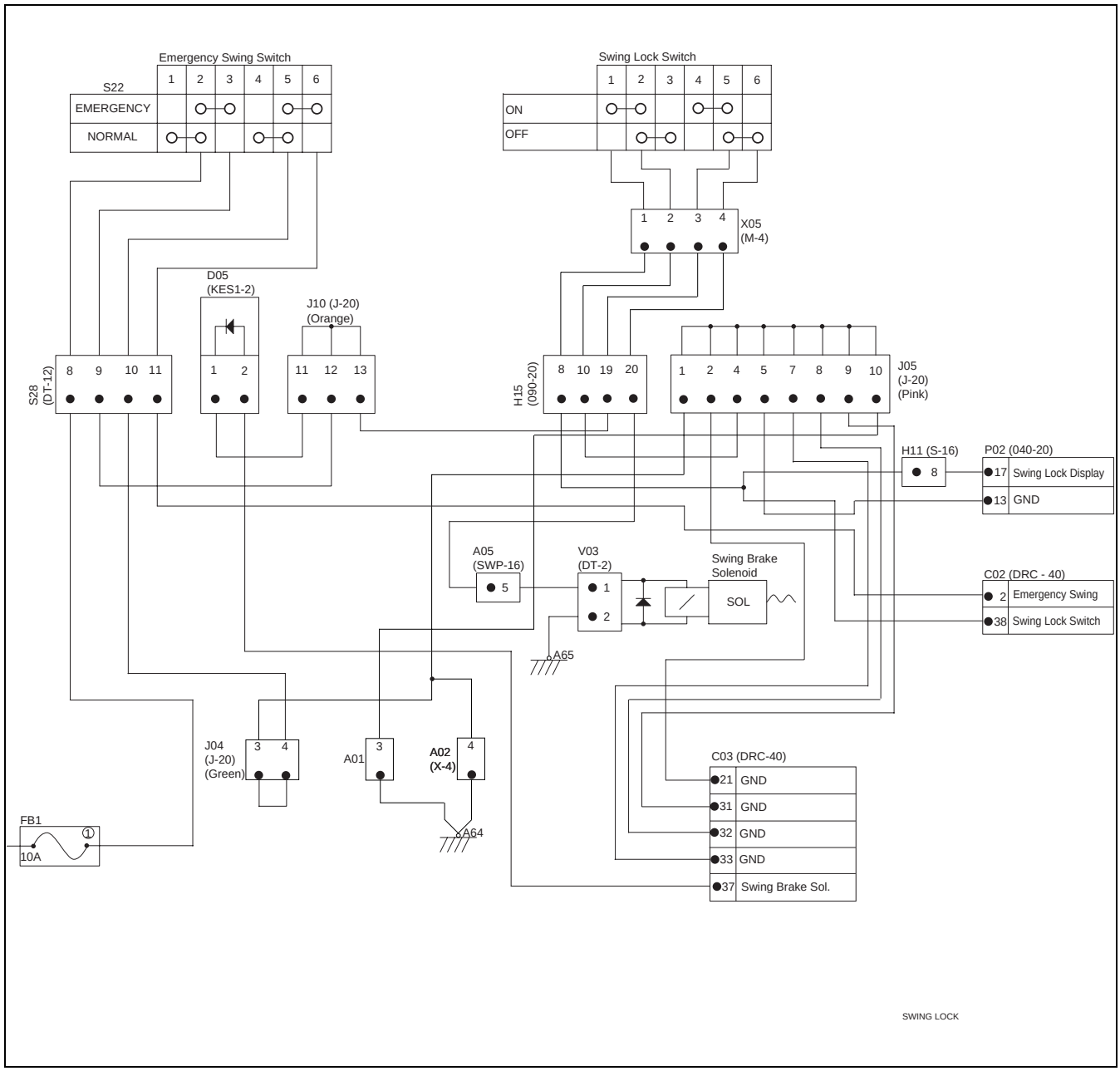
Circuit Diagram for Horn



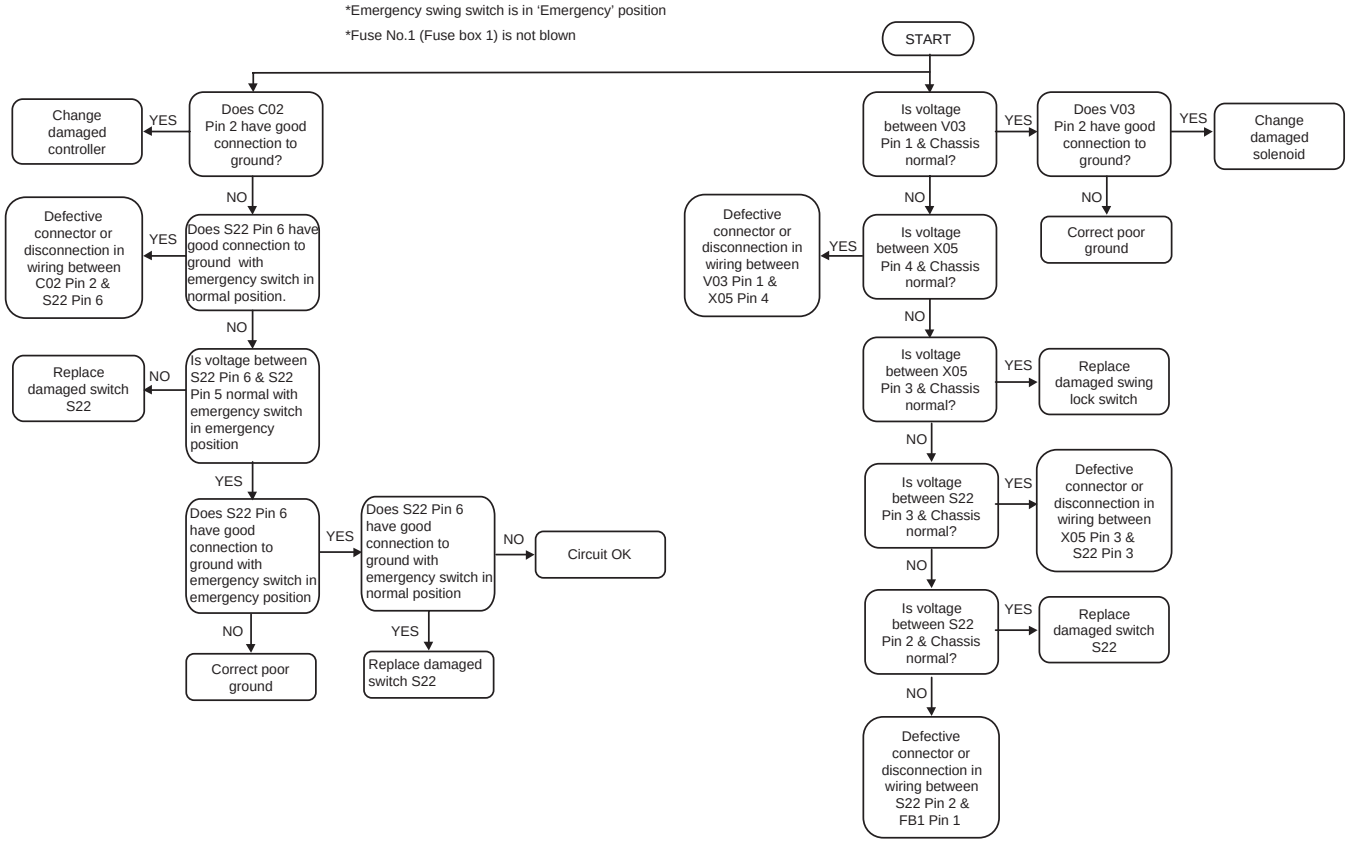
Swing Lock - Normal Operation



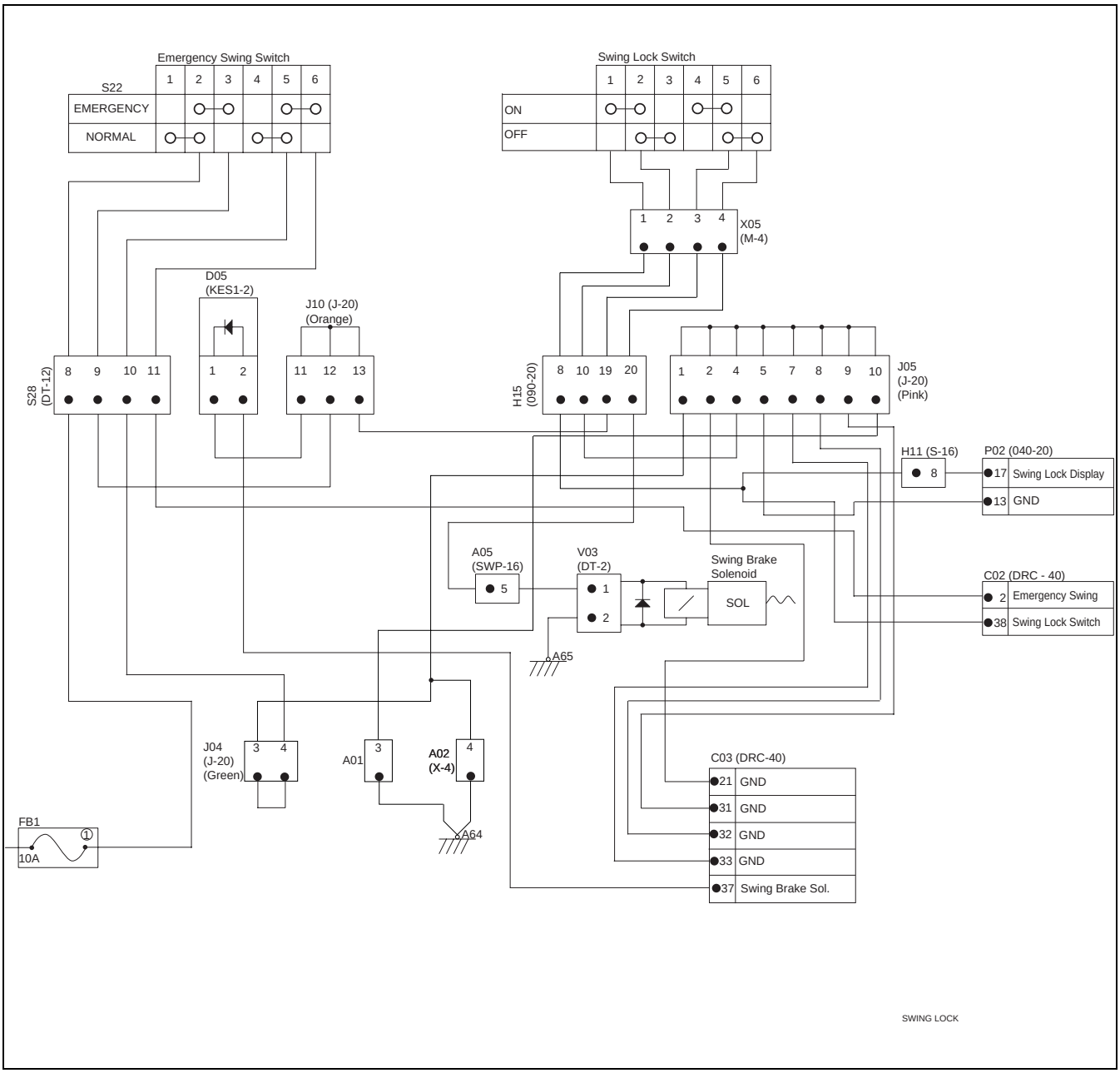
Circuit Diagram for Swing Lock



Swing Lock - Emergency Operation

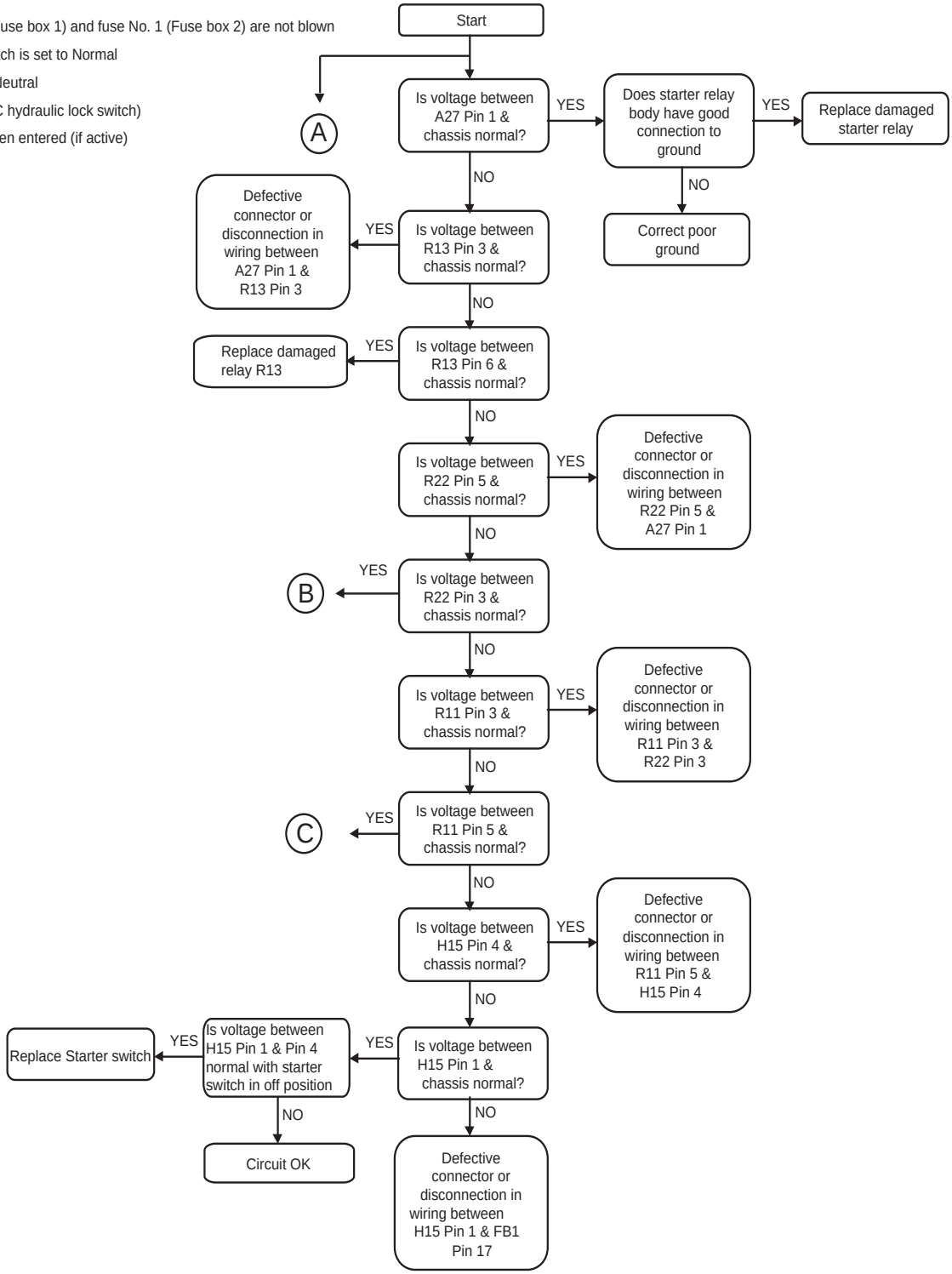


Circuit Diagram for Swing Lock - Emergency Operation

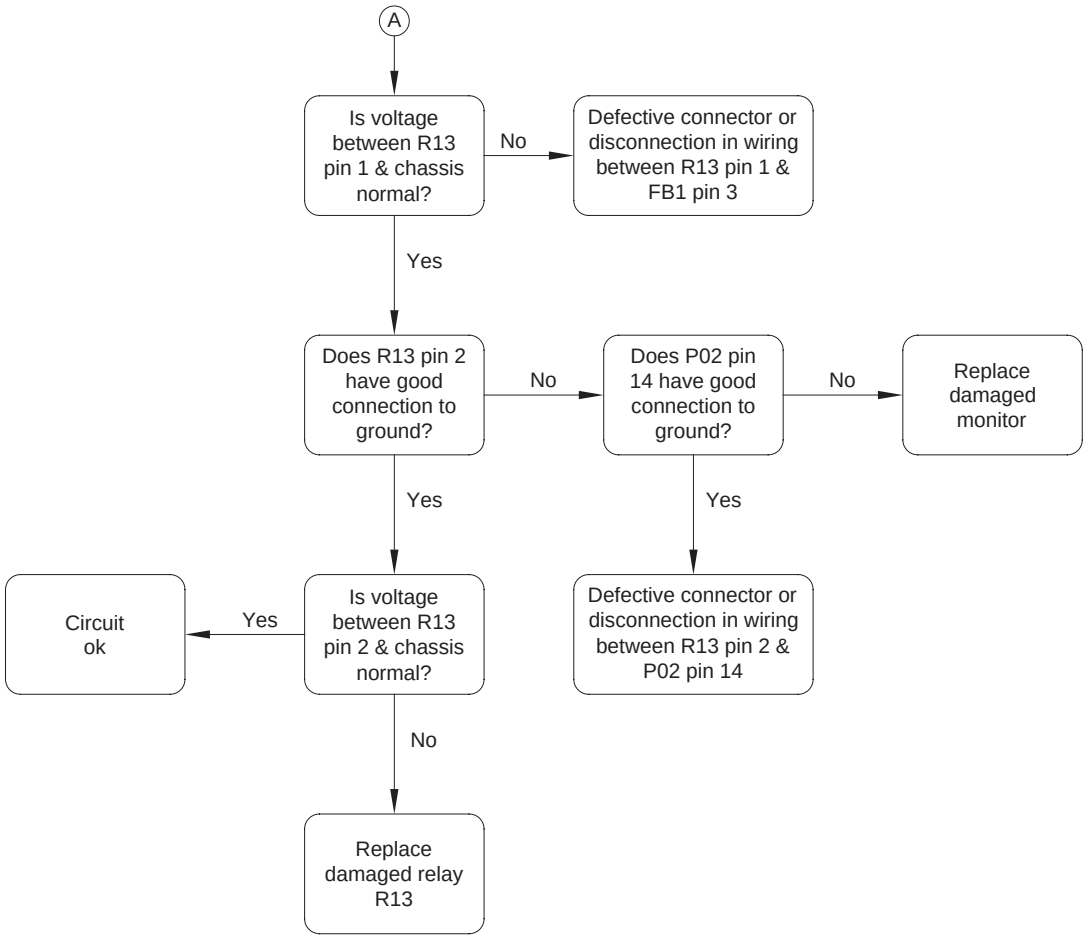


Neutral Start (Engine)

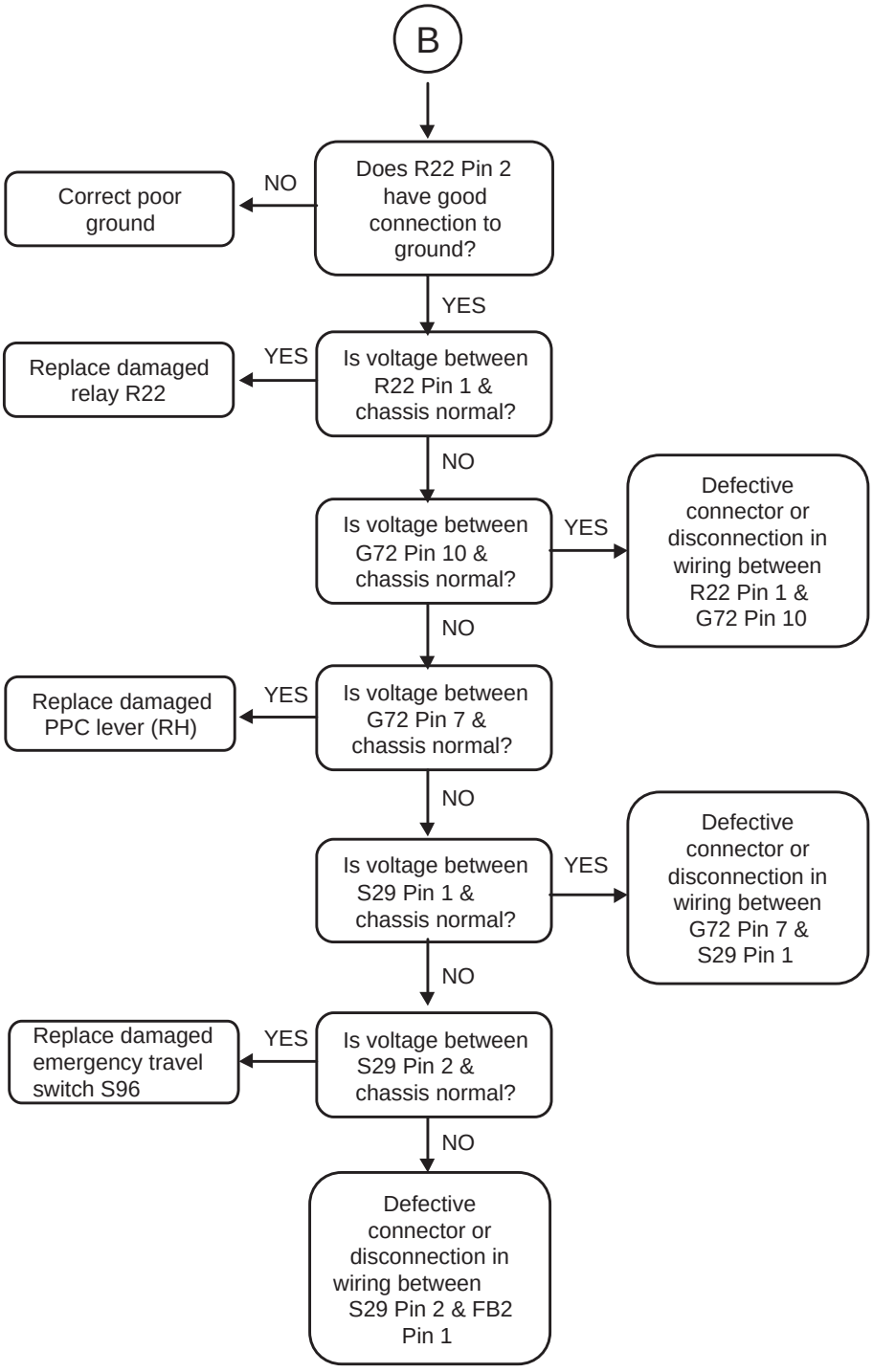
*When Fuses No.3, 15, 17 (Fuse box 1) and fuse No. 1 (Fuse box 2) are not blown
*When travel emergency switch is set to Normal
*When FNR switch is set to Neutral
*When LH pod is raised (PPC hydraulic lock switch)
*When personal code has been entered (if active)



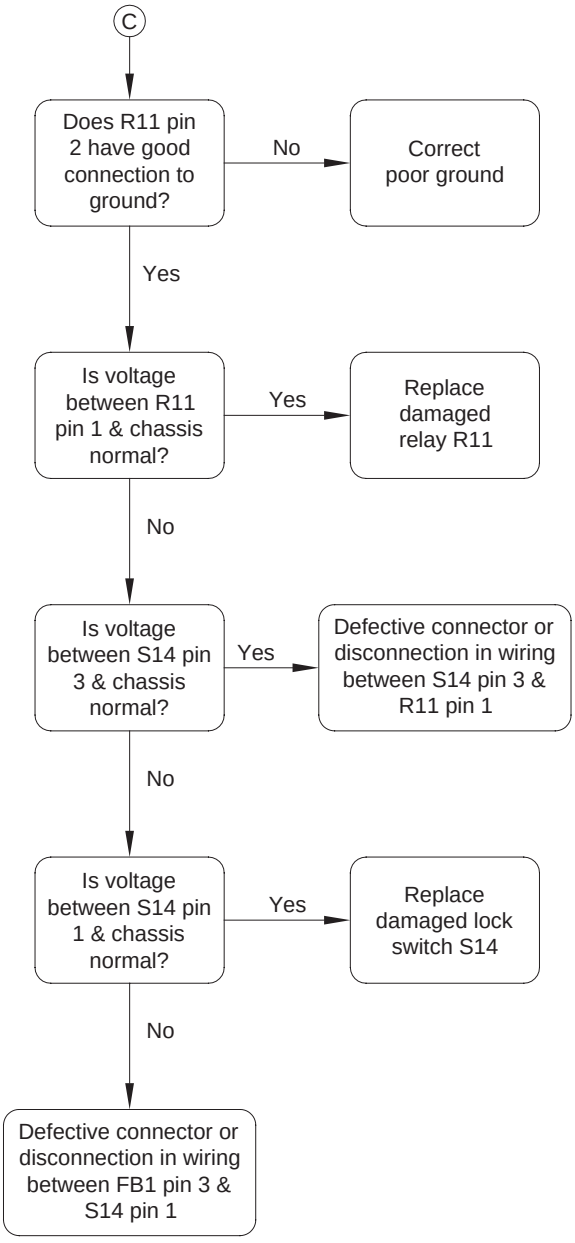
Neutral Start (Engine) cont'd (A)



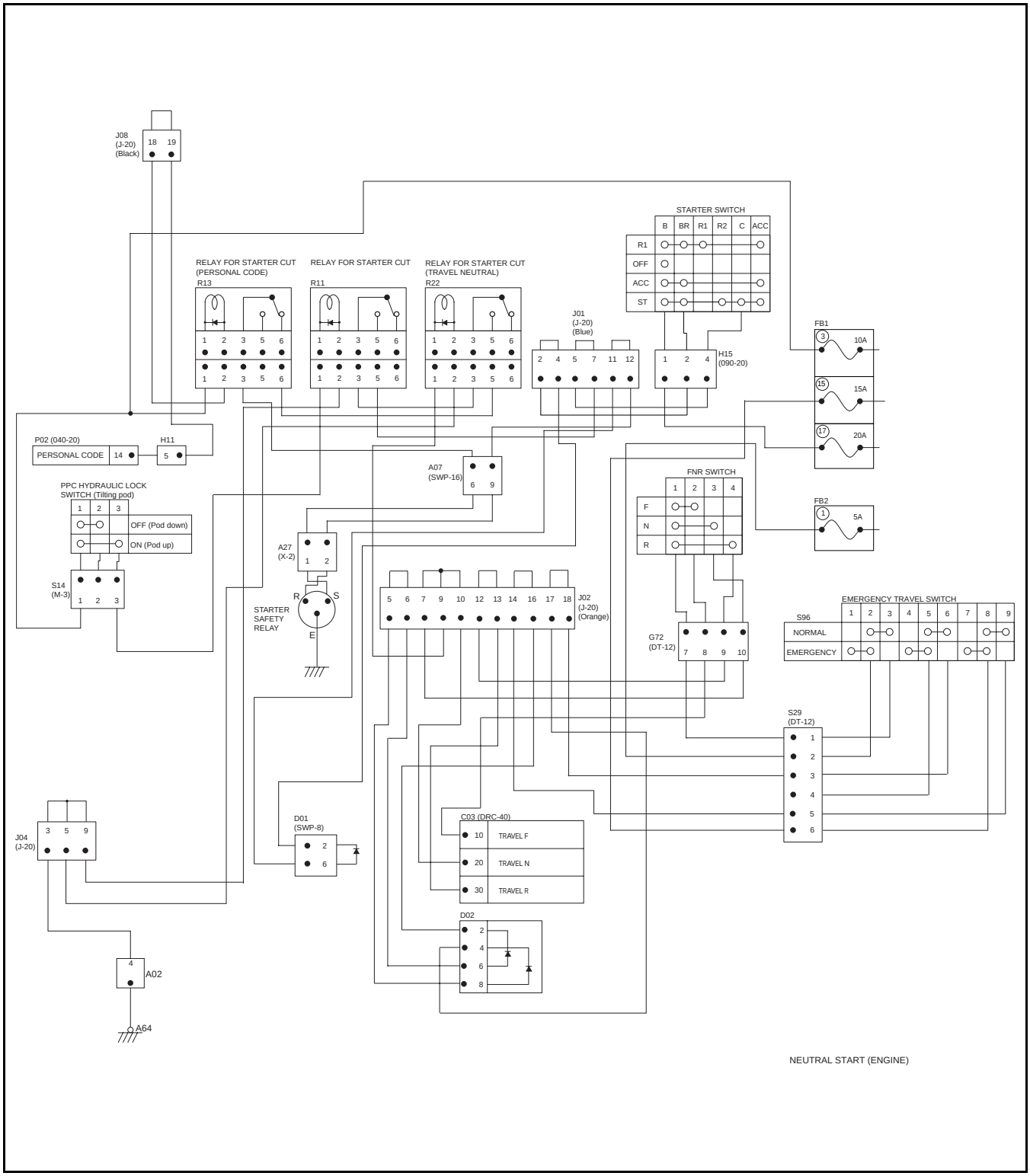
Neutral Start (Engine) cont'd (B)



Neutral Start (Engine) cont'd (C)



Circuit Diagram for Neutral Start (Engine)

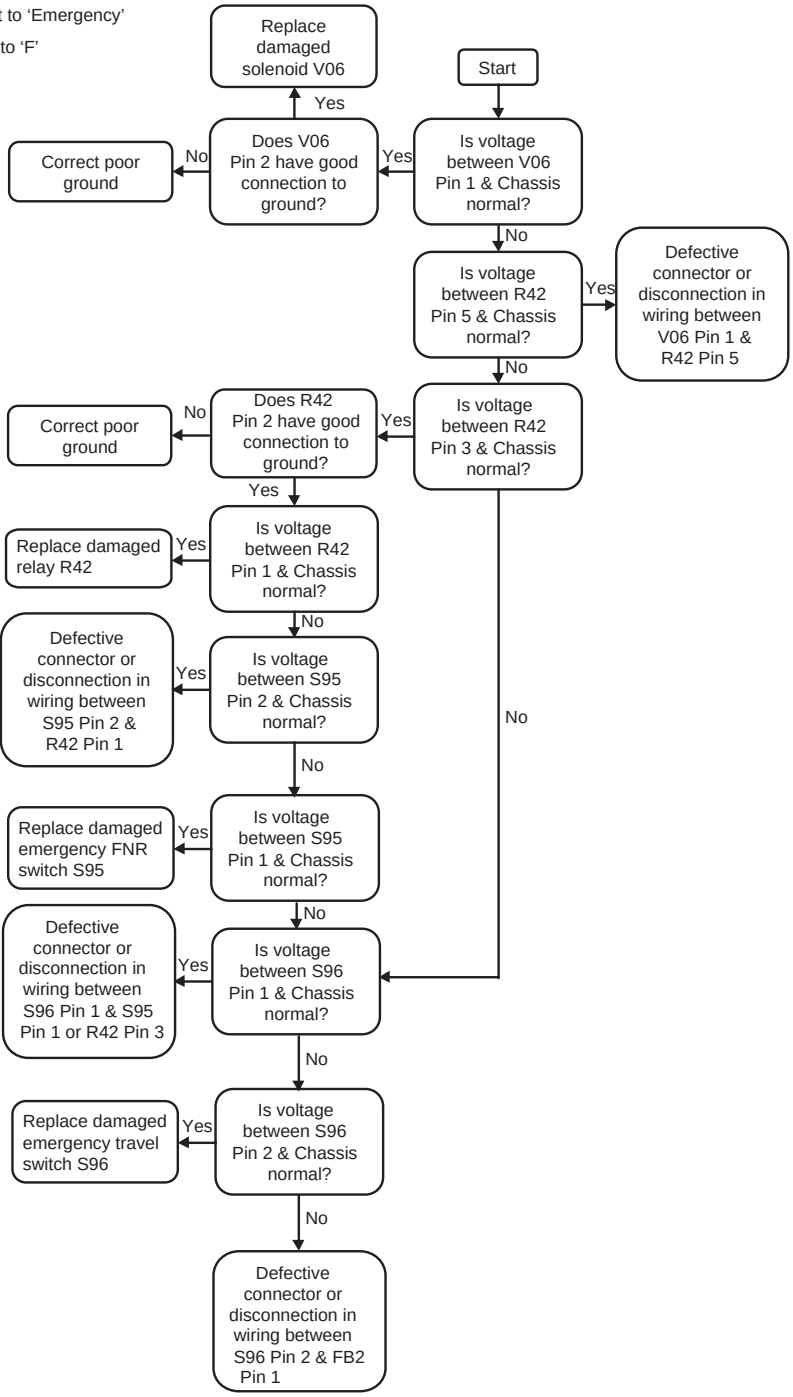


Emergency Travel Control - Forward

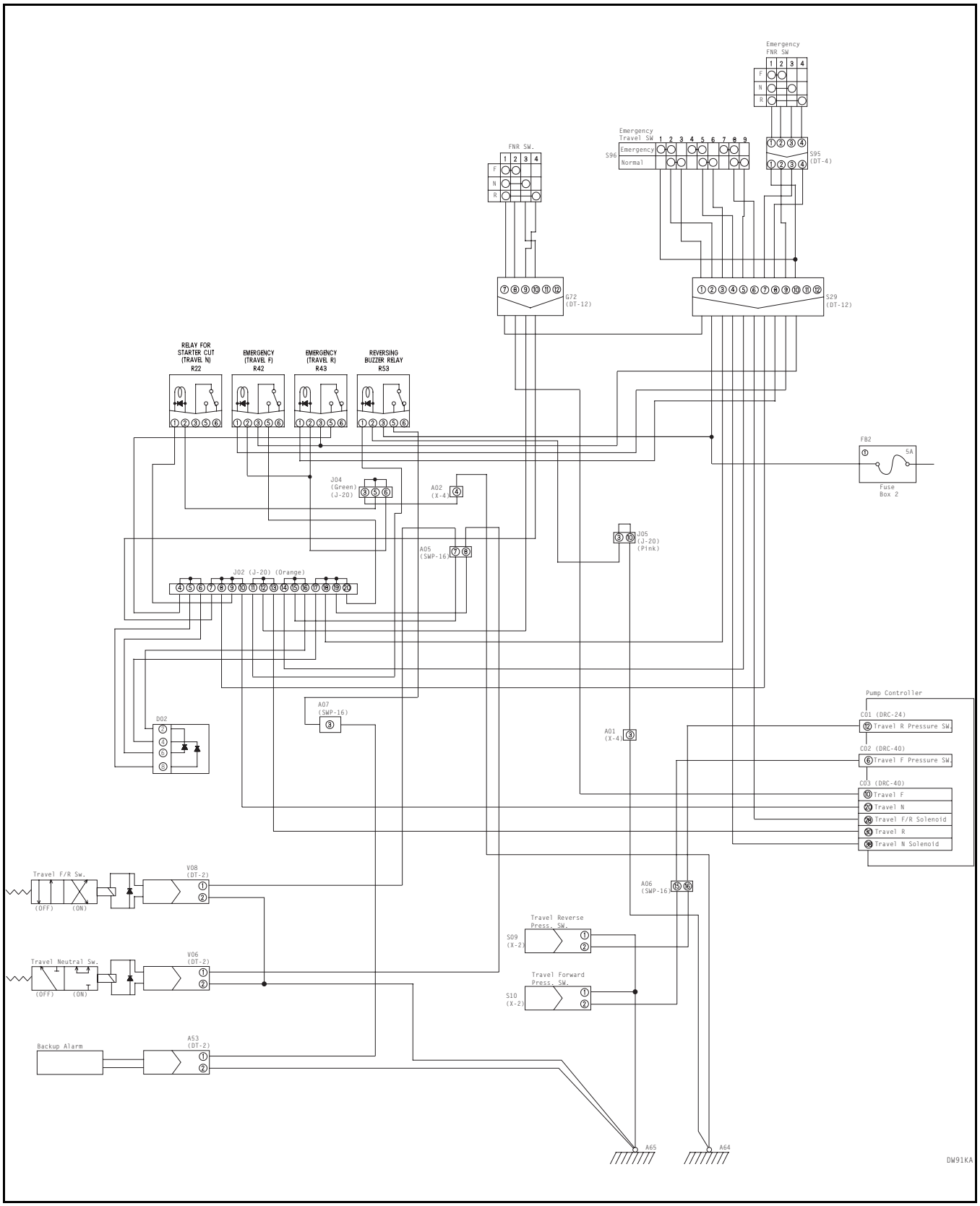
*When Fuse No. 1 (Fuse box 2) is not blown

*When emergency travel switch is set to 'Emergency'

*When emergency FNR switch is set to 'F'



Circuit Diagram for Travel Direction Control

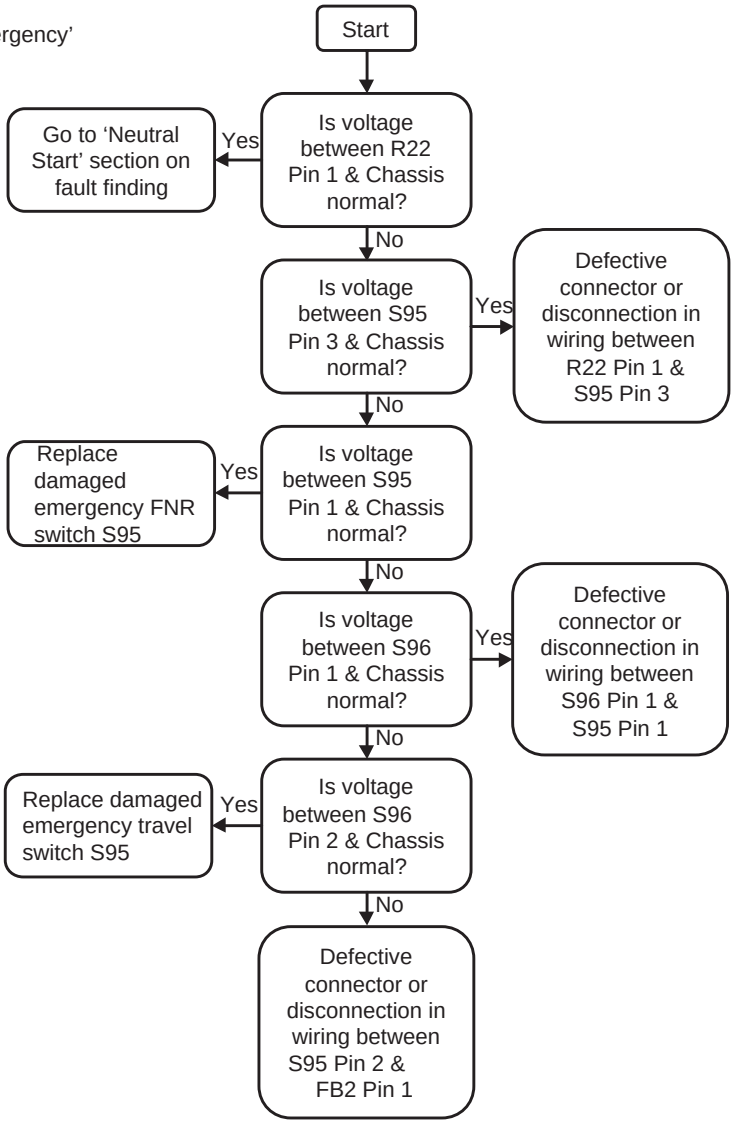


Emergency Travel Control - Neutral

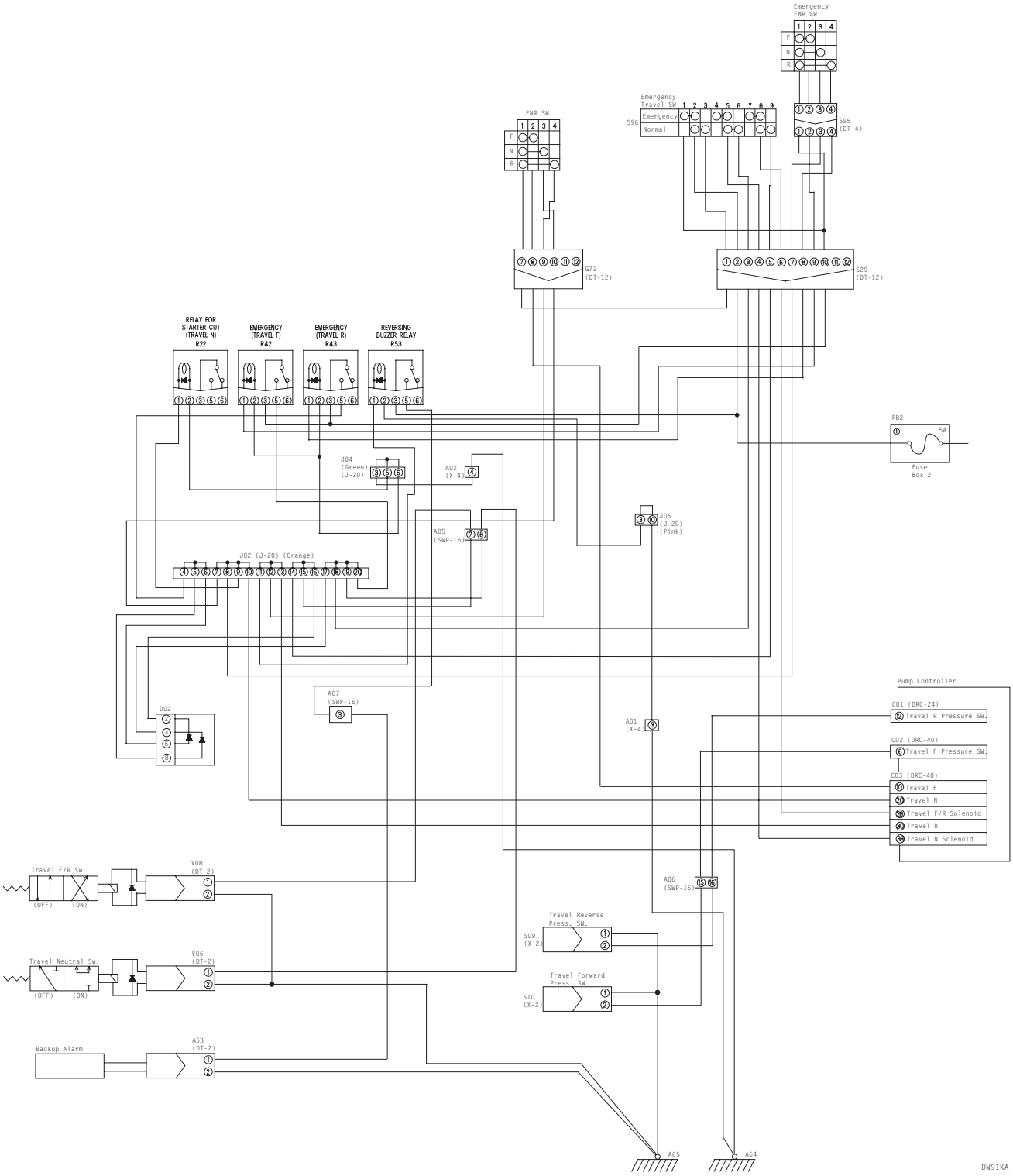
*When Fuse No. 1 (Fuse box 2) is not blown

When emergency travel switch is set to ‘Emergency’

*When emergency FNR switch is set to ‘N’



Circuit Diagram for Travel Direction Control

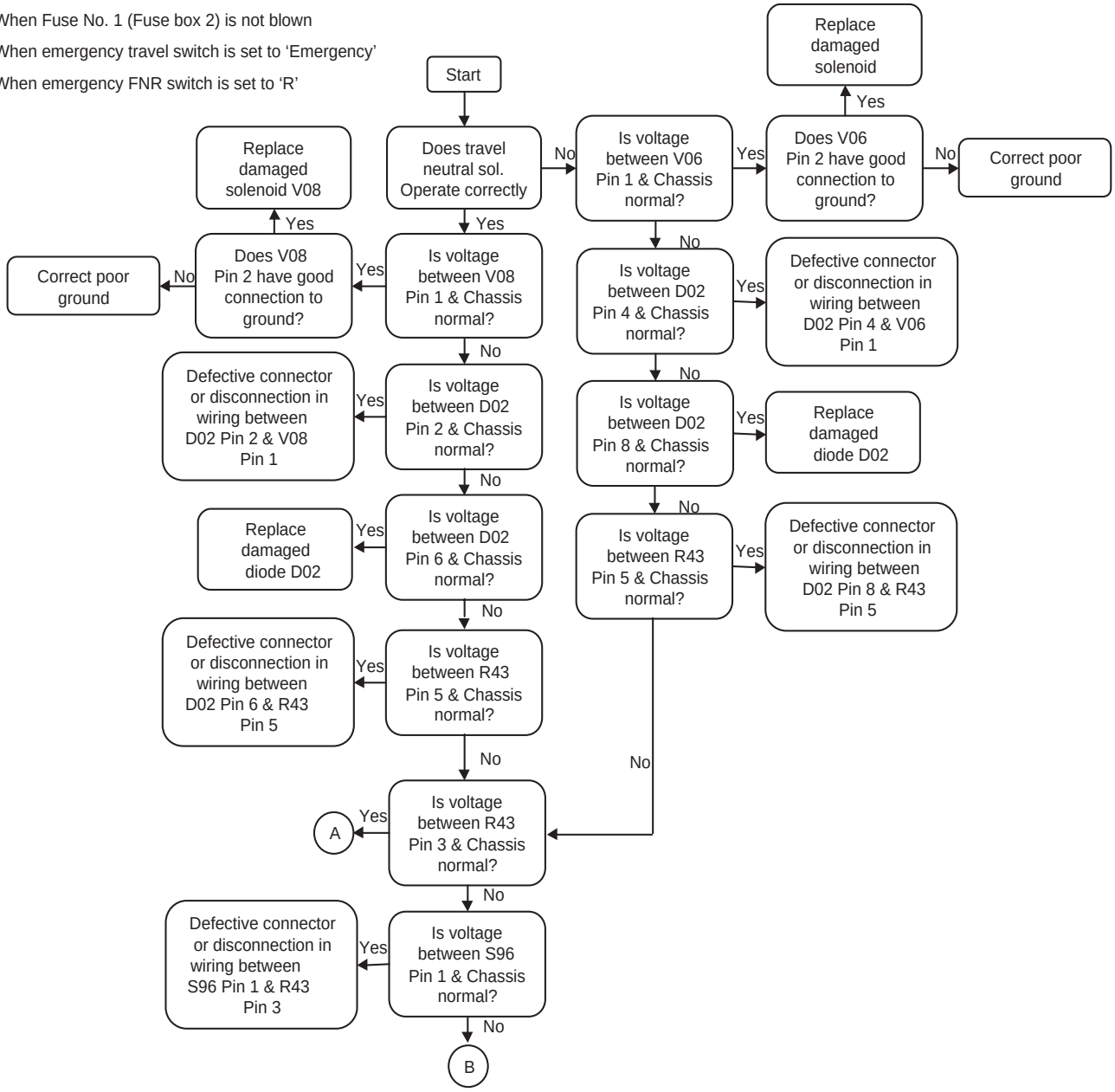


Emergency Travel Control - Reverse

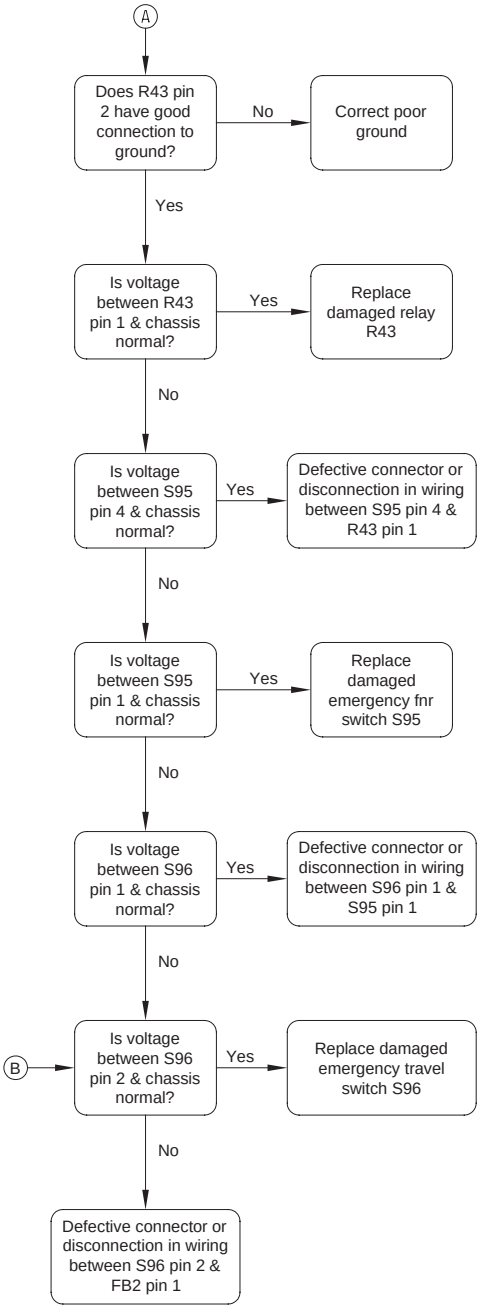
*When Fuse No. 1 (Fuse box 2) is not blown

*When emergency travel switch is set to 'Emergency'

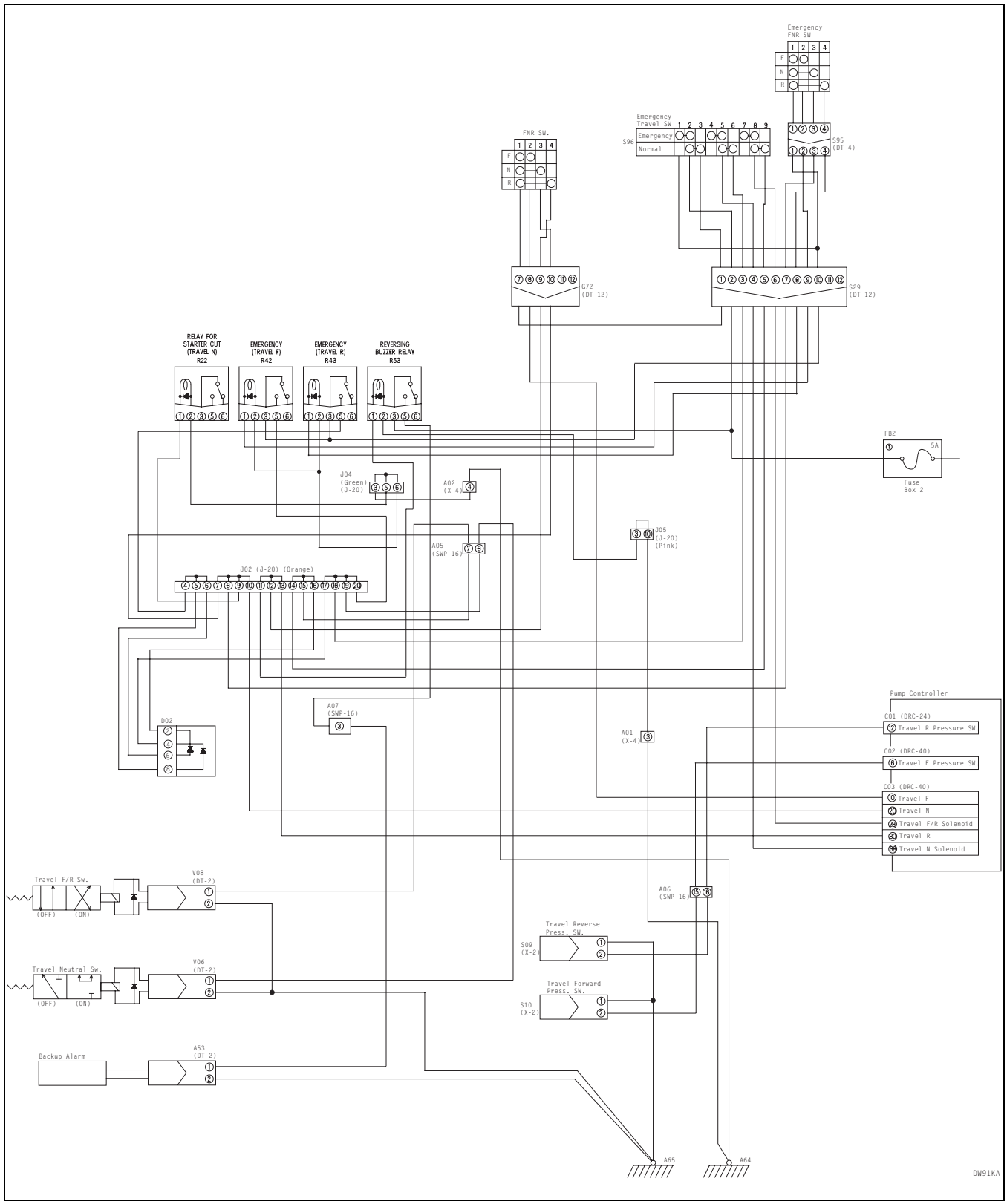
*When emergency FNR switch is set to 'R'



Emergency Travel Control - Reverse cont'd



Circuit Diagram for Travel Direction Control

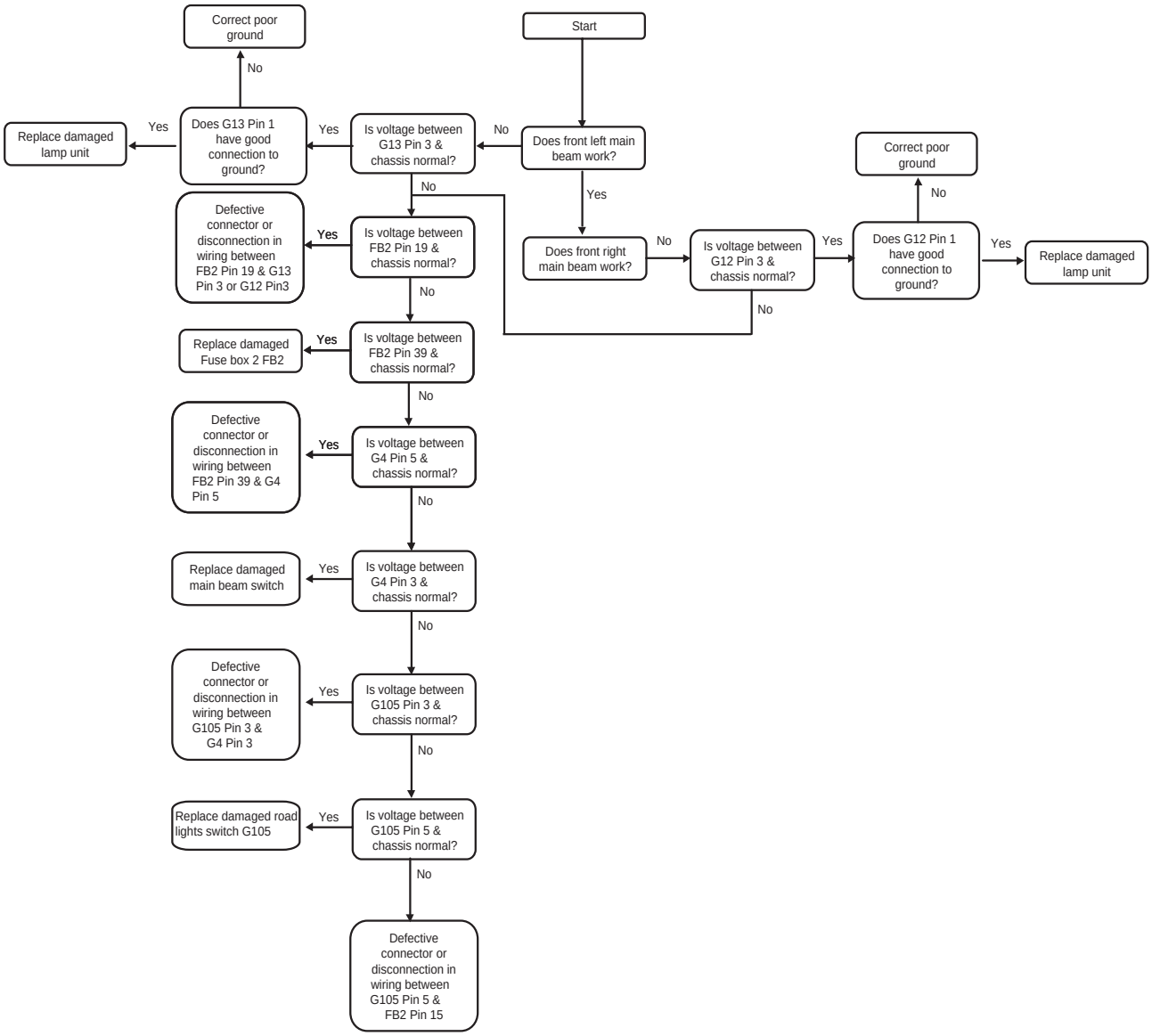


Driving Lights - Main Beam

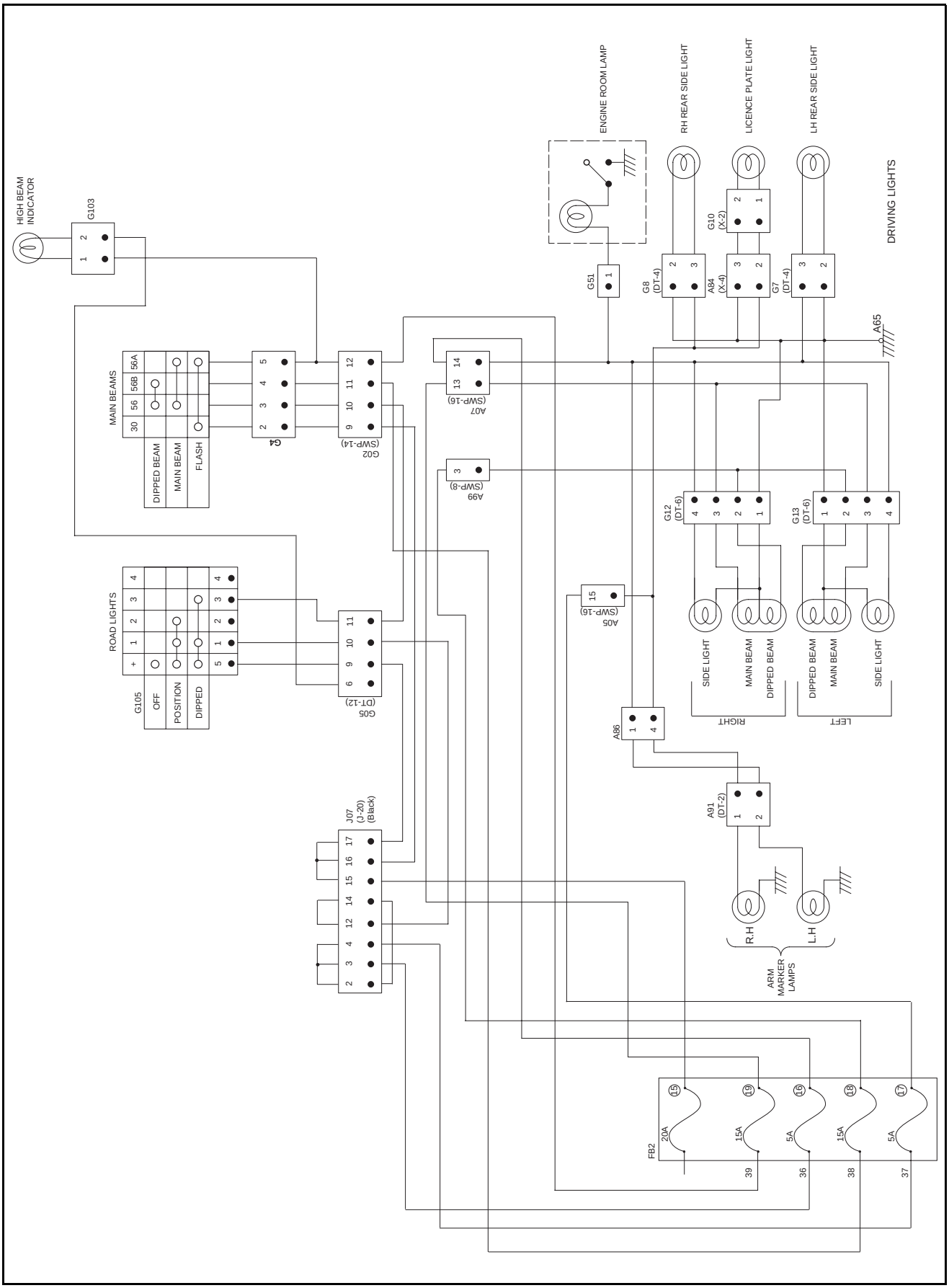
*Standard notes

*When fuse No.15 & 19 (Fuse box 2) are not blown

*When bulbs are fitted correctly and fully functional



Circuit Diagram for Driving Lights

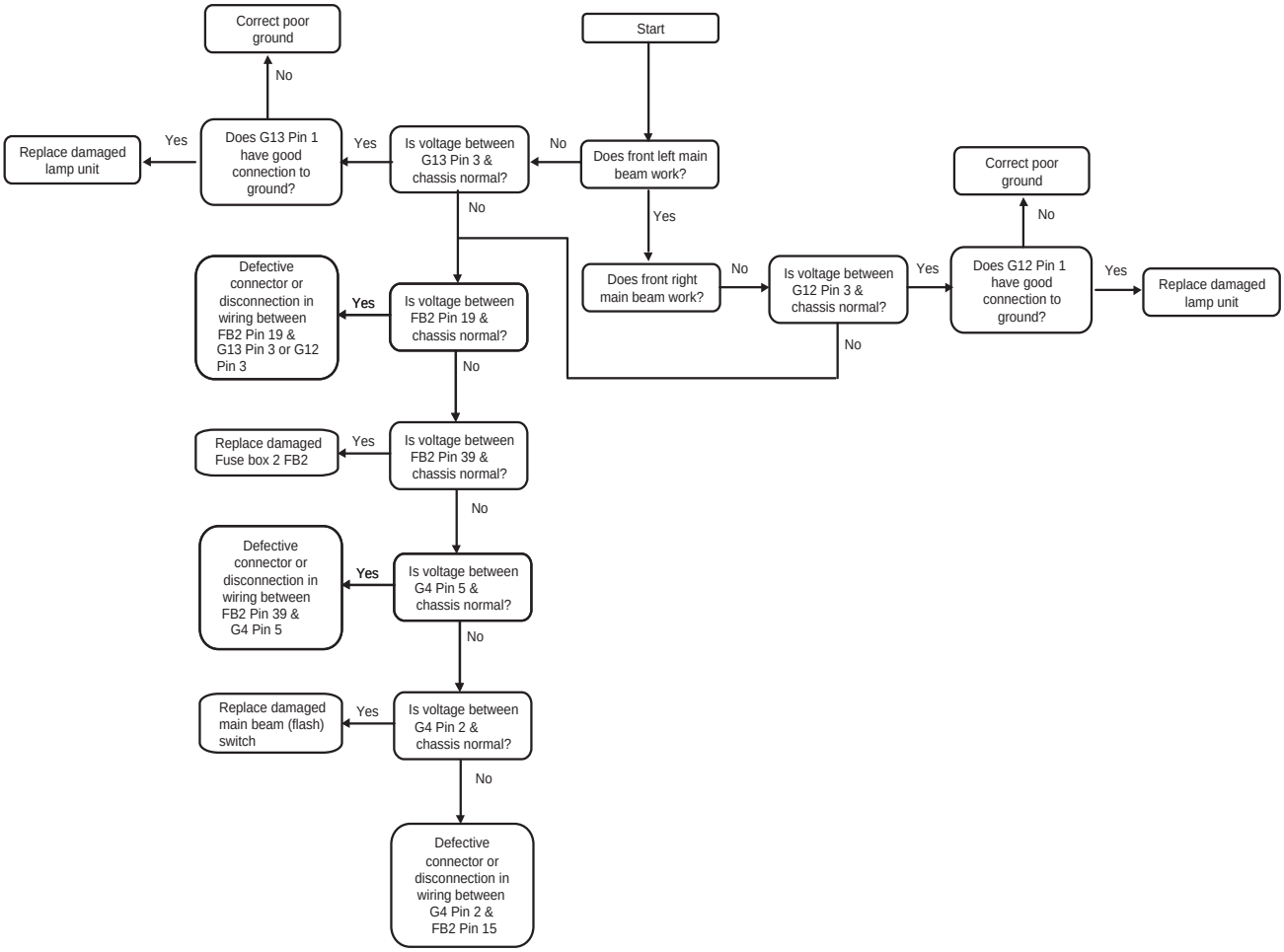


Driving Lights - Main Beam Flash

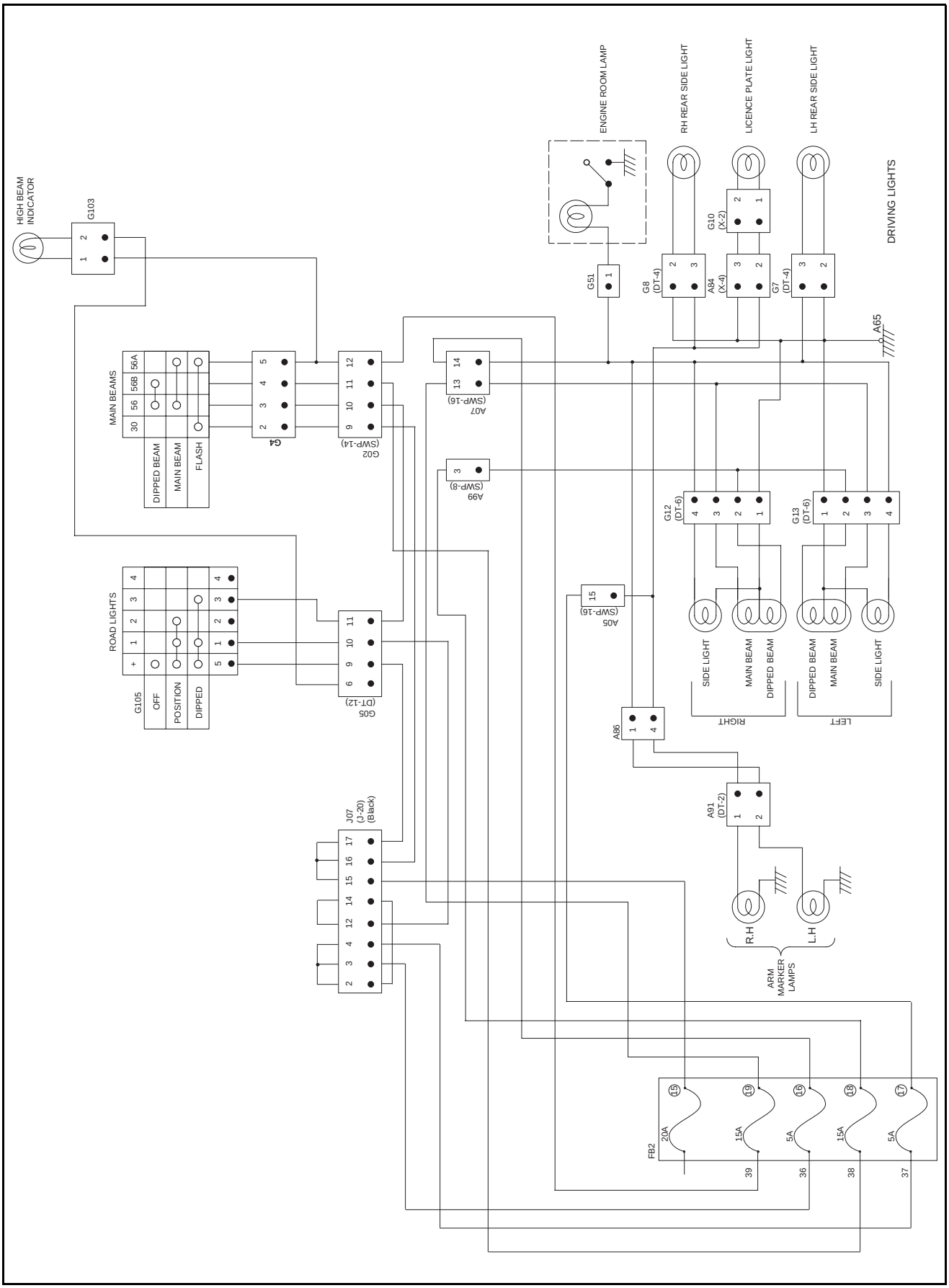
*Standard notes

*When fuse No.15 & 19 (Fuse box 2) are not blown

*When bulbs are fitted correctly and fully functional



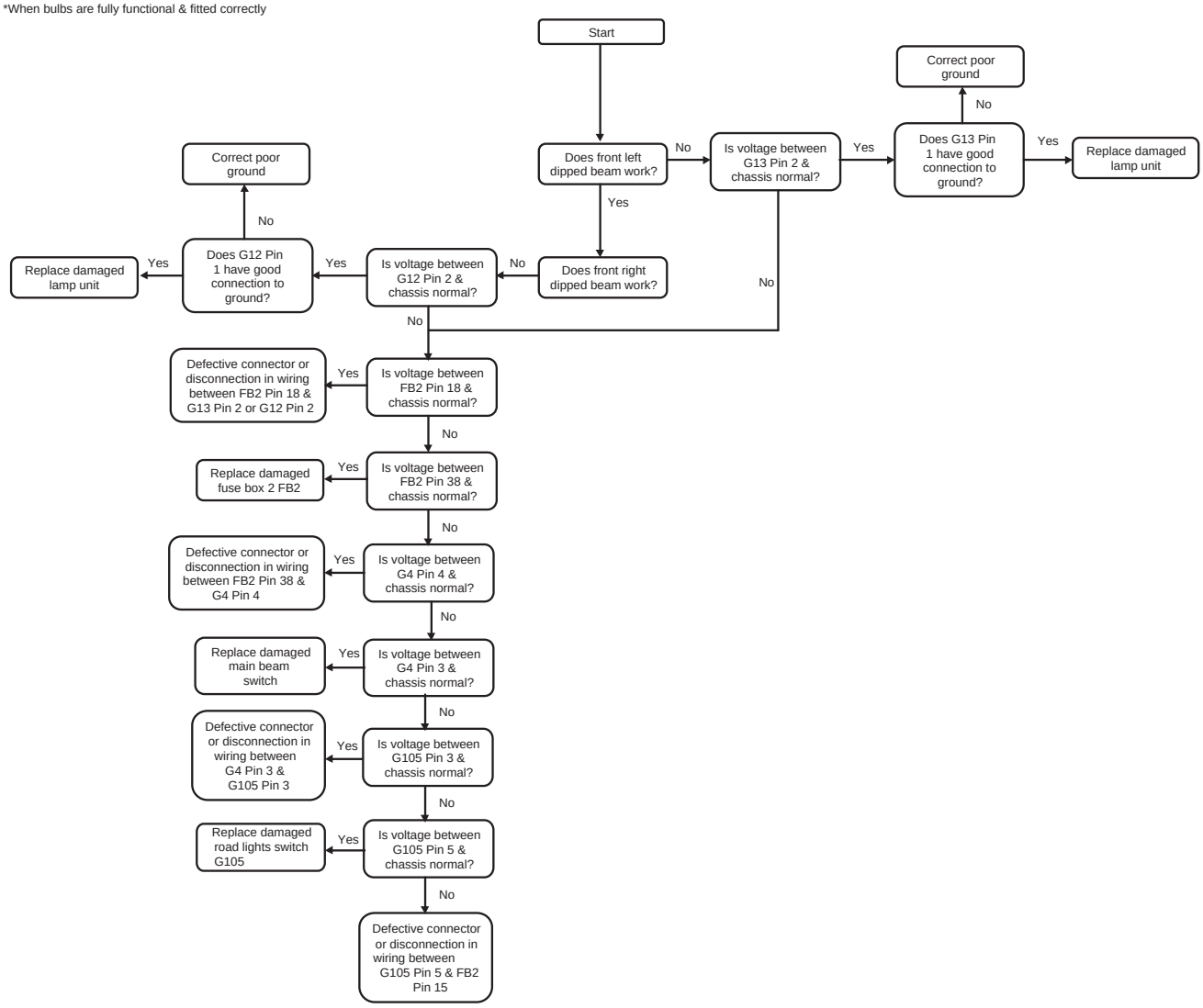
Circuit Diagram for Driving Lights



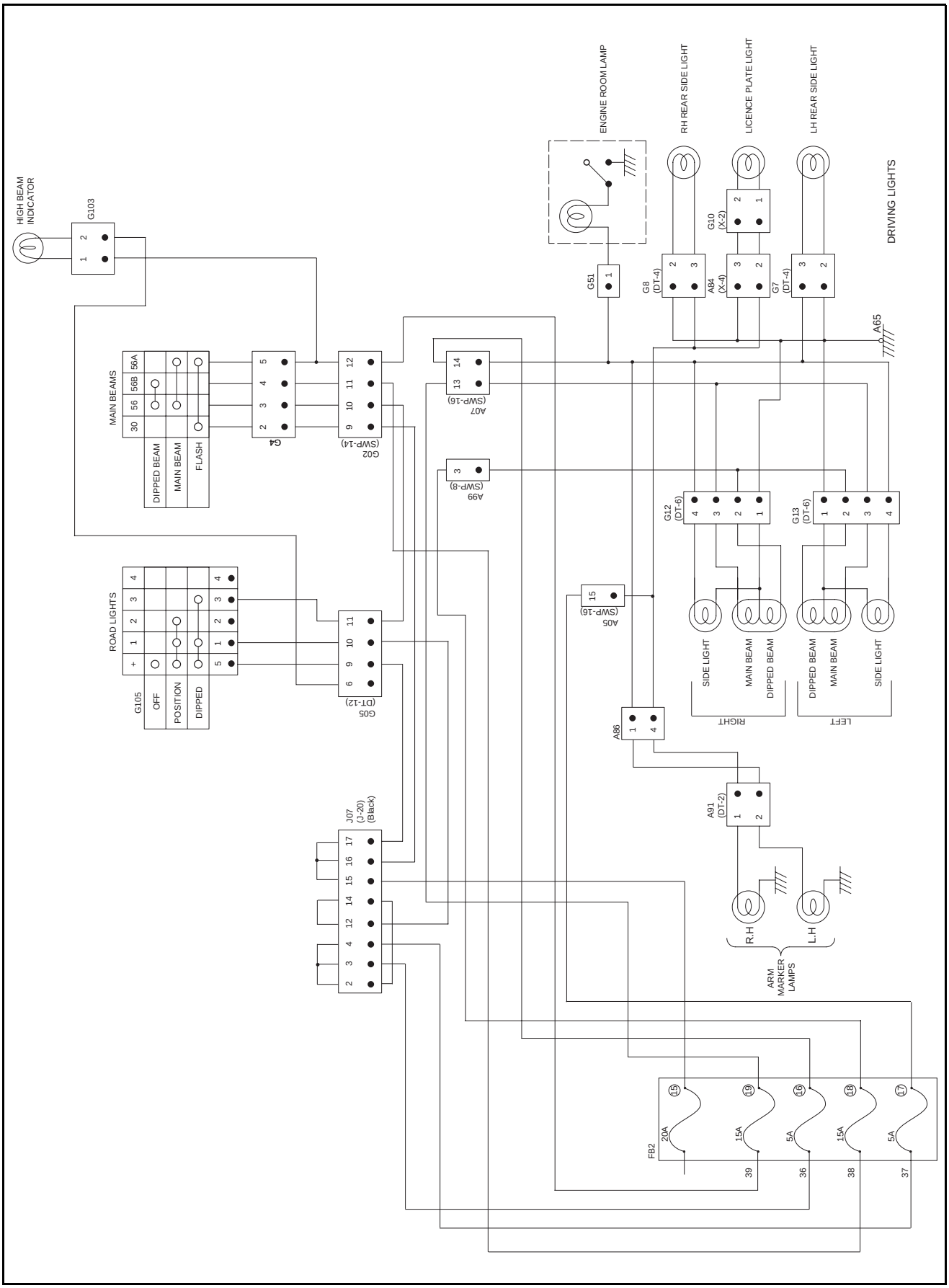
Driving Lights - Main Beam Dipped

*When Fuse No.15 & 18 (Fuse box 2) are not blown

*When bulbs are fully functional & fitted correctly



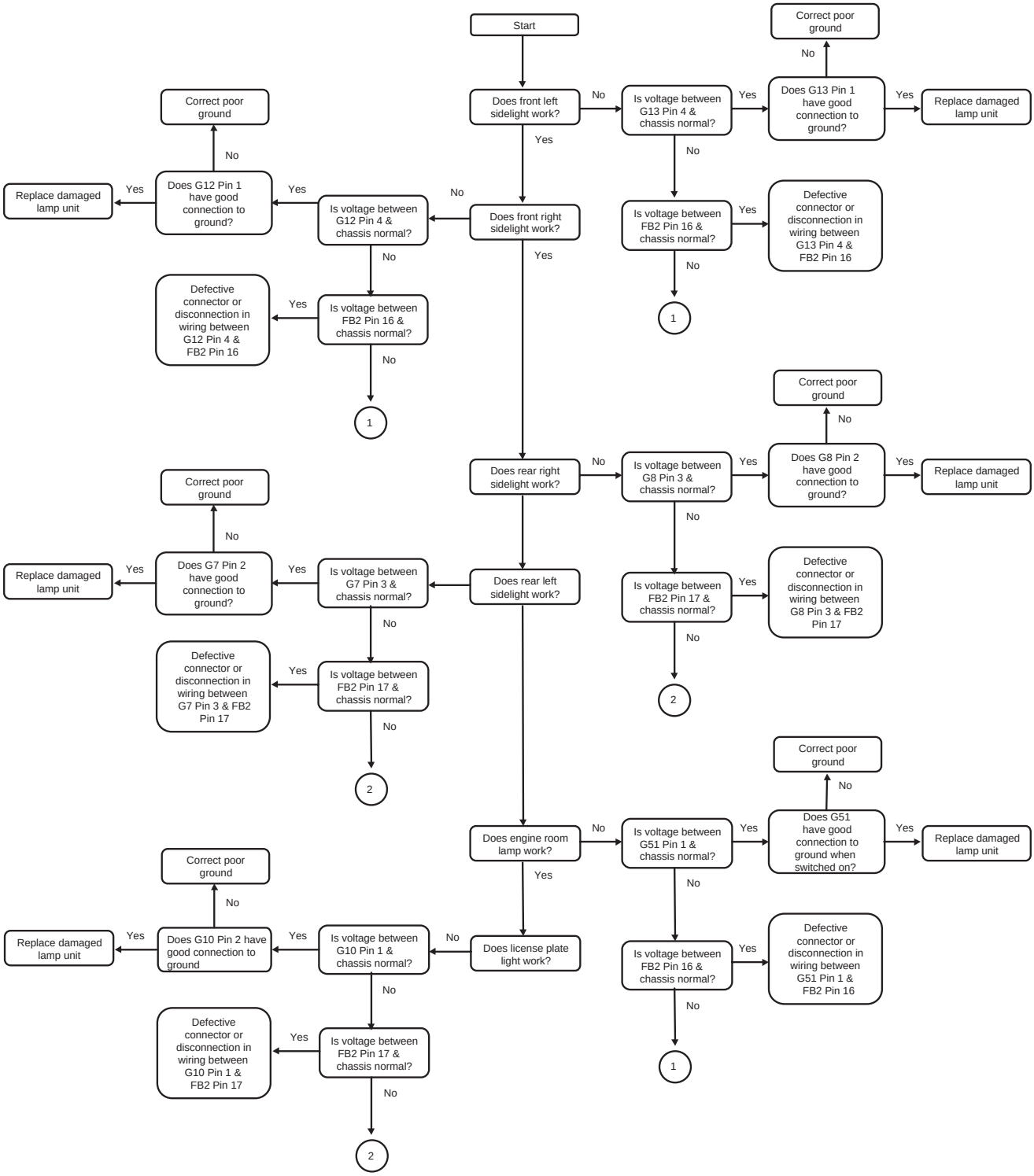
Circuit Diagram for Driving Lights



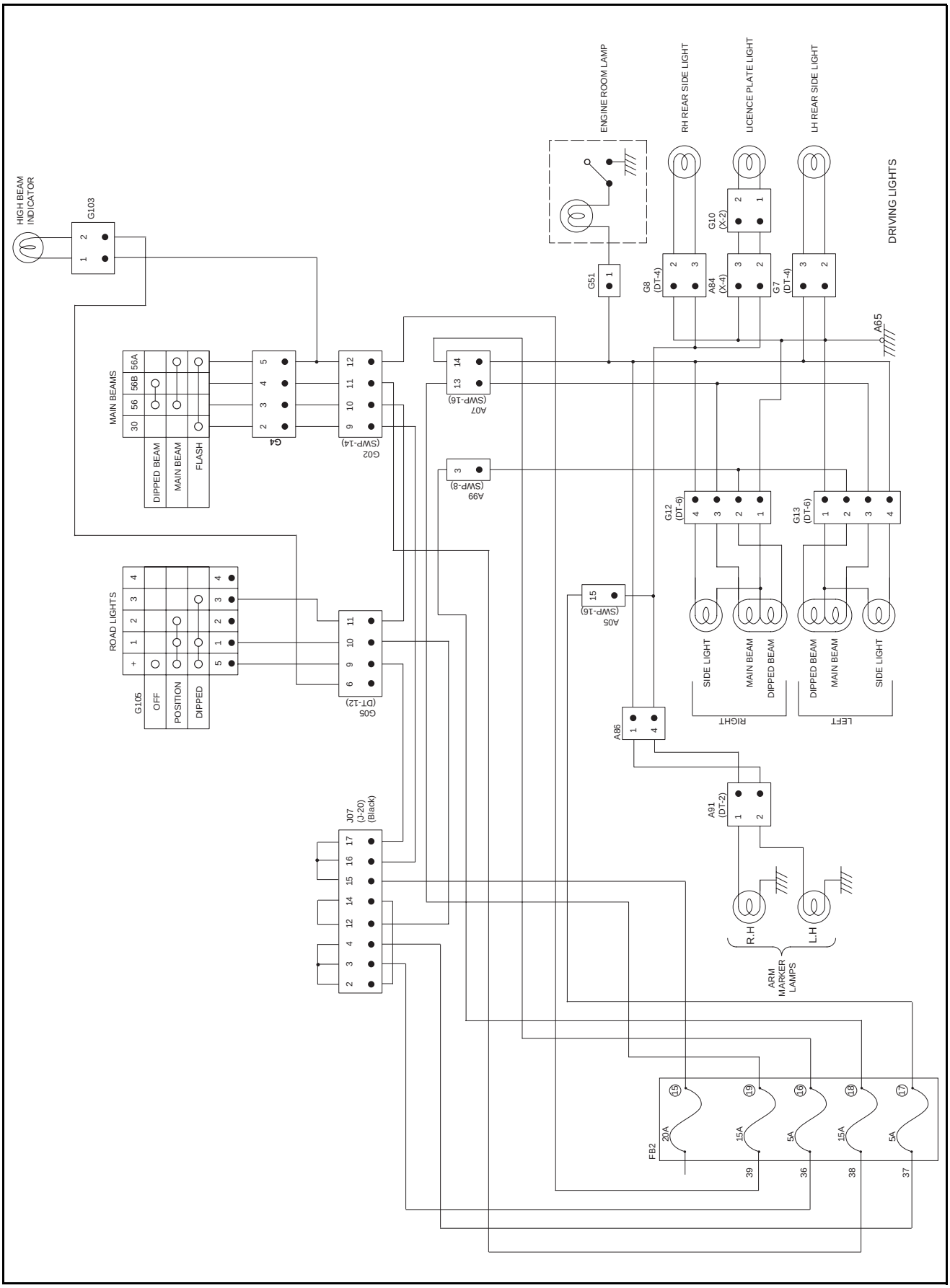
Driving Lights - Position Lights

*When fuse No.15 & 16 (Fuse box 2) are not blown

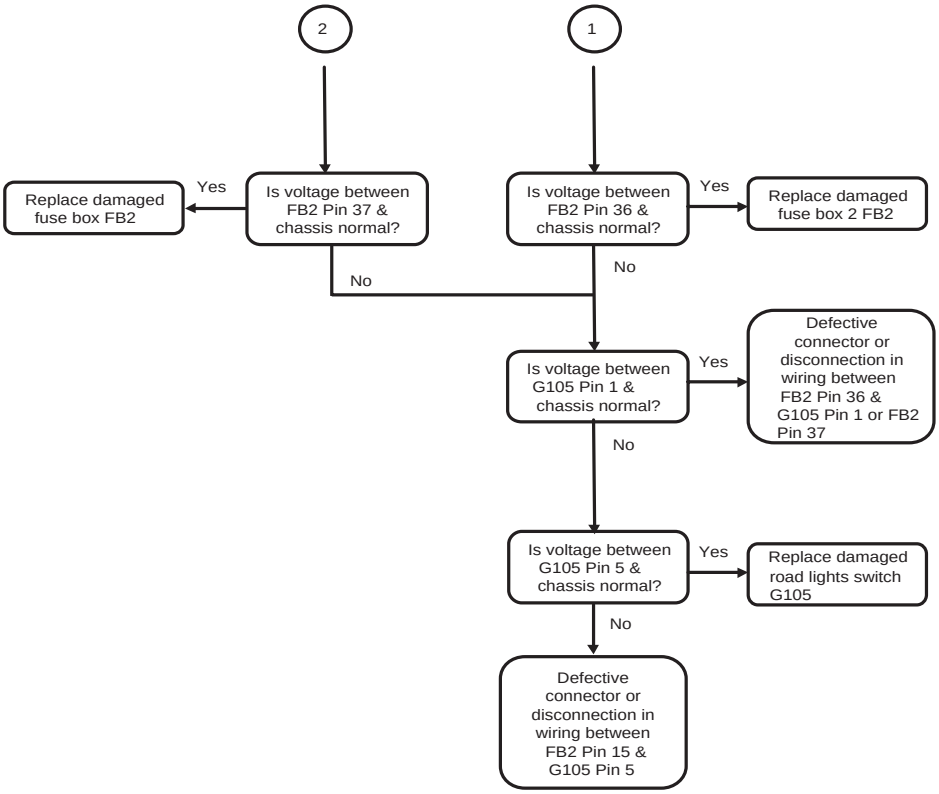
*When bulbs are fitted correctly and fully functional



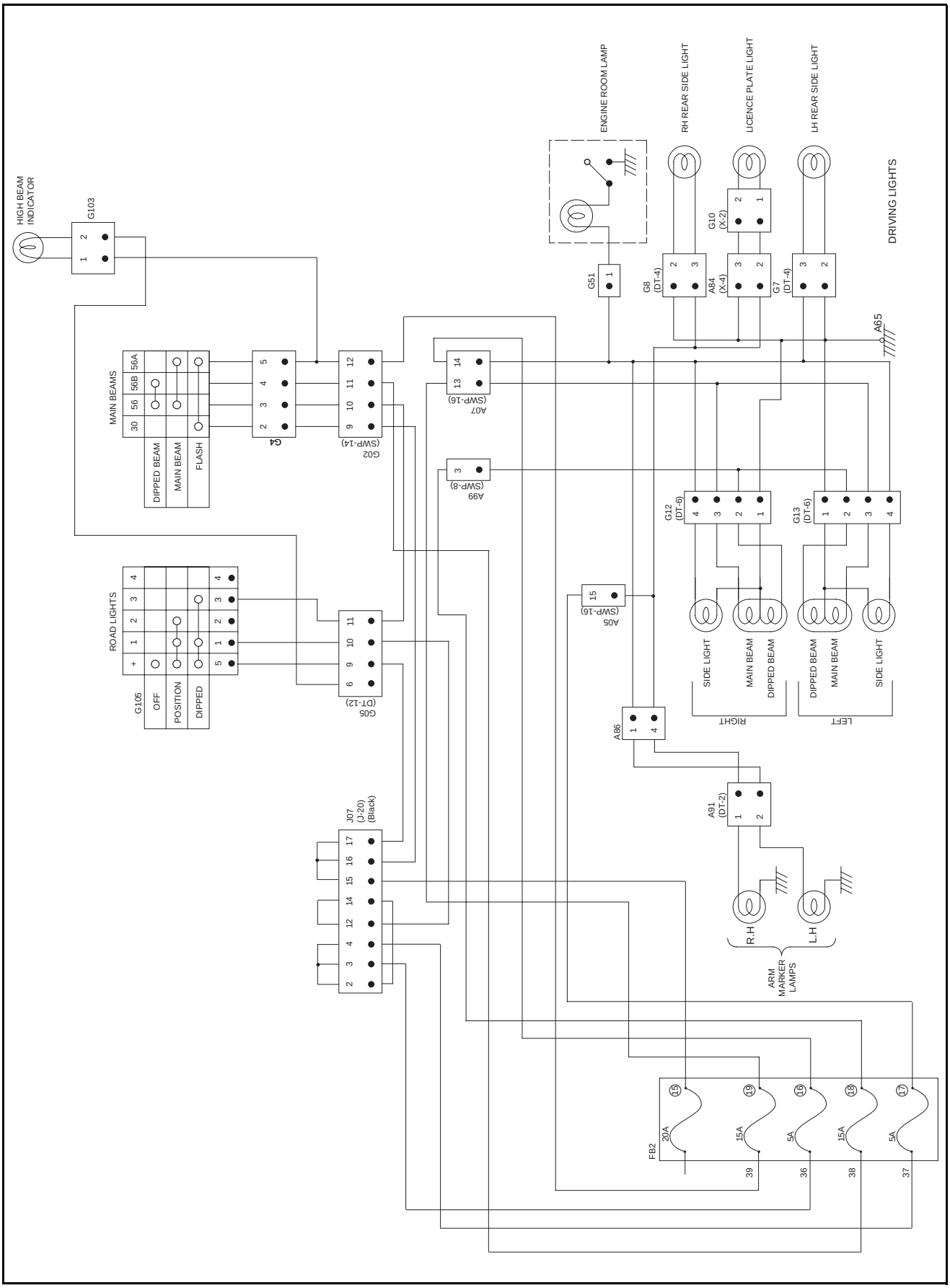
Circuit Diagram for Driving Lights



Driving Lights - Position Lights cont'd (1) and (2)



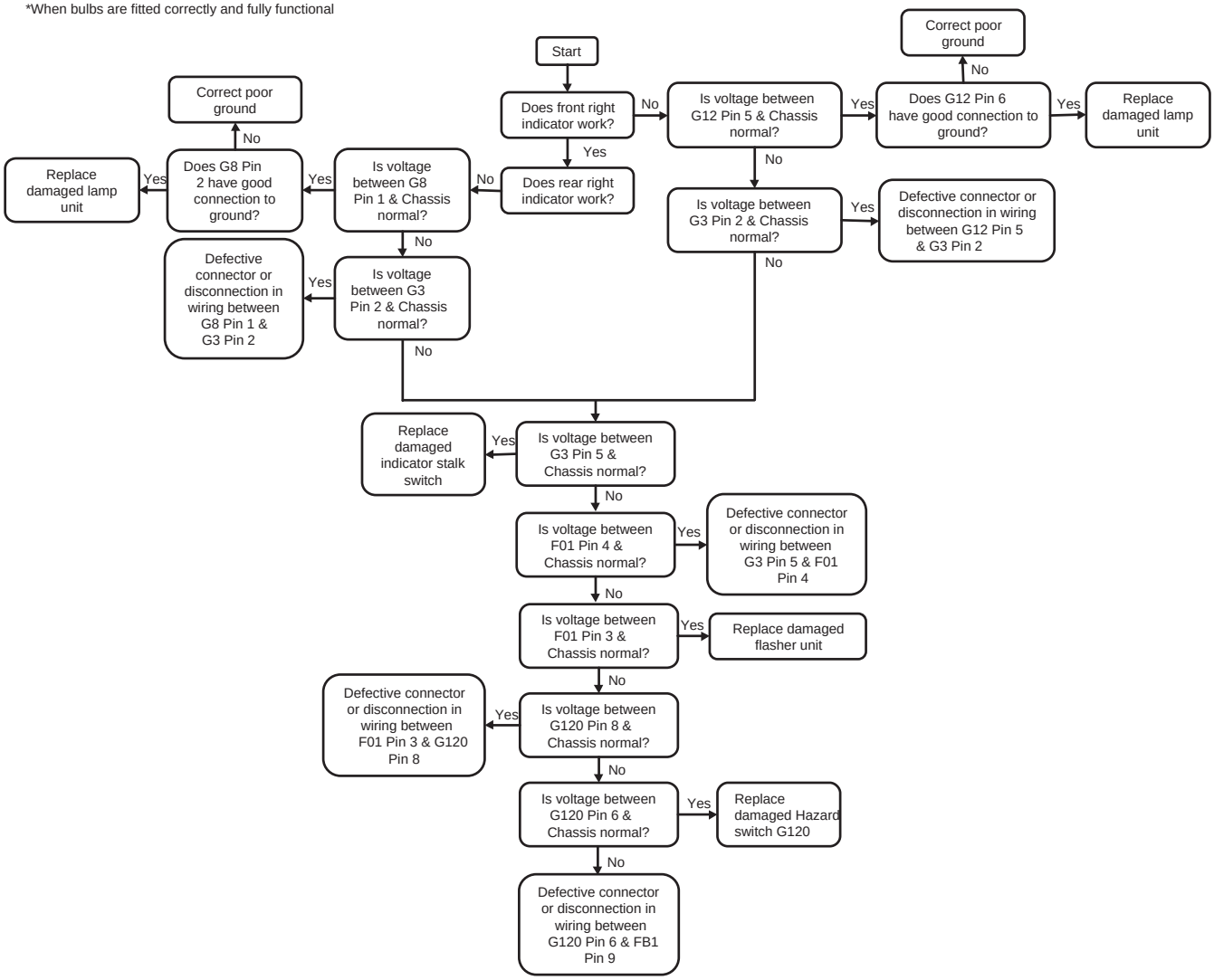
Circuit Diagram for Driving Lights



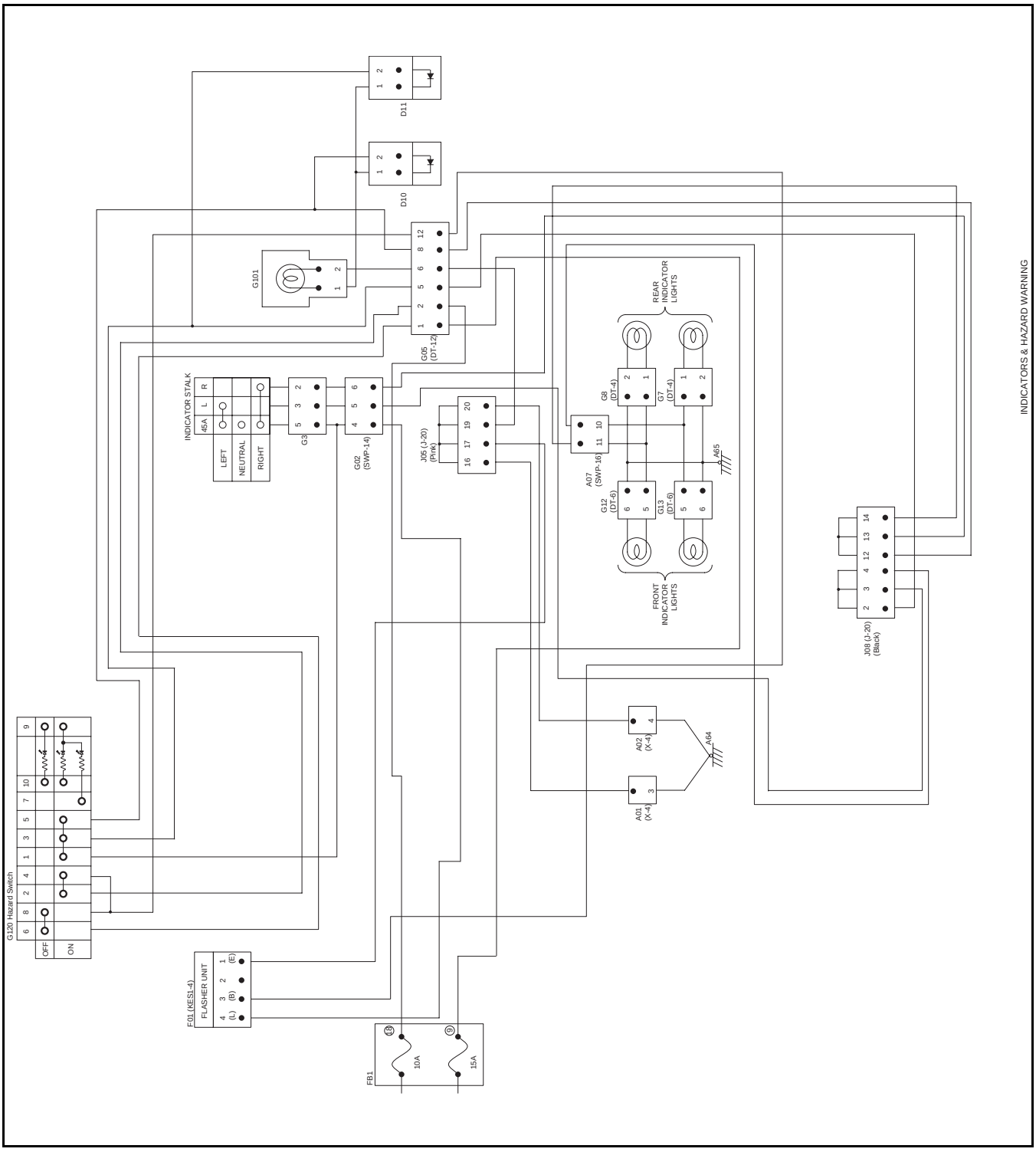
Indicators - Right Hand

*When Fuse No. 9 (Fuse box 1) is not blown

*When bulbs are fitted correctly and fully functional



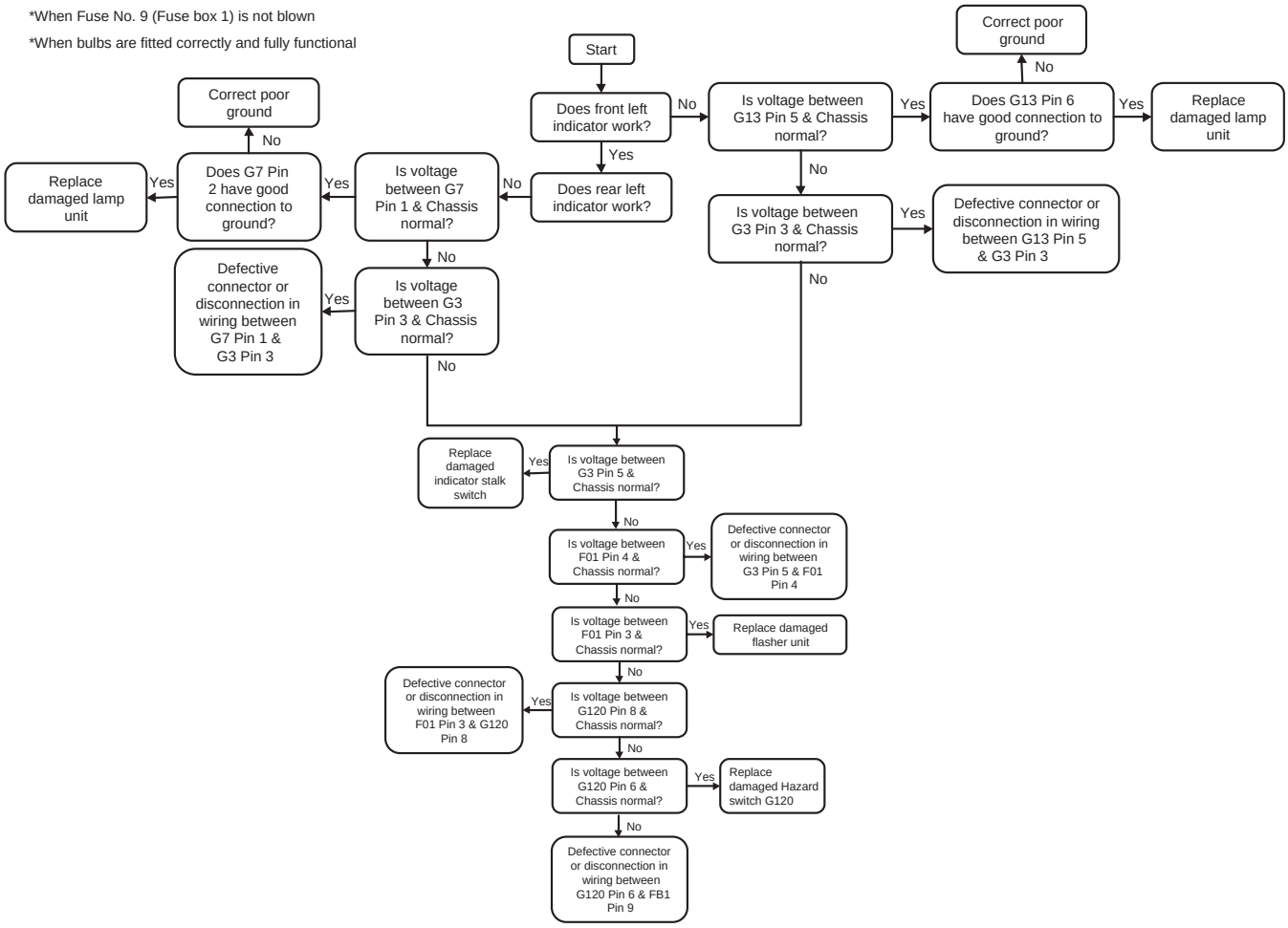
Circuit Diagram for Indicators & Hazard Warning



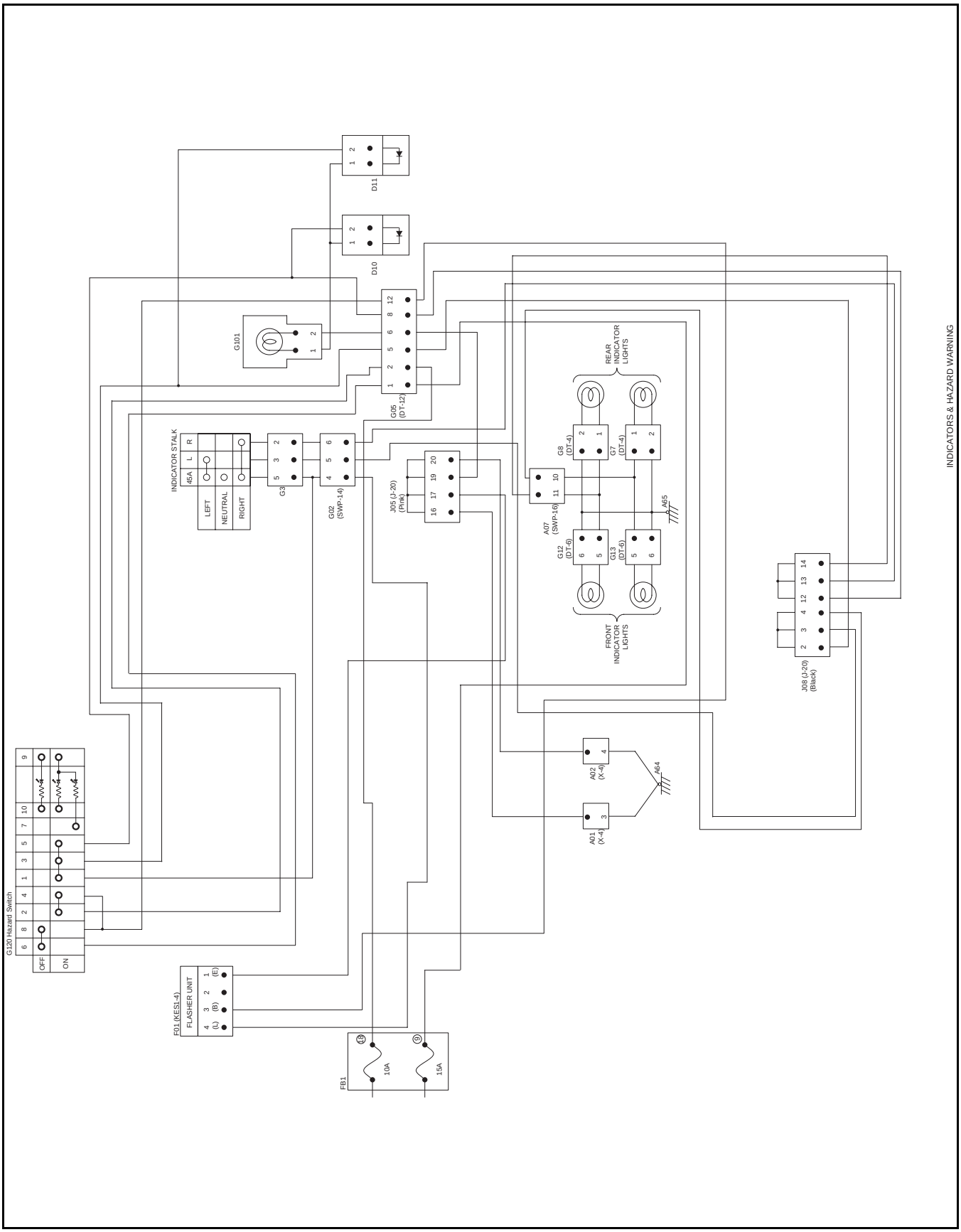
Indicators - Left Hand

*When Fuse No. 9 (Fuse box 1) is not blown

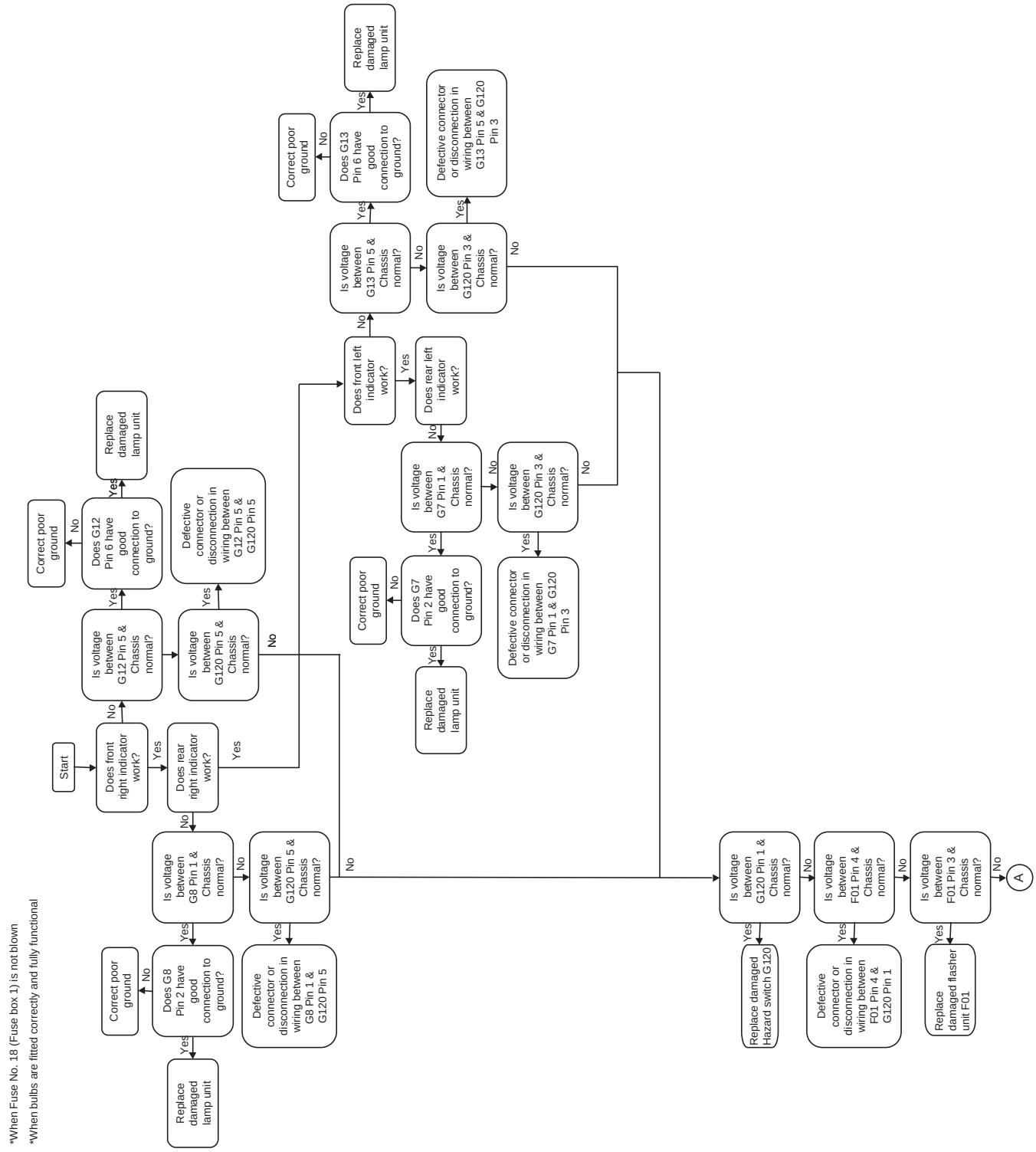
*When bulbs are fitted correctly and fully functional



Circuit Diagram for Indicators & Hazard Warning



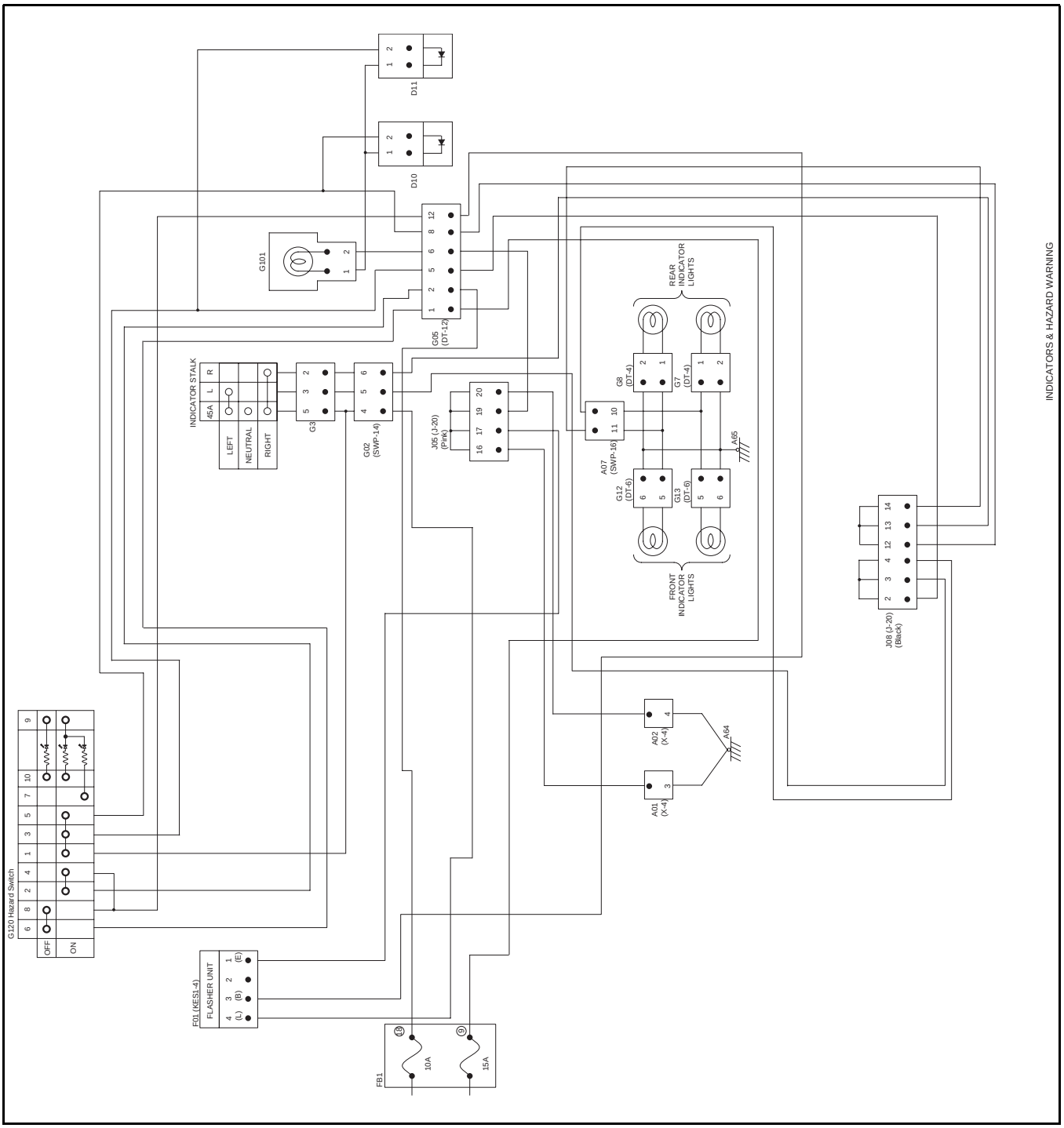
Hazard Warning Lights



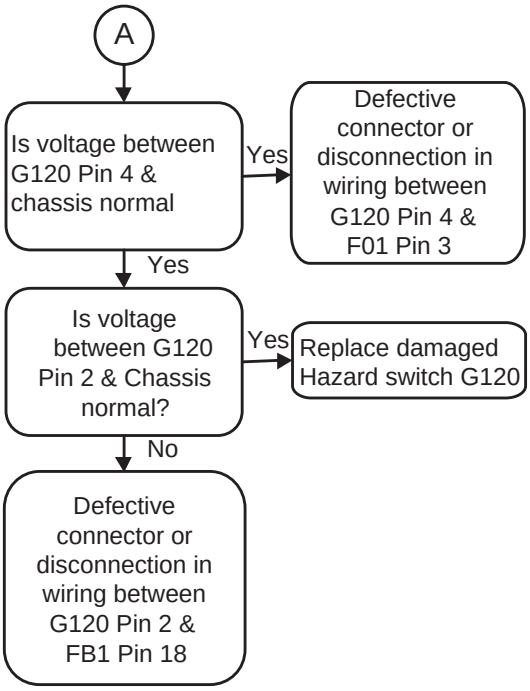
*When Fuse No. 18 (Fuse box 1) is not blown

*When bulbs are fitted correctly and fully functional

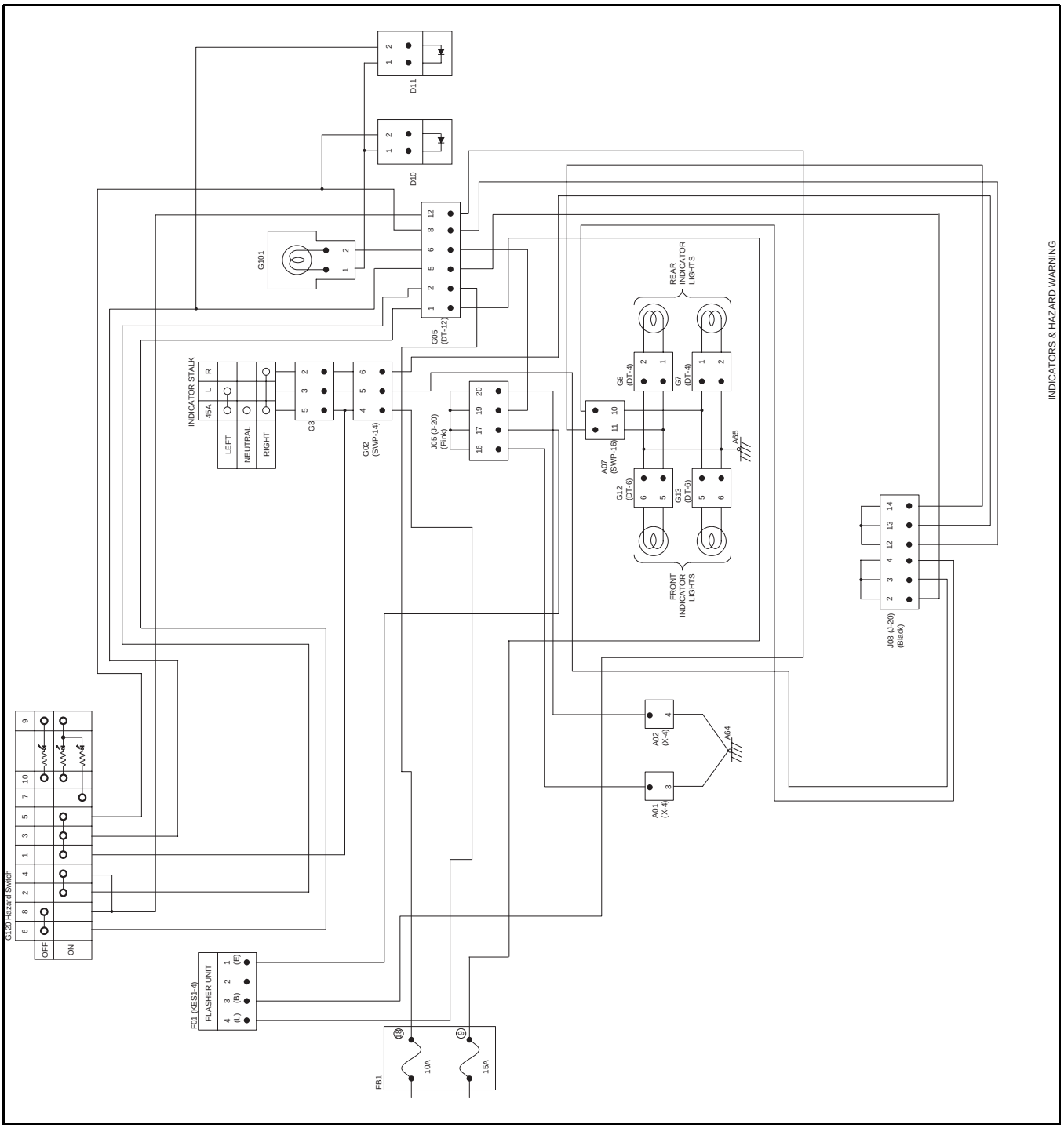
Circuit Diagram for Indicators & Hazard Warning



Hazard Warning Lights cont'd (A)

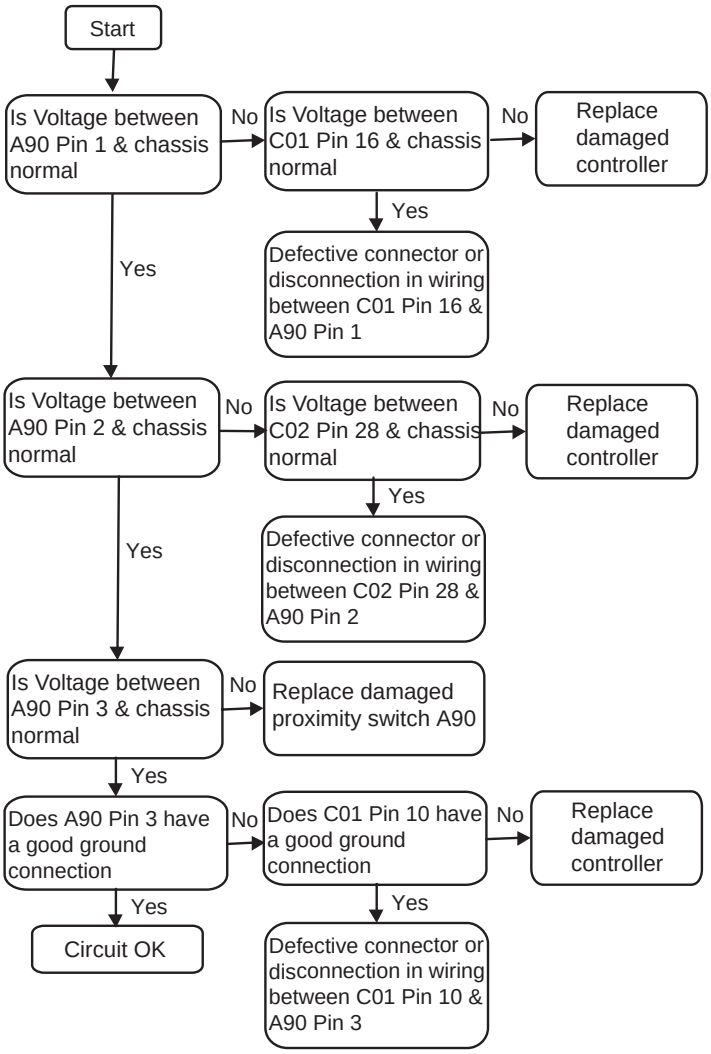


Circuit Diagram for Indicators & Hazard Warning

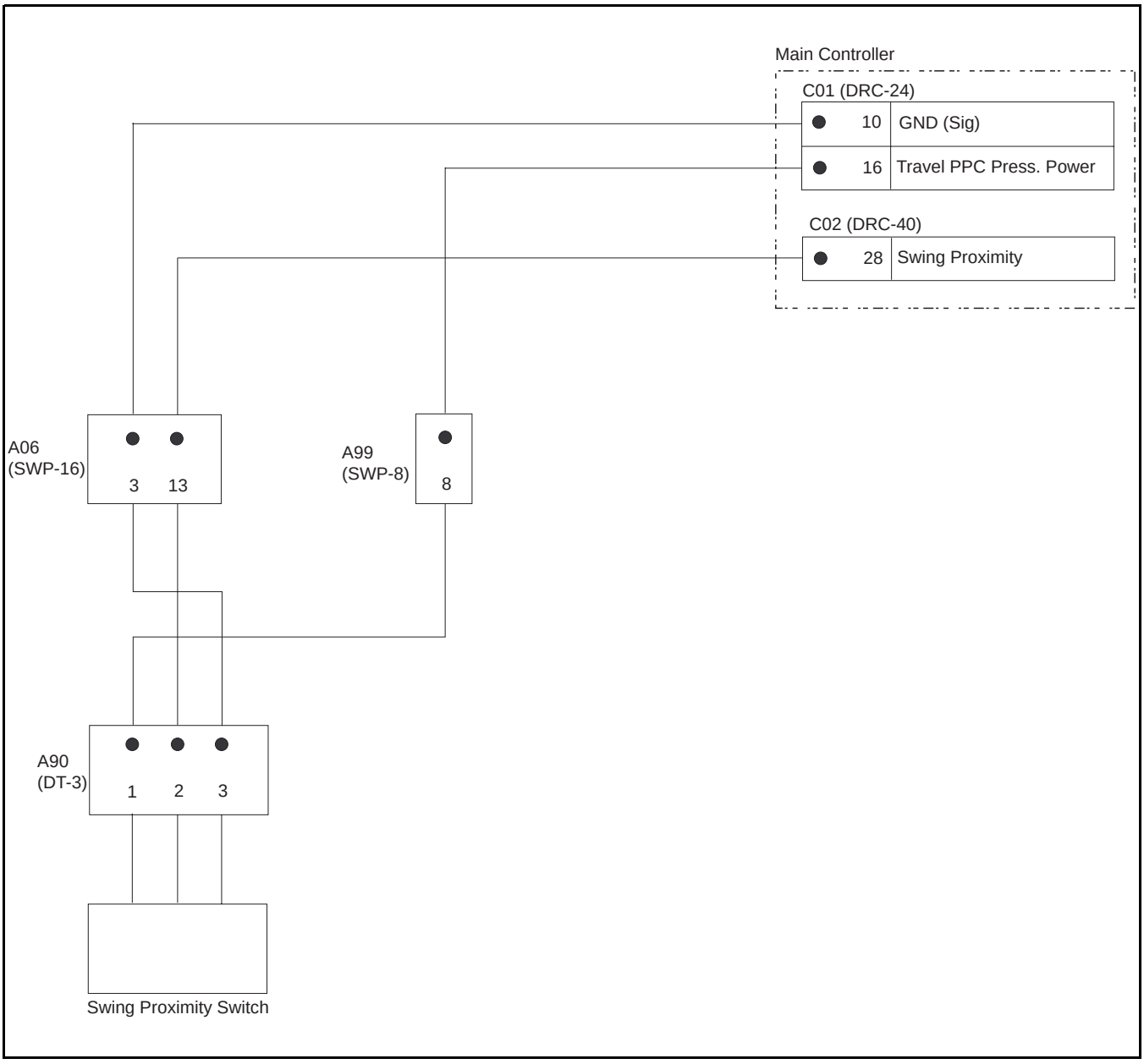


Swing Lock Proximity Switch

*With machine upper structure locked in the travel position



Brake and Swing Lock Proximity Switches

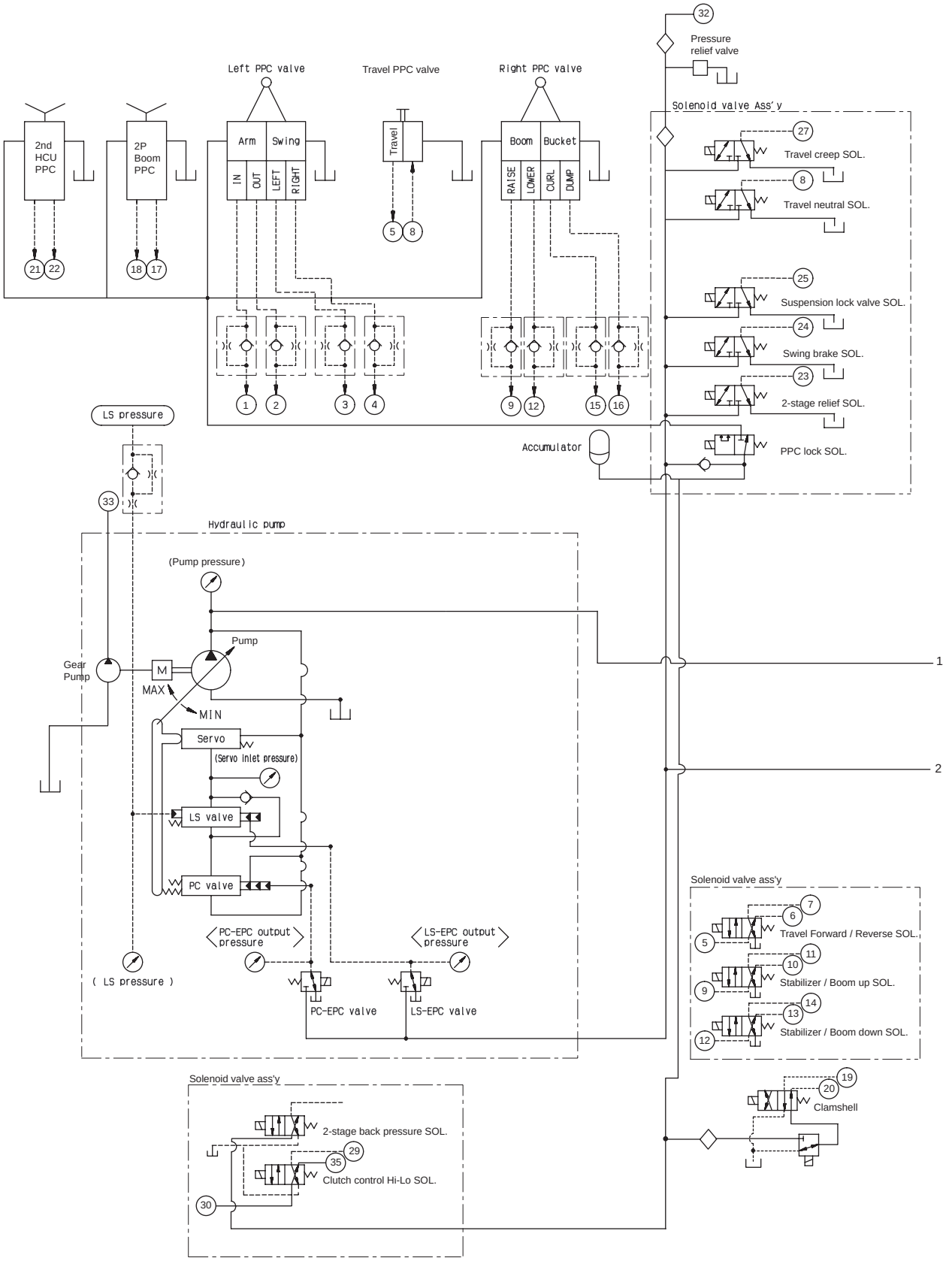


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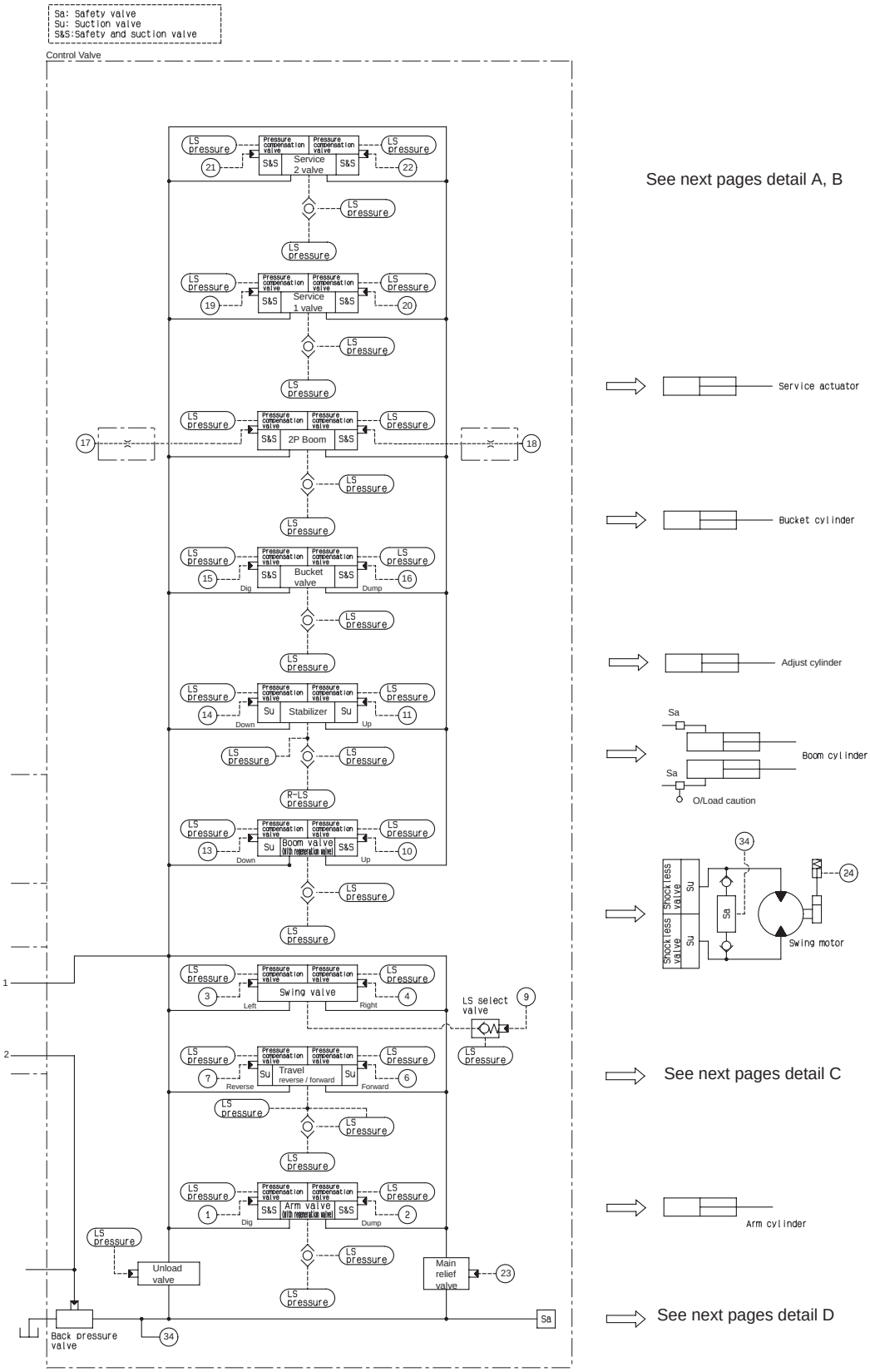
TROUBLESHOOTING OF HYDRAULIC AND MECHANICAL SYSTEM (H-MODE)

SYSTEM CHART FOR HYDRAULIC AND MECHANICAL SYSTEMS 702
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SYSTEM CHART FOR HYDRAULIC AND MECHANICAL SYSTEMS

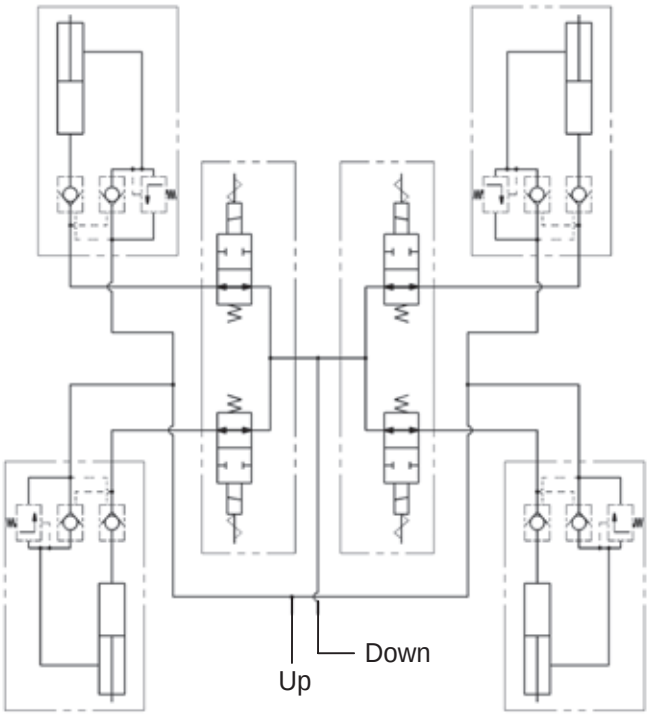


★ This is a system chart that has been drawn up by simplifying the whole hydraulic circuit chart. Use it as a reference material when troubleshooting the hydraulic and mechanical systems.



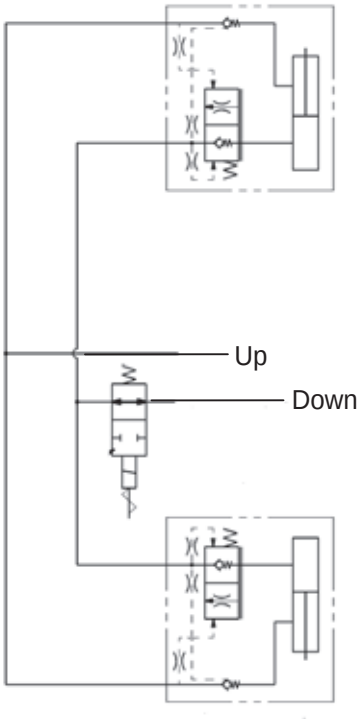
TWP02762Ab

Detail A



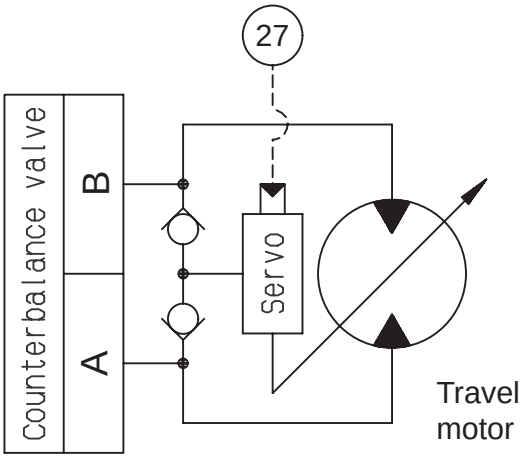
4 x outrigger option

Detail B

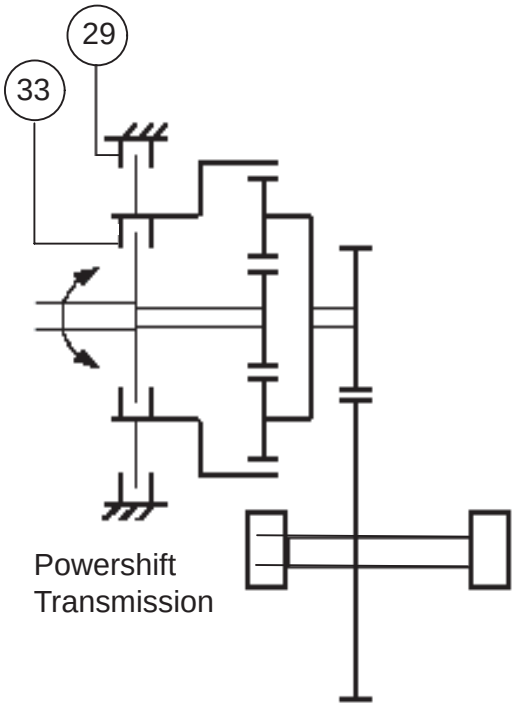


Dozer blade option

Detail C

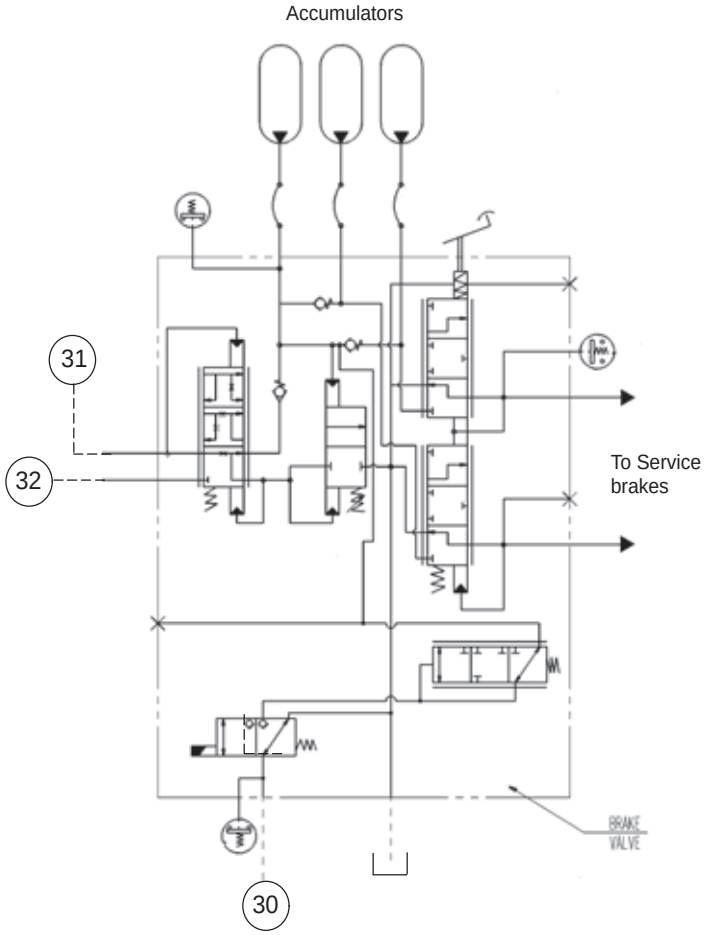


Travel motor

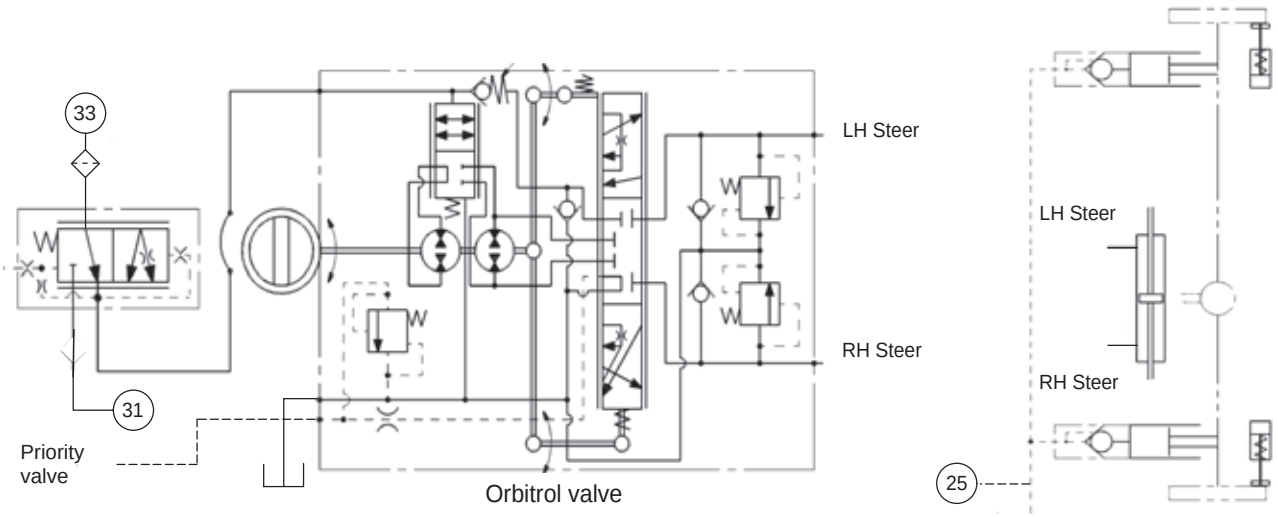


Powershift Transmission

Detail D



Detail E



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 A 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	Unload pressure
All control levers in NEUTRAL	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	Main relief pressure
Arm, DIGGING	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	Control circuit source pressure
All control levers in NEUTRAL	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.

Oil pressure to be measured	Measurement condition	Oil pressure ratio
Pump delivery pressure	Swing lock: ON Arm digging relief	1
PC valve output pressure		Approx. 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 speed	Travel mode	LS-EPC output pressure
Lo	NEUTRAL	3.5 – 3.8 MPa {35.7 – 38.8kg/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	Oil pressure ratio	
	NEUTRAL	Travel without load travel pedal held at half stroke
Pump delivery pressure	Nearly equal pressure	1
LS valve output pressure		Approx. 3/5

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	Main relief pressure	
		Arm, DIGGING	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	Measurement condition	Oil pressure ratio
		Pump delivery pressure	Swing lock: ON Arm digging relief	1
		PC valve output pressure		Approx. 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	Oil pressure ratio	
			Travel NEUTRAL	Travel without load (travel pedal held at half stroke)
		Pump delivery pressure	Nearly equal pressure	1
		LS valve output pressure		Approx. 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 A 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 A 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 (shuttle 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 – 38.8kg/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 A 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 – 38.8kg/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
			PC valve output pressure		Approx. 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 A 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 (in boom circuit)	★Stop engine for preparations. Start troubleshooting at engine high idling.	
			Boom lever	PPC valve output pressure
			NEUTRAL	0{0}
			RAISE or LOWER	3.5 – 3.8 MPa {35.7 – 38.8kg/cm^2}
	2	Malfunctioning of boom control valve (spool)	The spool in the boom control valve is presumed to malfunction. Check the valve itself.	
	3	Malfunctioning of boom control valve (pressure compensation valve)	The pressure compensation valve in the boom control valve is presumed to malfunction. Check the valve itself.	
	4	Malfunctioning of boom control valve (regeneration valve)	The regeneration valve in the boom control valve or the seal is presumed to malfunction. Check the valve itself.	
	5	Malfunctioning of safety valve for lock valve or seal defective	The safety valve for the lock valve is presumed to malfunction, or the seal is suspected to be defective. Check the valve itself.	
	6	Malfunctioning of boom control valve (suction valve) or seal defective	The suction valve in the boom control valve is presumed to malfunction, or the seal is suspected to be defective.	
	7	Malfunctioning of boom control valve (safety and suction valves) or seal defective	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.	
	8	Boom cylinder defective	★Stop engine for preparations. Start troubleshooting at engine high idling.	
			Boom lever	Amount oil leakage from cylinder
			Raise relief	20 cc/min

H-8 Arm moves slowly or lacks power

Failure information	• The arm moves slowly, or lacks power.
Relative information	• Set the working mode at A 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 – 38.8kg/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 A 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 – 38.8kg/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 A 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 – 38.8kg/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 A 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 A 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 A 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 A mode for the troubleshooting.

<table>
<tr><td rowspan="6">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="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 – 38.8kg/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 A 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 A mode for the troubleshooting.

<table>
<tr><td rowspan="5">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="3">1</td><td rowspan="3">Malfunctioning of 2-stage solenoid valve</td><td colspan="2">★Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td>Swing lock switch</td><td>Solenoid valve output pressure</td></tr>
<tr><td>OFF</td><td>0{0}</td></tr>
<tr><td>ON</td><td>3.5 – 3.8 MPa
{35.7 – 38.8kg/cm^2}</td></tr>
<tr><td>2</td><td>Malfunctioning of main relief valve</td><td colspan="2">The main relief valve is presumed to malfunction. Check the valve itself.</td></tr>
</table>

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 H-7 check first.

Presumed cause and standard value in normal condition		Cause	Standard value in normal condition and references for troubleshooting
	1	Malfunctioning of swing and boom control valves or seal defective.	The swing and 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 H-19 check first.

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 and 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 A 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	PPC valve output pressure	
		Forward or reverse	3.5 ~ 3.8 MPa {35.7 ~ 38.8kg/cm^2}	
2	Malfunctioning of self-pressure decompression valve	★Stop engine for preparations. Start troubleshooting at engine high idling.		
		Control lever	Control circuit source pressure	
		All control levers in NEUTRAL	3.5 ~ 3.8 MPa {35.7 ~ 38.8kg/cm^2}	
3	Malfunctioning of LS-EPC valve	★Stop engine for preparations. Start troubleshooting at engine high idling.		
		Travel speed	Travel control lever	LS-EPC valve output pressure
		Lo	NEUTRAL	Approx. 2.9 MPa {approx. 30 kg/cm^2}
		Hi	Travel control lever	0 {0}
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 lever	Amount of oil leakage from travel motor	
		Travel relief	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 A 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="8">1</td><td rowspan="8">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>0 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 ~ 38.8kg/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 travel speed solenoid 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>LS-EPC valve output pressure</td></tr>
<tr><td>Lo</td><td>NEUTRAL</td><td>0 {0}</td></tr>
<tr><td>Hi</td><td>Operation</td><td>3.5 ~ 3.8 MPa
{35.7 ~ 38.8kg/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 A 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 ~ 38.8kg/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 A 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 ~ 38.8kg/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 A 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 motor (parking brake)	The parking brake portion of the swing motor is presumed to malfunction. Check it directly.
	2	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.
	3	Swing motor defective	★Stop engine for preparations. Start troubleshooting at engine high idling.
			Swing 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 A 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 ~ 38.8kg/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 A 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	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.		
	2	Swing motor defective	★Stop engine for preparations. Start troubleshooting at engine high idling.		
			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 A 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 ~ 38.8kg/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 A 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 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 ~ 38.8kg/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 A 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 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 ~ 38.8kg/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.

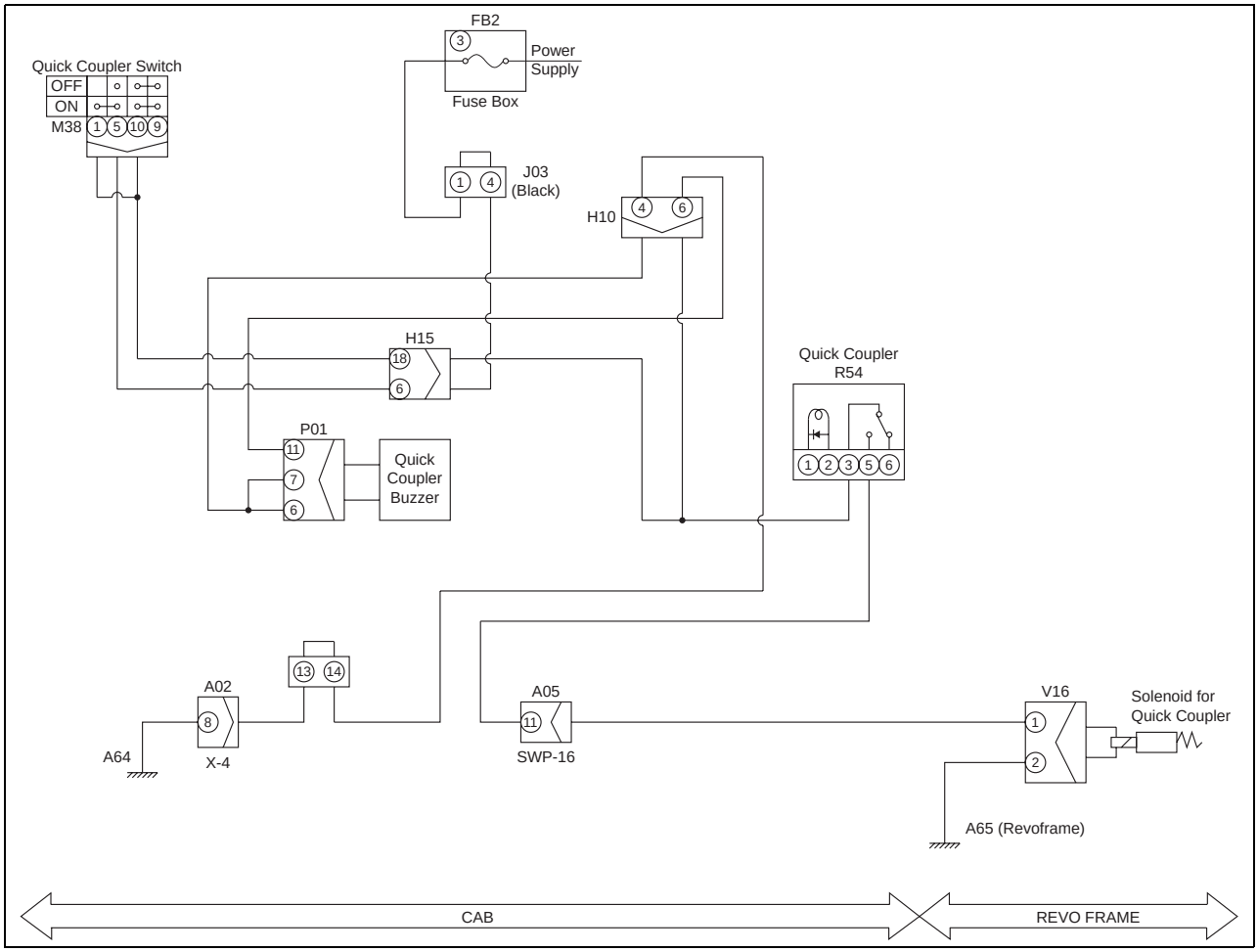
Presumed cause and standard value in normal condition	Cause		Standard value in normal condition and references for troubleshooting
	1	Swing control valve (spool) malfunctioned	The seal in the spool of the swing control valve is suspected of defect. Check the spool itself directly.
	2	Swing control valve (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.

QUICK COUPLER



Trouble	(1) Quick coupler cylinder will not extend		
Related information	Quick coupler block assembly has 2 cartridge valves in it, a 3 port pressure reducer to regulate the pressure to both the solenoid valve and quick coupler cylinder and a 4/2 solenoid operated directional control valve, this functions as follows: -Default position allows oil to flow to extend quick coupler cylinder [lock].		
Possible causes and standard value in normal state	Cause		Remarks on troubleshooting
	1	Pressure setting too low for particular quick coupler	If there is insufficient pressure achieved at the quick coupler cylinder, then it wont move. Adjust pressure according to quick coupler specification (refer to Testing and Adjusting Section 30 for measuring and adjustment procedure)
	2	Power supply to solenoid coil not removed	This will result in solenoid coil being energised and oil being directed to retract the quick coupler cylinder
			★ Prepare with starting switch OFF, then turn starting switch ON (but quick coupler switch OFF) and carry out troubleshooting.
			V16 (female) between (1) - (2). Voltage below 1V.
	3	Directional control valve malfunction	Directional control valve may have a malfunction (eg. sticking spool). Check it directly and replace complete directional control valve if necessary.
	4	Malfunction of pressure reducer	This may result in insufficient pressure being available. Measure pressure as explained in "Testing and Adjusting Section 30" then check if pressure can be adjusted, if it can't replace complete pressure reducer.

Trouble	(2) Quick coupler cylinder will not extend (but buzzer does not sound)		
Related information	Quick coupler block assembly has 2 cartridge valves in it, a 3 port pressure reducer to regulate the pressure to the solenoid valve and quick coupler cylinder and a 4/2 solenoid operated directional control valve, this functions as follows: -When operation switch in operators cab is in "ON" position solenoid is energised switching valve which allows oil to flow to retract quick coupler cylinder [UNLOCK]. At the same time a warning buzzer sounds and the lamp on the switch comes on.		
Possible causes and standard value in normal state	Cause		Remarks on troubleshooting
	1	Defective solenoid coil	Valve will not switch
			★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.
			V16 (male) between (1) (+ positive) and (2) (- negative) resistance 30+/-1.5Ω
			V16 (male) between (1) (+ positive) and chassis ground resistance Min 1MΩ
	2	No power supply to solenoid coil	Valve will not switch
			★ Prepare with starting switch OFF, then turn starting switch ON and quick coupler switch ON and carry out troubleshooting
			V16 (female) between (1) - (2). Voltage 20-30 V.
	3	Ground fault in wiring harness (short circuit with GND circuit)	★ Prepare with starting switch OFF, then carry out troubleshooting without turning starting switch ON.
			V16 (female) (1) - P51 (female) (1) resistance above 1MΩ
			V16 (female) (1) - S42 (female) (1) and (10) resistance above 1MΩ
	4	Directional control valve malfunction	Directional control valve may have a malfunction (eg sticking spool). Check it directly and replace the complete directional control valve if necessary.
	5	Malfunction of pressure reducer	This may result in insufficient pressure being available. Measure pressure as explained in "Testing and Adjusting Section 30" then check if pressure can be adjusted, if it can't replace complete pressure reducer.
	6	Pilot operated check in quick coupler falling to operate	Consult specific quick coupler manufacturer for the specification.

Trouble	(3) Buzzer does not sound (but quick coupler cylinder does retract)		
Related information	When operation switch in operators cab is in "ON" position a buzzer sounds and light on the switch comes on to warn the operator.		
Possible causes and standard value in normal state	Cause		Remarks on troubleshooting
	1	No power supply to buzzer	★ Prepare with starting switch OFF, then turn starting switch ON and quick coupler switch ON and carry out troubleshooting
			P51 (female) between (11) - (6) voltage 20-30 V.
	2	Buzzer malfunction	If (1) above is OK then replace buzzer.

Trouble	(4) Quick coupler cylinder extends and retracts slowly		
Possible causes and standard value in normal state	Cause		Remarks on troubleshooting
	1	Restriction in tank line	Check that hose isn't crushed or kinked.
	2	Hydraulic system pressure too low	Depending on the design of the quick coupler it may be necessary to operate the swing lever to raise the pressure in the hydraulic system.

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
     n: Special tools which cannot be substituted, should always be used.
     l: 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
     n: Special tools which cannot be substituted, should always be used.
     l: 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.
  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.

※1 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.

N·m 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.

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	

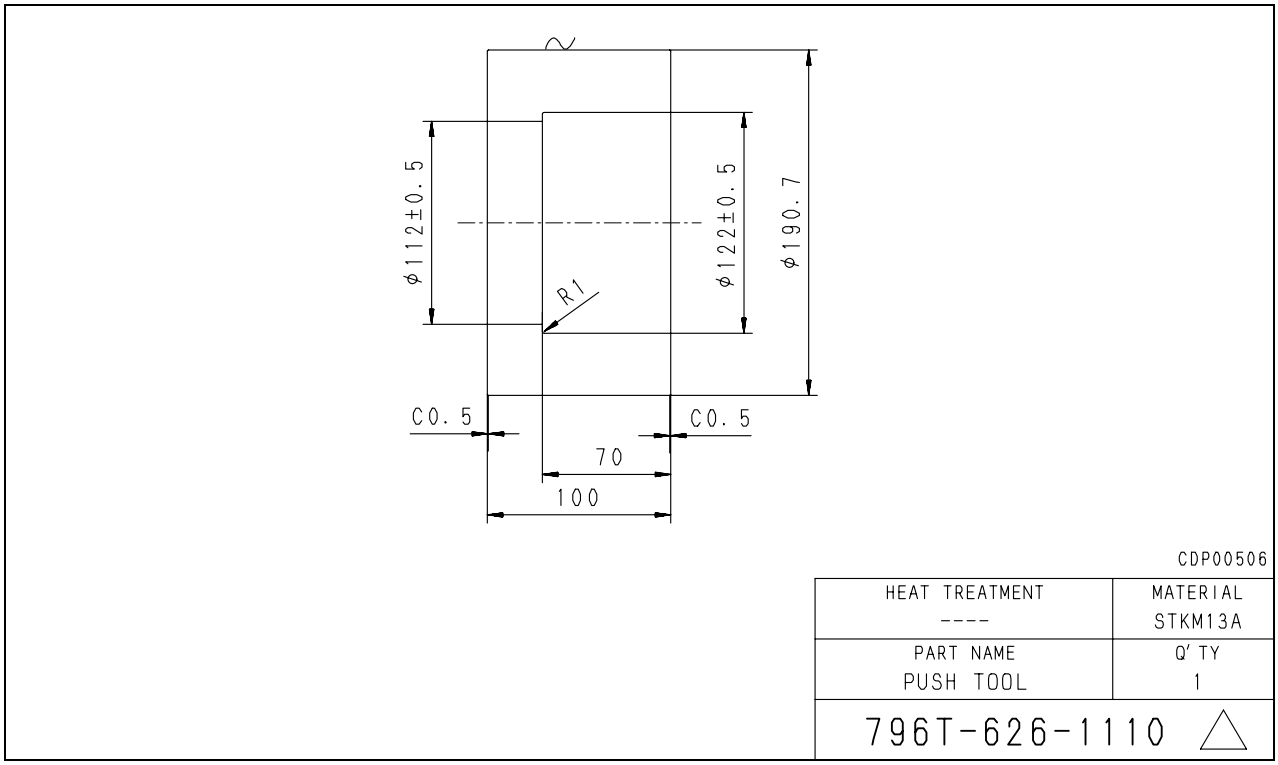
Component	Symbol		Part number	Part name	Nature of work, remarks
Control valve assembly	M	1	796-946-1310	Guide	Replacement of pressure compensation valve seal
			(For 723-46-40100, 723-46-40601)		
			796-946-1810	Guide	
			(For 723-46-43100, 723-46-43400)		
			796-946-2110	Guide	
			(For 723-46-44100)		
			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	

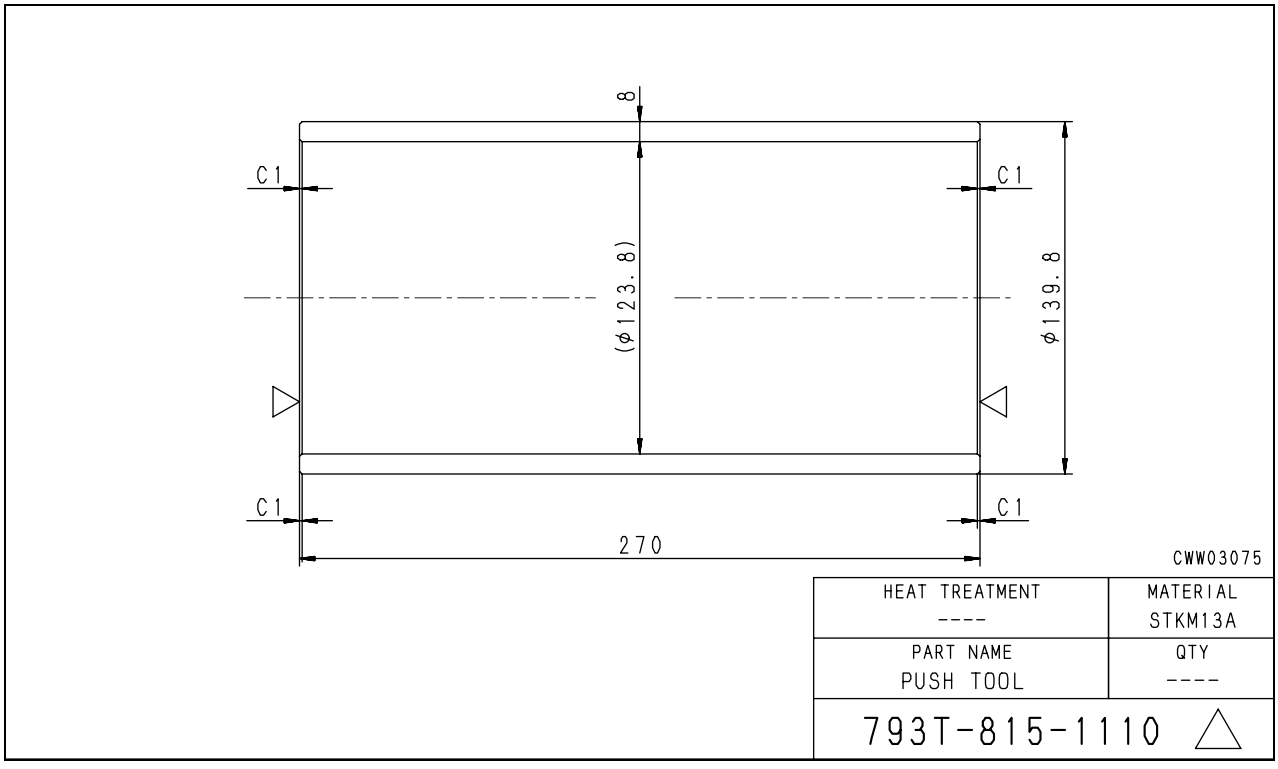
Sketches of special tools

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

E1 push tool



E5 push tool

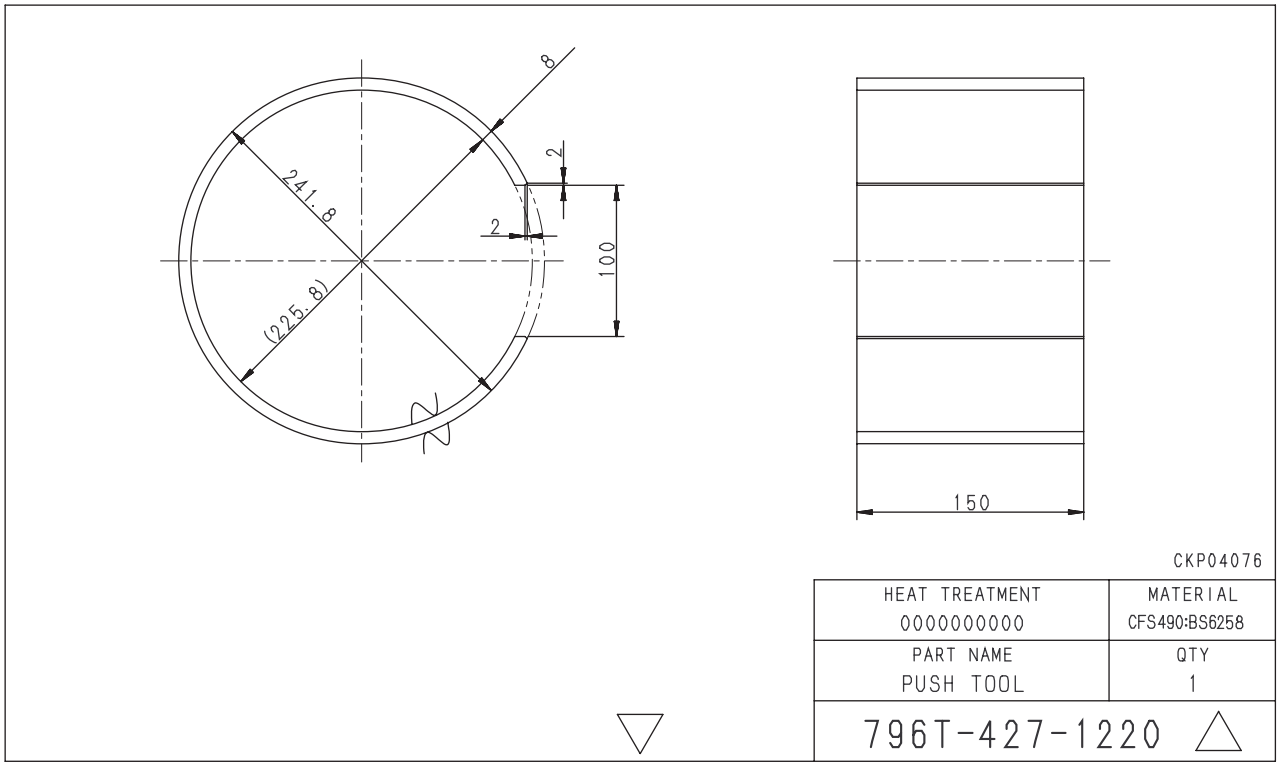


SPECIAL TOOLS

SKETCHES

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

F2 Push Tool



LIST OF TOOLS

Part Number	Part Name	Area Used on Machine
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

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.

Cate-gory	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)

Category	Komatsu code	Part number	Q'ty	Container	Main features and applications	
Adhesive	SUNSTAR PENGUINE SEAL 580 SUPER "S" or "W"	417-926-3910	320 ml	Polyethylene container	Adhesive for cab glass	• "S" is used for high-temperature season 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)

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

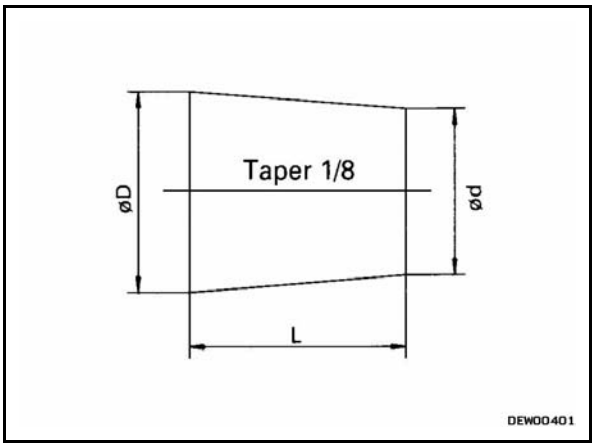
Nominal number	Plug (nut end)	Sleeve nut (elbow end) Use the two items below as a set
02	07376-50210	07221-20210 (Nut), 07222-00210 (Plug)
03	07376-50315	07221-20315 (Nut), 07222-00312 (Plug)
04	07376-50422	07221-20422 (Nut), 07222-00414 (Plug)
05	07376-50522	07221-20522 (Nut), 07222-00515 (Plug)
06	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.

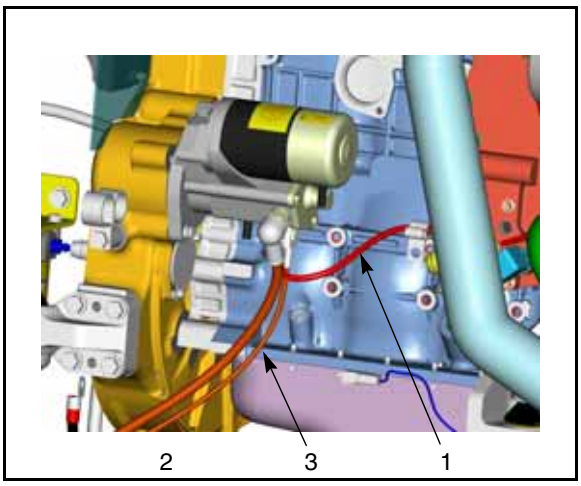
REMOVAL AND INSTALLATION OF STARTING MOTOR ASSEMBLY

REMOVAL

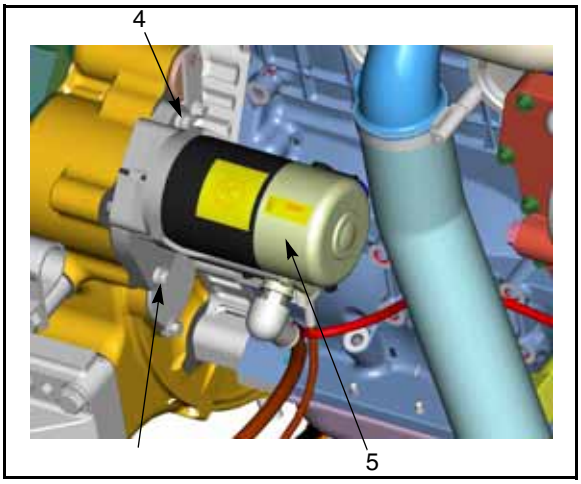
WARNING

Disconnect the cable from the negative (-) terminal of the battery.

1. Open up the engine hood.
2. Disconnect the two wires from the engine starting motor at: ※1
   - Wire (1) and (2) from terminal B.
   - Wire (3) from terminal C.



3. Remove two mounting bolts (4) to detach engine starting motor assembly (5). ※2



INSTALLATION

- Install in reverse order of removal.

※1

N·m Engine starting motor Terminal B Securing nut:
17.7 to 24.5 Nm (1.8 to 2.5 kgm)

N·m Engine starting motor Terminal C Securing nut:
2.6 to 4.6 Nm (0.26 to 0.46 kgm)

※2

Both faces of engine starting motor gasket: Gasket sealant (LG-1)

N·m Engine starting motor to Engine Securing Bolt:
43 ± 6 Nm (4.38 ± 0.61 kgm)

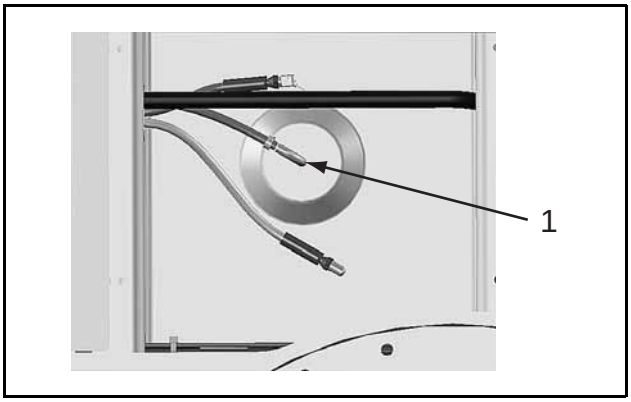
REMOVAL AND INSTALLATION OF FUEL SUPPLY PUMP ASSEMBLY

REMOVAL

⚠ WARNING

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

1. Close fuel stop valve (1) under the fuel tank.



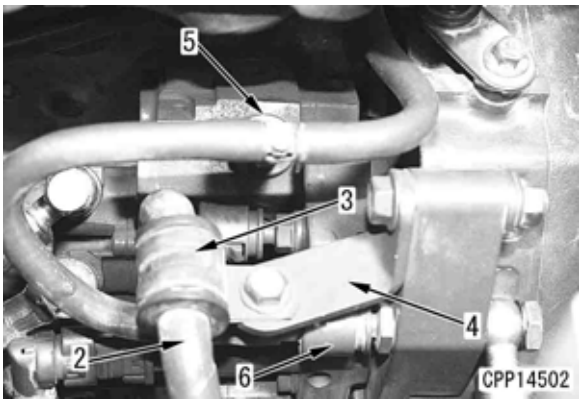
2. Open the engine hood.

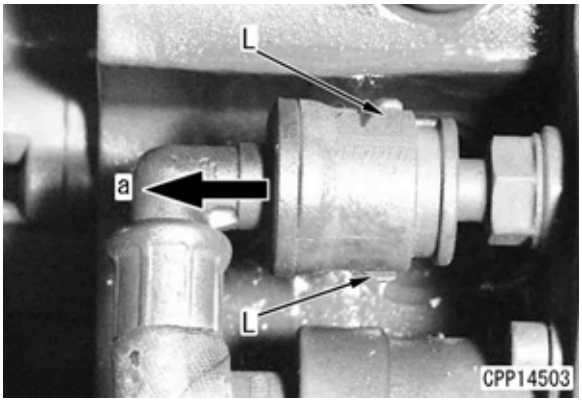
3. Disconnect clamp (3) of fuel hose (2) from bracket (4).
   ★ When loosening the bolt, fix the nut with wrench so that the hose will not be twisted. (If the hose is dragged and twisted, an excessive force is applied to the connector and the inside of the connector may be broken.)

4. Remove clamp bracket (4).

5. Disconnect fuel return hose connector (5) connected to the supply pump. [*1]
   ★ When removing a connector of quick coupler type, observe the following points.
   - Remove mud from each hose joint in advance (since the lock may be stuck in the mud).
   - Never use pliers or a screwdriver to disconnect the connector.
   - Pull out lock (L) of each hose joint straight (in direction [a]) while pressing it from both sides. (If the connector is disconnected forcibly by twisting or bending it to the right and left, its inside may be broken.)
   - Put plugs in the adapters of the disconnected hoses to prevent fuel from flowing out. (Do not use wooden plugs since chips may enter the fuel line.)

6. Disconnect fuel return hose (6).





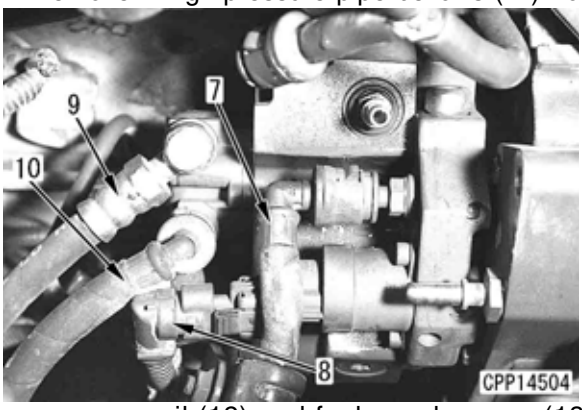
7. Disconnect hose (7) connected to the fuel filter.
   ★ Before disconnecting hose (7), be sure to perform steps 3 to 5.

8. Disconnect wiring connector (8).

9. Disconnect hose (9) connected to the prefilter. [*2]

10. Disconnect hose (10) connected to the fuel filter.

11. Remove 2 high-pressure pipe bellows (11) from

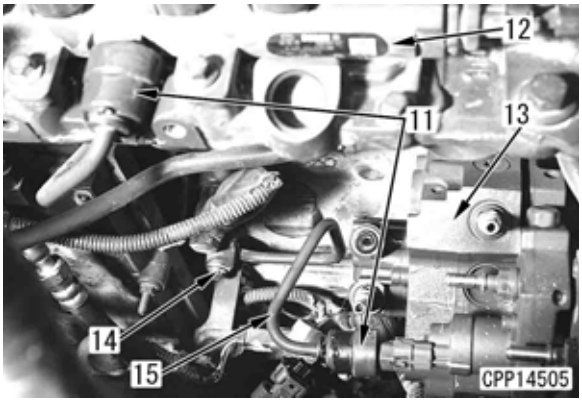


common rail (12) and fuel supply pump (13). [*3]

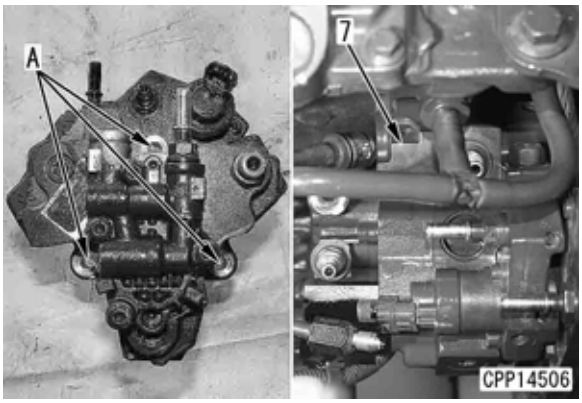
12. Disconnect 2 high-pressure pipe clamps (14) between the common rail (12) and fuel supply pump (13). [*4]

    ★ Since each clamps are divided two, take care not to drop them in the end cover when removing.

13. Disconnect high-pressure pipe (15) from fuel supply pump (13). [*5]
    ★ Loosen the sleeve nut on the common rail side in advance.



14. Remove the 3 fuel supply pump mounting nuts and fuel supply pump assembly (7). (Locations of nuts: [A]) [*6]



INSTALLATION

- Carry out installation in the reverse order to removal.

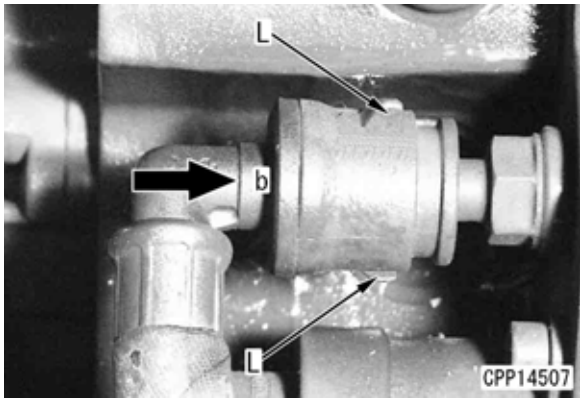
[*1]

When installing a connector of quick coupler type, observe the following points.

★ Replace the connector with new one in the following cases.
  1] The connector was removed with pliers or a screwdriver or by bending it to the right and left.
  2] There is damage or deformation in the connector.

★ Check that mud or dirt is not sticking to the hose adapter in advance.

★ Press and insert the connector straight (in direction [b]) without bending it to the right or left.
(If it is difficult to insert the connector, do not push it in forcibly but pull it out. Then, check the convex and concave parts for abnormality and mud.)



[*2]

N·m Joint bolt
19.6 - 29.4 Nm (2.0 - 3.0 kgm)

[*3]

★ Install each bellows with the slits out and down.

★ The bellows are installed so that fuel will not spout over the hot parts of the engine and catch fire when it leaks for some reason.

[*4]

N·m Clamp mounting bolt:
24 ± 4 Nm {2.45 ± 0.41 kgm}

[*5]

★ Temporarily tighten the high-pressure pipe sleeve nuts on the common rail side and fuel supply pump side and then tighten them to the specified torque in the order of the pump side and common rail side.

N·m Sleeve nut:
35 ± 3.5 Nm {3.6 ± 0.36 kgm}

[*6]

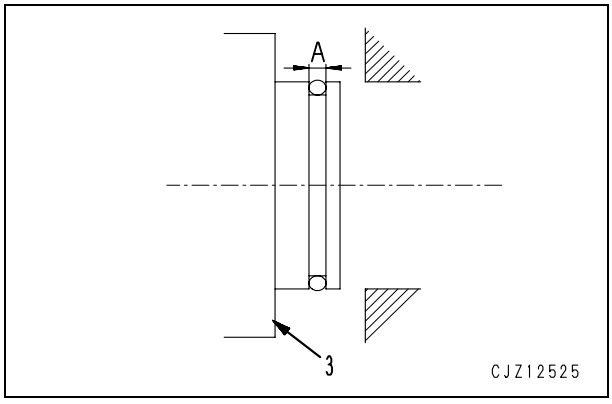
⚠ WARNING

- **If too much grease is applied to an O-ring at assembly, it will ooze out during operation. Accordingly, do not apply grease too much. (Apply grease to the O-ring groove area of part A.)**
- **When the supply pump mounting stud bolts of the gear housing were removed, apply adhesive to thier root side and mount them.**

2 Stud bolt: **Adhesive (LT-2)**

N·m Stud bolt:
12 ± 2 Nm {1.22 ± 0.2 kgm}

N·m Fuel supply pump mounting nut
24 ± 4 Nm {2.45 ± 0.41 kgm}



REMOVAL AND INSTALLATION OF FUEL INJECTOR ASSEMBLY

Special tools

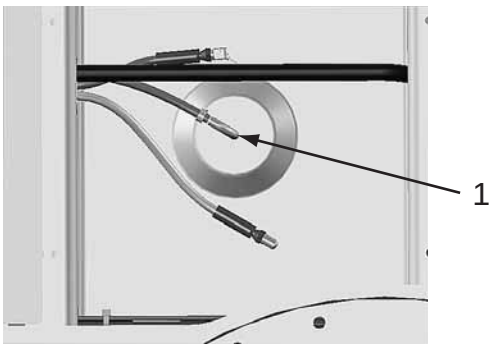
Sym-bol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
A	3	795-799-6700	Puller	■	1		
	4	795-799-1131	Gear	■	1		
	5	795-799-8150	Remover	●	1		

REMOVAL

⚠ WARNING

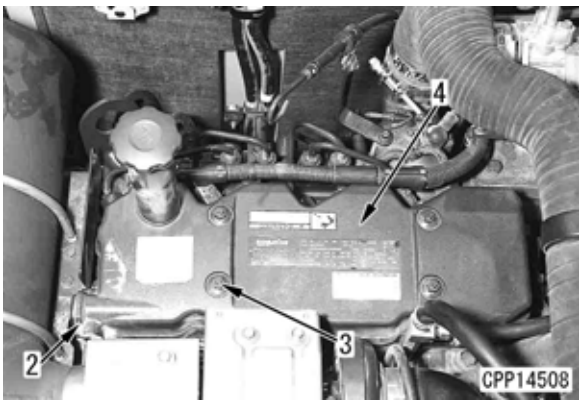
Disconnect the cable from the negative (–) terminal of the battery.

1. Close fuel stop valve (1) under the fuel tank.



2. Remove blow-by duct (2) mounting bolts and disconnect blow-by duct (2). [*1]

3. Remove cylinder head cover mounting bolts (3) and remove cylinder head cover (4). [*2]

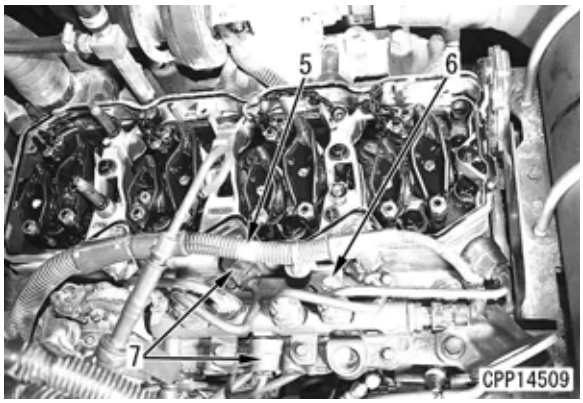


4. Referring to Testing and adjusting, "Adjusting valve clearance", set the No. 1 and 4 cylinders to the top dead center.

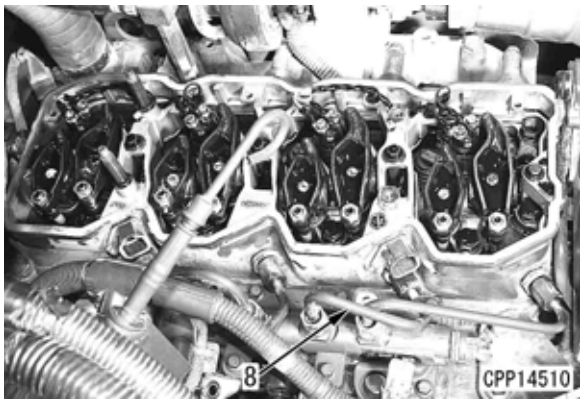
5. Disconnect wiring (5).

6. Disconnect bracket (6).

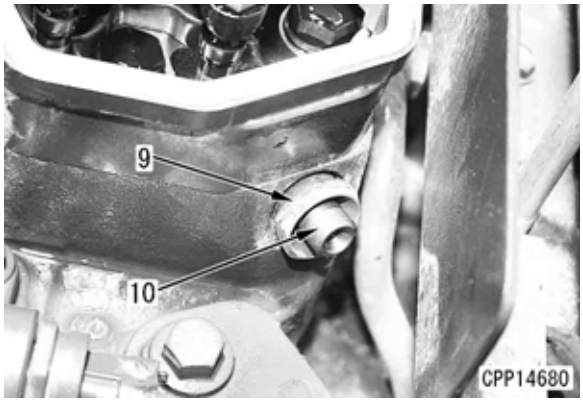
7. Remove high-pressure pipe bellows (7) from the cylinder head and common rail. [*3]



8. Remove high-pressure pipe (8). [*4]



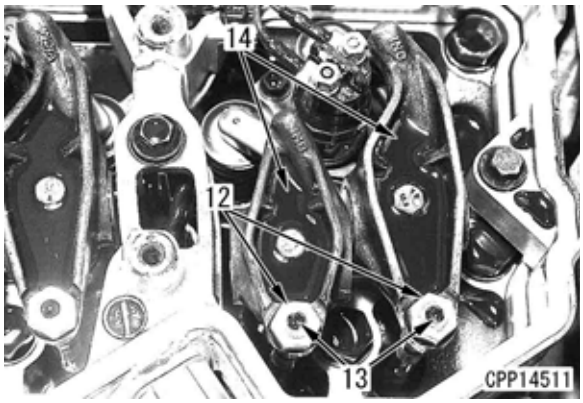
9. Remove retaining nut (9) and then remove inlet connector (10) .
   - ★ Tool **A5** is prepared for remove the inlet connector (10).
   - ★ Check that the inlet connector is free from flaw and dirt.



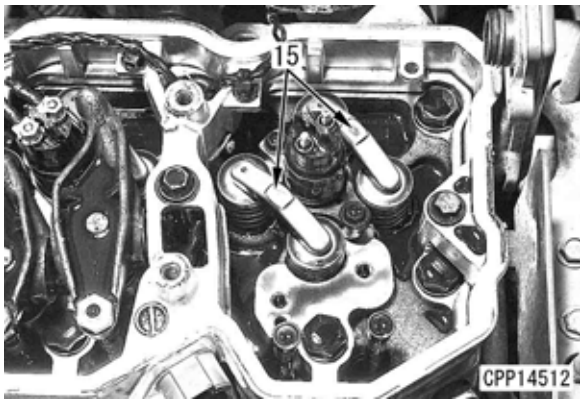
10. Disconnect wiring (11).
    ★ Since different cylinders have different wiring colors, record their combinations.

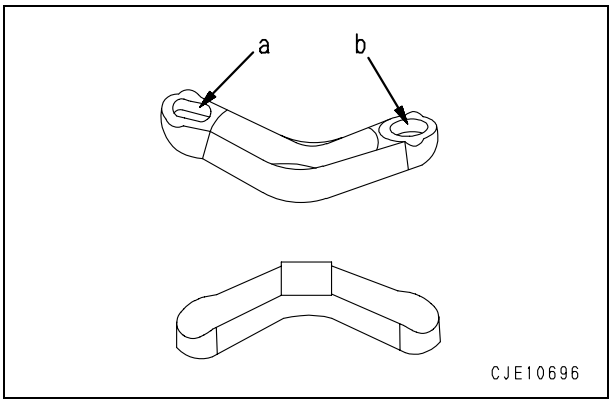
11. Loosen locknut (12) and then loosen adjustment screw (13) thoroughly.

12. Remove rocker arm (14).

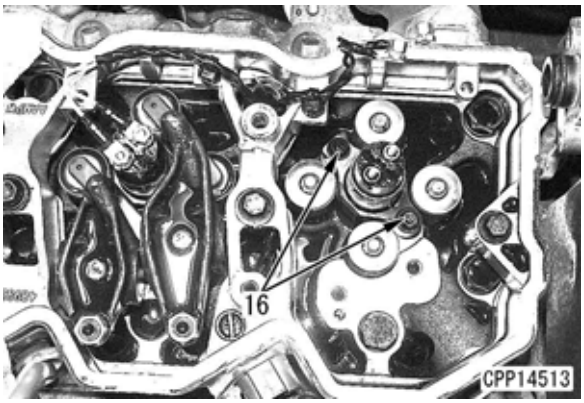


13. Remove crosshead (15).
    ★ Since the shapes of holes [a] and [b] of the crosshead are different, record the installed position of the crosshead.

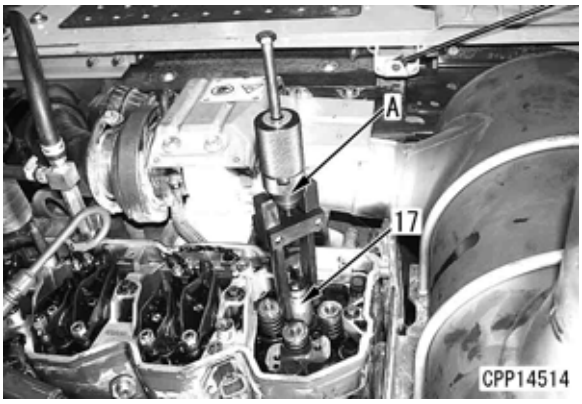




14. Remove fuel injector assembly mounting bolt (16).

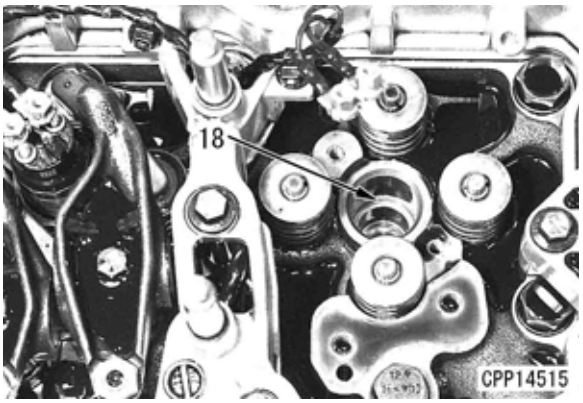


15. Using tool **A3**, remove fuel injector assembly (17).
    ★ Cover injector sleeve with cloth after removing fuel injector assembly for free from flaw and dirt.

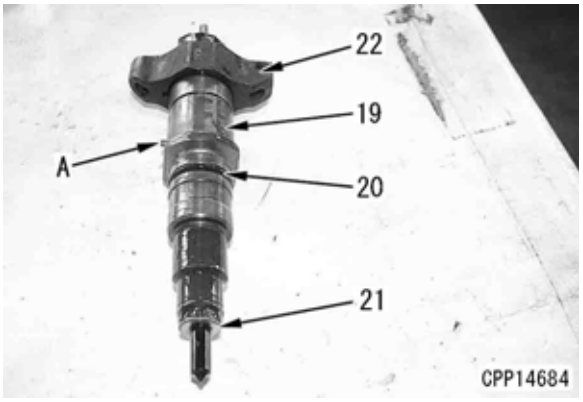


INSTALLATION

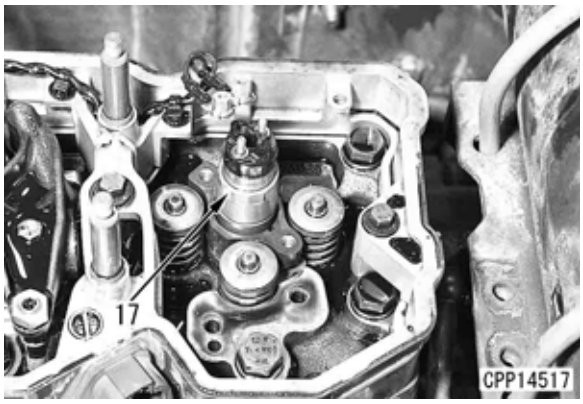
1. Fuel injector assembly
   ★ Check that fuel injector sleeve (18) is free from flaw and dirt.



   1) Fit O-ring (20) and gasket (21) to fuel injector (19).
      ★ Replace O-ring and gasket with new one.
   2) Apply engine oil (EO15W-40) to the O-ring of the fuel injector (19) and the mounting hole on the head.
   3) While setting the concave and convex (A), install holder (22) to fuel injector (19).

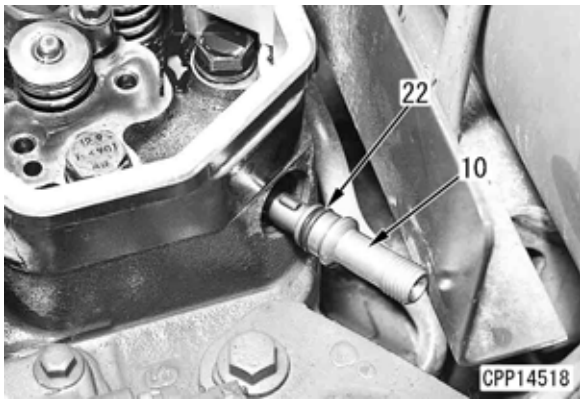


   4) Install fuel injector assembly (17) to the fuel injector sleeve and tighten the mounting bolt by 3 – 4 turns.
      ★ When installing the fuel injector assembly, check the direction of the inlet connector mounting hole.



   5) Apply engine oil (EO15W-40) to O-ring (22) of inlet connector (10) and the inlet connector mounting hole. While setting part of key to the groove on the head, insert inlet connector (10) to the end.
      ★ If the injector was replaced with new one, replace the inlet connector with new one, too.
      ★ Check of inlet connector
      Check the inlet connector for the following defects. If any defect is detected, replace the inlet connector.
      - Burrs and deformation of inlet and outlet of connector
      - Clogging and dirt of edge filter
        (If there is sediment here, do not use connector)
      - Breakage and deterioration of O-ring
      - Wear, improper contact and trace of leakage on outlet seal

      ★ If high-pressure fuel leaks, the seat surface is eroded and fine streaks or flaws are made.
      If this erosion is detected, replace the inlet connector and injector.



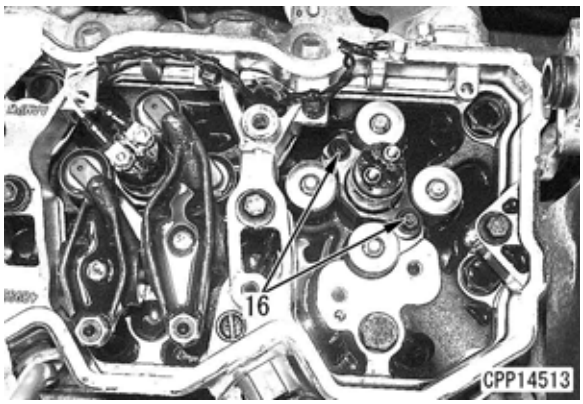
6) Install and finger-tighten retainer (9).

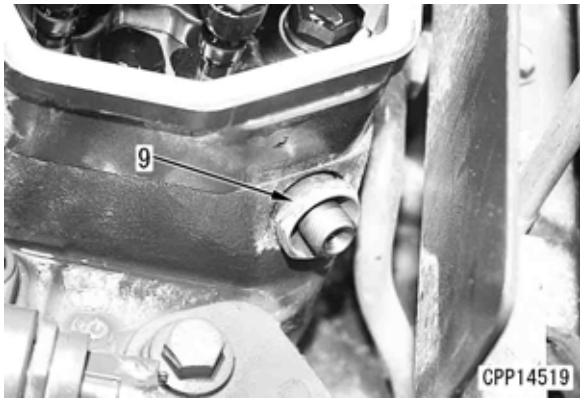
7) Tighten right and left mounting bolts (16) of fuel injector assembly alternately.

N·m Fuel injector mounting bolt:
8 ± 0.8 Nm {0.8 ± 0.08 kgm}

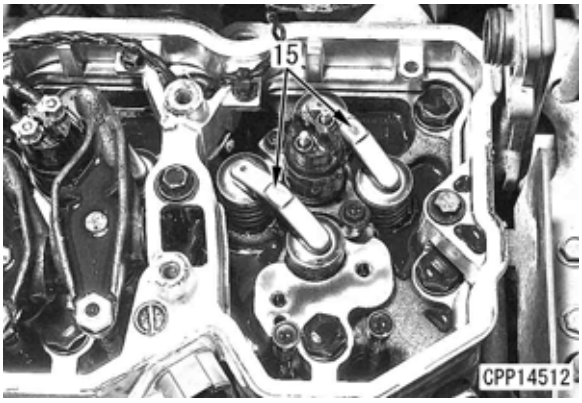
8) Tighten retaining nut (9) to the specified torque.

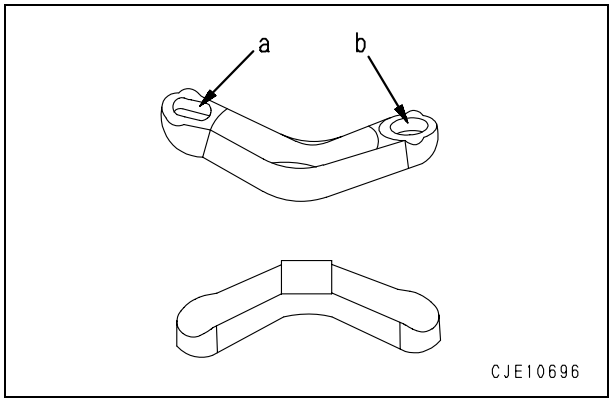
N·m Retaining nut:
50 ± 5 Nm {5.1 ± 0.5 kgm}





2. Install crosshead (15).
★ Since the shapes of holes [a] and [b] of the crosshead are different, take care when installing.
(Install the crosshead in the direction of the intake and exhaust valves recorded when it was removed.)





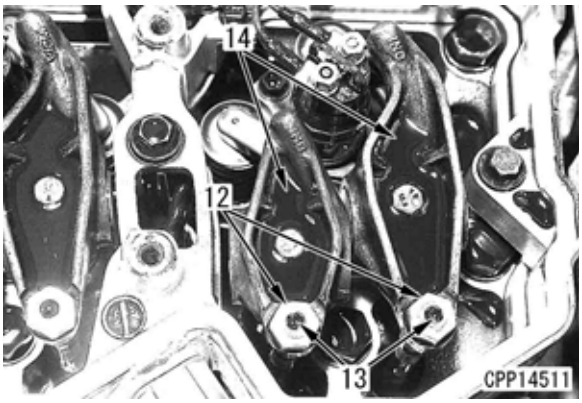
3. Install rocker arm (14).
★ Before installing the rocker arm, check that adjustment screw (13) is loosened thoroughly.
★ Check that the ball of the adjustment screw is fitted to the socket of the push rod.

N·m Rocker arm mounting bolt:
36 ± 5 Nm {3.7 ± 0.5 kgm}

4. Install wiring (11).
   ★ Since different cylinders have different wire colors, check their combinations before installing.
   ★ Installed positions of wirings

Wiring color	Cylinder No.
White	1, 3
Black	2, 4

N•m Wiring mounting nut:
1.5 ± 0.25 Nm {0.15 ± 0.03 kgm}



5. Adjusting valve clearance
   Referring to Testing and adjusting, "Adjusting valve clearance", adjust the valve clearance.

- Carry out the following installation in the reverse order to removal.

[*1]

N•m Blow-by duct mounting bolt:
7 ± 2 Nm {0.7 ± 0.2 kgm}

[*2]
★ If the stud bolts were removed, tighten them to the following torque.

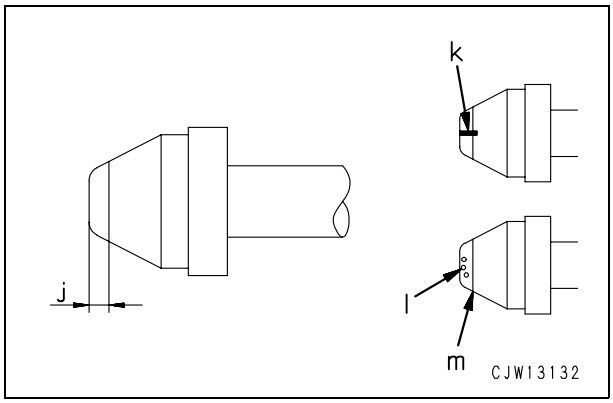
N•m Stud bolt:
24 ± 4 Nm {2.4 ± 0.4 kgm}

[*3] • [*4]

⚠ WARNING

- **Do not bend the high-pressure pipe to collect before installing.**
- **Be sure to use the genuine high-pressure pipe clamps and observe the tightening torque.**
- **After installing the high-pressure pipe, be sure to install the bellows to the sleeve nut.**

★ Before installing the high-pressure pipe, check it for the following defects. If there is any of these defects, it can cause fuel leakage. Accordingly, replace the high-pressure pipe with new one.
- Check the taper seal of the connecting part (Part "j": Part of 2 mm from the end) for visible lengthwise slit "k" and dent "l".
- Check part "m" (End of the taper seal: Part at 2 mm from the end) for stepped-type wear (fatigue) which your nail can feel.



- Install the high-pressure pipe according to the following procedure.
  1. Install the high-pressure pipe and temporarily tighten the sleeve nuts on the common rail side and cylinder head side.

N•m Sleeve nut:
0.2 – 0.8 Nm {0.02 – 0.08 kgm}

  2. Tighten the sleeve nuts on the common rail side and cylinder head side to the specified torque.

N•m Sleeve nut:
35 ± 3.5 Nm {3.57 ± 0.36 kgm}

  3. Install the sleeve nuts on the common rail side and cylinder head side.
     ★ Install each bellows with the slits out and down.
     ★ The bellows are installed so that fuel will not spout over the hot parts of the engine and catch fire when it leaks for some reason.

★ If all of the No. 1 – No. 4 injector assemblies were removed, install the high-pressure pipes, referring to "Removal and installation of cylinder head assembly".REMOVAL AND INSTALLATION OF FRONT OIL SEAL

REMOVAL AND INSTALLATION OF FRONT OIL SEAL

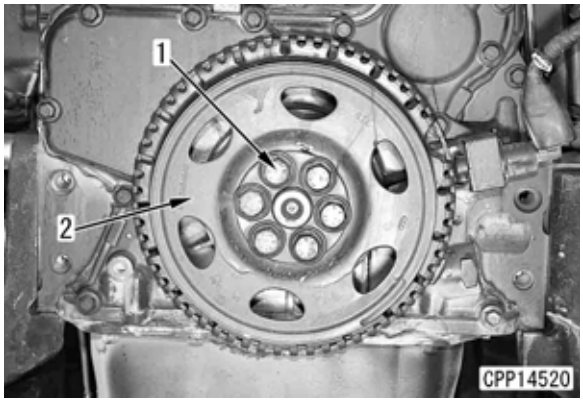
Special tools

Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
A	1	795-799-6400	Seal puller	■	1		
	6	790-331-1120	Wrench (Angle)	●	1		

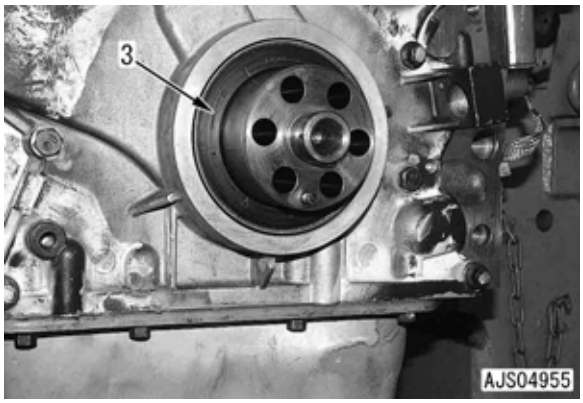
REMOVAL

1. Remove the engine assembly. For details, see "Removal and installation of engine assembly".

2. Remove crank pulley mounting bolts (1) and crank pulley (2).

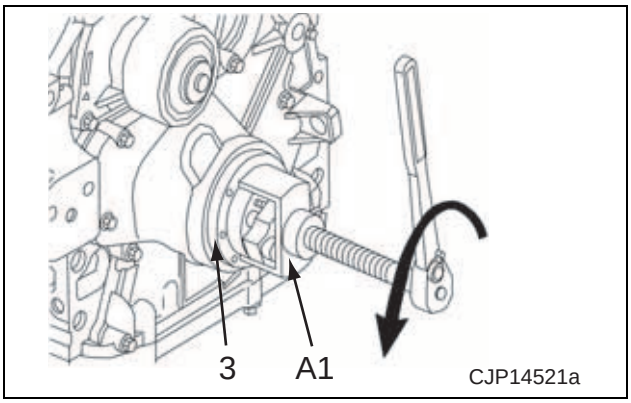


3. Remove seal (3).

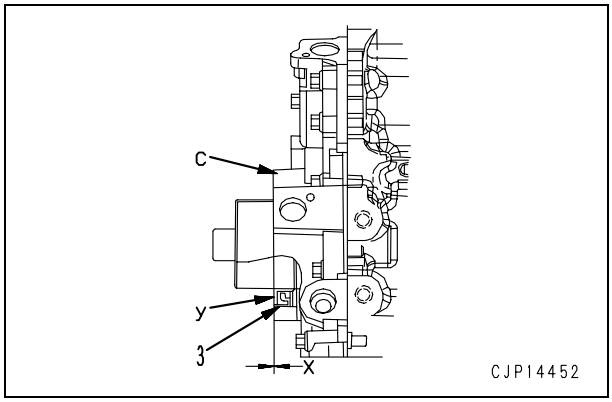


INSTALLATION

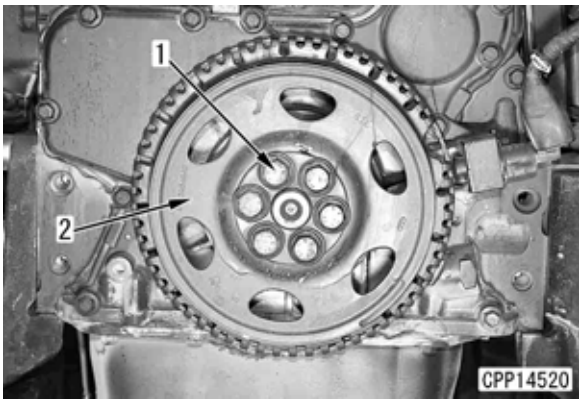
1. Using tool **A1**, install front oil seal (3).
   - ★ Replace the front oil seal with new one.
   - ★ Before installing the seal, check that the end corners and lip sliding surfaces of the crankshaft are free from flaw, burr, and rust of the housing.
   - ★ When installing the seal, do not apply oil or grease to the shaft and seal lip "a". Wipe off the oil from the shaft.



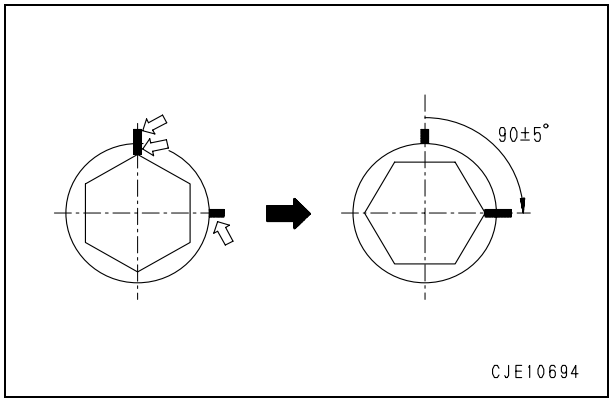
   - ★ The projection and runout of seal (3) from cover (C) must be as follows.
     - ● Projection x: Max. 0.38 mm
     - ● Runout y: Max. 0.25 mm



2. Crank pulley
   1) While checking the dowel pin hole on the back side of the crank pulley (2), install crank pulley (2) to the crankshaft.
      ★ If the dowel pin was removed, install it before installing the crank pulley.
   2) Tightening order of crank pulley mounting bolts (1)
      1] Tighten the bolts to
         55 ± 5 Nm {5.6 ± 0.5 kgm}
         in the diagonal order.
      2] Loosen the bolts by 180 °.
      3] Tighten the bolts to
         55 ± 5 Nm {5.6 ± 0.5 kgm}
         in the diagonal order.
      4] Tighten the bolts by
         90 ° ± 5 °
         (with angle tightening tool **A6**).



- When not using angle tightening tool
  Make a mark on the crank pulley and each bolt with paint and then tighten the bolt by 90 ° ± 5 °.



- Carry out the installation in the reverse order to removal.

REMOVAL AND INSTALLATION OF REAR OIL SEAL

Special tools

Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
A	**2**	795-799-6500	Seal puller	■	1		

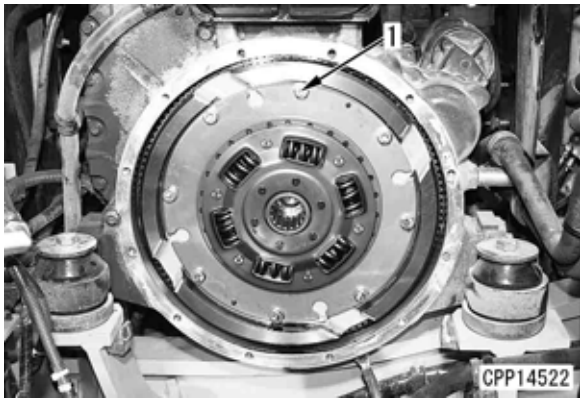
REMOVAL

⚠ WARNING

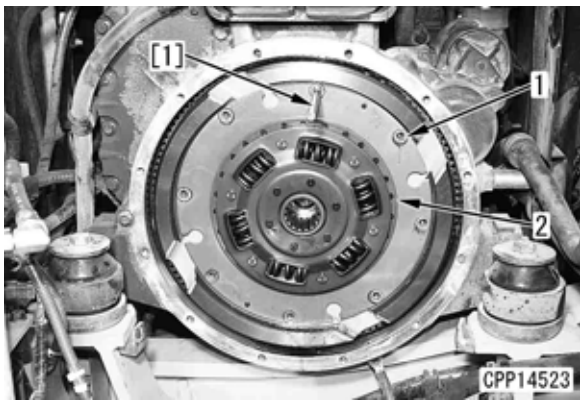
Disconnect the cable from the negative (–) terminal of the battery.

1. Remove the work equipment assembly. For details, see "Removal and installation of work equipment assembly".

2. Removal of damper
   1) Remove 1 damper mounting bolt (1) at the top.

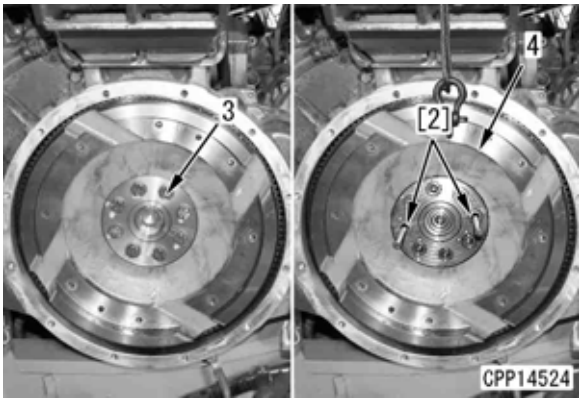


   2) Install guide bolt [1] and remove the 7 remaining damper mounting bolts (1).
   3) Remove damper (2).

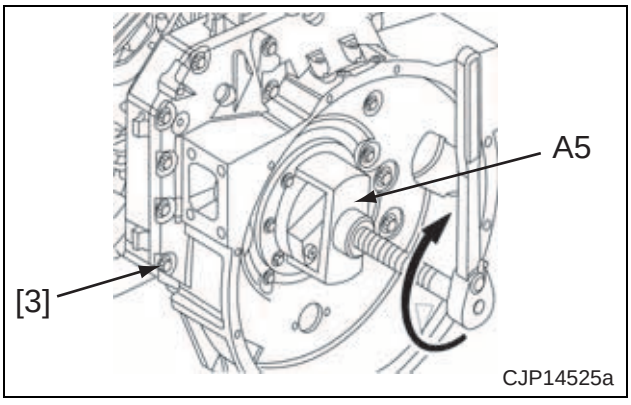


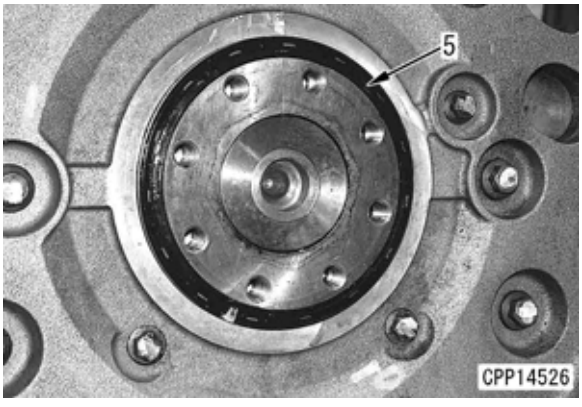
3. Removal of flywheel
   1) Remove 2 flywheel mounting bolts (3) on a diagonal line and install guide bolts [2]. [*1]
   2) Sling flywheel (4) and remove the remaining mounting bolts.
   3) Pull out flywheel (4) toward you.
   4) Remove guide bolts [2] and lift off flywheel (4).

kg Flywheel 35 kg



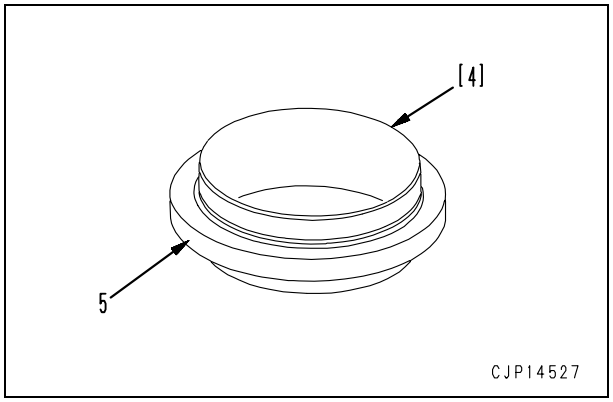
4. Removal of rear oil seal
   1) Install tool **A2** to the crankshaft.
   2) Tighten tapping screw [3] of tool **A2** into the seal carrier of rear oil seal (5).
   3) Turn the handle clockwise to remove rear oil seal (5).





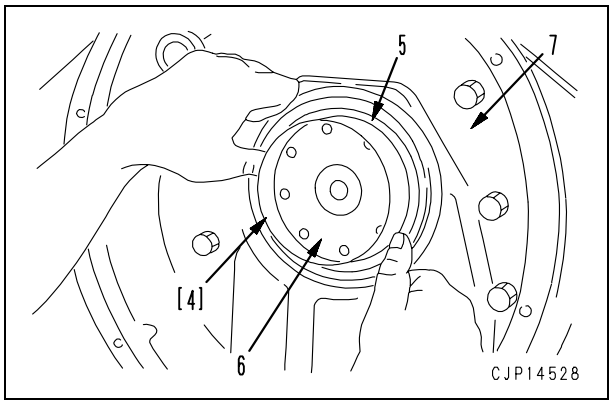
INSTALLATION

1. Install the rear seal according to the following procedure.
   - ★ Replace the front oil seal with new one.
   - ★ Do not remove pilot [4] which is attached to rear seal (5) until rear seal (5) is inserted to the crankshaft.
   - ★ Before installing the rear seal, degrease, clean and dry the crankshaft sealing face and the seal lip face to prevent oil leakage.

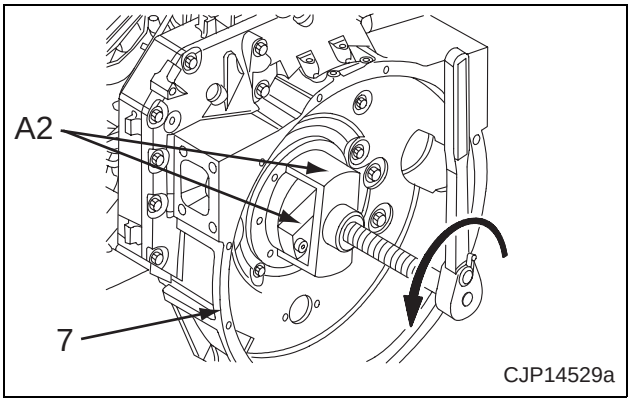


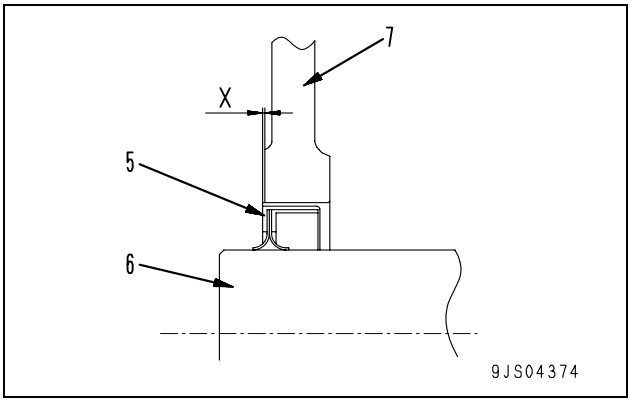
2. Insert pilot [4] to crankshaft (6) and push rear seal (5) into flywheel housing (7).

3. Push in rear seal (5) further and pull out pilot [4].



4. Install rear seal (5) on flywheel housing (7) to the proper depth by using tool **A2**.
   - ★ Push in rear seal (5) taking care that there are no bend etc. on it.
   - ★ Extrusion of rear seal (5) from flywheel housing (7)
     (X): less than 0.38 mm



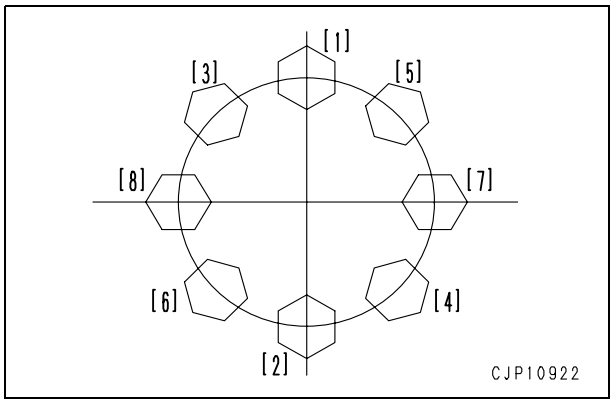


- Carry out the rest of installation in the reverse order to removal.

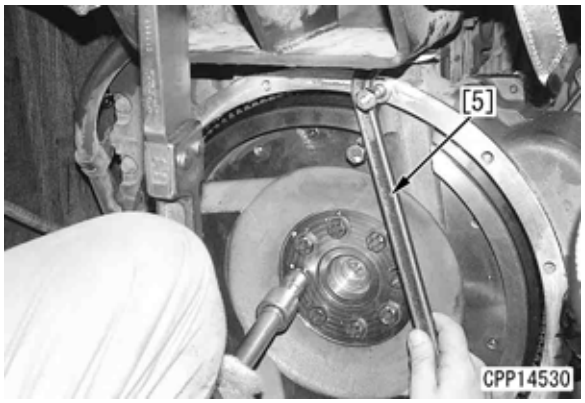
[*1]

- ★ Tighten the 8 flywheel assembly 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 [5] for preventing rotation of the flywheel assembly.



- Measurement of radial runout

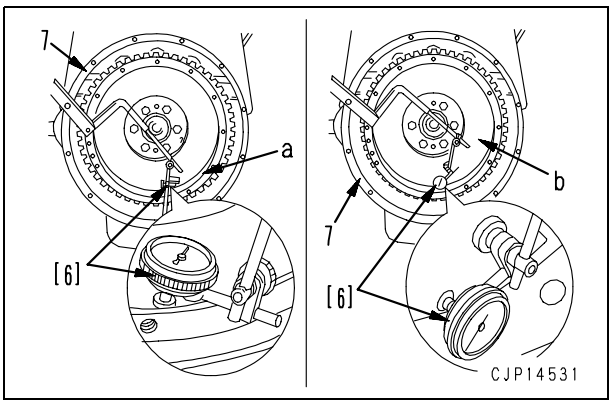
★ Radial runout: less than 0.13 mm

1) Set dial gauge [6] to the stand, and set it to flywheel housing (7).
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.
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 runout

★ Facial runout: less than 0.20 mm

4) As in the case of measurement of radial runout, 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.
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

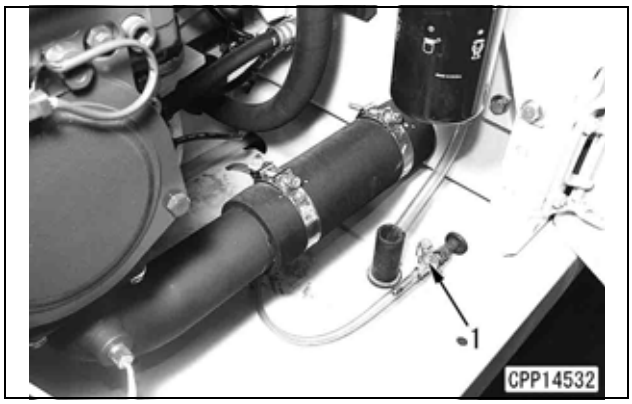
Sym-bol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
A	3	795-799-6700	Puller	■	1		
	4	795-799-1131	Gear	■	1		
	5	795-799-8150	Remover	●	1		
	6	790-331-1120	Wrench (Angle)	●	1		
	7	795-790-4510	Gauge	●	1		

REMOVAL

⚠ WARNING

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

1. Open the right rear inspection cover and open fuel stop valve (1) to drain the fuel.
   When fuel tank is full: 275L

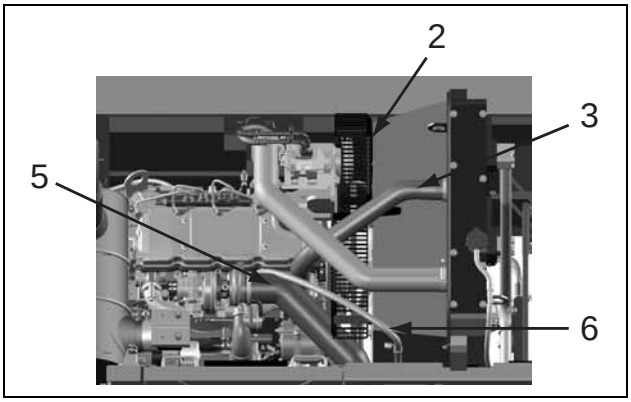


Drain the coolant from the engine.

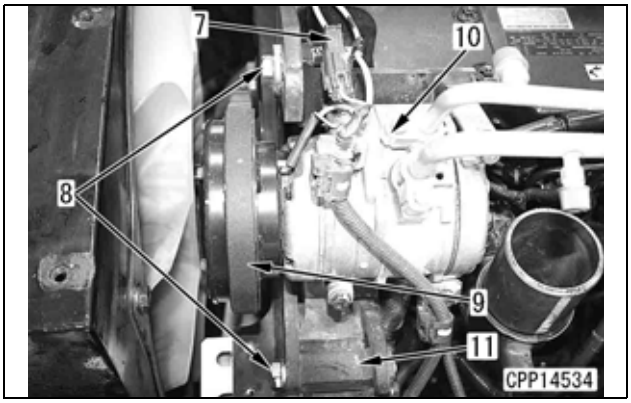
Coolant water: Approx. 18L

2. Removal of engine hood
   Remove the engine hood. For details, see "Removal and installation of engine hood".

3. Removal of hoses and guard above engine
   1) Remove air conditioner compressor drive belt guard (2).
   2) Remove radiator hose (3). [*1]
   3) Remove aftercooler hose (5). [*2]
   4) Disconnect heater hose (6).



4. Disconnection of air conditioner compressor assembly
   1) Disconnect wiring connector E05 (7).
   2) Remove 2 air conditioner compressor mounting bolts (8).
   3) Remove drive belt (9).
   4) Disconnect air conditioner compressor assembly (10) and move it so that it will not be an obstacle.
   5) Remove bracket (11).

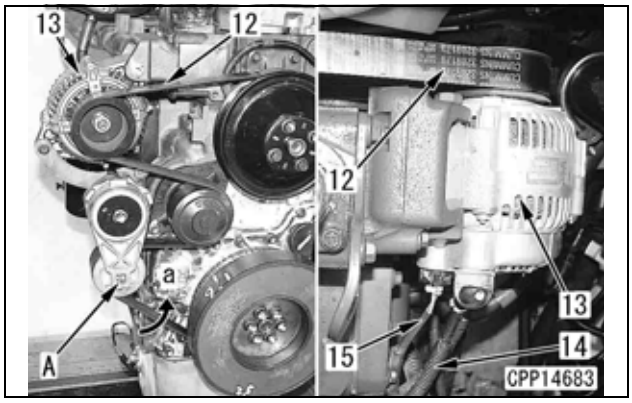


5. Removal of alternator
   1) Insert the wrench in part A and turn it to the direction of [a] to loosen fan belt (12).
   2) Remove fan belt (12) from alternator (13).

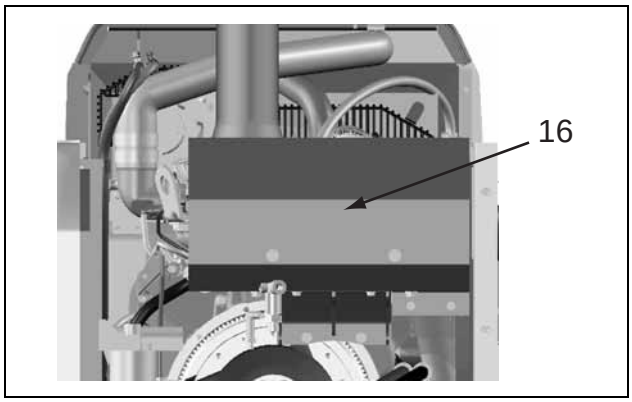
⚠ WARNING

- **Set the wrench in hole A securely and then turn the tension pulley to direction [a]. (The tension pulley spring is very strong. If the wrench is installed halfway and turned, it may come off and can cause a serious accident.)**
- **After removing the fan belt, return the wrench slowly and carefully.**
- **Take care not to catch your fingers between the pulley and fan belt during the work.**

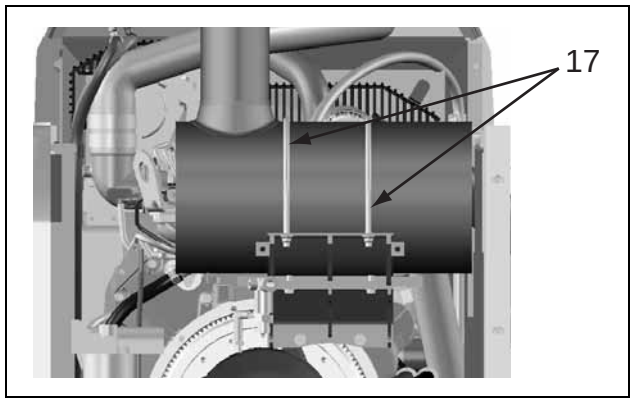
   3) Remove the alternator mounting bolts and disconnect alternator assembly (13). (Move the alternator without removing wirings (14) and (15) so that it will not be an obstacle.)



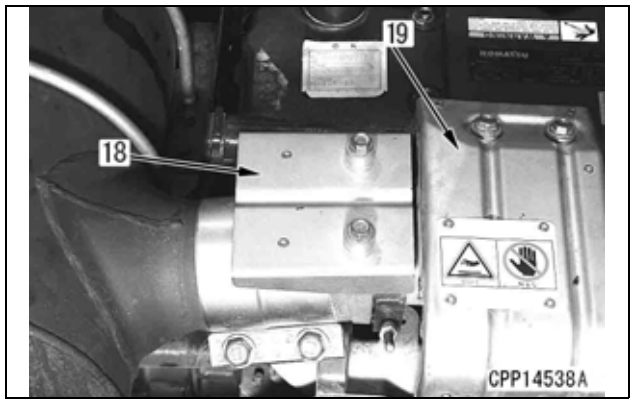
6. Disconnection of muffler and turbocharger assembly
   1) Remove guard (16).



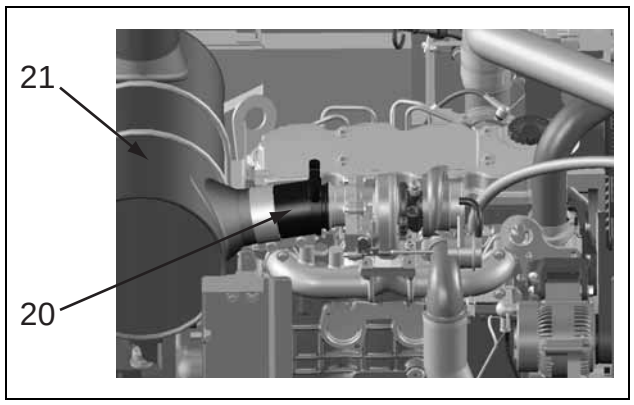
   2) Loosen 2 U-bands (17).



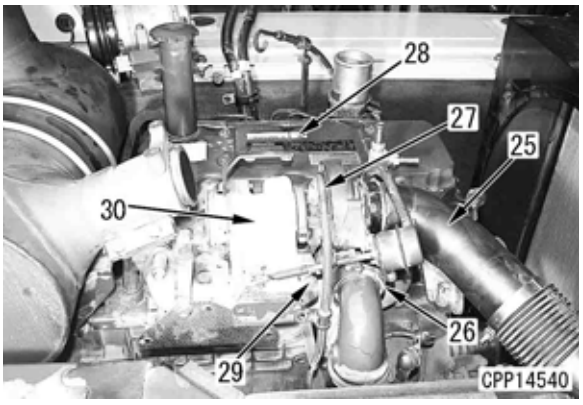
   3) Remove clamp top covers (18) and (19).



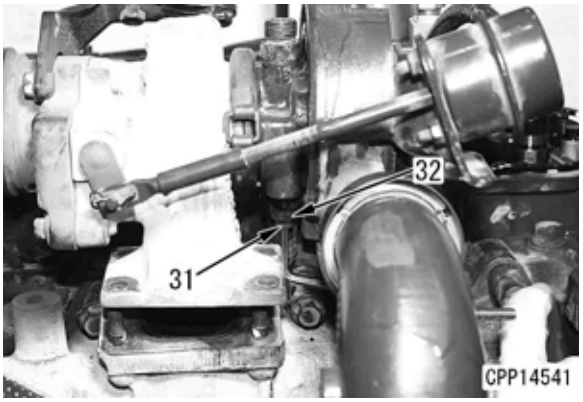
   4) Remove clamp (20).
   5) Slant muffler assembly (21) outward.



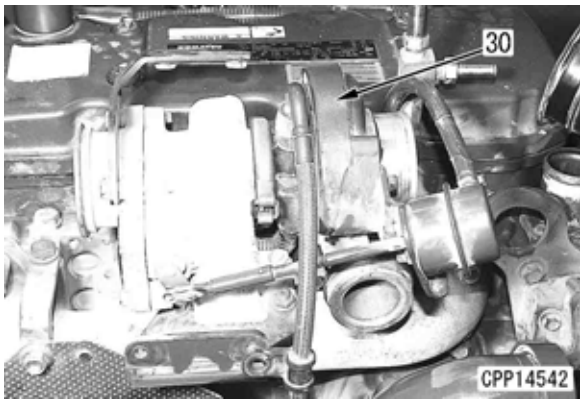
7. Removal of turbocharger assembly and exhaust manifold
   1) Disconnect hose (25) between the turbocharger and air cleaner from the turbocharger. [*3]
   2) Loosen the aftercooler lower hose at air connector (26). [*4]
   3) Disconnect the air intake connector from the turbocharger. [*5]
   4) Remove lubrication upper hose (27). [*6]
      ★ Fix the connector mounting nut with a spanner to prevent it from being dragged.
   5) Remove cylinder head cover (28). [*7]
      ★ If the cylinder head cover is not removed, the lubrication return tube mounting bolt on the cylinder head side cannot be removed.
   6) Remove 4 mounting nuts (29) of turbocharger assembly (30) and place turbocharger assembly (30) on the bolts. [*8]
      ★ If turbocharger assembly (30) is not raised to increase the clearance, the mounting bolts on the inside of the lubrication return tube cannot be removed.



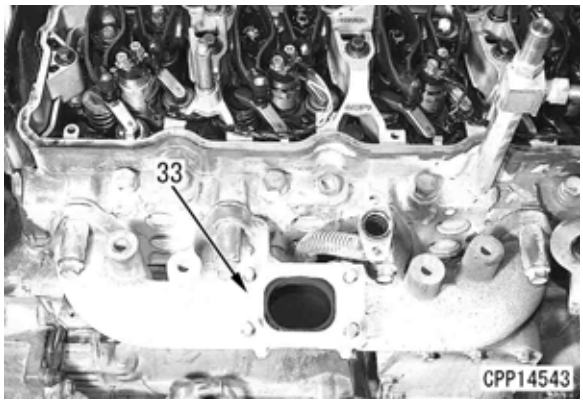
   7) Remove 2 lubrication return tube mounting bolts (31) and disconnect lubrication return tube (32). [*9]
      ★ Mounting bolt:
      Hexagon head bolt (M6 × 1.0)



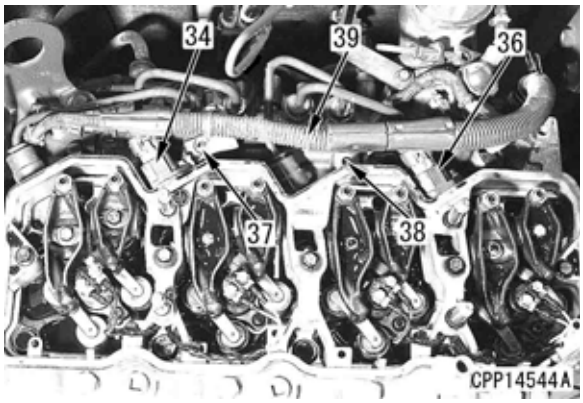
   8) Remove turbocharger assembly (30).



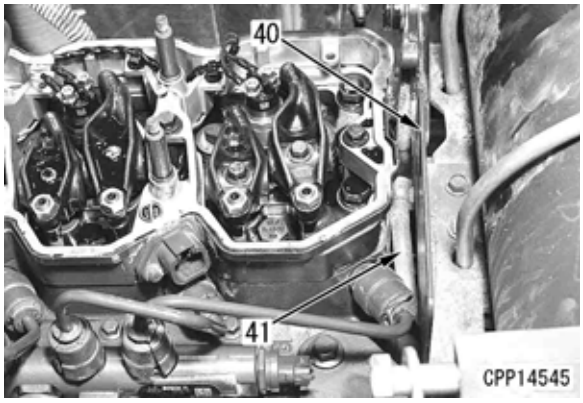
   9) Remove exhaust manifold (33). [*10]



8. Disconnect of wiring
   1) Disconnect wiring connectors (34) and (36).
   2) Disconnect wiring clamp mounting brackets (37) and (38).
   3) Move wiring (39) toward the counter weight side.

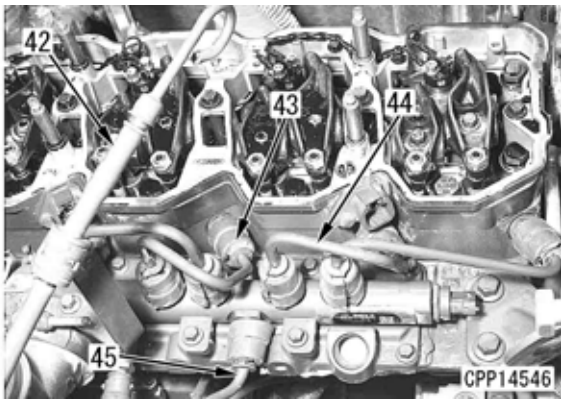


9. Disconnect fuel return hose
   1) Remove partition (40).
   2) Disconnect fuel return hose (41).



10. Remove oil level gauge guide (42).

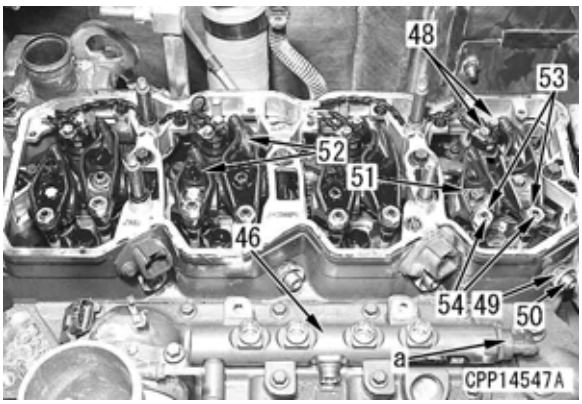
11. Removal of fuel high-pressure pipe
   1) Remove high-pressure pipe bellows (43) between the common rail and cylinder head and that between the common rail and fuel supply pump. [*11]
   2) Remove high-pressure pipe (44) between the common rail and cylinder head.
   3) Disconnect high-pressure pipe (45) between the common rail and fuel supply pump from the common rail.
      ★ Remove 2 high-pressure pipe clamps between the common rail and fuel supply pump and loosen the high-pressure pipe sleeve nut on the supply pump side.



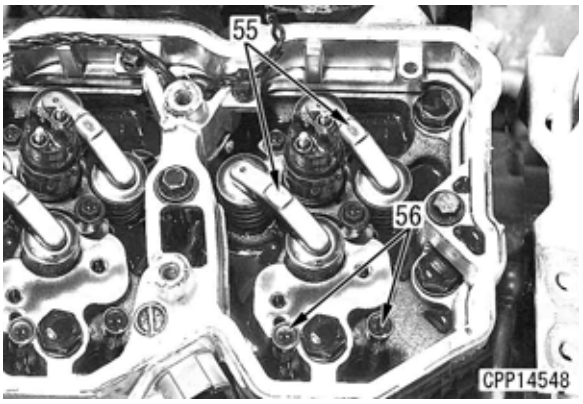
12. Remove common rail (46). [*13]
   ★ Do not remove fuel pressure sensor (a) for a reason other than replacement.
   ★ When removing the fuel pressure sensor to replace, remove all mud from and clean around it thoroughly.

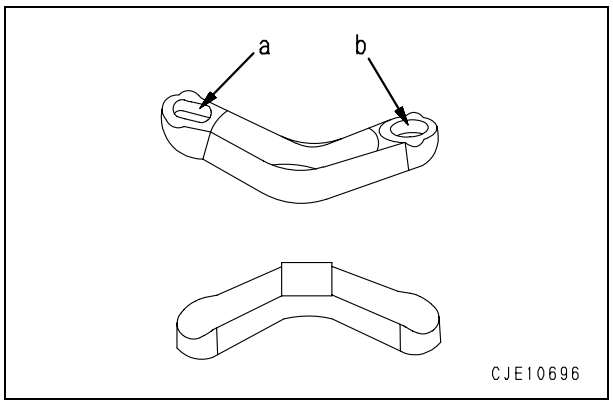
13. Referring to Testing and adjusting, "Adjusting valve clearance", check that the No. 1 and 4 cylinders are at the top dead center.

14. Removal of injector and rocker arm housing
   1) Disconnect wiring (48) from the injector. [*14]
   2) Loosen retaining nut (49) and remove inlet connector (50). [*15]
      ★ Tool **A5** is prepared for removal of the inlet connector.
   3) Remove rocker arm mounting bolts (51) and rocker arm (52) and its seat. [*16]
      ★ Loosen lock nut (53) and then loosen adjustment screw (54) thoroughly.

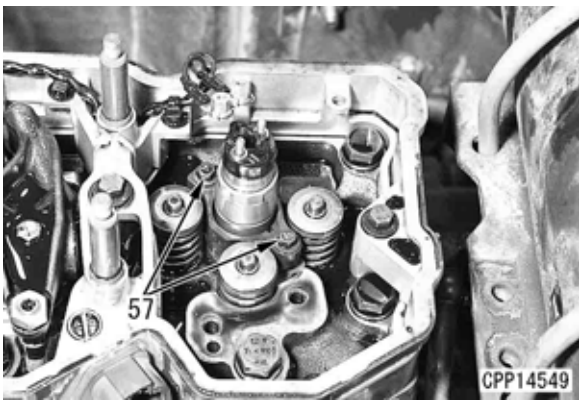


4) Remove crosshead (55). [*18]
   ★ Record the position and direction (shapes of holes "a" and "b") of each crosshead. (When reinstalling the crosshead, set it in the same direction.)
5) Remove push rod (56).

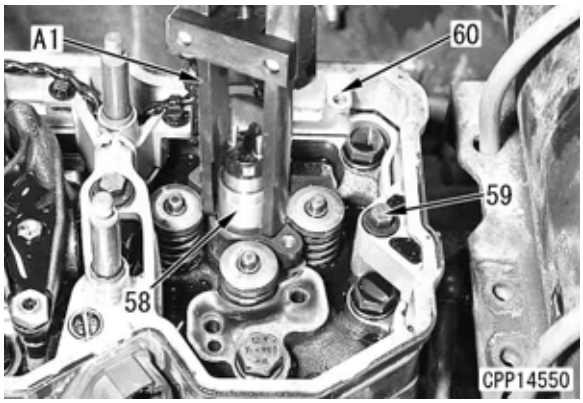




6) Remove 2 fuel injector assembly mounting bolts (57). [*19]

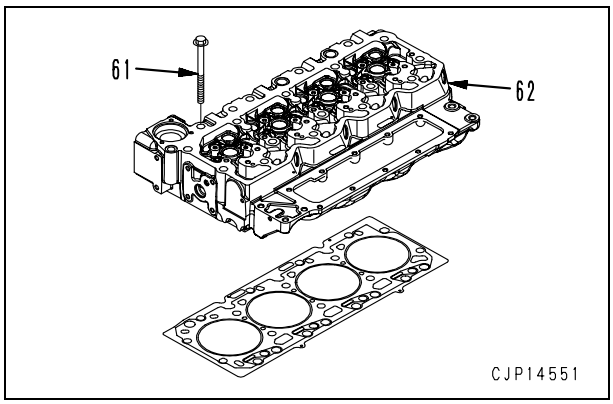


7) Using tool **A3**, remove fuel injector assembly (58). [*20]
8) Remove 5 rocker arm housing mounting bolts (59) and rocker arm housing assembly (60). [*21]



15. Remove 18 cylinder head mounting bolts (61) and lift off cylinder head assembly (62). [*22]

kg Cylinder head assembly Assembly: **50 kg**



INSTALLATION

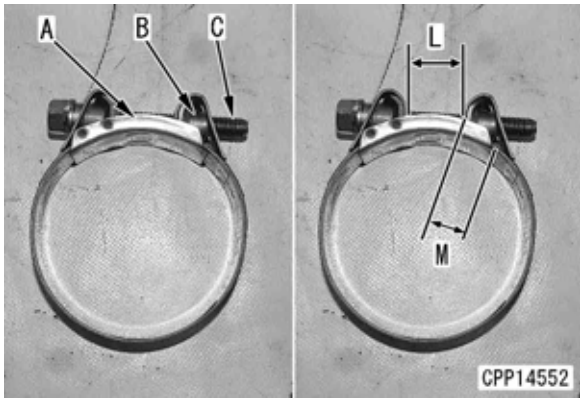
Carry out installation in the reverse order to removal.

[*1]

N·m Radiator hose mounting clamp bolt:
10.8 – 11.8 Nm {1.1 – 1.2 kgm}

[*2] [*4]

★ Procedure for installing MIKALOR clamp
- When tightening the clamp, apply the following lubricating oil or equivalent to its threaded part [C].
  Lubricating oil: Threebond (PANDO 18B)
- Adjust bridge [A] so that it will be under band [B].
- Tighten until dimensions [L] and [M] are set to the specified dimensions.
  Dimension L
  Between aftercooler and air intake connector:
  Aftercooler side: 10 (+0/-3) mm
  Air intake connector side: 16 (+0/-3) mm
  Between aftercooler and turbocharger connector: 10 (0/-3) mm
  Dimension M: Min. 5 mm
- If the tightened dimensions are out of the above ranges, replace the clamp with new one.
- Do not use an impact wrench.



[*3]

N·m Air hose clamp bolt:
10.0 – 11.0 Nm {1.02 – 1.12 kgm}

[*5]

N·m Connector mounting nut:
10 ± 2 Nm {1.02 ± 0.2 kgm}

[*6]

N·m Lubrication inlet hose mounting nut:
24 ± 4 Nm {2.4 ± 0.4 kgm}

★ When nut on turbocharger side was loosened

N·m Nut on turbocharger side:
36 ± 5 Nm {3.7 ± 0.5 kgm}

[*7]

★ When stud bolt was removed

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

[*8]

N·m Turbocharger mounting nut:
24 ± 4 Nm {2.4 ± 0.4 kgm}

★ When stud bolt was removed

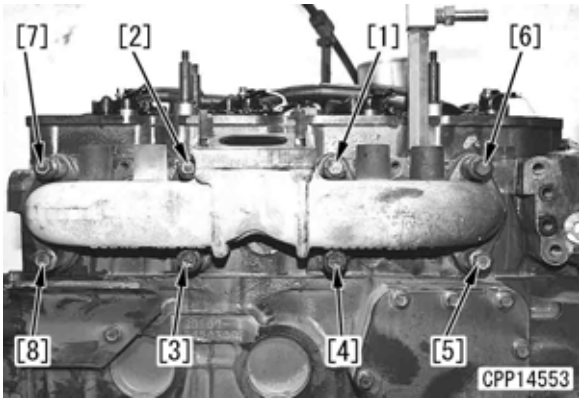
N·m Stud bolt:
10 ± 2 Nm {1.0 ± 0.2 kgm}

[*9]

N·m Lubrication return hose mounting bolt:
10 ± 2 Nm {1.0 ± 0.2 kgm}

[*10]

★ Tighten the exhaust manifold mounting bolts according to the following procedure.
1) Tighten the bolts to **24 ± 4 Nm {2.4 ± 0.4 kgm}** in the order shown in the figure.
2) Tighten the bolts to **53 ± 5 Nm {5.4 ± 0.51 kgm}** in the order shown in the figure.
3) Tighten only [1] – [4] in the figure to **53 ± 5 Nm {5.4 ± 0.51 kgm}** again.



[*11] [*12]

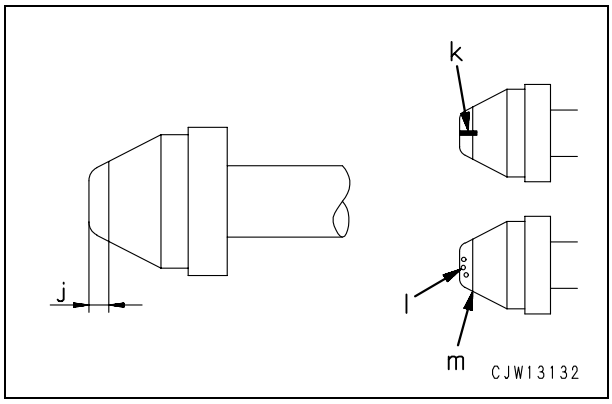
- Precautions for installing high-pressure pipe

⚠ WARNING

- **Do not bend the high-pressure pipe to collect before installing.**
- **Be sure to use the genuine high-pressure pipe clamps and observe the tightening torque.**
- **After installing the high-pressure pipe, be sure to install the bellows to the sleeve nut.**
- **Direct each bellows out and down.**

★ Before installing the high-pressure pipe, check it for the following defects. If there is any of these defects, it can cause fuel leakage. Accordingly, replace the high-pressure pipe.

- Check the taper seal of the connecting part (Part "j": Part of 2 mm from the end) for visible length-wise slit "k" and dent "l".
- Check part "m" (End of the taper seal: Part at 2 mm from the end) for stepped-type wear (fatigue) which your nail can feel.



- Install the high-pressure pipe according to the following procedure.

(Between common rail and cylinder head)

1. Tighten all the high-pressure pipes temporarily.

N·m Sleeve nut:
0.2 – 0.8 Nm {0.02 – 0.08 kgm}

2. Tighten the high-pressure pipes to the specified torque in the following order.

N·m Sleeve nut:
35 ± 3.5 Nm {3.57 ± 0.36 kgm}

1) #1 cylinder head side
2) #4 cylinder head side
3) #4 common rail side
4) #1 common rail side
5) #2 cylinder head side
6) #3 cylinder head side
7) #2 common rail side
8) #3 common rail side

(Between common rail and supply pump)

1. Finger-tighten the high-pressure pipes on the supply pump side and common rail side.
2. Tighten the high-pressure pipes to the specified torque in the order of the fuel supply pump side and common rail side.

N·m Sleeve nut:
35 ± 3.5 Nm {3.57 ± 0.36 kgm}

3. Install clamp bracket.

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

- Install the bellows to all the high-pressure pipe sleeves.
  - ★ Install each bellows with the slits out and down.
  - ★ The bellows are installed so that fuel will not spout over the hot parts of the engine and catch fire when it leaks for some reason.

[*13]

- Handling of fuel pressure sensor and relief valve

1. Procedure for installing fuel pressure sensor
   If the sensor was removed from the common rail, be sure to replace it with new one.
   1) Check the sensor connector for cracking/ breakage, damage of seal, foreign matter at pin, corrosion/bend/breakage of pin, etc.
   2) Install a new sensor.
   ★ Apply clean gear oil #90 to the threaded part.
   Tightening torque:
   70 ± 5 Nm {7.1 ± 0.5 kgm}
   3) Connect the wiring connector. At this time, take care not to connect the connector in reverse.
   (After starting the engine, check for leakage. For the checking procedure, see "Shop Manual, Testing and Adjusting".)
2. Procedure for installing relief valve
   1) If the leakage through the relief valve exceeds the specified value, do not reuse that relief valve.
   2) Install the relief valve.
   ★ Apply clean gear oil #90 to the threaded part.
   Tightening torque:
   100 ± 4 Nm {10.2 ± 0.4 kgm}
   ★ Tightening too strongly can cause leakage.
   (After starting the engine, check for leakage. For the checking procedure, see "Shop Manual, Testing and Adjusting".)

[*14]

N·m Wiring mounting bolt:
1.5 ± 0.25 Nm {0.15 ± 0.03 kgm}

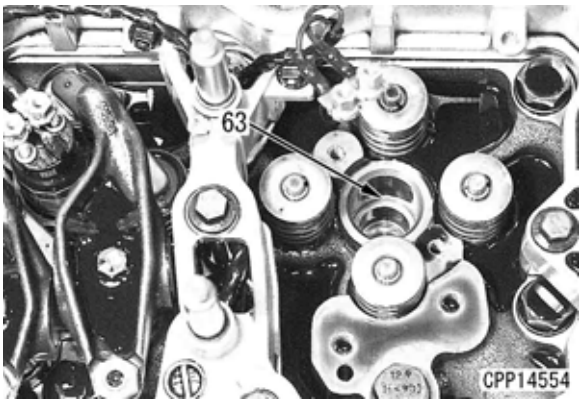
★ Connect the wirings to their original cylinders.

Wiring color	Cylinder No.
White	1, 3
Black	2, 4

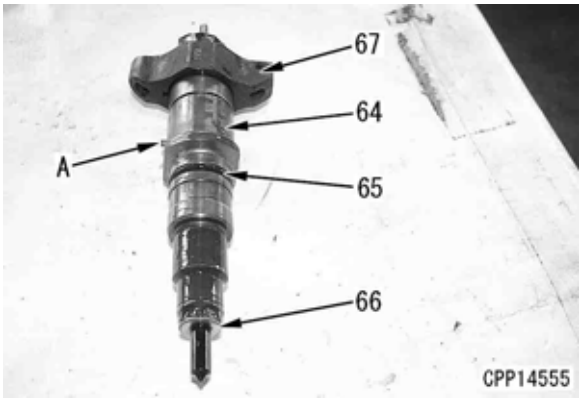
[*15] [*19] [*20]

- Procedure for installing fuel injector

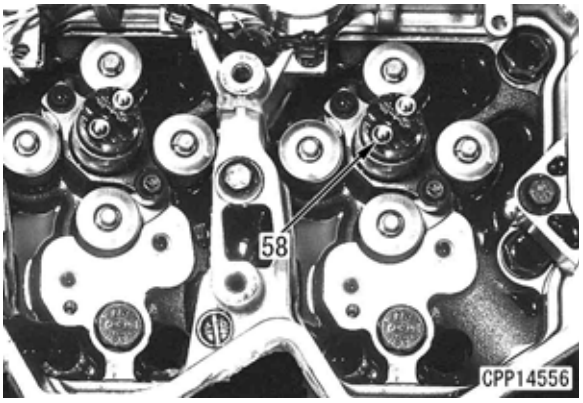
★ Check that fuel injector sleeve (63) is free from flaw and dirt.



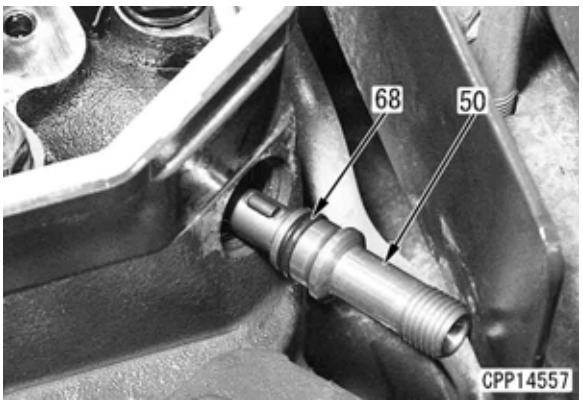
1) Fit O-ring (65) and gasket (66) to fuel injector (64).
   ★ Replace O-ring and gasket with new one.
2) Apply engine oil (EO15W-40) to the O-ring of the fuel injector (64) and the mounting hole on the head.
3) While setting the concave and convex (A), install holder (67) to fuel injector (64).



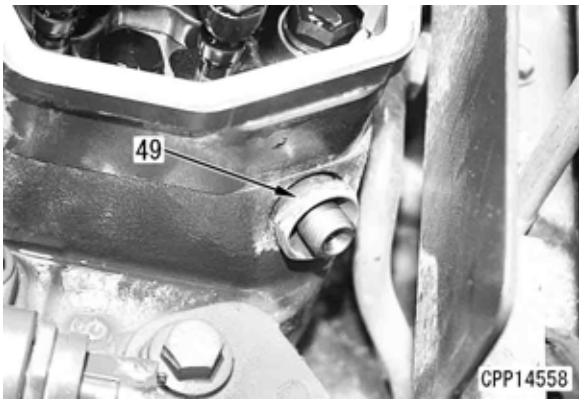
4) Install fuel injector assembly (58) to the fuel injector sleeve and tighten the mounting bolt by 3 – 4 turns.
★ When installing the fuel injector assembly, direct the fuel inlet hole (inlet connector mounting hole) toward the air intake manifold.



5) Apply engine oil (EO15W-40) to O-ring (68) of inlet connector (50) and the inlet connector mounting hole.
6) While setting part B of the inlet connector to the groove (upper side) on the head, insert inlet connector (50) to the end.



7) Install and finger-tighten retaining nut (49).

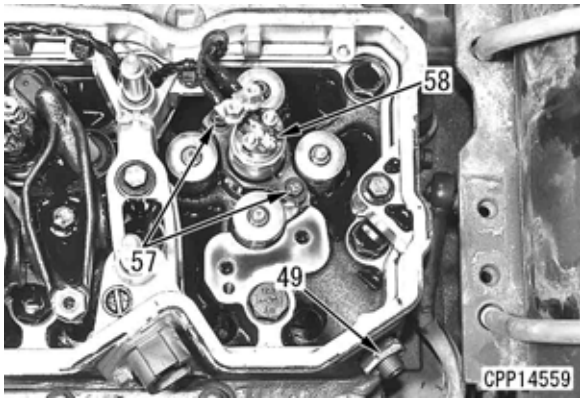


8) Tighten right and left mounting bolts (57) of injector assembly (58) alternately.

N•m Fuel injector mounting bolt:
8 ± 0.8 Nm {0.8 ± 0.08 kgm}

9) Tighten retaining nut (49) to the specified torque.

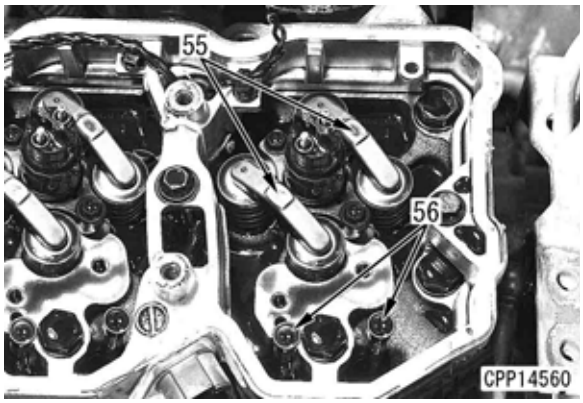
N•m Retaining nut:
50 ± 5 Nm {5.1 ± 0.5 kgm

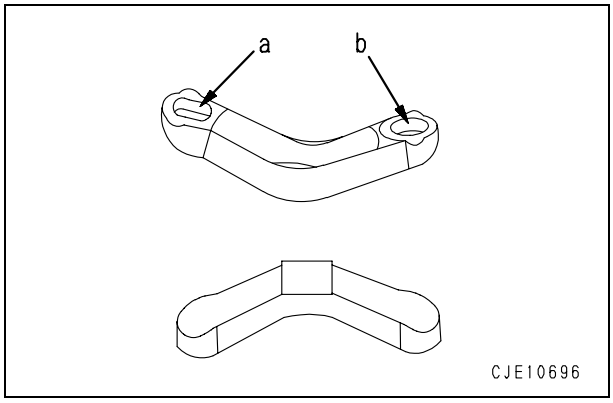


[*16] [*17] [*18]

- Installation of rocker arm

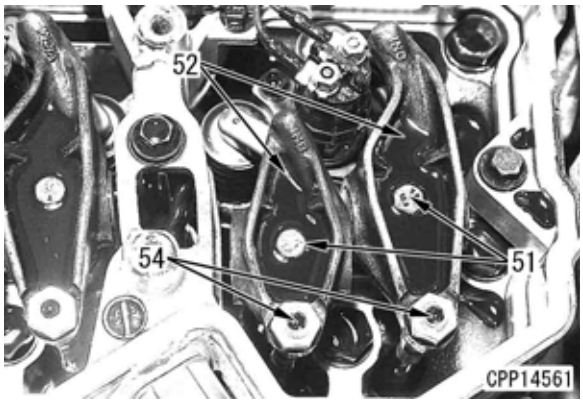
1) Install push rod (56).
2) Install crosshead (55).
★ Install the crosshead to the position in the direction recorded when it was removed (Check the shapes of holes "a" and "b").





3) Install rocker arm (52) and tighten the mounting bolt (51).
★ Check that adjustment screw (54) is loosened thoroughly.

N·m Rocker arm mounting bolt:
36 ± 5 Nm {3.7 ± 0.5l kgm}



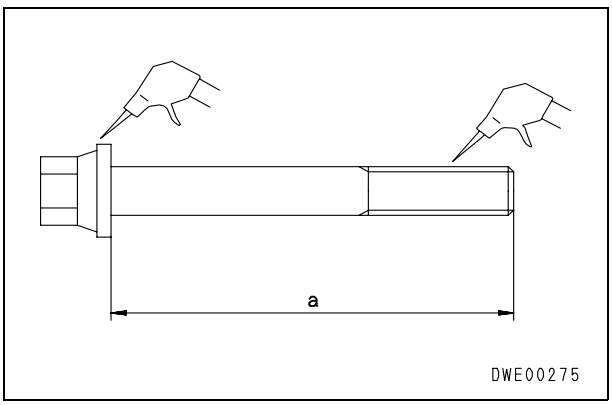
- Adjusting valve clearance

  Referring to Testing and adjusting, "Adjusting valve clearance", adjust the valve clearance.

[*21]

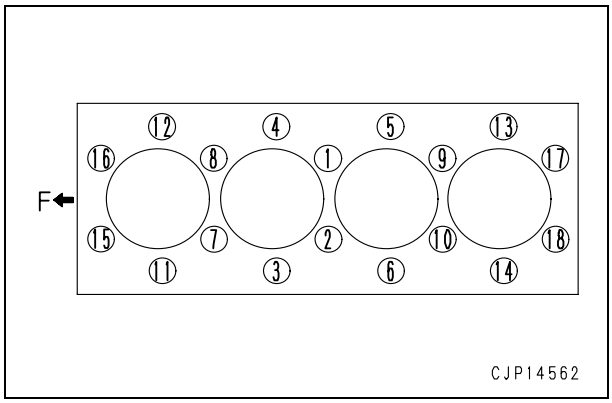
N·m Rocker arm housing mounting bolt:
24 ± 4 Nm {2.4 ± 0.4 kgm}

[*22]
- Precautions for installing cylinder head assembly
  - ★ Use a new gasket.
  - ★ Measure stem length "a" of every bolt and check that it is less than the using limit.
    Using limit length of bolt stem: 132.1 mm
  - ★ If the stem length of a bolt is longer than the using limit, do not reuse that bolt but replace it.
  - ★ Tool **A7** (Gauge) is prepared for measurement of the stem length of the bolts.



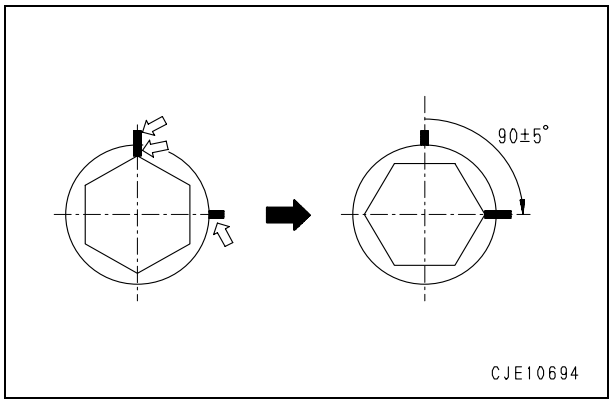
- Tighten each cylinder head mounting bolt 2 – 3 turns with the fingers first and then tighten them in the following order.
  - ★ Apply engine oil (SAE15W-40) to the threaded part of each bolt.

  1) Tighten the bolts to 70 ± 6 Nm {7.14 ± 0.61 kgm} in the order of 1 – 18.
  2) Loosen all the bolts by 360 ± 5 °.
  3) Tighten the bolts to 105 ± 3 Nm {110.7 ± 0.31 kgm} in the order of 1 – 18.
  4) Tighten the bolts by 90 ± 5 ° in the order of 1 – 18.
     - ★ **Tool A6 (wrench) is prepared for angle tightening.**



- When not using angle tightening tool

  Make a mark on the cylinder head and each bolt with paint and then tighten the bolt by 90 ° ± 5 ° in the order of 1 – 18.



REMOVAL AND INSTALLATION OF COMBINATION COOLER

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.

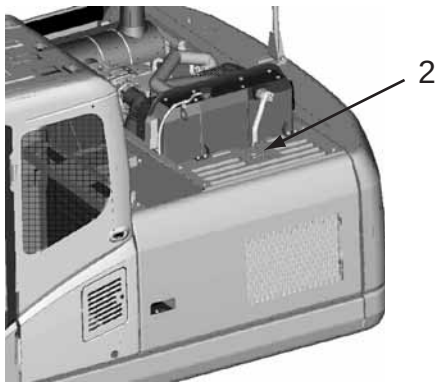
- Remove the hydraulic tank strainer, and using tool B stop the oil.
- When not using tool B, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

1. Drain the engine cooling water.

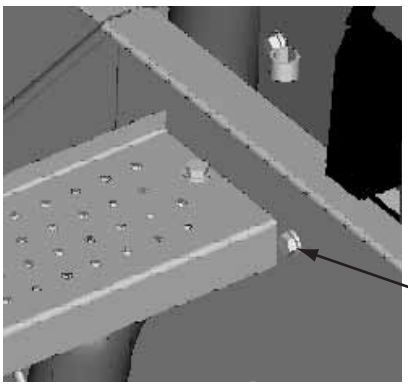
Engine cooling water: Approx. 18L

2. Open up the engine hood and remove (see page 30- 46).

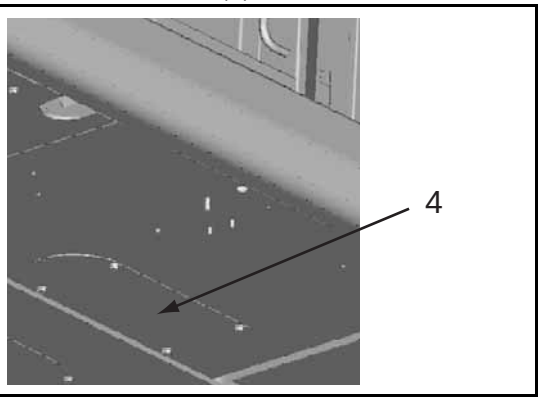
3. Remove cover (2).



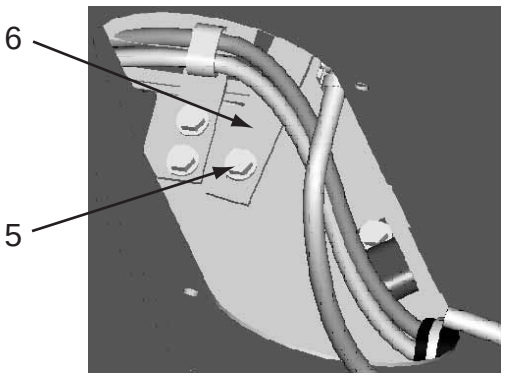
4. Remove Bolt (3).



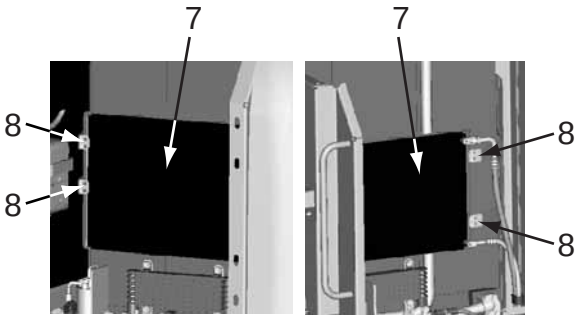
5. Remove UnderCover (4)



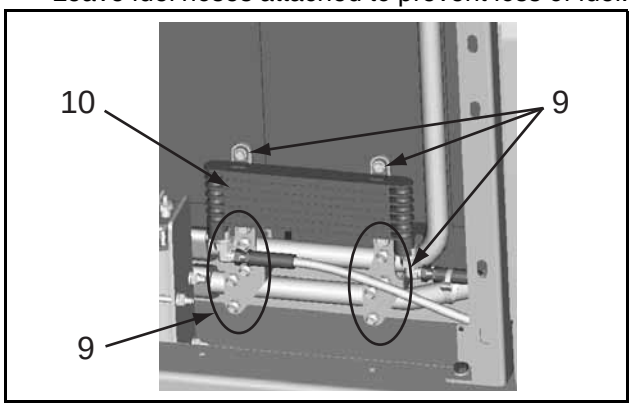
6. Remove bolt (5) to disconnect stay (6)



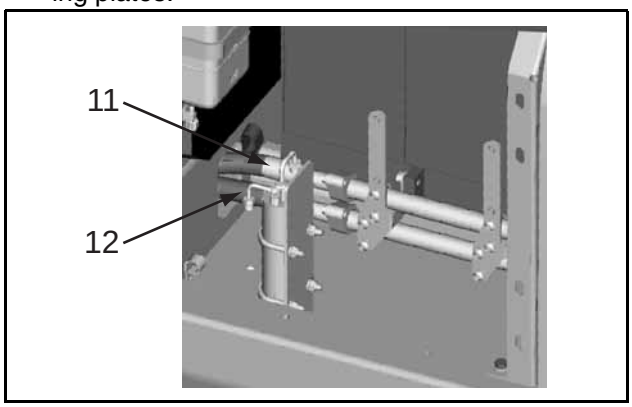
7. Remove condenser (7) by removing four bolts (8). Leave A/C hoses attached to prevent loss of A/C refridgeration.



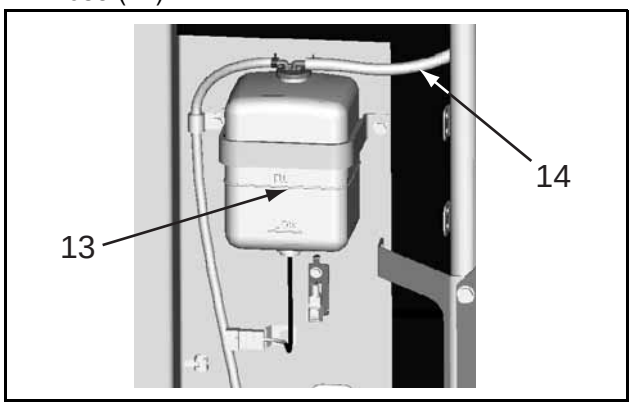
8. Remove fuel cooler (9) by removing bolts (10). Leave fuel hoses attached to prevent loss of fuel.



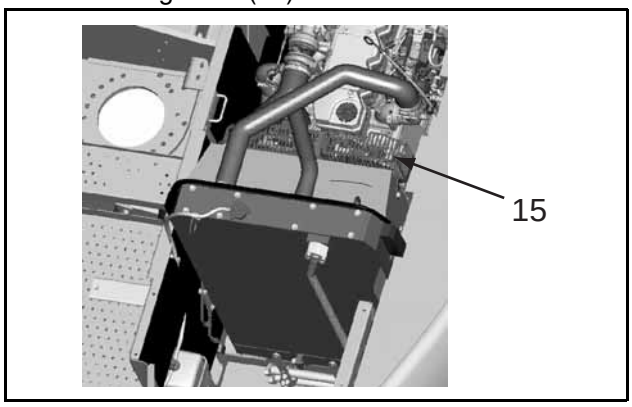
9. Disconnect oil cooler inlet (11) and outlet (12) hoses. Cap oil cooler hoses with suitable blanking plates.



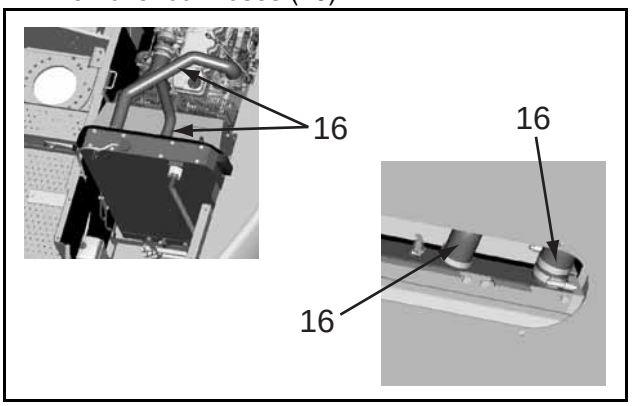
10. Disconnect resovoir tank (13) by disconnecting hose (14).



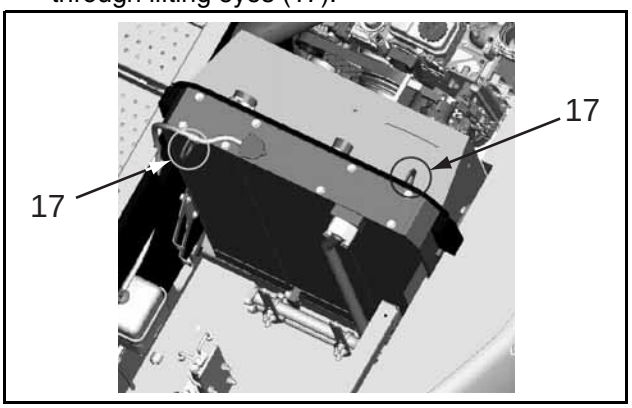
11. Remove guards (15).



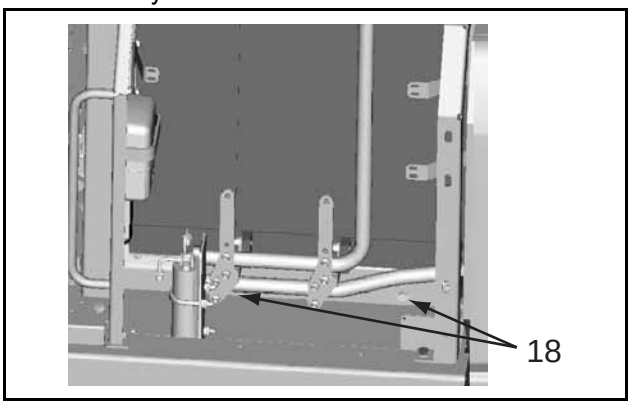
12. Remove four hoses (16).



13. Sling radiator assembly with two lifting hooks through lifting eyes (17).



14. Remove two mounting bolts (18) and lift radiator assembly out.



INSTALLATION

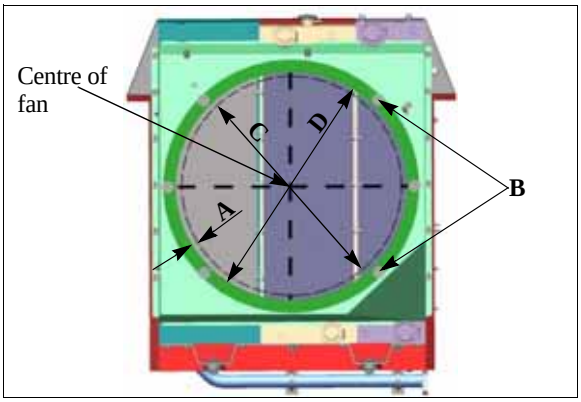
- Install in reverse order of removal.

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.

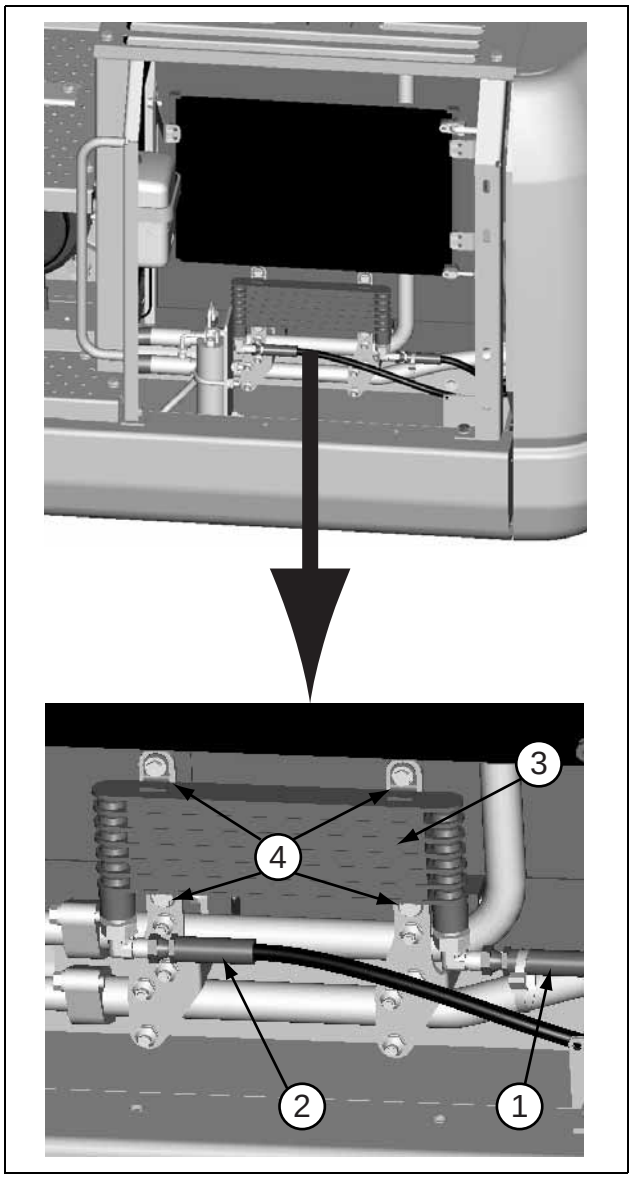
Engine cooling water: Approx. 18L

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 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

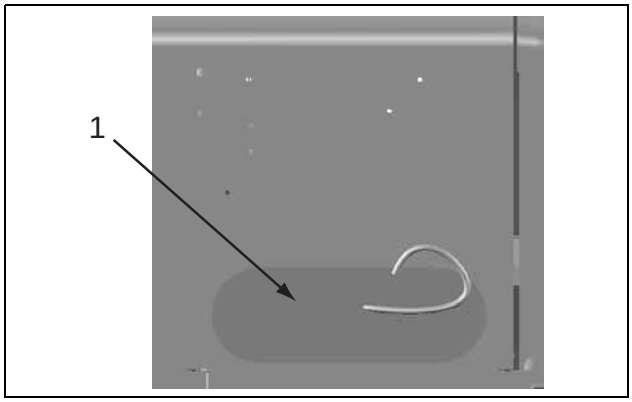
Sym-bol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
D	10	796-460-1210	Oil stopper	●	1		
	11	796-770-1320	Adapter	●	1		

REMOVAL

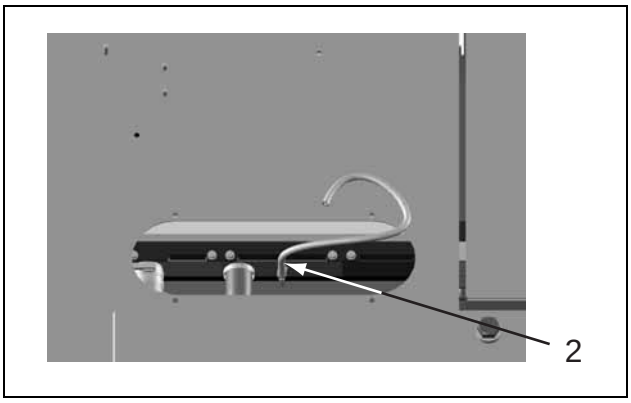
⚠ WARNING

- **Stop the machine on a level ground, lower the work equipment to the ground, stop the engine, and set the lock lever in the lock position.**
- **Disconnect the cable from the negative (–) terminal of the battery.**
- **Loosen the hydraulic tank cap gradually to release the residual pressure in the hydraulic tank.**

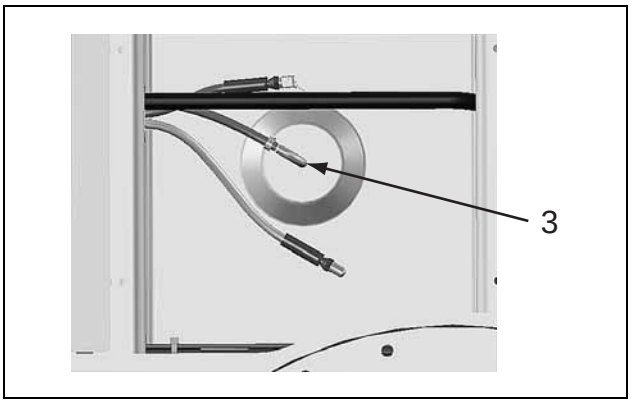
1. Remove undercover (1).



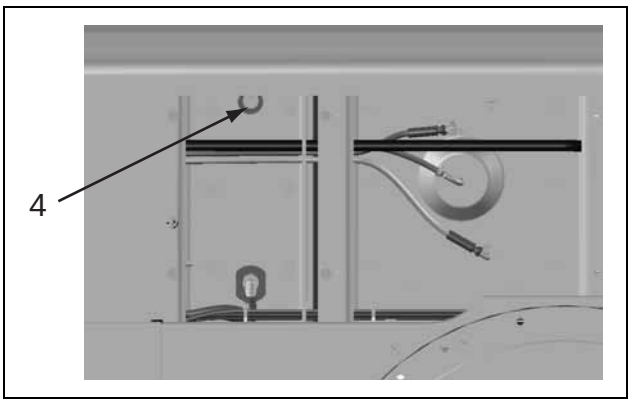
2. Drain the coolant through coolant drain port (2).
   Coolant: 18L



3. Close fuel stop valve (3).

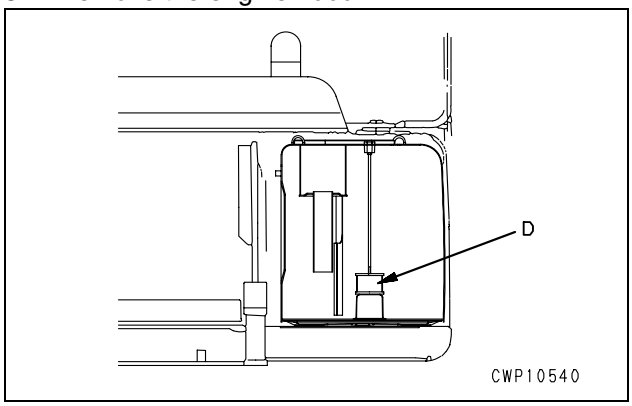


4. Loosen hydraulic oil drain plug (4) to drain the work equipment oil. [*1]
   Hydraulic tank: 131L

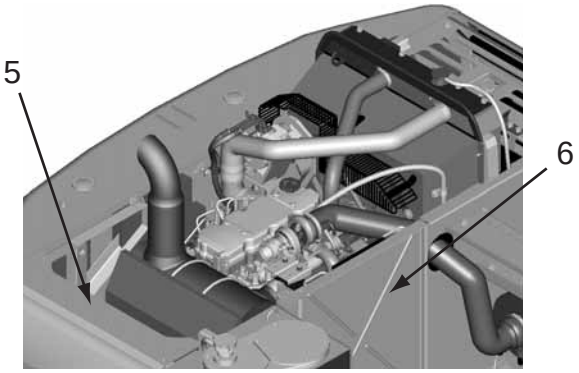


★ When using tool **D11**, remove the hydraulic tank strainer and stop the oil with tool **D10**.

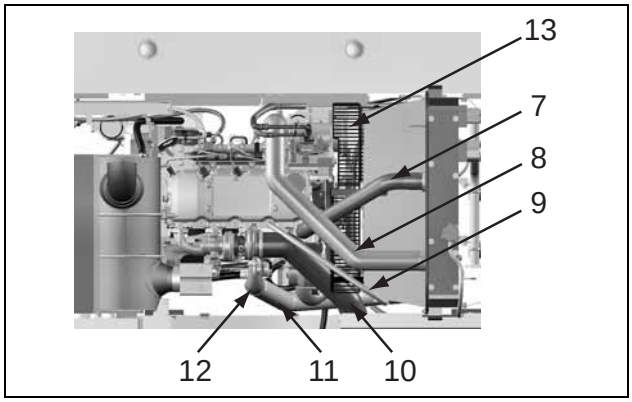
5. Remove the engine hood.



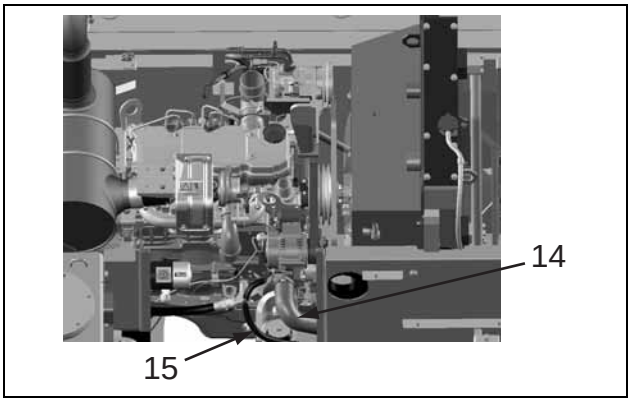
6. Removal of covers
   1) Remove cover (5).
   2) Remove partition (6).



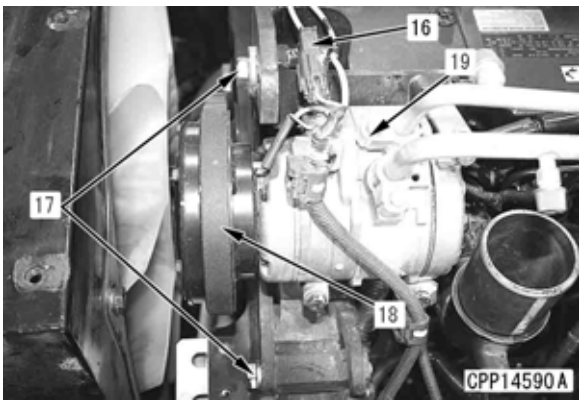
7. Removal of hoses
   1) Remove radiator hose (7) [*2]
   2) Remove aftercooler hose (8). [*3]
   3) Disconnect heater hose (9).
   4) Disconnect air hose (10) between the turbocharger and air cleaner. [*4]
   5) Disconnect hose (11) between the turbocharger and aftercooler from connector (12). [*5]
   6) Remove guard (13).



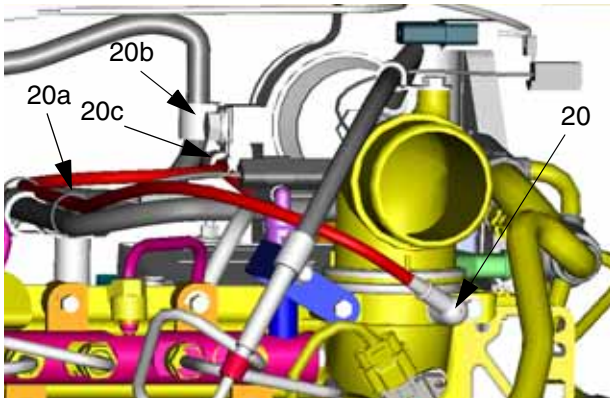
   7) Disconnect radiator lower hose (14) and heater lower hose (15). [*6]



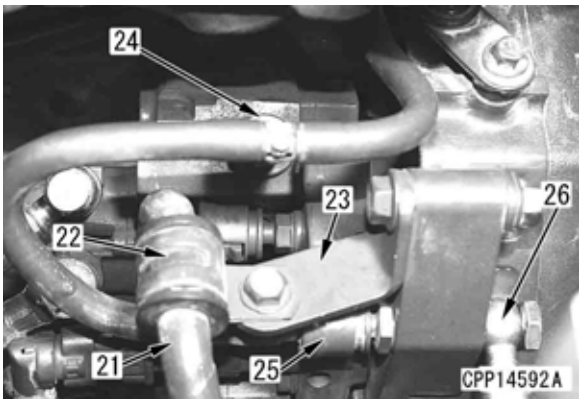
8. Disconnection of air conditioner compressor assembly
   1) Disconnect wiring connector E05 (16).
   2) Remove 2 air conditioner compressor mounting bolts (17).
   3) Remove drive belt (18).
   4) Disconnect air conditioner compressor assembly (19) and move it aside so that it will not be an obstacle. [*7]

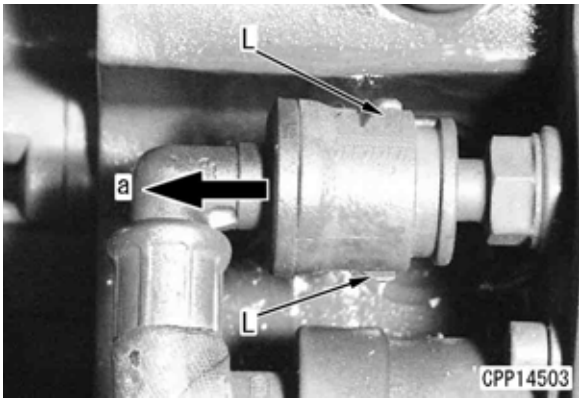


9. Disconnect electrical intake air heater wiring terminal E01 (20) from the air intake connector and remove clips (20a), (20b) and (20c)..

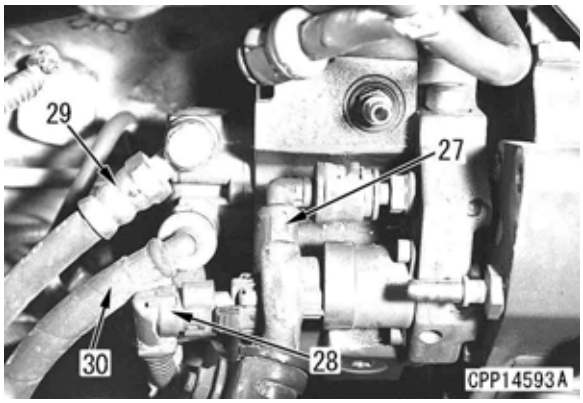


10. Disconnection of fuel supply pump hose and clamp
    1) Disconnect clamp (22) of fuel hose (21) from bracket (23).
    ★ When loosening the bolt, fix the nut with wrench so that the hose will not be twisted. (If the hose is dragged and twisted, an excessive force is applied to the connector and the inside of the connector may be broken.)
    2) Remove clamp bracket (23).
    3) Disconnect fuel return hose (24) connected to the supply pump. [*8]
    ★ When removing a connector of quick coupler type, observe the following points.
    - Remove mud from each hose joint in advance (since the lock may be stuck in the mud).
    - Never use pliers or a screwdriver to disconnect the connector.
    - Pull out lock (L) of each hose joint straight (in direction [a]) while pressing it from both sides. (If the connector is disconnected forcibly by twisting or bending it to the right and left, its inside may be broken.)
    - Put plugs in the adapters of the disconnected hoses to prevent fuel from flowing out. (Do not use wooden plugs since chips may enter the fuel line.)
    4) Disconnect fuel return hose (25).
    5) Disconnect hose (26) connected to the fuel cooler.

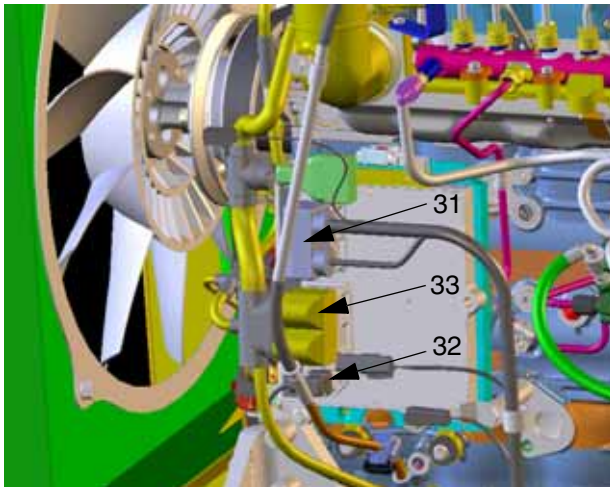




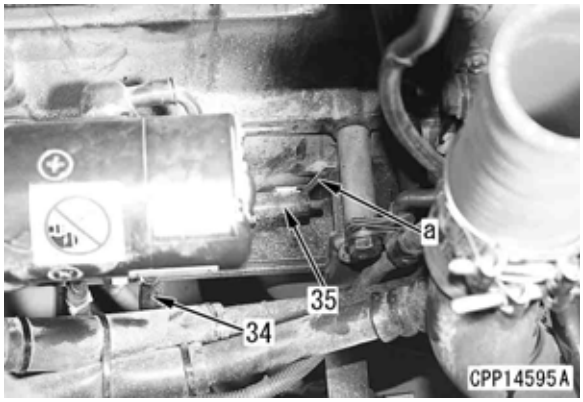
    6) Disconnect hose (27) connected to the fuel filter.
    ★ Before disconnecting hose (27), be sure to perform steps 1 to 5.
    7) Disconnect wiring connector (28).
    8) Disconnect hose (29) connected to the pre-filter.
    9) Disconnect hose (30) connected to the fuel filter.



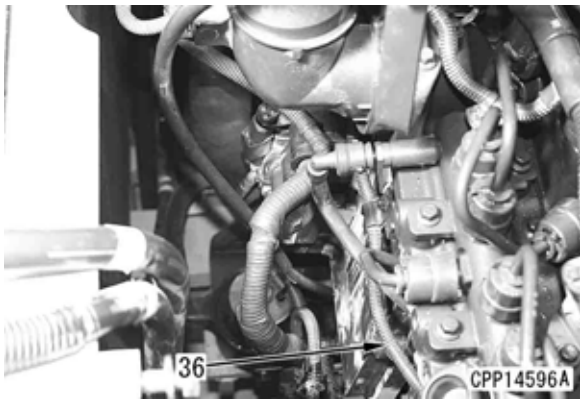
11. Disconnect wiring connectors CE02 (31) and CE03 (32) of the engine controller.
    ★ Do not disconnect ECM connector (33) but leave it connected, since it is on the engine side.



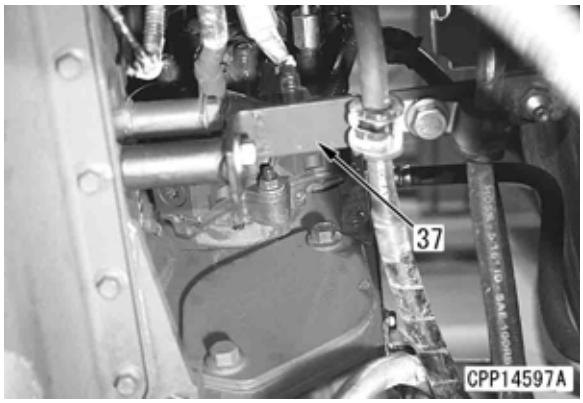
12. Disconnection of starting motor wiring
    1) Disconnect starting motor terminal B wiring SB (34).
    2) Disconnect starting motor wiring connector SC (35).
       ★ Pull connector (36) out of bracket [a] and disconnect the male and female pieces.



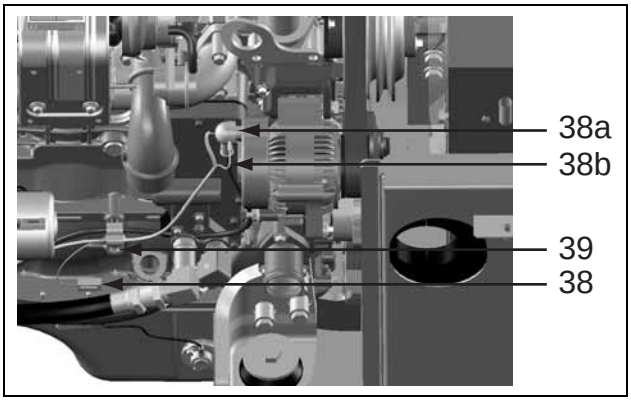
13. Disconnect water separator sensor wiring connector E06 (36).
    ★ The wiring connector No. on the engine side is WIF (female).



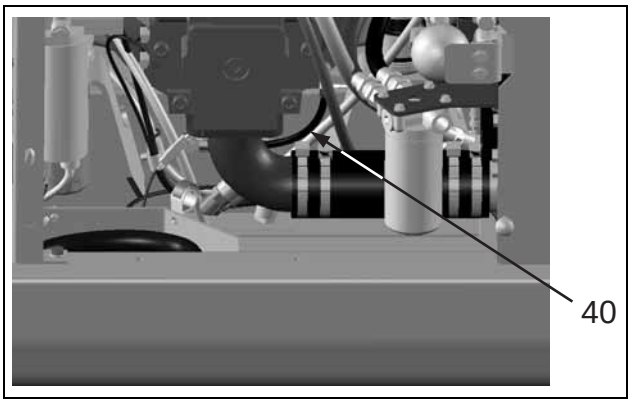
14. Disconnection of wiring from under chassis
    1) Disconnect fuel hose clamp bracket (37) from the engine block.



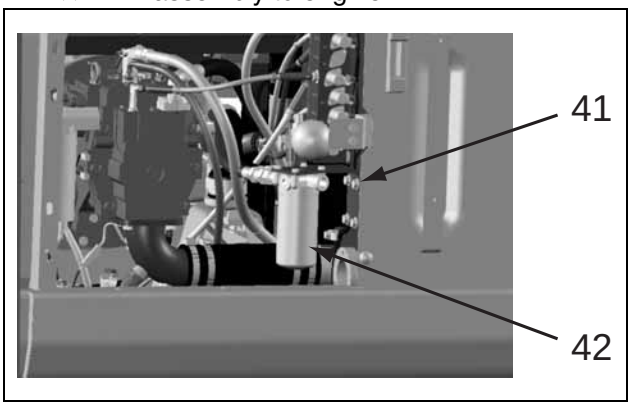
    2) Disconnect oil level sensor E03 (38), alternator wiring E12 (38a), AB (38b) and clamp (39).



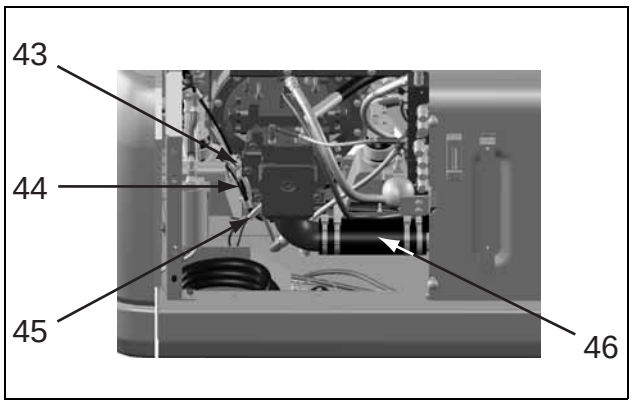
    3) Disconnect ground wire (40).



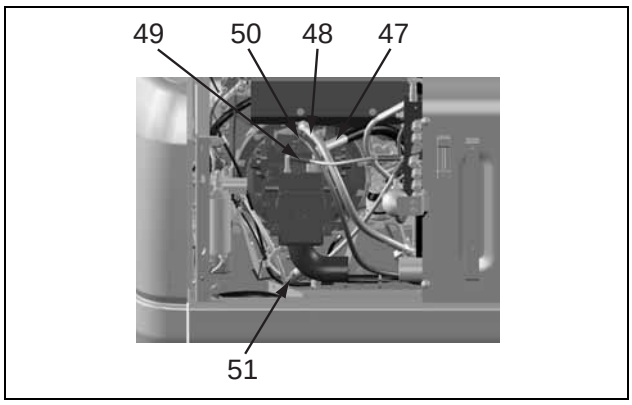
15. Remove four bolts (41) then disconnect engine oil filter (and bracket assembly (42).
    ★ Fix assembly to engine.



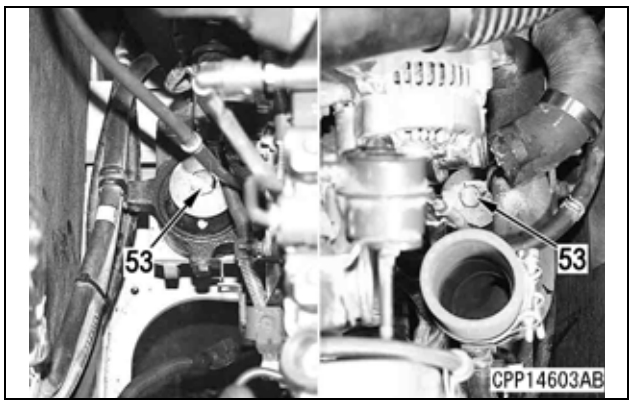
16. Removal of wirings and hoses around hydraulic pump
    1) Disconnect wiring connectors V22 (43), V21 (44) and A55 (45).
    2) Disconnect suction tube (46).
       ★ When disconnecting the hose, place a receiving pan under the pump.



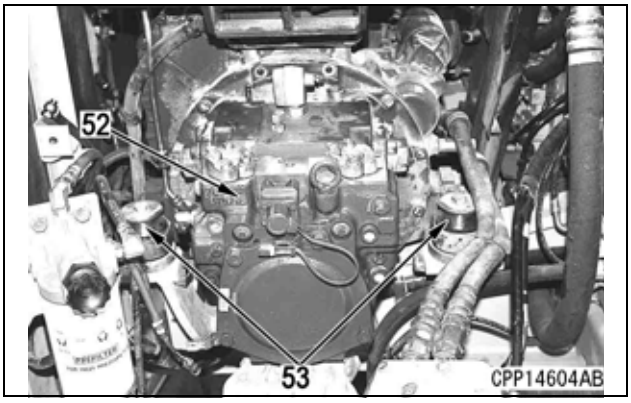
    3) Disconnect hoses (47), (48), (49), (50) and (51).



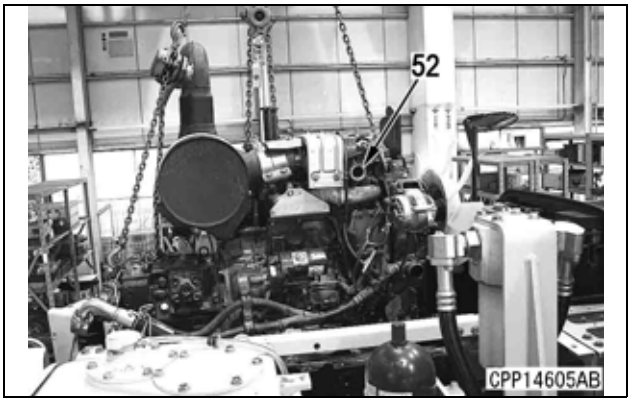
17. Sling engine and hydraulic pump assembly (52) and remove 4 mounting bolts (53). [*9]
    (Left of engine side) (Right of engine side)



(Right and left of hydraulic pump side)



18. Lift off engine and hydraulic pump assembly (52).



kg Engine and hydraulic pump assembly: **610 kg**

INSTALLATION

- Carry out installation in the reverse order to removal.

[*1]

N·m Hydraulic oil drain plug:
58.8 – 78.5 Nm {6.0 – 8.0 kgm}

[*2] [*6]

N·m Radiator hose clamp bolt:
(Both upper hose and lower hose)
10.8 – 11.8 Nm {1.1 – 1.2 kgm}

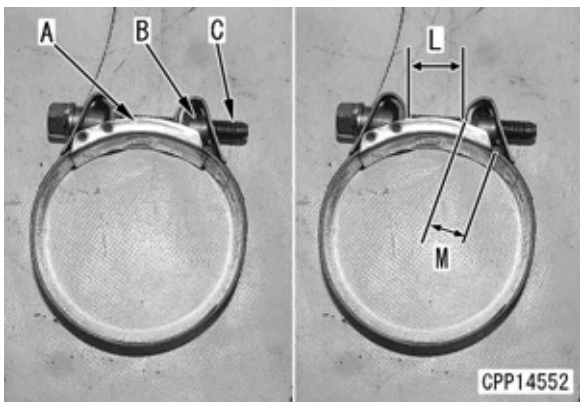
[*3]

★ Procedure for installing MIKALOR clamp

- When tightening the clamp, apply the following lubricating oil or equivalent to its threaded part [C].

  Lubricating oil: Threebond (PANDO 18B)
- Adjust bridge [A] so that it will be under band [B].
- Tighten until dimensions [L] and [M] are set to the specified dimensions.

  Dimension L
  Between aftercooler and air intake connector:
  Aftercooler side: 10 (+0/-3) mm
  Air intake connector side:
  16 (+0/-3) mm
  Between aftercooler and turbocharger connector: 10 (0/-3) mm
  Dimension M: Min. 5 mm
- If the tightened dimensions are out of the above ranges, replace the clamp with new one.
- Do not use an impact wrench.



[*4]

N·m Hose clamp between turbocharger and air cleaner: (Turbocharger side)
10.0 – 11.0 Nm {1.02 – 1.12 kgm}

[*5]

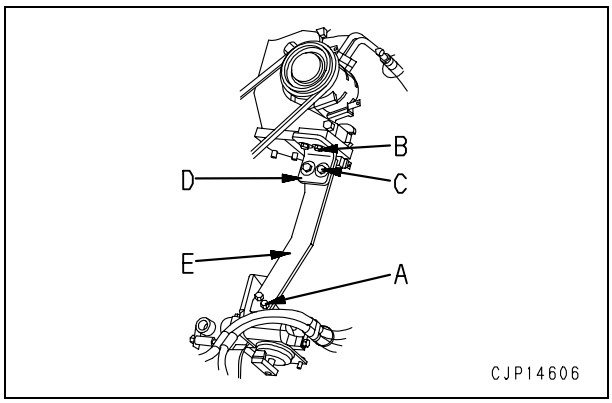
N·m Connector mounting bolt:
10 ± 2 Nm {1.02 ± 0.2 kgm}

[*6]

N·m Radiator lower hose clamp:
10.8 – 11.8 Nm {1.12 – 1.2 kgm}

[*7]

- If the air conditioner compressor bracket was removed, install it according to the following procedure.
  1) Tighten bolt A temporarily.
  2) While setting L-bracket D to stay E, tighten bolt B permanently.
     ★ After tightening permanently, the clearance between L-bracket D and stay E must not exceed 2 mm.
  3) Loosen bolt A and move stay E to adjust the level difference in the forward and backward directions.
  4) Tighten bolts A and C in order.



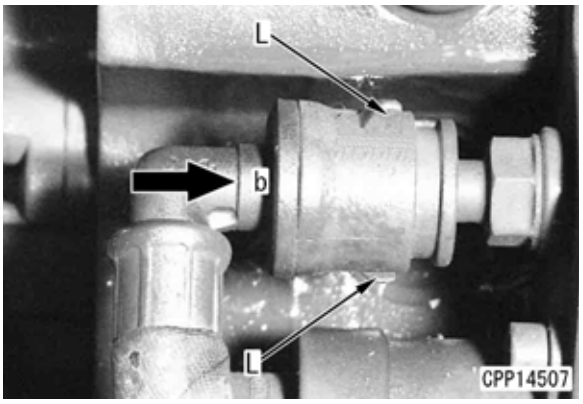
[*8]

When installing a connector of quick coupler type, observe the following points.

★ Replace the connector in the following cases.
  1] The connector was removed with pliers or a screwdriver or by bending it to the right and left.
  2] There is damage or deformation in the connector.
★ Check that mud or dirt is not sticking to the hose adapter in advance.
★ Press and insert the connector straight (in direction [b]) without bending it to the right or left.

(If it is difficult to insert the connector, do not push it in forcibly but pull it out.

Then, check the convex and concave parts for abnormality and mud.)



[*9]

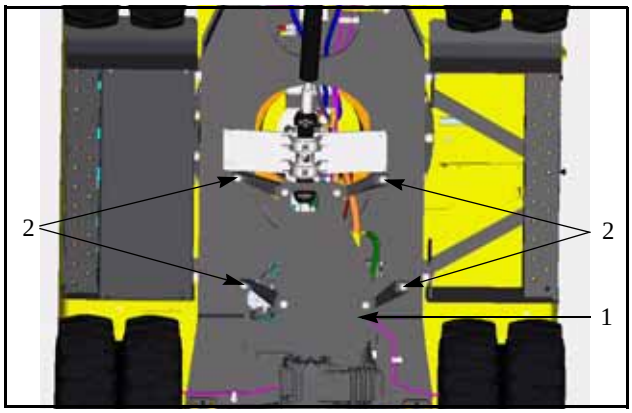
N·m Mounting bolt:
245 – 308.7 Nm {25 – 31.5 kgm

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) {if fitted} by removing bolts (2).

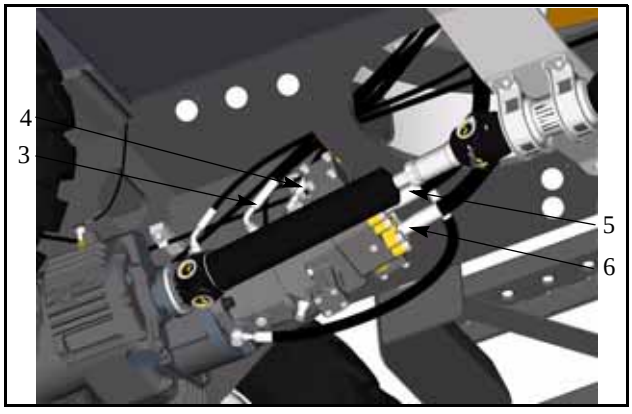


2. Drain oil out of transmission and travel motor.

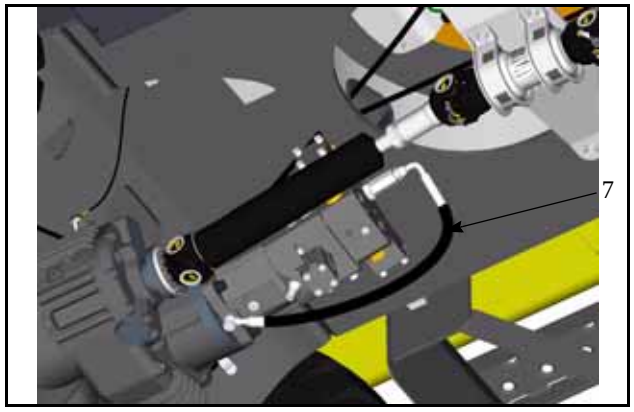
3. Attach an identification tag to hoses to avoid incorrect connection during re-assembly.

4. Attach vacuum pump to hydraulic tank.

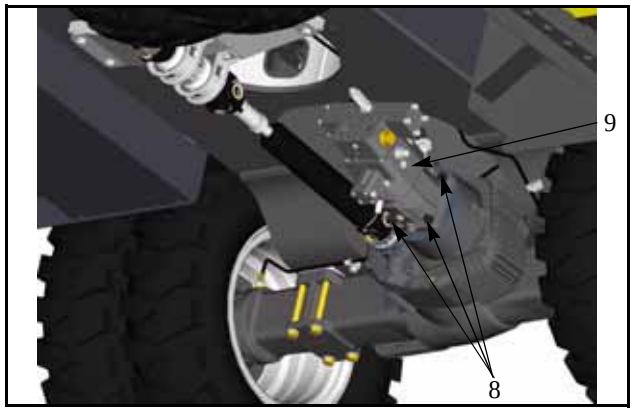
5. Disconnect each hose individually and plug with blank/plug and O-ring from blanking kit to prevent oil spillage and contamination (3 through 6).



6. Remove drain hose (7).



7. Remove 4 bolts (8) and remove travel motor (9) in direction to disengage the splined shaft. (Weight approx. 66kg).

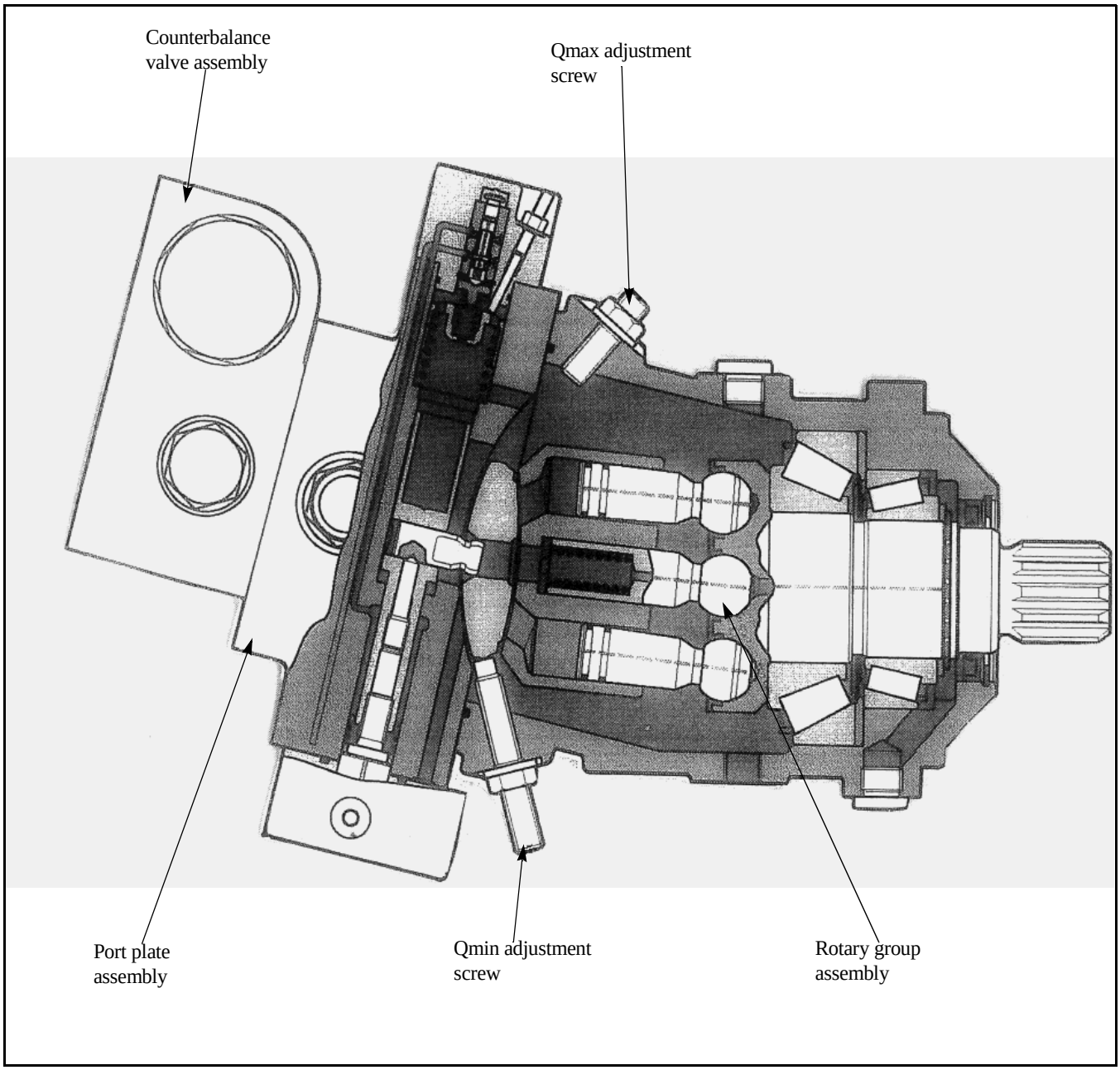


INSTALLATION

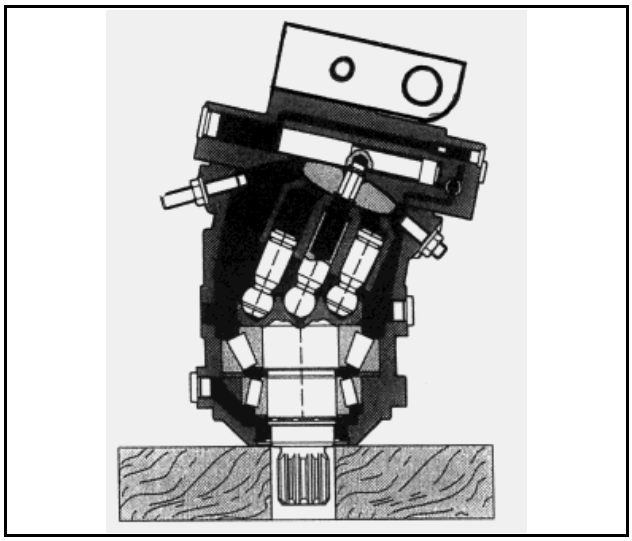
- Install in reverse order of removal.
- Tightening torque for propshaft nuts is: 25 - 31.5 kgf-m
- Refill the transmission oil to the required level (4.85 litres).
- Top up hydraulic through oil filler port to the specified level and let the oil circulate in the hydraulic system by starting the engine. 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

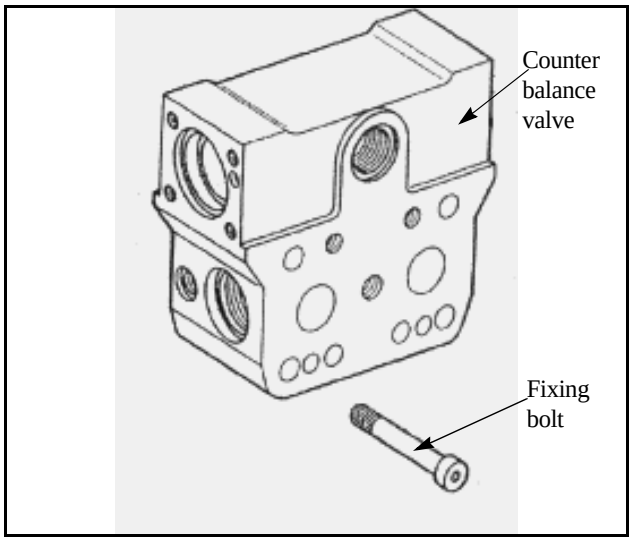
DISASSEMBLY



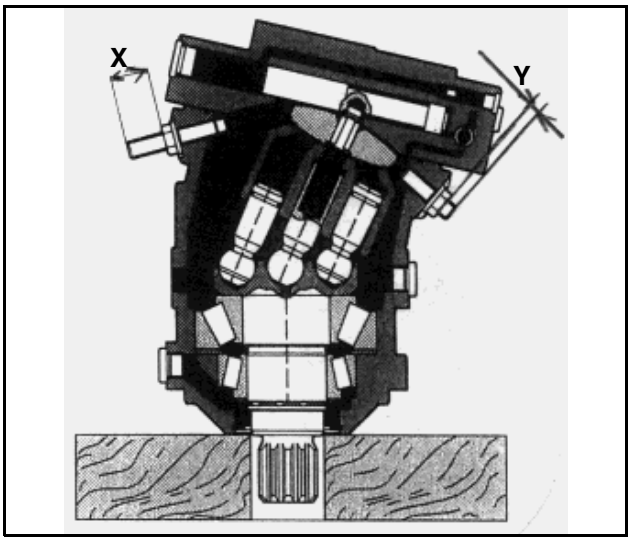
1. Put the unit in a bench with a hole or place it on a fixture for assembly.



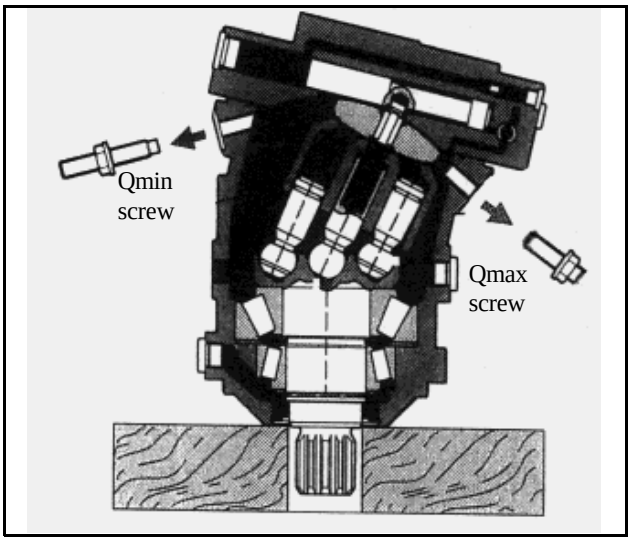
2. Remove the counterbalance valve by loosening the six fixing bolts.



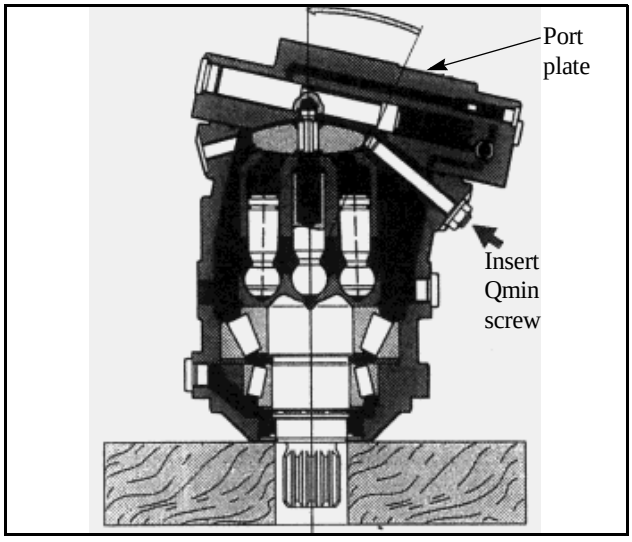
3. Before removing the port plate measure and record dimension **X** of the Qmin adjustment screw and dimension **Y** of the Qmax adjustment screw.



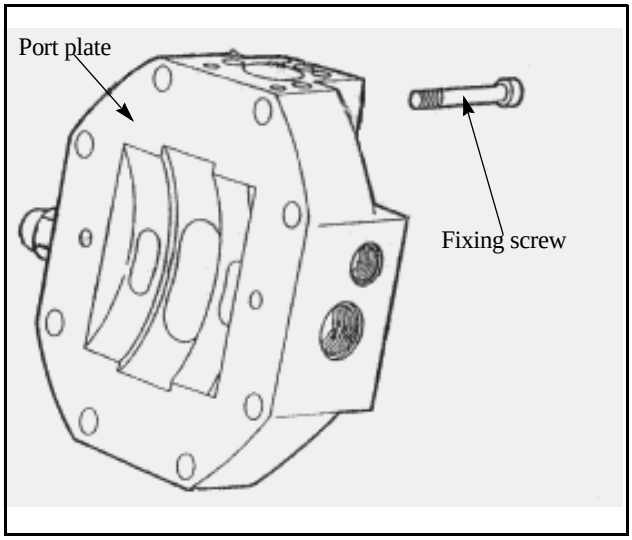
4. Remove the adjustment screws completely from the motor casing.



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).

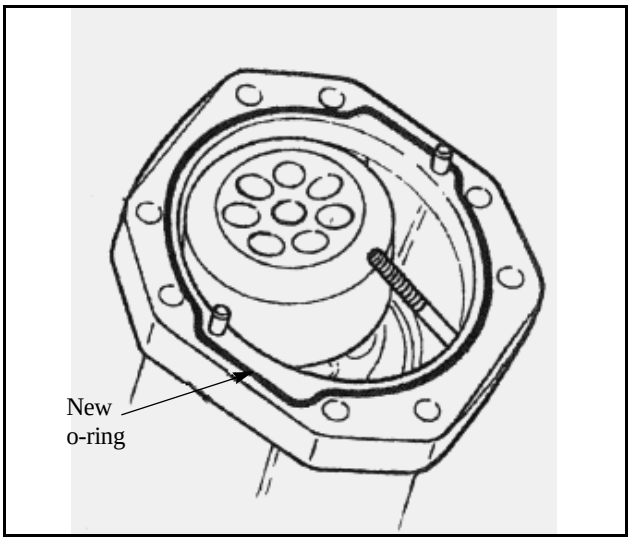


6. Remove the port plate by loosen the eight fixing bolts.

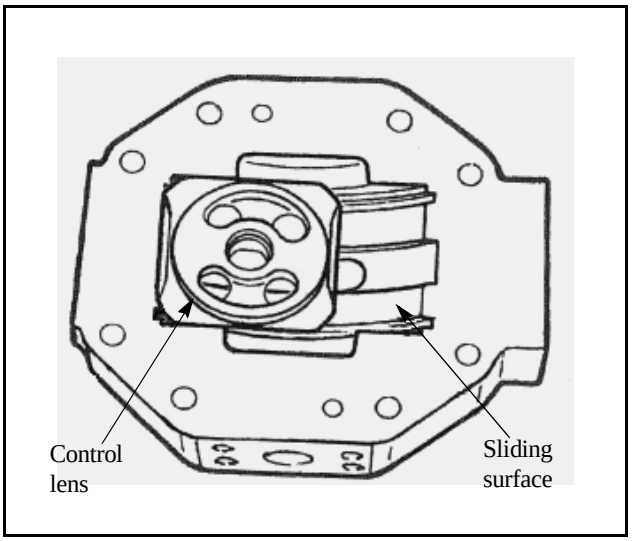


ASSEMBLY

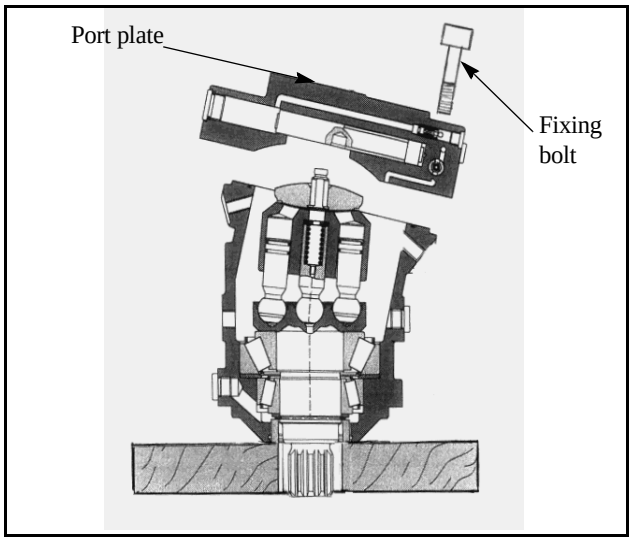
1. Do not remove rotary group from casing, just check for signs of damage or wear.
   Replace O-ring and install into position using grease.



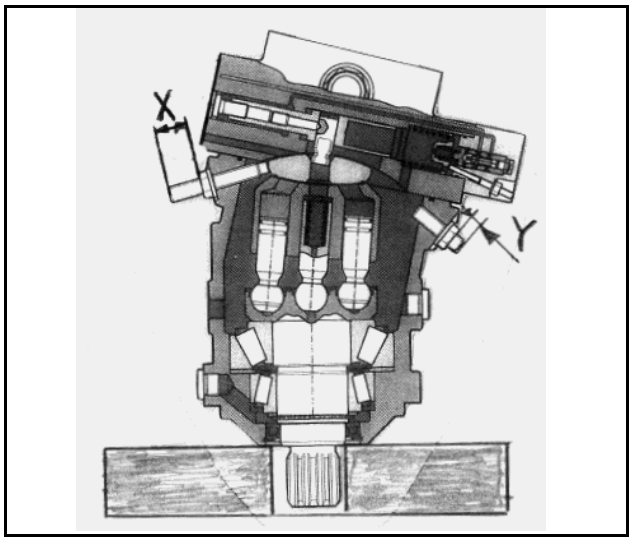
2. Apply grease to control lens sliding surface.



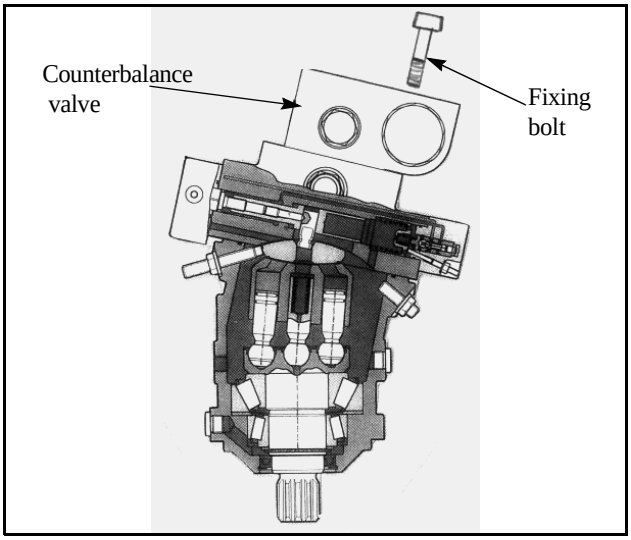
3. Assemble the port plate by locating the lens plate onto the rotary group.
   Secure the port plate by tightening the eight fixing bolts.
   Tightening torque - 310 Nm



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 ASSEMBLY

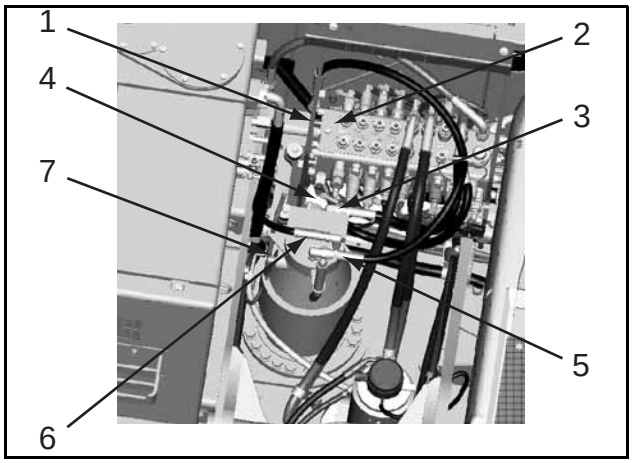
REMOVAL

⚠ 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.**

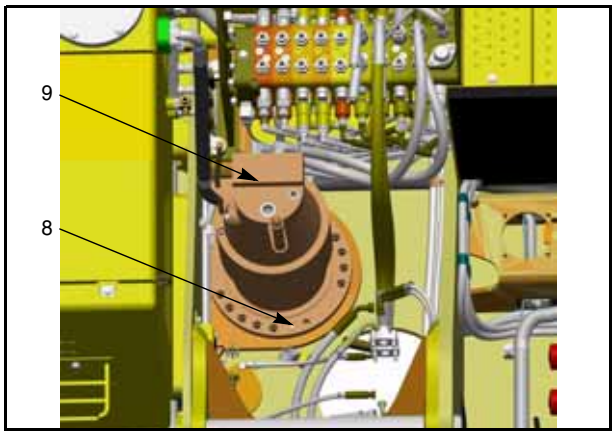
1. Remove bracket (1) from control valve and move valve (2) away from working area.

2. Disconnect 5 hoses (3) – (7).
- (3) : Between swing motor and control valve (Port MA)
- (4) : Between swing motor and control valve (Port MB)
- (5) : Suction hose (Port M)
- (6) : Drain hose between swing motor and hydraul (Port DB)
- (7) : Drain hose between swing motor and solenoid valve block (Port PB)



3. Remove 13 mounting bolts. Using forcing screws (8) {one located on opposite side}, lift off swing motor and swing machinery assembly (9).
   ★ 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 ASSEMBLY

SPECIAL TOOLS

Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
G	1	KBATZ080080	Wrench	t	1	N	
	2	KBATZ030190	Adapter	t	1	N	
	3	KBATZ060400	Stopper	t	1	N	

DISASSEMBLY

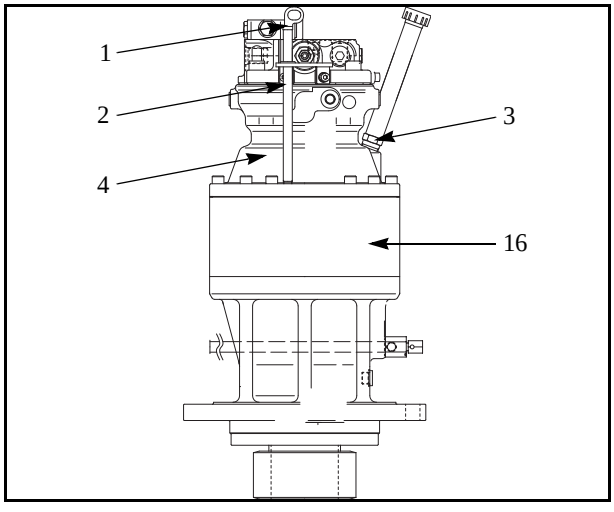
1. Draining oil

Loosen the drain plug and drain the oil from the swing machinery case.

Swing machinery case: **4.5 L**

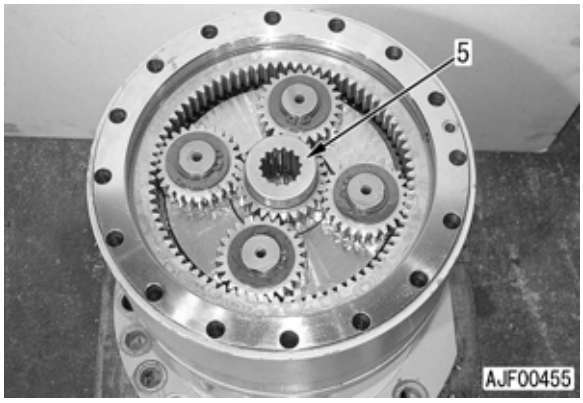
2. Swing motor assembly

1) Set the swing motor and swing machinery assembly on blocks.
2) Pull out level gauge (1) and remove pipe (2) and bracket.
   - Turn and remove pipe (2).
3) Loosen the mounting nut of pipe (3) and remove the pipe and bracket together.
4) Lift off swing motor assembly (4).
   - Make match marks on the swing motor case and cover (16) for reassembly.

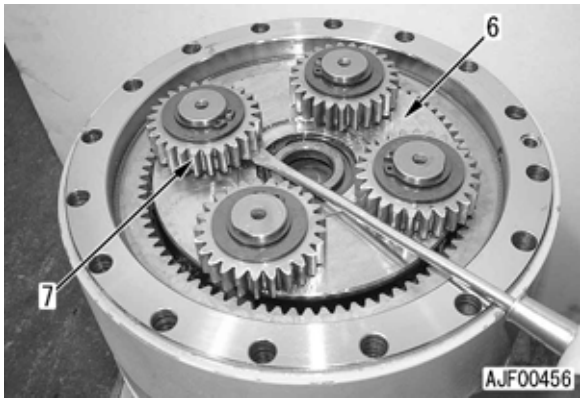


3. No. 1 carrier assembly

1) Remove No. 1 sun gear (5).



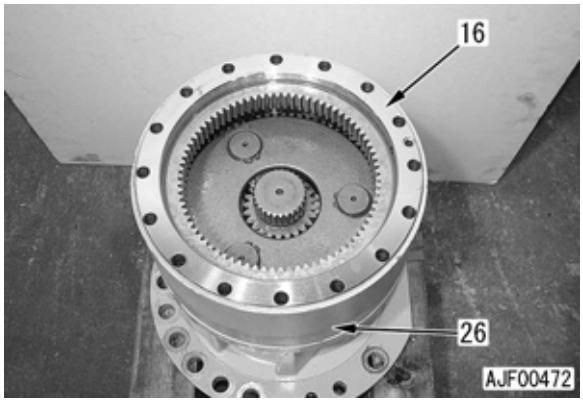
2) Remove No. 1 carrier assembly (6).
   - Insert a flat-head screwdriver, etc. under planetary gear (7) to float and remove the planetary gear.



4. Cover

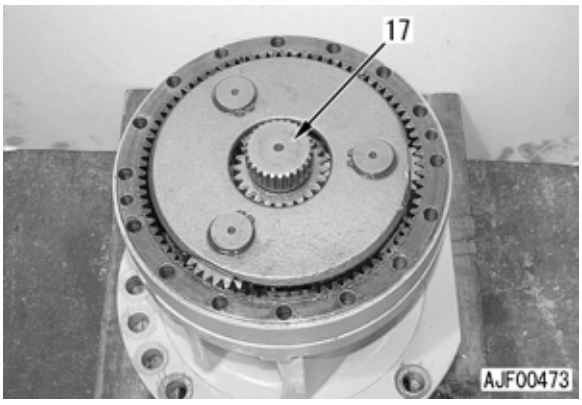
Remove cover (16).

- Make match marks on cover (16) and ring gear (26) for reassembly.

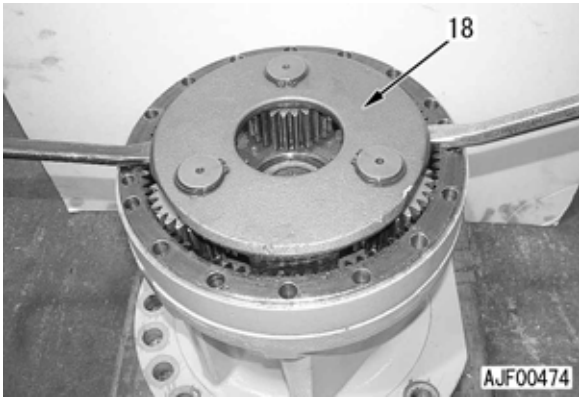


5. No. 2 carrier assembly

1) Remove No. 2 sun gear (17).



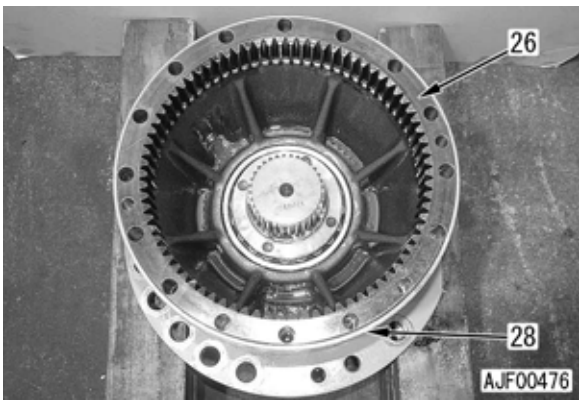
2) Using a bar, etc., float and remove No. 2 carrier assembly (18).



6. Ring gear

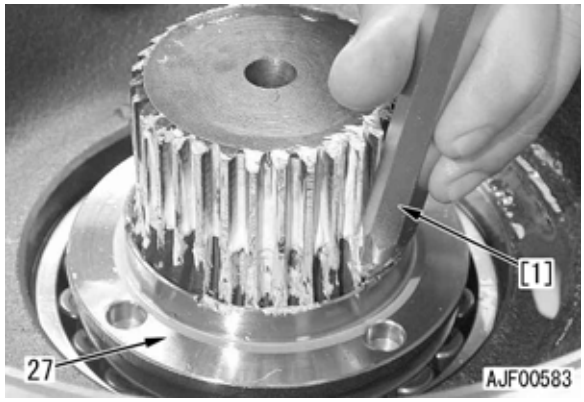
Remove ring gear (26).

- Make match marks on ring gear (26) and housing (28) for reassembly.

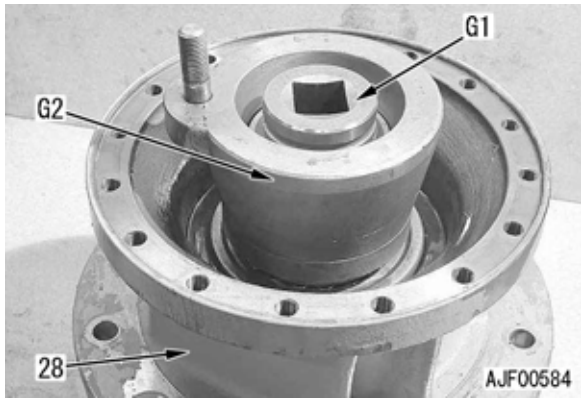


7. Ring nut

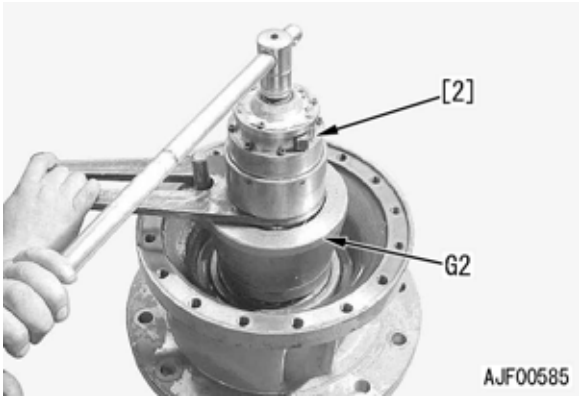
1) Using punch [1], etc., straighten the bent parts (3 places) of ring nut (27) around the pinion shaft spline.



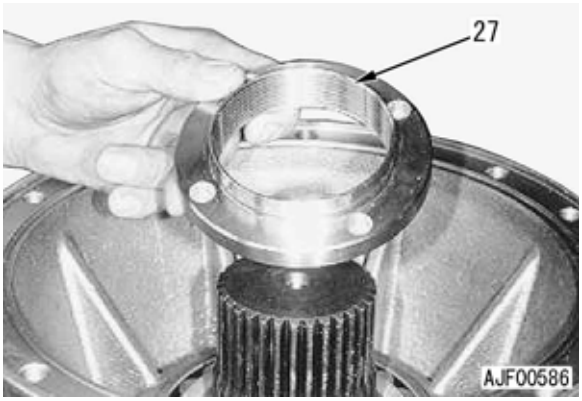
2) Place the flange of housing (28) on a block and float the pinion shaft at the center.
3) Install tool **G1** to the pinion shaft and install tool **G2** to the ring nut.



4) Fix tool **G2**. Using power wrench (25-time power) [2], turn tool **G1** to loosen the ring nut.
   - Tightening torque of ring nut (Reference): **1100 – 1200 Nm {112.2 – 122.3 kgm}**

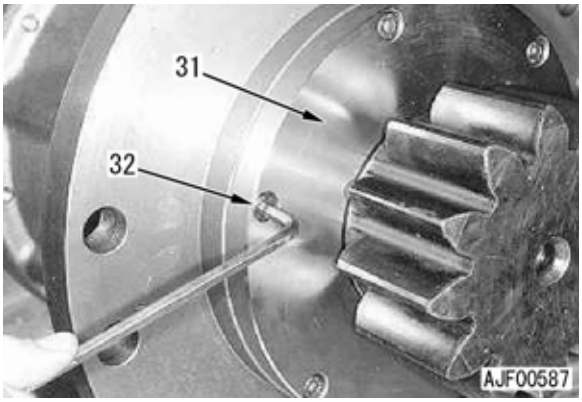


5) Remove ring nut (27).

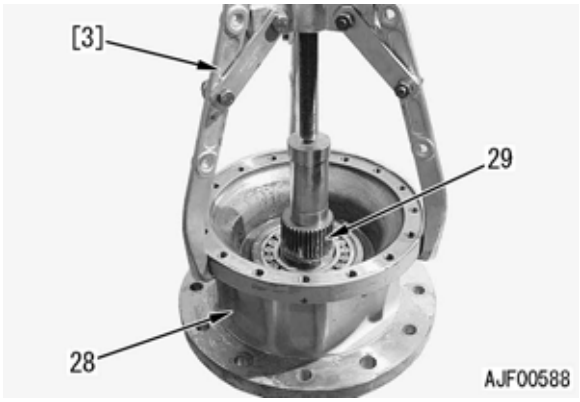


8. Housing and pinion shaft

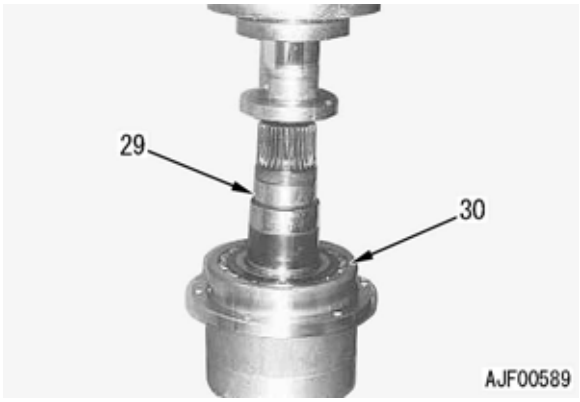
1) Remove 6 mounting screws (32) of front cover (31).



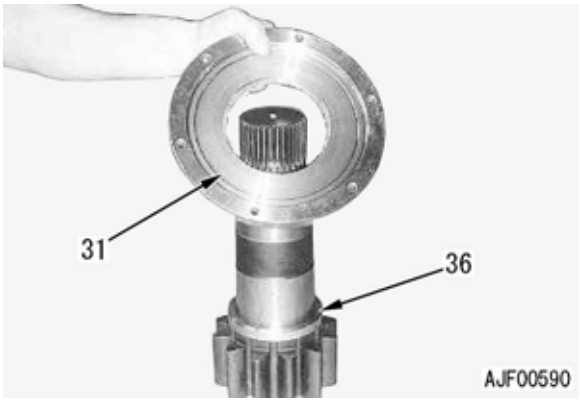
2) Using puller [3], separate housing (28) and pinion shaft assembly (29).



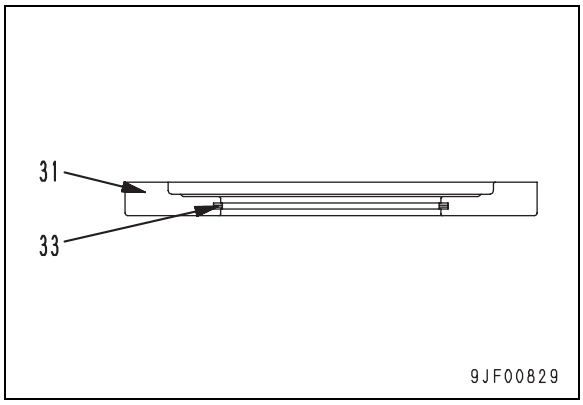
3) Using a press, separate pinion shaft assembly (29) and bearing (30).



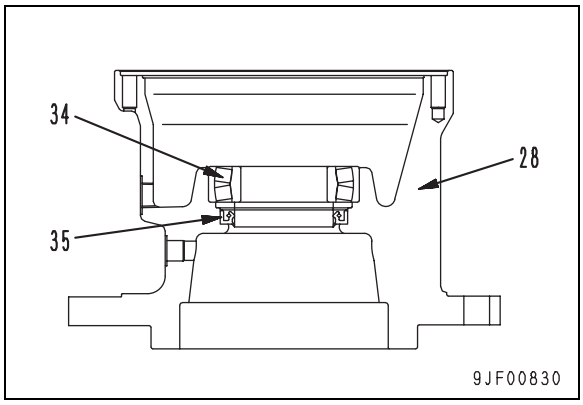
4) Remove front cover (31) and spacer (36).



5) Remove seal ring (33) from front cover (31).



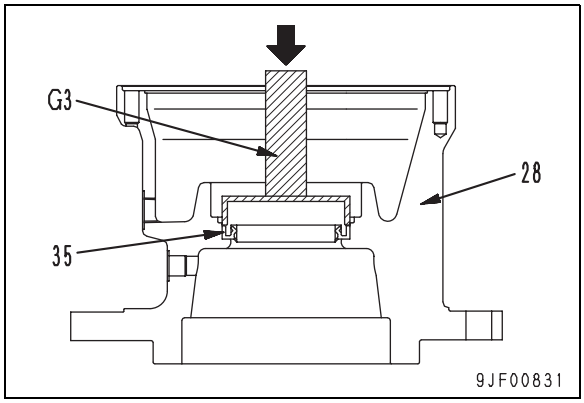
6) Remove bearing (34) and oil seal (35) from housing (28).



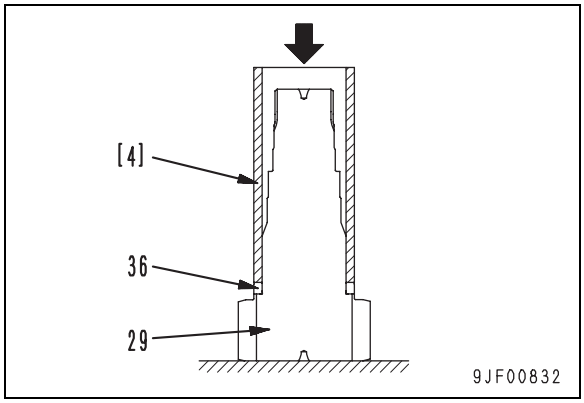
ASSEMBLY

1. Housing and pinion shaft

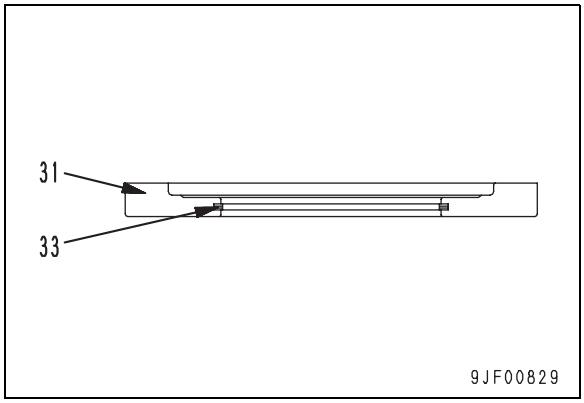
1) Using tool **G3**, install oil seal (35) to housing (28) as shown in the following figure.
   - Press fit the oil seal until its end reaches the housing end.



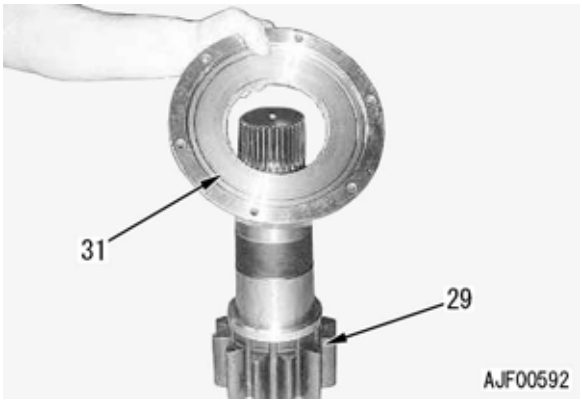
2) Using push tool [4], press fit spacer (36) to pinion shaft (29).



3) Install seal ring (33) to front cover (31).

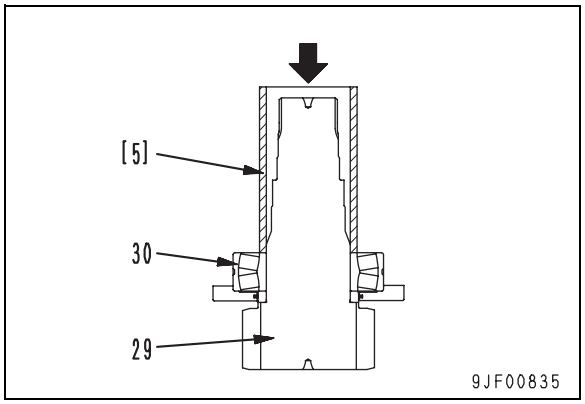


4) Set front cover (31) to pinion shaft (29).



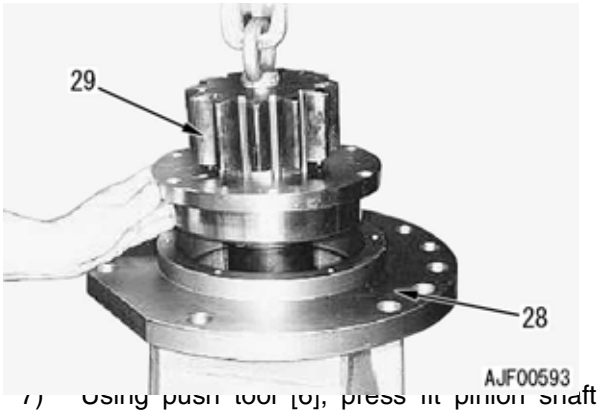
5) Using push tool [5], press fit bearing (30) to pinion shaft (29).
   - Press fit the bearing until the inner race end reaches the spacer.

Bearing: **Grease**
(SHELL RETINAX HD-2 or equivalent)

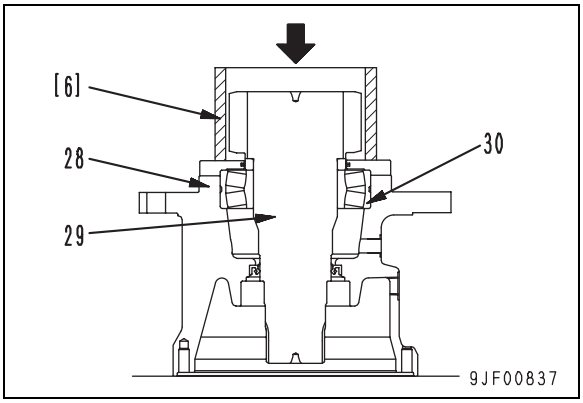


6) Set pinion shaft assembly (29) to housing (28).

Housing: **Grease**
(SHELL RETINAX HD-2 or equivalent)



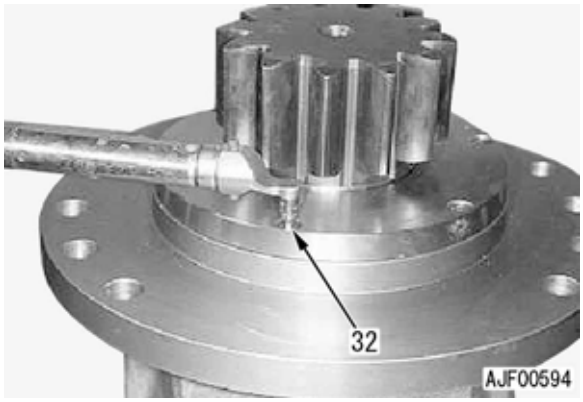
7) Using push tool [6], press fit pinion shaft assembly (29) to housing (28).
   - Press fit the bearing until the end of bearing (30) reaches the end of housing (28).



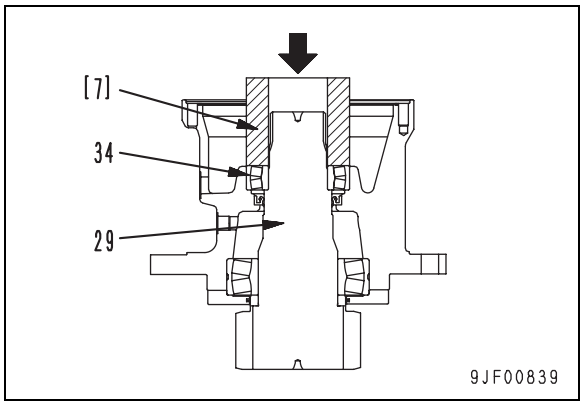
8) Tighten 6 front cover mounting screws (32).

Mounting screw:
LOCTITE 243 or equivalent

Mounting screw: **25 Nm {2.5 kgm}**

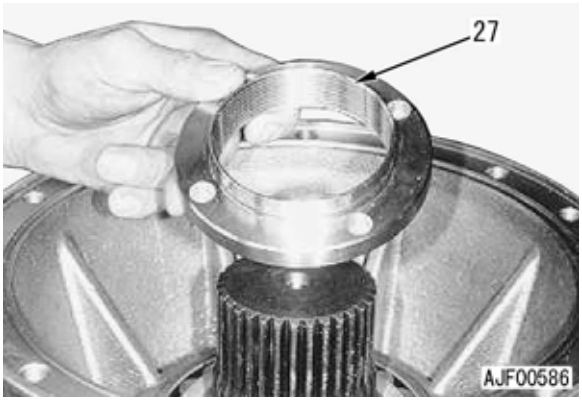


9) Using push tool [7], press fit bearing (34).
   - Press fit bearing (34) until its end reaches the shoulder of pinion shaft (29).

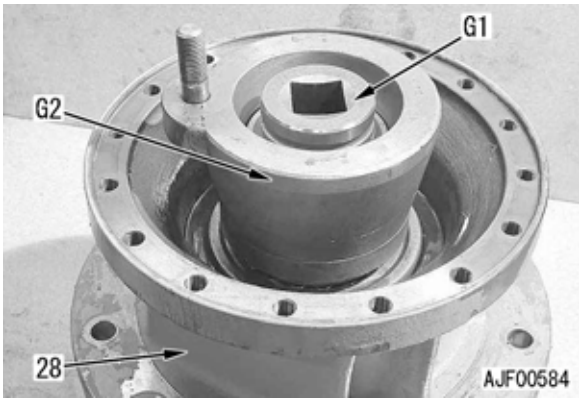


2. Ring nut

1) Install ring nut (27) to the pinion shaft.

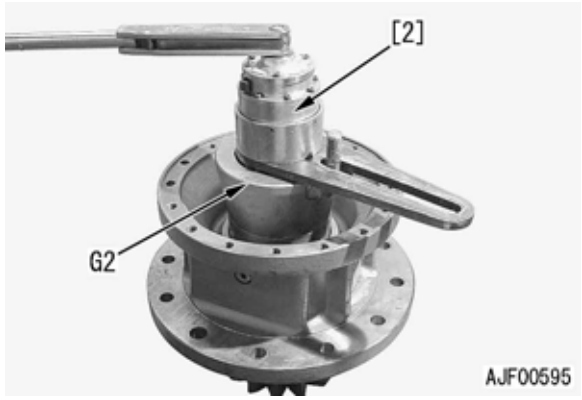


2) Place the flange of housing (28) on blocks and float the pinion shaft at the center.
3) Install tool **G1** to the pinion shaft and install tool **G2** to the ring nut.

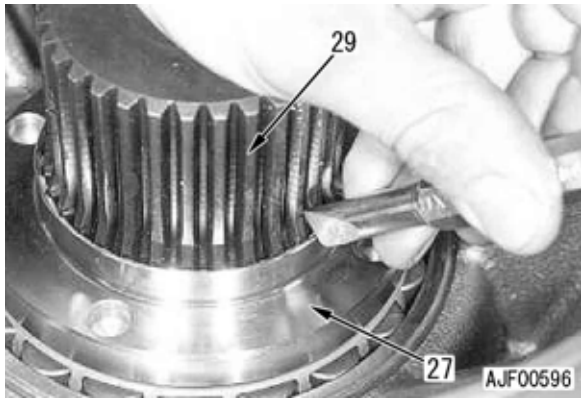


4) Fix tool **G2**. Using power wrench (25-time power) [2], turn tool **G1** to tighten the ring nut.

Ring nut:
1100 – 1200 Nm {112.2 – 122.3 kgm}

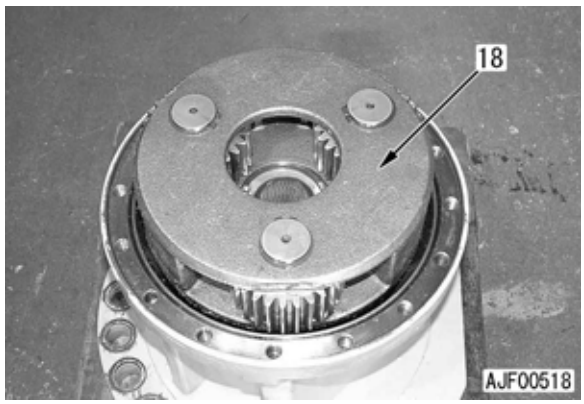


5) Using a punch, etc., bend the inside parts of ring nut (27) toward the spline of pinion shaft (29).
   - Bend 3 parts at intervals of 120°.

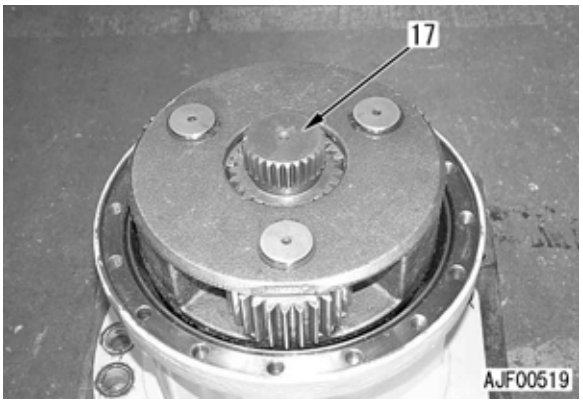


3. No. 2 carrier assembly

1) Install No. 2 carrier assembly (18).

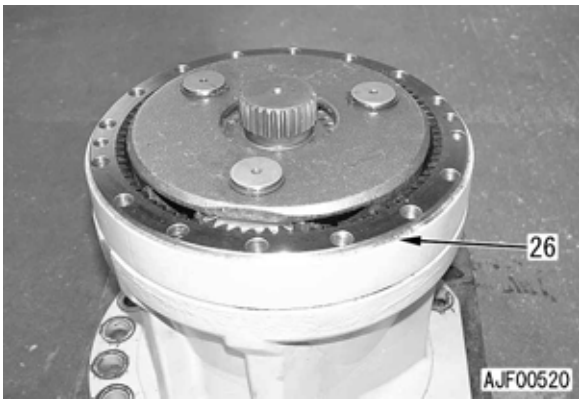


2) Install No. 2 sun gear (17).



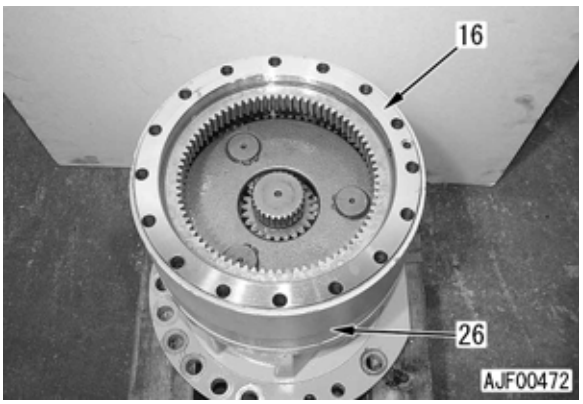
4. Ring gear

1) Fit the O-ring to the housing.
2) Install ring gear (26).
   - Match the match marks made when the ring gear was removed.



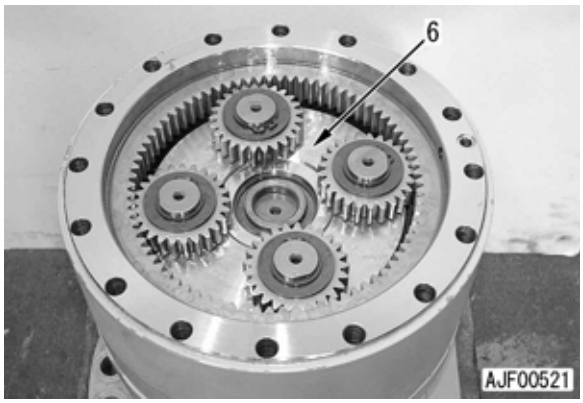
5. Cover

1) Fit the O-ring to the ring gear mounting face of cover (16).
2) Install cover (16).
   - Match the match marks made when the cover was removed.

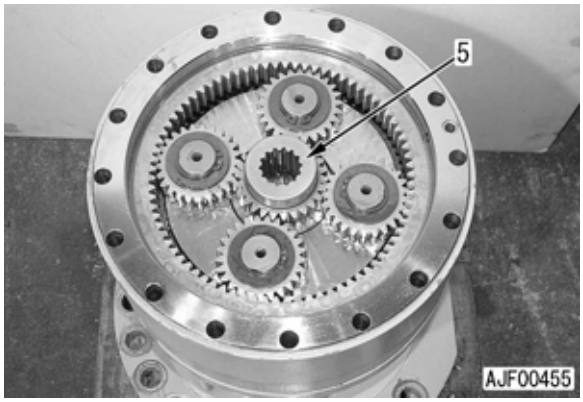


6. No. 1 carrier assembly

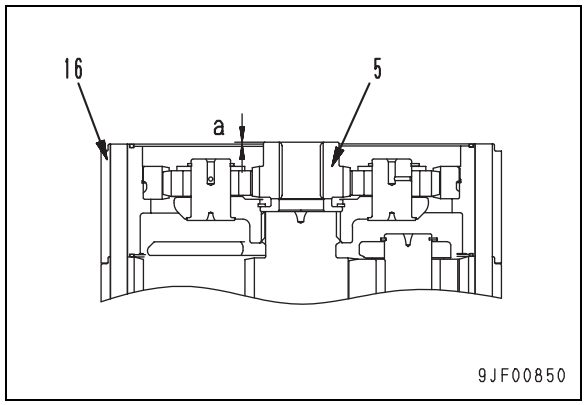
1) Install No. 1 carrier assembly (6).



2) Install No. 1 sun gear (5).



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** = **1.5** ^{0} **mm**



7. Swing motor assembly

1) Install swing motor assembly (4).
   - Match the match marks made when the swing motor assembly was removed.

N·m

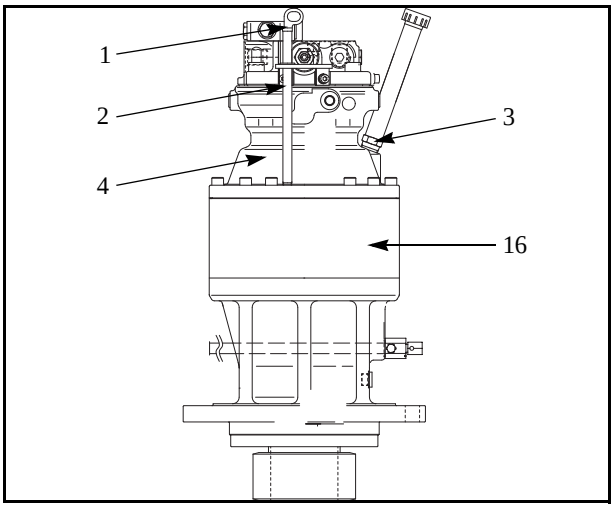
Mounting bolt:
85 ± 4.3 Nm {8.7 ± 0.44 kgm}

2) Install pipe (3) and bracket.

Pipe mounting nut (2 places):
56.4 ± 7.3 Nm {5.8 ± 0.74 kgm}

3) Install pipe (2) and bracket and insert level gauge (1).

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

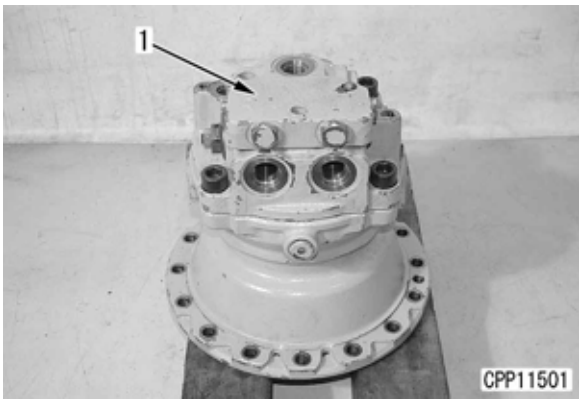
SPECIAL TOOLS

Symbol	Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
D1	799-301-1600	Oil leak tester kit	t	1		

DISASSEMBLY

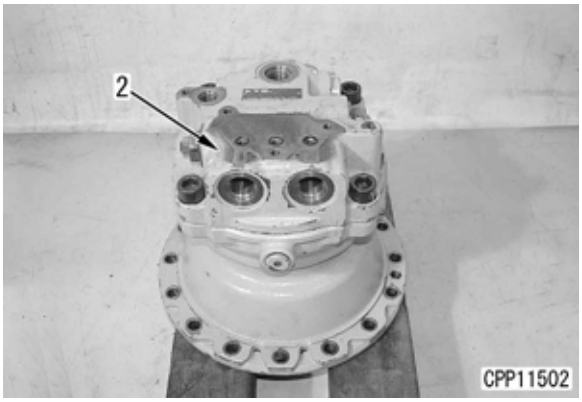
1. Set the swing motor and swing machinery assembly on blocks.

2. Reverse prevention valve assembly
Remove reverse prevention valve assembly (1).

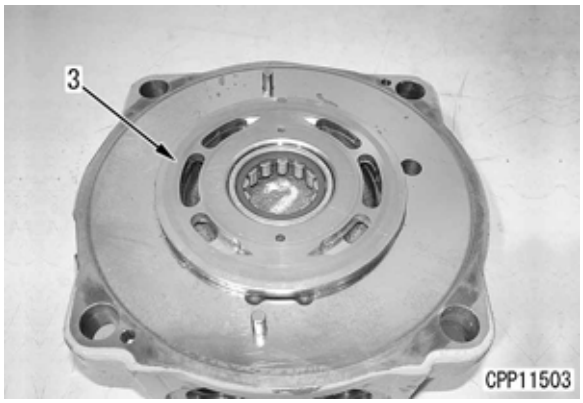


3. Cover assembly

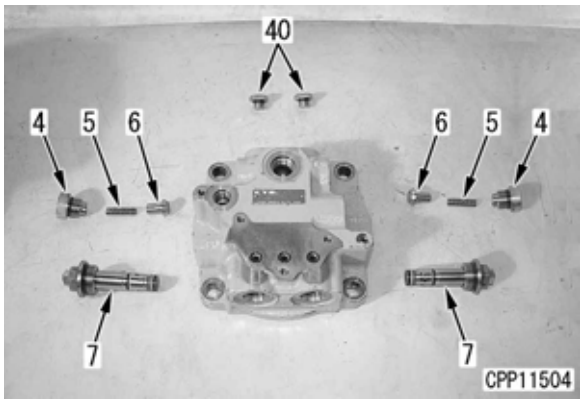
1) Remove cover assembly (2).
   - Note that the valve plate may fall from the cover assembly.



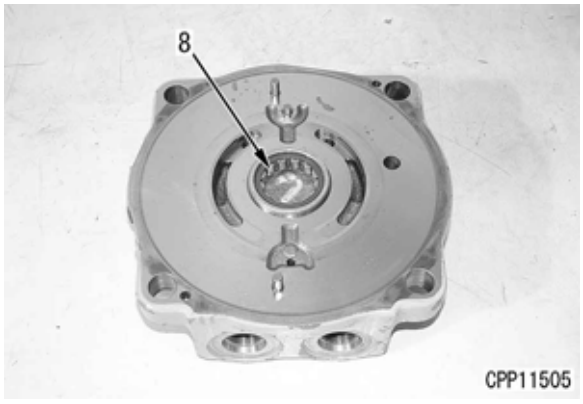
2) Remove valve plate (3) from the cover assembly.



3) Remove 2 plugs (4), 2 springs (5), and 2 poppets (6).
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.
5) Remove 2 plugs (40).



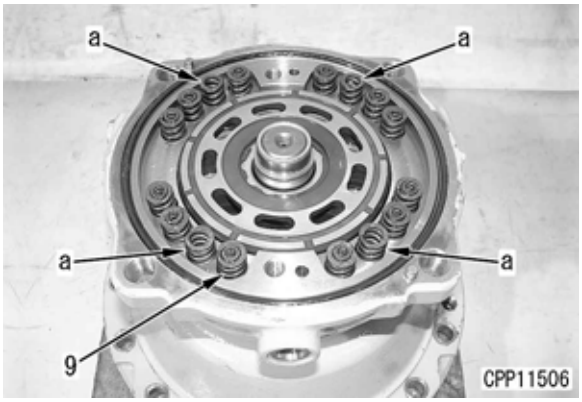
6) Remove bearing outer race (8).



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**.



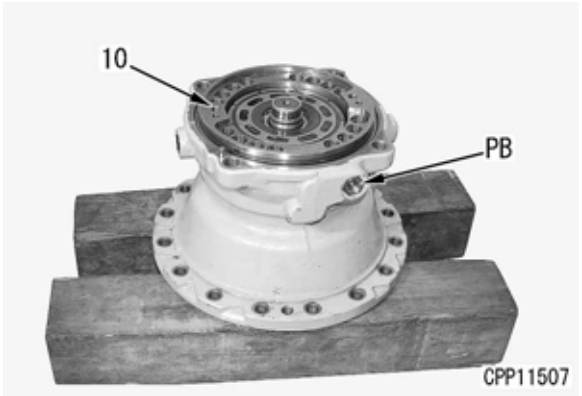
5. Brake piston

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).

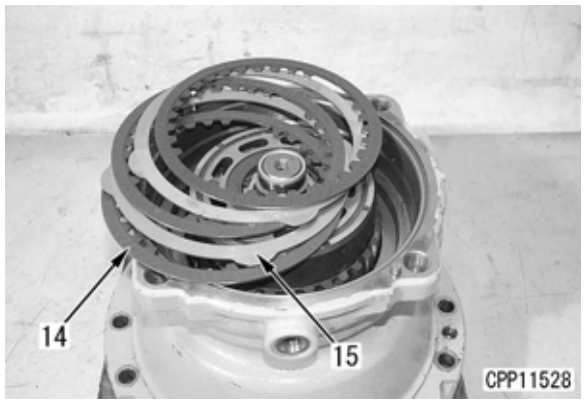
- Remove 1 disc (14) so that you can remove the collar easily.



7. Discs and plates

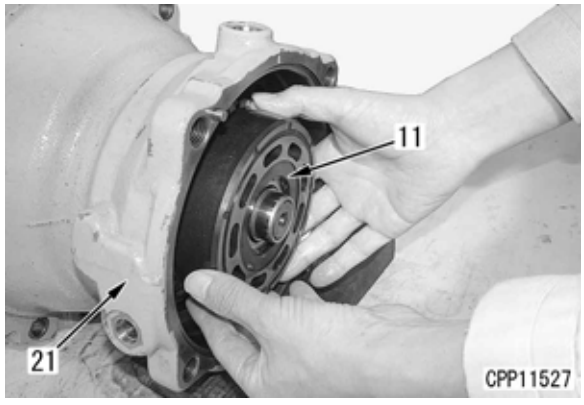
Remove 3 discs (14) and 2 plates (15).

- The number of the discs includes the one removed in step 6.

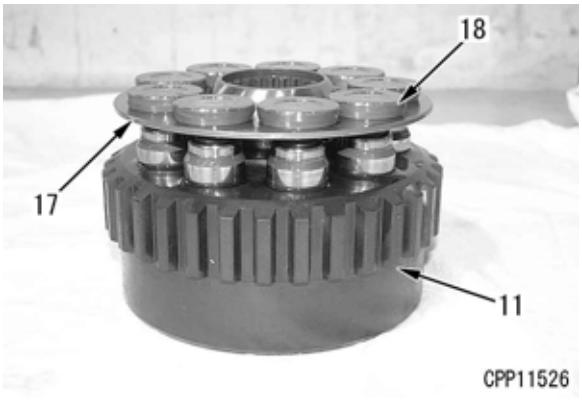


8. Cylinder block assembly

1) Place case (21) on its side.
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.



3) Lift up retainer plate (17) and remove it and piston (18) together from cylinder block (11).
4) Separate retainer plate (17) and piston (18).



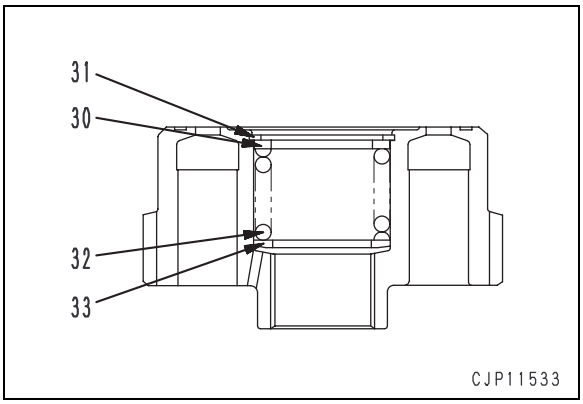
5) Remove retainer holder (16).



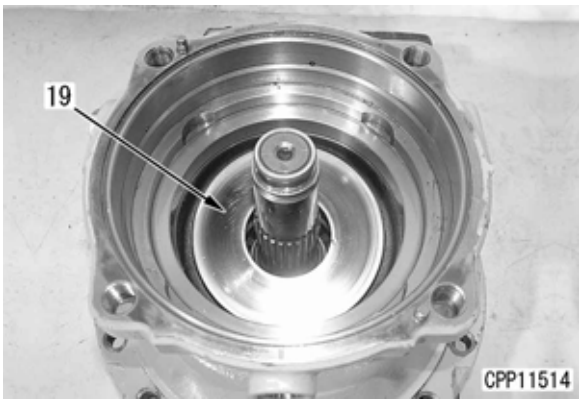
6) Remove 3 pins (12).



7) Press down collar (30) with a press, etc. and remove snap ring (31).
8) Remove collar (30), spring (32), and collar (33).

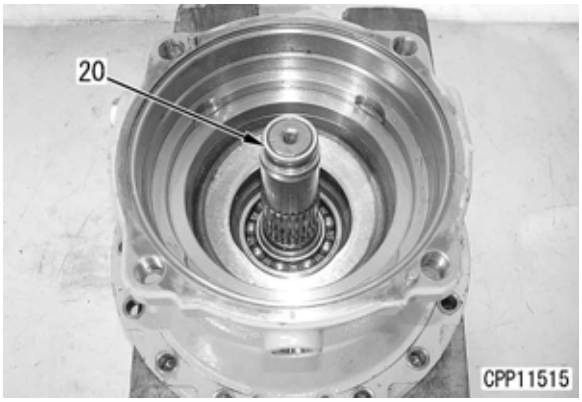


9. Thrust plate
Remove thrust plate (19).

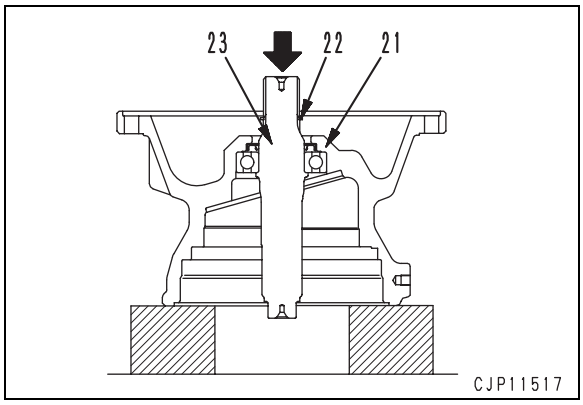


10. Shaft and case

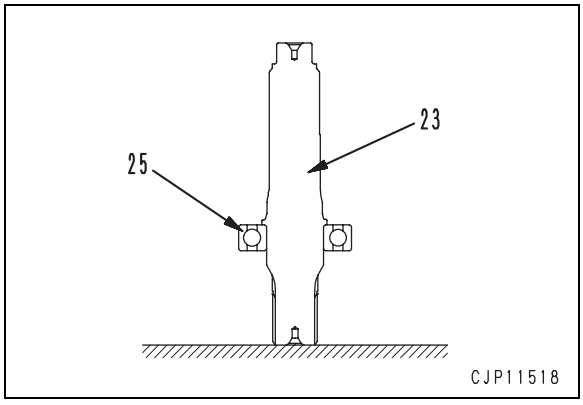
1) Remove bearing inner race (20).



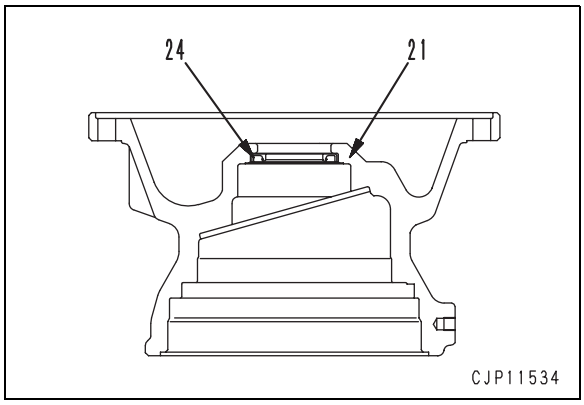
2) Turn over case (21) and set it on blocks.
3) Remove snap ring (22).
4) Press the end of shaft (23) with a press, etc. to remove the shaft.



5) Remove bearing (25) from shaft (23).



6) Remove oil seal (24) from case (21).



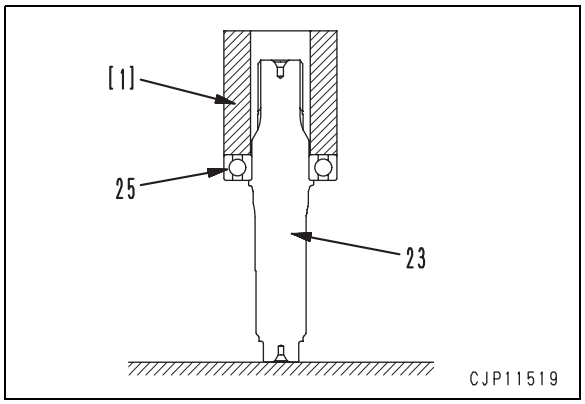
ASSEMBLY

★ Clean the all parts and check them for dirt or damage.

★ Coat the sliding surfaces of each part with engine oil (EO10-CD).

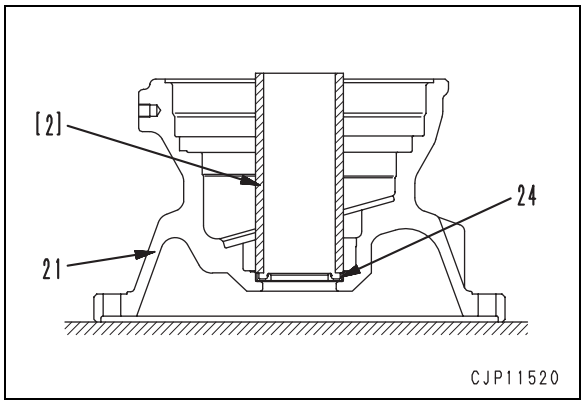
1. Shaft and case

1) 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.



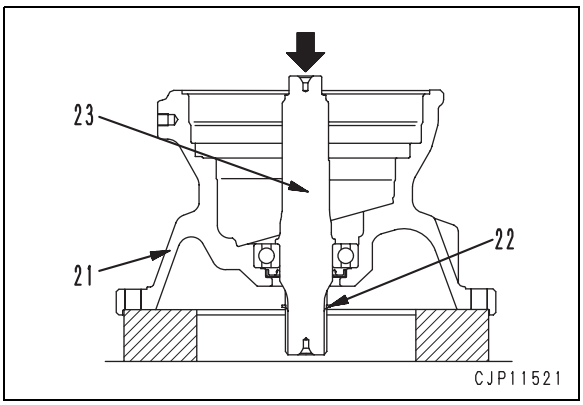
2) Using push tool [2], press fit oil seal (24) to case (21) as shown in the following figure.
   - Press fit the oil seal until its end reaches the case end.

Lip surface of oil seal: **Grease (G2-LI)**

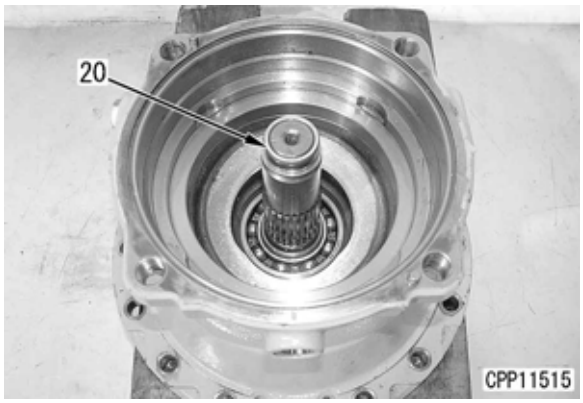


3) Press the end of shaft (23) with a press, etc. to press fit it to case (21).
   - Press fit the shaft until the end of the bearing outer race reaches the case end.

4) Install snap ring (22).



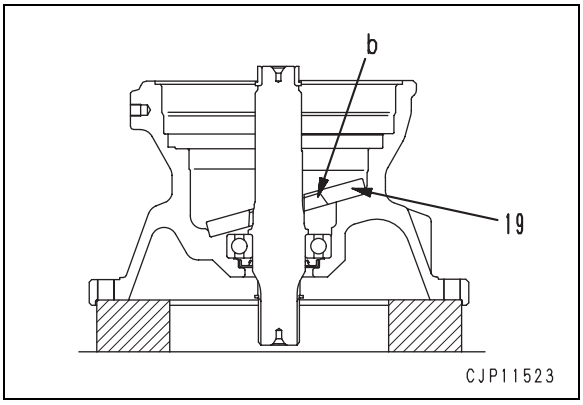
5) Install inner race (20).



2. Thrust plate

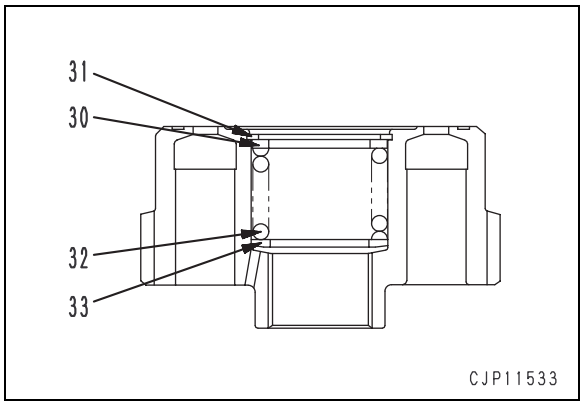
Install thrust plate (19).

★ Install the thrust plate with small hole side **b** up.



3. Cylinder block assembly

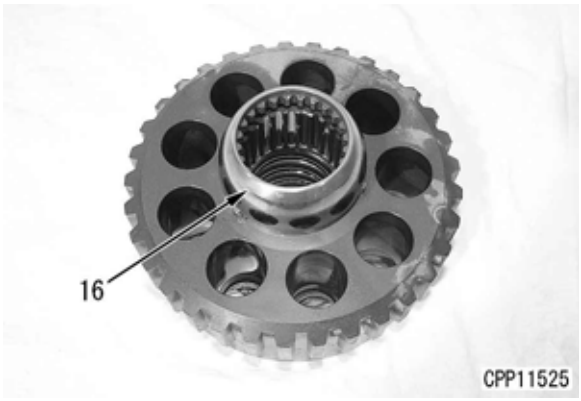
1) Install collar (33), spring (32), and collar (30).
2) Press down collar (30) with a press, etc., and install snap ring (31).



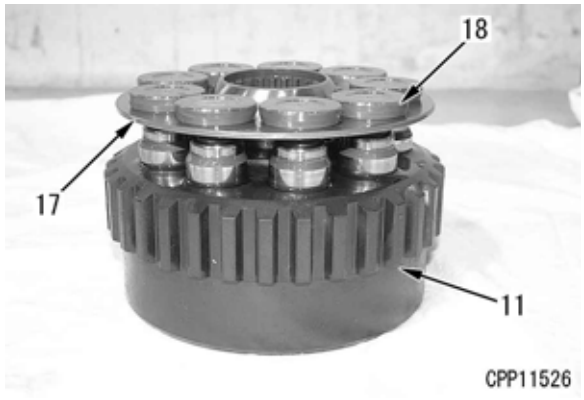
3) Install 3 pins (12).
   - Apply grease (G2-LI) to the pins so that they will not fall when the cylinder block assembly is installed.

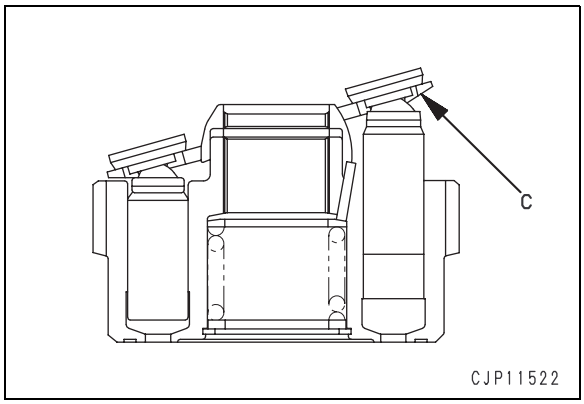


4) Install retainer holder (16).

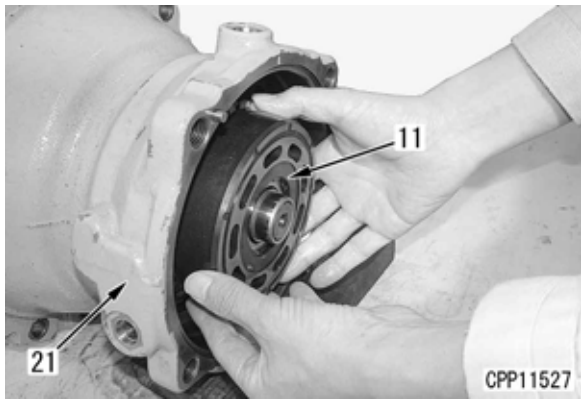


5) Install piston (18) to retainer plate (17).
   - Set chamfered periphery **c** of retainer plate (17) toward the cylinder block side.
6) Install the retainer plate and piston assembly to the cylinder block assembly (11).
   - Apply engine oil (EO10-CD) fully to the sliding surfaces of the piston and cylinder block.





7) Place case (21) on its side.
8) Install cylinder block assembly (11) to the case.
   - Take care that the piston will not come out of the cylinder block.

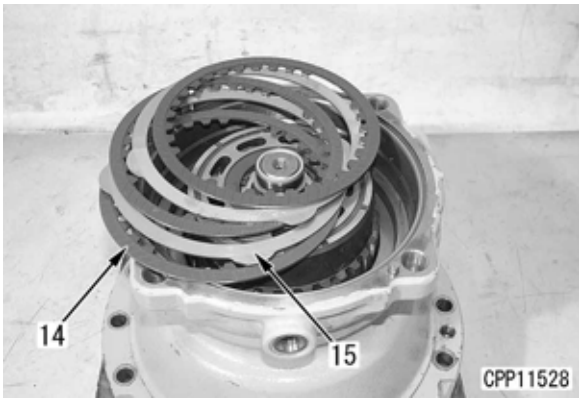


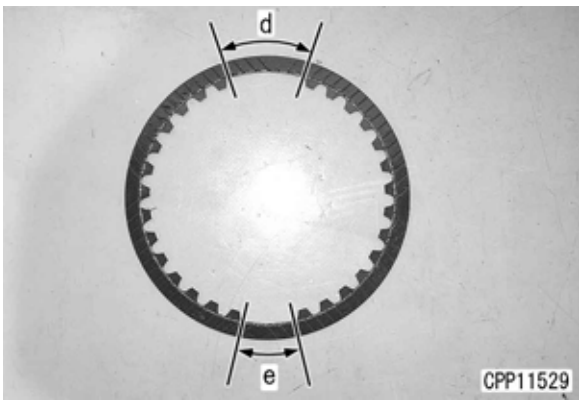
4. Discs and plates

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.



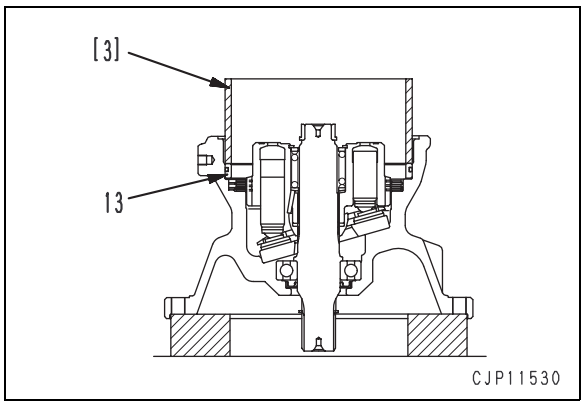


5. Collar

1) Fit the O-ring to collar (13).

Periphery of O-ring: Grease (G2-LI)

2) Using push tool [3], press fit collar (13) evenly.



6. Brake piston

1) Fit the O-ring to brake piston (10).

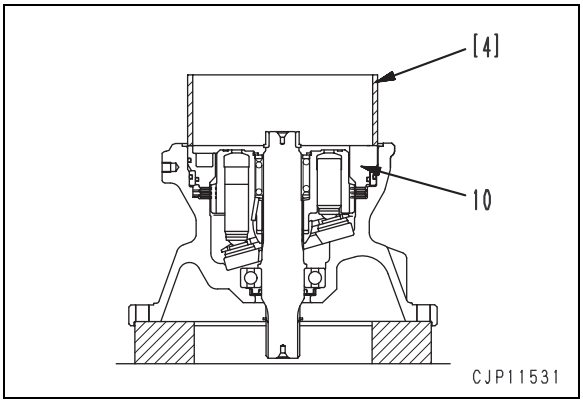
Periphery of O-ring: **Grease (G2-LI)**

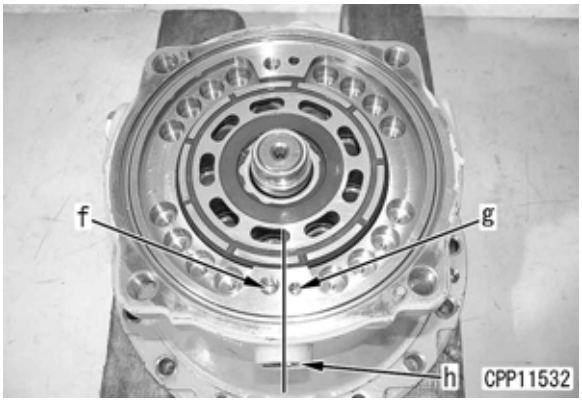
2) Using push tool [4], press fit brake piston (10) evenly.

- 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.)

3) Fit the O-ring to the case.

Periphery of O-ring: **Grease (G2-LI)**

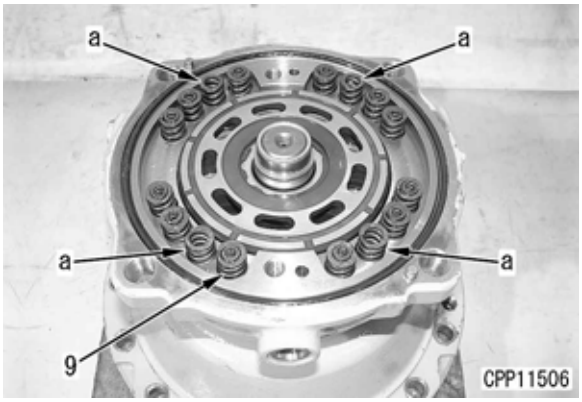




7. Springs

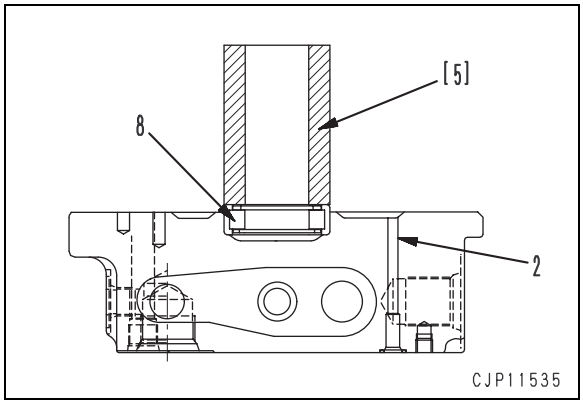
Install 16 springs (9).

- There are outer springs (large) and inner springs (small). Install only the outer springs (large) to 4 places **a**.



8. Cover assembly

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.



2) Install 2 plugs (40).

Periphery of O-ring: **Grease (G2-LI)**

Plug: **46 ± 0.98 Nm {4.7 ± 0.1 kgm}**

3) Fit the backup ring and O-ring and install 2 relief valve assemblies (7).

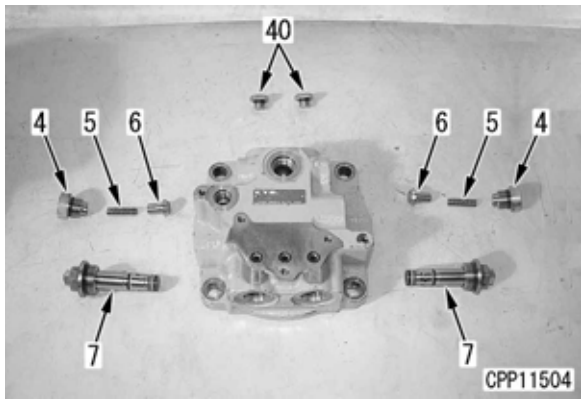
Periphery of backup ring and O-ring: **Grease (G2-LI)**

Relief valve assembly:
373 ± 20 Nm {38.0 ± 2.0 kgm}

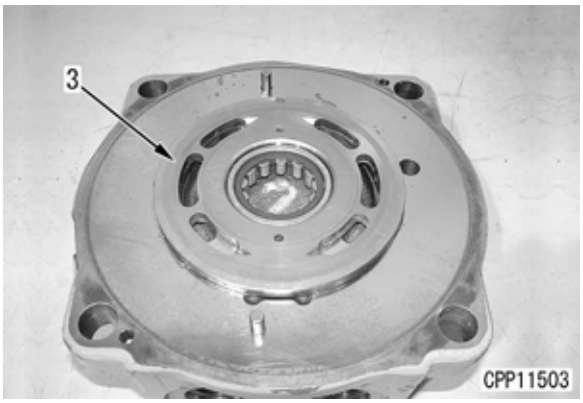
4) Install 2 poppets (6), 2 springs (5), and plugs (4).

Periphery of O-ring: Grease (G2-LI)

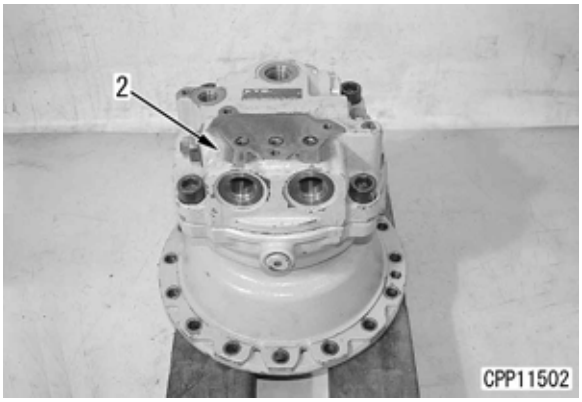
Plug: 157 ± 10 Nm {16.0 ± 1.0 kgm}



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.



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.



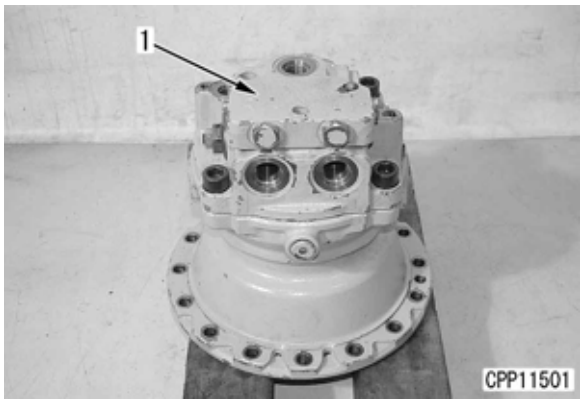
7) Tighten the mounting bolts.

9. **Reverse prevention valve assembly**

N·m Mounting bolt:
294 ± 20 Nm {29.9 ± 2.0 kgm}

Install reverse prevention valve assembly (1).

N·m Mounting bolt:
32.4 ± 2.0 Nm {3.3 ± 0.2 kgm}



REMOVAL AND INSTALLATION OF FRONT AXLE

REMOVAL

1. Drain oil out of front axle and hubs.

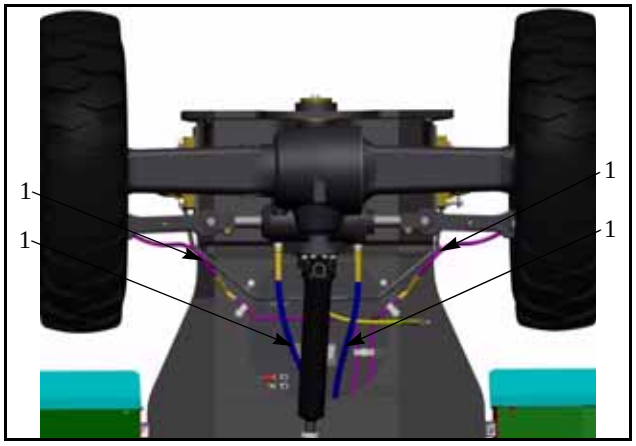
Front Axle: Approx. 11.5 Litres
Hubs: Approx.2.5 Litres (Each)

2. Retract front attachment fully.

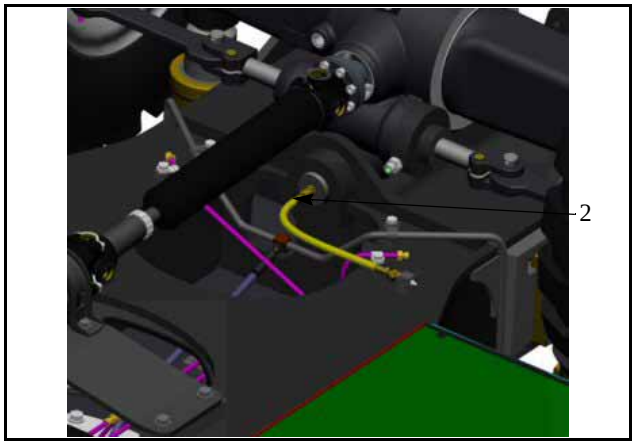
⚠ WARNING

Support suspension cylinder rod as this will drop freely when the axle is removed

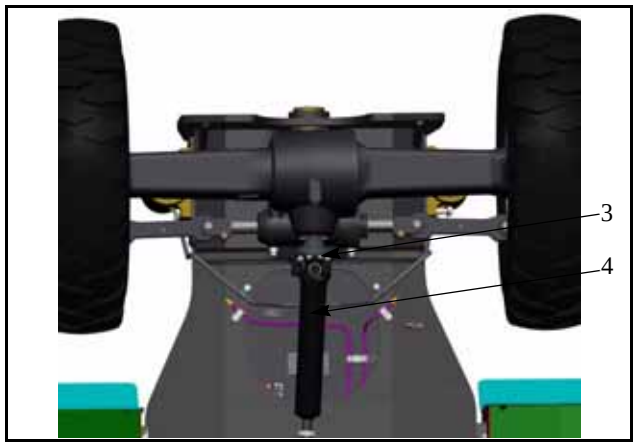
3. Remove 4 hoses (1).



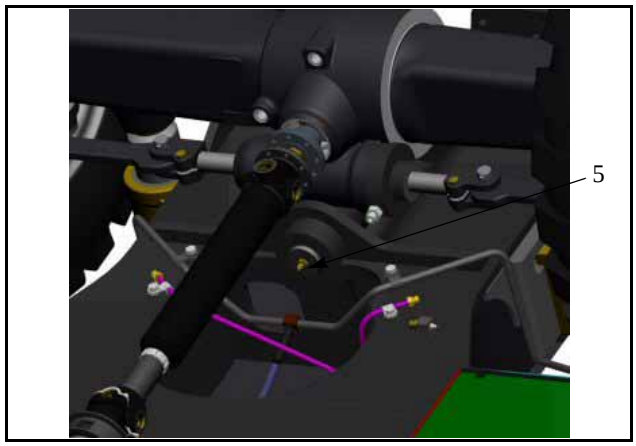
4. Remove hose (2).



5. Remove all nuts (3) from propshaft (4), then retract propshaft (4).



6. Remove pin (5).



7. Use work equipment to lift undercarriage above the axle.



8. Roll axle out on wheels.

9. Place supports in place of axle.

INSTALLATION

- Install in reverse order of removal.
- Grease all cylinders before installation
- Tightening torque for propshaft nuts (3): 58.8 - 73.5 Nm.

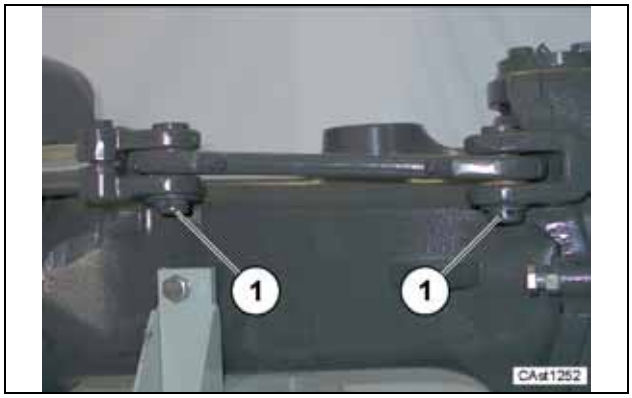
DISASSEMBLY AND ASSEMBLY OF FRONT AXLE

DISASSEMBLY OF STEERING CYLINDER

1. Remove the safety split pins (1).

⚠ WARNING

Reject the used split pins.



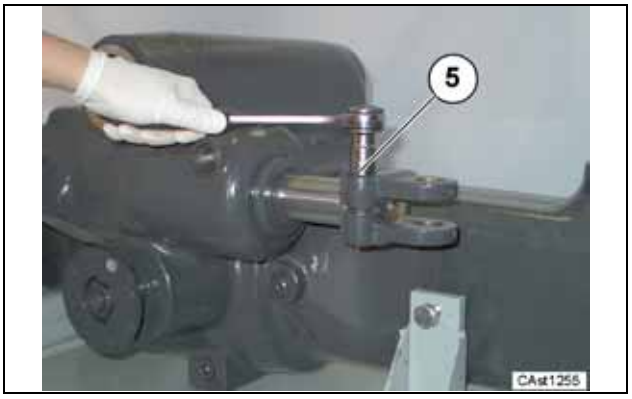
2. Remove the joint pivots (2) and the thicknesses (4).



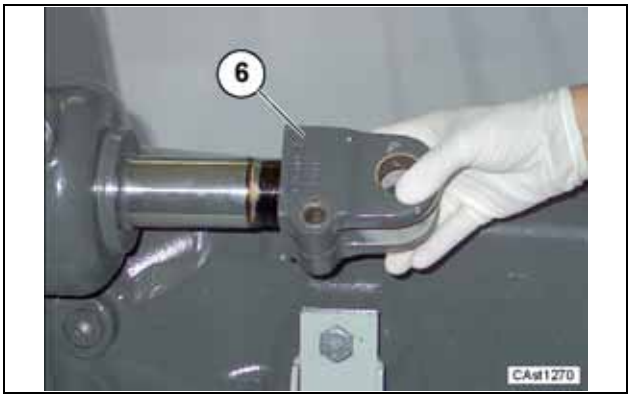
3. Remove the steering bars (3).



4. Remove the screws (5).



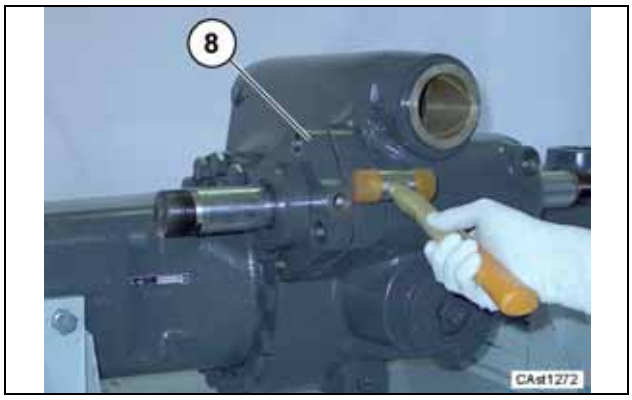
5. Unscrew the heads of the steering cylinder (6).



6. Remove the screws (7) of the steering cylinder.



7. Remove the head of the cylinder (8). Strike by means of a plastic hammer.



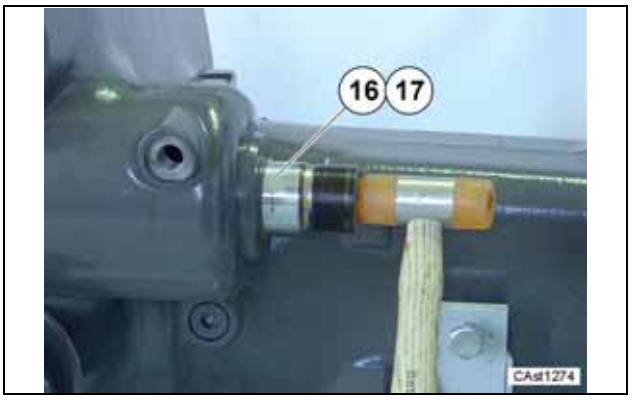
8. Remove the gaskets (11), (12) and the scraper ring.



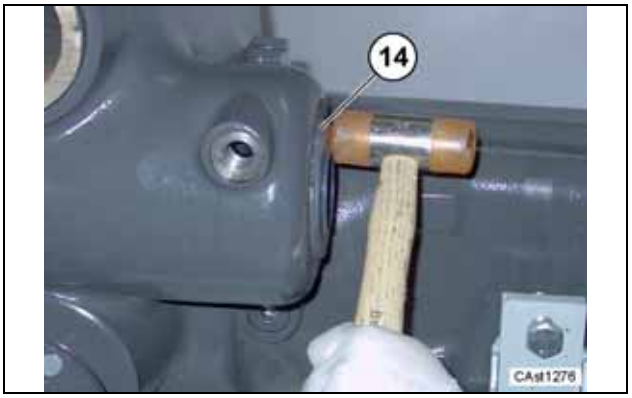
9. Remove the O-rings (9) and (10).



10. Remove the rod complete with cylinder (16) and cylinder liner (17).



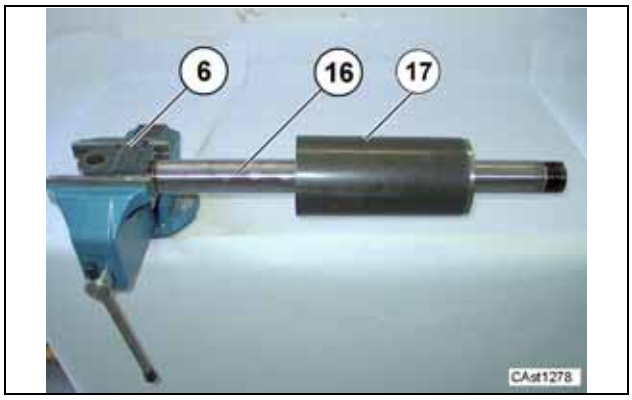
11. Remove the head of the cylinder (14).



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).

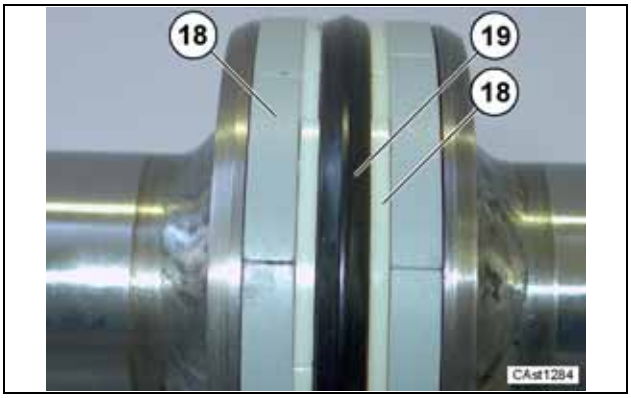


ASSEMBLY OF STEERING CYLINDER

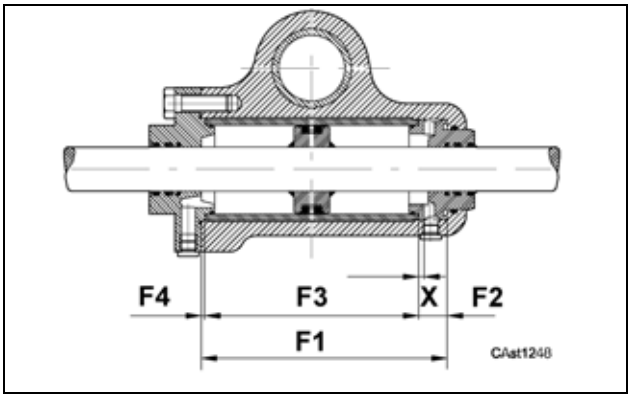
1. Fit the gaskets (21) and (22) and the scraper ring (23).



2. Fit the piston gaskets (18) and (19).
Warning: The gasket cuts (18) should not coincide.



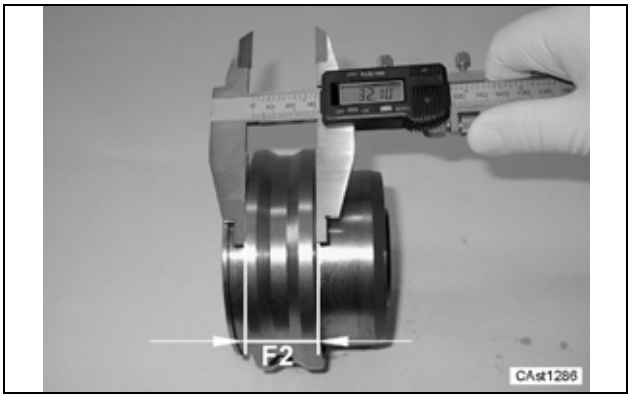
3. Thicknesses to be fitted.



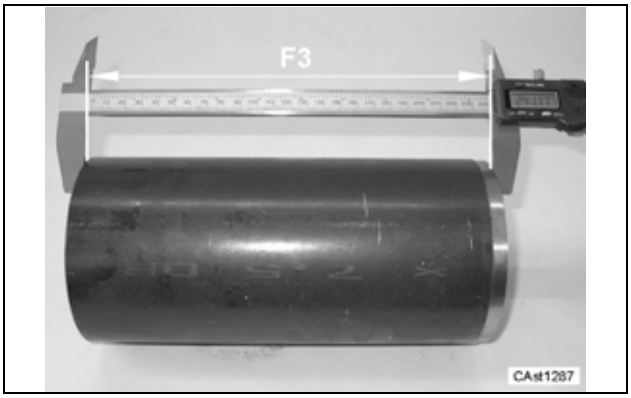
4. Measuring of value **F1.**



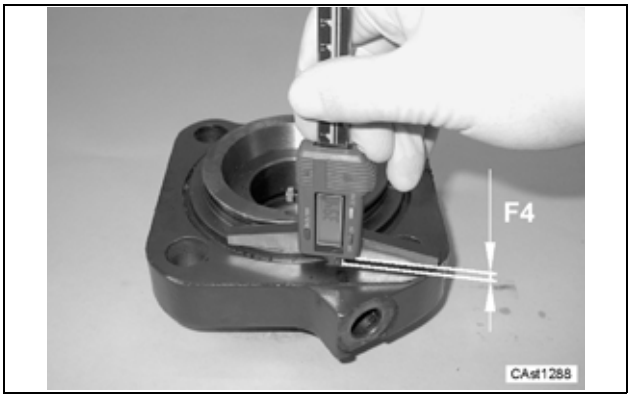
5. Measuring of value **F2.**



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).



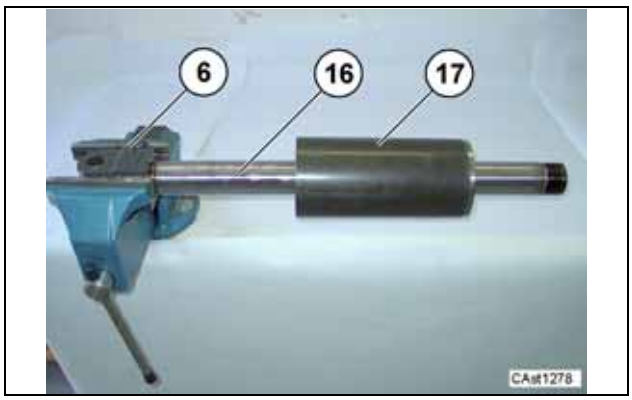
12. Lubricate with grease the contact surface.



13. Assemble the head of the cylinder (14).



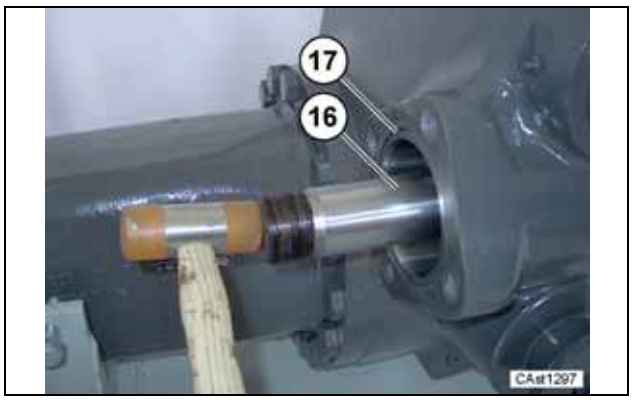
14. Lock the rod of the cylinder (16) on a vice after having screwed the head (6) and assemble the cylinder liner (17).



15. Lubricate with grease the gaskets of the right cylinder rod.



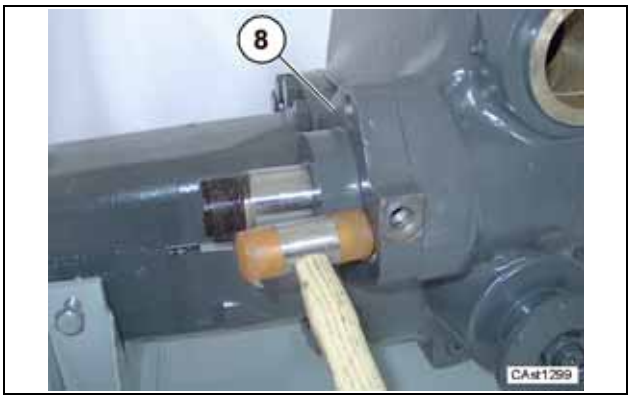
16. Assemble the rod complete with cylinder (16) and the cylinder liner (17).



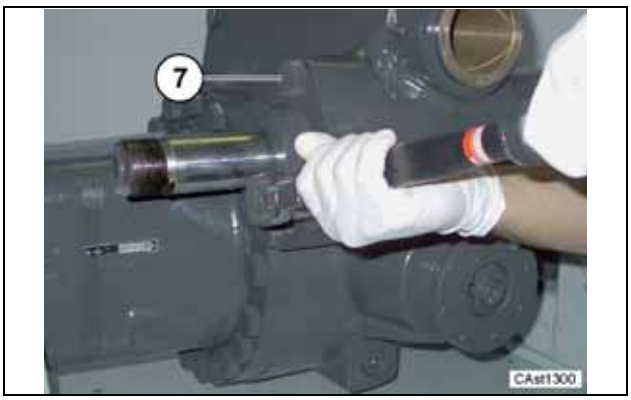
17. Lubricate with grease the gaskets of the left cylinder rod.



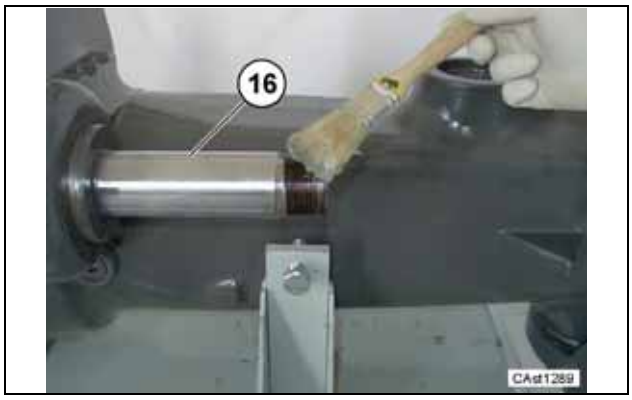
18. Assemble head of cylinder (8). Strike by means of a plastic hammer. Apply Loctite® 510.



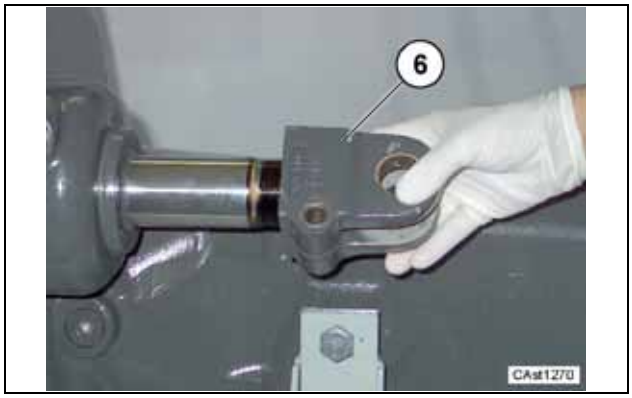
19. Assemble screws (7) of steering cylinder. Torque = 560Nm (57.1 kgf-m) Apply Loctite® 242.



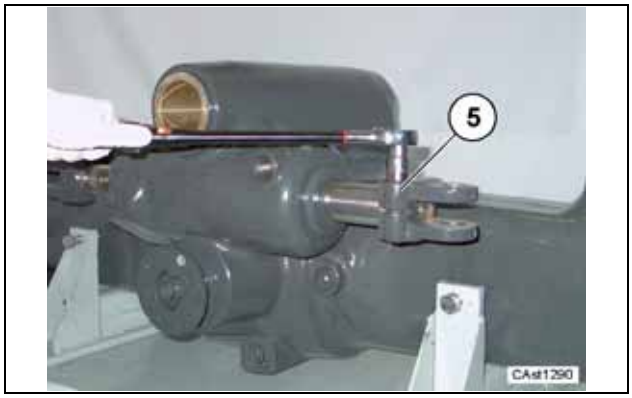
20. Lubricate the threads of the steering cylinder with grease.



21. Screw heads of steering cylinder (6).



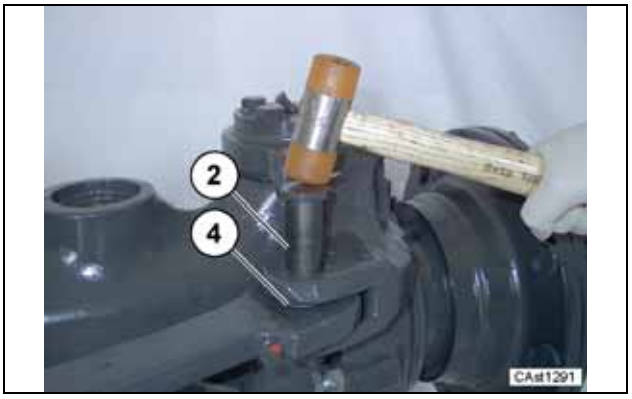
22. Fit screws (5). Torque = 117Nm (12 kgf-m)



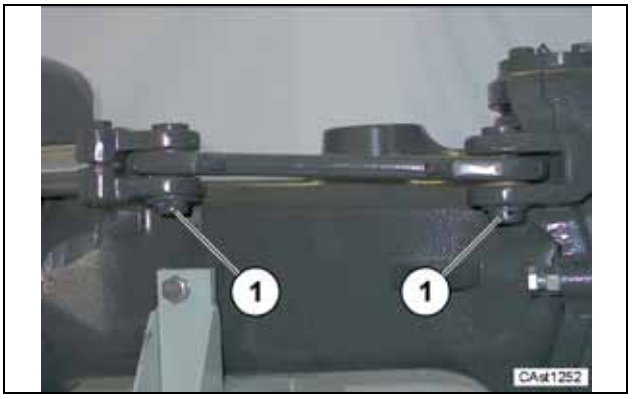
23. Assemble steering bars (3).



24. Assemble joint pivots (2) and thicknesses (4).

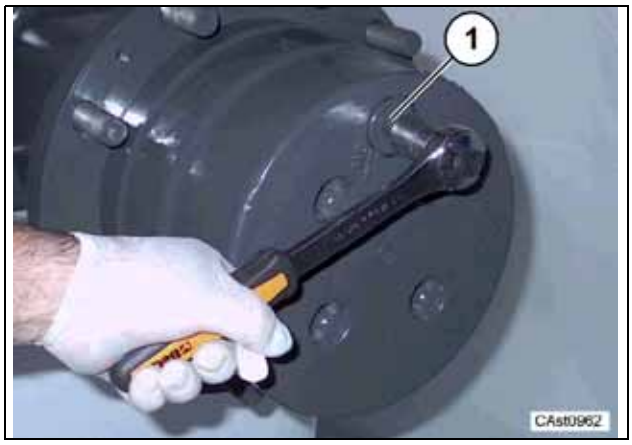


25. Assemble safety split pins (1).

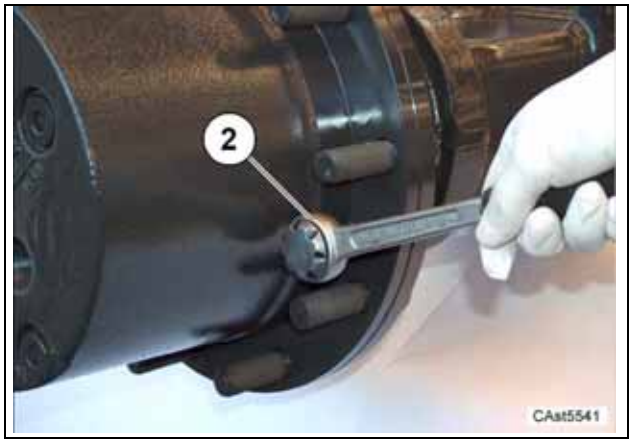


DISASSEMBLY OF EPICYCLIC REDUCTION GEAR AND BRAKE

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.



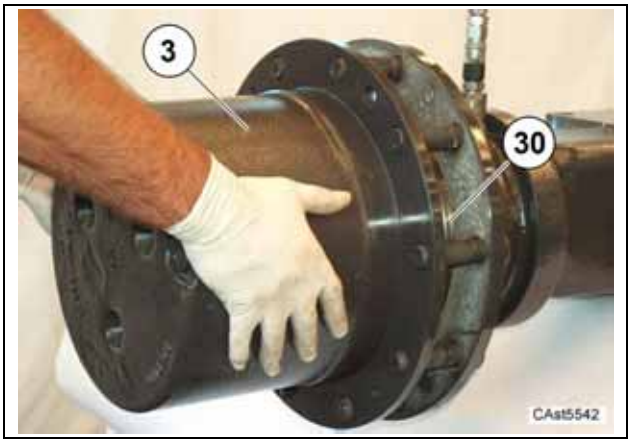
2. Remove fastening screws (2) from the cover of the planetary gears carrier.



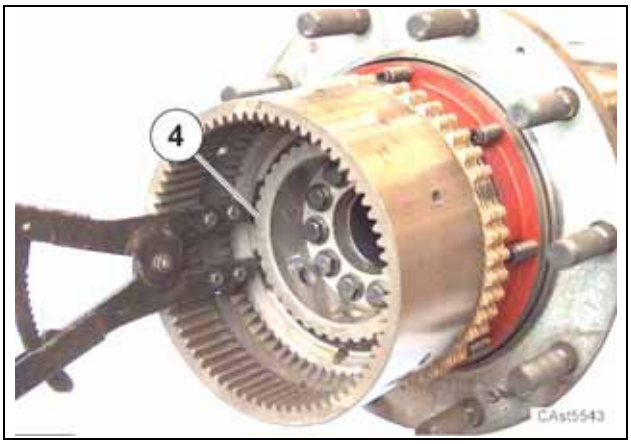
3. Use the levers inside the preset slots to detach the planetary gear carrier cover.



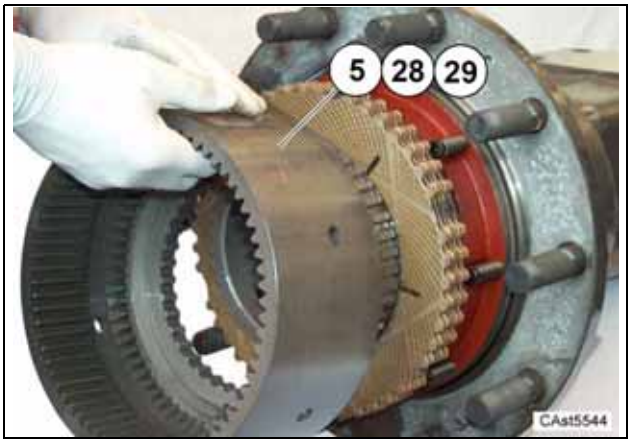
4. Remove the planetary gear carrier cover (3) and O-ring (30).



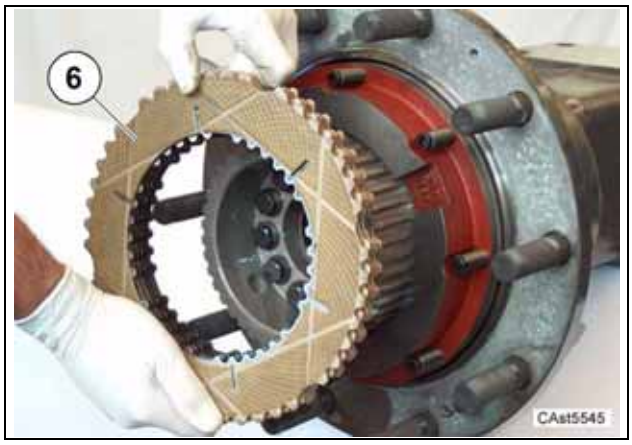
5. Remove split ring (4).



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).



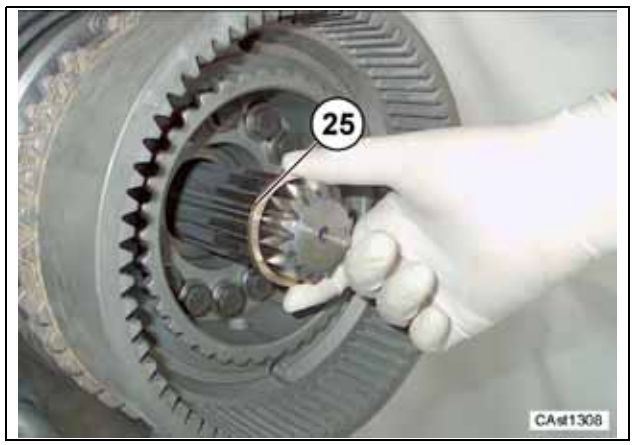
10. Remove seal rings (9) and (10) from piston (8).



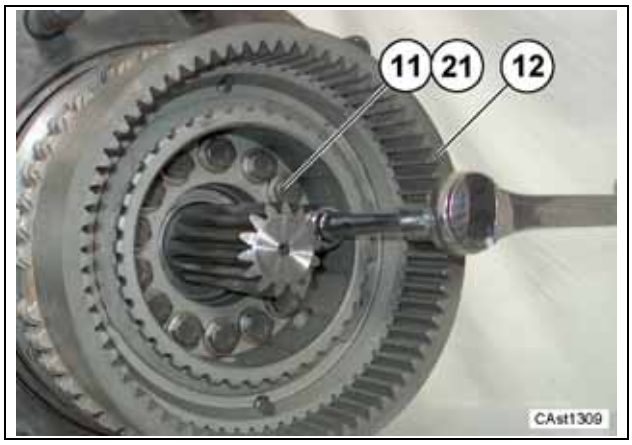
11. Remove snap ring (24).



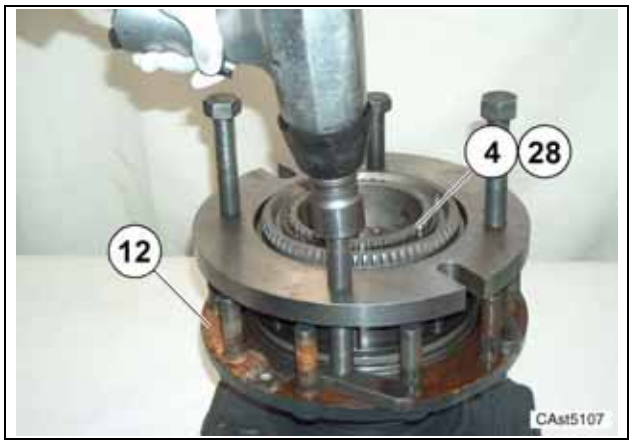
12. Remove spacer (25).



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).



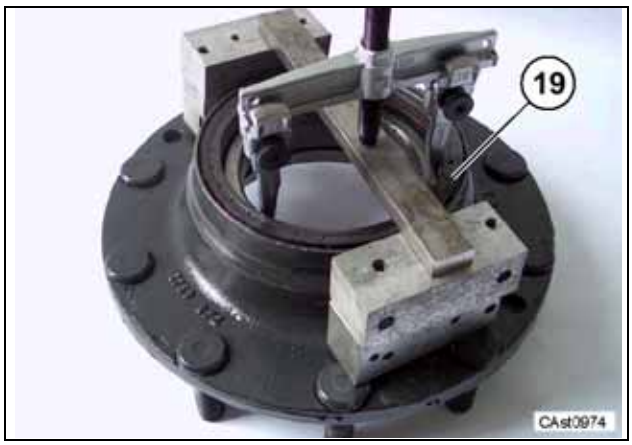
18. Remove wheel hub (16) with bearings (18) and (20) and seal ring (19).



19. Remove the drain valve (17).



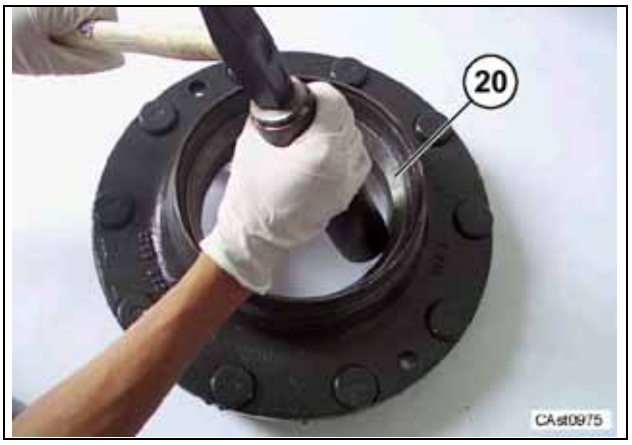
20. Remove seal ring (19).



21. Remove inner cup of bearing (18).



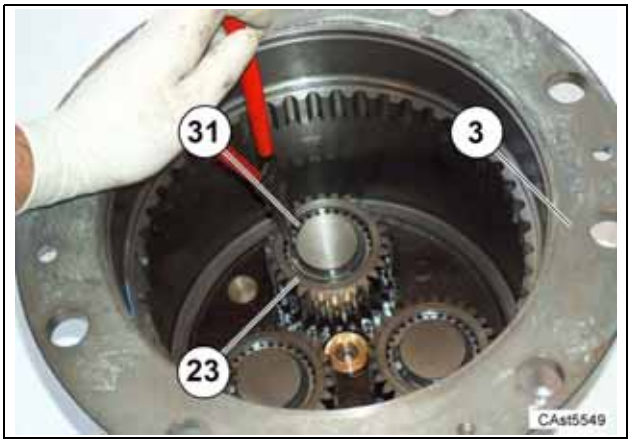
22. Remove outer cup of bearing (20).



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).



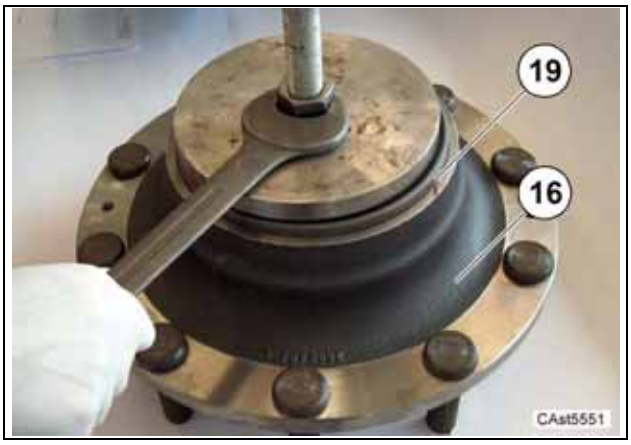
3. fit the remaining part of bearing 18) on wheel hub (16).



4. Apply Loctite® 510 on seal ring (19).



5. Fill seal ring (19) on wheelhub (16). Use tool 2897003.



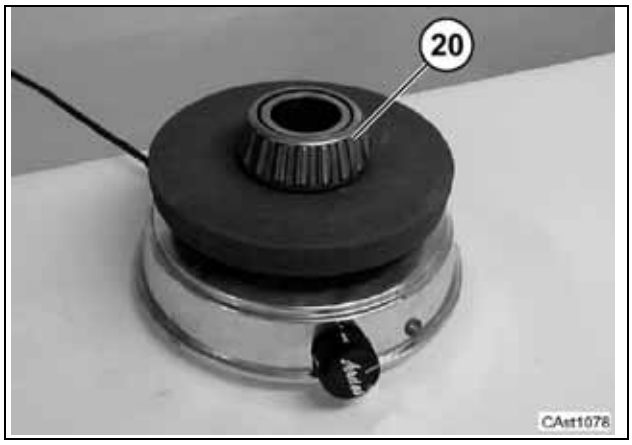
6. Lubricate axle shaft to assemble the wheel hub. **Warning**: Polish hub and oil holes.



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.



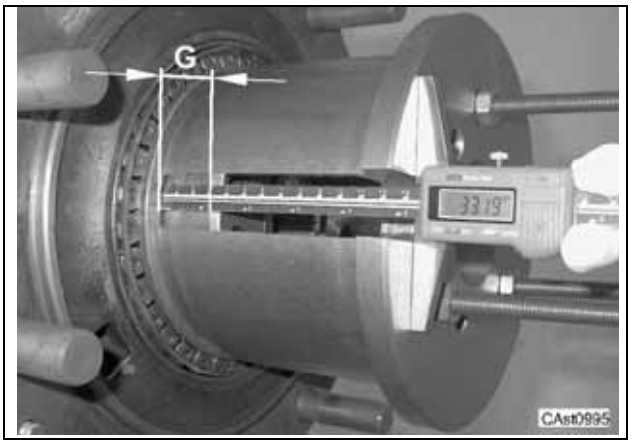
9. Fit bearing (20) inside beam trumpet.
   Warning: Wear gloves to avoid getting burnt.



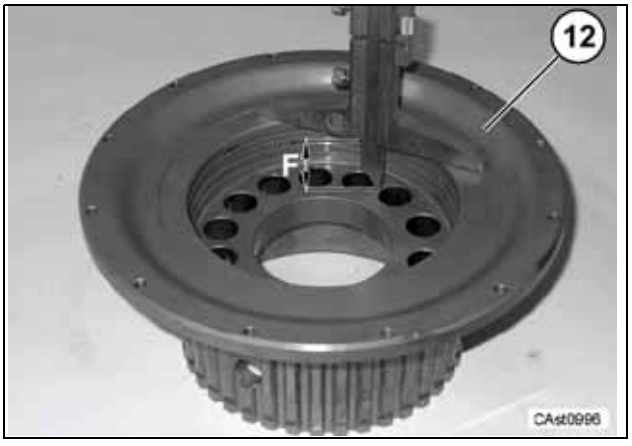
10. Assemble the tool 2897013, 3 draw plates M10 x 285 and 3 nuts M10.



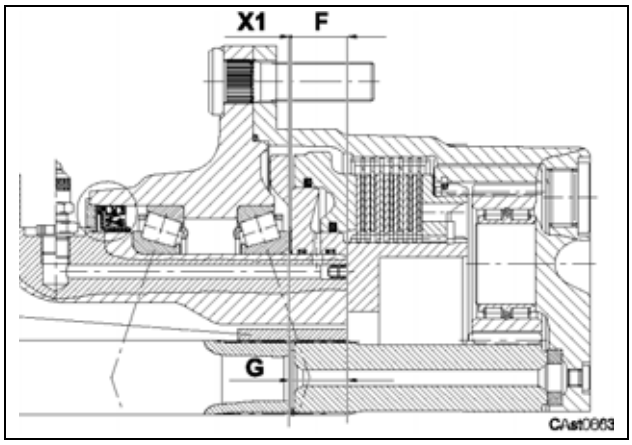
11. Use a depth gauge to measure dimension (g) of wheel hub.



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).

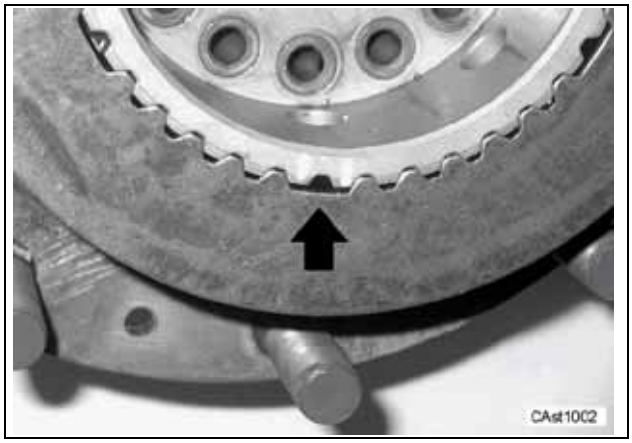


18. Fit the whole unit of the brake carrier on wheel hub.

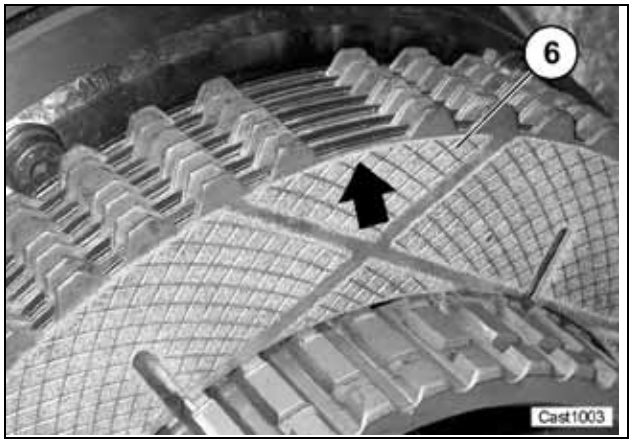
★ The brake carrier and beam trumpet holes should coincide.



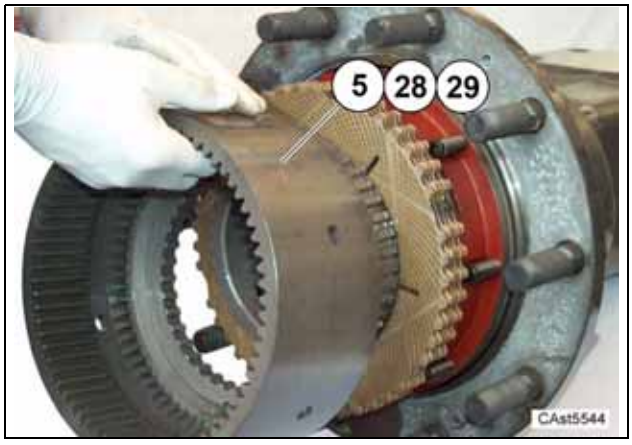
19. Assemble brake discs (6).
Warning: During assembly operations all the inner disc slots should coincide.



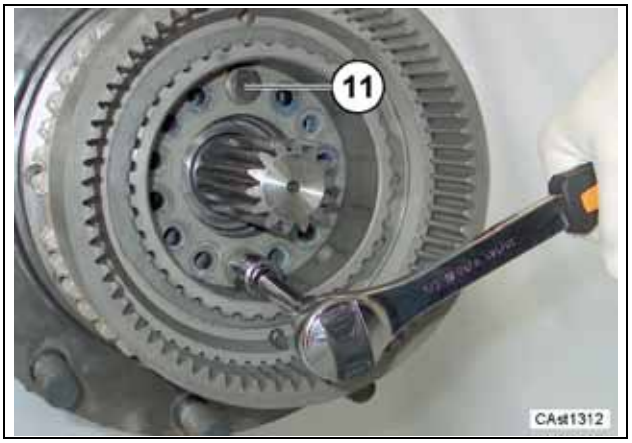
20. Assemble brake discs (6).
Warning: During assembly operations all the outer disc slots should coincide.



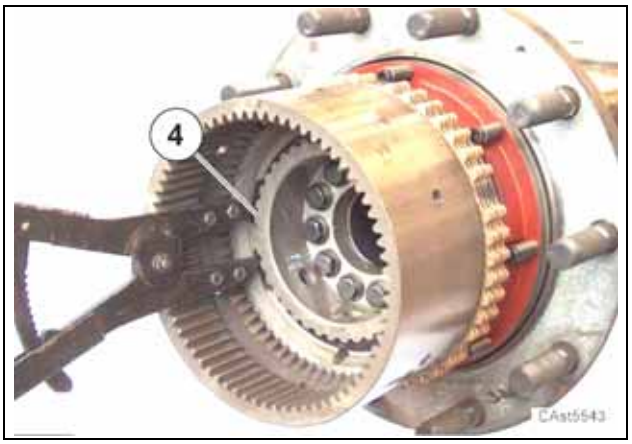
21. Fit ring bevel gear (5) with carrier (28) and split ring (29).



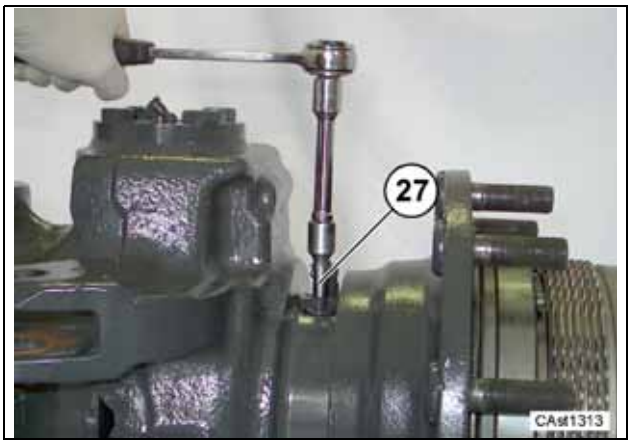
22. Test the brake by temporarily fitting two screws (11).
Warning: Do not assemble bushes (22).



23. Fit snap ring (4).



24. Remove plug (27).



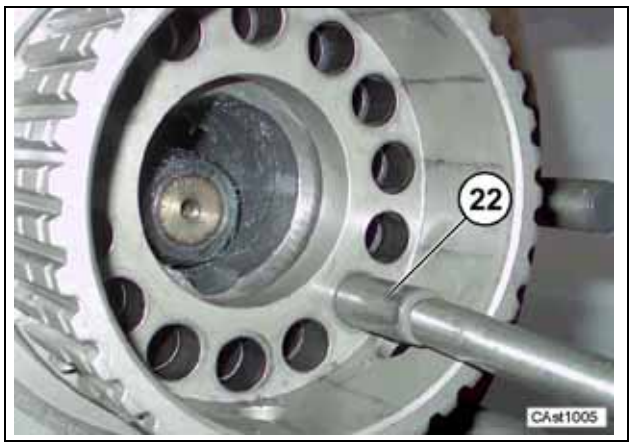
25. Fit an adapter instead of the plug.



26. Test the brakes by considering that pressure should be 100_{-5}^{0} bar for about one minute.



27. Fit bushes (22).
Warning: Pay attention to the assembly direction of bushes.



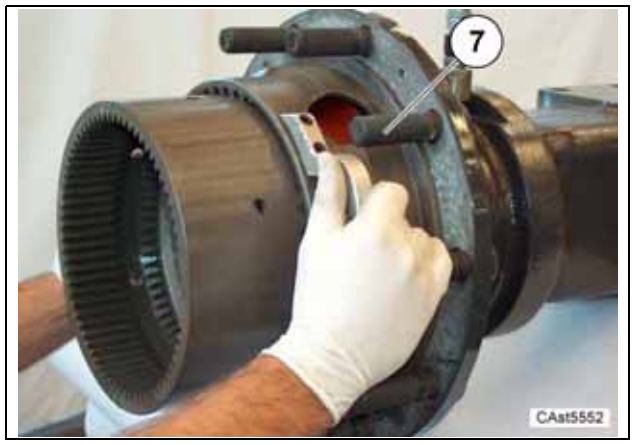
28. Apply Loctite® 242 inside slots.



29. Fit screws (11) and shims (21).
Tightening torque: 68Nm



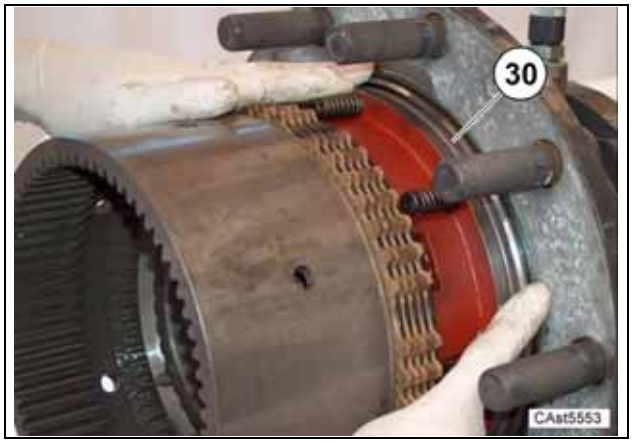
30. Line up brake discs. Use tool 2897014.
Warning: A tooth should coincide with a brake fastening screw (7).



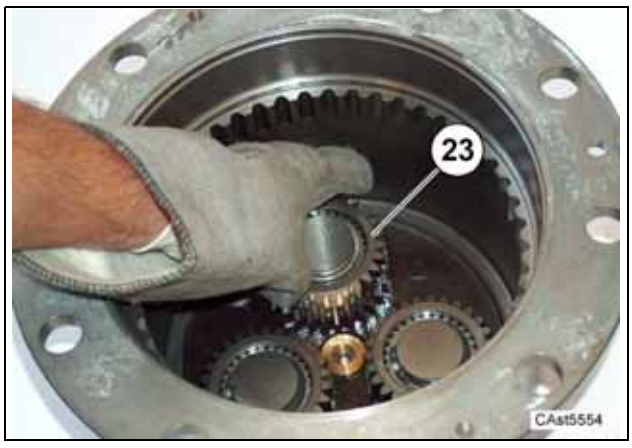
31. Put brakes under pressure to avoid outer disc misalignment.



32. Lubricate with grease and fit O-ring (30).



33. Heat the planetary gear bearing at 110°C. Assemble planetary gear.



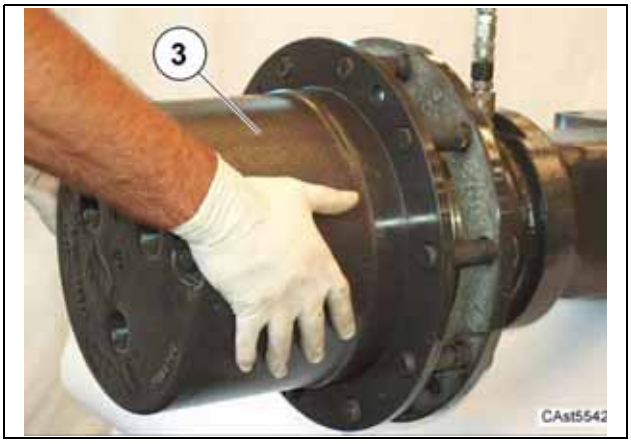
34. Assemble snap ring.



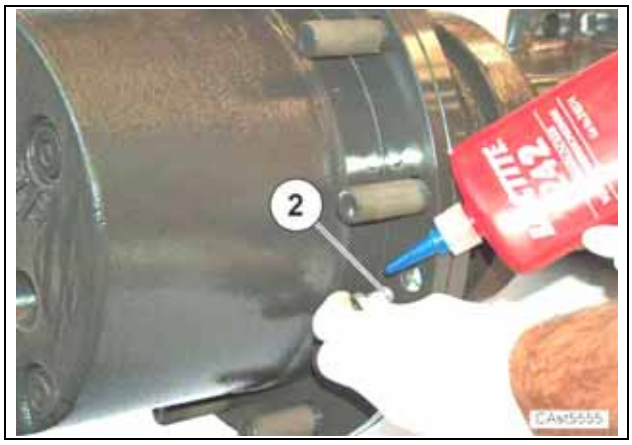
35. Lubricate with grease the contact surface of planetary gear cover (3). Apply Loctite® 510 in the holes.



36. Fit the planetary gear cover (3) and discharge pressure from the hydraulic pump.



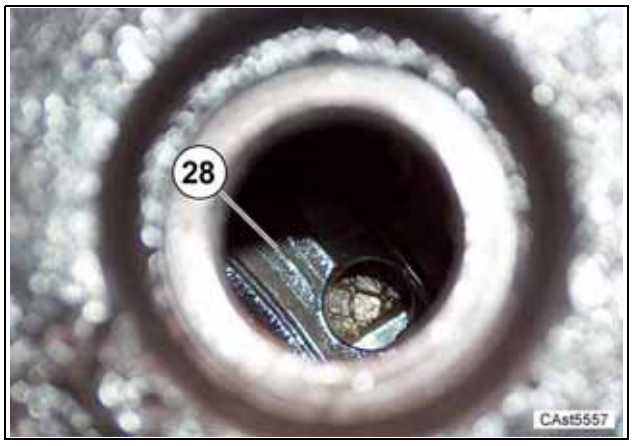
37. Apply Loctite® 242 on screw.



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.

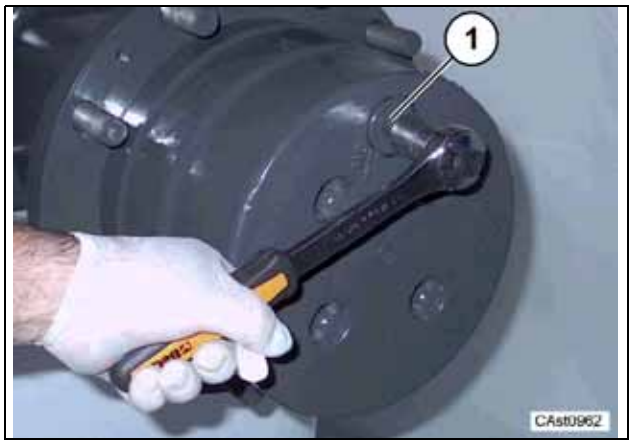


40. Apply pressure of 45-50 bar and check the distance between brake locking and unlocking (Min: 1.7mm; Max: 3.8 mm)

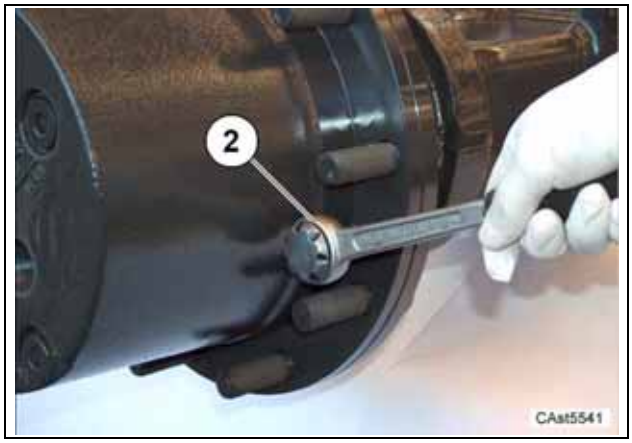


DISASSEMBLY OF JOINT BOX

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.



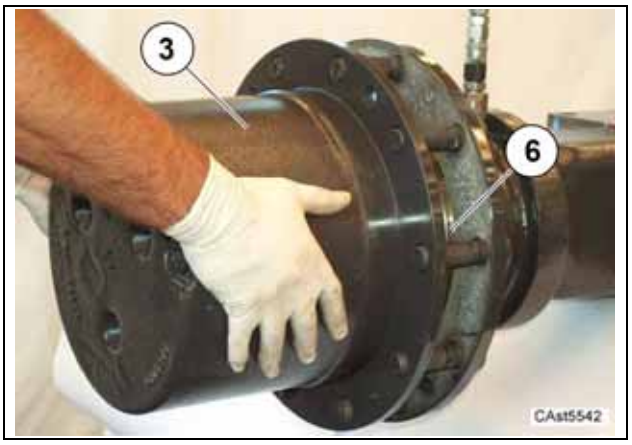
2. Remove fastening screws (2) from the cover of the planetary gears carrier.



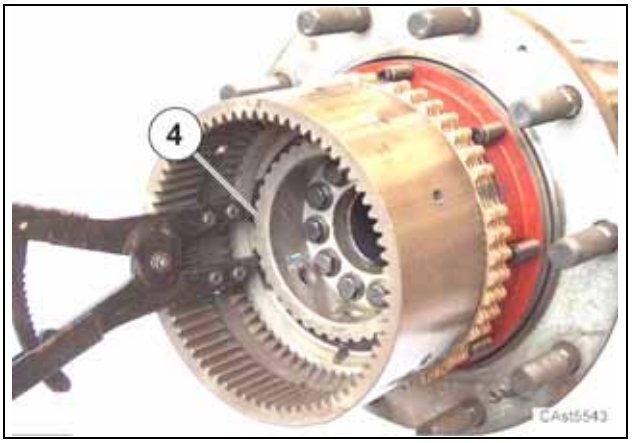
3. Use the levers inside the preset slots to detach the planetary gear carrier cover.



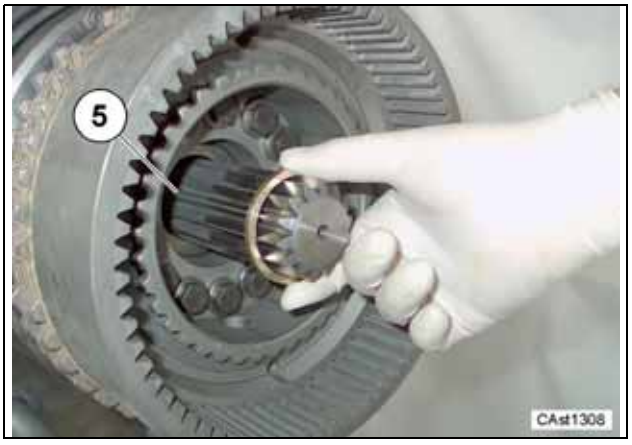
4. Remove the planetary gear carrier cover (3) and O-ring (6).



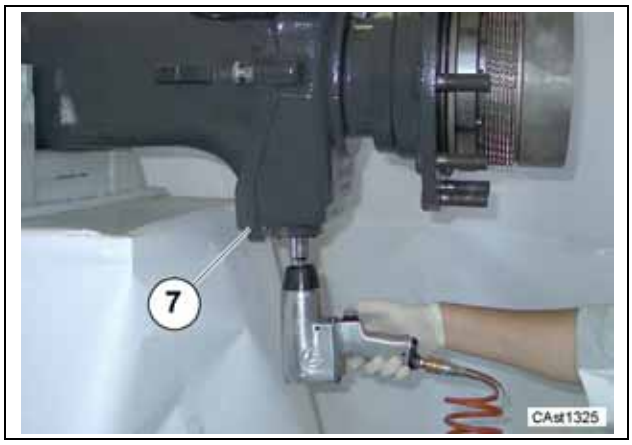
5. Remove split ring.



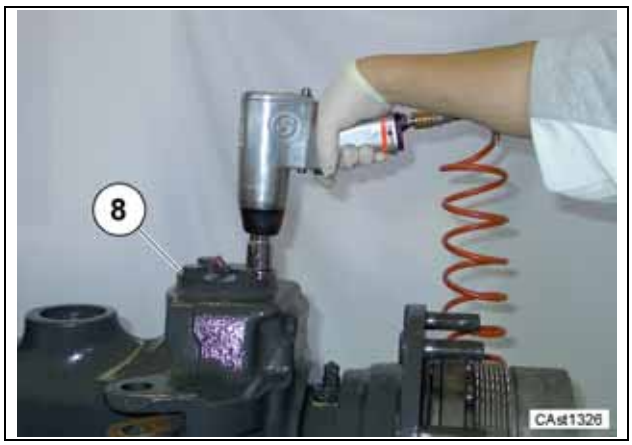
6. Remove spacer (5).



7. Remove the screw (7).



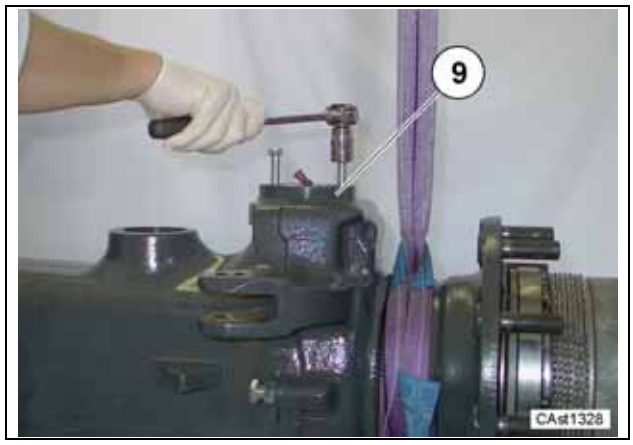
8. Remove the screw (8).



9. Secure the joint box to a hoisting equipment.



10. Screw two screws M12 x 100 and remove the pivot.



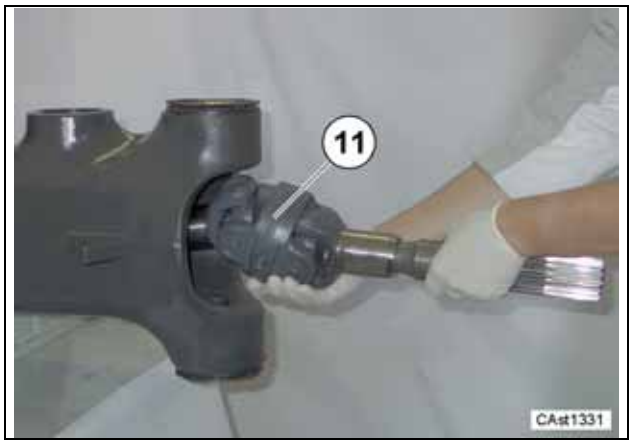
11. Screw screws M12 x 100 and remove the pivot.



12. Remove the complete joint group.



13. Remove the complete joint (11).



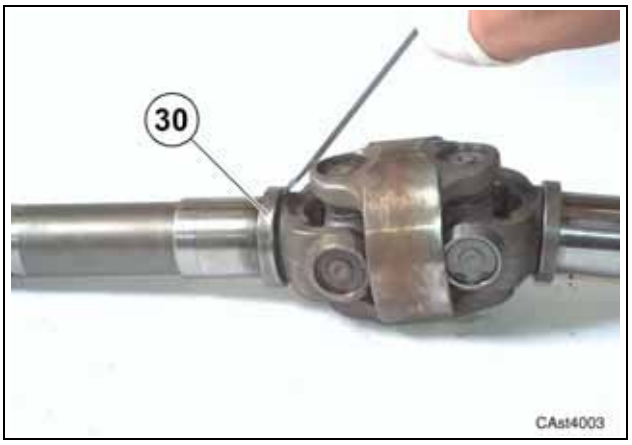
14. Remove the gasket (12).



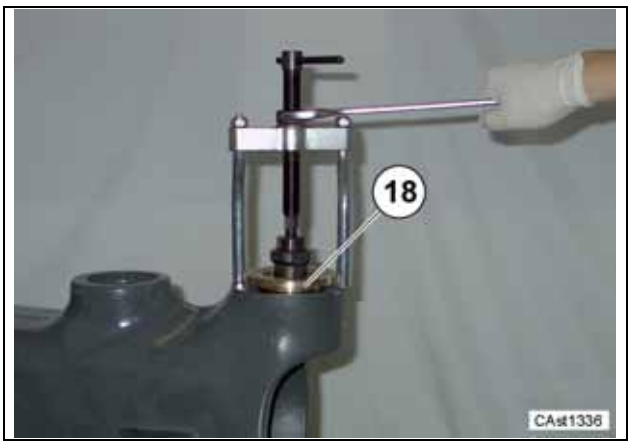
15. Remove the gasket (13).



16. Remove gasket (30).



17. Use an extractor to remove bush (18).



18. Remove the O-ring (19).



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.



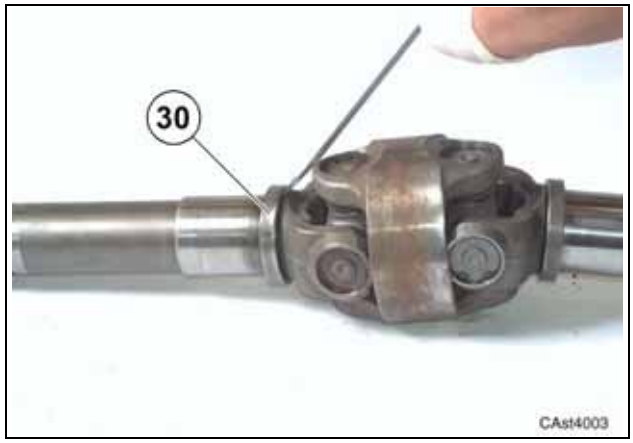
12. Assemble the pins (26).



13. Grease and assemble the spacer (27).



14. Assemble gasket (30).



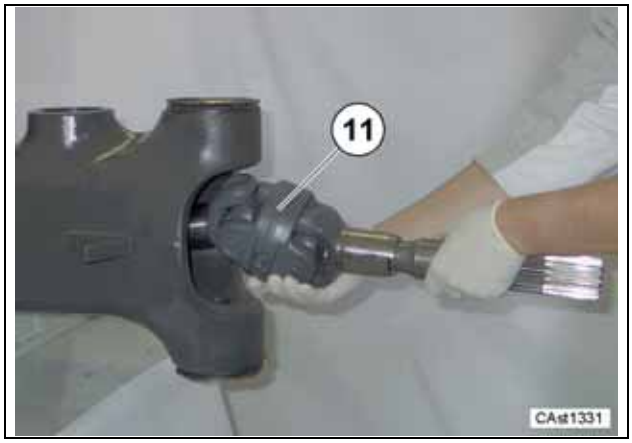
15. Assemble the gasket (12). Pay attention to assembling direction.



16. Assemble the gasket (13). Pay attention to assembling direction.



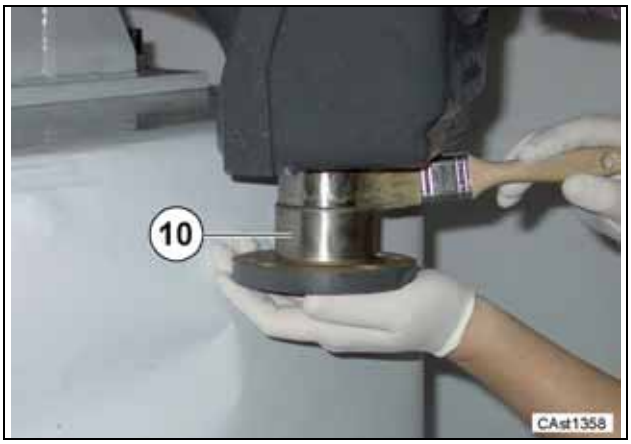
17. Assemble the complete joint (11).



18. Grease tabs of the joint group and assemble.



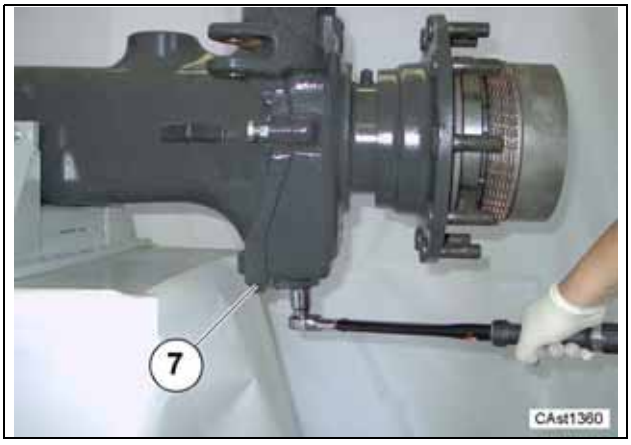
19. Lubricate and assemble the pivot.



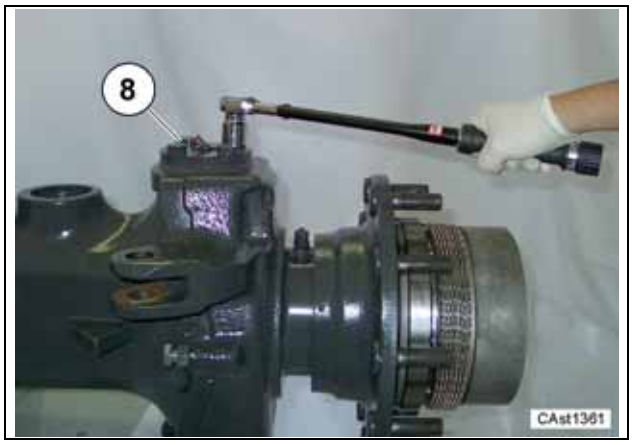
20. Lubricate and assemble the pivot (9).



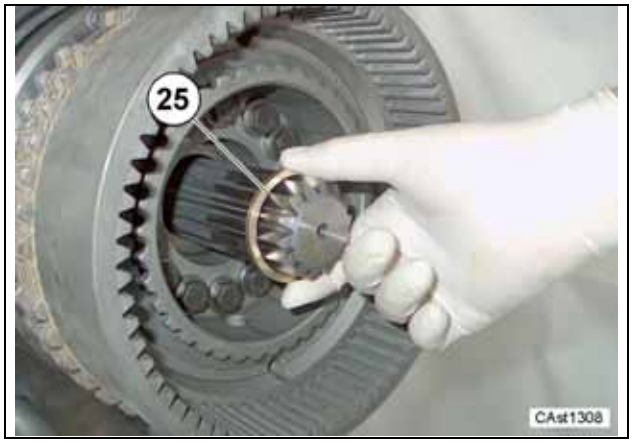
21. Apply Loctite® 242 and assemble the screw (7). Torque - 285Nm (29 kgf-m)



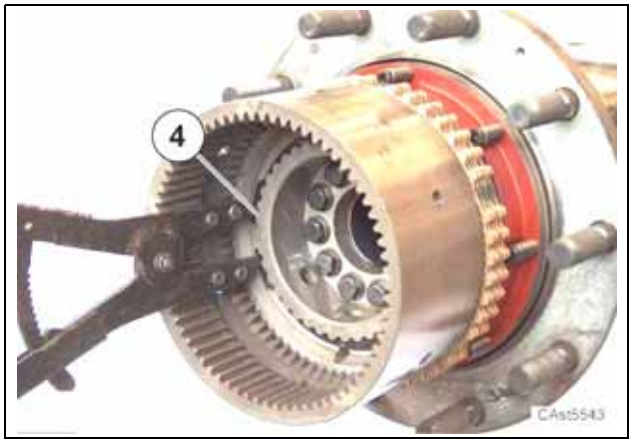
22. Apply Loctite® 242 and assemble the screw (8). Torque - 285 (29kgf-m)



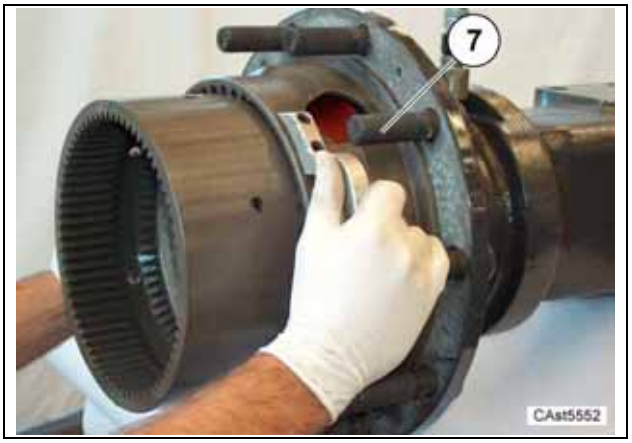
23. Assemble the snap ring (4).



24. Assemble the snap ring (4).



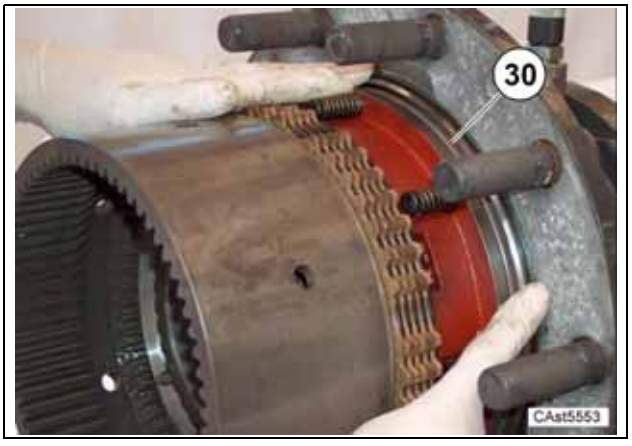
25. Line up brake discs. Use tool 2897014.
Warning: A tooth should coincide with a brake fastening screw (7)



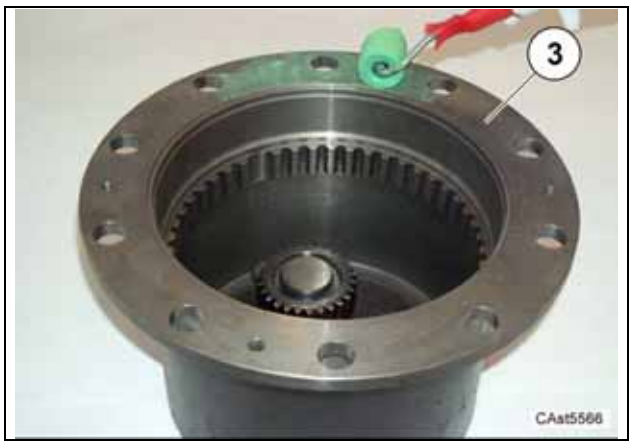
26. Put brakes under pressure to avoid outer discs misalignment.



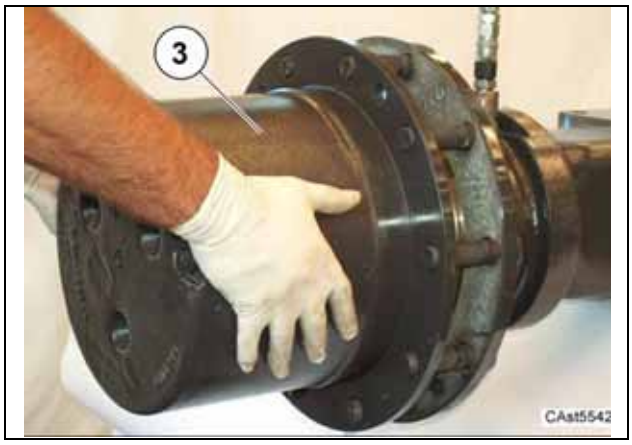
27. Lubricate with grease and fit O-ring (30).



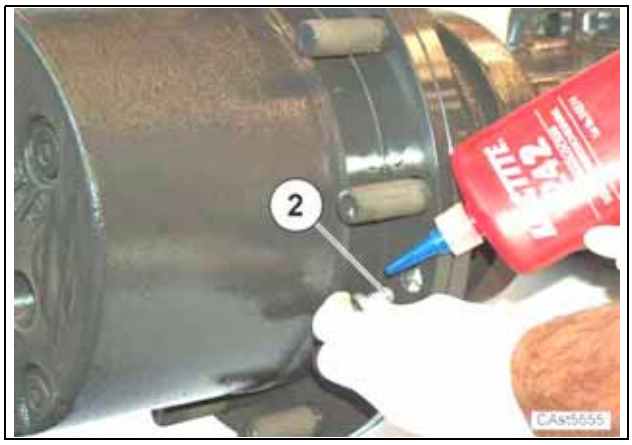
28. Lubricate with grease the contact surface of planetary gear cover (3).
    Apply Loctite® 510 in the holes.



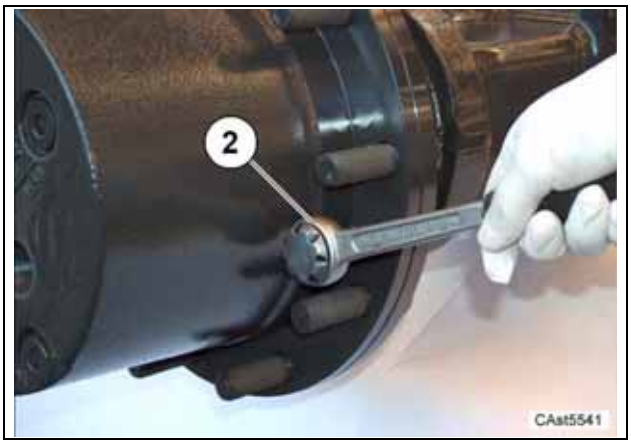
29. Fit the planetary gear cover (3) and discharge pressure from the hydraulic pump.



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).



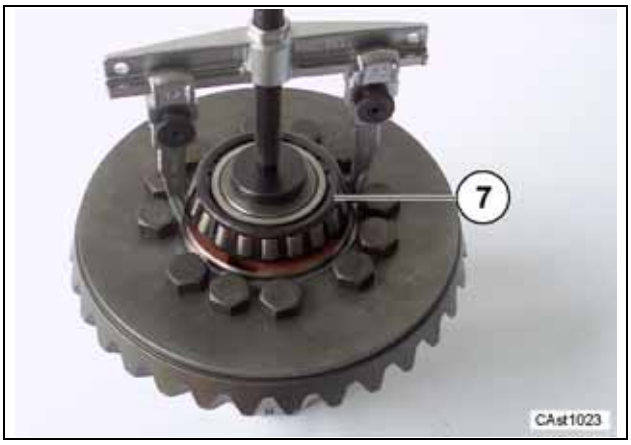
8. Use an extractor and remove from housing (3) the outer cup of bearing (7).



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.

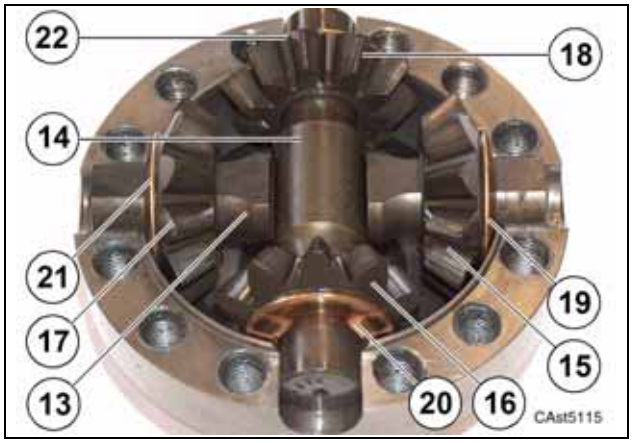


13. Check marking points (11) and (12) that will be useful during the assembly.



Note: Without differential torque limiter.

14. Remove differential pins (13 and (14), planetary gears (15), (16), (17) and (18) and spheric washers (19), (20), (21), and (22).

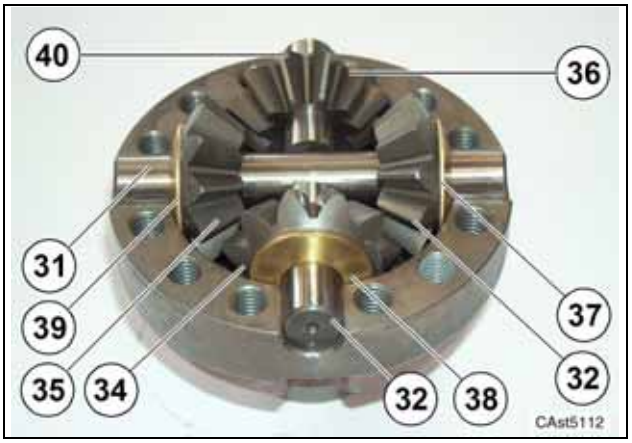


15. Remove planetary gear (24) and shim (26).



Note: With differential torque limiter.

16. Remove differential pins (31 and (32), planetary gears (33), (34), (35) and (36) and spheric washers (37), (38), (39), and (40).



17. Remove planetary gear (41).



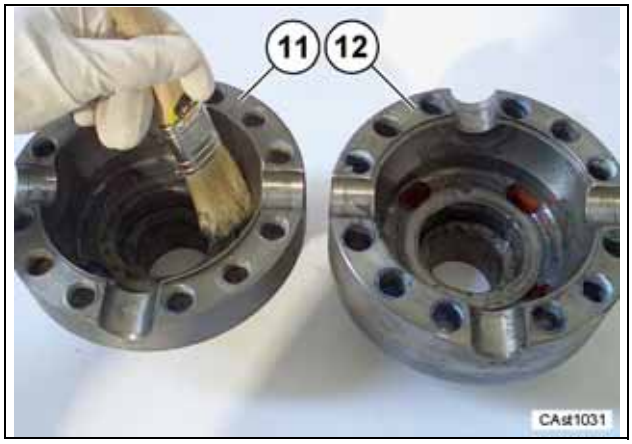
ASSEMBLY OF BEAM TRUMPET AND DIFFERENTIAL UNIT

Note: Without differential torque limiter.

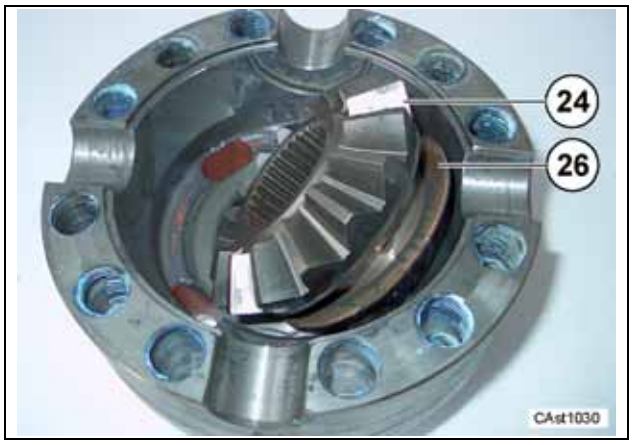
1. Apply a thin layer of molicote G-n plus paste on half boxes of differential (11) and (12).

⚠ WARNING

Remove remains of old sealing compound.



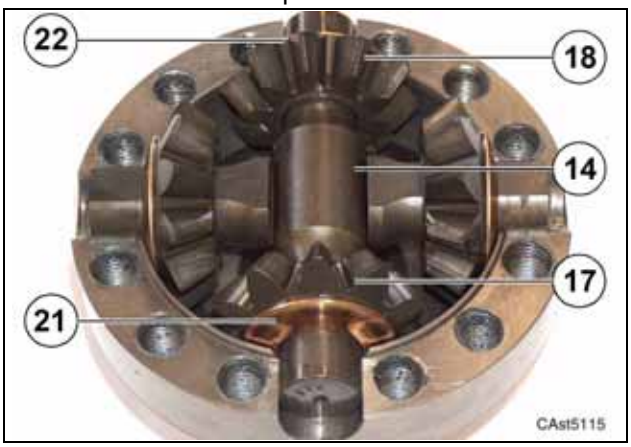
2. Set crown Wheel (24) and washer (26).



3. Fit the differential unit pin (13) and planetary gears (15) and (16) and washers (19) and (20).



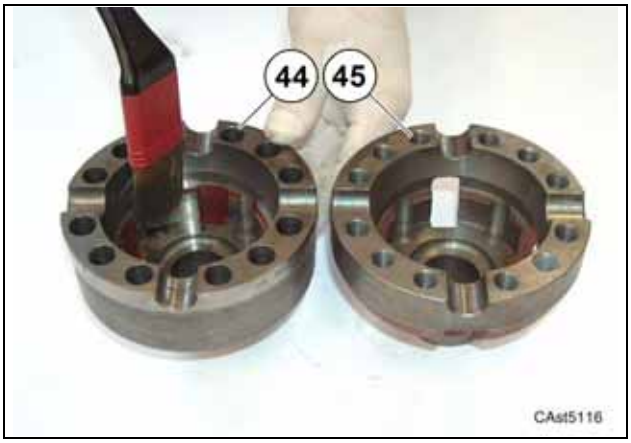
4. Fit the differential unit pin (14) and planetary gears (17) and (18) and washers (21) and (22). With differential torque limiter.



5. Apply a thin layer of Molicote G-n plus paste on half boxes of differential (44) and (45).

⚠ WARNING

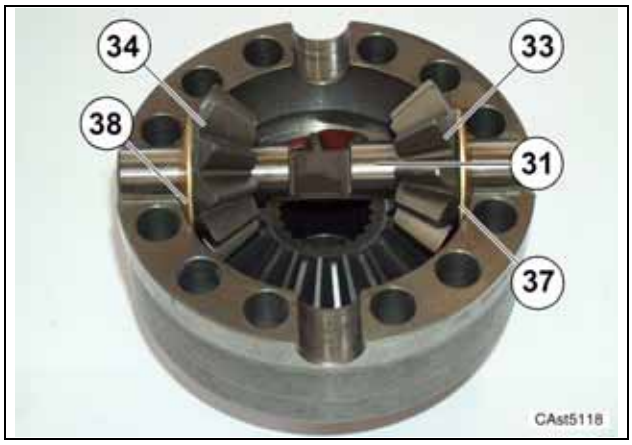
Remove remains of old sealing compound.



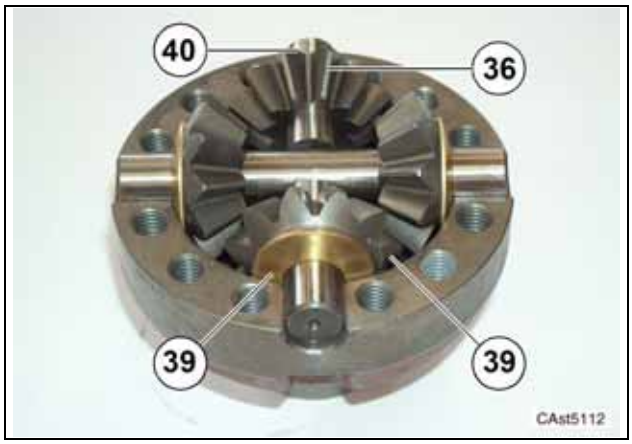
6. Assemble planetary gears (41).



7. Fit the differential unit pin (31) and planetary gears (33), (34) and washers (37) and (38).



8. Fit differential unit pin (32) and planetary gears (35), (36) and washers (39) and (40).



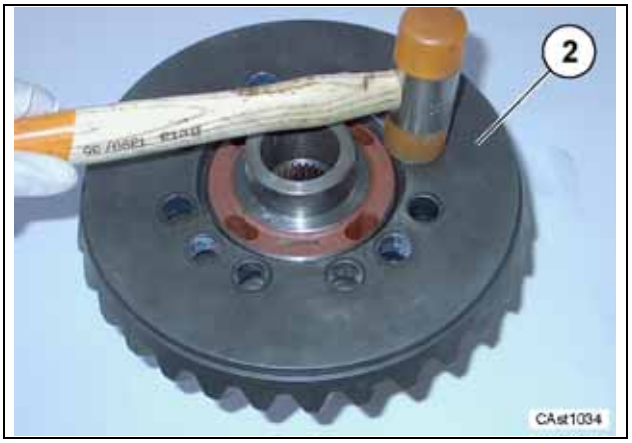
9. Fit the two half boxes of differential unit (11) and (12).

⚠ WARNING

Carefully check that the marks of both differential half boxes coincide.



10. Fit ring bevel gear (2) by using a hammer.



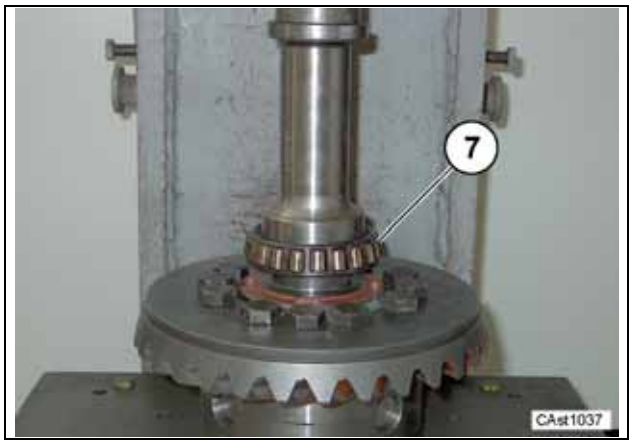
11. Apply Loctite® 242 on thread of screws (10).



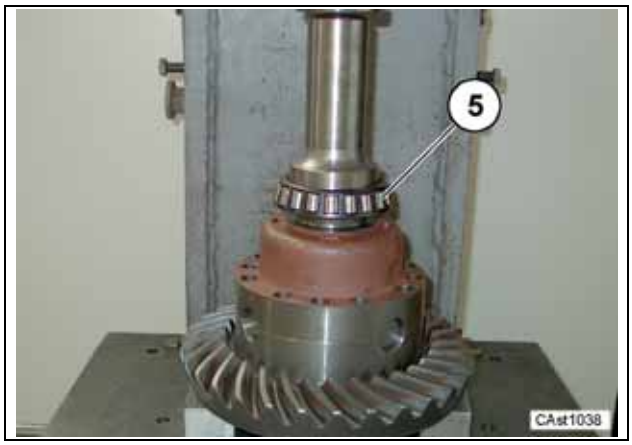
12. Tighten screws (10)
    Torque - 205 Nm (21 kgf-m)
    Note: Fix differential housing in the vice.



13. Press bearing (7) or assemble after preheating.



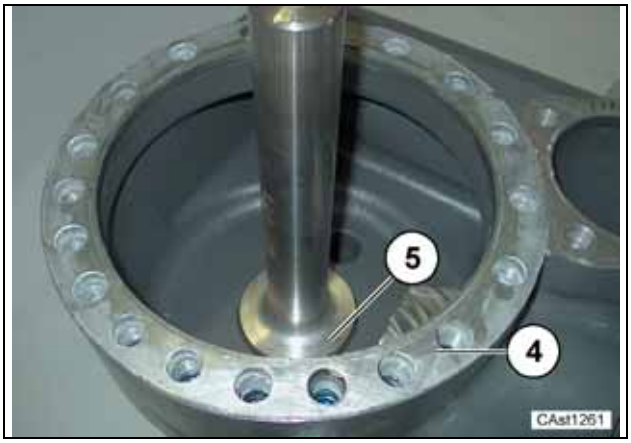
14. Press bearing (5) assemble after the preheating.



15. Fit adjustment shims (6) **X1** on beam trumpet (4).



16. Use tool 2897004 to fit bearing washer (5) on beam trumpet (4).



17. Fit O-ring (9) on beam trumpet (3). Lubricate O-ring (9)with grease.



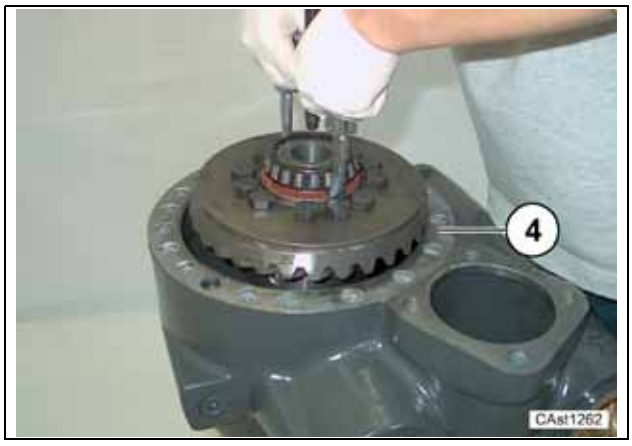
18. Position adjusting shims (8) **X2** on beam trumpet (3).



19. Use tool 2897004 to fit the bearing outer washer (7) on beam trumpet (3).



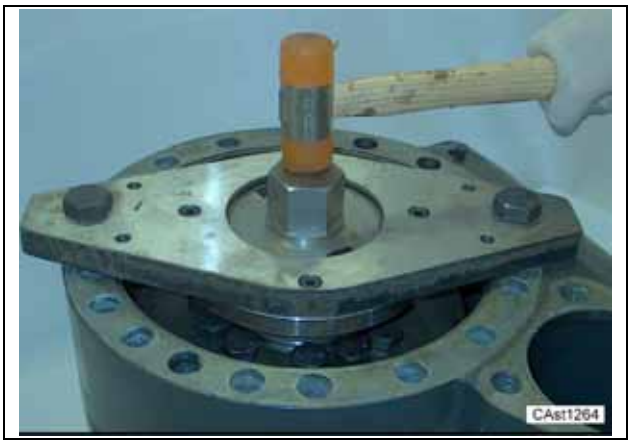
20. Position the differential unit beam trumpet (4).



21. Position tool 2897001. Assemble half bearing (7) inside tool.



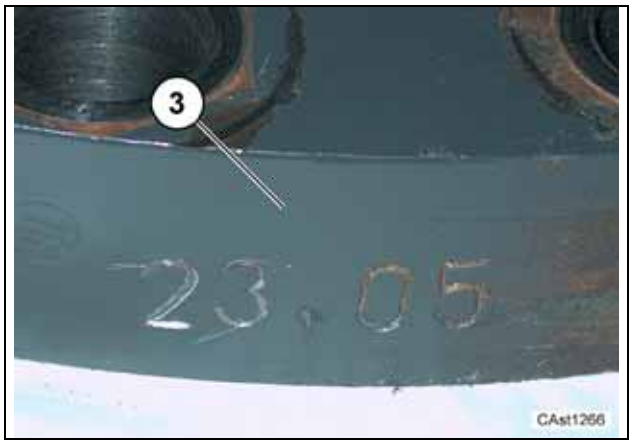
22. While Screwing the tool nut until the value of 10Nm has been reached turn the ring bevel gear and strike it with a hammer to fix whole unit.



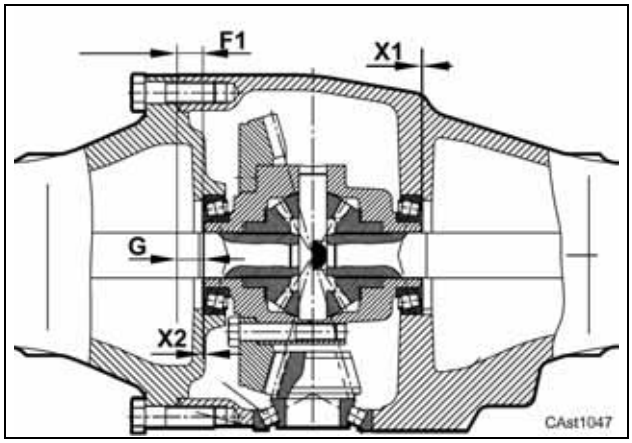
23. Measuring of value **G**.



24. Value written on beam trumpet (3) **F1**



25. Drawing used to determine backlashes between the bevel gear pair teeth.
X1 = 1.8
Check adjusting shims **X2** through the suggested procedure for axles
X2 = F1



26. Move alternately the pinion tang 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.



27. Apply Loctite® 510 on contact surface of beam trumpet (4).



28. Apply Loctite® 242 on screws (1).



29. Assemble screws (1) and washer (27).
    Torque - 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.



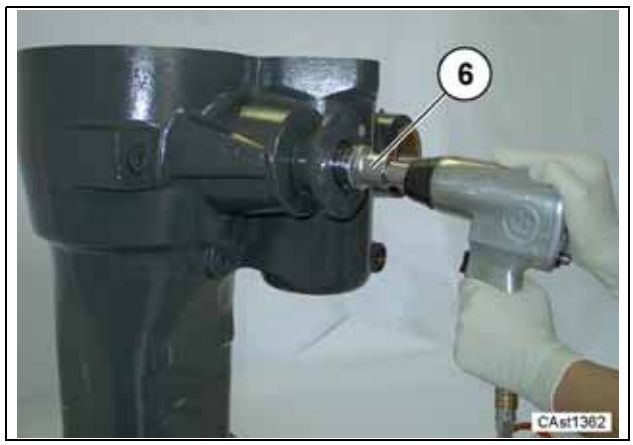
4. Remove O-ring (5).



5. Lift the whole differential unit.



6. Loosen the nut (6).



7. Remove the nut (6) and the flange (10).



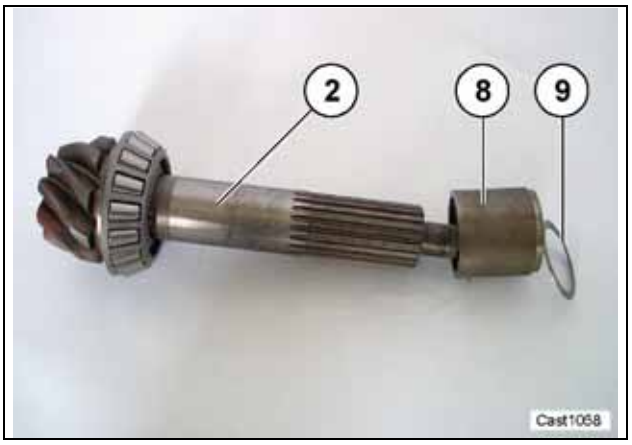
8. Remove the gasket (7).



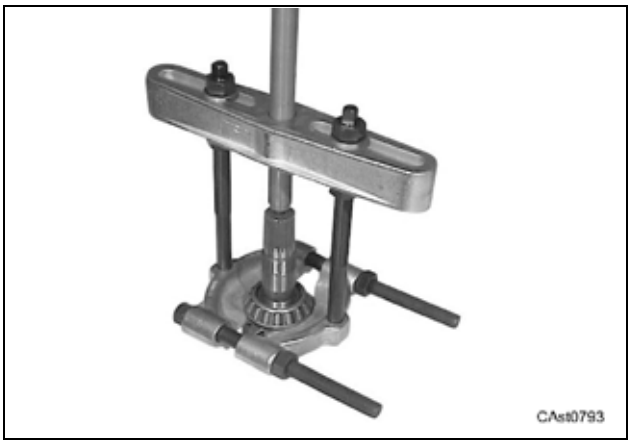
9. Take the bevel pinion out of its housing, by beating with hammer made of soft material on the splined end.



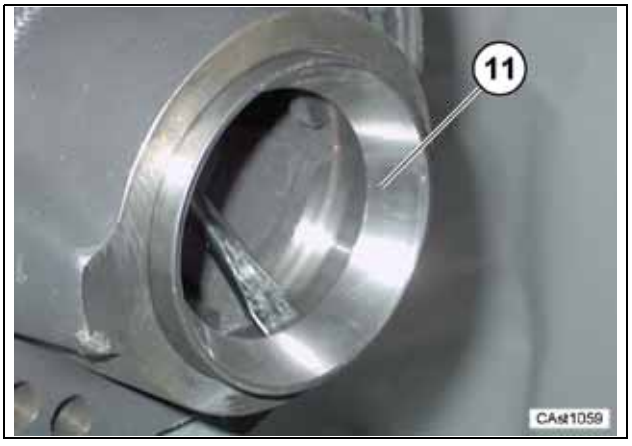
10. Once the bevel pinion (2) has been removed, collect shims (9) and spacer (8).



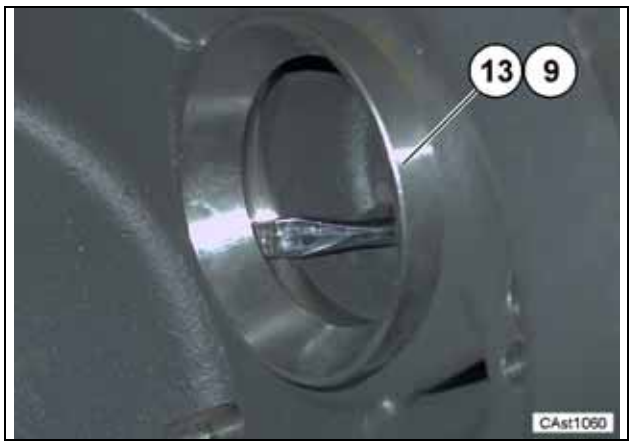
11. Take the bearing cone (13) out of the bevel pinion end, using a suitable extractor.



12. Take the cup of the taper roller bearing (11) out of the central body, using a chisel and hammer.



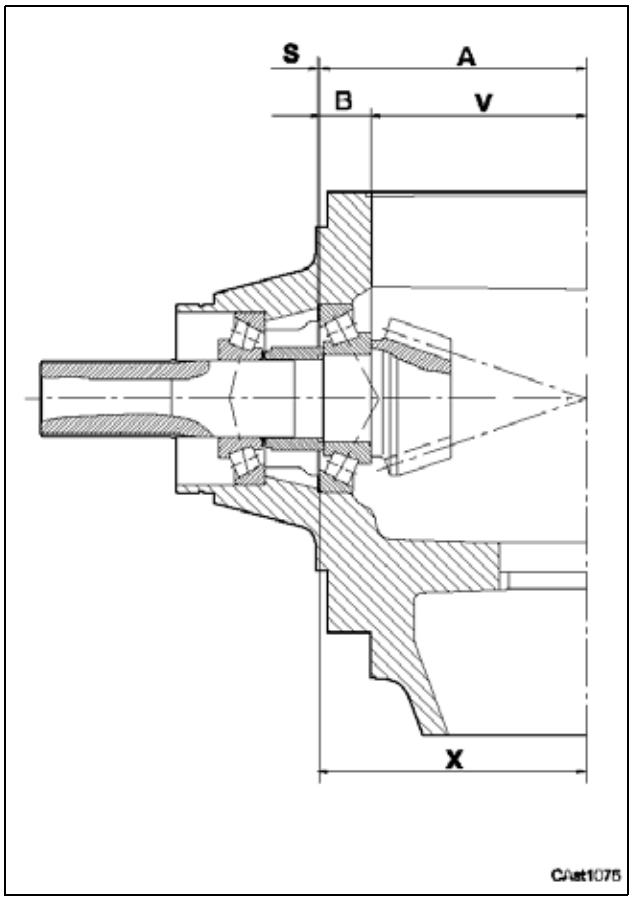
13. Remove the outer cup of the taper roller bearing (13) and shims (9) from the central body. Use a chisel and a hammer.



ASSEMBLY OF PINION GROUP

1. Bevel pinion adjustment.

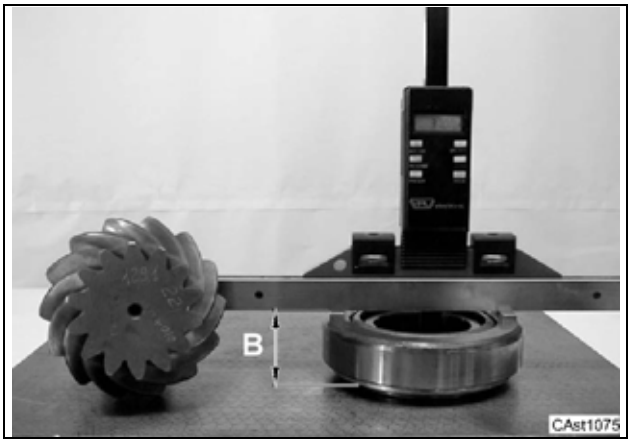
X	155.50	155.50	155.70
B	29.25	29.45	29.45
V	125.00	125.20	124.80
A	154.25	154.65	154.05
S	1.25	0.85	1.65



2. Value stamped on beam trumpet.



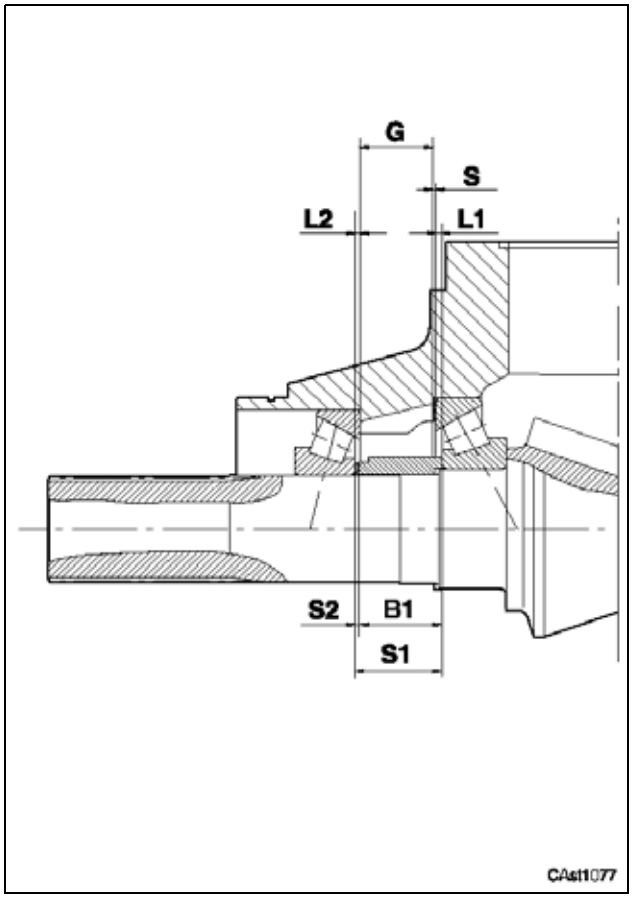
3. To determine shim (**S**) between pinion and bearing it is enough to add value (**V**) printed on pinion head (**V** = prescribed conical distance) to value **B** - bearing width - and subtract **X** from the value printed on beam
S = X - (V+B)
Example:shim **S** = 163.6 - (132.80 + 29.25) =1.55 mm



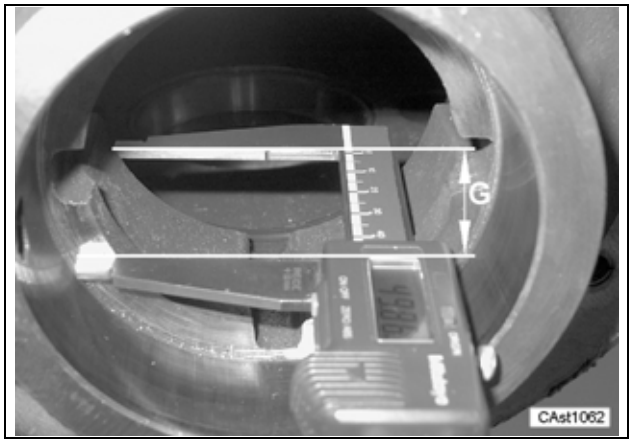
4. Bearings adjustment.

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

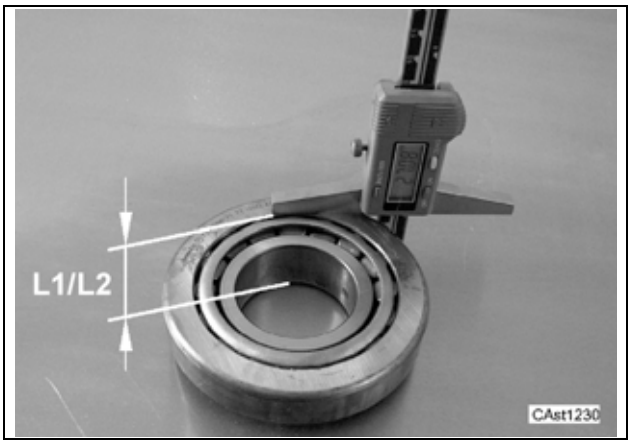
Preloading reduction ca. 0.02 - 0.04 for a 2-3 Nm torque.



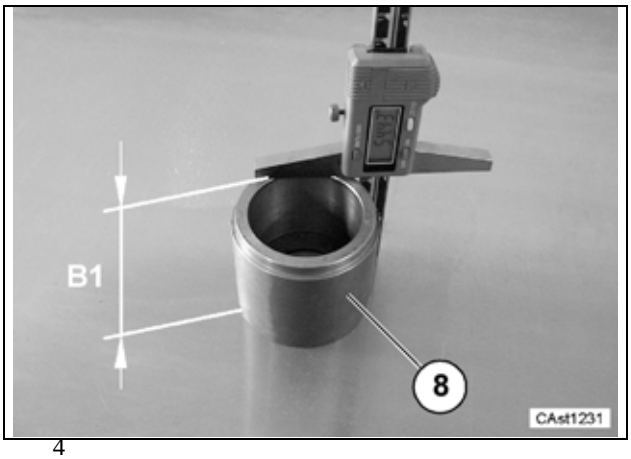
5. To determine shim **S2.**
   S2 = B1 - (L1 - S - G - L2)
   S = previously detected shims
   G = beam value



6. L1 = Bearing Height
   L2 = Bearing Height.

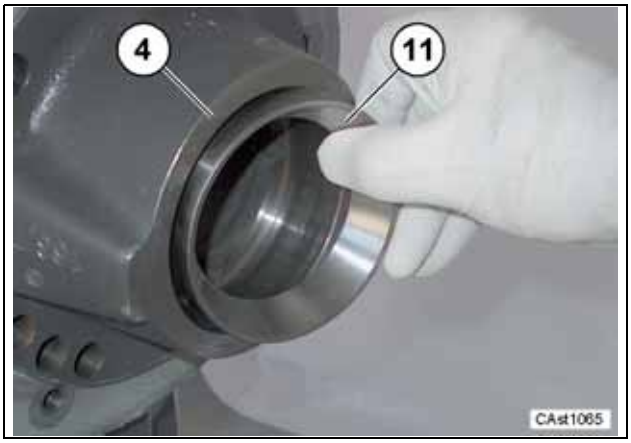


7. **B1** = spacer (8).
   Alternative procedure, use starting spacer **S** = 1.5.



4

8. Position half bearing (11) on beam trumpet (4).



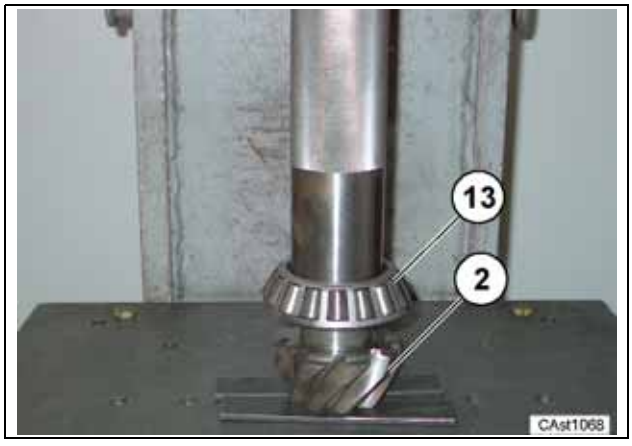
9. Position adjusting shims (9) and inner bearing washer (13) on beam trumpet (4).



10. Insert the cups of the taper roller bearings on their housings using the special tools included in the kit 2897006.



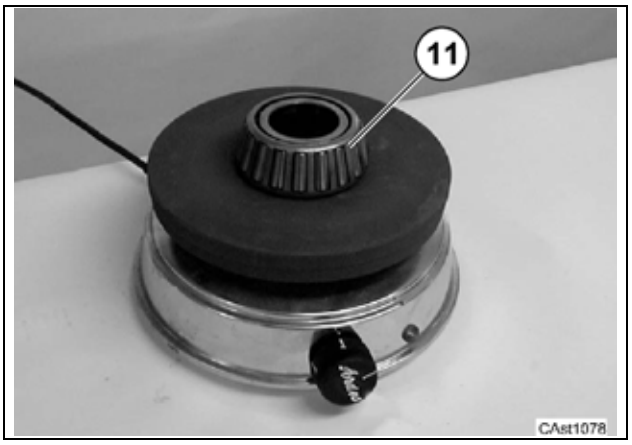
11. Press inner bearing (13) on pinion (2).
Use tool 2897009.



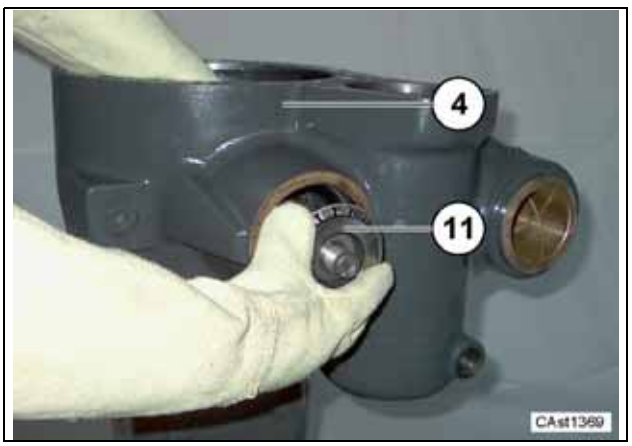
12. Fit the whole pinion of the bearing complete with spacer (8) and shims (12), on the beam trumpet (4).



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).

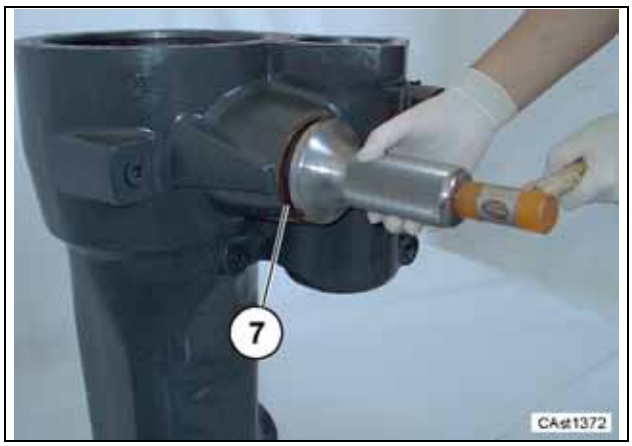


16. Fit oil seal (7) inside tool 2897015.
Apply Loctite® 510 on the oil seal outer edge.



17. Assemble the oil seal by slightly striking with a plastic hammer.

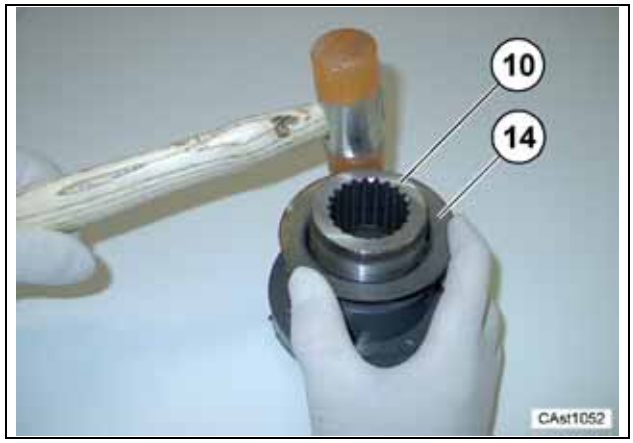
Note: Clean the box with a rolling brush.



18. Apply Loctite® 242 on nut (6).



19. Use a hammer to assemble flange (10) together with guard (14).



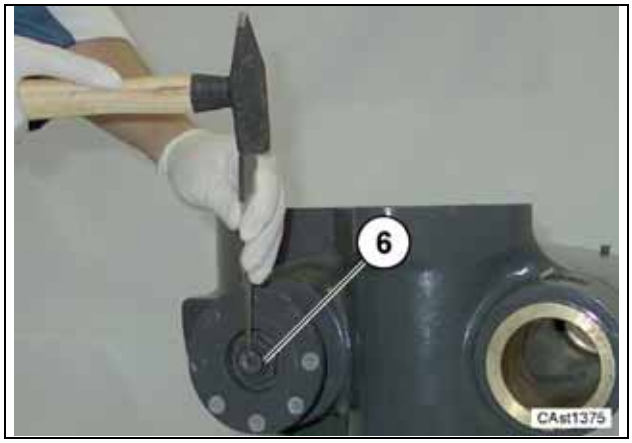
20. Assemble the flange (10) and the nut (6).



21. Apply tool 2987001.
    Torque - 340 Nm (35 kgf-m)



22. Drive the nut (6)with a tool.



23. Carry out the preloading 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 preloadings should be measured without the seal ring.
P = 2/3 Nm



24. Assemble the whole differential unit.



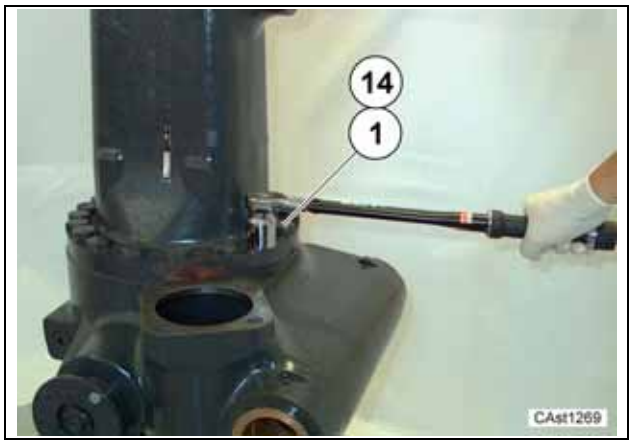
25. Assemble O-ring (5) on beam trumpet (3). Grease the O-ring (5)



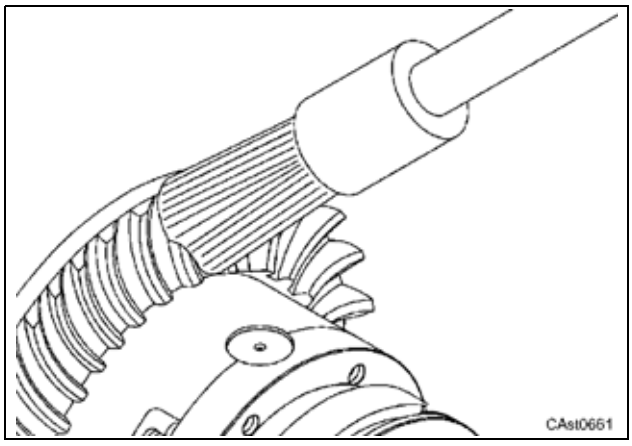
26. Apply Loctite® 510 on contact surface of beam trumpet (4).



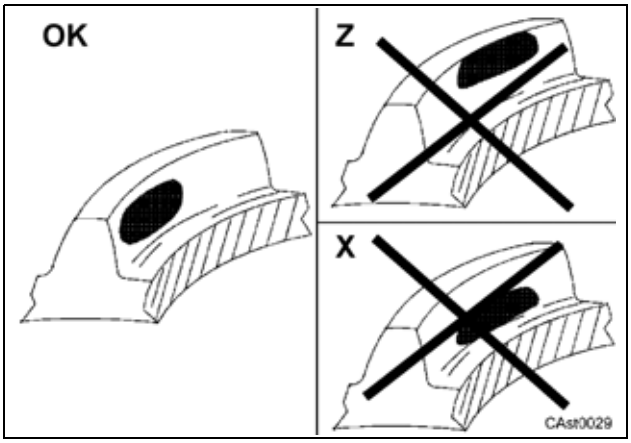
27. Fit screws (1) and tighten.
Torque - 205 Nm (21 kgf-m)



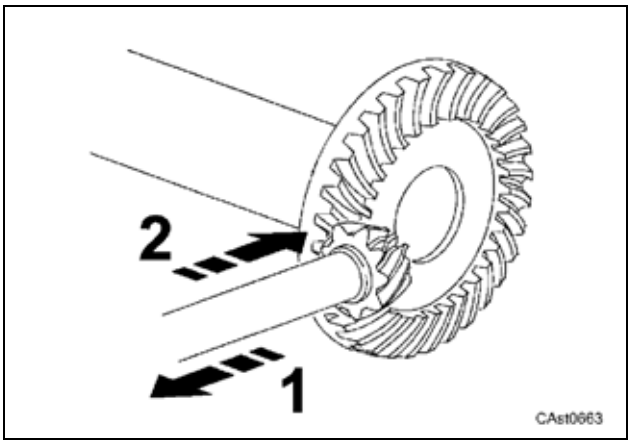
28. To test the marks of the bevel gear teeth, paint the ring gear with red lead paint and detect the contact. The marking test should be **always** carried out on the ring bevel gear teeth and on both sides.



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.

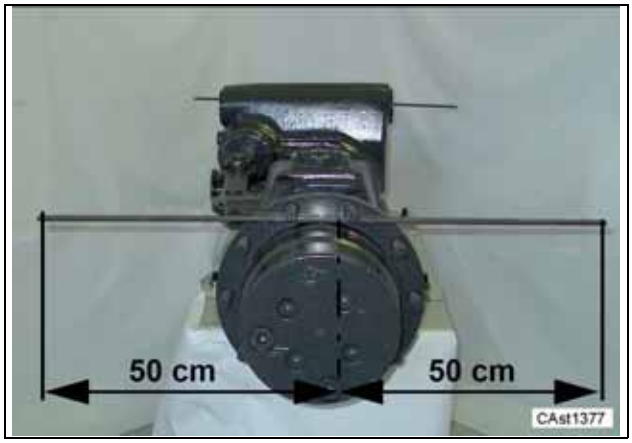


TOE-IN ADJUSTMENT

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.



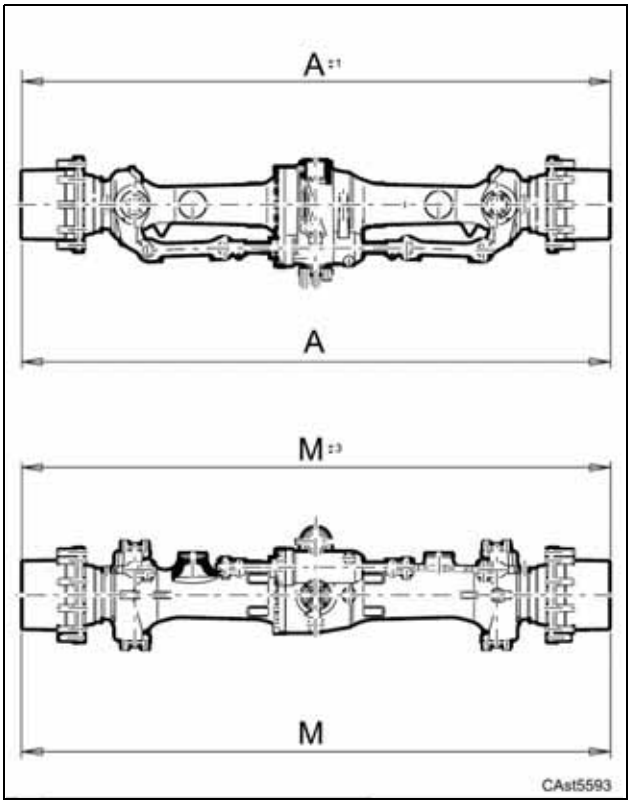
2. Measure the distance in mm between the bar ends with a tapeline (M).

   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	07376-70210 02896-11008	1 1	Rear Clutch Hose
Cap Plug O-ring	07376-70210 02896-11008	1 1	Top Clutch Hose
Plug	02789-00210	2	Brake fittings
Cap Plug O-ring	07376-70210 02896-11008	2 2	Hub Brake Lines

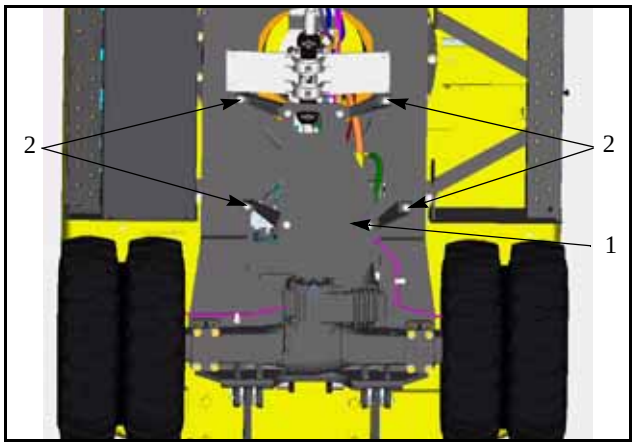
1. Drain oil out of rear axle and hubs.

Rear Axle: Approx. 9.5 Litres
Rear Hubs: Approx. 2.0 Litres (Each)

2. Lower work equipment to raise undercarriage so that rear axle is clear of ground.



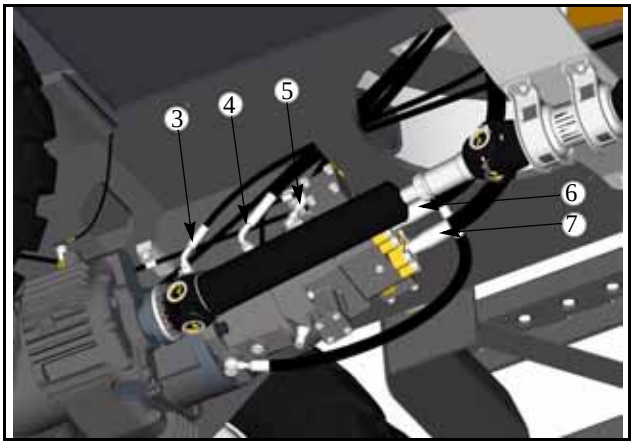
3. Remove cover (1) by removing bolts (2).



4. Attach an identification tag to hoses to avoid incorrect connection during re-assembly

5. Attach vacuum pump to hydraulic tank and apply vacuum.

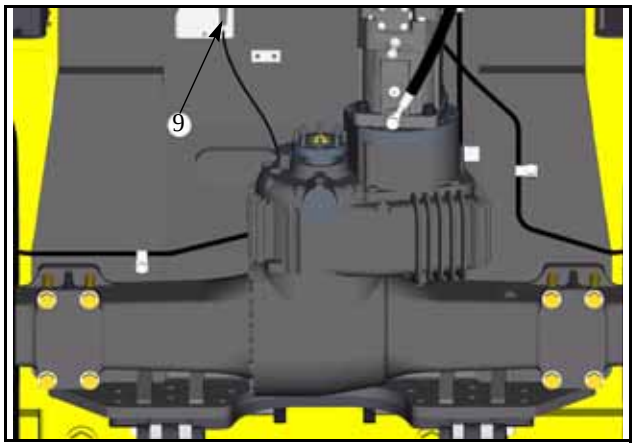
6. Disconnect each hose individually from the travel motor and hose from top of the transmission plug with blank / plug and O-ring from blanking kit to prevent oil spillage and contamination (3 through 7)



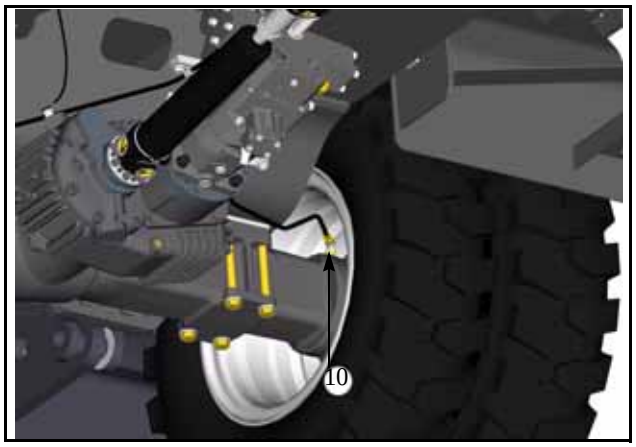
7. Disconnect hose (8) from rear axle and plug with blank/plug and O-ring from blanking kit to prevent oil spillage and contamination.

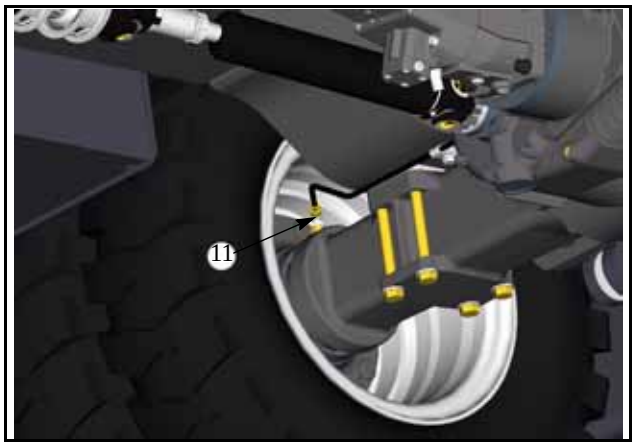


8. Disconnect electrical connection (9).

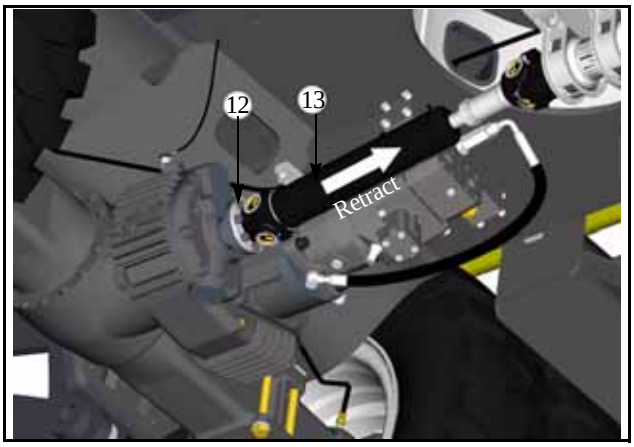


9. Disconnect brake lines (10), (11) and plug with blank/plug and O-ring from blanking kit. Also put cap on nipple fittings to prevent oil spillage and contamination.

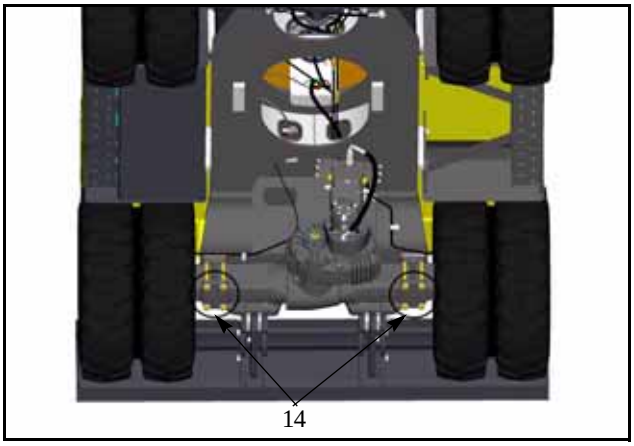




10. Disconnect propshaft (12) by removing bolts (13) and retracting propshaft in direction shown.



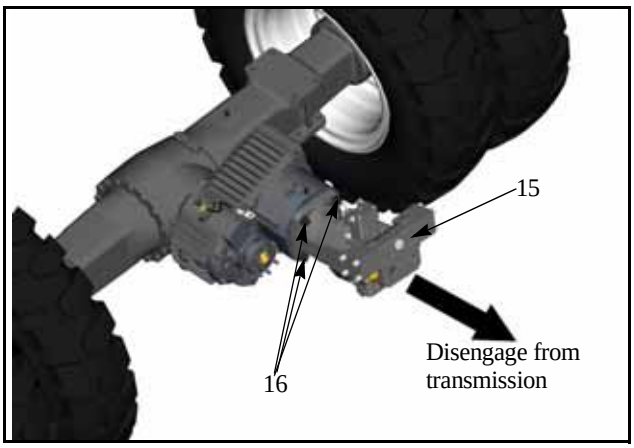
11. Remove bolts(14).



12. Roll axle and wheels clear of machine.

13. Position supports in place of axle.

14. 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.
- Tightening torque for axle mounting bolts (14):662.-828.5 Nm.
- Tightening torque for propshaft nuts (13): 58.8-73.5 Nm.
- Tightening torque for 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

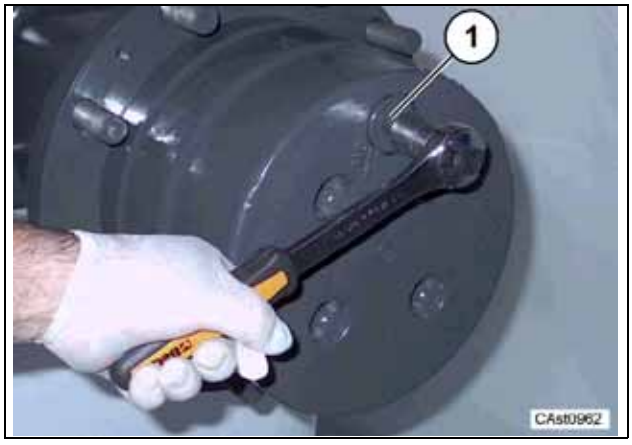
SPECIAL TOOLS

Part Number	Part Name	Quantity
2897101	Carrier removal	1
2897102	Hub removal	1
2897002	Torque control device	1
2897003	Chuck for bushings	1
2897004	Chuck for bushings	1
2897007	Assemble pin	1
2897009	Pin	1
2897012	Assemble device	1
2897014	Brake centering	1
2897015	Assemble pin	1
2897039	Assemble pin	1

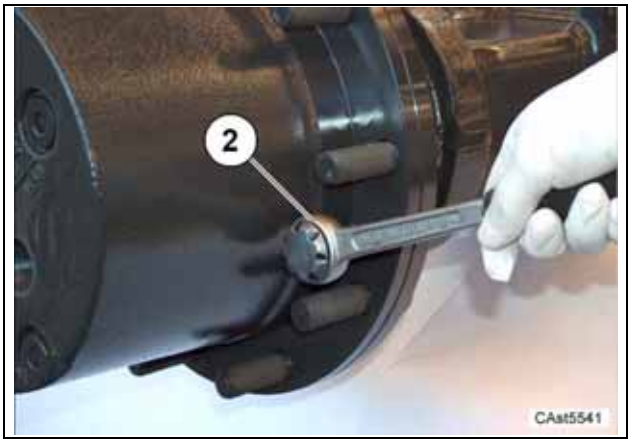
DISASSEMBLY

REMOVAL OF EPICYCLIC REDUCTION GEAR AND BRAKE

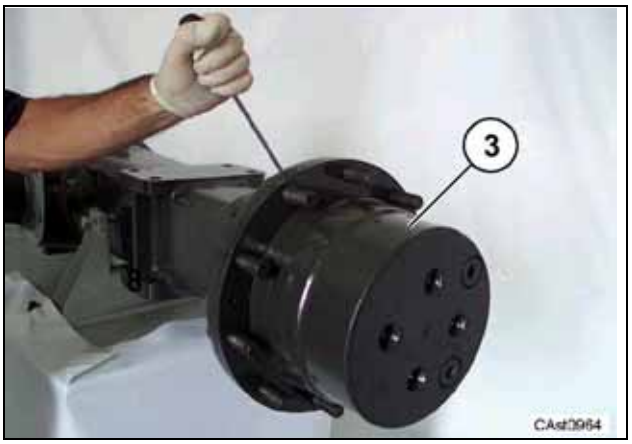
1. Before draining the oil, position the wheel hub (1) with the plug on the upper part and loosen it off some turns in order to eliminate any possible inner pressure, then remove it completely. Turn the wheel hub upside down till the hole is in the lowest point.
   Drain the oil completely.



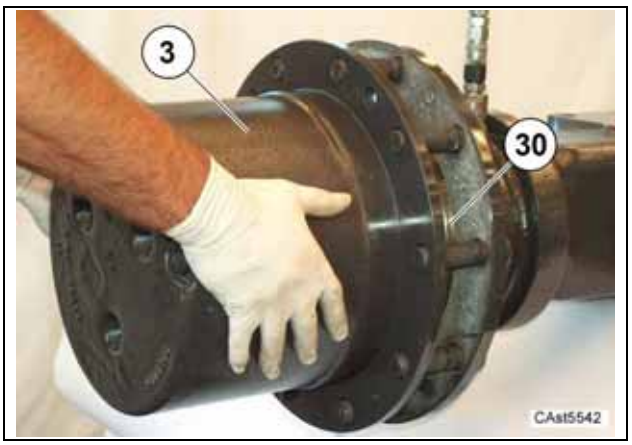
2. Remove fastening screws (2) from the cover of the planetary gears carrier.



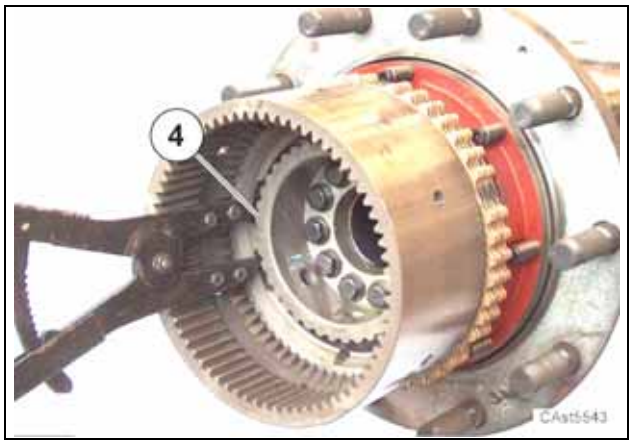
3. Use the levers inside the preset slots to detach the planetary gear carrier cover.



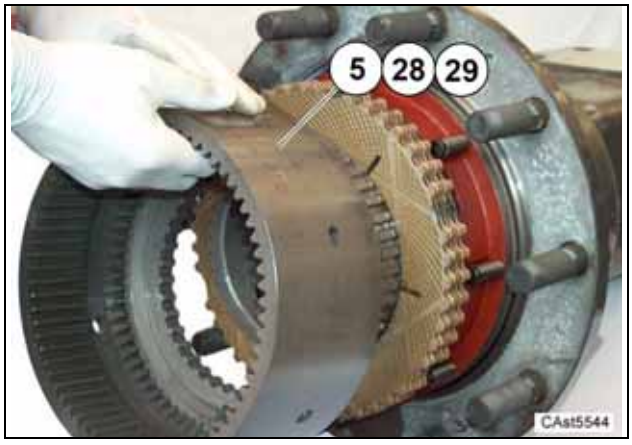
4. Remove the planetary gear carrier cover (3) and O-ring (30).



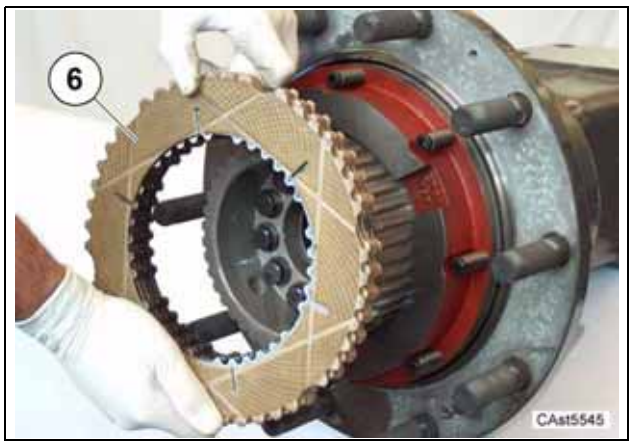
5. Remove split ring (4).



6. Remove ring bevel gear (5) complete with carrier (28) and split ring (29).



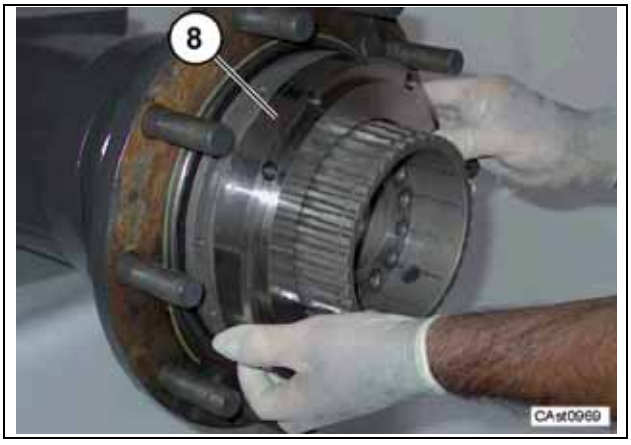
7. Remove brake discs (6).



8. Remove fastening screws of piston (7) and springs (15).



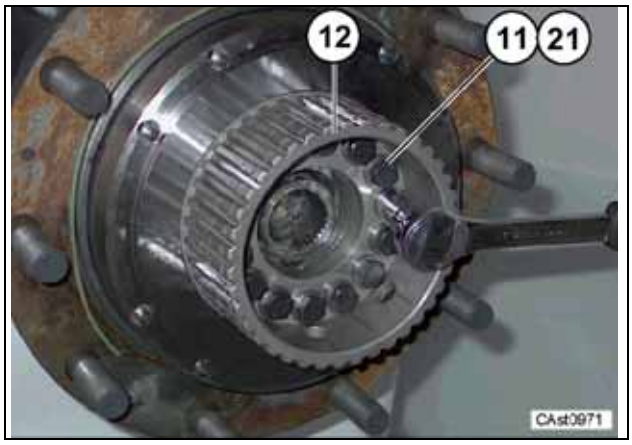
9. Remove piston (8).



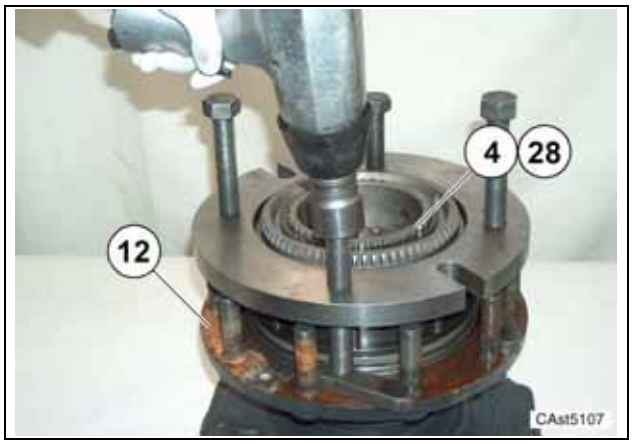
10. Remove seal rings (9) and (10) from piston (8).



11. Remove screws (11) and washers (21) from brake carrier (12).



12. Assemble carrier (28) and split ring (4). Remove brake carrier (12) using tool 289701.



13. Remove bushes (22).



14. Remove seal rings (13) and (14) from brake carrier (12).



15. Remove shims (26).



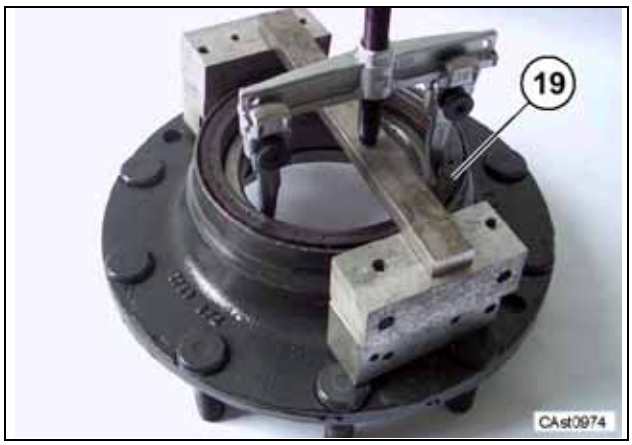
16. Remove wheel hub (16) with bearings (19) and (20) and seal ring (19) using tool 2897102.



17. Remove the drain valve (17).



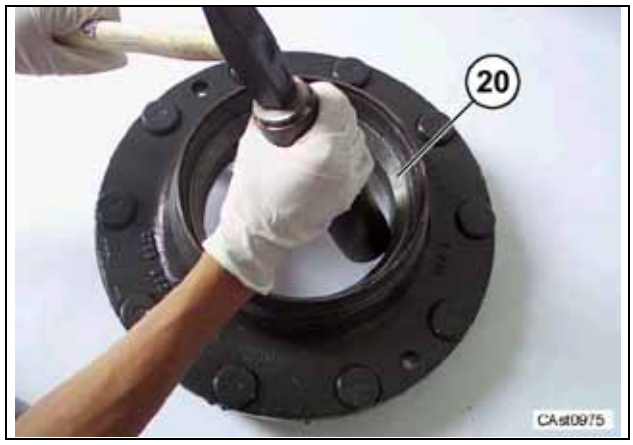
18. Remove seal ring (19).



19. Remove inner cup of bearing (18).



20. Remove outer cup of bearing (20).



21. Remove outer cup of bearing (18).



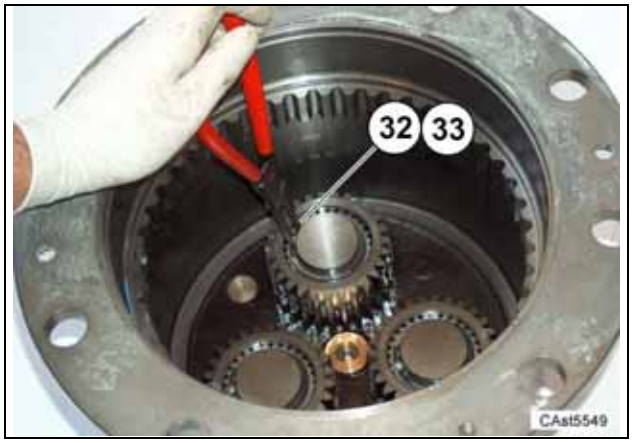
22. Remove sleeve (25).



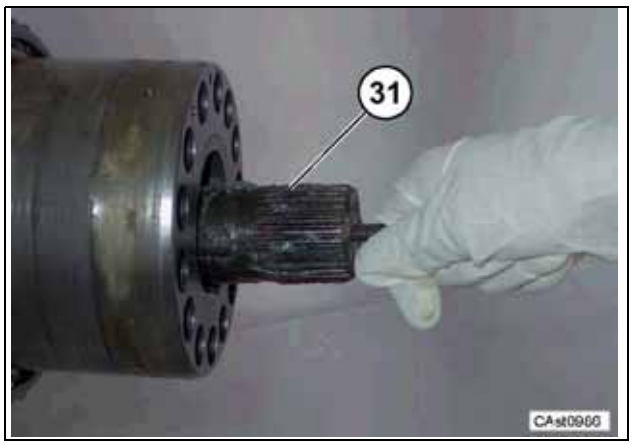
23. Remove shaft and pinion (24).



24. Remove snap ring (32) planetary gears (33).

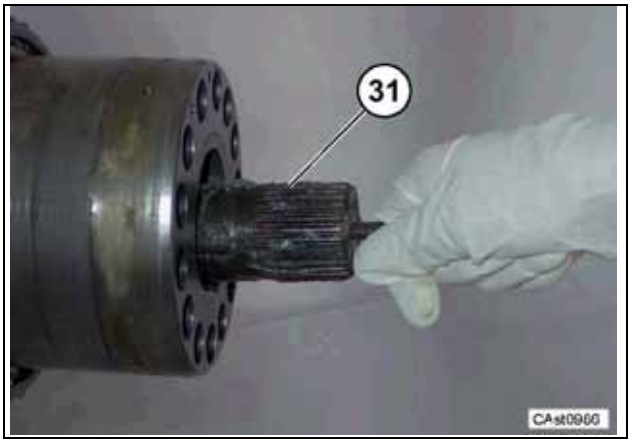


25. Remove universal joint (31).



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).



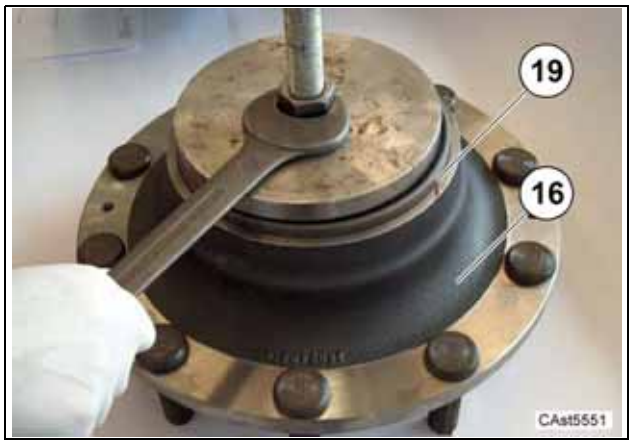
4. fit the remaining part of bearing 18) on wheel hub (16).



5. Apply Loctite® 510 on seal ring (19).



6. Fit seal ring (19) on wheelhub (16). Use tool 2897003.



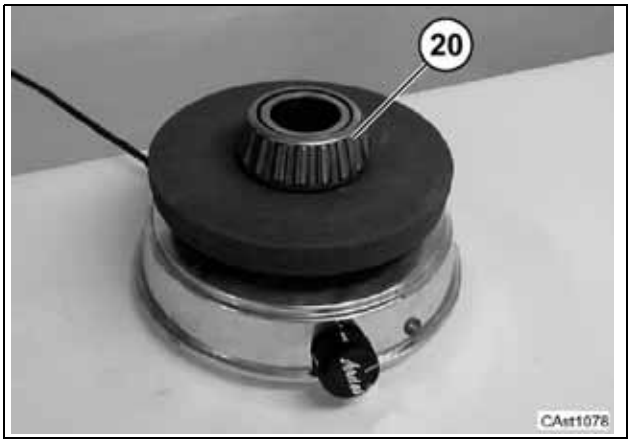
7. Lubricate axle shaft to assemble the wheel hub. **Warning**: Polish hub and oil holes.



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.



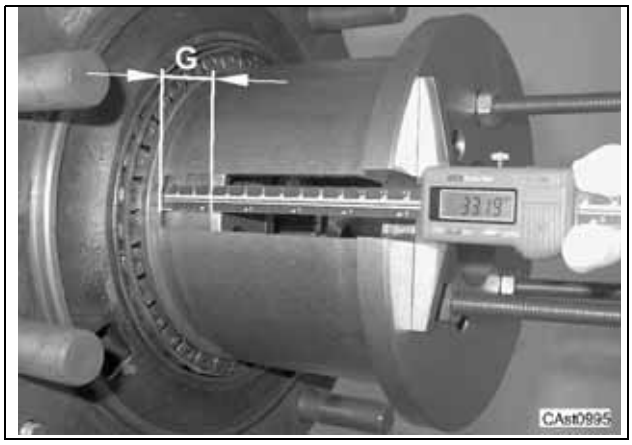
10. Fit bearing (20) inside beam trumpet.
Warning: Wear gloves to avoid getting burnt.



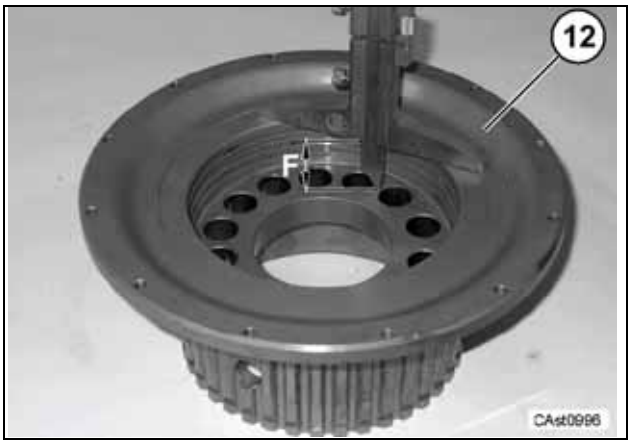
11. Assemble the tool 2897013, 3 draw plates M10 x 285 and 3 nuts M10.



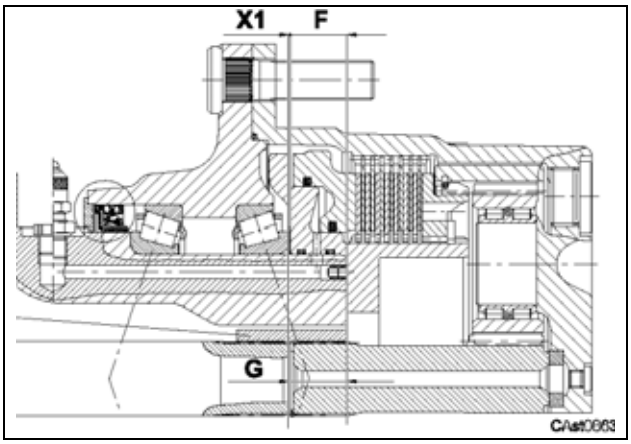
12. Use a depth gauge to measure dimension (G) of wheel hub.



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).



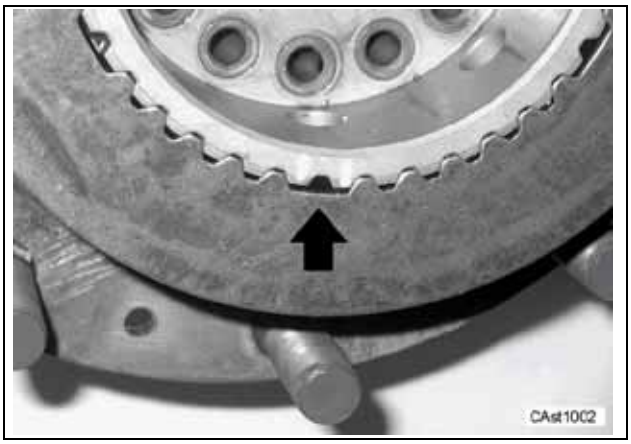
18. Fit piston (8) on brake carrier (12) with springs (15) and screws (7). Apply Loctite® 638 on the screws (7).



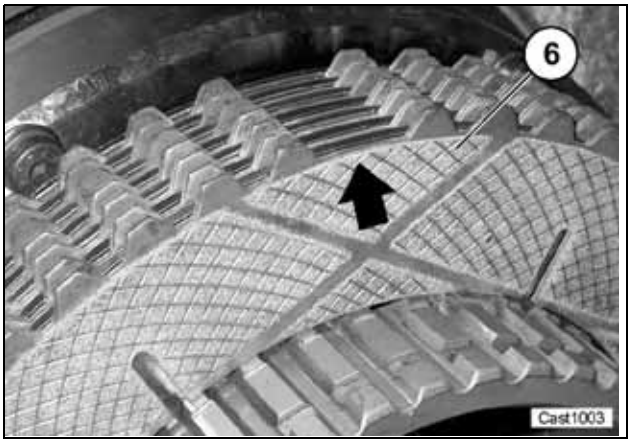
19. Fit the whole unit of the brake carrier on wheel hub.
Warning: The brake carrier and beam trumpet holes should coincide.



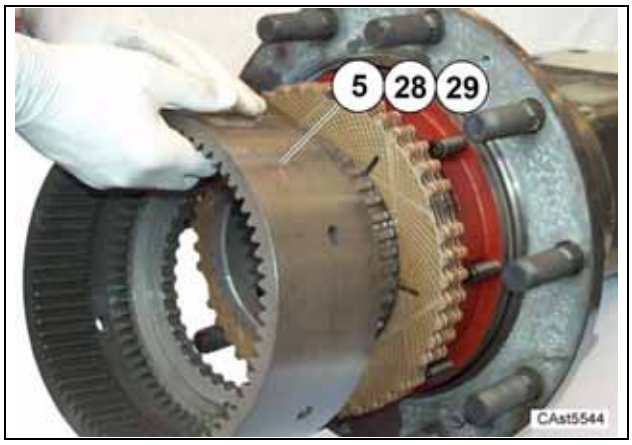
20. Assemble brake discs (6).
Warning: During assembly operations all the inner disc slots should coincide.



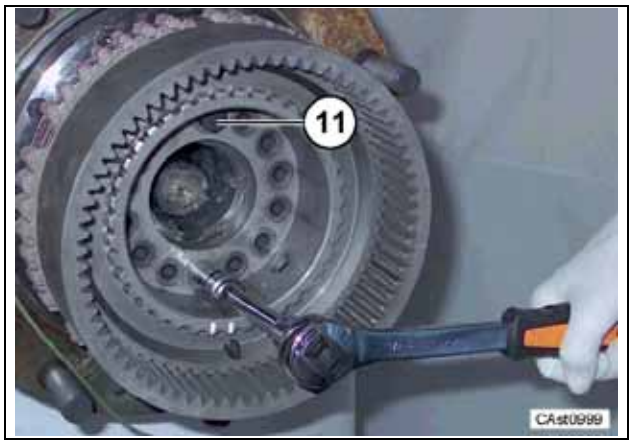
21. Assemble brake discs (6).
Warning: During assembly operations all the outer disc slots should coincide.



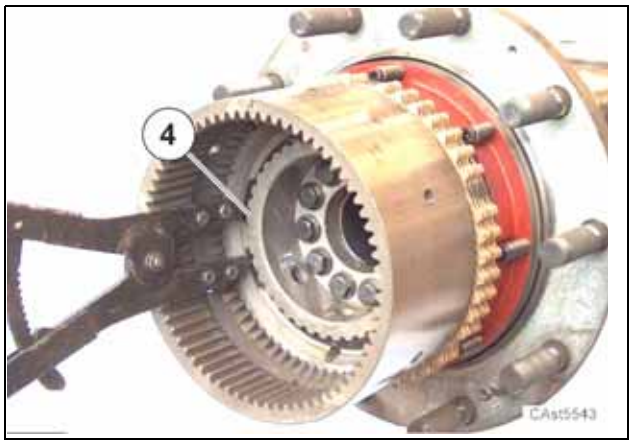
22. Fit ring bevel gear (5) with carrier (28) and split ring (29).



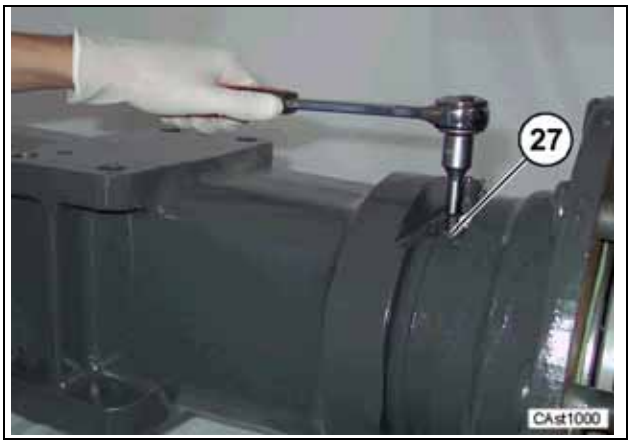
23. Test the brake by temporarily fitting two screws (11).
Warning: Do not assemble bushes (22).



24. Fit snap ring (4).



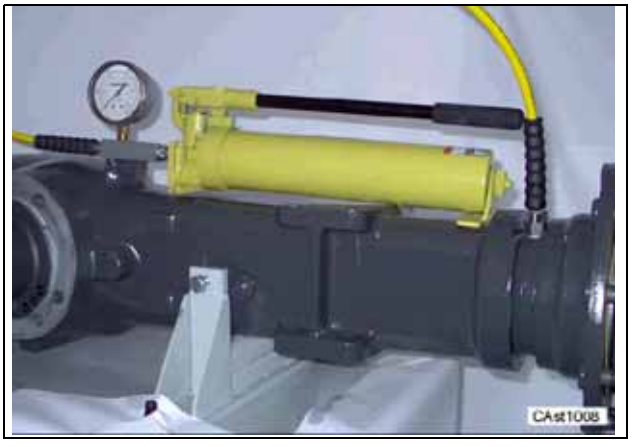
25. Remove plug (27).



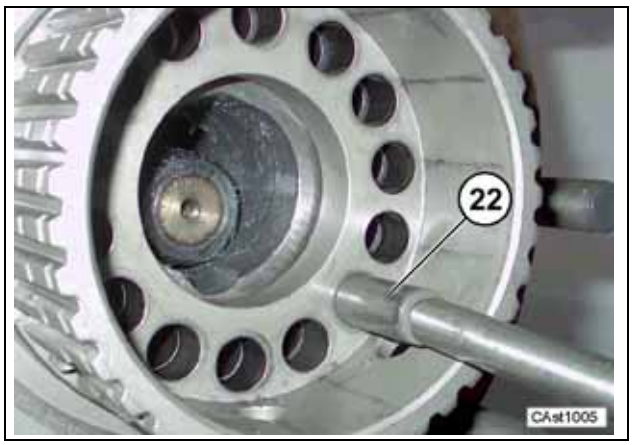
26. Fit an adapter instead of the plug.



27. Test the brakes by considering that pressure should be 45 - 50 bar for about one minute.



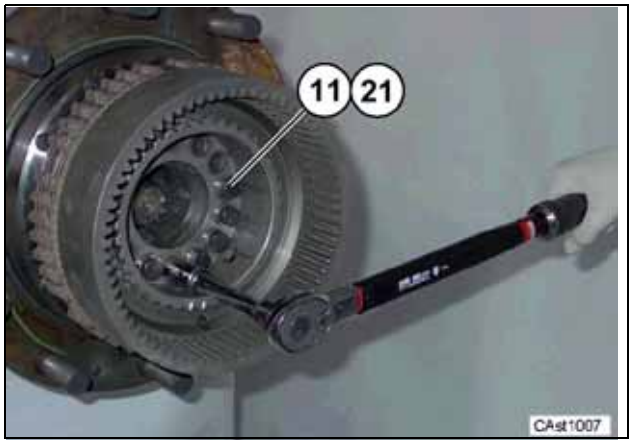
28. Fit bushes (22).
Warning: Pay attention to the assembly direction of bushes.



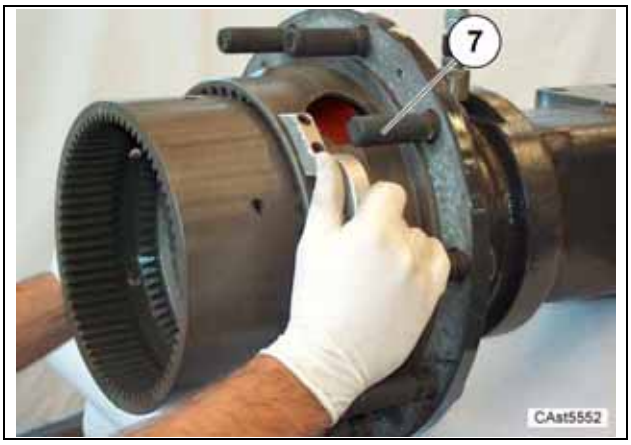
29. Apply Loctite® 242 inside slots.



30. Fit screws (11) and shims (21).
Tightening torque: 68Nm



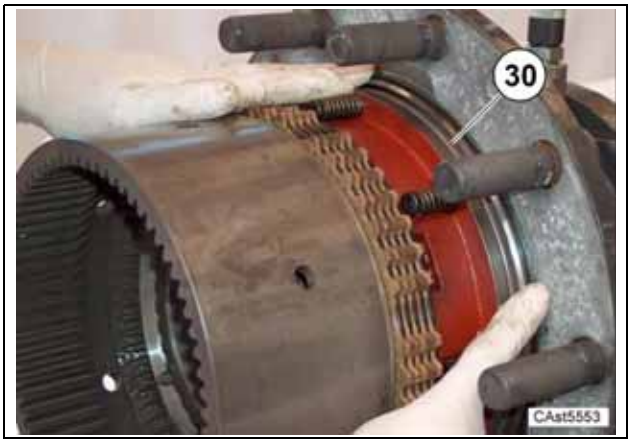
31. Line up brake discs. Use tool 2897014.
Warning: A tooth should coincide with a brake fastening screw (7).



32. Put brakes under pressure to avoid outer disc misalignment.



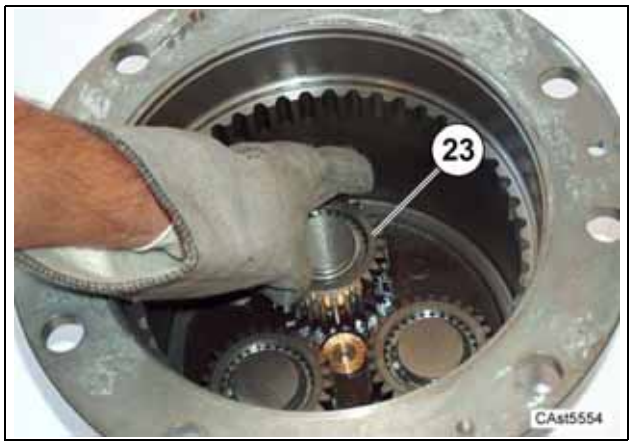
33. Lubricate with grease and fit O-ring (30).



34. Heat planetary gear bearing at 110ºC. Assemble planetary gear (23).

⚠ WARNING

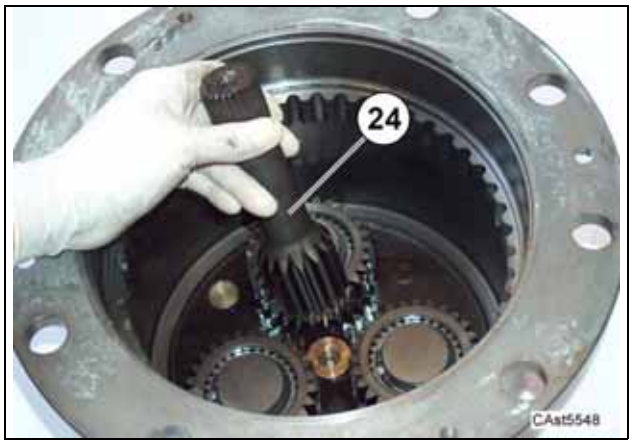
Wear suitable gloves to avoid being burnt



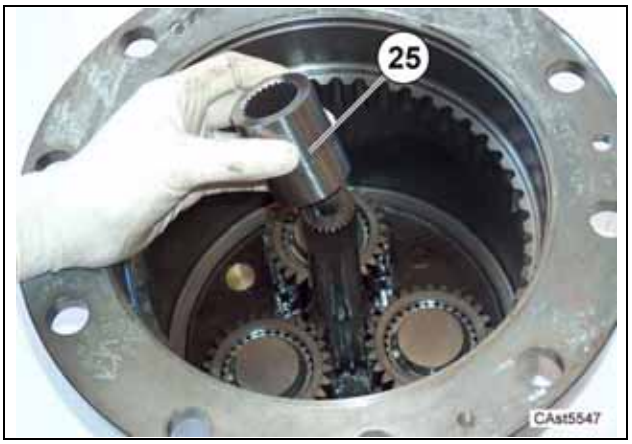
35. Assemble snap ring (32).



36. Fit pinion shaft (24).



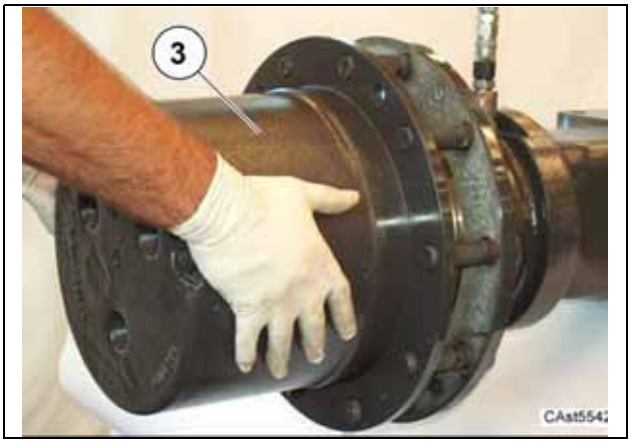
37. Fit sleeve (25).



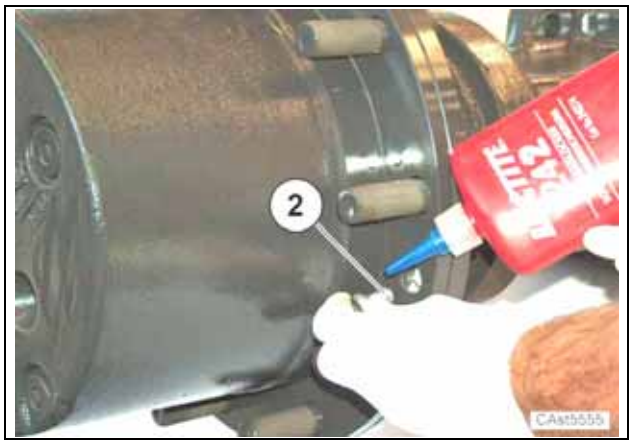
38. Lubricate with grease the contact surface of planetary gear cover (3). Apply Loctite® 510 in the holes.



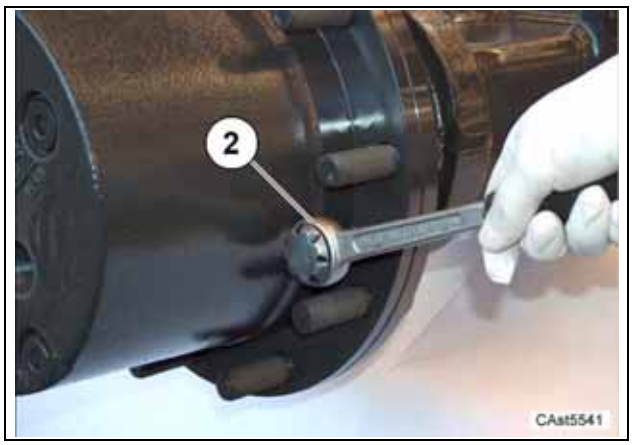
39. Fit the planetary gear cover (3) and discharge pressure from the hydraulic pump.



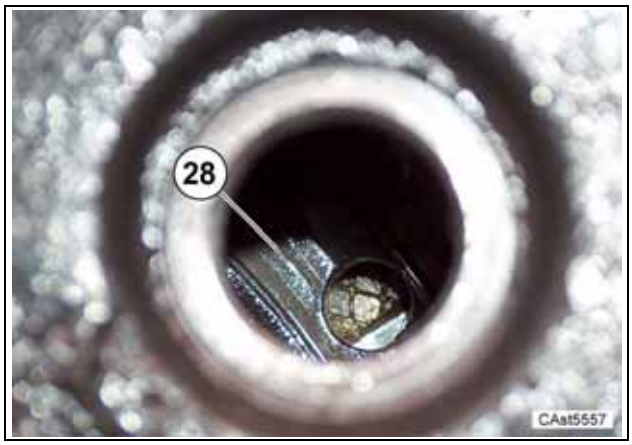
40. Apply Loctite® 242 on screw (2).



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).

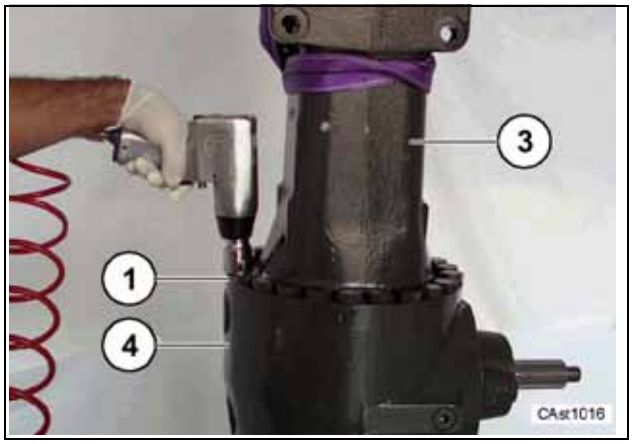


DISASSEMBLY OF BEAM TRUMPET AND DIFFERENTIAL UNIT

1. Remove the axle unit. Sling and slightly tension the rope. Turn and then fix it in vertical position.



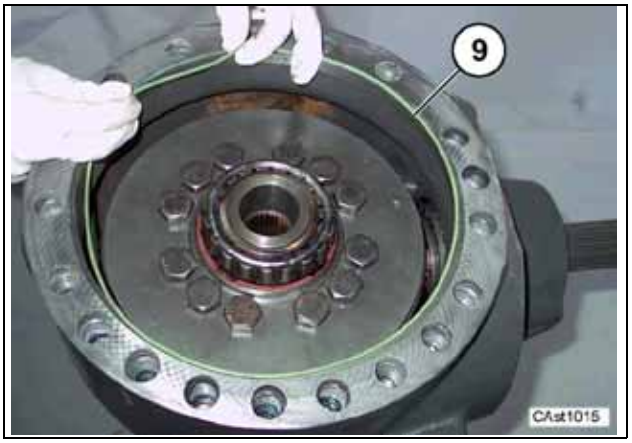
2. Loosen and remove screws (1) fixing beam trumpet (3) to the body (4).



3. Sling the beam trumpet (3) and slightly lift it.



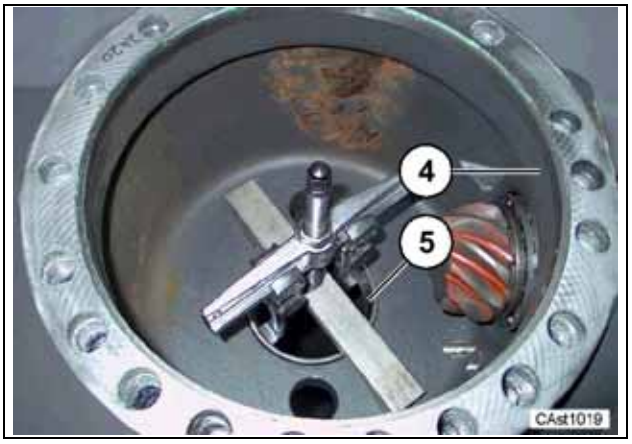
4. Remove O-ring (9).



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).



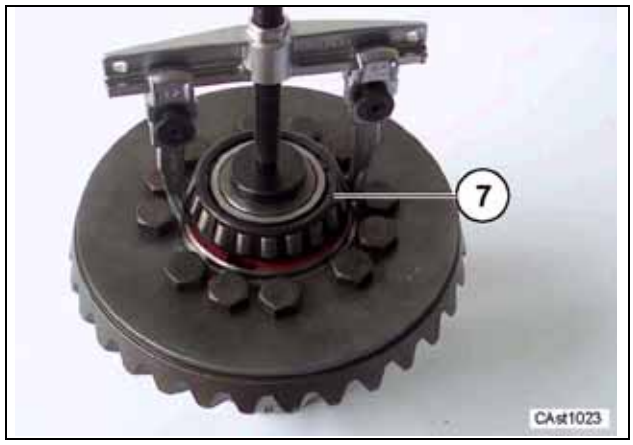
8. Use an extractor and remove from housing (3) the outer cup of bearing (7).



9. Remove shims (8).



10. Use and extractor to remove bearing (7) from differential unit.



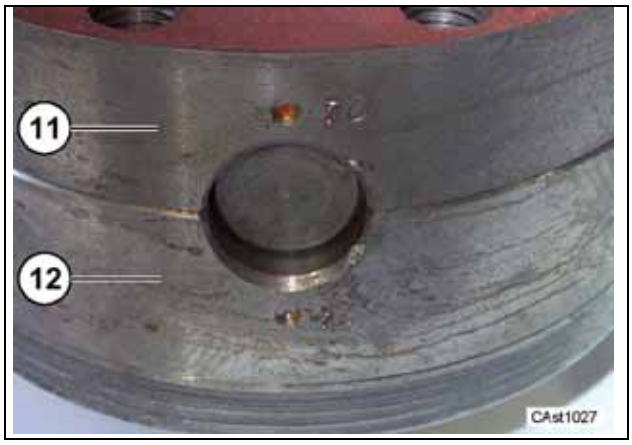
11. Use an extractor to remove bearing (5) from differential unit.



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. Check marking points (11) and (12) that will be useful during the assembly.



Note: Without differential torque limiter

14. Remove differential pins (13) and (14), planetary gears (15), (16), (17) and (18) and spheric washers (19), (20), (21) and (22).

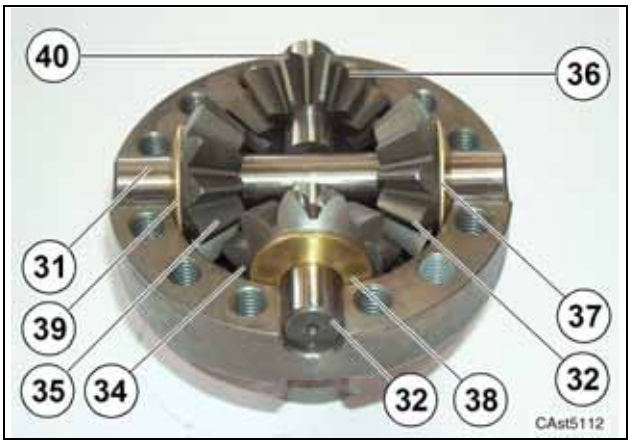


15. Remove planetary gear (24) and shim (26).



Note: With differential torque limiter

16. Remove differential pins (31), (32), planetary gears (33), (34), (35) and spheric washers (37), (38), (39) and (40).



17. Remove planetary gear (41).

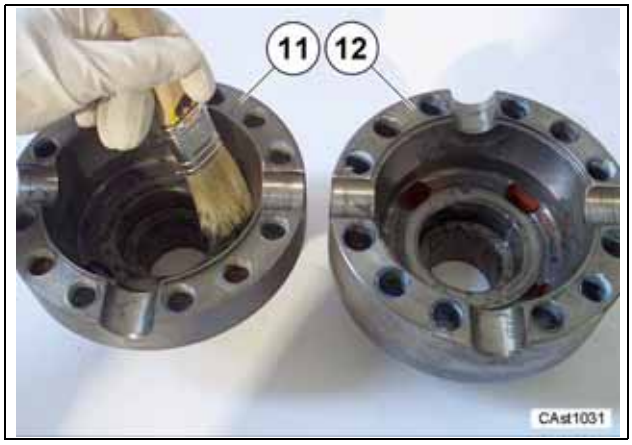


INSTALLATION OF BEAM TRUMPET AND DIFFERENTIAL UNIT

1. Apply a thin layer of molicote G-n plus paste on half boxes of differential (11) and (12).

⚠ WARNING

Remove remains of old sealing compound.



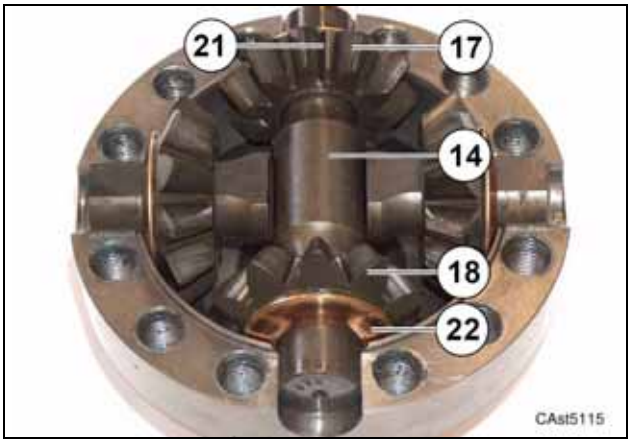
2. Assemble planetary gears (24) with shim (26).



3. Fit differential unit pin (13) and planetary gears (15), (16) and washers (19) and (20).



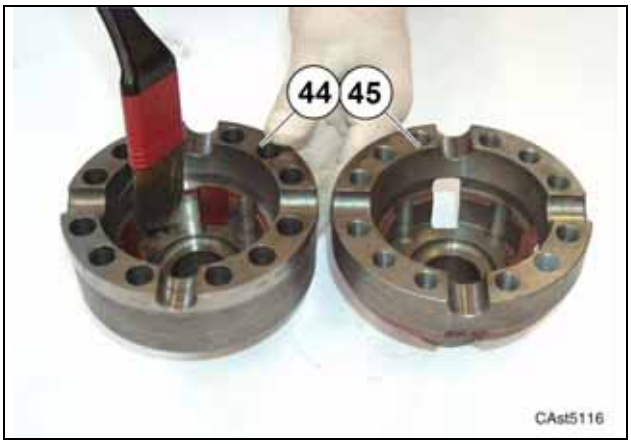
4. Fit the differential unit pin (14) and planetary gears (17), (18) and washers (21), (22).



5. Apply a thin layer of molicote G-n plus paste on half boxes of differential (44) and (45)

⚠ WARNING

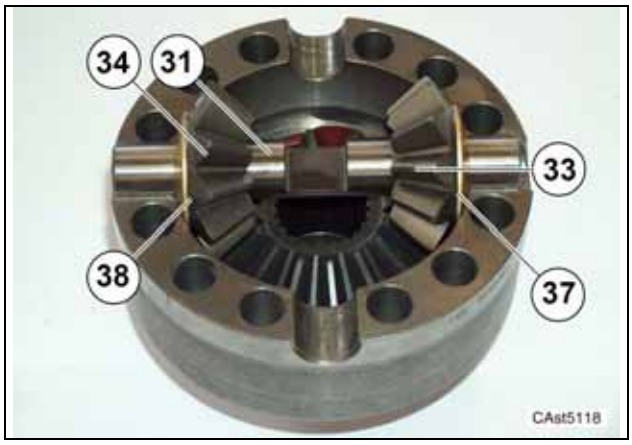
Remove remains of old sealing compound.



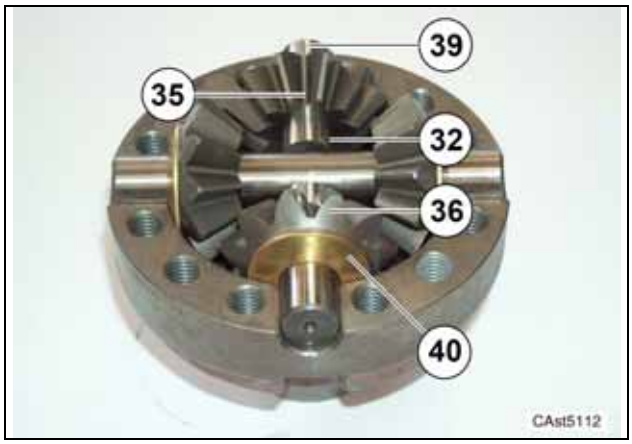
6. Assemble planetary gears (41).



7. Fit differential unit pin (31) and planetary gears (33) and (34) and washers (37) and (38).



8. Fit differential unit pin (32) and planetary gears (35) and (36) and washers (39) and (40).



9. Fit the two half boxes of differential unit (11) and (12).

⚠ WARNING

Carefully check that the marks of both differential half boxes coincide



10. Fit ring bevel gear (2) by using a hammer.



11. Apply loctite®242 on thread of screws (10).



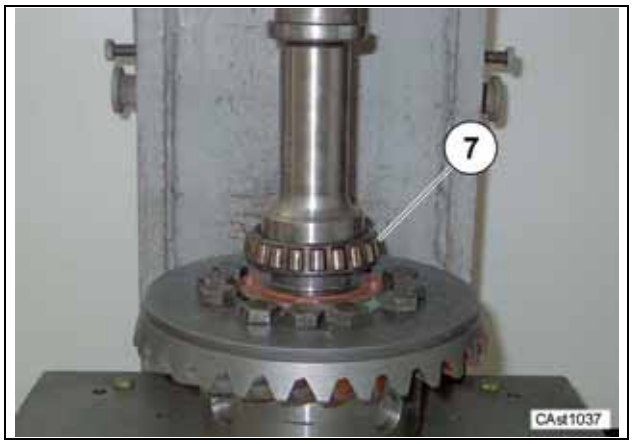
12. Tighten screws (10).

N·m Screws (10) torque: 205Nm

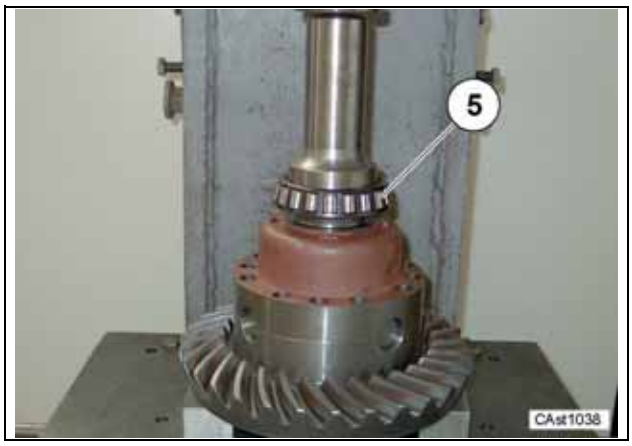
Note: Fix differential housing in the vice



13. Fit bearing (7)



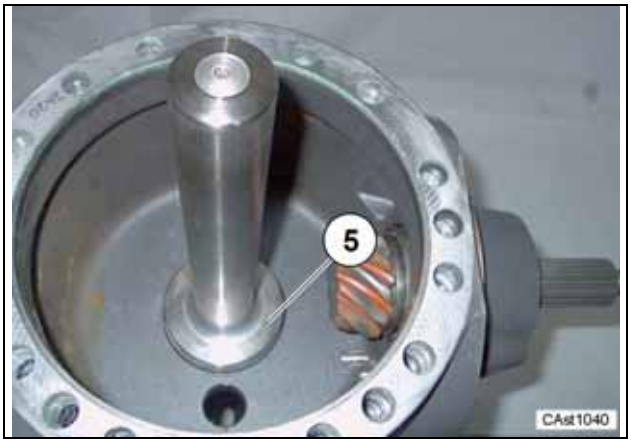
14. Press bearing (5).



15. Fit adjustment shims (6) (**X1**)=1.8.



16. Assemble cup of bearing (5).



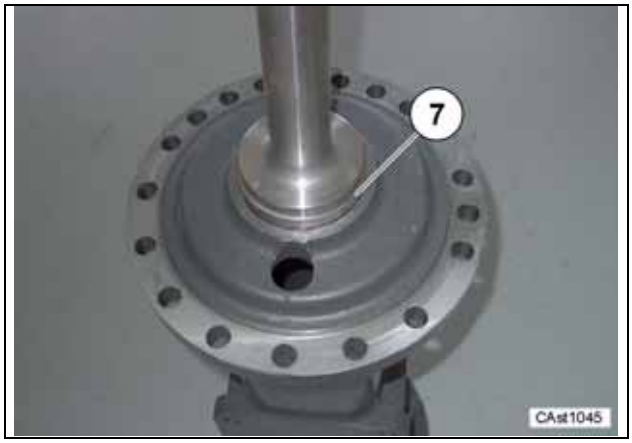
17. Assemble O-ring (9).



18. Assemble adjusting shims (8) (**X2**).



19. Assemble cup of bearing (3).



20. Assemble differential unit.



21. Install tool 2897001. Assemble half bearing (7) inside tool.



22. 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 the whole unit.



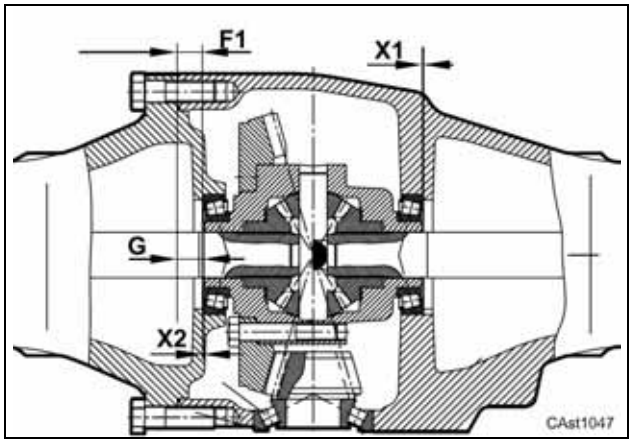
23. Measuring of value **G**.



24. Value (**F1**) written on axle beam (3).



25. Drawing used to determine backlashes between the bevel gear pair teeth.
X1 = 1.8
Check adjusting shims X2 through the suggested procedure: **X2 = F1.**



26. Move alternately the pinion tang and take note of the backlash between pinion and ring bevel gear (detected through a comparator). Make sure that the feeler touches the screw head mounted on the flange and is located at 90°. Check if the value of the detected backlash is within the preset field: 0.15 / 0.25mm.
Should the backlash be insufficient or excessive, adjust shim X1 = 1.8 by increasing or decreasing.



27. Apply loctite® 510 on contact surface of beam trumpet (4).



28. Apply loctite® 242 on screws (1).



29. Assemble screws (1) and washers (27) and tighten screws (1).

N·m Screws (1) torque: 285Nm

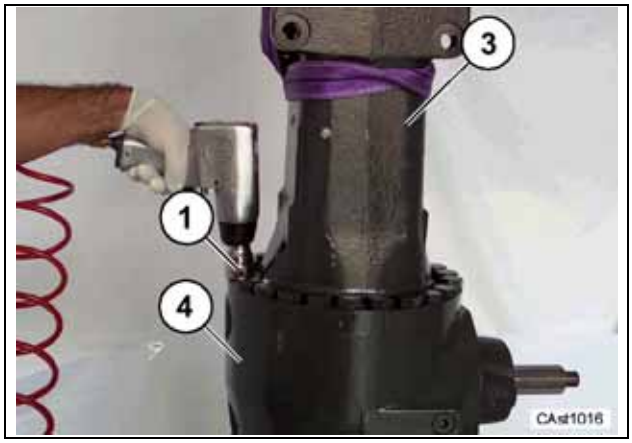


DISASSEMBLY OF PINION GROUP

1. Remove the axle unit. Sling and slightly tension the rope. Turn and then fix it in vertical position.



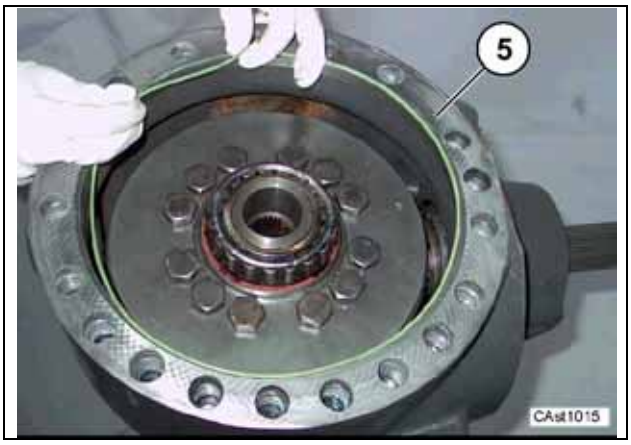
2. Loosen and remove screws (1) fixing beam trumpet (3) to the body (4).



3. Sling the beam trumpet (3) and slightly lift it.



4. Remove O-ring (5).



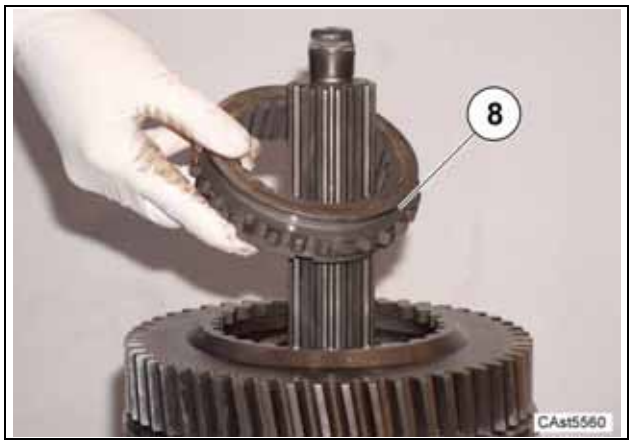
5. Lift the whole differential unit.



6. Remove bush (7).



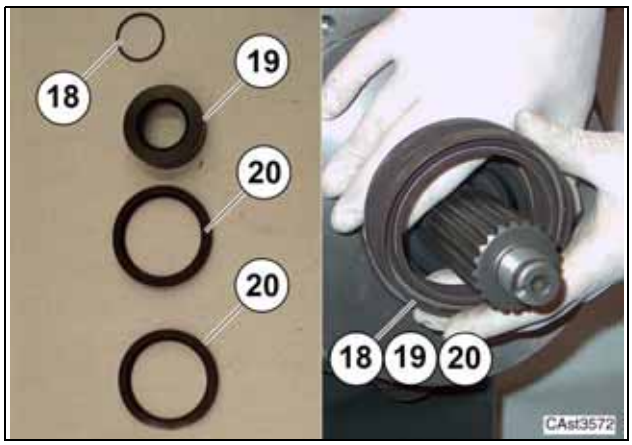
7. Remove sleeve (8).



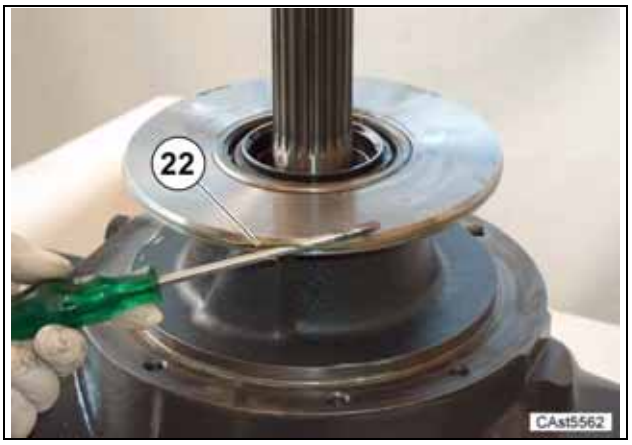
8. Remove gear wheel (9).



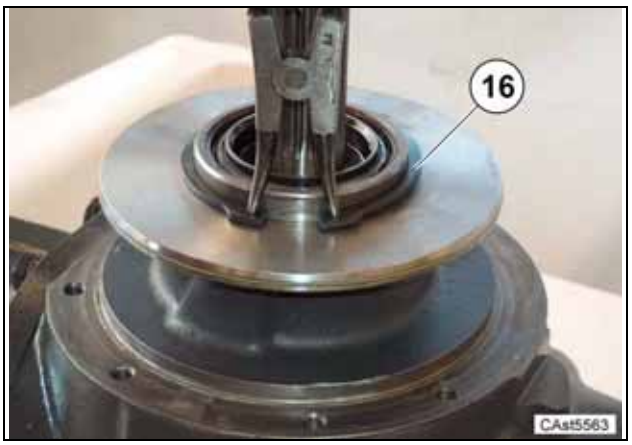
9. Remove O-ring (18), ring (19) and seal (20).



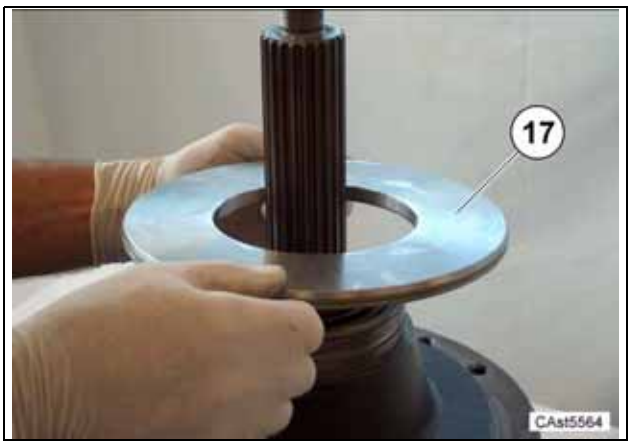
10. Remove O-ring (22).



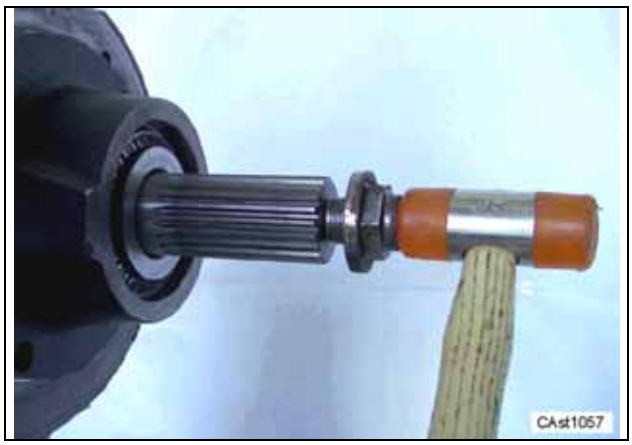
11. Remove snap ring (16).



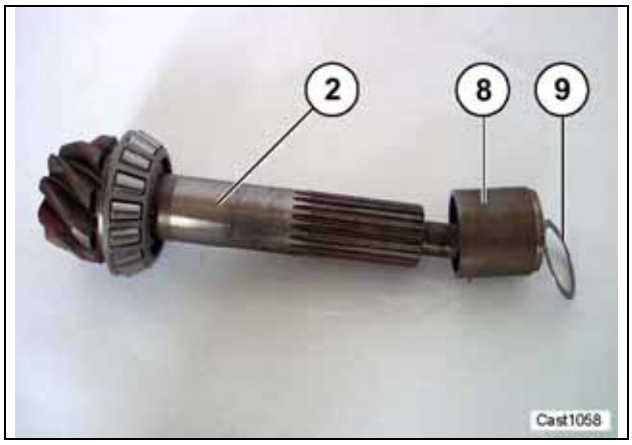
12. Remove the disc (17).



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).



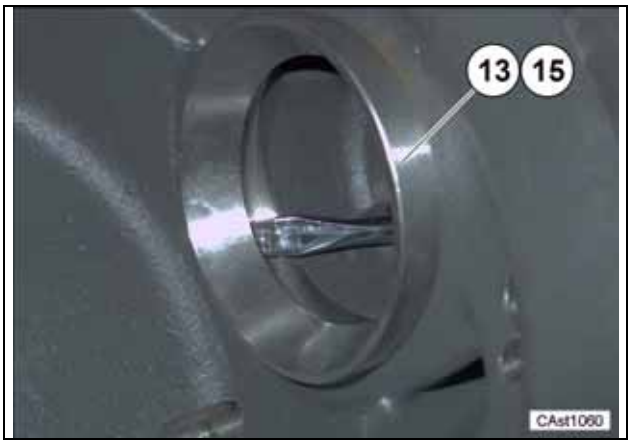
15. Take the bearing cone (13) out of the bevel pinion end, using a suitable extractor.



16. Take the cup of the taper roller bearing (11) out of the central body using a chisel and hammer.



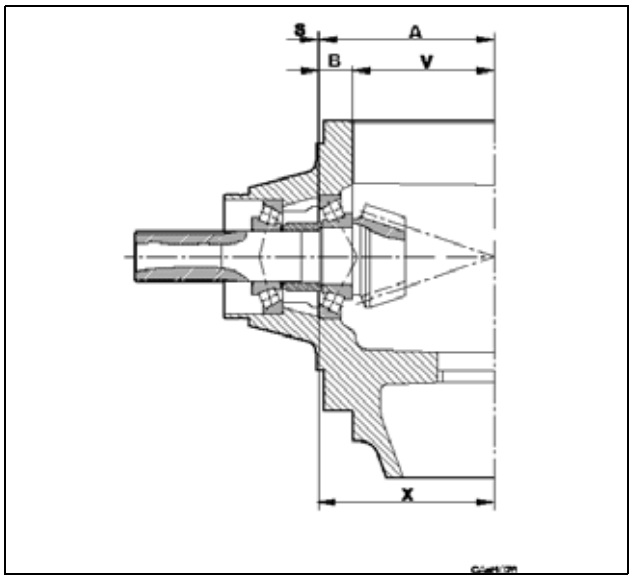
17. Remove the outer cup of the taper roller bearing (13) and shims (15) from the central body. Use a chisel and hammer.



INSTALLATION OF PINION GROUP

1. Bevel pinion adjustment.

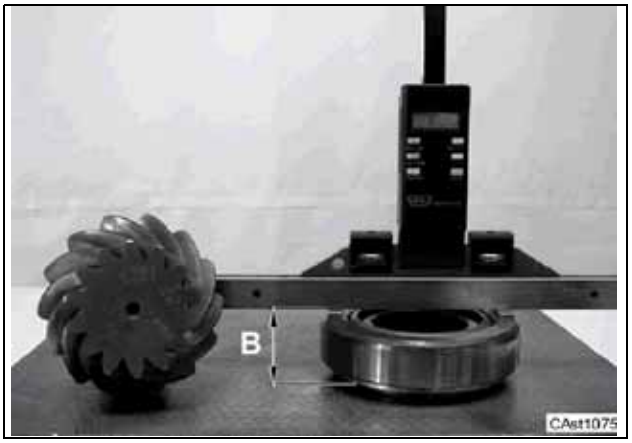
X	155.50	155.50	155.70
B	29.25	29.45	29.45
V	125.00	125.20	124.80
A	154.25	154.65	154.05
S	1.25	0.85	1.65



2. Value stamped on beam trumpet **X.**



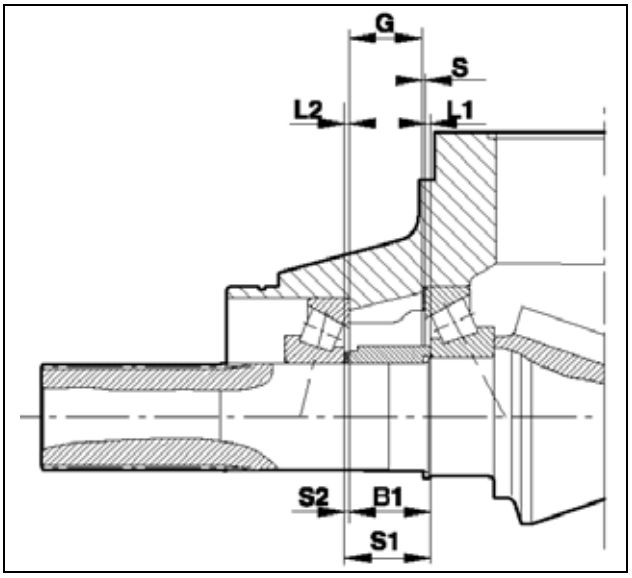
3. To determine shim (**S**) between pinion and bearing it is enough to add value (**V**) printed on pinion head (**V** = prescribed conical distance) to value **B** - bearing width - and subtract **X** from the value printed on beam.
S=X - (V+B)
Example: shim **S** = 163.7 - (132.80 + 29.25) = 1.55mm.



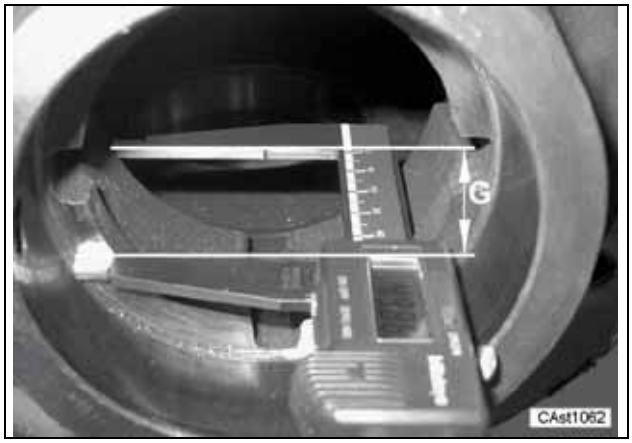
4. Bearings adjustment.

G	30.50	30.00	30.60
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	36.25	35.35	37.359
B_1	34.50	34.50	34.40
S_2	1.85	0.85	2.99

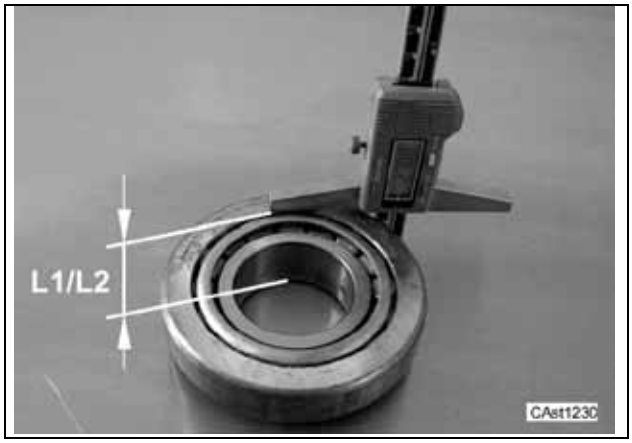
Preloading reduction ca. 0.02 - 0.04mm for a 2-3 Nm torque.



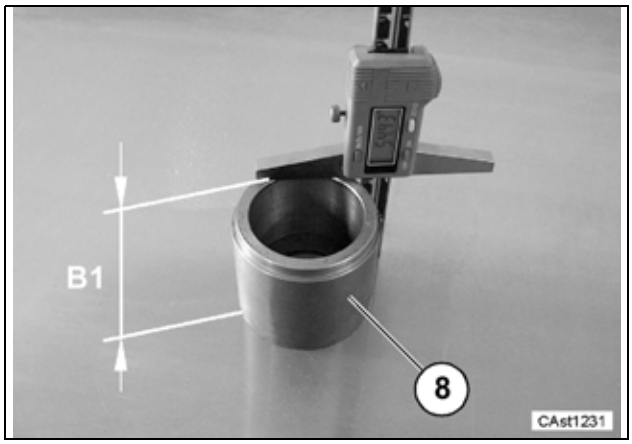
5. To determine shim **S2**
   S2 = B1 - (L1 - S - G - L2)
   S = previously detected shims
   G = beam value



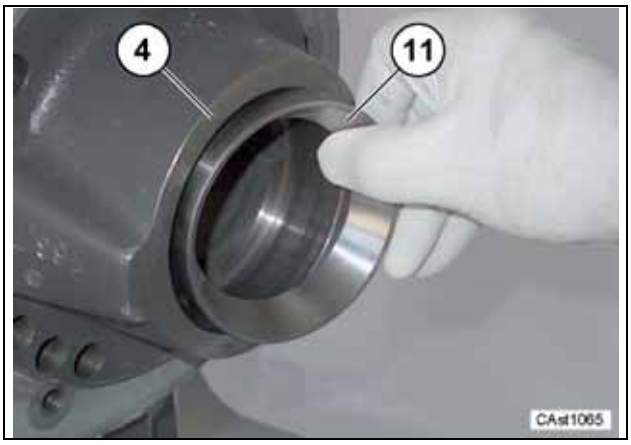
6. L1 = bearing height
   L2 = bearing height



7. **B1**= spacer (8) height.
   Alternative procedure, use starting spacer S= 1.5.



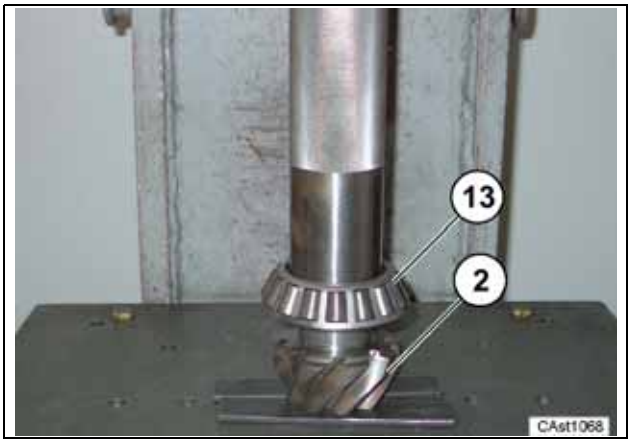
8. Position half bearing (11) on beam trumpet (4).



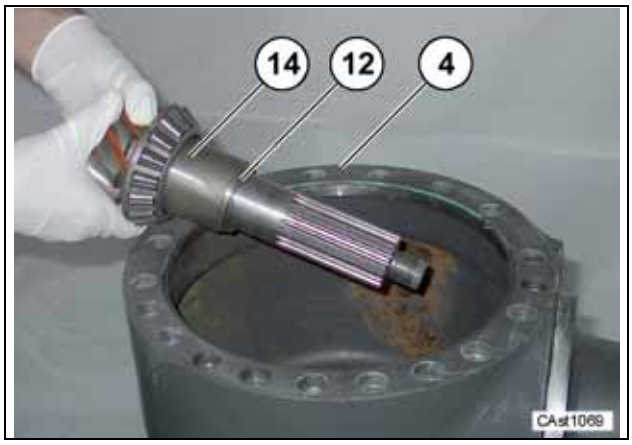
9. Position adjusting shims (9) and inner bearing washer (13) on beam trumpet (4).



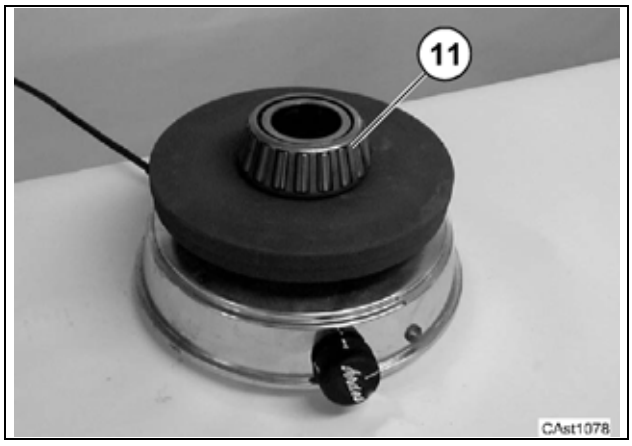
10. Press inner bearing (13) on pinion (2).



11. Fit the whole pinion of bearing on beam trumpet (4), spacer (14) and shims (12).



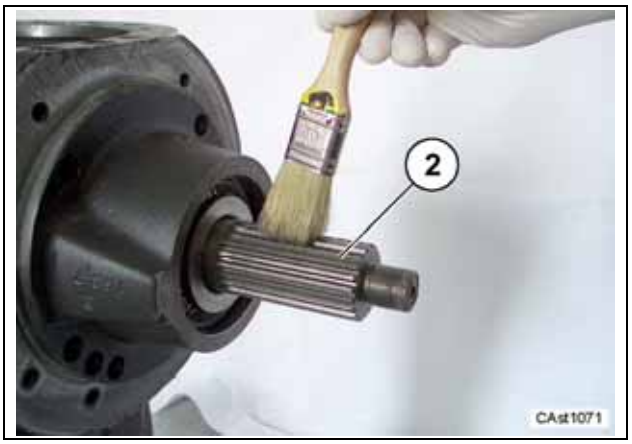
12. Preheat bearing (11) on proper plate up to 100°C.



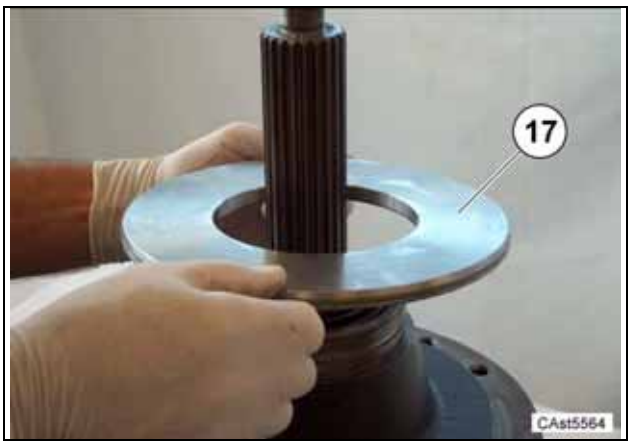
13. Fit bearing (11) in revelant housing on beam trumpet (4).
Warning: Use a special glove to protect from scorching.



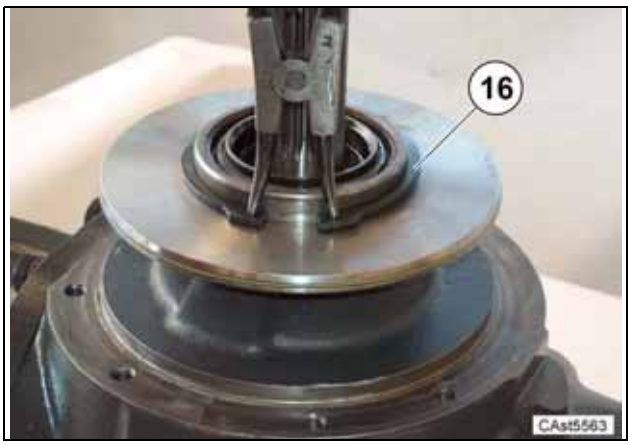
14. Grease bevel pinion.



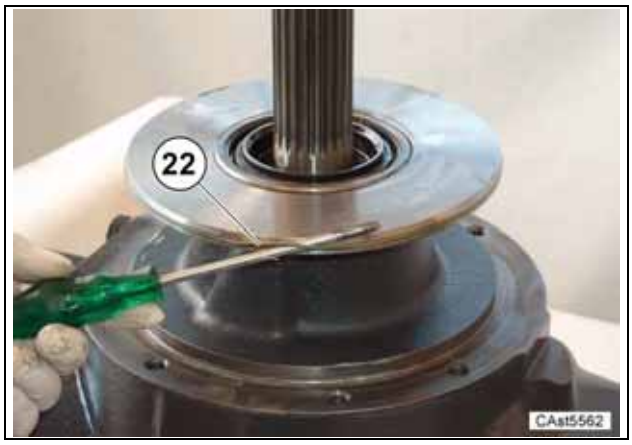
15. Assemble the disc (17).



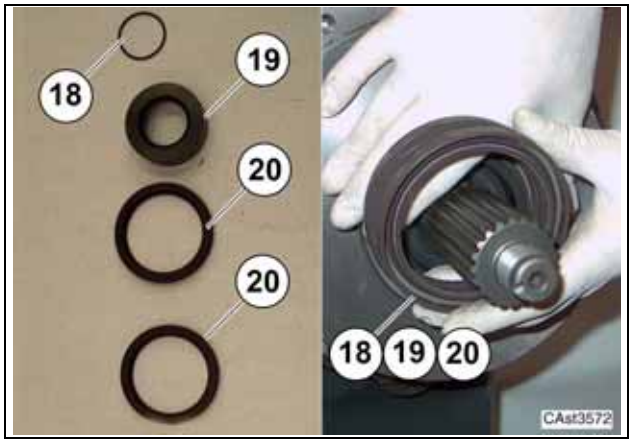
16. Assemble snap ring (16).



17. Assemble O-ring (22).



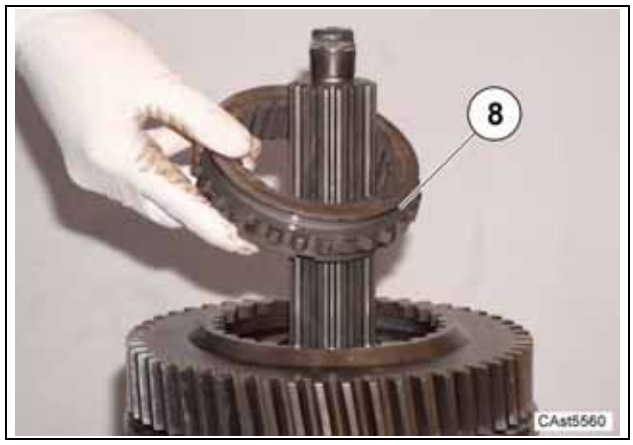
18. Assemble O-ring (18), ring (19) and seal (20).



19. Grease gear wheel (9) and assemble.



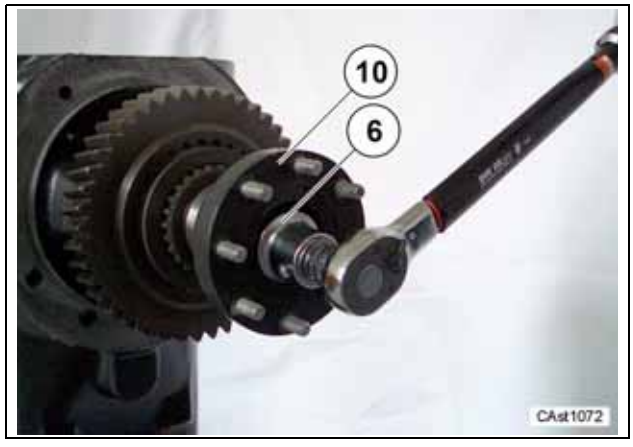
20. Assemble the bush (8).



21. Assemble sleeve (7) and grease surface.



22. Assemble flange (10) and nut (6). (Tightening torque - 400Nm).



23. Carry out the preloading 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: All preloadings should be measured without the seal ring.
P = 2 / 3 Nm



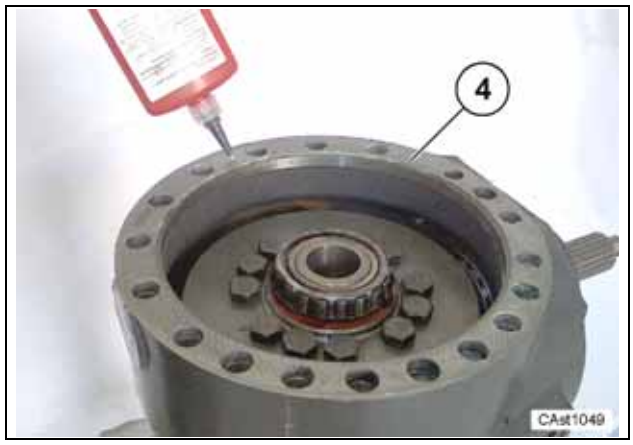
24. Assemble whole differential unit.



25. Assemble the O-ring (5) on beam trumpet (3). Grease the O-ring (5).



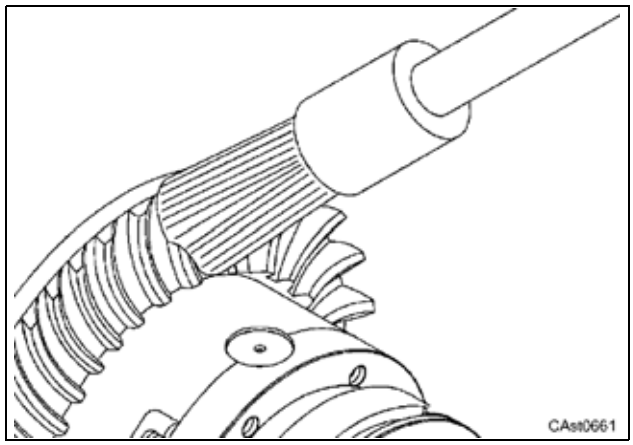
26. Apply Loctite® 510 on contact surface of beam trumpet (4).



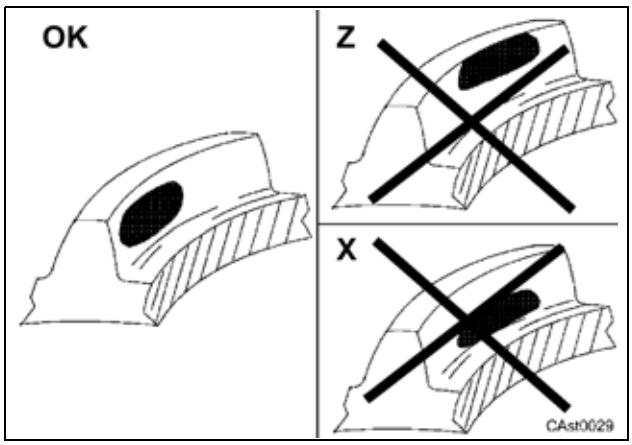
27. Fit screws (1) and tighten according to the prescribed torque: 285 Nm.



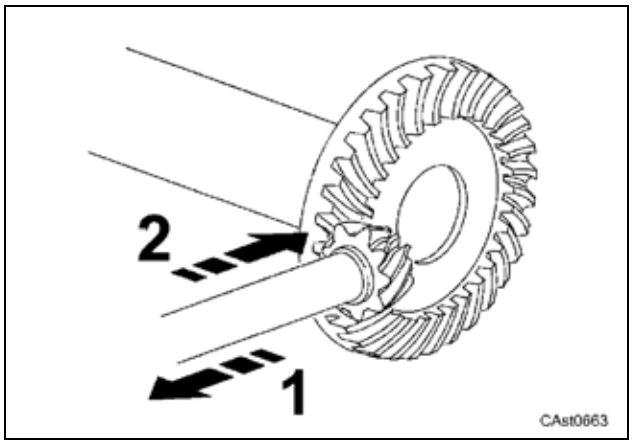
28. Note: To test the marks of the bevel gear teeth, paint the ring gear with red lead paint and detect the contact.
The markinking test should be **ALWAYS** carried out on the ring bevel gear teeth and on both sides.



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 ASSEMBLY

SPECIAL TOOLS

Part Number	Part Name	Quantity
2897005	Seal Assembly	1
2897008	Snap Ring Assembly	1
2897039	Handle	1

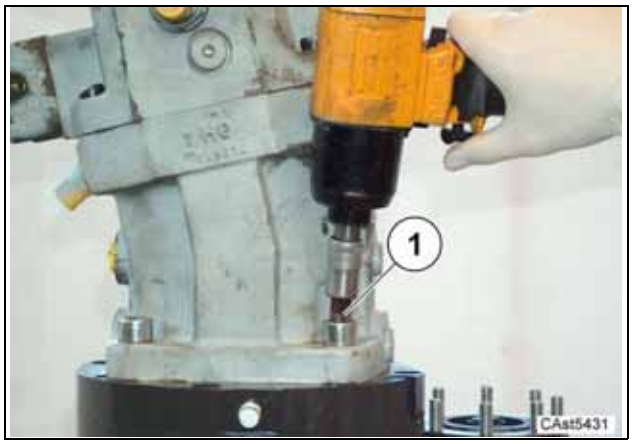
DISASSEMBLY

REMOVAL OF TRAVEL MOTOR AND FLANGE

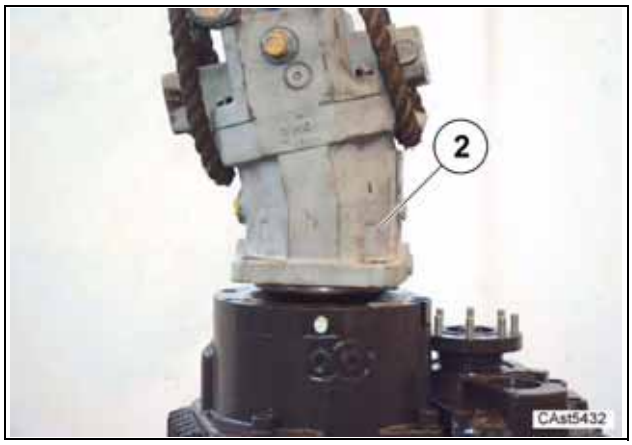
1. Remove drain plug and drain oil from transmission and travel motor.

Transmission: Approx. 4.85L

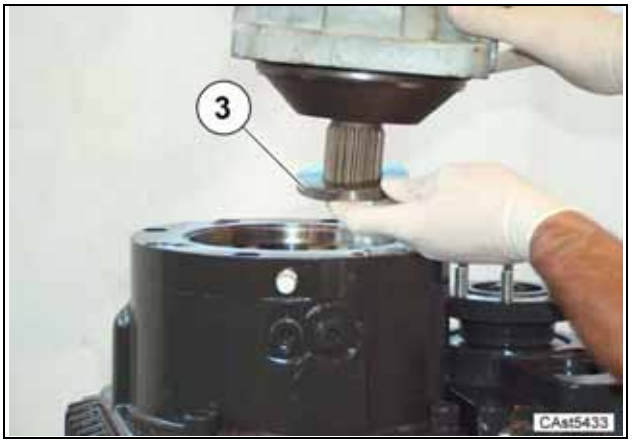
2. Remove screws (1).



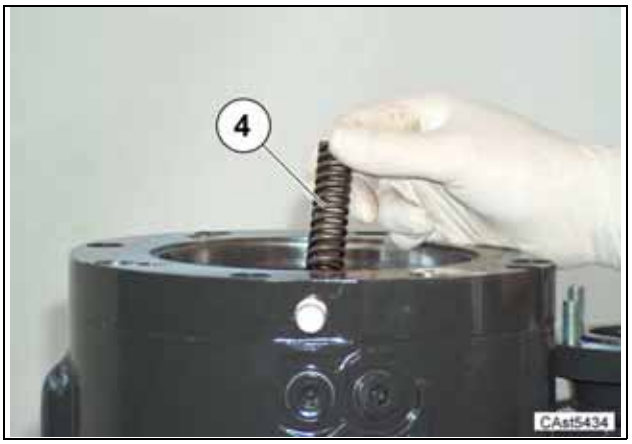
3. Remove the motor (2).



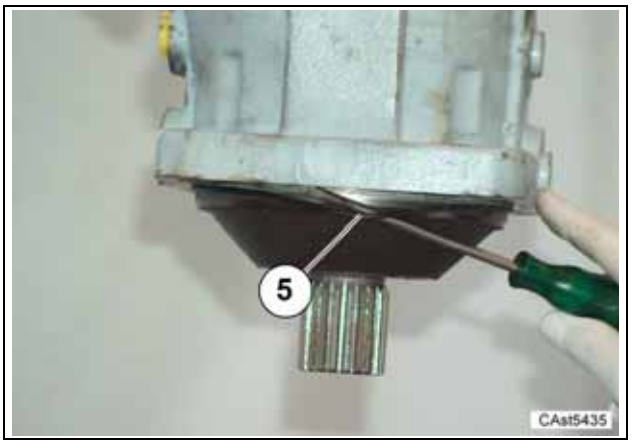
4. Remove disc (3).



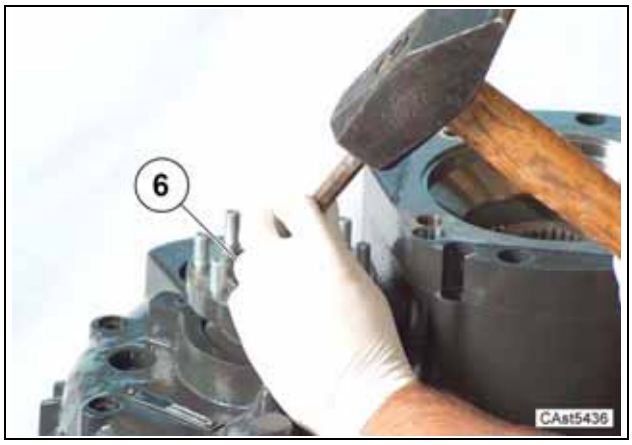
5. Remove spring (4).



6. Remove O-ring (5).



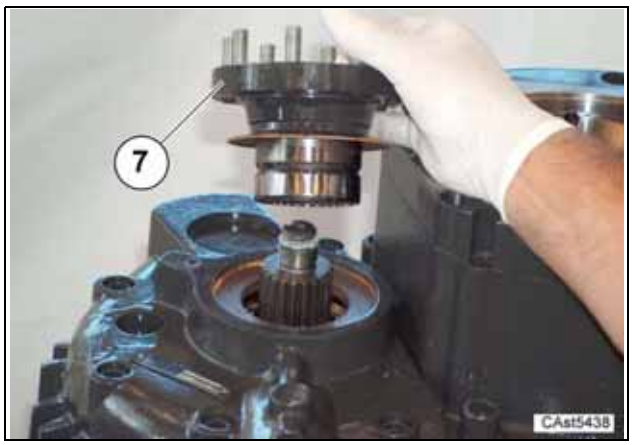
7. Loosen nut (6).



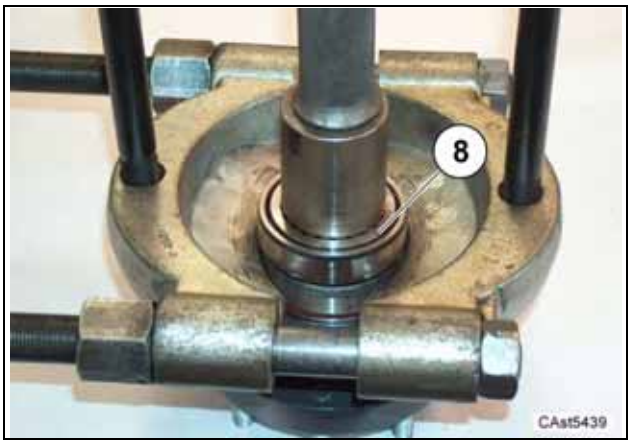
8. Remove nut (6).



9. Remove flange (7).



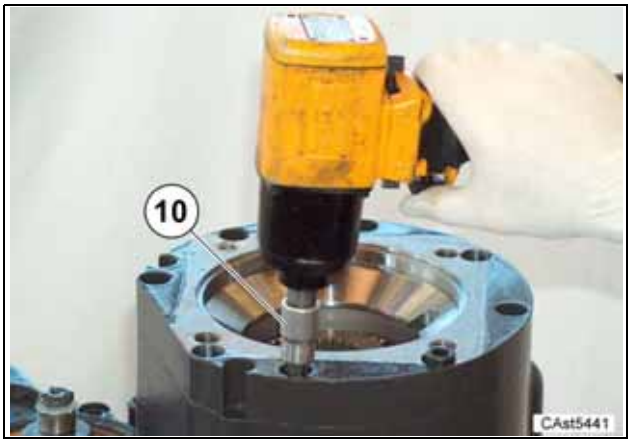
10. Use an extractor to remove the inner ring of the bearing (8).



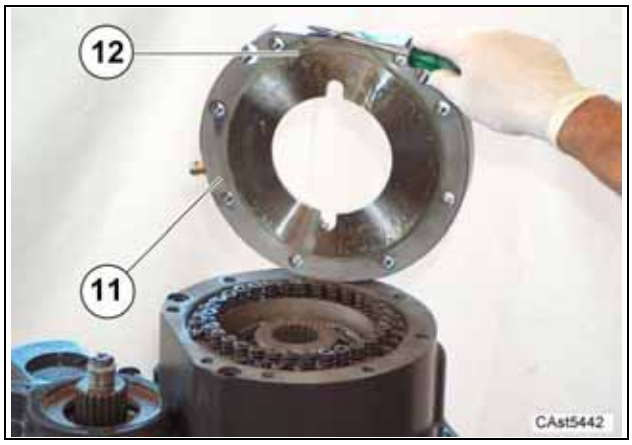
11. Remove flange protection (9).



12. Loosen and remove screws (10).

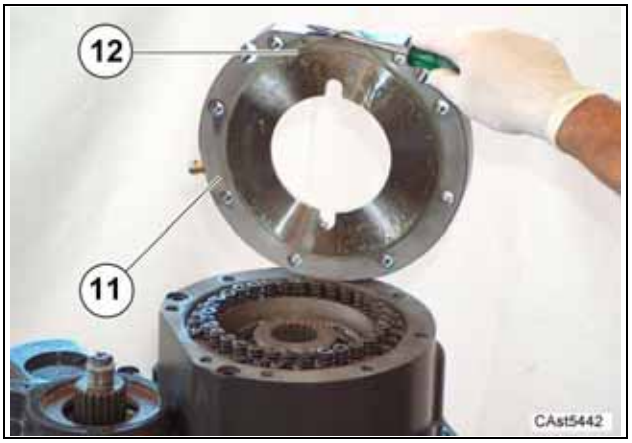


13. Remove hydraulic motor flange (11) and O-ring (12).



INSTALLATION OF TRAVEL MOTOR

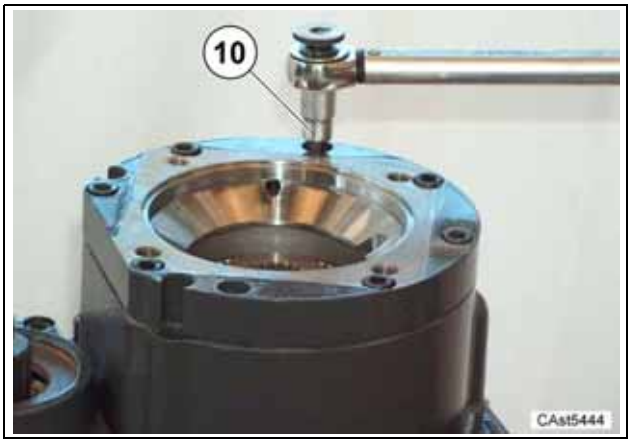
1. Assemble flange (11) and O-ring (12).



2. Apply Loctite® 242 on screws (10).



3. Assemble screw (10). (Tightening torque - 117Nm)



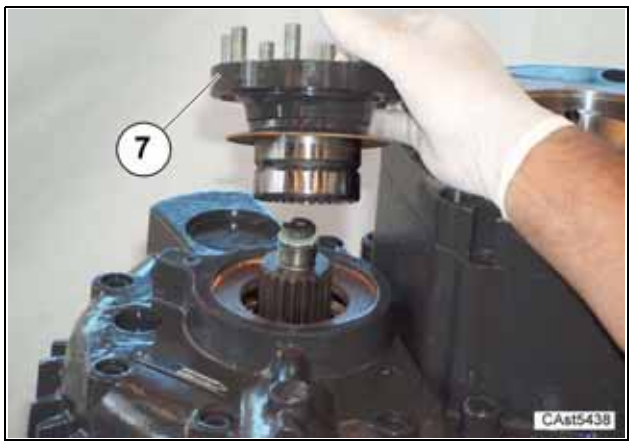
4. Assemble flange protection (9) on flange (7).



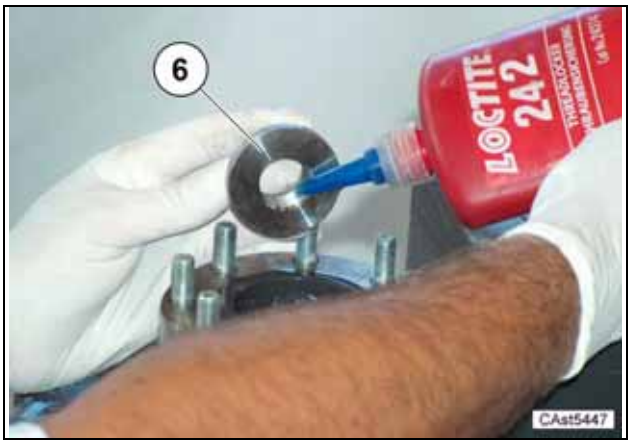
5. Assemble inner ring (8) of the bearing.



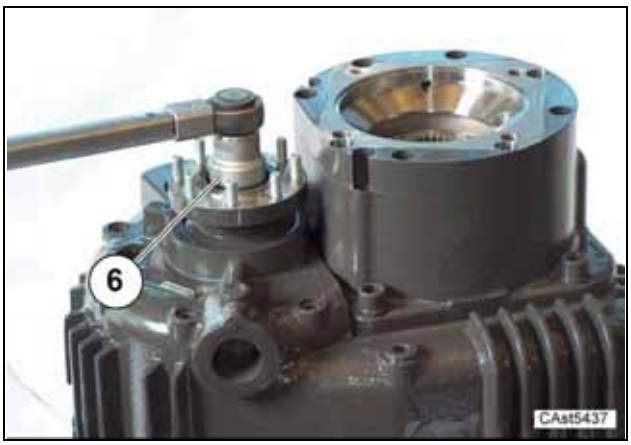
6. Assemble the flange (7).



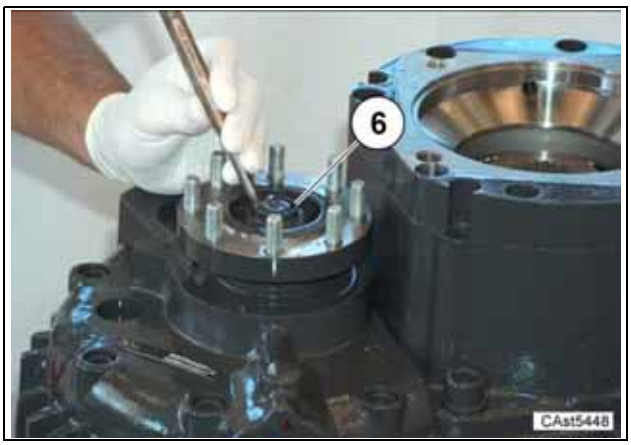
7. Apply Loctite® 242 on nut (6).



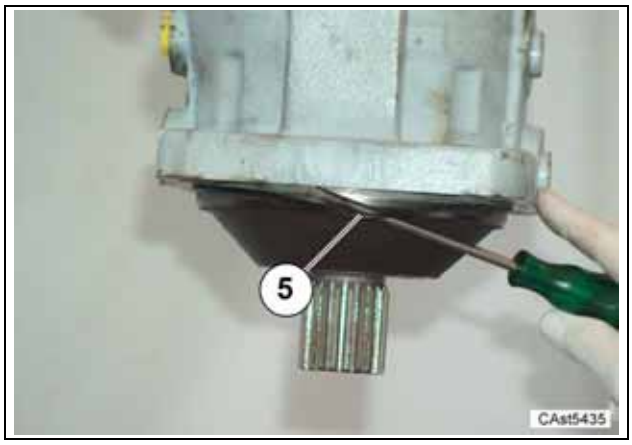
8. Assemble nut (6).



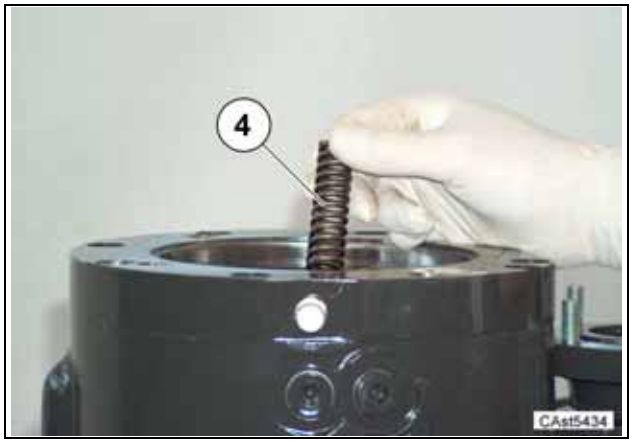
9. Carry out caulking on nut (6).



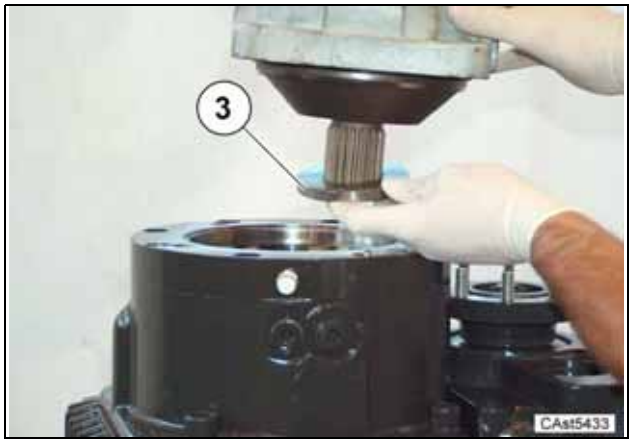
10. Assemble O-ring (5).



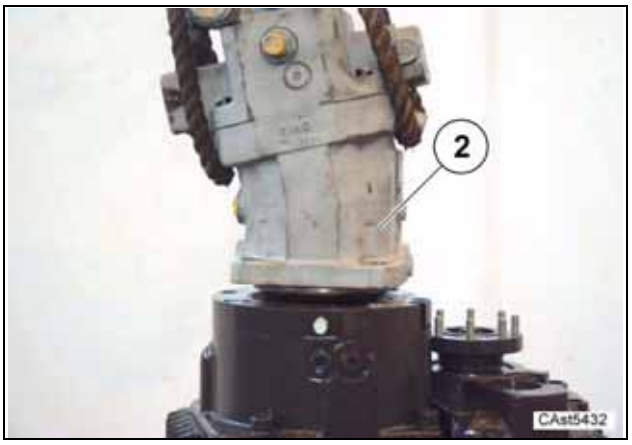
11. Assemble spring (4).



12. Assemble disc (3).



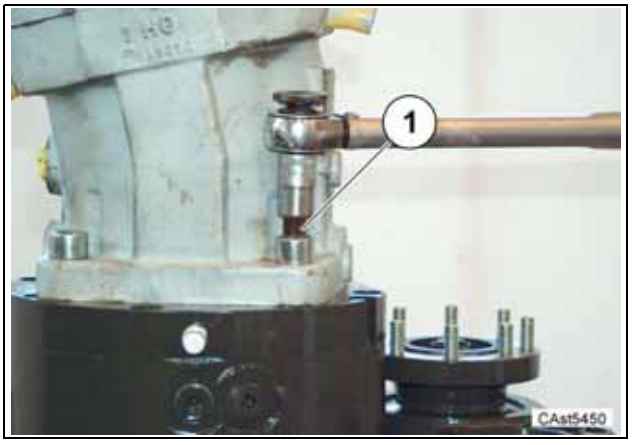
13. Assemble the travel motor (2).



14. Apply Loctite® 242 on screws (1).



15. Assemble screws (1). (Tightening torque - 285Nm)



REMOVAL OF TRANSMISSION BOX

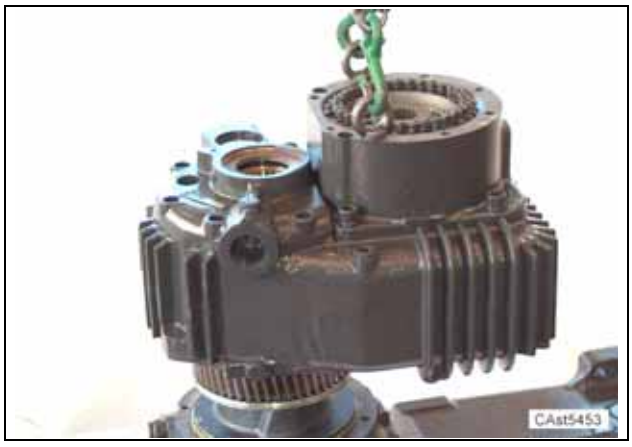
1. Remove screws (1).



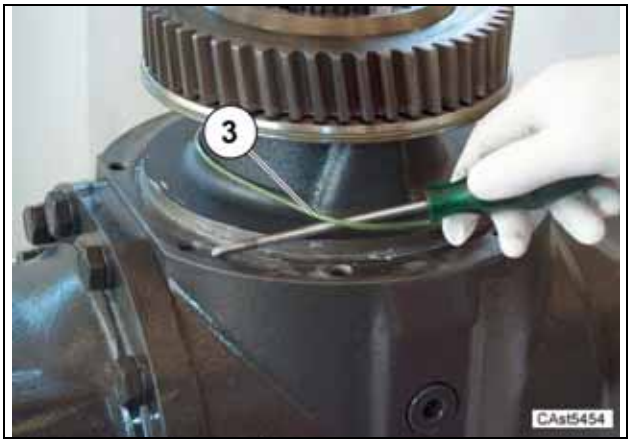
2. Remove screws (2).



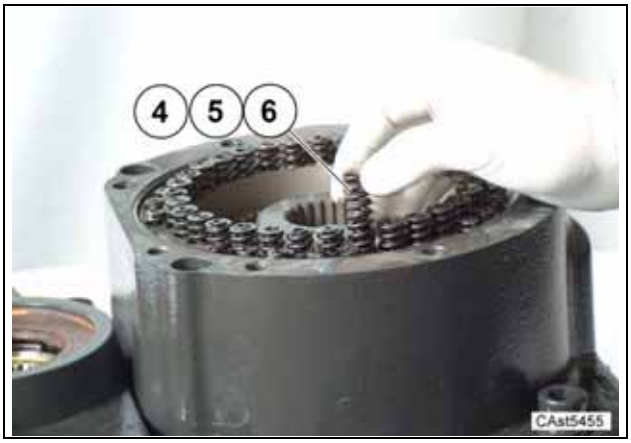
3. Remove transmission box.



4. Remove the O-ring (3).



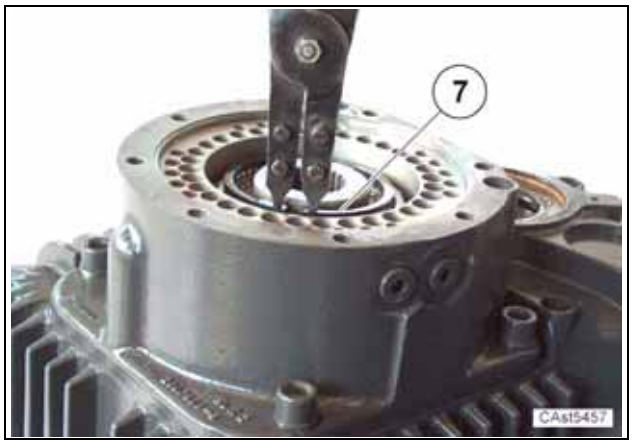
5. Remove springs (4), (5) and (6).



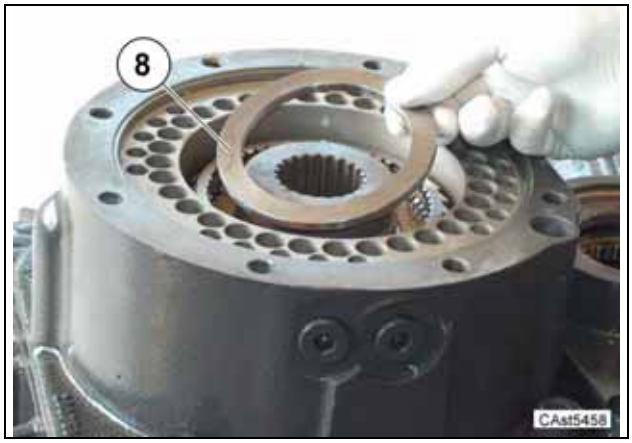
6. Unlock the clutch by pressing with 50-100 bar, through gearbox hole.



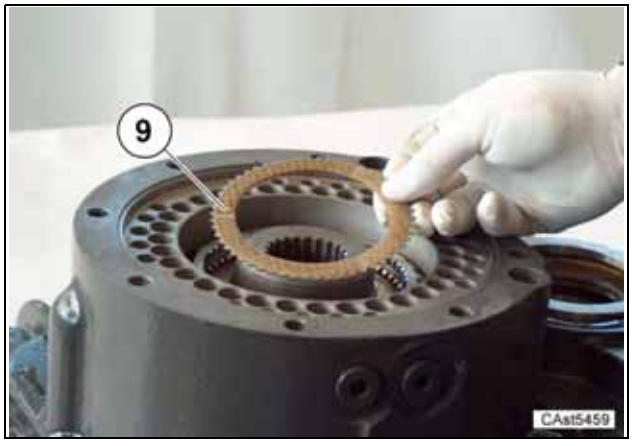
7. Remove snap ring (7).



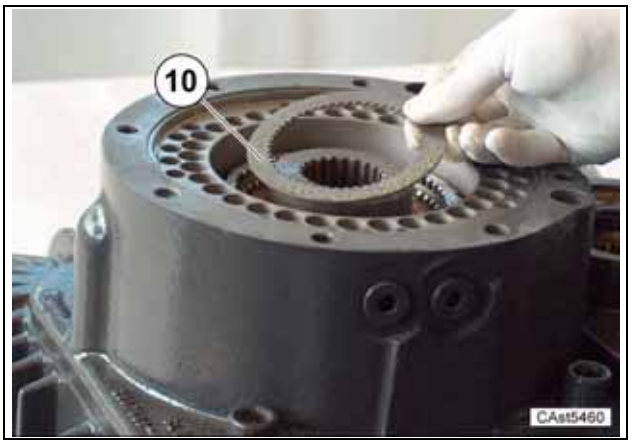
8. Remove ring (8).



9. Remove discs (9).



10. Remove disc (10).



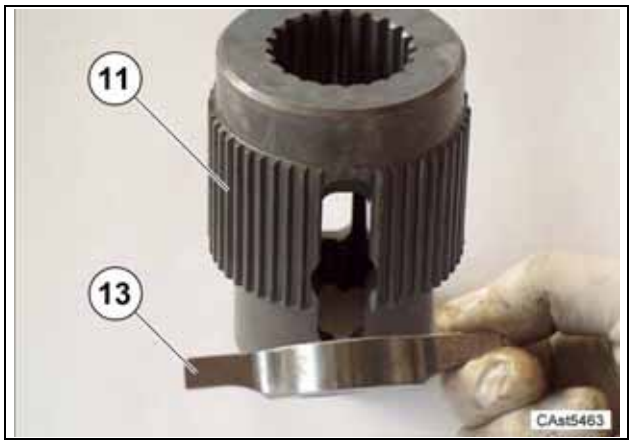
11. Remove bush assembly.



12. Remove the thrust ring (12).



13. Remove thrust plate (13) from bush (11).



14. Remove screws (14).



15. Remove the box assembly.



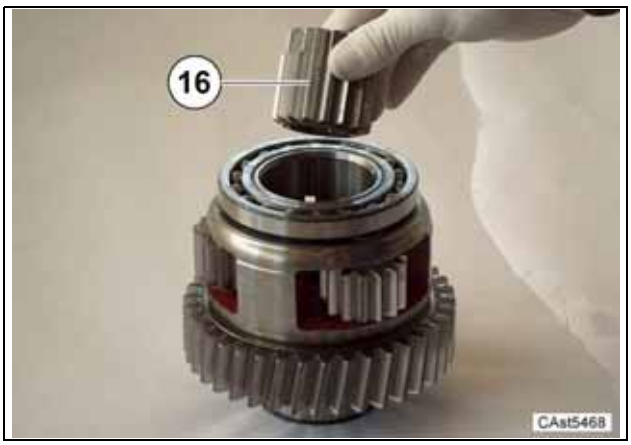
16. Remove complete planetary gears carrier.



17. Remove shaft (15).



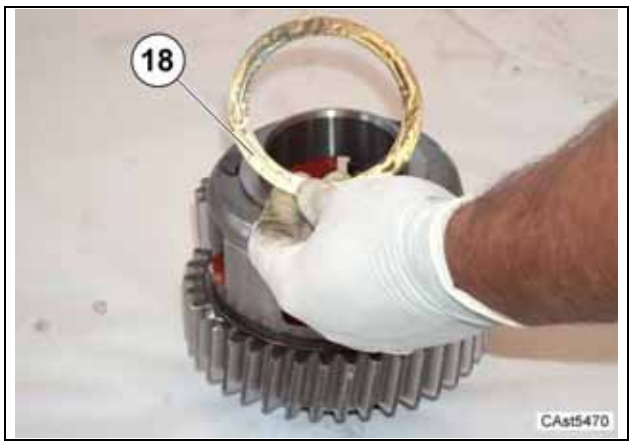
18. Remove gear (16).



19. Use an extractor to remove the bearing (17).



20. Remove shims(18).



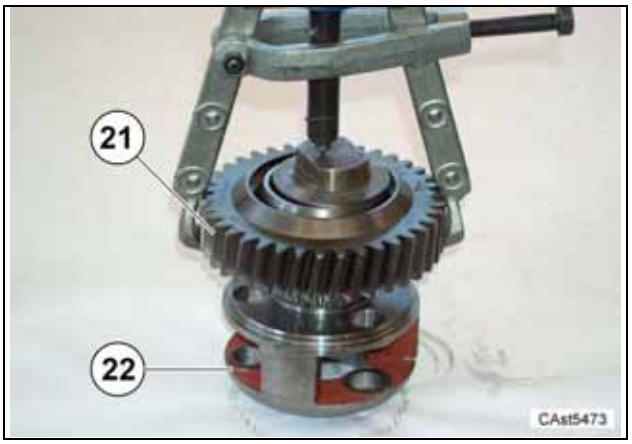
21. Remove ring (19).



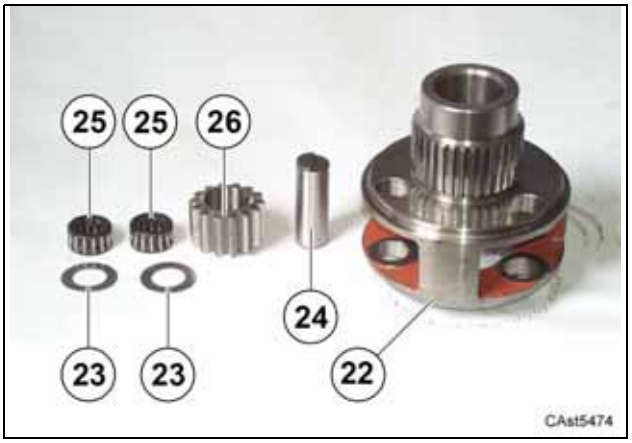
22. Use an extractor to remove bering inner cup (20).



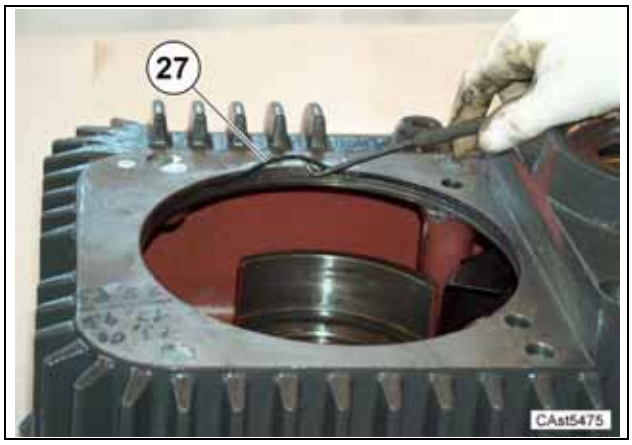
23. Use an extractor to remove gearwheel (21) from planetary gears carrier (22).



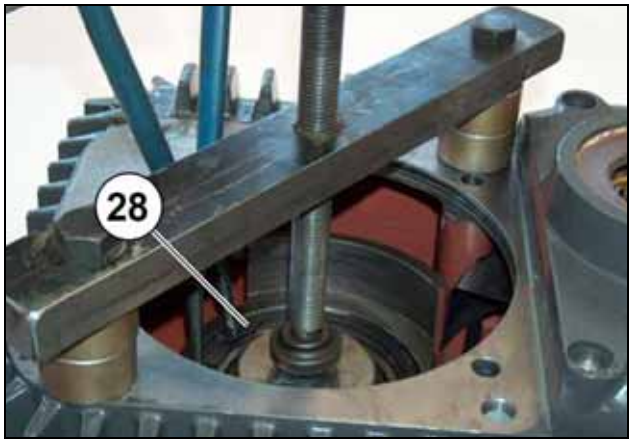
24. Remove washers (23), pins (24), bearings (25), and gears (26) from the planetary gears carrier (22).



25. Remove O-ring (27).



26. Remove snap ring (28).
Use tool 2897008



27. Remove bearing (20).



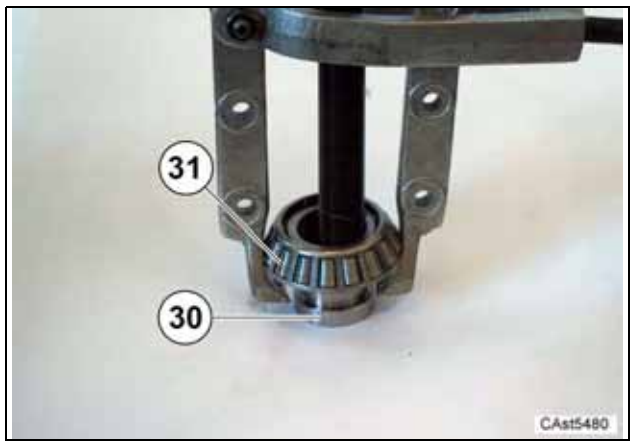
28. Remove ring (29).



29. Remove spin assembly.



30. Remove pin (30) from bearing (31).



31. Remove bearing outer cup (31).



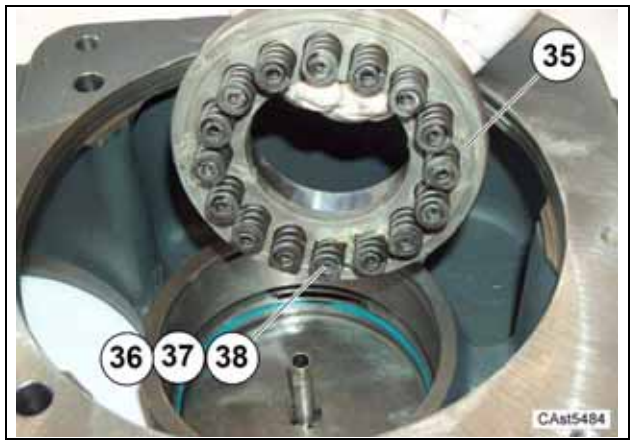
32. Remove piston (32).



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.



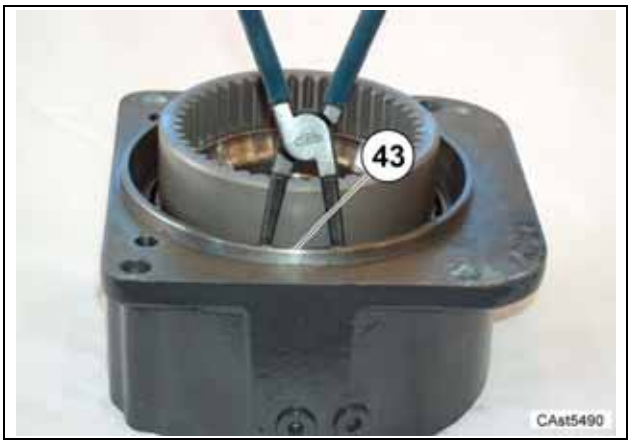
38. Remove disc (41).



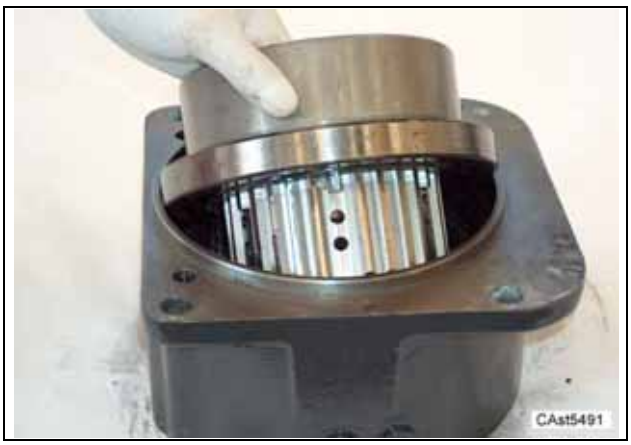
39. Remove the pin (42).



40. Remove snap ring (43).



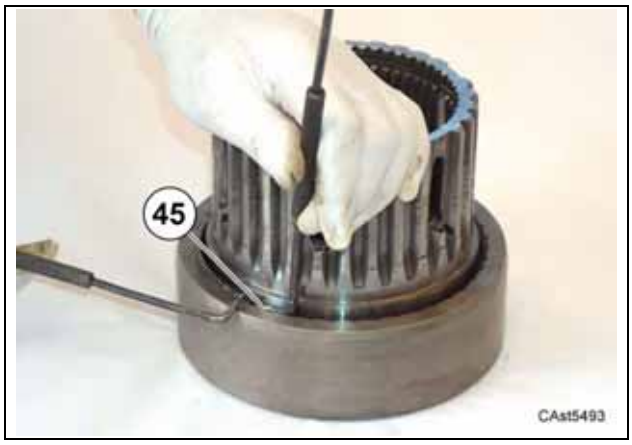
41. Remove hollow wheel assembly.



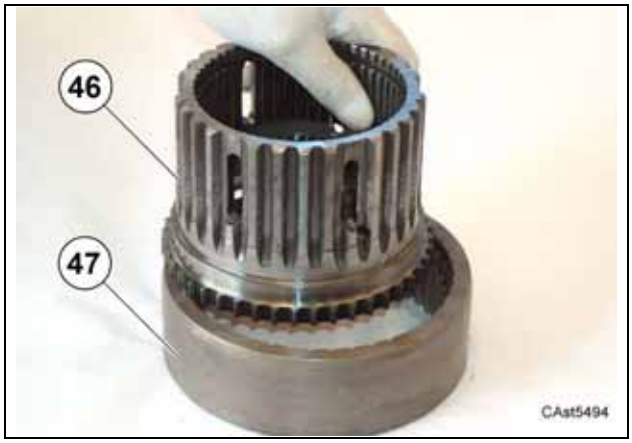
42. Remove bearing (44).



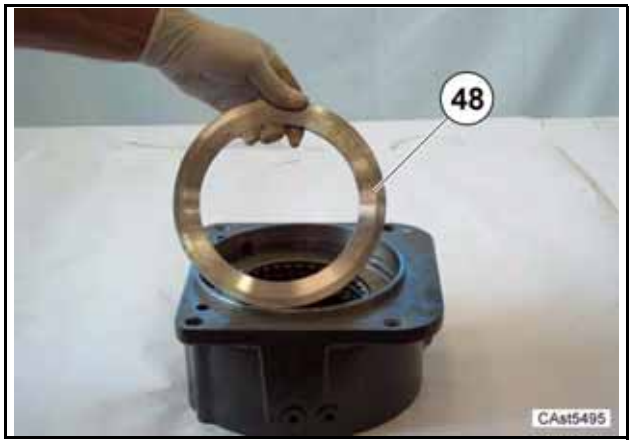
43. Remove snap ring (45).



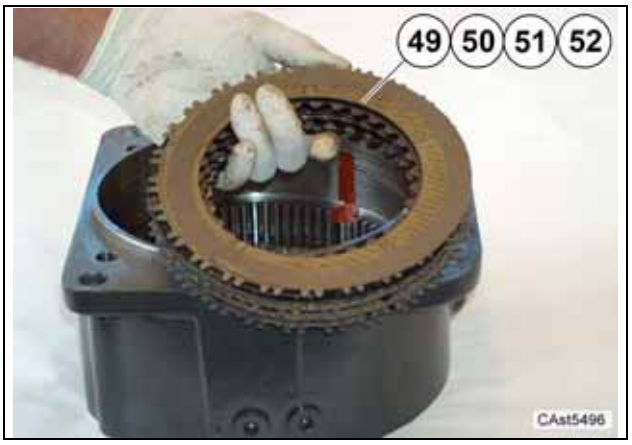
44. Remove external geared wheel (46) from hollow wheel (47).



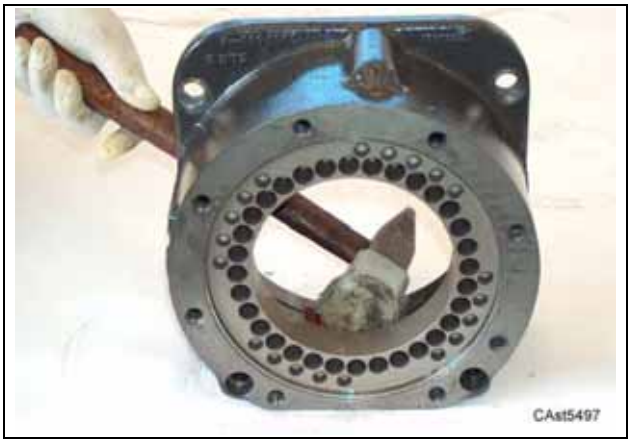
45. Remove disc (48).



46. Remove discs (49), (50), (51) and (52).



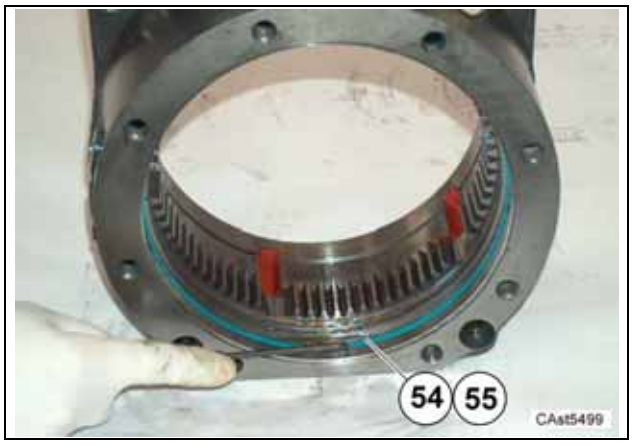
47. Remove piston assembly.



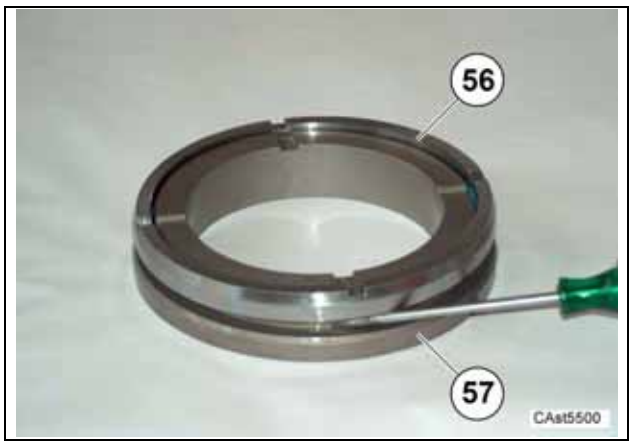
48. Remove O-ring (53).



49. Remove piston gasket (54) and O-ring (55).



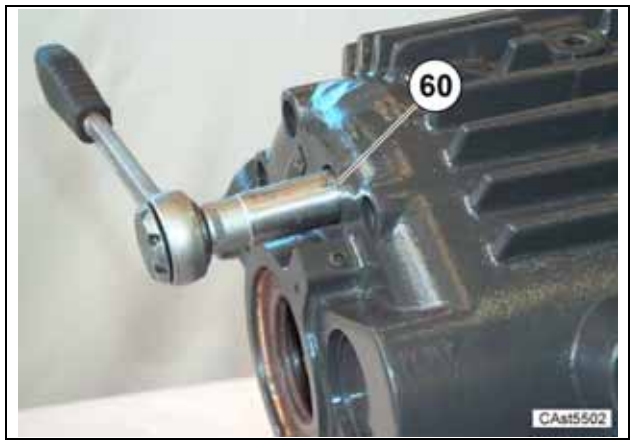
50. Remove outer ring (56) from piston (57).



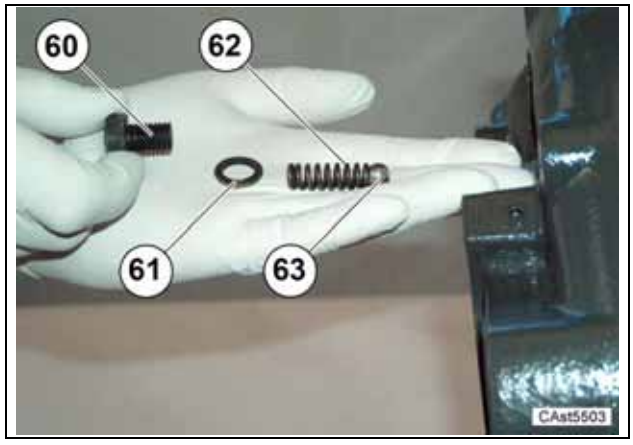
51. Remove gasket (58) and O-ring (59) from seat.



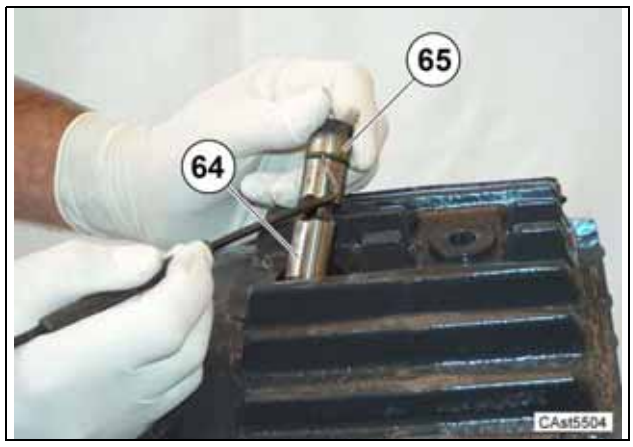
52. Loosen screw (60).



53. Remove screw (60), washer (61), spring (62), and ball (63).



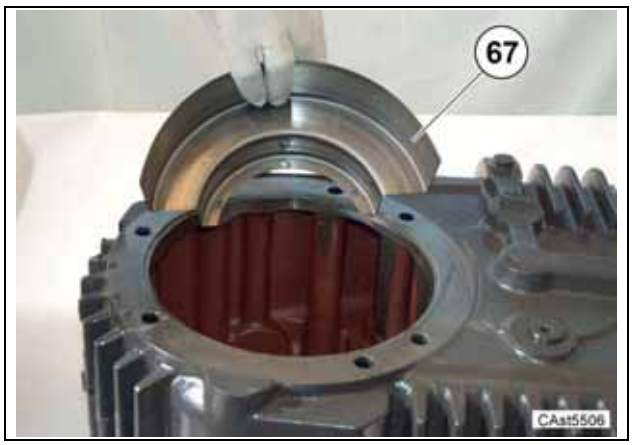
54. Remove pin (64) and O-ring (65).



55. Remove screws (66).



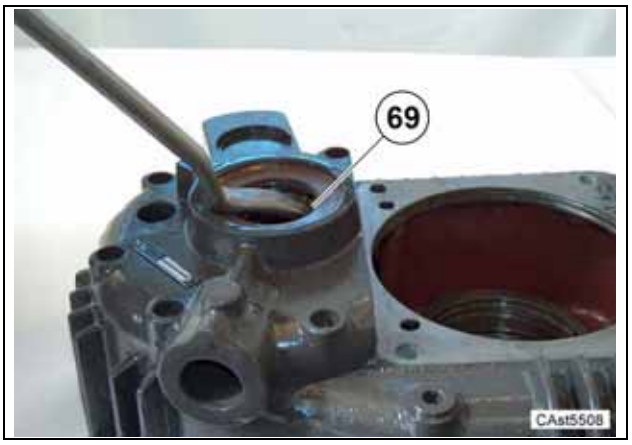
56. Remove the cover (67).



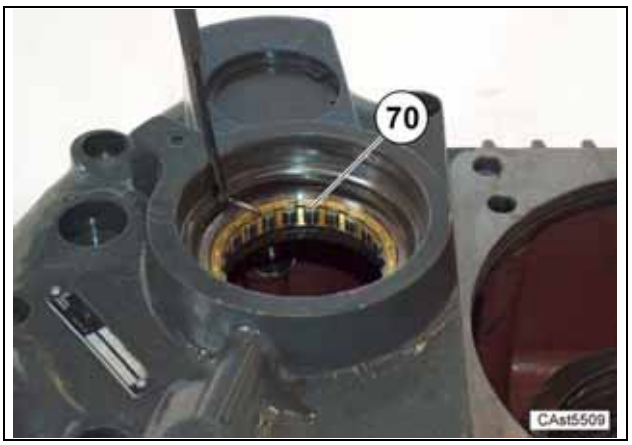
57. Remove disc (68).



58. Remove gasket (69).



59. Remove snap ring (70).



60. Remove bearing (71).

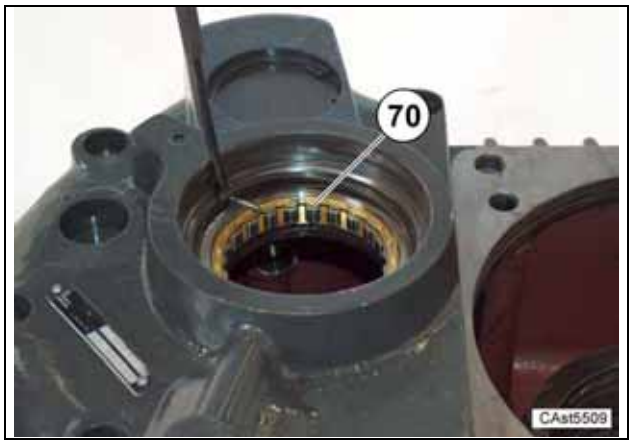


INSTALLATION OF TRANSMISSION BOX

1. Assemble bearing (71).



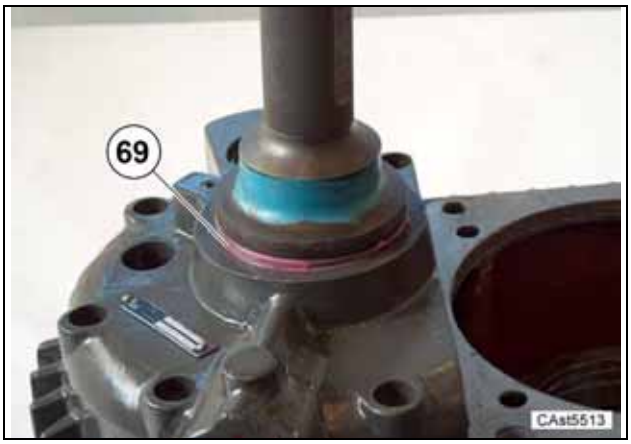
2. Assemble snap ring (70).



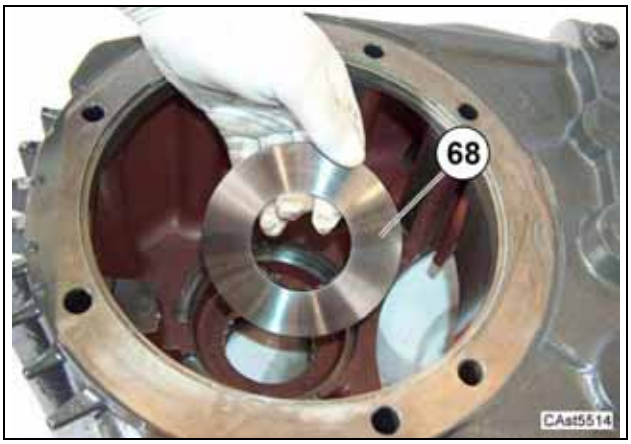
3. Install oil seal ring (69) inside tool 2897005. Apply Loctite® 510 on seal ring outer edge.



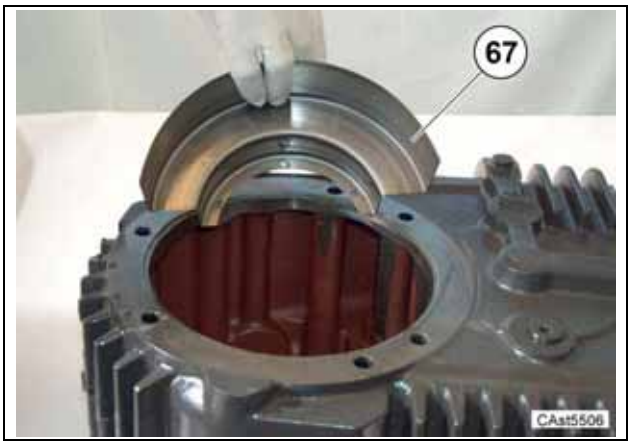
4. Assemble oil seal (69) on tool 2897005.
   Note: Clean the box with a rolling brush.



5. Assemble disc (68).



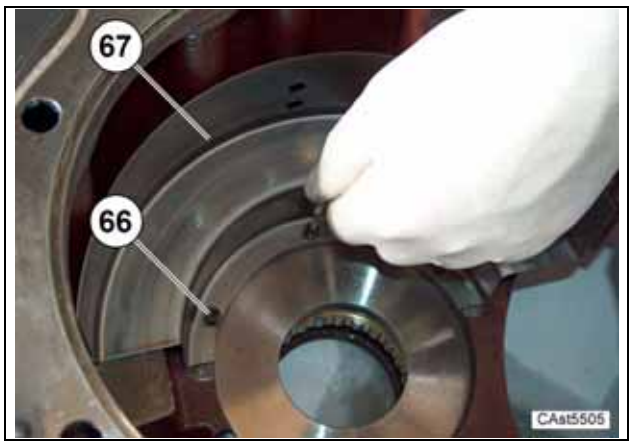
6. Install cover (67).



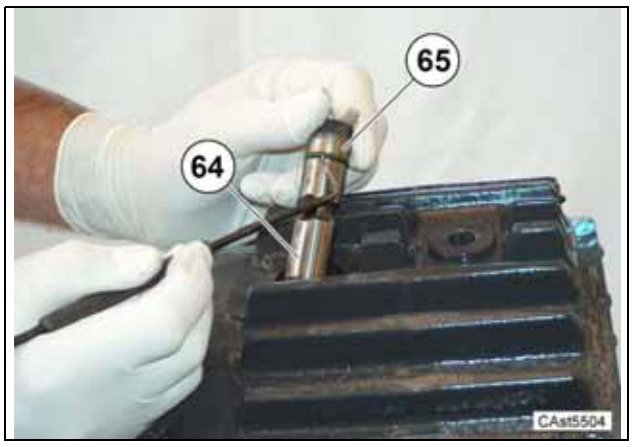
7. Apply Loctite® 242 on screws (66).



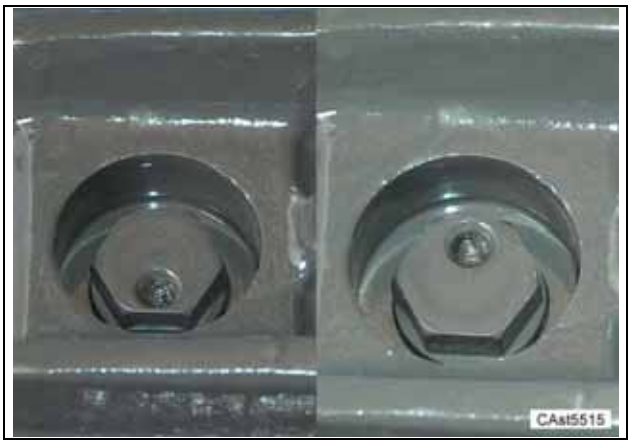
8. Fix cover (67) with screws (68).



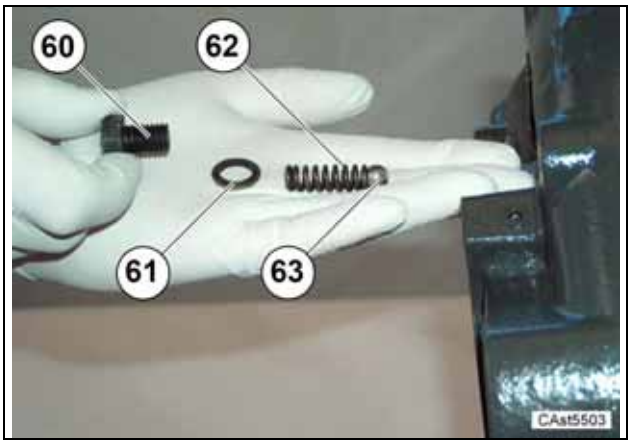
9. Assemble O-ring (65) on the pin (64) and apply a light layer of grease. Assemble the pin.



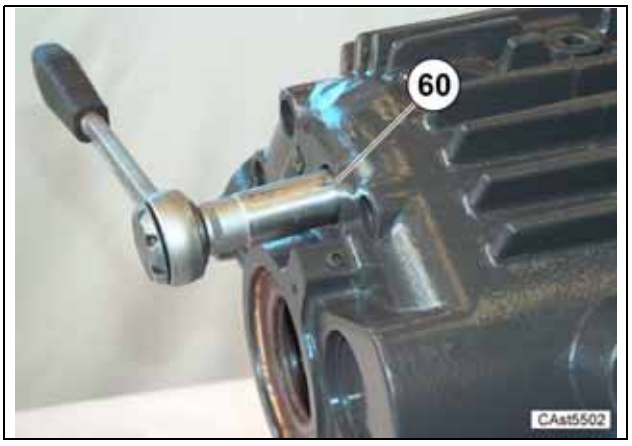
Note: to unlock the transmission in case of need, turn the eccentric pin 180° (notch upward).



10. Assemble ball (63), spring (62), washer (61) and screw (60).



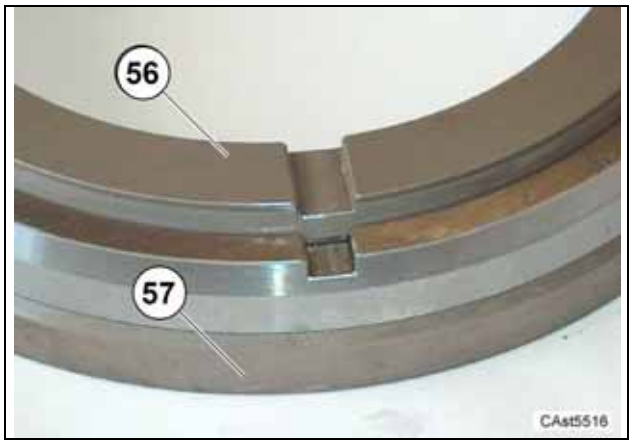
11. Tighten screw (60). (Tightening torque - 400Nm)



12. Assemble gasket (58) and O-ring (59) in the ring (56).



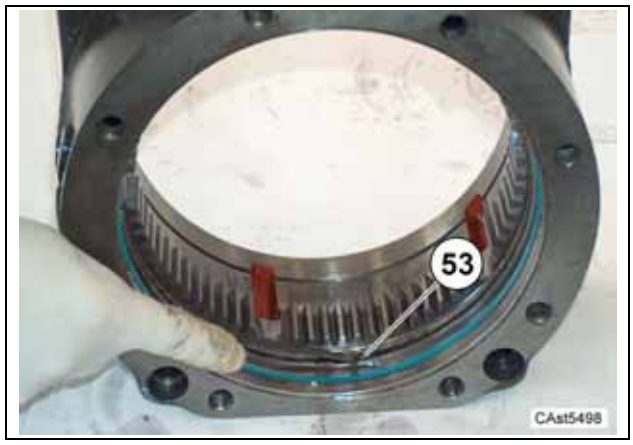
13. Assemble outer ring (56) on piston (57) making the notches match.



14. Assemble gasket (54) and O-ring (55).



15. Assemble O-ring (53).



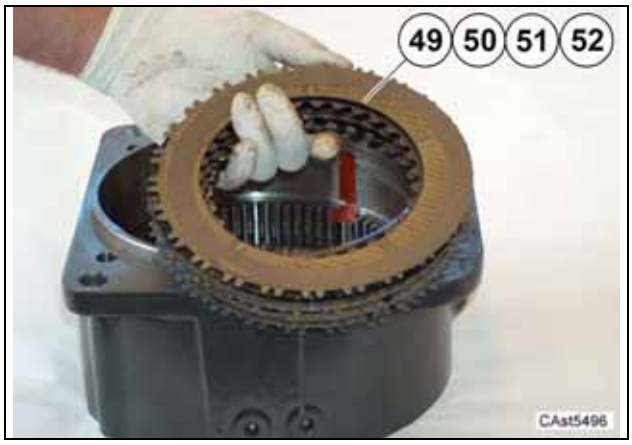
16. lubricate and install piston using tool 1743047. Make sure that the oil groove coincides with the toothed disc grooves.

⚠ WARNING

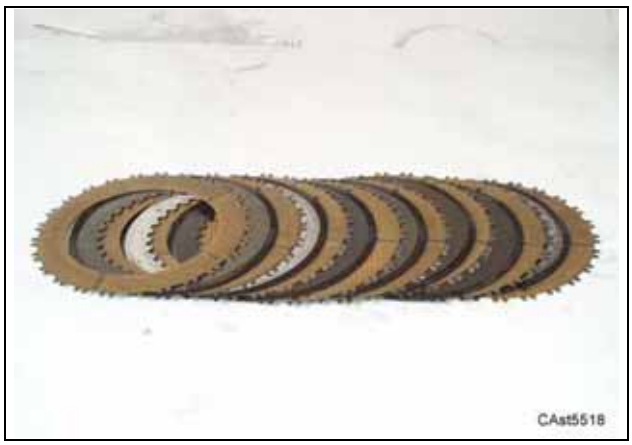
Warning make sure that the piston does not key.



17. Assemble discs (49), (50), (51) and (52).



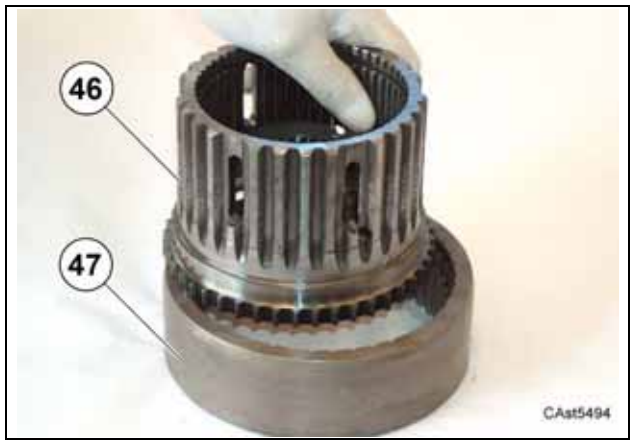
Note:check the sequence of discs.



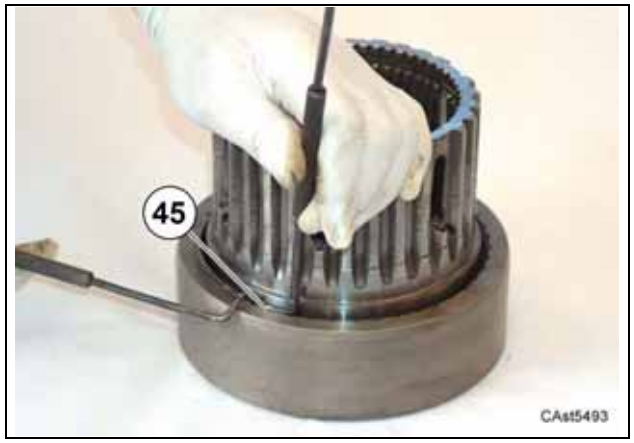
18. Assemble disc (48).



19. Assemble external geared wheel (46) on the hollow wheel (47).



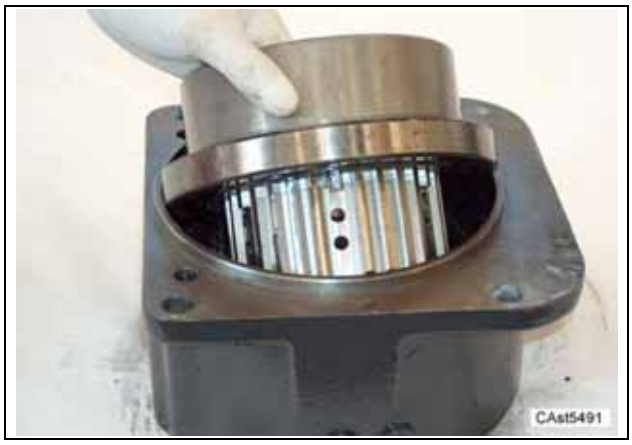
20. Assemble snap ring (45).



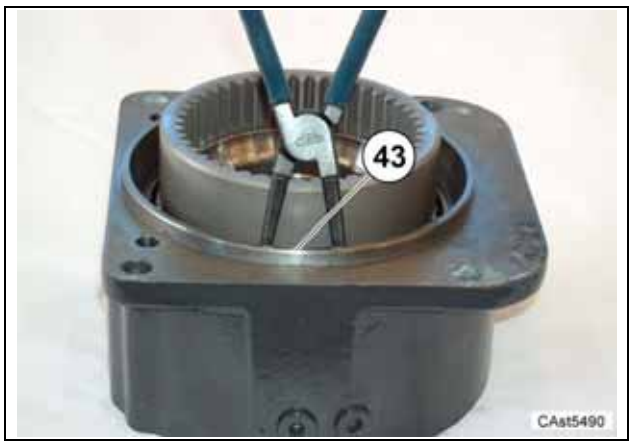
21. Assemble bearing (44) on hollow wheel assembly.



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).

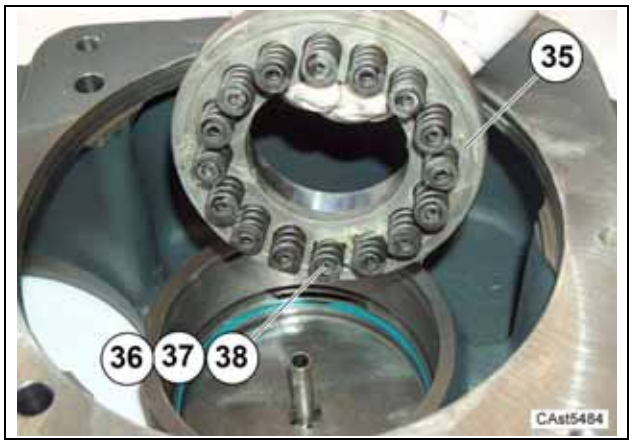


⚠ WARNING

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.



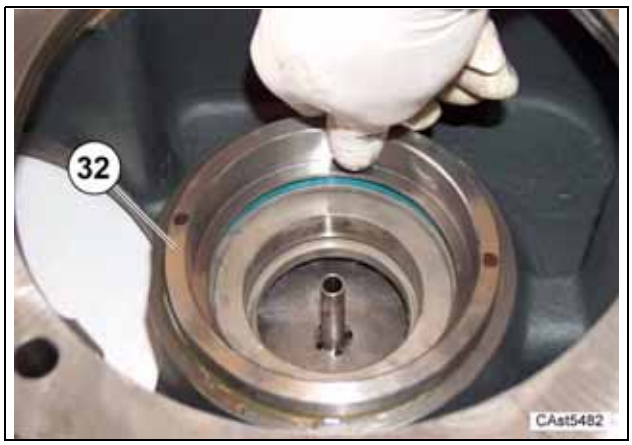
31. Assemble piston assembly



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).



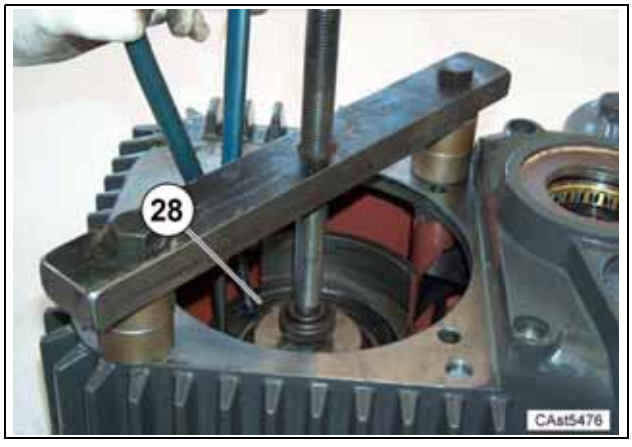
37. Assemble ring (29).



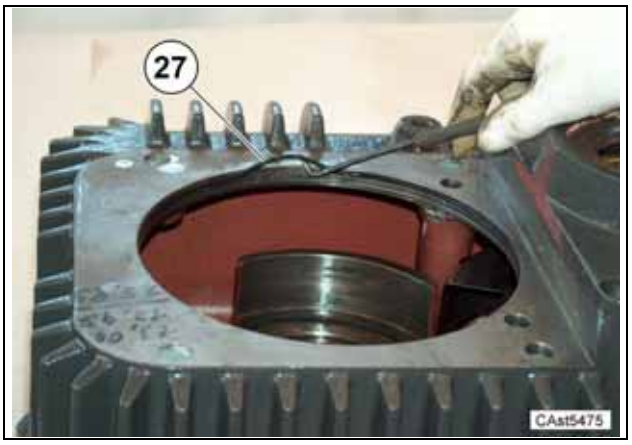
38. Assemble bearing outer cup (20).



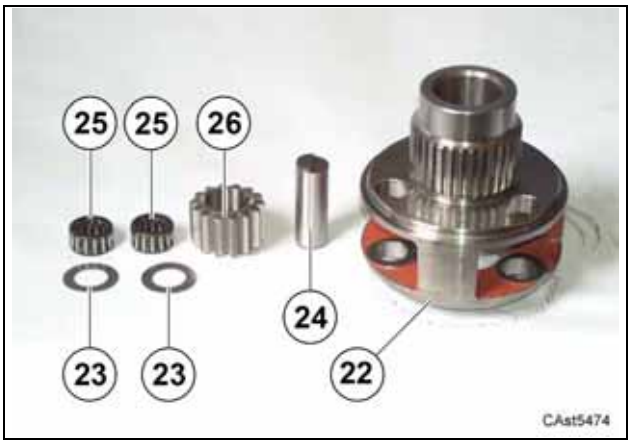
39. Assemble snap ring (28).
Use tool 2897008.



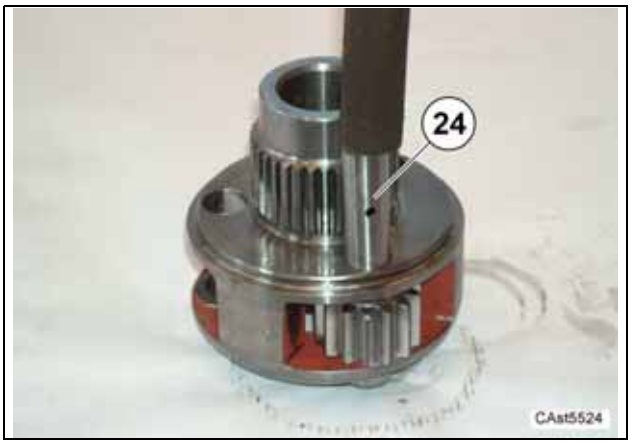
40. Assemble O-ring (27).



41. Assemble gears (26), bearings (25), pins(24) and washers (23) on the planetary gears carrier (22).



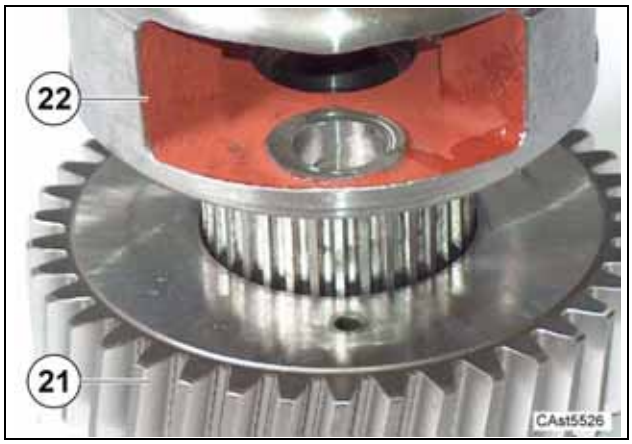
42. Assemble pins (24).



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).



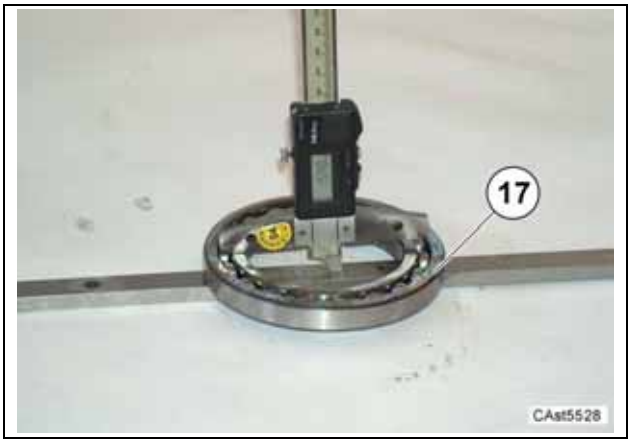
45. Apply Loctite® 638 on inner race of bearing(20)



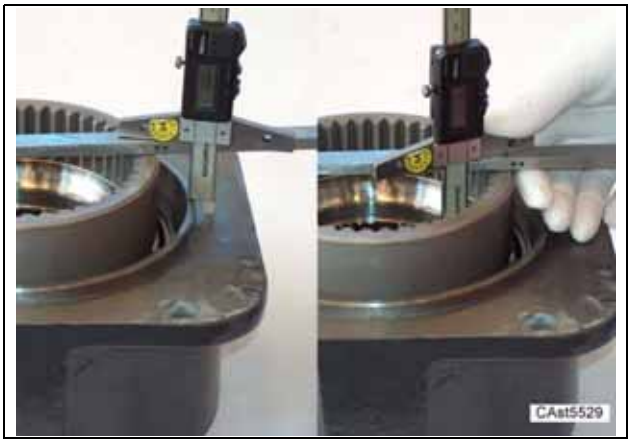
46. Assemble the ring (19).



47. Measure shim (S) of bearing (17).



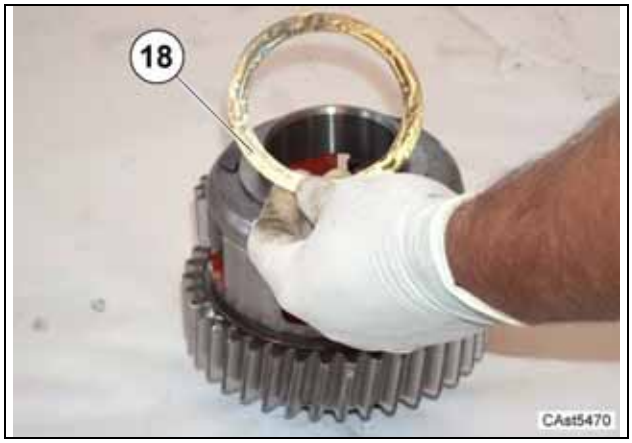
48. Measure the distance (A) between supporting plate and the bearing detent (17).



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).



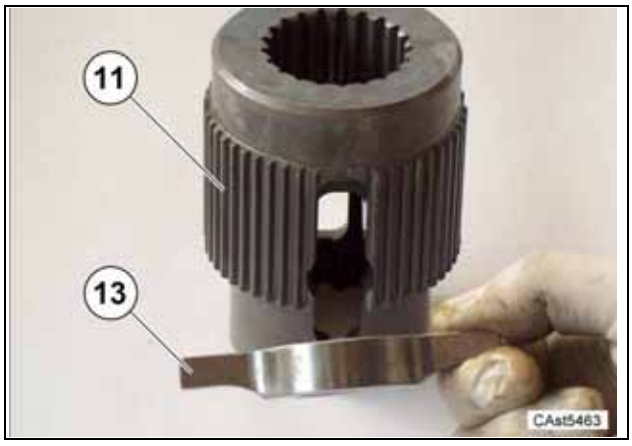
53. Assemble shaft (15).



54. Assemble the planetary gears carrier.



55. Assemble bush (11) and thrust plate (13).
Note:pay attention to assembly direction.



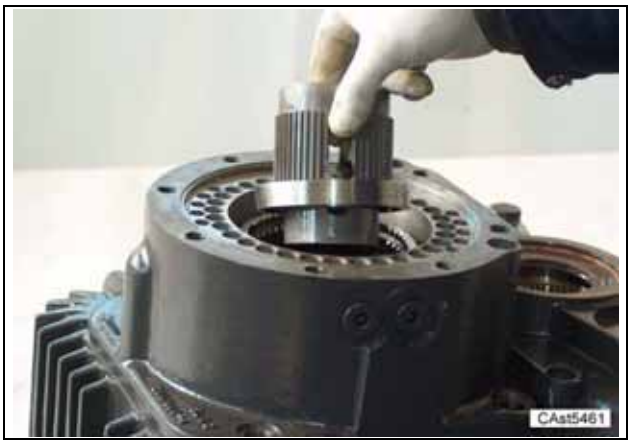
56. Install thrust ring (12).



57. Assemble the complete box.



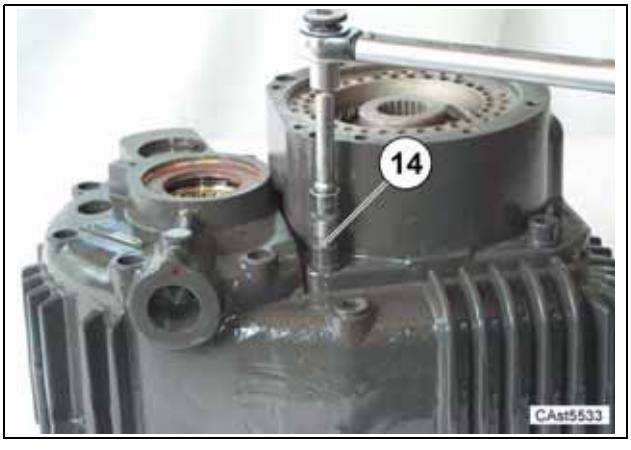
58. Assemble the complete bush.



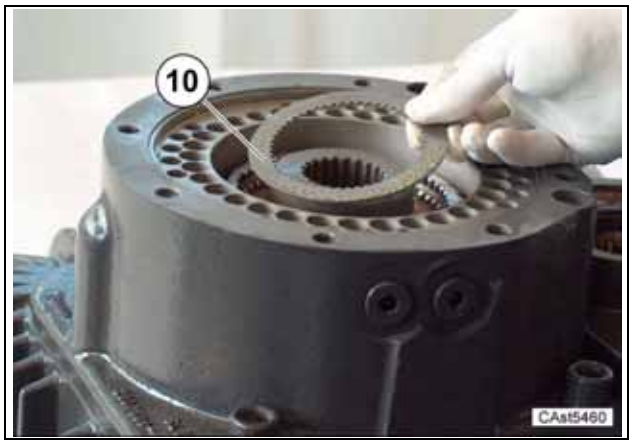
59. Apply Loctite® 242 on screws (14).



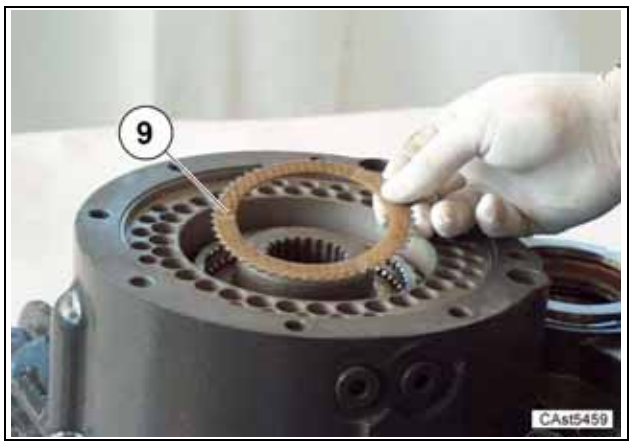
60. Assemble screws (14).
Screw in screws to tightening torque - 117Nm.



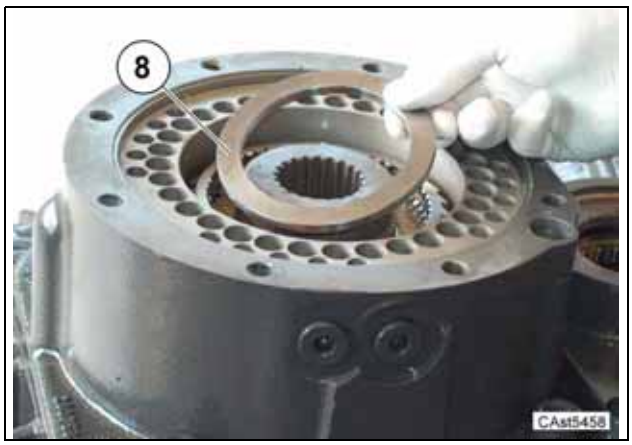
61. Assemble disc (10).



62. Assemble disc (9).



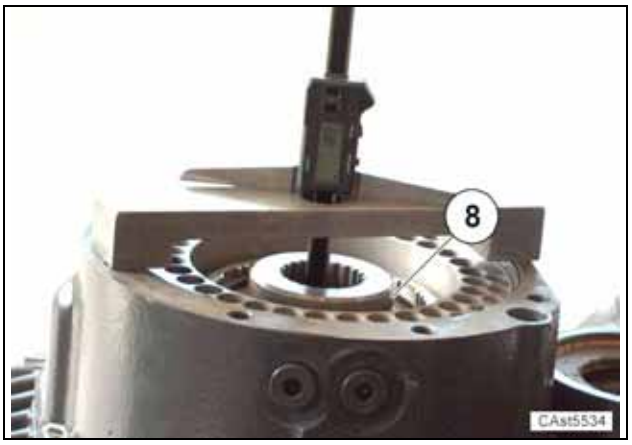
63. Assemble the ring (8).



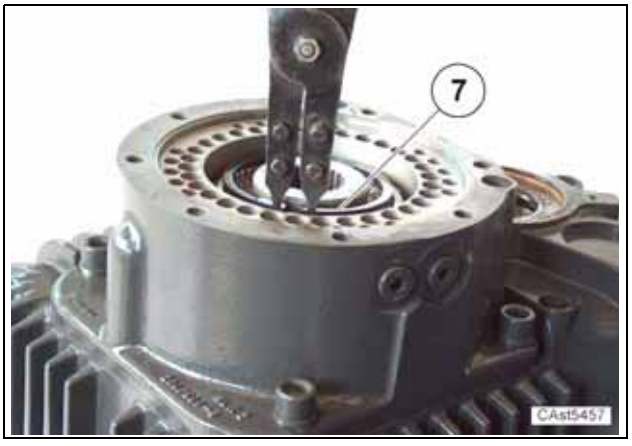
64. Unlock the clutch by pressing 50 - 100 bar.



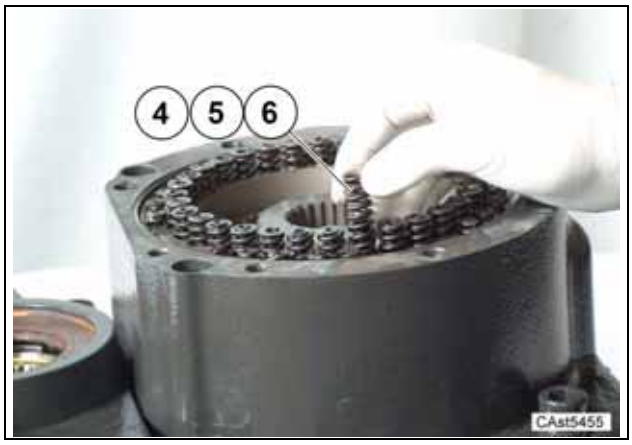
65. Measure the lowering of the discs using a digital gauge. the stroke should be between 1.7 and 1.9 mm. Otherwise replace the ring (8) with one of different thickness.



66. Assemble snap ring (7).



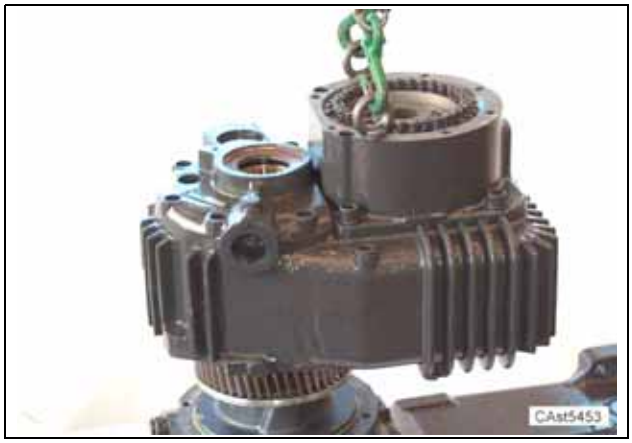
67. Assemble springs (4), (5) and (6).



68. Assemble O-ring (3).
Apply Loctite® 510.



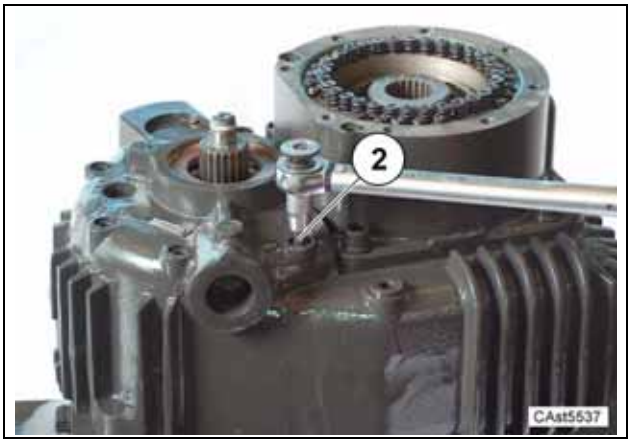
69. Assemble transmission box.



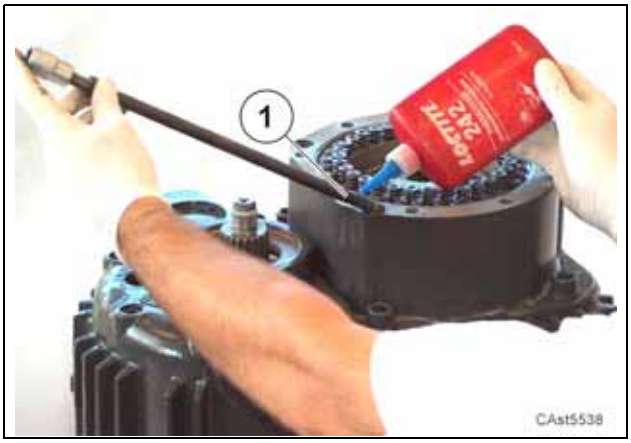
70. Apply Loctite® 242 on screws (2).



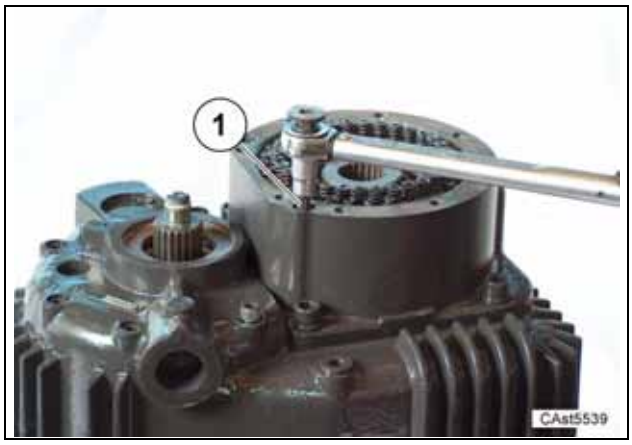
71. Assemble screws (2).
(Tightening torque - 70Nm)



72. Apply Loctite® 242 on screws (1).



73. Assemble screws (2).
(Tightening torque - 285Nm)



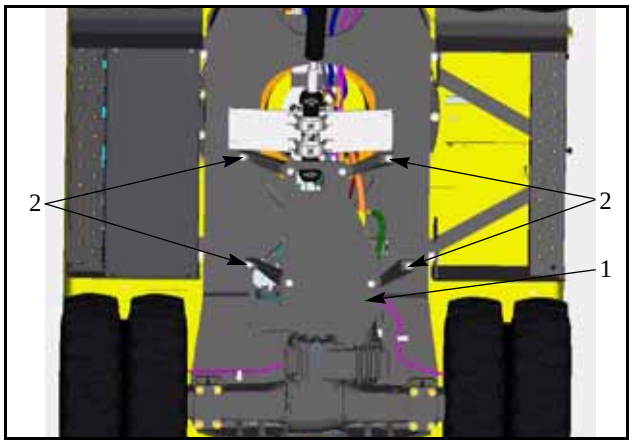
74. Drain clutch by pressing with 50 - 100 bar. Measure the lowering of discs using a digital gauge. The stroke should be between 2.2 and 2.4 mm.



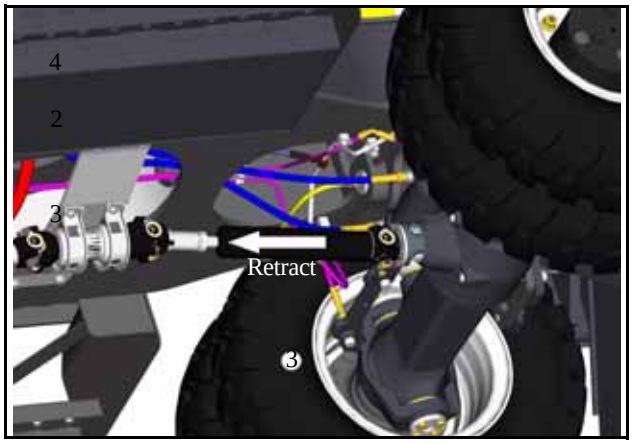
REMOVAL AND INSTALLATION OF PROPSHAFT

REMOVAL

1. Remove cover (1) {if fitted} by removing 4 bolts (2).

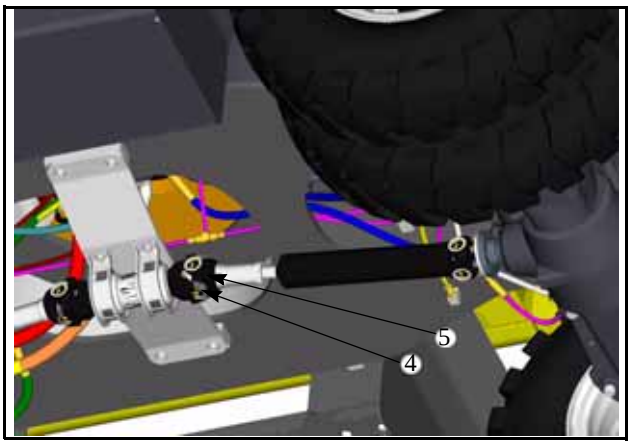


2. Remove nuts (3), then retract the front propshaft clear of studs on axle housing.



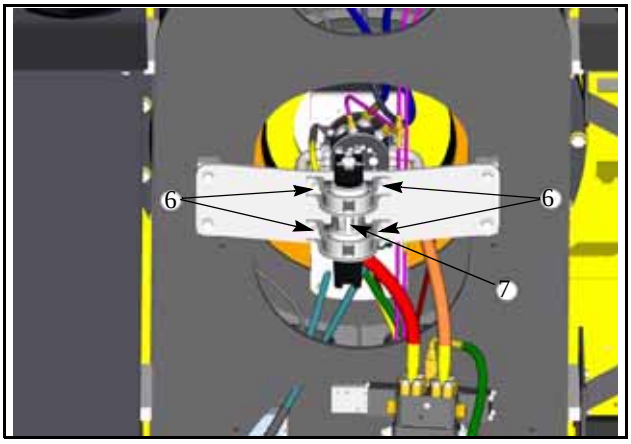
3. Remove the 4 coupling bolts (4) from the coupling assembly. Then remove the clamps (5) and then remove the propshaft.

Note: Coupling bolts (20G-20-31130) once removed, MUST be replaced by new bolts during installation.



4. Repeat for the rear propshaft.

5. Remove coupling assembly (6) by removing bolts (7).



INSTALLATION

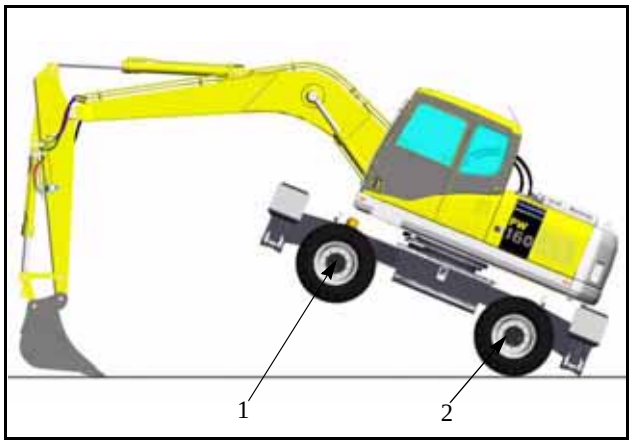
- Install in reverse order of removal.
- Tightening torque of propshaft nuts (58.8-73.5 Nm).
- Four new coupling bolts required for installation (20G-20-31130). Order from Komatsu supplier.
- Tightening torque of coupling bolts {torque heads} (61 ~ 81Nm)

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.

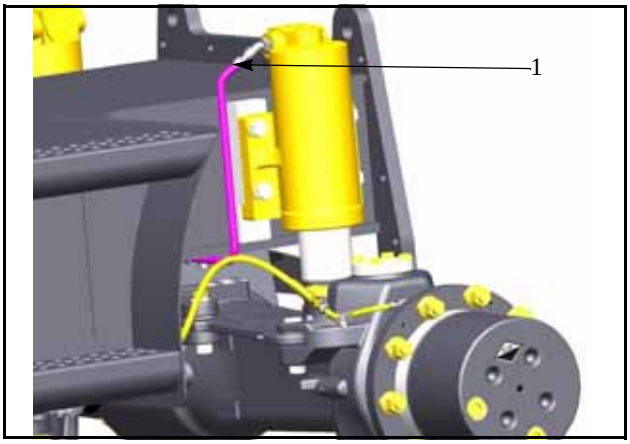
REMOVAL AND INSTALLATION OF SUSPENSION LOCK CYLINDER

SPECIAL TOOLS

REMOVAL

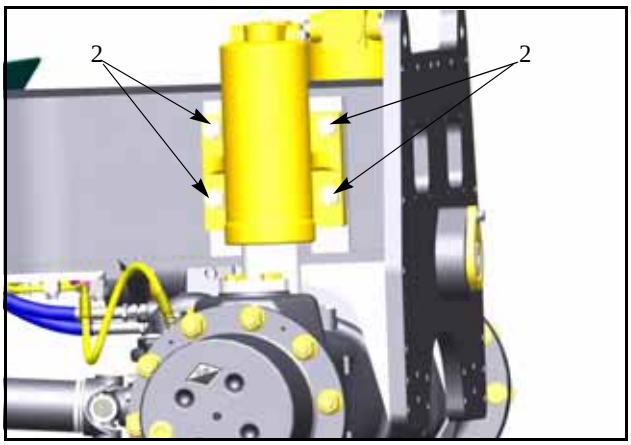
1. Remove front wheels See “WHEEL ASSEMBLY” on page 20-192.

2. Remove tube (1).



3. Remove the 4 bolts (2) attaching the suspension lock cylinders to the chassis.

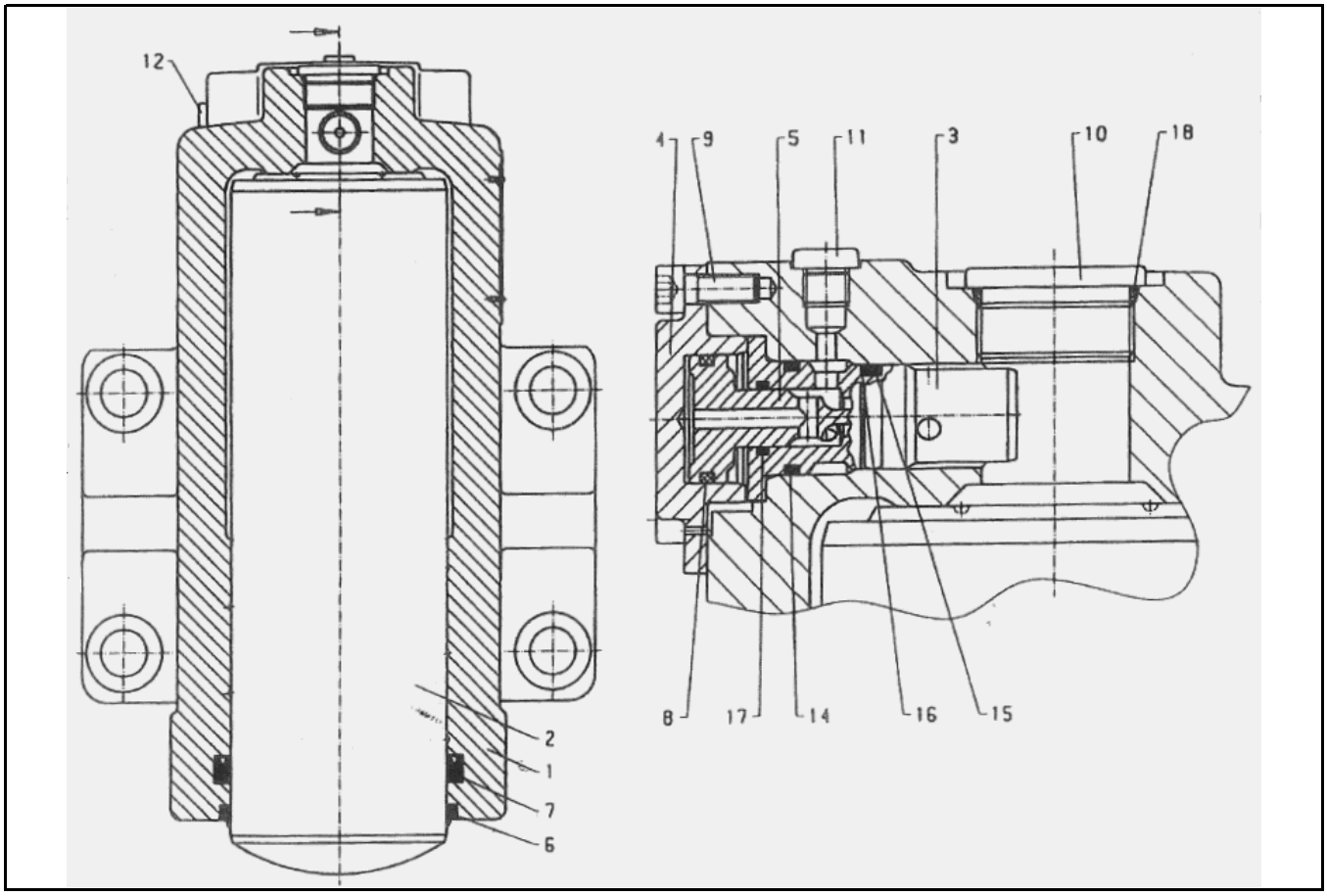
kg Suspension cylinder assembly: 57Kg



INSTALLATION

- Install in reverse order of removal.
- Be sure to grease axle pads when installing cylinders.

DISASSEMBLY AND ASSEMBLY OF SUSPENSION LOCK CYLINDERS



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 aa 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.

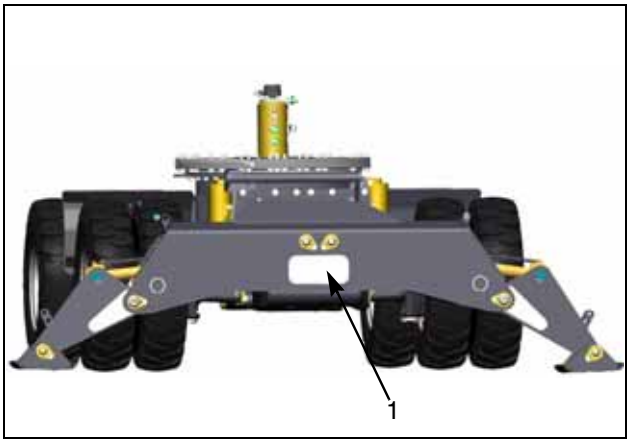
⚠ WARNING

With all repairs pay attention to extreme cleanliness!

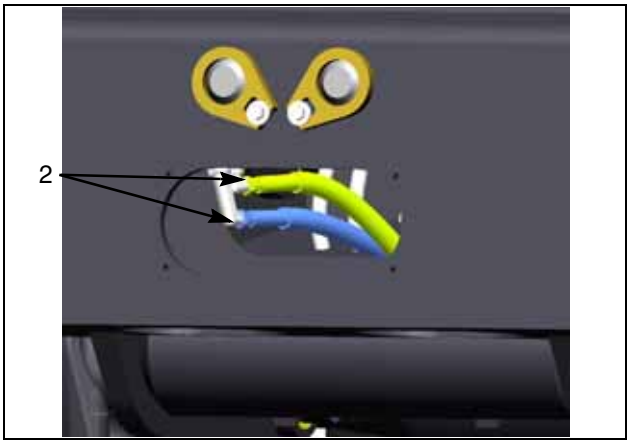
REMOVAL AND INSTALLATION OF OUTRIGGER

REMOVAL

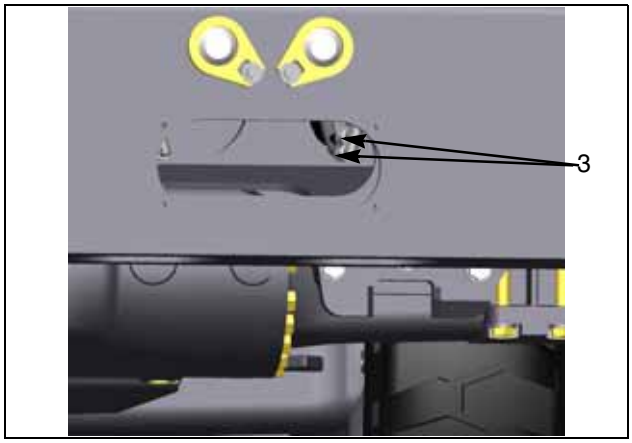
1. Lower outriggers untill they just touch the ground but do not take any of the weight of the machine.
2. Turn off engine.
3. Depressurise the outrigger hydraulic circuit.
4. Remove cover (1).



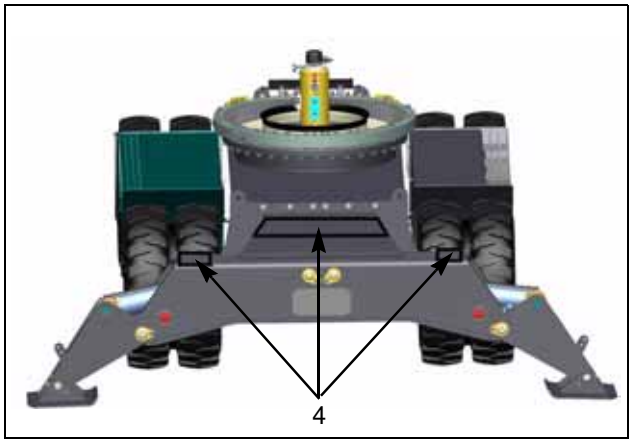
5. Remove 2 pipes (2).



6. Remove 2 pipes (3).

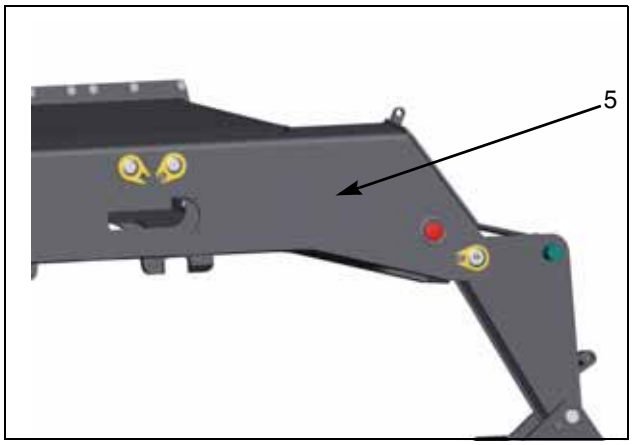


7. Sling outrigger assembly at points marked (4).



Remove all bolts (5) and remove outriggers.

kg O/R and Frame Assembly: **970 kg**



INSTALLATION

- Install in reverse order of removal.
- Grease all pins and cylinders before installing.

DISASSEMBLY AND ASSEMBLY OF OUTRIGGER

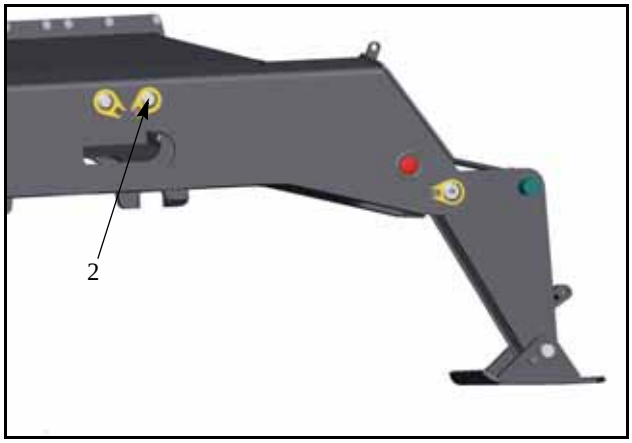
DISASSEMBLY

1. Insert plugs into oil connectors to prevent dirt blocking connectors.

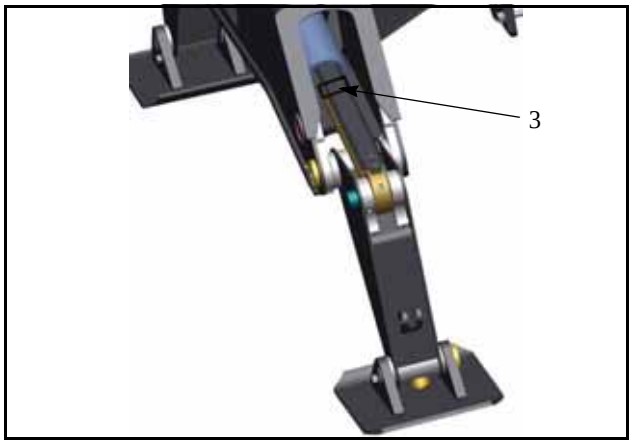
2. Insert support block below cylinder at (1).



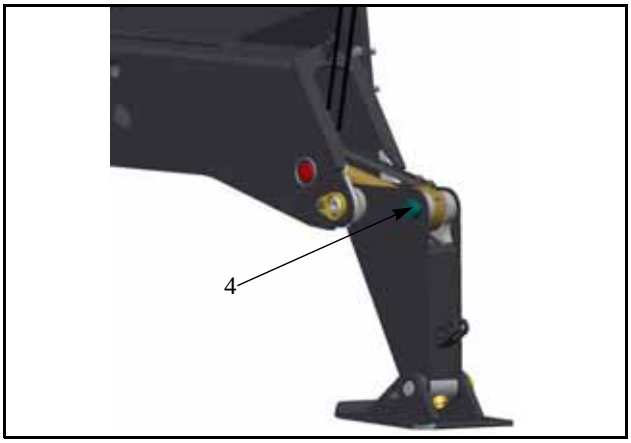
3. Remove pin (2).



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.

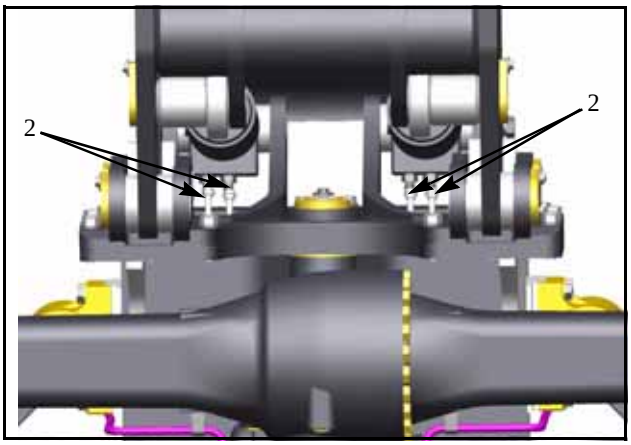
REMOVAL AND INSTALLATION OF DOZER BLADE

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).

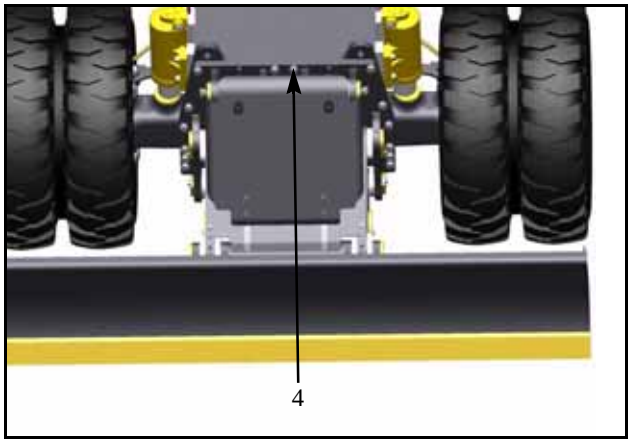


6. Attach lifting tackle (3).



7. Remove bolts (4) and remove dozer blade assembly.

kg Blade Assembly: **776 kg**



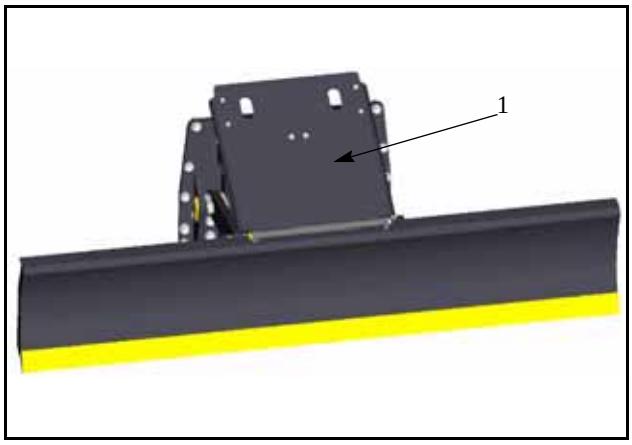
INSTALLATION

- Install in reverse order to removal.
- Grease all pins and cylinders.

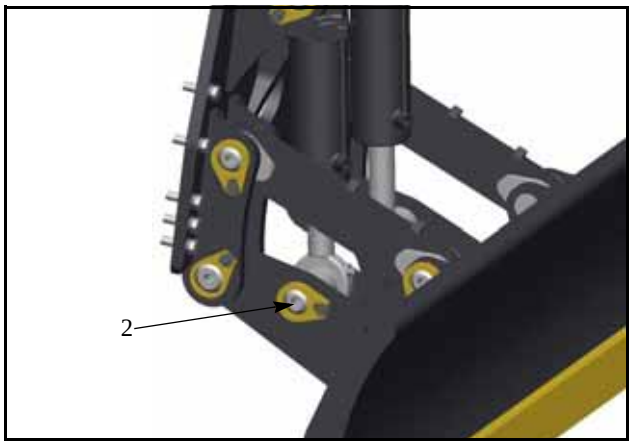
DISASSEMBLY AND ASSEMBLY OF DOZER BLADE

DISASSEMBLY

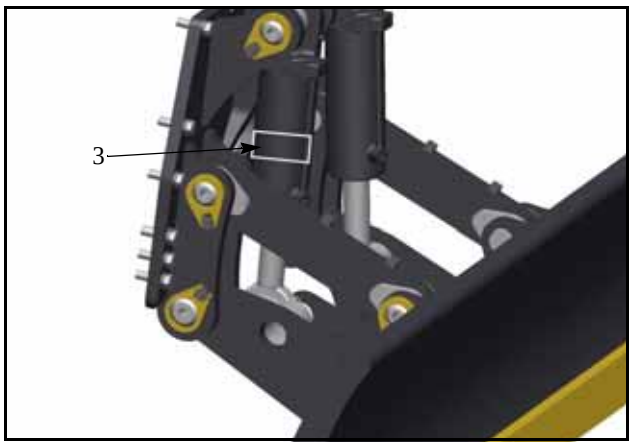
1. Remove plate (1).



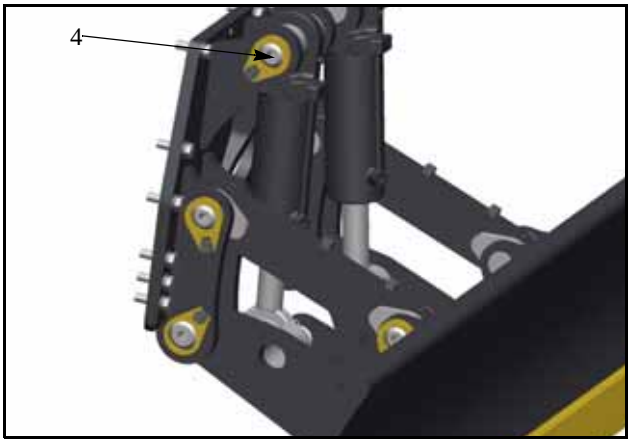
2. Remove pin (2).



3. Attach lifting tackle to cylinder at location (3).



4. Remove pin (4).



5. Slowly sling cylinder and remove from dozer.

ASSEMBLY

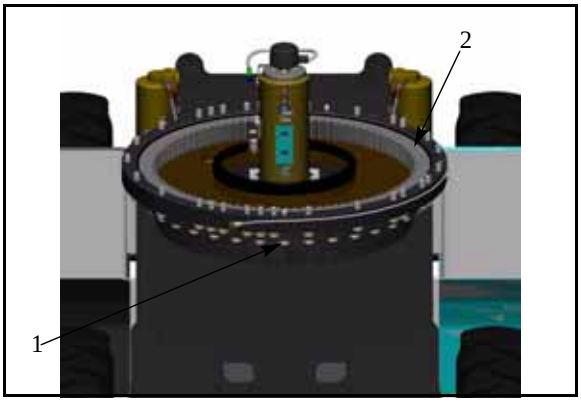
- Install in reverse order of removal.
- Grease all pins and cylinders before installing.
- Grease bearing points after assembly.

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:

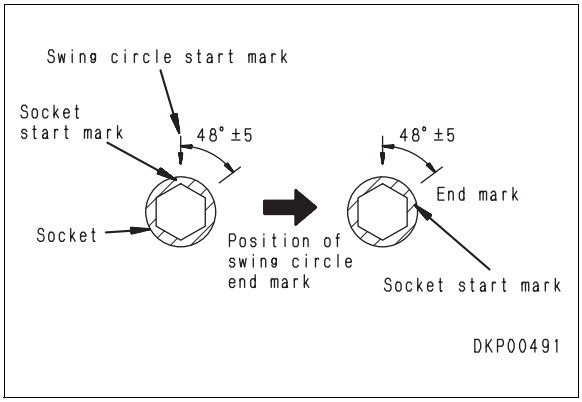
1st pass:

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

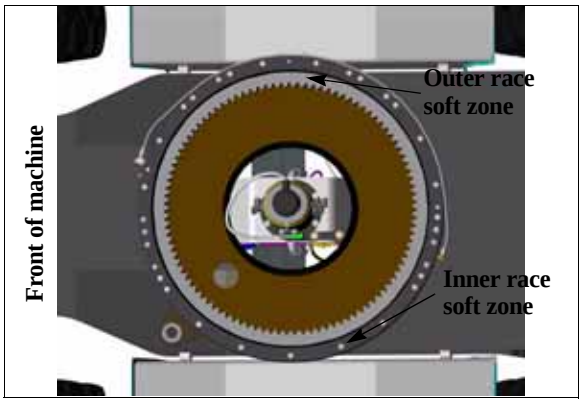


※2

★ 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

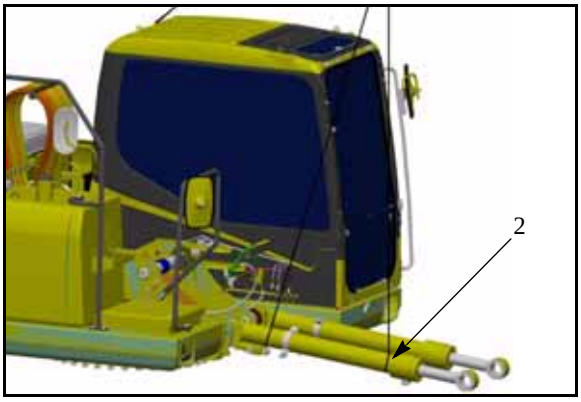
⚠ WARNING

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. Remove oil from hydraulic tank.
2. Remove work equipment. See “MONOBOOM WORK EQUIPMENT ASSEMBLY” on page 20-234.
3. Remove the counter weight. See “COUNTER-WEIGHT ASSEMBLY” on page 20-244.
4. Disconnect boom cylinder hoses (1) and plug the hoses to prevent flow of oil.



5. Sling boom cylinders (2).



6. Remove plate (3) and pin (4) and lift off boom cylinder assembly (2) to remove it.

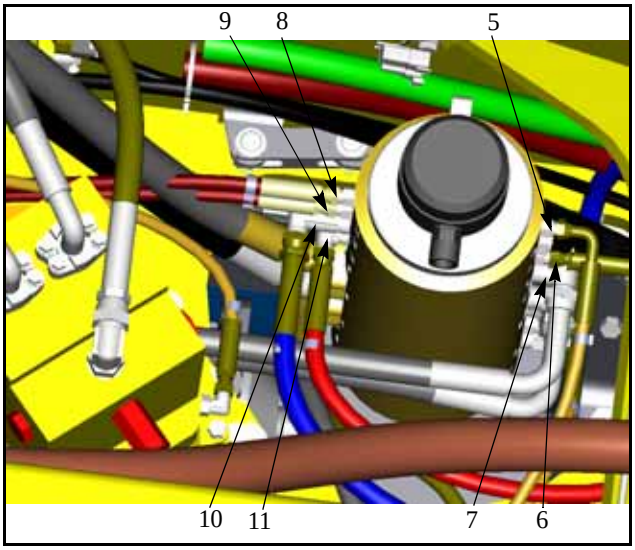
★ Remove the boom cylinder assembly on the opposite side in the same manner.

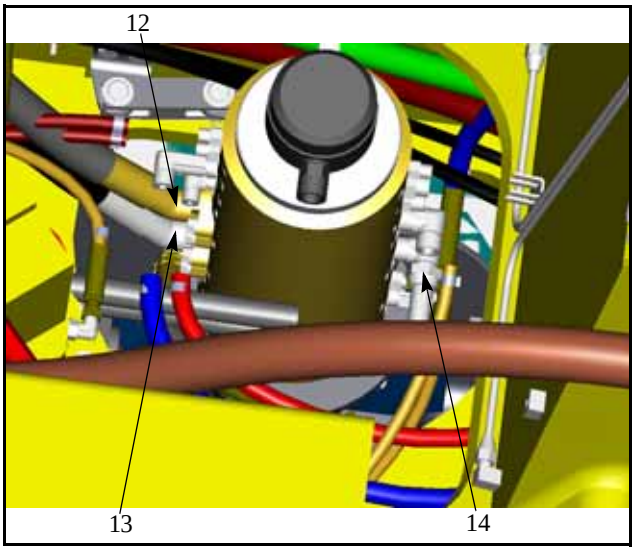
kg Boom cylinder assembly: 180 kg

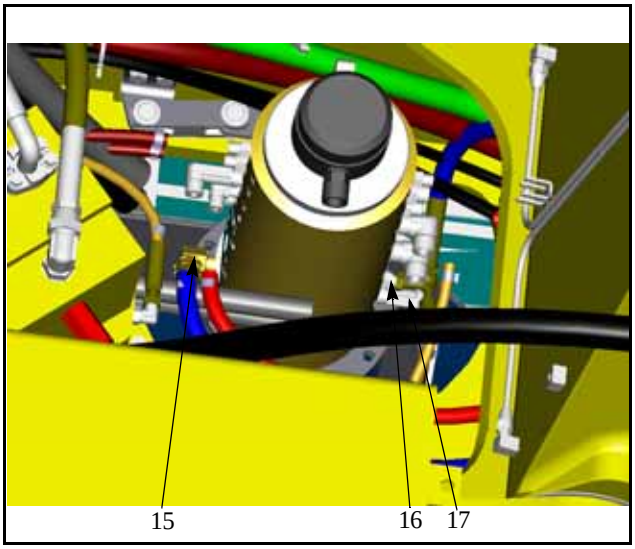


7. Disconnect the 14 hoses on the swivel joint assembly at the swivel joint side.

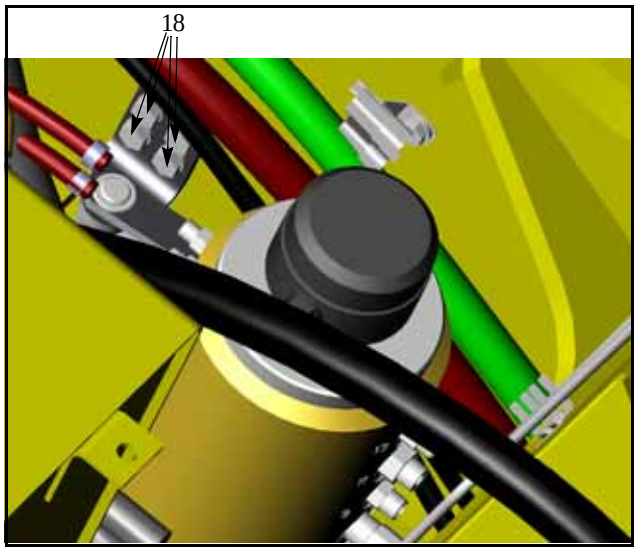
(5): Suspension lock
(6): Brake 2
(7): Attachment bottom
(8): 2nd clutch
(9): 1st clutch
(10): Steer right
(11): Brake 1
(12): Travel B
(13): Travel A
(14): Attachment Head
(15): Drain
(16): Motor volume pilot
(17): Steer left



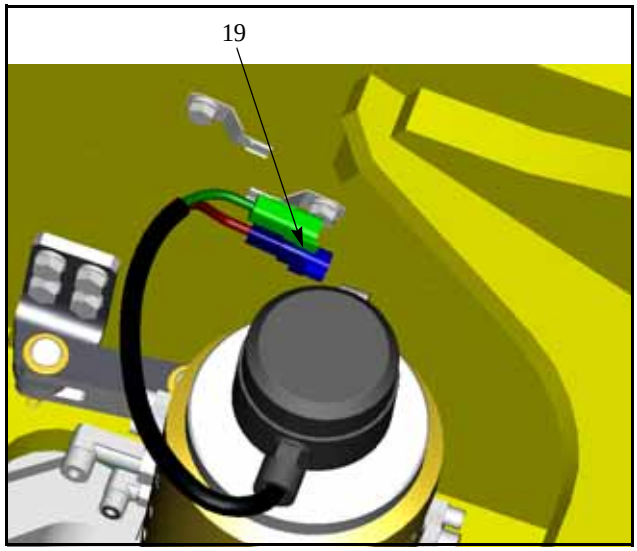




8. Remove 4 bolts (18) from revolving frame.



9. Disconnect connector (19).

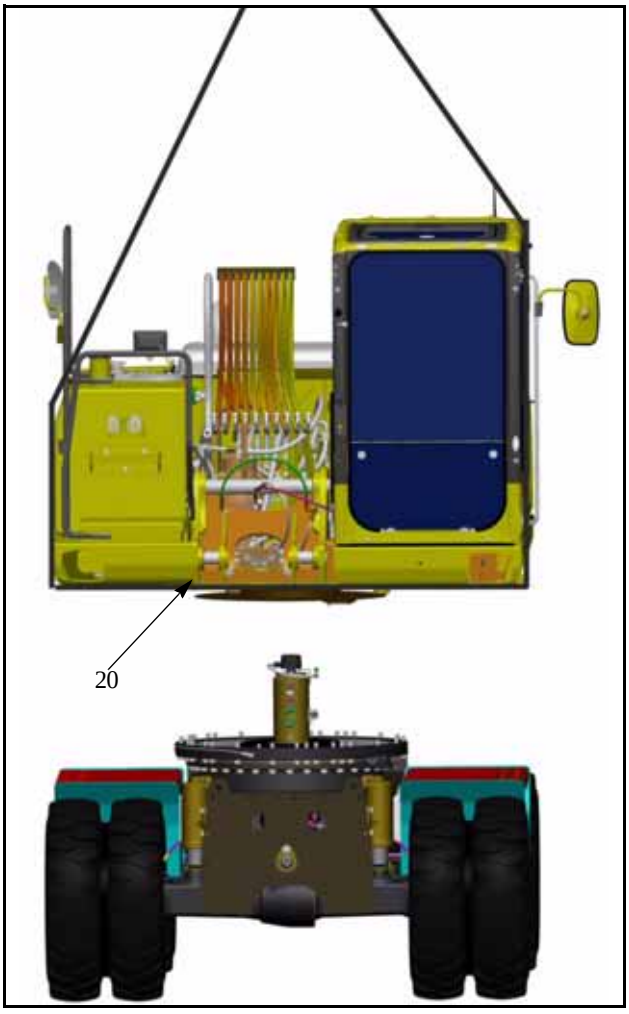


10. Remove the 32 revolving frame mounting bolts and remove revolving frame assembly (20) by lifting it off. ※2

★ 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)
PW160-7	6,052 kg	2,070 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

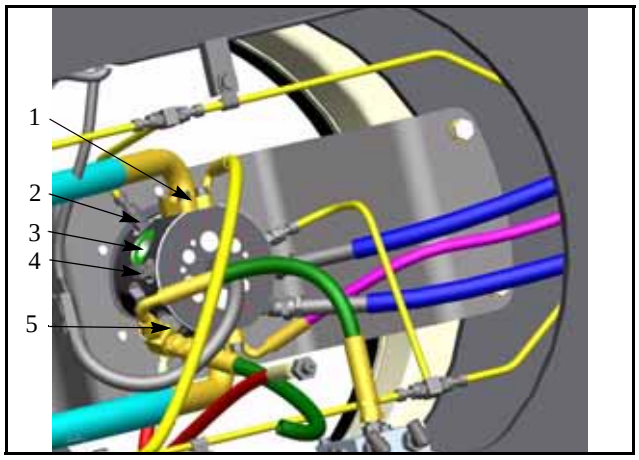
⚠ WARNING

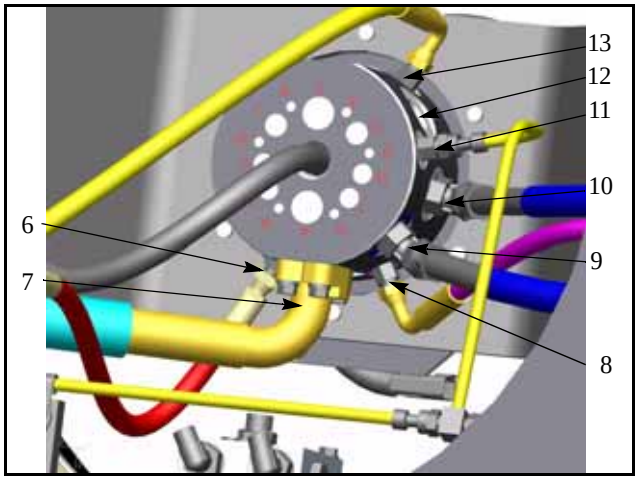
Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, release of remaining pressure in hydraulic circuit.

1. Remove oil from hydraulic tank and drain oil from system.

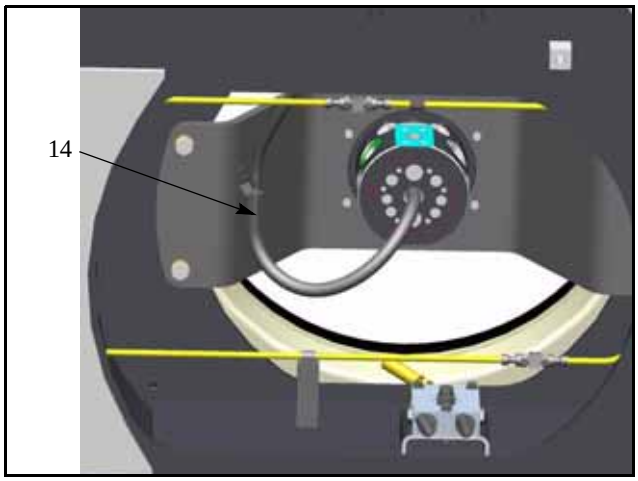
2. Disconnect 14 hoses (1) through (14).
   ★ When removing hoses mark all hoses with tags to prevent mistakes when installing.

- (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





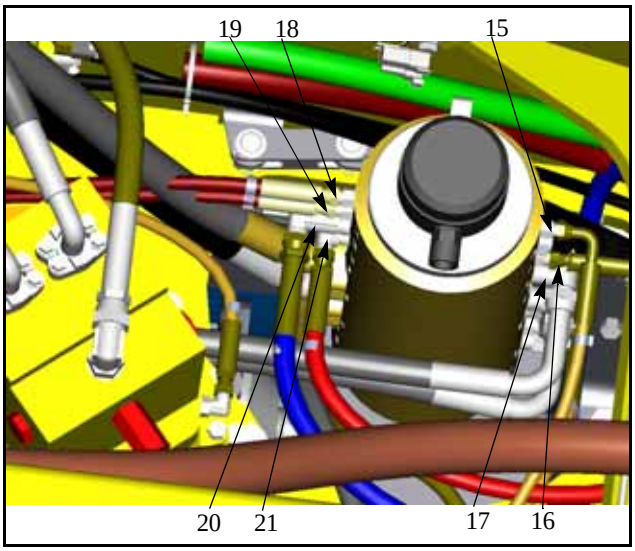
3. Disconnect connector (14)

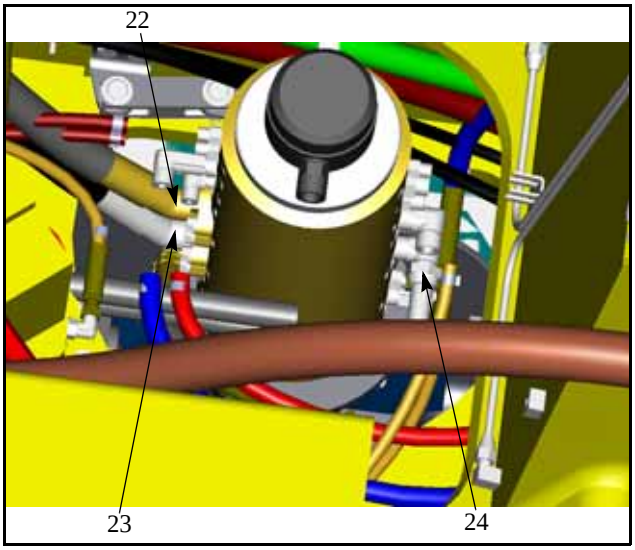


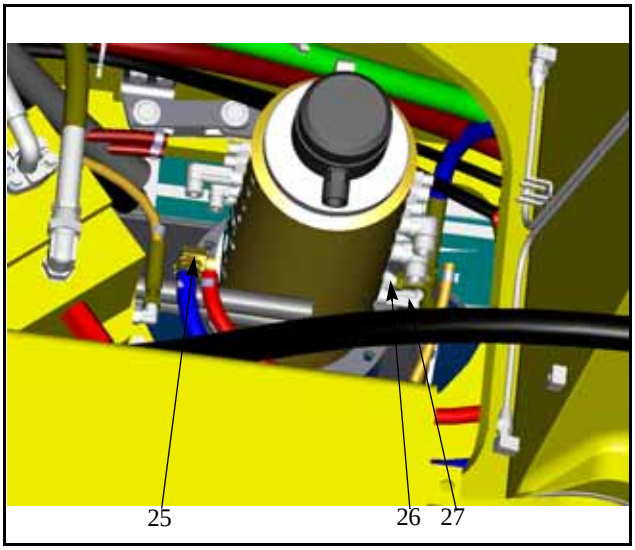
4. Disconnect 14 hoses (15) through (27).

- (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

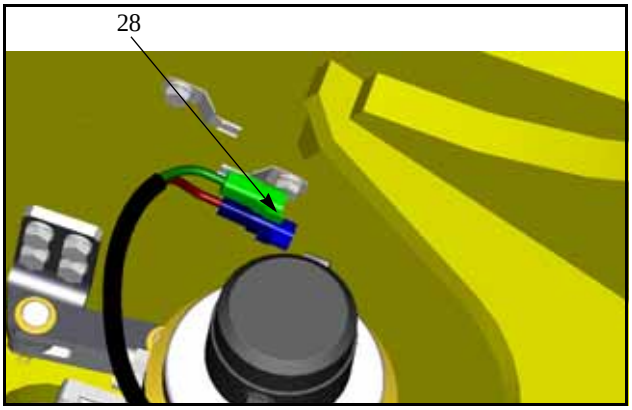
- (27): Steer left



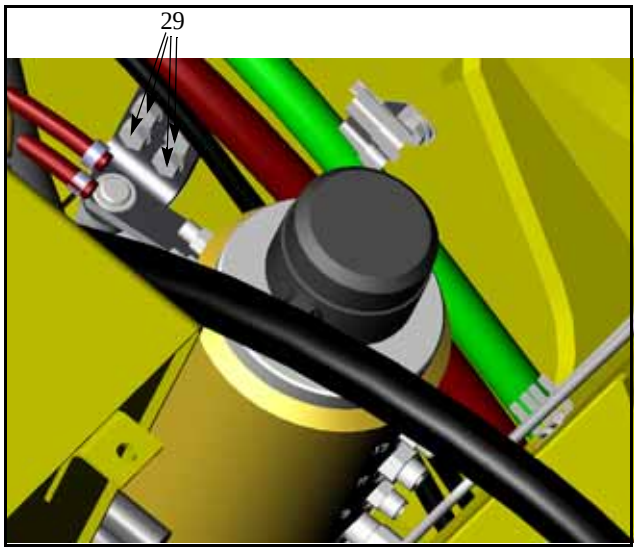




5. Disconnect connector (28).



6. Remove 4 bolts attached to revolving frame (29).



7. Remove 4 of the 6 mounting bolts (30).



8. Sling centre swivel joint then remove 2 remaining mounting bolts (30) and remove.

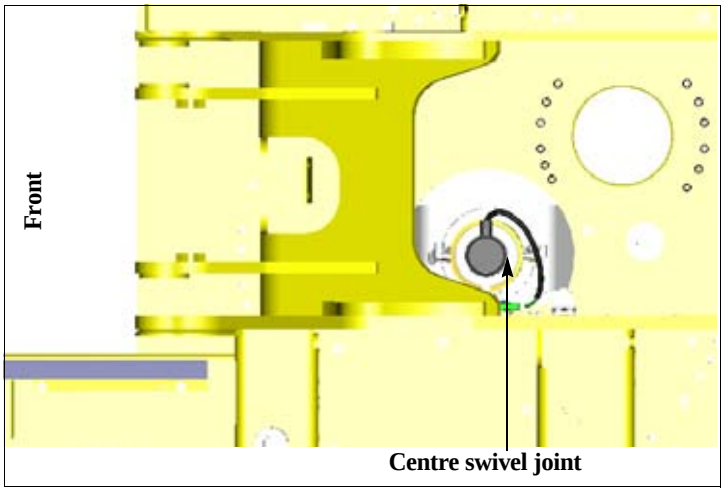
kg Centre swivel joint assembly: **95 kg**

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

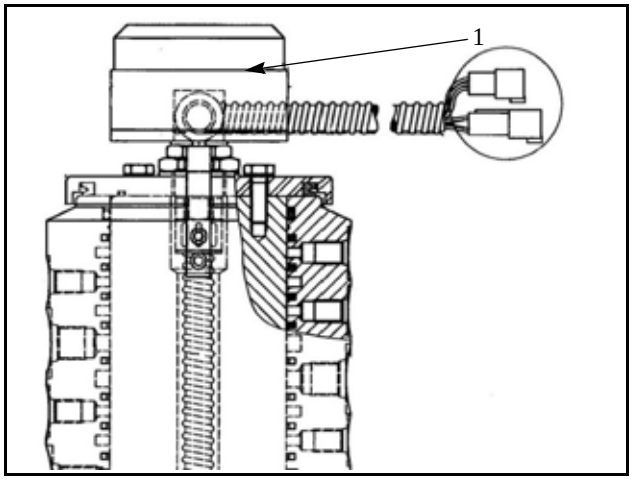
SPECIAL TOOLS

Mark	Part No.	Part Name	Necessity	Qty	Distinction*	Sketch
E	790-101-2501	Push puller	1	1		
	• 790-101-2510	• Block		1		
	• 790-101-2520	• Screw		1		
	• 791-112-1180	• Nut		1		
	• 790-101-2540	• Washer		1		
	• 790-101-2630	• Leg		2		
	• 790-101-2570	• Plate		4		
	• 790-101-2560	• Nut		2		
	• 790-101-2650	• Adapter		2		

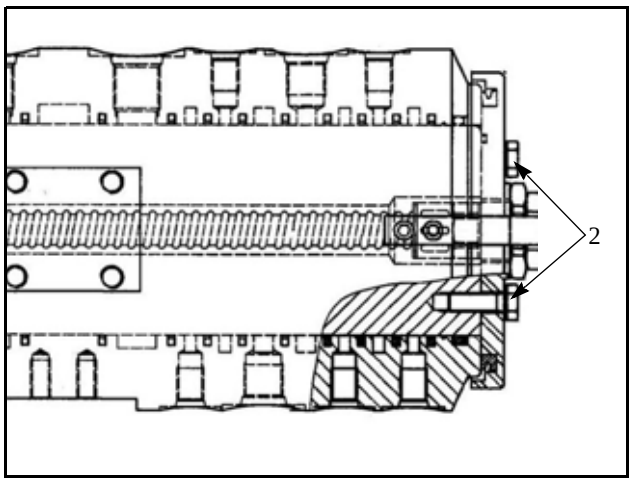
*Distinction between new and existing part.

DISASSEMBLY

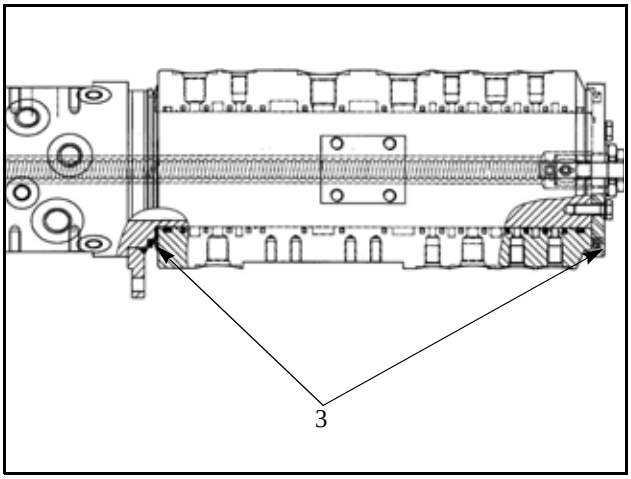
1. Remove the electric slipring (1) on the enclosure flange.



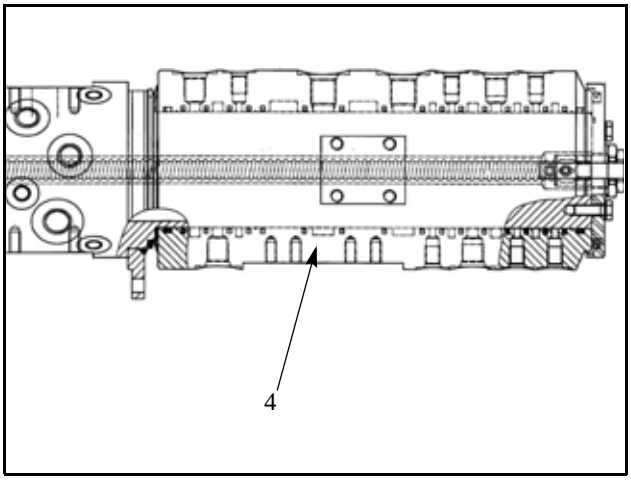
2. Remove all 4 screws (2) TE M10 x 30 on enclosure flange.



3. Remove the end cover and protection seal (3) VA130.

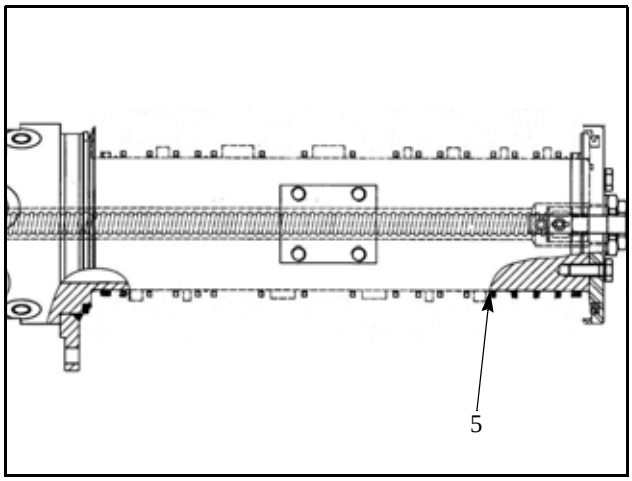


4. Remove housing (4) with appropiate tools.

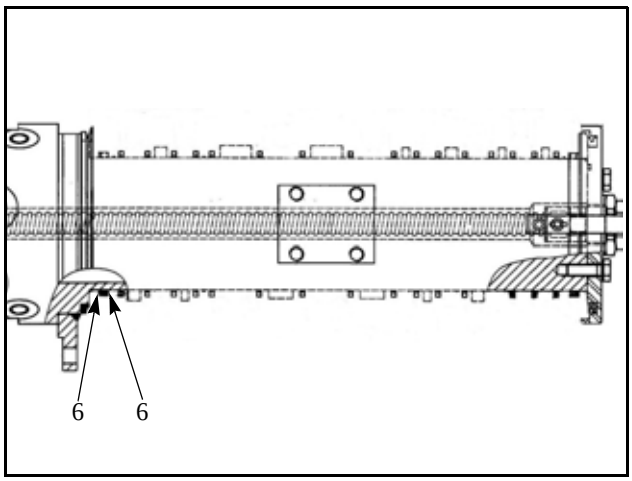


5. Prevent any possibility of damage on chromium plated surface of spool.

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.
- Clean all surfaces before assembly.
- Grease shaft before assembly.

Contact surface of rotor, shaft:
Grease (G2-L1)

Mounting bolt: **31.4 ± 2.9 Nm**
{3.2 ± 0.3 kgm)

REMOVAL AND INSTALLATION OF HYDRAULIC TANK ASSEMBLY

REMOVAL

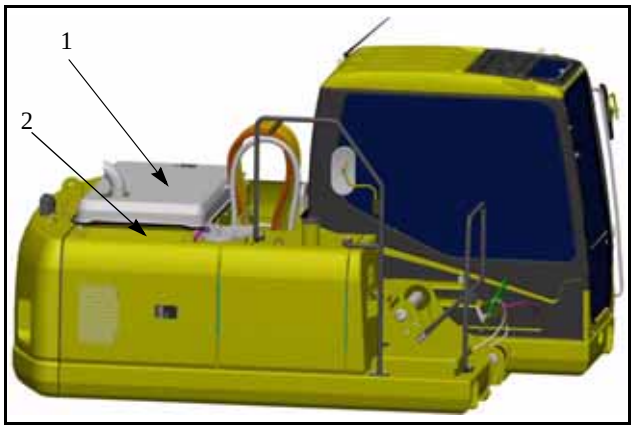
1. Drain oil from hydraulic tank.



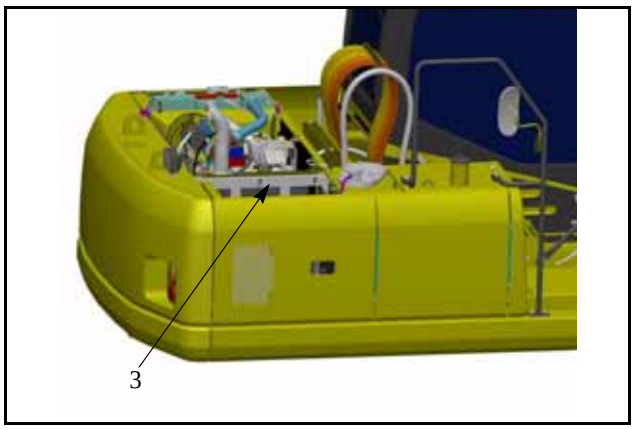


Hydraulic oil: 167L

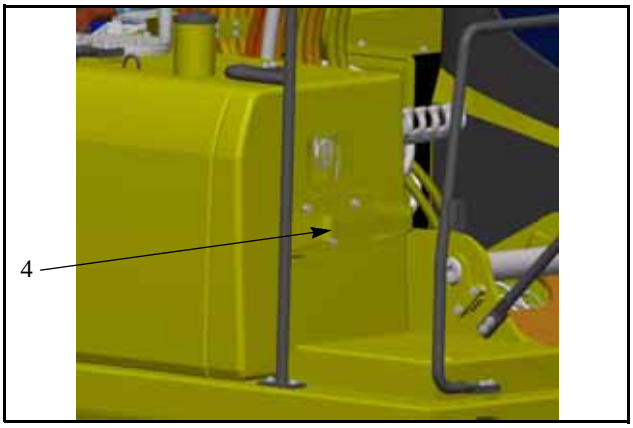
2. Open up the engine hood.
3. Remove engine hood (1) (see page 30- 46) and cover (2).



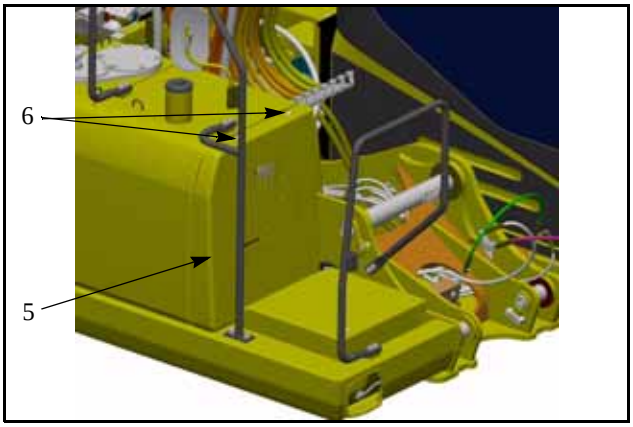
4. Remove support (3).



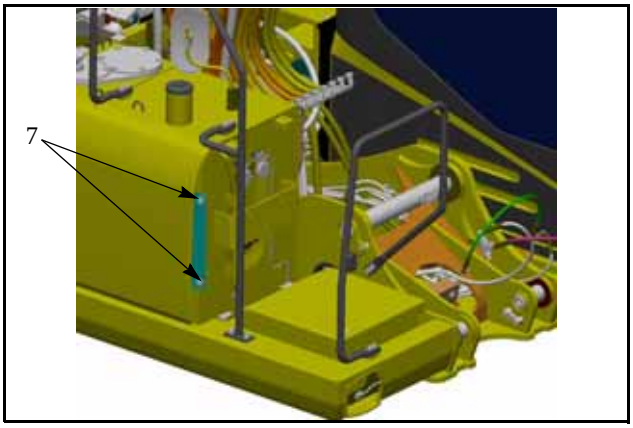
5. Remove step (4).



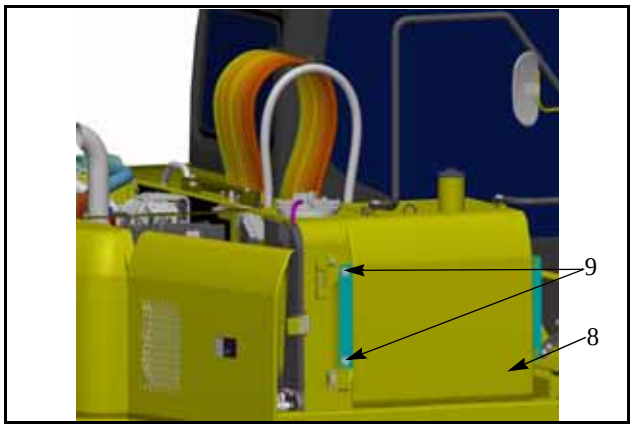
6. Remove cover (5) by removing 2 bolts (6).



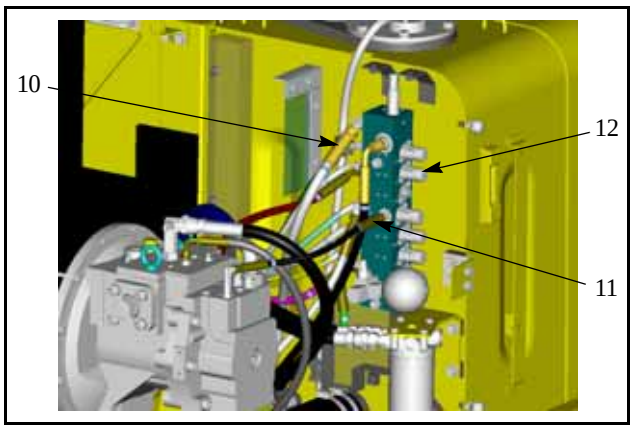
7. Remove bolts (7).



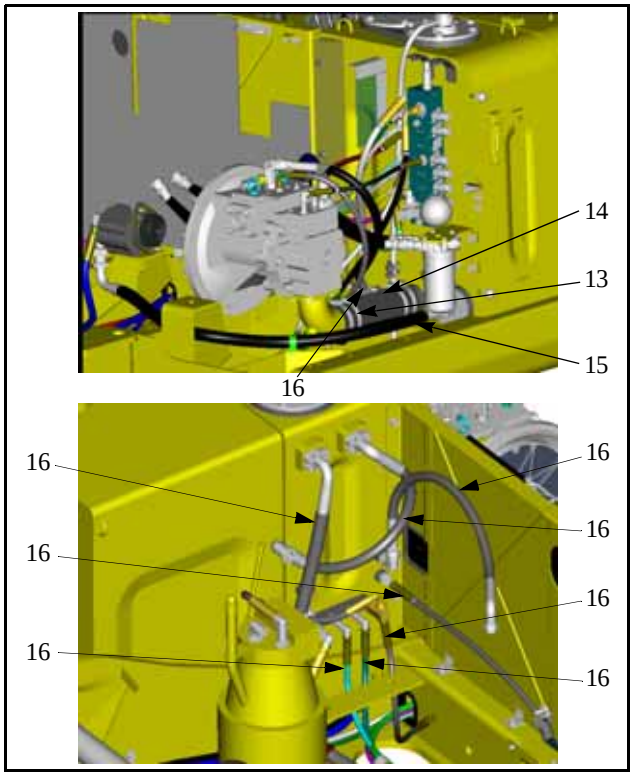
8. To remove cover (8) remove bolts (9).



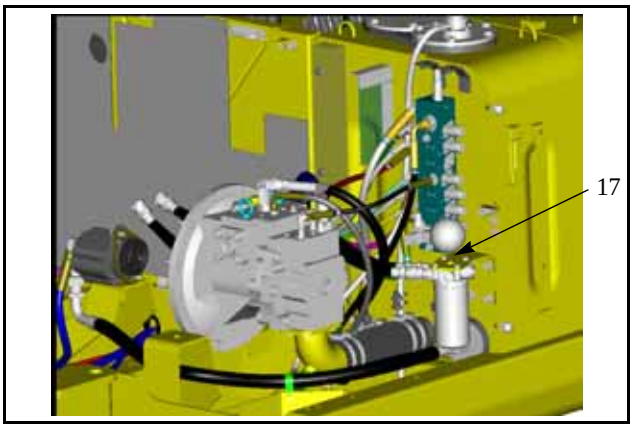
9. Disconnect all the hoses and connectors at points (10, 11, 12).



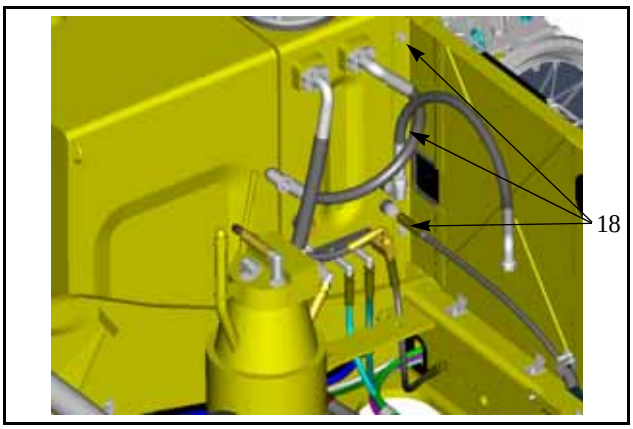
10. Remove the four jubilee clips (13), then remove hoses (14), (15), (16). Ensure all hoses are disconnected.



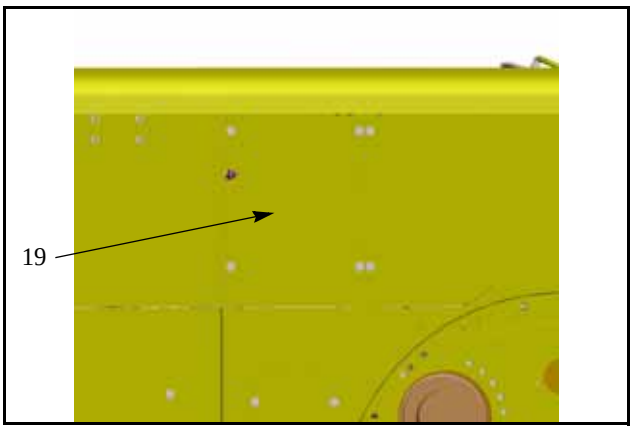
11. Remove the remote oil filter bracket (17).



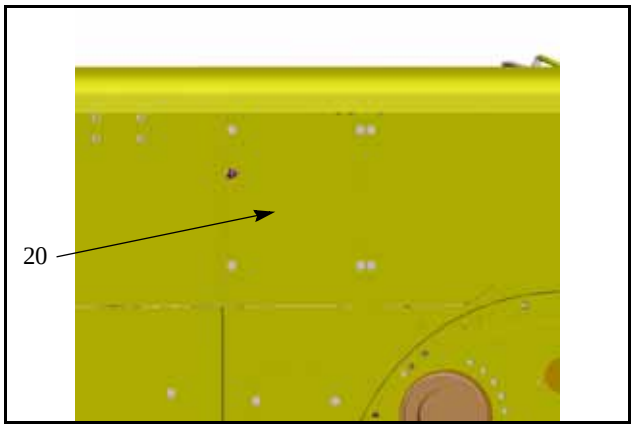
12. Remove bolts to detach the hydraulic tank from the centre frame (18).



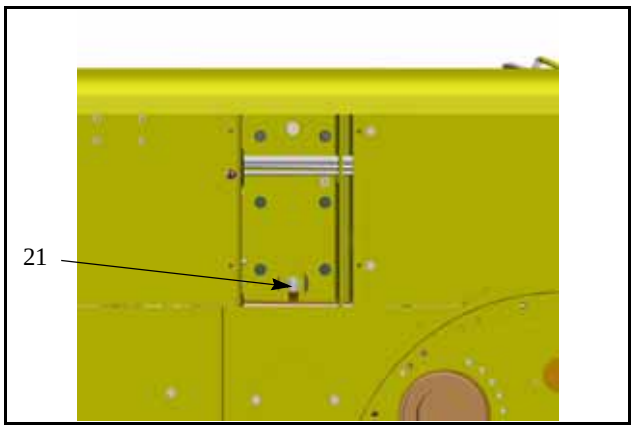
13. Remove cover (19).



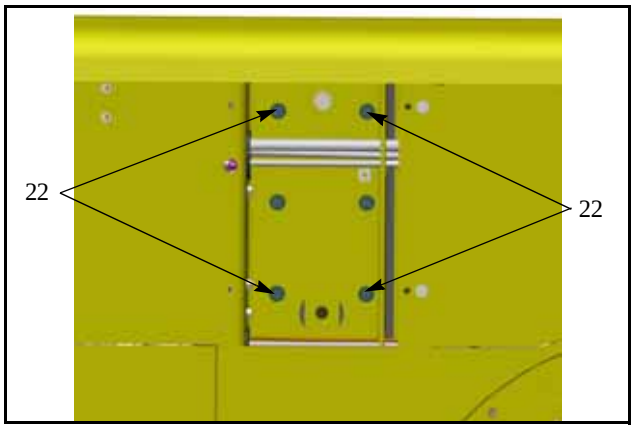
14. Remove cover (20).



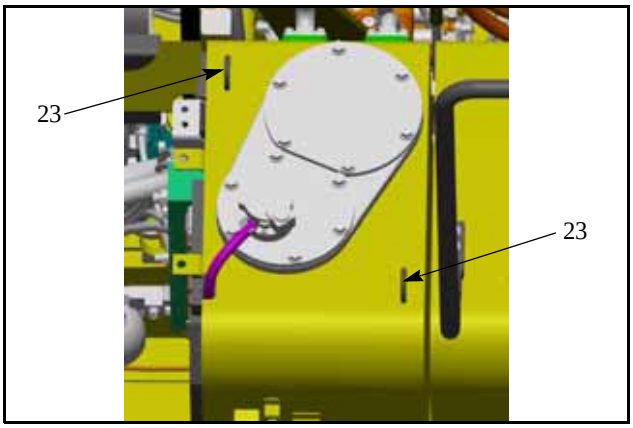
15. Disconnect hose (21).



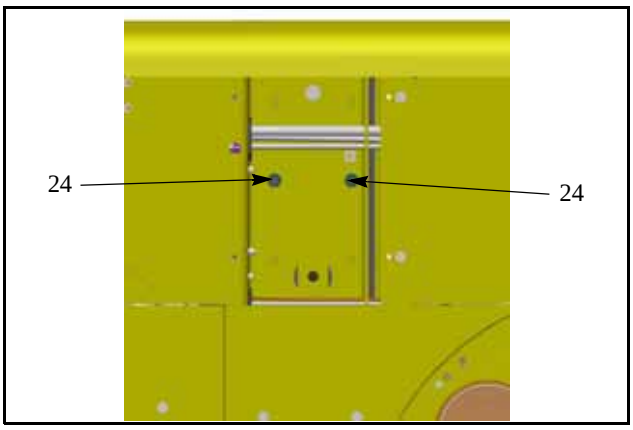
16. Remove 4 of 6 mounting bolts (22)



17. Sling at points (23).



18. Remove remaining 2 mounting bolts (24).



19. Remove hydraulic tank.

kg Hydraulic tank assembly: 124 kg

INSTALLATION

- Install in reverse order of removal.

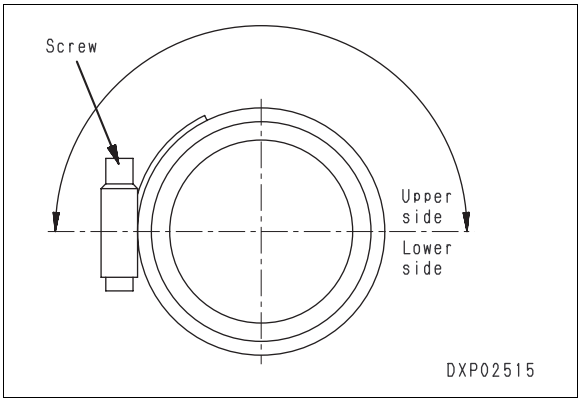
※1

Hydraulic tank drain plug:
58.8 - 78.5 Nm {6.0 - 8.0 kgm}

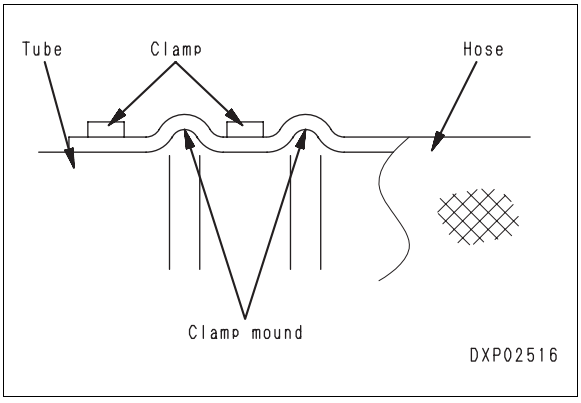
※2

★ 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.



※3

Hose clamp screw:
245.2 - 308.9 Nm {25 - 31.5 kgm}

- Refilling with oil (hydraulic tank)
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

Hydraulic tank: **Approx. 167L**

- Bleeding air
  ★ Bleed the air.
  For details, see TESTING AND ADJUSTING. Air Bleeding of Various Parts.

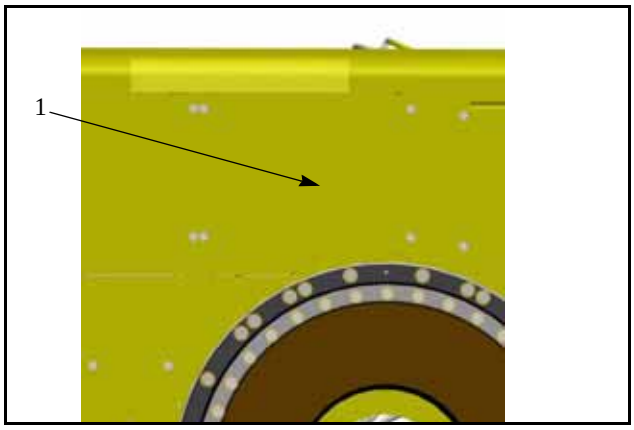
REMOVAL AND INSTALLATION OF FUEL TANK

REMOVAL

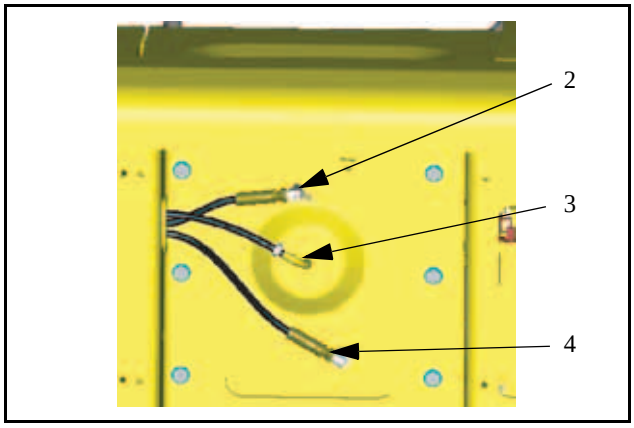
1. Empty fuel tank.

Fuel Tank: 290 L

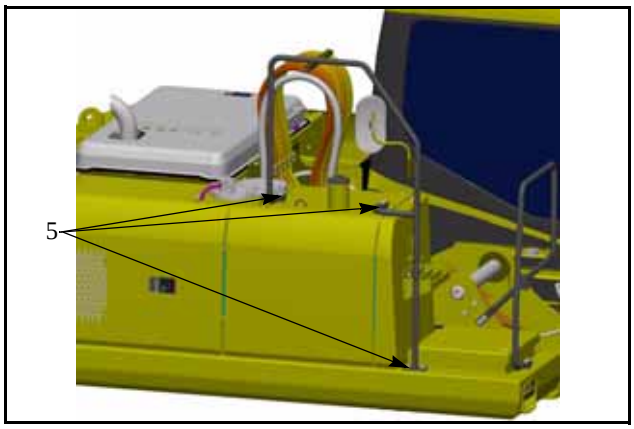
2. Remove cover (1).



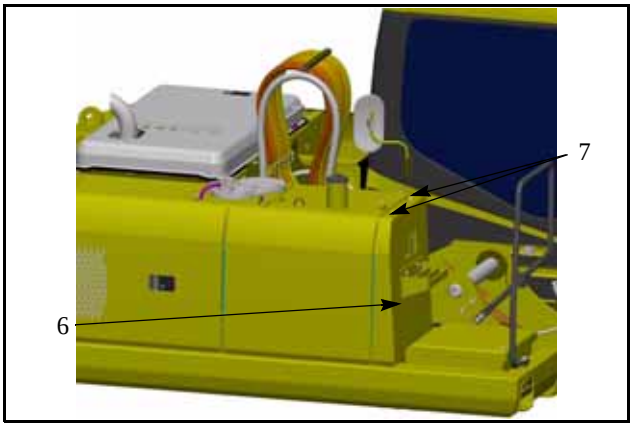
3. Disconnect hoses (2), (3) and (4).



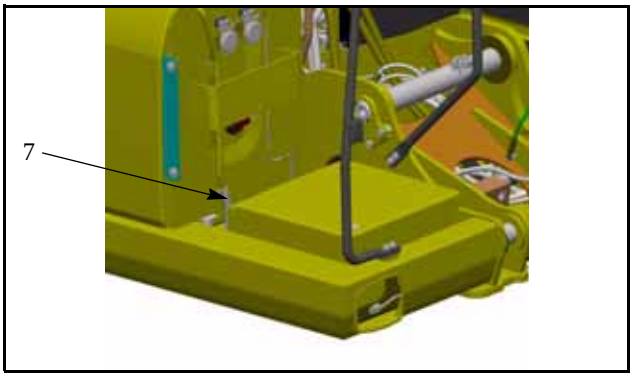
4. Remove handrail at points (5).



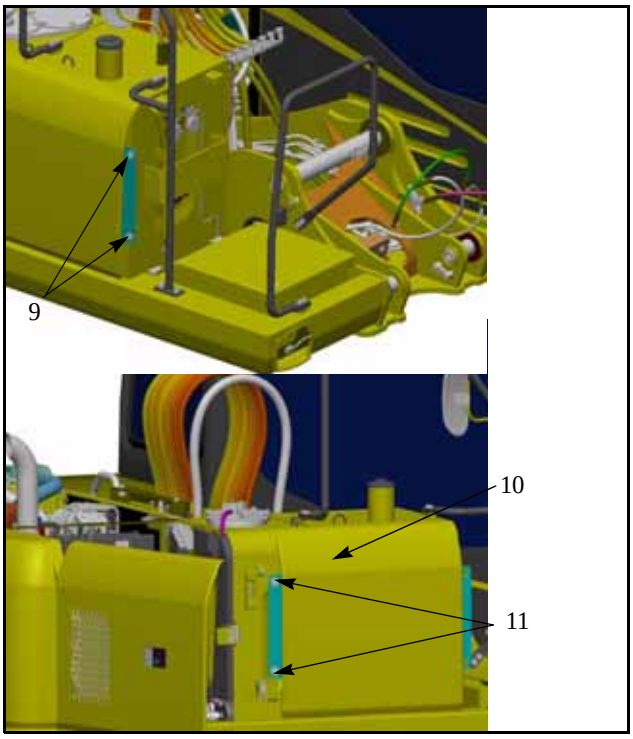
5. Remove cover (6) by removing bolts (7).



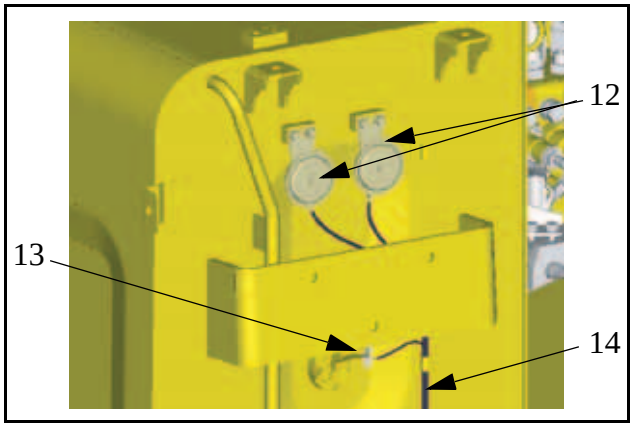
6. Remove hose (8).



7. Remove cover (10) by first removing 2 bolts (9) and then removing bolts (11).



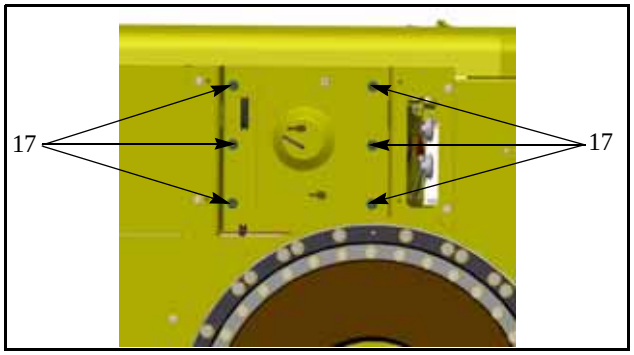
8. Disconnect horns (12) by disconnecting spade connectors. Disconnect the fuel sensor (13) and unclip cable (14).



9. Sling at points (15) and (16).



10. Remove 6 mounting bolts (17).



11. Remove fuel tank.

kg Fuel tank assembly: **120 kg**

INSTALLATION

- Install in reverse order of removal.
- Refilling with fuel (fuel tank)

★ Add fuel through the fuel filler to the specified level.

Fuel tank: **Approx. 290 L**

REMOVAL AND INSTALLATION OF CONTROL VALVE

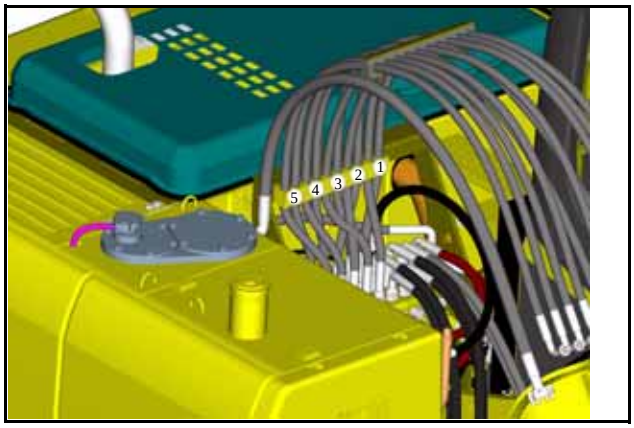
REMOVAL

⚠ WARNING

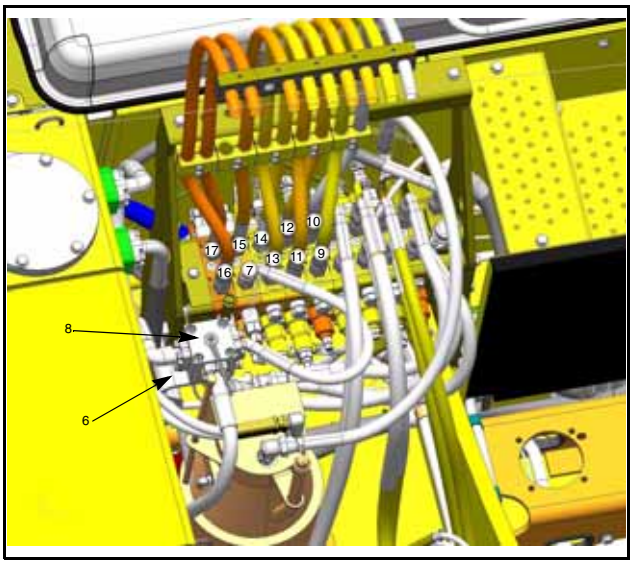
Lower the work equipment to the ground for safety and stop the engine. Unscrew the oil filler cap on the hydraulic tank slowly to release pressure inside the tank. Then move the safety lock lever to the LOCK position.

★ 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, including back block (1, 2, 3, 4 and 5 if fitted).

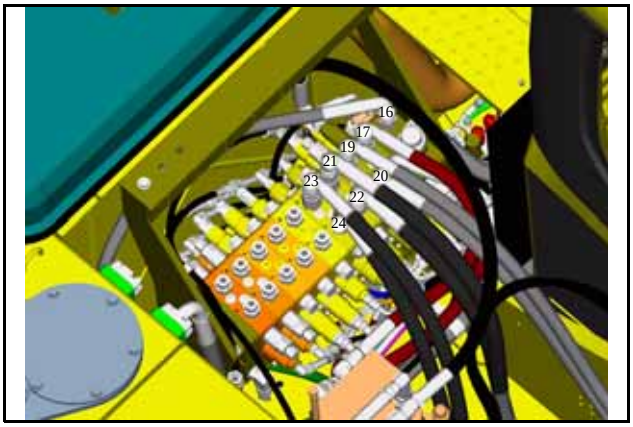


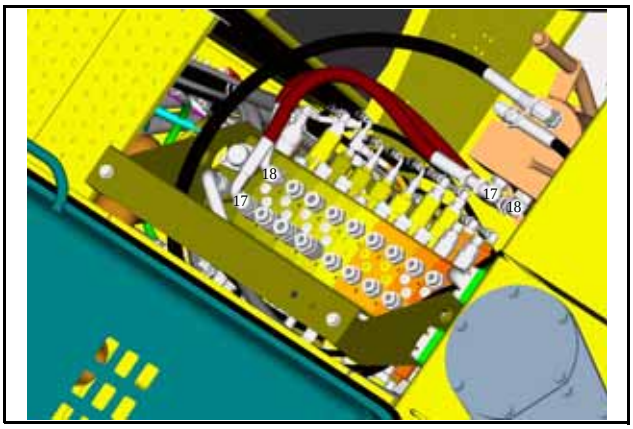
5. Disconnect bracket (6) and hose (7) from control valve from and move valve (8) away from working area.
6. Disconnect hoses (9 through 14, also 15 through 17 if fitted).



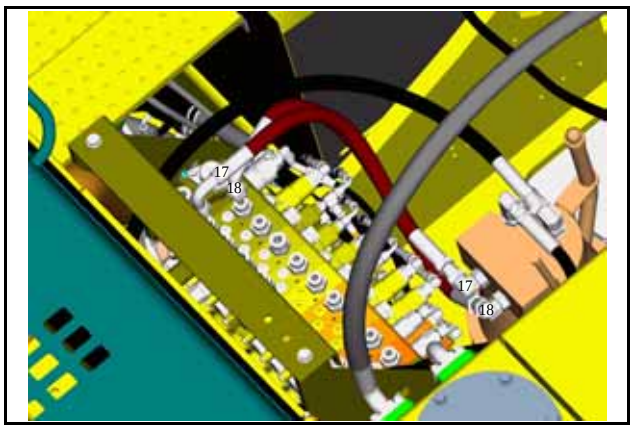
Note: Valve (8) is not shown in the following images to enhance image clarity.

7. Disconnect hoses (16 through 24) from top of control valve.

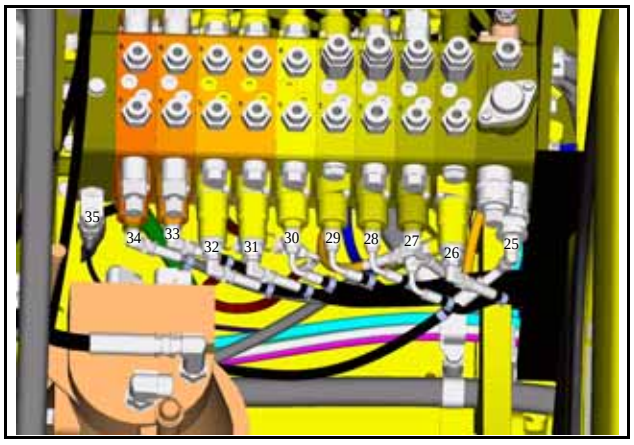




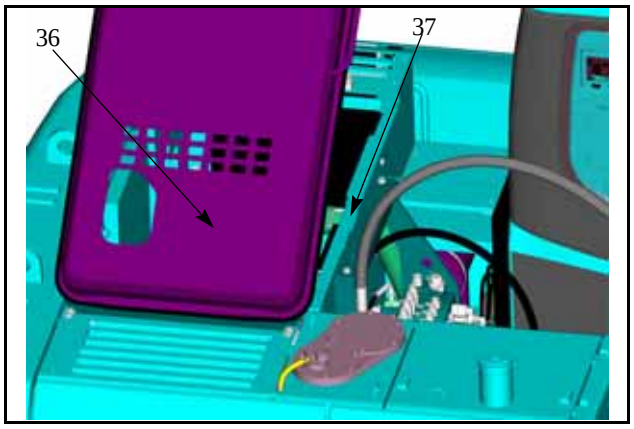
8. Also disconnect hoses 17 and 18 from swing machinery to aid removal of control valve and improve accessibility.



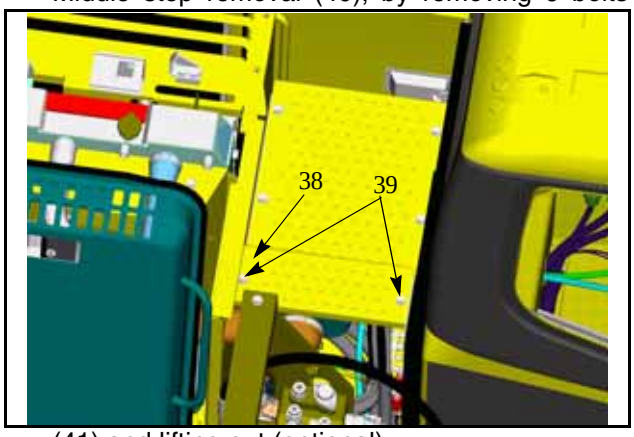
9. Disconnect hoses (25 through 32, also 33 and 34 if fitted). Also disconnect electrical connector (35).



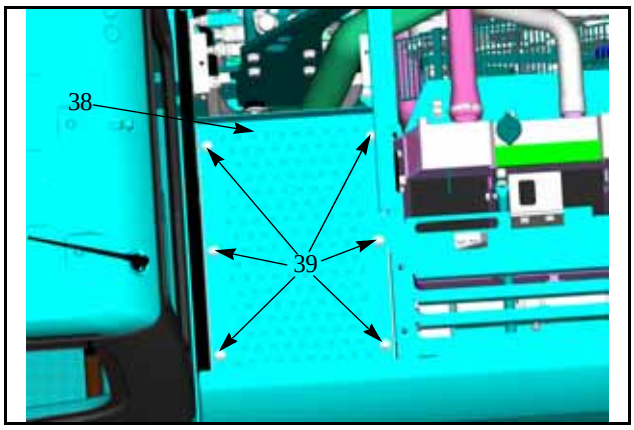
10. Open hood (36) and remove centre partition (37).



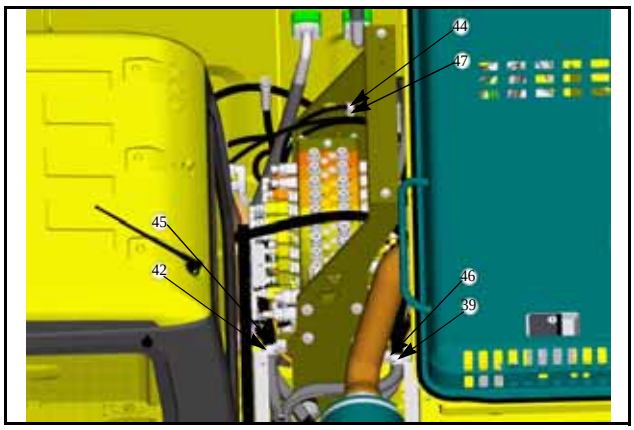
11. Step removal. Remove top step (38), by removing 2 bolts (39) and lifting step out.
    Middle step removal (40), by removing 6 bolts



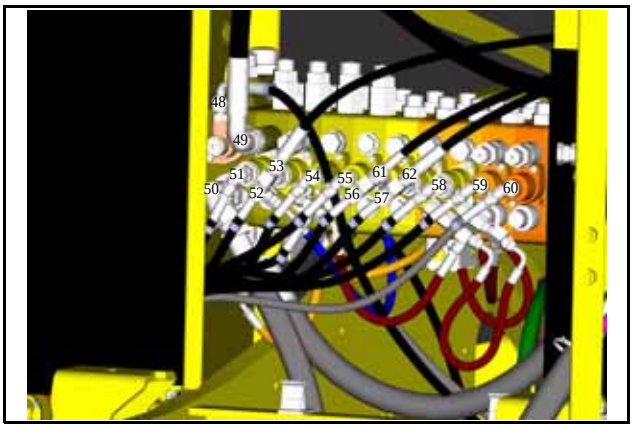
    (41) and lifting out (optional).



12. Remove clips (42, 43 and 44), by removing retaining bolts (45, 46 and 47).



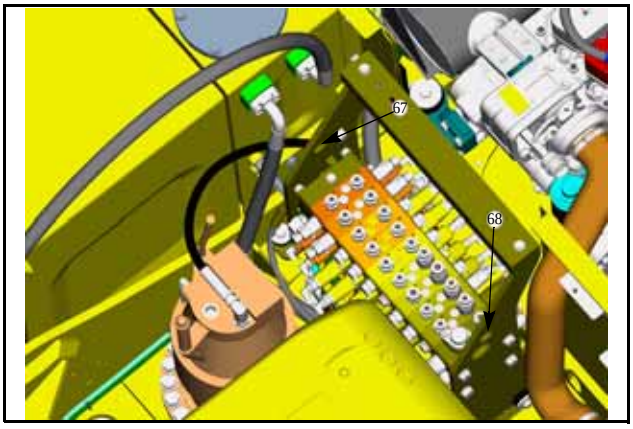
13. Disconnect hoses (48 through 58, also 59, 60, 61 and 62 if fitted).



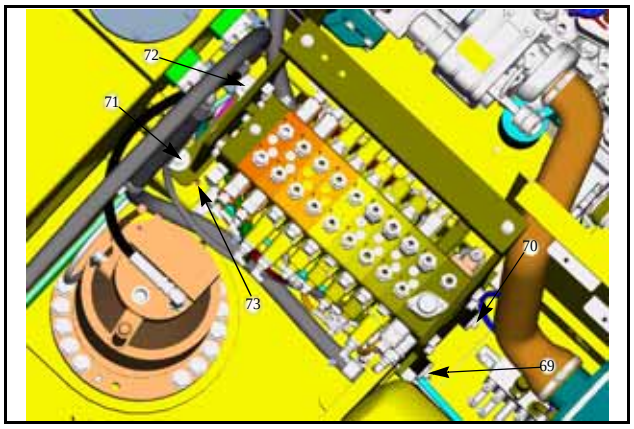
14. Disconnect hoses (63 through 66).



15. Attach lifting shackles to points indicated (67 and 68).

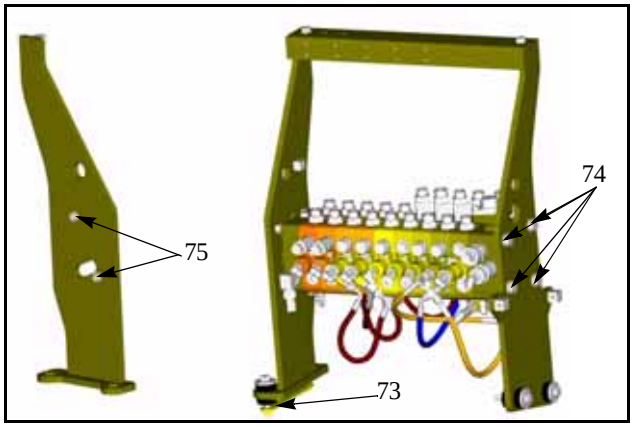


16. Slacken bolts indicated (69 through 72), then sling/support weight of the control valve.



17. Remove bolts and lift control valve clear. Retrieve retaining plate (73).

18. To remove the control valve from bracket remove bolts (74 and 75).



kg Control valve assembly: 117 kg

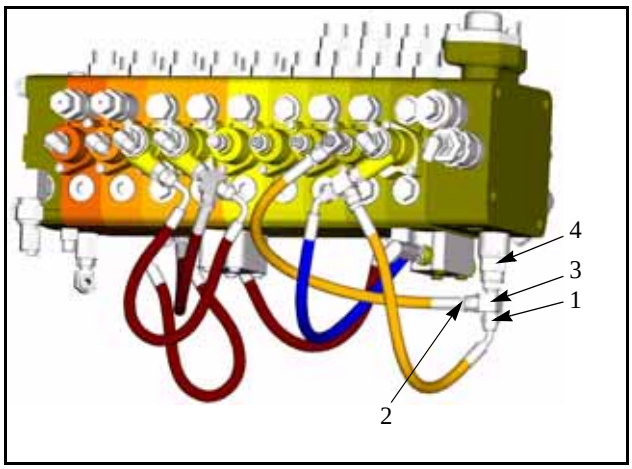
INSTALLATION

- 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.



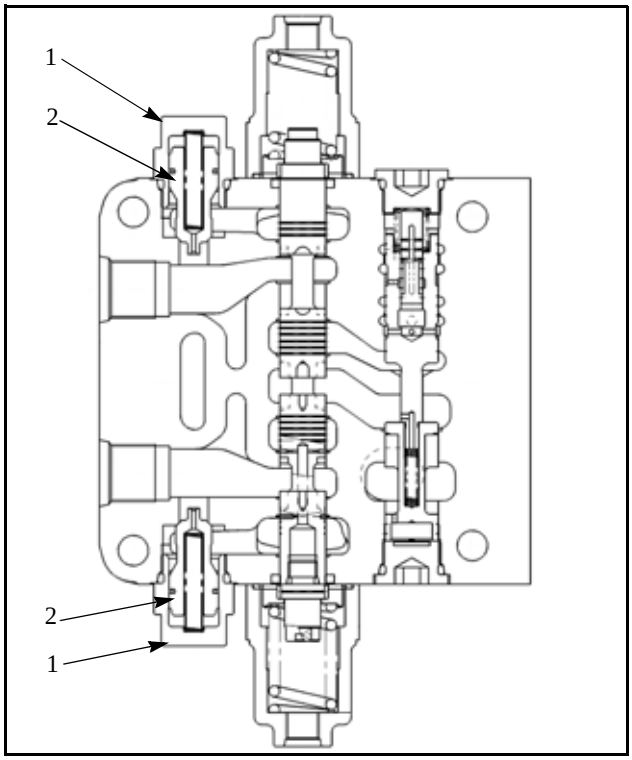
INSTALLATION

- Install in reverse order of removal.
- Tightening torque for 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).



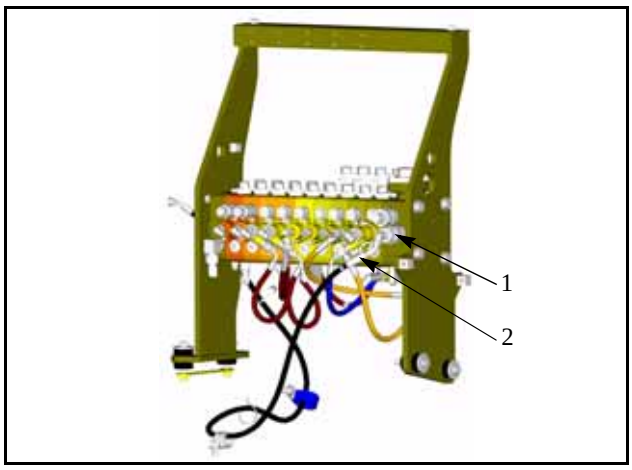
INSTALLATION

- Install in reverse order of removal.
- Tightening torque for cap (1) is: 137 - 157Nm.

REMOVAL AND INSTALLATION OF MAIN RELIEF VALVE ASSEMBLY

REMOVAL

1. Remove hose (1).
2. Remove main relief valve (2).



INSTALLATION

- Install in reverse order to removal.
- Tightening torque for main relief valve (2): 88.3 - 107.9Nm.

REMOVAL AND INSTALLATION OF LS CONTROL EPC VALVE ASSEMBLY

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.
- Tightening torque for 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.



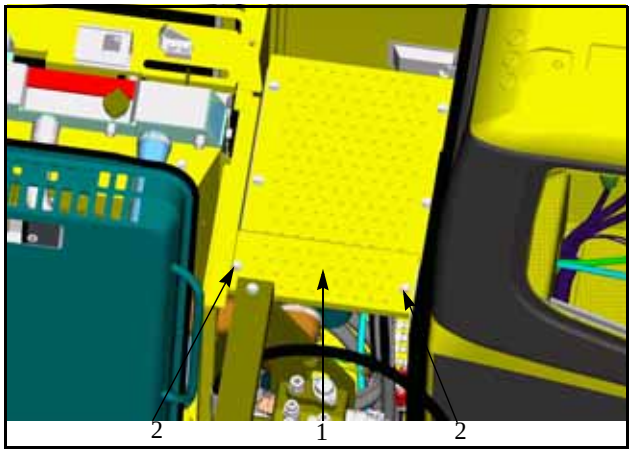
INSTALLATION

- Install in reverse order of removal.
- Tightening torque for EPC solenoid valve bolts (1): 11.8 - 14.7 Nm.

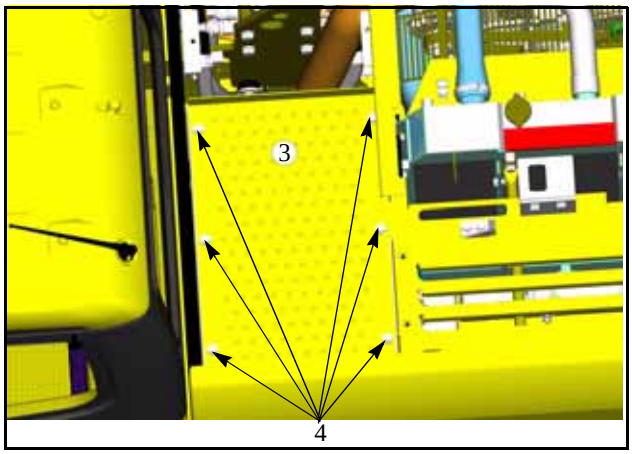
REMOVAL AND INSTALLATION OF 4 STATION PPC SOLENOID VALVE BLOCK ASSEMBLY

REMOVAL

1. Step removal. Remove top step (1), by removing 2 bolts (2) and lifting step out.

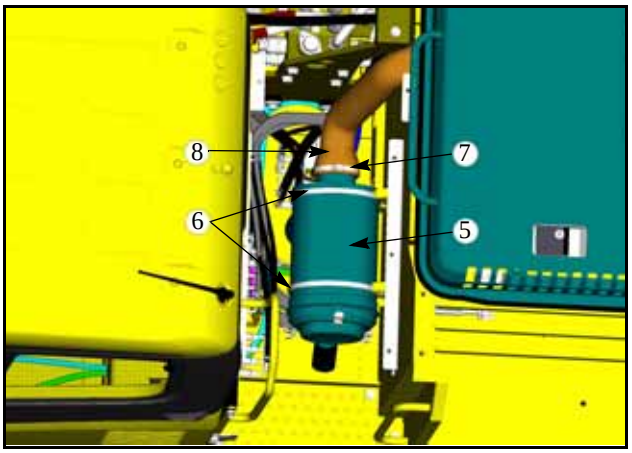


Remove middle step (3), by removing 6 bolts (4) and lifting step out.



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 loosening clips (6 and 7) and disconnecting hose (8). Disconnect electrical connection from the underside air cleaner.

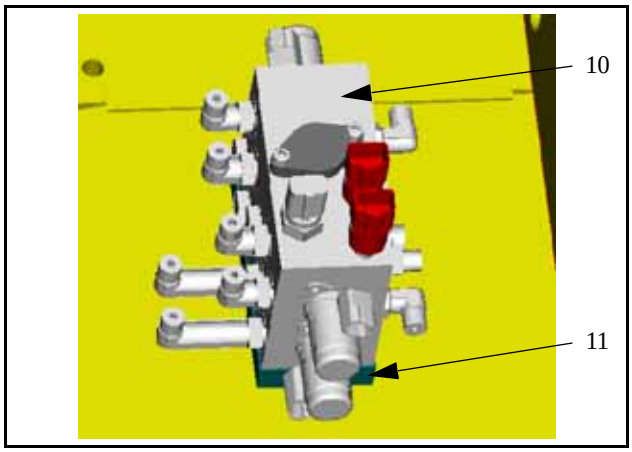


4. Remove all hoses and electrical connections.

5. Remove 4 securing bolts (9).



6. Remove PPC solenoid valve block (10) and spacer block (11).



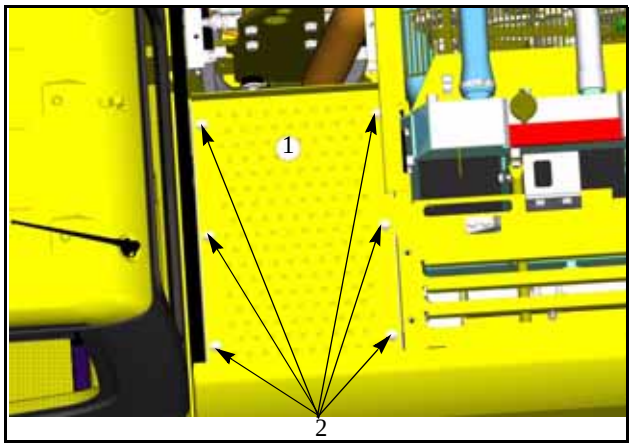
INSTALLATION

- Install in reverse order of removal.

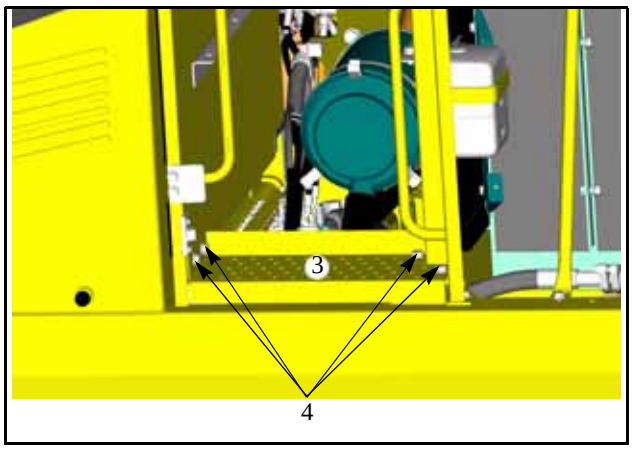
REMOVAL AND INSTALLATION OF MANIFOLD BLOCK

REMOVAL

1. Remove middle step (1), by removing 6 bolts (2) and lifting step out.



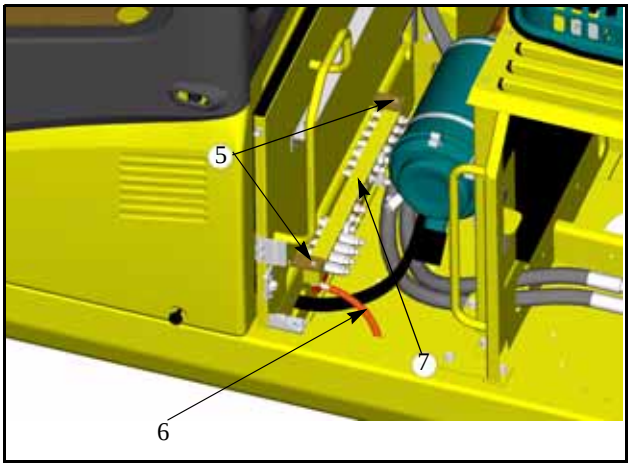
Remove bottom step (3), by removing 4 bolts (4) lifting step out.



2. Attach an identification tag to hoses and electrical connections to avoid incorrect connection during re-assembly.

3. Remove all hoses and electrical connections from manifold block.

4. Remove 2 bolts (5), disconnect earth strap (6) and remove manifold block (7).



INSTALLATION

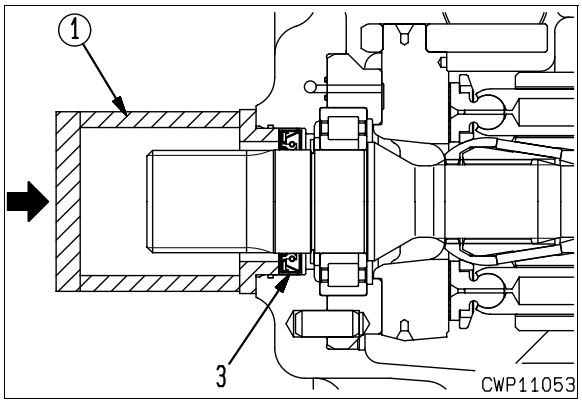
- Install in reverse order of removal.

REMOVAL AND INSTALLATION OF OIL SEAL IN HYDRAULIC PUMP INPUT SHAFT

SPECIAL TOOLS

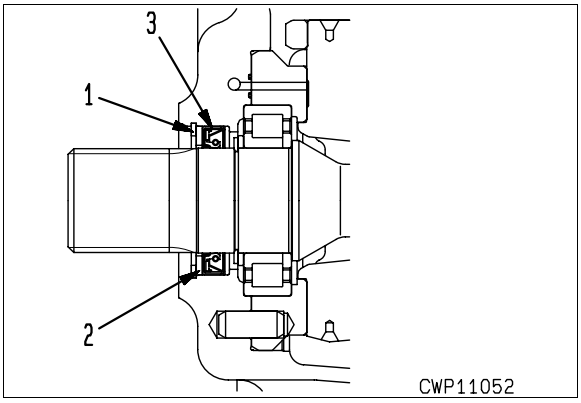
Mark	Part No.	Part Name	Necessity	Qty	Distinction*	Sketch
N	790-201-2000	Push tool	n	1		
	790-201-2740	Spacer	n	1		

*Distinction between new and existing part.



REMOVAL

1. Remove the hydraulic pump assembly. Refer to “ENGINE AND HYDRAULIC PUMP ASSEMBLIES -20 -46
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

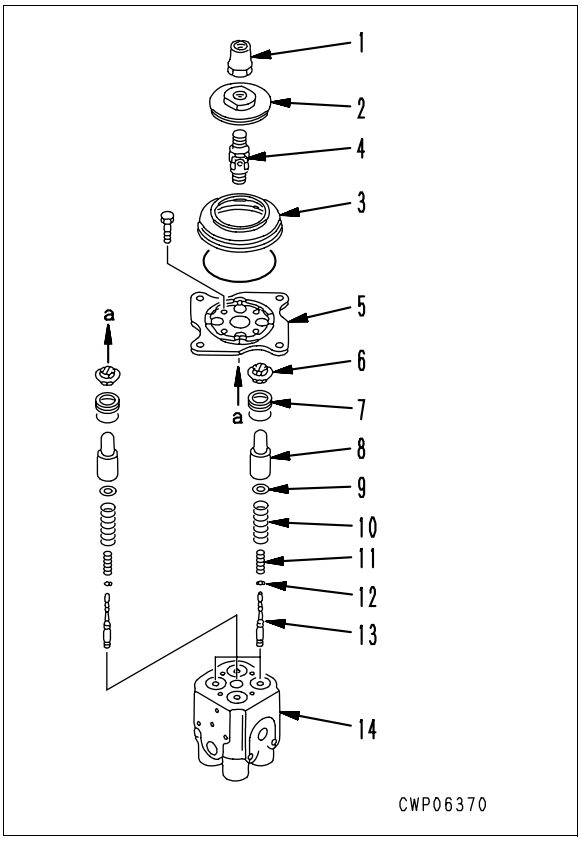
Oil seal lip portion: Grease (G2-LI)

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)

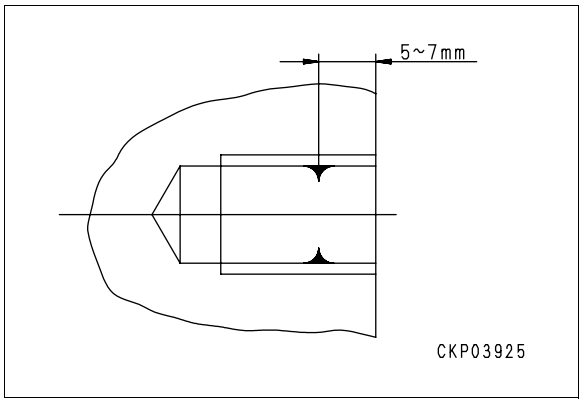
Joint (4) sliding surface:
Grease 2 - 4 cc (G2-LI)

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

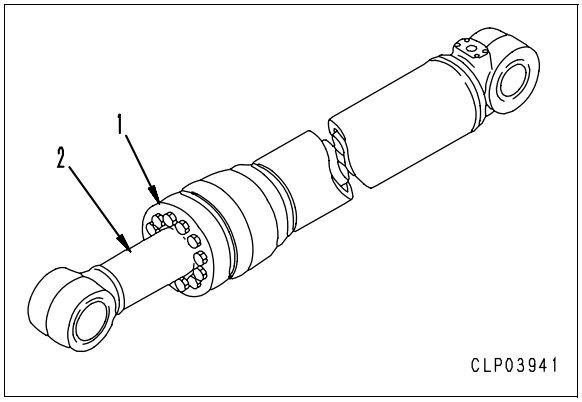
SPECIAL TOOLS

Mark		Part No.	Part Name	Necessity	Qty	Distinction*	Sketch
Q	1	790-502-1003	Cylinder repair stand	l	1		
		790-101-1102	Pump	l			
	2	790-102-4300	Wrench Assembly	n	1		
		790-102-4310	Pin	n	2		
	3	790-720-1000	Expander	l	1		
	4	796-720-1670	Rubber Band (for boom and arm)	l	1		
		07281-01279	Clamp	l	1		
		796-720-1660	Rubber band (for bucket)	l	1		
		07281-01159	Clamp	l	1		
	5	790-201-1702	Push tool kit	n	1		
		• 790-201-1830	Push tool (for bucket)		1		
		• 790-201-1930	Push tool (for arm)		11		
		• 790-201-1940	Push tool (for boom)		1		
		• 790-101-5021	Grip		1		
		• 01010-50816	Bolt		1		
	6	790-201-1500	Push tool kit (for bucket)	l	1		
		• 790-201-1640	Push tool		1		
		• 790-101-5021	Grip		1		
		• 01010-50816	bolt		1		
		790-201-1980	Plate (for boom)	l	1		
		790-201-1990	Plate (for arm)	l	1		
		790-101-5021	Grip	l	1		
		01010-50816	Bolt	l	1		

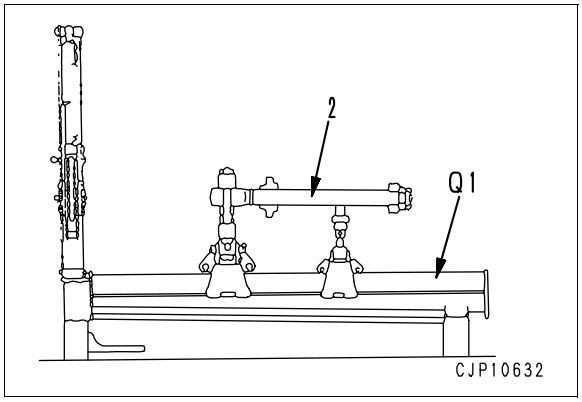
*Distinction between new and existing part.

DISASSEMBLY OF ARM AND BUCKET CYLINDERS

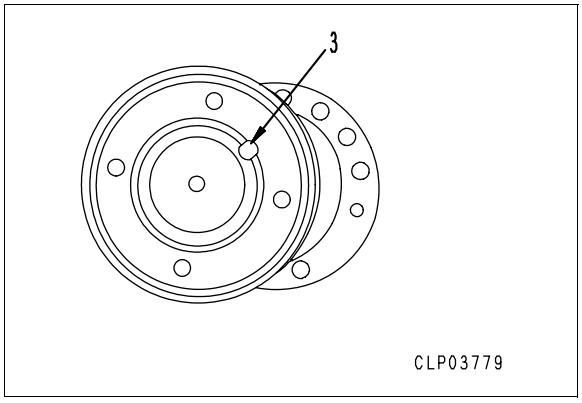
1. Piston rod assembly
   1) Remove piping from cylinder assembly.
   2) Remove mounting bolts and disconnect head assembly (1).
   3) Pull out piston rod assembly (2).
      ★ Place a container under the cylinder to catch the oil.



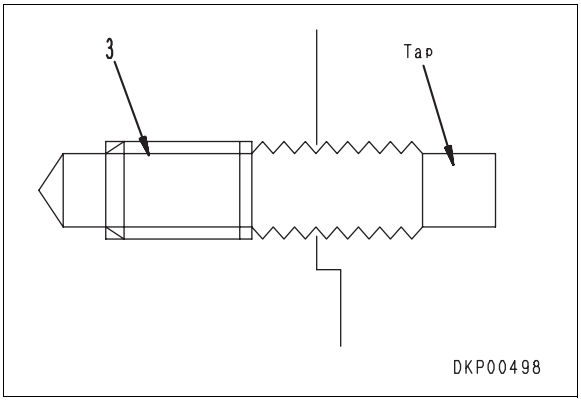
   4) Disassemble piston rod assembly as follows.
      Set piston rod assembly (2) in tool **Q1.**



      Remove stopper screw (3) of piston assembly.
      ★ Common screw size for boom, arm, and bucket cylinder: M12 x Pitch 1.75.

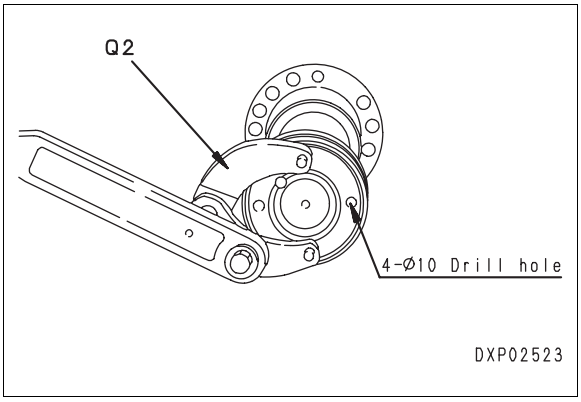


★ If the caulking of screw (3) is too strong and it cannot be removed, tighten the screw fully, then fit a tap to the thread and remove the screw.



Using tool **Q2**, remove piston assembly (4).

★ When not using tool **Q2**, use the drill holes (∅ 10, 4 places) and loosen the piston assembly.



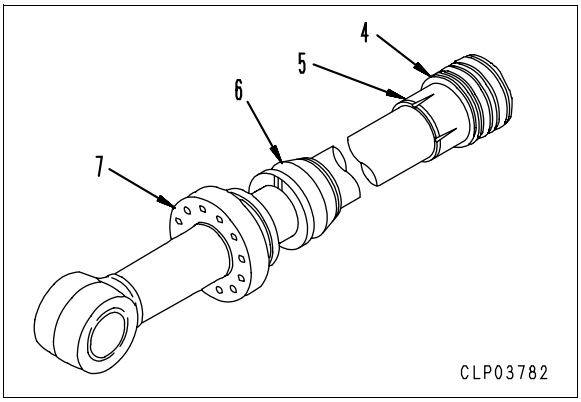
Remove plunger (5).

★ Boom and arm cylinder only

Remove collar (6).

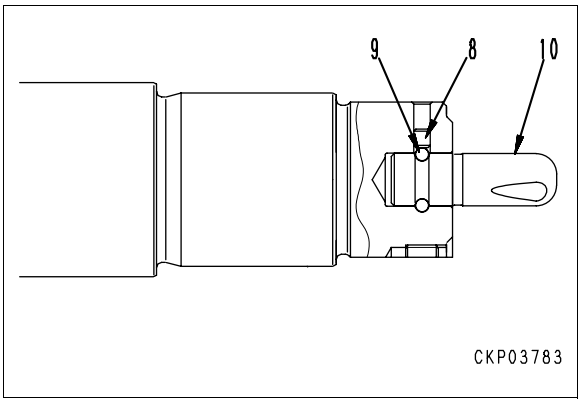
★ Boom and arm cylinder only

Remove head assembly (7).

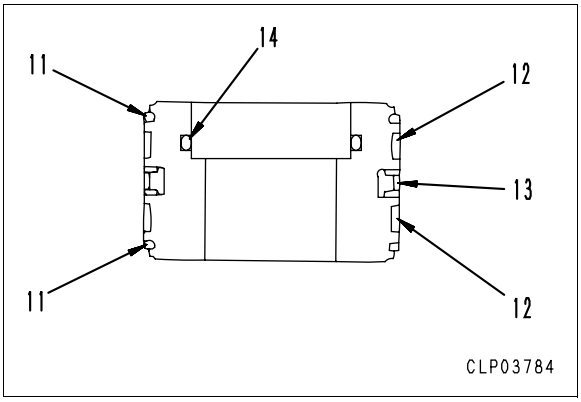


Remove cap (8), and pull 12 balls (9), then remove plunger (10).

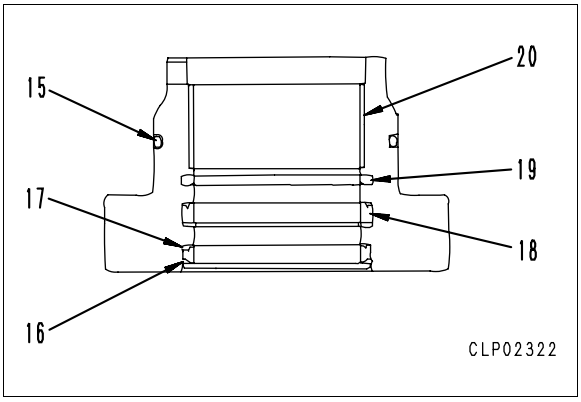
★ Arm cylinder only



2. Disassembly of piston assembly
   1) Remove rings (11).
   2) Remove wear rings (12).
   3) Remove piston ring (13).
   4) Remove O-ring and backup ring (14).



3. Disassembly of cylinder head assembly
   1) Remove O-ring and backup ring (15).
   2) Remove snap ring (16), then remove dust seal (17).
   3) Remove rod packing (18).
   4) Remove buffer ring (19).
   5) Remove busing (20).

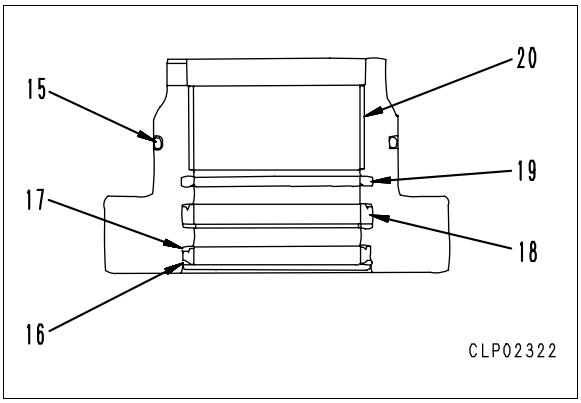


ASSEMBLY

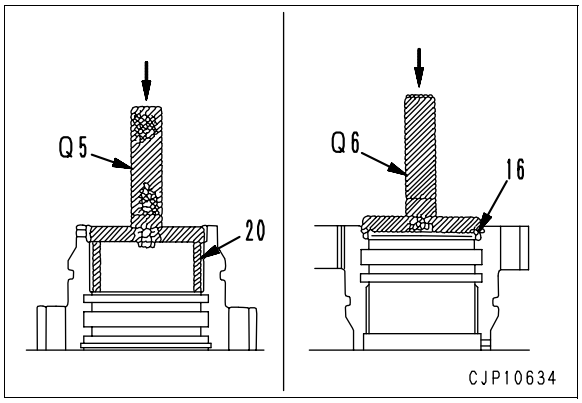
★ Be careful not to damage the packing, dust seals, and O-rings.

★ Clean each part, then cover the piping ports and pin-inserting hole to prevent dust from entering them.

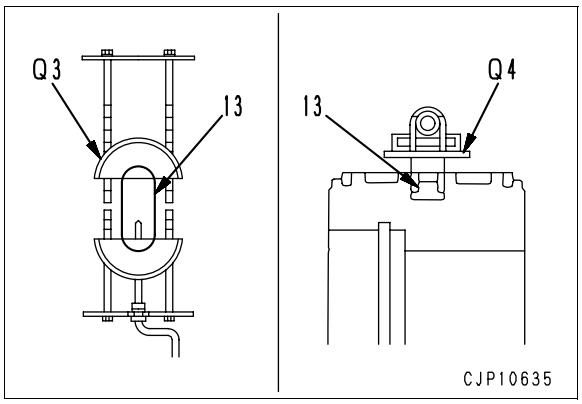
★ Do not try to force the backup ring into position. Warm it in warm water (50 - 60°C) before installing it.



1. Assembly of head assembly
   1) Using tool **Q5**, press fit bushing (20).
   2) Assemble buffer ring (19).
   3) Assemble rod packing (18).
   4) Using tool **Q6**, install dust seal (17), and secure with snap ring (16).
   5) Install backup ring and O-ring (15).

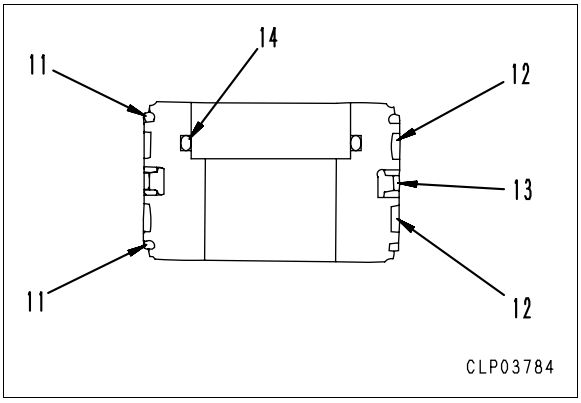


2. Assembly of piston assembly
   1) Using tool **Q3**, expand piston ring (13).
      ★ Set the piston ring on tool **Q3**, and turn the handle 8 - 10 times to expand the ring.
   2) Set tool **Q4** in position, and compress piston ring (13).

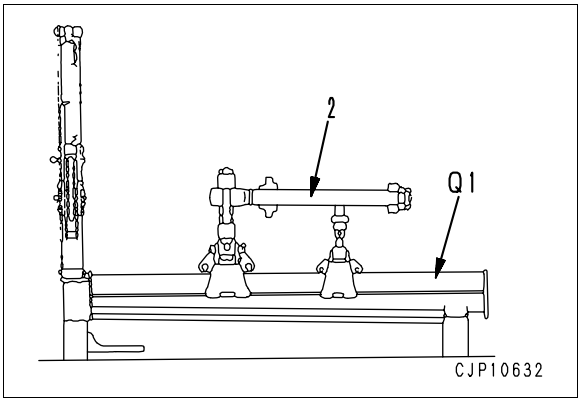


3) Install backup ring and O-ring (14).
4) Assemble wear ring (12).
5) Assemble ring (11).
   ★ Be careful not to open the end gap of the ring too wide.

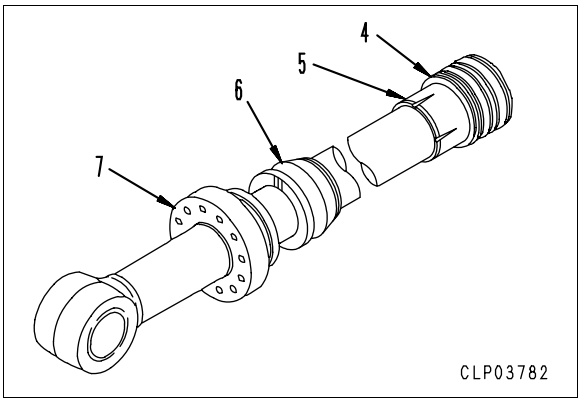
Ring grove: **Grease (G2-L1)**



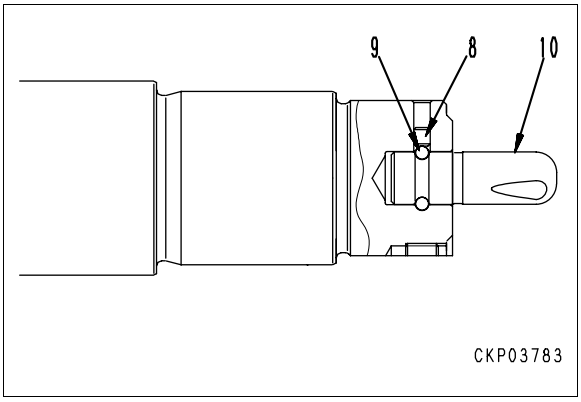
3. Piston rod assembly
   1) Set piston rod assembly (2) to tool **Q1**.



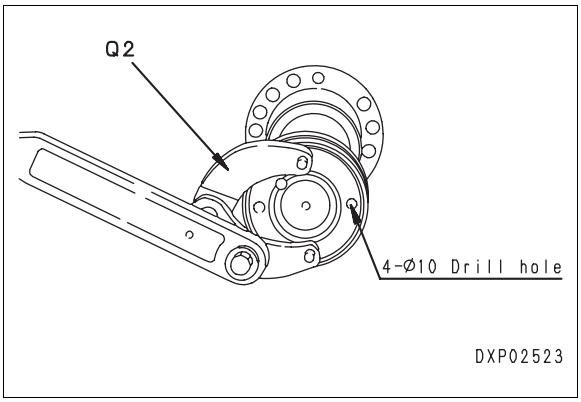
2) Assemble head assembly (7).
3) Fit O-ring and backup ring to collar (6), then assemble.
   - Boom and arm cylinder only
4) Assemble plunger (5).
   - Boom and arm cylinder only



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



6) Assemble piston assembly (4) as follows.
   - When using rod piston (2) again:
     ★ Wash thoroughly and remove all metal particles and dirt.
     ★i) 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.

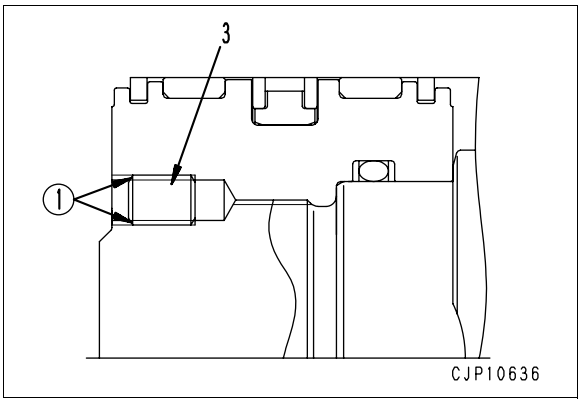


★ii) Tighten screw (3).

Screw thread: Loctite No. 262

Screw: 58.9 - 73.6 Nm {6 - 7.5 kgm}

★iii) Caulk thread at 2 places with punch.

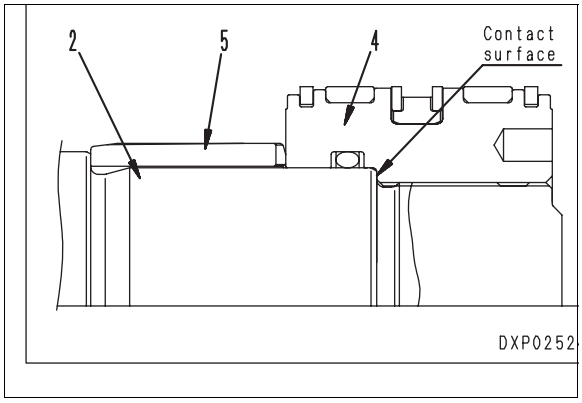


- When using a new part for either or both of rod piston assembly (2)
  ★ For the rod with bottom cushion, mark the cushion plug position on the end of the rod.
  - Arm cylinder only

  i) Screw in until piston assembly (4) contacts end face of rod, then use tool to tighten.

Piston assembly: **294 ± 29.4 Nm {30 ± 3.0 kgm)**

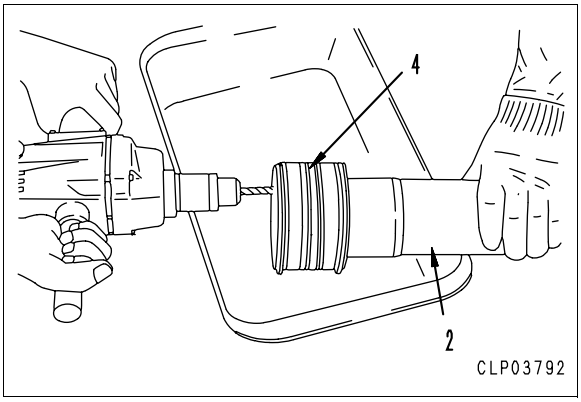
  ★ After tightening the piston, check that there is play in plunger (5).
  - Boom, arm cylinder only



  ii) 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

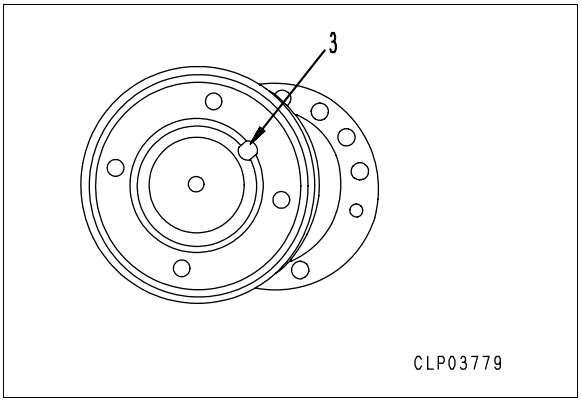
iii) After machining, wash thoroughly to remove all metal particles and dust.



iv) Tighten screw (3).

N·m Screw: 58.9 - 73.6 Nm {6 - 7 kgm}

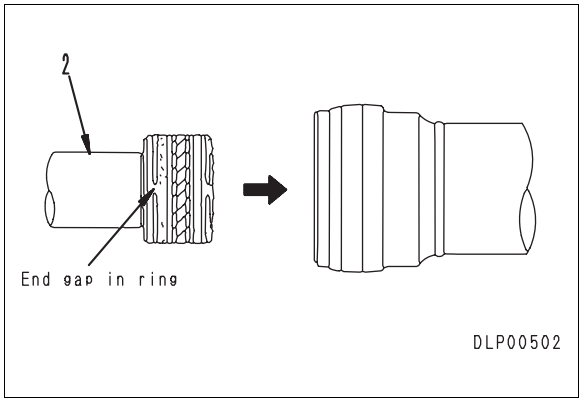
v) Caulk thread at 4 places with punch.



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.

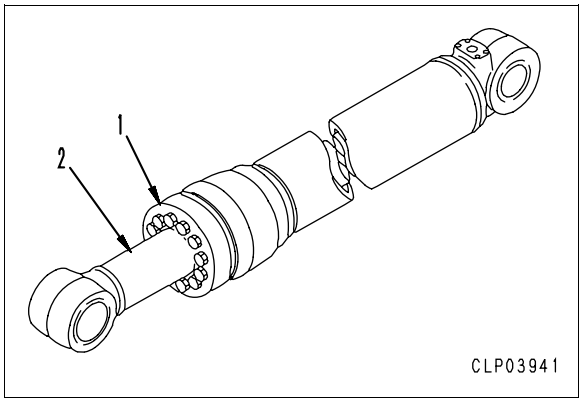
★ After inserting, check that the ring is not broken and has not come out, then push in fully.



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}



9) Install piping.

REMOVAL AND INSTALLATION OFMONOBOOM WORK EQUIPMENT

SPECIAL TOOLS

Mark	Part No.	Part Name	Necessity	Qty	Distinction*	Sketch
R	796-900-1200	Remover	n	1		
	790-101-4000	Puller (490 kN 50-T-long)	n	1		
	790-101-1102	Pump (294 kN 30 T)	n	1		

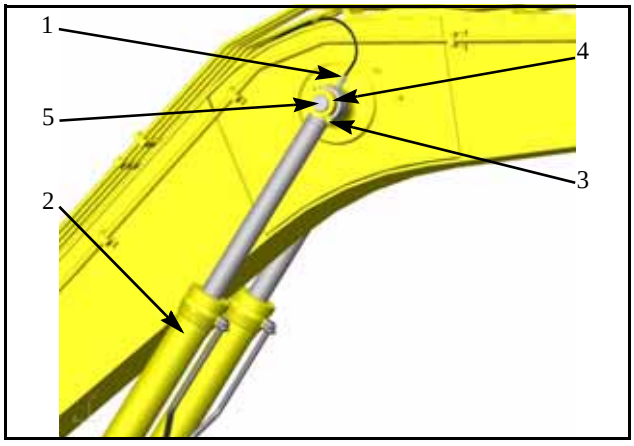
*Distinction between new and existing part.

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.**

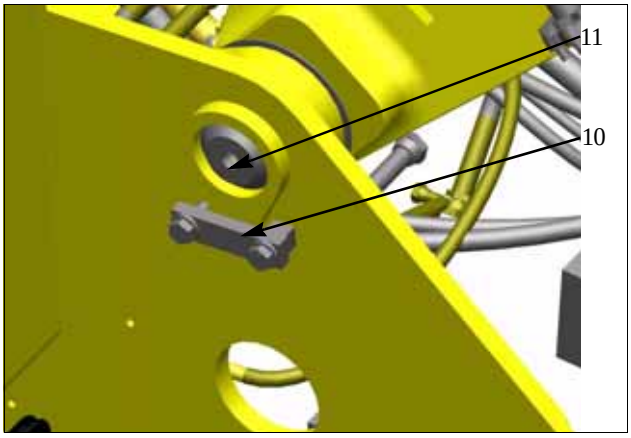
1. Disconnect grease hose (1).
2. Sling boom cylinder assembly (2), and remove lock bolt (3) on both sides of boom.
3. Remove plate (4), then remove head pin (5). ※1
   - ★ There are shims installed, so check the number and thickness, and keep them in a safe place.



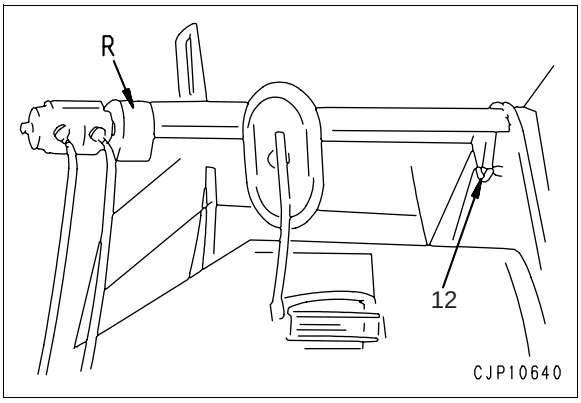
4. Start the engine and retract the piston rod.
   - ★ Fasten the piston rod with wire so that it will not slip out and lower the cylinder onto a stand, or place a support under the bottom of the cylinder to support it. In the latter case, remove the grease fitting on the bottom side first.
   - ★ Remove 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 CN-A86 (9) for a working lamp.



7. Support with sling 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
PW160: 1,742 kg

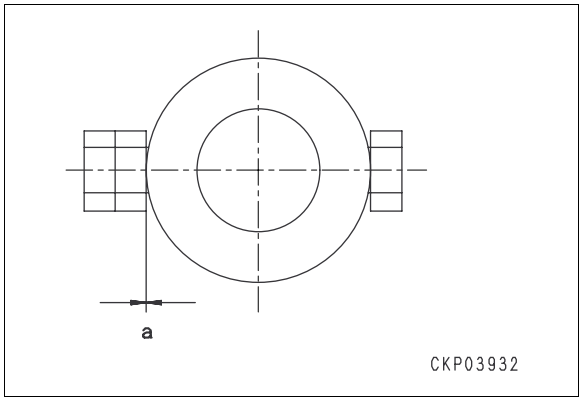


INSTALLATION

- 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.



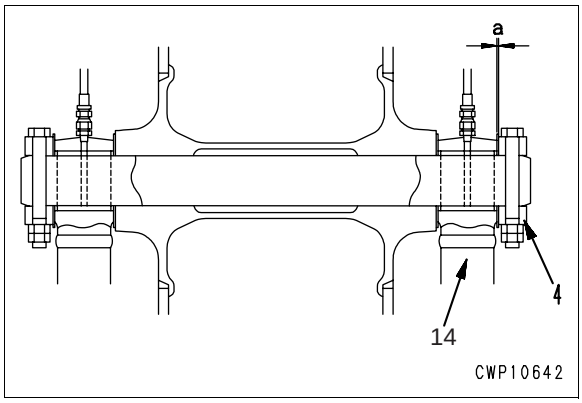
Inside surface of bushing when assembling pin:
Anti-friction compound (LM-P)

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	Necessity	Qty	Distinction*	Sketch
R	796-900-1200	Remover	n	1		
	790-101-4000	Puller (490 kN 50-T-long)	n	1		
	790-101-1102	Pump (294 kN 30 T)	n	1		

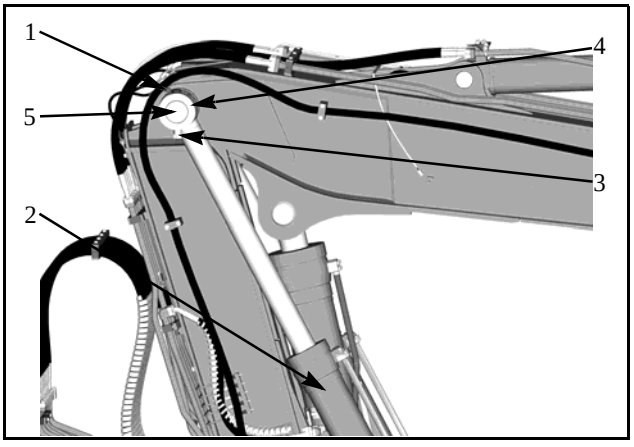
*Distinction between new and existing part.

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.**

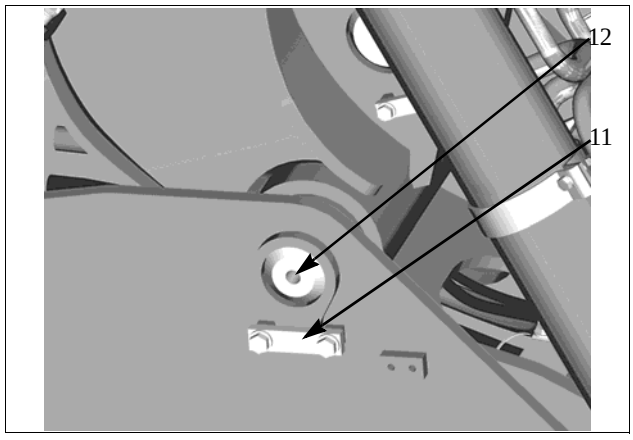
1. Disconnect grease hose (1).
2. Sling boom cylinder assembly (2), and remove lock bolt (3) on both sides of boom.
3. Remove plate (4), then remove head pin (5). ※1
   - ★ There are shims installed, so check the number and thickness, and keep them in a safe place.



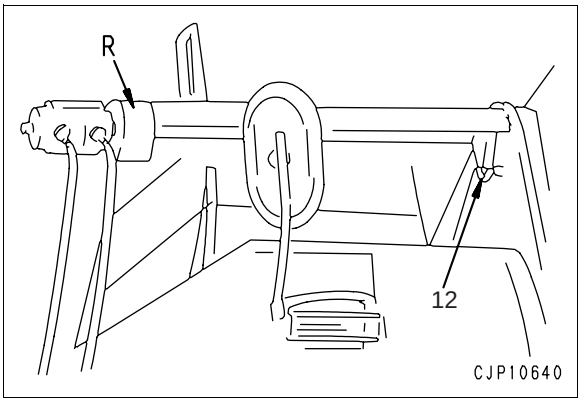
4. Start the engine and retract the piston rod.
   - ★ Fasten the piston rod with wire so that it will not slip out and lower the cylinder onto a stand, or place a support under the bottom of the cylinder to support it. In the latter case, remove the grease fitting on the bottom side first.
   - ★ Remove the boom cylinder on the other side in the same manner.
5. Disconnect arm cylinder (6), boom cylinder hoses (7), adjust cylinder hoses (8), stabilizer hose (9) two for each.
   - ★ Plug the hoses to prevent oil flow-out, and fasten them on the valve side.
6. Disconnect intermediate connector CN-A86 (10) for a working lamp.



7. Support with sling the work equipment and remove plate (11) and then pin (12) at the foot. ※2



- When removing them, first remove plate (11) and then remove pin (12) 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 (13) and disassemble it.

kg Work equipment assembly
PW160: 1,926 kg

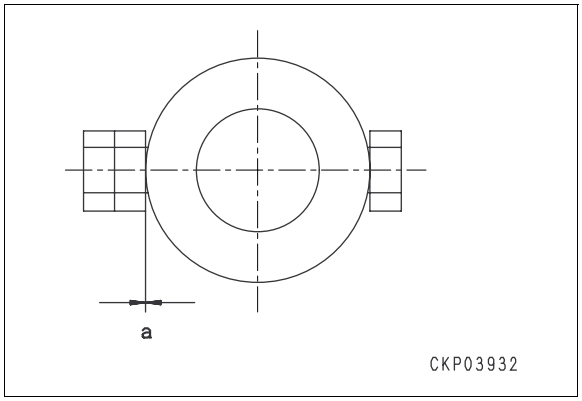


INSTALLATION

- 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)

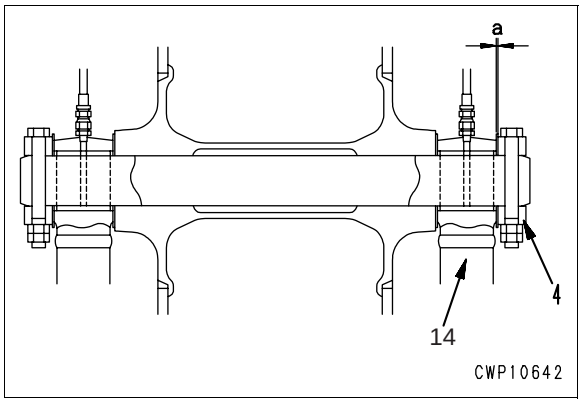
Grease after assembling pin:
Grease (LM-G)

⚠ 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 (14) 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	Necessity	Qty	Distinction*	Sketch
S	799-703-1200	Service tool kit	n	1		
	799-703-1100	Vacuum Pump (100 V)	n	1		
	799-703-1110	Vacuum Pump (220 V)	n	1		
	799-703-1120	Vacuum Pump (240 V)	n	1		
	799-703-1400	Gas leak tester	n	1		

*Distinction between new and existing part.

REMOVAL

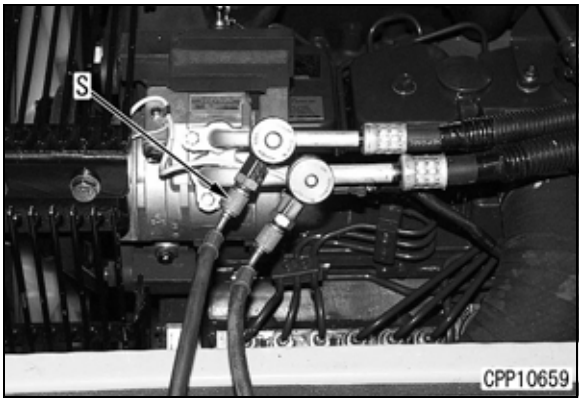
WARNING

First, disconnect the cable from the negative terminal (-) of the battery.

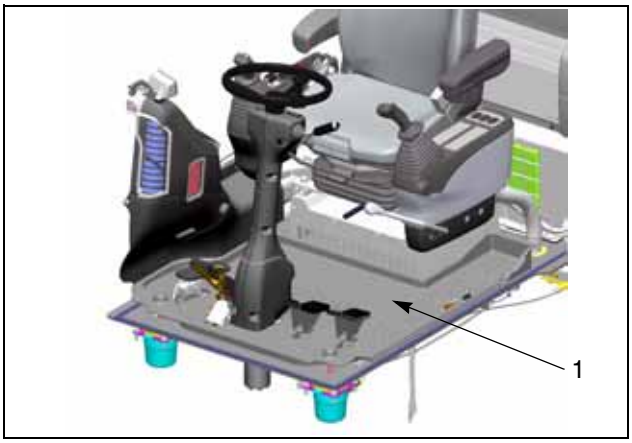
1. Drain cooling water.

   Cooling water: Approx. **18 L**

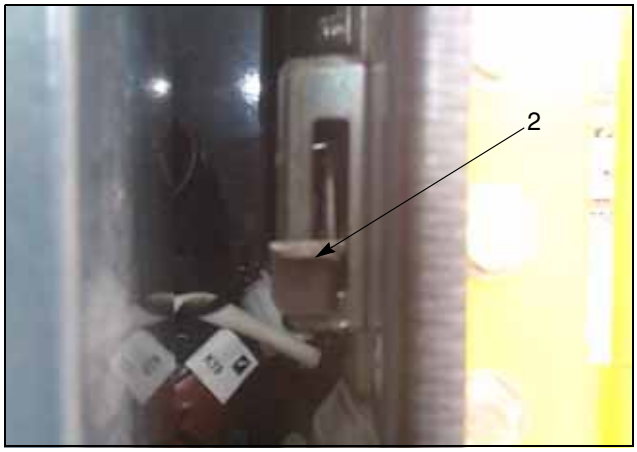
2. Bleed gas from the air conditioner, using tool **S**.



3. Remove floor mat (1).



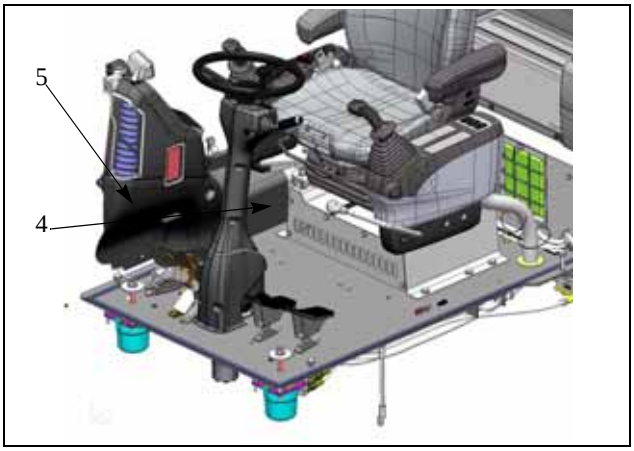
4. Pull down outside air filter cover opening-closing lever (2).



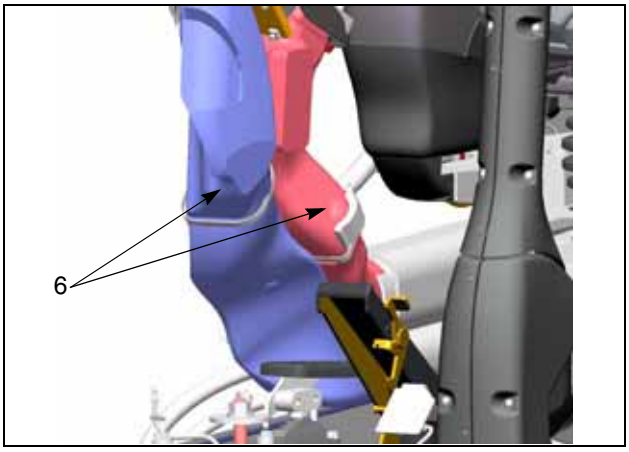
5. Remove outside air filter (3).



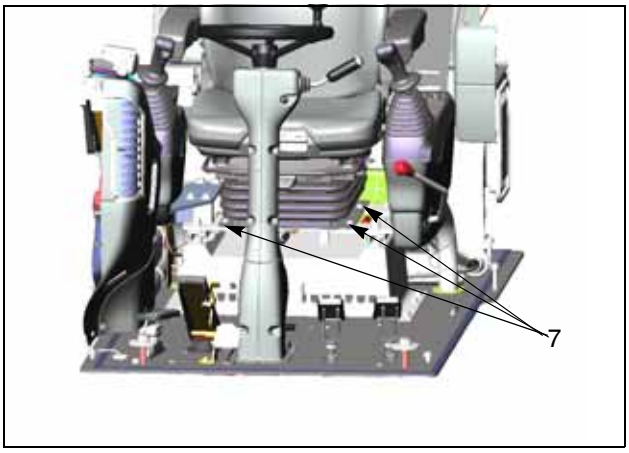
6. Remove monitor panel lower covers (4) and (5).
   ★ When removing cover (4), first remove the M19 wiring for cigarette lighter.



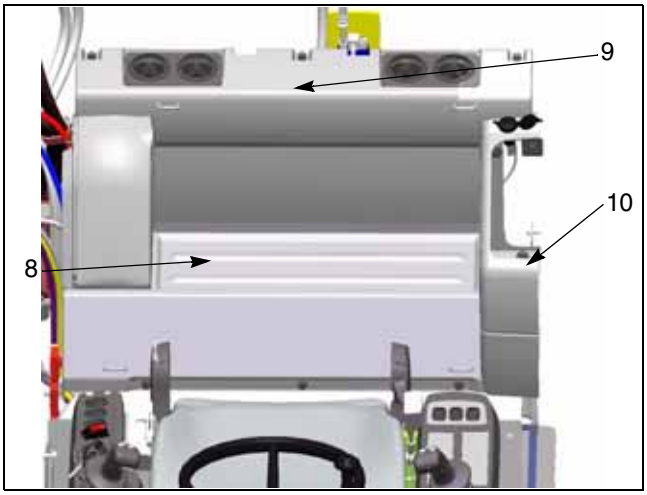
7. Remove duct (6) on the right side.



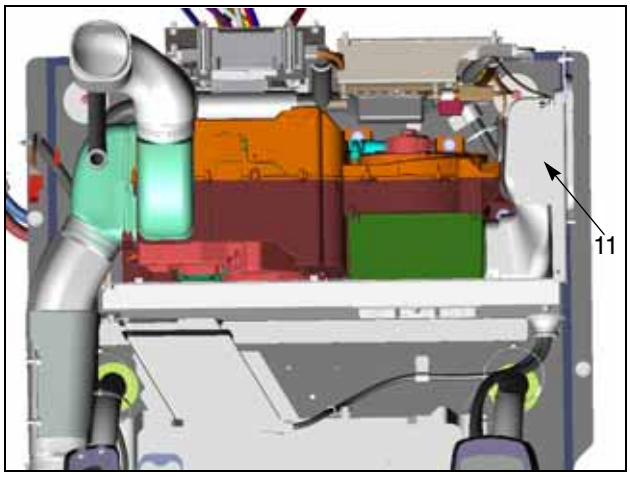
8. Remove operator seat by removing 4 mounting bolts (7). When removing the seat be sure to disconnect connector G33 (if fitted), then remove carefully.



9. Remove rear covers (8), (9) and (10).

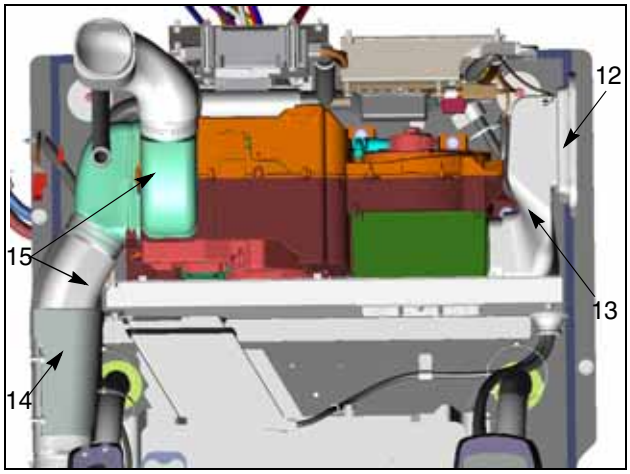


10. Remove plate (11).



11. Remove plate (12) and then remove duct (13).

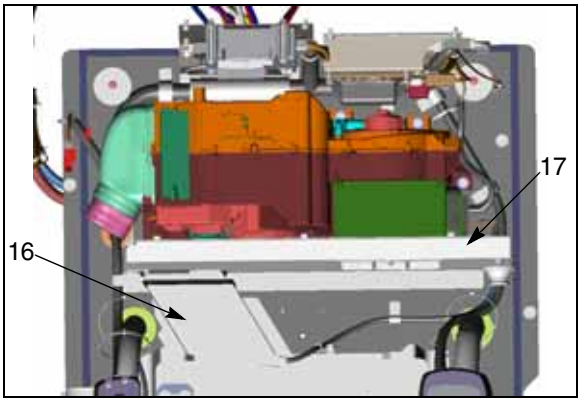
12. Remove plate (14) and right duct (15).



13. Disconnect cab intermediate connectors at the following two points. (Refer to TROUBLESHOOTING section on “CONNECTOR LOCATION CHART AND ELECTRICAL CIRCUIT DIAGRAM BY SYSTEM -20 -222)
    - H09: Upper side
    - H08: Lower side

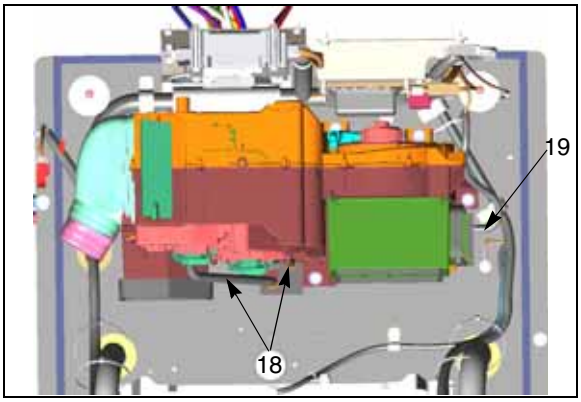
14. Remove duct (16).

15. Remove cover (17).



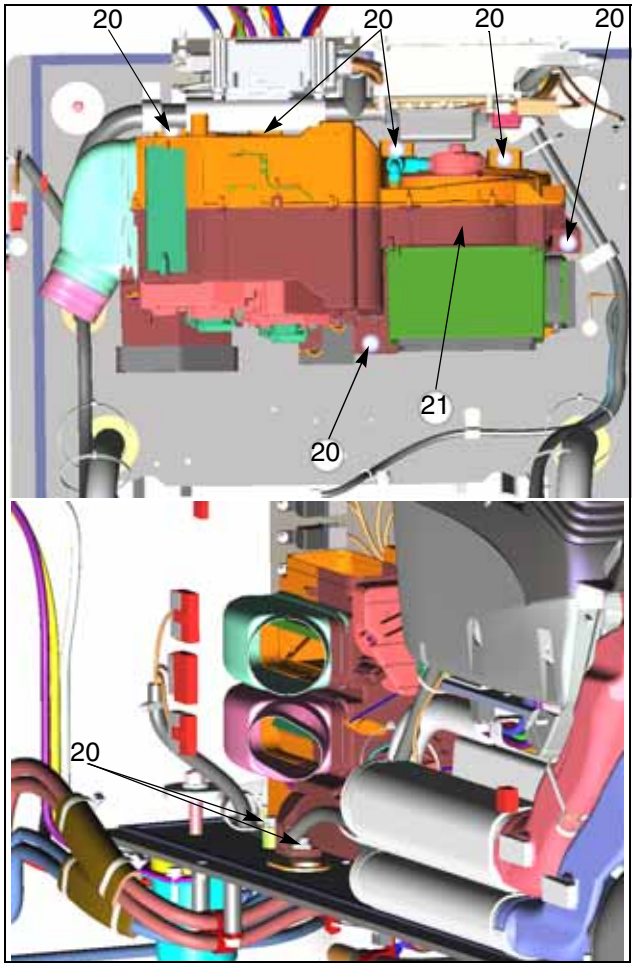
16. Disconnect connectors at the following seven points. (Refer to TROUBLESHOOTING section on “CONNECTOR LOCATION CHART AND ELECTRICAL CIRCUIT DIAGRAM BY SYSTEM -20 -222)
    - D01
      (Assembled-type diode connector)
    - D02
      (Assembled-type diode connector)
    - C09 (Model selection switch 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**.

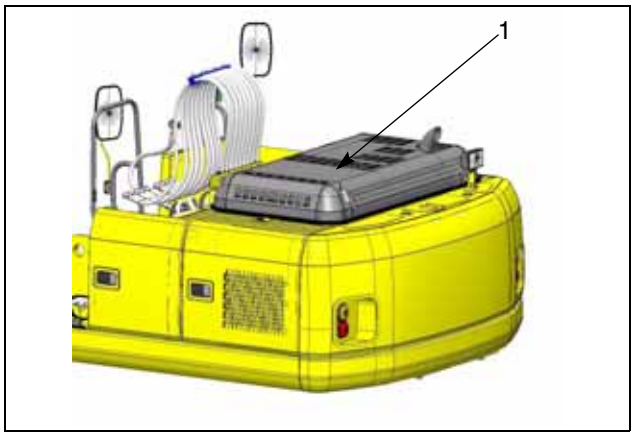
REMOVAL AND INSTALLATION OF COUNTERWEIGHT ASSEMBLY

★ Before beginning with removal of all the counterweight make sure all electrical connectors are disconnected.

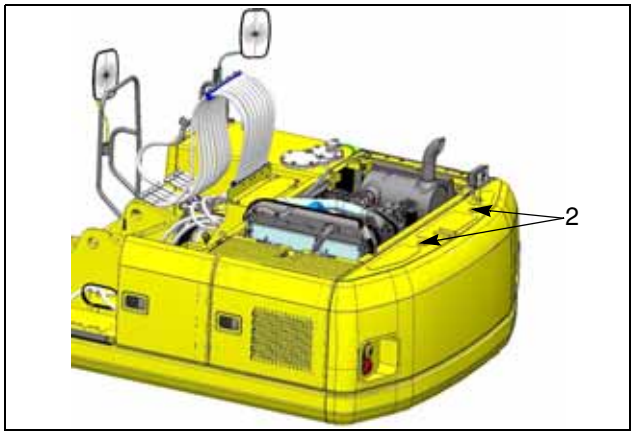
★ Attach tags to all wires to avoid confusion when installing counterweight.

REMOVAL

1. Open hood (1) and remove (see page 30- 42).

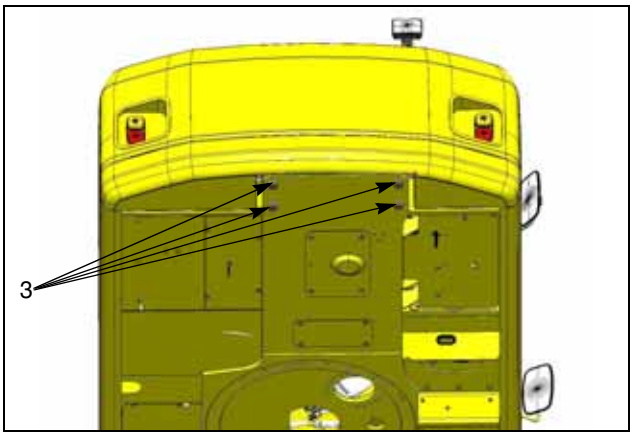


2. Remove caps (2) from counterweight.



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

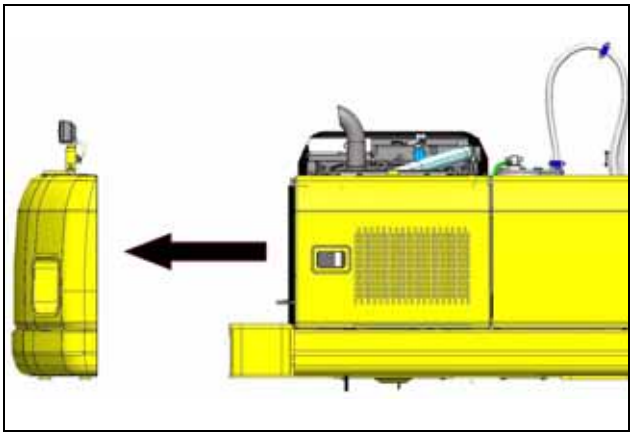
4. Loosen 4 bolts (3).



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
PW160: 3,101 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}

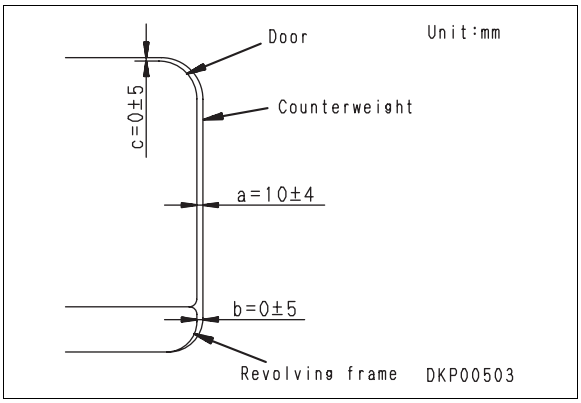
※2

★ 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

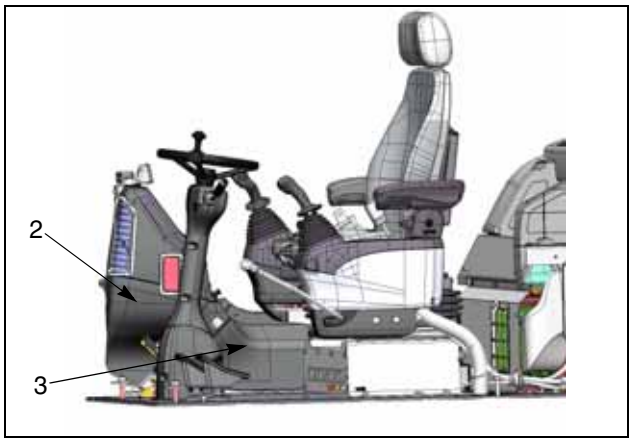
⚠ WARNING

- **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).

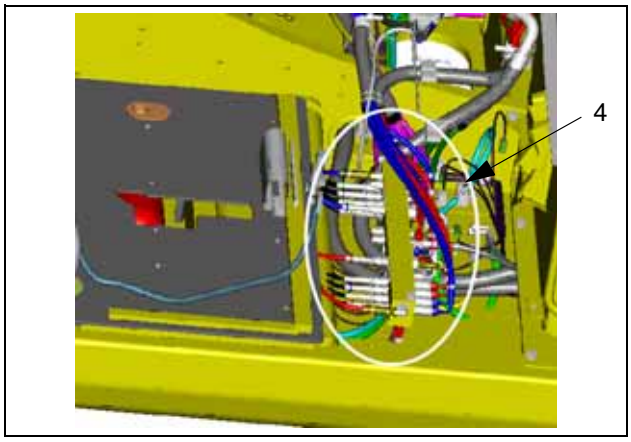


2. Remove covers (2) and (3) under the monitor panel.
   ★ When removing cover (2), first disconnect the M19 wiring for cigarette lighter.

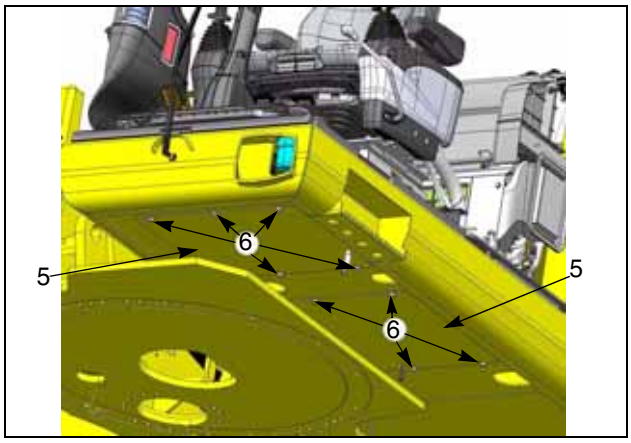


3. Remove air conditioner unit, for details See “AIR CONDITIONER UNIT ASSEMBLY” on page 20-240.

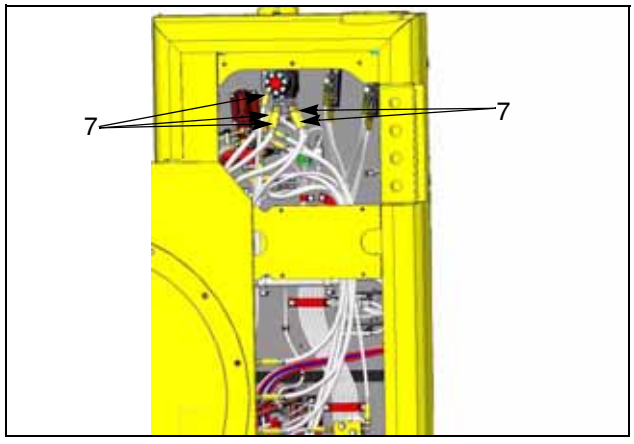
4. Disconnect all hoses at (4) on cab side of the manifold block.



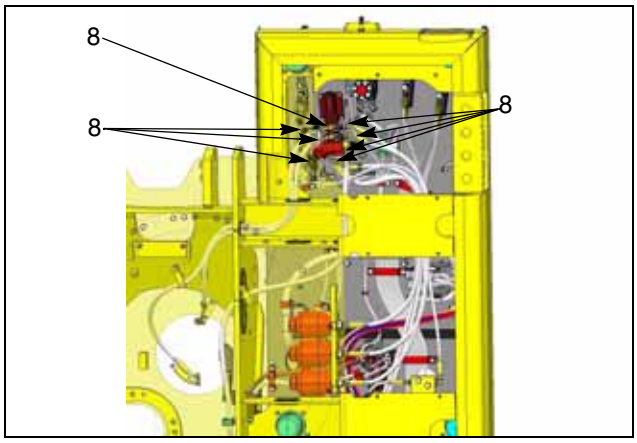
5. Remove plate (5) by removing bolts (6).



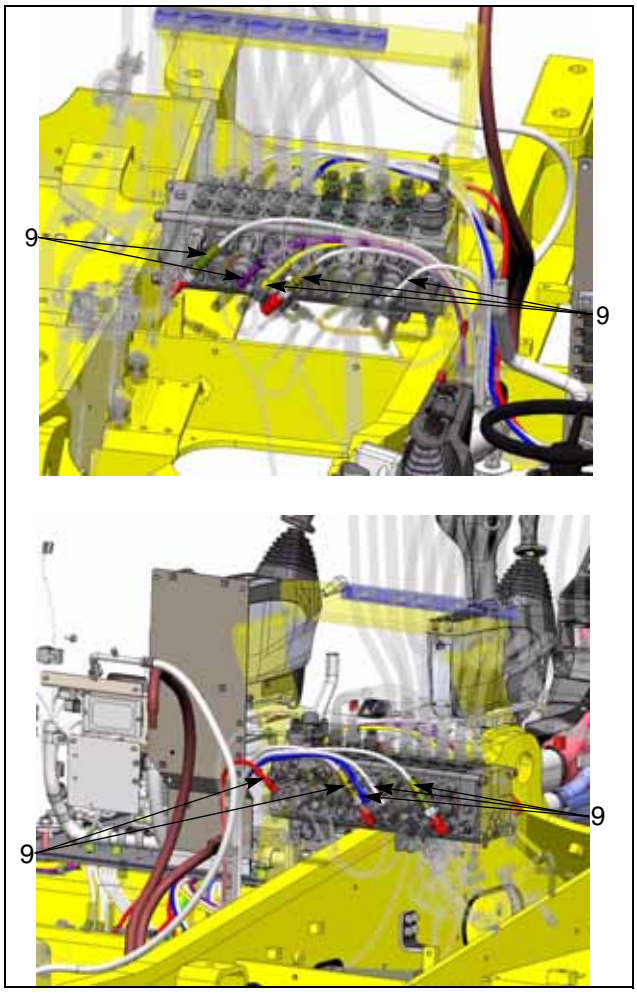
6. Disconnect hoses (7) from orbitrol valve.



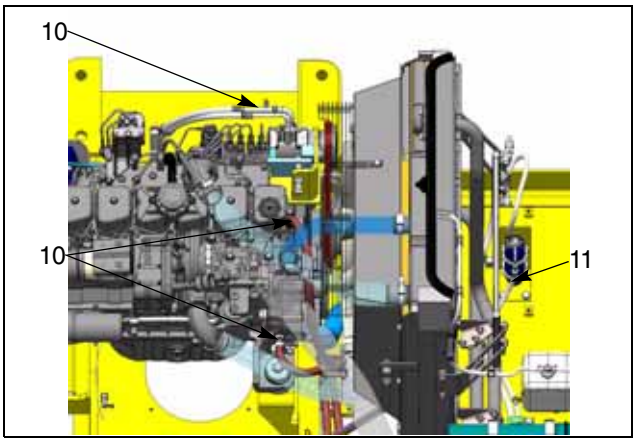
7. Disconnect hoses (8) from brake valve.



8. Remove 10 hoses from control valve (9).



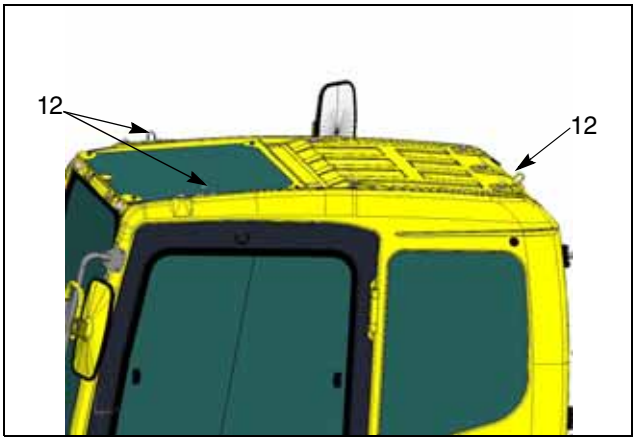
9. Remove 3 hoses (10) from engine and 1 hose from the dryer (11).



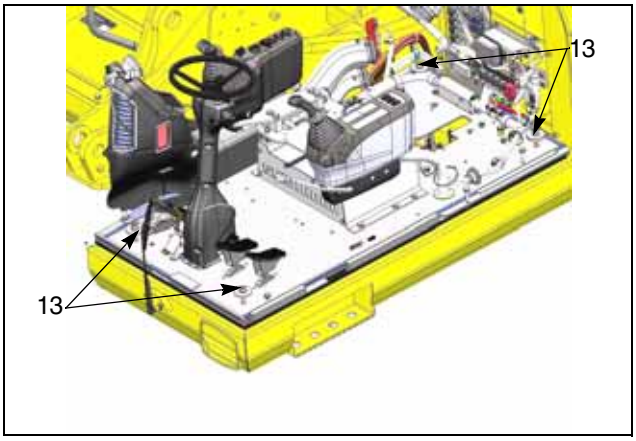
10. Ensure door is securely fastened.

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

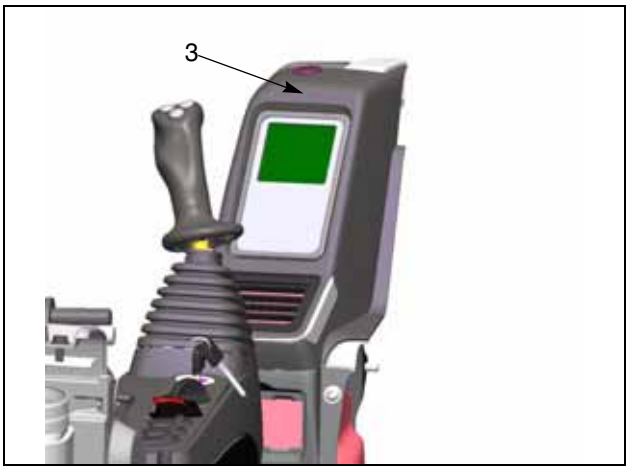
⚠ WARNING

First, disconnect the cable from the negative terminal (-) of the battery.

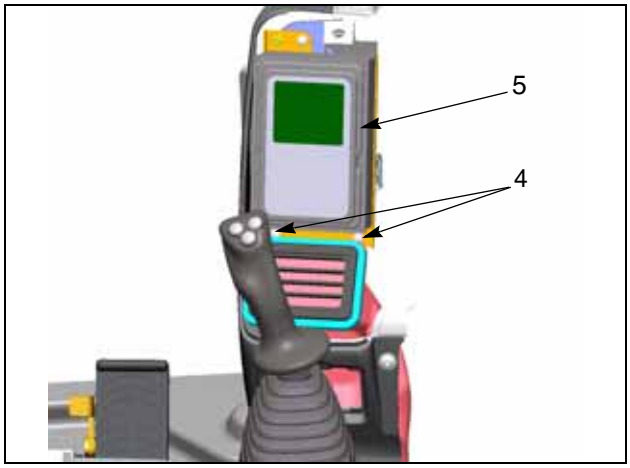
1. Remove 2 bolts (1) from cab wall to remove monitor assembly (2).



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.

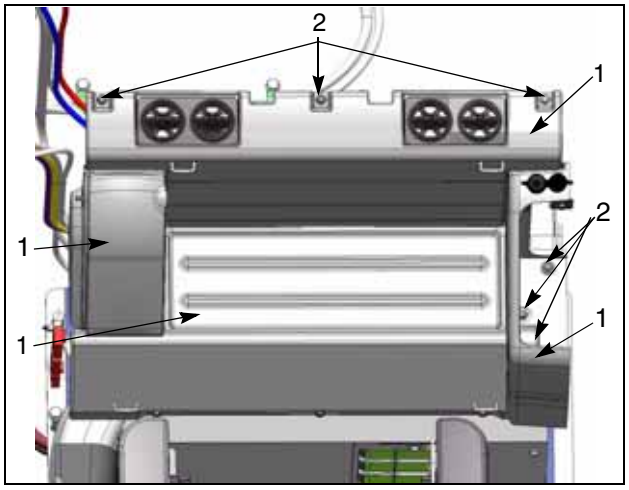
REMOVAL AND INSTALLATION OF GOVERNOR / PUMP CONTROLLER ASSEMBLY

REMOVAL

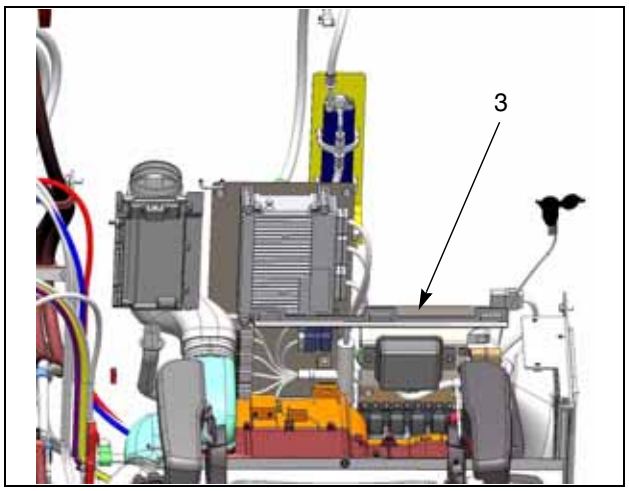
⚠ WARNING

First, disconnect the cable from the negative terminal (-) of the battery. Then disconnect the cable from positive terminal (+) of the battery.

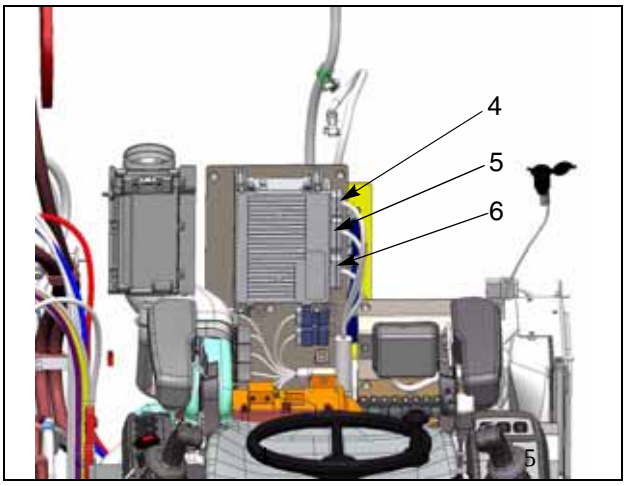
1. Remove covers (1) by removing bolts (2).



2. Remove plate (3).

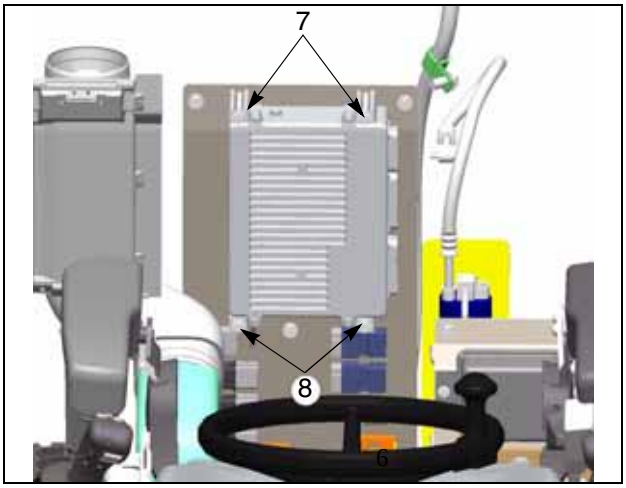


3. Disconnect 3 electrical connectors C01 (4), C02 (5), C03 (6).



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.

REMOVAL AND INSTALLATION OF KOMTRAX TERMINAL

REMOVAL

⚠ WARNING

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

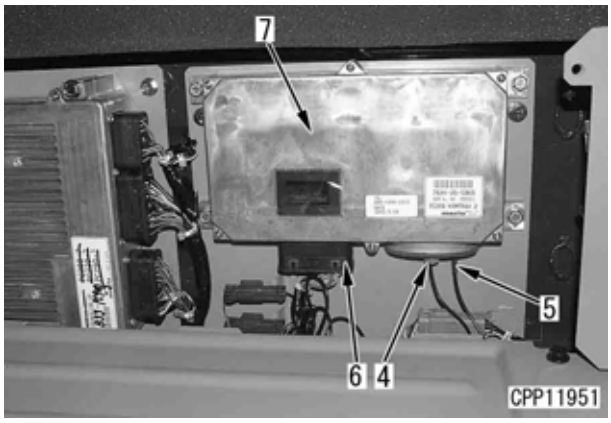
1. Remove covers (1), (2) and (3).



2. Disconnect GPS connector (4) and antenna wire (5).

3. Disconnect connector G01 (6).

4. Remove the 4 bolts and KOMTRAX terminal assembly (7).



INSTALLATION

- Carry out installation in the reverse order to removal.

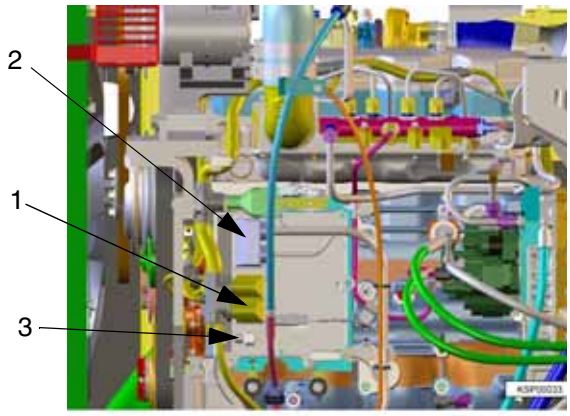
REMOVAL AND INSTALLATION OF ENGINE CONTROLLER

REMOVAL

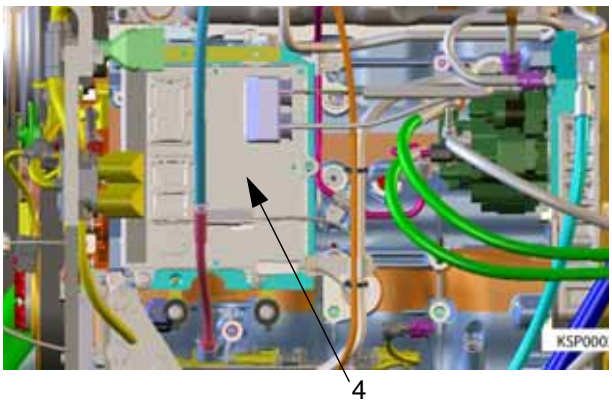
⚠ WARNING

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

1. Open the engine hood.
2. Disconnect connectors CE01 (1), CE02 (2), and CE03 (3).



3. Remove engine controller (4).



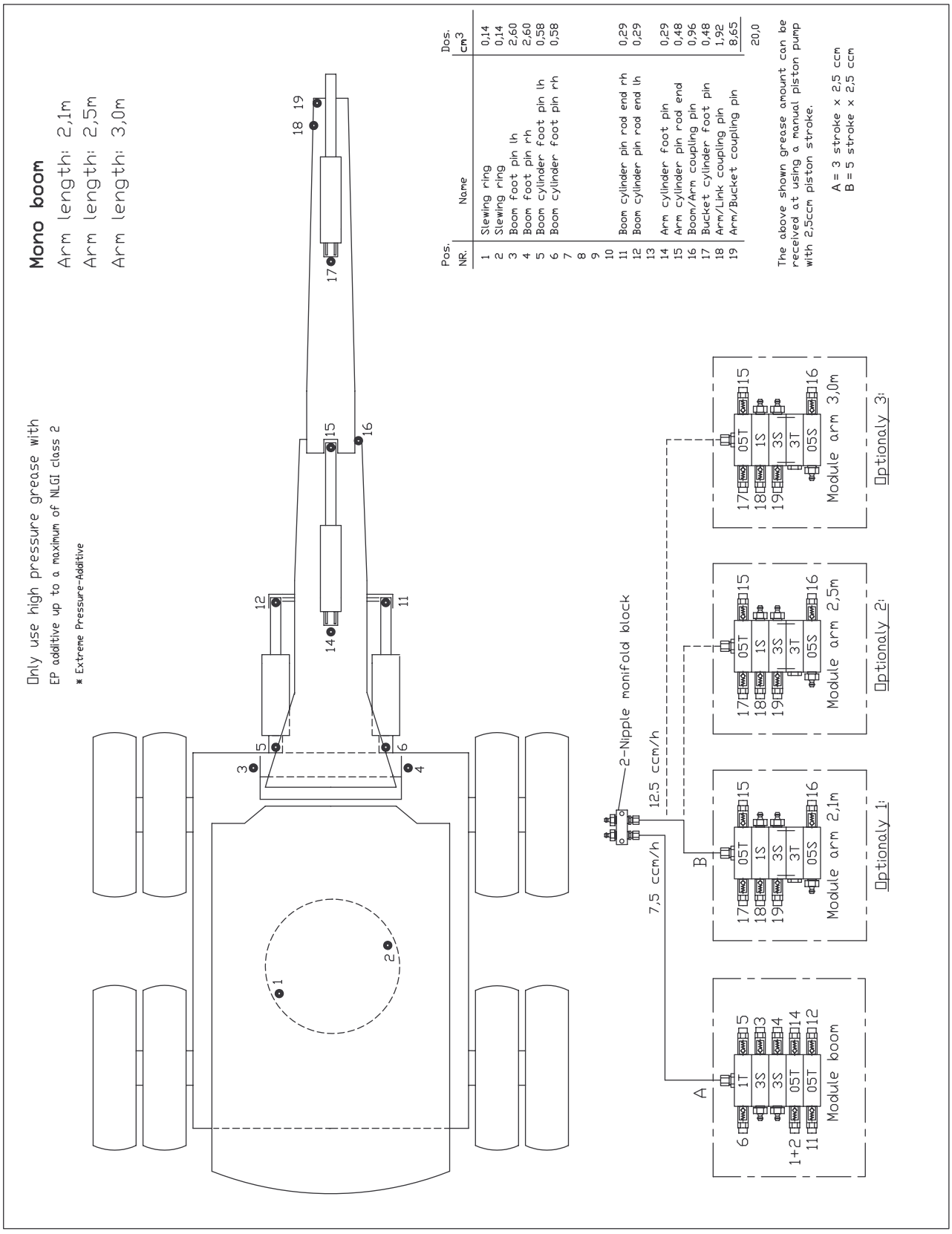
INSTALLATION

- Carry out installation in the reverse order to removal.

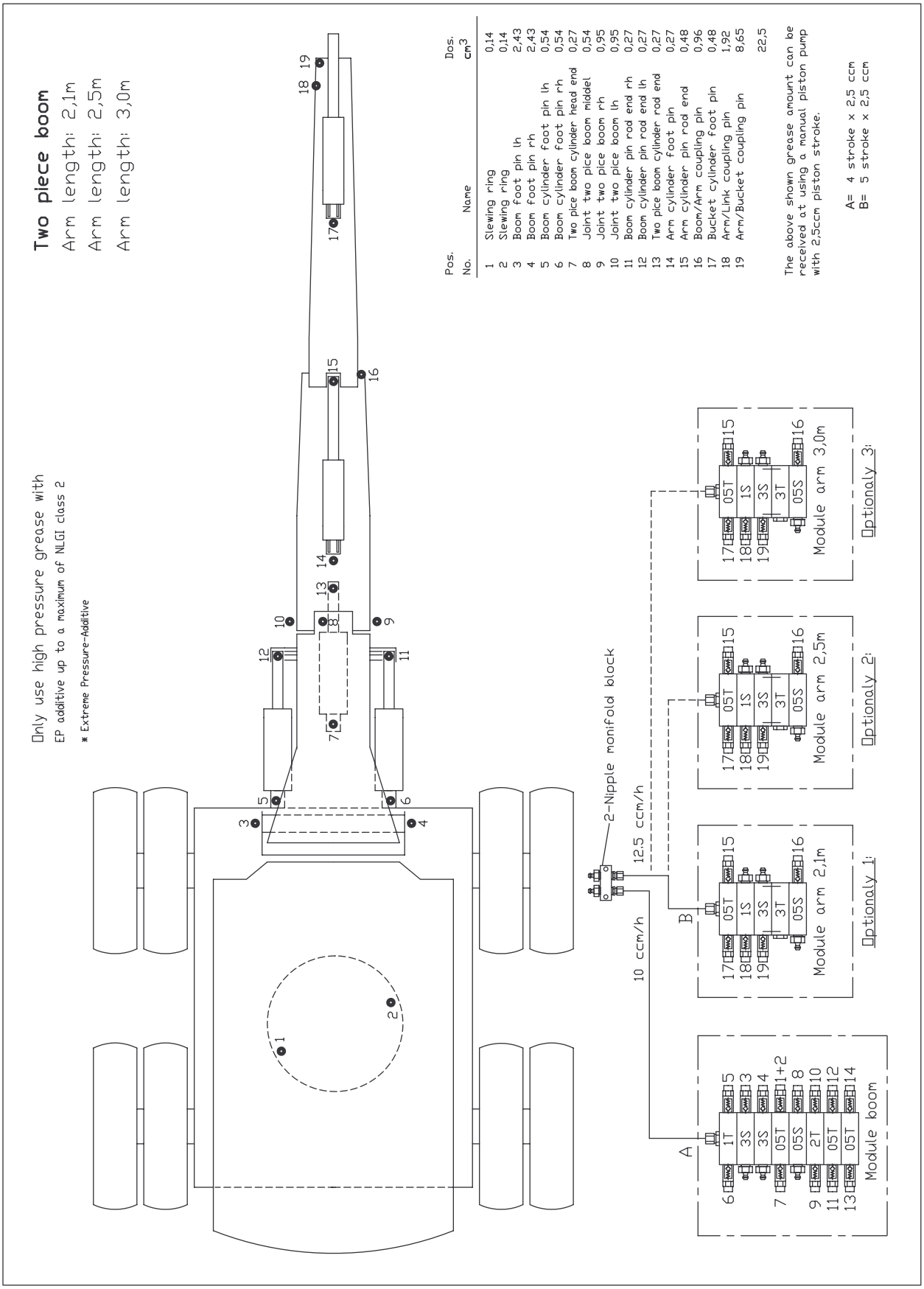
90 OTHERS

Mono boom. 90-2
Two plece boom 90-3
Hydraulic circuit diagram 1/3 90-5
Hydraulic circuit diagram 2/3 90-7
Hydraulic circuit diagram 3/3 90-9
Electrical circuit diagram 1/7. 90-11
Electrical circuit diagram 2/7. 90-13
Electrical circuit diagram 3/7. 90-15
Electrical circuit diagram 4/7. 90-17
Electrical circuit diagram 5/7. 90-19
Electrical circuit diagram 6/7. 90-21
Electrical circuit diagram 7/7. 90-23

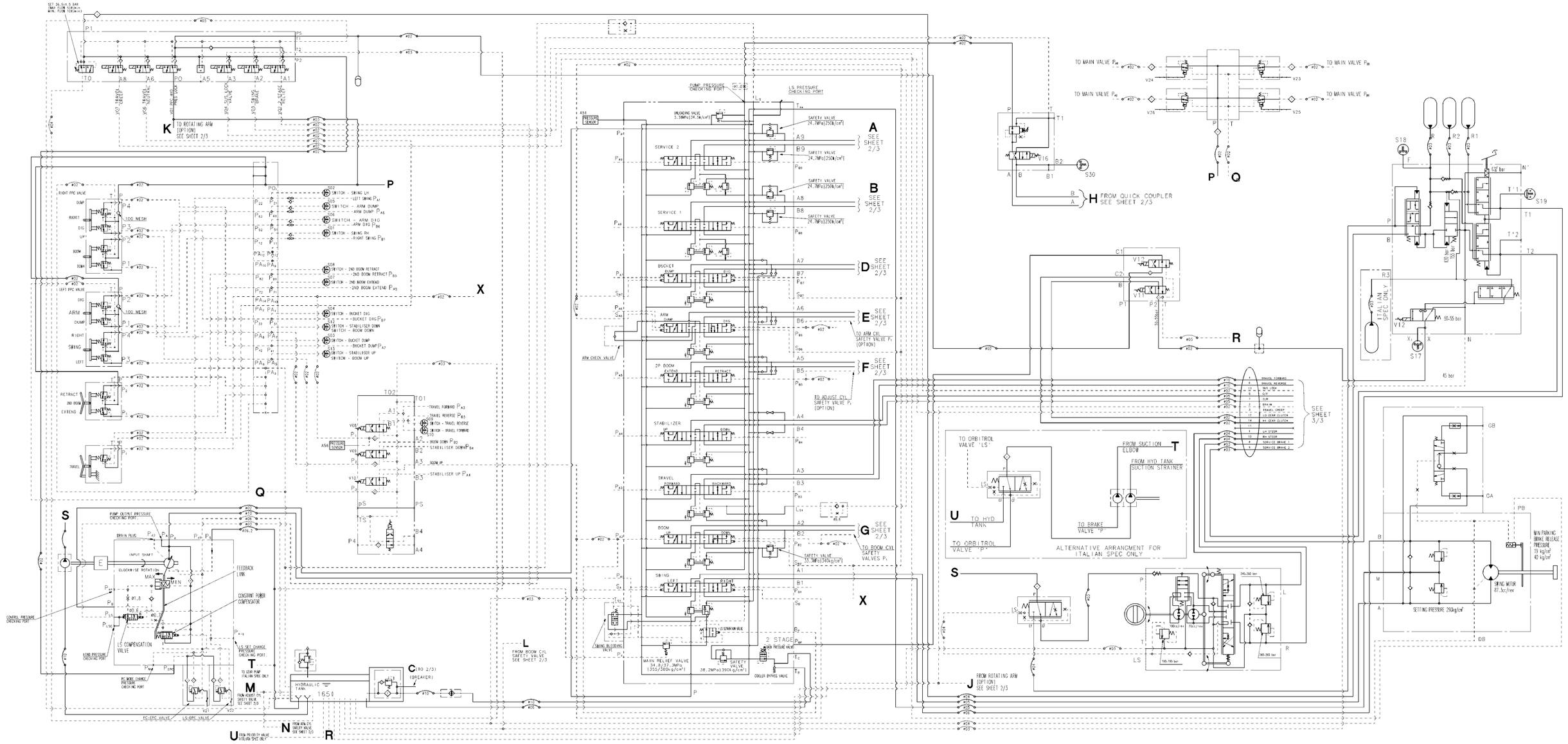
MONO BOOM


Mono boom
Arm length: 2,1m
Arm length: 2,5m
Arm length: 3,0m
Only use high pressure grease with
EP additive up to a maximum of NLGI class 2
* Extreme Pressure-Additive
Pos. NR.
Name
Dos. cm3
1 Slewing ring 0,14
2 Slewing ring 0,14
3 Boom foot pin lh 2,60
4 Boom foot pin rh 2,60
5 Boom cylinder foot pin lh 0,58
6 Boom cylinder foot pin rh 0,58
7
8
9
10
11 Boom cylinder pin rod end rh 0,29
12 Boom cylinder pin rod end lh 0,29
13
14 Arm cylinder foot pin 0,29
15 Arm cylinder pin rod end 0,48
16 Boom/Arm coupling pin 0,96
17 Bucket cylinder foot pin 0,48
18 Arm/Link coupling pin 1,92
19 Arm/Bucket coupling pin 8,65
20,0
The above shown grease amount can be received at using a manual piston pump with 2,5ccm piston stroke.
A = 3 stroke x 2,5 ccm
B = 5 stroke x 2,5 ccm
2-Nipple monifold block
12.5 ccm/h
7,5 ccm/h
A
B
Module boom
Module arm 2,1m
Module arm 2,5m
Module arm 3,0m
Optionaly 1:
Optionaly 2:
Optionaly 3:

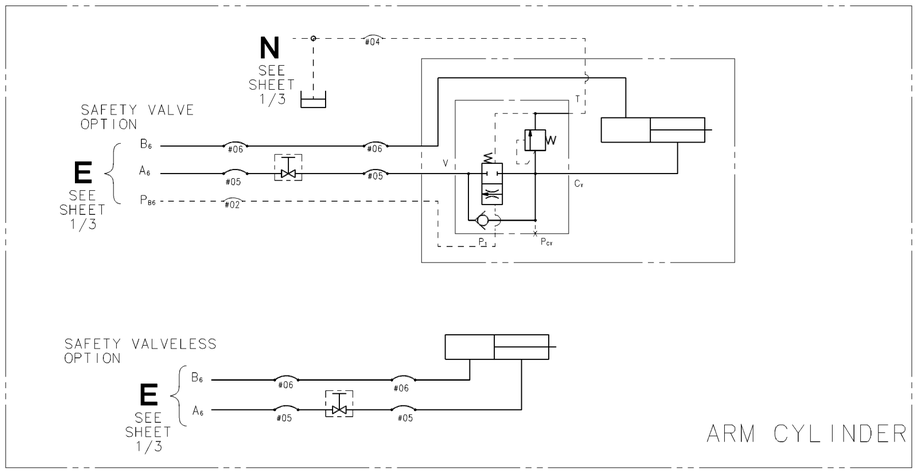
TWO PLECE BOOM

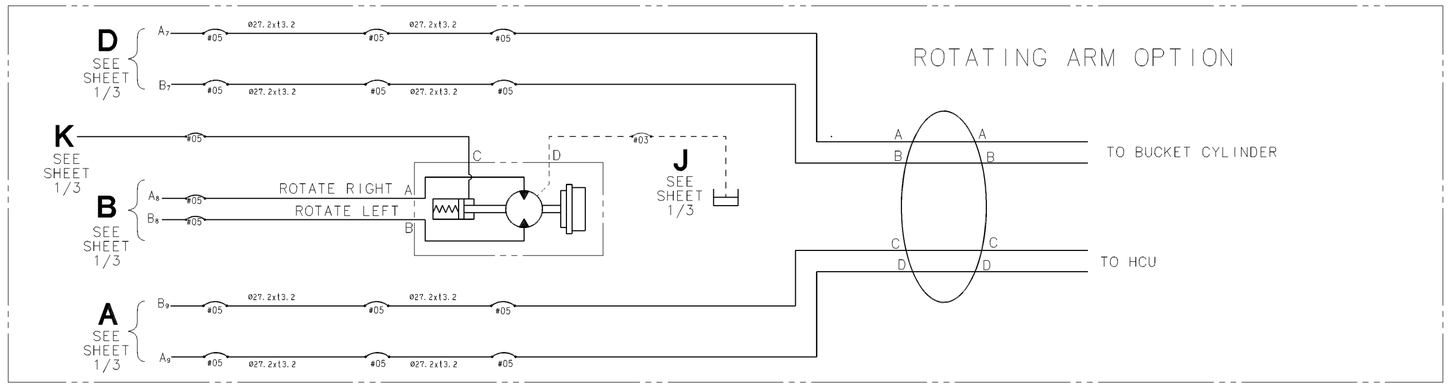


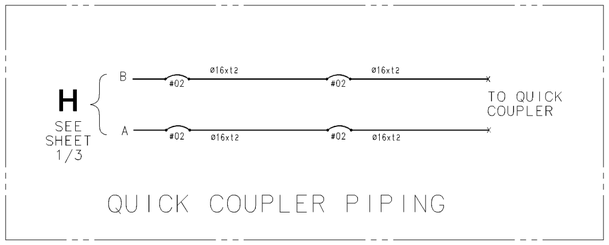
HYDRAULIC CIRCUIT DIAGRAM 1/3

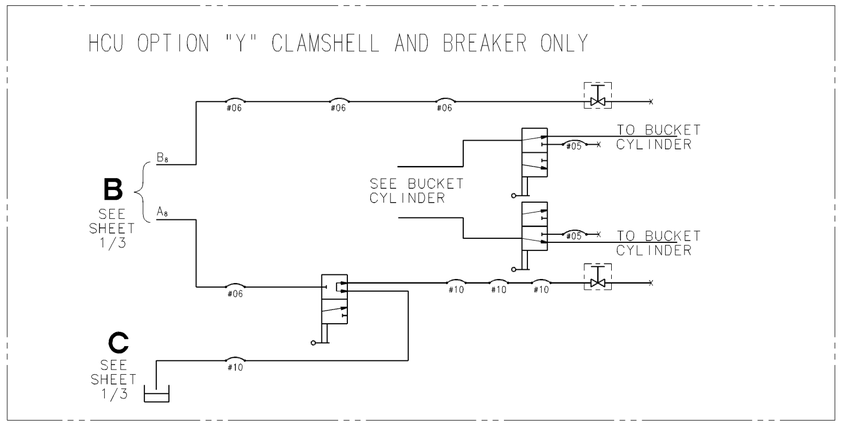


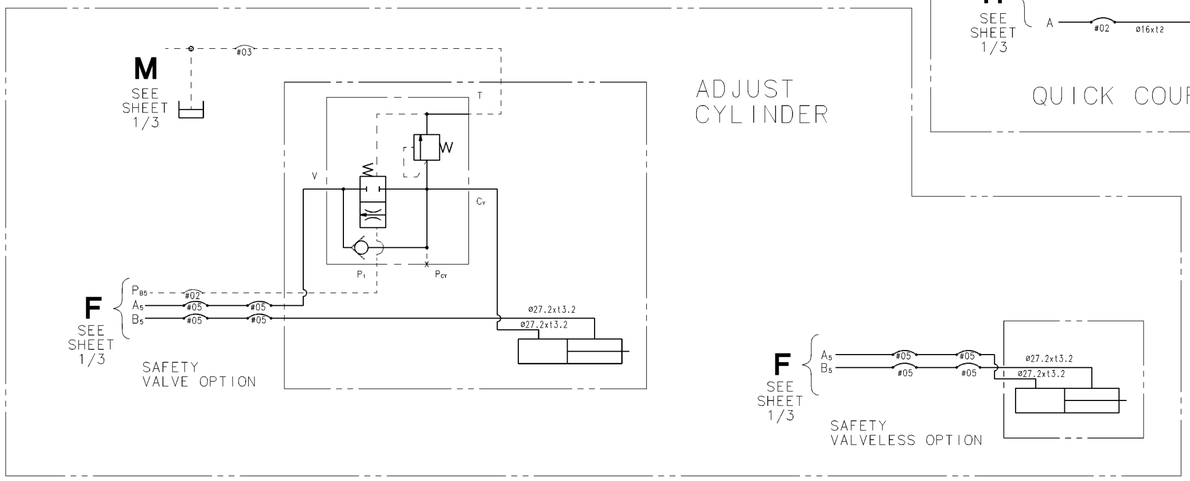
HYDRAULIC CIRCUIT DIAGRAM 2/3

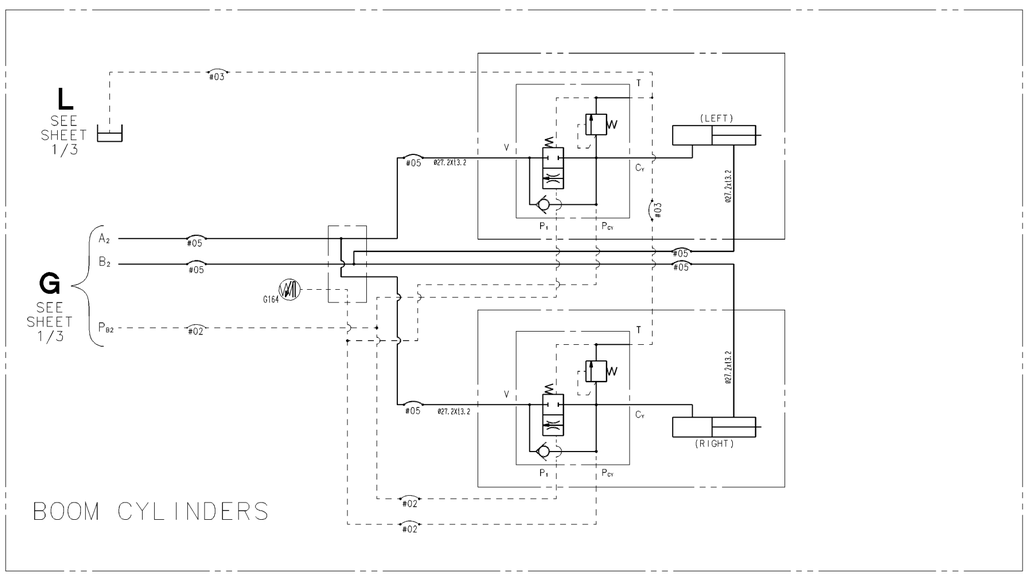


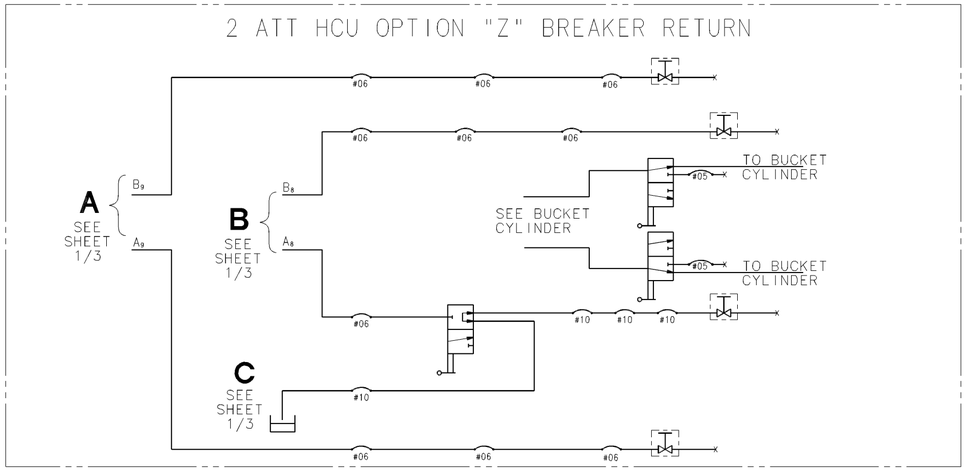


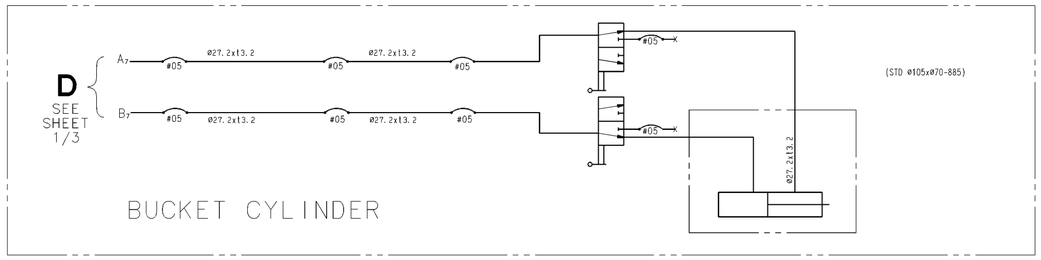




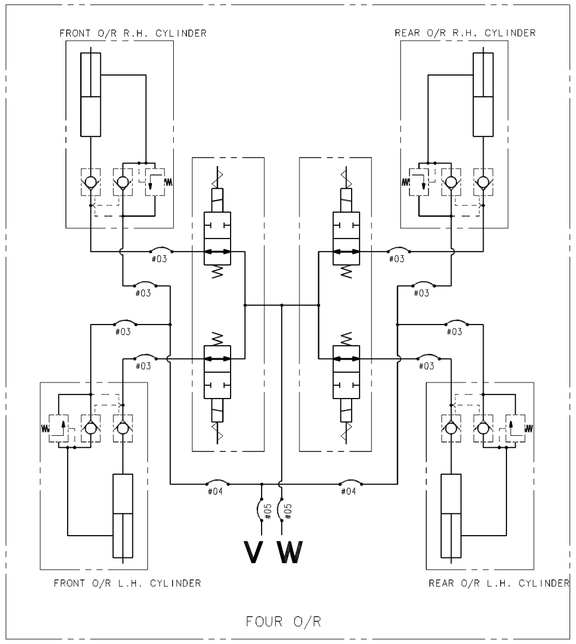




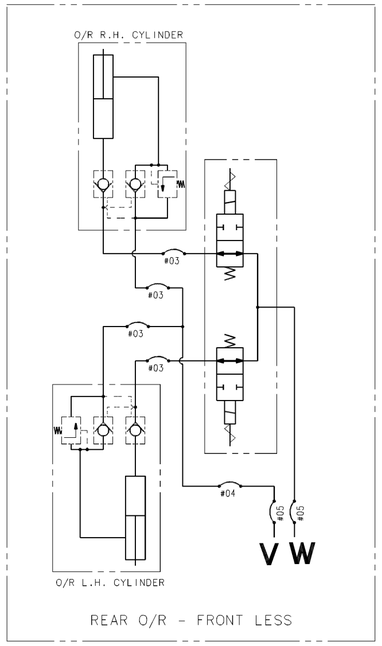




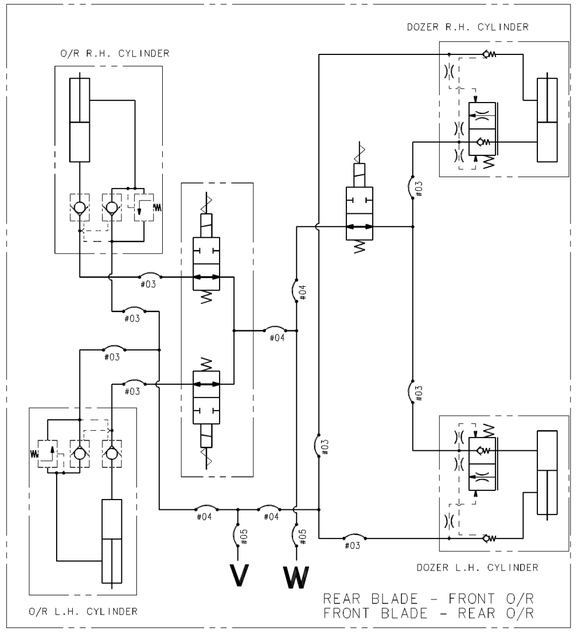
HYDRAULIC CIRCUIT DIAGRAM 3/3

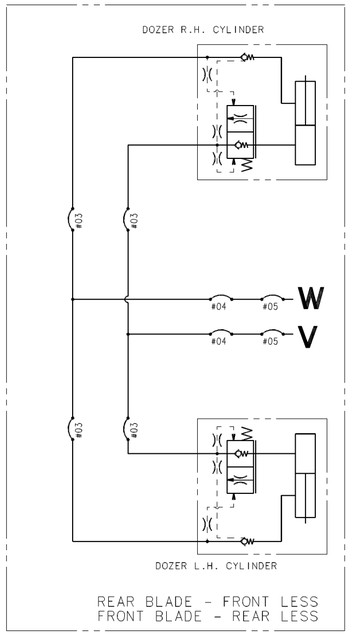


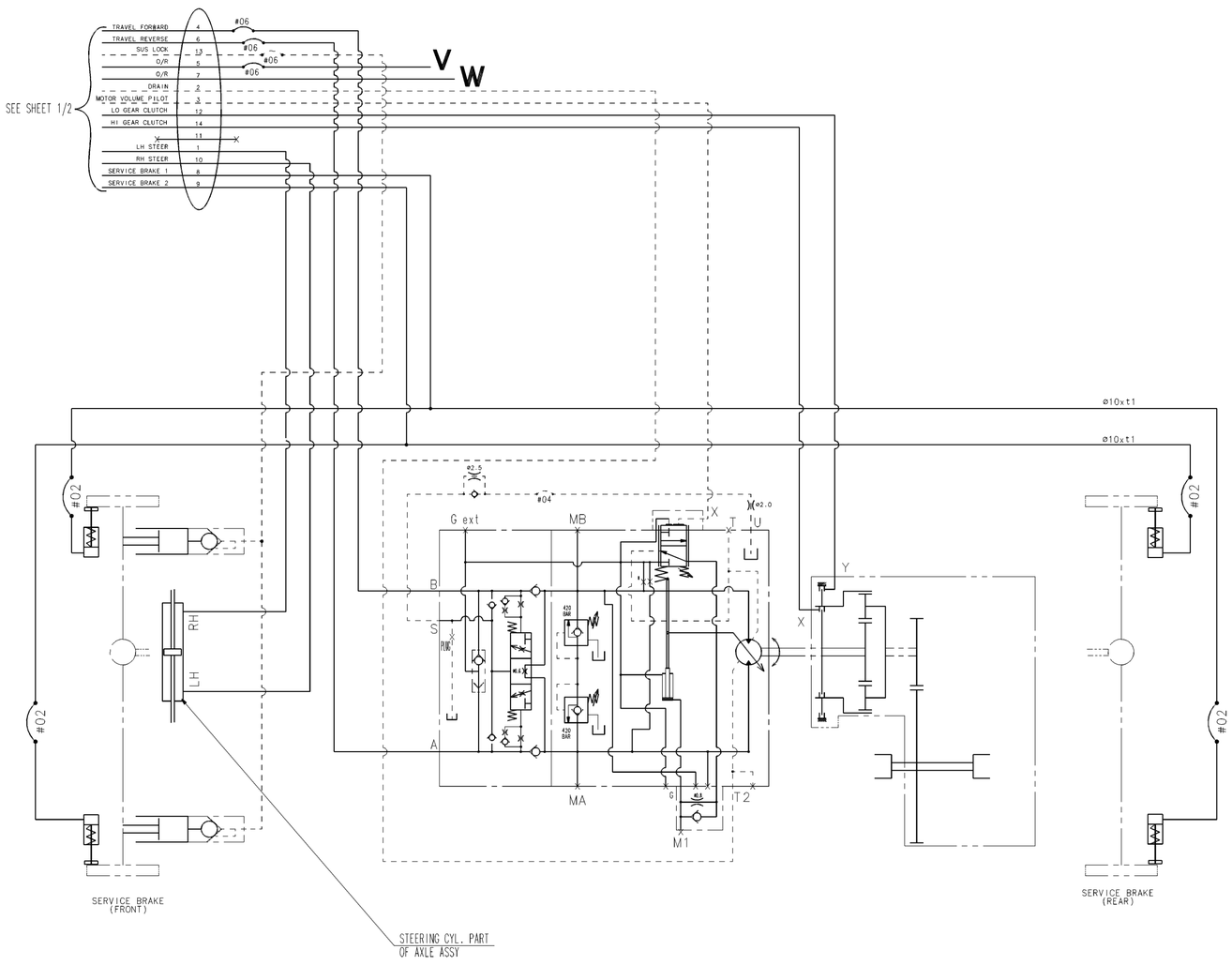
FOUR O/R



REAR O/R - FRONT LESS







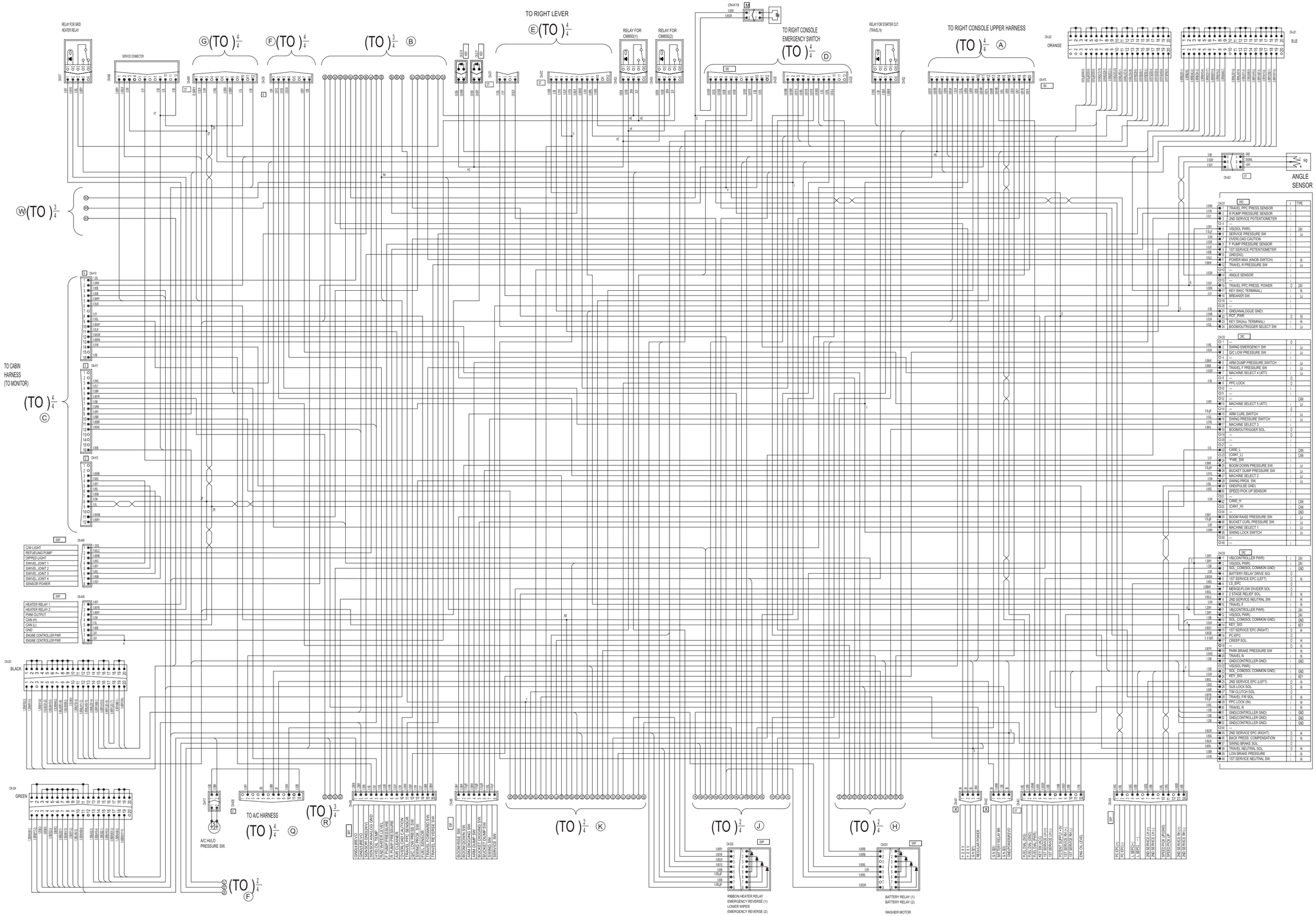
1) LOW SPEED : HIGH GEAR CLUTCH DISENGAGED (LOW SPEED CLUTCH ENGAGED)
HIGH SPEED : LOW GEAR CLUTCH DISENGAGED (HIGH SPEED CLUTCH ENGAGED)

LO GEAR = HI TORQUE (LO SPEED)
HI GEAR = LO TORQUE (HI SPEED)

2) MACHINE DEFAULTS TO LO SPEED AT START UP (NO FAULT CONDITION)

3) MACHINE DEFAULTS TO HI SPEED BEFORE ENG. START.

ELECTRICAL CIRCUIT DIAGRAM 1/7

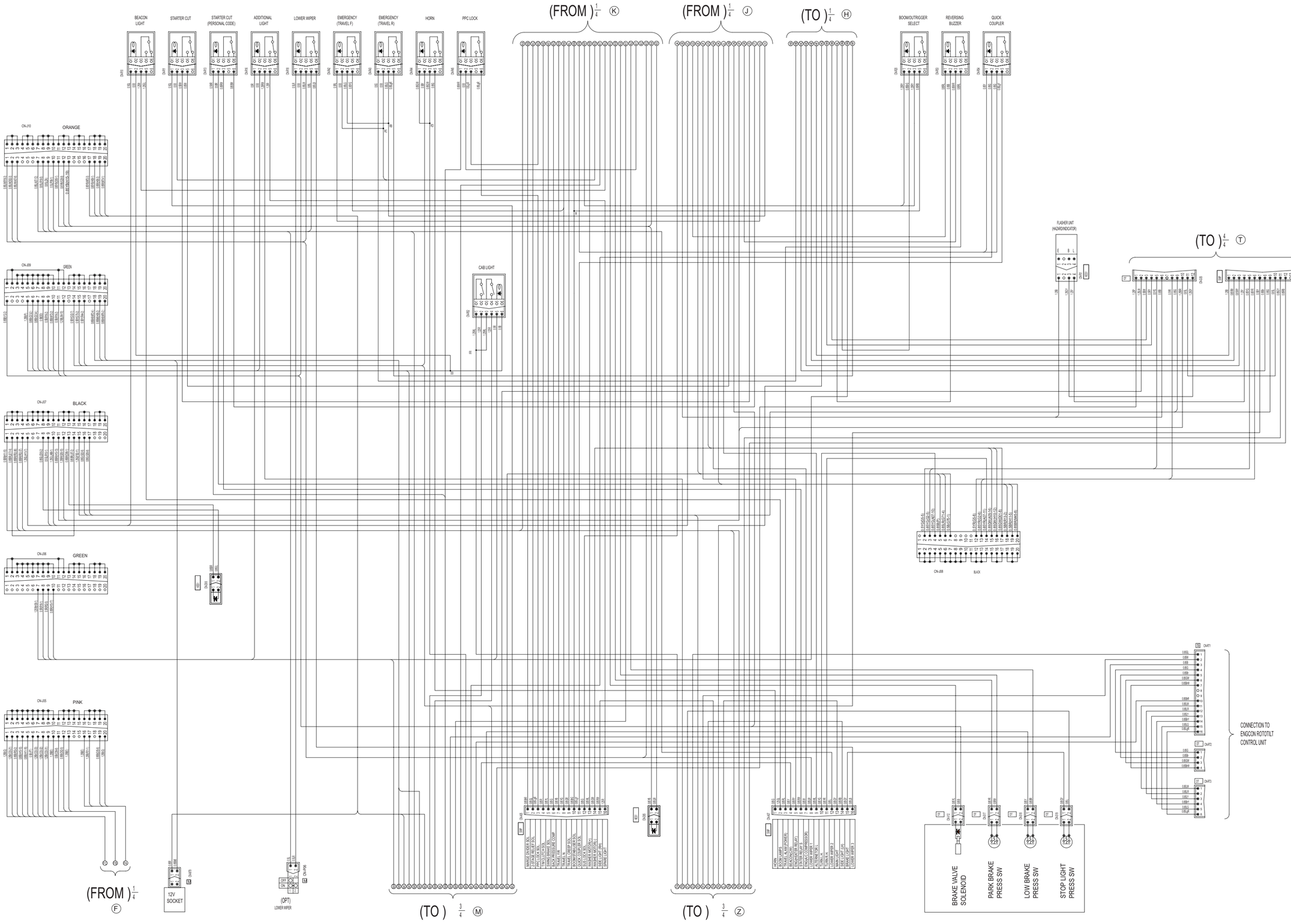


24C			
CN-237	1	TRAVEL PPC PRESS.SENSOR	I
	2	R PUMP PRESSURE SENSOR	I
	3	2ND SERVICE POTENTIOMETER	I
	4	—	
	5	VBI/SOL PWR)	I
	6	SERVICE PRESSURE SW	I
	7	OVERLOAD CAUTION	I
	8	F PUMP PRESSURE SENSOR	I
	9	1ST SERVICE POTENTIOMETER	I
	10	GND(SIG)	I
	11	POWER MAX (KNOB SWITCH)	I
	12	TRAVEL R PRESSURE SW	I
	13	—	I
	14	ANGLE SENSOR	I
	15	—	I
	16	TRAVEL PPC PRESS. POWER	O
	17	KEY SW(C TERMINAL)	I
	18	BREAKER SW.	I
	19	—	I
	20	—	I
	21	GND(ANALOGUE GND)	
	22	POT_PWR	O
	23	KEY SW(Acc TERMINAL)	I
	24	BOOM/OUTRIGGER SELECT SW.	I

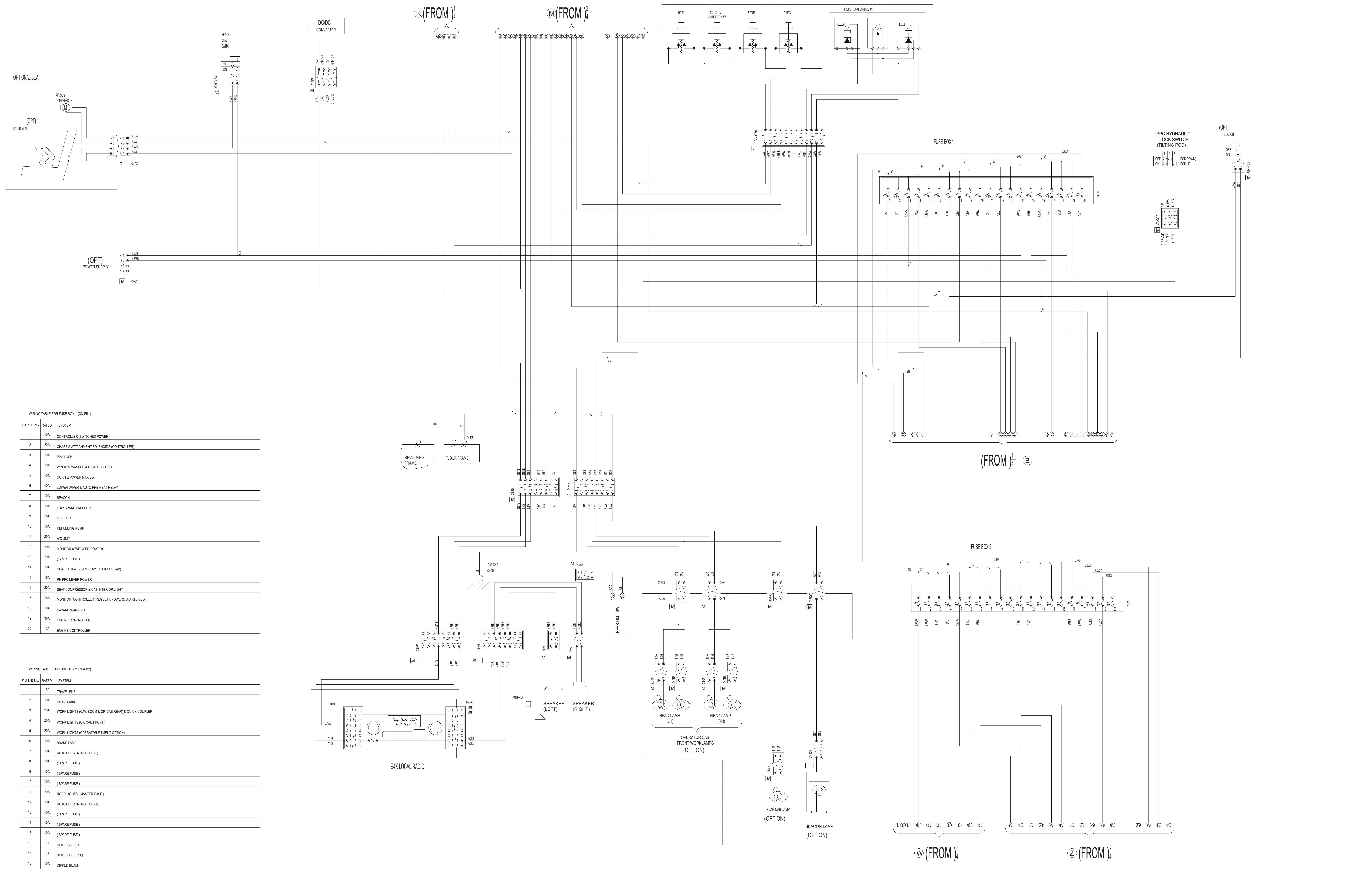
24C			
CN-238	1	—	O
	2	SWING EMERGENCY SW	I
	3	Q/C LOW PRESSURE SW.	I
	4	—	I
	5	ARM DUMP PRESSURE SWITCH	I
	6	TRAVEL F PRESSURE SW.	I
	7	MACHINE SELECT 4 (ATT)	I
	8	—	O
	9	PPC LOCK	O
	10	—	I
	11	—	I
	12	—	CAN
	13	MACHINE SELECT 5 (ATT)	I
	14	—	O
	15	ARM CURL SWITCH	I
	16	SWING PRESSURE SWITCH	I
	17	MACHINE SELECT 3	I
	18	BOOM/OUTRIGGER SOL	O
	19	—	O
	20	—	I
	21	CAN0_L	CAN
	22	CAN1_L	CAN
	23	*FWE_SW	I
	24	BOOM DOWN PRESSURE SW.	I
	25	BUCKET DUMP PRESSURE SW.	I
	26	MACHINE SELECT 2	I
	27	SWING PROX. SW.	I
	28	GND(PULSE GND)	I
	29	SPEED PICK UP SENSOR	I
	30	—	I
	31	CAN0_H	CAN
	32	CAN1_H	CAN
	33	—	GND
	34	BOOM RAISE PRESSURE SW.	I
	35	BUCKET CURL PRESSURE SW.	I
	36	MACHINE SELECT 1	I
	37	SWING LOCK SWITCH	I
	38	—	I
	39	—	I
	40	—	I

18C			
CN-233	1	VBI(CONTROLLER PWR)	I
	2	VISUSOL PWR)	I
	3	SOL_COM(SOL COMMON GND)	I
	4	BATTERY RELAY DRIVE SIG	O
	5	1ST SERVICE EPC (LEFT)	O
	6	LS_EPC	O
	7	MERGE/FLOW DIVIDER SOL	O
	8	2 STAGE RELIEF SOL	O
	9	2ND SERVICE NEUTRAL SW.	I
	10	TRAVEL F	I
	11	VBI(CONTROLLER PWR)	I
	12	VISUSOL PWR)	I
	13	SOL_COM(SOL COMMON GND)	I
	14	KEY_SIG	I
	15	1ST SERVICE EPC (RIGHT)	O
	16	PC-EPC	O
	17	CREEP SOL	O
	18	—	O
	19	PARK BRAKE PRESSURE SW	I
	20	TRAVEL N	I
	21	GND(CONTROLLER GND)	I
	22	VISUSOL PWR)	I
	23	SOL_COM(SOL COMMON GND)	I
	24	KEY_SIG	I
	25	2ND SERVICE EPC (LEFT)	O
	26	SUB LOCK SOL	O
	27	T/M CLUTCH SOL	O
	28	TRAVEL F/R SOL	O
	29	PPC LOCK (IN)	I
	30	TRAVEL R	I
	31	GND(CONTROLLER GND)	I
	32	GND(CONTROLLER GND)	I
	33	GND(CONTROLLER GND)	I
	34	—	I
	35	2ND SERVICE EPC (RIGHT)	O
	36	BACK PRESS. COMPENSATION	O
	37	SWING BRAKE SOL	O
	38	TRAVEL NEUTRAL SOL	O
	39	LOW BRAKE PRESSURE	I
	40	1ST SERVICE NEUTRAL SW.	I

ELECTRICAL CIRCUIT DIAGRAM 2/7



ELECTRICAL CIRCUIT DIAGRAM 3/7



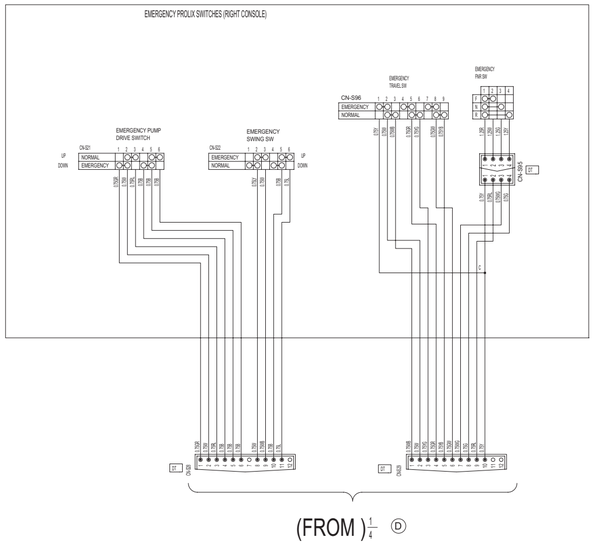
WIRING TABLE FOR FUSE BOX 1 (CN-FB1)

FUSE No.	RATED	SYSTEM
1	10A	CONTROLLER (SWITCHED POWER)
2	20A	CHASSIS ATTACHMENT SOLENOIDS (CONTROLLER)
3	10A	PPC LOCK
4	10A	WINDOW WASHER & CIGAR LIGHTER
5	10A	HORN & POWER MAX SW.
6	10A	LOWER WIPER & AUTO PRE-HEAT RELAY
7	10A	BEACON
8	10A	LOW BRAKE PRESSURE
9	15A	FLASHER
10	10A	REFUELING PUMP
11	20A	A/C UNIT
12	20A	MONITOR (SWITCHED POWER)
13	20A	(SPARE FUSE)
14	10A	HEATED SEAT & OPT POWER SUPPLY (24V)
15	15A	RH PPC LEVER POWER
16	20A	SEAT COMPRESSOR & CAB INTERIOR LIGHT
17	15A	MONITOR, CONTROLLER (REGULAR POWER), STARTER SW.
18	10A	HAZARD WARNING
19	30A	ENGINE CONTROLLER
20	5A	ENGINE CONTROLLER

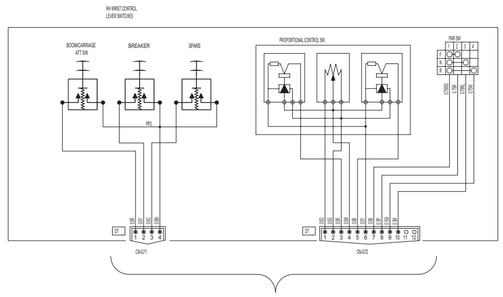
WIRING TABLE FOR FUSE BOX 2 (CN-FB2)

FUSE No.	RATED	SYSTEM
1	5A	TRAVEL FNR
2	10A	PARK BRAKE
3	20A	WORK LIGHTS (C/W, BOOM & OP. CAB REAR) & QUICK COUPLER
4	25A	WORK LIGHTS (OP. CAB FRONT)
5	20A	WORK LIGHTS (OPERATOR FITMENT OPTION)
6	10A	BRAKE LAMP
7	10A	ROTOTILT CONTROLLER (2)
8	10A	(SPARE FUSE)
9	10A	(SPARE FUSE)
10	10A	(SPARE FUSE)
11	20A	ROAD LIGHTS (MASTER FUSE)
12	10A	ROTOTILT CONTROLLER (1)
13	10A	(SPARE FUSE)
14	10A	(SPARE FUSE)
15	10A	(SPARE FUSE)
16	5A	SIDE LIGHT (LH)
17	5A	SIDE LIGHT (RH)
18	15A	DIPPED BEAM
19	15A	MAIN BEAM
20	10A	(SPARE FUSE)

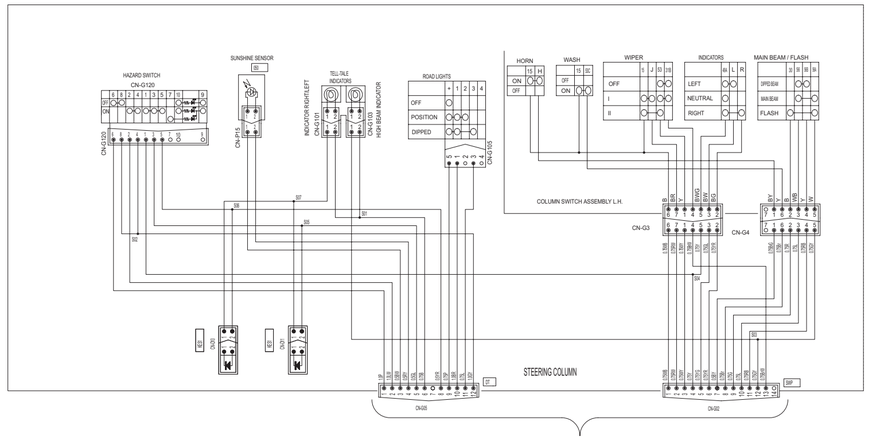
ELECTRICAL CIRCUIT DIAGRAM 4/7



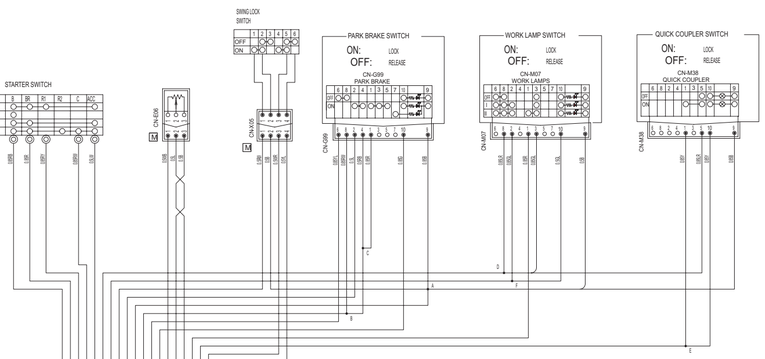
(FROM) 1/4 Ⓓ



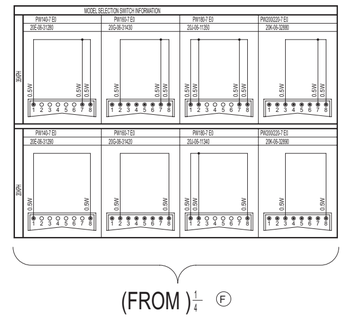
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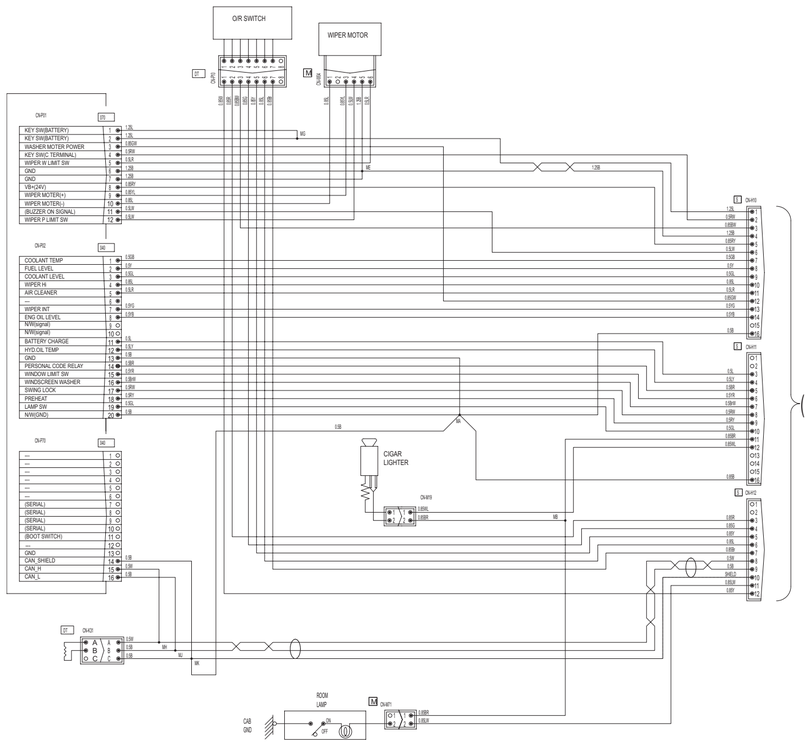
(FROM) 2/4 Ⓣ



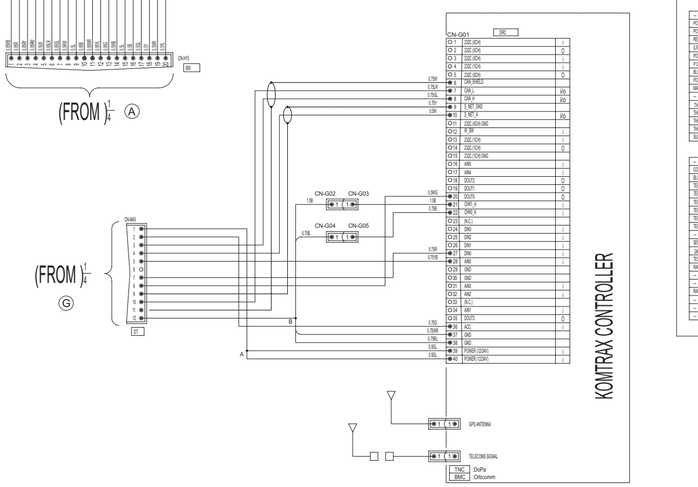
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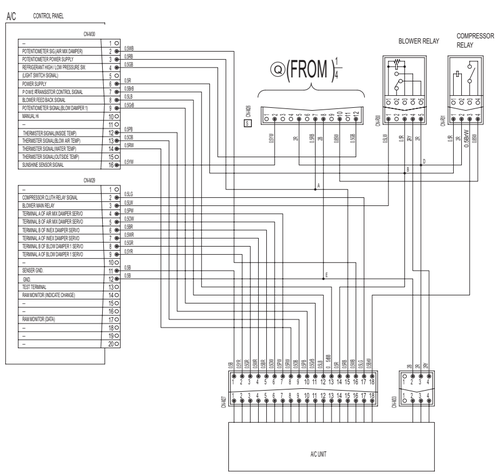
(FROM) 1/4 Ⓕ



(FROM) 1/4 Ⓒ

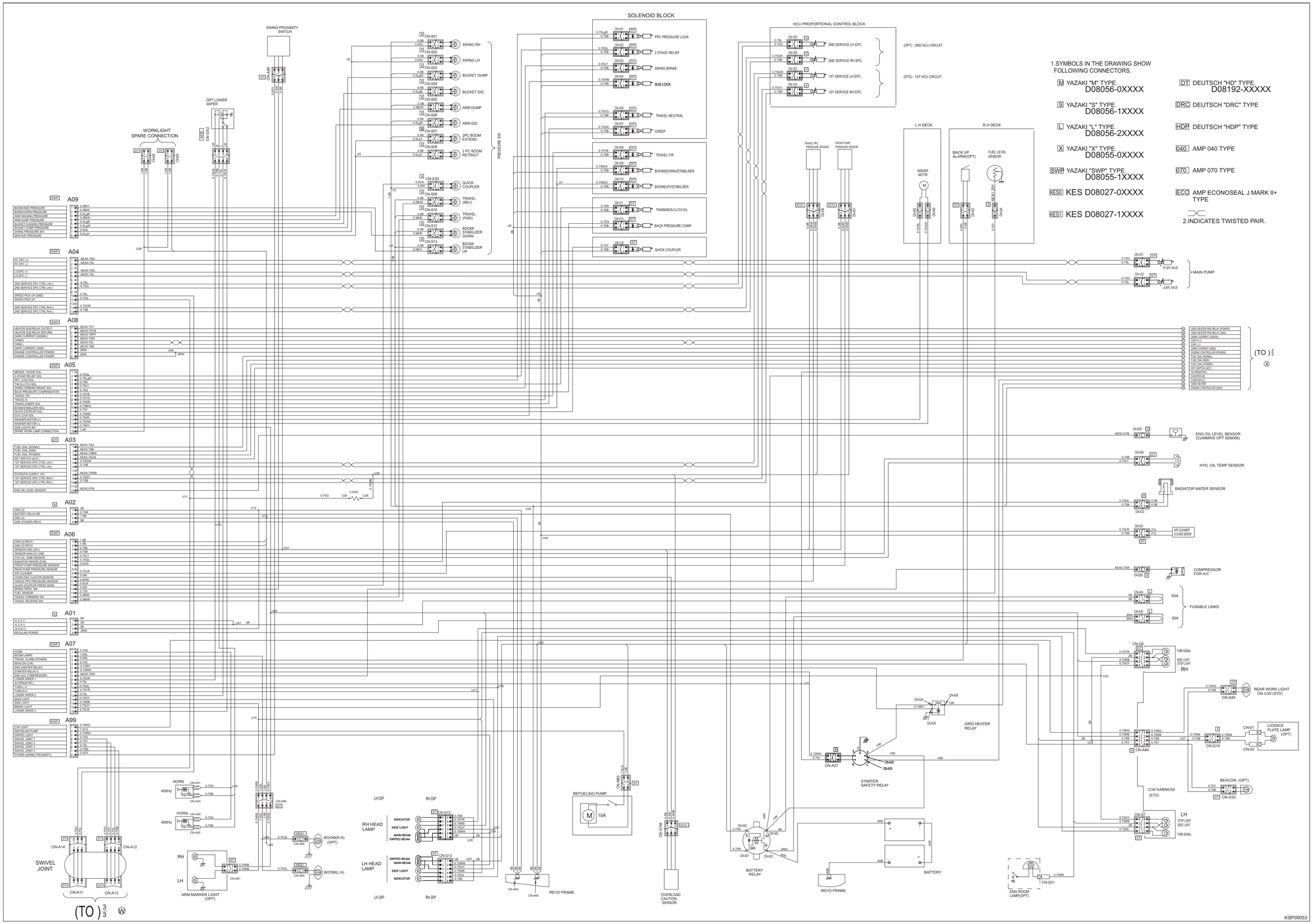


(FROM) 1/4 Ⓖ

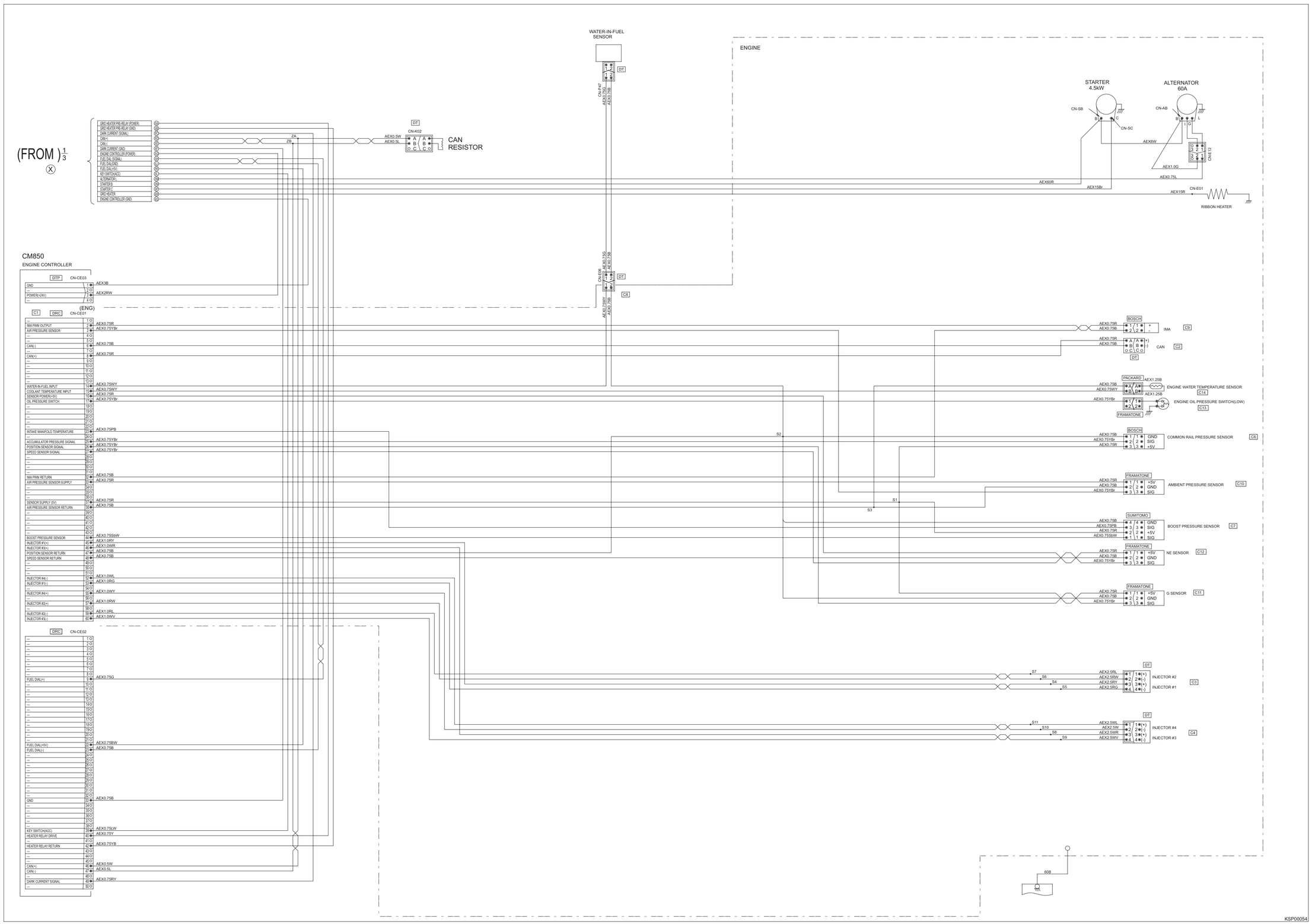


(FROM) 1/4 Ⓠ

ELECTRICAL CIRCUIT DIAGRAM 5/7

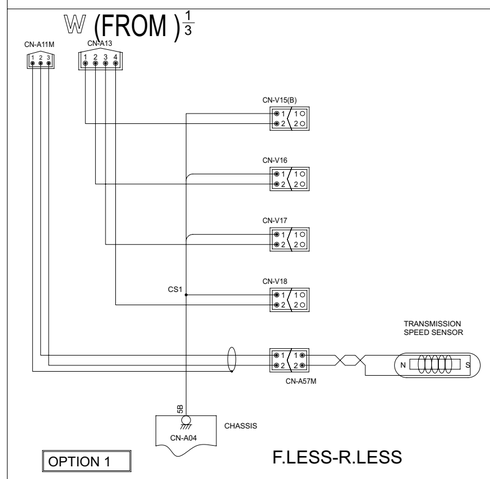


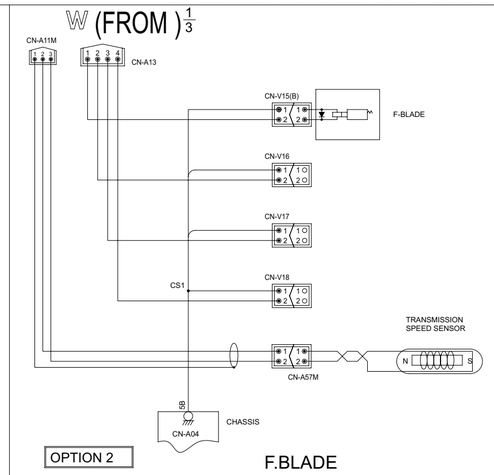
ELECTRICAL CIRCUIT DIAGRAM 6/7

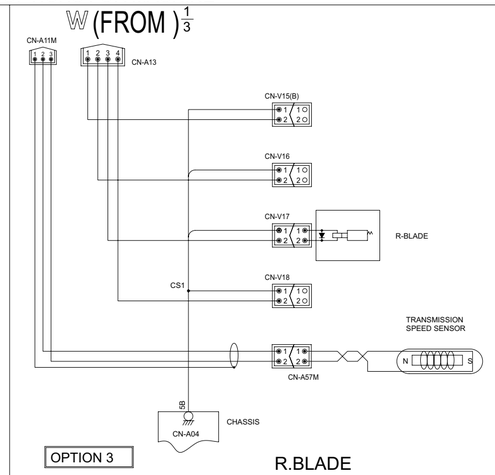


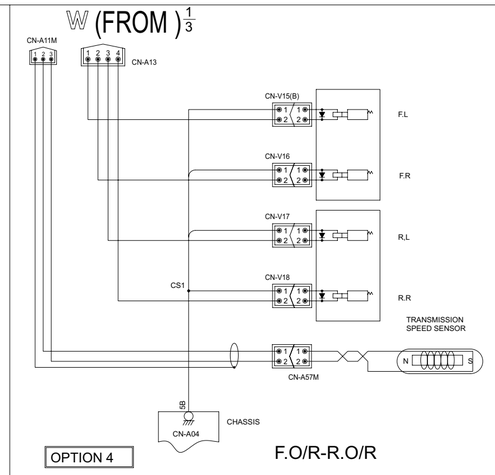
ELECTRICAL CIRCUIT DIAGRAM 7/7

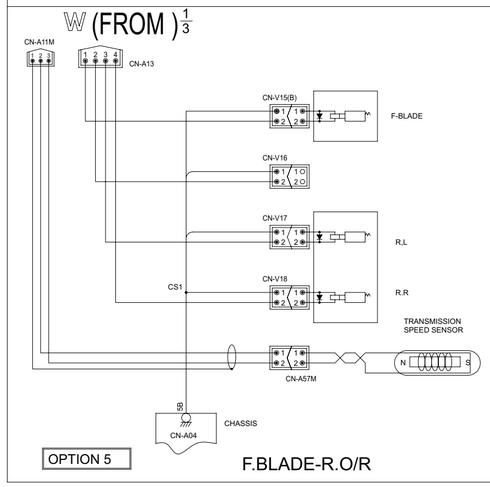
CHASSIS ATTACHMENT CONFIGURATION OPTIONS FOR MACHINE

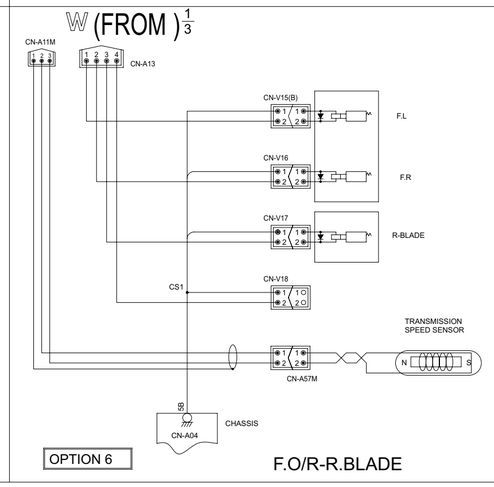


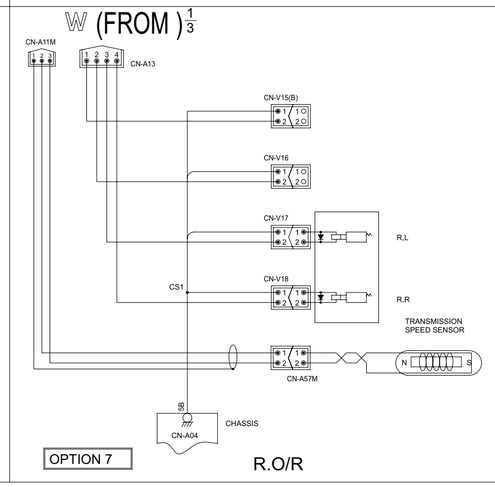


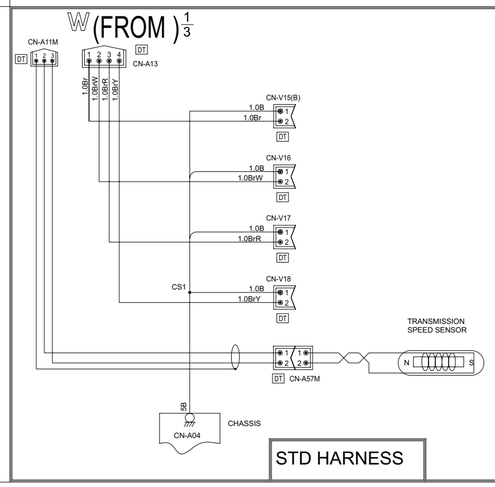












KSP00055