SHOP MANUAL

KOMATSU

PW160-7H

MACHINE MODEL	SERIAL NUMBER
PW160-7H	**H50051 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.
- PW160-7H mount the SAA4D102E-2 engine.
  For details of the engine, see the 102 Series Engine Shop Manual.

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CONTENTS

No. of page

01 GENERAL 01-1

10 STRUCTURE, FUNCTION AND MAINTENANCE STANDARD 10-1

20 TESTING AND ADJUSTING 20-1

30 DISASSEMBLY AND ASSEMBLY 30-1

90 OTHERS 90-1

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:

   10 - 3

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

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

10-4
10-4-1
10-4-2 — Added pages
10-5

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

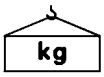
So that the shop manual can be of ample practical use, important places for safety and quality are marked with the following symbols.

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.
kg	Weight	Weight of parts or systems. Caution necessary when selecting hoisting wire or when working posture is important, etc.
kgm	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

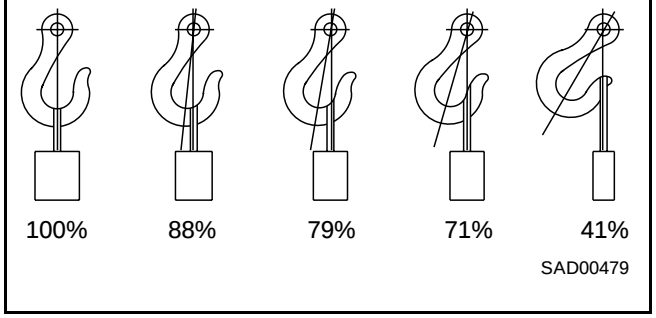
1. Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

Wire ropes
(Standard “Z” or “S” twist ropes without galvanizing)

Rope diameter	Allowable load	
mm	kN	tons
10	9.8	1.0
11.2	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.

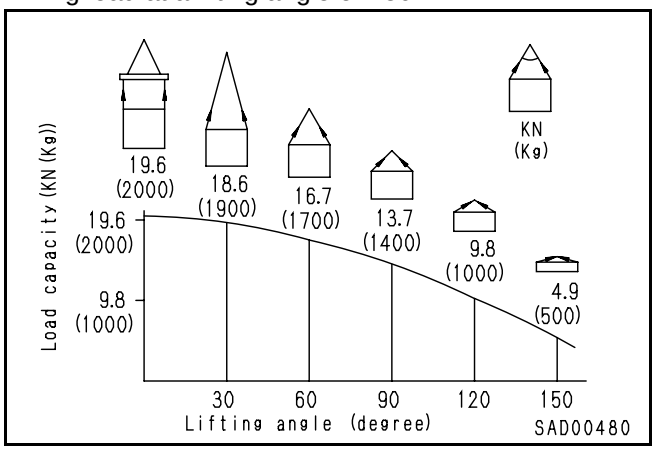
2. Sling wire ropes from the middle portion of the hook. Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result. Hooks have maximum strength at the middle portion.



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

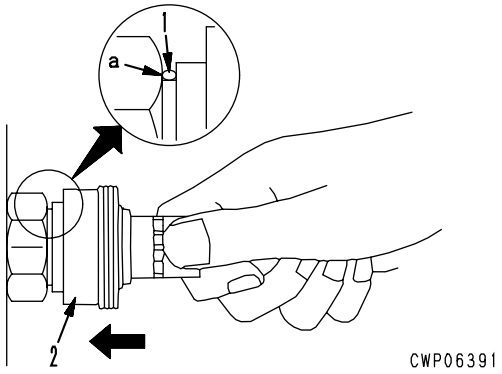
WARNING! Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident

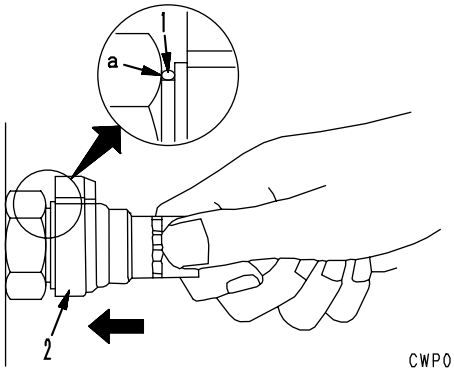
4. Do not sling a heavy load with ropes forming a wide hanging angle from the hook. When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles. The table below shows the variation of allowable load (kg) when hoisting is made with two ropes, each 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°

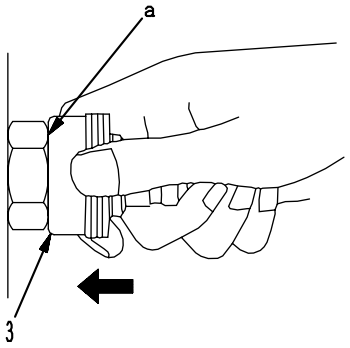


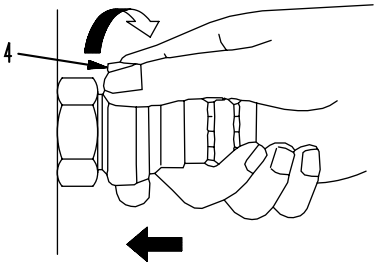
PUSH-PULL TYPE COUPLERS

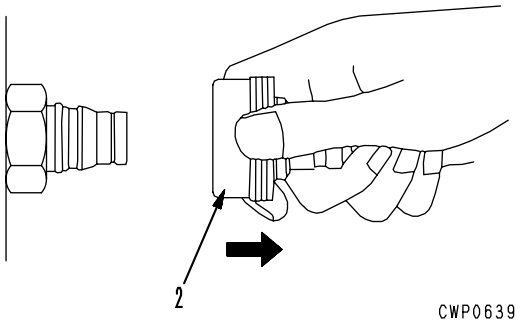
★ There are 2 types of push-pull type couplers. The method of connecting and disconnecting are different, so see the table below when connecting and disconnecting the coupler.

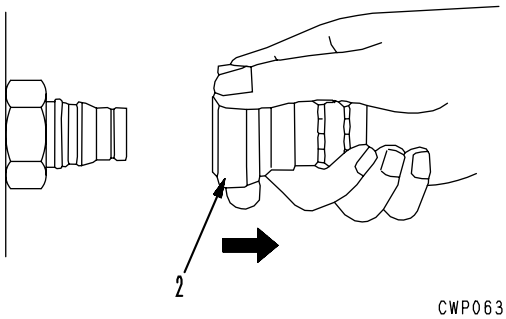
<table>
<tr><th></th><th>Type 1</th><th>Type 2</th></tr>
<tr><td rowspan="3">Disconnecting</td><td>1. Hold the mouthpiece of the tightening portion. Push the body (2) in straight until the sliding prevention ring (1) contacts the surface (a) of the hexagonal portion at the male end.
 

CWP06391</td><td>1. Hold the mouthpiece of the tightening portion. Push the body (2) in straight until the sliding prevention ring (1) contacts the surface (a) of the hexagonal portion at the male end.
 

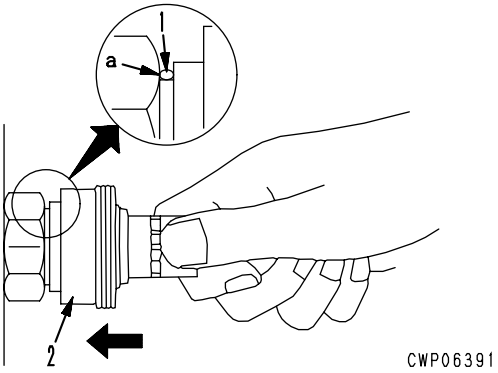
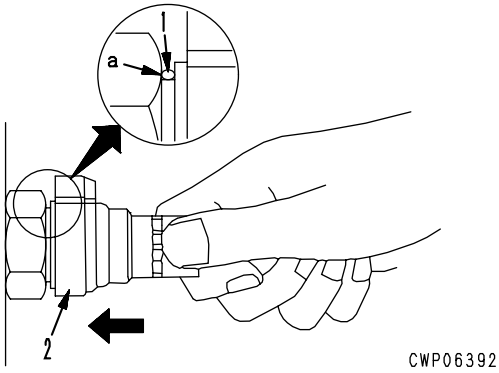
CWP06392</td></tr>
<tr><td>2. Hold in the condition in Step 1. Push in until the cover (3) contacts the surface (a) of the hexagonal portion at the male end.
 

CWP06393</td><td>2. Hold in the condition in Step 1. Turn lever (4) clockwise.
 

CWP06394</td></tr>
<tr><td>3. Hold in the condition in Steps 1 and 2. Pull out entire body (2) to disconnect it.
 

CWP06395</td><td>3. Hold in the condition in Steps 1 and 2. Pull out entire body (2) to disconnect it.
 

CWP06396</td></tr>
</table>

	Type 1	Type 2
Connection	• Hold the mouthpiece of the tightening portion. Push body (2) in straight until sliding prevention ring (1) contacts the contact surface (a) of the hexagonal portion at the male end to connect it. 	• Hold the mouthpiece of the tightening portion. Push body (2) in straight until sliding prevention ring (1) contacts the contact surface (a) of the hexagonal portion at the male end to connect it. 

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

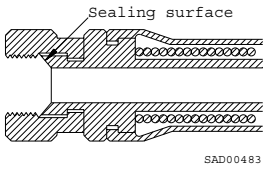
TIGHTENING TORQUE OF SPLIT FLANGE BOLTS

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 TORQUE FOR FLARED NUTS

Use these torques for flared part of nut.



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

TIGHTENING TORQUE FOR 102 ENGINE SERIES (BOLTS AND NUTS)

Use these torque values for bolts and nuts (unit: mm).

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

TIGHTENING TORQUE FOR 102 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 102 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.

Millimeters to inches — 1 mm = 0.03937 in

	0	1	2	3	4	5 ②	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				
50 ①	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

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

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

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

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

Liter to U.S. Gallon **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

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

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

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

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

kg/cm^2 to lb/in^2

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

	0	1	2	3	4	5	6	7	8	9
0	0	14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.4	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.1	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	995.6	1010	1024	1038	1053	1067	1081	1095	1109	1124
80	1138	1152	1166	1181	1195	1209	1223	1237	1252	1266
90	1280	1294	1309	1323	1337	1351	1365	1380	1394	1408
100	1422	1437	1451	1465	1479	1493	1508	1522	1536	1550
110	1565	1579	1593	1607	1621	1636	1650	1664	1678	1693
120	1707	1721	1735	1749	1764	1778	1792	1806	1821	1835
130	1849	1863	1877	1892	1906	1920	19324	1949	1963	1977
140	1991	2005	2034	2048	2062	2077	2091	2105	2119	
150	2134	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2389	2404
170	2418	2432	2446	2460	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	2603	2617	2631	2646	2660	2674	2688
190	2702	2717	2731	2745	2759	2773	2788	2802	2816	2830
200	2845	2859	2873	2887	2901	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3343	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

Temperature

Fahrenheit Centigrade Conversion; a simple way to convert a Fahrenheit temperature reading into a Centigrade temperature reading or vise versa is to enter the accompanying table in the center or boldface column of figures. These figures refer to the temperature in either Fahrenheit or Centigrade degrees. If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left. If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

°C		°F	°C		°F	°C		°F	°C		°F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	.35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4	85	185.0
-28.3	-19	-2.2	-8.9	16	60.8	10.6	51	123.8	30.0	86	186.8
-27.8	-18	-0.4	-8.3	17	62.6	11.1	52	125.6	30.6	87	188.6
-27.2	-17	1.4	-7.8	18	64.4	11.7	53	127.4	31.1	88	190.4
-26.7	-16	3.2	-7.2	19	66.2	12.2	54	129.2	31.7	89	192.2
-26.1	-15	5.0	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-25.6	-14	6.8	-6.1	21	69.8	13.3	56	132.8	32.8	91	195.8
-25.0	-13	8.6	-5.6	22	71.6	13.9	57	134.6	33.3	92	197.6
-24.4	-12	10.4	-5.0	23	73.4	14.4	58	136.4	33.9	93	199.4
-23.9	-11	12.2	-4.4	24	75.2	15.0	59	138.2	34.4	94	201.2
-23.3	-10	14.0	-3.9	25	77.0	15.6	60	140.0	35.0	95	203.0
-22.8	-9	15.8	-3.3	26	78.8	16.1	61	141.8	35.6	96	204.8
-22.2	-8	17.6	-2.8	27	80.6	16.7	62	143.6	36.1	97	206.6
-21.7	-7	19.4	-2.2	28	82.4	17.2	63	145.4	36.7	98	208.4
-21.1	-6	21.2	-1.7	29	84.2	17.8	64	147.2	37.2	99	210.2
-20.6	-5	23.0	-1.1	30	86.0	18.3	65	149.0	37.8	100	212.0
-20.0	-4	24.8	-0.6	31	87.8	18.9	66	150.8	40.6	105	221.0
-19.4	-3	26.6	0	32	89.6	19.4	67	152.6	43.3	110	230.0
-18.9	-2	28.4	0.6	33	91.4	20.0	68	154.4	46.1	115	239.0
-18.3	-1	30.2	1.1	34	93.2	20.6	69	156.2	48.9	120	248.0
-17.8	0	32.0	1.7	35	95.0	21.1	70	158.0	51.7	125	257.0
-17.2	1	33.8	2.2	36	96.8	21.7	71	159.8	54.4	130	266.0
-16.7	2	35.6	2.8	37	98.6	22.2	72	161.6	57.2	135	275.0
-16.1	3	37.4	3.3	38	100.4	22.8	73	163.4	60.0	140	284.0
-15.6	4	39.2	3.9	39	102.2	23.3	74	165.2	62.7	145	293.0
-15.0	5	41.0	4.4	40	104.0	23.9	75	167.0	65.6	150	302.0
-14.4	6	42.8	5.0	41	105.8	24.4	76	168.8	68.3	155	311.0
-13.9	7	44.6	5.6	42	107.6	25.0	77	170.6	71.1	160	320.0
-13.3	8	46.4	6.1	43	109.4	25.6	78	172.4	73.9	165	329.0
-12.8	9	48.2	6.7	44	111.2	26.1	79	174.2	76.7	170	338.0
-12.2	10	50.0	7.2	45	113.0	26.7	80	176.0	79.4	175	347.0

UNITS

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

Example:

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

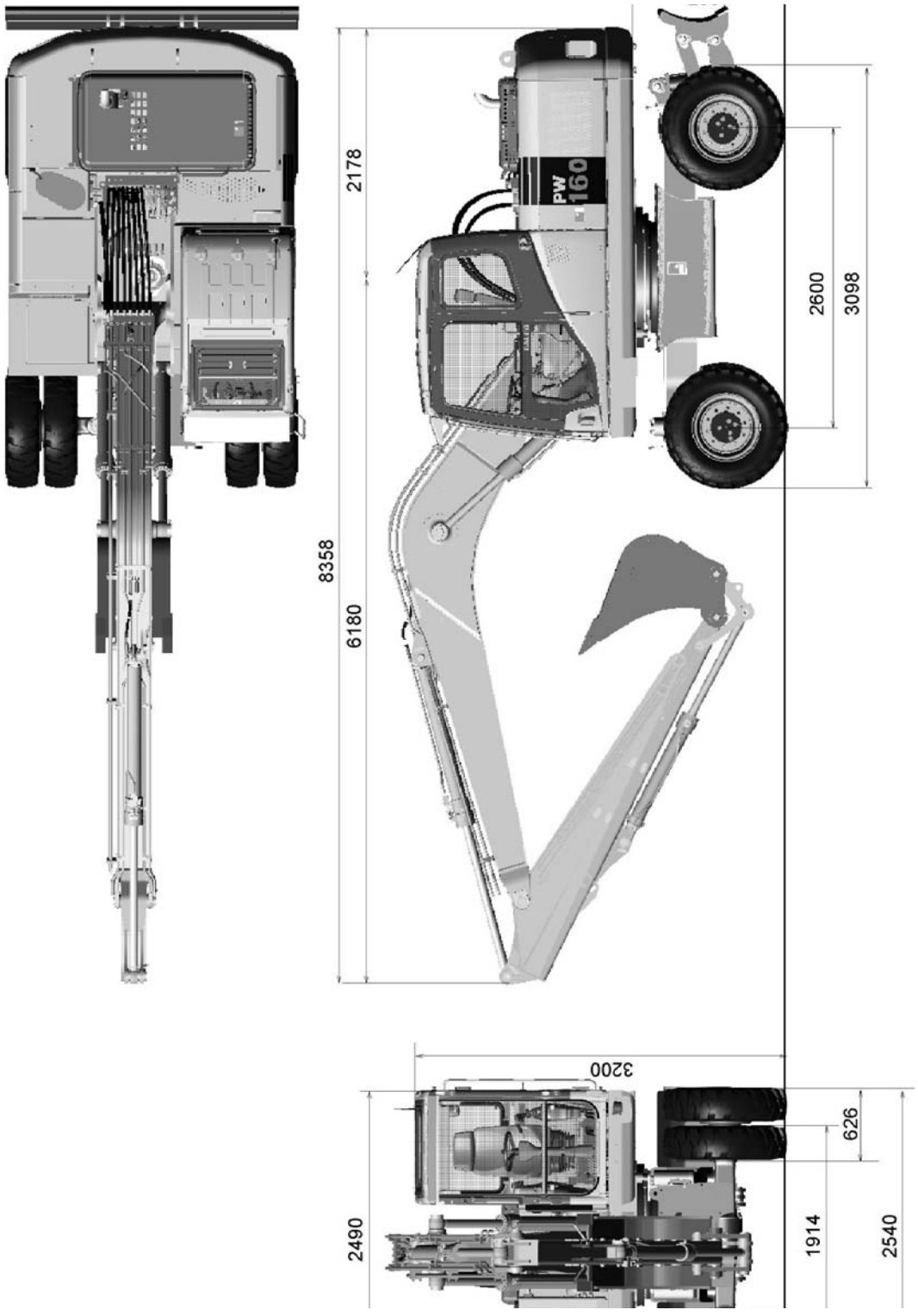
01 GENERAL

Specification Dimension Drawings
1 Piece Boom 01-2
2 Piece Boom 01-3
Working range
1 Piece Boom 01-4
2 Piece Boom 01-5
Specifications. 01-6
Weight Table 01-8
Fuel, Coolant, And Lubricants 01-11

SPECIFICATION DIMENSION DRAWINGS

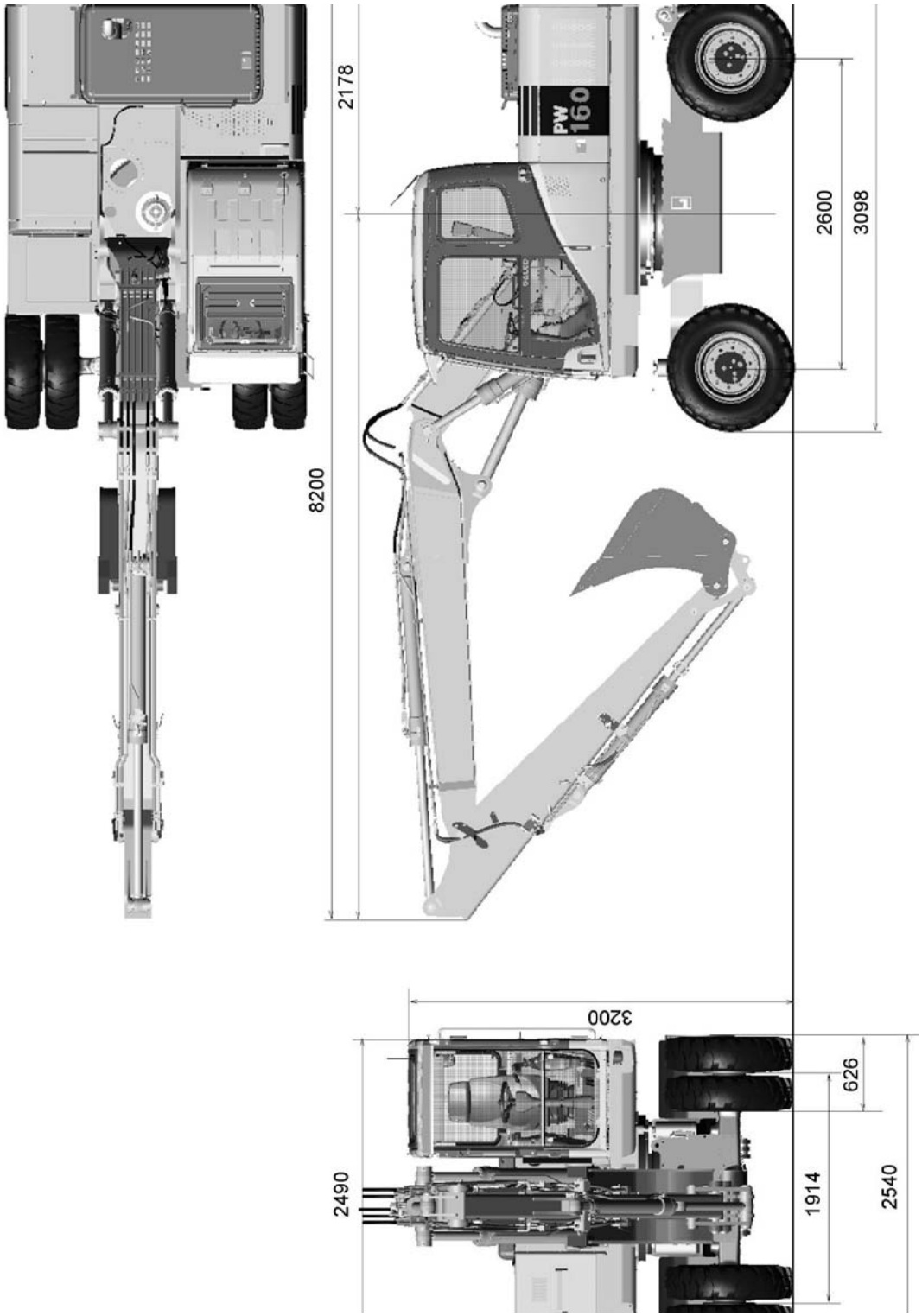
DIMENSIONS

1 PIECE BOOM



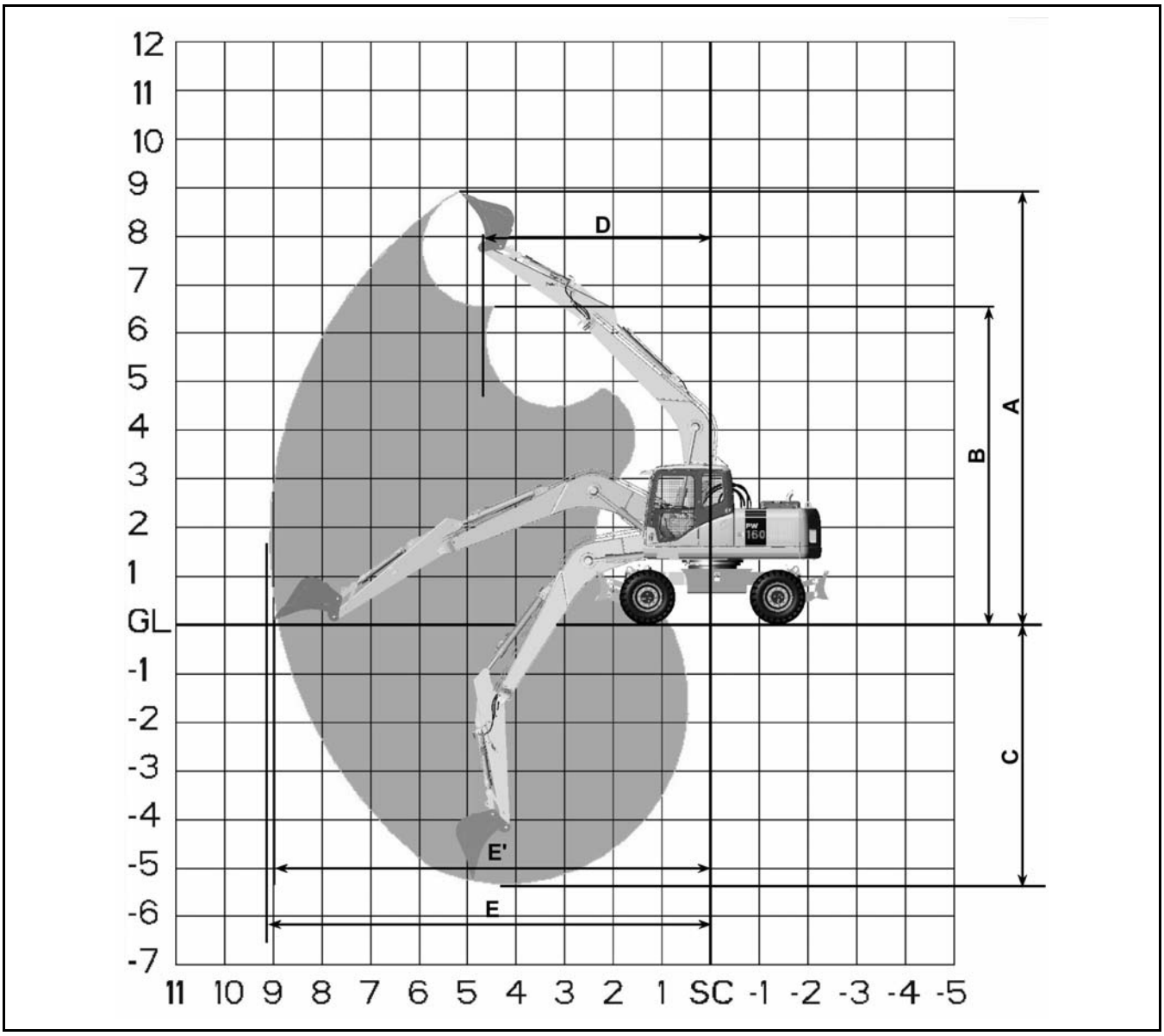
DIMENSIONS

2 PIECE BOOM



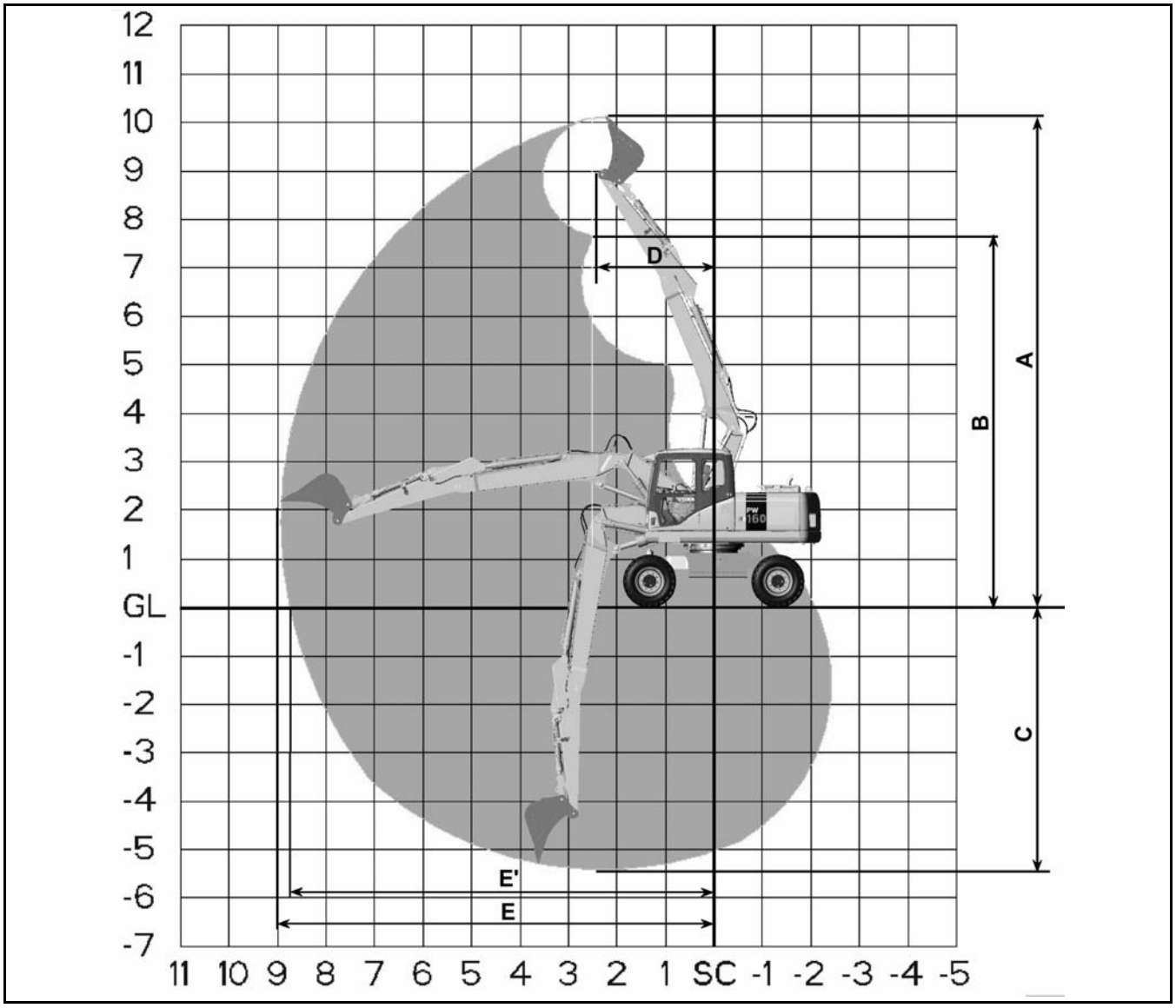
WORKING RANGES

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				PW160-7H
Serial Number				H50051 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

Machine model							PW160-7H	
Serial Number							H50051 and up	
Engine	Model Type No. of cylinders - bore x stroke Piston displacement				mm l {cc}		SAA4D102E-2 4-cycle, water-cooled, in-line, vertical, direct injection, with turbo charger 4 - 102 x 120 3.9 {3900}	
	Performance	Flywheel horsepower Max. torque Max. speed at no load Min. speed at no load			kW/rpm Nm/rpm rpm rpm		93.3/2200 481/1400 2,450 950	
	Starting motor Alternator Battery						24V, 4.5 kW 24V, 40 A 12V, 95 Ah x 2	
	Radiator core type						Triple Cooler	
Hydraulic system	Hydraulic pump	Type x No. Delivery Set pressure			l/min MPa (kg/cm²)		HPV140, variable displacement Piston type: 308 x 1 Piston type: 37.2 {380}	
	Control valve	Type x No. Control method	1 Piece Boom				7-spool + 1 service spool type x 1 Hydraulic	
			2 Piece Boom				8-spool + 1 service spool type x 1 Hydraulic	
	Hydraulic motor	Travel motor Swing motor					A6VM107 HAXT/63W-VAB380A-SK, Piston type (with counter balance valve): x 1 MSF85P, Piston type (with safety valve, holding brake): x 1	
	Hydraulic culinder	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
		2 Pice Boom	Type			Adjust	Boom	Arm	Bucket
						Double acting piston	L.H / R.H Double acting piston	Double acting piston	Double acting piston
			Inside diameter of cylinder Diameter of piston rod Stroke Max. distance between pins Min. distance between pins		mm mm mm mm mm	160 100 702 1,900 1,198	115 75 996 2,523 1,527	115 80 1,175 2,877 1,702	105 70 885 2,263 1,378
	Hrdraulic tank Hydraulic filter Hydraulic cooler						Closed box type Tank return side 7320/7043 (Air cooled)	

WEIGHT TABLE

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

Unit: kg

Machine model		PW160-7H
Serial Number		H50051 and up
Engine assembly • Engine • Damper • Hydraulic pump		453.5 338 1.5 114
Radiator oil cooler assembly		90
Hydraulic tank, filter assembly (excluding hydraulic oil)		123
Fuel tank (excluding fuel)		120
Revolving frame		1,620
Operator's cab		286
Operator's seat	Mechanical	38
	Air Suspension	42
Counterweight		3,100
Swing machinery		170
Control valve		107
Travel motor		66
Center swivel joint		95

1 PIECE BOOM

Unit: kg

Machine model		PW160-7H
Serial Number		H50051 and up
Boom assembly		980
Arm assembly	2.1m	291
	2.5m	328
	3.0m	442
Bucket assembly		460
Lift cylinder	Left Hand	135
	Right Hand	135
Arm cylinder assembly		140
Bucket cylinder assembly	2.1m	90
	2.5m	
	3.0m	
Link / pins assembly		112.8
Boom pin		20+12
Arm pin		12

2 PIECE BOOM

Unit: kg

Machine model		PW160-7H
Serial Number		H50051 and up
Boom assembly	1st Boom	470
	2nd Boom	684
Arm assembly	2.1m	291
	2.5m	328
	3.0m	442
Bucket assembly		460
Lift cylinder	Left Hand	128
	Right Hand	128
Adjust cylinder		195
Arm cylinder assembly		215.4
Bucket cylinder assembly	2.1m	90
	2.5m	
	3.0m	
Link / pins assembly		112.8
Boom pin	1st Boom	26.5
	2nd Boom	26
Arm pin		12

FUEL, COOLANT AND LUBRICANTS

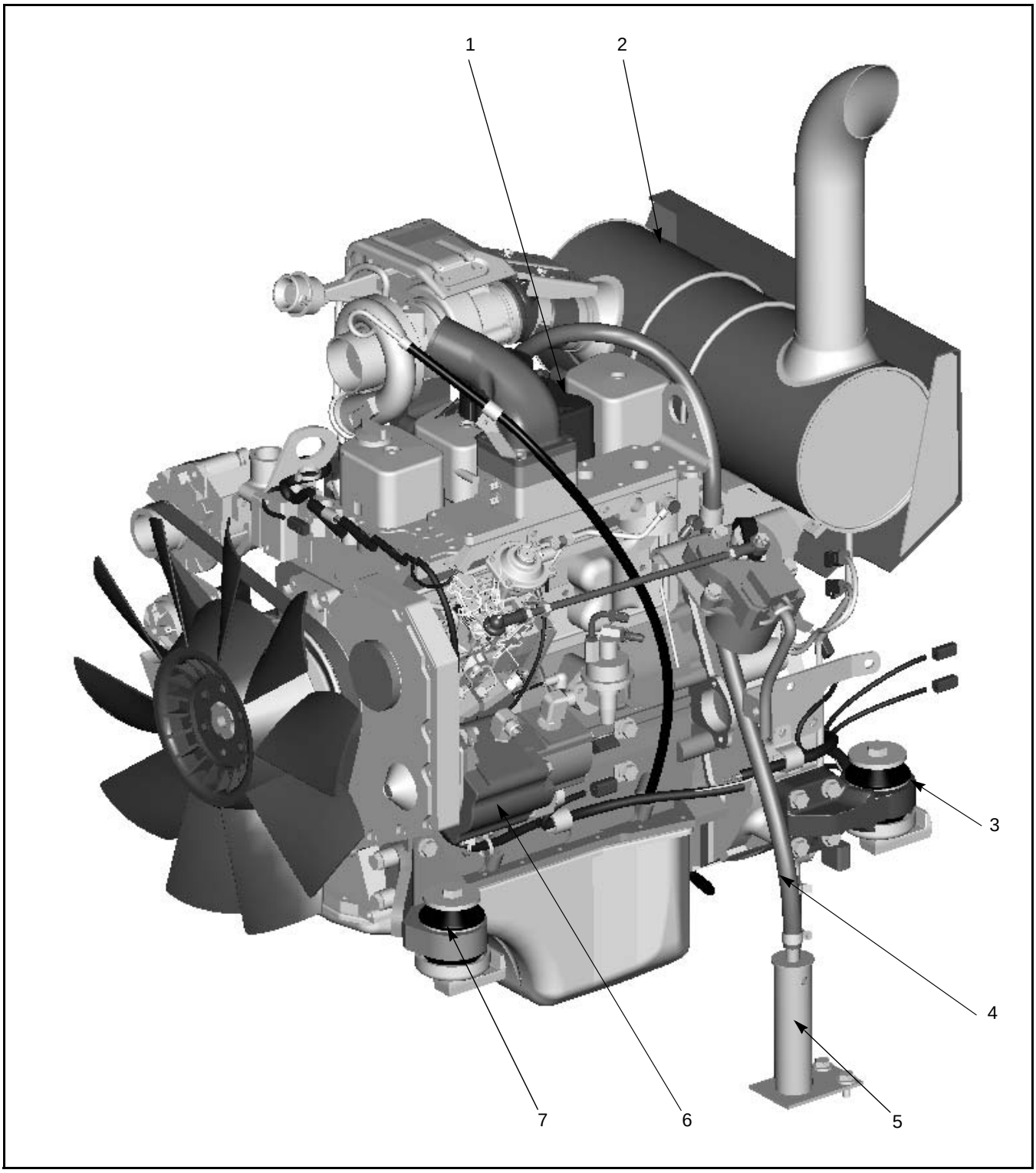
RESERVOIR		KIND OF FLUID	AMBIENT TEMPERATURE -22 -4 14 32 50 68 86 104°F -30 -20 -10 0 10 20 30 40°C	CAPACITY (l)	
				Specified	Refill
Engine oil pan		Engine oil	SAE 30 / SAE 10W / SAE 10W-30 / SAE 15W-40	16	16
Swing machinery case			SAE 30	4.5	4.5
Hydraulic system			SAE 10W / SAE 10W-30 / SAE 15W-40	160	120
		Hydraulic oil	H046-HM (H)		
Fuel tank		Diesel fuel	ASTM D975 No. 2 / ASTM D975A No.1	290	—
Cooling system		Water	Add antifreeze	14.5	—
Axles	Front	Multi oil		11.5	—
					—
	Rear		Fuchs titan hydra 20W-40	9.5	—
					—
Transmission + clutch			BP traction 8	4.85	4.85
Hubs	Front		Fuchs titan hydra 20W-40	2.5	—
	Rear			2.0	—

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

10 STRUCTURE, FUNCTION AND MAINTENANCE STANDARD

Engine Related Parts 10-2
Radiator • Oil Cooler • Charge air cooler 10-3
Power Train 10-4
Swing Circle 10-6
Swing Machinery 10-8
Swing Motor 10-12
Undercarriage 10-18
Transmission 10-20
Travel Motor 10-23
Clutch Control Circuit 10-27
Axle 10-30
Suspension Lock Cylinder 10-34
Braking System 10-36
Brake/Steer Pump 10-38
Priority Valve 10-39
Power Brake Valve 10-40
Accumulator for Brake System 10-42
Steering Train 10-43
Steering Column 10-44
Orbitrol Valve 10-45
Hydraulic Layout Drawing 10-46
Hydraulic Circuit Diagram 10-48
Hydraulic Tank 10-49
Hydraulic Pump 10-50
Pilot Pressure Control System 10-71
Control Valve 10-72
CLSS 10-82
Centre Swivel Joint 10-102
Travel PPC Pedal 10-103
Work Equipment • Swing PPC Valve 10-106
Service PPC Pedal 10-110
Solenoid Valve Manifold 10-113
Boom Safety Valve 10-122
Hydraulic Cylinder (Boom-Arm-Bucket) 10-124
Outrigger Cylinder 10-126
Dozer Cylinder 10-128
Work Equipment 10-130
Air Conditioner 10-134
Electrical Wiring Diagram 10-135
Engine Control System 10-136
Electronic control System 10-142
Machine Monitor System 10-168
Overload Warning Device 10-196
Sensor 10-197
1st Attachment Cicuit Hydraulic Perfomance (Main Valve Bypassed) 10-204
Travel System 10-206
Steering System 10-228
Service Brake and Suspension System 10-241

ENGINE RELATED PARTS

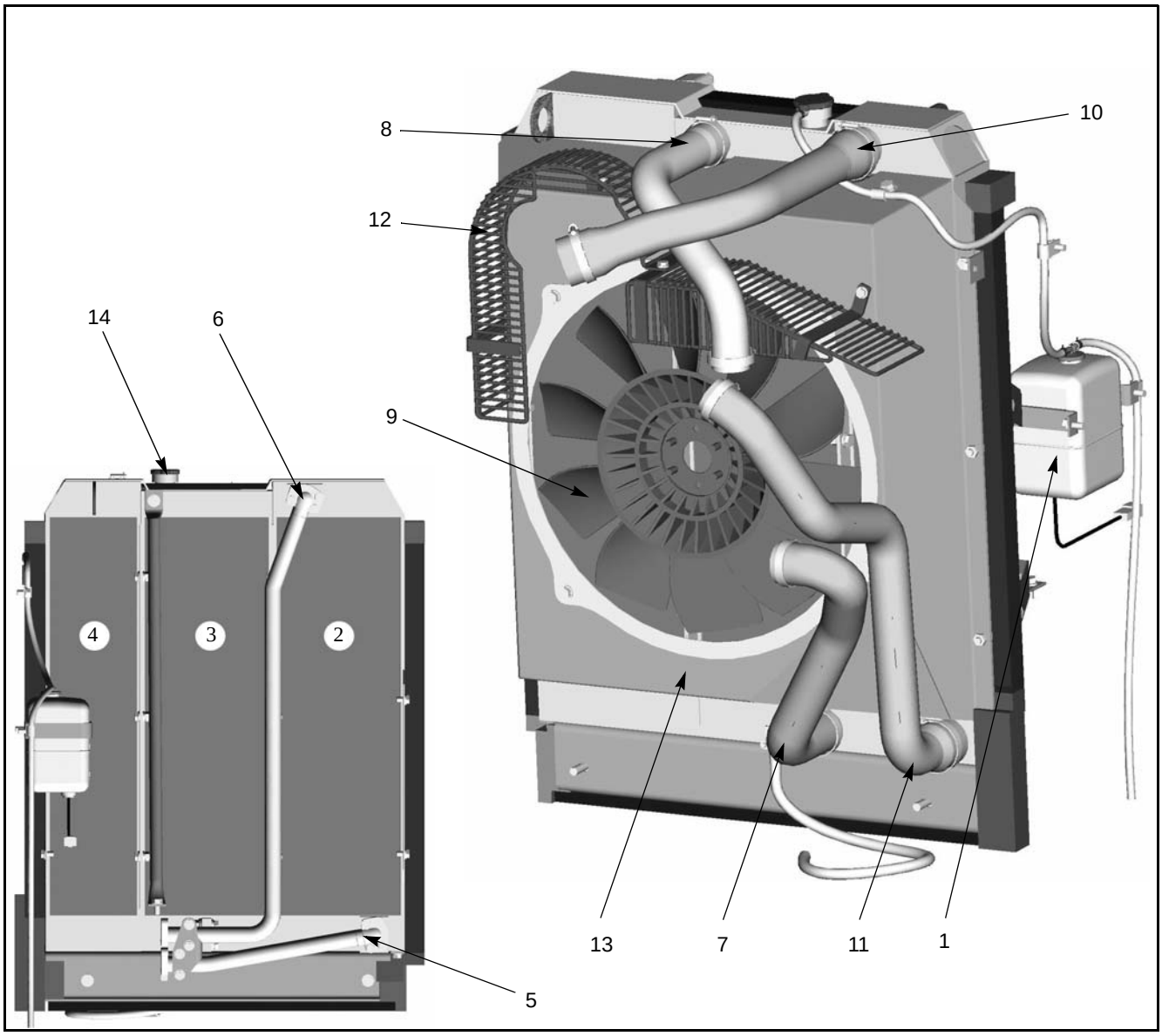


1. Breather cap
2. Muffler
3. Rear engine mount
4. Breather hose
5. Oil catcher tube
6. Brake/Steer pump
7. Front engine mount

OUTLINE

- The damper assembly is a dry type.

RADIATOR • OIL COOLER • CHARGE AIR COOLER



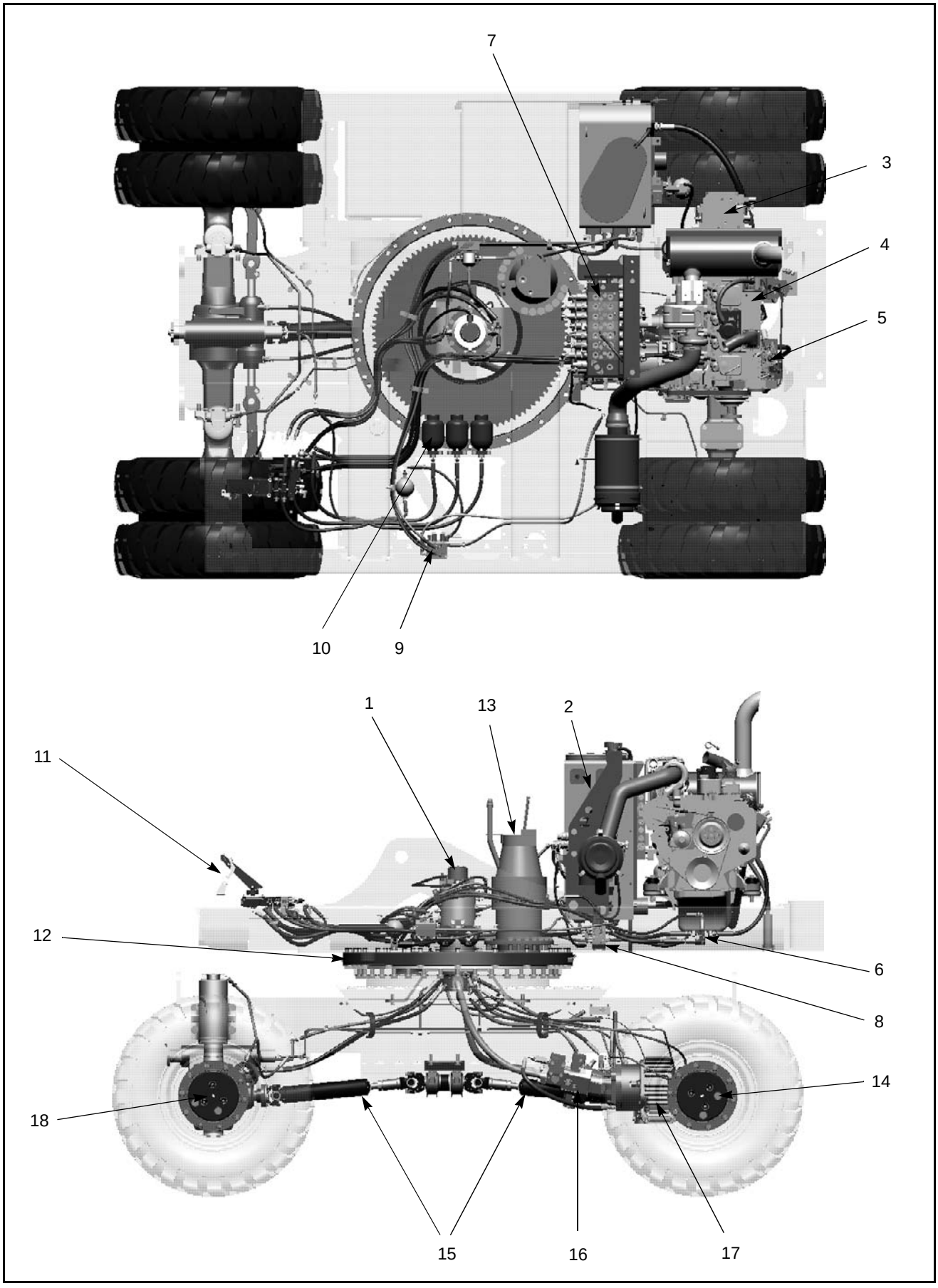
1. Reservoir tank
2. Oil cooler
3. Radiator
4. Charge Air Cooler
5. Oil Cooler outlet tube
6. Oil Cooler inlet tube
7. Radiator outlet hose
8. Radiator inlet hose
9. Fan
10. Charge Air Oil Cooler outlet hose
11. Charge Air Oil Cooler inlet hose
12. Net
13. Shroud
14. Radiator Cap

SPECIFICATIONS:

Combination Cooler

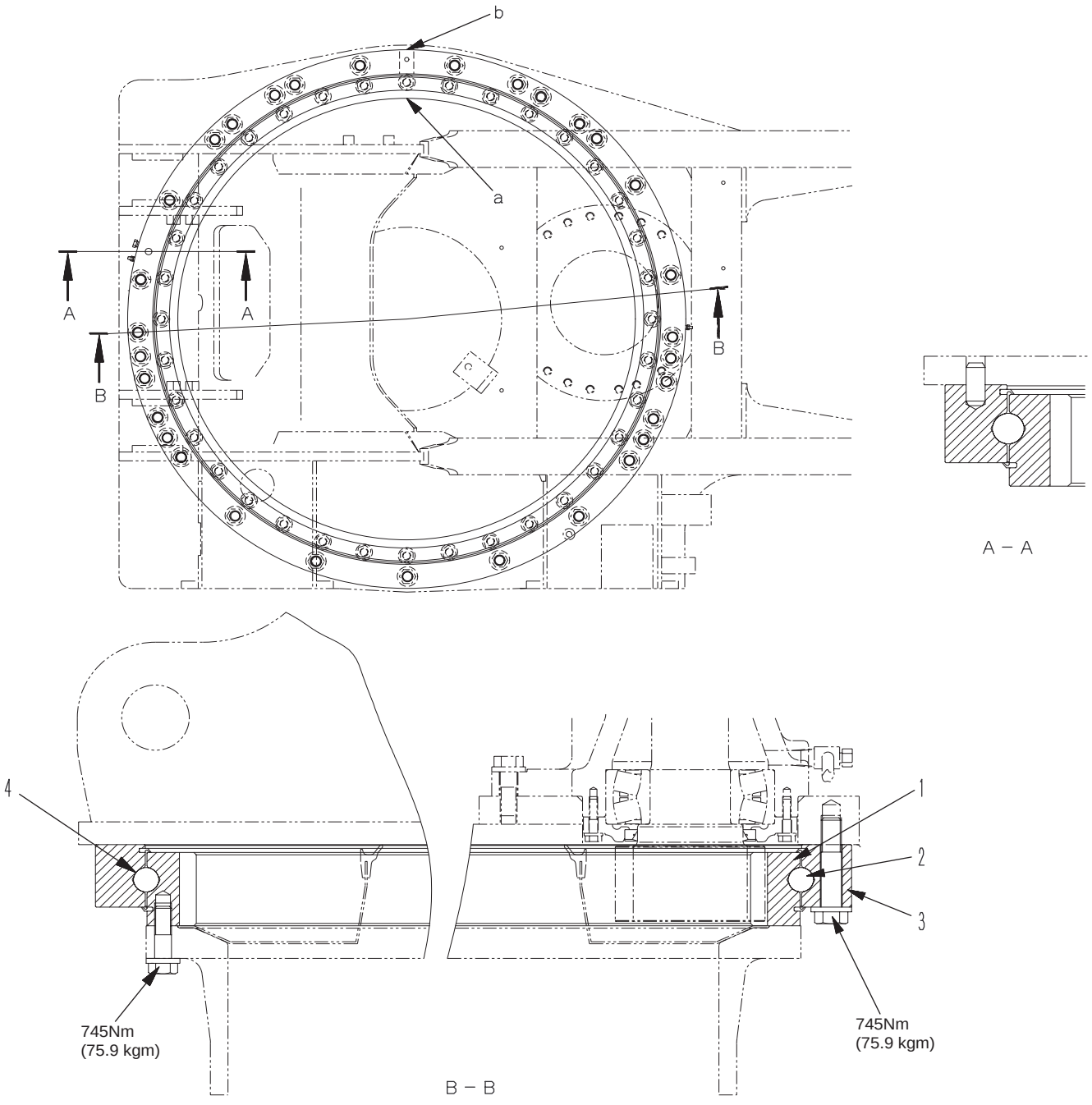
	Oil	Coolant	Air
Max working pressure. bar	10	0.6	1.7
Max working temperature ^{o}C	100	100	16.0
Cooler volume l.	6.3	6.3	6.1

POWER TRAIN



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

SWING CIRCLE



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

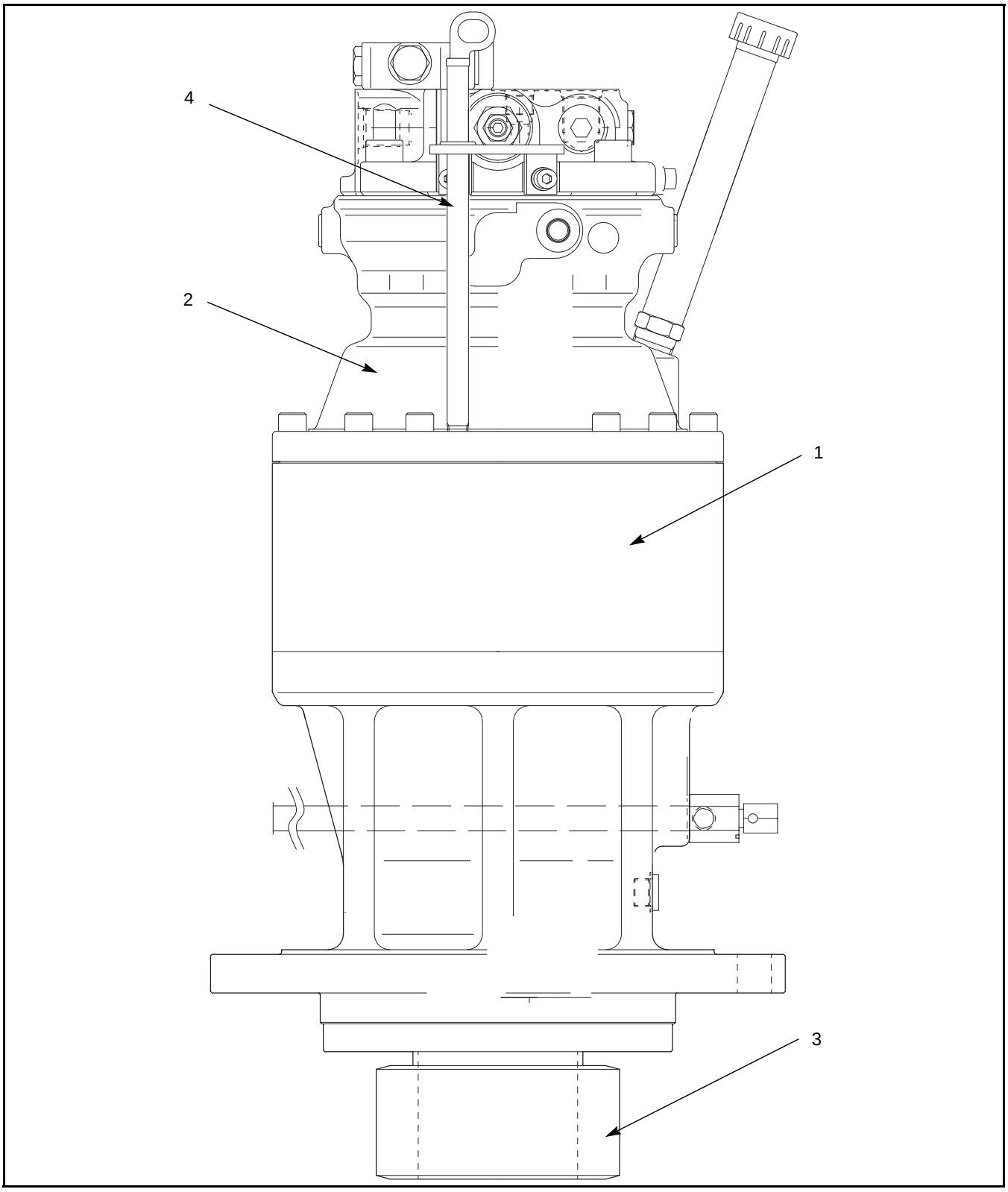
Reduction ratio:

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

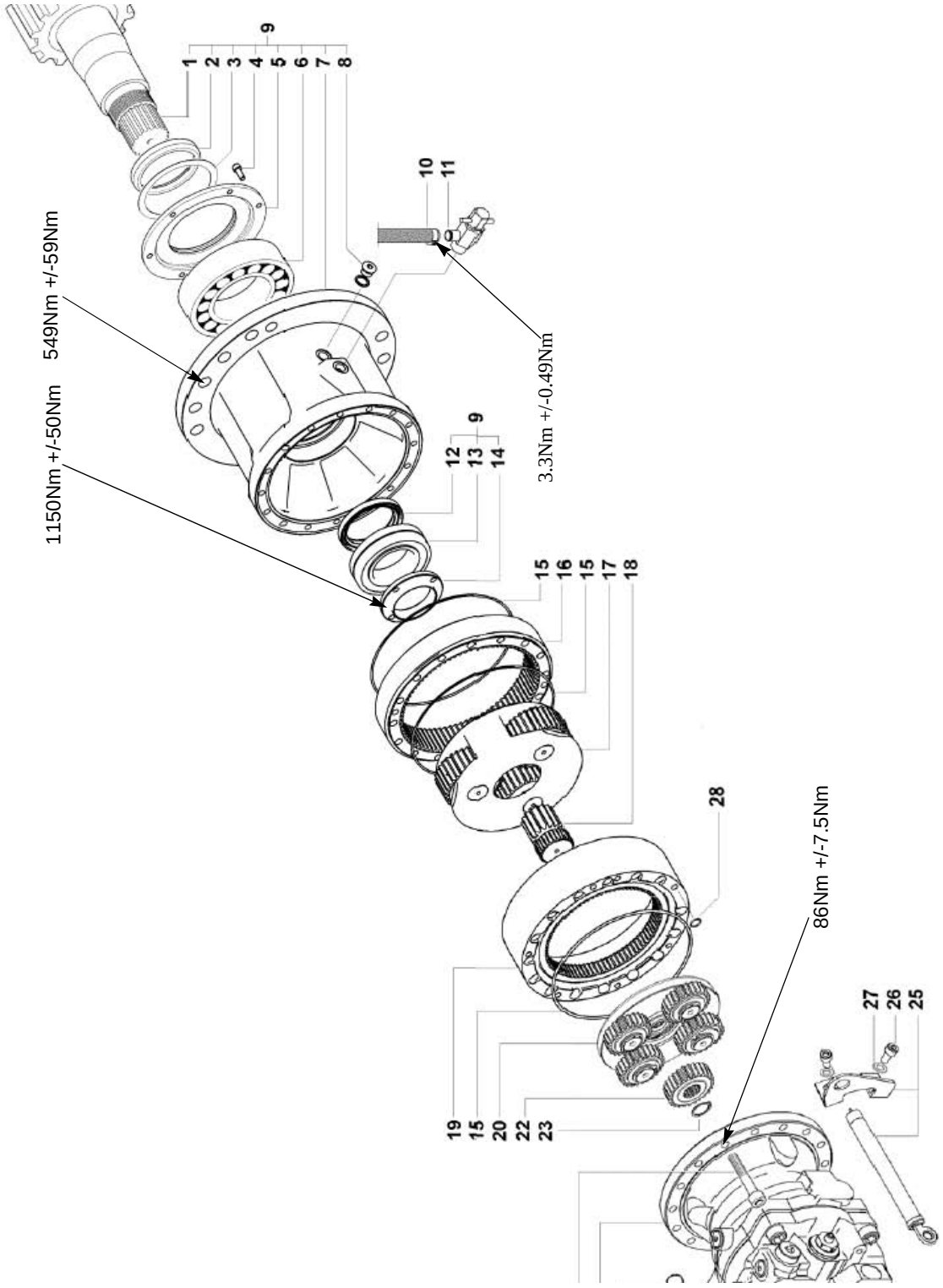
Amount of grease: 10.5 litres

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



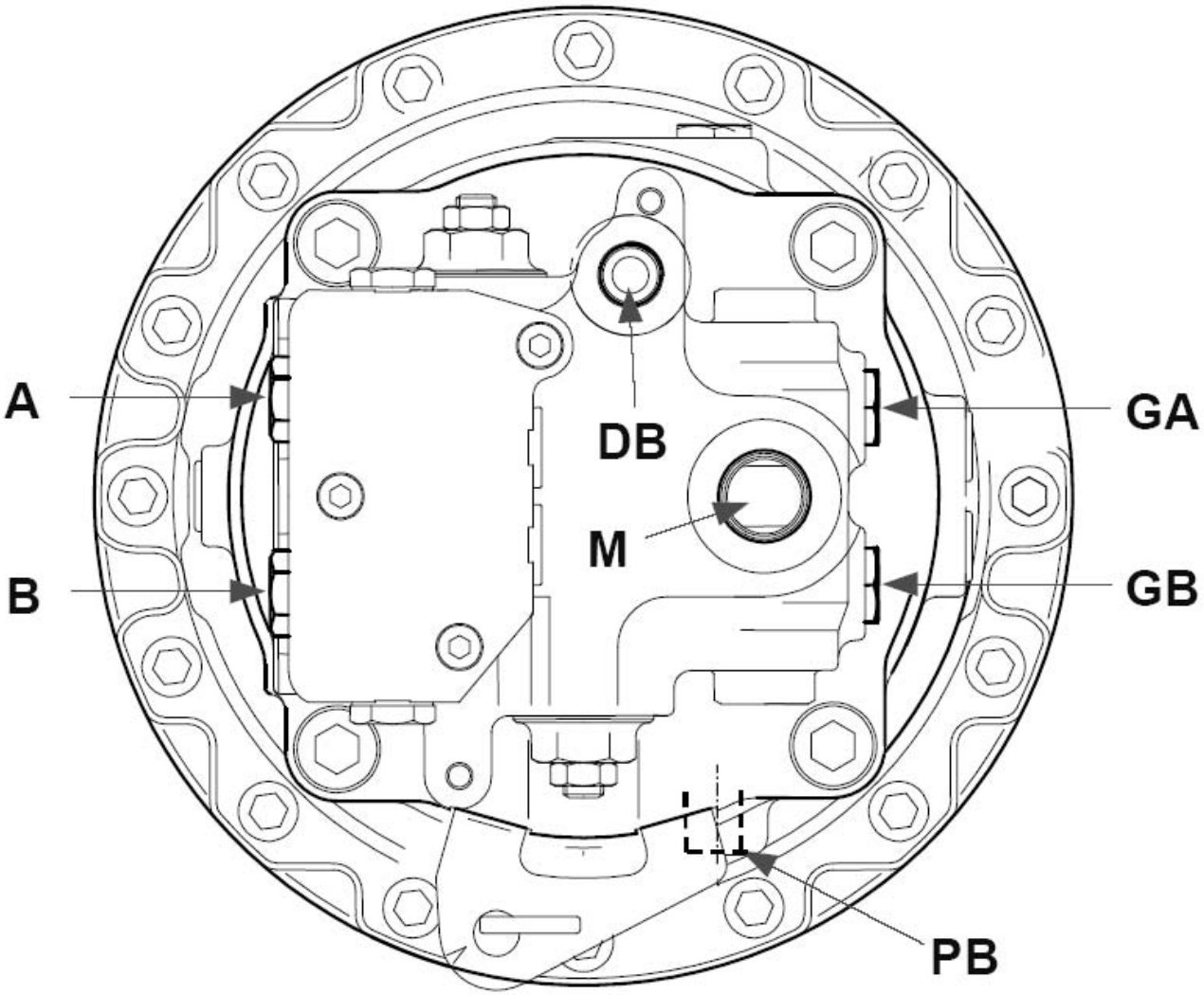
1. Swing machinery
2. Swing motor
3. Swing pinnion
4. Dipstick


549Nm +/-59Nm
1150Nm +/-50Nm
3.3Nm +/-0.49Nm
86Nm +/-7.5Nm
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
22
23
25
26
27
28

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

SWING MOTOR

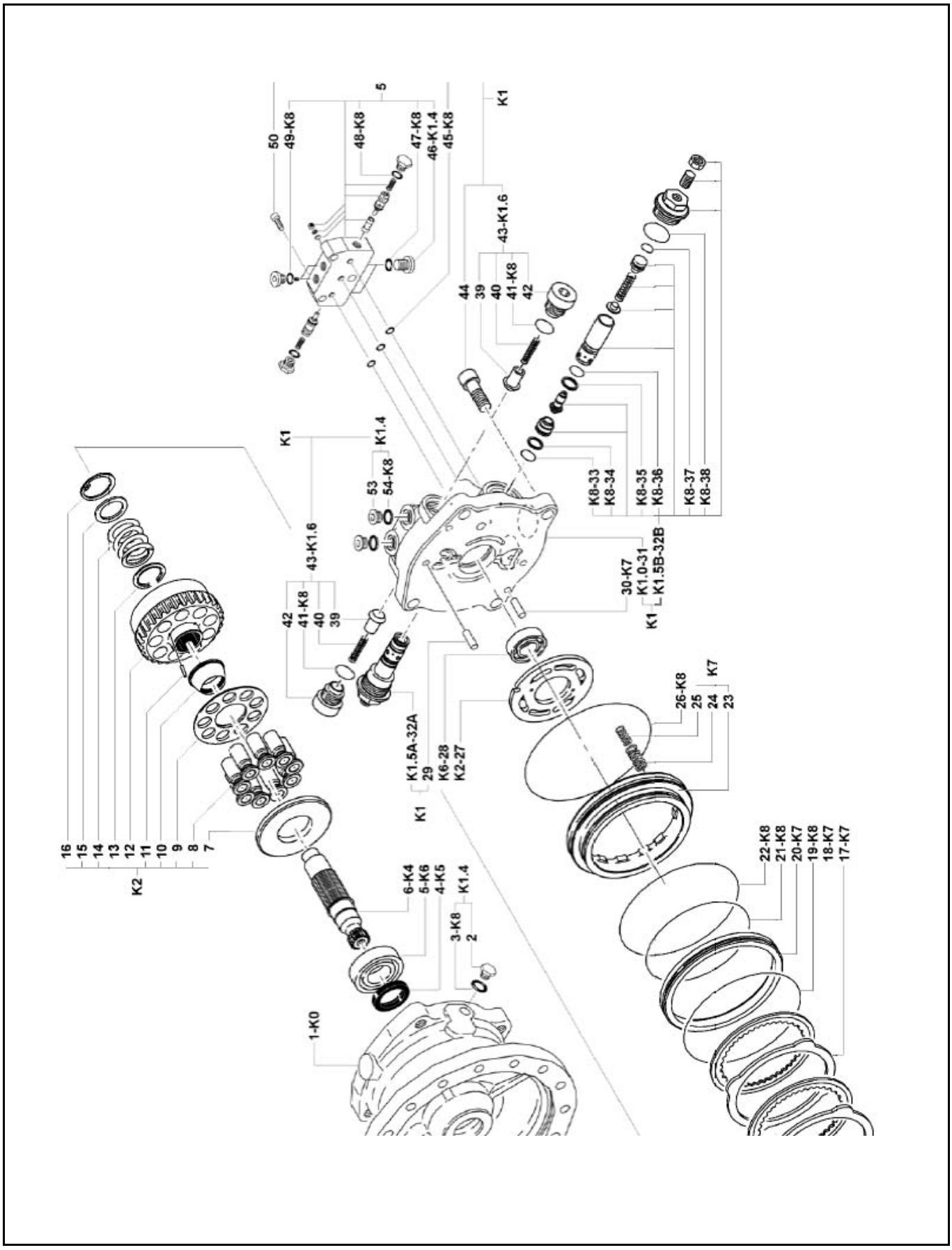
MSF 85P



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

SPECIFICATIONS

	PW160-7H
Model	MSF85P
Theoretical displacement	87.3 cm³/rev
Safety valve set pressure	19.6 MPa {200 kg/cm²}
Rated revolving speed	1,553 rpm
Brake release pressure	1.9 MPa {19 kg/cm²}


5
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
K1.5B-32B
K1
26-K8
25
24
23
K7
K1.5A-32A
29
K6-28
K2-27
K1
16
15
14
13
12
11
10
9
8
7
K2
6-K4
5-K6
4-K5
K1.4
3-K8
2
1-K0
22-K8
21-K8
20-K7
19-K8
18-K7
17-K7

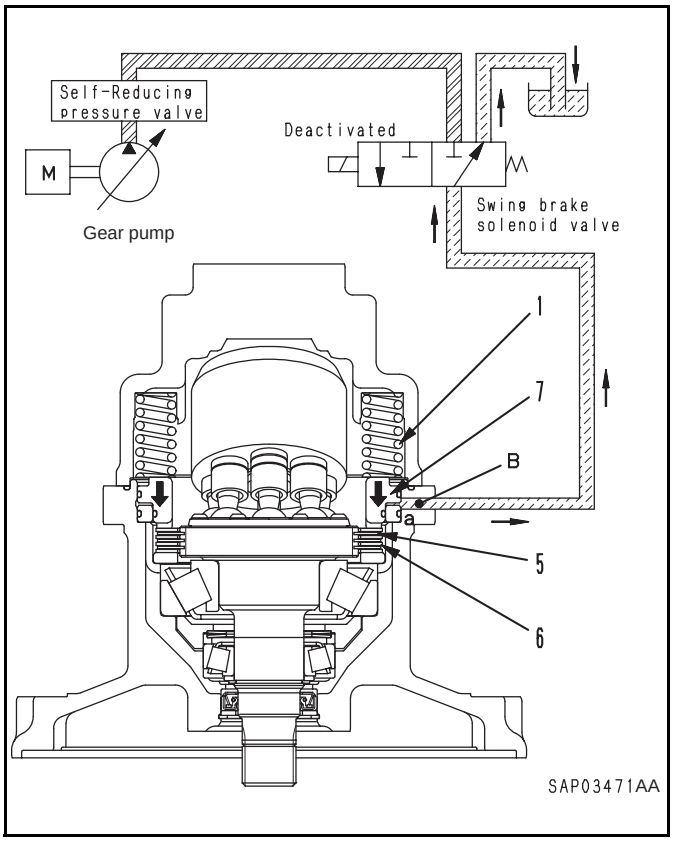
Kit	Ref. No.	Description	Kit	Ref. No.	Description
K0	1	Motor housing kit	K2	13	Collar
K1		Base plate assembly		14	Spring
	29	Pin		15	Collar washer
	31	Base plate		16	Circlip
	32A	Relief valve		27	Valve plate
	32B	Relief valve	K4	6	Motor shaft assembly
	43	Anti-cavitation valve assembly	K5	4	Motor seal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

Operation of swing lock

1. When swing lock solenoid valve is deactivated

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

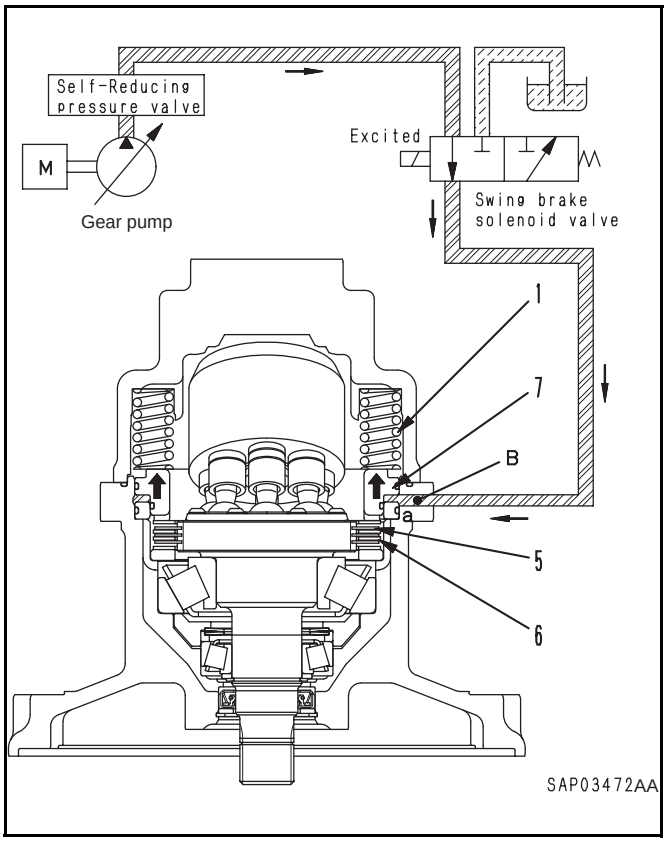
As a result, brake piston (7) is pushed down by brake spring (1), discs (5) and plates (6) are pushed together, and the brake is applied.



2. When swing lock solenoid valve is excited

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

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



RELIEF VALVE PORTION

1. Outline

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

2. Function

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

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

Operation

1. When starting swing

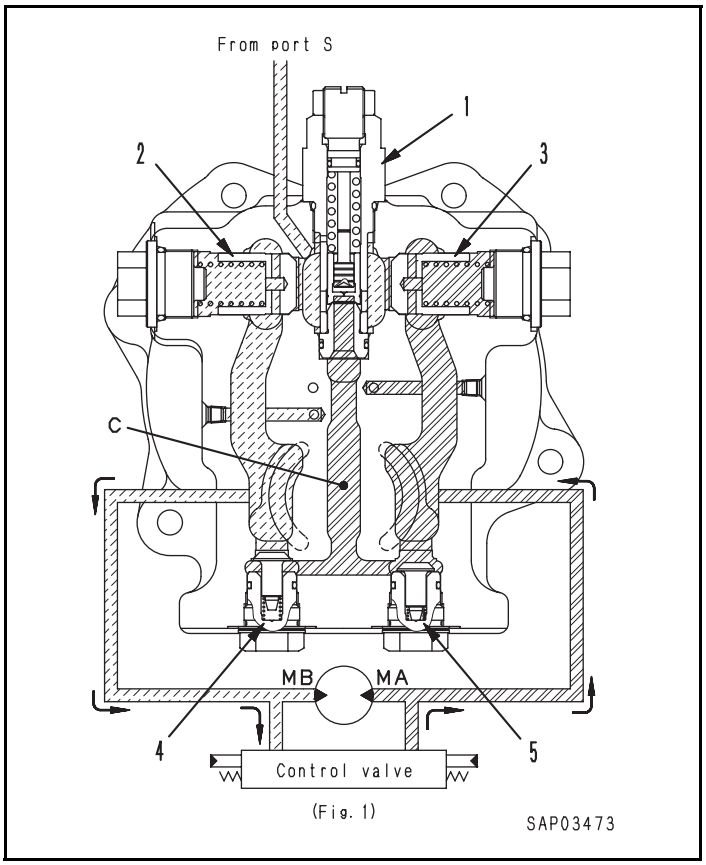
When the swing control lever is operated to swing right, the pressure oil from the pump passes through the control valve and is supplied to port MA. As a result, the pressure at port MA rises, the starting torque is generated in the motor, and the motor starts to rotate. The oil from the outlet port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

2. When stopping swing

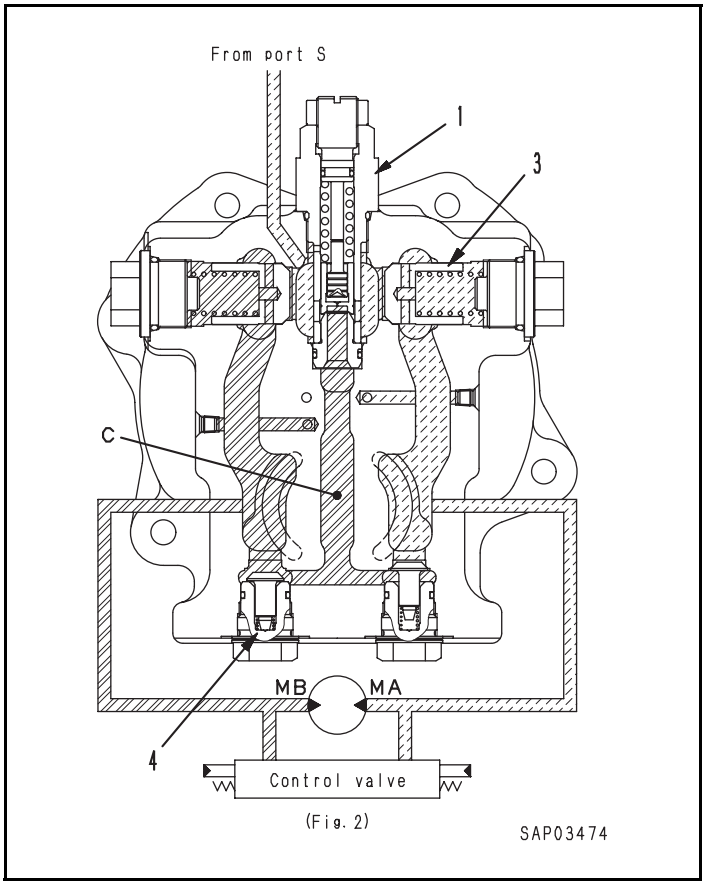
When the swing control lever is returned to neutral, the supply of pressure oil from the pump to port MA is stopped. With the oil from the outlet port of the motor, the return circuit to the tank is closed by the control valve, so the pressure at port MB rises. As a result, rotation resistance is generated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

If the pressure at port MB becomes higher than the pressure at port MA, it pushes shuttle valve A (4) and chamber C becomes the same pressure as port MB. The oil pressure rises further until it reaches the set pressure of relief valve (1). As a result, a high braking torque acts on the motor and stops the motor. (Fig.2)

When relief valve (1) is being actuated, the relief oil and oil from port **S** passes through check valve **B** (3) and is supplied to port **MA**. This prevents cavitation at port **MA**.

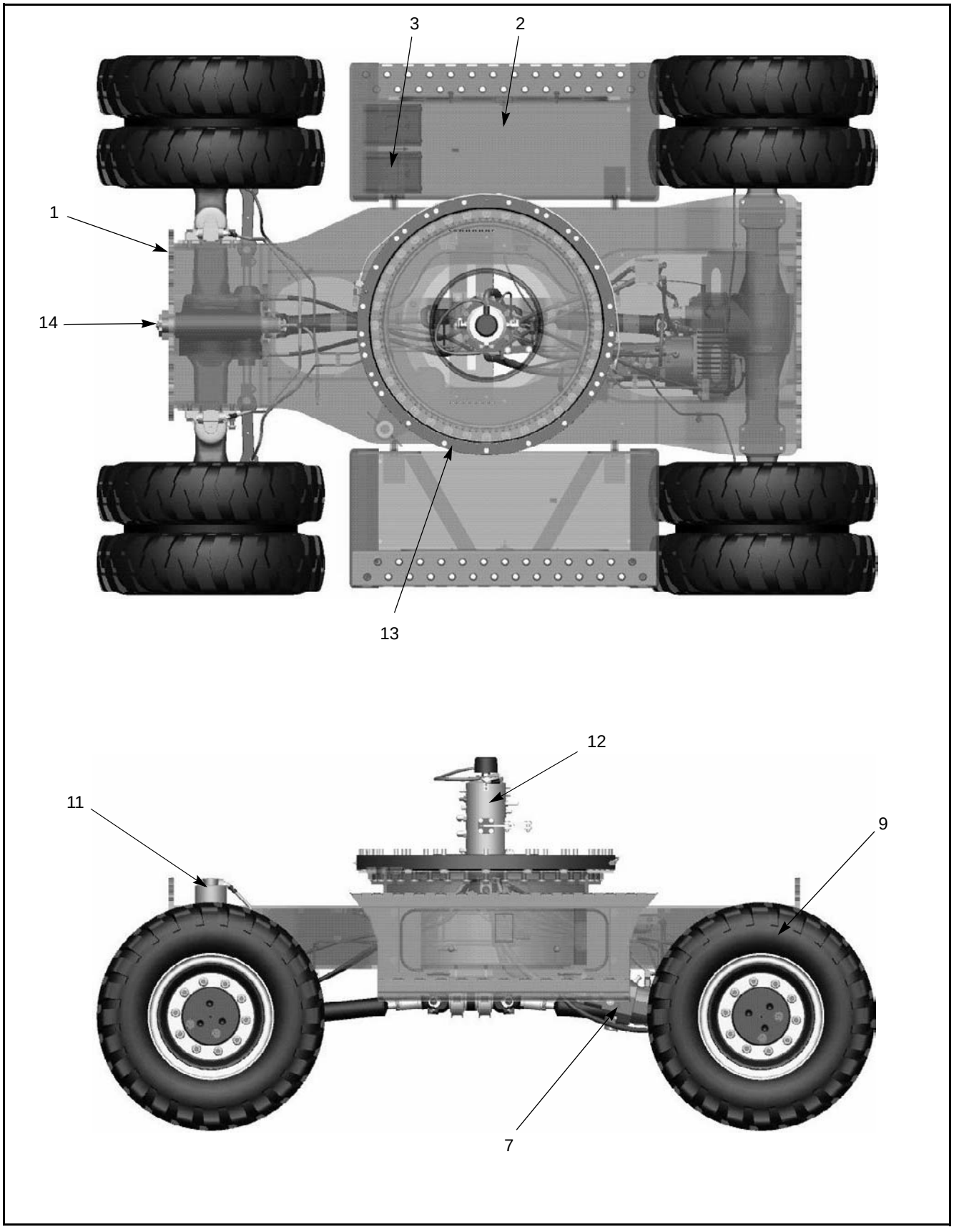


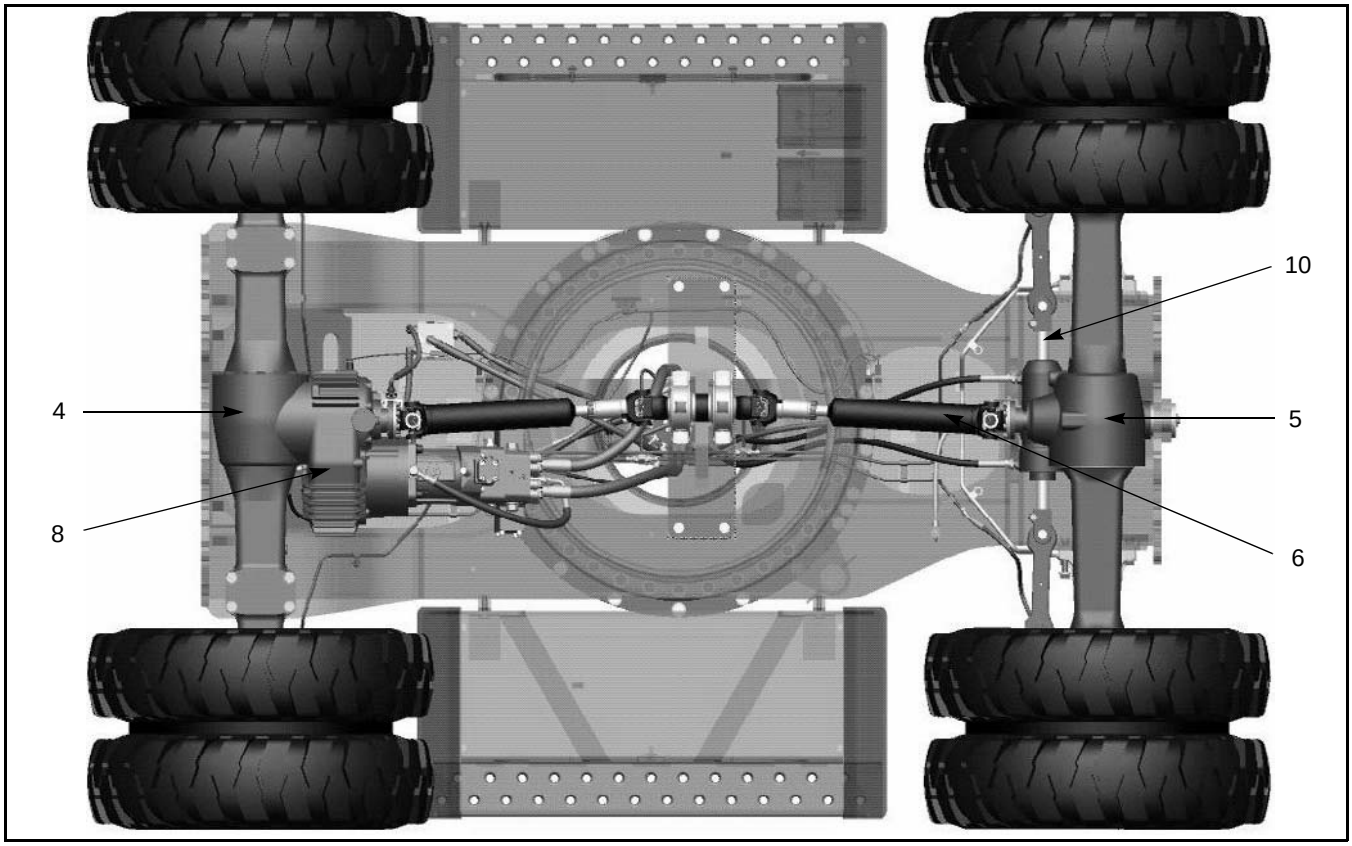
(Fig. 1)



(Fig. 2)

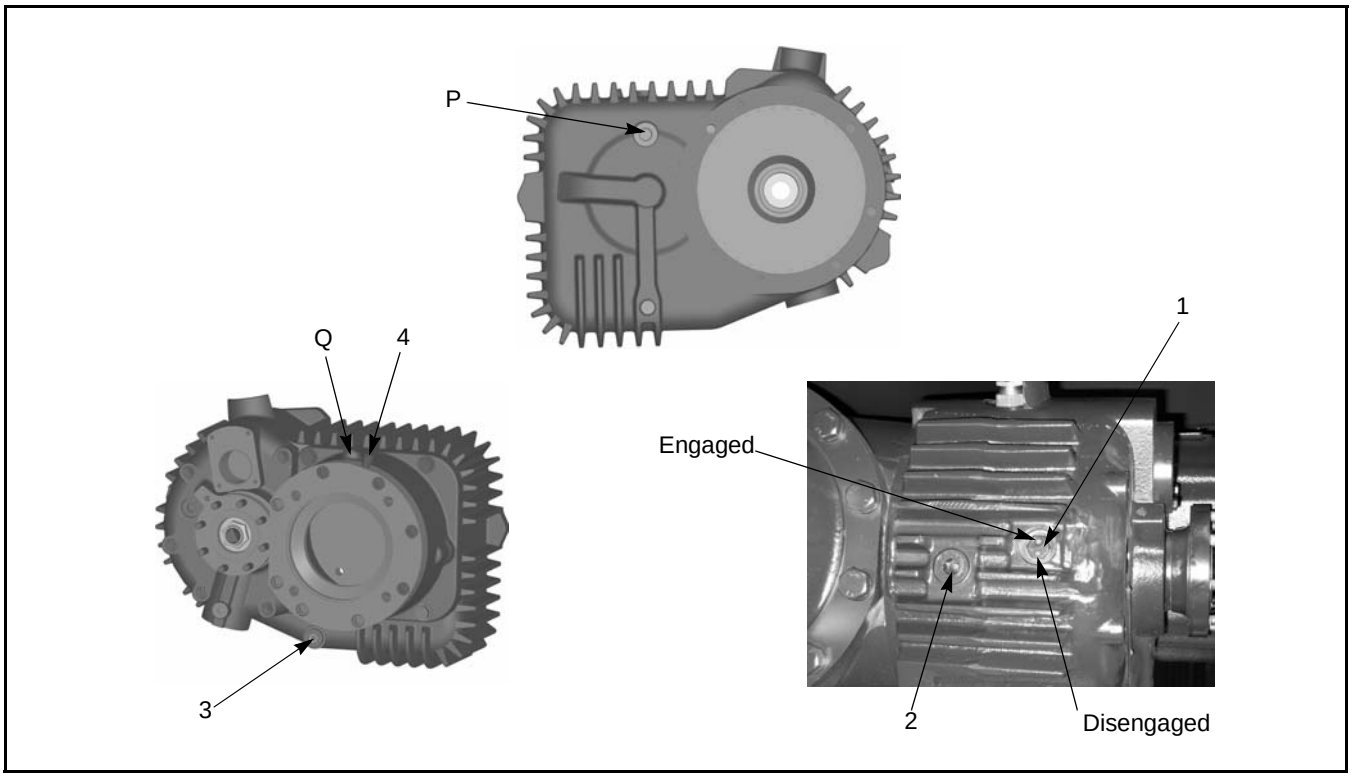
UNDERCARRIAGE





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



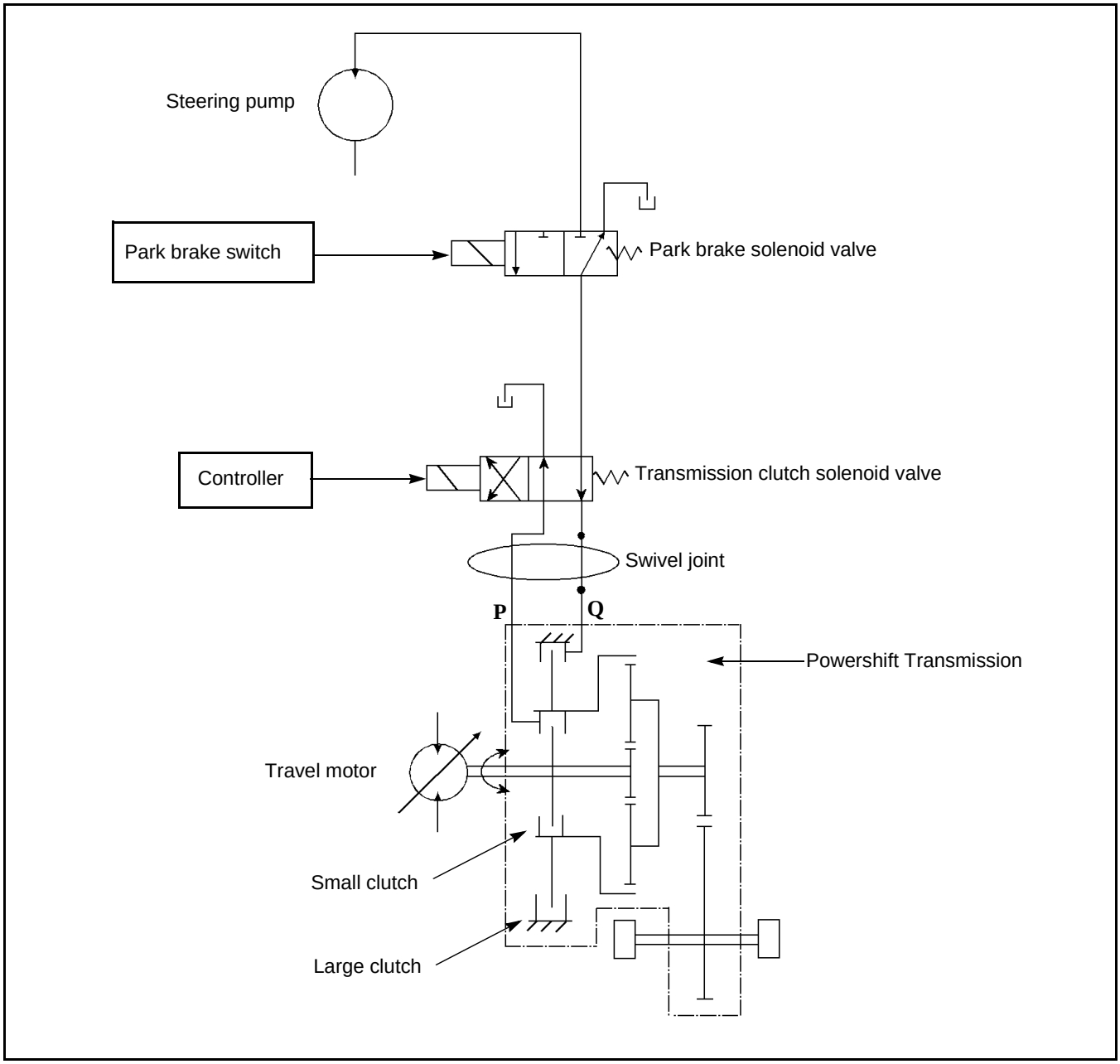
1. Transmission disengagement pin (for towing)
2. Oil filler plug
3. Oil drain plug
4. Breather

SPECIFICATIONS:

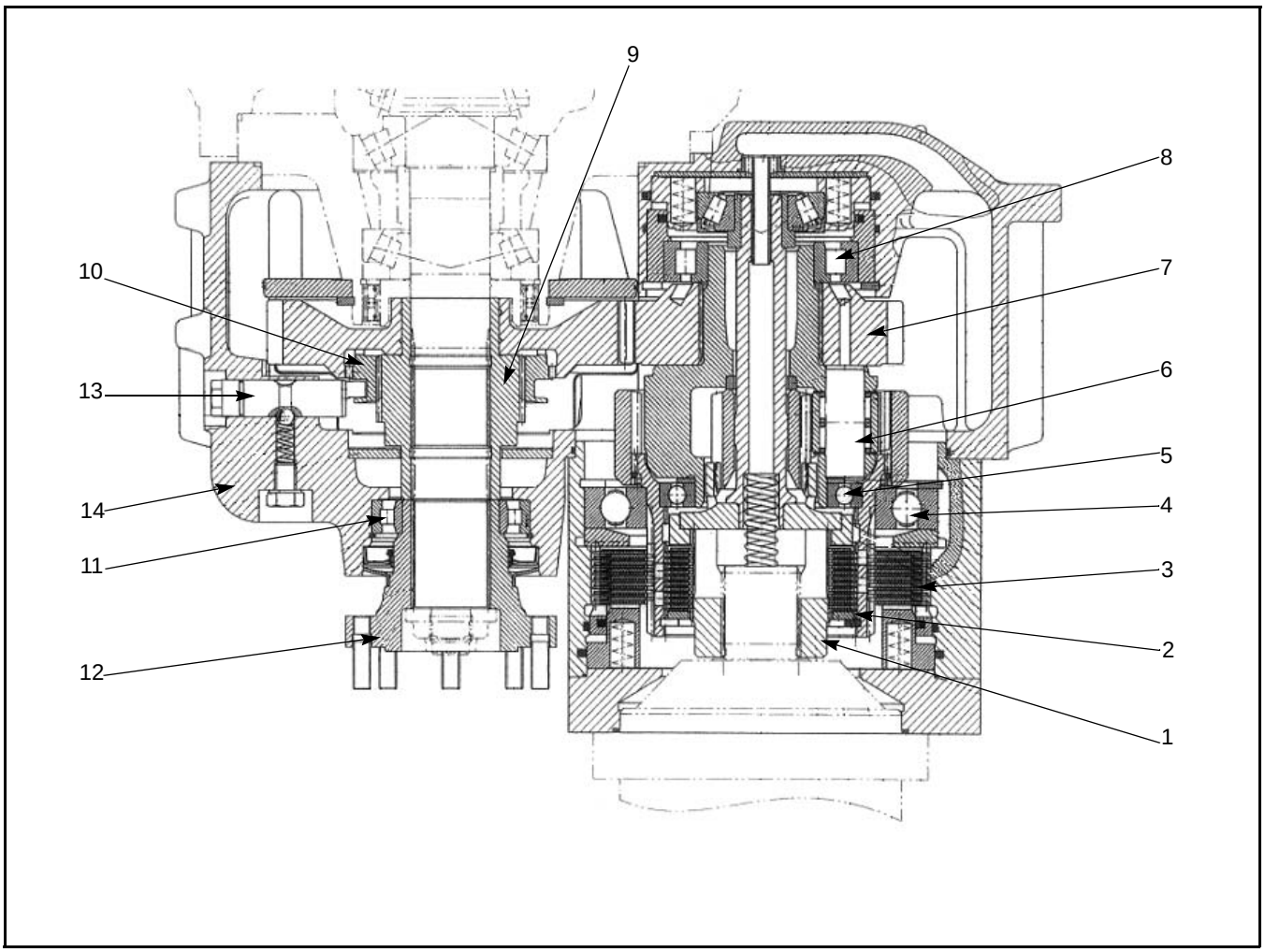
Type	Single motor two speed automatic powershift
Gear ratio	Small clutch (High gear) 1.32 : 1.
	Large clutch (Low gear) 4.93 : 1
Pressure required to disengage clutches (Large & Small)	58 +/- 7 bar.
Output shaft	DIN 120 (8stud) fixing.
Oil capacity	4.85 litres.
Oil change interval	1000 hours

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.



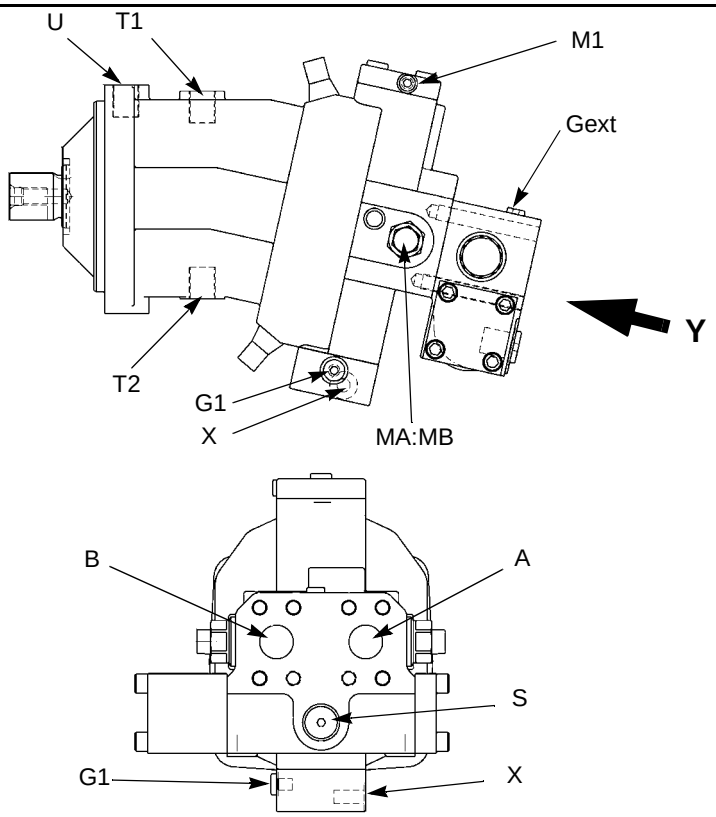
Hi = sun + planets locked together, planetary drive = (1.180 : 1)
Lo = sun drives planets annulus is held, planet carrier is the output = (4.423 : 1)



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

TRAVEL MOTOR

A6VM107 HAXT/63W-VAB380A-SK



View Y

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

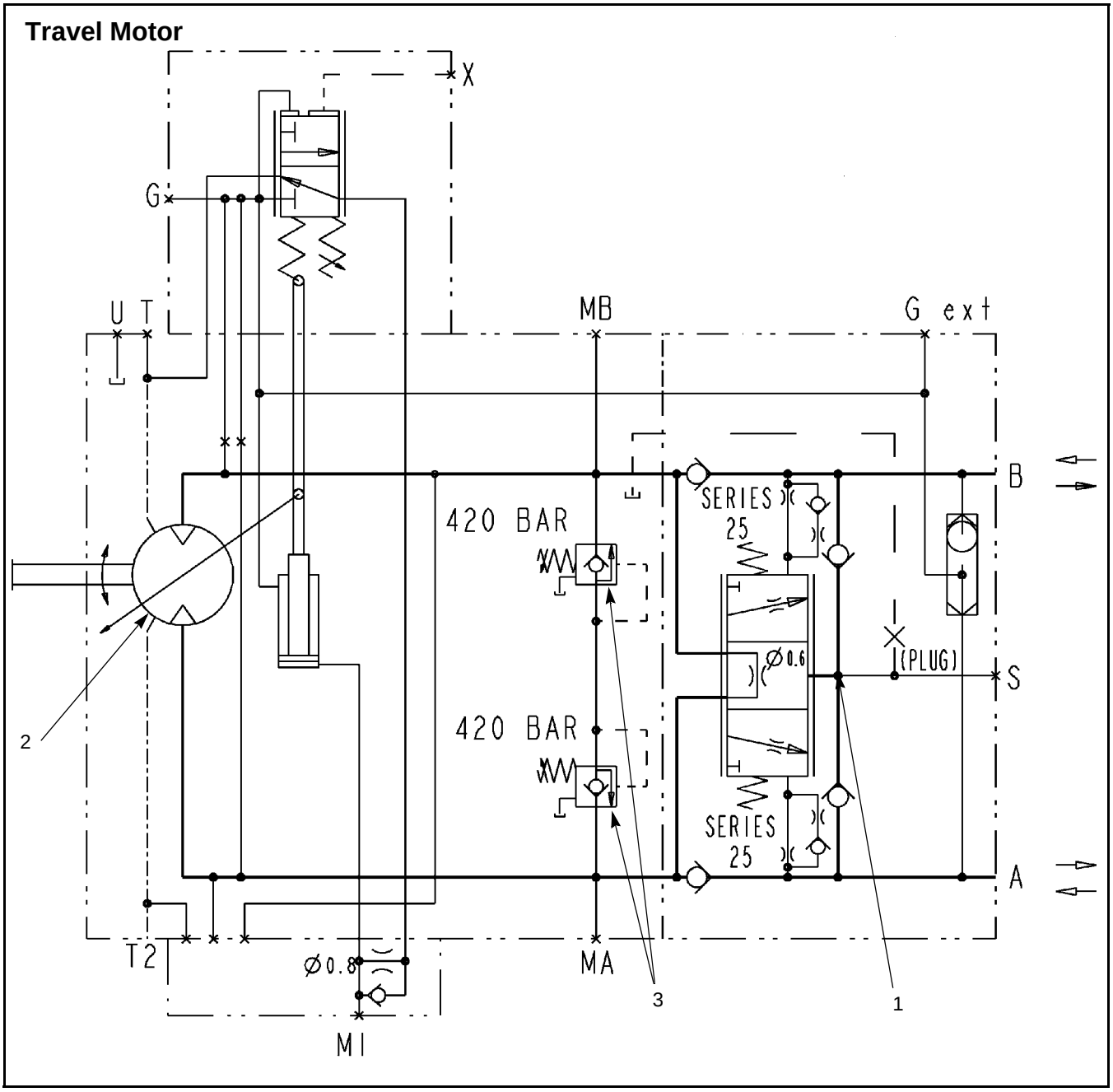
SPECIFICATIONS

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.

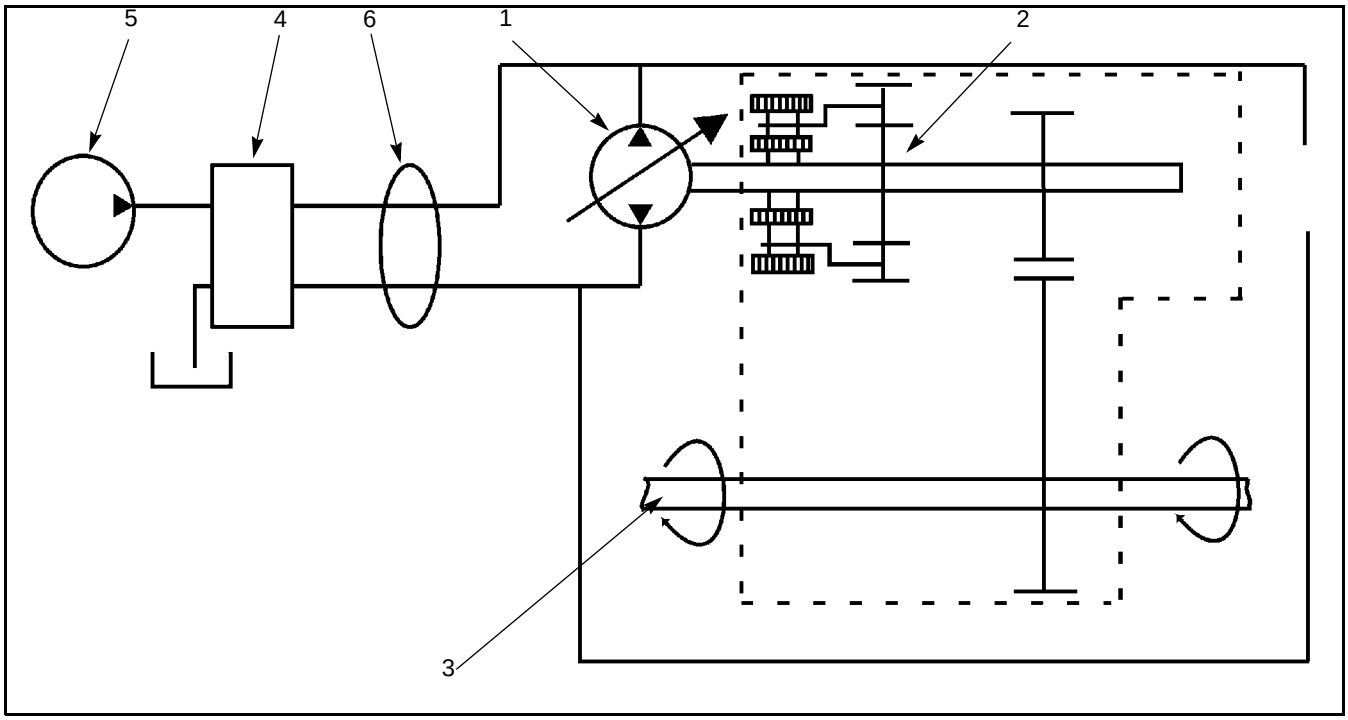
Travel Motor



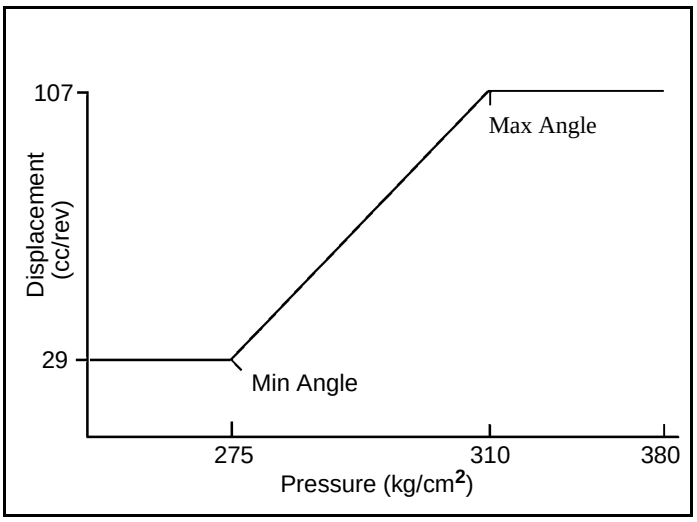
1. Counterbalance valve
2. Motor
3. Relief valve

OPERATION OF TRAVEL MOTOR

1. During normal travel

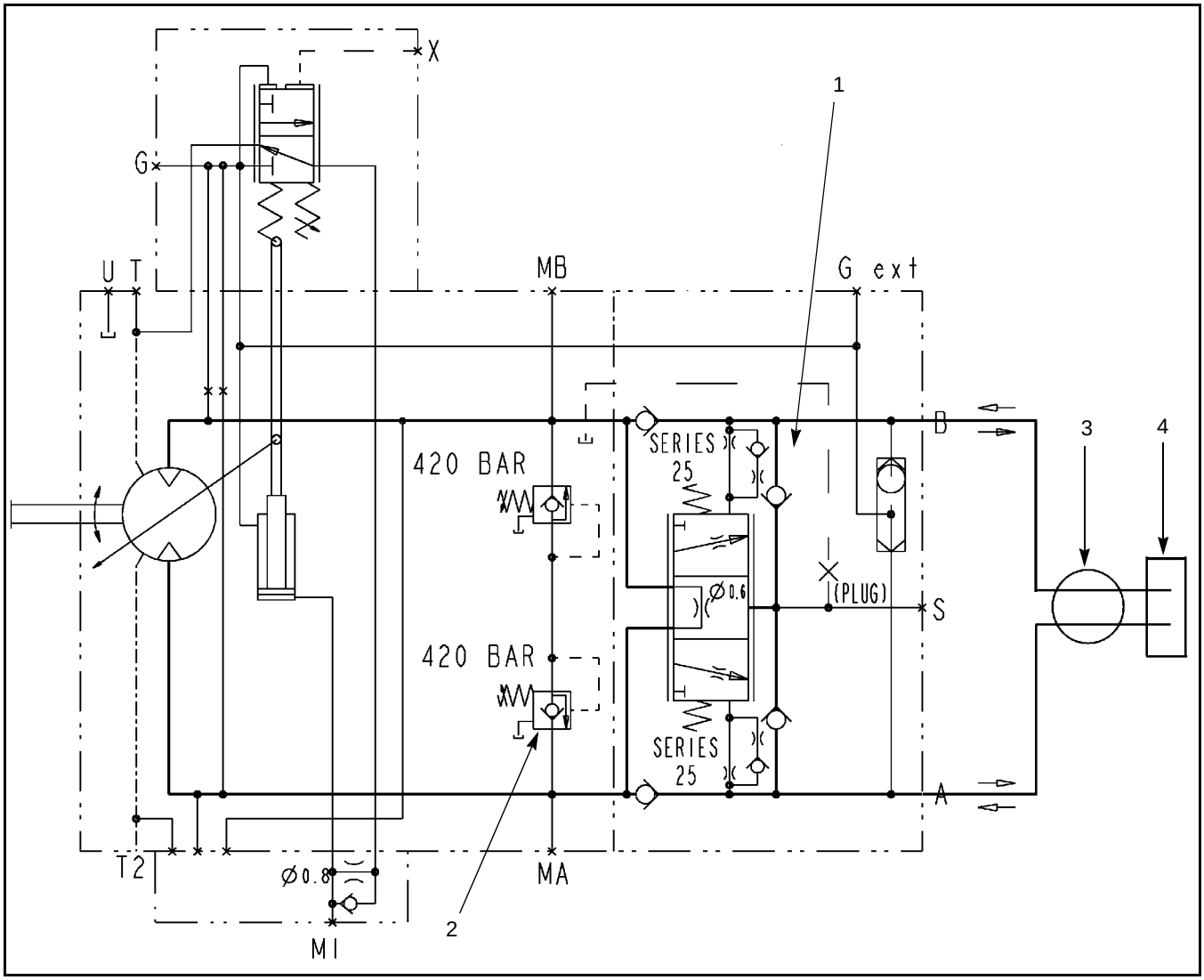


1. Travel motor
2. Transmission and clutch
3. Drive shafts
4. Main control valve
5. Main pump
6. Swivel joint



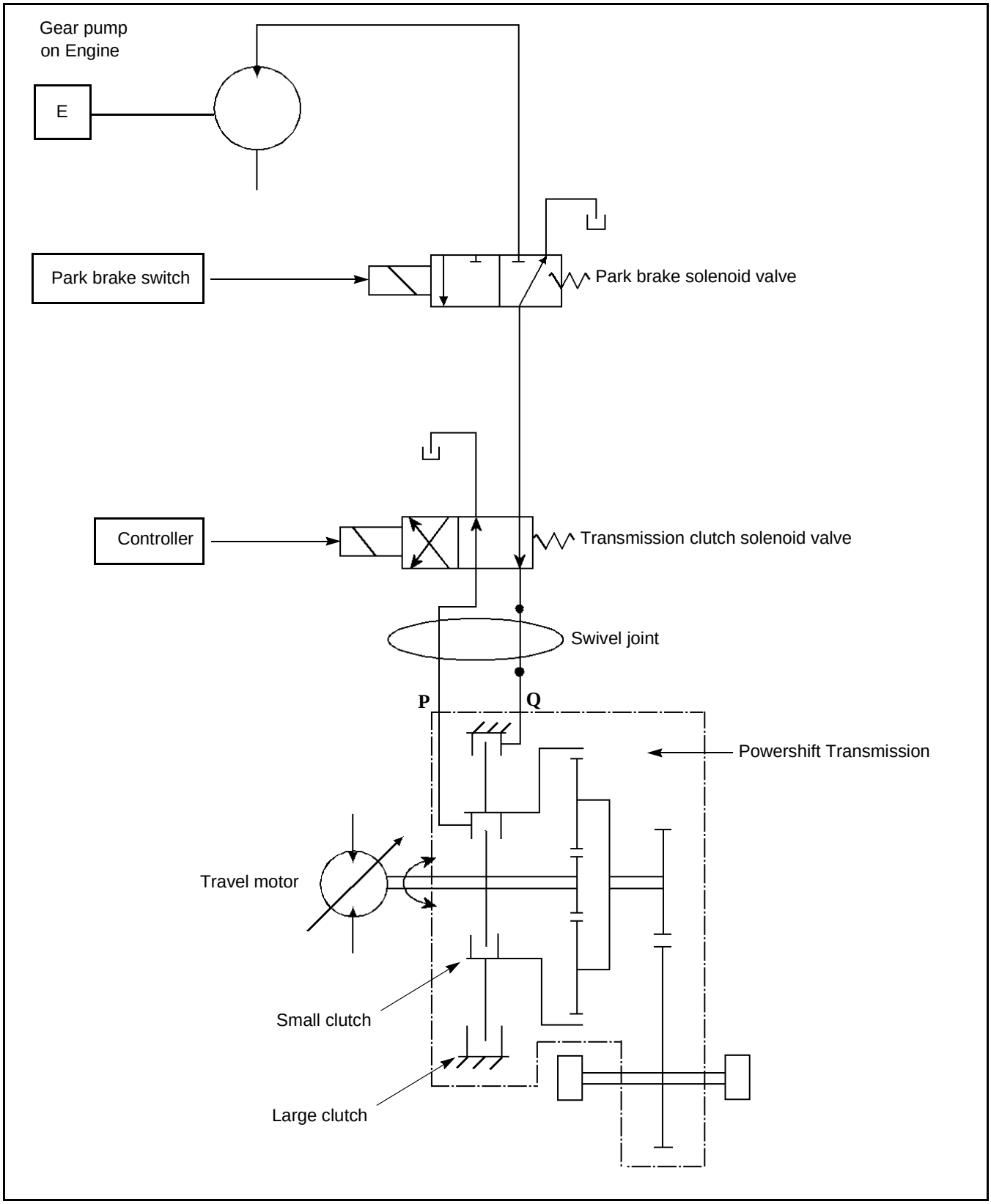
- Oil is supplied to the travel motor from the control valve by the travel spool. When the spool is opened the machine accelerates from the stationary the pressure at the travel motor rises to maximum. This high pressure is used to set the displacement of the travel motor to maximum to give maximum torque.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

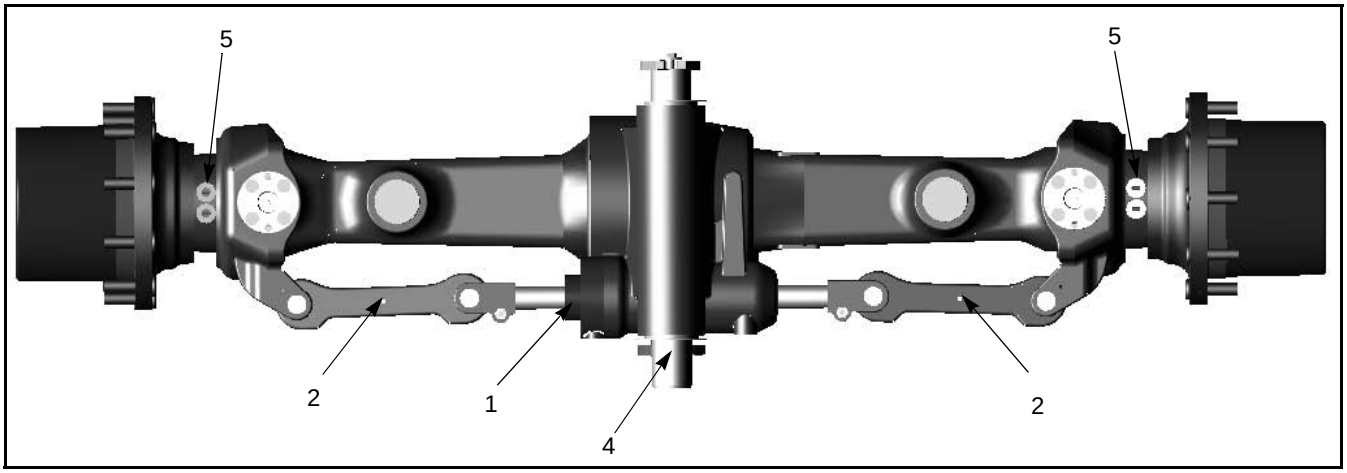
1. Pressure applied to transmission port 'P' disengages the high speed clutch pack meaning the low speed clutch pack is engaged - low speed has been selected.
2. Pressure applied to transmission port 'Q' disengages the low speed clutch pack meaning the high speed clutch pack is engaged - high speed has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

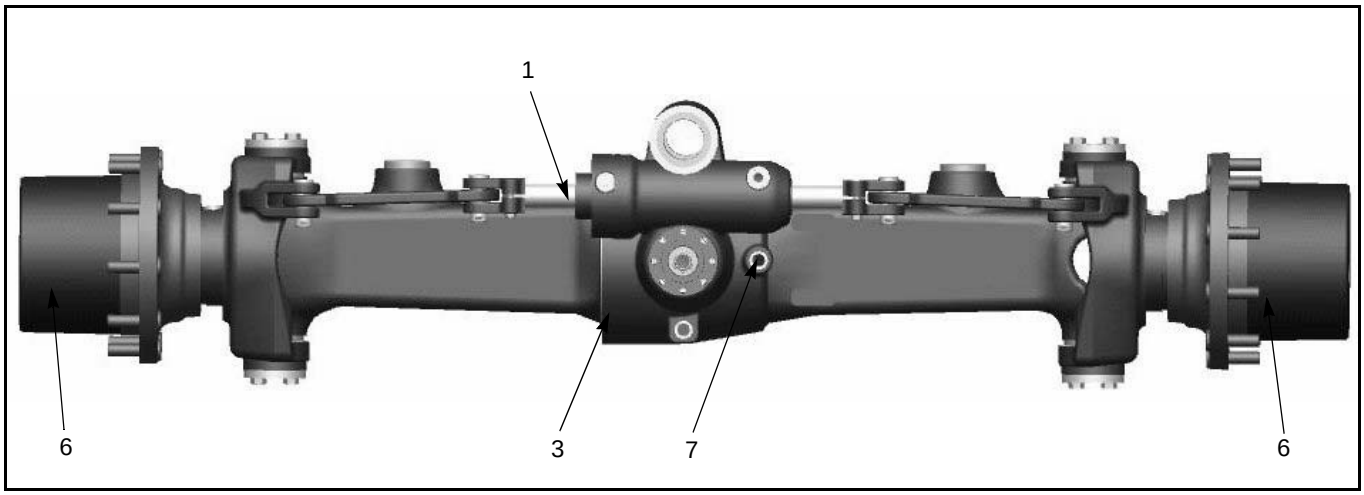
AXLE

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.

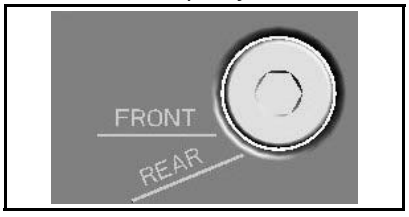
FRONT AXLE





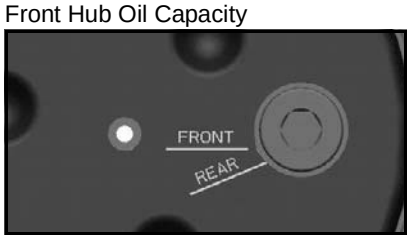
1. Steer cylinder
2. Track control arms
3. Axle housing
4. Drive shaft input
5. Brake line input
6. Wheel hub
7. Oil level plug

Front Axle Oil Capacity

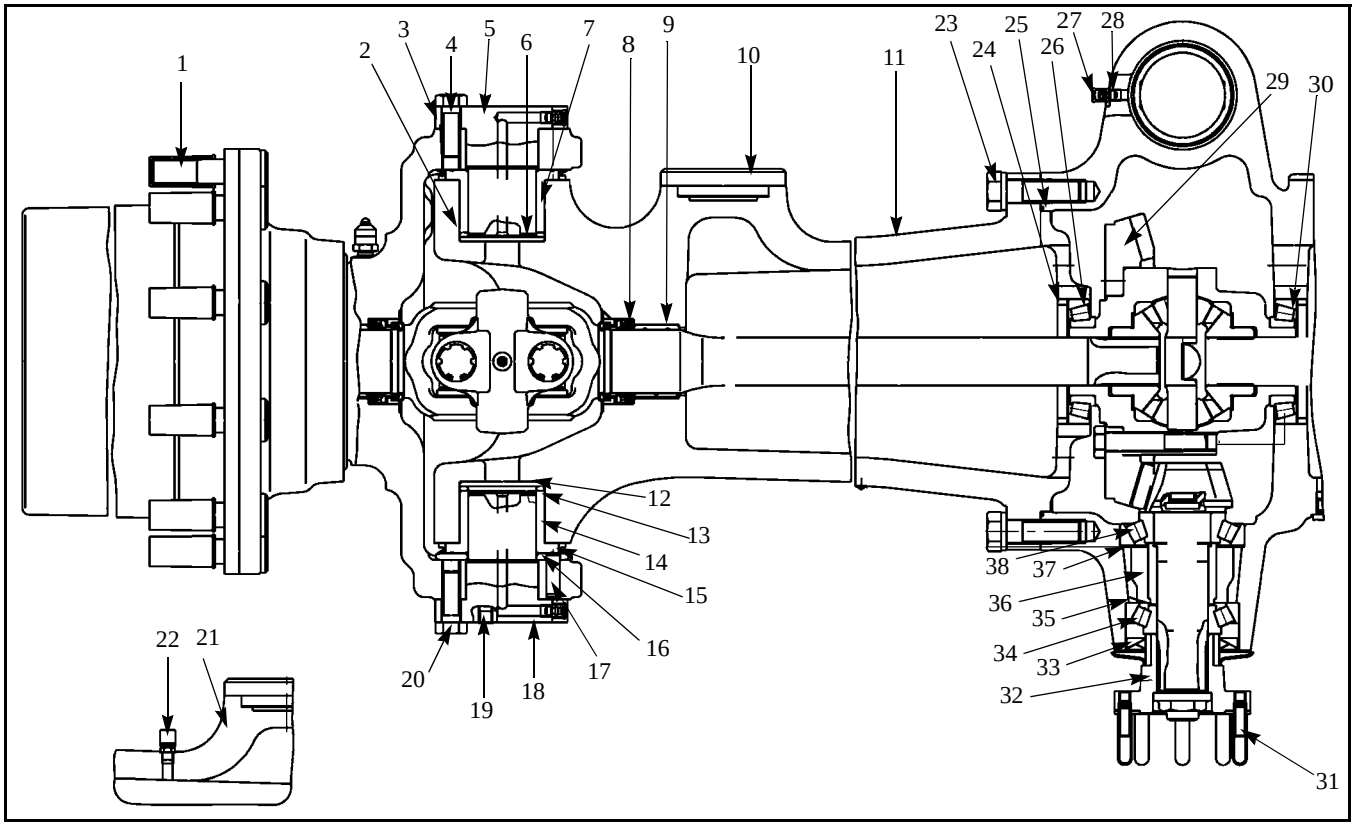


PW160	11.5 Litres

Front Hub Oil Capacity

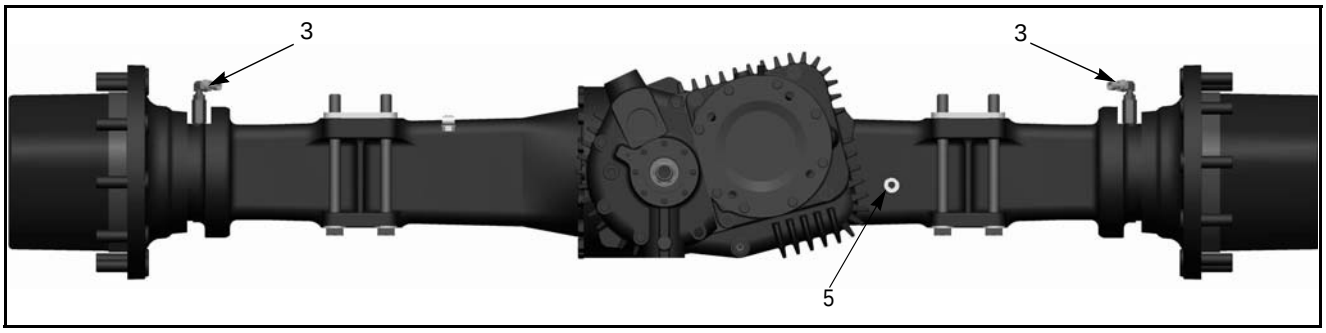


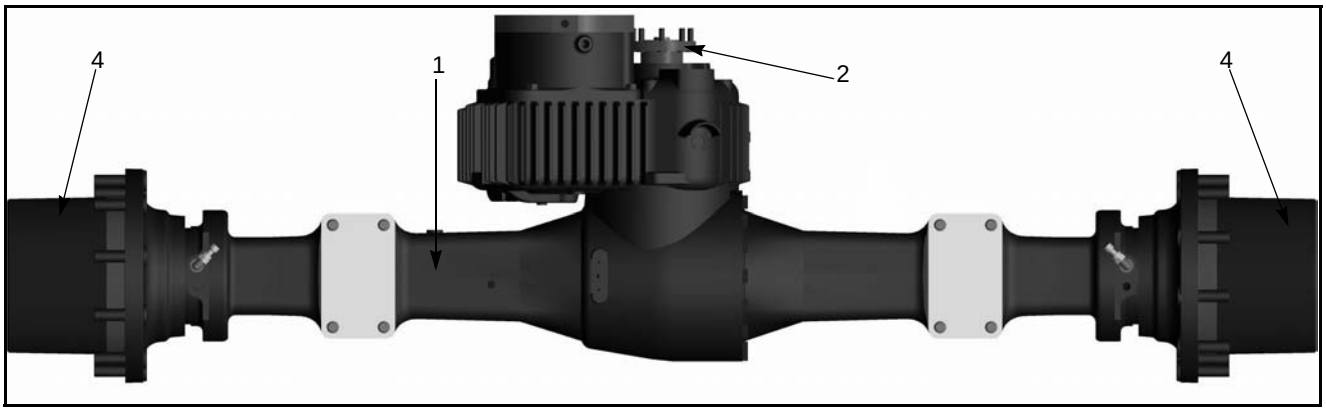
PW160	2.5 Litres



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.	Beval 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





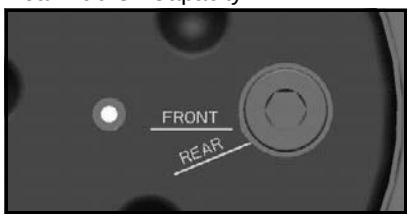
1. Axle housing
2. Drive shaft input
3. Brake line input
4. Wheel hub
5 Oil level plug

Rear Axle Oil Capacity

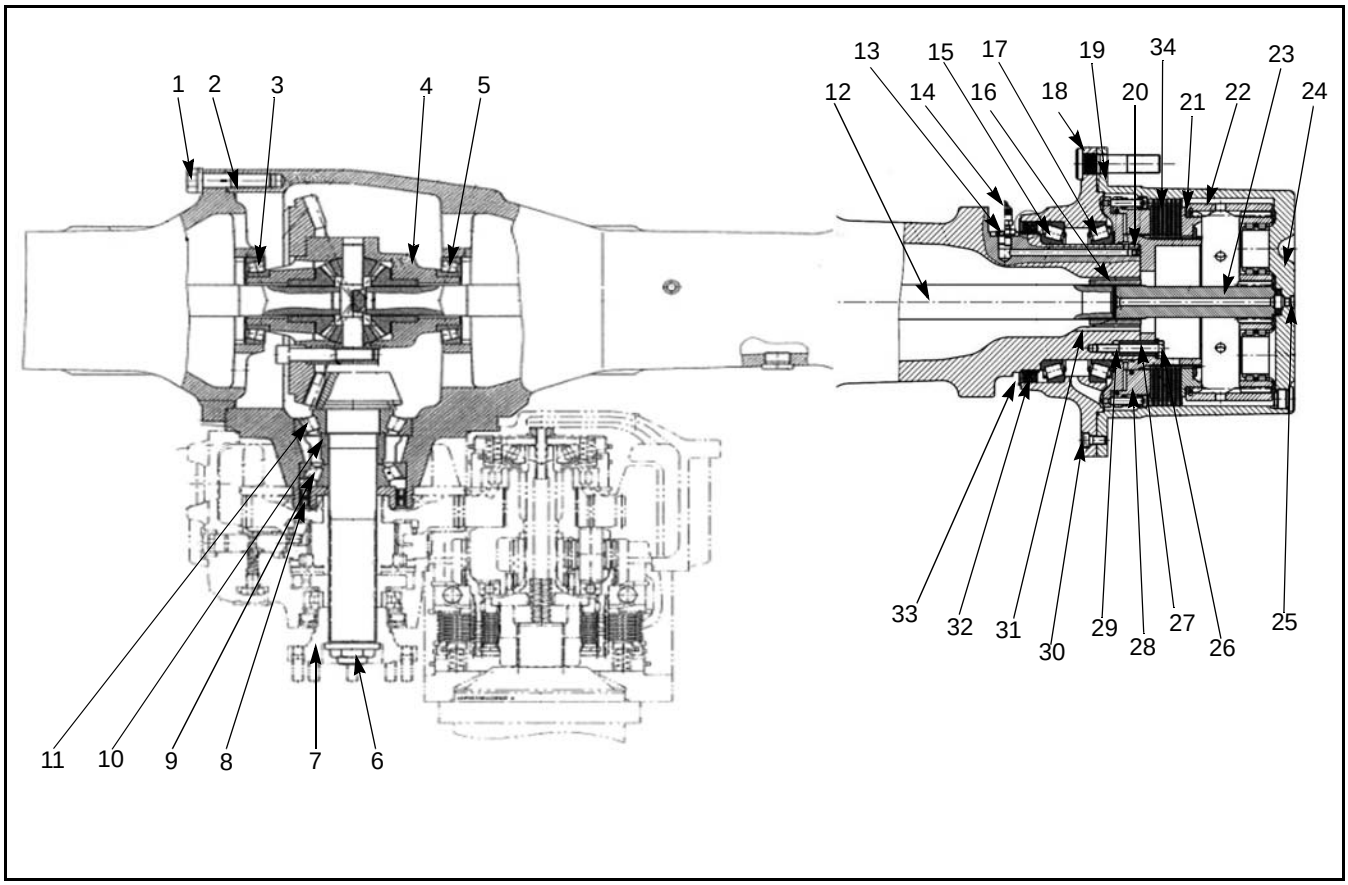


PW160 2.5m Axle	9.5 Litres

Rear Hub Oil Capacity



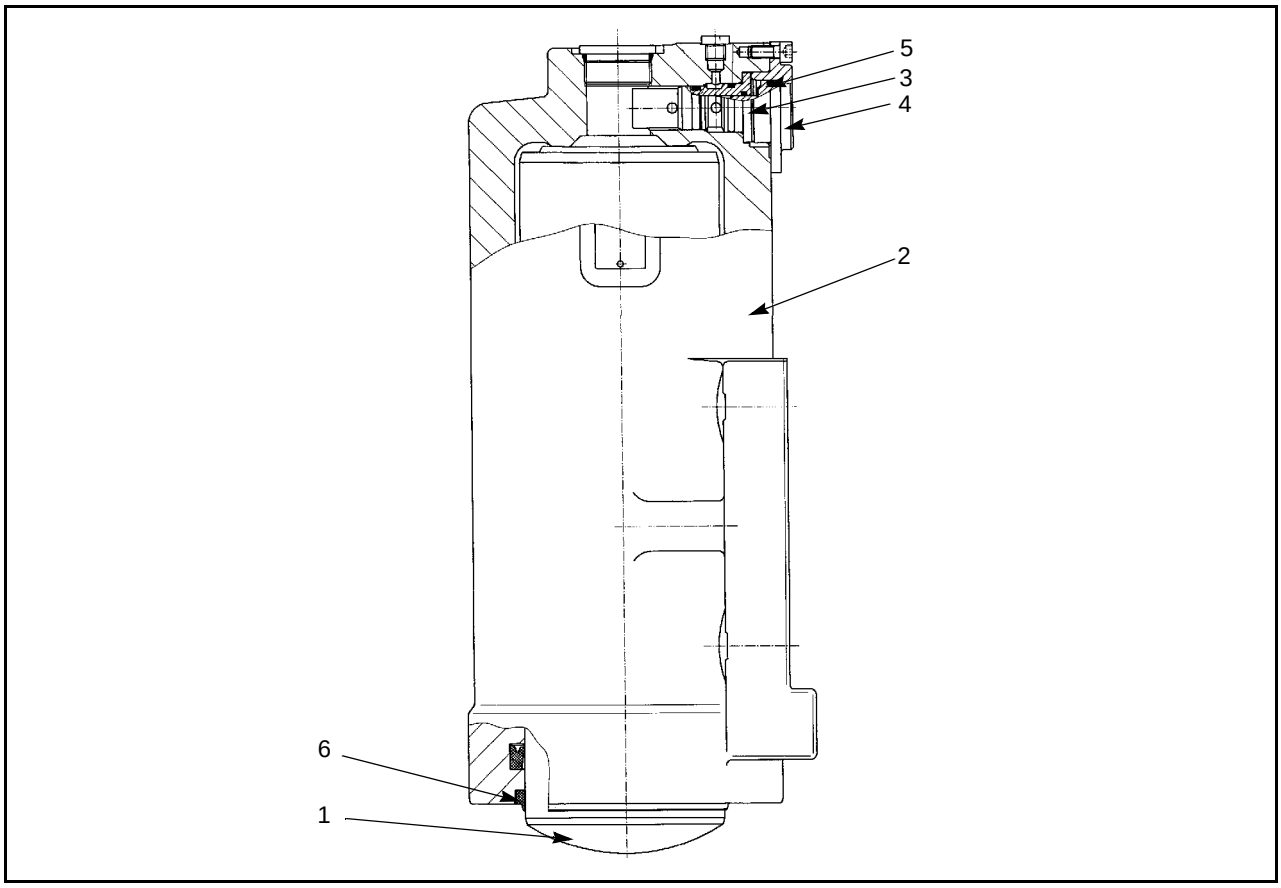
PW160	2 Litres



1. Screw
2. O-ring
3. Roller Bearing
4. Beval 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

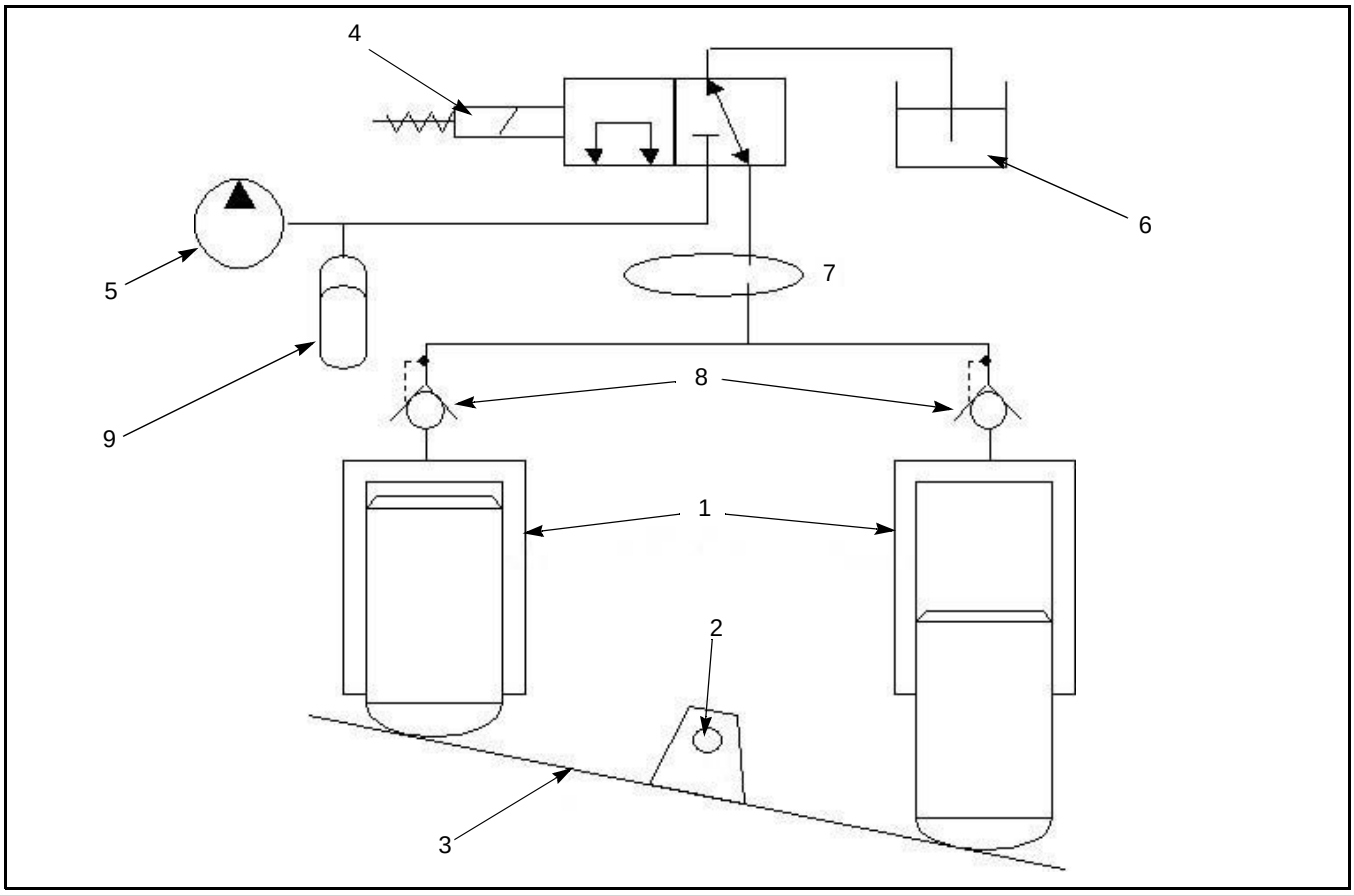
Plunger cylinder with inbuilt check valve.
The check valve is designed as a leak free ball seat valve which is released by a control spool.

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

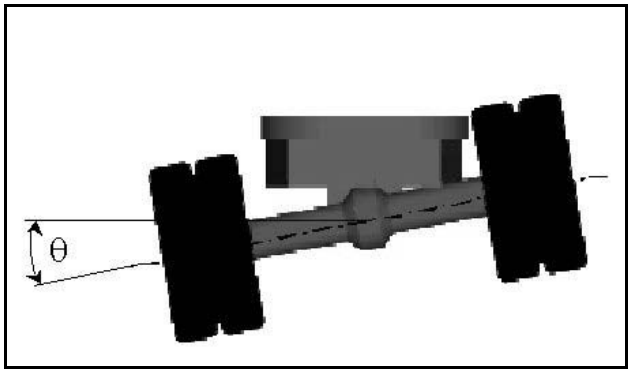
CIRCUIT

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



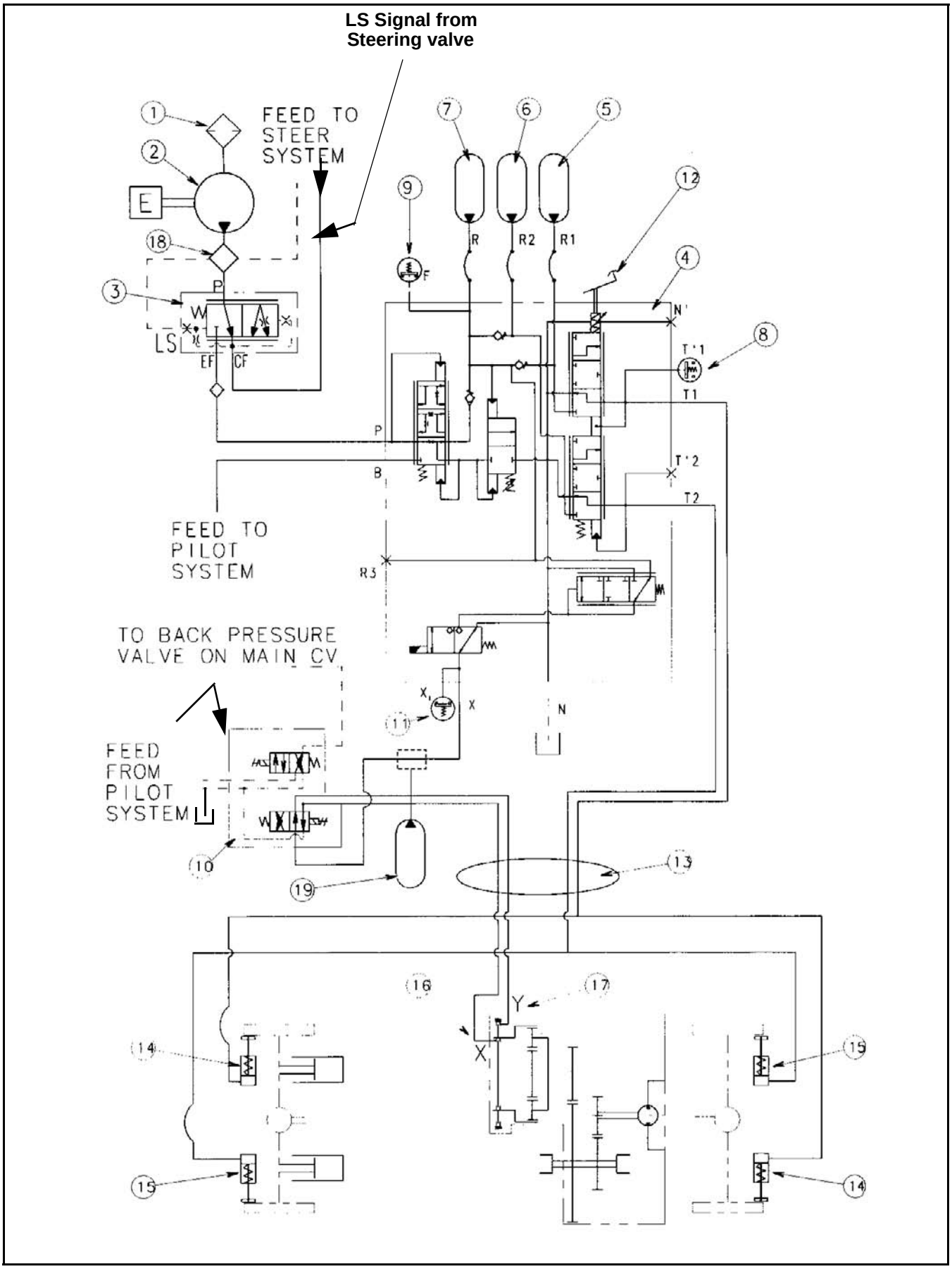
1. Cylinder
2. Axle mount pin
3. Oscillating axle
4. Oscillation lock solenoid valve
5. PPC pressure reducing valve
6. Hydraulic tank
7. Swivel joint
8. PPC operated check valve
9. Accumulator



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.)

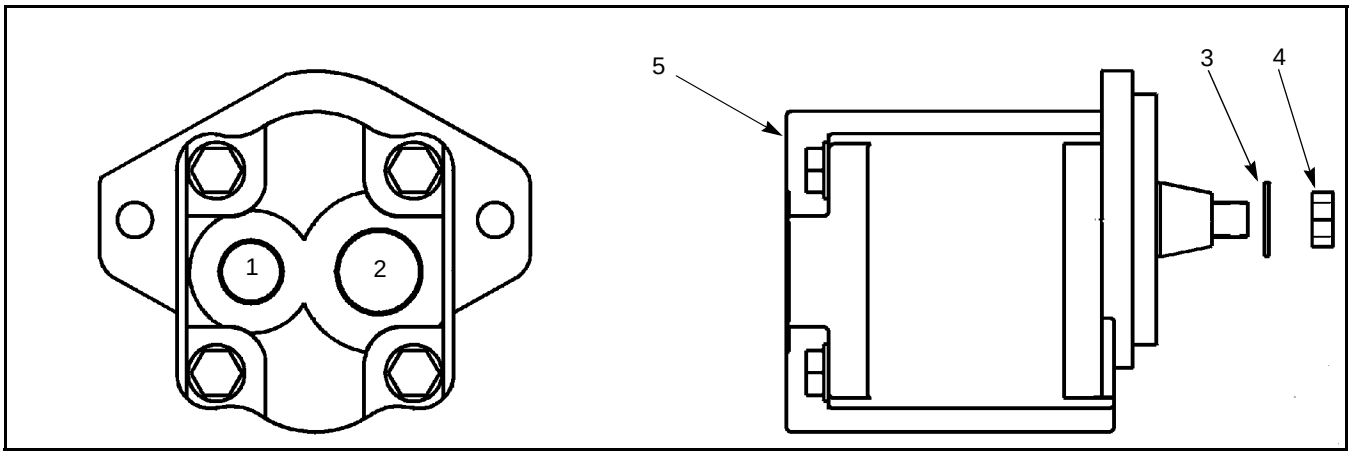
Structure and Function

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.

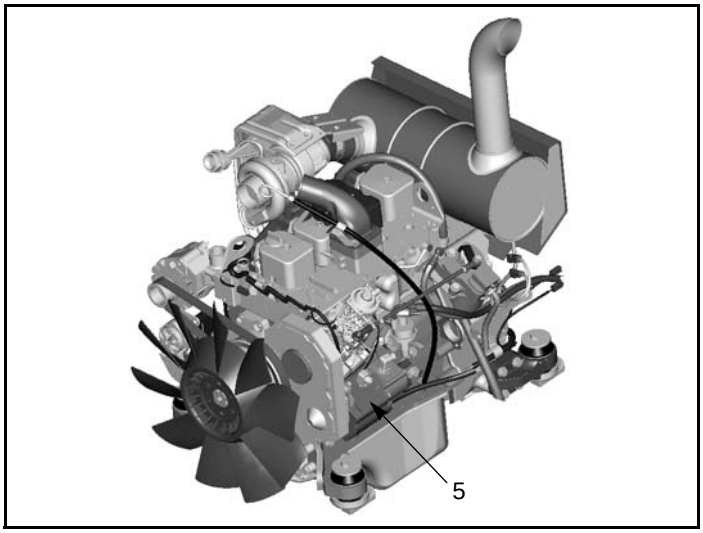
BRAKE/STEER PUMP



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

SPECIFICATIONS

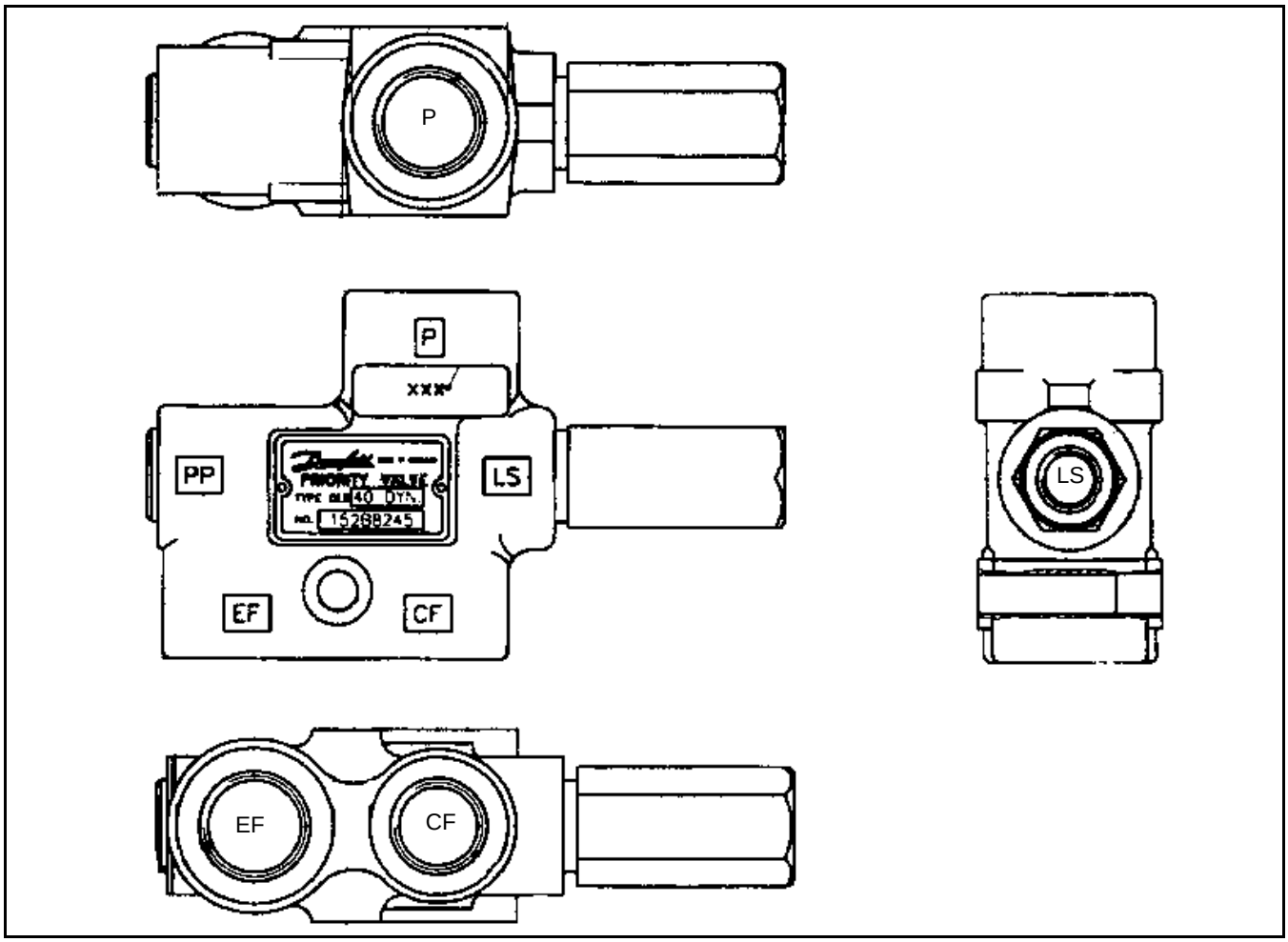
Type	gear pump
Rated speed	2500 RPM
Displacement	23cc/REV
Rated pressure	250 bar



FUNCTION

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

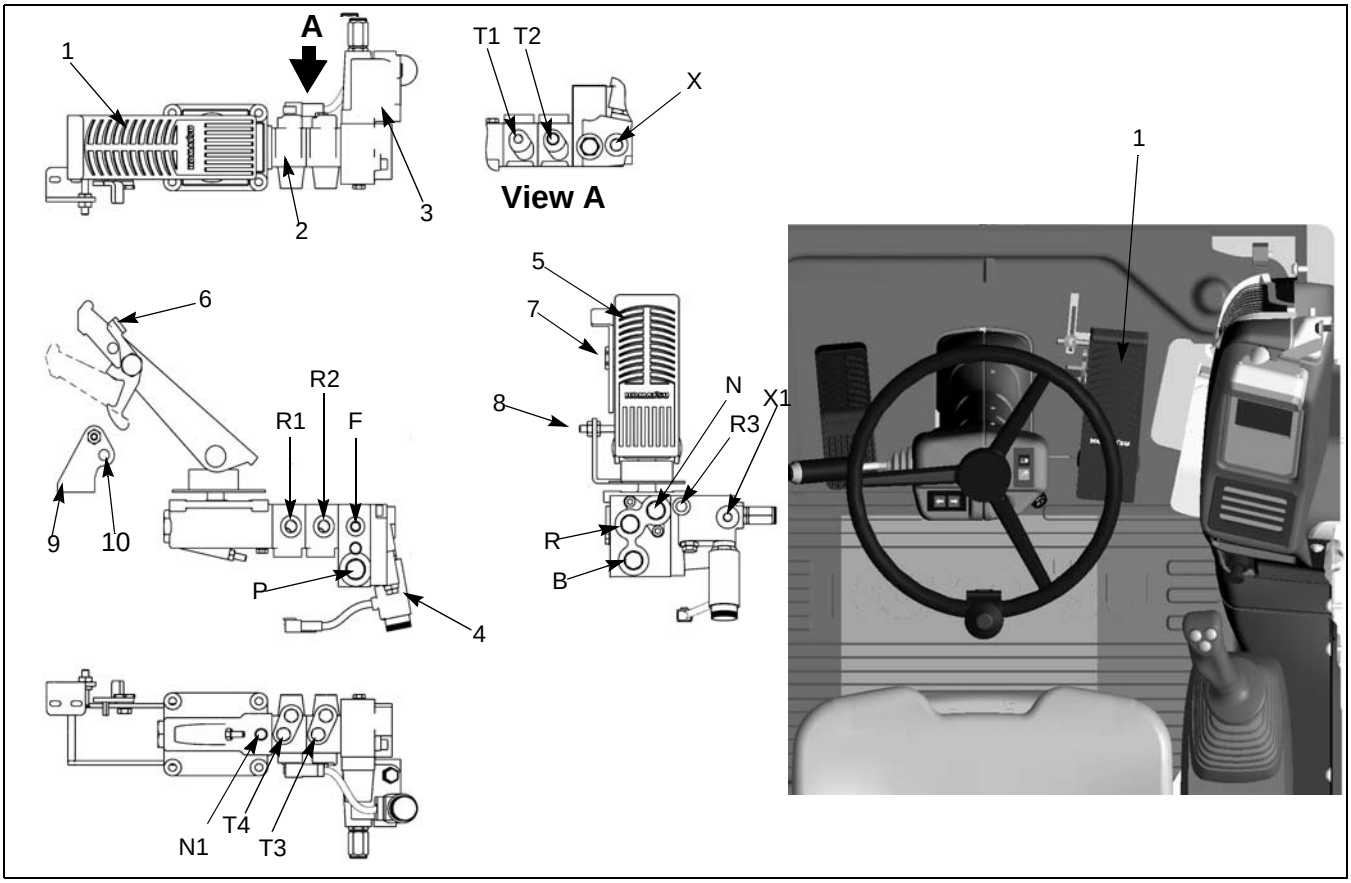
SPECIFICATION

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		

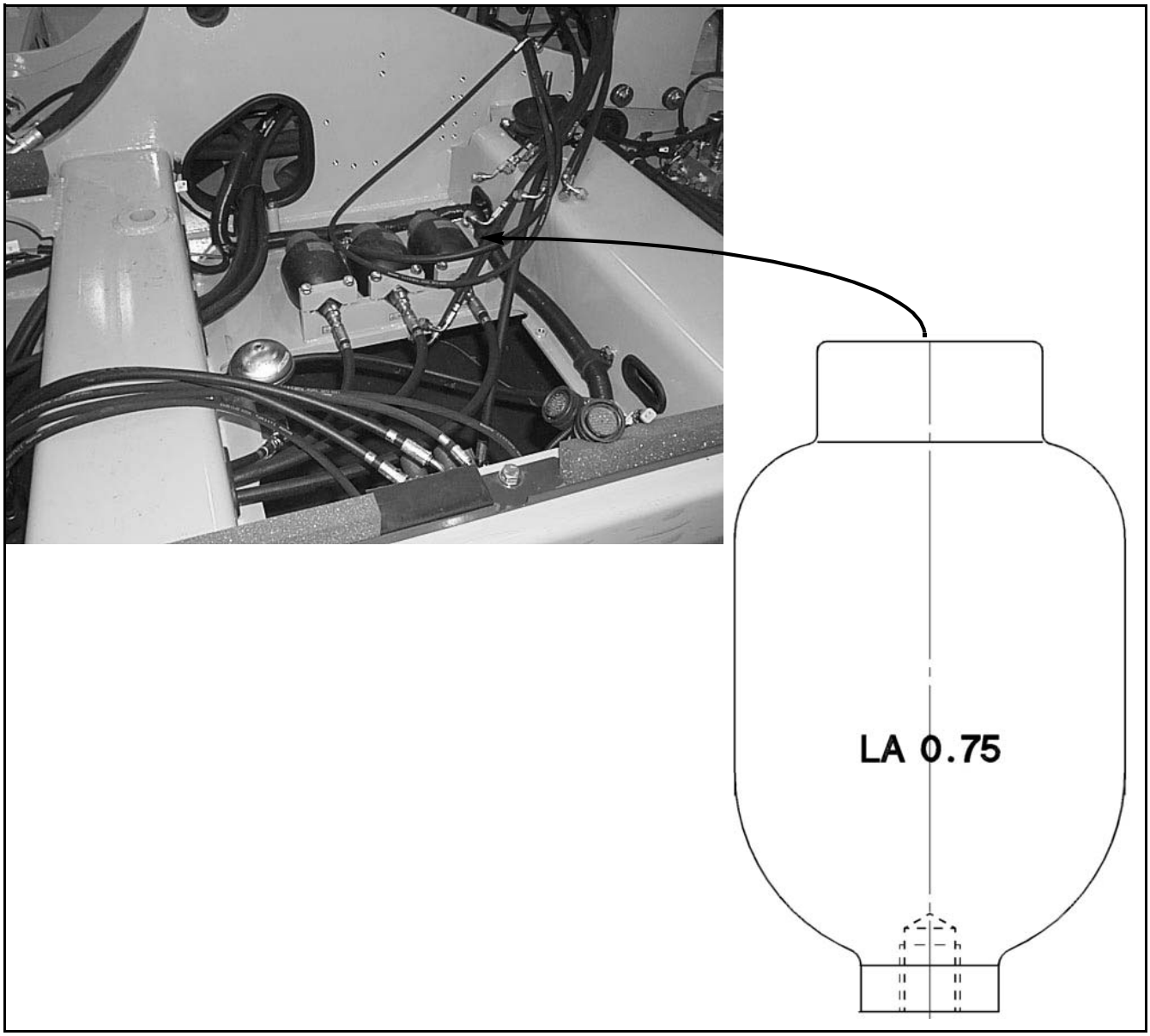
SPECIFICATIONS

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

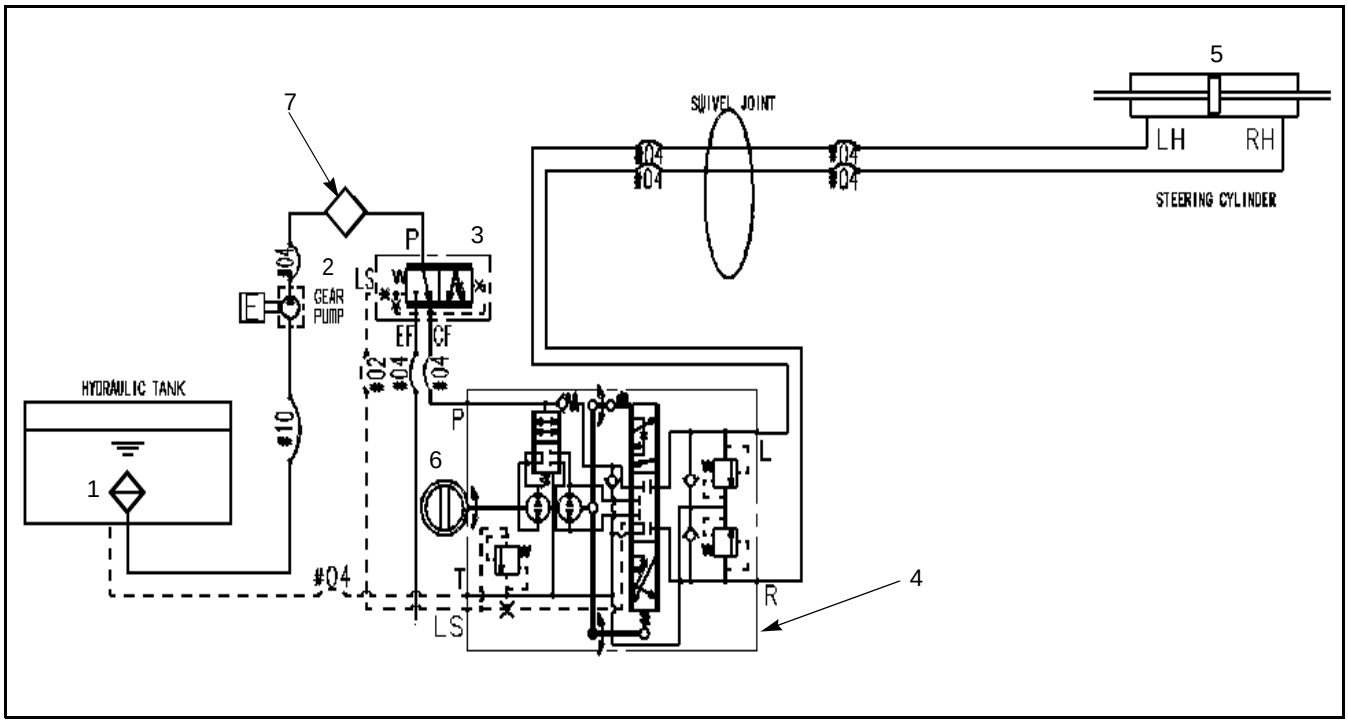
1.	Nominal capacity	0.75L
2.	Max working pressure	210 bar
3.	Max p dynamic	175 bar
4.	Working temperature	- 30° to 125° C
5.	Diaphragm	NBR
6.	Fluid	Mineral oil
7.	Body	Forged steel
8.	Surface finish	Rust preventative coating
9.	Pre-charge gas	Nitrogen
10.	Pre-charge Pressure	50 bar

Structure and Function

- The accumulators are installed below the operators cab accessible from the undercovers.

- Installed into the brake circuit the accummulators provide pressure to the brakes in the event of a power failure ensuring the machine is stopped safely.

STEERING SYSTEM

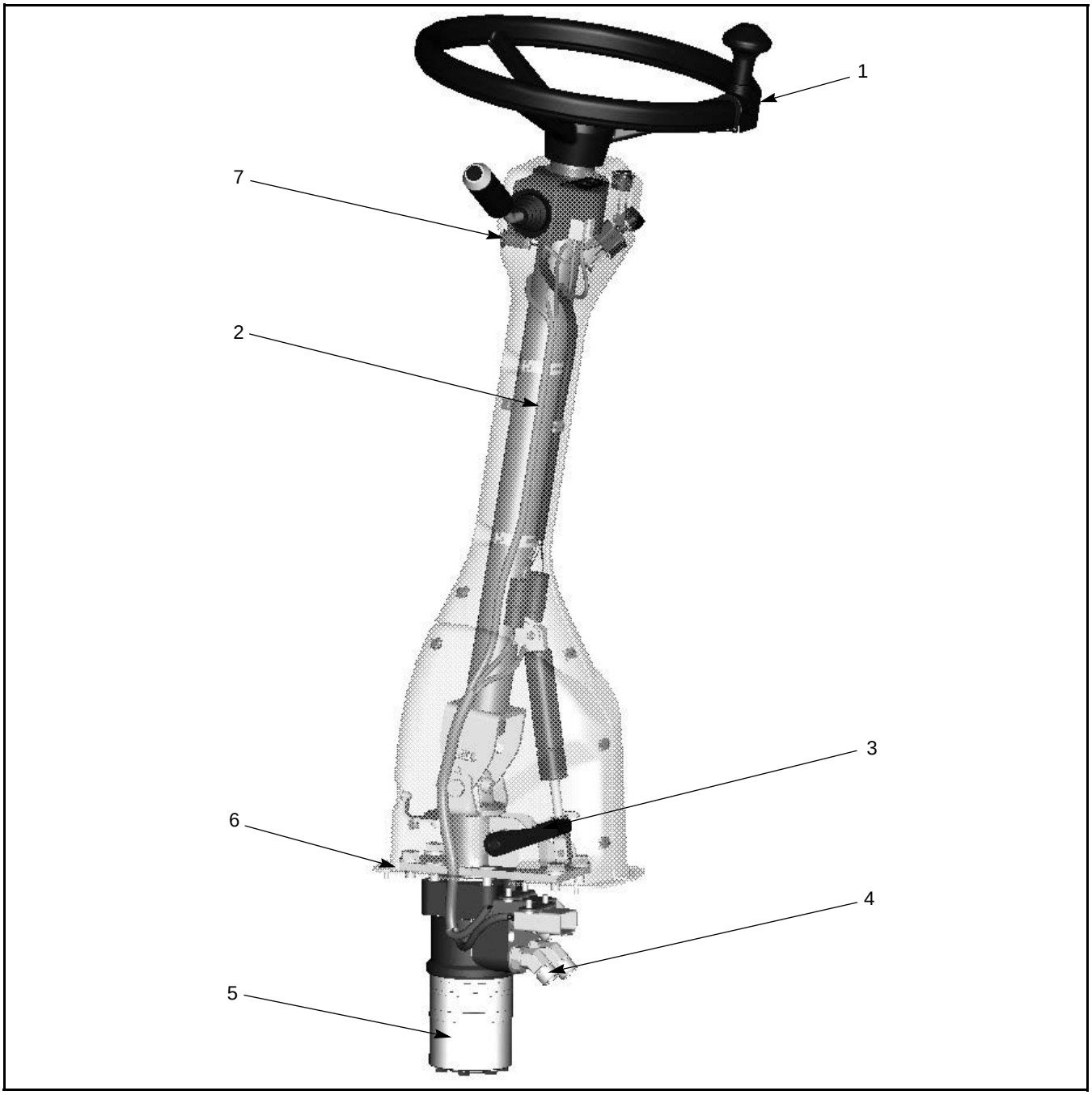


1. Hydraulic filter
2. Brake/steer pump
3. Priority valve
4. Steering valve
5. Steering cylinder
6. Steering wheel
7. In-line filter

Structure and Function

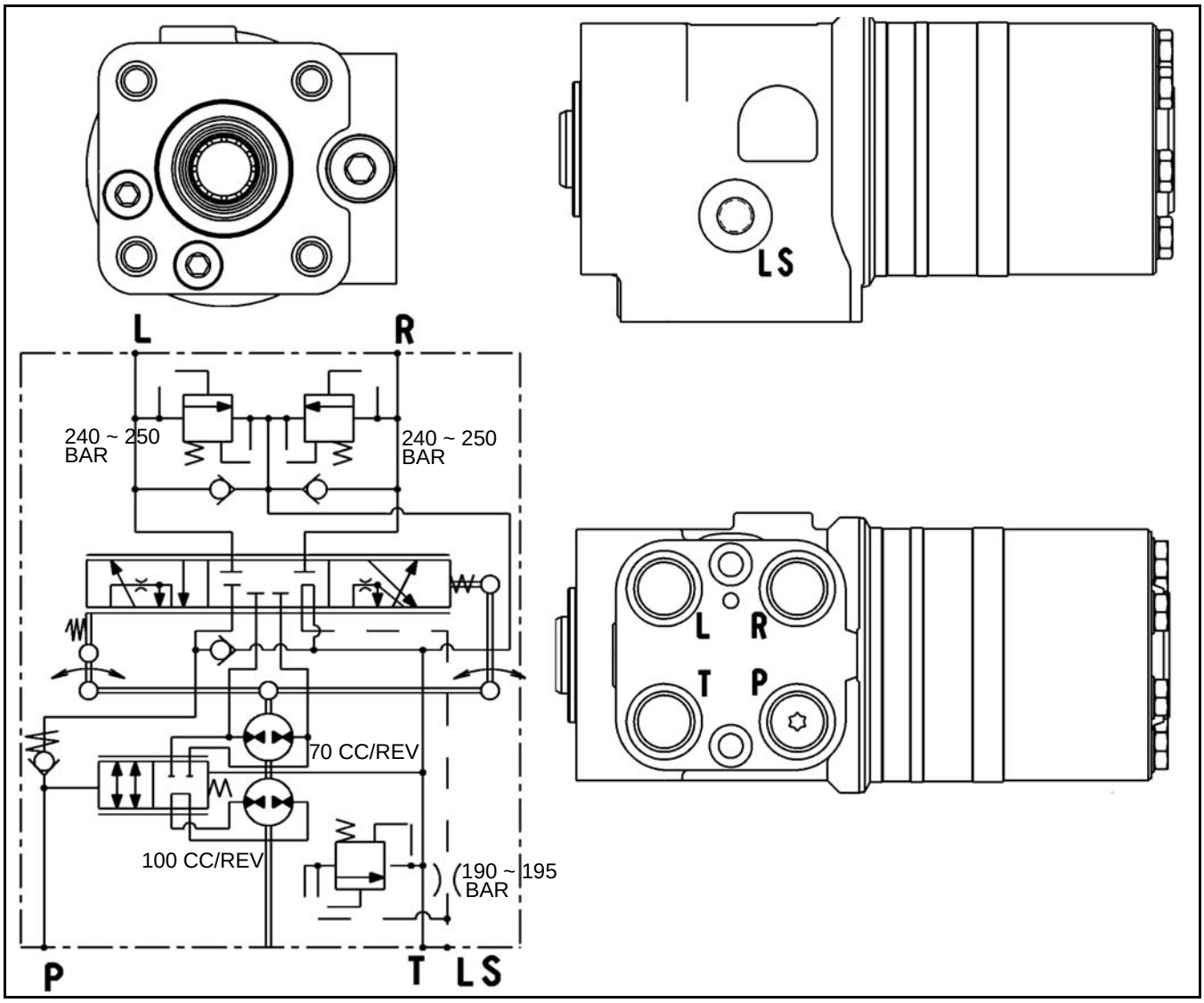
- The steering is fully hydraulic. The oil sent by the brake/steer pump (2) mounted on the PTO at the front of the engine, flows via the priority valve (3) to the steering valve (4). From here it is passed through swivel joint to steering cylinder (5). the steering cylinder then extends or retracts to 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

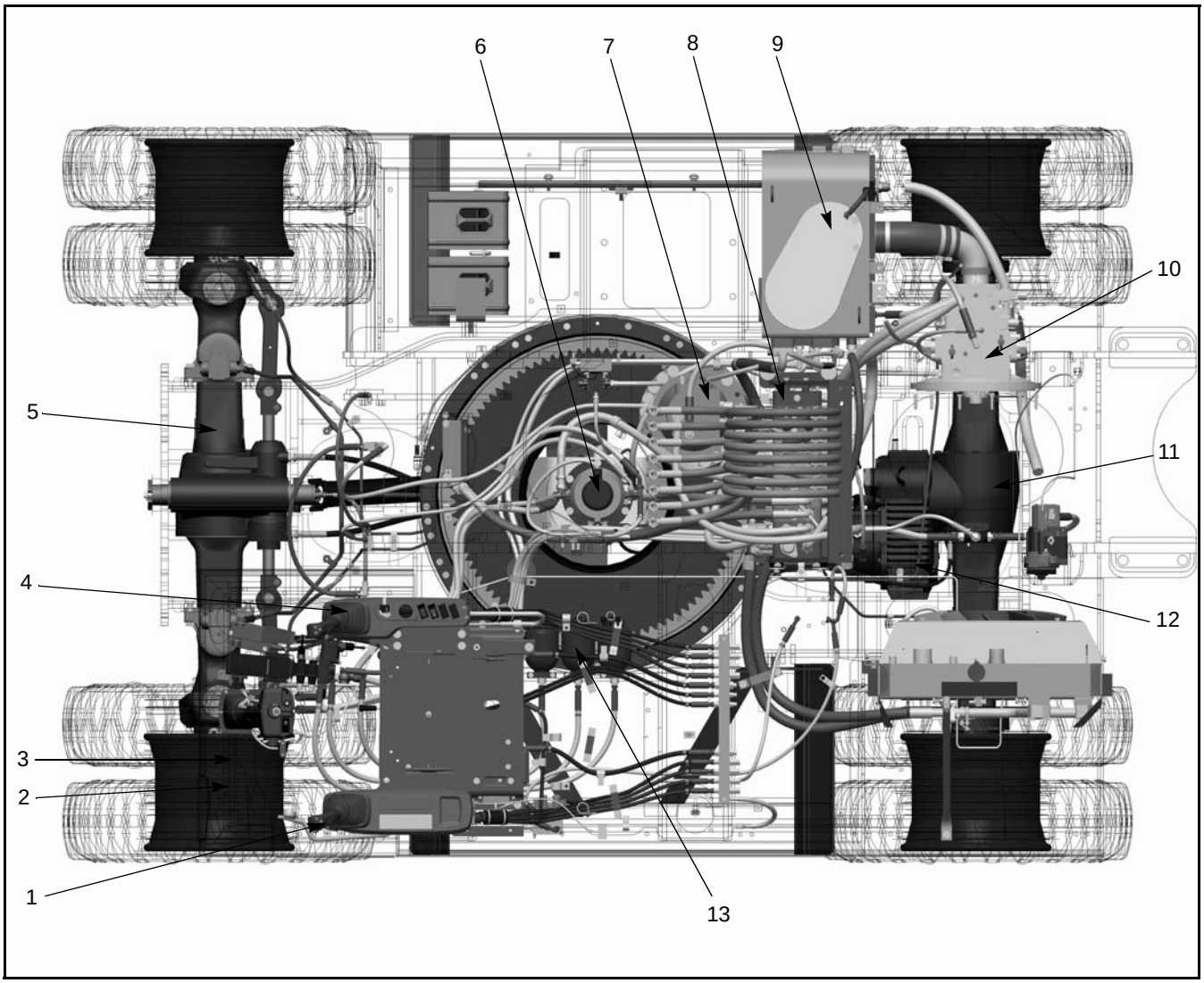
Structure and Function

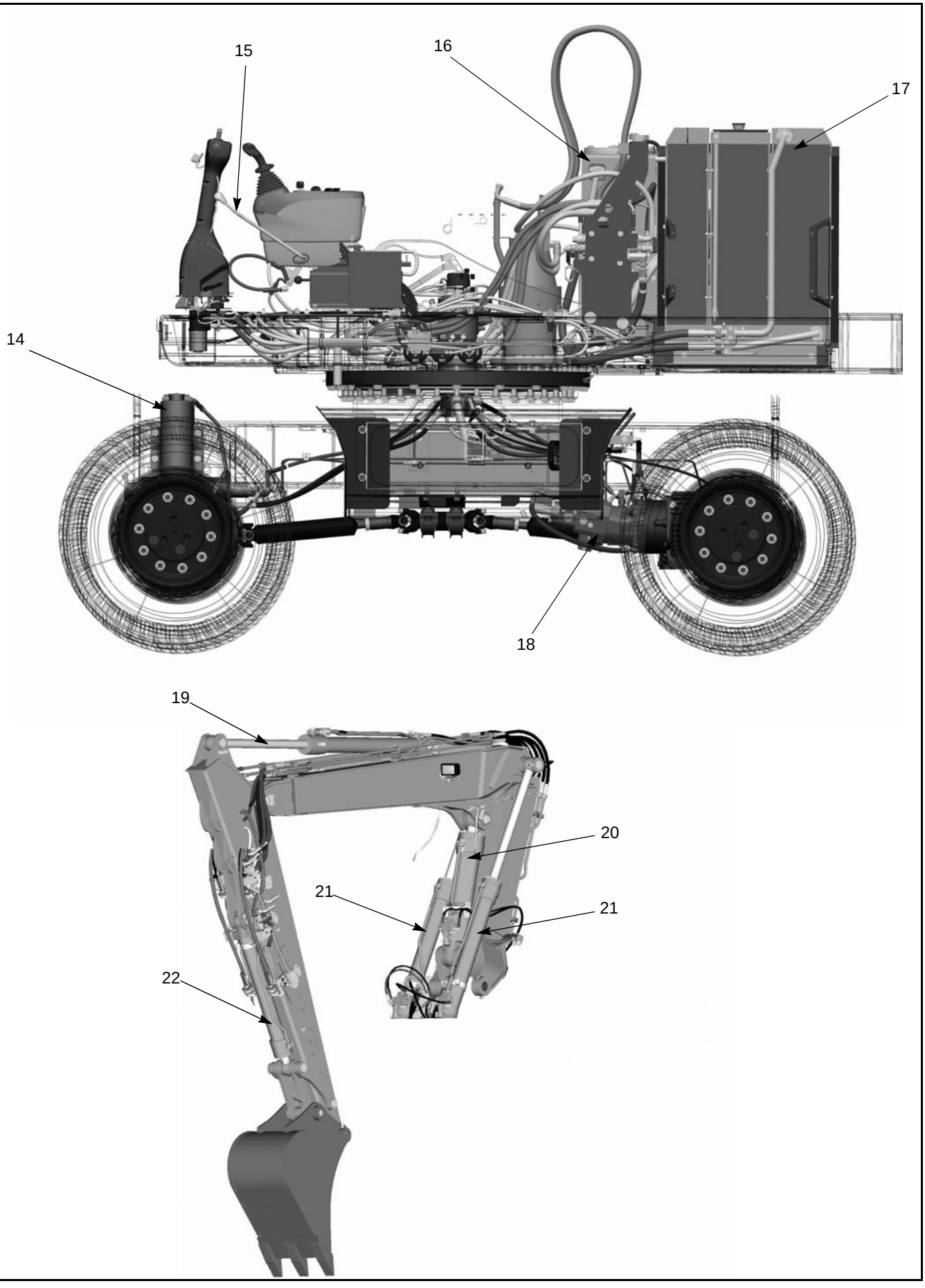
- The steering is fully hydraulic, the oil sent by the brake/steer pump on the front of the engine flows via the priority valve to the orbitrol valve, and finally to the steering cylinder which controls, extends or retracts the tie rod on the axle to steer the machine.

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

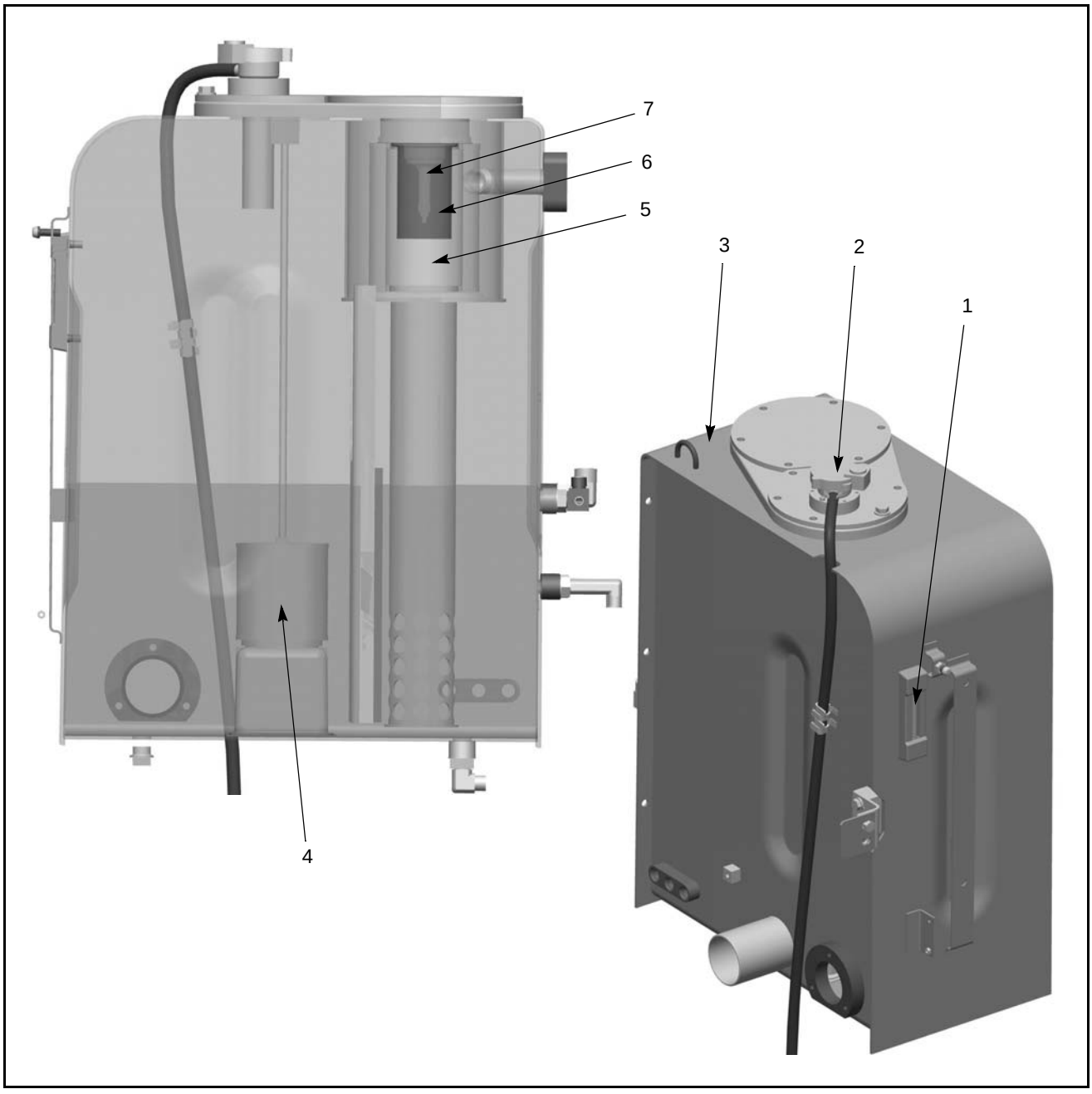



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HYDRAULIC CIRCUIT DIAGRAM

(Please refer to Section 90)

HYDRAULIC TANK



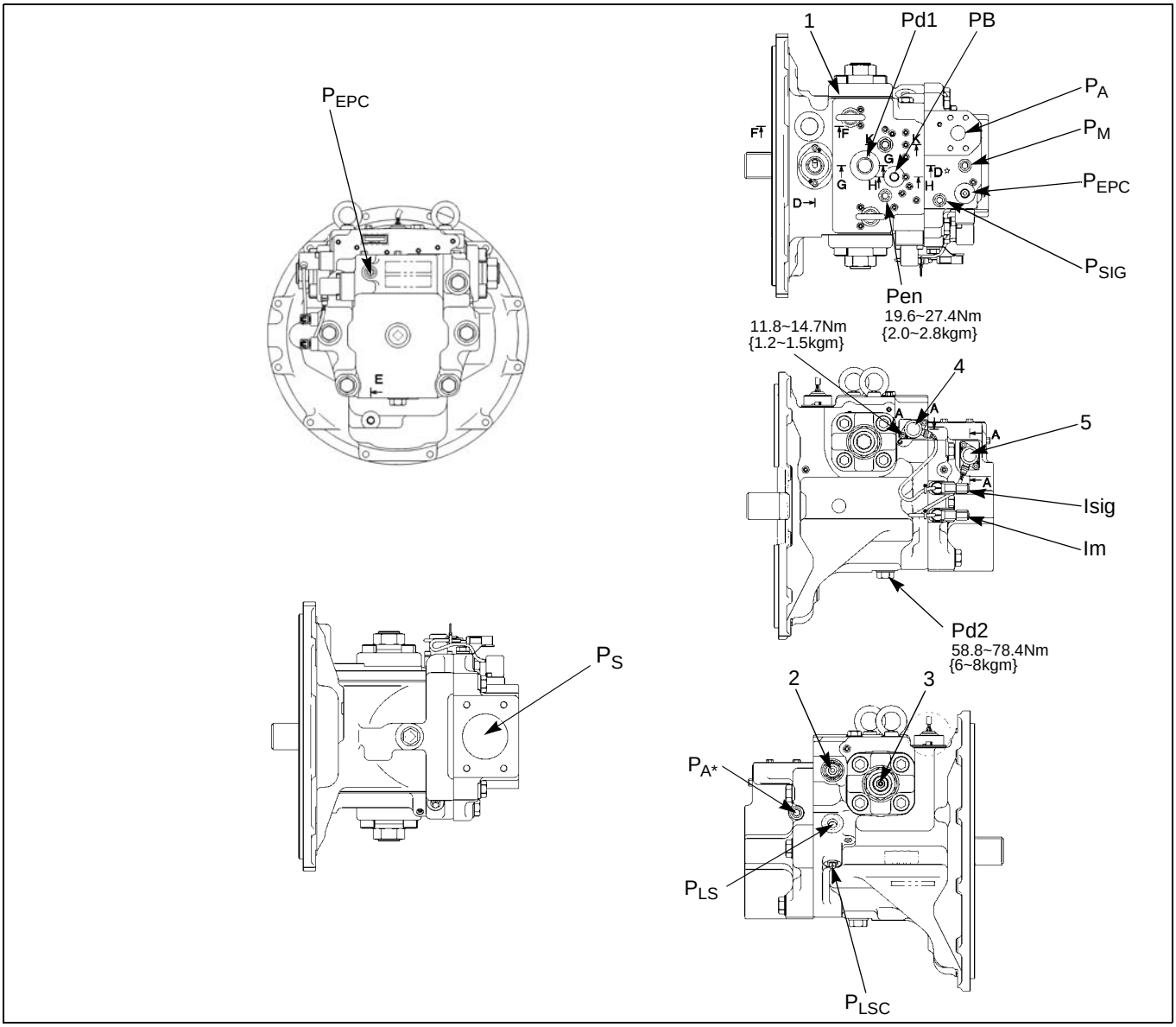
1. Sight gauge
2. Oil filler cap
3. Hydraulic tank
4. Suction strainer
5. Filter element
6. Strainer
7. Bypass valve

SPECIFICATIONS

Tank	166 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



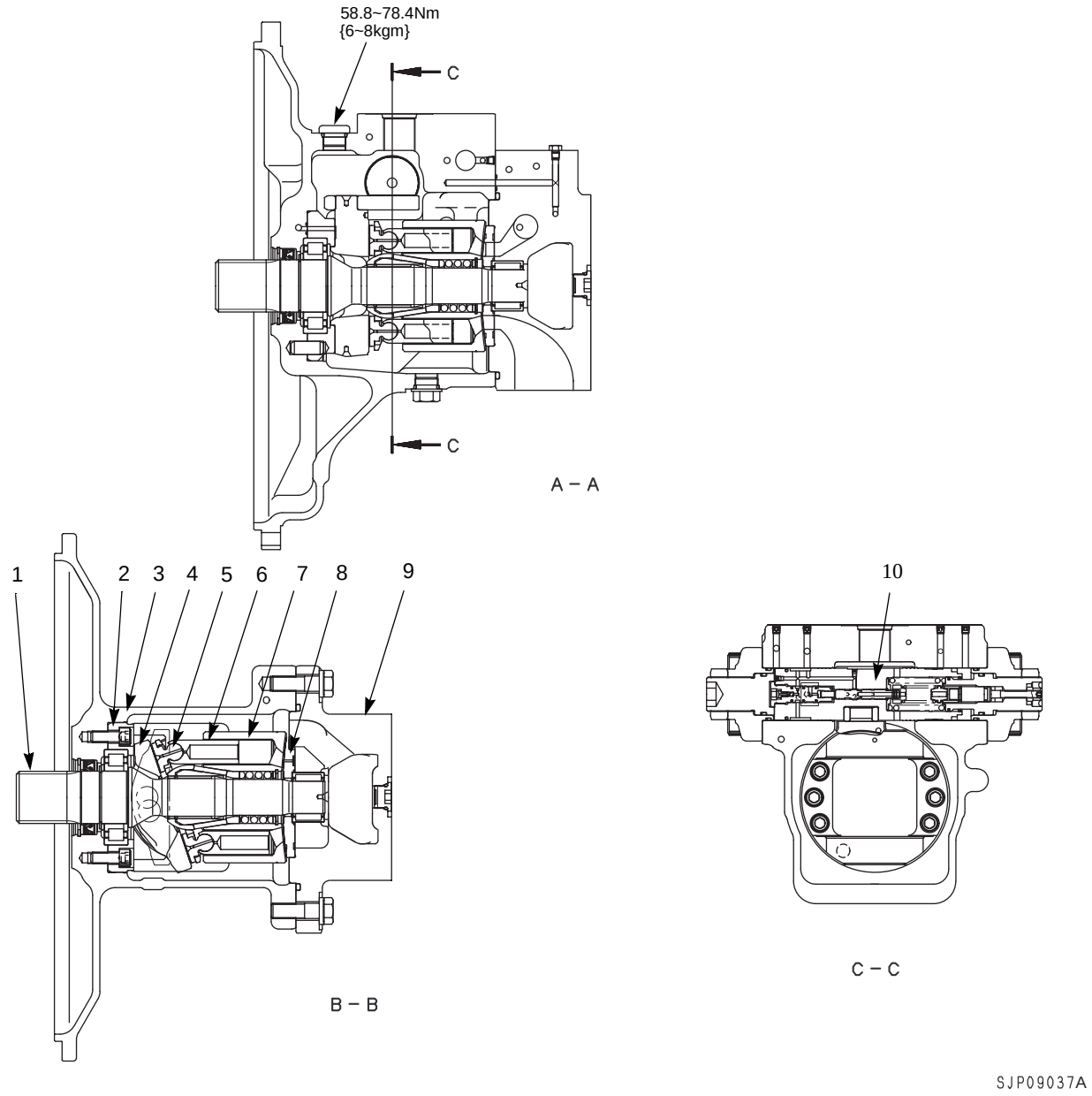
1. Main pump
2. LS valve
3. PC valve
4. LS-EPC valve
5. PC-EPC valve

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

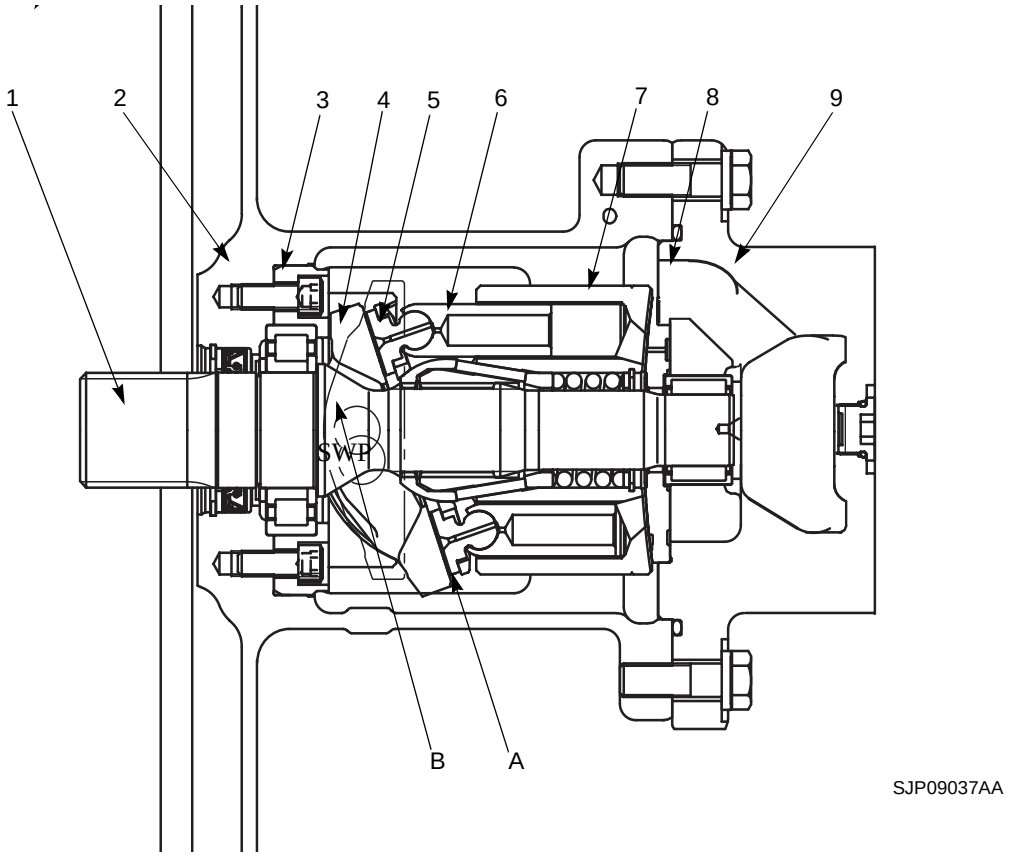
P_{LS} :Load pressure input port
P_{LSC} :Load pressure detection port
P_S :Pump suction port
P_{LSC}:LS set selector pressure detection port
P_M :PC set selector pressure detection port
P_{EPC}:EPC basic pressure input port
P_{EPC} :EPC basic pressure checking port
P_{SIG} :LS set change pressure checking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

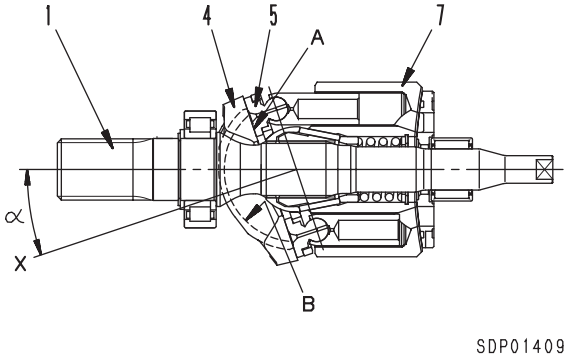
Structure

- 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).

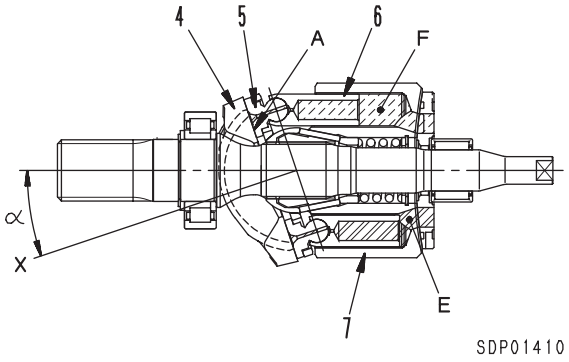
Operation

1) Operation of pump

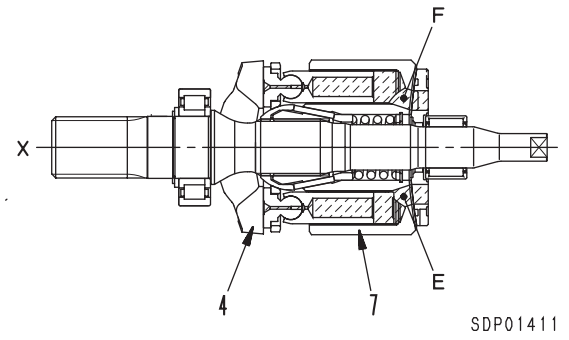
- Cylinder block (7) rotates together with shaft (1), and shoe (5) slides on flat surface **A**.
- When this happens, rocker cam (4) moves along cylindrical surface **B**, so angle α between center line **X** of rocker cam (4) and the axial direction of cylinder block (7) changes. (Angle α is called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



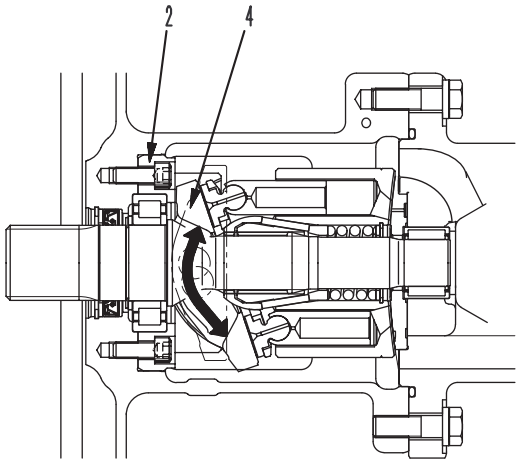
SDP01410



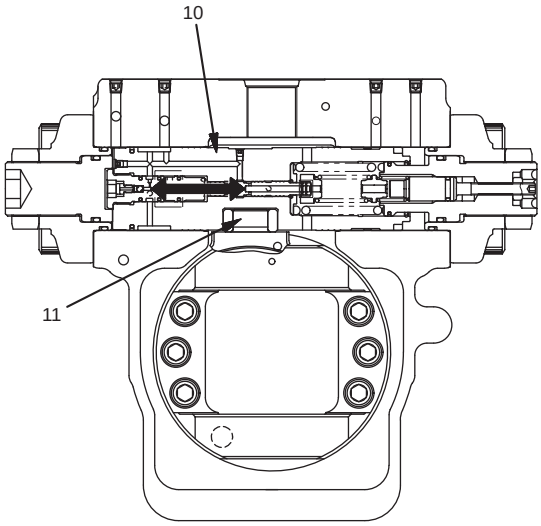
SDP01411

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).

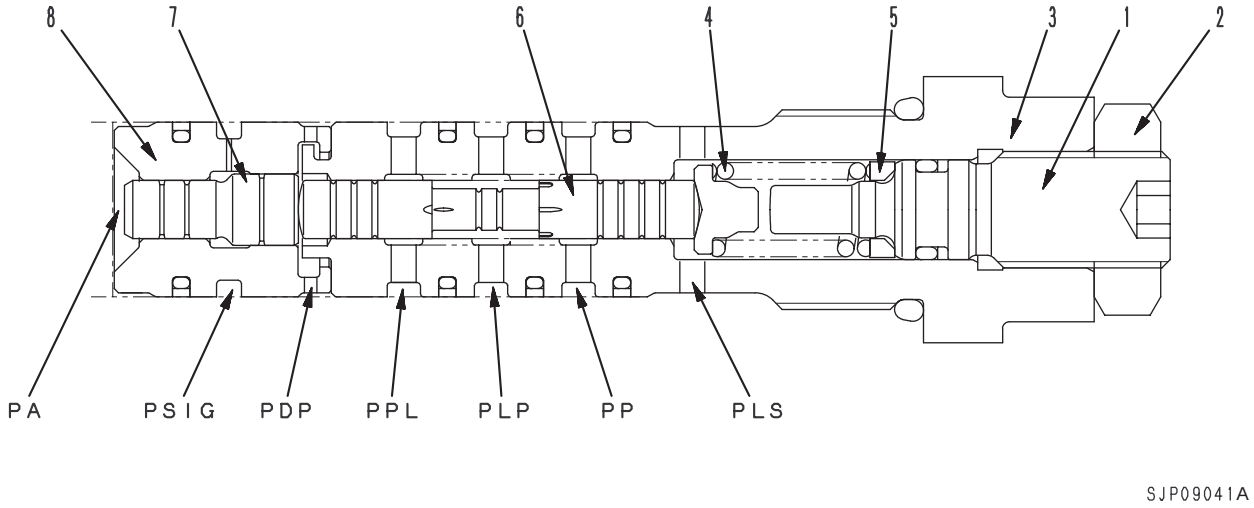


SJP09039A



SJP09040A

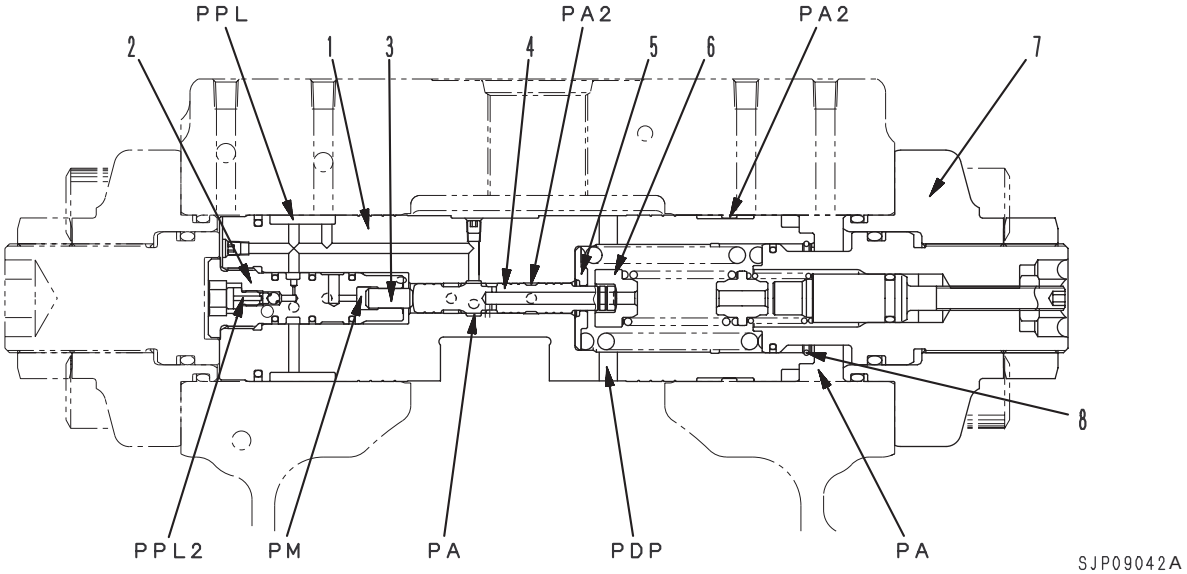
LS VALVE



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



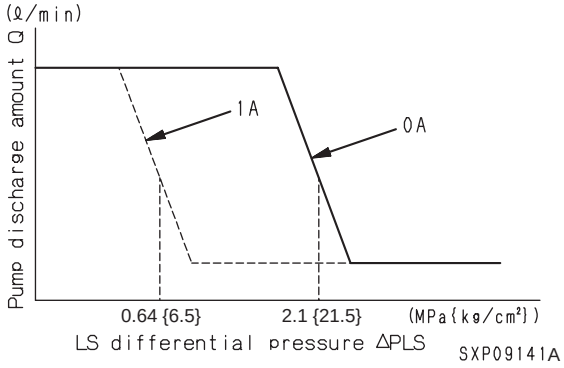
1) Servo piston assembly
2) Plug
3) Pin
4) Spool
5) Retainer
6) Seat
7) Cover
8) Wiring

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

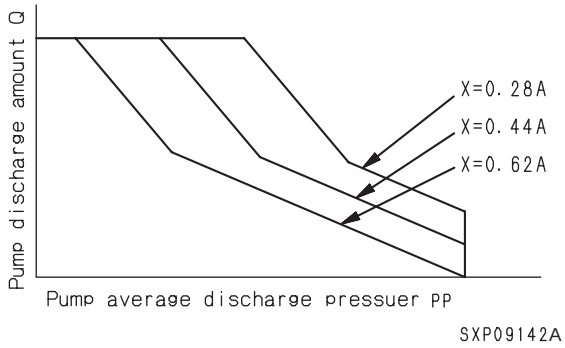
(1) LS valve

- 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}.

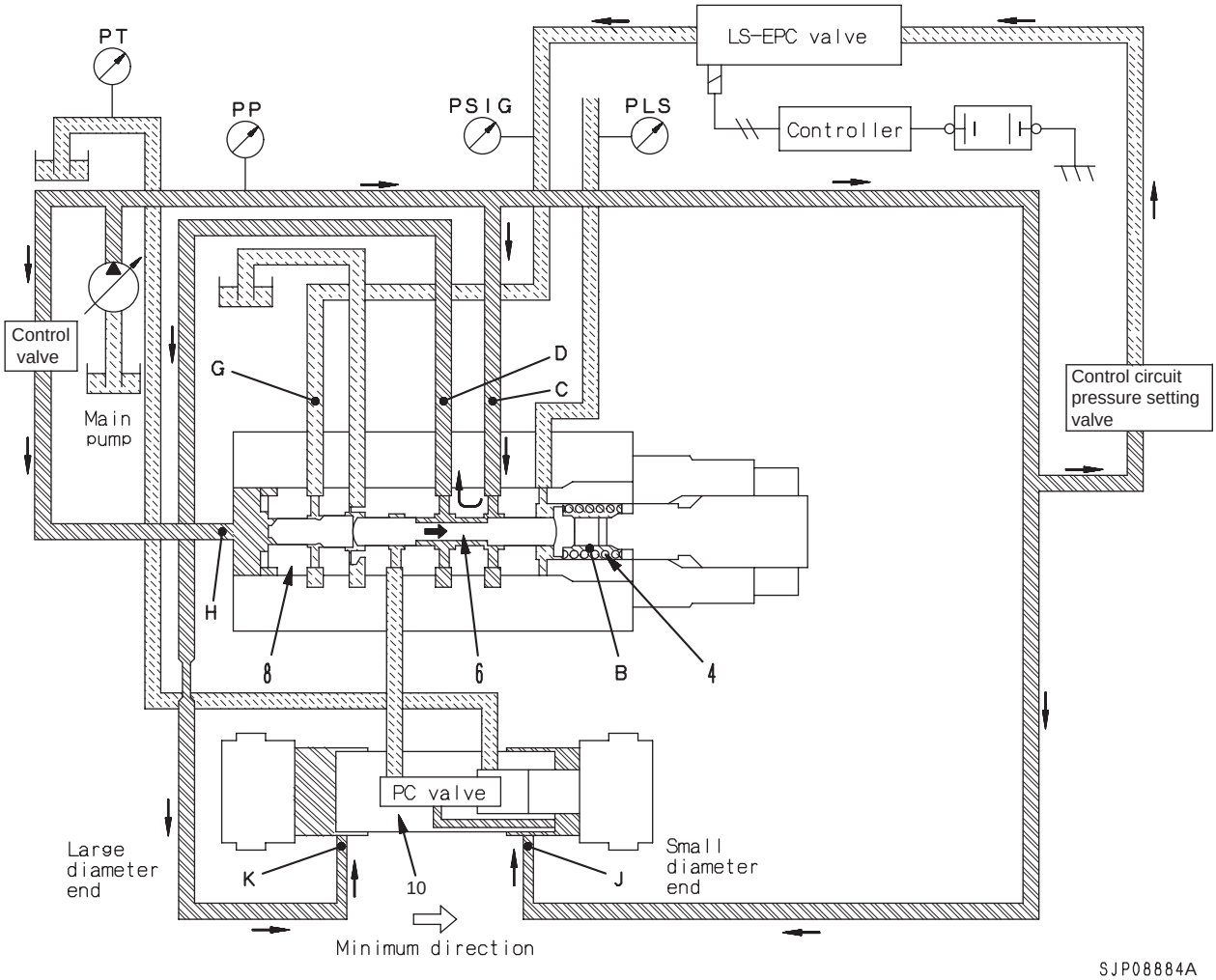


(2) PC valve

- 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



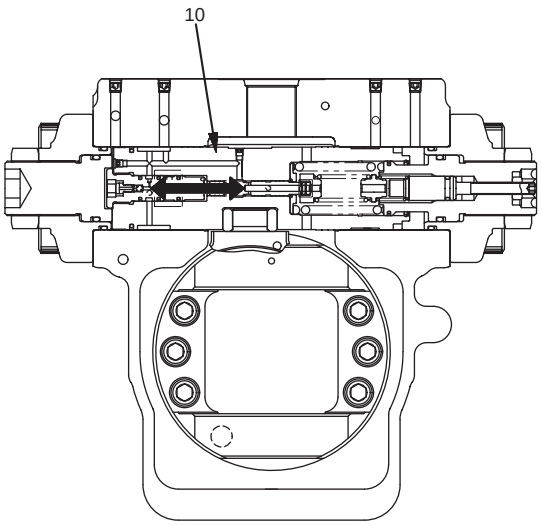
SJP08884A

(1) LS valve

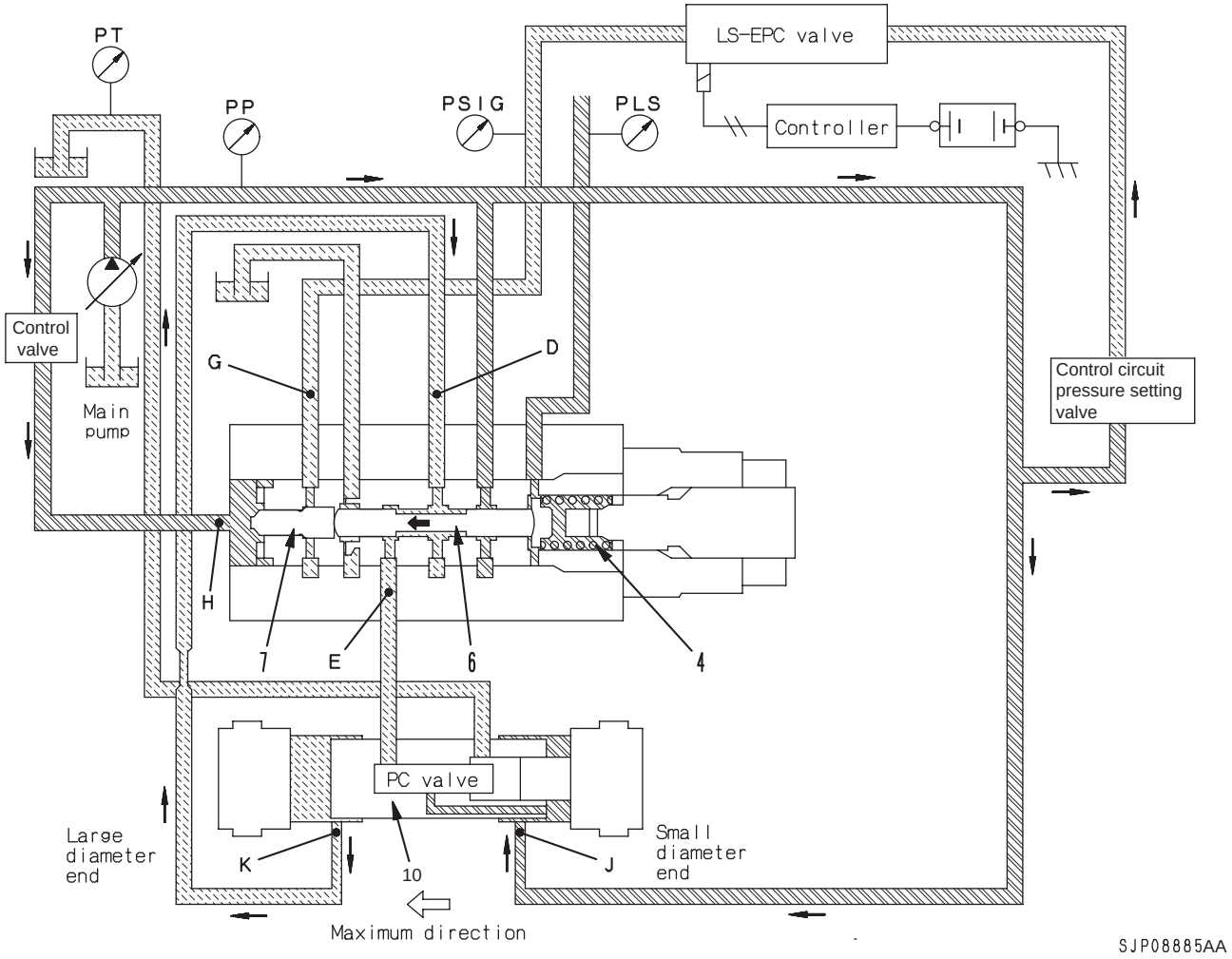
1) When control valve is at neutral position

- 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).

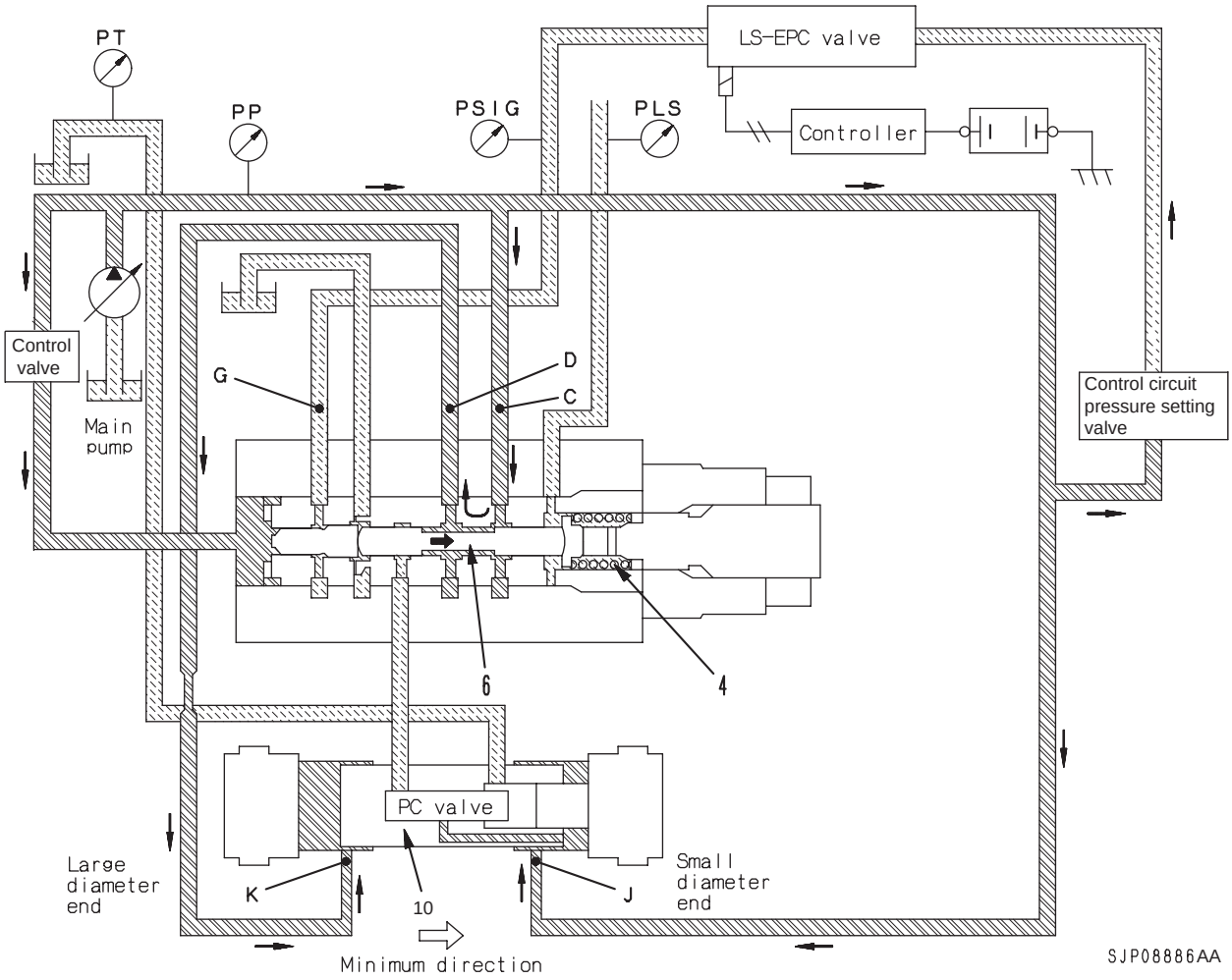


SJP09045



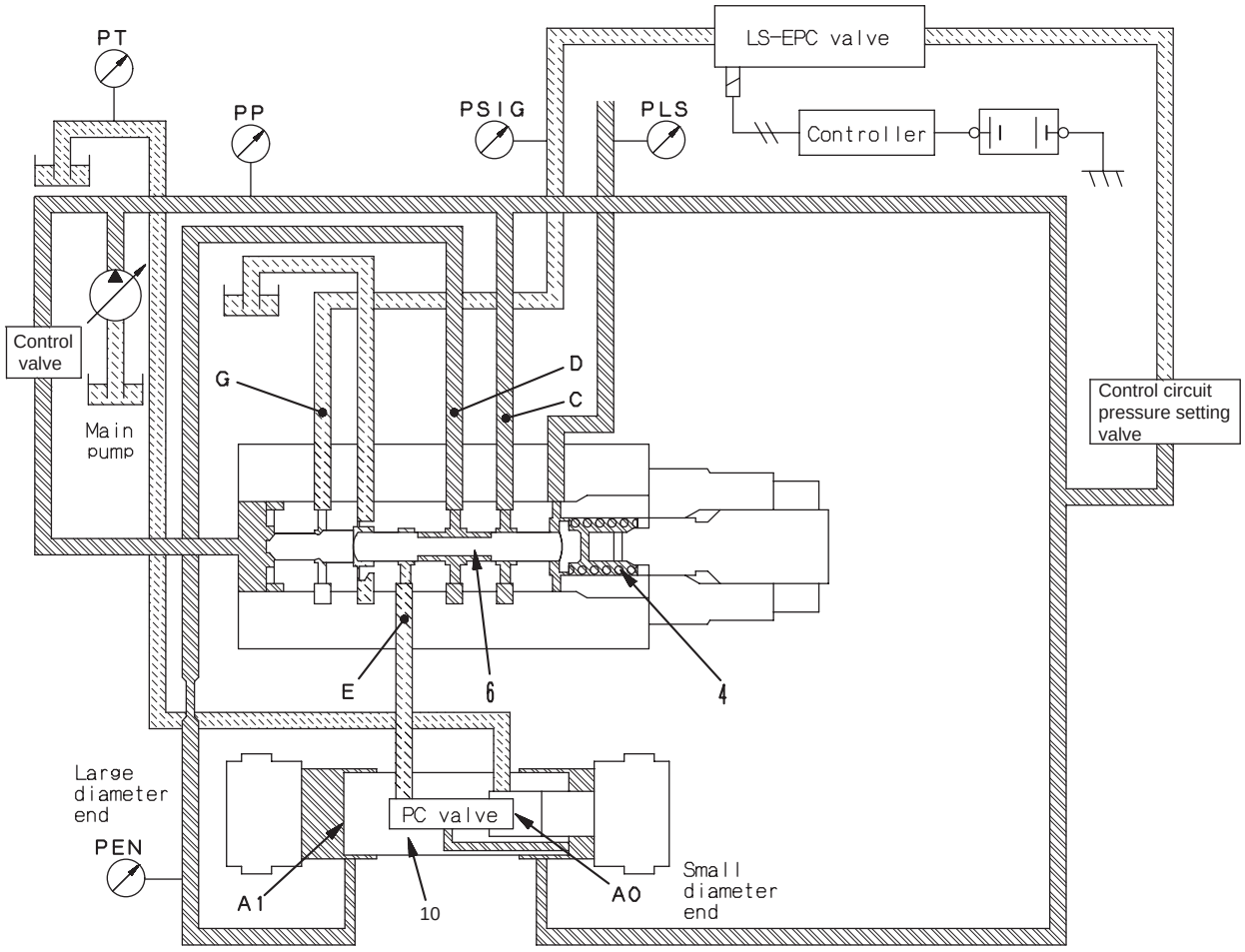
2. Operation in increase direction for pump discharge amount

- 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

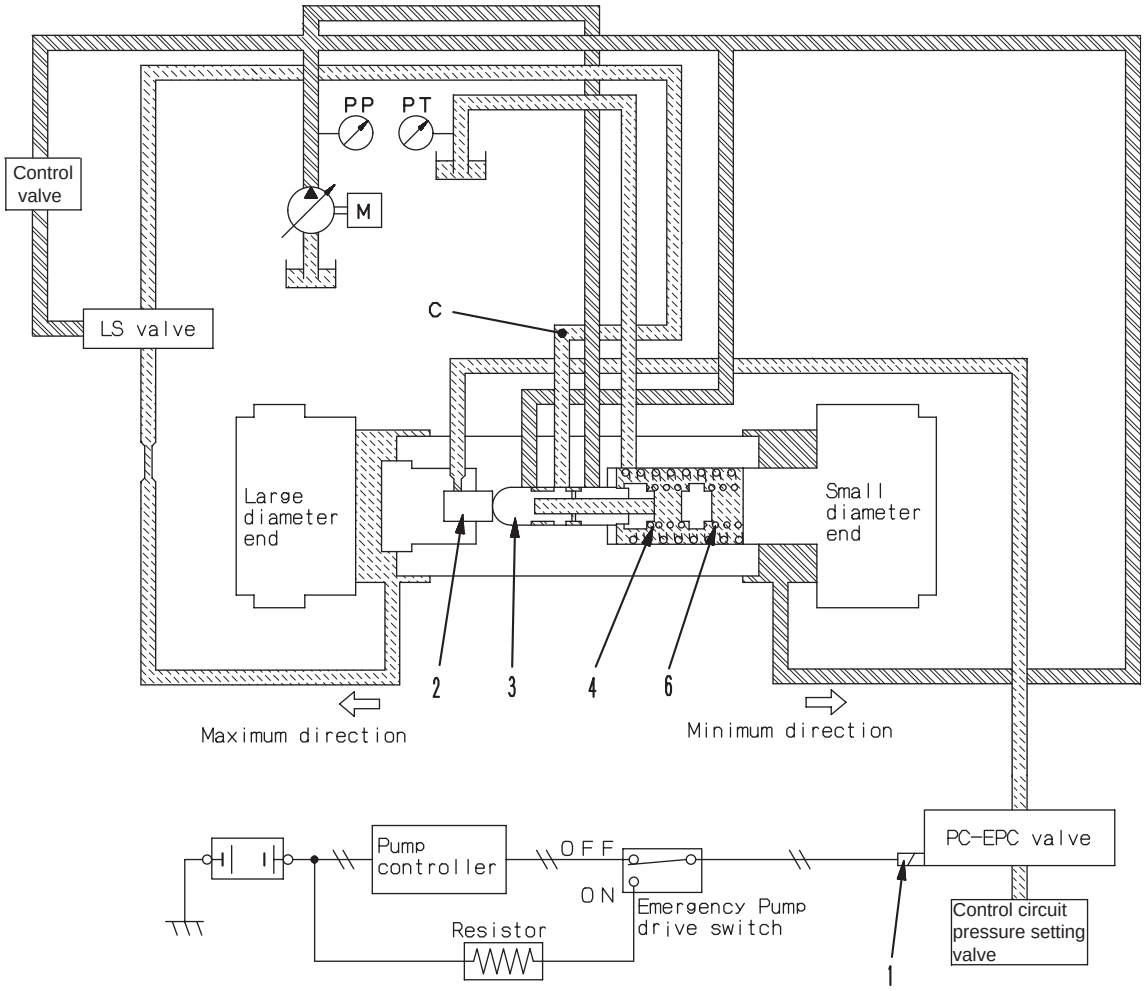
- The following explains the situation if the servo piston (10) moves to the right (the discharge amount becomes smaller). When LS differential pressure ∆**PLS** becomes larger (for example, when the area of opening of the control valve becomes smaller and pump pressure **PP** rises), pump pressure **PP** 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.



SJP08887A

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}.



SXP09143AA

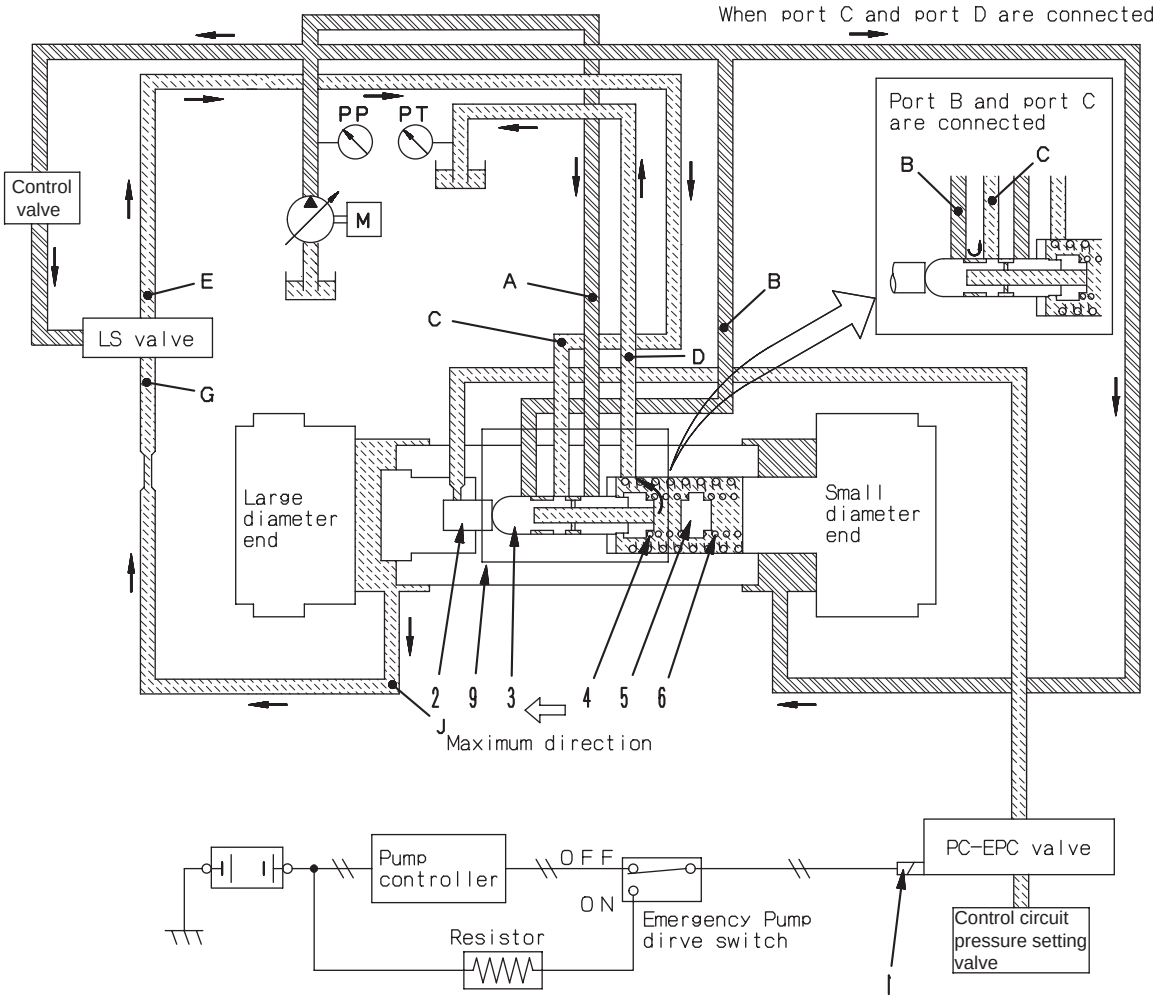
(2) PC Valve

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.

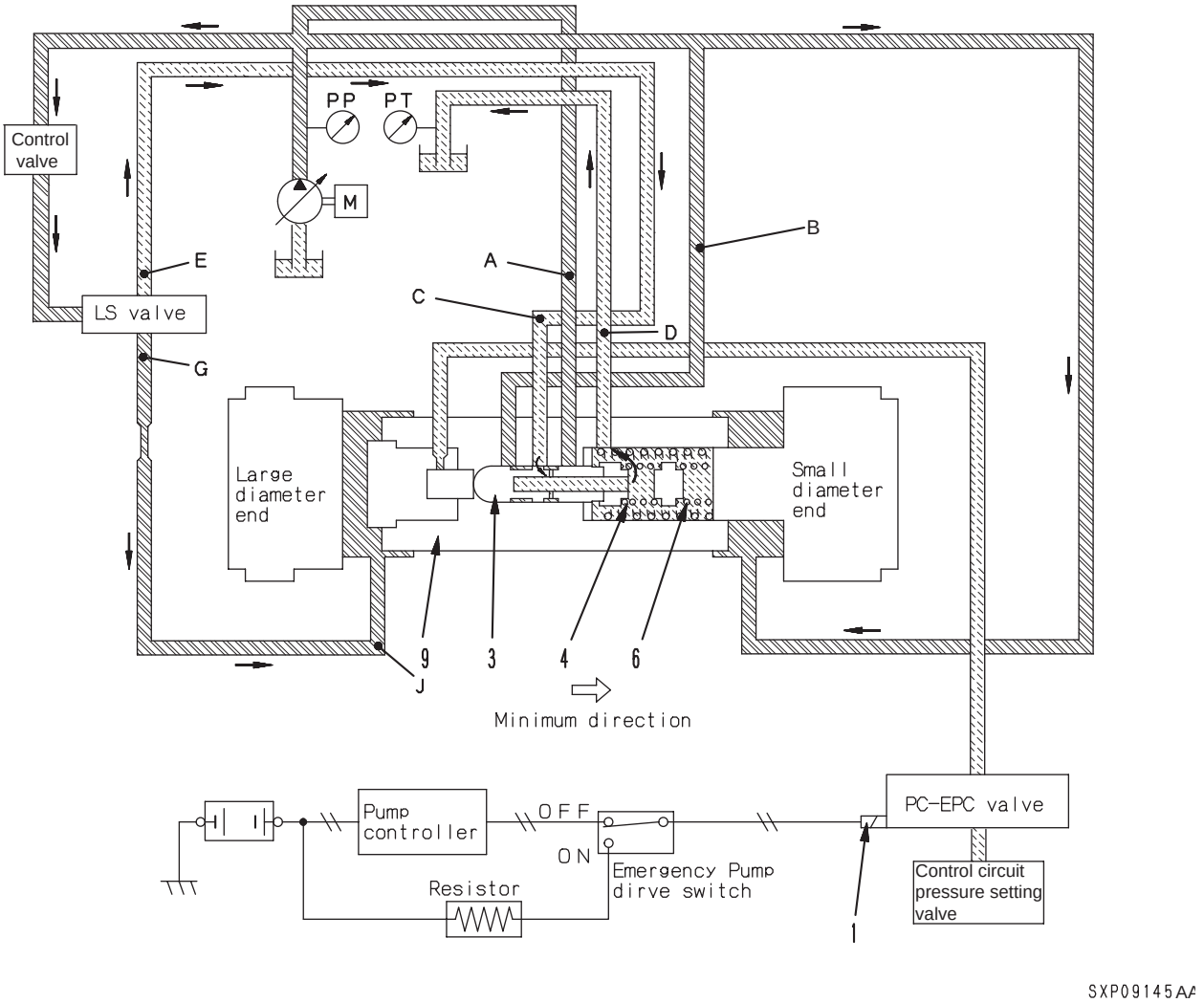


SXP09144AA

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.

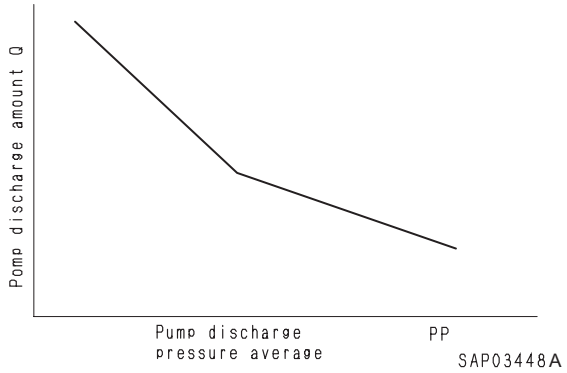


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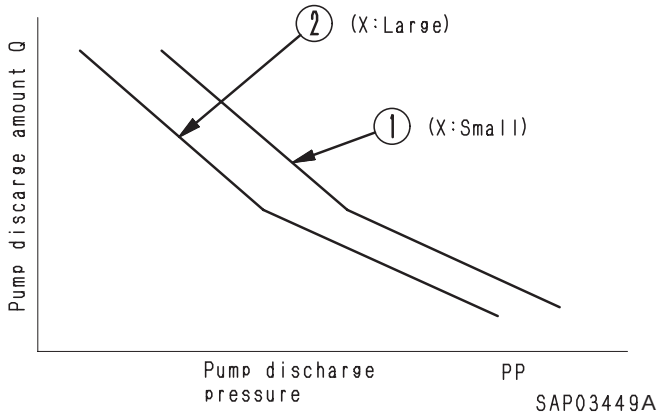
b). When load on actuator is large and pump discharge pressure is high

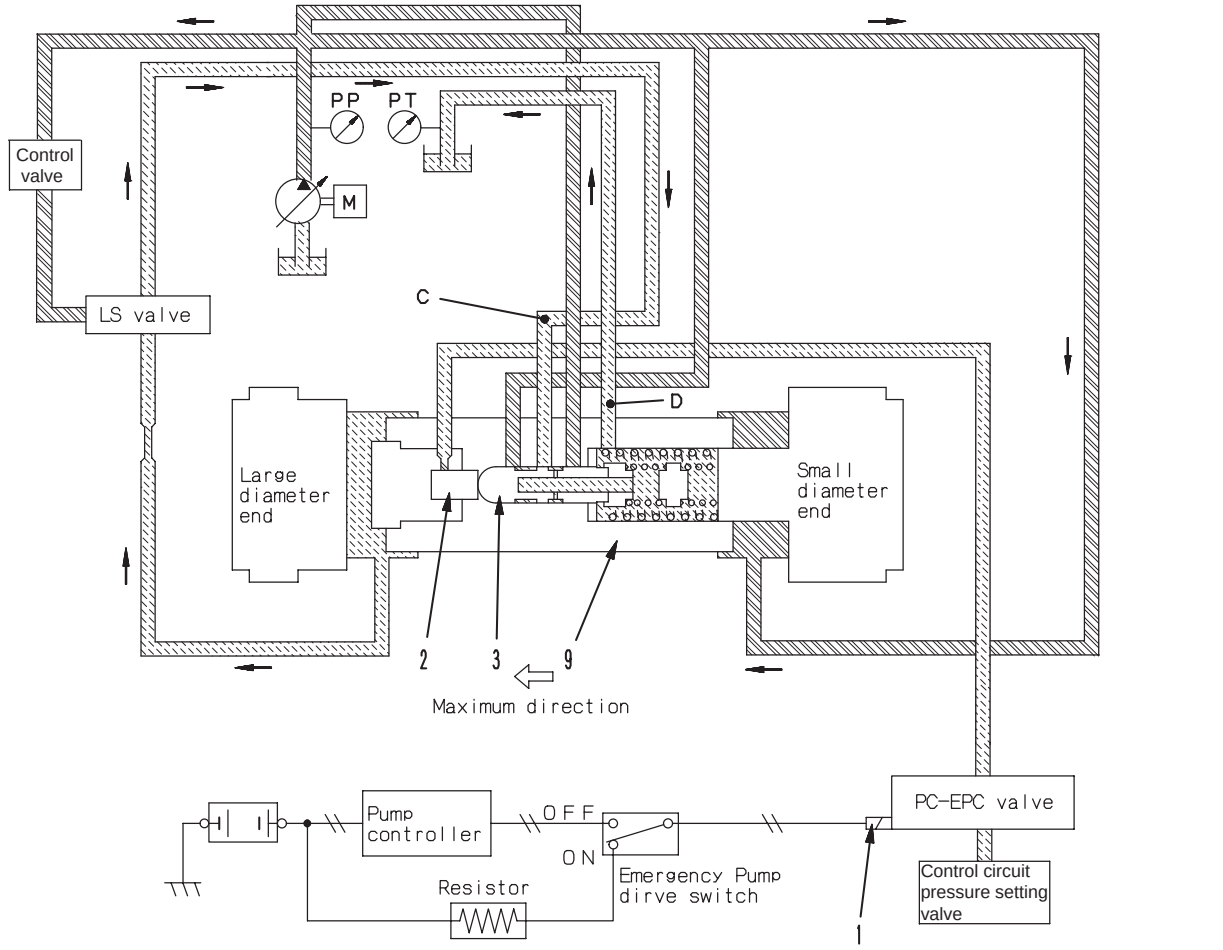
- When the load is large and pump discharge pressure **PP** is high, the force pushing servo piston (9) to the left becomes larger and spool (3) moves to the position in the diagram above. When this happens, as shown in the diagram above, part of the pressurized oil from port **B** flows out through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



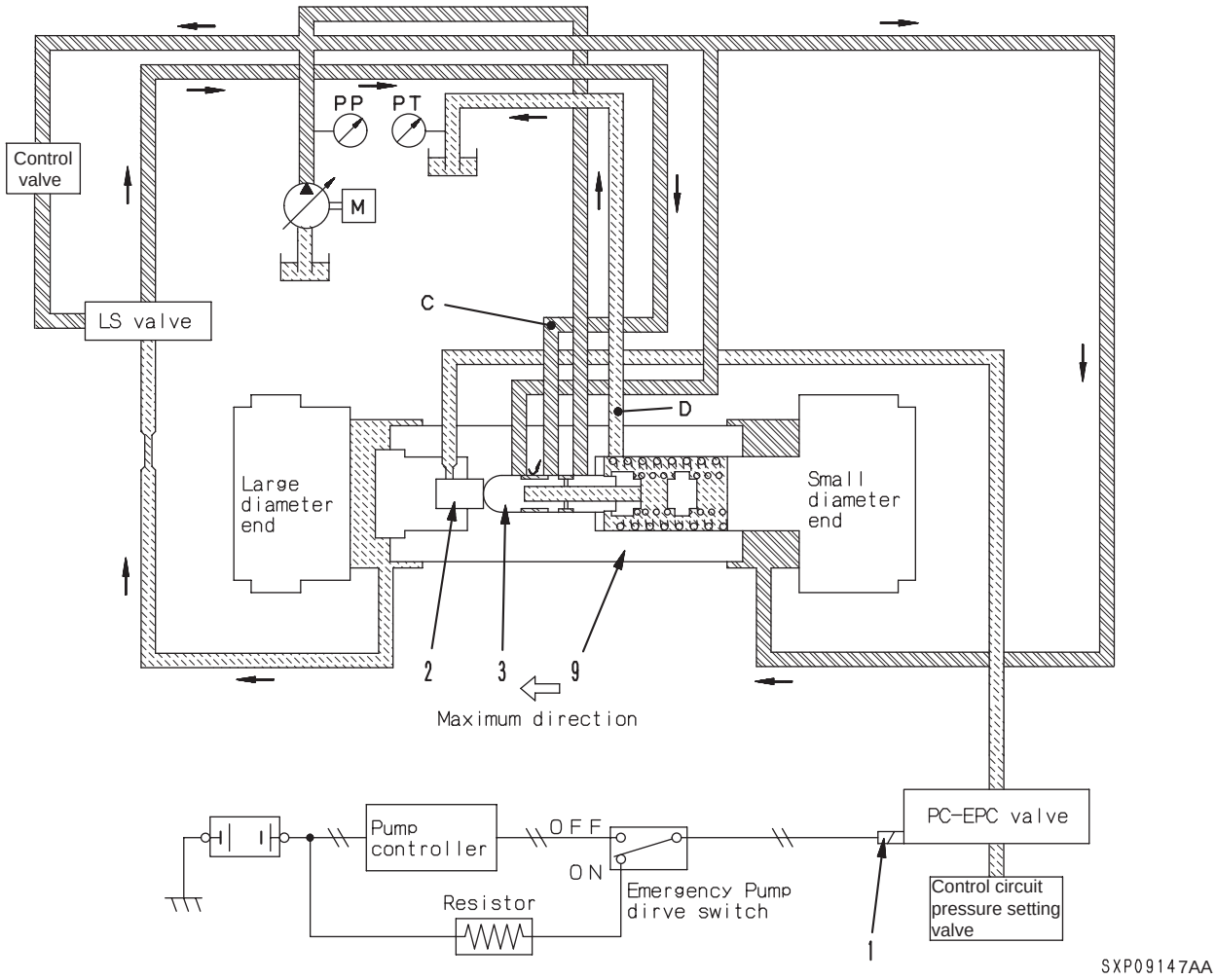


SXP09146AA

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

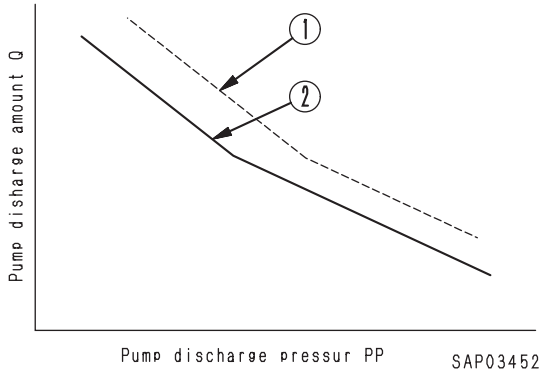
a. When load on main pump is light

- 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.

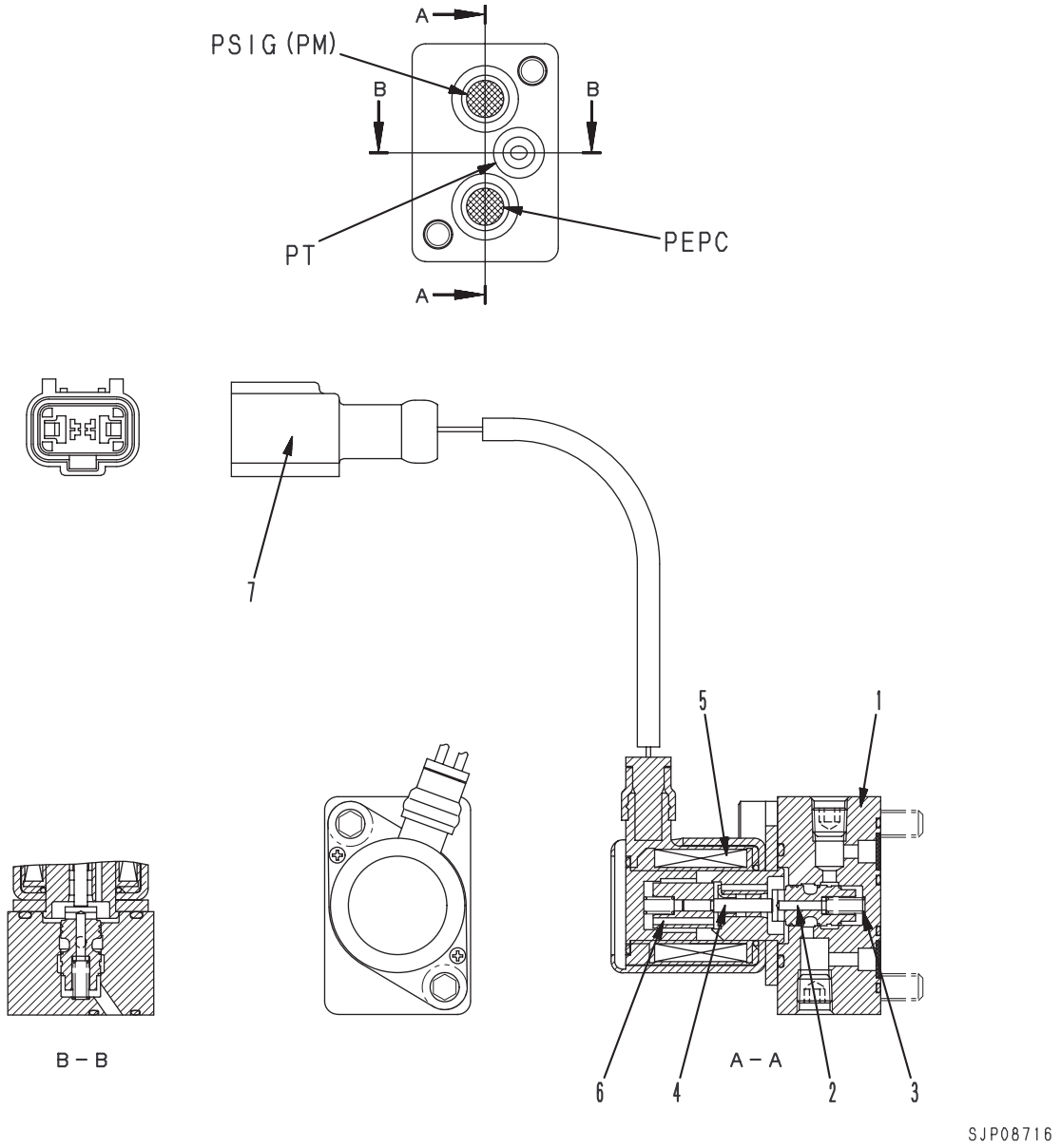


b. When main pump load is heavy

- 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

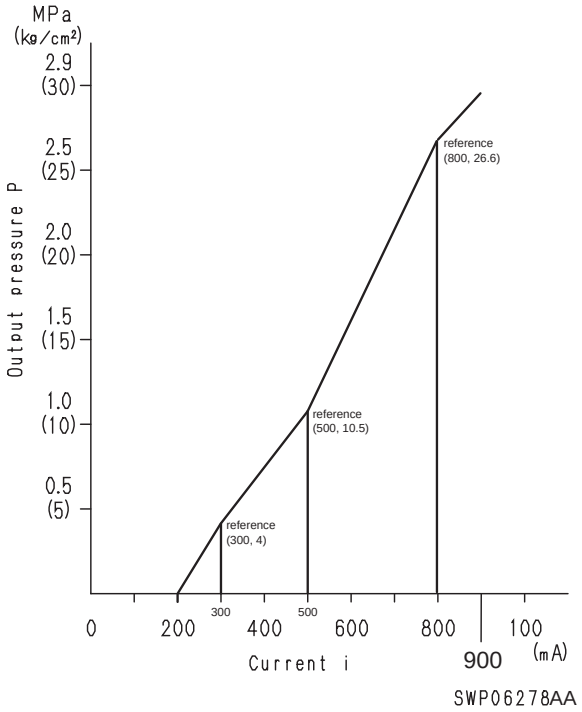


1) Body
2) Spool
3) Spring
4) Rod
5) Coil
6) Plunger
7) Connector

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.

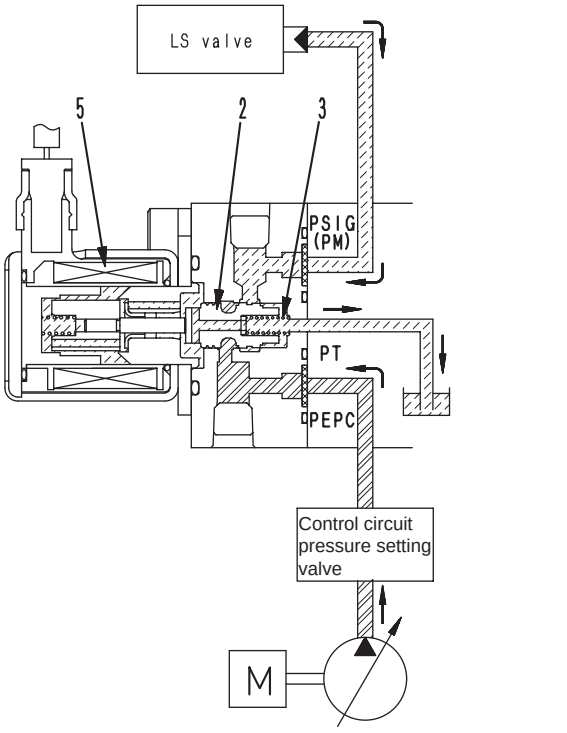


SWP06278AA

Operation

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

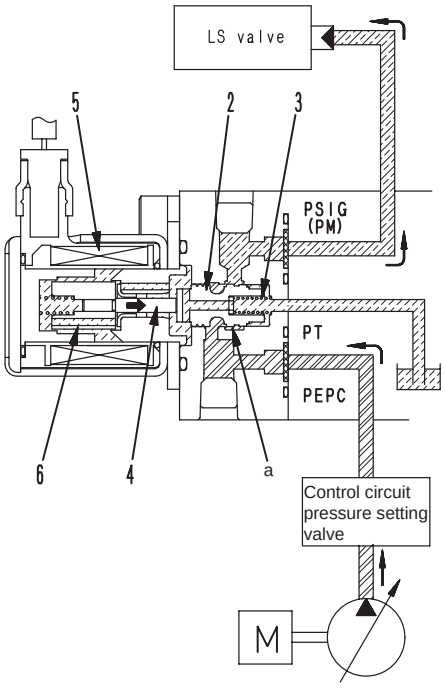
- When there is no signal current flowing from the controller to coil (5), coil (5) is de-energized.
- For this reason, spool (2) is pushed to the left in the direction of the arrow by spring (3).
- As a result, port **PEPC** closes and the pressurized oil from the main pump does not flow to the LS (PC)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

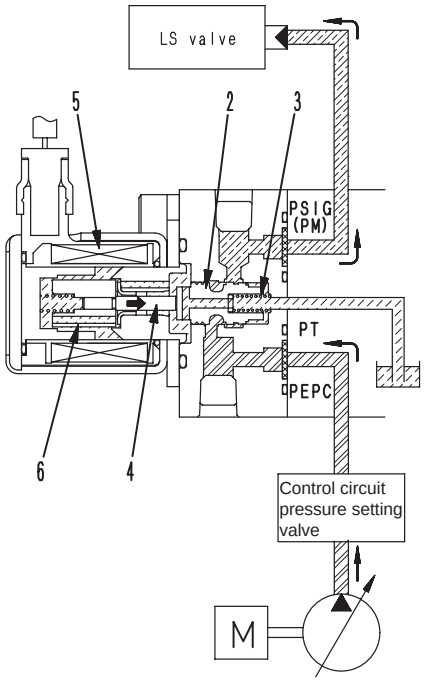
- When a very small signal current flows to coil (5), coil (5) is energized, and a propulsion force is generated which pushes plunger (6) to the right.
- Push pin (4) pushes spool (2) to the right, and pressurized oil flows from port **PEPC** to port **PSIG(PM)**.
- When the pressure at port **PSIG(PM)**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

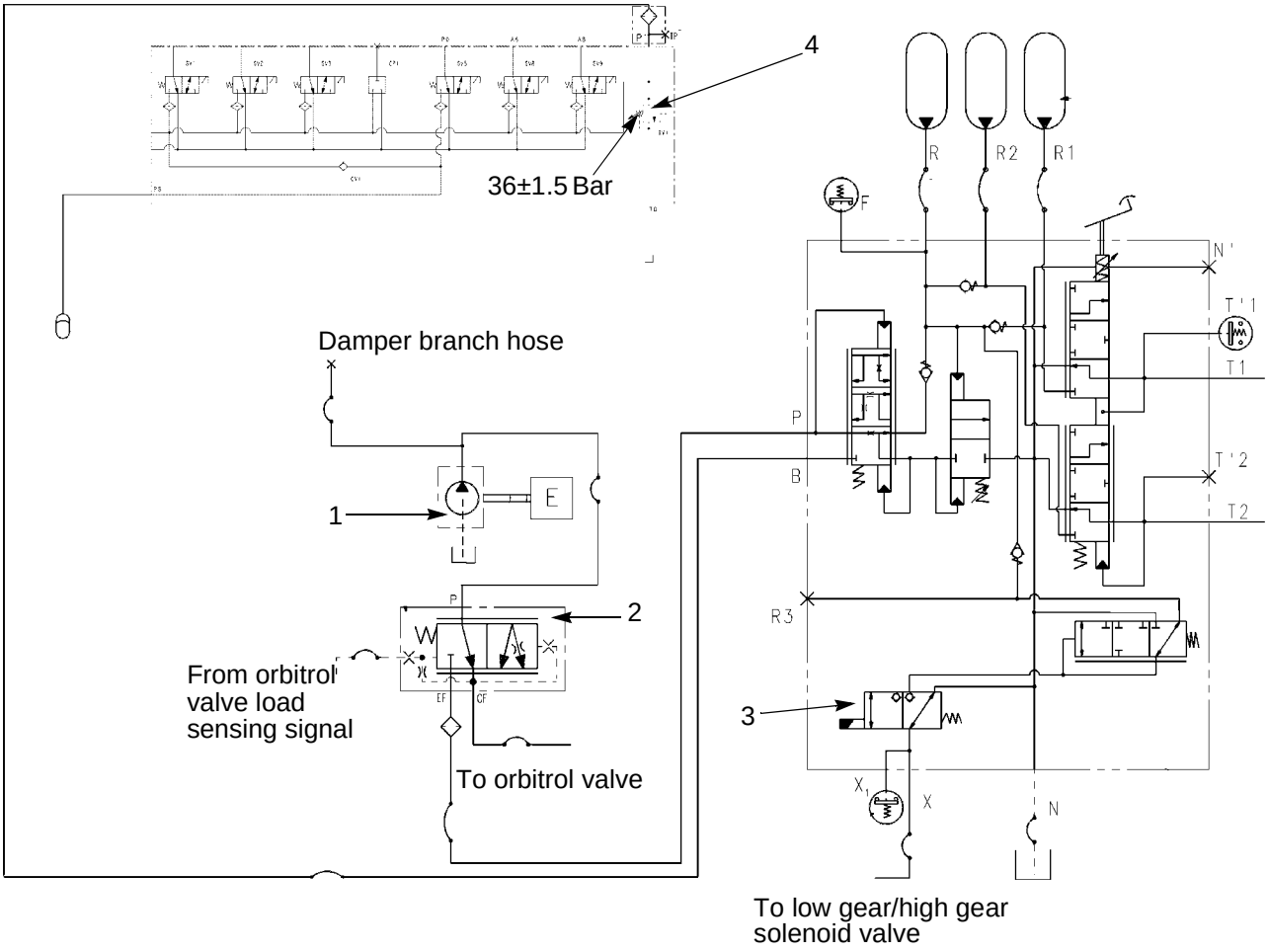
3. When signal current is maximum (coil energized)

- 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 Reducing Valve
   Incorporated in Main Solenoid Valve Block

FUNCTION

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

OPERATION

- The PPC 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 38 ±1.5 BAR.

CONTROL VALVE

PW160-7H

OUTLINE

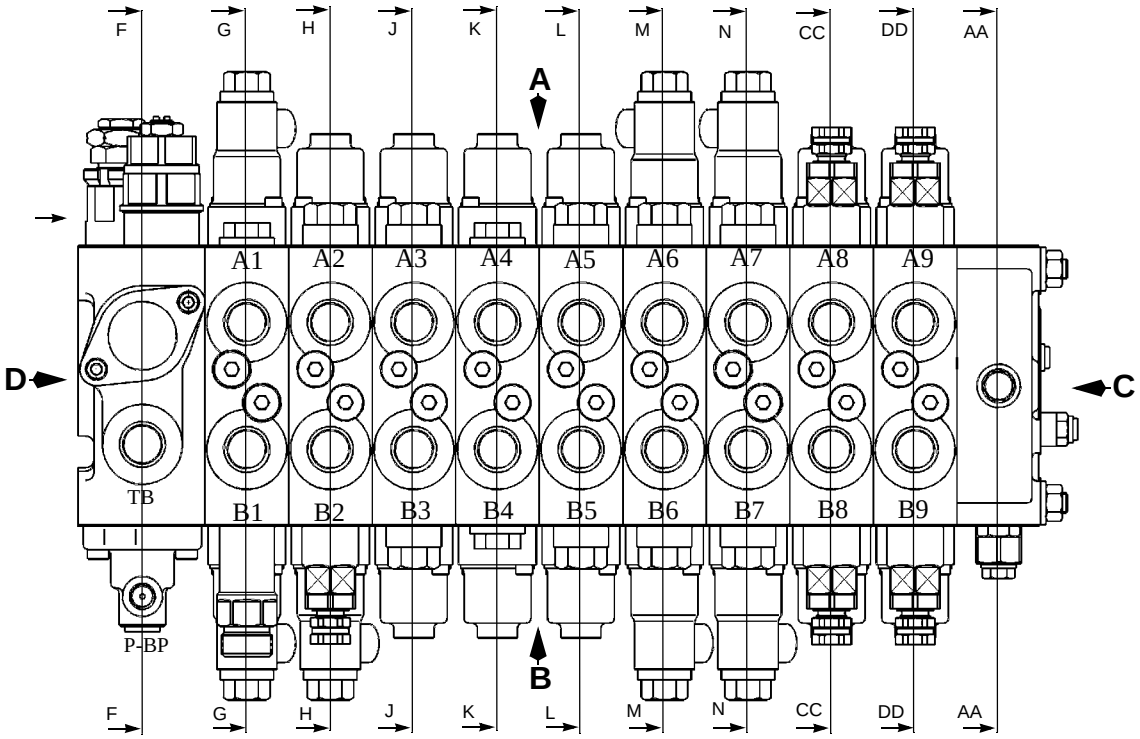
The following four types of control valve are set.

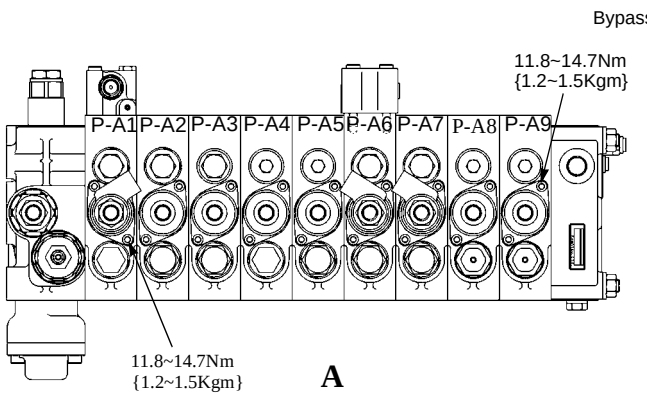
- 7-spool (monoboom + service valve)
- 8-spool (monoboom + two service valve)
- 8-spool (2P boom + service valve + 2nd boom cylinder valve)
- 9-spool (2P boom + two service valve + 2nd boom cylinder valve)

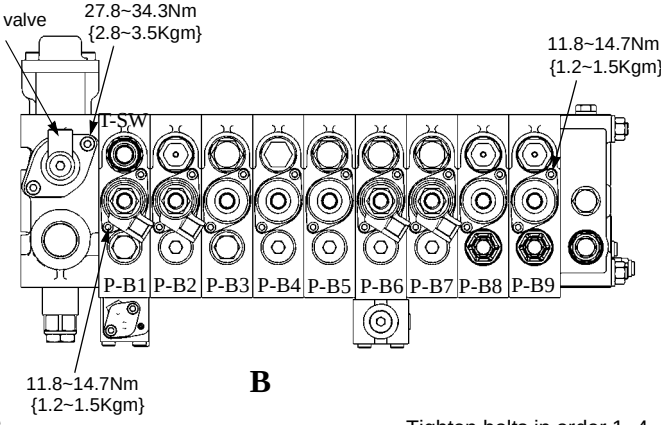
★ Each service valve is an add-on type where one valve each can be added, so it is possible to add valves or remove valves if necessary.
(Maximum: 9 spool)

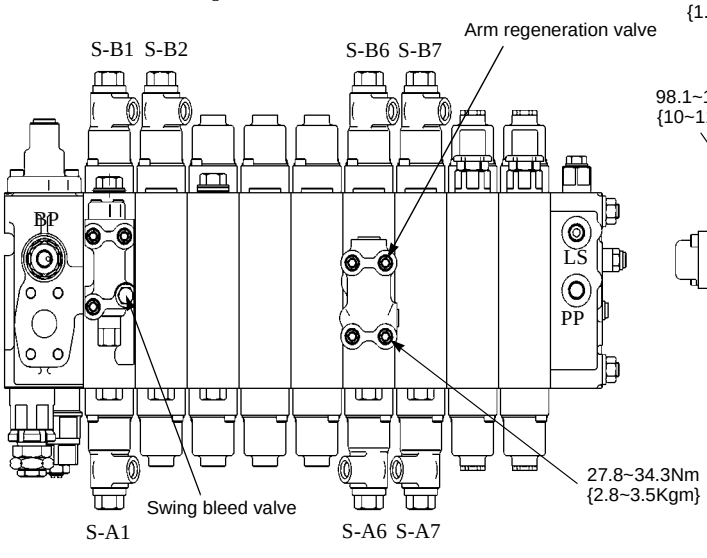
An explanation of the external appearance and the cross section is given only for the 9-spool valve (2P boom + two service valve + 2nd boom cylinder valve)

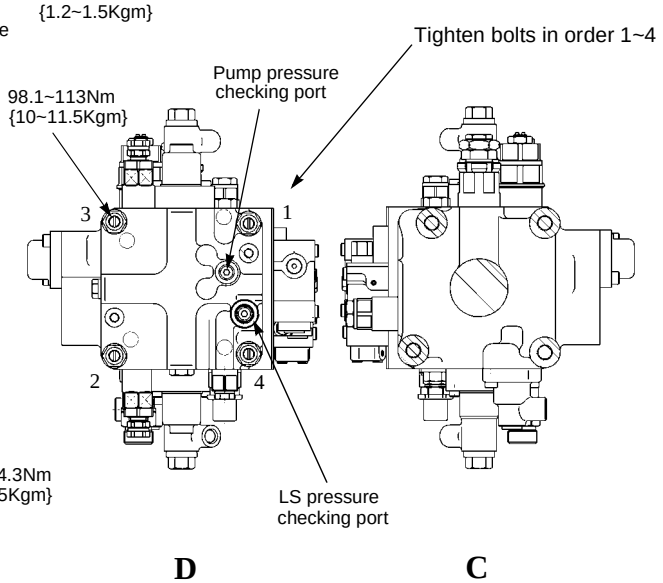
A1.	To swing motor LH	PA1.	From swing PPC valve LEFT	PP.	from main pump
A2.	To boom cyl bott	PA2.	From boom PPC valve RAISE	PX.	from 2-stage relief sol valve
A3.	To travel fwd	PA3.	From travel PPC valve FORWARD	PBP	from 2-stage lift check sol valve
A4.	To stabilizer cyl bott	PA4.	From stabilizer PPC valve RAISE	P.	From pump
A5.	To adjust cyl bott	PA5.	From adjust cyl PPC valve EXTEND	BP.	from boom RAISE PPC
A6.	To arm cyl head	PA6.	From arm cyl PPC valve OUT	SA1.	from boom RAISE PPC valve
A7.	To bucket cyl head	PA7.	From bucket cyl PPC valve DUMP	SA6.	from travel PPC valve
A8.	To service	PA8.	From service PPC valve	SA7.	from travel PPC valve
A9.	To service	PA9.	From service PPC valve	SB1.	from boom RAISE PPC
B1.	To swing motor RH	PB1.	From swing PPC valve RIGHT	SB2.	from travel PPC valve
B2.	To boom cyl head	PB2.	From boom PPC valve LOWER	SB6.	from travel PPC valve
B3.	To travel rev	PB3.	From travel PPC valve REVERSE	SB7.	from travel PPC valve
B4.	To stabilizer cyl bott	PB4.	From stabilizer PPC valve LOWER	TSW.	to swing motor
B5.	To adjust cyl head	PB5.	From adjust cyl PPC valve RETRACT	TS1.	to tank
B6.	To arm cyl bott	PB6.	From arm cyl PPC valve IN	LS.	to pump LS valve
B7.	To bucket cyl bott	PB7.	From bucket cyl PPC valve CURL	TC.	to oil cooler
B8.	To service	PB8.	From service PPC valve	TB.	to tank
B9.	To service	PB9.	From service PPC valve		

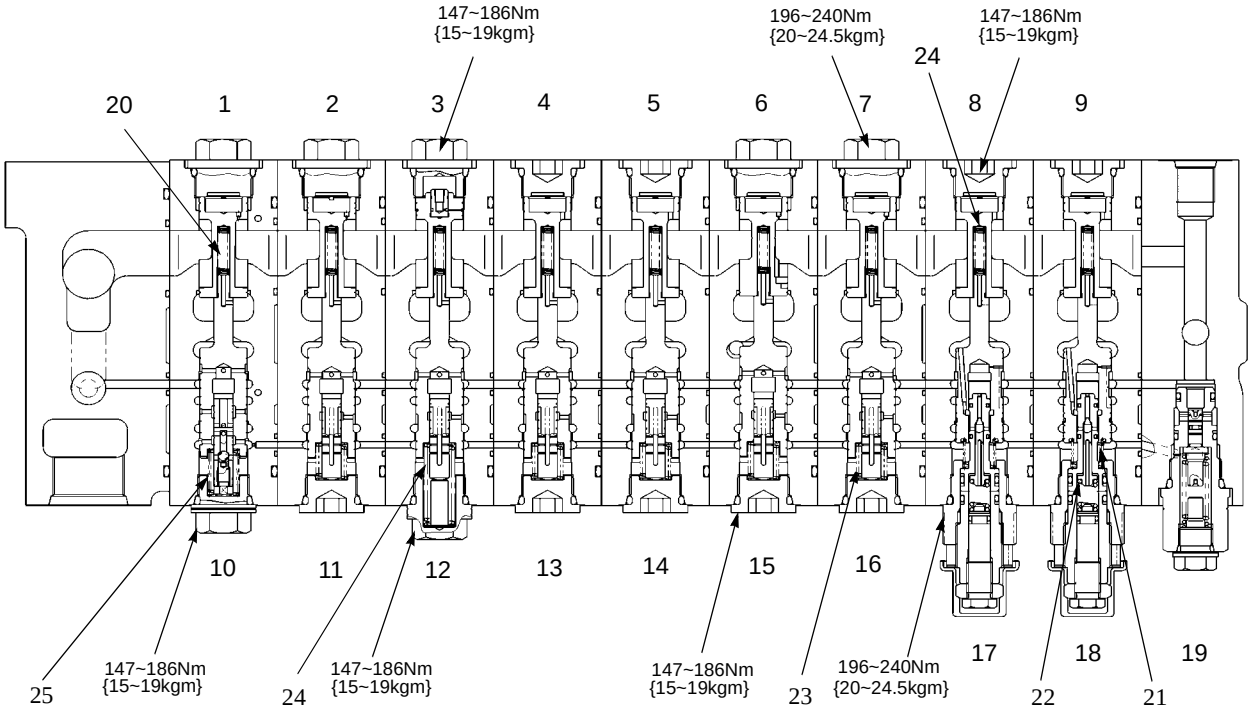

F
G
H
J
K
L
M
N
CC
DD
AA
A
A1
A2
A3
A4
A5
A6
A7
A8
A9
D
C
TB
B1
B2
B3
B4
B5
B6
B7
B8
B9
P-BP
B


11.8~14.7Nm
{1.2~1.5Kgm}
P-A1
P-A2
P-A3
P-A4
P-A5
P-A6
P-A7
P-A8
P-A9
11.8~14.7Nm
{1.2~1.5Kgm}
A


Bypass valve
27.8~34.3Nm
{2.8~3.5Kgm}
11.8~14.7Nm
{1.2~1.5Kgm}
T-SW
P-B1
P-B2
P-B3
P-B4
P-B5
P-B6
P-B7
P-B8
P-B9
11.8~14.7Nm
{1.2~1.5Kgm}
B


S-B1
S-B2
S-B6
S-B7
Arm regeneration valve
BP
LS
PP
Swing bleed valve
27.8~34.3Nm
{2.8~3.5Kgm}
S-A1
S-A6
S-A7
E


Tighten bolts in order 1~4
Pump pressure
checking port
98.1~113Nm
{10~11.5Kgm}
3
1
2
4
LS pressure
checking port
D
C

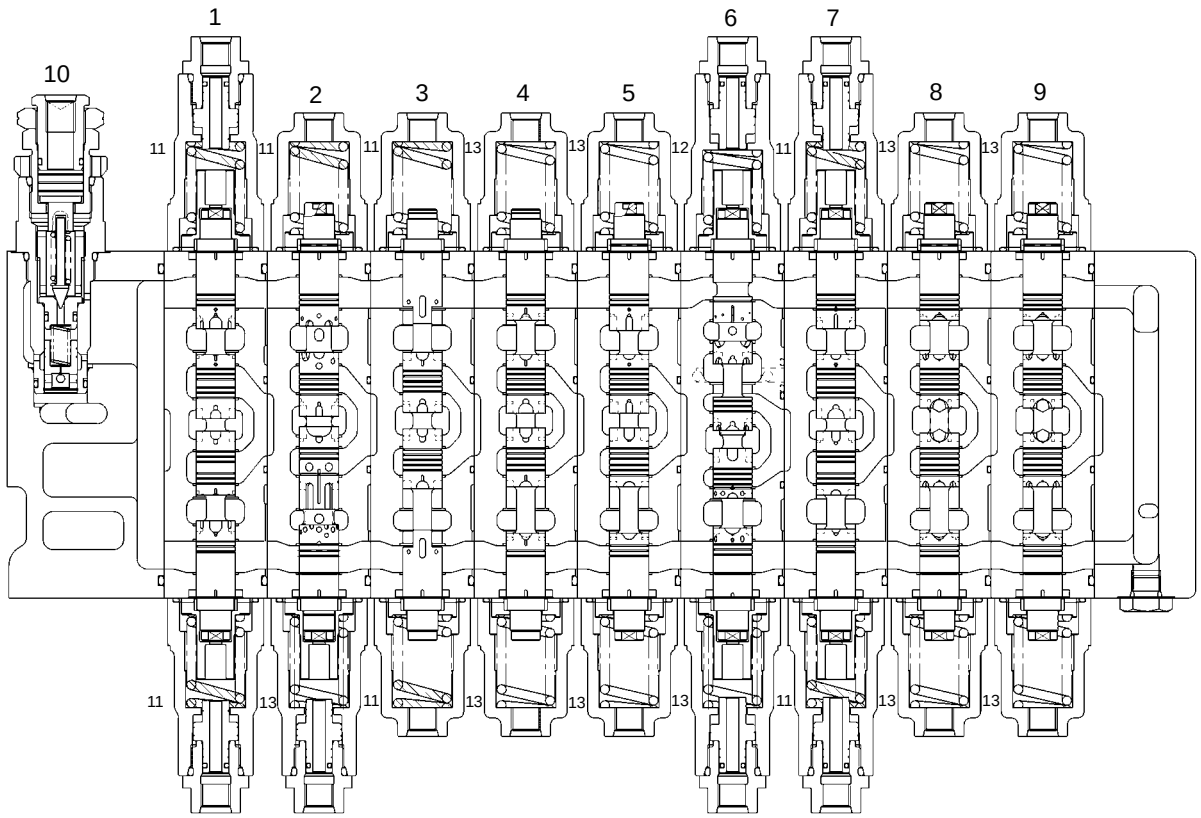


1. Pressure compensation valve F (Swing Left)
2. Pressure compensation valve F (Boom Raise)
3. Pressure compensation valve F (Travel Forward)
4. Pressure compensation valve F (Stabilizer Raise)
5. Pressure compensation valve F (2PBoom Raise)
6. Pressure compensation valve F (Arm Out)
7. Pressure compensation 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

★ The letters F and R refer to the following valves.
F: Flow control valve R: Reducing valve

Unit:mm

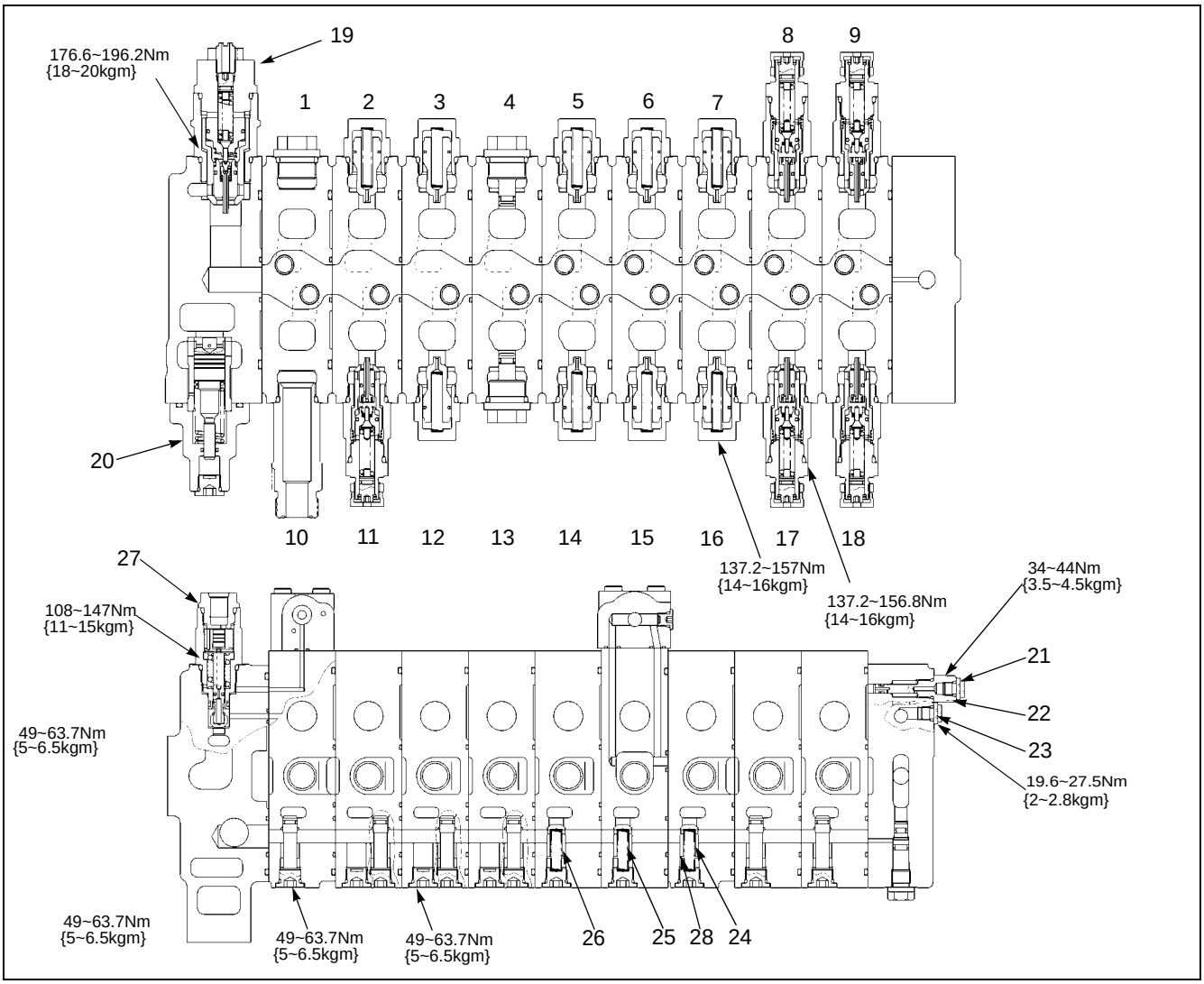
No	Check Item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	
20.	Flow control valve spring	36.2 x 5.3	32	9.8Nm (1kgm)		7.8Nm (0.8kgm)	If damaged or deformed, replace spring
21.	Reducing valve spring	24.5 x 15	14.5	9.8Nm (1kgm)		7.8Nm (0.8kgm)	
22.	Relief valve spring	17.1 x 9	15.5	74.5Nm (7.6kgm)		59.8Nm (6.1kgm)	
23.	Reducing valve spring	27.5 x 14.2	18	17.6Nm (1.8kgm)		13.7Nm (1.4kgm)	
24.	Reducing valve spring	74.8 x 14.2	40	66.4Nm (6.8kgm)		53.1Nm (5.4kgm)	
25.	Reducing valve spring	32.5 x 14.2	23	17.6Nm (1.8kgm)		13.7Nm (1.4kgm)	



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

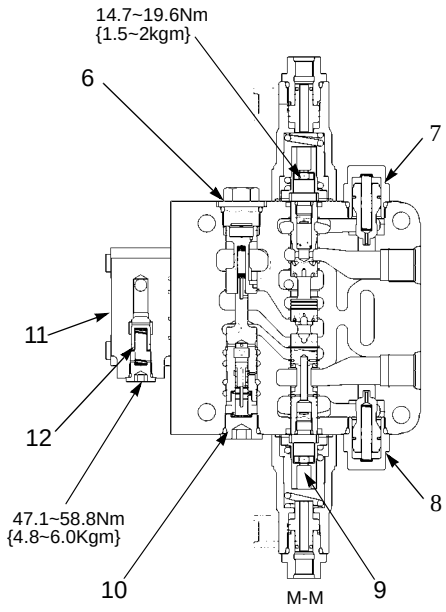
No	Check Item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Out-side diameter	Installed length	Installed load	Free length	Installed load	
11.	Spool return spring	45.7 x 28	43	221.5Nm (22.6kgm)		187.4Nm (19.1kgm)	If damaged or deformed, replace spring
12.	Spool return spring	42.4 x 28	39	245Nm (22.kgm)		187.4Nm (19.1kgm)	
13.	Spool return spring	45.6 x 28	43	230.Nm (23.5kgm)		184Nm (18.8kgm)	



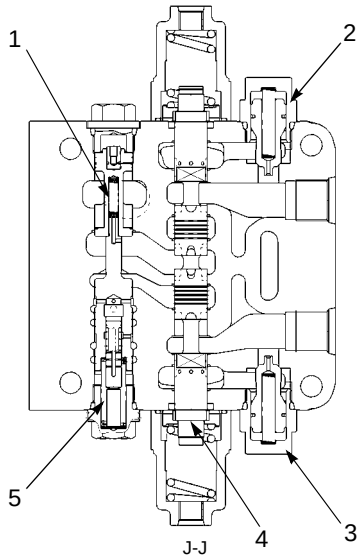
1. N/A
2. Suction valve (Boom Raise)
3. Suction valve (Travel Forward)
4. N/A
5. Suction valve (2PBoom Extend)
6. Suction valve (Arm Dump)
7. Suction valve (Bucket Dump)
8. Variable safety suction valve (Service)
9. Variable safety suction valve (Service)
10. N/A
11. Suction valve (Boom Lower)
12. Suction 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 Out-side diameter	Installed length	Installed load	Free length	Installed load	If damaged or deformed, replace spring
28.	Check valve spring	41.5 x 8.5	31.5	5.9Nm (0.6kgm)		4.7Nm (0.48kgm)	



Arm control valve

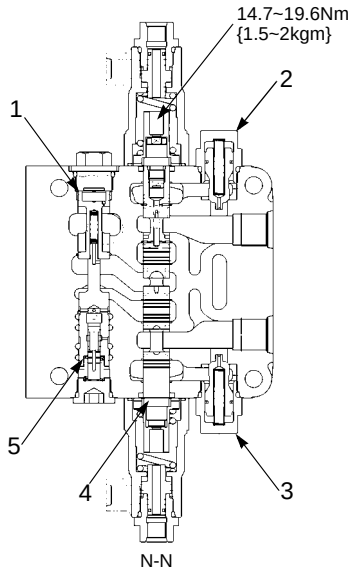


Travel control valve

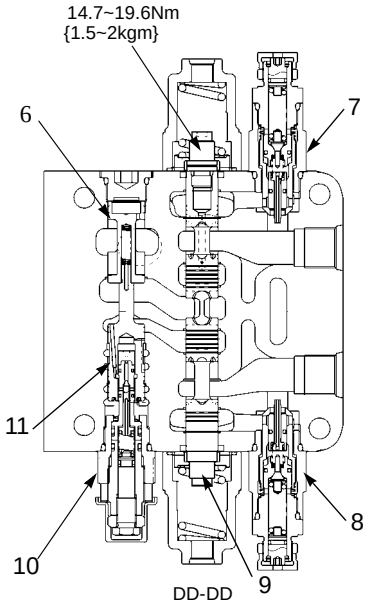
1. Pressure compensation valve
2. Suction valve
3. Suction valve
4. Spool (Travel)
5 Pressure compensation valve
6. Pressure compensation valve F
7. Suction valve
8. Suction valve
9. Spool (Arm)
10. Pressure compensation valve R
11. Arm regeneration valve

Unit:mm

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



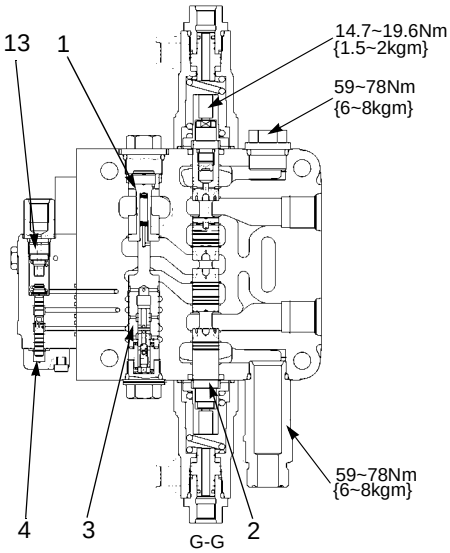
Bucket control valve

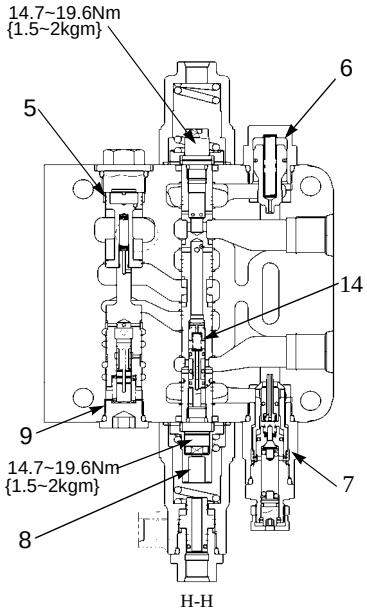


Service control valve

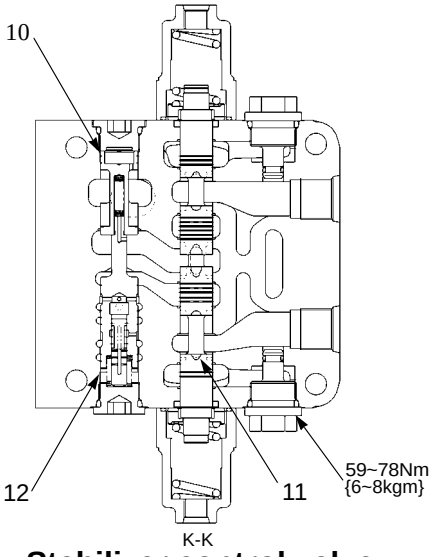
1. Pressure compensation valve F
2. Safety suction valve
3. Safety suction valve
4. Spool (Bucket)
5. Pressure compensation valve R
6. Pressure compensation valve F
7. Safety suction valve mount
8. Safety suction valve mount
9. Spool (service)
10. Variable pressure compensation valve
11. Pressure compensation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

Swing control valve





Boom control valve



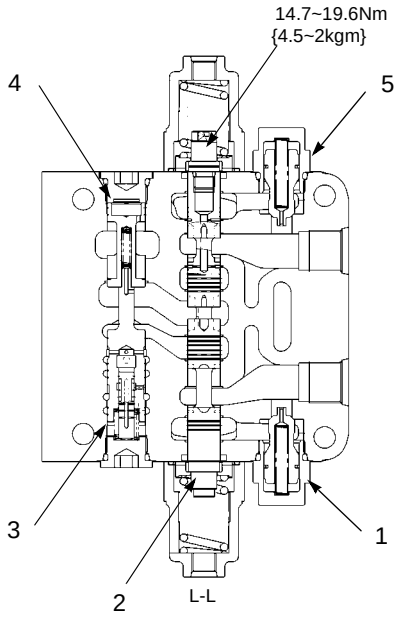
Stabilizer control valve

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

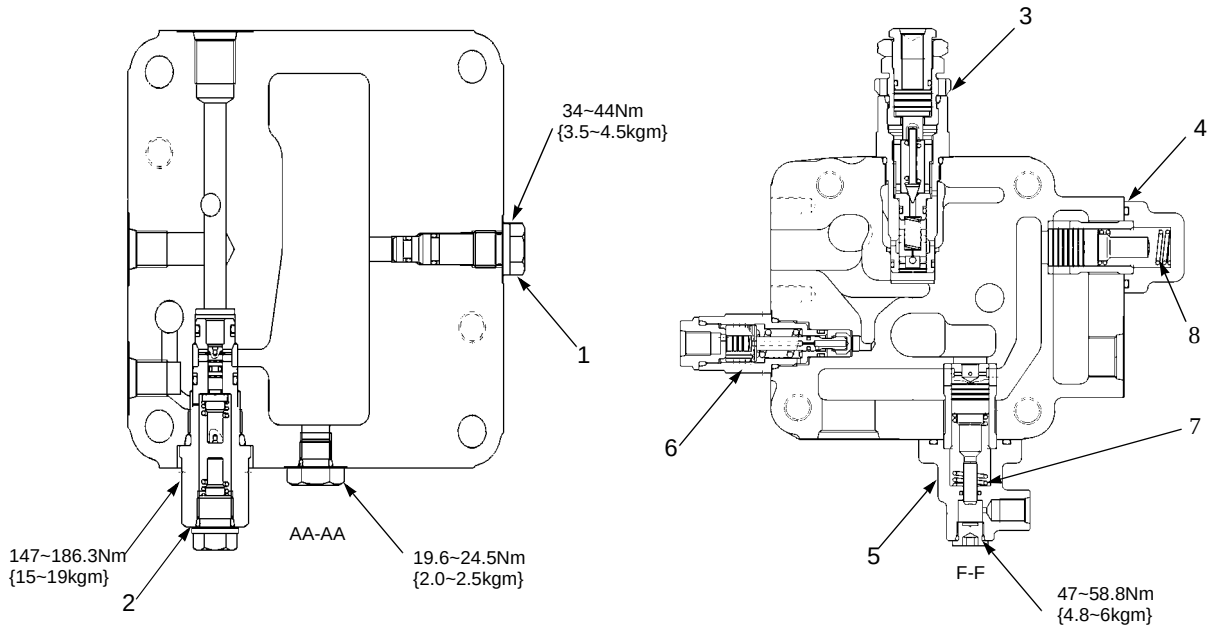
Unit:mm

No	Check Item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	
13.	Bleed spool return spring	23.3 x 12.5	23	3.9Nm (0.4kgm)		2.9Nm 0.3kgm)	If damaged or deformed, replace spring

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 diame-ter	Installed length	Installed load	Free length	Installed load	If damaged or deformed, replace spring
7.	Lift check valve spring	72.7 x 20.6	42.5	135.3Nm (13.8kgm)		112.7Nm 11.5(kgm)	
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

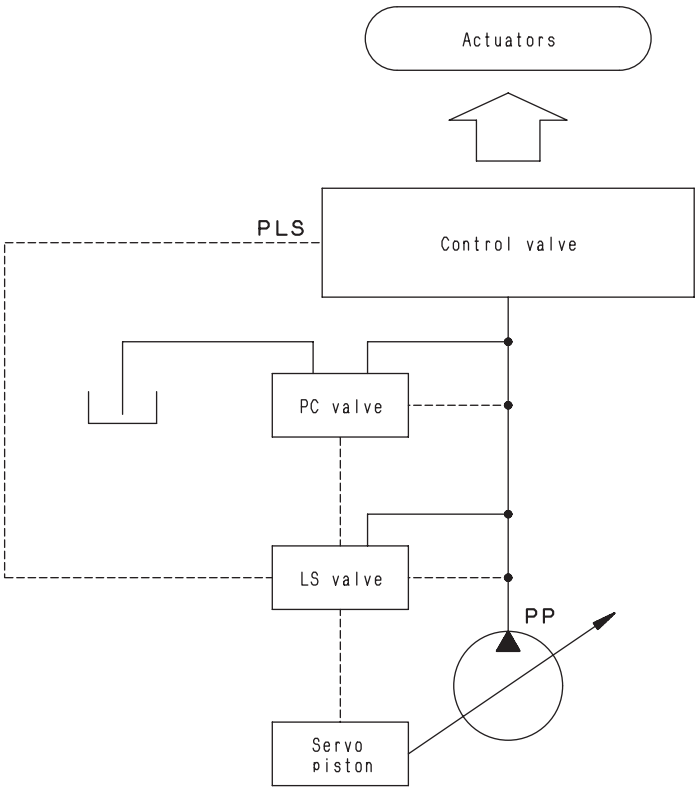
FEATURES

CLSS is an abreviation 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.

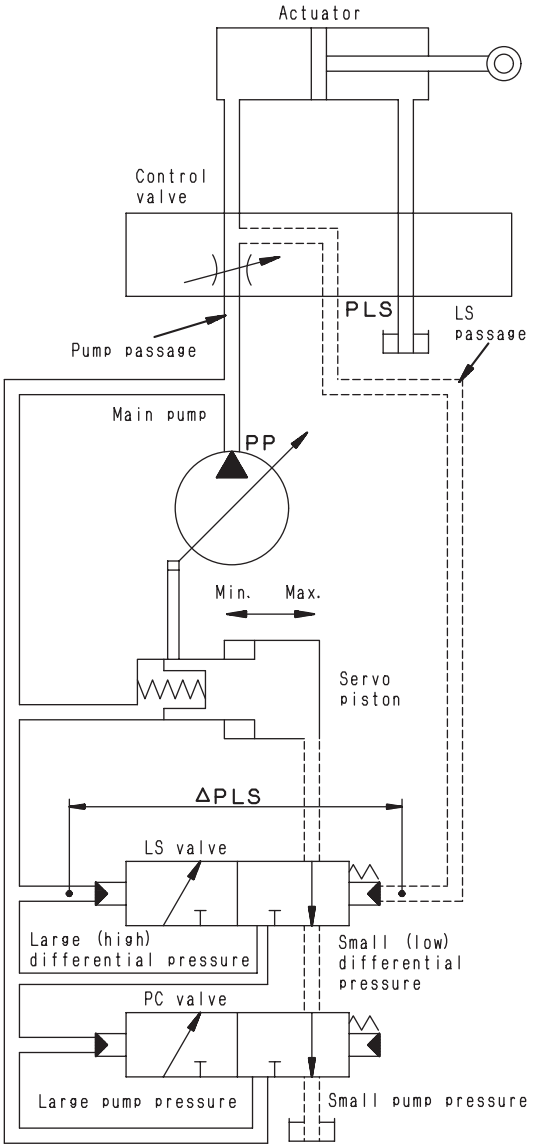


SJP07975

BASIC PRINCIPLE

1. Control of pump swash plate angle

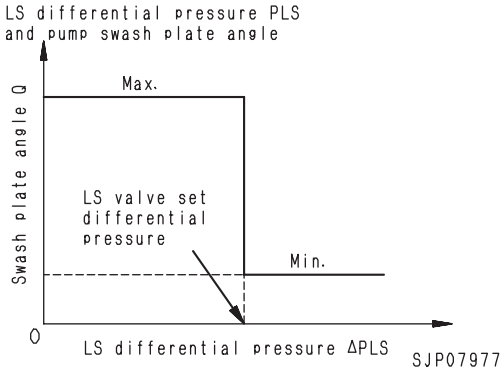
- The pump swash plate angle (pump discharge amount) is controlled so that LS differential pressure ∆**PLS** (the difference between pump (discharge) pressure **PP** and control valve outlet port LS pressure **PLS**) load pressure of actuator) is constant.
  (LS pressure ∆**PLS**=Pump discharge pressure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

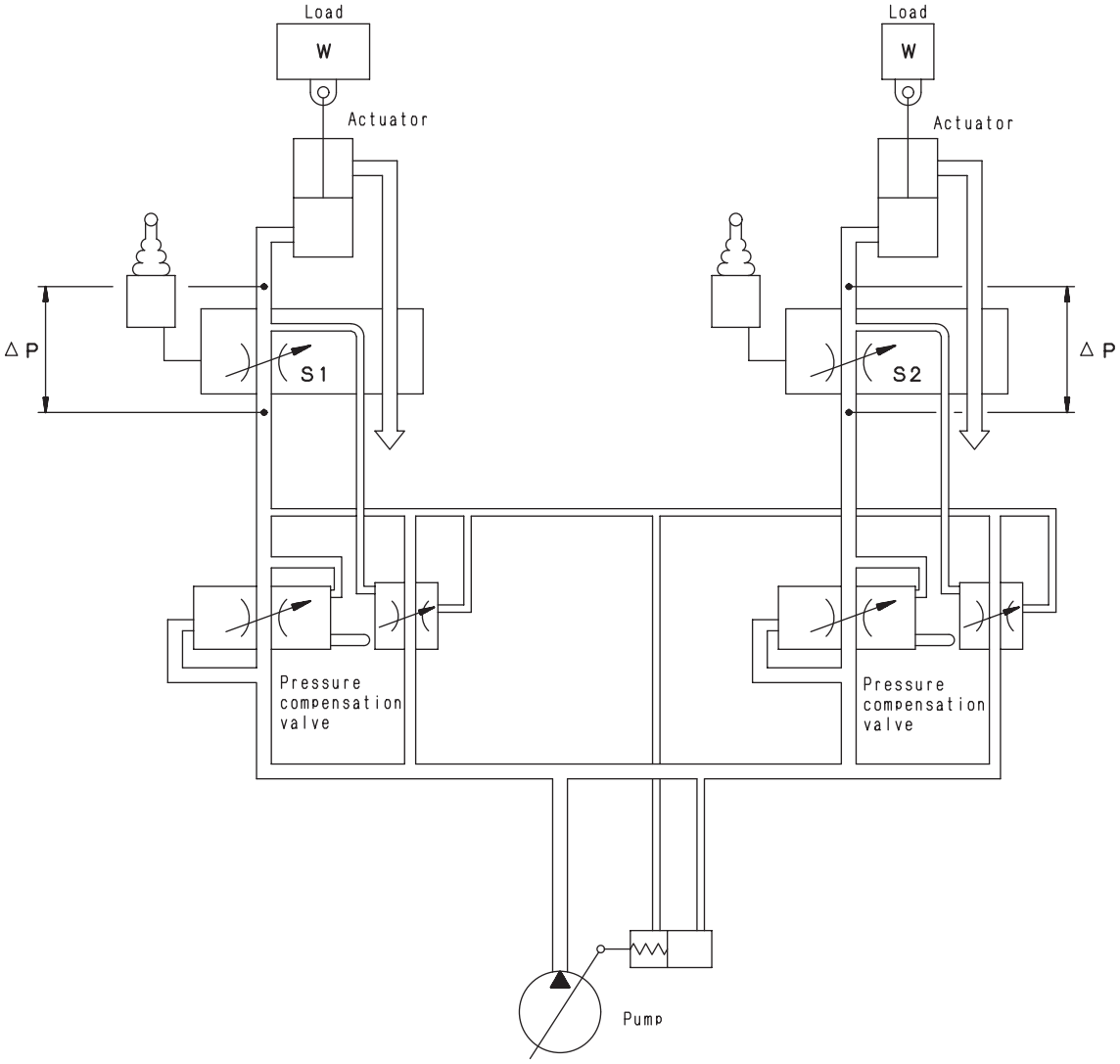


SJP07977

2. Pressure compensation control

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

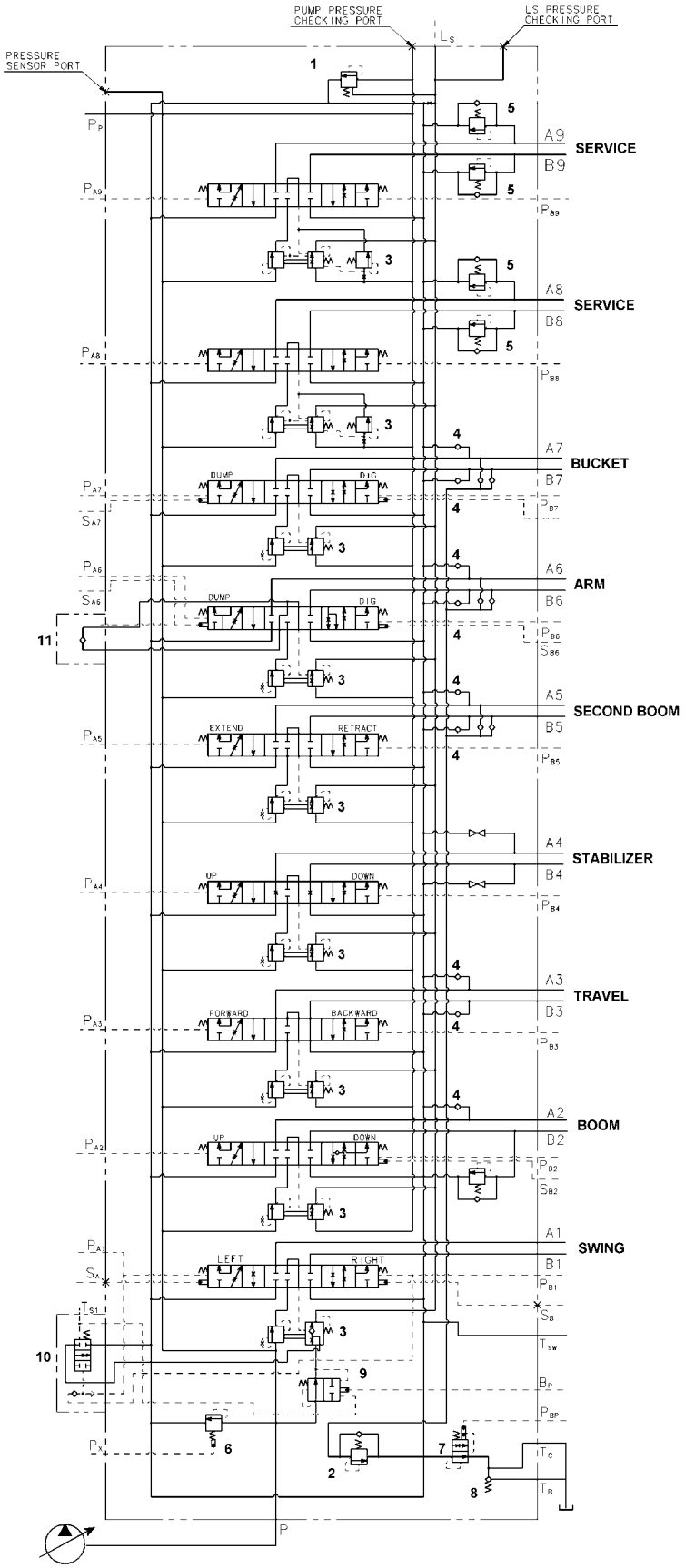
When to actuators are operated together, this valve acts to make pressure difference ∆**P** between the upstream (inlet port) and downstream (outlet port) the same, regardless of the size of the load (pressure). In this way, the flow of oil from the pump is divided (compensated) in proportion to the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

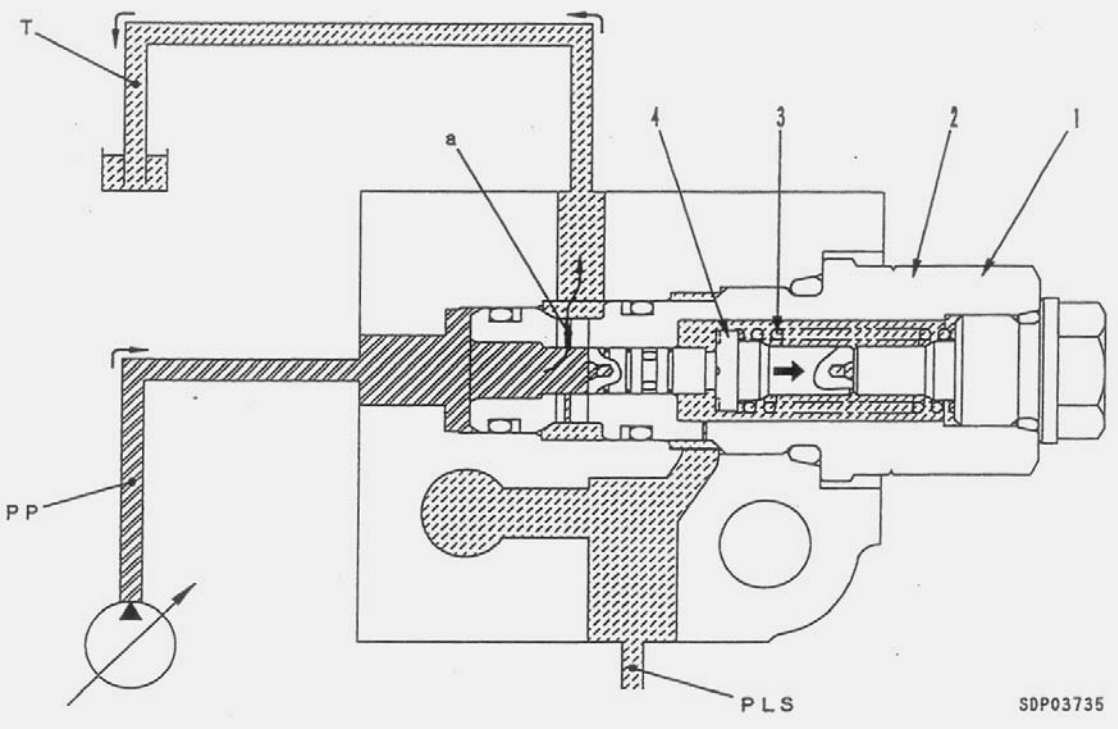


1. Unload valve
   Set pressure: 3.38 MPa {34.5 kg/cm^2}
2. Safety-suction valve
   Set pressure: 38.2 MPa {390 kg/cm^2}
3. Pressure compensation valve
4. Suction valve
5. Safety-suction valve
   Set pressure: 24.7 MPa {250 kg/cm^2}
6. Main relief valve
   Set pressure: Normal: 34.8 MPa {355 kg/cm^2}
   When rising: 37.3 MPa {380 kg/cm^2}
7. Lift check valve
8. Cooler bypass valve
9. LS select valve
10. Swing bleed plug
11. Arm regeneration 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

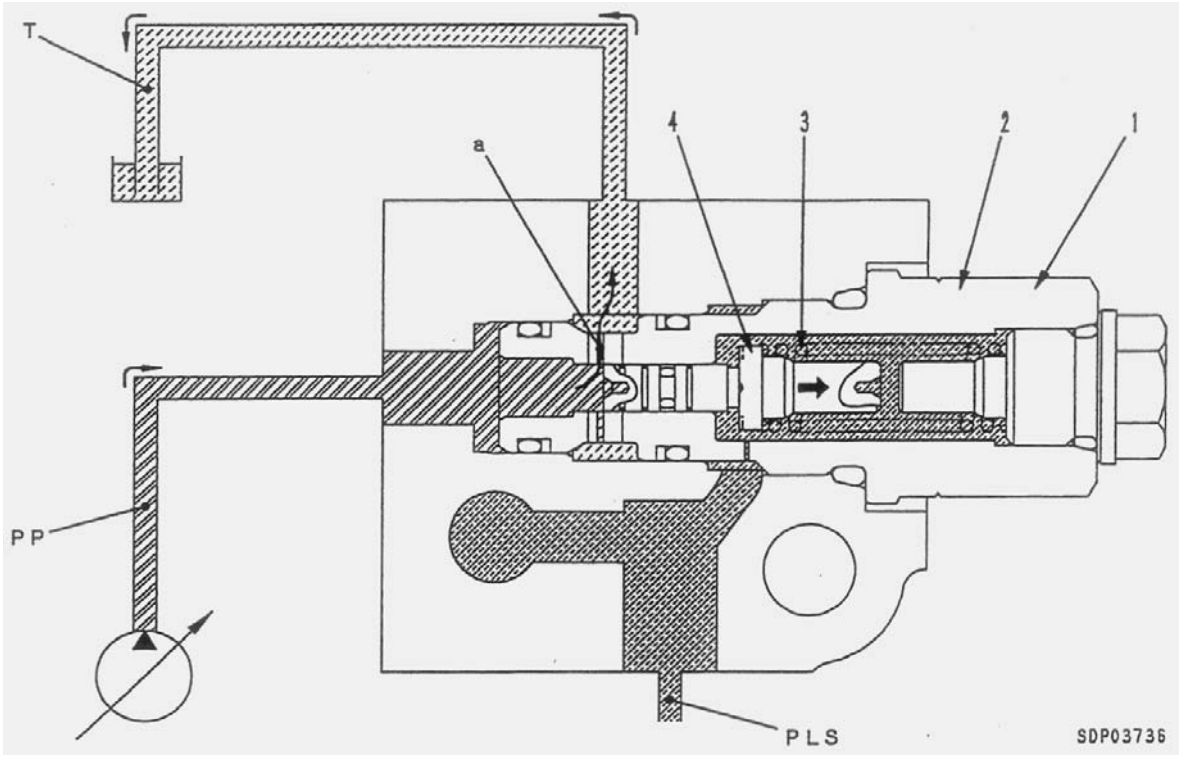
When control valve is neutral

- 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

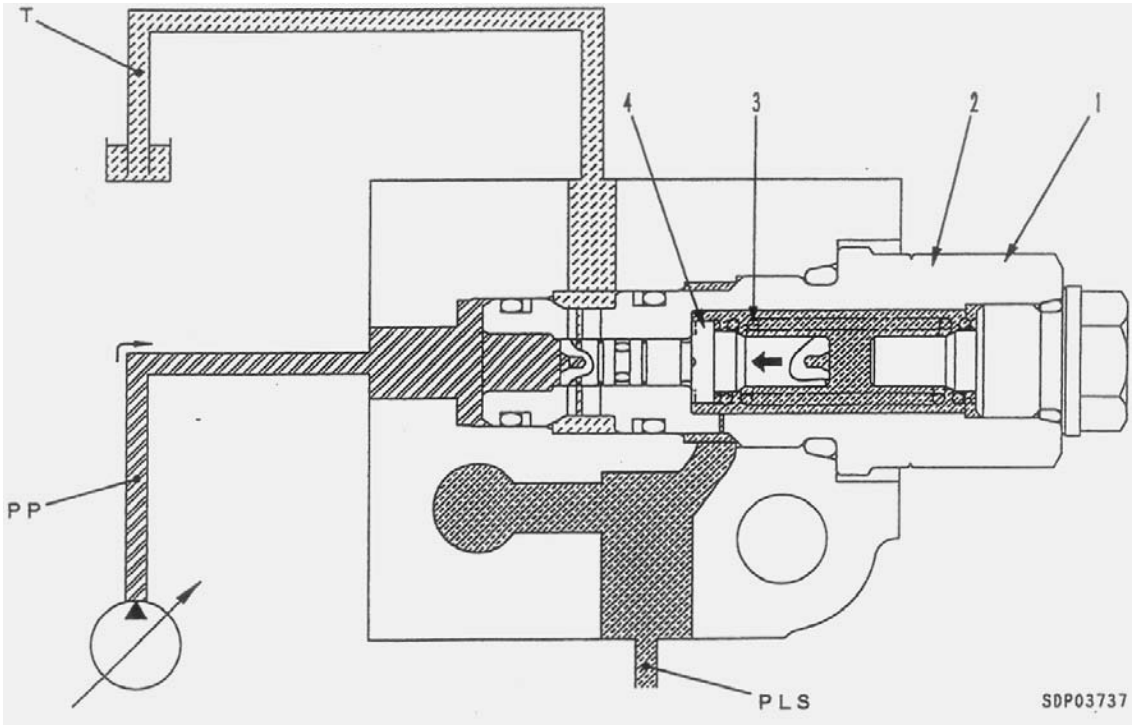
Fine control of control valve

- 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

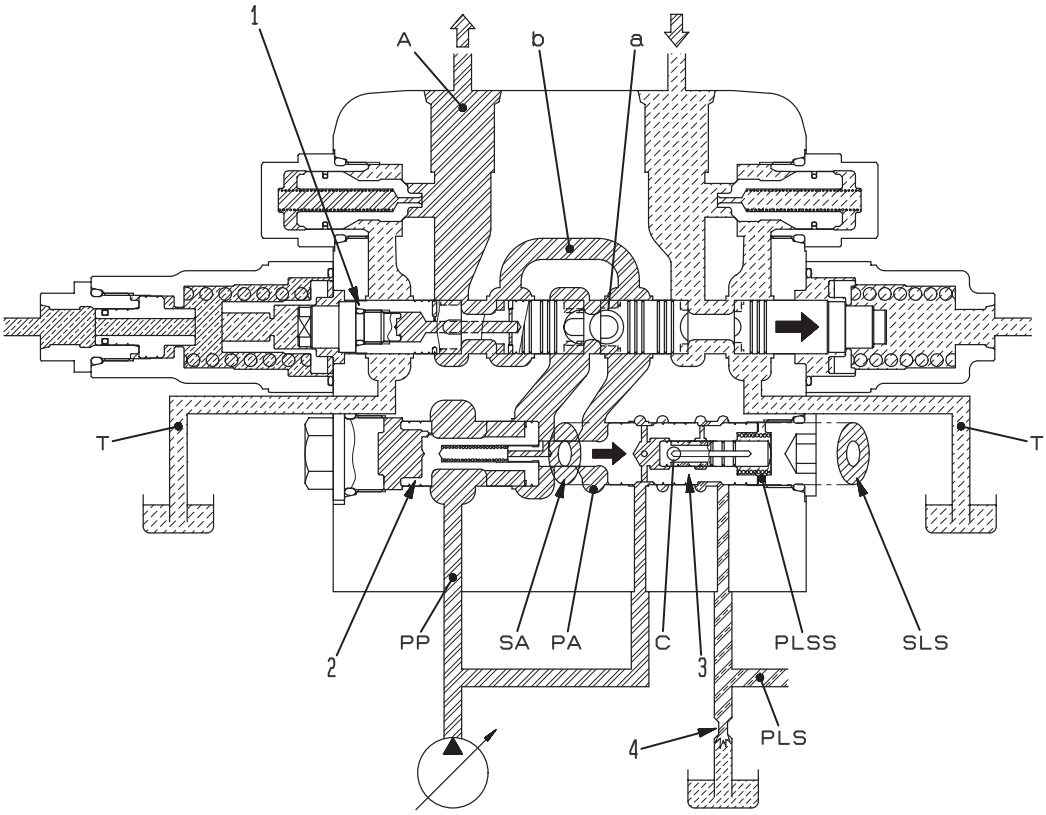
- When fine control valve is operated to a bigger stroke, LS pressure **PLS** is generated and acts on the right end of the spool (4). When this happens, the area of the opening of the control valve spool is large, so the difference between LS pressure **PLS** and pump discharge pressure **PP** is small.
- 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 cricuit **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

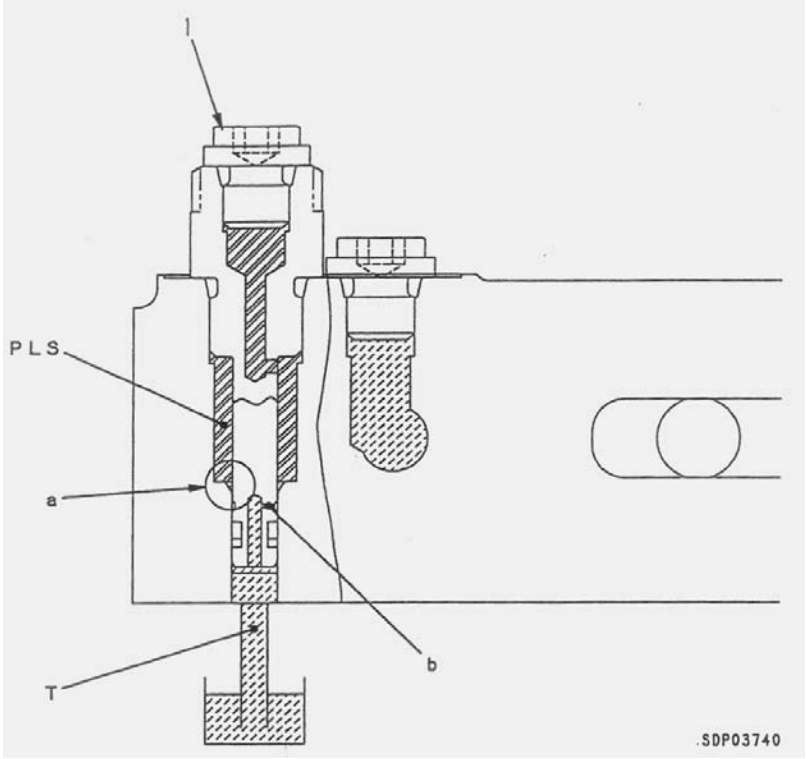
- When spool (1) is operated, pump discharge pressure **PP** flows from flow control valve (2) through notch (a) in the spool and bridge passage (b) to actuator circuit **A**.
- At the same time, reducing valve (3) also moves to the right, so pump discharge pressure **PP** is reduced by the pressure 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. LS Bypass plug

Outline

1. This releases the residual pressure of LS pressure **PLS**.

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



Operation

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

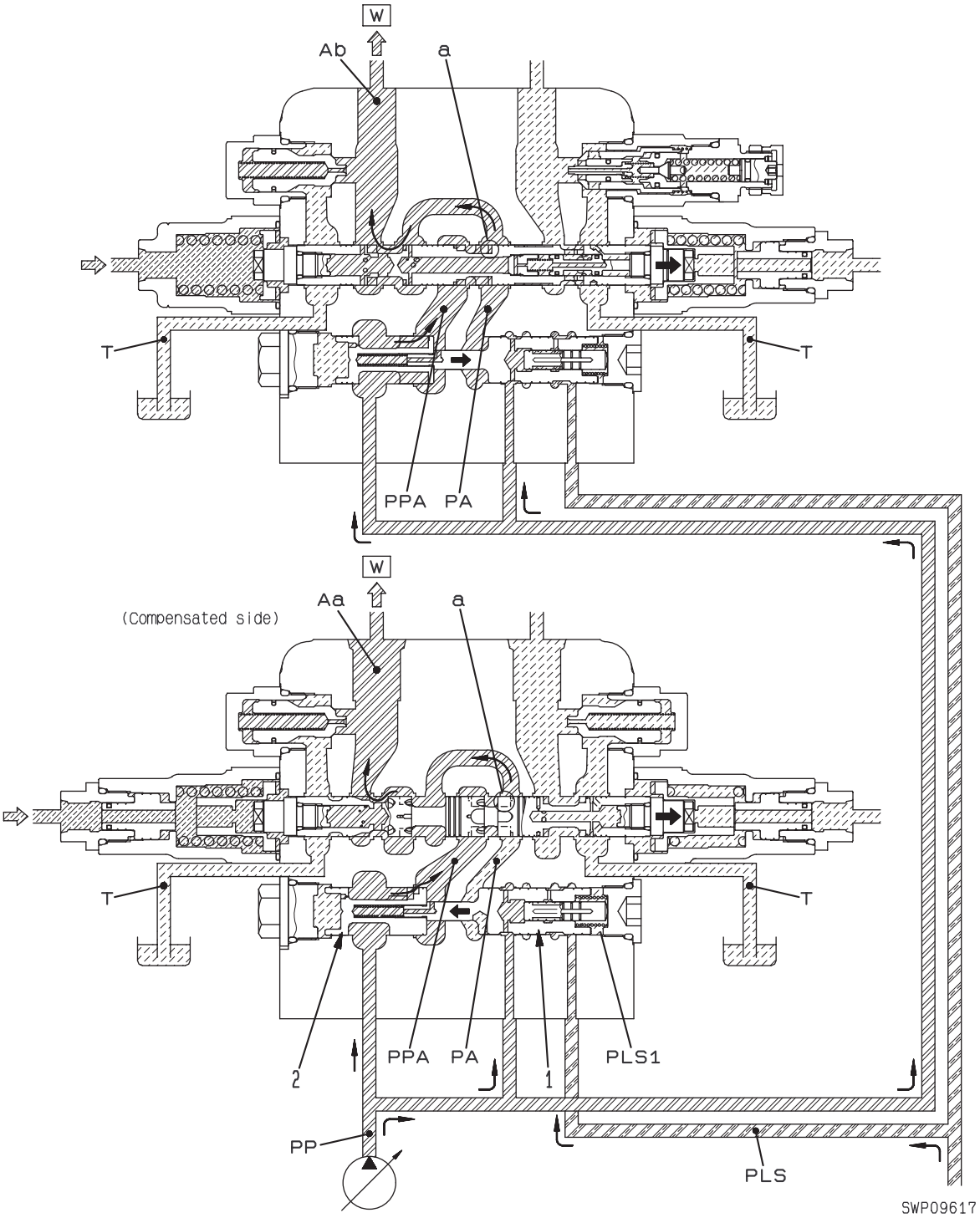
1. LS bypass plug

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

4. Pressure compensation valve

Function

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



Operation

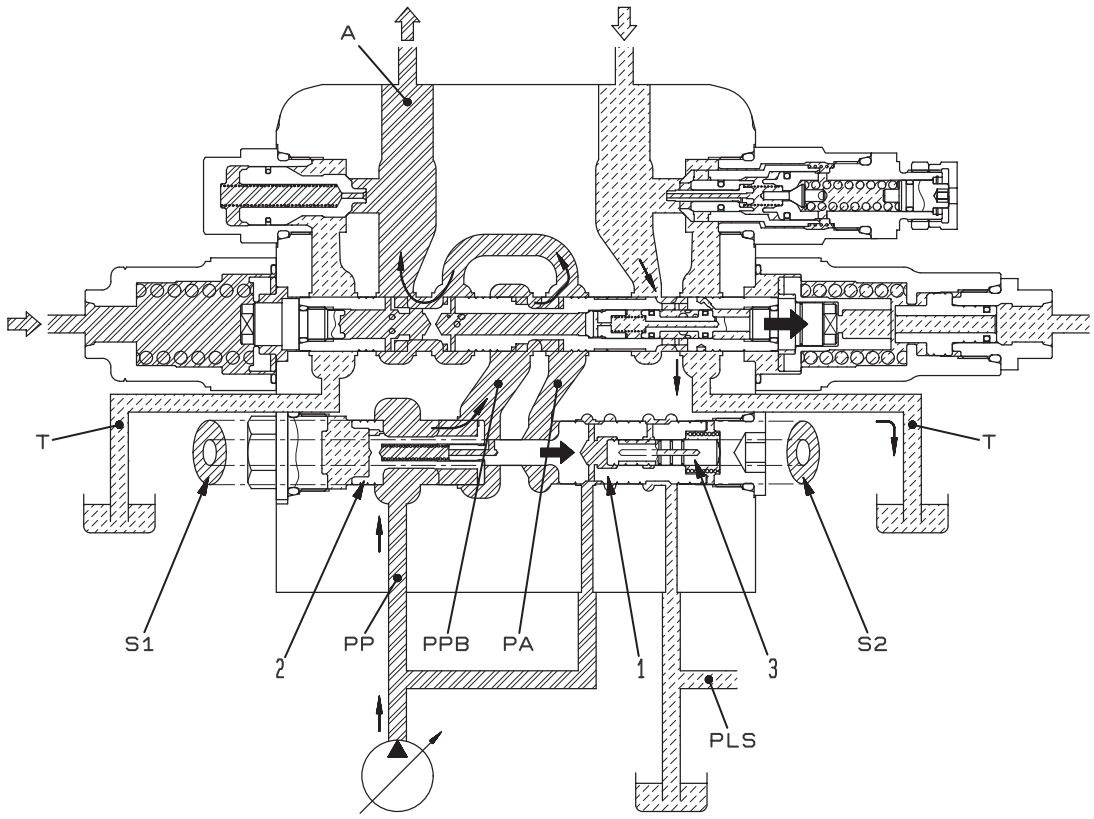
- When the load pressure of another actuator side (the upper side) rises during a compound operation, the flow in the actuator circuit **Aa** on this side (the lower side) is apt to increase.
- In this case, the LS pressure **PLS** of another actuator is applied to the spring chamber **PLS1** and pushes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

5. Area ratio of pressure compensation valve

Function

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

S1 : Area of the flow control valve (2) - area of the piston (3)
S2 : Area of the pressure reducing valve (1) - area of the piston (3)



Area ratio (S1:S2) and compensation characteristics

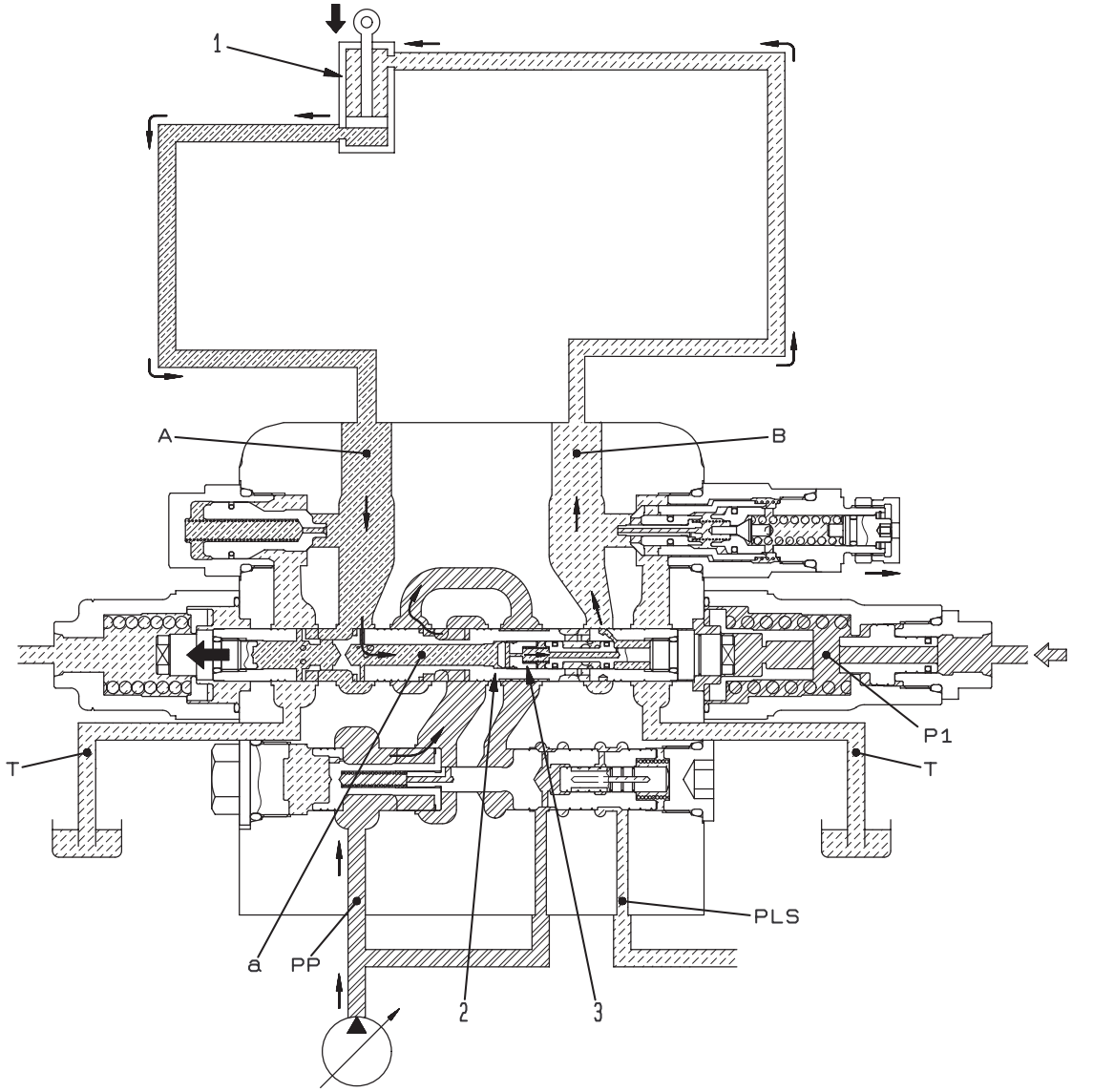
- When the ratio is 1.00 :The expression [Pump (discharge) pressure **PP** – Spool notch upstream pressure **PPB**] ≒ [LS circuit pressure **PLS** – Actuator circuit pressure **PA** (= **A**)] can be held, and the flow is distributed as per the spool opening area ratio.
- When the ratio is more than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

6. Boom regeneration circuit

1. 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.



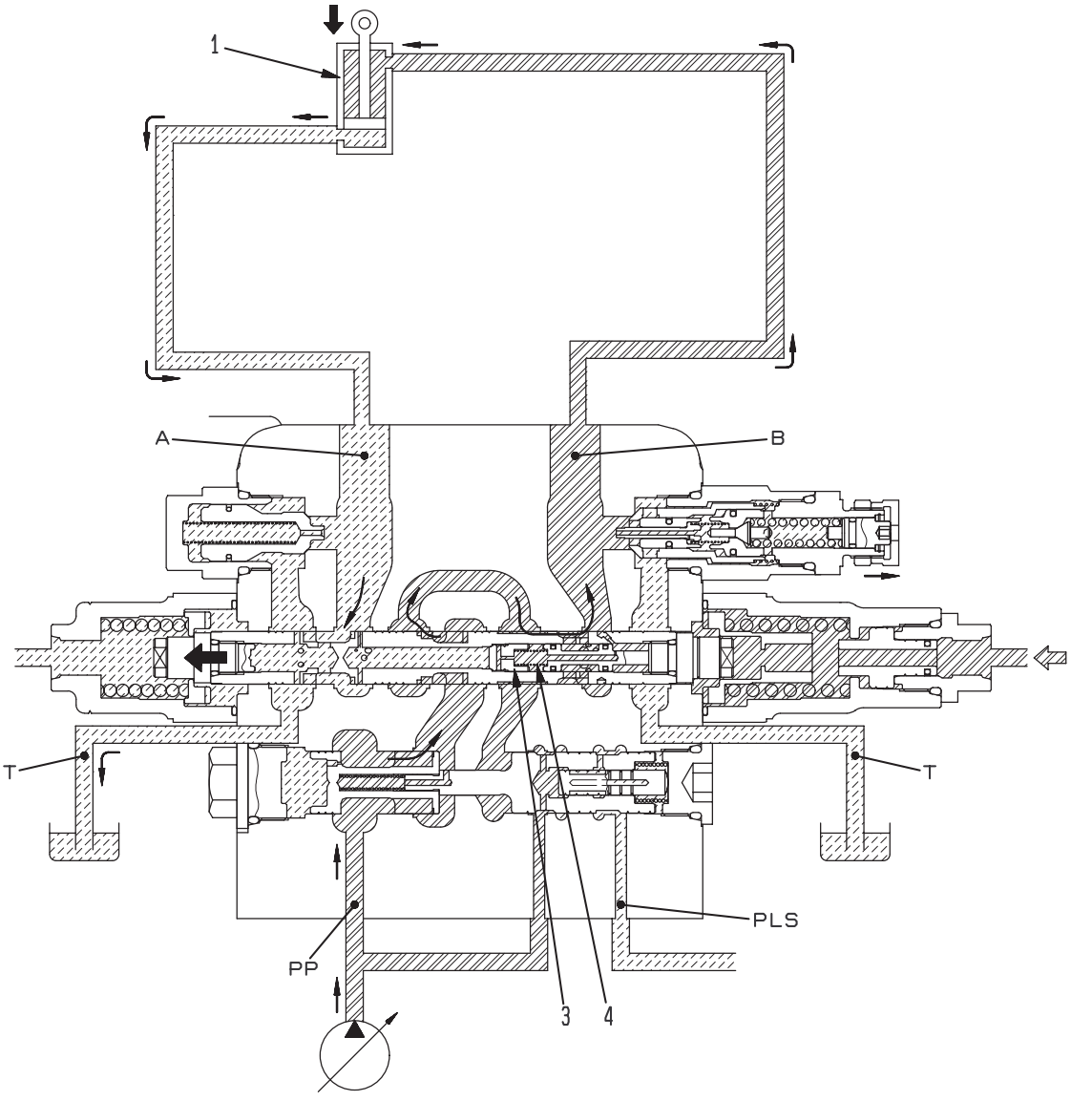
Operation

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

2. 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.



Operation

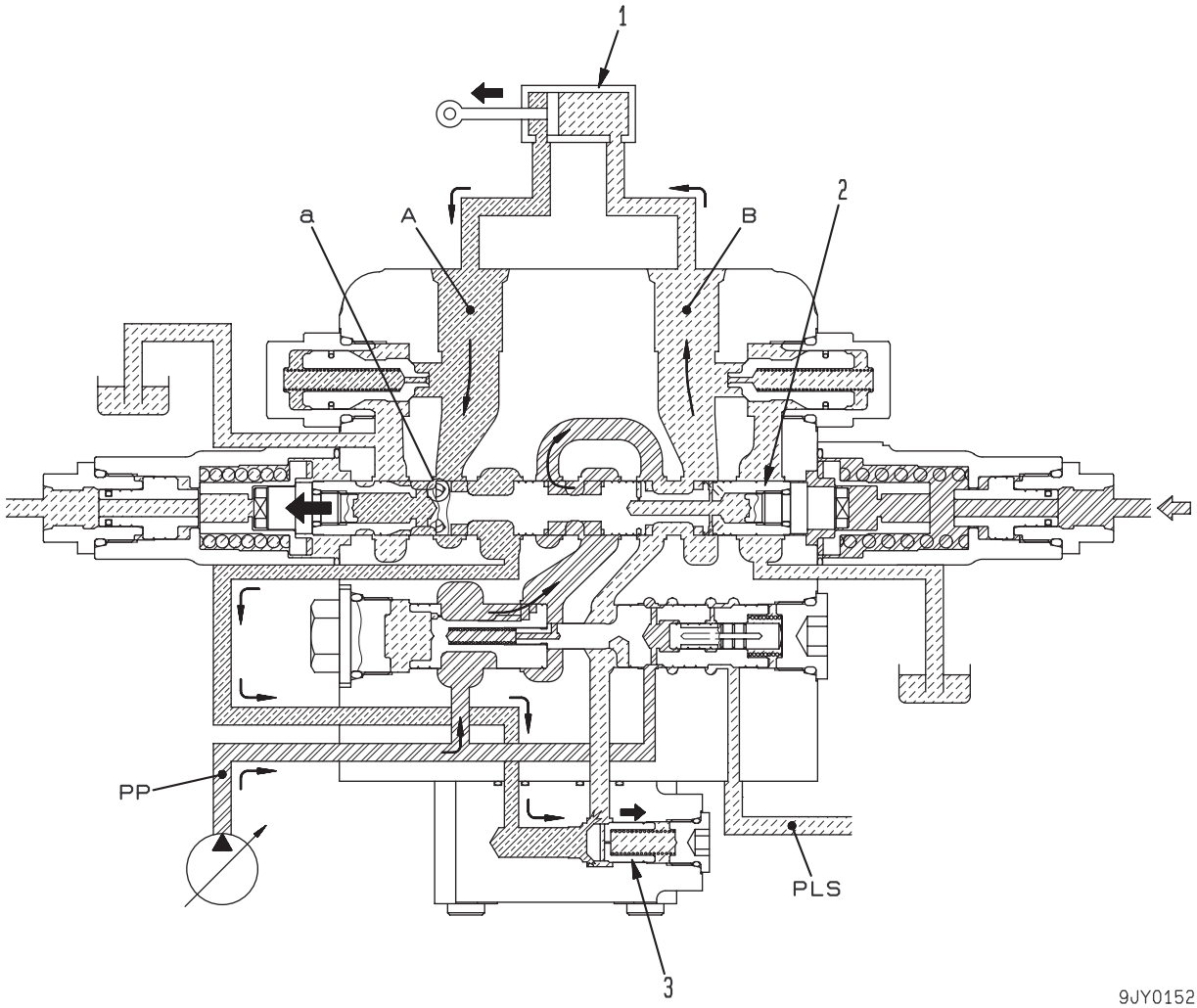
- When the boom is lowered and is in the load process, the head side pressure **B** of the boom cylinder (1) rises above the bottom side pressure **A**
- At the time, the head side pressure **B** and the spring (4) close the check valve (3), and the circuits on the head side and the bottom side are interrupted.

7. Arm regeneration circuit

1. 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.

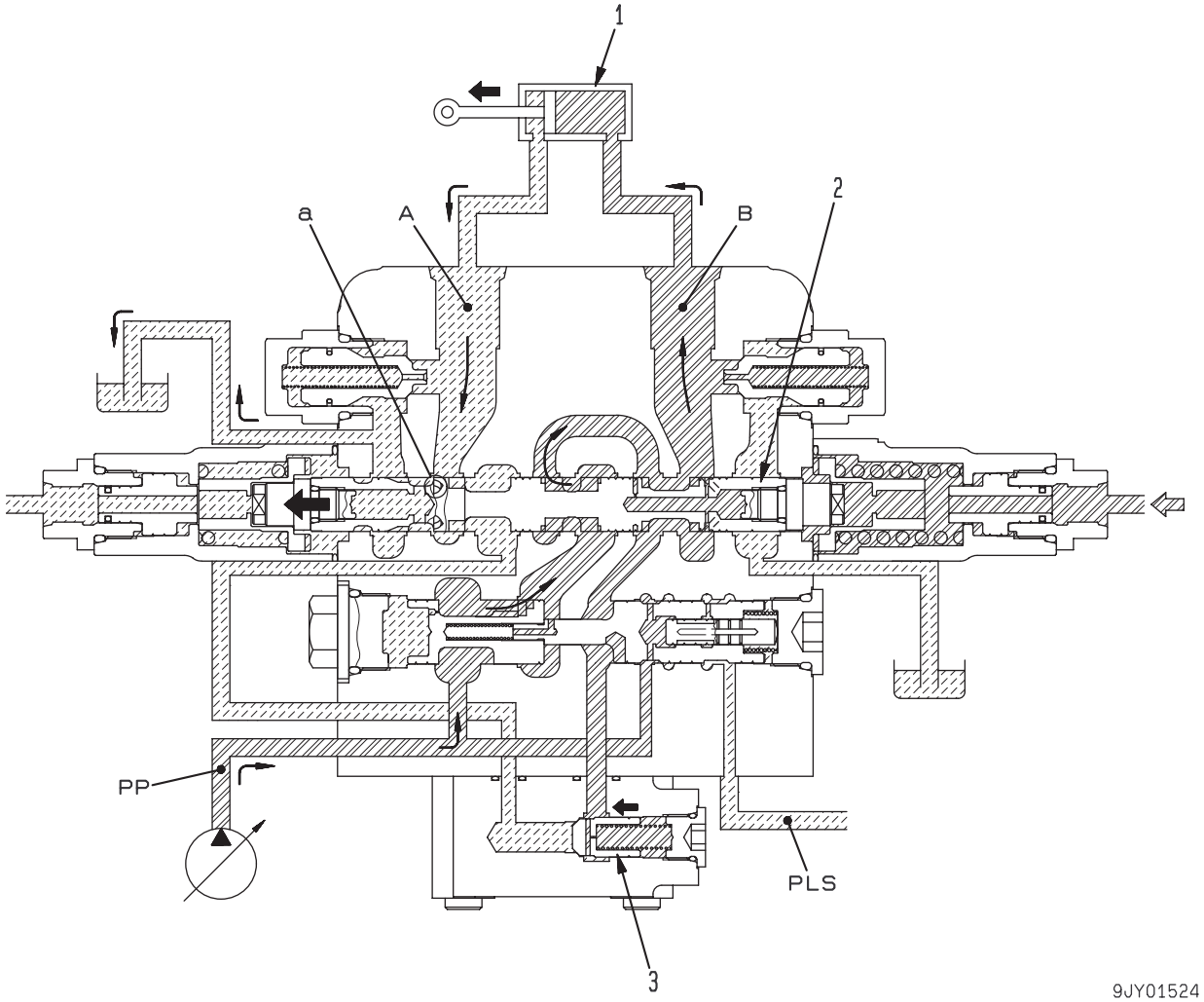
1. Arm cylinder
2. Arm spool
3. Check valve

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.

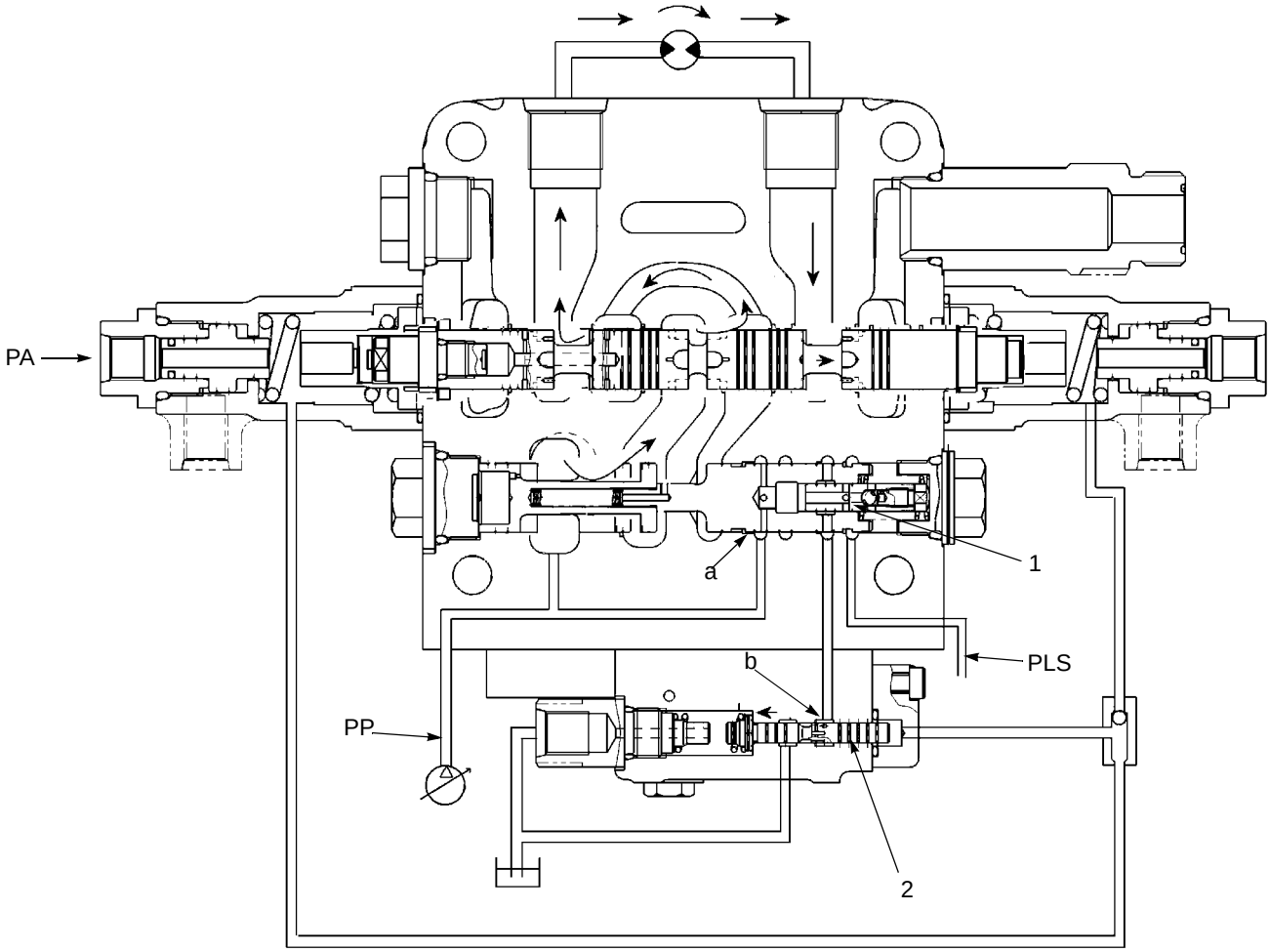
1. Arm cylinder
2. Arm spool
3. Check valve

A : Head circuit (pressure)
B : Bottom circuit (pressure)
PP : Pump circuit (pressure)

8. Swing bleeding valve

Function

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



Operation (In fine control operation)

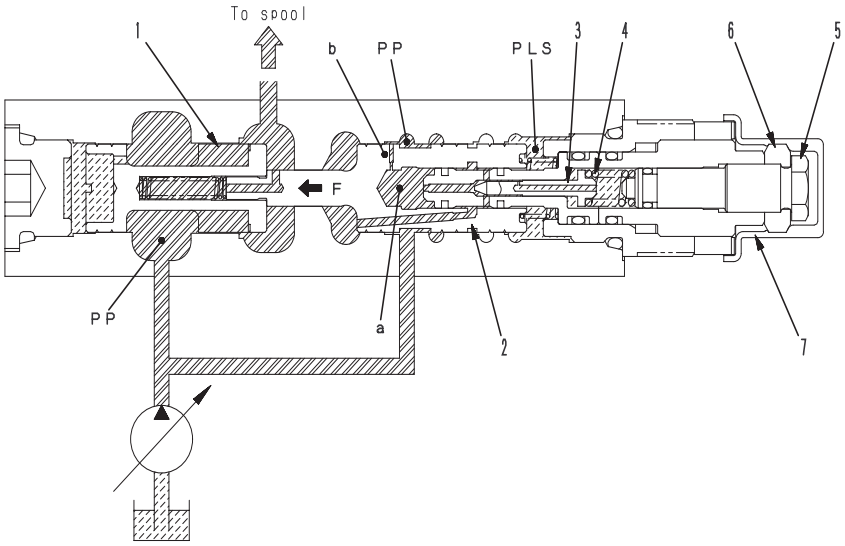
- The pressure reducing valve moves to the right and notch **a** connects to the LS circuit. As a result, pump circuit **PP**, bleed-off circuit, and Ls circuit are connected through piston (1).
- Bleeding spool (2) moves to the left in proportion as swing **PPC** pressure **PA** rises. In the fine control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

1. Piston
2. Pressure Compensation Valve

9. Variable type pressure compensation valve (for service)

Function

- It is possible to adjust the division of the oil flow to the service valve (for attachment) 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.)

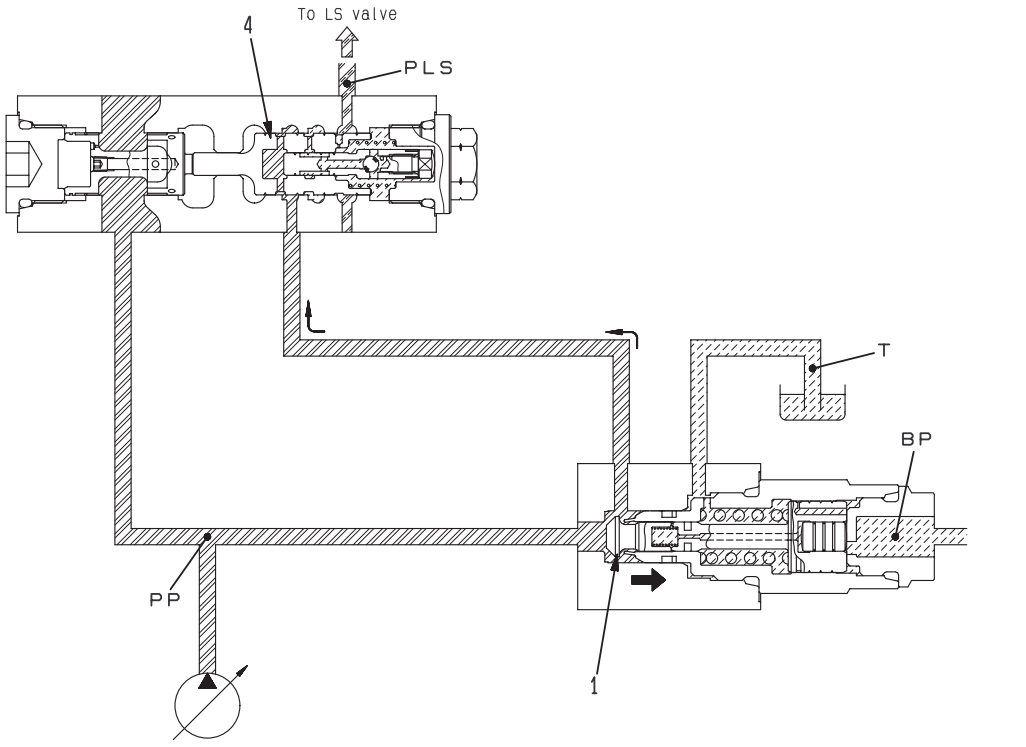
- Pump pressure **PP** and LS pressure **PLS** are determined by other work equipment.
- When the pressure in chamber **a** reaches the set pressure of spring (4), poppet (3) opens and the pressure in chamber **a** is maintained at a pressure lower than the pump pressure at throttle **b**.
- As a result, 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 valv e (1) moves to the right and the flow of oil from the pump to the service valve increases.

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

10. LS select valve

Function

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



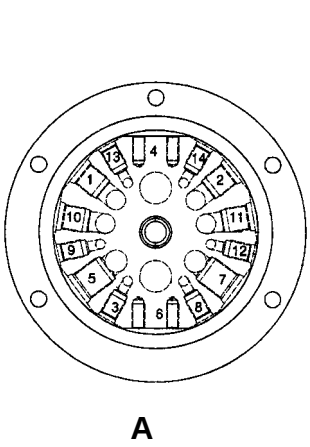
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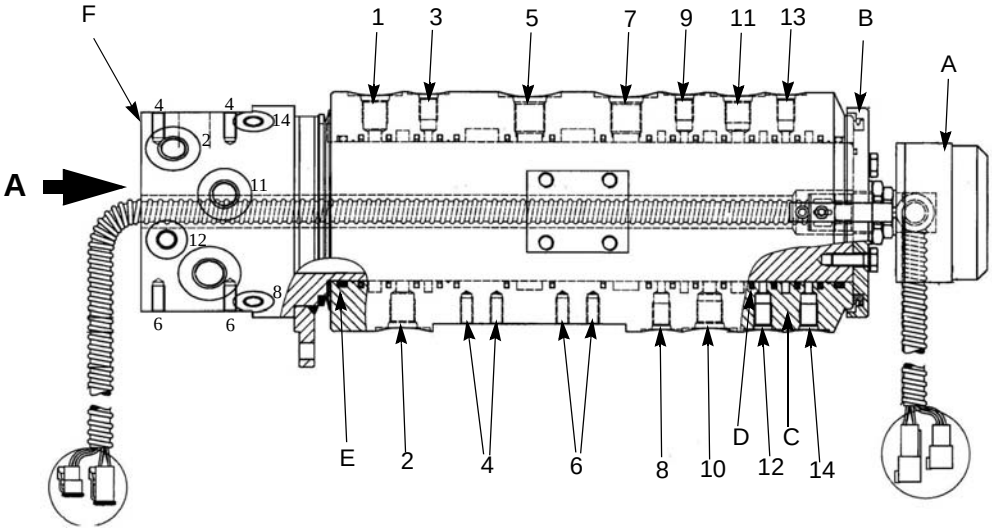
Operation

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



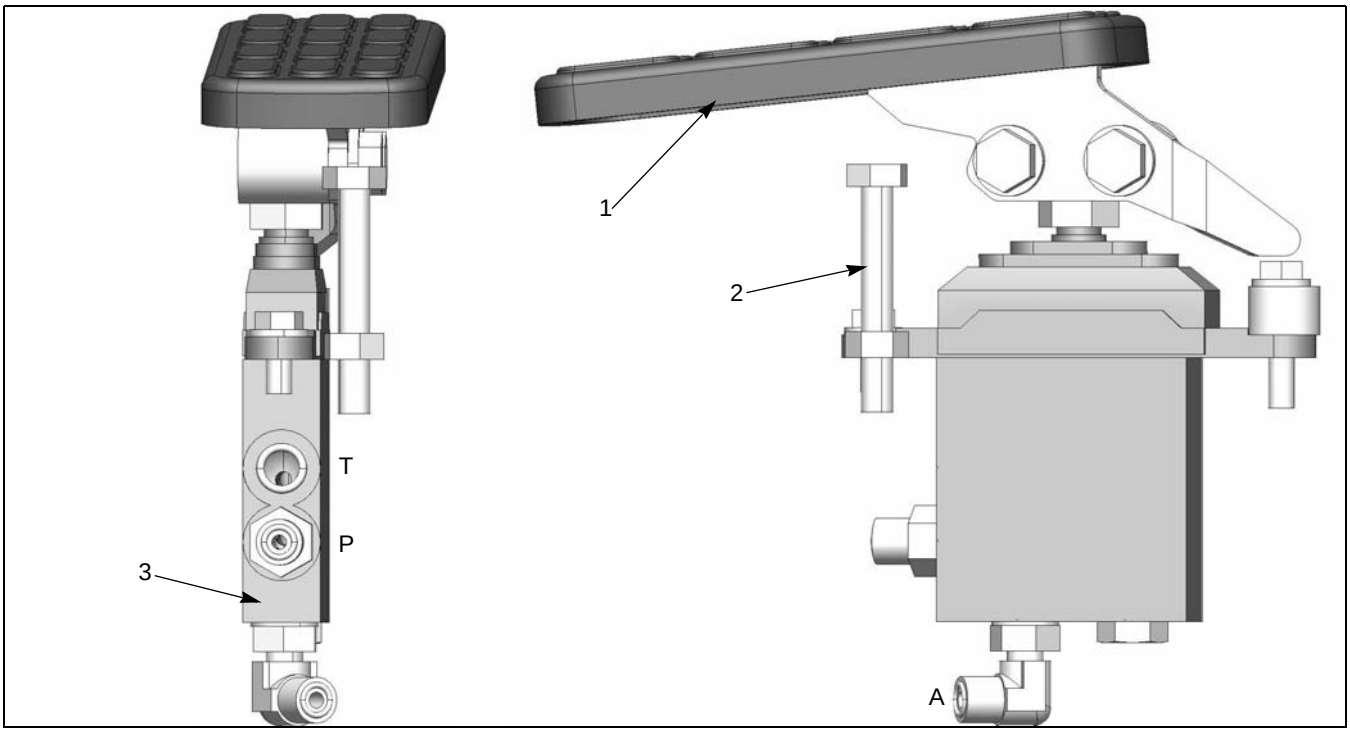


1. Steering left
2. Drain
3. Motor volume pilot
4. Travel motor A
5. Undercarriage attachment cylinder head
6. Travel motor B
7. Undercarriage attachment cylinder bottom
8. Service brake-1
9. Service brake-2
10. Steering right
11. Blanked off
12. Transmissiom large clutch
13. Suspension lock
14. Transmission small clutch
- A. Slip ring assembly
- B. Cover
- C. Housing
- D. Sealing ring
- E. O-ring/backup ring seal
- F. Rotor

Unit: mm

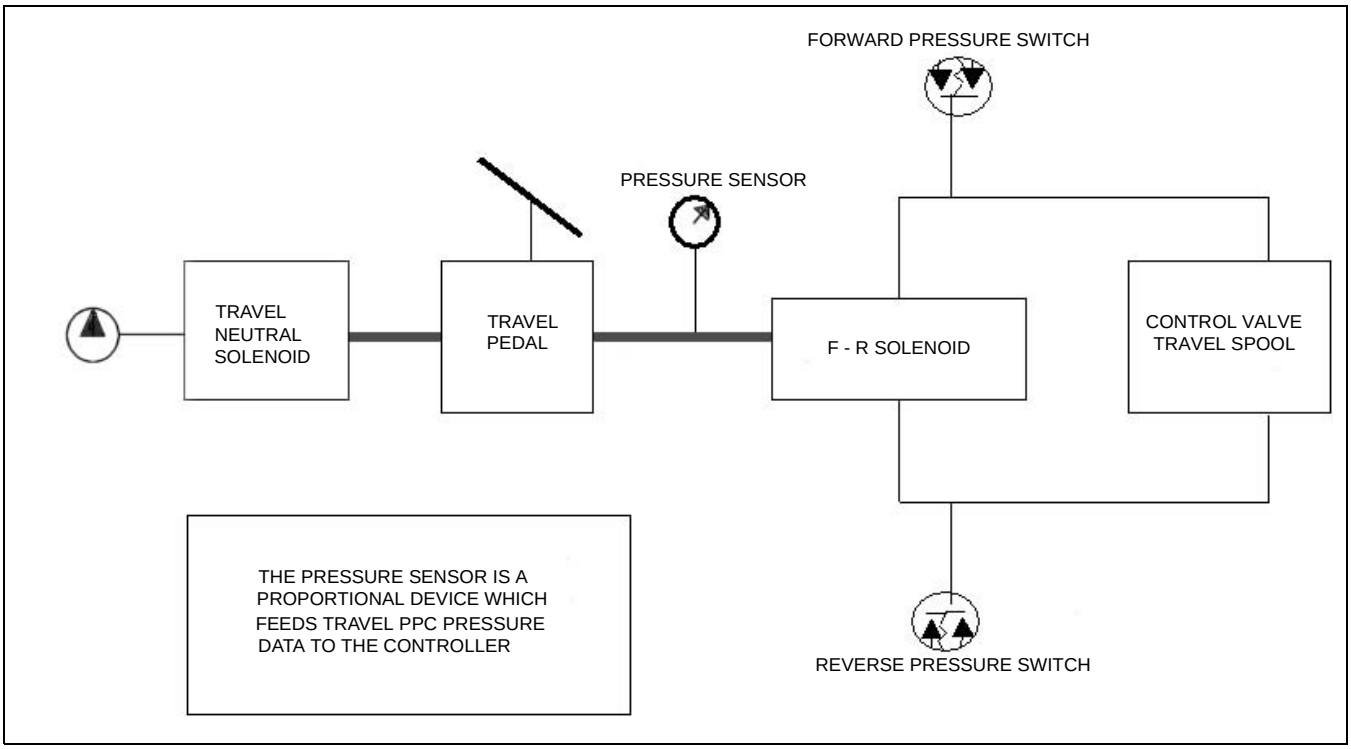
No.	Check Item	Criteria			Remedy
		Standard Size	Standard clearance	Repair limit	
1	Internal shaft	$110^{-0.02}_{-0.06}$	Max.=0.21 Min.=0.12	>=0.26	Replace
2	External rotor	$110^{0.15}_{0.10}$			

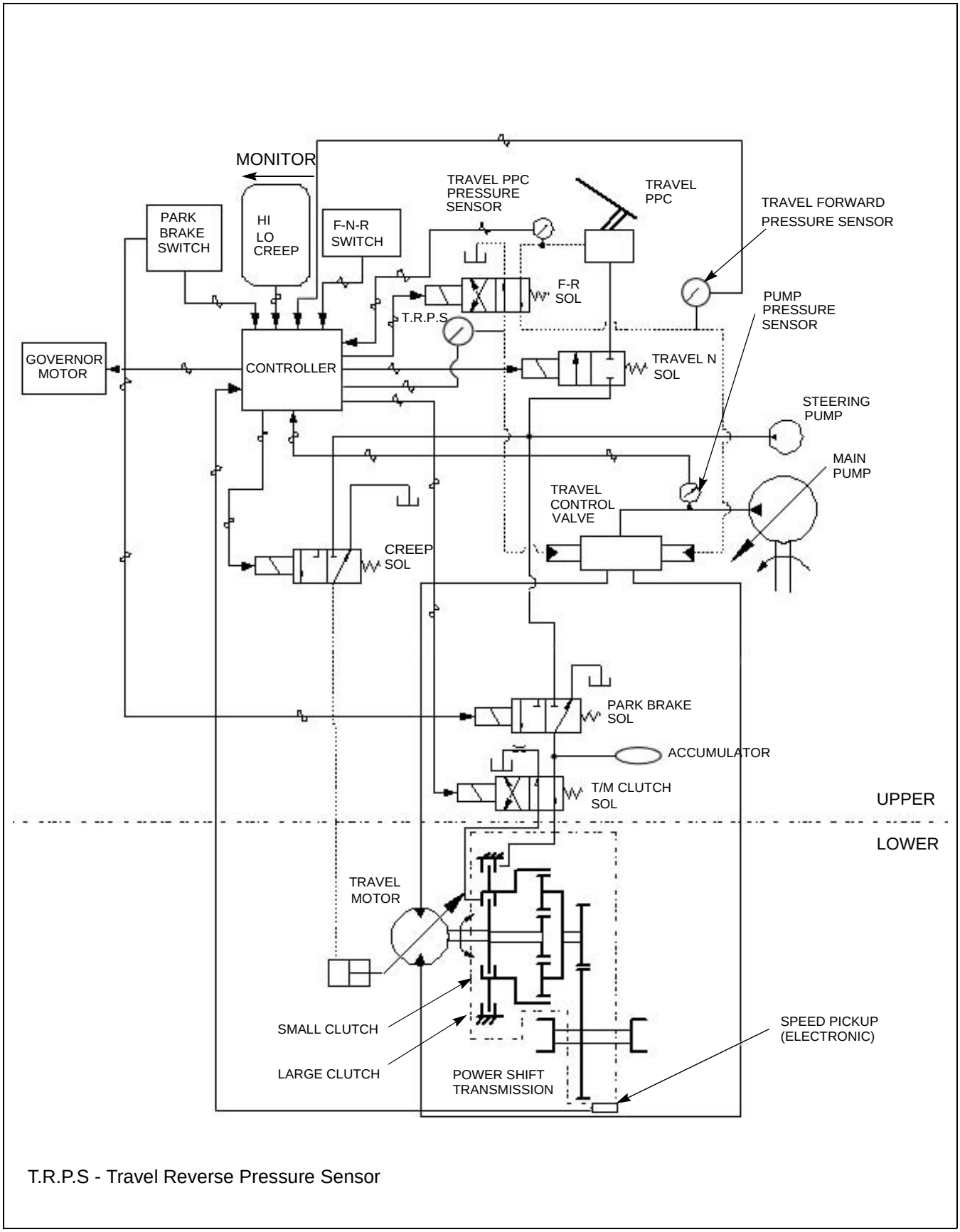
TRAVEL PPC PEDAL



1. Pedal
2. Pedal Adjuster
3. Valve

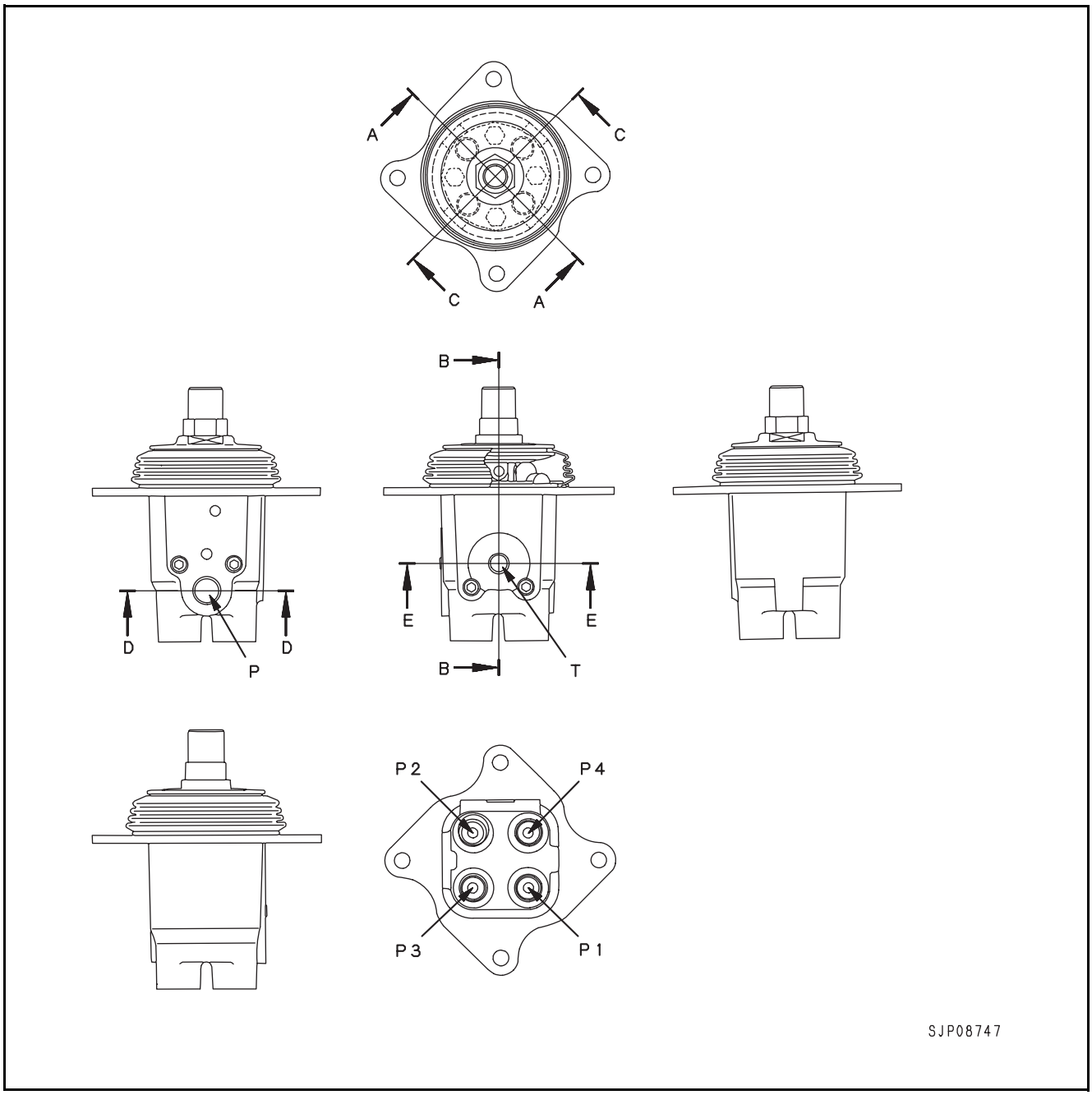
A. To forward-reverse solenoid
P. To travel neutral solenoid
T. To tank





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

WORK EQUIPMENT • SWING PPC VALVE



P. From main pump

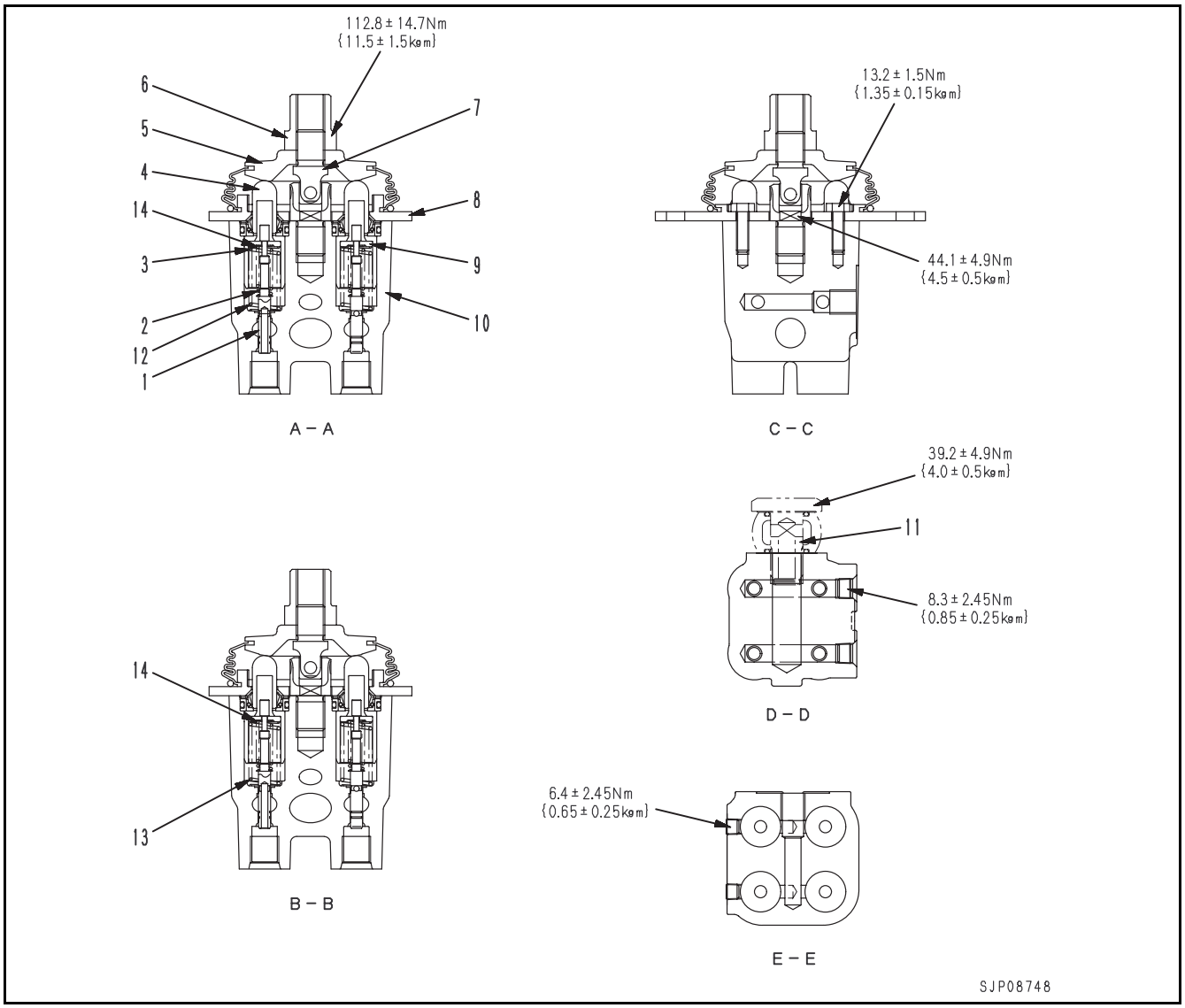
T. To tank

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

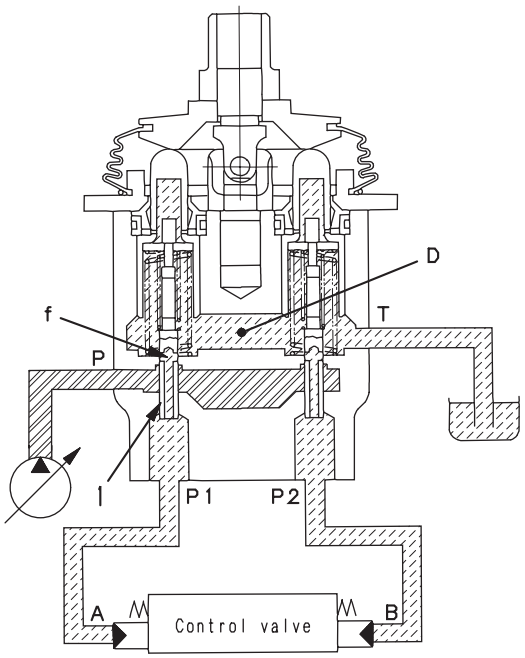
Unit: mm

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	If damaged or deformed, replace spring
		38.7 x 15.5	34	9.81 N {1.0 kg}	—	7.85 N {0.8 kg}	
13	Centering spring (For P3 and P4)	42.5 x 15.5	34	17.7 N {1.8 kg}	—	14.1 N {1.44 kg}	
14	Metering spring	26.5 x 8.2	24.9	16.7 N {1.7 kg}	—	13.3 N {1.36 kg}	

OPERATION

1) At neutral

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



(Fig. 1)

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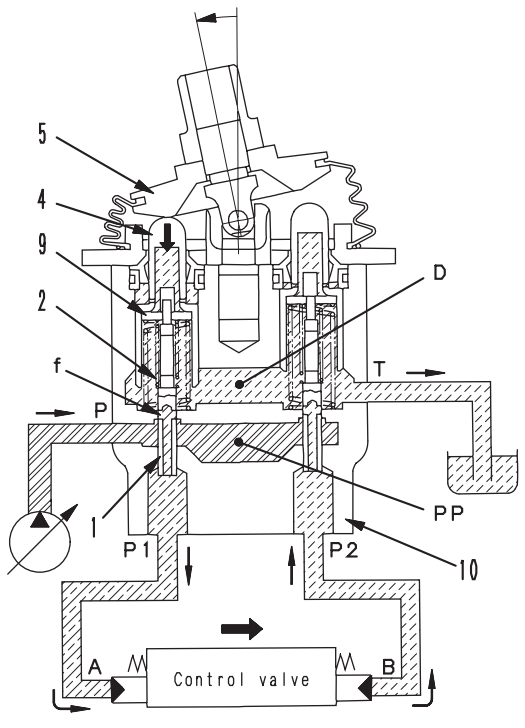
2. During fine control (neutral → fine control)

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

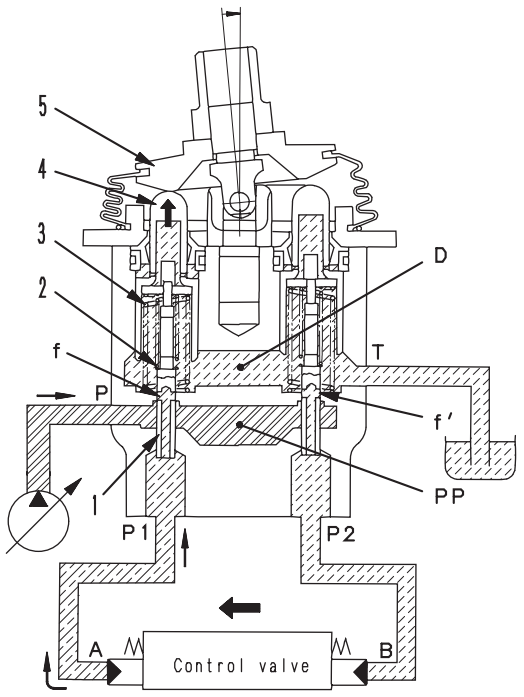
3. During fine control (when control lever is returned)

- 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)



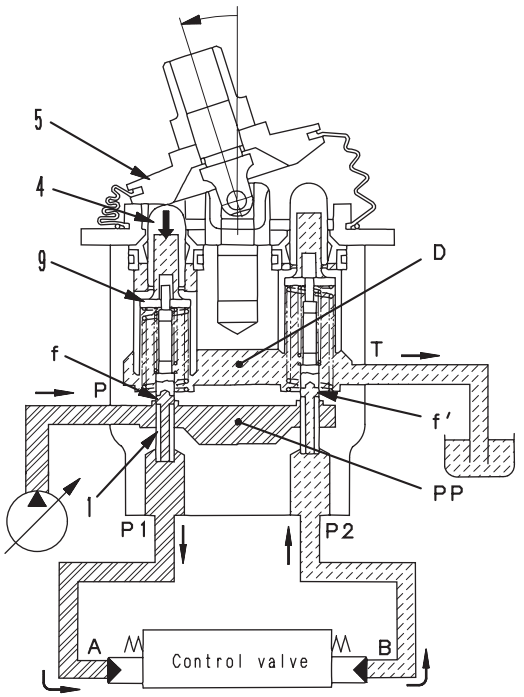
(Fig. 3)

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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.

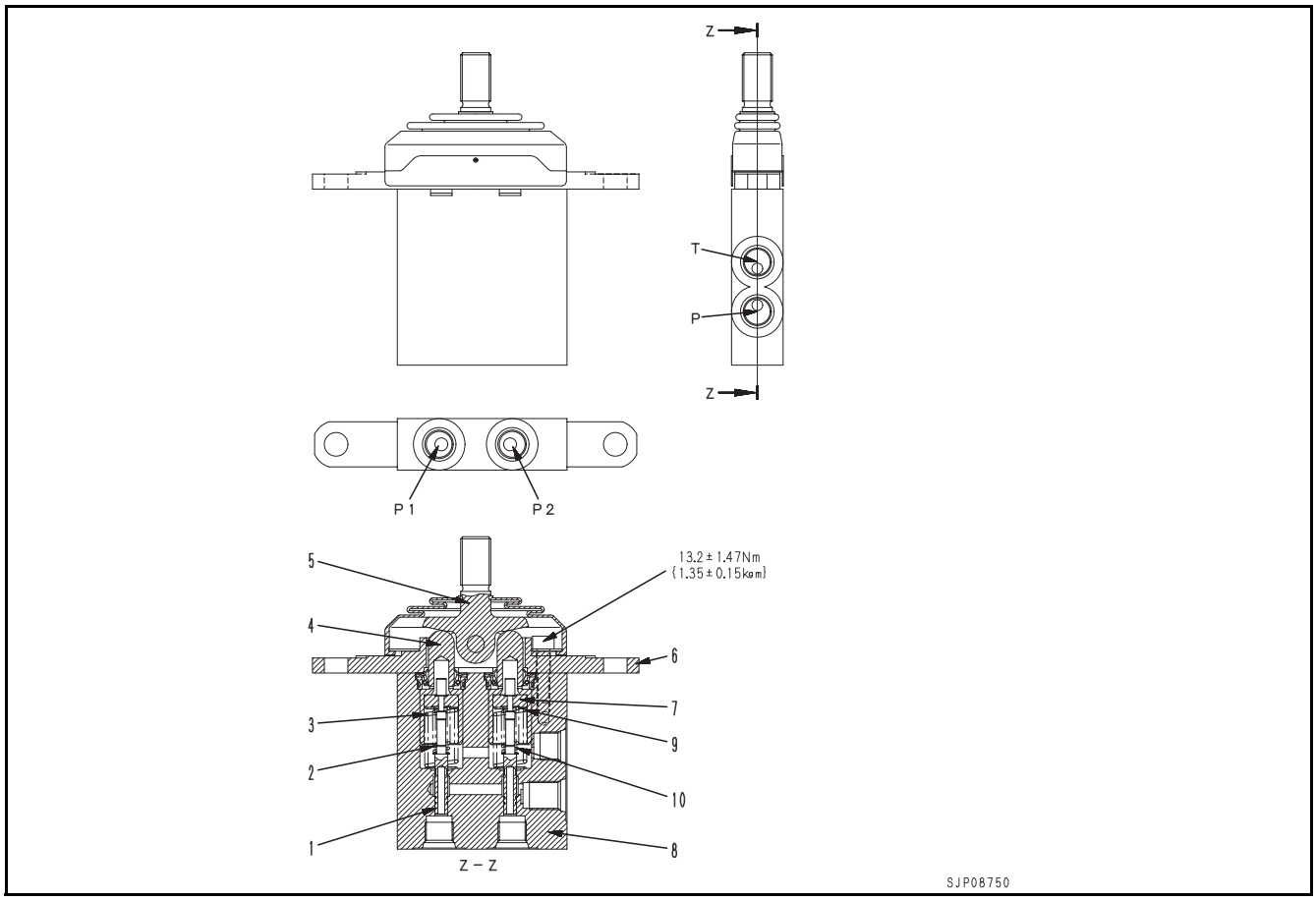
The oil returning from chamber **B** passes from port **P2** through fine control hole **f** and flows to drain chamber **D**. (Fig. 4)



(Fig. 4)

SBP03496A

SERVICE PPC VALVE



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

T. To tank
P. From main pump
P1. Port
P2. Port

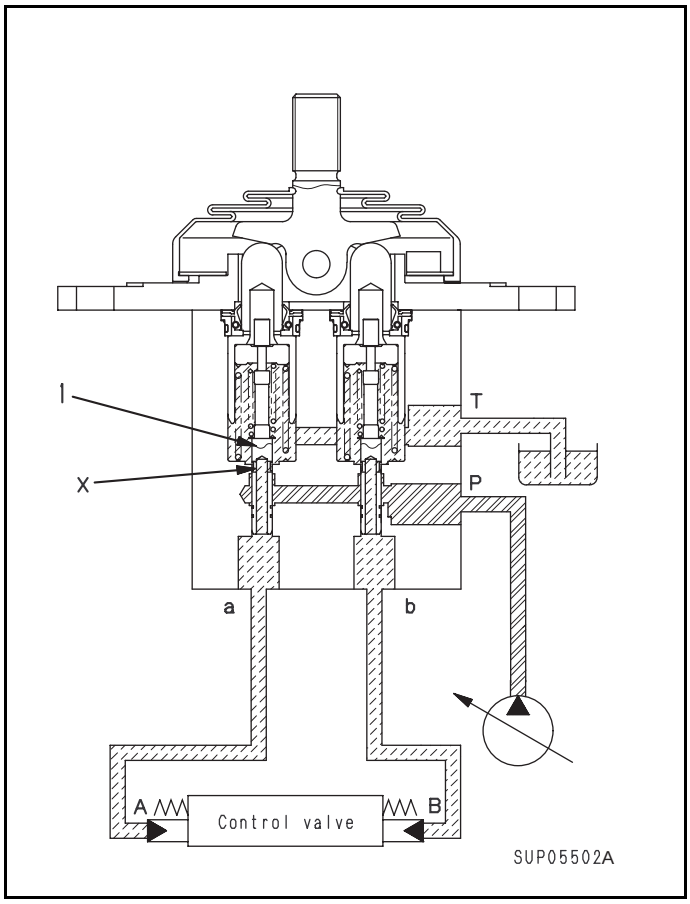
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
9	Centering spring	Free length x Outside diameter	Installed length	Installed load	Free length	Installed load	If damaged or deformed, replace spring
		33.9 x 15.3	28.4	124.5 N {12.7 kg}	—	100 N {10.2 kg}	
10	Metering spring	22.7 x 8.1	22	16.7 N {1.7 kg}	—	13.7 N {1.4 kg}	

OPERATION

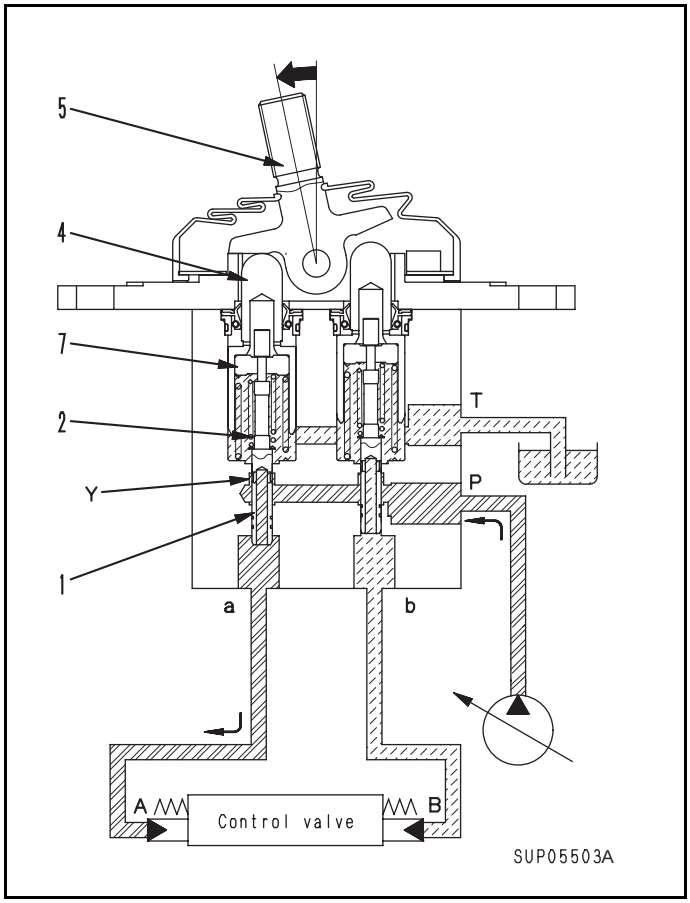
At neutral

- The pressurized oil from the control circuit enters from port **P** and is blocked by spool (1).
- Ports **A** and **B** of the control valve and ports **a** and **b** of the PPC valve are connected to drain port **T** through fine control hole **X** of spool (1).

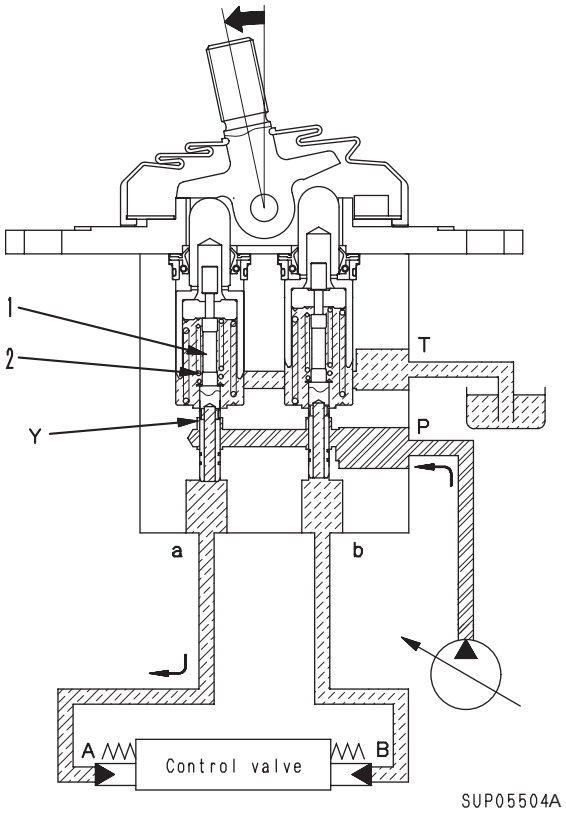


WHEN OPERATED

- When lever (5) is moved, metering spring (2) is pushed by piston (4) and retainer (7), and spool (1) is pushed down by this.
- As a result, fine control portion **Y** is connected with port **a**, and the pressurized oil from port **P** flows from port **a** to port **A** of the control valve.



- When the pressure at port **a** becomes higher, spool (1) is pushed back by the force acting on the end of the spool, and fine control portion **Y** closes.
- As a result, spool (1) moves up and down to balance the force at port **a** and the force at metering spring (2).
- Therefore, metering spring (2) is compressed in proportion to the amount the control lever is moved. The spring force becomes larger, so the pressure at port **a** also increases in proportion to the amount the control lever is operated.
- In this way, the control valve spool moves to a position where the pressure of port **A** (the same as the pressure at port **a**) is balanced with the force of the return spring of the control valve spool.

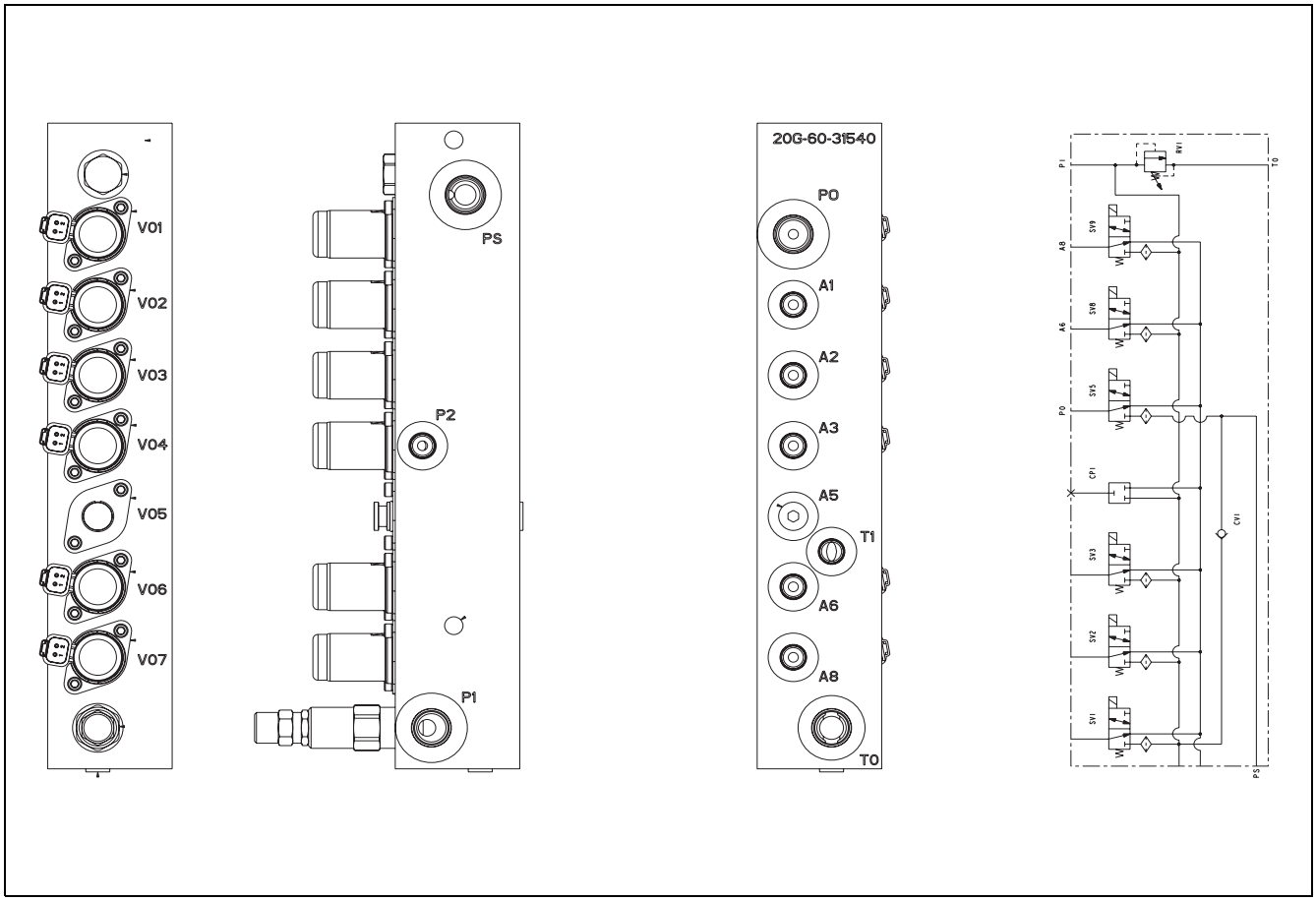


SOLENOID VALVE MANIFOLD

6-stage manifold block:
PPC lock, 2-stage relief, swing brake,suspension lock, merge flow, travel neutral, travel creep solenoid valves.(see page 10-226)

4-stage manifold block:
Travel forward / reverse, stabilizer / boom down, stabilizer / boom up, rotate CW / ACW solenoid valves. (see page 10-226)

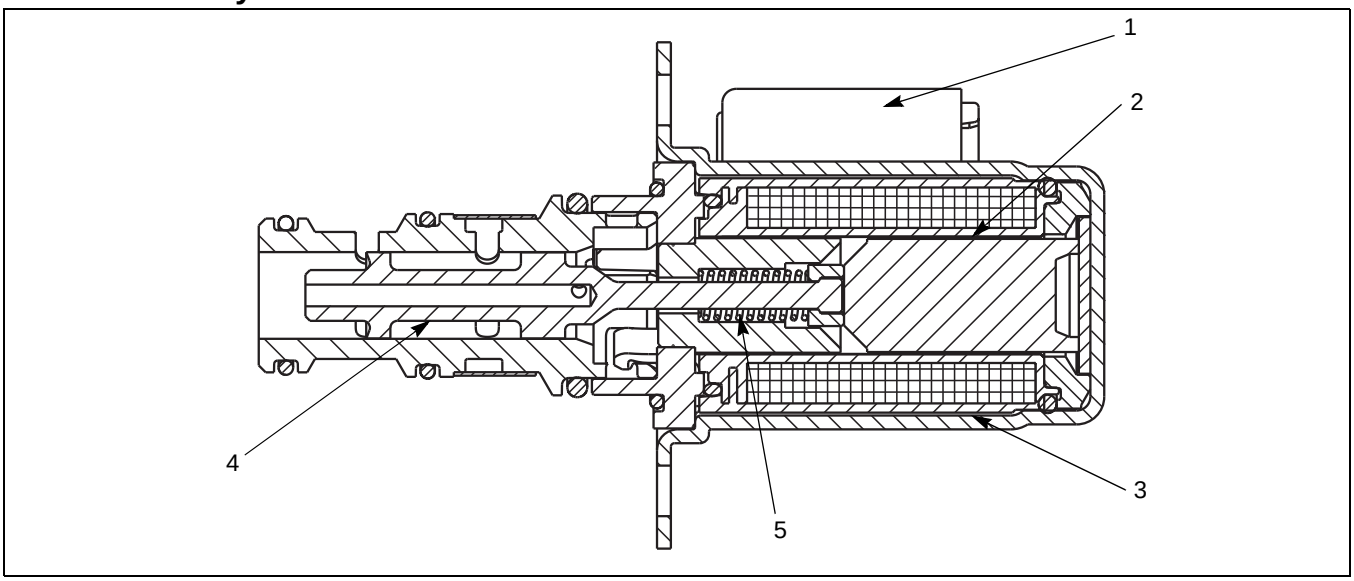
2-stage manifold:
Hi-lo (see page 10-222),
2-stage back pressure (see page 10-224) solenoid valves.



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 hydraluic pressure lock	A8.	Travel creep (motor volume pilot)	V07	Travel creep sol

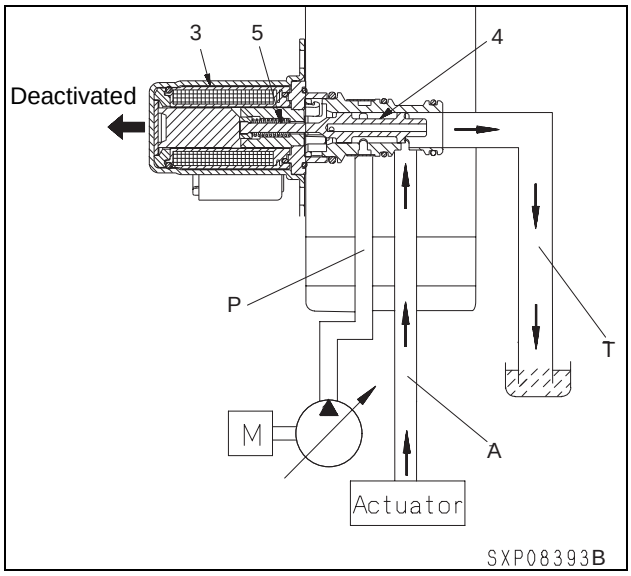
SOLENOID VALVE BLOCK

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

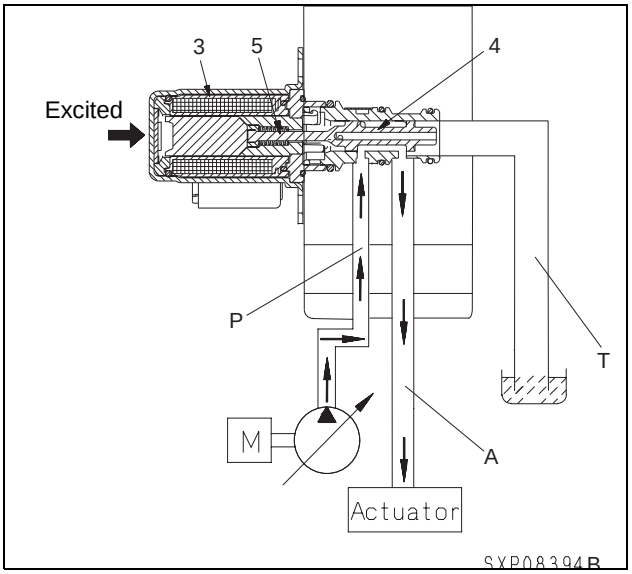
OPERATION

When solenoid is deactivated

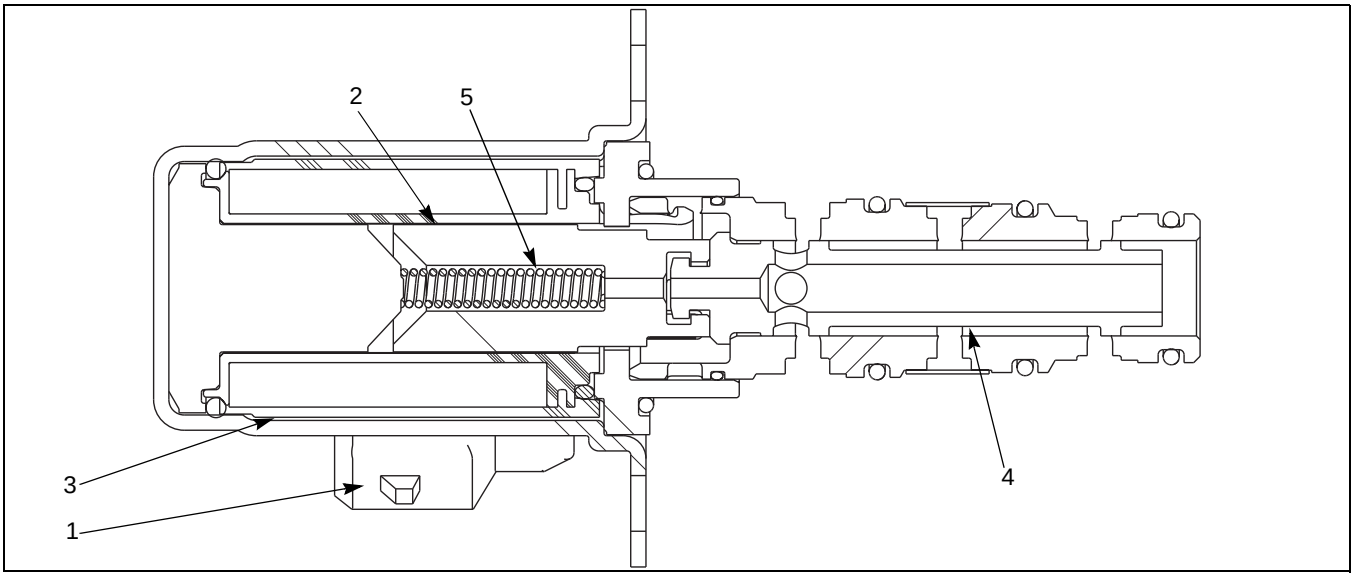
- Since the signal current does not flow from the controller, coil (3) is turned off
  Accordingly, spool (4) is pressed by spring (5) against the left side.
  By this operation, the passage from **P** to **A** is closed and the hydraulic oil from the control circuit does not flow into the actuator.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



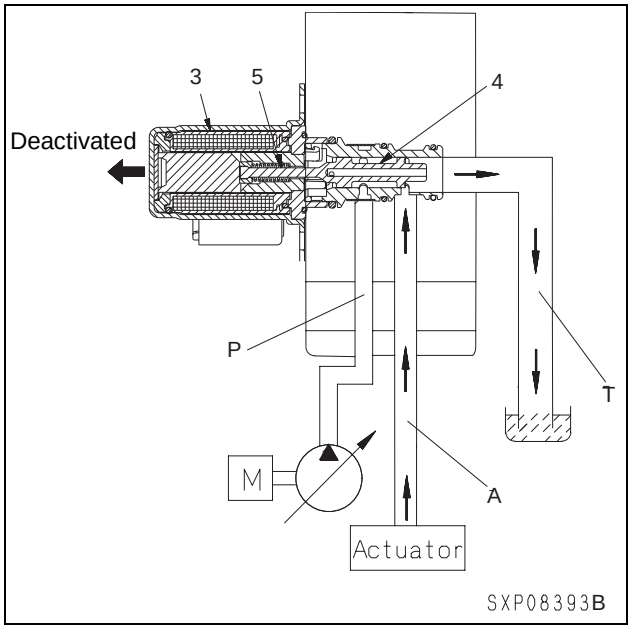
2 Position 4 way valve



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



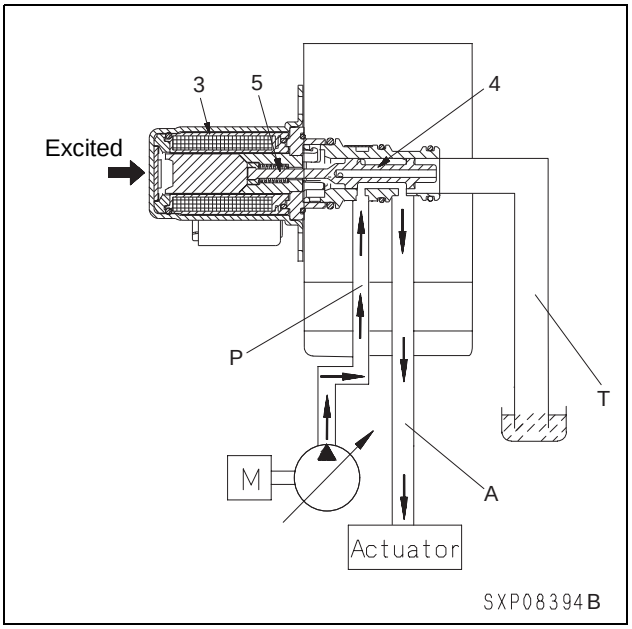
OPERATION

When solenoid is deactivated

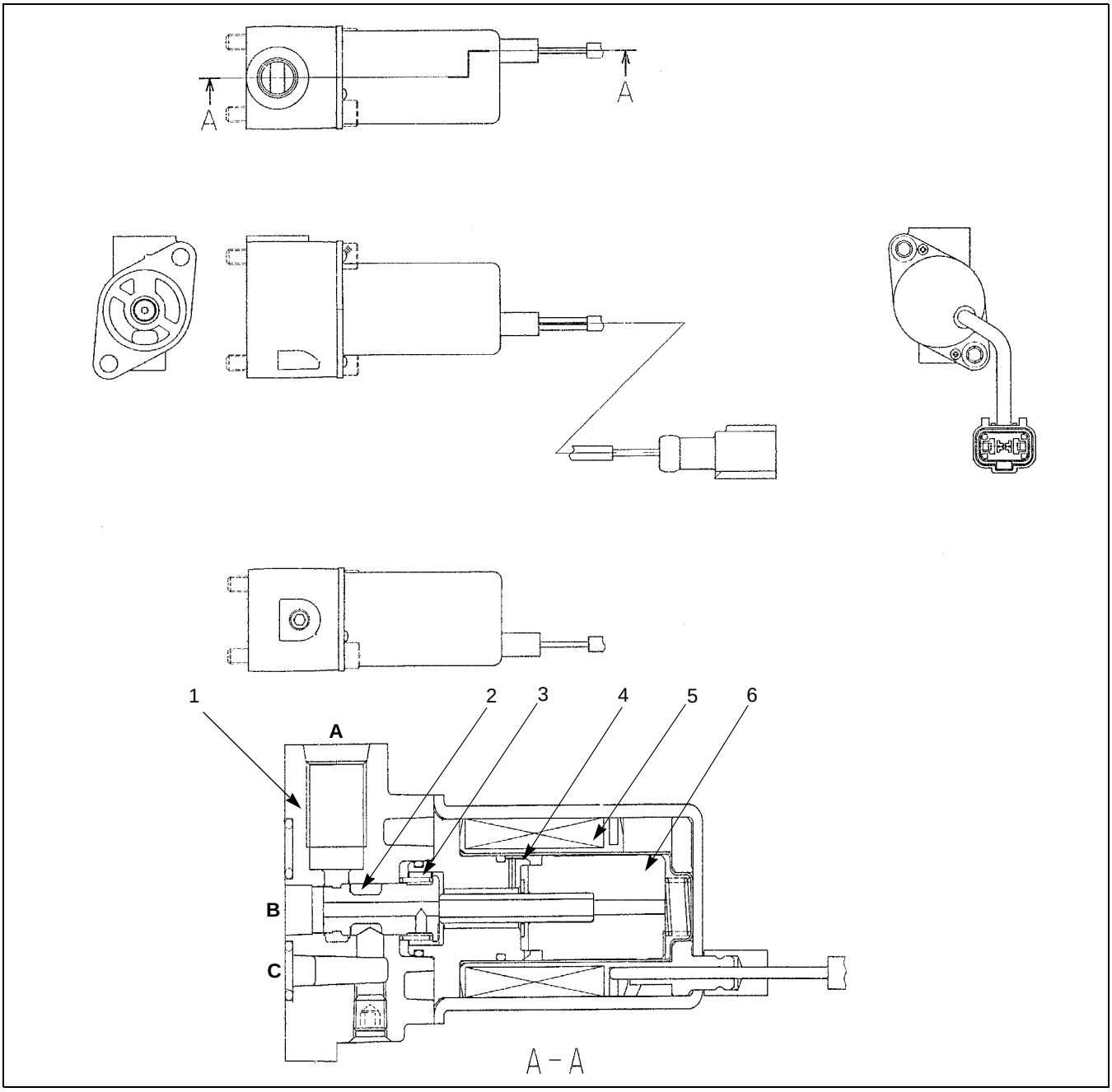
- Since the signal current does not flow from the controller, coil (3) is turned off
  Accordingly, spool (4) is pressed by spring (5) against the left side.
  By this operation, the passage from **P** to **A** is closed and the hydraulic oil from the control circuit does not flow into the actuator.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

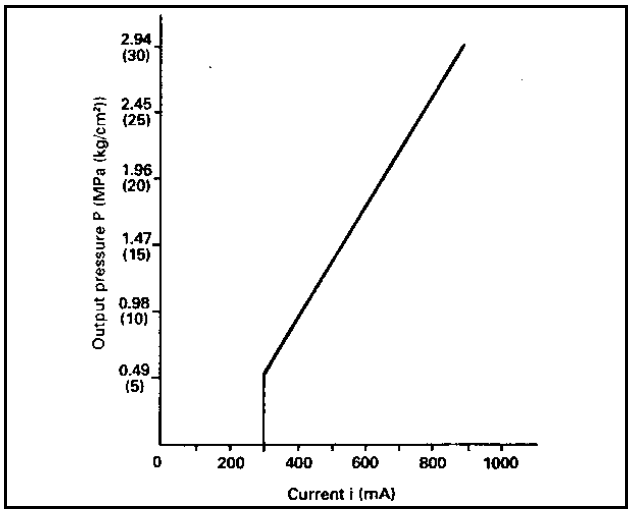


A. Port C (to LS valve)
B. Port T (to tank)
C. Port P (from PPC pressure reducing valve)

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

Function

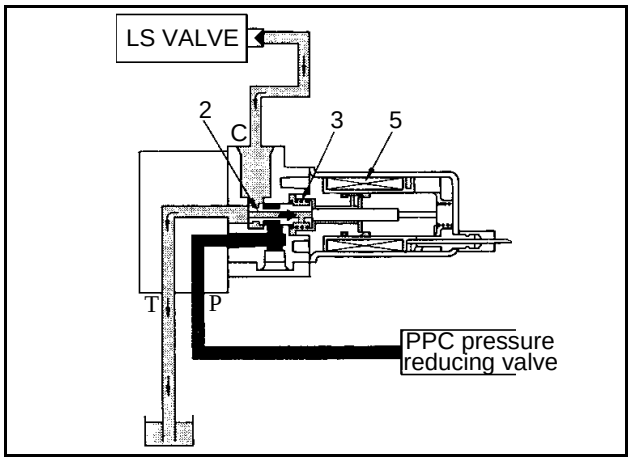
- The EPC valve consists of the proportional solenoid portion and the hydraulic valve poertion.
- When it receivers signal current **i** from the pump controller, it generates EPC output pressure **P** in proportion to the size of the signal, and outputs it to the control valve.



Operation

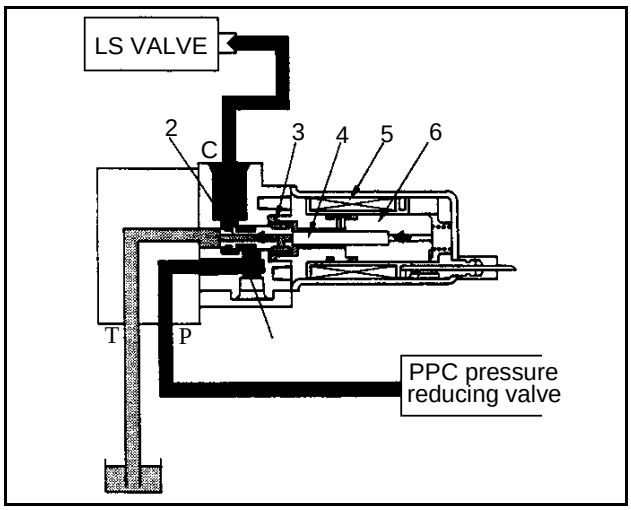
1) When signal current is 0 (coil deactivated)

- 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.



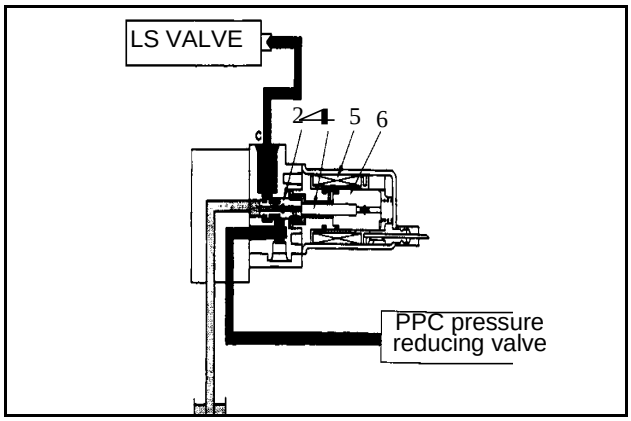
2. When signal current is very small (coil excited)

- 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 proporton 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.**
- Therefore, the circuit pressure betwen the EPC valve and the Att pedal is controlled in proportion to the size of the signal current.

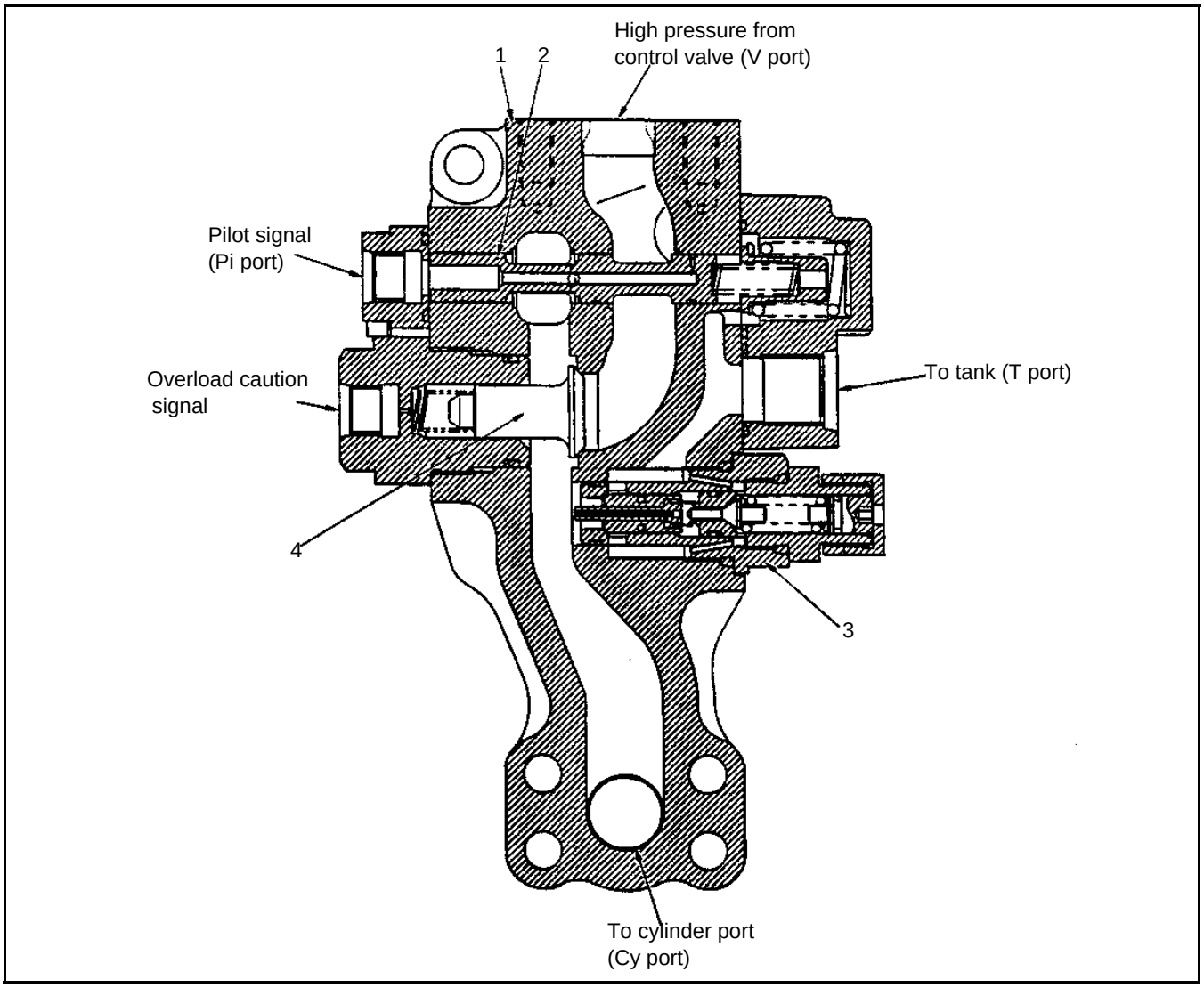


3. When signal current is maxium (coil excited)

- 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.

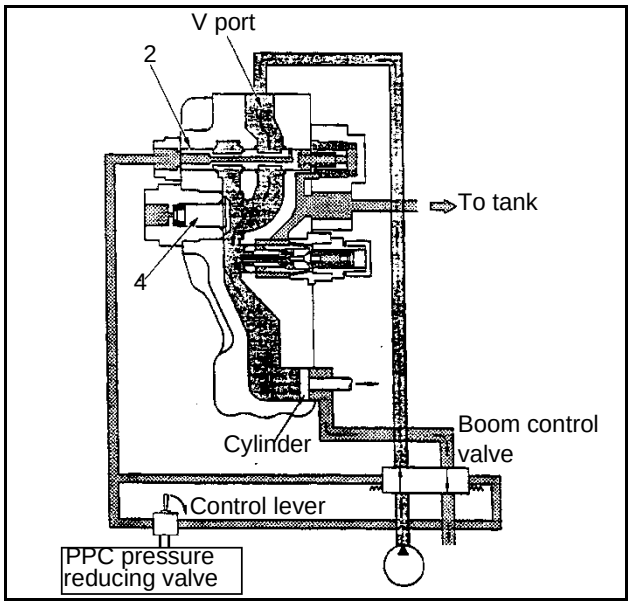


BOOM SAFETY VALVE



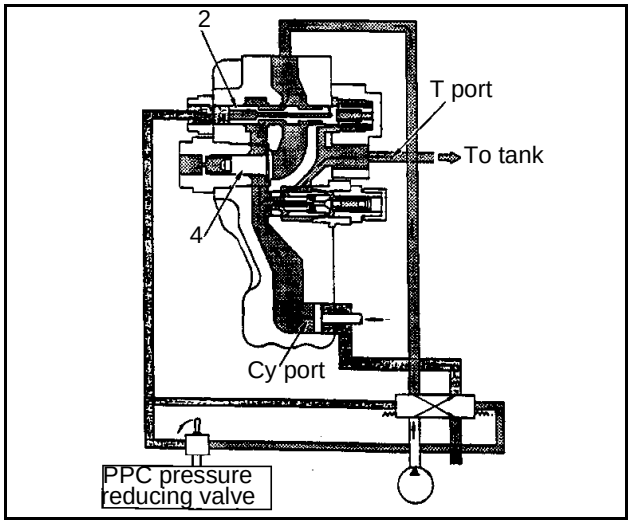
Operation
Boom Raise

- 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.



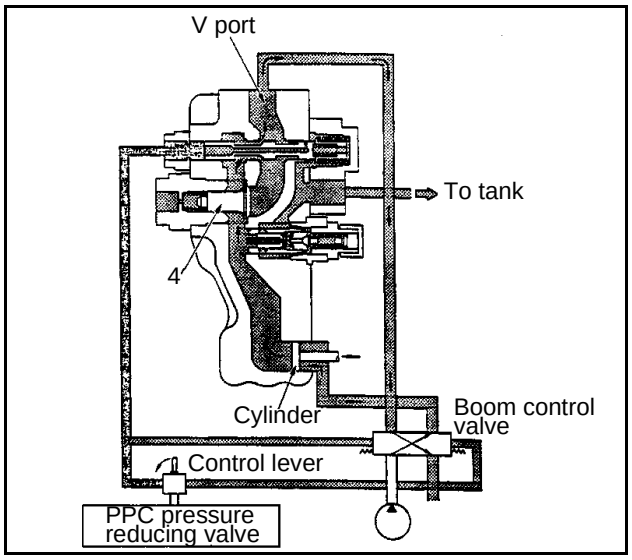
Boom Lower

- 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.



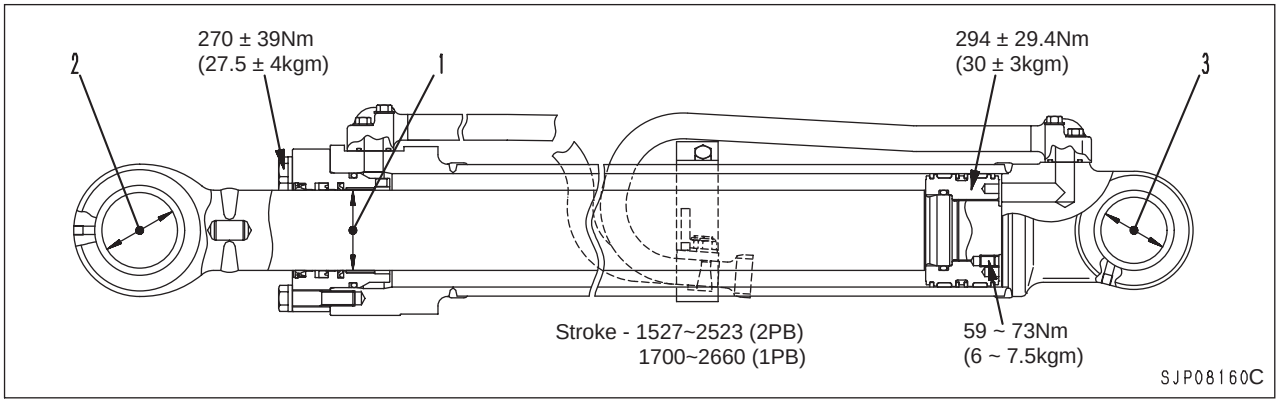
When hose burst occurs
(operation to lower safety)

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

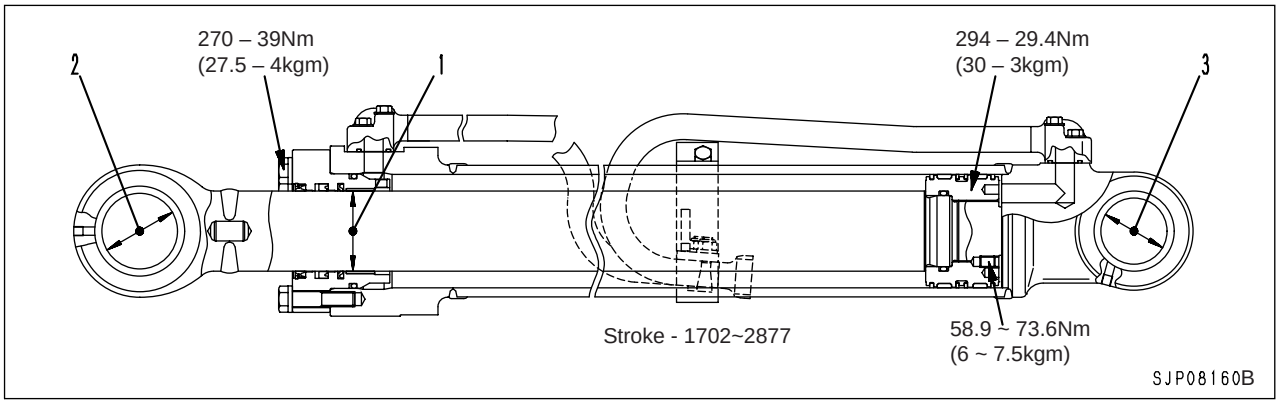


HYDRAULIC CYLINDER

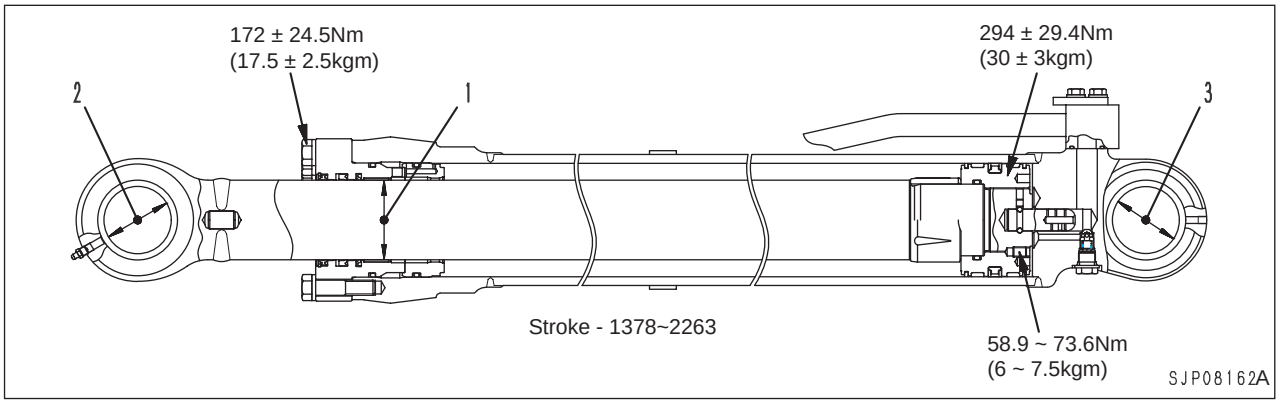
BOOM CYLINDER



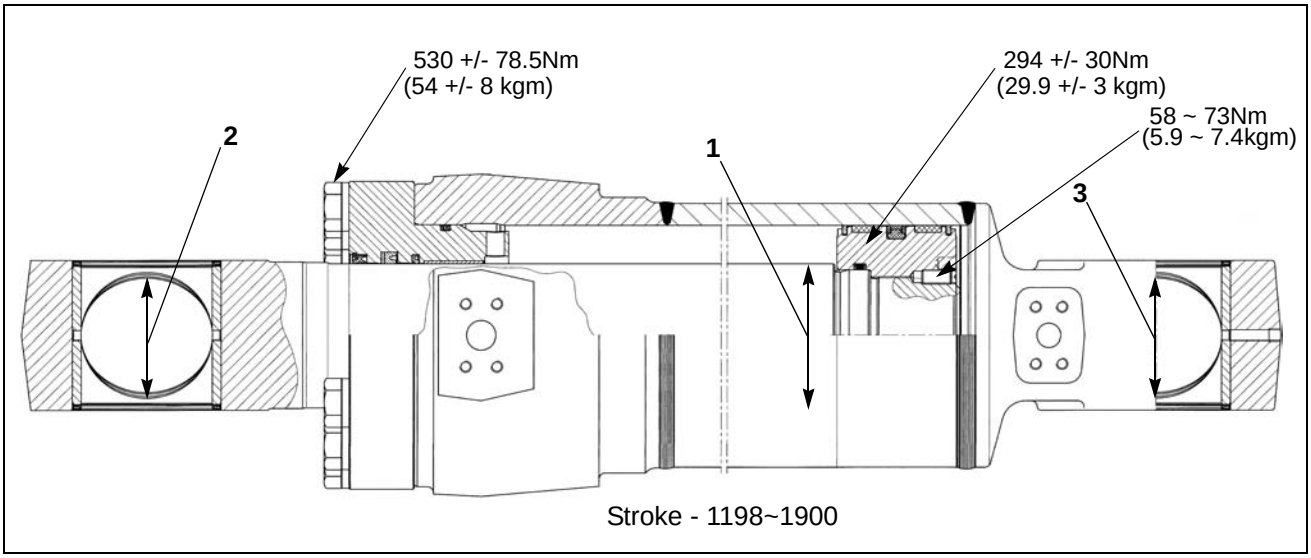
ARM CYLINDER



BUCKET CYLINDER



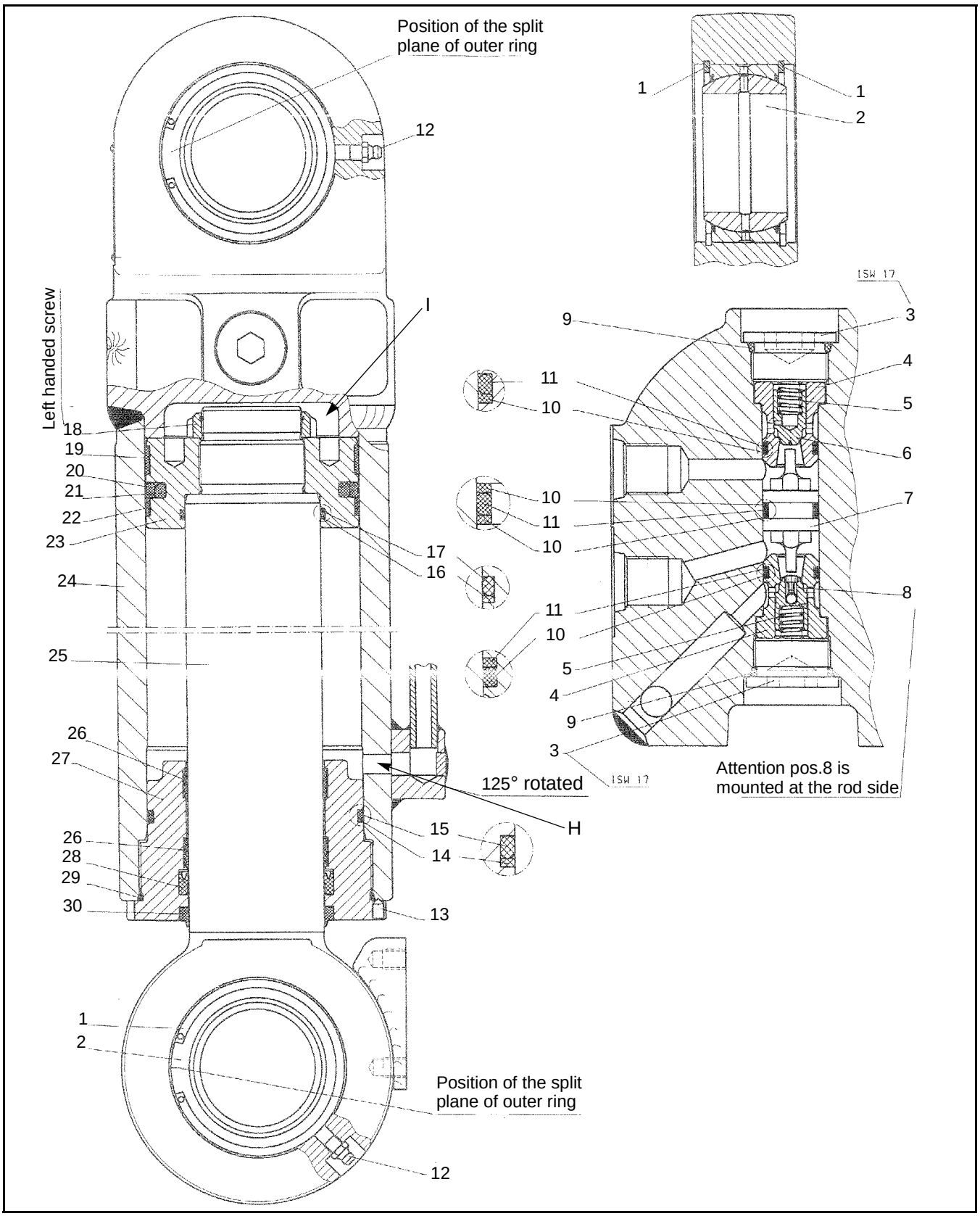
ADJUST CYLINDER



Unit: mm

No.	Check item		Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
-1	Clearance between piston rod and bushing	Cylinder						Replace bushing
		2 piece boom	75	-0.025 -0.076	+0.279 +0.085	0.110 ~ 0.355		
		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	80	-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.

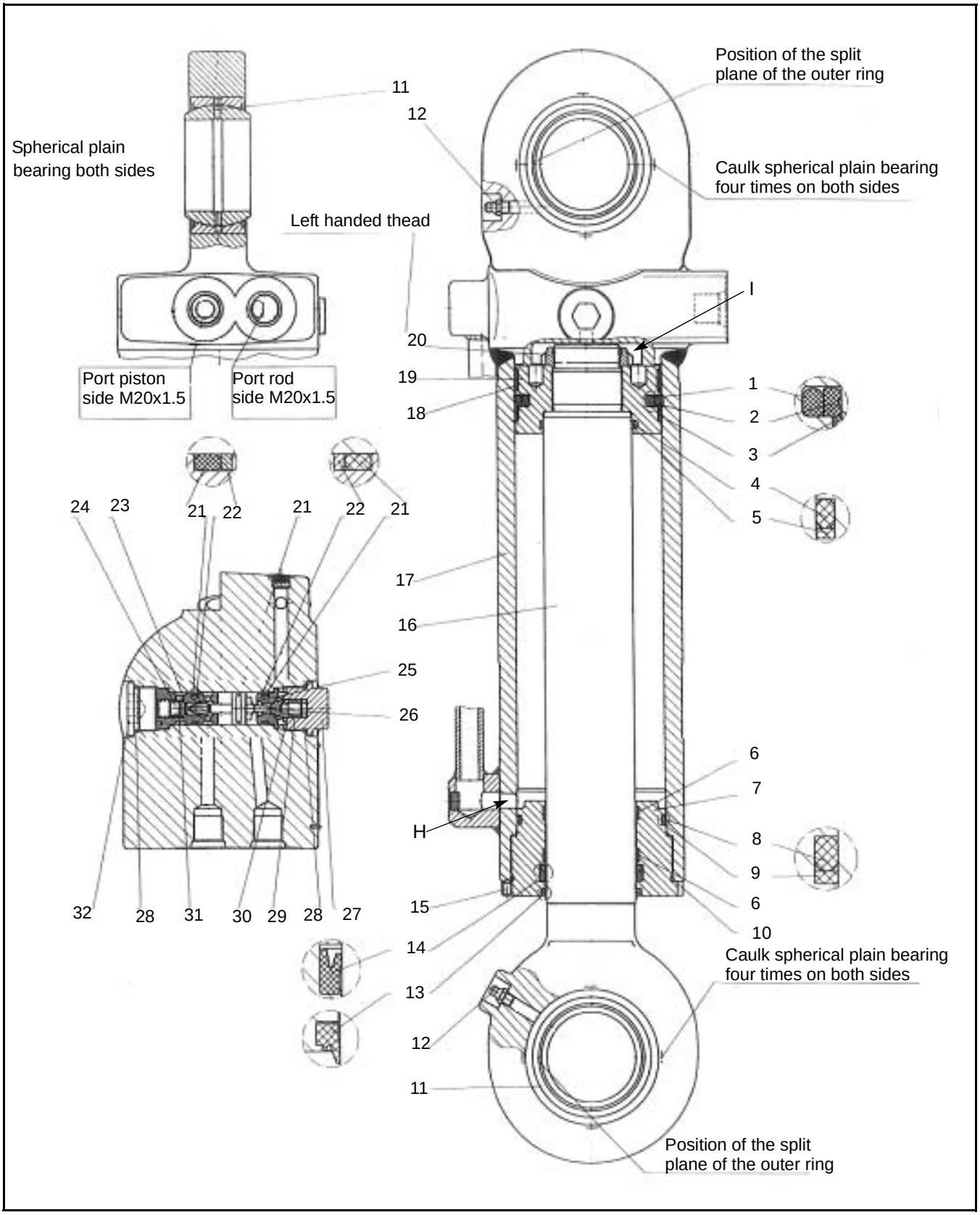
The built in check valve also holds hydraulic pressure within the cylinder when the hydraulic hoses are removed from the cylinder.

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 absolutly 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.

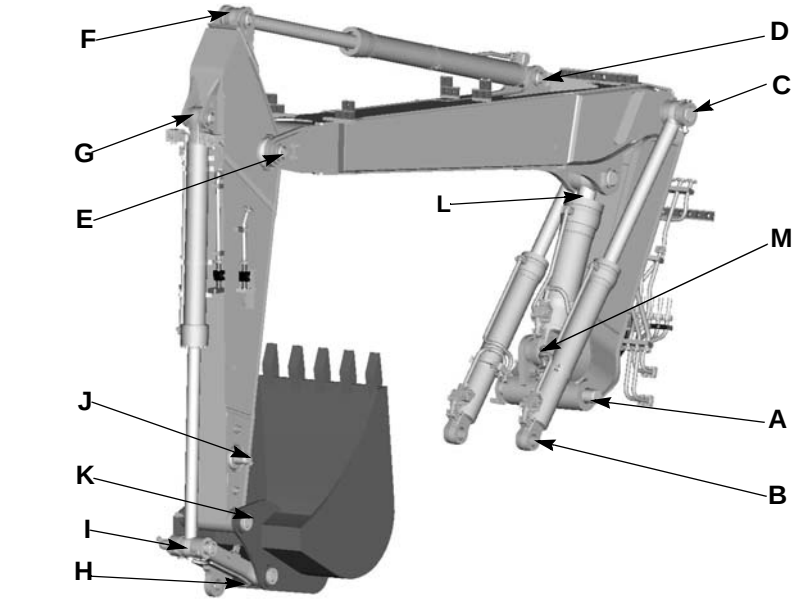
The built in check valve also holds hydraulic pressure within the cylinder when the hydraulic hoses are removed from the cylinder.

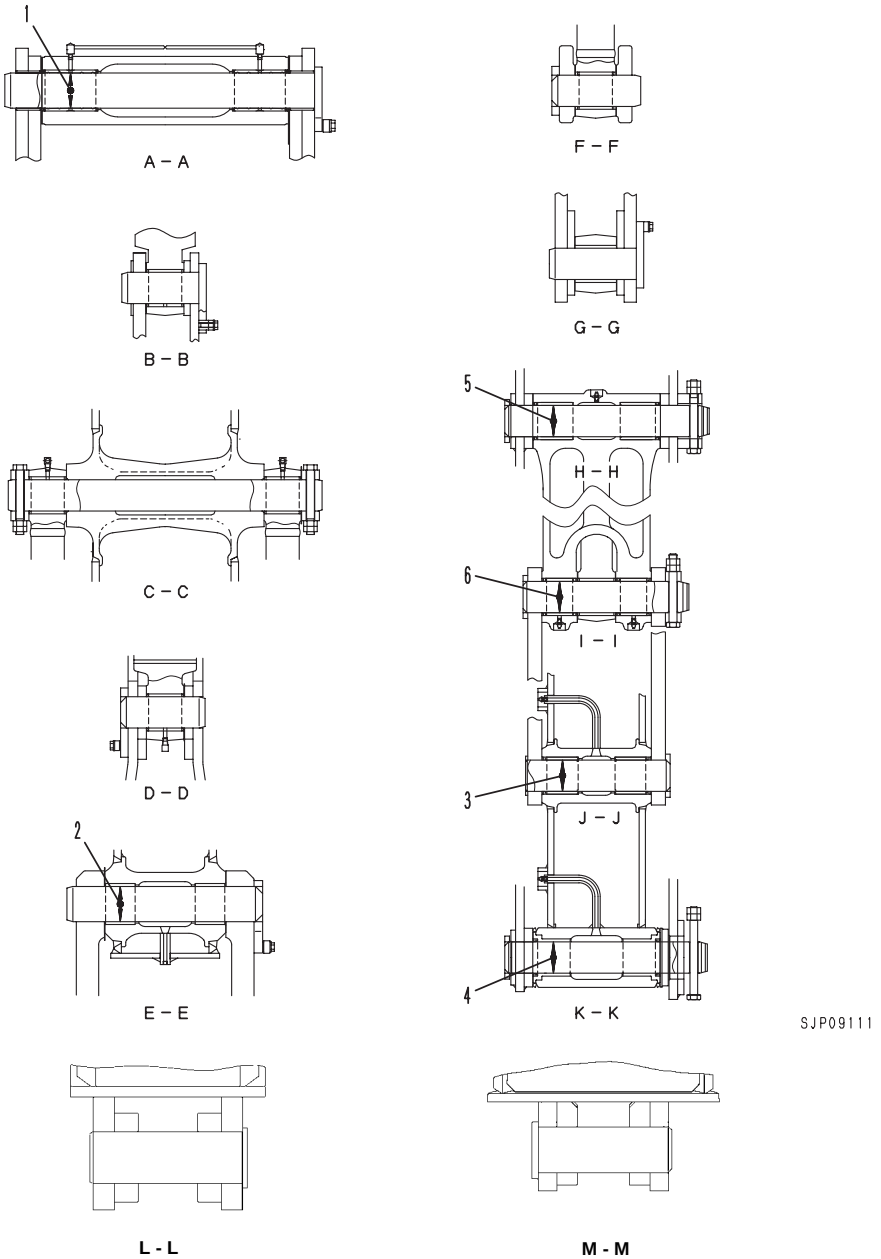
Depressurise the cylinder before opening

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

To be absolutly sure the plug can be completely removed.

WORK EQUIPMENT





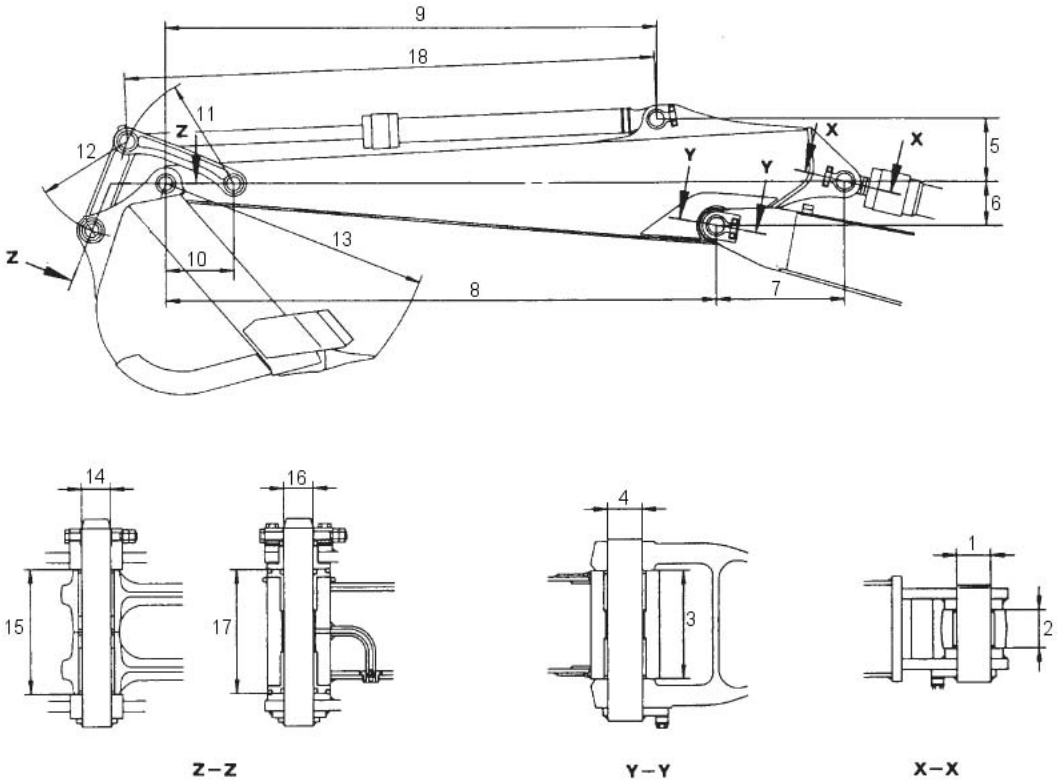
L - L M - M

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	

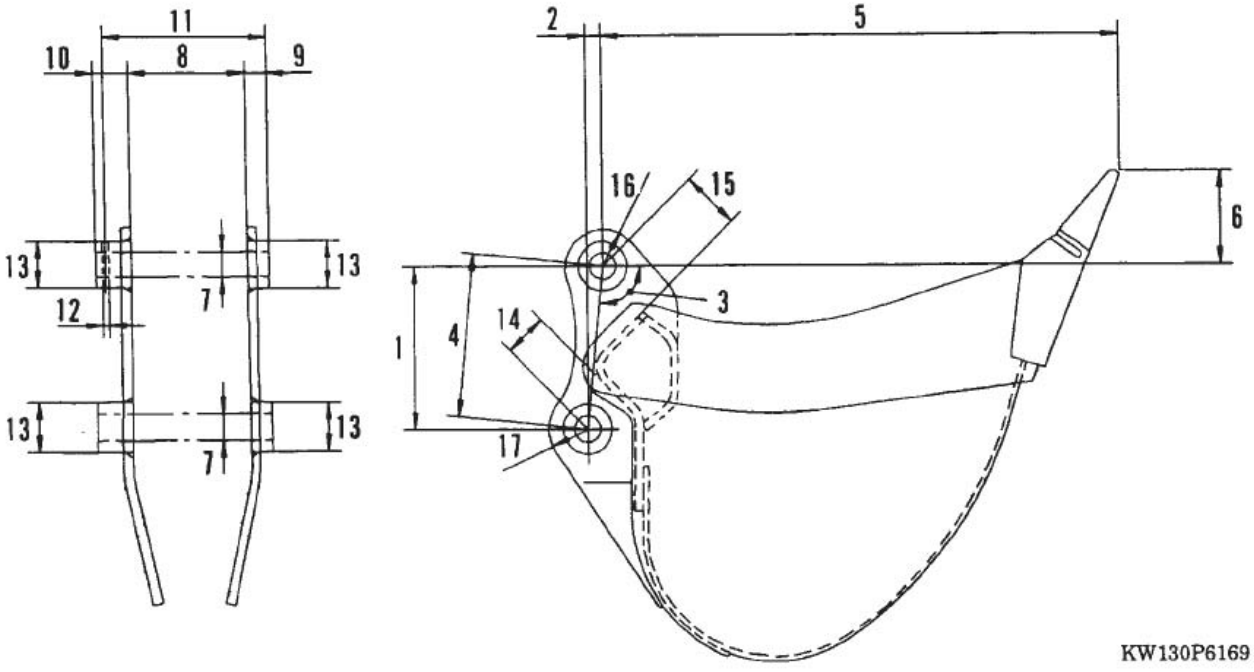
1. DIMENSION OF ARM



Unit: mm

Model No.		PW160-7H 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		

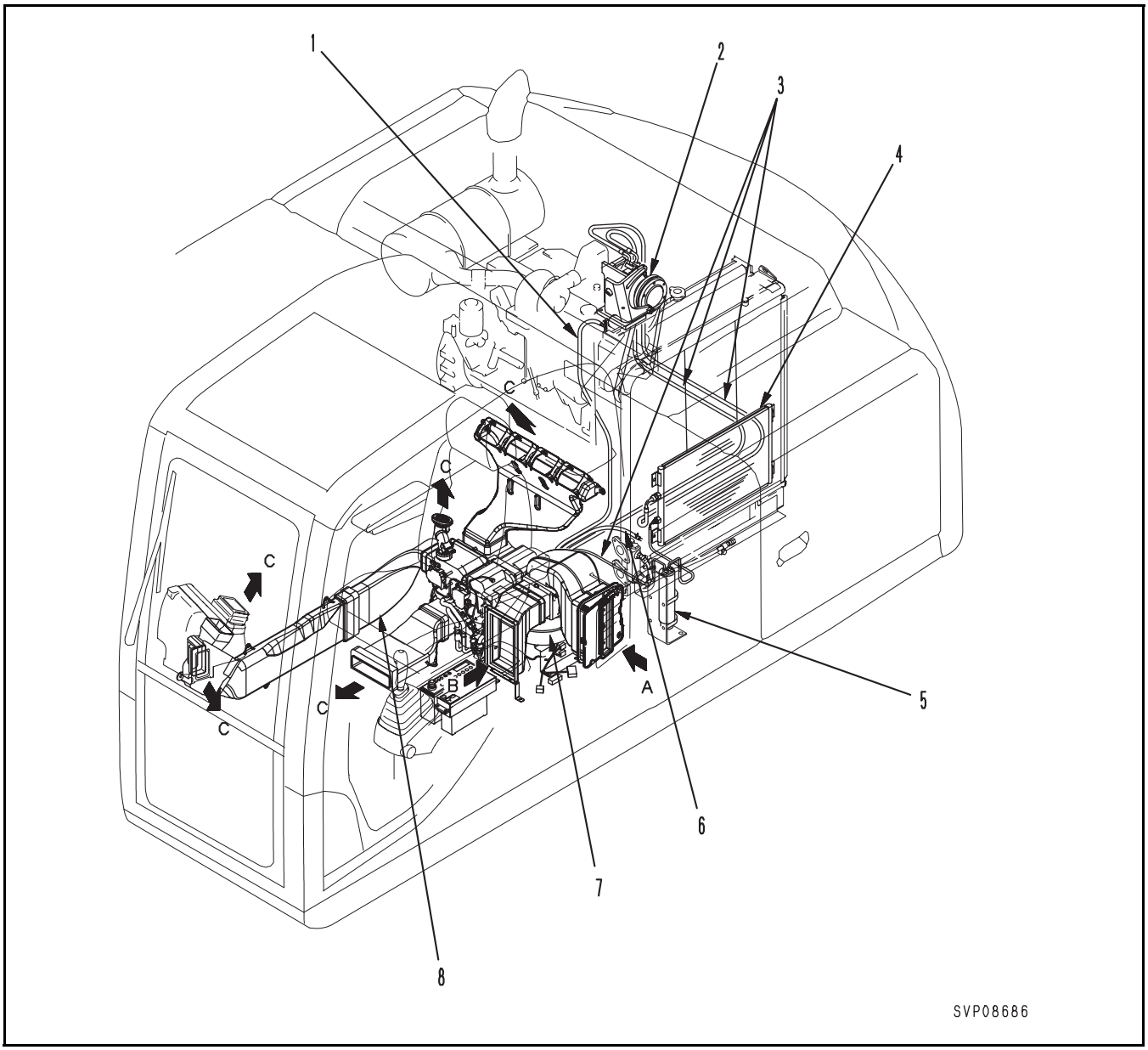
2.DIMENSION OF BUCKET



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



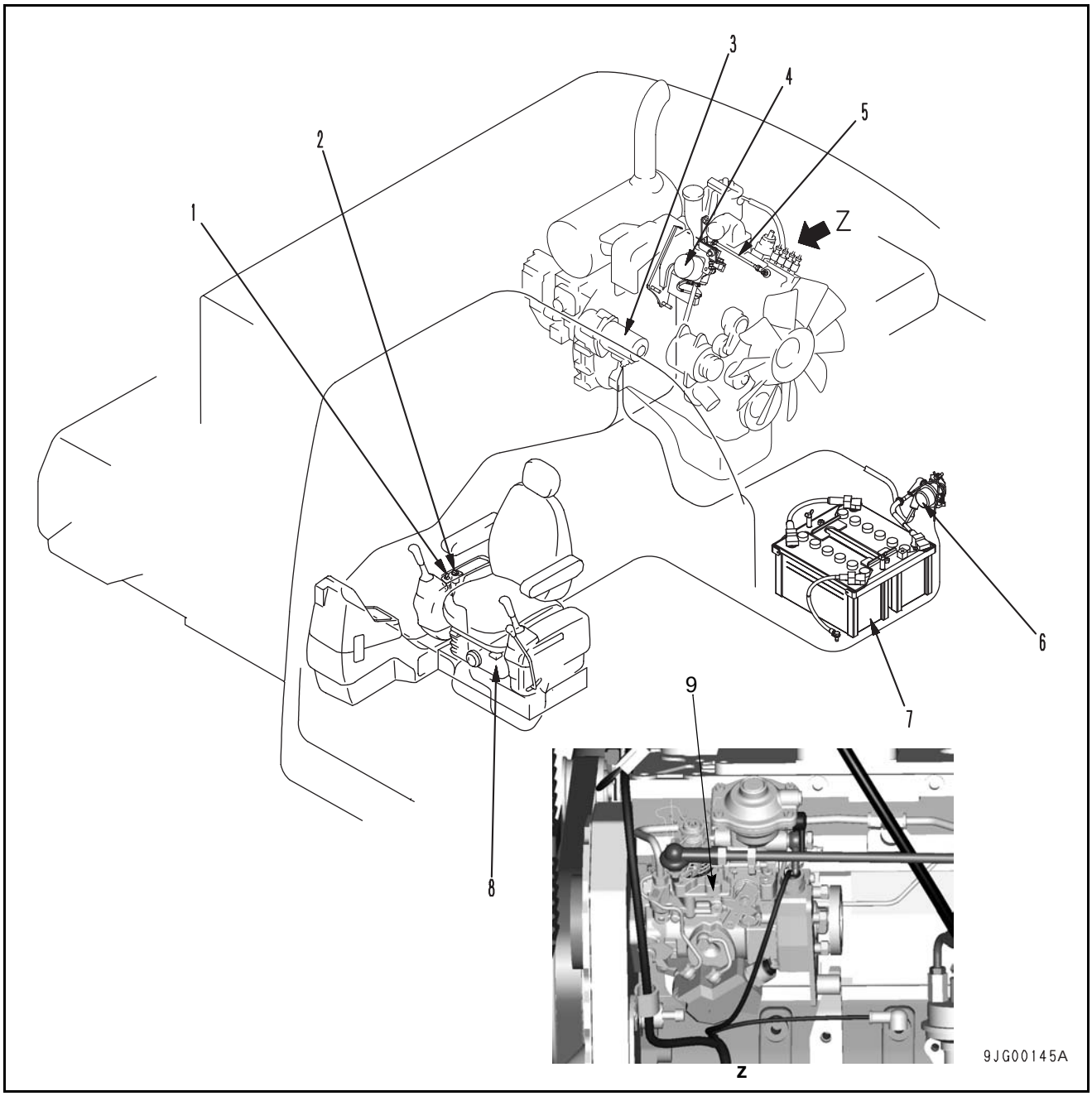
1. Hot water pickup piping
2. Air conditioner compressor
3. Refrigerant piping
4. Condenser
5. Receiver tank
6. Hot water return piping
7. Air conditioner unit
8. Duct

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

ELECTRICAL WIRING DIAGRAM

Please refer to section 90.

ENGINE CONTROL SYSTEM



Z

1. Starting switch
2. Fuel control dial
3. Starting motor
4. Governor motor
5. Linkage
6. Battery relay
7. Battery
8. Engine throttle and pump controller
9. Fuel injection pump

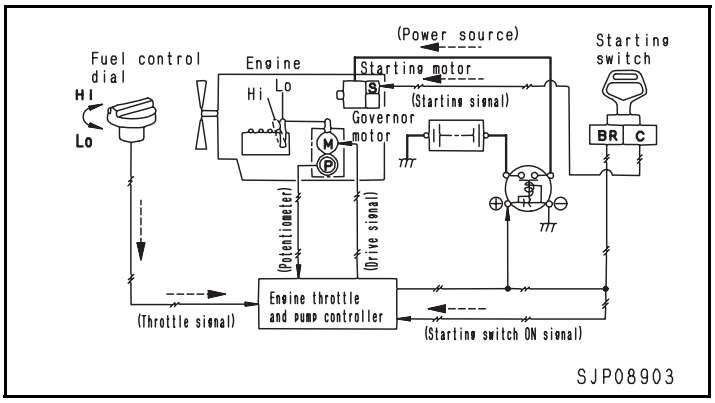
OUTLINE

- The engine can be started and stopped with only starting switch (3).
- The engine throttle and pump controller (7) reveives the signal of fuel control dial (4) and transmits the drive signal to governor motor (9) to control the governor lever angle of fuel injection pump (8) and control the engine speed.

1) OPERATION OF SYSTEM

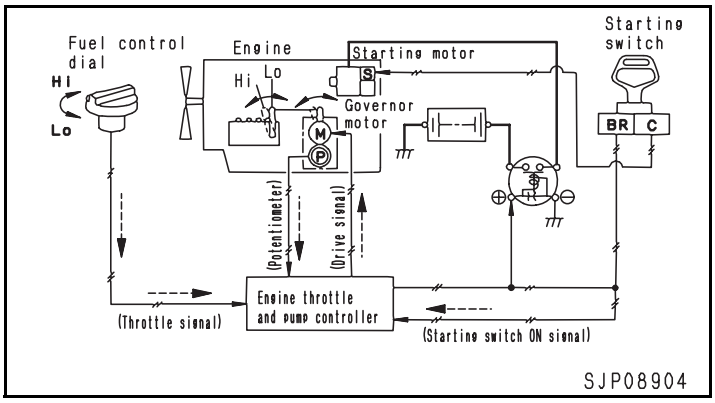
Starting engine

- When the starting switch is turned to the START position, the starting signal flows to the starting motor, and the starting motor turns to start the engine.
  When this happens, the engine throttle and pump controller checks the signal from the fuel control dial and sets the engine speed to the speed set by the fuel control dial.



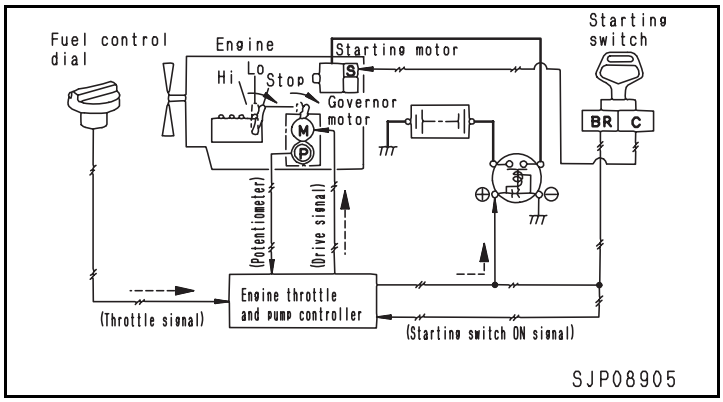
Engine speed control

- The fuel control dial sends a signal to the engine throttle and pump controller according to the position of the dial. The engine throttle and pump controller calculates the angle of the governor motor according to this signal, and sends a signal to drive the governor motor so that it is at that angle.
  When this happens, the operating angle of the governor motor is detected by the potentiometer, and feedback is sent to the engine throttle and pump controller, so that it can observe the operation of the governor motor.



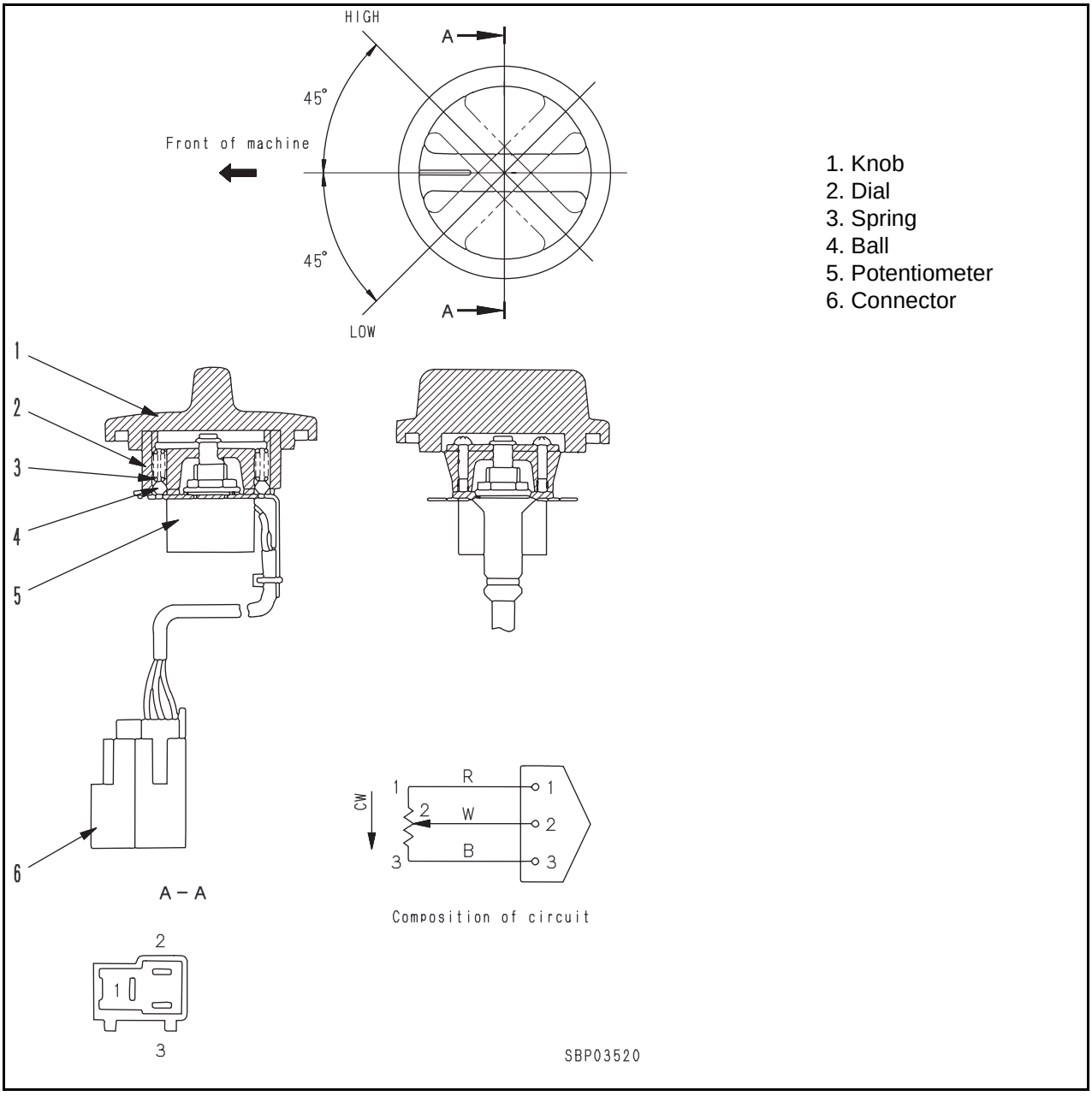
Stopping engine

- When the starting switch is turned to the STOP position, the engine throttle and pump controller drives the governor motor so that the governor lever is set to the NO INJECTION position, and the electrical signal to the fuel shut off solenoid is cancelled
- When this happens, to maintain the electric power in the system until the engine stops completely, the engine throttle and pump controller itself drives the battery relay.



2. COMPONENT

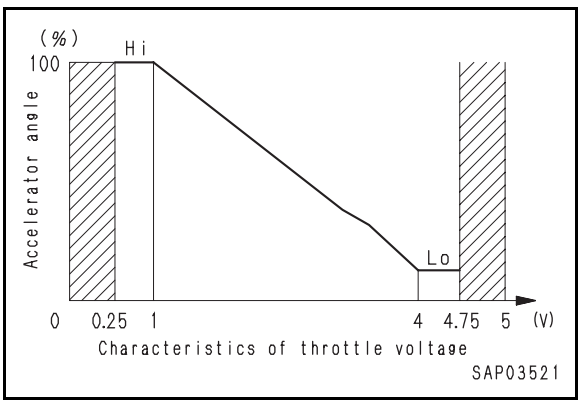
Fuel control dial



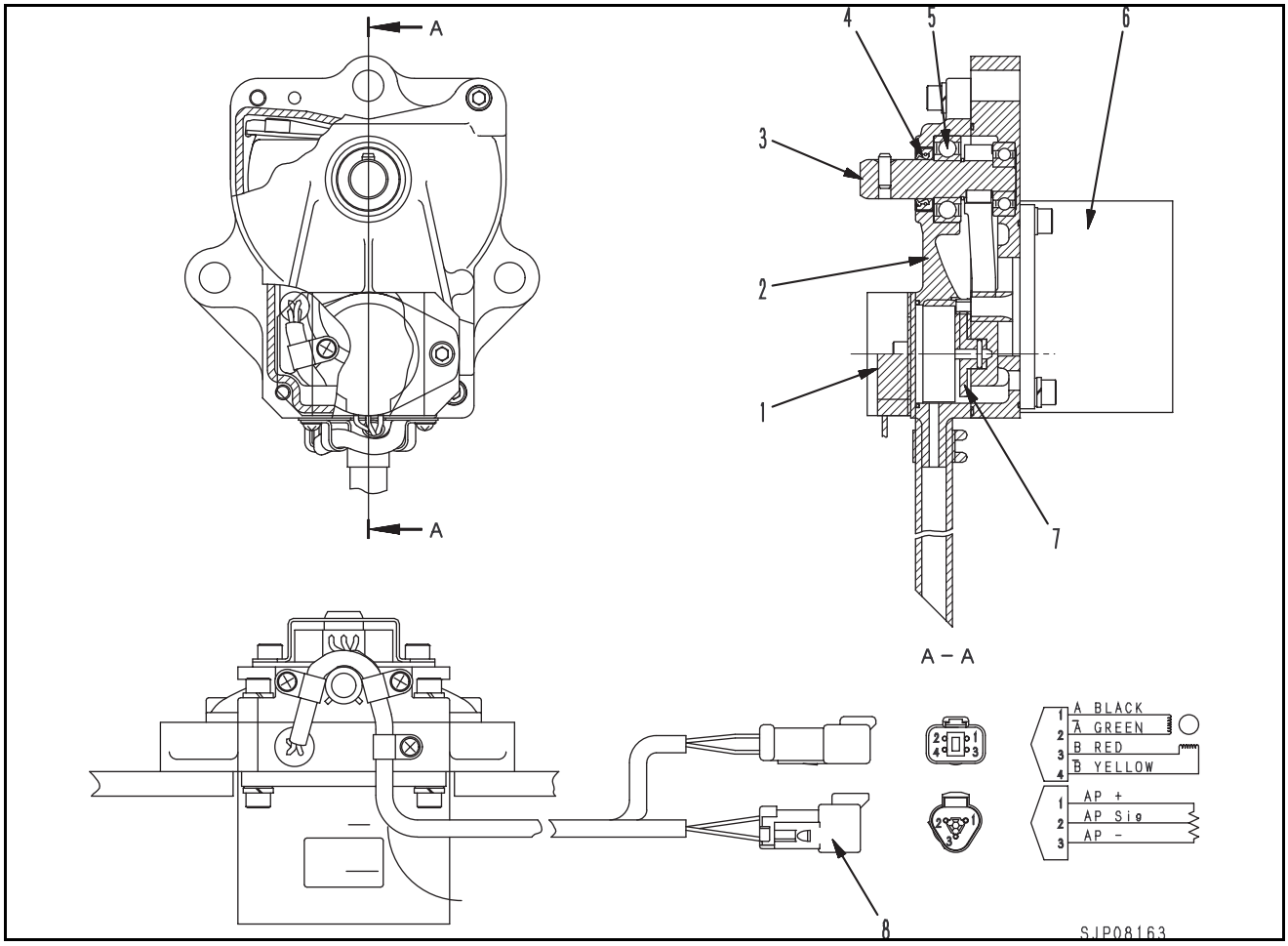
1. Knob
2. Dial
3. Spring
4. Ball
5. Potentiometer
6. Connector

Function

- The fuel control dial is installed near the monitor panel, and a potentiometer 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.



Governor motor



1. Potentiometer
2. Cover
3. Shaft
4. Dust seal
5. Bearing
6. Motor
7. Gear
8. Connector

Function

- The motor is turned according to the drive signal from the engine throttle and pump controller to control the governor lever of the fuel injection pump.
  This motor used as the motive power source is a stepping motor.
- A potentiometer for feedback is installed to monitor the operation of the motor.
- Revolution of the motor is transmitted through the gear to the potentiometer.

Operation

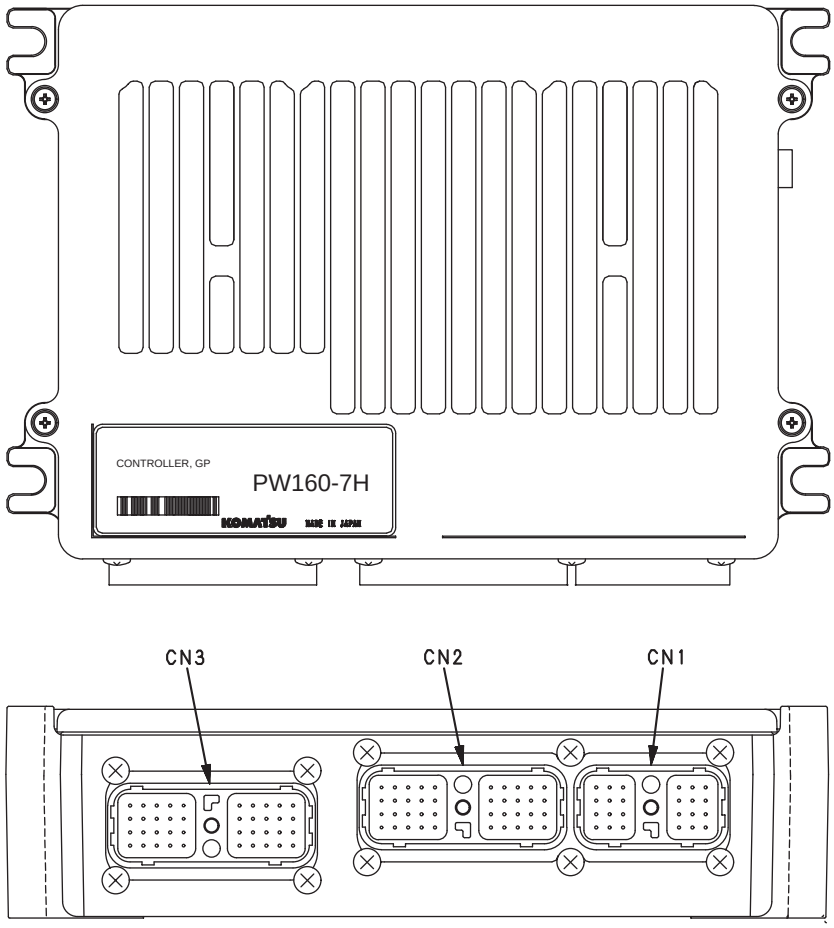
While motor is stopped

- Electric power is applied to both phases A and B of the motor.

While motor is running

- The engine throttle and pump controller supplies a pulse current to phases A and B, and the motor revolves, synchronizing to the pulse.

Engine throttle and pump controller



Input and output signals

CN-1

Pin	Signal name	Input/
1	Travel PPC pressure sensor	Input
2	R pump pressure sensor	Input
3	NC	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	NC	Input
10	Signal GND	
11	Knob SW (power max.)	Input
12	Travel reverse press. switch	Input
13	Throttle actuator feedback signal	Input
14	Angle sensor	Input
15	NC	Input
16	Travel PPC pressure power	Output
17	Start Switch (Terminal C)	Input
18	Clamshell LH	Input
19	Throttle potentiometer	Input
20	NC	Input
21	GND (analog GND)	
22	POT_PWR	Output
23	Start switch (terminal ACC)	Input
24	Clamshell RH	Input

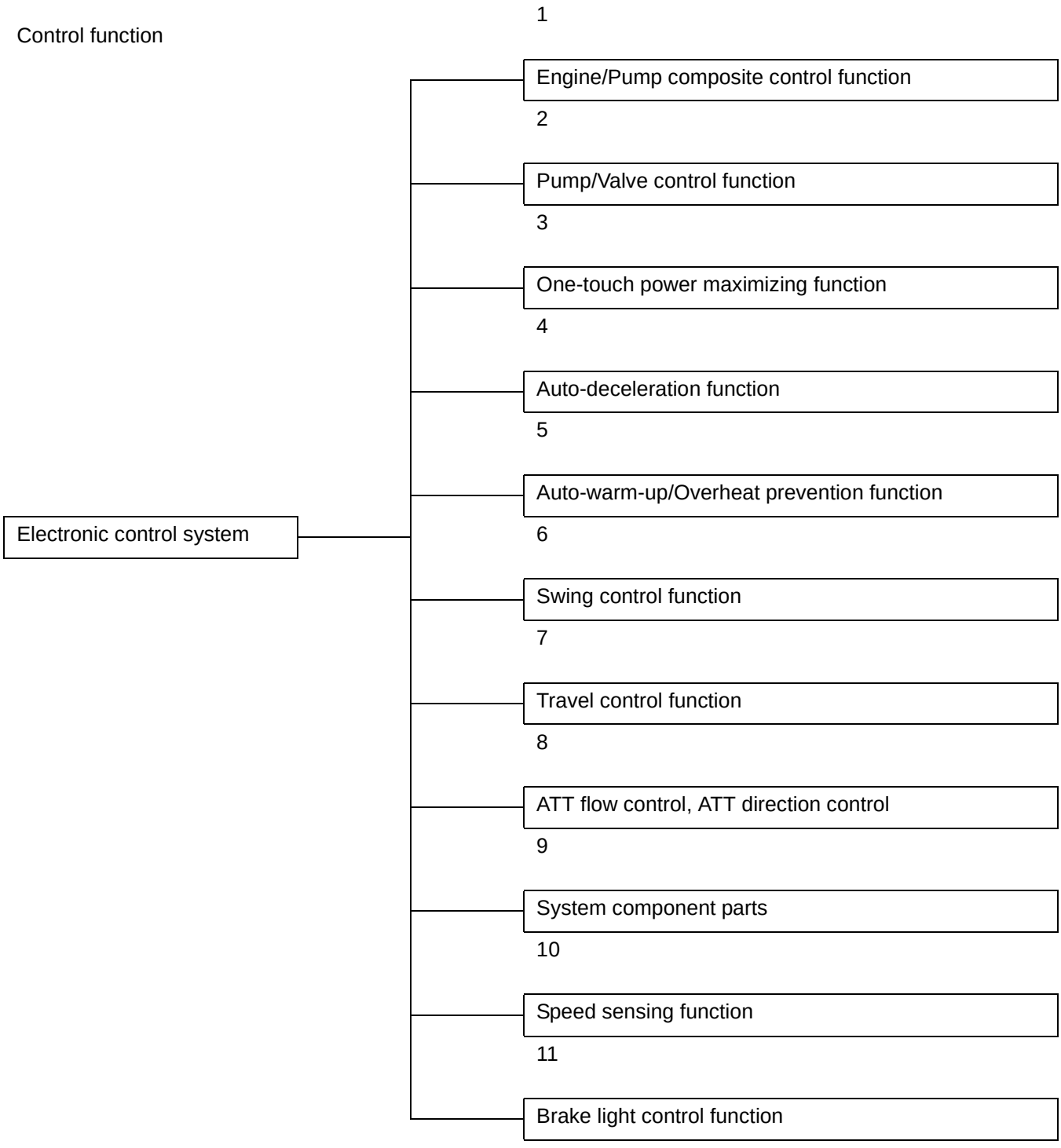
CN-2

Pin	Signal name	Input/
1	NC	Out-
2	Swing emergency switch	Input
3	Brake lock proximity switch	Input
4	232C_RxD	Input
5	Arm dump pressure switch	Input
6	Travel forward pressure switch	Input
7	Model selection 4 switch	Input
8	Brake light cut relay	Out-
9	PPC lock (relay)	Out-
10	NC	Input
11	NC	Out-
12	CAN shield	
13	Model selection 5	Input
14	232C_TxD	Out-put
15	Arm DIG switch	Input
16	Swing pressure switch	Input
17	Model selection 3	Input
18	Clamshell solenoid relay	Out-
19	Suspension lock relay	Out-
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	Engine speed sensor	Input

CN-3

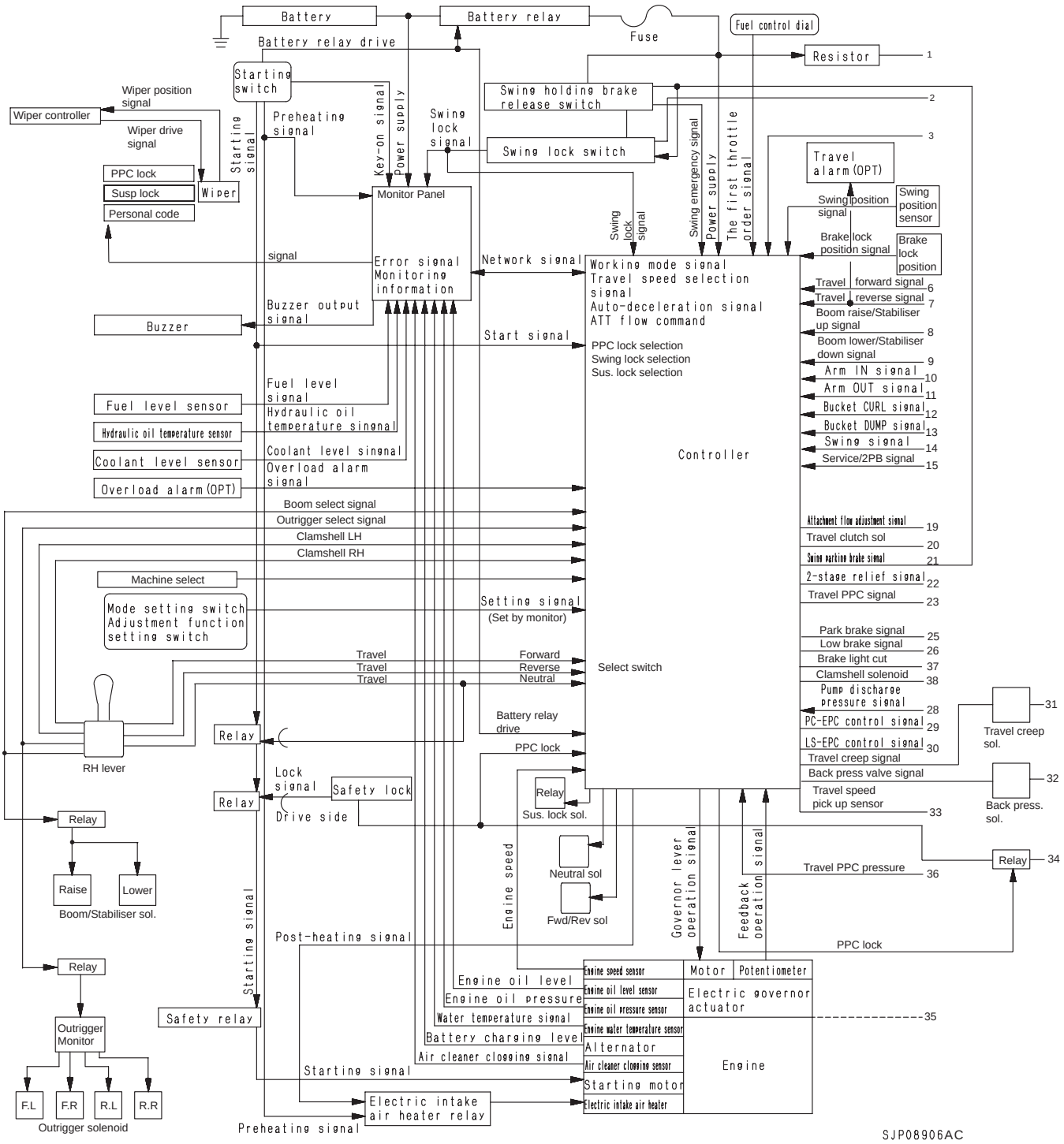
Pin	Signal name	Input/
1	VB (controller power)	Input
2	VIS (solenoid power)	Input
3	SOL_COM (solenoid common	
4	Battery relay drive signal	Output
5	Governor motor A (+)	Output
6	LS-EPC solenoid	Output
7	Merge/Flow divider solenoid	Output
8	2 stage relief solenoid	Output
9	Outrigger select switch	Input
10	Travel direction F switch	Input
11	VB (controller power)	Input
12	VIS (solenoid power)	Input
13	SOL_COM (solenoid common	
14	KEY signal	Input
15	Governor motor A (-)	Output
16	PC-EPC solenoid	Output
17	Creep solenoid	Output
18	Heater relay drive	Output
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 common gnd)	
24	KEY signal	Input
25	Governor motor B (+)	Output
26	Service flow control EPC (2)	Output
27	Transmission clutch solenoid	Output
28	Travel FR solenoid	Output
29	PPC lock (IN)	Input
30	Travel direction R switch	Input
31	GND (controller GND)	
32	GND (controller GND)	
33	GND (controller GND)	
34	NC	
35	Governor motor B (-)	Output
36	2 stage back pressure solenoid	Output
37	Swing brake solenoid	Output
38	Travel N solenoid	Output
39	Low brake pressure switch	Input
40	Boom select switch	Input

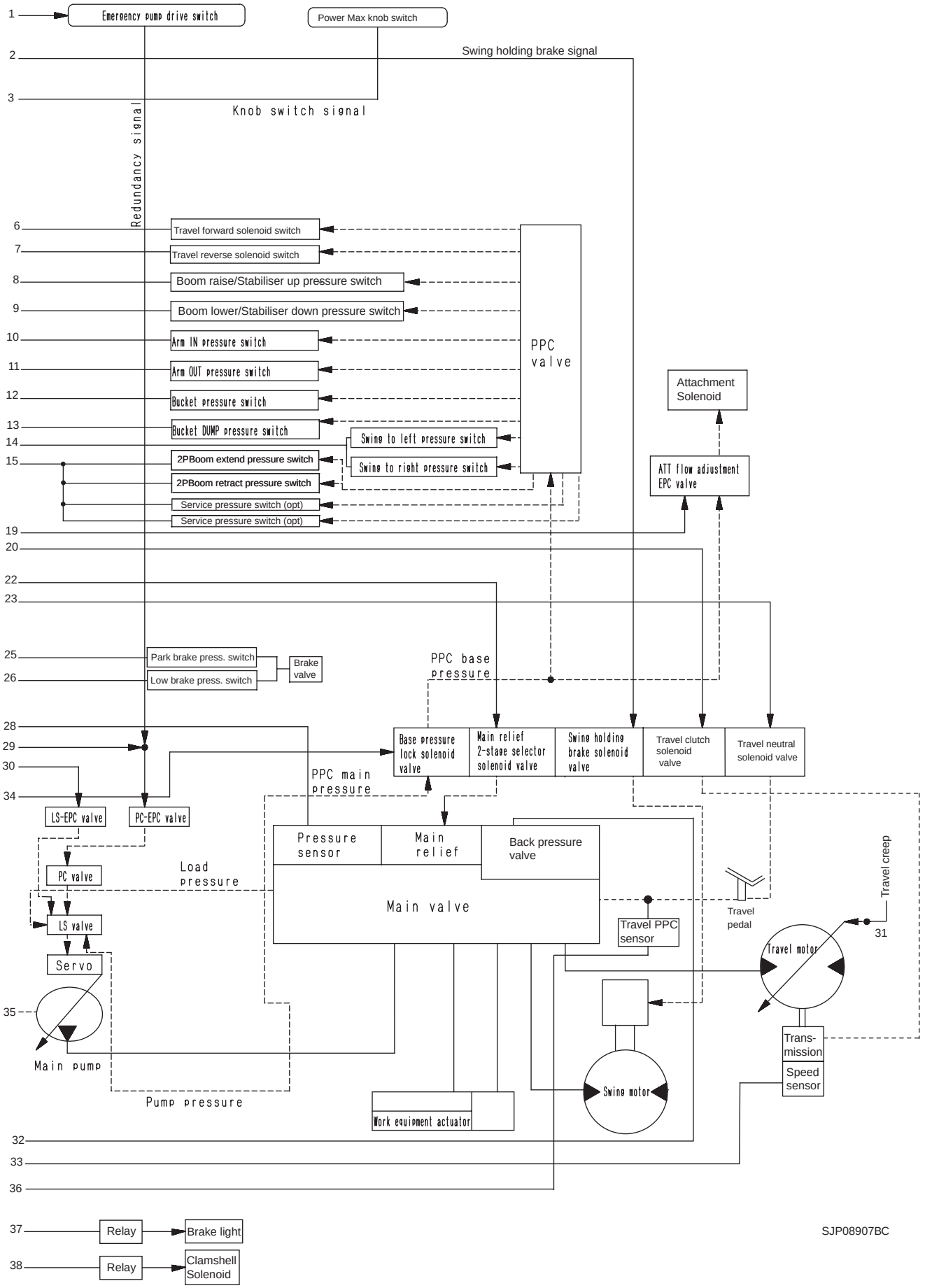
ELECTRONIC CONTROL SYSTEM



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

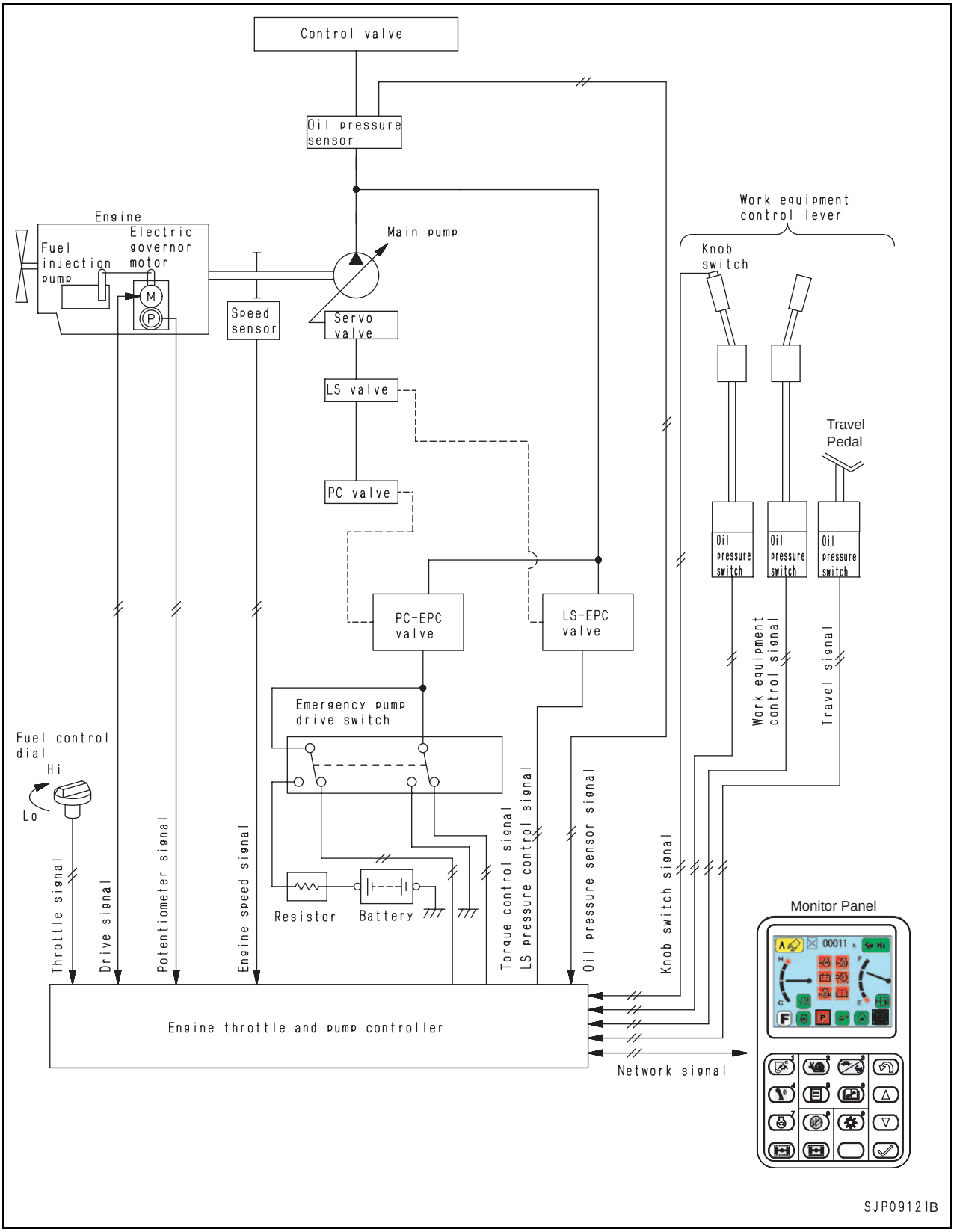
MACHINE CONTROL SYSTEM DIAGRAM




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
LS valve
Servo
Travel PPC sensor
Travel pedal
Travel creep
31
Travel motor
35
Main pump
Pump pressure
Work equipment actuator
Swing motor
Trans-mission
Speed sensor
32
33
36
37
Relay
Brake light
38
Relay
Clamshell Solenoid

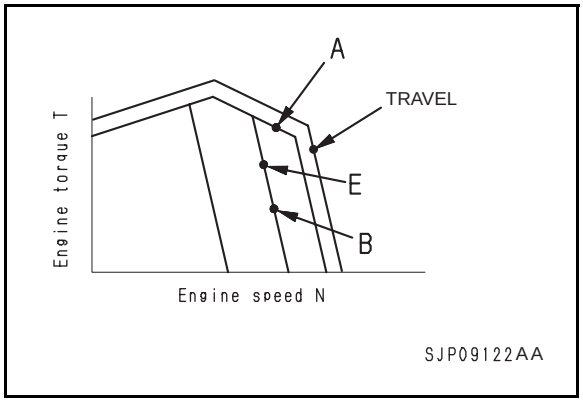
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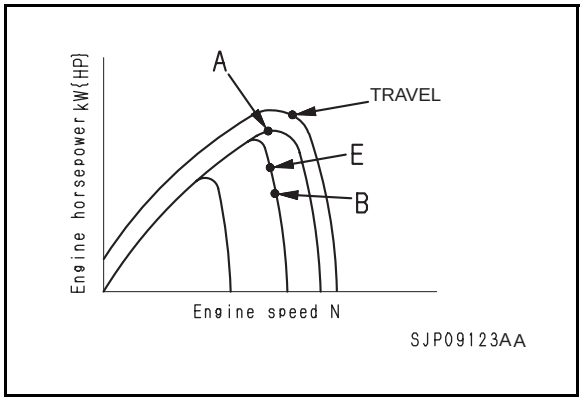
1. Engine and Pump control function

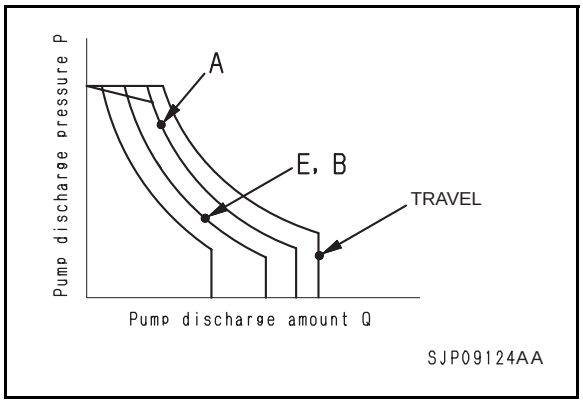


FUNCTION

- 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.







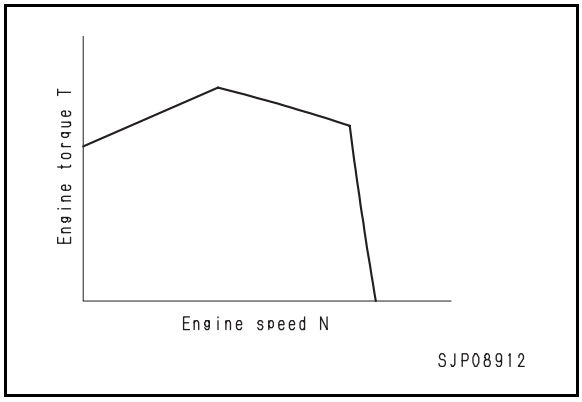
1) Control method in each mode

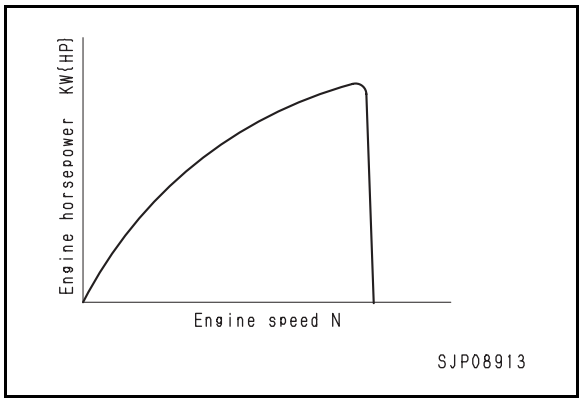
Mode A

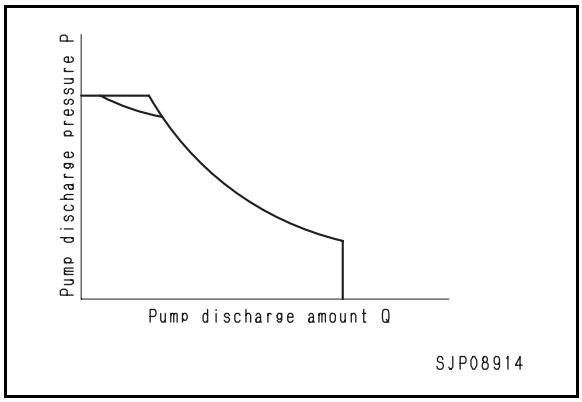
- Matching point in mode A: Rated speed

Model	PW160-7H
Mode A 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.



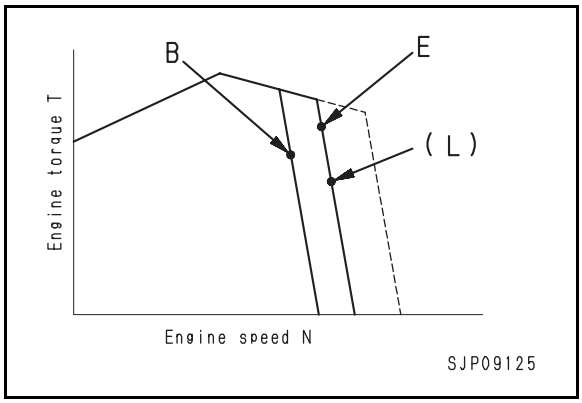




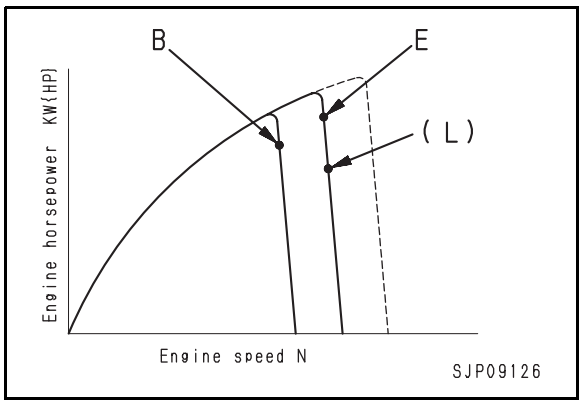
Mode E / Mode B / Mode L

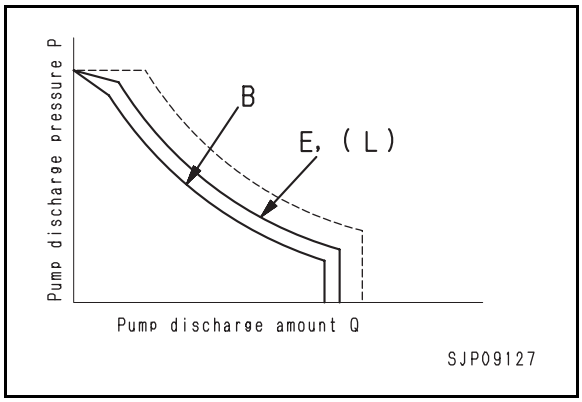
Mode	Digging	Breaker	Finishing
Partial output point	85%	75%	70%

Mode	PW160-7H
Mode E	2,010 RPM
Mode B	2,040 RPM
Mode L	1,830 RPM

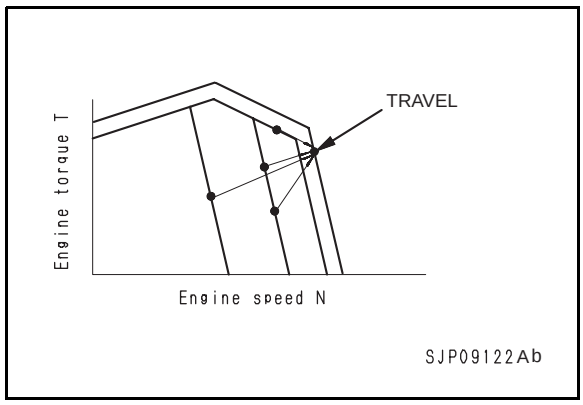


- At this time, the controller keeps the pump absorption torque along the constant horsepower curve and lower the engine speed by the composite control of the engine and pump.
  By this method, the engine is used in the low fuel consumption area.



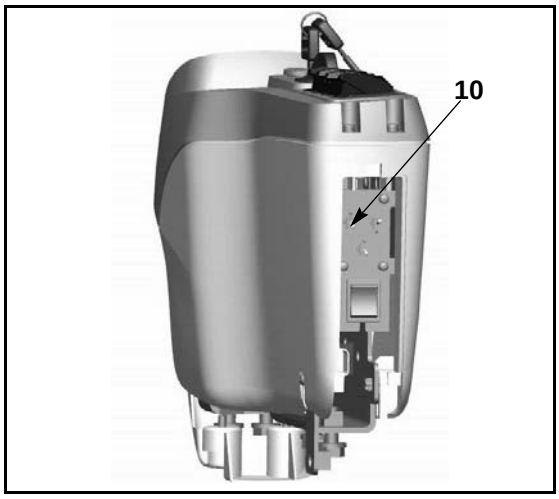


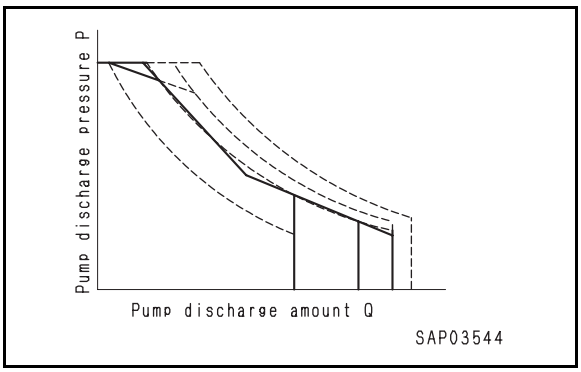
- When travel is activated in each mode matching point changes to travel matching point.



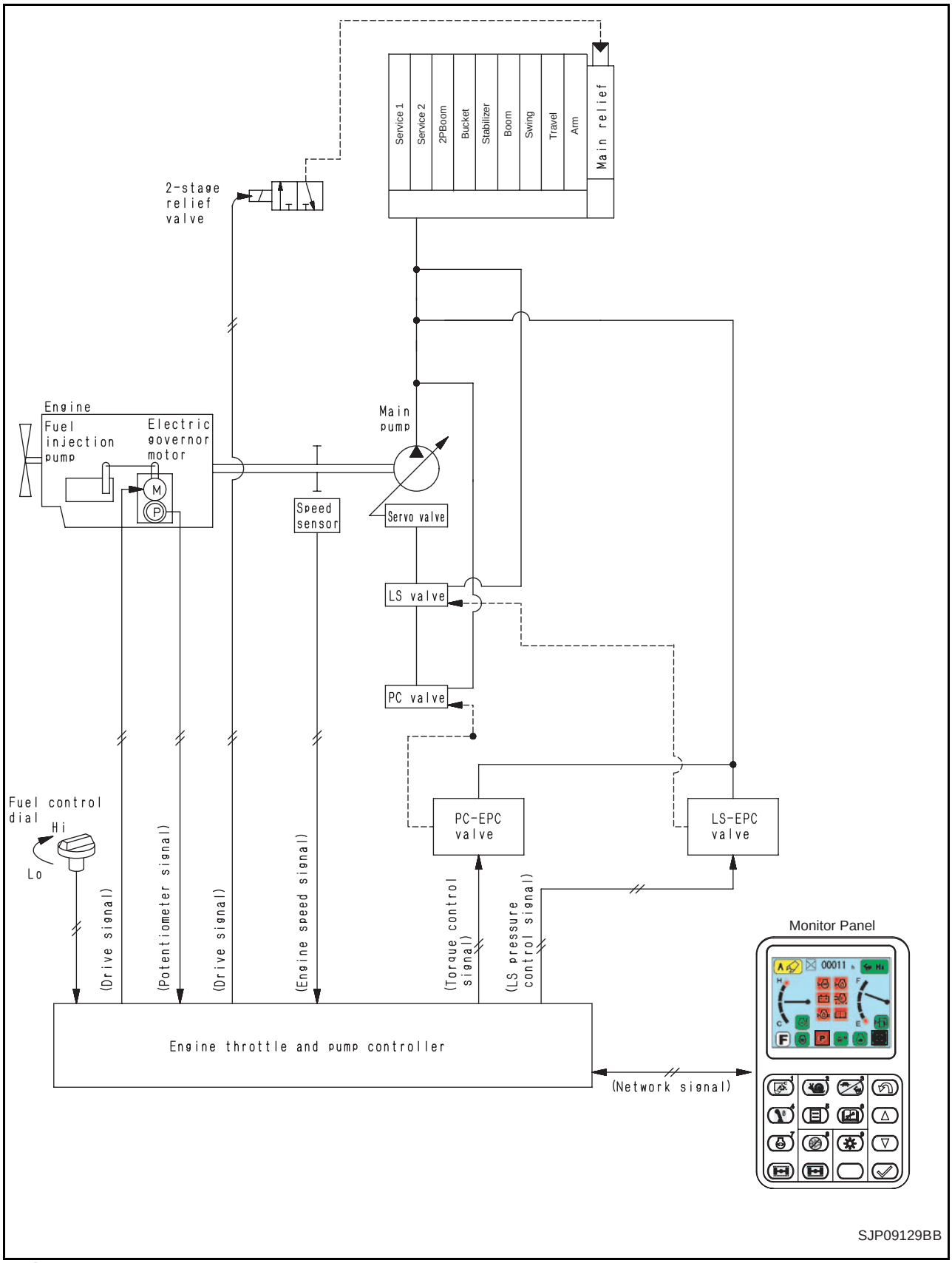
2. Function to control when emergency pump drive switch is turned ON

- 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

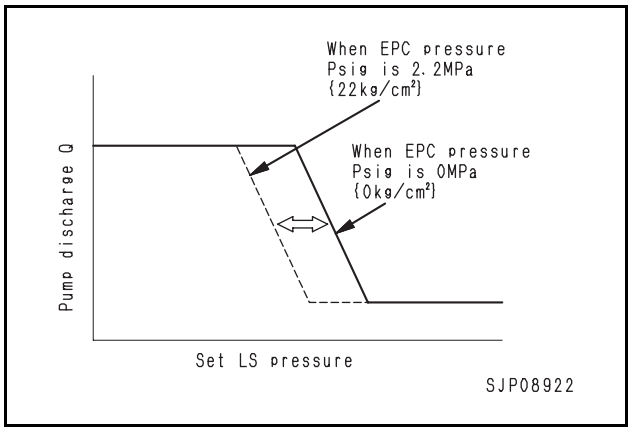
The cut-off function does not work, however, while the machine is travelling in mode A .

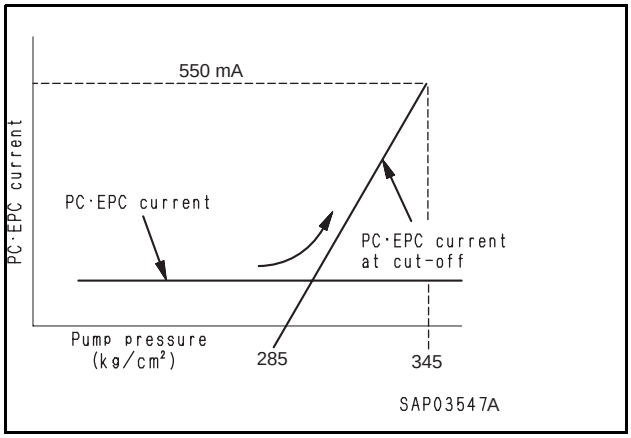
3. 2-stage relief function

- 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}.

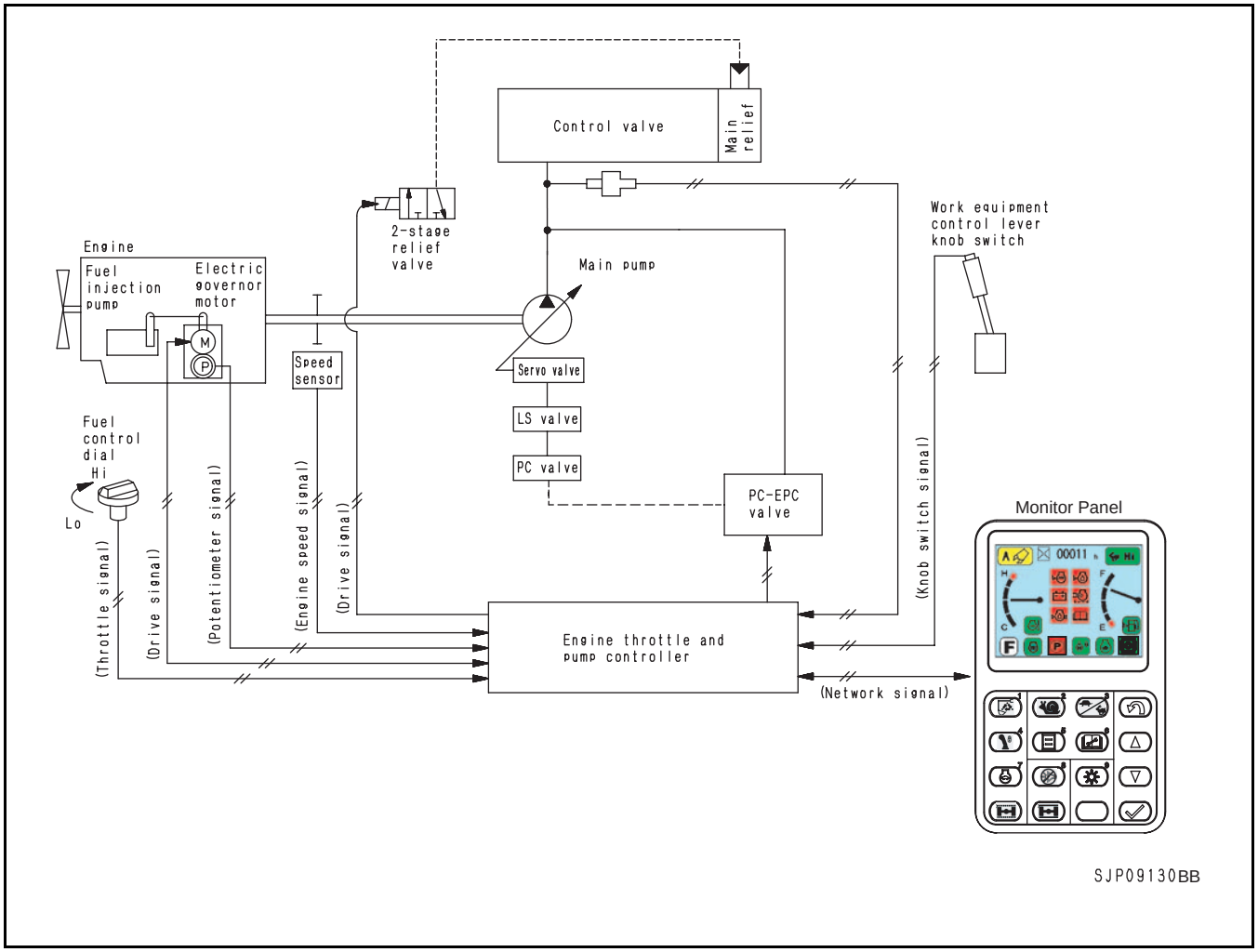
  By this operation, the hydraulic force is increased further.
- Operating condition for turning on 2-stage relief function

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

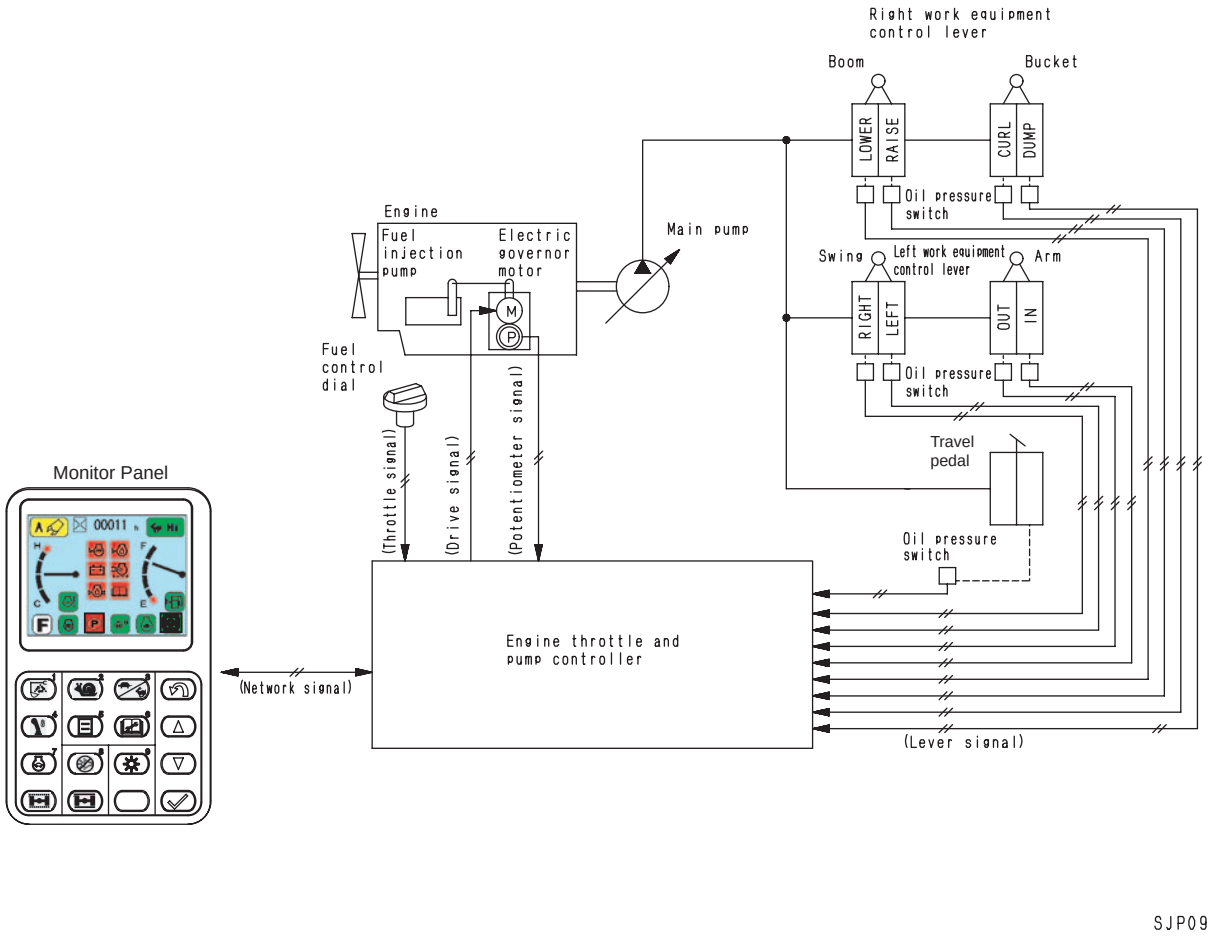
- When the operator needs more digging force to dig up a large rock, etc., if the left knob switch is pressed, the hydraulic force is increased about 7% to increase the digging force.
- If the left knob switch is turned on in working mode "A" or "E", each function is set automatically as shown below.

⇓

Software cut-off function

Working mode	Engine/Pump control	2-stage relief function	Operation time	
A, 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.

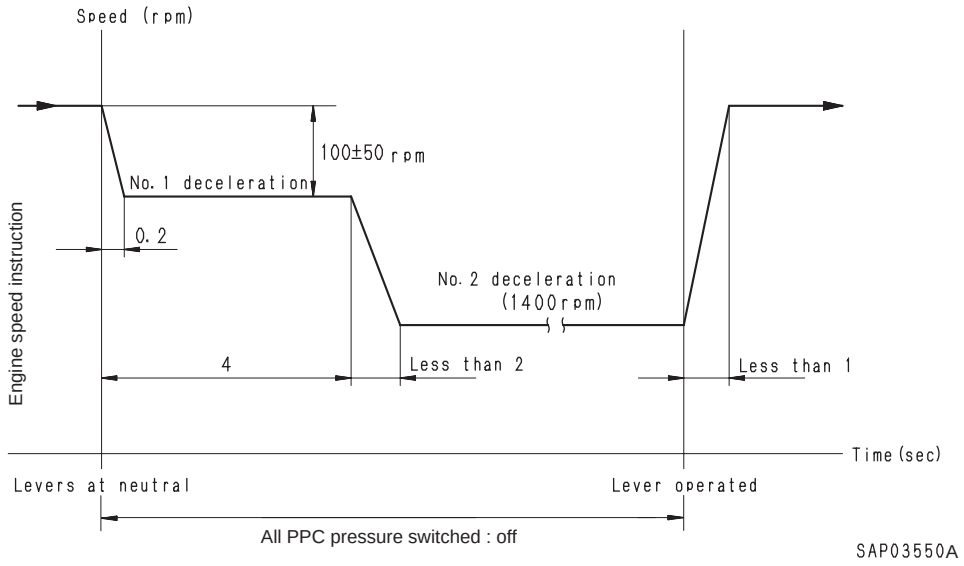
OPERATION

WHEN CONTROL LEVERS ARE SET IN NEUTRAL

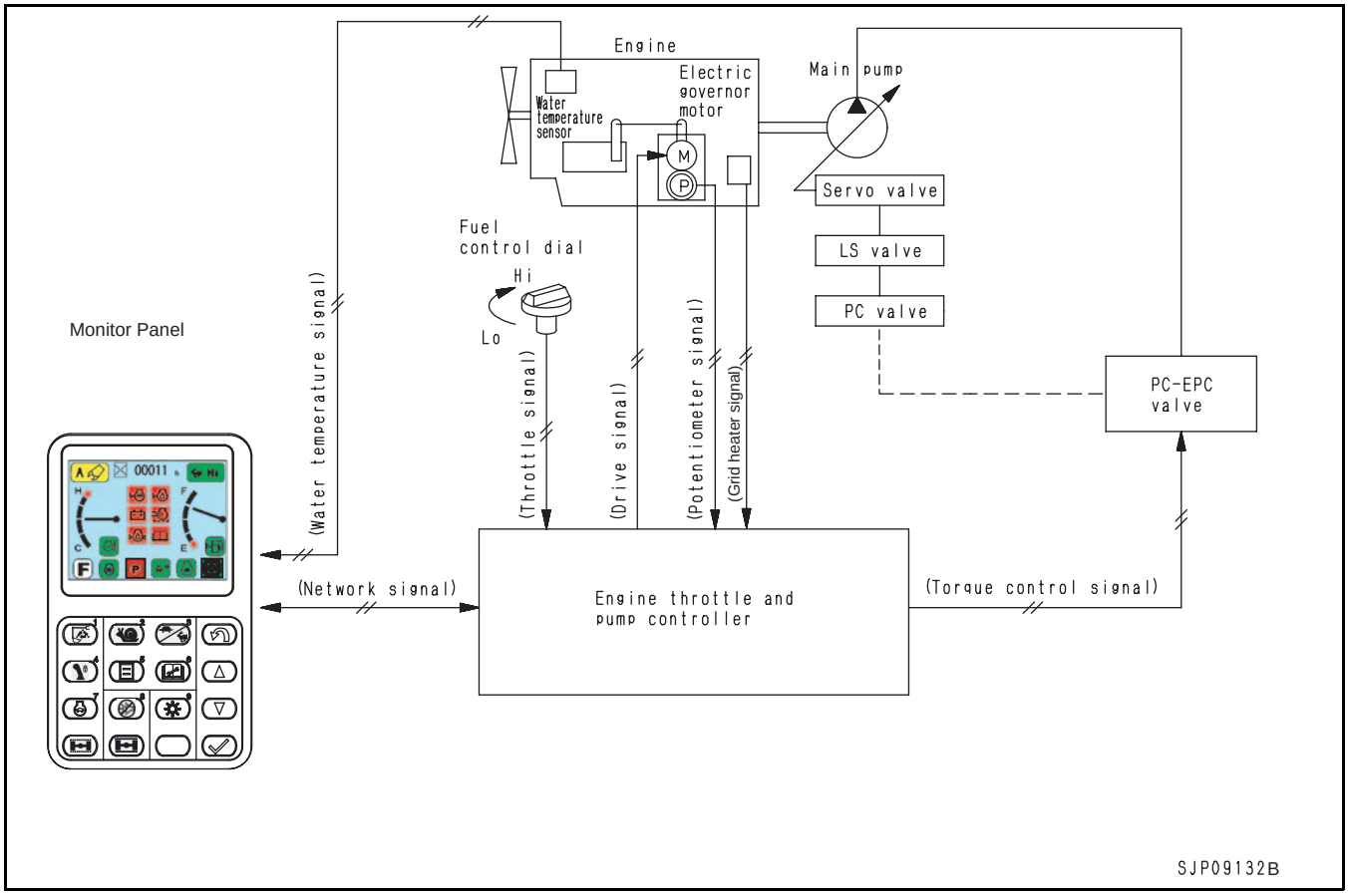
- If all the control levers are set in NEUTRAL while the engine speed is above the decelerator operation level (about 1,400 rpm), the engine speed lowers instantly to the first deceleration level about 100 rpm lower than the set speed.
- If 4 more seconds pass, the engine speed lowers to the second deceleration 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)	⇒	Operated
Water temperature: Below 30°C. Engine speed: Max. 1,200 rpm		Engine speed: Max. 1,200 rpm

⇓

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

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.

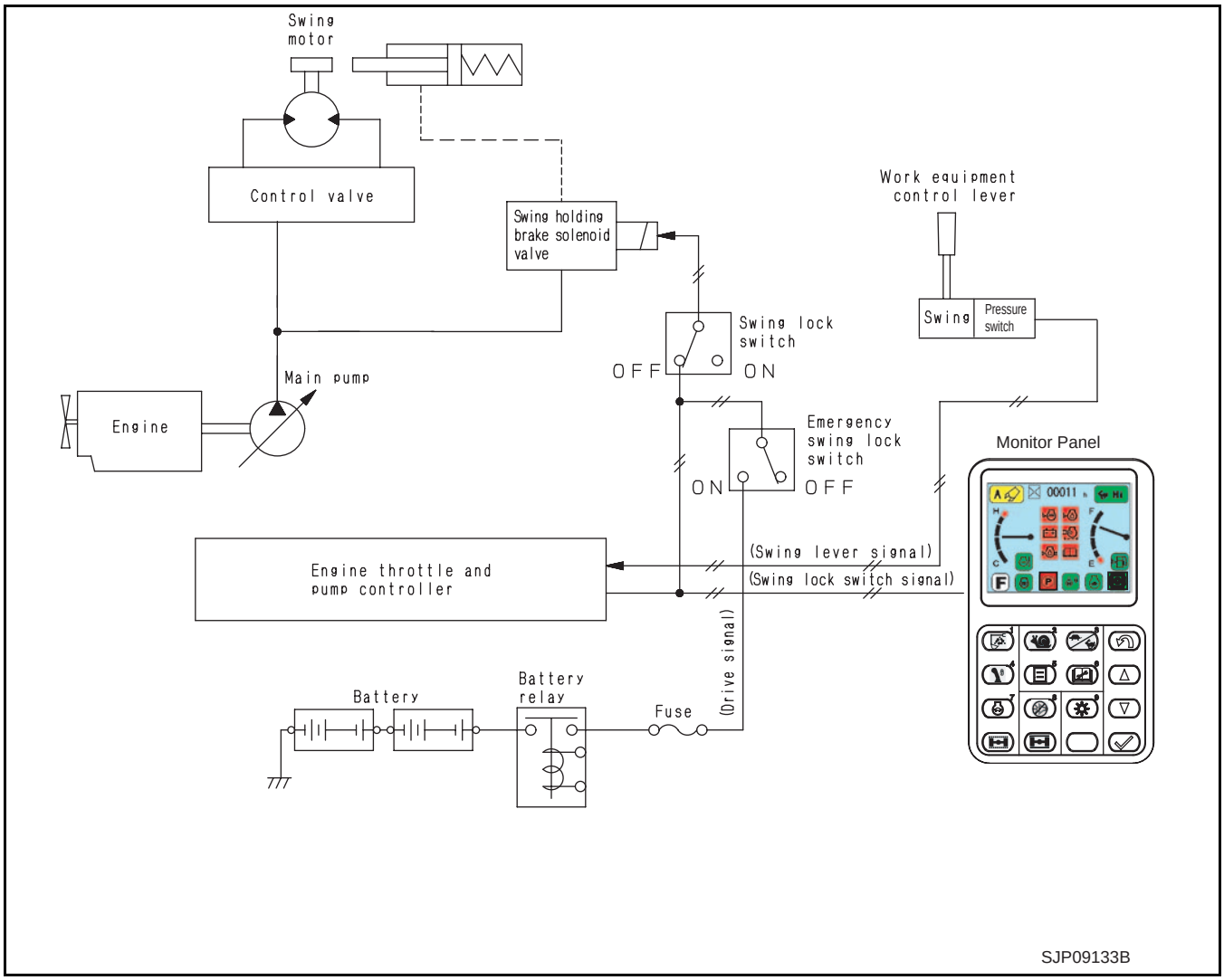
Operating condition	⇒	Operation/Remedy	⇒	Resetting condition
Water temperature: Above 105°C		Work mode: Any mode Engine speed: Low idle Monitor alarm lamp: Lights up Alarm buzzer: Sounds		Water temperature: Below 105°C Fuel control dial: Return to low idle position once. • Under above condition, controller 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

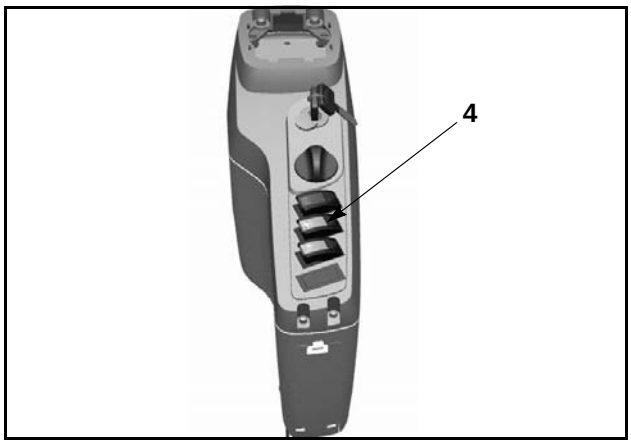
Lock switch	Lock lamp	Function	Operation
OFF	OFF	Swing holding brake	If swing lever is set in neutral, swing brake operates in about 5 sec. If swing lever is operated, brake is released and machine can swing freely.
ON	ON	Swing lock	Swing lock operates and machine is locked from swinging. Even if swing 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.

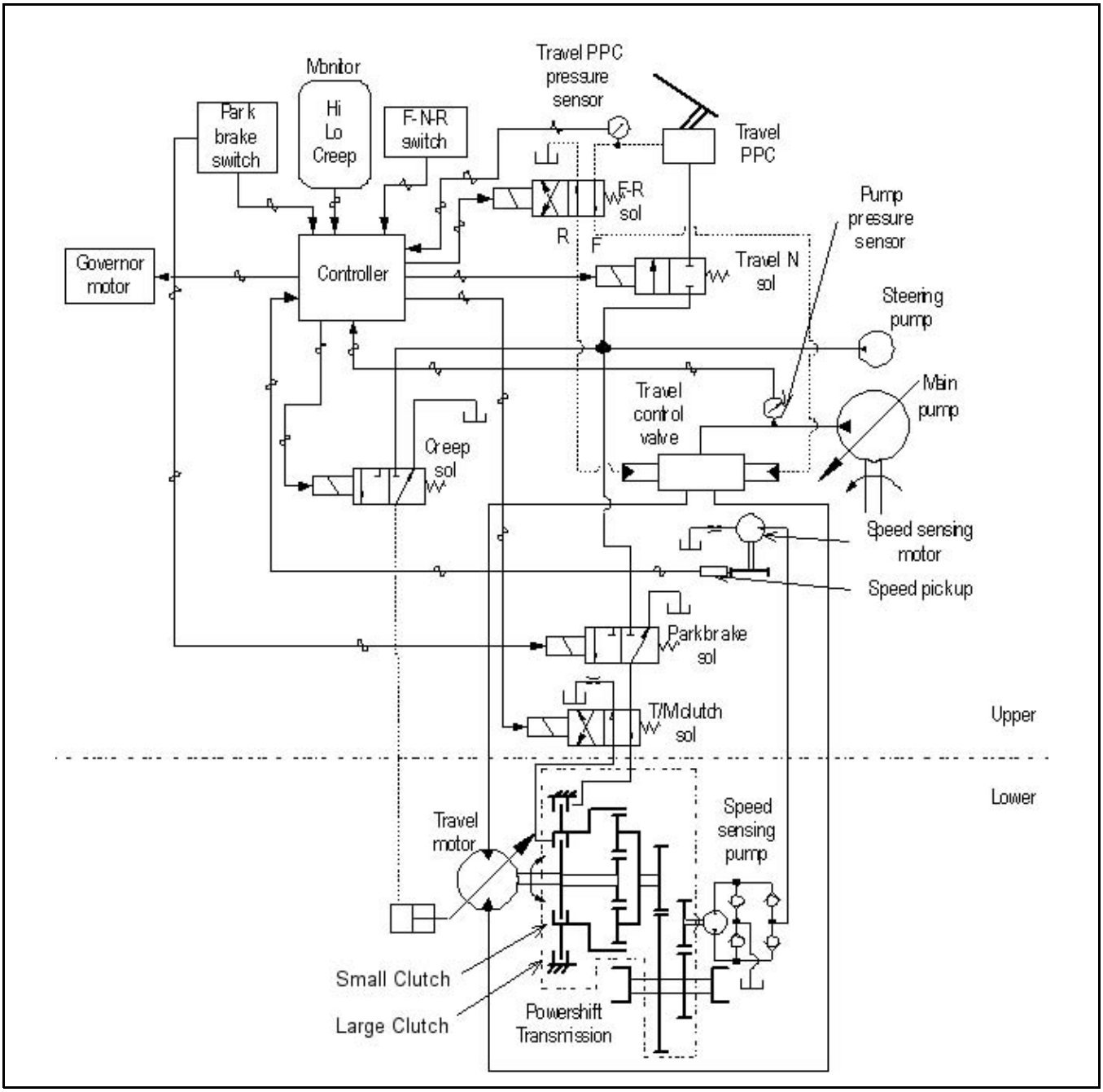
- Even if the swing holding brake release switch is turned on, if the swing lock switch is turned on, the swing brake is not released.
- If the swing lock is reset, swinging is stopped by only the hydraulic brake of the safety valve. Accordingly, if swinging is stopped on a slope, the upper structure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

★ 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)..

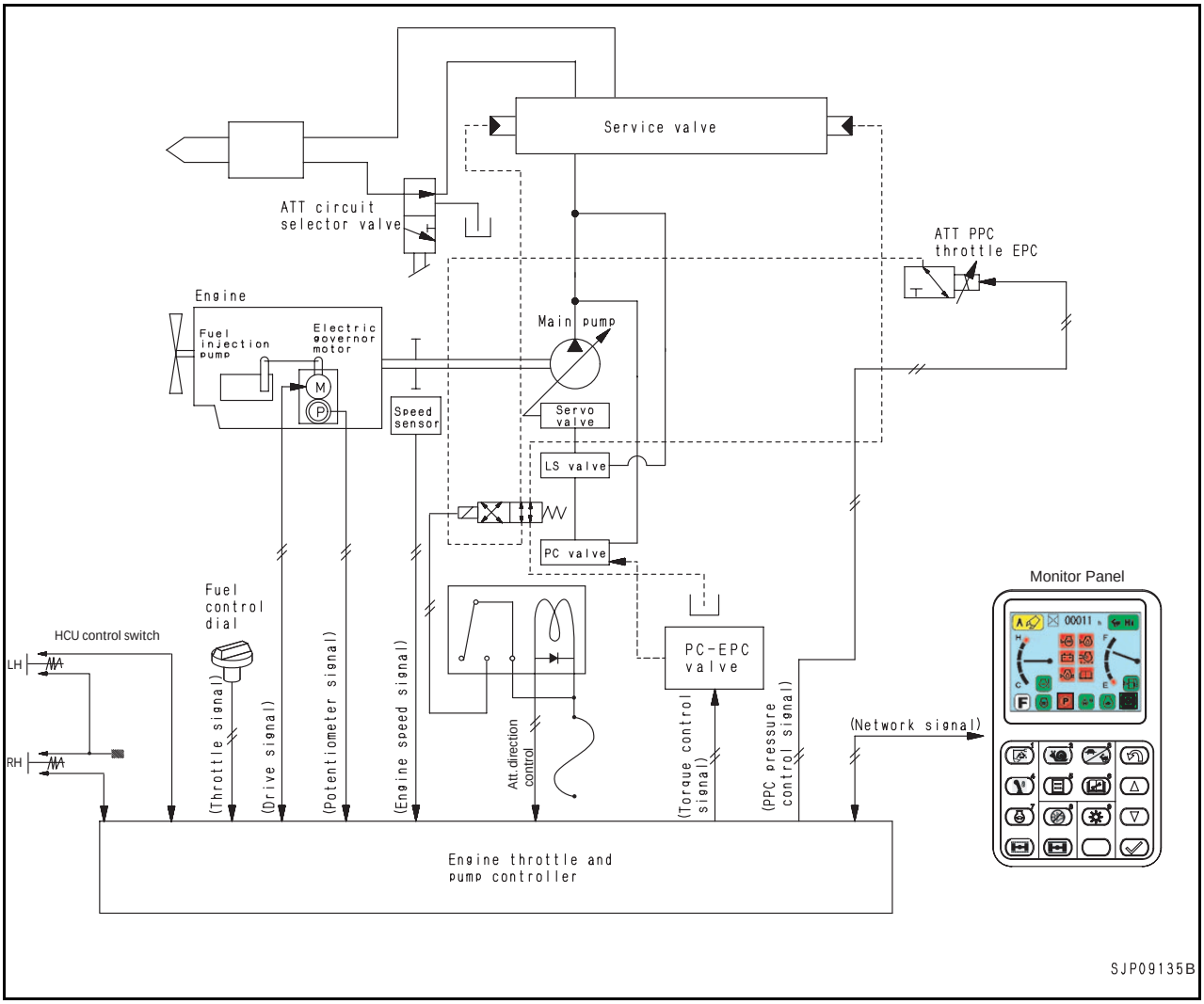
Travel speed switch	CREEP	LO	HI	AUTO (LO~HI)
Pump capacity (%)	60	100	100	
Motor capacity	Max.	Min~Max	Min~Max	Min~Max
Travel speed (km/h)	2.5	0 ~9.5	0 - 26 0 - 35	0 - 35 0 - 20

- 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 2100 rpm.

Maximum engine speed:

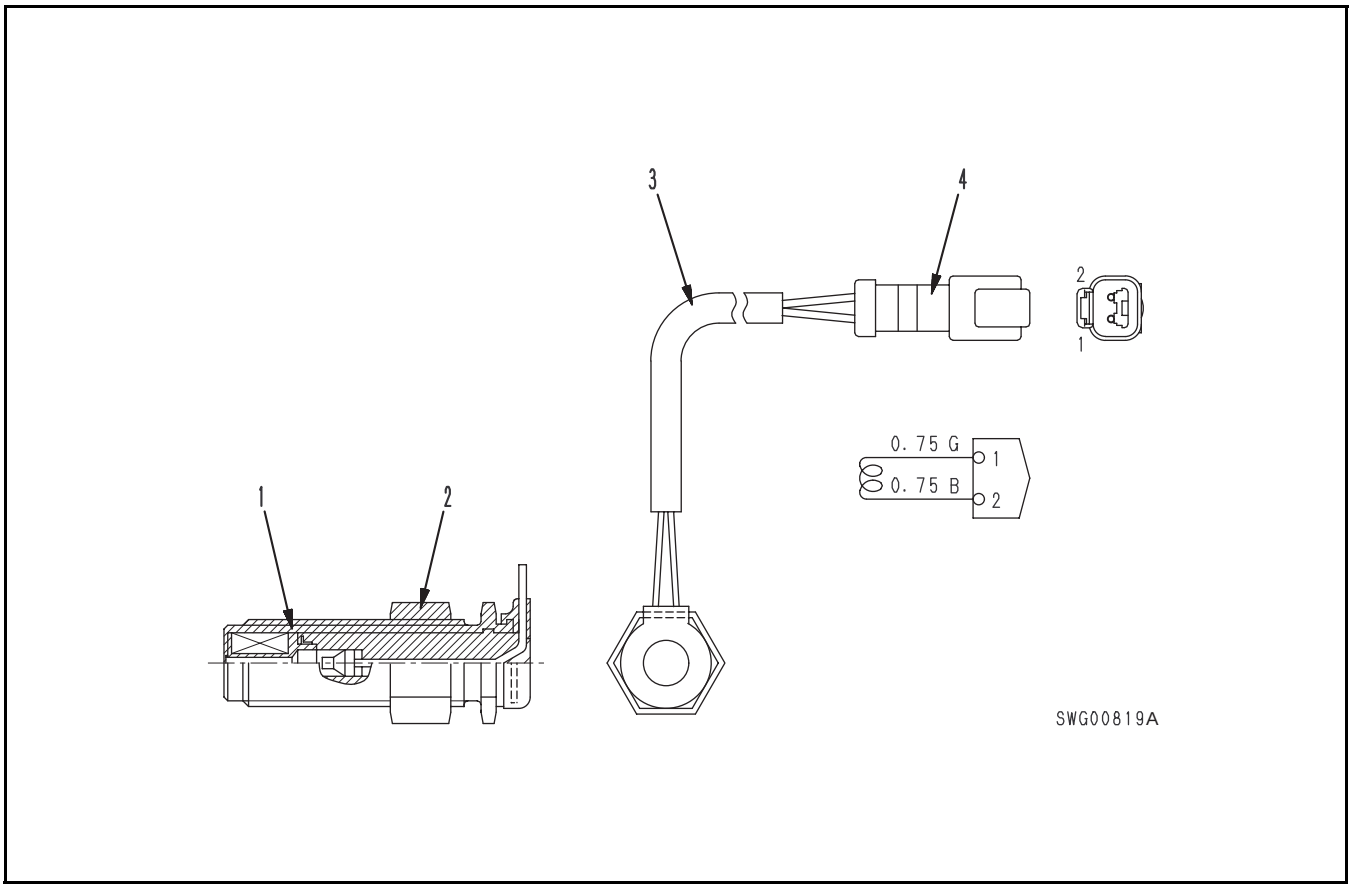
Max. Engine speed	
Travel	2450 rpm
A Mode	2150 rpm
E Mode	2010 rpm
L Mode	1830 rpm
B Mode	2040 rpm

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



9 . System component parts

1) Engine revolution sensor

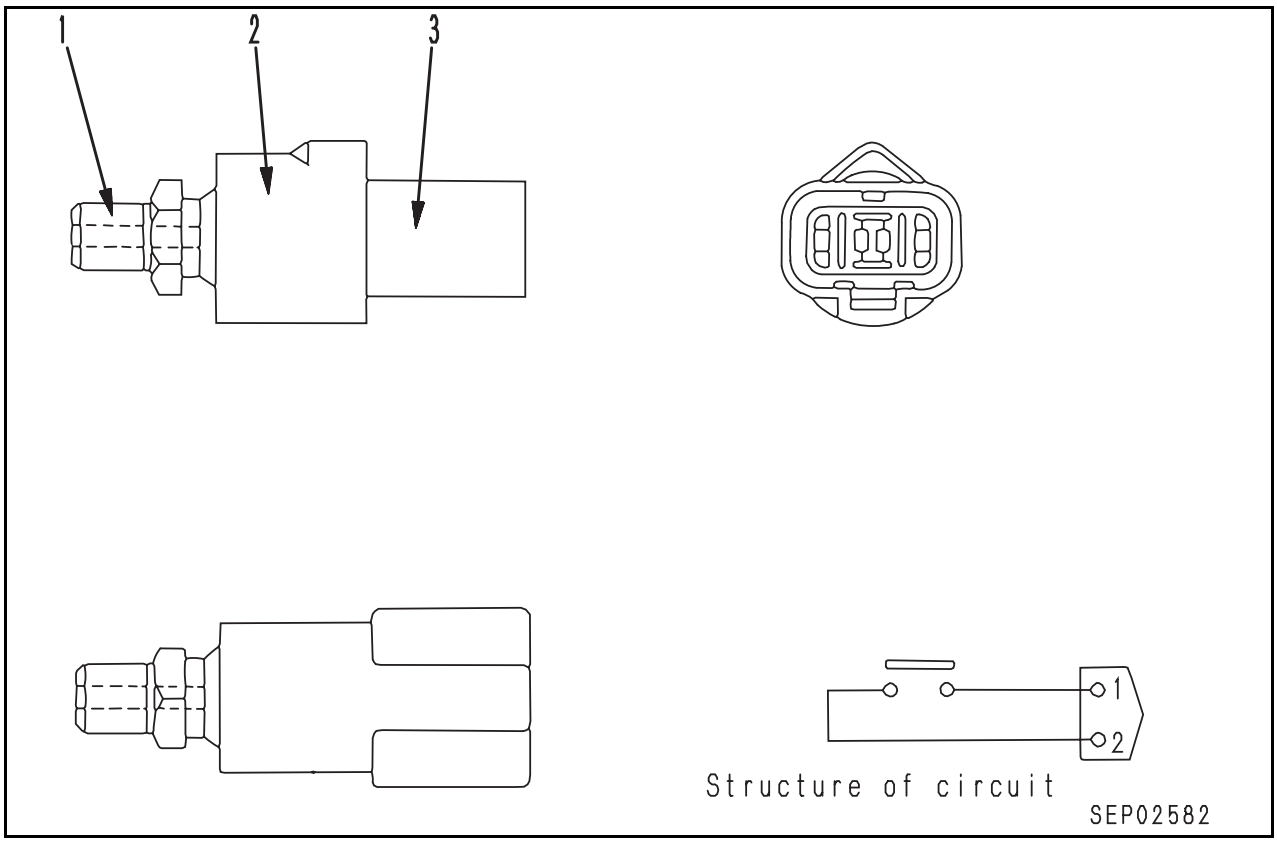


1. Sensor
2. Locknut
3. Wiring harness
4. Connector

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

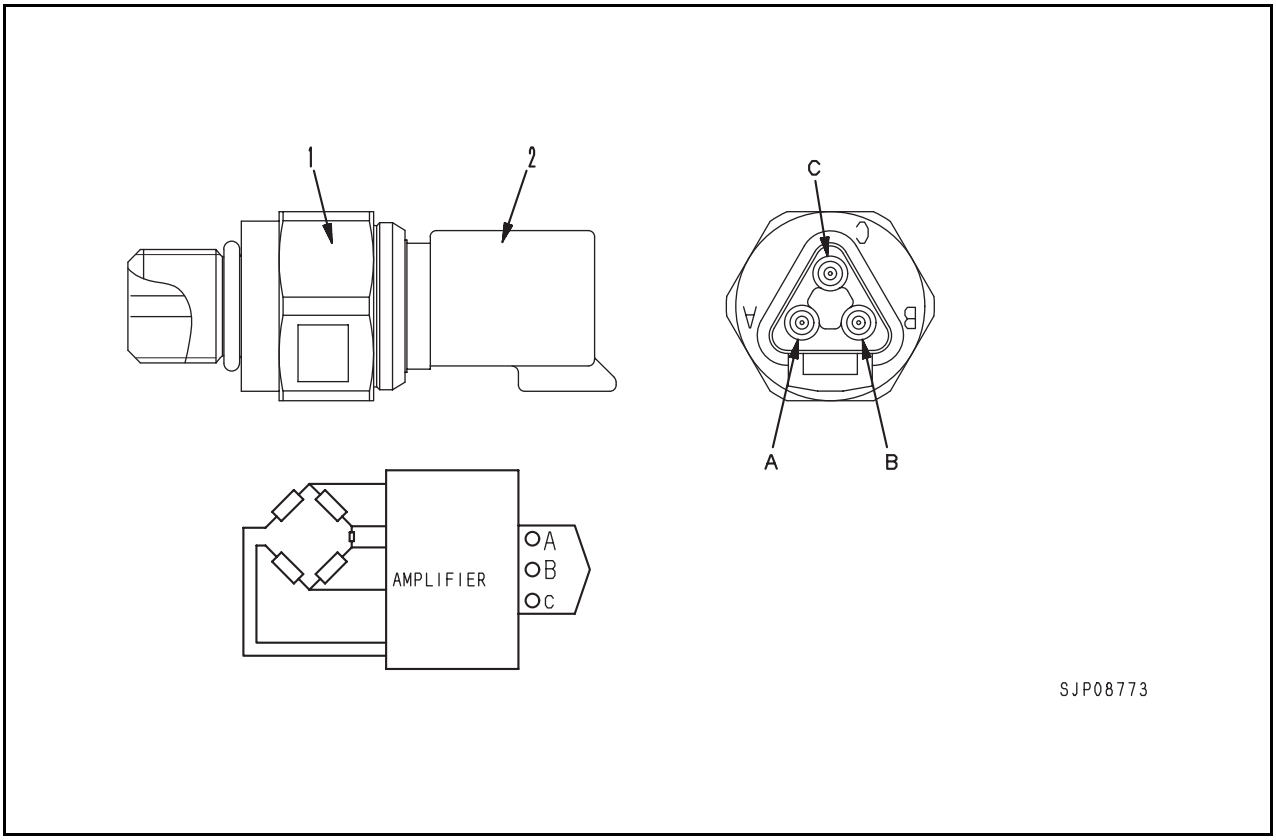
SPECIFICATIONS

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}

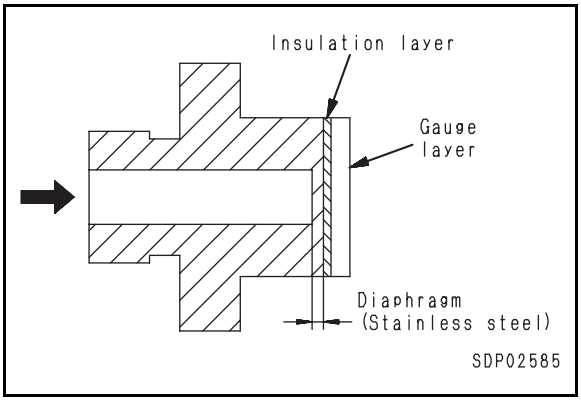
FUNCTION

- The junction block has 8 pressure switches, the 4-stage solenoid block has 8 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

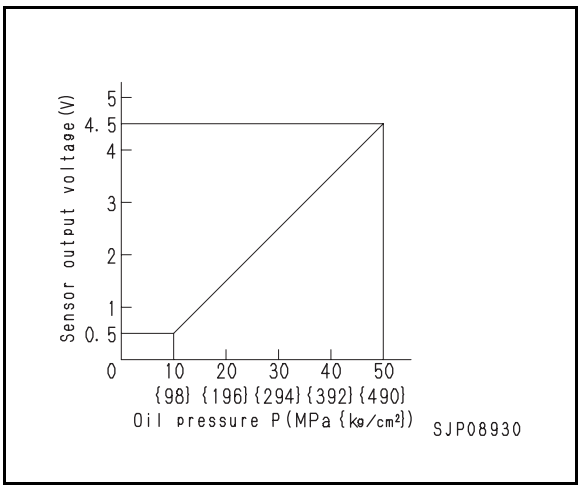


FUNCTION

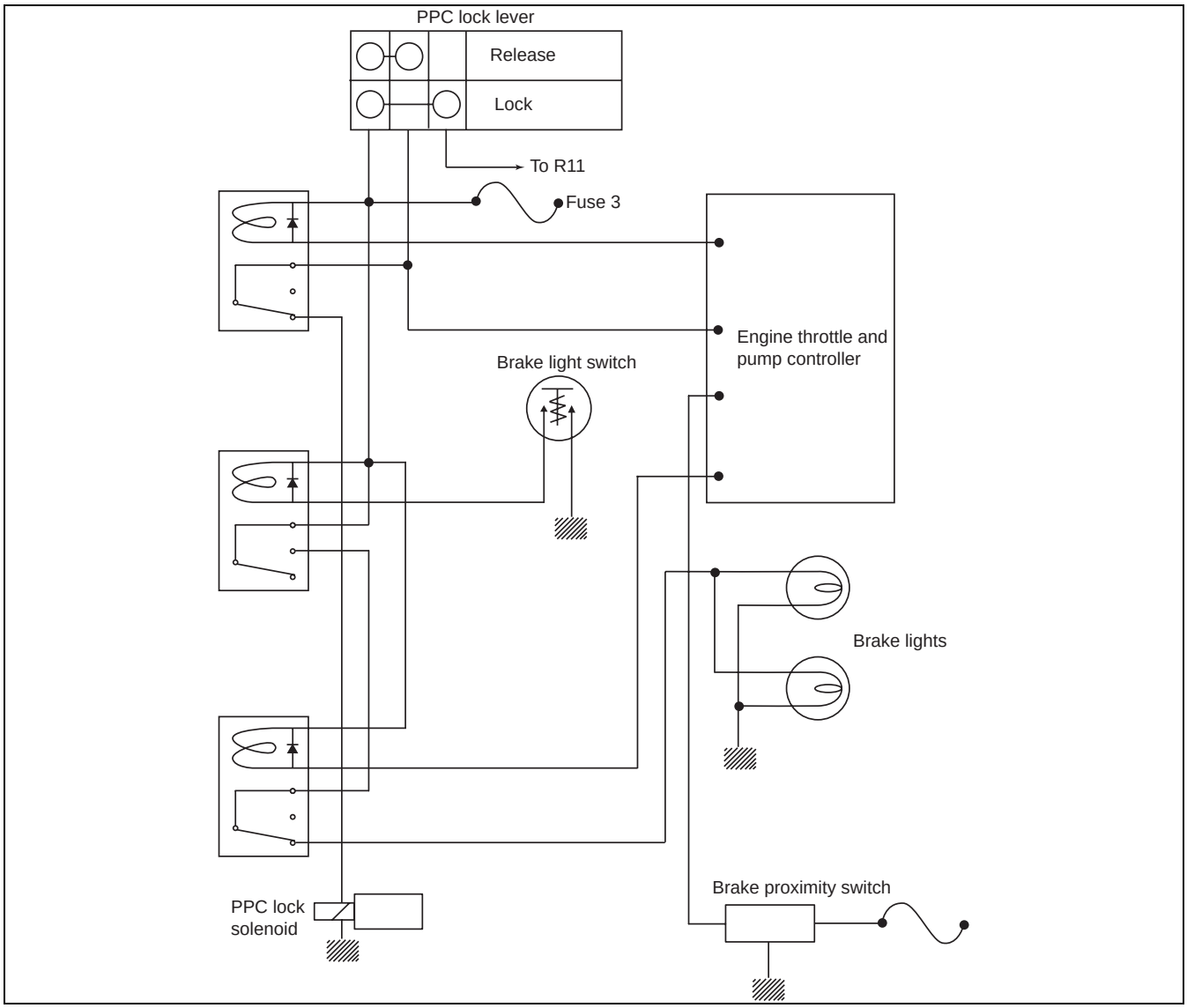
- The pump pressure sensor is installed to the inlet circuit of the control valve. It converts the pump discharge pressure into a voltage and transmits it to the governor/pump controller.

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

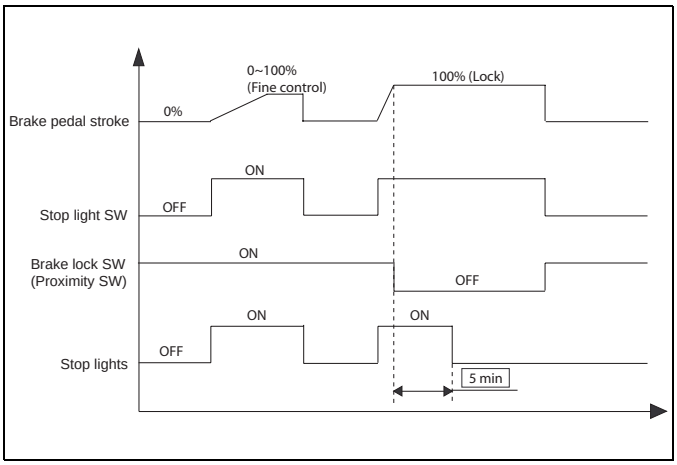


10 . Brake light control function

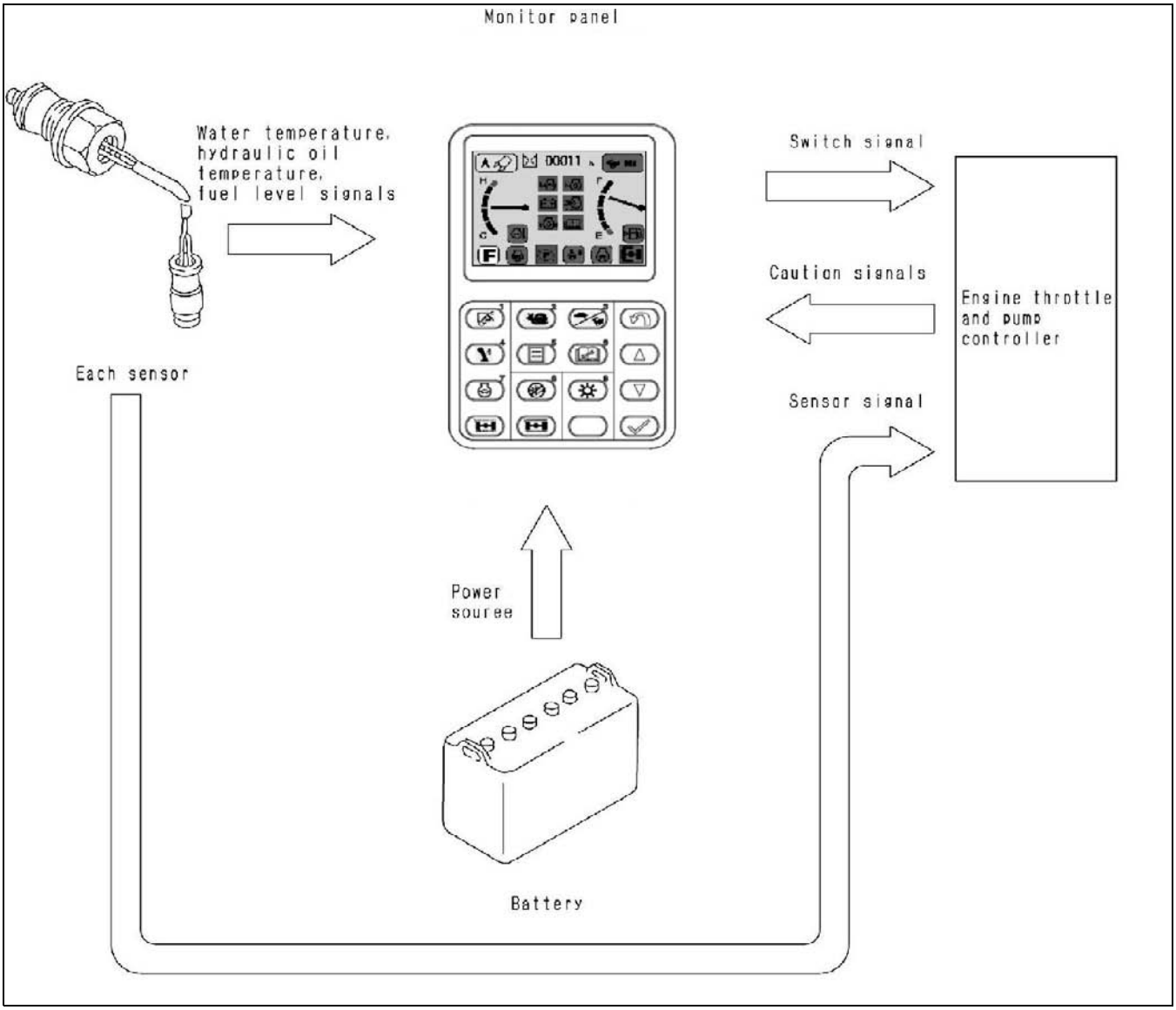


		PPC lock lever	
		Release	Lock
PPC lock SW	OFF	O*	O*
	ON	O	O*

O: Always work
O*: Follow the logic below



MACHINE MONITOR SYSTEM



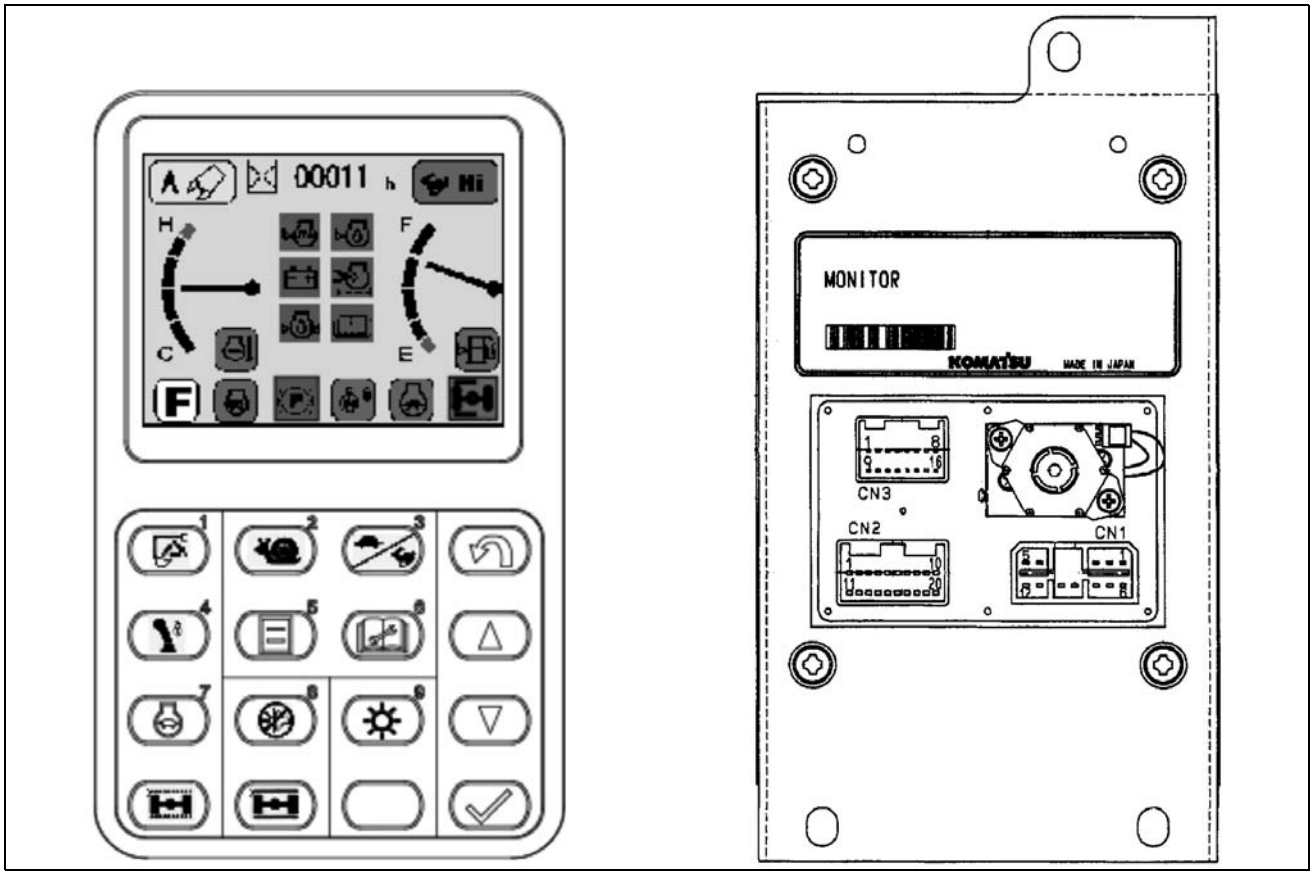
- The monitor system monitors the condition of the machine with sensors installed on various parts of the machine. It processes and immediately displays the obtained information on the panel notifying the operator of the condition of the machine.
  The panel is roughly divided as follows.

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

2. Gauge section to display the condition constantly (Coolant temperature, hydraulic oil temperature, fuel level, etc.)

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

MONITOR PANEL



OUTLINE

- The monitor panel has the functions to display various items and the functions to select modes and electric parts.
  The monitor panel has a CPU (Central Processing Unit) in it to process, display, and output the information.
  The monitor display unit consists of LCD (Liquid Crystal Display). The switches are flat sheet switches.

Input and output signals

CN1

Pin No.	Signal name	Input/ Output
1	Key ON	Input
2	Key ON	Input
3	Washer	Output
4	Start	Input
5	Limit switch (W)	Input
6	GND	-
7	GND	Input
8	VB+	Input
9	Wiper (+)	Output
10	Wiper (-)	Input
11	Buzzer on input	Output
12	Limit switch	Input

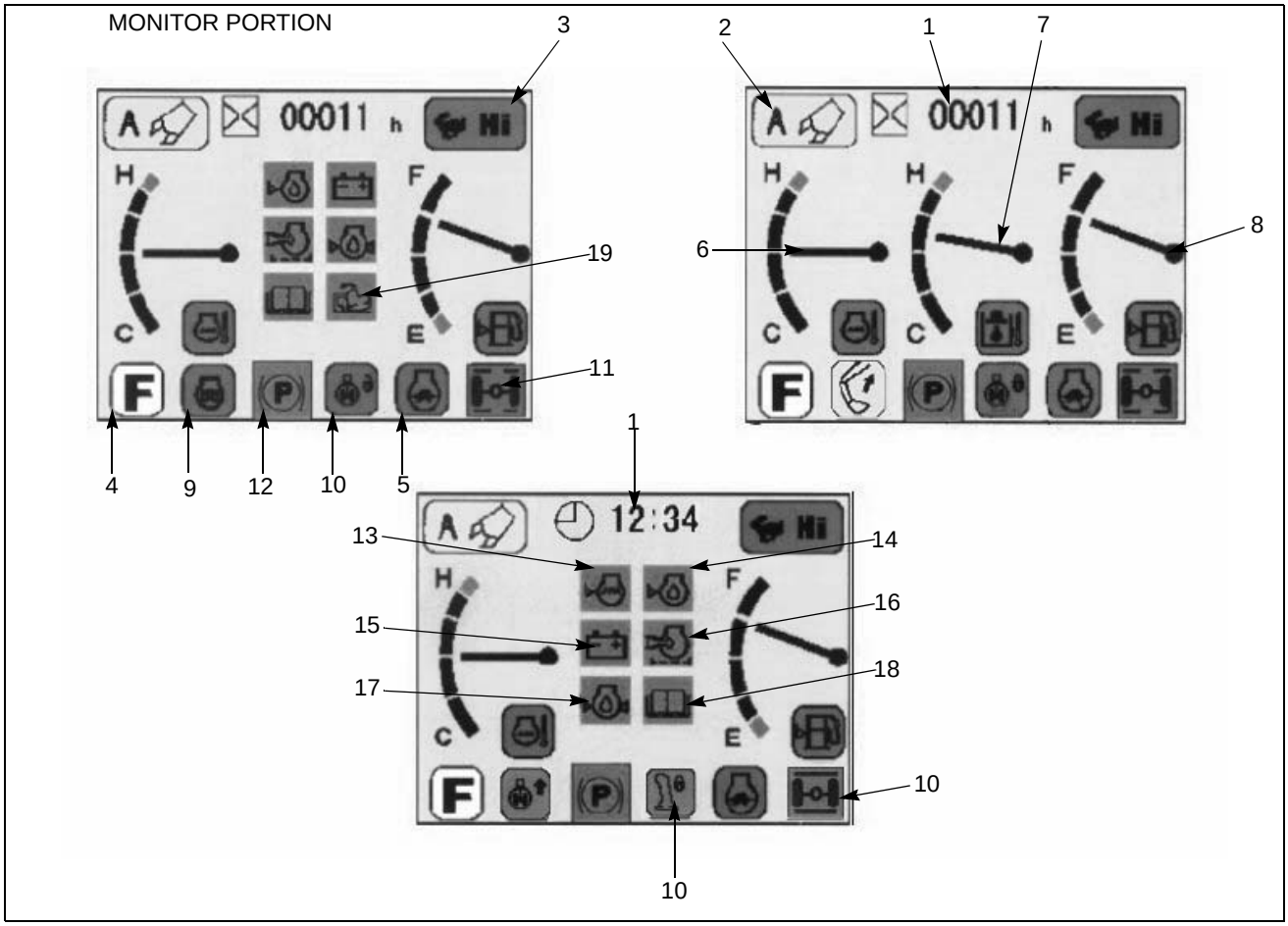
CN2

Pin No.	Signal name	Input/ Output
1	Coolant temp	Input
2	Fuel level	Input
3	Coolant level	Input
4	(Hydraulic oil level)	Input
5	Air filter	Input
6	NC	Input
7	Engine oil pressure	Input
8	Engine oil level	Input
9	N/W signal	Input/ Output
10	N/W signal	Input/ Output
11	Charge	Input
12	Hydraulic-oil temp (A)	Input
13	GND	Input
14	Buzzer drive	Input
15	Buzzer switch (window)	Input
16	Buzzer cancel	Input
17	Swing Lock	Input
18	Pre-heating	Input
19	Light	Input
20	N/W GND	-

CN3

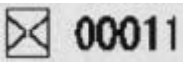
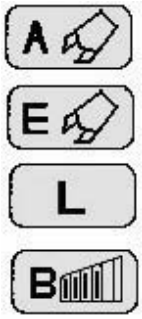
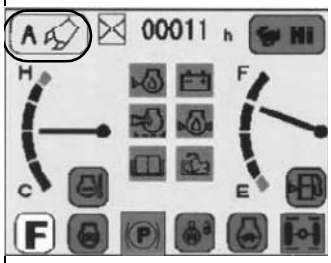
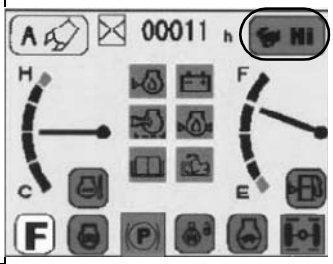
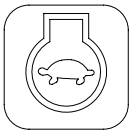
Pin No.	Signal name	Input/ Output
1	NC	Input
2	NC	Input
3	NC	Input
4	NC	Input
5	NC	Input
6	NC	Input
7	RS230C-CTS	Input
8	RS232C-RXD	Input
9	RS232C-RXD	Input/ Output
10	RS232C-RXD	Input/ Output
11	Boot switch	Input
12	NC	Input
13	GND	-
14	CAN (Shield)	Input
15	CAN (+)	Input
16	CAN(-)	Input

MONITOR CONTROL, DISPLAY PORTION



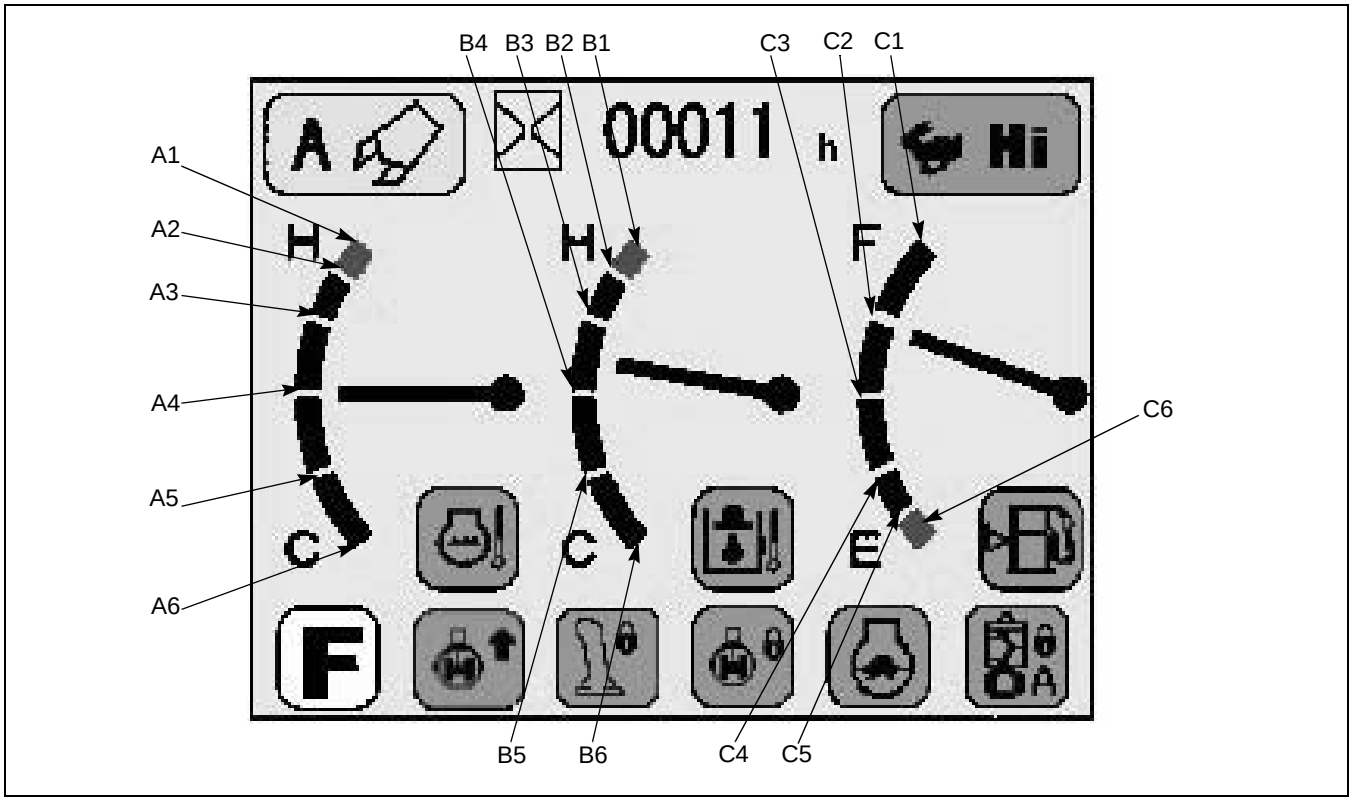
1.	Hour meter / Clock	11.	Suspension lock (Manual) / Suspension lock (Auto)
2.	Working mode	12.	Parking brake
3.	Travel modes	13.	Radiator level caution
4.	Travel direction	14.	Engine oil level caution
5.	Auto-deceleration	15.	Battery charge caution
6.	Engine water temperature guage	16.	Air filter caution
7.	Hydraulic oil temperature guage	17.	Engine oil pressure caution
8.	Fuel guage	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

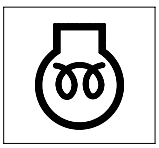
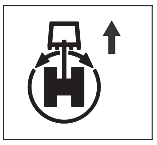
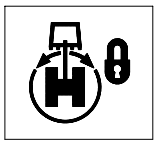
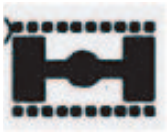
Item No.	Symbol	Display item	Display method	
1.		Servise meter indicator	When service meter is	Lights up when service meter is working, engine not running and ignition is on.
		Clock	Other than above, clock is shown	
2.		Working mode	Displays set mode in top left hand corner of monitor as shown in diagram 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 175.	

Item No.	Symbol	Display item	Display method
7.		Hydraulic oil temperature gauge	See “Monitor Gauge Displays” on page 175.
8.		Fuel gauge	

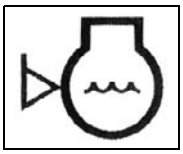
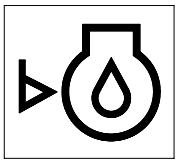
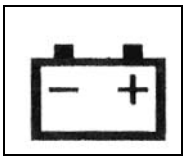
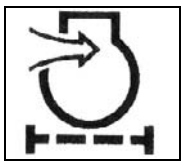
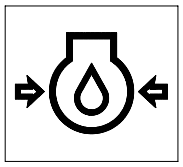
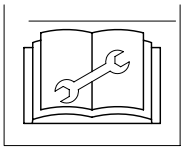
Monitor Gauge Displays



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.

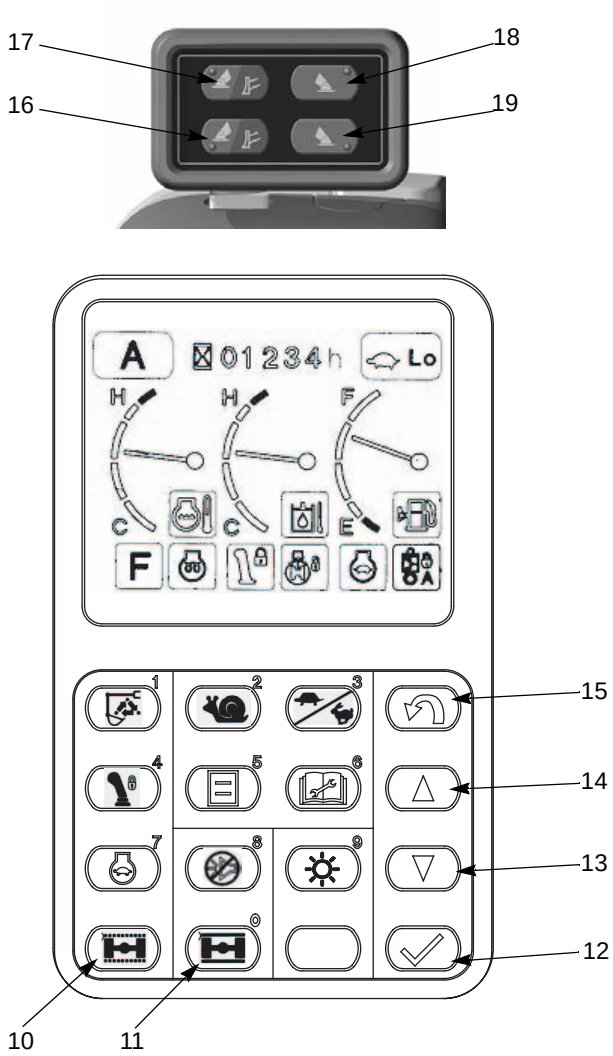
Item No.	Symbol	Display item	Check before starting item	When engine is stopped	When engine is running
13.		Radiator water level	Yes	Lights up when abnormal	When abnormal, lights up and buzzer sounds
14.		Engine oil level	Yes	Lights up when abnormal	--
15.		Battery charge	Yes	--	Lights up when abnormal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

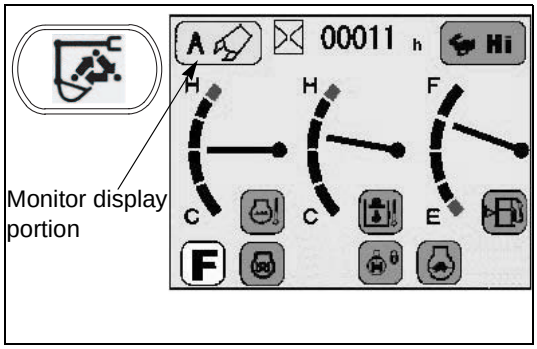
L mode: For fine-control operations and lifting

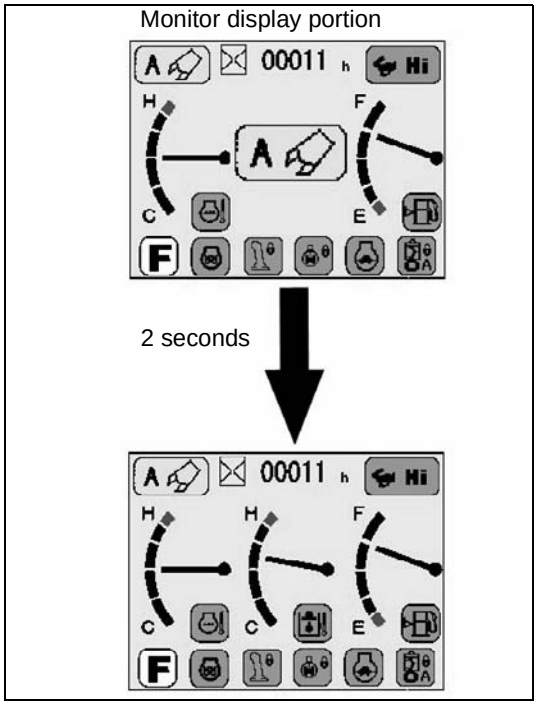
B mode: For breaker operations

- 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.





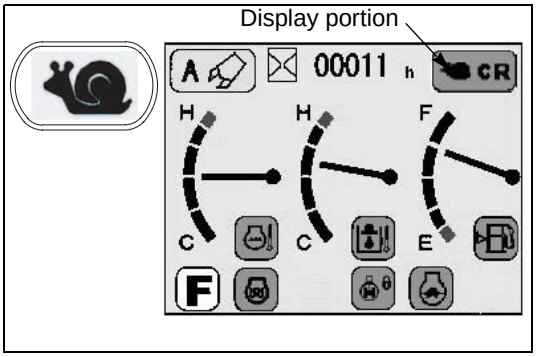
2. CREEP SPEED SELECTOR SWITCH

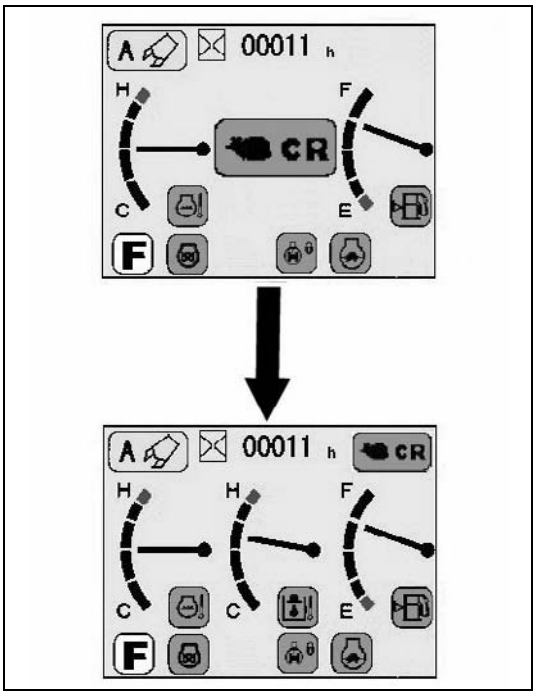
This switch (2) is used to set the travel mode to creep.

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

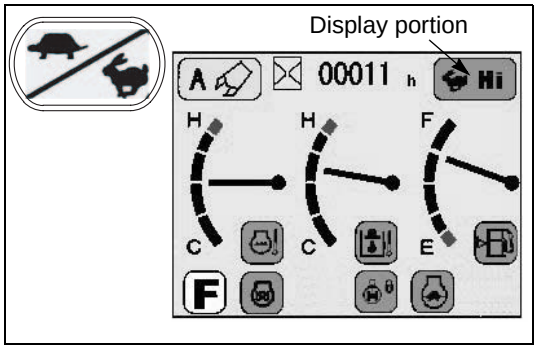
This switch (3) is used to set the travel speed in 3 stages.

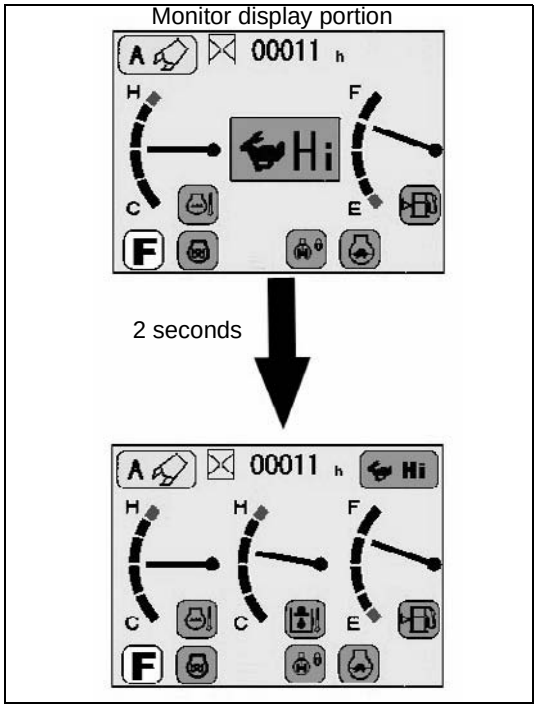
Lo lights up:	Low-mode travel
Hi lights up:	Hi-mode travel
AT lights up:	Auto mode travel

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.

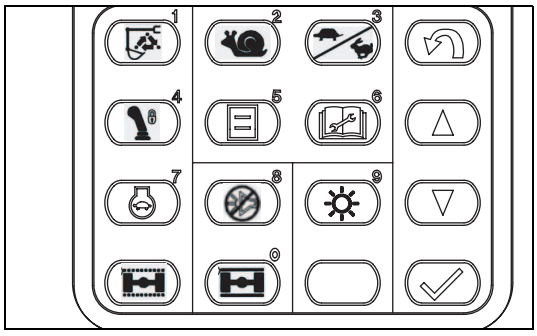
Each time that the travel speed selector switch is operated, the mode is displayed in the centre of the monitor display, and the screen returns to the normal screen after 2 seconds.





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

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

- When the working mode is A or E

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

Press up switch (14) or down switch (13) to adjust to the desired flow.

  2. 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.

- When the working mode is B mode

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

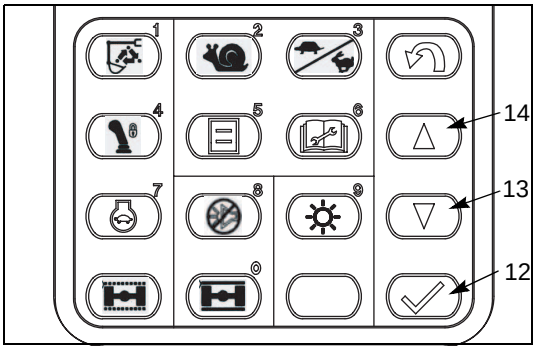
  2. Press up switch (14) or down switch (13) to adjust to the desired flow.

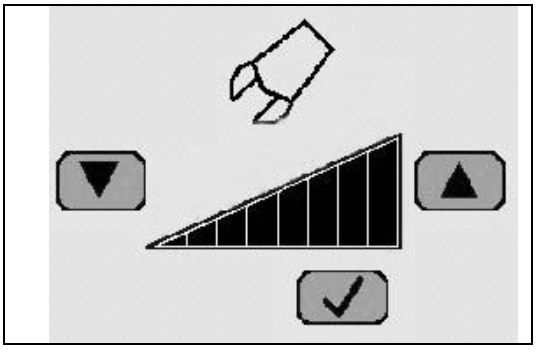
  3. After completing the flow setting, press input confirmation switch (12).

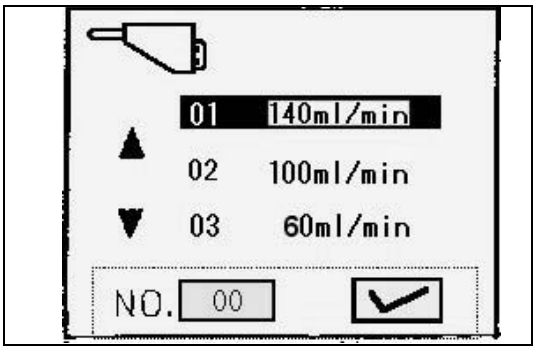
  4. With the operation in Step 3, the flow setting screen changes to the fine flow adjustment screen shown in the diagram on the right.

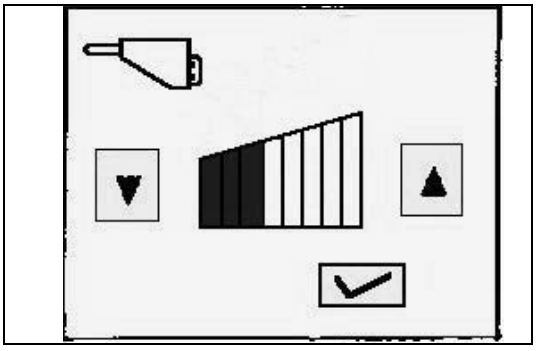
  5. Press up switch (14) or down switch (13) to adjust to the desired flow.

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

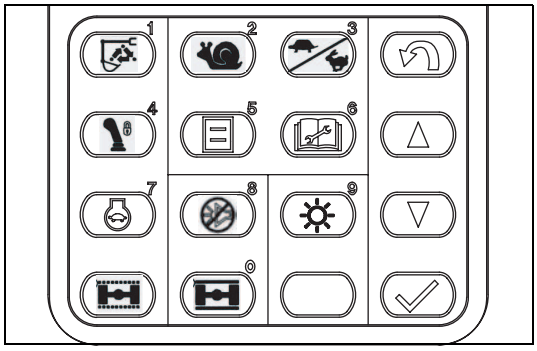








6 . SERVICE MENU SWITCH



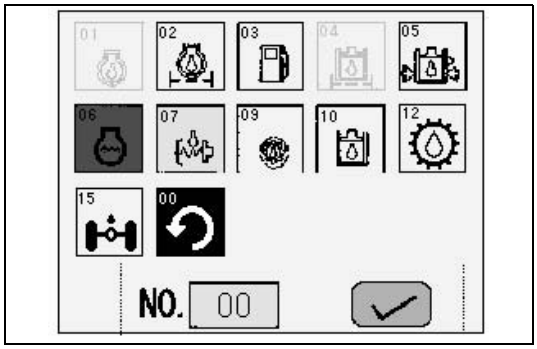
- This switch (6) is used to check the time remaining to maintenance.
- When this switch (6) is pressed, the screen on the monitor display changes to the maintenance screen shown in the diagram below right.

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

  White display:More than 30 hours remaining to maintenance

  Yellow display:Less than 30 hours remaining to maintenance

  Red display:Maintenance time has already passed

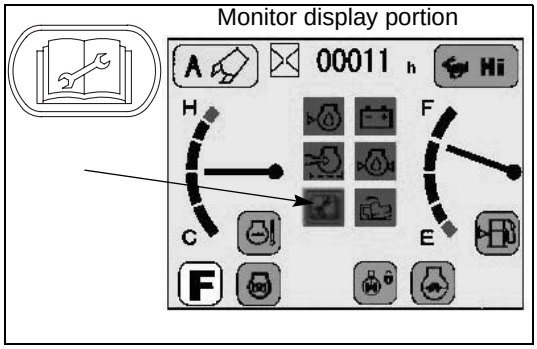


l If the monitor display changes to the maintenance warning screen when the engine is started or when the machine is being operated, stop operations immediately. When this happens, the monitor corresponding to the maintenance warning screen will light up red.

l Press switch (6) to display the maintenance screen and check that there is no abnormality in any other monitor.

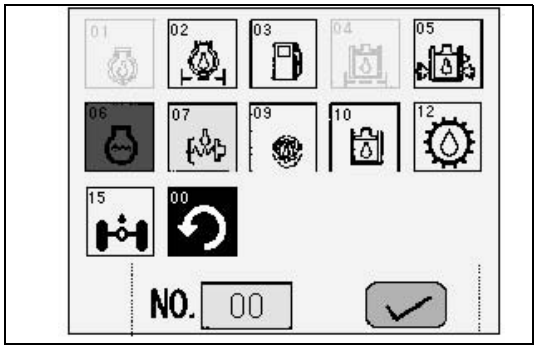
l If another monitor is lit up red on the maintenance screen, carry out maintenance for that item also.

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

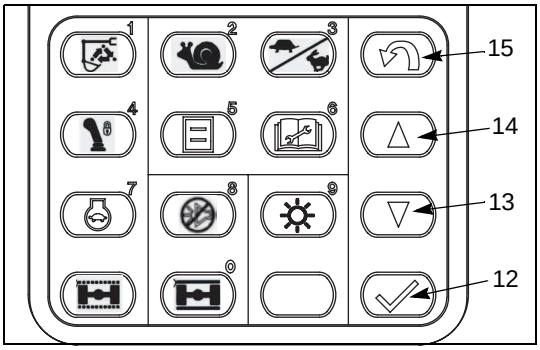
(b) : Default setting for maintenance interval

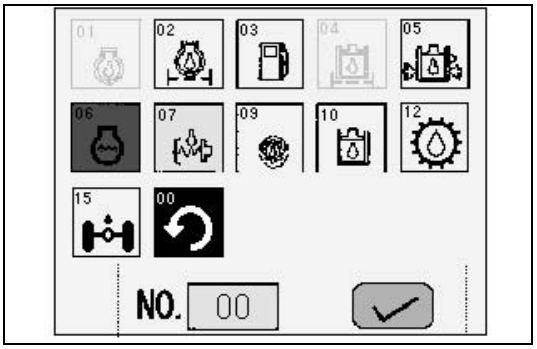
When only checking the time remaining to maintenance, press back switch (15) twice.

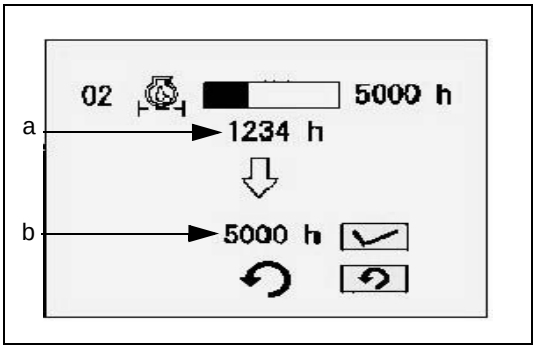
The screen will return to the normal operation monitor screen.

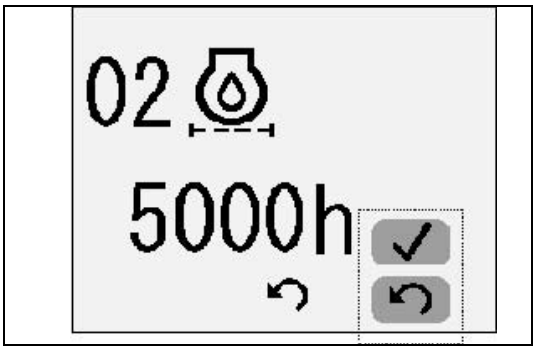
When canceling the time remaining to maintenance and returning to the default time setting, press input confirmation switch (12). The screen will switch to the default setting screen.

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.)









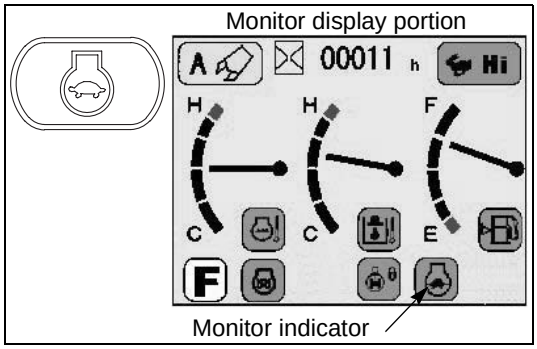
7 . AUTO-DECELERATION SWITCH

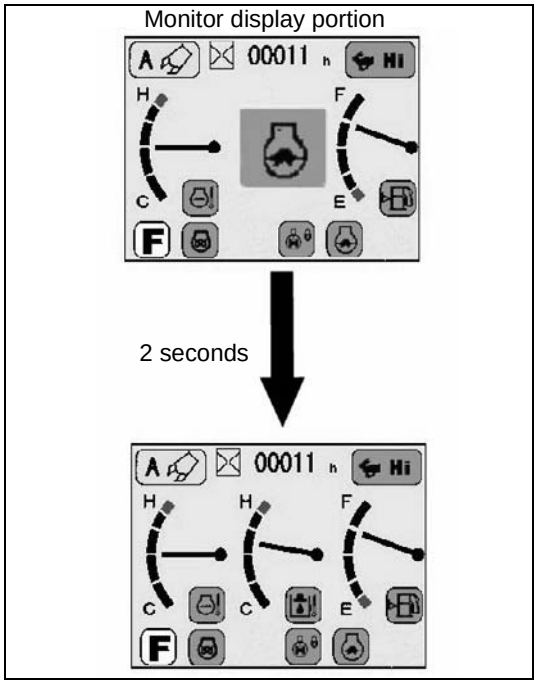
When this auto-deceleration switch (7) is depressed, the auto-deceleration is actuated. If the control levers and foot pedals are in the neutral position, the engine speed is automatically lowered to reduce fuel consumption.

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.



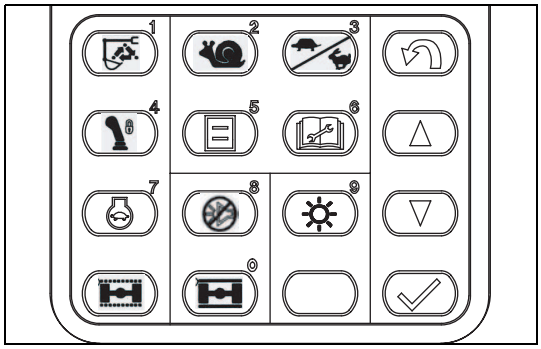


8. BUZZER CANCEL SWITCH

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 189.



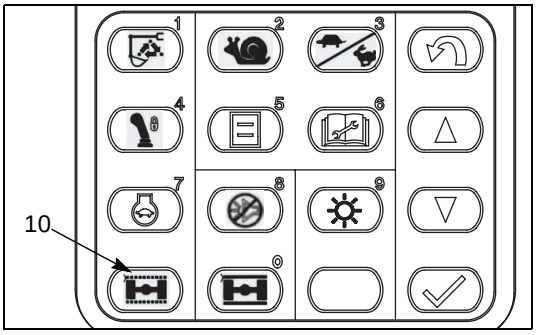
10. AUTOMATIC SUSPENSION LOCK SWITCH

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.

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

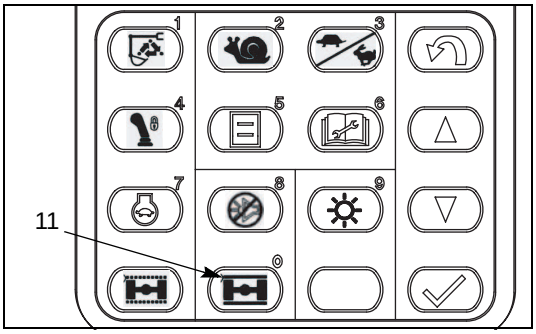
Permanent and automatic suspension lock cannot be active at the same time. Each mode can be turned on and off by their individual switches.



11. PERMANENT SUSPENSION LOCK SWITCH

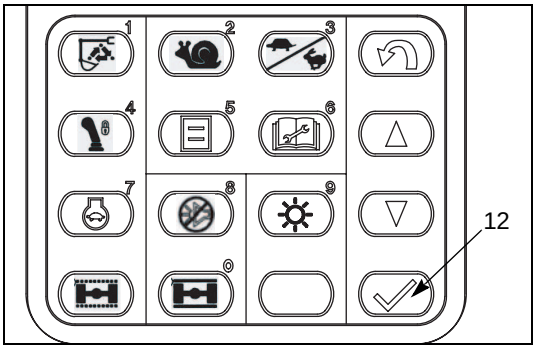
Press switch (11) in order to engage permanent front axle lock. Front axle will be fixed in place when engaged, the permanent suspension lock indicator will illuminate. To disengage lock, press switch (11) again.

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.

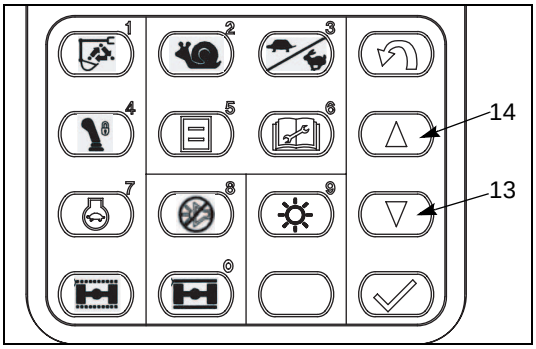


13. SCROLL DOWN

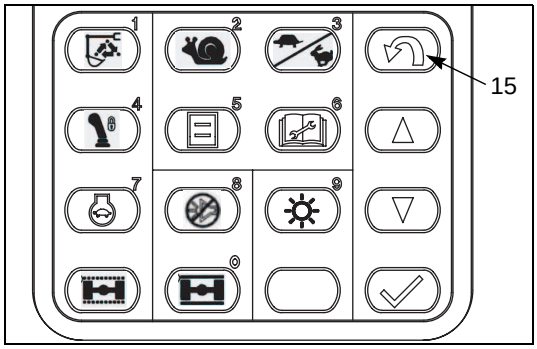
14. SCROLL UP

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

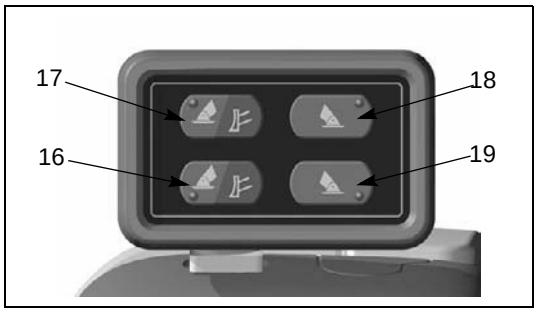
In certain menus they can also be used to increase and decrease displayed values (i.e. breaker force)



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

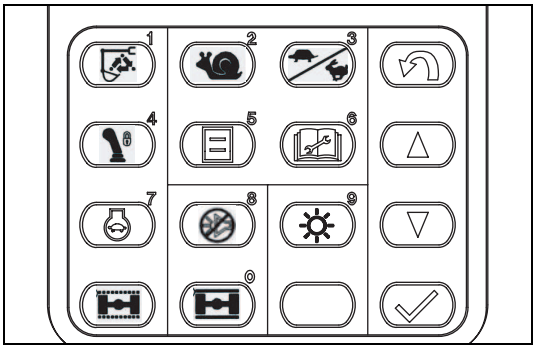


16. REAR LEFT OUTRIGGER/BLADE SWITCH
This switch enables selection of rear left outrigger or rear blade Light illuminates when active.
17. FRONT LEFT OUTRIGGER/BLADE SWITCH
This switch enables selection of front left outrigger / front blade. Light illuminates when active.
18. FRONT RIGHT OUTRIGGER SWITCH
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.



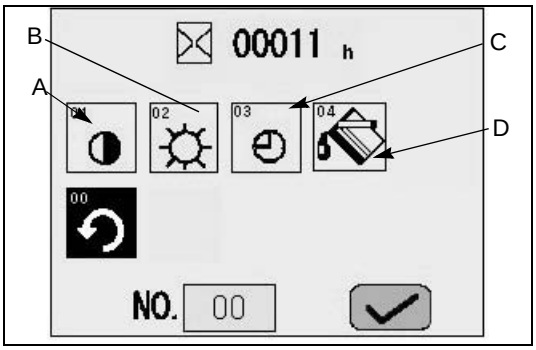
LIQUID CRYSTAL MONITOR ADJUSTMENT SWITCH

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

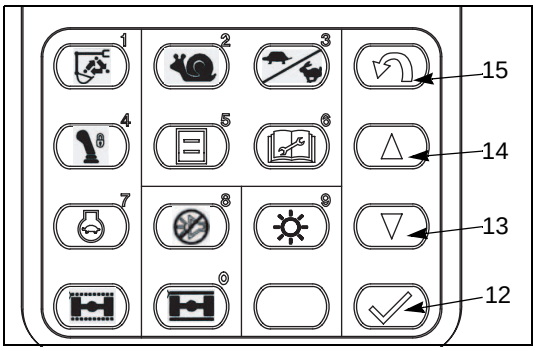
- (A).Adjusting contrast

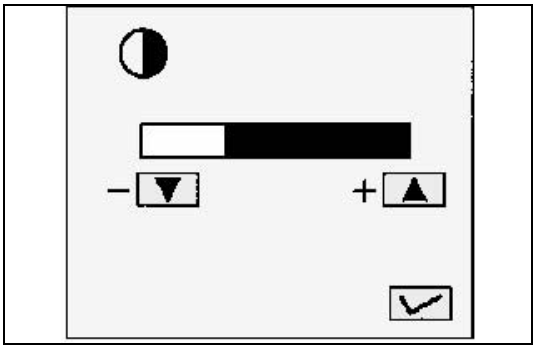
  1. Use the brightness/contrast screen and press up switch (14) or down switch (13) to select the contrast monitor.
  (The selected monitor is inverted to black.)

  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.

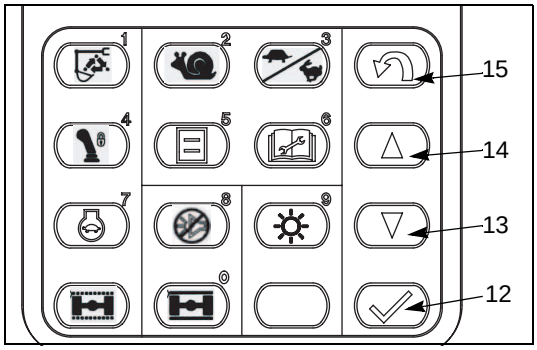
  As normal, within any menu, press switch (15) to return to the previous screen at any time.





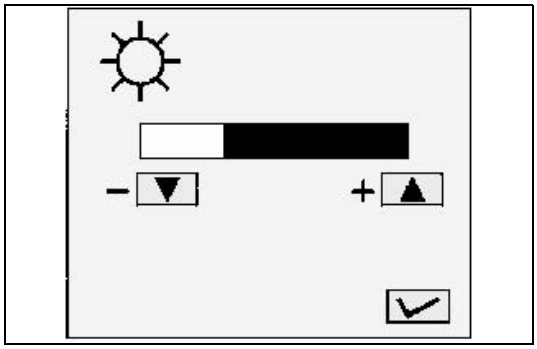
- (B). Adjusting brightness

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.

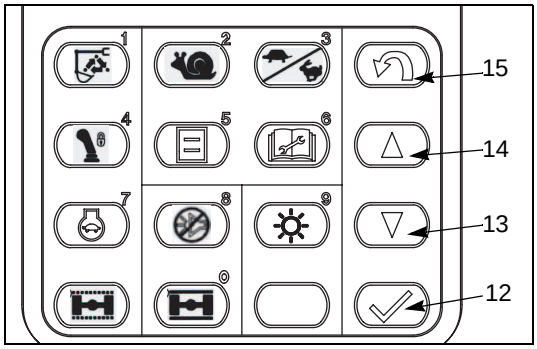


- (C). Adjusting the clock

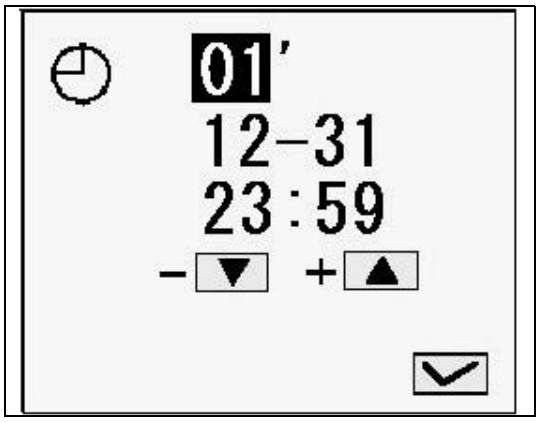
1. Use the adjustment screen and press up switch (14) or down switch (13) to select the clock monitor.
(The selected monitor is inverted to black.)

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.



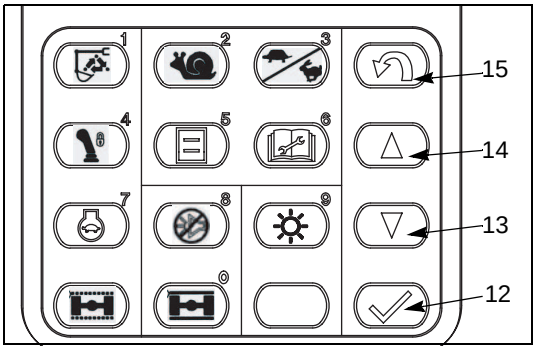
- (D). Adjusting background colour

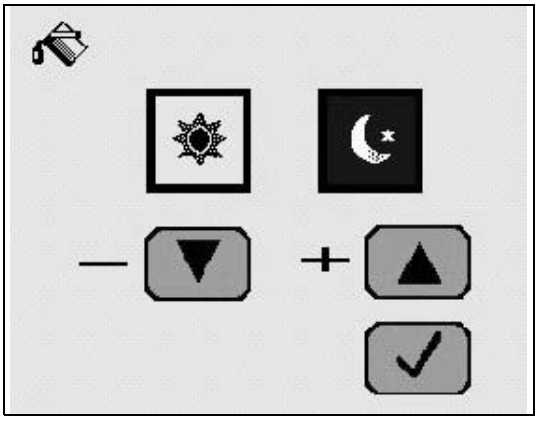
  1. Use the adjustment screen and press up switch (14) or down switch (13) to select the background colour monitor.
  (The selected monitor is inverted to black.)

  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.

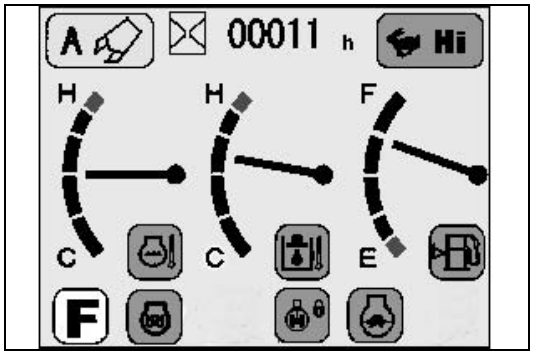




PASSWORD FUNCTION

- 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.

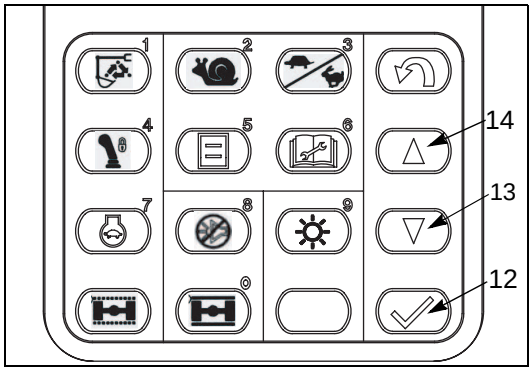
  This becomes possible 10 minutes after the starting switch is turned ON and the monitor screen has changed to the normal screen.

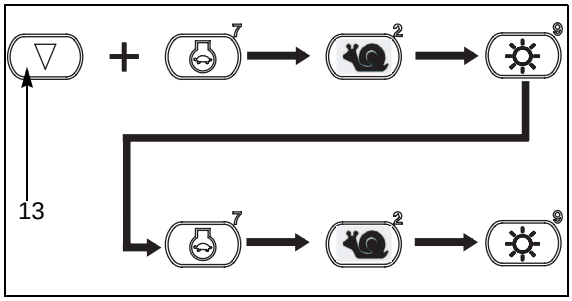


METHOD OF SETTING, CHANGING PASSWORD

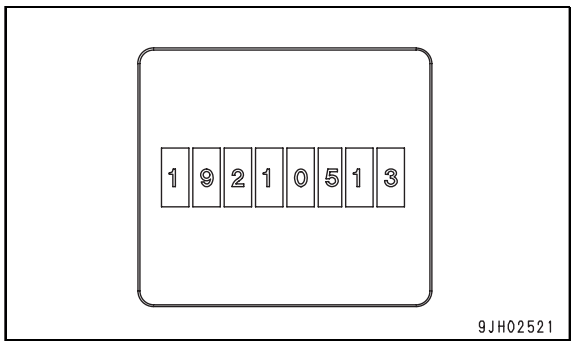
1. Turn Starter key switch to 'on' position (wait 10 minutes). Press and hold down switch (13). Using the 10 digit key pad, input the following number sequence: 7->2->9->7->2->9

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



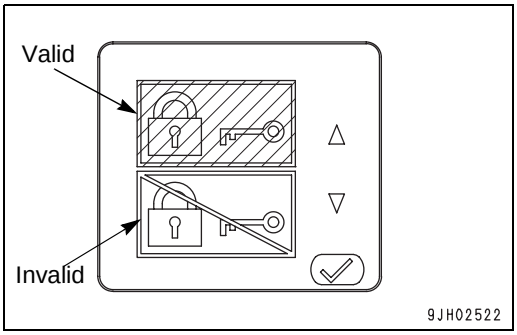


2. On the input screen, use the 10-key pad to input an 8-digit number [19210513]. When the final digit [number 3] is input, the screen will change to the Valid/Invalid screen for the password function.



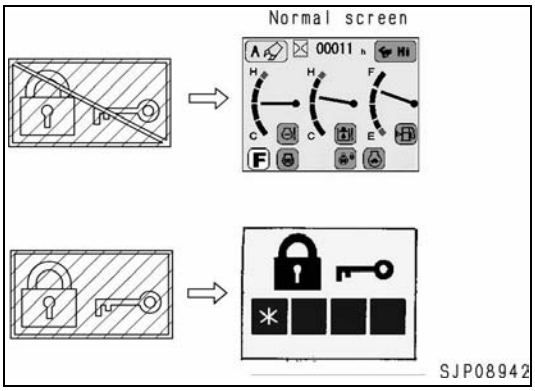
3. Press control switch (14) or (13) to set to Valid/ Invalid.

   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.



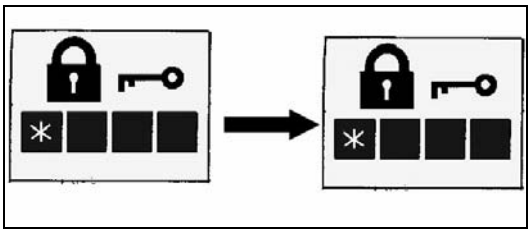
4. Input a 4-digit number on the input screen (the lock and key symbol are displayed), then press input confirmation switch (12).

   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.

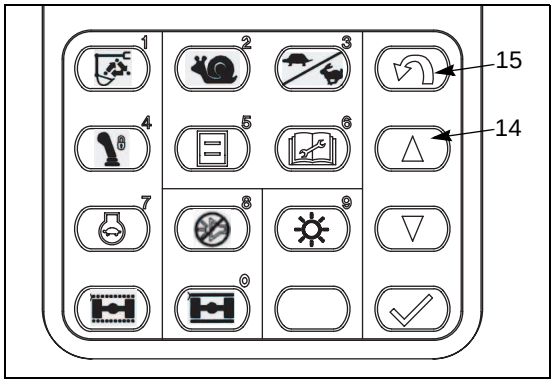
   NOTE: If the number input the second time is different from the number input the first time, the password will not be confirmed and the screen will return to the first screen, so input the same 4-digit password 2 times in succession.



SERVICE METER CHECK FUNCTION

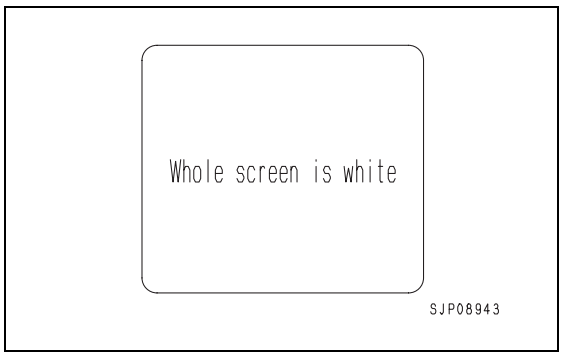
- When the starting switch is in the OFF position, press return switch (15) and control switch (14) of the monitor at the same time, and the service meter will be shown on the display.
- This display is shown only while the two switches are being pressed. When the switches are released, the display goes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

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



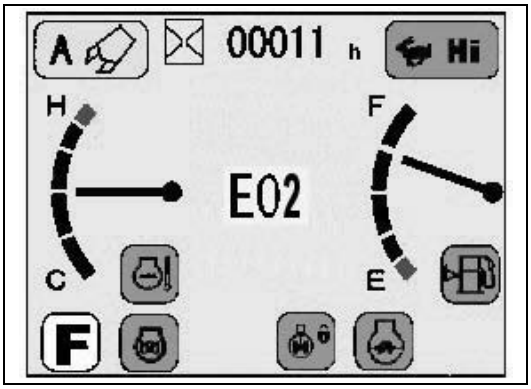
DISPLAY LCD CHECK FUNCTION

- 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.

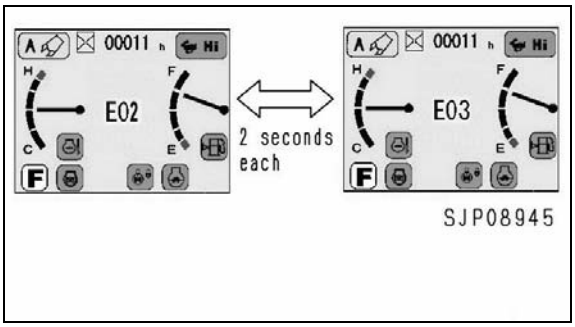


USER CODE DISPLAY FUNCTION

- 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.

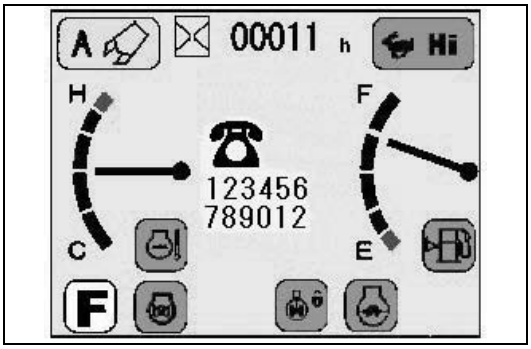


- While the user code is being displayed, if the input confirmation switch is pressed, the service code and failure code can be displayed.
- If there is more than one service code or failure code, the display switches every 2 seconds and displays all the service codes/failure codes that caused the user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

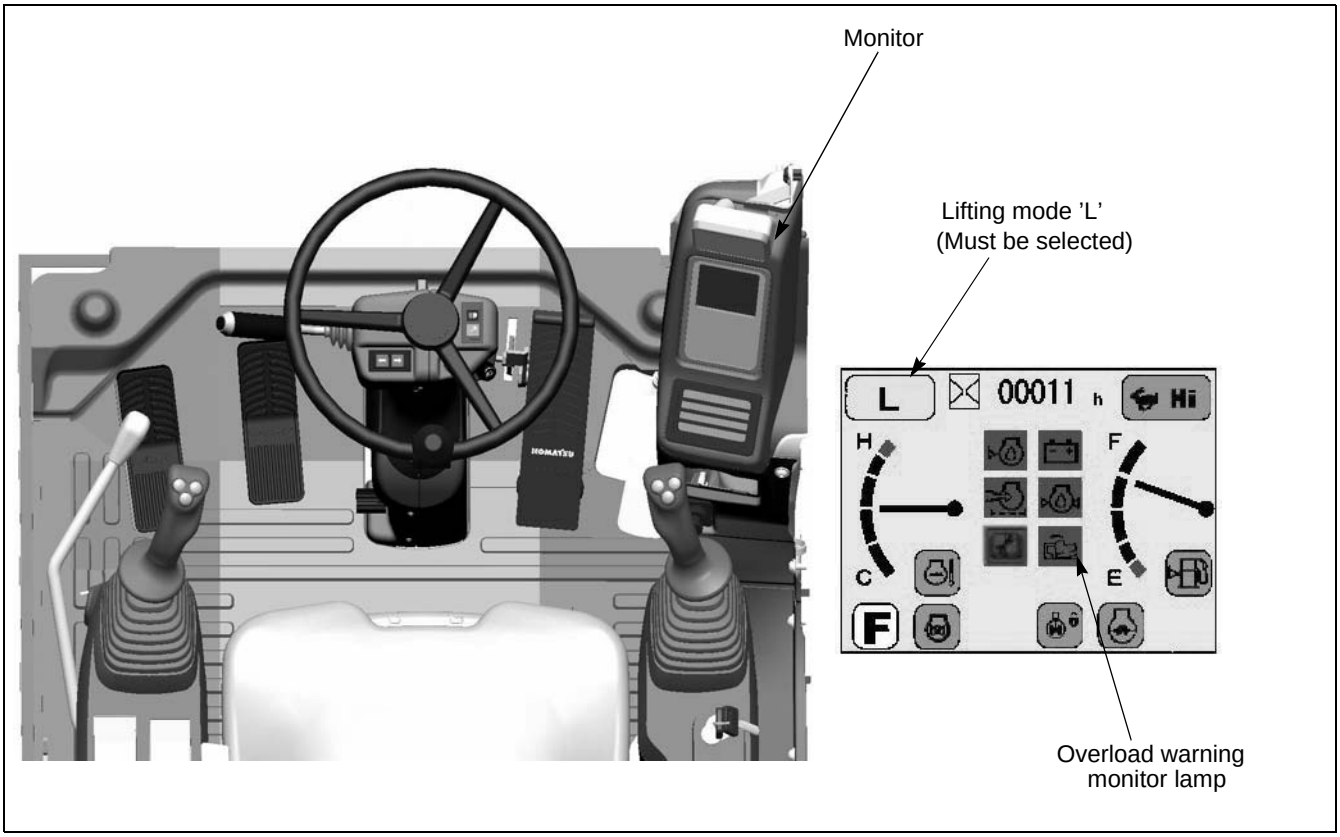
FUNCTION

- 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.

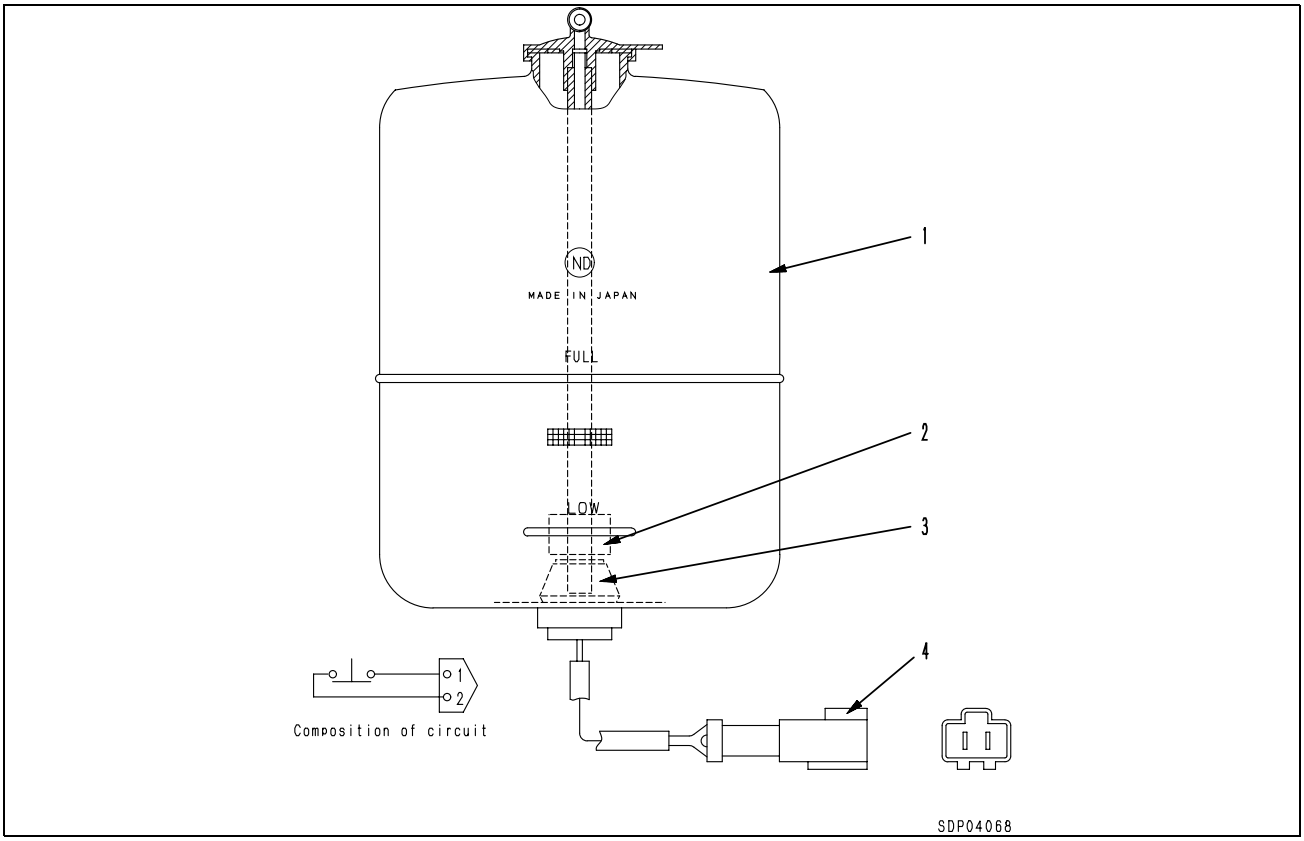


SENSOR

- 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

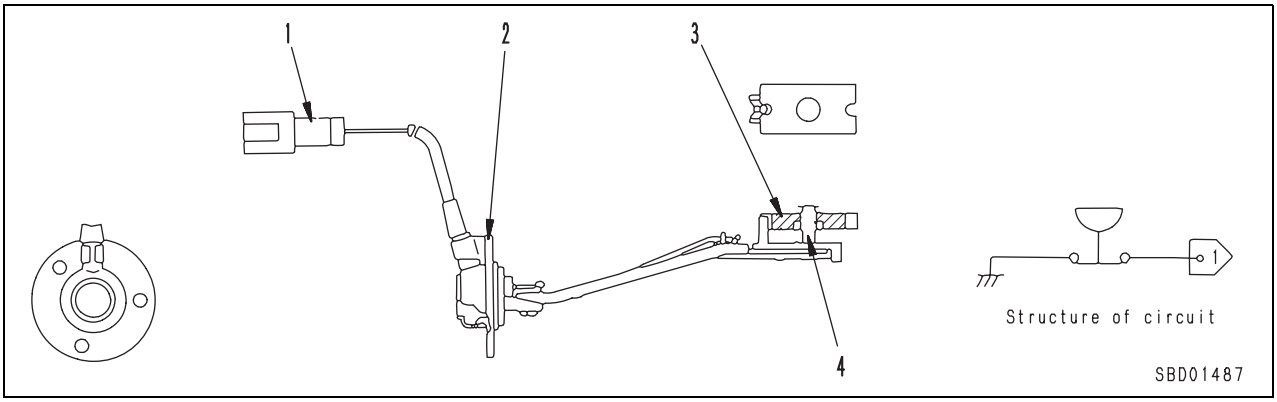
Sensor name	Type of sensor	When normal	When abnormal	Input controller
Coolant level	Contact	ON (closed)	OFF (open)	Monitor
Engine oil level	Contact	ON (Closed)	OFF (Open)	
Engine oil pressure	Contact	ON (Open)	OFF (Closed)	Engine controller
Coolant temperature	Resistance	—	—	
Fuel level	Resistance	—	—	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
Brake lock proximity		—	—	Controller
Travel PPC	Analog	—	—	
PPC pressure	Contact	OFF (Open)	ON (Closed)	
Park brake pressure				
Brake accumulator low pressure				
Brake stop light				

Coolant level sensor



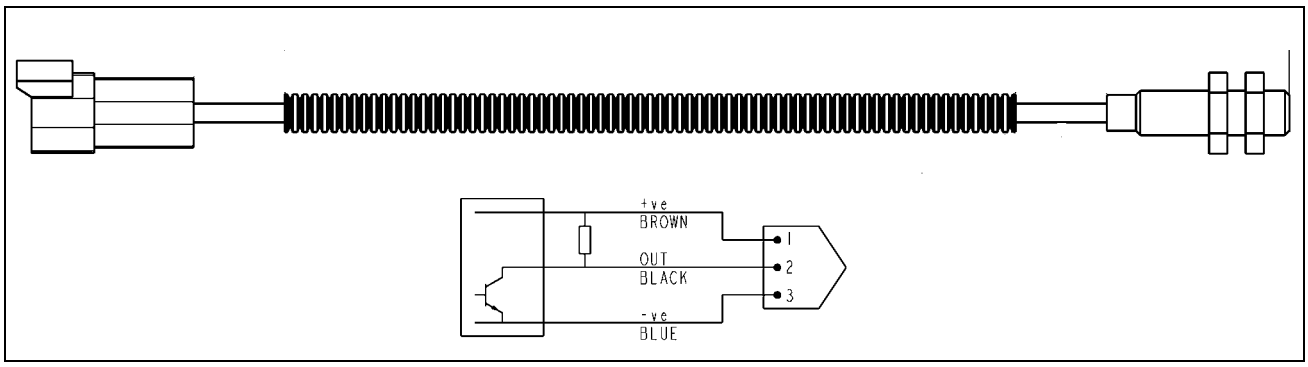
1. Sub-tank
2. Float
3. Sensor
4. Connector

Engine oil level sensor

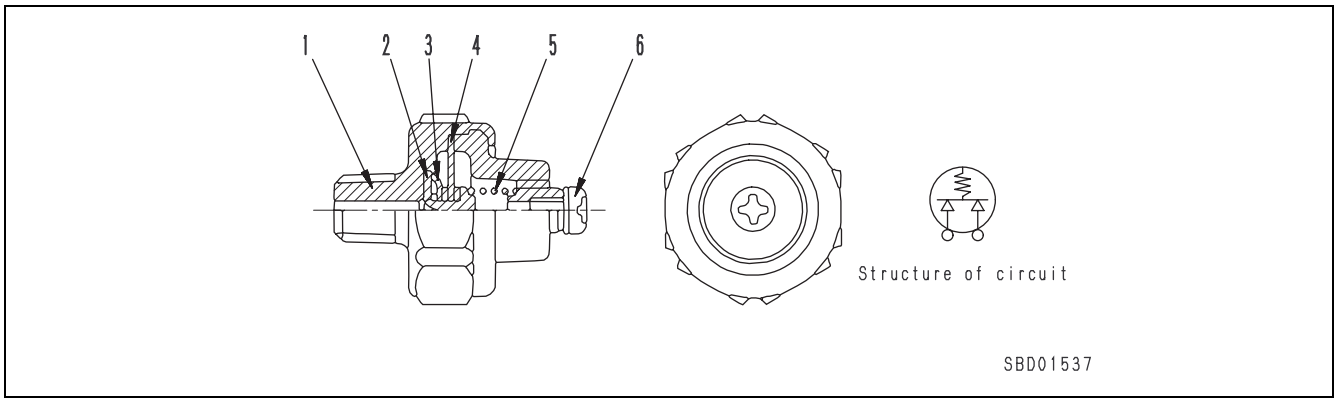


1. Connector
2. Bracket
3. Float
4. Switch

Brake proximity sensor

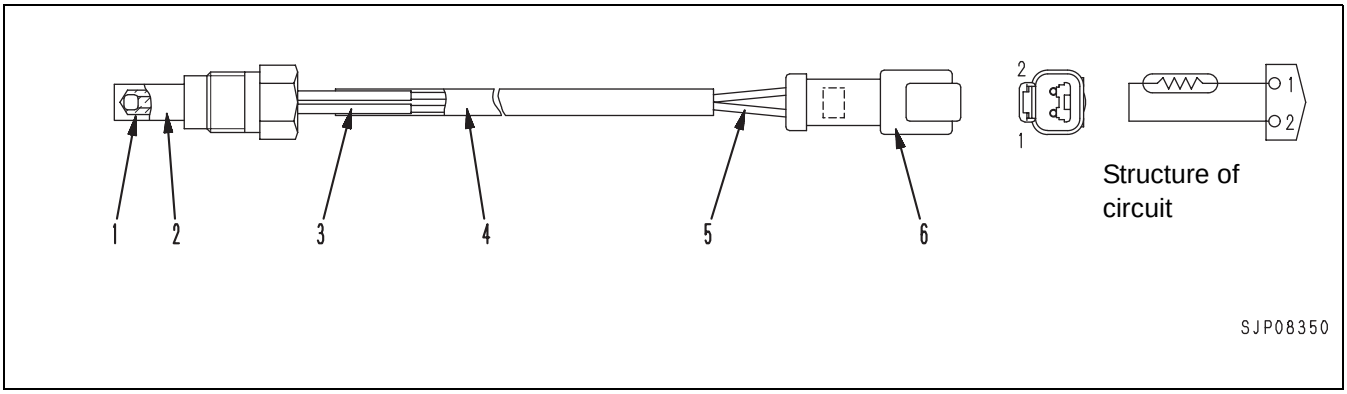


Engine oil pressure sensor (For low pressure)



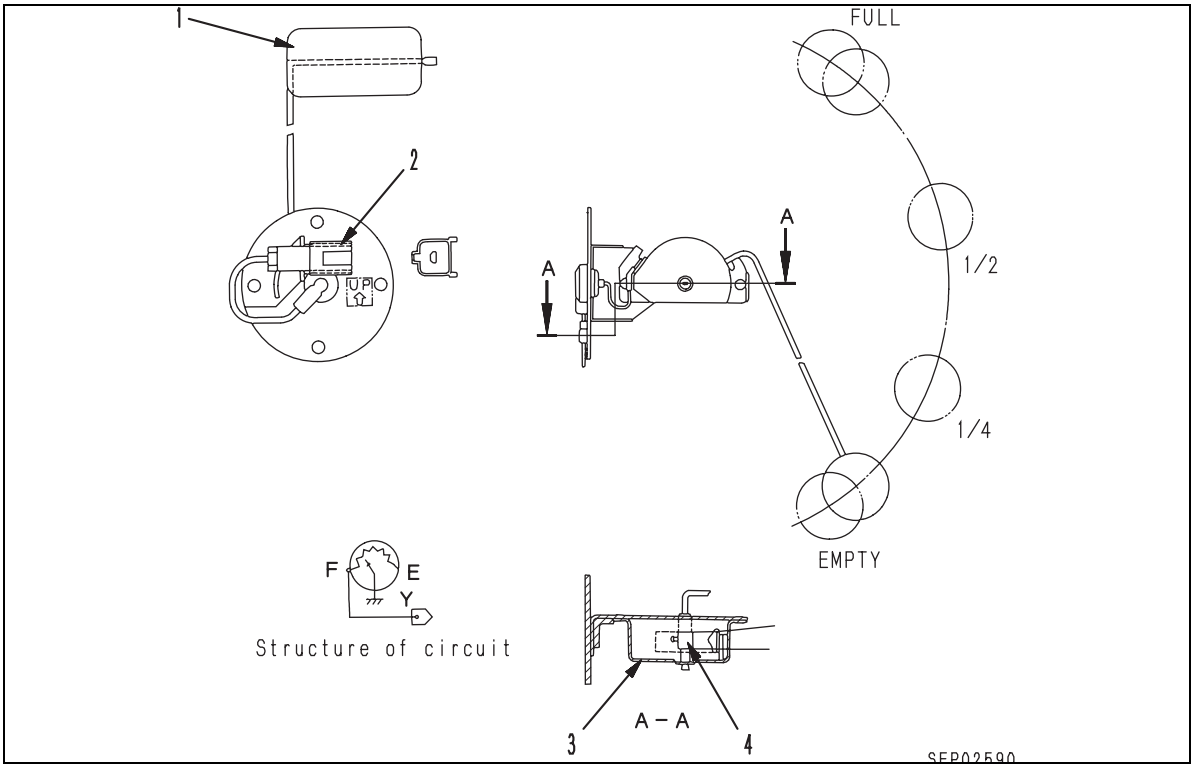
1. Plug
2. Contact ring
3. Contact
4. Diaphragm
5. Spring
6. Terminal

Coolant temperature sensor
Hydraulic oil temperature sensor



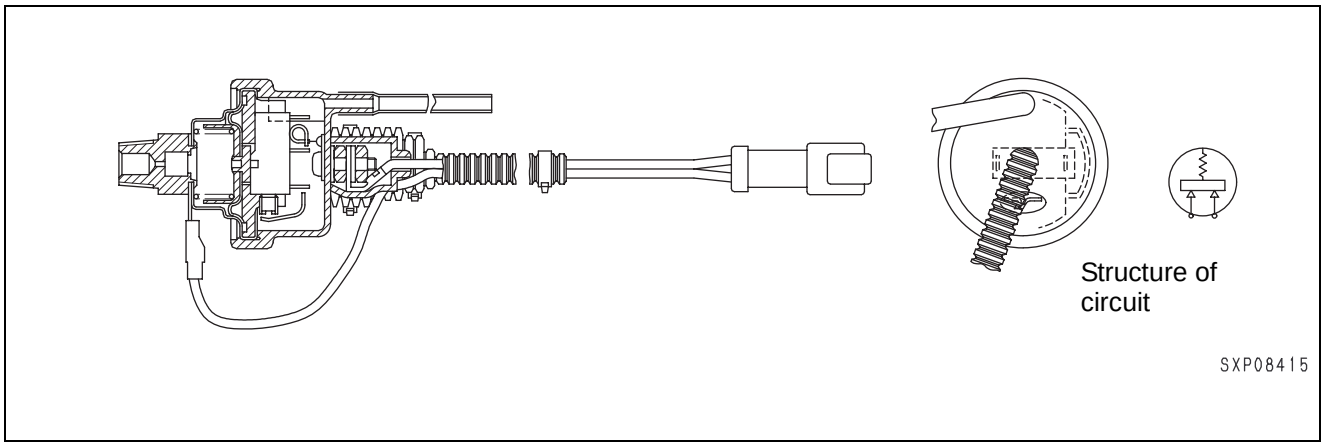
1. Thermistor
2. Body
3. Tube
4. Tube
5. Wire
6. Connector

Fuel level sensor

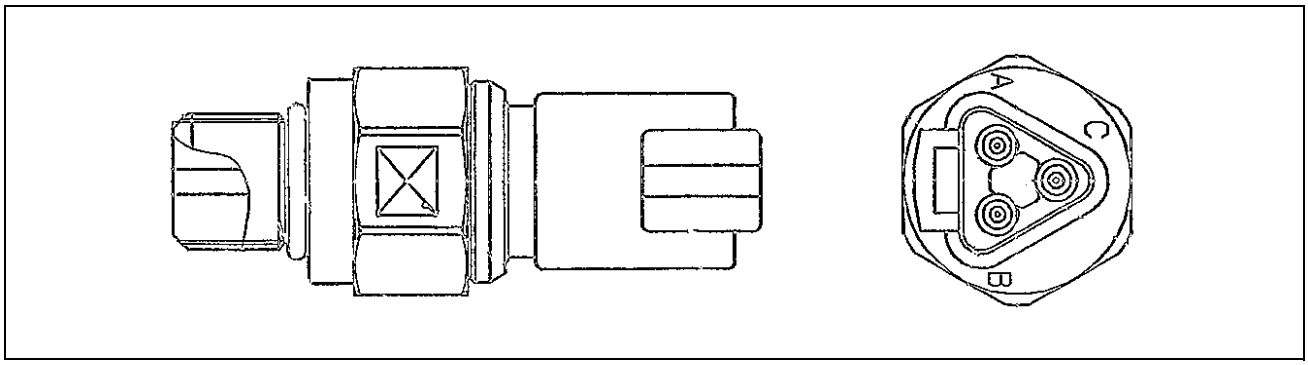


1. Float
2. Connector
3. Cover
4. Variable resistor

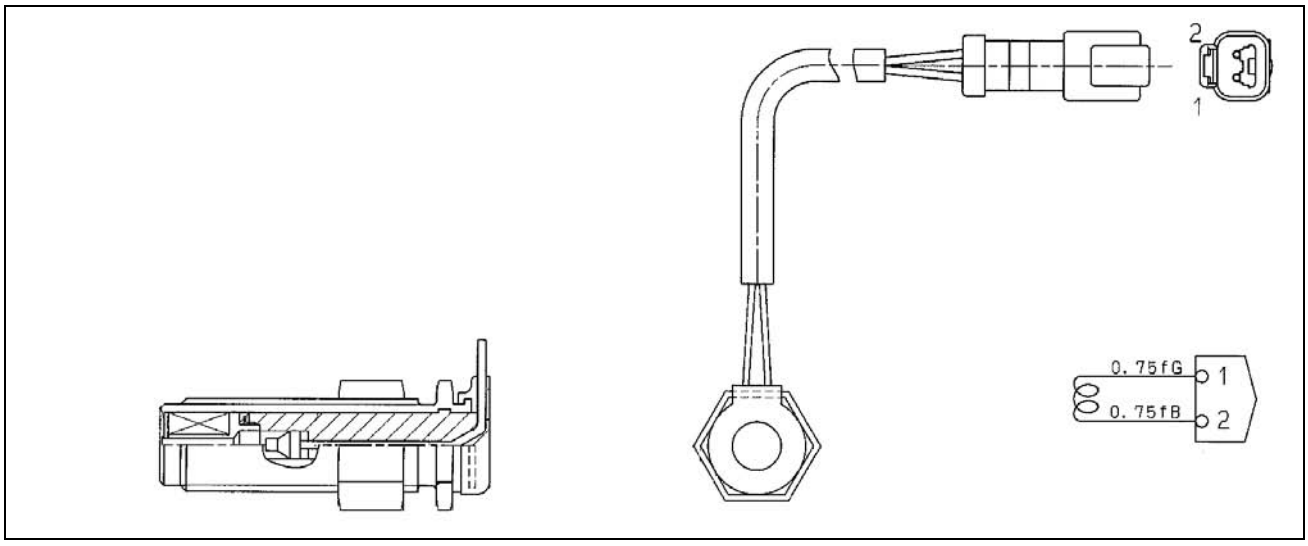
Air cleaner clogging sensor



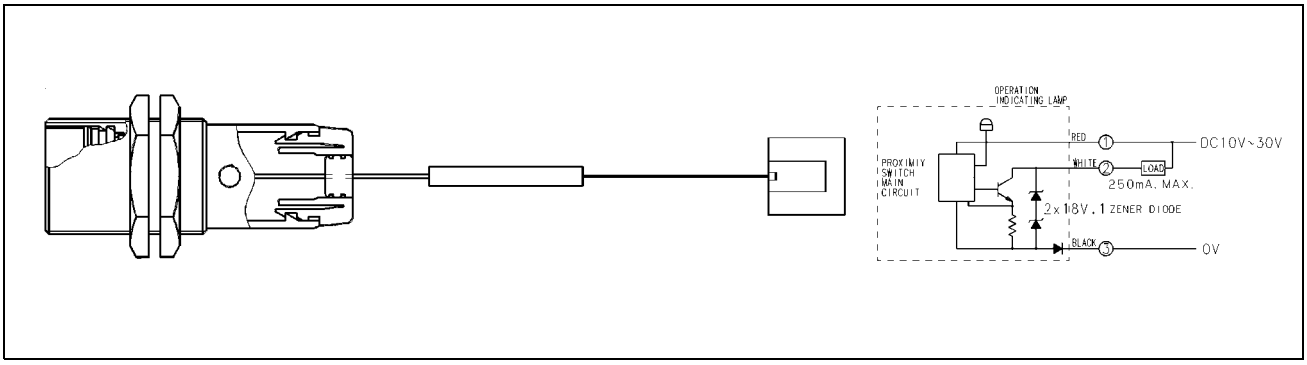
Overload Caution sensor



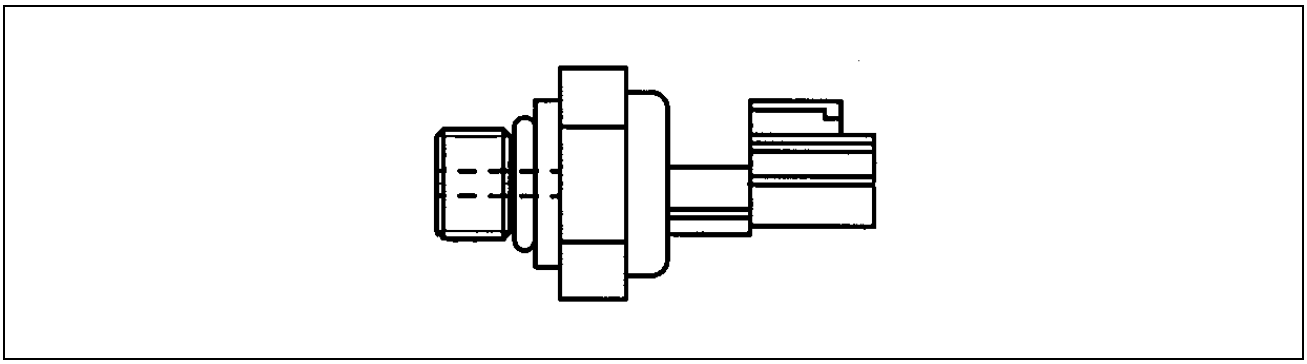
Engine speed sensor
Tranmission speed sensor



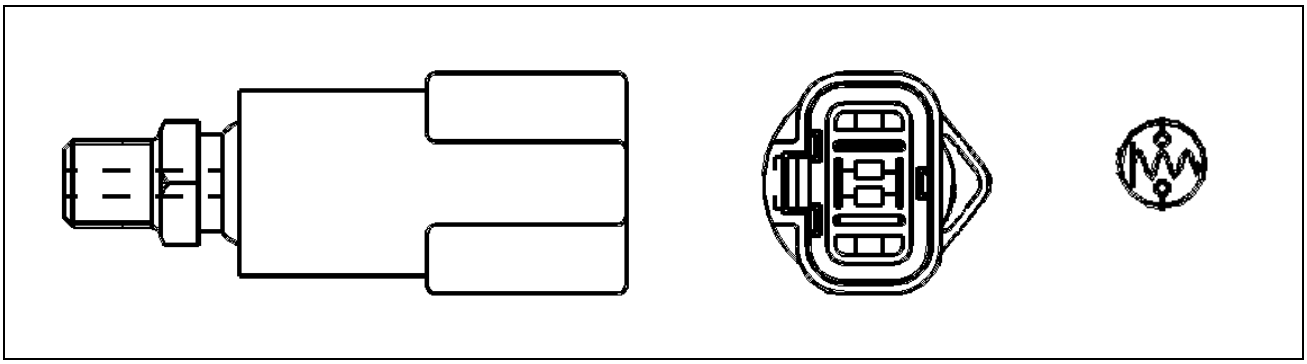
Swing proximity sensor



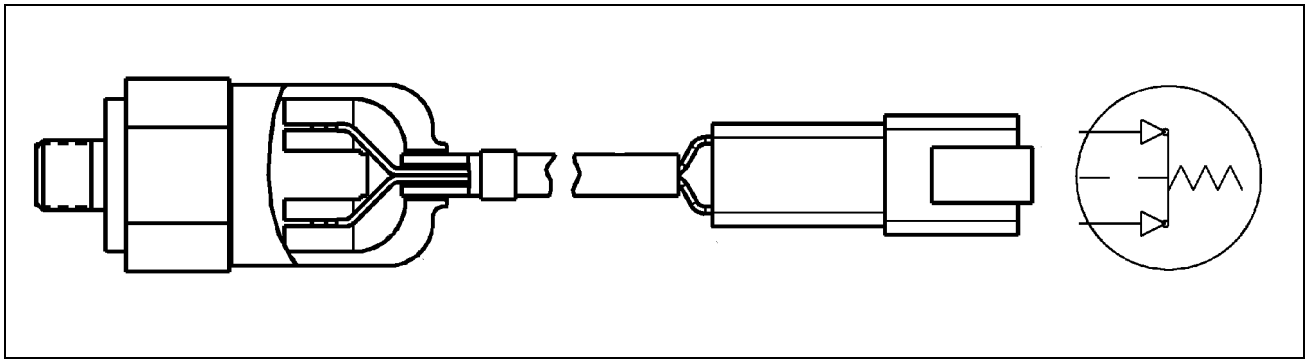
Travel PPC sensor



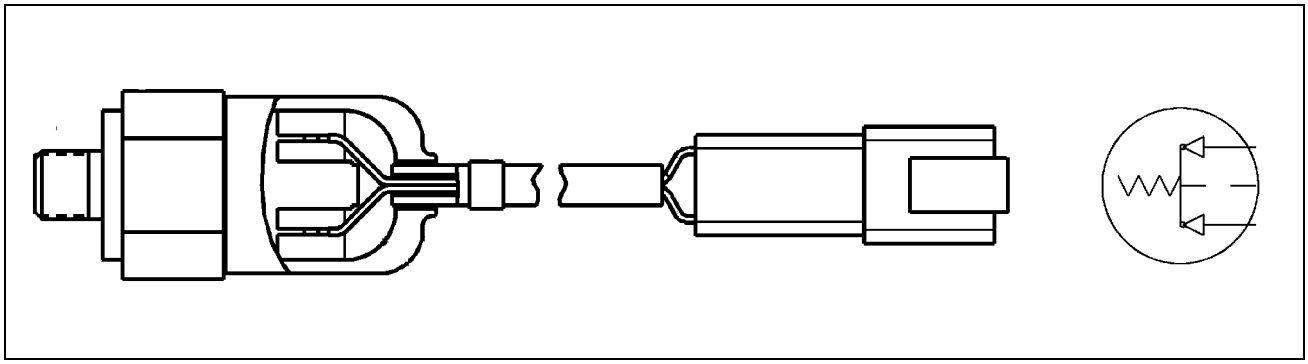
PPC pressure sensor



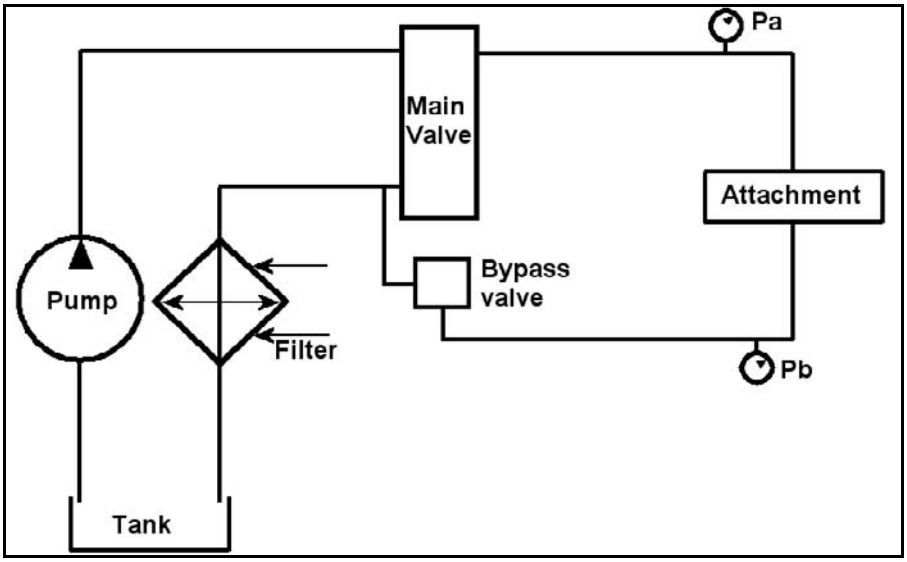
Park brake pressure sensor
Brake acculmulator low pressure sensor



Brake stop light sensor



1st ATTACHMENT CIRCUIT HYDRAULIC PERFORMANCE (MAIN VALVE BYPASSED)

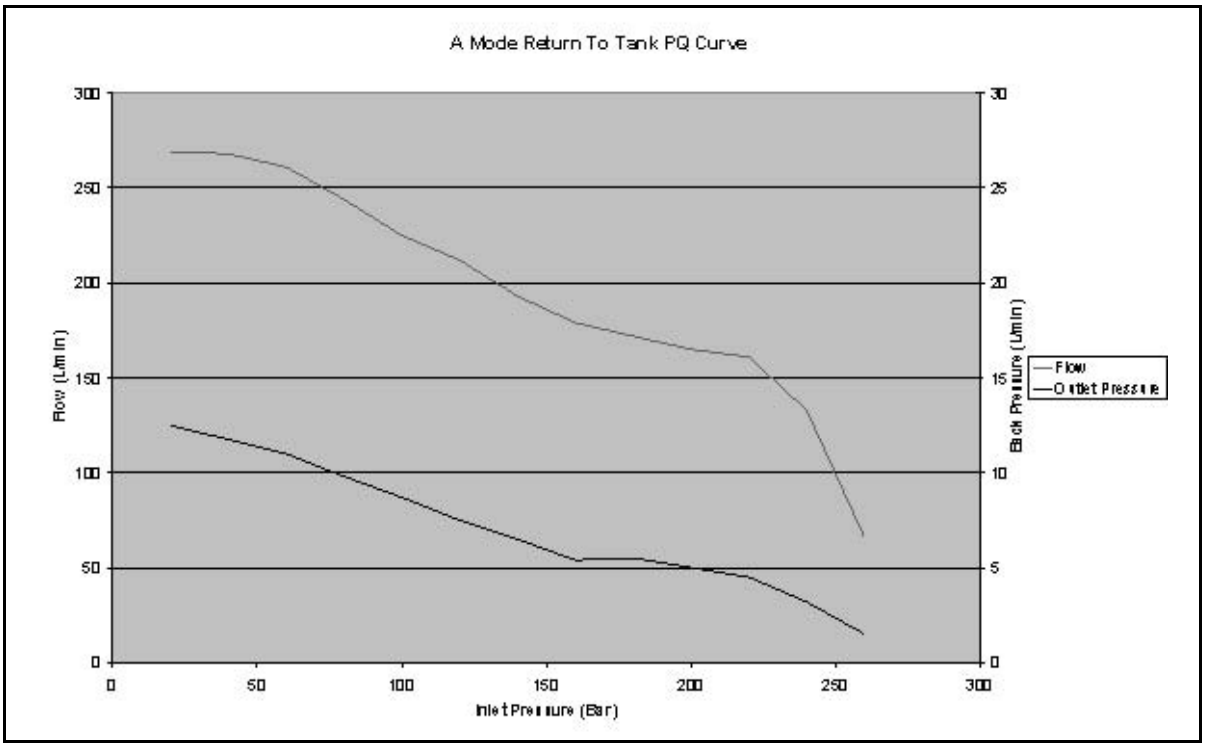


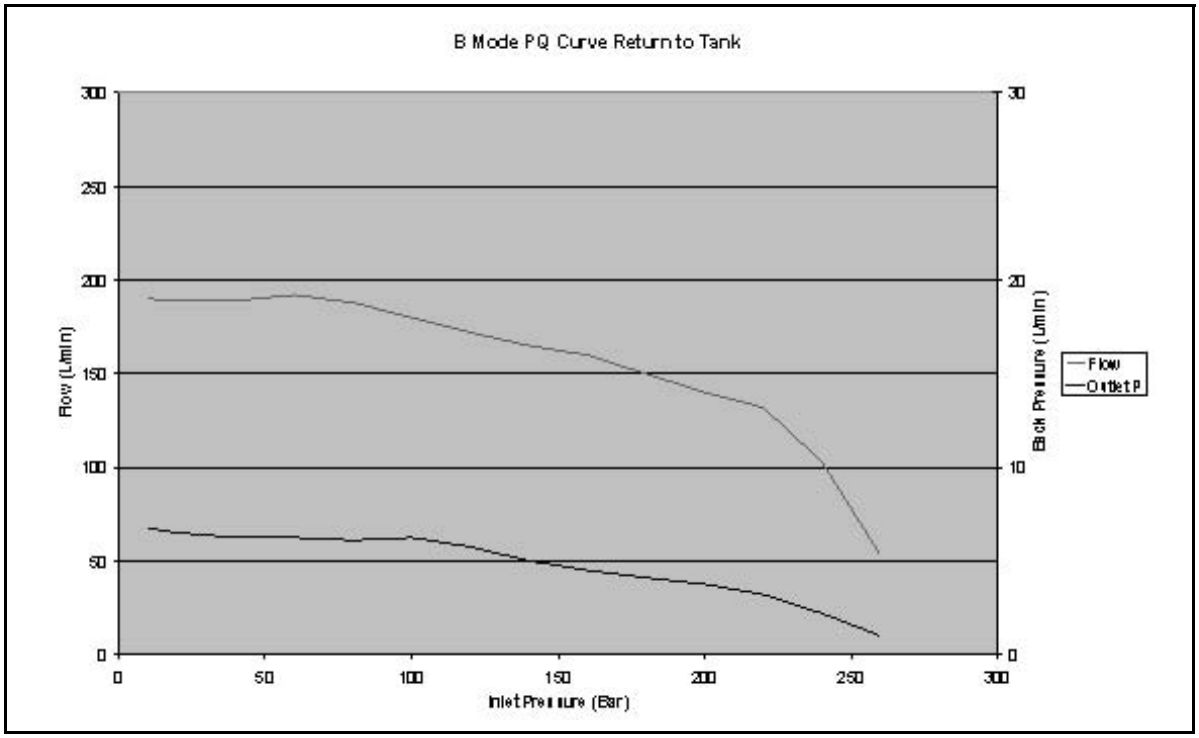
The performance of the hydraulic system when operating the 1st attachment circuit is shown below.

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.

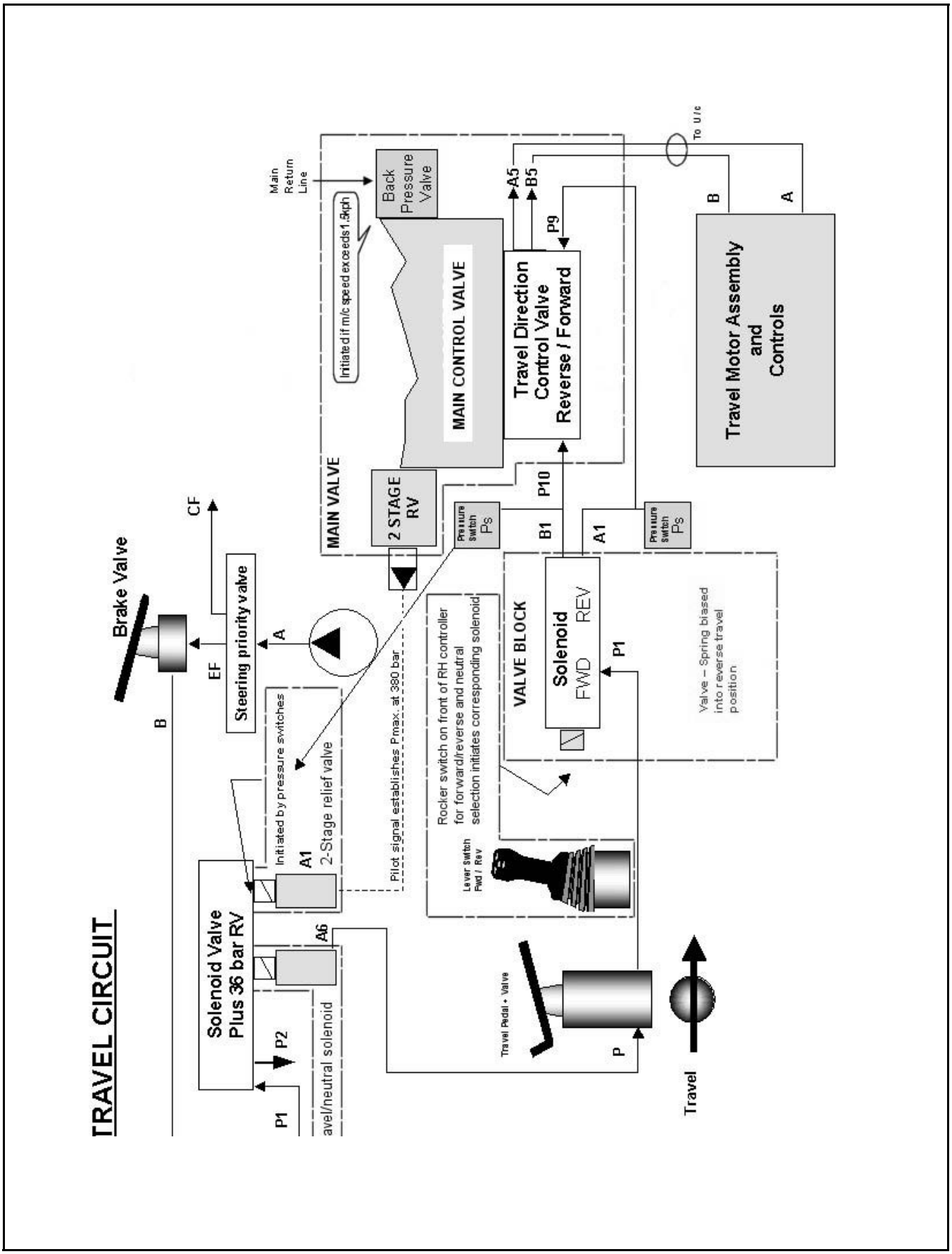




NOTE: The data given here is intended as a guide only. This is because the data is typical for an excavator of this type therefore there will be variation from one machine to another.

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)

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

★ **Operators Input via travel mode switch**

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

★ **Torque Maximisation**

When travel / reverse solenoid is selected the respective pressure switch in the line initiates the 2 stage relief valve solenoid valve. This valve directs a pilot signal into connection 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)

Operator's Input via travel mode switch

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

★ In Lo mode the controller energises the transmission clutch control solenoid valve in the on position. This gives a travel speed of 0 - 10 kph.

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

In both of these operating modes, 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)

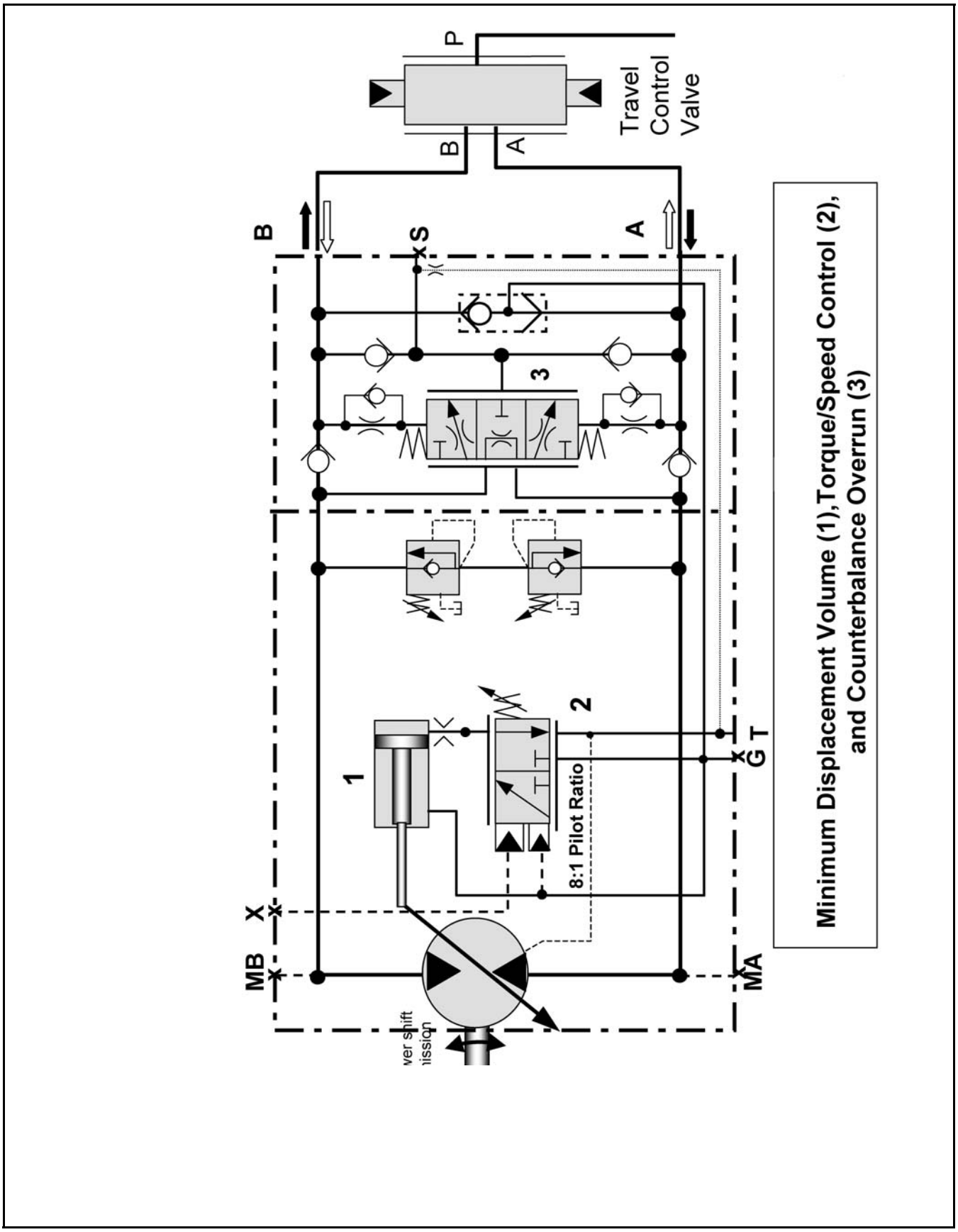
★ To prevent cavitation of the travel motor a 2 stage back -pressure valve is incorporated in the main return line. This valve is part of the main control valve. (Set at 4 bar. This is raised to 8 bar during travel.)

★ 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.

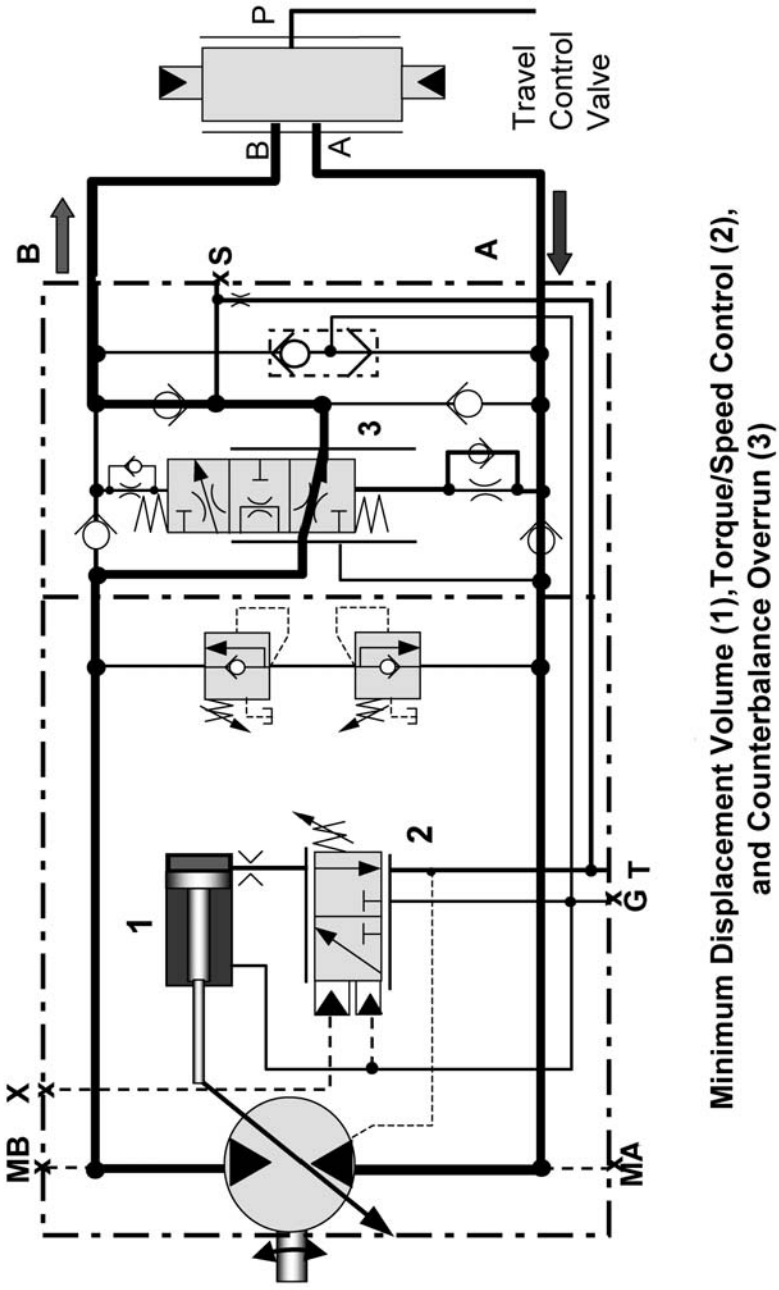
1. Travel Motor.

1.1 Shown in the neutral position.



1. Travel Motor.

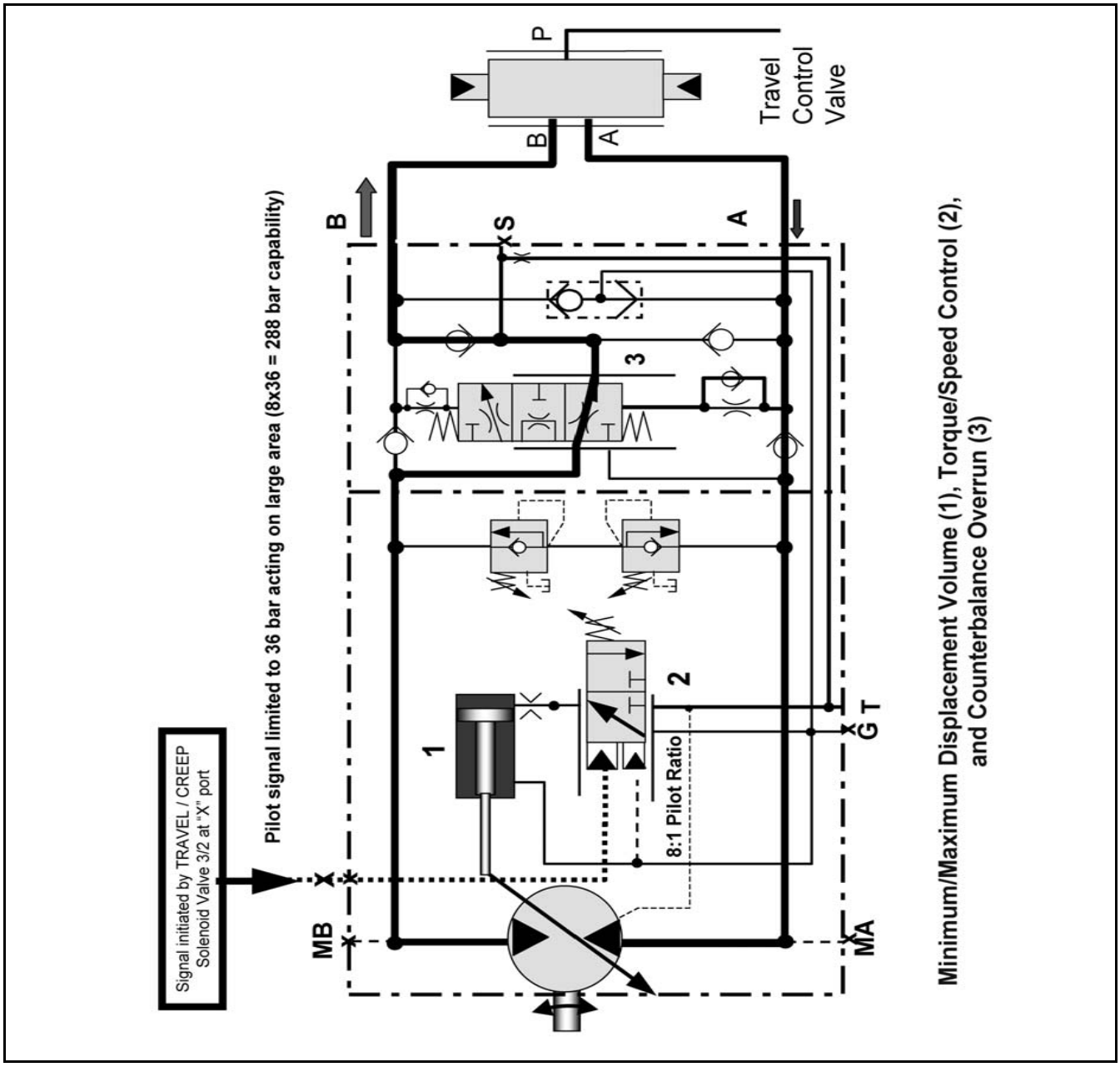
1.2 Flow path representing: Low Torque - High speed with counterbalance taking up an active position. (Default for Travel)
The counterbalance valve (3) is activated ehich allows a constant flow of oil around the circuit.
From port A through to port B the motor displacement is at minimum pending maximum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



1. Travel Motor

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

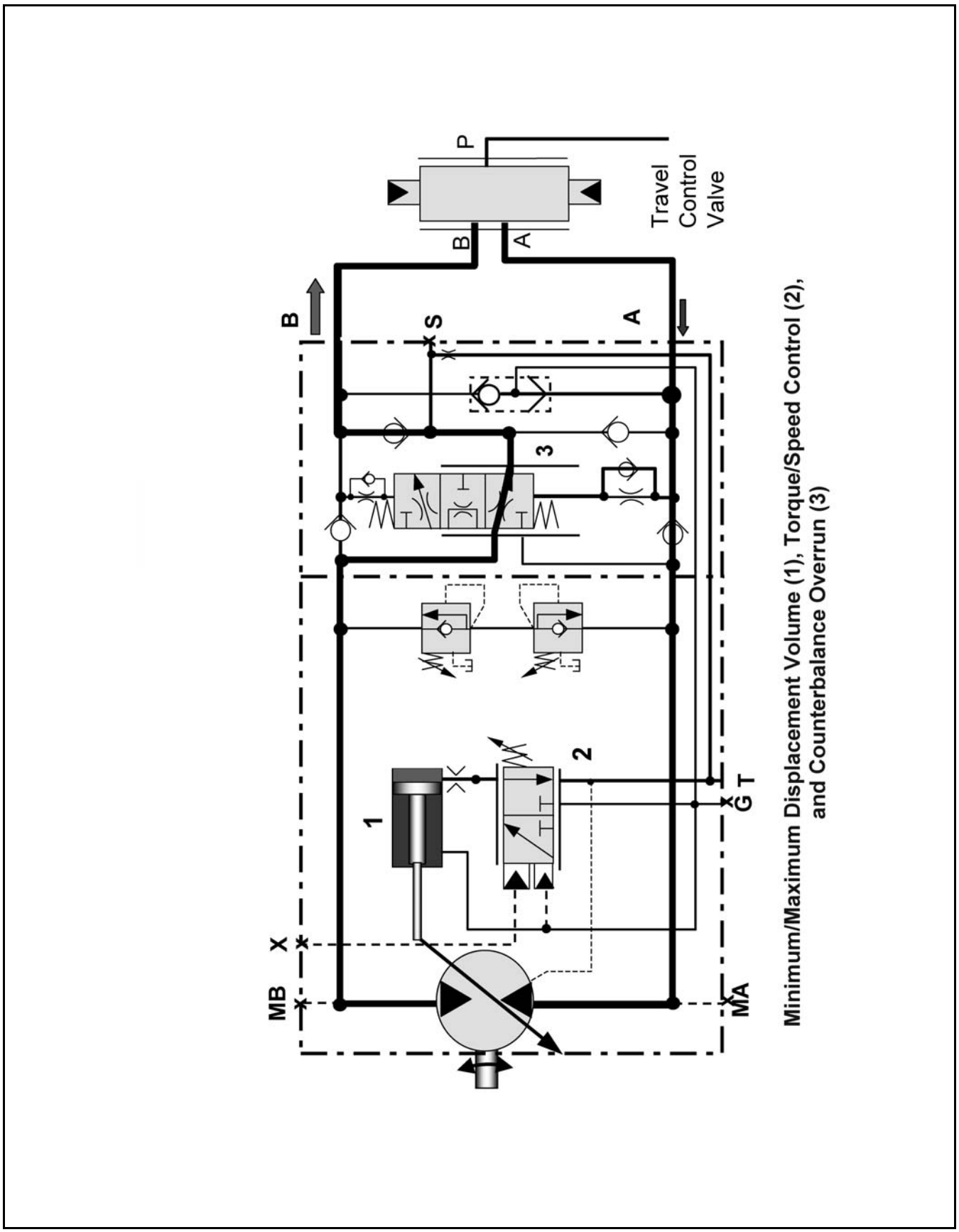
It can be seen from the diagram that the spool moves across on the torque speed control valve (2) which directs the flow to move the servo and supply the motor displacement to maximum giving creep speed of 2.5kph



1. Travel Motor

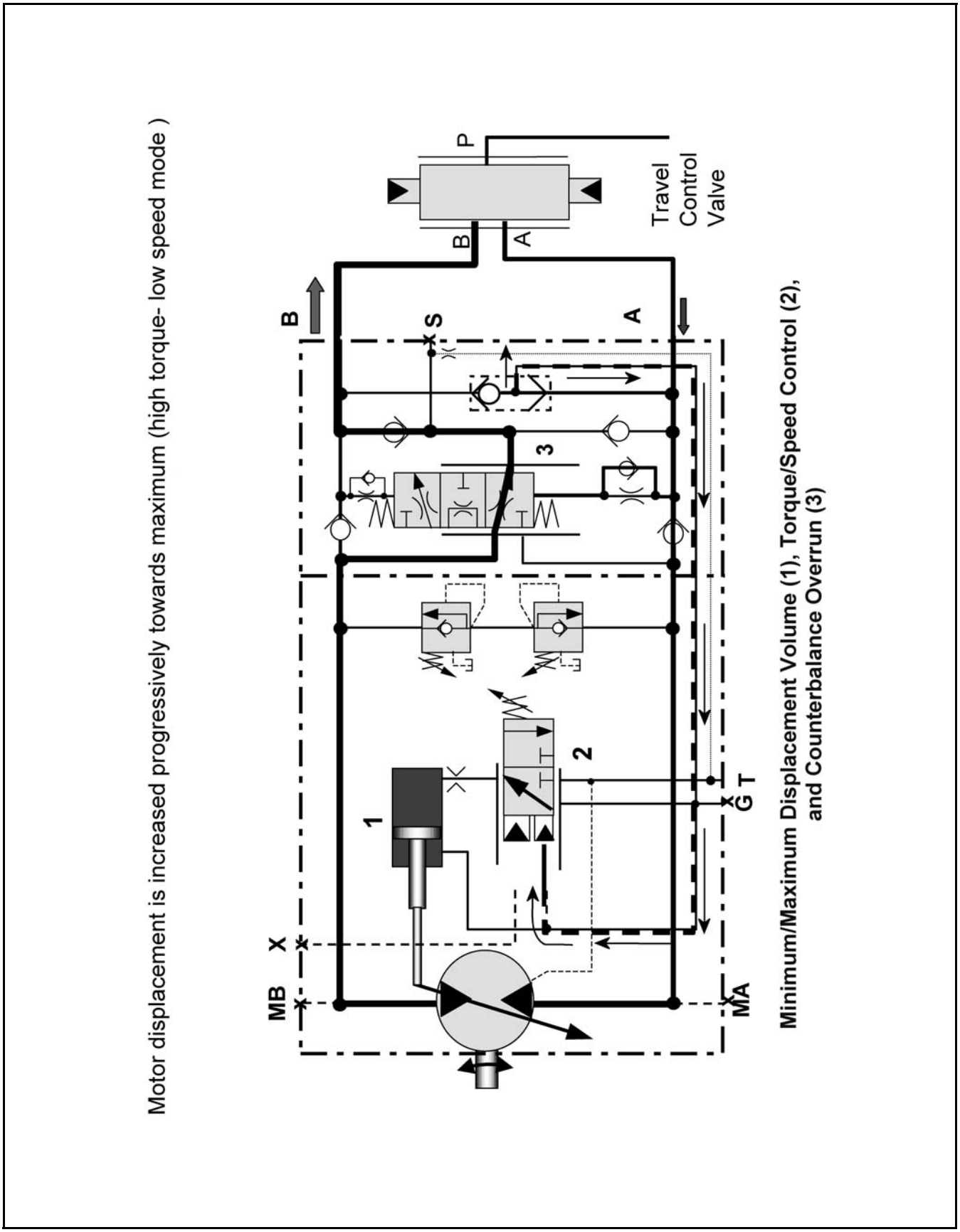
1.4 Opposing load torque on motor increases causing Torque / Speed control valve to react.

Diagram showing Hi speed with minimum displacement



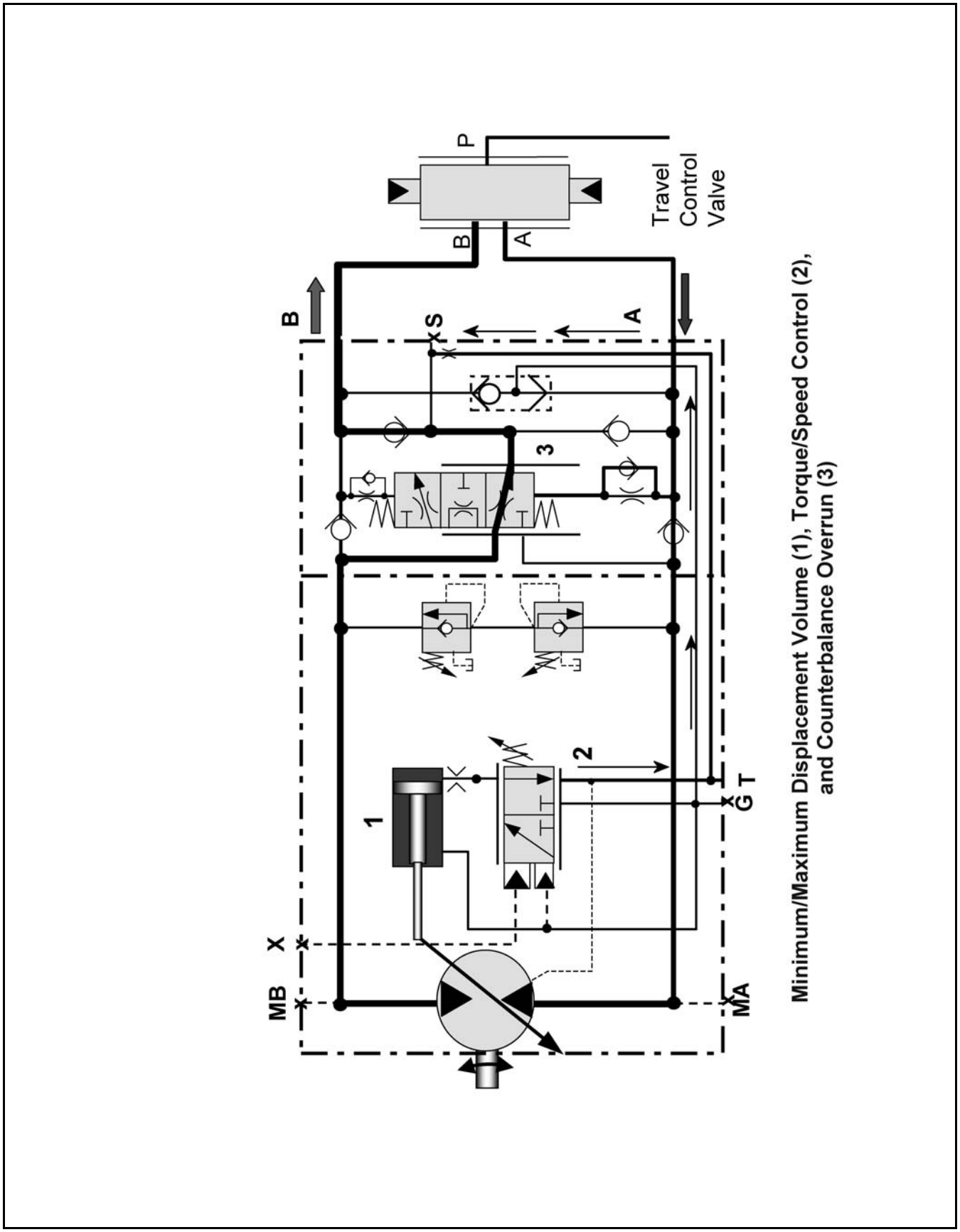
1. Travel Motor.

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



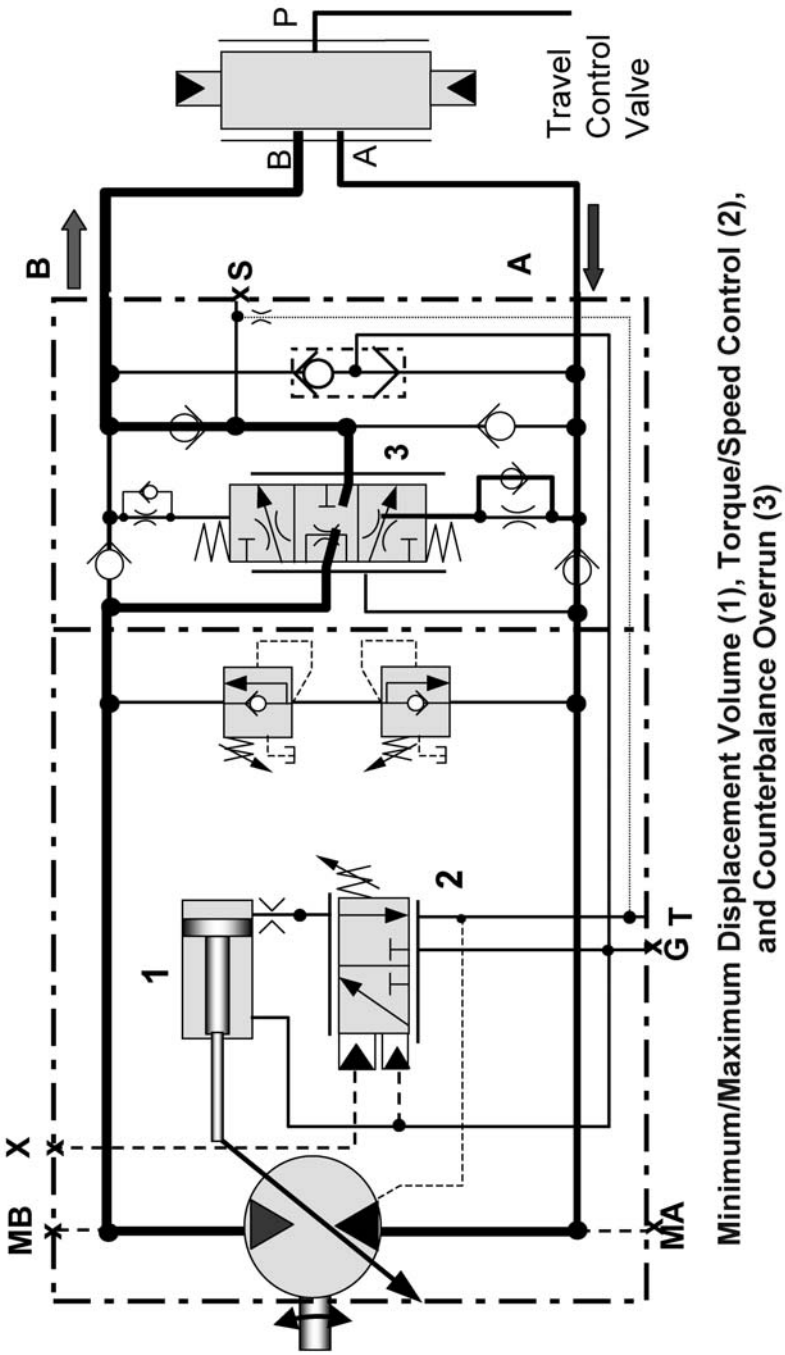
1. Travel Motor.

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.



1. Travel Motor.

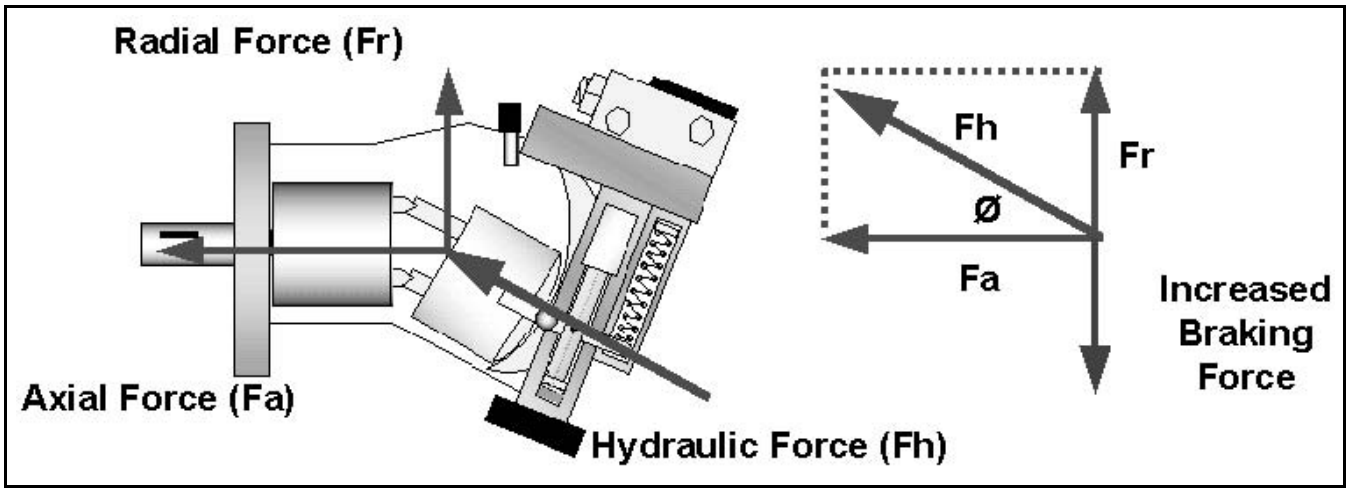
1.6 Motor begins to overrun and pressure falls on supply side: This causes counterbalance valve to begin to close and throttle return to flow motor. Pressure line in return line rises providing a braking torque.



1. Travel Motor.

1.7 Travel Motor Performance.

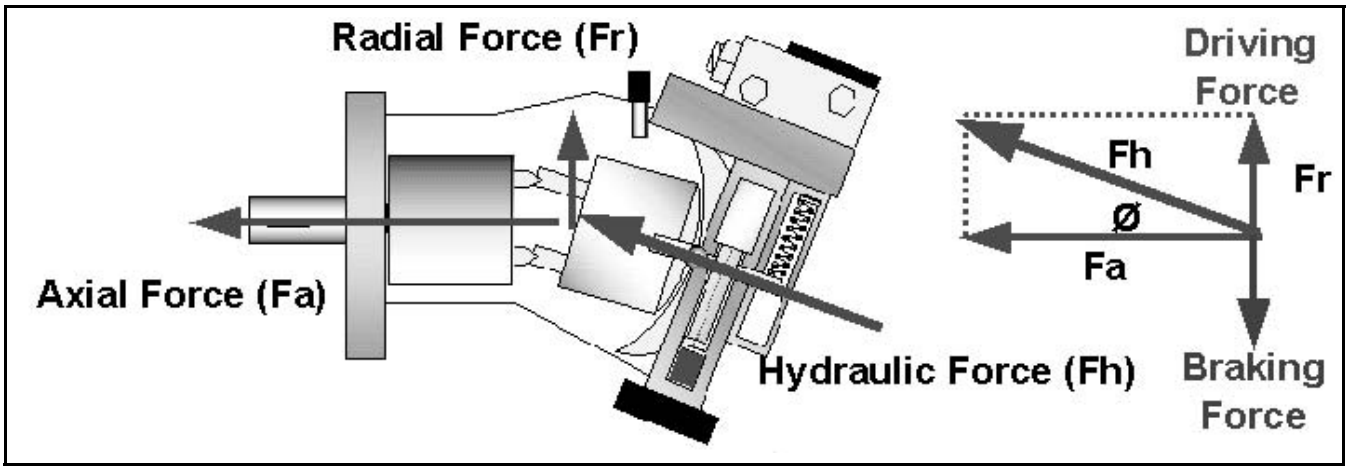
1.7.1 High Torque - Low Speed.



- 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.

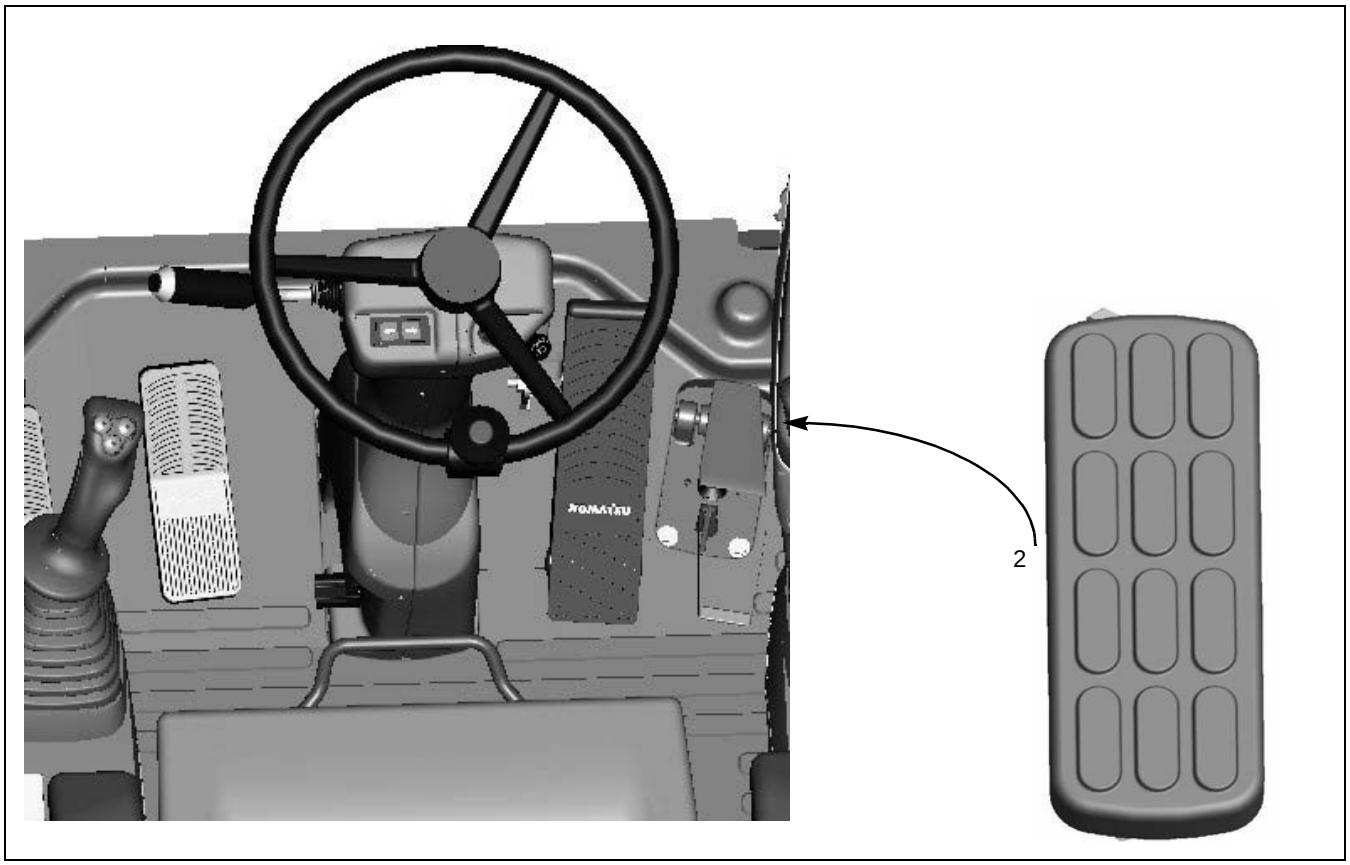


- Ø represents motor minimum displacement angle (usually about 5 to 7°). Fr represents the radial force developed by the hydraulic oil pressure which in turn develops the corresponding driving or braking torque.

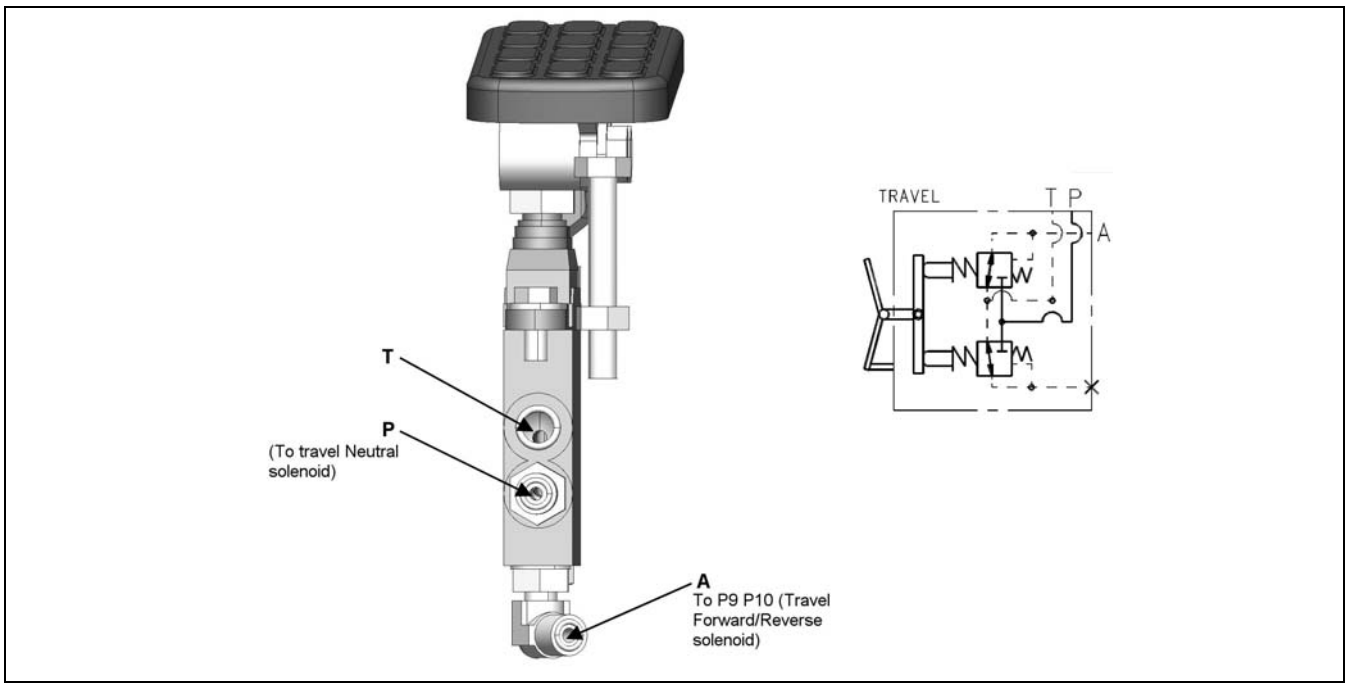
Motor size:

31 - 107cm^3 / rev for machines rated at 35 kph.

2. Travel Pedal

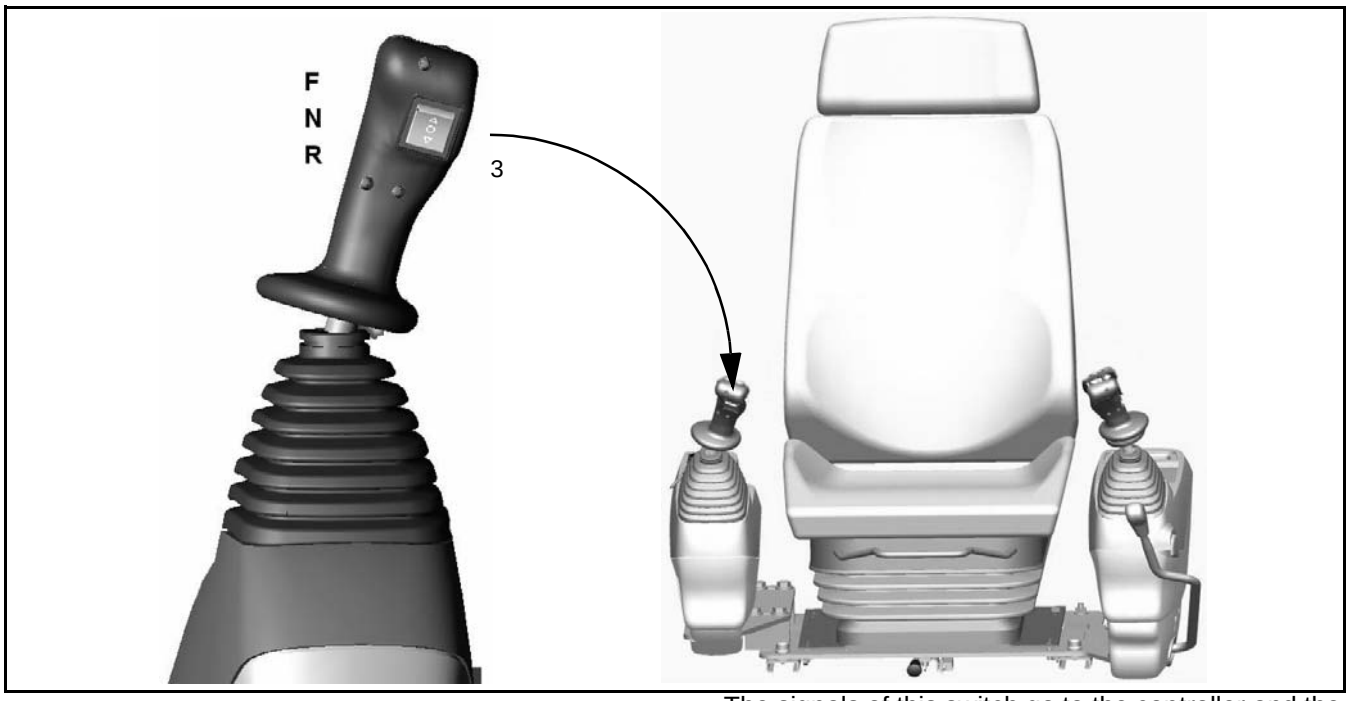


2.1. Travel Pedal Schematic.



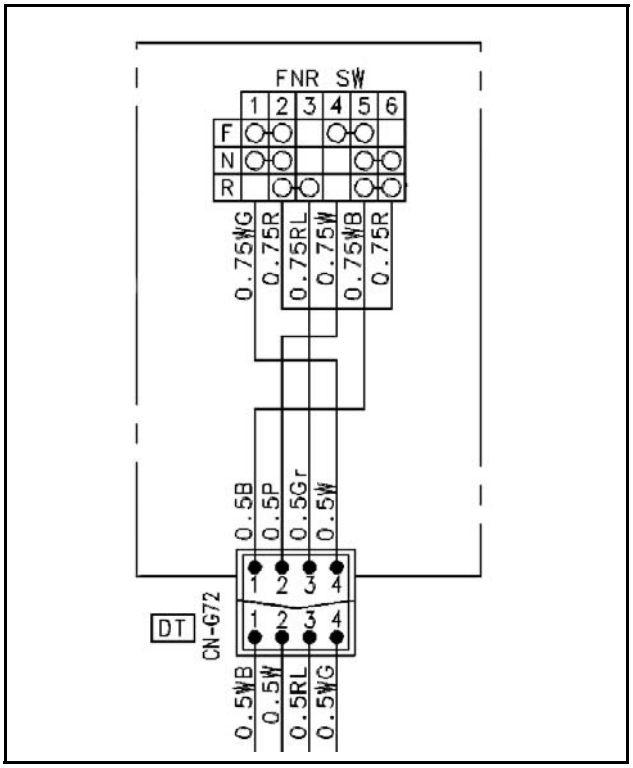
2.2. Travel Pedal: Located to the extreme right of the steering column on the floor of the Operators cab, a proportional valve when activated controls the flow of oil to the travel motor.

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



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

3.1 F-N-R Switch Schematic.



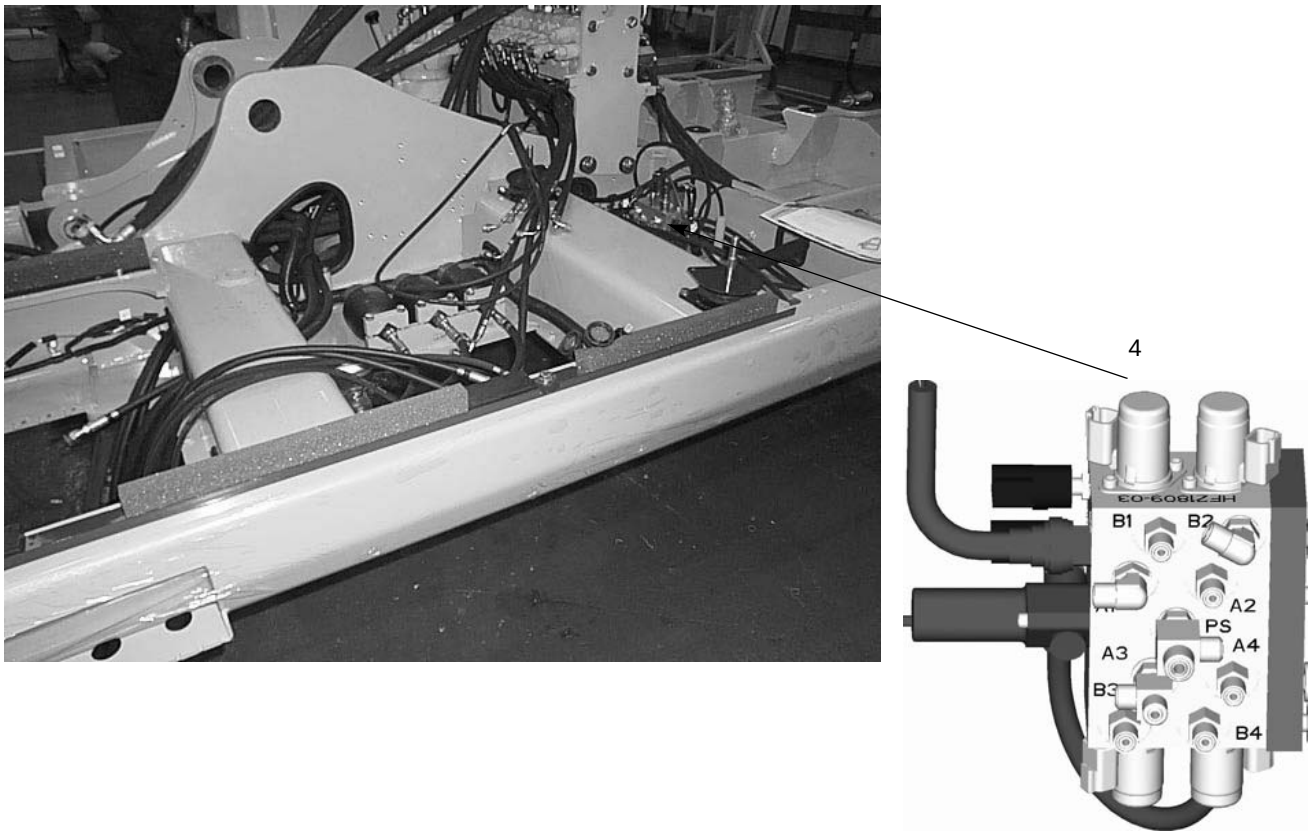
F/N/R Status Table

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)

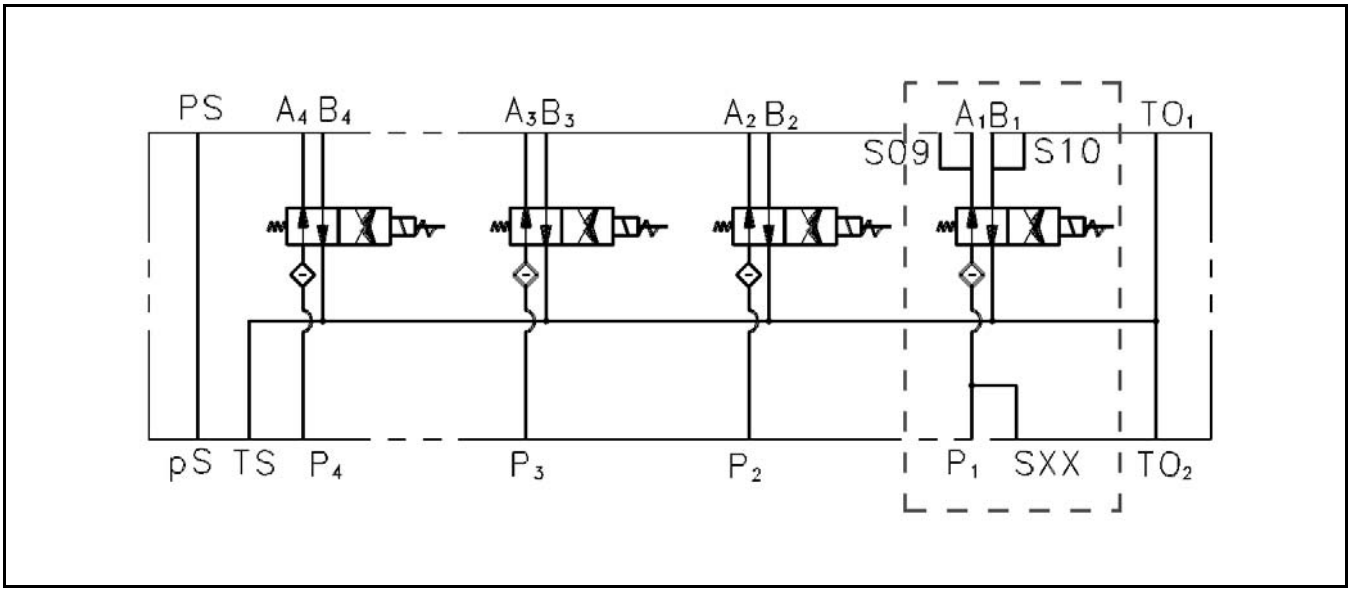
3.2 F-N-R Switch: Located on the front of the RH control lever, this rocker type switch determines whether the travel direction is forward, reverse or neutral.

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

4. Forward / Reverse Travel Solenoid

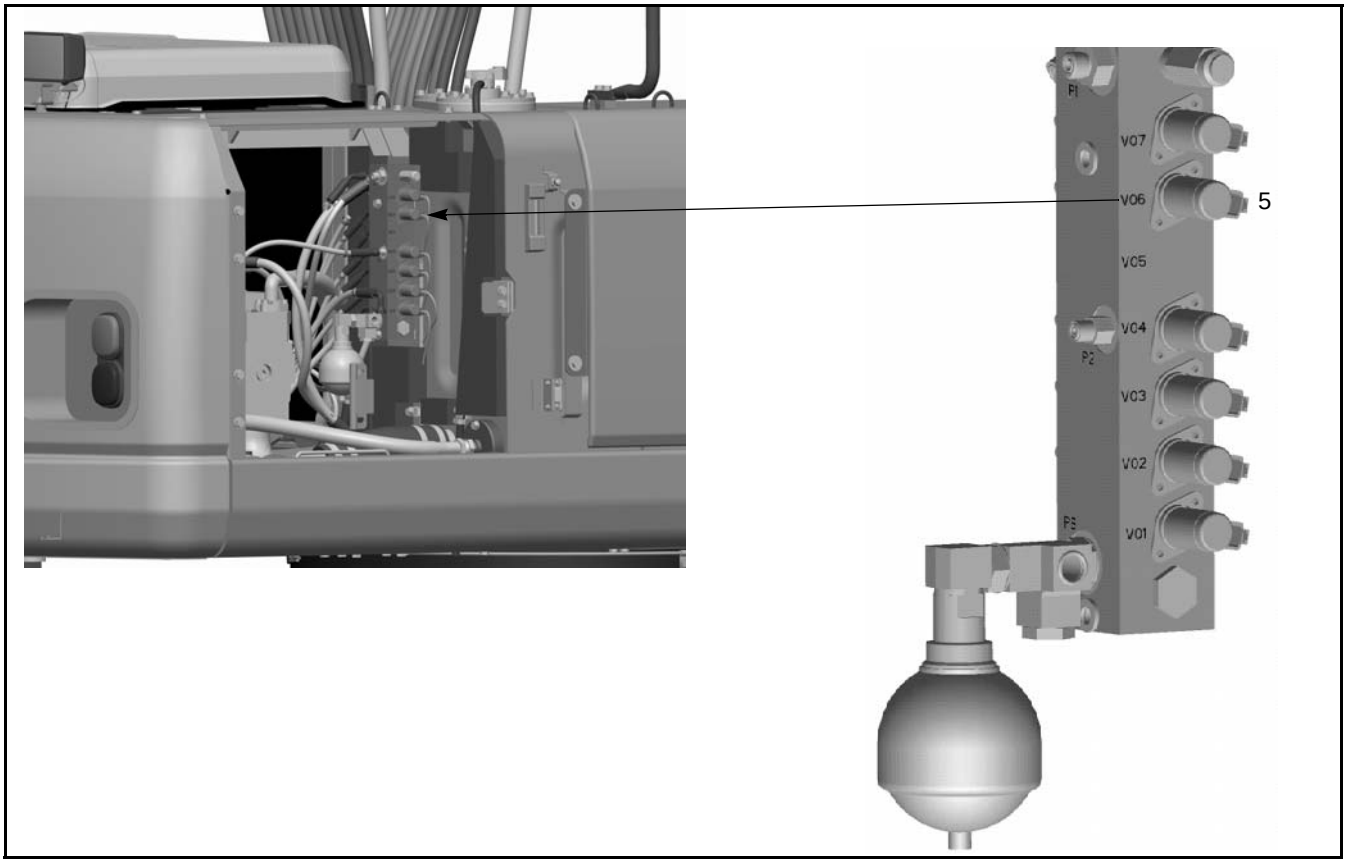


4.1 Forward / Reverse Travel Solenoid Schematic

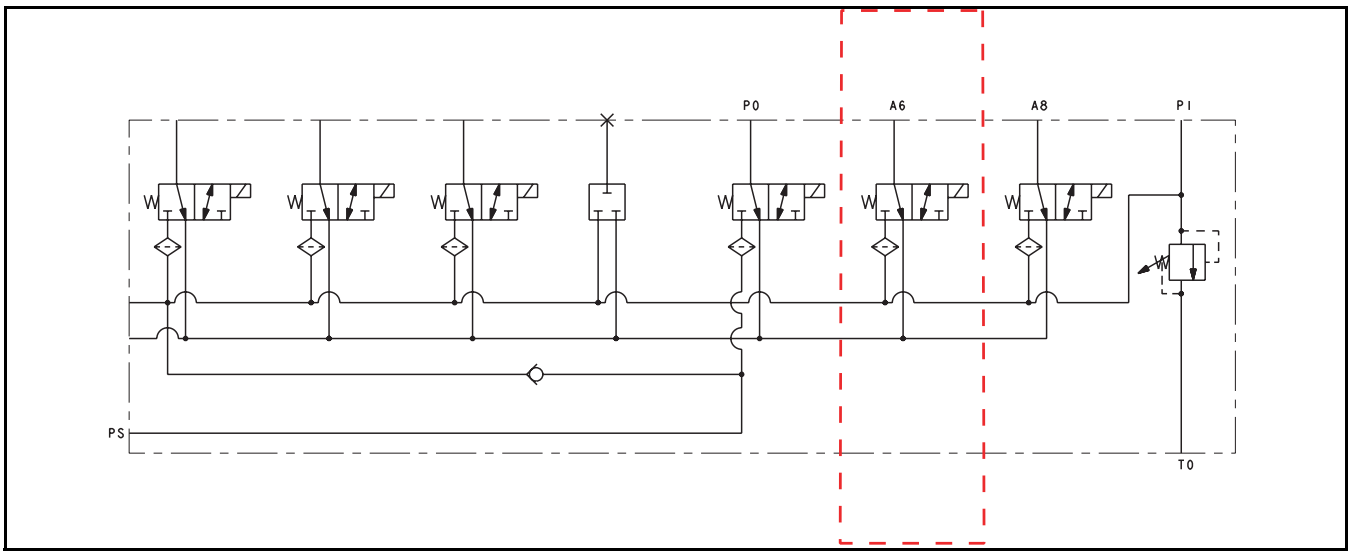


4.2 Forward / Reverse Travel Solenoid: Located on the 4-stage solenoid block in the service compartment at the rear of the operators cab. This device controls the travel motor direction (forward or reverse) by a signal from the F-N-R switch. Solenoid energised ~Forward or Reverse. Travel is engaged,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

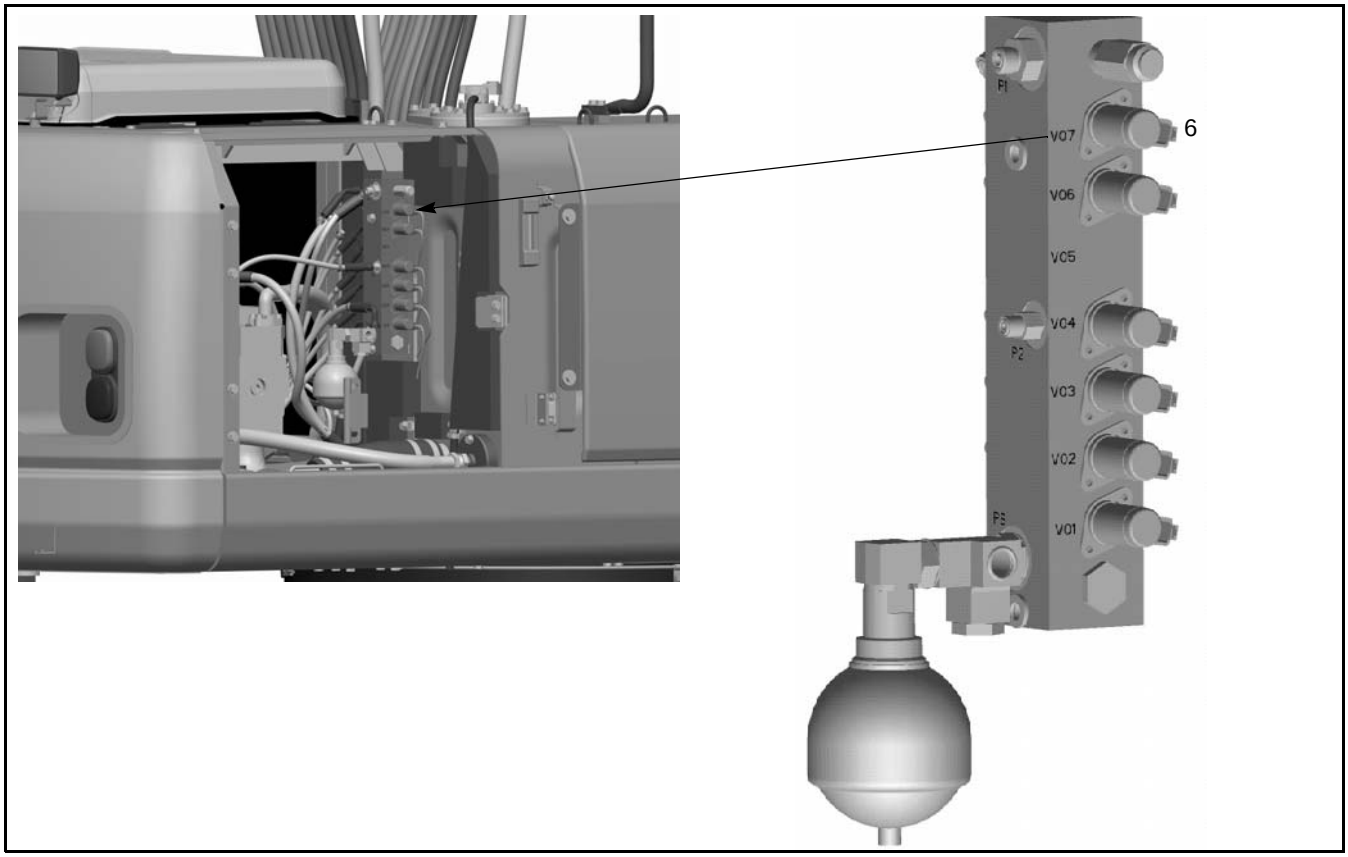


5.1 Travel Neutral Solenoid Schematic.

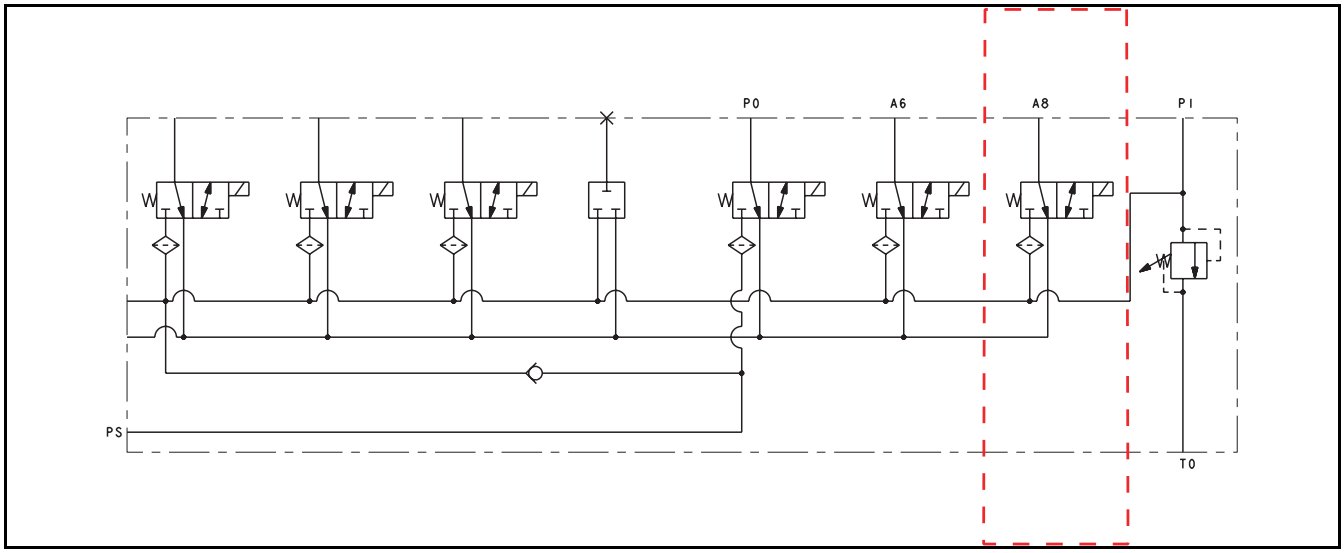


5.2Travel Neutral Solenoid: Located on the 7-stage solenoid manifold in the service compartment at the rear of the operators cab. This device interlocks with the forward / reverse solenoid to give supply pressure to the foot pedal control valve.
Solenoid active - PPC pressure to foot valve
Solenoid inactive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



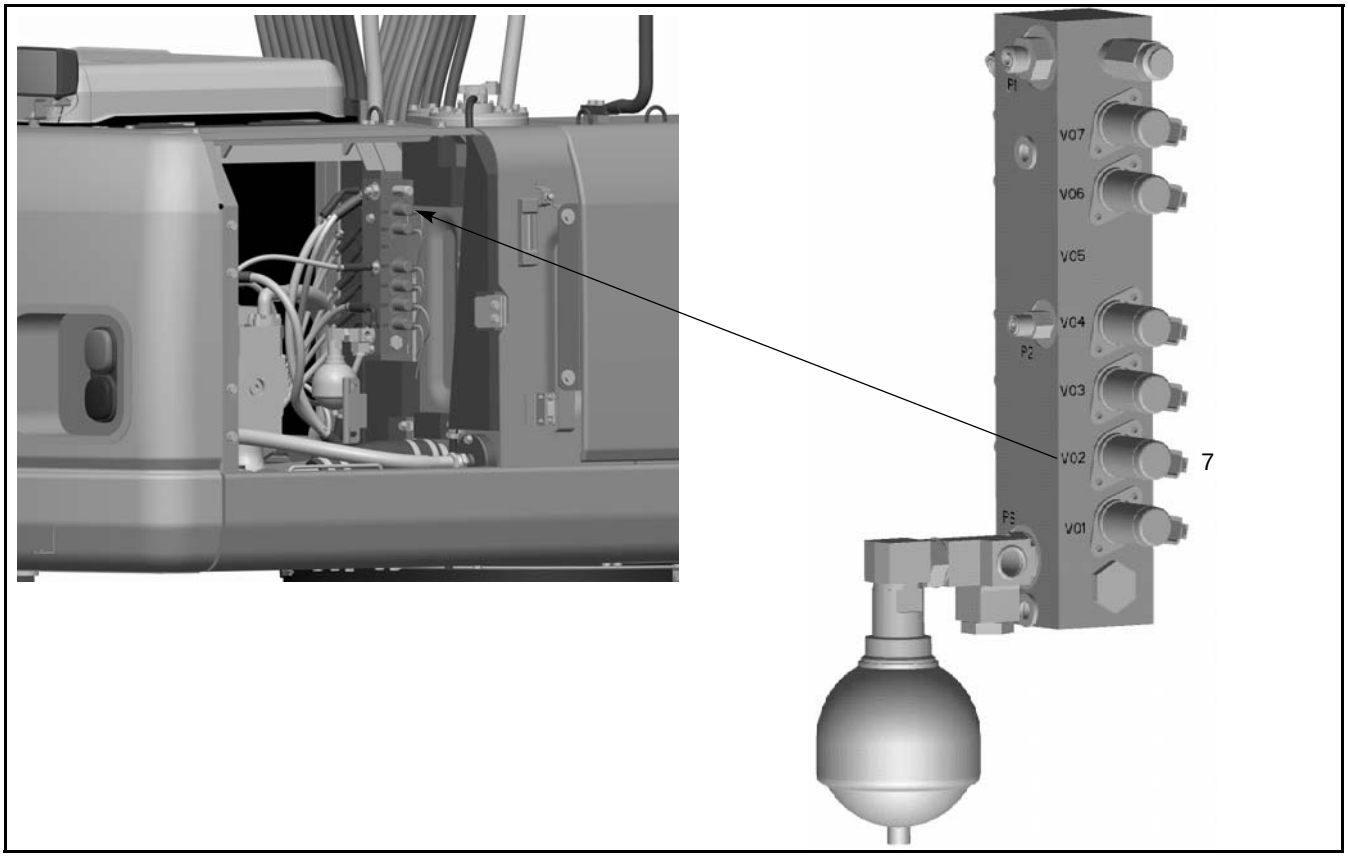
6.1 Travel Creep Solenoid Schematic.



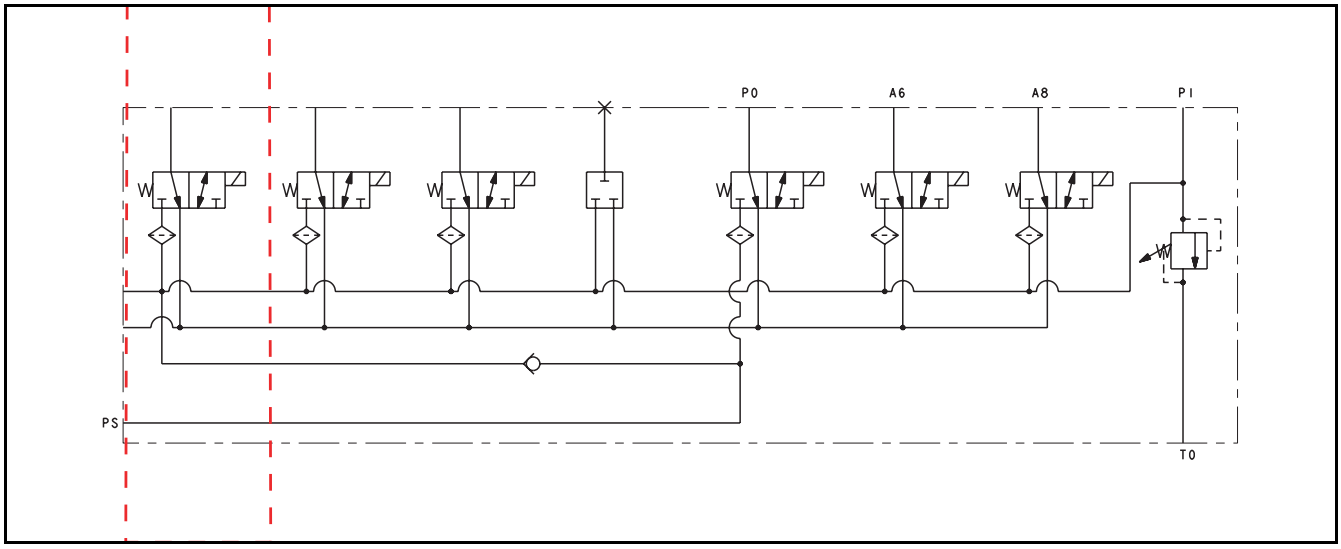
6.2 Travel Creep Solenoid: Located on the 7-stage solenoid manifold in the service compartment at the rear of the operators cab. When this device is activated 'CREEP' mode is selected and travel speed, sends PPC pressure to port X on travel motor ensure ttravel motor stays at maximum displacement.

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

7. 2-Stage Relief Solenoid.



7.1 2-Stage Relief Solenoid Schematic.

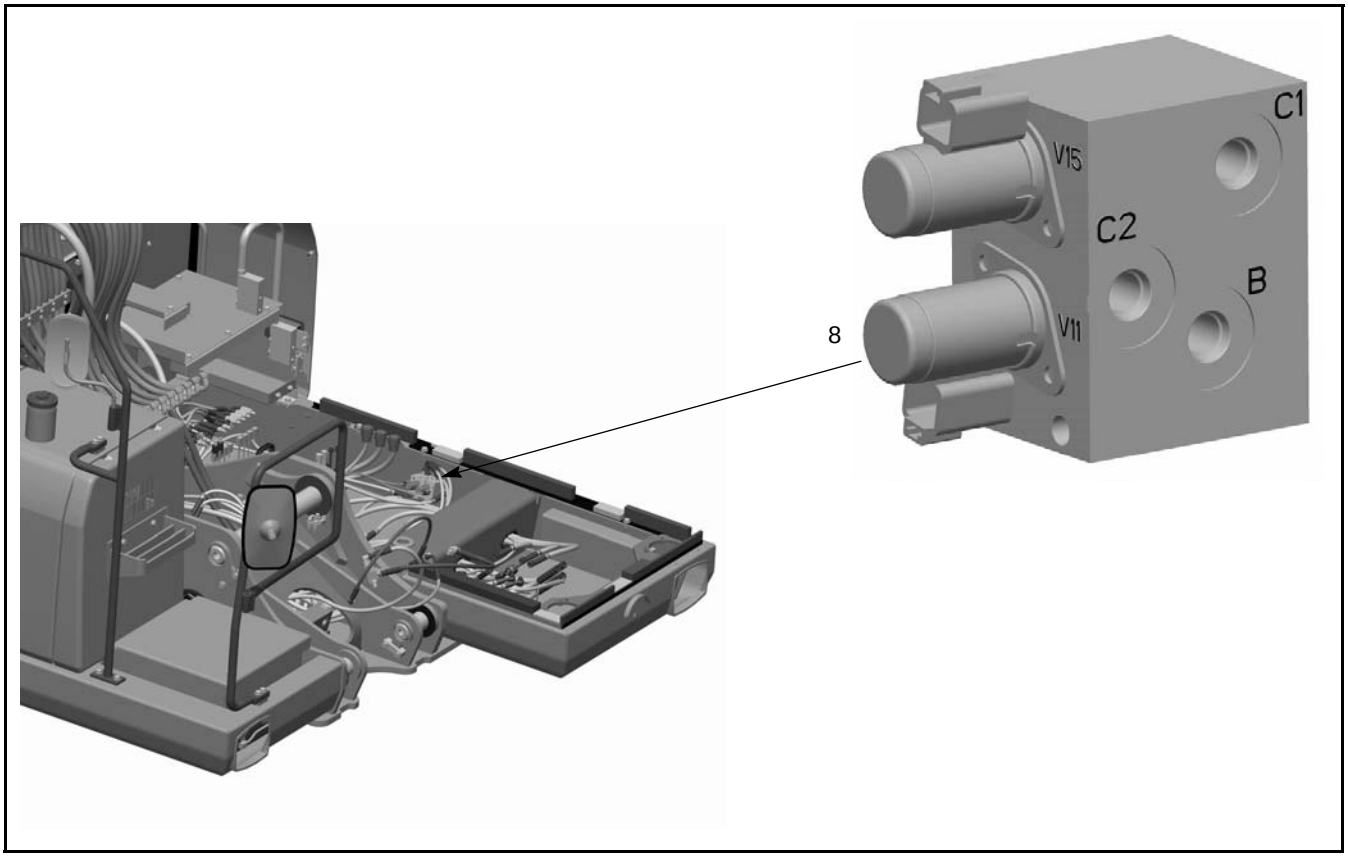


7.2 2-Stage Relief Solenoid: Located on the 7-stage solenoid manifold in the service compartment at the rear of the operators cab. This device is activated when the forward / reverse travel solenoid is selected.

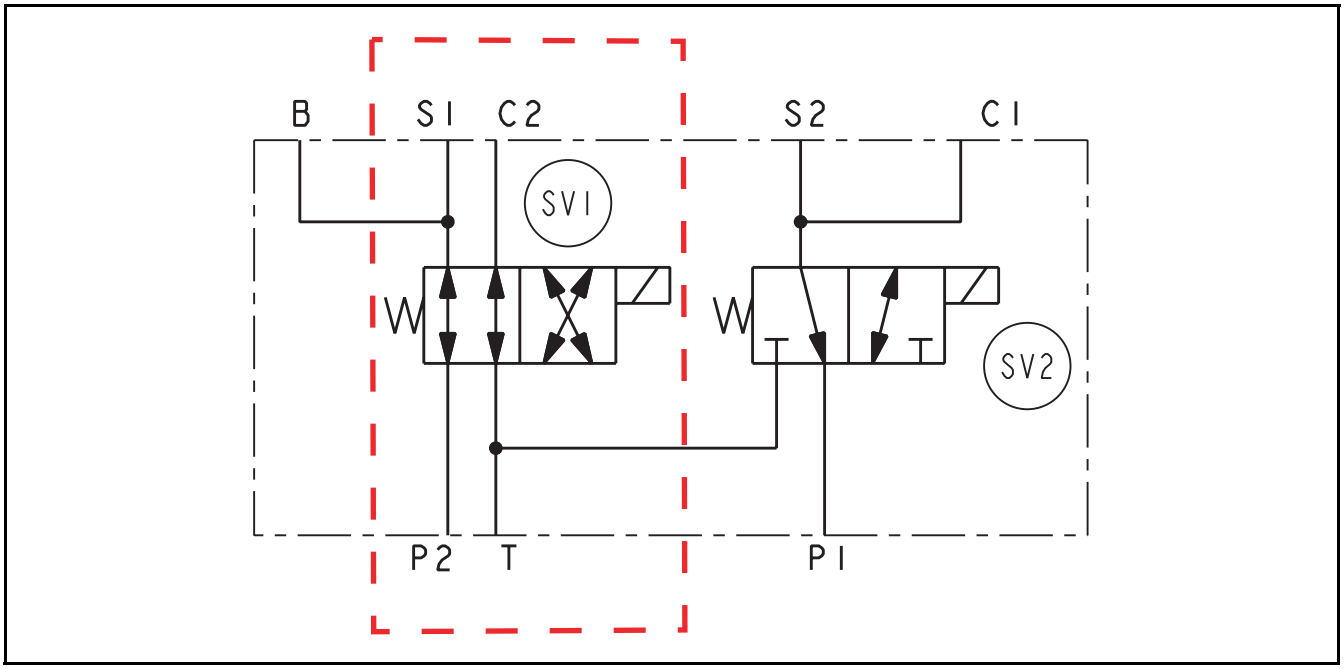
- The relief pressure in the normal working mode is 34.8 Mpa (355 kg/cm^2). If the 2-stage relief function is turned on, however, the relief pressure rises to about 37.2 MPa (380 kg/cm^2). By this operation, the hydraulic force is increased further
- Operating condition for turning on 2-stage relief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

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

8. Transmission Clutch Control Valve



8.1 Transmission Clutch Control Valve Schematic.

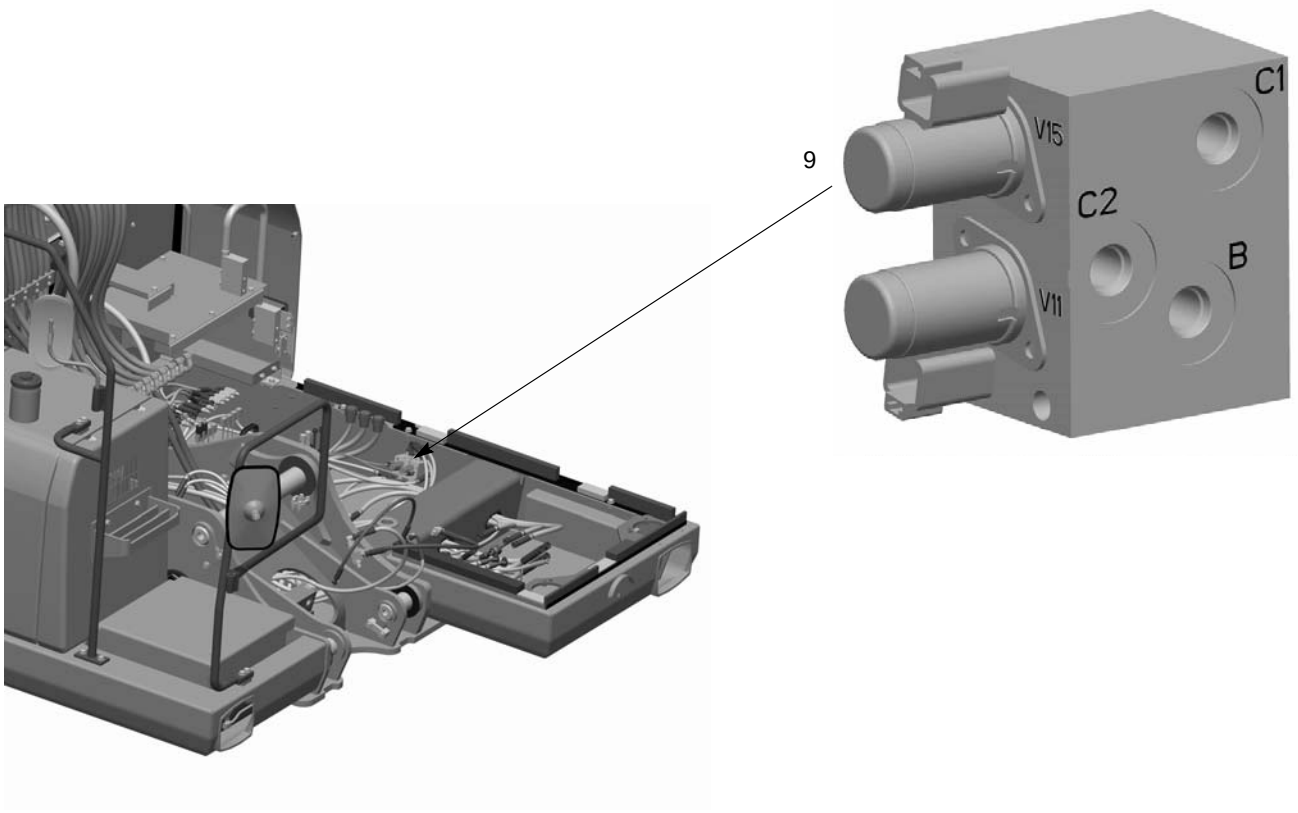


8.2 Hi / Lo Solenoid Valve: Located on the 2-stage solenoid block in the service compartment at the rear of the operators cab. This device is activated-when 'HI or 'LO' speeds are selected.

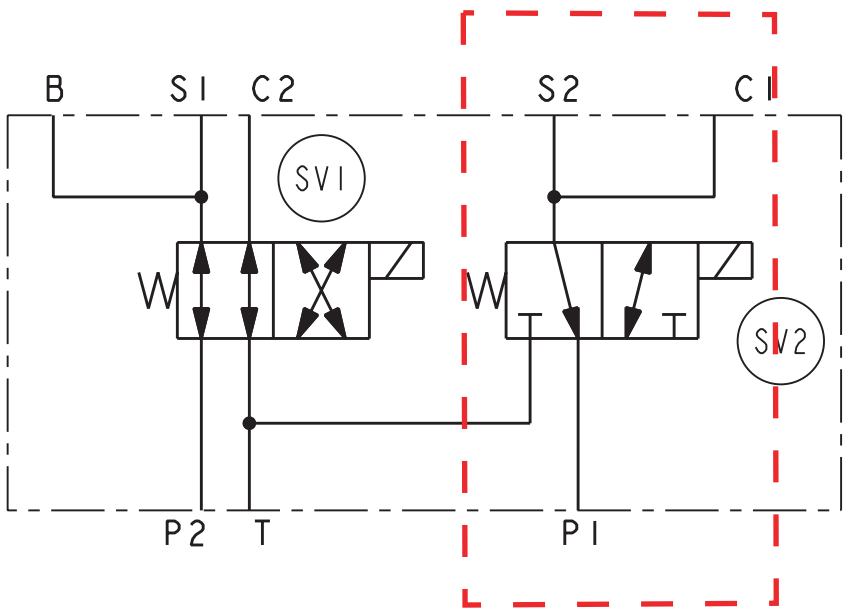
Solenoid On	Lo	0 - 9 kph
Solenoid Off	Hi	0 - 35 kph *

* : To max speed

9. 2 Stage Back Pressure Solenoid.



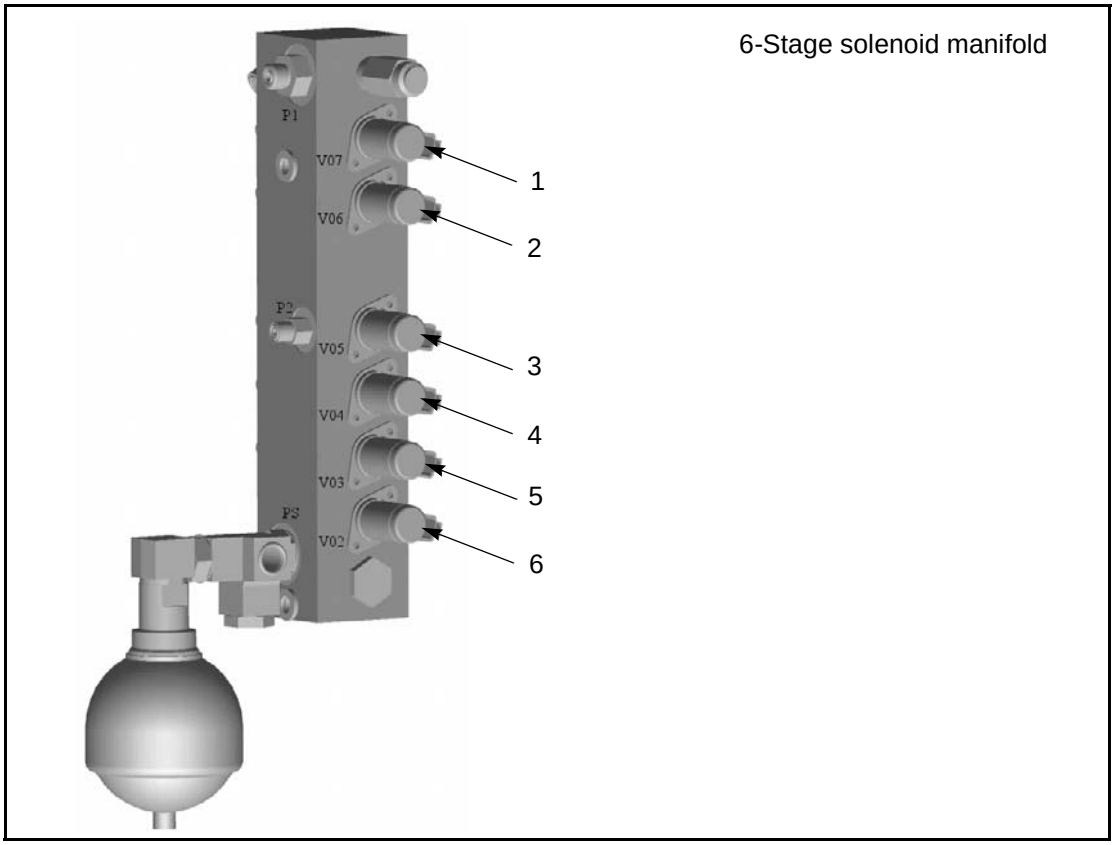
9.1 2 Stage Back Pressure Solenoid Schematic.



Solenoid Off	8 Bar
Solenoid On	4 Bar

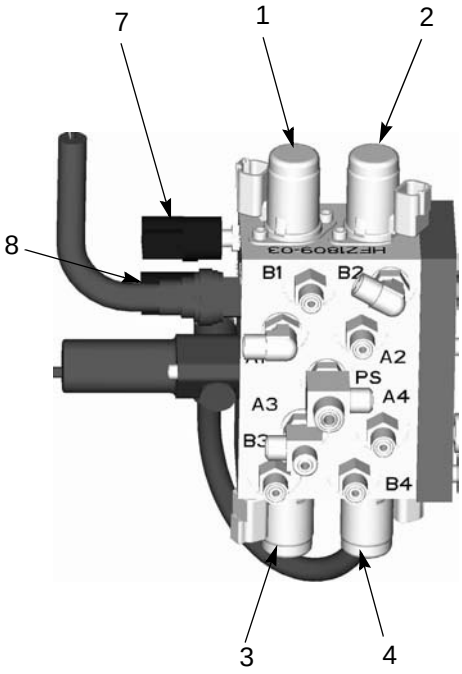
9.2 2-Stage Back Pressure Solenoid: Located on the solenoid block in the service compartment at the rear of the operators cab. This device enables the back pressure valve to supply pressure thus preventing cavitation to the travel motor.

10. Solenoid Valves & Pressure Switches

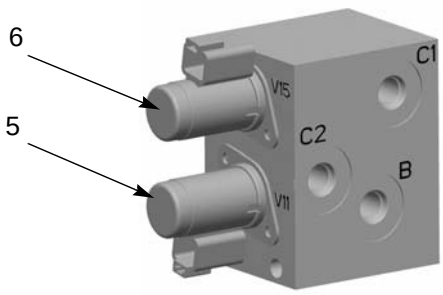


Solenoid Valves			
1	Travel Creep (see page 10-221)	4	Swing Brake
2	Travel Neutral (see page 10-220)	5	2 Stage Relief (see page 10-222)
3	Suspension Lock Valve	6	PPC Hyd Pressure Lock

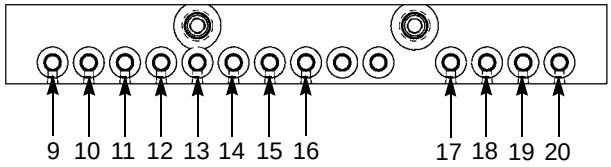
4-Stage solenoid manifold



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 oorbitrol 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 vavle 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

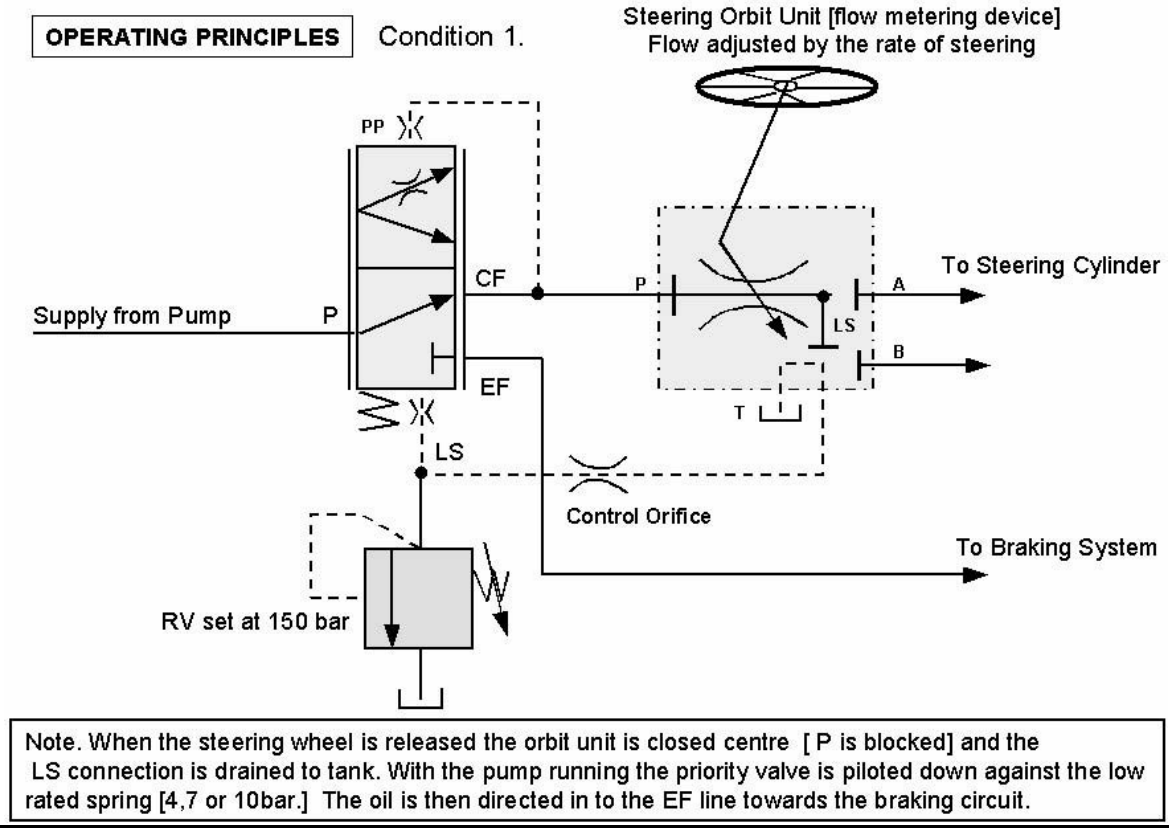
In the static steering unit, the LS connection is drained to tank via the spool / sleeveset when the steering unit is in the neutral position.
In the dynamic steering unit the drain connection has been made active. The spool of the dynamic priority valve has a port drilled connecting the CF port to the 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

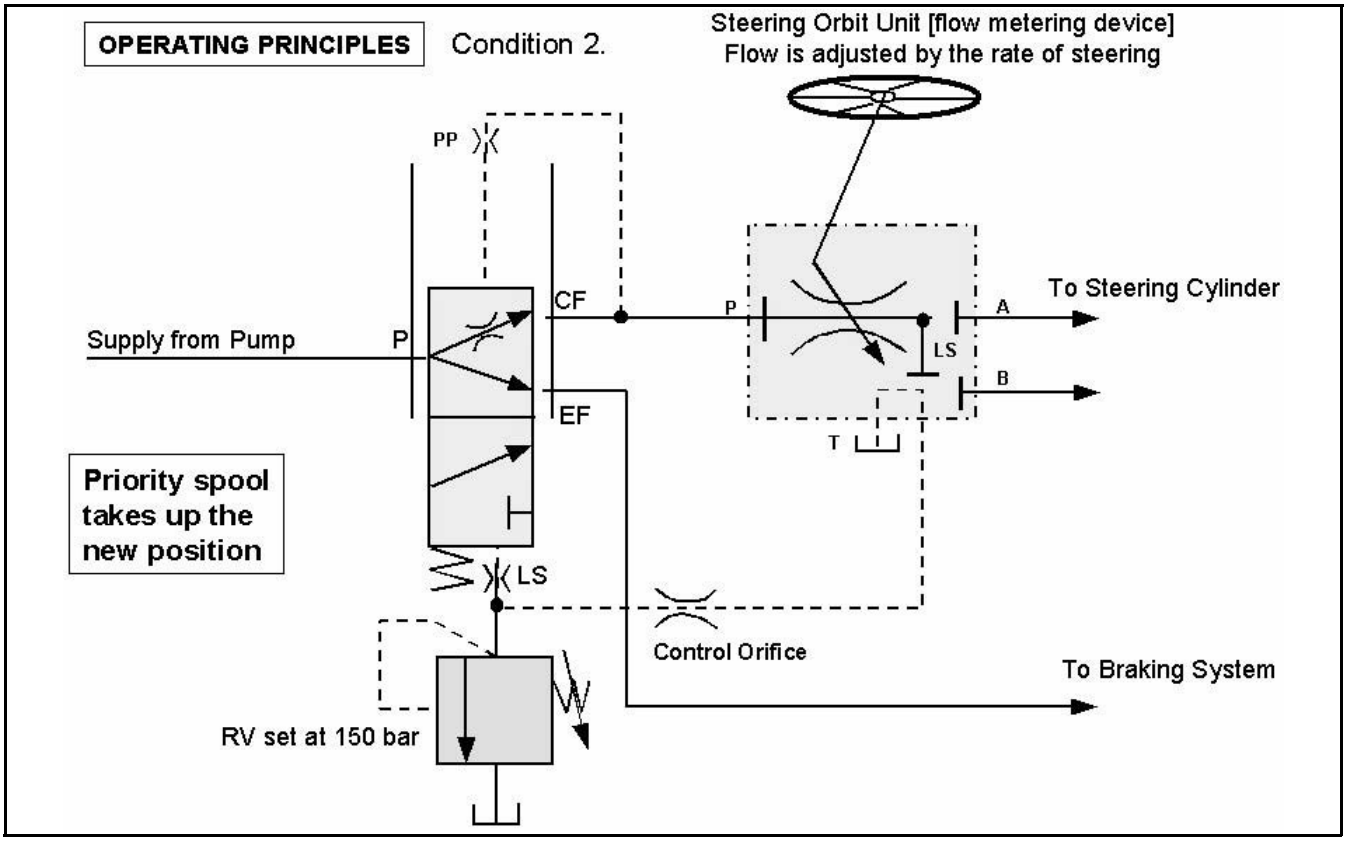
Any valve operation in which the main stage is controlled by a pilot stage and involves the application of a control orifice to create a pressure differential between the ends of the main stage to offset the effect of the main stagespring is operating on the 2-stage principle.

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

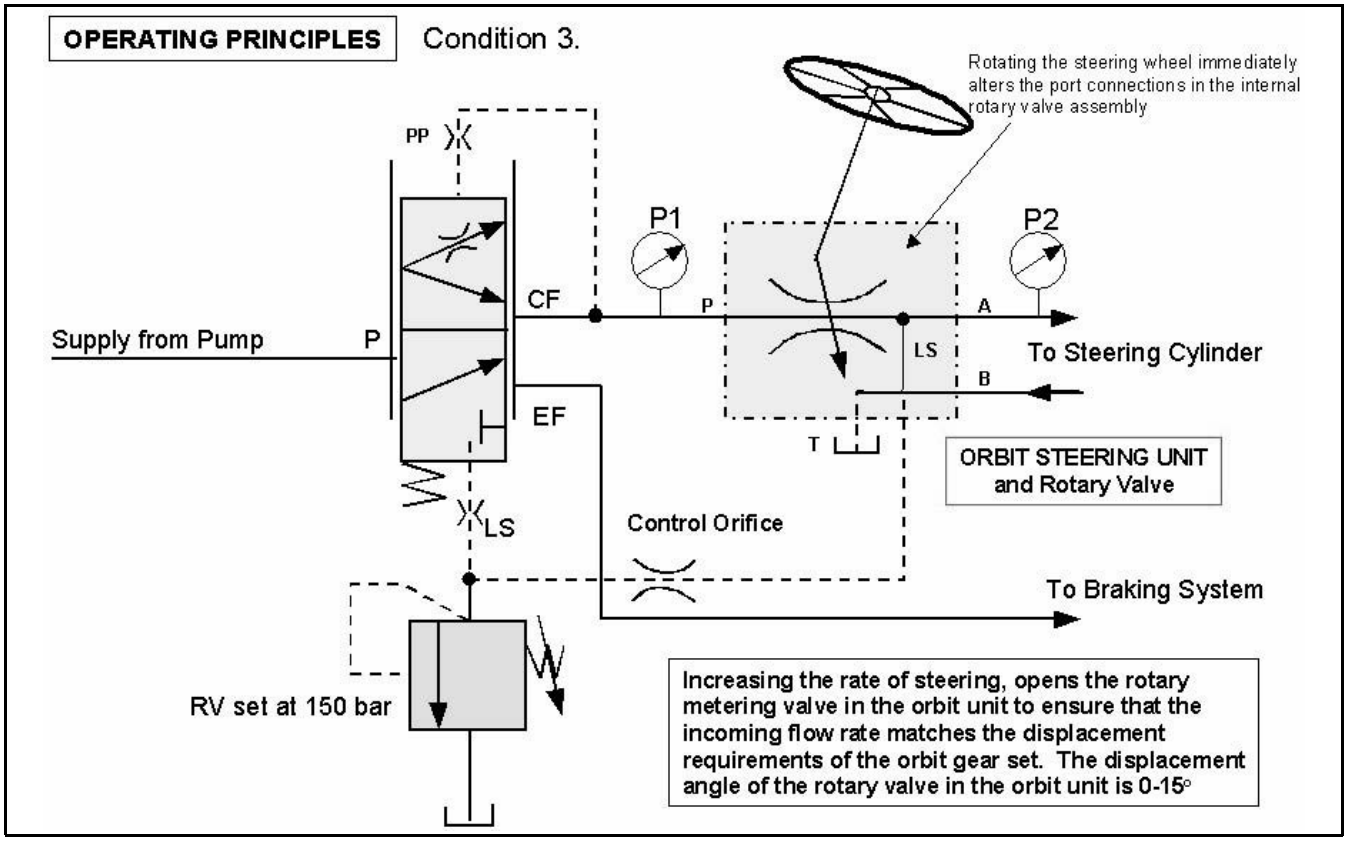
1. Condition 1.



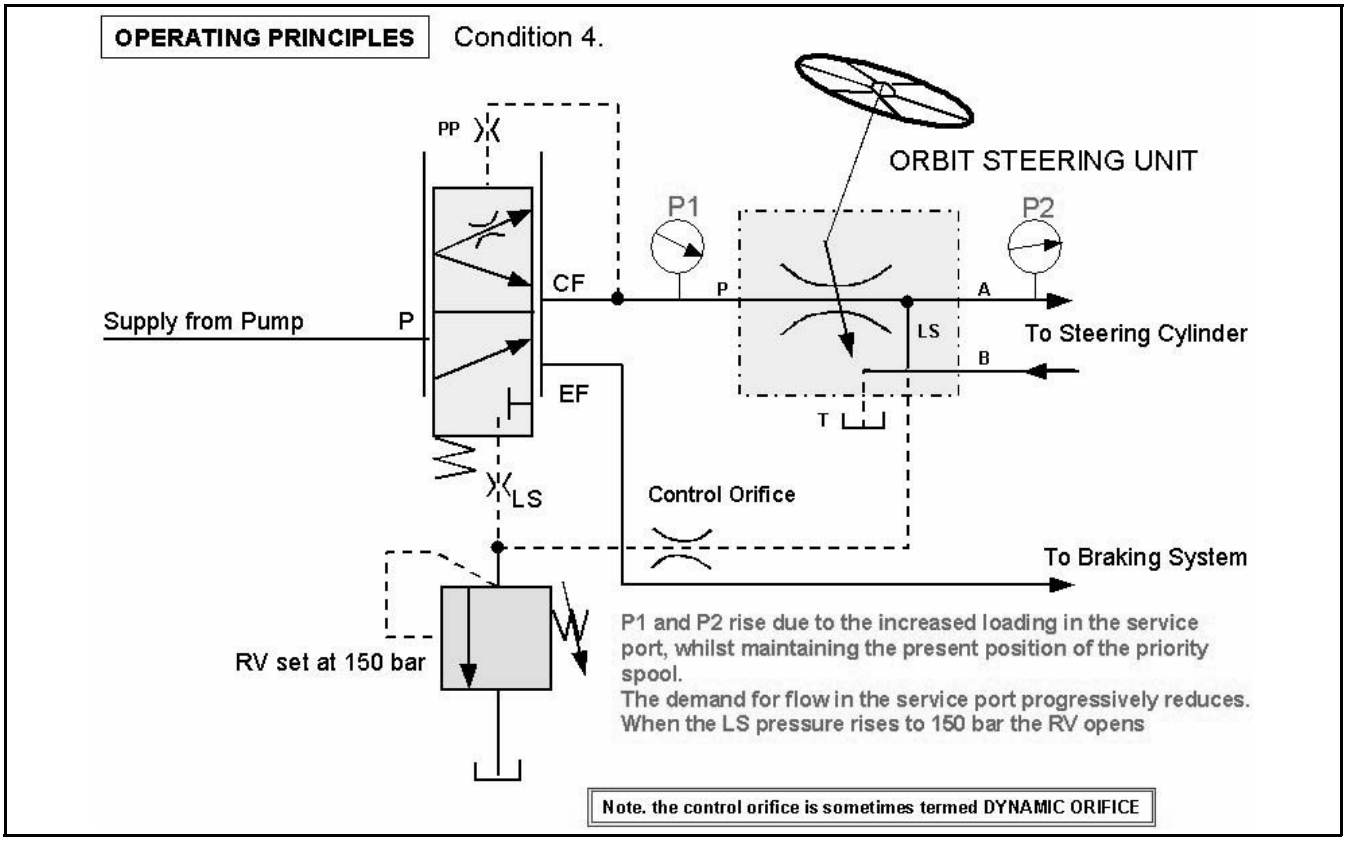
2. Condition 2.



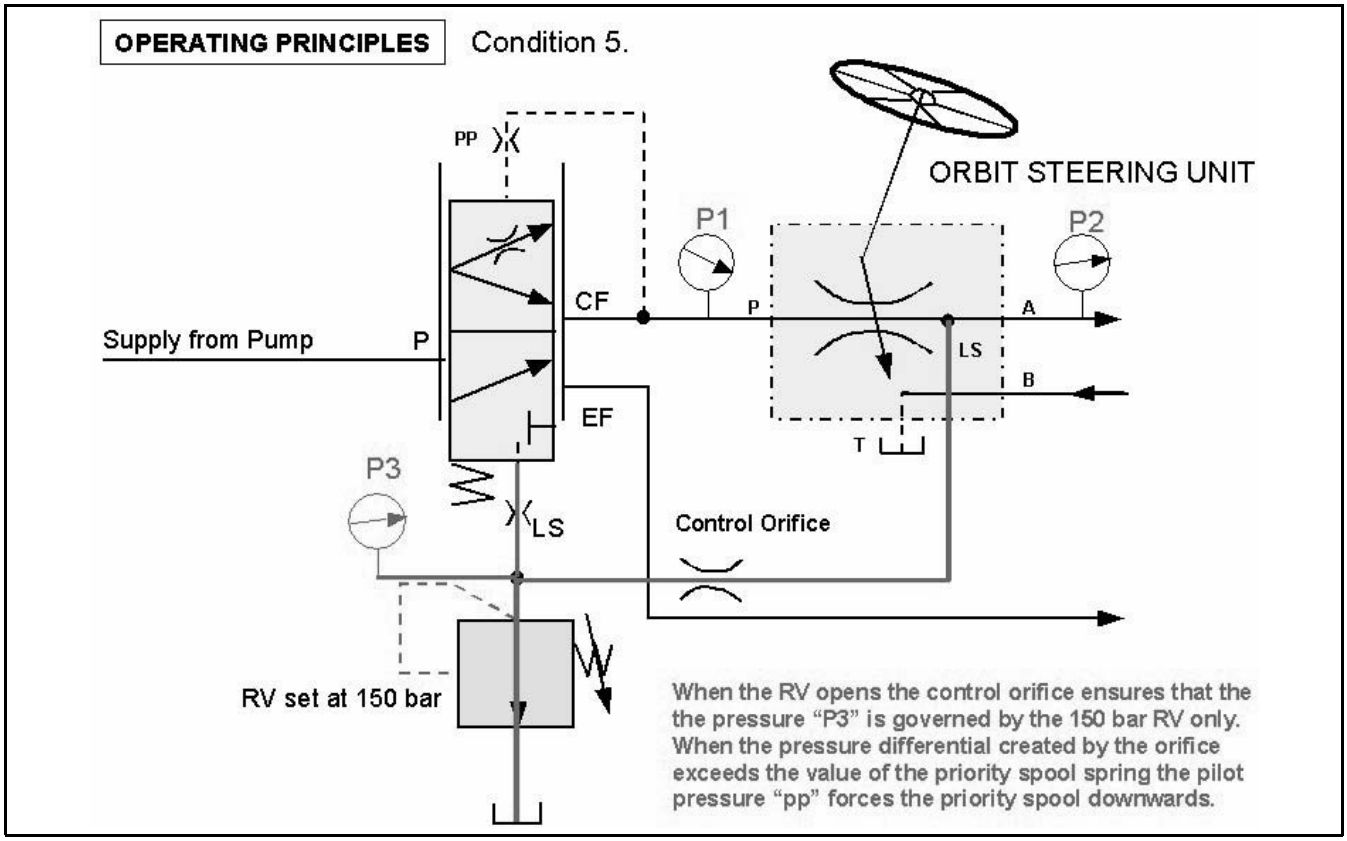
3. Condition 3.



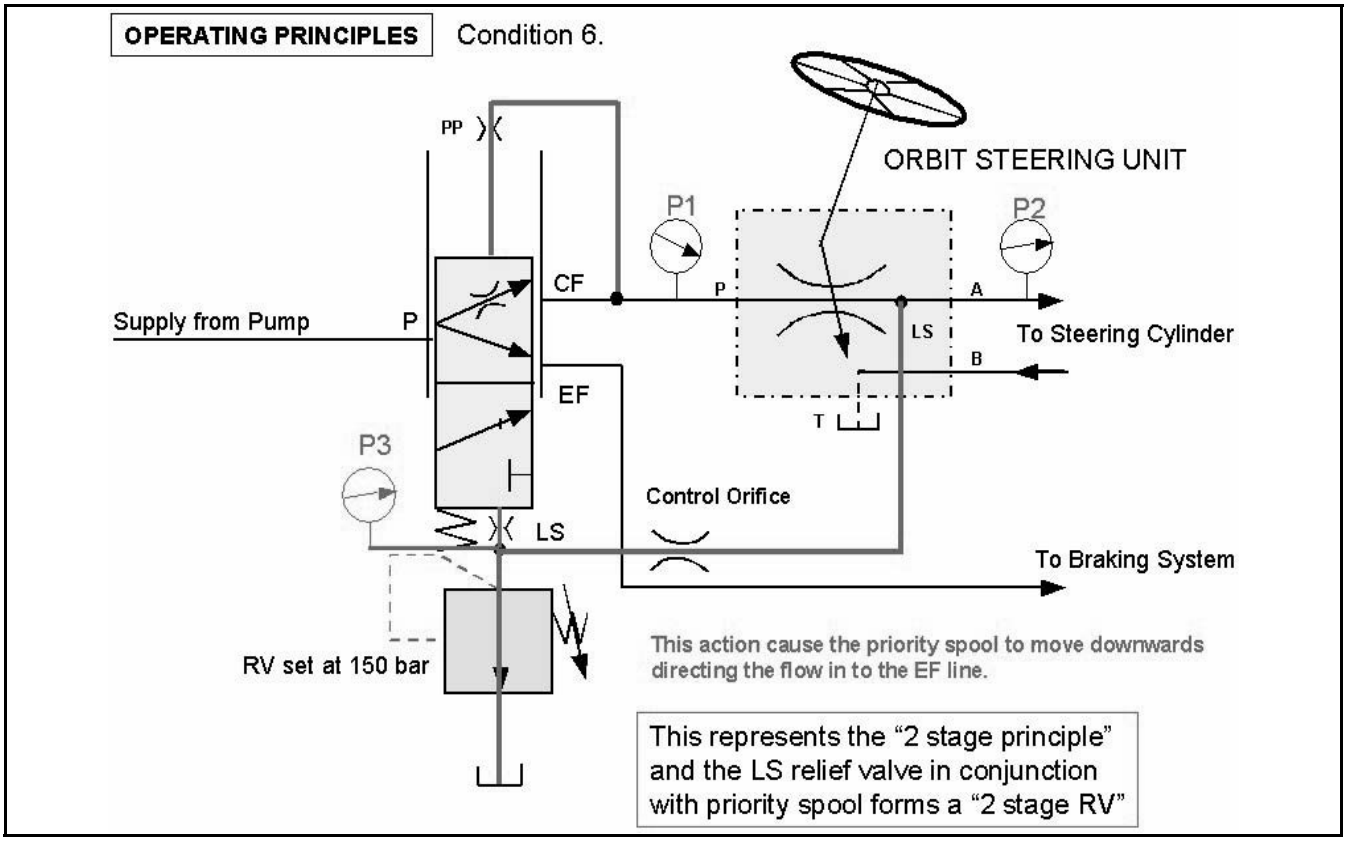
4. Condition 4.



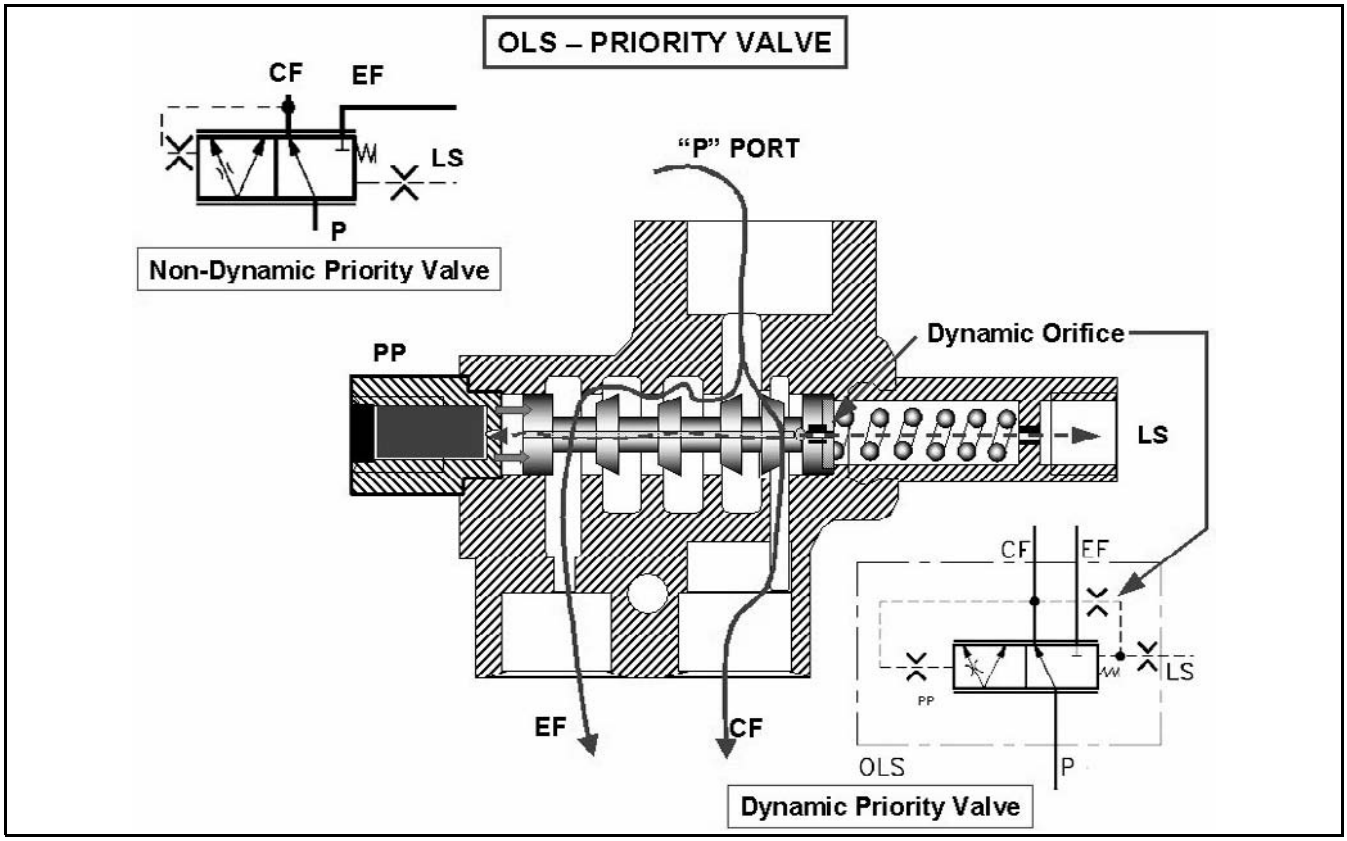
5. Condition 5.



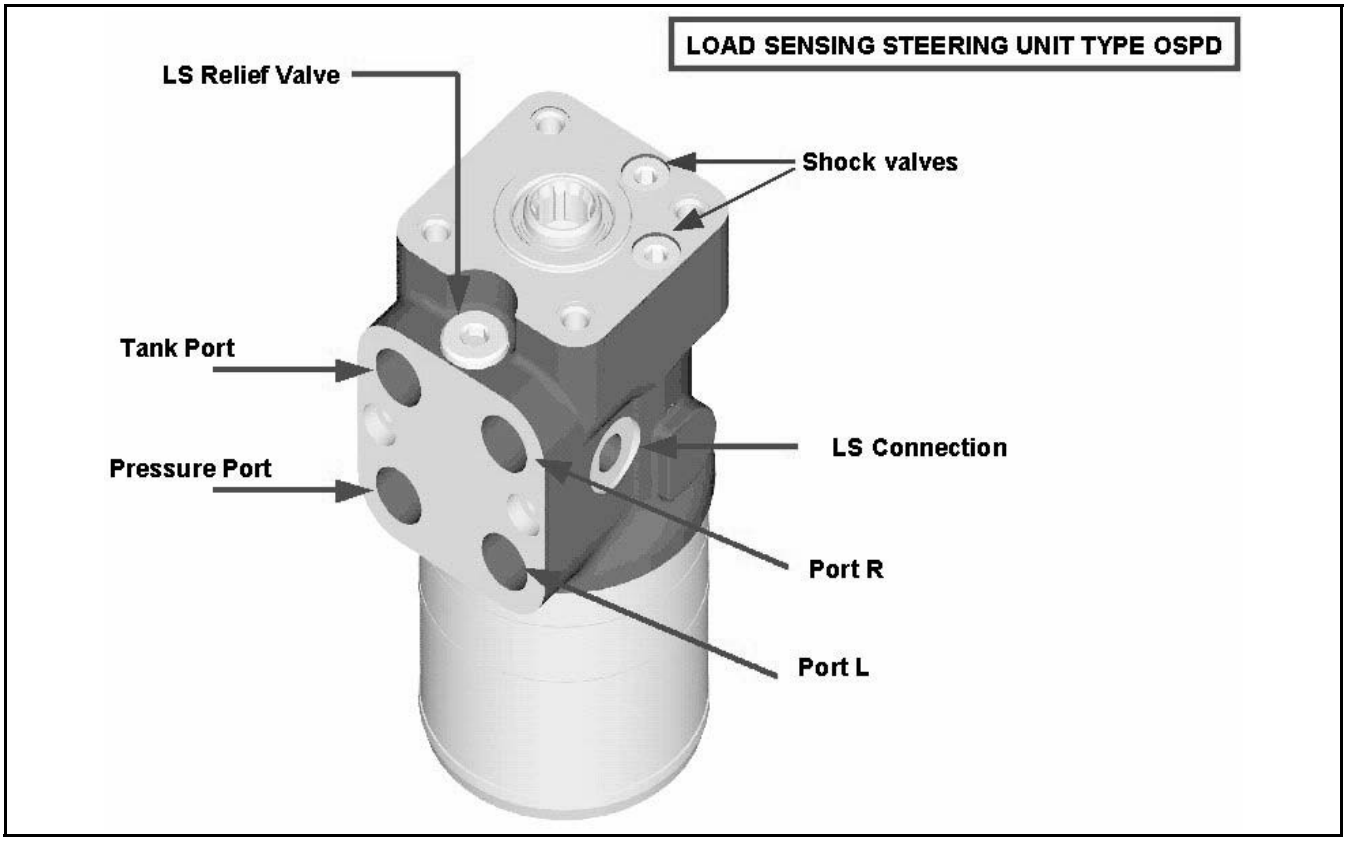
6. Condition 6.



7. OLS Priority Valve.



8. Load sensing steering unit

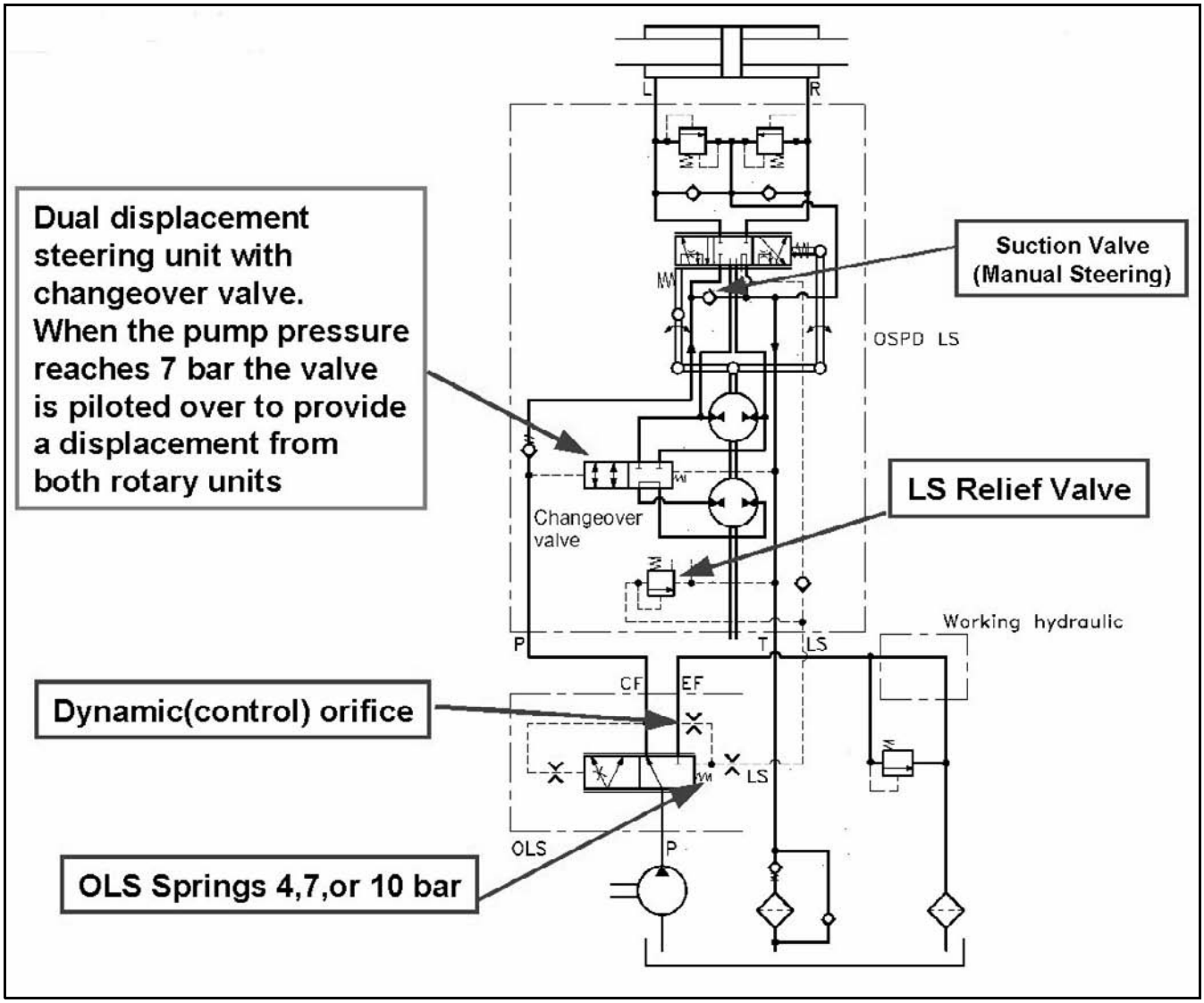


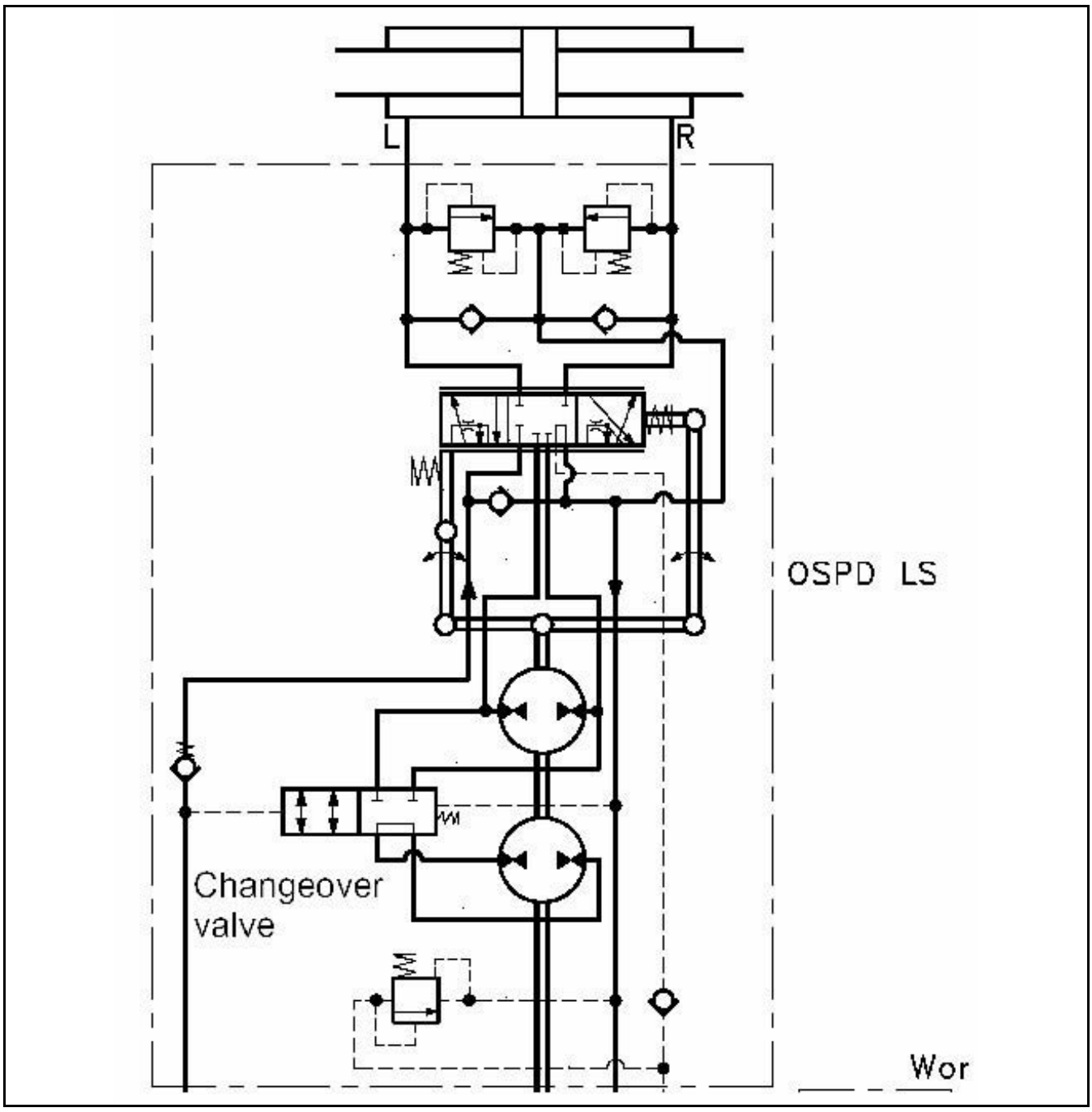
Technical data

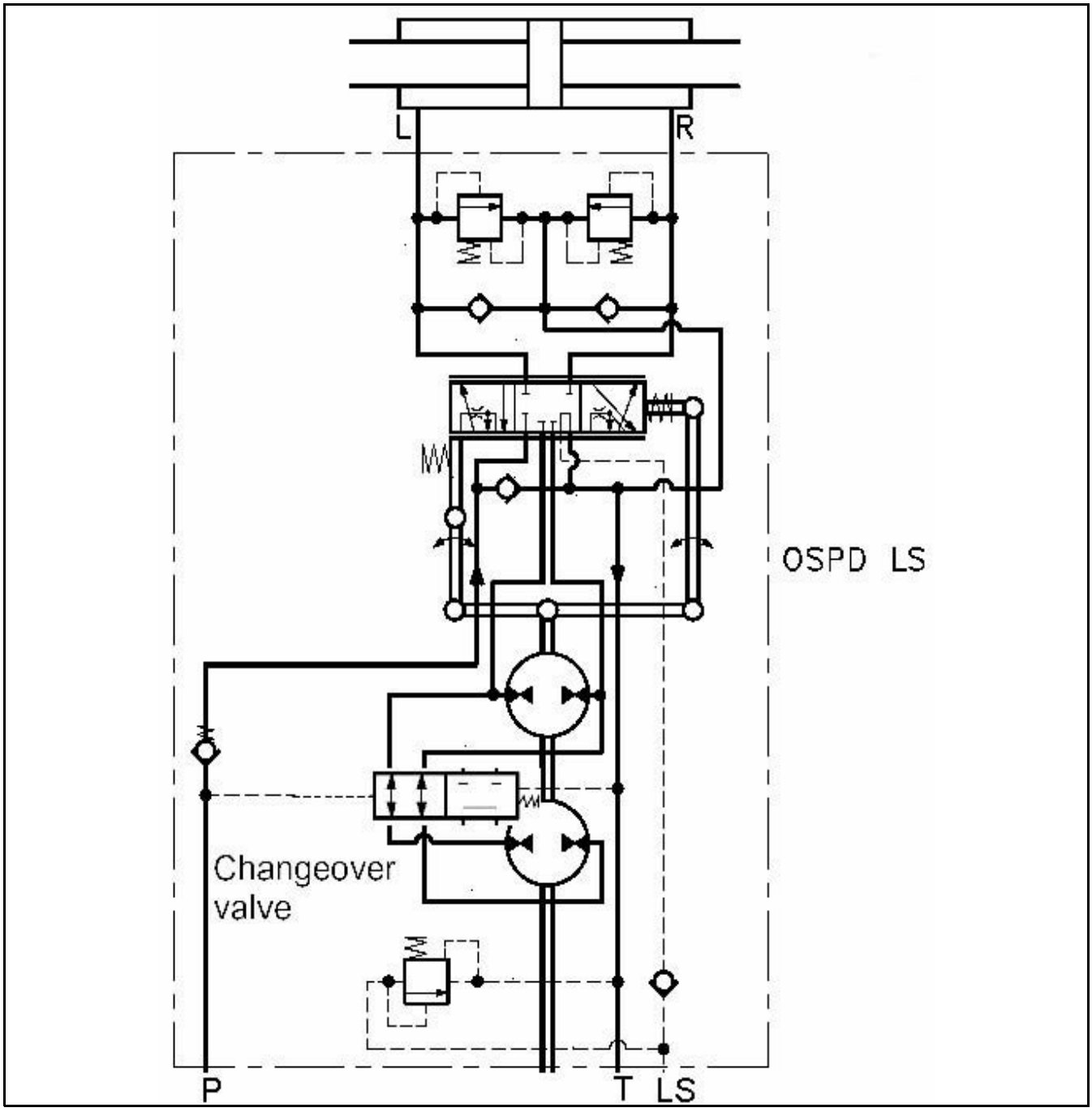
Displacement	Small gear wheel set	70 cc/rev.	
	Large gear wheel set	100 cc/rev.	
	OSPD 70/170	Small gear set	70 cc/rev.
		Large gear set	170 cc/rev.

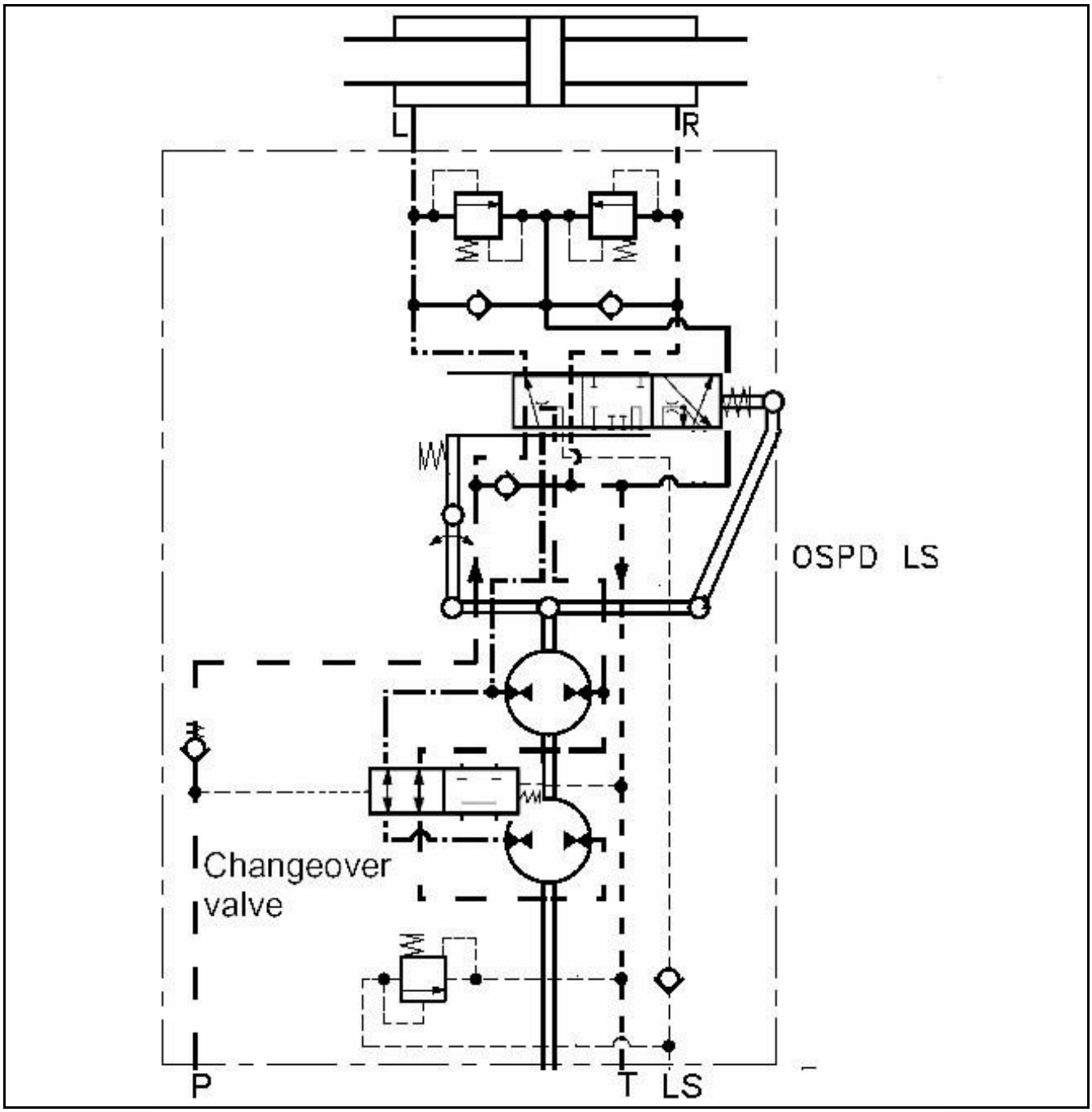
Valve functions	Pilot pressure relief valve
	Shock valves
	Suction valves
	Check valves in LS-connection
	Check valves in P connection

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
L
R
OSPD LS
Changeover valve
Working hydraulic
P
T
LS
CF
EF
OLS


L
R
OSPD LS
Changeover valve
Wor


L
R
OSPD LS
Changeover valve
P
T
LS


L
R
OSPD LS
Changeover valve
P
T
LS

SERVICE BRAKE AND SUSPENSION SYSTEM

BRAKING SYSTEM

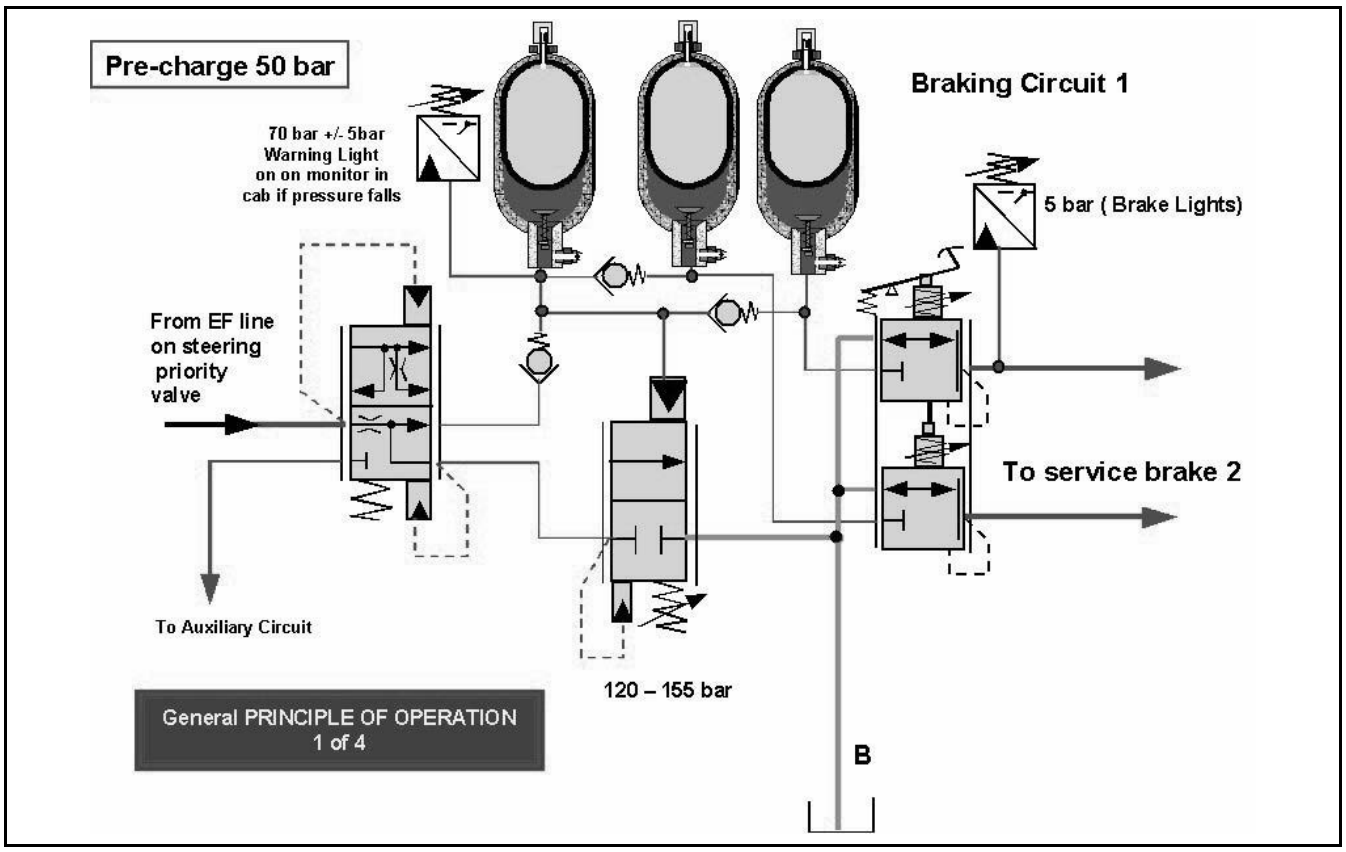
The hydraulic braking sytem unit contains the following services.

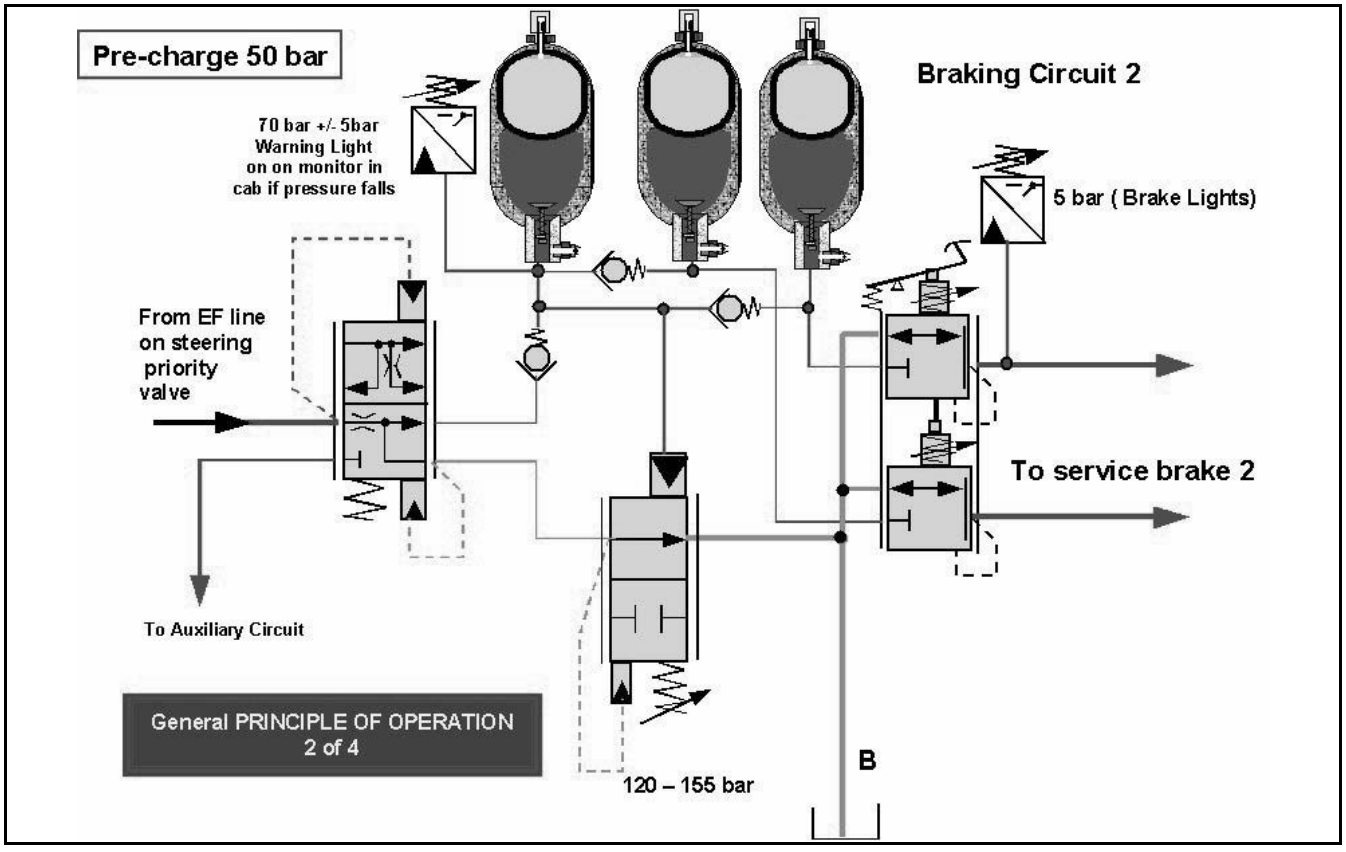
- Inlet Bypass Valve:
  distributing flow to other services when braking demand is low or not required.

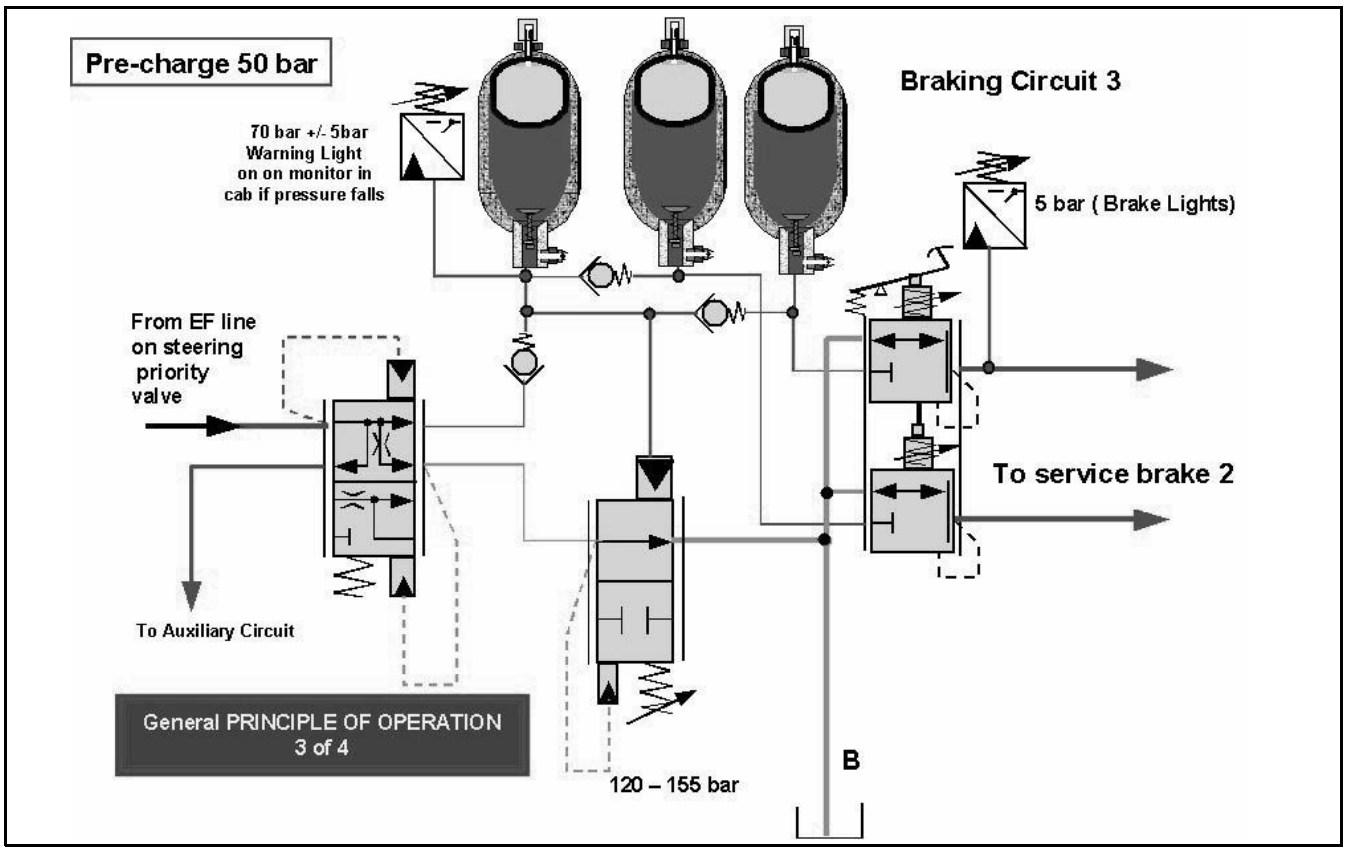
- Accumulators:
  for fluid storage providing a number of brake operations (usually 5 ~ 8 operations depending upon accumulator capacity)

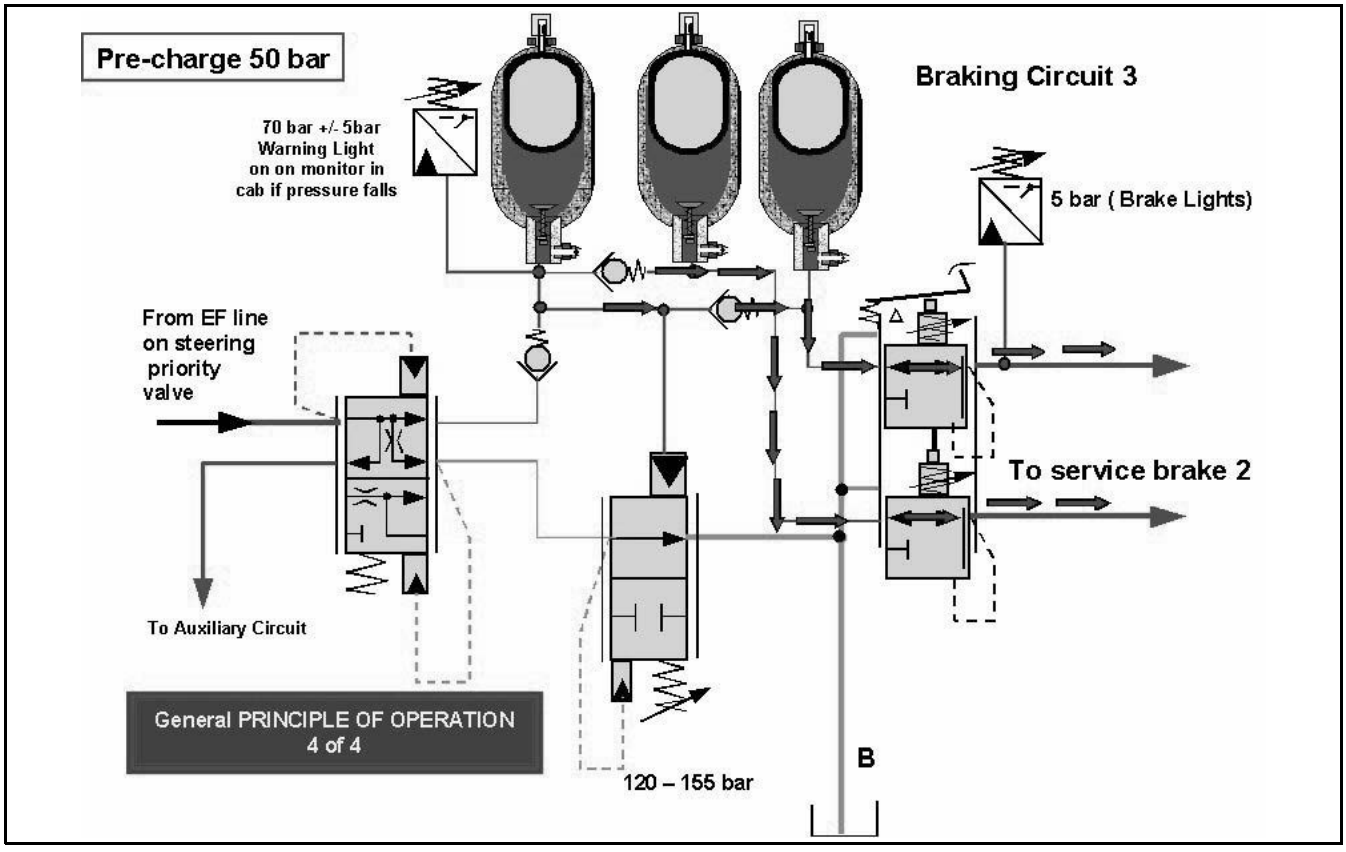
- Check Valves:
  to isolate the inlet supply from the charged accumulators and isolate individually charged accumulators from each other, thereby allowing individual brake circuits to be controlled.
  NOTE: Service brakes1 and 2 are individually supplied but simultaneously applied.

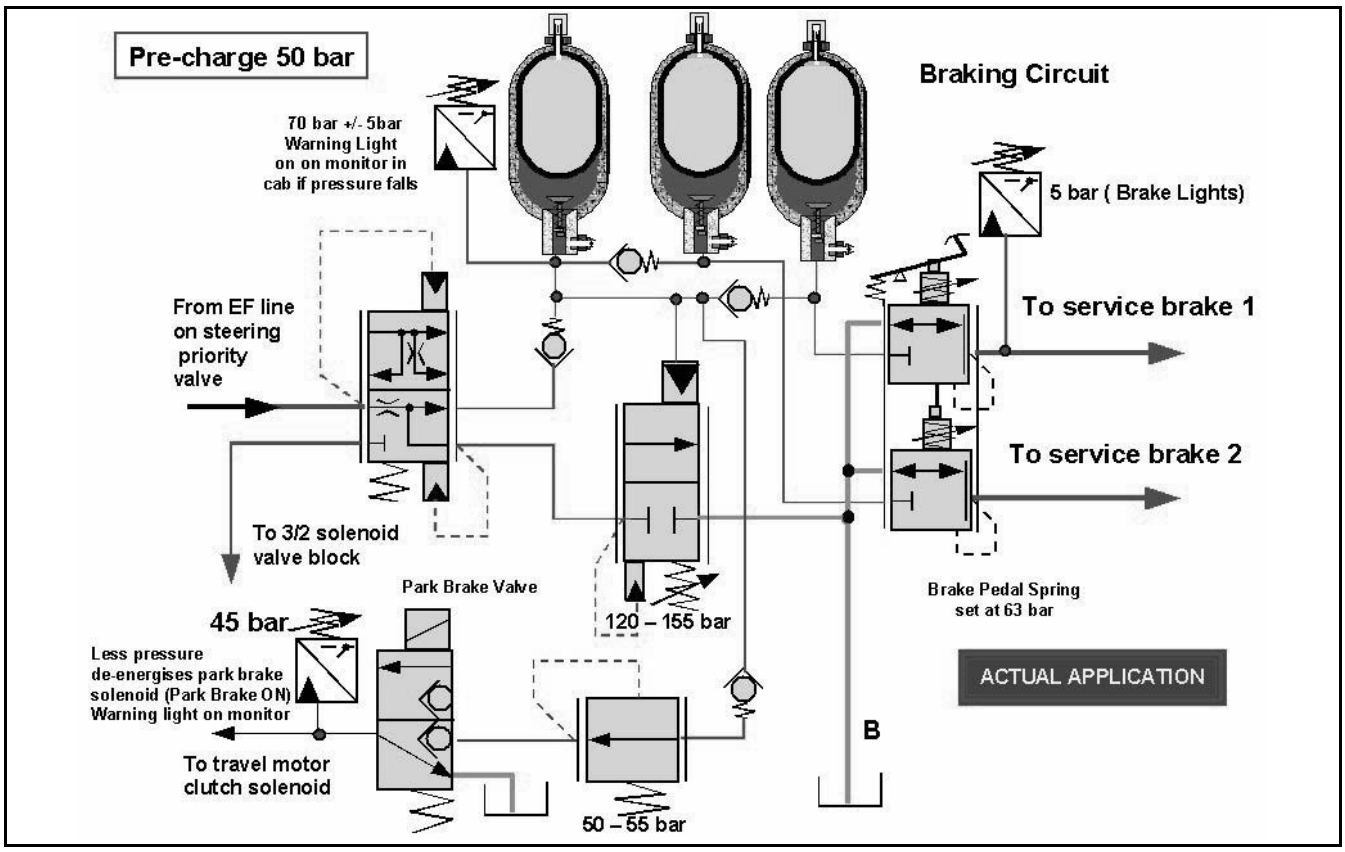
- Pressure Limiting Valve:
  to control the maximum pressure in the accumulators. This valve provides relief valve protection and diverts the fluid via its unloaded valve action.


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
B
General PRINCIPLE OF OPERATION
1 of 4


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
B
General PRINCIPLE OF OPERATION
2 of 4


Pre-charge 50 bar
Braking Circuit 3
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
General PRINCIPLE OF OPERATION
3 of 4
120 – 155 bar
B


Pre-charge 50 bar
Braking Circuit 3
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
General PRINCIPLE OF OPERATION
4 of 4
120 – 155 bar
B



OPERATION

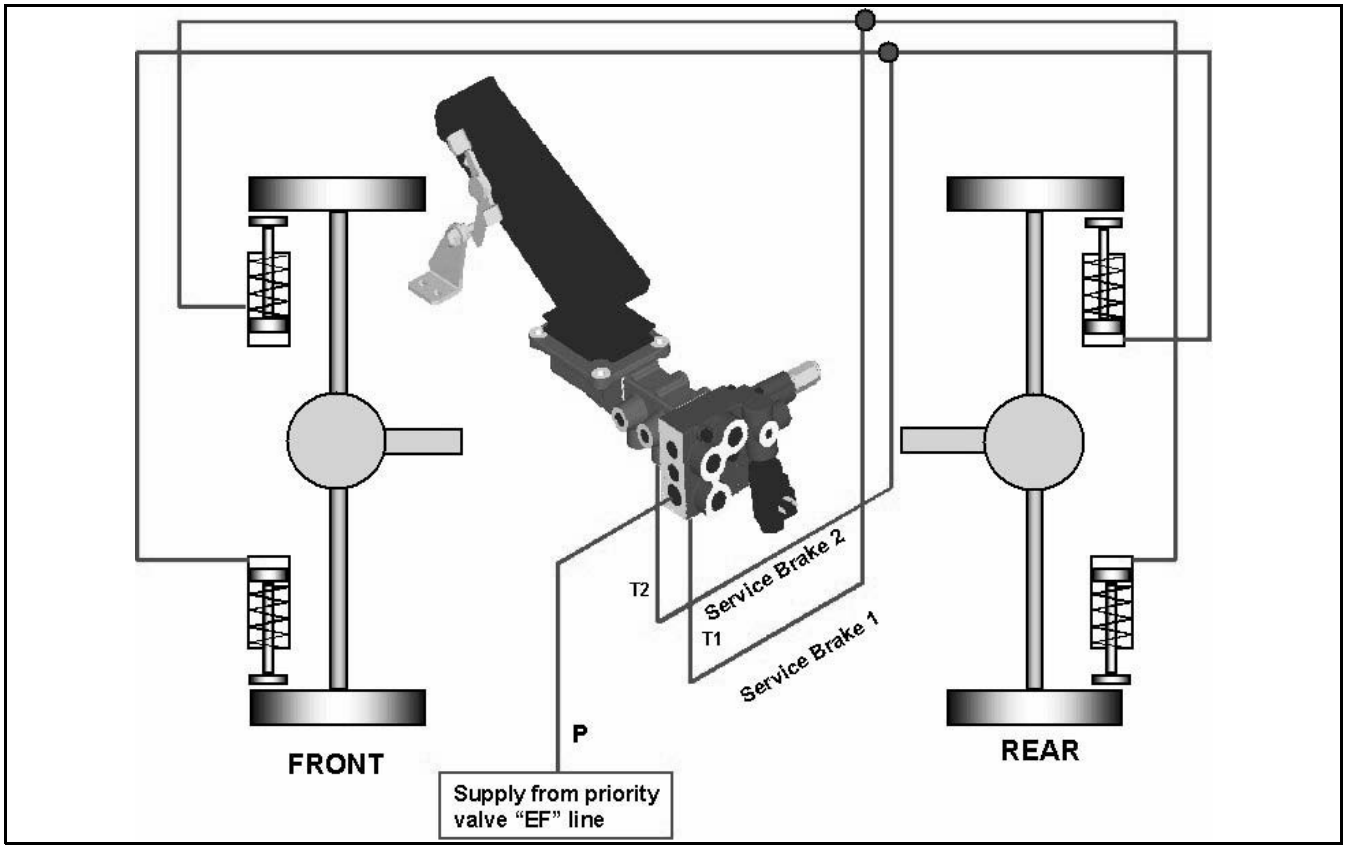
- Oil from the steering priority valve passes at a controlled rate to charge the accumulators. The inlet bypass valve is spring biased into the positionshown and hydraulically balanced.
- When the oil pressure in the accumulators reach the cracking pressure of the pressure limiting valve it begins to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

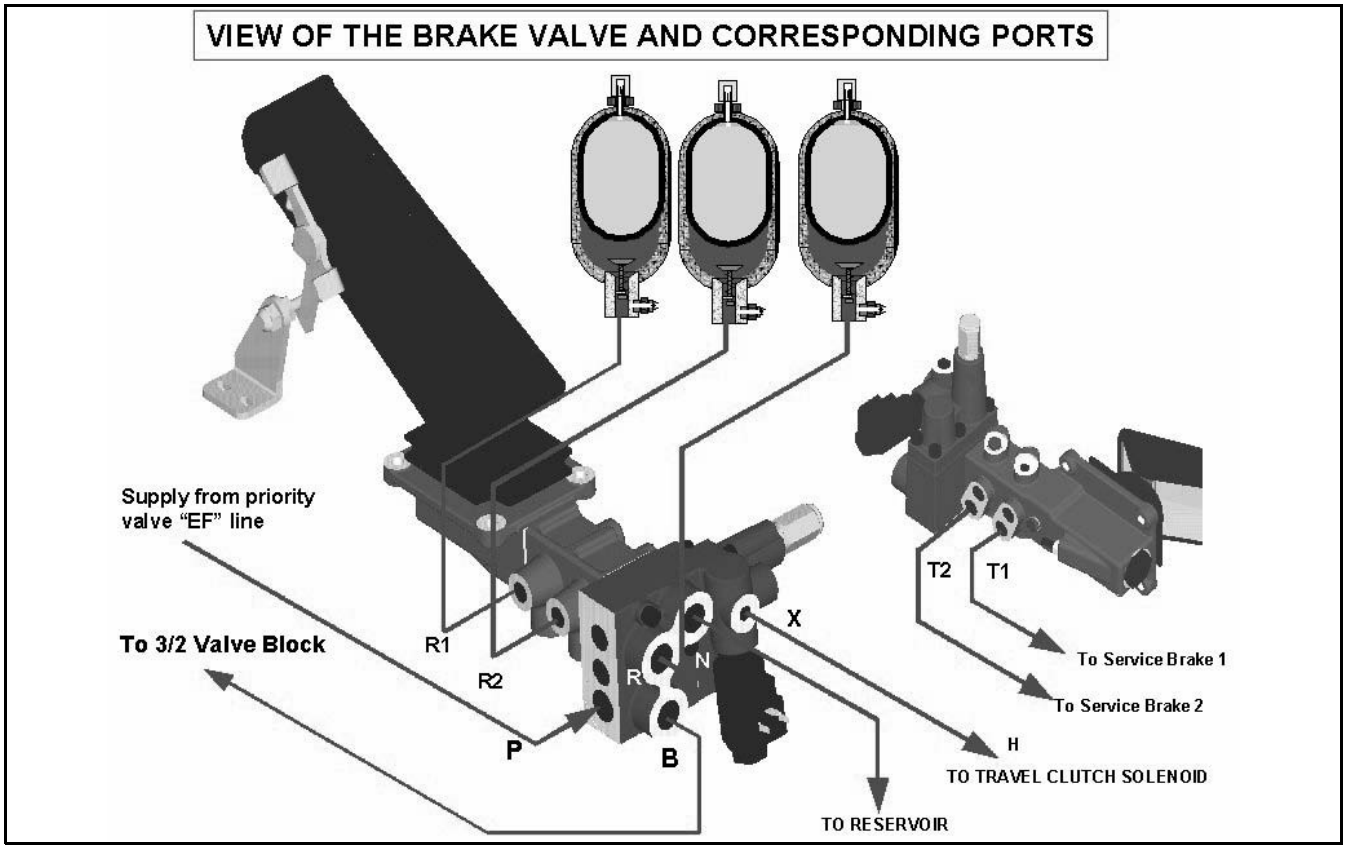
  Between 120 and 155 bar the accumulators continue to charge until the bottom pilot signal on the inlet bypass valve is diverted to tank, allowing the inlet bypass valve to move downwards thereby diverting all the incoming flow to the auxilliary circuit.

  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
R
N
X
P
B
T2
T1
To Service Brake 1
To Service Brake 2
H
TO TRAVEL CLUTCH SOLENOID
TO RESERVOIR

20 TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR ENGINE RELATED PARTS 20- 2
STANDARD VALUE TABLE FOR CHASSIS RELATED PARTS..... 20- 4
TESTING AND ADJUSTING 20-101
TROUBLESHOOTING..... 20-201

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

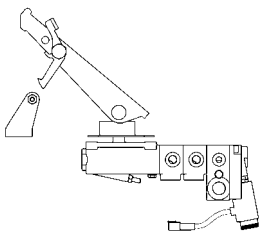
1. The standard value for a new machine given in the table is the value used when shipping the machine from the factory and is given for reference. It is used as a guideline for judging the progress of wear after the machine has been operated, and as a reference value when carrying out repairs.
2. The 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.

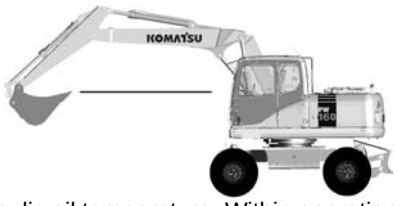
! When carrying out testing, adjusting, or troubleshooting, park the machine on level ground, insert the safety pins, and use blocks to prevent the machine from moving.
! When carrying out work together with other workers, always use signals and do not let unauthorized people near the machine.
! When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

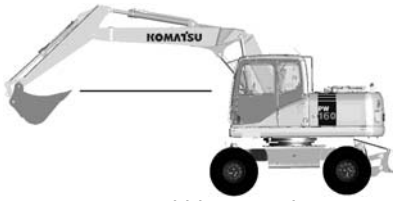
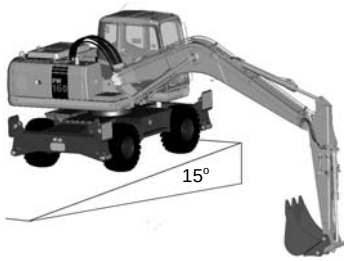
STANDARD VALUE TABLE FOR ENGINE RELATED PARTS

Applicable model			PW160-7H	
Engine				
Item	Measurement condition	Unit	Standard value for new machine	Service limit value
Engine speed	High idling	rpm	2,450 ±70	
	Low idling		950 ±50	
	Rated speed		2,200 ±20	
Exhaust gas color	At sudden acceleration LO idle - HI idle	Bosch index	Max. 4.0	Max. 6.0
	At high idling		Max. 1.5	
Valve clearance (Normal temperature)	Intake valve	mm	0.25	—
	Exhaust valve		0.51	—
Compression pressure	Oil temperature: 40–60ºC Engine speed: 250rpm	MPa {kg/cm^2}	Min. 1.0 {Min. 10.3}	
Blow-by pressure	2500rpm full load with 0.221 inch orifice	L/min. {mm H_2O}	51 {76.2}	102 {330.2}
Oil pressure (SAE15W-40)	(Water temperature: operating range) At high idling At low idling	MPa {kg/cm^2}	High Idle: 0.42 {4.26} Rated: 0.207 Minimum {2.11} Low Idle: 0.07 Minimum {0.7}	
Oil temperature	Whole speed range (inside oil pan)	ºC	127	
Fuel injection timing	Before Top Dead Center	(mm)	0.8	
Fan belt tension	Deflection when pressed with finger force of approx. 58.8 N{6 kg}	mm	8	Min. 6, Max. 10
Air conditioner compressor belt tension		mm	5–8	

STANDARD VALUE TABLE FOR CHASSIS RELATED PARTS

Applicable model				PW160-7H	
Category	Item	Measurement Condition	Unit	Standard value	Permissible value
Engine speed	Pump at relief A mode	• Engine water temperature: Within operation range • Hydraulic oil temperature: Within operation range • Engine at high idling • Arm in relief condition	rpm	1,940 ±100	1,940 ±100
	At pump relief + one touch power up A mode	• Engine water temperature: Within operation range • Hydraulic oil temperature: Within operation range • Engine at high idling • Arm relief + One-touch power max. switch in ON condition		1,900 ±100	1,900 ±100
	Speed when auto-deceleration is operated	• Engine at high idling • Auto-deceleration switch in ON condition • All control levers in NEUTRAL condition		1,400 ±100	1,400 ±100
Spool stroke	Boom control valve		mm	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 center of control lever grip • Max. reading up to stroke end (excepting lever play in NEUTRAL position)	mm	60.5 ±3.5	60.5 ±3.5
	Arm control lever			60.5 ±3.5	60.5 ±3.5
	Bucket control lever			60.5 ±3.5	60.5 ±3.5
	Swing control lever			60.5 ±3.5	60.5 ±3.5
	Travel control pedal			9.2 ±0.2	9.2 ±0.2
	Play of control lever			Max. 3.0	Max. 3.0
Operating force of control levers	Boom control lever	• Hydraulic oil temperature: Within operation range • Engine at high idling • At center of control lever grip • At tip in case of pedal • Max. reading up to stroke end	N{kg}	17 ±3.9 {1.7 ±0.4}	Max. 24.5 {Max. 2.5}
	Arm control lever			17 ±3.9 {1.6 ±0.4}	Max. 24.5 {Max. 2.5}
	Bucket control lever			14 ±2.9 {1.4 ±0.3}	Max. 21.6 {Max. 2.2}
	Swing control lever			14 ±2.9 {1.4 ±0.3}	Max. 21.6 {Max. 2.2}
	Travel control pedal			55.4 ±5 {5.5 ±0.5}	Max. 65 {Max. 6.5}
	Brake pedal			340 ±17 {35 ±3.5}	Max. 510 {Max. 52.5}

Applicable model					PW160-7H (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}	33.3–36.8 {340–375}
	Arm					
	Bucket				(37.3 ±1.0 {380 ±10})	(36.3–39.2 {370–400})
	Swing				30.9 ±1.5 {315 ±15}	28.9–32.9 {295–335}
	Travel				38.2 ±1.0 {390 ±10}	37.3–40.2 {380–410}
	Stabiliser					
	Control circuit source pressure	• Hydraulic oil temperature: Within operation range • Engine running at high idling • Control circuit pressure setting valve input (7 station solenoid valve block port P_1)			$3.72^{+0}_{-0.3}$ {38^{+0}_{-3}}	3.2–3.72 {32.6–38}
	LS control circuit (Δ PLS)	• Hydraulic oil temperature: Within operation range • Engine at high idling • Working mode: L mode • Disconnect the LS EPC solenoid CN V22 • Hydraulic pump pressure - LS pressure	• Roadwheels raised off ground • LO travel speed • Service brake disengaged travel pedal fully depressed		2.2 ±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: A 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: A 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				PW160-7H	
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: A 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	

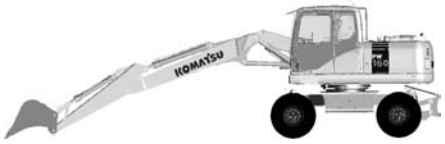
<table>
<tr><td colspan="5">Applicable model</td><td colspan="2">PW160-7H</td></tr>
<tr><td>Category</td><td>Item</td><td colspan="3">Measurement Condition</td><td>Unit</td><td>Standard value</td><td>Permissible value</td></tr>
<tr><td rowspan="4">Travel</td><td rowspan="4">Travel speed (1)</td><td rowspan="4"> 
• Machine in road travel posture
• Engine running at high idle
• Hydraulic oil temperature 45~55°C
• Run up for at least 200M or until the max travel speed is stabilised,then measure time taken to travel the next 50M on flat ground</td><td colspan="2">CR</td><td rowspan="4">sec.</td><td colspan="2">72±10%</td></tr>
<tr><td colspan="2">LO</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 rowspan="2">Travel speed (2)</td><td rowspan="2"> 
• Raise machine road wheels off ground using work equipment and chassis attachments
• Engine running at high idle
• Service brake and park brake both disengaged
• Fully depress travel pedal and measure propshaft rotations.
• Hydraulic oil temperature 45~55°C. Within operation range</td><td colspan="2">CR</td><td rowspan="2">rpm</td><td colspan="2">230 ±5%</td></tr>
<tr><td colspan="2">LO</td><td colspan="2">930±5%</td></tr>
</table>

Applicable model					PW160-7H	
Category	Item		Measurement Condition	Unit	Standard value	Permissible value
Leakage of travel motor	Leakage of travel motor		• Engine running at high idle • Hydraulic oil temperature 45~55°C. Within operation range. • Apply service brake and relieve travel circuit. • Disconnect transmission drain line.	l/min	5 ±1	Max. 10
Work equipment	Hydraulic drift of work equipment	Whole work equipment (tooth tip fall amount)	 (including 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						PW160-7H	
Category	Item		Measurement Condition		Unit	Standard value	Permissible value
Work equipment	Work equipment speed	Mono boom boom lift	 • Hydraulic oil temperature: Within operation range • Engine running at high idle • Working mode: A • Time required from raise stroke end till bucket touches ground	RAISE	sec	3.8 ±0.4	Max. 4.6
				LOWER		2.9 ±0.5	Max. 3.5
		Two piece boom 1st boom lift	 • Hydraulic oil temperature: Within operation range • Engine running at high idle • Working mode: A • Time required from raise stroke end till bucket touches ground	RAISE		4.5 ±0.4	Max. 5.3
				LOWER		3.8 ±0.3	Max. 4.4
		Two piece boom 2nd boom adjust	 • Hydraulic oil temperature: Within operation range • Engine running at high idle • Working mode: A • Time required from raise stroke end till lower stroke end	RAISE		5.0 ±0.5	Max. 6.0
				LOWER		5.0 ±0.5	Max. 6.0

Applicable model						PW160-7H	
Category	Item		Measurement Condition		Unit	Standard value	Permissible value
		Outrigger	• Hydraulic oil temperature: Within operation range • Engine running at high idle • Working mode: A • Time required for 1 outrigger raise stroke end to lower stroke end.	RAISE		3.5 ±0.5	Max. 4.5
				LOWER		3.9 ±0.4	Max. 4.7
		Dozer Blade	• Hydraulic oil temperature: Within operation range • Engine running at high idle • Working mode: A • Time required from raise stroke end to lower sroke end.	RAISE		2.1 ±0.3	Max. 2.7
				LOWER		2.1 ±0.3	Max. 2.7

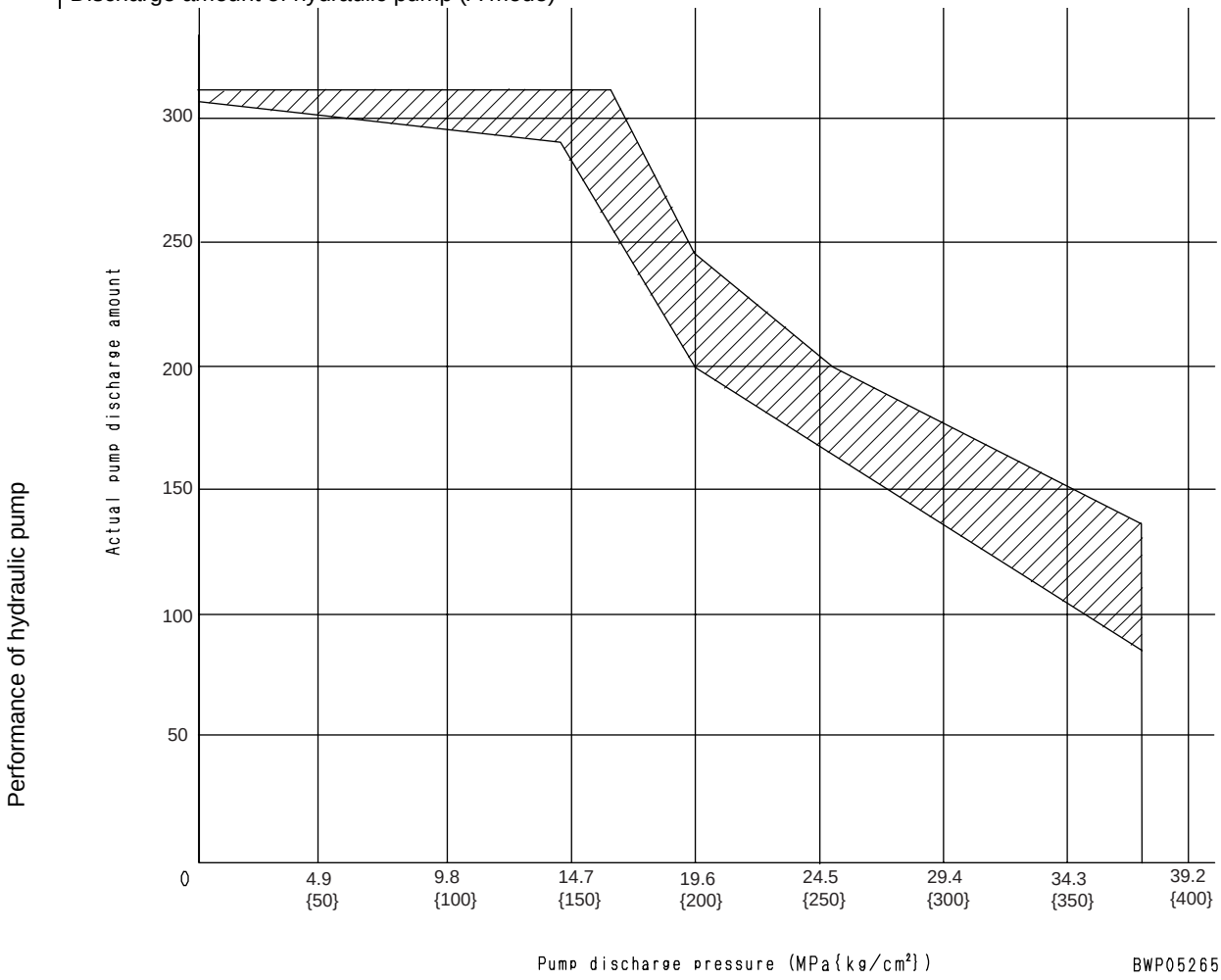
Applicable model						PW160-7H	
Category	Item		Measurement Condition		Unit	Standard value	Permissible value
Work equipment	Work equipment speed	Arm	 • Hydraulic oil temperature: Within operation range • Engine running at high idling • Working mode: A mode • Time required from dumping stroke end to digging stroke end	IN		3.1 ±0.4	Max. 3.9
				OUT		3.0 ±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		2.8 ±0.3	Max. 3.4
				DUMP		2.6 ±0.3	Max. 3.2
	Time lag	Monoboom boom lift	 • Hydraulic oil temperature: Within operation range • Engine running at low idling • Working mode: 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					PW160-7H	
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
		Center 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					PW160-7H	
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				PW160-7H	
Cate-gory	Item	Measurement Condition	Unit	Standard value	Permissible value

Discharge amount of hydraulic pump (A mode)



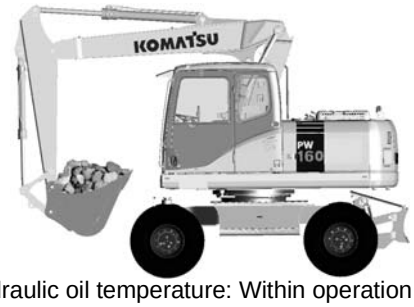
• Pump speed: At 1,950 rpm, PC current 310 mA

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				PW160-7H (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

20 TESTING AND ADJUSTING

INSPECTION AND ADJUSTMENT OF ENGINE RPM 20-102
MEASUREMENT OF EXHAUST GAS COLOR 20-104
ADJUSTMENT OF VALVE CLEARANCE 20-107
MEASUREMENT OF COMPRESSION PRESSURE 20-109
MEASUREMENT OF BLOW-BY PRESSURE 20-110
INSPECTION AND ADJUSTMENT OF FUEL INJECTION TIMING 20-111
MEASUREMENT OF ENGINE OIL PRESSURE 20-113
ADJUSTMENT OF ENGINE SPEED SENSOR 20-114
INSPECTION AND ADJUSTMENT OF AIR COMPRESSOR BELT TENSION 20-114
EMERGENCY SETTING IF FAILURE OCCURS IN ENGINE CONTROL SYSTEM 20-116
MEASUREMENT OF CLEARANCE IN SWING CIRCLE BEARINGS 20-117
INSPECTION AND ADJUSTMENT OF HYDRAULIC OIL PRESSURE IN HYDRAULIC CIRCUIT FOR WORK EQUIPMENT, SWING AND TRAVEL 20-118
INSPECTION AND ADJUSTMENT OF CONTROL CIRCUIT OIL PRESSURE 20-121
INSPECTION AND ADJUSTMENT OF PUMP PC CONTROL CIRCUIT OIL PRESSURE 20-124
INSPECTION AND ADJUSTMENT OF PUMP LS CONTROL CIRCUIT OIL PRESSURE 20-128
MEASUREMENT OF SOLENOID VALVE OUTPUT PRESSURE 20-132
MEASUREMENT OF PPC VALVE OUTPUT PRESSURE 20-138
ADJUSTMENT OF WORK EQUIPMENT AND SWING PPC VALVE 20-140
ADJUSTING TRAVEL MOTOR RELIEF PRESSURE 20-142
RELEASE OF REMAINING PRESSURE IN HYDRAULIC CIRCUIT 20-148
MEASUREMENT OF OIL LEAKAGE AMOUNT 20-150
AIR BLEEDING OF VARIOUS PARTS 20-152
INSPECTION PROCEDURES FOR DIODE 20-154
SPECIAL FUNCTION OF MONITOR PANEL 20-156
PREPARATIONS FOR TROUBLESHOOTING ELECTRICAL SYSTEM 20-190

INSPECTION AND ADJUSTMENT OF ENGINE RPM

- Engine inspection and maintenance tools

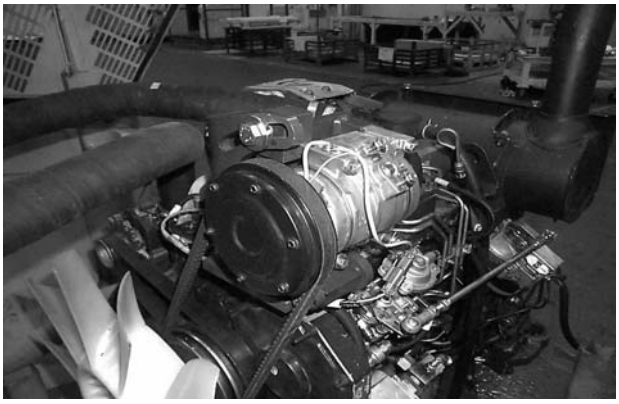
Mark		Part No.	Part Name
A	1	799-203-8001	Multi-tachometer
	2	795-790-2500	Adapter

- Engine RPM may be read off the monitor panel (special function on the monitor panel).

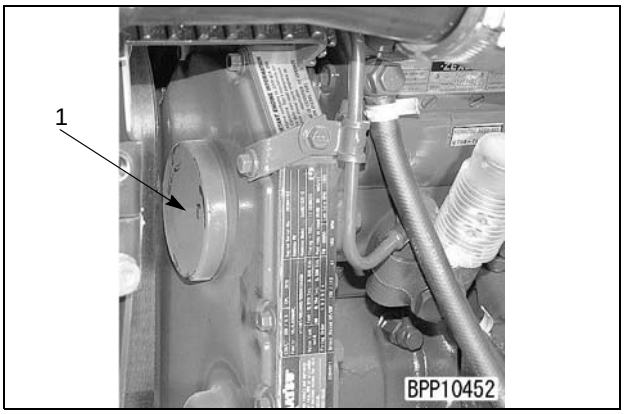
WARNING! Be careful not to touch the engine by accident while installing a measurement equipment as the engine can get extremely hot.

INSPECTION

1. Open up the engine hood.
   - Slacken off the air conditioner compressor and unhook the belt from the pulley wheel. (Refer to operation and maintenance manual for adjusting).
   - Pass the belt over the fan and remove the air conditioner compressor belt from machine.
   - Secure the compressor bracket with the fixing bolts prior to starting the engine.



   - If the fan guard was removed during disassembly then refit this guard correctly prior to starting the engine.
   - Use a filter wrench to take off the cover.



2. Fit adapter **A2**, and connect pickup set ① and meter ② of multi-tachometer **A1**.



3. Measure the engine RPM after setting each measurement condition.
   NOTE: RPM at low idling:
   A. Set the fuel dial at low idling (MIN).
   B. Move all the control levers of work equipment, swing and travel to the NEUTRAL position.

3.1. RPM at high idling:
   A. Turn the auto-decelerator OFF.
   B. Set the fuel dial at high idling (MAX).
   C. Move all the control levers of work equipment, swing and travel to the NEUTRAL position.

3.2. RPM at fuel pump relief
   A. Set the fuel dial at high idling (MAX)
   B. Put the arm in the digging relief position.

3.3. RPM when pump relief and one-touch power max. switch are set (near rated RPM)
   A. Set the fuel dial at high idling (MAX).
   B. Put the arm in digging relief position and keep the one-touch max. power switch depressed.
   - The one-touch power max. function is automatically released in 8.5 seconds, even if the knob switch is kept depressed. Take measurement during the period.

3.4. RPM when auto-decelerator is set
   A. Turn the auto-decelerator ON.
   B. Set the fuel dial at high idling (MAX).
   C. Move all the control levers of work equipment, swing and travel to the NEUTRAL position.

- Approx. 5 seconds after all the control levers are moved to the NEUTRAL position, the rpm falls automatically. That is when the rpm with the auto-decelerator in motion should be measured.



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

WARNING! Stop engine before detaching measurement tools.

ADJUSTMENT

1. Adjustment of RPM at low idling
   - If the rpm at low idling deviates from the standard value, make adjustment using the adjustment function provided in the monitor panel.
   - For the adjustment procedures, See “SPECIAL FUNCTION OF MONITOR PANEL” on page 156.

2. Adjustment of Governor Spring
   - If the rpm at high idling deviates from the standard value, or it is unsteady (hunting), adjust the governor spring securing dimensions, using the adjustment function in the monitor panel.
   - For the adjustment procedures, See “SPECIAL FUNCTION OF MONITOR PANEL” on page 156.

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**.

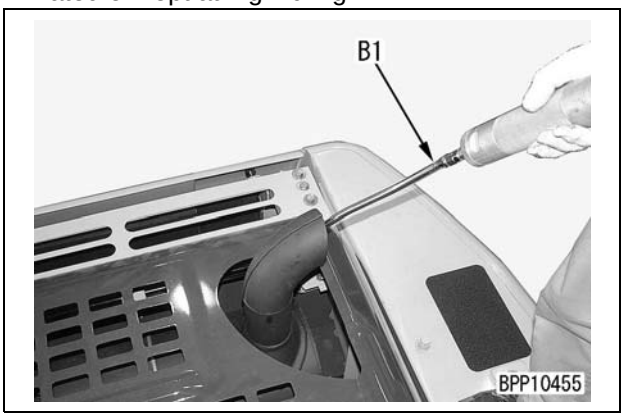
1. Measurement with Handy Smoke Checker **B1**.

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.

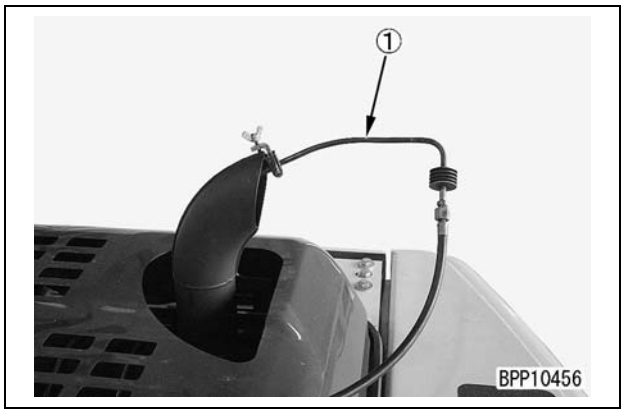


1.5.Take out the filtering paper and compare it with the attached scale for judgement.

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}.

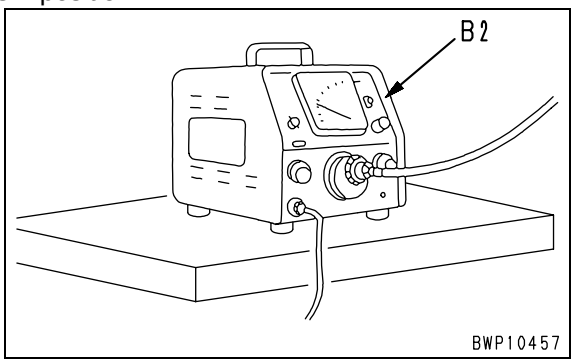
2.3.Connect the power cable to an outlet of AC100V.

- 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.

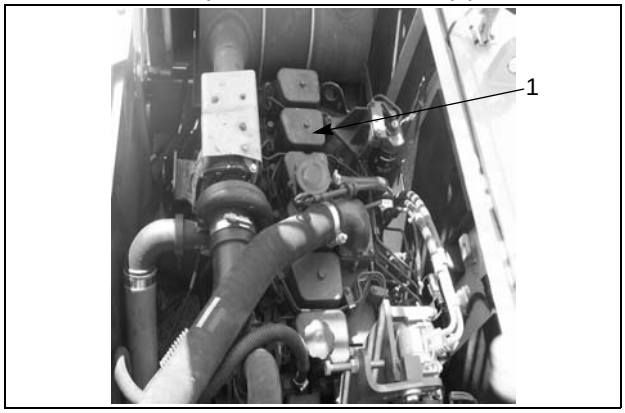
ADJUSTMENT OF VALVE CLEARANCE

- Valve clearance adjustment tools

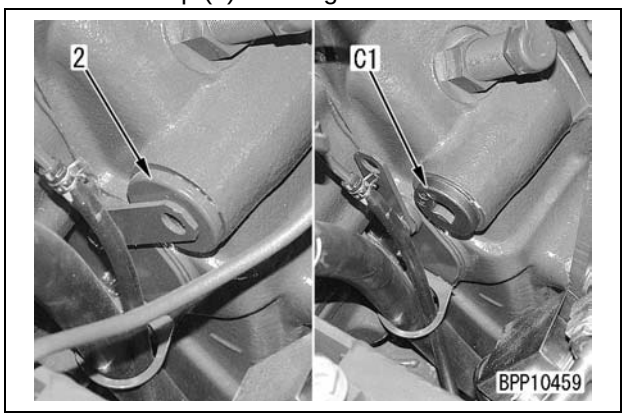
Mark		Part No.	Part Name
C	1	795-799-1131	Gear
	2	Commercial product	Feeler Gauge

1. Open up the engine hood, and remove the fan guard.

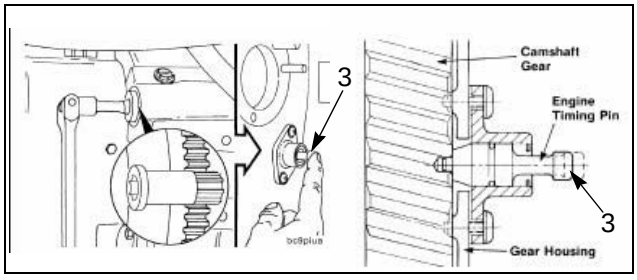
2. Remove all cylinder head covers (1).



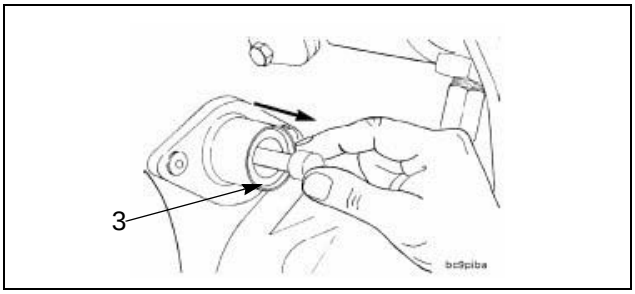
3. Take off cap (2) and fit gear **C1**.



4. Locate top dead centre (TDC) for cylinder No.1 by barring the crankshaft slowly in the normal direction (clockwise as viewed from the front of the engine) using gear **C1**. At the same time pressing on the engine timing pin (3).
When the timing pin (3) engages in the hole in the camshaft gear, cylinder No. is at TDC on the compression stroke.

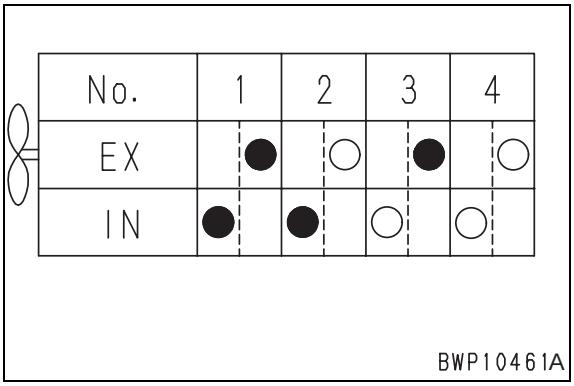


- At the compression top dead centre, the rocker arm of the No. 1 cylinder can be moved by hand an amount equal to the valve clearance. If the rocker arm does not move it is not at the compression top dead centre, so rotate the crankshaft one more turn.



CAUTION!To reduce the possibility of engine or timing pin damage, you must disengage the timing pin after locating top dead centre.

5. When No. 1 cylinder is at the top dead center, adjust valve clearances indicated with a black bullet mark (●) in the chart below in the following manner.



5.1.Insert feeler gauge **C2** in clearance 'b' between rocker arm (4) and valve stem (5), and adjust the valve clearance with adjusting screw (6).

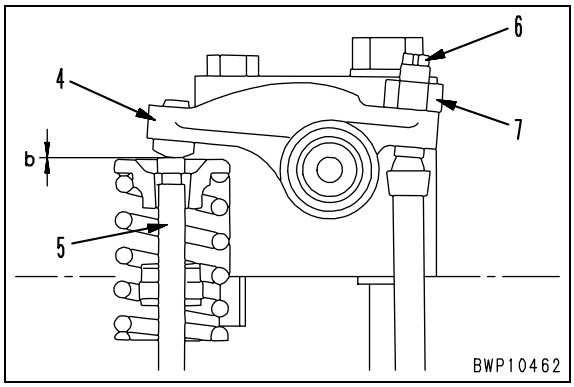
- For the adjustment, turn the adjusting screw with feeler gauge **C2** inserted to the extent that feeler gauge **C2** can be lightly moved.

5.2.Fix adjusting screw (6) and then tighten lock nut (7).

N·m Lock nut: **24±4 Nm {2.45±0.41kgm}**

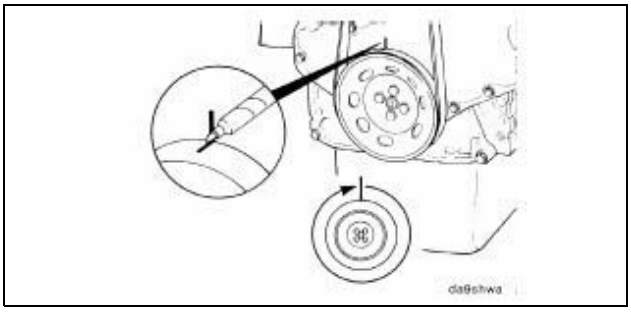
- Check the valve clearance again after tightening lock nut (7).

- Proceed to the next step once all the adjustments of valve clearance indicated with a black bullet mark (●) have been completed.



6. Mark the pulley, and rotate the crankshaft 360°.

CAUTION!To reduce the possibility of engine or pin damage, be sure timing pin is disengaged.



7. When No. 6 cylinder is at the top dead center, adjust valve clearances indicated with a white bullet mark (O) in the chart.
   - Repeat steps 5.1 and 5.2 for adjustment procedure.

8. After the adjustment, make sure that the machine is back to normal condition.

N·m Cylinder head cover securing bolt: **24±4 Nm{2.45±0.41 kgm}**

MEASUREMENT OF COMPRESSION PRESSURE

★ Compression pressure measurement tools

Mark		Part No.	Part Name
D	1	795-502-1205	Compression Gauge
	2	795-502-1700	Adapter

CAUTION! Be careful not to get burnt by touching the exhaust manifold or muffler, or get caught with a rotating parts, while taking measurement of compression pressure.

1. Adjust the valve clearances.

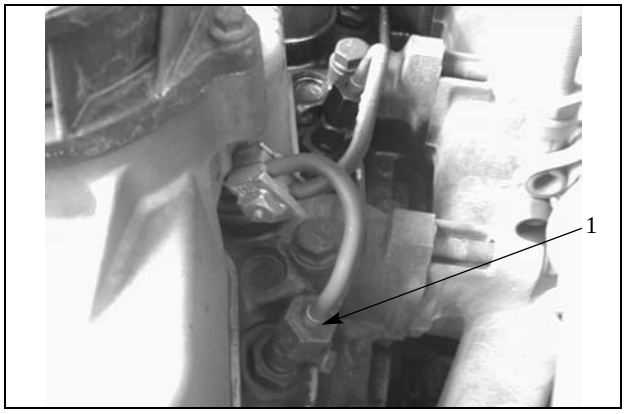
   ★ For the adjustment, refer to the section, "Adjustment of Valve Clearance".

2. Make preparations for measuring the engine rpm.

   ★ For the preparations, refer to the section, "Inspection and adjustment of Engine RPM".

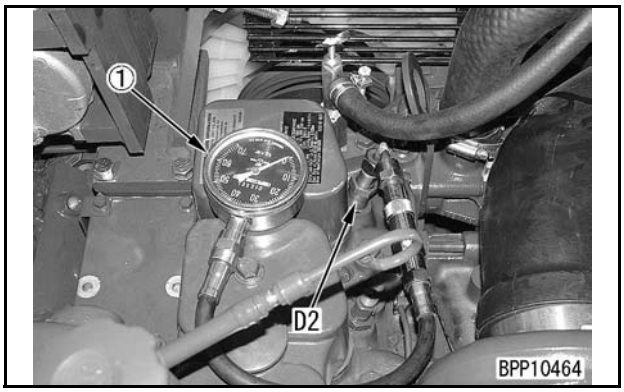
3. Warm up the engine until the engine oil temperature rises up to 40 – 60°C.

4. Detach nozzle holder (1) of a cylinder to be measured.



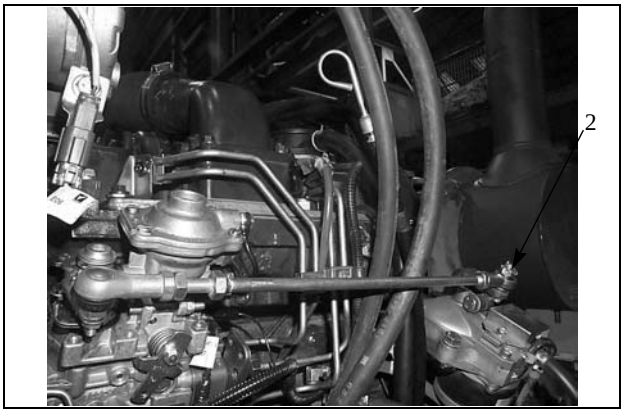
5. Fit Adapter **D2** to the nozzle holder mounting, and connect with gauge assembly ① of compression gauge **D1**.

N·m Adapter: **60±9 Nm{6.12±0.92 kgm}**



6. Detach governor link rod from governor motor.

7. Move governor lever (3) of the fuel injection pump, so it is in contact with the stopper on the STOP side.



8. Crank up the engine with the engine starting motor, and measure the compression pressure.

   ★ Read off the value, when the needle of the compression gauge steadies itself.

   ★ When taking measurement of the compression pressure, be sure to measure the engine rpm, too, so that it stays within the range of designated measurement conditions.

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

Nozzle holder:
Seizure preventive (Molycoat 1000)

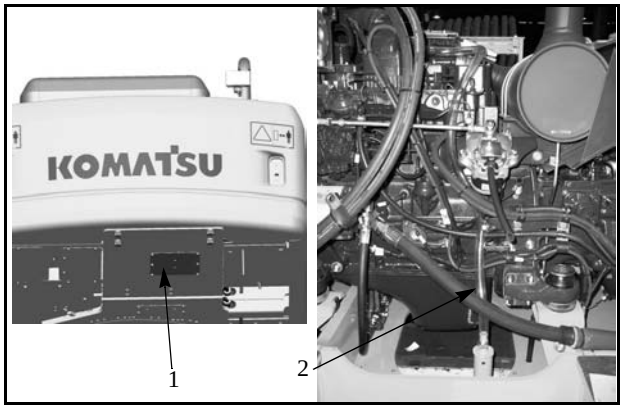
N·m Nozzle holder:
60±9 Nm{6.12±0.92 kgm

MEASUREMENT OF BLOW-BY PRESSURE

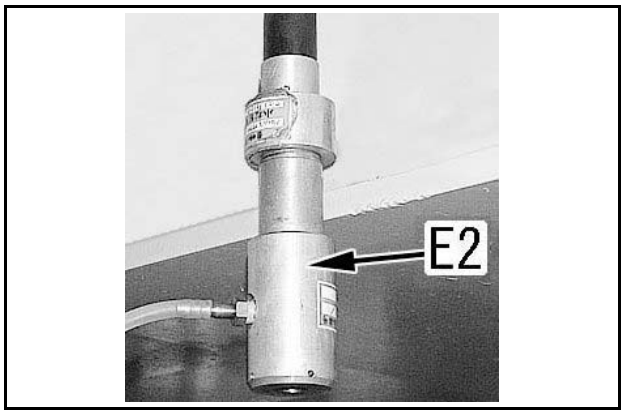
★ Blow-by pressure measurement tools

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

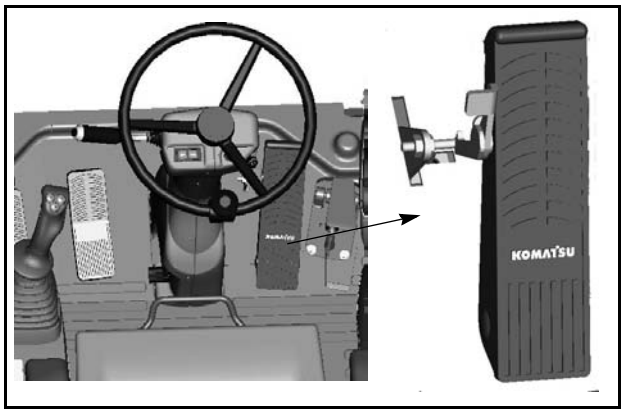


2. Fit tool **E2** to blow-by hose and connect it with gauge ① of blow-by kit **E1**.



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.

INSPECTION AND ADJUSTMENT OF FUEL INJECTION TIMING

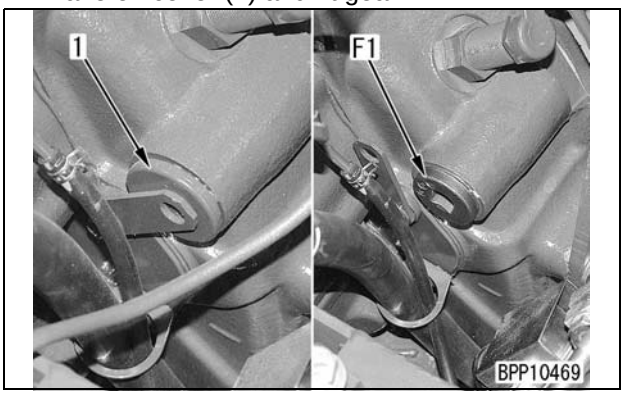
- Fuel injection timing inspection and adjustment tools

Mark		Part No.	Part Name
F	1	795-799-1131	Gear
	2	795-799-1900	Pin Ass'y
	3	795-799-1950	Lock Pin
	4	795-799-1270	Timing Tool

INSPECTION

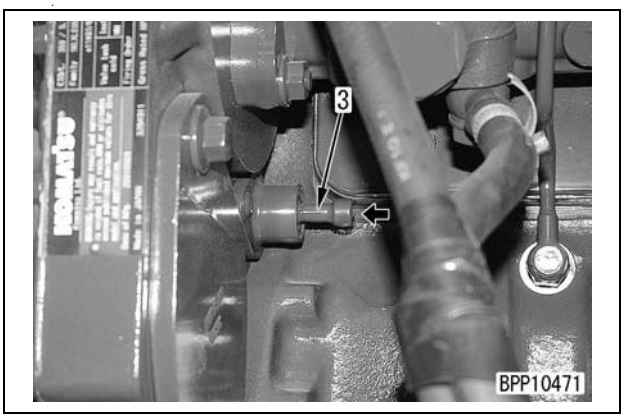
1. Open up the engine hood, and then detach the fan guard.

2. Take off cover (1) and fit gear **F1**.



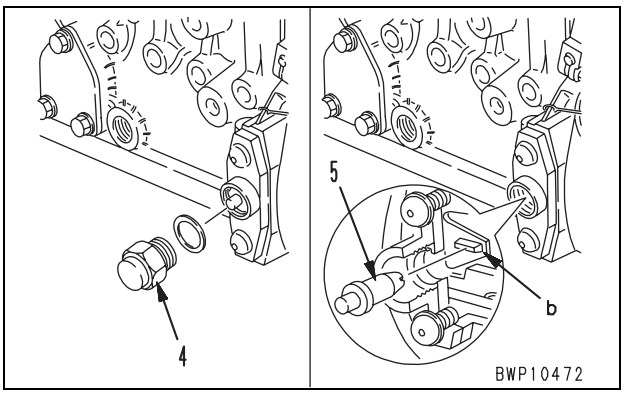
3. Locate top dead centre (TDC) for cylinder No. 1 by following procedure described See “ADJUSTMENT OF VALVE CLEARANCE” on page 107.

4. Fix the fuel injection pump drive gear to match injection timing by pushing drive gear timing pin (3) in the direction of the front cover.
   - Injection timing requires adjustment of high precision. Be sure to fix the drive gear with timing pin (3) so as to match injection timing.
   - Push-in depth: 8 mm
   - If timing pin (3) cannot be pushed in, turn the crankshaft a bit fore or aft with gear **F1**.
   - If it is found difficult to confirm the push-in depth with timing pin (3) as installed in the engine, metallic pin ass'y **F2** may well be used instead.



5. Disconnect plug (4) of the fuel injection pump.

6. Reverse and push in timing pin (5) of the fuel injection pump, and confirm its cut out portion matches with protruding portion **b** inside the pump.
   - If timing pin (5) can be pushed in smoothly, then injection timing is correct.
   - If timing pin (5) cannot be pushed in smoothly, injection timing is incorrect and requires adjustment
   - If it is found difficult to confirm the push-in depth with timing pin (5) as installed in the engine, metallic pin assembly **F3** may well be used instead.



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

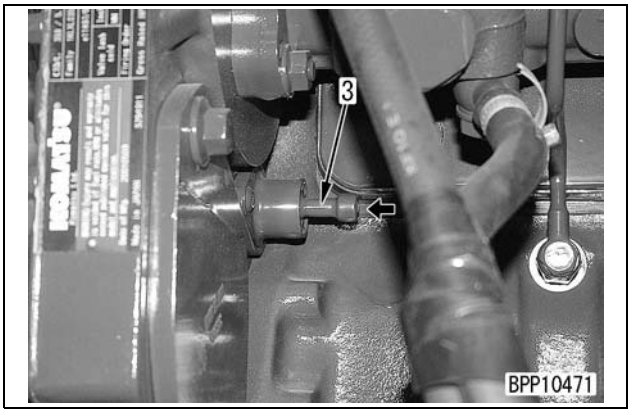
N·m Cylinder head cover securing bolt: 24±4 Nm {2.45±0.45 kgm}

- Do not forget to bring driving gear timing pin (3) and injection pump timing pin (5) back to the pre-inspection condition.
- In case the adjustment follows, leave gear **F1** and timing pin (3) as they are.

ADJUSTMENT

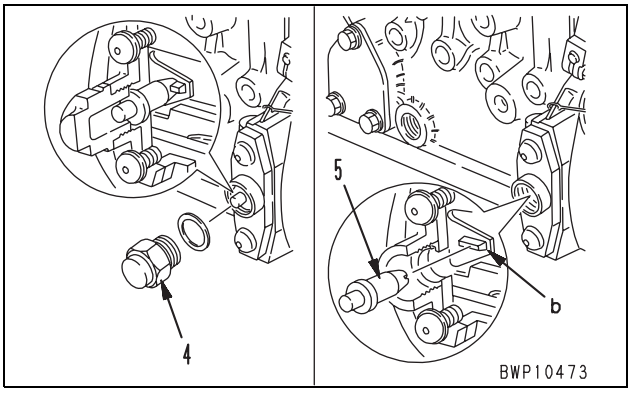
- If fuel injection timing is found incorrect, adjust it in the following manner.

1. Confirm that drive gear injection timing is fixed with driving gear timing pin (3).
   - If timing pin (3) was pulled back after the inspection had been completed, push it in again following the previous inspection procedures.



2. Dismantle the fuel injection pump.
   - For dismantling the fuel injection pump, see “FUEL INJECTION PUMP ASSEMBLY” on page 30- 11.

3. Reverse and push in timing pin (5) of the fuel injection pump, then match the pin cut-out portion and protruding portion "**b**" inside the fuel injection pump by turning the shaft.
   - After fuel timing has been set, fix it by fitting plug (4).



4. Mount the fuel injection pump.
   - For mounting the pump, refer to the same section mentioned in item 2 above.

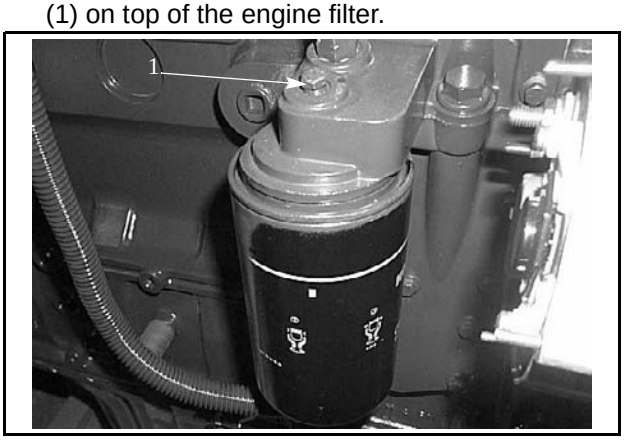
5. Detach the measurement tools after the adjustment, and make sure that the machine is back to normal condition.
   - Before starting the engine again, check that driving gear timing pin (3) and fuel injection pump timing pin (5) have been brought back to the pre-adjustment condition.

MEASUREMENT OF ENGINE OIL PRESSURE

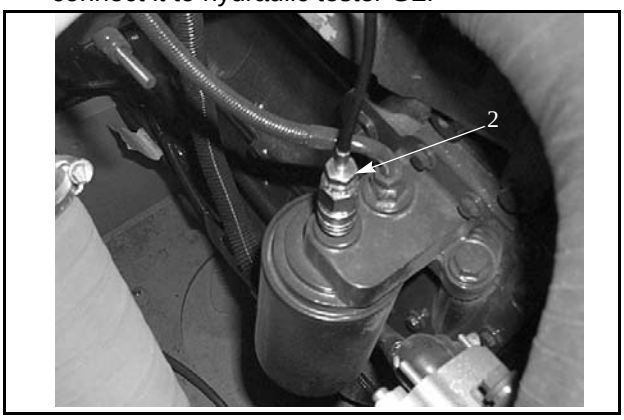
★ Engine oil pressure measurement tools

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

1. Take off engine oil pressure measurement plug (1) on top of the engine filter.



2. Install fitting (2) of the hydraulic tester **G1**, and connect it to hydraulic tester **G2**.



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

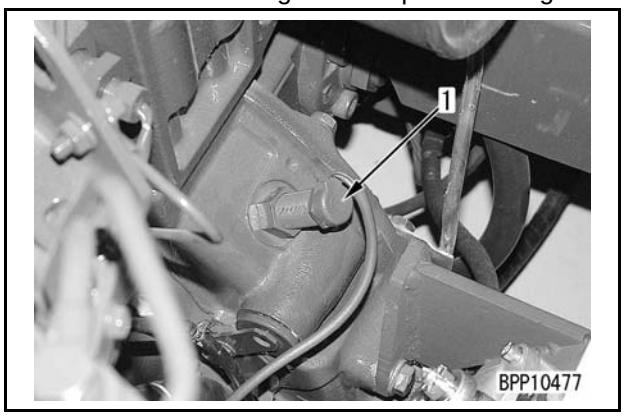
4. Measure engine oil pressure at low idling as well as at high idling.



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

ADJUSTMENT OF ENGINE SPEED SENSOR

★ Detach engine speed sensor (1) before the adjustment, then check that there is no metal dust stuck or damage at the tip and fit it again.



1. Screw in sensor (1) until its tip comes to contact with the tip of flywheel ring gear teeth (2).

Threaded portion:
Gasket sealant (LG-6)

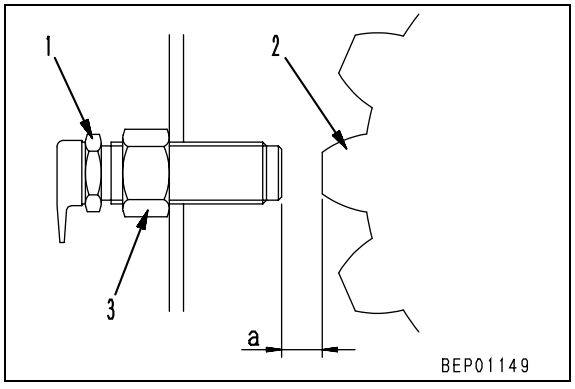
2. Screw back sensor (1) from that position by the prescribed angle.

★ Screw-back angle: 1±1/6 turn

★ Adjust clearance "**a**" between the sensor tip and gear tooth tip to be 1.25–1.75 mm.

3. Fasten sensor (1) with nut (3).

N·m Nut: **49.0–68.6 Nm{5–7 kgm}**



4. After the adjustment, confirm that correct engine speed is displayed in the monitor panel, using the special monitoring function.

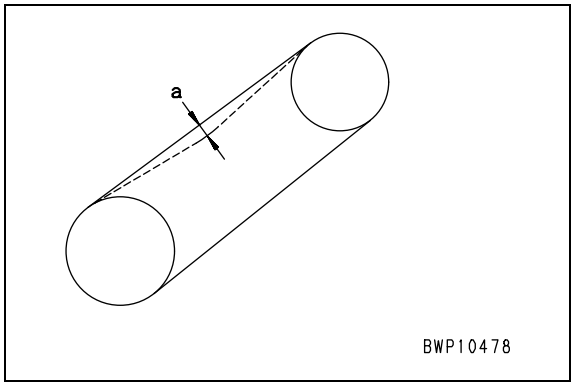
★ For monitoring engine speed, refer to the section, "Special Function of Monitor Panel".

INSPECTION AND ADJUSTMENT OF AIR COMPRESSOR BELT TENSION

INSPECTION

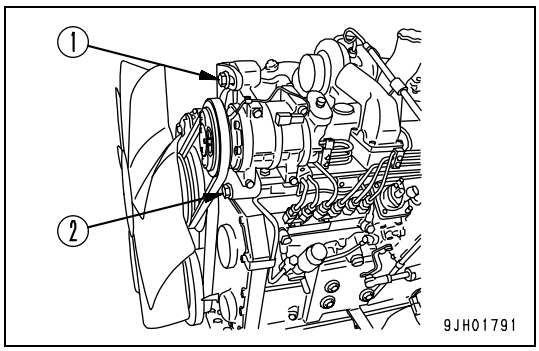
Check belt deflection amount **a** when depressing the mid point between the fan pulley and the compressor with a thumb.

★ Belt depressing force: Equivalent to **58.8 N{6 kg}**

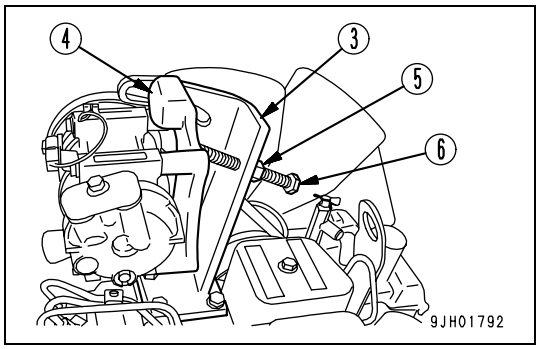


ADJUSTMENT

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



★ Bracket (4) holds the compressor in place. When bolts (1) and (2) are loosened, bracket (4) moves with the securing position of bolt (2) as a fulcrum.



2. Loosen nut (5) attached to fixed bracket (3), and then tighten bolt (6).

★ Tighten bolt (6) so that the deflection of the belt will be 5 ~ 8 mm (approx. 58.8N (6kgf)

3. Tighten bolts (1) and (2) to secure bracket (4).

4. Loosen bolt (6) to remove from bracket (4).

5. Tighten nut.

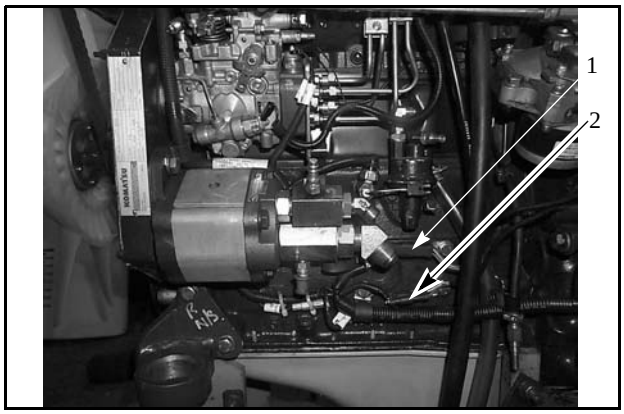
★ Check the belt tension again after the adjustment.

EMERGENCY SETTING IF FAILURE OCCURS IN ENGINE CONTROL SYSTEM

★ If a failure occurs on any of the engine control devices like fuel dial, governor pump controller or governor motor potentiometer, and the engine gets out of control, first fix the engine rpm and take the following steps to avoid the immediate danger.

★ The suggested steps are provisional ones. Identify the cause for the failure and carry out repairs promptly thereafter.

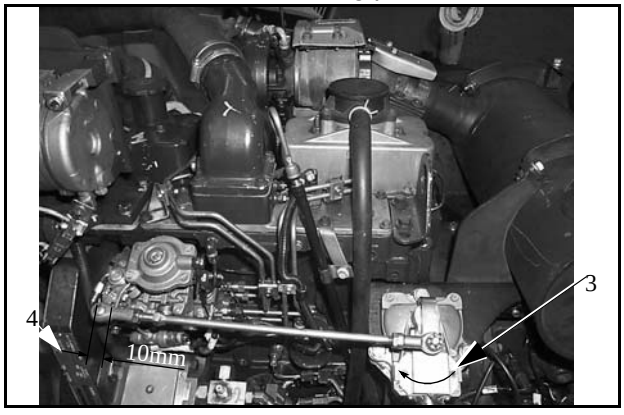
1. Disconnect **E11** connector (1) of the governor motor from **E10** connector (2) of the governor potentiometer.
   ! If the governor motor connector is left connected, the governor motor will be suddenly activated while the engine is running, causing a mechanical damage. Be sure to disconnect it.



2. Manually adjust the governor linkage.

6. Tilt the governor motor lever to the fuel injection pump side (3), until the injection pump lever hits the mechanical stop. Backoff the lever by approx. 10mm (4).

   ★ The governor lever of the fuel injection pump is fixed at a near-idling position.



3. Start the engine again and travel the machine to a safe place.

4. Turn the key switch to the 'OFF' position and the engine should stop.

MEASUREMENT OF CLEARANCE IN SWING CIRCLE BEARINGS

★ Swing circle bearing clearance measurement tools

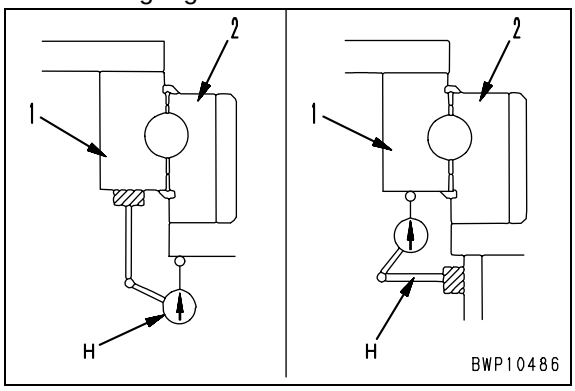
Mark	Part No.	Part Name
H	Commercial Product	Dial Gauge

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

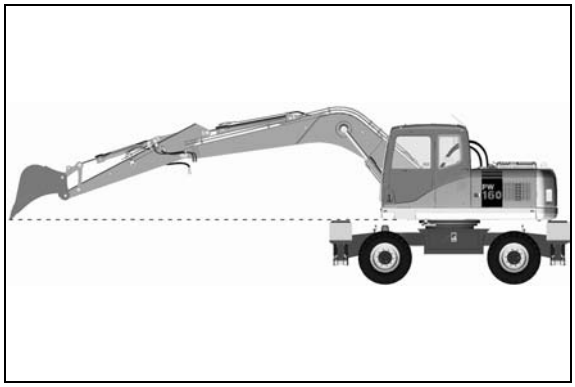
CAUTION!Be careful not to put a hand or foot under the undercarriage, while taking measurement.

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.

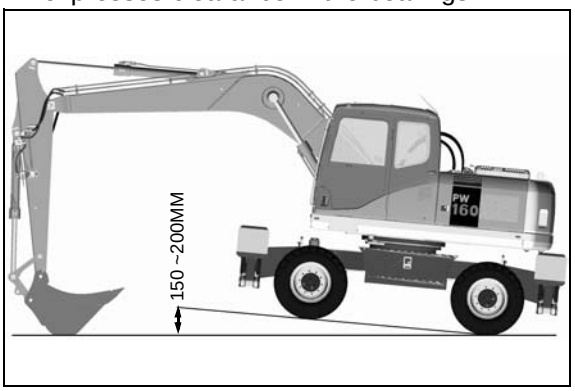
3. Set dial gauge **H** at zero point.

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

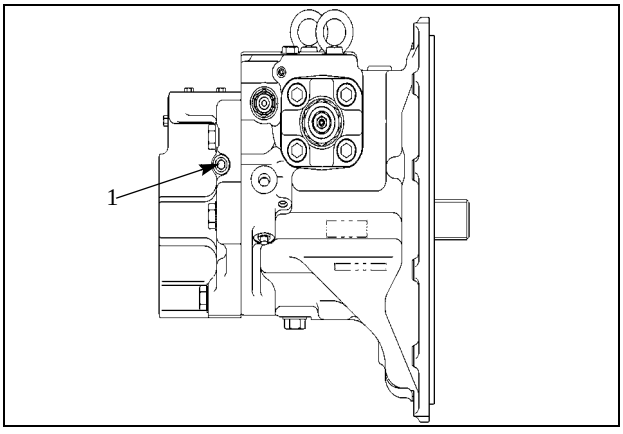
★ Hydraulic oil pressure in the hydraulic circuit for work equipment, swing and travel (hydraulic pump output pressure) may be also confirmed with a monitoring function in the monitor panel (special function of monitor panel).

MEASUREMENT

1. Pre-measurement work

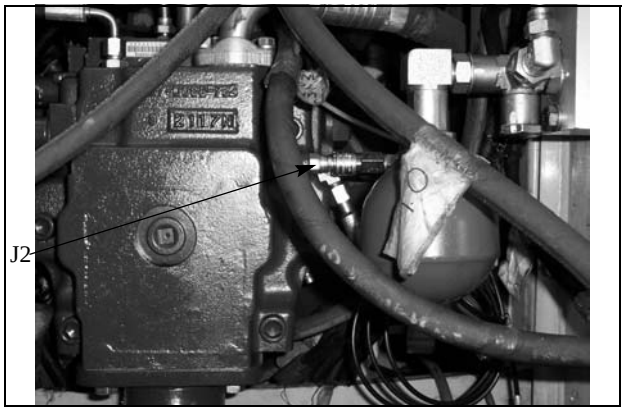
Lower the work equipment to the ground, then release the remaining pressure in the piping by operating the control lever several times after stopping the engine, and release the pressure inside the hydraulic tank by gradually loosening the oil filler cap. Ignition switch must be in the 'ON' position.

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

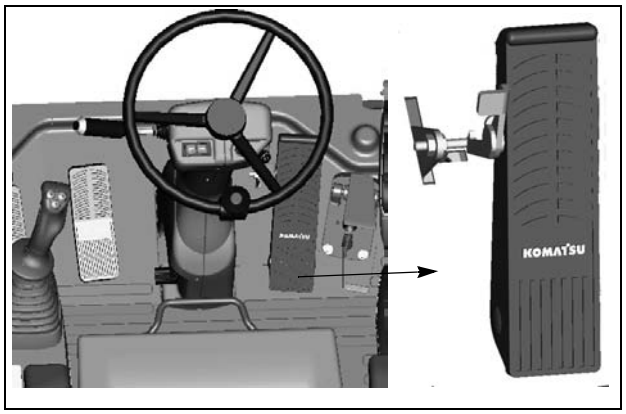
1) Start the engine and move the swing lock switch to the ON position.
2) Measure hydraulic oil pressure when the engine is running at high idling and the swing circuit is relieved.

★ 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.

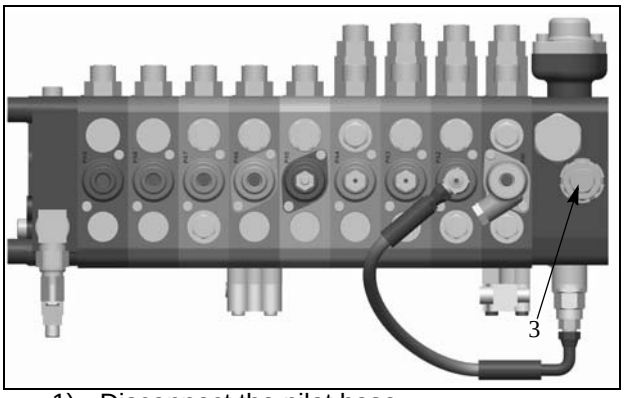
ADJUSTMENT

★ 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 settinging is the state in which th 2 stage relief solenoid valve is turned ON and the pilot pressure is applied.

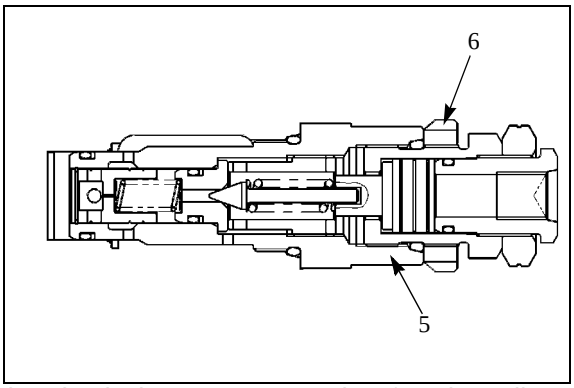


1) Disconnect the pilot hose.
2) Loosen lock nut (5) and adjust the pressure by turning holder (6).

★ 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 changeover port.

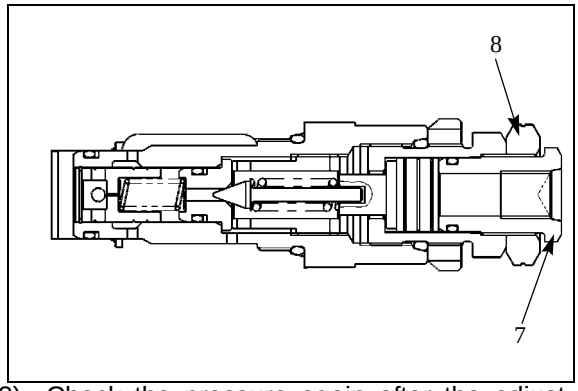
1) Disconnect pilot hose.
2) Loosen lock nut (7) and adjust the pressure by turning holder (8).

★ 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}**

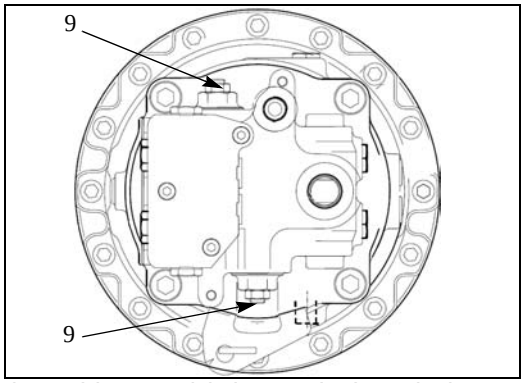


3) Check the pressure again after the adjustment, following the aforementioned steps for measurement.

★ 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 locknut (10).

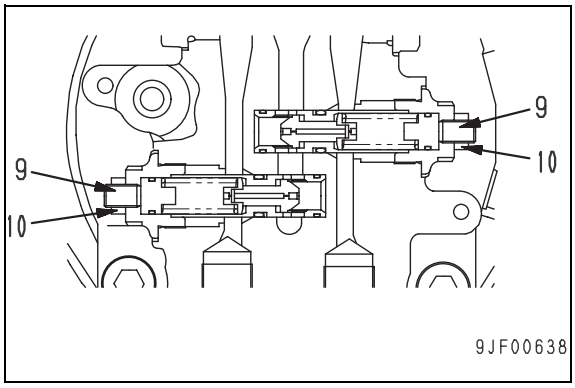
★ Fix the screw with a hexagonal wrench.

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

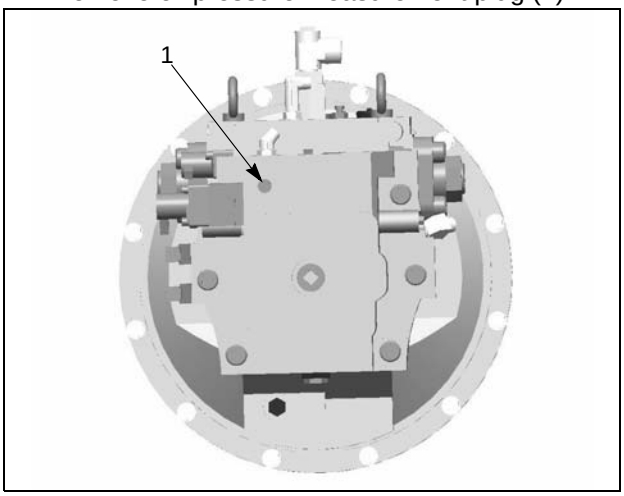
★ Control circuit oil pressure inspection and adjustment tools

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

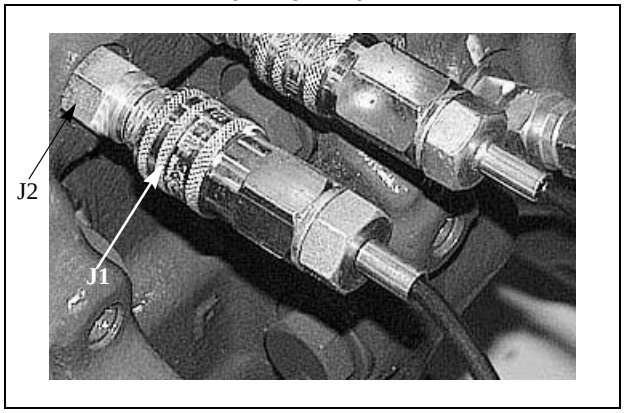
CAUTION!Lower the work equipment to the ground and stop the engine. After the engine stops, operate the control lever several times to release the remaining pressure in the piping. Then loosen the oil filler cap to release the pressure inside the hydraulic tank.

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.

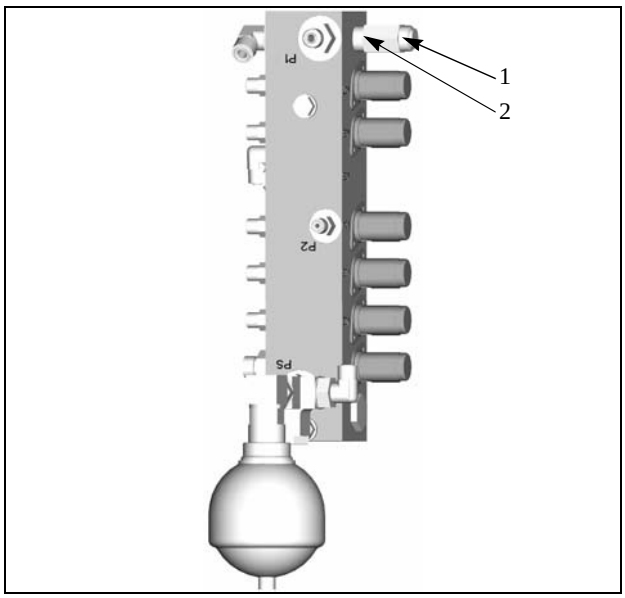
4. Measure oil pressure with the engine running at high idling and all the control levers in the NEUTRAL position.

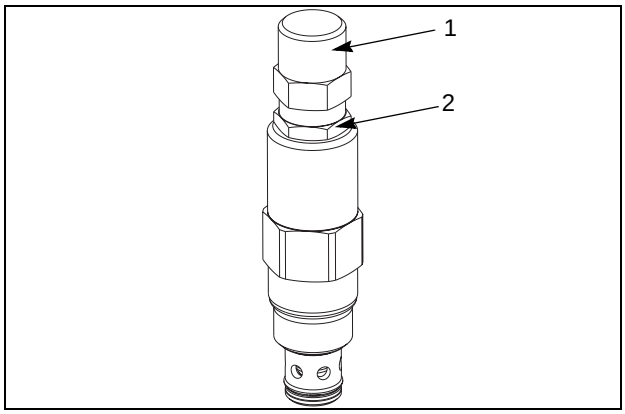


5. Detach all the measurement tools after the measurement, and make sure that the machine is back to normal condition.

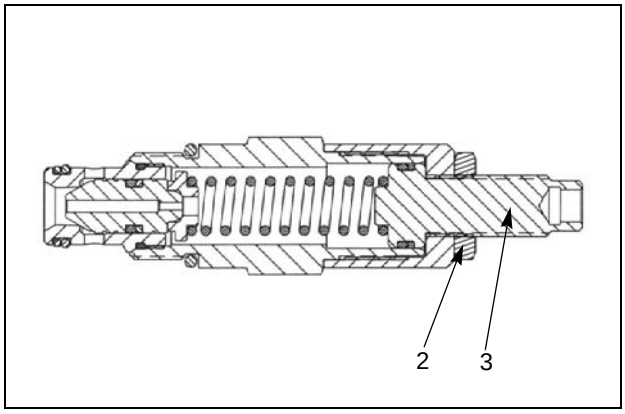
PROCEDURE FOR PRESSURE REDUCING ADJUSTMENT

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

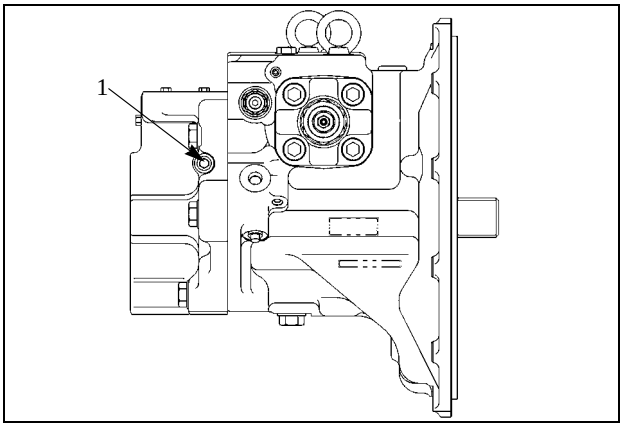
★ Implement measuring the pump PC control circuit oil pressure after confirming that the work equipment, swing and travel circuit oil pressure as well as the control circuit original oil pressure are normal.

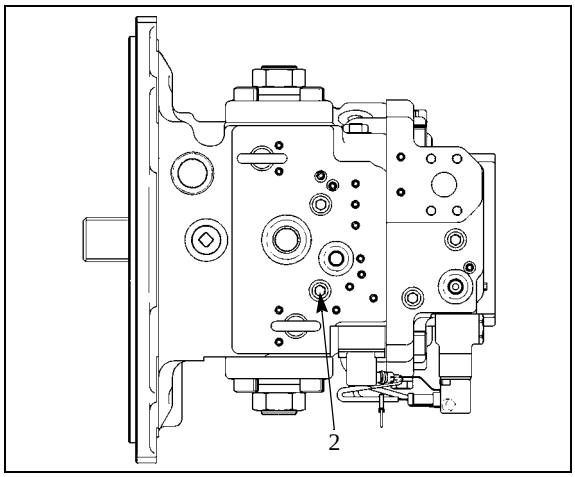
CAUTION!Lower the work equipment to the ground and stop the engine. After the engine stops, operate the control lever several times to release the remaining pressure in the piping. Then loosen the oil filler cap to release the pressure inside the hydraulic tank. Ignition switch must be in the 'ON' position.

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.

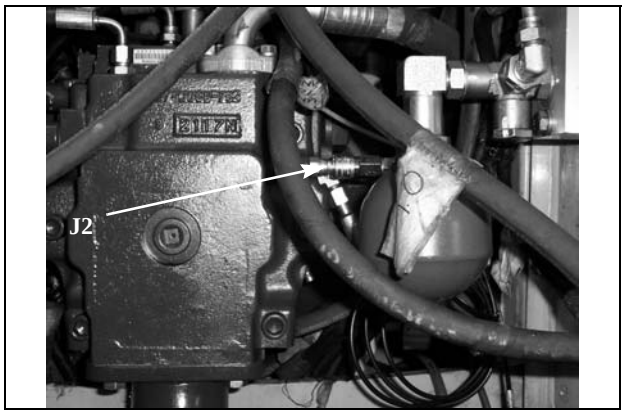
1) Remove oil pressure measurement plugs (1) and (2).
   - Plug (1): For measuring the pump delivery pressure
   - Plug (2): For measuring the pump PC valve delivery pressure

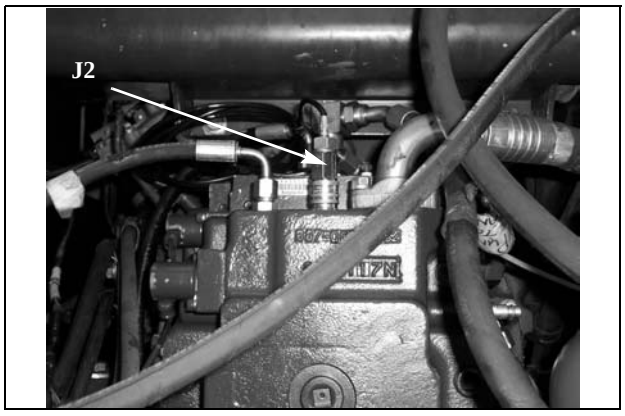




2) Fit fitting **J2** and connect to oil pressure gauge ① of hydraulic tester **J1**.

★ 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.



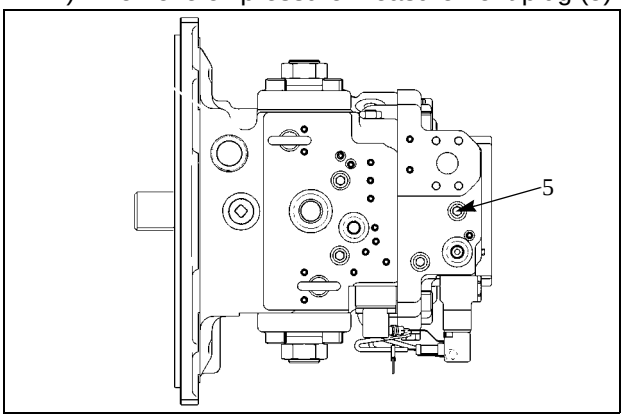
4) Measure the pump delivery pressure and PC valve output pressure (servo piston inlet pressure) together with the engine running at high idling, after setting the machine at the following conditions.
   - Working mode: A mode
   - Swing lock switch: ON (switched to high pressure relief with 2-stage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

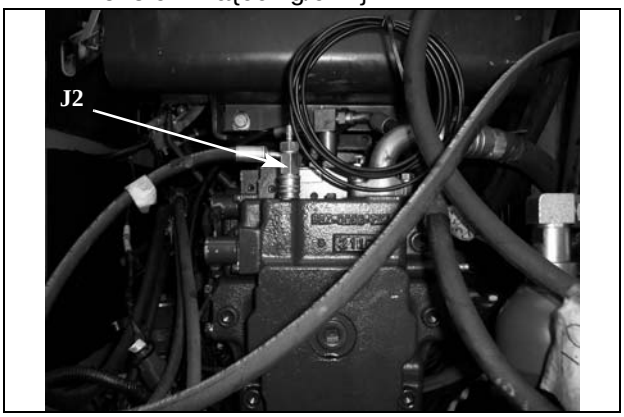
★ If there is any abnormality with PC valve or servo piston, the PC valve output pressure (servo piston output pressure) equals to the pump delivery pressure, or approximates to 0 pressure.

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.



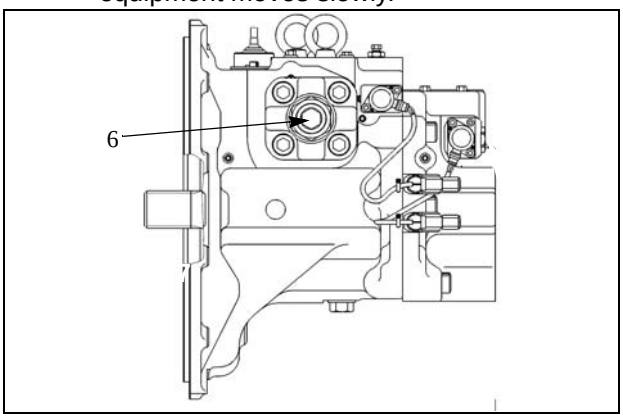
4) Measure the hydraulic oil pressure with all the control levers kept in the NEUTRAL position and the engine running at high idling and at low idling.

★ 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.

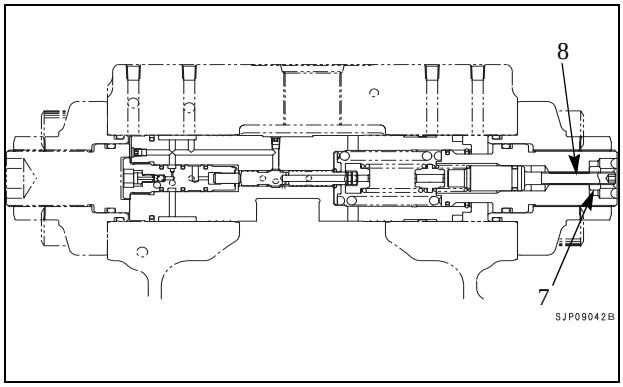


1. Loosen lock nut (7) and make adjustment, turning adjusting screw (8).

★ 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

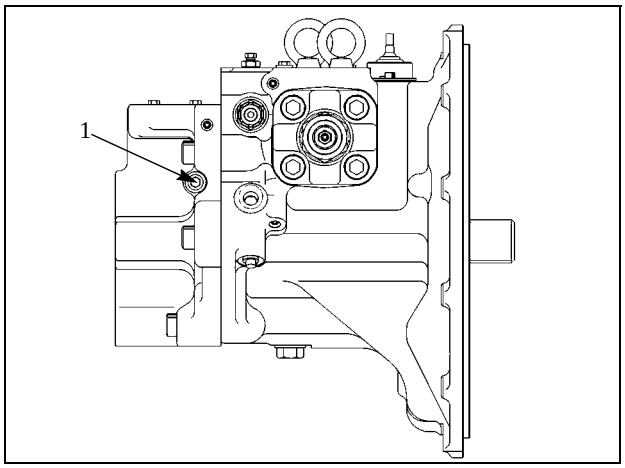
★ Measure pump LS control circuit oil pressure after confirming that the work equipment, swing and travel circuit oil pressure as well as control circuit original pressure are normal.

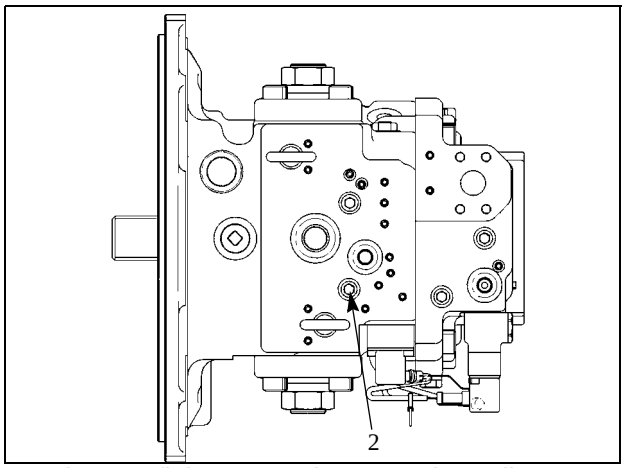
CAUTION!Lower the work equipment to the ground and stop the engine. After the engine stops, operate the control lever several times to release the remaining pressure in the piping. Then loosen the oil filler cap to release the pressure inside the hydraulic tank. Ignition switch must be in the 'ON' position.

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.

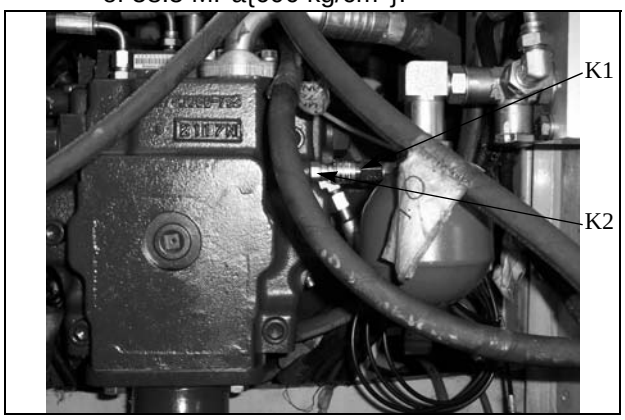
1) Remove oil pressure measurement plugs (1) and (2).
   - Plug (1): For measuring the pump delivery pressure
   - Plug (2): For measuring the pump LS valve delivery pressure





2) Use fitting **K2** and connect it to oil pressure gauge ① of hydraulic tester **K1**.

★ 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.

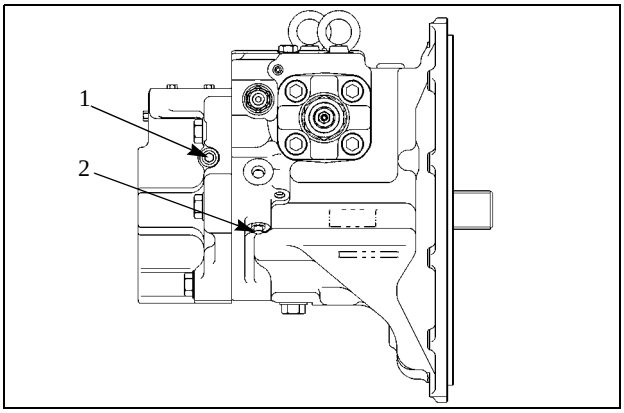
Oil pressure to be measured	Oil pressure ratio	
	All control levers in NEUTRAL	During test.
Pump delivery pressure	Nearly equal pressure	1
LS valve delivery pressure		Approx. 3/5

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.

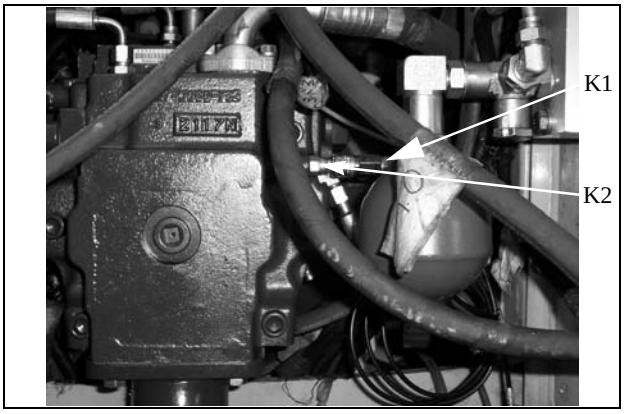
1) Remove oil pressure measurement plugs (1) and (2).
   - Plug (1): For measuring the pump delivery pressure
   - Plug (2): For measuring the pump LS pressure



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

★ 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

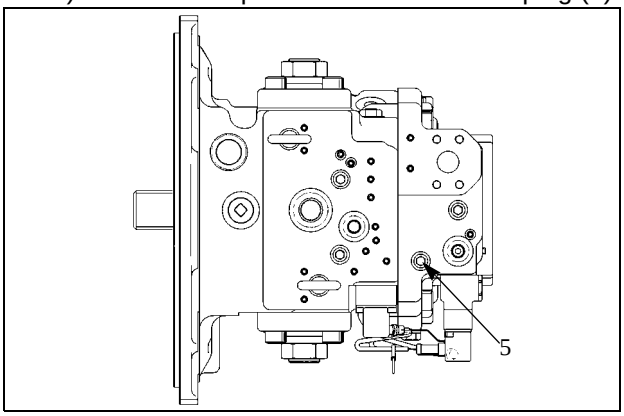
★ If LS differential pressure is in the following conditions, it is judged normal.

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.

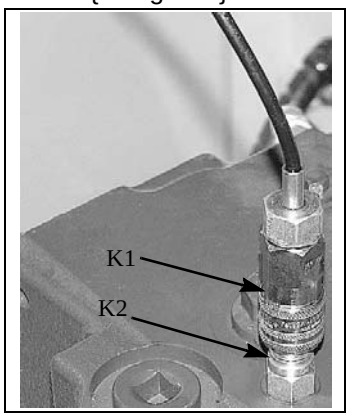
3. Measurement of LS-EPC valve output pressure

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.

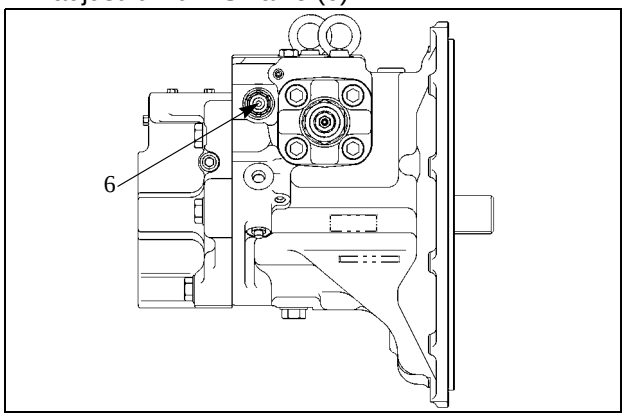
l.

Working Mode	Work Eqpt Operationl	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).



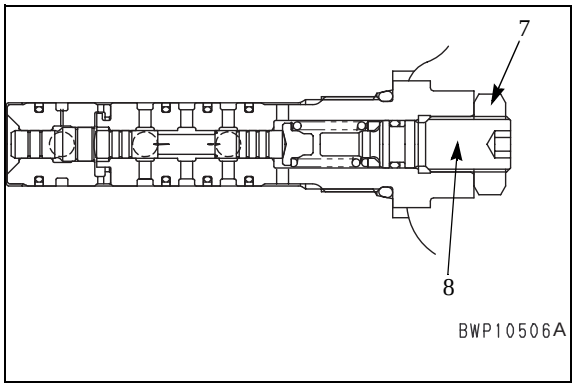
1. Loosen lock nut (7) and adjust the pressure by turning adjusting screw (8).

   ★ 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

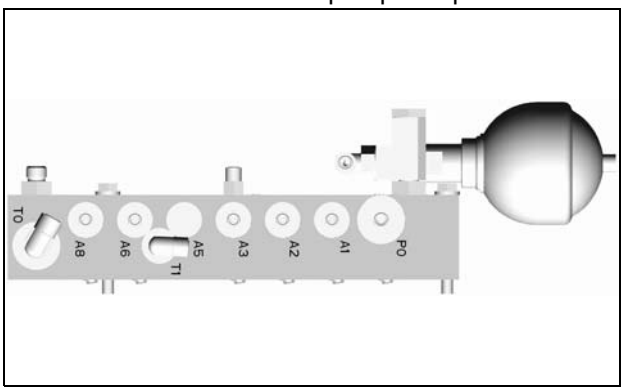
★ Measure solenoid valve output pressure after confirming that control circuit original pressure is normal.

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.

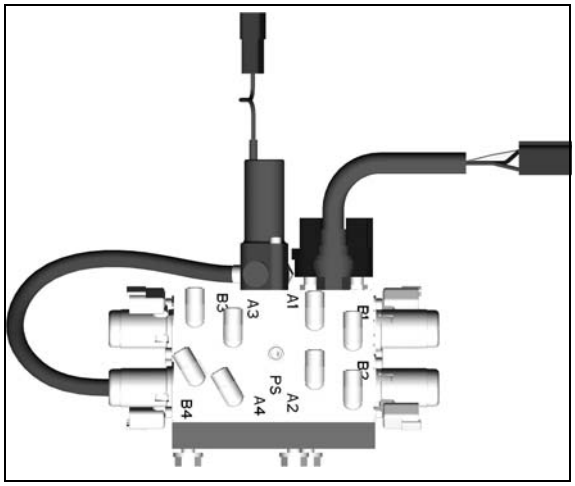
No.	Solenoid valve to be measured
PO	PPC hydraulic pressure lock solenoid valve
A1	2 stage relief solenoid valve
A2	Swing brake solenoid valve
A3	Suspension lock solenoid valve
A5	Blanked
A6	Travel neutral solenoid valve
A8	Travel creep solenoid valve

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



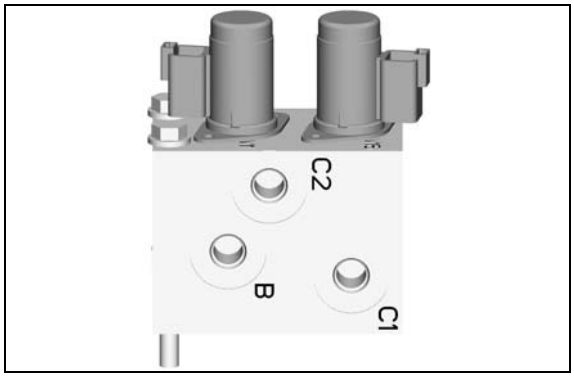
No.	Solenoid valve to be measured
A1	Travel solenoid valve - forward
B1	Travel solenoid valve - reverse
A2	Boom / Stabilizer solenoid valve - Boom down
B2	Boom / Stabilizer solenoid valve - Stabilizer down
A3	Boom / Stabilizer solenoid valve - Boom up
B3	Boom / Stabilizer solenoid valve - Stabilizer up
A4	Arm rotate solenoid valve - anti-clockwise
B4	Arm rotate solenoid valve - clockwise

★ 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 gearh

★ 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.

7 - 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.

Functiong Condition			Functioning
When overheat setting of 1st stage is ON			OFF
When overheat setting of 2nd stage is ON			
When all the signals for work equipment, swing and travel are OFF			
When swing lock switch is ON			ON
When travel signal is ON			
When working mode is L mode			
When boom LOWER signal is ON			
When working mode is A or E mode	When left knob is switched	If signals other than swing operation only ON	
		If swing operation only is ON	OFF
In conditions other than above			

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

Table for Functioning Conditions - Arm rotate solenoid valve. (ANTI-CLOCKWISE / CLOCKWISE)

Functioning Condition	Functioning
No operation	OFF
Clockwise rotation (Solenoid de-energised)	Rotate right
Anti-clockwise rotation (Solenoid actuated)	Rotate left

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	799-101-5002	Hydraulic Tester
	790-261-1203	Digital Type Hydraulic Tester

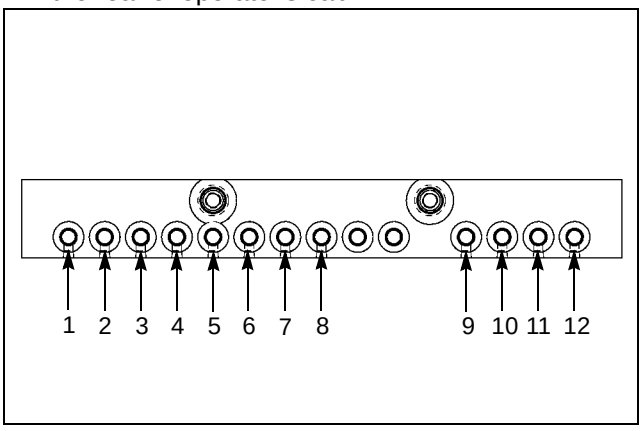
- Measure PPC valve output pressure after confirming that control circuit original pressure is normal.

1. Remove PPC oil pressure switches (1) through (24) in the hydraulic circuits to be measured.

No.	Circuit to be measured	No.	Circuit to be measured
1	Left swing - P_{21}	7	Adjust cylinder retract - P_{81**}
2	Arm dump - P_{61}	8	Adjust cylinder extend - P_{71**}
3	Arm dig - P_{51}	9	Bucket dig - P_{31}
4	Right swing - P_{11}	10	Boom down - PA_7
5	2nd HCU - PA_{11*}	11	Bucket dump P_{41}
6	2nd HCU - PA_{9*}	12	Boom raise - PA_5

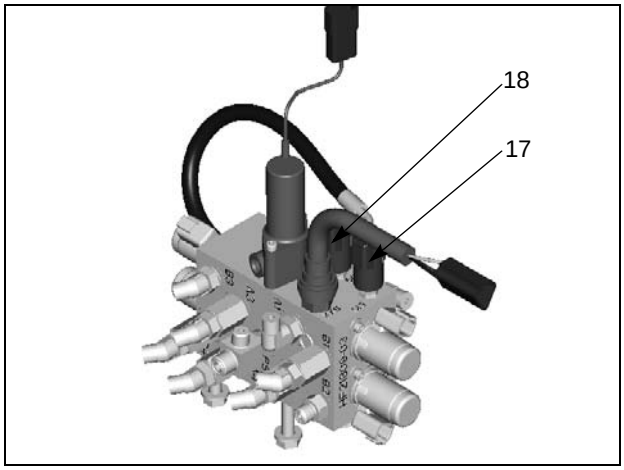
* Pressure switch fitted to this port if 2 attachment fitted
** Pressure switch fitted to this port if 2 piece boom fitted

➧ Oil pressure switches (1) through (12) are installed in the PPC manifold block installed at the rear of operator's cab.



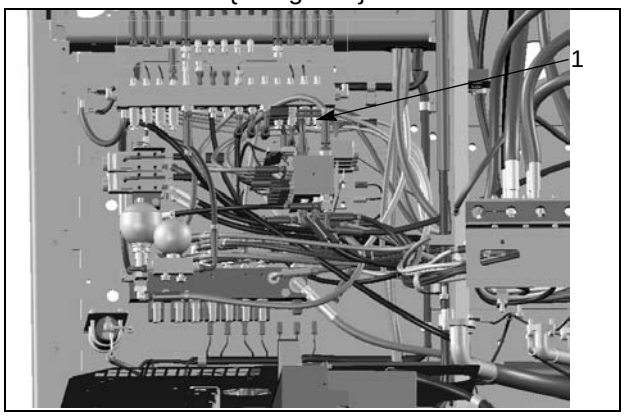
No.	Circuit to be measured
17	Travel reverse
18	Travel forward

➧ Oil pressure switches (17) and (18) are installed in the 4 - stage solenoid block in the service area at the rear of the operator's cab.



1. Attach fitting ① of hydraulic tester **M** and connect oil pressure gauge ② .

➧ Use an oil pressure gauge with the capacity of 5.9 MPa{60 kg/cm^2}.



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



3. Measure the pressure when the engine is running at high idling and the control lever of the circuit to be measured is kept in the NEUTRAL position and at the full stroke.
   ★ If PPC valve output pressure is at the level shown below, it is judged normal.

Lever Control	Hydraulic Pressure
In NEUTRAL	0{0}
At full stroke	Nearly equal to control original pressure (see standard value table)

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

ADJUSTMENT OF WORK EQUIPMENT AND SWING PPC VALVE

★ If there is excessive play in the work equipment or swing lever, adjust it in the following manner.

1. 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).

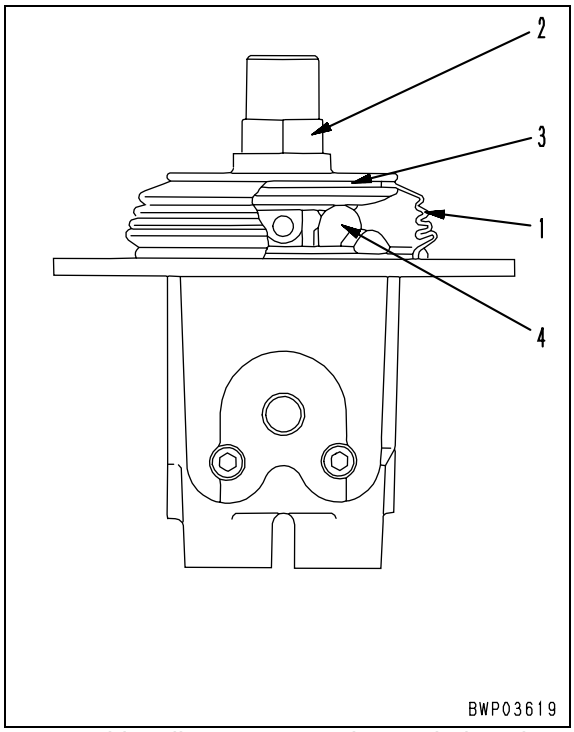
   ★ Do not move the piston while doing this work.

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 enviromment. Do not allow dirt particals under the boot.

TESTING TRAVEL MOTOR RELIEF PRESSURE

★ The travel motor has two pressure relief valves which control the deceleration of the machine. One operates in forward travel and one in reverse.

★ Set pressure = 42 MPa (428 kg/cm^2)

MEASURING TRAVEL MOTOR RELIEF PRESSURE.

Oil temperature should be 45 - 50°

★ Fit a 600 kg/cm^2 pressure gauge to port Mb on the front travel motor.

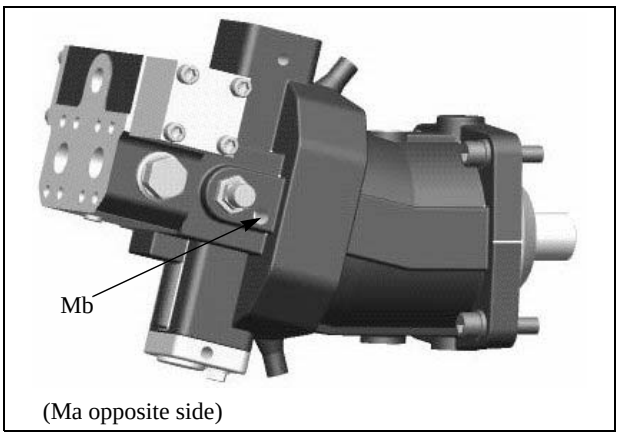
★ Test the machine on a downhill slope with a smooth surface and long enough to allow the pressure to stabilize. If the slope is steep (more than 5 degrees) test in LOW mode, otherwise test in HIGH mode.

★ Travel forward at approximately half maximum speed (for the selected mode), then release the travel pedal. Read the pressure gauge after the pressure stabilizes.

NOTE: Always use a guage 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 extremly 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 counterclockwise to decrease the pressure.

★ Tighten locknut.

NOTE: The set pressure cannot be measured whilst making an adjustment.
Always repeat the measurement to check the set pressure after adjusting.

TESTING PROPSHAFT SPEED

MEASURING ROTATING SPEED OF PROPSHAFT

- Lift the wheels from the ground using the blade and outriggers or work equipment.
- Set the machine to high idle.
- Measure in CREEP and LO travel speeds.
- Gently depress the travel pedal to full stroke.

WARNING! Hazard from rotating wheels exists.

- Allow the speed of the propshaft / wheels to stabilize for a few minutes then measure the rotating speed of the propshaft using an optical tachometer.
- Gently release the travel pedal to stop the wheel rotation.

★ Always change rotating speed slowly. Sudden release of the travel pedal could damage the transmission or motors.

★ **Judgement table**

Propshaft speed in RPM

Oil temperature 45 ~ 50°C

Check Item		Unit	Standard	Remarks
Travel Speed - CREEP	A Mode	rpm	198 +/-5%	If too high check travel EPC valve.
Travel Speed - LO	A Mode		990 +/-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 phenomenom 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 (ie 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.

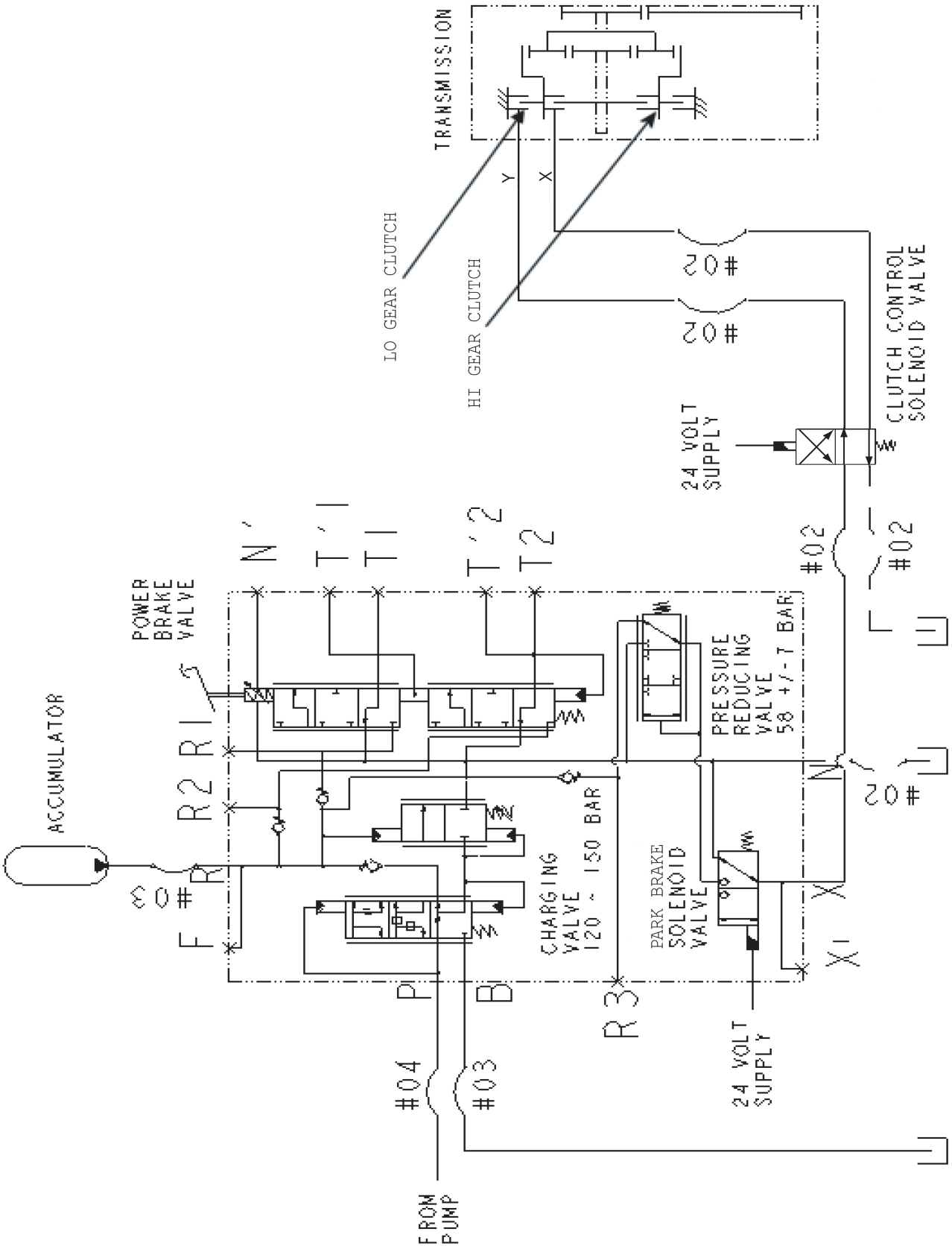
1. Measuring clutch actuation pressure

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
#02
#02
20#
POWER BRAKE VALVE
N'
T'1
T1
T'2
T2
PRESSURE REDUCING VALVE 50 +/- 7 BAR
ACCUMULATOR
F
R2
R1
S
R
50#
CHARGING VALVE 120 ~ 150 BAR
PARK BRAKE SOLENOID VALVE
P
B
R3
X1
#04
#03
24 VOLT SUPPLY
FROM PUMP

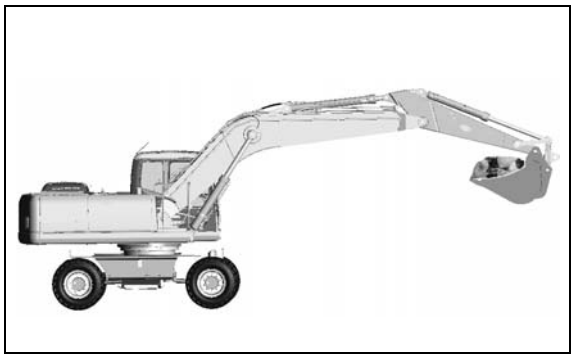
INSPECTION OF LOCATIONS OF HYDRAULIC DRIFT OF WORK EQUIPMENT

★ 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.



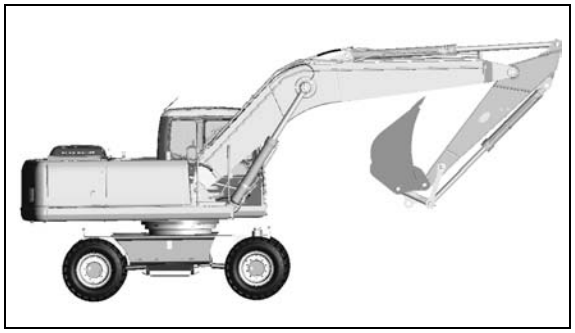
2) Operate the control lever to the RAISE position or the bucket control lever to the CURL position.
   - If the lowering speed increases, the cylinder packing is defective.
   - If there is no change, the control valve is defective.

★ 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.

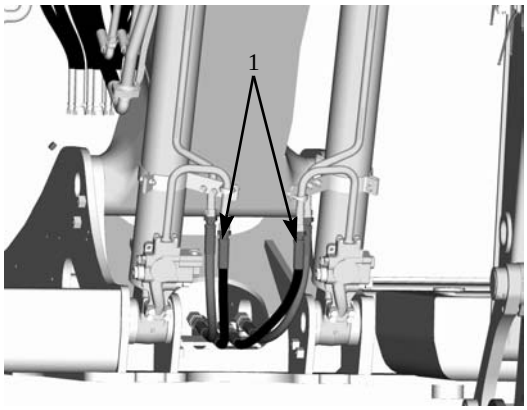
! Release the pressure remaining in the piping, referring to the foregoing section of "Release of Remaining Pressure in Hydraulic Circuit".

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.

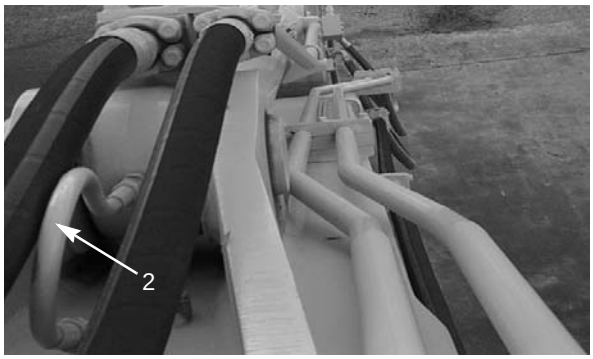
! Release the pressure remaining in the piping, referring to the foregoing section of "Release of Remaining Pressure in Hydraulic Circuit".

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.

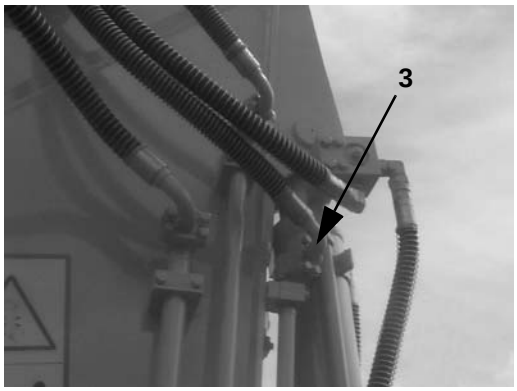
! Release the pressure remaining in the piping, referring to the foregoing section of "Release of Remaining Pressure in Hydraulic Circuit".

2) Disconnect hose (3) at the cylinder head end block the hose end with a plate.

! 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.



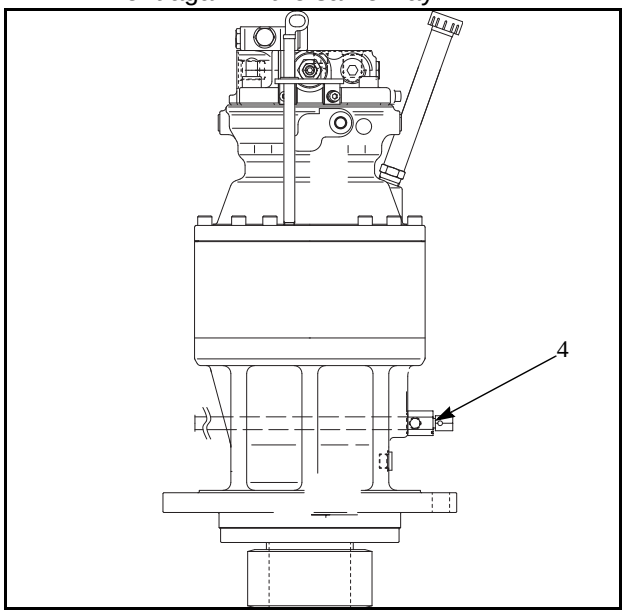
5) After the measurement, make sure that the machine is back to normal condition.

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.

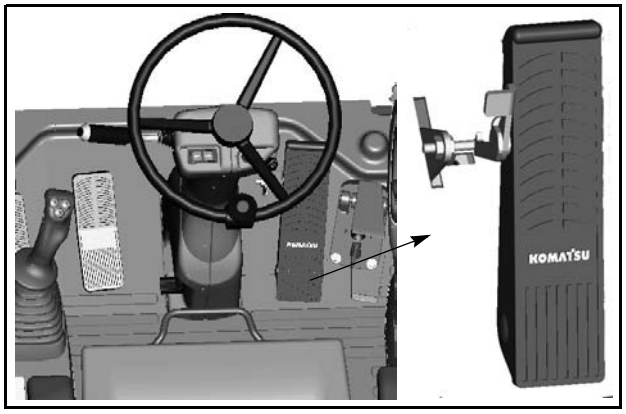
★ After the first measurement, turn the upper structure by 180 degrees and take measurement again in the same way.



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



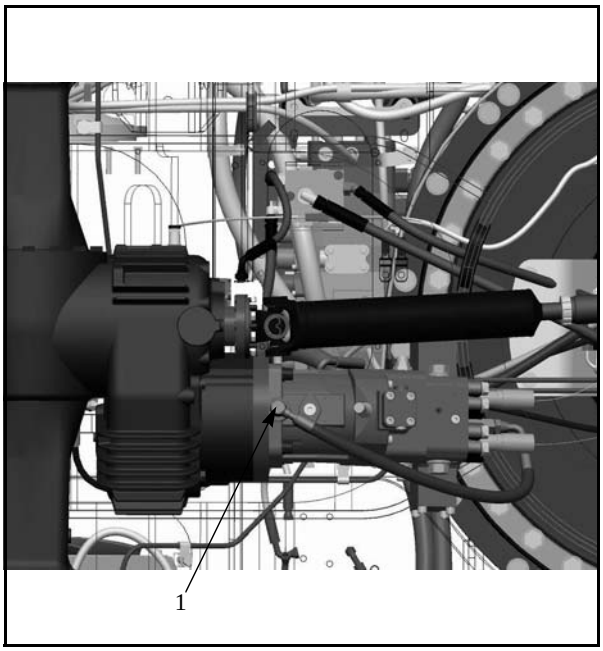
2) Disconnect flushing hose (1) of the travel motor and fit a blind plug in the hose end.
3) Lock travel pedal so that rotary group cannot rotate.
4) Port A or B are set under pressure above the setting of relief valves (i.e. 380 bar)

! 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	Air bleeding procedure					
	1	2	3	4	5	6
Contents of work	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		●	→	→	→	●

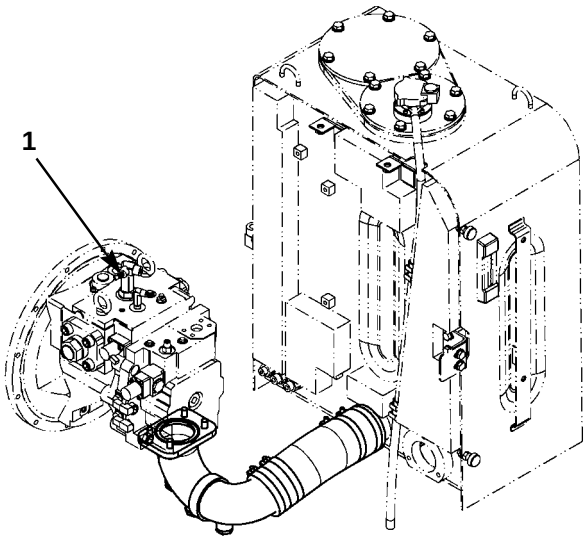
NOTE: Bleed air from the swing motor and travel motor only when oil in the casing is drained.

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.

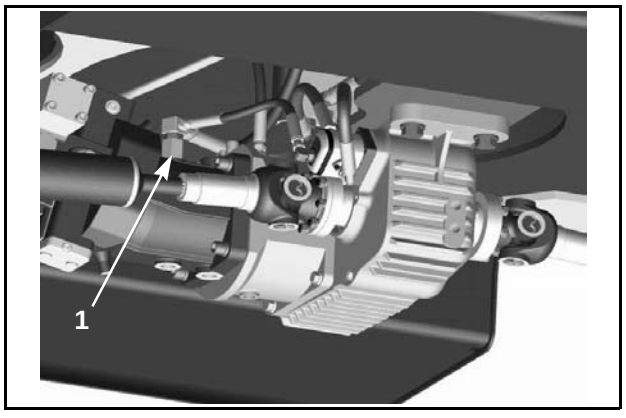
★ In case a cylinder is replaced with new one, it is advised to bleed air from the new one before mounting the work equipment. It is especially so with the boom cylinder, because its rod does not extend to the stroke end of LOWER side, after the work equipment is mounted.

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).

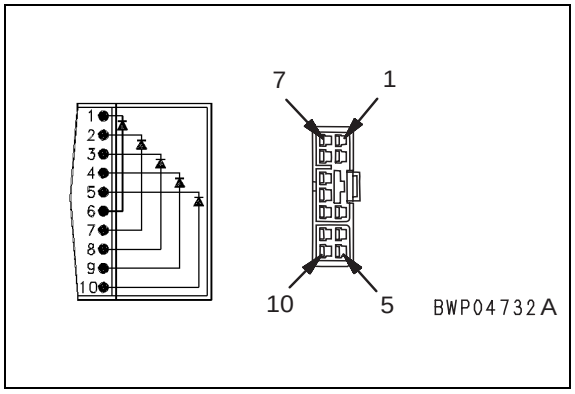


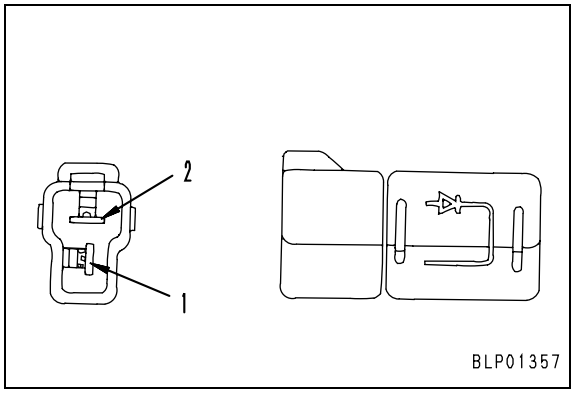
INSPECTION PROCEDURES FOR DIODE

★ 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

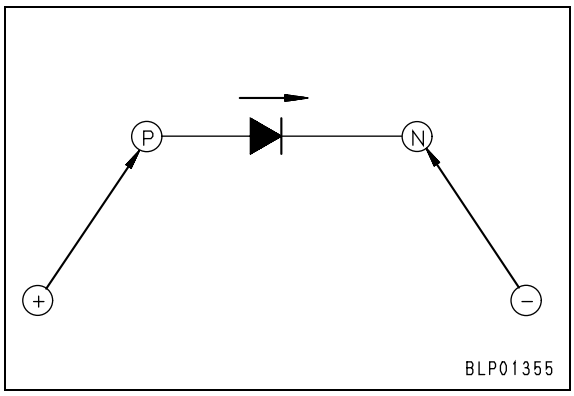
1) Switch the testing mode to diode range and confirm the indicated value.

★ 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.

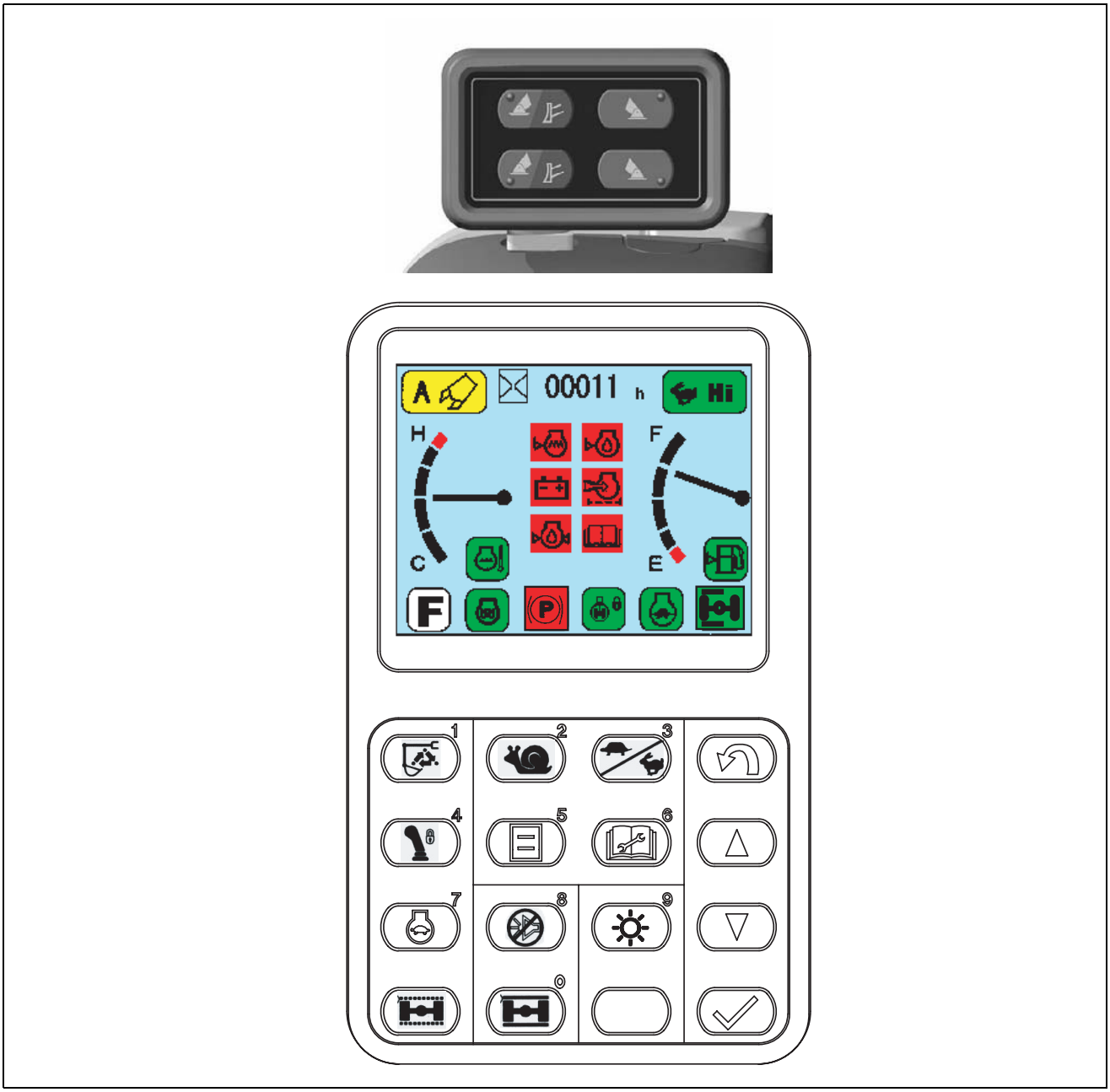
a. Put the red probe (+) of the test lead to the anode (P) and the black probe (–) to the cathode (N) of diode.

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.

2. Special function: Service Menu

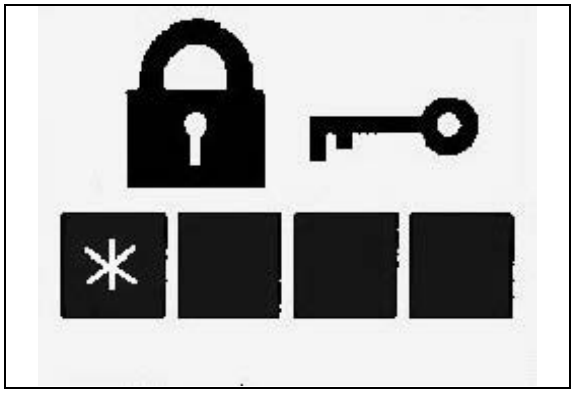
This is a function by which a service mechanic can set or show displays by special switch operations. The display contents are those which are not normally shown. It is mainly used for inspection, adjustment, trouble-shooting or special setting of machines.

Operator's Menu	
1	Function for inputting and setting password
2	Function for showing Komatsu's logo
3	Function for machine inspection before starting day's work
4	Function for showing machine maintenance
5	Function for showing precaution items
6	Function for confirming working mode and travel speed
7	Function for display of ordinary items
8	Function for adjusting display luminance and contrast
9	Function for adjusting breaker and attachment flow rate
10	Function for confirming maintenance information
11	Function for showing service meter reading or clock
12	Function for checking display LCD
13	Function for showing occurrence of caution item
14	Function for showing users' code No.
15	Function for showing service code No. and failure code No.
16	Clock Adjustment

Service Menu		
17	Function for monitoring [01]	
18	Function for abnormality history [02]	Electrical system
		Mechanical system
19	Function for maintenance history [03]	
20	Function for maintenance mode change [04]	
21	Function for recording phone No. [05]	
22	Function for initial value setting and default [06]	Mode with key on
		Unit
		Attachment installed/No attachment installed
		Language
23	Function for adjustment [07]	Adjustment of governor lever stroke
		Fuel pump absorbtion torque
		RPM at low idling
		Adjustment of oil flow to attachment
		Service circuit R adjustment
		Service circuit L adjustment

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.

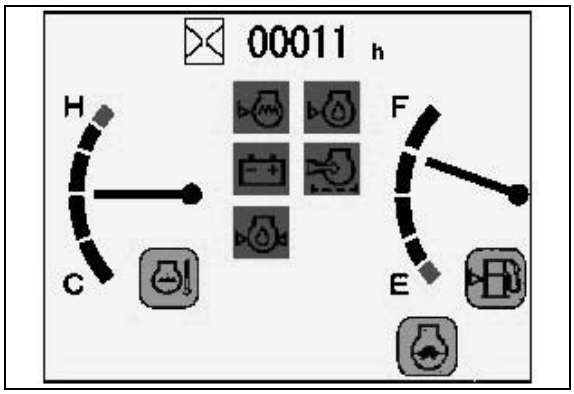
2. Function for showing KOMATSU logo

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

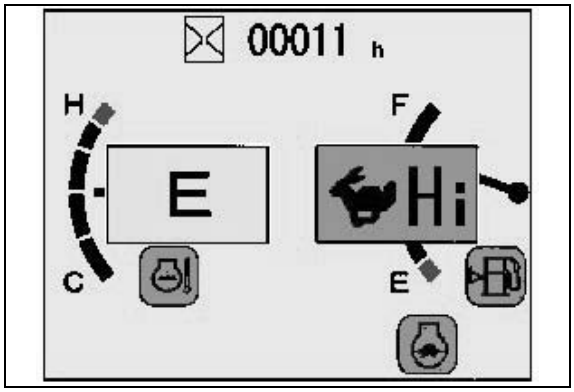
Following the KOMATSU logo, the display of machine inspection before starting day's work is shown for 2 seconds.



4. Function for machine maintenance

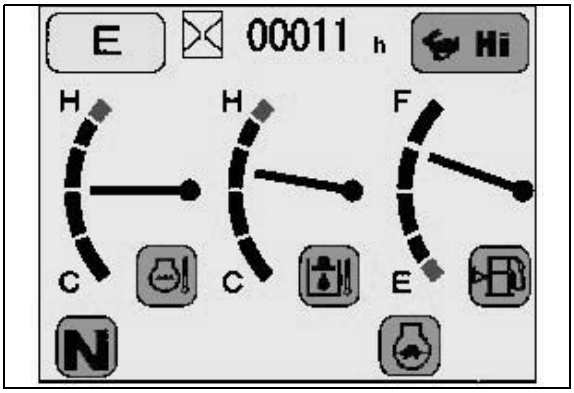
Following the display of machine inspection before starting day's work, the maintenance mark appears for 30 seconds, if there is a service item whose maintenance time is approaching or has just passed.

- This display appears only when the maintenance function is set.



5. Function for showing precaution items

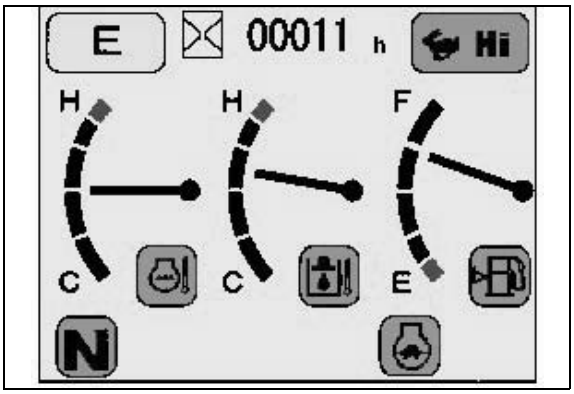
If there is any item of machine inspection before starting day's work that indicates some abnormality, a corresponding symbol mark is shown after the display of machine inspection before starting day's work.



6. Function for display of ordinary items

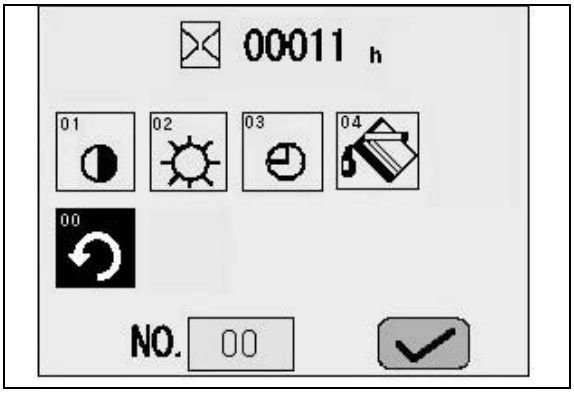
The display of confirming working mode and travel speed is switched to this display of ordinary items.

- 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.



7. Function for adjusting display

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.



8. 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

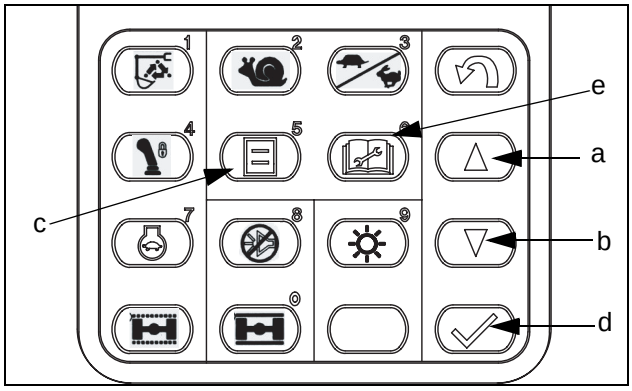
Select switch (c) is used to select the hydraulic flow setting in each of the working modes A, E and B.

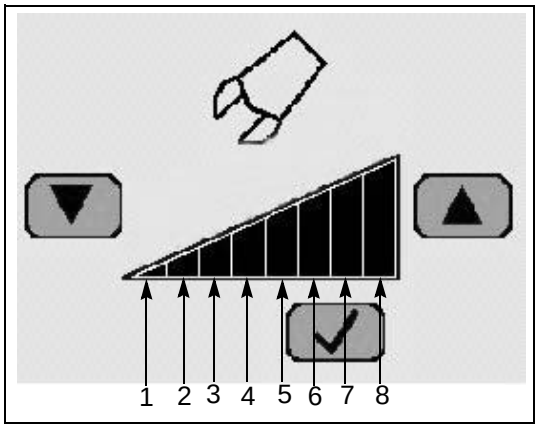
When the working mode is A or E

8.1.Press select switch (c) and normal screen on monitor display changes to the flow setting screen shown in the diagram on the right

Press up switch (a) or down switch (b) to adjust to the desired flow.

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





- When working in B mode

A. Press select switch (c) and the normal screen on the monitor display changes to the flow setting screen shown in the diagram on the right.

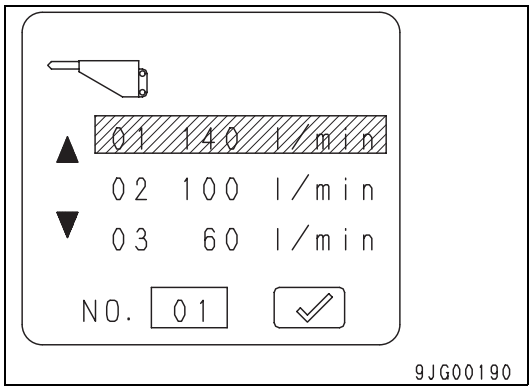
B. Press up switch (a) or down switch (b) to adjust to the desired flow.

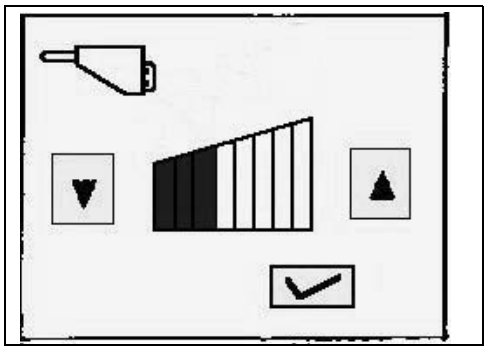
C. After completing the flow setting, press input confirmation switch (d).

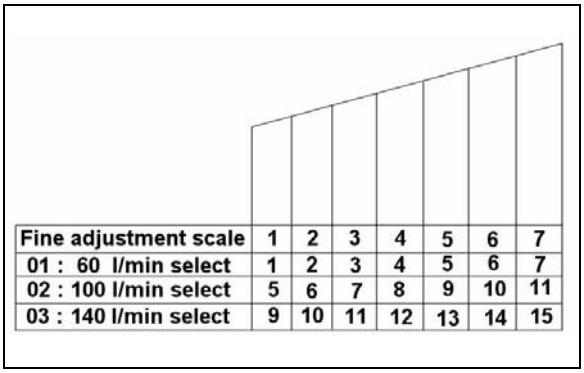
D. With the operation in step 3, and before pressing switch (d), after a slight pause, the flow setting screen changes to the fine flow adjustment screen shown in the diagram.

E. Press up switch (a) or down switch (b) to adjust to the desired flow.

F. After completing the flow setting, press input confirmation switch (d). 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

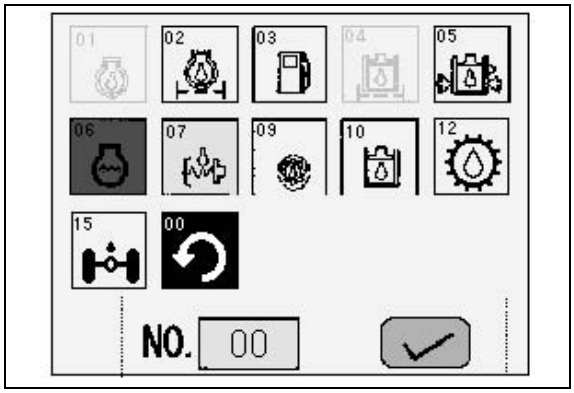
For approximate flow rate setting look at flow rate table below.

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

9. 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.



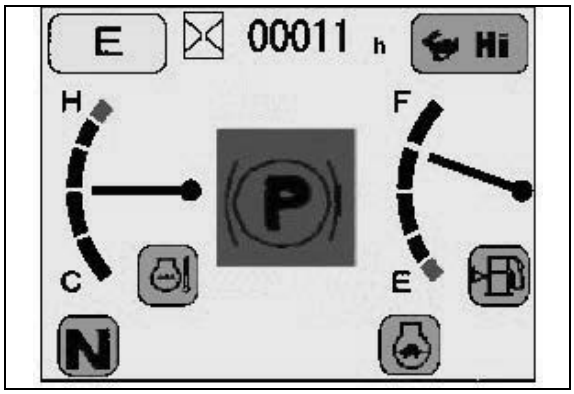
10. Function for showing occurrence of caution item

If any of the caution items occurs, the magnified corresponding symbol mark is shown.

A. Park brake

B. Low Brake Pressure

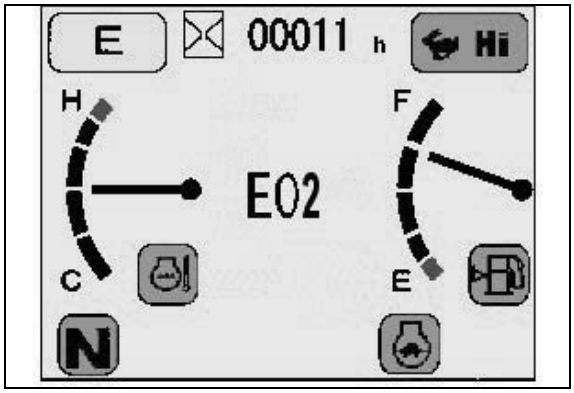
C. Undercarriage Attach Select.



11. 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

12. 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 Service and Failure Code Nos.





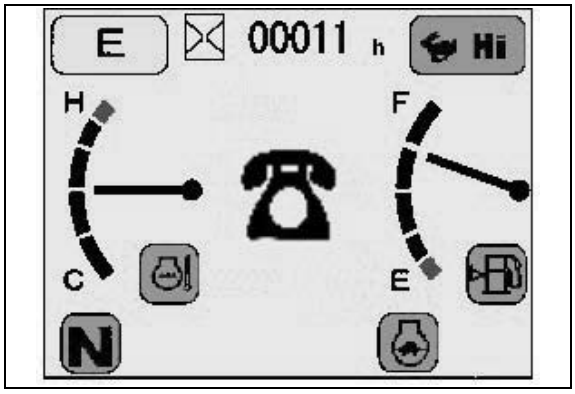


TABLE FOR ERROR AND FAILURE CODE NO.

User Code No.	Error Code		Failure Code			Failure Classification
	Code No.	Content	Code No.	Location	Phenomenon	
E01	E132	S-net comm. discontinuity-Hot short	DA2SKA	Controller	Monitor Display	Electrical system
–	E133	PPC lock sol. discontinuity-Hot short	DW2CKA	Solenoid	Disconnected	
–	E134	PPC lock sol. G_{ND} short	DW2CKB	Solenoid	Short Circuit	
E01	E135	Sus. lock sol. discontinuity-Hot short	DW4AKA	Solenoid	Disc	
E01	E136	Sus. lock sol. G_{ND} short	DW4AKB	Solenoid	Short	
–	E137	Working light-F switch discontinuity-Hot short	DDW2KA			
–	E138	Working light-F switch G_{ND} short	DDW2KB			
–	E139	Working light-R switch discontinuity-Hot short	DDW2KA			
–	E140	Working light-R switch G_{ND} short	DDW2KB			
–	E141	Beacon light switch discontinuity-Hot short	DDR3KA			
–	E142	Beacon light switch G_{ND} short	DDR3KB			
–	E143	Wiper switch discontinuity-Hot short	DDW1KA			
–	E144	Wiper switch G_{ND} short	DDW1KB			
–	E145	Seat heater switch discontinuity-Hot short	DDH3KA			
–	E146	Seat heater switch G_{ND} short	DDH3KB			
–	E147	Hazard lamp switch discontinuity-Hot short	DDWJKA			
–	E148	Hazard lamp Switch G_{ND} short	DDWJKB			
–	E149	Outrigger-FR sol. discontinuity-Hot short	DWB1KA			
–	E150	Outrigger-FR sol. G_{ND} short	DWB1KB			
–	E151	Outrigger-FL sol. discontinuity-Hot short	DWB1KA			
–	E152	Outrigger-FL sol.G_{ND} short	DWB1KB			
–	E153	Outrigger-RR sol. discontinuity-Hot short	DWB1KA			
–	E154	Outrigger-RR sol. G_{ND} short	DWB1KB			
–	E155	Outrigger-RL sol. discontinuity-Hot short	DWB1KA			
–	E156	Outrigger-RL| sol. G_{ND} short	DWB1KB			
–	E157	Starter cut switch discontinuity-Hot short	D5ZKKA			
–	E158	Starter cut switch G_{ND} short	D5ZKKB			
E20	E201	Travel N sol.	DW91KB			
E20	E202	Travel FR sol.	DW44KB			
E03	E203	Swing brake sol. G_{ND} short	DW45KB			
–	E204	Merge/Flow divider sol. G_{ND} short	DWJ0KB			
–	E205	2-stage relief solenoid G_{ND} short	DWK0KB	2-stage relief solenoid valve	Short circuit	
E20	E206	Transmission clutch sol.	DW27KB			
E20	E207	Creep sol.	DW4MKB			
E20	E208	Creep sol.	DW4MKA			
E20	E211	Travel N sol.	DW91KA			
E20	E212	Travel FR sol.	DW44KA			
E03	E213	Swing brake sol.	DW45KA			
–	E214	Merge/Flow divider sol.	DWJ0KA			
–	E215	2-stage relief sol. discontinuity-Hot short	DWK0KA			
E20	E216	Transmission clutch sol.	DW27KA			

User Code No.	Error Code		Failure Code			Failure Classification
	Code No.	Content	Code No.	Location	Phenomenon	
–	E217	Model selection abnormality	DA2SKQ			Electrical system
E20	E218	S-net comm abnormality	DA2SKA			
–	E222	LS-EPC sol. G_{ND} short	DXE0KB			
–	E223	LS-EPC sol. discontinuity - Hot short	DXE0KA			
–	E224	F pump press sensor abnormality	DDHPAKP			
–	E225	R pump press sensor abnormality	DHPBMA			
–	E226	Press sensor power abnormality	DH10KS			
–	E227	Engine speed sensor abnormality	DLE2MA			
E02	E232	PC-EPC sol.	DXA0KB			
E02	E233	PC-EPC sol.	DXA0KA			
–	E236	2 stage back pressure sol.	DWK2KB			
–	E237	2 stage back pressure sol.	DWK2KA			
–	E245	Service EPC	DXE4KB			
–	E246	Service EPC	DXE4KA			
E20	E247	Travel F-N-R signal switch abnormality	DDWCKZ			
E20	E248	Boom/Outrigger SW select abnormality	DDC3KZ			
–	E251	Overload sensor abnormality	DHX1MA			
E20	E252	Travel PPC sensor abnormality	DHS5KX			
–	E253	Travel PPC press. SW abnormality	DDP4KX			
E20	E254	Speed sensor discontinuity	DLT4KA			
–	E256	Memory error	DA20KT			
E20	E257	Travel PPC press SW hydraulic abnormality	6B2JMA			
E20	E258	Brake lock proximity switch	DDB2KX			
–	E261	Service sol. relay	PD00KB			
–	E262	Service sol. relay	PD00KA			
E20	E263	Brake light cut relay	DDB2KB			
E20	E264	Brake light cut relay	DDB2KA			
E20	E274	Suspension lock relay	DW4AKB			
E20	E275	Suspension lock relay	DW4AKA			
–	E276	PPC lock relay	DW4CKB			
–	E277	PPC lock relay	DW4CKA			
–	E301	Engine speed low (under 500 rpm)	A000N2			
–	E302	Engine speed is over (travel + 150) rpm	A000N1			
–	E306	Gov. motor potentiometer abnormality	DK54KZ			
E05	E308	Fuel Dial Abnormality	DK10KZ			
–	E313	Auto lub. abnormal	DA80MA			
–	E315	Battery relay drive G_{ND} short	D110KB			
–	E316	Governor motor step out	DY10K4			
E05	E317	Governor motor discontinuity - Hot short	DY10KA			
E05	E318	Governor motor G_{ND} short	DY10KB			

User Code No.	Error Code		Failure Code			Failure Classification
	Code No.	Content	Code No.	Location	Phenomenon	
–	None	Engine high idling out of rate	A000N1	Engine	Overrunning	Mechanical system
–	None	Engine low idling out of rate	A000N2	Engine	Low idling out of rate	
–	None	Air cleaner clogged	AA10NX	Air cleaner element	Clogging	
–	None	Charging voltage abnormally low	AB00KE	Alternator	Insufficient charging	
–	None	Engine oil pressure abnormally low	B@BAZG	Engine oil	Oil pressure lowered	
–	None	Engine oil level abnormally low	B@BAZK	Engine oil	Oil level lowered	
–	None	Engine cooling water overheated	B@BCNS	Engine cooling water	Overheating	
–	None	Radiator water level abnormally low	B@BCZK	Engine cooling water	Cooling water level lowered	
–	None	Hydraulic oil overheated	B@HANS	Hydraulic oil	Overheating	
–	None	Auto-lubrication system abnormal	DA80MA	Auto-lubrication system controller	Malfunction	
–	None	Crane ope. overload	989EKX			

- In case there is no number assigned in the column of User Code No., or in case "none" is described in the column of Code No. of Service Code, the corresponding service code or failure code is not shown in the display of ordinary items, even if some abnormality occurs. It is recorded only in the failure history (either in electrical system or mechanical system) of Service Menu.
- History Classification indicates that a specific failure is classified as belonging to either electrical system or mechanical system, when it is recorded in Service Menu.
- "E" at the head of Code No. of Service Code means the following status of a specific failure.

• With "E":The failure is yet to be resolved and continues.
• Without "E":The failure has already been resolved.

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.

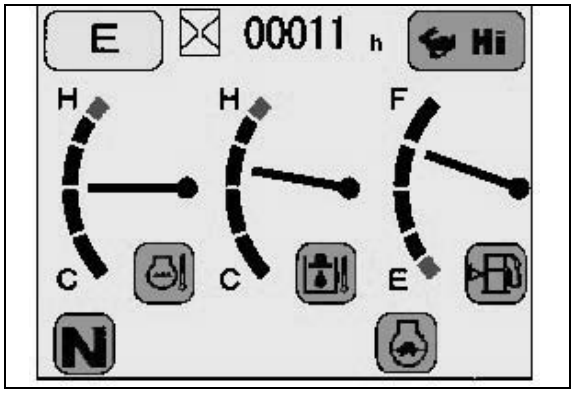
1. Confirmation of display
   Confirm that the display of ordinary items is shown (Normally engine stopped).
   - Changing to Service Menu cannot be made from displays other than this.

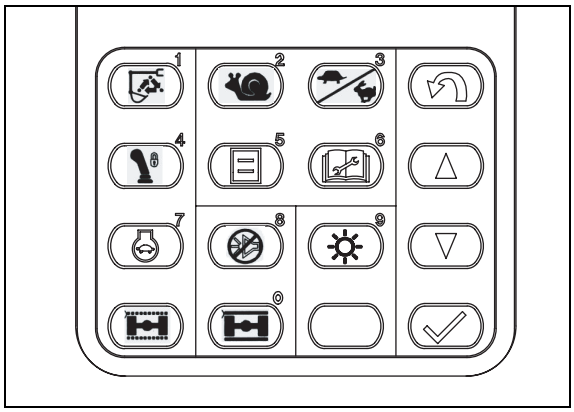
2. Switch operation
   Operate the switch as instructed below.
   - Switch operation: [▲] + [1] → [2] → [3]

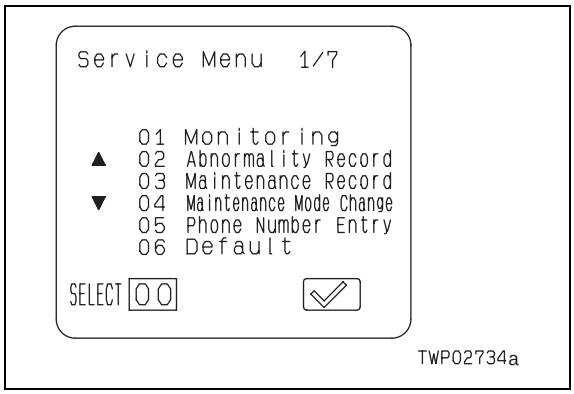
3. Showing Service Menu display
   The display is changed to the initial display of Service Menu program. Select an appropriate item from among the menu.

No.	Service Menu
01	Monitoring
02	Abnormality Record
03	Maintenance Record
04	Maintenance Mode Change
05	Phone Number Entry
06	Default
07	Adjustment

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.
   ① Depress [↶] switch. (This method may be used for terminating any display)
   ② If "Return" switch is shown, depress it.
   ③ If "Return" menu is shown, call that menu and depress [√] switch.







1. Function of monitoring [01]
The monitor panel monitors signals from an assortment of switches, sensors and actuators installed in various parts of the machine. Monitored information can be put in display or confirmed on a real time basis through the following operations.

1.1.Selection of menu

Select "01 Monitoring" in the initial display of Service Menu and depress [√] switch.

1.2.Setting of monitoring item

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

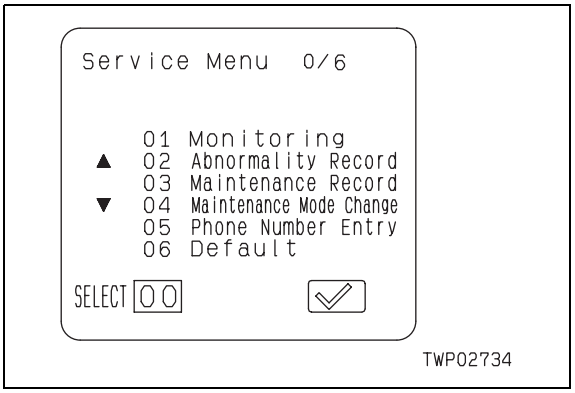
- [▲] switch: Selection
- [▼] switch: Selection
- [√] switch: Registration

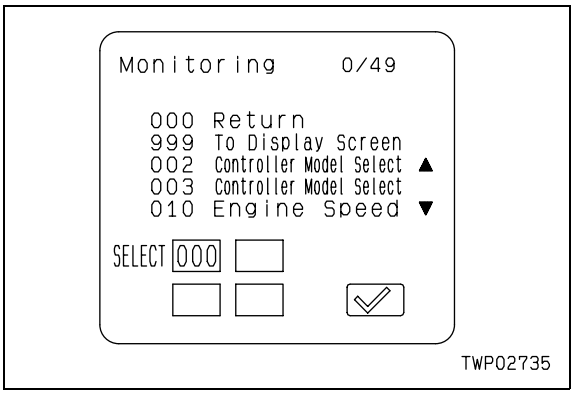
- A monitoring item can be set in any number between the min. one to the max. four. (Depending upon the selected item, the max. number maybe less than four)
- In case of monitoring 1 to 3 items, move to the monitored information display through any of the

following switch operations, after the registration work has been completed.

- Keep [☑] switch depressed. (For about 3 seconds)
- Select Menu 999 and depress [☑] switch.

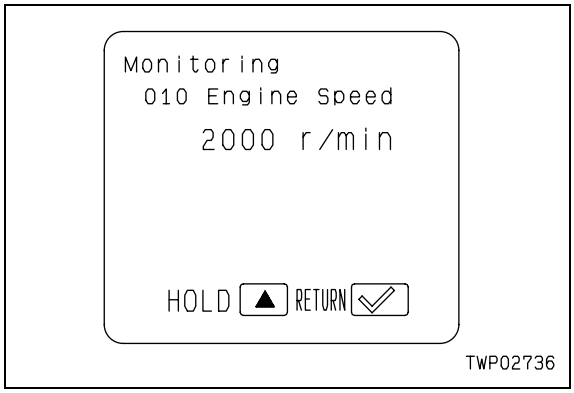
- The display automatically moves to the display of monitored information, when all of the registrable items have been duly registered.
- Monitored information are transmitted via communication circuits. Thus the number of selected items can impact the communication speed. If truly real time monitoring is required, reduce the selected items to the minimum.
- For details on the monitoring items, display unit, etc., refer to the Table for Monitoring Items.





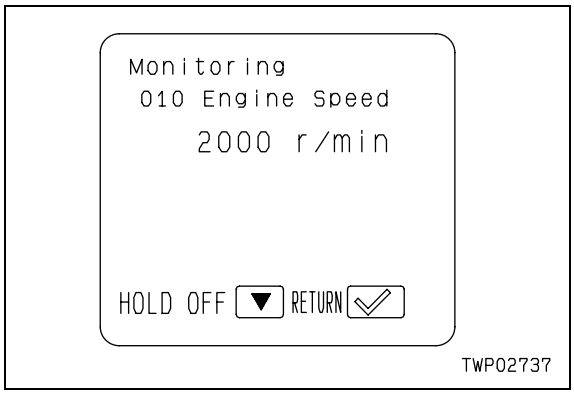
1.3.Monitoring operation

Call the monitoring information display and confirm the monitored information, while operating the machine.



1.4.Monitored information holding function

If [▲] switch is depressed while monitoring, all the monitored information are put on hold. If [▼] switch is depressed in this condition, information holding is released.



1.5.Machine setting mode switching function

If it becomes necessary to change settings of working mode, select mode, travel speed and auto-decel while monitoring, depress the corresponding switch, then the mode confirmation display is shown. Then each can be changed as normal.

- An illustration at right shows the display in A 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.

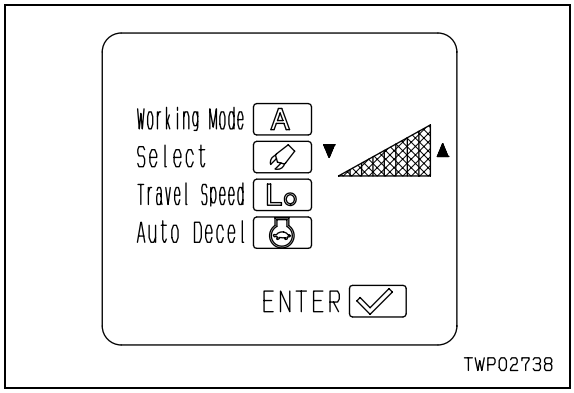


Table for Monitoring Items

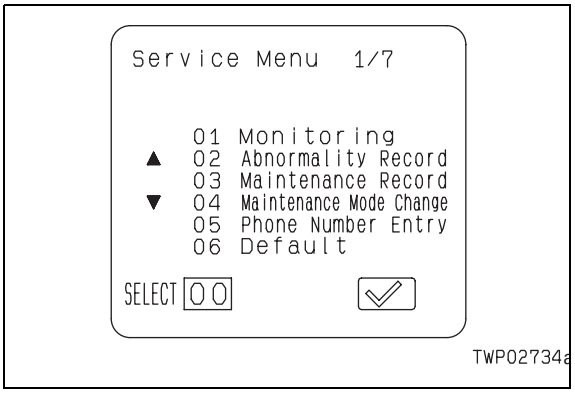
Code No.	Item to be monitored		Unit (Default: ISO)			Remark
			ISO	Meter	Inch	
000	Return		(Not displayed)			Termination menu
999	To Display Screen		(Not displayed)			Execute Command menu
002	Controller Model Select		Figure			
003	Controller Model Select		Figure			
010	Engine Speed		r/min.	rpm	rpm	
011	Pump Pressure		MPa	kg/cm^2	psi	
013	PC-EPC Sol. Curr.		mA	mA	mA	
015	LS-EPC Sol. Curr.		mA	mA	mA	
016	2nd Eng. Speed Command		r/min.	rpm	rpm	
017	Service Sol. Curr.(1)		mA	mA	mA	
019	Pressure Switch 1	Swing	ON/OFF			
		Boom Lower	ON/OFF			
		Boom Raise	ON/OFF			
		Arm Curl	ON/OFF			
		Arm Dump	ON/OFF			
021	Pressure Switch 2	Bucket Curl	ON/OFF			
		Bucket Dump	ON/OFF			
		Service	ON/OFF			(Not used)
		Travel Forward	ON/OFF			
		Travel Reverse	ON/OFF			
022	Switch Input 1	Lever Sw.	ON/OFF			
		Swing Brake Release Sw.	ON/OFF			
		Swing Brake Sw.	ON/OFF			
		Travel Forward Sw	ON/OFF			
		Travel Neutral Sw	ON/OFF			
		Travel Reverse Sw	ON/OFF			
023	Solenoid valve 1	Swing Brake	ON/OFF			
		Merge-divider	ON/OFF			
		Travel Creep	ON/OFF			(Not used)
		2-Stage Relief	ON/OFF			
		Transmission Clutch	ON/OFF			
024	Solenoid valve 2	2-Stage Back Pressure	ON/OFF			
		Travel Neutral	ON/OFF			
		Travel - Forward / Reverse	ON/OFF			
		PPC Lock	ON/OFF			
		Sus Lock	ON/OFF			
027	Switch Input 2	Model Select 1	ON/OFF			
		Model Select 2	ON/OFF			
		Model Select 3	ON/OFF			
		Model Select 4	ON/OFF			
		Model Select 5	ON/OFF			

Code No.	Item to be monitored		Unit (Default: ISO)			Remark
			ISO	Meter	Inch	
028	Switch Input 4	Outrigger Sw.1	ON/OFF			
		Boom select switch	ON/OFF			
		Service right switch	ON/OFF			
		Service left switch	ON/OFF			
		Safety lock switch	ON/OFF			
		Brake lamp switch	ON/OFF			
030	Fuel Dial Vol.		V	V	V	
031	Gov. Motor Potential Vol.		V	V	V	
032	Battery Voltage		V	V	V	
033	Gov. Motor Phase A Curr.		mA	mA	mA	
034	Gov. Motor Phase B Curr.		mA	mA	mA	
035	Battery Relay O/P Vol.		V	V	V	
036	Switch Input 3	Key Switch	ON/OFF			
037	Controller Output	Batt. Relay Dr.	ON/OFF			
041	Engine Water Temperature		ºC	ºC	ºF	
042	Fuel Lever Sensor Vol.		V	V	V	
043	Battery Charge Vol.		V	V	V	
044	Hydr. Oil Temperature		ºC	ºC	ºF	
045	Monitor Input 1	Key Switch	ON/OFF			
		Start	ON/OFF			
		Preheat	ON/OFF			
		Light	ON/OFF			
		Rad. level	ON/OFF			
046	Monitor Input 2	Aircleaner	ON/OFF			
		Eng. Oil Press.	ON/OFF			
		Eng. Oil Level.	ON/OFF			
		Battery Charge	ABN•NOR			
049	Monitor Input 3	Swing Brake Sw.	ON/OFF			
052	Switch Input 5	Park Brake Sw.	ON/OFF			
		Brake Pressure Lo Sw.	ON/OFF			
		Travel Position Sw	ON/OFF			
071	Travel PPC Pressure					
120	Engine Speed					
159	Boom Bottom Pressure					
200	Monitor Prog. Version		Figure			
201	Controller Prog. Version		Figure			
400	Travel Speed					

- Select the most favorite display unit from among the prepared three kinds, i.e. ISO, meter and inch. When changing one display unit for another, refer to "Unit" in the initial value setting of Service Menu.
- Abbreviations, ABN and NOR, stand for the following conditions.
  ABN: Abnormal, NOR: Normal

2. Function for Abnormality Record [02]

The monitor panel records failures that occurred on the machines in the past after classifying them into failures in the electric system and those in the mechanical system. Information on them can be displayed through the following operation.



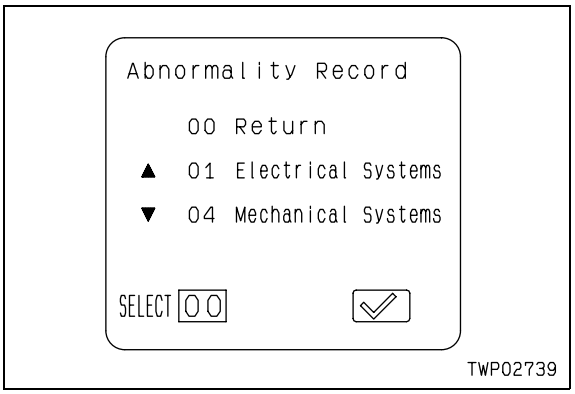
2.1.Selection of menu

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

2.2.Selection of Submenu

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

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



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

①: The numerator expresses sequence of failure occurrence, counting from the latest one. The denominator expresses the total number of a specific failure recorded.

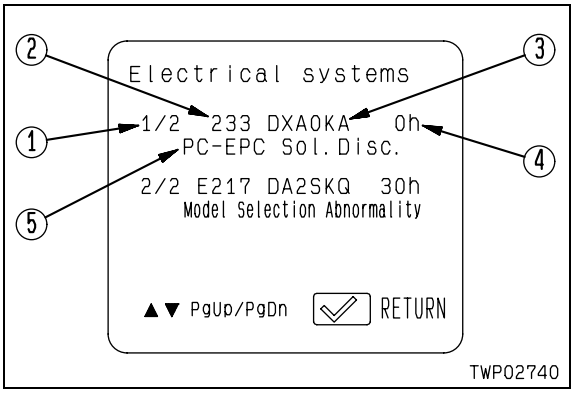
②: Error Code

③:Failure Code No. (system in 4 digits and phenomenon in 2 digits)

④:Time elapsed since the occurrence of the first failure

⑤:Contents of failure

- Refer to "Table for Error Code and Abnormality Code" in Operator's Menu.



2.4.Information shown in display of Failure History in the mechanical systems

①: Record No.

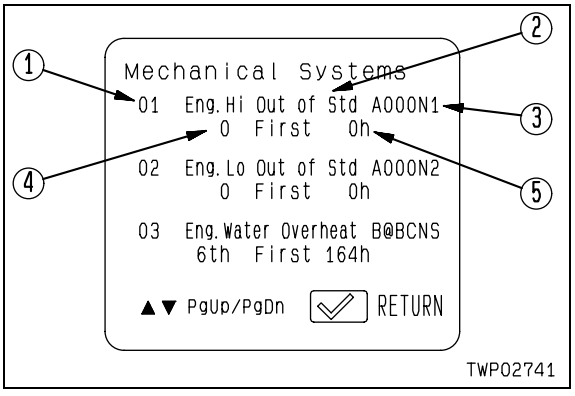
②:Contents of Failure

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 "Table for Error Code and Failure Code" in Operator's Menu.



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.

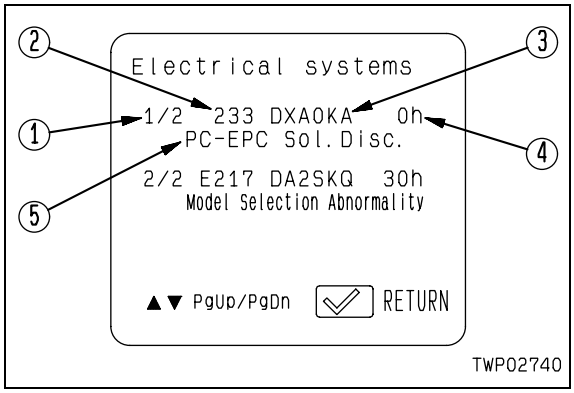
- Switch operation:

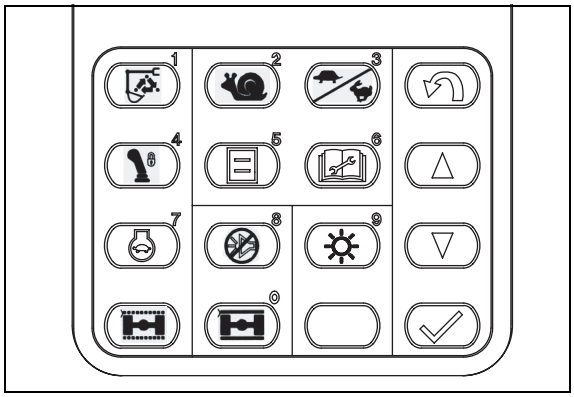
[▲] +[1] → [2] → [3]

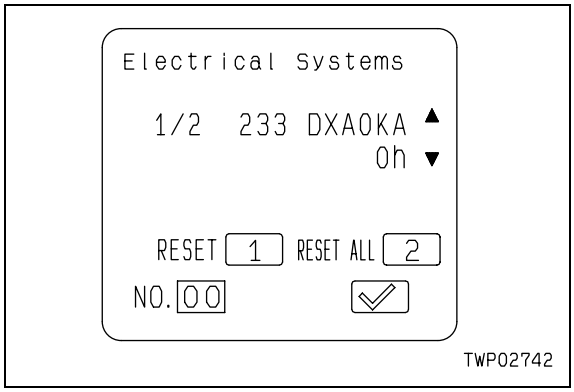
- This is the same switch operation in changing the display to Service Menu.

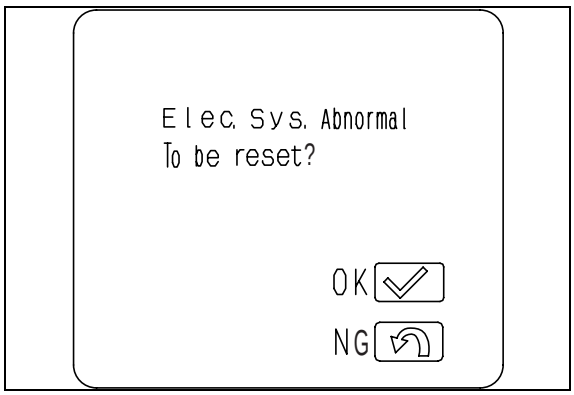
B. Operate the switch, following the instructions shown in the resetting display.

- 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.



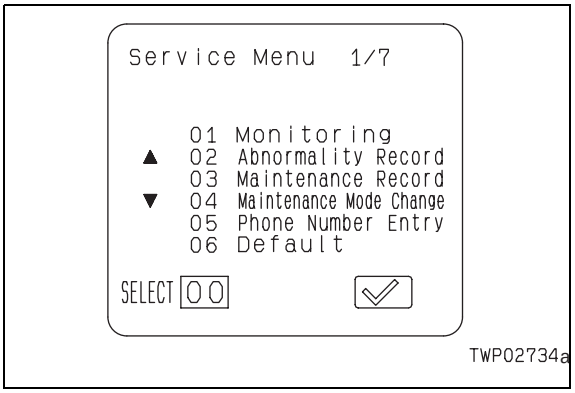






3. Function for Maintenance Record [03]

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

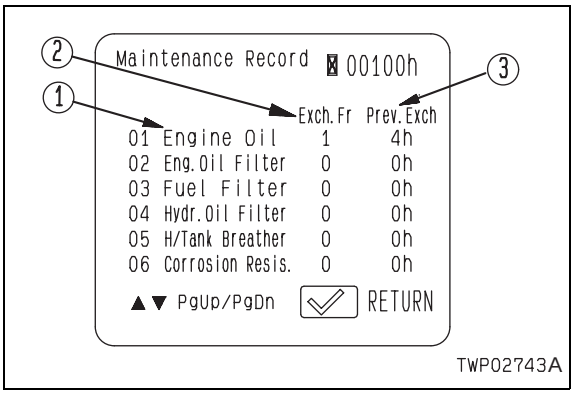
Select 03 Maintenance Record in Service Menu and depress [☑] switch.

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



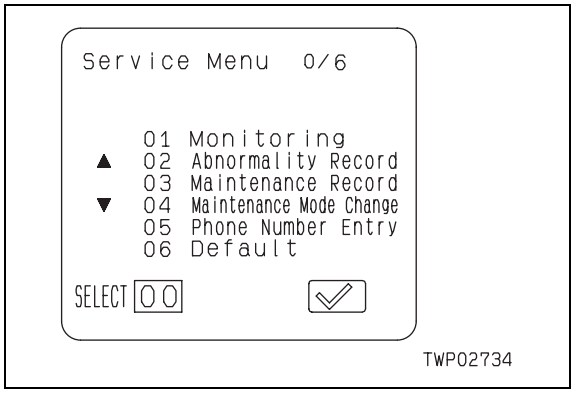
4. Function for Maintenance Mode Change [04]

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

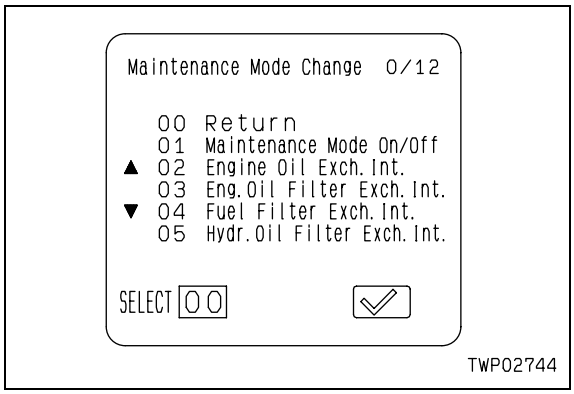
Select 04 Maintenance Mode Change in the initial display of Service Menu, and depress [√] switch.



4.2.Selection of item to be changed

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

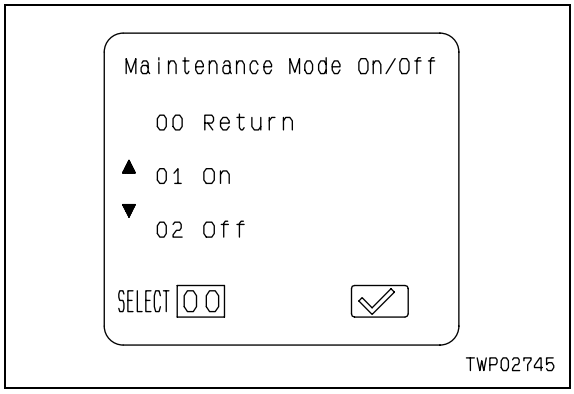
No.	Maintenance mode change item
00	Return
01	Maintenance Mode On/Off
02	Engine Oil Exch. Int.
03	Engine Oil Filter Exch. Int.
04	Fuel Filter Exch. Int.
05	Hydr. Oil Filter Exch. Int.
06	H/Tank Breather Exch. Int.
07	Corro. Resis. Exch. Int.
08	PTO Oil Service Int.
09	S/Machinery Oil Exch. Int.
10	Hydraulic Oil Exch. Int.
11	Transmission Oil Exch. Int.
12	Axle Oil Exch. Int.
13	Use Default Values



- 01 and 13 menus are provided for setting the whole maintenance mode, while those from 02 through 12 are for setting individual items.

4.3. Contents of Maintenance Mode On/Off

- Use: The maintenance display function of all oil and filter-related items are turned effectual. (Irrespective of whether "On" or "Off" set for individual items, this setting prevails)
- Do not use: The maintenance display function of all oil and filter-related items are turned ineffectual. (Irrespective of whether "On" or "Off" set for individual items, this setting prevails)



4.4.Set contents of individual items

①: Default: The maintenance time set in the monitor (recommended by the manufacturer and cannot be changed).

②: Set: Maintenance time that can be freely set. The maintenance mode program functions based on this maintenance time. (The maintenance time can be increased or decreased by 50 hours with [▲] or [▼] switch)

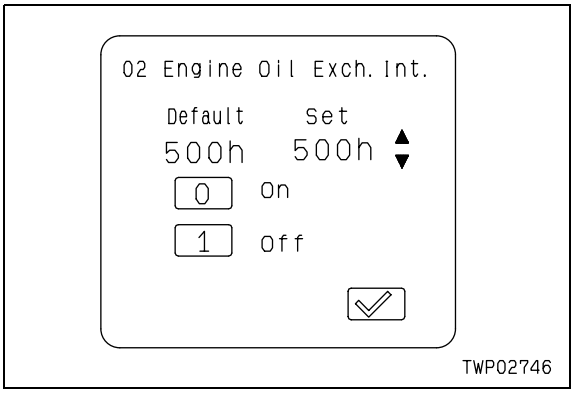
③: On: Maintenance display function with this instruction becomes effectual.

④: Off: Maintenance display with this instruction becomes ineffectual.

- The lowest maintenance time is 50 h.

4.5.Set contents of "Use Default Values"

When selecting this menu and depressing the switch [√], all individual time settings are returned to the factory settings.



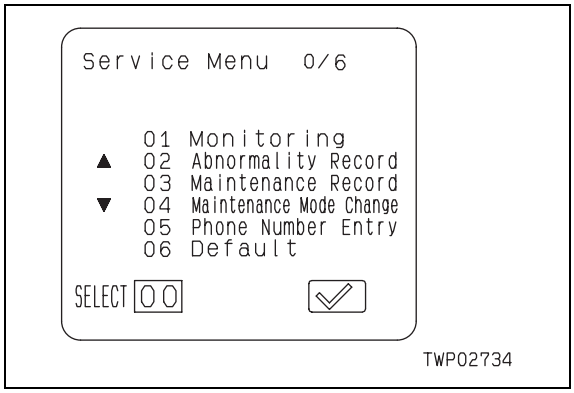
5. Function for Phone Number Entry [05]

In the display of User Code, a telephone number and Error Code are shown alternately. Phone number can be input or modified in the following manner.

- If there is no Phone number registered, the display for Phone numbers does not appear.

5.1.Selection of menu

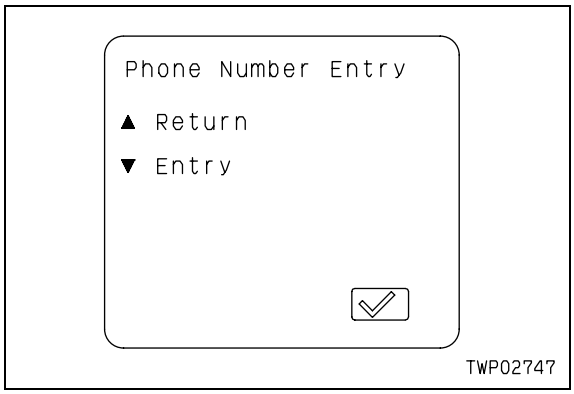
Select 05 Phone Number Entry menu in the display of Service Menu, and depress [√] switch.



5.2.Changing the display

Select Entry next to change the display to the Phone Number Entry display.

- Even if a Phone number is already inputted, it is deleted, upon switching to the Phone Number Entry display.



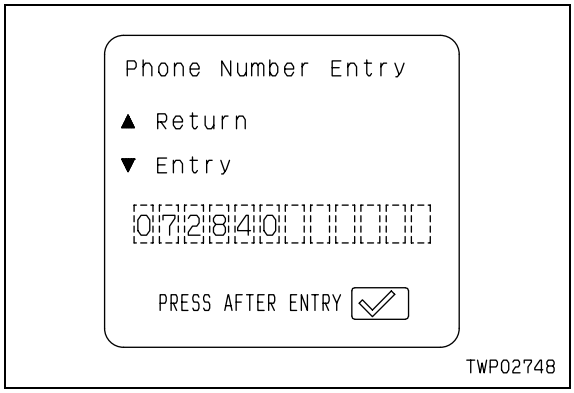
5.3.Entry and setting Phone number

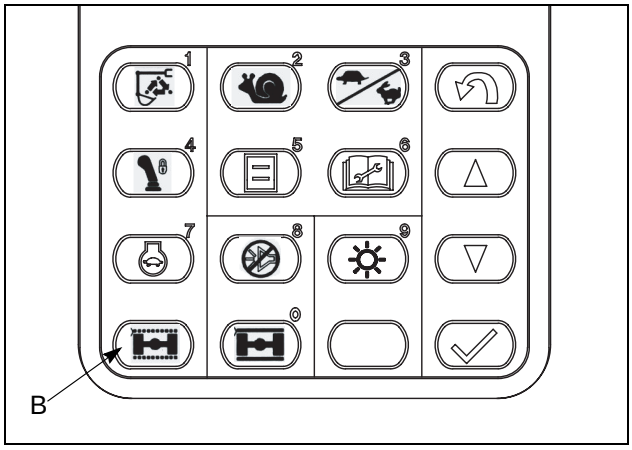
Follow the method explained below, enter a Phone number in the Phone Number Entry display. (Entry automatically begins with a cursor at the left end)

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

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

- Numbers can be entered up to the max. 12 digits, but omit unnecessary digits.
- When entering a wrong number, depress [B] switch, then the cursor goes back by one digit.
- When input is finished, the display changes to Entry display shown above. If the inputted Phone number is shown in this display, the input is connect.





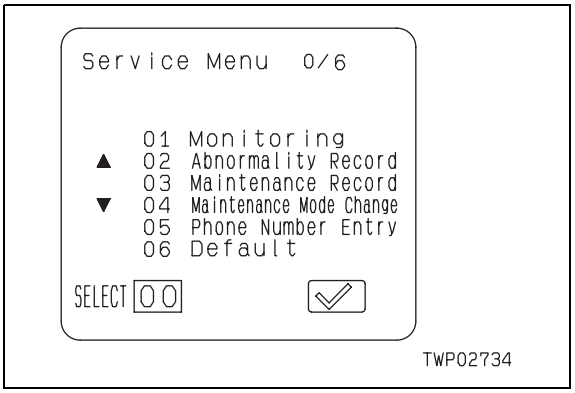
6. Function for Default [06]

It is possible to change the following settings for the monitor panel as well as the machine. Make changes as required.

- Working mode when the engine starting switch is in the ON position.
- Display unit in the monitoring function
- With/Without Service Circuit.

6.1.Selection of menu

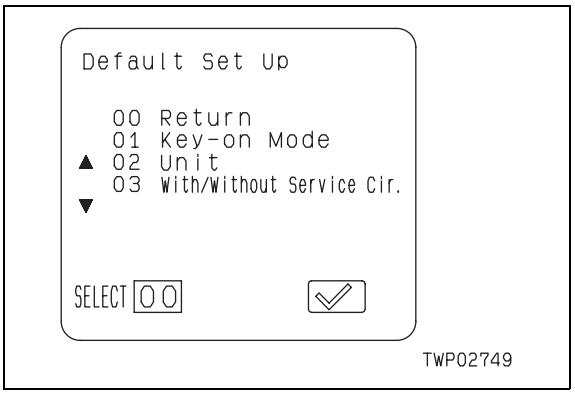
Select 06 "Default menu" in the initial display of Service Menu, and depress [√] switch.



6.2.Selection of submenu

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

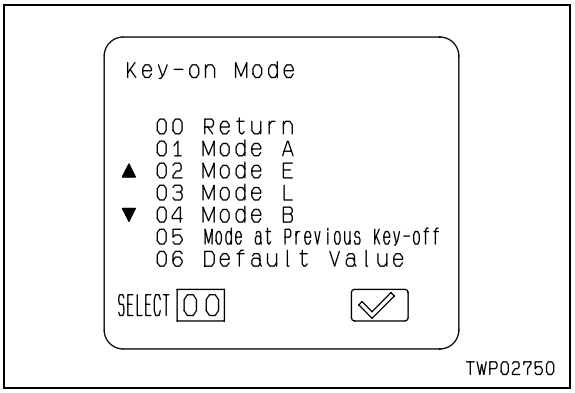
No.	Default submenu
00	Return (Termination of Default)
01	Key-on Mode
02	Unit
03	With/Without Service Circuit



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.

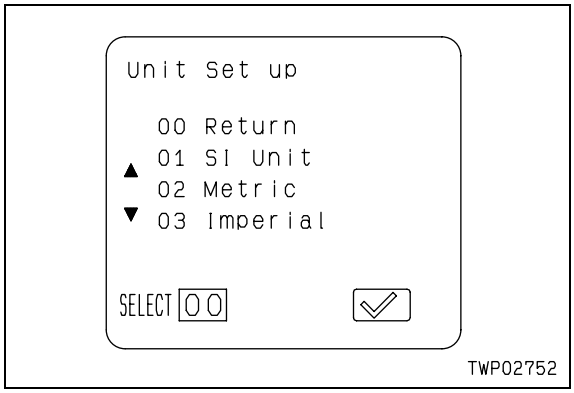
- A, E, L and B Modes: If any of them is set, the machine always starts up with that working mode, when turning the engine starting switch ON.
- Mode at Previous Key-off: If this mode is set, the machine starts up with the same working mode as when the machine was last used.
- Default Value: If this mode is set, the machine starts up with the mode (A mode) set at the original factory setting.
- Irrespective of this setting mode, a machine "With service circuit" always starts up with B mode, when the engine starting switch is turned ON at the subsequent operation, if that was the working mode used in the last machine work.



6.4.Function for unit selection

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

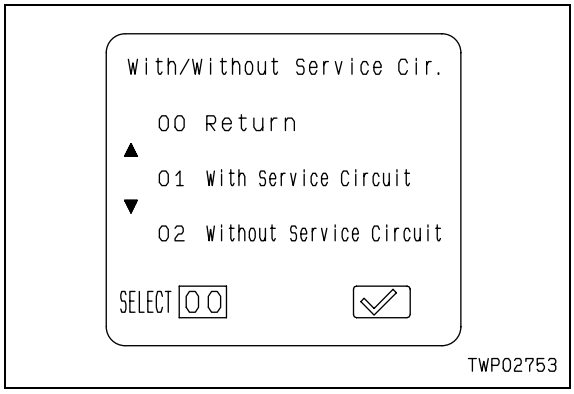
- Unit used for default setting in the monitor panel is SI, i.e. International System of Units.



6.5.Function for selecting distinction of With/Without Service Circuit.

It is possible in this function to set a distinction between with or without service circuit.

- With Service Circuit: When an attachment is installed.
- Without Service Circuit: When no attachment is installed.
- If "With Service Circuit" setting is not made in this display, when it is actually installed on a specific machine, the SELECT function in Operator's Mode (attachment oil flow rate adjustment) cannot be used.

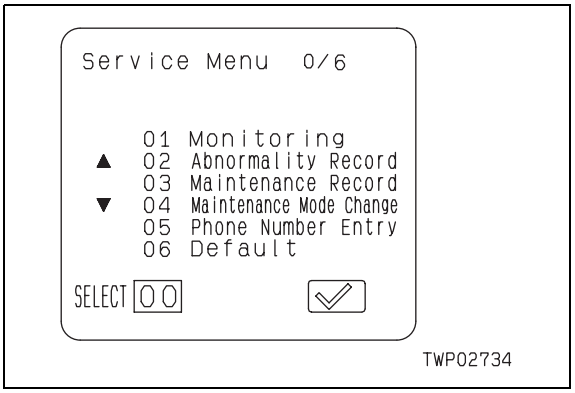


7. Function for Adjustment [07]

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

7.1.Selection of menu

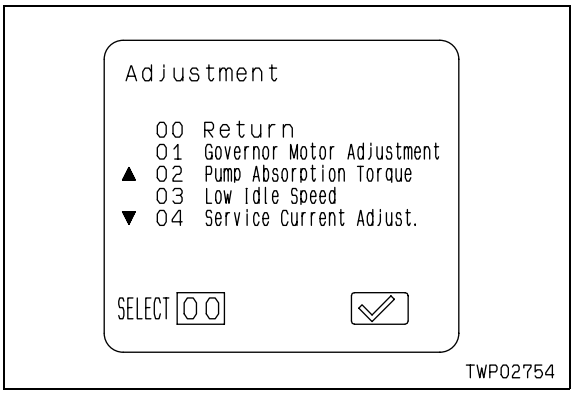
Select 07 adjustment in the initial display of Service Menu, and depress [√] switch.



7.2.Selection of submenu

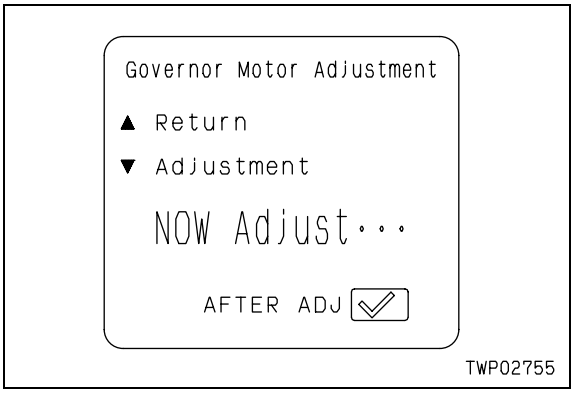
Select an item to change from the submenu and depress [√] switch.

No.	Adjustment submenu
00	Return (termination of adjustment)
01	Governor Motor Adjustment
02	Pump Absorption Torque
03	Low Idle Speed
04	Service Current Adjust.



7.3.Function for Governor Motor Adjustment

- When adjusting the securing position of governor actuator, fuel injection pump and governor spring, call up this display and carry out the work in the following manner.



7.3.1 Set the fuel dial at MAX.

- In this condition, the governor actuator lever shifts to the full throttle. Hold this display while in adjustment.

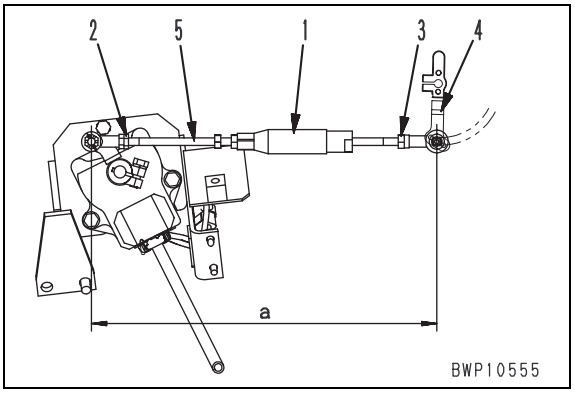
7.3.2 Loosen nuts (2) and (3) of governor spring (1).

- Nut (2) is of inverse thread (left hand).

7.3.3 Turn rod (5) so that governor lever (4) of the fuel injection pump contacts the full stopper.

7.3.4 Screw in rod (5) by 2 turns from this position to reduce distance **a** between the pin of governor spring (1).

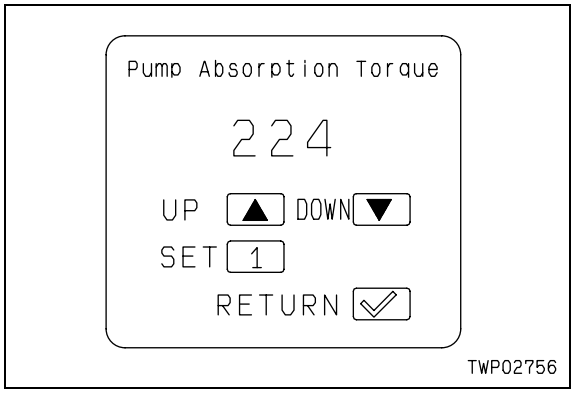
- Distance **a** between the pins is reduced by 5 mm.



7.3.5 Tighten nuts (2) and (3).

N·m Nut:**11.8–19.6 Nm{1.2–2.0 kgm}**

7.3.6 Confirm that governor spring stretches by 4.0 mm, when the fuel dial is returned to the MAX side again.



7.4.Function for Pump Absorption Torque adjustment.

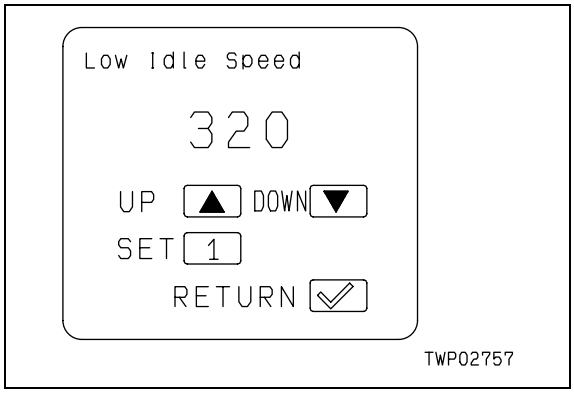
The pump absorption torque can be adjusted within the range shown in the table below.

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

7.5.Function for Low Idle Speed adjustment

The engine rotation at low idling can be adjusted within the range shown in the table below.

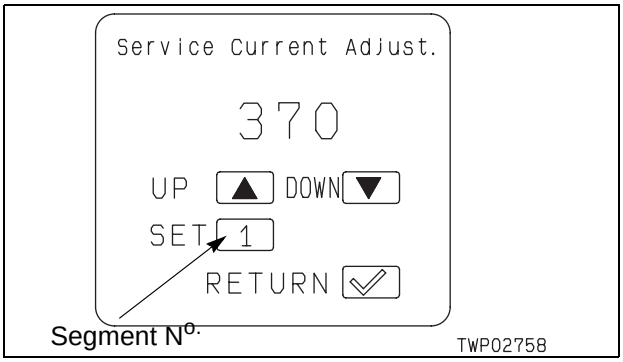
Adjustment value	Low idling rotation
320	1,000 rpm
321	1,100 rpm
322	1,200 rpm
323	1,300 rpm

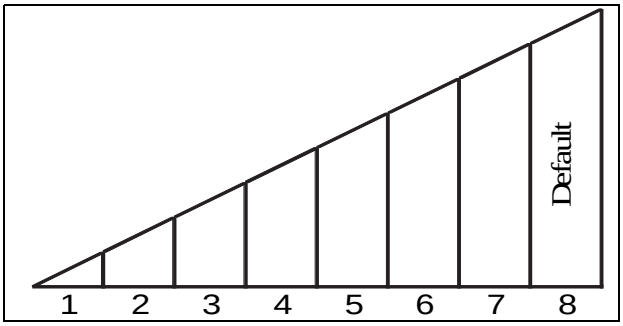


7.6.Function for Service Current Adjust.

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)

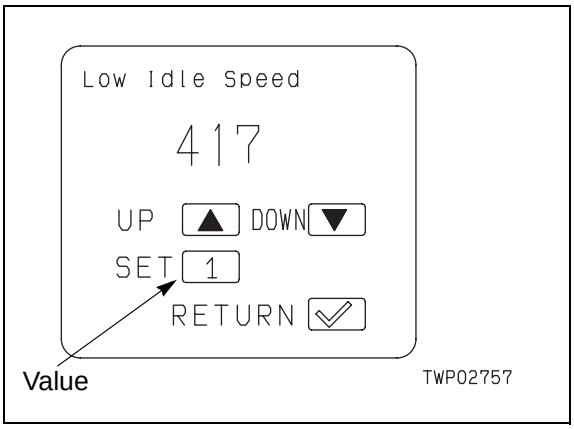
Segment	Oil flow (L/ min)	EPC current (mA)
1	30	485
2	55	535
3	80	582
4	100	615
5	120	651
6	160	722
7	200	780
8 (Default)	230	900

Adjustment value 373 (Super heavy ATT)

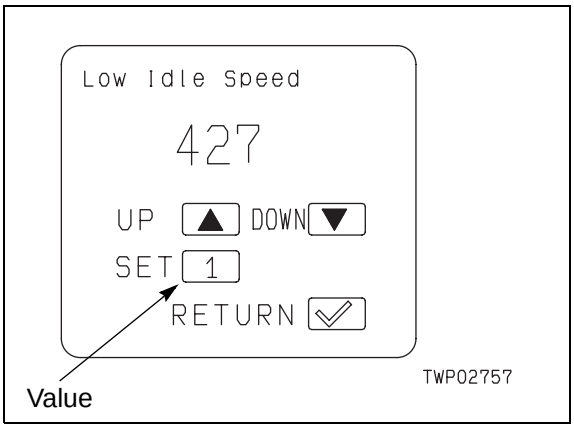
Segment	Oil flow (L/ min)	EPC current (mA)
1	30	485
2	30	485
3	35	495
4	40	504
5	48	428
6	64	548
7	80	582
8 (Default)	92	600

7.7.Service circuit adjustment (Left hand).

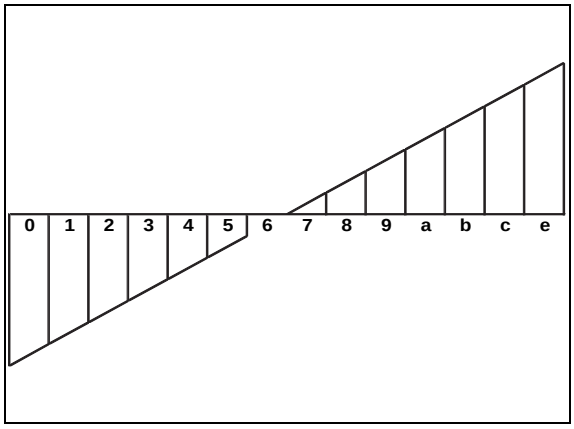
Adjustment value 417.



7.8.Service circuit adjustment (Right hand).



Adjustment value 427 (See table on the right).



Value	Offset current (mA)
0	-35
1	-30
2	-25
3	-20
4	-15
5	-10
6	-5
7 (Default)	0
8	5
9	10
a	15
b	20
c	25
d	30
e	35

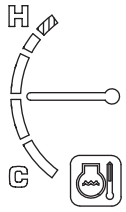
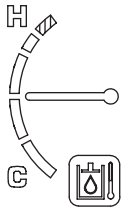
Pm - Tune up Service (PW160-7)

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 ☐ ( )		☐

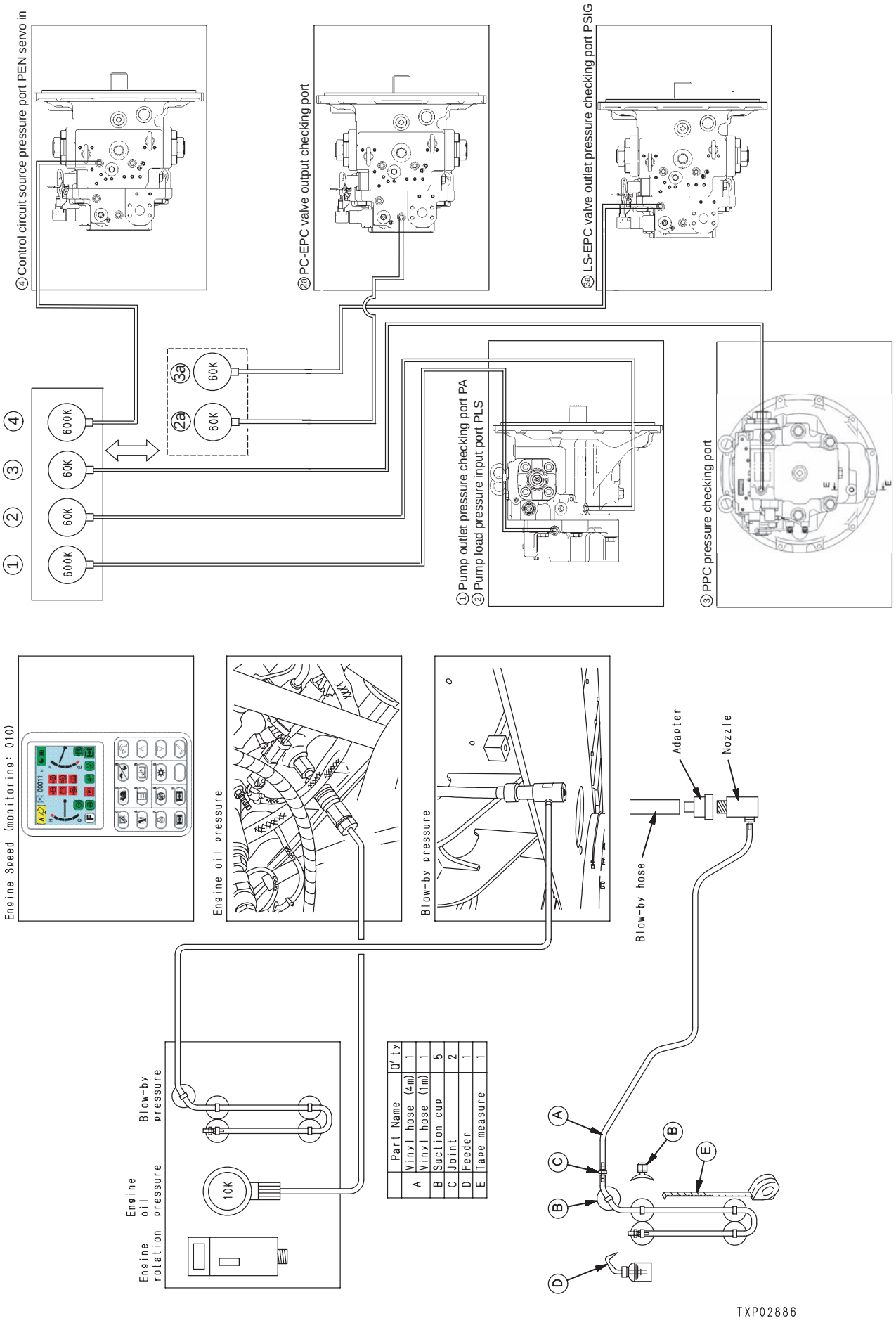
Oil and cooling water level check		
☐ Radiator water	As required	
☐ Engine oil	☐ Machinery case oil	☐
☐ Hydraulic oil		☐

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:				


④Control circuit source pressure port PEN servo in
2a PC-EPC valve output checking port
39 LS-EPC valve outlet pressure checking port PSIG
4
3
2
1
600K
60K
3a
2a
①Pump outlet pressure checking port PA
②Pump load pressure input port PLS
③PPC pressure checking port
Engine Speed (monitoring: 010)
Engine oil pressure
Blow-by pressure
Adapter
Nozzle
Blow-by hose
Engine rotation pressure
Engine oil pressure
Blow-by 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 (PW180-7)

No	Condition setting					Measurement item	Unit	Standard value		Measured value	Judgement
	Fuel Dial	Working mode	Auto decelerator	One-touch power max switch	Work equipment operation			New machine	Failure 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 (PW180-7)

Hydraulic oil temperature (45 ~ 55° C)

No	Condition Setting			Measurement item		Unit	Standard Value PW180-7				Measured value PW180-7*	Judgement
							Monoboom		Two Piece Boom		Monoboom / Two Piece Boom*	
	Fuel Dial	Working mode	Work equipment posture				Nom Value	Tolerance	Nom Value	Tolerance		
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
			No load, 1st Boom max extend	2nd Boom RAISE					5.0	4.5 ~ 5.5		Good/No good
2			Boom held level	Arm DUMP			3.0	2.7 ~ 3.3	3.0	2.7 ~ 3.3		Good/No good
3				Arm DIG			3.1	2.7 ~ 3.5	3.1	2.7 ~ 3.5		Good/No good
4		E										Good/No good
5		(L)										Good/No good
6		A	Boom & Arm held level	Bucket DIG			2.8	2.5 ~ 3.1	2.8	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 (PW180-7)

Hydraulic oil temperature (45 ~ 55° C)

No	Condition Setting			Measurement item	Unit	Standard Value				Measured value	Judgement
						Mono Boom		Two Piece Boom			
	Fuel Dial	Working mode	Work equipment posture			New model	Failure judgement	New model	Failure 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

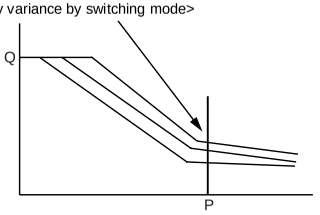
No	Part to be checked	Condition Setting						① kg/cm² main pump	② kg/cm² main pump LS	③ kg/cm² Control circuit pressure	④ kg/cm² main pump servo	Remarks
		Fuel Dial	Working mode	Auto decelerator	One-touch power max switch	Work equipment operation						
1	PPC circuit	Full	A	OFF	OFF	Arm dumping relief						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					① kg/cm² main pump	② kg/cm² main pump LS	③ kg/cm² Control circuit pressure	④ kg/cm² main pump servo	Remarks
		Fuel Dial	Working mode	Auto decelerator	One-touch power max switch	Work equipment operation					
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					① kg/cm² main pump	2A kg/cm² PC EPC	3A kg/cm² LS EPC		Remarks < Reference value : kg/cm² >
		Fuel Dial	Working mode	Auto decelerator	One-touch power max switch	Work equipment operation					
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)



PREPARATIONS FOR TROUBLESHOOTING ELECTRICAL SYSTEM

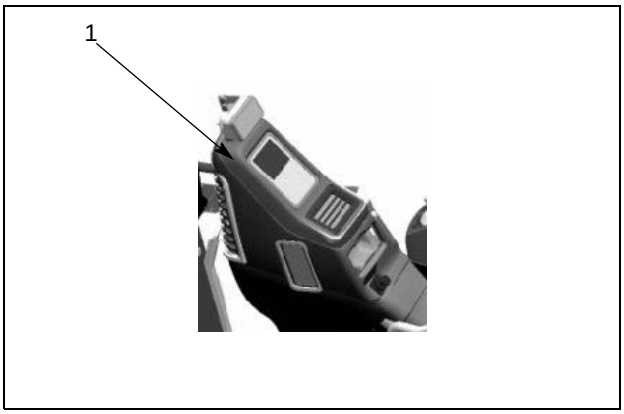
- When diagnosing electric circuits related to the monitor panel and governor pump controller, first open up the connector portions in the following manner.

1. Monitor panel

1.1.Take off cover (1).

- The cover is fixed with one upper and lower clip. Pull it up for the removal.

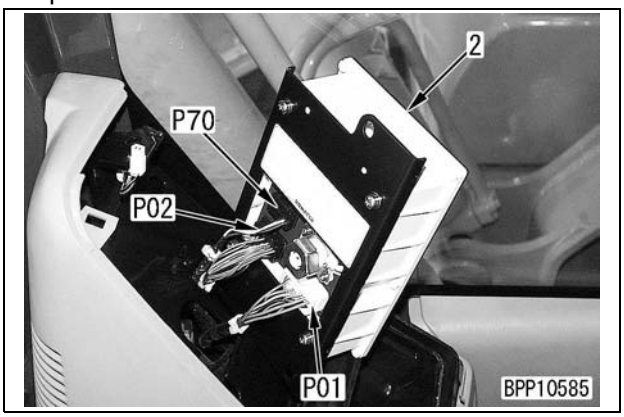
.



1.2.Remove the 3 mounting screws and disconnect monitor panel (2) from the mount.

- Take care not to drop the mounting screws in the console.

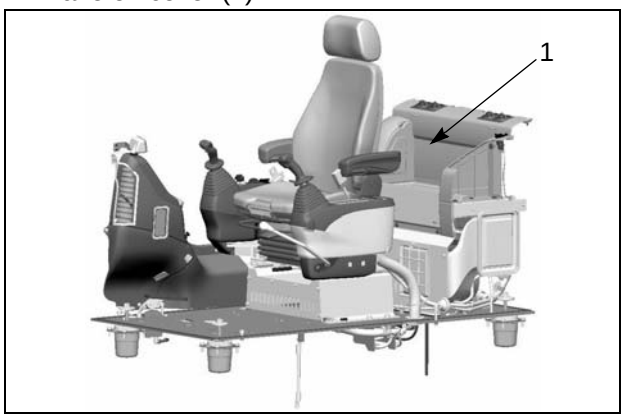
1.3.Insert or connect a T-adaptors for troubleshooting to connectors **P01**, **P02** and **P70** of the monitor panel.



1. Governor pump controller

- The governor pump controller is installed inside the cover behind the operator's seat.

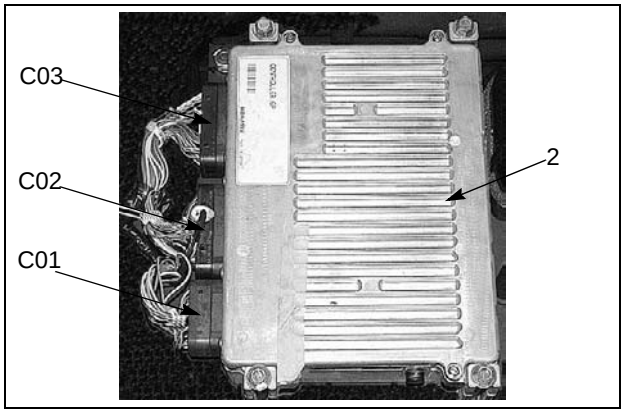
1.1.Take off cover (1).



1.2.Insert or connect a T-adapter for diagnosis with **C01**, **C02** and **C03** connectors of governor pump controller (2).

- The connectors are fixed with screws. Loosen the screws and detach the connectors.
- When putting the connectors back into position, tighten them to the specified torque.

N·m Screw: **2.82Nm {0.288 kgm}**



TROUBLESHOOTING

POINTS TO REMEMBER WHEN TROUBLESHOOTING 20-202
SEQUENCE OF EVENTS IN TROUBLESHOOTING 20-203
POINTS TO REMEMBER WHEN CARRYING OUT MAINTENANCE 20-204
CHECKS BEFORE TROUBLESHOOTING 20-212
CLASSIFICATION AND STEPS FOR TROUBLESHOOTING 20-213
CONNECTOR LOCATION CHART AND ELECTRICAL CIRCUIT DIAGRAM BY SYSTEM 20-218
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS 20-239

TROUBLESHOOTING WHEN SERVICE CODE "ELECTRICAL SYSTEM" AND FAILURE CODE "MECHANICAL SYSTEM" ARE INDICATED 20-301
TROUBLESHOOTING OF ELECTRICAL SYSTEM (E-MODE) 20-501
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 reoccurrence of the failure.
When carrying out troubleshooting, and important point is of course to understand the structure and function.
However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible causes of the failure that would produce the reported symptoms.

1. When carrying out troubleshooting, do not hurry to disassemble the components.
If components are disassembled immediately any failure occurs:
- Parts that have no connection with the failure or other unnecessary parts will be disassembled.
- It will become impossible to find the cause of the failure.

It will also cause a waste of manhours, parts, or oil or grease, and at the same time, will also lose the confidence of the user or operator.
For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.

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

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

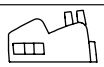
4. Confirming failure
- Confirm the extent of the failure yourself, and judge whether to handle it as a real failure or as a problem with the method of operation, etc.
  - ★ When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.

5. Troubleshooting
- Use the results of the investigation and inspection in Items 2 – 4 to narrow down the causes of failure, then use the troubleshooting flowchart to locate the position of the failure exactly.
  - ★ The basic procedure for troubleshooting is as follows.
    1)Start from the simple points.
    2)Start from the most likely points.
    3)Investigate other related parts or information.

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

SEQUENCE OF EVENTS IN TROUBLESHOOTING

Office, shop



TEW00180



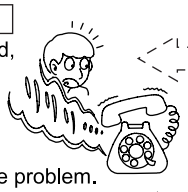
TEW00181

Jobsite

Step 1

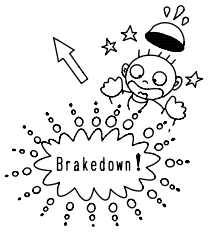
Examination, confirmation of symptoms

1) When a request for repairs is received, first ask the following points.
   - Name of customer
   - Type, serial number of machine
   - Details of jobsite, etc.
2) Ask questions to gain an outline of the problem.
   - Condition of failure
   - Work being carried out at the time of the failure
   - Operating environment
   - Past history, details of maintenance, etc.



TEW00182



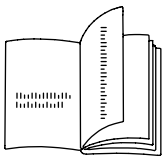


TEP01348

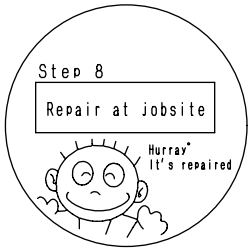
Step 2

Determining probable location of cause

1) Look at the troubleshooting section of the shop manual to find locations of possible causes.



TEP01350

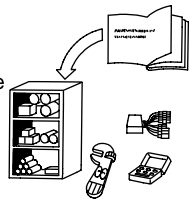


TEP01349

Step 3

Preparation of troubleshooting tools

1) Look at the table of troubleshooting tools in the shop manual and prepare the necessary tools.
   - T-adapter
   - Hydraulic pressure gauge kit, etc.
2) Look in the parts book and prepare the necessary replacement parts.

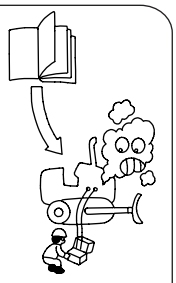


TEW00186

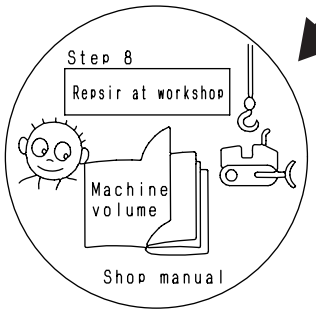
Step 7

- Pinpoint locations of failure (carry out troubleshooting)
- Decide action to take

1) Before starting troubleshooting, locate and repair simple failures.
   - Check before starting items
   - Other check items
2) See the Troubleshooting Section of the shop manual, select a troubleshooting flowchart that matches the symptoms, and carry out troubleshooting.



TEW00187



TEP01351

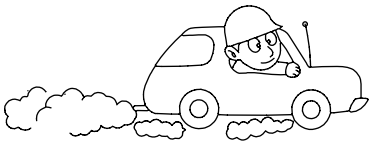
Step 6

Re-enacting failure

- Drive and operate the machine to confirm the condition and judge if there is really a failure.

Step 4

Go to jobsite

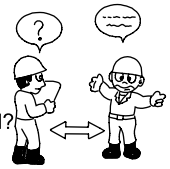


TEW00189

Step 5

Ask operator questions to confirm details of failure.

- Was there anything strange about the machine before the failure occurred?
- Did the failure occur suddenly?
- Had any repairs been carried out before the failure?



TEW00190

POINTS TO REMEMBER WHEN CARRYING OUT MAINTENANCE

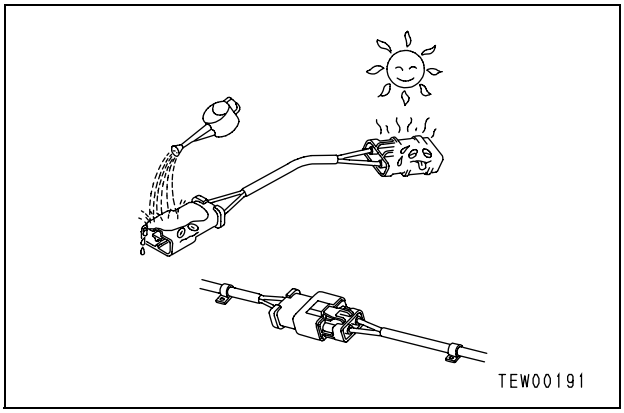
To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct operation, maintenance and inspection, troubleshooting, and repairs must be carried out. This section deals particularly with correct repair procedures for mechatronics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

1. Points to remember when handling electric equipment

1) Handling wiring harnesses and connectors

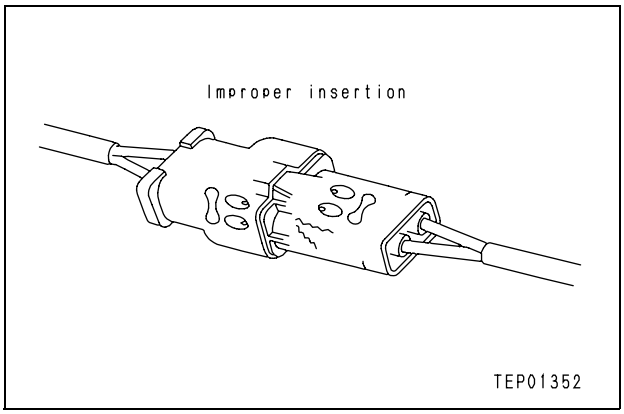
Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protectors or tubes used for protecting the wiring.

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

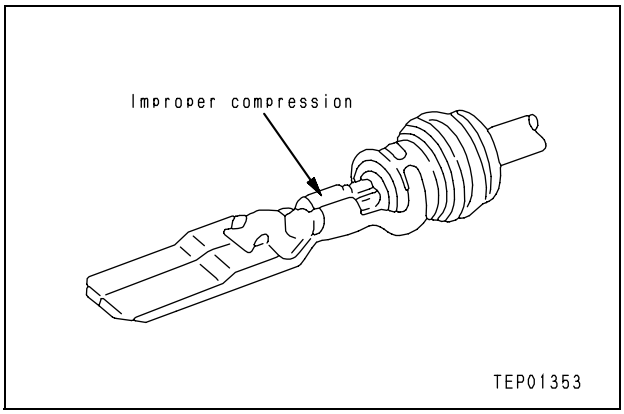


Main failures occurring in wiring harness

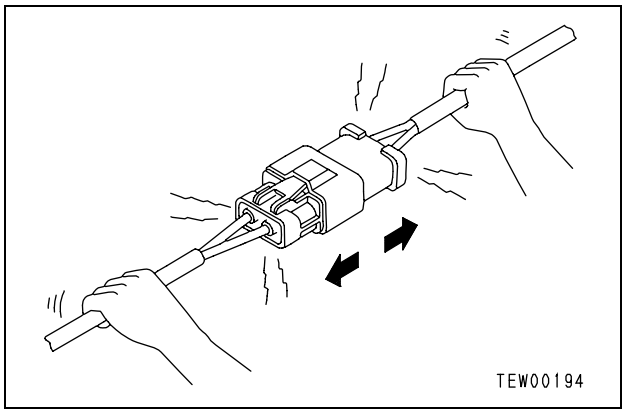
1) Defective contact of connectors (defective contact between male and female)
   Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned,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



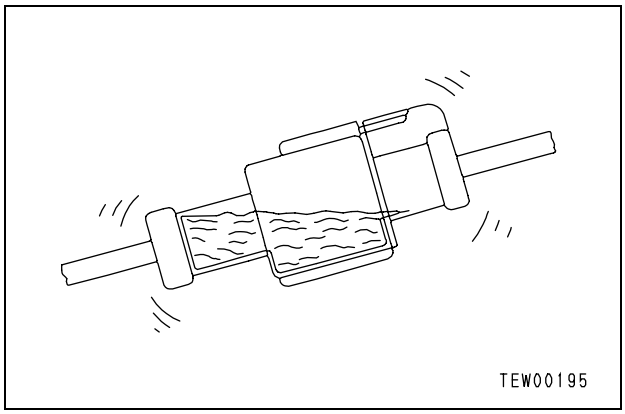
2) Defective crimping or soldering of connectors
   The pins of the male and female connectors are in contact at the crimped terminal or soldered portion, but if there is excessive force brought to bear on the wiring, the plating at the joint will peel and cause improper connection or breakage.



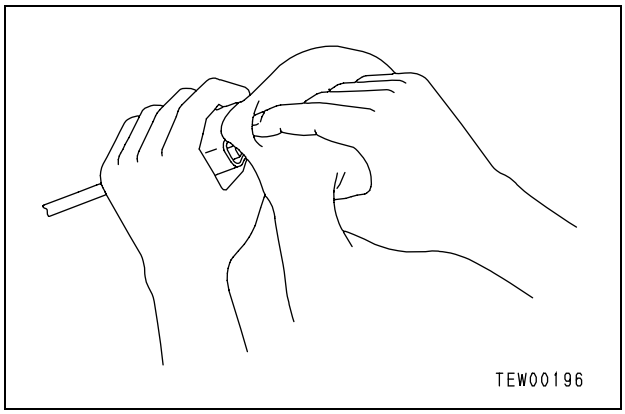
3) Disconnections in wiring
If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping of the connector may separate, or the soldering may be damaged, or the wiring may be broken.



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

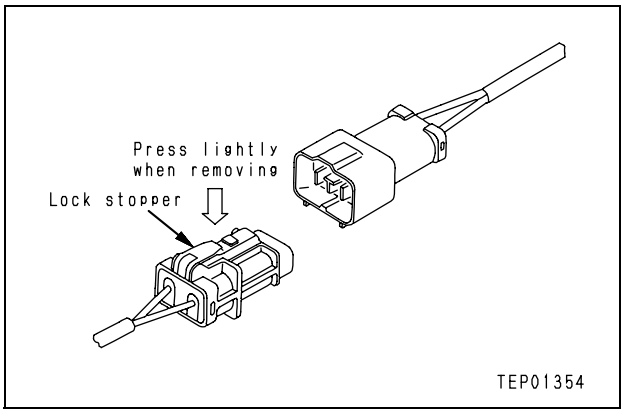


5) Oil or dirt stuck to connector
If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact.
If there is oil or grease stuck to the connector, wipe it off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

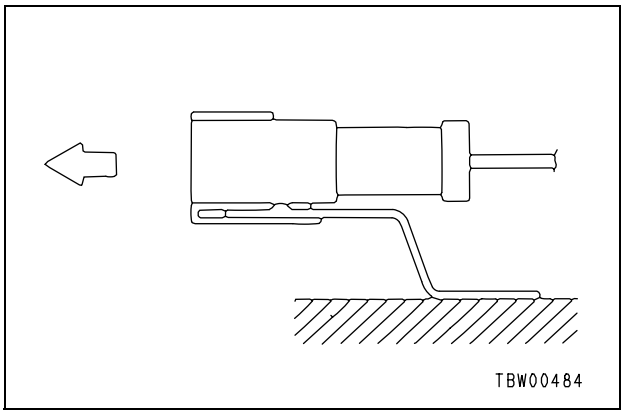


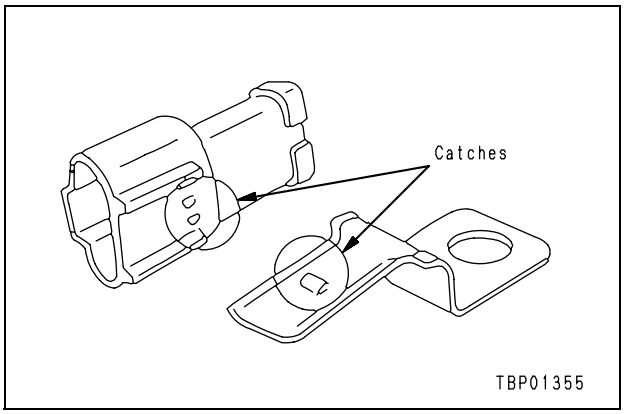
2) Removing, installing, and drying connectors and wiring harnesses

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

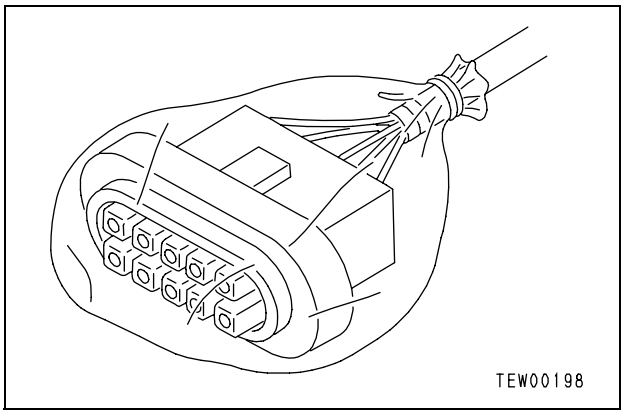


  2) When removing from clips
     When removing a connector from a clip, pull the connector in a parallel direction to the clip.
     ★ If the connector is twisted up and down or to the left or right, the housing may break.





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



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

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

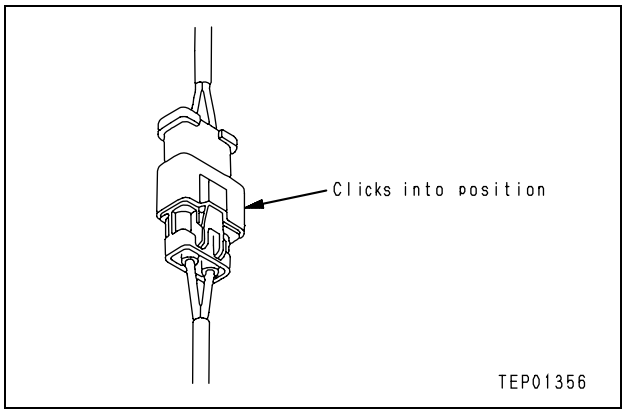
     ★ If there is any damage or breakage, replace the connector.

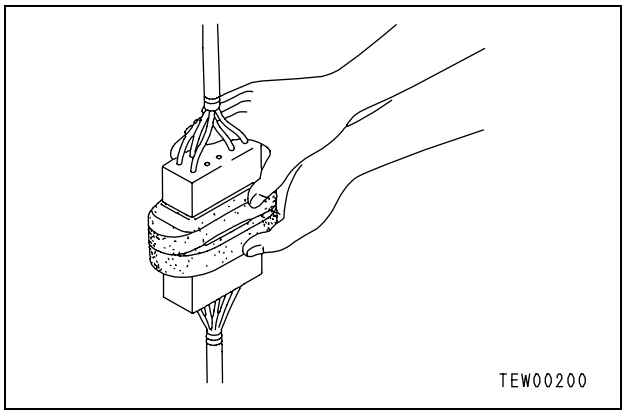
  2) Fix the connector securely.
     Align the position of the connector correctly, then insert it securely.
     For connectors with lock stopper, push in the connector until the stopper clicks into position.

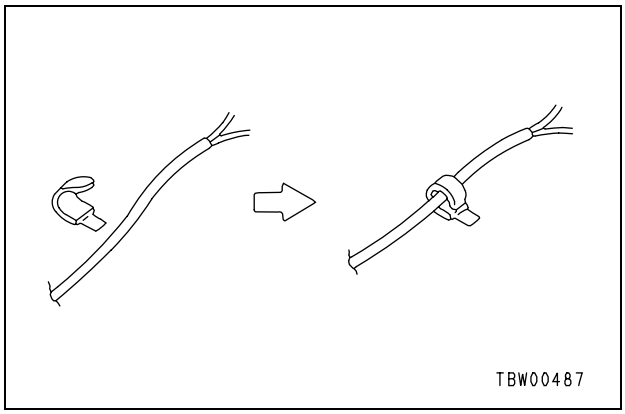
  3) Correct any protrusion of the boot and any misalignment of the wiring harness
     For connectors fitted with boots, correct any protrusion of the boot. In addition, if the wiring harness is misaligned, or the clamp is out of position, adjust it to its correct position.

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

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

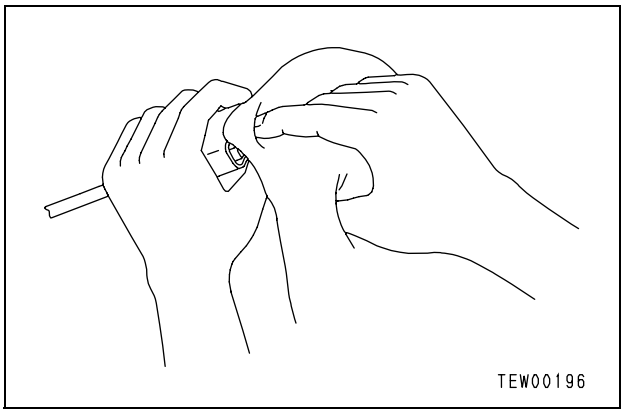




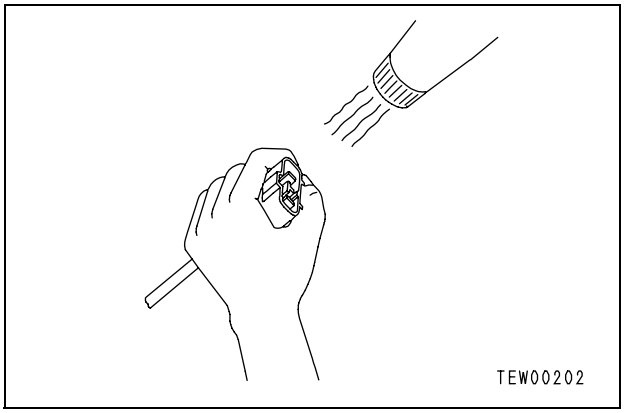


- **Drying wiring harness**
  If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high-pressure water or steam directly on the wiring harness.

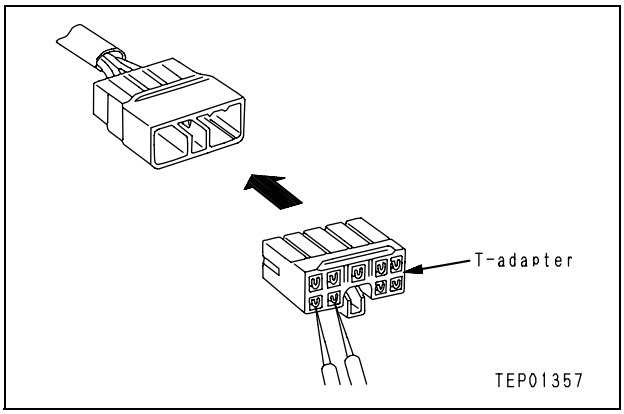
  If water gets directly on the connector, do as follows.
  1) Disconnect the connector and wipe off the water with a dry cloth.
     ★ If the connector is blown dry with compressed air, there is the risk that oil in the air may cause defective contact, so remove all oil and water from the compressed air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

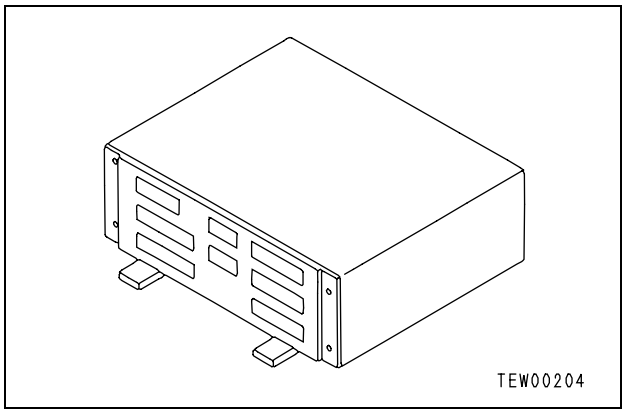


  3) Carry out a continuity test on the connector.
     After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.
     ★ After completely drying the connector, blow it with contact restorer and reassemble.

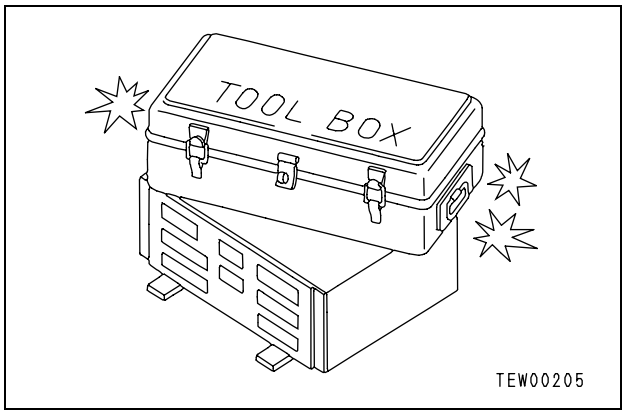


3) Handling control box

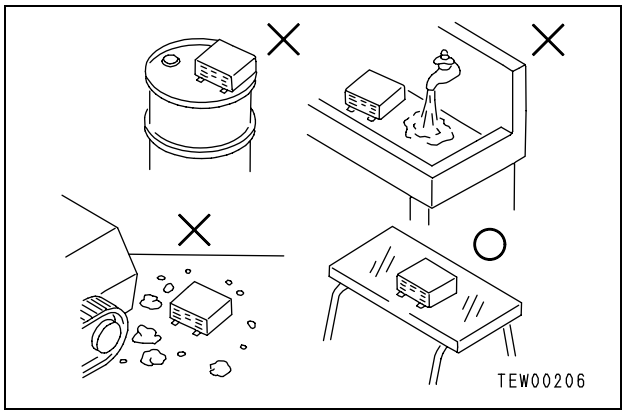
1) The control box contains a microcomputer and electronic control circuits. These control all of the electronic circuits on the machine, so be extremely careful when handling the control box.
2) Do not open the cover of the control box unless necessary.



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

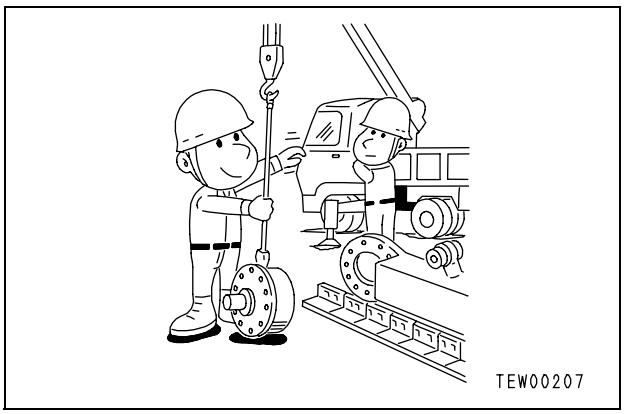
1) Always turn the power OFF before disconnecting or connect connectors.
2) Before carrying out troubleshooting, check that all the related connectors are properly inserted.
   ★ Disconnect and connect the related connectors several times to check.
3) Always connect any disconnected connectors before 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

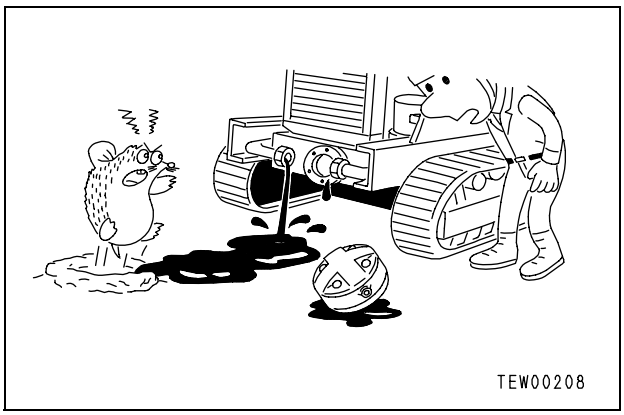
With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

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.

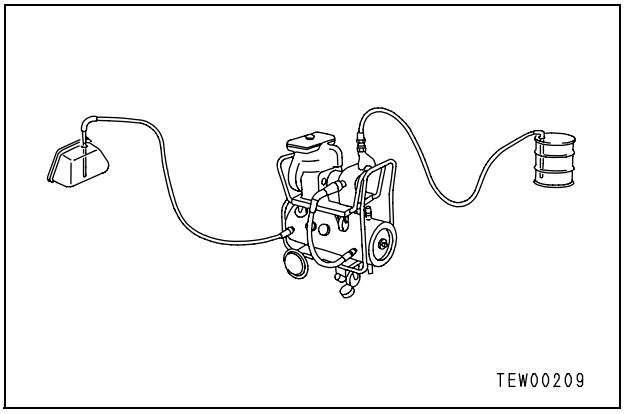
2) Disassembly and maintenance work in the field
If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to confirm the performance after repairs, so it is desirable to use unit exchange. Disassembly and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



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



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



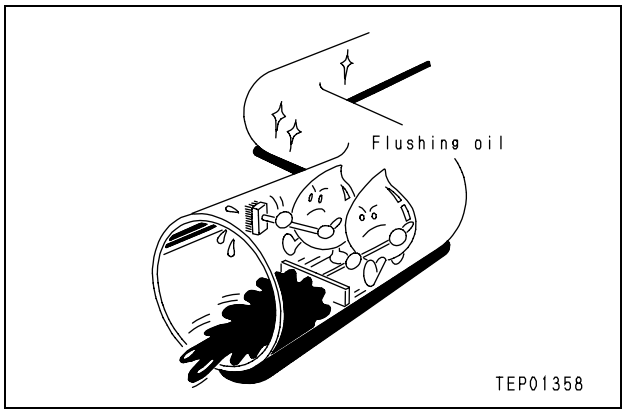
5) Change hydraulic oil when the temperature is high.

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

6) Flushing operations

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

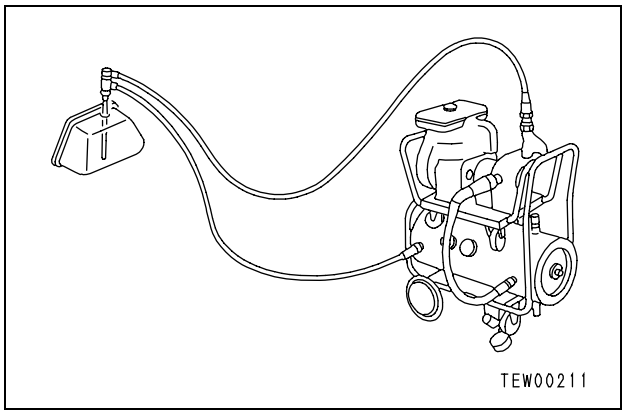
Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.



7) Cleaning operations

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

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



CHECKS BEFORE TROUBLESHOOTING

	Item	Judgement value	Action
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 discolored, burnt, exposed wiring	—	Replace
	4. Check for missing wiring clamps, hanging wiring	—	Repair
	5. Check for water leaking on wiring (be particularly careful attention to water leaking on connectors or terminals)	—	Disconnect connector and dry
	6. Check for blown, corroded fuses	—	Replace
	7. Check alternator voltage (engine running at 1/2 throttle or above)	After running for several minutes : 27.5 – 29.5V	Replace
	8. Check operating sound of battery relay (when switch is turned ON/OFF)	—	Replace

CLASSIFICATION AND STEPS FOR TROUBLESHOOTING

Classification of troubleshooting

Mode	Content
Code display	Troubleshooting when Service Code (electrical system) and Failure Code (mechanical system) are displayed.
E mode	Troubleshooting of electrical system
H mode	Troubleshooting of hydraulic and mechanical systems
(Engine)	Troubleshooting of engine assembly (refer to the shop manual for engine in 102 series)

Steps for troubleshooting

If some phenomenon occurs on a machine that looks like a failure, identify the corresponding troubleshooting No. and proceed to the explanations for diagnosis.

1. **Troubleshooting steps when calling User Code display in the monitor panel**
   If User Code display, enter service mode on monitor to display Service Code. Following displayed Service Code for the electrical system, carry out the troubleshooting along the corresponding code display.

2. **Troubleshooting steps when the electrical system Service Code or mechanical system Failure Code is recorded in the failure history:**
   If not calling User Code in the monitor panel, check the electrical system Service Code or mechanical system Failure Code, using the failure history function of the monitor panel.
   - ★ If Service Code in the electrical system is recorded, delete the all codes once and revive the code in the display again to check if the same abnormality still persists.
   - ★ Failure Code in the mechanical system cannot be deleted.

3. **Troubleshooting steps without User Code display and no failure history is available**
   If there is no display of User Code nor the failure history in the monitor panel, it is possible that a failure that the monitor panel cannot diagnose by itself may have occurred in any of the electrical, hydraulic or mechanical system. In such a case, re-examine the phenomenon, find out the most similar phenomenon from among "Failure like Phenomena and Troubleshooting No." and carry out troubleshooting related to the phenomenon in question.

Failure-looking Phenomenon and Troubleshooting No.

No.	Failure-looking phenomenon		Troubleshooting			
			Code display	E mode	H mode	(Engine)
Action to be taken concerning Service Code, User Code and Failure Code						
1	Display User Code in monitor panel		According to displayed code			
2	Display Service Code in electrical system after checking failure history					
3	Display Failure Code in mechanical system after checking failure history					
Engine-related failure						
4	Engine does not start up easily. (It always takes some time to start up the engine)					S-1
5	Engine does not start	Engine does not rotate		E-1		S-2 ①
6		Engine rotates, but there is no exhaust gas				S-2 ②
7		There is exhaust gas, but engine does not start				S-2 ③
8	Engine pickup is poor. (Engine does not follow acceleration)					S-3
9	Engine stops while in operation			E-2	H-2	S-4
10	Engine rotation is irregular. (There is hunting)			E-3		S-5
11	Engine is short of output, or lacks power				H-1	S-6
12	Color of exhaust gas is too dark. (Incomplete combustion)					S-7
13	Excessive engine oil consumption, or color of exhaust gas is blue					S-8
14	Premature engine oil contamination					S-9
15	Excessive fuel consumption					S-10
16	Engine cooling water is mixed with engine oil, spurts out or decreases					S-11
17	Engine oil amount increases. (Water or fuel gets in)					S-13
18	Abnormal noises are heard					S-15
19	Excessive vibrations are caused					S-16
20	Engine does not stop			E-4		
21	Auto-decelerator does not work			E-5	H-5	
22	Engine auto warming-up device does not work			E-6		
23	Engine preheater does not work			E-7		
Failure related to work equipment, swing and travel						
24	Speeds of all work equipment, travel and swing are slow, or they lack power				H-1	S-6
25	Engine rotation drops sharply or stalls				H-2	S-4
26	All work equipment, travel and swing do not move			E-8	H-3	
27	There are abnormal noises from around hydraulic pump				H-4	
28	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				
Swing-related failure					
44	Machine does not swing		E-27	H-23	
45	Swing acceleration is poor, or swing speed is slow			H-24	
46	Upper structure overruns excessively, when stopping swing			H-25	
47	There is a big shock caused when stopping swing			H-26	
48	There is abnormal noise generated when stopping swing			H-27	
49	There is natural drift while in swing			H-28	
Monitor panel-related failure (Operator's Menu: ordinary display)					
50	No display appears in monitor panel at all		E-10		
51	Part of display is missing in monitor panel		E-11		
52	Descriptions on monitor panel do not apply to the machine model		E-12		
53	In startup inspection, radiator water level caution symbol is displayed on the monitor panel, when the engine is running	B@BCZK			
54	In startup inspection, engine oil level caution symbol is displayed, when the engine is stopped (with the starting key in the ON position)	B@BAZK			

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No.	Failure-looking phenomenon	Troubleshooting			
		Code display	User code	H mode	(Engine)
55	In startup inspection, maintenance hour monitor lamp lights up red	Refer to Operation and Maintenance Manual			
56	While engine is running, battery charging caution symbol is displayed on the monitor panel.	AB00KE			
57	While engine is running, fuel level monitor lamp lights up red		E-13		
58	While engine is running, air cleaner clogging charging caution symbol is displayed on the monitor panel.	AA10NX			
59	While engine is running, engine cooling water temperature gauge is diplayed in red range	B@BCNS			
60	While engine is running, hydraulic oil temperature gauge is diplayed in red range	B@HANS			
61	Engine cooling water temperature gauge does not display correctly		E-14		
62	Hydraulic oil temperature gauge does not display correctly		E-15		
63	Fuel gauge does not display correctly		E-16		
64	Swing lock monitor does not display correctly		E-17		
65	When operating monitor switch, no display appears		E-18		
66	Windshield wiper does not work		E-19		
67	Warning buzzer cannot be stopped		E-20		
Monitor panel-related failure (Service Menu: Special Function Display)					
68	In monitoring function, "Boom RAISE" cannot be displayed correctly		E-21		
69	In monitoring function, "Boom LOWER" cannot be displayed correctly		E-22		
70	In monitoring function, "Arm DIGGING" cannot be displayed correctly		E-23		
71	In monitoring function, "Arm DUMPING" cannot be displayed correctly		E-24		
72	In monitoring function, "Bucket DIGGING" cannot be displayed correctly		E-25		
73	In monitoring function, "Bucket DUMPING" cannot be displayed correctly		E-26		
74	In monitoring function, "Swing" cannot be displayed correctly		E-27		
75	In monitoring function, "Travel" cannot be displayed correctly		E-28		
76	In monitoring function, "Service" cannot be displayed correctly		E-29		
Other failure					
77	Air conditioner does not work		E-301		
78	Travel alarm does not sound		E-31		

CONNECTOR LOCATION CHART AND ELECTRICAL CIRCUIT DIAGRAM BY SYSTEM

Connector table

Connector No.	Type	No.of Pin	Name of Device	Address	Sheet
A01	X	4	Intermediate Connector	O-17 K-2	1 4
A02	X	4	Intermediate Connector	N-18 I-2	1 4
A03	DT	12	Intermediate Connector	N-18 H-2	1 4
A04	SWP	12	Intermediate Connector	N-20 F-2	1 4
A04	Terminal	1	Ground (Chassis)	K-17	5
A05	SWP	16	Intermediated connector	O-11 G-2	2 4
A06	SWP	16	Intermediated connector	N-7 J-2	1 4
A07	SWP	16	Intermediated connector	O-14 L-2	2 4
A09	SWP	8	Intermediated connector	N-8 D-2	1 4
A11	DT	3	Swivel Joint Connector	O-2 D-2	4 5
A12	DT	4	Swivel Joint Connector	O-2	4
A13	DT	4	Swivel Joint Connector	O-2 A-2	4 5
A14	DT	3	Swivel Joint Connector	O-2	4
A20	Terminal	1	Battery Relay (E Terminal)	O-13	4
A21	Terminal	1	Battery Relay (BR Terminal)	O-13	4
A22	Terminal	1	Battery Relay (M Terminal)	O-13	4
A23	Terminal	1	Battery Relay (B Terminal)	O-13	4
A24	Terminal	1	Heater relay (Contact)	M-16	4
A25	Terminal	1	Heater Relay (Contact)	M-16	4
A26	Terminal	1	Heater relay (contact)	M-16	4
A27	X	2	Starter Safety Relay (S & R Terminals).	M-16	4
A28	Terminal	1	Starter Safety Relay (B Terminal)	M-16	4
A29	Terminal	1	Starter Safety Relay (C Terminal).	M-16	4
A31	DT	2	Air cleaner clogging system	L-20	4
A33	X	2	Radiator Water Level sensor	L-20	4
A34	L	2	Fusible Link (60A)	M-20	4
A35	M	2	Fusible Link (30A)	M-20	4

Connector No.	Type	No.of Pin	Name of Device	Address	Sheet
A40	Spade	1	Alarm Horn (low tone)	N-3	4
A41	Spade	1	Alarm Horn (high tone)	N-3	4
A50	Spade	1	Washer Motor Connector	D-15	4
A51	DT	3	Pump hydraulic oil pressure sensor	D-14	4
A53	Bullet	1	Back up alarm (OPT)	D-16	4
A54	X	1	Fuel Level Sensor	D-16	4
A55	DT	2	Hydraulic Oil Temperature Sensor	F-20	4
A56	DT	3	Travel PPC oil pressure sensor	C-13	4
A57	DT	2	Transmission Speed Sensor	D-3	5
A59	Spade	1	Washer Motor Connector	D-15	4
A64	Terminal	1	Revolving Frame Grounding	O-9	4
A65	Terminal	1	Revolving Frame Grounding	O-9	4
A84	X	4	Rear Work light harness conn	M-21	4
A85	X	1	Rear Work Light on Counter weight	M-22	4
A86	DT	2	Work Equipment Lights	O-4	4
A89	KES1	1	Boom Light RH (OPT)	O-5	4
A90	KES1	1	Boom light LH (OPT)	P-5	4
A90	DT	3	Swing proximity switch	B-5	4
A91	DT	2	Arm Marker Light (OPT)	P-4	4
A91	DT	3	Brake proximity switch	H-23	2
A99	SWP	8	Intermediated connector	J-2 N-2	1 4
AS1	DT	3	Angle sensor (Japan spec.)	C-22	1
C01	DRC	24	Governor Pump Controller	E-23	1
C02	DRC	40	Governor Pump Controller	G-23	1
C03	DRC	40	Governor Pump Controller	K23	1
C09	S	8	Model selection connector	B-6	1
D01	SWP	8	Assembled type diode	P-16	1
D02	SWP	8	Diode	P-14	1
D03	KES1	2	Assembled type diode	J-19	2
D04	KES1	2	Assembled type diode	O-13	2
D05	KES1	2	Assembled type diode	O-14	2
E01	Terminal	1	Suction type air heater (Grid Heater)	F-18	4
E02	Terminal	1	Engine oil pressure switch	I-20	4
E03	X	2	Engine oil level Switch	J-20	4
E04	DT	2	Engine speed sensor	J-20	4

Connector No.	Type	No.of Pin	Name of Device	Address	Sheet
E05	DT	2	Engine cooling water temperature sensor	J-20	4
E06	X	1	Air Con comp. Electromagnetic switch	I-20	4
E06	M	3	Fuel dial	M-17	3
E10	DT	3	Governor potentiometer	H-21	4
E11	DT	4	Goverenor motor	H-21	4
E12	Terminal	2	Alternator (B + D)	F-20	4
E13	Terminal	2	Engine Starter (B + C)	F-20	4
E21	DT	12	Intermediate Connector	J-18	4
E22	DT	12	Intermediate Connector	H-18	4
FB1	-	20	Fuse Box	D-16	3
F01	KES1	4	Flasher Unit	K-20	2
F02A	Yazaki	2	Operator cab beacon	G-13	3
F02B	Yazaki	2	Operator cab beacon	J-13	3
G02	DT	12	Steering Column	F-22	2
G3	AMP	7	Steering Column switch assy	D-22	3
G4	AMP	7	Steering Column switch assy	D-23	3
G05	DT	12	Steering Column	F-19	2
G7	DT	4	Rear Lights L.H	O-21	4
G8	DT	4	Rear Lights R.H	N-21	4
G10	X	2	Harness for licence No. plate	N-22	4
G12	DT	6	Front light connector (R.H)	O-8	4
G13	DT	6	Front light connector (L.H)	P-8	4
G33	DT	4	Heated seat (OPT)	C-4	3
G51	Bullet	1	Engine compartment lamp (OPT)	C-4	3
G52	KES0	4	Lower wiper (OPT)	P-18	4
G53	DT	2	Beacon	C-4	4
G70	DT	6	LH Wrist control lever switch	O-23	4
G71	DT	6	RH Wrist control lever switch	B-13	3
G72	DT	4	RH F-N-R switch	D-12 B-10	2 1
G73	DT	4	RH console emergency F.N.R switch	D-13 B-11	2 1
G99	Britax	10	Park Brake	E-9 B-14	2 1
G101	Britax	2	Indicator Switch (Left)	L-16	3
G102	Britax	2	Indicator Switch (Right)	B-18	2
G103	Britax	2	High beam indicator	B-18	2

Connector No.	Type	No.of Pin	Name of Device	Address	Sheet
G104	Spade	2	Worklamp indicator	B-15	2
G105	Britax	4	Road lights switch	C-19	2
G110	Spade	1	Hazard switch	B-16	2
G111	Spade	1	Hazard Switch	B-16	2
G164	DT	3	Overload Caution Sensor	O-12	4
H08	M	8	Intermediate Connector	E-10	3
H09	S	8	Intermediate Connector	E-11	3
H10	S	16	Intermediate Connector	K-10	3
H11	S	16	Intermediate Connector	M-10	3
H12	S	12	Intermediate Connector	M-10	3
H15	090	20	Intermediate Connector	P-15 B-18	3 1
J01	J	20	Junction connector (Black)	B-22	1
J02	J	20	Junction connector (Black)	B-20	1
J03	J	20	Junction connector (Green)	L-2	1
J04	J	20	Junction connector (Green)	N-2	1
J05	J	20	Junction connector (Pink)	N-23	2
J06	J	20	Junction connector (Pink)	H-1	2
J07	J	20	Junction connector (Black)	H-4	2
J08	J	20	Junction connector (Black)	J-17	2
J09	J	20	Junction connector (Pink)	L-2	2
J10	J	20	Junction connector (Orange)	L-5	2
K19	M	2	Pump resistor (for driving emerg. pump)	A-12	1
K30	DT	3	CAN terminating resistor	I-20	3
K31	DT	3	CAN terminating resistor	O-3	3
M07	M	3	Lamp switch	C-13	3
M13	M	2	Speaker (right)	G-13	3
M19	Yazaki	2	Cigar lighter	N-6	3
M26	S	12	Air Con Unit	L-22 O-5	3 1
M27	Yazaki	18	Air Con Unit	O-22	3
M29	AMP	20	Air Con control panel	M-19	3
M30	AMP	16	Air Con control panel	L-19	3
M31	M	4	Power supply (Option)	F-7	3
M33	Sumitomo	4	Air Con Unit	O-23	3
M33	M	2	Heated seat switch	B-5	3
M38	M	2	Quick coupler switch (Option)	O-16	3

Connector No.	Type	No.of Pin	Name of Device	Address	Sheet
M40	M	2	Working lamp (LH)	G-13	3
M40	AMP	8	Radio	I-7	3
M41	M	2	Working lamp (RH)	G-13	3
M41	AMP	8	Radio	I-9	3
M45	D	12	Network bus	H-22	3
M46	X	4	Controller program tool	P-18	1
M50	AMP	8	Intermediate Connector (Radio)	G-8	3
M51	Amp	8	Intermediate Connector (Radio)	G-9	3
M71	M	2	Cab Room Lamp	P-6	3
M72	M	4	DC/DC convertor	B-6	3
M73	M	2	Speaker (left)	G-10	3
M79	Yazaki	2	12V elec. equip. socket (Phone Socket)	P-4	2
M80	DT	2	Refueling pump connection	N-12	4
P01	AMP 070	12	Monitor Panel	J-3	3
P02	AMP 040	20	Monitor Panel	L-3	3
P05	M	2	Beacon Switch (Option)	C-21	3
P06	M	2	Lower Wiper (Option)	D-23	3
P10	DT	8	Outrigger Switch	I-5	3
P15	BRITAX	2	Air Conditioner Sunlight sensor	B-17	2
P17	Sumiomo	2	Air Con Hi/Lo pressure sw.	O-4	1
P70	AMP 040	16	Monitor Panel	N-3	3
R10	JDK	6	Light relay	H-5	2
R11	JDK	6	Starter cut relay	B-16	1
R13	JDK	6	Starter cut relay (Personal code)	B-14	1
R16	JDK	6	Lamp relay	H-6	2
R18	Grote	9	Lower wiper relay	L-6	2
R20	JDK	6	Service relay	D-2	1
R22	JDK	6	Starter cut relay (Travel N)	B-15	1
R30	Sumitomo	5	Air Con unit (Blower Relay)	L-22	3
R31	AMP	4	Air Con Unit (Compressor Relay)	L-23	3
R40	JDK	6	Emergency relay (travel F/R)	B-4	1
R41	JDK	6	Emergency relay (Travel N)	B-3	1
R42	JDK	6	Emergency relay (Drive F)	B-2	1
R43	JDK	6	Emergency relay (Drive R)	B-1	1
R44	JDK	6	Horn relay	L-8	2
R45	JDK	6	PPC lock relay (1)	H-7	2

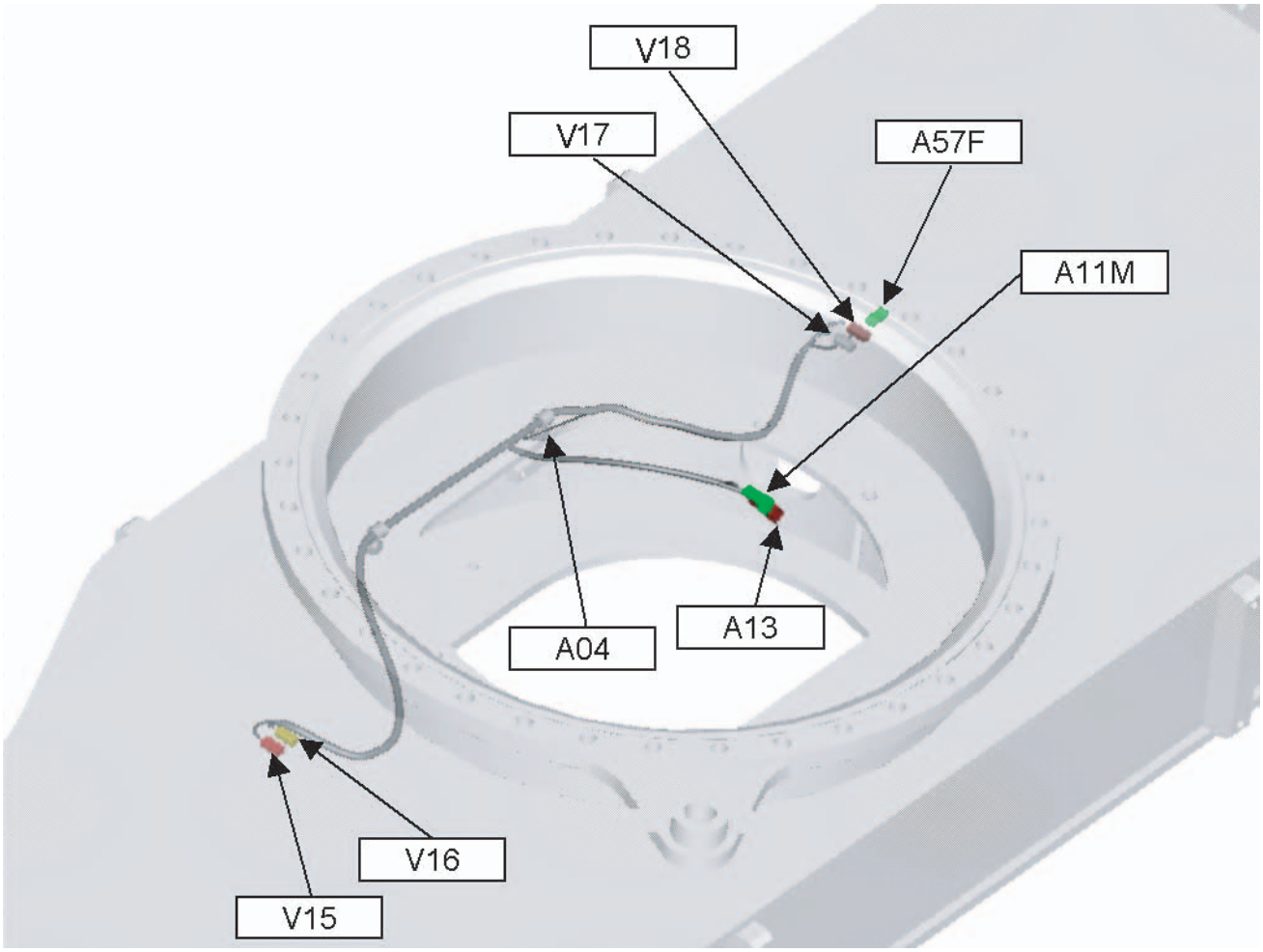
Connector No.	Type	No.of Pin	Name of Device	Address	Sheet
R46	JDK	6	PPC lock relay (2)	H-8	2
R47	JDK	6	Suspension lock relay	H-9	2
R48	JDK	6	Clamshell relay	E-2	1
R50	KES0	6	Hazard waring relay	J-19	2
R51	JDK	6	Brake light cut relay	H-10	2
S01	X	2	Swing RH oil pressure switch	B-8	4
S02	X	2	Swing LH oil pressure switch	B-8	4
S03	X	2	Bucket dumping oil pressure switch	B-8	4
S04	X	2	Bucket digging oil pressure switch	B-8	4
S05	X	2	Arm dump oil pressure switch	C-8	4
S06	X	2	Arm digging oil pressure switch	C-8	4
S07	X	2	2PB extend oil pressure switch	C-8	4
S08	X	2	2PB retract oil pressure switch	D-8	4
S09	X	2	Travel reverse oil pressure switch	E-8	4
S10	X	2	Travel forward oil pressure switch	E-8	4
S12	X	2	Stabilizer + boom down oil pressure switch	E-8	4
S13	X	2	Stabilizer + boom up oil pressure switch	F-8	4
S14	M	3	PPC hydraulic lock switch	E-20	3
S17	DT	2	Park brake oil pressure switch	O-17	2
S18	DT	2	Low brake oil presssure switch	O-18	2
S19	DT	2	Stop lights oil pressure switch	O-19	2
S20	X	2	Service oil pressure switch	D-8	4
S21	X	2	Service oil pressure switch	D-8	4
S21	OTAX	6	Pump emergency driving switch	C-2	2
S22	OTAX	6	Swing and parking brake emergency switch	C-5	2
S23	OTAX	6	Emegency travel switch	C-6	2
S25	090	16	Intermediate connector (RH console emergency sw.)	E-4 B-12	2 1
T05	Terminal	1	Earth to floor frame	E-9	3
T11	Terminal	1	Earth	G-9	3
V01	DT	2	PPC Pressure Lock Solenoid	D-11	4
V02	DT	2	2 Stage Relief Solenoid	D-11	4
V03	DT	2	Swing Brake Sol	E-11	4
V04	DT	2	Suspension Lock Solenoid	E-11	4
V06	DT	2	Travel Neutral Solenoid	E-11	4
V07	DT	2	Creep solenoid	F-11	4

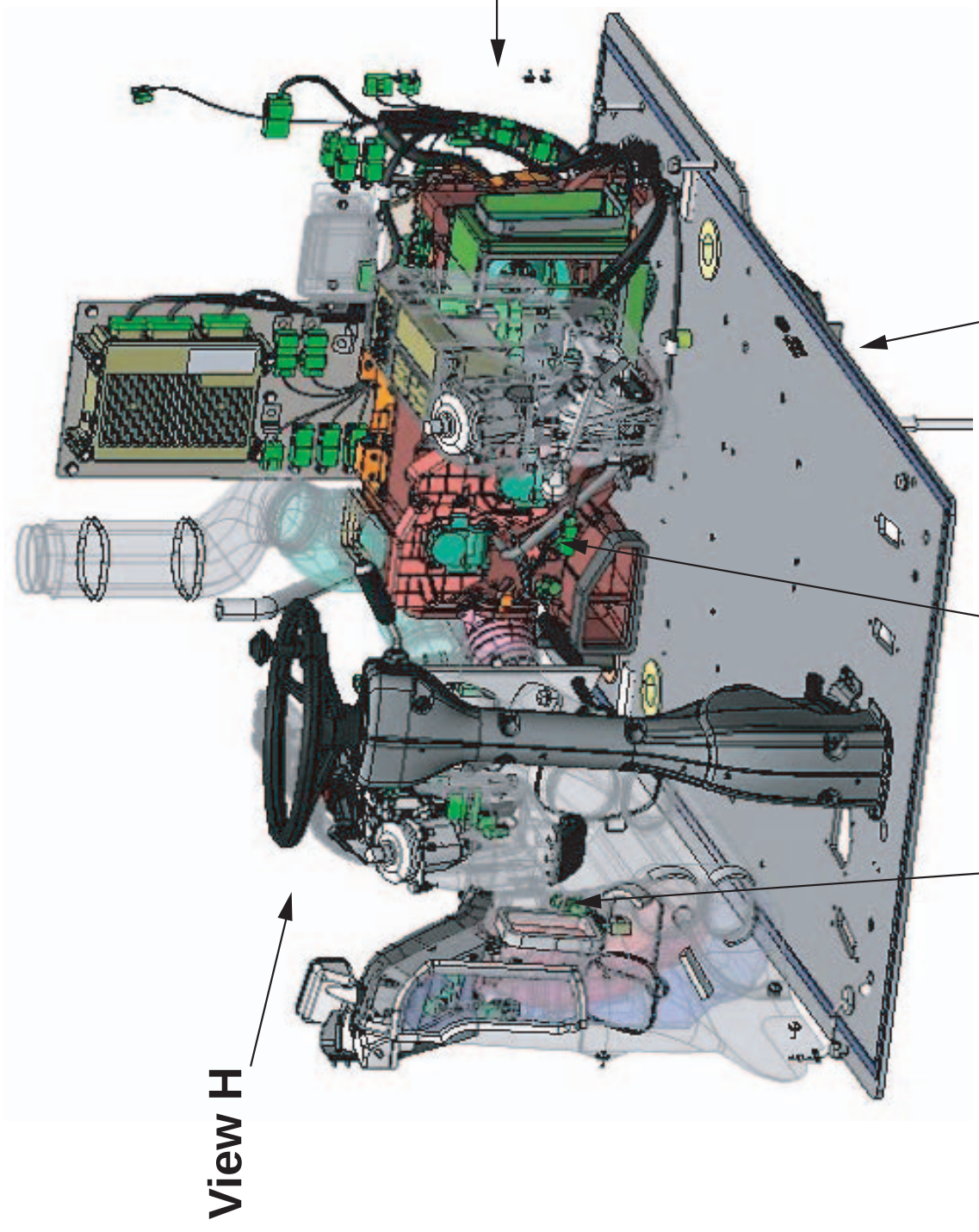
Connector No.	Type	No.of Pin	Name of Device	Address	Sheet
V08	DT	2	Travel F/R solenoid	C-11	4
V09	DT	2	Boom / Stabilizer down solenoid	C-11	4
V10	DT	2	Boom / Stabilizer up solenoid	C-11	4
V11	DT	2	Transmission clutch solenoid	A-11	4
V12	DT	2	Park brake solenoid valve	O-16	2
V13	X	2	Service Flow control solenoid	C-11	4
V14	DT	2	Clamshell CW/ACW solenoid	D-11	4
V15A	DT	2	Transmission back pressure solenoid	B-11	4
V15B	DT	2	Front attatchment solenoid (LHS)	–	5
V16	DT	2	Front attachment solenoid (RHS)	–	5
V17	DT	2	Rear attatchment solenoid (LHS)	–	5
V18	DT	2	Rear attatchment solenoid (RHS)	–	5
V21	DT	2	PC-EPC solenoid valve	G-21	4
V22	DT	2	LS-EPC solenoid valve	G-21	4
W03	M	2	Rear Limit Switch	F-11	3
W04	M	6	Wiper Motor	I-6	3
W08	070	18	Wiper Motor Controller	J-21	2
X05	M	4	Swing lock switch	P-18	3
40A	Yazaki	2	Rear lamp (Op cab)	G-12	3
40B	Yazaki	2	Rear lamp (Op cab)	J-12	3

NOTE: (Sheets 1, 2, 3, 4 & 5 are located in Section 90)

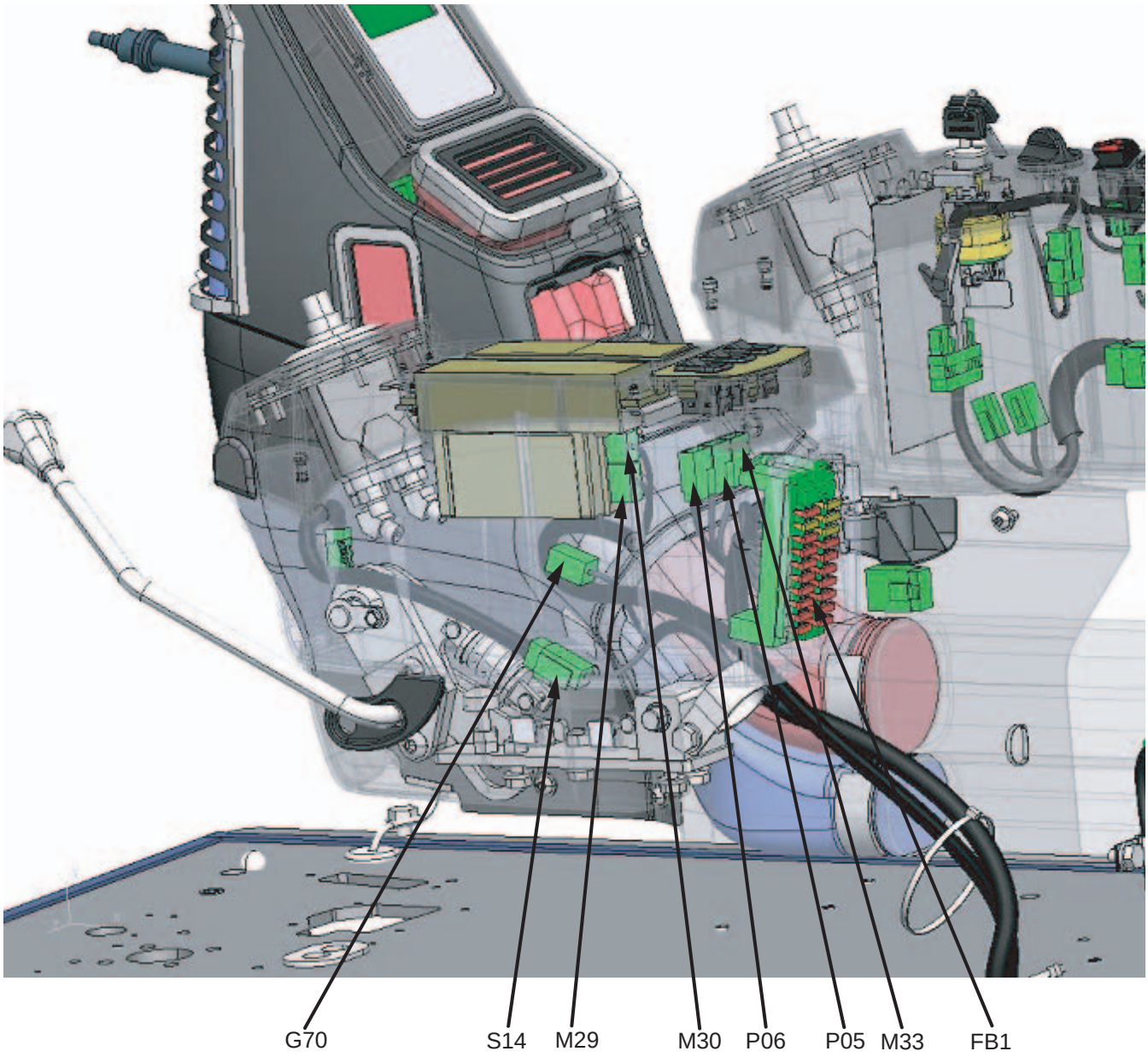
Connector No.	Detailed information
D or DT	Product of Deutsch USA DT type connector (08192-XXXXX)
L	Product of Yazaki Corporation L type connector (08056-2XXXX)
J	Product of Sumitomo Wiring Systems 090 type splice
M	Product of Yazaki M type connector (08056-0XXXX)
Grote	Product of Grote & Hartmann Germany
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)
Terminal	Round pin type single terminal connector
Terminal	Round terminal
DENSO	Product of DENSO (Japan)

*An affiliated company of Mitsubishi Cable Industries, Ltd.

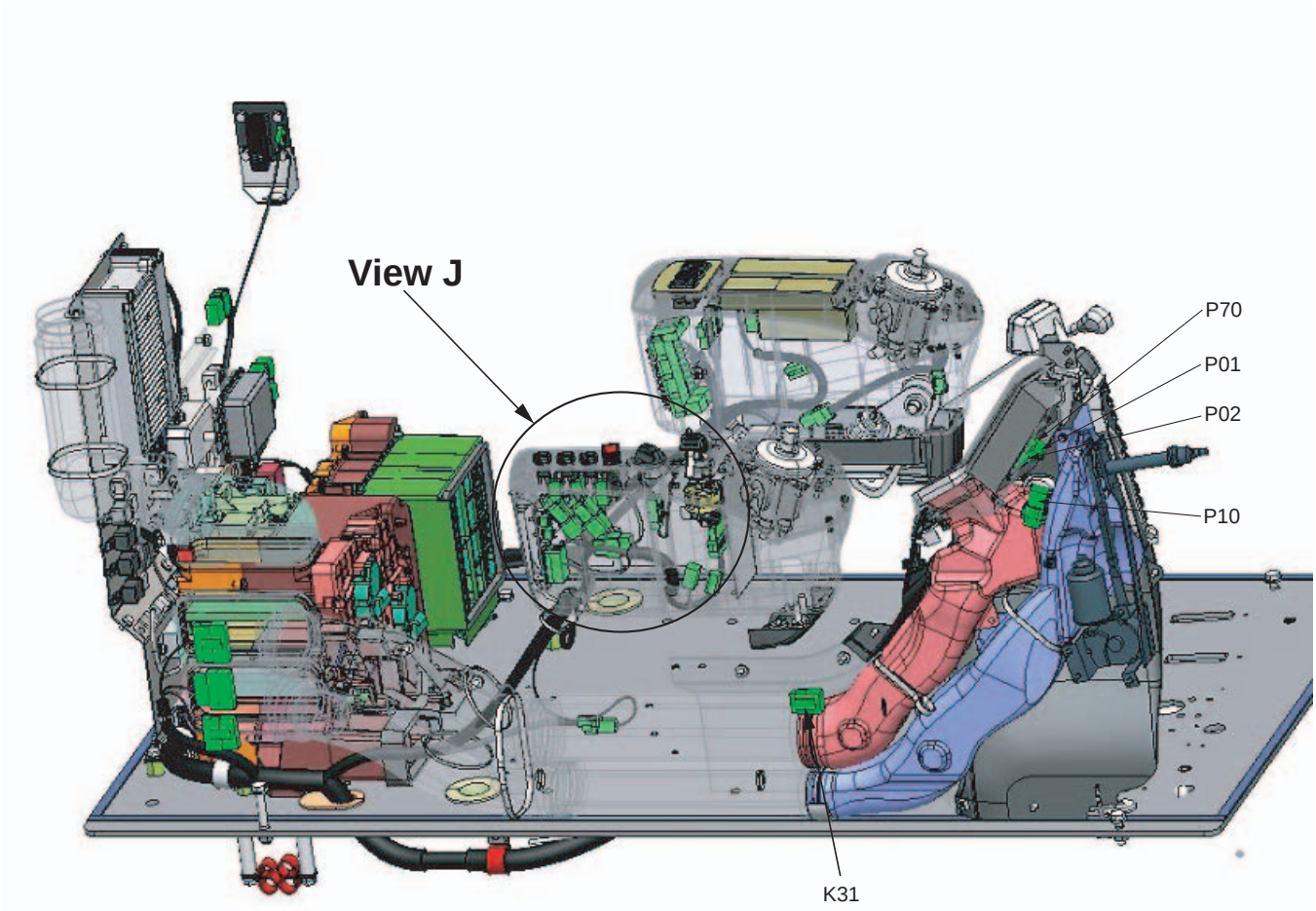

V18
V17
A57F
A11M
A04
A13
V16
V15


View G
View I
G33
M19
View H

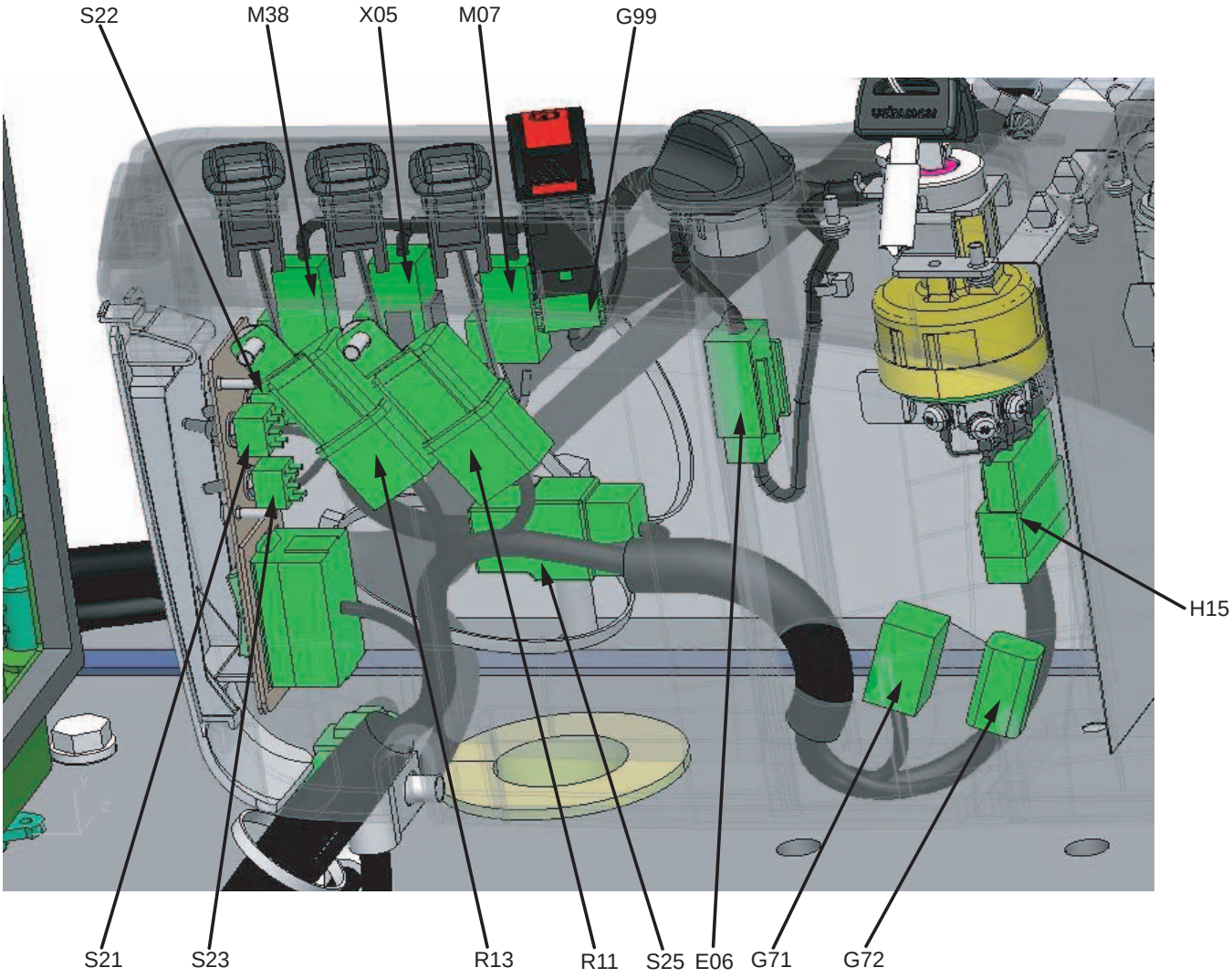
View G



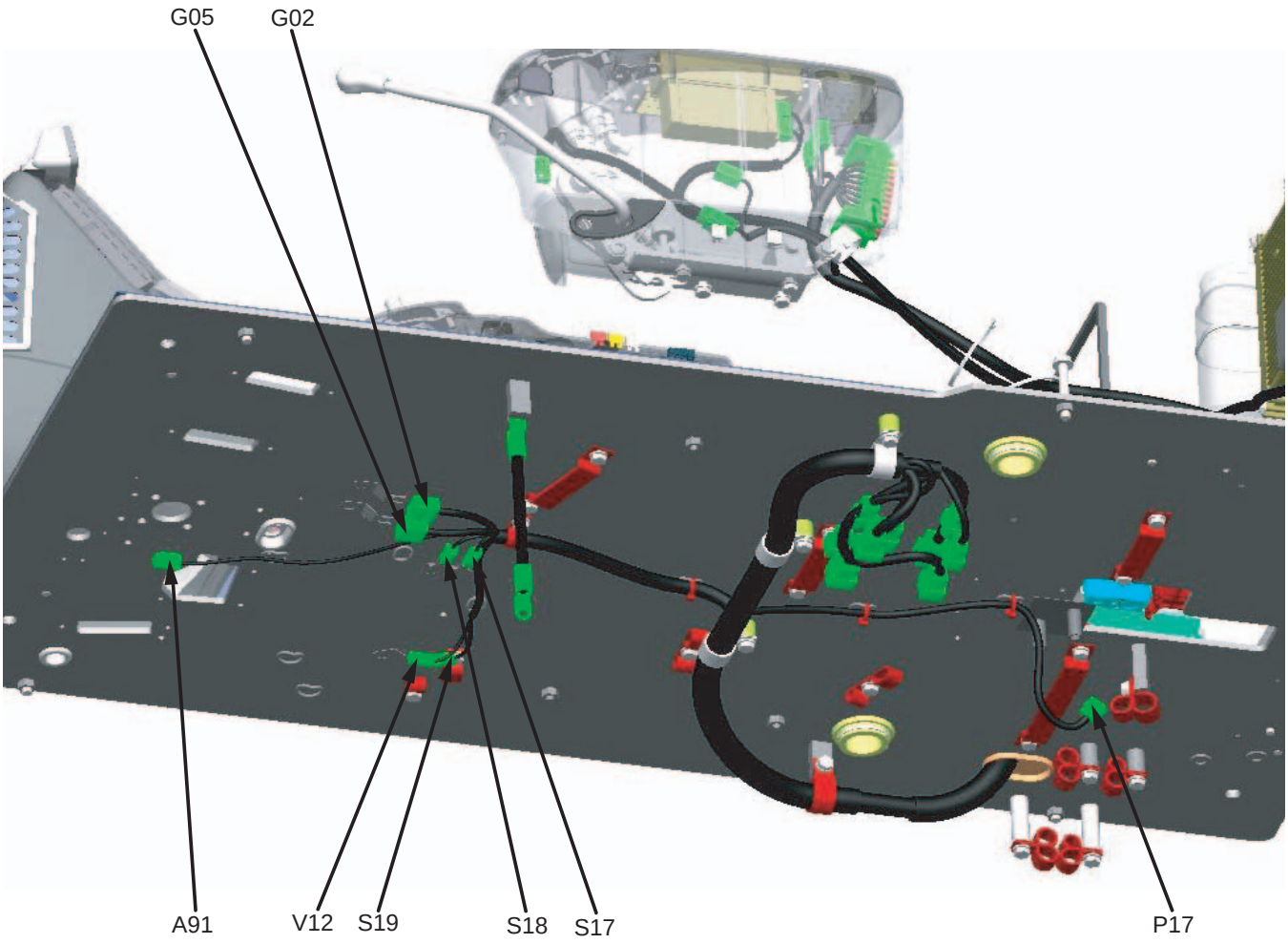
View H

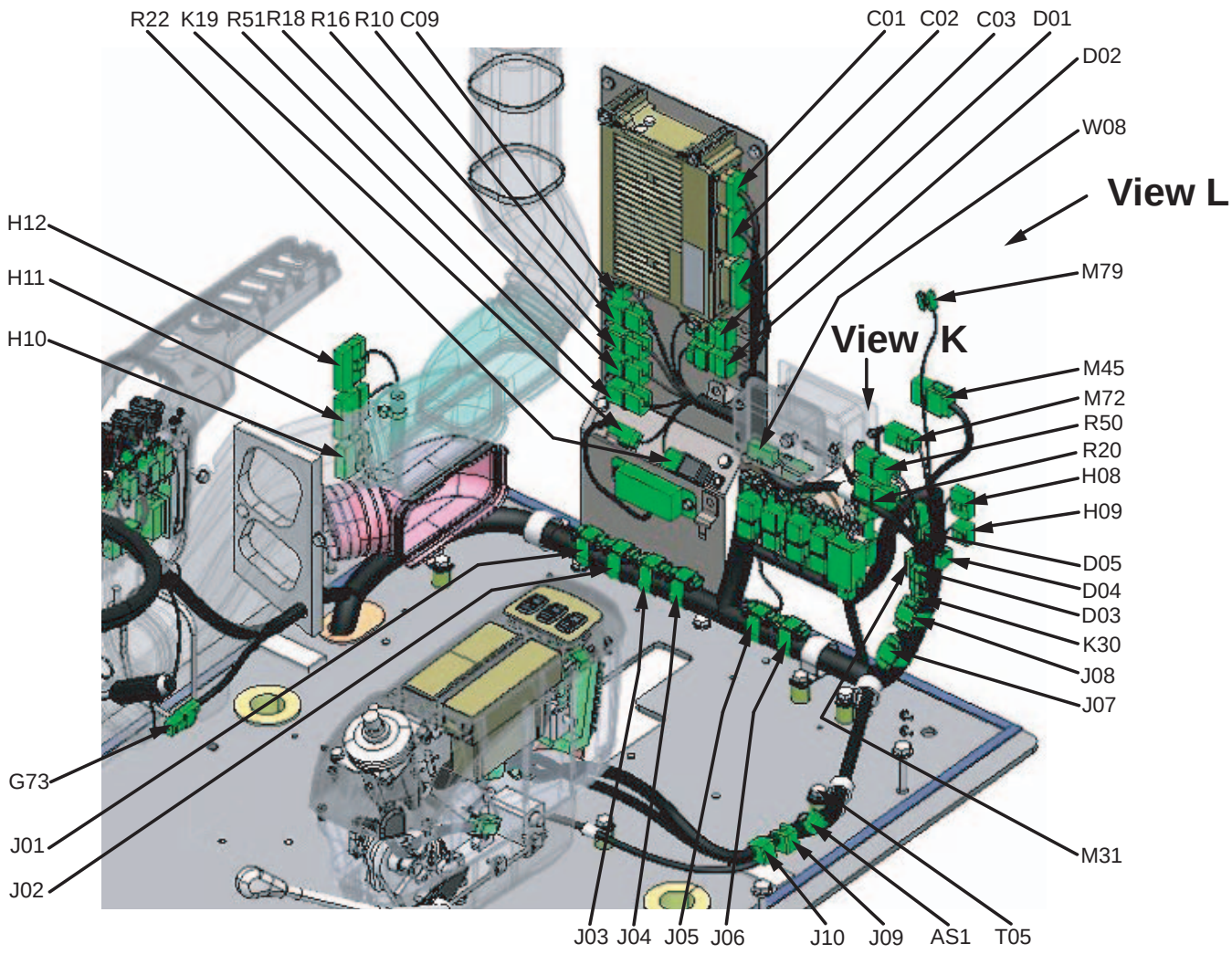


View J

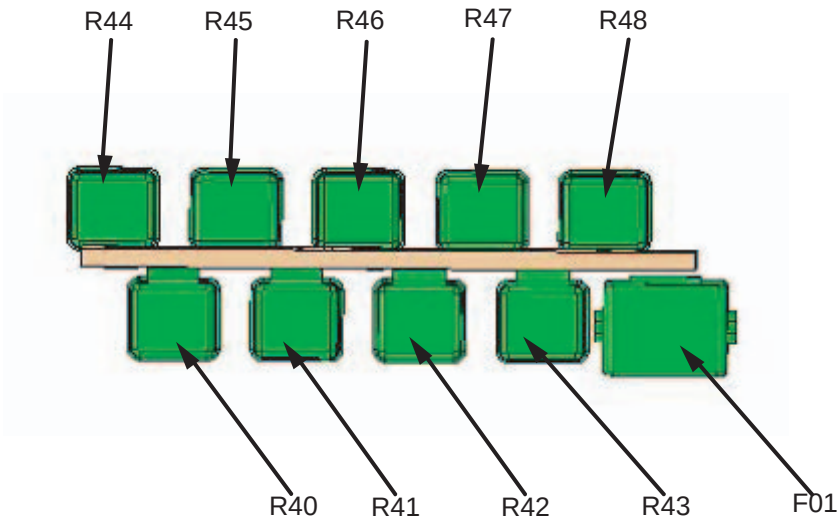


View I

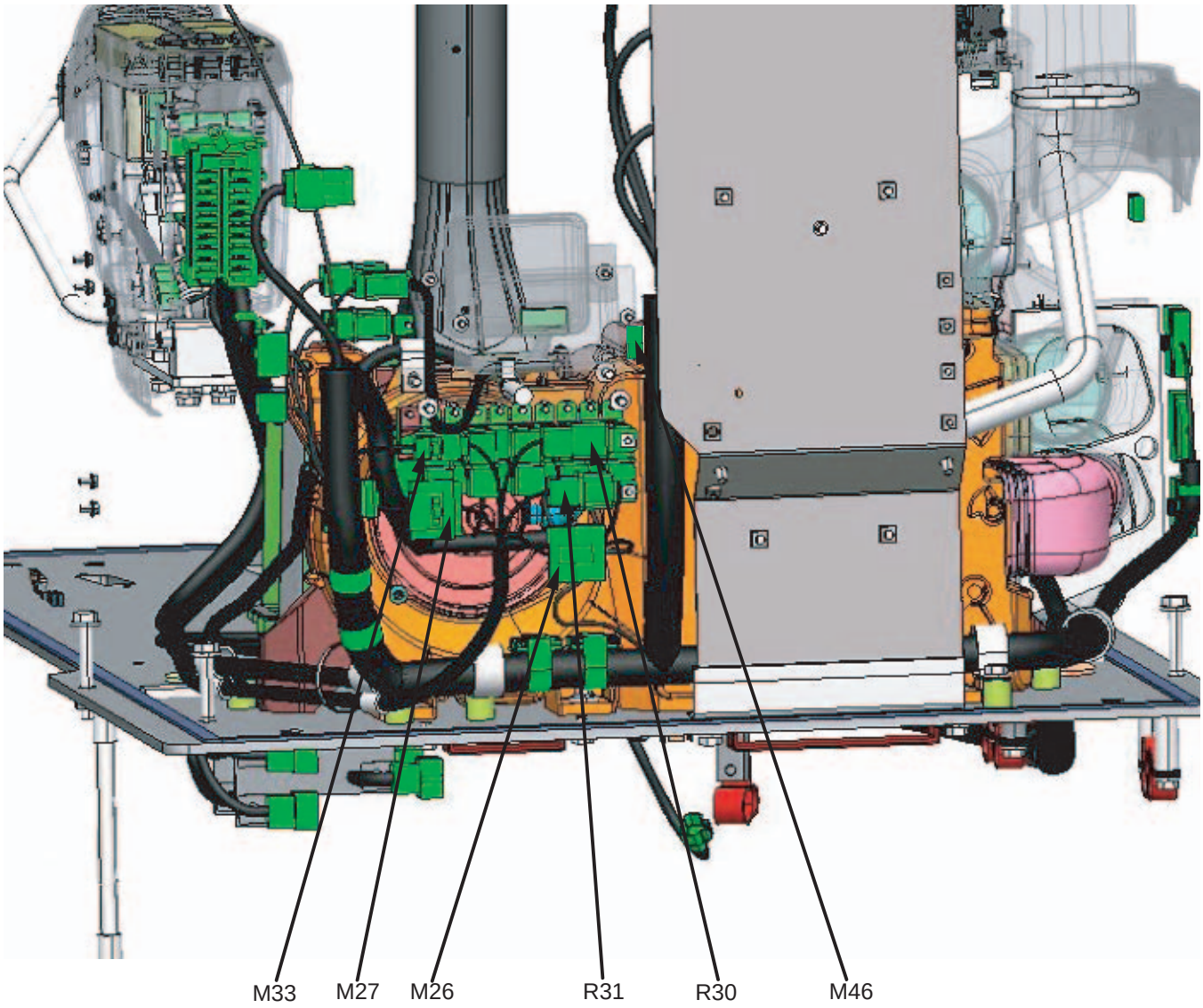



R22
K19
R51
R18
R16
R10
C09
C01
C02
C03
D01
D02
W08
View L
H12
H11
H10
M79
View K
M45
M72
R50
R20
H08
H09
D05
D04
D03
K30
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J06
J10
J09
AS1
T05

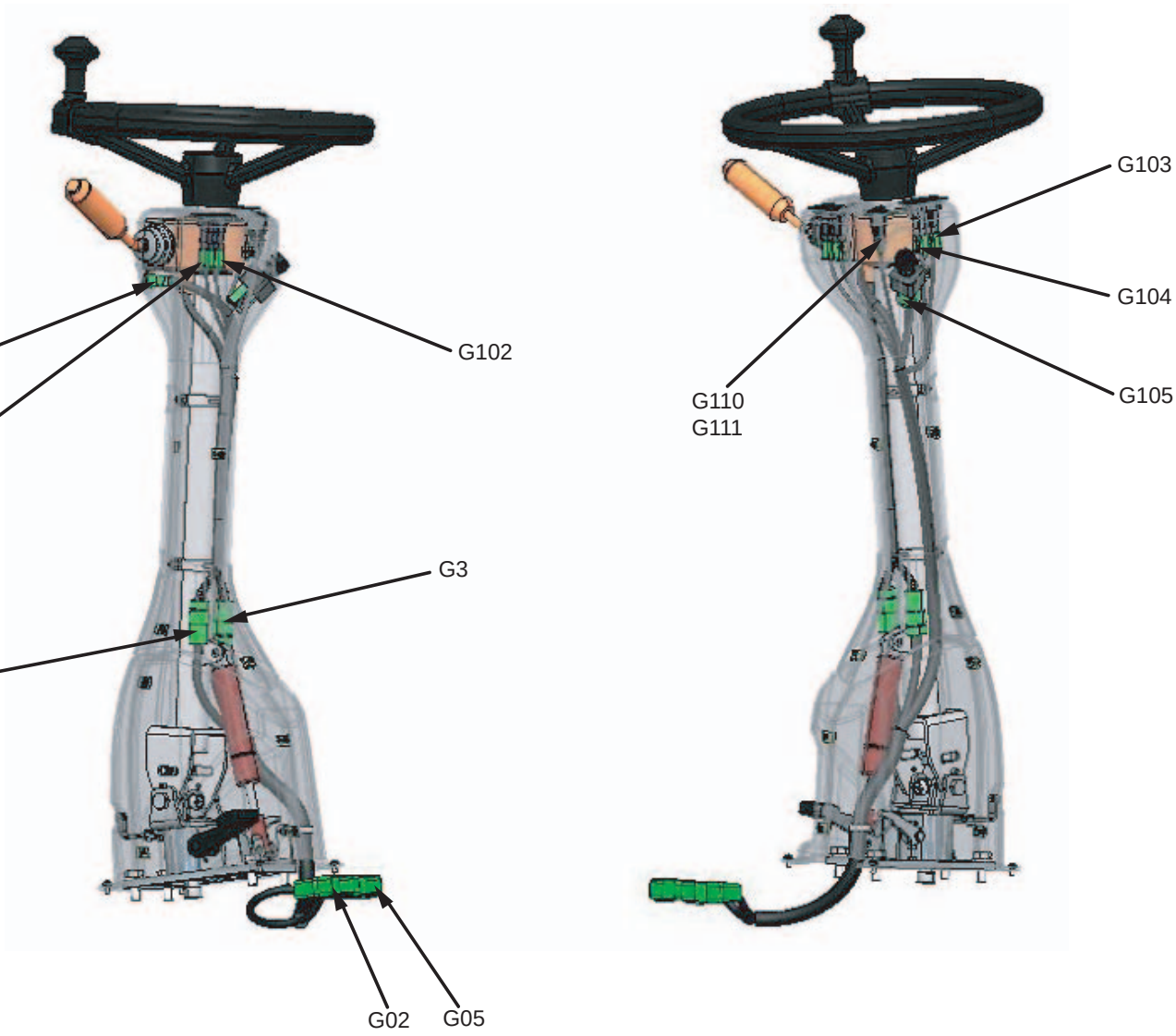
View K



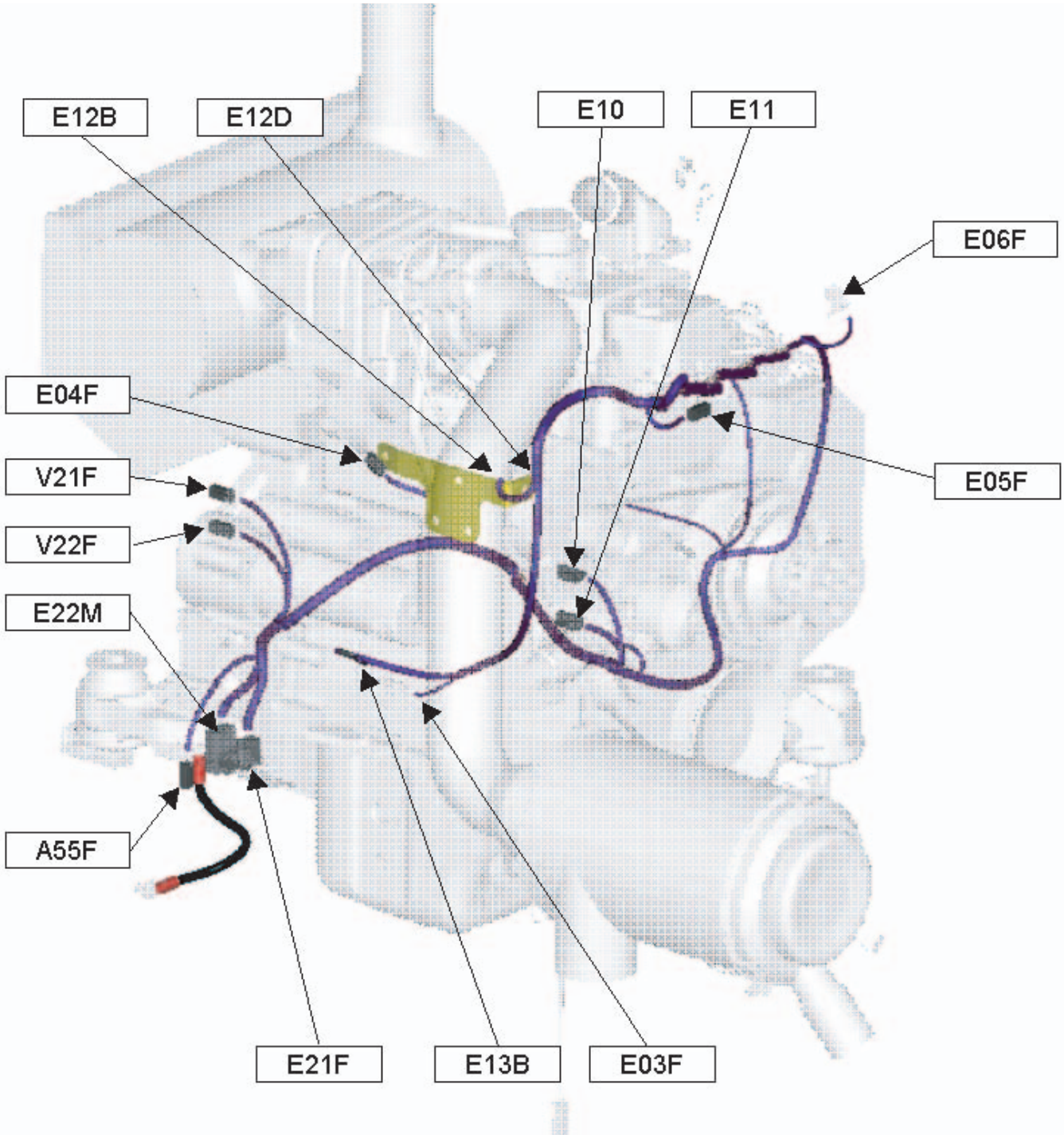
View L



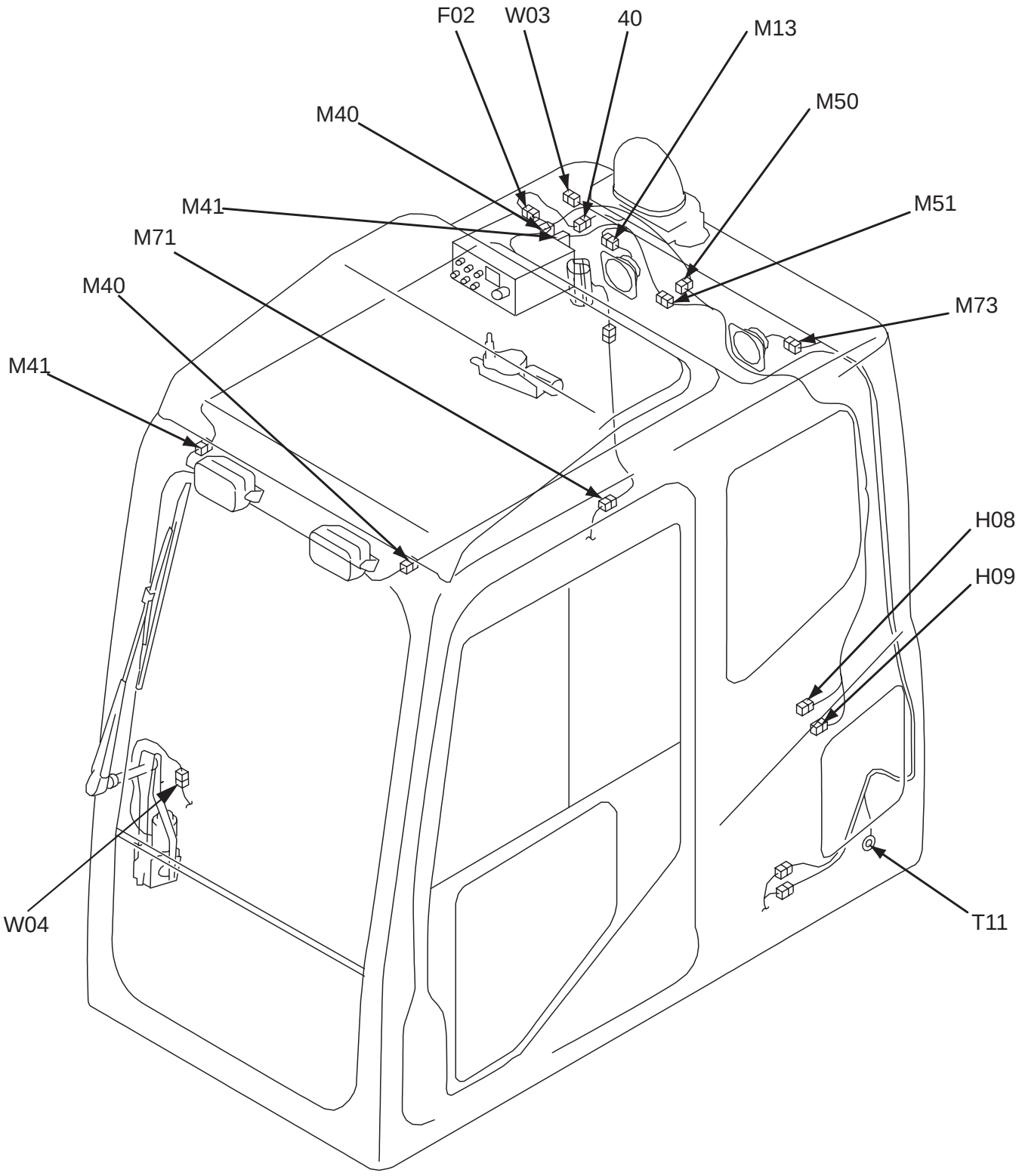
Steering Column



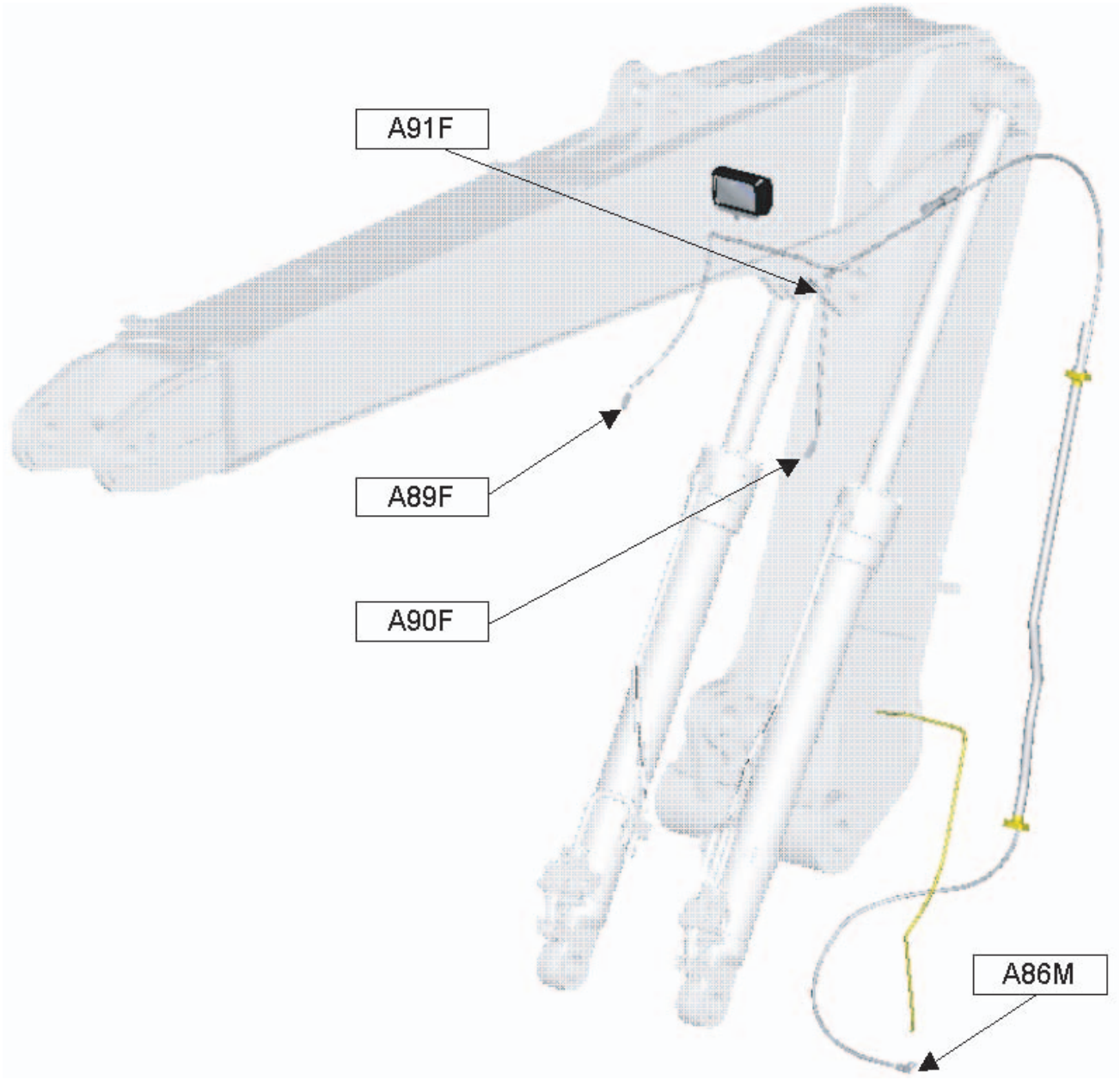
Engine


E12B
E12D
E10
E11
E06F
E04F
V21F
V22F
E22M
E05F
A55F
E21F
E13B
E03F

Operator Cab

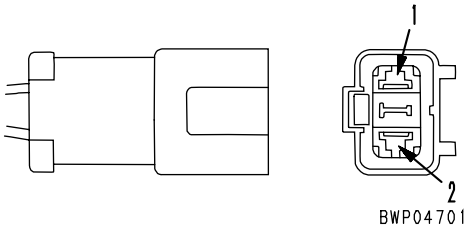
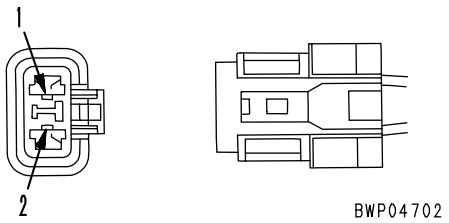
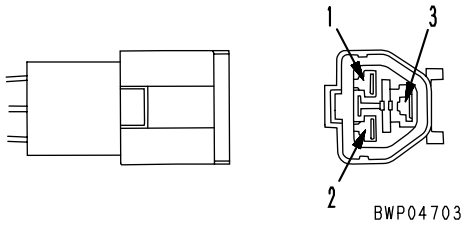
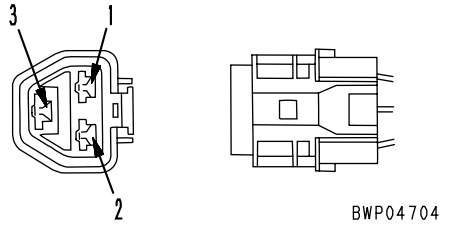
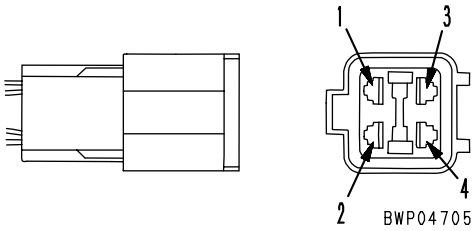
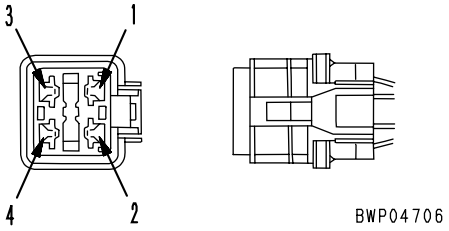


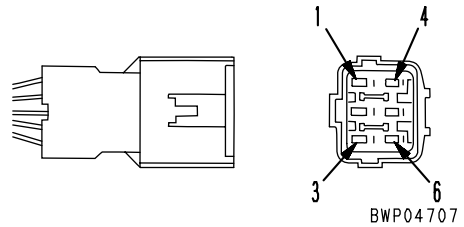
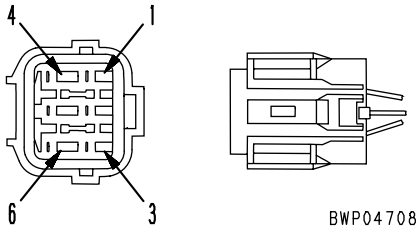
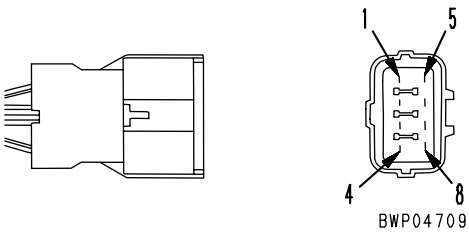
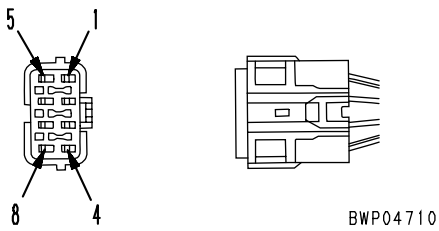
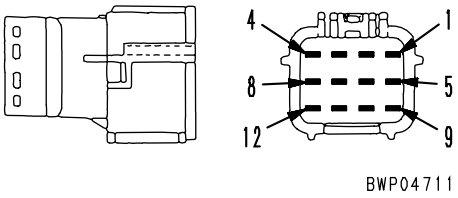
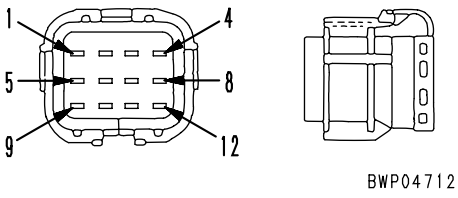
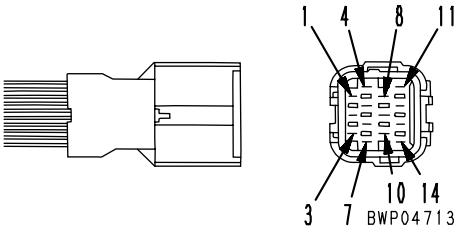
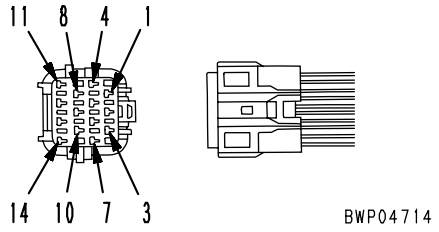
Work Equipment

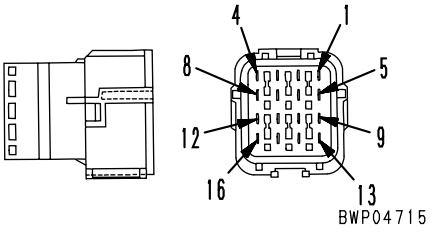
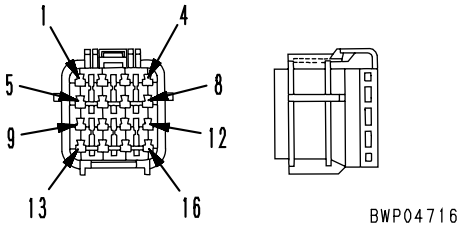


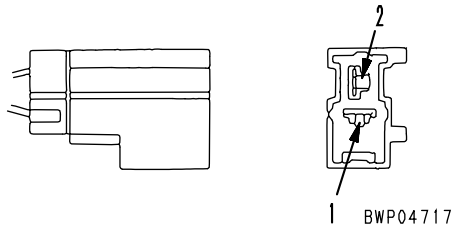
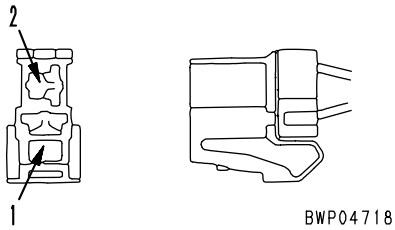
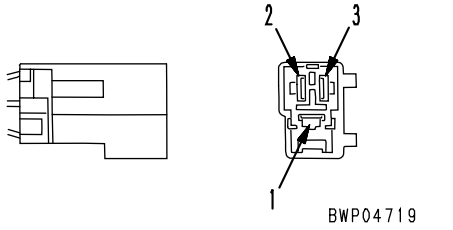
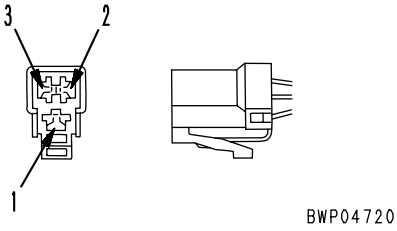
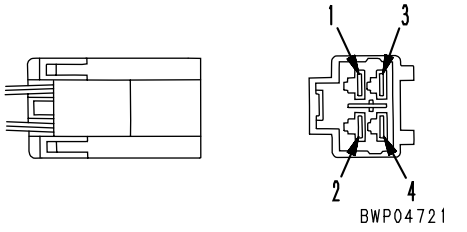
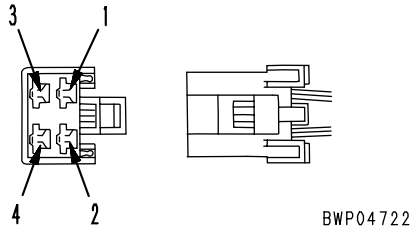
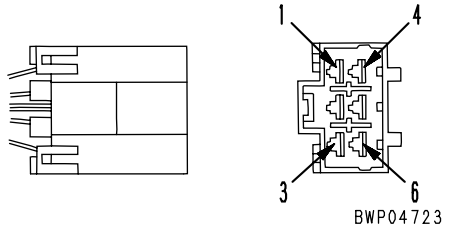
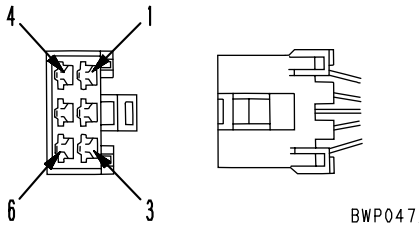
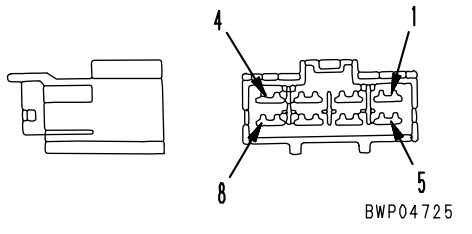
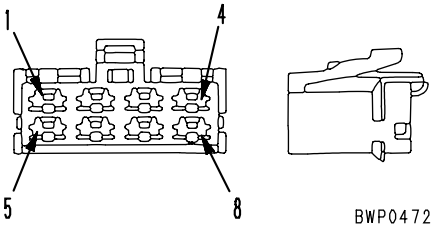
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

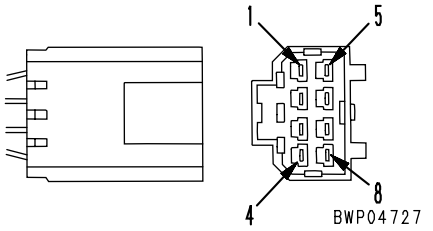
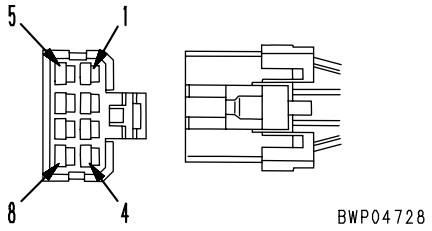
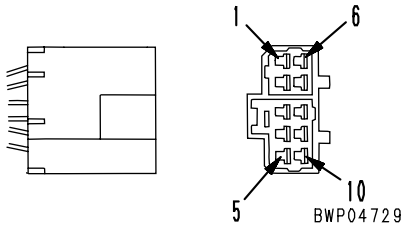
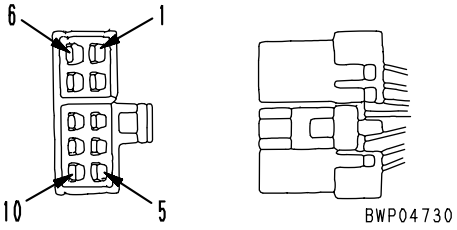
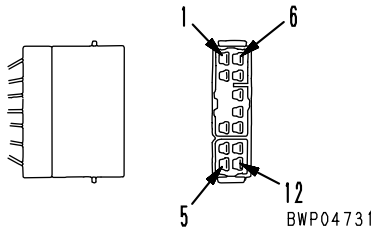
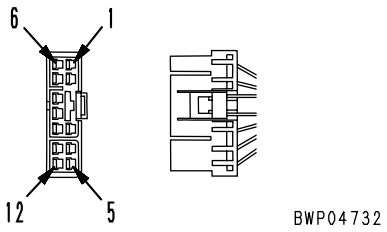
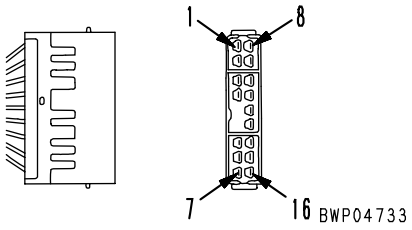
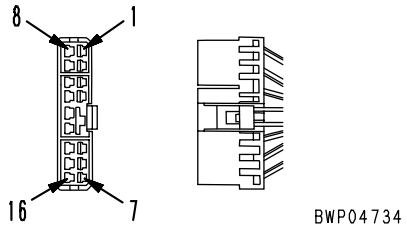
★ The terms male and female refer to the pins, while the terms male housing and female housing refer to the mating portion of the housing.

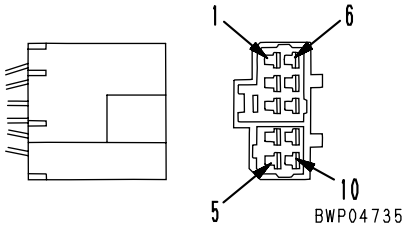
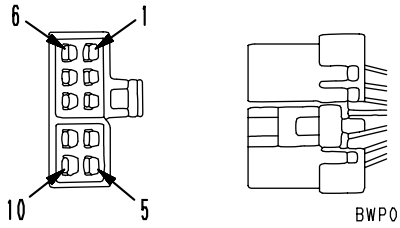
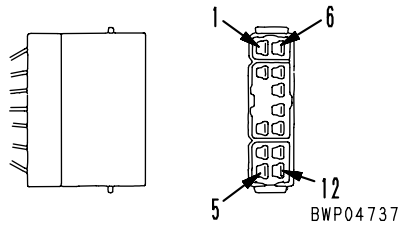
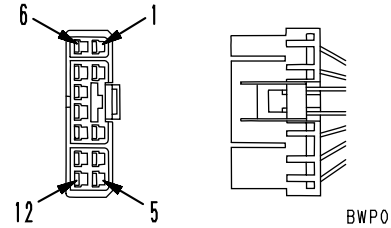
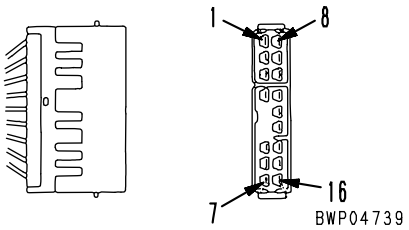
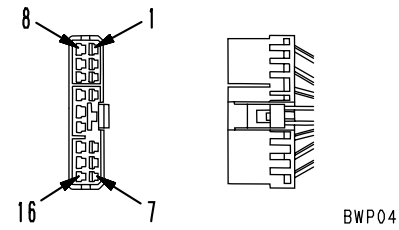
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<tr><td rowspan="2">No.of pins</td><td colspan="2">X type connector</td><td rowspan="2">T-adapter Part No.</td></tr>
<tr><td>Male (female housing)</td><td>Female (male housing)</td></tr>
<tr><td>1</td><td>Part No.: 08055-00181</td><td>Part No.: 08055-00191</td><td>799-601-7010</td></tr>
<tr><td rowspan="2">2</td><td> 
</td><td> 
</td><td rowspan="2">799-601-7020</td></tr>
<tr><td>Part No.: 08055-00282</td><td>Part No.: 08055-00292</td></tr>
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</td><td rowspan="2">799-601-7030</td></tr>
<tr><td>Part No.: 08055-00381</td><td>Part No.: 08055-00391</td></tr>
<tr><td rowspan="2">4</td><td> 
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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
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• Grommet: Red
• Q’ty: 20</td><td>—</td></tr>
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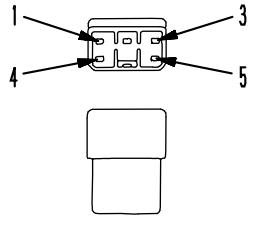
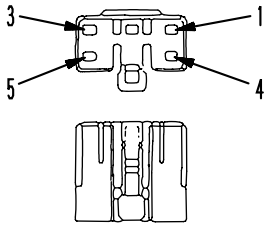
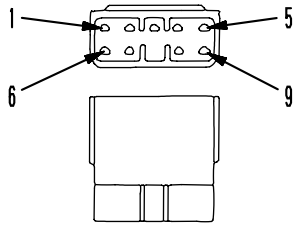
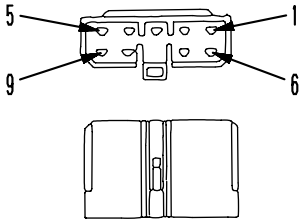
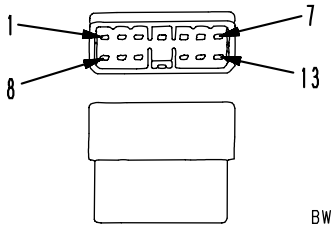
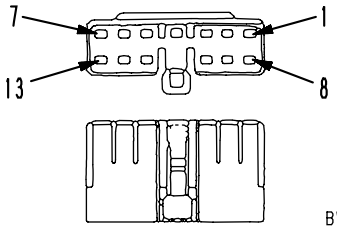
No.of pins	SWP type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
6			799-601-7050
	Part No.: 08055-10681	Part No.: 08055-10691	
8			799-601-7060
	Part No.: 08055-10881	Part No.: 08055-10891	
12			799-601-7310
	Part No.: 08055-11281	Part No.: 08055-11291	
14			799-601-7070
	Part No.: 08055-11481	Part No.: 08055-11491	

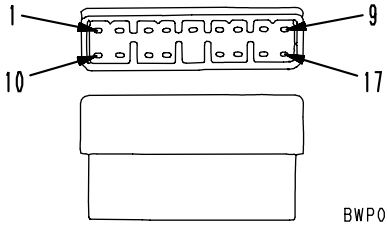
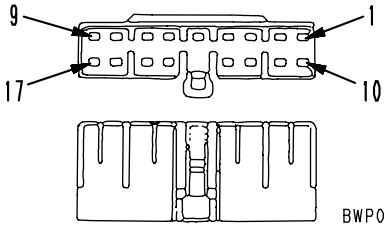
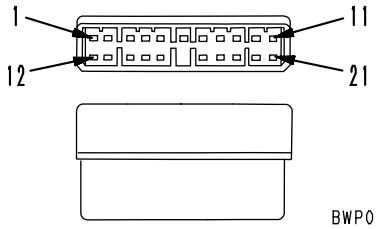
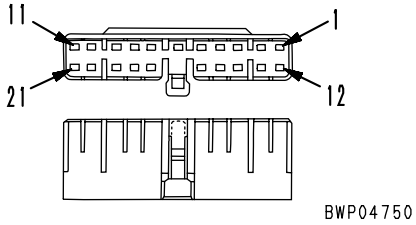
No. of pins	SWP type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
16			799-601-7320
	Part No.: 08055-11681	Part No.: 08055-11691	
—	Terminal part No.: • Electric wire size: 0.85 • Grommet: Black • Q'ty: 20	Terminal part No.: • Electric wire size: 0.85 • Grommet: Black •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

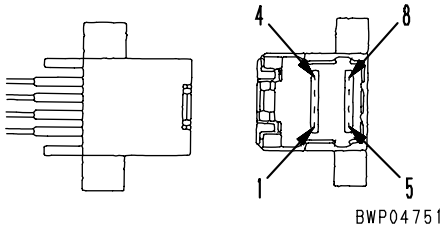
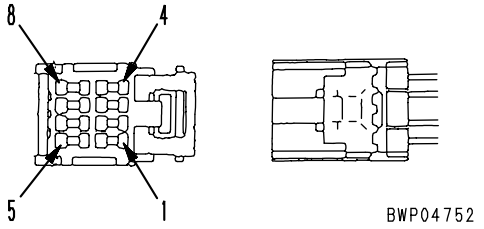
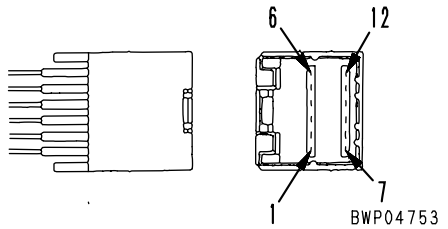
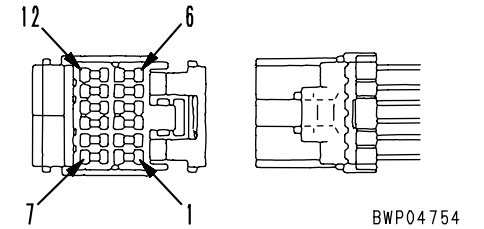
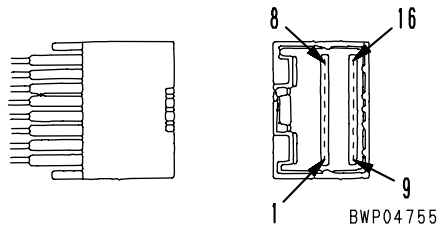
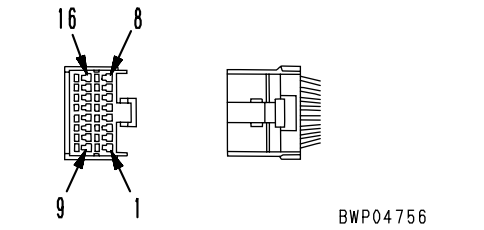
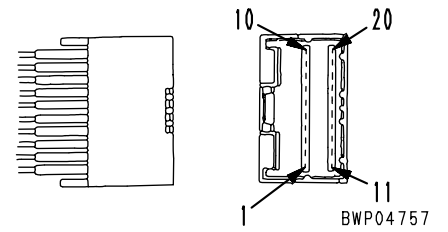
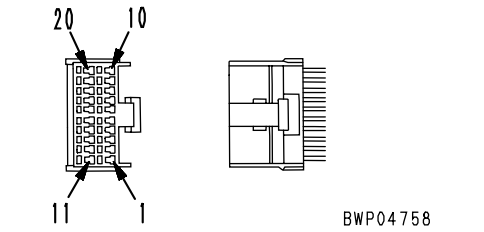
No.of pins	M type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
1	Part No.: 08056-00171	Part No.: 08056-00181	799-601-7080
2			799-601-7090
	Part No.: 08056-00271	Part No.: 08056-00281	
3			799-601-7110
	Part No.: 08056-00371	Part No.: 08056-00381	
4			799-601-7120
	Part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

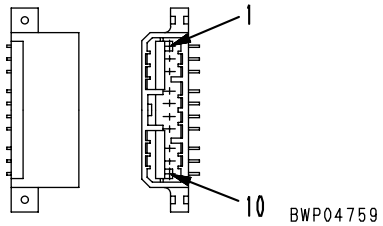
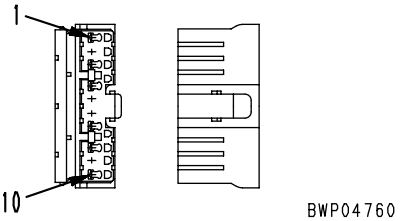
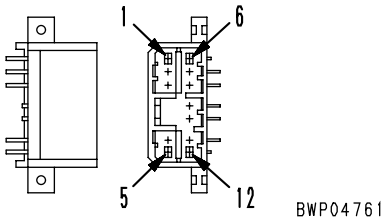
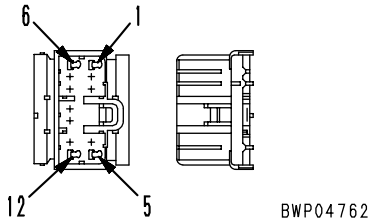
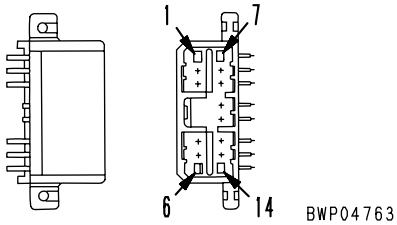
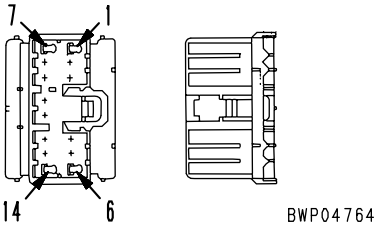
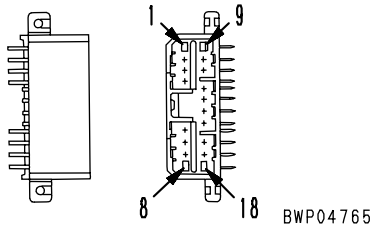
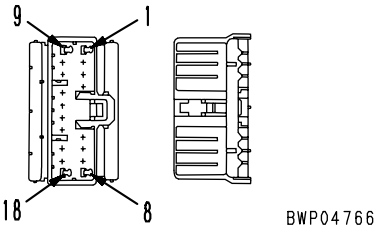
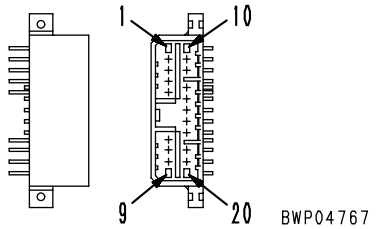
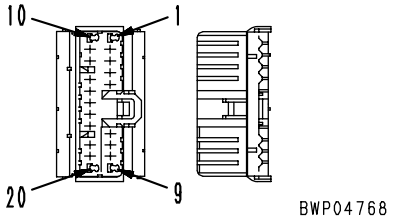
No.of pins	S type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10 (Blue)			—
	—	—	
12 (Blue)			799-601-7160
	Part No.: 08056-11272	Part No.: 08056-11282	
16 (Blue)			799-601-7170
	Part No.: 08056-11672	Part No.: 08056-11682	

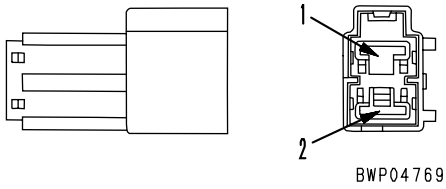
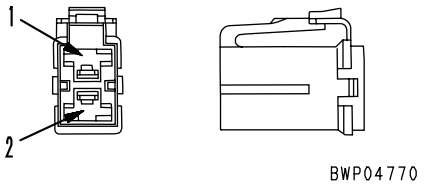
No.of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
7	Body part No.: 79A-222-2640 (Q'ty: 5)	Body part No.: 79A-222-2630 (Q'ty: 5)	—
11	Body part No.: 79A-222-2680 (Q'ty: 5)	Body part No.: 79A-222-2670 (Q'ty: 5)	—
5	 BWP04741	 BWP04742	799-601-2710
	Body part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

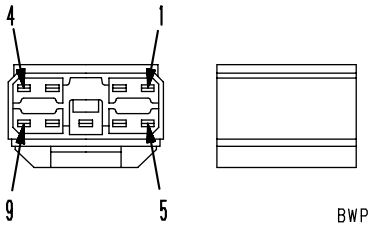
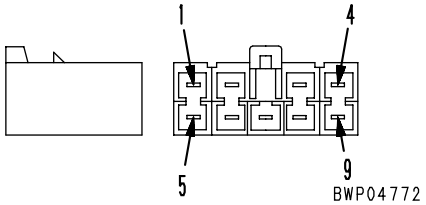
No.of pins	MIC type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
17			799-601-2730
	Body part No.: 79A-222-2730 (Q'ty: 2)	Body part No.: 79A-222-2720 (Q'ty: 2)	
21			799-601-2740
	Body part No.: 79A-222-2750 (Q'ty: 2)	Body part No.: 79A-222-2740 (Q'ty: 2)	
	Terminal part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

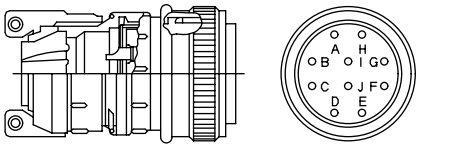
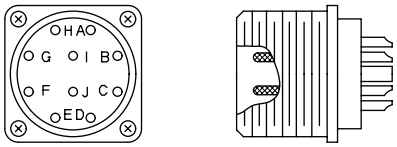
No.of pins	AMP040 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8			799-601-7180
	—	Housing part No.: 79A-222-3430 (Q'ty: 5)	
12			799-601-7190
	—	Housing part No.: 79A-222-3440 (Q'ty: 5)	
16			799-601-7210
	—	Housing part No.: 79A-222-3450 (Q'ty: 5)	
20			799-601-7220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

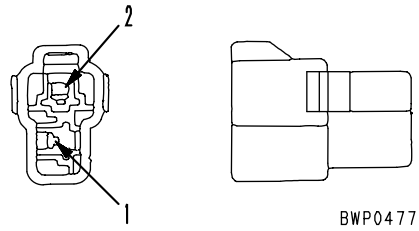
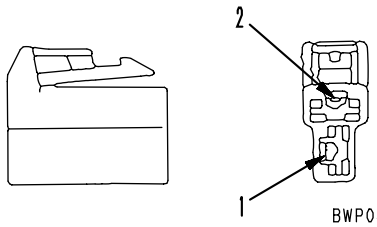
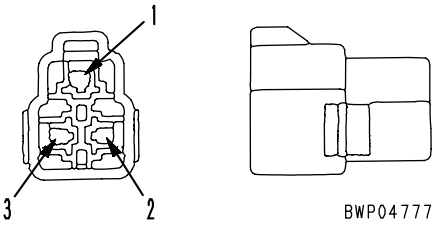
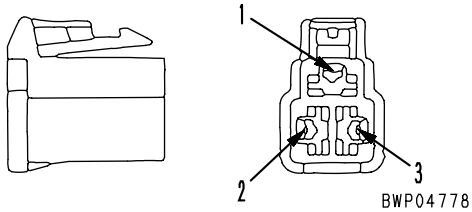
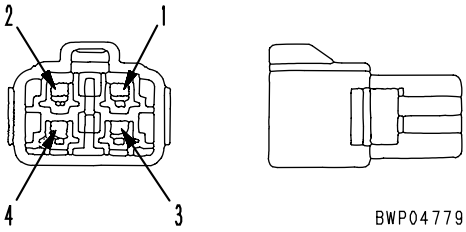
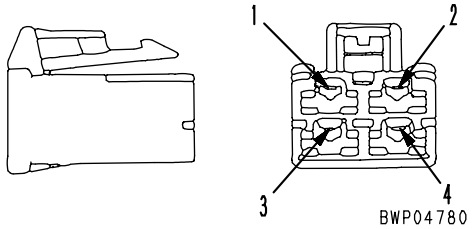
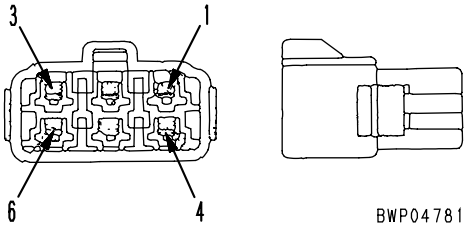
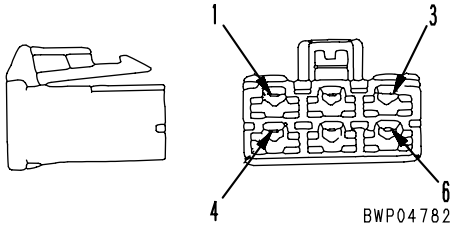
★ Terminal part No.: 79A-222-3470 (No relation with number of pins)

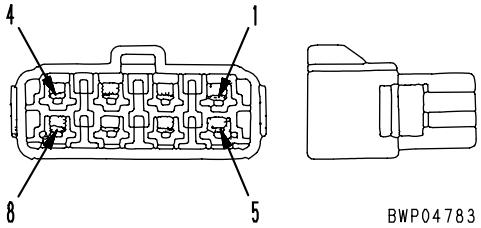
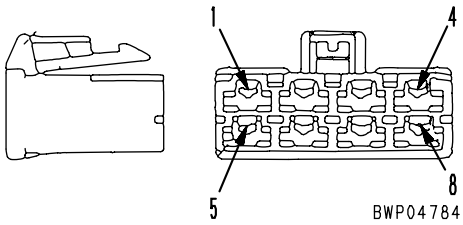
No.of pins	AMP070 type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
10			799-601-7510
	—	Part No.: 08195-10210	
12			799-601-7520
	—	Part No.: 08195-12210	
14			799-601-7530
	—	Part No.: 08195-14210	
18			799-601-7540
	—	Part No.: 08195-18210	
20			799-601-7550
	—	Part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

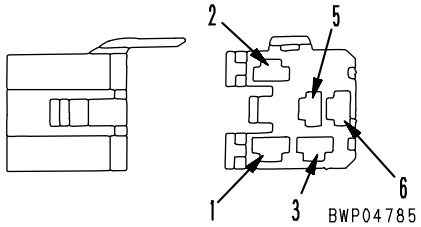
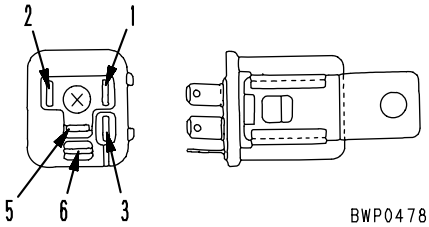
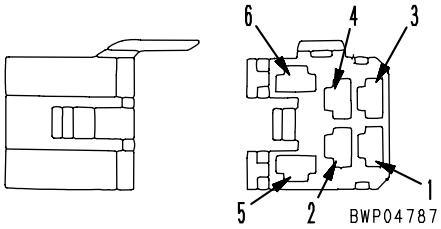
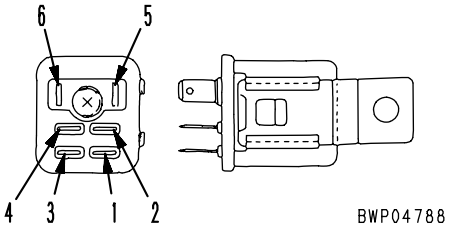
No.of pins	L type connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2	 BWP04769	 BWP04770	—
	—	—	

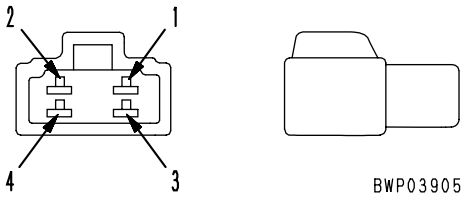
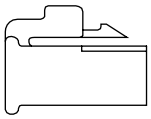
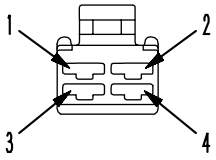
No.of pins	Connector for PA		
	Male (female housing)	Female (male housing)	T-adapter Part No.
9	 BWP04771	 BWP04772	—
	—	—	

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

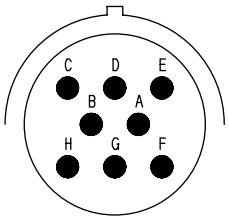
No.of pins	KES 1 (Automobile) connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
2			—
	Part No.: 08027-10210 (Natural color) 08027-10220 (Black)	Part No.: 08027-10260 (Natural color) 08027-10270 (Black)	
3			—
	Part No.:08027-10310	Part No.:08027-10360	
4			—
	Part No.: 08027-10410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

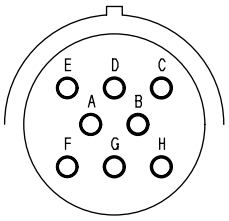
No.of pins	KES 1 (Automobile) connector		
	Male (female housing)	Female (male housing)	T-adapter Part No.
8			—
	Part No.: 08027-10810 (Natural color) 08027-10820 (Black)	Part No.: 08027-10860 (Natural color) 08027-10870 (Black)	

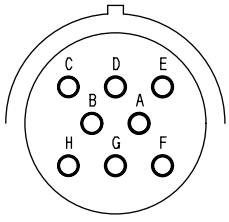
No.of pins	Connector for relay (Socket type)		
	Male (female housing)	Female (male housing)	T-adapter Part No.
5			799-601-7360
	—	—	
6			799-601-7370
	—	—	

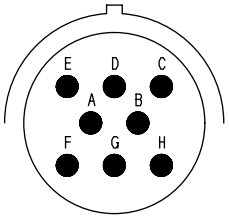
No.of pins	F type connector			
	Male (female housing)		Female (male housing)	T-adapter Part No.
4	 BWP03905		  BWP03906	—
	—		—	

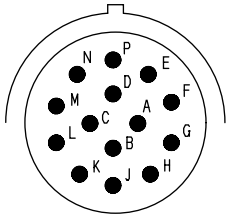
[The pin No. is also marked on the connector (electric wire insertion end)]

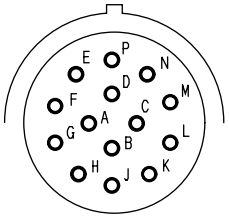
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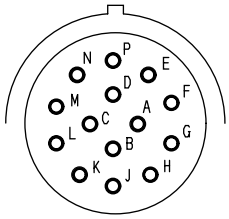
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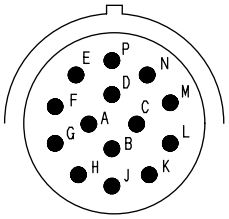
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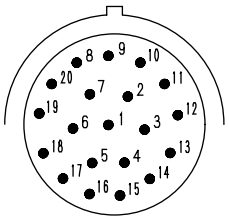
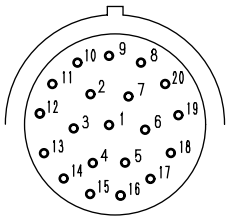
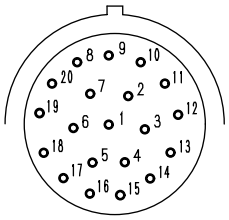
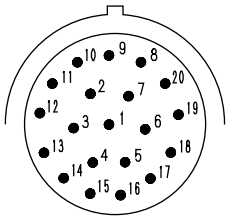
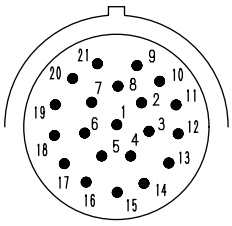
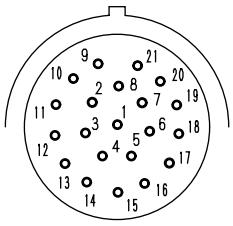
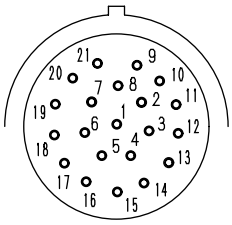
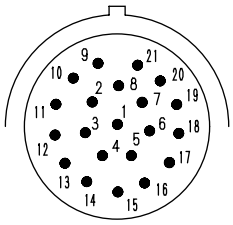
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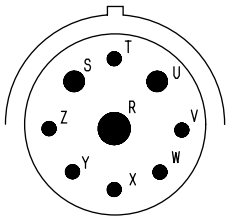
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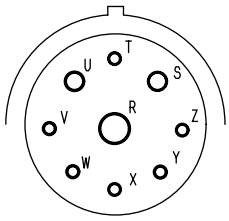
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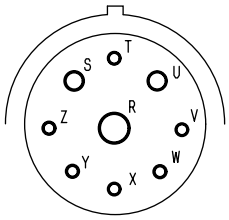
[The pin No. is also marked on the connector (electric wire insertion end)]

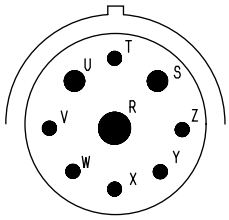
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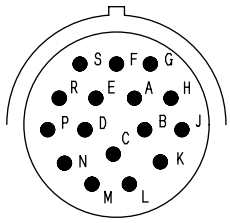
[The pin No. is also marked on the connector (electric wire insertion end)]

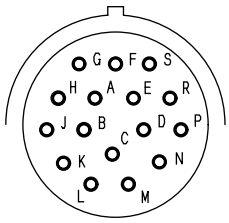
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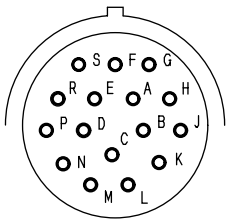
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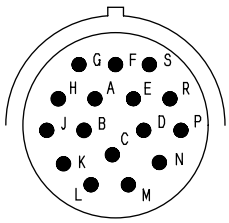
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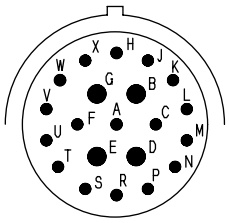
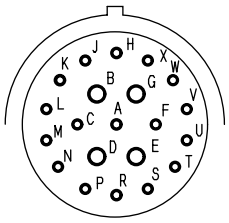
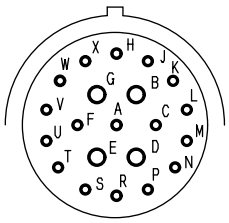
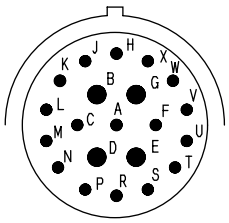
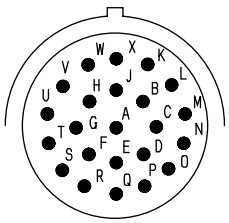
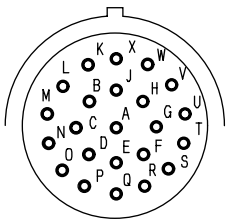
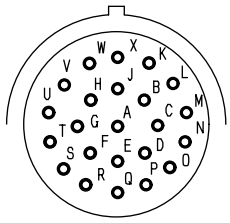
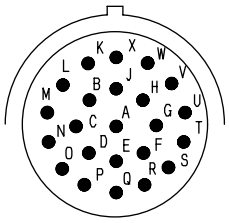
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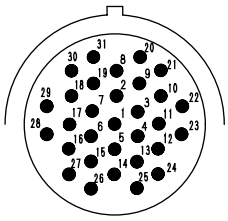
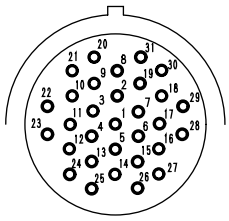
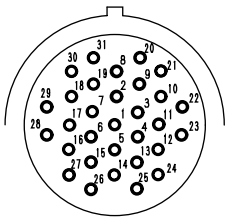
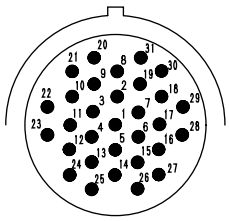
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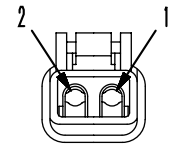
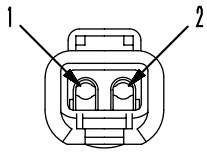
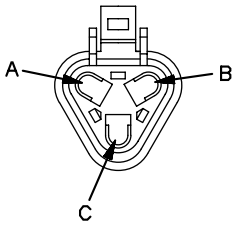
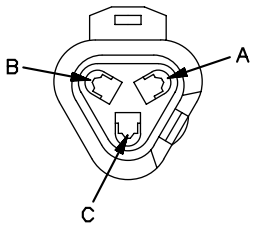
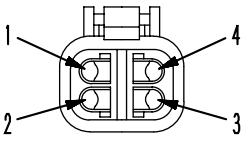
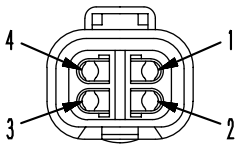
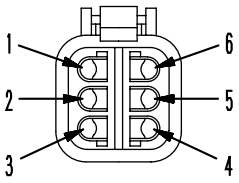
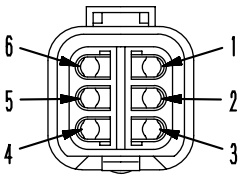
[The pin No. is also marked on the connector (electric wire insertion end)]

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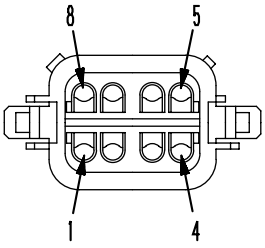
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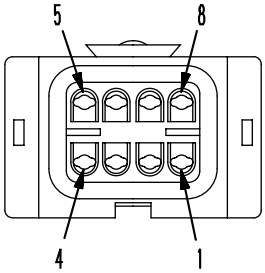
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<tr><td rowspan="2">Type (shell size code)</td><td colspan="3">HD30 Series connector</td></tr>
<tr><td>Body (plug)</td><td>Body (receptacle)</td><td>T-adapter Part No.</td></tr>
<tr><td rowspan="4">24-31 (9)</td><td>Pin (male termial)</td><td>Pin (female terminal)</td><td rowspan="2">799-601-9290</td></tr>
<tr><td> 
BWP05033</td><td> 
BWP05034</td></tr>
<tr><td>Part No.: 08191-91203, 08191-91204, 08191-91205, 08191-91206</td><td>Part No.: 08191-94103, 08191-94104, 08191-94105, 08191-94106</td></tr>
<tr><td>Pin (female terminal)</td><td>Pin (male termial)</td><td rowspan="2">799-601-9290</td></tr>
<tr><td> 
BWP05035</td><td> 
BWP05036</td></tr>
<tr><td>Part No.: 08191-92203, 08191-92204, 08191-92205, 08191-92206</td><td>Part No.: 08191-93103, 08191-93104, 08191-93105, 08191-93106</td></tr>
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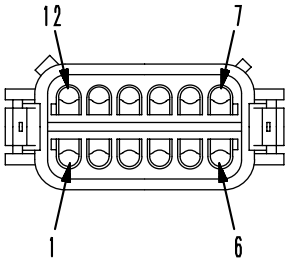
[The pin No. is also marked on the connector (electric wire insertion end)]

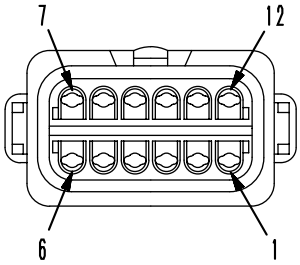
No.of pins	DT Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2	 BWP05037	 BWP05038	799-601-9020
	Part No.: 08192-12200 (normal type) 08192-22200 (fine wire type)	Part No.: 08192-12100 (normal type) 08192-22100 (fine wire type)	
3	 BWP05039	 BWP05040	799-601-9030
	Part No.: 08192-13200 (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)]

<table>
<tr><th rowspan="2">No.of pins</th><th colspan="3">DT Series connector</th></tr>
<tr><th>Body (plug)</th><th>Body (receptacle)</th><th>T-adapter Part No.</th></tr>
<tr><td rowspan="2">8</td><td> 

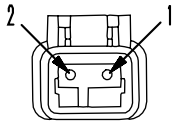
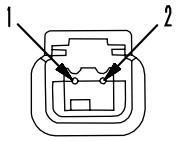
BWP05045</td><td> 

BWP05046</td><td rowspan="2">8GR: 799-601-9060
8B: 799-601-9070
8G: 799-601-9080
8BR: 799-601-9090</td></tr>
<tr><td>Part No.: 08192-1820☐ (normal type)
08192-2820☐ (fine wire type)</td><td>Part No.: 08192-1810☐ (normal type)
08192-2810☐ (fine wire type)</td></tr>
<tr><td rowspan="2">10</td><td> 

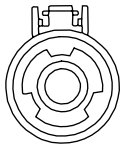
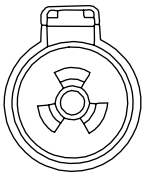
BWP05047</td><td> 

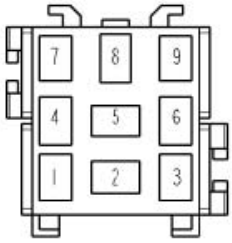
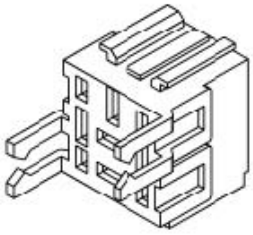
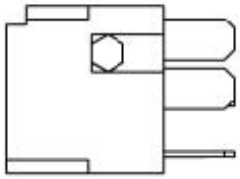
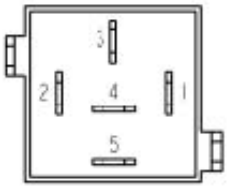
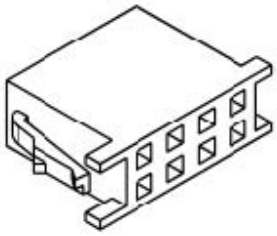
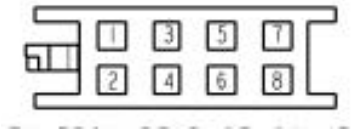
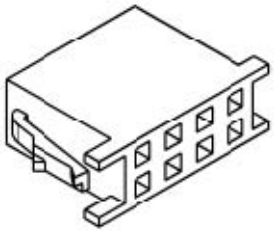
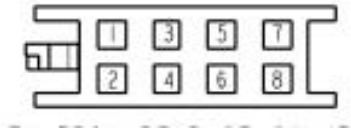
BWP05048</td><td rowspan="2">12GR: 799-601-9110
12B: 799-601-9120
12G: 799-601-9130
12BR: 799-601-9140</td></tr>
<tr><td>Part No.: 08192-1920☐ (normal type)
08192-2920☐ (fine wire type)</td><td>Part No.: 08192-1910☐ (normal type)
08192-2910☐ (fine wire type)</td></tr>
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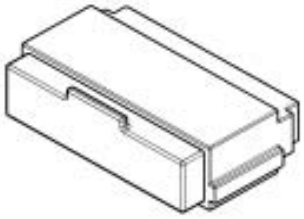
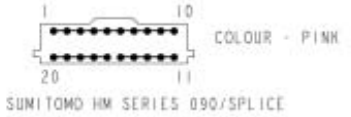
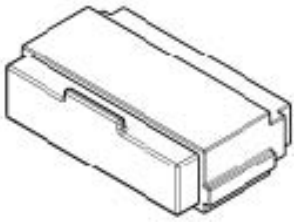
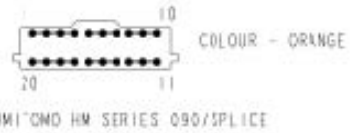
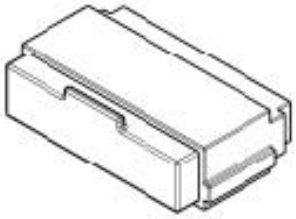
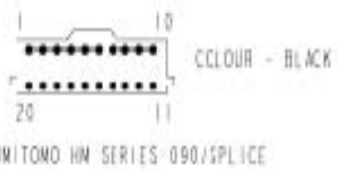
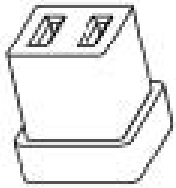
[The pin No. is also marked on the connector (electric wire insertion end)]

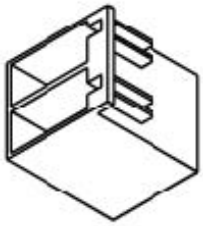
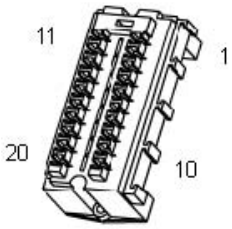
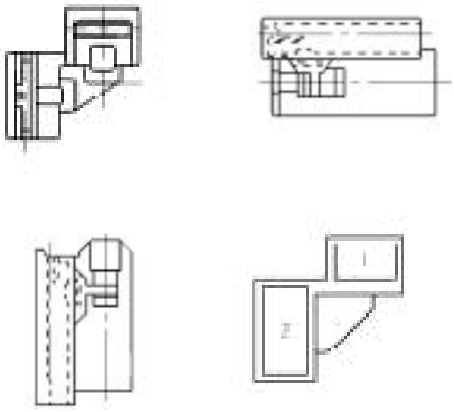
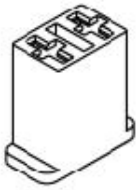
No.of pins	DTM Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2	 BWP05049	 BWP05050	799-601-9010
	Part No.: 08192-02200	Part No.: 08192-02100	

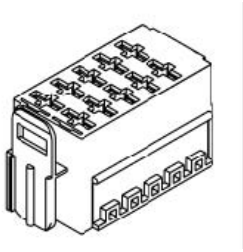
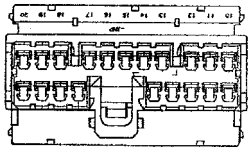
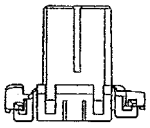
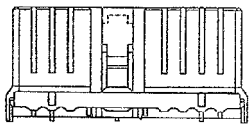
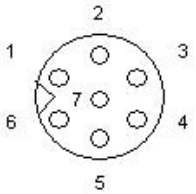
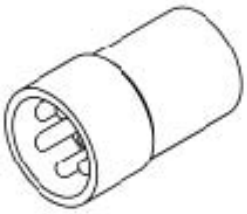
[The pin No. is also marked on the connector (electric wire insertion end)]

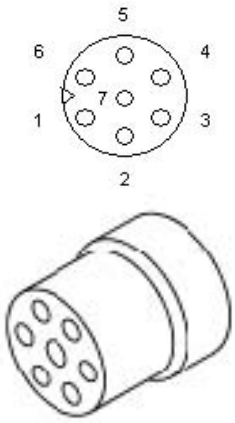
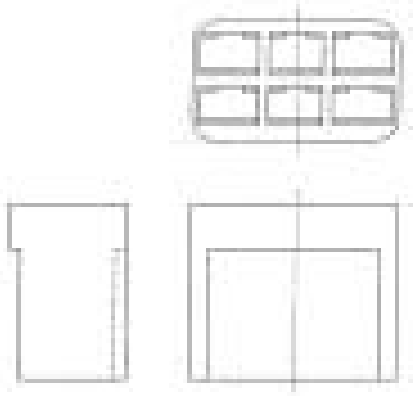
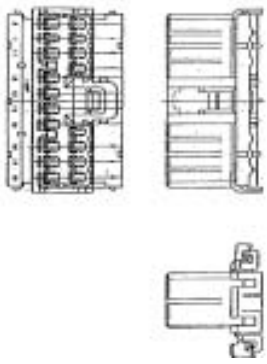
No.of pins	DTHD Series connector		
	Body (plug)	Body (receptacle)	T-adapter Part No.
2	 BWP05051	 BWP05052	—
	Part No.: 08192-31200 (Contact size#12) 08192-41200 (Contact size #8) 08192-51200 (Contact size #4)	Part No.: 08192-31100 (Contact size#12) 08192-41100 (Contact size #8) 08192-51100 (Contact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

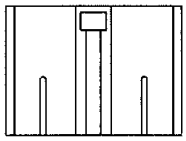
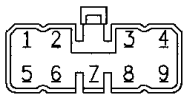
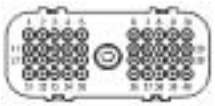
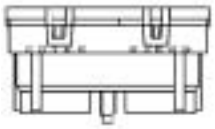
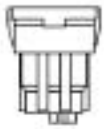
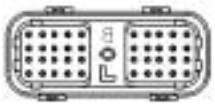
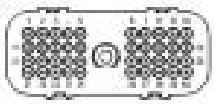
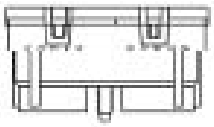
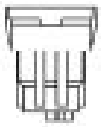
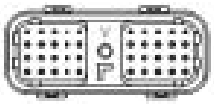
No.of pins	Miscellaneous connectors	
	Body (plug)	Body (receptacle)
9		
	Part No.: 20K-06-31960	Part No.:
5		
	Part No.: 20K-06-32130	Part No.:
8		
	Part No.: 20K-06-32170	Part No.:
8		
	Part No.: 20K-06-K32160	Part No.:

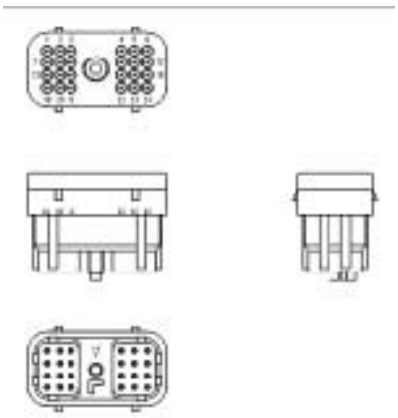
No.of pins	Miscellaneous connectors	
	Body (plug)	Body (receptacle)
20		
	Part No.: 20K-06-31460	Part No.:
20		
	Part No.: 20K-06-31470	Part No.:
20		
	Part No.: 20K-06-31450	Part No.:
2		
	Part No.:	Part No.:

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

	 	
	Part No.: 20Y-06-13590	Part No.:
	   	
	Part No.: 7821-93-3130	Part No.:
	   	
	Part No.: 7821-93-3120	Part No.:

24		
	Part No.: 7821-93-3110	Part No.:
3		
	Part No.:	Part No.:
4		
	Part No.:	Part No.:

TROUBLESHOOTING WHEN SERVICE CODE "ELECTRICAL SYSTEM" AND FAILURE CODE "MECHANICAL SYSTEM" ARE INDICATED

INFORMATION CONTAINED IN TROUBLESHOOTING TABLE 20-303
Service Code in Electrical System **E101** (Abnormal data in error history) 20-306
Service Code in Electrical System **E132** (Disconnection of S-NET signal) 20-308
Service Code in Electrical System **E201** (Short-circuiting in travel neutral solenoid) 20-310
Service Code in Electrical System **E202** (Short-circuiting in travel F/R solenoid) 20-312
Service Code in Electrical System **E204** (Short-circuiting in merge/divide solenoid) 20-314
Service Code in Electrical System **E205** (Short-circuiting in 2-stage relief solenoid) 20-314
Service Code in Electrical System **E206** (Short-circuiting in transmission clutch solenoid) 20-316
Service Code in Electrical System **E207** (Short-circuiting in creep solenoid) 20-318
Service Code in Electrical System **E208** (Disconnection of creep solenoid) 20-320
Service Code in Electrical System **E211** (Disconnection in travel neutral solenoid) 20-322
Service Code in Electrical System **E212** (Disconnection of travel F/R solenoid) 20-324
Service Code in Electrical System **E213** (Disconnection in swing parking brake solenoid) 20-326
Service Code in Electrical System **E214** (Disconnection of merge/divide solenoid) 20-328
Service Code in Electrical System **E215** (Disconnection in 2-stage relief solenoid) 20-328
Service Code in Electrical System **E216** (Disconnection in transmission clutch solenoid) 20-330
Service Code in Electrical System **E217** (Abnormality in inputting model code) 20-332
Service Code in Electrical System **E218** (Disconnection of S-NET signal) 20-334
Service Code in Electrical System **E222** (Short-circuiting in LS-EPC solenoid) 20-336
Service Code in Electrical System **E223** (Disconnection in LS-EPC solenoid system) 20-339
Service Code in Electrical System **E224** (Abnormality in F pump pressure sensor) 20-340
Service Code in Electrical System **E225** (Abnormality in R pump pressure sensor) 20-342
Service Code in Electrical System **E226** (Abnormality in pressure sensor power source) 20-342
Service Code in Electrical System **E227** (Abnormality in engine rotation sensor in governor • pump controller system) 20-344
Service Code in Electrical System **E232** (Short-circuiting in PC-EPC solenoid 20-346
Service Code in Electrical System **E233** (Disconnection in PC-EPC solenoid system) 20-348
Service Code in Electrical System **E236** (Short-circuiting 2 stage back pressure valve) 20-351
Service Code in Electrical System **E237** (Disconnection 2 stage back pressure valve) 20-352
Service Code in Electrical Equipment **E245** (Short-circuiting in attachment oil flow rate adjusting EPC) . 20-354
Service Code in Electrical System **E246** (Disconnection in attachment oil flow rate adjusting EPC) 20-355
Service Code in Electrical System **E247** (Abnormality in travel PPC switch 20-356
Service Code in Electrical System **E251** (Abnormality in overload caution sensor) 20-358
Service Code in Electrical System **E252** (Abnormality in PPC sensor) 20-360
Service Code in Electrical System **E254** (Disconnection in engine rotation sensor) 20-362
Service Code in Electrical System **E256** (Incorrect non-volatile memory data) 20-364
Service Code in Electrical System **E306** (Abnormality in governor potentiometer) 20-366
Service Code in Electrical System **E308** (Abnormality in fuel dial) 20-368
Service Code in Electrical System **E315** (Short-circuiting in battery relay) 20-370
Service Code in Electrical System **E316** (Step-out in governor motor) 20-372
Service Code in Electrical System **E317** (Disconnection in governor motor phase A and B) 20-374

Service Code in Electrical System E318 (Short-circuiting in governor motor phase A and B) 20-376
Service Code in Electrical System E501 ("Model Selection" function not provided yet) 20-378
Service Mode in Electrical System E502 (Model selecting signal fault) 20-378
Failure Code in Mechanical System A000N1 (Out-of-rate engine rotation at high idling) 20-378
Failure Code in Mechanical System A000N2 (Out-of-rate engine rotation at low idling) 20-378
Failure Code in Mechanical System AA10N (Air cleaner clogging) 20-379
Failure Code in Mechanical System AB00K (Abnormally lowered charging voltage) 20-380
Failure Code in Mechanical System B@BAZ (Abnormally lowered engine oil pressure) 20-382
Failure Code in Mechanical System B@BAZ (Abnormally lowered engine oil level) 20-383
Failure Code in Mechanical System B@BCN (Engine cooling water overheating) 20-384
Failure Code in Mechanical System B@BCZ (Abnormally lowered radiator water level) 20-385
Failure Code in Mechanical System B@HAN (Hydraulic oil overheating) 20-386

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	Service Code	Failure Code	Failure phenomenon	Title of failure phenomenon shown in failure history
Display in monitor panel	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.

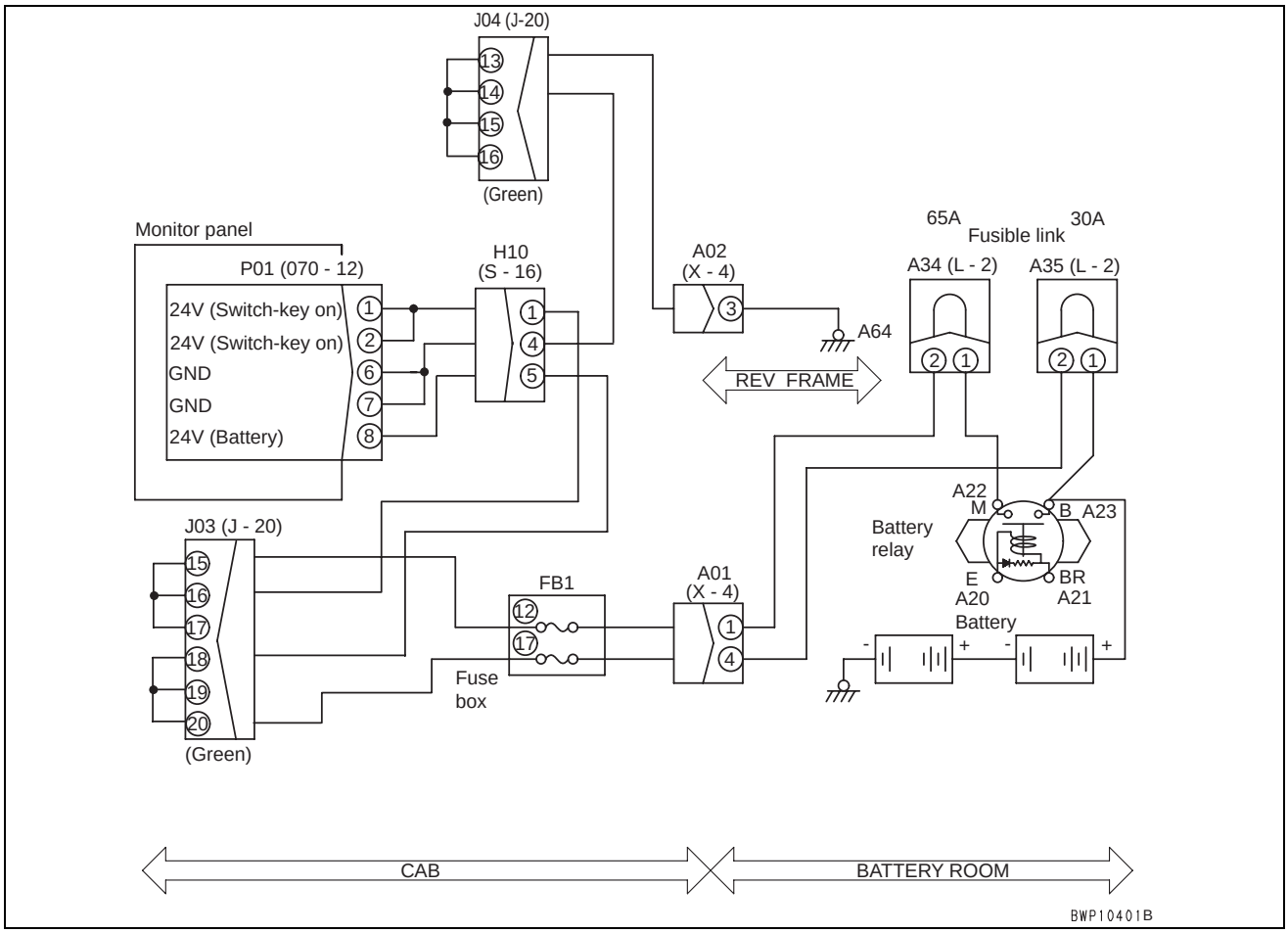
- Connector No.: Indicates (Type - numbers of a pin) (colour)
- Arrow: Roughly indicates the location in the machine where it is installed.

Service Code in Electrical System E101 (Abnormal data in Error History)

User Code	Service Code	Failure Code	Failure phenomenon	Abnormal data in the error history (in Monitor Panel system)
—	**E101**	**DAF0KT**		
Failure content	➢ The voltage in the firm power source circuit for Monitor Panel (battery) has dropped below 12 V or exceeded 36 V.			
Response from Monitor Panel	➢ None in particular			
Phenomenon occurring on machine	➢ A display for information on the failure history (in the electrical system) cannot be called.			

	Cause		Standard value in normal and references for troubleshooting		
Presumed cause and standard value in normal	1	Fuse No. 12 and/or 17 defective	If the fuse is blown, there is a big possibility that the circuit has a grounding fault.		
	2	Fusible link No. A34 and/or A35 defective	If the fusible link is blown, there is a big possibility that the circuit has a grounding fault.		
	3	Disconnection of wiring harness (Disconnection or connector contact fault)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position for the troubleshooting.		
			Wiring harness from P01 (female) ⑧ to FB1-17 outlet	Resistance value	Above 1 Ω
			Wiring harness between FB1-17 inlet and A35 (male) ②	Resistance value	Above 1 Ω
			Wiring harness between A35 (male) ① and A23 (B terminal)	Resistance value	Above 1 Ω
	4	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 for the troubleshooting.		
			Between wiring harness between P01 (female) ⑧ to FB1-17 outlet and grounding	Resistance value	Above 1 MΩ
			Between wiring harness between FB1-17 inlet and A35 (male) ② and grounding	Resistance value	Above 1 MΩ
			Between wiring harness between A35 (male) ① and A23 (B terminal) and grounding	Resistance value	Above 1 MΩ
	5	Monitor Panel defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position for the troubleshooting.		
			P01	Voltage	
			Between ⑧ and ⑥ ⑦	20 – 30 V	

Monitor Panel Power Source Electric Circuit Diagram

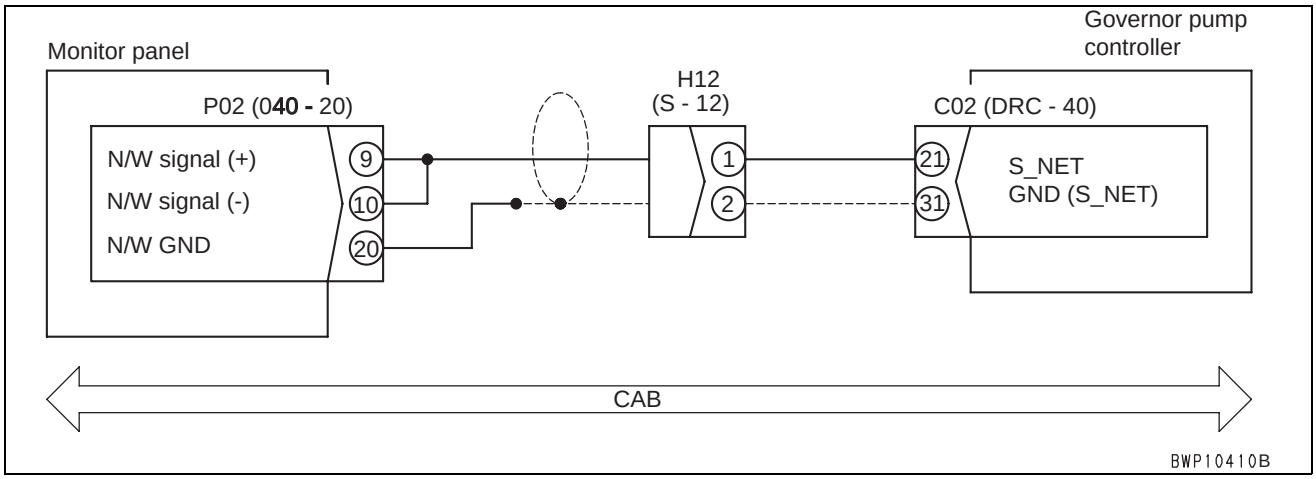


Service Code in Electrical System E132 (Disconnection of S-NET signal)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in S-NET signal (in governor • pump controller system)
E01	**E132**	**DA2SKA**		
Failure content	➢ A failure occurred in S-NET communication between the monitor and controller in the past. (The machine operation returned to normal, when the display was resumed)			
Response from controller	➢ While the failure is still continuing, the machine operation is controlled by the following default setting. 1. Working mode: E mode 2. Travel speed: Lo 3. Auto-deceleration: ON 4. Attachment oil flow rate: Minimum ➢ When the failure cause disappears of itself, the machine operation returns to normal.			
Phenomenon occurring on machine	➢ The working mode cannot be changed. (The display changes normally in the monitor panel) ➢ The travel speed cannot be shifted. (The display changes normally in the monitor panel) ➢ The auto-deceleration cannot be released. (The display changes normally in the monitor panel) ➢ The attachment oil flow rate cannot be changed. (The display changes normally in the monitor panel)			
Relative information	➢ This Service Code No. is displayed to inform that there was a failure occurred in the past, when S-NET communication between the monitor panel and the governor • pump controller is returned to normal. ➢ The communication has already returned to normal by the time this Service Code No. is displayed. But thoroughly diagnose all the related equipment and circuits, and remove all potential causes for a failure in order to prevent recurrence of failures.			

	Cause		Standard value in normal and references for troubleshooting		
Presumed cause and standard value in normal	1	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) ⑨ ⑩ and C02 (female) ㉑	Resistance value	Below 1 Ω
			Wiring harness between P02 (female) ⑳ and C02 (female) ㉛	Resistance value	Below 1 Ω
	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 between P02 (female) ⑨ ⑩ and C01 (female) ㉑ and grounding	Resistance value	Above 1 MΩ
	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 between P02 (female) ⑨ ⑩ and C02 (female) ㉑ and grounding	Voltage	Below 1 V
	4	Monitor panel defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.		
			P02 (male)	Voltage	
			Between ⑨ ⑩ and ⑳	6 – 9 V	
	5	Governor • pump controller defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.		
			C02 (male)	Voltage	
			Between ㉑ and ㉛	6 – 9 V	

Electrical Circuit Diagram for S-NET Communication between Monitor Panel and Governor • Pump Controller

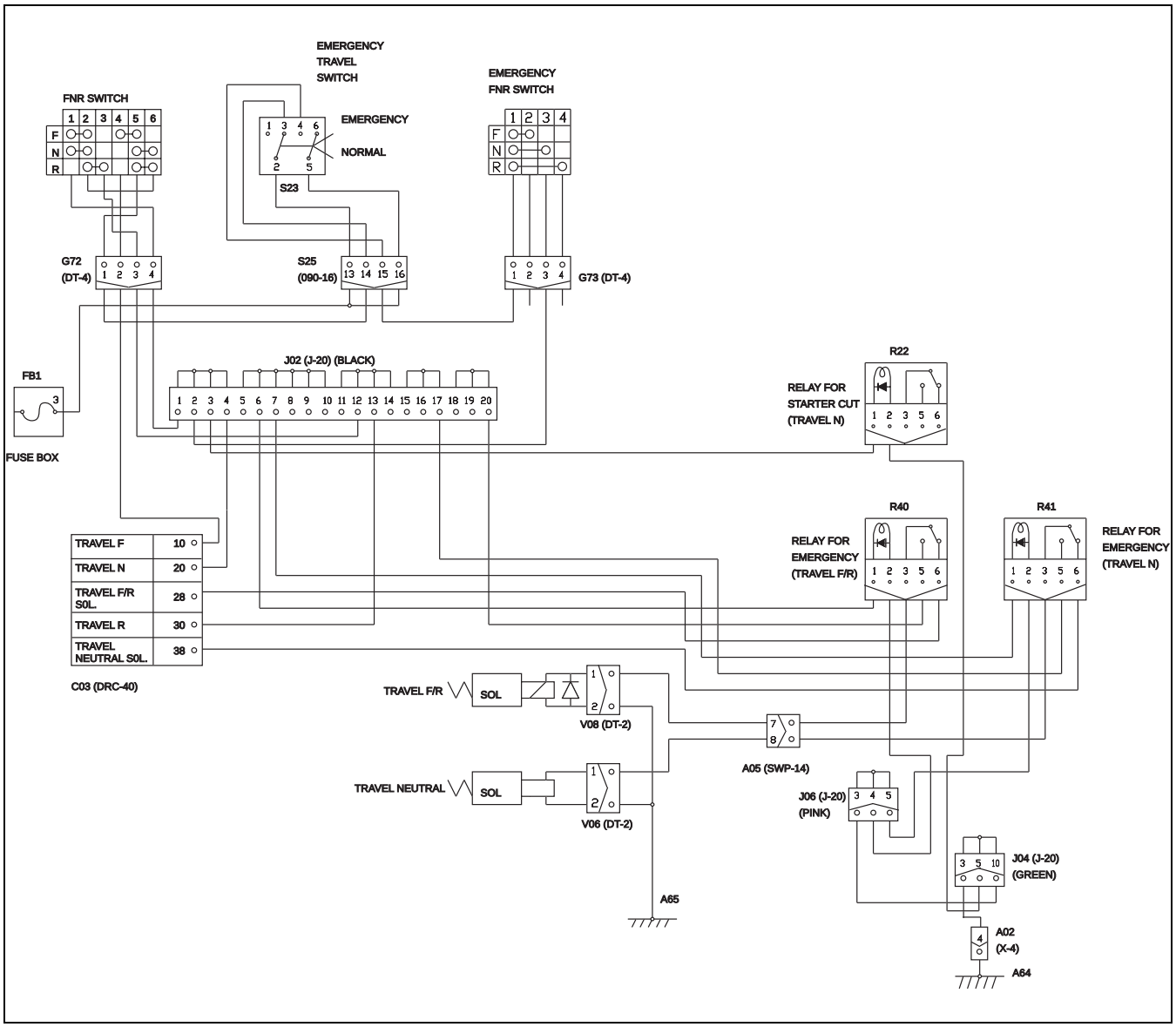


Service Code in Electrical System E201 (Short-circuiting in Travel Neutral Solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Short-circuiting in travel neutral solenoid (in governor • pump controller system)
E20	**E201**	**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. 024: Solenoid 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	Assembled-type relay R41 defective (Internal short-circuiting)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			R41 (male)	Resistance value		
			Between ① and ②	Above 400 MΩ		
	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 from C03 (female) ㊳ to R41 (female) ⑥ and grounding.	Resistance value	Above 1 MΩ	
			Between wiring harness from R41 (female) ③ to A05 to V06 (female) ① and grounding.			

Electrical Circuit for Travel Neutral Solenoid in Governor Pump Controller

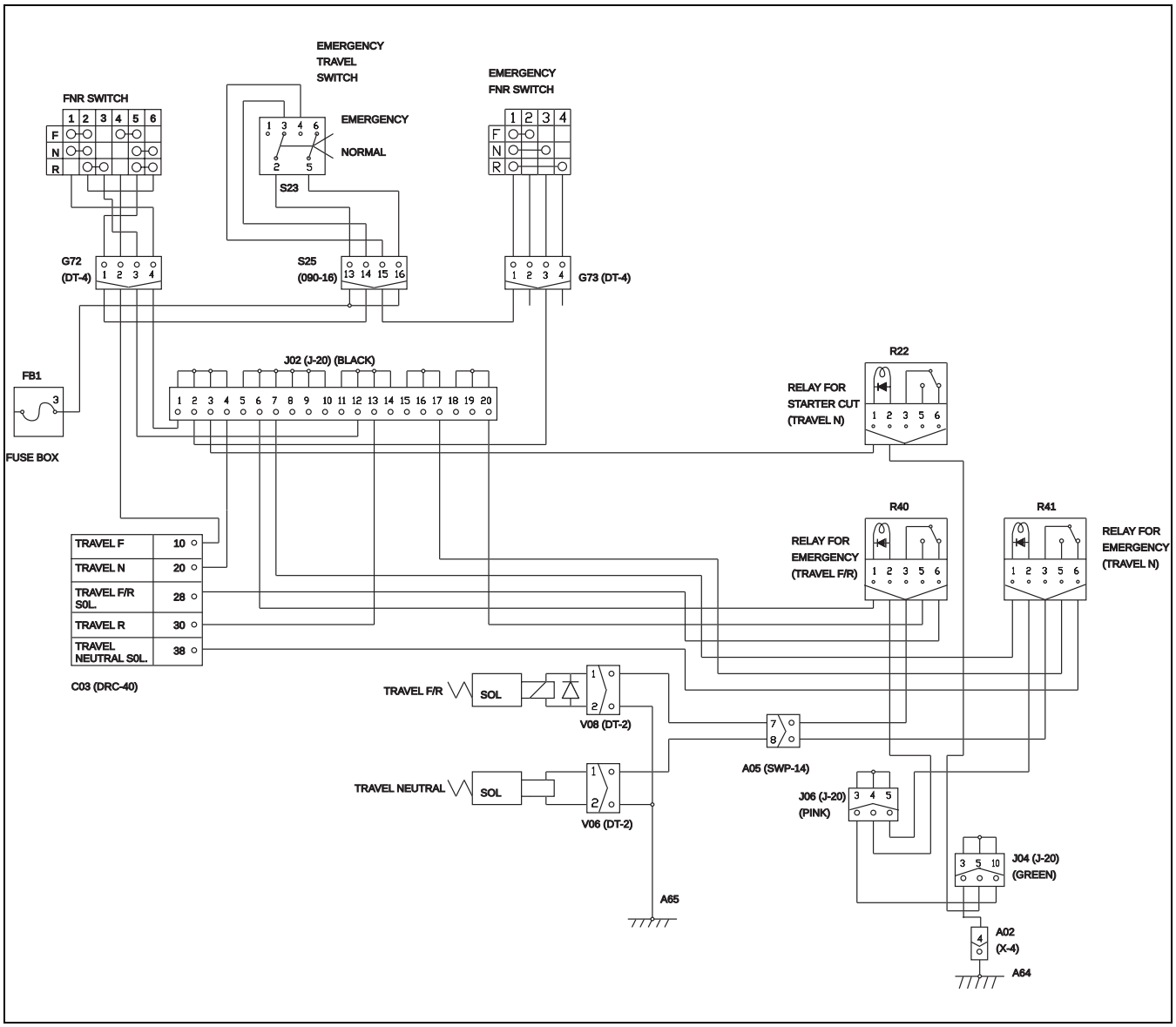


Service Code in Electrical System E202 (Short-circuiting of Travel F/R solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Short-circuiting in travel F/R solenoid (in governor • pump controller system)
E20	**E202**	**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. 024: Solenoid 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	Assembled-type relay R40 defective (Internal short-circuiting)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			R40 (male)	Resistance value		
			Between ① and ②	Above 400 MΩ		
	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 from C03 (female) ㉘ to R40 (female) ⑥ and grounding	Resistance value	Above 1 MΩ	
			Between wiring harness from R40 (female) ③ to A05 to V08 (female) ① and grounding.			

Electrical Circuit for Travel F/R Solenoid in Governor Pump Controller

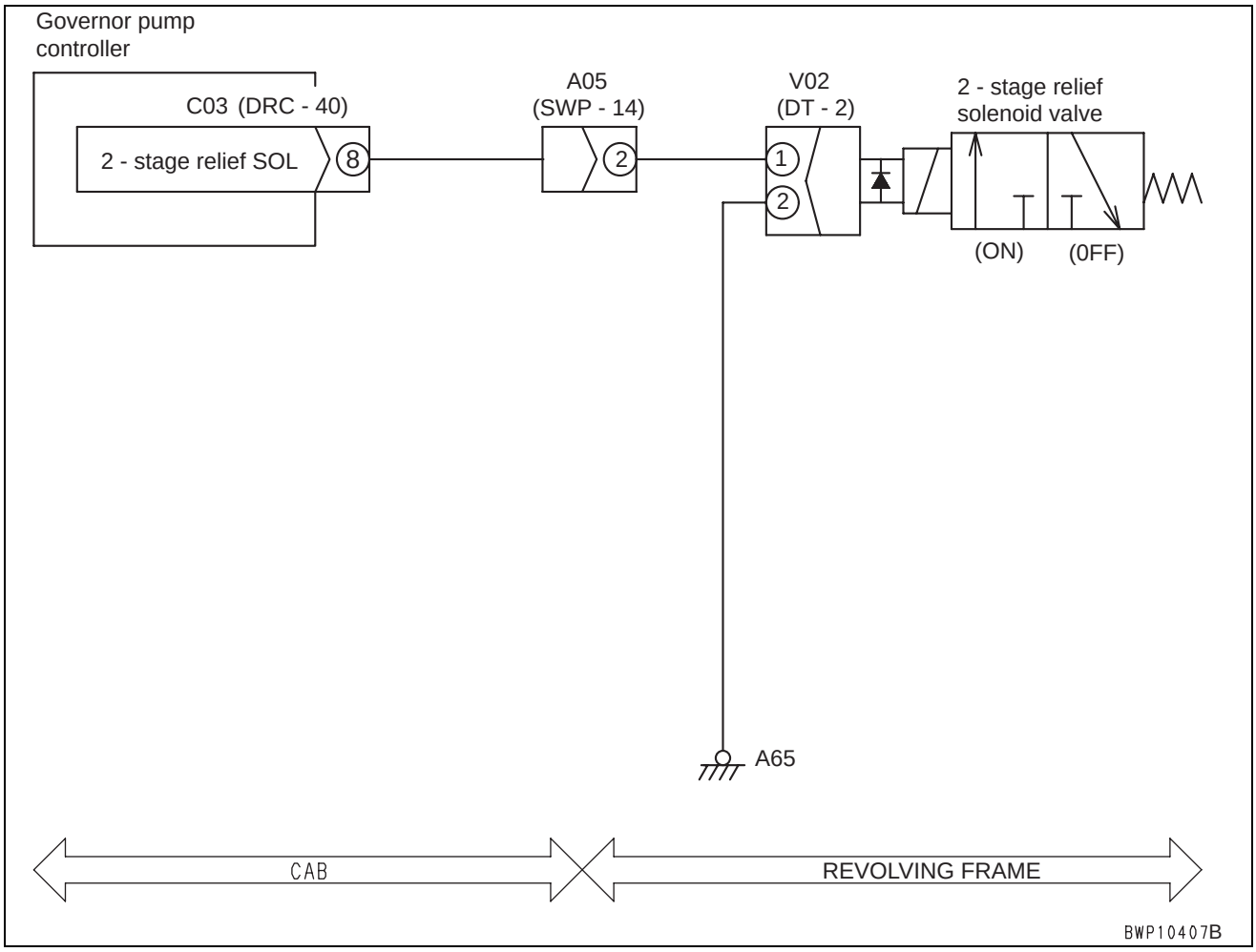


Service Code in Electrical System E205 (Short-circuiting in 2-Stage Relief Solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Short-circuiting in 2-stage relief solenoid (in governor • pump controller system)
—	**E205**	**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. 023: Solenoid 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	Governor • 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 Governor • Pump Controller

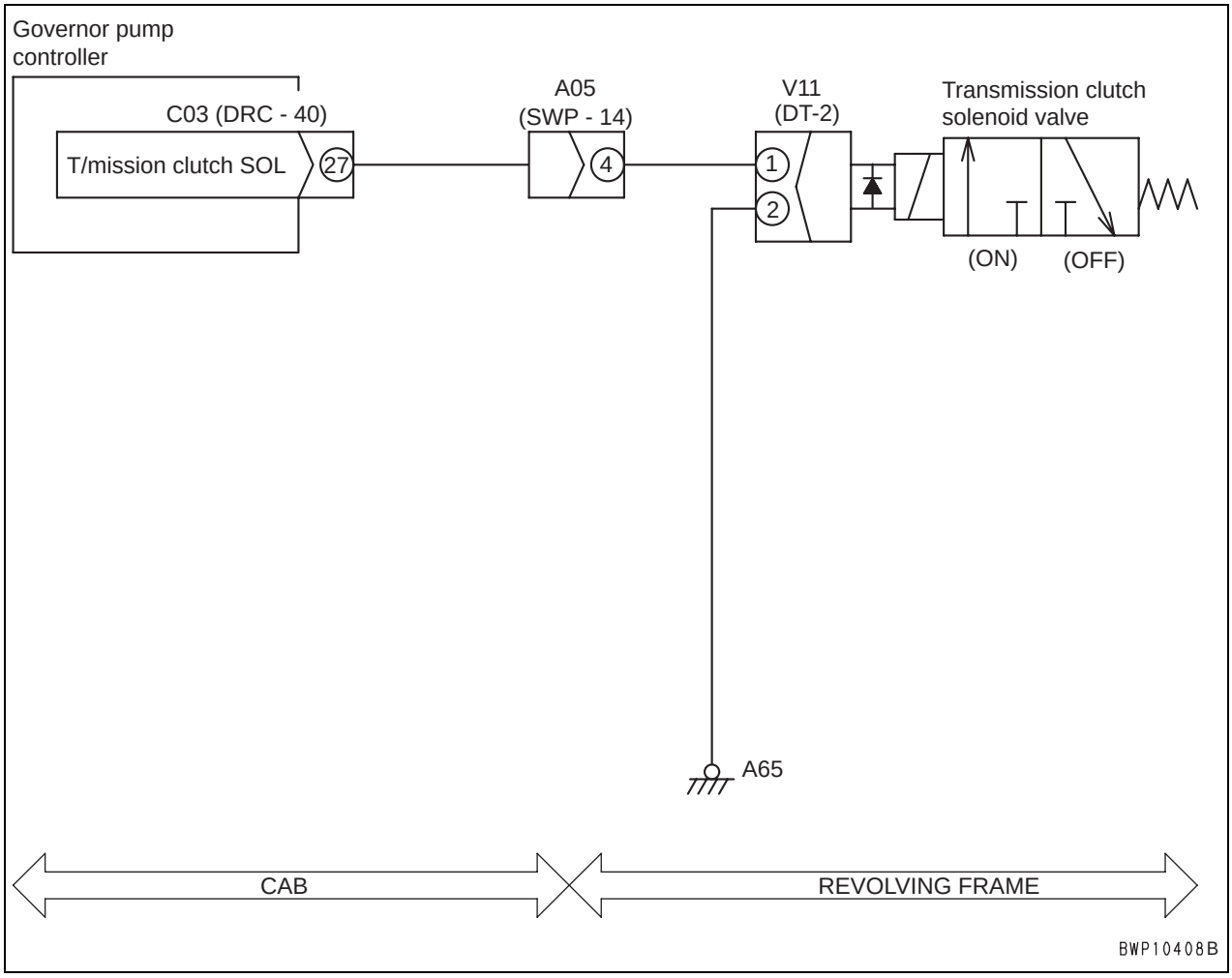


Service Code in Electrical System E206 (Short-circuiting in Transmission Clutch solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in transmission clutch solenoid (in governor • pump controller system)
E20	**E206**	**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. 023: Solenoid 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	Governor • 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

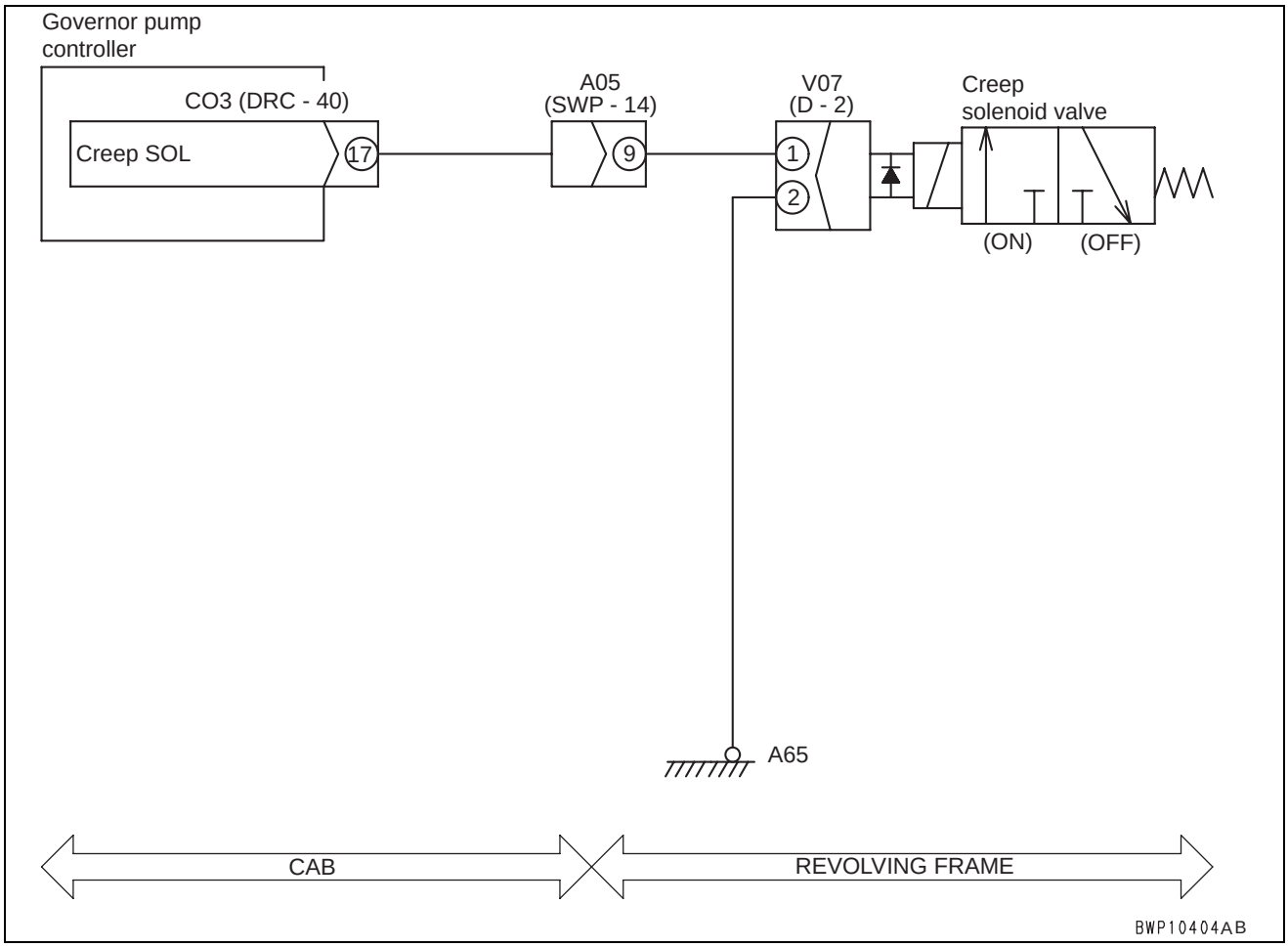


Service Code in Electrical System E207 (Short-circuiting in Creep solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Short-circuit in creep solenoid (in governor • pump controller system)
E20	**E207**	**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. 023: Solenoid 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	Governor • 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 Governor Pump Controller

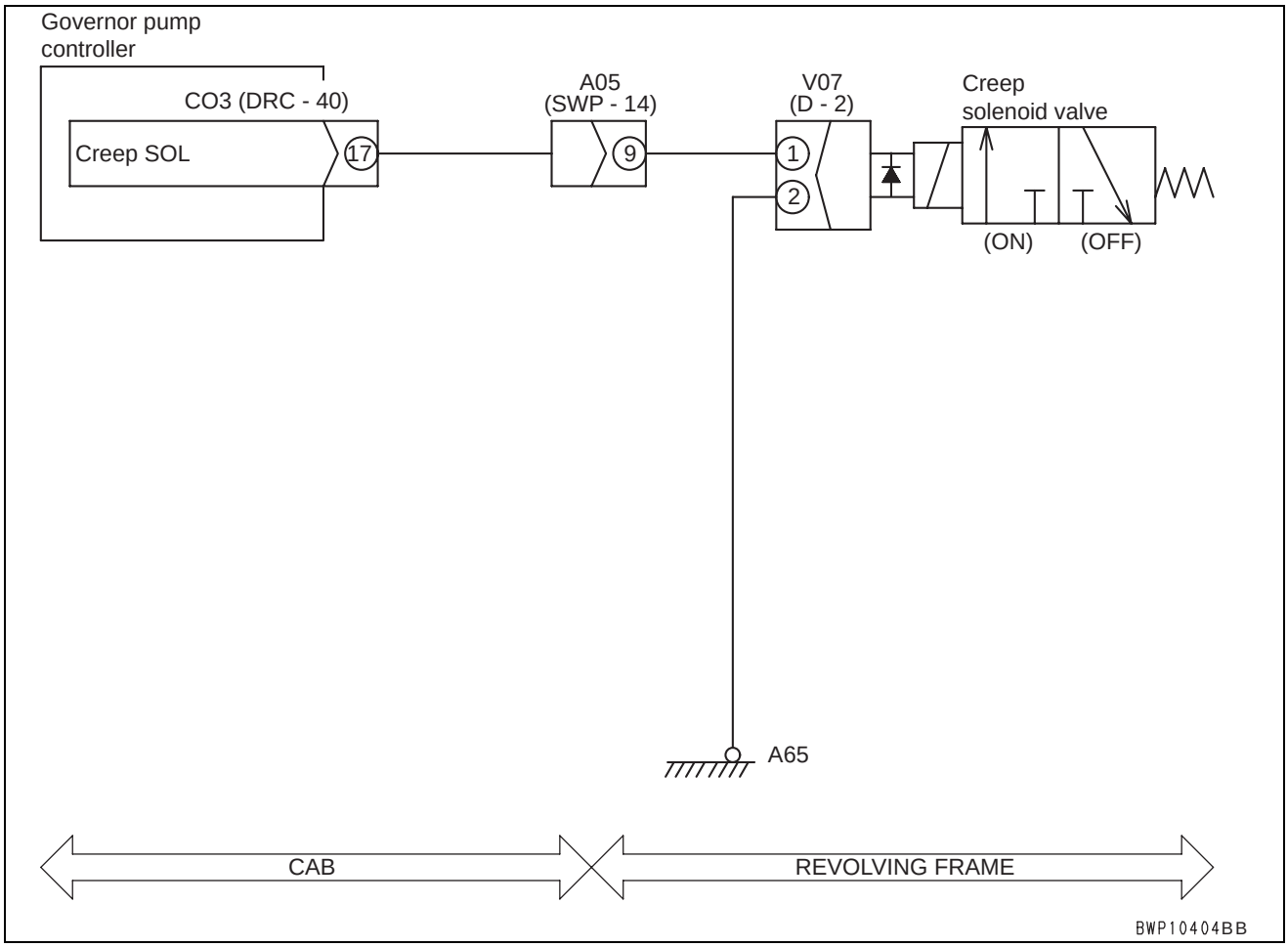


Service Code in Electrical System E208 (Disconnection in Creep solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in creep solenoid (in governor • pump controller system)
E20	**E208**	**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. 023: Solenoid 1) ➢ 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 Service Code [E208].)			

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 Governor Pump Controller

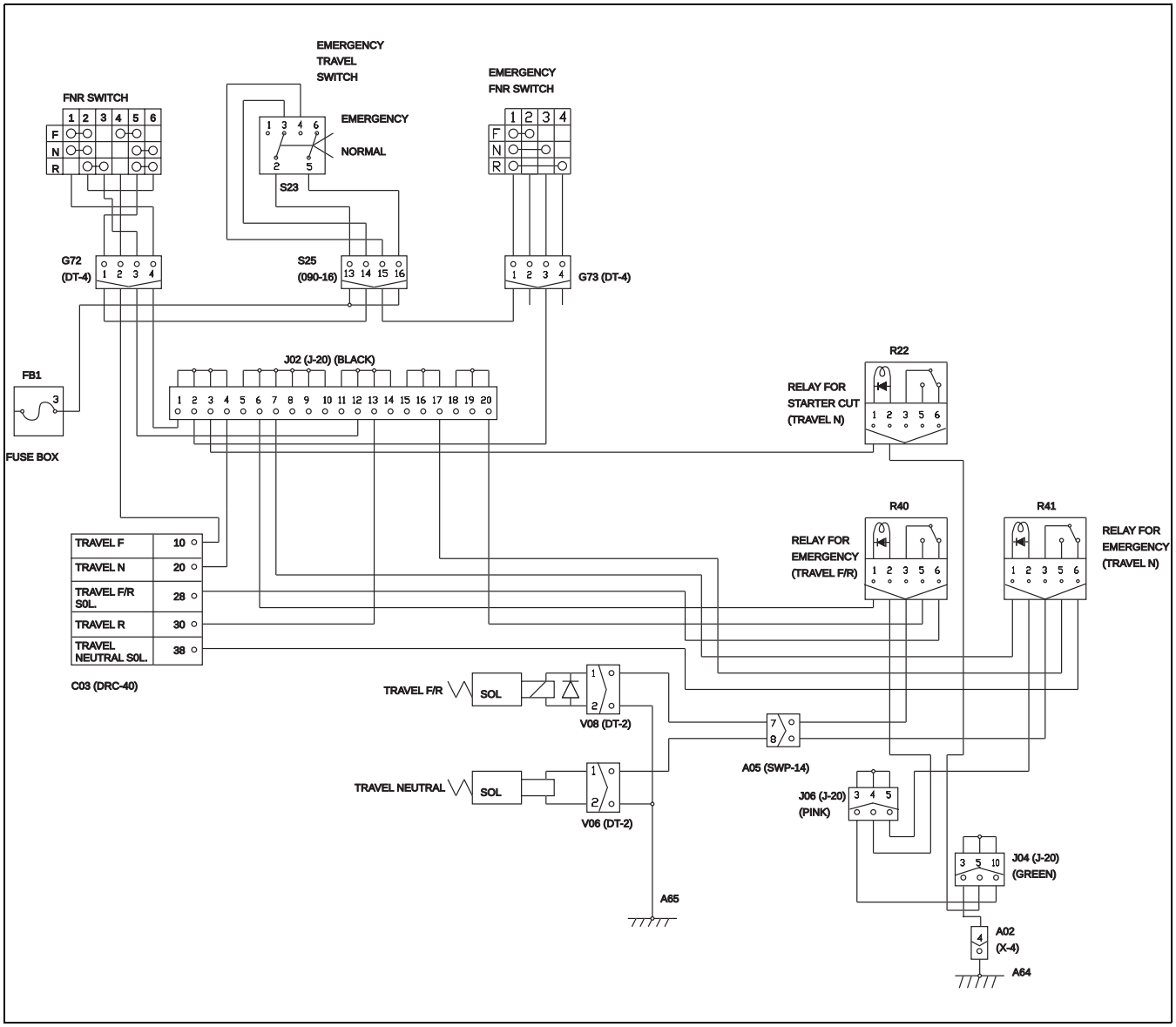


Service Code in Electrical System E211 (Disconnection in Travel Neutral solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in travel neutral solenoid (in governor • pump controller system)
E20	**E211**	**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. 024: Solenoid 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 Service Code [E211])			

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 R41 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 R41 to A05 to V06 (female) ①, or between wiring harness C03 (female) ㊳	Voltage	Below 1 V	
	4	Governor • 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 Governor • Pump Controller

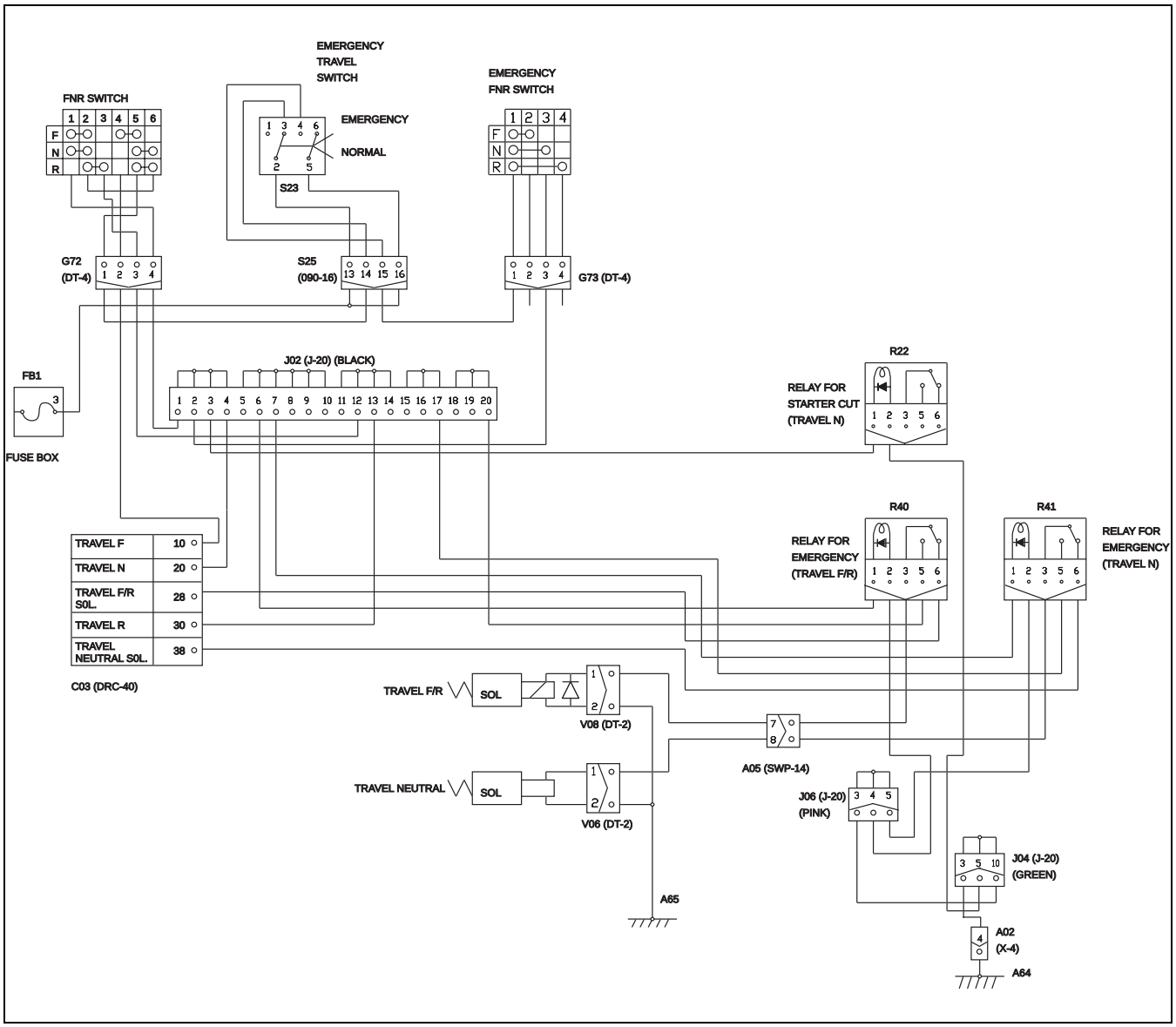


Service Code in Electrical System E212 (Disconnection of Travel F/R solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in travel F/R solenoid (in governor • pump controller system)
E20	**E212**	**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. 024: Solenoid 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 Service Code [E212])			

	Cause		Standard value in normal and references for troubleshooting			
Presumed cause and standard value in normal	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 to R40 to A05 to 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 to R40 to A05 to V08 (female) ①, or between wiring harness C03 (female) ㉘	Voltage	Below 1 V	
	4	Governor • 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

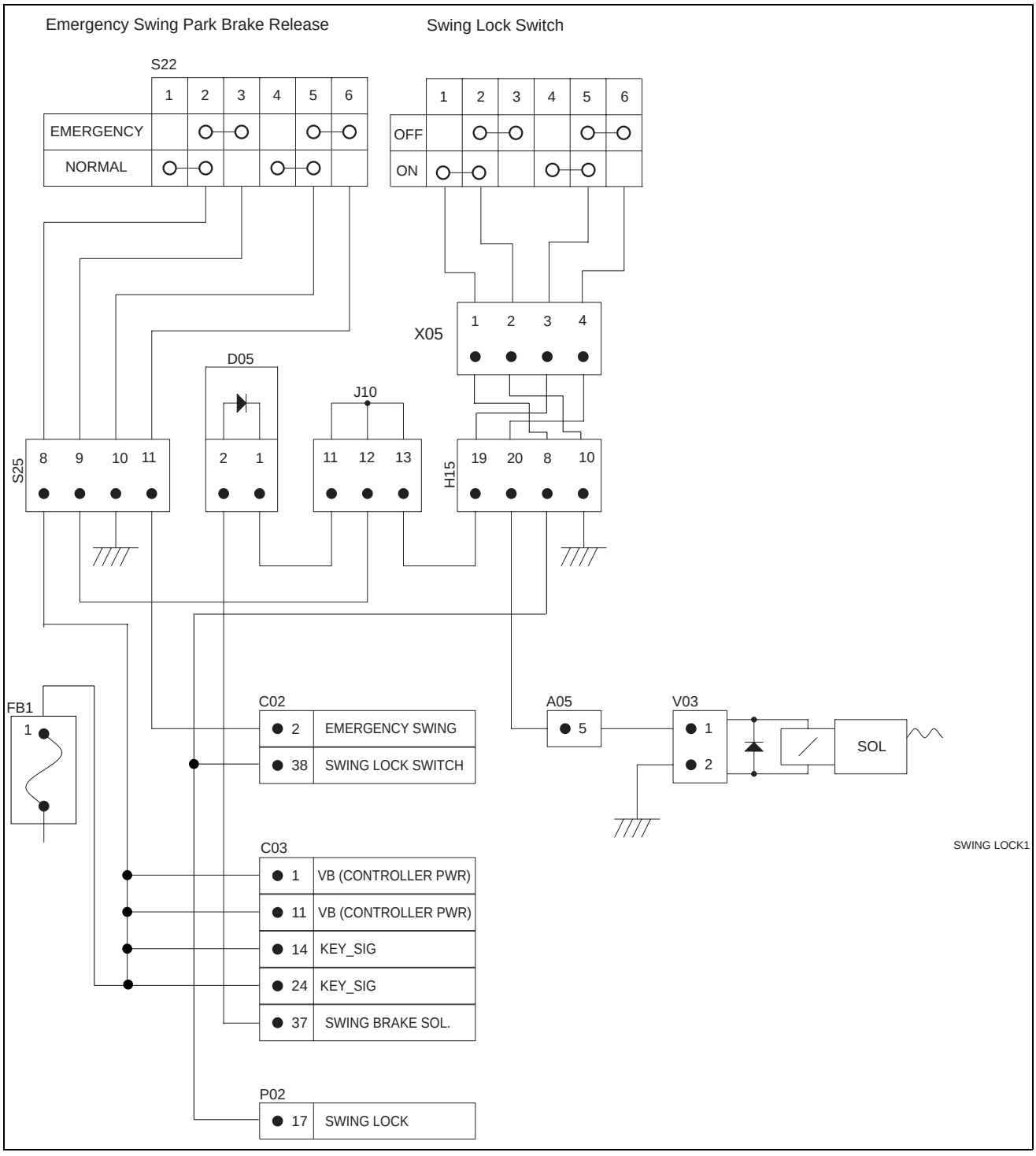


Service Code in Electrical System E213 (Disconnection in Swing Parking Brake solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in swing and parking brake solenoid (in governor • pump controller system)
E03	**E213**	**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. 023: Solenoid 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 Service Code [E213])			

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	
				LOCK	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) 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	
	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) ㊲ and D05 (female) ② and grounding	Voltage	Below 1 V	
	5	Governor • 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 Governor • Pump Controller

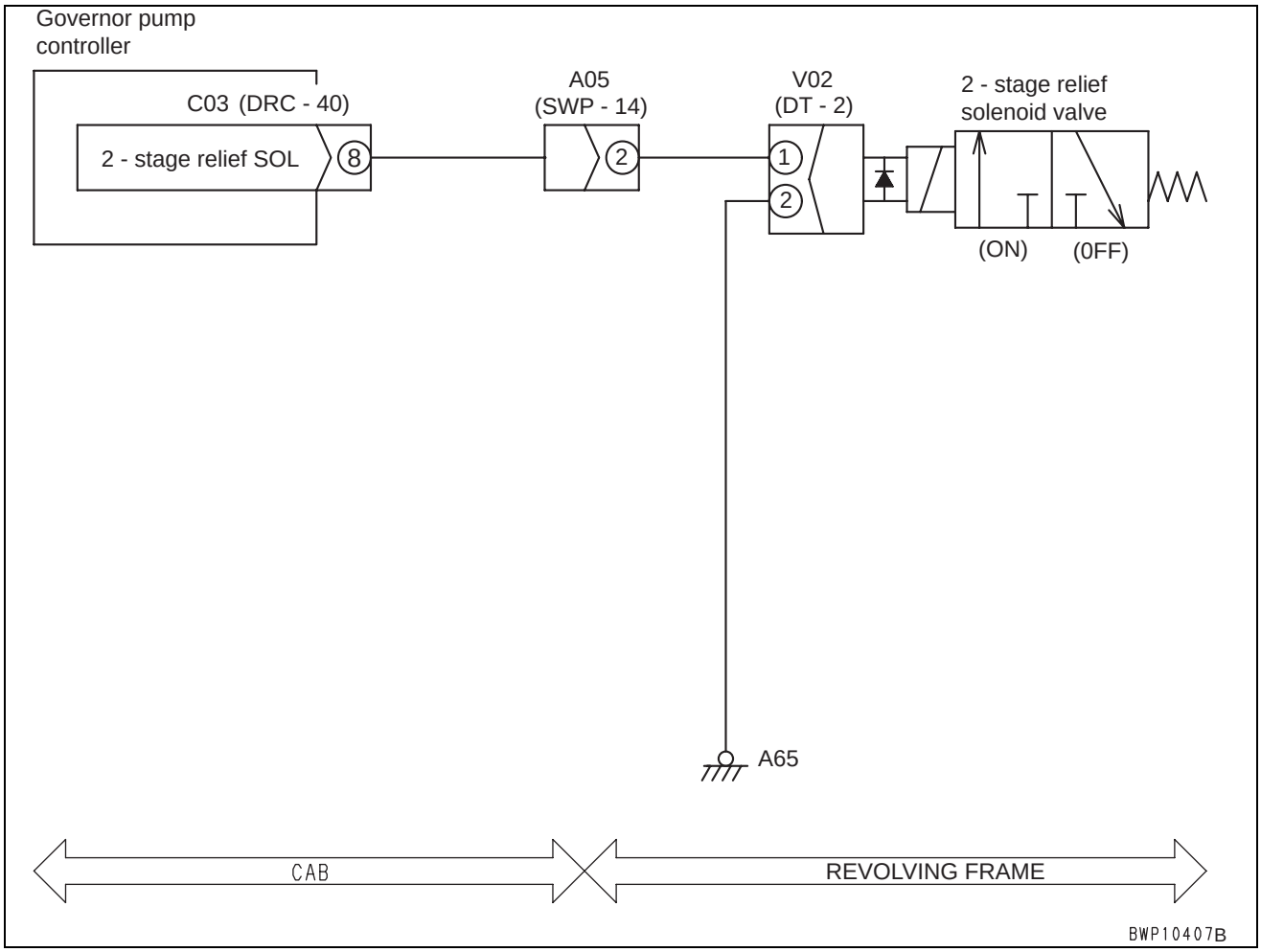


Service Code in Electrical System E215 (Disconnection in 2-stage Relief solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in 2-stage relief solenoid (in governor • pump controller system)
—	**E215**	**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. 023: Solenoid 1) ➢ 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 Service Code [E215].)			

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	Governor • 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 Governor • Pump Controller

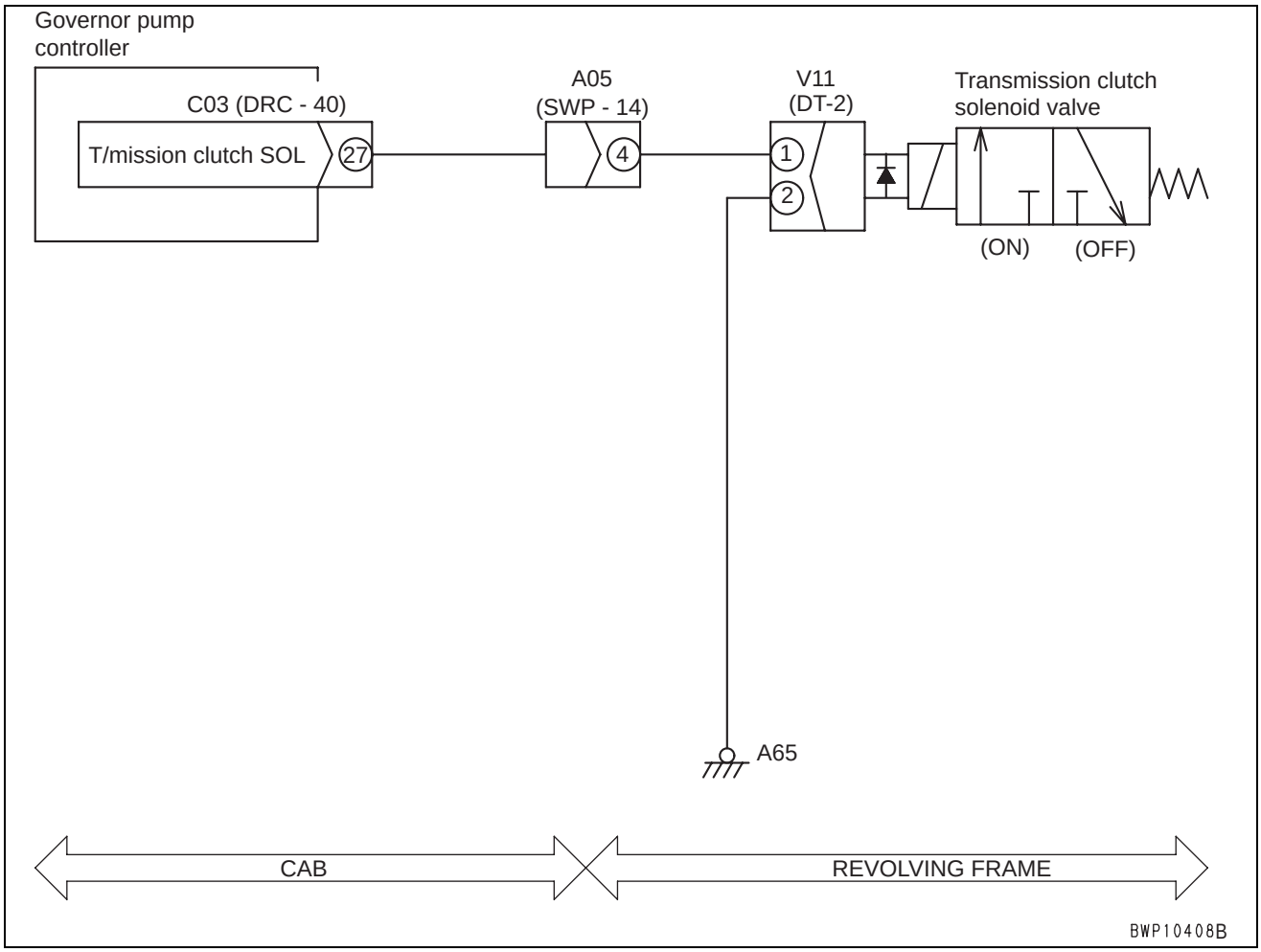


Service Code in Electrical System E216 (Disconnection in Transmission Clutch solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in transmission clutch solenoid (in governor • pump controller system)
E20	**E216**	**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. 023: Solenoid 1) ➢ 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 Service Code [E216])			

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Transmission clutch solenoid defective (Internal disconnection)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V11 (male)	Resistance value		
			Between ① and ②	27 – 30 Ω at 20°C		
	2	Disconnection of wiring harness (Disconnection or defective contact with connector)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ㉗ to A05 to V11 (female) ①	Resistance value	Below 1 Ω	
			Wiring harness between V11 (female) ② and grounding	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Betwen wiring harness from C03 (female) ㉗ to A05 to V11 (female) ①.	Voltage	Below 1 V	
	4	Governor • 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 Governor • Pump Controller



Service Code in Electrical System E217 (Abnormality in inputting model code)

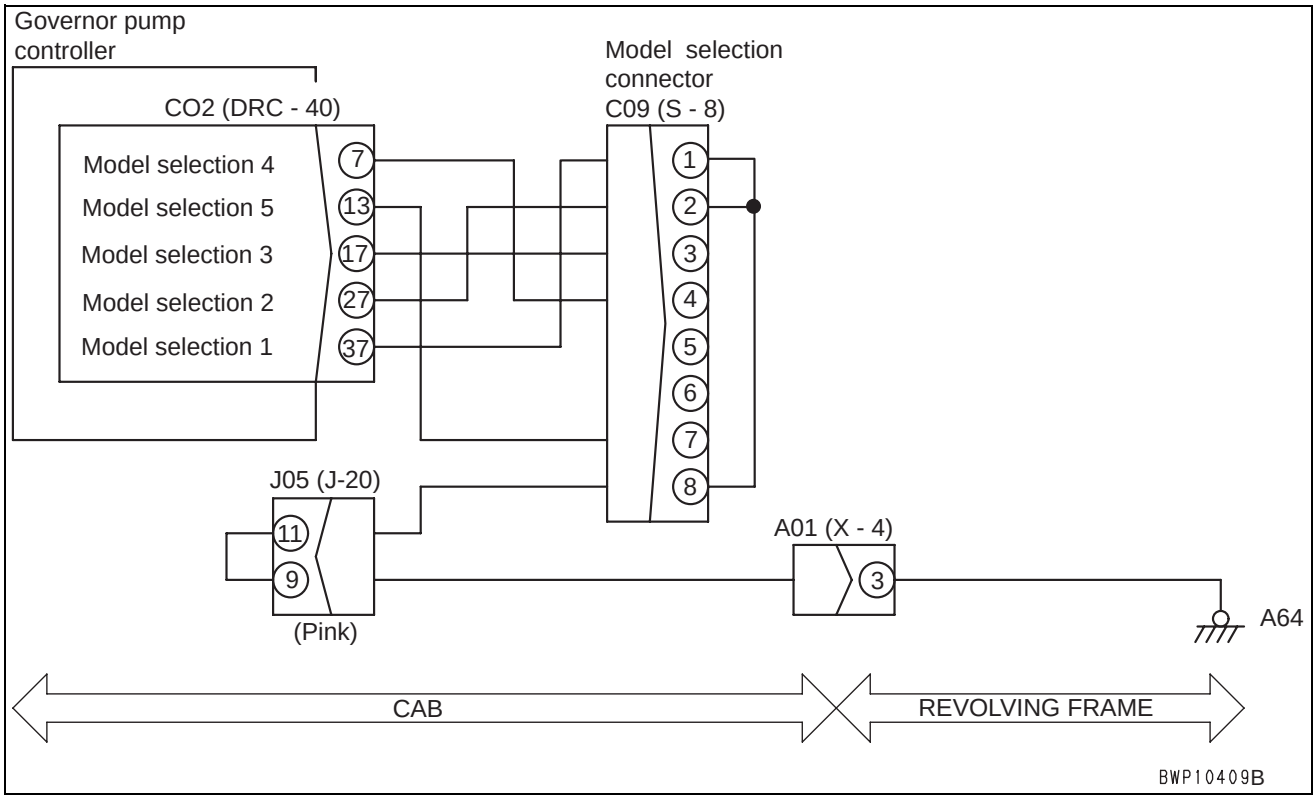
20/25kph

User Code	Service Code	Failure Code	Failure phenomenon	Abnormality in inputting model code (in governor • pump controller system)
—	**E217**	**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 ② and ⑧	Below 1 Ω		
			Between ①, 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	
			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) ② and grounding	Resistance value	Above 1 MΩ	
			Between wiring harness C02 ㊲ and C09 ① and grounding	Resistance value	Above 1 MΩ	
	4	Governor • 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, ⑰ or ㊲ and grounding	20 – 30 V		
			Between ㉗ and grounding	Below 1 V		

Electrical Circuit Diagram for Model Selecting Connector in Governor • Pump Controller

20/25kph



Service Code in Electrical System E217 (Abnormality in inputting model code)

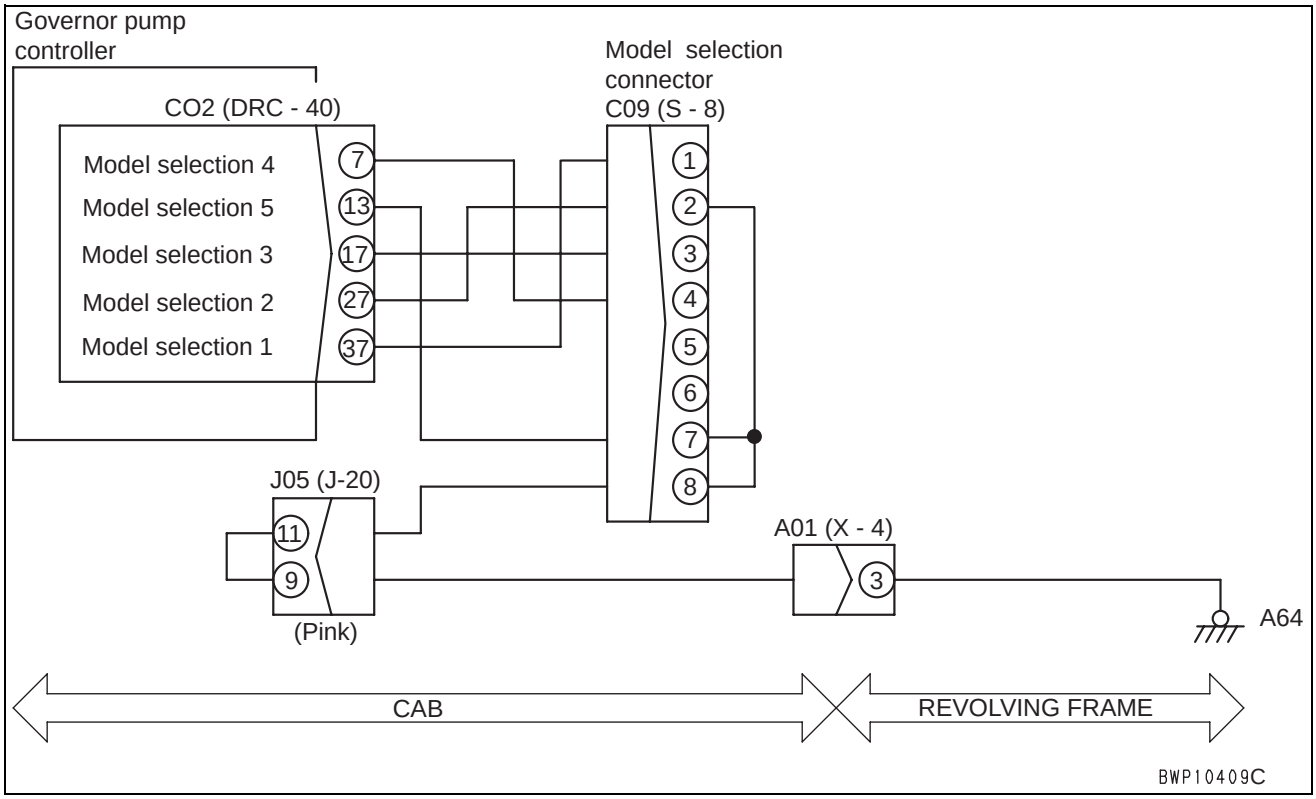
35kph

User Code	Service Code	Failure Code	Failure phenomenon	Abnormality in inputting model code (in governor • pump controller system)
—	**E217**	**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 ②, ⑦ and ⑧	Below 1 Ω		
			Between ①, 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 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) ④ and grounding	Resistance value	Above 1 MΩ	
			Between wiring harness C02 (female) ⑰ and C09 (male) ③ and grounding	Resistance value	Above 1 MΩ	
			Between wiring harness C02 ㊲ and C09 ① and grounding	Resistance value	Above 1 MΩ	
	4	Governor • 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, ⑰ or ㊲ and grounding	20 – 30 V		
			Between ㉗ or ⑬ and grounding	Below 1 V		

Electrical Circuit Diagram for Model Selecting Connector in Governor • Pump Controller

35kph



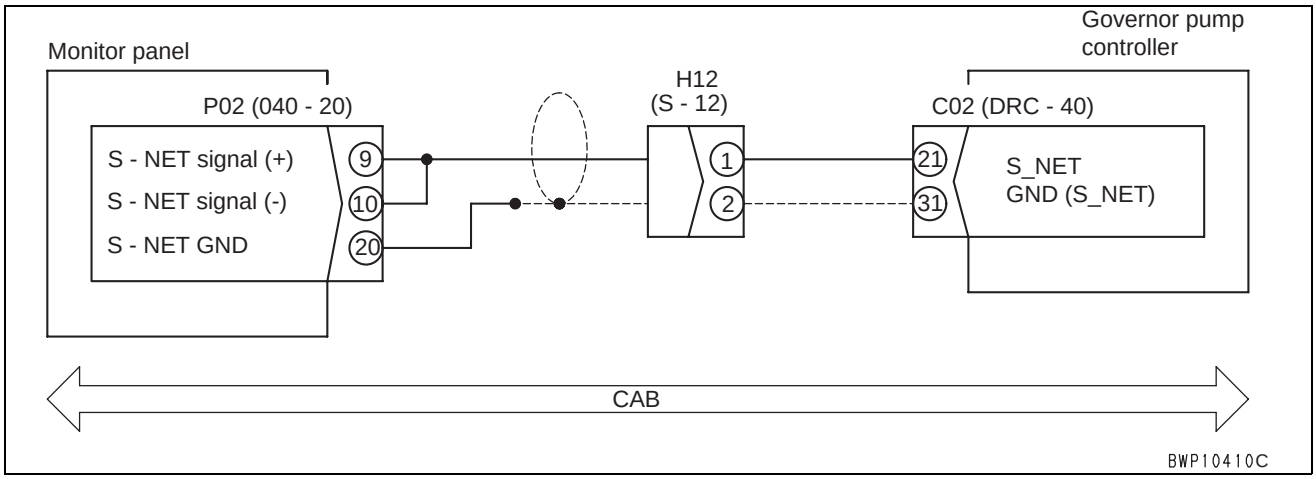
Service Code in Electrical System E218 Disconnection of S-NET signal)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in S-NET signal (in governor • pump controller system)
E20	**E218**	**DA2SKA**		
Failure content	➢ A failure occurred in S-NET communication between the monitor and controller in the past. (The machine operation returned to normal, when the display was resumed)			
Response from controller	➢ While the failure is still continuing, the machine operation is controlled by the following default setting. 1. Working mode: E mode 2. Travel speed: Lo 3. Auto-deceleration: ON 4. Attachment oil flow rate: Minimum (※) ➢ When the failure cause disappears of itself, the machine operation returns to normal.			
Phenomenon occurring on machine	➢ The working mode cannot be changed. (The display changes normally in the monitor panel) ➢ The travel speed cannot be shifted. (The display changes normally in the monitor panel) ➢ The auto-deceleration cannot be released. (The display changes normally in the monitor panel) ➢ The attachment oil flow rate cannot be changed. (The display changes normally in the monitor panel) (※)			
Relative information	➢ This Service Code No. is displayed to inform that there was a failure occurred in the past, when S-NET communication between the monitor panel and the governor • pump controller is returned to normal. ➢ The communication has already returned to normal by the time this Service Code No. is displayed. But thoroughly diagnose all the related equipment and circuits, and remove all potential causes for a failure in order to prevent recurrence of failures.			

※**: The multi-monitor specification machine only.**

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting		
	1	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) ⑨ ⑩ and C02 (female) ㉑	Resistance value	Below 1 Ω
			Wiring harness between P02 (female) ⑳ and C02 (female) ㉛	Resistance value	Below 1 Ω
	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 P02 (female) ⑥ ⑦ and C02 (female) ㉑ and grounding	Resistance value	Above 1 MΩ
	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 P02 (female) ⑥ ⑦ and C02 (female) ㉑ and grounding	Voltage	Below 1 V
	4	Monitor panel defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.		
			P02 (male)	Voltage	
			Between ⑥ ⑦ and ⑧	6 – 9 V	
	5	Governor • pump controller defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.		
			C02 (male)	Voltage	
			Between ㉑ and ㉛	6 – 9 V	

Electrical Circuit Diagram for S-NET Communication between Monitor Panel and Governor • Pump Controller

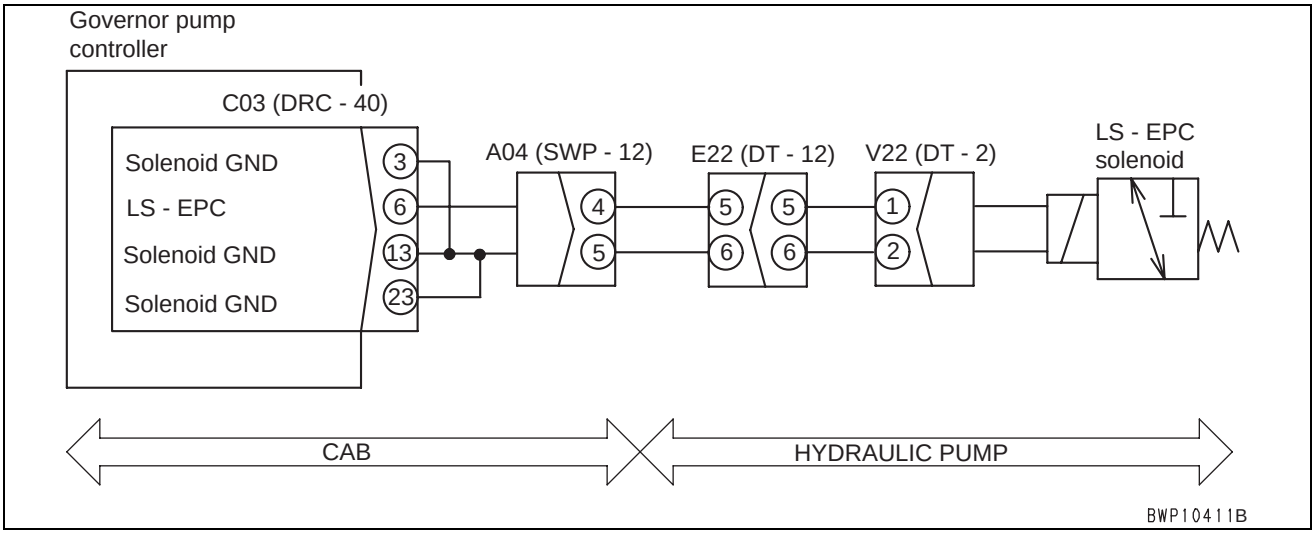


Service Code in Electrical System E222 (Short-circuiting in LS-EPC solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in LS-EPC solenoid (in governor • pump controller system)
—	**E222**	**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. 015: 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	Governor • 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 Governor • Pump Controller

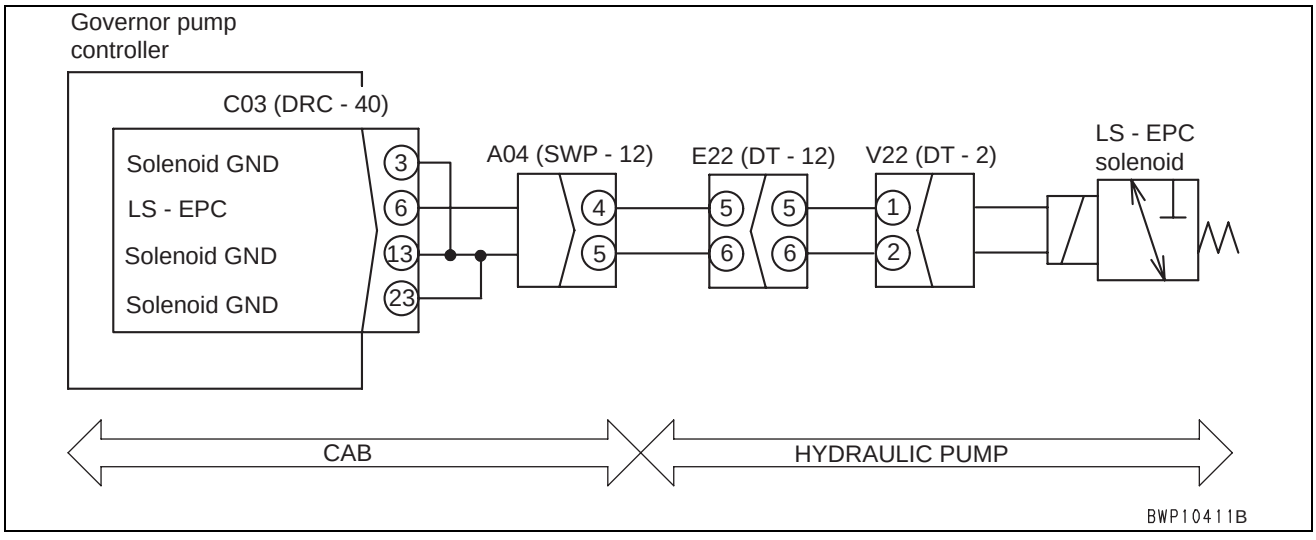


Service Code in Electrical System E223 (Disconnection in LS-EPC solenoid system)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in LS-EPC solenoid (in governor • pump controller system)
—	**E223**	**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. 015: 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	Governor • 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 Governor • Pump Controller

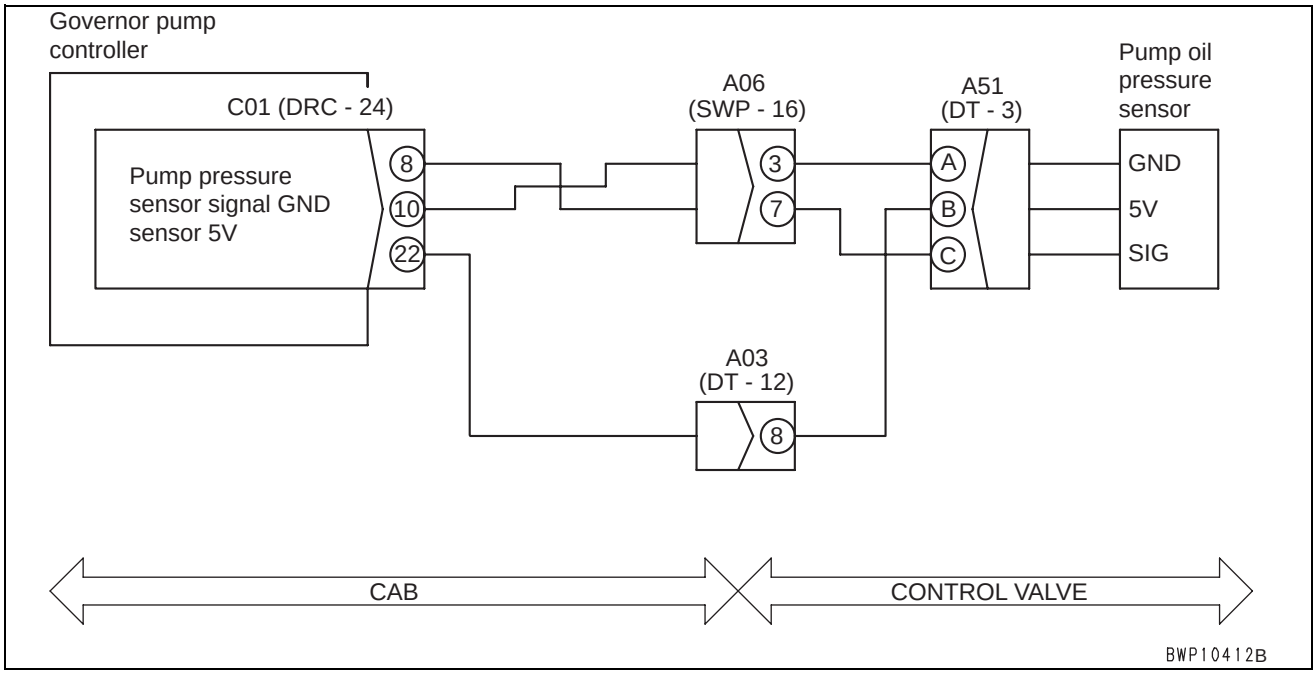


Service Code in Electrical System E224 (Abnormality in pump pressure sensor)

User Code	Service Code	Failure Code	Failure phenomenon	Abnormality in pump pressure sensor (in governor • pump controller system)
—	**E224**	**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. 011: pump pressure)			

	Cause		Standard value in normal and references for troubleshooting		
Presumed cause and standard value in normal	1	Sensor power source fault	If the Service Code No. [E226] is displayed, troubleshoot the failure first.		
	2	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 Ⓑ and Ⓐ	4.5 – 5.5 V	
			Between Ⓒ and Ⓐ	0.5 – 4.5 V	
	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.		
			Between wiring harness from C01 (female) ㉒ to A51 (female) Ⓑ	Resistance value	Below 1 Ω
			Wiring harness between C01 (female) ⑩ and A51 (female) Ⓐ	Resistance value	Below 1 Ω
			Wiring harness between C01 (female) ⑧ and A51 (female) Ⓒ	Resistance value	Below 1 Ω
	4	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) Ⓒ 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.		
			Between wiring harness C01 (female) ㉒, A51 (female) Ⓑ and grounding	Voltage	Below 1 V
			Between wiring harness C01 (female) ⑧ and A51 (female) Ⓒ and grounding	Voltage	Below 1 V
	6	Governor • 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 in Governor • Pump Controller

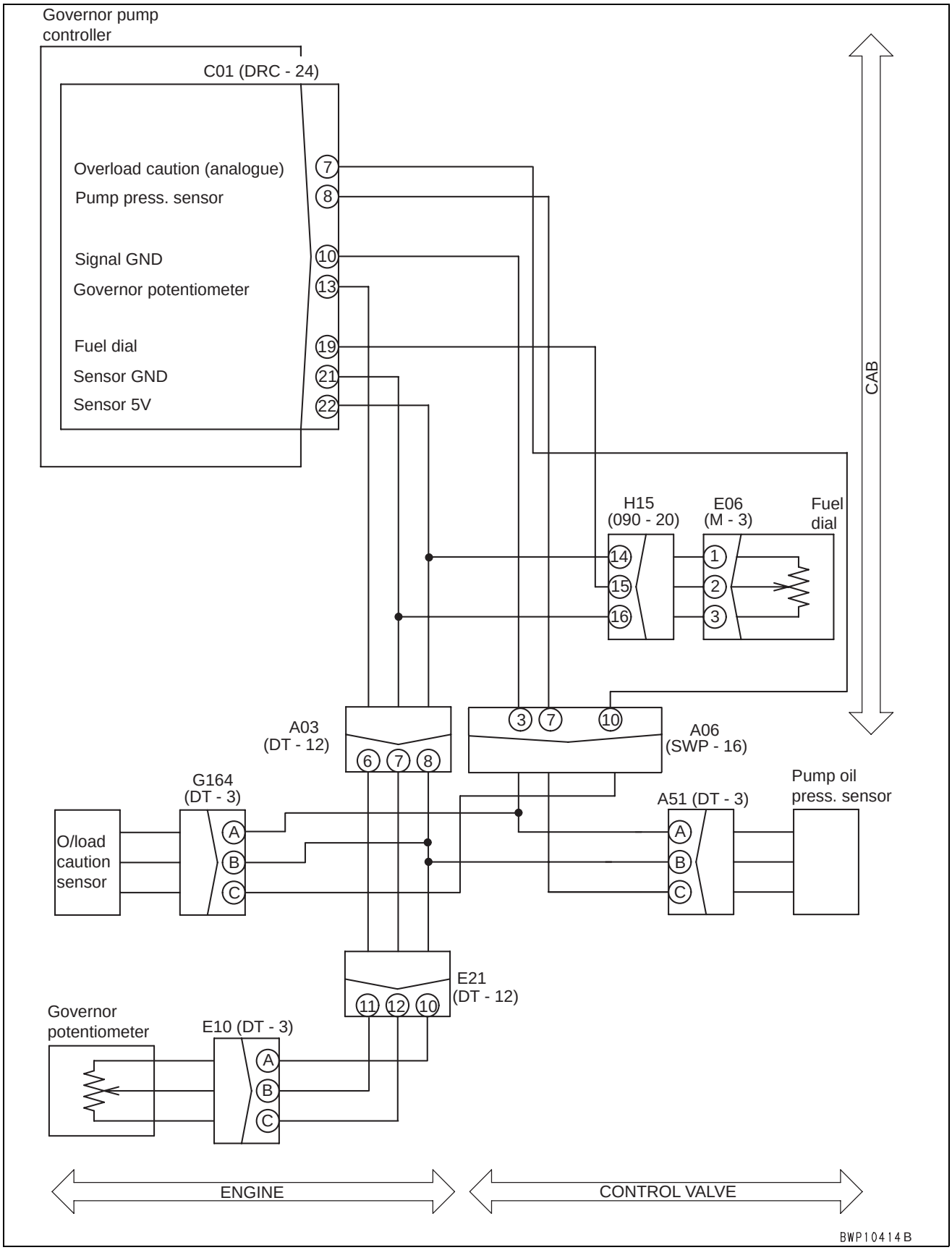


Service Code in Electrical System E226 (Abnormality in Pressure sensor power source)

User Code	Service Code	Failure Code	Failure phenomenon	Abnormality in pressure sensor power source (in governor • pump controller system)
—	**E226**	**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.		
			Fuel dial	E06 Connector	
			Governor motor potentiometer	E10 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 E06 (female) ① and grounding [Fuel dial system]	Resistance value	Above 1 MΩ
			Between wiring harness from C01 (female) ㉒ to E10 (female) Ⓐ and grounding [Governor potentiometer system]	Resistance value	Above 1 MΩ
			Between wiring harness from C01 (female) ㉒ to A51 (female) Ⓑ and grounding [Pump pressure sensor system]	Resistance value	Above 1 MΩ
			Between wiring harness C01 (female) ㉒ to G164 (female) Ⓑ and grounding.	Resistance value	Above 1 MΩ
	3	Governor • 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 ㉑	4.5 – 5.5 V	

Electrical Circuit Diagram for Sensor Power Source in Governor • Pump Controller

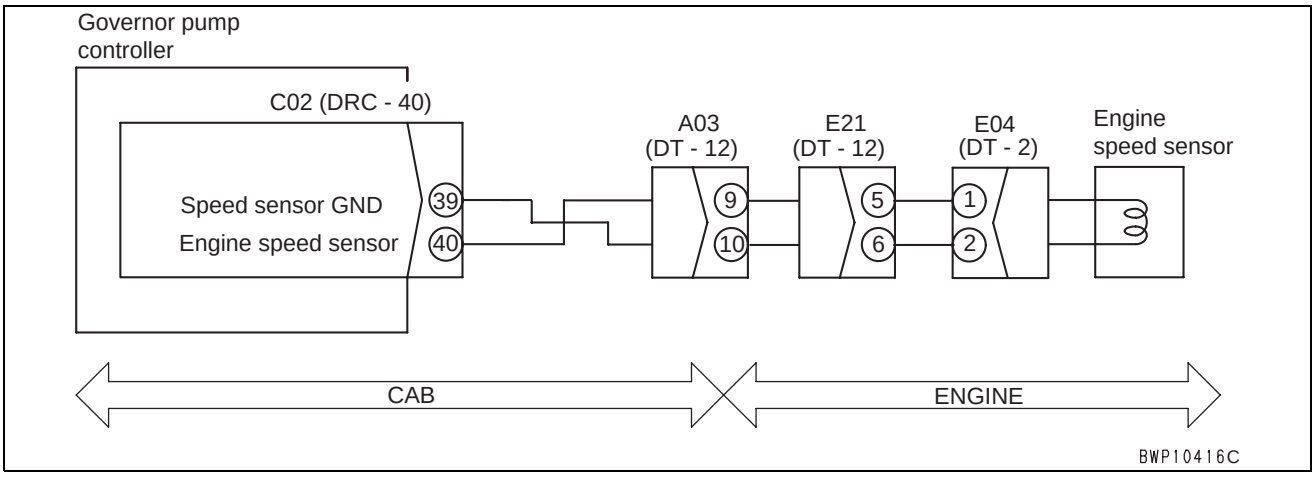


Service Code in Electrical System E227 (Abnormality in engine rotation sensor in governor • pump controller system)

User Code	Service Code	Failure Code	Failure phenomenon	Abnormality in engine rotation sensor (in governor • pump controller system)
—	**E227**	**DLE2MA**		
Failure content	➢ A normal pulse signal is not inputted to the signal circuit in the engine rotation 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	➢ The machine lacks power.			
Relative information	➢ Input from the engine rotation sensor (rpm) can be confirmed in the monitor function. (Code No. 010: Engine RPM)			

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting		
	1	Engine rotation 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.		
			E04 (male)	Resistance value	
			Between ① and ②	500 – 1,000 Ω	
			Between ① and grounding	Above 1 MΩ	
	2	Engine rotation sensor adjustment improper	For the inspection and adjustment, refer to the section of "Adjusting Engine Rotation 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) ㊵ and E04 (female) ①	Resistance value	Below 1 Ω
			Wiring harness between C02 (female) ㊴ and E04 (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 C02 (female) ㊵ and E04 (female) ① and grounding	Voltage	Below 1 V
	5	Governor • 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 ㊵ and ㊴	500 – 1,000 Ω	
			Between ㊵ and grounding	Above 1 MΩ	

Electrical Circuit Diagram for Monitor Panel Power Source

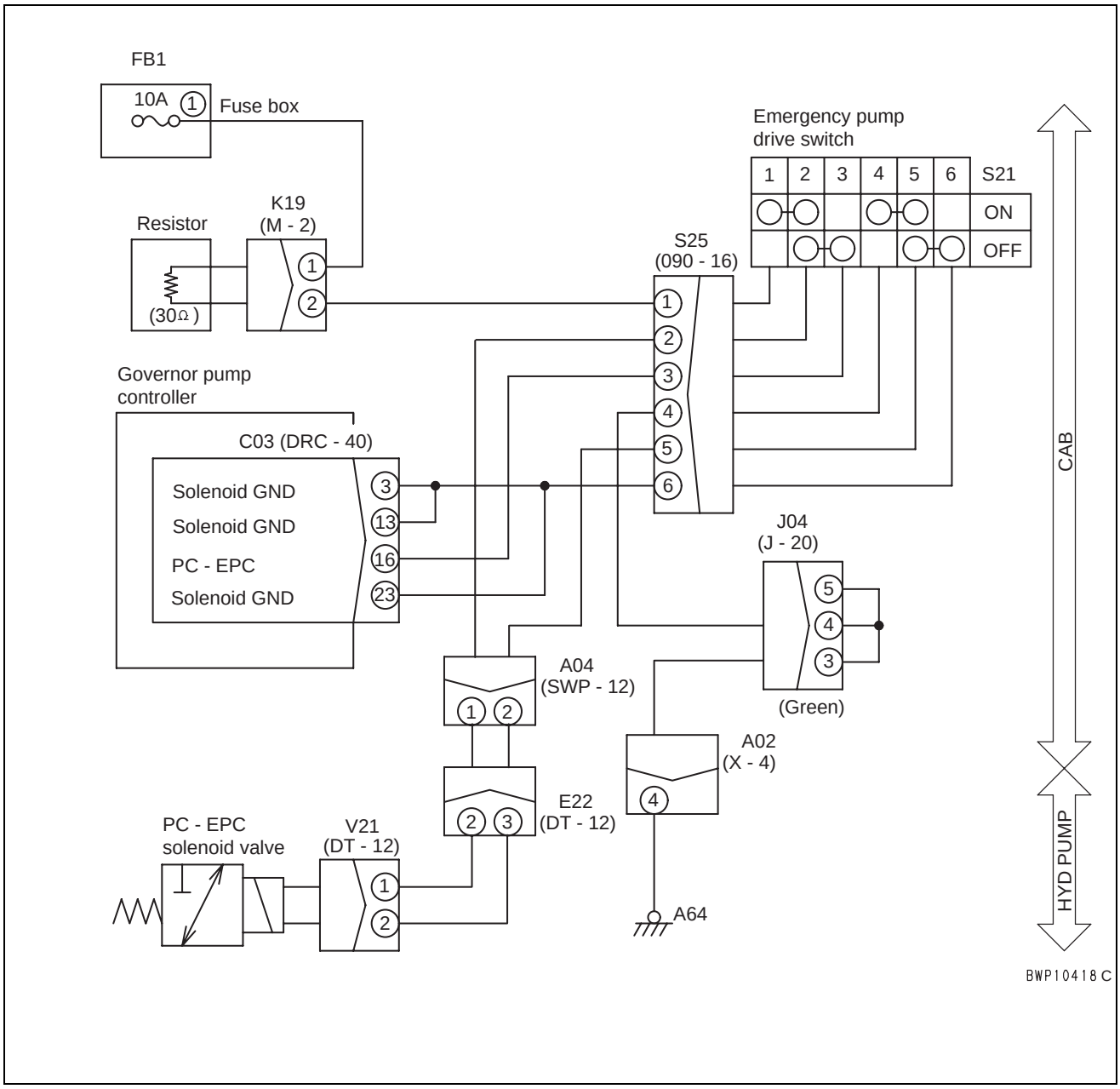


Service Code in Electrical System E232 (Short-circuiting in PC-EPC solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in PC-EPC solenoid (in governor • pump controller system)
E02	**E232**	**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. 013: 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 service code No. [E232], but this is not abnormal) ➢ Turn the emergency driving switch ON during the troubleshooting.			

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	PC-EPC solenoid defective (Internal short-circuiting or grounding fault)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V21 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
			Between ① and grounding	Above 1 MΩ		
	2	Grounding fault of wiring harness (Contact with grounding circuit)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between wiring harness from C03 (female) ⑯ to S25 to A04 to V21 (female) ① and grounding	Resistance value	Above 1 MΩ	
	3	Governor • 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 Governor • Pump Controller

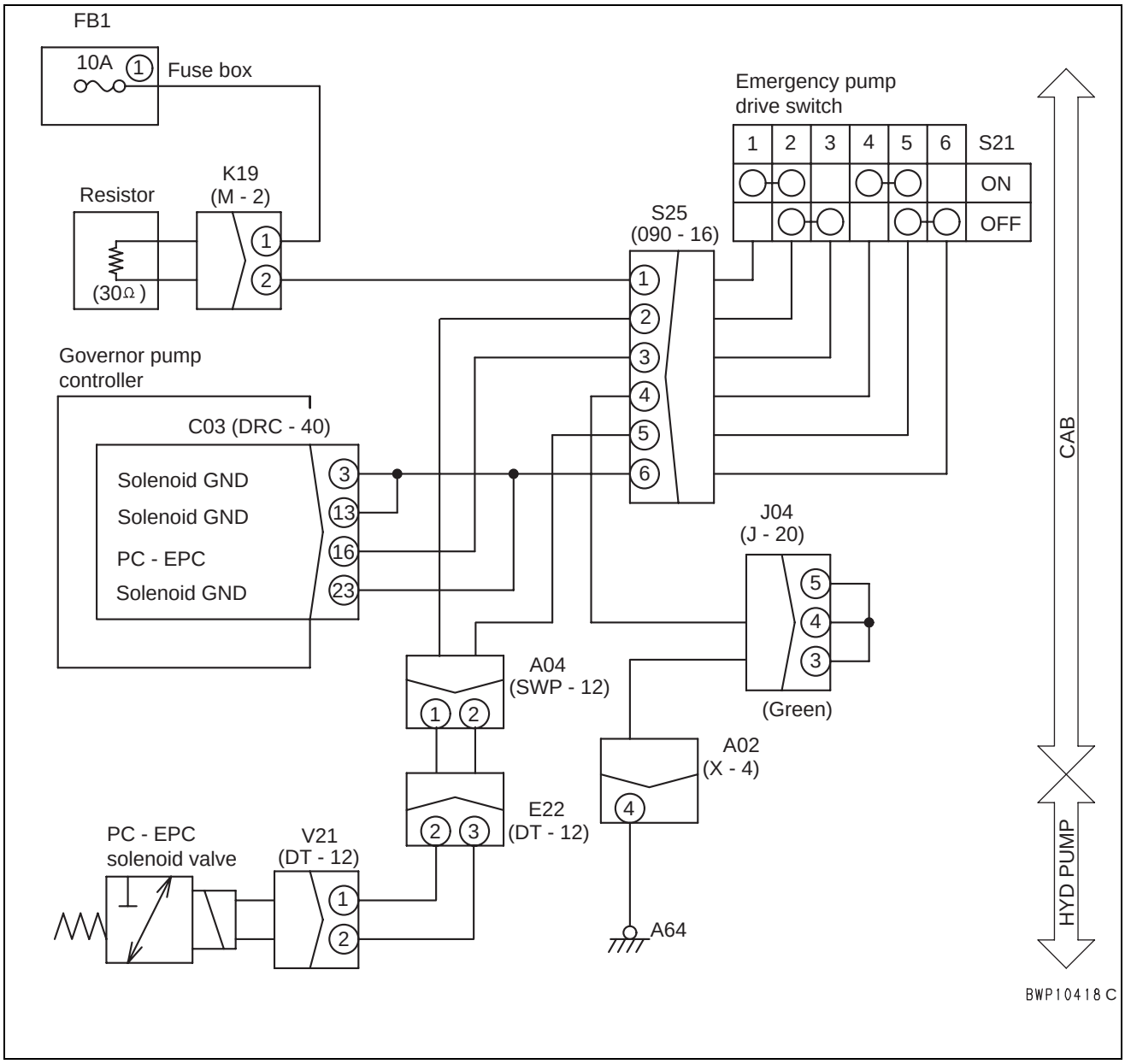


Service Code in Electrical System E233 (Disconnection in PC-EPC solenoid system)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in PC-EPC solenoid (in governor • pump controller system)
E02	**E233**	**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. 013: 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 Service Code No. [E233], but this is not abnormal)			

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	PC-EPC solenoid defective (Internal short-circuiting)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V21 (male)	Resistance value		
			Between ① and ②	7 – 14 Ω		
	2	Emergency pump driving switch defective (Internal disconnection)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			S25	Switch	Resistance value	
			Between ② and ③	OFF	Below 1 Ω	
				ON	Above 1 MΩ	
			Between ⑤ and ⑥	OFF	Below 1 Ω	
				ON	Above 1 MΩ	
	3	Disconnection of wiring harness (Disconnection or defective contact with connector)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between C03 (female) ⑯ and S25 ③		Resistance value	Below 1 Ω
			Wiring harness between S25 ② and V21 (female) ①		Resistance value	Below 1 Ω
			Wiring harness between C03 (female) ③, ⑬, ㉓ and S25 ⑥		Resistance value	Below 1 Ω
			Wiring harness between S25 ⑤ and V21 (female) ②		Resistance value	Below 1 Ω
	4	Short-circuiting of wiring harness (Contact with 24 V circuit)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness C03 (female) ⑯ and S25 ③ and grounding		Voltage	Below 1 V
			Between wiring harness S25 ② and V21 (female) ① and grounding		Voltage	Below 1 V
	5	Governor • 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 Governor • Pump Controller

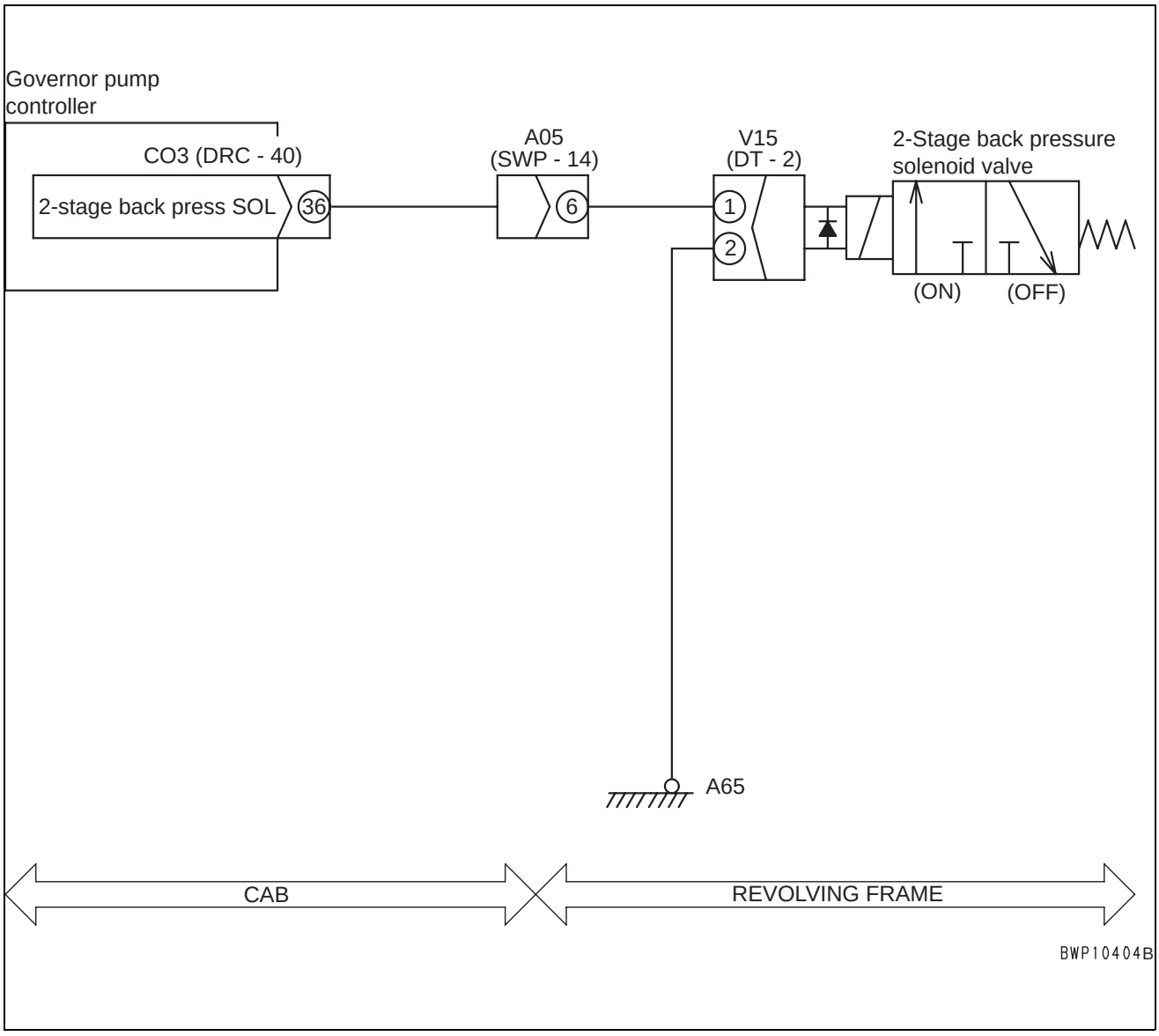


Service Code in Electrical System E236 (Short circuiting in 2-stage back pressure solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Short circuit of 2-stage back pressure solenoid (in governor • pump controller system)
—	**E236**	**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. 024: Solenoid 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	Governor • 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 Governor • Pump Controller

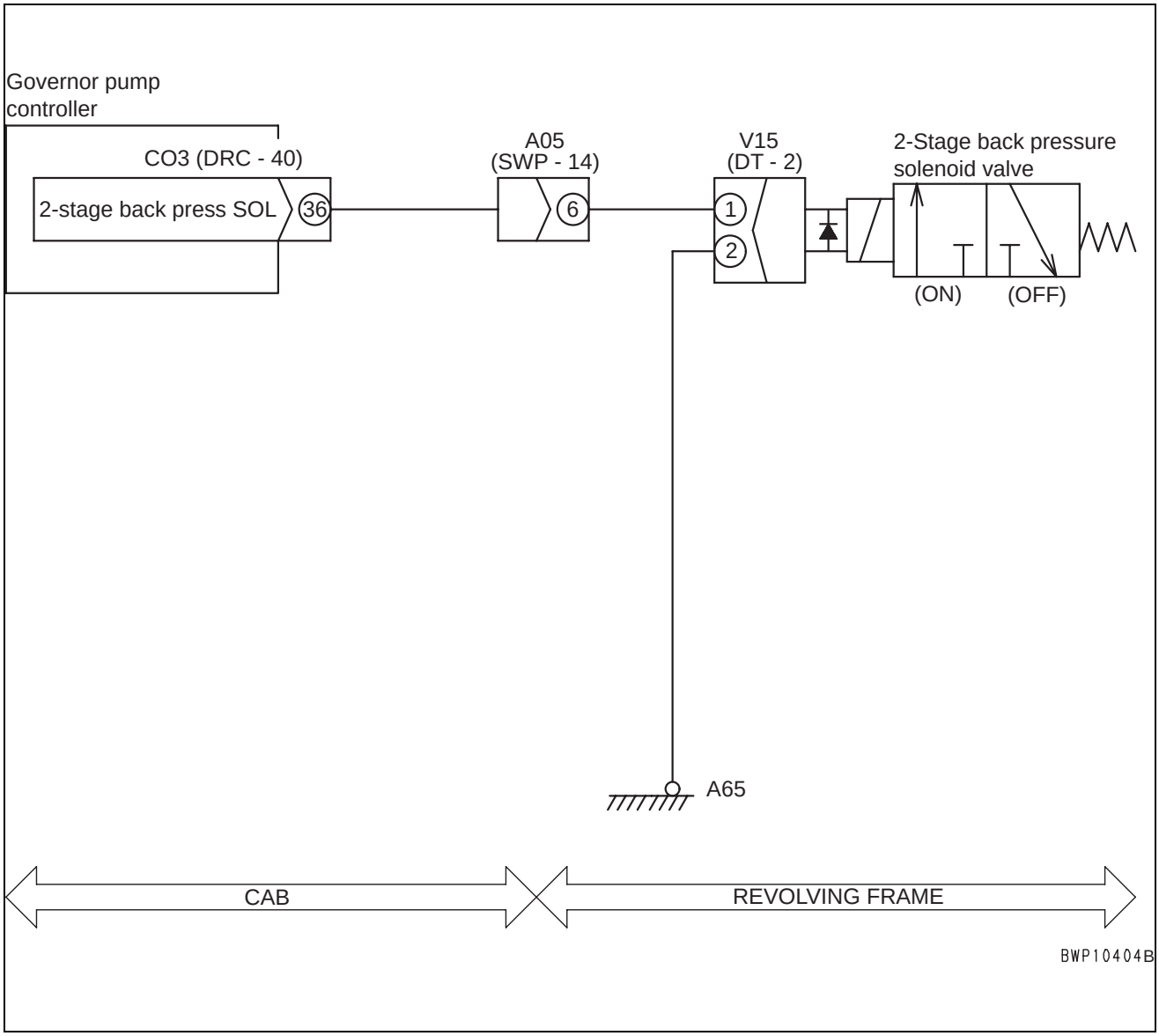


Service Code in Electrical System E237 (Disconnection in 2-stage Back Pressure solenoid)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in 2-stage back pressure solenoid (in governor • pump controller system)
—	**E237**	**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. 024: Solenoid 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 024: solenoid 2]).			

	Cause		Standard value in normal and references for troubleshooting		
Presumed cause and standard value in normal	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	Governor • 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 Governor • Pump Controller

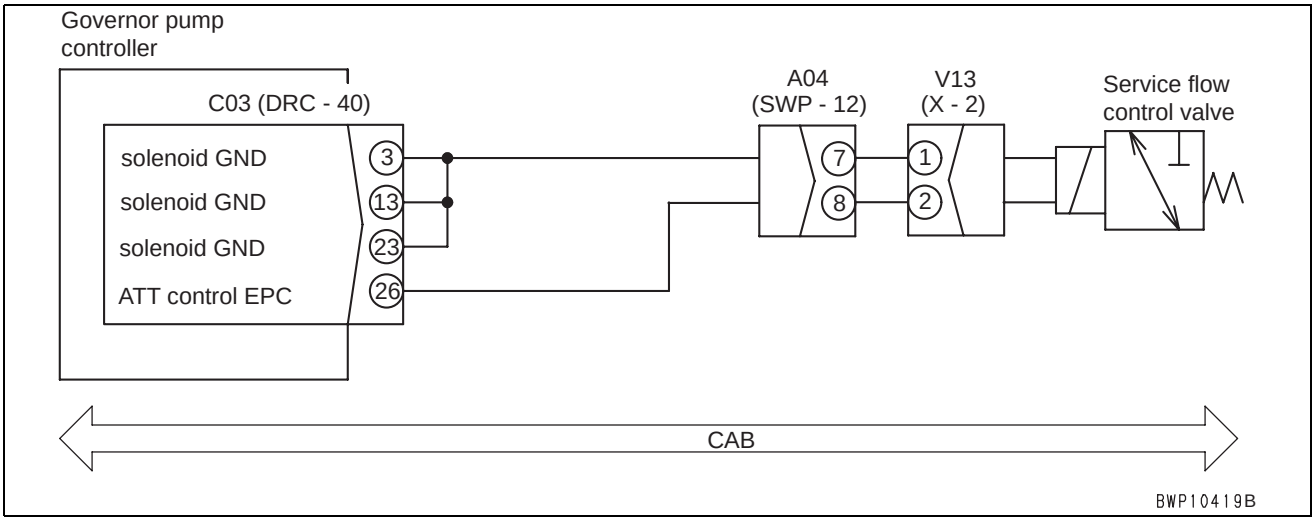


Service Code in Electrical System E245 (Short-circuiting in attachment oil flow rate adjusting EPC)

User Code	Service Code	Failure Code	Failure phenomenon	Short-circuiting in attachment oil flow rate adjusting EPC (in governor • pump controller system)
—	**E245**	**DXE4KB**		
Failure content	➢ Abnormal current flew to the attachment oil flow rate adjusting EPC solenoid circuit.			
Response from controller	➢ The controller reduces to zero (0) power to the attachment oil flow rate adjusting EPC solenoid circuit. ➢ Even when the failure cause disappears, the EPC solenoid circuit does not return to normal, unless the engine starting switch is once turned OFF.			
Phenomenon occurring on machine	➢ The attachments do not move.			
Relative information	➢ It can be confirmed in the monitor function how power (ampere) is supplied to the attachment oil flow rate adjusting EPC solenoid circuit. (Code No. 017: Service solenoid current)			

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Attachment oil flow rate adjusting EPC defective (Internal short-circuiting or grounding fault)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V13 (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) ㉖ and V13 (female) ① and grounding	Resistance value	Above 1 MΩ	
	3	Governor • 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 ③ ⑬ ㉓	7 – 14 Ω		
			Between ㉖ and grounding	Above 1 MΩ		

Electrical Circuit Diagram for Attachment Oil Flow Rate Adjusting EPC Solenoid in Governor • Pump Controller

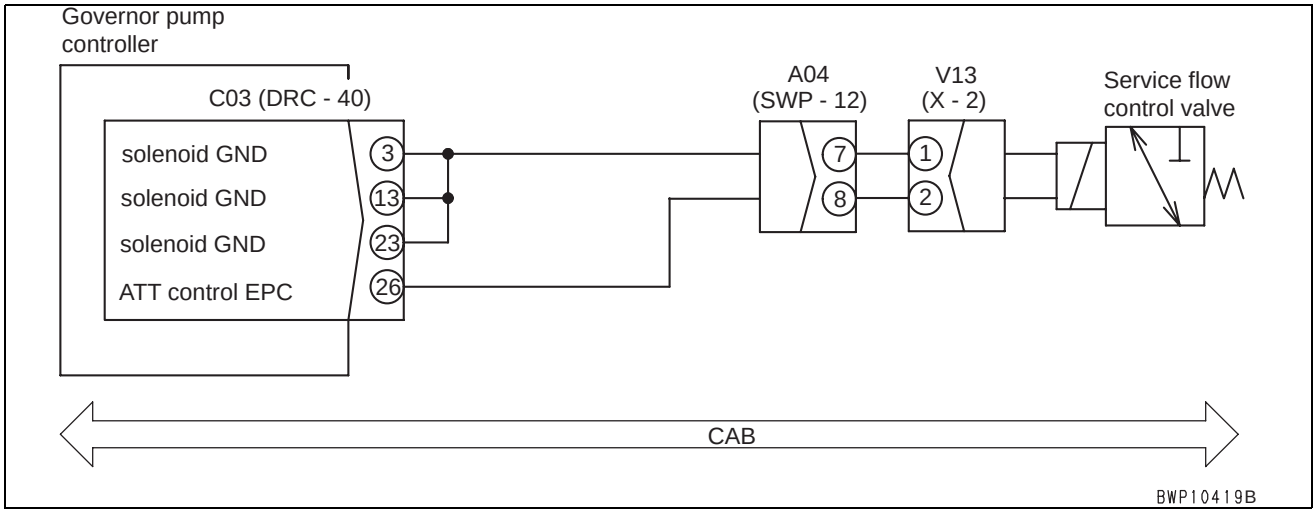


Service Code in Electrical System E246 (Disconnection in attachment oil flow rate adjusting EPC)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in attachment oil flow rate adjusting EPC (in governor • pump controller system)
—	**E246**	**DXE4KA**		
Failure content	➢ No current flew to the attachment oil flow rate adjusting EPC solenoid circuit.			
Response from controller	➢ None in particular (The solenoid does not work, as there is no current flowing to it) ➢ If the failure cause disappears, the EPC solenoid circuit returns to normal of itself.			
Phenomenon occurring on machine	➢ The attachments do not move.			
Relative information	➢ It can be confirmed in the monitor function how power (ampere) is supplied to the attachment oil flow rate adjusting EPC solenoid circuit. (Code No. 017: Service solenoid current)			

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Attachment oil flow rate adjusting EPC defective (Internal short-circuiting or grounding fault)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			V13 (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) ㉖ and V13 (male) ① and grounding	Resistance value	Below 1 Ω	
			Between wiring harness C03 (female) ③ ⑬ ㉓ and V13 (male) ② and grounding	Resistance value	Below 1 Ω	
	3	Short-circuiting of wiring harness (Contact with 24 V circuit)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Between wiring harness C03 (female) ㉖ and V13 (female) ① and grounding	Voltage	Below 1 V	
	4	Governor • 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 ③, ⑬, ㉓.	7 – 14 Ω		

Electrical Circuit Diagram for Attachment Oil Flow Rate Adjusting EPC Solenoid in Governor • Pump Controller

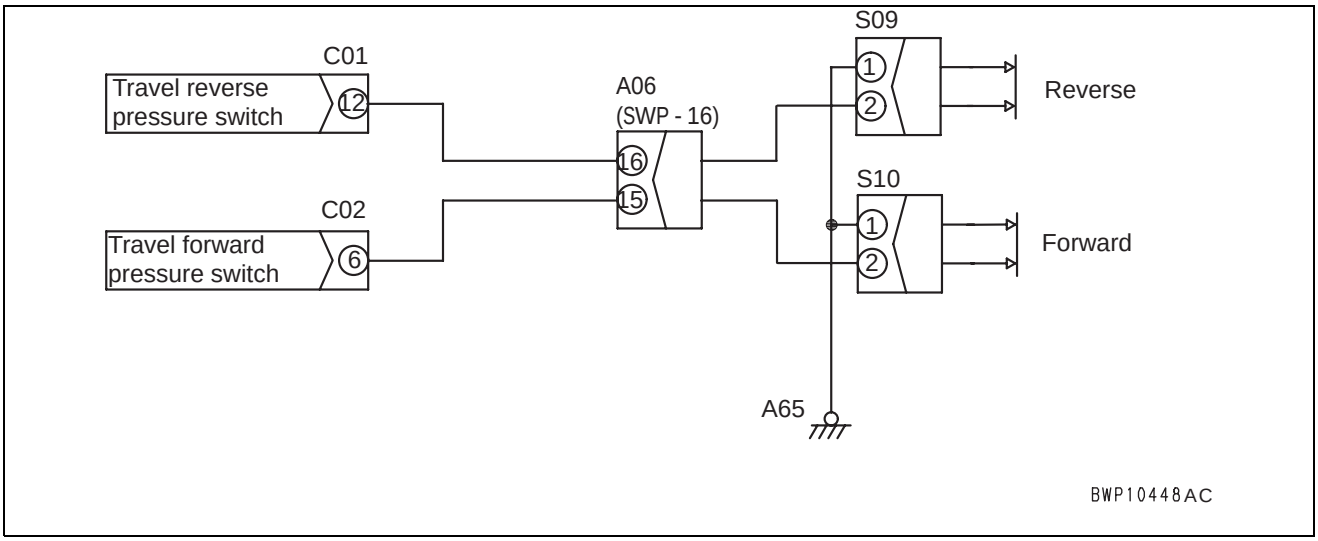


Service Code in Electrical System E247 (Abnormality in travel direction control switch)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in direction control switches (in governor • pump controller system)
E20	**E247**	**DDWCKZ**		
Failure content	➢ Error code appears on monitor when travel pedal operated.			
Response from controller	➢ Defaults travel mode to 'N' (Neutral).			
Phenomenon occurring on machine	➢ Machine cannot travel			
Relative information	➢			

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting		
	1	Pressure switch defective(Internal short circuiting or grounding).	➢ Turn starting switch OFF for the preparations, and hold it OFF during troubleshooting.		
			S09 and S10	Resistance value	
			Between ① and ② with oil pressure.	Above 1 Ω	
			Between ① and ② without oil pressure.	Less than 100 Ω	
	2	Disconnection of wirirng harness (disconnection or deffective contact with connector)	➢ Turn starting switch OFF for the preparations, and hold it OFF during troubleshooting.		
			Between C01-12 and S09-2.	Resistance value	Below 1 Ω
			Between C02-6 and S10-2.		

Electrical Circuit Diagram for Travel PPC Switch

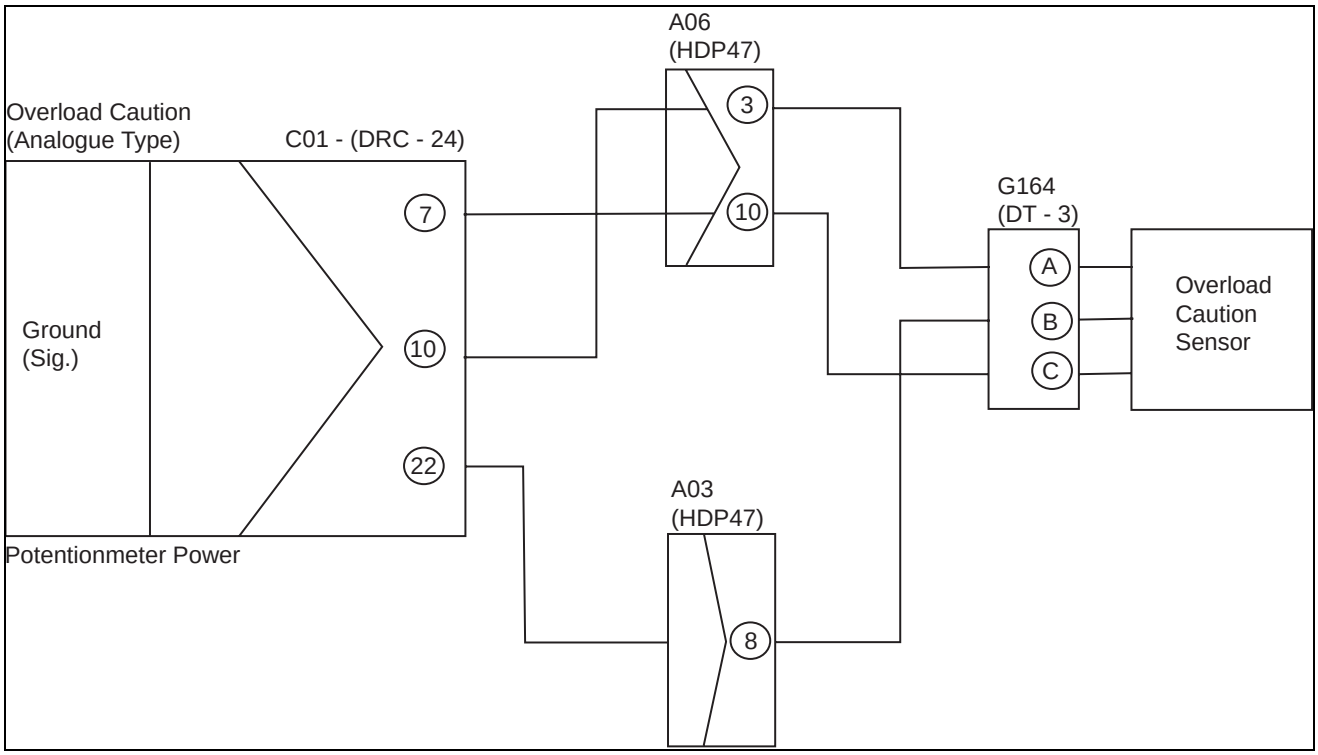


Service Code In Electrical System E251 (Abnormality in overload caution sensor)

User Code	Service Code	Failure Code	Failure phenomenon	Abnormality in overload caution sensor (in governor • pump controller system)
—	**E251**	**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 Ⓐ and Ⓑ	500 – 1,000 Ω		
			Between Ⓐ and Ⓒ	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) Ⓒ	Resistance value	Below 1 Ω	
			Wiring harness between C01 (female) ⑩ and G164 (female) Ⓐ Wiring harness between C01 (female) ㉒ and G164 (female) Ⓑ	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) Ⓑ and grounding Wiring harness between C01 (female) ⑦ and G164 Ⓒ and grounding.	Voltage	Below 1 V	
	4	Governor • 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		

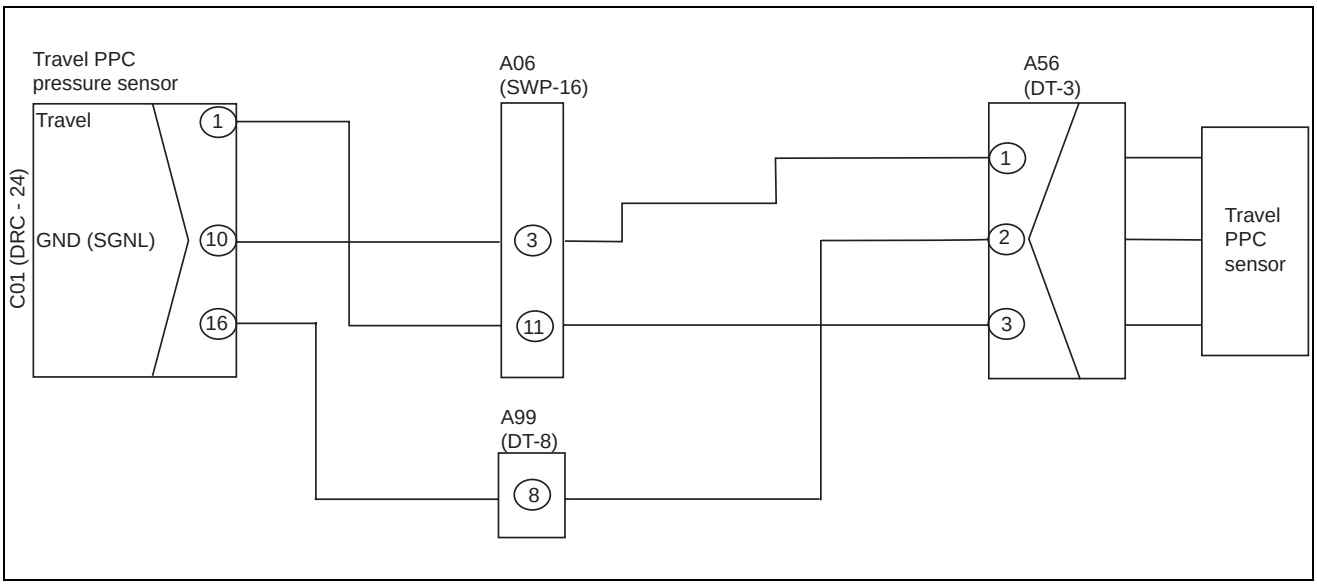
Electrical Circuit Diagram for Overload Caution



Service Code in Electrical System E252 (Abnormality in travel PPC sensor)

User Code	Service Code	Failure Code	Failure phenomenon	Abnormality in the travel PPC sensor in governor • pump controller system)
E20	**E252**	**DHS2KX**		
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				

	Cause		Standard value in normal and references for troubleshooting			
Presumed cause and standard value in normal	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 ① and ②	500 – 1,000 Ω		
			Between ① 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) ⑩ and A56 (female) ①	Resistance value	Below 1 Ω	
			Wiring harness between C01 (female) ① and A56 (female) ③	Resistance value	Below 1 Ω	
			Wiring harness between C01 (female) ⑯ 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) ⑯ and A56 (female) ① and grounding	Voltage	Below 1 V	
	4	Governor • 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 ⑯ and ⑩	500 – 1,000 Ω		
			Between ① and ⑩	Above 1 MΩ		

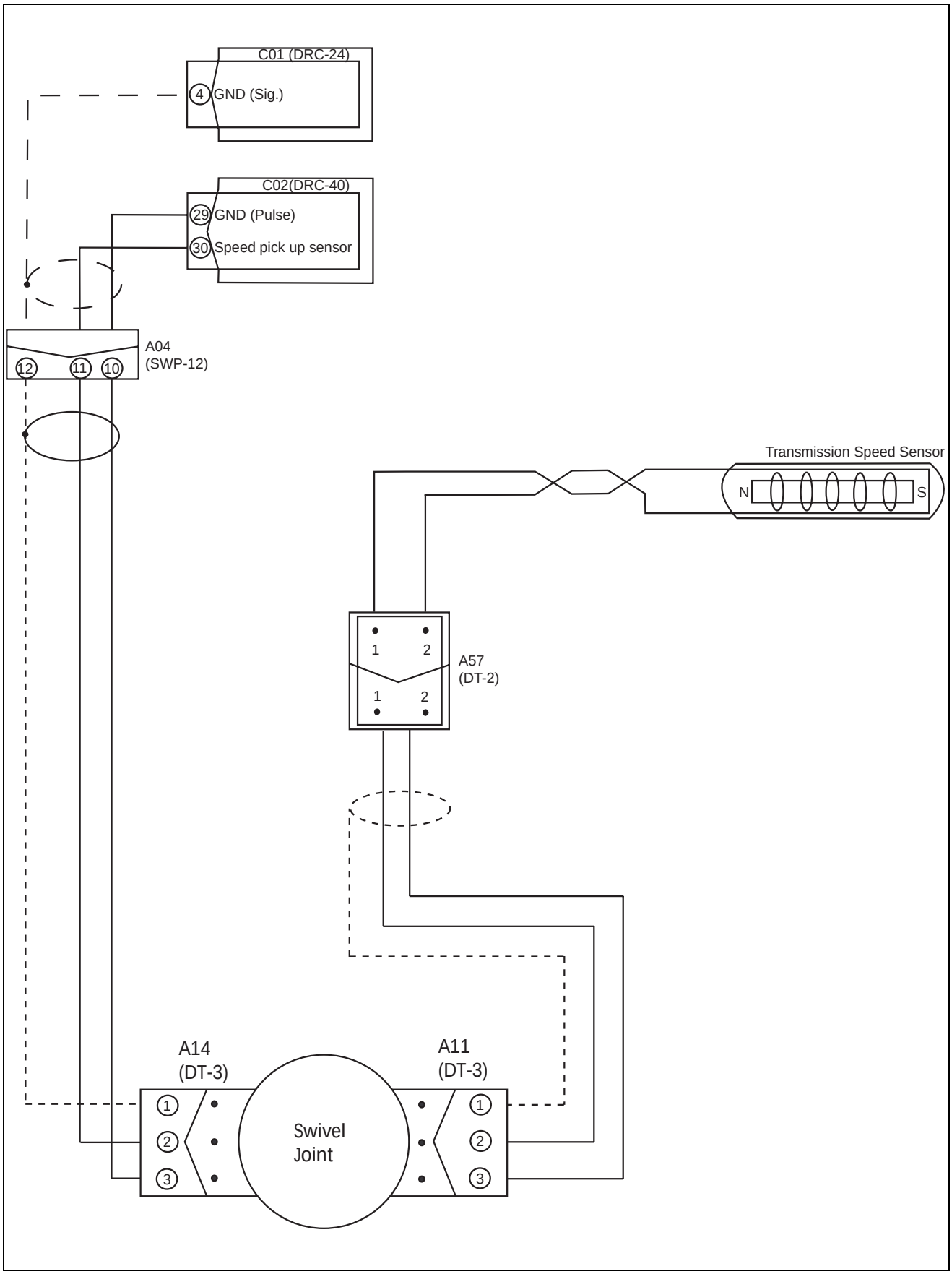


Service Code in Electrical System E254 (Disconnection in transmission speed sensor in governor • pump controller system)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in transmission speed sensor (in governor • pump controller system)
E20	**E254**	**DLT4KA**		
Failure content	➢ A normal pulse signal is not inputted to the signal circuit in the transmission speed sensor.			
Response from controller	➢ The machine will default to 'Hi' travel speed only. ➢ If the failure cause disappears of itself, the signal input returns to normal condition.			
Phenomenon occurring on machine	➢ The machine defaults to 'Hi' speed travel. ➢ Monitor will not display travel speed.			
Relative information	➢ Input from the transmission speed sensor (rpm) can be confirmed in the monitor function.			

	Cause		Standard value in normalcy and references for troubleshooting			
Presumed cause and standard value in normal	1	Transmission speed sensor fault (Internal short-circuiting or disconnection)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			A57 (male)	Resistance value		
			Between ① and ②	500 – 1,000 Ω		
			Between ① and grounding	Above 1 MΩ		
	2	Transmission speed sensor adjustment improper	For the inspection and adjustment, refer to the section of "Adjusting Transmission speed Sensor" in this manual.			
	3	Disconnection of wiring harness (Disconnection or defective contact with connector)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Wiring harness between C02 (female) ㉚ and A57 (female) ①	Resistance value	Below 1 Ω	
			Between C02 (female) ㉙ and A57 ②.	Resistance value	Below 1 Ω	
	4	Short-circuiting of wiring harness (Contact with 24 V circuit)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			Wiring harness between C02 (female) ㉚ and A57 (female) ② and grounding	Voltage	Below 1 V	
	5	Governor • 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



Service Code in Electrical System E256 (Incorrect non-volatile memory data)

User Code	Service Code	Failure Code	Failure phenomenon	Incorrect non-volatile memory data (in governor • pump controller)
—	**E256**	**DA20KT**		
Failure content	➢ The data in the non-volatile memory in the controller cannot be updated.			
Response from controller	➢ None in particular ➢ Even if the failure cause disappears, the non-volatile memory does not return to normal, unless the engine starting switch is once turned OFF.			
Phenomenon occurring on machine	➢ In some cases control parameters of the machines change, resulting in increase or decrease of the machine's power.			
Relative information	➢ Recorded in the non-volatile memory are part of the machine control parameters			

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting
	1	Governor • pump controller defective	As it is an internal failure, troubleshooting is impossible. (There is no problem with continuing with use of the controller, so long as no failure is visually evident)

Service Code in Electrical System E257 (Abnormality in travel PPC switch hydraulics)

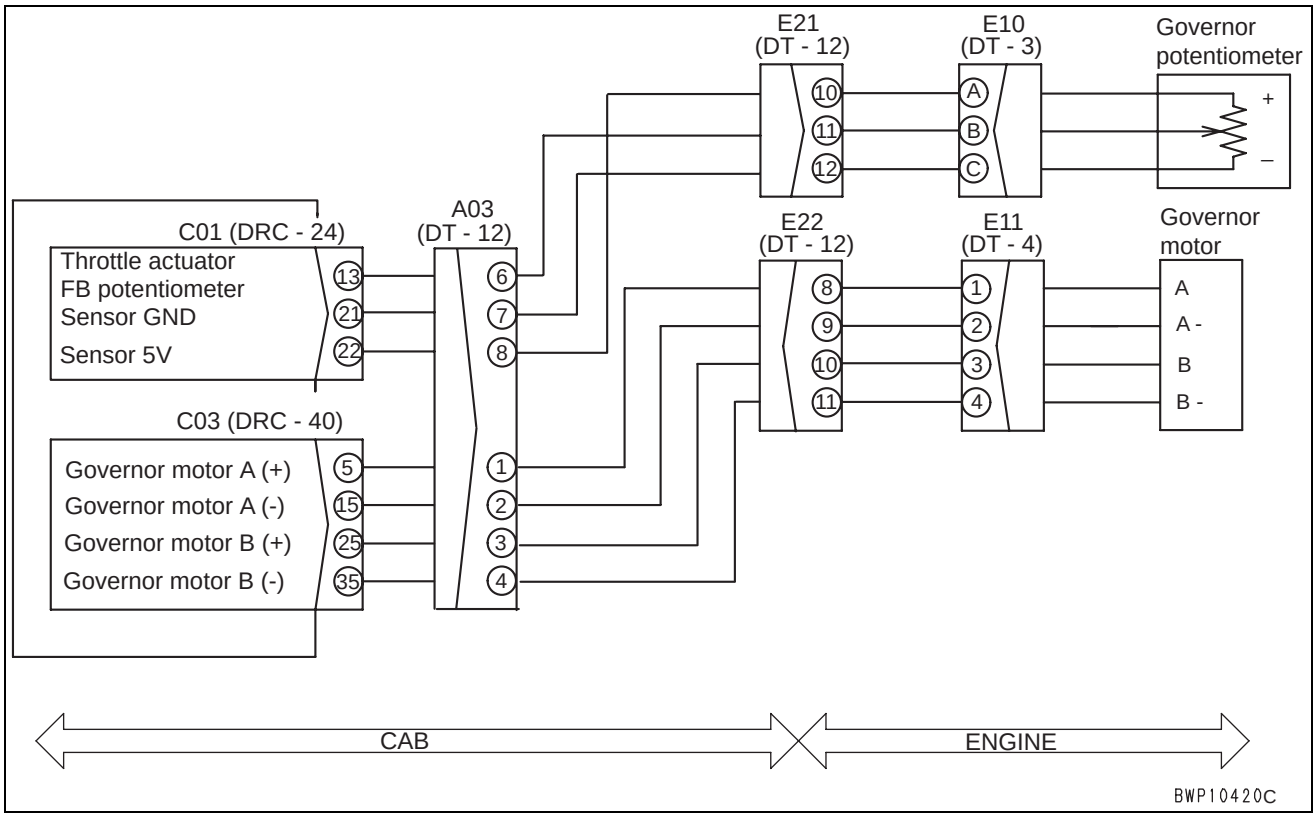
User Code	Service Code	Failure Code	Failure phenomenon	Incorrect non-volatile memory data (in governor • pump controller)
—	**E257**	**6B2JMA**		
Failure content	➢ Hydraulic signal activates one pressure switch (Either forward or reverse but R.H PPC work lever switch selects opposite travel direction.			
Response from controller	➢ Error code is displayed on the monitor panel.			
Phenomenon occurring on machine	➢ Engine speed raises when travel pedal is operated but machine does not travel.			
Relative information	➢ This error ocurs when hydraulic PPC travel hoses are connected to incorrect ports. Countermeasure - Swap hoses.			

Service Code in Electrical System E306 (Abnormality in governor potentiometer)

User Code	Service Code	Failure Code	Failure phenomenon	Abnormality in governor potentiometer (in governor • pump controller)
—	**E306**	**DK54KZ**		
Failure content	➢ Signal voltage from the governor potentiometer dropped below 0.4 V or exceeded 4.6 V.			
Response from controller	➢ The controller exercises control by computing the motor position through voltage right before a failure occurred. ➢ Even if the failure cause disappears of itself, the governor potentiometer does not return to normal, unless the engine starting switch is once turned OFF.			
Phenomenon occurring on machine	➢ The engine cannot attain the specified rotation at high idling. (Lower than normal operation) ➢ The engine cannot attain the specified rotation at low idling (Higher than normal operation) ➢ The auto-deceleration or automatic warming-up function does not work. ➢ There is hunting while the engine is running. ➢ The engine stalls. ➢ The engine does not stop.			
Relative information	➢ Input from the governor potentiometer (voltage) can be confirmed in the monitor function. (Code No. 031: Governor potentiometer voltage)			

	Cause		Standard value in normal and references for troubleshooting			
Presumed cause and standard value in normal	1	Sensor power source defective	If Service Code No. [E226] is displayed, troubleshoot the failure first.			
	2	Governor potentiometer defective (Internal failure)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			E10 (male)	Resistance value		
			Between Ⓐ and Ⓒ	4.0 – 6.0 kΩ		
			Between Ⓑ and Ⓐ	0.25 – 5.0 kΩ		
			Between Ⓑ and Ⓒ	0.25 – 5.0 kΩ		
	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) ㉒ to E10 (female) Ⓐ	Resistance value	Below 1 Ω	
			Wiring harness between C01 (female) ㉑ and E10 (female) Ⓒ	Resistance value	Below 1 Ω	
			Wiring harness between C01 (female) ⑬ and E10 (female) Ⓑ	Resistance value	Below 1 Ω	
	4	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 C01 (female) ⑬ and E10 (female) Ⓑ 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.			
			Between wiring harness from C01 (female) ㉒ to E10 (female) Ⓐ and grounding	Voltage	Below 1 V	
			Between wiring harness between C01 (female) ⑬ and E10 (female) Ⓑ and grounding	Voltage	Below 1 V	
	6	Governor • pump controller defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C01	Resistance value		
			Between ㉒ and ㉑	4.5 – 5.5 V		
			Between ⑬ and ㉑	0.5 – 4.5 V		

Electrical Circuit Diagram for Governor Motor in Governor • Pump Controller

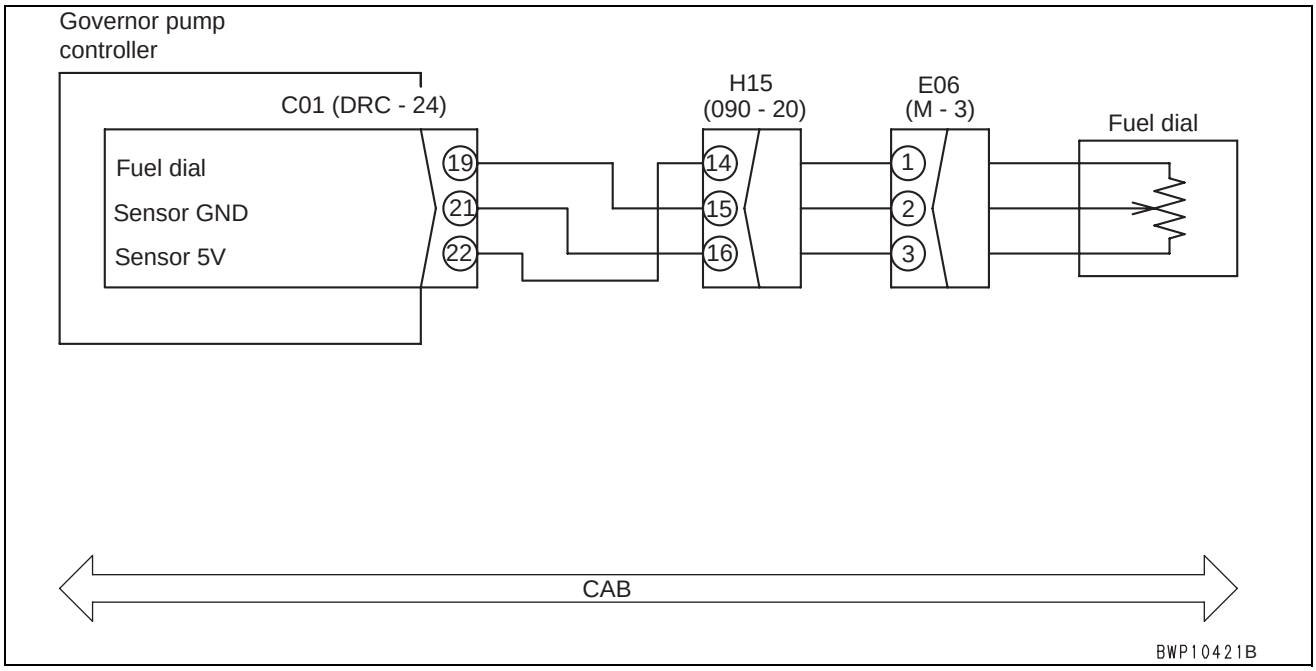


Service Code in Electrical System E308 (Abnormality in fuel dial)

User Code	Service Code	Failure Code	Failure phenomenon	Abnormality in governor fuel dial (in governor • pump controller)
E05	**E308**	**DK10KZ**		
Failure content	➢ Signal voltage from the from fuel dropped below 0.23 V or exceeded 4.77 V.			
Response from controller	➢ The controller exercises control by computing the fuel dial position through voltage right before a failure occurred. ➢ If the failure cause disappears, the fuel dial returns to normal.			
Phenomenon occurring on machine	➢ If the fuel dial had been set at FULL before a failure occurred, it does not change to PARTIAL. ➢ If the fuel dial had been set at PARTIALLY before a failure occurred, it does not change to FULL. ➢ There is hunting while the engine is running. ➢ The engine cannot attain the specified rotation at high idling and lacks power.			
Relative information	➢ Input from the fuel dial (voltage) can be confirmed in the monitor function. (Code No. 030: Fuel dial voltage)			

	Cause		Standard value in normal and references for troubleshooting			
Presumed cause and standard value in normal	1	Sensor power source defective	If Service Code No. [E226] is displayed, troubleshoot the failure first.			
	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.			
			E06 (male)	Resistance value		
			Between ① and ③	4.0 – 6.0 kΩ		
			Between ② and ①	0.25 – 5.0 kΩ		
			Between ② and ③	0.25 – 5.0 kΩ		
	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) ㉒ to E06 (female) ①	Resistance value	Below 1 Ω	
			Wiring harness between C01 (female) ㉑ and E06 (female) ③	Resistance value	Below 1 Ω	
			Wiring harness between C01 (female) ⑲ and E06 (female) ②	Resistance value	Below 1 Ω	
	4	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 C01 (female) ⑲ and E06 (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.			
			Between wiring harness from C01 (female) ㉒ to E06 (female) ① and grounding	Voltage	Below 1 V	
			Wiring harness between C01 (female) ⑲ and E06 (female) ② and grounding	Voltage	Below 1 V	
	6	Governor • pump controller defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C01	Resistance value		
			Between ㉒ and ㉑	4.5 – 5.5 V		
			Between ⑲ and ㉑	0.5 – 4.5 V		

Electrical Circuit Diagram for Fuel Dial in Governor • Pump Controller

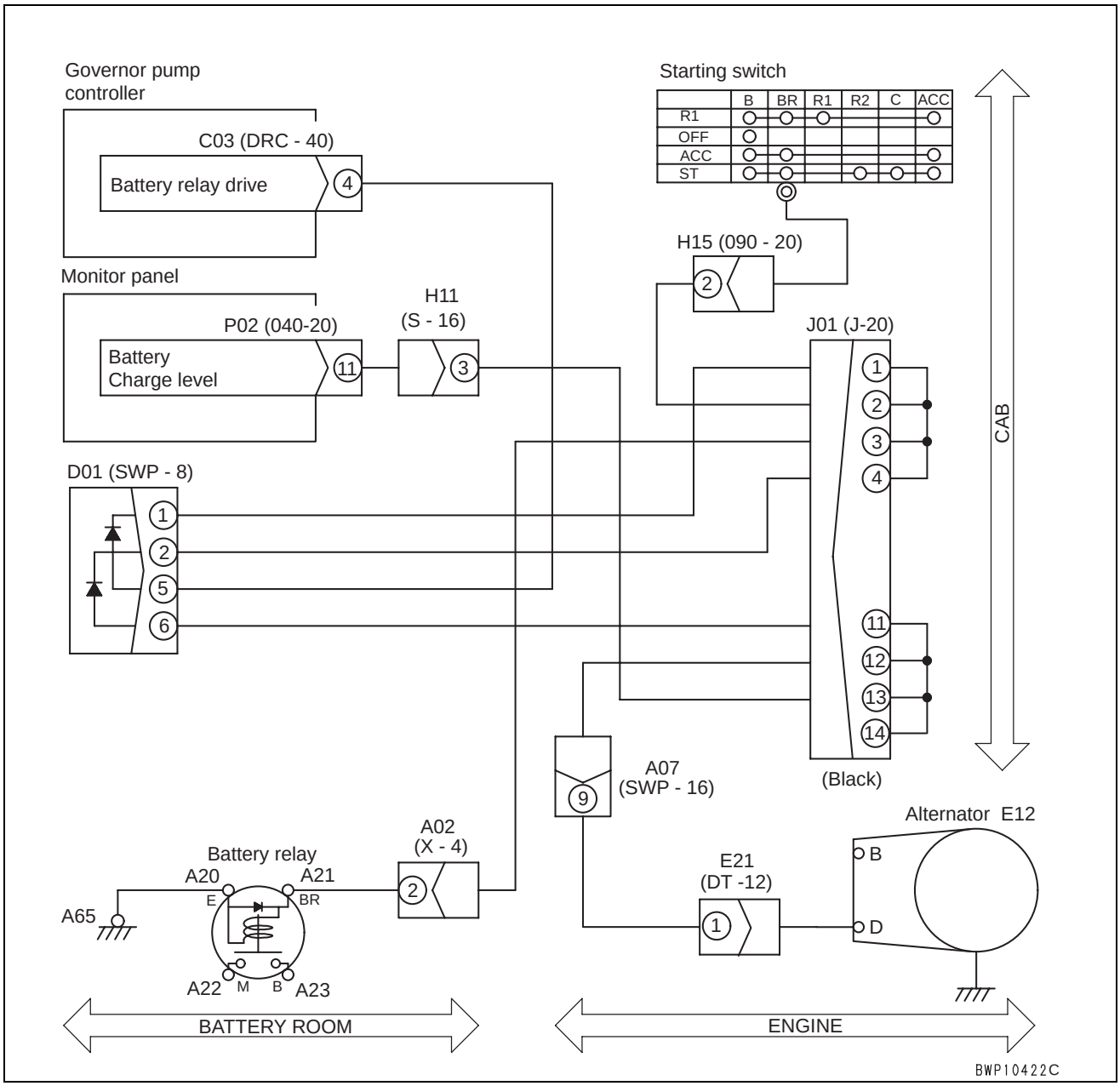


Service Code in Electrical System E315 (Short-circuiting in battery relay)

User Code	Service Code	Failure Code	Failure phenomenon	Short-circuiting in battery relay (in governor • pump controller)
—	**E315**	**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. 037: 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	Governor • 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 in Governor • Pump Controller



Service Code in Electrical System E316 (Step-out in governor motor)

User Code	Service Code	Failure Code	Failure phenomenon	Step-out in governor motor (in governor • pump controller)
—	**E316**	**DY10K4**		
Failure content	➢ There is a big difference between signals from the potentiometer and the set values in the controller.			
Response from controller	➢ The controller repeats the same controlling motions (step-out). ➢ Even when the failure cause disappears, the governor motor does not return to normal, unless the engine starting switch is once turned OFF.			
Phenomenon occurring on machine	➢ The engine rotation cannot be controlled. ➢ There is hunting in the rotation. ➢ The engine does not stop.			

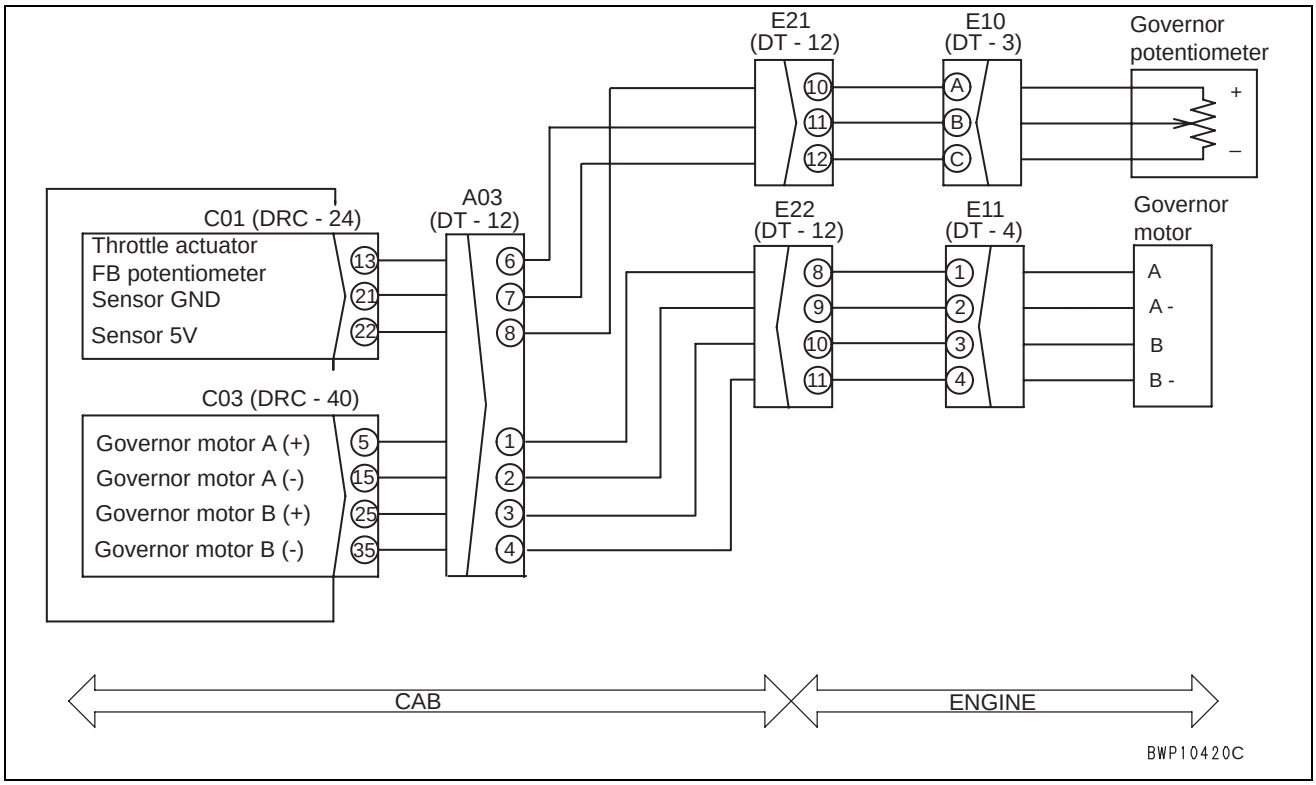
Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting
	1	Fuel dial defective	If Service Code [E308] is displayed, troubleshoot that failure first.
	2	Governor potentiometer defective	If Service Code [E306] is displayed, troubleshoot that failure first.
	3	Governor motor defective (disconnection)	If Service Code [E317] is displayed, troubleshoot that failure first.
	4	Governor motor defective (short-circuiting)	If Service Code [E318] is displayed, troubleshoot that failure first.
	5	Governor lever adjustment improper	Refer to the section of "Inspection and Adjustment - Special Function of Monitor Panel" in this manual.
	6	Engine fuel control system defective	Refer to Engine Shop Manual.
	7	Governor • pump controller defective	As this is an internal failure, no troubleshooting can be carried out. (If there is none of the failures listed above, the controller is judged as defective)

Service Code in Electrical System E317 (Disconnection in governor motor Phase A and B)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in governor motor Phase A and B (in governor • pump controller)
E05	**E317**	**DY10KA**		
Failure content	➢ No current flow to the governor motor, when power was supplied to the motor.			
Response from controller	➢ None in particular. ➢ If the failure cause disappears, the governor returns to normal.			
Phenomenon occurring on machine	➢ The engine rotation drops to low idling. ➢ There is hunting in the rotation ➢ The engine does not stop. ➢ The governor motor steps out.			
Relative information	➢ Operation of the governor motor (current) can be confirmed in the monitor function. (Code No. 033: Governor motor Phase A current, Code No. 034: Governor motor Phase B current)			

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Governor motor defective (Internal disconnection)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			E11 (male)	Resistance value		
			Between ① and ②	2.5 – 7.5 Ω		
			Between ③ and ④	2.5 – 7.5 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 C03 (female) ⑤ and E11 (female) ①	Resistance value	Below 1 Ω	
			Wiring harness between C03 (female) ⑮ and E11 (female) ②	Resistance value	Below 1 Ω	
			Wiring harness between C03 (female) ㉕ and E11 (female) ③	Resistance value	Below 1 Ω	
			Wiring harness between C03 (female) ㉟ and E11 (female) ④	Resistance value	Below 1 Ω	
	3	Governor • pump controller defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ⑤ and ⑮	2.5 – 7.5 Ω		
			Between ㉕ and ㉟	2.5 – 7.5 Ω		

Electrical Circuit Diagram for Governor Motor in Governor • Pump Controller

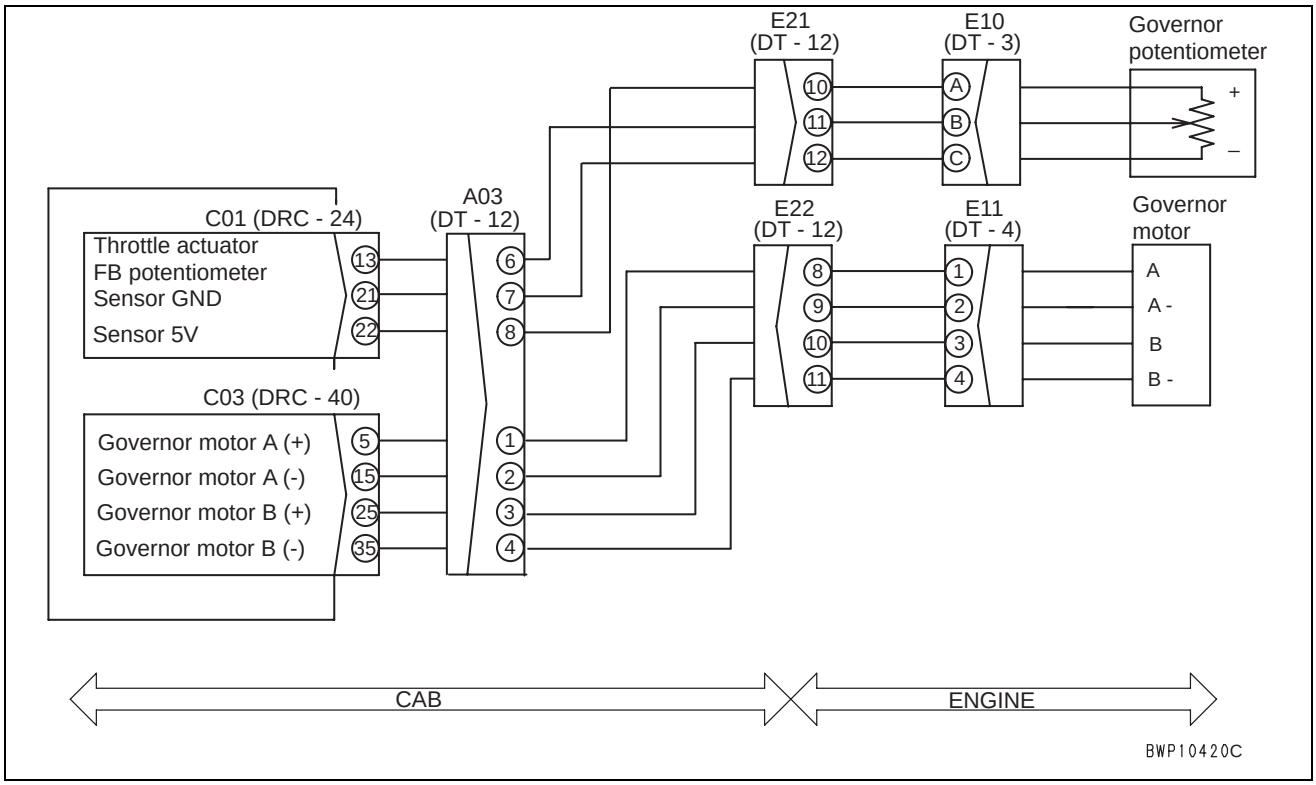


Service Code in Electrical System E318 (Short-circuiting in governor motor Phase A and Phase B)

User Code	Service Code	Failure Code	Failure phenomenon	Disconnection in governor motor Phase A and Phase B (in governor • pump controller system)
E05	**E318**	**DY10KB**		
Failure content	➢ Abnormal current flow to the governor motor, when power is supplied to the motor.			
Response from controller	➢ None in particular ➢ If the failure cause disappears, the governor motor returns to normal.			
Phenomenon occurring on machine	➢ The engine rotation cannot be controlled. ➢ The engine rotation drops to low idling. ➢ There is hunting in the rotation. ➢ The engine does not stop.			
Relative information	➢ Operation of the governor motor (current) can be confirmed in the monitor function. (Code No. 033: Governor motor Phase A current, Code No. 034: Governor motor Phase B current)			

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Governor motor 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.			
			E11 (male)	Resistance value		
			Between ① and ②	2.5 – 7.5 Ω		
			Between ③ and ④	2.5 – 7.5 Ω		
			Between ① and grounding	Above 1 MΩ		
			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 C03 (female) ⑤ and E11 (female) ① and grounding	Resistance value	Above 1 MΩ	
			Wiring harness between C03 (female) ⑮ and E11 (female) ② and grounding	Resistance value	Above 1 MΩ	
			Wiring harness between C03 (female) ㉕ and E11 (female) ③ and grounding	Resistance value	Above 1 MΩ	
			Wiring harness between C03 (female) ㉟ and E11 (female) ④ and grounding	Resistance value	Above 1 MΩ	
	3	Governor • pump controller defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			C03 (female)	Resistance value		
			Between ⑤ and ⑮	2.5 – 7.5 Ω		
			Between ㉕ and ㉟	2.5 – 7.5 Ω		
			Between ⑤ and grounding	Above 1 MΩ		
			Between ⑮ and grounding	Above 1 MΩ		
			Between ㉕ and grounding	Above 1 MΩ		
			Between ㉟ and grounding	Above 1 MΩ		

Electrical Circuit Diagram for Governor Motor in Governor • Pump Controller



Failure Code in Mechanical System A000N1 (Out-of-rate engine rotation at high idling)

User Code	Service Code	Failure Code	Failure phenomenon	Engine rotation at high idling out of rate (in mechanical system)
—	—	**A000N1**		
Failure content	• Engine rotation above 2,450 rpm was detected for more than 10 seconds, while the engine was running.			
Response from controller	• None in particular • If the failure cause disappears of itself, the engine rotation returns to normal.			
Phenomenon occurring on machine	• There is a possibility that the engine is damaged, if it is used continuously without adjustment.			
Relative information	• Input from the engine rotation sensor (rpm) can be confirmed in the monitor function. (Code No. 010: Engine rotation)			

	Cause		Standard value in normal and references for troubleshooting
Presumed cause and standard value in normal	1	Failure in engine mechanical system	Check if there has been an internal or external factor that would cause the engine to overrun at high idling, and troubleshoot the mechanical system of the engine.
	2	Governor • pump controller defective	As this is an internal failure, troubleshooting cannot be conducted. (Unless there is any visible trouble found in the machine, use of the controller may be continued as it is)

Failure Code in Mechanical System A000N2 (Out-of-rate engine rotation at low idling)

User Code	Service Code	Failure Code	Failure phenomenon	Out-of-rate engine rotation at low idling (in mechanical system)
—	—	**A000N2**		
Failure content	• Engine rotation below 500 rpm was detected for more than 10 seconds, while the engine was running.			
Response from controller	• None in particular • If the failure cause disappears of itself, the rotation returns to normal.			
Phenomenon occurring on machine	• There is a possibility that the engine is damaged, if it is used continuously without adjustment.			
Relative information	• Input from the engine rotation sensor (rpm) can be confirmed in the monitor function. (Code No. 010: Engine rotation)			

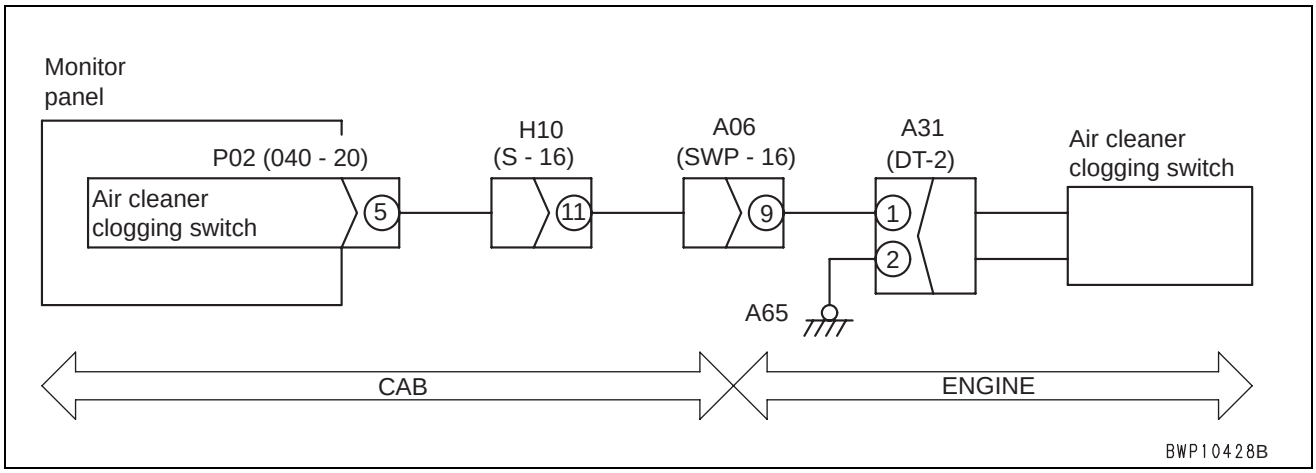
	Cause		Standard value in normal and references for troubleshooting
Presumed cause and standard value in normal	1	Failure in engine mechanical system	Check if there has been an internal or external factor that would cause the engine to overrun at high idling, and troubleshoot the mechanical system of the engine.
	2	Governor • pump controller defective	As this is an internal failure, troubleshooting cannot be conducted. (Unless there is any visible trouble found in the machine, use of the controller may be continued as it is)

Failure Code in Mechanical System AA10NX (Air cleaner clogging)

User Code	Service Code	Failure Code	Failure phenomenon	Air cleaner clogged (in mechanical system)
—	—	**AA10NX**		
Failure content	➢ While the engine was running, the signal circuit in the air cleaner clogging switch was opened (i.e. disconnected from grounding circuit).			
Response from controller	➢ None in particular			
Phenomenon occurring on machine	➢ There is a possibility that the engine is damaged, if it is used continuously without corrective action.			
Relative information	➢ This Failure Code is recorded, when the air cleaner clogging caution symbol is displayed in the monitor panel while the engine is running. ➢ Input from the air cleaner clogging switch (ON or OFF) can be confirmed in the monitor panel. (Code No. 046: Monitor input 2)			

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Air cleaner clogged (when the system is in normal condition)	➢ Check the air cleaner for clogging. If it is clogged, clean or replace it with new one.			
	2	Air cleaner clogging switch defective (Internal disconnection)	➢ Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
			A31 (male)	Air cleaner	Resistance value	
			Between ① and ②	When in normal condition	Below 1 Ω	
				When clogged	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 running during the troubleshooting.			
			Wiring harness between P02 (female) ⑤ and A31 (female) ①		Resistance value	Below 1 Ω
			Between wiring harness A31 (female) ② and grounding		Resistance value	Below 1 Ω
	4	Monitor panel defective	➢ Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
			P02	Air cleaner	Voltage	
			Between ⑤ and grounding	When in normal condition	Below 1 V	
				When clogged	20 – 30 V	

Electrical Circuit for Air Cleaner Clogging Switch in Monitor Panel

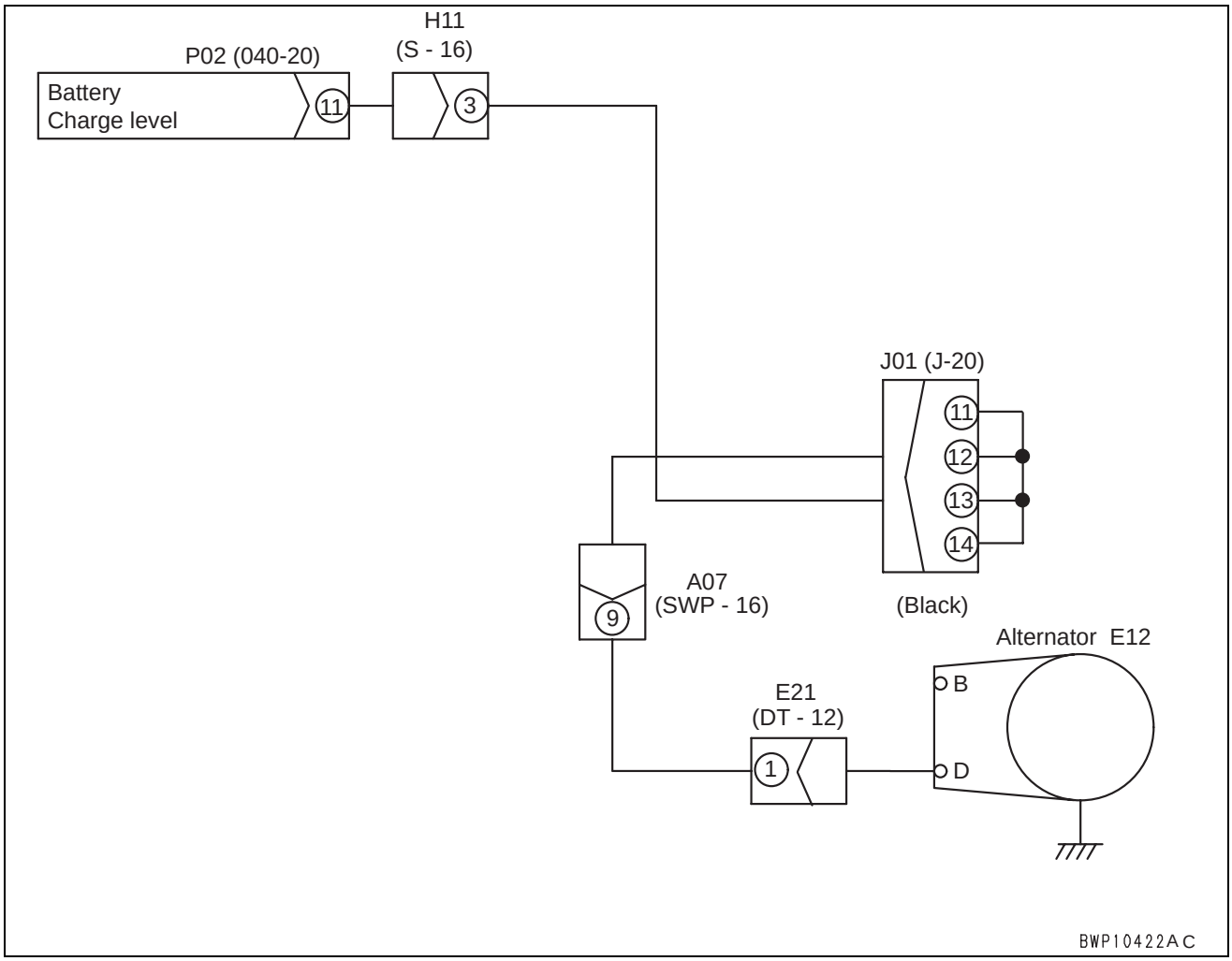


Failure Code in Mechanical System AB00KE (Charging voltage abnormally low)

User Code	Service Code	Failure Code	Failure phenomenon	Charging voltage abnormally lowered (in mechanical system)
—	—	**AB00KE**		
Failure content	➢ Generation signal from the alternator is not inputted, while the engine is running.			
Response from controller	➢ None in particular			
Phenomenon occurring on machine	➢ There is a possibility that the battery may not be charged, if charging is continued without corrective action.			
Relative information	➢ This Failure Code is recorded, if the charging caution symbol is displayed in the monitor panel, while the engine is running. ➢ Input from the alternator (voltage) can be confirmed in the monitor function. (Code No. 043: Charging voltage)			

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Alternator defective (short generating output)	➢ Turn the engine starting switch OFF for the preparations, and hold it running during the troubleshooting.			
			E12 (male)	Engine rotation	Voltage	
			Between D and grounding	Above medium speed	27.5 – 29.5 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.			
			Wiring harness from P02 (female) ⑪ to H11 to J01 to A07 to E21 to E12 (female) D.		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 from P02 (female) ⑪ to H11 to J01 to A07 to E21 to E12 (female) D.		Resistance value	Above 1 MΩ
	4	Monitor panel defective	➢ Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
			P02	Engine rotation	Voltage	
			Between ⑪ and grounding	Above medium speed	27.5 – 29.5 V	

Electrical Circuit Diagram for Engine Start, Stop and Charging in Monitor Panel

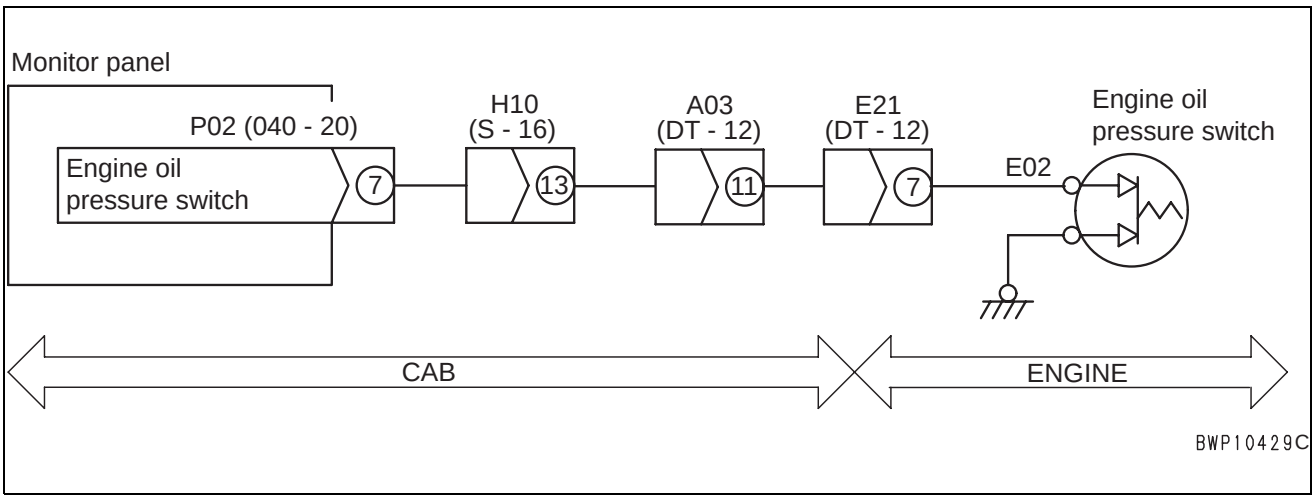


Failure Code in Mechanical System B@BAZG (Abnormally lowered engine oil pressure)

User Code	Service Code	Failure Code	Failure phenomenon	Engine oil pressure abnormally lowered (in mechanical system)
—	—	**B@BAZG**		
Failure content	➢ The signal circuit in the engine oil pressure switch was closed (i.e. connected with grounding), while the engine was running.			
Response from controller	➢ None in particular			
Phenomenon occurring on machine	➢ There is a possibility that the engine may seize, if the engine is kept running without corrective action.			
Relative information	➢ This Failure Code is recorded, if the engine oil pressure caution symbol is displayed in the monitor panel, while the engine is running. ➢ Input from the engine oil pressure switch (ON or OFF) can be confirmed in the monitor function. (Code No. 046: Monitor input 2)			

	Cause		Standard value in normal and references for troubleshooting			
Presumed cause and standard value in normal	1	Engine oil pressure lowered (the system in normal condition)	➢ Check the failure cause and damage to the engine, and then make repairs.			
	2	Engine oil pressure switch defective (Internal short-circuiting)	➢ Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
			E02 (on switch side)	Engine oil pressure	Resistance value	
			Between terminal and grounding	When in normal condition	Above 1 MΩ	
				When lowered	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 P02 (female) ⑦ and E02 (terminal) and grounding		Resistance value	Above 1 MΩ
	4	Monitor panel defective	➢ Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting.			
			P02	Engine oil pressure	Voltage	
			Between ⑦ and grounding	When in normal condition	20 – 30 V	
				When lowered	Below 1 V	

Electrical Circuit Diagram for Engine Oil Pressure Switch in Monitor Panel

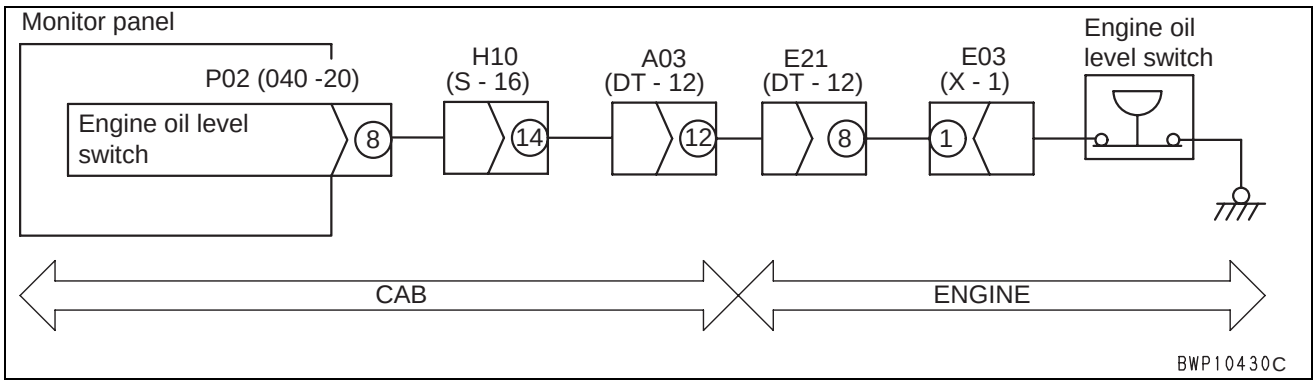


Failure Code in Mechanical System B@BAZK (Abnormally lowered engine oil level)

User Code	Service Code	Failure Code	Failure phenomenon	Engine oil level abnormally lowered (in mechanical system)
—	—	**B@BAZK**		
Failure content	➢ The signal circuit in the engine oil level switch was opened (i.e. disconnected from grounding), when the engine is stopped (with the starting switch in the ON position).			
Response from controller	➢ None in particular			
Phenomenon occurring on machine	➢ There is a possibility that the engine seizes if it is kept running without a corrective action.			
Relative information	➢ This Failure Code is recorded if the engine oil level caution symbol is displayed, when the engine is stopped (with the starting key in the ON position). ➢ Input from the engine oil level switch (ON or OFF) can be confirmed in the monitor function. (Code No. 046: Monitor input 2)			

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Engine oil level lowered (System in normal condition)	➢ Check the engine oil level, and refill oil. (If the phenomenon occurs frequently, check the cause)			
	2	Engine oil level switch defective (Internal disconnection)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			E03 (male)	Engine oil level	Resistance value	
			Between ① and grounding	When in normal condition	Below 1 Ω	
				When lowered	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 P02 (female) ⑧ and E03 (female) ①		Resistance value	Below 1 Ω
	4	Monitor panel defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			P02	Engine oil pressure	Voltage	
			Between ⑧ and grounding	When in normal condition	Below 1 V	
				When lowered	20 – 30 V	

Electrical Circuit Diagram for Engine Oil Level Switch in Monitor Panel

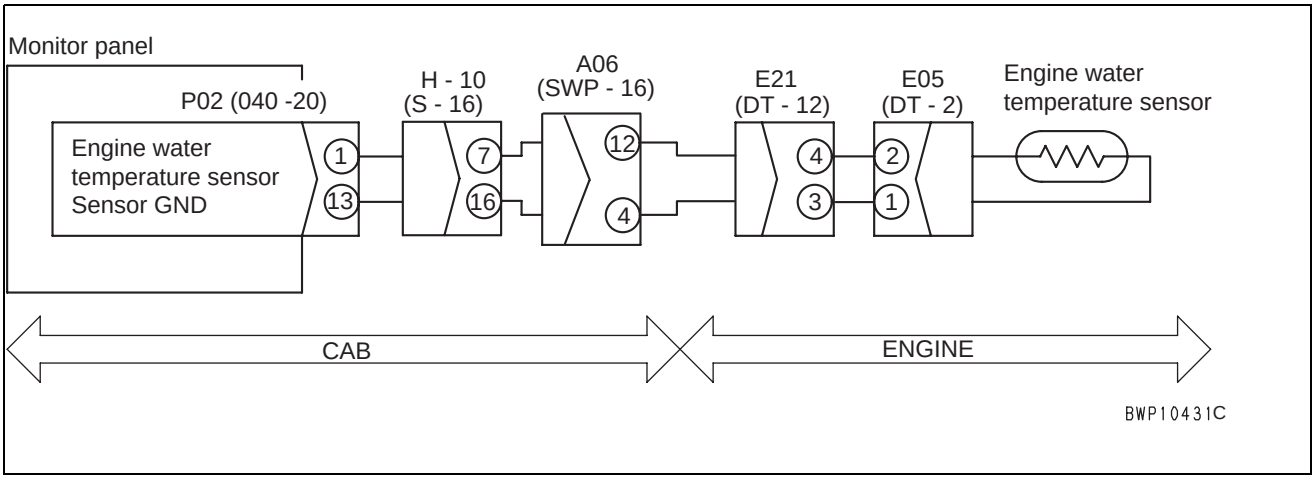


Failure Code in Mechanical System B@BCNS (Engine cooling water overheating)

User Code	Service Code	Failure Code	Failure phenomenon	Engine cooling water overheated (in mechanical system)
—	—	**B@BCNS**		
Failure content	➢ The engine cooling water sensor inputted a signal of 102°C, while the engine was running.			
Response from controller	➢ Response from controller			
Phenomenon occurring on machine	➢ There is a possibility that the engine seizes, if it is kept running without a corrective action.			
Relative information	➢ This Failure Code is recorded, if the engine cooling water temperature gauge is displayed in the red range, when the engine is running. ➢ Input from the engine cooling water temperature sensor (temperature) can be confirmed in the monitor function. (Code No. 041: Engine cooling water temperature)			

	Cause		Standard value in normal and references for troubleshooting			
Presumed cause and standard value in normal	1	Engine Overheating (system in normal condition)	➢ Check the engine for the cause and damage, and repair it.			
	2	Engine cooling water temperature sensor defective (Internal short-circuiting)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			E05 (male)	Engine cooling water temperature	Resistance value	
			Between ① and ②	10 – 100 °C	90 – 3.5kΩ	
			Between ② and grounding		Above 1 MΩ	
	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 P02 (female) ① and E05 (female) ② and grounding		Resistance value	Above 1 MΩ
	4	Monitor panel defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			P02 (female)	Engine water temperature	Resistance value	
			Between ① and ⑬	10 – 100 °C	90 – 3.5kΩ	
			Between ① and grounding		Above 1 MΩ	

Electrical Circuit Diagram for Engine Cooling Water Temperature Sensor in Monitor Panel



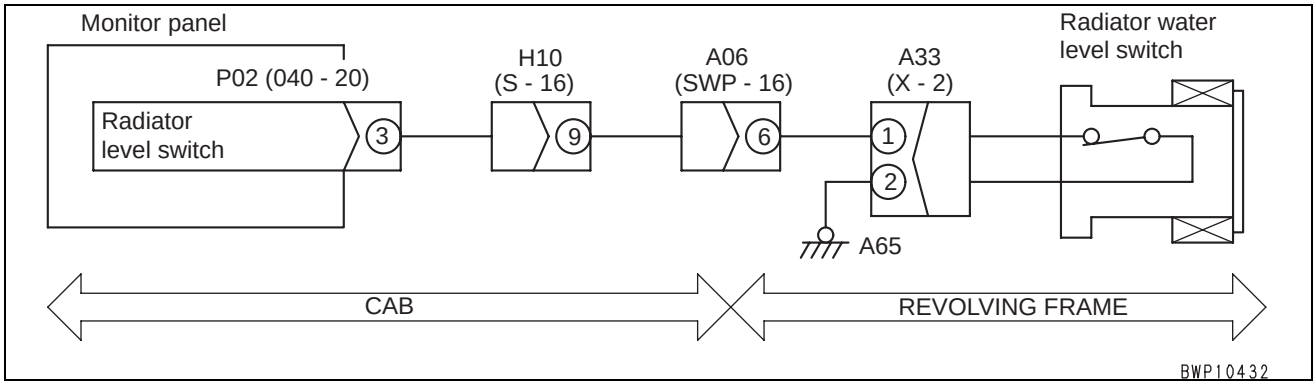
Failure Code in Mechanical System B@BCZK (Abnormally low radiator water level)

(Multi-monitor only)

User Code	Service Code	Failure Code	Failure phenomenon	Radiator water level abnormally lowered (in mechanical system)
—	—	**B@BCZK**		
Failure content	➢ The signal circuit in the radiator water level switch was opened (i.e. disconnected from grounding).			
Response from controller	➢ None in particular			
Phenomenon occurring on machine	➢ There is a possibility that the engine seizes, if it is kept running without a corrective action.			
Relative information	➢ This Failure Code is recorded, if the radiator water level caution symbol is displayed in the monitor panel, when the engine is running. ➢ Input from the radiator water level switch (ON or OFF) can be confirmed in the monitor function. (Code No. 045: Monitor input 1)			

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Radiator water level lowered (system in normal condition)	➢ Check the water level and refill cooling water. (If this phenomenon occurs frequently, check the cause)			
	2	Radiator water level switch defective (Internal disconnection)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			A33 (male)	Engine cooling water level	Resistance value	
			Between ① and ②	When in normal condition	Below 1 Ω	
				When lowered	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 P02 (female) ③ and A33 (female) ①		Resistance value	Below 1 Ω
			Wiring harness between A33 (female) ② and grounding		Resistance value	Below 1 Ω
	4	Monitor panel defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			P02	Engine water temperature	Resistance value	
			Between ③ and grounding	When in normal condition	Below 1 V	
				When lowered	20 – 30 V	

Electrical Circuit Diagram for Radiator Water Level Switch in Monitor Panel



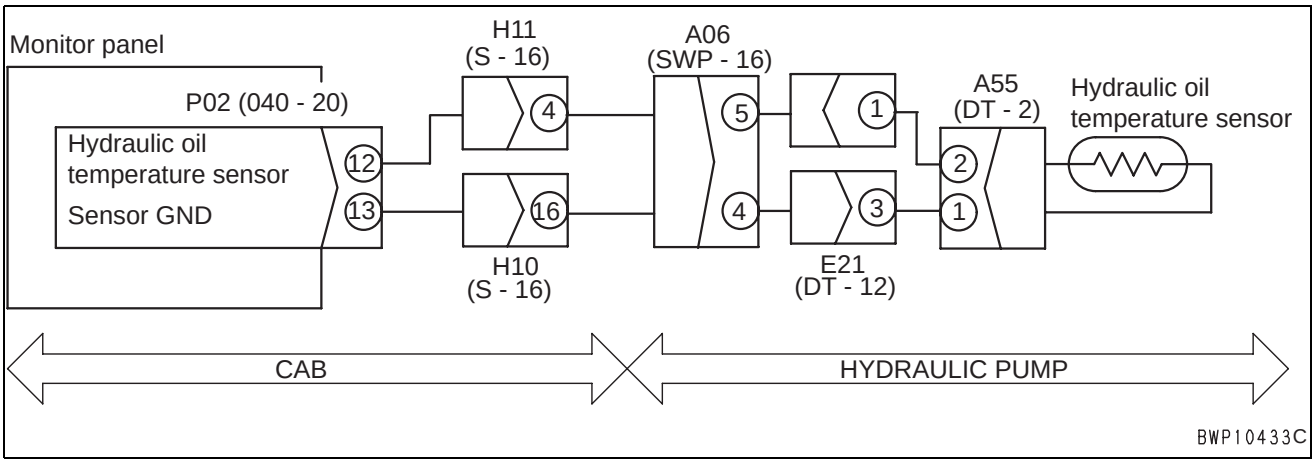
Failure Code in Mechanical System B@HANS (Hydraulic oil overheating)

(Multi-monitor only)

User Code	Service Code	Failure Code	Failure phenomenon	Hydraulic oil overheated (in mechanical system)
—	—	**B@HANS**		
Failure content	➢ The hydraulic oil temperature sensor inputted a signal of 102°C, while the engine was running.			
Response from controller	➢ None in particular			
Phenomenon occurring on machine	➢ There is a possibility that the engine seizes, if it is kept running without a corrective action.			
Relative information	➢ This Failure Code is recorded, if the hydraulic oil temperature gauge is displayed in the red range, when the engine is running. ➢ Input from the hydraulic oil temperature sensor (temperature) can be confirmed in the monitor function. (Code No. 044: Hydraulic oil temperature)			

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Hydraulic oil overheating (system in normal condition)	➢ Check the cause and damage to the hydraulic equipment, and repair it.			
	2	Hydraulic oil temperature sensor defective (Internal short-circuiting)	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			A55 (male)	Hydraulic oil temperature	Resistance value	
			Between ① and ②	10 – 100 °C	90 – 3.5kΩ	
			Between ② and grounding		Above 1 MΩ	
	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 P02 (female) ⑫ and A55 (female) ② and grounding		Resistance value	Above 1 MΩ
	4	Monitor panel defective	➢ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			P02 (female)	Engine water temperature	Resistance value	
			Between ⑫ and ⑬	10 – 100 °C	90 – 3.5kΩ	
			Between ⑫ and grounding		Above 1 MΩ	

Electrical Circuit Diagram for Hydraulic Oil Temperature Sensor in Monitor Panel



TROUBLESHOOTING OF ELECTRICAL SYSTEM (E-MODE)

INFORMATION CONTAINED IN TROUBLESHOOTING TABLE....20-502
E-1 Engine does not start (Engine does not rotate)....20-503
E-2 Engine stops while in operation....20-506
E-3 Engine speed is irregular, or there is hunting....20-508
E-4 Engine does not stop....20-510
E-5 Auto-decelerator does not work....20-512
E-6 Auto engine warm-up device does not work....20-513
E-7 Pre heater does not work....20-514
E-8 All work equipment, swing and travel do not move....20-516
E-9 One-touch Power Max Switch does not work....20-518
E-10 No display in monitor panel at all....20-519
E-11 Part of display on monitor panel is missing....20-520
E-12 Monitor panel displays contents irrelevant to the model....20-520
E-13 Fuel level monitor red lamp lights up while engine is running....20-521
E-14 Engine cooling water temperature gauge does not indicate correctly....20-522
E-15 Hydraulic oil temperature gauge does not display correctly....20-523
E-16 Fuel gauge does not display correctly....20-524
E-17 Swing lock monitor does not display correctly....20-525
E-18 When the monitor switch is operated, no display appears....20-528
E-19 Windshield wiper does not work....20-529
E-20 Alarming buzzer cannot be cancelled....20-532
E-21 "Boom RAISE" is not correctly displayed in monitor function....20-532
E-22 "Boom LOWER" is not correctly displayed in monitor function....20-533
E-23 "Arm DIGGING" is not correctly displayed in monitor function....20-534
E-24 "Arm DUMPING" is not correctly displayed in monitor function....20-535
E-25 "Bucket DIGGING" is not correctly displayed in monitor function....20-536
E-26 "Bucket DUMPING" is not correctly displayed in monitor function....20-537
E-27 "SWING" is not correctly displayed in monitor function....20-538
E-28 "TRAVEL" is not correctly displayed in monitor function....20-540
E-29 "Service" is not correctly displayed in monitor function....20-542
E-30 Air Conditioner does not work....20-544
E-31 Travel alarm does not sound....20-546

INFORMATION CONTAINED IN TROUBLESHOOTING TABLE

★ The following information are edited and contained in the "Information Contained in Troubleshooting Table". You are required to proceed with troubleshooting after fully grasping the contents.

Failure information	Phenomena occurring on machine
Relative information	Information on occurred failures and troubleshooting

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting
	1	Cause for presumed failure (The attached No. for filing and reference purpose only. It does not stand for any priority)	<Contents> • The standard values in normal by which to judge "good" or "no good" about presumed causes. • References for making judgement of "good" or "no good" <Phenomena of wiring harness fault> • Failure due to disconnection Defective contact with connector or disconnection of wiring harness has occurred. • Grounding fault A wiring harness that is not originally connected with a grounding circuit is in contact with it. • Failure due to short-circuiting A wiring harness that is not originally connected with a power source circuit (24 V) is in contact with it. <Points to remember in troubleshooting> 1) Connector denotation method and handling of T-adapters Insert or connect T-adapters in the following manner, unless specifically otherwise instructed. • If there is no indication of (male) or (female) in the connector No., pull off a connector and insert a T-adapter into both sides of male and female. • If there is an indication of (male9 and (female) in the connection No., pull off a connector and insert a T-adapter into only one side of (male) or (female). 2) Description sequence of pin No. and handling of circuit tester leads Connect the positive lead (+) and negative lead (–) for troubleshooting in the following manner unless specifically otherwise instructed. • Connect the positive lead (+) to a pin No. marked at the front or wiring harness. • Connect the negative lead (–) to a pin No. marked at the rear or wiring harness.
	2		
	3		
	4		
	5		

Relative Electrical Circuit Diagram

This is part of the electrical circuit diagram which shows the portion where the failure occurred.

- Connector No.: Indicates (Type - numbers of a pin) (color)
- Arrow: Roughly indicates the location in the machine where it is installed.

E-1 Engine does not start (Engine does not rotate)

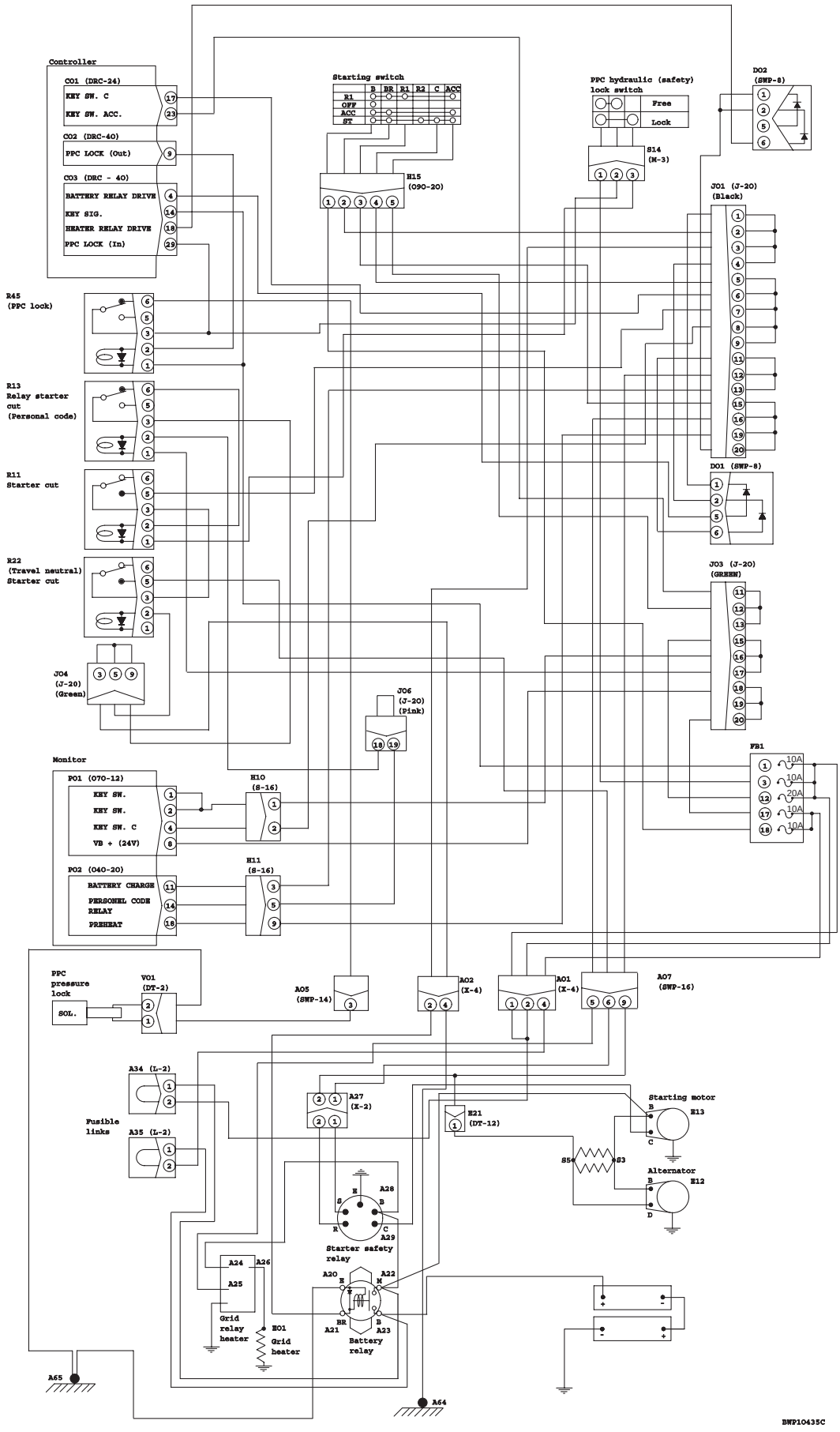
Failure information	• The engine does not start (the engine does not rotate).
Relative information	• The following two engine start locking mechanisms are provided in the engine starting circuit. 1) Engine start locking by means of password in the monitor panel (※) 2) Engine start locking by means of safety lock lever

Presumed cause and standard value in normal

	Cause	Standard value in normal and references for troubleshooting		
1	Shortage in battery capacity	Battery voltage	Battery electrolyte specific gravity	
		Above 24 V	Above 1.26	
2	Fuse Nos. 3 and 18 and Fusible Link A35 fault	When a fuse or fusible link is blown, there is a big possibility that grounding fault occurred in the circuit. If a monitor lamp does not light up in the monitor panel, check the power source circuit between the battery and the specific fuse.		
3	Engine starting switch fault (Internal disconnection)	★Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
		H15 (male)	Position	Resistance value
		Between ① and ④	OFF	Above 1 MΩ
			Start	Below 1 Ω
4	Safety lock switch fault (Internal short-circuiting)	★Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
		S14 (female)	Lock lever	Resistance value
		Between ① and ③	Release	Above 1 Ω
			LOCK	Below 1 MΩ
5	Engine starting + R22 motor cut relay, R11 and R13 defective (Internal disconnection or short-circuiting)	★Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
		R11 (female) & R13 (male) + R22	Resistance value	
		Between ① and ②	100 – 500 Ω	
		Between ③ and ⑤	Above 1 MΩ	
		Between ③ and ⑥	Below 1 Ω	
6	Engine starting motor fault (Internal disconnection or short-circuiting)	★Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting. (If all of the power source, grounding (GND), generation signal and engine start input are normal and yet the engine start output is not normal, the engine starting motor relay is defective)		
		Safety relay	Engine starting switch	Voltage
		Power source: Between B terminal and grounding	Start	20 – 30 V
		GND (grounding): Between E terminal and grounding		Connected
		Generation signal: Between R terminal (A27 ②) and grounding		Below 1 V
		Engine start input: Between C terminal and grounding		20 – 30 V
		Engine start output: Between S terminal (A27 ①) and grounding		20 – 30 V
7	Engine starting motor fault (Internal disconnection or damage)	★Turn the engine starting switch OFF for the preparations, and keep the engine running during the troubleshooting. (If all of the power source, grounding (GND), generation signal and engine start input are normal and yet the engine start output is not normal, the engine starting motor relay is defective)		
		Engine starting motor (E13)	Engine starting switch	Voltage
		Power source: B terminal and grounding	Start	20 – 30 V
		Engine start input: C terminal and grounding		20 – 30 V

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting		
	8	Alternator fault (Internal short-circuit)	➽ Turn the engine starting switch OFF for the preparations, and hold it in the ON position or running during the troubleshooting.		
			E12 (male)	Voltage	
			Between ① and grounding	Below 1 V	
	9	Disconnection of wiring harness (Disconnection or defective contact with connector)	➽ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.		
			Wiring harness between FB1-18 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 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 and R13 (female) ⑥	Resistance value	Below 1 Ω
			Wiring harness from R13 (female) ③ to J04 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 FB1-18 and grounding	Resistance value	Above 1 MΩ
			Wiring harness between FB1-18 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 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 J06 to H11 to P02 (female) ⑭ and grounding	Resistance value	Above 1 MΩ
	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 E08 (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

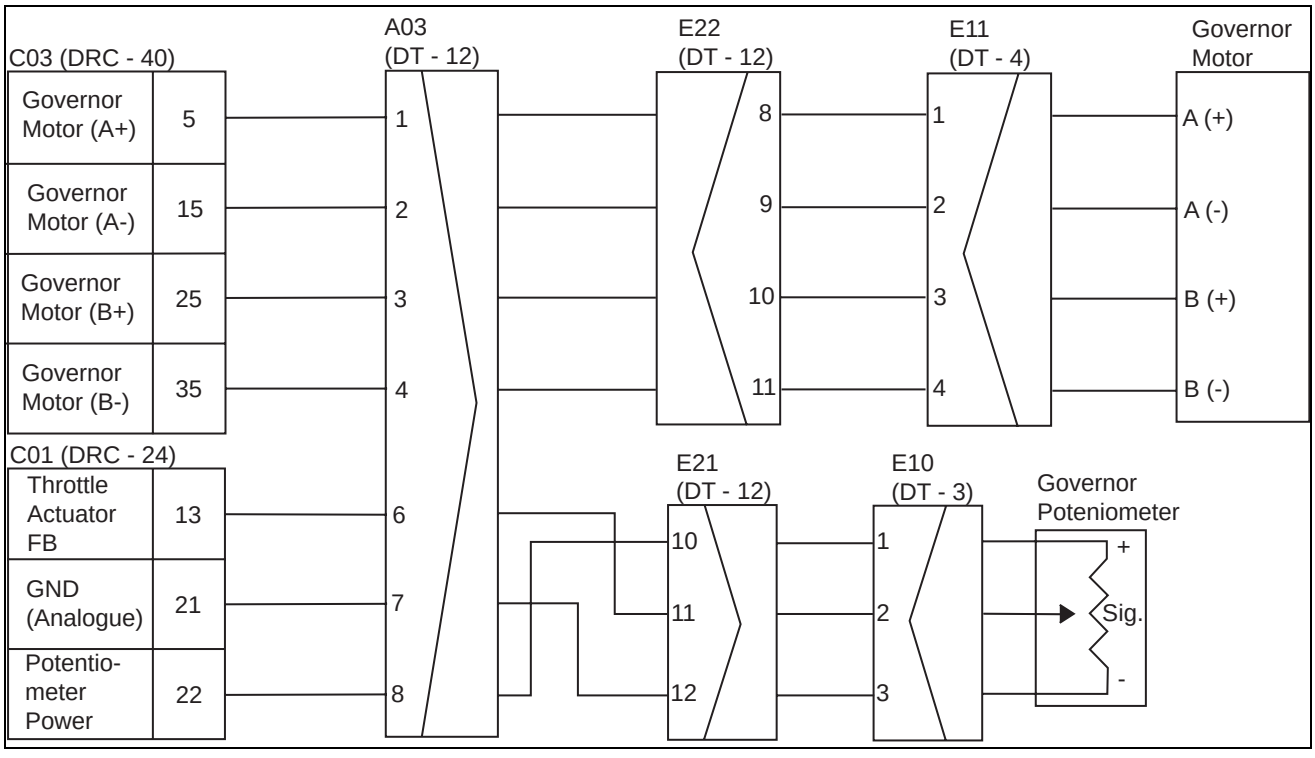


E-2 Engine stops while in operation

Failure information	➧ The engine suddenly stopped while in operation.
Relative information	➧ Input from the governor potentiometer (voltage) can be confirmed in the monitor function. (Code No. 031: governor potentiometer voltage)

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Governor potentiometer fault (Internal failure)	➧ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			E10 (male)	Resistance value		
			Between A and C	4.0 – 6.0 kΩ		
			Between B and A	0.25 – 5.0 kΩ		
			Between B and C	0.25 – 5.0 kΩ		
	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) ⑬ to A03 to E10 (female) Ⓑ	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 C01 (female) ⑬ and E10 (female) Ⓑ and grounding	Resistance value	Above 1 MΩ	
	4	Governor • 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 ㉑	4.5 – 5.5 V		
			Between ⑬ and ㉑	0.5 – 4.5 V		

Electrical Circuit Diagram for Fuel Dial

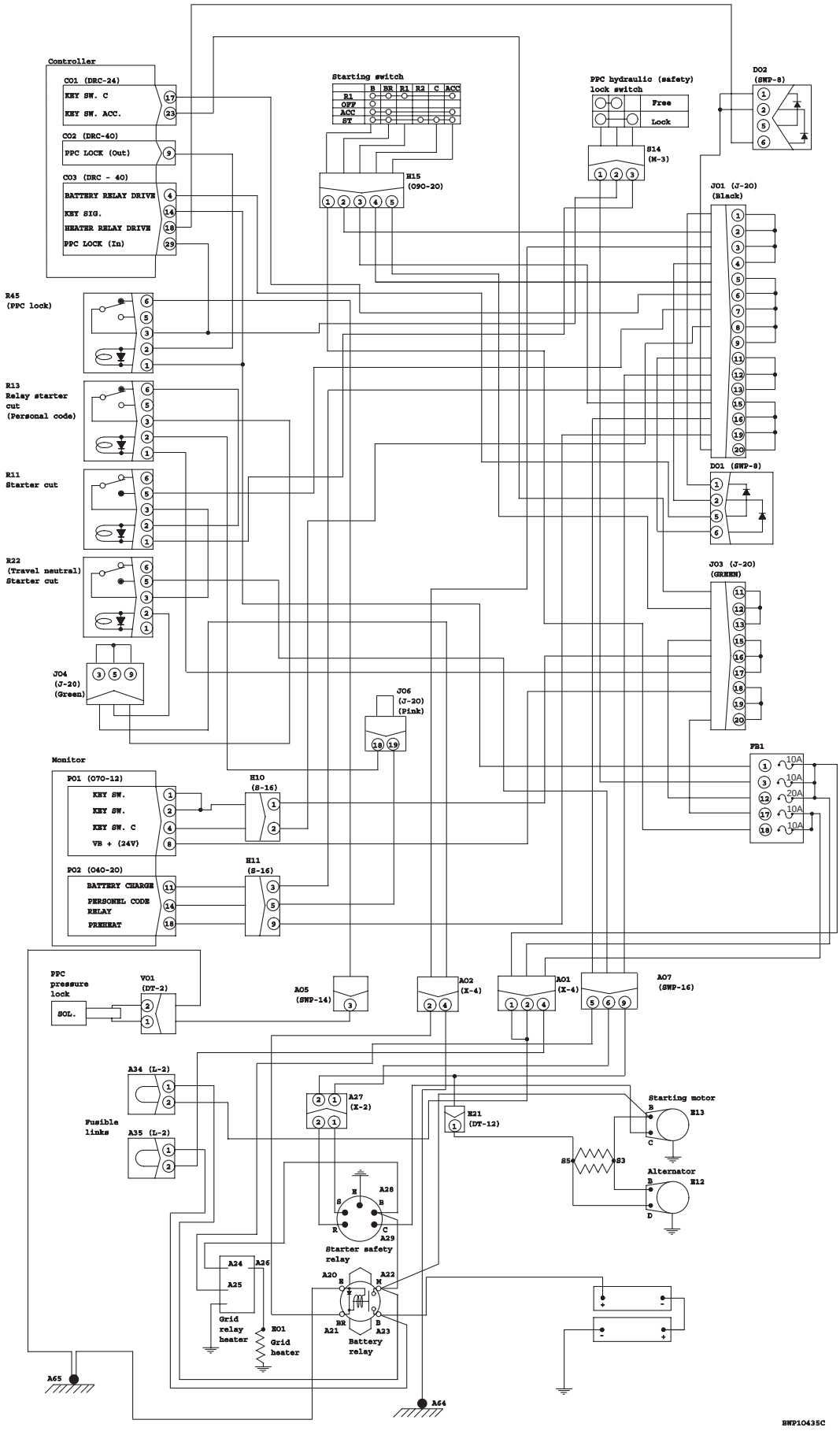


E-3 Engine speed is irregular, or there is hunting

Failure information	➧ Engine speed is irregular at low idling. ➧ There is hunting. ➧ Engine speed is lower than specified at high idling.
Relative information	➧ Engine rotation can be confirmed in the monitor function. (Code No. 010: Engine rotation)

<table>
<tr><td rowspan="11">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">1</td><td rowspan="3">Model code signal fault
(Internal failure)</td><td colspan="4">If the monitor display is not normal, proceed to Service Code [E217].</td></tr>
<tr><td>Monitoring Code</td><td>Item</td><td colspan="2">Normal display</td></tr>
<tr><td>002
003</td><td>Controller model code</td><td colspan="2">200</td></tr>
<tr><td>2</td><td>Governor lever improperly adjusted</td><td colspan="4">Refer to the section "Special Function of Monitor Panel" in this manual.</td></tr>
<tr><td>3</td><td>Governor motor improperly working</td><td colspan="4">If the governor motor lever moves smoothly in the following operations, it is judged as normal.
➧ The fuel dial is operated between low idling and high idling.
➧ The engine is stopped with the fuel dial.</td></tr>
<tr><td>4</td><td>Engine fuel control system defective</td><td colspan="4">Refer to the Engine Shop Manual.</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">Disconnection of wiring harness (Disconnection or defective contact with connector)</td><td colspan="4">➧ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.</td></tr>
<tr><td colspan="2">Wiring harness from C01 (female) ㉓ to J03 to H15 (female) ⑤</td><td>Resistance value</td><td>Below 1 Ω</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Grounding fault of wiring harness (Contact with grounding circuit)</td><td colspan="4">➧ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.</td></tr>
<tr><td colspan="2">Wiring harness between C01 (female) ㉓ to J03 and H15 (female) ⑤ and grounding</td><td>Resistance value</td><td>Above 1 MΩ</td></tr>
<tr><td>7</td><td>Governor • pump controller defective</td><td colspan="4">As this is an internal failure, troubleshooting cannot be conducted.
(If there is none of the causes from Item 1 to 6 above, the controller is judged as defective)</td></tr>
</table>

Electrical Circuit Diagram for Engine Start and Stop and Battery Charging

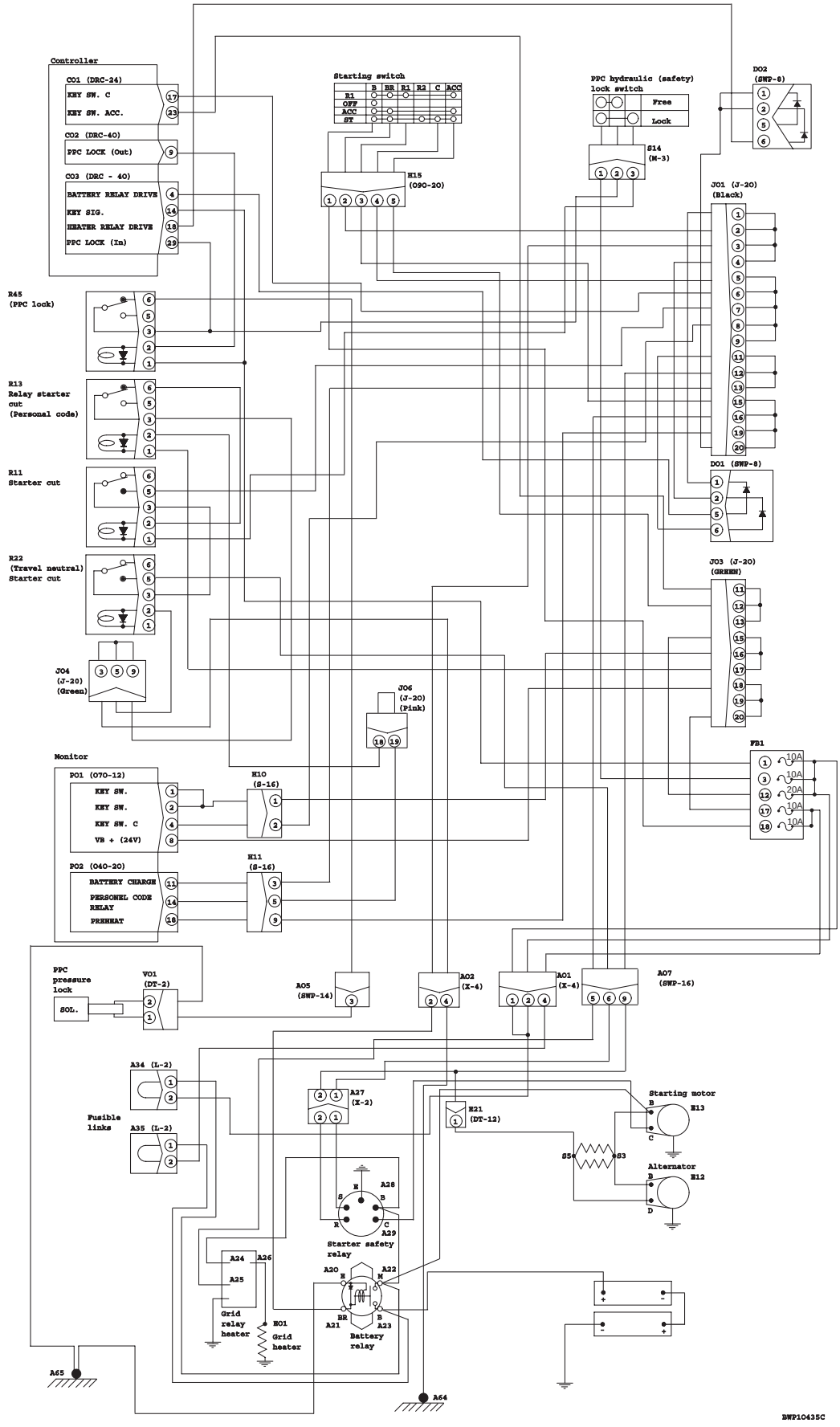


E-4 Engine does not stop

Failure information	• The engine does not stop.
Relative information	• The Governor • pump controller drives the battery relay for the min. 4 seconds and max. 7 seconds from the moment the engine starting switch is turned OFF to the moment the engine completely stops. • It can be confirmed in the monitor function how the battery relay works (ON or OFF) (Code No. 037: Controller output)

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting			
	1	Battery relay fault	If operating sound is heard from the battery relay contact, when turning the engine starting switch, the battery relay is judged as normal. • Starting switch OFF→ON→OFF			
	2	Assembled-type diode D01 fault (Internal disconnection)	★Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			D01 (male)	Digital type circuit tester	Continuity	
			Between ⑤ and ①	Diode mode	Continued	
	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) ④ and D01 (female) ⑤		Resistance value	Below 1 Ω
			Wiring harness from D01 (female) ① to J01 to A02 to battery relay BR terminal (A21)		Resistance value	Below 1 Ω
			Wiring harness between battery relay E terminal (A20) and grounding		Resistance value	Below 1 Ω
	4	Governor • pump controller defective	★Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.			
			C03	Engine starting switch	Voltage	
			Between ④ and grounding	ON→OFF	20 – 30 V (for 4 to 7 seconds)	

Electrical Circuit Diagram for Engine Start and 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 No. E-21 Troubleshooting.		
			Monitoring code	Item	Normal display
			019	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 No. E-22 Troubleshooting.		
			Monitoring code	Item	Normal display
			019	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 No. E-23 Troubleshooting.		
			Monitoring code	Item	Normal display
			019	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 No. E-24 Troubleshooting.		
			Monitoring code	Item	Normal display
			019	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 No. E-25 Troubleshooting.		
			Monitoring code	Item	Normal display
			021	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 No. E-26 Troubleshooting.		
			Monitoring code	Item	Normal display
			021	Bucket DUMPING	Lever operation: ON Lever NEUTRAL: OFF
	7	Swing signal fault	If the display on the monitor panel is not normal, proceed to No. E-27 Troubleshooting.		
			Monitoring code	Item	Normal display
			019	Swing	Lever operation: ON Lever NEUTRAL: OFF
	8	Travel signal fault	If the display on the monitor panel is not normal, proceed to No. E-28 Troubleshooting.		
			Monitoring code	Item	Normal display
			019	Travel	Lever operation: ON Lever NEUTRAL: OFF
	9	Attachment signal fault	If the display on the monitor panel is not normal, proceed to No. E-29 Troubleshooting.		
			Monitoring code	Item	Normal display
			021	Service	Lever operation: ON Lever NEUTRAL: OFF
	10	Governor • pump controller defective	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.		

E-6 Auto engine warm-up device does not work

Failure information	• The auto engine warm-up device does not work.
Relative information	• The auto engine warm-up device is activated, when the engine cooling water temperature is below 30°C, and the engine speed is below 1,200 rpm. • The auto engine warm-up device is canceled by keeping the fuel dial opening at above 70% for more than 3 seconds, when the engine starting switch is in the ON position or after the engine is started.

<table>
<tr><td rowspan="4">Presumed cause and standard value in normal</td><td colspan="2">Cause</td><td colspan="3">Standard value in normal and references for troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Engine cooling water temperature signal fault</td><td colspan="3">If the display on the monitor panel is not normal, proceed to No. E-14 Troubleshooting.</td></tr>
<tr><td>Monitoring code</td><td>Item</td><td>Normal display</td></tr>
<tr><td>041</td><td>Engine cooling water temperature</td><td>Compare with the actual engine cooling water temperature.</td></tr>
<tr><td>2</td><td>Governor • pump controller defective</td><td colspan="3">As this is an internal failure, troubleshooting cannot be conducted.
(If the fault mentioned in the above item is not found, the Governor • pump controller is judged as defective)</td></tr>
</table>

E-7 Pre heater does not work

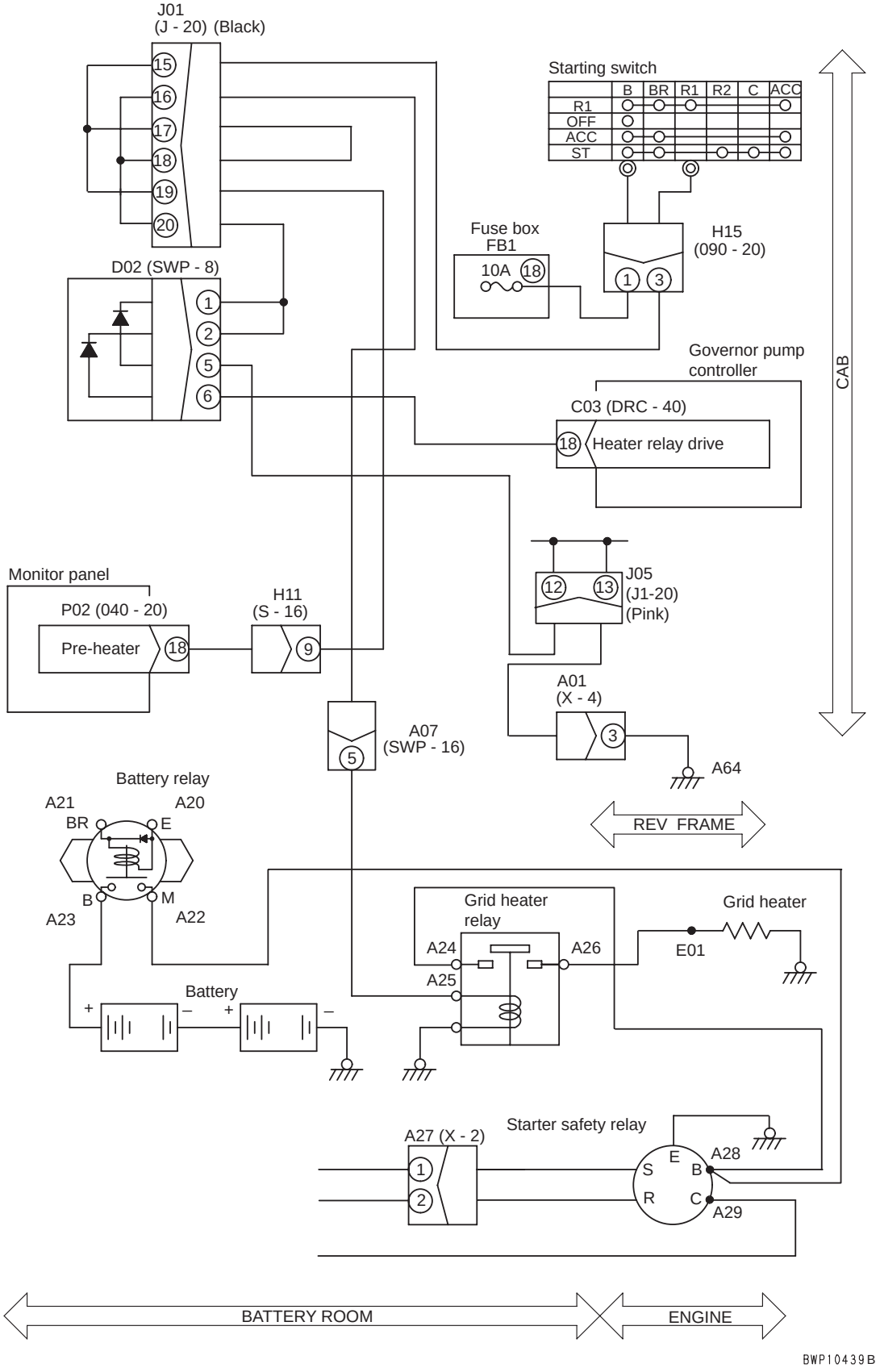
Failure information (1)	• Even if the pre heater switch is turned to the PREHEAT position, the pre heating monitor lamp does not light up.
Relative information	• Input of the pre heating signal (ON or OFF) can be confirmed in the monitor function. (Code No. 045: Monitor input 1)

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Engine starting switch fault	If preheating does not occur (the heater is not warmed up), refer to Failure Phenomenon (2) below.			
	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) ⑥ and J01		Resistance value	Below 1 Ω
	3	Monitor panel fault	★Turn the engine starting switch OFF for the preparations.			
			P02	Engine starting switch	Voltage	
			Between ⑥ and grounding	OFF	Below 1 V	
				HEAT	20 – 30 V	

Failure information (2)	• Even if the pre heater switch is turned to the PREHEAT position, the pre heater does not become warm.
Relative information	• In low cooling water temperature (lower than 30°C), the governor • pump controller drives the heater relay for 100 seconds after the engine is started and automatically warms up the engine.

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Engine starting switch fault (Internal disconnection)	★Turn the engine starting switch OFF for the preparations.			
			H15 (male)	Engine starting switch	Resistance value	
			Between ① and ③	OFF	Above 1 MΩ	
				HEAT	Below 1 Ω	
	2	Heater relay fault (Internal disconnection)	★Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Heater relay		Continuity and resistance value	
			Between coil terminal and grounding		Continued	
			Between contact terminals		Above 1 MΩ	
	3	Electrical intake air heater (Internal disconnection)	★Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.			
			Between heater terminals		Normal if continuity is established.	
	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 from H15 (female) ③ to J01 to heater relay terminal (A25)		Resistance value	Below 1 Ω
			Wiring harness between battery relay M terminal (A22) and heater relay terminal		Resistance value	Below 1 Ω

Electrical Circuit Diagram for Engine Pre heater



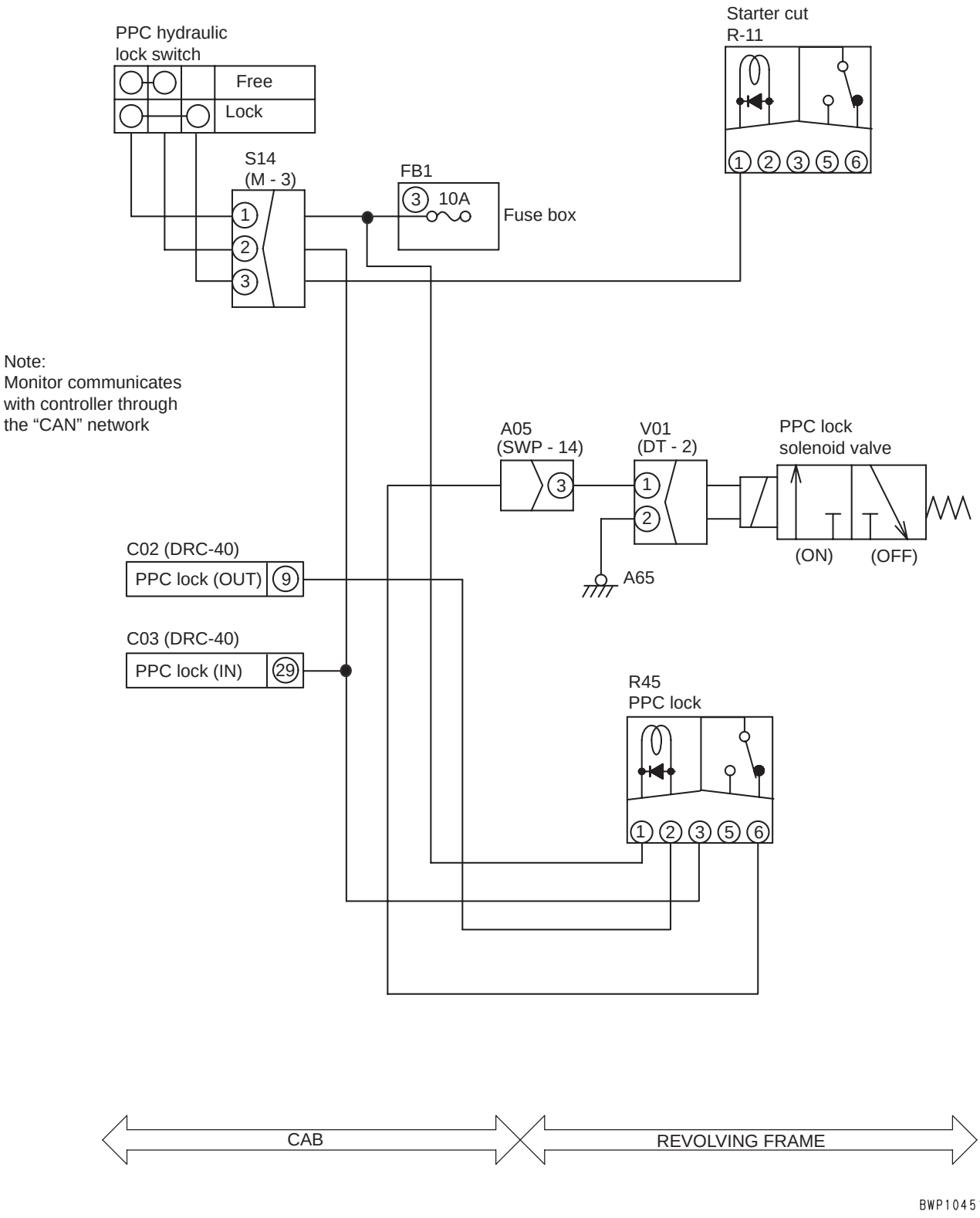
E-8 All work equipment, swing and travel do not move

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	Lock	Above 1 MΩ	
				Free	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



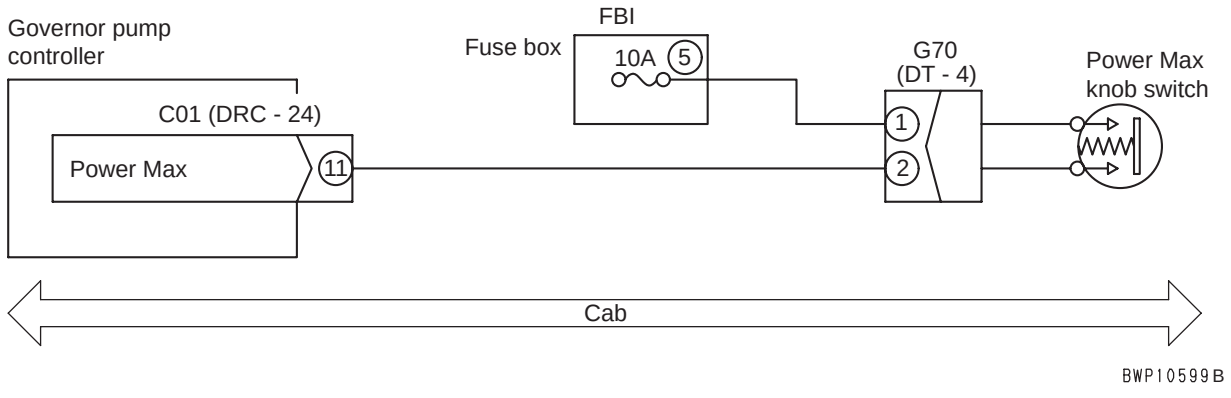
E-9 One-touch Power Max Switch does not work

Failure information	• The one-touch power max. switch does not work.
Relative information	• If the one touch-power max. switch is pressed 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. 022: Switch input 1)

Presumed cause and standard value in normal

	Cause	Standard value in normal and references for troubleshooting			
1	Fuse No. 9 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 ① and ②	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) ①		Resistance value	Above 1 MΩ
		Wiring harness between G70 (female) ② and C01 (female) ⑪		Resistance value	Above 1 MΩ
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.			
		Between wiring harness between FB1 ⑤ outlet and G70 (female) ① and grounding		Resistance value	Above 1 MΩ
		Between wiring harness between G70 (female) ② and C01 (female) ⑪ and grounding		Resistance value	Above 1 MΩ
5	Governor • 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

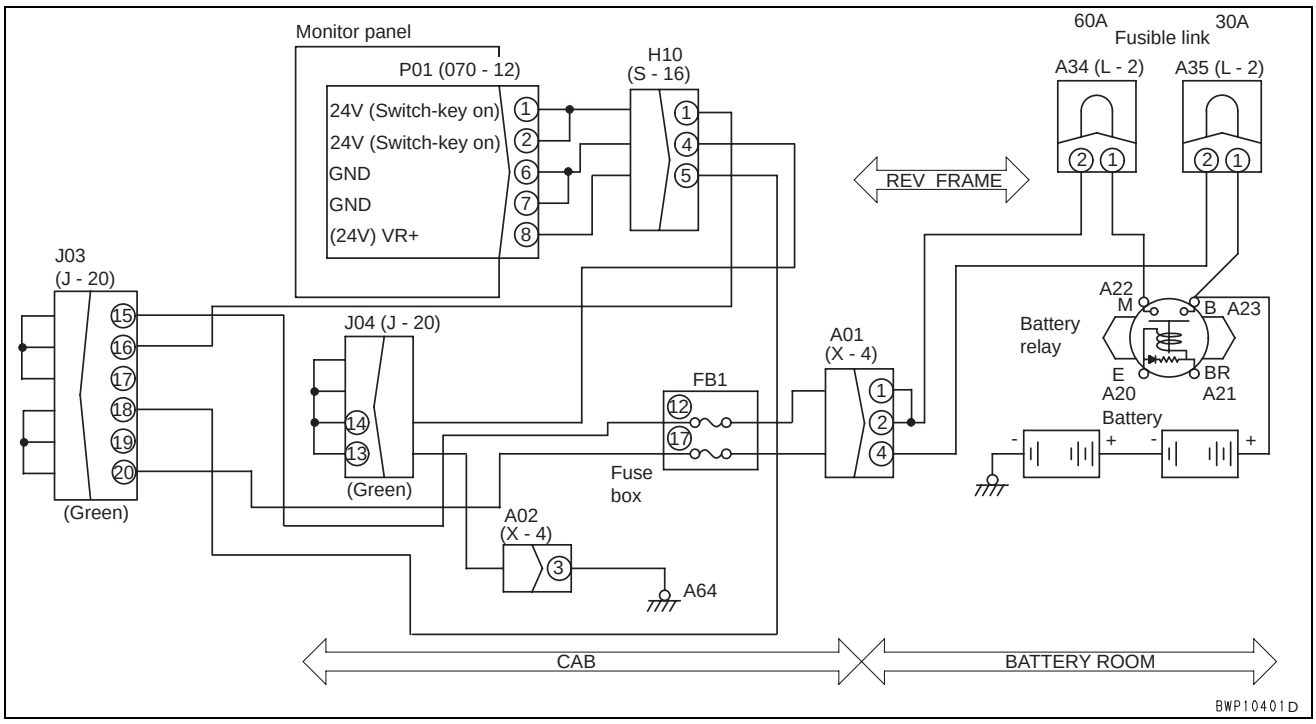


E-10 No display in monitor panel at all

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 J03 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	Governor • 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	—

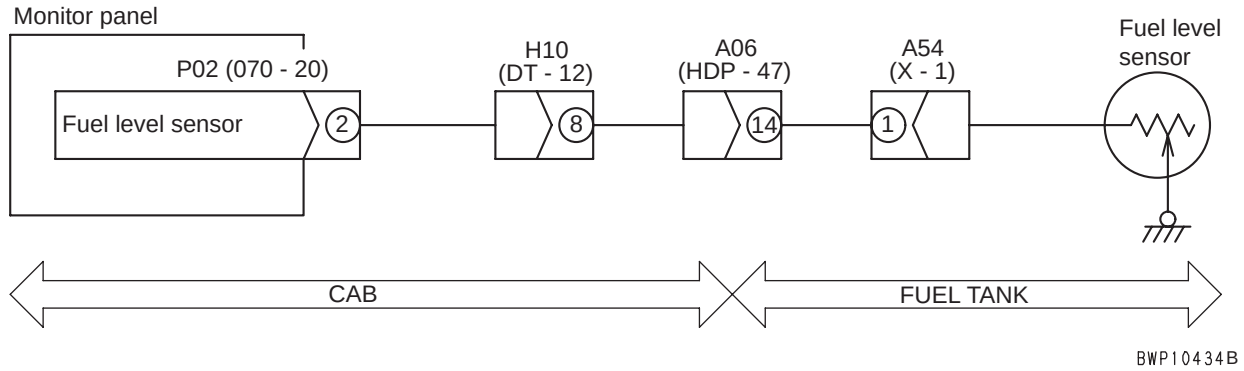
<table>
<tr><th rowspan="4">Presumed cause and standard value in normal</th><th colspan="2">Cause</th><th colspan="3">Standard value in normal and references for troubleshooting</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Model code signal fault
(Internal failure)</td><td colspan="3">If the display on the monitor panel is normal, proceed to Service Code [E217].</td></tr>
<tr><td>Monitoring code</td><td>Item</td><td>Normal display</td></tr>
<tr><td>002
003</td><td>Controller model code</td><td>200</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 switching operation, 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. • (5) Input signal from the fuel level sensor (voltage) can be confirmed in the monitor function. (Code No. 042: 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



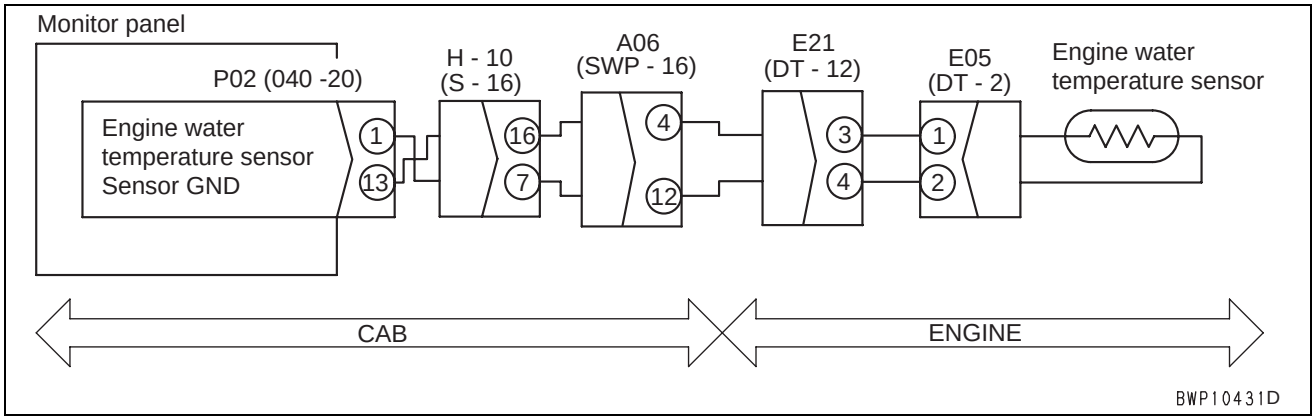
E-14 Engine cooling water temperature gauge does not indicate correctly

Failure information	➧ The engine cooling water rises normally, but the display does not exceed the white range (C). ➧ The engine cooling water temperature remains stable, but the display rises to the red range (H).
Relative information	➧ Input from the engine cooling water temperature sensor can be confirmed in the monitor function. (Code No. 041: Engine cooling water temperature)

Presumed cause and standard value in normal

	Cause	Standard value in normal and references for troubleshooting		
1	Engine cooling water 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.		
		E05	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) ① and E05 (female) ①	Resistance value	Below 1 Ω
		Wiring harness between P02 (female) ⑬ and E05 (female) ②	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) ① and E05 (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.		
		Between wiring harness between P02 (female) ① and E05 (female) ① and grounding	Voltage	Below 1 V
5	Governor • 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 ① and ⑤	10 – 100 °C	90 – 3.5 kΩ
		Between ① and grounding		Above 1 MΩ

Electrical Circuit Diagram for Engine Cooling Water Temperature Sensor



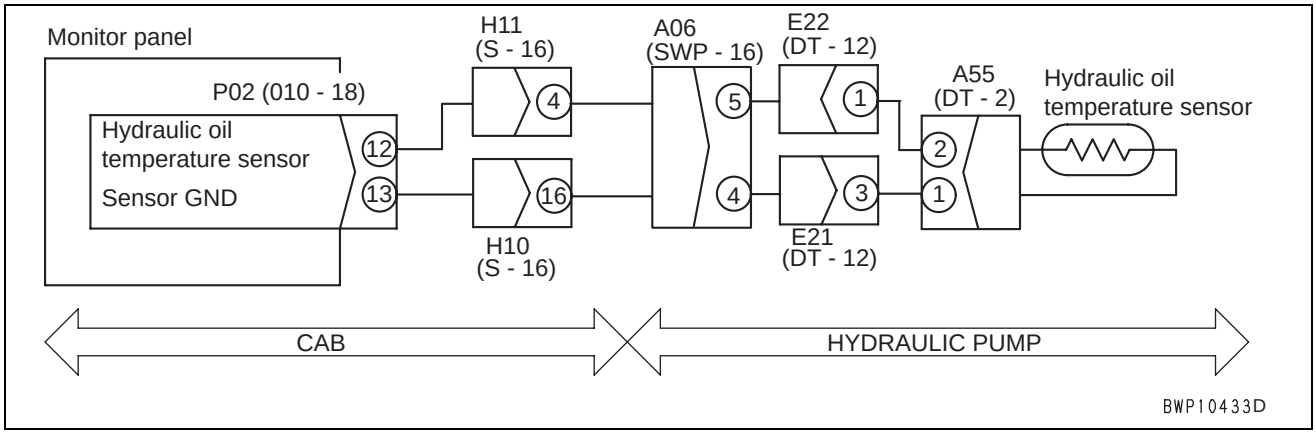
E-15 Hydraulic oil temperature gauge does not display correctly

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. 044: 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	Governor • 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 ⑤	10 – 100 °C	90 – 3.5 kΩ	
		Between ⑫ and grounding		Above 1 MΩ	

Electrical Circuit Diagram for Hydraulic Oil Temperature Sensor

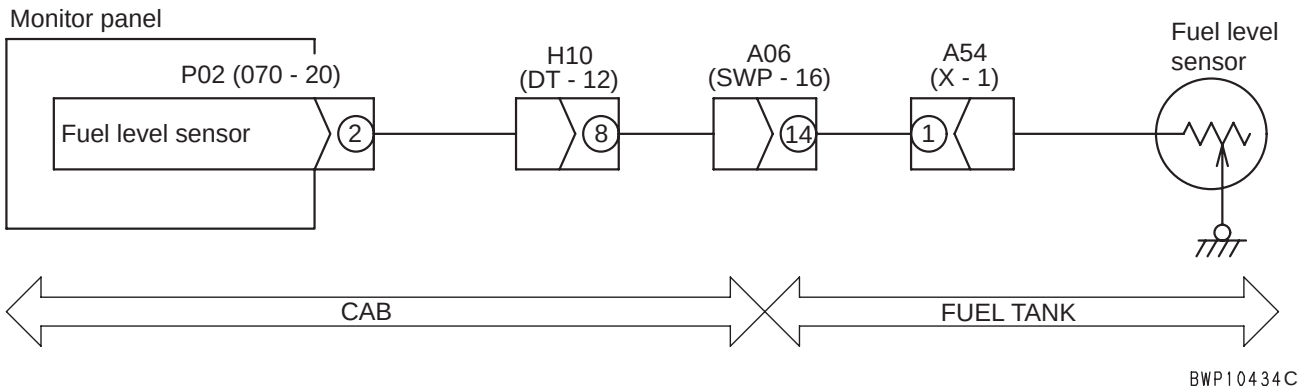


E-16 Fuel gauge does not display correctly

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. 042: 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.			
			Between 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.			
			Between wiring harness between P02 (female) ② and A54 (female) ① and grounding		Voltage	Below 1 V
	5	Governor • 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



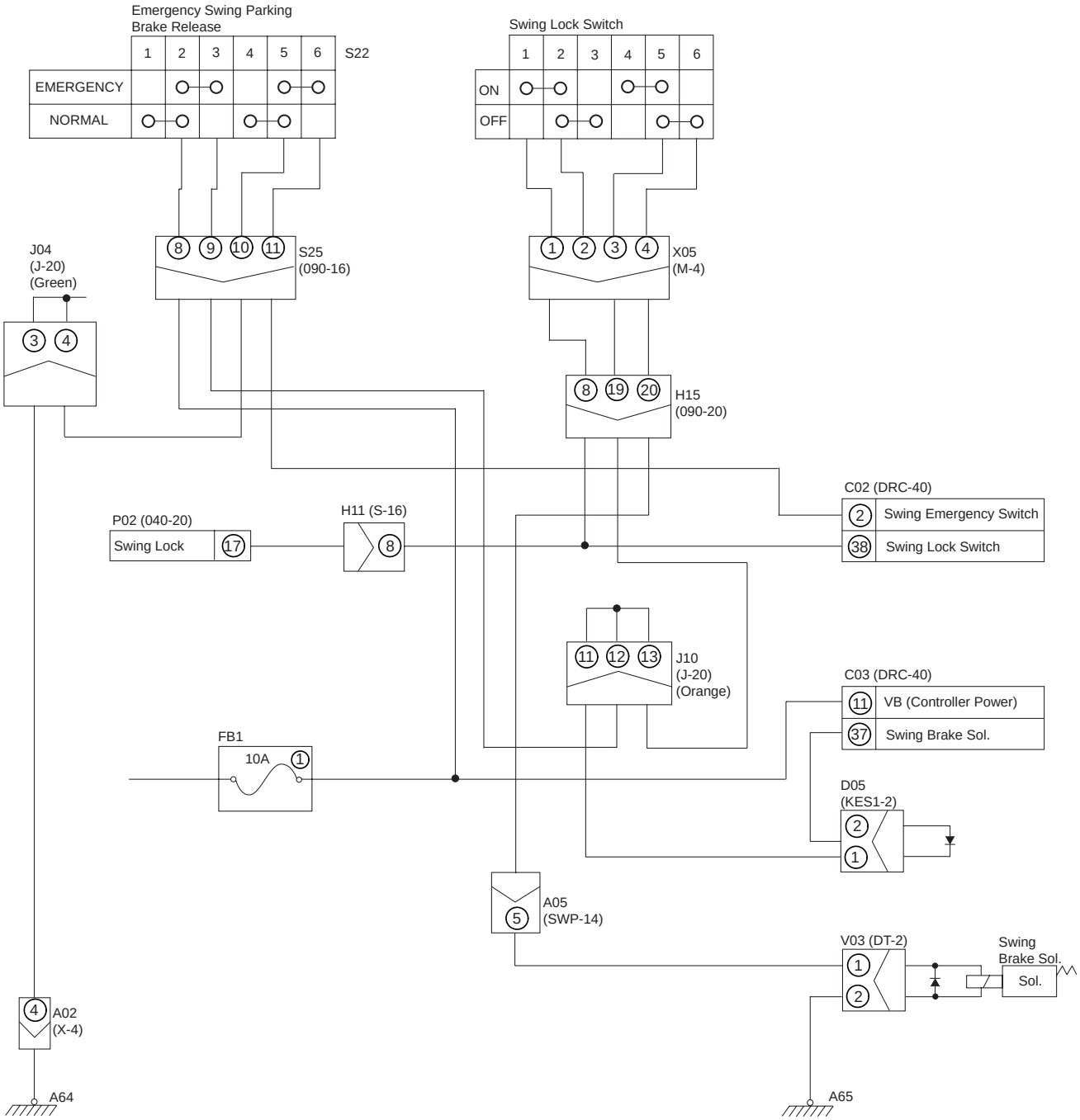
E-17 Swing lock monitor does not display correctly

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. 049: 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, carry out No. E-5 Troubleshooting.

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, carry out No. H-21 Troubleshooting.

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting
	1	Monitor panel defective	As this is an internal failure, troubleshooting cannot be conducted.

Failure information (4)	• When operating the windshield wiper switch, the windshield wiper monitor does not appear.
Relative information	★If the windshield wiper itself does not work, either, carry out No. E-19 Troubleshooting.

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	—

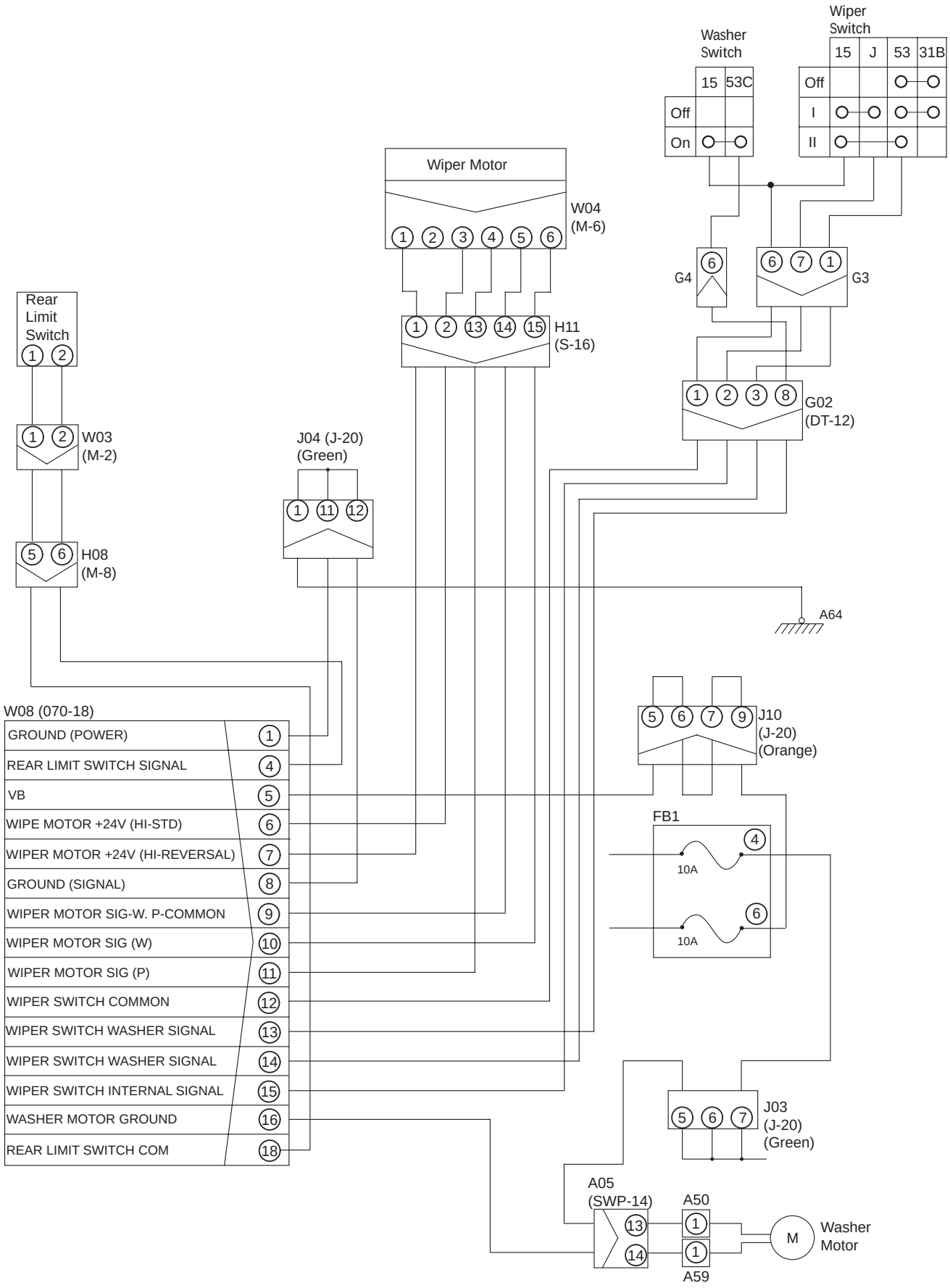
Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting
	1	Monitor panel defective	As this is an internal failure, troubleshooting cannot be conducted.

E-19 Windshield wiper does not work

Failure information	➧ The windshield wiper does not work.
Relative information	—

<table>
<tr><td rowspan="16">Presumed cause and standard value in normal</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal and references for troubleshooting</td></tr>
<tr><td rowspan="4">1</td><td rowspan="4">Window rear limit switch fault (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>H08 (Switch side)</td><td>Front window</td><td colspan="2">Resistance value</td></tr>
<tr><td rowspan="2">Between ⑤ and ⑥</td><td>When installed at front</td><td colspan="2">Above 1 MΩ</td></tr>
<tr><td>When retracted at rear</td><td colspan="2">Below 1 Ω</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Windshield wiper motor fault (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">W04 (male)</td><td colspan="2">Continuity and resistance value</td></tr>
<tr><td colspan="2">Between ③ and ①</td><td colspan="2">Continued</td></tr>
<tr><td colspan="2">Between ③ ① and grounding</td><td colspan="2">Above 1 MΩ</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Disconnection of wiring harness (Disconnection or defective contact with connector)</td><td colspan="4">➧ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.</td></tr>
<tr><td colspan="2">Wiring harness between W08 (female) ⑥ to H11 to W04 (female) ③</td><td>Resistance value</td><td>Below 1 Ω</td></tr>
<tr><td colspan="2">Wiring harness between W08 (female) ⑦ to H11 to W04 (female) ①</td><td>Resistance value</td><td>Below 1 Ω</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Grounding fault of wiring harness (Contact with grounding (GND) circuit)</td><td colspan="4">➧ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting. ②</td></tr>
<tr><td colspan="2">Wiring harness between W08 (female) ⑱ and H08 ⑤</td><td>Resistance value</td><td>Above 1 MΩ</td></tr>
<tr><td rowspan="5">5</td><td rowspan="3">Monitor panel fault (Rear limit switch system)</td><td colspan="4">➧ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.</td></tr>
<tr><td>W08</td><td>Front window</td><td colspan="2">Voltage</td></tr>
<tr><td>Between ⑱ and grounding</td><td>When installed at front</td><td colspan="2">20 – 30 V</td></tr>
<tr><td rowspan="2"></td><td>When retracted at rear</td><td colspan="2">Below 1 V</td></tr>
<tr><td rowspan="3">Monitor panel fault (Windshield wiper motor system)</td><td colspan="4">➧ Turn the engine starting switch OFF for the preparations, and hold it in the ON position during the troubleshooting.</td></tr>
<tr><td>W08</td><td>Windshield wiper switch</td><td colspan="2">Resistance value</td></tr>
<tr><td>Between ⑩ and grounding
Between ⑪ and grounding</td><td>OFF</td><td colspan="2">Below 3 V</td></tr>
<tr><td></td><td>ON</td><td colspan="2">Below 3 V ⇔ 20 – 30 V (Constant cycle)</td></tr>
</table>

Electrical Circuit Diagram for Windshield Wiper Motor



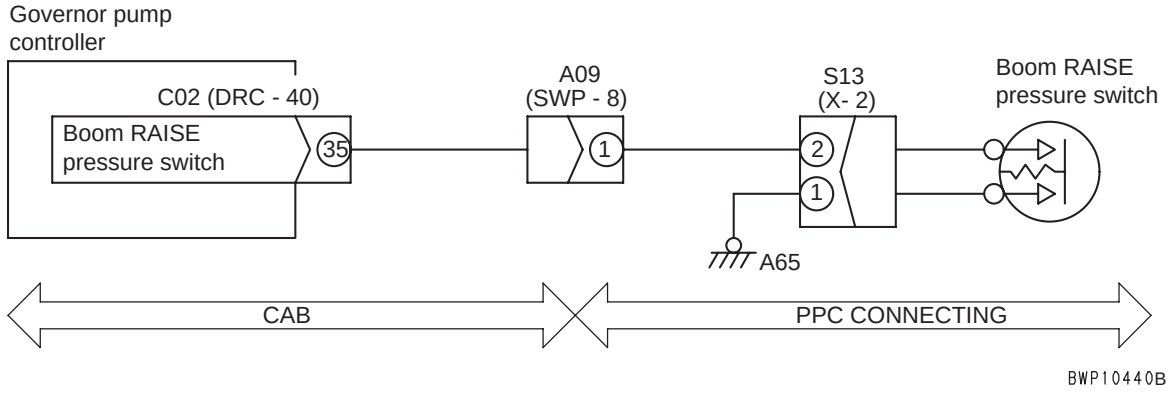
E-21 "Boom/Stabiliser RAISE" is not correctly displayed in monitor function

Failure information	• "Boom RAISE" is not correctly displayed in the monitor function on the monitor panel.
Relative information	—

Presumed cause and standard value in normal

	Cause	Standard value in normal and references for troubleshooting			
1	Boom 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.			
		Between 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.			
		Between wiring harness between C02 (female) ㉟ and S13 (female) ② and grounding		Voltage	Below 1 V
5	Governor • 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

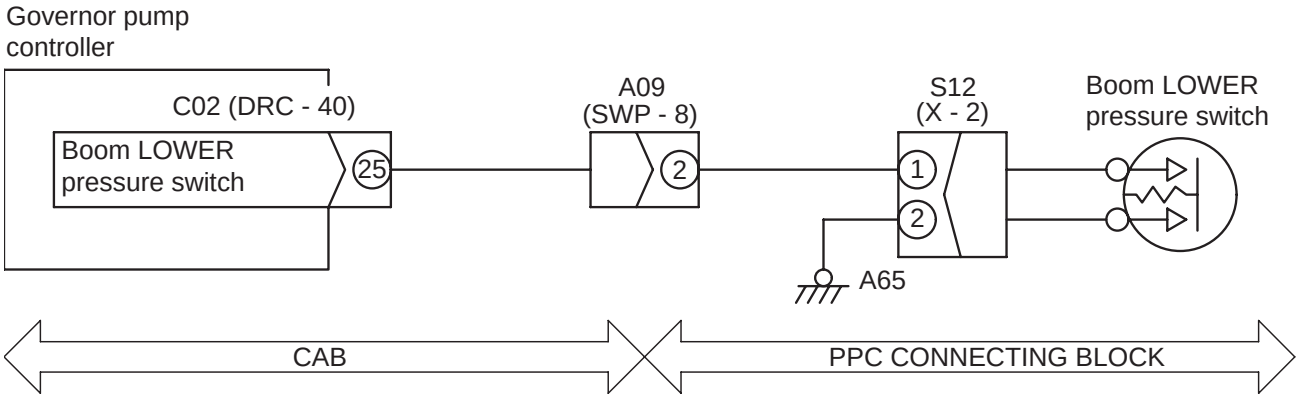


E-22 "Boom LOWER" is not correctly displayed in monitor function

Failure information	• "Boom LOWER" is not correctly displayed in the monitor function on the monitor panel.
Relative information	—

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	Boom 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.			
			Between 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.			
			Between wiring harness between C02 (female) ㉕ and S12 (female) ② and grounding		Voltage	Below 1 V
	5	Governor • 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



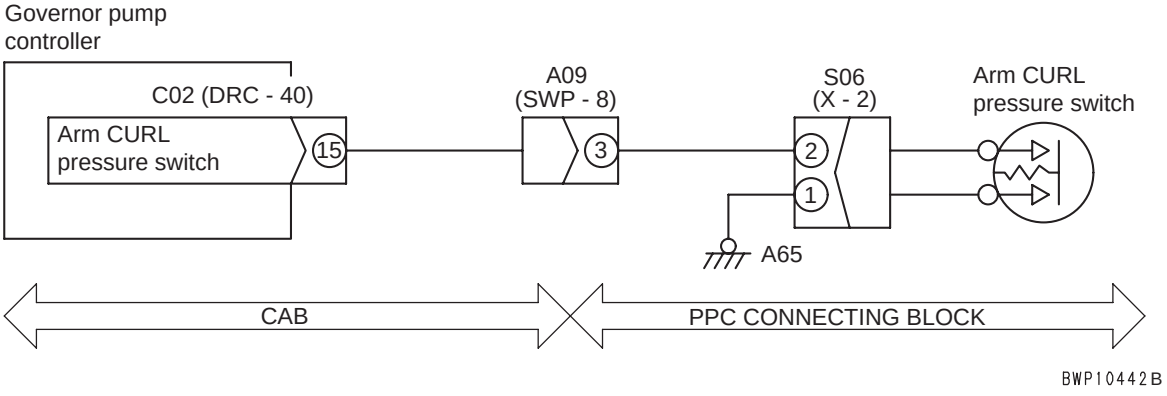
BWP10441B

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	—

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.			
			Between 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.			
			Between wiring harness between C02 (female) ⑮ and S06 (female) ② and grounding		Voltage	Below 1 V
	5	Governor • 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

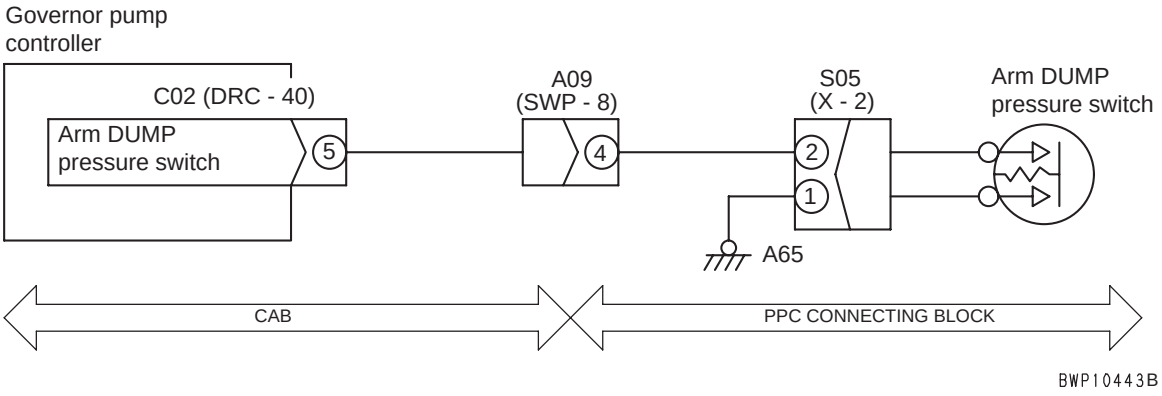


E-24 "Arm DUMPING" is not correctly displayed in monitor function

Failure information	• "Arm DUMPING" is not correctly displayed in the monitor function (special function) on the monitor panel.
Relative information	—

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.			
			Between 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.			
			Between wiring harness between C02 (female) ⑤ and S05 (female) ② and grounding		Voltage	Below 1 V
	5	Governor • 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

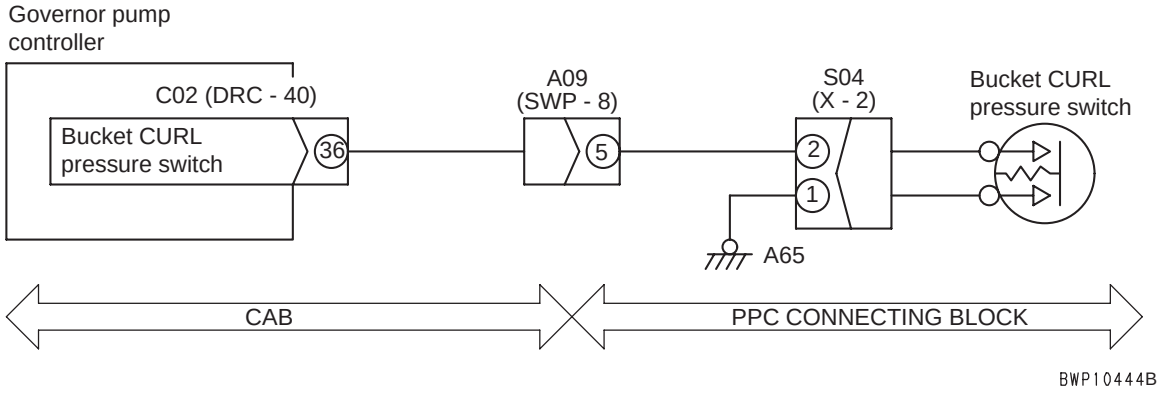


E-25 "Bucket DIGGING" is not correctly displayed in monitor function

Failure information	• "Bucket DIGGING" is not correctly displayed in the monitor function (special function) on the monitor panel.
Relative information	—

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.			
			Between 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.			
			Between wiring harness between C02 (female) ㊱ and S04 (female) ② and grounding		Voltage	Below 1 V
	5	Governor • 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 ⑨ and grounding	NEUTRAL	20 – 30 V	
				DIGGING	Below 1 V	

Electrical Circuit Diagram for Bucket DIGGING PPC hydraulic Switch

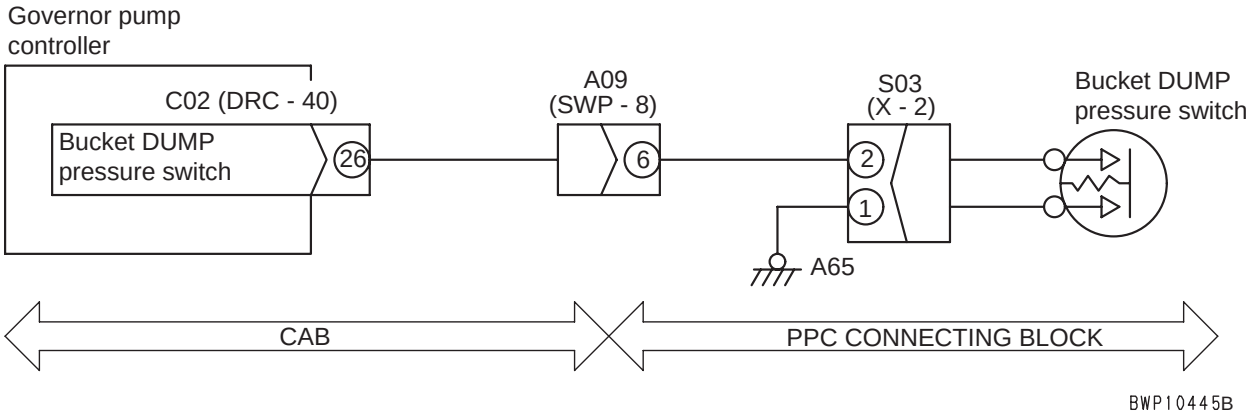


E-26 "Bucket DUMPING" is not correctly displayed in monitor function

Failure information	• "Bucket DUMPING" is not correctly displayed in the monitor function (special function) on the monitor panel.
Relative information	—

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.			
			Between 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.			
			Between wiring harness between C02 (female) ㊱ and S06 (female) ② and grounding		Voltage	Below 1 V
	5	Governor • 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

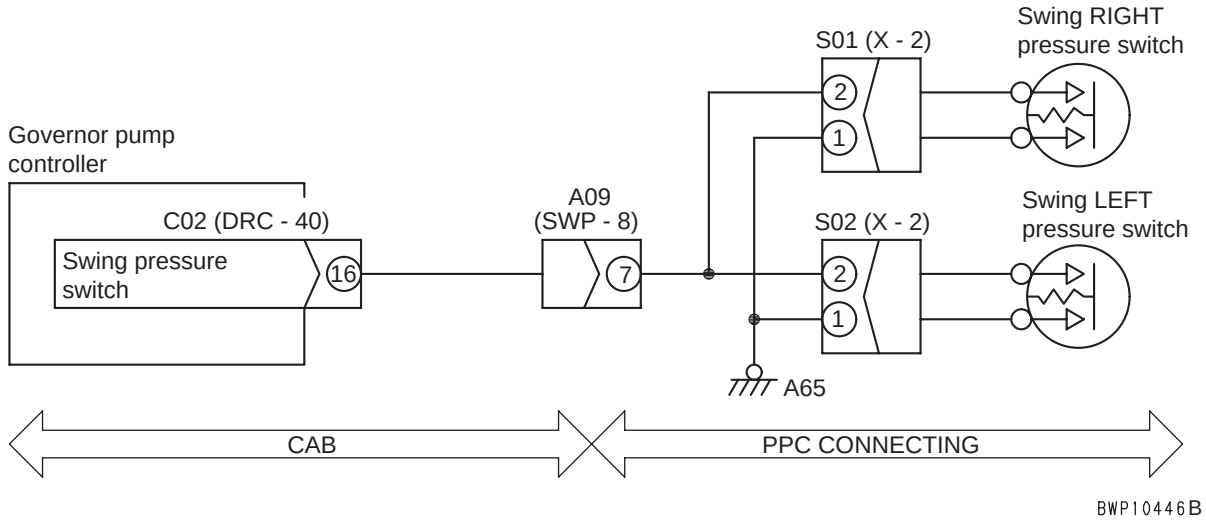


E-27 "SWING" is not correctly displayed in monitor function

Failure information	• "SWING" is not correctly displayed in the monitor function (special function) on the monitor panel.
Relative information	—

Presumed cause and standard value in normal		Cause	Standard value in normal and references for troubleshooting			
	1	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	
	2	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	
	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 S02 (female) ②, or wiring harness between C02 (female) ⑯ and S01 (female) ②		Resistance value	Below 1 Ω
			Wiring harness between S02 (female) ① and grounding		Resistance value	Below 1 Ω
			Wiring harness between S01 (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 S02 (female) ②, or wiring harness between C02 (female) ⑯ and S01 (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 S02 (female) ②, or wiring harness between C02 (female) ⑯ and S01 (female) ② and grounding		Voltage	Below 1 V
	6	Governor • 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



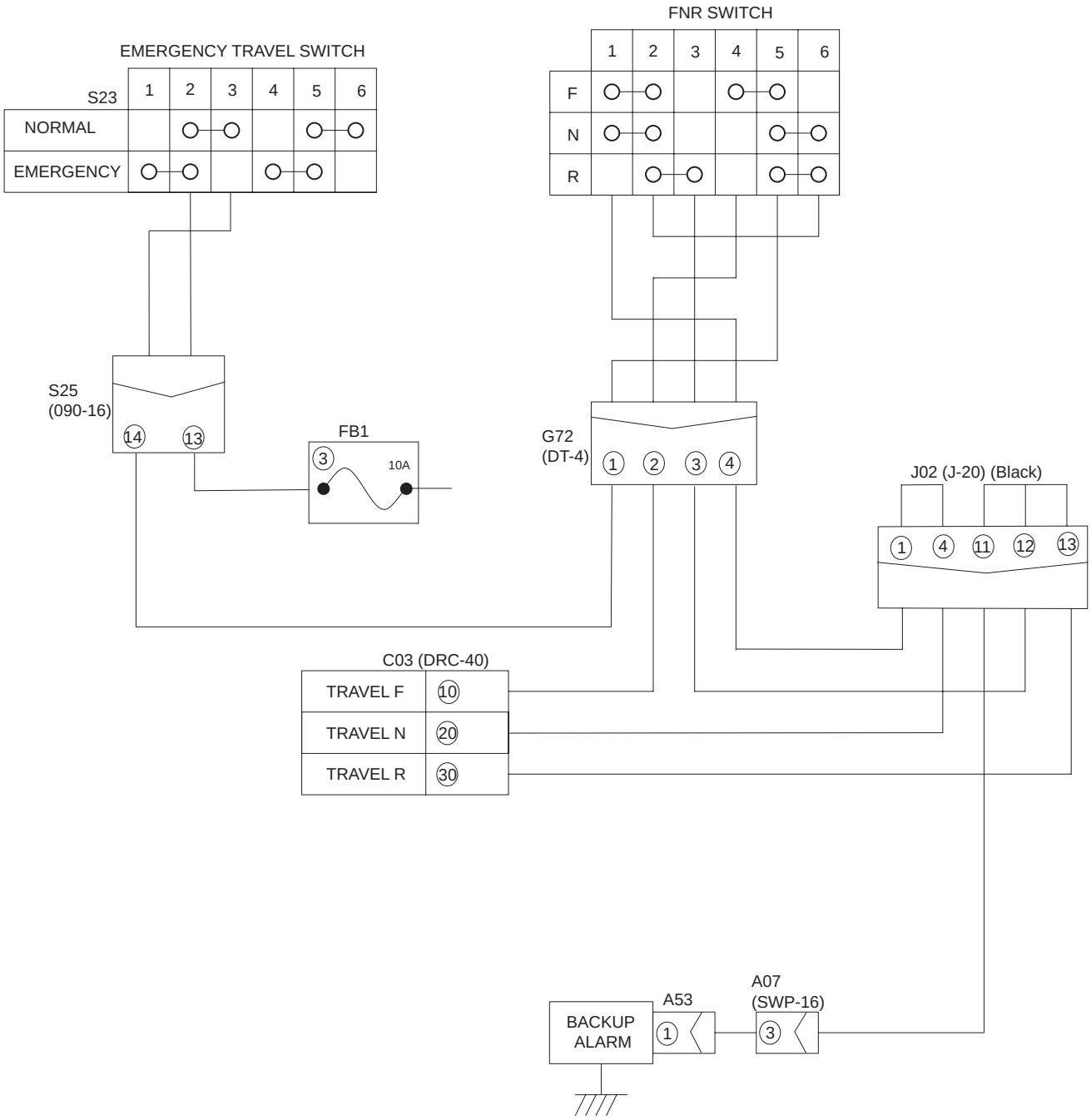
E-28 "TRAVEL" is not correctly displayed in monitor function

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 ① and ②	NEUTRAL	Above 1 MΩ	
			Forward	Below 1 Ω	
		Between ① and ③	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) ②		Resistance value	Below 1 Ω
		Wiring harness from C03 (female) ⑳ to G72 (female) ④		Resistance value	Below 1 Ω
		Wiring harness from C03 (female) ㉚ to G72 ③		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	Governor • 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

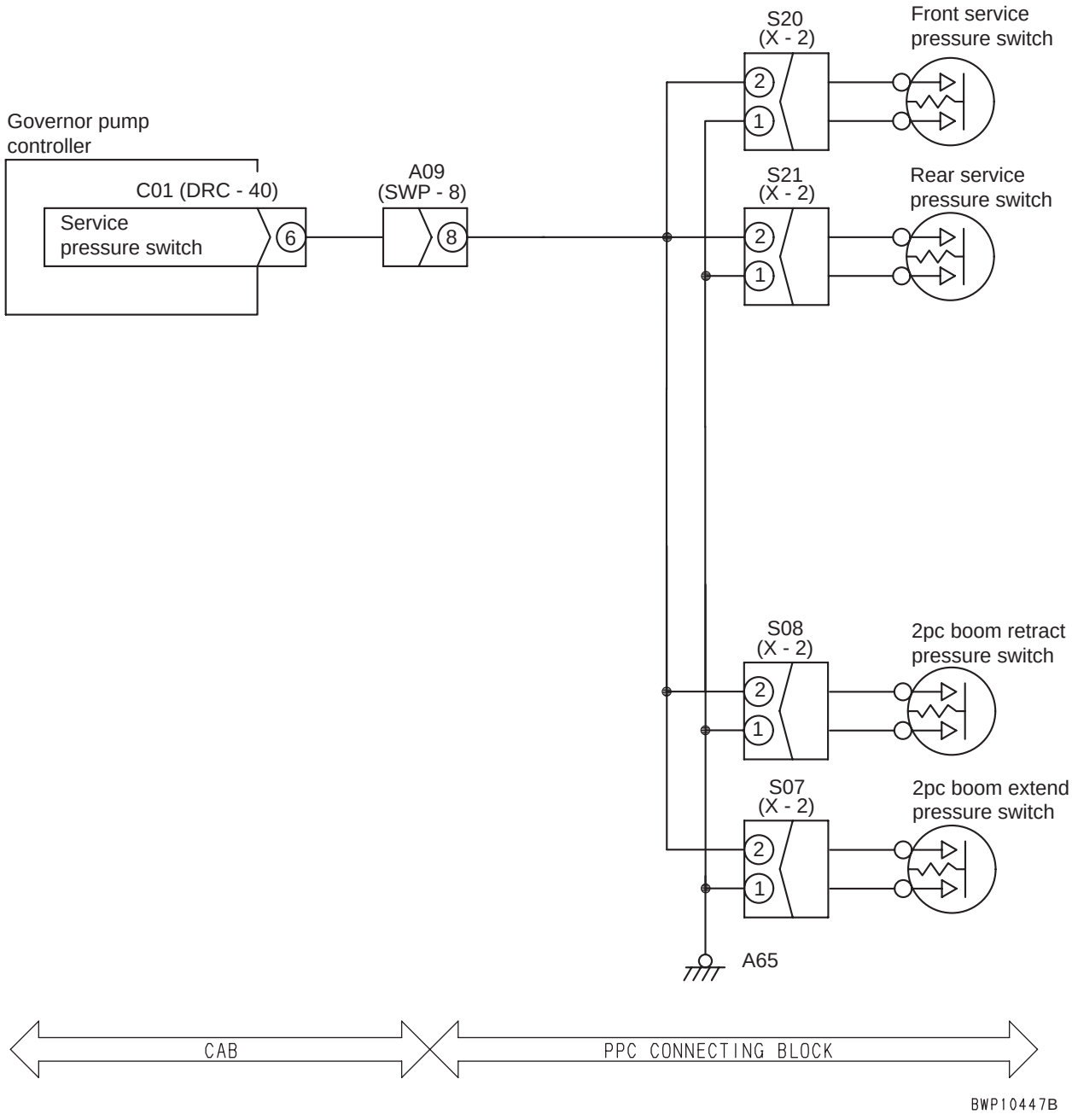


E-29 "Service" is not correctly displayed in monitor function

Failure information	• "Service" 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	Service (front) 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.			
			S20 (male)	Service pedal	Resistance value	
			Between ① and ②	NEUTRAL	Above 1 MΩ	
				Front	Below 1 Ω	
	2	Service (rear) 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.			
			S21 (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 S21 (female) ②, or wiring harness between C01 (female) ⑥ and S20 (female) ②		Resistance value	Below 1 Ω
			Wiring harness between S21 (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 S21 (female) ②, or between wiring harness between C01 (female) ⑥ and S20 (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 S21 (female) ①, or between wiring harness between C01 (female) ⑥ and S20 (female) ① and grounding		Voltage	Below 1 V
	6	Governor • 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 Service PPC hydraulic Switch

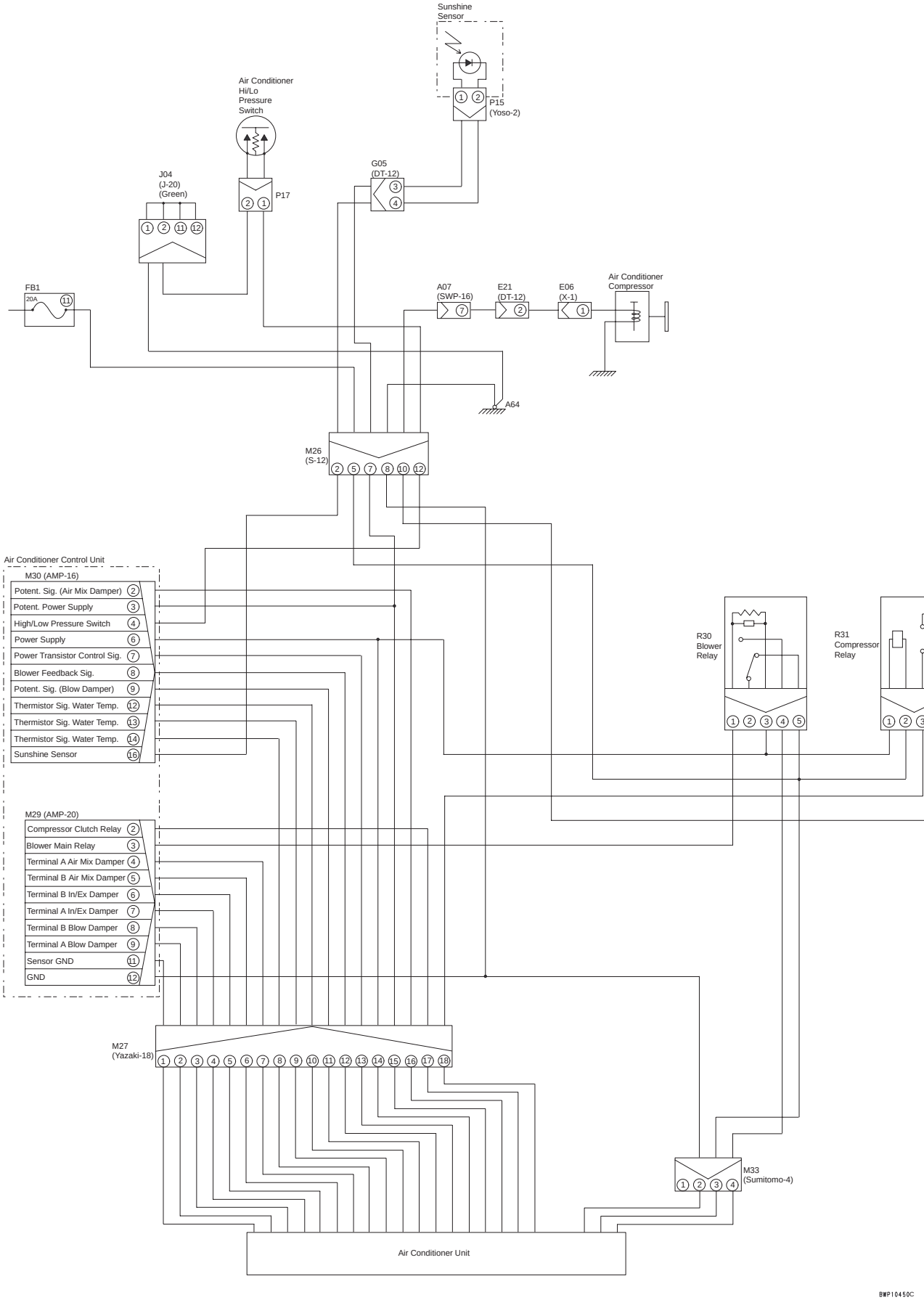


E-30 Air Conditioner does not work

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

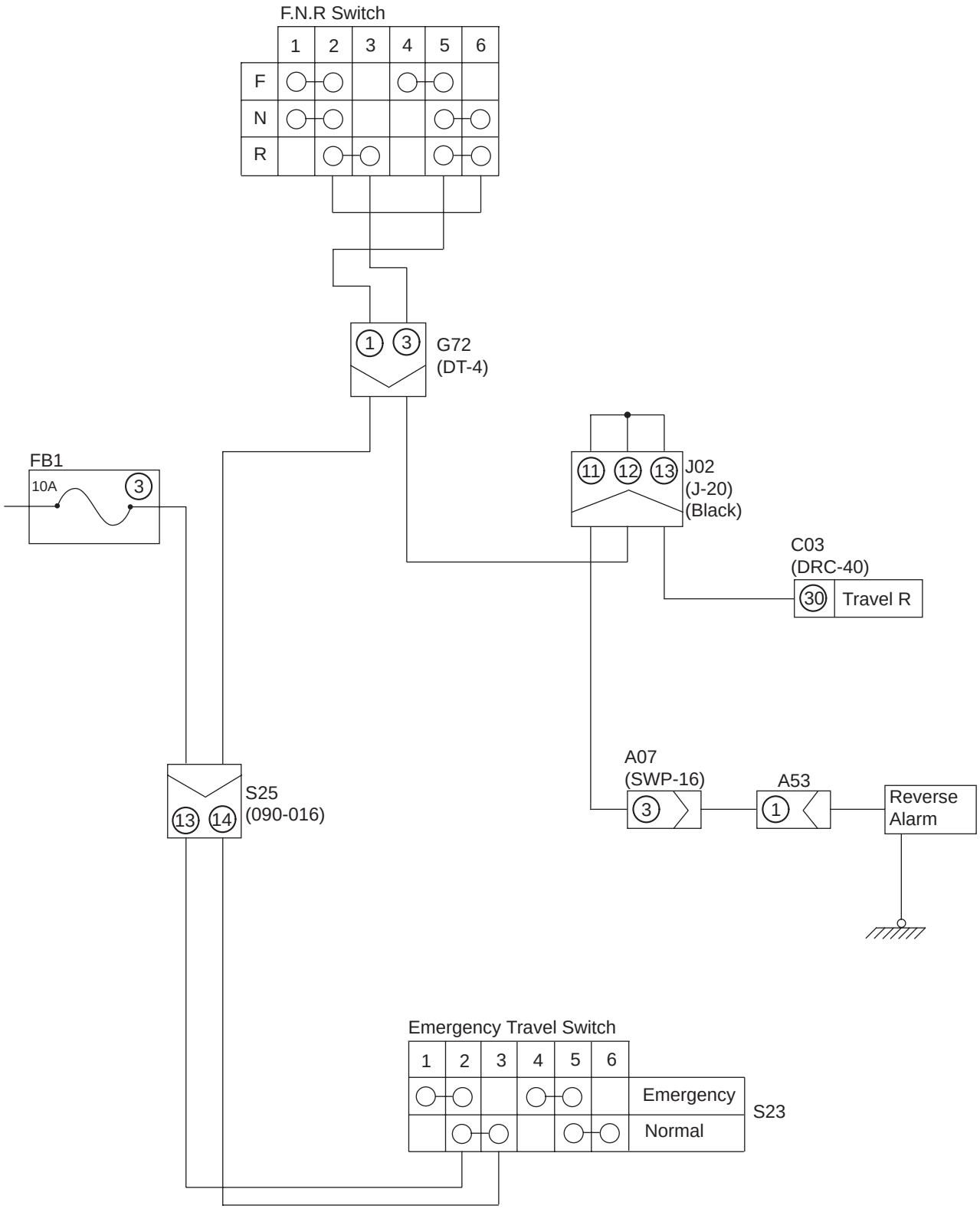


E-31 Travel reverse alarm does not sound

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	—

<table>
<tr><td rowspan="11">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>1</td><td>Fuse No. 3 fault</td><td colspan="4">When the fuse is blown, there is a big possibility that grounding fault occurred in the circuit.</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Travel signal fault</td><td colspan="4">If the monitor display is not correct, proceed to section E-21 of this troubleshooting chapter.</td></tr>
<tr><td>Monitoring code</td><td>Item</td><td colspan="2">Normal display</td></tr>
<tr><td>021</td><td>Travel Reverse</td><td colspan="2">Control lever operation: ON
Control lever NEUTRAL: OFF</td></tr>
<tr><td rowspan="2">3</td><td rowspan="2">Disconnection of wiring harness (Disconnection or defective contact with connector)</td><td colspan="4">➧ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.</td></tr>
<tr><td colspan="2">Wiring harness between FB1-3 outlet to S25 to S23 to G72 to J02 to A07 and A53 (female) ①</td><td>Resistance value</td><td>Below 1 Ω</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Grounding fault of wiring harness (Contact with grounding (GND) circuit)</td><td colspan="4">➧ Turn the engine starting switch OFF for the preparations, and hold it in the OFF position during the troubleshooting.</td></tr>
<tr><td colspan="2">Between wiring harness between FB1-3 outlet to S25 to S23 to G72 to J02 to A07 and A53 (female) ① and grounding</td><td>Resistance value</td><td>Above 1 MΩ</td></tr>
<tr><td>5</td><td>Travel alarm fault</td><td colspan="4">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)</td></tr>
</table>

Electrical Circuit Diagram for Travel Alarm System



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.

INFORMATION CONTAINED IN TROUBLESHOOTING TABLE 20-602
Radio Cassette & Telephone Socket 20-604
PPC Circuit & Brake Light Interlock 20-606
Undercarriage Attachments - Mode Selection 20-608
Undercarriage Attachments - Front Left Outrigger 20-610
Undercarriage Attachments - Front Right Outrigger 20-612
Undercarriage Attachments - Rear Left Outrigger 20-614
Undercarriage Attachments - Rear Right Outrigger 20-616
Heated Seat Does Not Warm Up 20-618
Suspension Lock 20-620
Lower Wiper Does Not Work (Optional Fitment) 20-622
Work Lights (Operator Cab) 20-624
Worklights (Boom & Counterweight) 20-626
Beacon Light 20-628
Air Seat Compressor (Option - Air Suspension Seat) 20-630
Operator Cab Interior Light 20-632
Cigar Lighter 20-634
Park Brake (Not Activating) 20-636
Park Brake (Displayed Symbol) 20-638
Clamshell Control - Rotate Right (1st Service) 20-640
Clamshell Control - Rotate Left (1st Service) 20-642
Horns 20-644
Swing Lock - Normal Operation 20-648
Swing Lock - Emergency Operation 20-650
Neutral Start (Engine) 20-652
Emergency Travel Control - Forward 20-656
Emergency Travel Control - Neutral 20-660
Emergency Travel Control - Reverse 20-662
Driving Lights - Main Beam 20-666
Driving Lights - Main Beam Flash 20-668
Driving Lights - Dipped Beam 20-670
Driving Lights - Position Lights 20-672
Indicators - Right hand 20-676
Indicators - Left hand 20-678
Hazard Warning Lights 20-680
Brake Proximity Switch 20-686
Swing Proximity Switch 20-688

INFORMATION CONTAINED IN TROUBLESHOOTING TABLE

- The following information are edited and contained in the "Information Contained in Troubleshooting Table". You are required to proceed with troubleshooting after fully grasping the contents.

Failure information	Phenomena occurring on machine
Relative information	Information on occurred failures and troubleshooting

Presumed cause and standard value in normal	Cause		Standard value in normal and references for troubleshooting
	1	Cause for presumed failure (The attached No. for filing and reference purpose only. It does not stand for any priority)	<Contents> • The standard values in normal by which to judge "good" or "no good" about presumed causes. • References for making judgement of "good" or "no good" <Phenomena of wiring harness fault> • Failure due to disconnection Defective contact with connector or disconnection of wiring harness has occurred. • Grounding fault A wiring harness that is not originally connected with a grounding circuit is in contact with it. • Failure due to short-circuiting A wiring harness that is not originally connected with a power source circuit (24 V) is in contact with it. <Points to remember in troubleshooting> 1. Connector denotation method and handling of T-adapters Insert or connect T-adapters in the following manner, unless specifically otherwise instructed. • If there is no indication of (male) or (female) in the connector No., pull off a connector and insert a T-adapter into both sides of male and female. • If there is an indication of (male9 and (female) in the connection No., pull off a connector and insert a T-adapter into only one side of (male) or (female). 2. Description sequence of pin No. and handling of circuit tester leads Connect the positive lead (+) and negative lead (–) for troubleshooting in the following manner unless specifically otherwise instructed. • Connect the positive lead (+) to a pin No. marked at the front or wiring harness. • Connect the negative lead (–) to a pin No. marked at the rear or wiring harness.
	2		
	3		
	4		
	5		

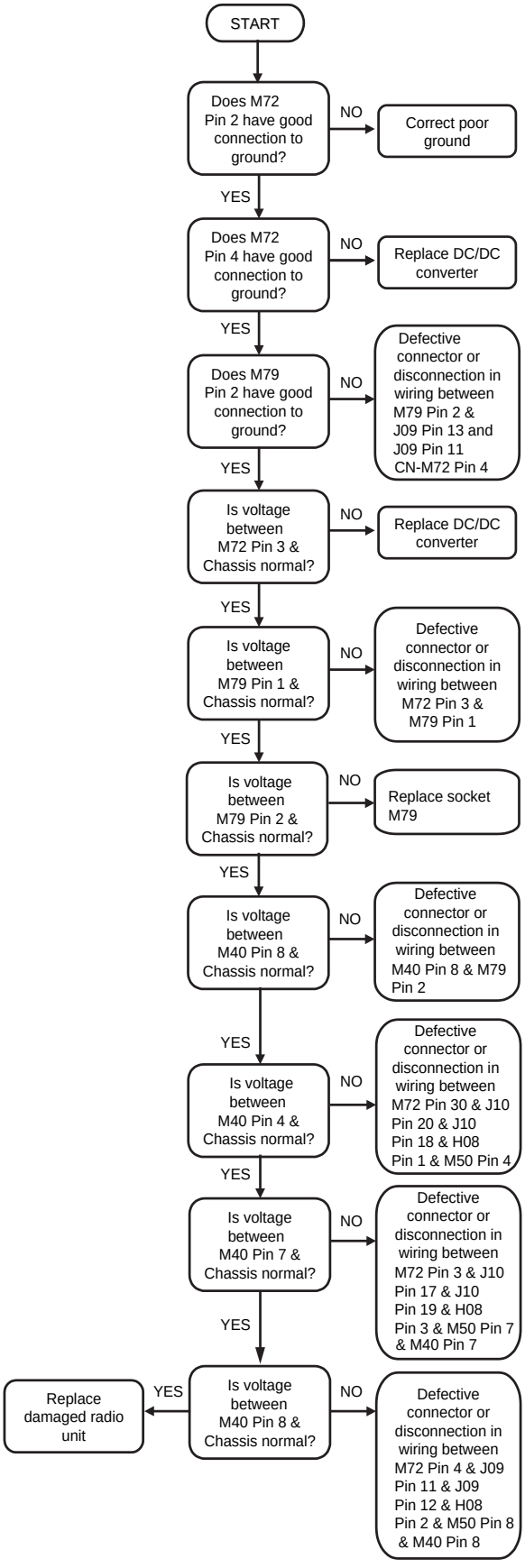
Relative Electrical Circuit Diagram

This is part of the electrical circuit diagram which shows the portion where the failure occurred.

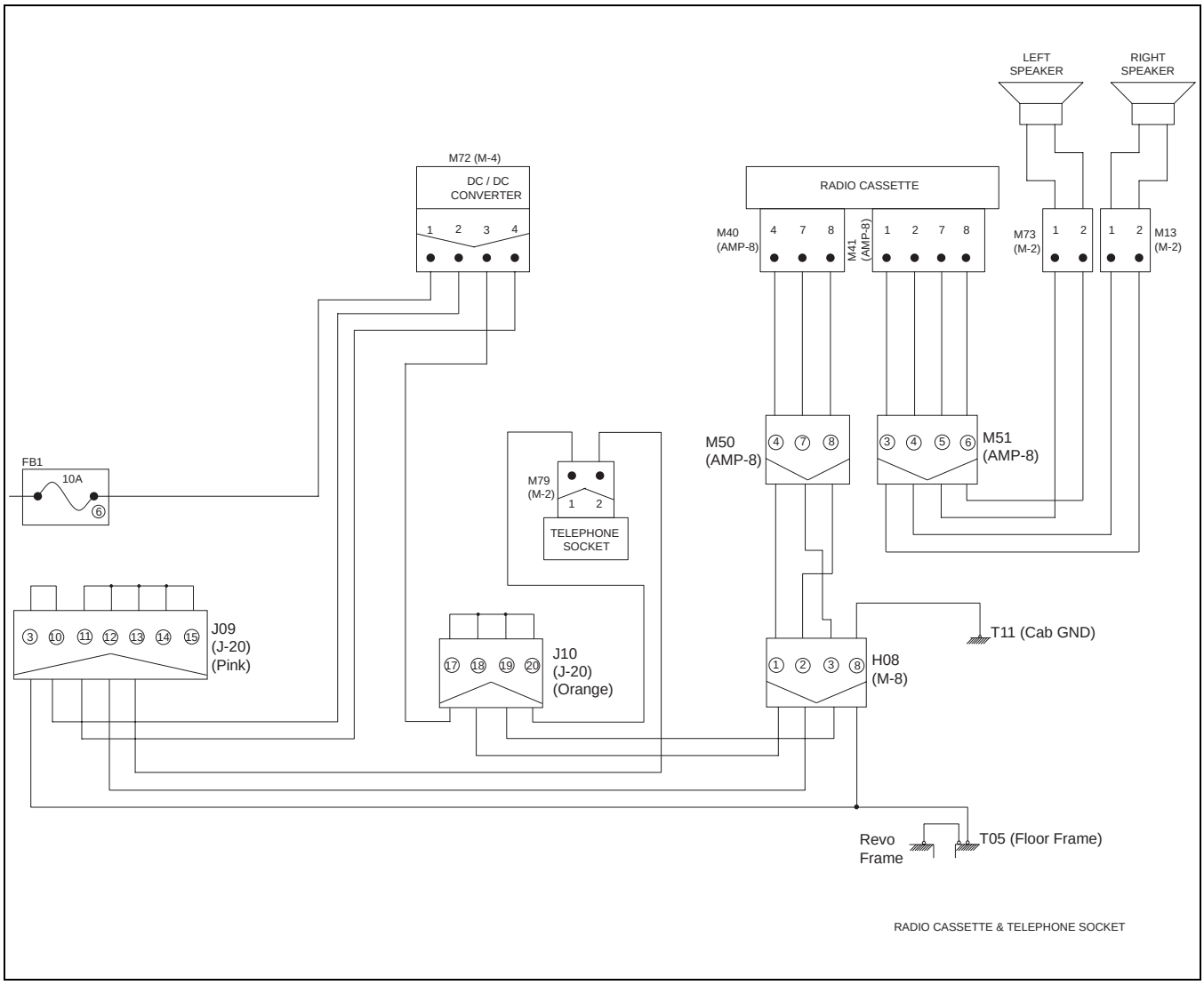
- Connector No.: Indicates (Type - numbers of a pin) (color)
- Arrow: Roughly indicates the location in the machine where it is installed.

Radio Cassette & Telephone Socket

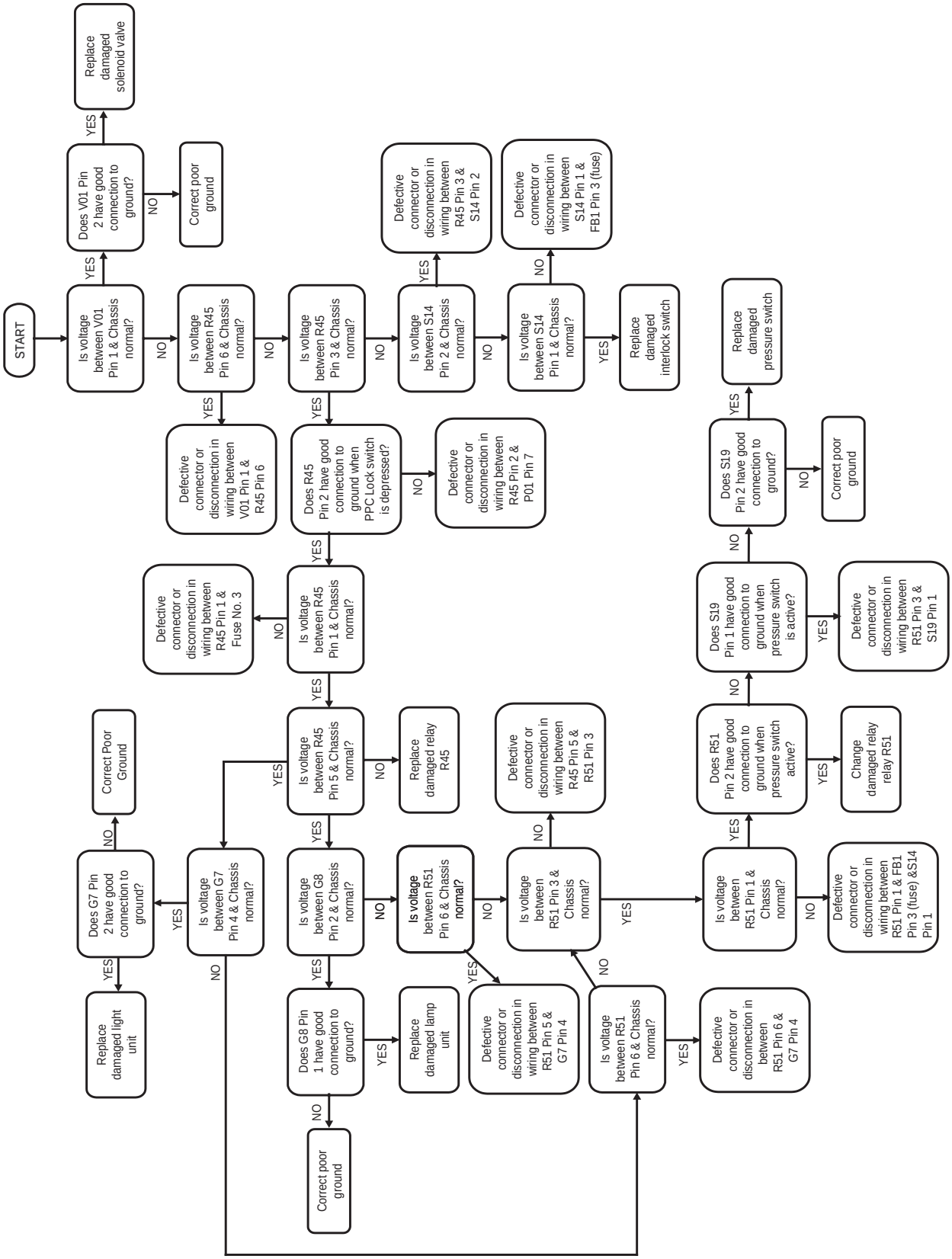
*When fuse no.6 is not blown



Electrical Circuit Diagram For Radio Cassette & Telephone Socket



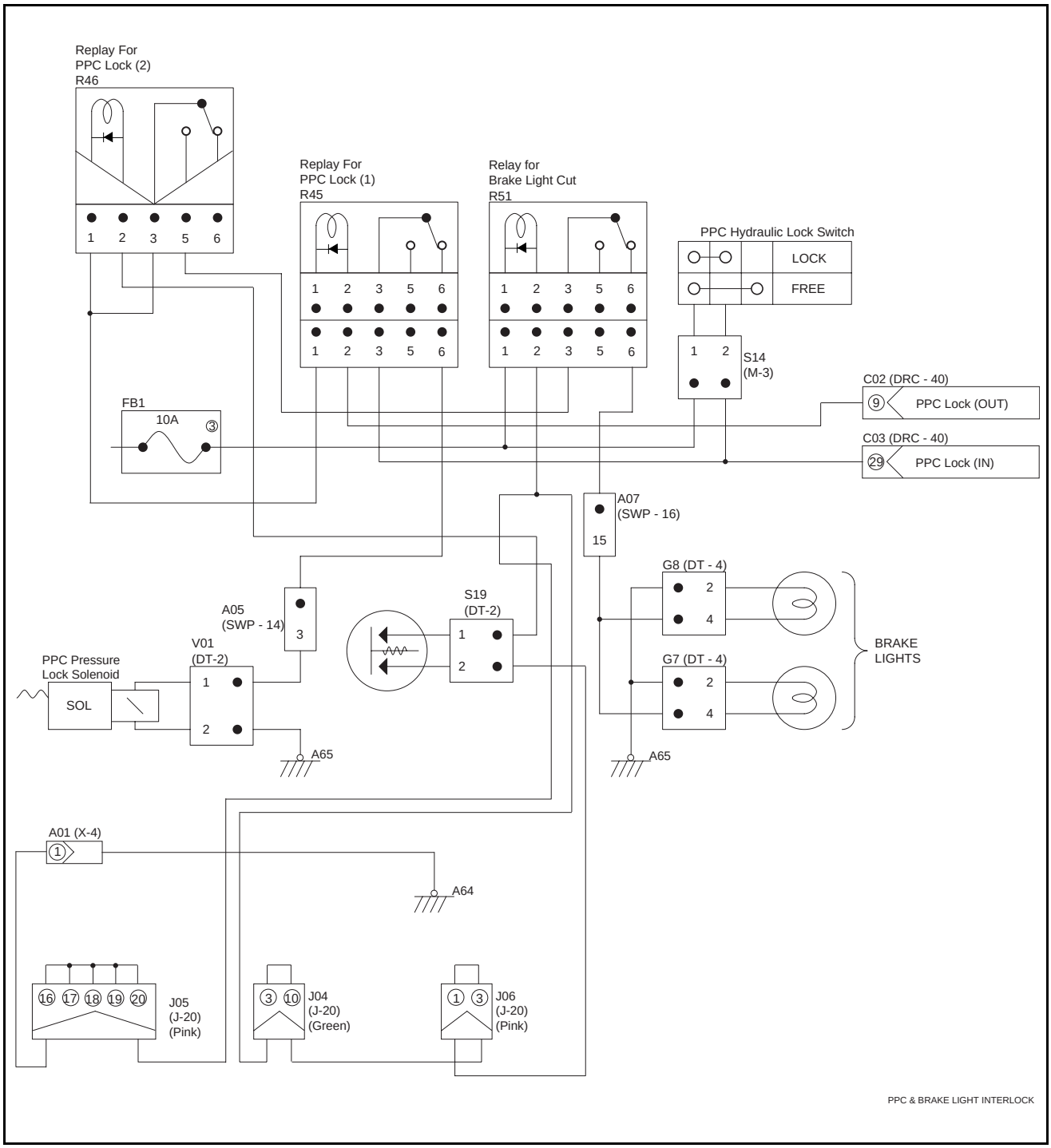
PPC Circuit & Brake Light Interlock



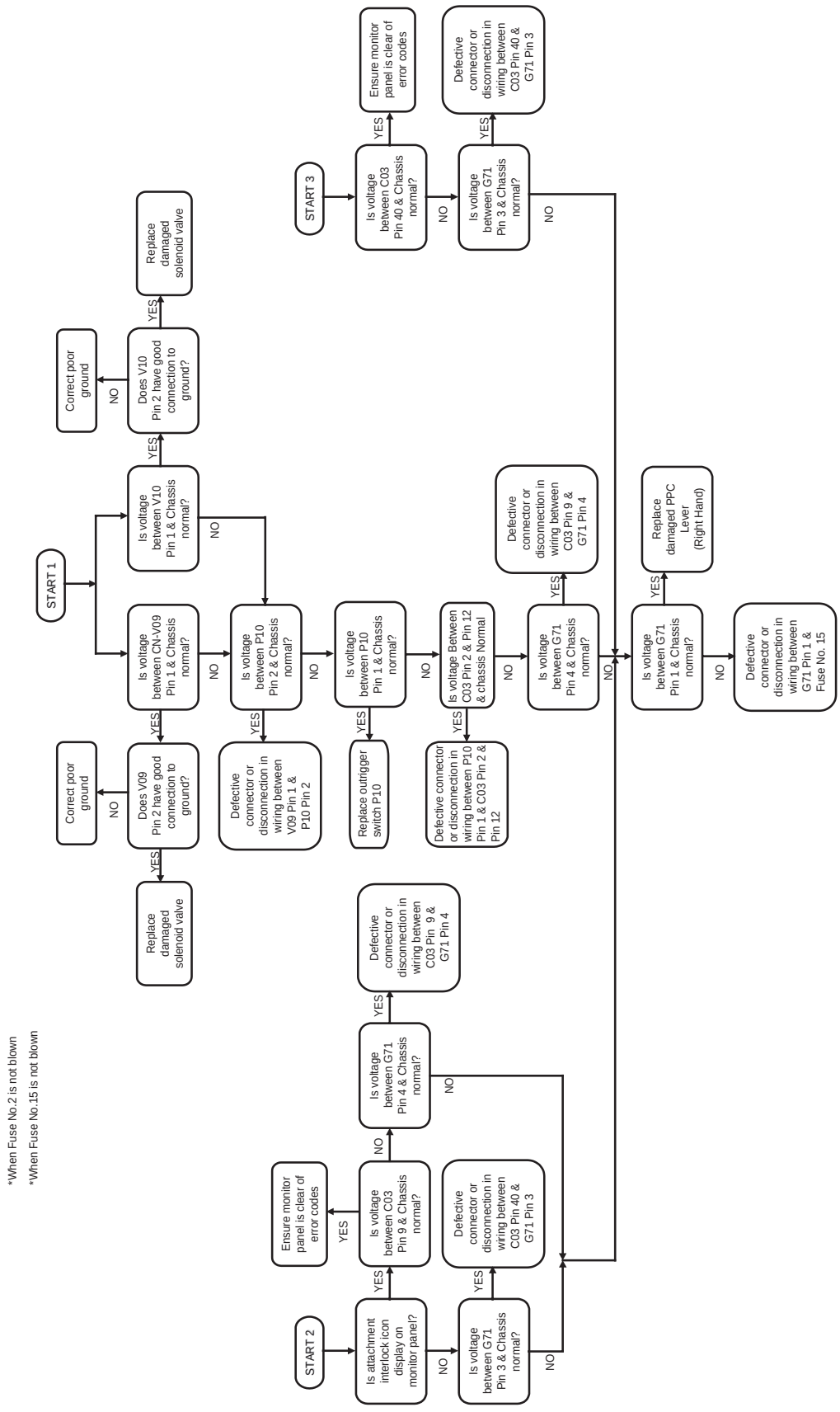
*When Fuse No.3 is not blown

*When bulbs are fitted correctly & fully functional

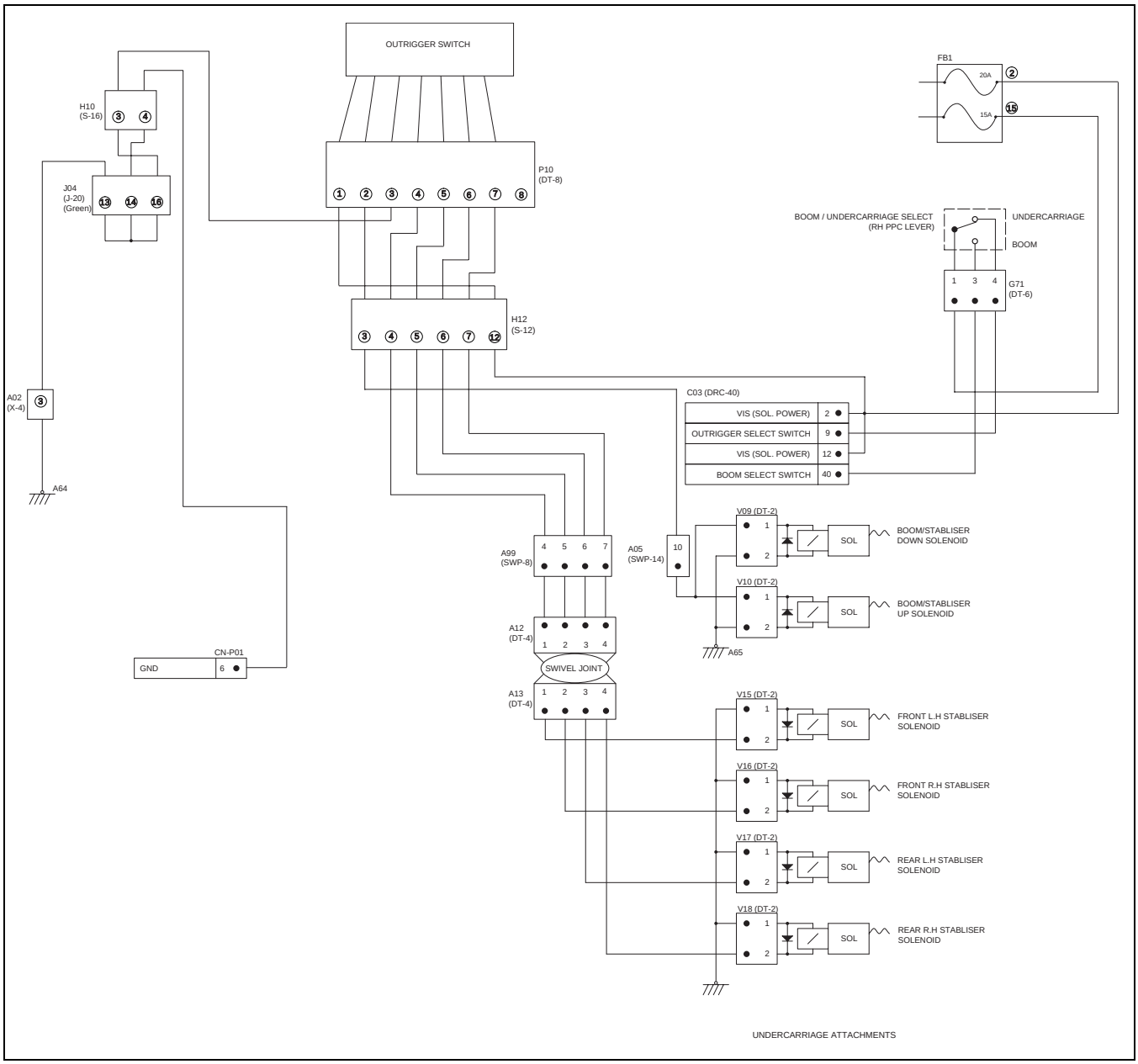
Circuit Diagram for PPC Circuit & Brake Light Interlock



Undercarriage Attachments - Mode Selection



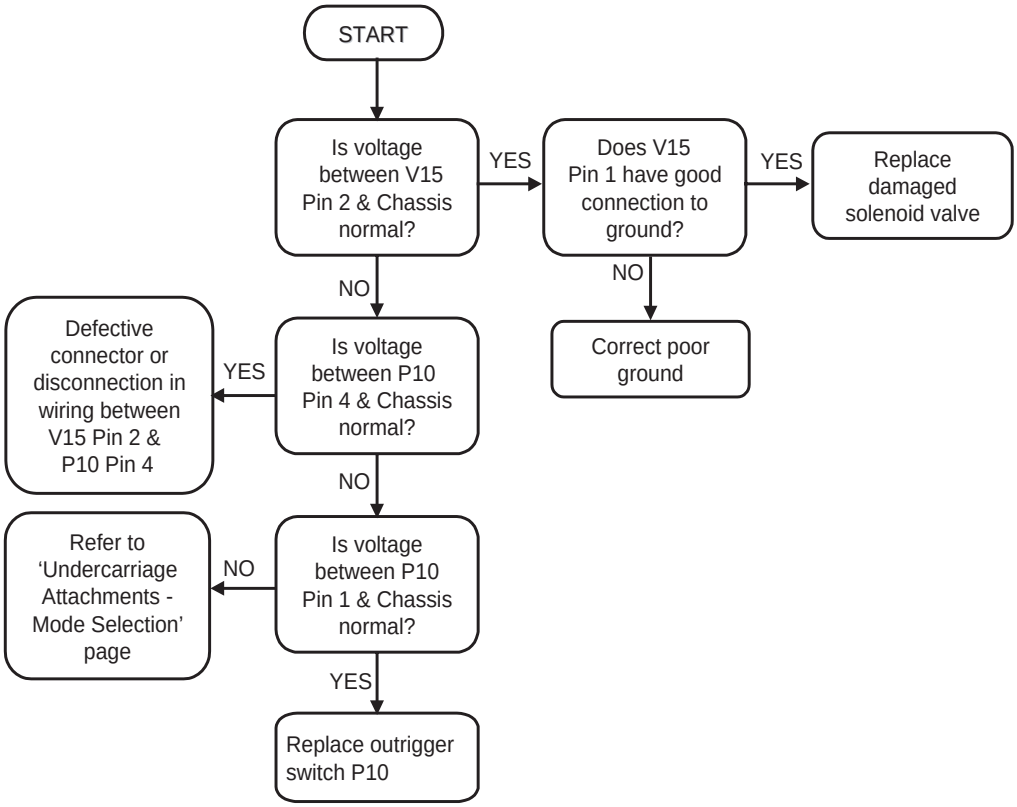
Circuit Diagram for Undercarriage Attachments - Mode Selection



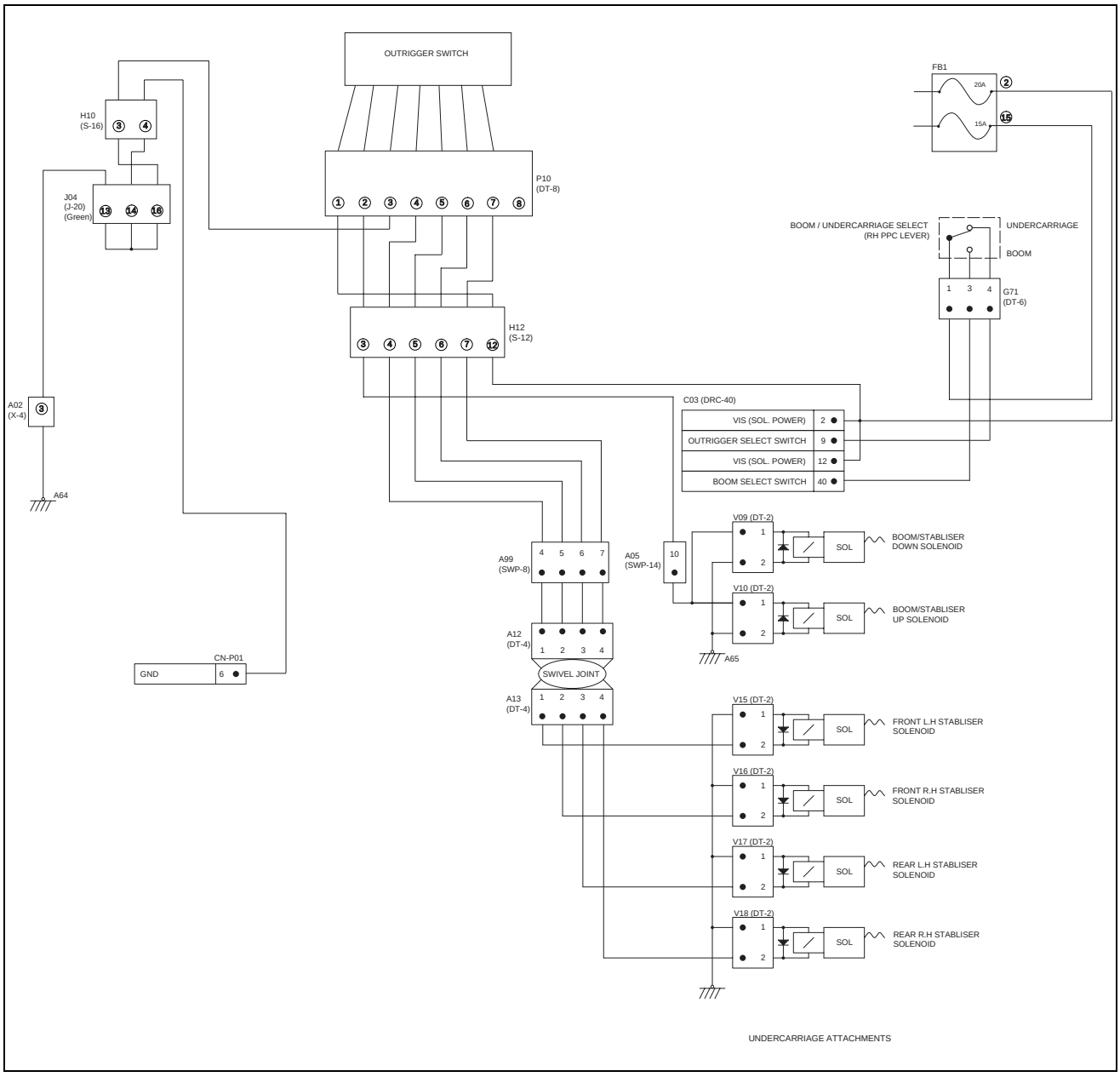
Undercarriage Attachments - Front Left Outrigger

*When Fuse No.2 is not blown

*When attachment 'Mode Select' circuit is fully functional



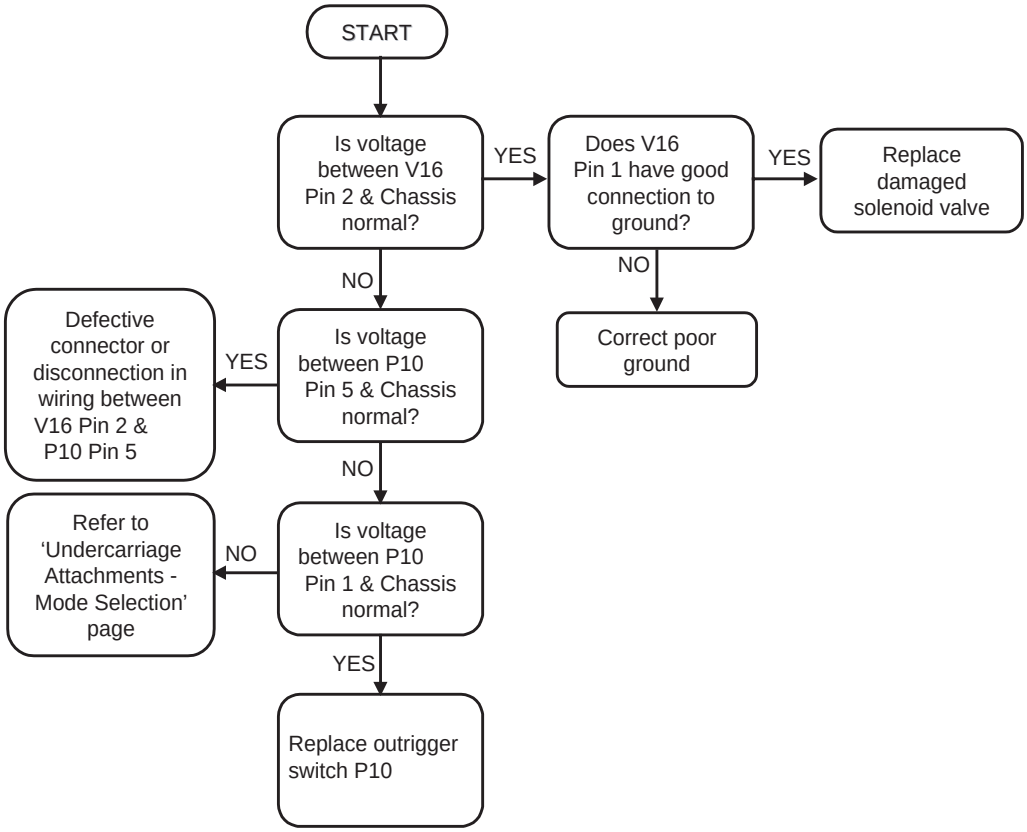
Circuit Diagram for Undercarriage Attachments - Front Left Outrigger



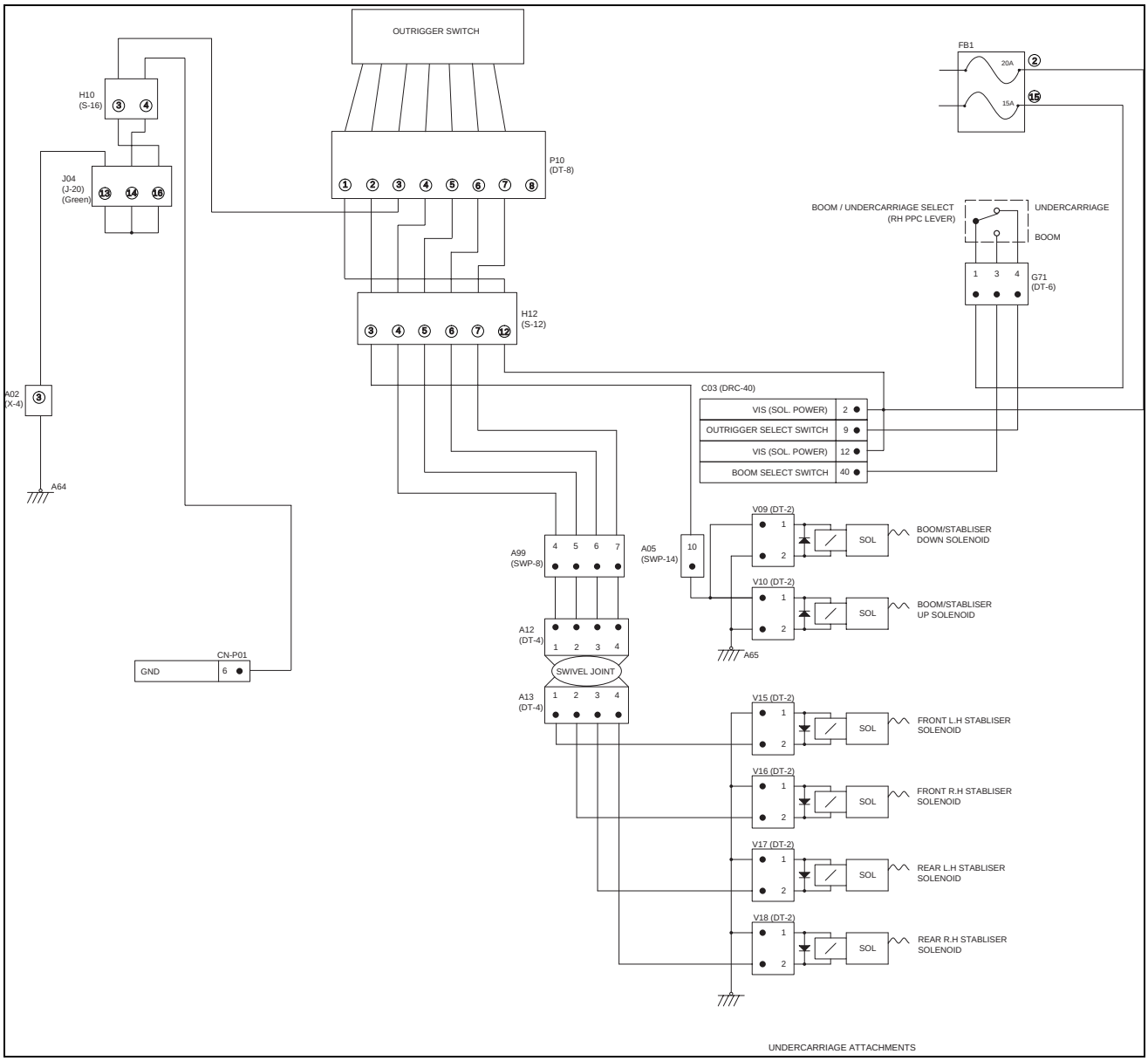
Undercarriage Attacments - Front Right Outrigger

*When Fuse No.2 is not blown

*When attachment 'Mode Select' circuit is fully functional



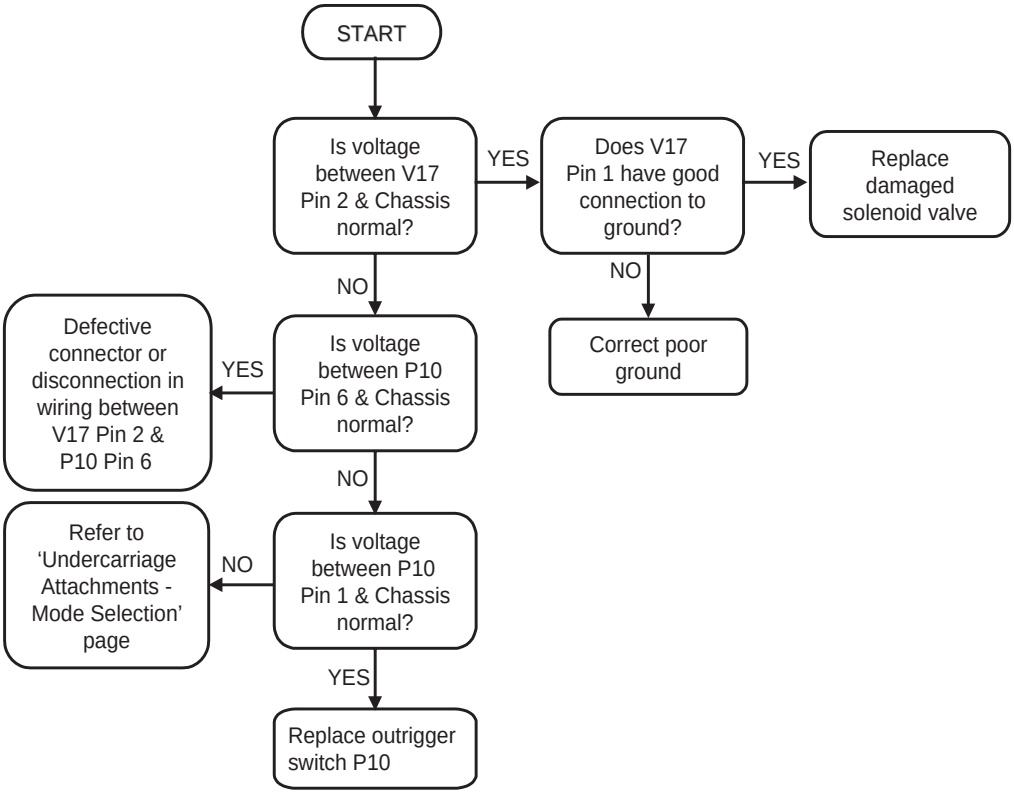
Circuit Diagram for Undercarriage Attachments - Front Right Outrigger



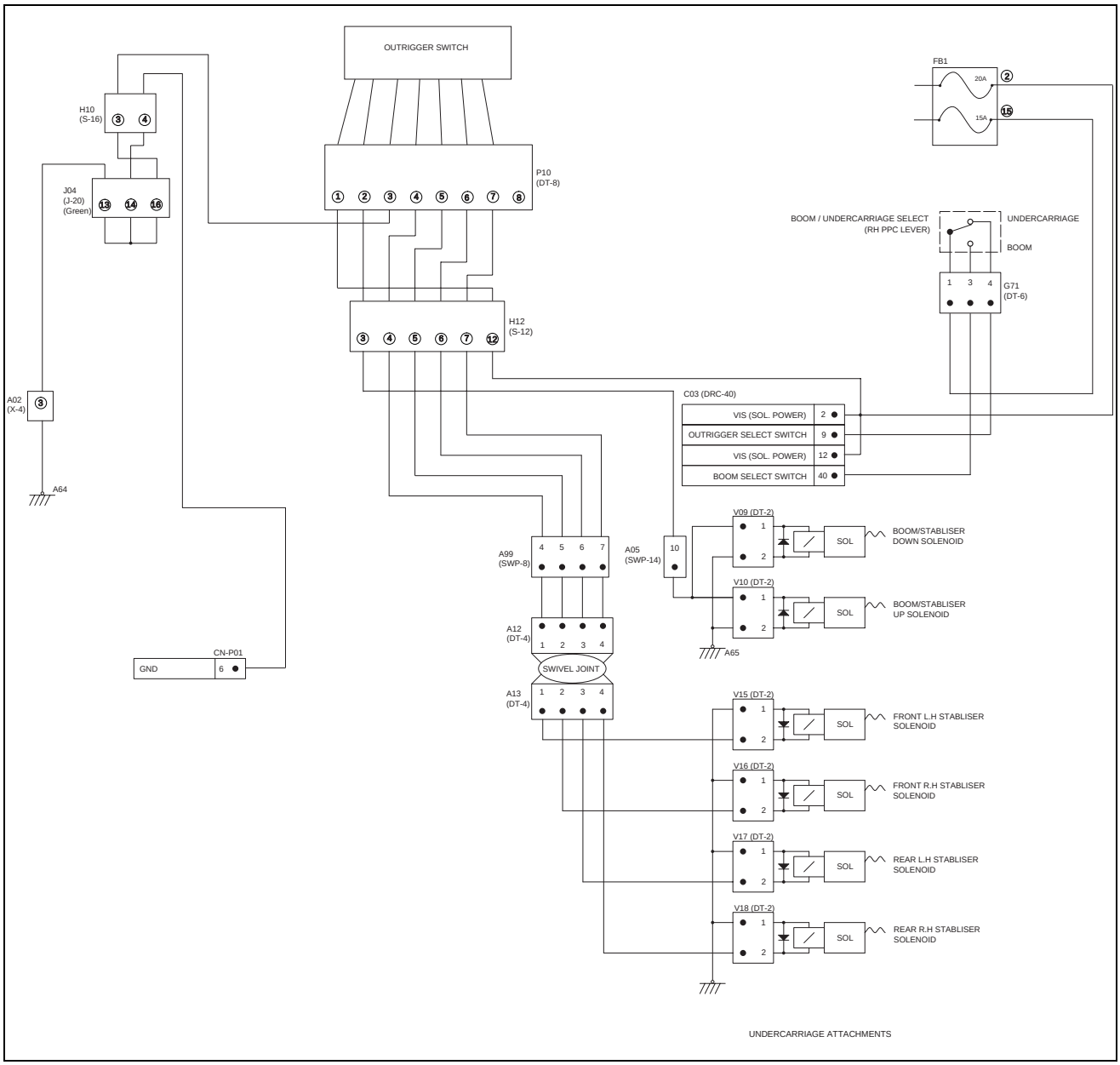
Undercariage Attachments - Rear Left Outrigger

*When Fuse No.2 is not blown

*When attachment 'Mode Select' circuit is fully functional



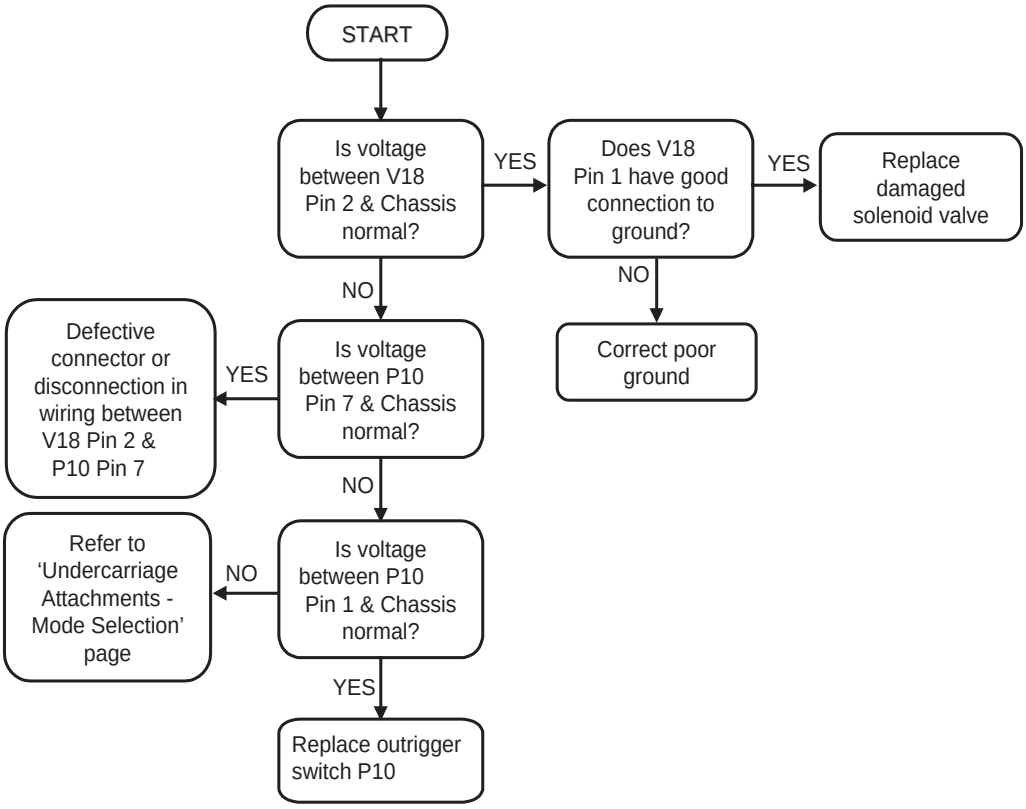
Circuit Diagram for Undercarriage Attachments - Rear left outrigger



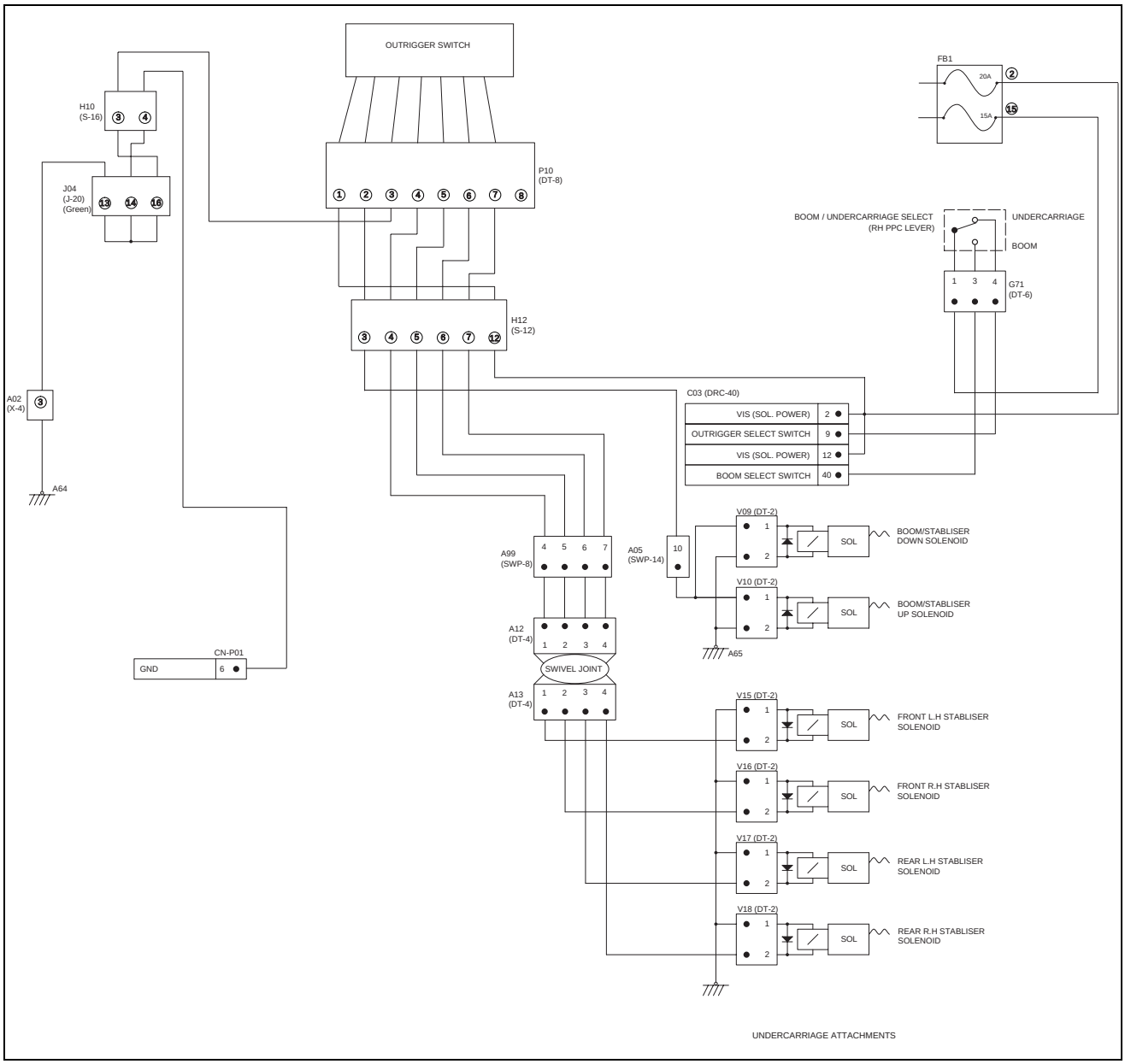
Undercarriage Attachments - Rear Right Outrigger

*When Fuse No.2 is not blown

*When attachment 'Mode Select' circuit is fully functional

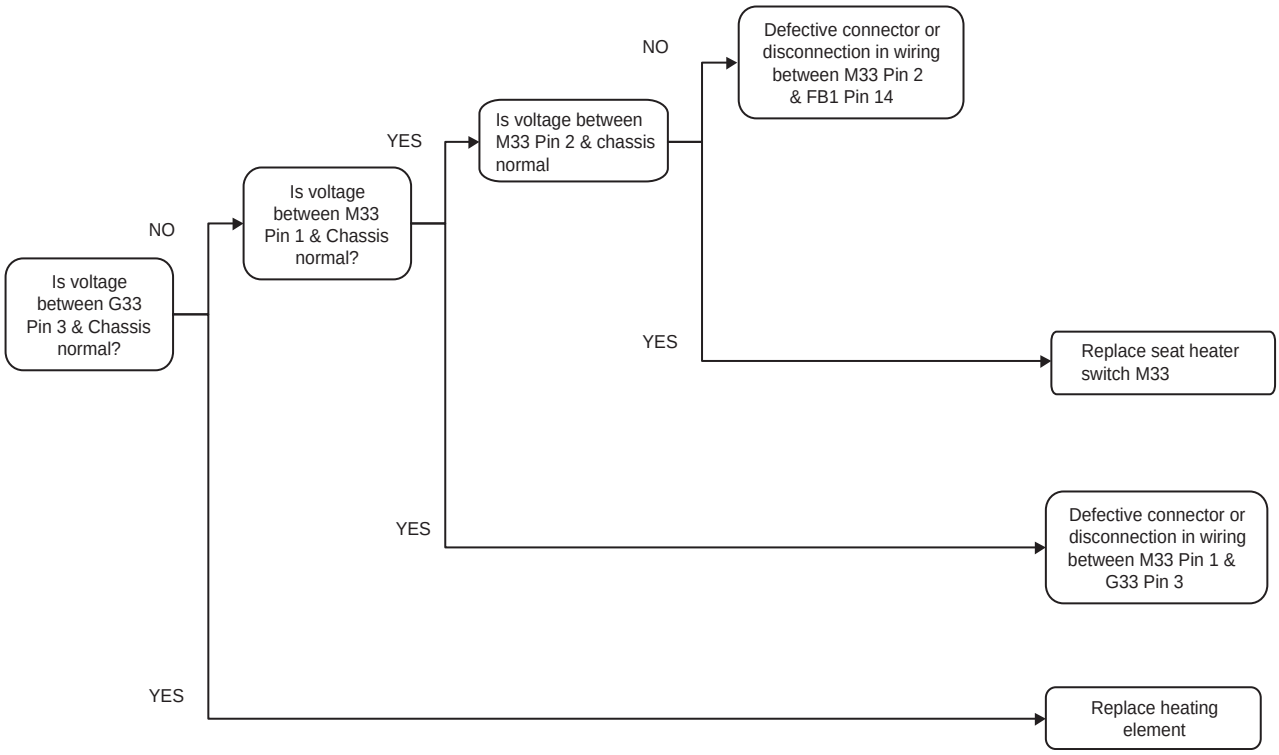


Circuit Diagram for Undercarriage Attachments - Rear Right Outrigger

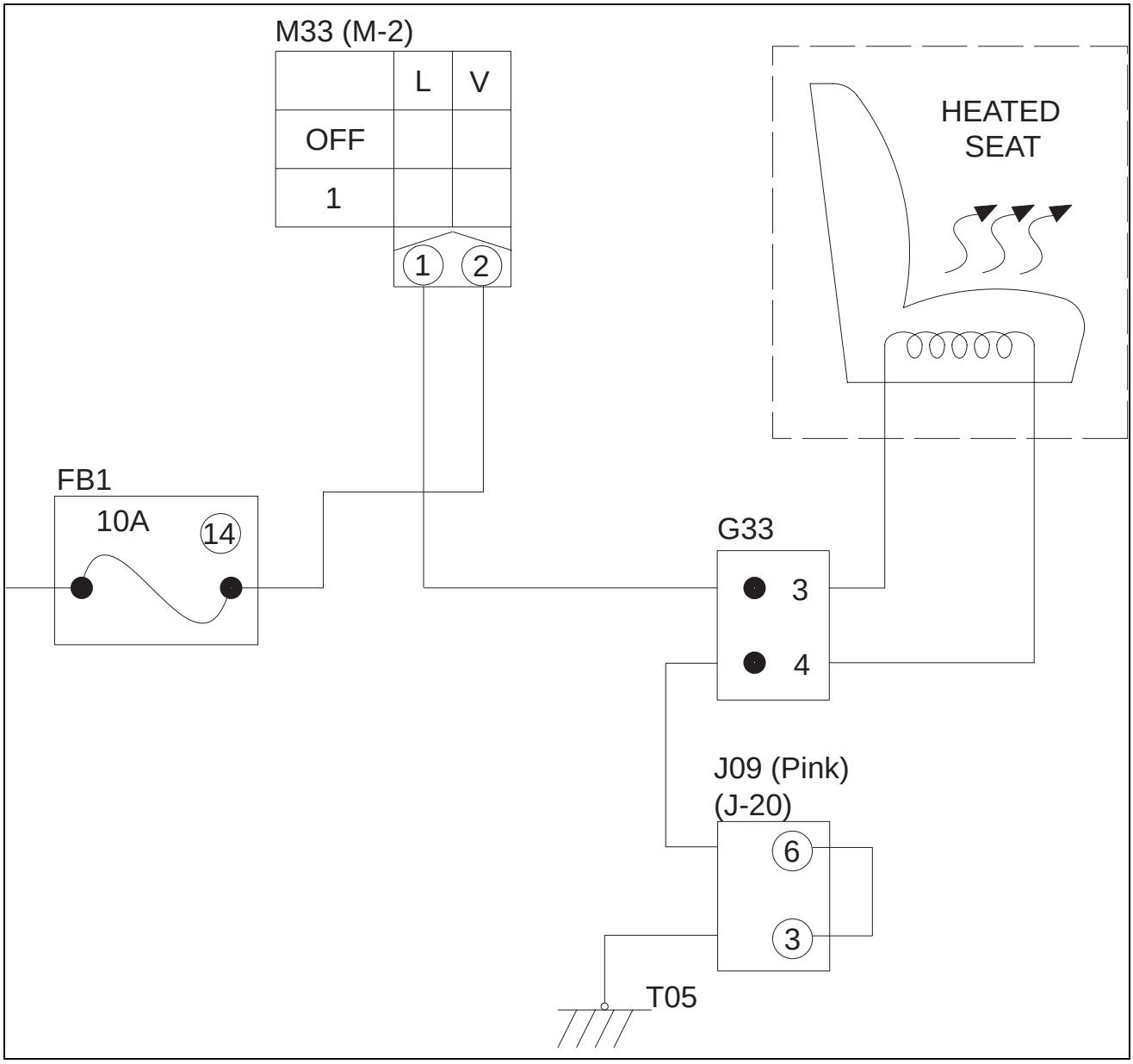


Heated Seat Does Not Warm Up

*When Fuse No.14 is not blown

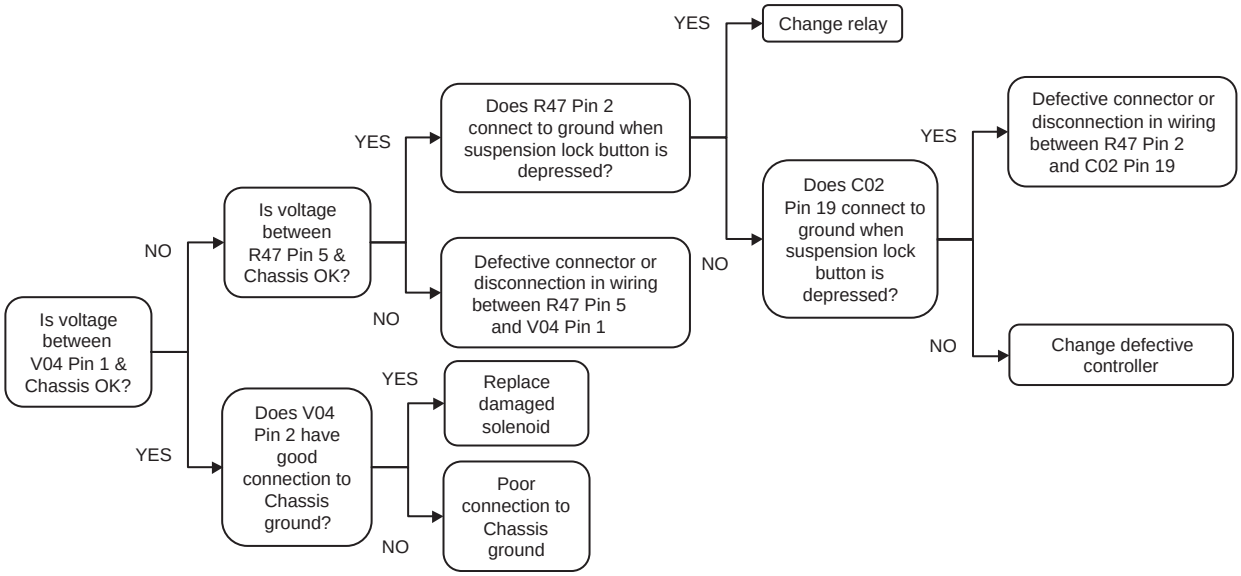


Circuit Diagram for the Heated Seat

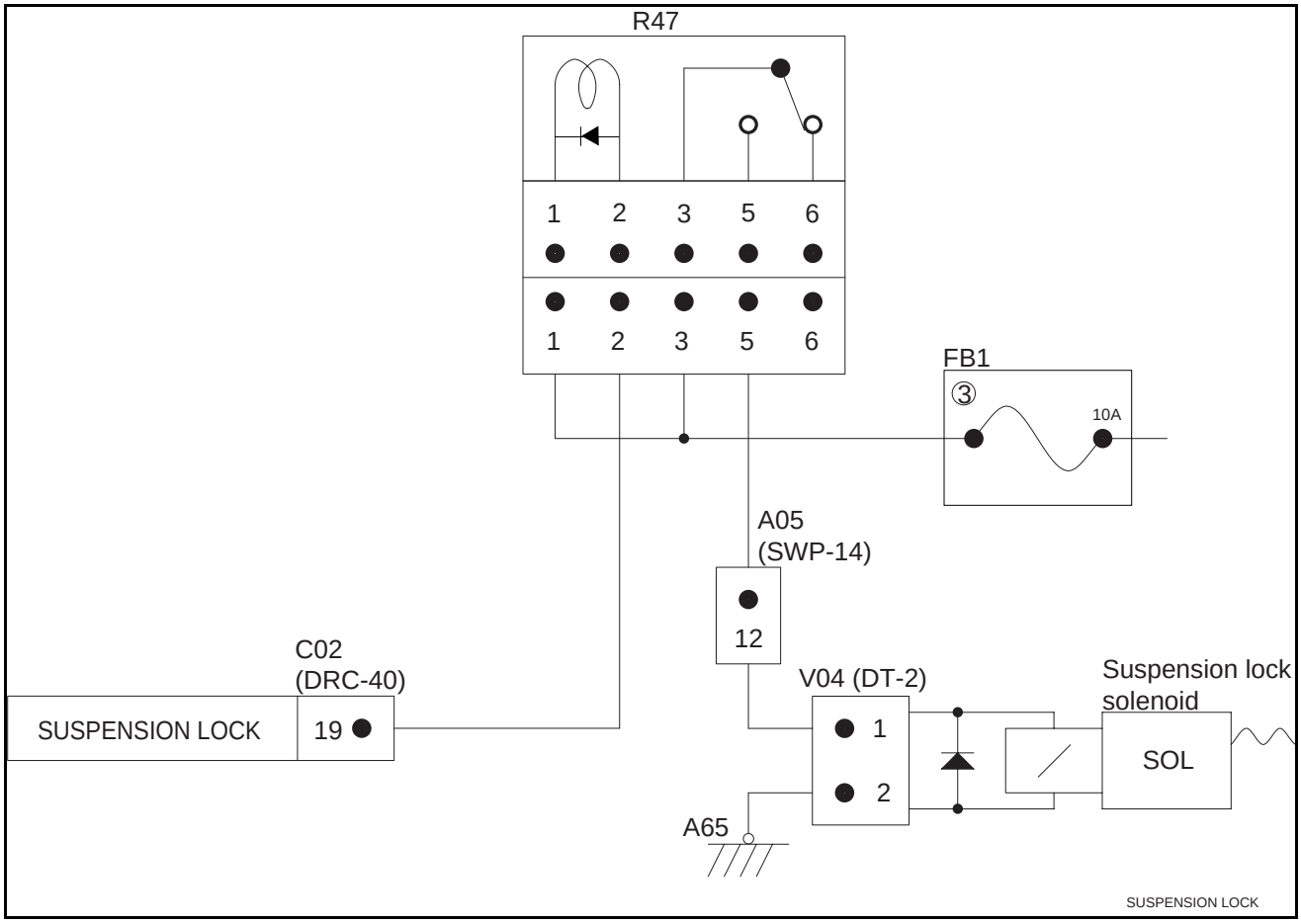


Suspension Lock

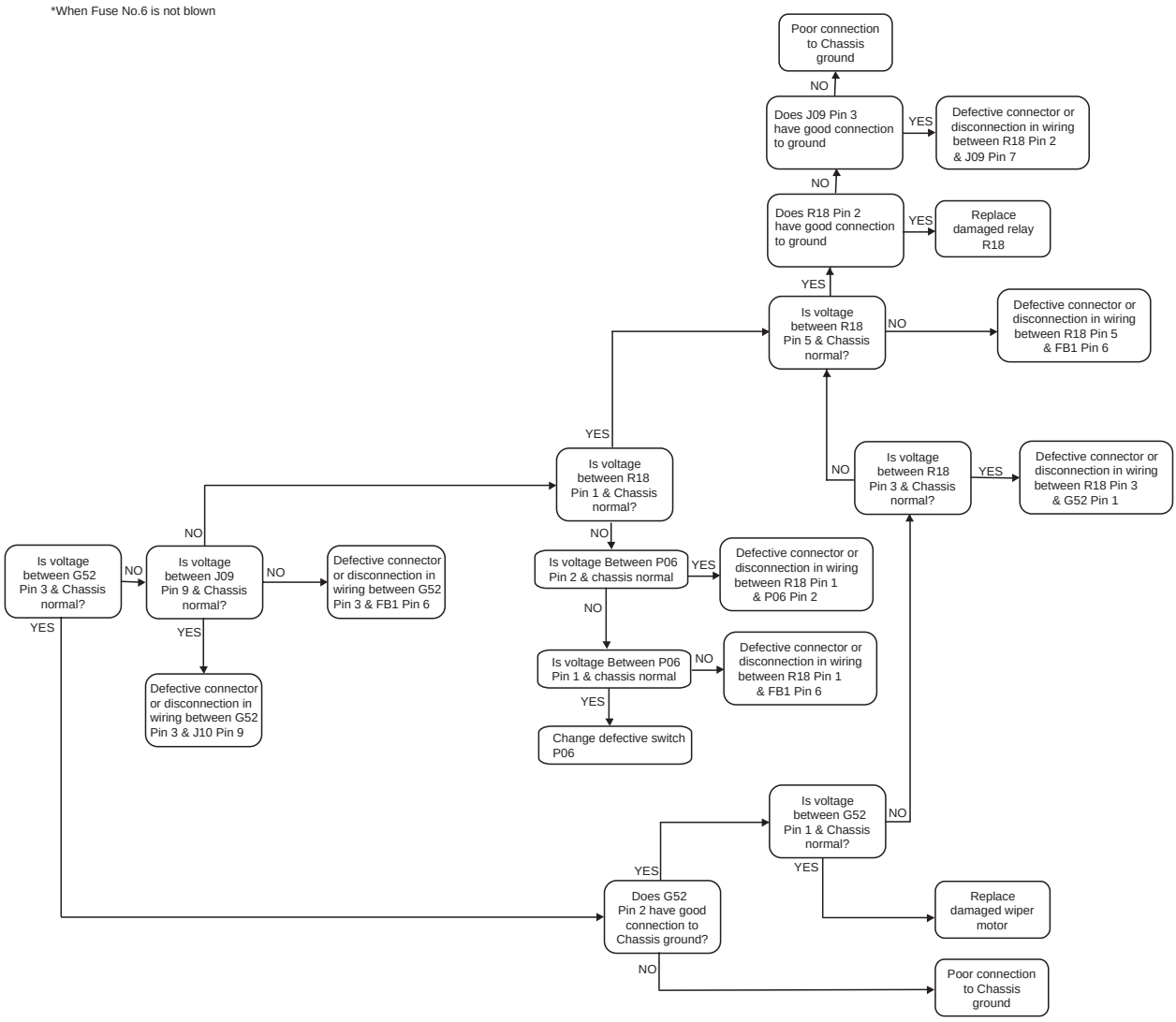
*When fuse No.3 is not blown



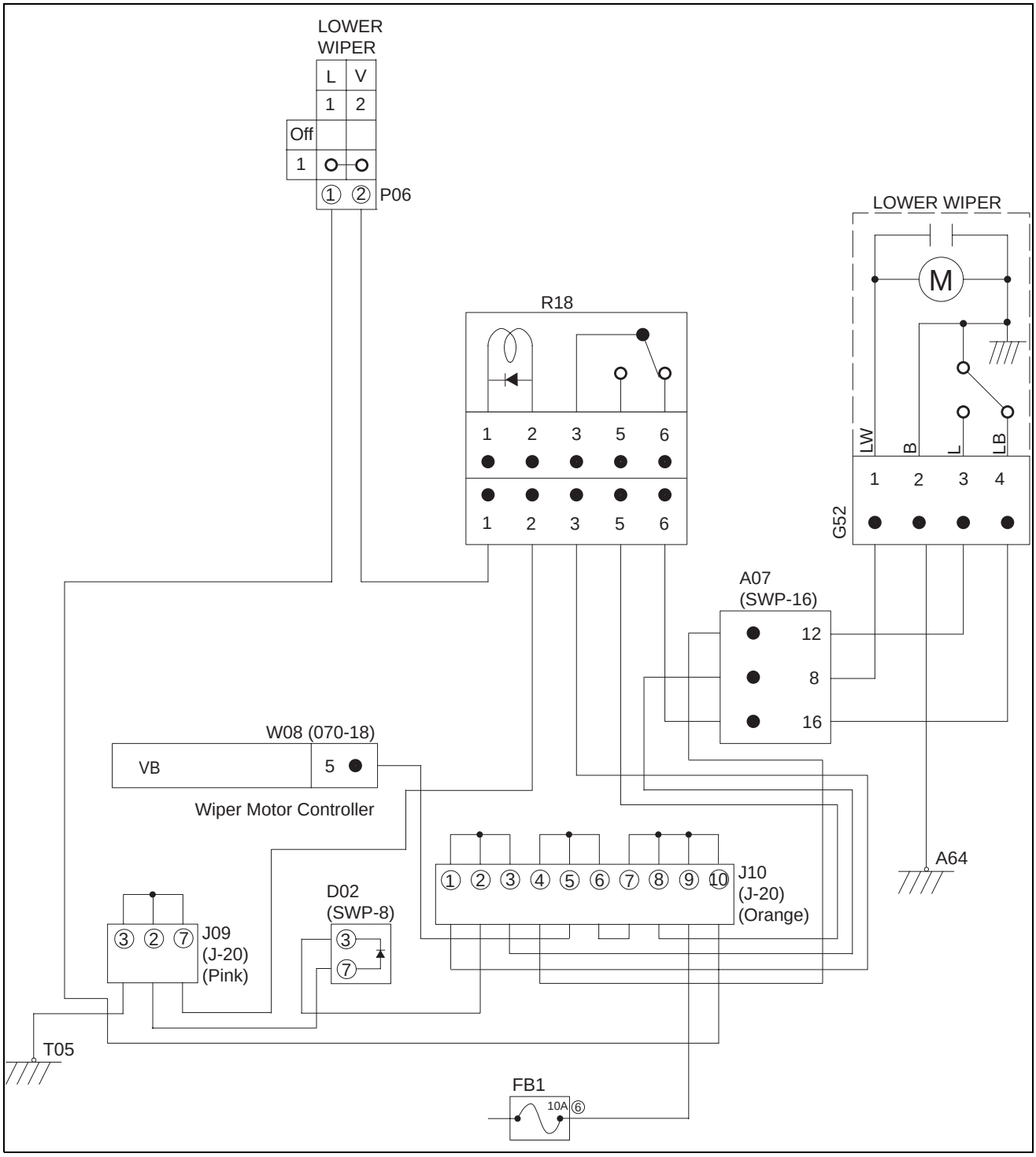
Circuit Diagram for Suspension Lock



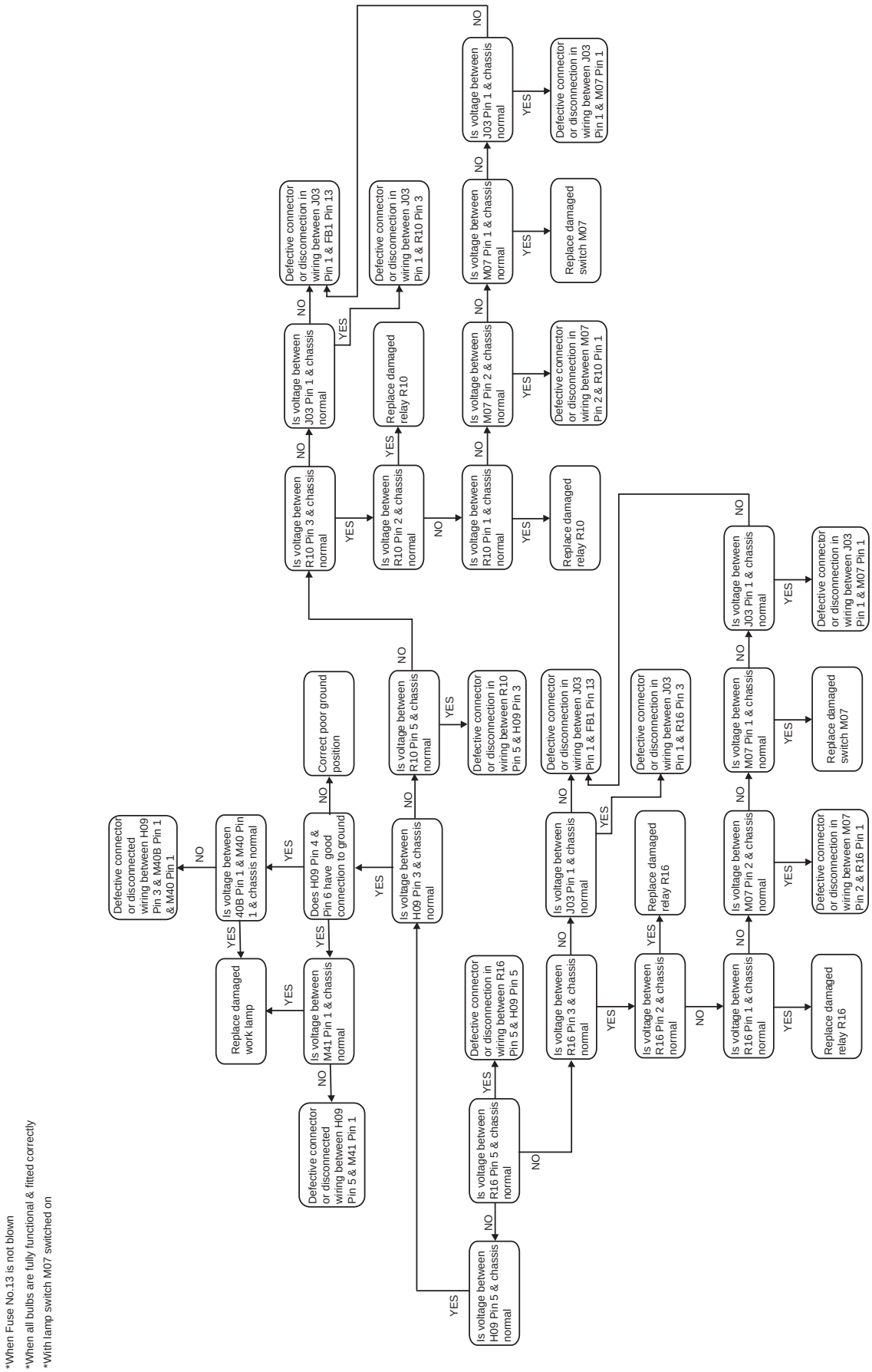
Lower Wiper Does Not Work (Optional Fitment)



Circuit Diagram for Lower Wiper

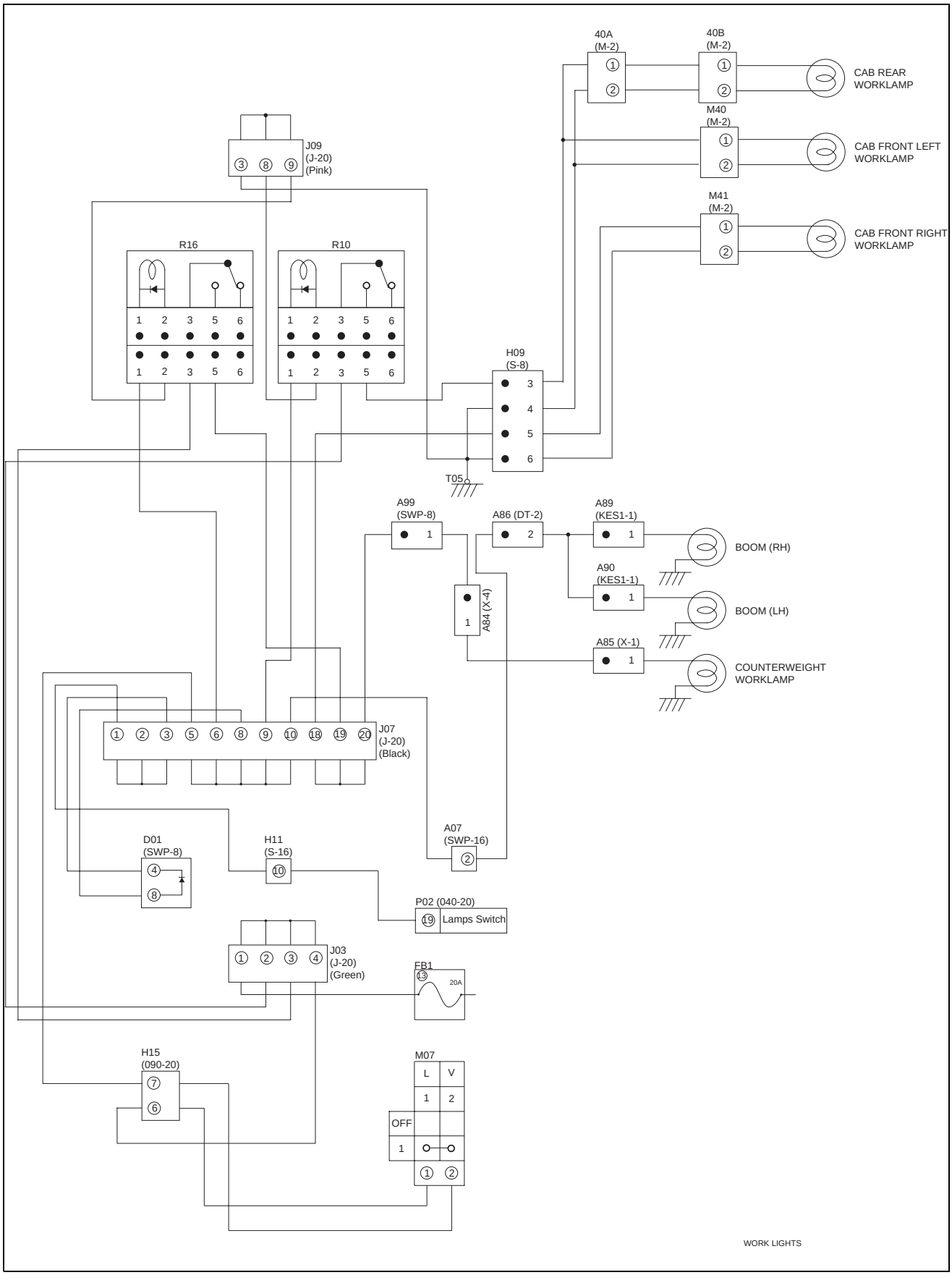


Work Lights (Operator Cab)



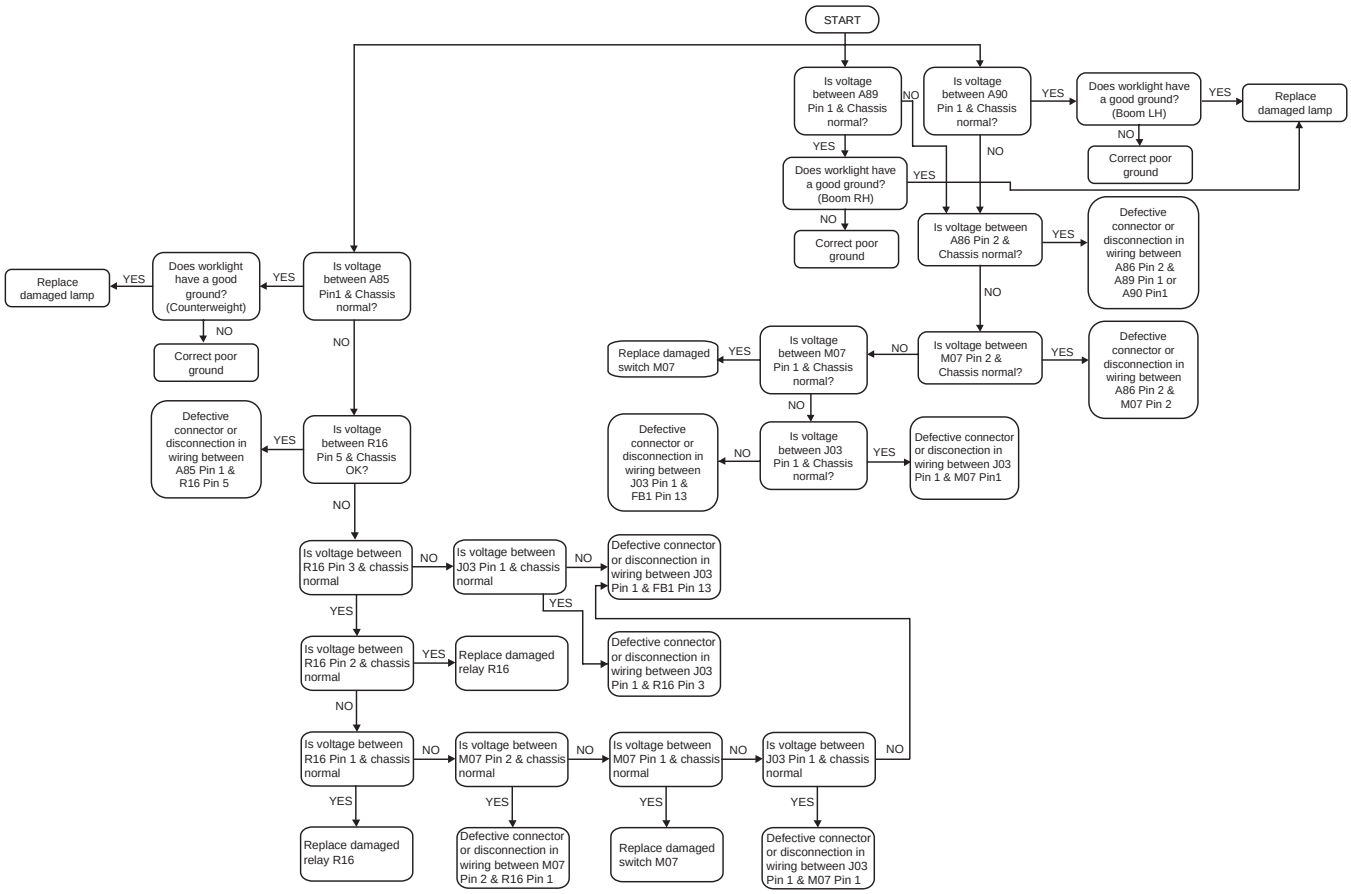
*When Fuse No.13 is not blown
*When all bulbs are fully functional & fitted correctly
*With lamp switch M07 switched on

Circuit Diagram for Work Lights (Operator Cab)

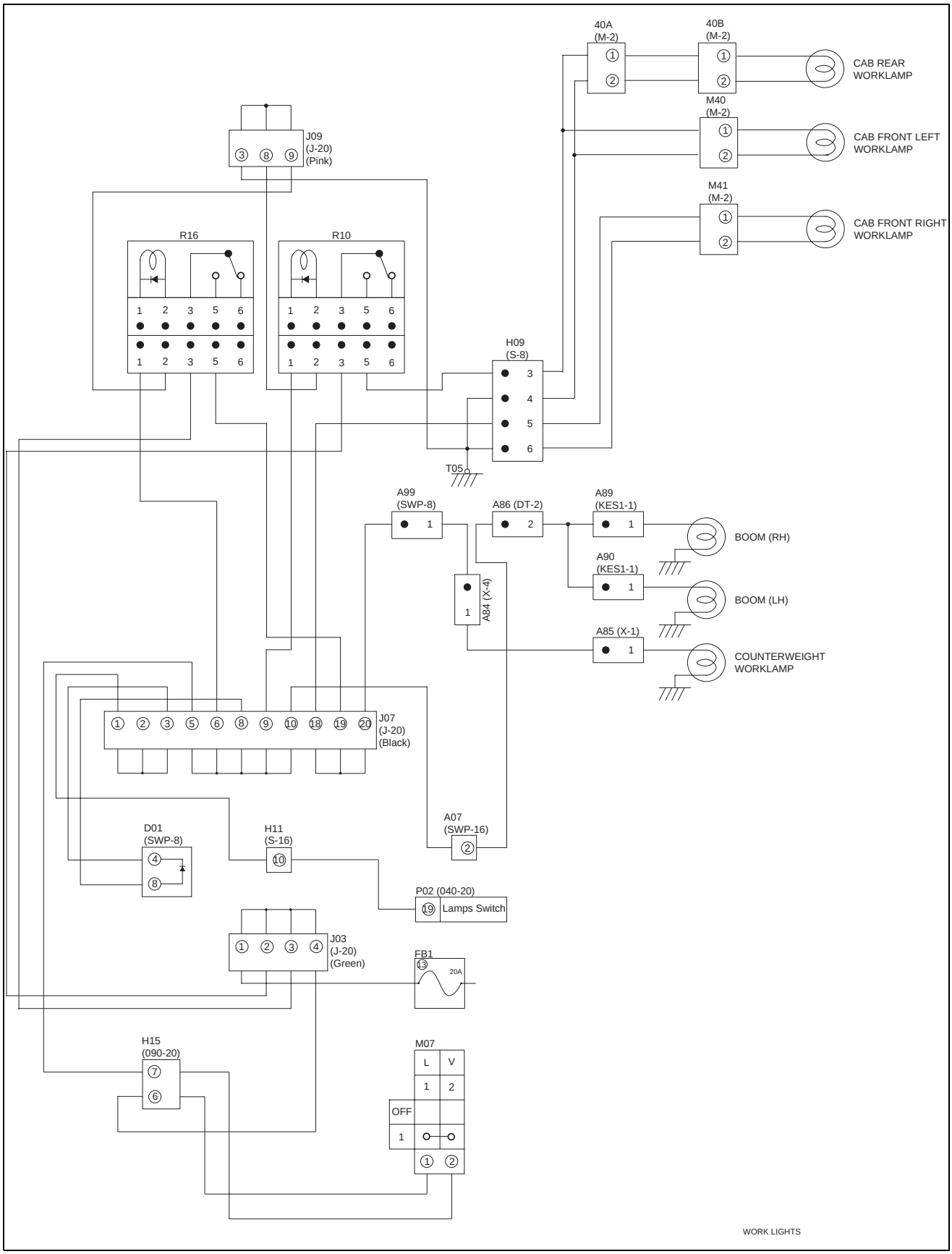


Worklights (Boom & Counterweight)

*When Fuse No.13 is not blown
*When all bulbs are fully functional & fitted correctly
*When lamp switch M07 switched on



Circuit Diagram for Worklights (Boom & Counterweight)

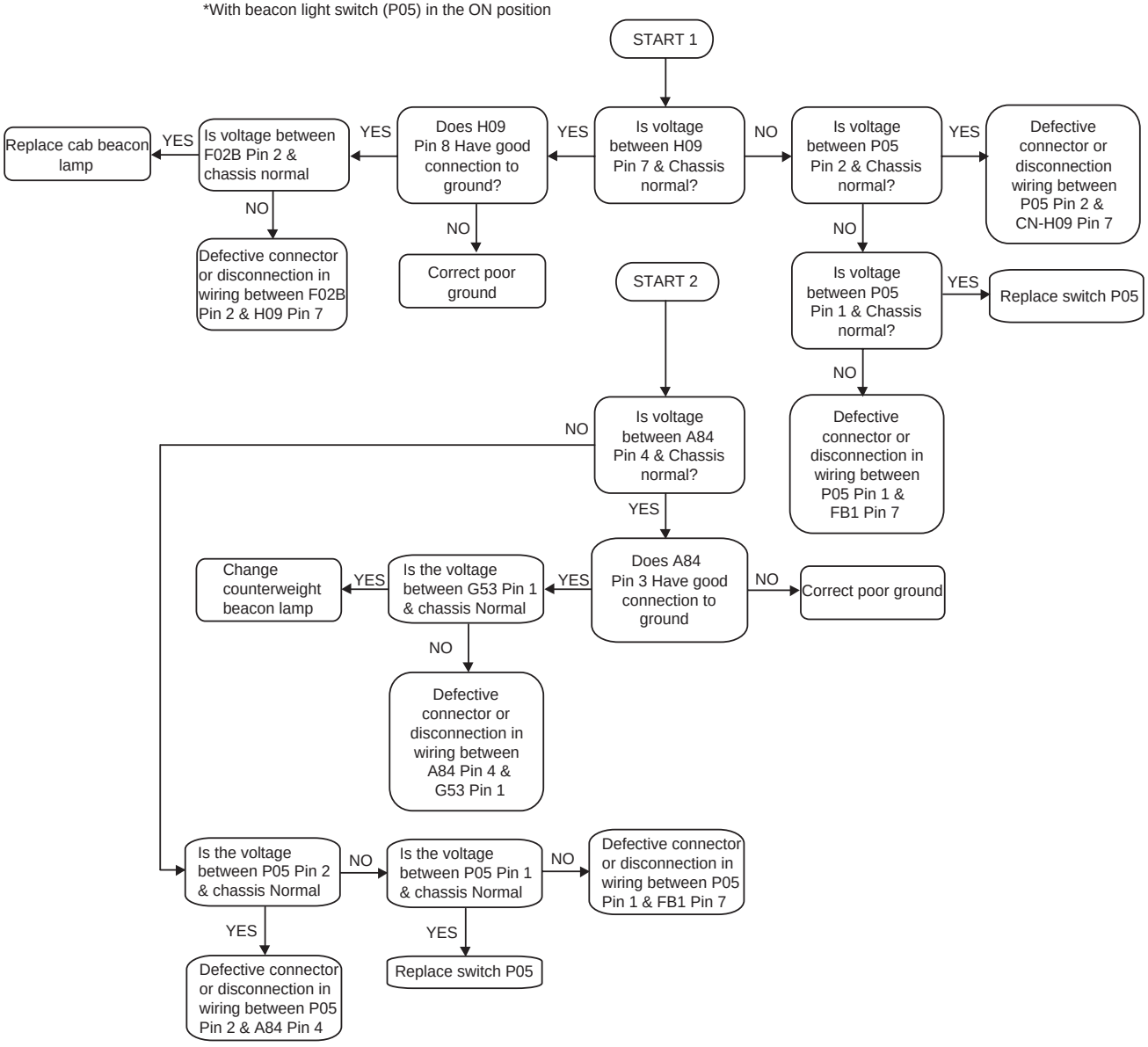


Cab and Counterweight Beacon Light

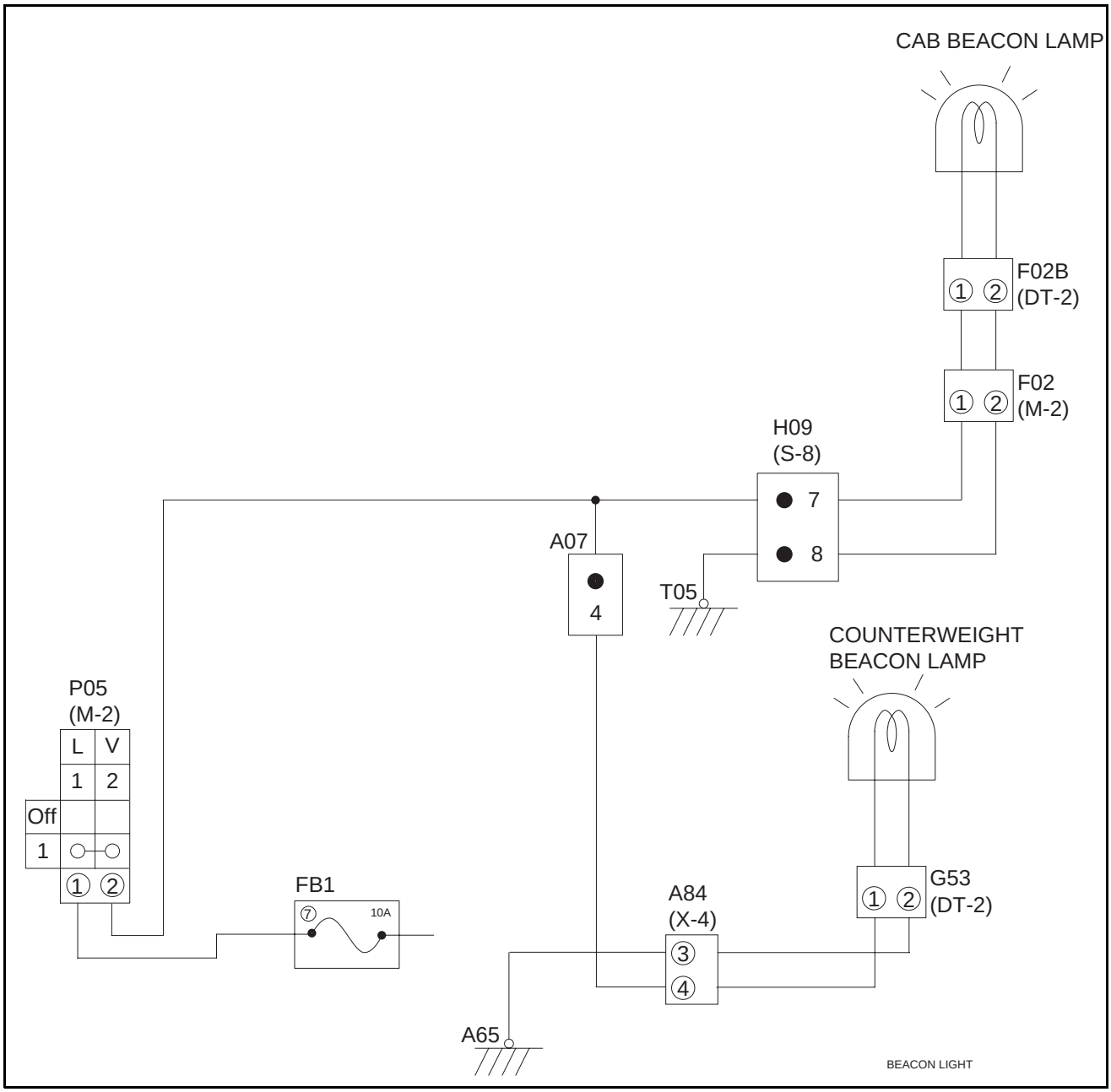
*When Fuse No.7 is not blown

*When bulb is fitted correctly and fully functional

*With beacon light switch (P05) in the ON position

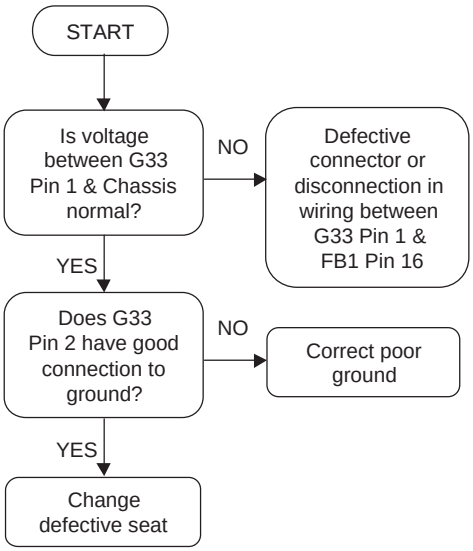


Circuit Diagram for Cab & Counterweight Beacon Light

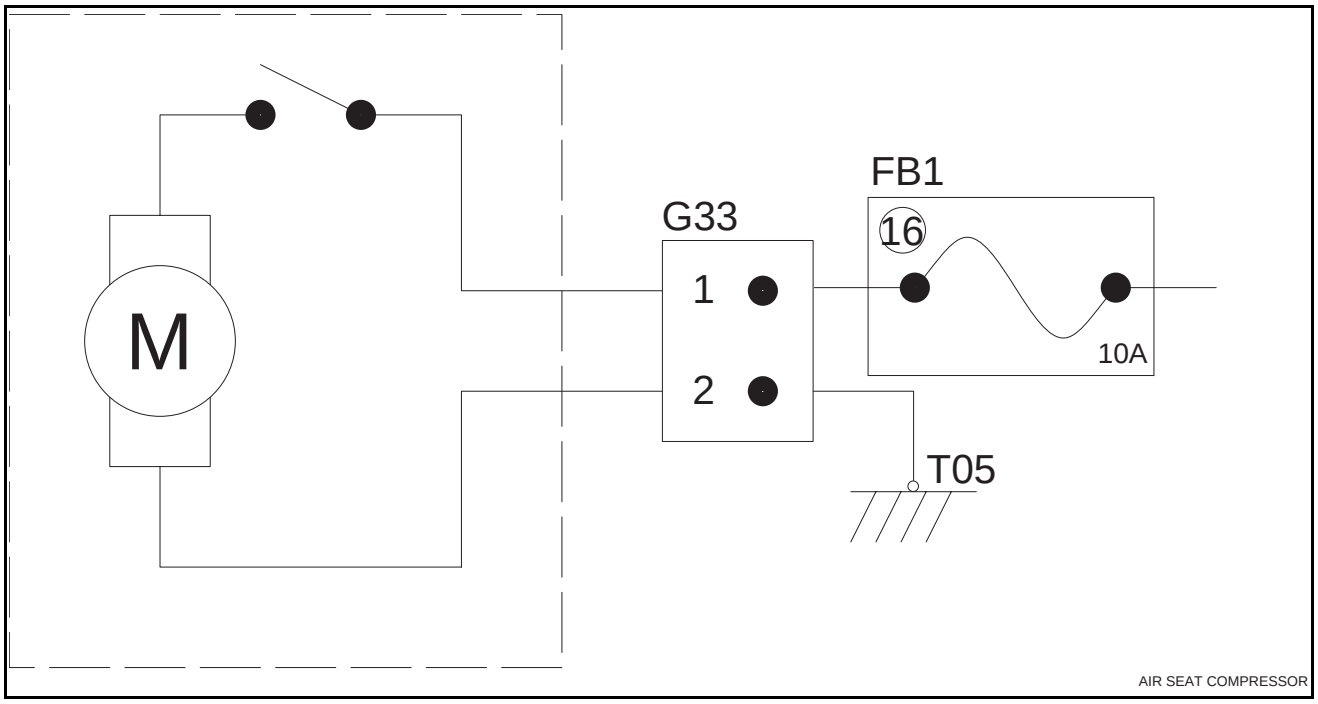


Air Seat Compressor (Option - Air Suspension Seat)

*When Fuse No.16 is not blown



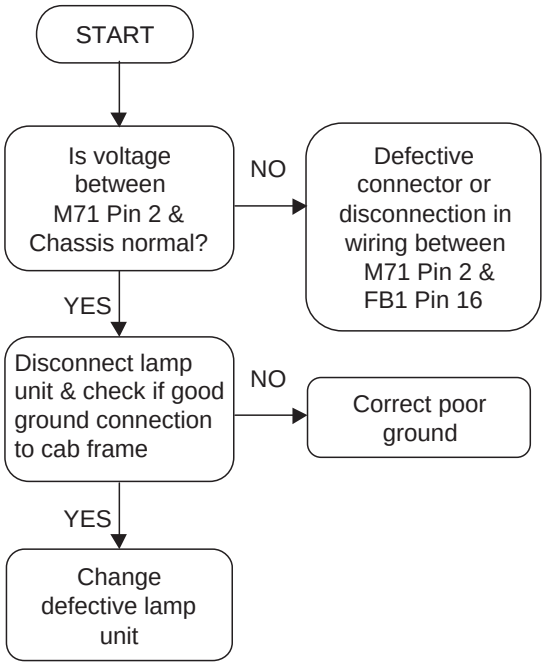
Circuit Diagram for Air Seat Compressor (Option - Air Suspension Seat)



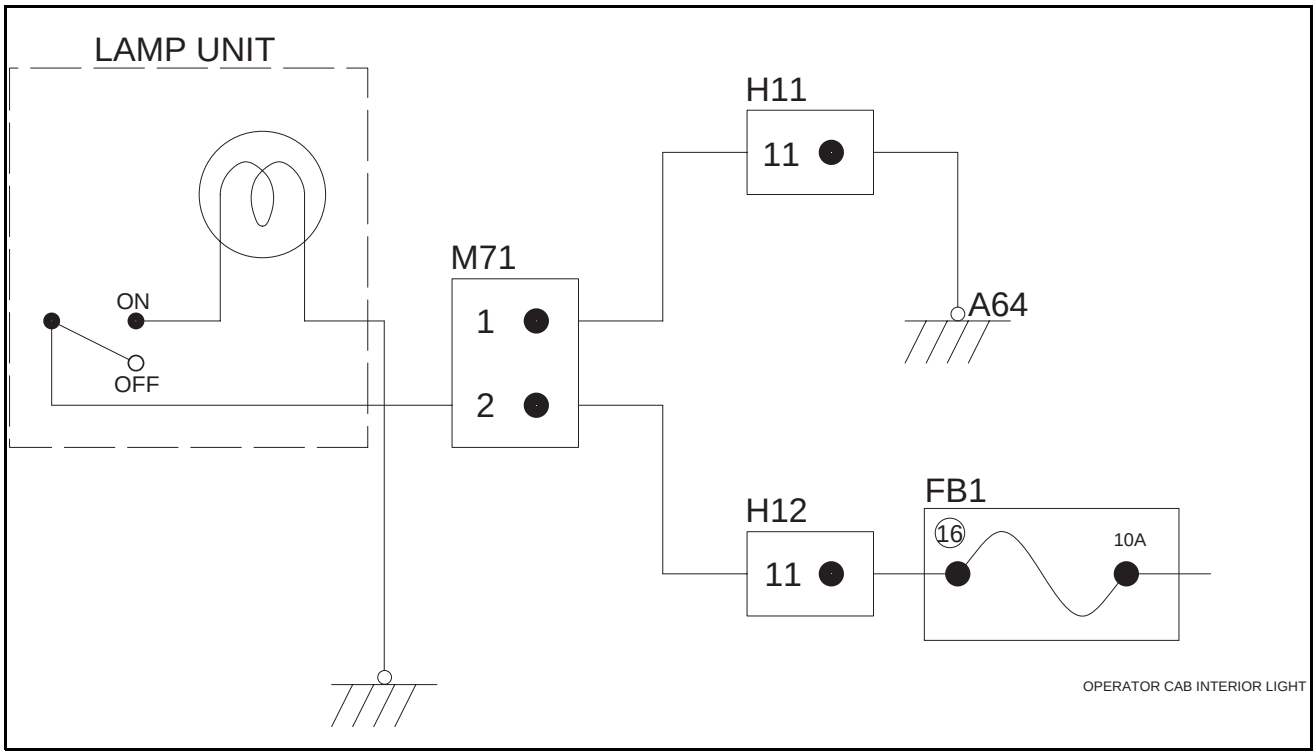
Operator Cab Interior Light

*When Fuse No.16 is not blown

*When bulb is fully functional & fitted correctly

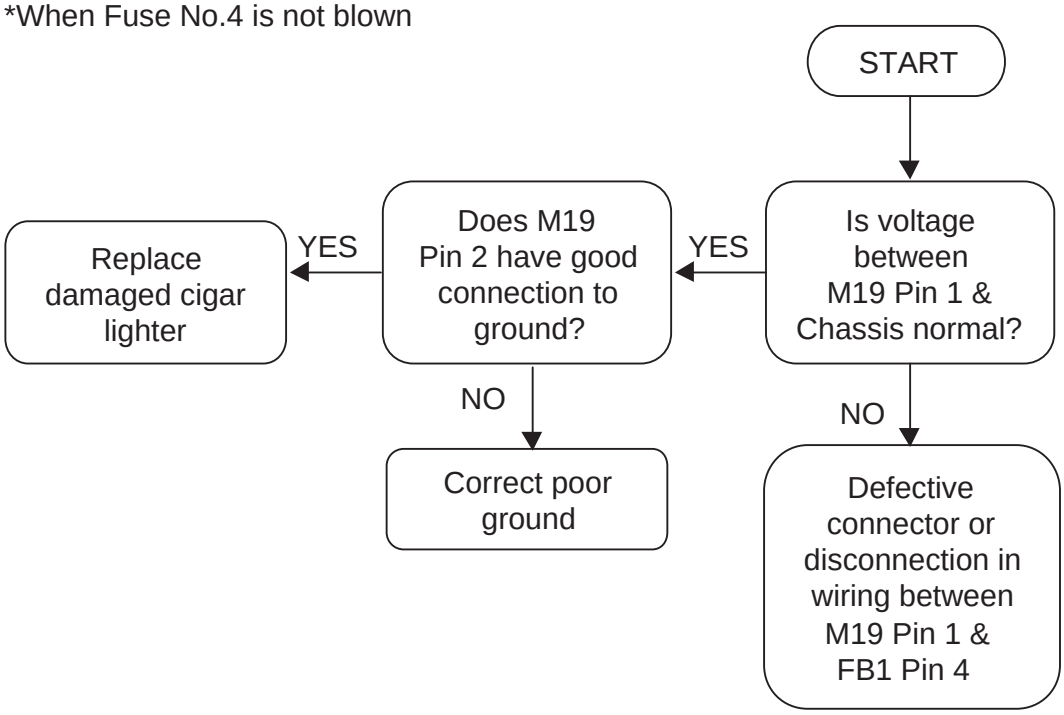


Circuit Diagram for Operator Cab Interior Light

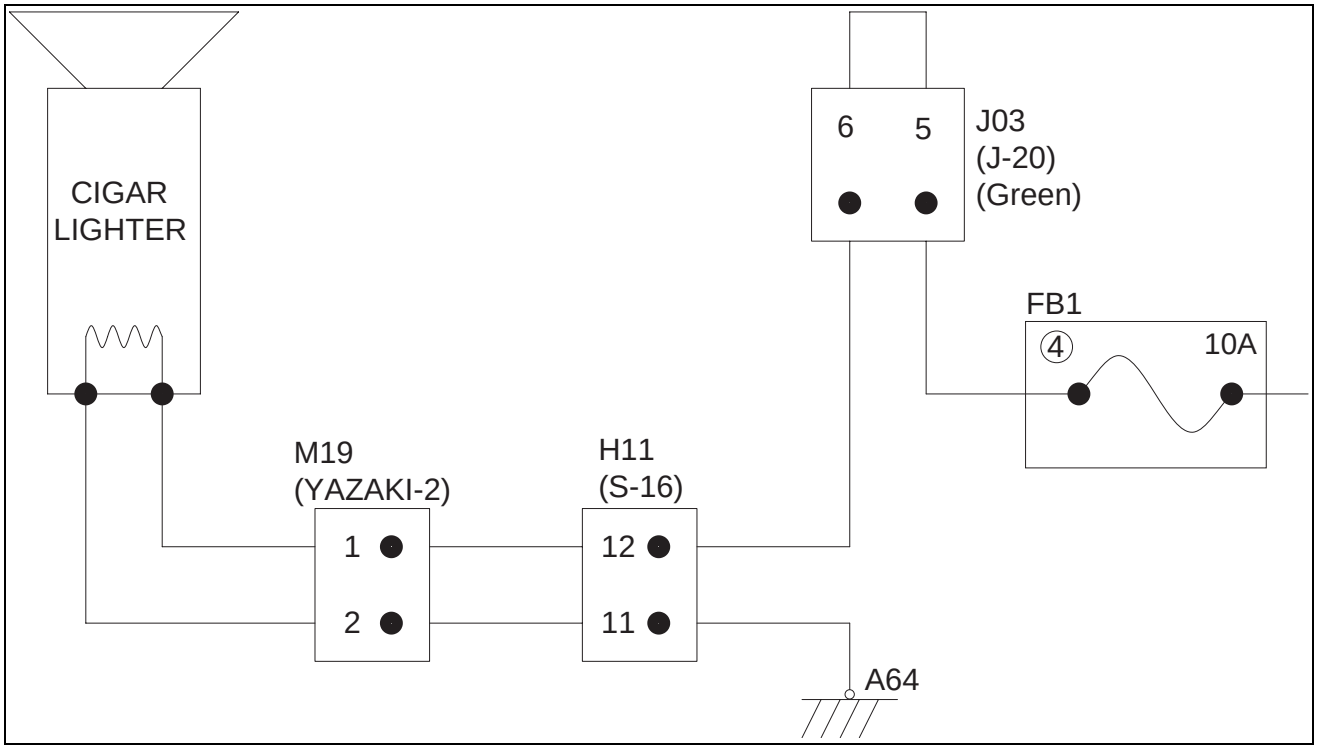


Cigar Lighter

*When Fuse No.4 is not blown

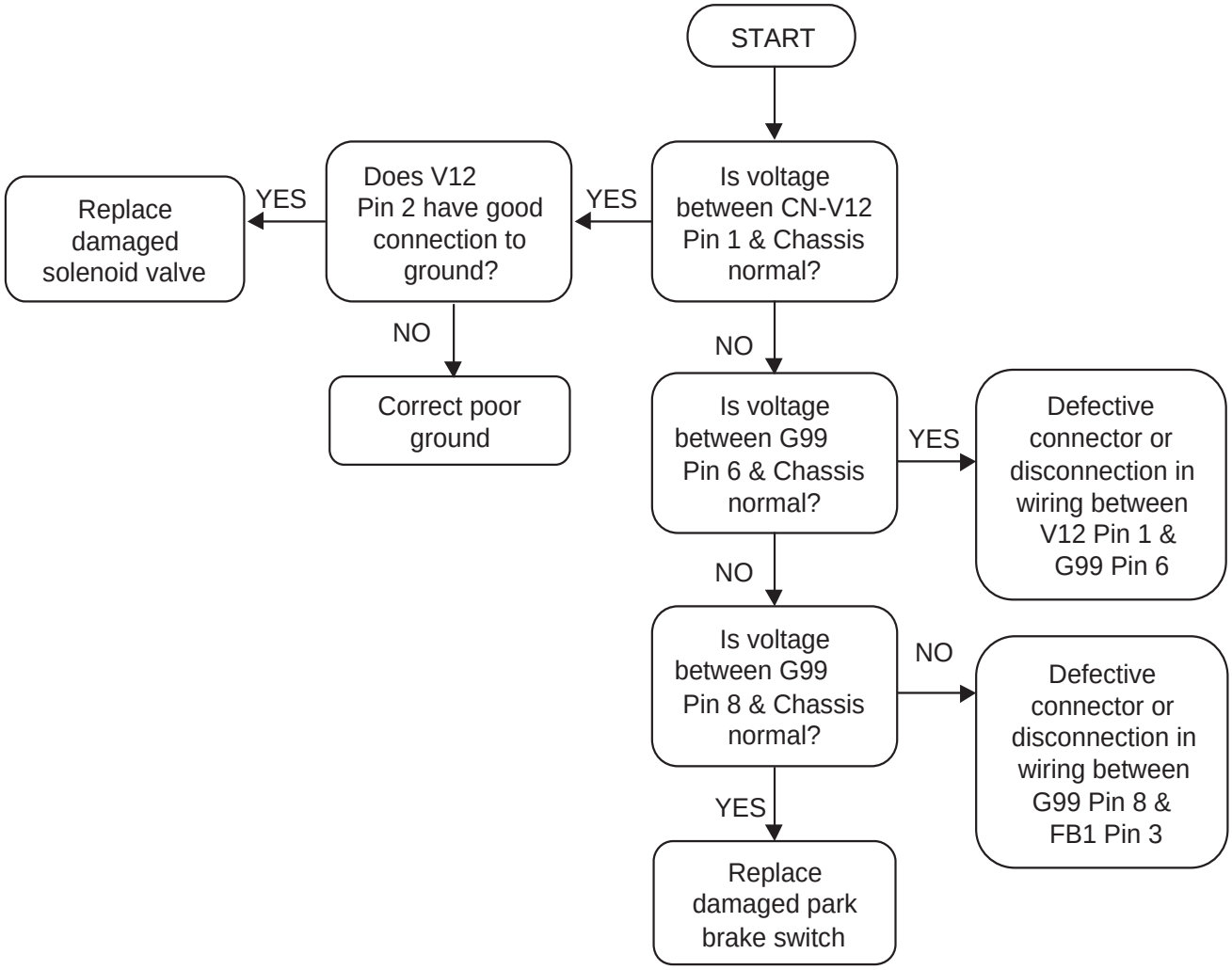


Circuit Diagram for Cigar Lighterr

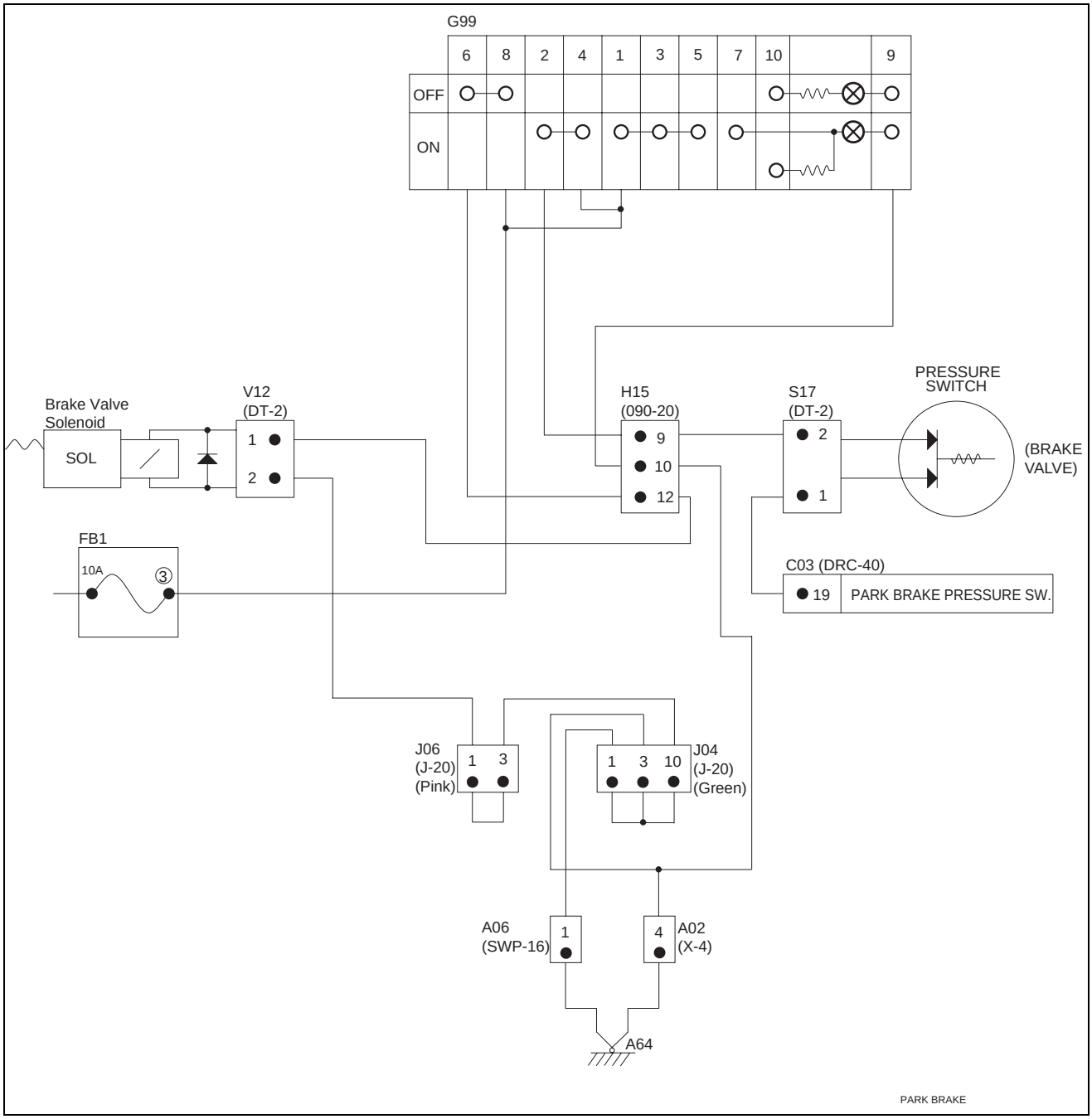


Park Brake (Not Activating)

*When Fuse No.3 is not blown

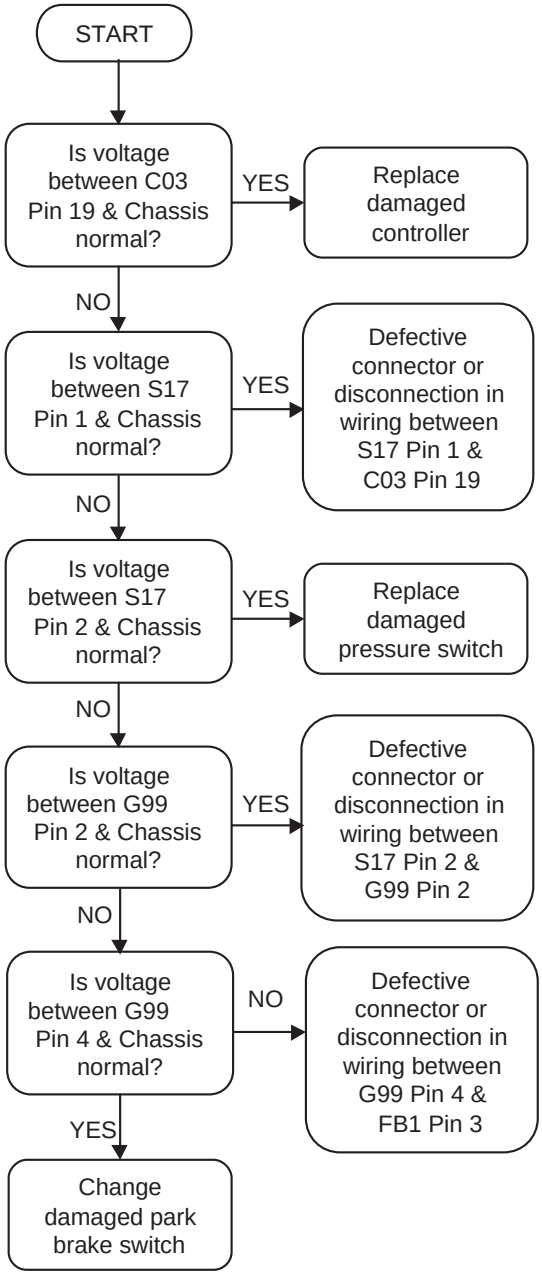


Circuit Diagram for Park Brake

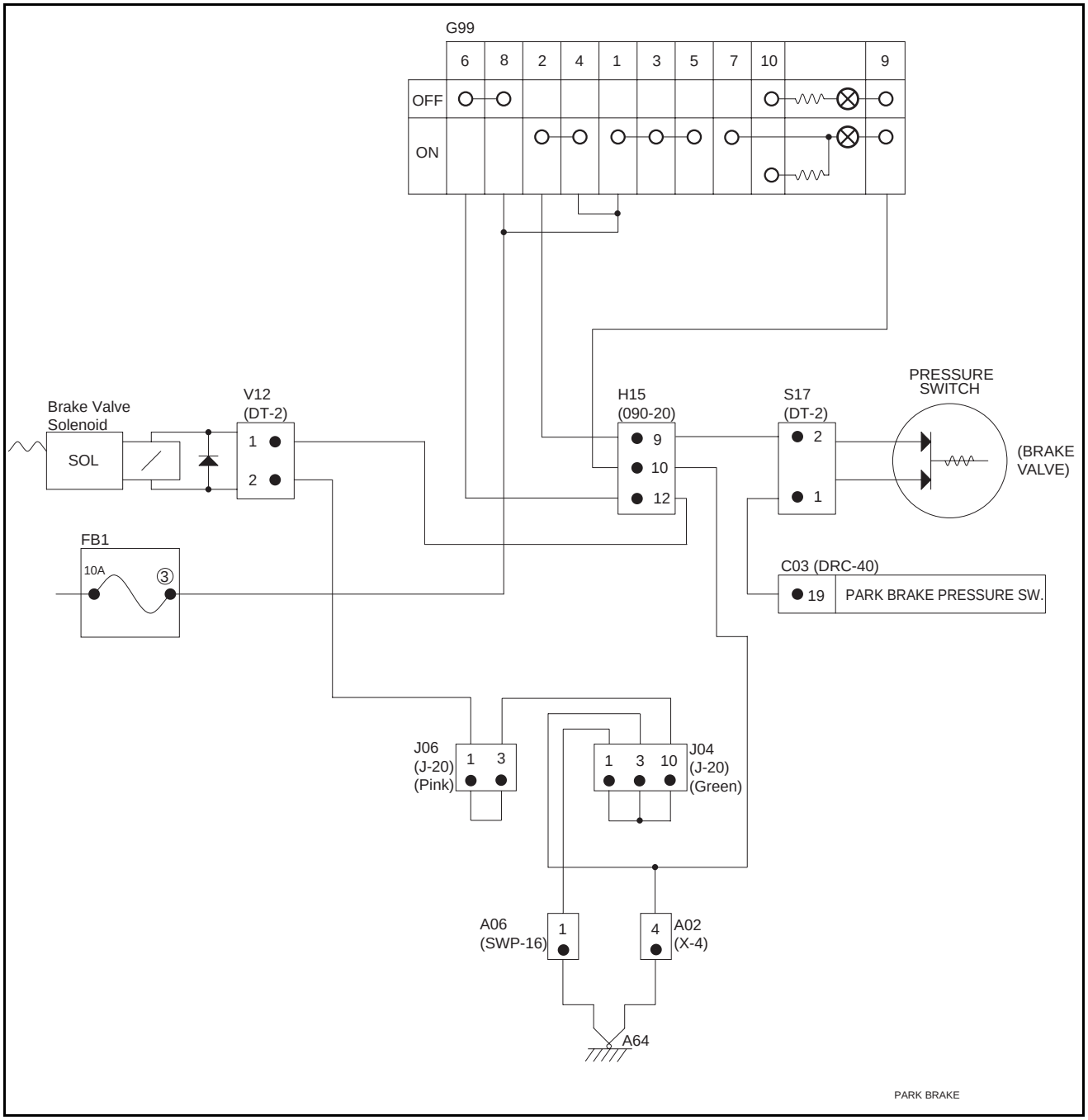


Park Brake (Displayed Symbol)

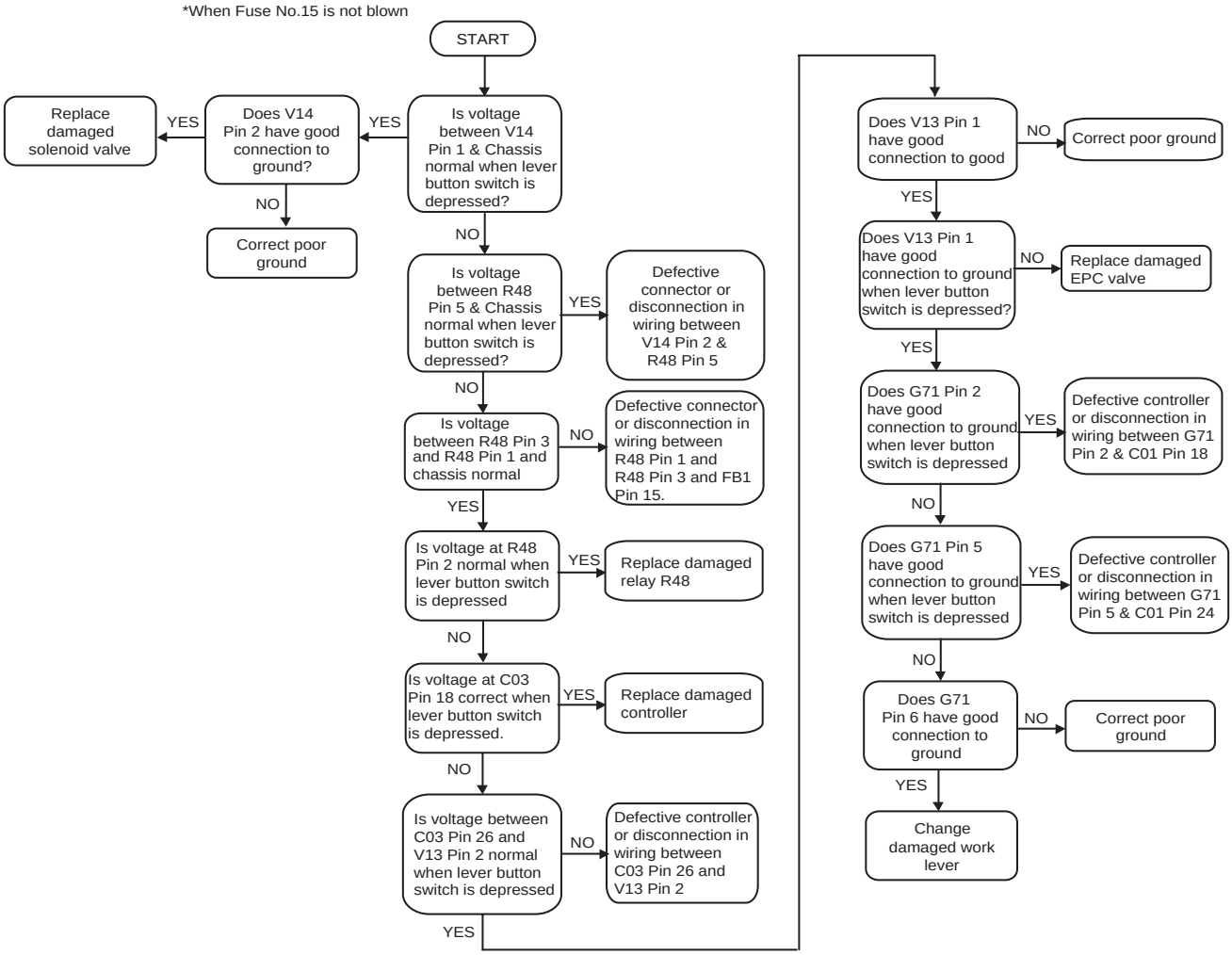
*When Fuse No.3 is not blown



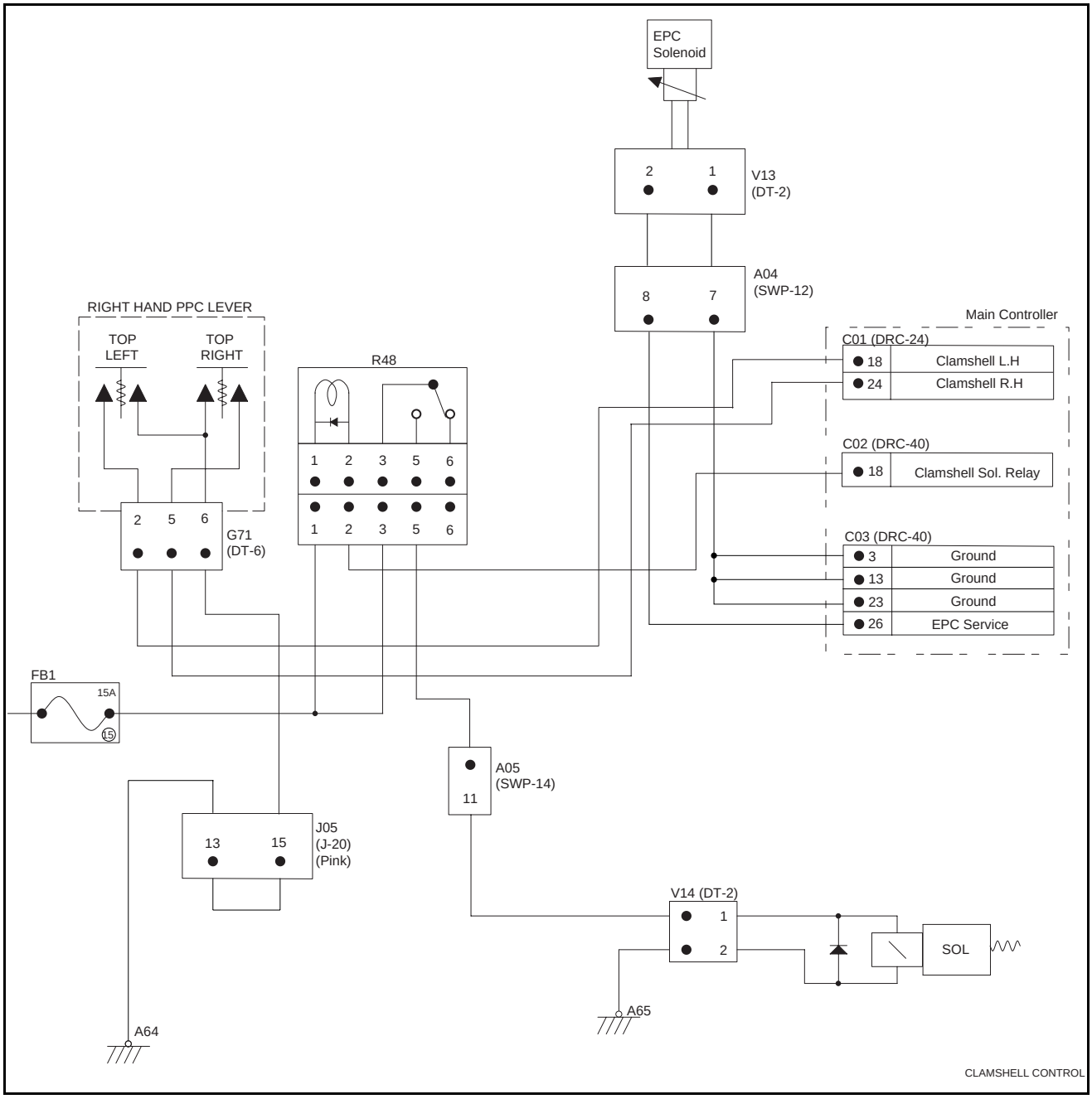
Circuit Diagram for Park Brake



Clamshell Control - Rotate Right (1st Service)

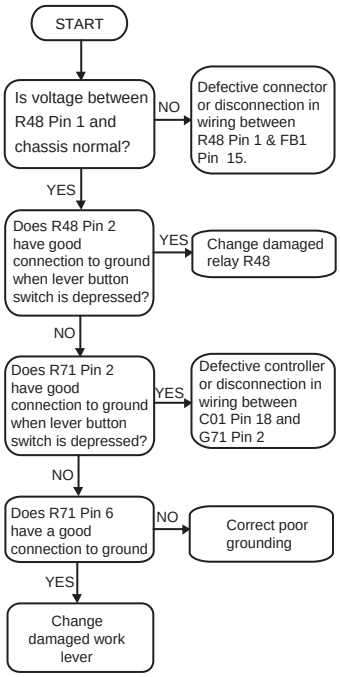


Circuit Diagram for Clamshell Control

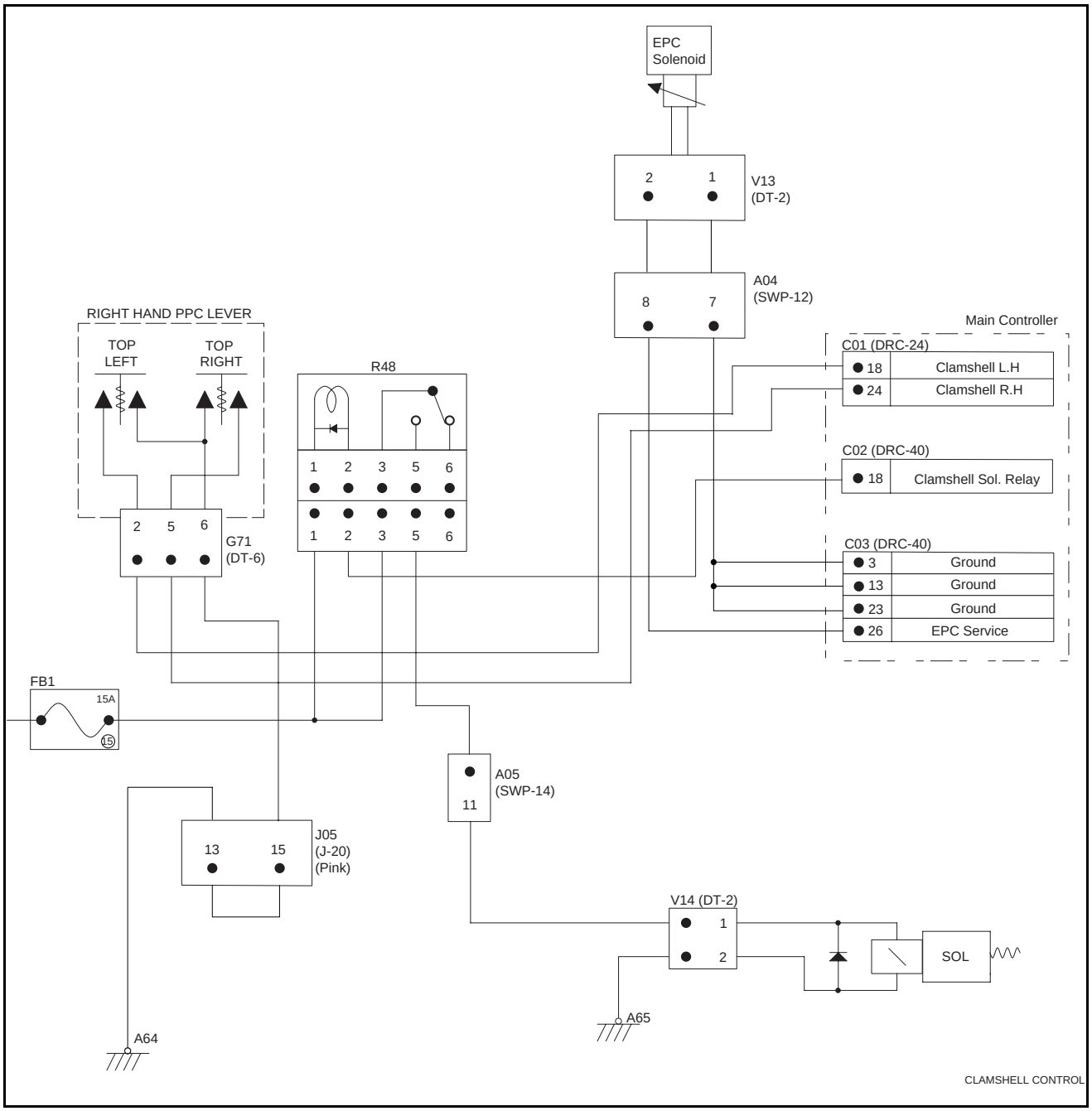


Clamshell Control - Rotate Left - Check Work Lever Circuit

*When Fuse No.15 is not blown

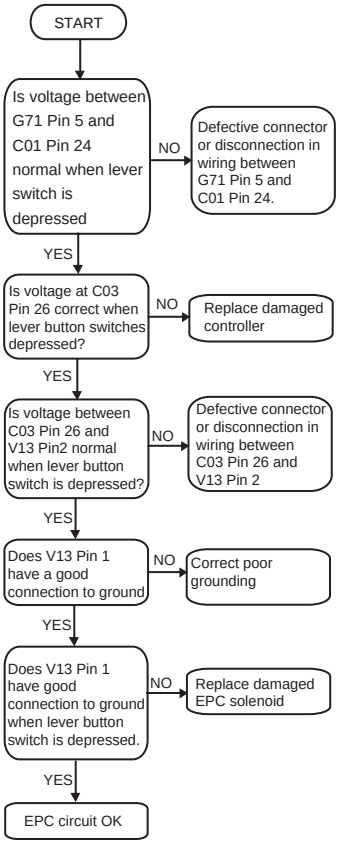


Circuit Diagram for Clamshell Control

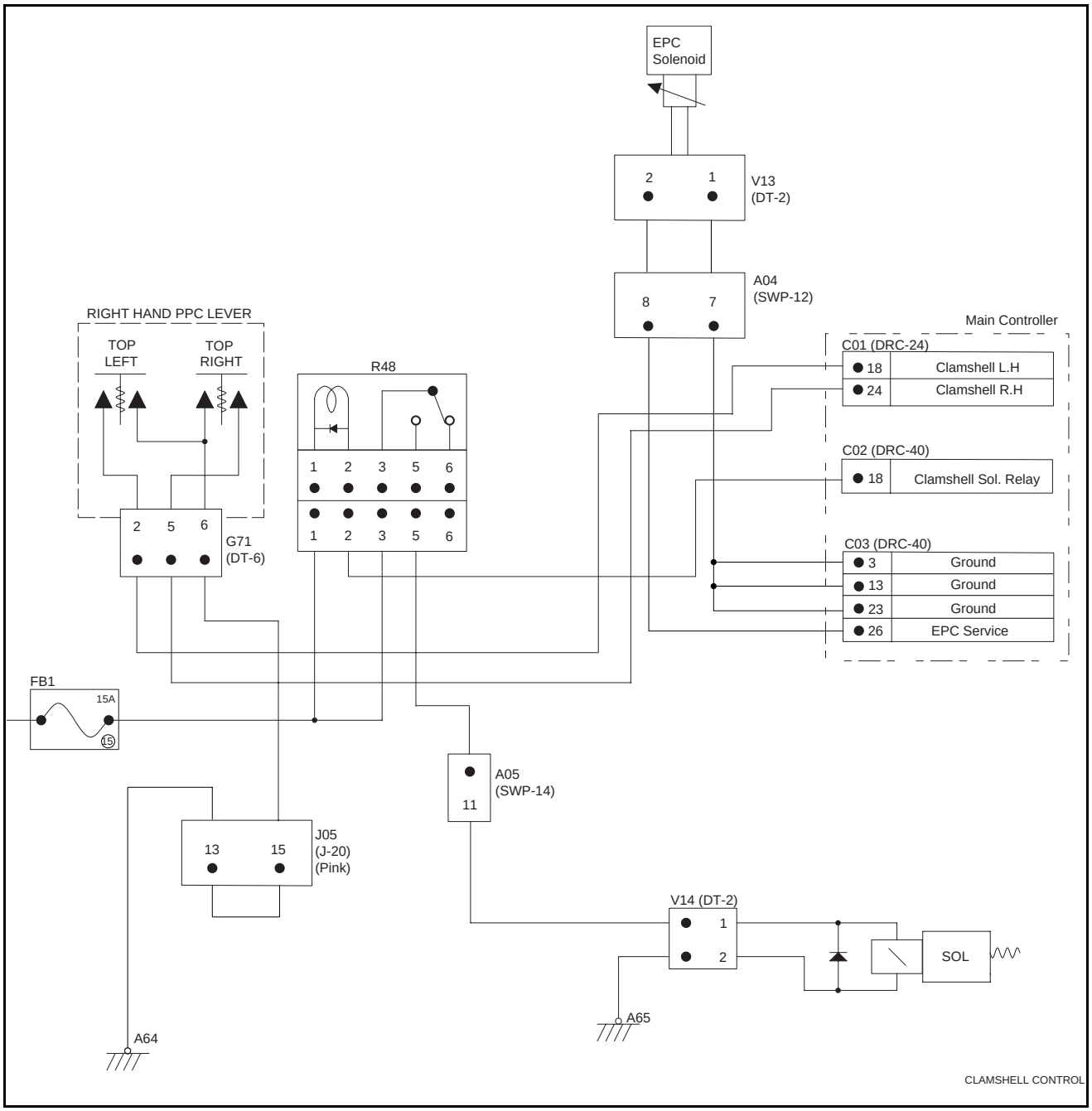


Clamshell Control - Rotate Left - Check EPC Circuit

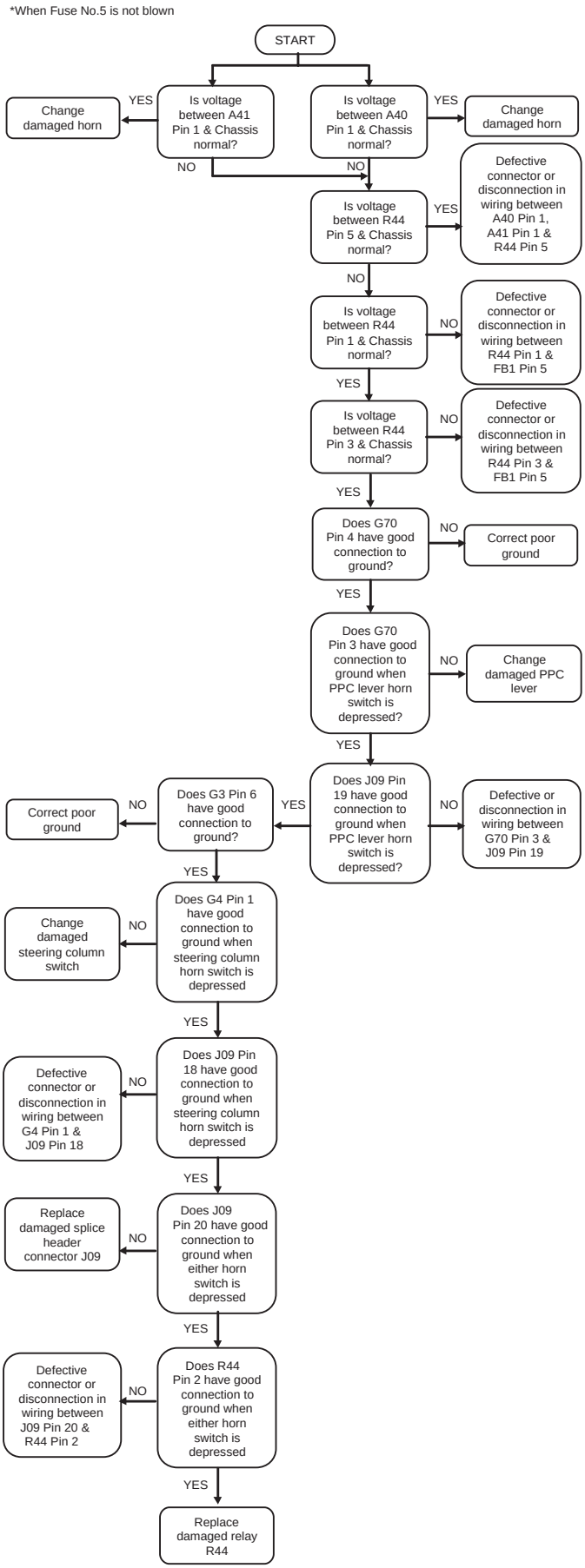
*When Fuse No.15 is not blown



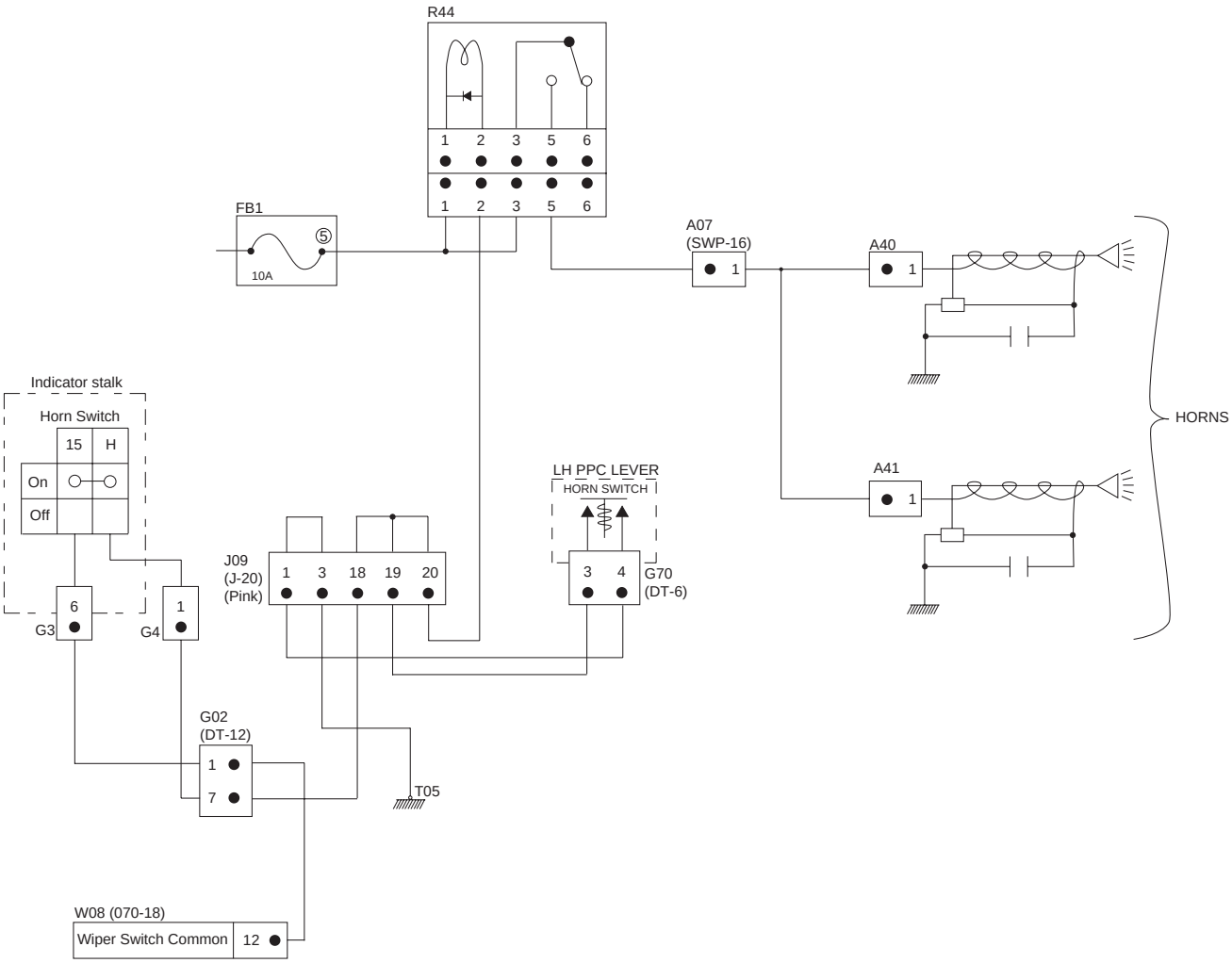
Circuit Diagram for Clamshell Control



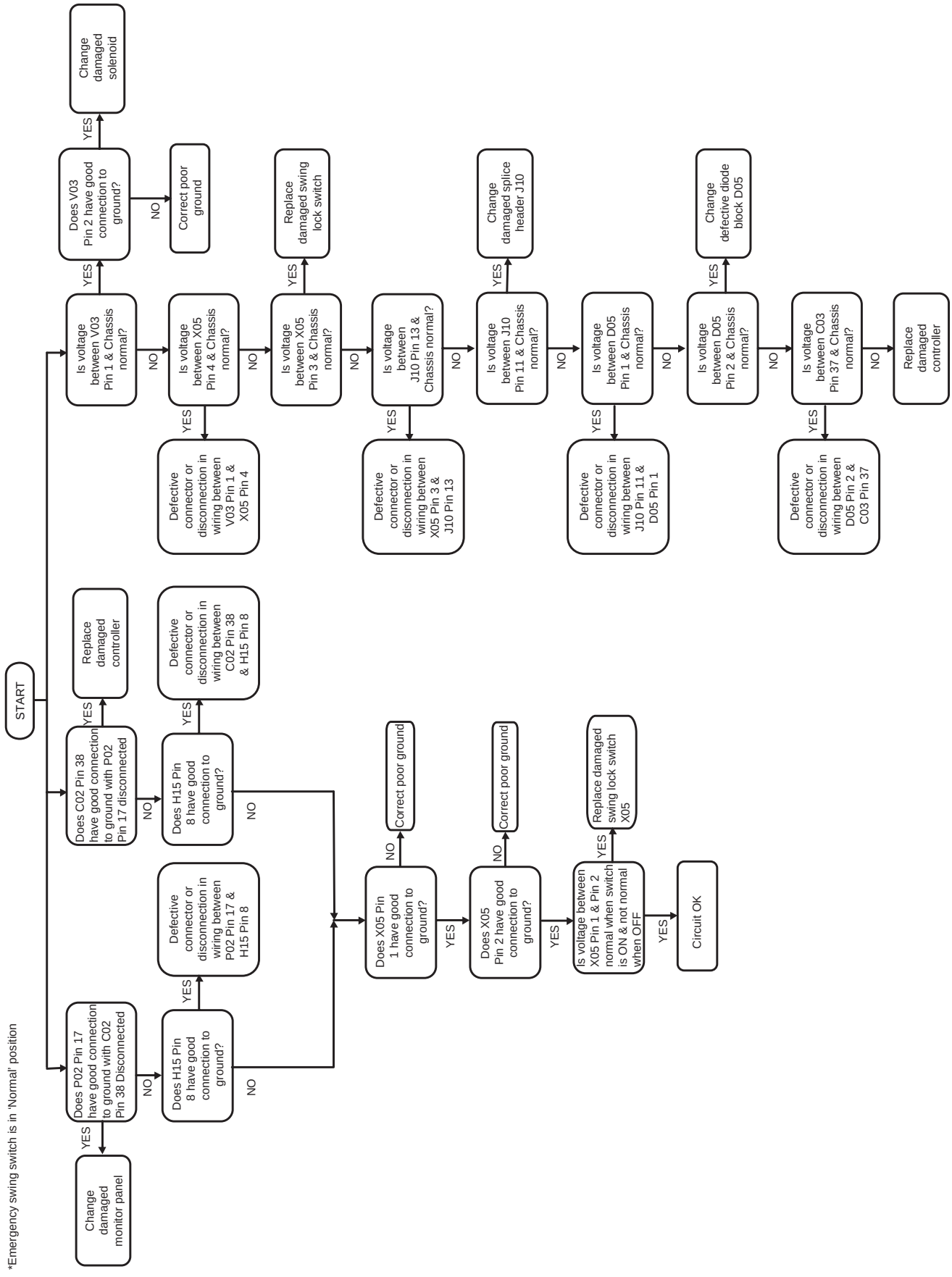
Horns


*When Fuse No.5 is not blown
START
Is voltage between A41 Pin 1 & Chassis normal?
YES
Change damaged horn
NO
Is voltage between A40 Pin 1 & Chassis normal?
YES
Change damaged horn
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 4 have good connection to ground?
NO
Correct poor ground
YES
Does G70 Pin 3 have good connection to ground when PPC lever horn switch is depressed?
NO
Change damaged PPC lever
YES
Does J09 Pin 19 have good connection to ground when PPC lever horn switch is depressed?
NO
Defective or disconnection in wiring between G70 Pin 3 & J09 Pin 19
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 18 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 18
YES
Does J09 Pin 20 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 20 & R44 Pin 2
YES
Replace damaged relay R44

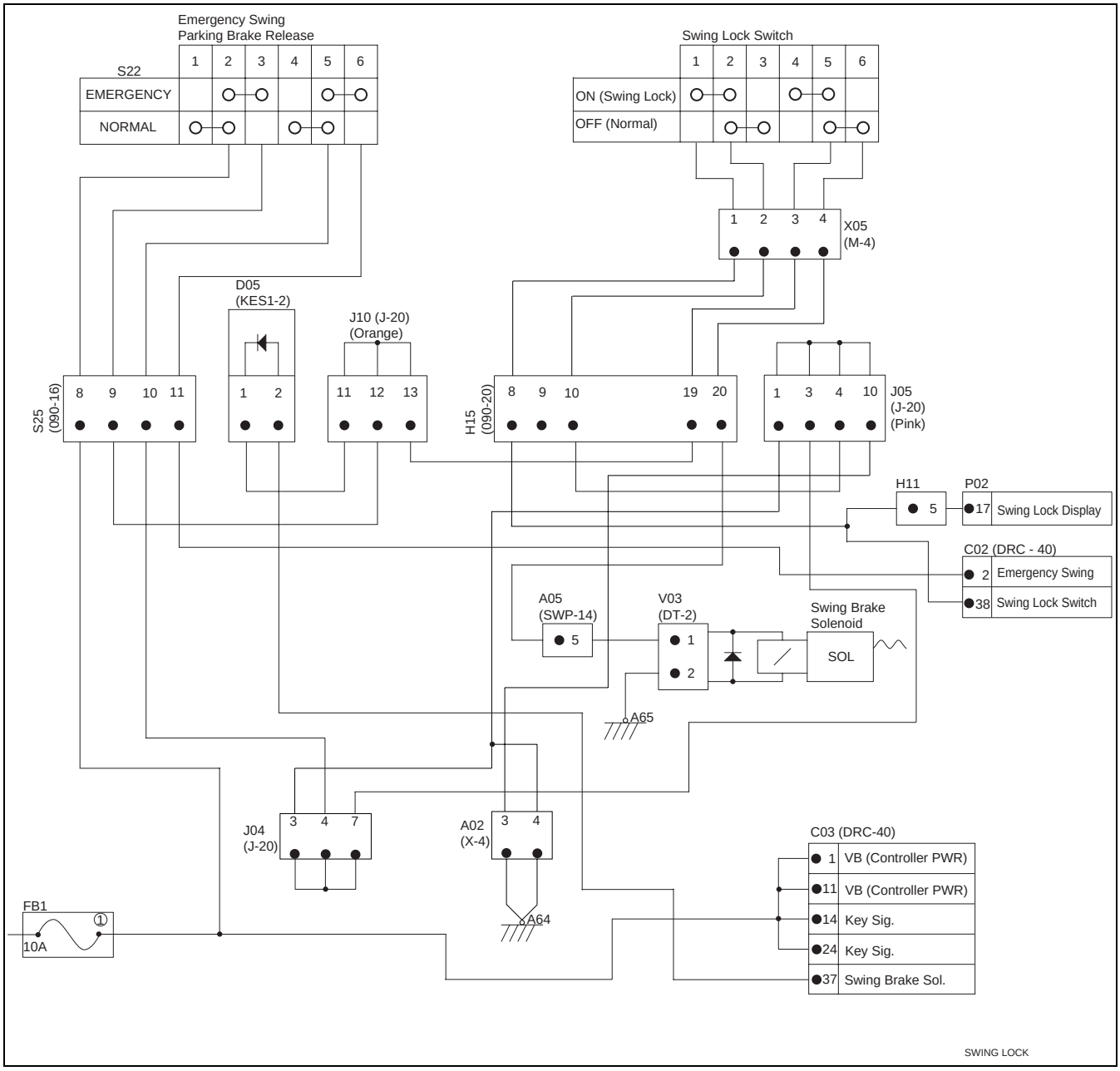
Circuit Diagram for Horn



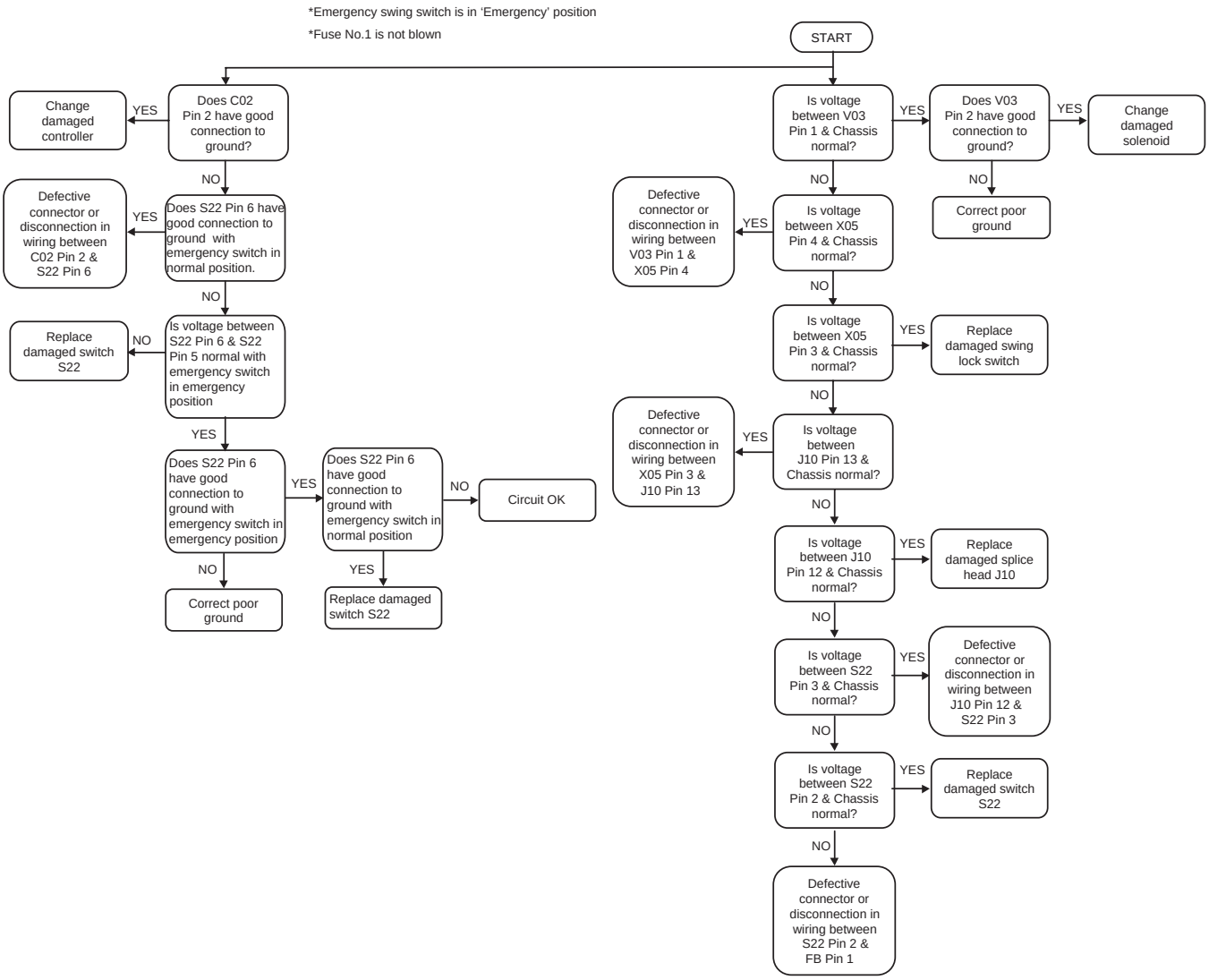
Swing Lock - Normal Operation



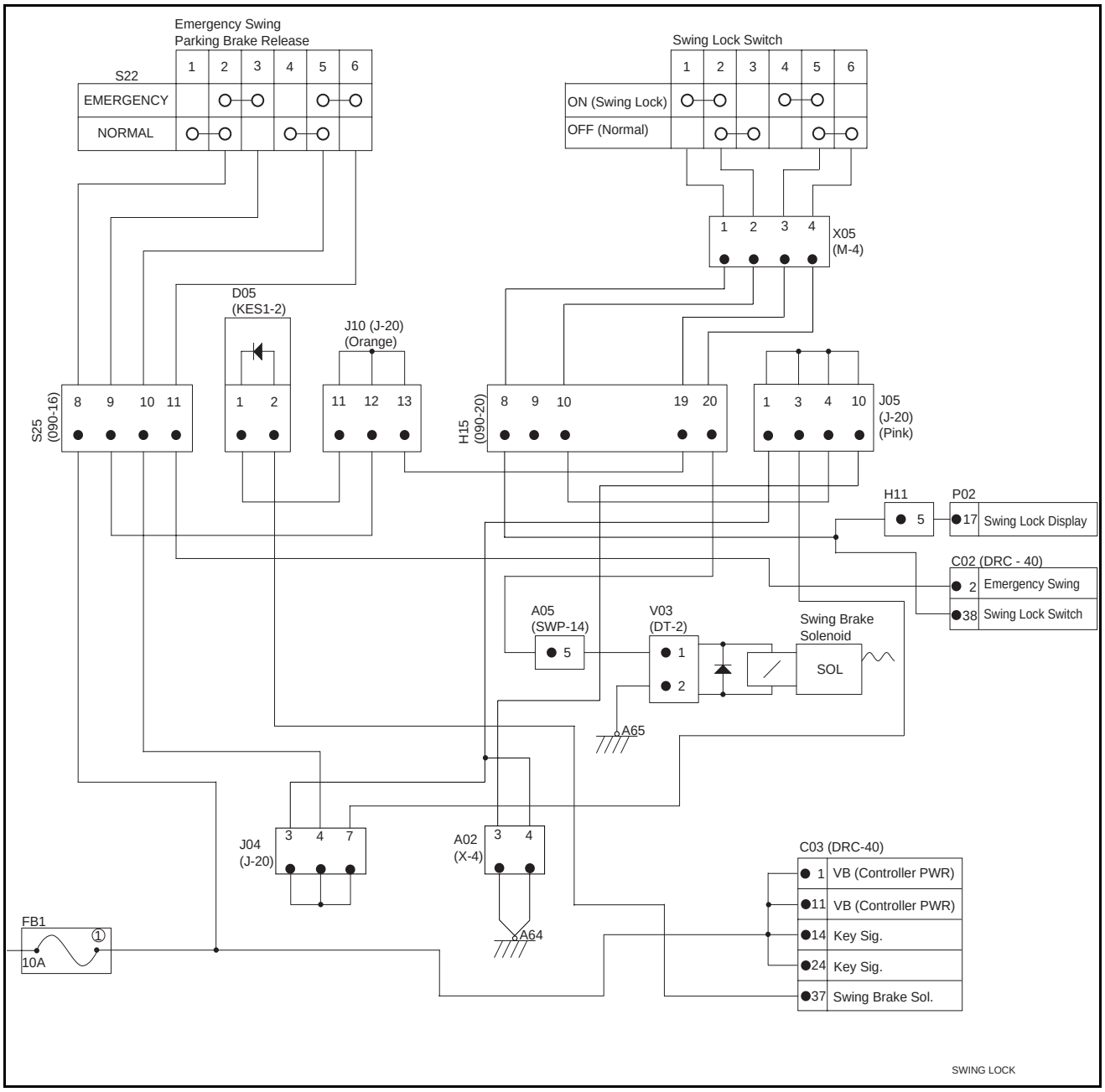
Circuit Diagram for Swing Lock



Swing Lock - Emergency Operation

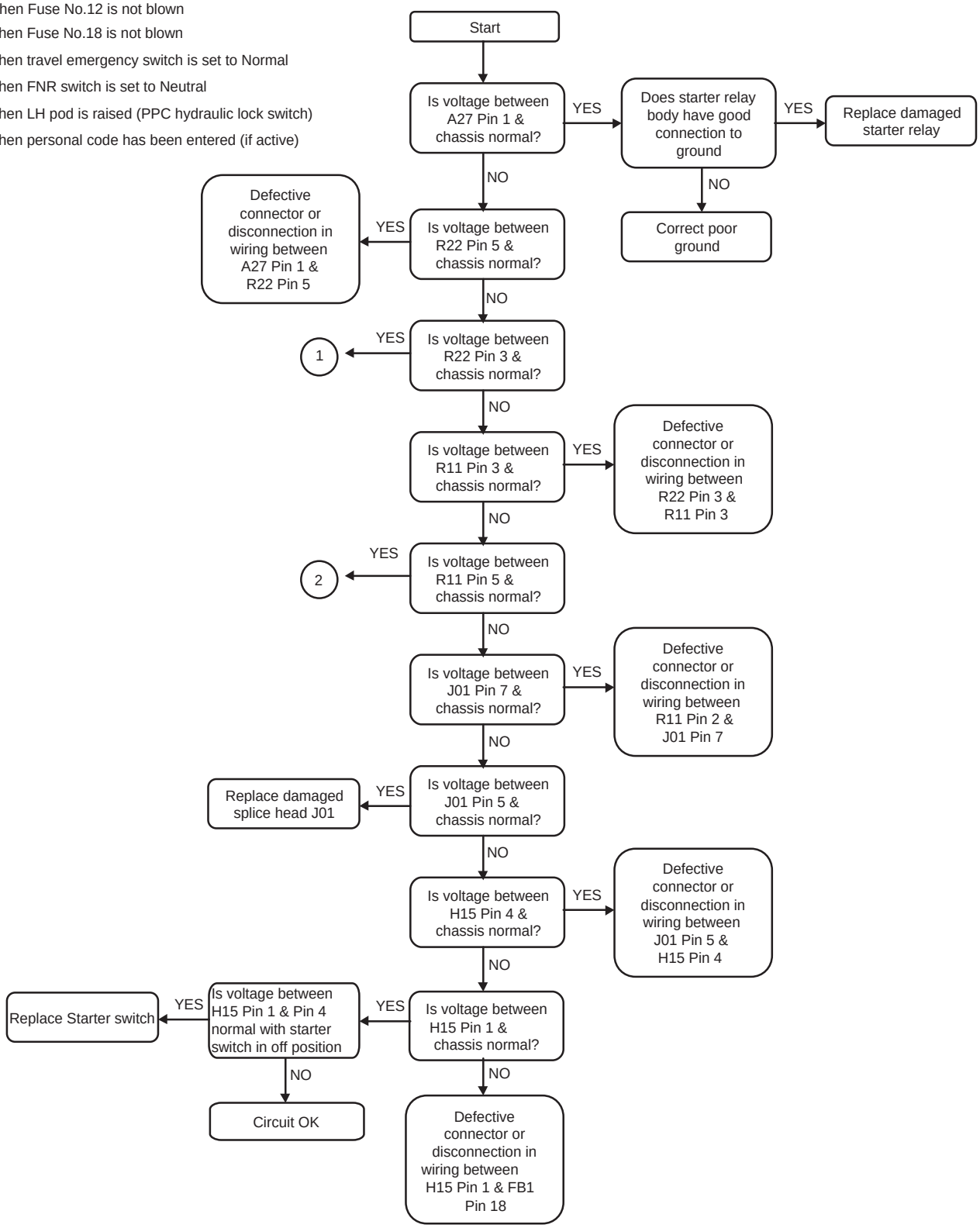


Circuit Diagram for Swing Lock - Emergency Operation

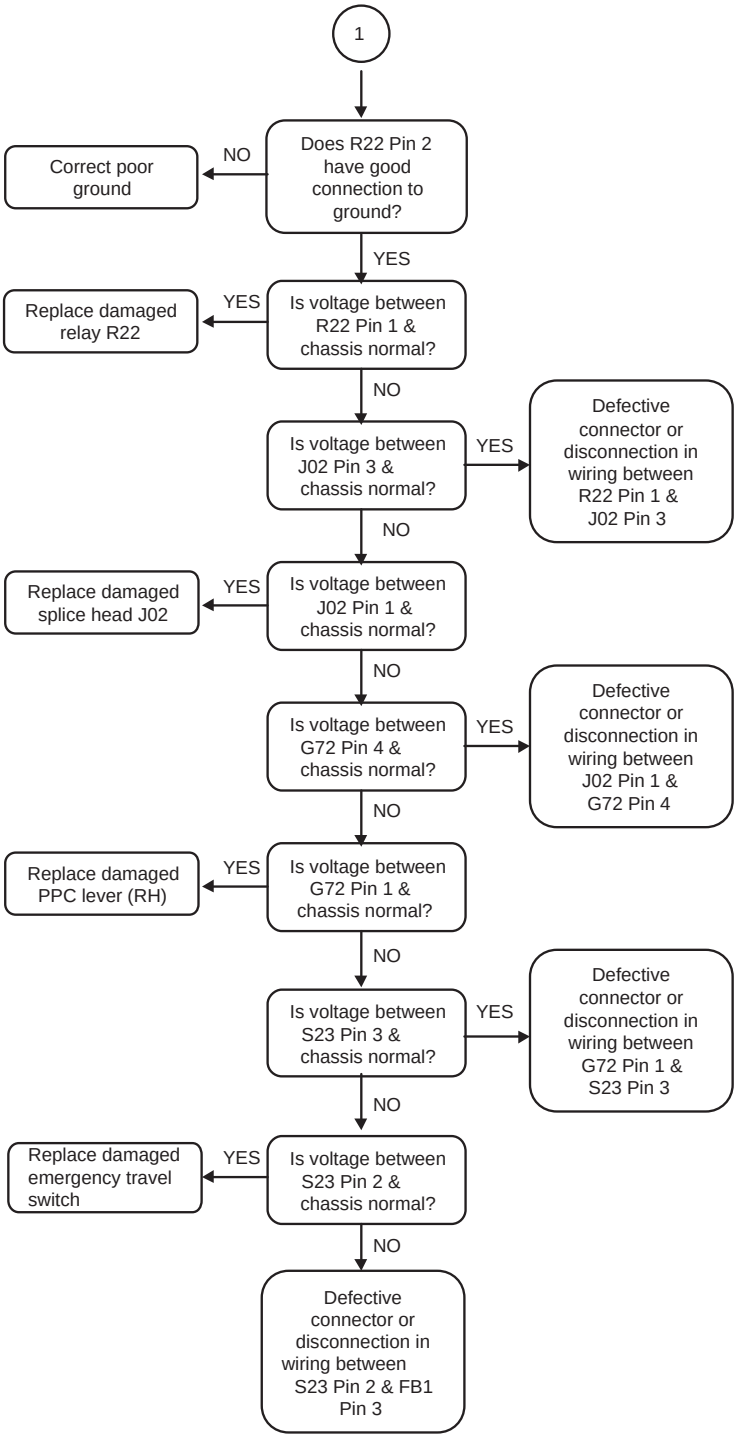


Neutral Start (Engine)

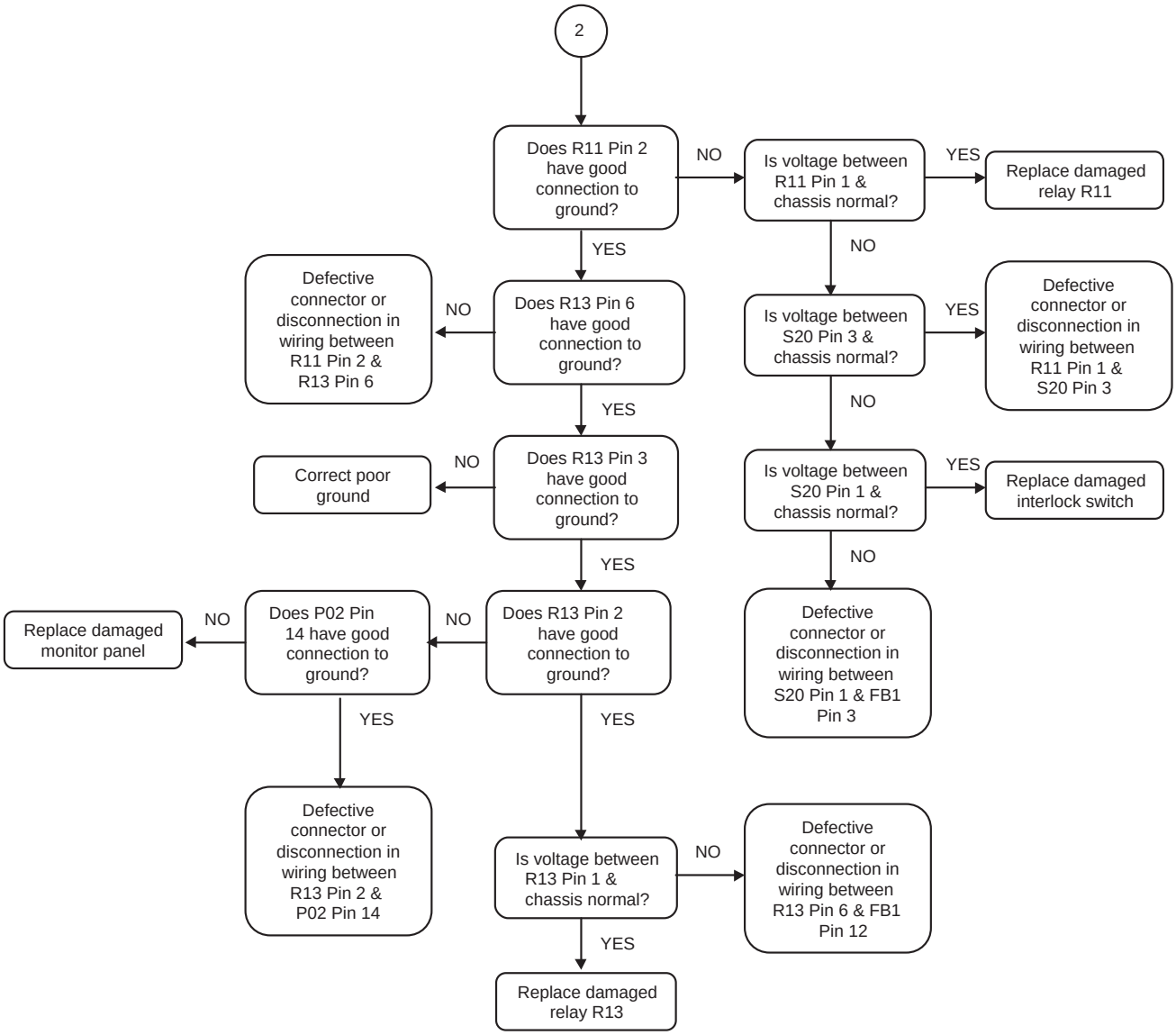
*When Fuse No.3 is not blown
*When Fuse No.12 is not blown
*When Fuse No.18 is not blown
*When travel emergency switch is set to Normal
*When FNR switch is set to Neutral
*When LH pod is raised (PPC hydraulic lock switch)
*When personal code has been entered (if active)



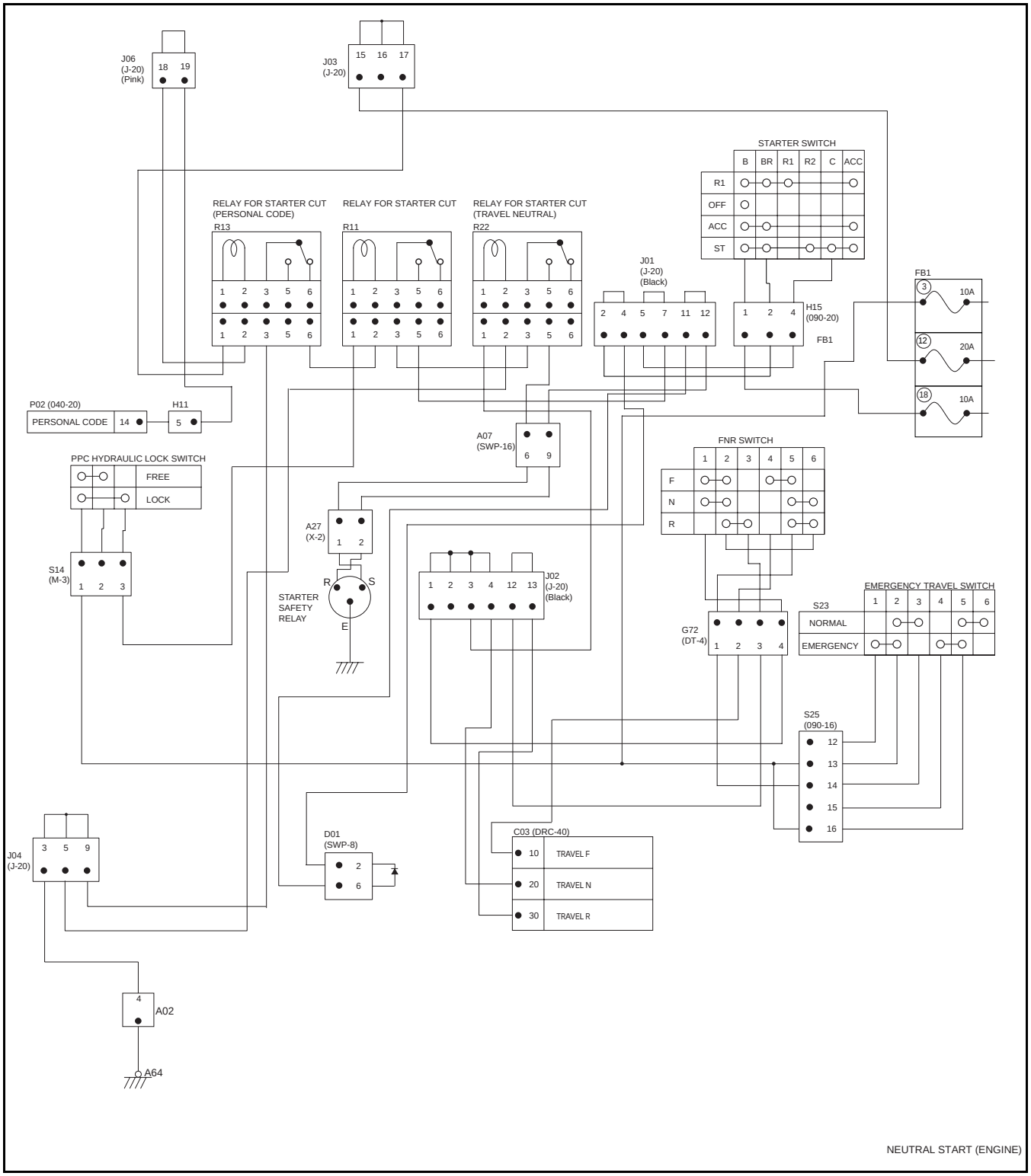
Neutral Start (Engine) cont'd (1)



Neutral Start (Engine) cont'd (2)



Circuit Diagram for Neutral Start (Engine)

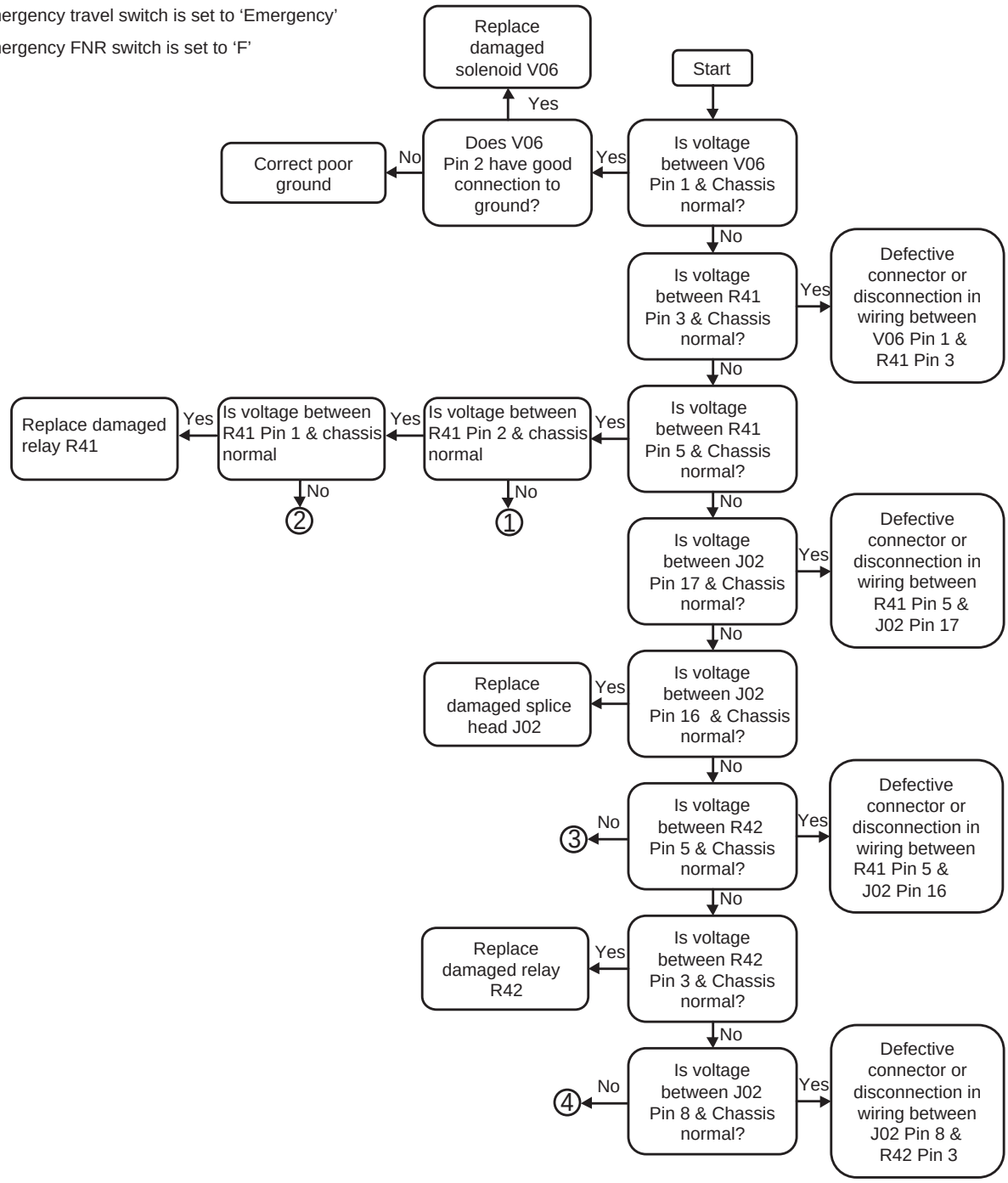


Emergency Travel Control - Forward

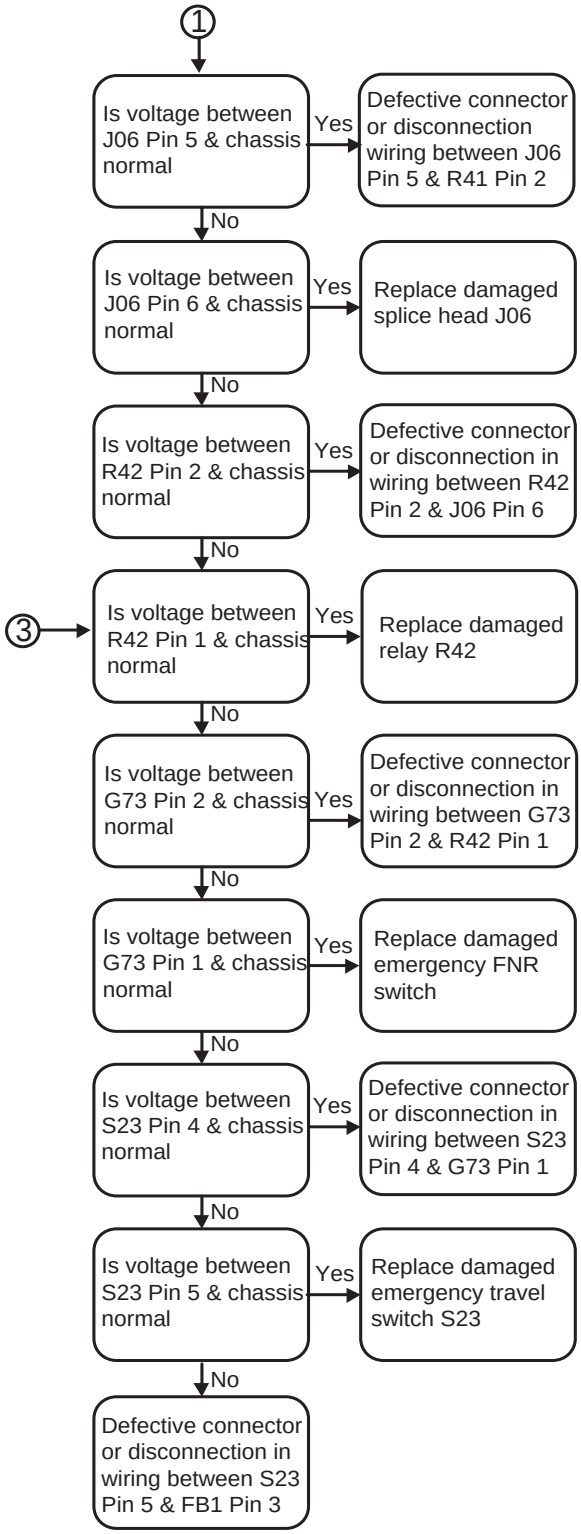
*When Fuse No. 3 is not blown

*When emergency travel switch is set to 'Emergency'

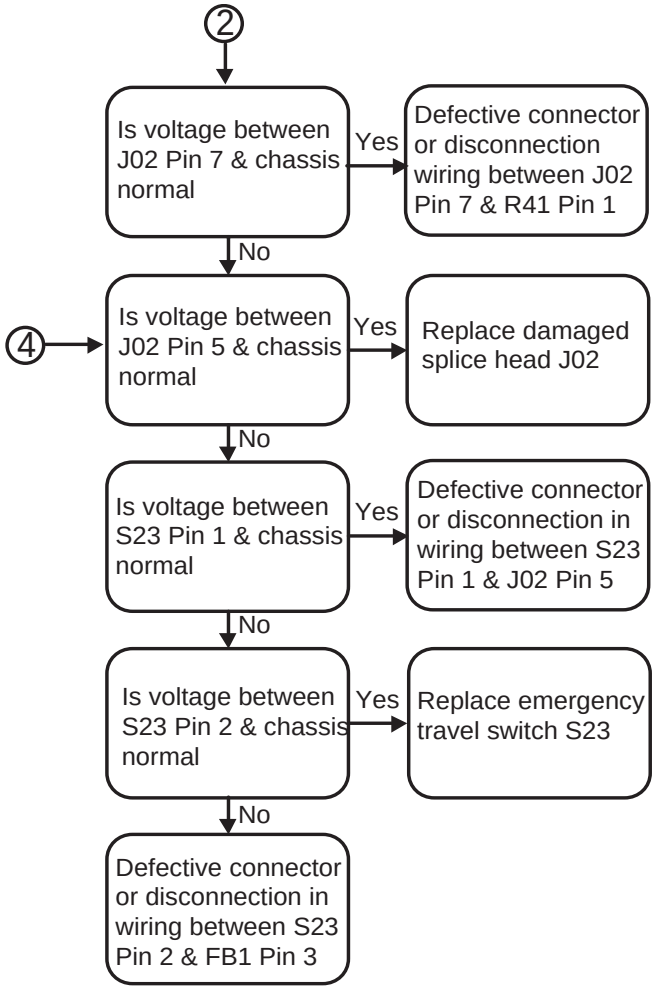
*When emergency FNR switch is set to 'F'



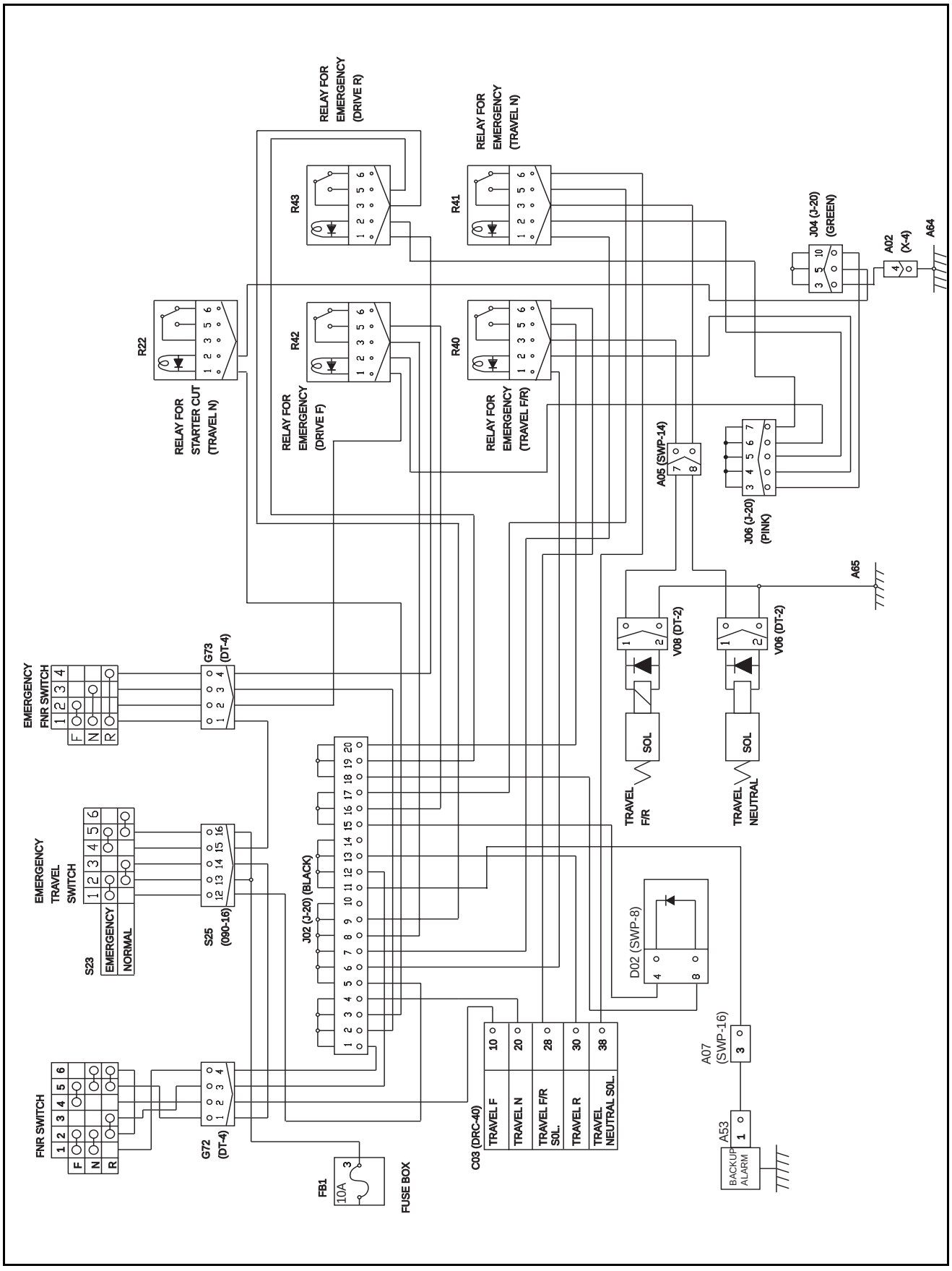
Emergency Travel Control - Forward (Continued)



Emergency Travel Control - Forward (Continued)



Circuit Diagram for Travel Direction Control

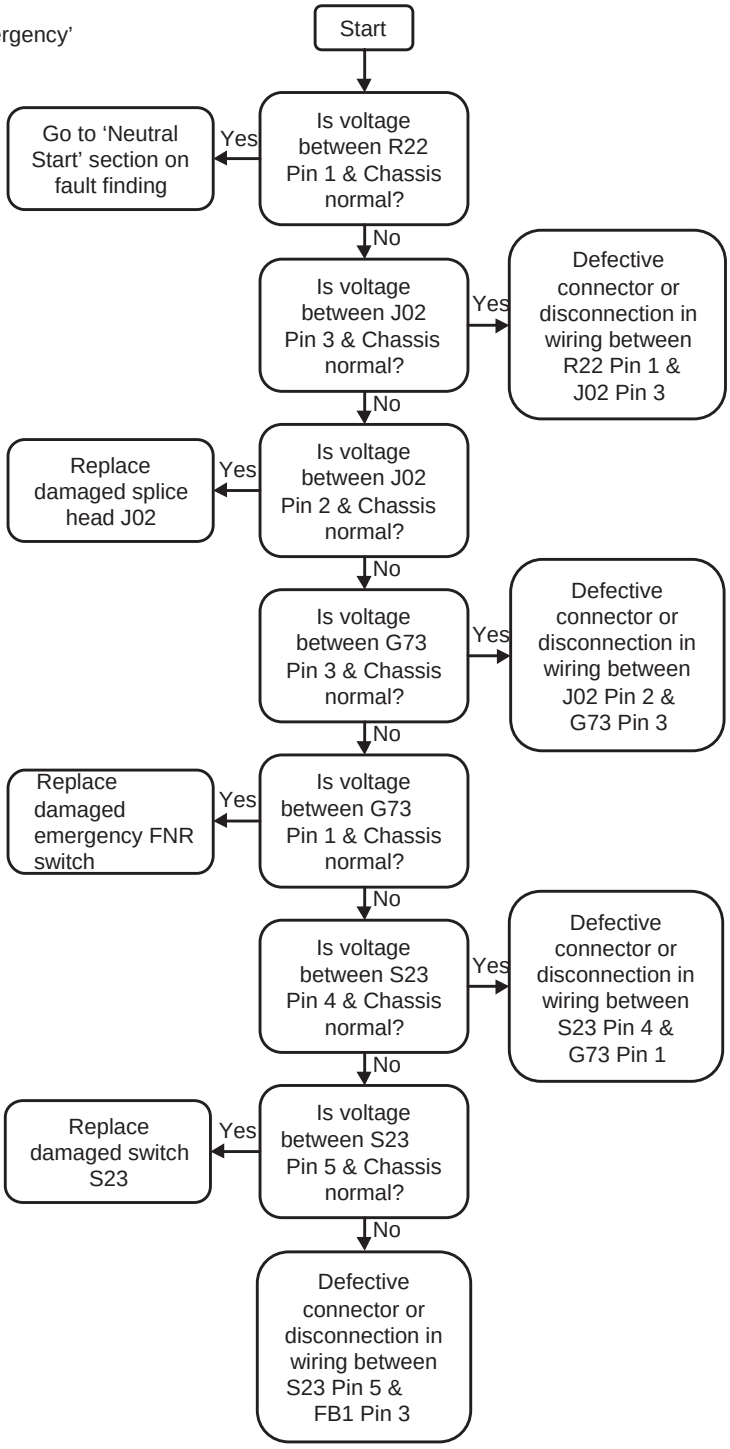


Emergency Travel Control - Neutral

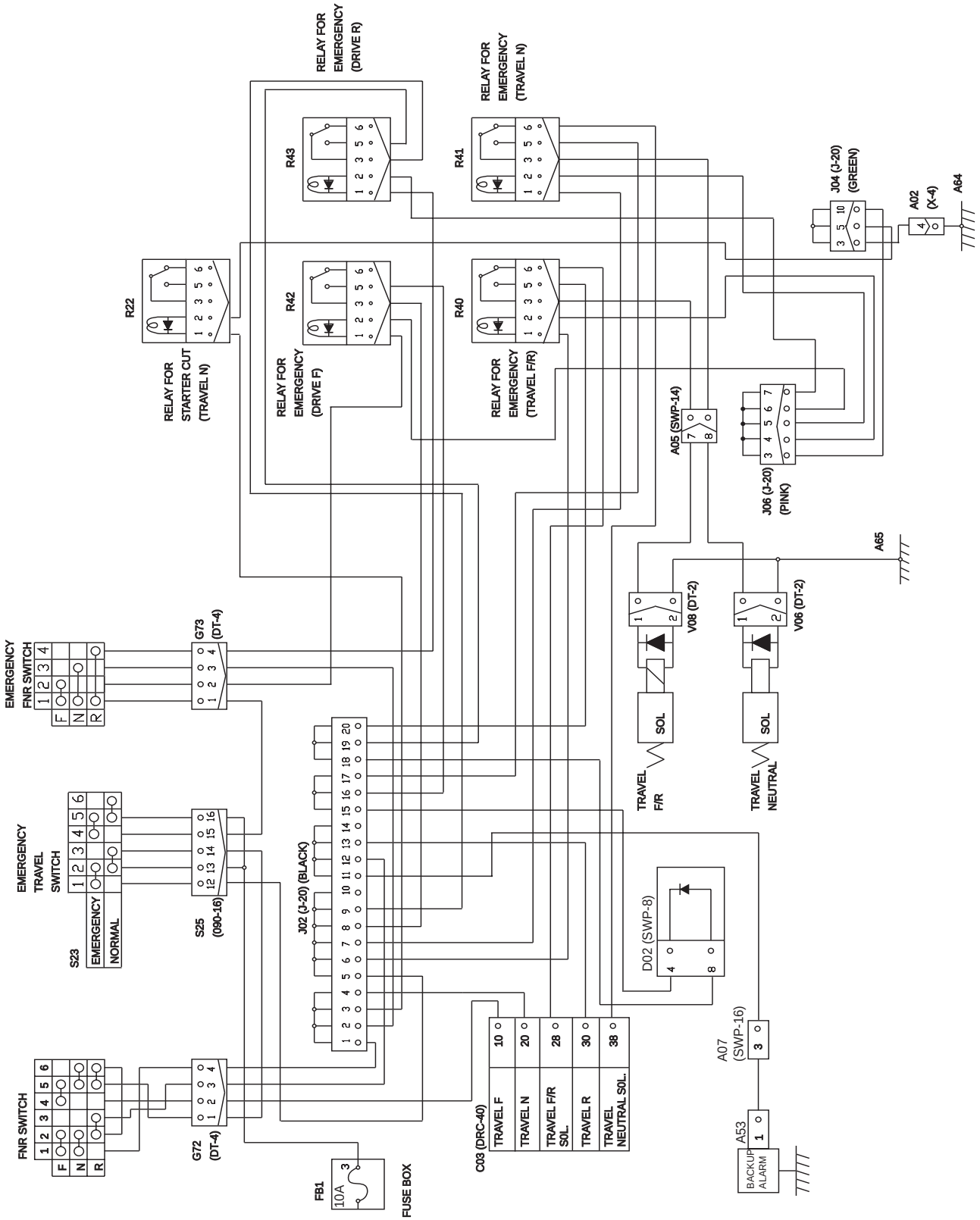
*When Fuse No. 3 is not blown

When emergency travel switch is set to 'Emergency'

*When emergency FNR switch is set to 'N'



Circuit Diagram for Travel Direction Control

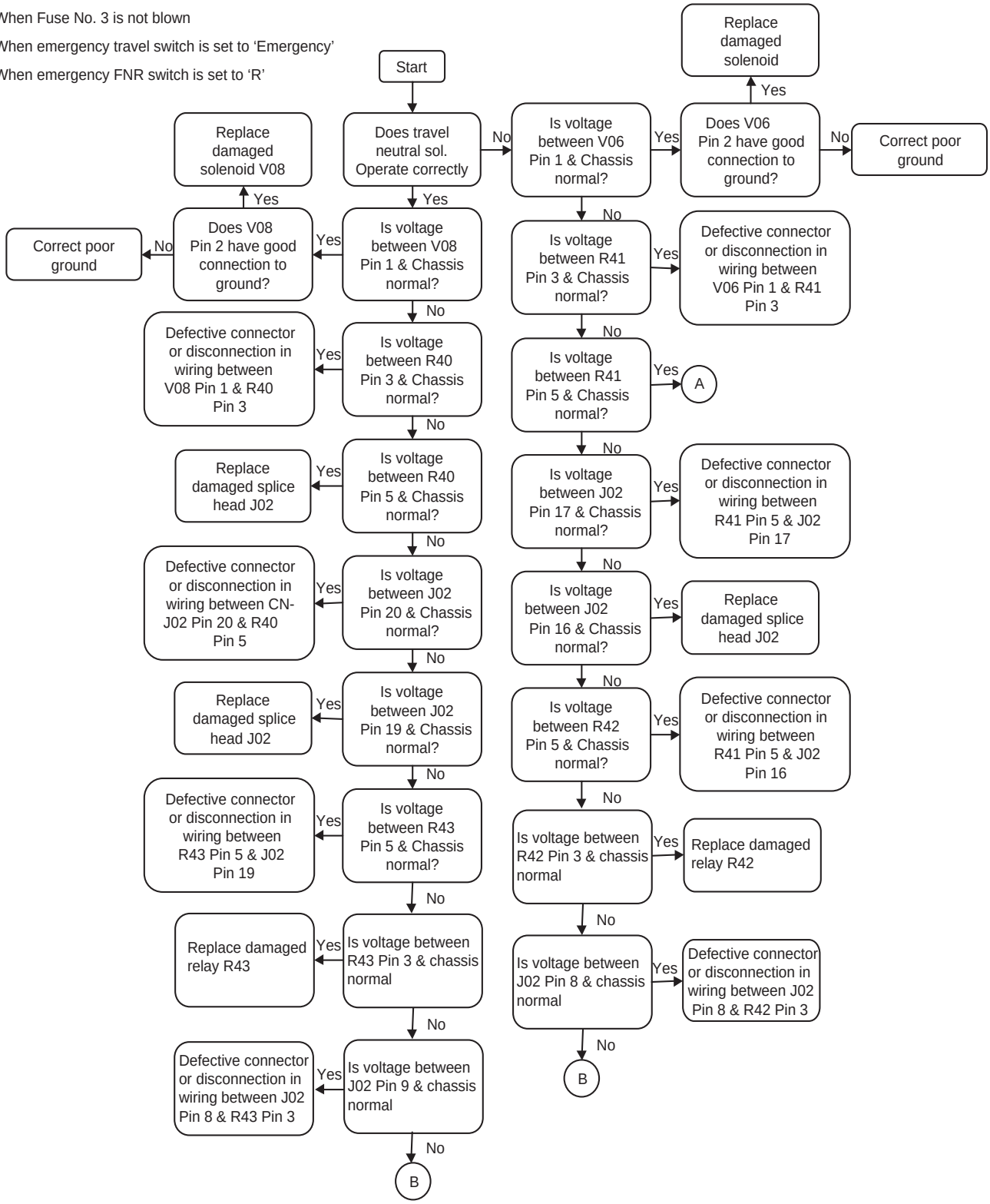


Emergency Travel Control - Reverse

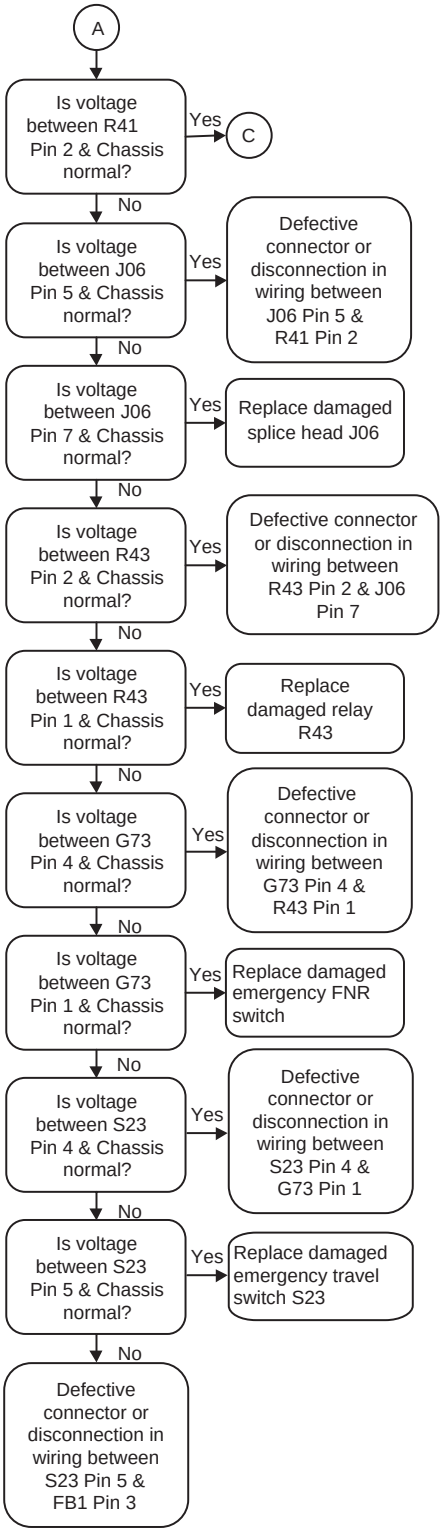
*When Fuse No. 3 is not blown

*When emergency travel switch is set to 'Emergency'

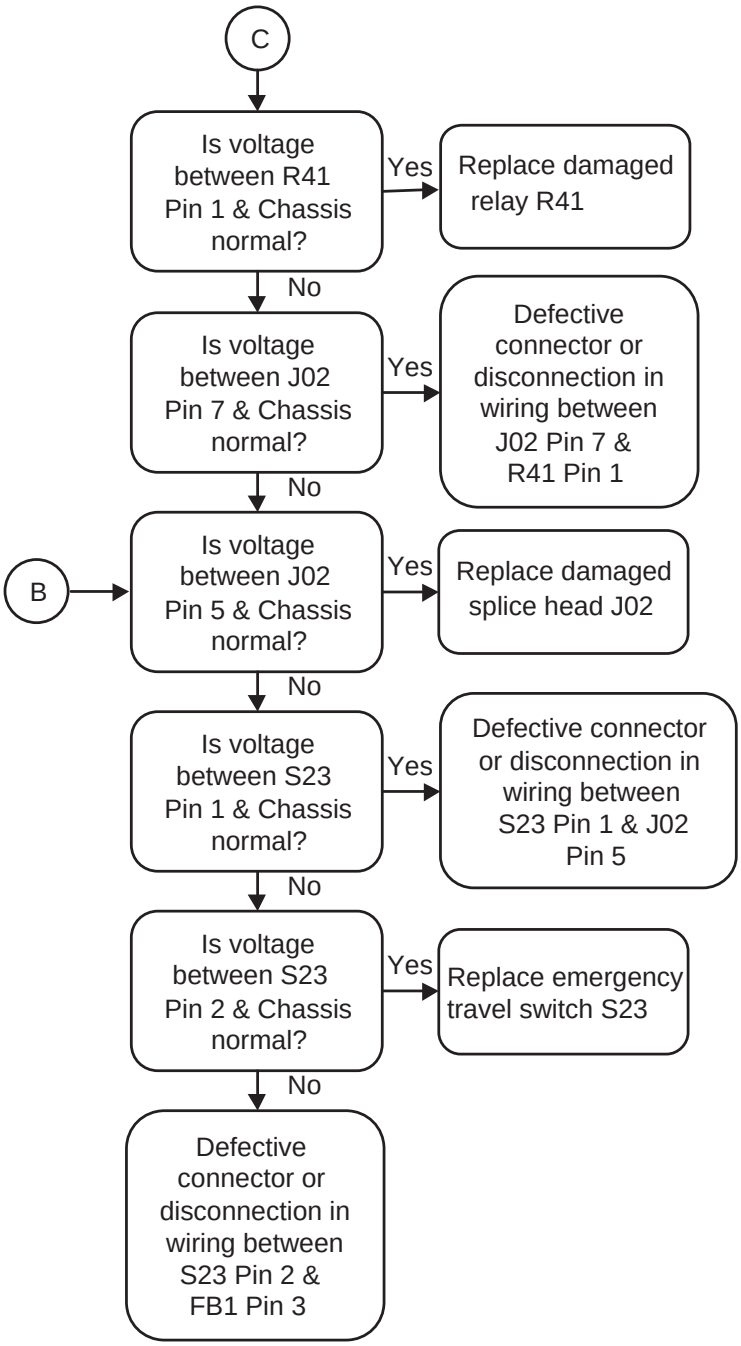
*When emergency FNR switch is set to 'R'



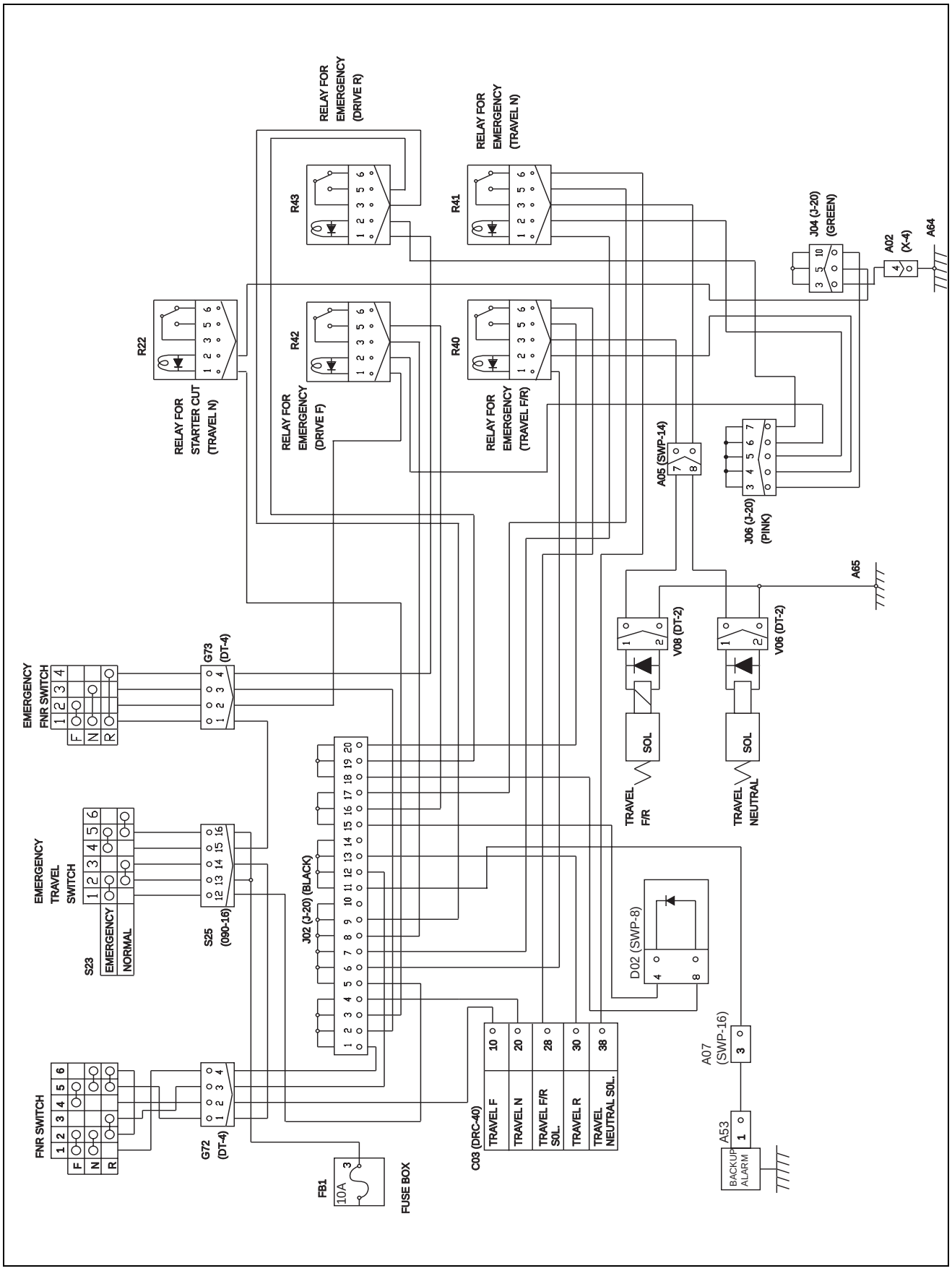
Emergency Travel Control - Reverse cont'd



Emergency Travel Control - Reverse cont'd



Circuit Diagram for Travel Direction Control

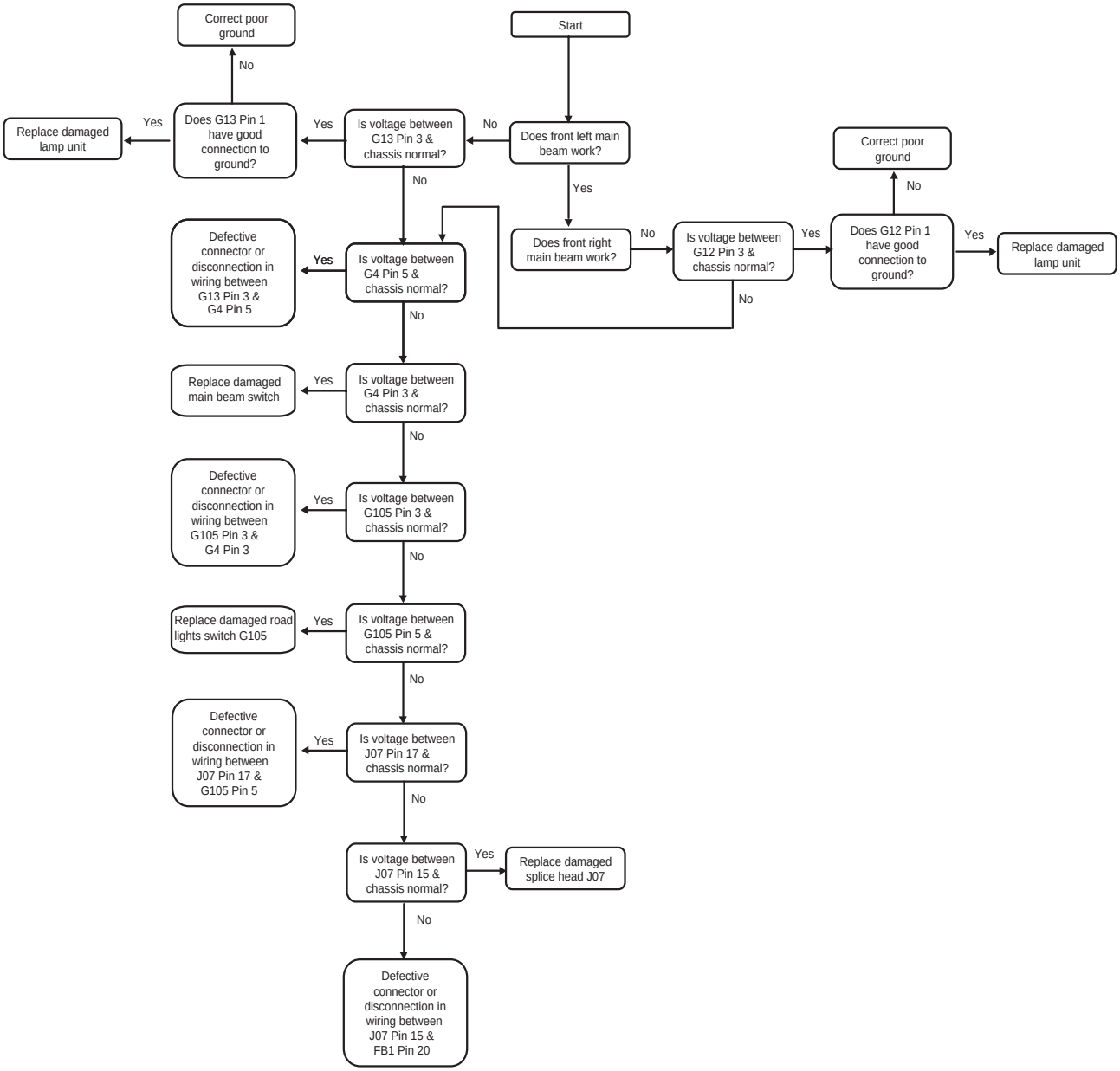


Driving Lights - Main Beam

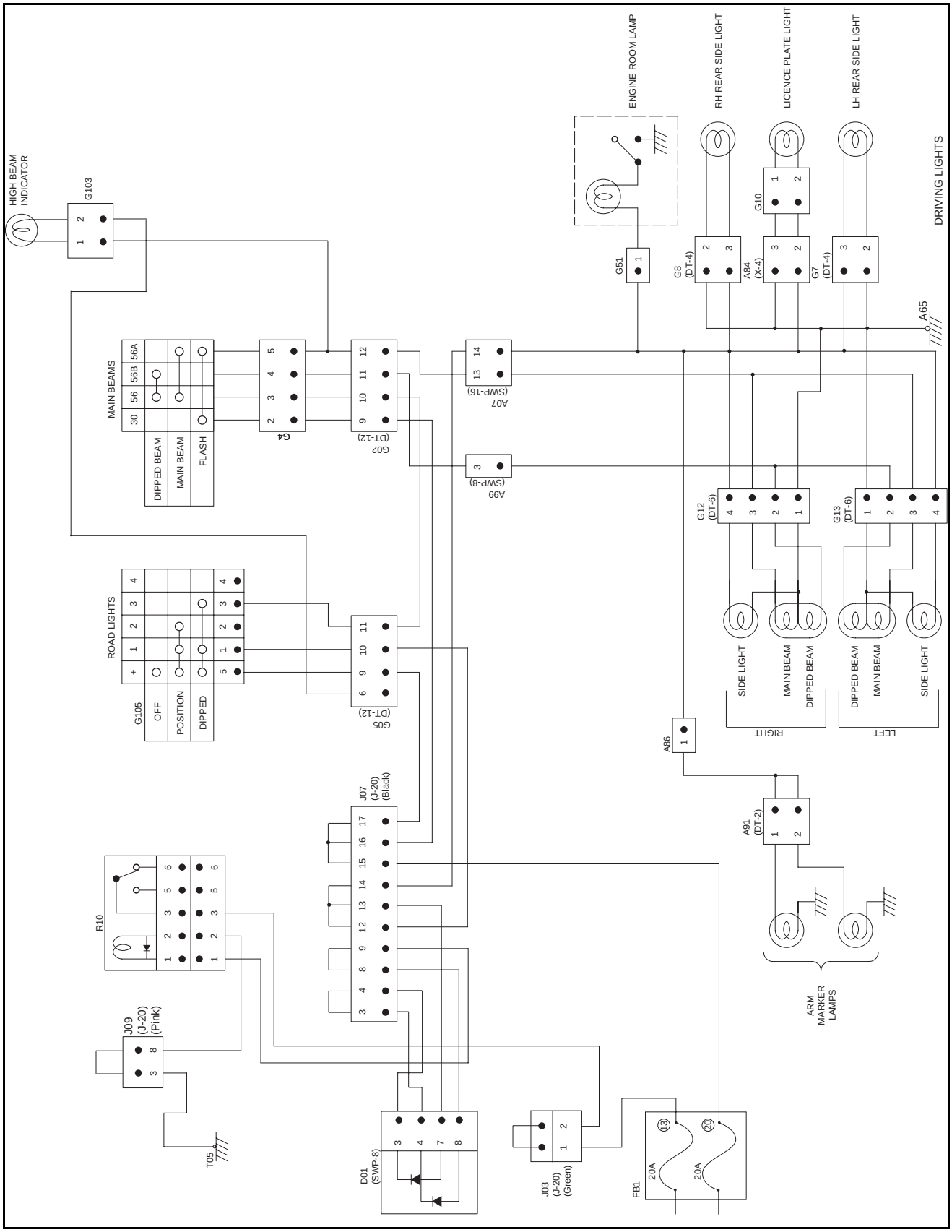
*Standard notes

*When fuse No.20 is not blown

*When bulbs are fitted correctly and fully functional



Circuit Diagram for Driving Lights

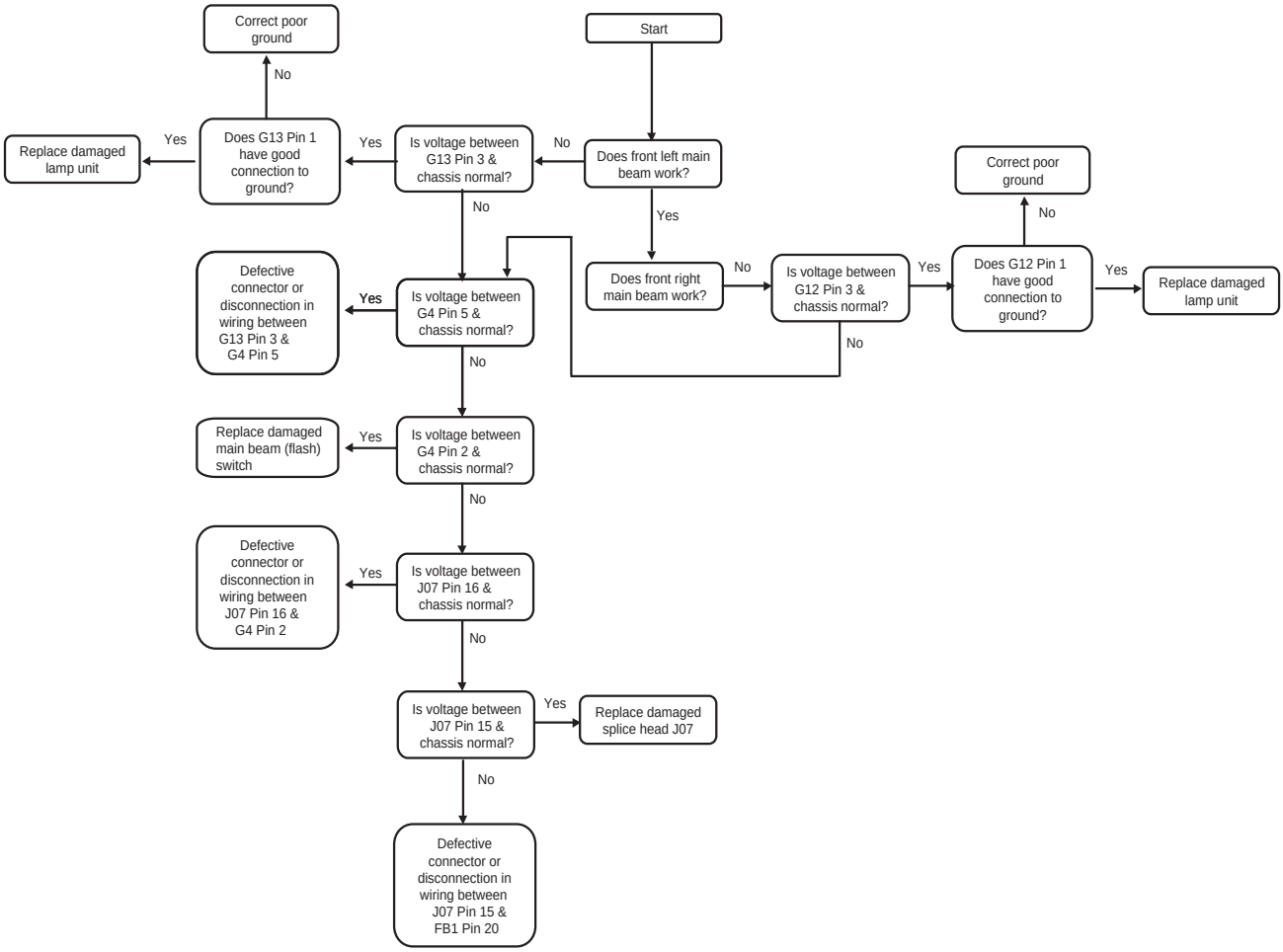


Driving Lights - Main Beam Flash

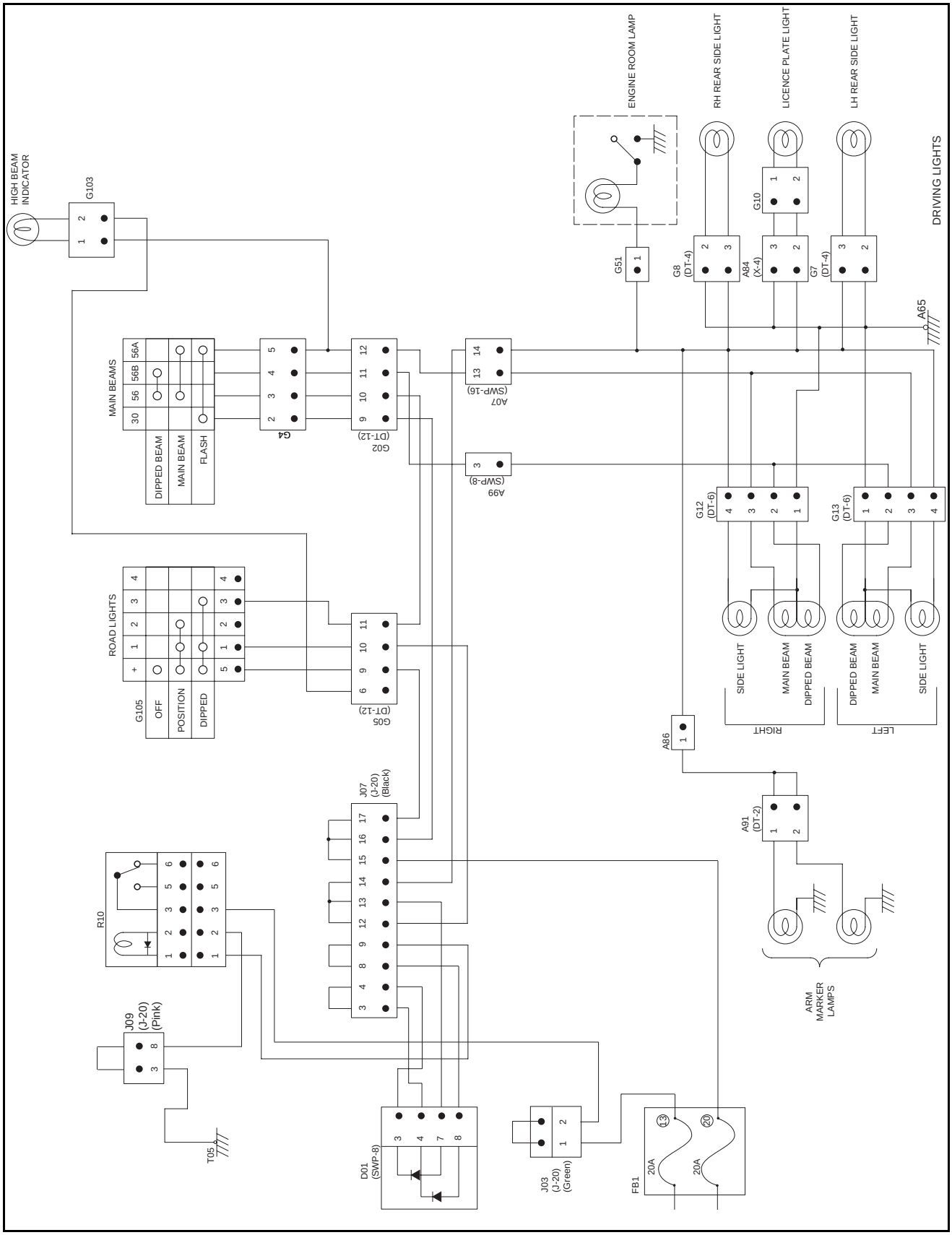
*Standard notes

*When fuse No.20 is not blown

*When bulbs are fitted correctly and fully functional



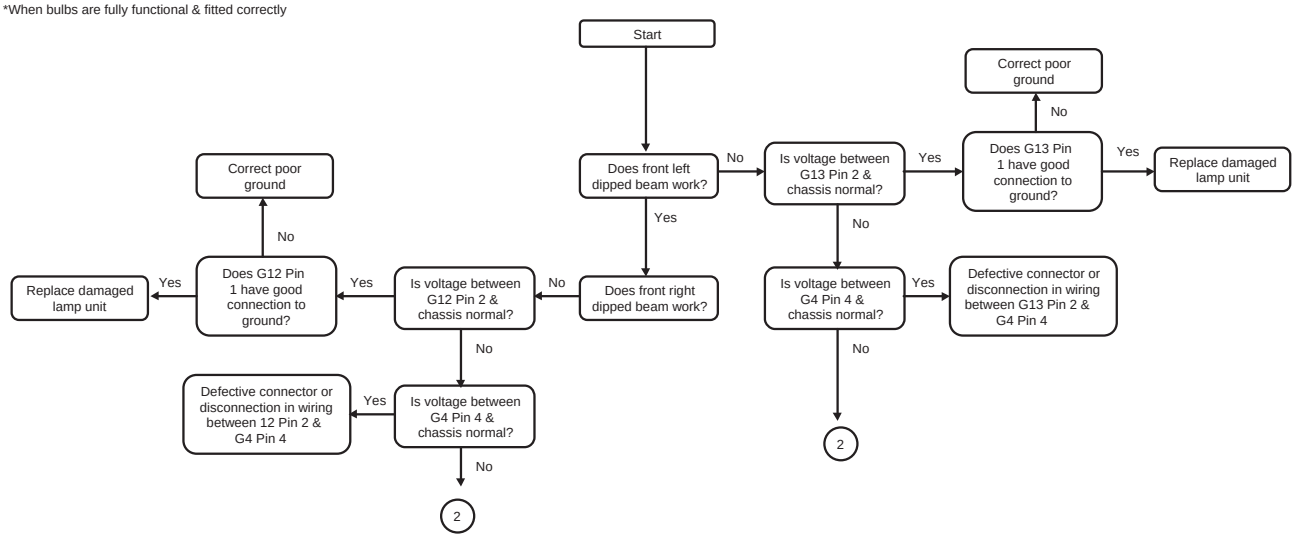
Circuit Diagram for Driving Lights

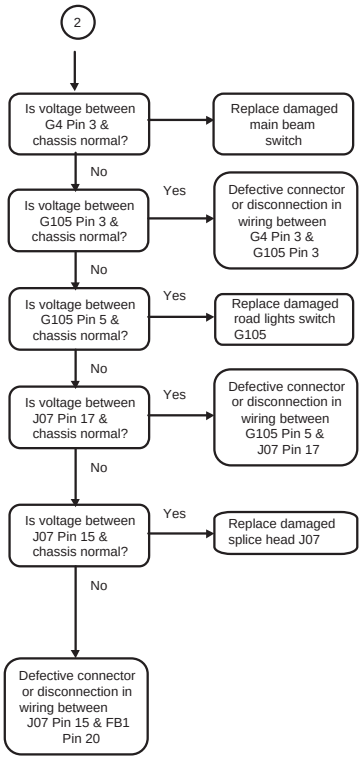


Driving Lights - Main Beam Dipped

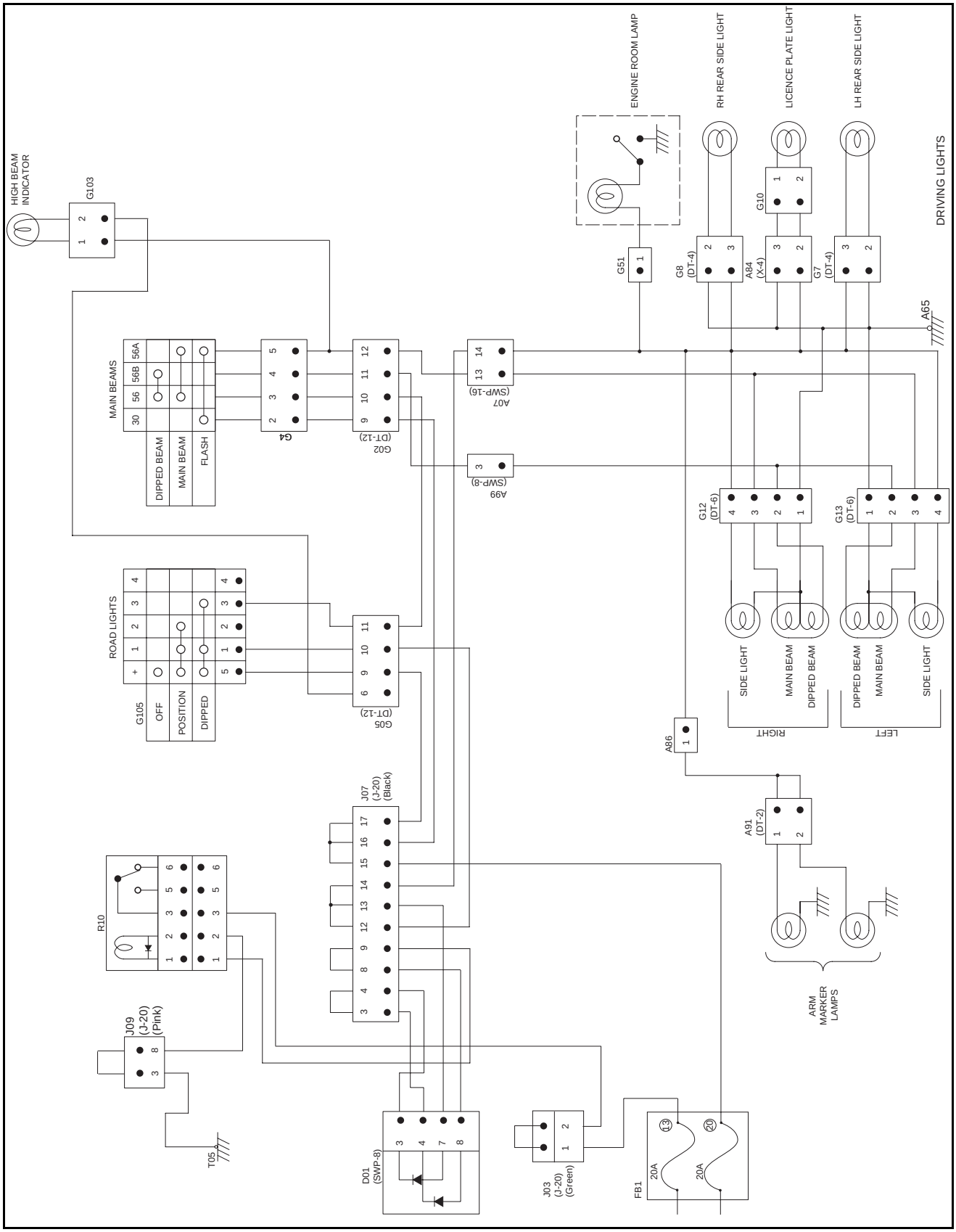
*When Fuse No.20 is not blown

*When bulbs are fully functional & fitted correctly





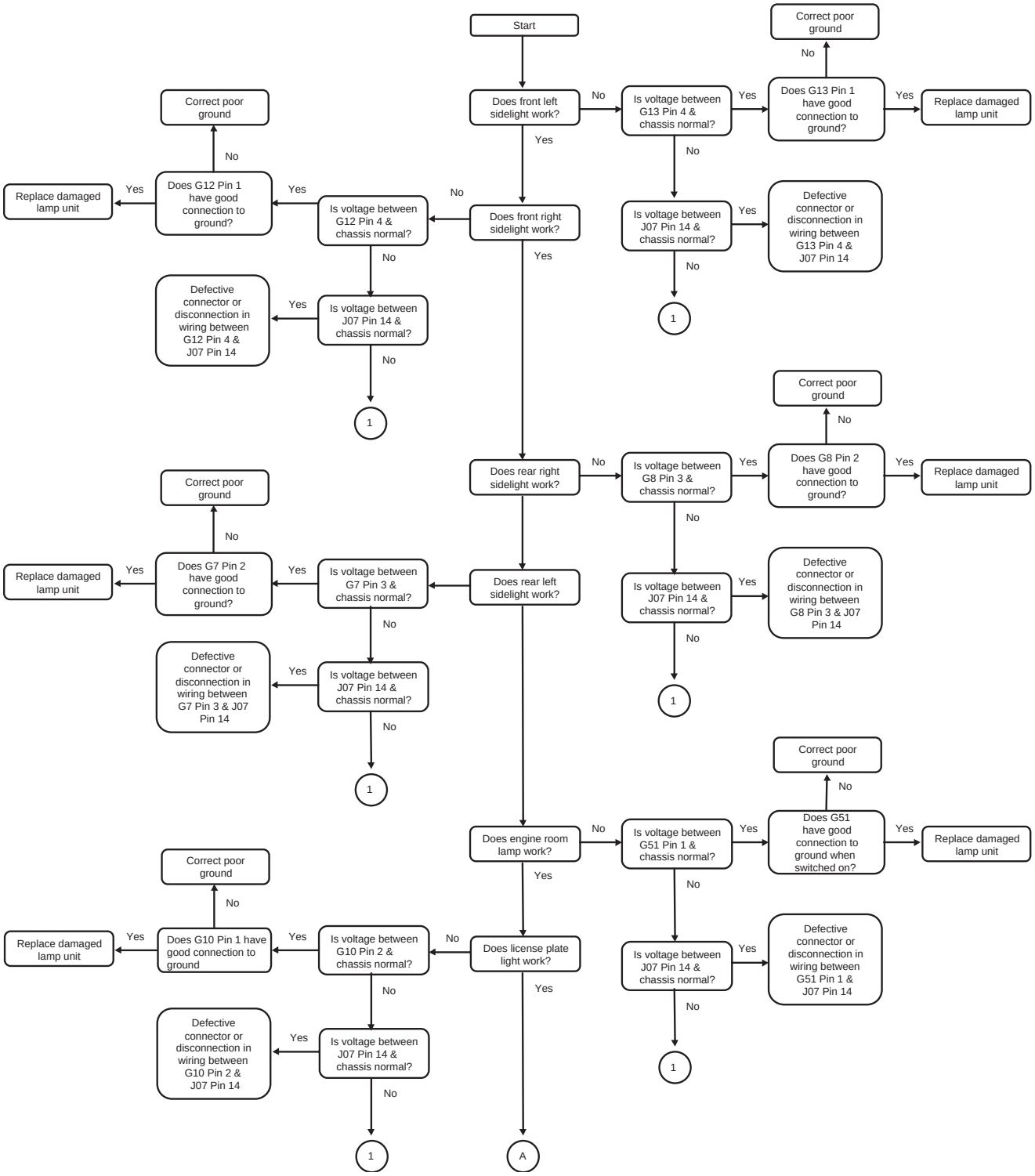
Circuit Diagram for Driving Lights



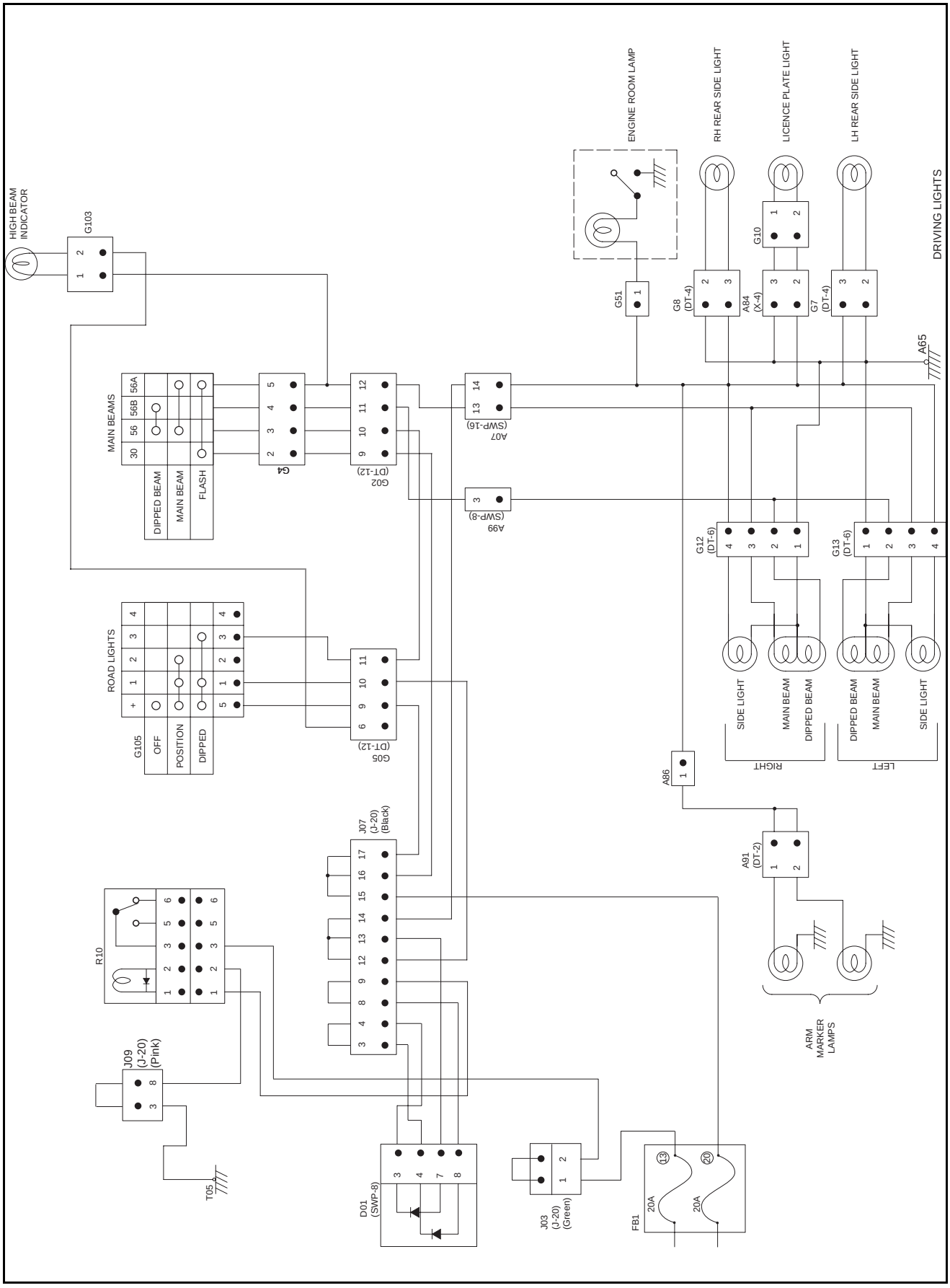
Driving Lights - Position Lights

*When fuse No.20 is not blown

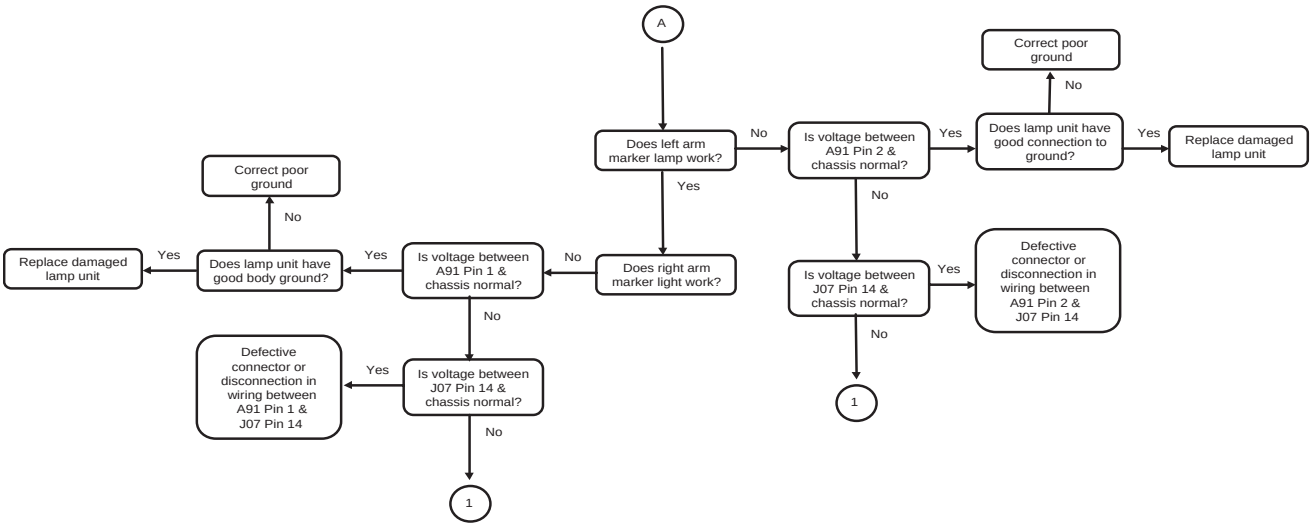
*When bulbs are fitted correctly and fully functional

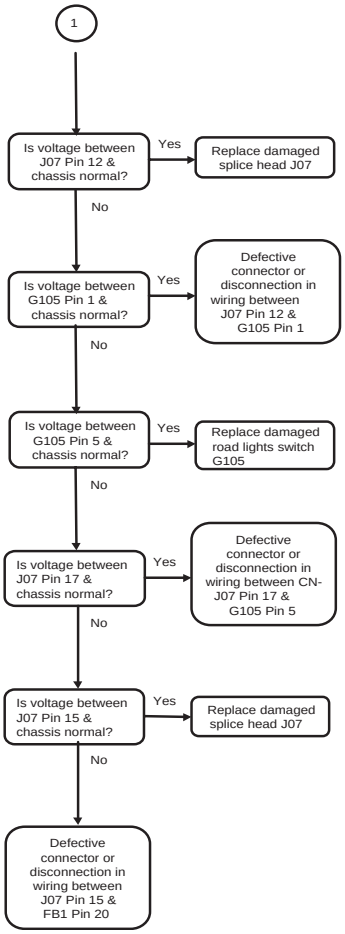


Circuit Diagram for Driving Lights

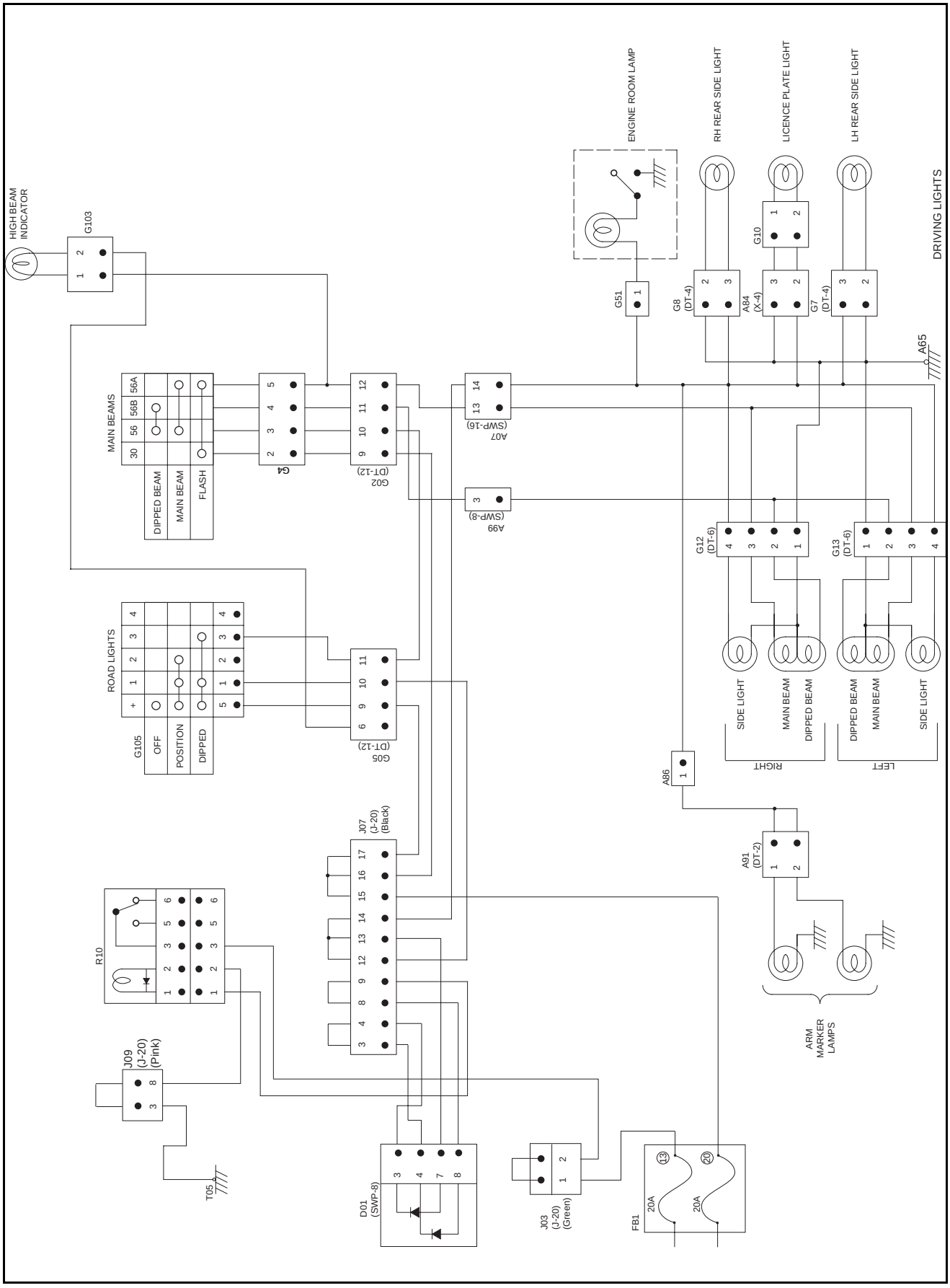


Driving Lights - Position Lights cont'd (1)





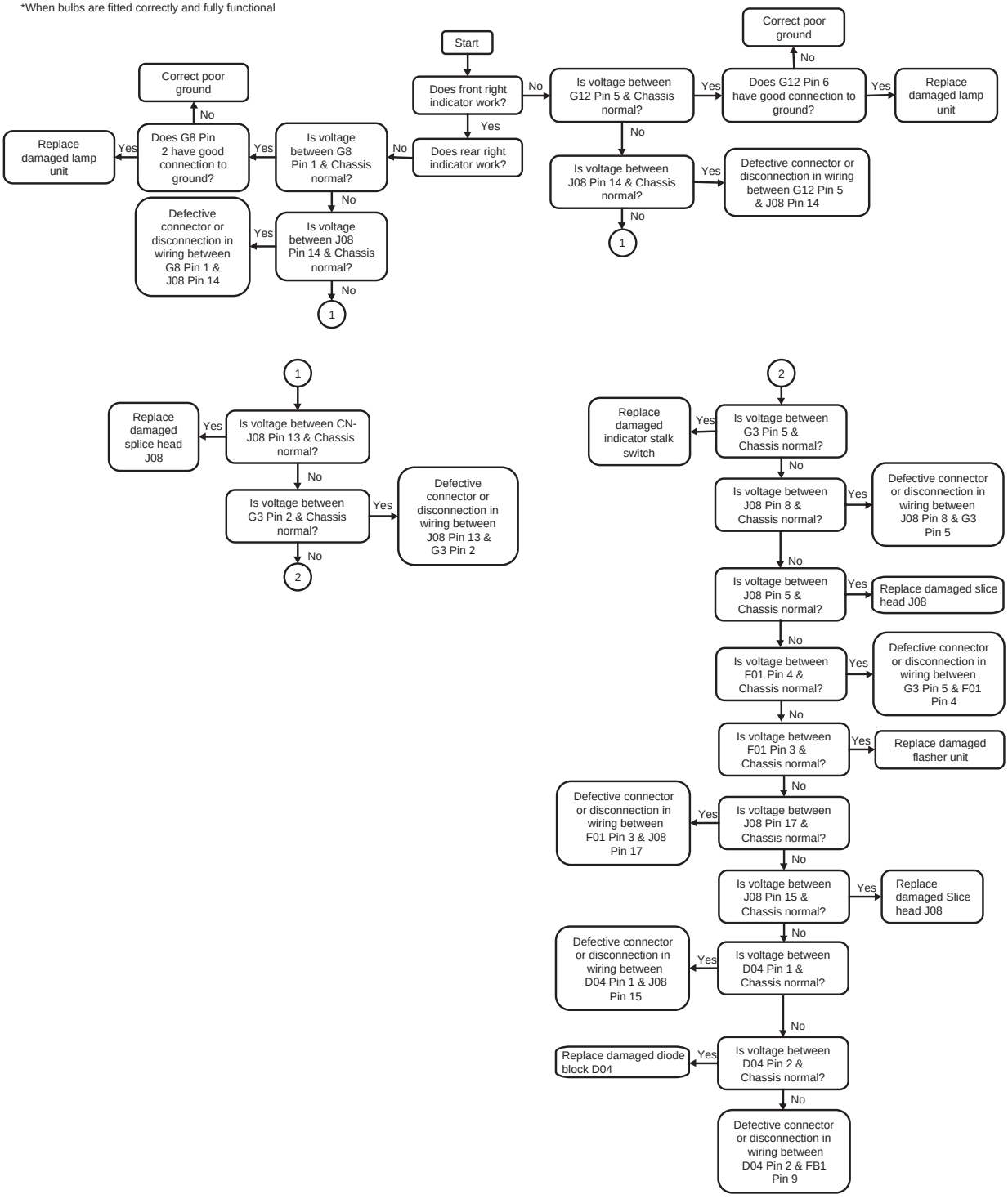
Circuit Diagram for Driving Lights



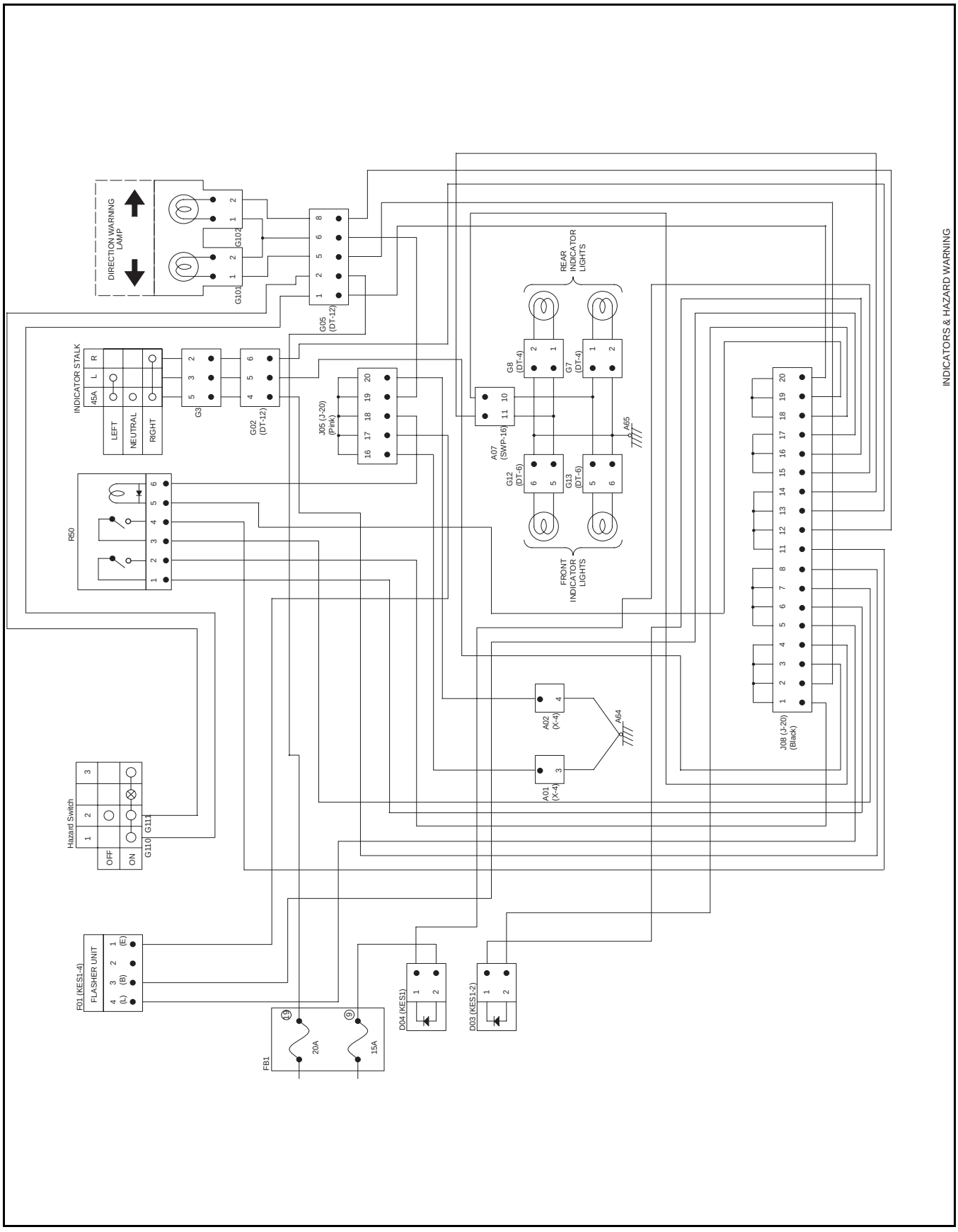
Indicators - Right Hand

*When Fuse No. 9 is not blown

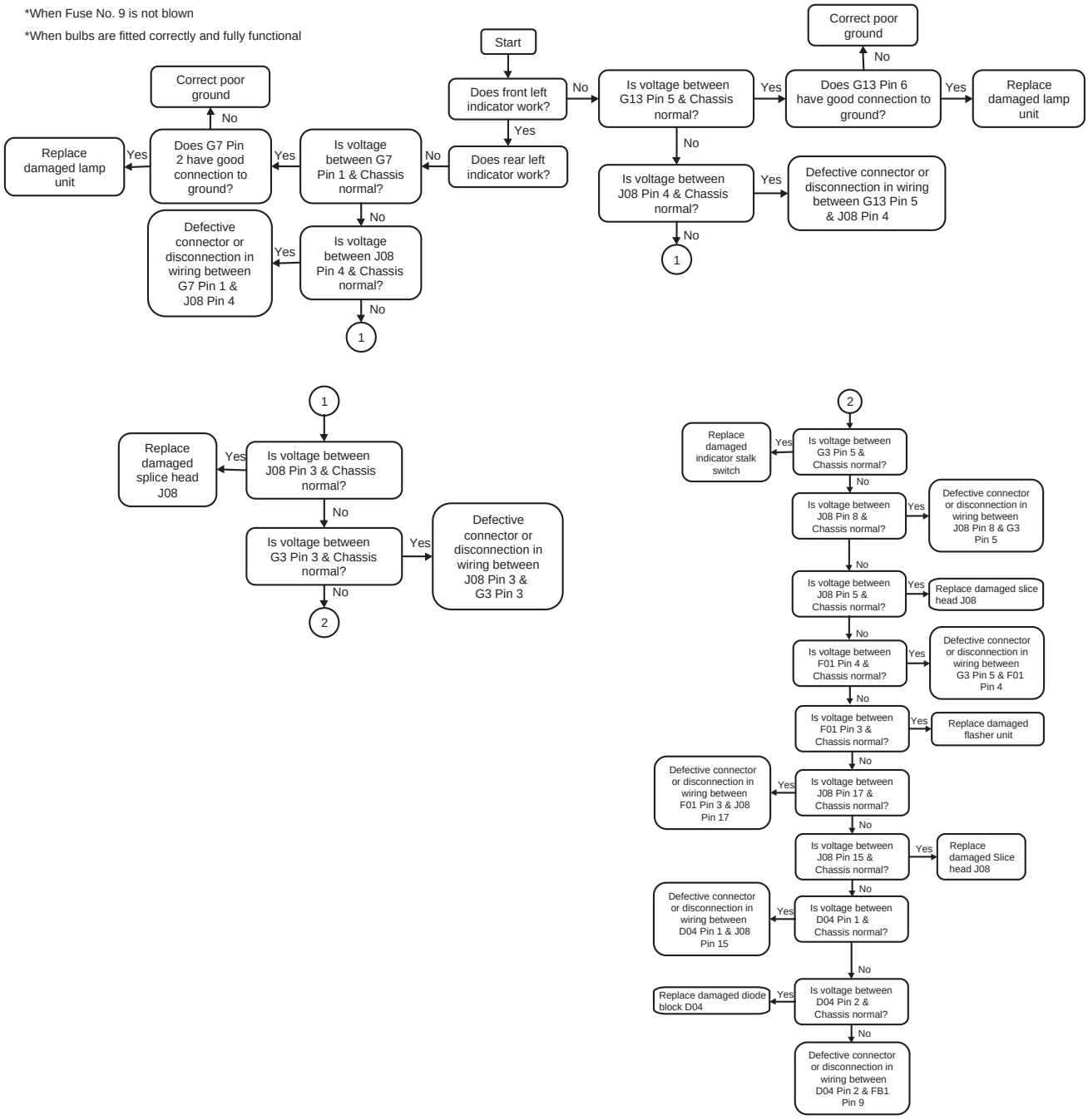
*When bulbs are fitted correctly and fully functional



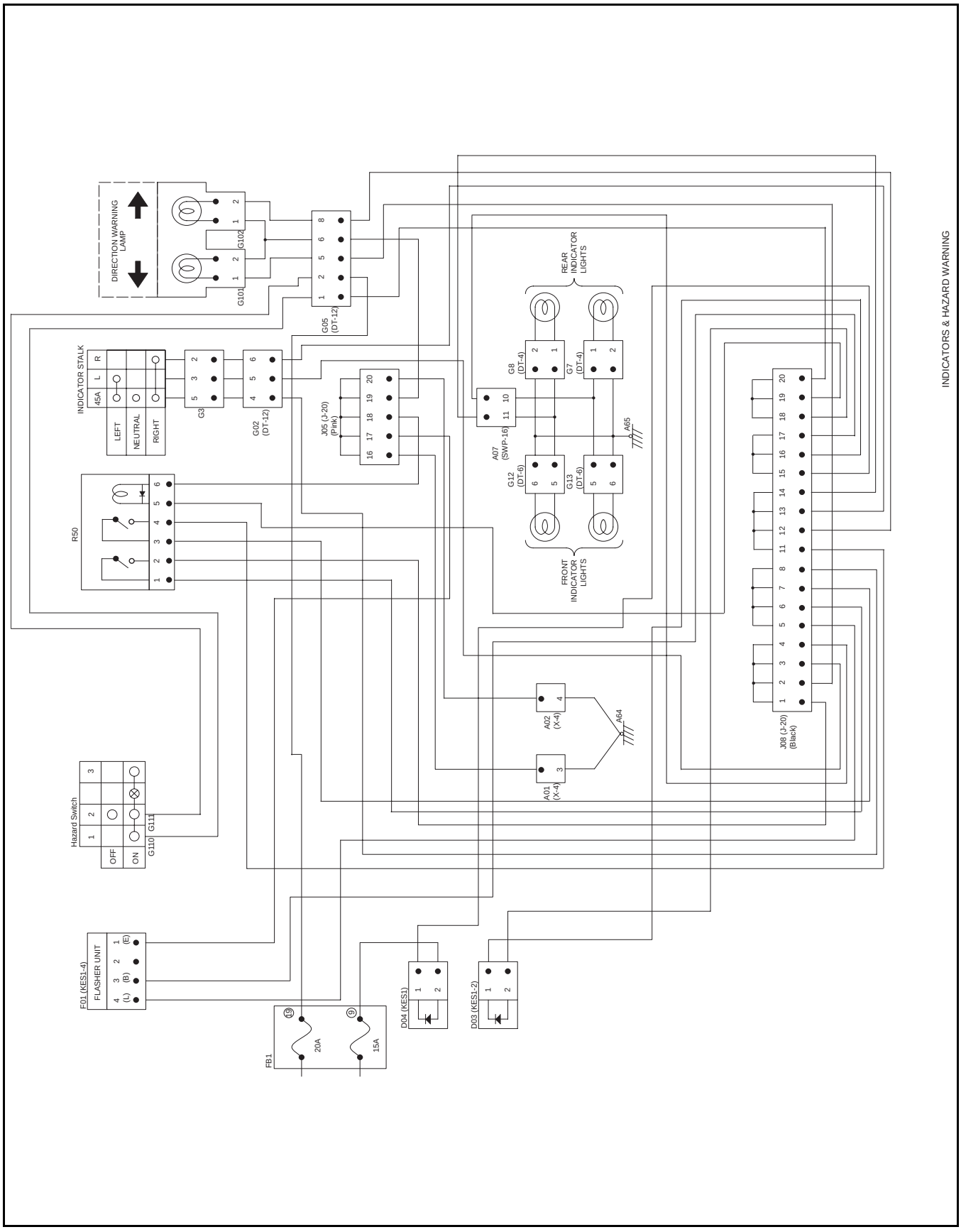
Circuit Diagram for Indicators & Hazard Warning



Indicators - Left Hand



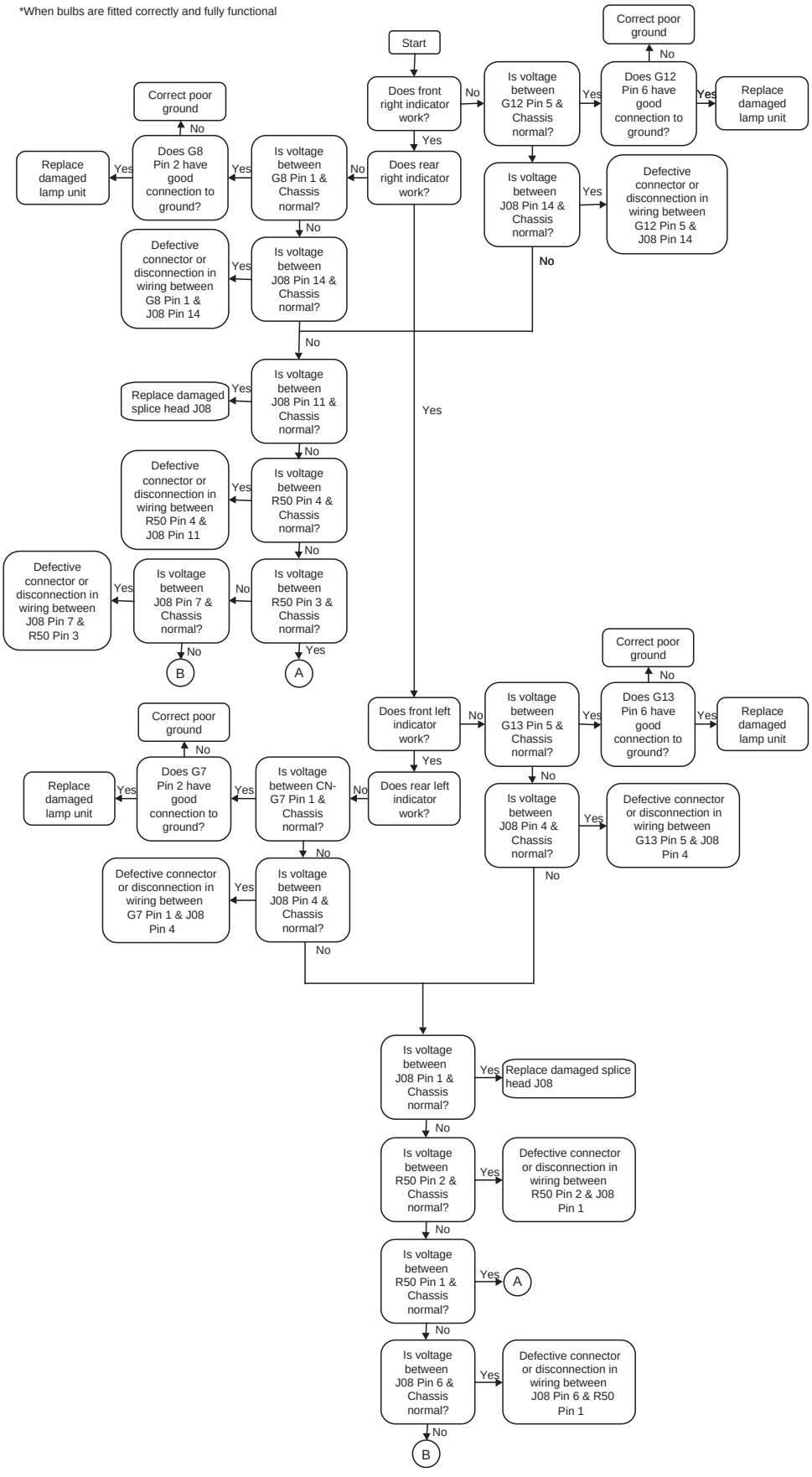
Circuit Diagram for Indicators & Hazard Warning



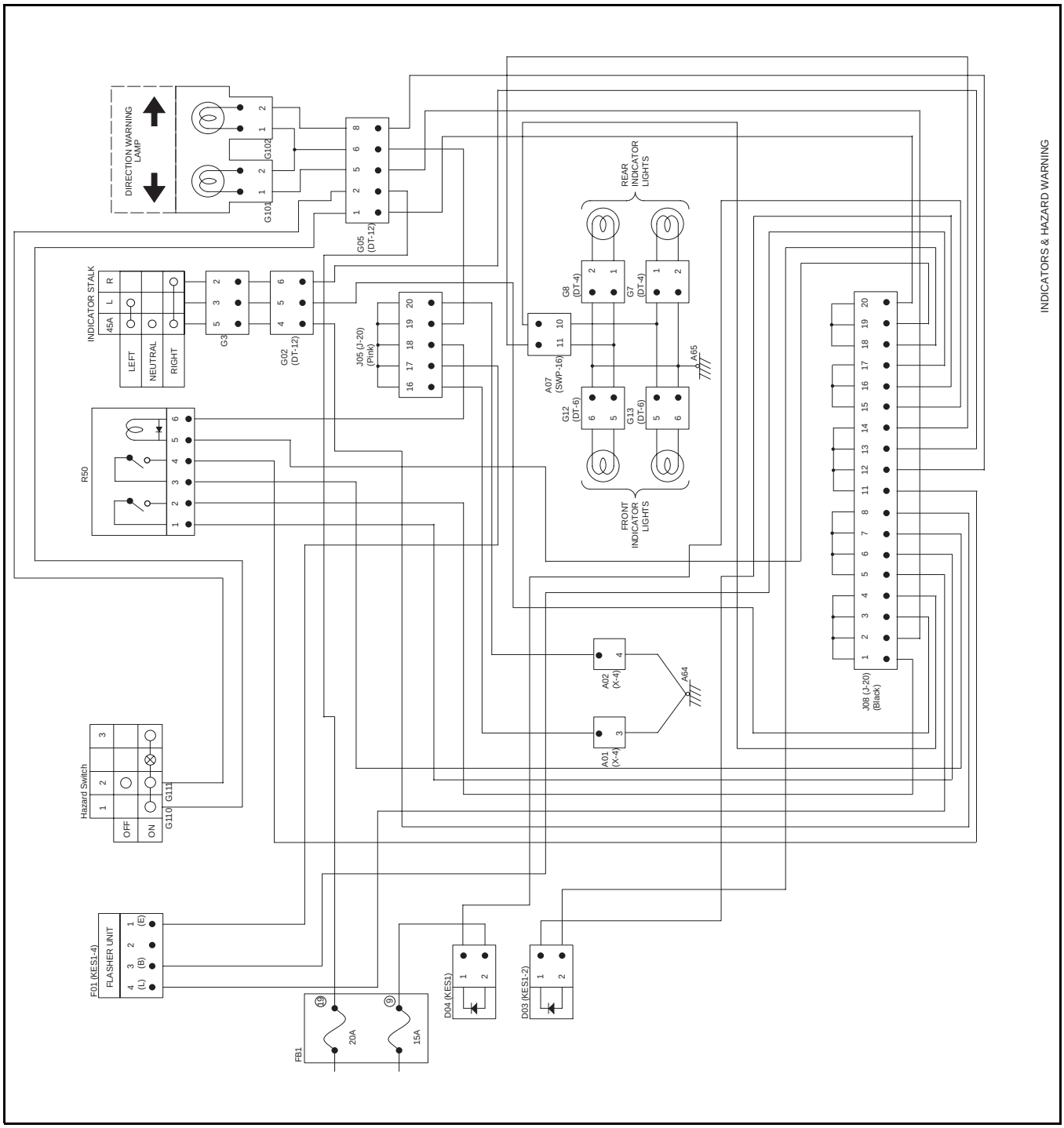
Hazard Warning Lights

*When Fuse No. 19 is not blown

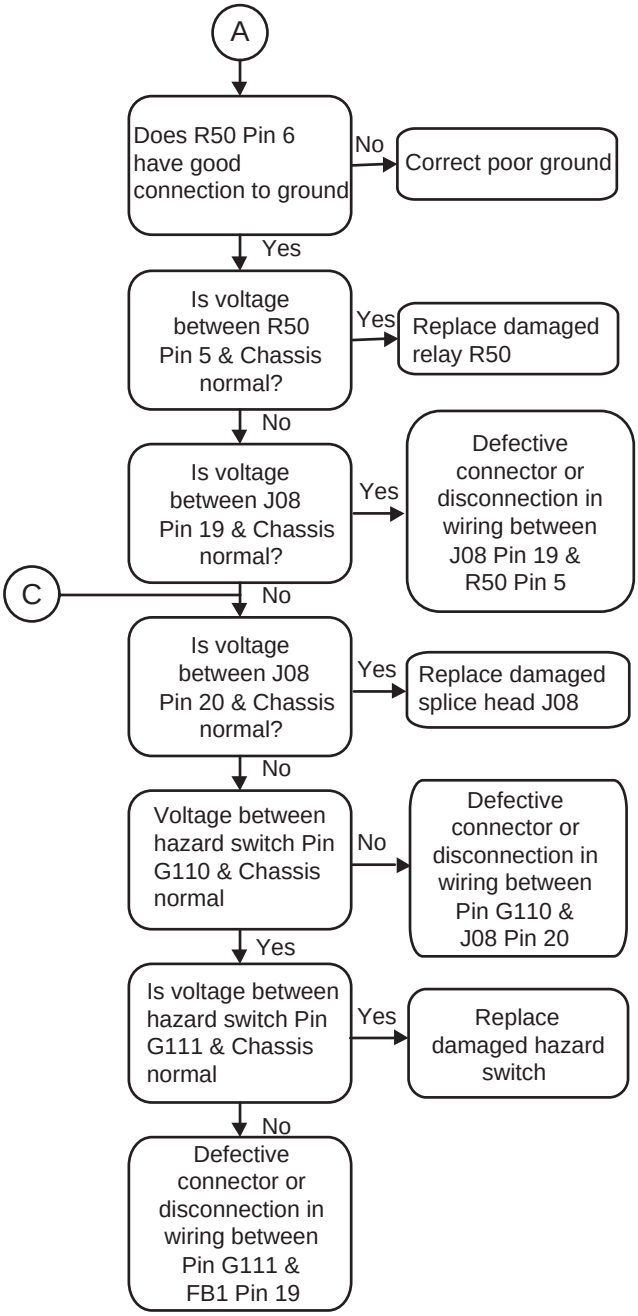
*When bulbs are fitted correctly and fully functional



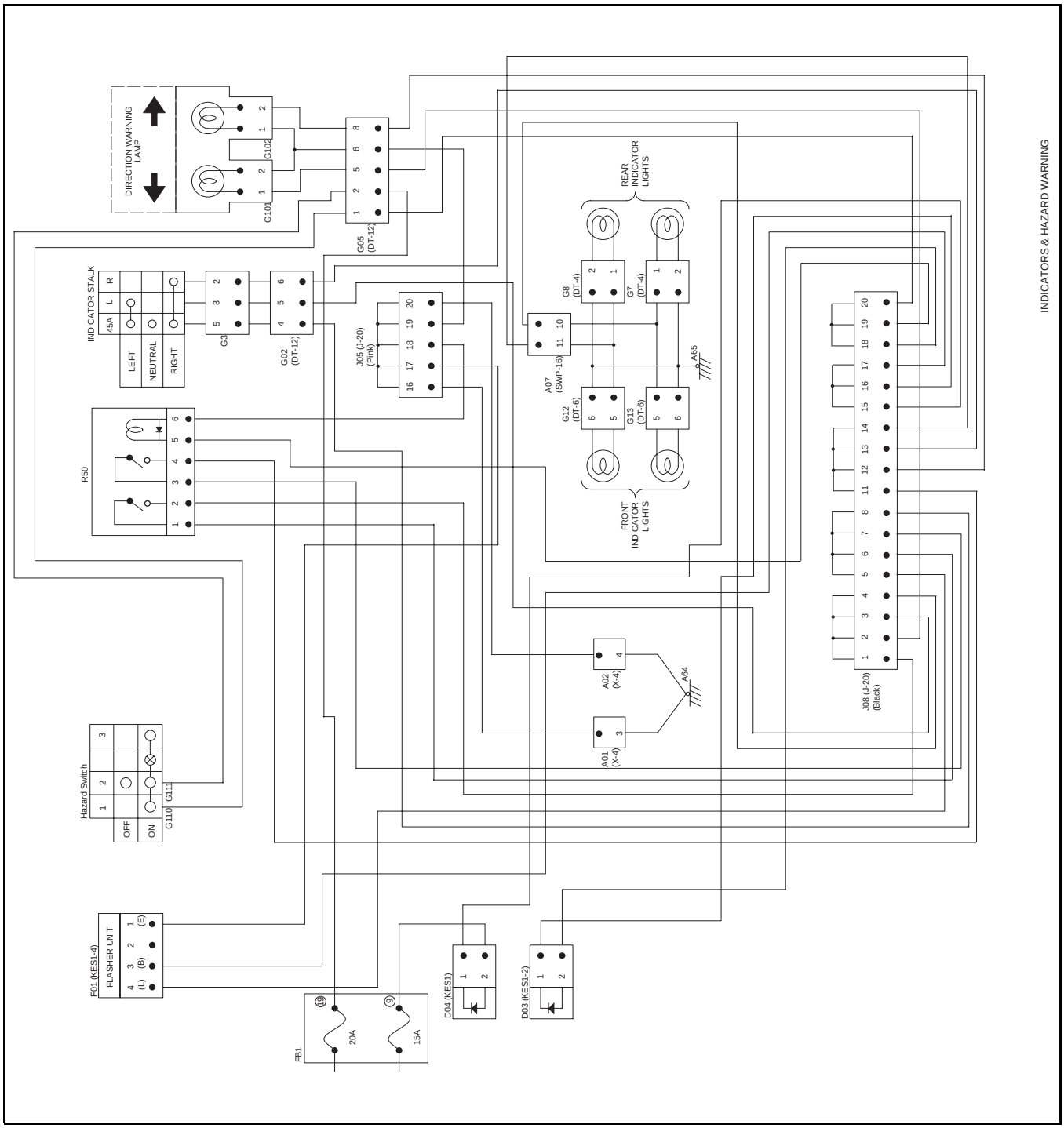
Circuit Diagram for Indicators & Hazard Warning



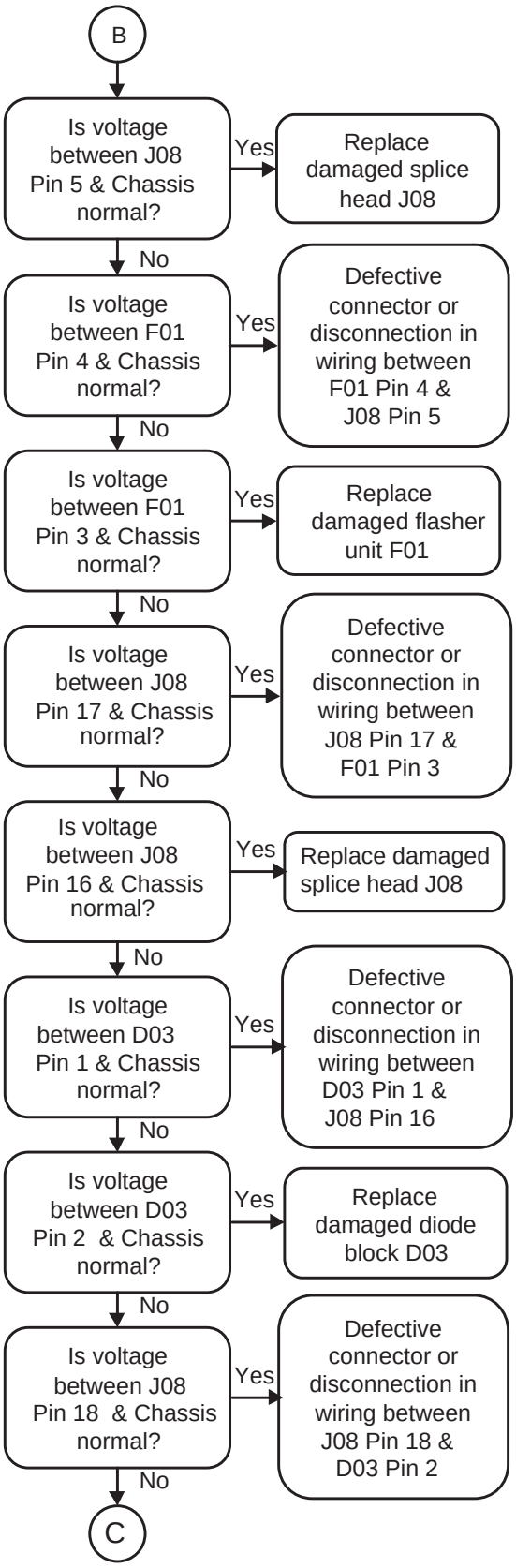
Hazard Warning Lights cont'd (A)



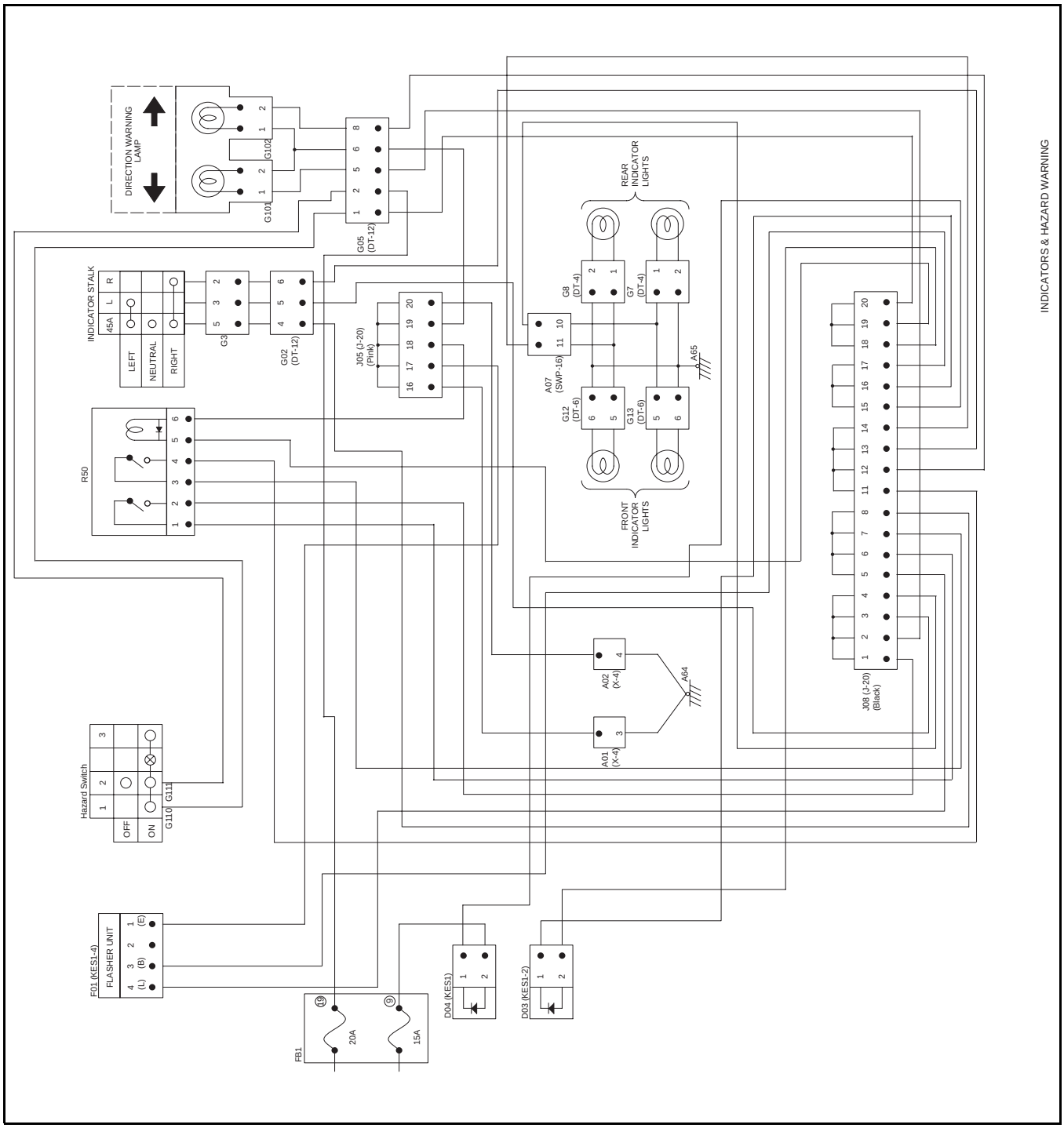
Circuit Diagram for Indicators & Hazard Warning



Hazard Warning Lights cont'd (B)

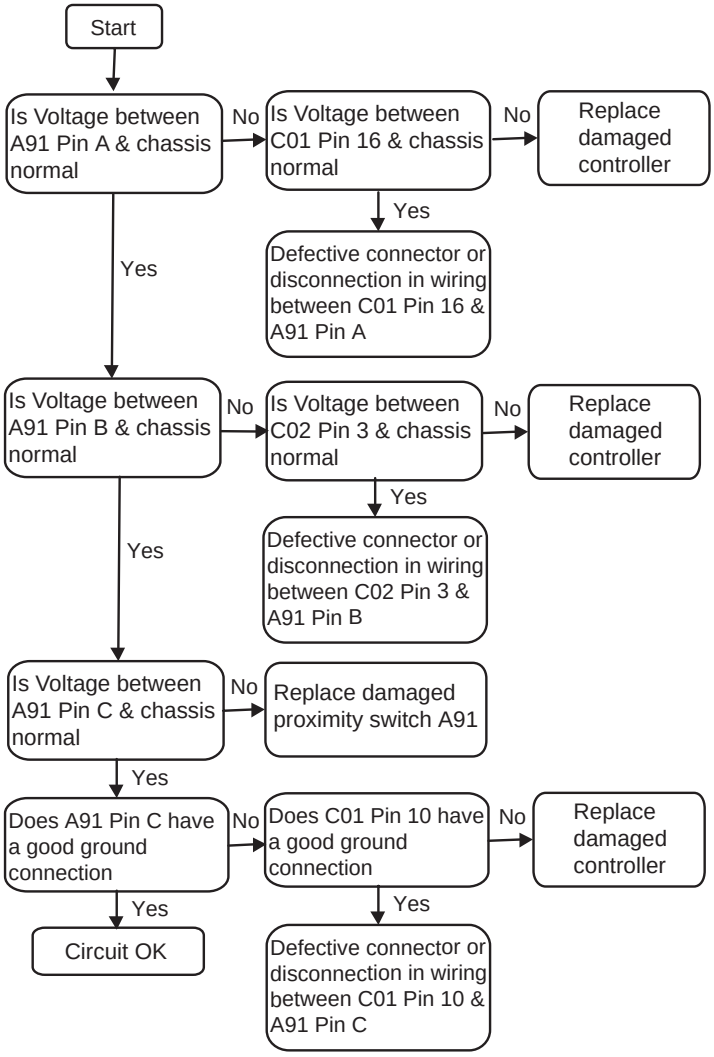

B
Is voltage between J08 Pin 5 & Chassis normal?
Yes
Replace damaged splice head J08
No
Is voltage between F01 Pin 4 & Chassis normal?
Yes
Defective connector or disconnection in wiring between F01 Pin 4 & J08 Pin 5
No
Is voltage between F01 Pin 3 & Chassis normal?
Yes
Replace damaged flasher unit F01
No
Is voltage between J08 Pin 17 & Chassis normal?
Yes
Defective connector or disconnection in wiring between J08 Pin 17 & F01 Pin 3
No
Is voltage between J08 Pin 16 & Chassis normal?
Yes
Replace damaged splice head J08
No
Is voltage between D03 Pin 1 & Chassis normal?
Yes
Defective connector or disconnection in wiring between D03 Pin 1 & J08 Pin 16
No
Is voltage between D03 Pin 2 & Chassis normal?
Yes
Replace damaged diode block D03
No
Is voltage between J08 Pin 18 & Chassis normal?
Yes
Defective connector or disconnection in wiring between J08 Pin 18 & D03 Pin 2
No
C

Circuit Diagram for Indicators & Hazard Warning

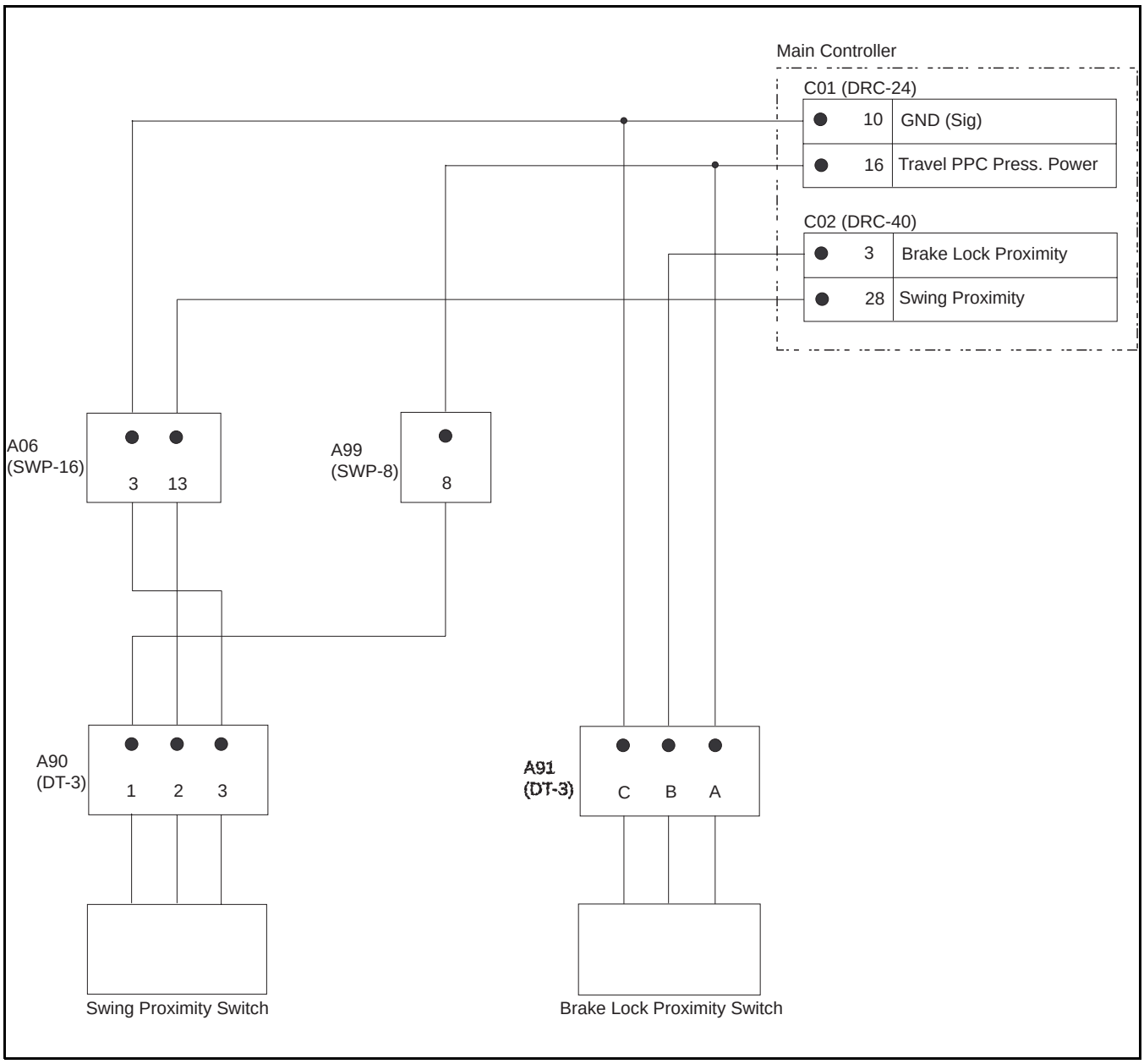


Brake Lock Proximity Switch

*Brake should be in locked position

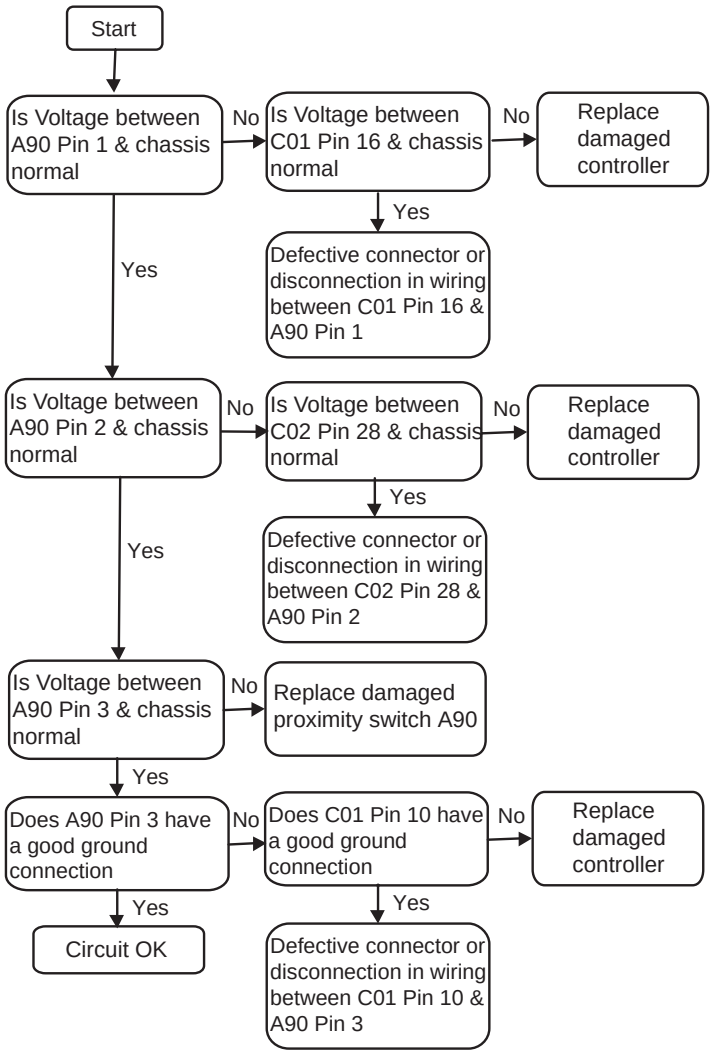


Brake Lock & Swing Lock Proximity Switches

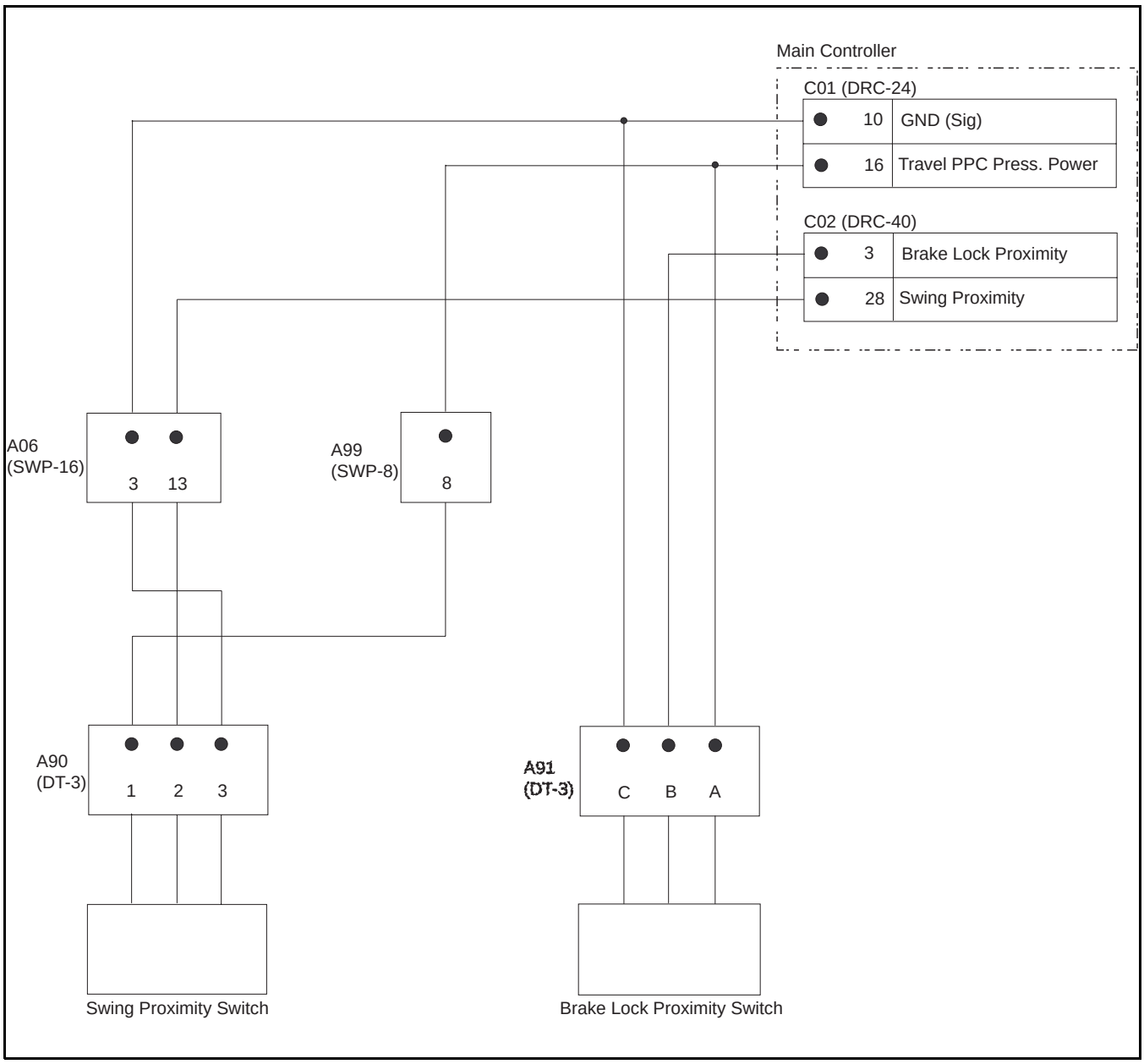


Swing Lock Proximity Switch

*With machine upper structure locked in the travel position



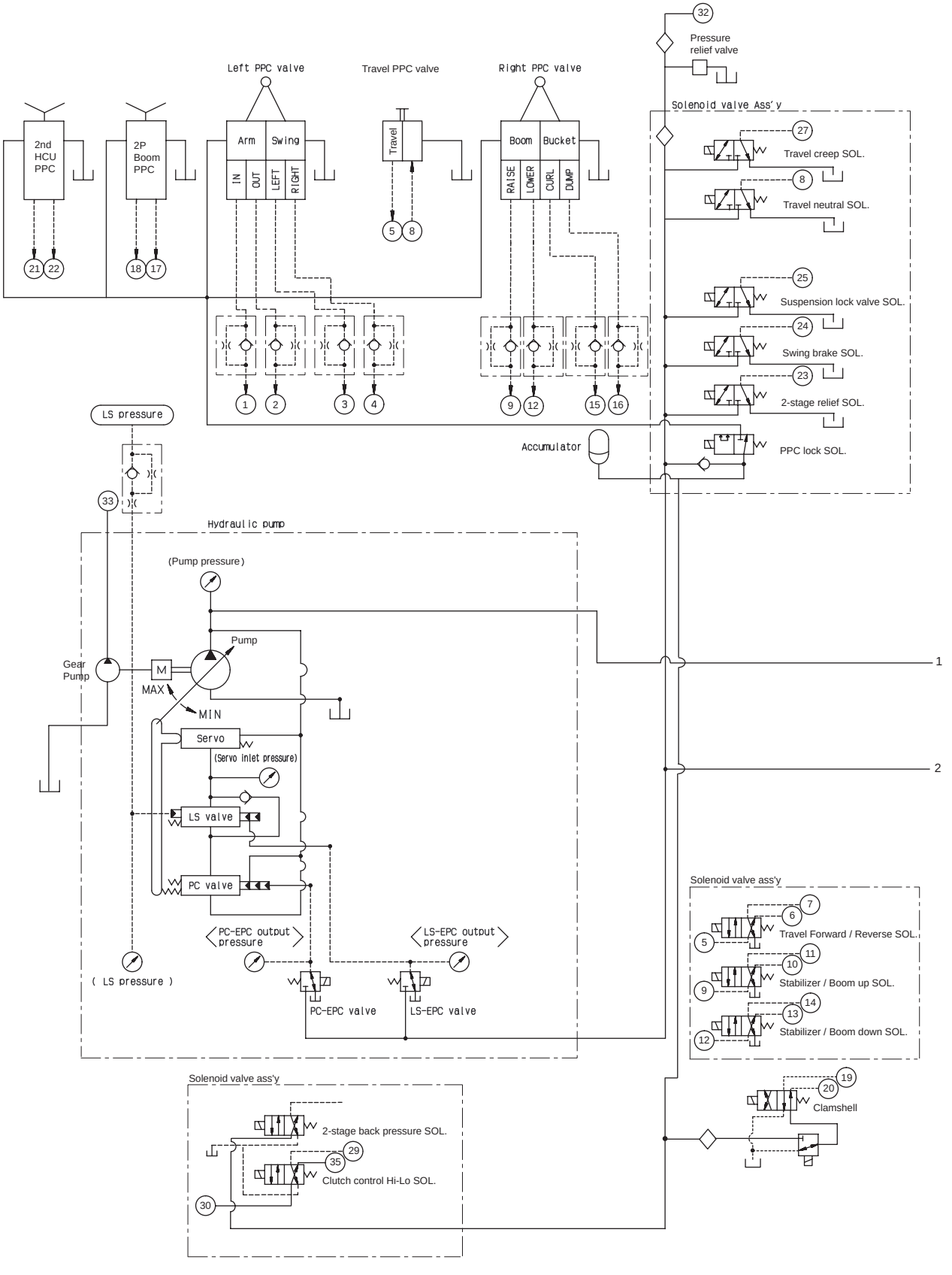
Brake and Swing Lock Proximity Switches



TROUBLESHOOTING OF HYDRAULIC AND MECHANICAL SYSTEM (H-MODE)

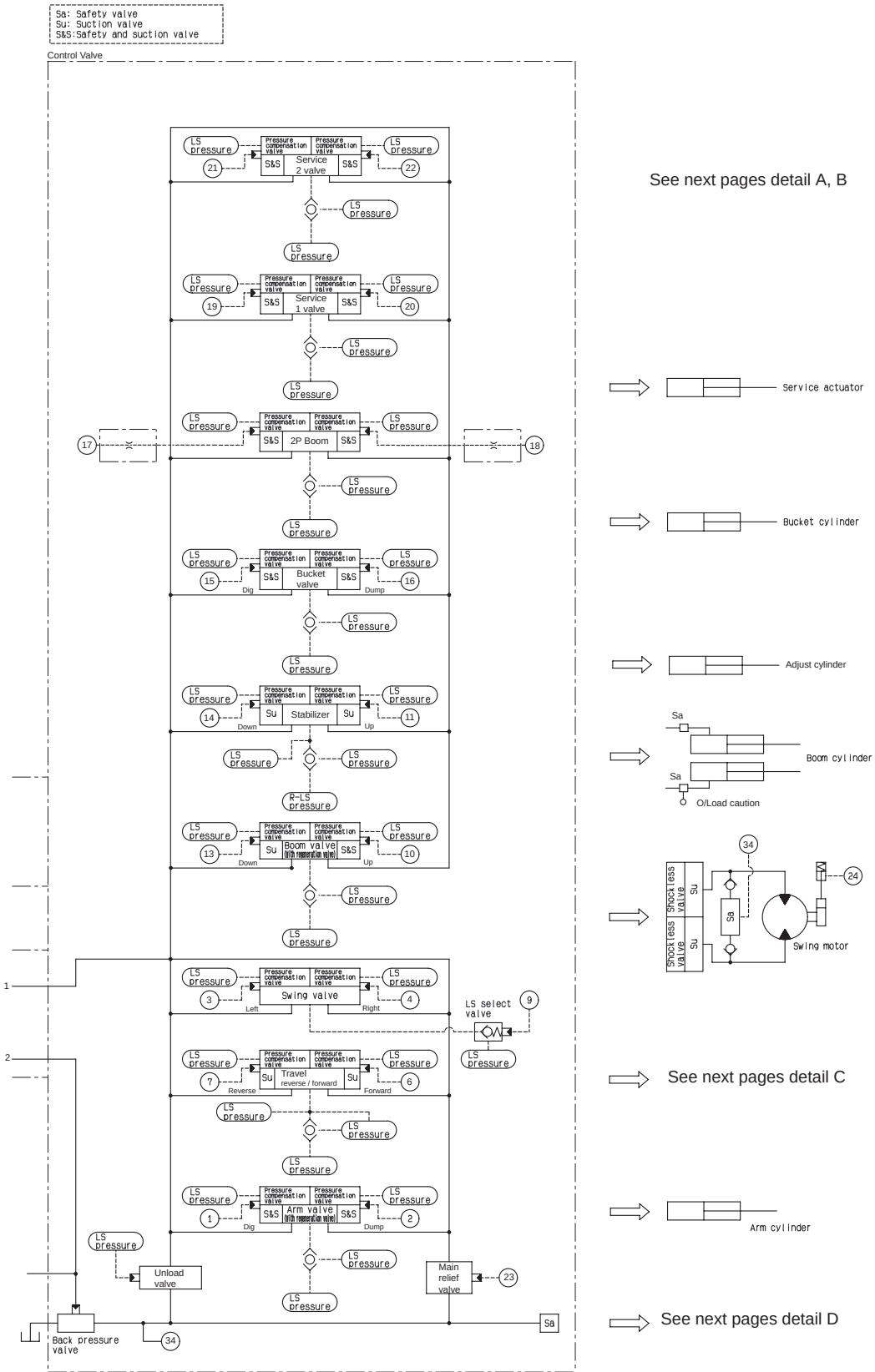
SYSTEM CHART FOR HYDRAULIC AND MECHANICAL SYSTEMS 20-702
INFORMATION CONTAINED IN TROUBLESHOOTING TABLE 20-706
H-1 All work equipment lacks power, or travel and swing speeds are slow 20-707
H-2 Engine speed sharply drops or engine stalls 20-708
H-3 No work equipment, travel or swing move 20-709
H-4 Abnormal noise is heard from around hydraulic pump 20-709
H-5 Auto-decelerator does not work 20-710
H-6 Fine control mode does not function 20-710
H-7 Boom moves slowly or lacks power 20-711
H-8 Arm moves slowly or lacks power 20-712
H-9 Bucket moves slowly or lacks power 20-713
H-10 Work equipment does not move in its single operation 20-713
H-11 Work equipment hydraulic drift is too fast 20-714
H-12 Work equipment has big time lag 20-715
H-13 Other work equipment moves when relieving single circuit 20-715
H-14 One-touch power max. switch does not operate 20-715
H-15 In compound operation, work equipment with larger load moves slowly 20-716
H-16 In swing + boom RAISE operation, boom moves slowly 20-716
H-17 In swing + travel, travel speed drops sharply 20-716
H-18 Travel speed does not switch 20-717
H-19 Travel speed does not shift, or it is too slow or fast. 20-718
H-20 Machine does not swing 20-719
H-21 Swing acceleration is poor, or swing speed is slow 20-720
H-22 Excessive overrun when stopping swing 20-721
H-23 There is big shock when stopping swing 20-722
H-24 There is loud abnormal noise caused when stopping swing 20-722
H-25 Swing natural drift is too big 20-723
H-26 Swing speed is faster than specified speed 20-723

SYSTEM CHART FOR HYDRAULIC AND MECHANICAL SYSTEMS



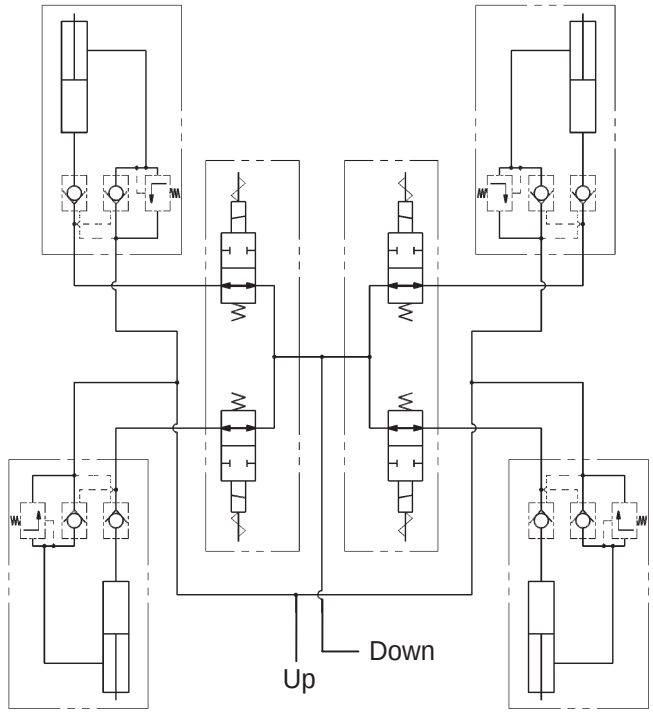
TWP02761B

★ 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.



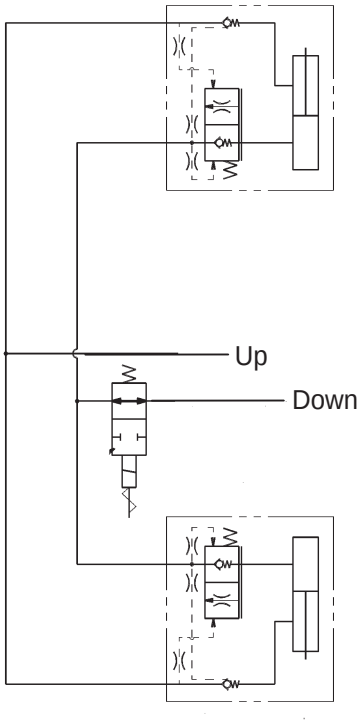
TWP02762Ab

Detail A



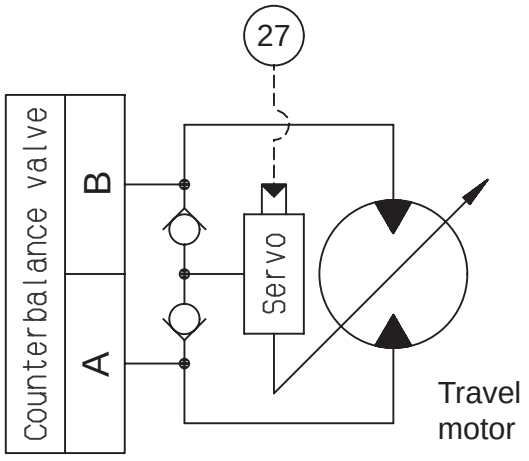
4 x outrigger option

Detail B

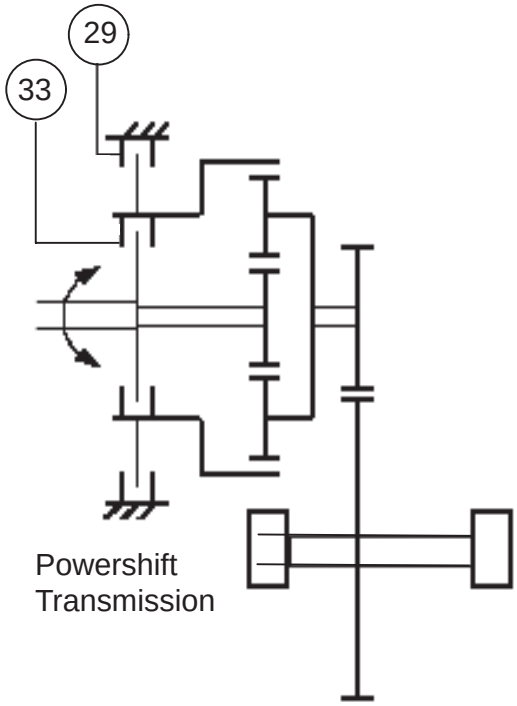


Dozer blade option

Detail C

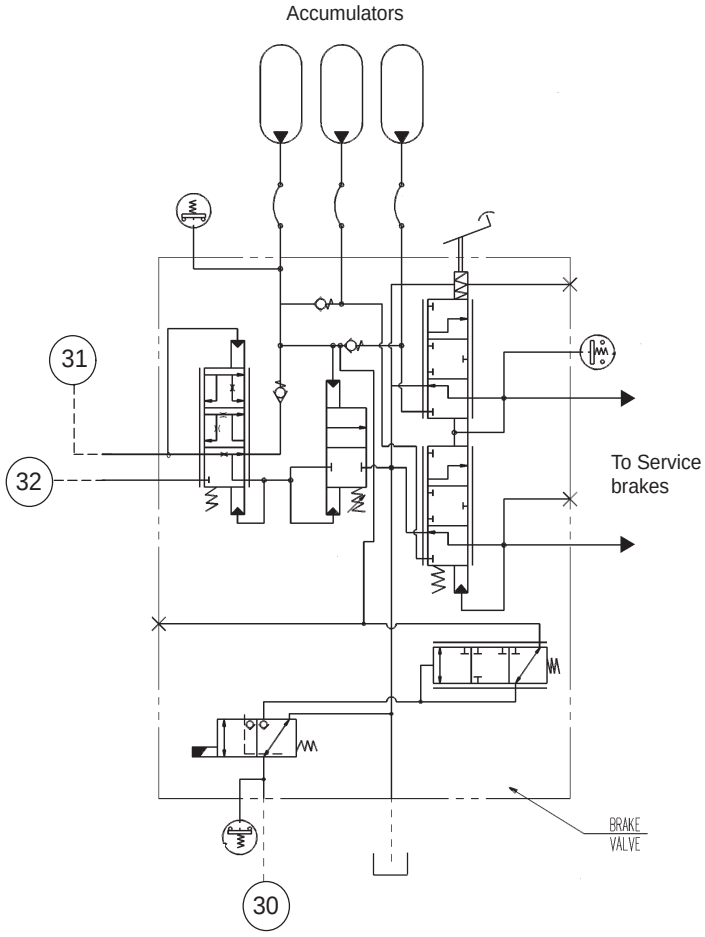


Travel motor

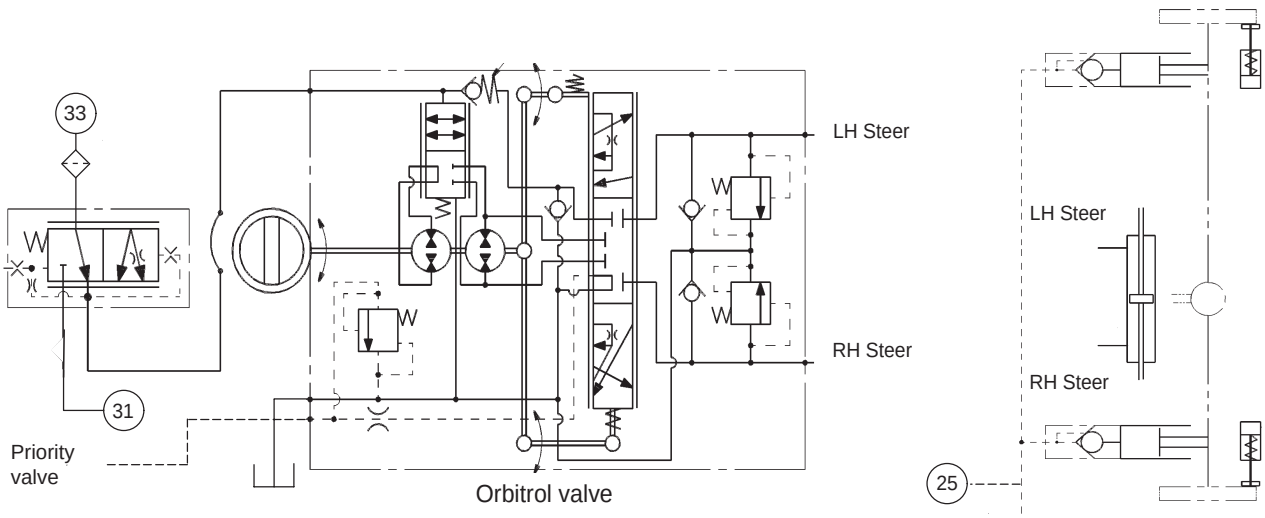


Powershift Transmission

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: All control levers in NEUTRAL Unload pressure: 3.38 ± 1.0 MPa {34.5 ± 10kg/cm^2}
2	Improper adjustment or malfunctioning of main relief valve	★Stop engine for preparations. Start troubleshooting at engine high idling. Control lever: Arm, DIGGING Main relief pressure: 34.8 – 37.3 MPa {355 – 380kg/cm^2} If the pressure does not return to normal condition even after the adjustment, malfunctioning of main relief valve or its internal failure is suspected. In that case, check the valve itself.
3	Malfunctioning of relief valve on solenoid block	★Stop engine for preparations. Start troubleshooting at engine high idling. Control lever: All control levers in NEUTRAL Control circuit source pressure: 3.5 – 3.8 MPa {35.7 – 38.8kg/cm^2}
4	Improper adjustment or malfunctioning of PC valve	★Stop engine for preparations. Start troubleshooting at engine high idling. Measurement condition: Swing lock: ON, Arm digging relief Pump delivery pressure: 1 PC valve output pressure: Approx. 3/5 If the oil pressure does not return to normal condition even after the adjustment, malfunctioning of PC valve or its internal failure is suspected. In that case, check the valve itself.
5	Malfunctioning of LS-EPC valve	★Stop engine for preparations. Start troubleshooting at engine high idling. Travel mode: NEUTRAL Travel speed: Lo → LS-EPC output pressure: 3.5 – 3.8 MPa {35.7 – 38.8kg/cm^2} Travel speed: Hi → Travel F/R lever → LS-EPC output pressure: 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: Pump delivery pressure, LS valve output pressure Measurement condition: NEUTRAL, Travel without load travel pedal held at half stroke Oil pressure ratio: Nearly equal pressure → 1 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

<table>
<tr><td rowspan="15">Presumed cause and standard value in normal condition</td><td colspan="2">Cause</td><td colspan="4">Standard value in normal condition and references for troubleshooting</td></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Improper adjustment or malfunctioning of main relief valve</td><td colspan="4">★Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td colspan="2">Control lever</td><td colspan="2">Main relief pressure</td></tr>
<tr><td colspan="2">Arm, DIGGING</td><td colspan="2">34.8 – 37.3 MPa
{355 – 380kg/cm^2}</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td rowspan="4">2</td><td rowspan="4">Improper adjustment or malfunctioning of PC valve</td><td colspan="4">★Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td>Oil pressure to be measured</td><td>Measurement condition</td><td colspan="2">Oil pressure ratio</td></tr>
<tr><td>Pump delivery pressure</td><td rowspan="2">Swing lock: ON
Arm digging relief</td><td colspan="2">1</td></tr>
<tr><td>PC valve output pressure</td><td colspan="2">Approx. 3/5</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td rowspan="5">3</td><td rowspan="5">Improper adjustment or malfunctioning of LS valve</td><td colspan="4">★Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td rowspan="2">Oil pressure to be measured</td><td colspan="3">Oil pressure ratio</td></tr>
<tr><td>Travel
NEUTRAL</td><td colspan="2">Travel without load (travel pedal held at half stroke)</td></tr>
<tr><td>Pump delivery pressure</td><td rowspan="2">Nearly equal pressure</td><td colspan="2">1</td></tr>
<tr><td>LS valve output pressure</td><td colspan="2">Approx. 3/5</td></tr>
<tr><td colspan="4">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.</td></tr>
<tr><td>4</td><td>Orifice or filter in servo equipment clogged</td><td colspan="4">The orifice or filter in the pump servo equipment is suspected of clogging. Check the equipment itself.</td></tr>
<tr><td>5</td><td>Malfunction of servo piston</td><td colspan="4">The servo piston is suspected of malfunction. Check the piston itself.</td></tr>
</table>

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="14">Presumed cause and standard value in normal condition</td><td colspan="2">Cause</td><td colspan="3">Standard value in normal condition and references for troubleshooting</td></tr>
<tr><td rowspan="9">1</td><td rowspan="9">Malfunctioning of LS-EPC valve</td><td colspan="3">★Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td>Travel speed</td><td>Travel control lpedal</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: Operation; Solenoid valve: 3.5 ~ 3.8 MPa {35.7 ~ 38.8kg/cm^2} Swing: NEUTRAL; Solenoid valve: 0 {0}
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: 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.
4	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
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: Swing operation; PPC valve output pressure: 3.5 ~ 3.8 MPa {35.7 ~ 38.8kg/cm^2} Left control lever: NEUTRAL; PPC valve output pressure: 0 {0}
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	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.		
	3	Swing motor defective	★Stop engine for preparations. Start troubleshooting at engine high idling.		
			Swing control lever	Amount of oil leakage from swing motor	
			Swing relief	Below 21 cc/min	

Failure information (2)	• Swing acceleration is poor only on one side, or swing speed is slow.
Relative information	• Set the working mode at 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	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.

<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="3">1</td><td rowspan="3">Improper adjustment or malfunctioning of swing motor (safety valve)</td><td colspan="3">★Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td>Swing lock switch</td><td>Swing control lever</td><td>Swing relief pressure</td></tr>
<tr><td>ON</td><td>Swing relief</td><td>28.4 – 28.9 MPa
{290 – 295 kg/cm^2}</td></tr>
<tr><td colspan="3">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.</td></tr>
<tr><td rowspan="3">2</td><td rowspan="3">Swing motor defective</td><td colspan="3">★Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td colspan="2">Control lever</td><td>Amount of oil leakage from swing motor</td></tr>
<tr><td colspan="2">Swing relief</td><td>Below 21 cc/min</td></tr>
</table>

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.

<table>
<tr><td rowspan="6">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 PPC valve</td><td colspan="2">★Stop engine for preparations. Start troubleshooting at engine high idling.</td></tr>
<tr><td>Swing control lever</td><td>PPC valve output pressure</td></tr>
<tr><td>NEUTRAL</td><td>0 {0}</td></tr>
<tr><td>Left or right</td><td>3.5 ~ 3.8 MPa
{35.7 ~ 38.8kg/cm^2}}</td></tr>
<tr><td>2</td><td>Swing PPC slow return valve clogged</td><td colspan="2">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.</td></tr>
<tr><td>3</td><td>Malfunctioning of swing control valve (spool)</td><td colspan="2">The spool in the swing control valve is resumed to malfunction. Check the valve itself.</td></tr>
<tr><td>4</td><td>Swing motor (suction valve) seal defective</td><td colspan="2">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.</td></tr>
<tr><td>5</td><td>Swing motor (check valve) seal defective</td><td colspan="2">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.</td></tr>
</table>

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	
			★Stop engine for preparations. Start troubleshooting at engine high idling.	
	1	Swing and parking brake solenoid valve malfunctioned	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.

30 DISASSEMBLY AND ASSEMBLY

HOW TO READ THIS MANUAL 30- 3
Removal and Installation of Assemblies . . . 30- 3
Disassembly and Assembly of Assemblies. 30- 4
SPECIAL TOOLS 30- 5
Sketches 30- 5
List of Tools. 30- 6
PRECAUTIONS WHEN PERFORMING OPERATION 30- 7
GOVERNOR MOTOR ASSEMBLY 30- 9
Removal 30- 9
Installation. 30- 9
STARTING MOTOR ASSEMBLY 30- 10
Removal 30- 10
Installation. 30- 10
FUEL INJECTION PUMP ASSEMBLY 30- 11
Special Tools 30- 11
Removal 30- 11
Installation. 30- 12
ENGINE FRONT SEAL 30- 16
Removal 30- 16
Installation. 30- 17
ENGINE REAR SEAL 30- 19
Removal 30- 19
Installation. 30- 20
CYLINDER HEAD ASSEMBLY 30- 21
Special Tools 30- 21
Removal 30- 21
Installation. 30- 24
COMBINATION COOLER ASSEMBLY 30- 27
Removal 30- 27
Installation. 30- 29
ENGINE AND HYDRAULIC PUMP ASSEMBLIES 30- 30
Special Tools 30- 30
Removal 30- 30
Installation. 30- 33
TRAVEL MOTOR ASSEMBLY 30- 35
Removal 30- 35
Installation. 30- 36
DISASSEMBLY AND ASSEMBLY OF TRAVEL MOTOR
Disassembly 30- 38
Assembly 30- 40
SWING MOTOR AND SWING MACHINERY ASSEMBLY 30- 42
Removal 30- 42
Installation. 30- 42
SWING MACHINERY DISASSEMBLY AND ASSEMBLY
Special Tools 30- 43
Disassembly 30- 43
Assembly 30- 46
SWING MOTOR DISASSEMBLY AND ASSEMBLY
Special Tools 30- 51
Disassembly 30- 51
Assembly 30- 54
FRONT AXLE ASSEMBLY 30- 60
Removal. 30- 60
Installation 30- 61
DISASSEMBLY AND ASSEMBLY
Special Tools 30- 62
Disassembly 30- 62
REAR AXLE AND TRANSMISSION ASSEMBLY 30- 112
Removal. 30- 112
Installation 30- 114
DISASSEMBLY AND ASSEMBLY OF REAR AXLE
Special Tools 30- 115
Disassembly 30- 115
DISASSEMBLY AND ASSEMBLY TRANSMISSION
Special Tools 30- 146
Disassembly 30- 146
Assembly 30- 148
PROPSHAFT ASSEMBLY 30- 174
Removal. 30- 174
Installation 30- 175
WHEELS 30- 176
Removal 30- 176
Installation 30- 176
SUSPENSION LOCK CYLINDER ASSEMBLY 30- 177
Removal. 30- 177
Installation 30- 177
DISASSEMBLY AND ASSEMBLY
Special Tools 30- 178
Disassembly 30- 178
Assembly 30- 178
OUTRIGGER ASSEMBLY 30- 179
Removal 30- 179
Installation 30- 179
DISASSEMBLY AND ASSEMBLY
Disassembly 30- 180
Assembly 30- 180
DOZER BLADE ASSEMBLY 30- 181
Removal 30- 181
Installation 30- 181
DISASSEMBLY AND ASSEMBLY
Disassembly 30- 182

Assembly. 30- 182
SWING CIRCLE ASSEMBLY 30- 183
Removal 30- 183
Installation 30- 183
REVOLVING FRAME ASSEMBLY 30- 184
Removal 30- 184
Installation 30- 186
CENTER SWIVEL JOINT ASSEMBLY . . . 30- 187
Removal 30- 187
Installation 30- 189
DISASSEMBLY AND ASSEMBLY
Special Tools. 30- 190
Disassembly 30- 190
Assembly. 30- 191
HYDRAULIC TANK ASSEMBLY 30- 192
Removal 30- 192
Installation 30- 194
FUEL TANK ASSEMBLY 30- 196
Removal 30- 196
Installation 30- 197
CONTROL VALVE ASSEMBLY 30- 198
Removal 30- 198
Installation 30- 201
LS SELECT VALVE ASSEMBLY 30- 202
Removal. 30- 202
Installation 30- 202
PRESSURE COMPENSATION VALVE
ASSEMBLY 30- 203
Removal. 30- 203
Installation 30- 203
MAIN RELIEF VALVE ASSEMBLY 30- 204
Removal. 30- 204
Installation 30- 204
LS CONTROL EPC VALVE ASSEMBLY . . 30- 205
Removal. 30- 205
Installation 30- 205
EPC SOLENOID VALVE ASSEMBLY 30- 206
Removal. 30- 206
Installation 30- 206
PPC VALVE BLOCK ASSEMBLY 30- 207
Removal 30- 207
Installation 30- 208
MANIFOLD BLOCK ASSEMBLY 30- 209
Removal 30- 209
Installation 30- 209
OIL SEAL IN HYDRAULIC PUMP
INPUT SHAFT. 30- 210
Special Tools. 30- 210
Removal. 30- 210
Installation 30- 210
WORK EQUIPMENT PPC VALVE
ASSEMBLY 30- 211
DISASSEMBLY AND ASSEMBLY
Assembly. 30- 211
HYDRAULIC CYLINDER ASSEMBLY 30- 212
DISASSEMBLY AND ASSEMBLY
Special Tools. 30- 212
Disassembly 30- 212
Assembly. 30- 214
MONOBOOM ASSEMBLY 30- 218
Removal 30- 218
Installation. 30- 219
2 PIECE BOOM ASSEMBLY 30- 221
Removal 30- 221
Installation. 30- 222
AIR CONDITIONER UNIT 30- 224
Special Tools 30- 224
Removal 30- 224
Installation. 30- 227
COUNTERWEIGHT ASSEMBLY 30- 228
Removal 30- 228
Installation. 30- 229
OPERATOR'S CAB ASSEMBLY 30- 230
Removal 30- 230
Installation. 30- 232
MONITOR ASSEMBLY 30- 233
Removal 30- 233
Installation. 30- 234
GOVERNOR PUMP CONTROLLER
ASSEMBLY 30- 235
Removal 30- 235
Installation. 30- 236

HOW TO READ THIS MANUAL

REMOVAL AND INSTALLATION OF ASSEMBLIES

SPECIAL TOOLS

- Special tools that are deemed necessary for removal or installation of parts are listed.
- List of the special tools contains the following kind of information.
  1) Necessity
     - ■: Special tools which cannot be substituted, should always be used.
     - ●: Special tools which are very useful if available, can be substituted with commercially available tools.
  2) Distinction of new and existing special tools
     - N: Tools with new part numbers, newly developed for this model.
     - R: Tools with upgraded part numbers, remodeled from already available tools for other models.
     - Blank: Tools already available for other models, used without any modification.
  3) Circle mark (○) 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.

※1 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 ※1 mark in the INSTALLATION Section, identifying which step the instructions are intended for.
- Marks shown in the INSTALLATION Section stand for the following.

⚠ This mark indicates safety-related precautions which must be followed when doing the work.

★ This 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

- Various special tools are illustrated for the convenience of local manufacture.

DISASSEMBLY AND ASSEMBLY OF ASSEMBLIES

SPECIAL TOOLS

- Special tools which are deemed necessary for disassembly and assembly are listed in this section.
- List of the special tools contains the following kind of information.
  1) Necessity
     ■: Special tools which cannot be substituted, should always be used.
     ●: Special tools which are very useful if available, can be substituted with commercially available tools.
  2) Distinction of new and existing special tools
     N: Tools with new part numbers, newly developed for this model.
     R: Tools with upgraded part numbers, remodeled from already available tools for other models.

  Blank: Tools already available for other models, used without any modification.
  3) Circle mark (○) in sketch column:
     A circle mark means that a sketch of the special tool is presented in the section of Sketches for Special Tools.
  4) Part No. of special tools starting with 79*T means that they are locally made parts and as such not interchangeable with those made by Komatsu in Japan e.g. 79*T--- xxx --- xxxx.

DISASSEMBLY

- The DISASSEMBLY Section contains procedures, precautions and the amount of oil or water to be drained.
- Various symbols used in the DISASSEMBLY Section are explained and listed below.

 This mark indicates safety-related precautions which must be followed when doing the work.

This mark gives guidance or precautions when doing the procedure.

※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.

 This mark indicates the specified torque.

 This mark indicates an amount of oil or water to be added.

SKETCHES OF SPECIAL TOOLS

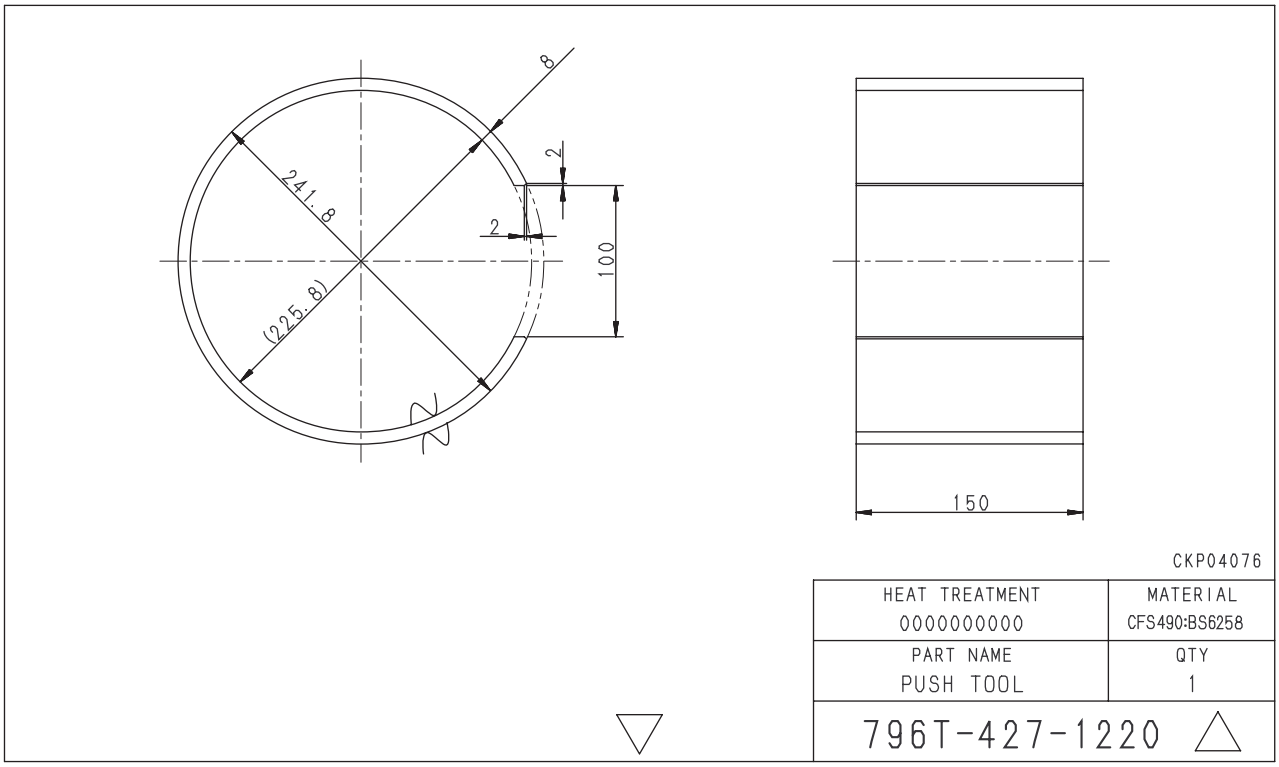
1) Various special tools are illustrated for the convenience of local manufacture.

SPECIAL TOOLS

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
799-203-8001	Multi Tachometer	Setting of engine revs
799-201-2202	Boost Gauge Kit	Air boost pressure
799-101-5210	Fitting (PT 1/4)	Air boost pressure
799-201-9000	Handy Smoke Checker	Measurement of exhaust colour
795-799-1131	Gear	Adjustment of valve clearance
795-799-1900	Pin Assembly	Adjustment of valve clearance
799-201-1504	Blow By Kit	Measurement of blow by
795-790-1950	Tool (Nozzle)	Measurement of blow by
795-799-1131	Gear	Adjustment of fuel injection timing
795-799-1900	Pin Assembly	Adjustment of fuel injection timing
795-799-1950	Lock Pin	Adjustment of fuel injection timing
799-101-5002	Hydraulic Tester	Measurement of engine oil pressure
790-261-1203	Digital Type Hydraulic Tester	Measurement of engine oil pressure
799-401-2320	Hydraulic Tester	Measurement of engine oil pressure
673-281-3170	Joint	Measurement of engine oil pressure
621-581-9710	O-Ring	Measurement of engine oil pressure
796-627-1130	Wear Gauge	Inspection of wear on the sprocket
799-101-5220	Nipple (10 x 1.25mm)	Hydraulic testing
799-101-1340	Differential Pressure Gauge	Hydraulic testing
799-401-2910	Nipple (Size 02)	Solenoid valve output
799-401-2920	Nipple (Size 03)	Measurement of solenoid valve output
795-502-1205	Compression Gauge	Cylinder compression
795-502-1700	Adapter	Cylinder compression

PRECAUTIONS WHEN PERFORMING OPERATION

Be sure to follow the general precautions given below when performing removal or installation (disassembly or assembly) of units.

1. Precautions when performing removal work

- If the engine coolant water contains antifreeze, dispose of it correctly.
- After disconnecting hoses or tubes, cover them or install blind plugs to prevent dirt or dust from entering.
- When draining oil, prepare a container of adequate size to catch the oil.
- Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
- To avoid loosening any wire contacts, do not pull on the wires. In-order to prevent excessive force to the wiring, hold onto the connectors when disconnecting them.
- Fasten tags to wires and hoses to identify and show their installation position and help prevent any mistakes when re-installing.
- Count and check the number and thickness of the shims, and keep them in a safe place.
- When raising or lifting components, be sure to use proper lifting equipment of ample strength and safety.
- When using forcing screws to remove any components, tighten the forcing screws uniformly in turn.
- Before removing any unit, clean the surrounding area and install a cover to prevent any dust or dirt from entering after removal.

- **Precautions when handling piping during disassembling**

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

A. Hoses and tubes using sleeve nuts

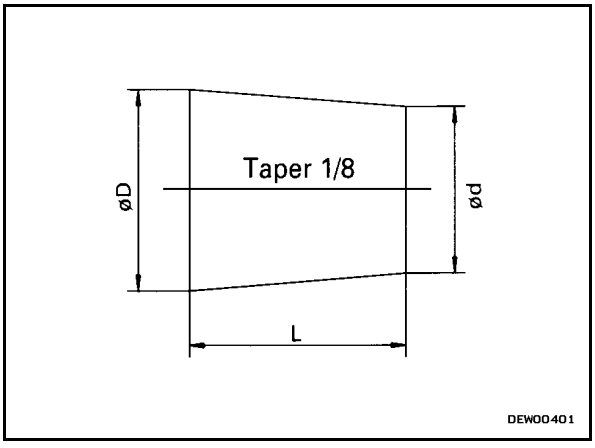
Nominal number	Plug (nut end)	Sleeve nut (elbow end) Use the two items below as a set
02	07376-50210	07221-20210 (Nut), 07222-00210 (Plug)
03	07376-50315	07221-20315 (Nut), 07222-00312 (Plug)
04	07376-50422	07221-20422 (Nut), 07222-00414 (Plug)
05	07376-50522	07221-20522 (Nut), 07222-00515 (Plug)
06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

B. Split flange type hoses and tubes

Nominal number	Flange (hose end)	Sleeve head (tube end)	Split flange
04	07379-00400	07378-10400	07371-30400
05	07379-00500	07378-10500	07371-30500

C. If the part is not under hydraulic pressure, the following corks can be used:

Nominal number	Part Number	Dimensions		
		D	d	L
06	07049-00608	6	5	8
08	07049-00811	8	6.5	11
10	07049-01012	10	8.5	12
12	07049-01215	12	10	15
14	07049-01418	14	11.5	18
16	07049-01620	16	13.5	20
18	07049-01822	18	15	22
20	07049-02025	20	17	25
22	07049-02228	22	18.5	28
24	07049-02430	24	20	30
27	07049-02734	27	22.5	34



2. Precautions when carrying out installation work
   - ✗ Tighten all bolts and nuts (sleeve nuts) to the specified (KES) torque.
   - ✗ Install the hoses without twisting or interference.
   - ✗ Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
   - ✗ Bend the cotter pin or lock plate securely.
   - ✗ When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with two or three drops of adhesive.
   - ✗ When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
   - ✗ Clean all parts, and correct any damage, dents, burrs, or rust.
   - ✗ Coat rotating parts and sliding parts with engine oil.
   - ✗ When press-fitting parts, coat the surface with anti-friction compound (LM-P).
   - ✗ After installing snap rings, check that the snap ring is installed securely in the ring groove.
   - ✗ When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
   - ✗ When using eye bolts, check that there is no deformation or deterioration, screw them in fully, and align the direction of the hook.
   - ✗ When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.

✗ When operating the hydraulic cylinders for the first time after reassembling cylinders, pumps and other hydraulic equipment removed for repair, bleed the air as follows:

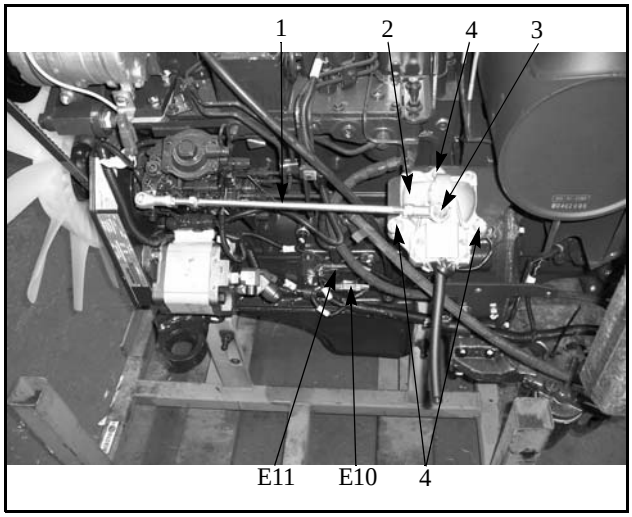
1) Start the engine and run it at low idle.
2) Operate the work equipment control lever to operate the hydraulic cylinders, 4 - 5 times, stopping the cylinders 100 mm from the end of their stroke.
3) Next operate the hydraulic cylinder 3 - 4 times to the end of its stroke.
4) After doing this run the engine at normal speed.

➽ When using the machine for the first time after repair or long storage, follow the same procedure.

3. Precautions when completing the operations
   - ✗ If the engine coolant water has been drained, tighten the drain valve, and add coolant water to the specified level. Run the engine to circulate the coolant water through the system. Then check the coolant water level again.
   - ✗ If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
   - ✗ If the piping or hydraulic equipment, have been removed for repair, Bleed the air from the system after reassembling the parts.
   - ➽ For details, see TESTING AND ADJUSTING, Bleeding air.
   - ✗ Add the specified amount of grease (molybdenum disulphide grease) to the work equipment related parts.

REMOVAL AND INSTALLATION OF GOVERNOR MOTOR ASSEMBLY

REMOVAL



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

1. Open engine hood and disconnect governor motor electrical connectors E10 and E11.
2. Disconnect rod (1) from governor motor (2) by removing rod locking nut (3).
3. Remove governor motor assembly (2) by removing the three securing bolts (4). ※1

INSTALLATION OF GOVERNOR MOTOR ASSEMBLY

✔ Carry out installation in the reverse order to removal.

✔ When installing the governor motor, rotate the shaft by hand to the correct orientation -
Do not stop the rod rotation suddenly.

※1

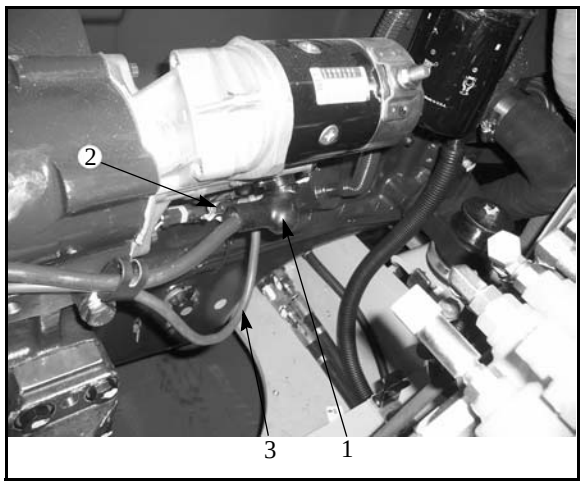
✔ Adjust the rod. For details, see TESTING AND ADJUSTING, Testing and adjusting of governor motor lever stroke.

REMOVAL AND INSTALLATION OF STARTING MOTOR ASSEMBLY

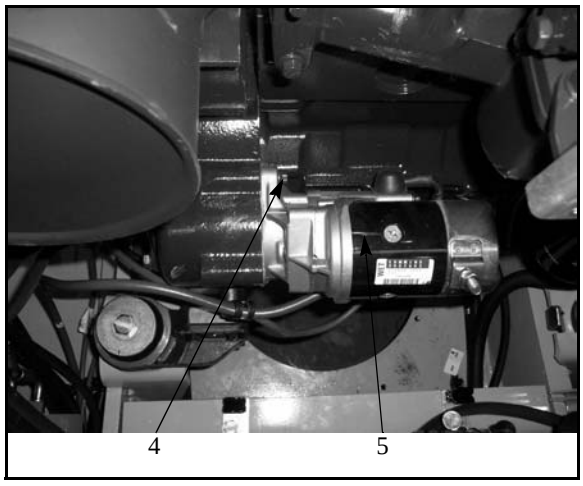
REMOVAL

⚠ 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)

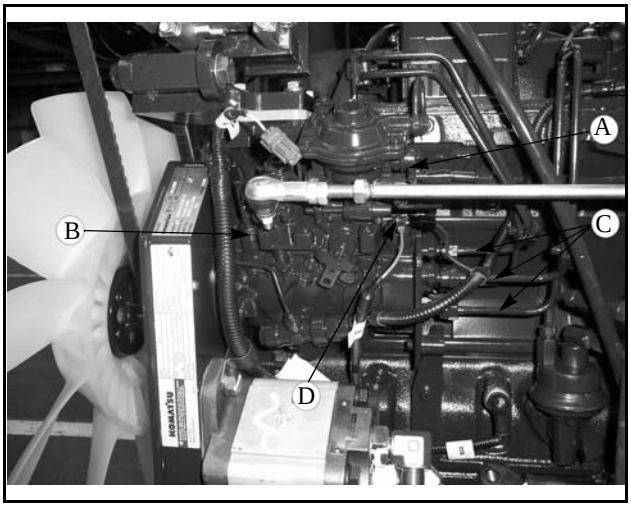
REMOVAL AND INSTALLATION OF ASSEMBLY FUEL INJECTION PUMP

SPECIAL TOOLS

Mark	Part No.	Part Name	Neces-sity	Qty	Distinc-tion*	Sketch
A	795-799-1390	Puller	n	1		

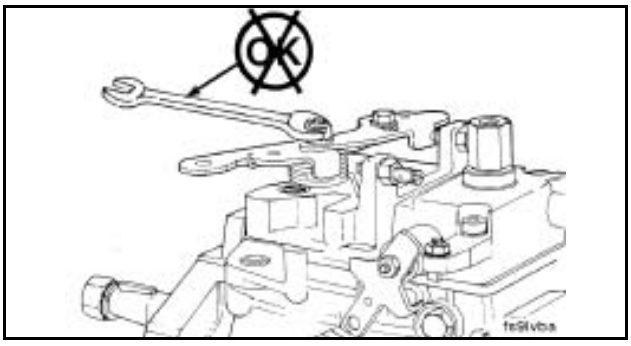
*Distinction between new and existing part.

- ✔ Disconnect the fuel drain manifold. (A)
- ✔ Remove the injection pump supply. (B)
- ✔ Remove the high-pressure lines. (C)
- ✔ Disconnect the electrical wire to the fuel shutoff valve. (D)



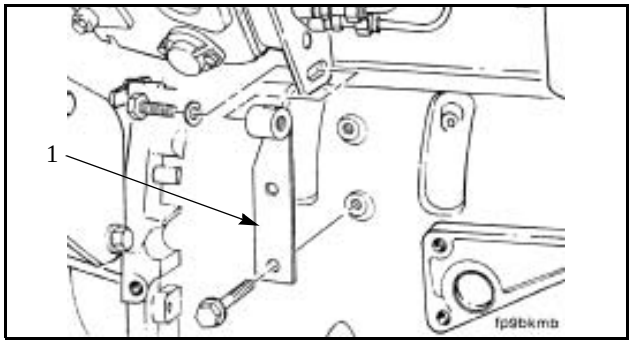
REMOVAL

WARNING! Do not remove the control lever. The fuel control lever on the fuel injection pump is indexed to the shaft during pump calibration. If the lever has been removed and reinstalled incorrectly, engine speed and power will be affected.

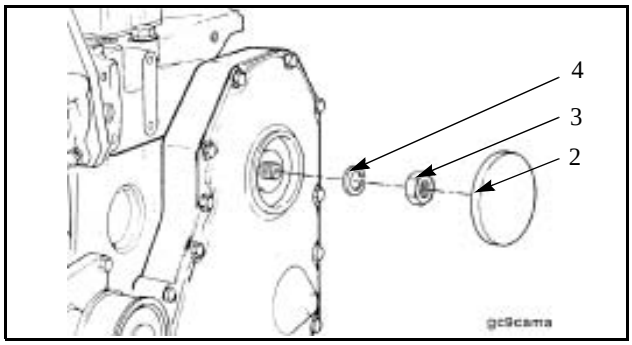


1. Disconnect all control linkage. Refer to OEM service manual.

2. Remove the pump support bracket (1).

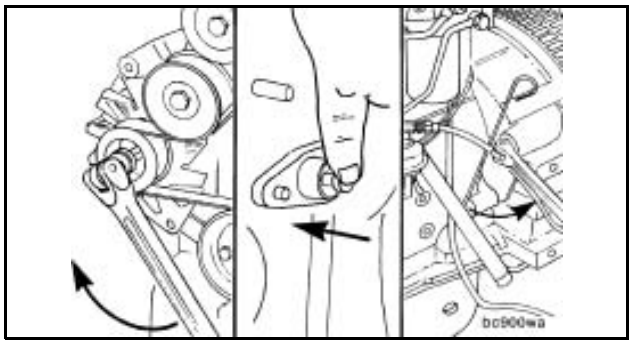


3. Remove the access cap (2), gear retaining nut (3) and washer (4).



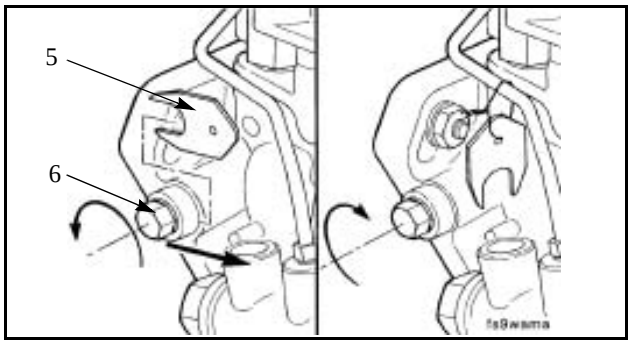
4. Locate top dead centre (TDC) for cylinder No.1 by barring engine slowly while pushing in on TDC pin.
   See “INSPECTION AND ADJUSTMENT OF FUEL INJECTION TIMING<$paranumonly>-20 - 111

   Note: Be sure to disengage the pin after locating TDC.

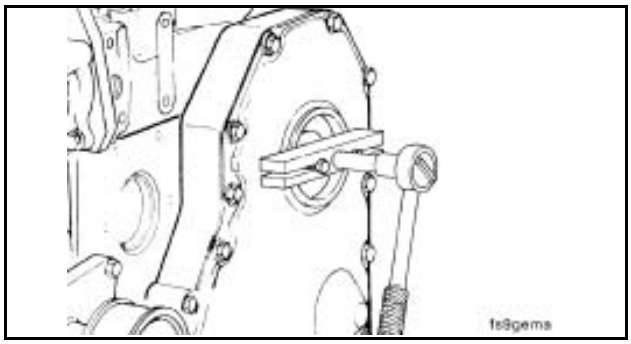


5. The special washer (5) on the fuel injection pump must be removed so the lock screw (6) can be tightened against the driveshaft.

N•m Torque value: 30Nm

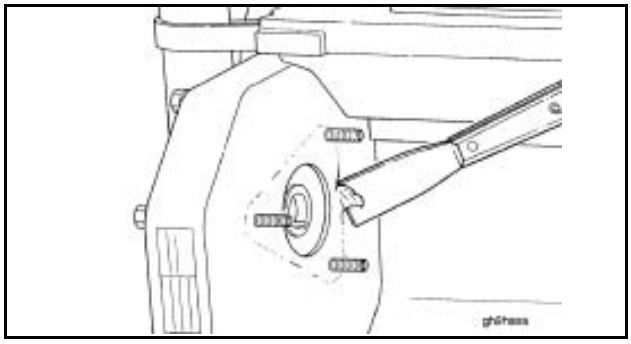


6. Pull the fuel injection pump drive gear loose from the pump driveshaft.



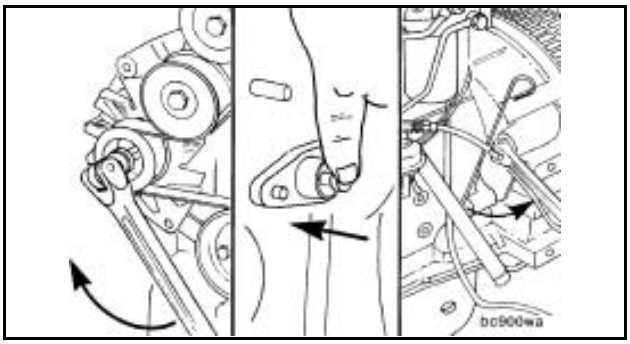
7. Remove the 3 mounting nuts, and take off the fuel injection pump.

8. Remove the gasket, and clean the surface.

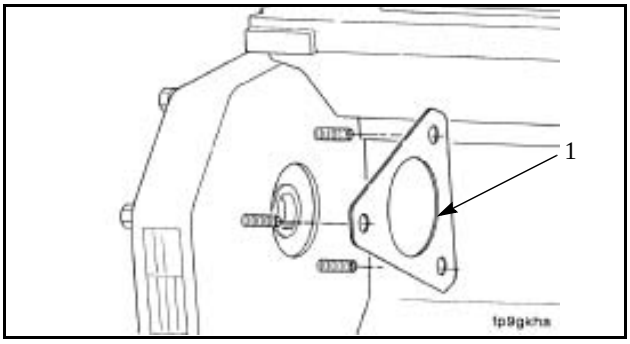


Installation

1. Verify cylinder No.1 is at TDC by barring engine slowly while pushing in on TDC pin.
   See “INSPECTION AND ADJUSTMENT OF FUEL INJECTION TIMING<$paranumonly>-20 - 111

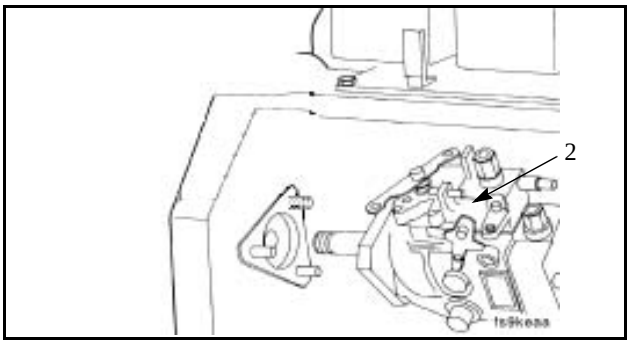


2. Install a new gasket (1).



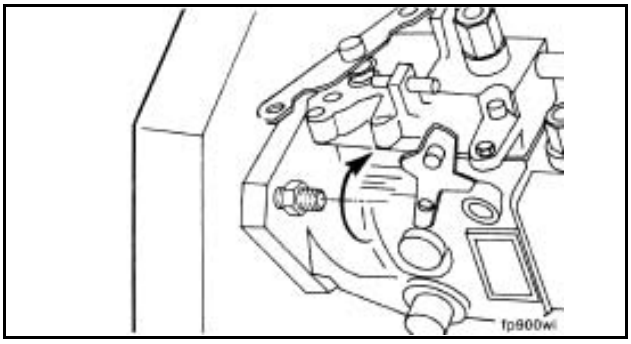
WARNING! The driveshaft must be clean and free of all oil before installation. Failure to make certain the driveshaft is free of oil can result in the drive gear slipping on the shaft.

3. Install the pump (2).



4. Use your hands to tighten the 3 mounting nuts.

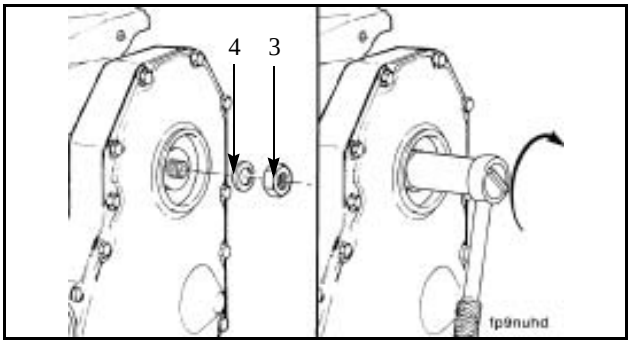
Note: Fuel pumps on engines designed to meet Tier 2 industrial emissions levels have straight holes (not kidney slots) and do not use a timing key.



WARNING! Be sure the timing pin is disengaged before the final torque step to avoid damage to the timing pin.

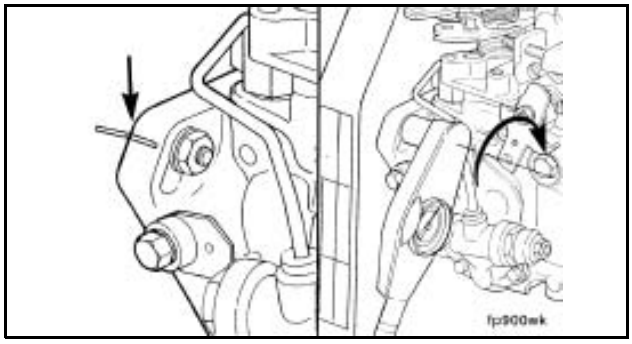
5. Install the pump driveshaft nut (3) and rotate washer (4). The pump will rotate slightly because of gear helix and clearance. This is acceptable provided the pump is free to move on the flange slots and the crankshaft does not move.

N•m Torque value: 15 - 20Nm



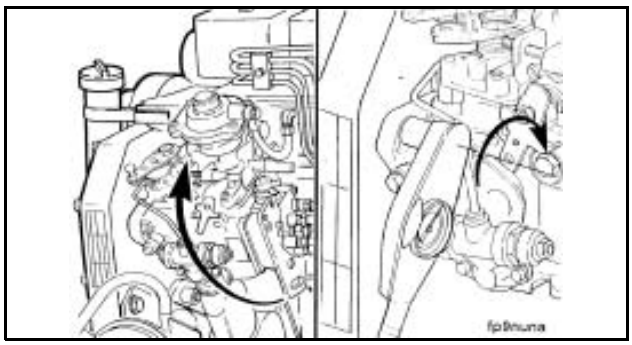
6. If installing the original pump, rotate the pump to align the scribe marks.

N•m Torque value: 24Nm

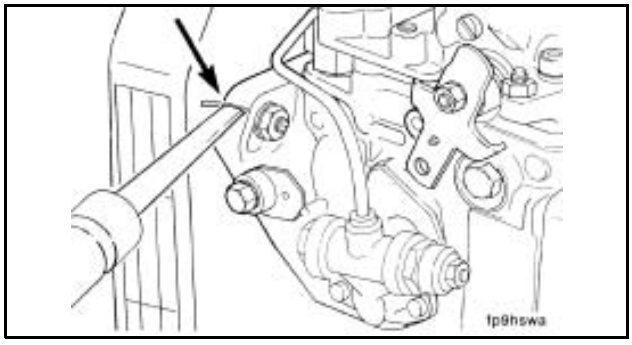


7. If installing a new or rebuilt pump without scribe marks, take up gear lash by rotating the pump against the direction of drive rotation. Tighten the flange mounting nuts.

N•m Torque value: 24Nm

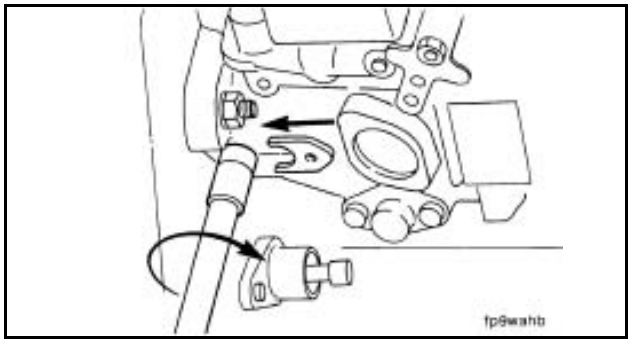


8. Permanently mark the injection pump flange to match the mark on the gear housing.

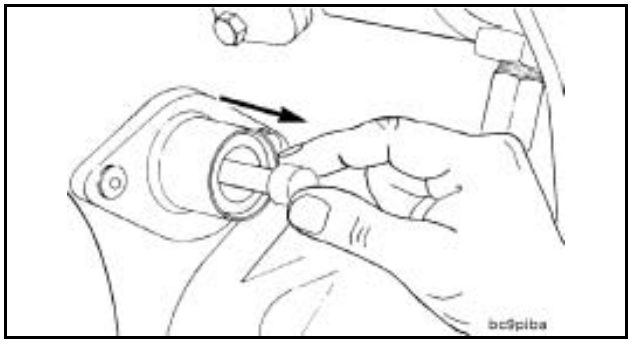


9. The special washer is wired to the pump and must be installed under the lockscrew.

N·m Torque value: 13Nm

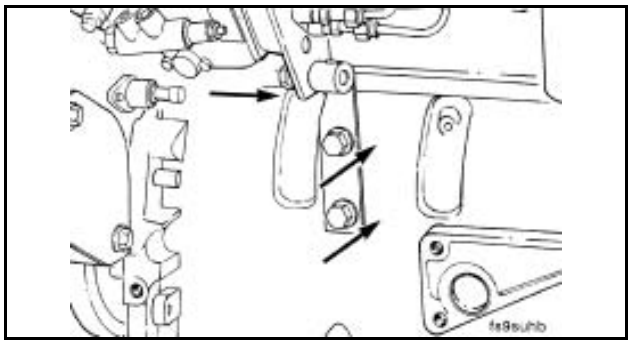


10. Disengage the timing pin before rotating the crankshaft.

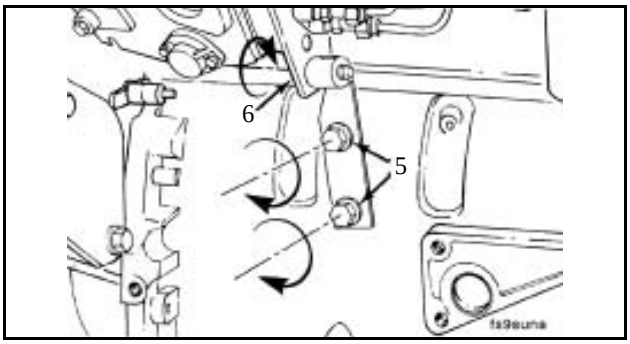


11. Install the injection pump support bracket. Finger-tighten all capscrews before final tightening.

Note: Tighten the bracket to block mounting capscrew before tightening the bracket to injection pump capscrews.

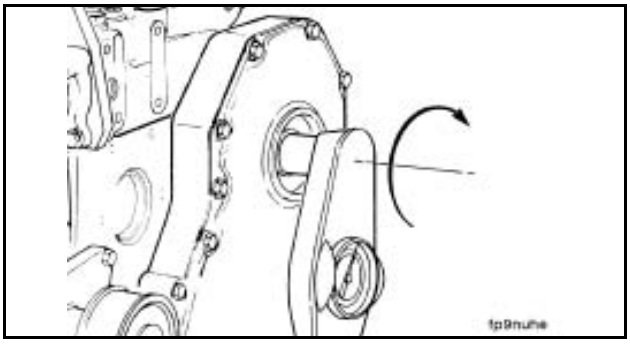


12. Tighten the bracket capscrews to the cylinder block (5).
Tighten the tail support bracket capscrew to the fuel pump (6).

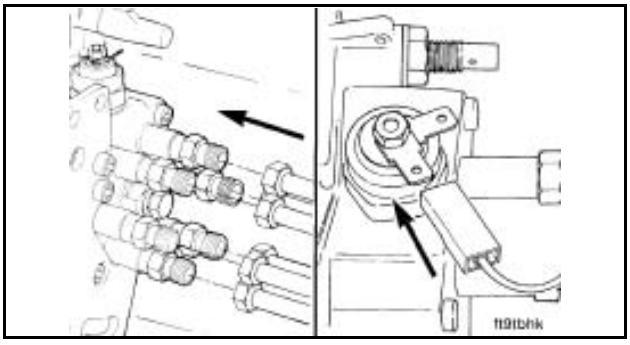


13. Tighten the pump retaining nut.

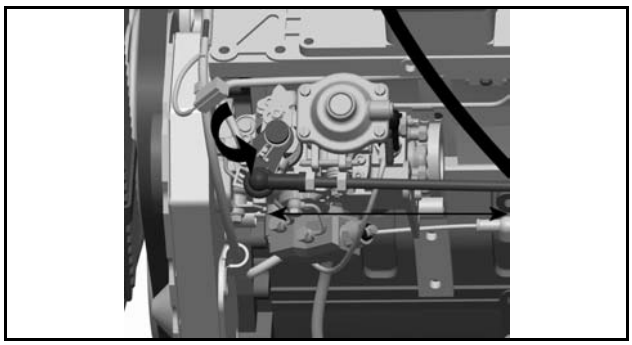
N·m Tightening torque:
M14x1.5 nut: 98Nm
M12 nut: 93Nm



14. Install all high-pressure fuel lines and the electrical wire to the fuel shutoff valve.
Install drain manifold fitting and reconnect drain tube.



15. When connecting the rod to the control lever, adjust the length so the lever has stop-to-stop movement.
    See “Function for Governor Motor Adjustment” on page 20-181.



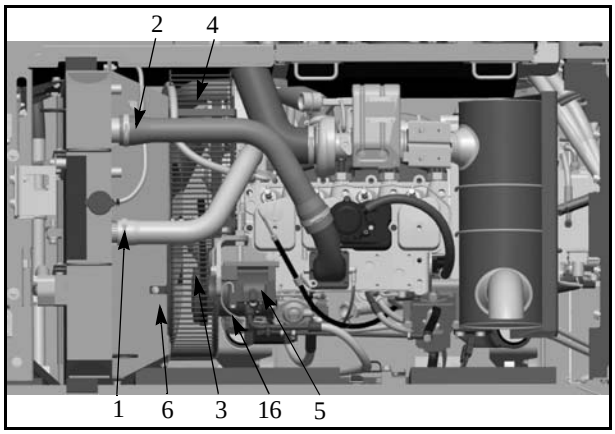
16. Bleed air from the fuel system and reinstall fan guard as initial machine condition.

REMOVAL AND INSTALLATION OF ENGINE FRONT SEAL

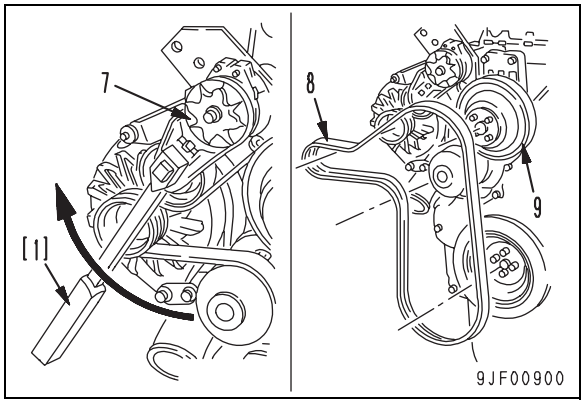
Removal

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

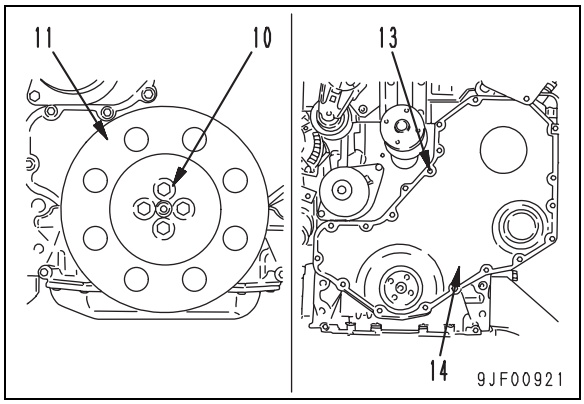
1. Drain the coolant.
   ✔ Drain the coolant to a degree that it will not leak when hose (1) is disconnected.
2. Remove hoses (1) and (2).
3. Remove fan guards (3) and (4).
4. Remove air conditioner compressor belt.[*1]
5. Disconnect connector E06 (16) and remove air conditioner compressor (5) and bracket and move them toward the counterweight.
   ✔ Do not separate the air conditioner piping.
6. Remove fan shroud (6).
   ✔ Take care that the fan shroud will not interfere with the other parts.
7. Remove the cooling fan.

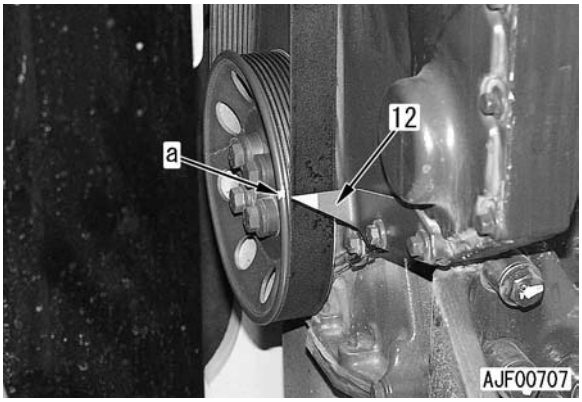


8. Install lever [1] to tensioner (7) and move the lever in the direction of the arrow to remove fan belt (8).
   ✔ Take care not to catch your hands between the tensioner and pulley.
9. Remove fan pulley (9).

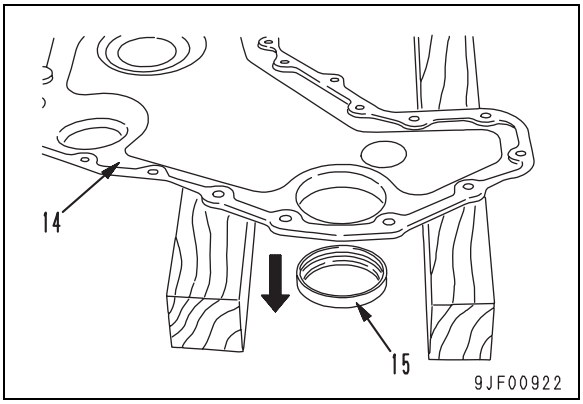


10. Remove 4 mounting bolts (10) and crank pulley (11). [*2]
    ➽ Remove the crank pulley with its timing mark (a) matched to pointer (12) or make match marks on the crank pulley and front cover so that you can position the crank pulley correctly when installing it.
11. Remove 20 mounting bolts (13) and front cover (14). [*3]





12. Remove engine front seal (15) from front cover (14). [*4]



Installation

✔ Carry out installation in the reverse order to removal.

[*1]

- Install the air conditioner compressor belt. For details, see TESTING AND ADJUSTING, Inspection and adjustment of air compressor belt tension.

[*2]

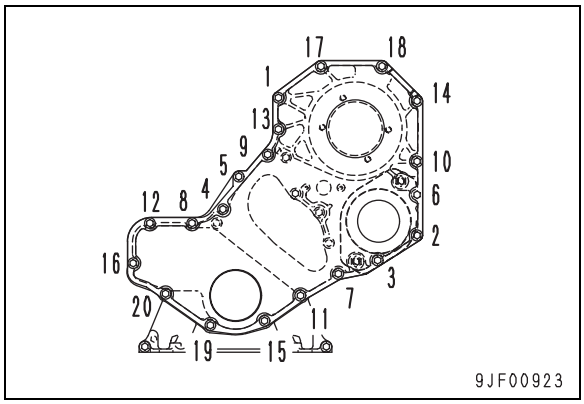
- Install the belt to the position from which it was removed.
- Install the crank pulley temporarily and fan belt, and then tighten the mounting bolts to the specified torque.

N•m Mounting bolt:
125 ± 5 Nm {12.75 ± 0.51 kgm}

[*3]

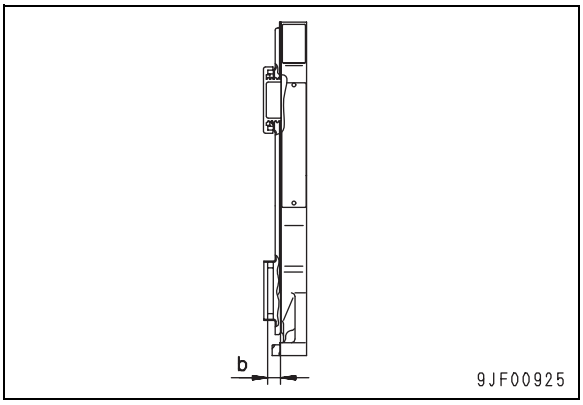
- Apply ThreeBond 1207D or equivalent in the form of a continuous string 1 – 2 mm thick to the fitting face of the front cover.
- Install the gasket to the front cover, and then install them to the engine.
- Tighten the mounting bolts in the following order.

N•m Mounting bolt:
24 ± 4 Nm {2.45 ± 0.41 kgm}



[*4]

- Using the push tool, install so that dimension **b** will be as follows.
  - Dimension **b**: **21 ± 0.38 mm**

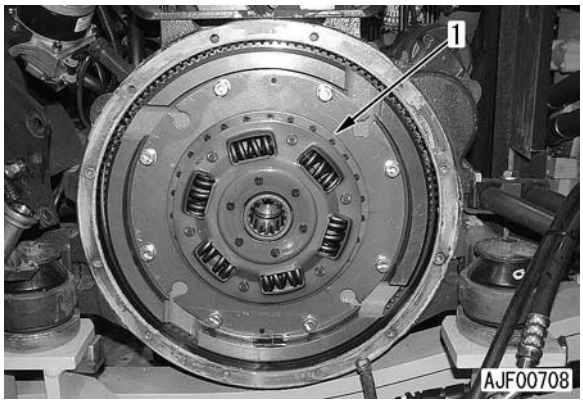


REMOVAL AND INSTALLATION OF ENGINE REAR SEAL

Removal

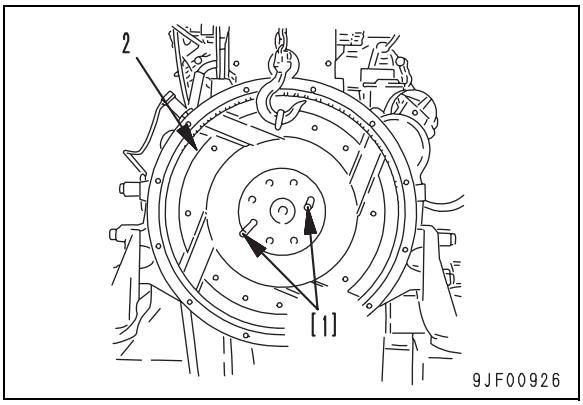
1. Remove the hydraulic pump assembly. For details, see Removal and installation of hydraulic pump assembly.

2. Remove damper assembly (1).



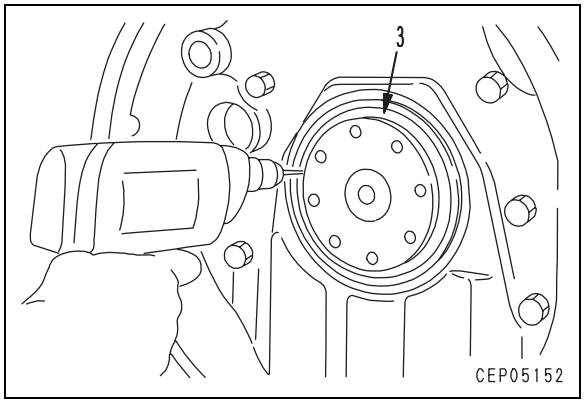
3. Set guide bolts [1] and lift off flywheel assembly (2). [*1]

   - Flywheel assembly: **25 kg**

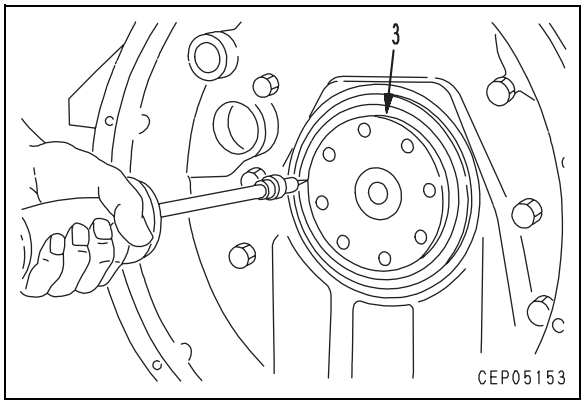


4. Remove engine rear seal (3). [*2]
   - Break the seal carrier with a screwdriver, etc. to remove the seal.
   - Take care not to damage the other parts.
   - The engine rear seal may be removed according to the following procedure.

   1) Make a hole about 3 mm in diameter on the seal with a drill.



   2) Attach a dent puller to a slide hammer and insert the hammer into the drilled hole. Then pull out seal (3) by sliding the hammer.



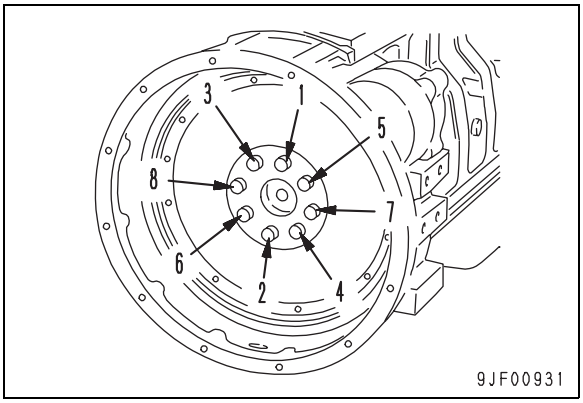
Installation

✔ Carry out installation in the reverse order to removal.

[*1]

➧ Tighten the mounting bolts in the following numerical order.

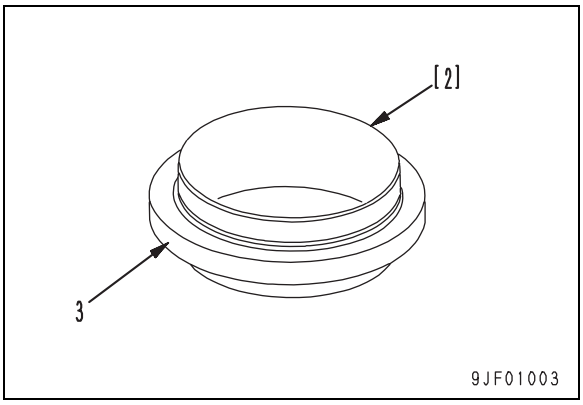
N·m Mounting bolt:
137 ± 7 Nm {13.97 ± 0.71 kgm}



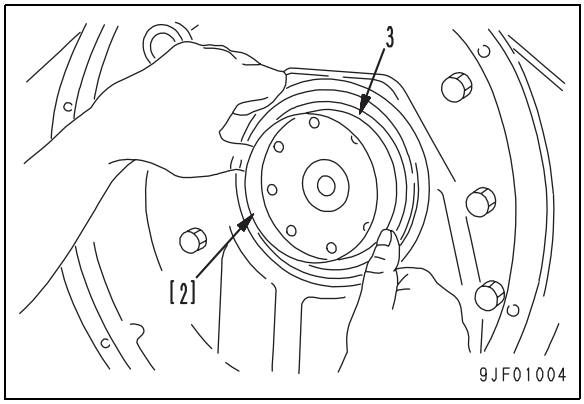
[*2]

➧ Install the engine rear seal according to the following procedure.

1. Install pilot [2] to new engine rear seal (3).
   ➧ Before installing the engine rear seal, degrease and dry the seal contact surface of the crankshaft and the lip surface of the seal to prevent oil leakage.

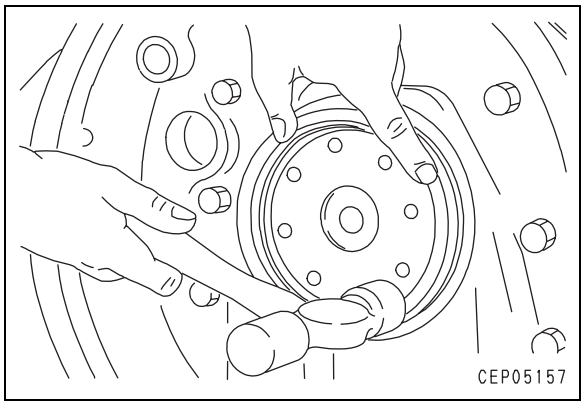


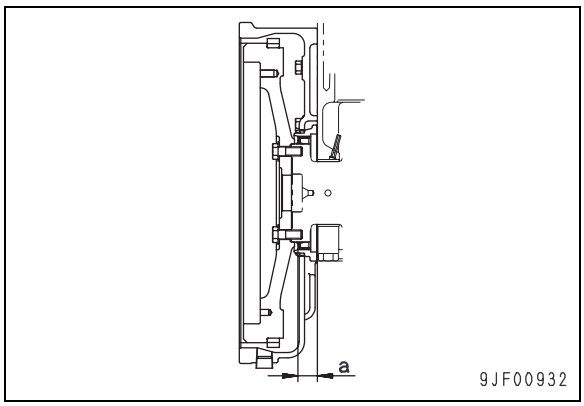
2. Install pilot [2] fitted with engine rear seal (3) in the crankshaft.



3. Pull out pilot [2].

4. Using the push tool, set the engine rear seal so that dimension "a" will be the following value.
   ✔ Dimension **a**: **25.8 mm**
   ➧ Lightly hit the top, bottom, right, and left of the push tool with a hammer to push in the seal, taking care that the seal carrier will not be bent.





REMOVAL AND INSTALLATION OF CYLINDER HEAD ASSEMBLY

SPECIAL TOOLS

Symbol		Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
A	2	795-799-1171	Puller	t	1		
	3	790-331-1110	Wrench	t	1		

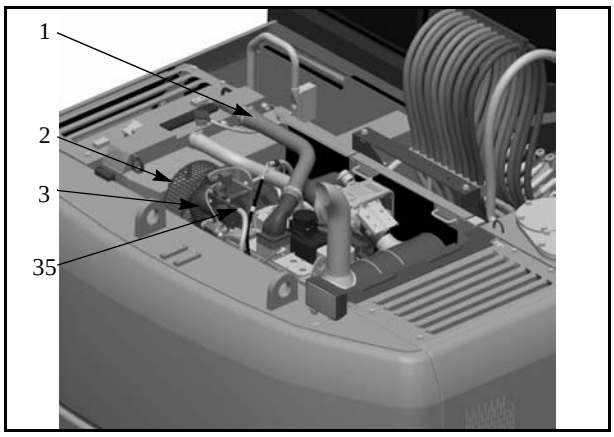
REMOVAL

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

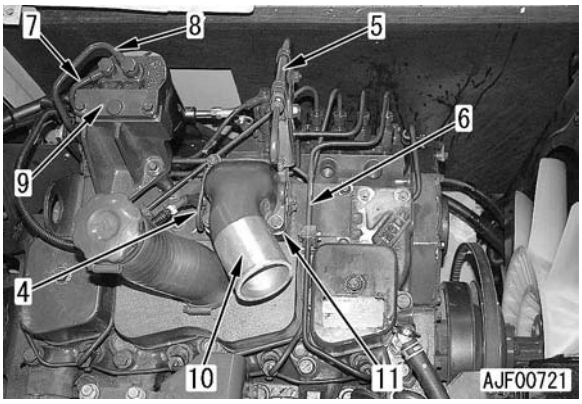
1. Drain the coolant.

Engine cooling water: Approx. 16.2 l

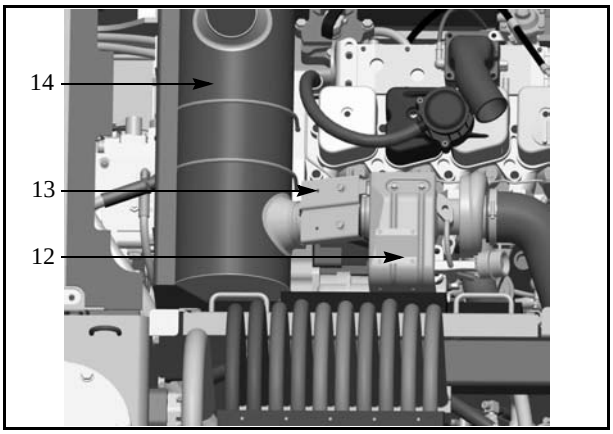
2. Close the fuel stop valve.
3. Open the engine hood.
4. Disconnect hose (1) from the engine. [*1]
5. Remove fan guard (2).
6. Remove the air conditioner compressor belt.[*2]
7. Disconnect connector E06 (35), and then remove air conditioner compressor (3) and bracket and move them toward the counter-weight.
   ➧ Do not separate the air conditioner piping.



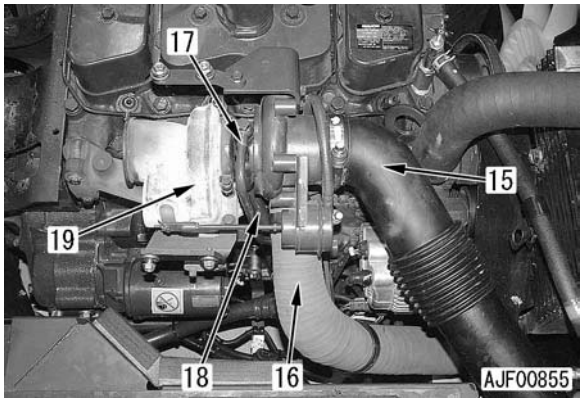
8. Disconnect terminal E01 (4) - Grid heater.
9. Remove the bracket mounting bolts of engine oil level gauge guide (5) and move the level gauge guide.
10. Remove 4 delivery tubes (6).
11. Remove tubes (7) and (8) between fuel filter and fuel injection pump.
12. Remove bracket (9) and fuel filter as a unit. [*3]
13. Remove air intake connector (10) and ribbon heater (11). [*4]
    ➧ Cover the openings with adhesive tapes, etc. to prevent foreign matter from entering the engine.



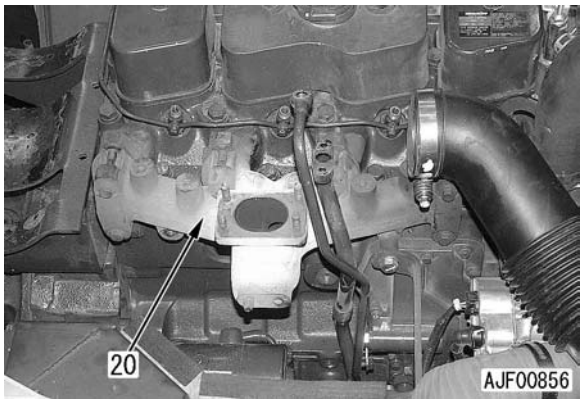
14. Remove heat insulation covers (12) and (13).
15. Remove muffler (14). [*5]



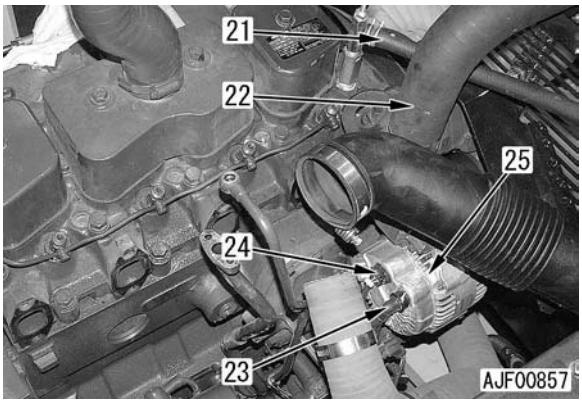
16. Disconnect hoses (15) and (16). [*6]
17. Disconnect tubes (17) and (18). [*7]
18. Remove turbocharger assembly (19). [*8]



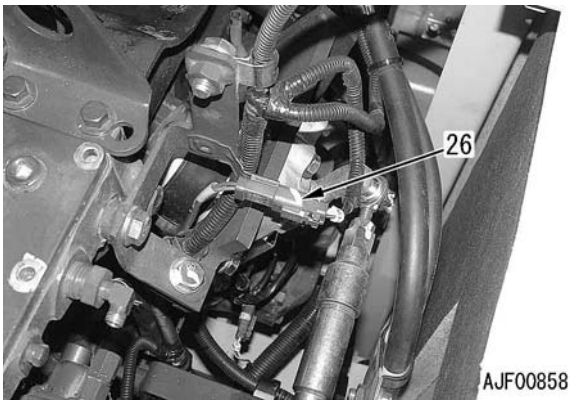
19. Remove exhaust manifold (20). [*9]



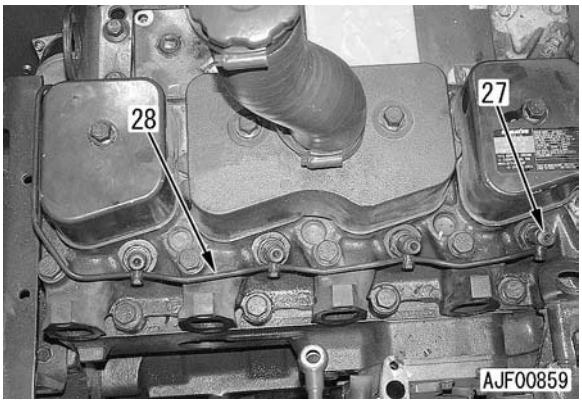
20. Referring to REMOVAL AND INSTALLATION OF ENGINE FRONT SEAL, Removal procedure steps 2 – 9, remove the cooling fan pulley.
21. Remove the tensioner.
22. Disconnect hoses (21) and (22). [*10]
23. Disconnect terminal B (23) and connector E12 (24).
24. Remove alternator (25) and bracket.



25. Disconnect connector E05 (26) in the rear of the left of the engine.

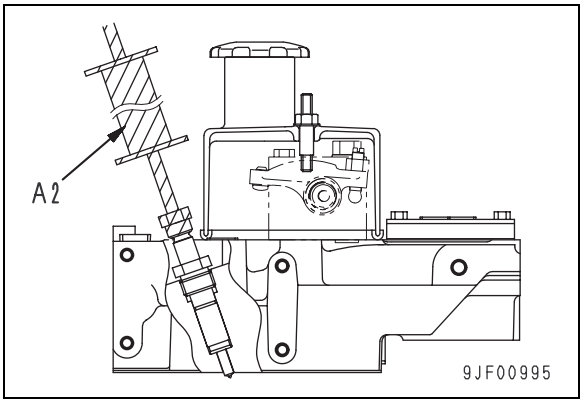


26. Disconnect spill tube (28).
27. Remove 4 nozzle holder assemblies (27).

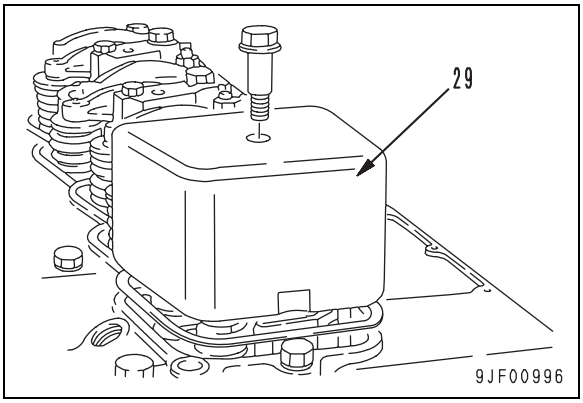


➢ If it is difficult to pull the nozzle holder assemblies out of the cylinder head, use tool **A2**.

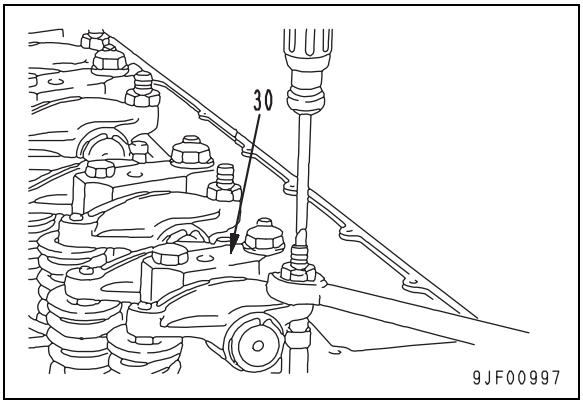
➤ Cover the nozzle holder assembly mounting parts to prevent foreign matter from entering the engine.



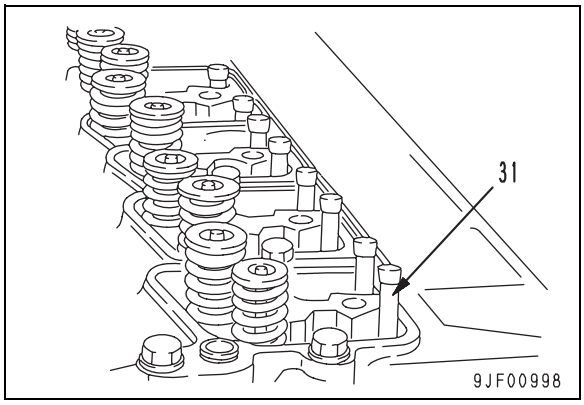
28. Remove head cover (29). [*11]



29. Remove rocker arm assemblies (30). [*12]
    ➤ Loosen the locknut and loosen the adjustment screw of each rocker arm 2 – 3 turns.



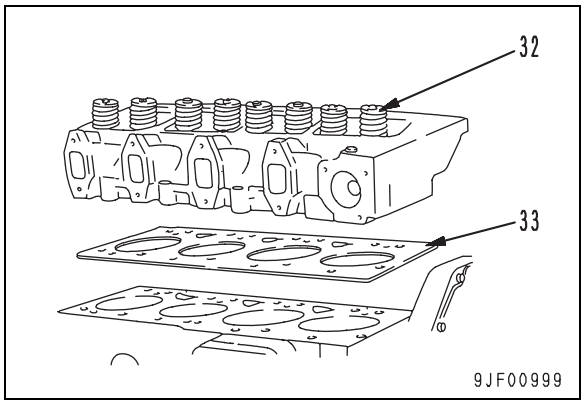
30. Remove push rods (31). [*13]



31. Lift off cylinder head assembly (32). [*14]

    Cylinder head assembly: **40 kg**

32. Remove cylinder head gasket (33).



INSTALLATION

✔ Carry out installation in the reverse order to removal.

[*1]

N·m Hose clamp:
1st time: 10.8 ± 1 Nm {1.1 ± 0.1 kgm}
2nd time: 10.8 ± 1 Nm {1.1 ± 0.1 kgm}

[*2]

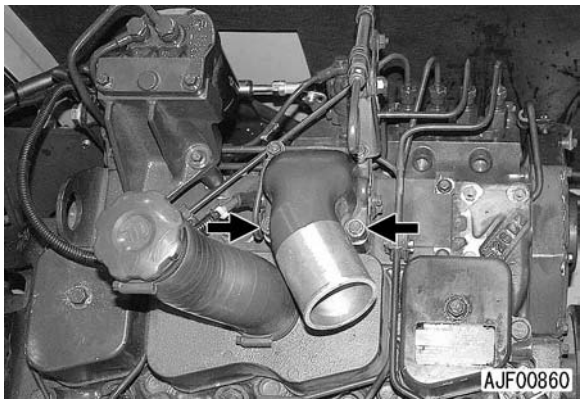
➤ Install the air conditioner compressor belt. For details, see TESTING AND ADJUSTING, Inspection and adjustment of air compressor belt tension.

[*3]

➤ Apply gasket sealant to the threads of the bolt (only 1 piece) on the head cover side among the 3 fuel filter bracket mounting bolts.

[*4]

➤ Apply gasket sealant to the threads of only the 2 of the air intake connector mounting bolts indicated by the arrows in the following figure



[*5]

➤ When connecting the exhaust pipe to under the muffler, apply thermosetting sealant (Firegum manufactured by Nihon Holts Co., Ltd. or equivalent) all round the pipe end.

N·m Clamp nut of muffler U-bolt:
9.8 – 14.7 Nm {1.0 – 1.5 kgm}

[*6]

N·m Clamp of hose (15):
10.0 – 11.0 Nm {1.02 – 1.12 kgm}

N·m Clamp of hose (16):
1st time: 10.8 ± 1 Nm {1.1 ± 0.1 kgm}
2nd time: 10.8 ± 1 Nm {1.1 ± 0.1 kgm}

N·m Tube (17):
Turbocharger side:
10.3 ± 1.2 Nm {1.1 ± 0.1 kgm}
Cylinder block side:
35 ± 5 Nm {3.6 ± 0.5 kgm}

N·m Tube (18):10 ± 2 Nm {1.0 ± 0.2 kgm}

N·m Mounting nut: 24 ± 4 Nm {2.4 ± 0.4 kgm}

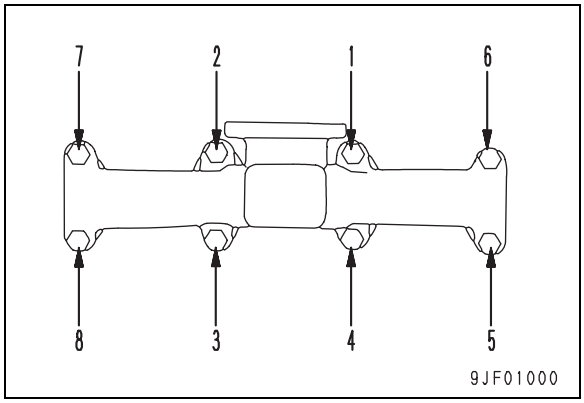
[*8]

N·m Mounting nut: 24 ± 4 Nm {2.4 ± 0.4 kgm}

[*9]

➤ Tighten the mounting bolts in the following numerical order.

N·m Mounting bolt:
1st time: Tighten all the bolts to:
43 ± 6 Nm {4.38 ± 0.61 kgm}.
2nd time: Tighten only bolts 1 – 4 to:
43 ± 6 Nm {4.38 ± 0.61 kgm}



[*10]

N·m Clamp of hose (22):
8.8 ± 0.5 Nm {0.9 ± 0.05 kgm}

[*11]

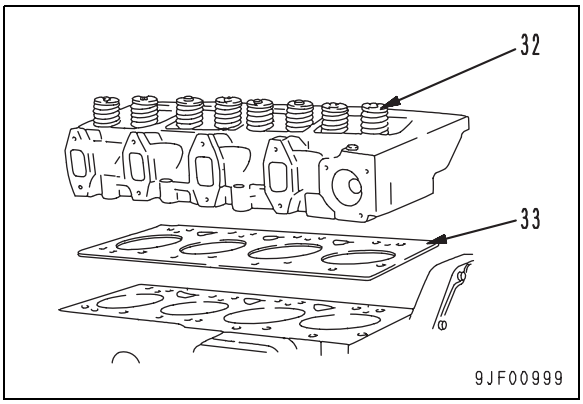
N·m Mounting bolt:
24 ± 4 Nm {2.45 ± 0.41 kgm}

[*12] [*13] [*14]

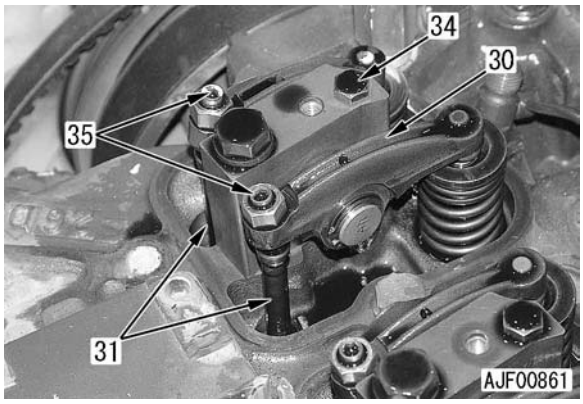
- Install the rocker arm assembly and cylinder head assembly according to the following procedure.
- Check that there is not foreign matter on the cylinder head mounting face and in the cylinder.

1) Set cylinder head gasket (33) to the cylinder block.
   - ✔ Check that the gasket is matched to the holes of the block.

2) Sling cylinder head assembly (32) and set it to the cylinder block.



3) Install push rods (31).
4) Install rocker arm assemblies (30) and tighten mounting bolts (34) with the fingers.
   - ✔ Check that the balls of adjustment screws (35) are fitted to the sockets of push rods (31).

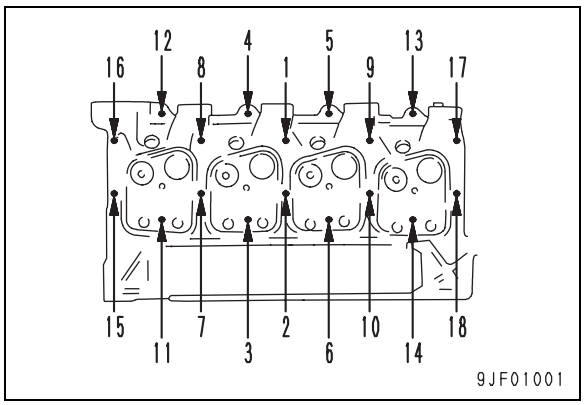


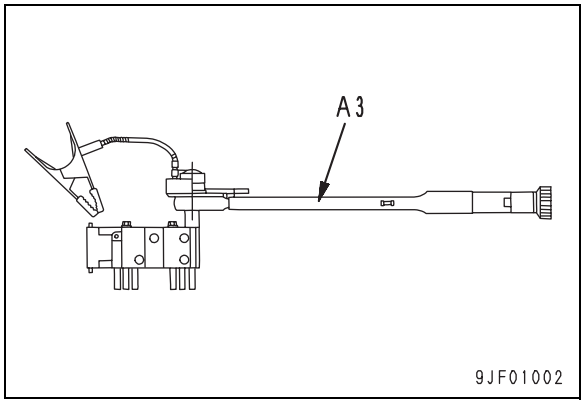
5) Tighten the cylinder head bolts in the following numerical order in 3 times.

Threads and seat of mounting bolt:
Engine oil (SAE15W-40)

N·m Cylinder head bolt:
1st time: Tighten all the bolts to:
90 ± 5 Nm {9.18 ± 0.51 kgm} in the numerical order shown in the figure.
2nd time: Tighten bolts 3, 6, 11, and 14 to:
120 ± 5 Nm {12.24 ± 0.51 kgm} in order.
3rd time: Using tool **A3**, tighten all the bolts by 90° ± 5° in the numerical order shown in the figure. (Angle tightening)

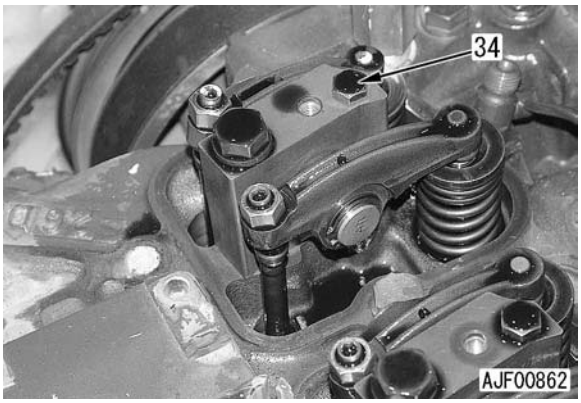
- ✔ When not using tool **A3**, make marks on the bolts and cylinder head, and then tighten each bolt by the above angle.





6) Tighten rocker arm assembly mounting bolts (34) permanently.

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



7) Adjust the valve clearance. For details, see TESTING AND ADJUSTING, Adjustment of valve clearance.

✔ Refilling with water

Add water to the specified level. Run the engine to circulate the water through the system. Then, check the water level again.

Cooling water: Approx. 16.2 l

✔ Bleeding air

Bleed air from the fuel piping. For details, see REMOVAL AND INSTALLATION OF FUEL INJECTION PUMP ASSEMBLY.

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.

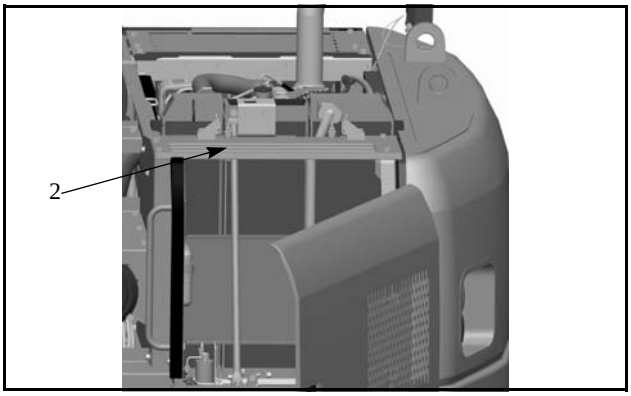
- ✔ Remove the hydraulic tank strainer, and using tool B stop the oil.
- ✔ When not using tool B, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

1. Drain the engine cooling water.

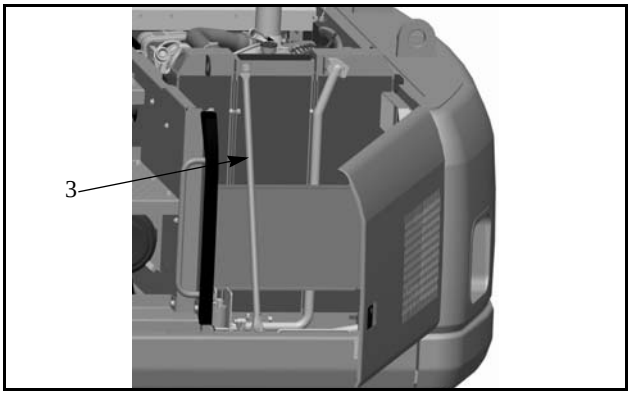
Engine cooling water: Approx. 16.2 l

2. Open up the engine hood and remove (see page 30- 30).

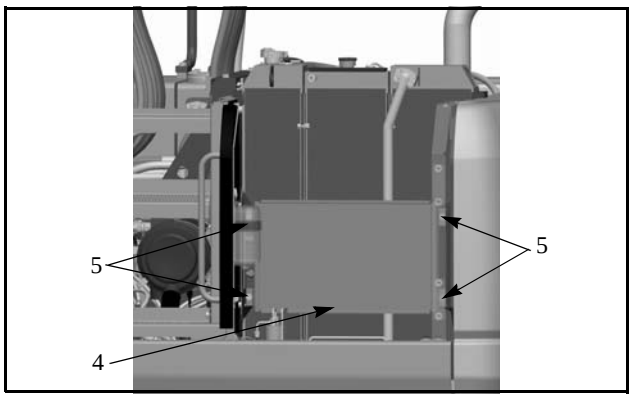
3. Remove cover (2).



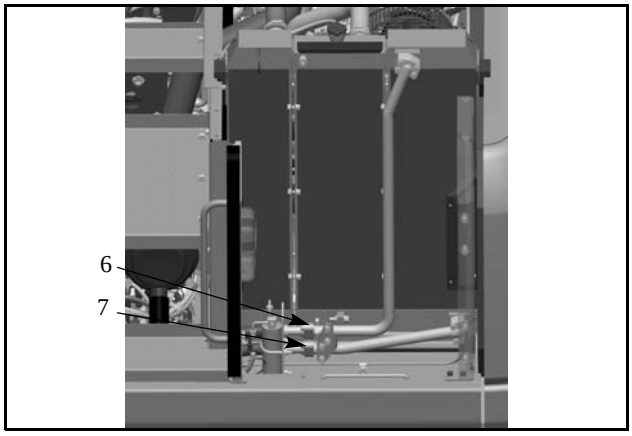
4. Remove support (3).



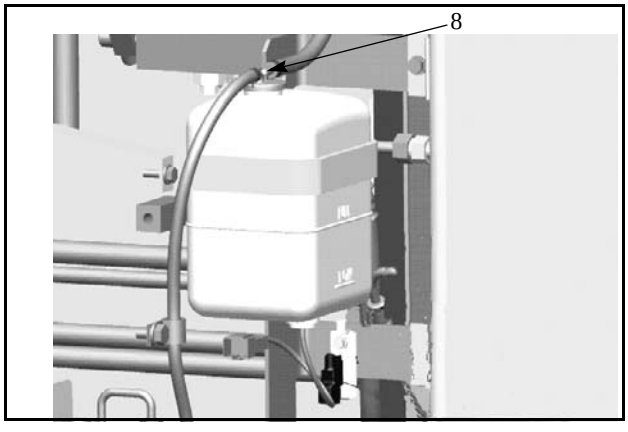
5. Remove condenser (4) by removing 4 bolts (5).



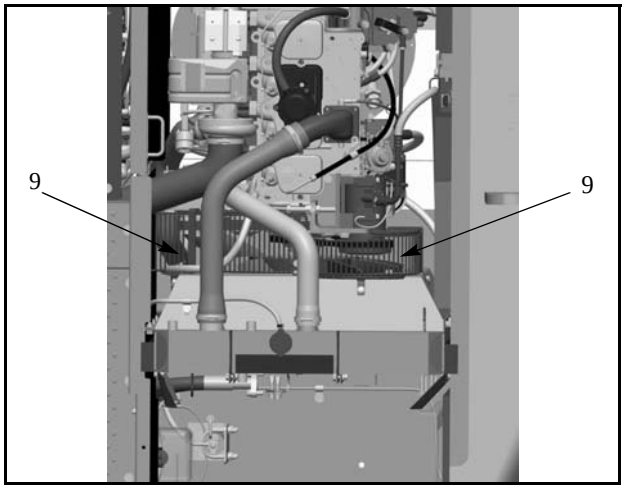
6. Disconnect oil cooler inlet (6) and outlet (7) hoses.



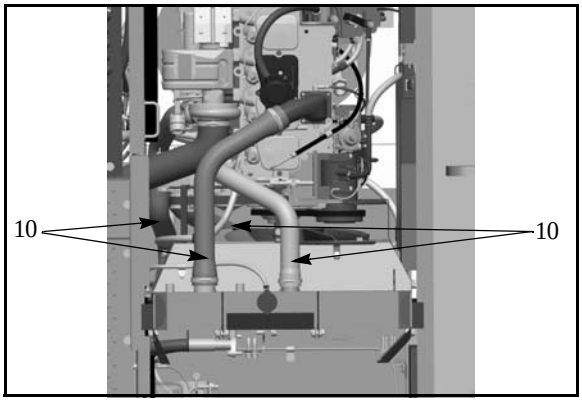
7. Disconnect reservoir tank (8).



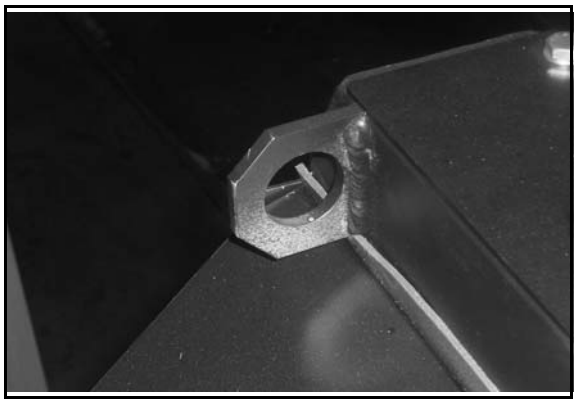
8. Remove guards (9).
.



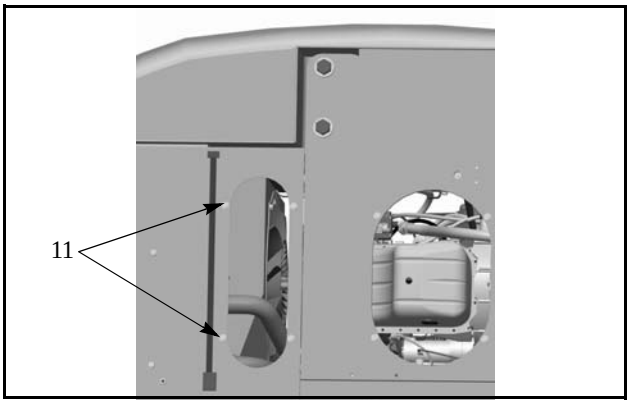
9. Remove 4 hoses (10).



10. Sling radiator assembly with two lifting hooks.



11. Remove two mounting bolts (11) and lift radiator assembly out.

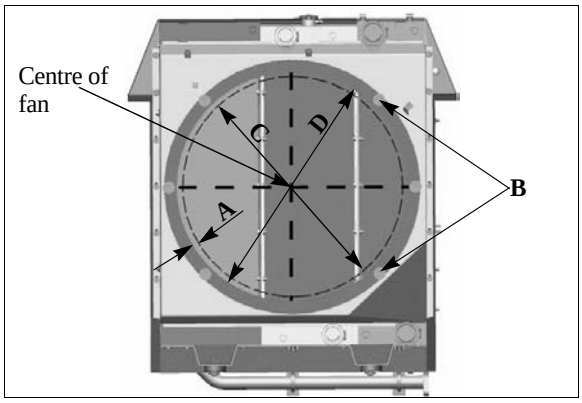


INSTALLATION

✔ Install in reverse order of removal.

N•m 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. 16.2 **l**

REMOVAL AND INSTALLATION OF ENGINE AND HYDRAULIC PUMP ASSEMBLIES

SPECIAL TOOLS

Mark	Part No.	Part Name	Necessity	Qty	Distinction*	Sketch
D	796-460-1210	Oil Stopper	■	1		

*Distinction between new and existing part.

REMOVAL

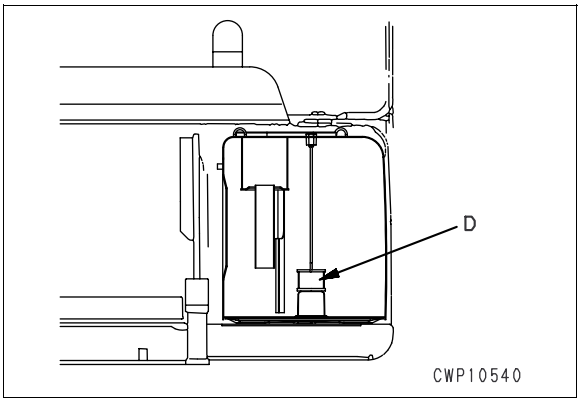
Lower the work equipment to the ground for safety and stop the engine. Disconnect the cable from the negative terminal (-) of the battery.

To release the internal pressure, gradually loosen the oil filler cap on the hydraulic tank.

✕ Attach an identification tag to each pipe. This will avoid a possible mistake when reinstalling.

1. Remove the hydraulic tank strainer and stop the flow of oil, using Tool **D**.
   - When not using tool **D**, remove the drain plug to drain oil from the hydraulic tank and piping.

Hydraulic tank: Approx. 160 **l**



2. Drain engine cooling water.

Engine cooling water: Approx. 16.2 **l**

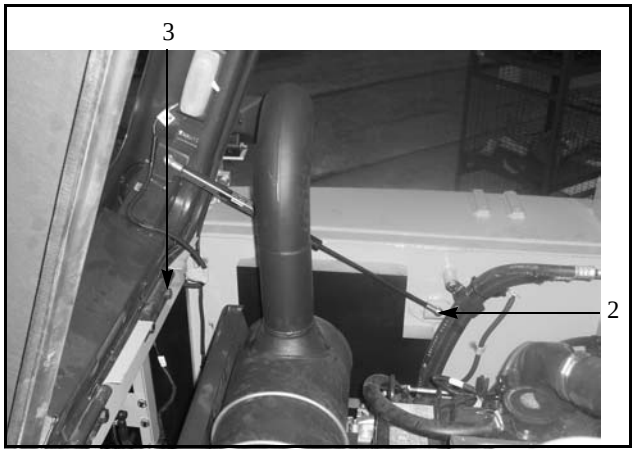
3. Lift up engine hood (1).

Support the engine hood with an appropriate strap and lifting device.

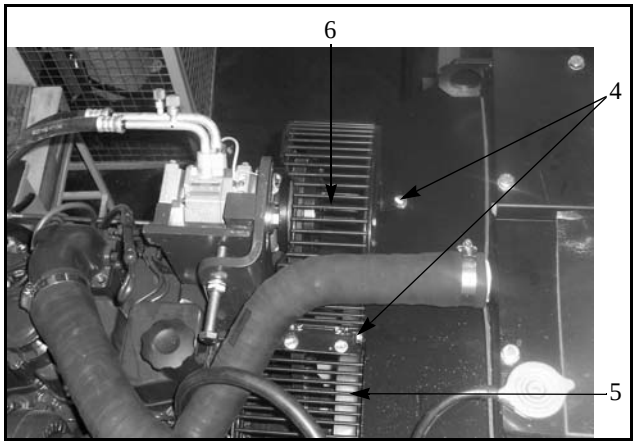


4. Remove pin (2) and mounting bolt (3). Lift off the hood and set it aside.

kg Engine hood assembly: 38 kg



5. Remove radiator fan guards (5) and (6) by removing bolts (4).

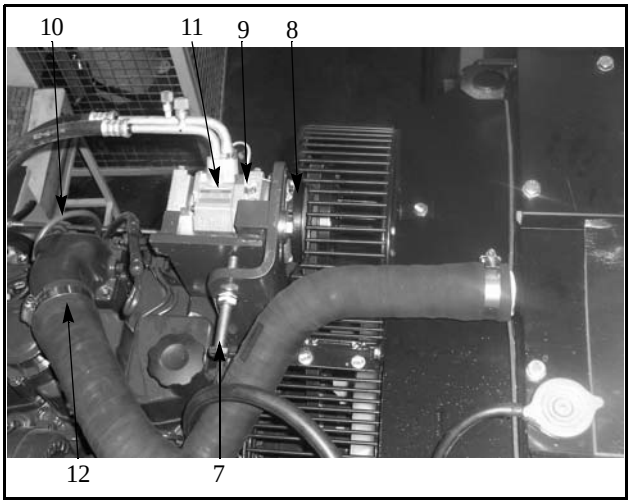


6. Loosen air compressor belt tension adjusting bolt (7) and remove belt (8).

7. Disconnect E06 air conditioner wiring connector (9) and E01 ribbon heater wiring connector (10).

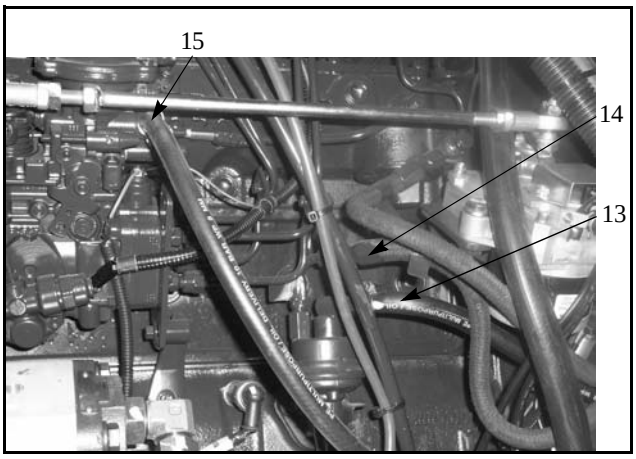
8. Displace air compressor assembly (11). ※1
   - Remove air compressor assembly (11) in one piece with the bracket, and set them aside near the counter weight.

9. Disconnect air intake hose (12). ※2

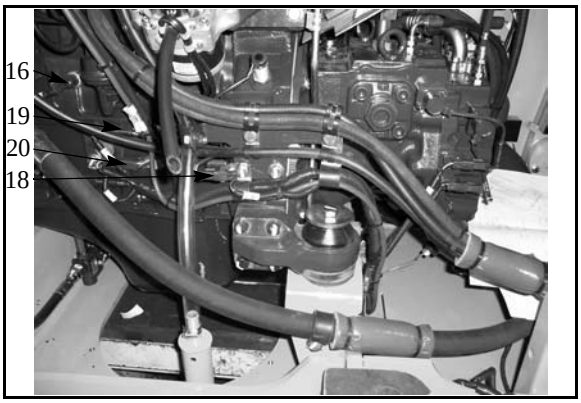


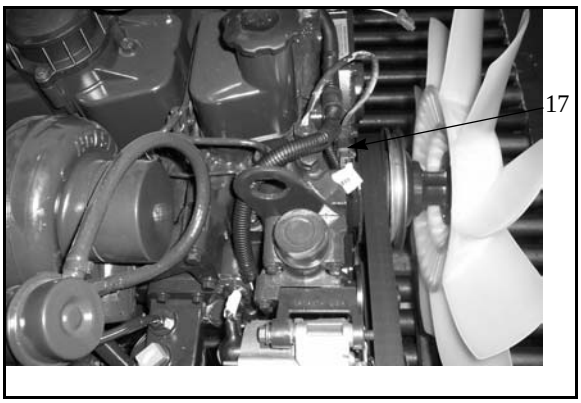
10. Disconnect fuel inlet hose (13) and fuel outlet hose (14). ※3

11. Disconnect fuel return hose (15).



12. Disconnect engine wiring connectors at the following five points.
   - (16): E02 (Engine oil pressure switch)
   - (17): E05 (Engine cooling water temperature sensor).
   - (18): E04 (Engine revolution sensor).
   - (19): E10 (Governor and potentiometer).
   - (20): E11 (Governor and motor).

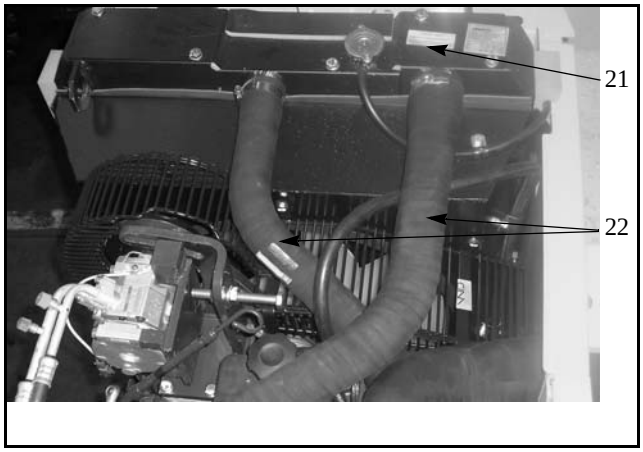




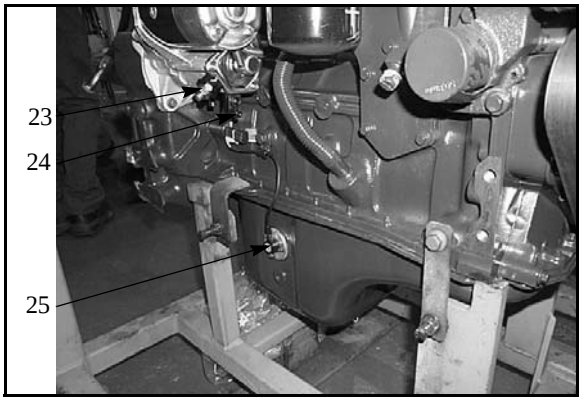
13. Remove the combination cooler (21) (See “COMBINATION COOLER” on page 20-27.).

14. Disconnect two radiator hoses (22) on the upper and lower sides.

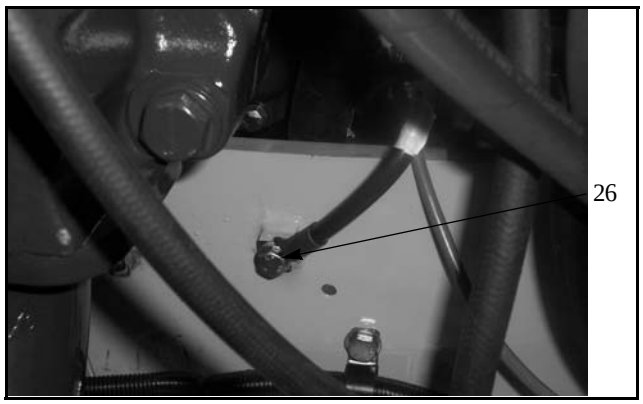
※4



15. Disconnect engine starting motor wiring (23) and connectors (24), (25) and (26).
   - (23): Engine starting motor terminal B (red)
   - (24): T13 (Engine starting motor terminal C)
   - (25): E03 (Engine oil level sensor)

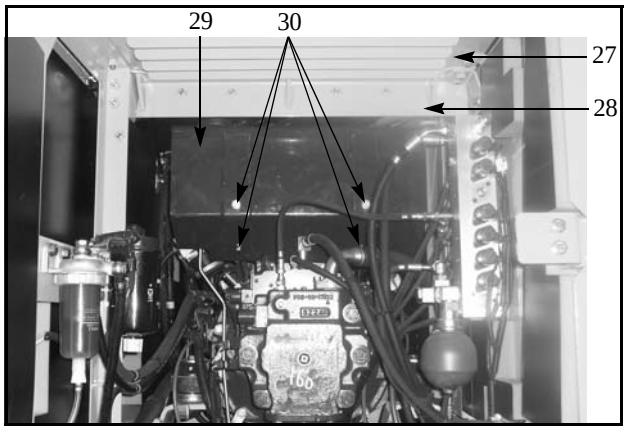


16. Disconnect engine ground (26).

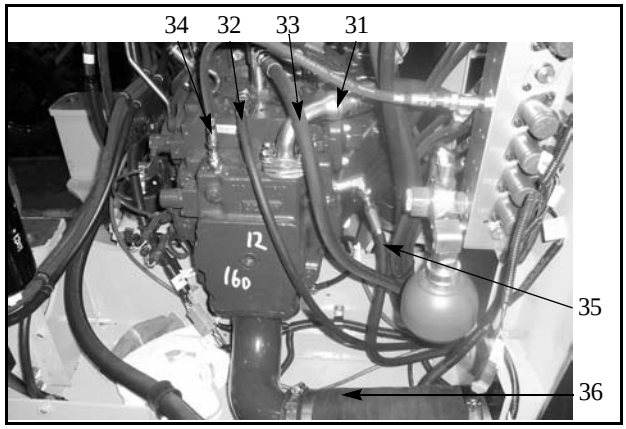


17. Remove cover (27) and bracket (28).

18. Remove muffler guard (29) by removing bolts (30).

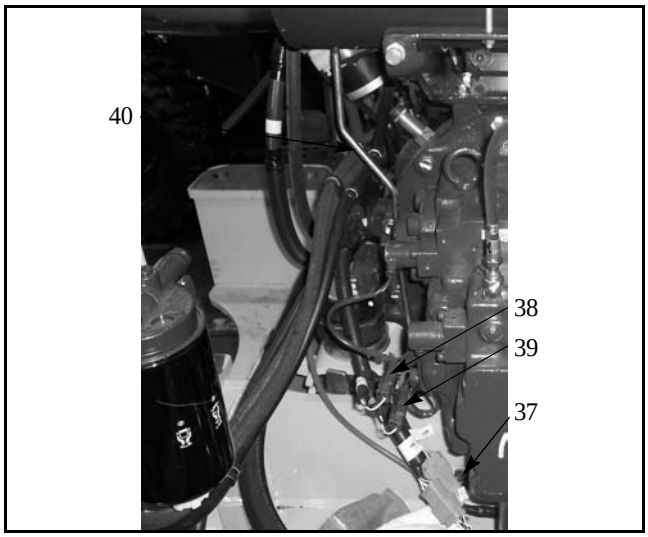


19. Disconnect eight hoses. ※5
   - (31): Pump delivery port hose
   - (32): Pump pressure input port hose
   - (33): Case drain port hose
   - (34): PPC basic pressure input port hose
   - (35): Load pressure input port hose
   - (36): Pump suction port hose - Note orientation of hose clamp.



20. Disconnect the pump wiring connectors at the following three points.
    - ✗ (37): A61 (Hydraulic oil temperature sensor)
    - ✗ (38): V21 (PC-EPC solenoid valve)
    - ✗ (39): V22 (LS-EPC solenoid valve)

21. Disconnect exhaust muffler drain tube (40).

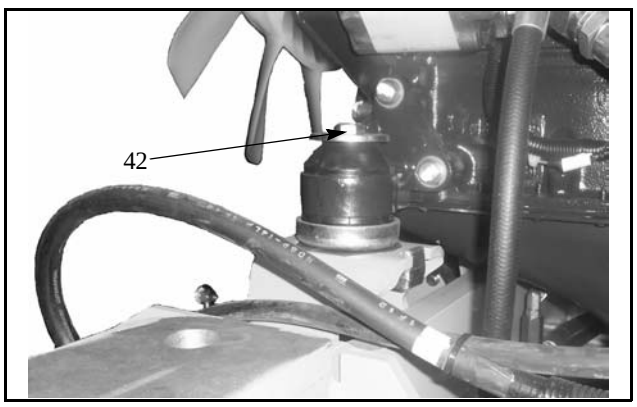


22. Remove water separator piping clamp (41).



23. Remove four engine mounting bolts (42) at the front and rear.

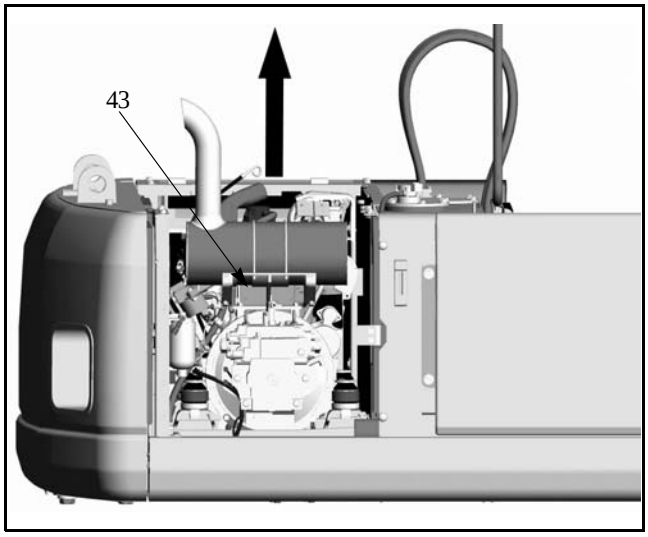
※6



- Check that there is no wiring or piping still connected.

24. Lift out engine and hydraulic pump assembly (43).

kg Engine and hydraulic pump assembly: 550 kg



INSTALLATION

✗ Install in reverse order of removal.

※1

- Refer to the Inspection and Adjustment of Air Compressor Belt Tension section in the TESTING AND ADJUSTING chapter of this manual.

※2

N·m Air intake hose clamp screw: 5.4 - 6.4 Nm (0.55 - 0.65 kgm)

※3

N·m Fuel inlet hose clamp screw: 29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)

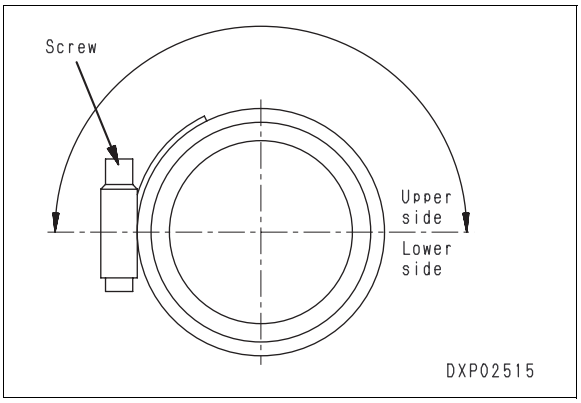
※4

N·m Radiator hose clamp screw: 8.3 - 9.3 Nm (0.85 - 0.95 kgm)

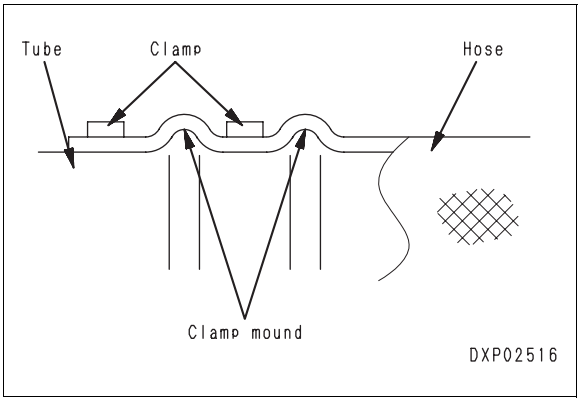
※5

- After tightening the suction hose clamp screw, check that the screw is in the position as illustrated below.

N·m Suction 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.



※6

➧ Install the engine and hydraulic pump assembly.

Engine mounting bolt:
245 - 308.7 Nm (25 - 31.5 kgm)

✗ Refilling engine cooling water
Refill engine cooling water through the water filler port up to the specified level.

Engine cooling water: Approx. 16.2 l

✗ Refilling hydraulic oil (hydraulic tank)
Refill hydraulic oil through oil filler port up to the specified level.

Hydraulic tank: Approx. 165 l

✗ Let the water circulate to release any air pockets by starting the engine. Check the water level again.

✗ Circulate oil in the hydraulic system by starting the engine. Then check the oil level again.

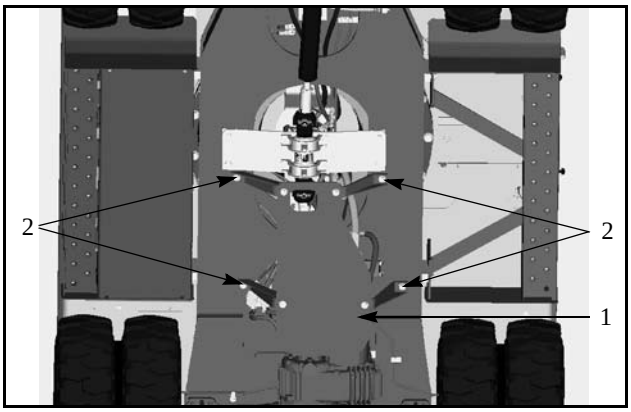
✗ Air bleeding
Refer to the Air Bleeding of Various Part section in the TESTING AND ADJUSTING chapter of this manual.

REMOVAL AND INSTALLATION OF TRAVEL MOTOR

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).

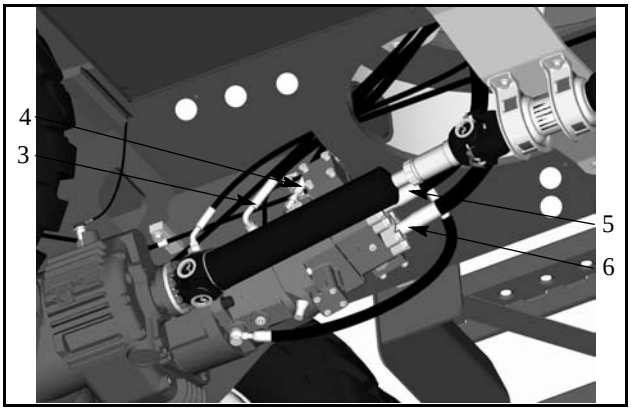


2. Drain oil out of transmission and travel motor.

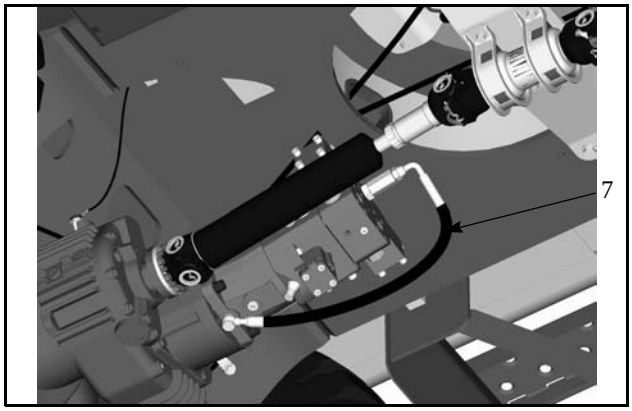
3. Attach an identification tag to hoses to avoid incorrect connection during re-assembly.

4. Attach vacuum pump to hydraulic tank.

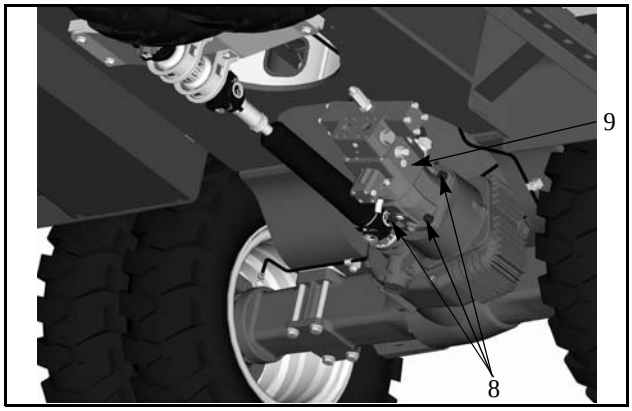
5. Disconnect each hose individually and plug with blank/plug and O-ring from blanking kit to prevent oil spillage and contamination (3 through 6).



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).

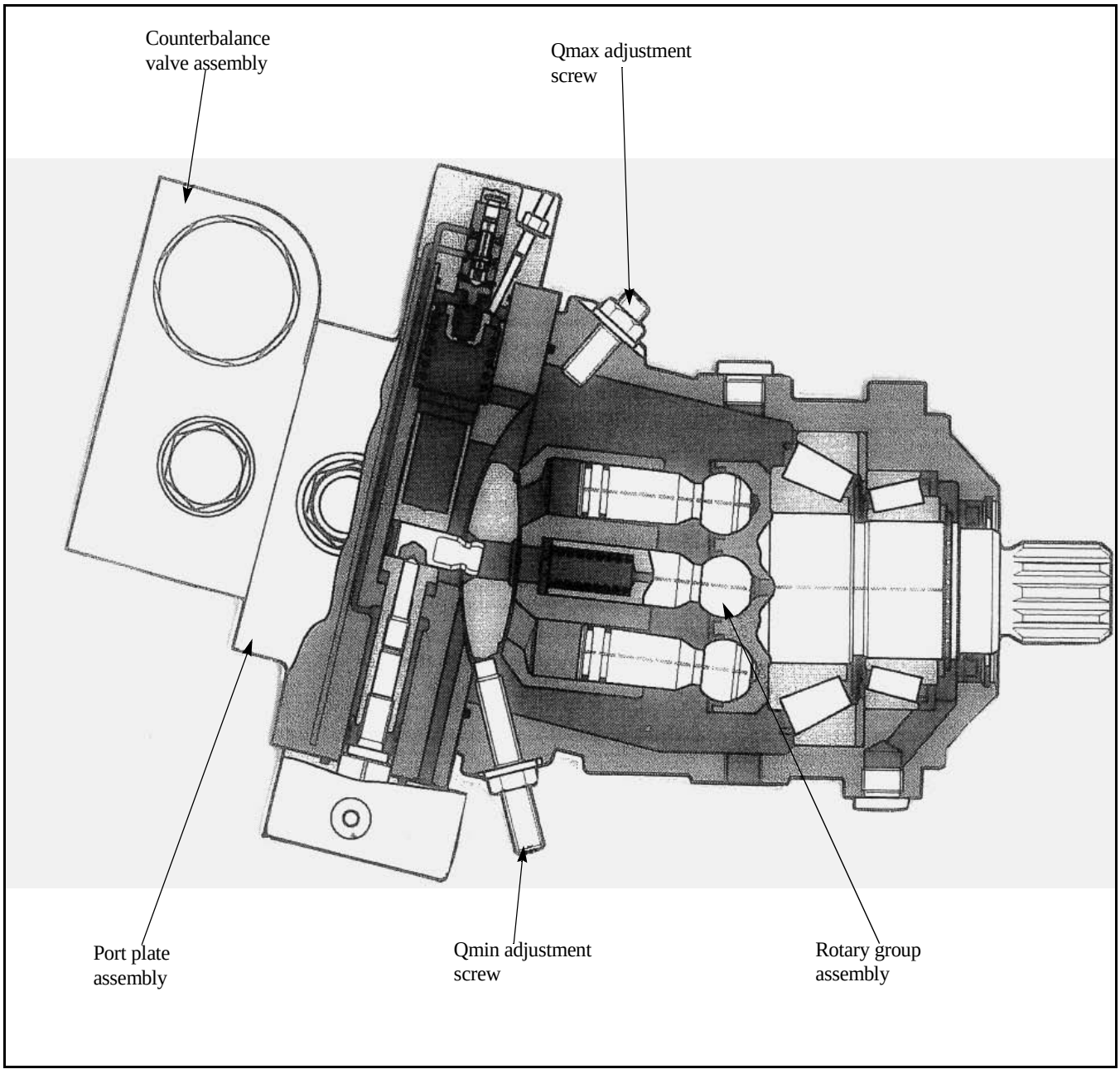


INSTALLATION

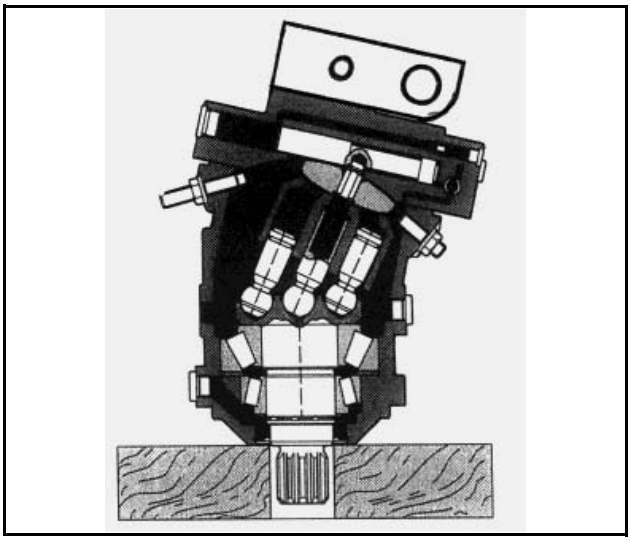
- Install in reverse order of removal.
- Tightening torque for propshaft nuts is: 25 - 31.5 kgf-m
- Refill the transmission oil to the required level (4.85 litres).
- Top up hydraulic through oil filler port to the specified level and let the oil circulate in the hydraulic system by starting the engine. 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

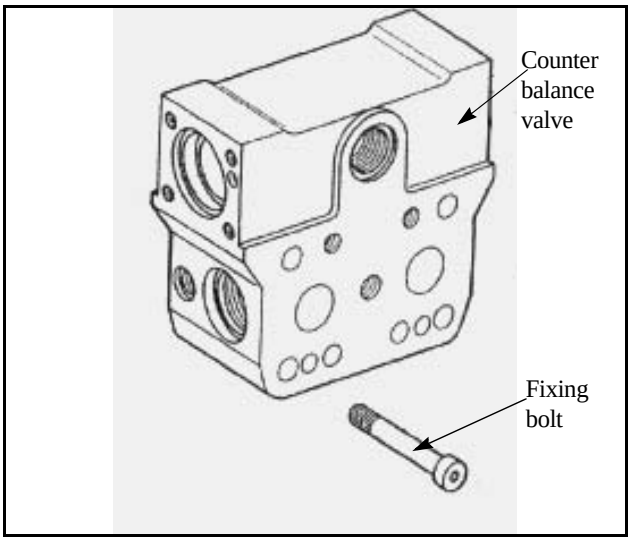
Disassembly



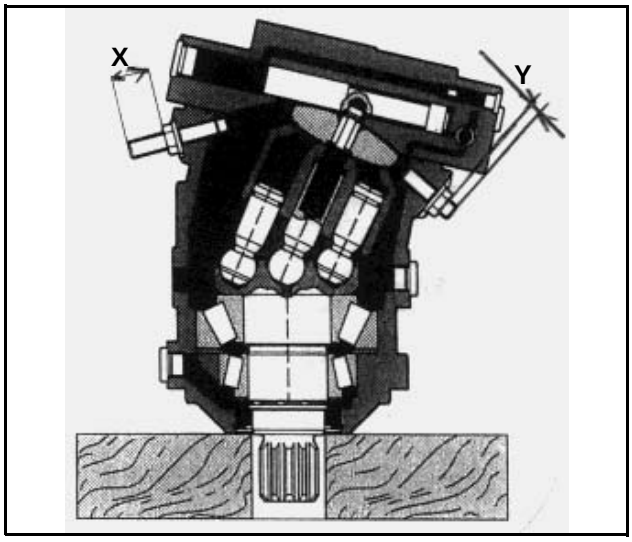
1. Put the unit in a bench with a hole or place it on a fixture for assembly.



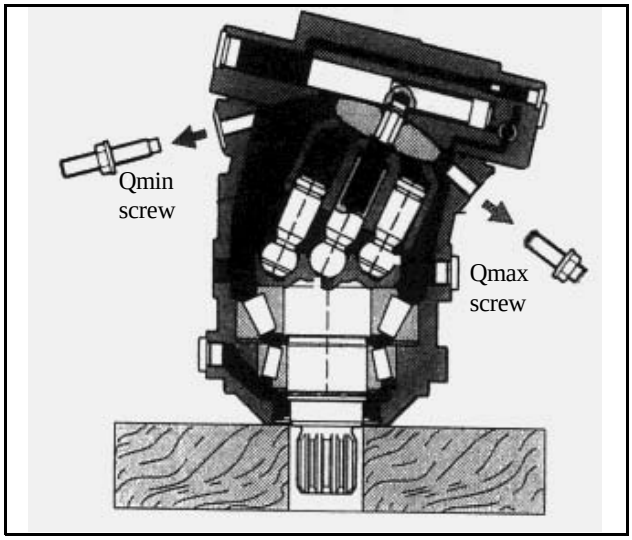
2. Remove the counterbalance valve by loosening the six fixing bolts.



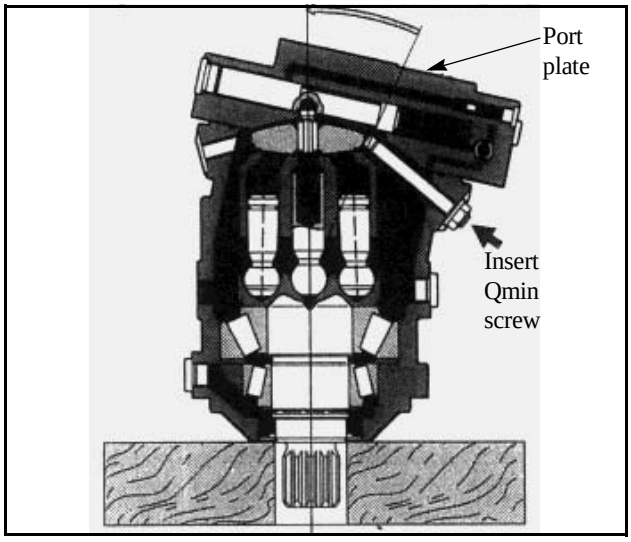
3. Before removing the port plate measure and record dimension **X** of the Qmin adjustment screw and dimension **Y** of the Qmax adjustment screw.



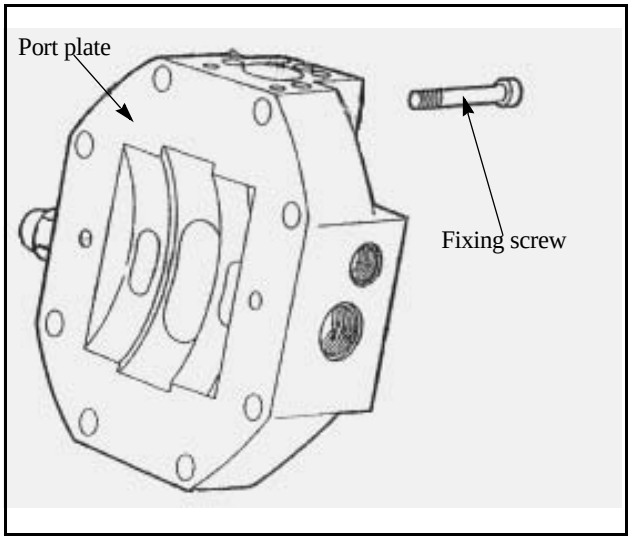
4. Remove the adjustment screws completely from the motor casing.



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).

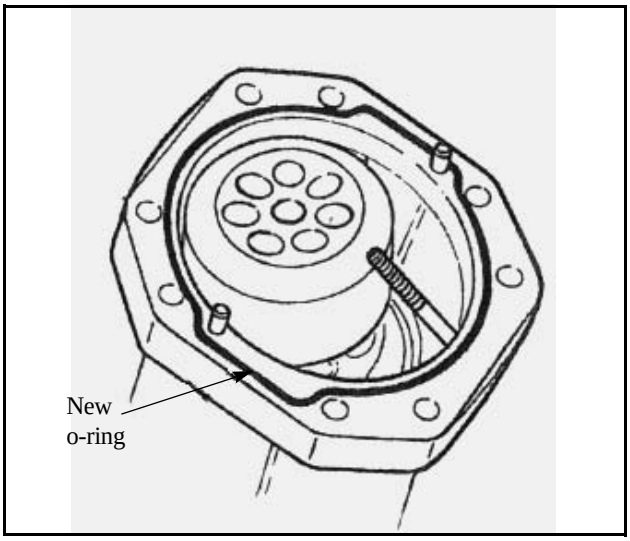


6. Remove the port plate by loosen the eight fixing bolts.

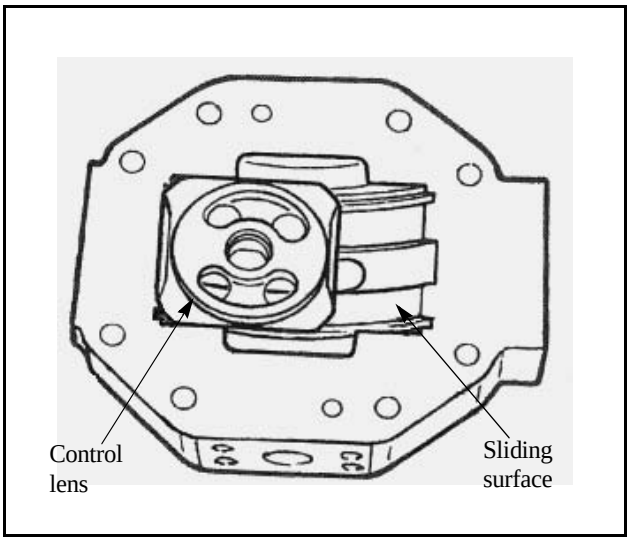


Assembly

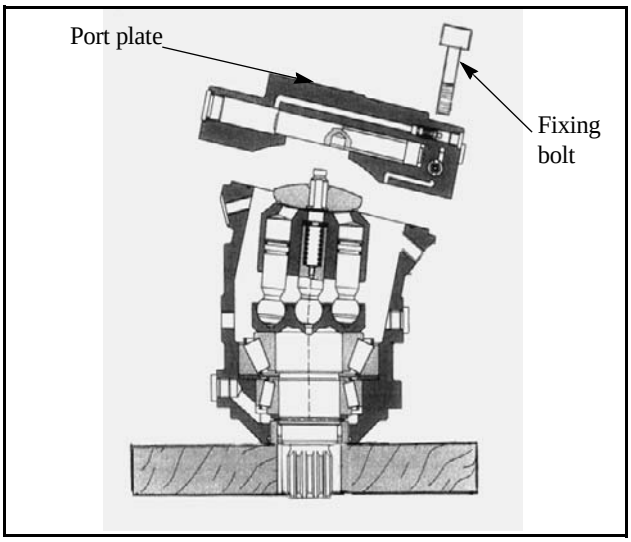
1. Do not remove rotary group from casing, just check for signs of damage or wear.
   Replace O-ring and install into position using grease.



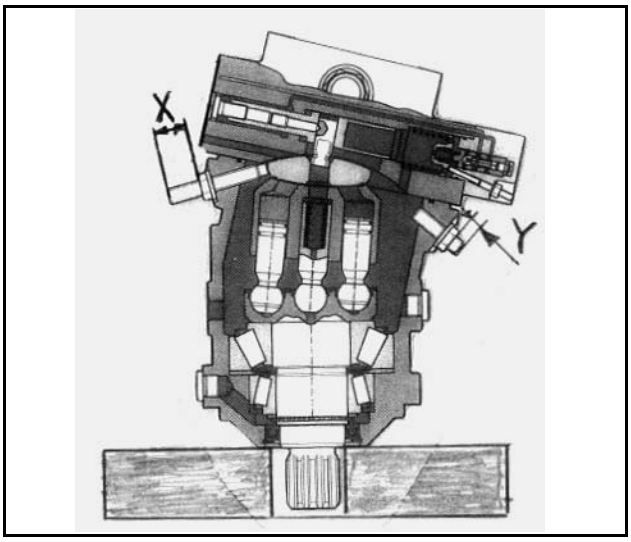
2. Apply grease to control lens sliding surface.



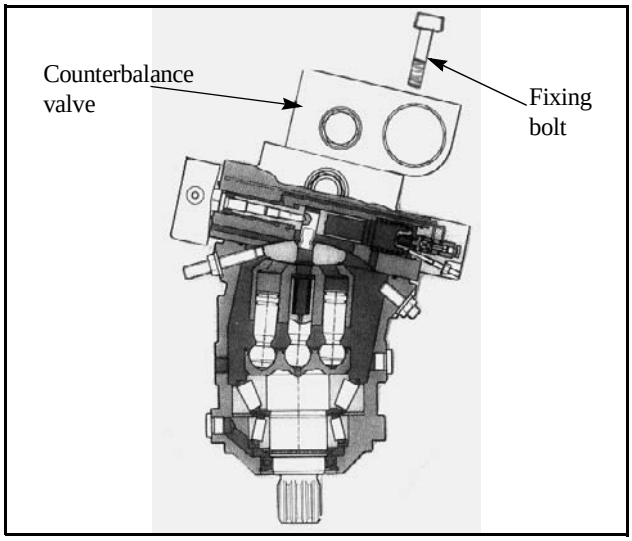
3. Assemble the port plate by locating the lens plate onto the rotary group.
   Secure the port plate by tightening the eight fixing bolts.
   Tightening torque - 310 Nm



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

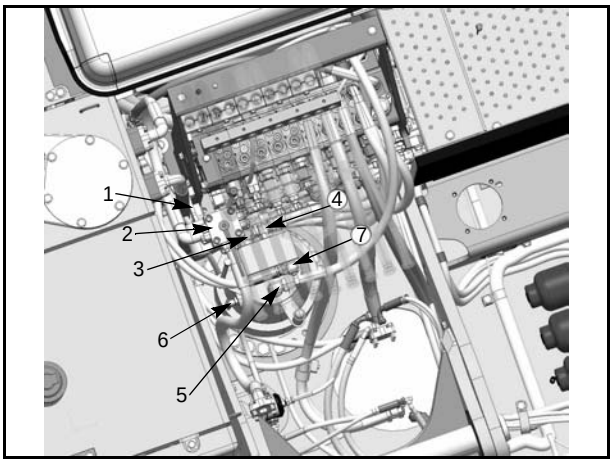
Removal

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).

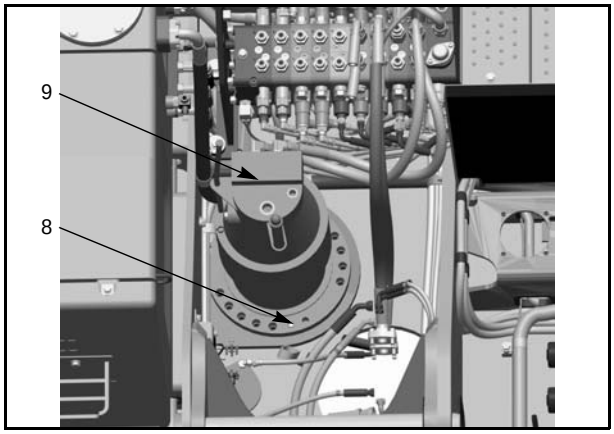
- (3) : Between swing motor and control valve (Port MA)
- (4) : Between swing motor and control valve (Port MB)
- (5) : Suction hose (Port S)
- (6) : Drain hose between swing motor and swivel joint (Port DB)
- (7) : Drain hose between swing motor and hydraulic tank (Port DB)



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

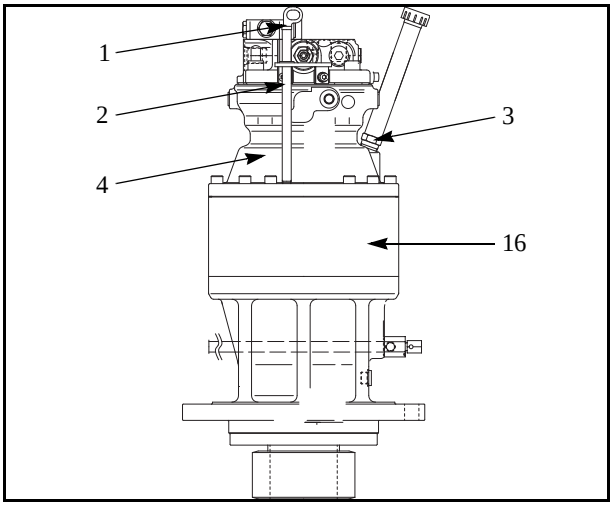
1. Draining oil

Loosen the drain plug and drain the oil from the swing machinery case.

Swing machinery case: **4.5** ℓ

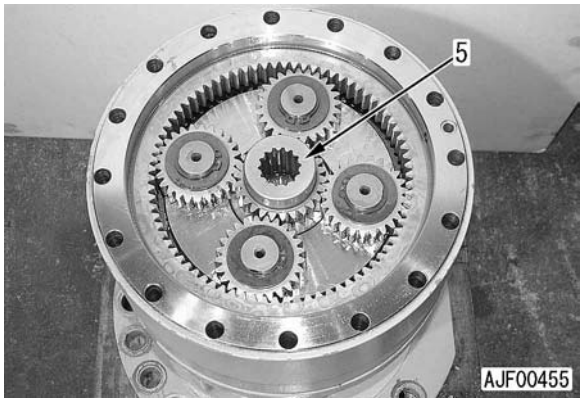
2. Swing motor assembly

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.

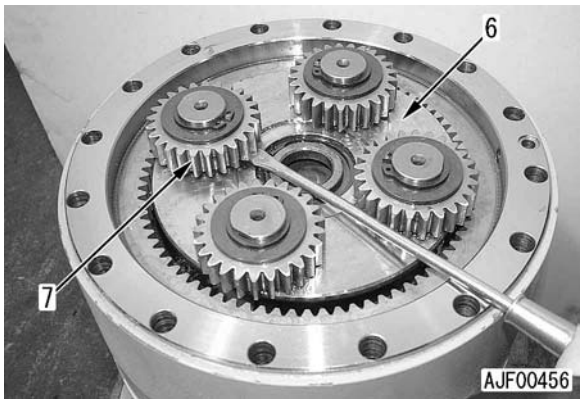


3. No. 1 carrier assembly

1) Remove No. 1 sun gear (5).



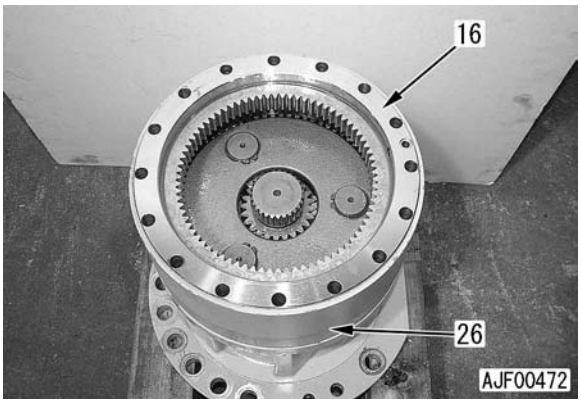
2) Remove No. 1 carrier assembly (6).
   ✔ Insert a flat-head screwdriver, etc. under planetary gear (7) to float and remove the planetary gear.



4. Cover

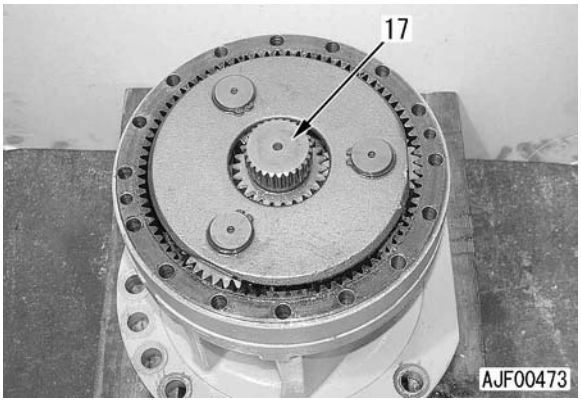
Remove cover (16).

✔ Make match marks on cover (16) and ring gear (26) for reassembly.

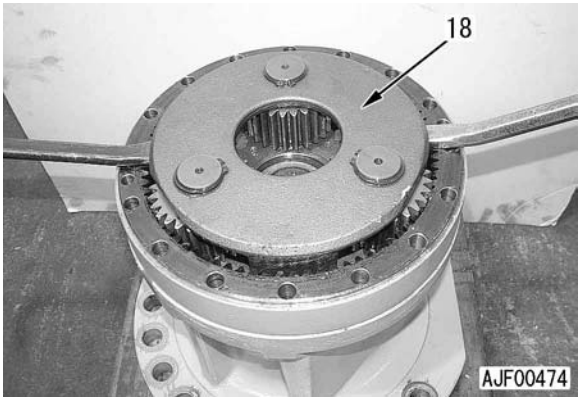


5. No. 2 carrier assembly

1) Remove No. 2 sun gear (17).



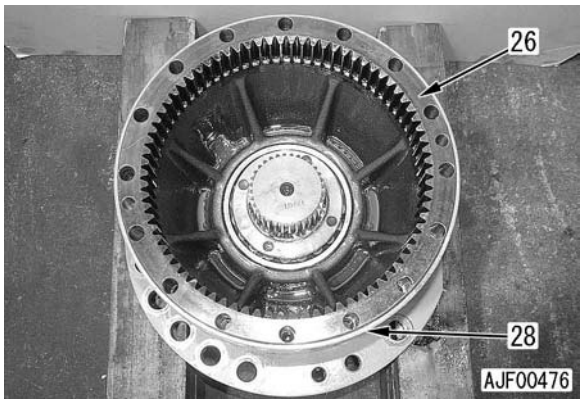
2) Using a bar, etc., float and remove No. 2 carrier assembly (18).



6. Ring gear

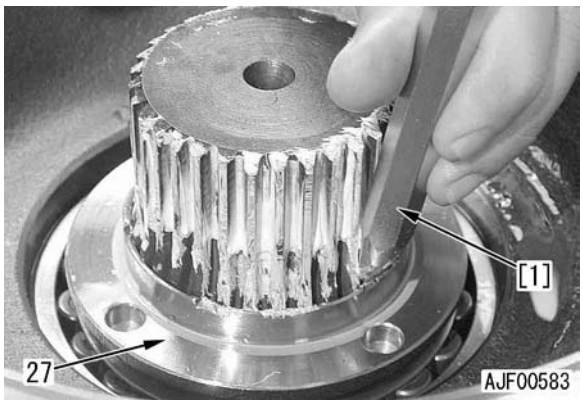
Remove ring gear (26).

✔ Make match marks on ring gear (26) and housing (28) for reassembly.



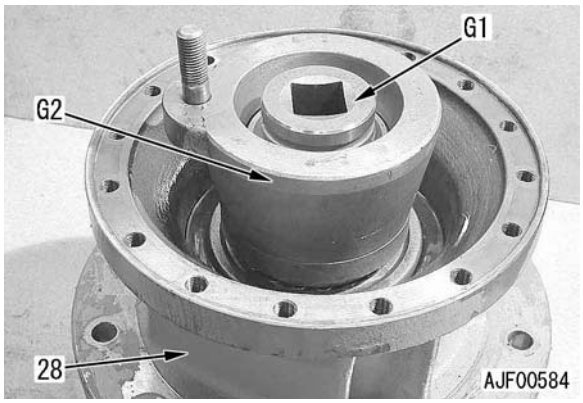
7. Ring nut

1) Using punch [1], etc., straighten the bent parts (3 places) of ring nut (27) around the pinion shaft spline.

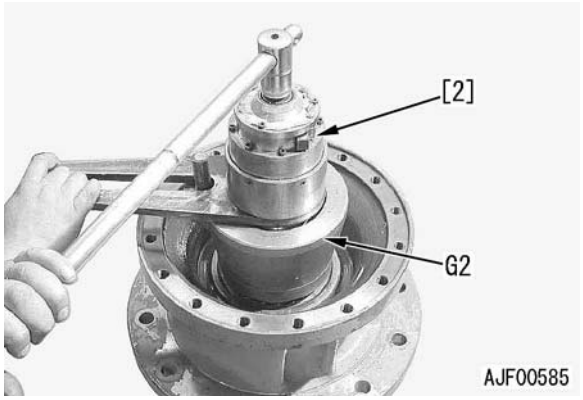


2) Place the flange of housing (28) on a block and float the pinion shaft at the center.

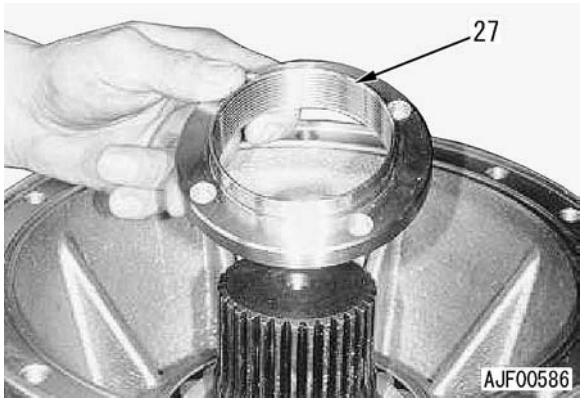
3) Install tool **G1** to the pinion shaft and install tool **G2** to the ring nut.



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}**

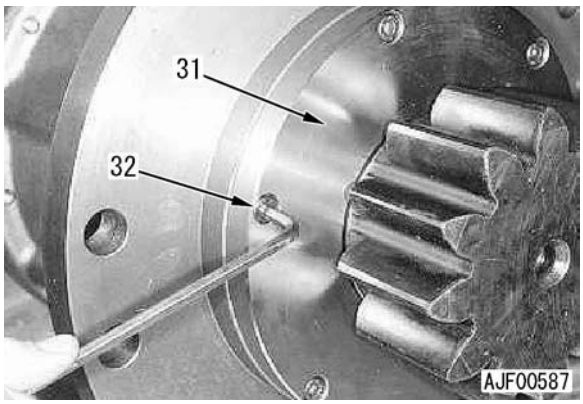


5) Remove ring nut (27).

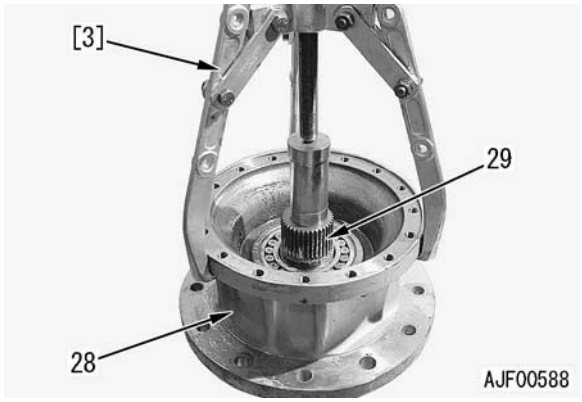


8. Housing and pinion shaft

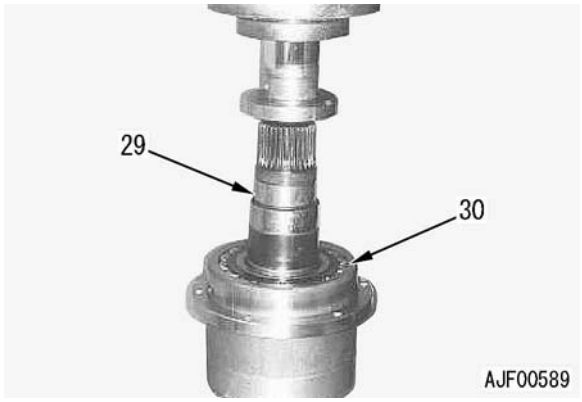
1) Remove 6 mounting screws (32) of front cover (31).



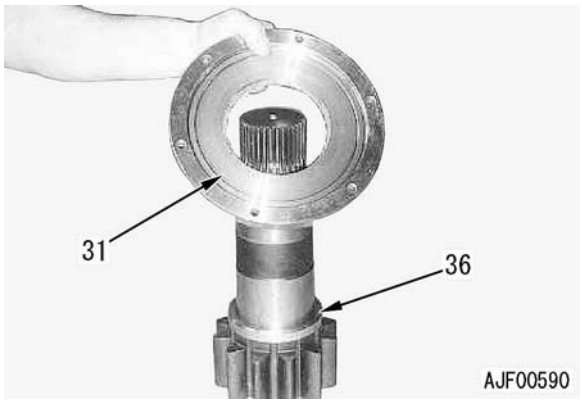
2) Using puller [3], separate housing (28) and pinion shaft assembly (29).



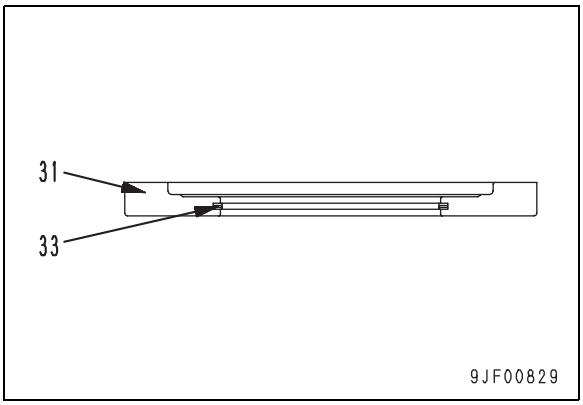
3) Using a press, separate pinion shaft assembly (29) and bearing (30).



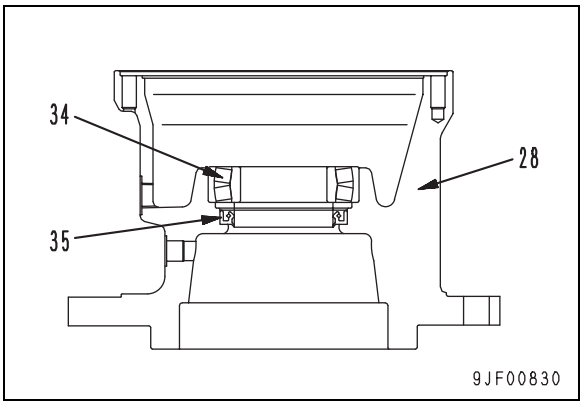
4) Remove front cover (31) and spacer (36).



5) Remove seal ring (33) from front cover (31).



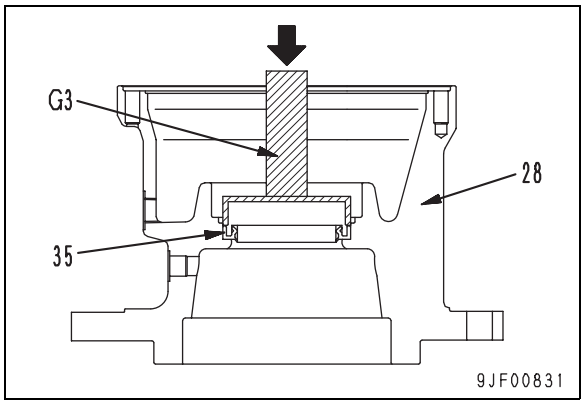
6) Remove bearing (34) and oil seal (35) from housing (28).



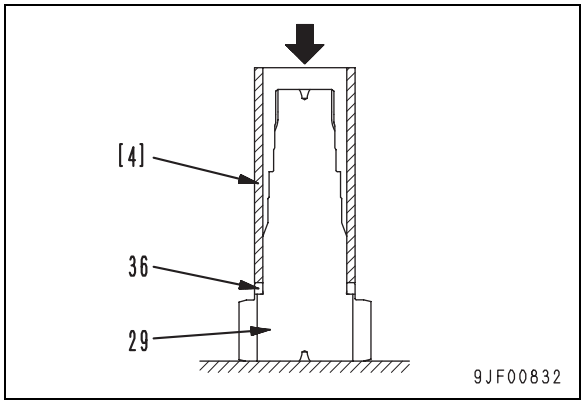
Assembly

1. Housing and pinion shaft

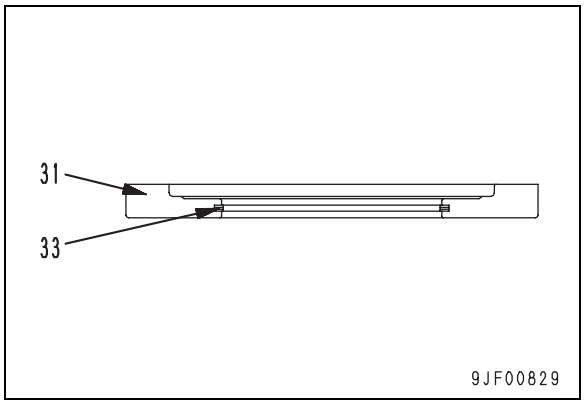
1) Using tool **G3**, install oil seal (35) to housing (28) as shown in the following figure.
   - ✔ Press fit the oil seal until its end reaches the housing end.



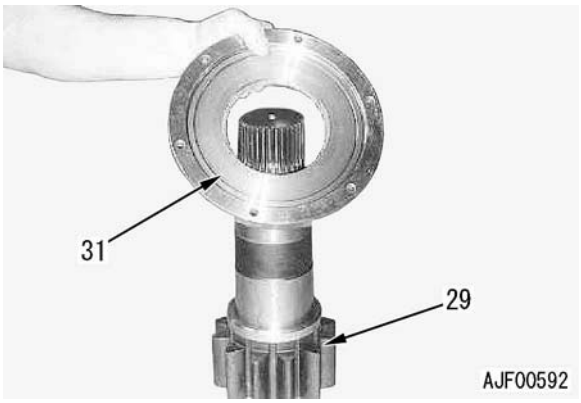
2) Using push tool [4], press fit spacer (36) to pinion shaft (29).



3) Install seal ring (33) to front cover (31).

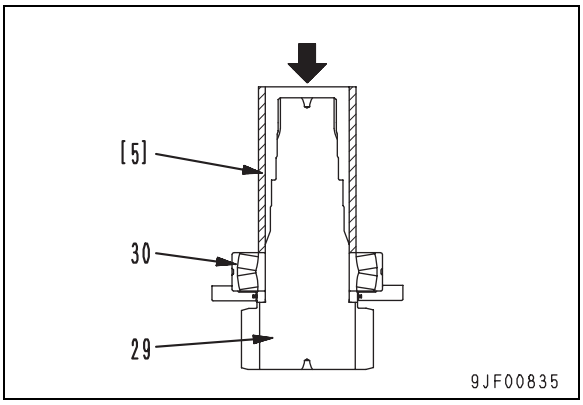


4) Set front cover (31) to pinion shaft (29).



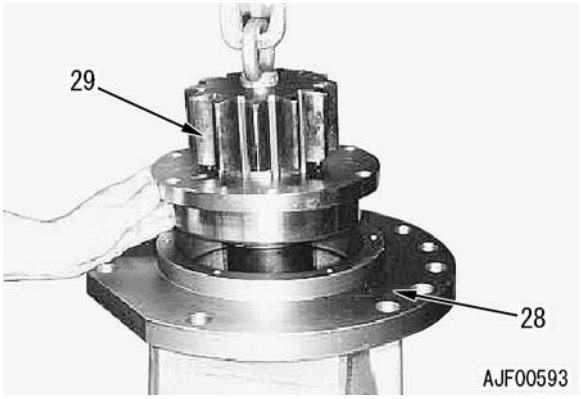
5) Using push tool [5], press fit bearing (30) to pinion shaft (29).
   - ✔ Press fit the bearing until the inner race end reaches the spacer.

Bearing: Grease
(SHELL RETINAX HD-2 or equivalent)

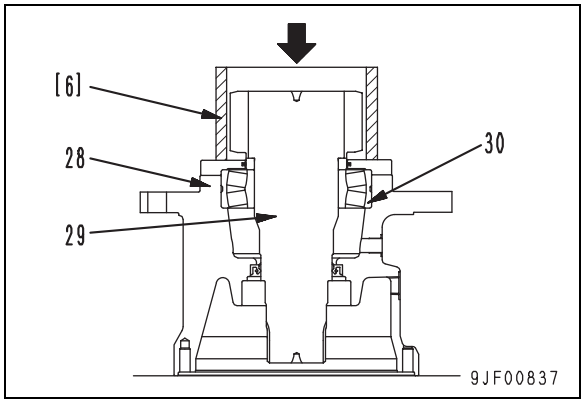


6) Set pinion shaft assembly (29) to housing (28).

Housing: Grease
(SHELL RETINAX HD-2 or equivalent)



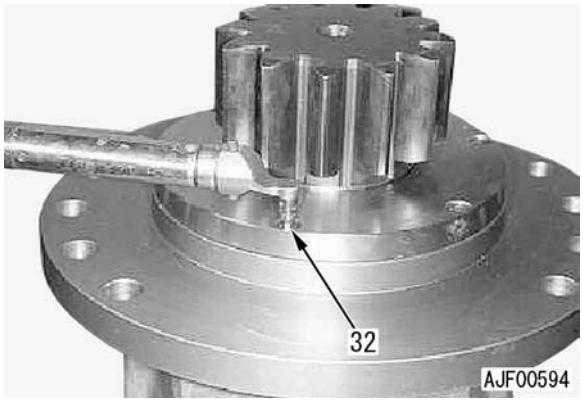
7) Using push tool [6], press fit pinion shaft assembly (29) to housing (28).
   - ✔ Press fit the bearing until the end of bearing (30) reaches the end of housing (28).



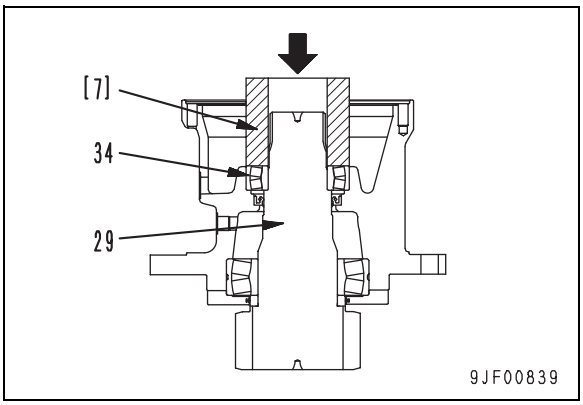
8) Tighten 6 front cover mounting screws (32).

Mounting screw:
LOCTITE 243 or equivalent

N·m Mounting screw: 25 Nm {2.5 kgm}

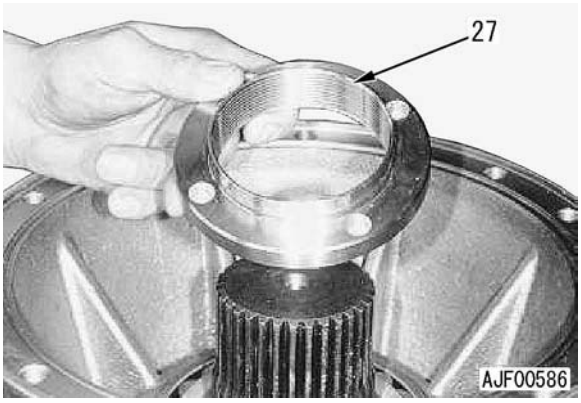


9) Using push tool [7], press fit bearing (34).
   ✔ Press fit bearing (34) until its end reaches the shoulder of pinion shaft (29).

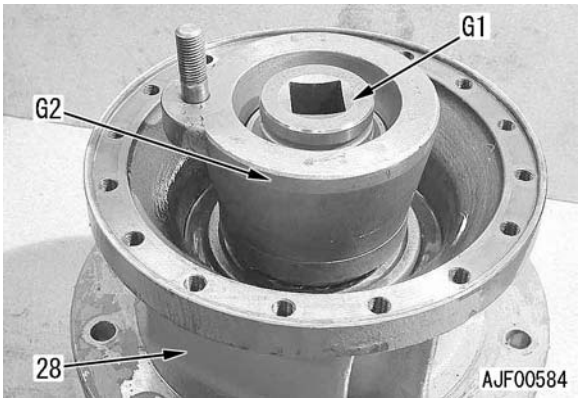


2. Ring nut

1) Install ring nut (27) to the pinion shaft.

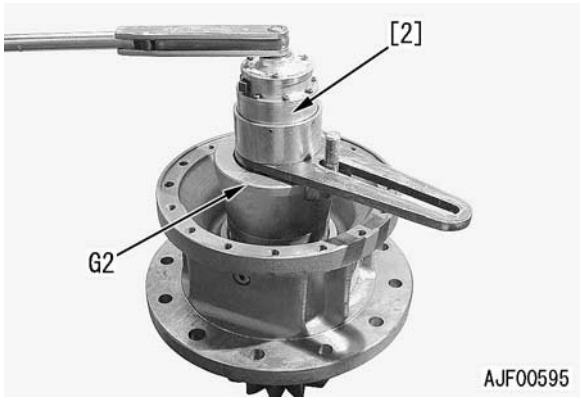


2) Place the flange of housing (28) on blocks and float the pinion shaft at the center.
3) Install tool **G1** to the pinion shaft and install tool **G2** to the ring nut.

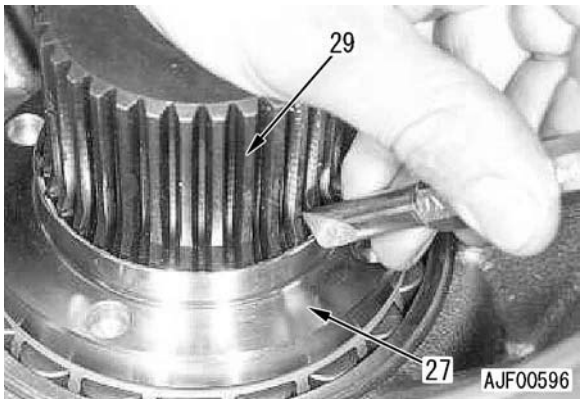


4) Fix tool **G2**. Using power wrench (25-time power) [2], turn tool **G1** to tighten the ring nut.

N·m Ring nut:
1100 – 1200 Nm {112.2 – 122.3 kgm}

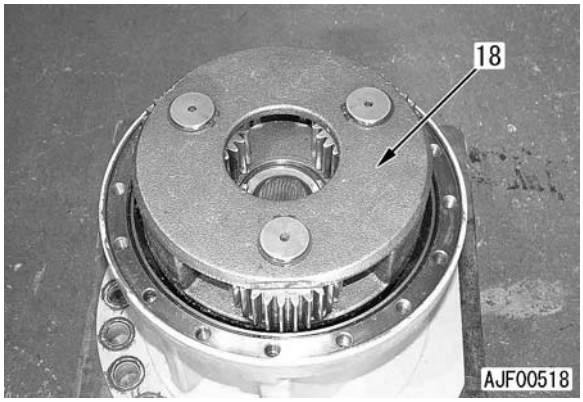


5) Using a punch, etc., bend the inside parts of ring nut (27) toward the spline of pinion shaft (29).
   ✔ Bend 3 parts at intervals of 120°.

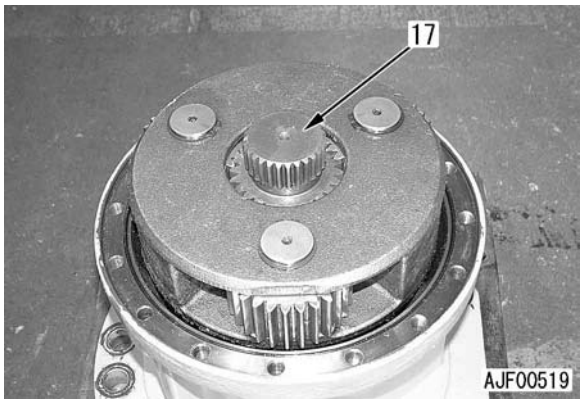


3. No. 2 carrier assembly

1) Install No. 2 carrier assembly (18).

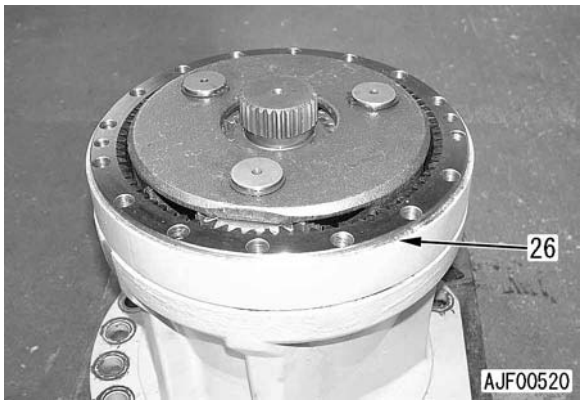


2) Install No. 2 sun gear (17).



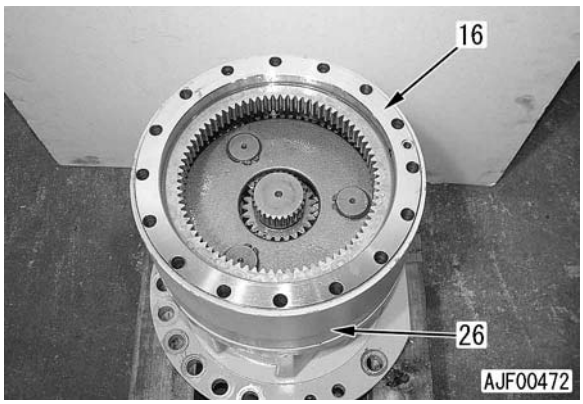
4. Ring gear

1) Fit the O-ring to the housing.
2) Install ring gear (26).
   - ✔ Match the match marks made when the ring gear was removed.



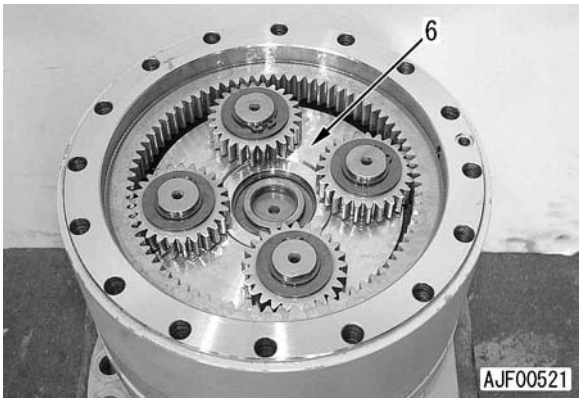
5. Cover

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.

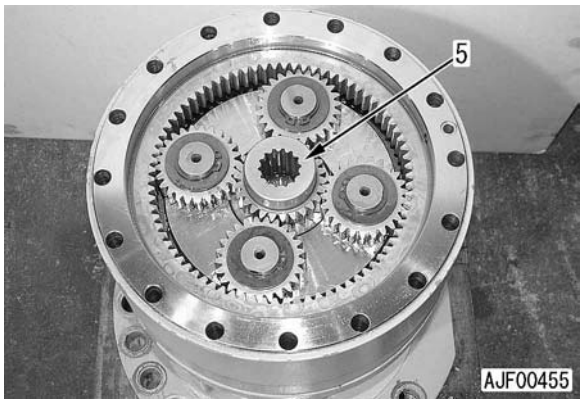


6. No. 1 carrier assembly

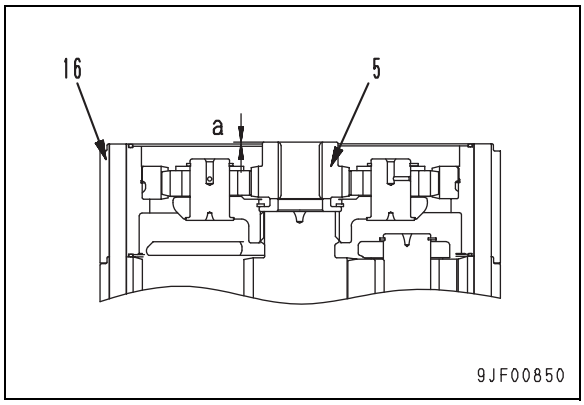
1) Install No. 1 carrier assembly (6).



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** = $\mathbf{1.5}^{\ 0}_{-0.5}$ **mm**



7. Swing motor assembly

1) Install swing motor assembly (4).
   ✔ Match the match marks made when the swing motor assembly was removed.

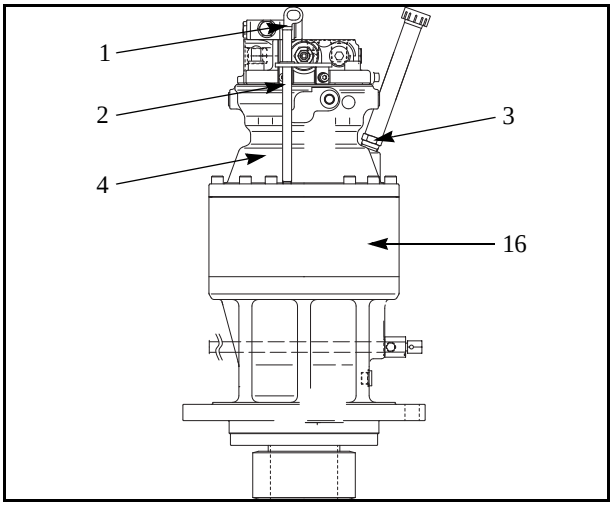
N·m Mounting bolt:
85 ± 4.3 Nm {8.7 ± 0.44 kgm}

2) Install pipe (3) and bracket.

N·m 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).

N·m Pipe: 12.3 ± 2.5 Nm {1.25 ± 0.25 kgm}



8. Refilling with oil

Swing machinery case: **4.5 ℓ (EO30-CD)**

DISASSEMBLY AND ASSEMBLY OF SWING MOTOR ASSEMBLY

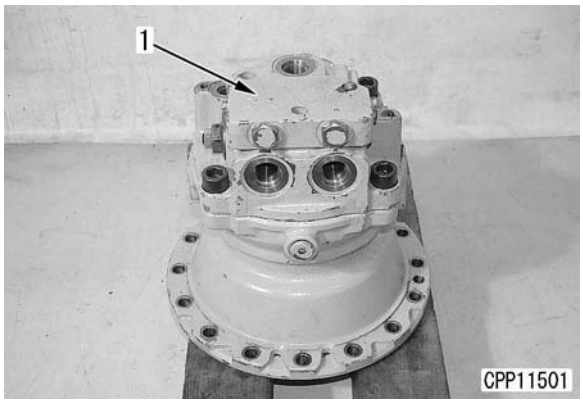
SPECIAL TOOLS

Symbol	Part No.	Part name	Necessity	Q'ty	New/Remodel	Sketch
D1	799-301-1600	Oil leak tester kit	t	1		

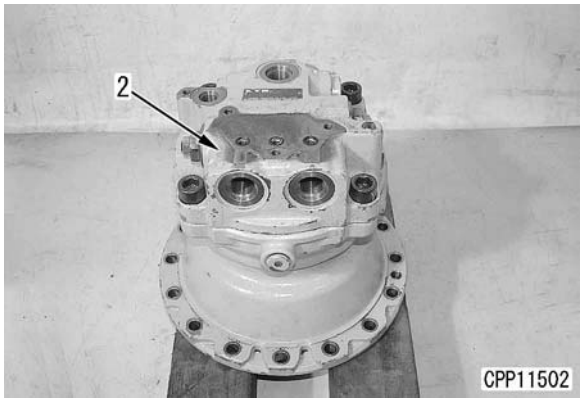
Disassembly

1. **Set the swing motor and swing machinery assembly on blocks.**

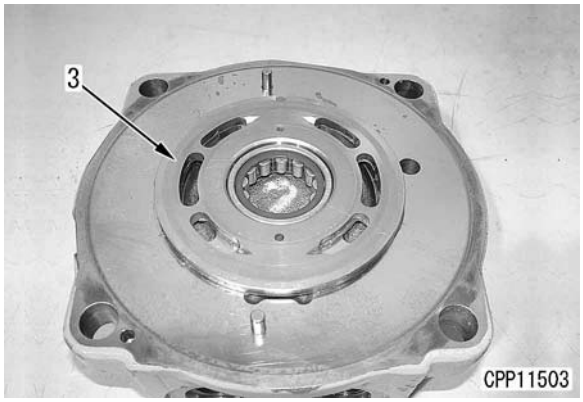
2. **Reverse prevention valve assembly**
   Remove reverse prevention valve assembly (1).



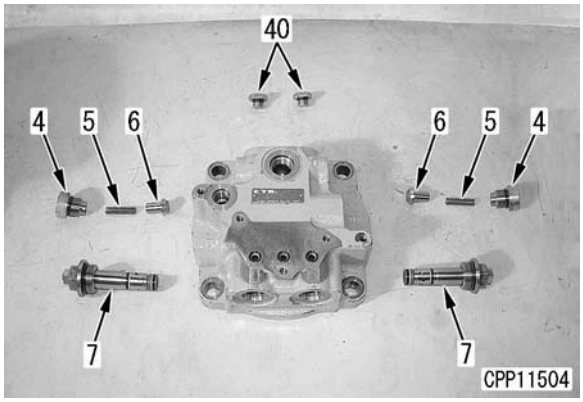
3. **Cover assembly**
   1) Remove cover assembly (2).
      ✔ Note that the valve plate may fall from the cover assembly.



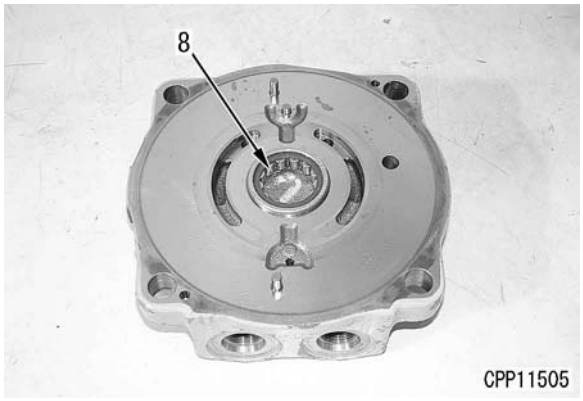
2) Remove valve plate (3) from the cover assembly.



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).



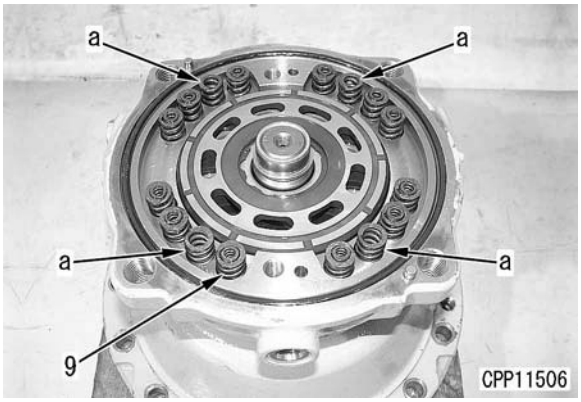
6) Remove bearing outer race (8).



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**.

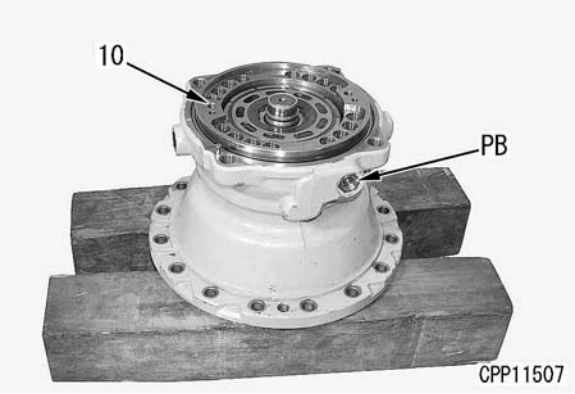


5. Brake piston

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.

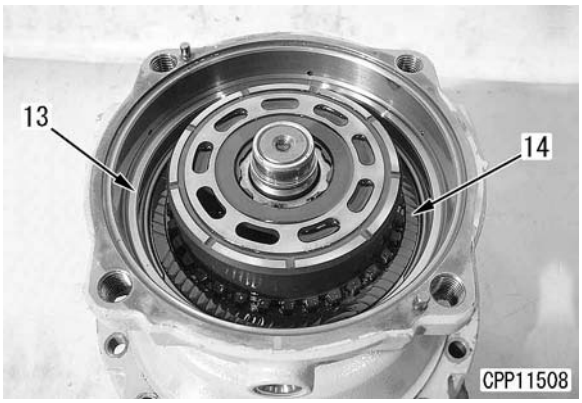
WARNING! If high-pressure air is supplied, the brake piston jumps out. Accordingly, supply very low-pressure air at first and check the movement of the brake piston, and then adjust the air pressure.



6. Collar

Using a puller, etc., remove collar (13).

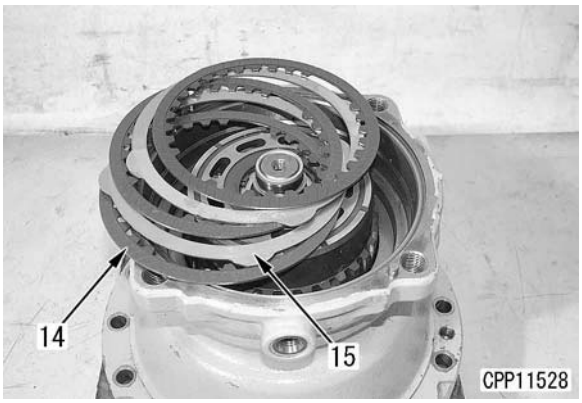
✔ Remove 1 disc (14) so that you can remove the collar easily.



7. Discs and plates

Remove 3 discs (14) and 2 plates (15).

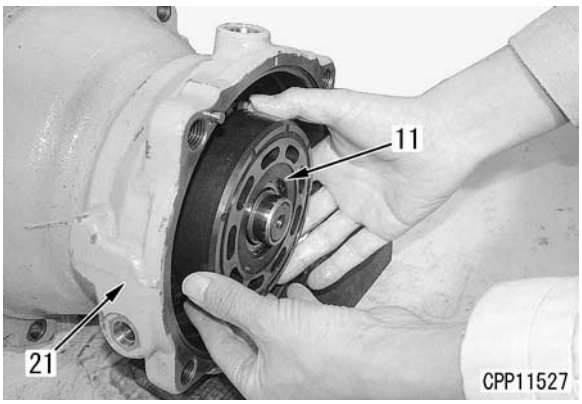
✔ The number of the discs includes the one removed in step 6.



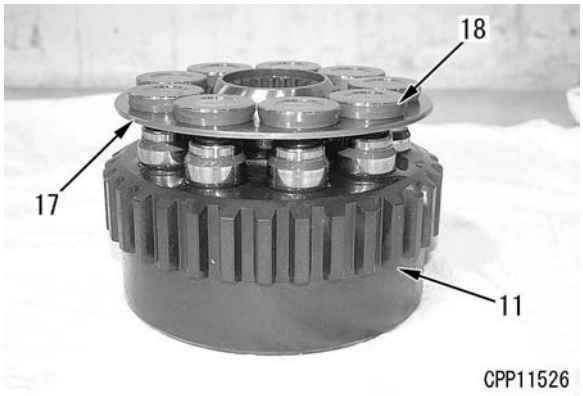
8. Cylinder block assembly

1) Place case (21) on its side.
2) Pull out cylinder block assembly (11).

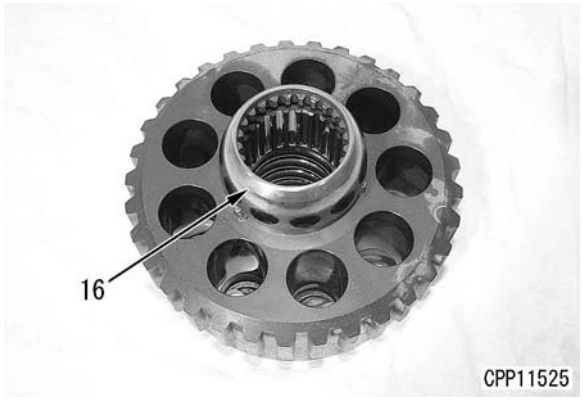
✔ When removing the cylinder block assembly, slant the case down a little so that the internal parts (piston, retainer holder, and pin) will not be left in the case.



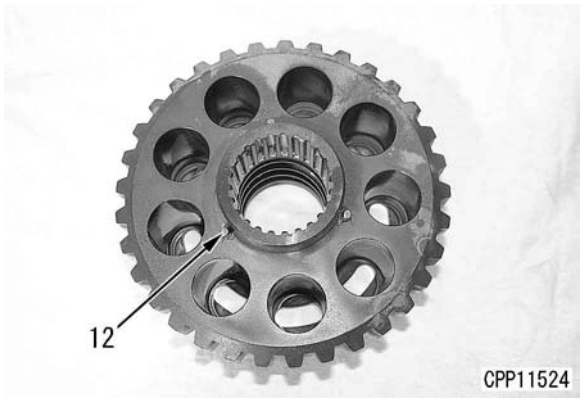
3) Lift up retainer plate (17) and remove it and piston (18) together from cylinder block (11).
4) Separate retainer plate (17) and piston (18).



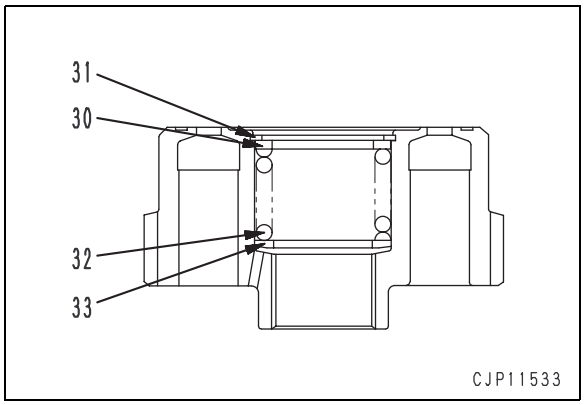
5) Remove retainer holder (16).



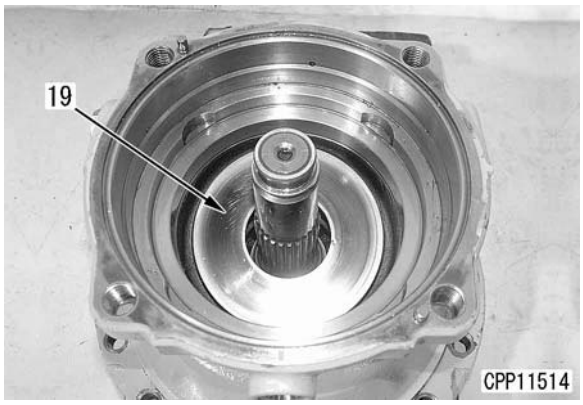
6) Remove 3 pins (12).



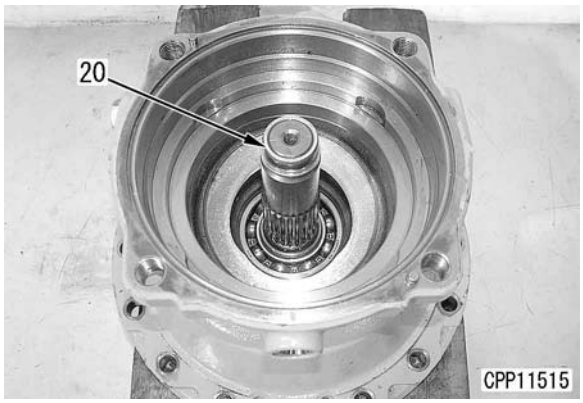
7) Press down collar (30) with a press, etc. and remove snap ring (31).
8) Remove collar (30), spring (32), and collar (33).



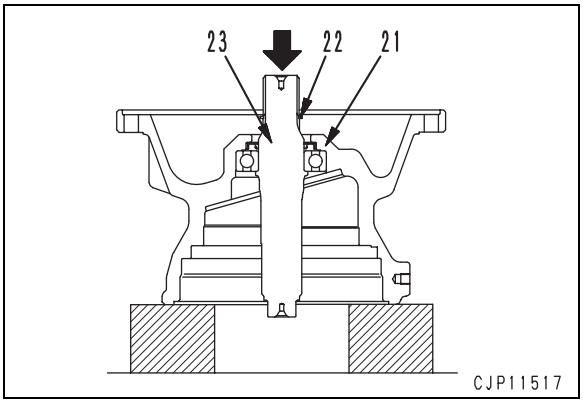
9. Thrust plate
Remove thrust plate (19).



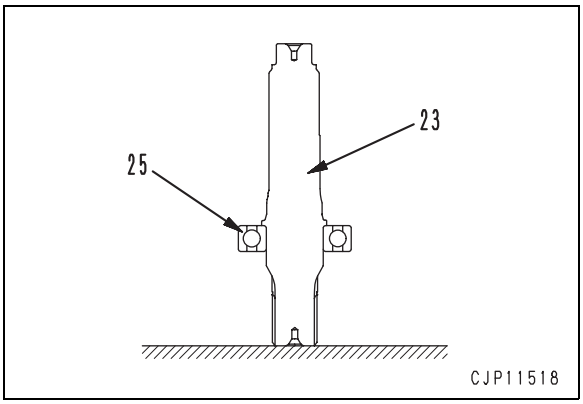
10. Shaft and case
1) Remove bearing inner race (20).



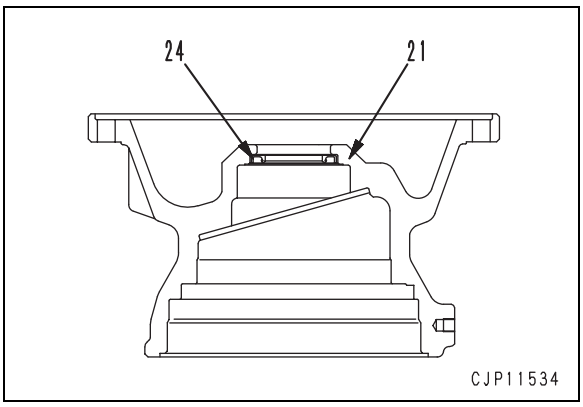
2) Turn over case (21) and set it on blocks.
3) Remove snap ring (22).
4) Press the end of shaft (23) with a press, etc. to remove the shaft.



5) Remove bearing (25) from shaft (23).



6) Remove oil seal (24) from case (21).

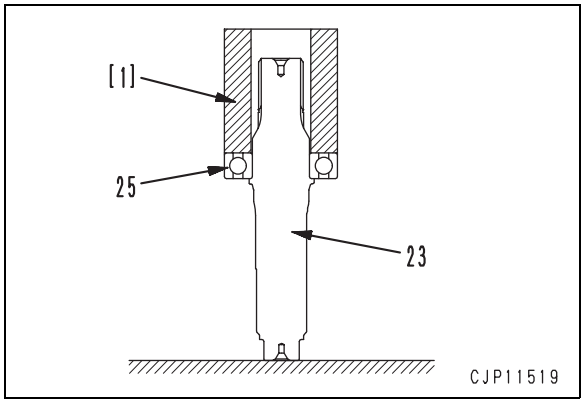


Assembly

- Clean the all parts and check them for dirt or damage.
- Coat the sliding surfaces of each part with engine oil (EO10-CD).

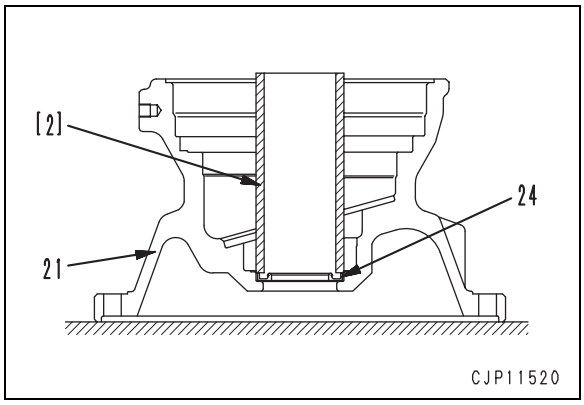
1. Shaft and case

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.

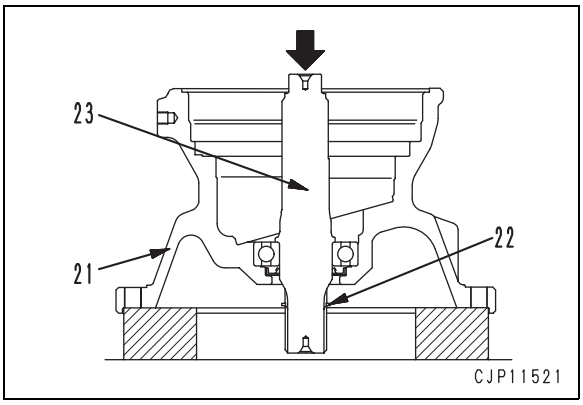


2) Using push tool [2], press fit oil seal (24) to case (21) as shown in the following figure.
   - Press fit the oil seal until its end reaches the case end.

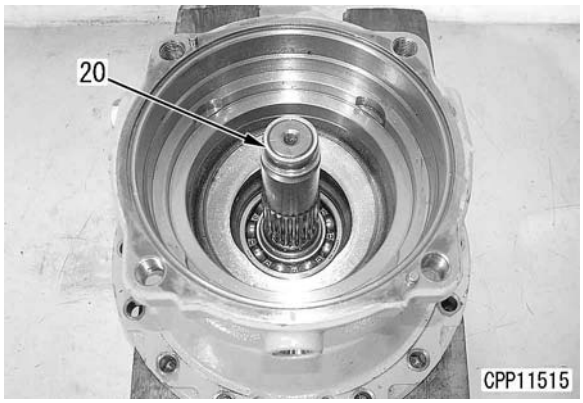
Lip surface of oil seal: Grease (G2-LI)



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).

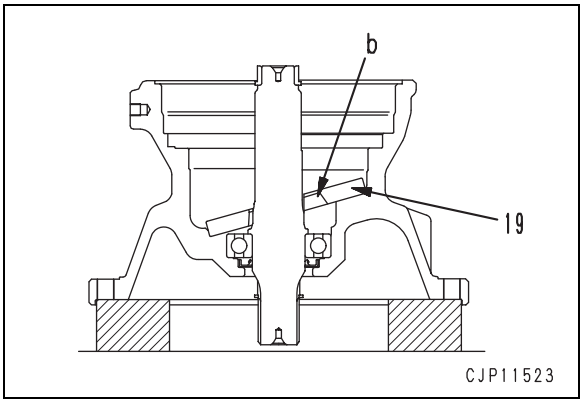


5) Install inner race (20).



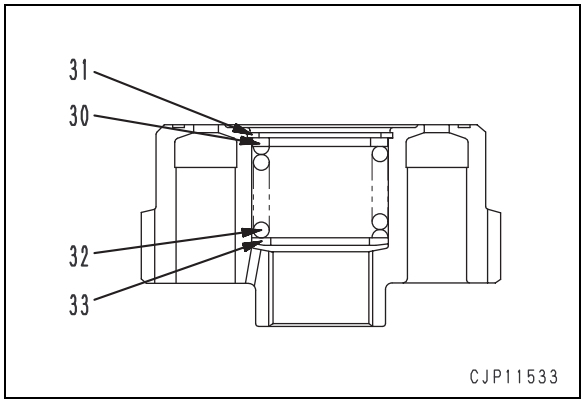
2. Thrust plate

Install thrust plate (19).
   ➽ Install the thrust plate with small hole side **b** up.



3. Cylinder block assembly

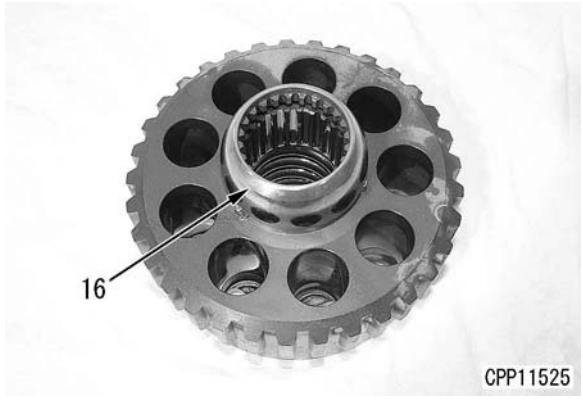
1) Install collar (33), spring (32), and collar (30).
2) Press down collar (30) with a press, etc., and install snap ring (31).



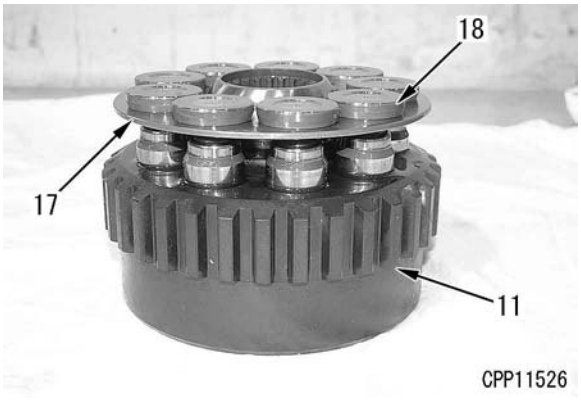
3) Install 3 pins (12).
   ✔ Apply grease (G2-LI) to the pins so that they will not fall when the cylinder block assembly is installed.

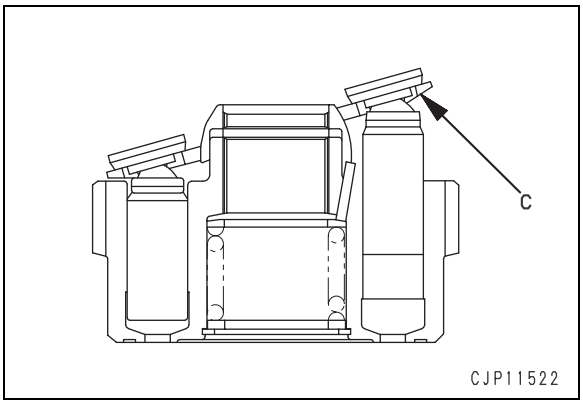


4) Install retainer holder (16).

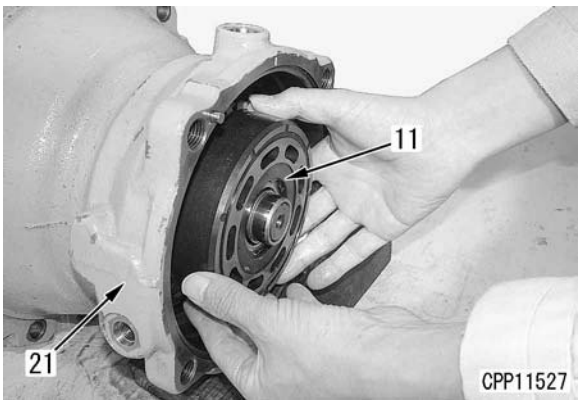


5) Install piston (18) to retainer plate (17).
   - ✔ Set chamfered periphery **c** of retainer plate (17) toward the cylinder block side.
6) Install the retainer plate and piston assembly to the cylinder block assembly (11).
   - ✔ Apply engine oil (EO10-CD) fully to the sliding surfaces of the piston and cylinder block.



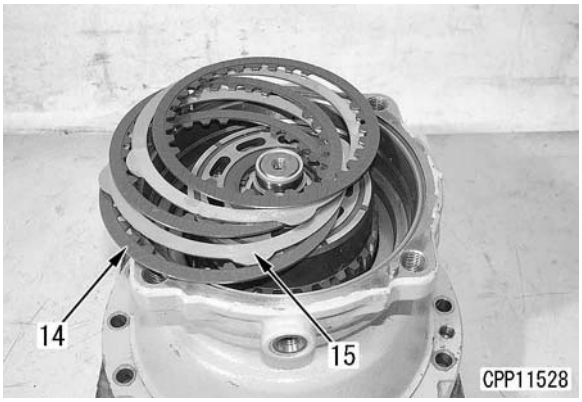


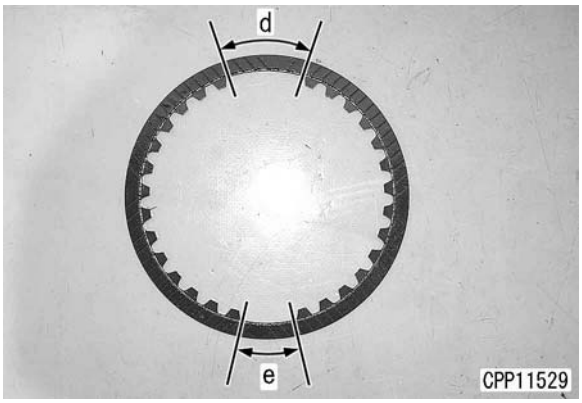
7) Place case (21) on its side.
8) Install cylinder block assembly (11) to the case.
   - ✔ Take care that the piston will not come out of the cylinder block.



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.



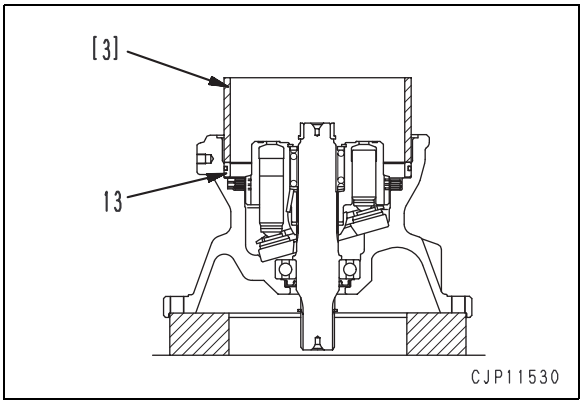


5. Collar

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).

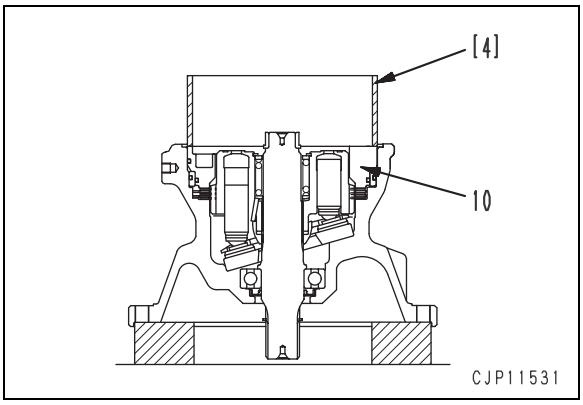
Periphery of O-ring: Grease (G2-LI)

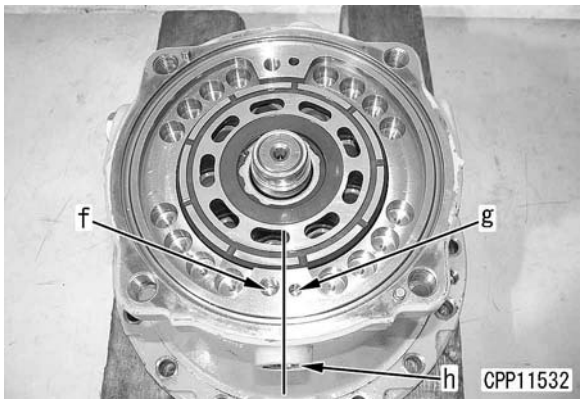
2) Using push tool [4], press fit brake piston (10) evenly.

✔ 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)

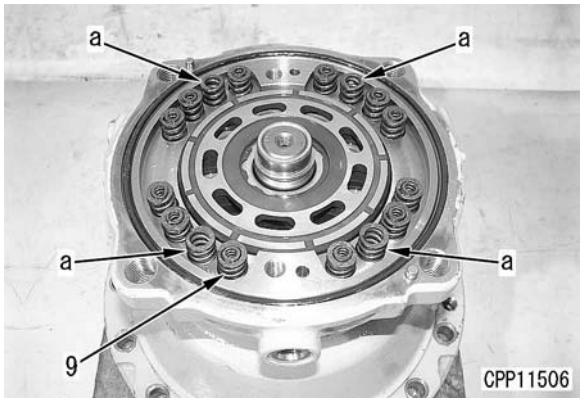




7. Springs

Install 16 springs (9).

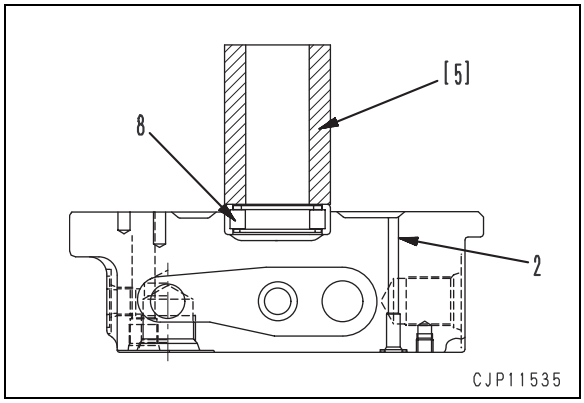
✔ There are outer springs (large) and inner springs (small). Install only the outer springs (large) to 4 places **a**.



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).

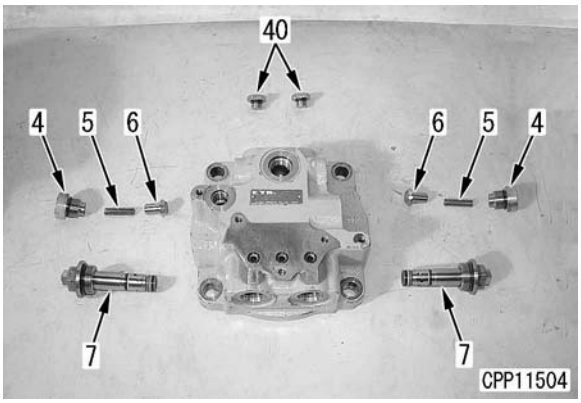
Periphery of backup ring and O-ring: Grease (G2-LI)

Relief valve assembly: 373 ± 20 Nm {38.0 ± 2.0 kgm}

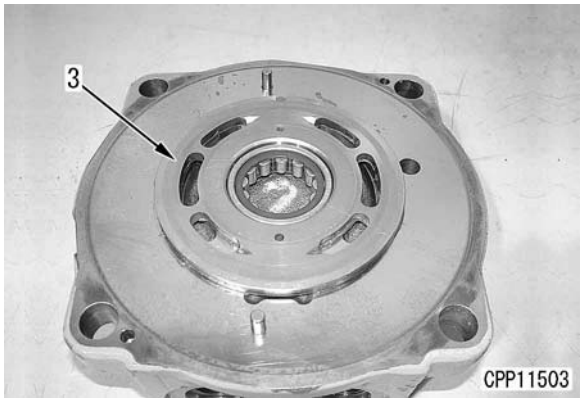
4) Install 2 poppets (6), 2 springs (5), and plugs (4).

Periphery of O-ring: Grease (G2-LI)

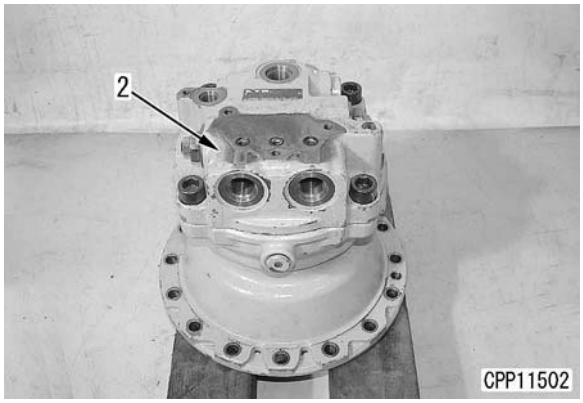
Plug: 157 ± 10 Nm {16.0 ± 1.0 kgm}



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.

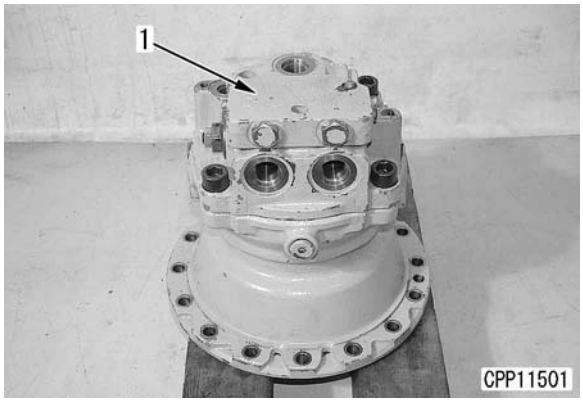


7) Tighten the mounting bolts.

Mounting bolt: 294 ± 20 Nm {29.9 ± 2.0 kgm}

9. Reverse prevention valve assembly
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

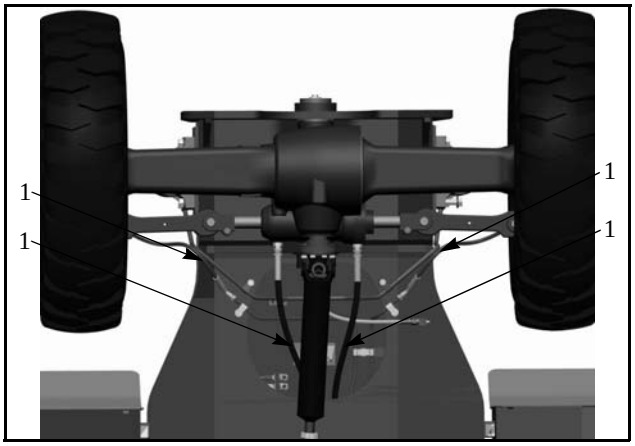
1. Drain oil out of front axle and hubs.

Front Axle: Approx. 11.5 Litres
Hubs: Approx.2.5 Litres (Each)

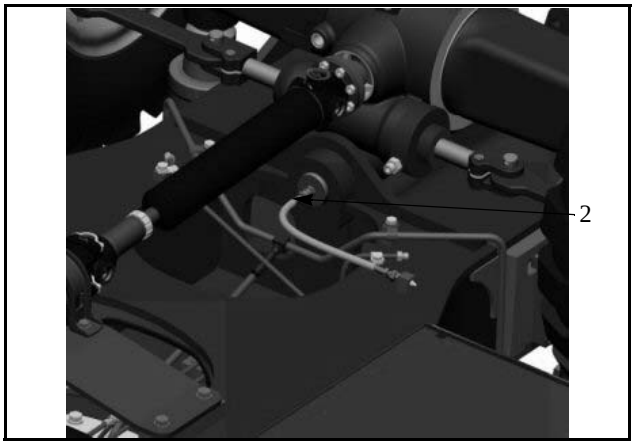
2. Retract front attachment fully.

Support suspension cylinder rod as this will drop freely when the axle is removed

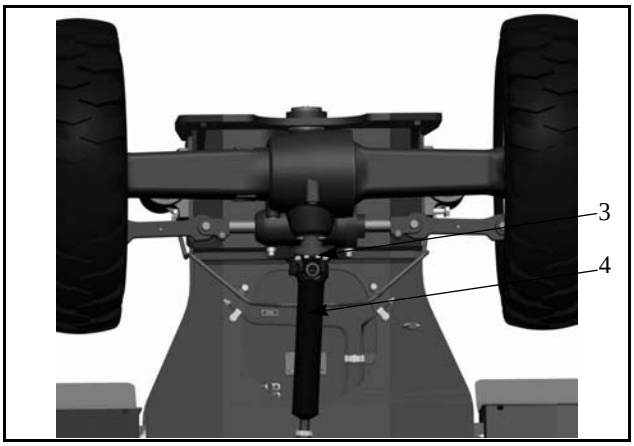
3. Remove 4 hoses (1).



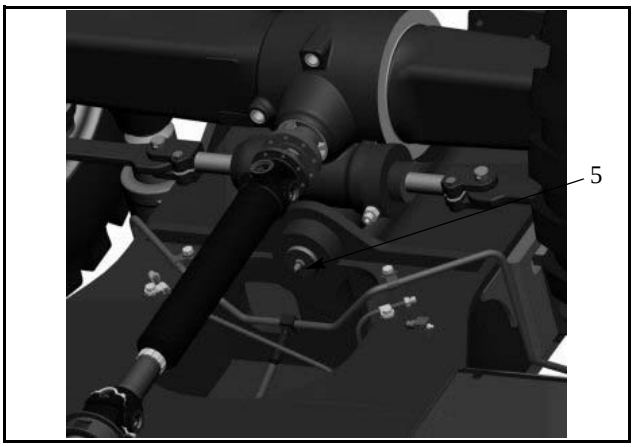
4. Remove hose (2).



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

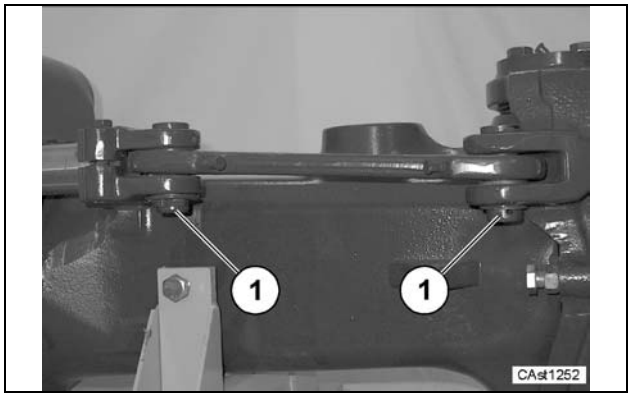
- Install in reverse order of removal.
- Grease all cylinders before installation
- Tightening torque for propshaft nuts (3): 58.8 - 73.5 Nm.

DISASSEMBLY AND ASSEMBLY OF FRONT AXLE

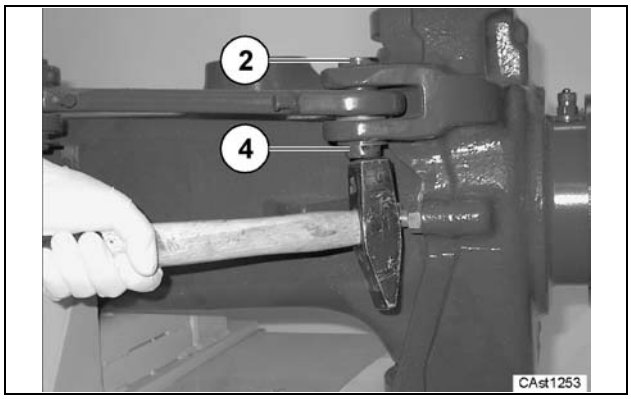
Disassembly of steering cylinder

1. Remove the safety split pins (1).

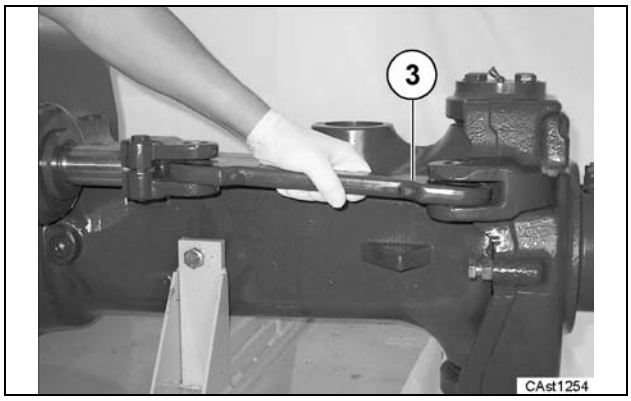
WARNING! Reject the used split pins.



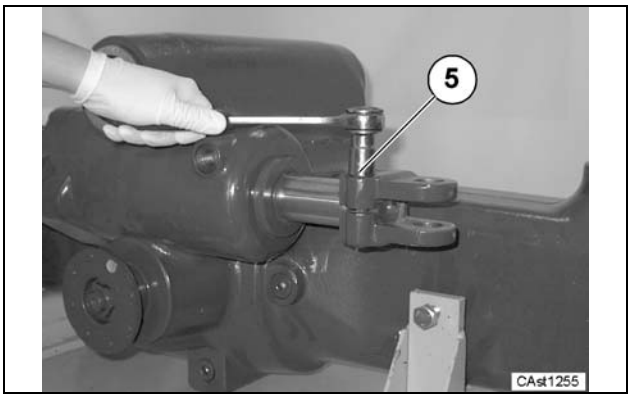
2. Remove the joint pivots (2) and the thicknesses (4).



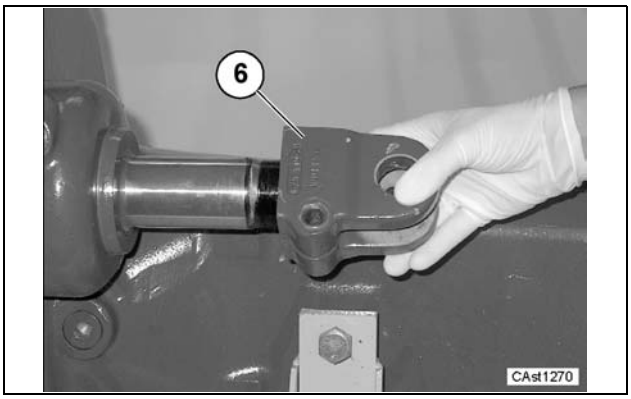
3. Remove the steering bars (3).



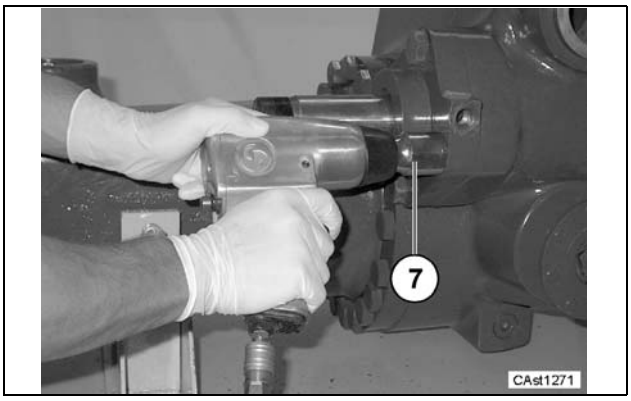
4. Remove the screws (5).



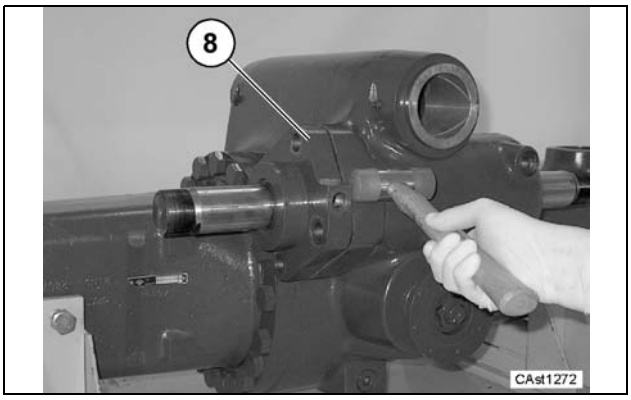
5. Unscrew the heads of the steering cylinder (6).



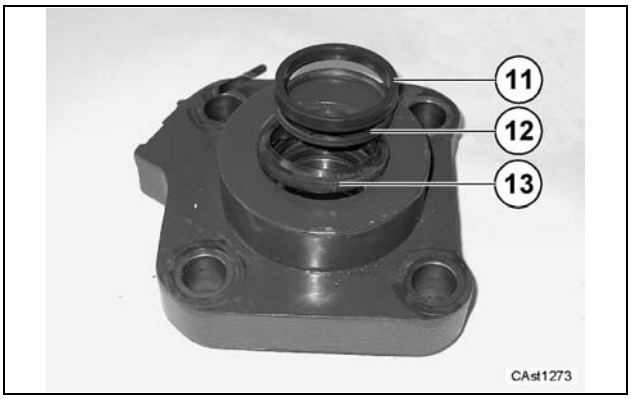
6. Remove the screws (7) of the steering cylinder.



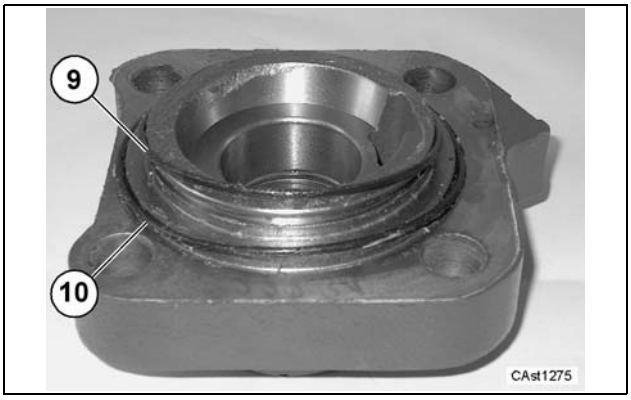
7. Remove the head of the cylinder (8). Strike by means of a plastic hammer.



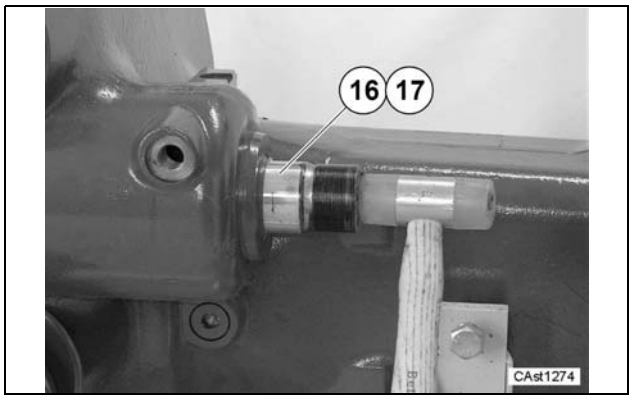
8. Remove the gaskets (11), (12) and the scraper ring.



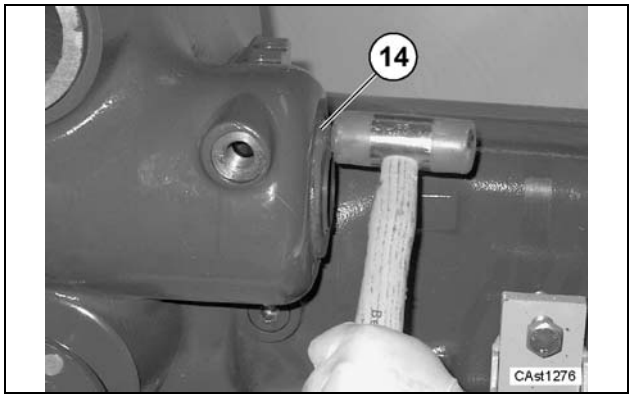
9. Remove the O-rings (9) and (10).



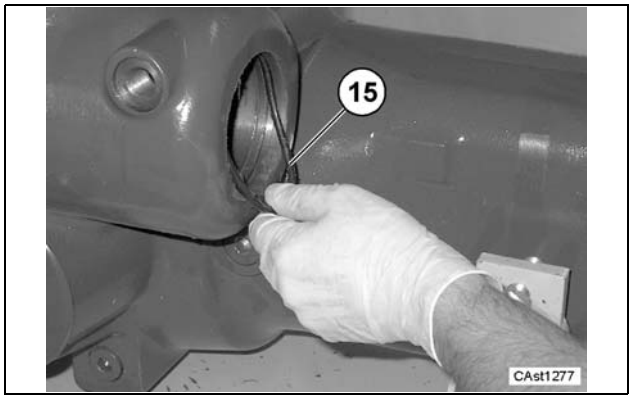
10. Remove the rod complete with cylinder (16) and cylinder liner (17).



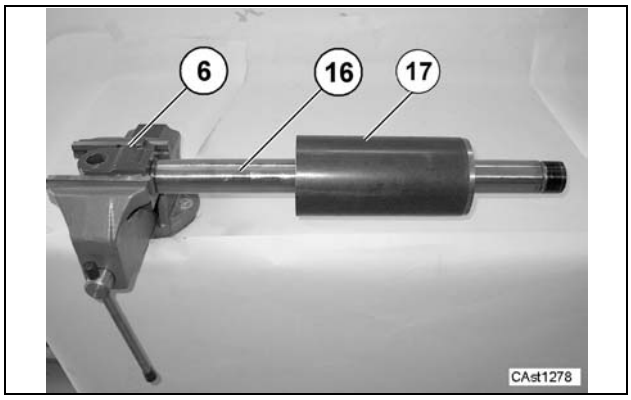
11. Remove the head of the cylinder (14).



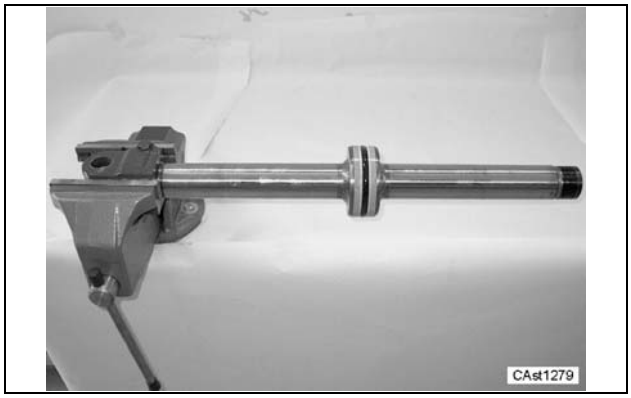
12. Remove O-ring (15).



13. Lock the rod of the cylinder (16) on a vice after having screwed the head (6).



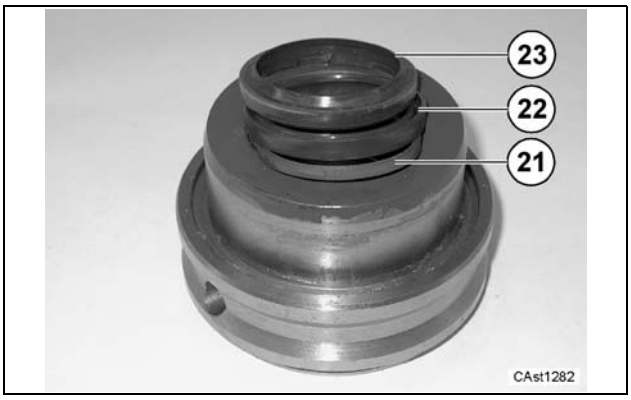
14. Remove the cylinder liner (17).



15. Remove the O-ring (20) and the setting thicknesses (24).

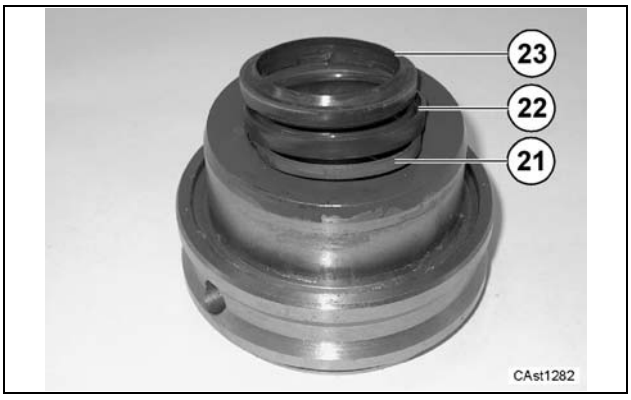


16. Remove the gaskets (21), (22) and the scraper ring (23).

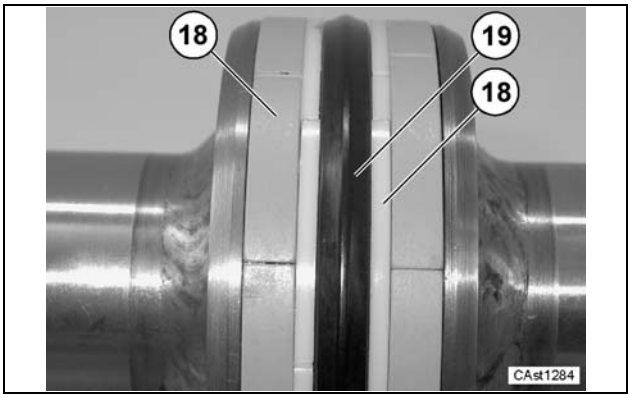


Assembly of steering cylinder

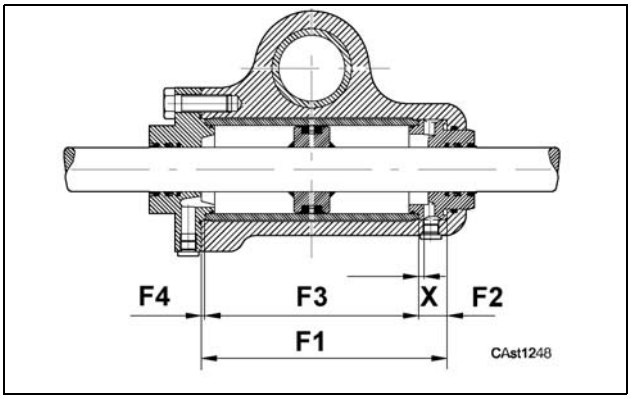
1. Fit the gaskets (21) and (22) and the scraper ring (23).



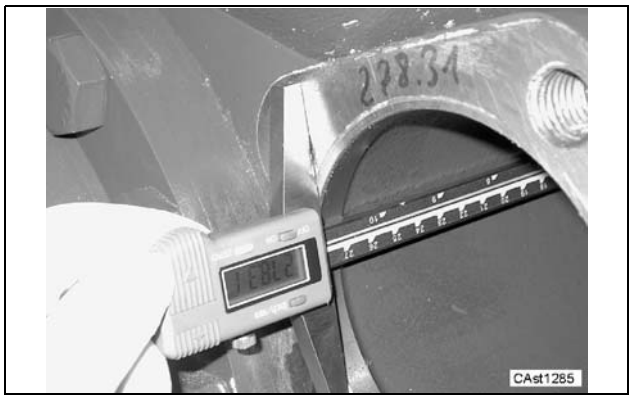
2. Fit the piston gaskets (18) and (19).
WARNING! The gasket cuts (18) should not coincide.



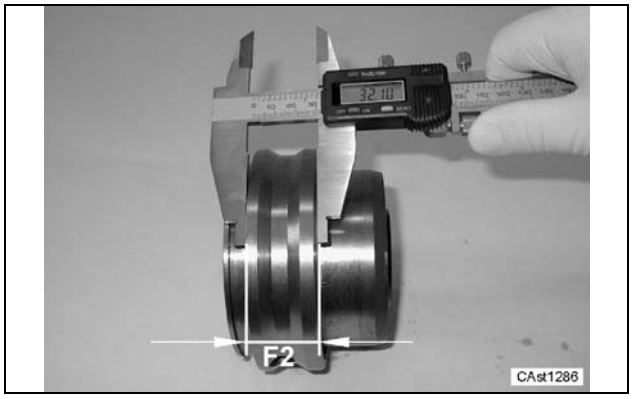
3. Thicknesses to be fitted.



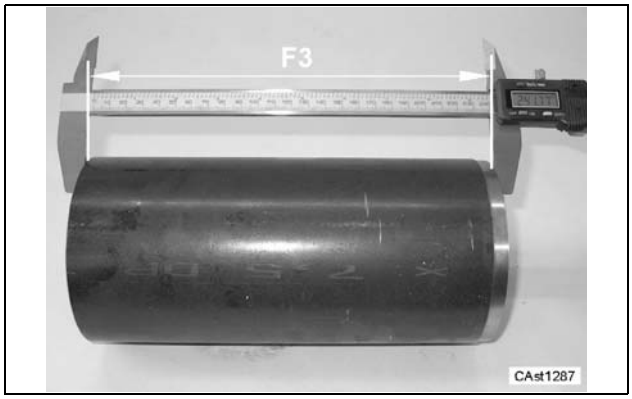
4. Measuring of value **F1.**



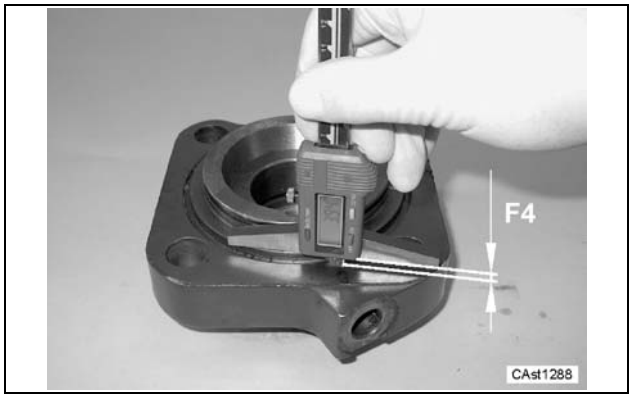
5. Measuring of value **F2.**



6. Measuring of value **F3.**



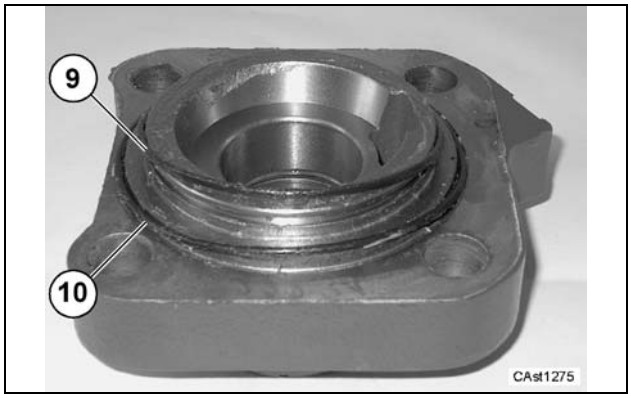
7. Measuring of value **F4.**



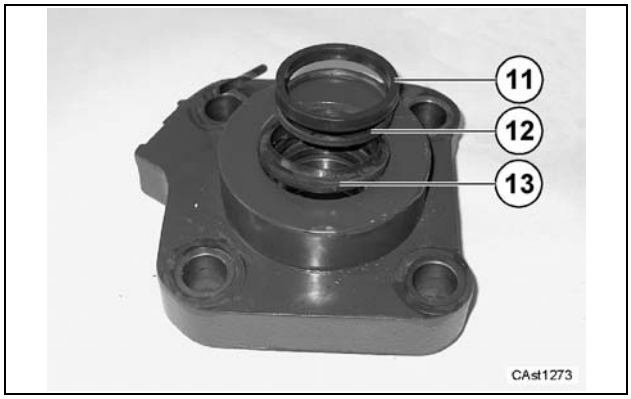
8. Assemble the thicknesses **X** (24) and the O-ring (20).



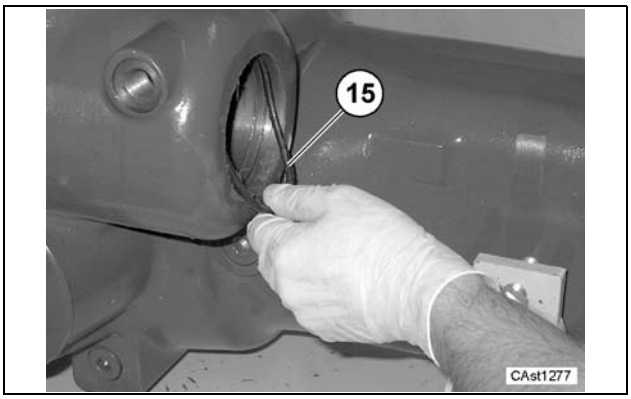
9. Assemble the O-rings (9) and (10).



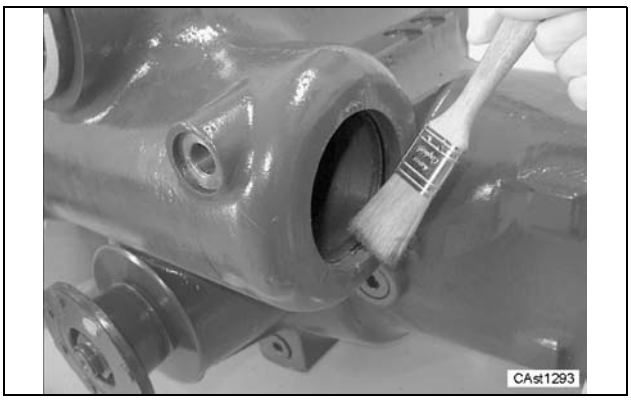
10. Assemble the gaskets (11), (12) and the scraper ring (13).



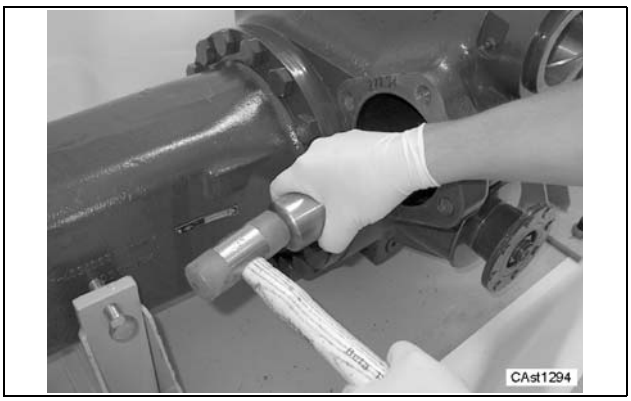
11. Assemble the O-ring (15).



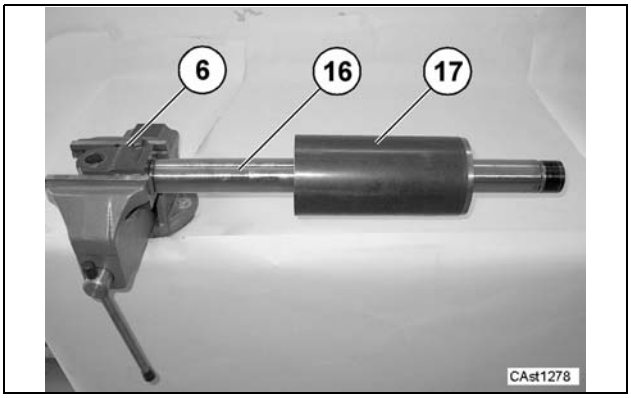
12. Lubricate with grease the contact surface.



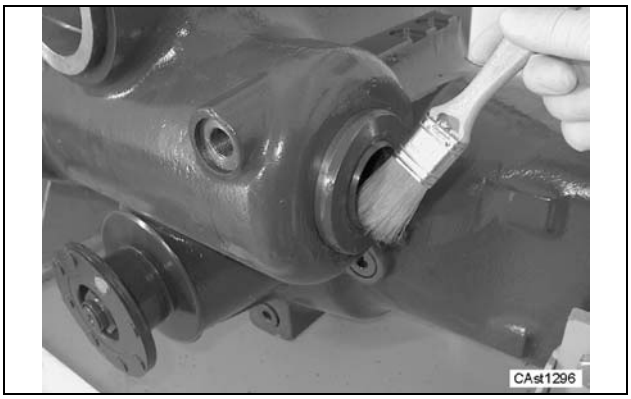
13. Assemble the head of the cylinder (14).



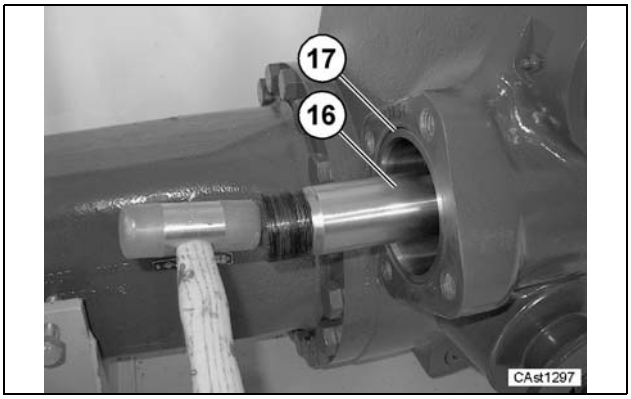
14. Lock the rod of the cylinder (16) on a vice after having screwed the head (6) and assemble the cylinder liner (17).



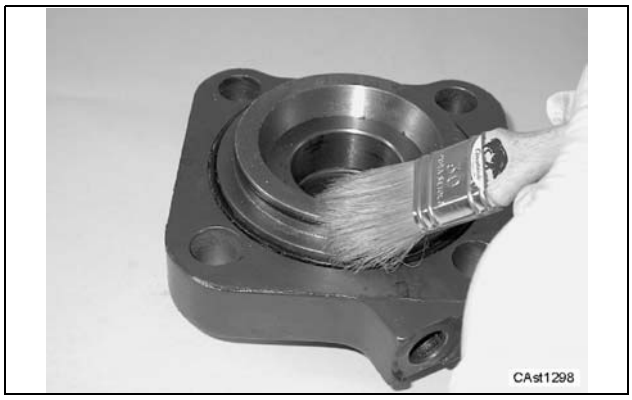
15. Lubricate with grease the gaskets of the right cylinder rod.



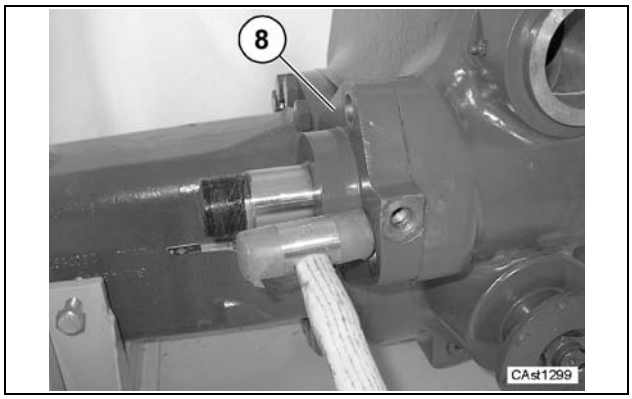
16. Assemble the rod complete with cylinder (16) and the cylinder liner (17).



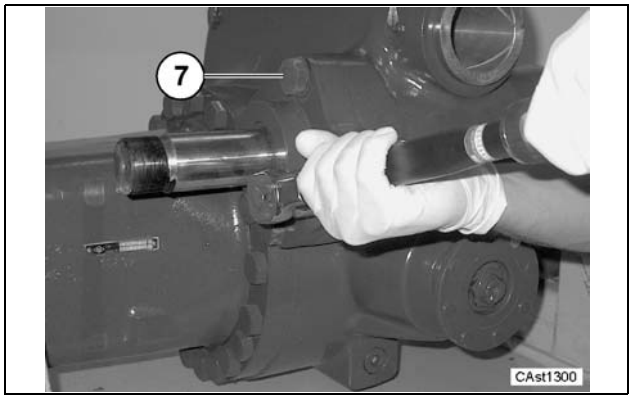
17. Lubricate with grease the gaskets of the left cylinder rod.



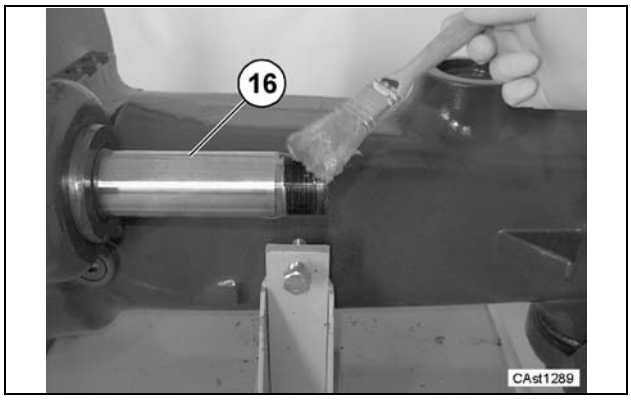
18. Assemble head of cylinder (8). Strike by means of a plastic hammer. Apply Loctite® 510.



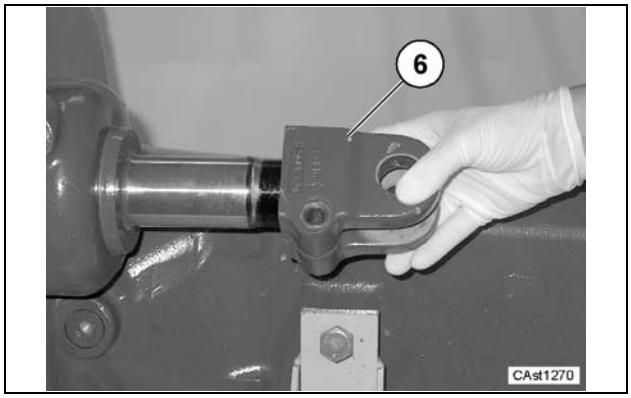
19. Assemble screws (7) of steering cylinder. Torque = 560Nm (57.1 kgf-m) Apply Loctite® 242.



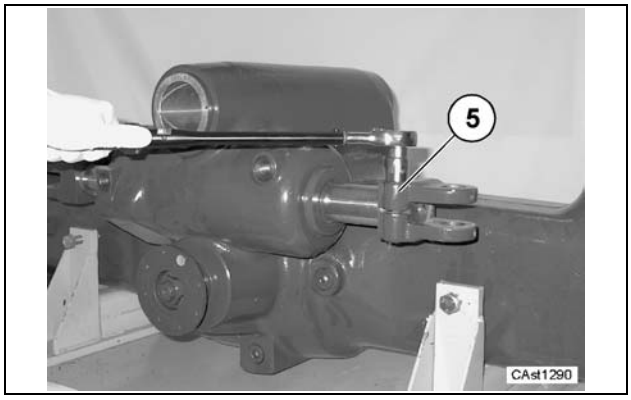
20. Lubricate the threads of the steering cylinder with grease.



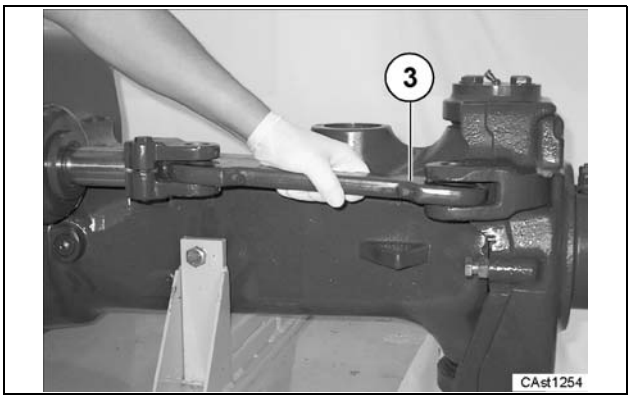
21. Screw heads of steering cylinder (6).



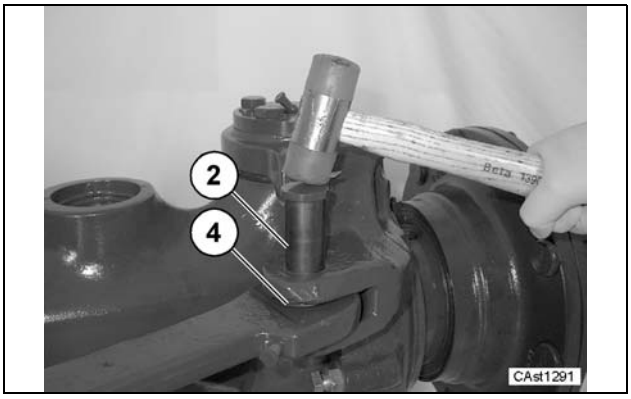
22. Fit screws (5). Torque = 117Nm (12 kgf-m)



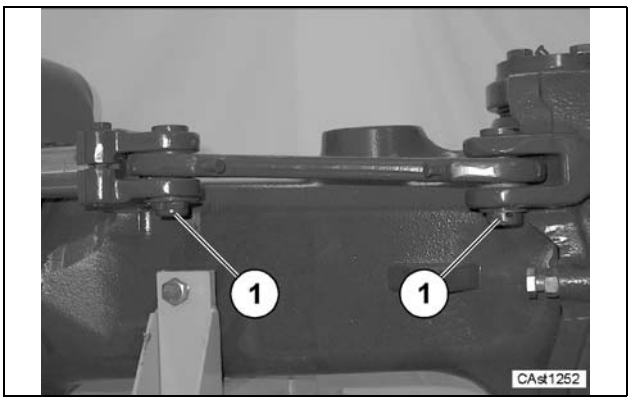
23. Assemble steering bars (3).



24. Assemble joint pivots (2) and thicknesses (4).

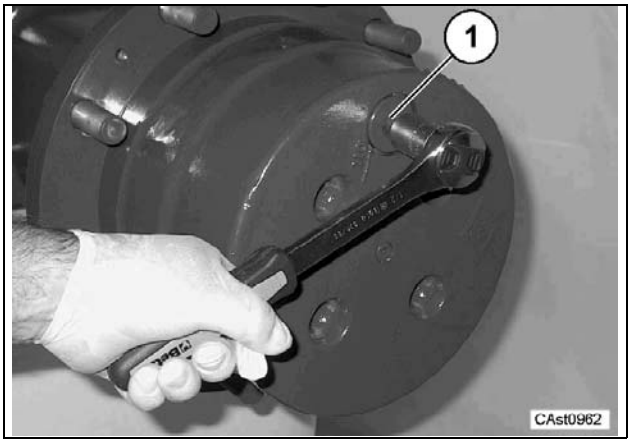


25. Assemble safety split pins (1).

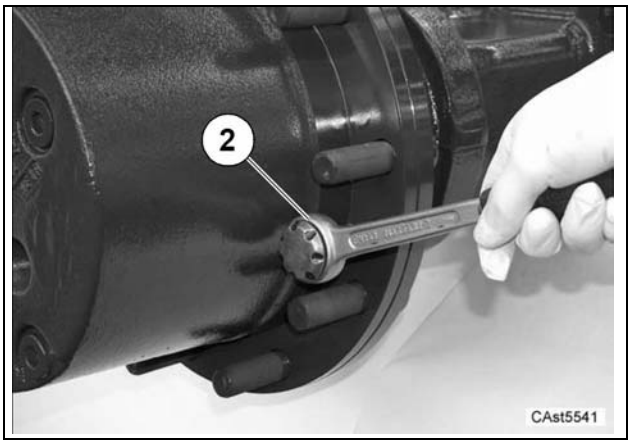


Disassembly of epicyclic reduction gear and brake

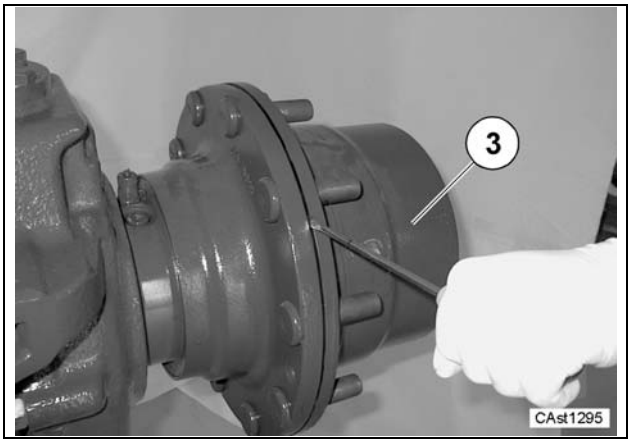
1. Before draining the oil, position the wheel hub (1) with the plug on the upper part and loosen it off some turns in order to eliminate any possible inner pressure, then remove it completely. Turn the wheel hub upside down till the hole is in the lowest point.
   Drain the oil completely.



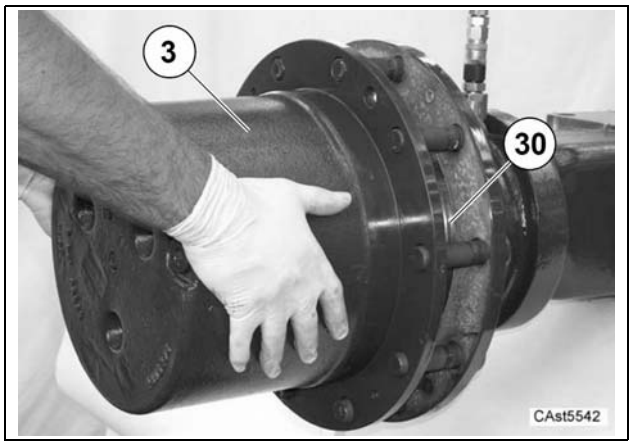
2. Remove fastening screws (2) from the cover of the planetary gears carrier.



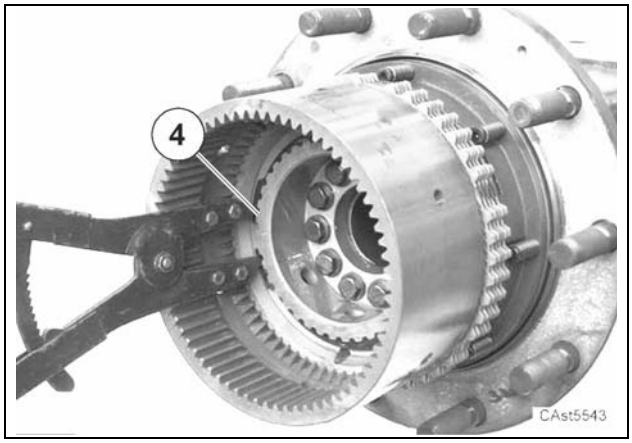
3. Use the levers inside the preset slots to detach the planetary gear carrier cover.



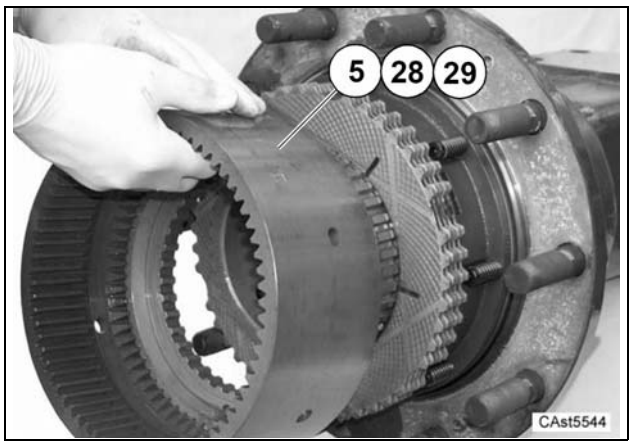
4. Remove the planetary gear carrier cover (3) and O-ring (30).



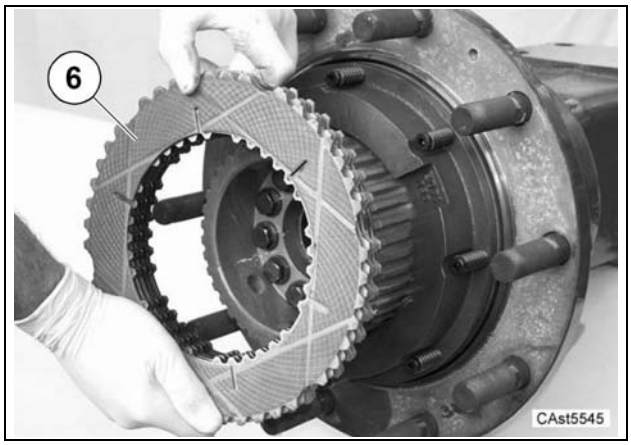
5. Remove split ring (4).



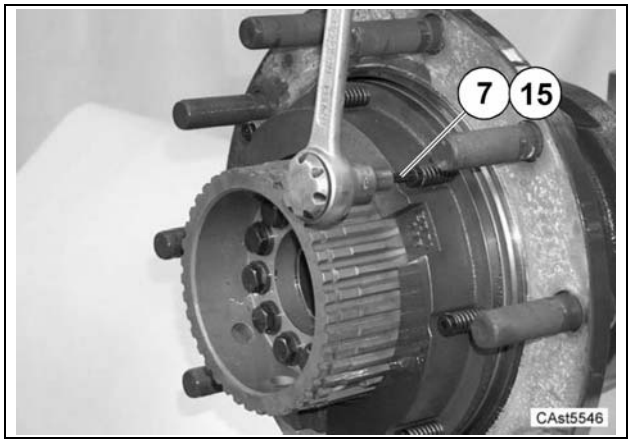
6. Remove ring bevel gear (5) complete with carrier (28) and split ring (29).



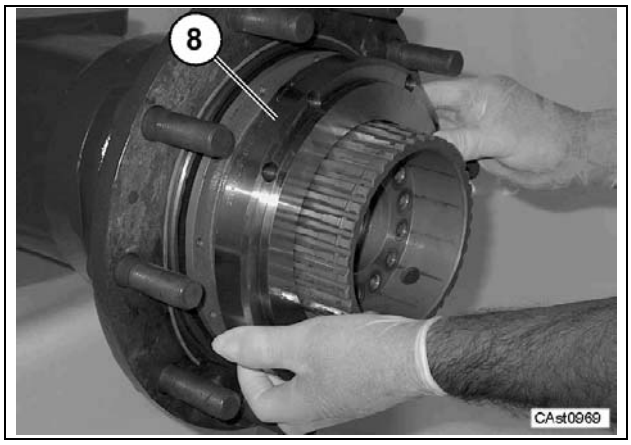
7. Remove brake discs (6).



8. Remove fastening screws of piston (7) and springs (15).



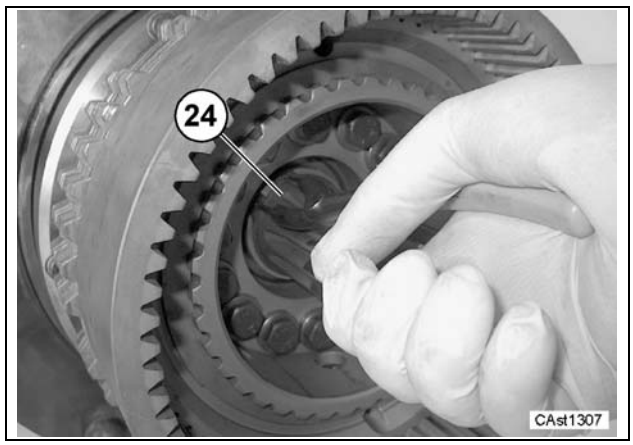
9. Remove piston (8).



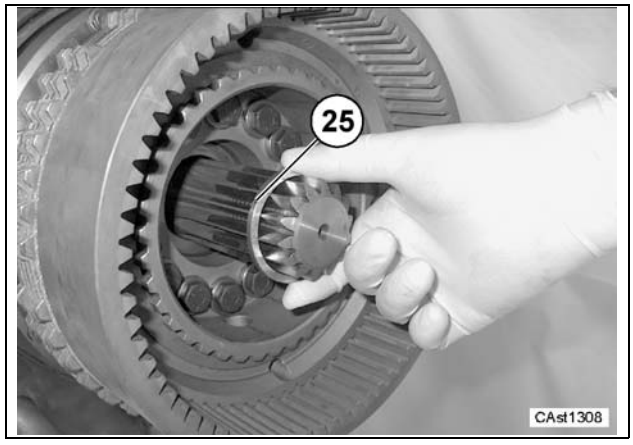
10. Remove seal rings (9) and (10) from piston (8).



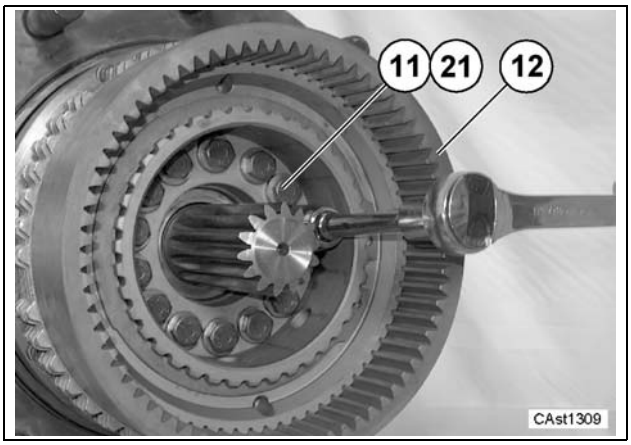
11. Remove snap ring (24).



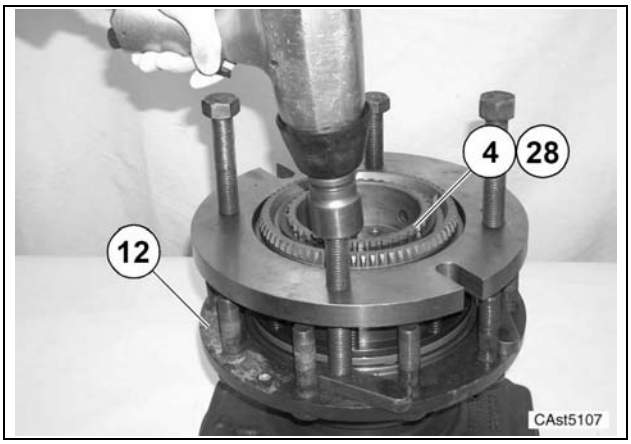
12. Remove spacer (25).



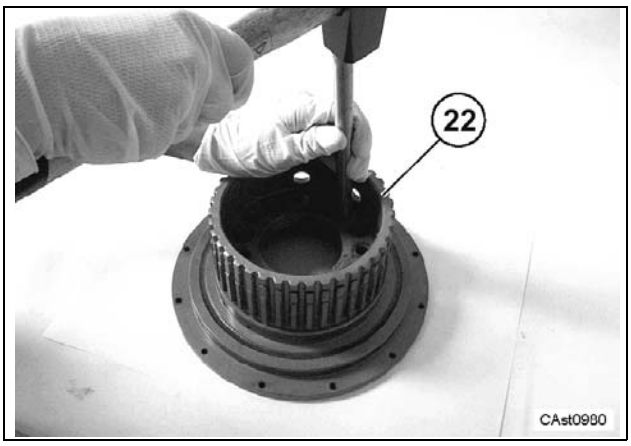
13. Remove screws (11) and washers (21) from brake carrier (12).



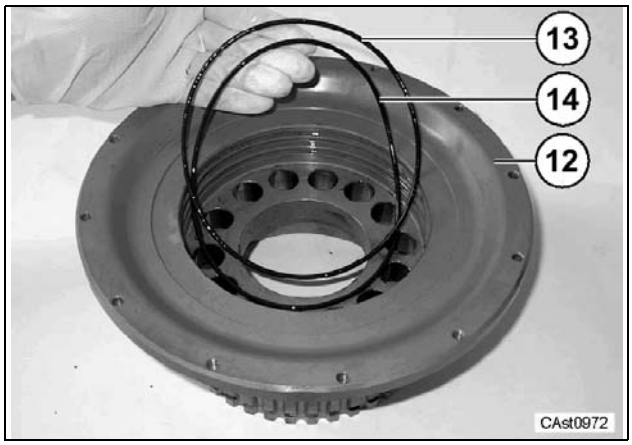
14. Assemble carrier (28) and split ring (4). Remove brake carrier (12).



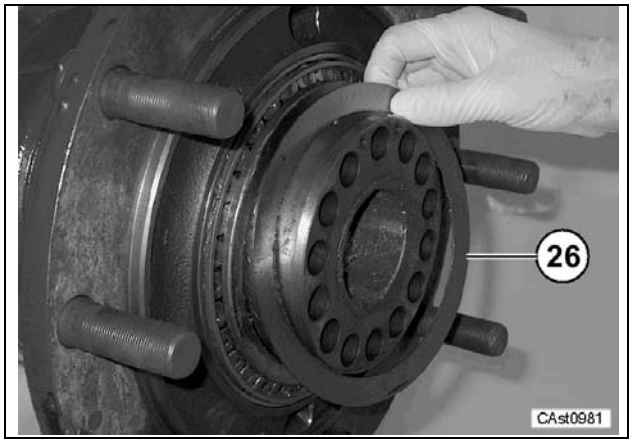
15. Remove bushes (22).



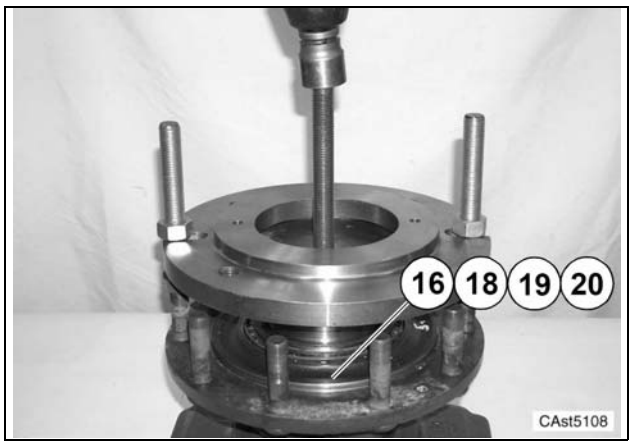
16. Remove seal rings (13) and (14) from brake carrier (12).



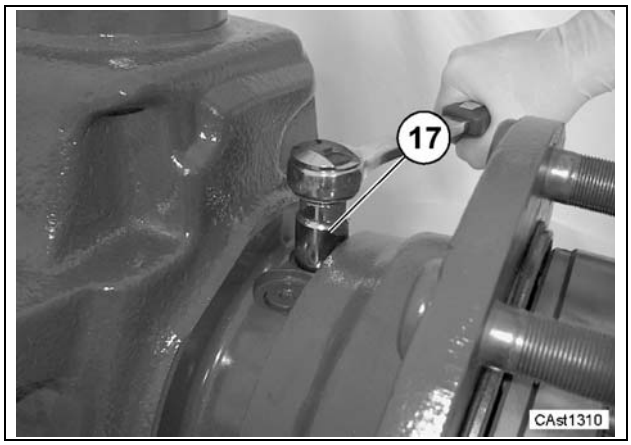
17. Remove shims (26).



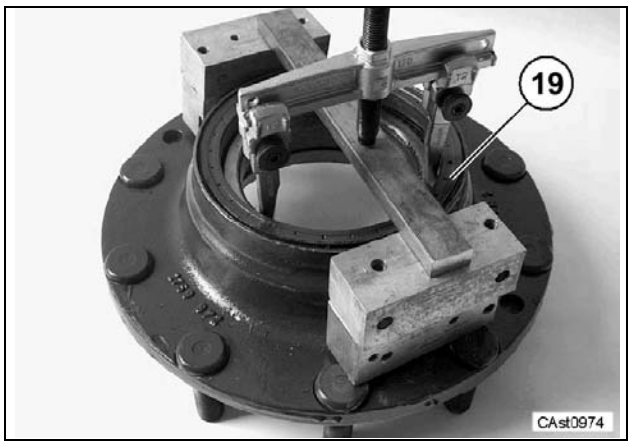
18. Remove wheel hub (16) with bearings (18) and (20) and seal ring (19).



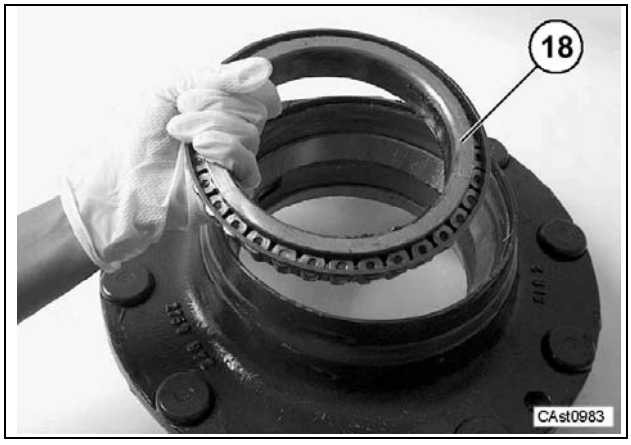
19. Remove the drain valve (17).



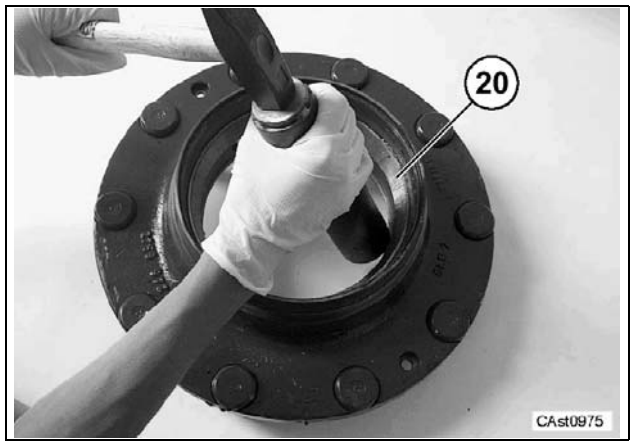
20. Remove seal ring (19).



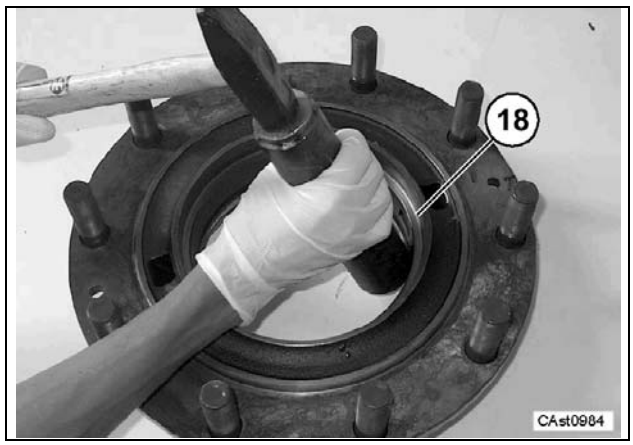
21. Remove inner cup of bearing (18).



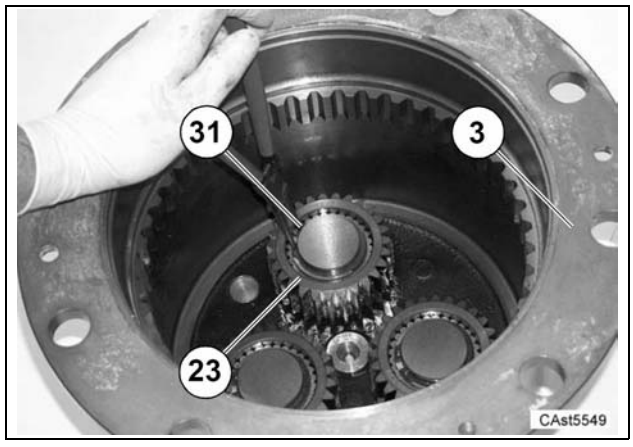
22. Remove outer cup of bearing (20).



23. Remove outer cup of bearing (18).

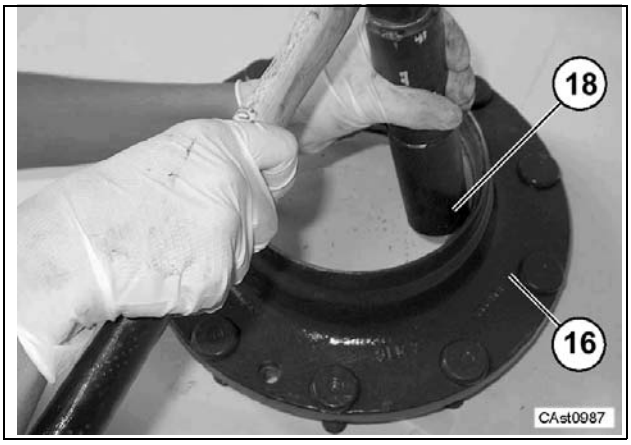


24. Remove snap ring (31). Remove planetary gears (23) from planetary gear carrier cover (3).



Assembly of Epicylic Reduction Gear and Brake

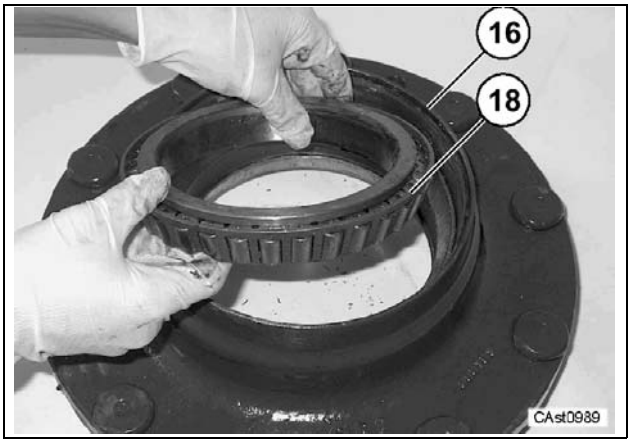
1. Fit outer cup of bearing (18) wheel hub (16).



2. Fit outer cup of bearing (20) wheel hub (16).



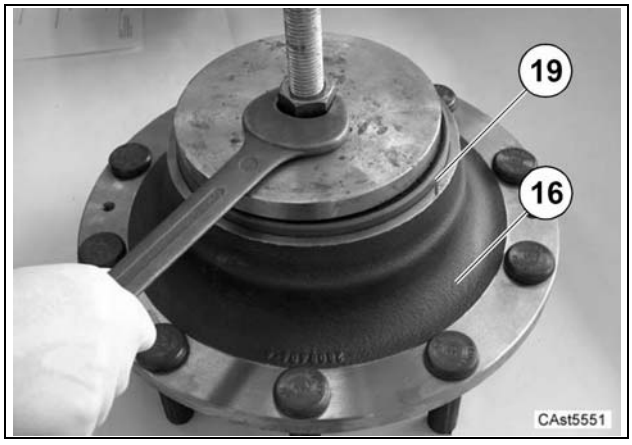
3. fit the remaining part of bearing 18) on wheel hub (16).



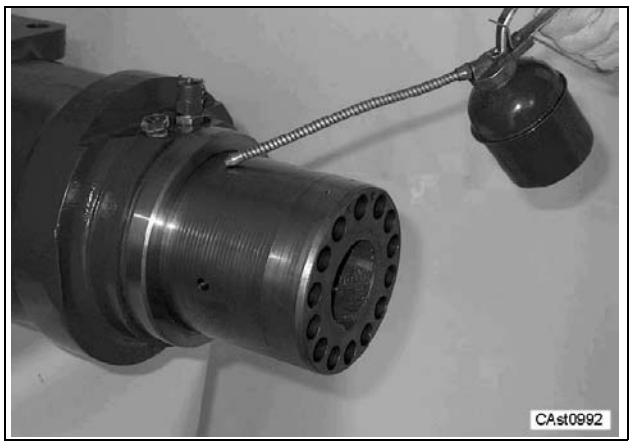
4. Apply Loctite® 510 on seal ring (19).



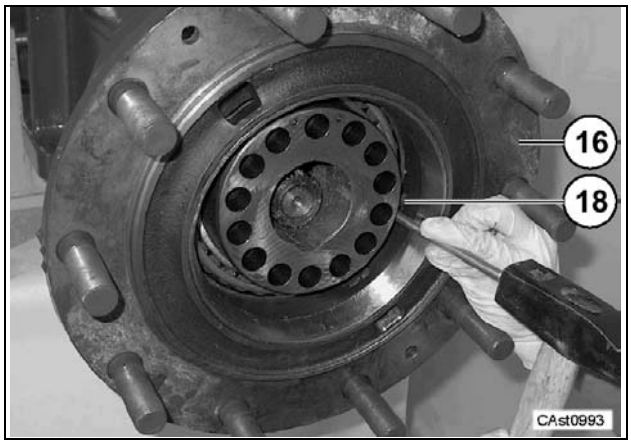
5. Fill seal ring (19) on wheelhub (16). Use tool 2897003.



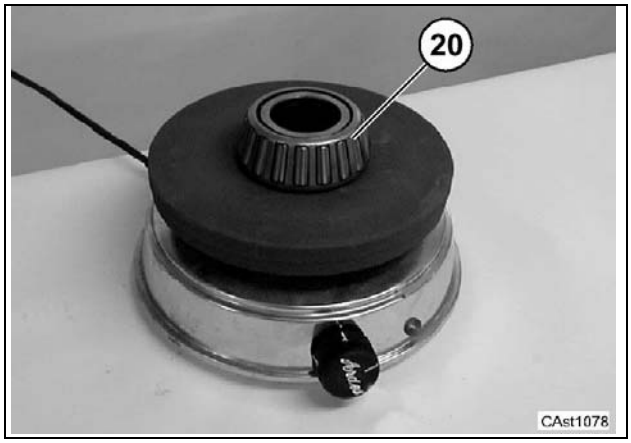
6. Lubricate axle shaft to assemble the wheel hub. **Warning**: Polish hub and oil holes.



7. Assemble the whole wheel hub (16). Alternately strike bearings (18).
   Warning: The roller bearing should be rested on the beam trumpet.



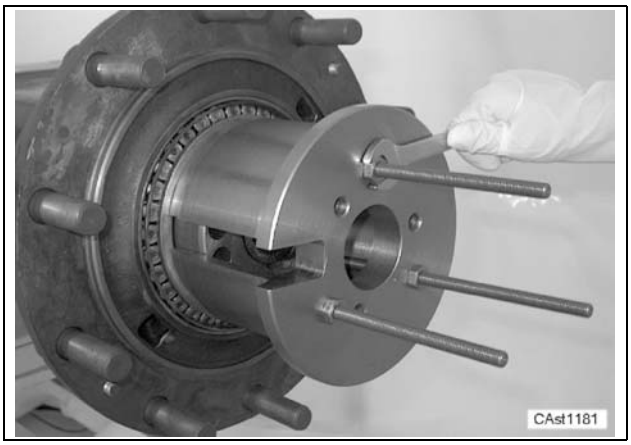
8. Preheat bearing (20) on proper plate up to 100°C.



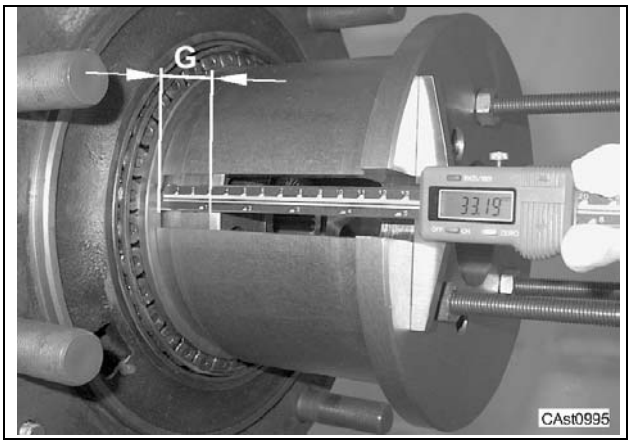
9. Fit bearing (20) inside beam trumpet.
   Warning: Wear gloves to avoid getting burnt.



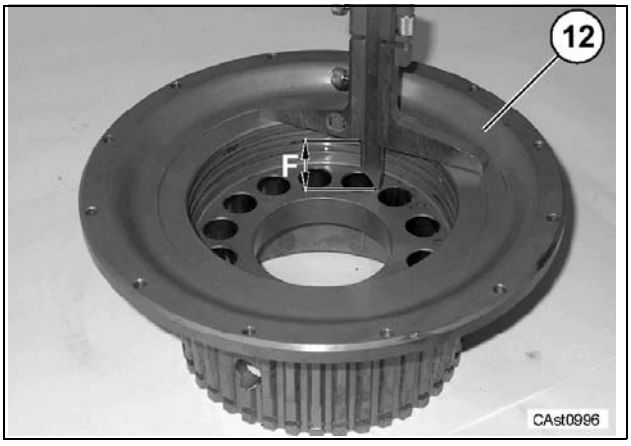
10. Assemble the tool 2897013, 3 draw plates M10 x 285 and 3 nuts M10.



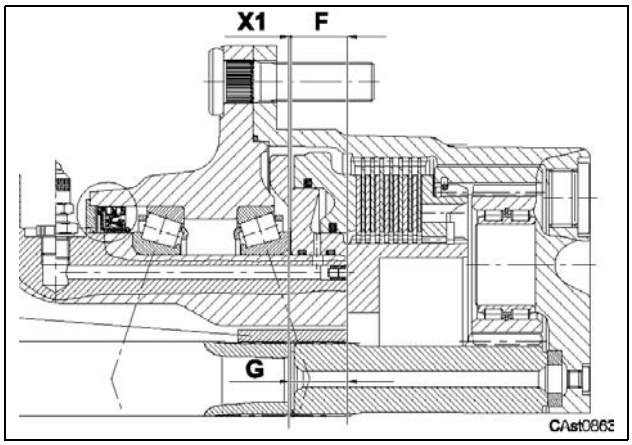
11. Use a depth gauge to measure dimension (g) of wheel hub.



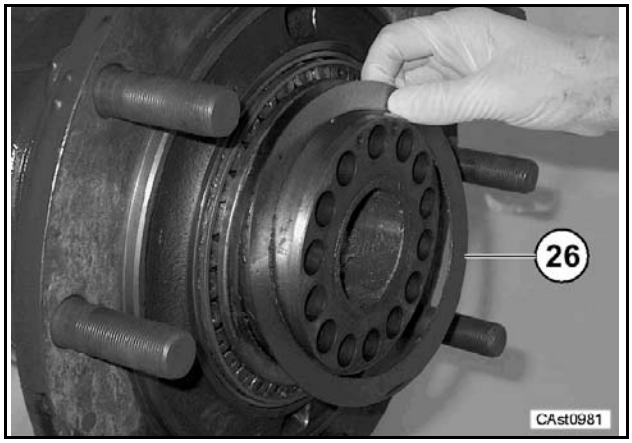
12. Use a depth gauge to measure dimension F of brake carrier (12).



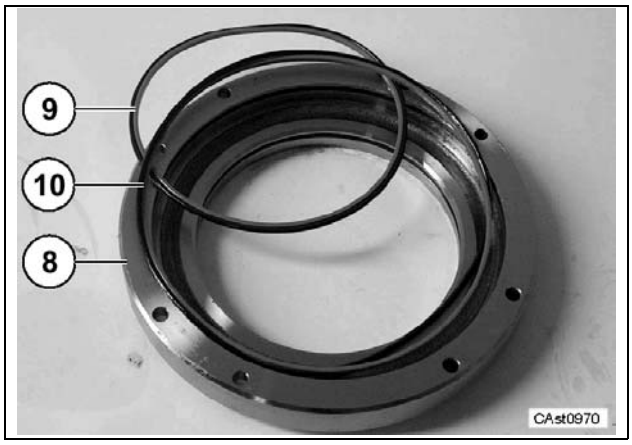
13. Calculate shims X1 of adjustment shims by using the following procedure: X1 (G-F) + 0.05.



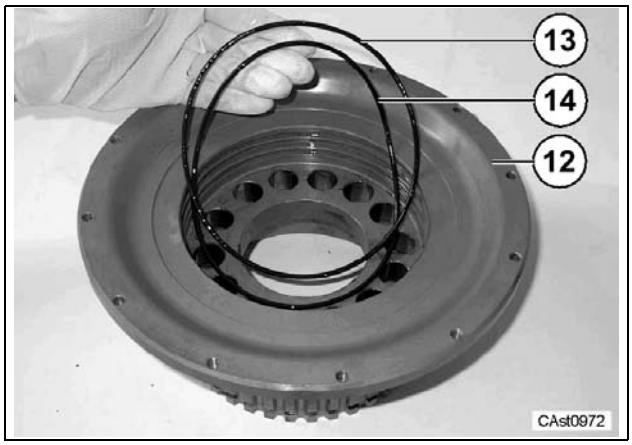
14. Assemble previously calculated shims (26) X1.



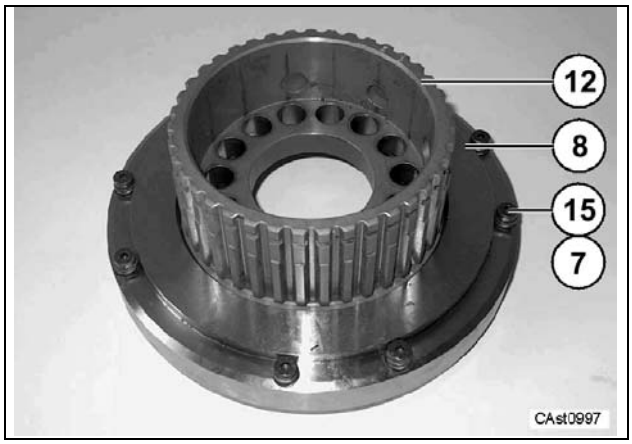
15. Assemble O-rings (9) and (10) on piston (8).



16. Assemble O-rings (13) and (14) on brake carrier (12).



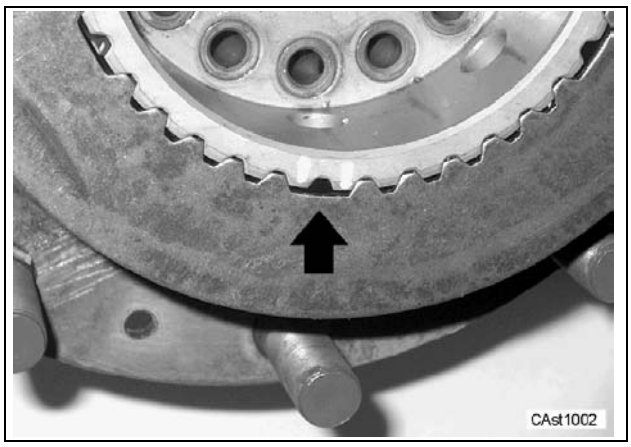
17. Fit piston (8) on brake carrier (12) with springs (15) and screws (7). Apply Loctite® 638 on the screws (7).



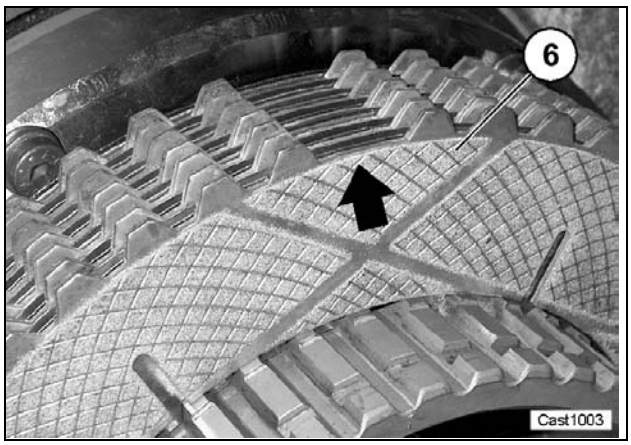
18. Fit the whole unit of the brake carrier on wheel hub.
Warning: The brake carrier and beam trumpet holes should coincide.



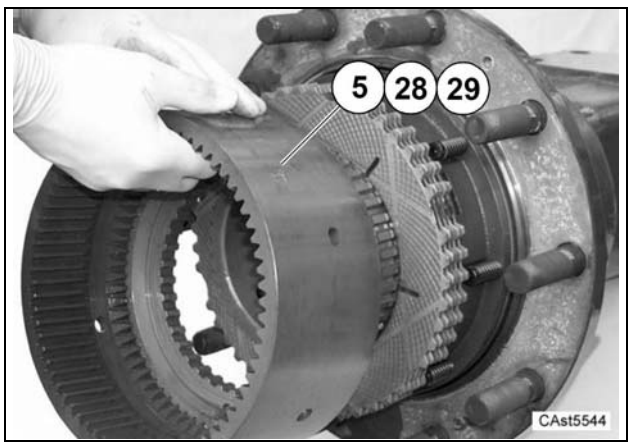
19. Assemble brake discs (6).
Warning: During assembly operations all the inner disc slots should coincide.



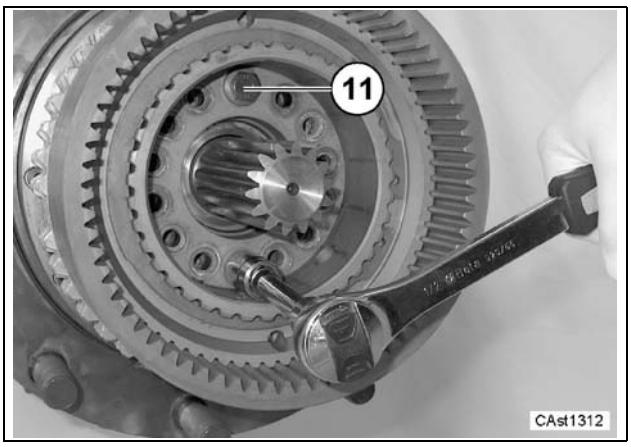
20. Assemble brake discs (6).
Warning: During assembly operations all the outer disc slots should coincide.



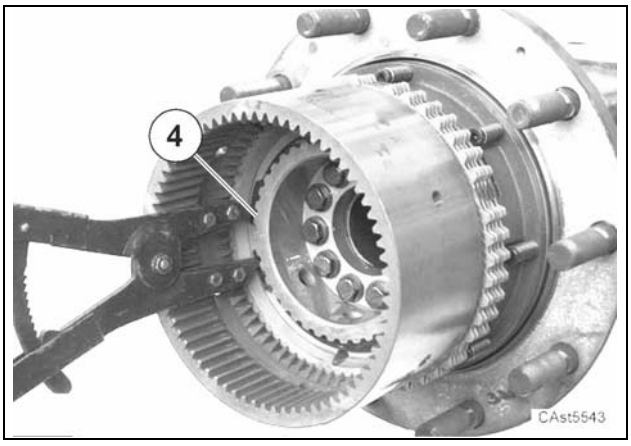
21. Fit ring bevel gear (5) with carrier (28) and split ring (29).



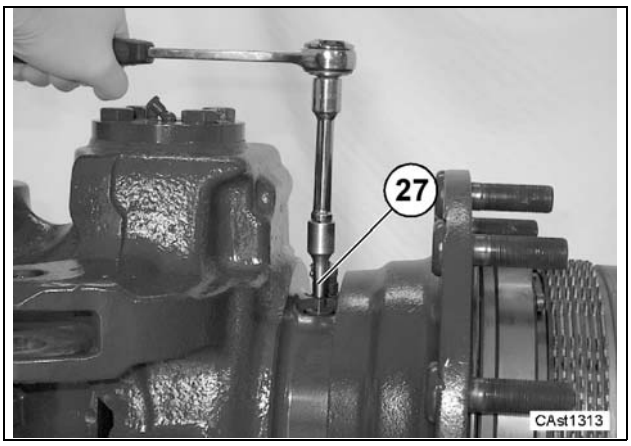
22. Test the brake by temporarily fitting two screws (11).
Warning: Do not assemble bushes (22).



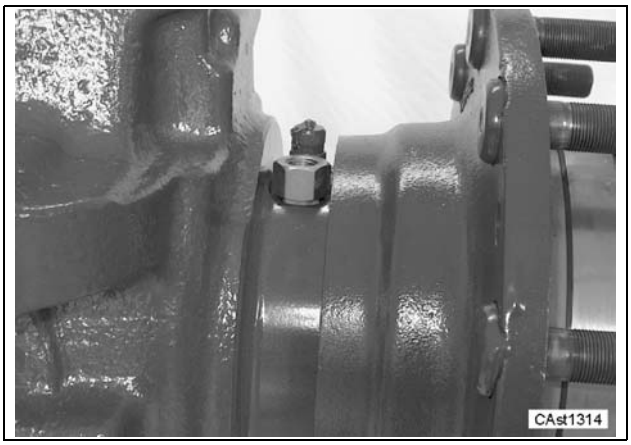
23. Fit snap ring (4).



24. Remove plug (27).



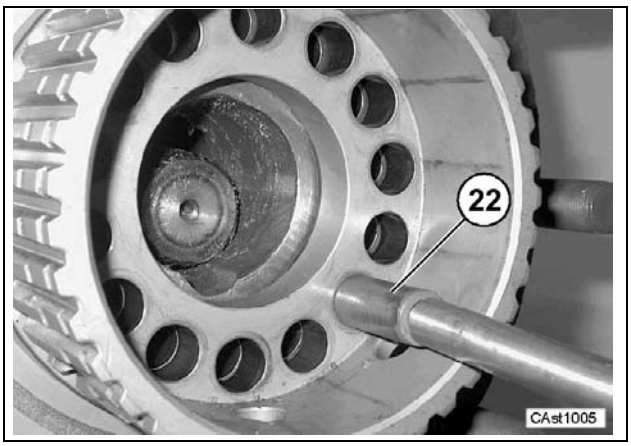
25. Fit an adapter instead of the plug.



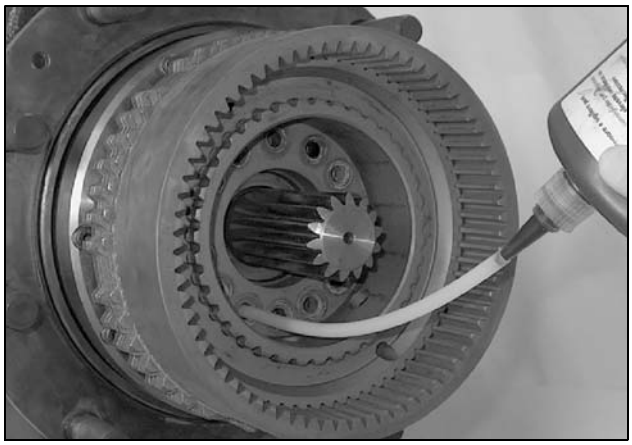
26. Test the brakes by considering that pressure should be 100^{0}_{-5} bar for about one minute.



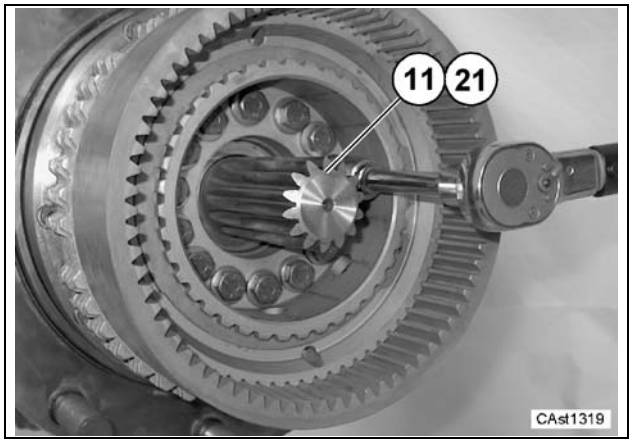
27. Fit bushes (22).
Warning: Pay attention to the assembly direction of bushes.



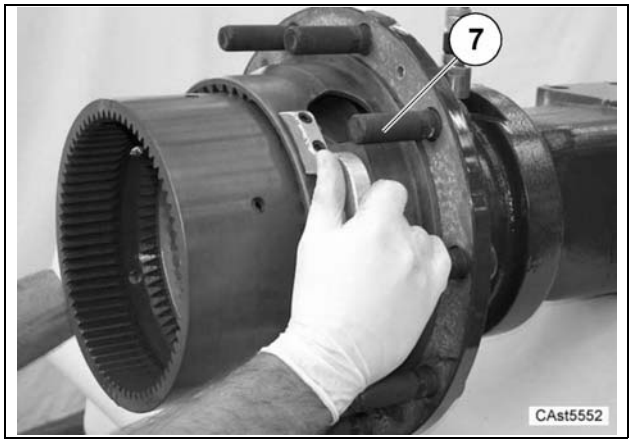
28. Apply Loctite® 242 inside slots.



29. Fit screws (11) and shims (21).
Tightening torque: 68Nm



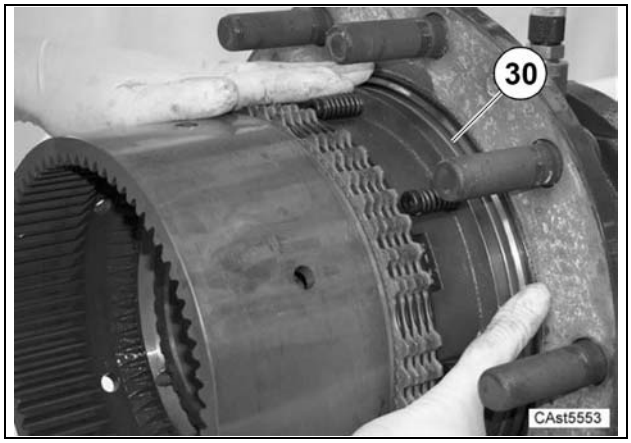
30. Line up brake discs. Use tool 2897014.
Warning: A tooth should coincide with a brake fastening screw (7).



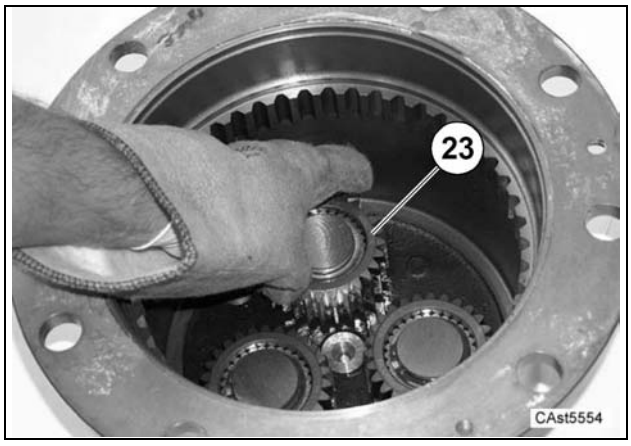
31. Put brakes under pressure to avoid outer disc misalignment.



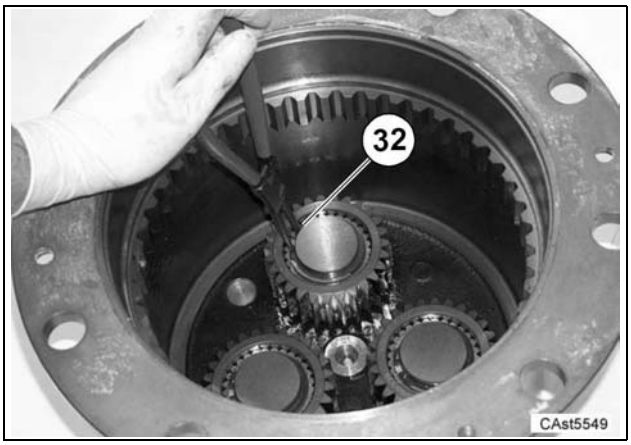
32. Lubricate with grease and fit O-ring (30).



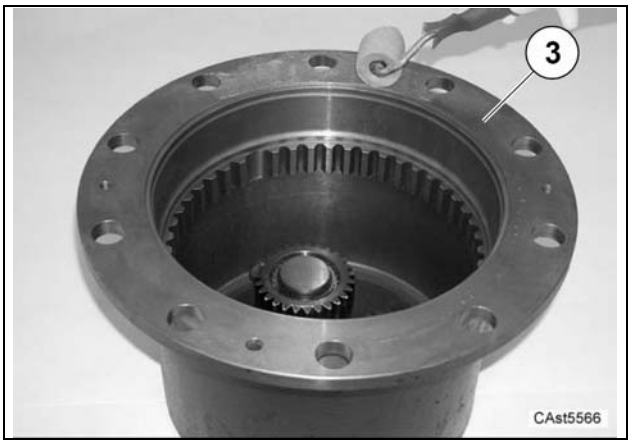
33. Heat the planetary gear bearing at 110°C. Assemble planetary gear.



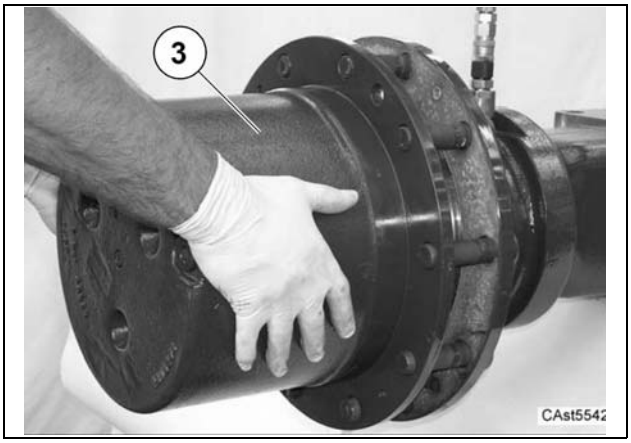
34. Assemble snap ring.



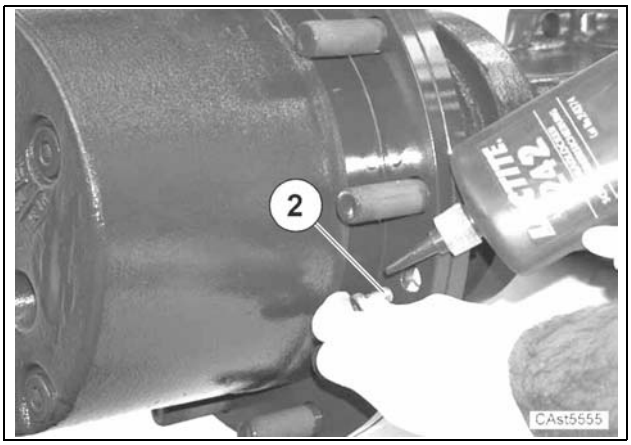
35. Lubricate with grease the contact surface of planetary gear cover (3). Apply Loctite® 510 in the holes.



36. Fit the planetary gear cover (3) and discharge pressure from the hydraulic pump.



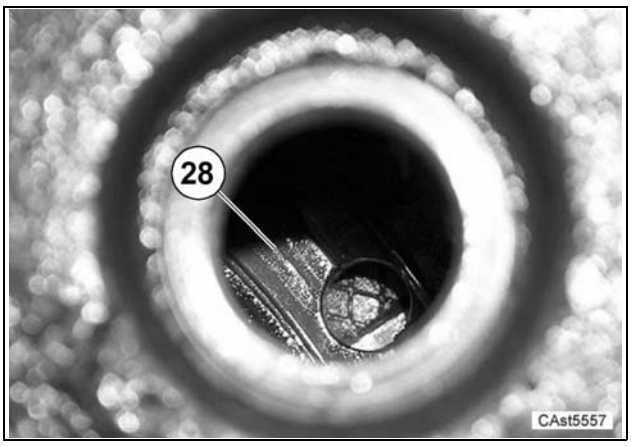
37. Apply Loctite® 242 on screw.



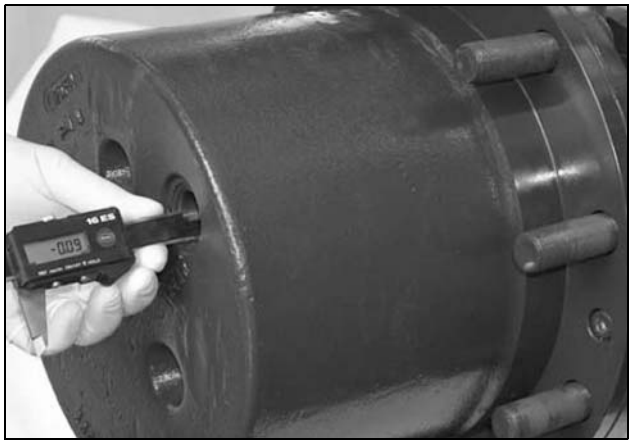
38. Fit screws (2) according to the proper tightening torque (48Nm).



39. Remove oil drain plug and turn the final drive up to meeting item (28) hole.

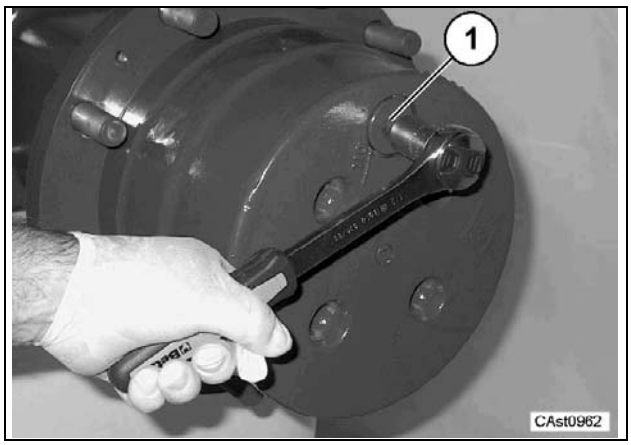


40. Apply pressure of 45-50 bar and check the distance between brake locking and unlocking (Min: 1.7mm; Max: 3.8 mm)

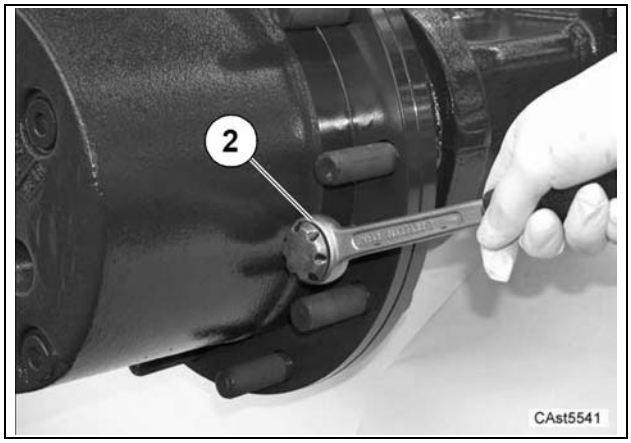


Disassembly of joint box

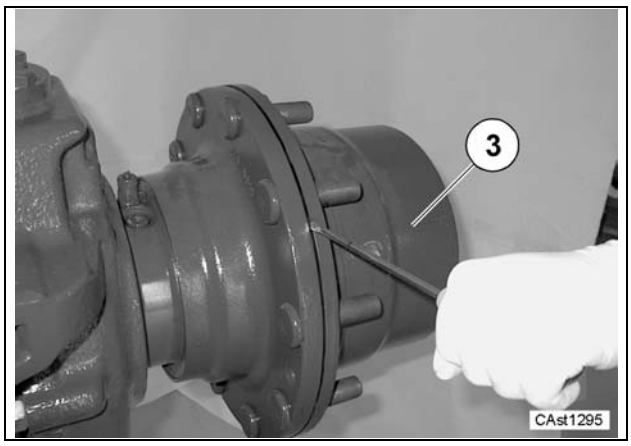
1. Before draining the oil, position the wheel hub (1) with the plug on the upper part and loosen it off some turns in order to eliminate any possible inner pressure, then remove it completely. Turn the wheel hub upside down till the hole is in the lowest point.
   Drain the oil completely.



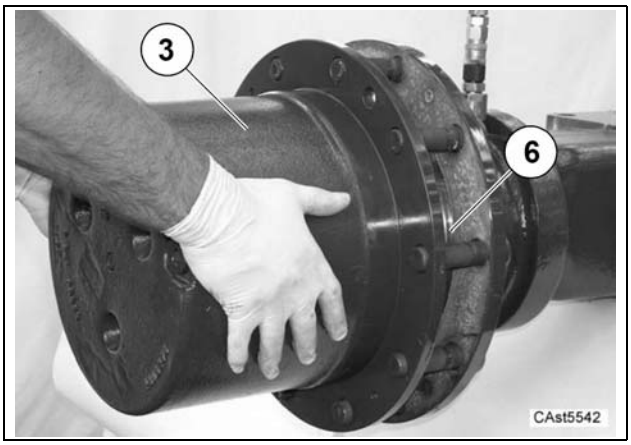
2. Remove fastening screws (2) from the cover of the planetary gears carrier.



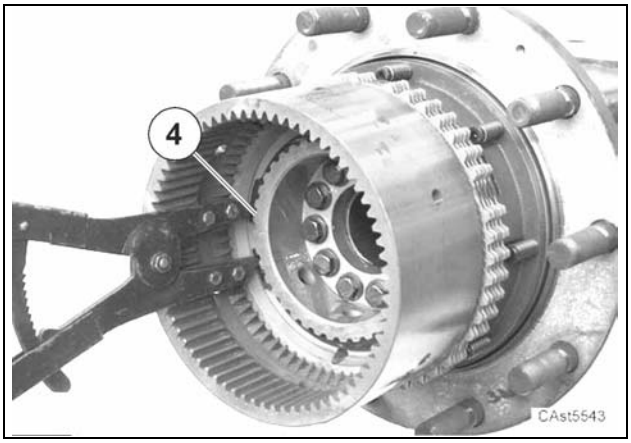
3. Use the levers inside the preset slots to detach the planetary gear carrier cover.



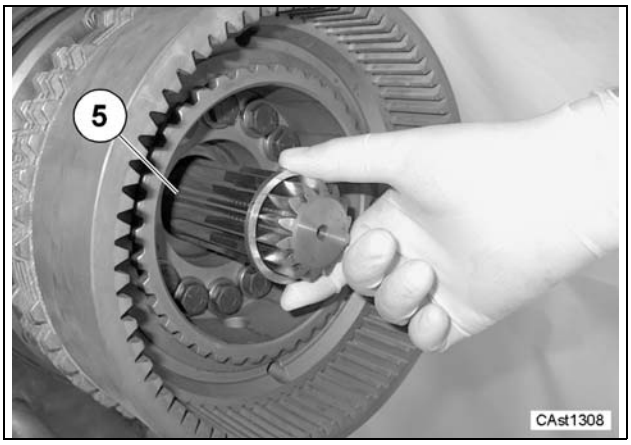
4. Remove the planetary gear carrier cover (3) and O-ring (6).



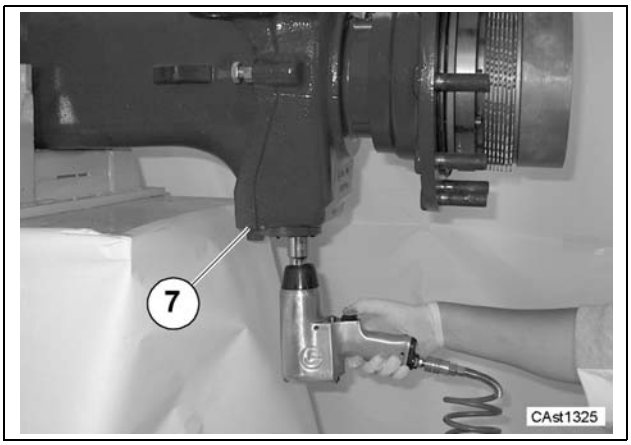
5. Remove split ring.



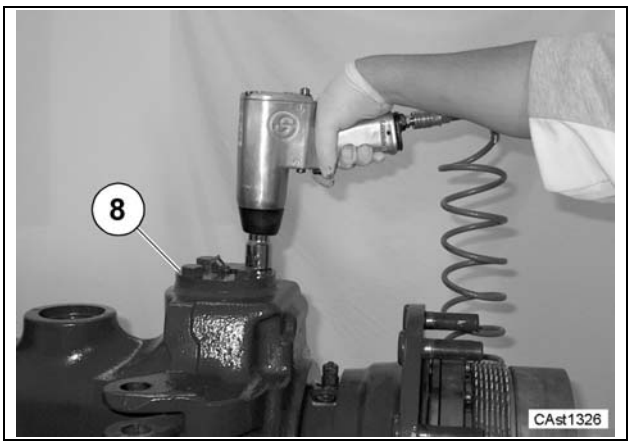
6. Remove spacer (5).



7. Remove the screw (7).



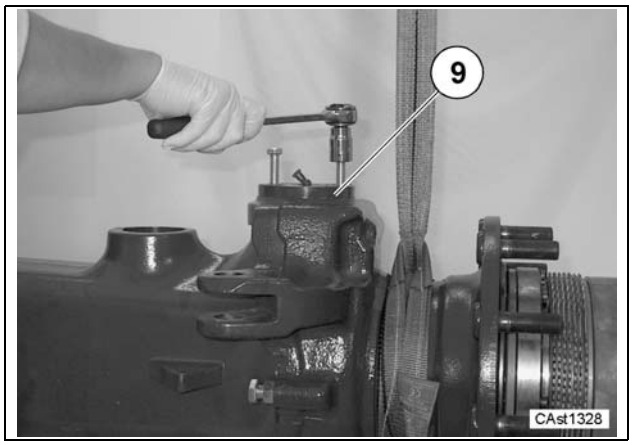
8. Remove the screw (8).



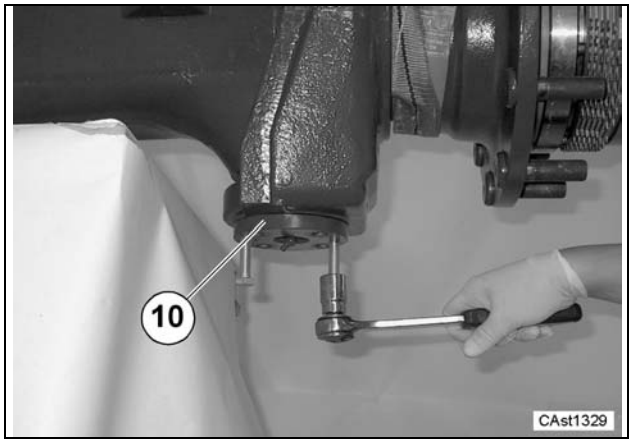
9. Secure the joint box to a hoisting equipment.



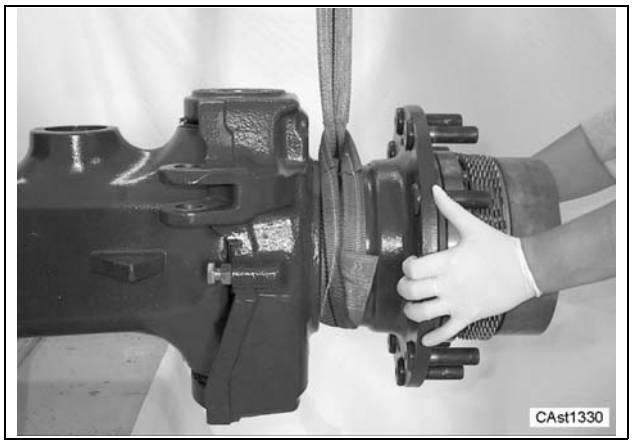
10. Screw two screws M12 x 100 and remove the pivot.



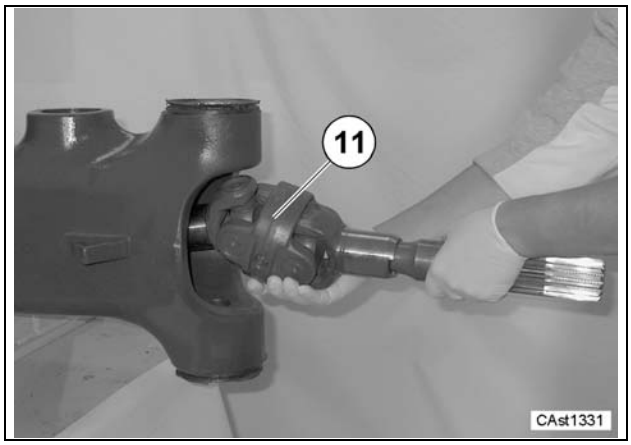
11. Screw screws M12 x 100 and remove the pivot.



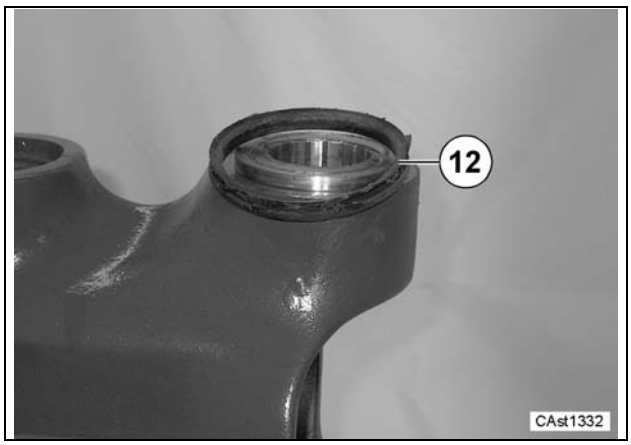
12. Remove the complete joint group.



13. Remove the complete joint (11).



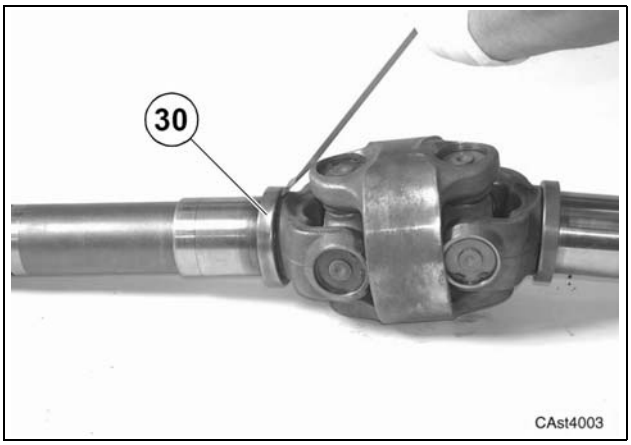
14. Remove the gasket (12).



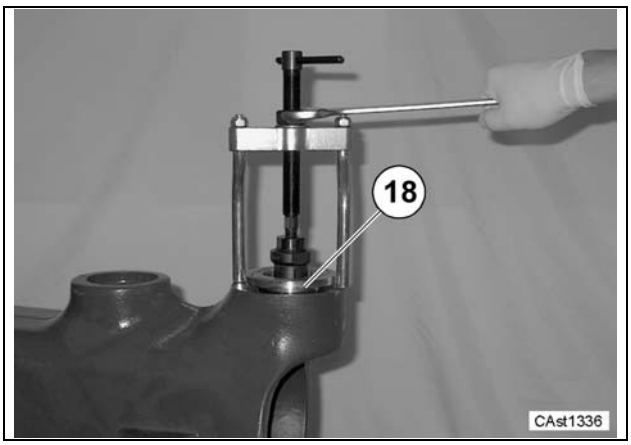
15. Remove the gasket (13).



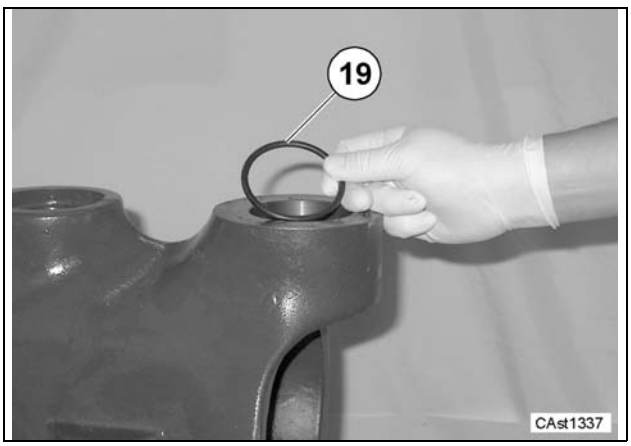
16. Remove gasket (30).



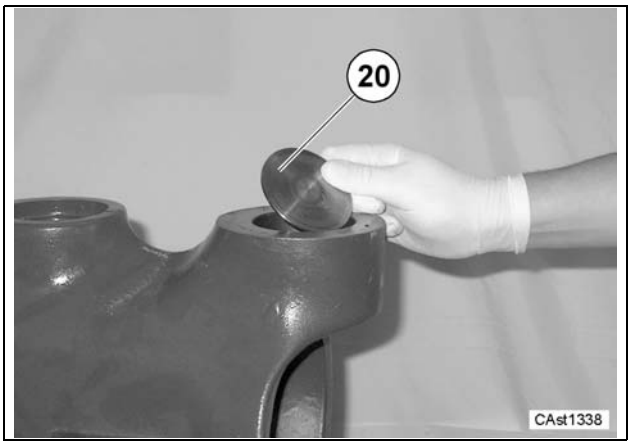
17. Use an extractor to remove bush (18).



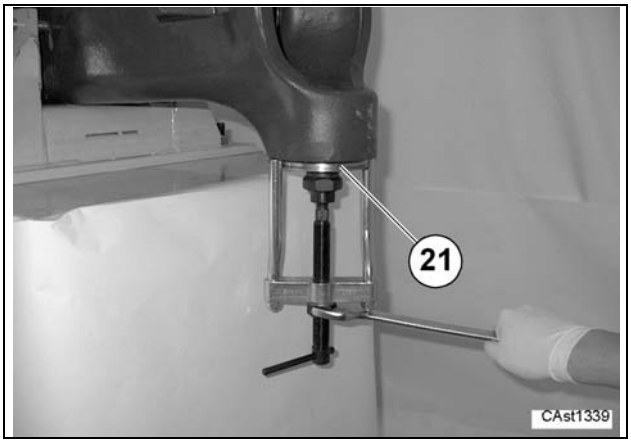
18. Remove the O-ring (19).



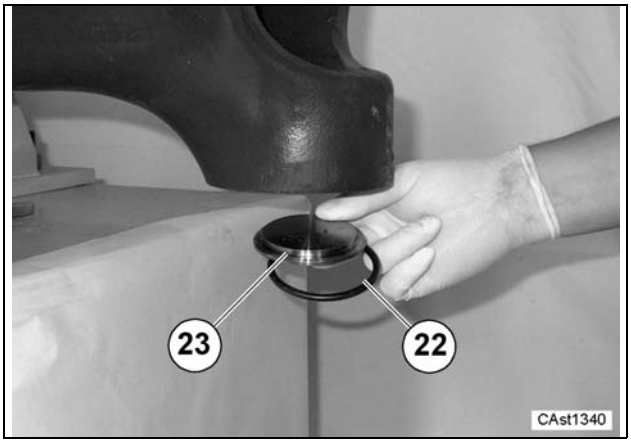
19. Remove the disk (20).



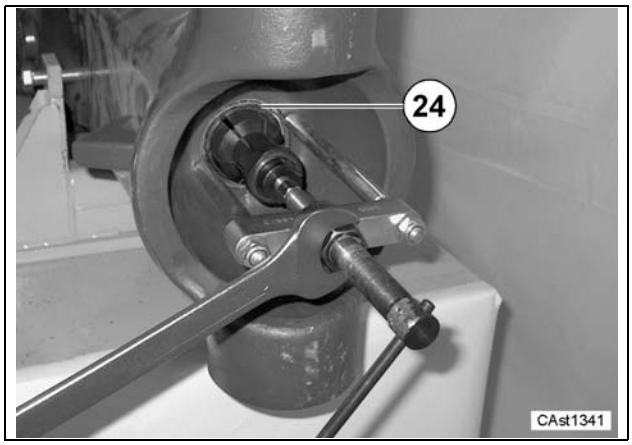
20. Remove the bush (21).



21. Remove the O-ring (22) and the disk (23).



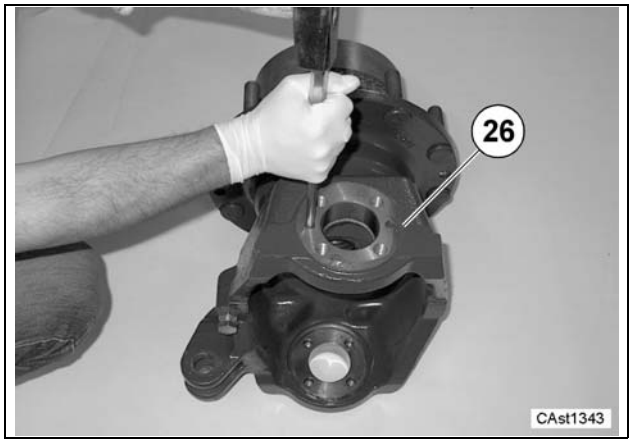
22. Remove the gasket (24).



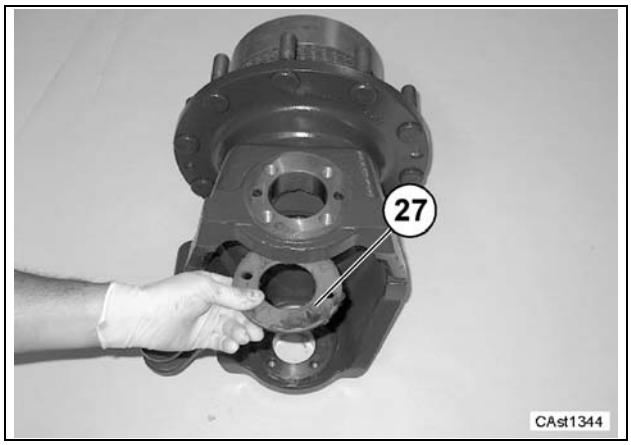
23. Remove the bush (25).



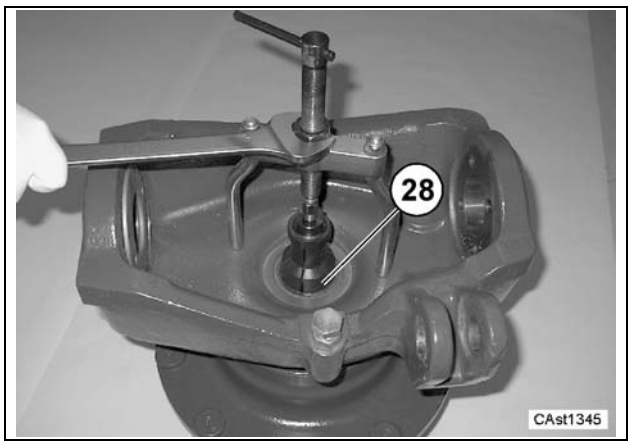
24. Remove pins (26).



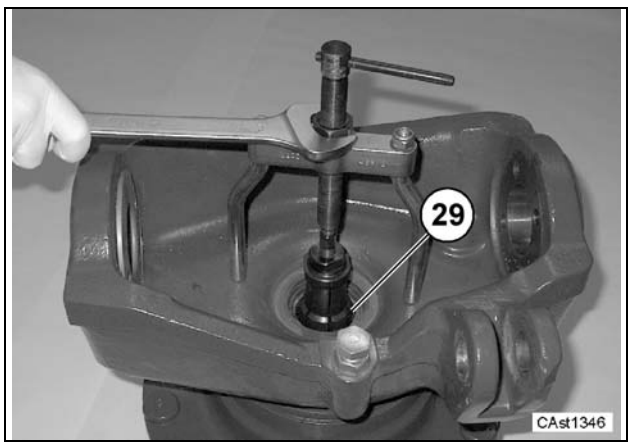
25. Remove the spacer (27).



26. Remove gaskets (28).

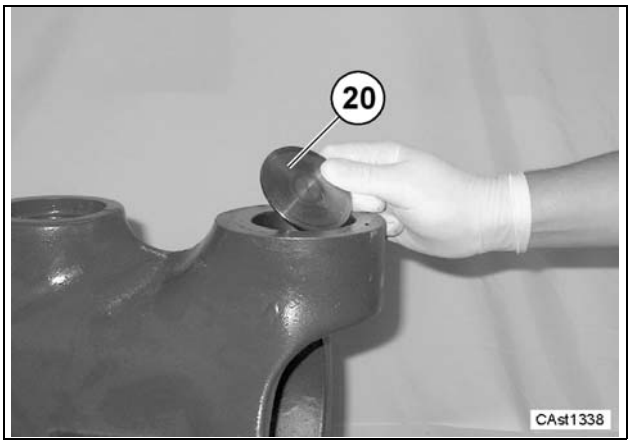


27. Remove the bush (29).

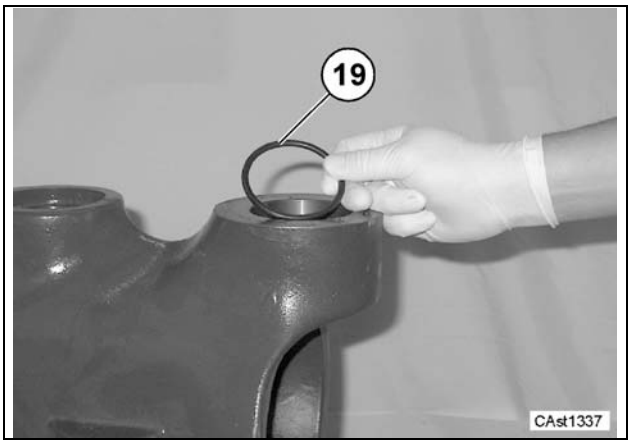


Assembly of joint box

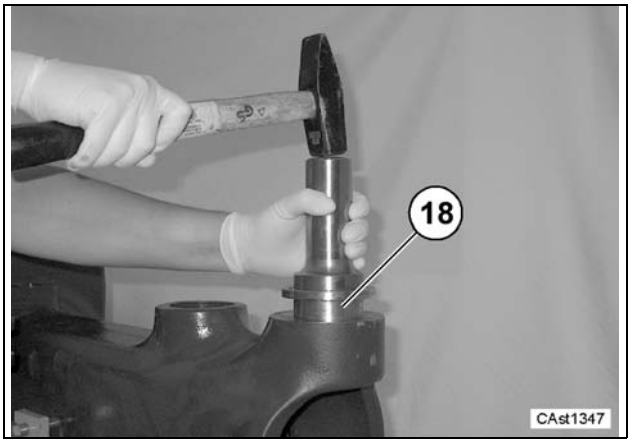
1. Assemble the disk (20).
   Pay attention to assembling direction.



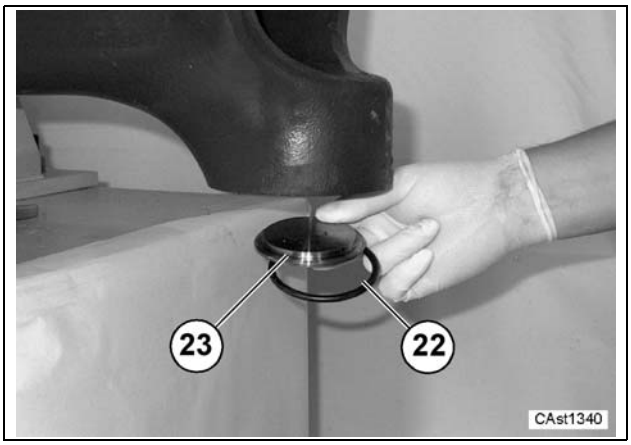
2. Assemble the O-ring (19).



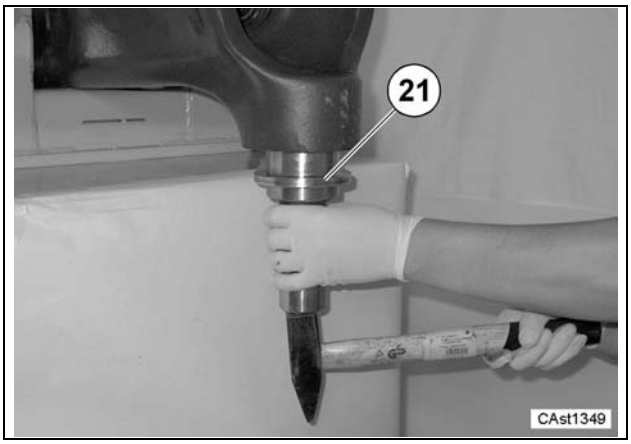
3. Assemble the bush (18).
   Use tool 2897017.



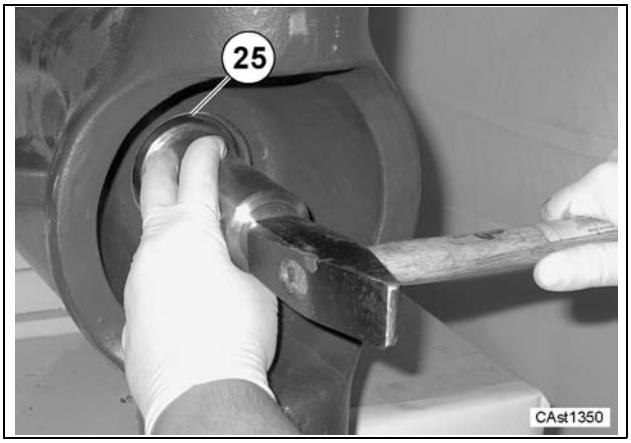
4. Assemble the O-ring (22) and the disk (23). Pay attention to assembling direction.



5. Assemble the bush (21).
Use tool 2897017.



6. Assemble the bush (25).
Use tool 2897017.



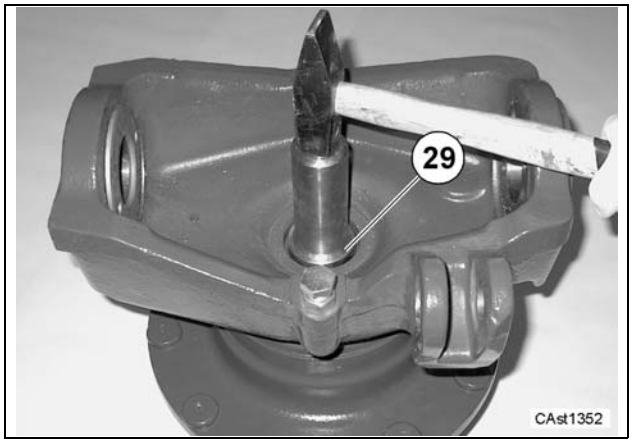
7. Apply Loctite® 510 on the gasket (24).



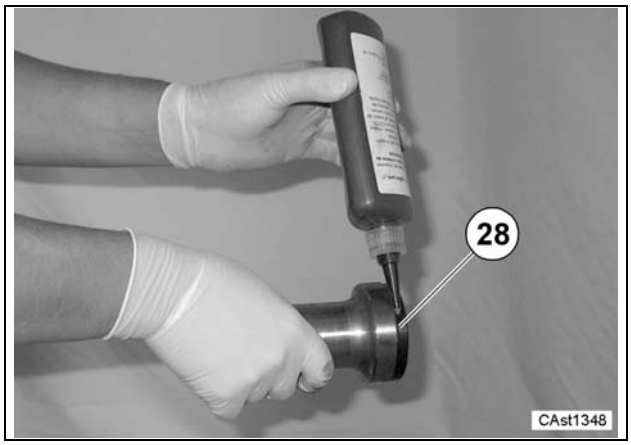
8. Assemble the gasket (24).
Use tool 2897017.



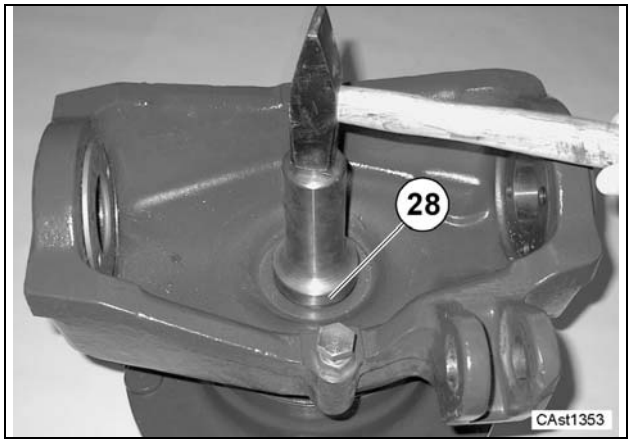
9. Assemble the bush (29).
Use tool 2897016.



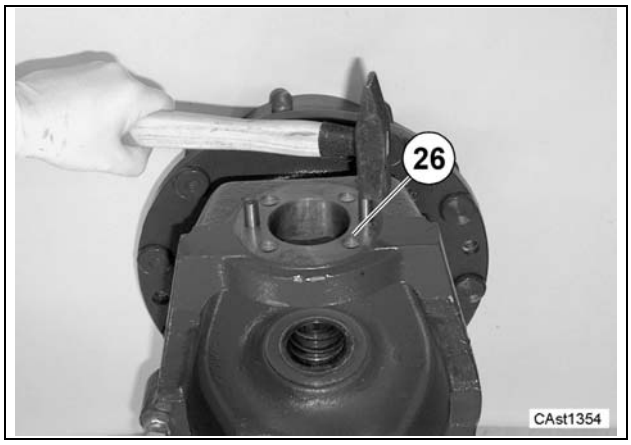
10. Apply Loctite® 510 on the gasket (28).



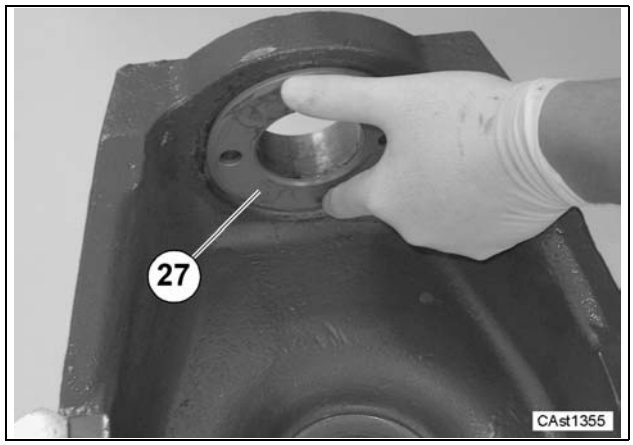
11. Assemble the gasket (28).
Use tool 2897017.



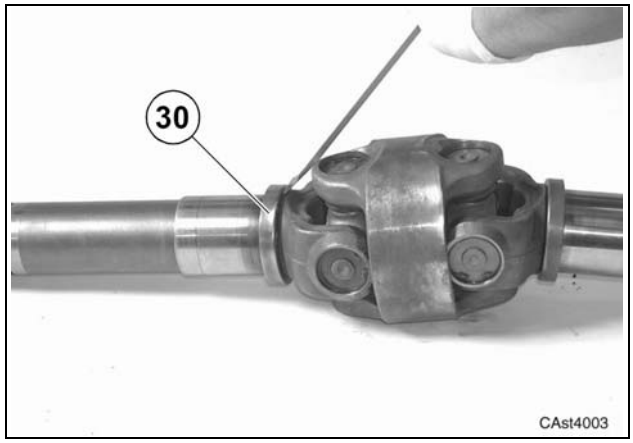
12. Assemble the pins (26).



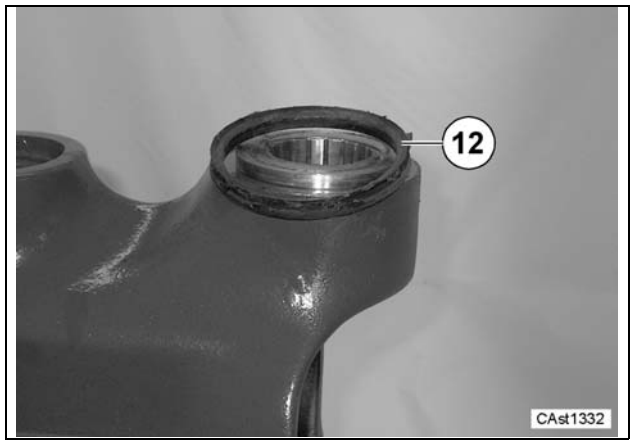
13. Grease and assemble the spacer (27).



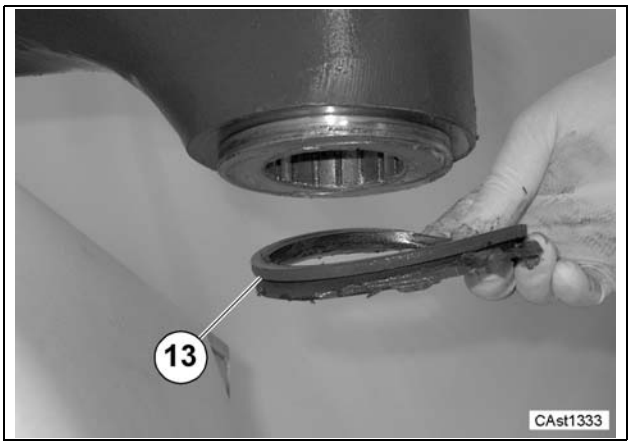
14. Assemble gasket (30).



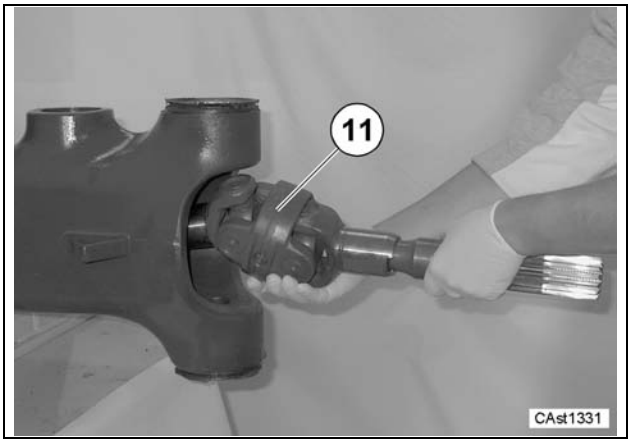
15. Assemble the gasket (12). Pay attention to assembling direction.



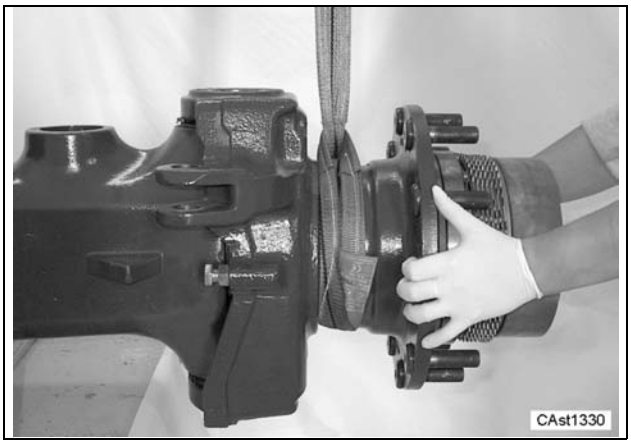
16. Assemble the gasket (13). Pay attention to assembling direction.



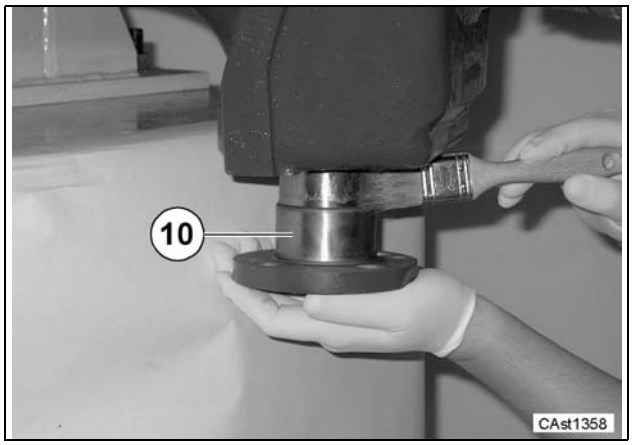
17. Assemble the complete joint (11).



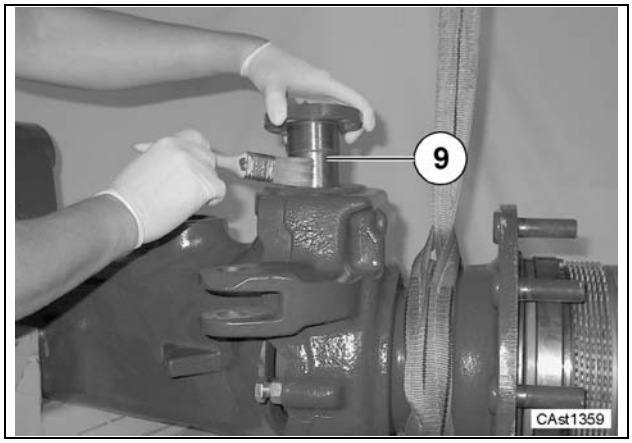
18. Grease tabs of the joint group and assemble.



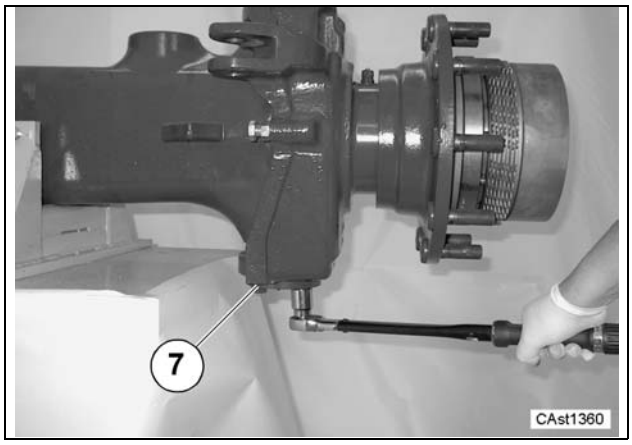
19. Lubricate and assemble the pivot.



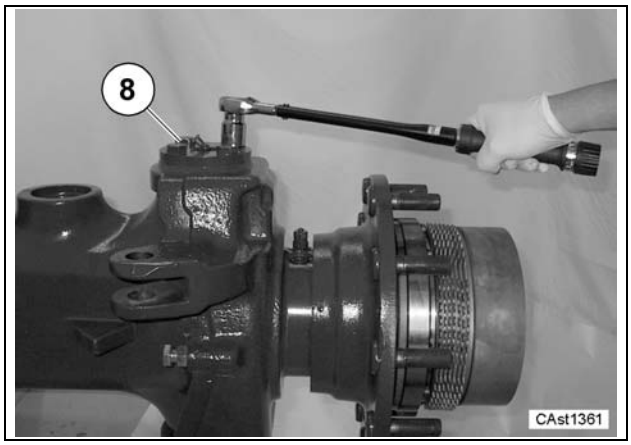
20. Lubricate and assemble the pivot (9).



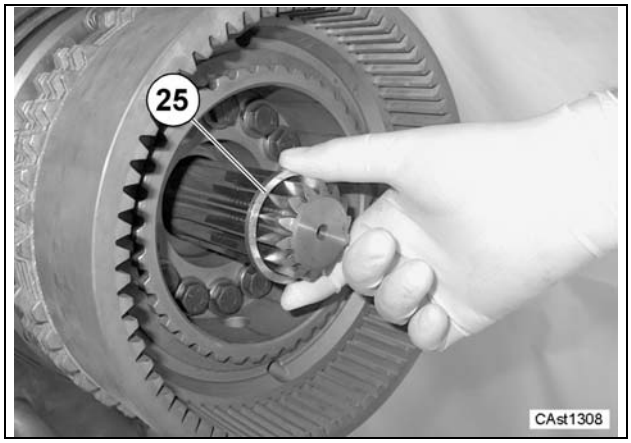
21. Apply Loctite® 242 and assemble the screw (7). Torque - 285Nm (29 kgf-m)



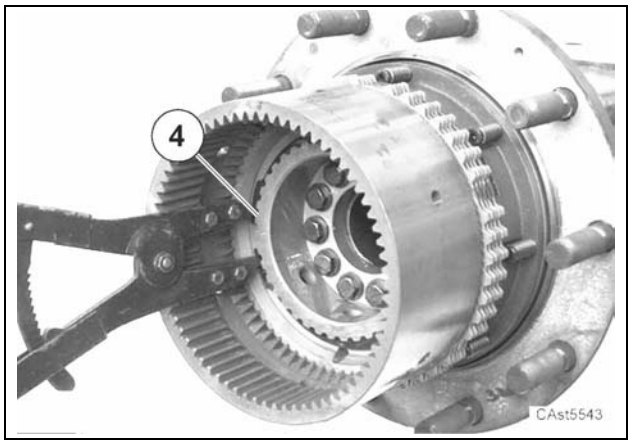
22. Apply Loctite® 242 and assemble the screw (8). Torque - 285 (29kgf-m)



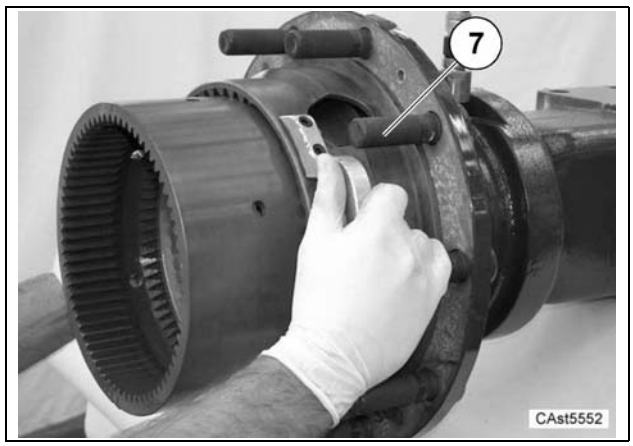
23. Assemble the snap ring (4).



24. Assemble the snap ring (4).



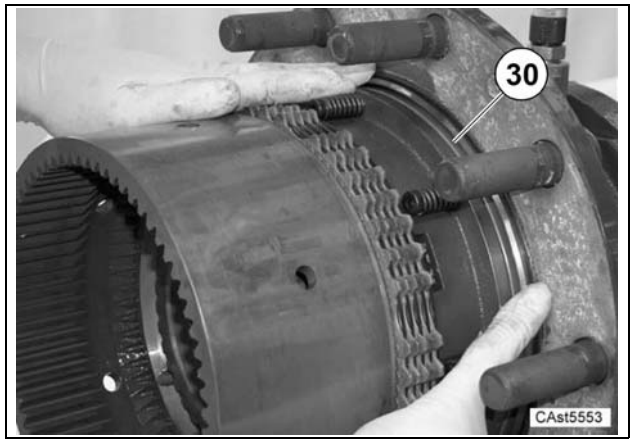
25. Line up brake discs. Use tool 2897014.
WARNING! A tooth should coincide with a brake fastening screw (7)



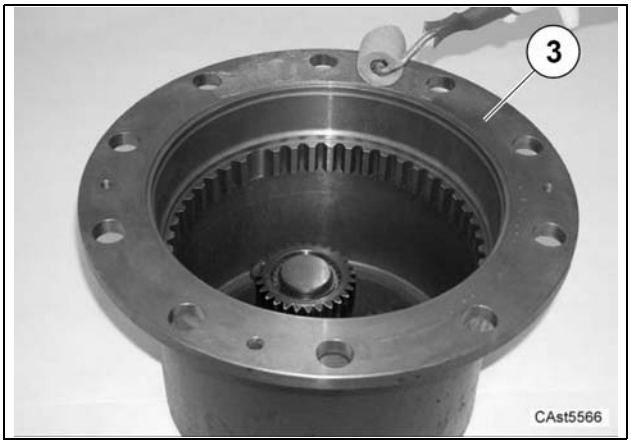
26. Put brakes under pressure to avoid outer discs misalignment.



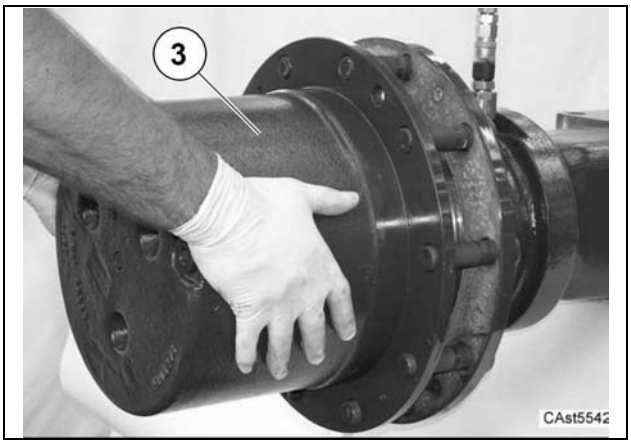
27. Lubricate with grease and fit O-ring (30).



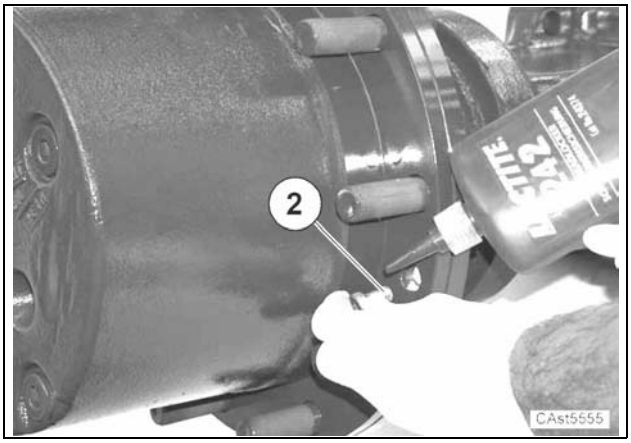
28. Lubricate with grease the contact surface of planetary gear cover (3).
    Apply Loctite® 510 in the holes.



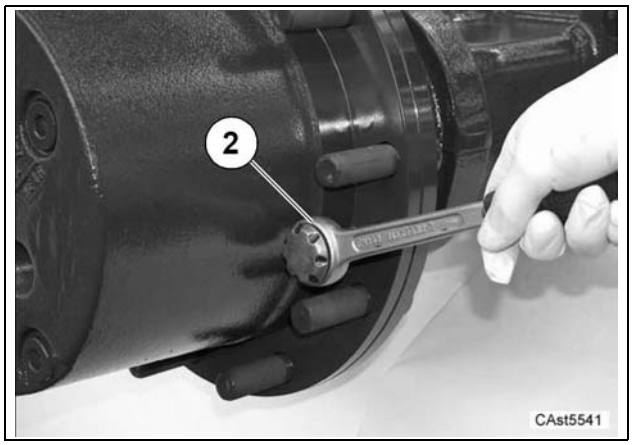
29. Fit the planetary gear cover (3) and discharge pressure from the hydraulic pump.



30. Apply Loctite® 242 on screw (2).



31. Fit screws (2).
    Torque - 55 Nm (6 kgf-m)



Disassembly of beam trumpet and differential unit

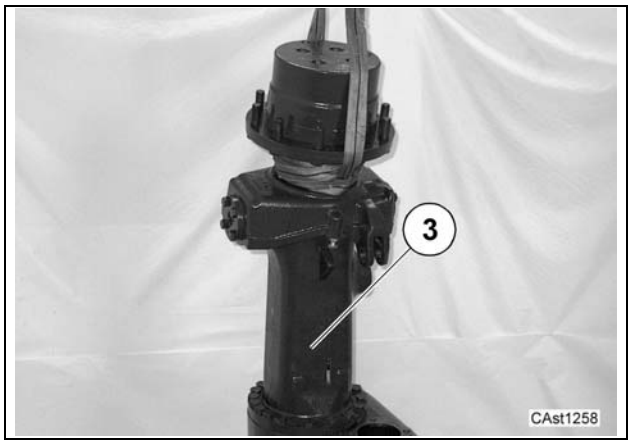
1. Remove the axle unit. Sling and slightly tension the rope. Turn and then fix it in vertical position.



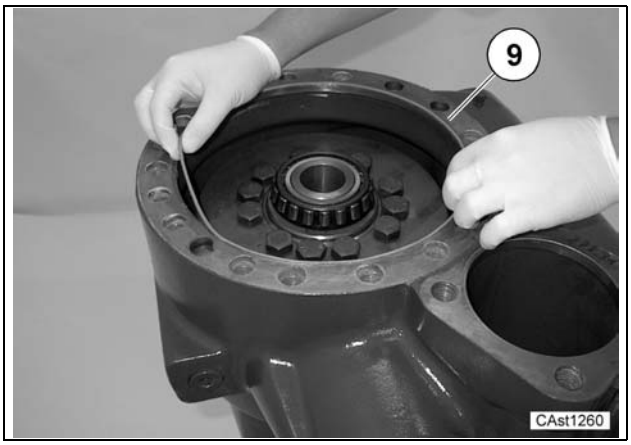
2. Loosen and remove screws (1) with washers (27).



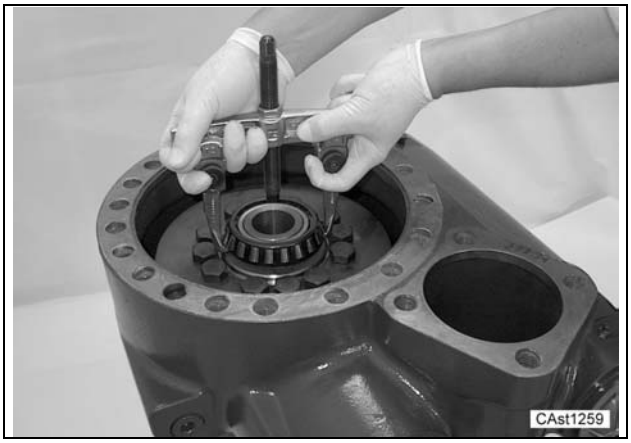
3. Sling the beam trumpet (3) and slightly lift it.



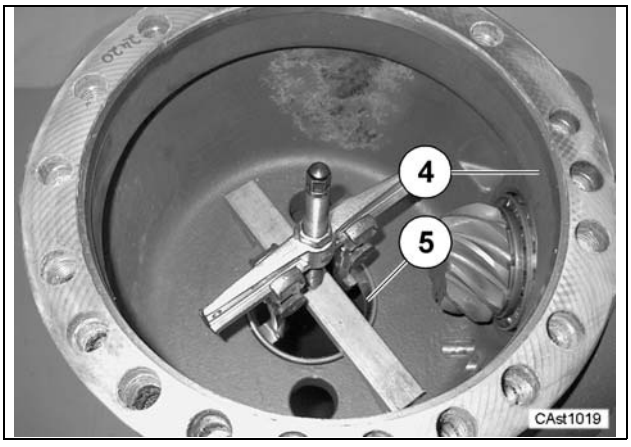
4. Remove O-ring (9).



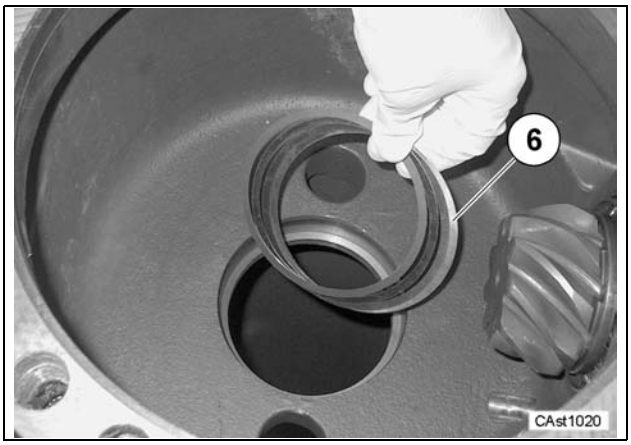
5. Lift the whole differential unit.



6. Use an extractor and remove from housing (4) the outer cup of bearing (5).



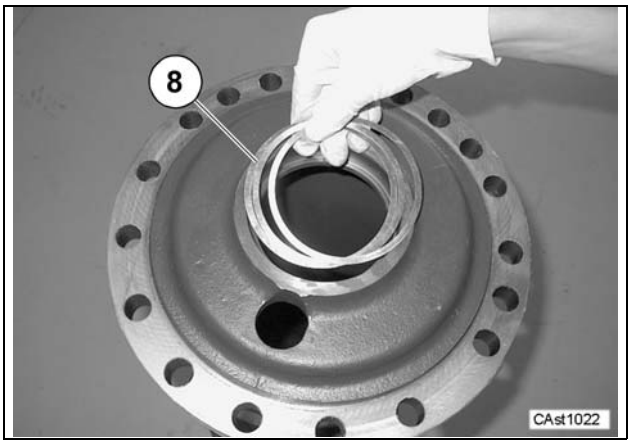
7. Remove shims (6).



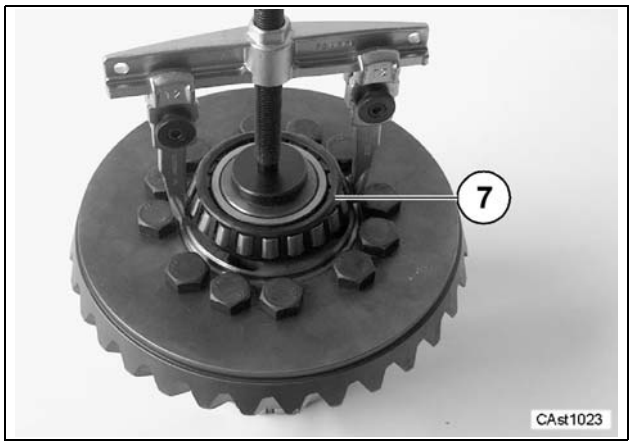
8. Use an extractor and remove from housing (3) the outer cup of bearing (7).



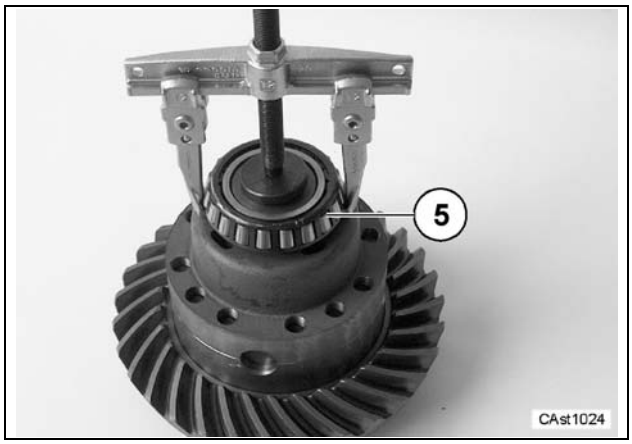
9. Remove shims (8).



10. Use an extractor to remove bearing (7) from differential unit.

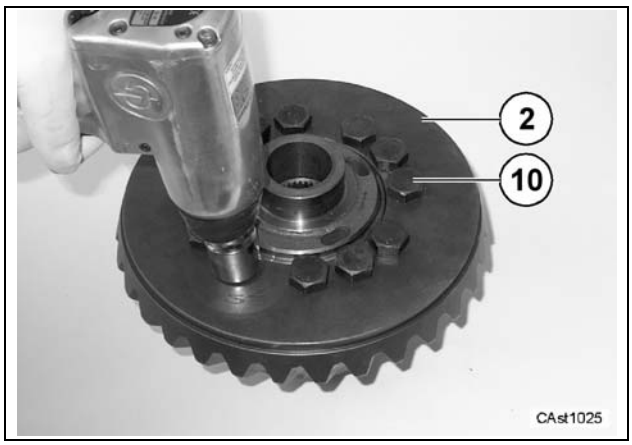


11. Use an extractor to remove bearing (5) from differential unit.



12. Unscrew all fastening screws (10) of bevel gear crown (2).

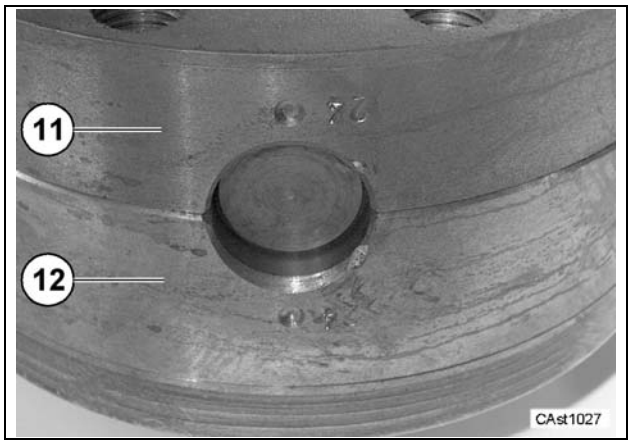
WARNING! This operation makes both differential half boxes free, so take care not to drop the inner components.



13. Remove ring bevel gear (2) by means of a mallet.

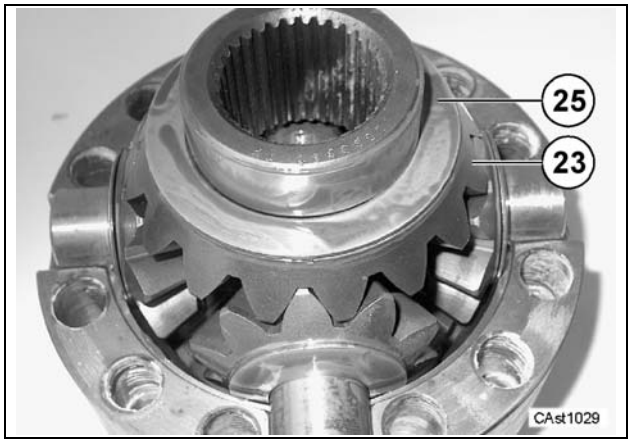


14. Check marking points (11) and (12) that will be useful during the assembly.

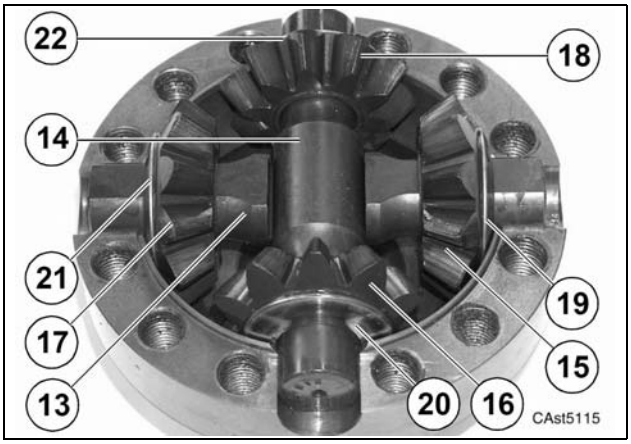


Note: Without differential torque limiter.

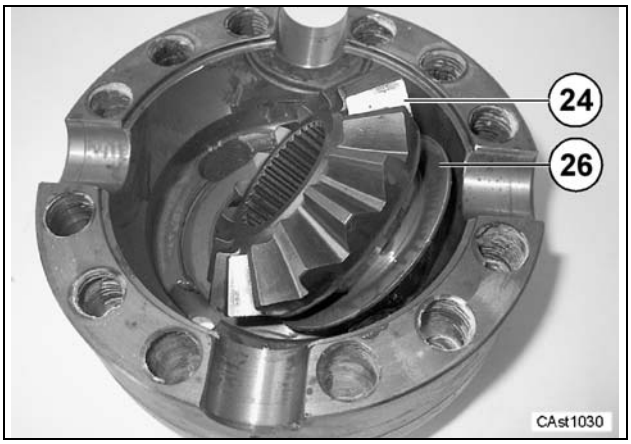
15. Remove planetary gear (23) and shim (25).



16. Remove differential pins (13 and (14), planetary gears (15), (16), (17) and (18) and spheric washers (19), (20), (21), and (22).

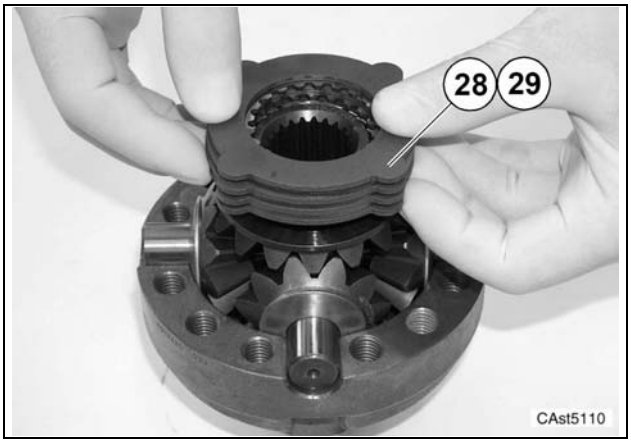


17. Remove planetary gear (24) and shim (26).

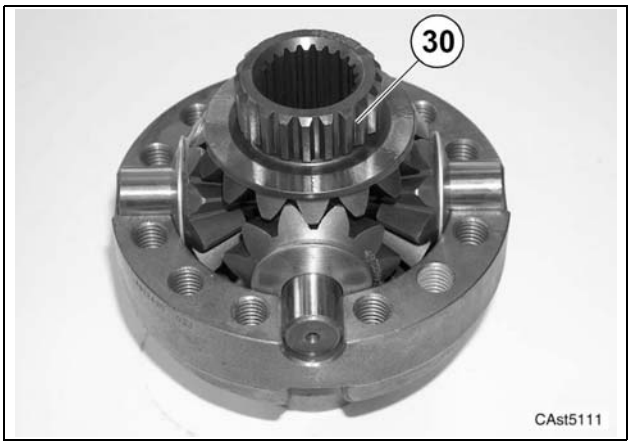


Note: With differential torque limiter.

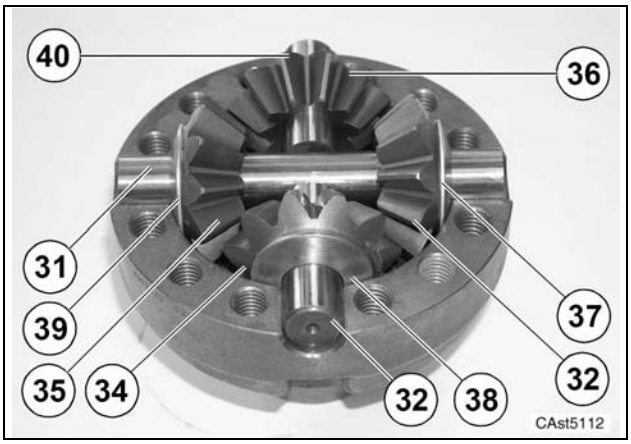
18. Remove discs (28) and (29).



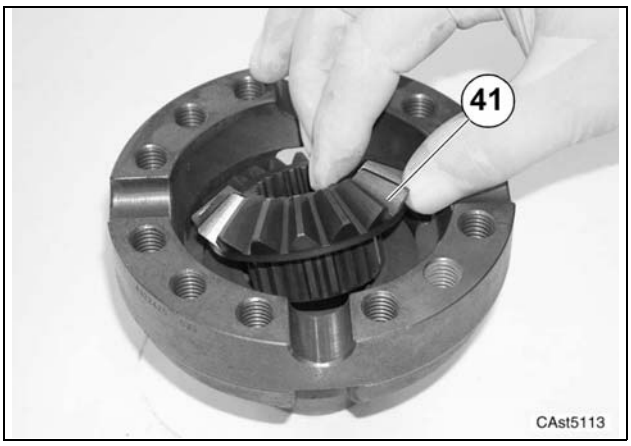
19. Remove planetary gear (30).



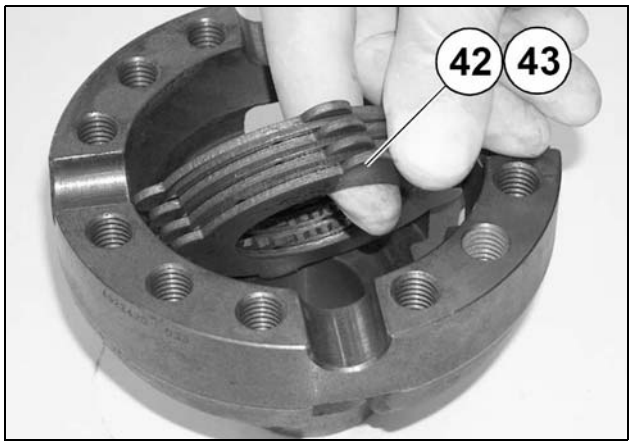
20. Remove differential pins (31 and (32), planetary gears (33), (34), (35) and (36) and spheric washers (37), (38), (39), and (40).



21. Remove planetary gear (41).



22. Remove discs (42) and (43).

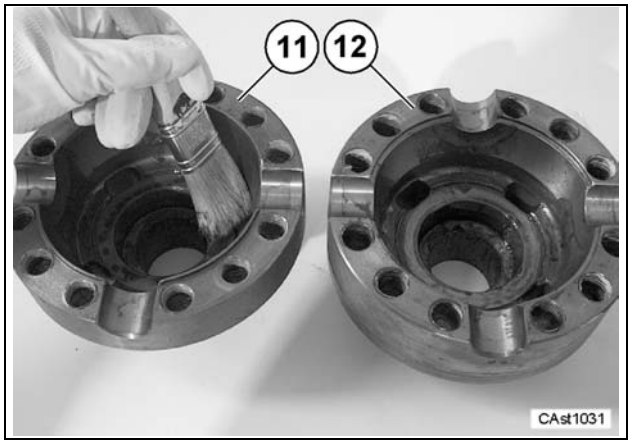


Assembly of beam trumpet and differential unit.

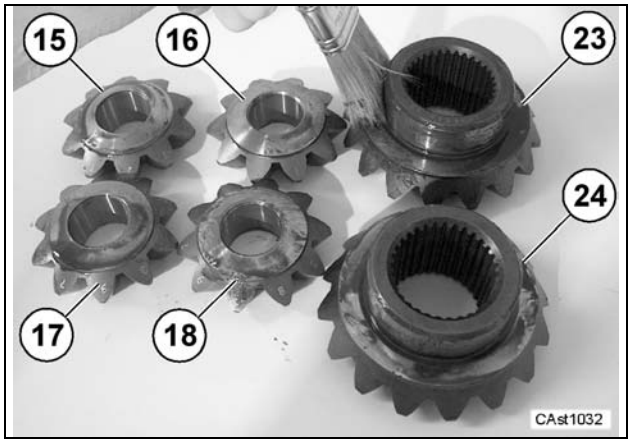
Note: Without differential torque limiter.

1. Apply a thin layer of molicote G-n plus paste on half boxes of differential (11) and (12).

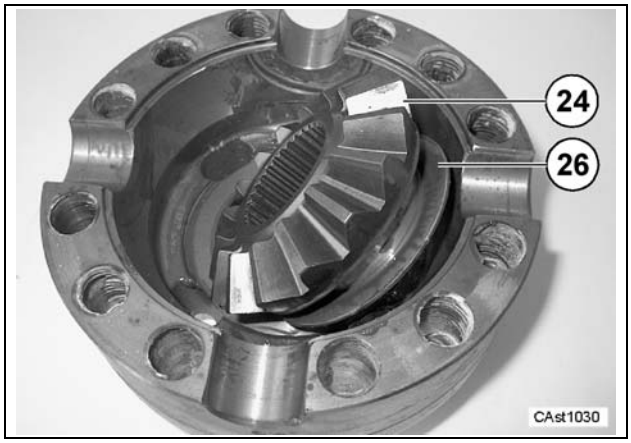
WARNING! Remove remains of old sealing compound.



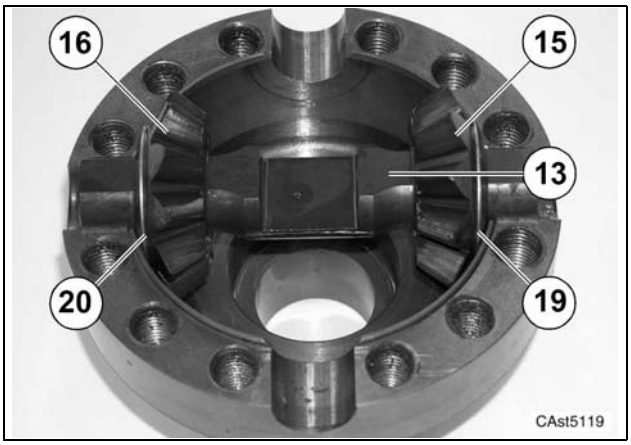
2. Apply a thin layer of molicote G-n plus paste on planetary gears (15), (16), (17) and (18) and on crown wheels (23) and (24).



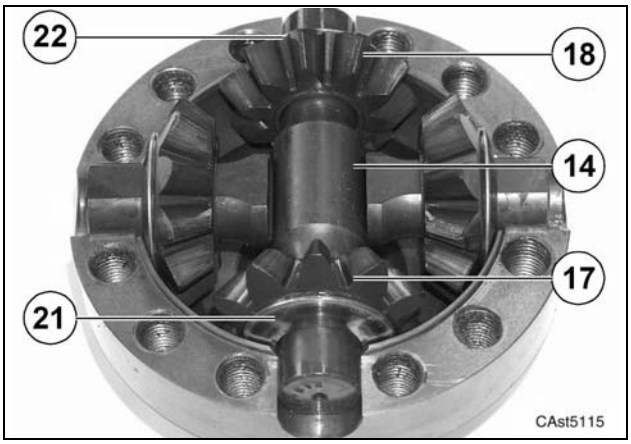
3. Set crown Wheel (24) and washer (26).



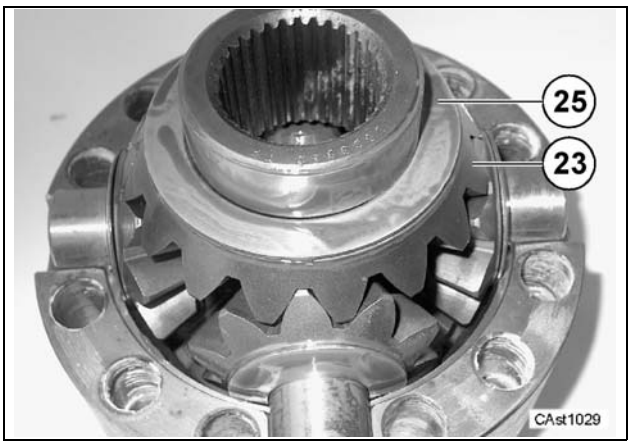
4. Fit the differential unit pin (13) and planetary gears (15) and (16) and washers (19) and (20).



5. Fit the differential unit pin (14) and planetary gears (17) and (18) and washers (21) and (22).



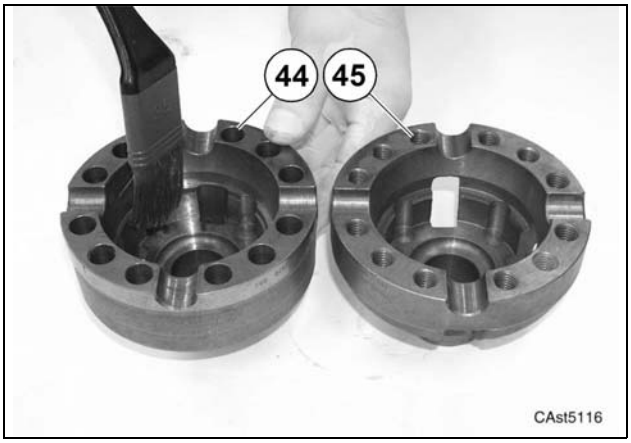
6. Fit ring bevel gear (23) and washer (25).



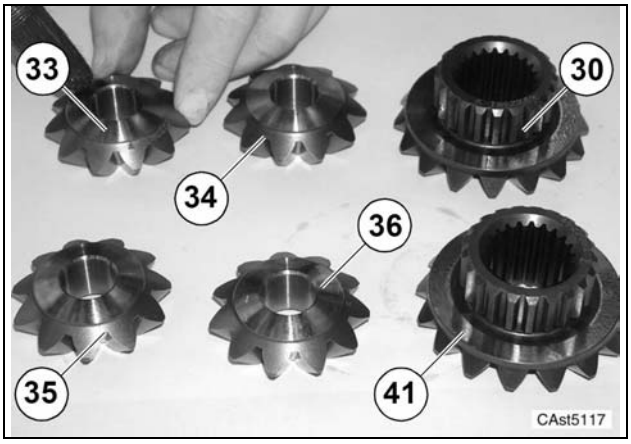
Note: With differential torque limiter.

7. Apply a thin layer of Molicote G-n plus paste on half boxes of differential (44) and (45).

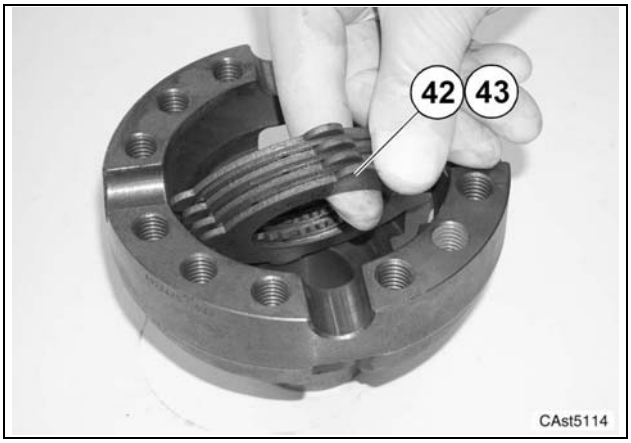
WARNING! Remove remains of old sealing compound.



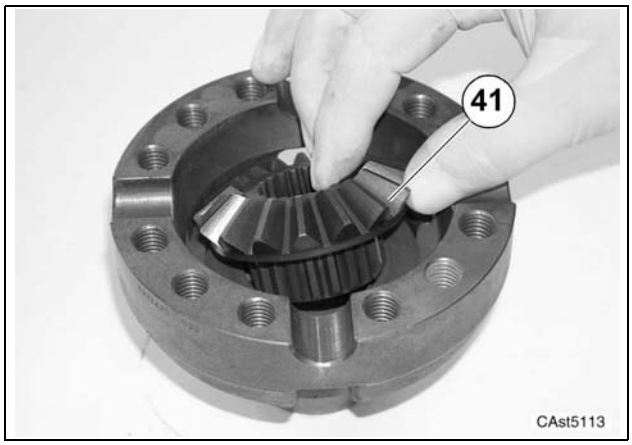
8. Apply a thin layer of Molicote G-n plus paste on planetary gears (33), (34), (36) and on crown wheels (30) and (41).



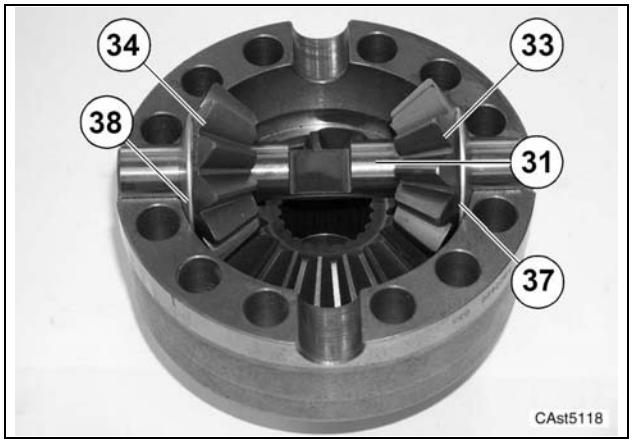
9. Assemble discs (42) and (43).



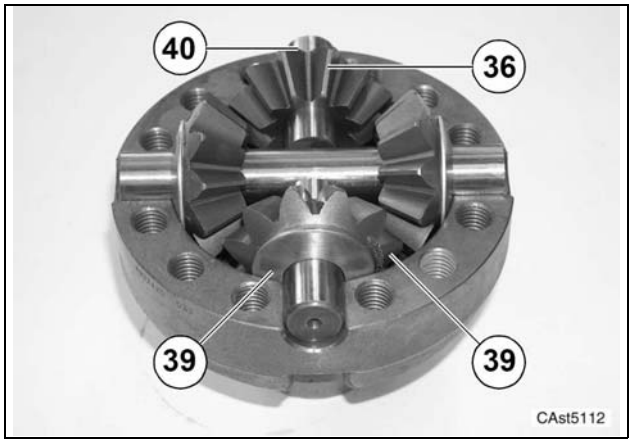
10. Assemble planetary gears (41).



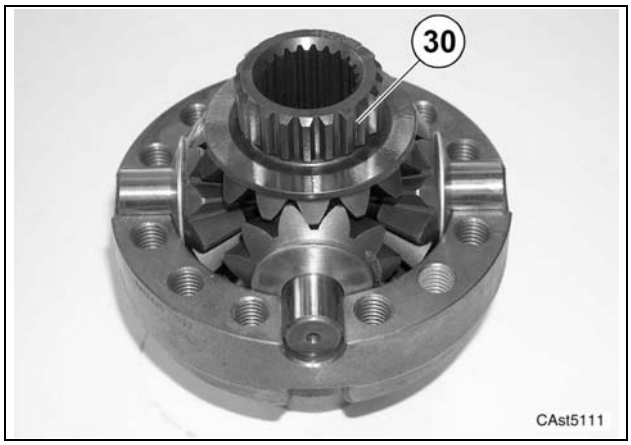
11. Fit the differential unit pin (31) and planetary gears (33), (34) and washers (37) and (38).



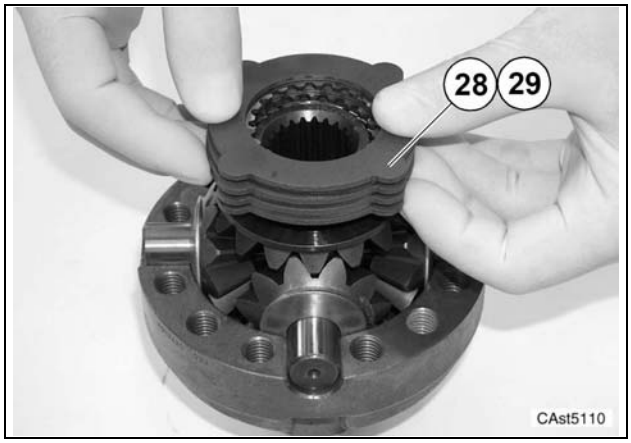
12. Fit differential unit pin (32) and planetary gears (35), (36) and washers (39) and (40).



13. Assemble planetary gears (30).

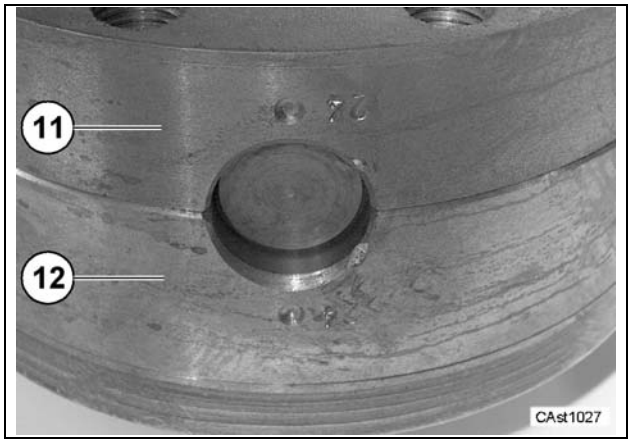


14. Assemble discs (28) and (29).

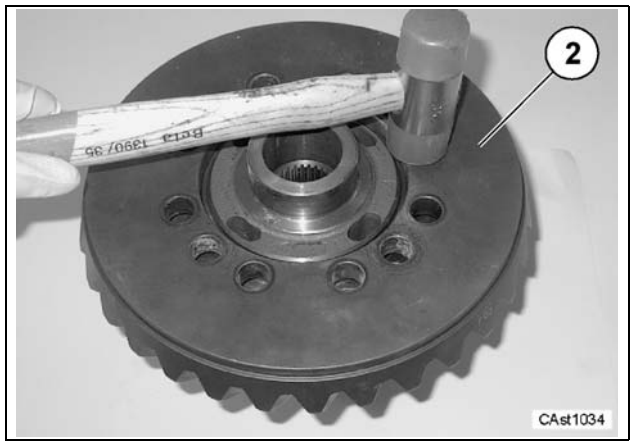


15. Fit the two half boxes of differential unit (11) and (12).

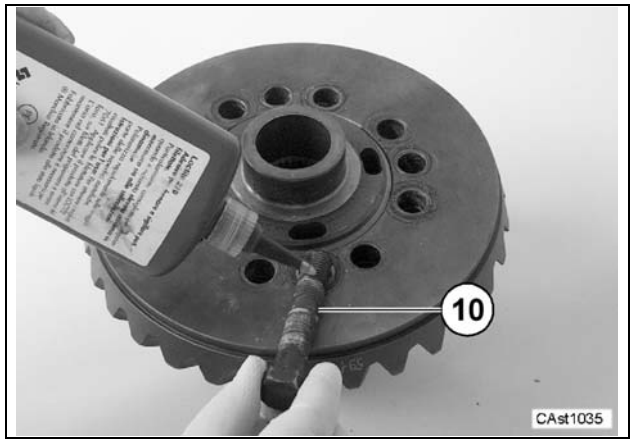
WARNING! Carefully check that the marks of both differential half boxes coincide.



16. Fit ring bevel gear (2) by using a hammer.

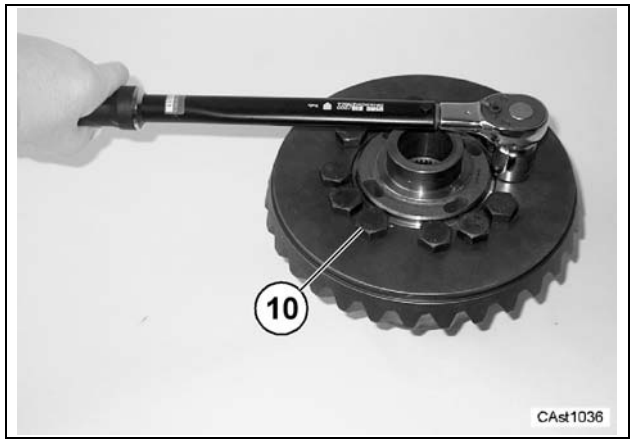


17. Apply Loctite® 242 on thread of screws (10).

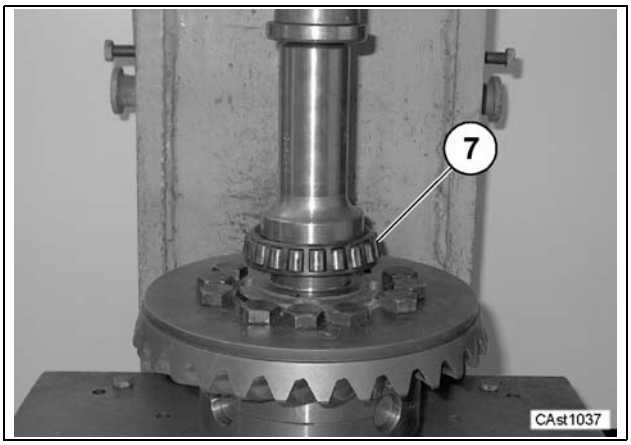


18. Tighten screws (10)
    Torque - 205 Nm (21 kgf-m)

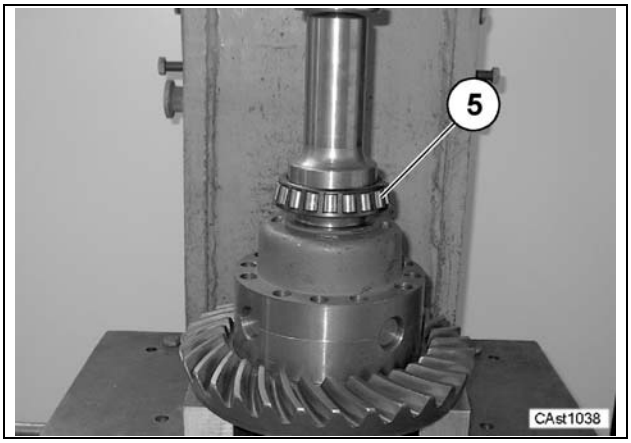
Note: Fix differential housing in the vice.



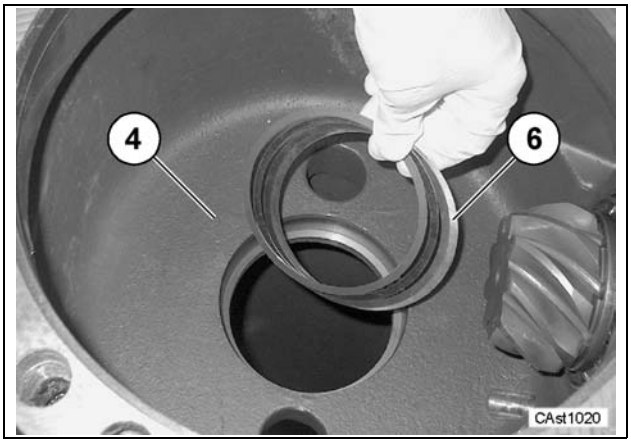
19. Press bearing (7) or assemble after preheating.



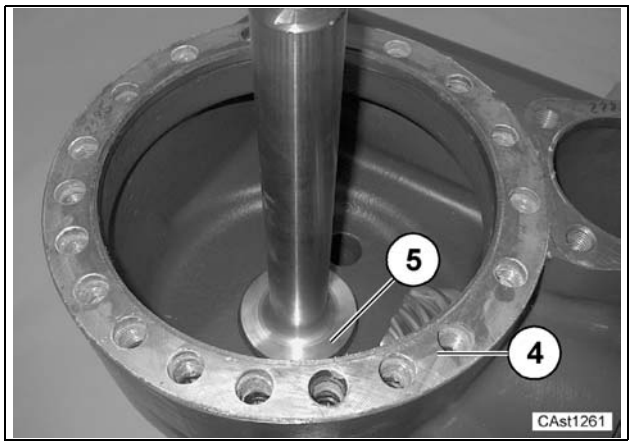
20. Press bearing (5) assemble after the preheating.



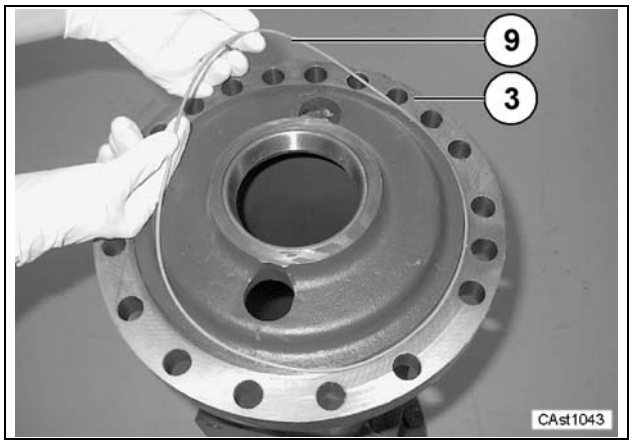
21. Fit adjustment shims (6) **X1** on beam trumpet (4).



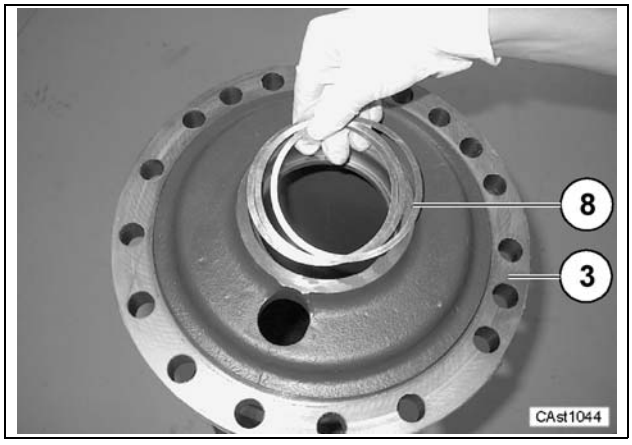
22. Use tool 2897004 to fit bearing washer (5) on beam trumpet (4).



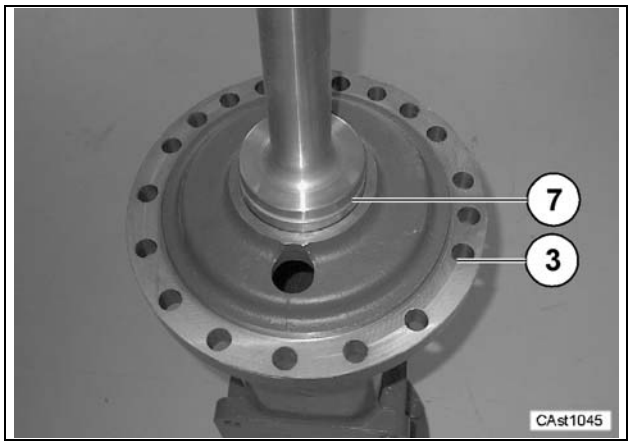
23. Fit O-ring (9) on beam trumpet (3). Lubricate O-ring (9)with grease.



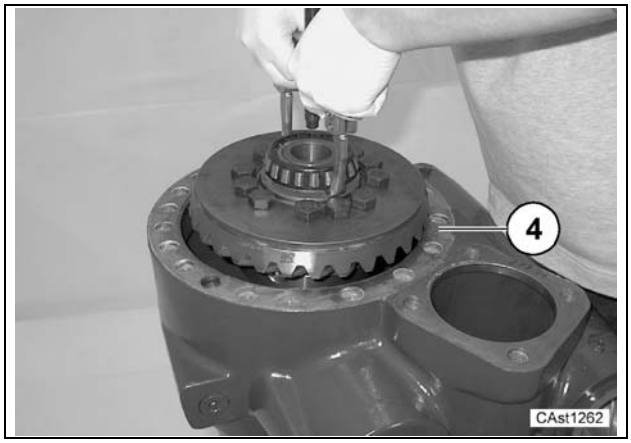
24. Position adjusting shims (8) **X2** on beam trumpet (3).



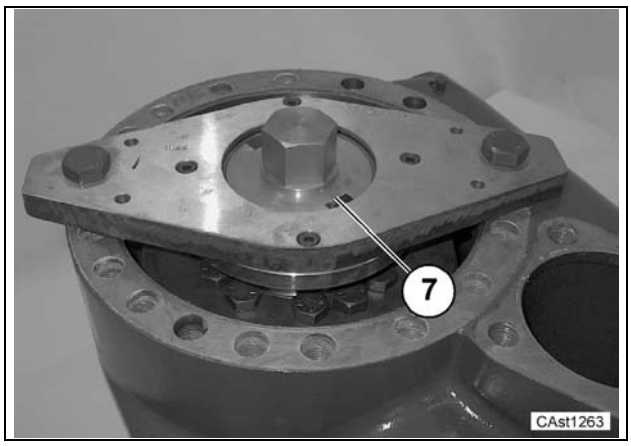
25. Use tool 2897004 to fit the bearing outer washer (7) on beam trumpet (3).



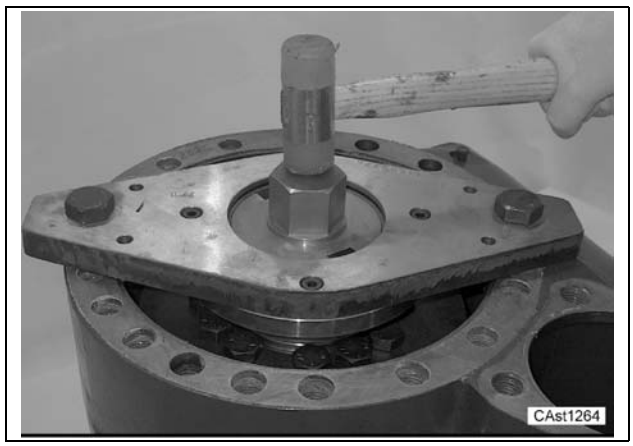
26. Position the differential unit beam trumpet (4).



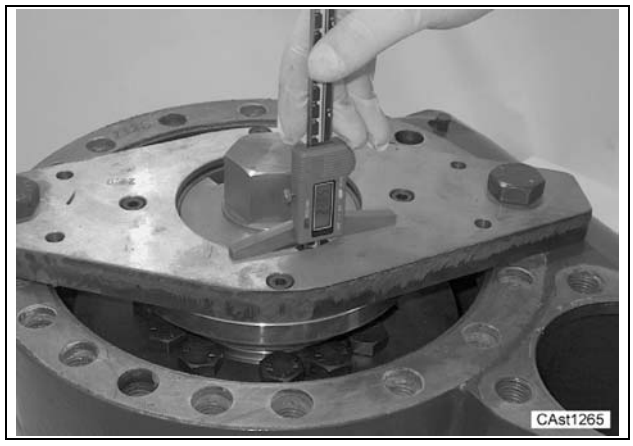
27. Position tool 2897001. Assemble half bearing (7) inside tool.



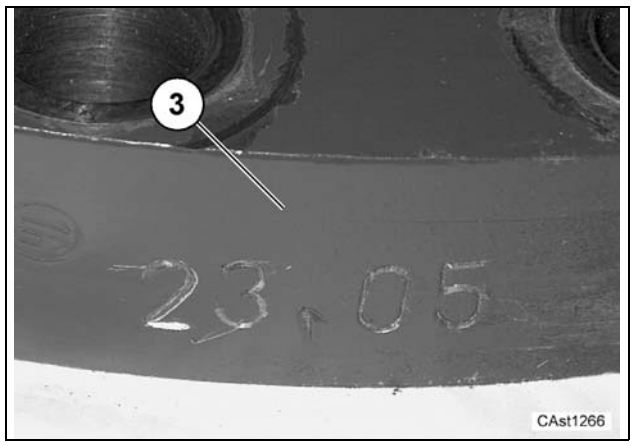
28. While Screwing the tool nut until the value of 10Nm has been reached turn the ring bevel gear and strike it with a hammer to fix whole unit.



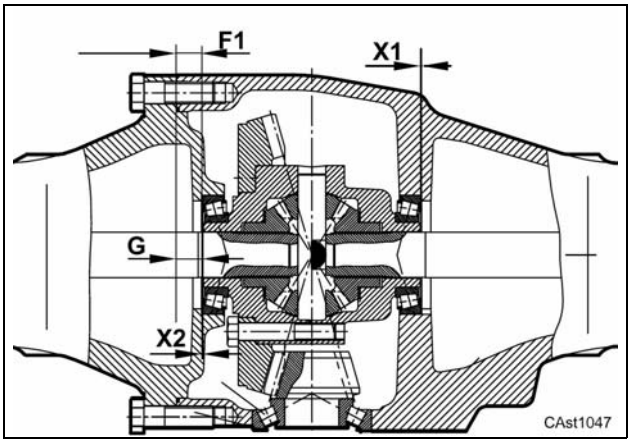
29. Measuring of value **G.**



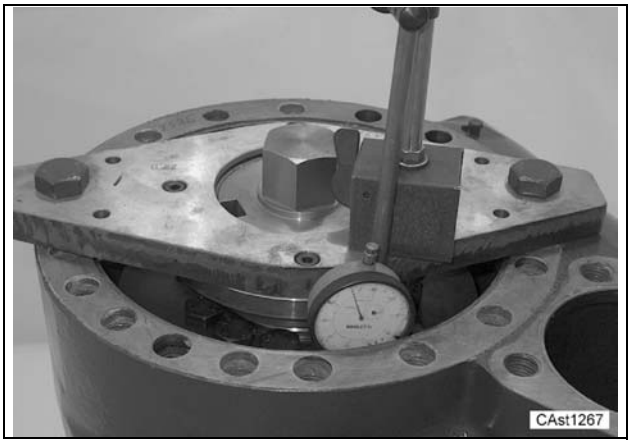
30. Value written on beam trumpet (3) **F1**



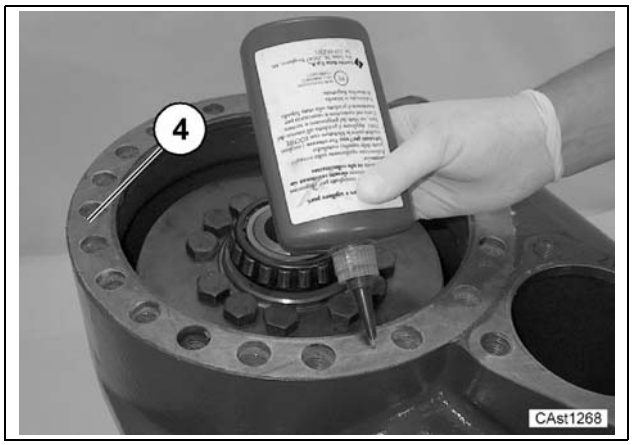
31. Drawing used to determine backlashes between the bevel gear pair teeth.
    X1 = 1.8
    Check adjusting shims **X2** through the suggested procedure for axles
    X2 = F1



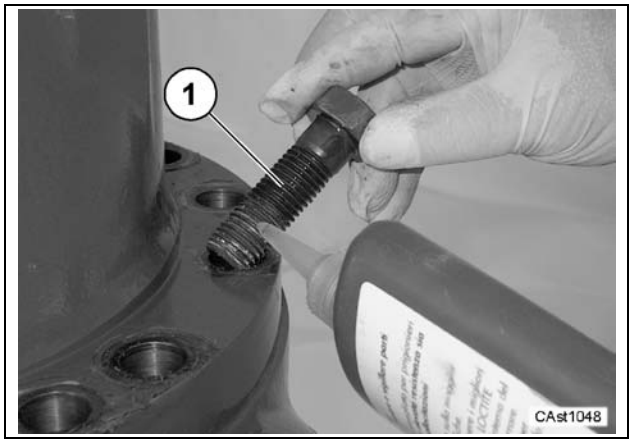
32. Move alternately the pinion tang and take note of the backlash between pinion and ring bevel gear (detected through a compactor). Make sure that the feeler touches the screw head mounted on the flange and is located at 90 degrees. Check if the value of the detected backlash is within the preset field: 0.15/0.25 mm.
    Should the backlash be insufficient or excessive, adjust shim **X1**=1.8 by increasing or decreasing.



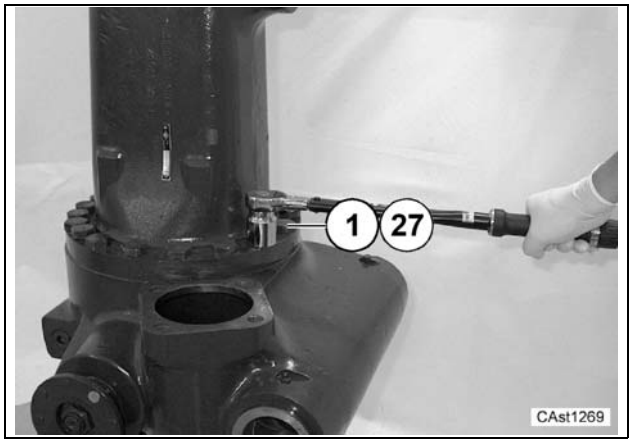
33. Apply Loctite® 510 on contact surface of beam trumpet (4).



34. Apply Loctite® 242 on screws (1).



35. Assemble screws (1) and washer (27).
    Torque - 560Nm (57 kgf-m)

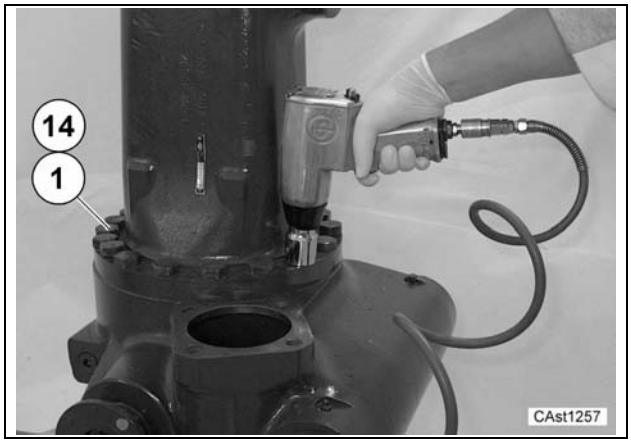


Disassembly of pinion group

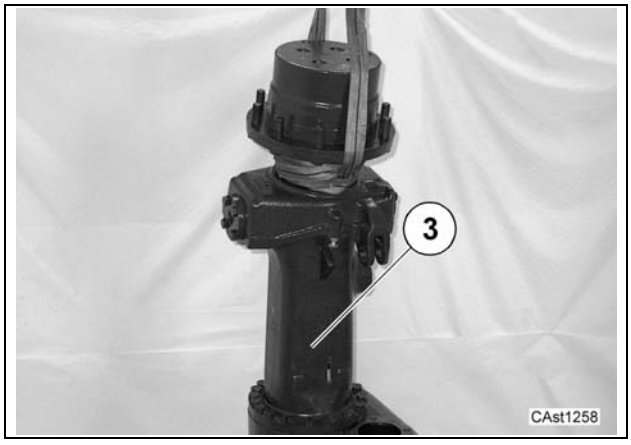
1. Remove the axle unit. Sling and slightly tension the rope. Turn and then fix it in vertical position.



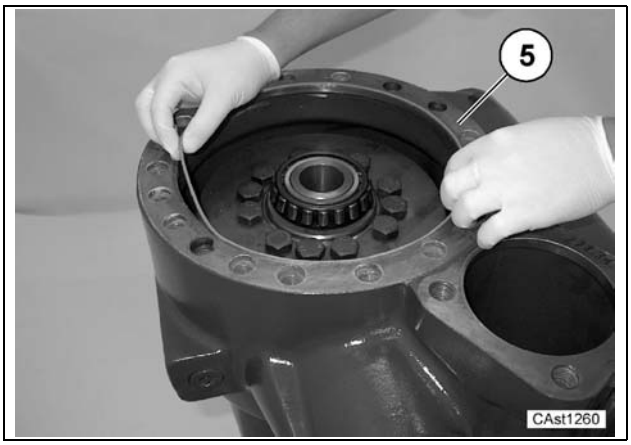
2. Loosen and remove screws (1) with washers (14).



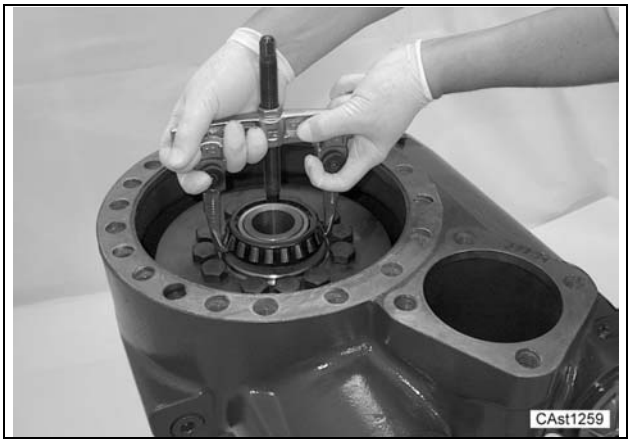
3. Sling the beam trumpet (3) and slightly lift it.



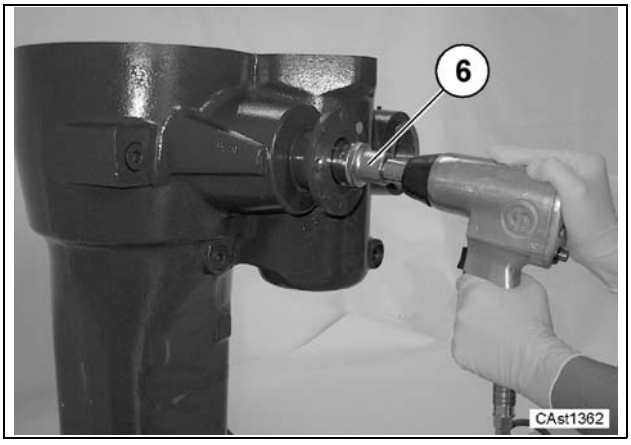
4. Remove O-ring (5).



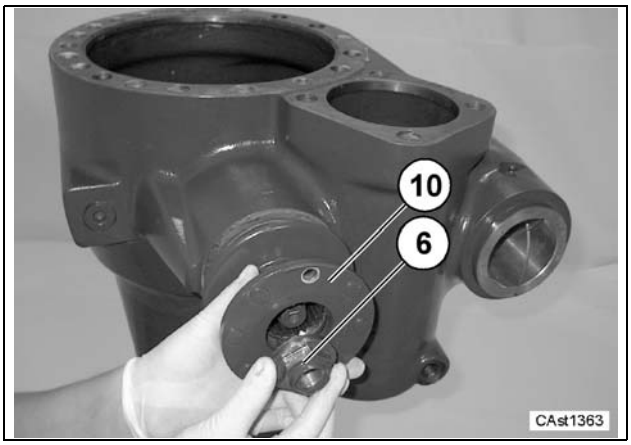
5. Lift the whole differential unit.



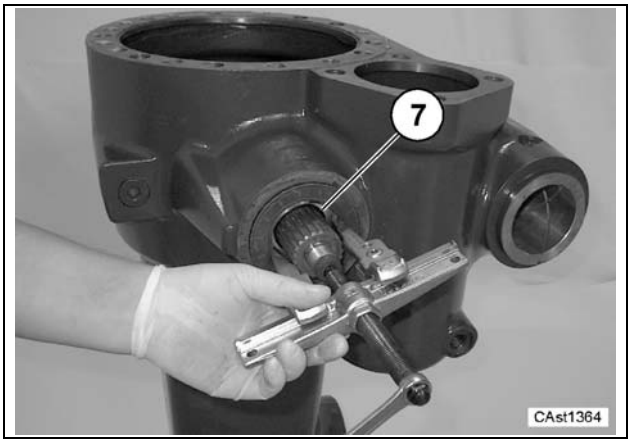
6. Loosen the nut (6).



7. Remove the nut (6) and the flange (10).



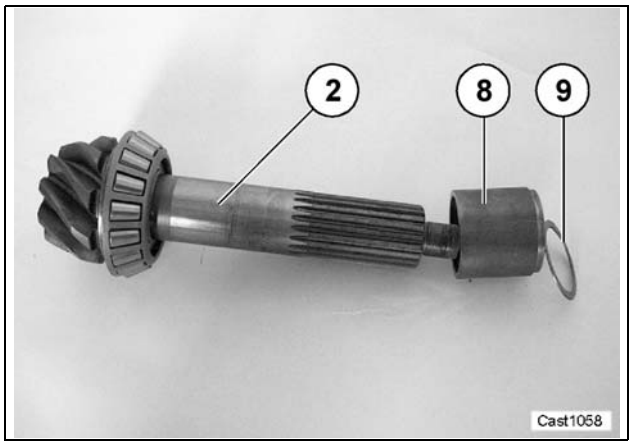
8. Remove the gasket (7).



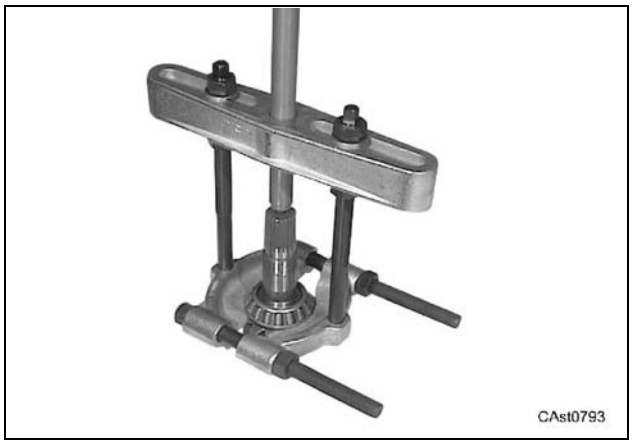
9. Take the bevel pinion out of its housing, by beating with hammer made of soft material on the splined end.



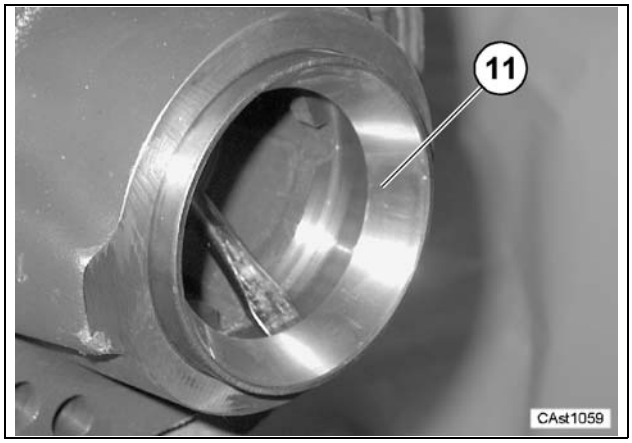
10. Once the bevel pinion (2) has been removed, collect shims (9) and spacer (8).



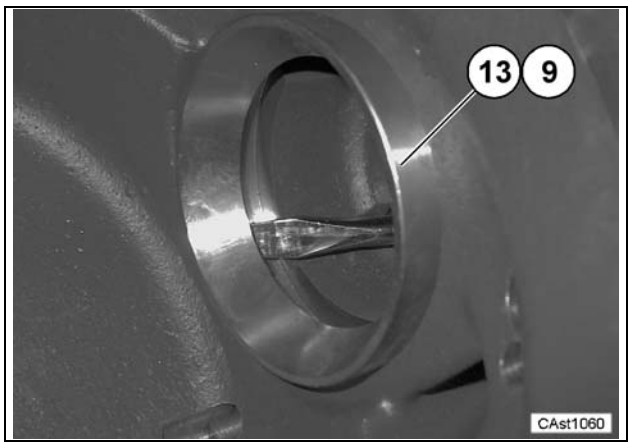
11. Take the bearing cone (13) out of the bevel pinion end, using a suitable extractor.



12. Take the cup of the taper roller bearing (11) out of the central body, using a chisel and hammer.



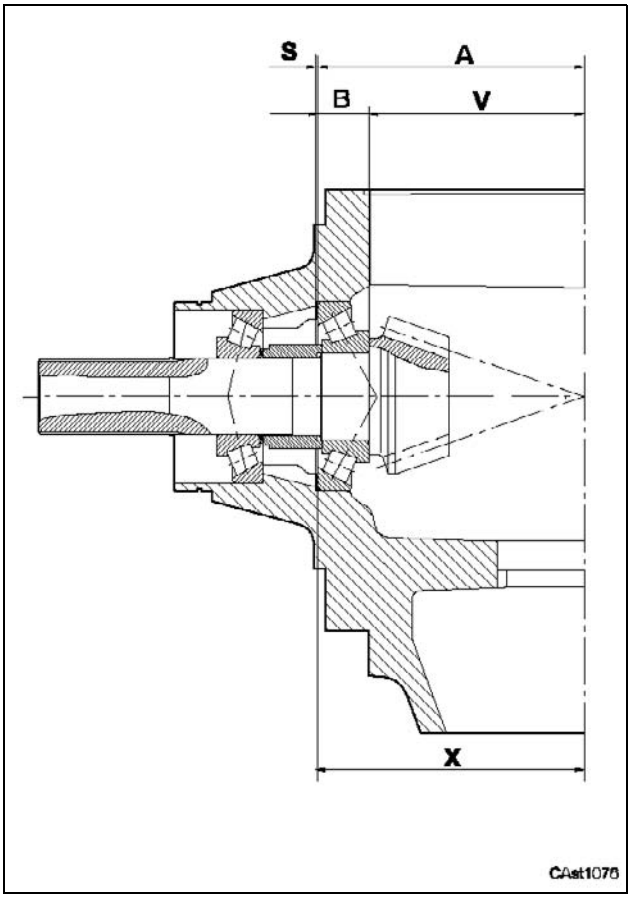
13. Remove the outer cup of the taper roller bearing (13) and shims (9) from the central body. Use a chisel and a hammer.



Assembly of pinion group

1. Bevel pinion adjustment.

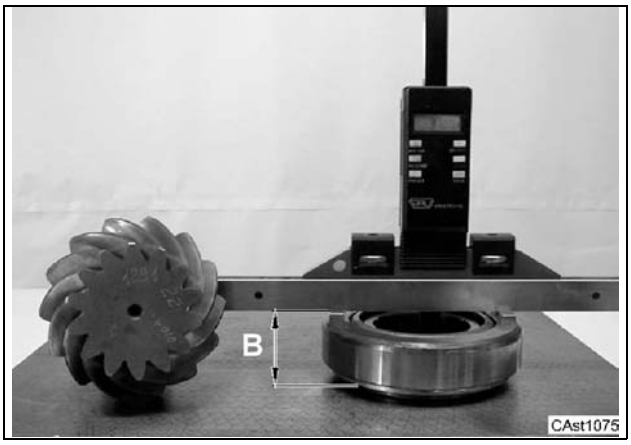
X	155.50	155.50	155.70
B	29.25	29.45	29.45
V	125.00	125.20	124.80
A	154.25	154.65	154.05
S	1.25	0.85	1.65



2. Value stamped on beam trumpet.



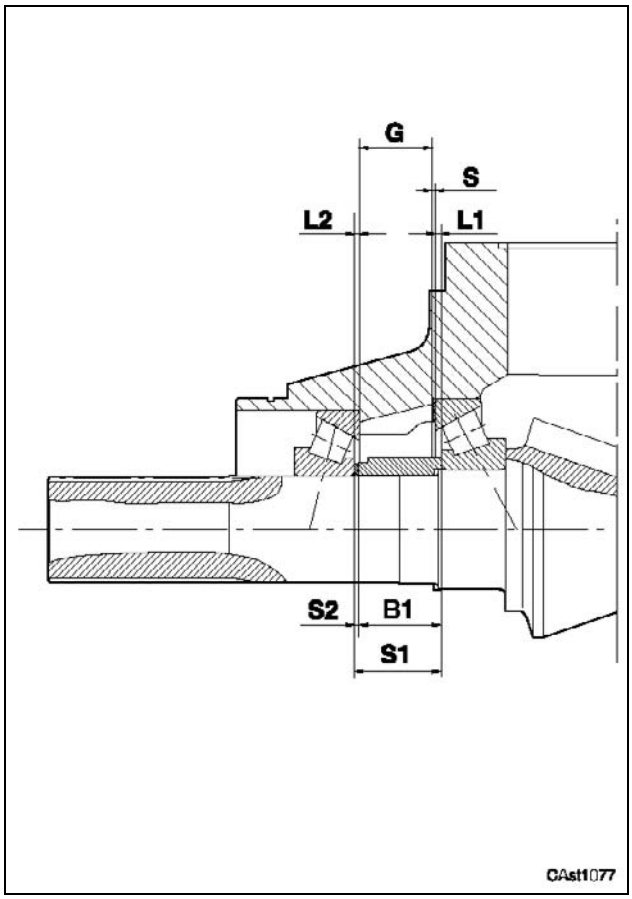
3. To determine shim (**S**) between pinion and bearing it is enough to add value (**V**) printed on pinion head (**V** = prescribed conical distance) to value **B** - bearing width - and subtract **X** from the value printed on beam
   S = X - (V+B)
   Example:shim **S** = 163.6 - (132.80 + 29.25) =1.55 mm



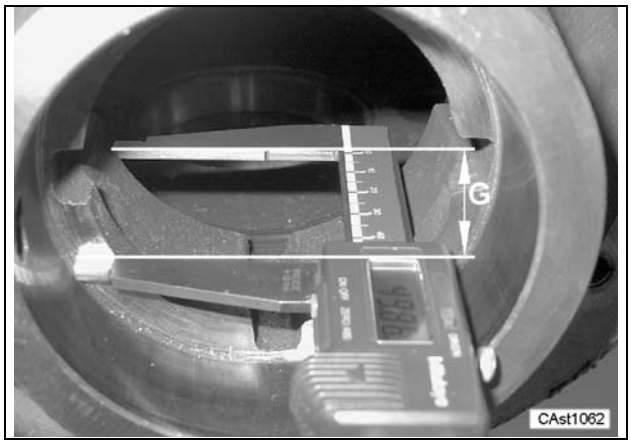
4. Bearings adjustment.

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

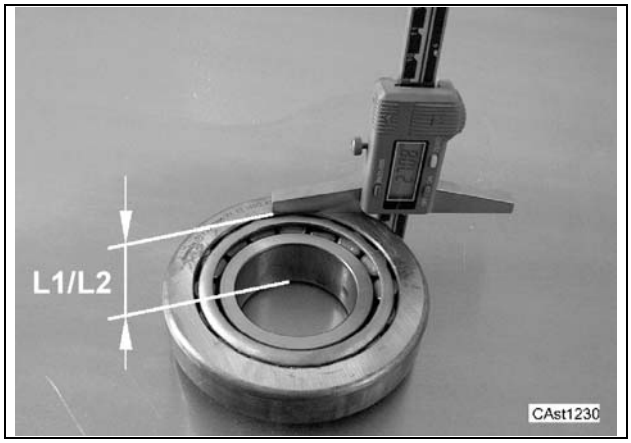
Preloading reduction ca. 0.02 - 0.04 for a 2-3 Nm torque.



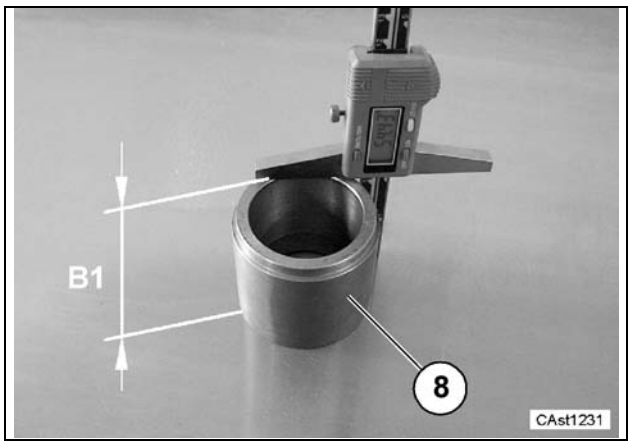
5. To determine shim **S2.**
   S2 = B1 - (L1 - S - G - L2)
   S = previously detected shims
   G = beam value



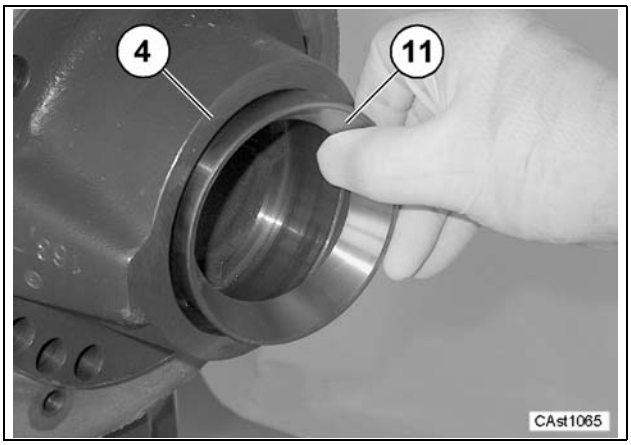
6. L1 = Bearing Height
   L2 = Bearing Height.



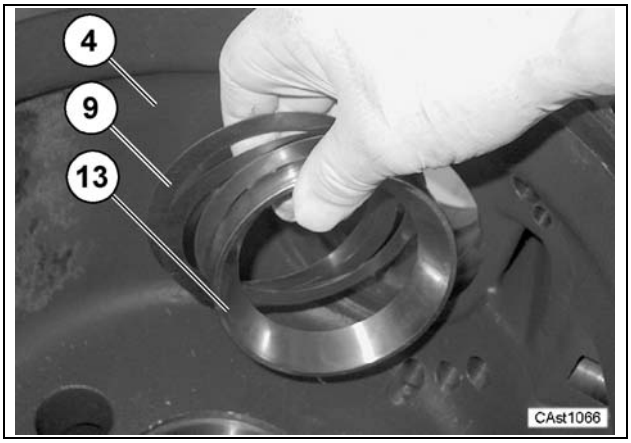
7. **B1** = spacer (8).
   Alternative procedure, use starting spacer **S** = 1.5.



8. Position half bearing (11) on beam trumpet (4).



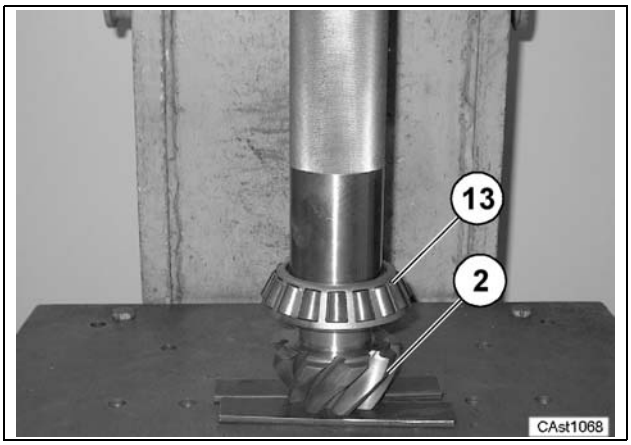
9. Position adjusting shims (9) and inner bearing washer (13) on beam trumpet (4).



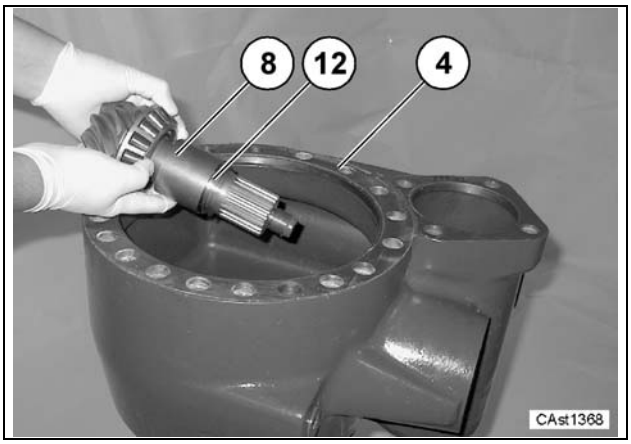
10. Insert the cups of the taper roller bearings on their housings using the special tools included in the kit 2897006.



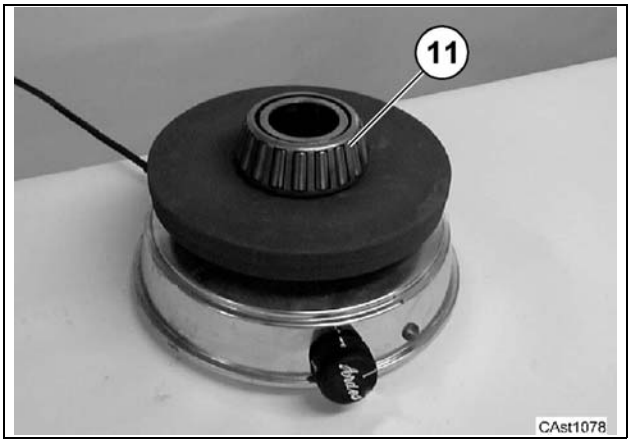
11. Press inner bearing (13) on pinion (2).
    Use tool 2897009.



12. Fit the whole pinion of the bearing complete with spacer (8) and shims (12), on the beam trumpet (4).

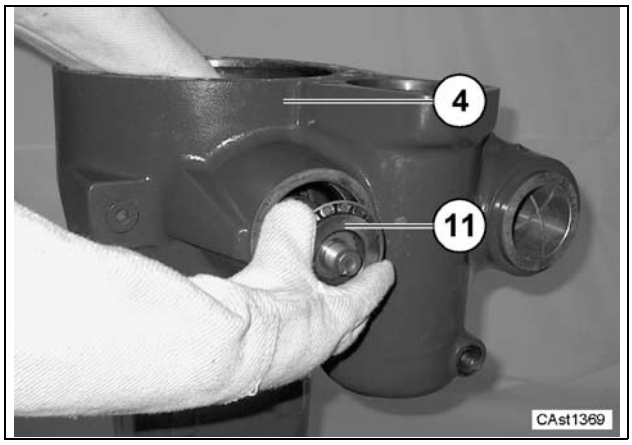


13. Preheat bearing (11) on proper plate up to 100ºC.

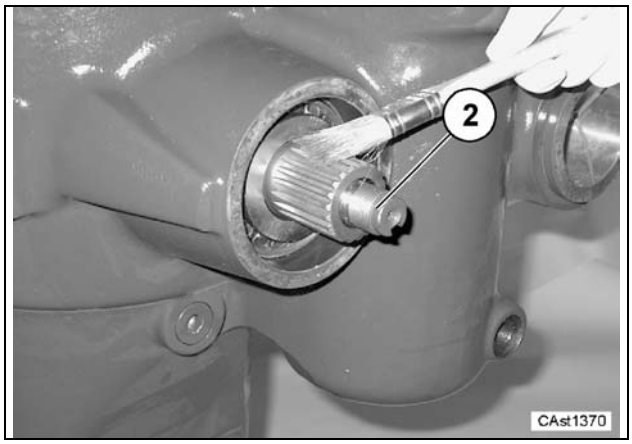


14. Fit bearing (11) in relevant housing on beam trumpet (4).

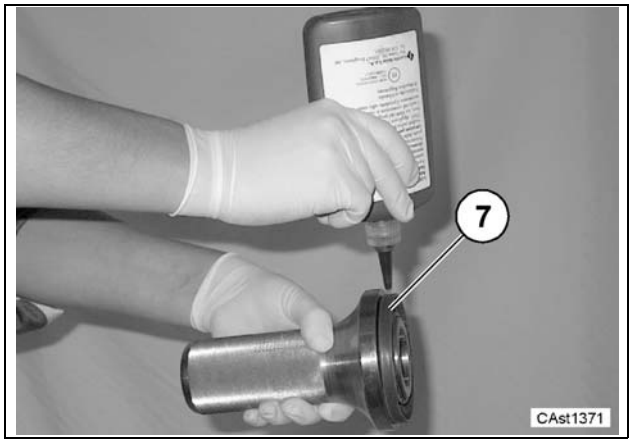
WARNING! Use a special glove to protect from-scorching.



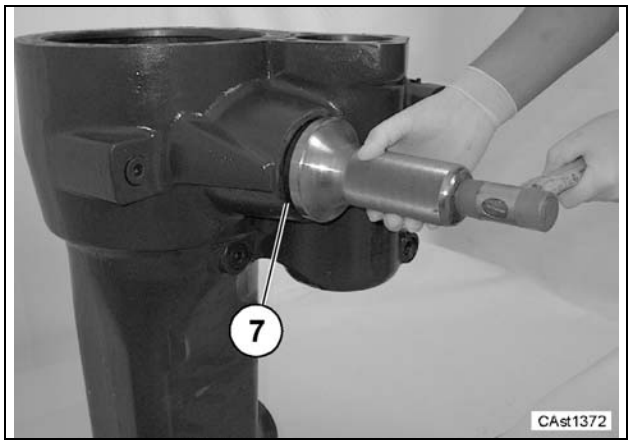
15. Grease shaft pinion (2).



16. Fit oil seal (7) inside tool 2897015.
    Apply Loctite® 510 on the oil seal outer edge.



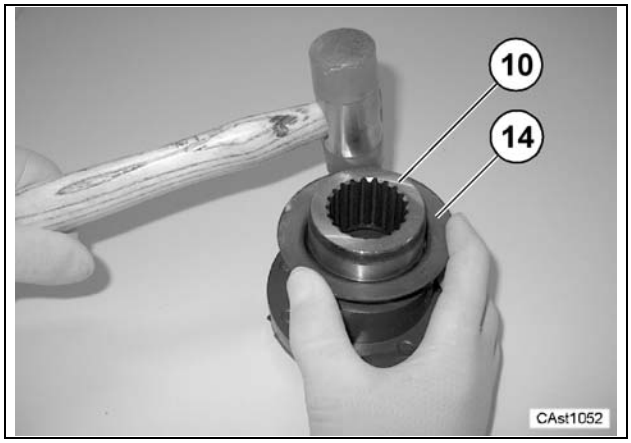
17. Assemble the oil seal by slightly striking with a plastic hammer.
Note: Clean the box with a rolling brush.



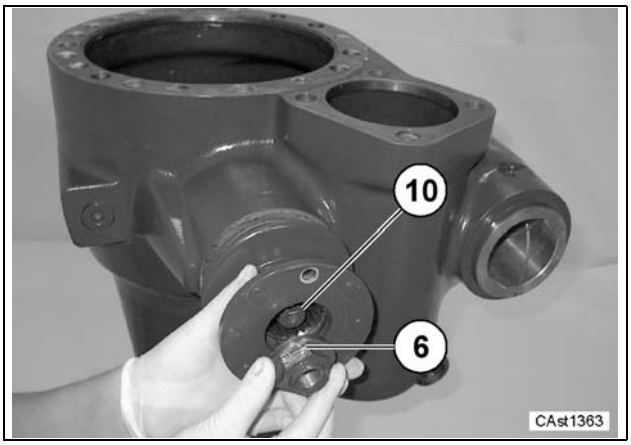
18. Apply Loctite® 242 on nut (6).



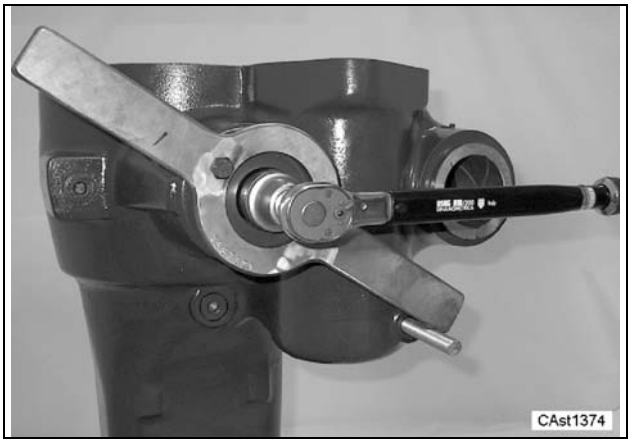
19. Use a hammer to assemble flange (10) together with guard (14).



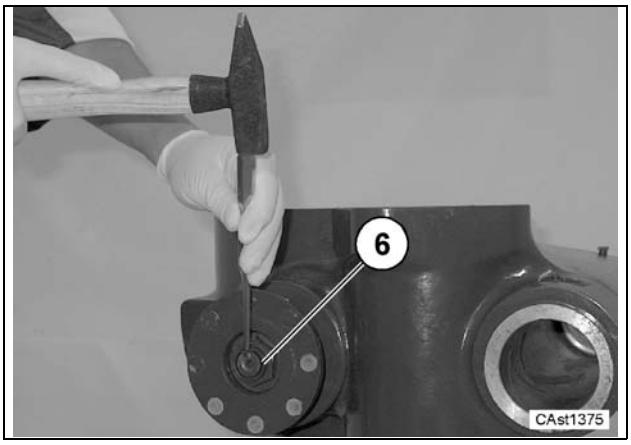
20. Assemble the flange (10) and the nut (6).



21. Apply tool 2987001.
Torque - 340 Nm (35 kgf-m)



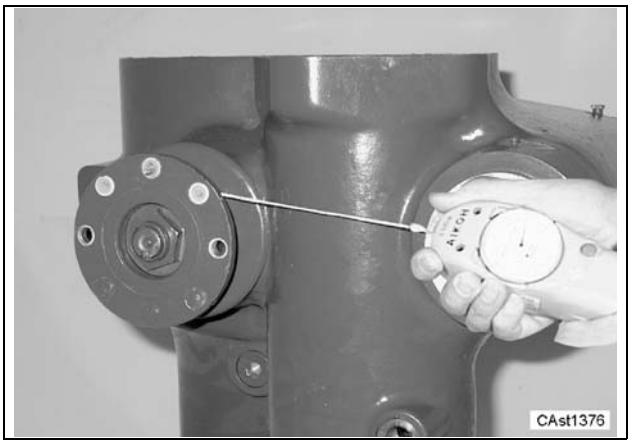
22. Drive the nut (6)with a tool.



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.

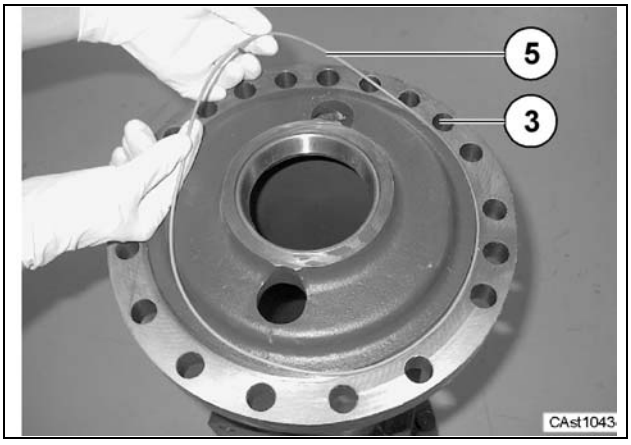
P = 2/3 Nm



24. Assemble the whole differential unit.



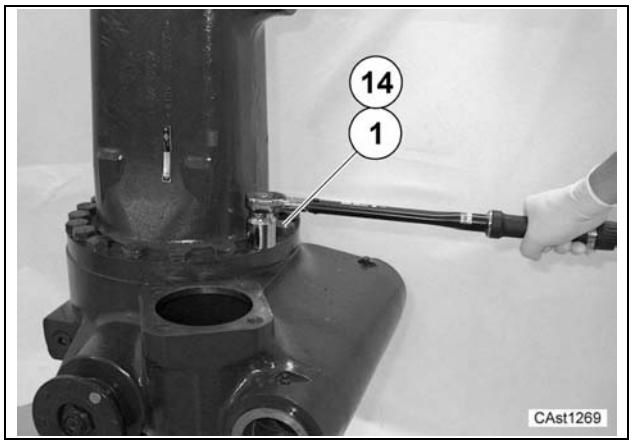
25. Assemble O-ring (5) on beam trumpet (3). Grease the O-ring (5)



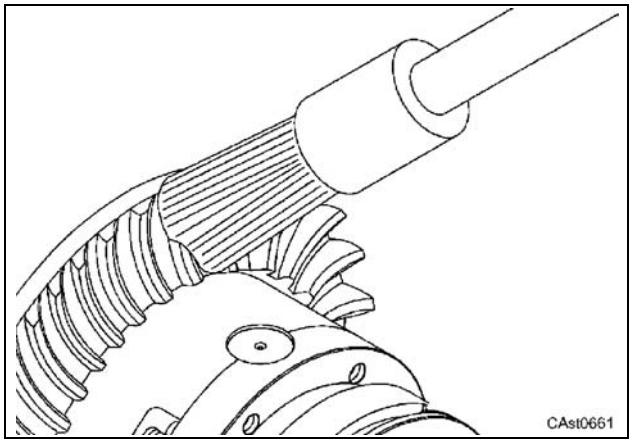
26. Apply Loctite® 510 on contact surface of beam trumpet (4).



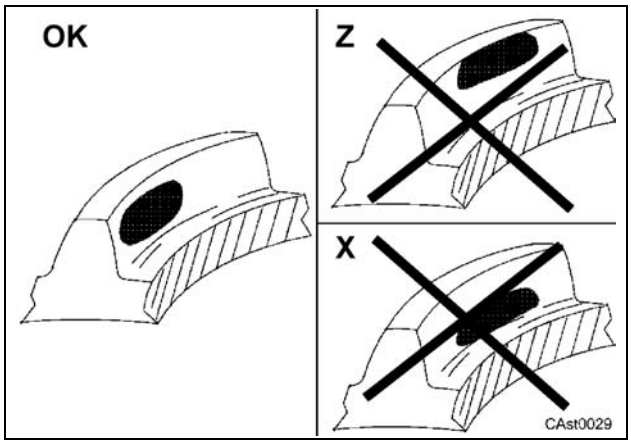
27. Fit screws (1) and tighten.
Torque - 205 Nm (21 kgf-m)



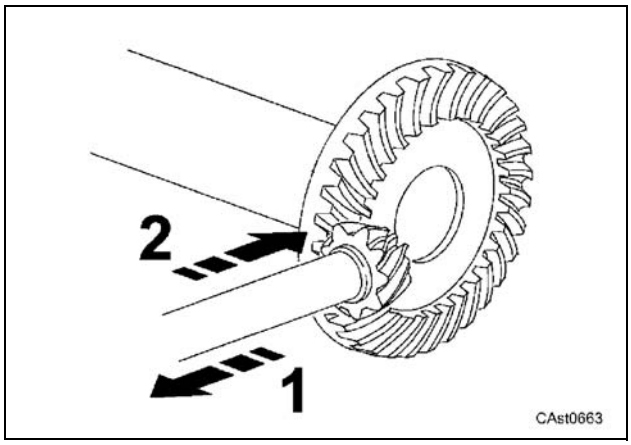
28. To test the marks of the bevel gear teeth, paint the ring gear with red lead paint and detect the contact. The marking test should be **always** carried out on the ring bevel gear teeth and on both sides.



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.



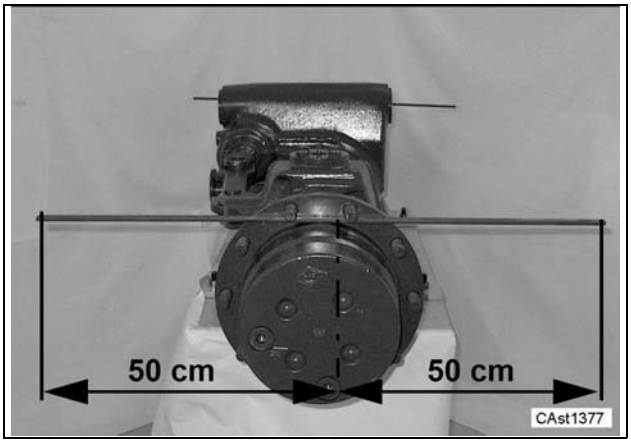
30. Movements to correct
    1 - Move the pinion for type **X** contact adjustment.
    2 - Move the pinion for type **Z** contact adjustment.



Toe-in adjustment

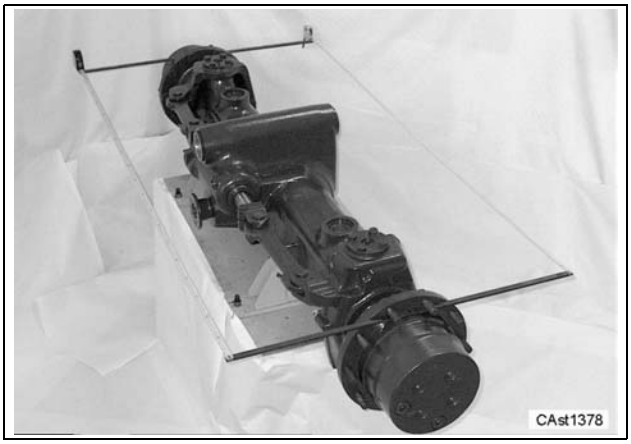
1. Put 2 equal one meter long linear bars on the wheel sides and lock them with two nuts on the wheel hub stud bolt.

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.



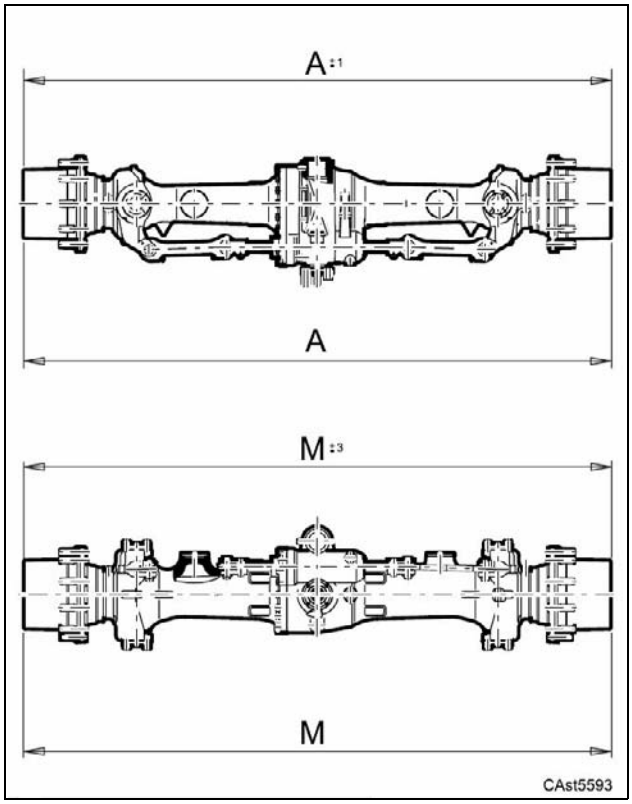
2. Measure the distance in mm between the bar ends with a tapeline (M).

Note: Keep the minimum value, swinging the measurement point.

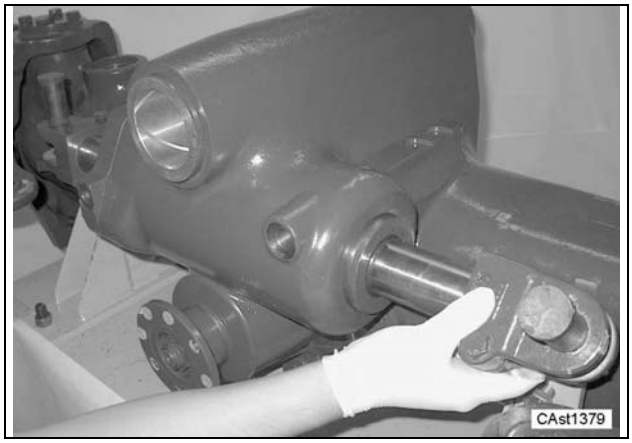


3. Check that the difference of the measurements between the wheel hubs diameters ends is within the requested tolerance range (Tolerance = 0)
The nominal toe-in (A) value is referred to the external diameter of the wheel hubs flange, therefore the measured toe-in value (M) at the bars ends must be related to the ratio between length of the bar and flange diameter.

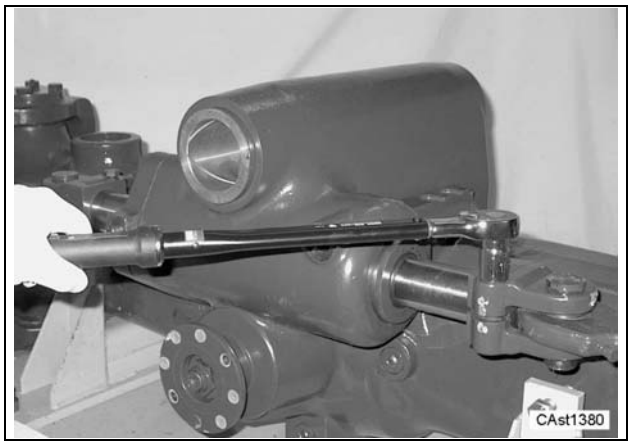
Nominal toe-in	**Measured**
(Tolerance = 0) = A±1	**Toe-in = M±3**



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)

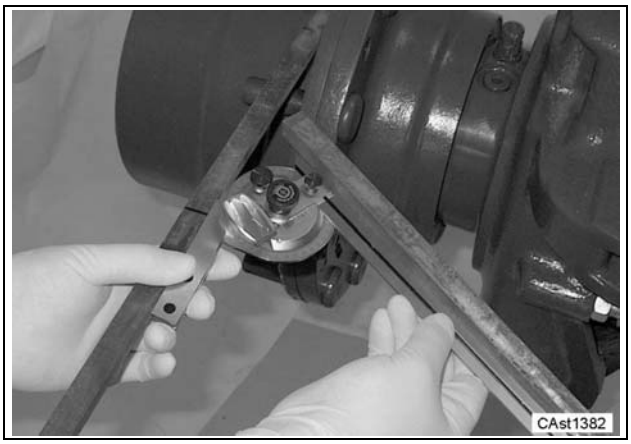


Steering angle adjustment

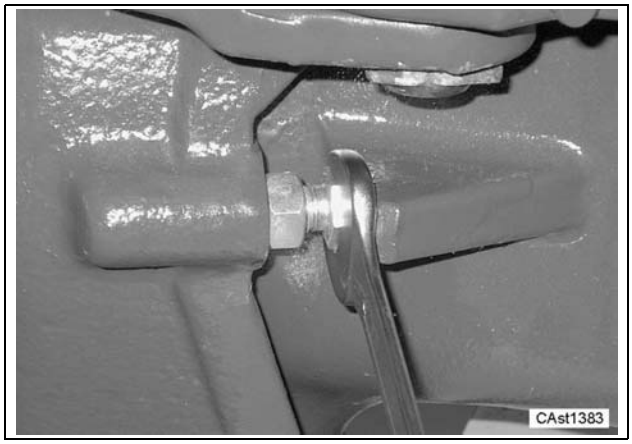
1. Use the same bars assembled for the toe-in adjustment and a long bar perfectly balanced over the machined part of the central body (pinion side), so that the 2 bars form an acute angle at the maximum steering.



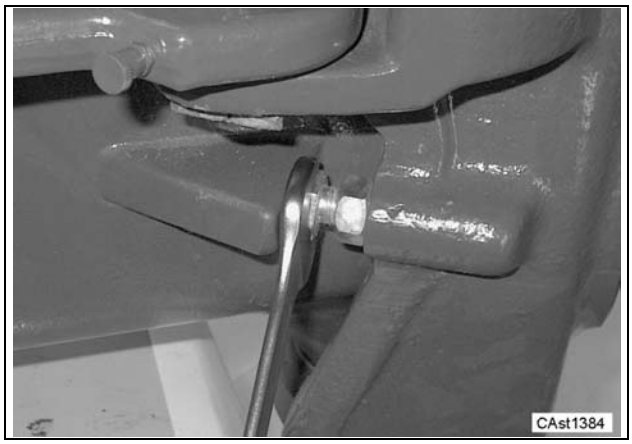
2. Adjust a goniometer to the to the requested angle 32º/26.2º (inner/outer) and position it on the long bar.
   Move a wheel side till it forms with the 2 bars, the angle fixed by the goniometer.



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

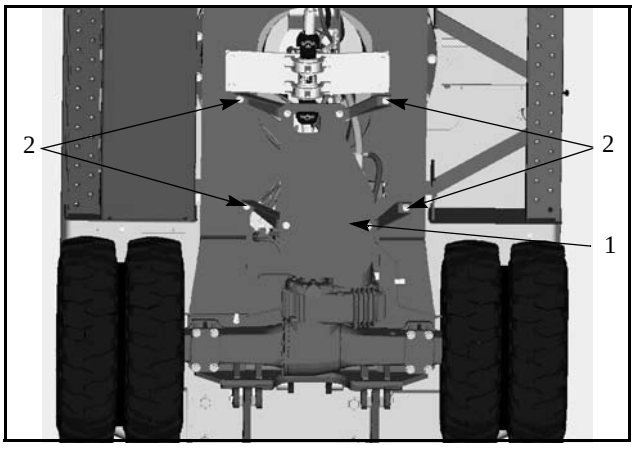
1. Drain oil out of rear axle and hubs.

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.



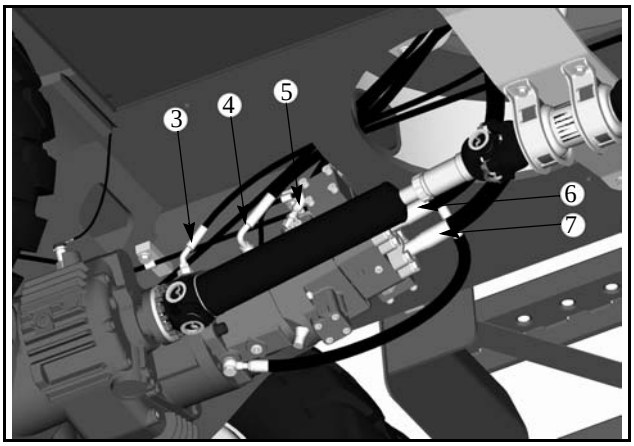
3. Remove cover (1) by removing bolts (2).



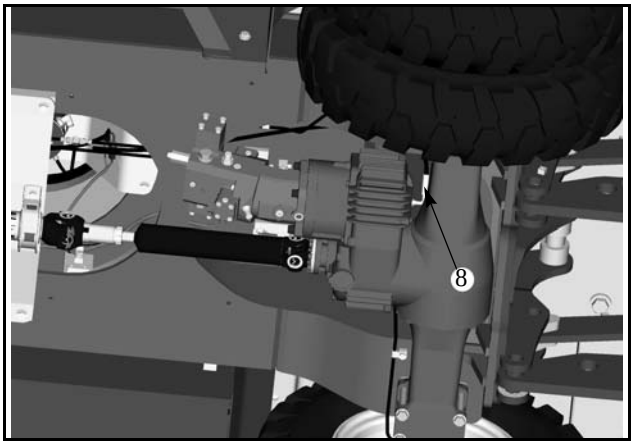
4. Attach an identification tag to hoses to avoid incorrect connection during re-assembly

5. Attach vacuum pump to hydraulic tank and apply vacuum.

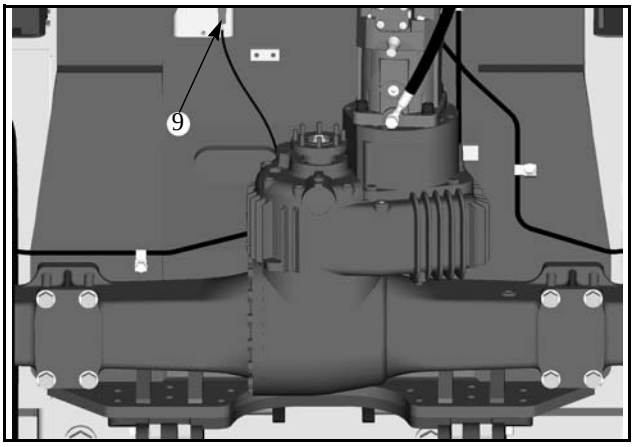
6. Disconnect each hose individually from the travel motor and hose from top of the transmission plug with blank / plug and O-ring from blanking kit to prevent oil spillage and contamination (3 through 7)



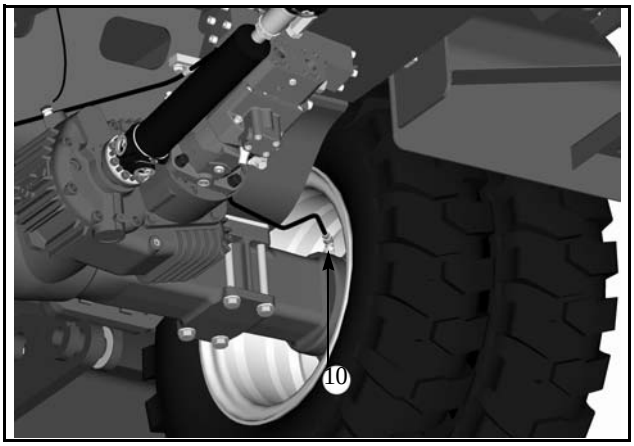
7. Disconnect hose (8) from rear axle and plug with blank/plug and O-ring from blanking kit to prevent oil spillage and contamination.

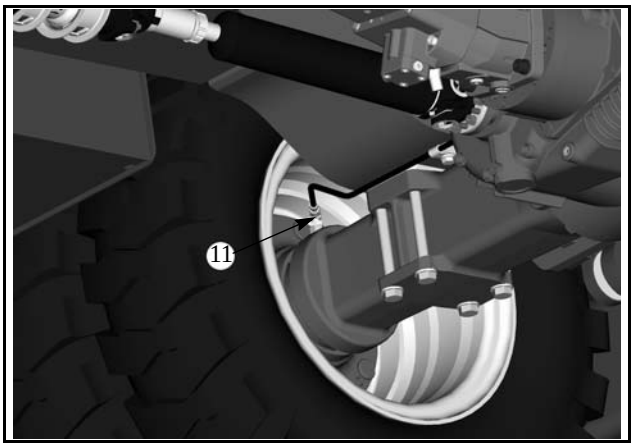


8. Disconnect electrical connection (9).

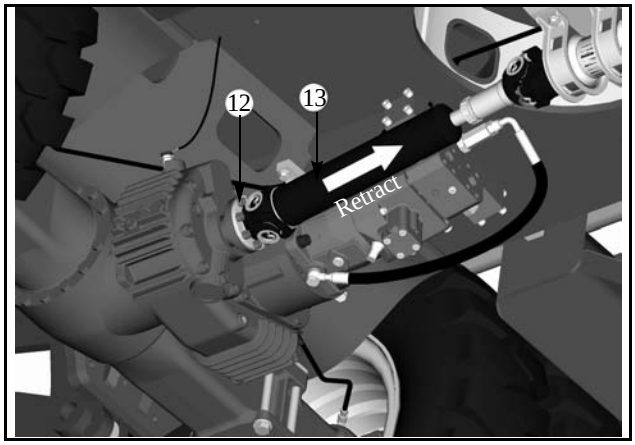


9. Disconnect brake lines (10), (11) and plug with blank/plug and O-ring from blanking kit. Also put cap on nipple fittings to prevent oil spillage and contamination.

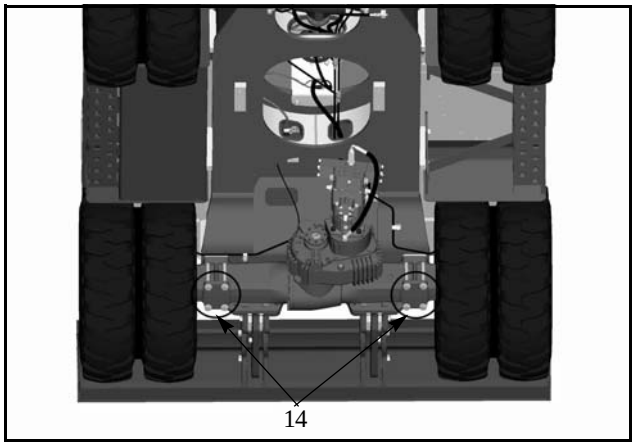




10. Disconnect propshaft (12) by removing bolts (13) and retracting propshaft in direction shown.



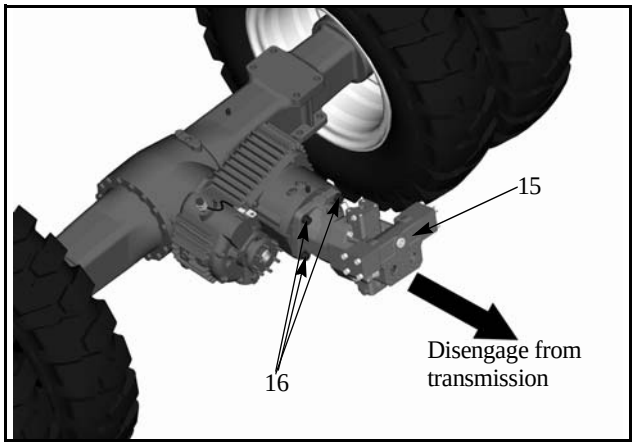
11. Remove bolts(14).



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

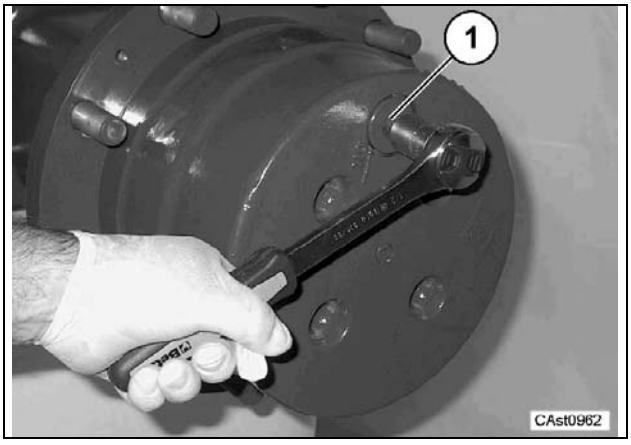
SPECIAL TOOLS

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

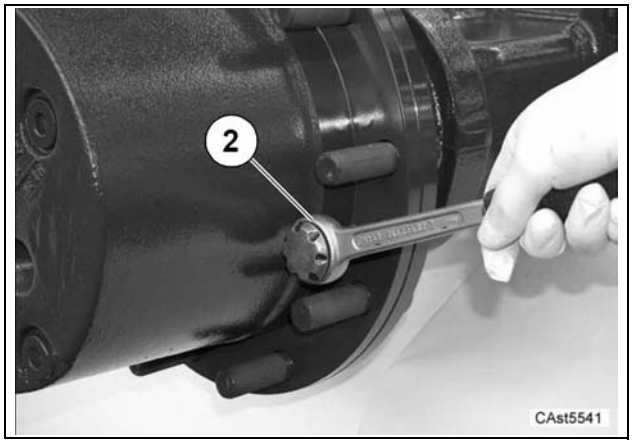
DISASSEMBLY

Removal of Epicyclic Reduction Gear and Brake

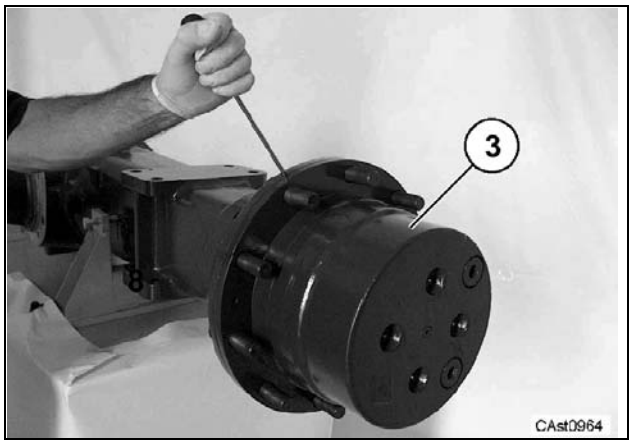
1. Before draining the oil, position the wheel hub (1) with the plug on the upper part and loosen it off some turns in order to eliminate any possible inner pressure, then remove it completely. Turn the wheel hub upside down till the hole is in the lowest point.
   Drain the oil completely.



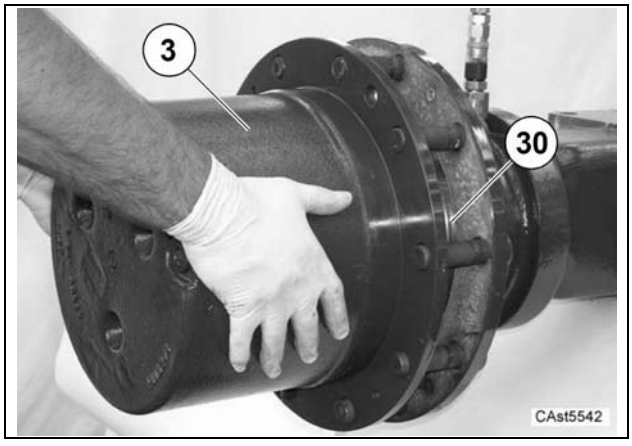
2. Remove fastening screws (2) from the cover of the planetary gears carrier.



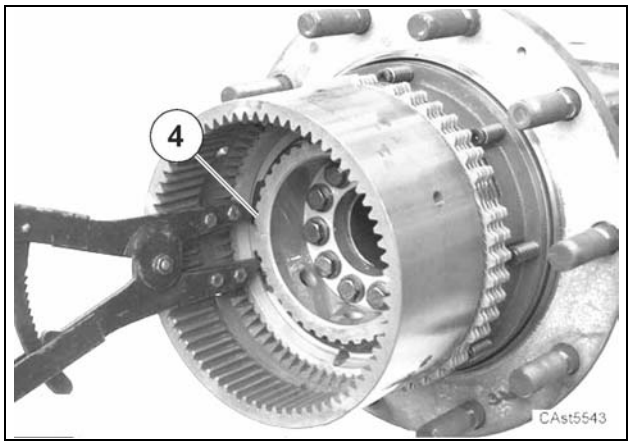
3. Use the levers inside the preset slots to detach the planetary gear carrier cover.



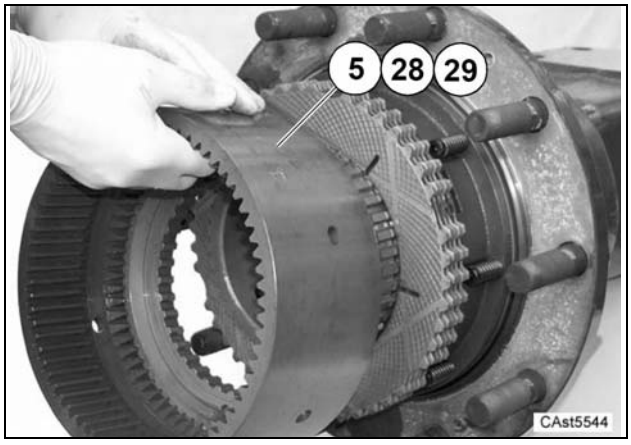
4. Remove the planetary gear carrier cover (3) and O-ring (30).



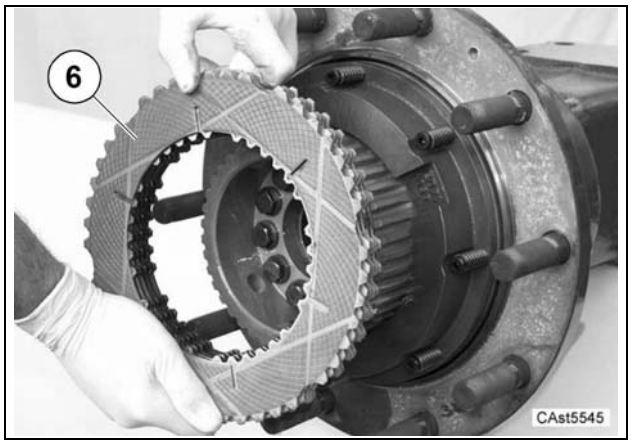
5. Remove split ring (4).



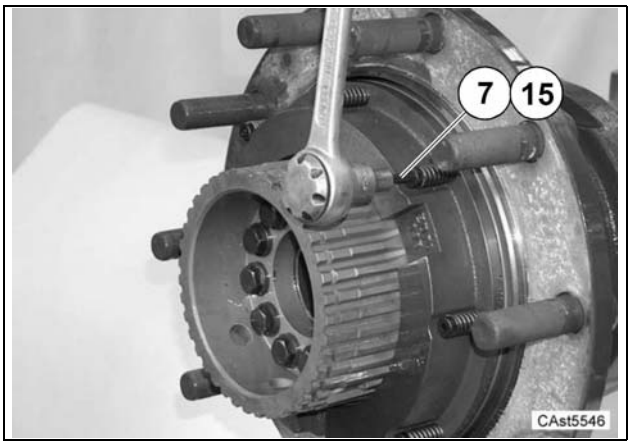
6. Remove ring bevel gear (5) complete with carrier (28) and split ring (29).



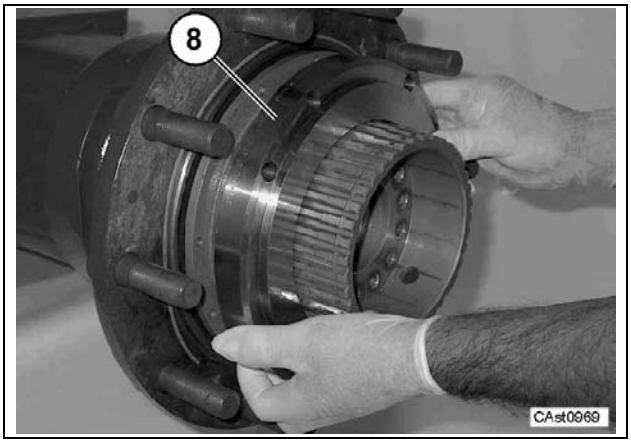
7. Remove brake discs (6).



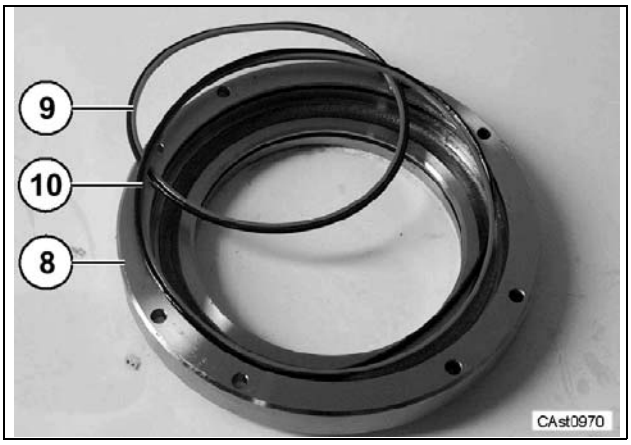
8. Remove fastening screws of piston (7) and springs (15).



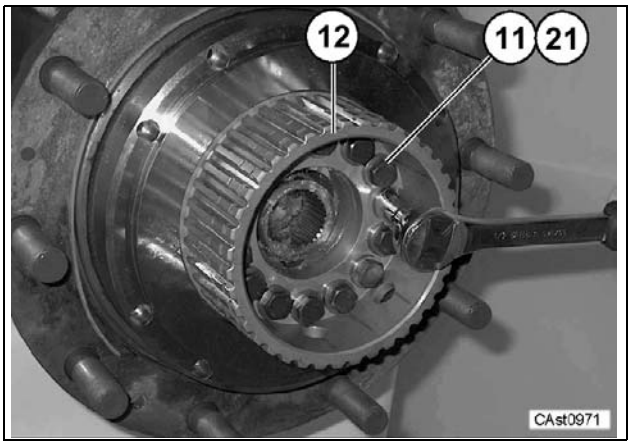
9. Remove piston (8).



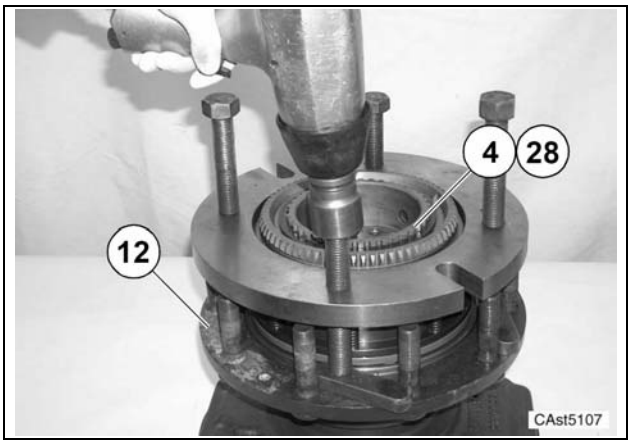
10. Remove seal rings (9) and (10) from piston (8).



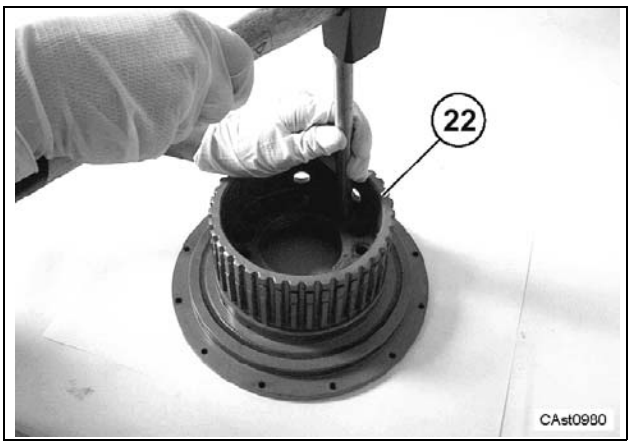
11. Remove screws (11) and washers (21) from brake carrier (12).



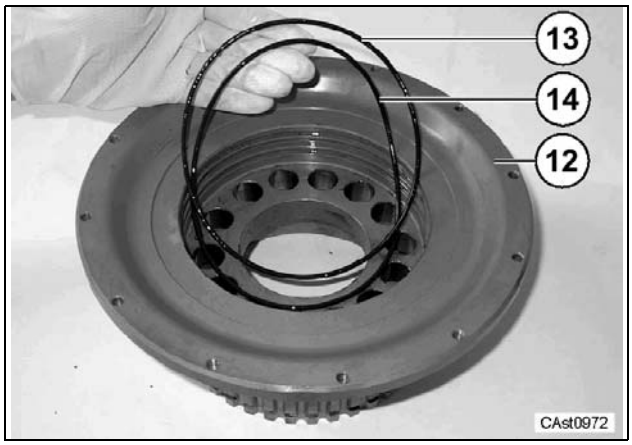
12. Assemble carrier (28) and split ring (4). Remove brake carrier (12) using tool 289701.



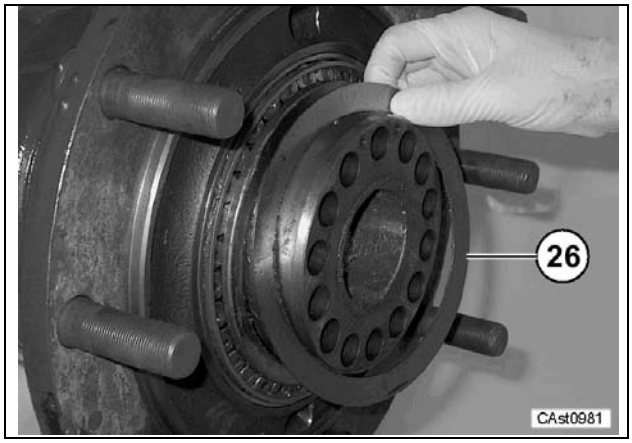
13. Remove bushes (22).



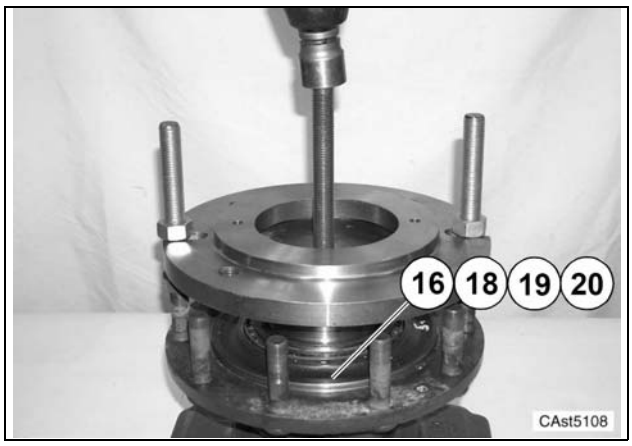
14. Remove seal rings (13) and (14) from brake carrier (12).



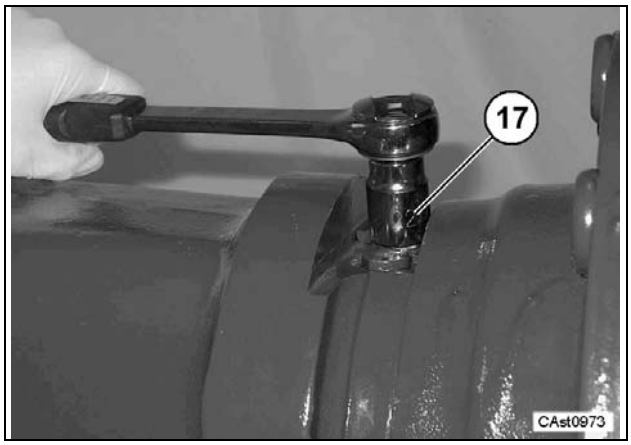
15. Remove shims (26).



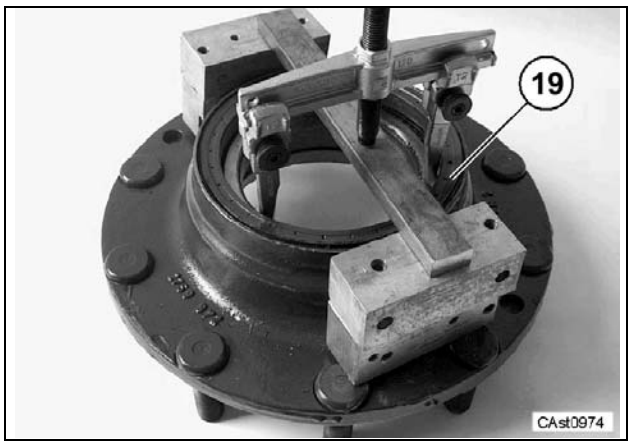
16. Remove wheel hub (16) with bearings (19) and (20) and seal ring (19) using tool 2897102.



17. Remove the drain valve (17).



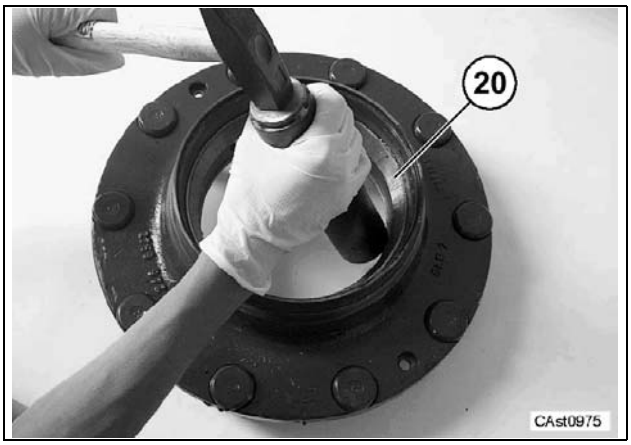
18. Remove seal ring (19).



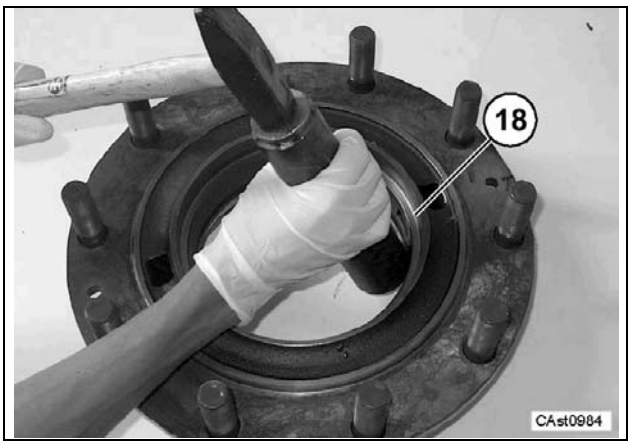
19. Remove inner cup of bearing (18).



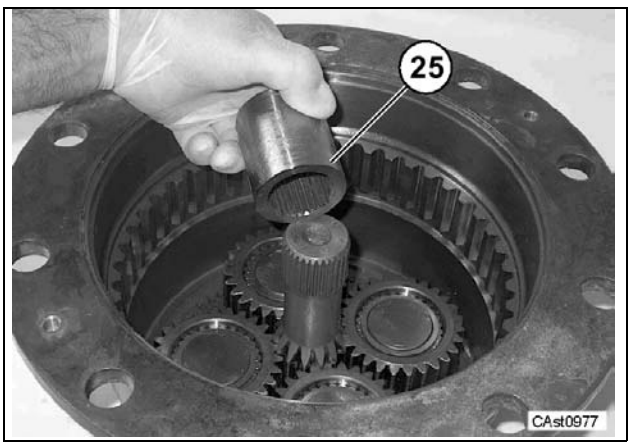
20. Remove outer cup of bearing (20).



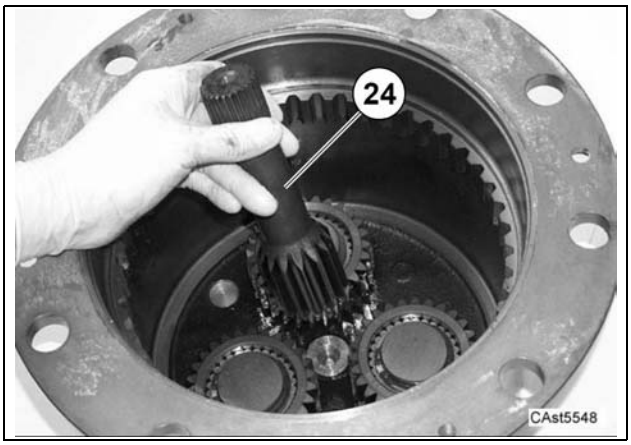
21. Remove outer cup of bearing (18).



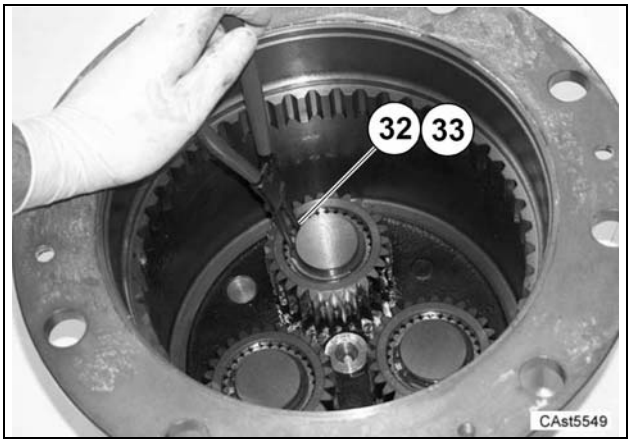
22. Remove sleeve (25).



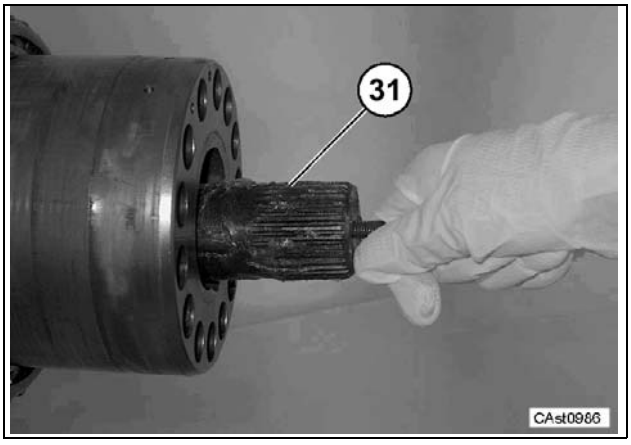
23. Remove shaft and pinion (24).



24. Remove snap ring (32) planetary gears (33).

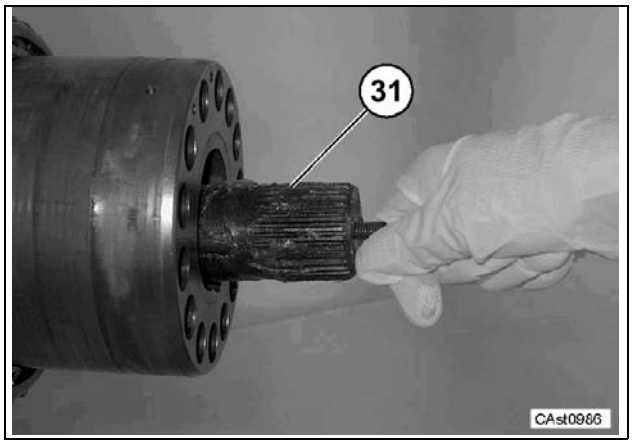


25. Remove universal joint (31).

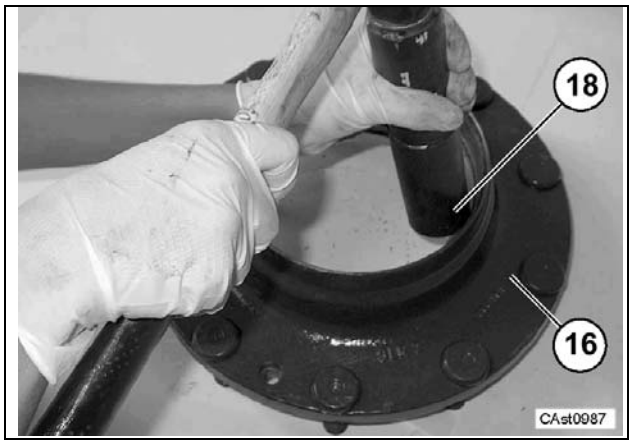


Installation of Epicylic Reduction Gear and Brake

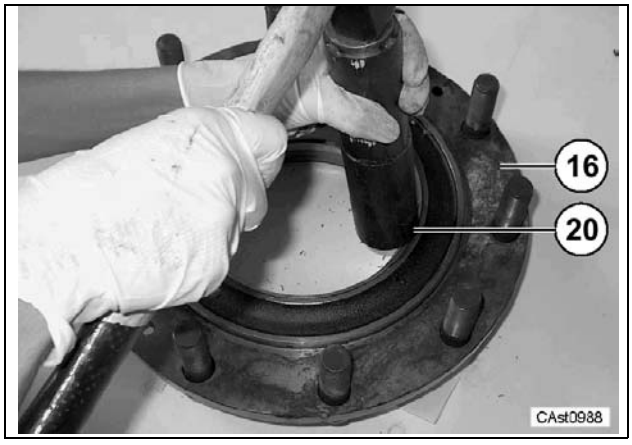
1. Assemble universal joint (31).



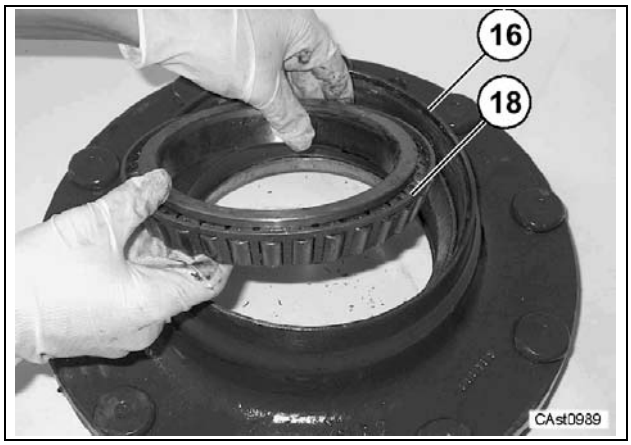
2. Fit outer cup of bearing (18) wheel hub (16).



3. Fit outer cup of bearing (20) wheel hub (16).



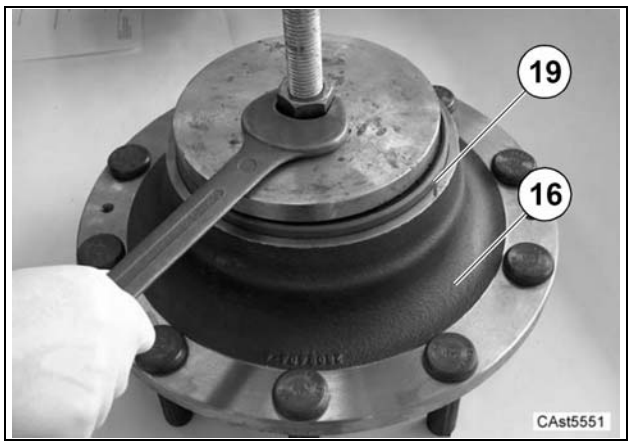
4. fit the remaining part of bearing 18) on wheel hub (16).



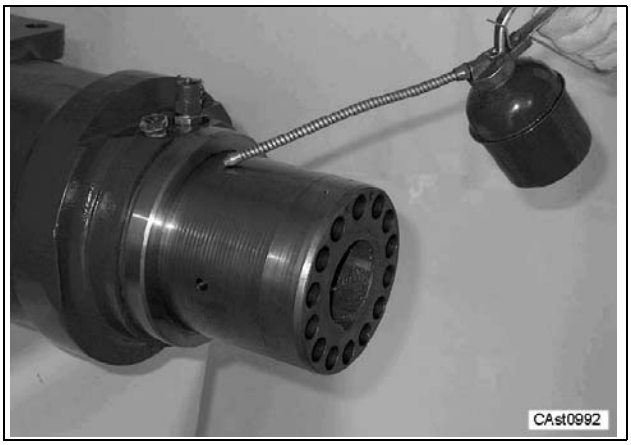
5. Apply Loctite® 510 on seal ring (19).



6. Fit seal ring (19) on wheelhub (16). Use tool 2897003.



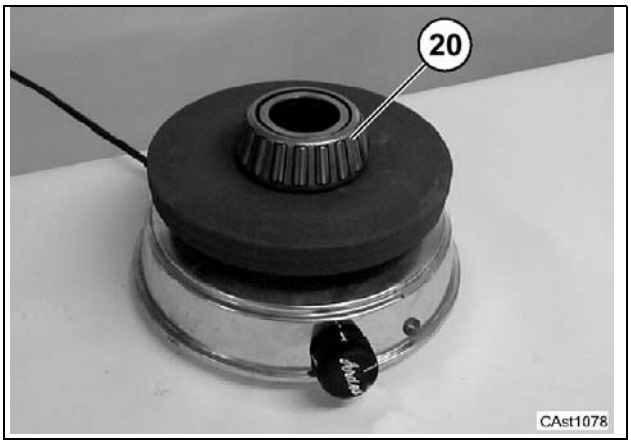
7. Lubricate axle shaft to assemble the wheel hub. **Warning**: Polish hub and oil holes.



8. Assemble the whole wheel hub (16). Alternately strike bearings (18).
Warning: The roller bearing should be rested on the beam trumpet.



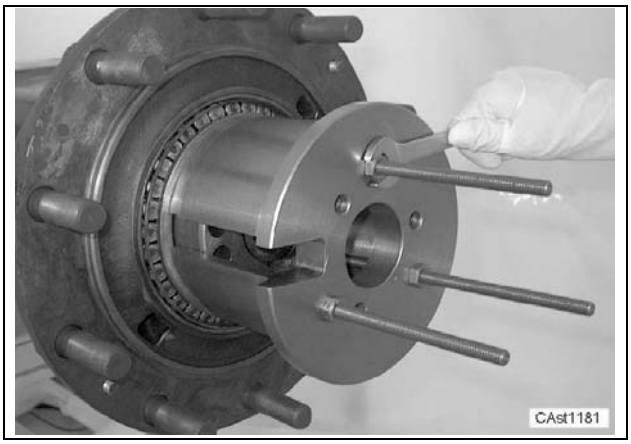
9. Preheat bearing (20) on proper plate up to 100°C.



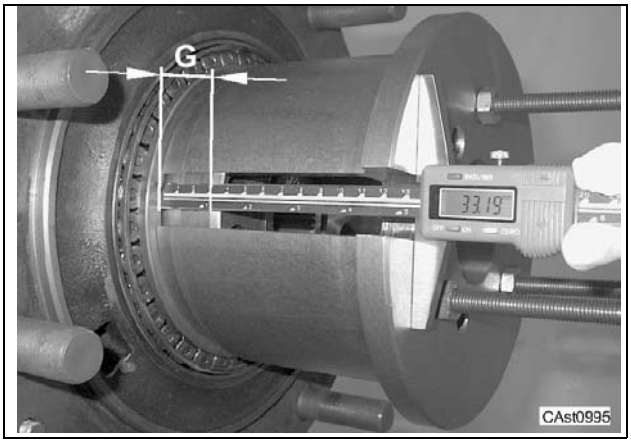
10. Fit bearing (20) inside beam trumpet.
Warning: Wear gloves to avoid getting burnt.



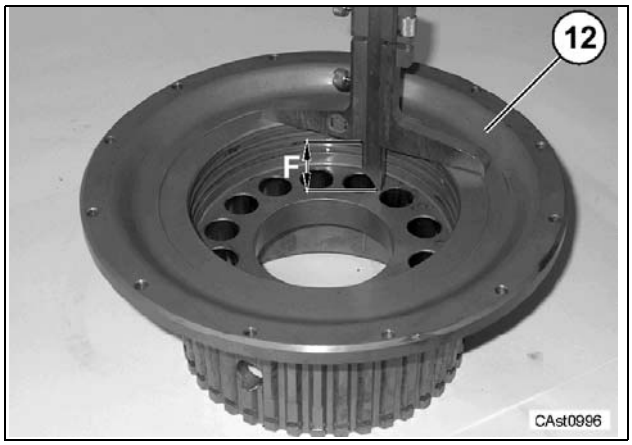
11. Assemble the tool 2897013, 3 draw plates M10 x 285 and 3 nuts M10.



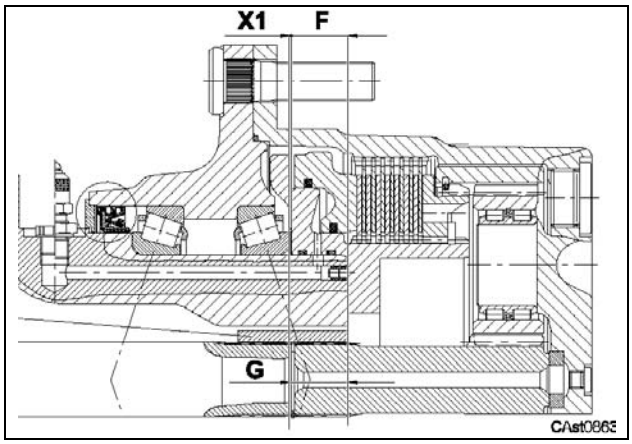
12. Use a depth gauge to measure dimension (G) of wheel hub.



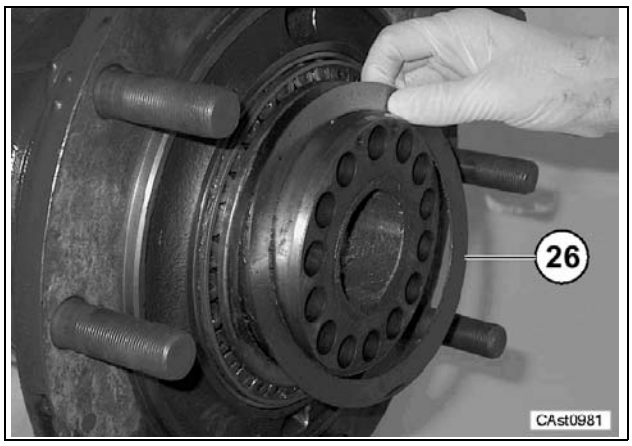
13. Use a depth gauge to measure dimension (F) of brake carrier (12).



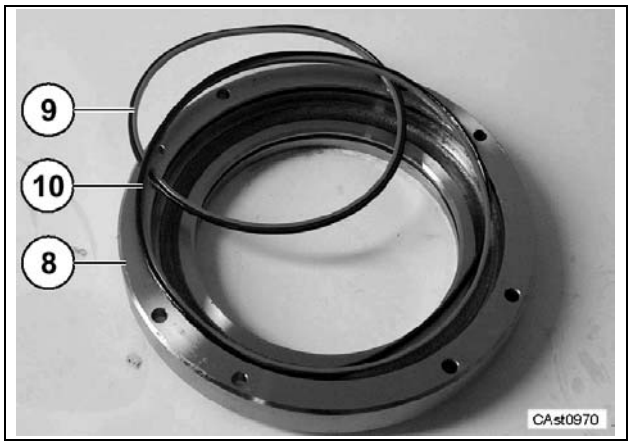
14. Calculate shims X1 of adjustment shims by using the following procedure: X1=(G-F) + 0.05.



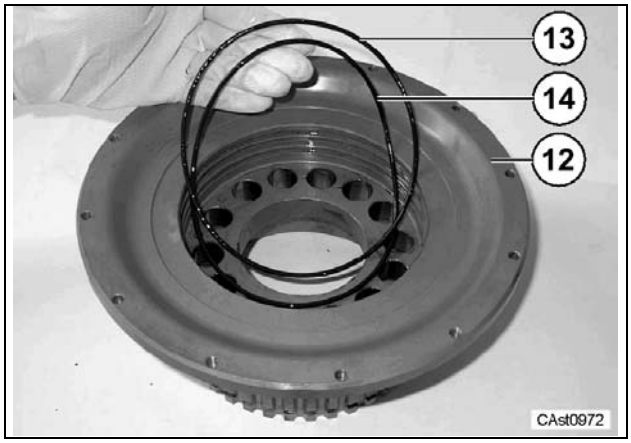
4 15. Assemble previously calculated shims (26) (X1).



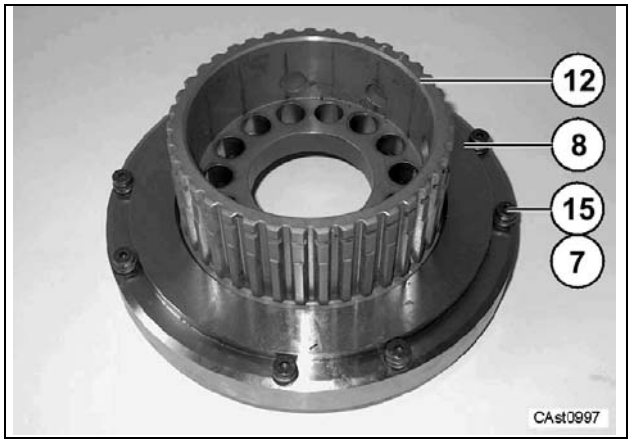
16. Assemble O-rings (9) and (10) on piston (8).



17. Assemble O-rings (13) and (14) on brake carrier (12).



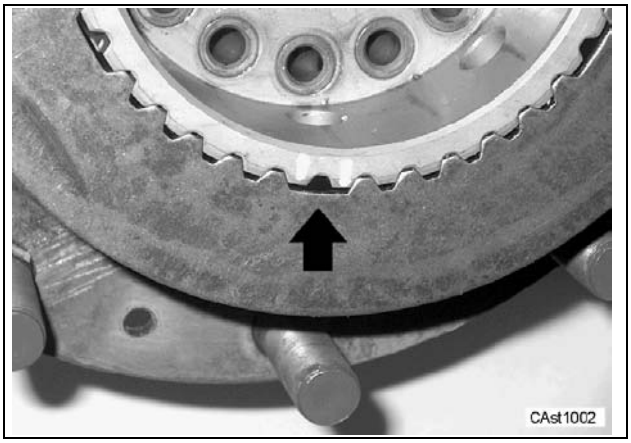
18. Fit piston (8) on brake carrier (12) with springs (15) and screws (7). Apply Loctite® 638 on the screws (7).



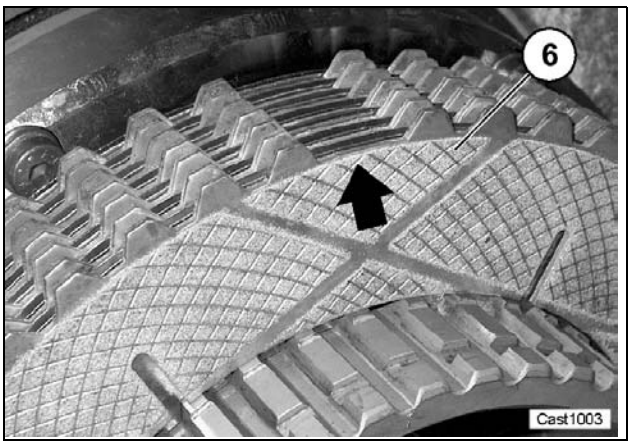
19. Fit the whole unit of the brake carrier on wheel hub.
Warning: The brake carrier and beam trumpet holes should coincide.



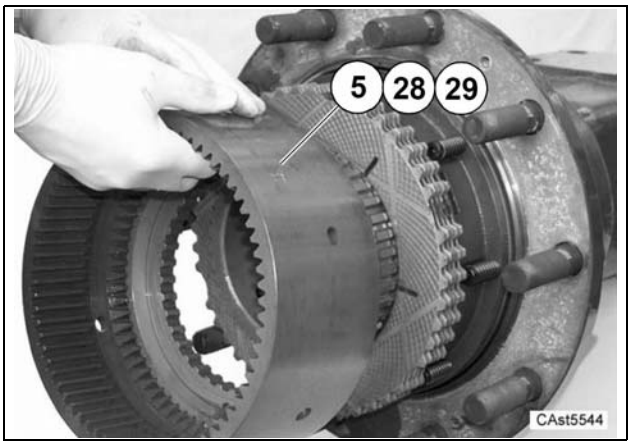
20. Assemble brake discs (6).
Warning: During assembly operations all the inner disc slots should coincide.



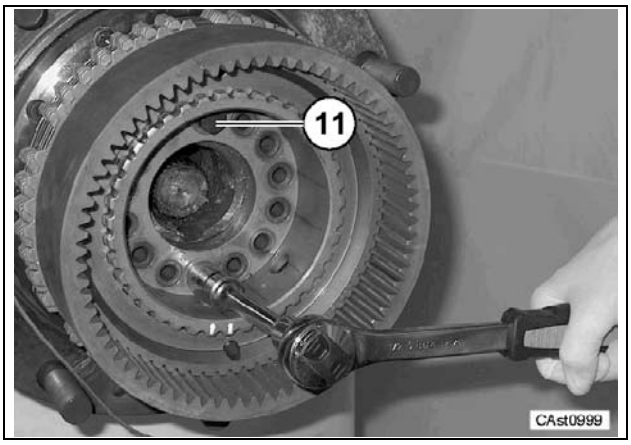
21. Assemble brake discs (6).
Warning: During assembly operations all the outer disc slots should coincide.



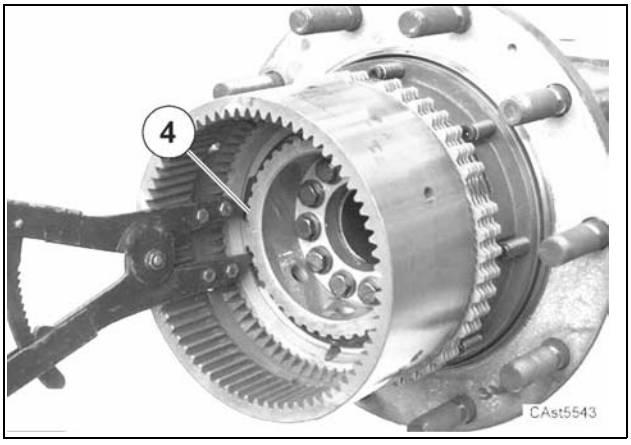
22. Fit ring bevel gear (5) with carrier (28) and split ring (29).



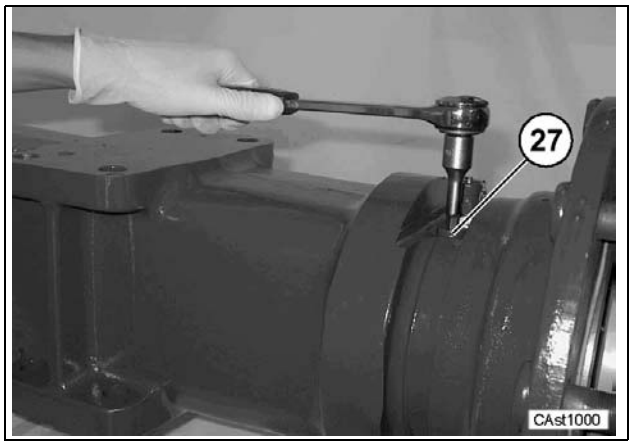
23. Test the brake by temporarily fitting two screws (11).
Warning: Do not assemble bushes (22).



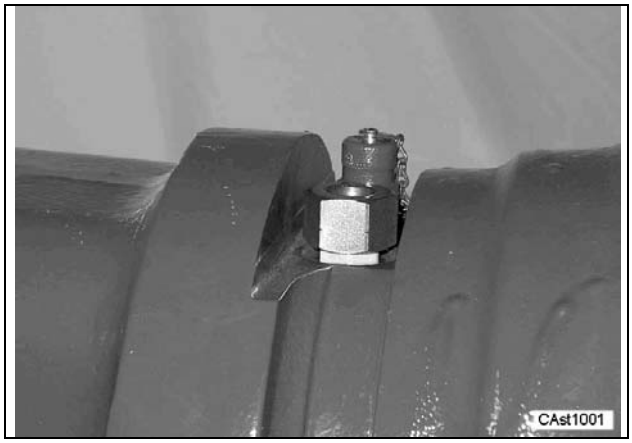
24. Fit snap ring (4).



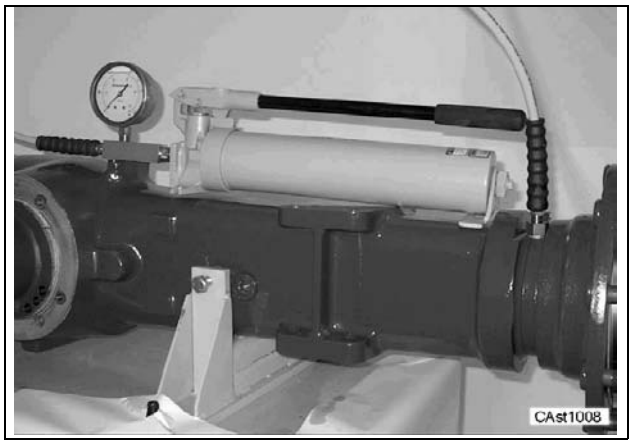
25. Remove plug (27).



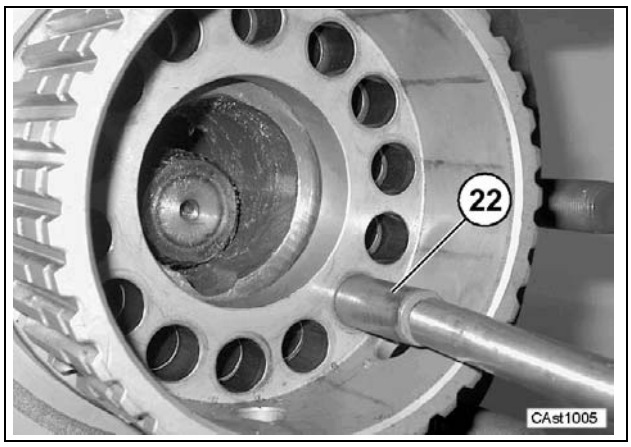
26. Fit an adapter instead of the plug.



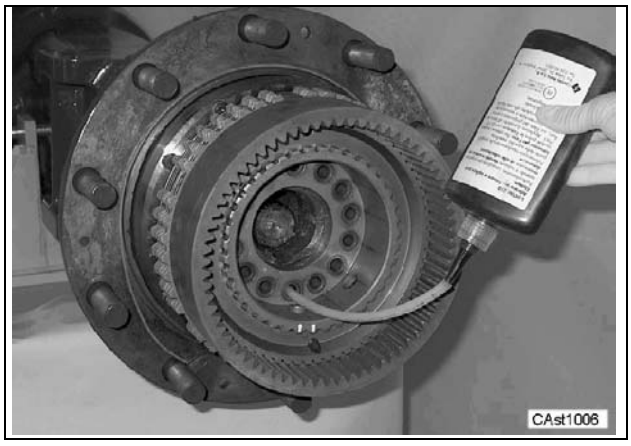
27. Test the brakes by considering that pressure should be 45 - 50 bar for about one minute.



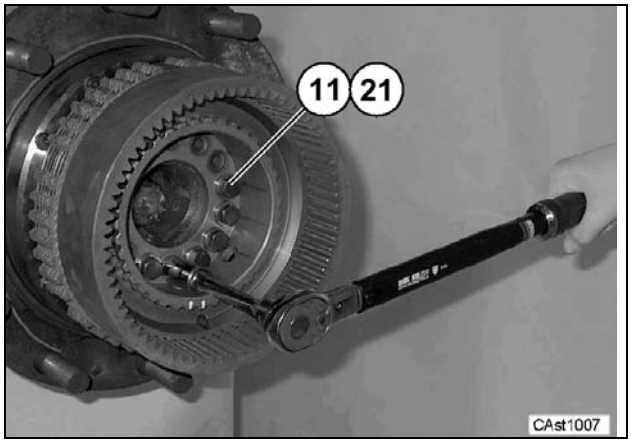
28. Fit bushes (22).
Warning: Pay attention to the assembly direction of bushes.



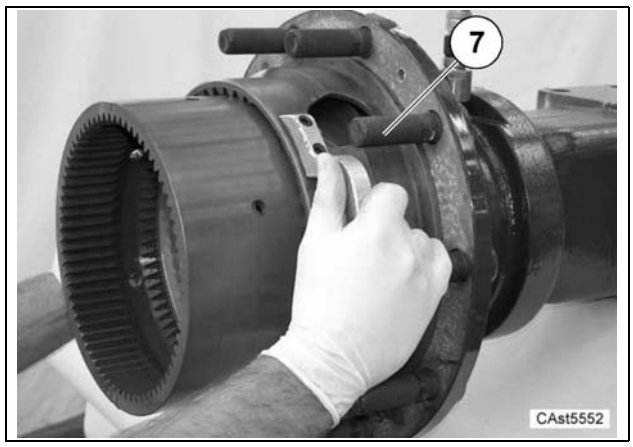
29. Apply Loctite® 242 inside slots.



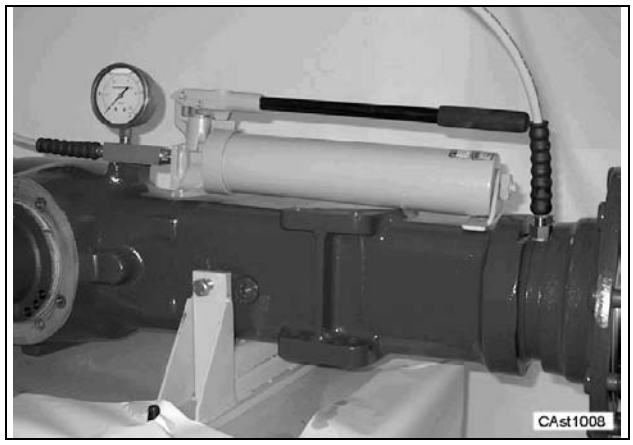
30. Fit screws (11) and shims (21).
Tightening torque: 68Nm



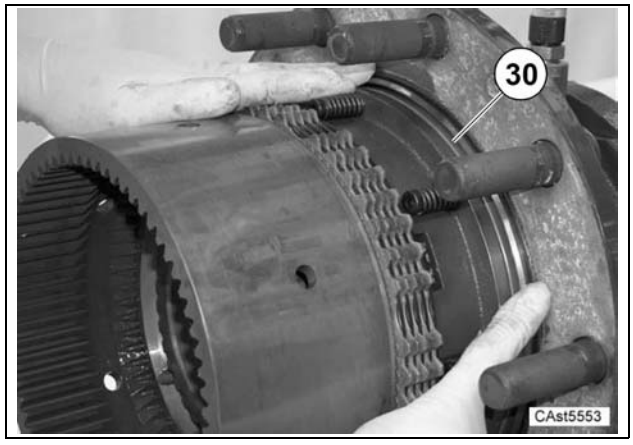
31. Line up brake discs. Use tool 2897014.
Warning: A tooth should coincide with a brake fastening screw (7).



32. Put brakes under pressure to avoid outer disc misalignment.

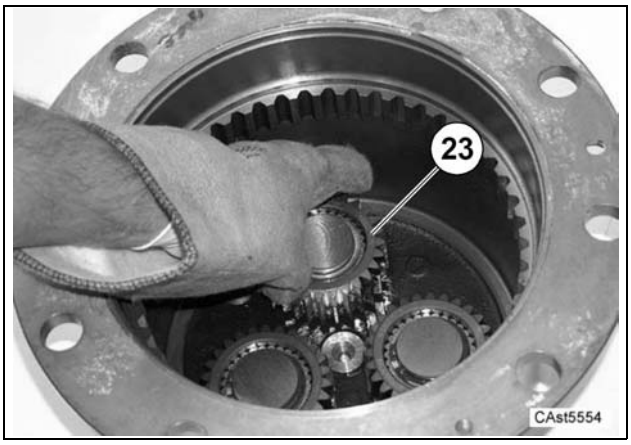


33. Lubricate with grease and fit O-ring (30).

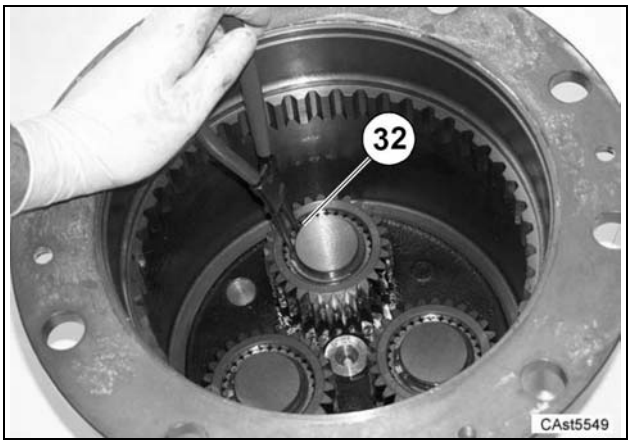


34. Heat planetary gear bearing at 110ºC. Assemble planetary gear (23).

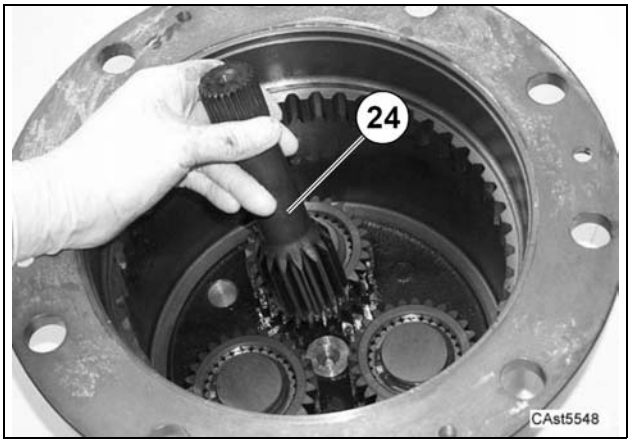
WARNING! Wear suitable gloves to avoid being burnt



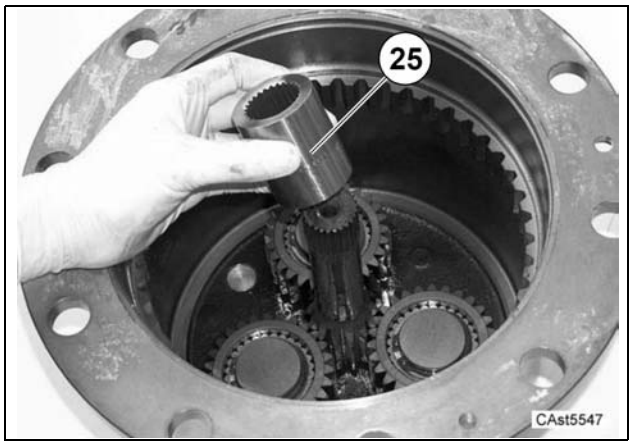
35. Assemble snap ring (32).



36. Fit pinion shaft (24).



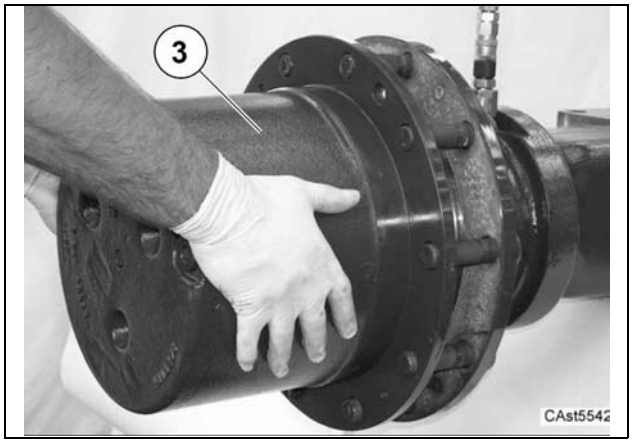
37. Fit sleeve (25).



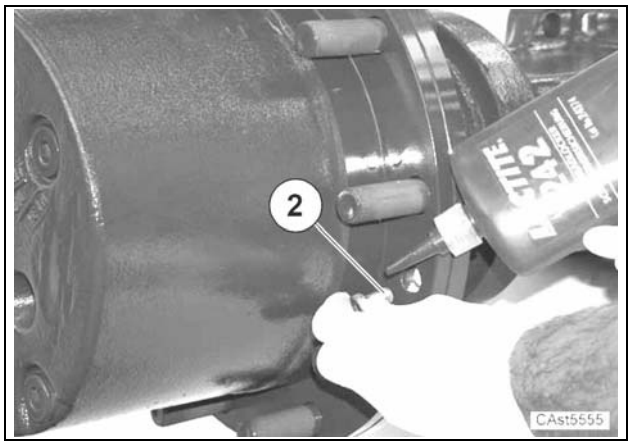
38. Lubricate with grease the contact surface of planetary gear cover (3). Apply Loctite® 510 in the holes.



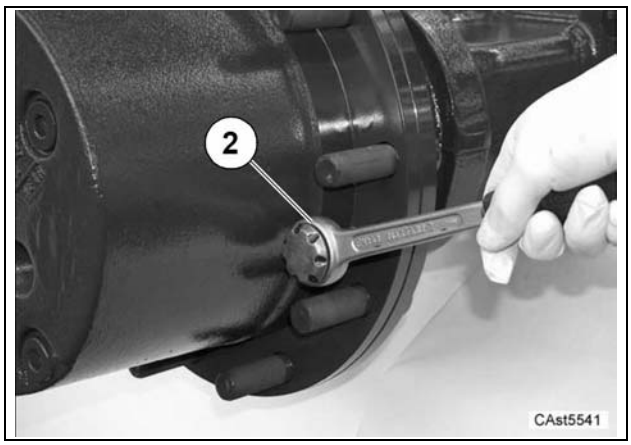
39. Fit the planetary gear cover (3) and discharge pressure from the hydraulic pump.



40. Apply Loctite® 242 on screw (2).

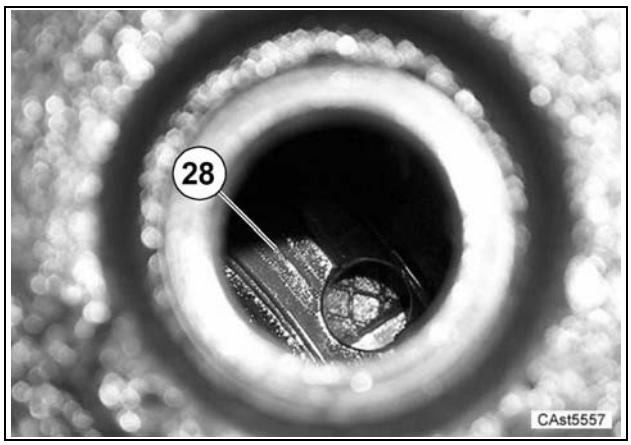


41. Assemble screws(2). (Tightening torque - 46Nm)

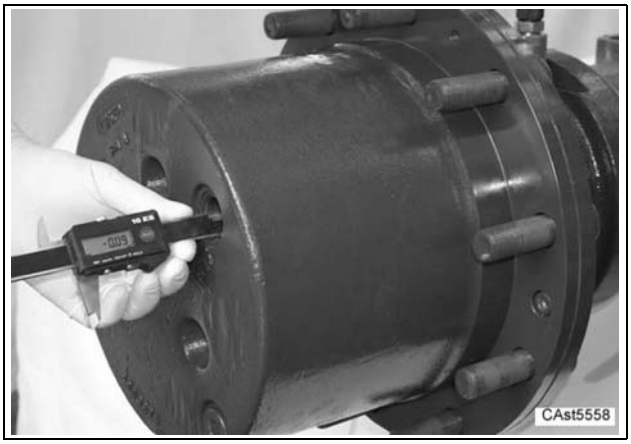


42. Remove oil drain plug and turn the final drive up to meeting the item (28) hole.

Note: Brakes wear check.

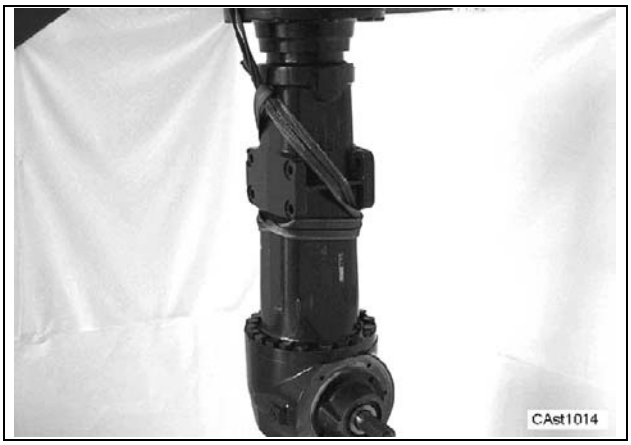


43. Apply a pressure of 45-50 bar and check the distance between brake locking and unlocking (MIN: 1.7mm, MAX: 3.8mm).

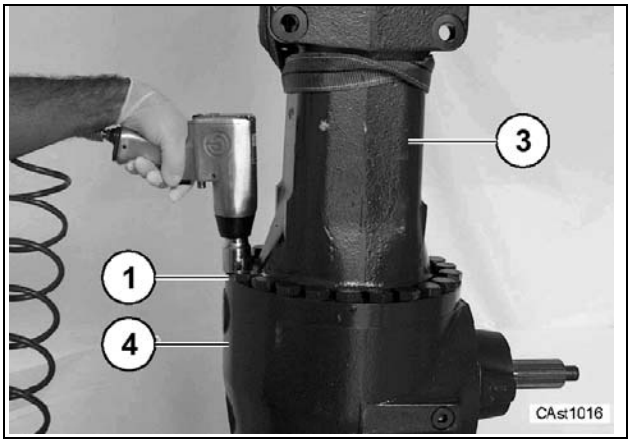


Disassembly of Beam Trumpet and Differential Unit

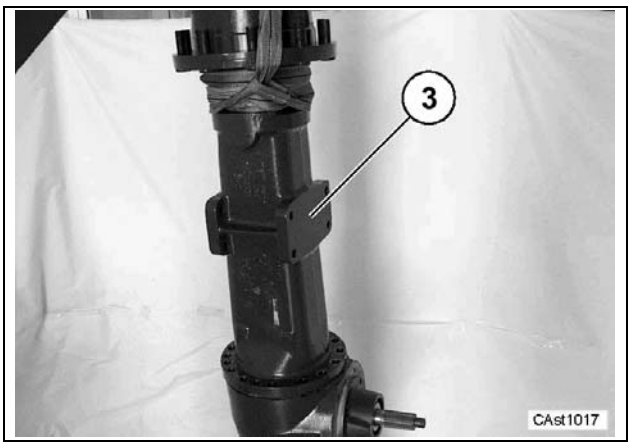
1. Remove the axle unit. Sling and slightly tension the rope. Turn and then fix it in vertical position.



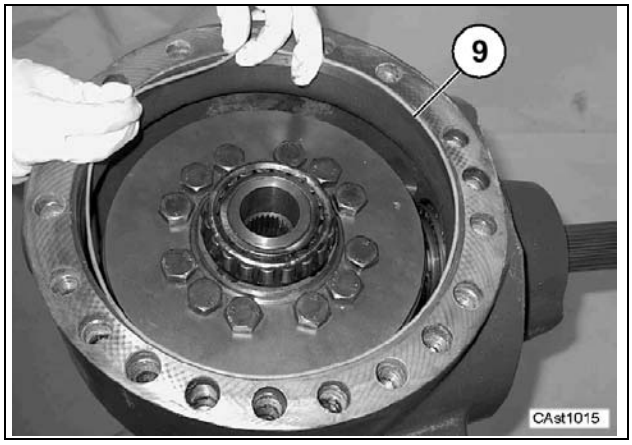
2. Loosen and remove screws (1) fixing beam trumpet (3) to the body (4).



3. Sling the beam trumpet (3) and slightly lift it.



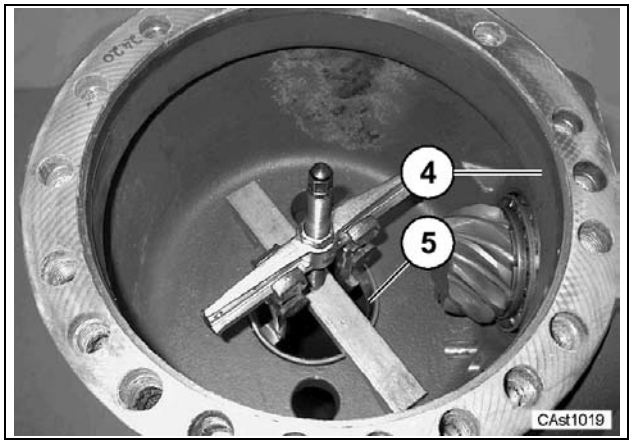
4. Remove O-ring (9).



5. Lift the whole differential unit.



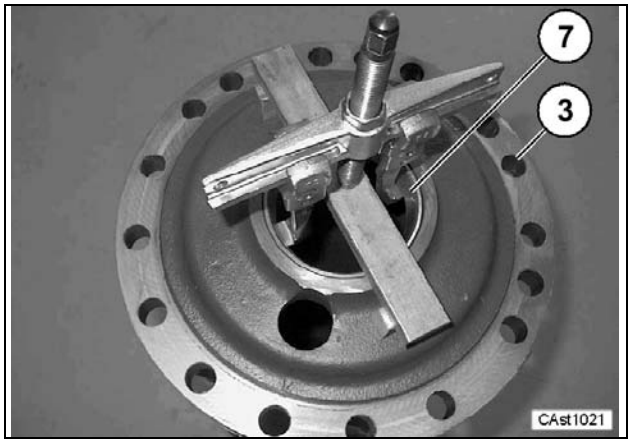
6. Use an extractor and remove from housing (4) the outer cup of bearing (5).



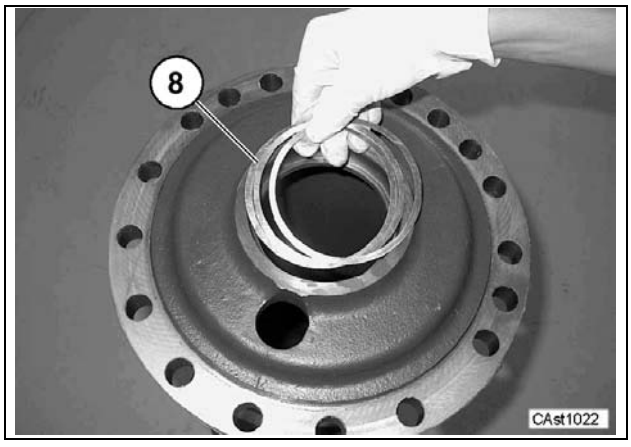
7. Remove shims (6).



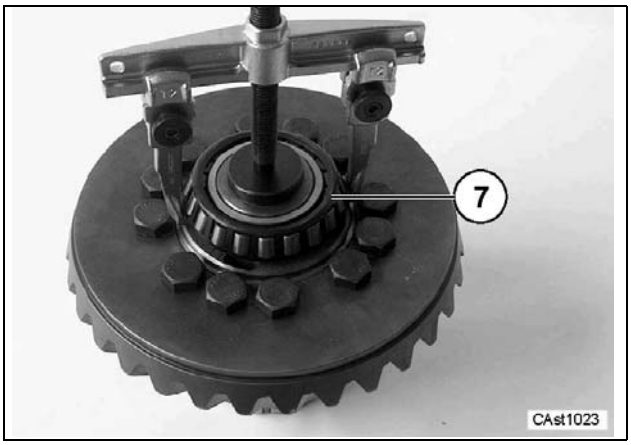
8. Use an extractor and remove from housing (3) the outer cup of bearing (7).



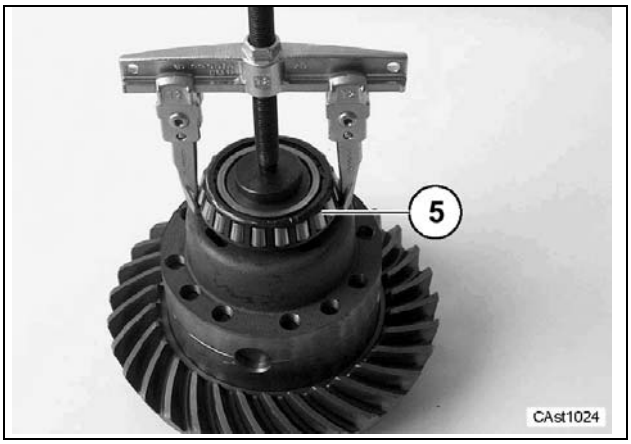
9. Remove shims (8).



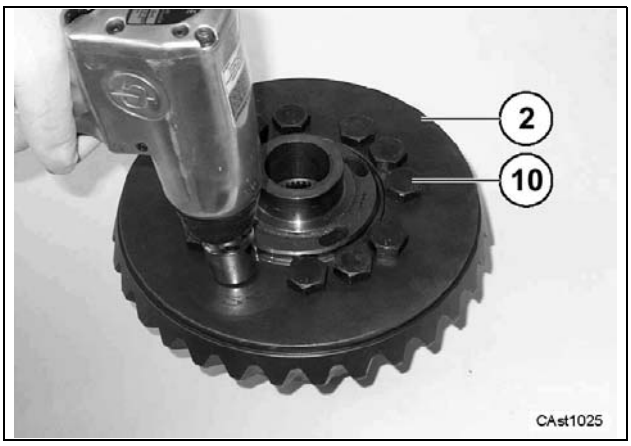
10. Use and extractor to remove bearing (7) from differential unit.



11. Use an extractor to remove bearing (5) from differential unit.



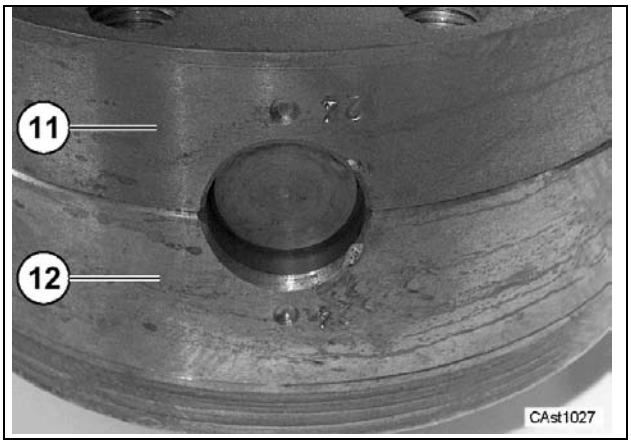
12. Unscrew all fastening screws (10) of bevel gear crown (2).
Warning: This operation makes both differential half boxes free, so take care not to drop the inner components.



13. Remove ring bevel gear (2) by means of a mallet.

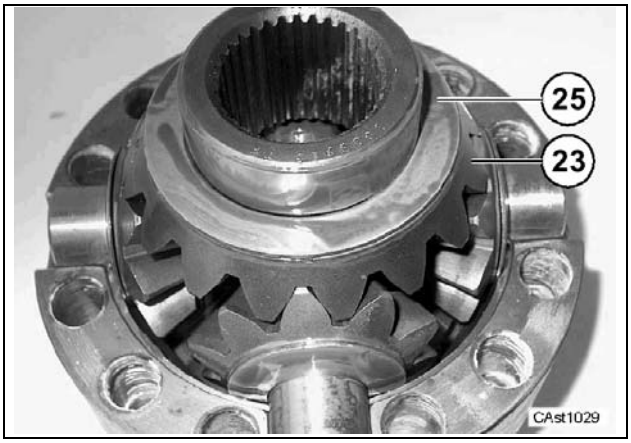


14. Check marking points (11) and (12) that will be useful during the assembly.

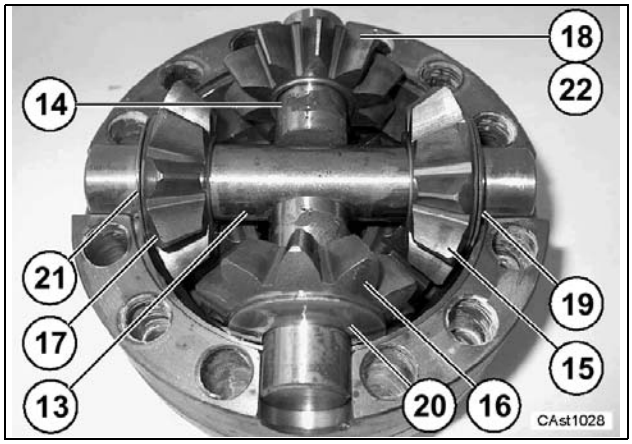


Note: Without differential torque limiter

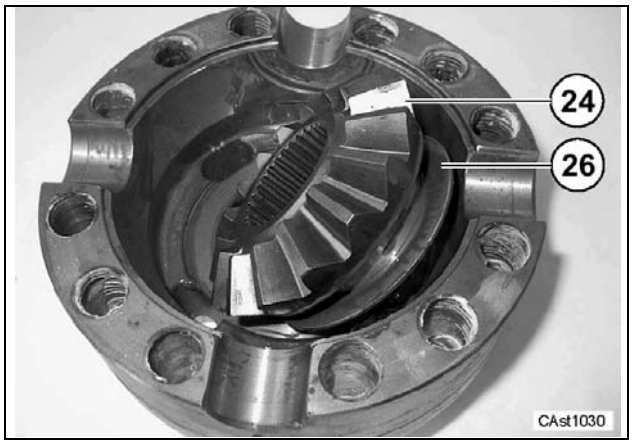
15. Remove planetary gear (23) and shim (25).



16. Remove differential pins (13) and (14), planetary gears (15), (16), (17) and (18) and spheric washers (19), (20), (21) and (22).

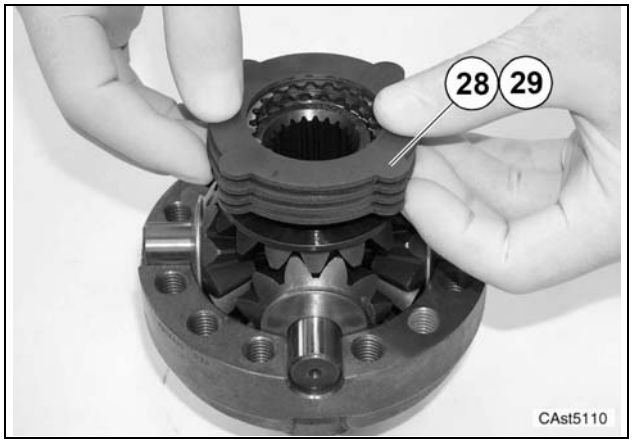


17. Remove planetary gear (24) and shim (26).

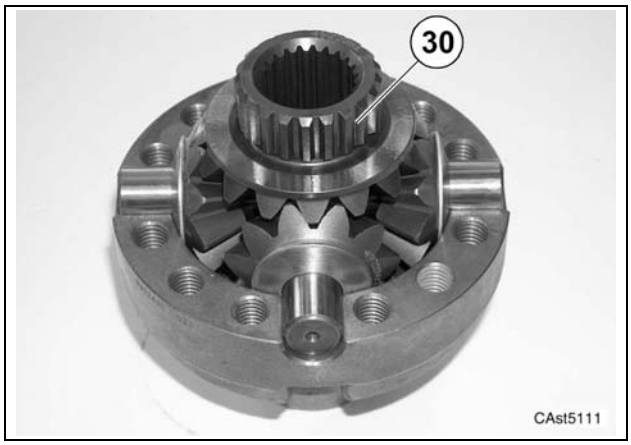


Note: With differential torque limiter

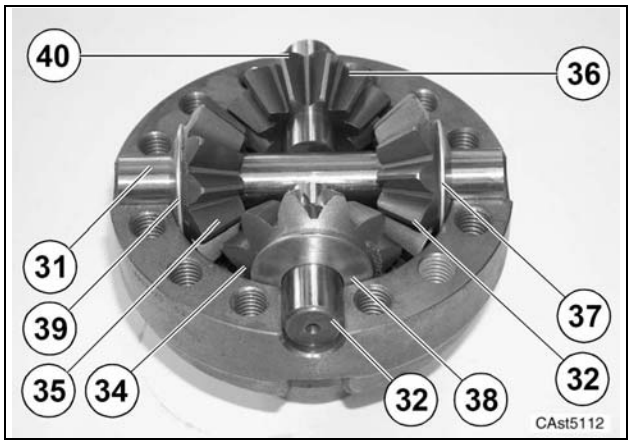
18. Remove discs (28) and (29).



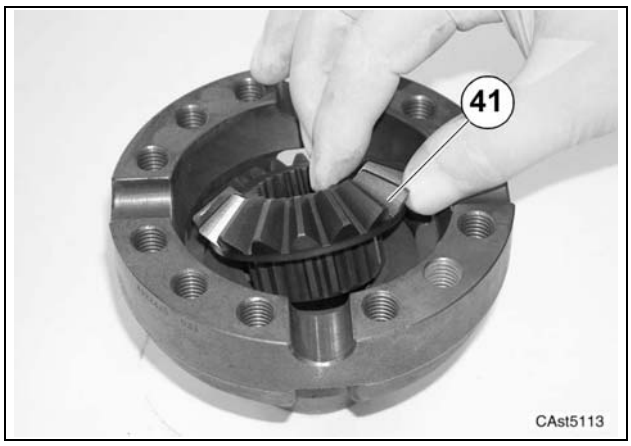
19. Remove planetary gear (30).



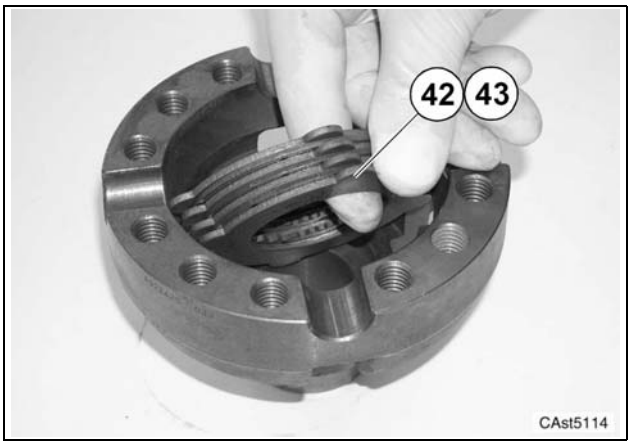
20. Remove differential pins (31), (32), planetary gears (33), (34), (35) and spheric washers (37), (38), (39) and (40).



21. Remove planetary gear (41).



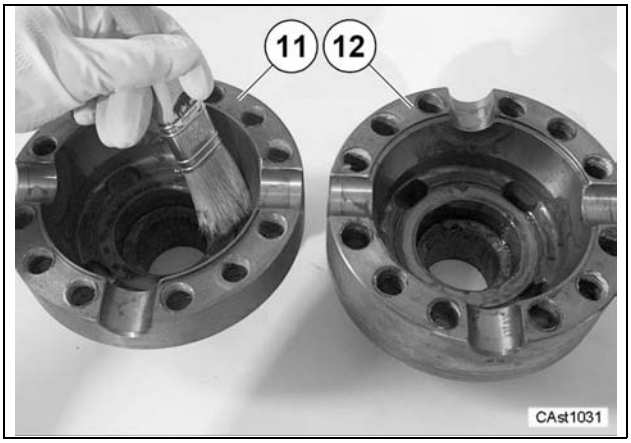
22. Remove discs (42) and (43).



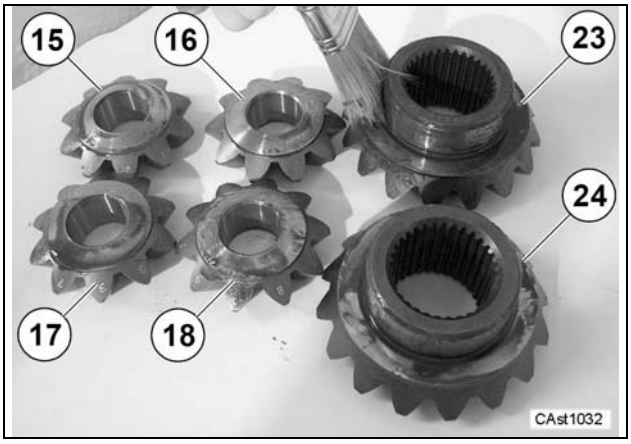
Installation of Beam Trumpet and Differential Unit

1. Apply a thin layer of molicote G-n plus paste on half boxes of differential (11) and (12).

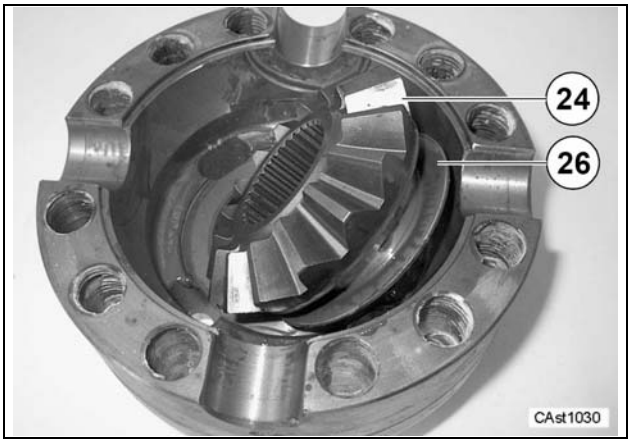
WARNING! Remove remains of old sealing compound.



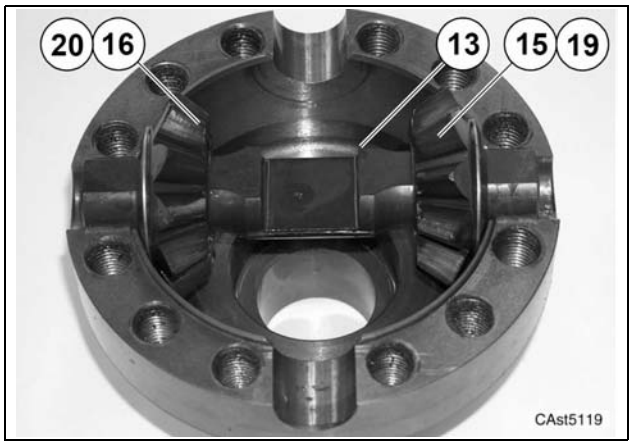
2. Apply a thin layer of molicote G-n plus paste on planetary gears (15), (16), (17) and on planetary gears (23) and (24).



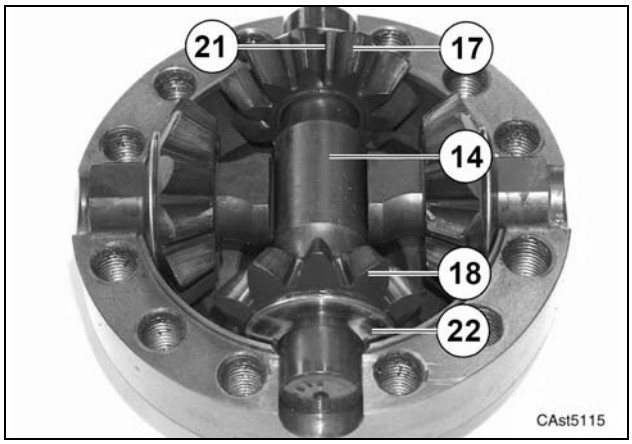
3. Assemble planetary gears (24) with shim (26).



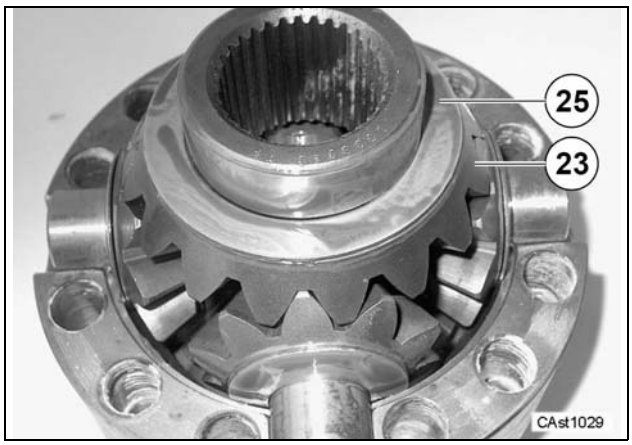
4. Fit differential unit pin (13) and planetary gears (15), (16) and washers (19) and (20).



5. Fit the differential unit pin (14) and planetary gears (17), (18) and washers (21), (22).

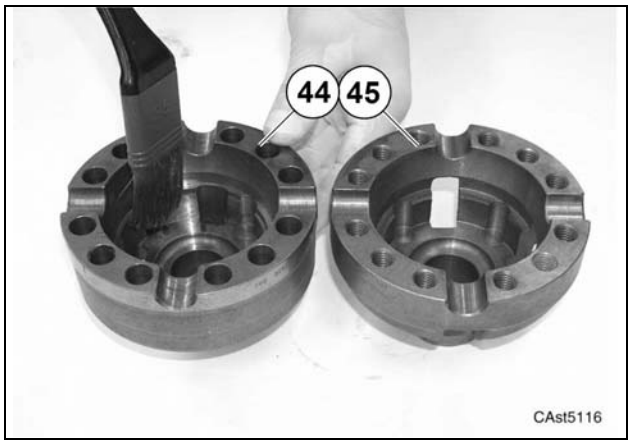


6. Assemble planetary gears (23) with shim (25).

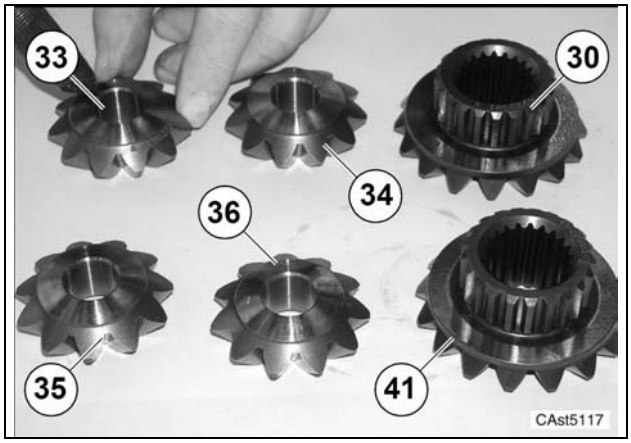


7. Apply a thin layer of molicote G-n plus paste on half boxes of differential (44) and (45)

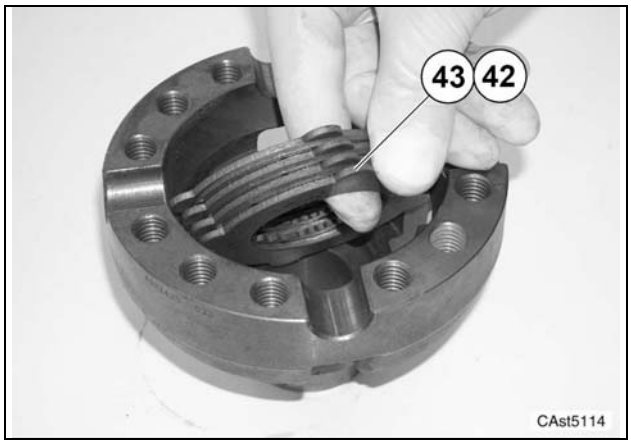
WARNING! Remove remains of old sealing compound.



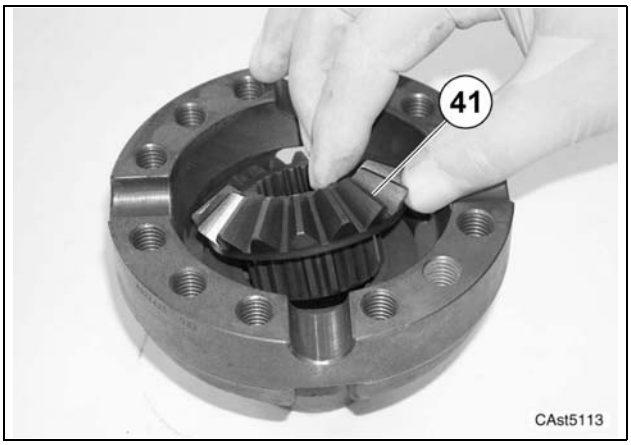
8. Apply a thin layer of molicote G-n plus paste on plantetary gears (33), (34), (35) and (36) and on planetary gears (30) and (41).



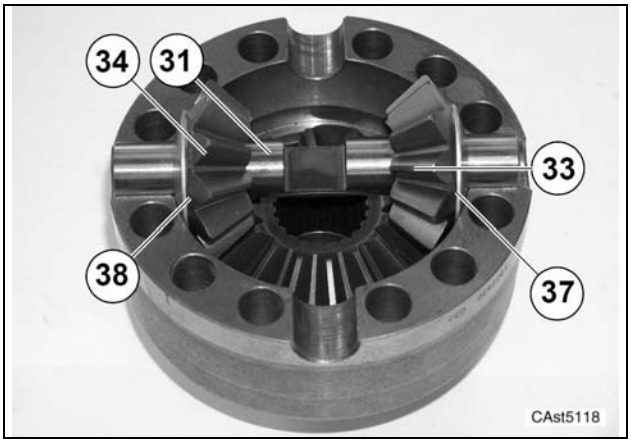
9. Assemble discs (42) and (43).



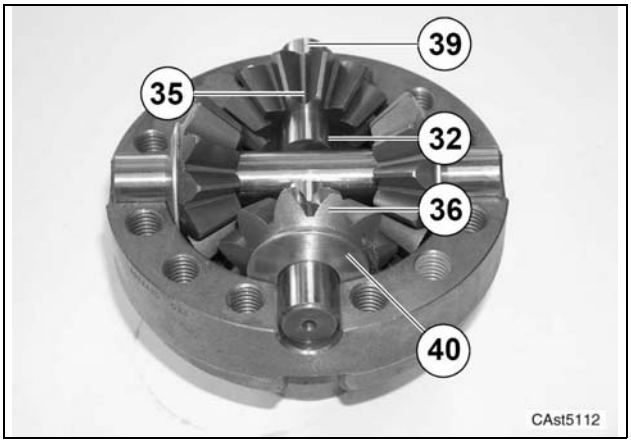
10. Assemble planetary gears (41).



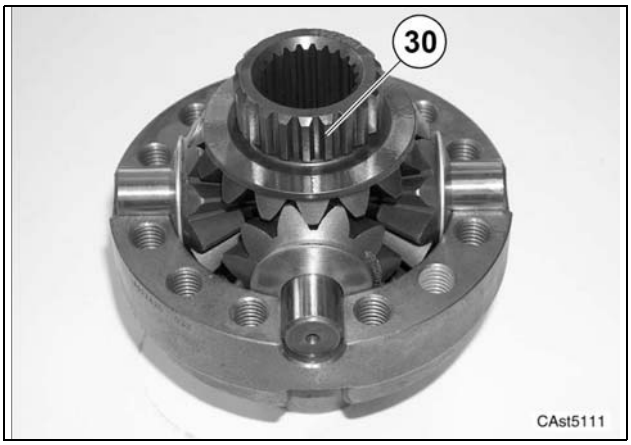
11. Fit differential unit pin (31) and planetary gears (33) and (34) and washers (37) and (38).



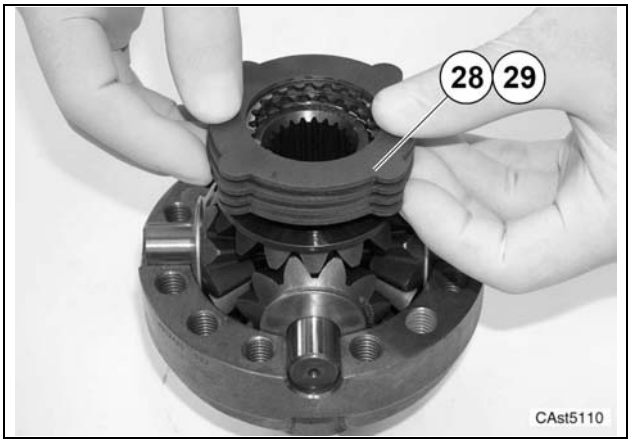
12. Fit differential unit pin (32) and planetary gears (35) and (36) and washers (39) and (40).



13. Assemble planetary gears (30).

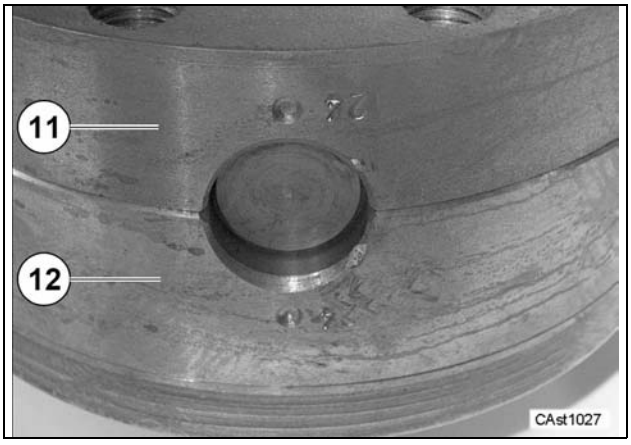


14. Assembly discs (28) and (29).

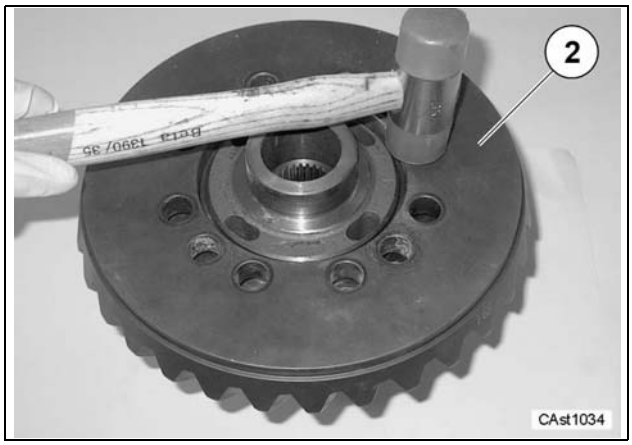


15. Fit the two half boxes of differential unit (11) and (12).

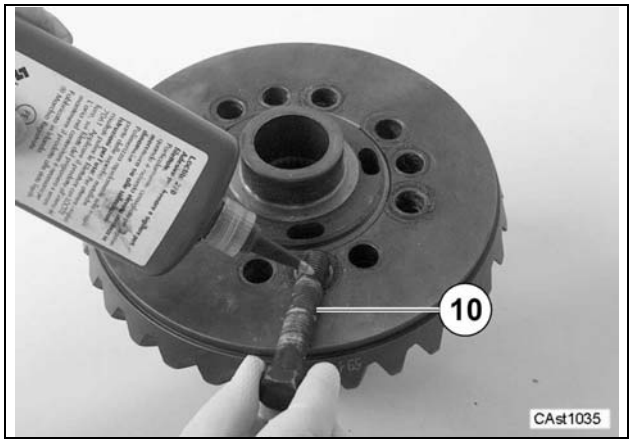
WARNING! Carefully check that the marks of both differential half boxes coincide



16. Fit ring bevel gear (2) by using a hammer.



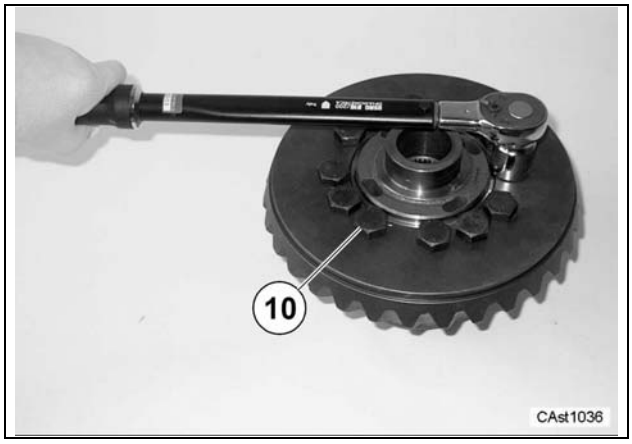
17. Apply loctite®242 on thread of screws (10).



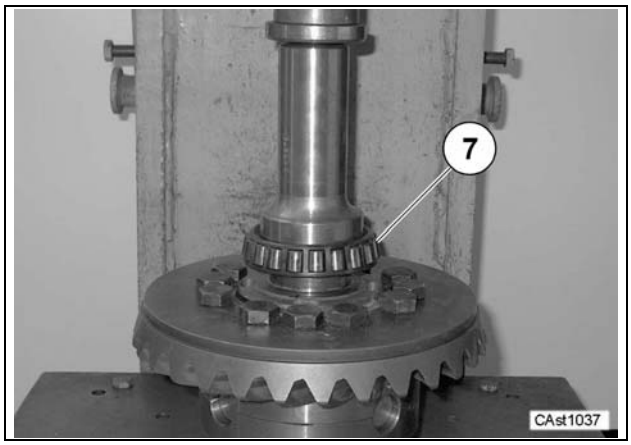
18. Tighten screws (10).

N·m Screws (10) torque: 205Nm

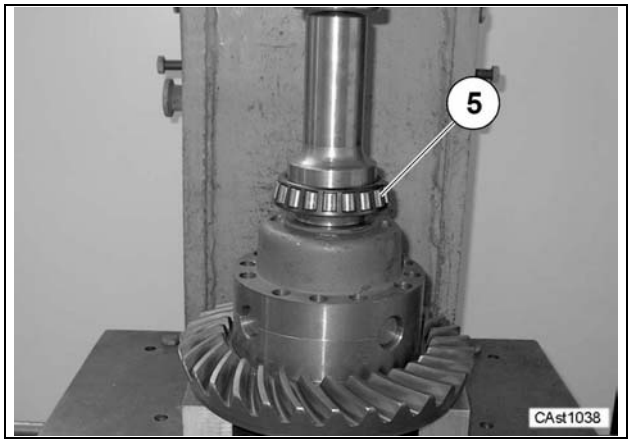
Note: Fix differential housing in the vice



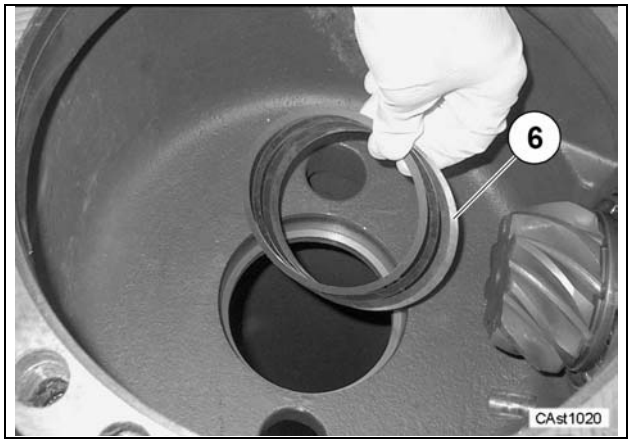
19. Fit bearing (7)



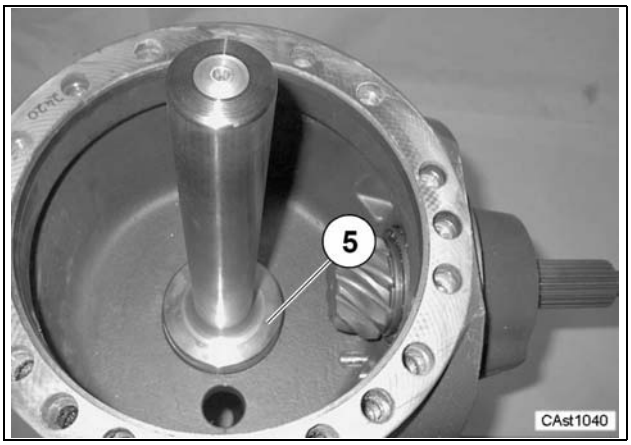
20. Press bearing (5).



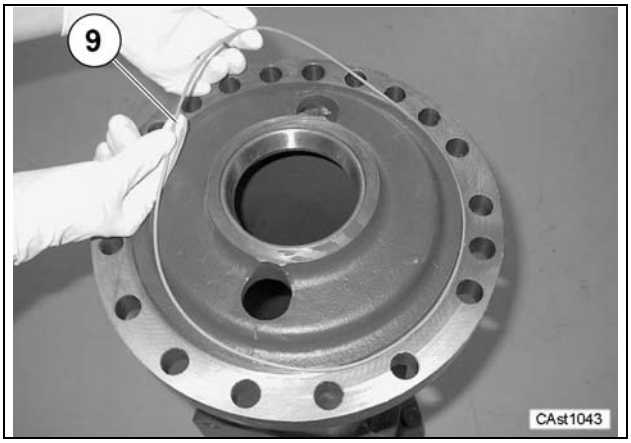
21. Fit adjustment shims (6) (**X1**)=1.8.



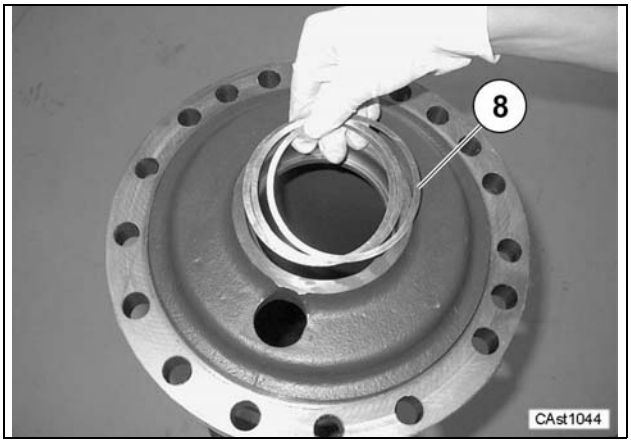
22. Assemble cup of bearing (5).



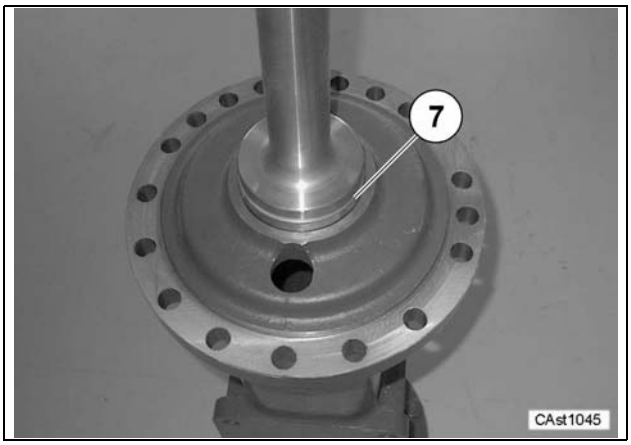
23. Assemble O-ring (9).



24. Assemble adjusting shims (8) (**X2**).



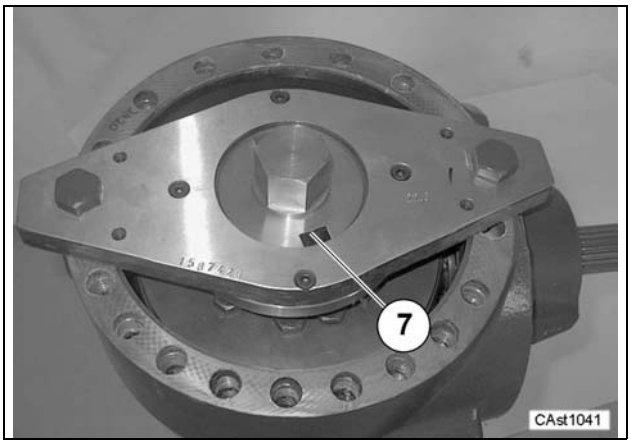
25. Assemble cup of bearing (3).



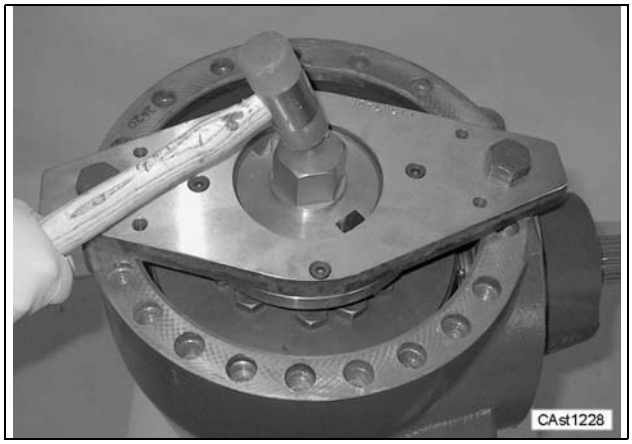
26. Assemble differential unit.



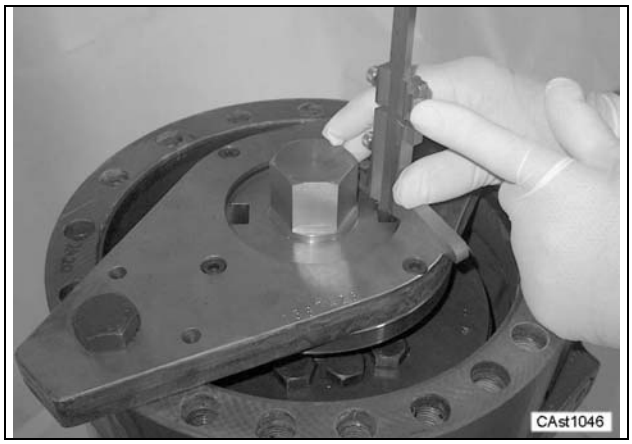
27. Install tool 2897001. Assemble half bearing (7) inside tool.



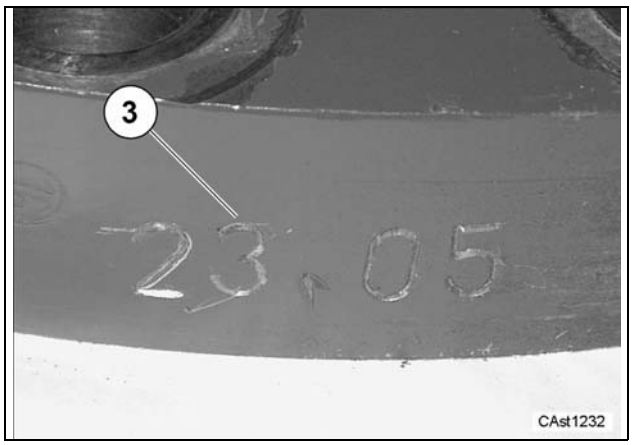
28. While screwing the tool nut until the value of 10Nm has been reached, turn the ring bevel gear and strike it with a hammer to fix the whole unit.



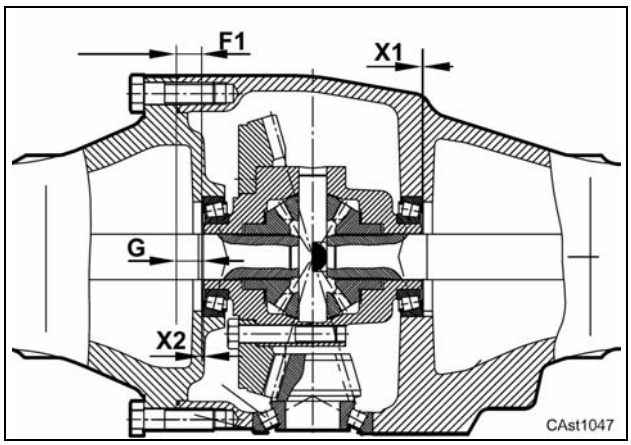
29. Measuring of value **G**.



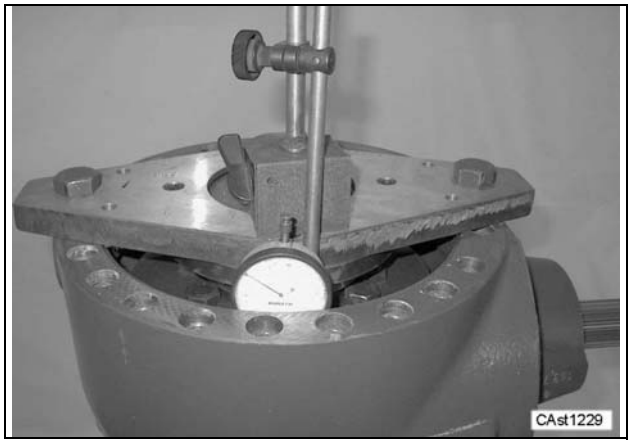
30. Value (**F1**) written on axle beam (3).



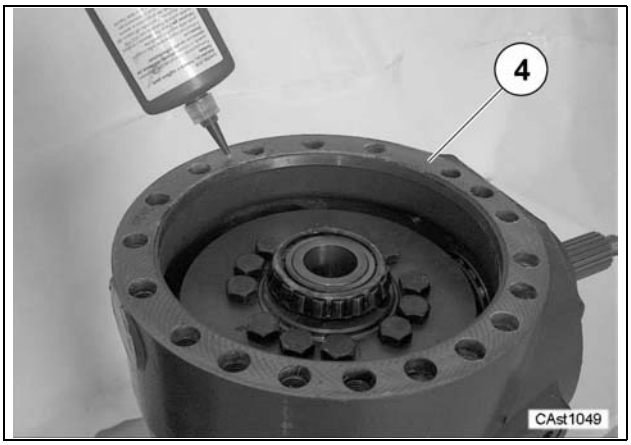
31. Drawing used to determine backlashes between the bevel gear pair teeth.
X1 = 1.8
Check adjusting shims X2 through the suggested procedure: **X2 = F1.**



32. 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 pre-set field: 0.15 / 0.25mm.
Should the backlash be insufficient or excessive, adjust shim X1 = 1.8 by increasing or decreasing.



33. Apply loctite® 510 on contact surface of beam trumpet (4).

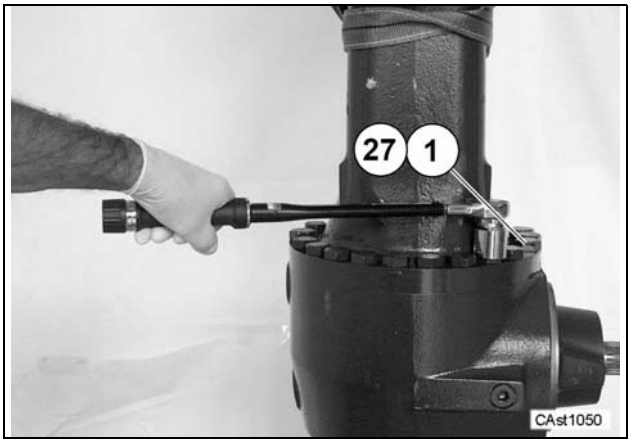


34. Apply loctite® 242 on screws (1).



35. Assemble screws (1) and washers (27) and tighten screws (1).

N·m Screws (1) torque: 285Nm

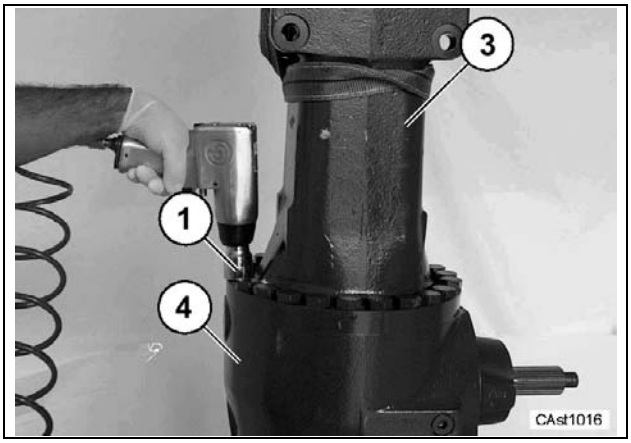


Disassembly of Pinion Group

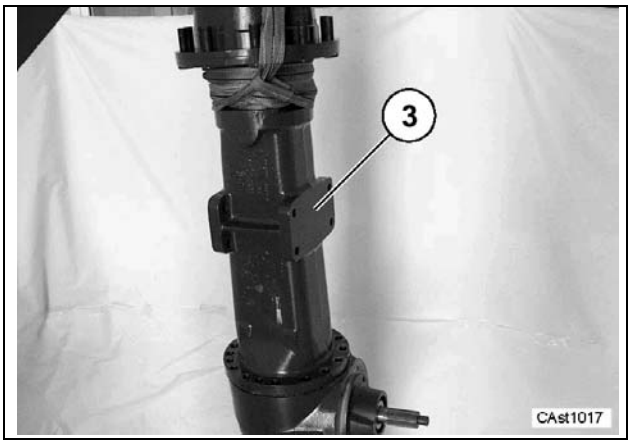
1. Remove the axle unit. Sling and slightly tension the rope. Turn and then fix it in vertical position.



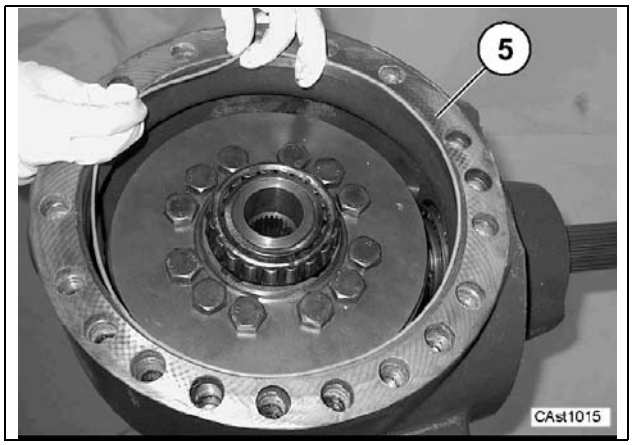
2. Loosen and remove screws (1) fixing beam trumpet (3) to the body (4).



3. Sling the beam trumpet (3) and slightly lift it.



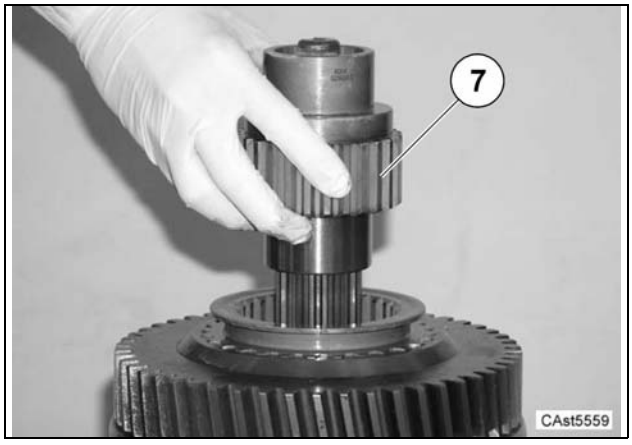
4. Remove O-ring (5).



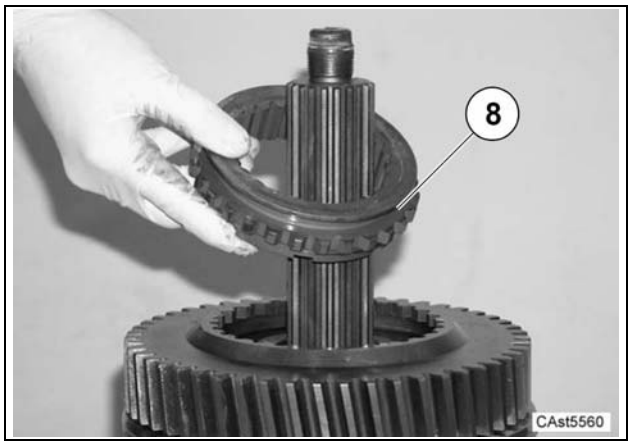
5. Lift the whole differential unit.



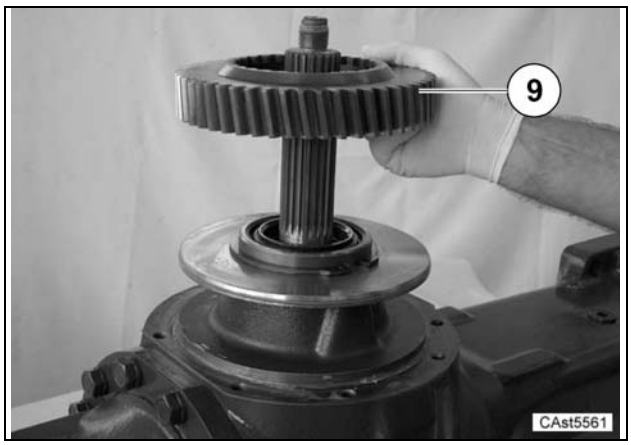
6. Remove bush (7).



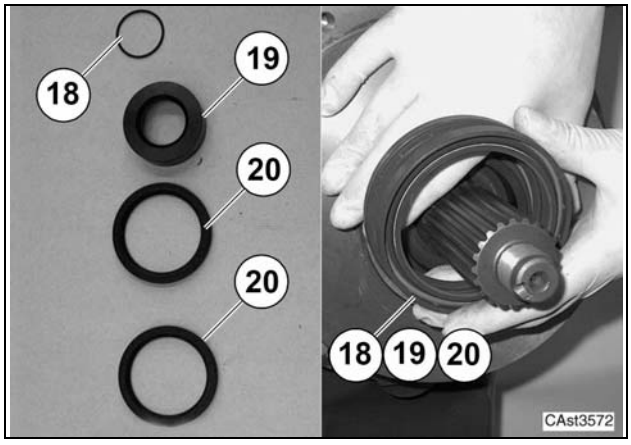
7. Remove sleeve (8).



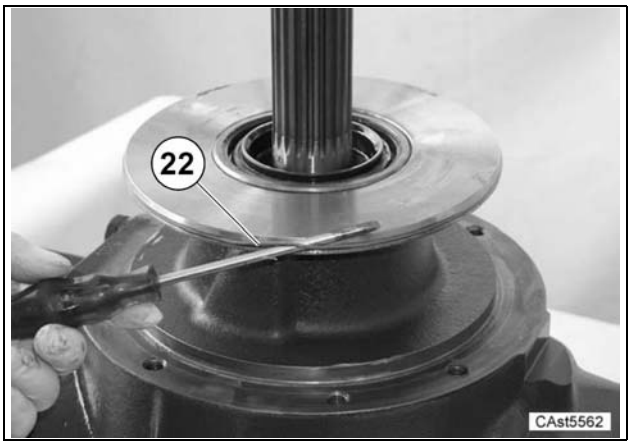
8. Remove gear wheel (9).



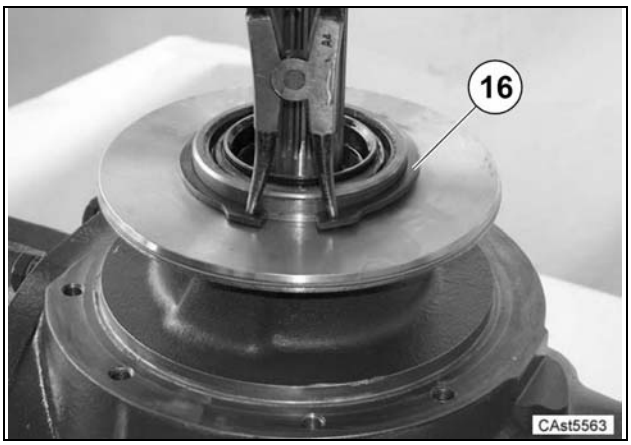
9. Remove O-ring (18), ring (19) and seal (20).



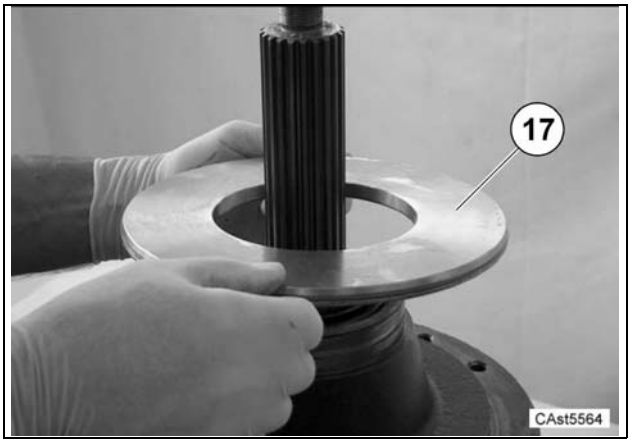
10. Remove O-ring (22).



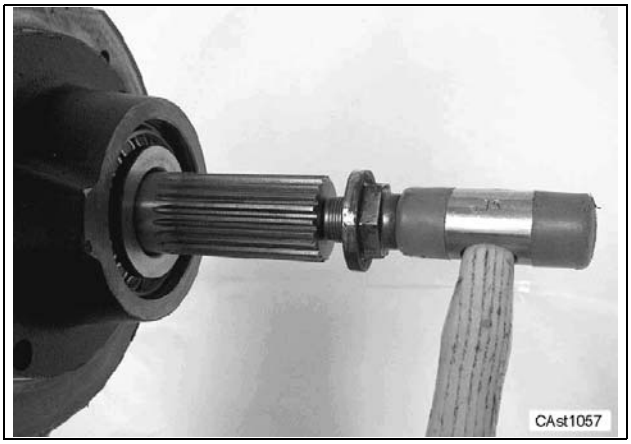
11. Remove snap ring (16).



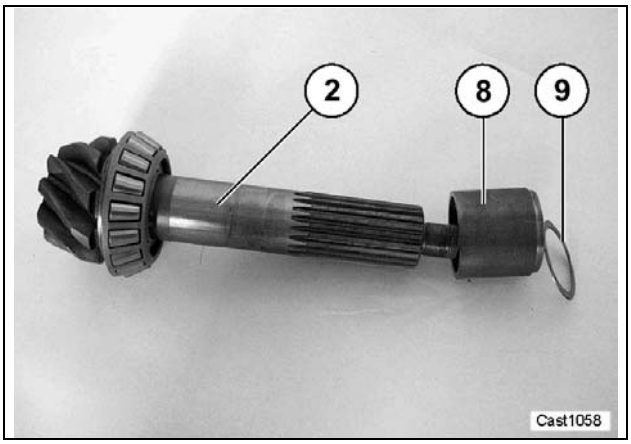
12. Remove the disc (17).



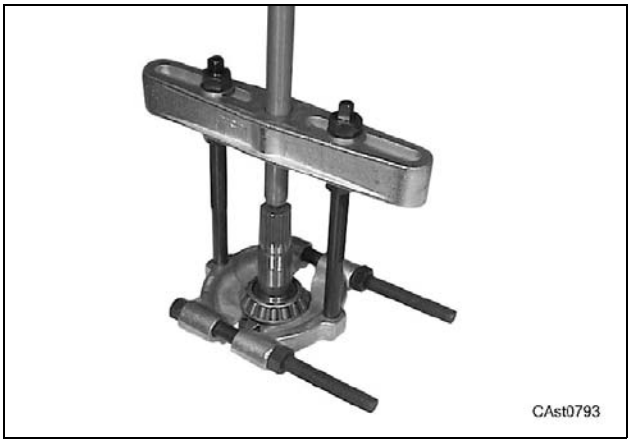
13. Take the bevel pinion out of its housing, by beating with a hammer made of soft material on the splined end.



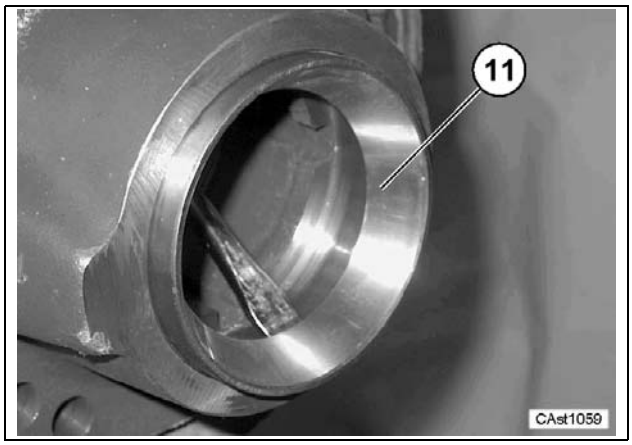
14. Once the bevel pinion (2) has been removed, collect shims (9) and spacer (8).



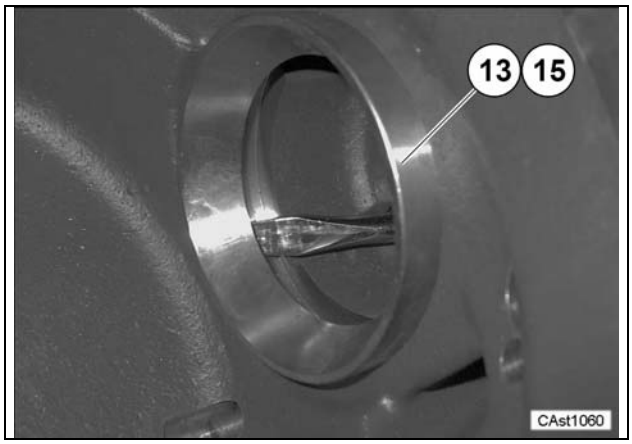
15. Take the bearing cone (13) out of the bevel pinion end, using a suitable extractor.



16. Take the cup of the taper roller bearing (11) out of the central body using a chisel and hammer.



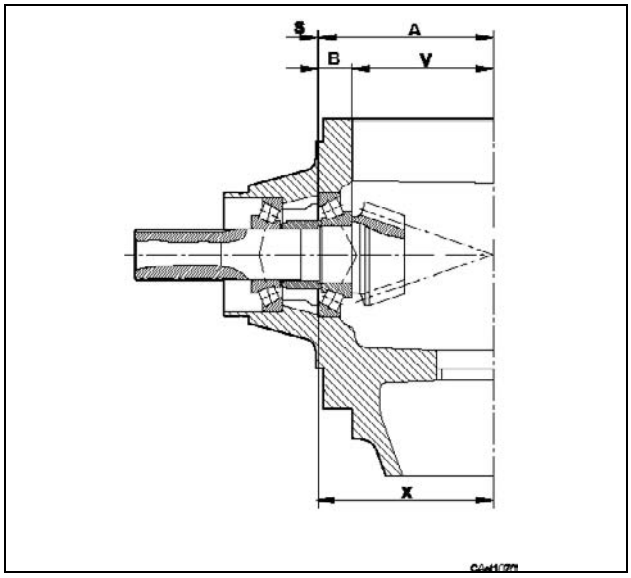
17. Remove the outer cup of the taper roller bearing (13) and shims (15) from the central body. Use a chisel and hammer.



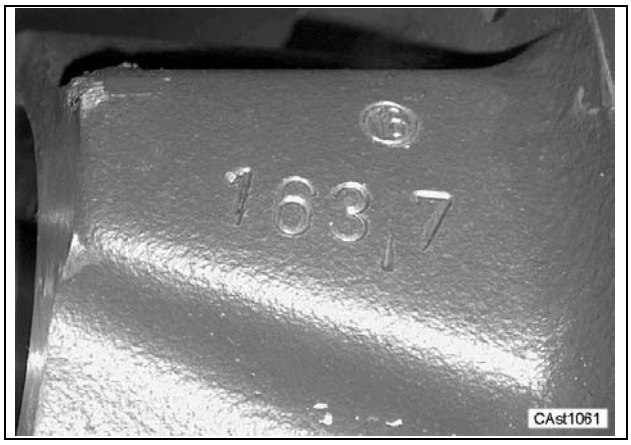
Installation of Pinion Group

1. Bevel pinion adjustment.

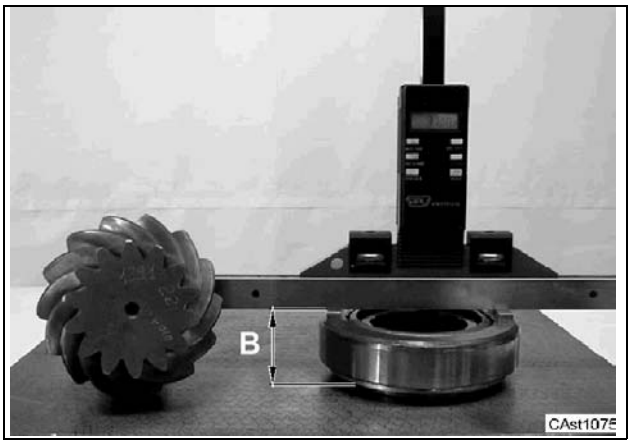
X	155.50	155.50	155.70
B	29.25	29.45	29.45
V	125.00	125.20	124.80
A	154.25	154.65	154.05
S	1.25	0.85	1.65



2. Value stamped on beam trumpet **X.**



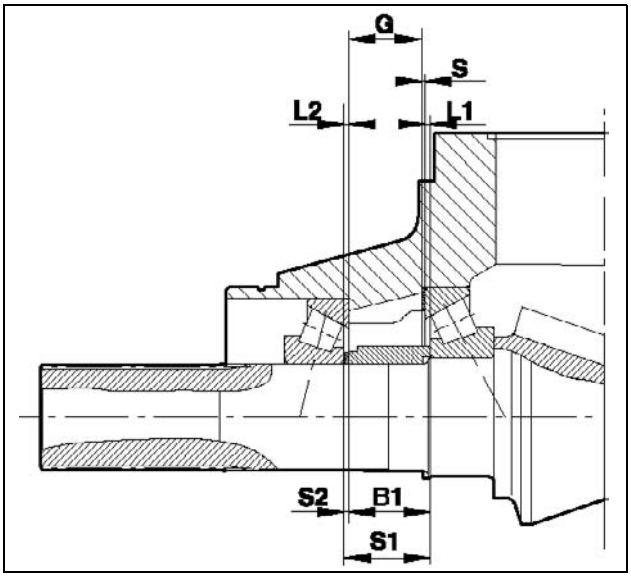
3. To determine shim (**S**) between pinion and bearing it is enough to add value (**V**) printed on pinion head (**V** = prescribed conical distance) to value **B** - bearing width - and subtract **X** from the value printed on beam.
S=X - (V+B)
Example: shim **S** = 163.7 - (132.80 + 29.25) = 1.55mm.



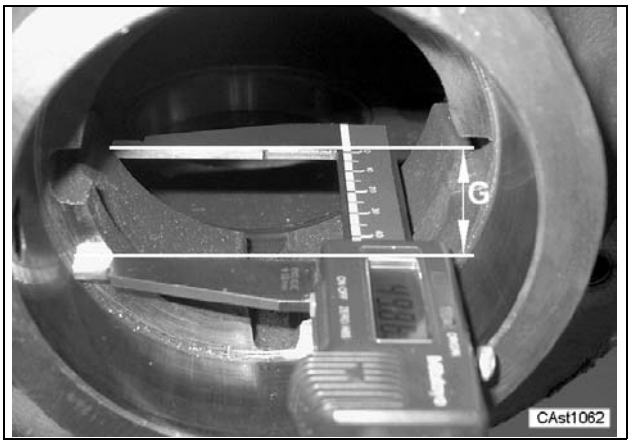
4. Bearings adjustment.

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

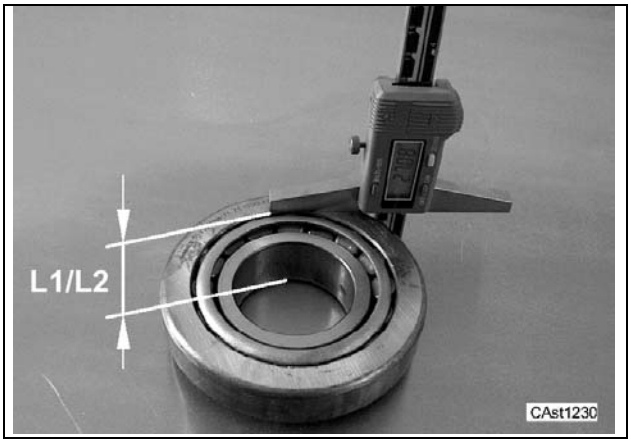
Preloading reduction ca. 0.02 - 0.04mm for a 2-3 Nm torque.



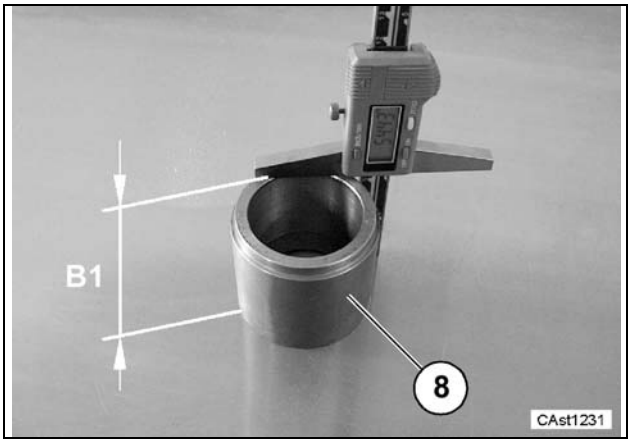
5. To determine shim **S2**
   S2 = B1 - (L1 - S - G - L2)
   S = previously detected shims
   G = beam value



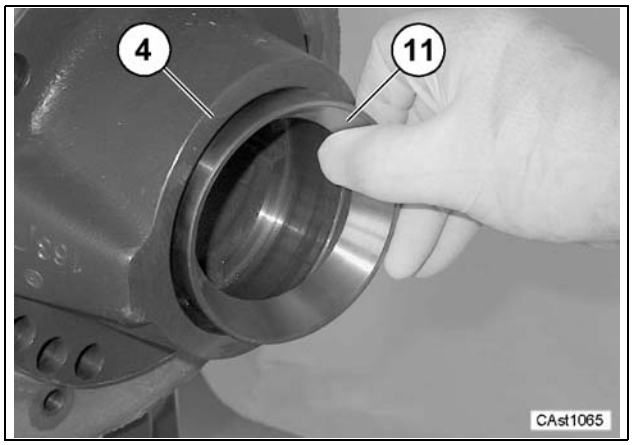
6. L1 = bearing height
   L2 = bearing height



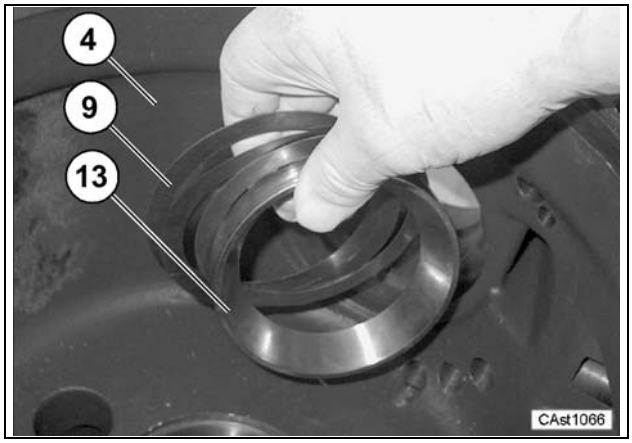
7. **B1**= spacer (8) height.
   Alternative procedure, use starting spacer S= 1.5.



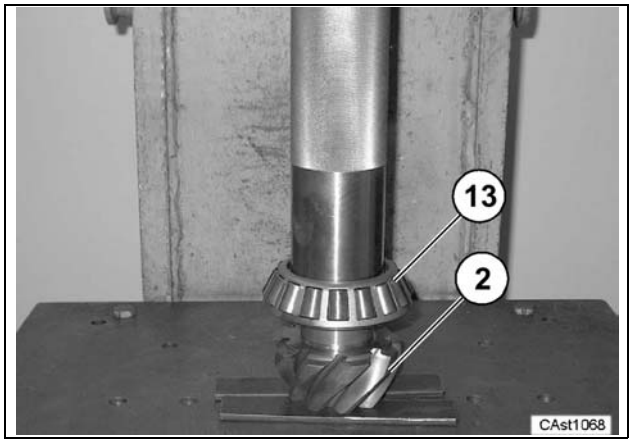
8. Position half bearing (11) on beam trumpet (4).



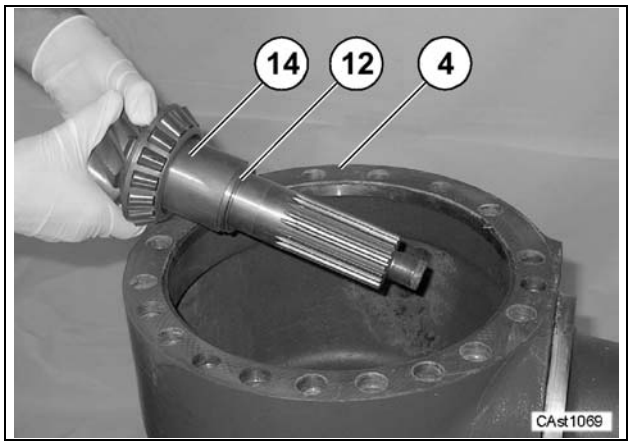
9. Position adjusting shims (9) and inner bearing washer (13) on beam trumpet (4).



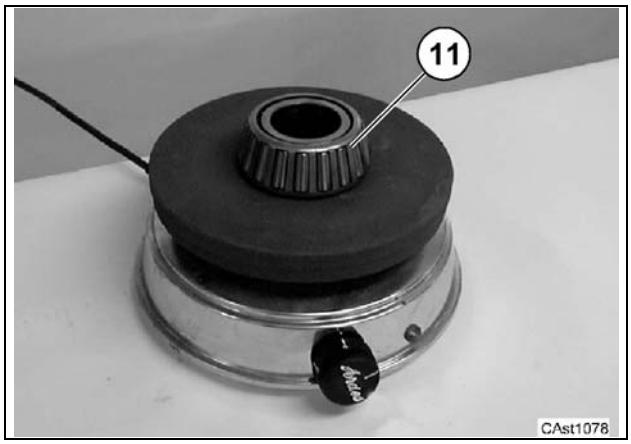
10. Press inner bearing (13) on pinion (2).



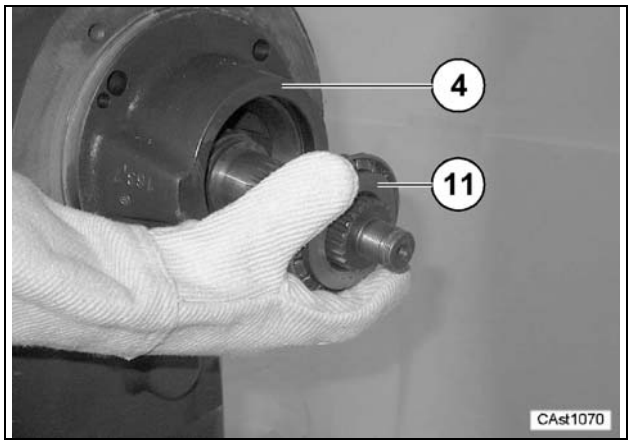
11. Fit the whole pinion of bearing on beam trumpet (4), spacer (14) and shims (12).



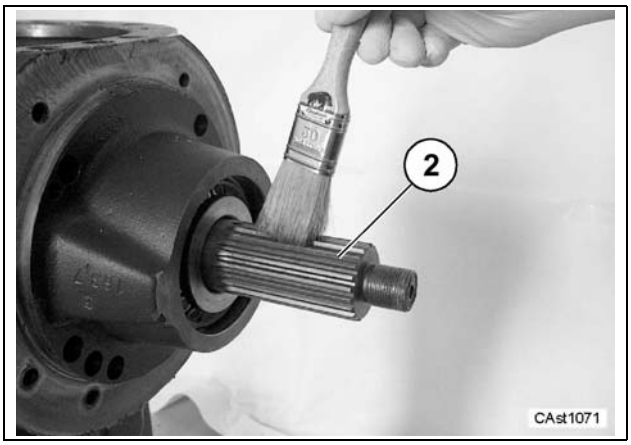
12. Preheat bearing (11) on proper plate up to 100°C.



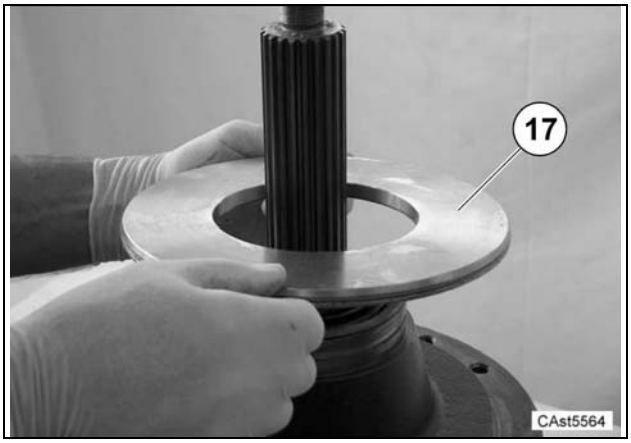
13. Fit bearing (11) in revelant housing on beam trumpet (4).
Warning: Use a special glove to protect from scorching.



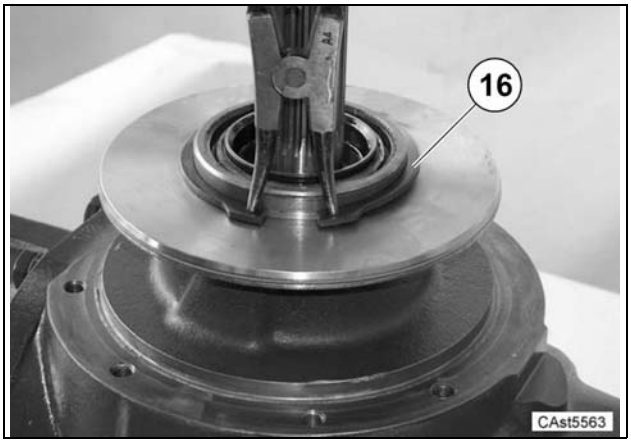
14. Grease bevel pinion.



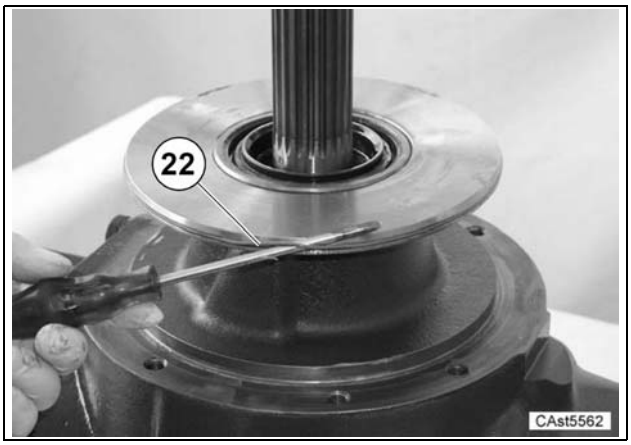
15. Assemble the disc (17).



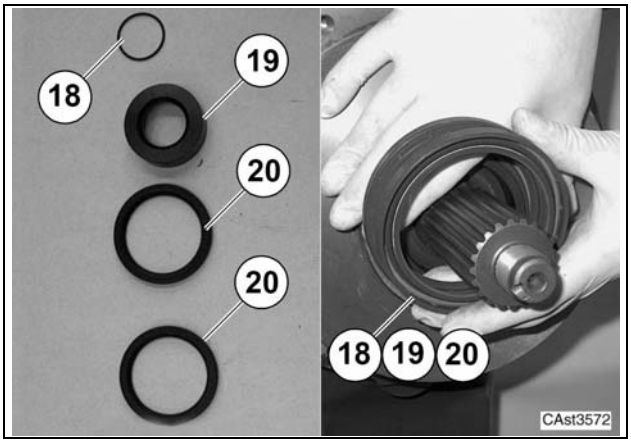
16. Assemble snap ring (16).



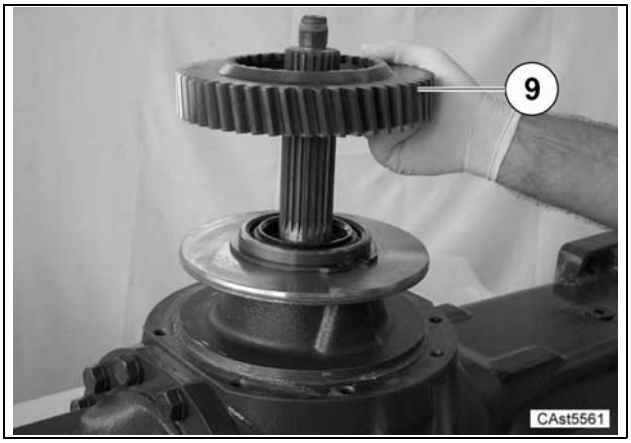
17. Assemble O-ring (22).



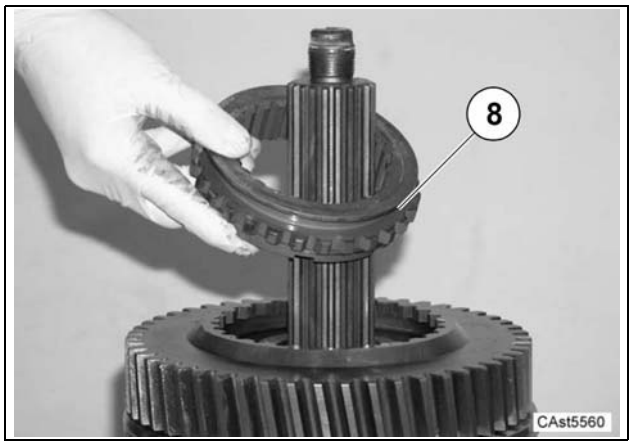
18. Assemble O-ring (18), ring (19) and seal (20).



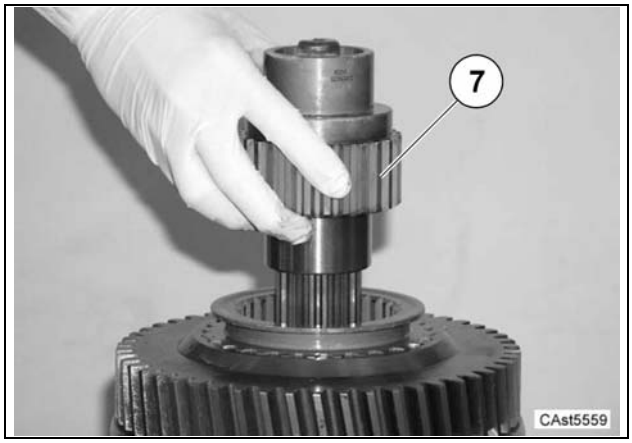
19. Grease gear wheel (9) and assemble.



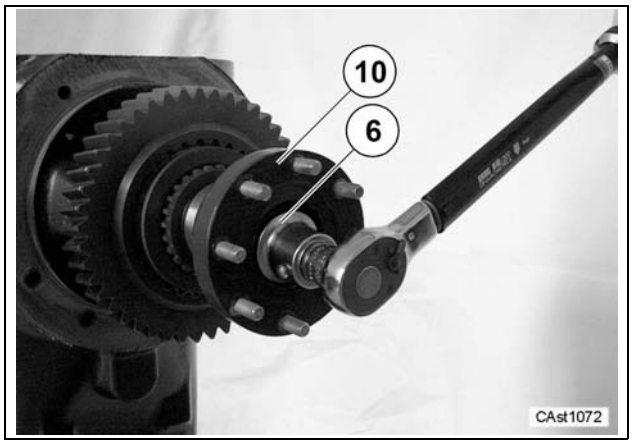
20. Assemble the bush (8).



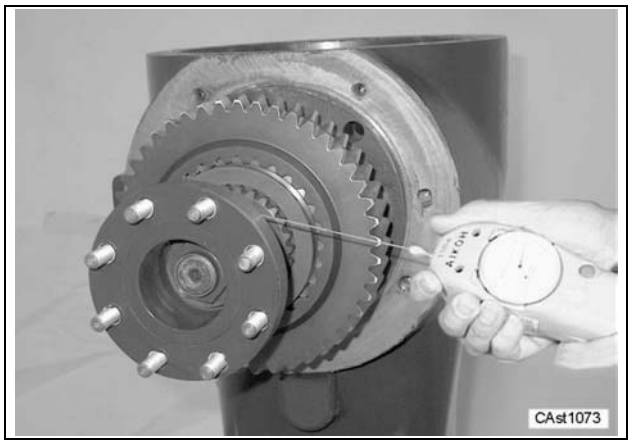
21. Assemble sleeve (7) and grease surface.



22. Assemble flange (10) and nut (6). (Tightening torque - 400Nm).



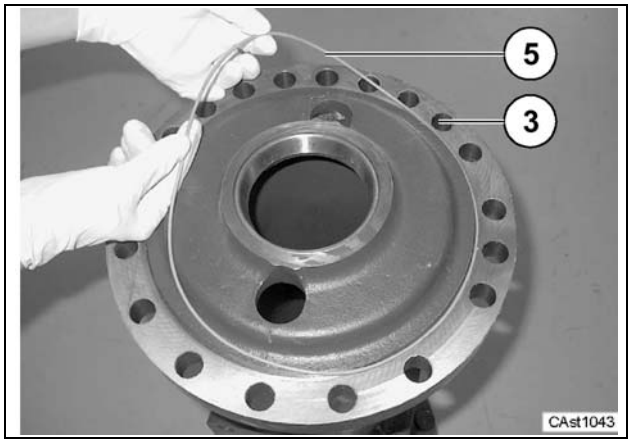
23. Carry out the preloading measurement (P) of pinion taper roller using a dynamometer whose cord is wound on the flange diameter. The adjustment is performed by gradually increasing shims mounted under bearing.
    Warning: All preloadings should be measured without the seal ring.
    P = 2 / 3 Nm



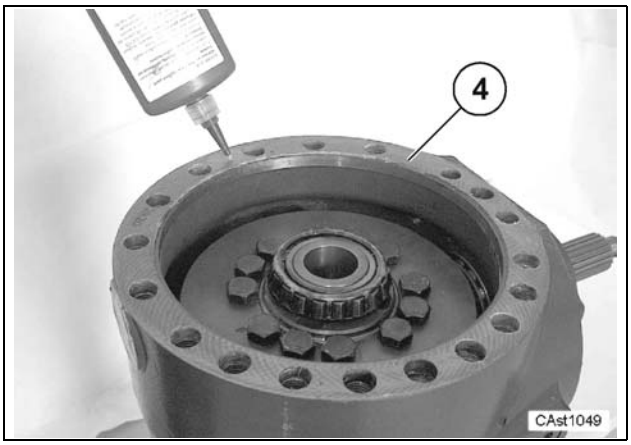
24. Assemble whole differential unit.



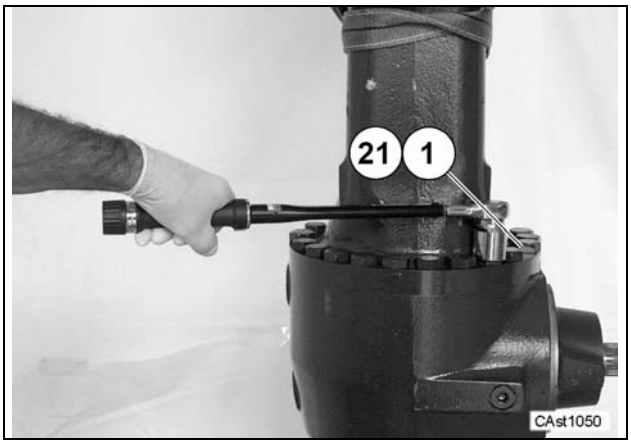
25. Assemble the O-ring (5) on beam trumpet (3). Grease the O-ring (5).



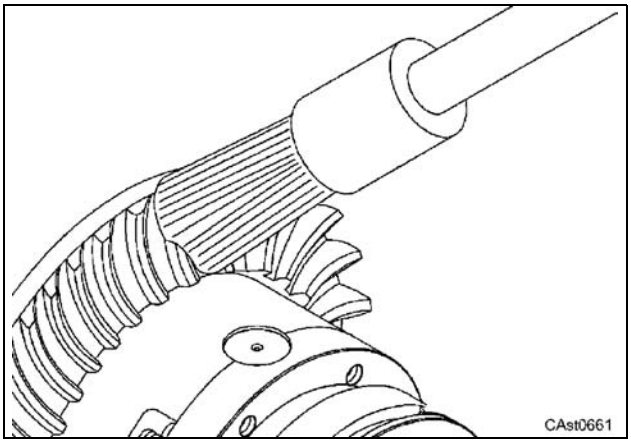
26. Apply Loctite® 510 on contact surface of beam trumpet (4).



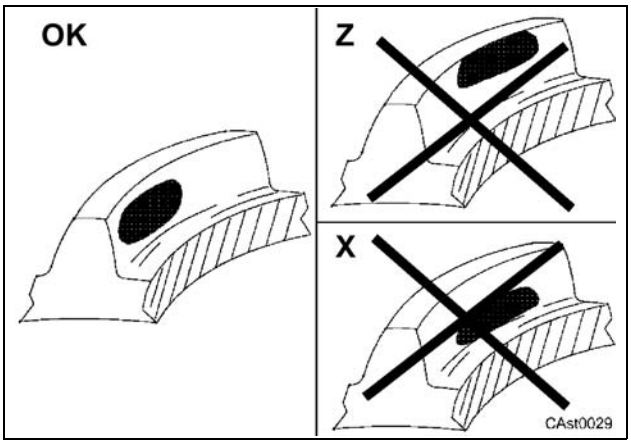
27. Fit screws (1) and tighten according to the prescribed torque: 285 Nm.



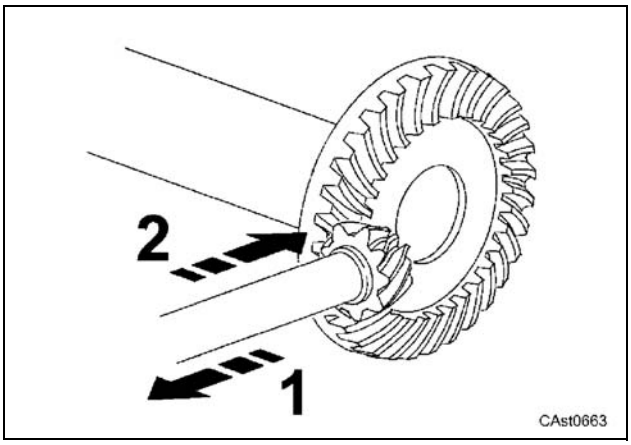
28. Note: To test the marks of the bevel gear teeth, paint the ring gear with red lead paint and detect the contact.
    The markinking test should be **ALWAYS** carried out on the ring bevel gear teeth and on both sides.



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

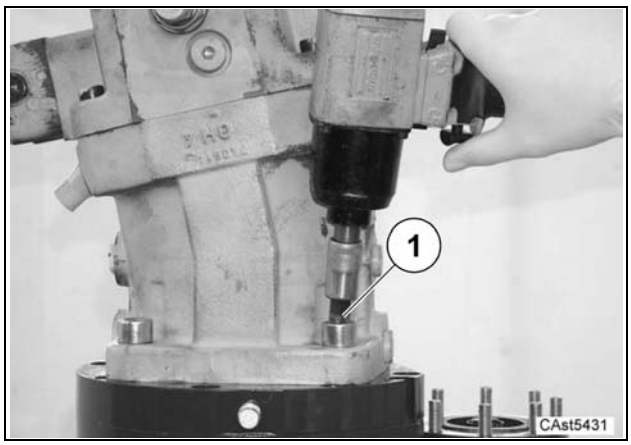
DISASSEMBLY

Removal of Travel Motor and Flange

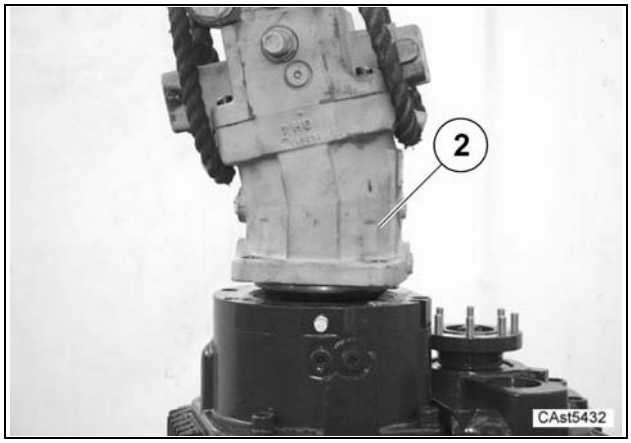
1. Remove drain plug and drain oil from transmission and travel motor.

Transmission: Approx. 4.85 l

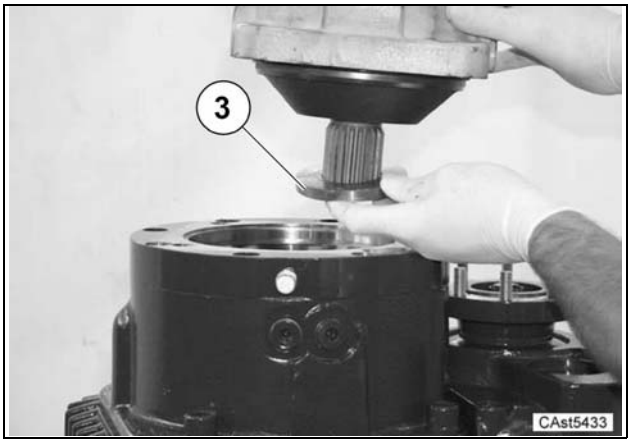
2. Remove screws (1).



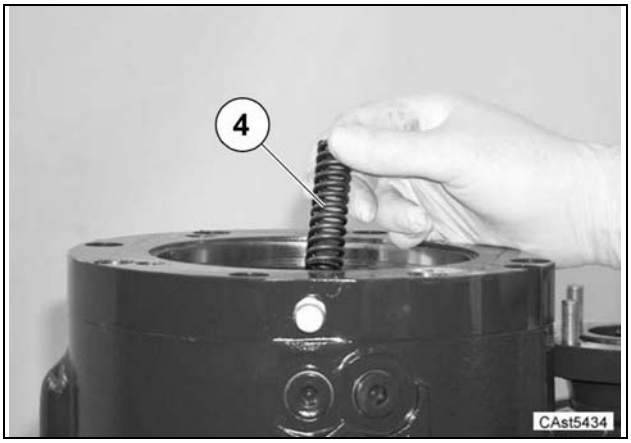
3. Remove the motor (2).



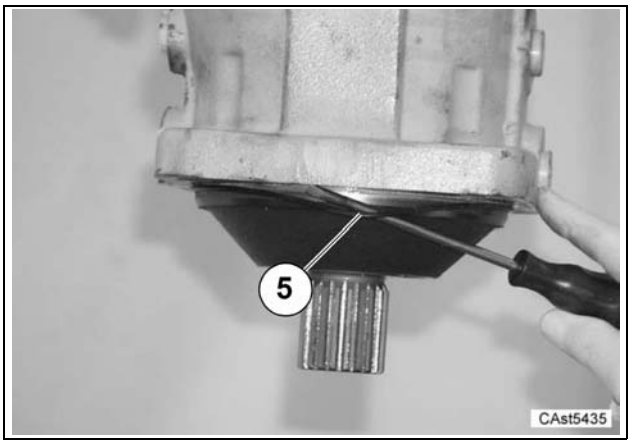
4. Remove disc (3).



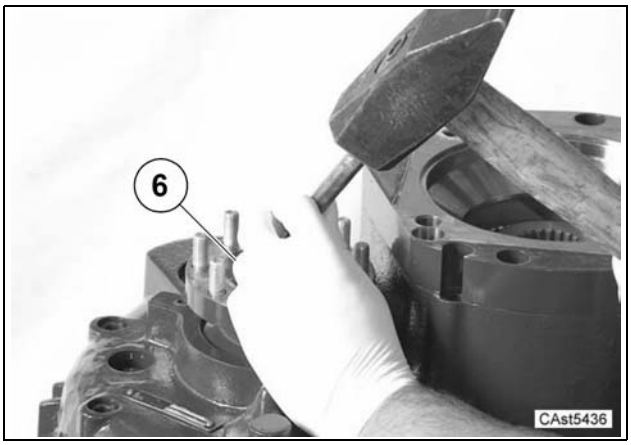
5. Remove spring (4).



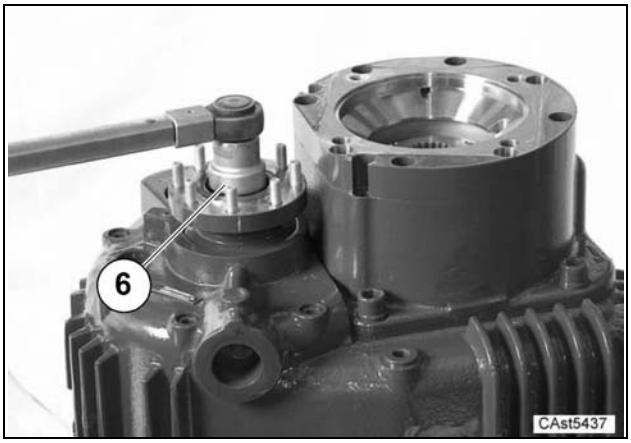
6. Remove O-ring (5).



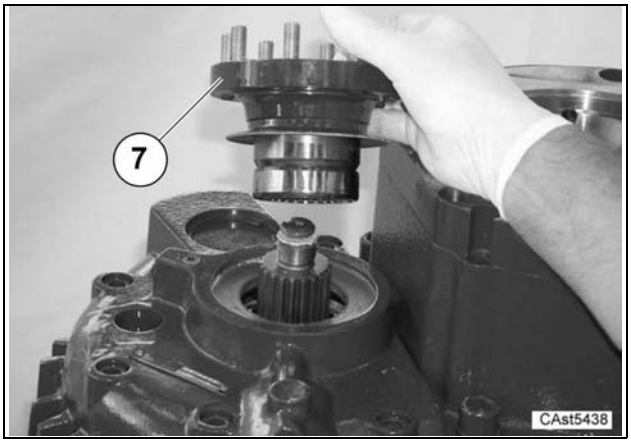
7. Loosen nut (6).



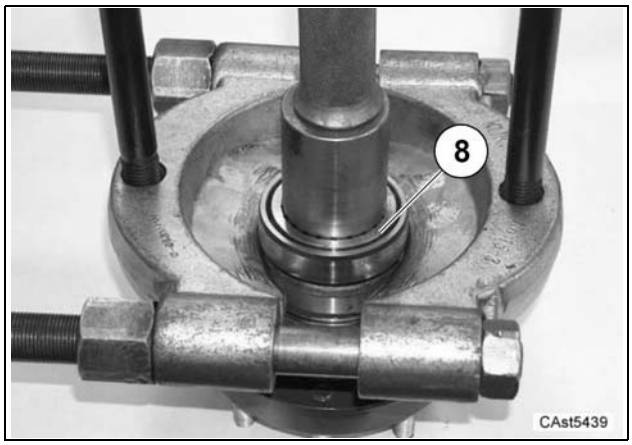
8. Remove nut (6).



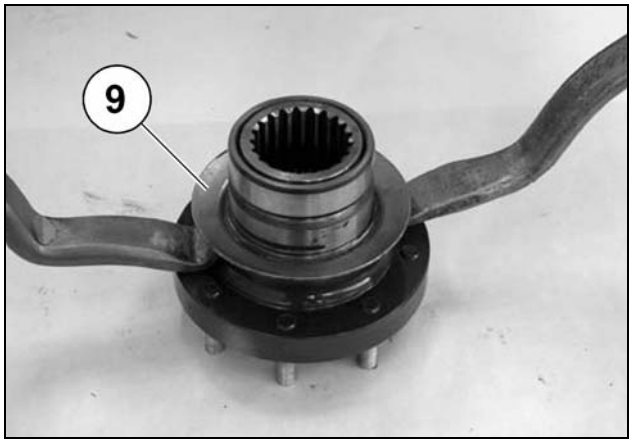
9. Remove flange (7).



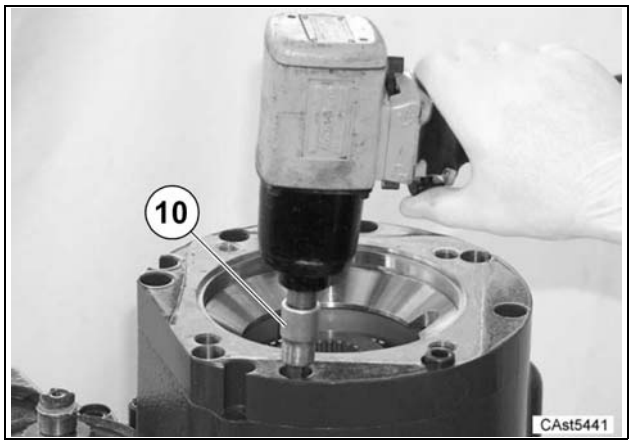
10. Use an extractor to remove the inner ring of the bearing (8).



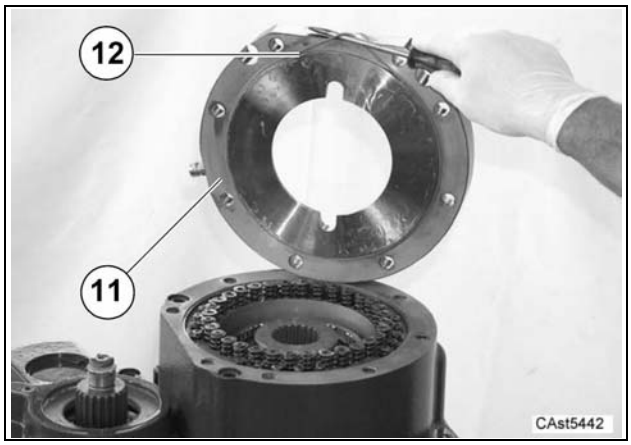
11. Remove flange protection (9).



12. Loosen and remove screws (10).

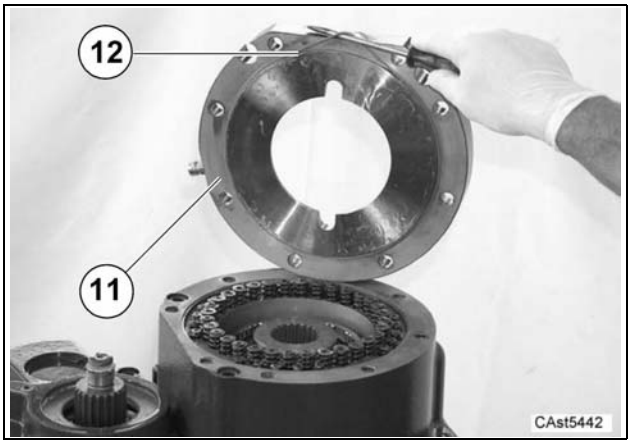


13. Remove hydraulic motor flange (11) and O-ring (12).



Installation of Travel Motor

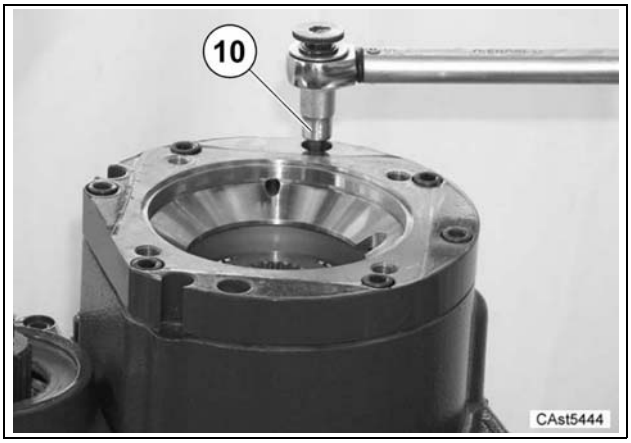
1. Assemble flange (11) and O-ring (12).



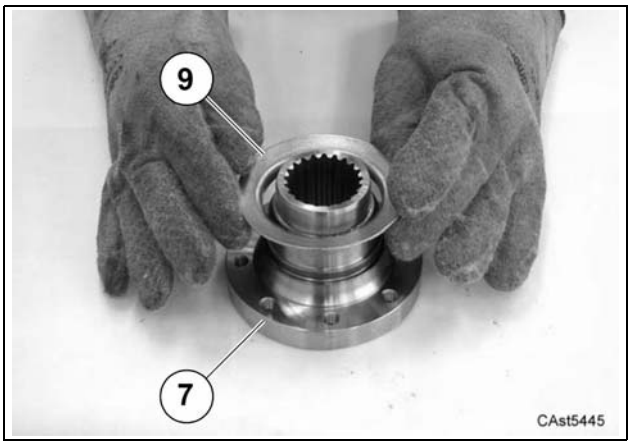
2. Apply Loctite® 242 on screws (10).



3. Assemble screw (10). (Tightening torque - 117Nm)



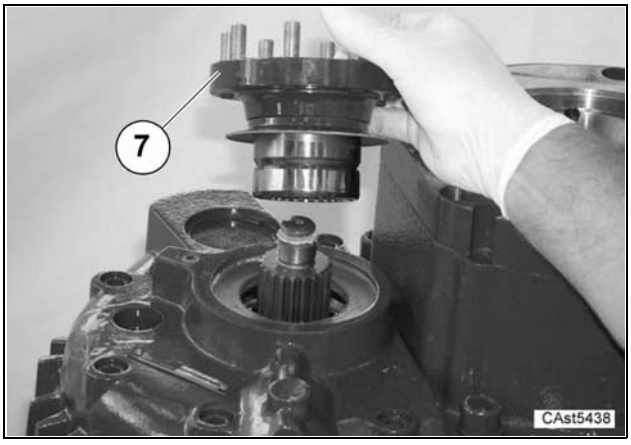
4. Assemble flange protection (9) on flange (7).



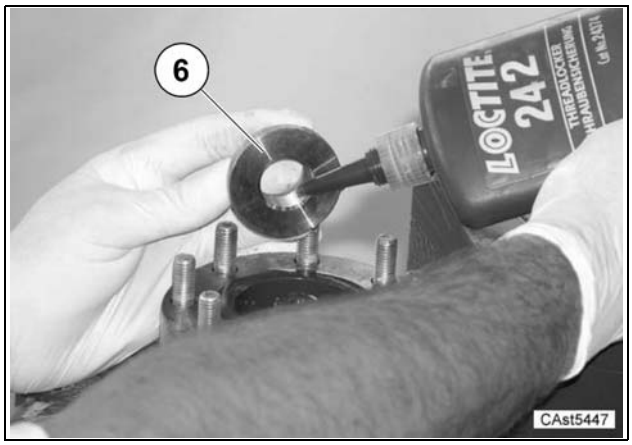
5. Assemble inner ring (8) of the bearing.



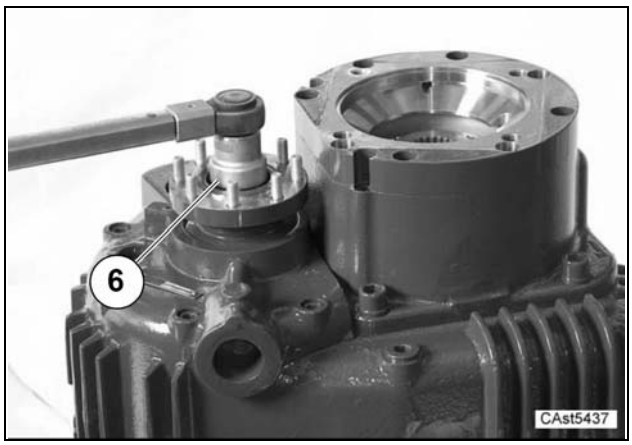
6. Assemble the flange (7).



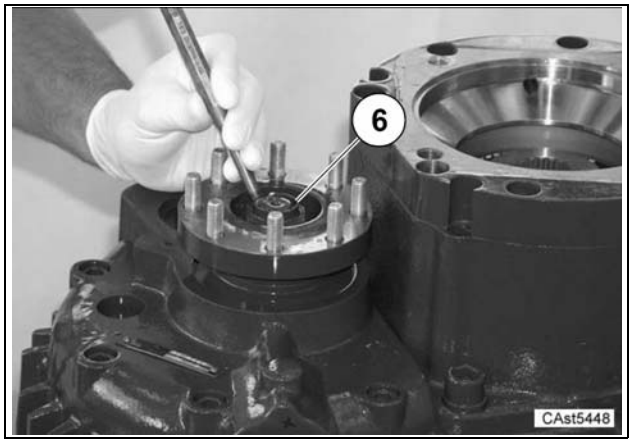
7. Apply Loctite® 242 on nut (6).



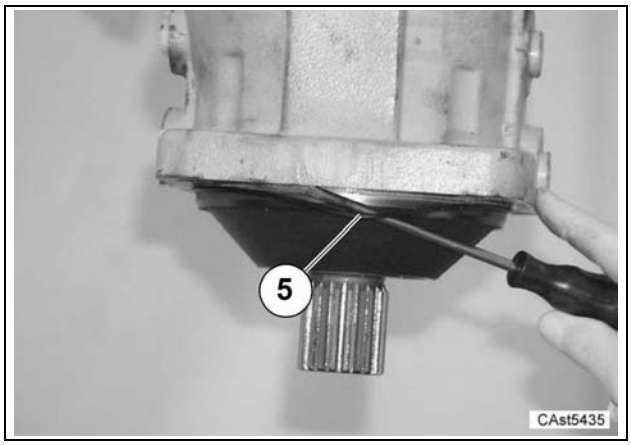
8. Assemble nut (6).



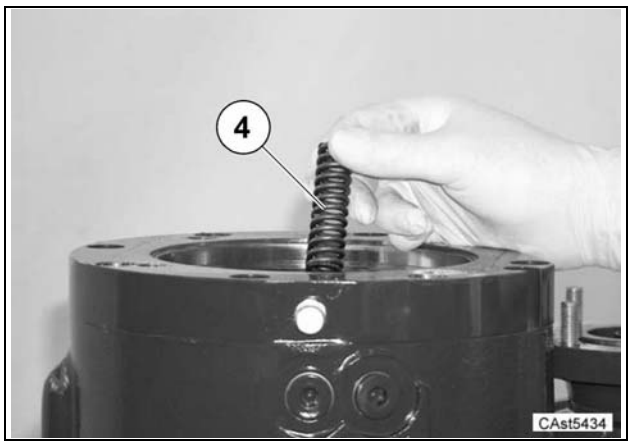
9. Carry out caulking on nut (6).



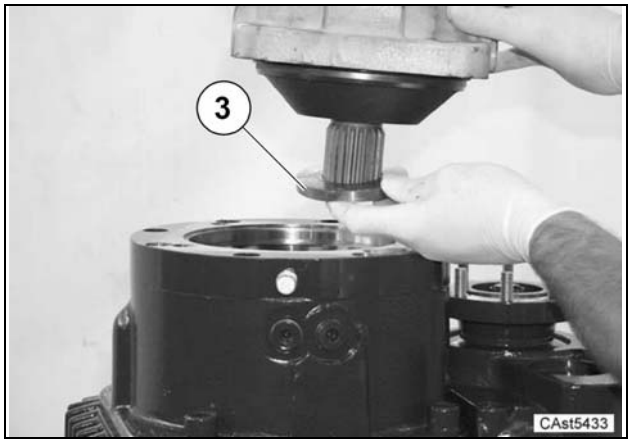
10. Assemble O-ring (5).



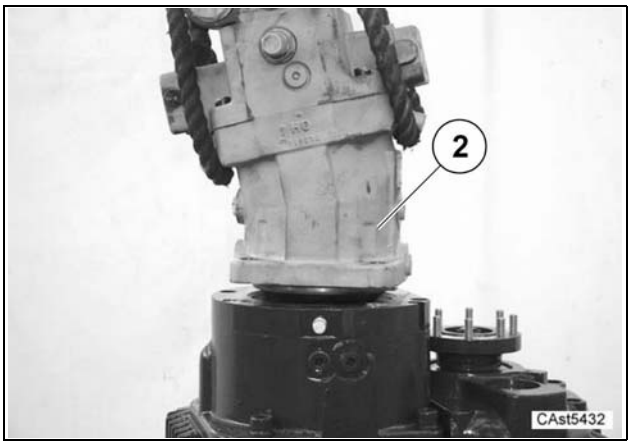
11. Assemble spring (4).



12. Assemble disc (3).



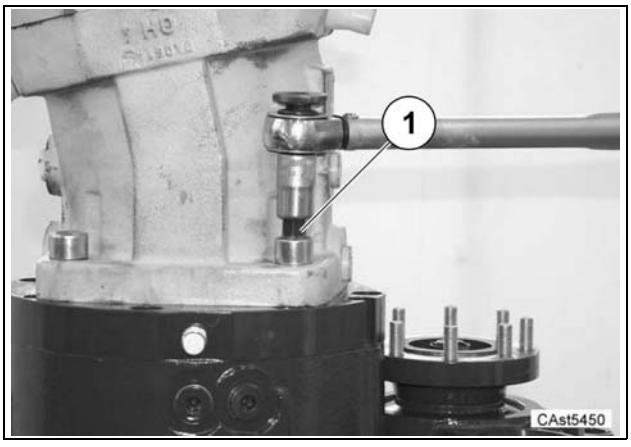
13. Assemble the travel motor (2).



14. Apply Loctite® 242 on screws (1).

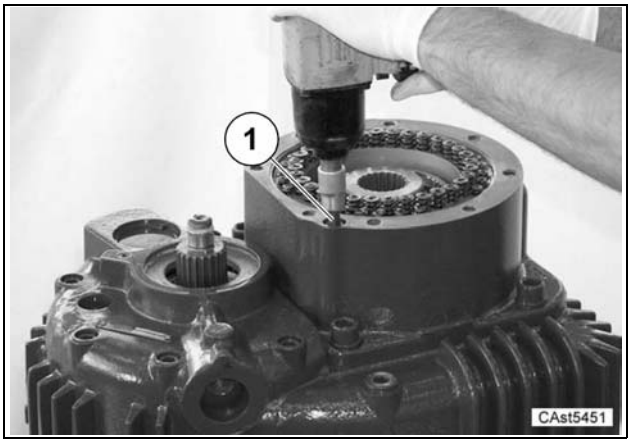


15. Assemble screws (1). (Tightening torque - 285Nm)

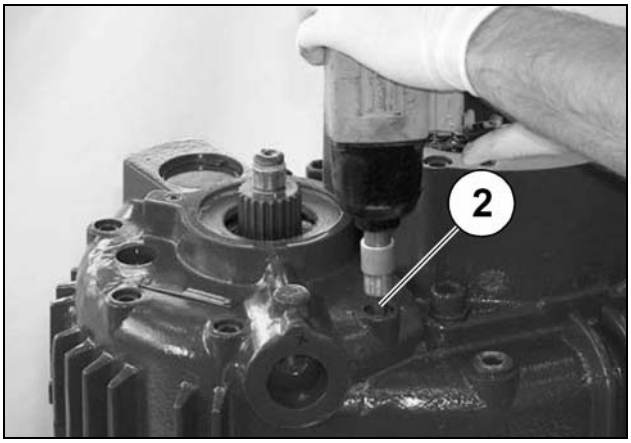


Removal of Transmission Box

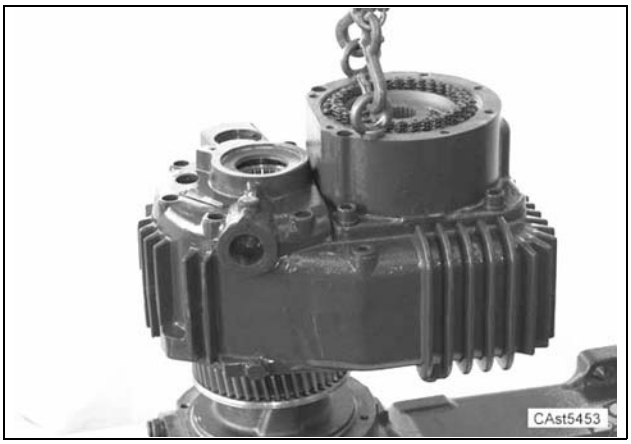
1. Remove screws (1).



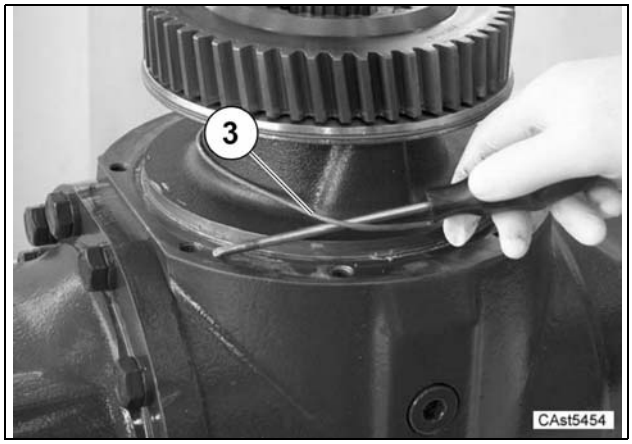
2. Remove screws (2).



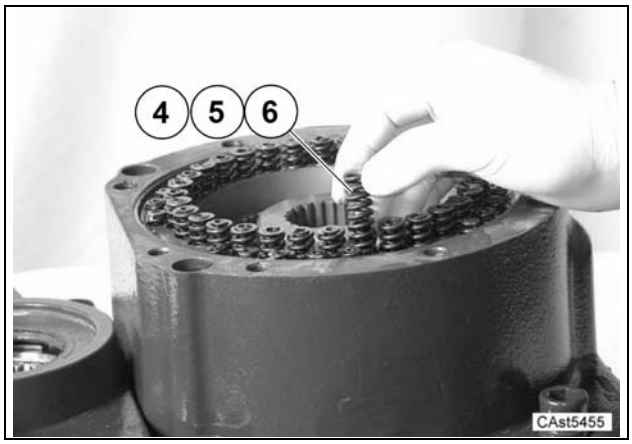
3. Remove transmission box.



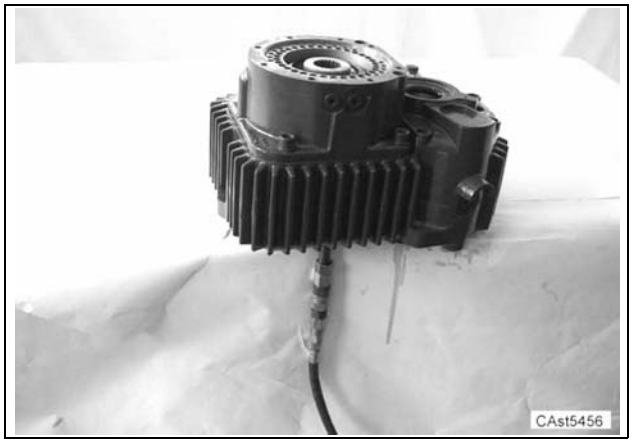
4. Remove the O-ring (3).



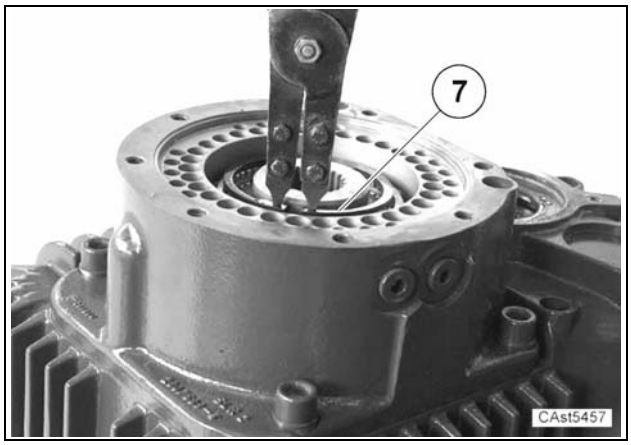
5. Remove springs (4), (5) and (6).



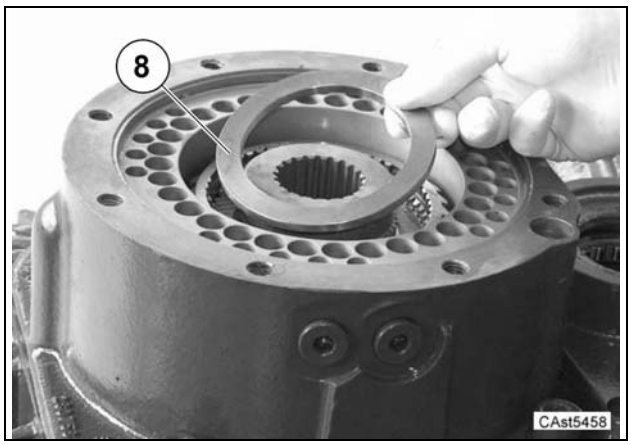
6. Unlock the clutch by pressing with 50-100 bar, through gearbox hole.



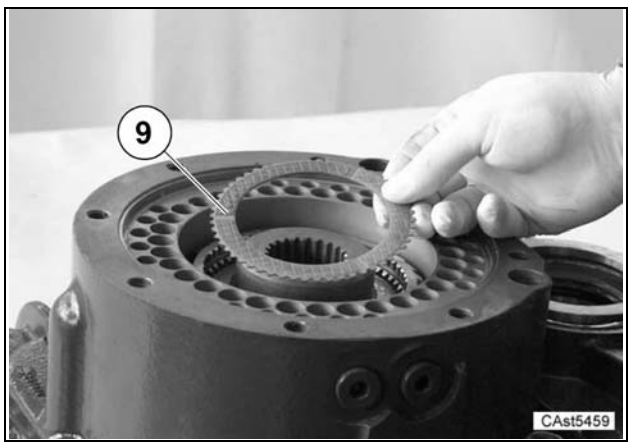
7. Remove snap ring (7).



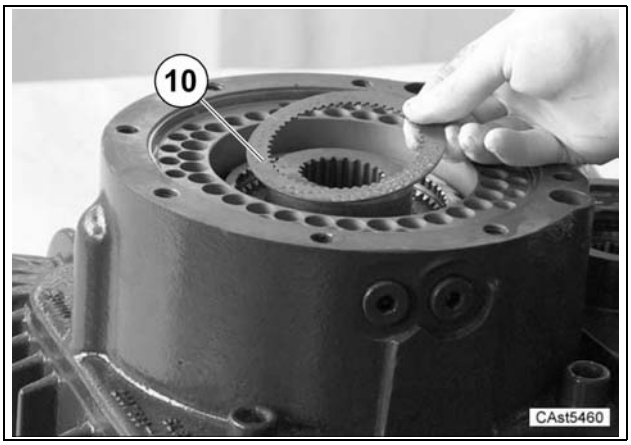
8. Remove ring (8).



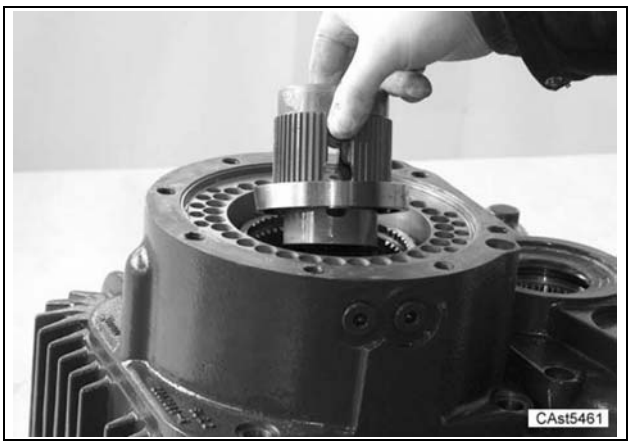
9. Remove discs (9).



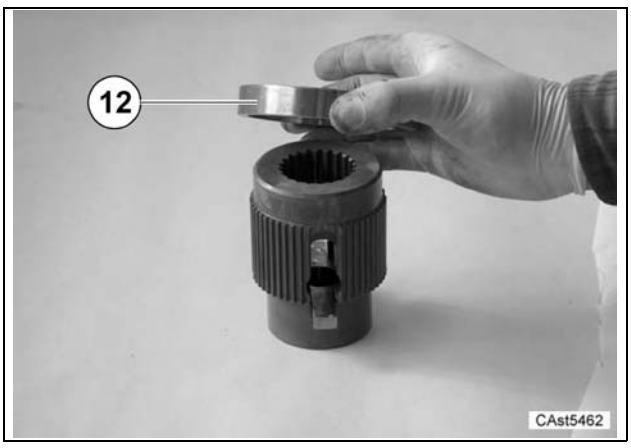
10. Remove disc (10).



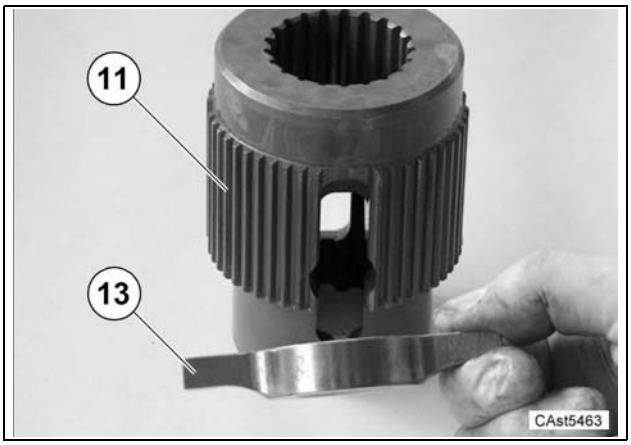
11. Remove bush assembly.



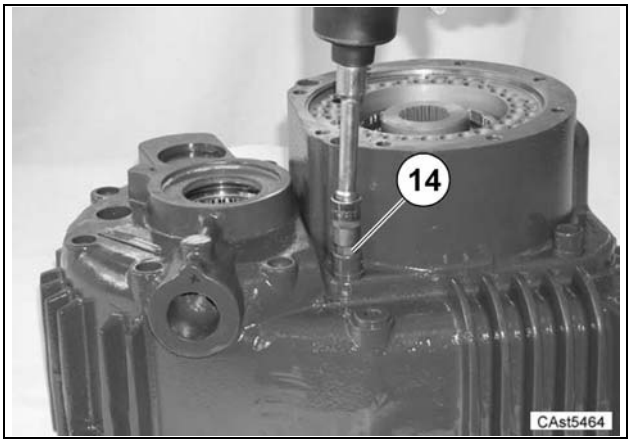
12. Remove the thrust ring (12).



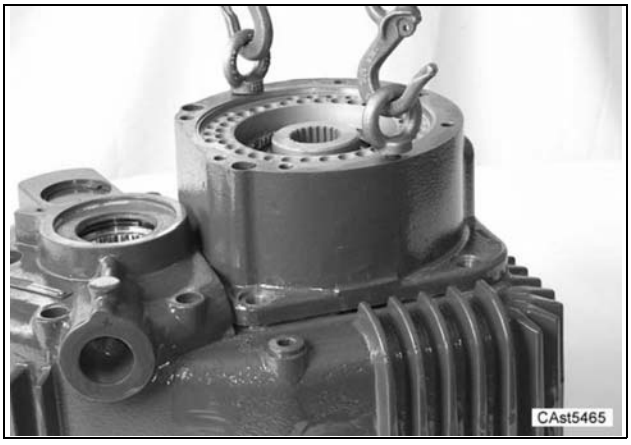
13. Remove thrust plate (13) from bush (11).



14. Remove screws (14).



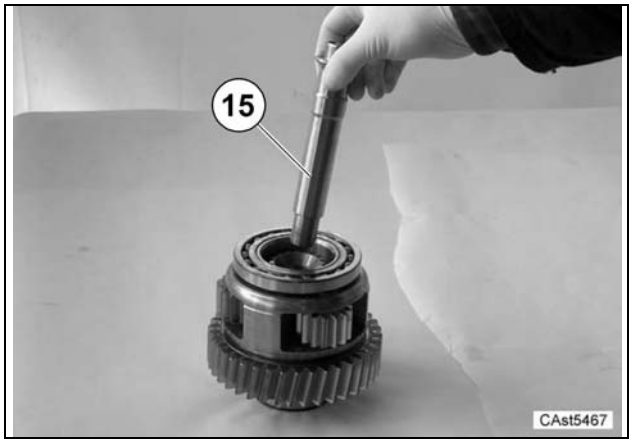
15. Remove the box assembly.



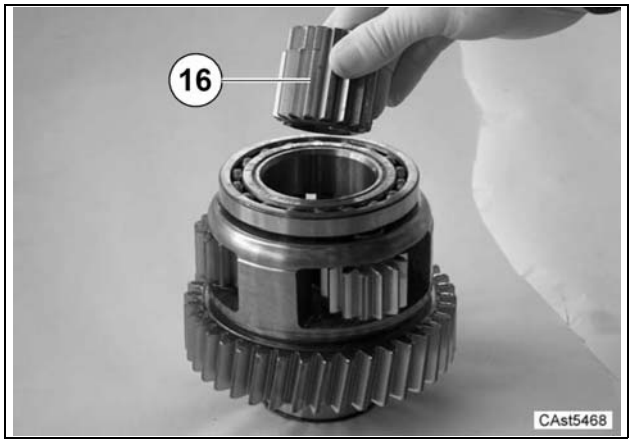
16. Remove complete planetary gears carrier.



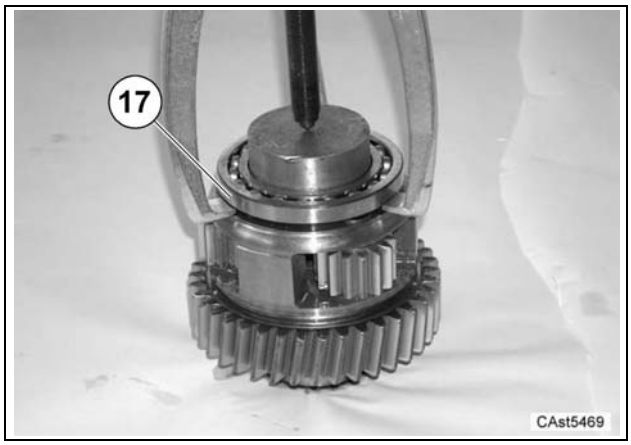
17. Remove shaft (15).



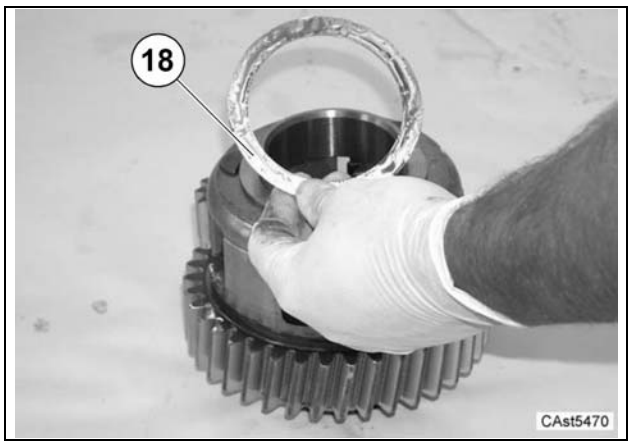
18. Remove gear (16).



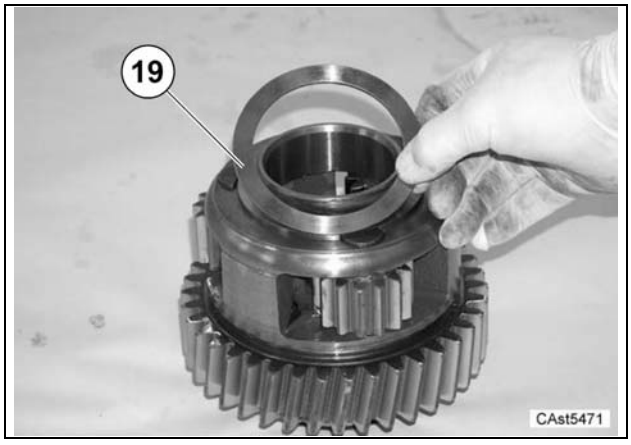
19. Use an extractor to remove the bearing (17).



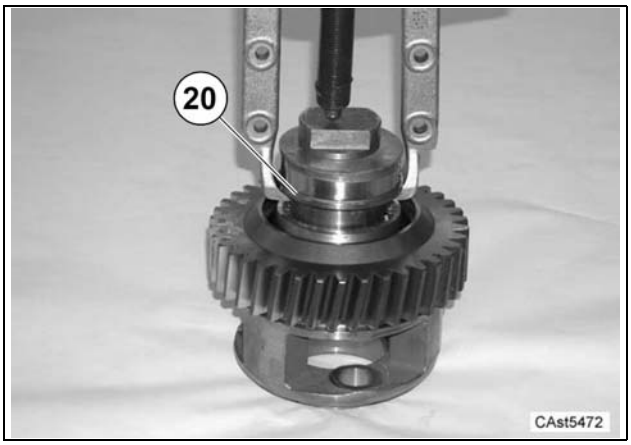
20. Remove shims(18).



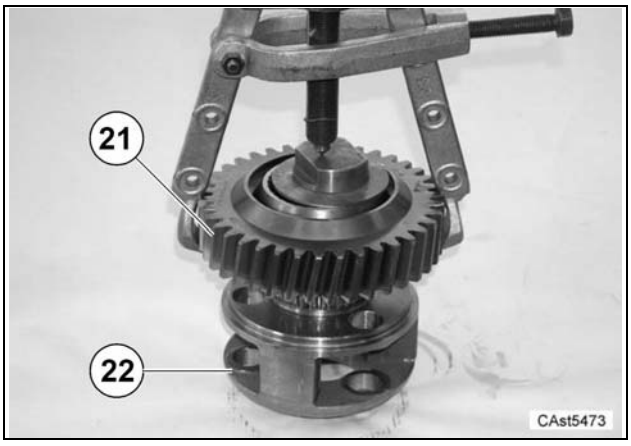
21. Remove ring (19).



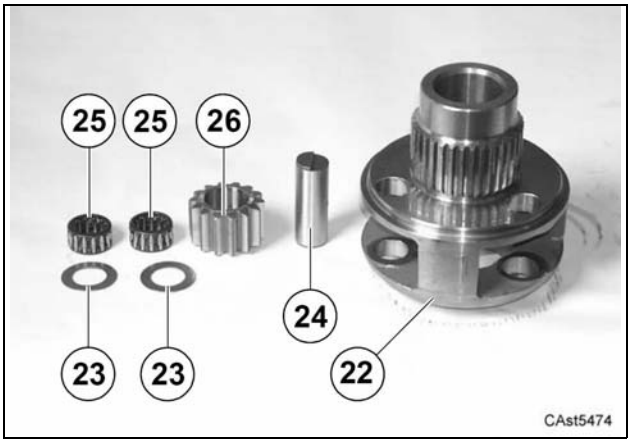
22. Use an extractor to remove bering inner cup (20).



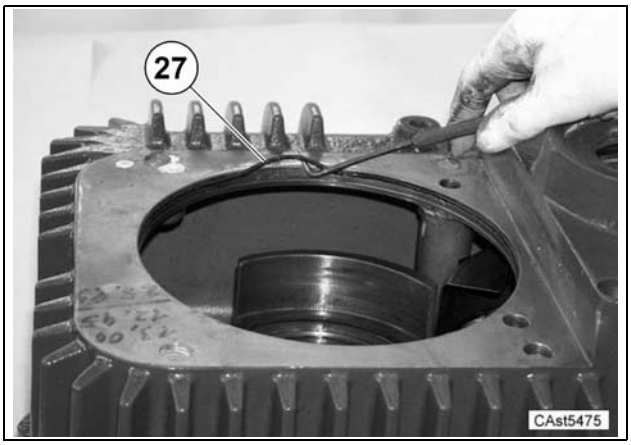
23. Use an extractor to remove gearwheel (21) from planetary gears carrier (22).



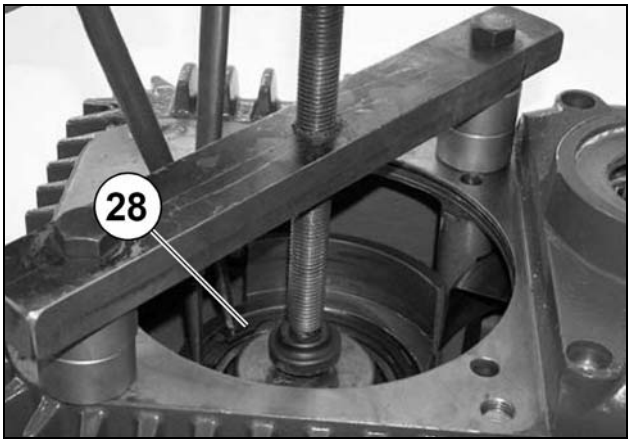
24. Remove washers (23), pins (24), bearings (25), and gears (26) from the planetary gears carrier (22).



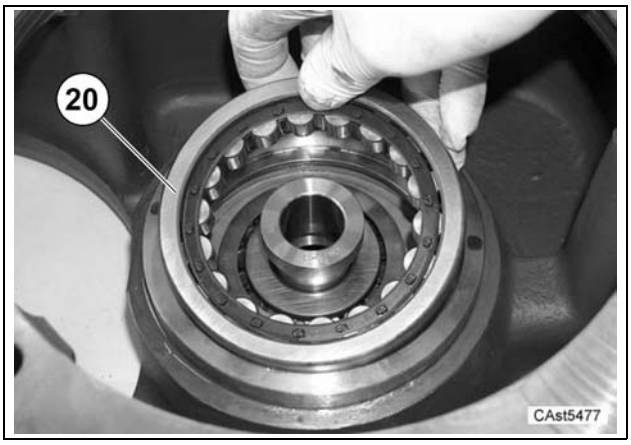
25. Remove O-ring (27).



26. Remove snap ring (28).
Use tool 2897008



27. Remove bearing (20).



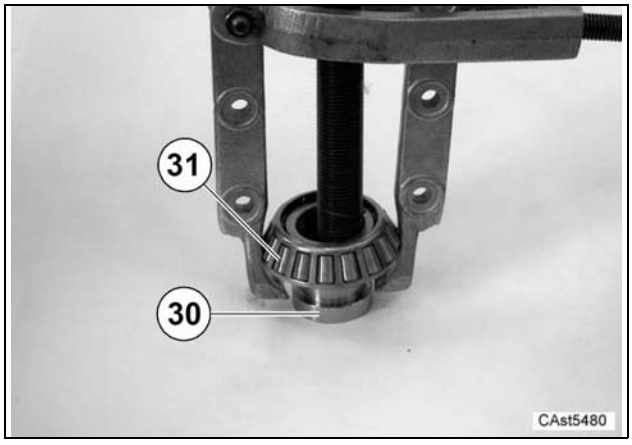
28. Remove ring (29).



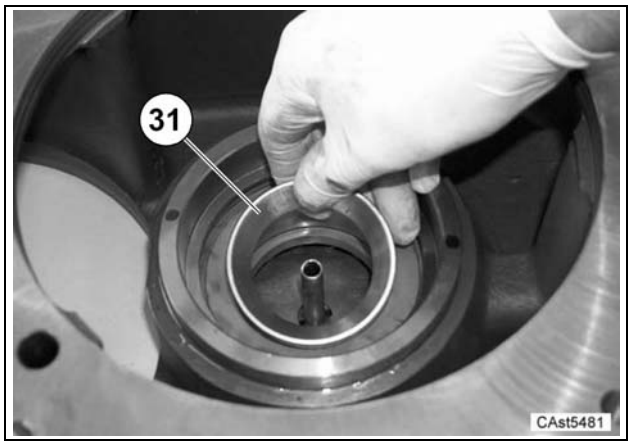
29. Remove spin assembly.



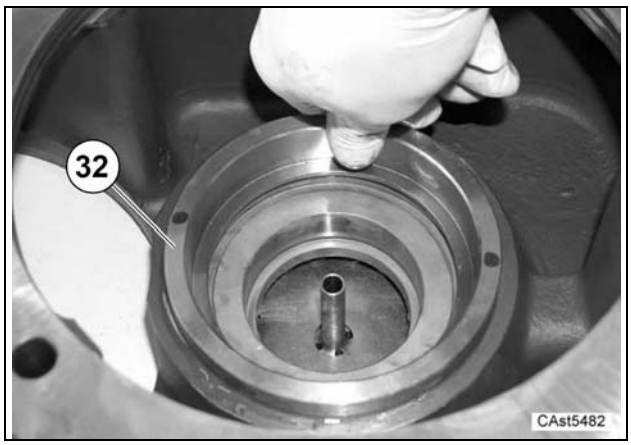
30. Remove pin (30) from bearing (31).



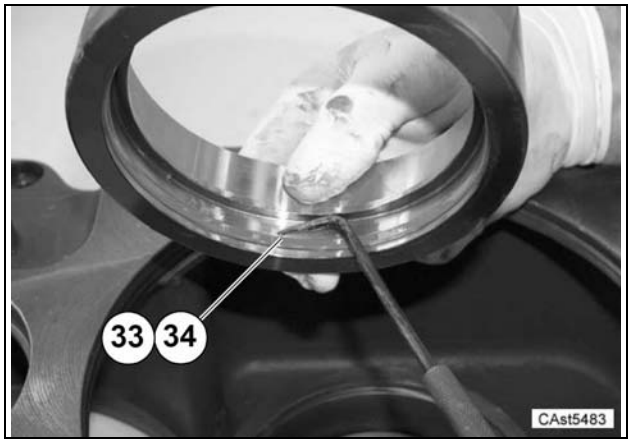
31. Remove bearing outer cup (31).



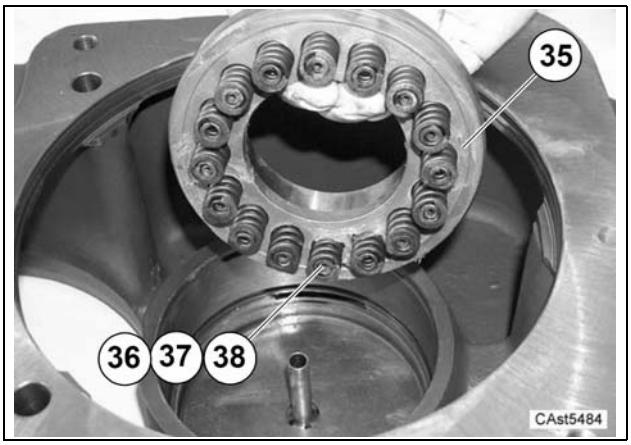
32. Remove piston (32).



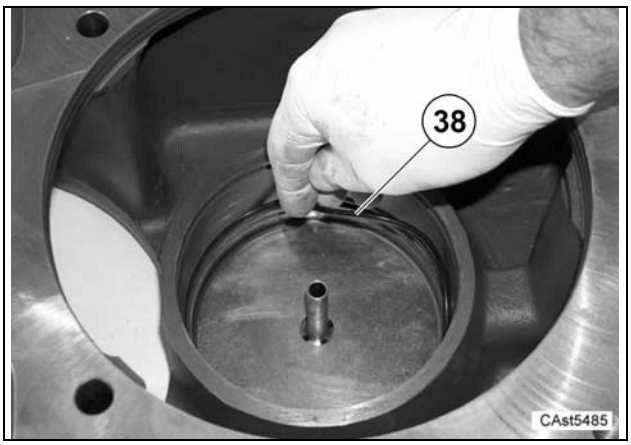
33. Remove gasket (33) and O-ring (34).



34. Remove piston (35) and springs (36), (37).



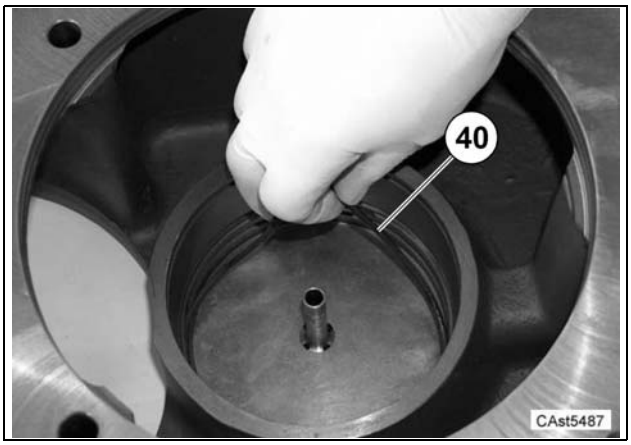
35. Remove bearing cup (38).



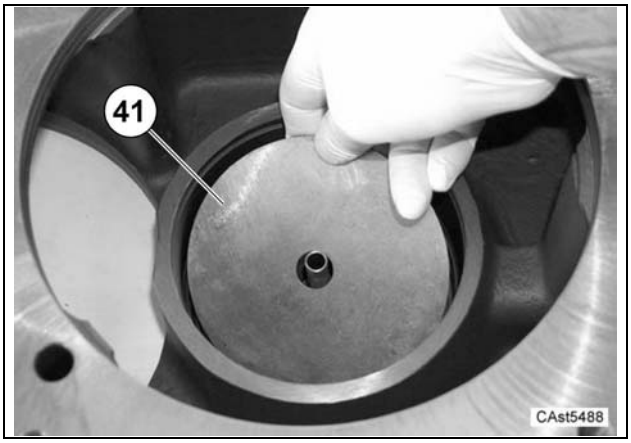
36. Remove gasket (39).



37. Remove O-ring (40.



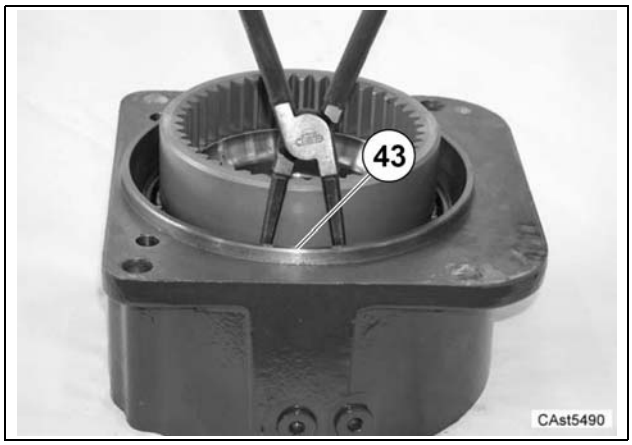
38. Remove disc (41).



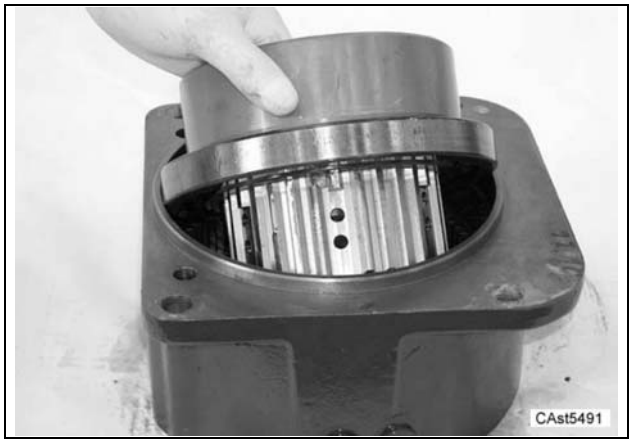
39. Remove the pin (42).



40. Remove snap ring (43).



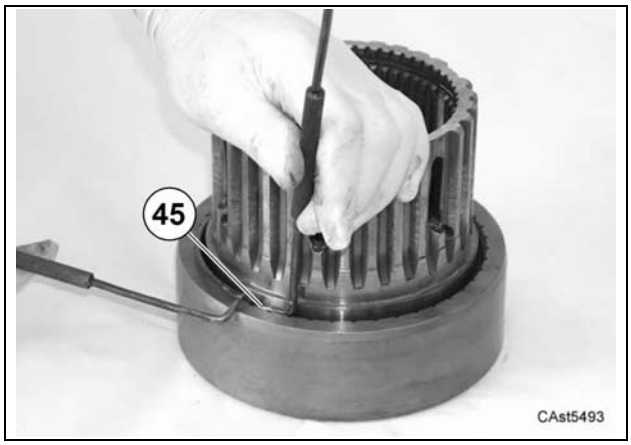
41. Remove hollow wheel assembly.



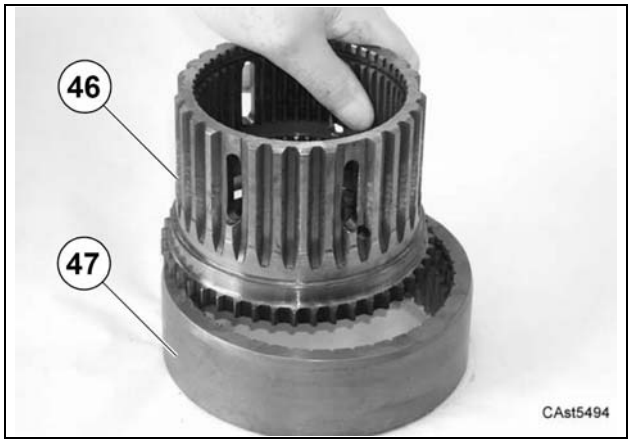
42. Remove bearing (44).



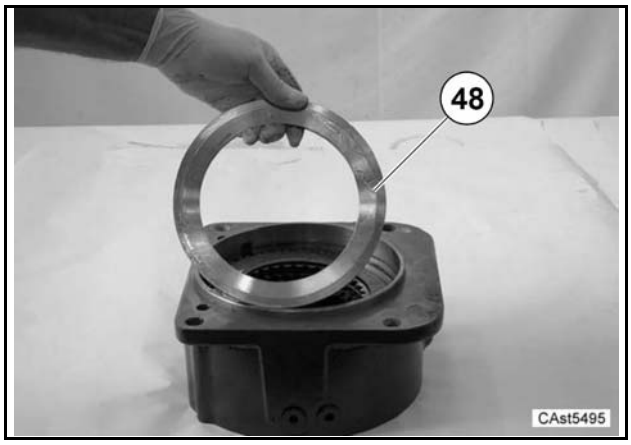
43. Remove snap ring (45).



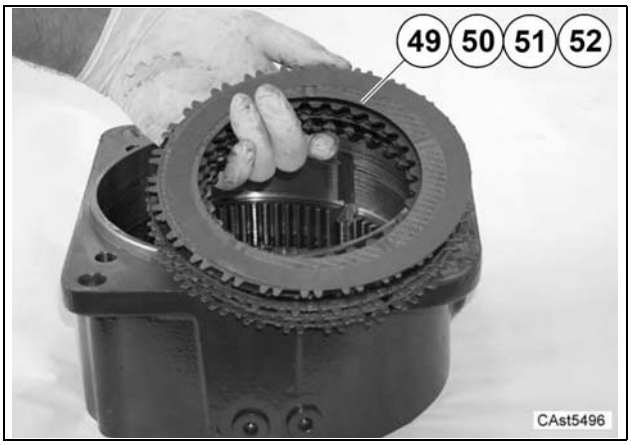
44. Remove external geared wheel (46) from hollow wheel (47).



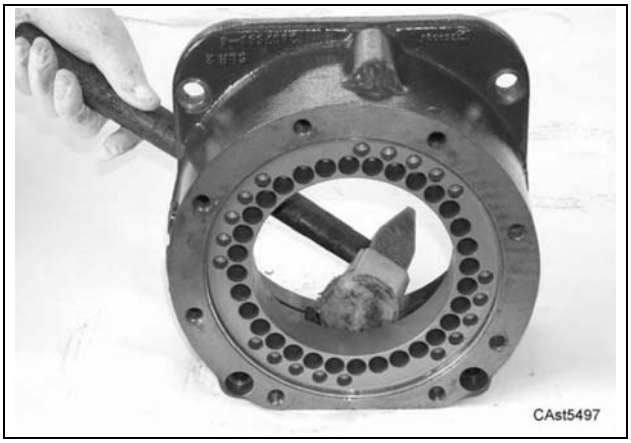
45. Remove disc (48).



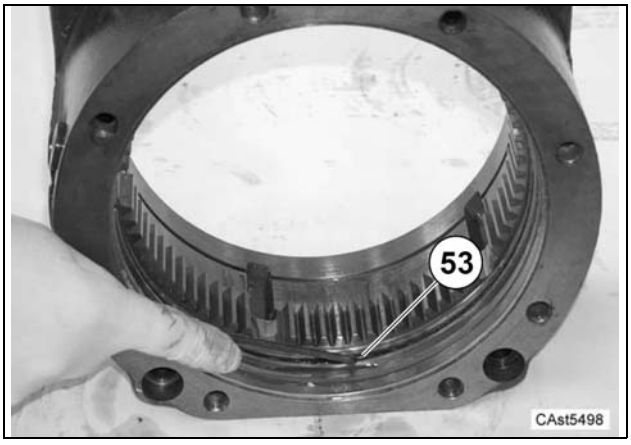
46. Remove discs (49), (50), (51) and (52).



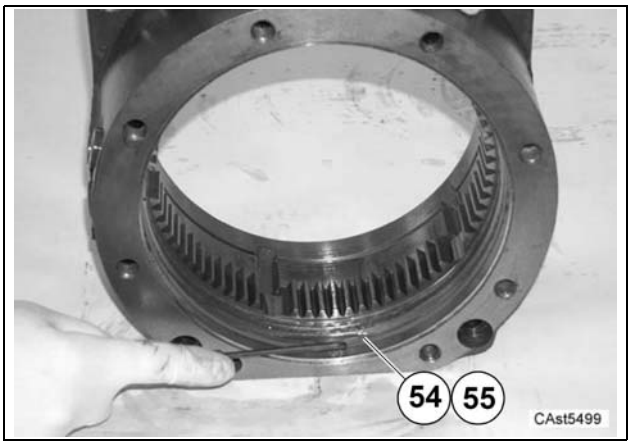
47. Remove piston assembly.



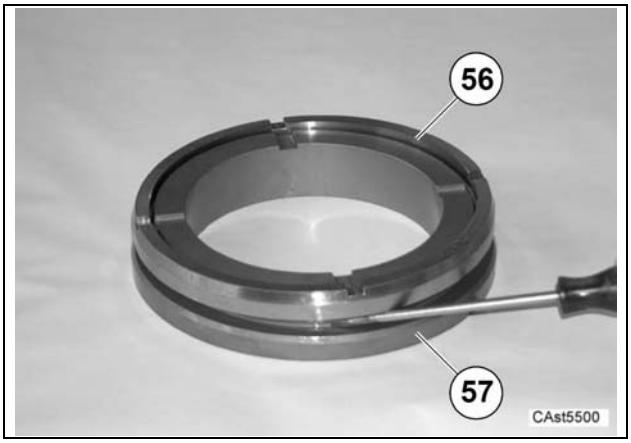
48. Remove O-ring (53).



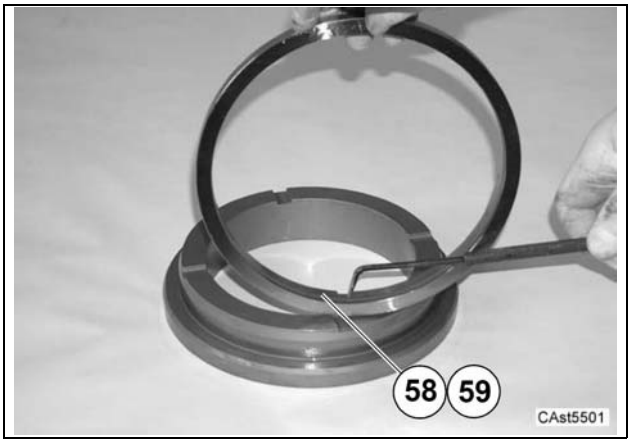
49. Remove piston gasket (54) and O-ring (55).



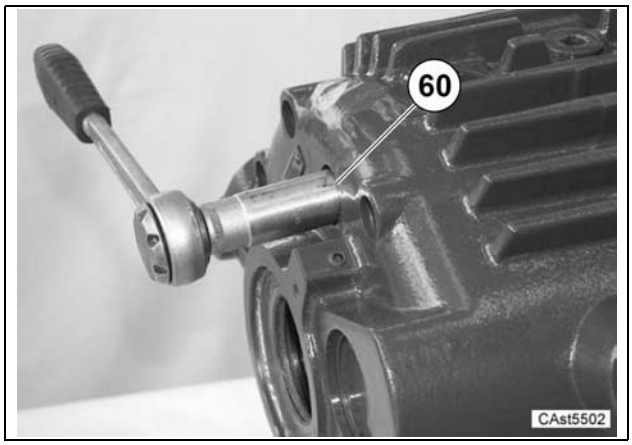
50. Remove outer ring (56) from piston (57).



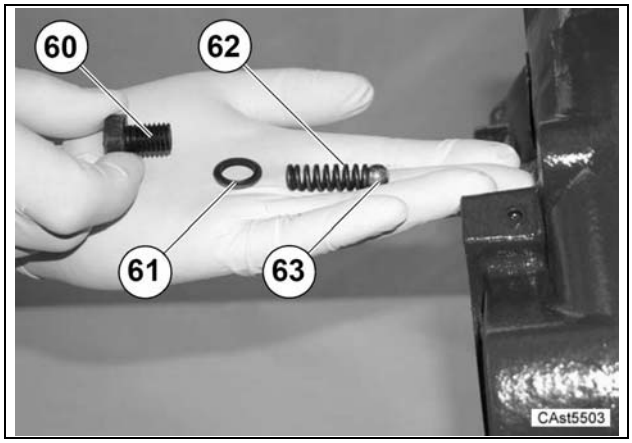
51. Remove gasket (58) and O-ring (59) from seat.



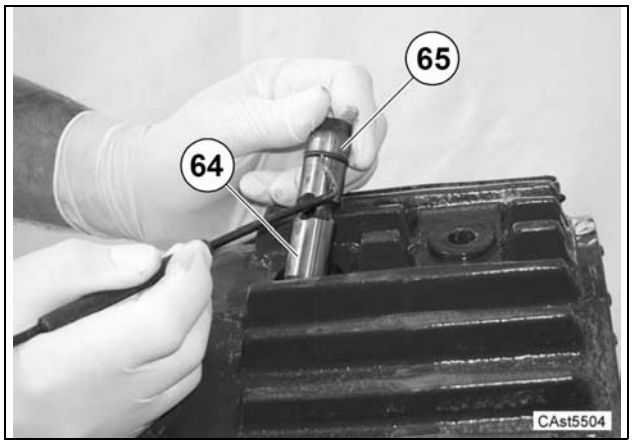
52. Loosen screw (60).



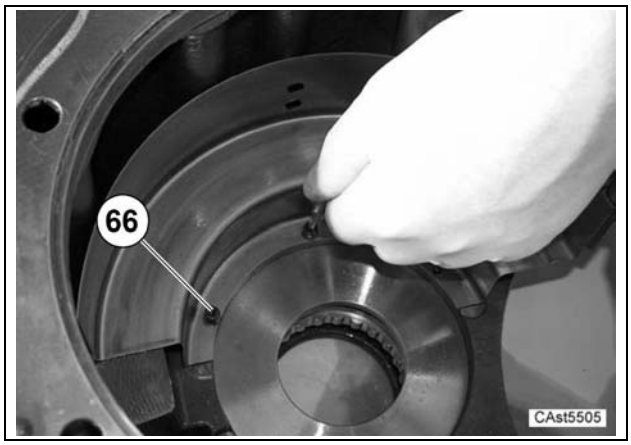
53. Remove screw (60), washer (61), spring (62), and ball (63).



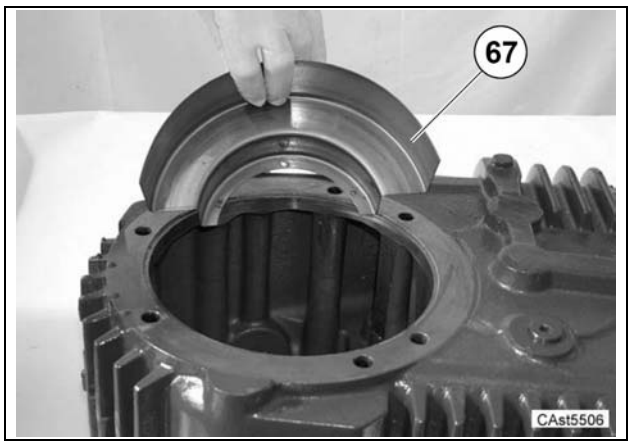
54. Remove pin (64) and O-ring (65).



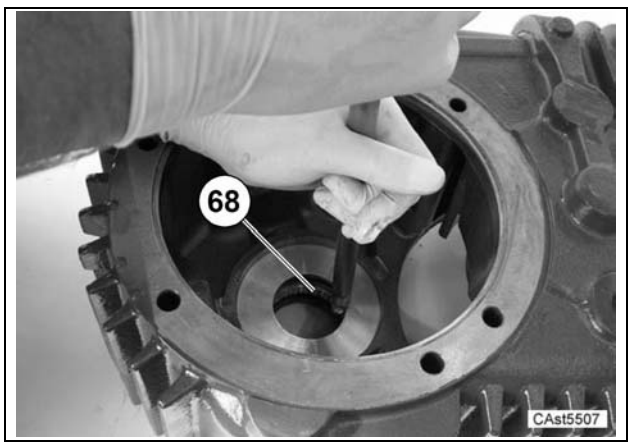
55. Remove screws (66).



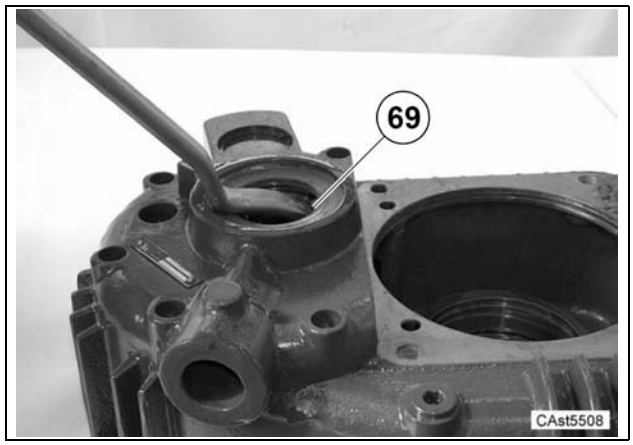
56. Remove the cover (67).



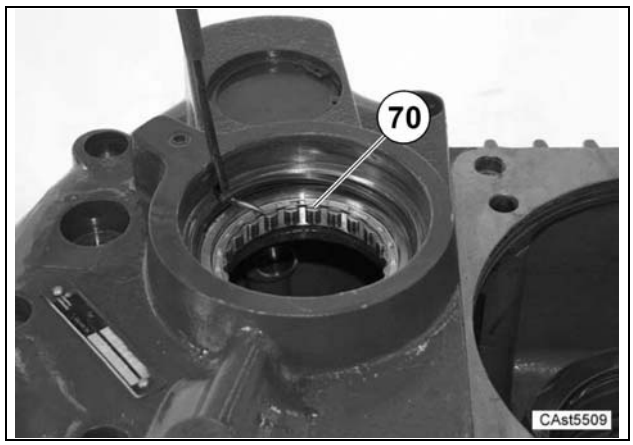
57. Remove disc (68).



58. Remove gasket (69).



59. Remove snap ring (70).

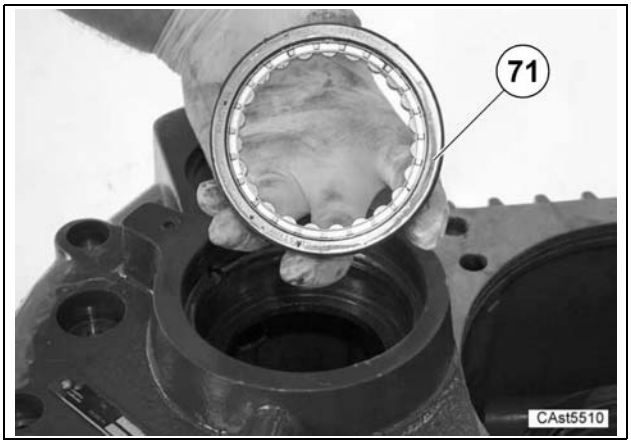


60. Remove bearing (71).

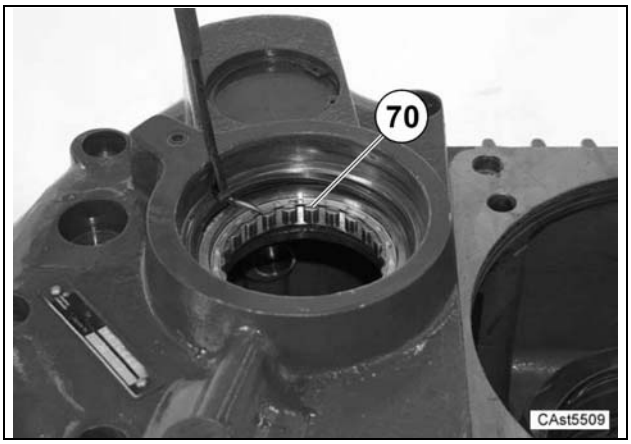


Installation of Transmission Box

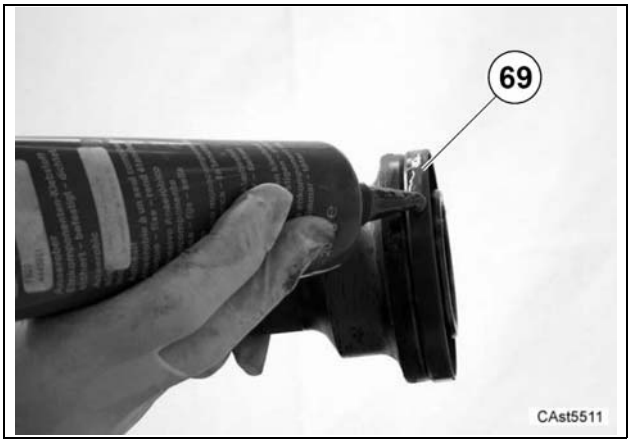
1. Assemble bearing (71).



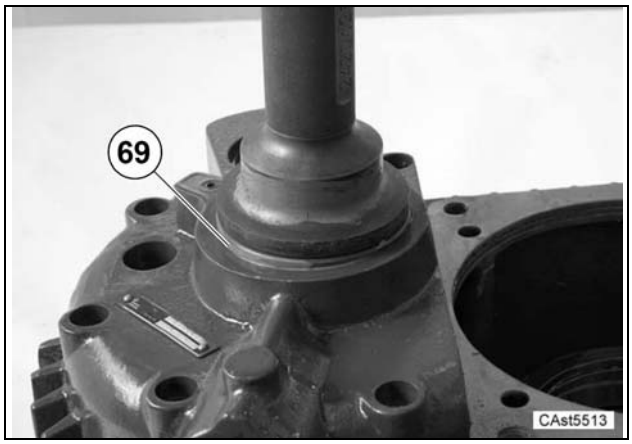
2. Assemble snap ring (70).



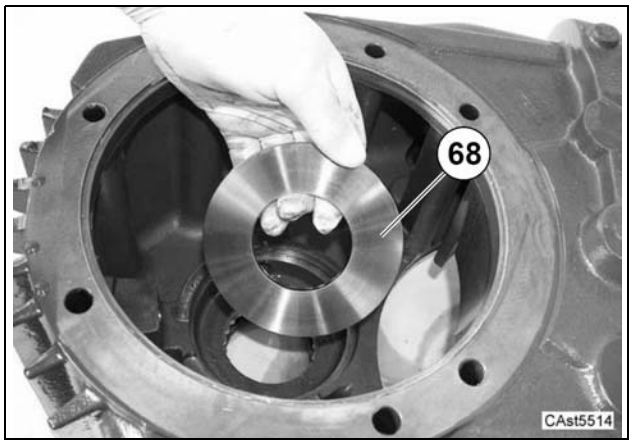
3. Install oil seal ring (69) inside tool 2897005.
   Apply Loctite® 510 on seal ring outer edge.



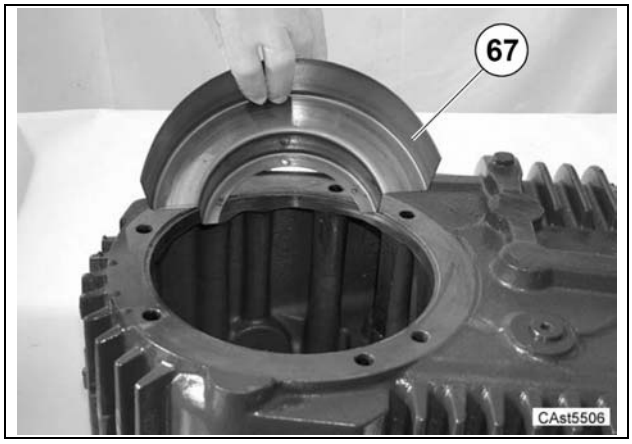
4. Assemble oil seal (69) on tool 2897005.
   Note: Clean the box with a rolling brush.



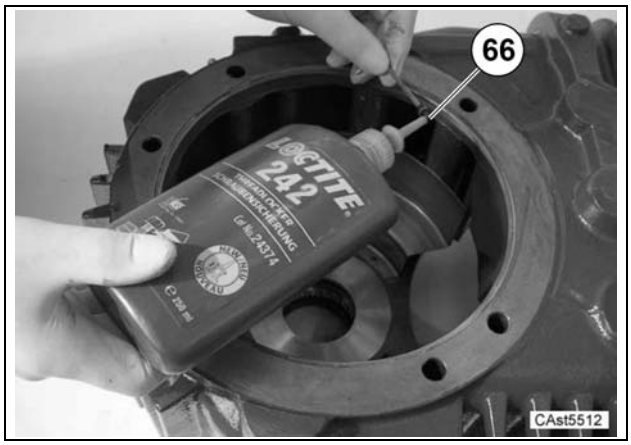
5. Assemble disc (68).



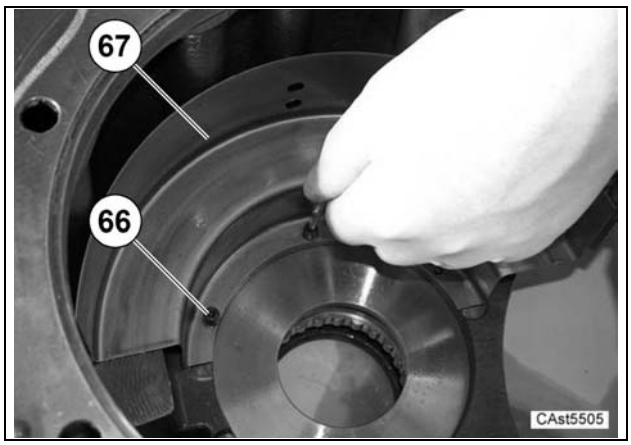
6. Install cover (67).



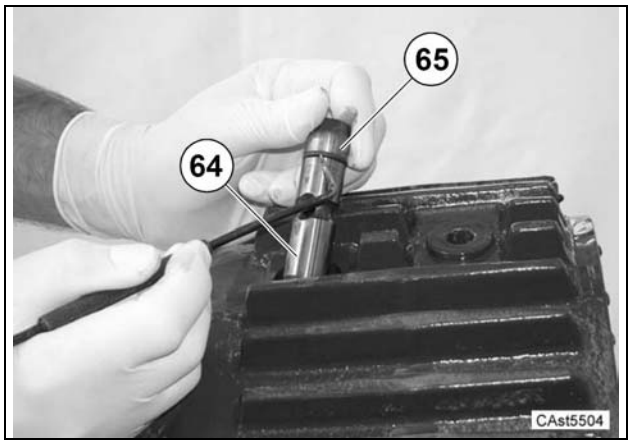
7. Apply Loctite® 242 on screws (66).



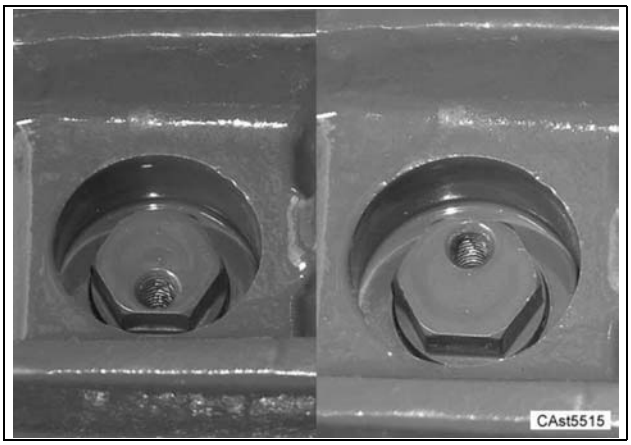
8. Fix cover (67) with screws (68).



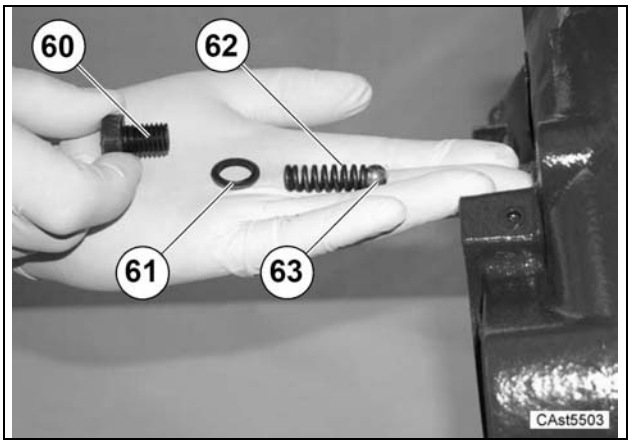
9. Assemble O-ring (65) on the pin (64) and apply a light layer of grease. Assemble the pin.



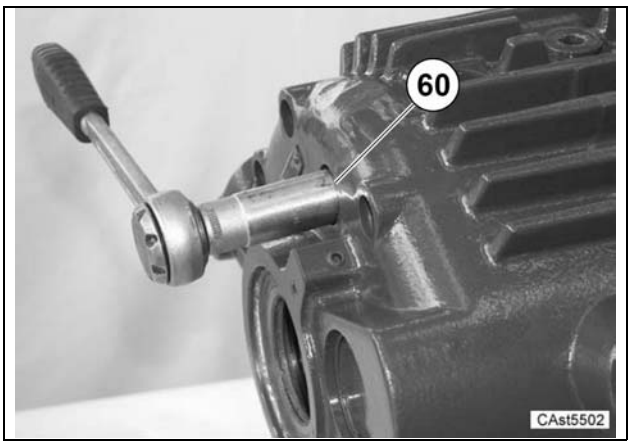
Note:to unlock the transmission in case of need, turn the eccentric pin 180° (notch upward).



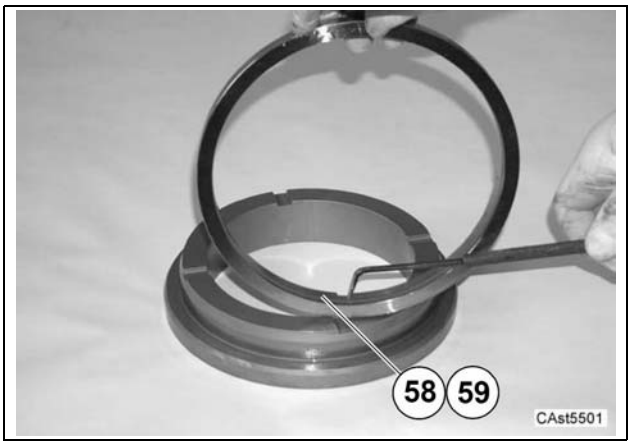
10. Assemble ball (63), spring (62), washer (61) and screw (60).



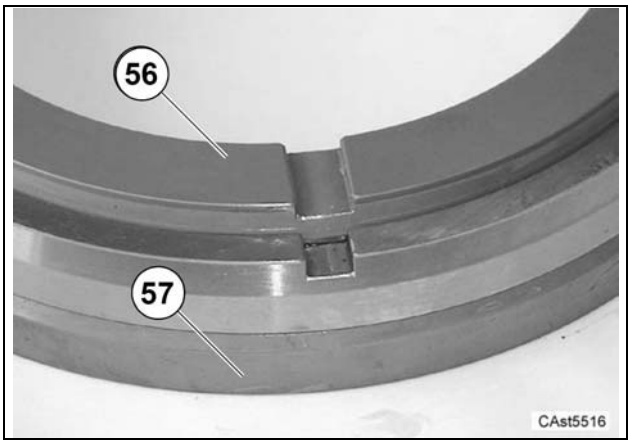
11. Tighten screw (60). (Tightening torque - 400Nm)



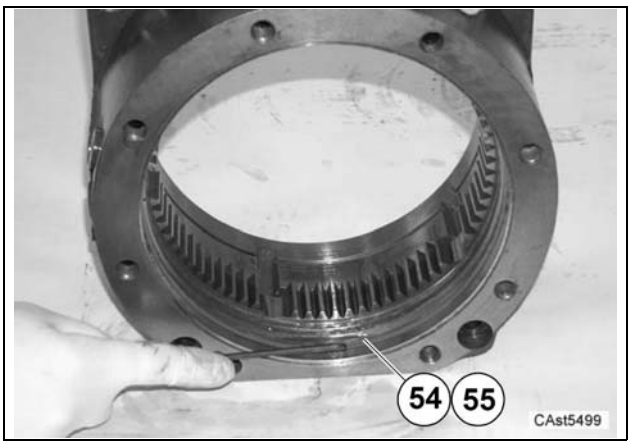
12. Assemble gasket (58) and O-ring (59) in the ring (56).



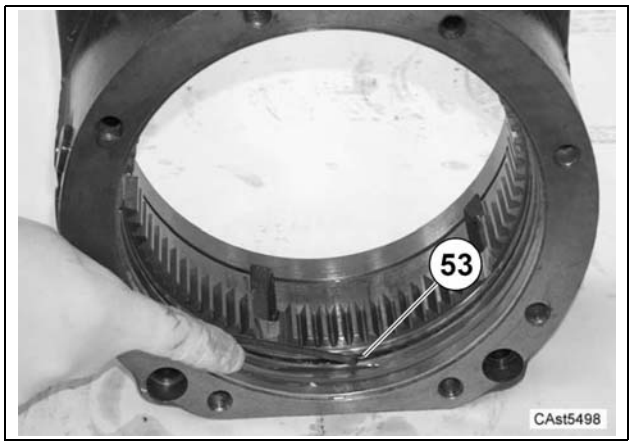
13. Assemble outer ring (56) on piston (57) making the notches match.



14. Assemble gasket (54) and O-ring (55).

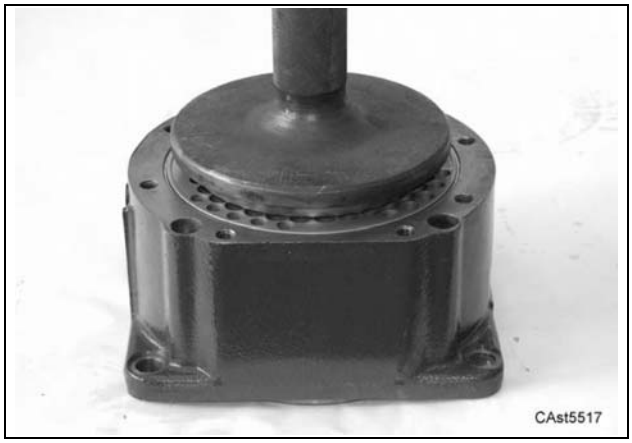


15. Assemble O-ring (53).

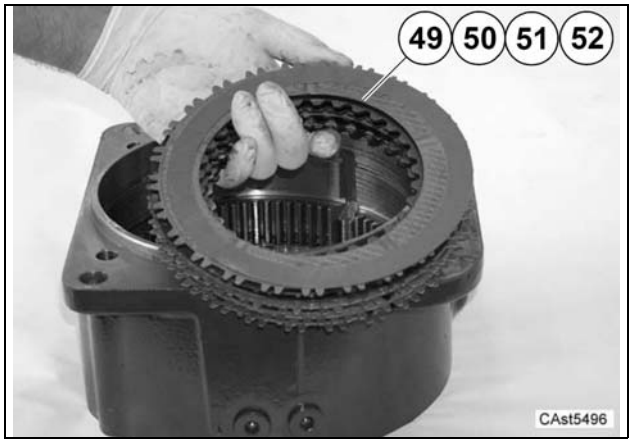


16. lubricate and install piston using tool 1743047. Make sure that the oil groove coincides with the toothed disc grooves.

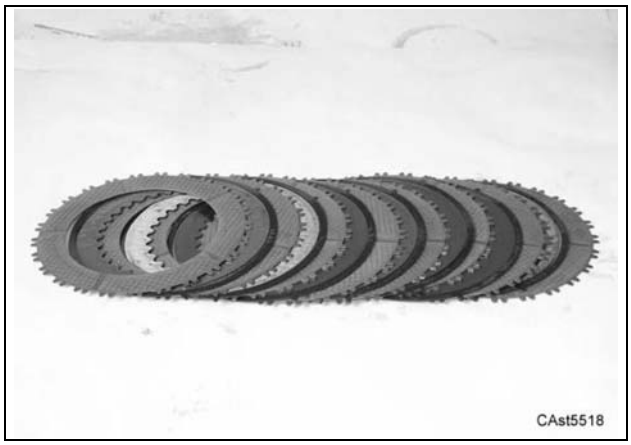
WARNING! Warning make sure that the piston does not key.



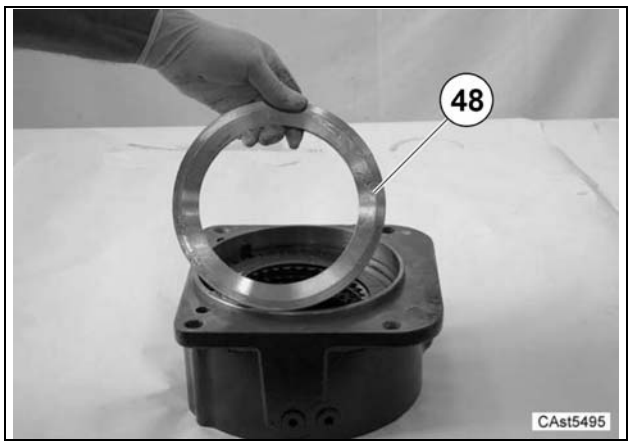
17. Assemble discs (49), (50), (51) and (52).



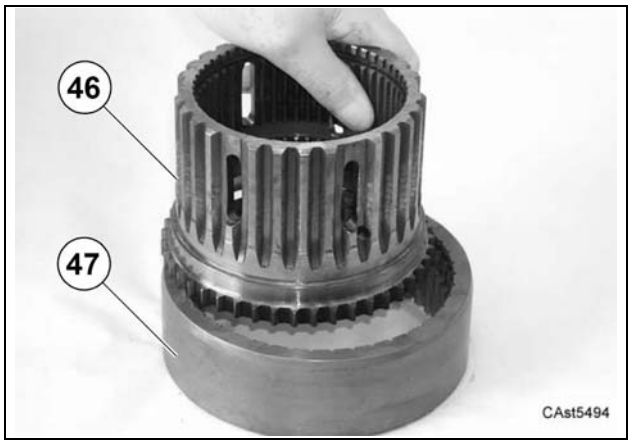
Note:check the sequence of discs.



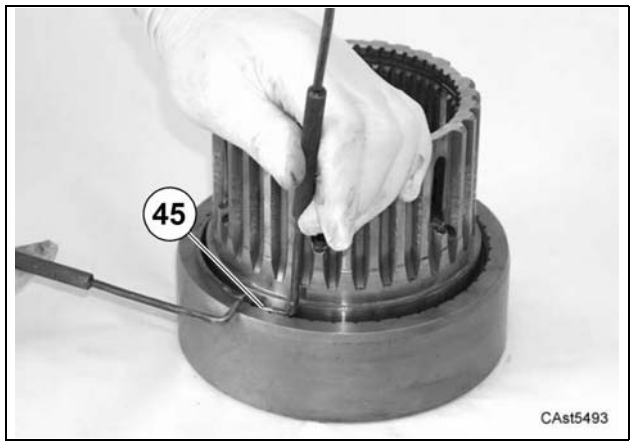
18. Assemble disc (48).



19. Assemble external geared wheel (46) on the hollow wheel (47).



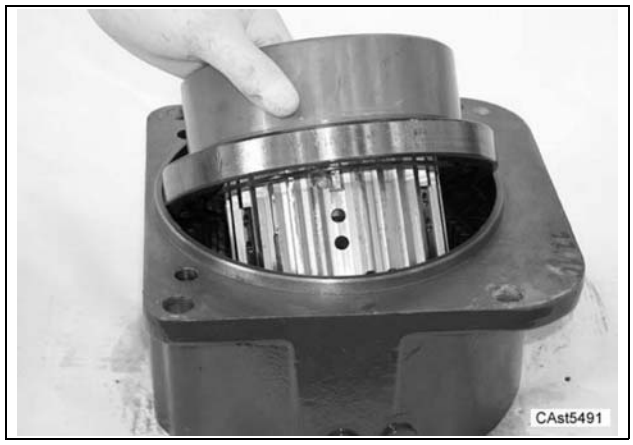
20. Assemble snap ring (45).



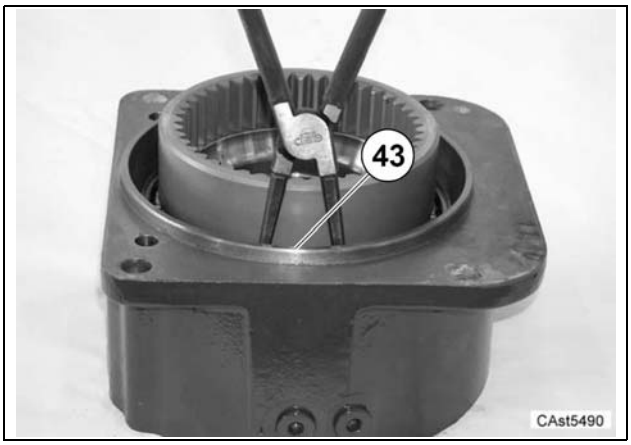
21. Assemble bearing (44) on hollow wheel assembly.



22. Assemble hollow wheel assembly.



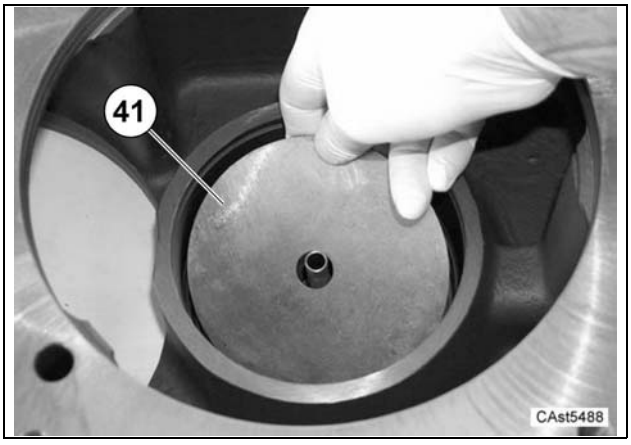
23. Assemble snap ring (43).



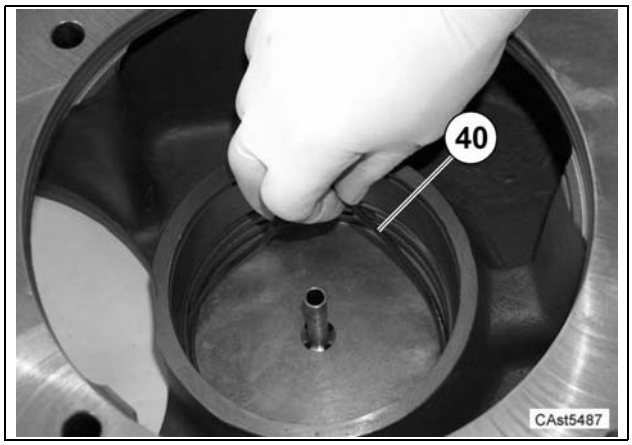
24. Assemble pin (42).



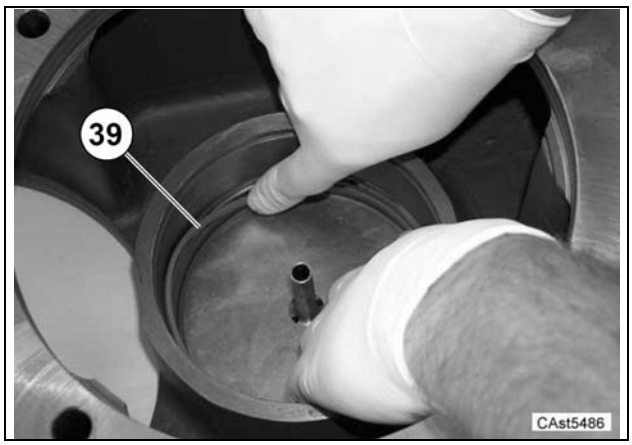
25. Assemble disc (41).



26. Assemble O-ring (40).



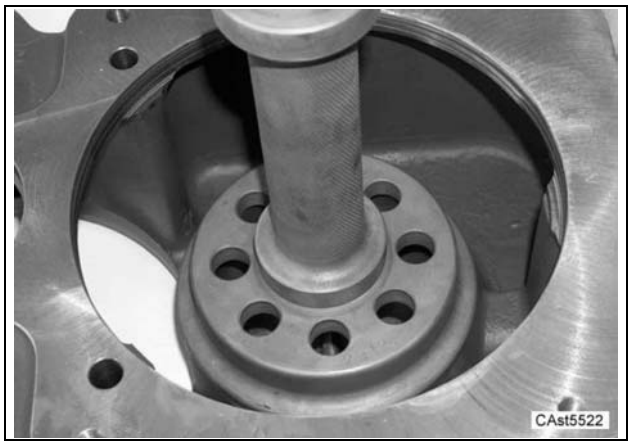
27. Assemble gasket (39).



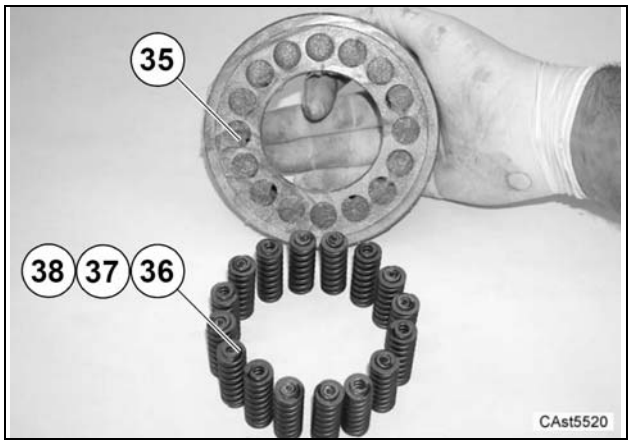
28. Assemble O-ring (38).



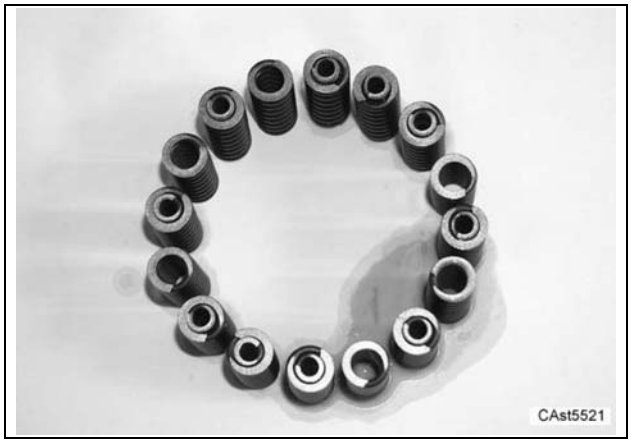
29. Install O-ring (38) and gasket (39).
Use tool 2912484.



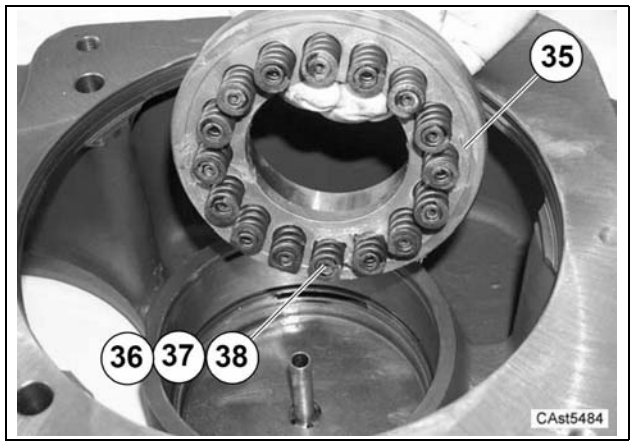
30. Apply grease on piston (35) to prevent springs from falling and insert springs (36), (37) and (38).



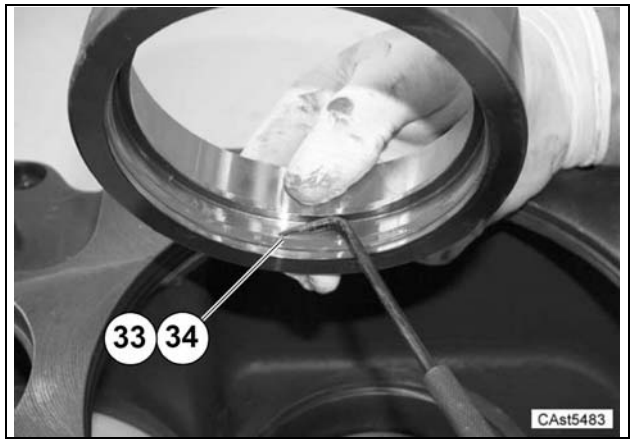
WARNING! Springs are assembled as follows:
N.1 series with 1 spring;
N.1 series with 2 spring;
N.1 series with 1 spring;
N.3 series with 2 spring;
N.1 series with 1 spring;
N.1 series with 2 spring.
Repeat this operation twice.



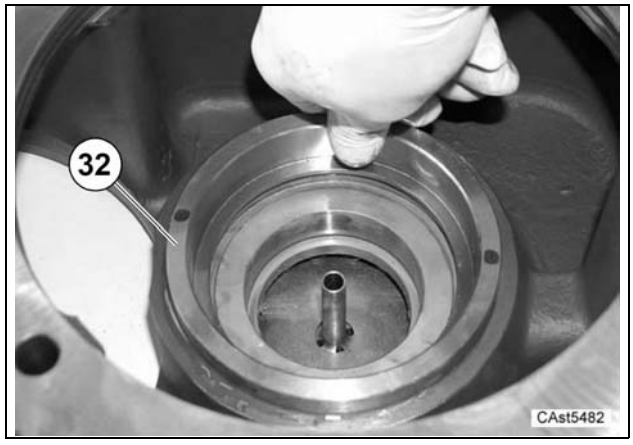
31. Assemble piston assembly



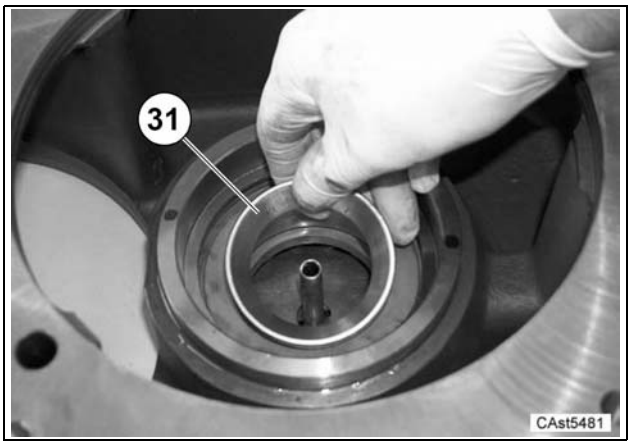
32. Assemble O-ring (34) and gasket (33).



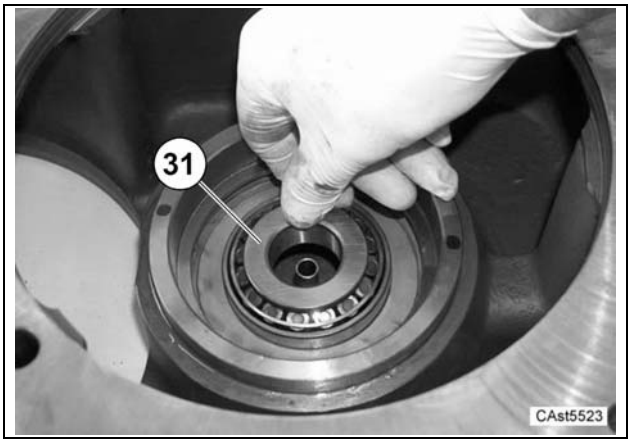
33. Assemble piston (32).



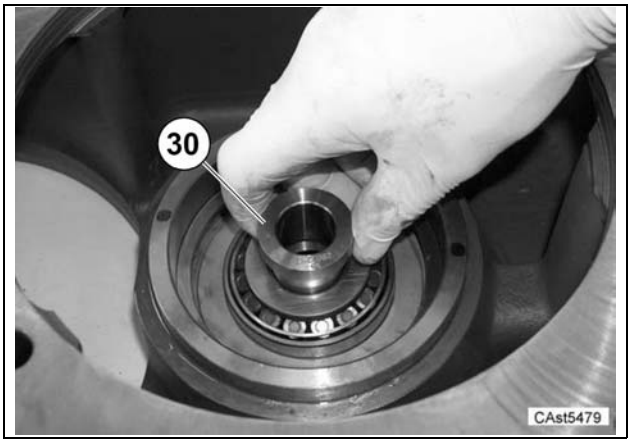
34. Assemble cup of bearing (31).



35. Assemble bearing (31).



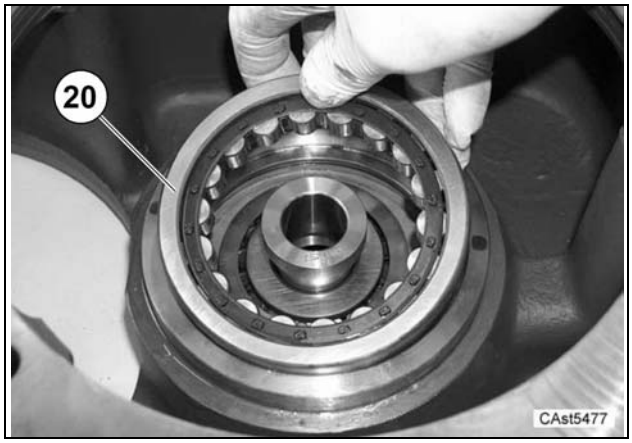
36. Assemble pin (30).



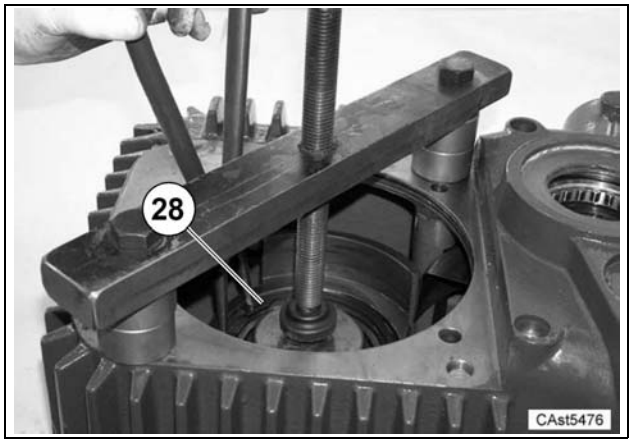
37. Assemble ring (29).



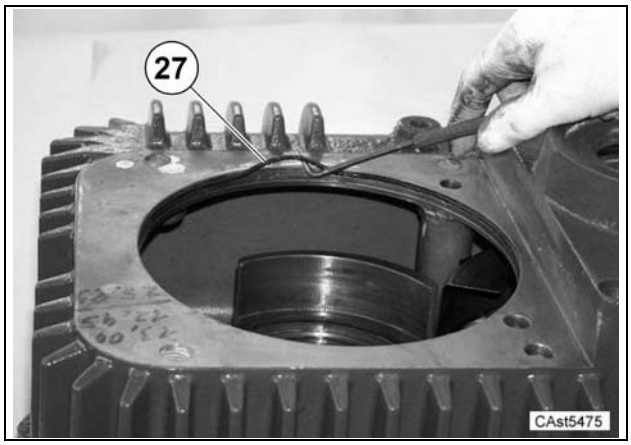
38. Assemble bearing outer cup (20).



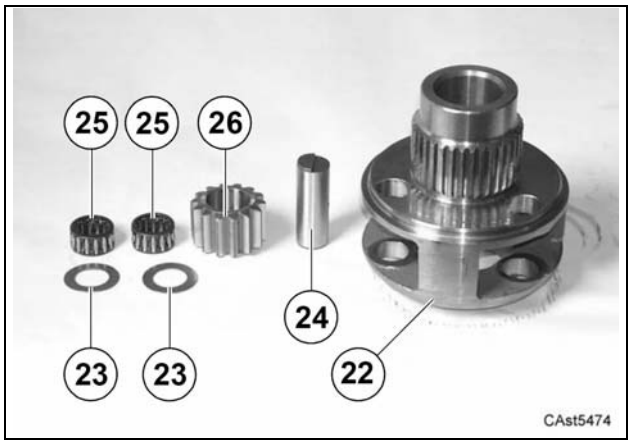
39. Assemble snap ring (28).
Use tool 2897008.



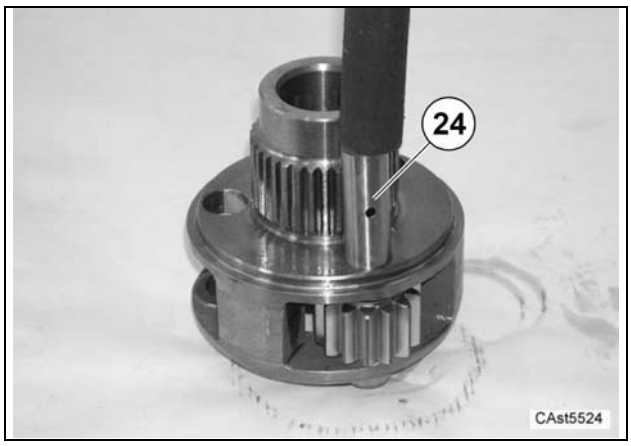
40. Assemble O-ring (27).



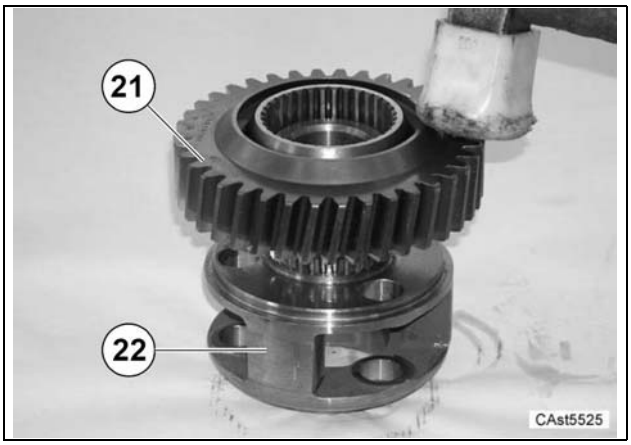
41. Assemble gears (26), bearings (25), pins(24) and washers (23) on the planetary gears carrier (22).



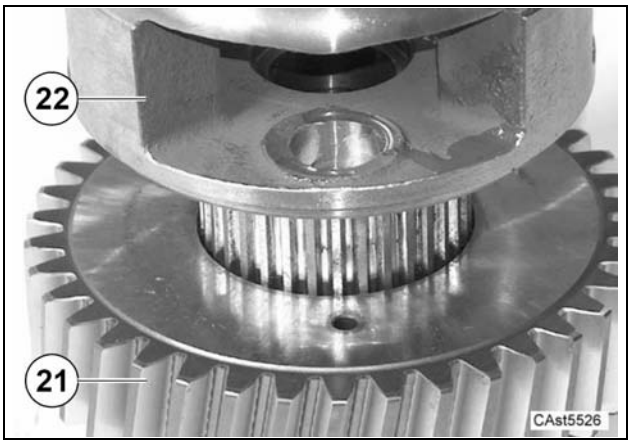
42. Assemble pins (24).



43. Assemble gear wheel (21) on planetary gears carrier (22).



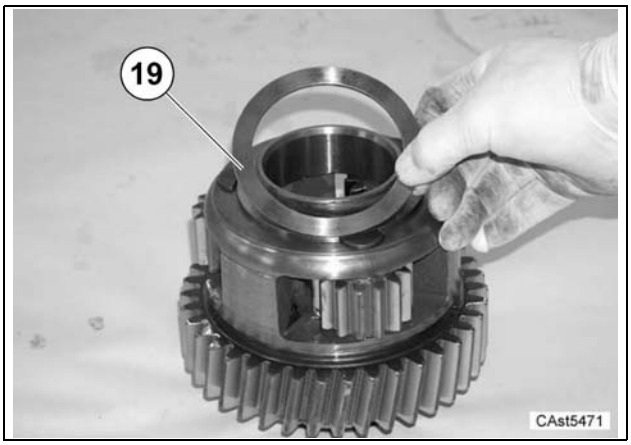
44. Align the holes of the wheel (21) with the holes of the planetary gears carrier (22).



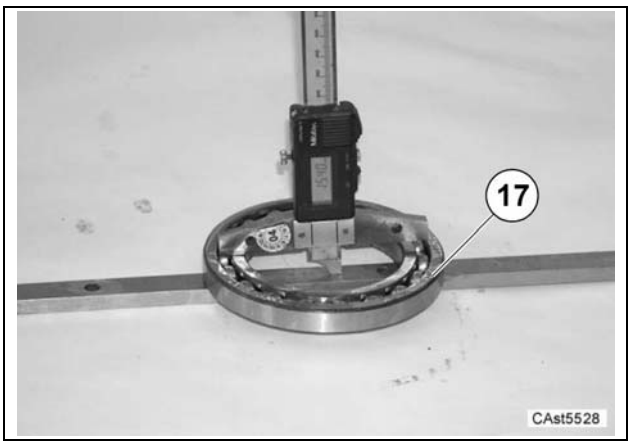
45. Apply Loctite® 638 on inner race of bearing(20)



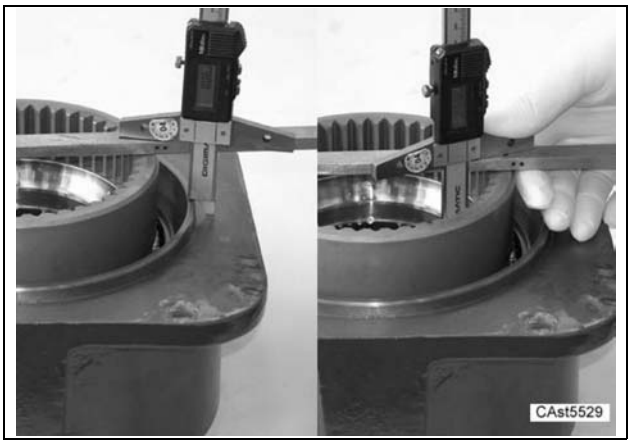
46. Assemble the ring (19).



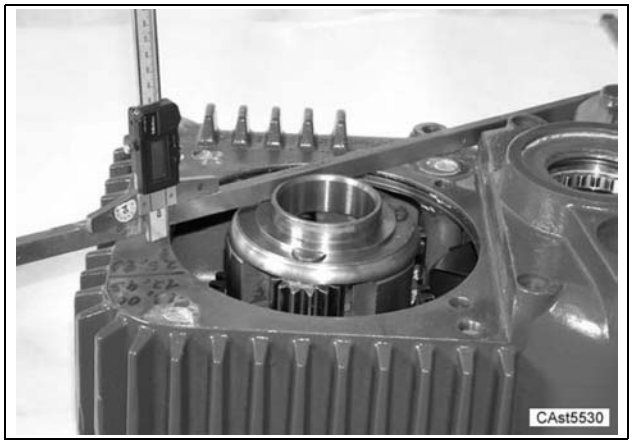
47. Measure shim (S) of bearing (17).



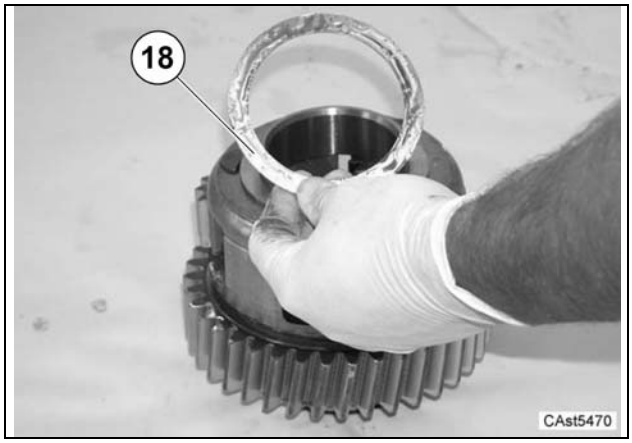
48. Measure the distance (A) between supporting plate and the bearing detent (17).



49. Measure the distance (B) between the case supporting plate and the upper detent of the bearing(17).



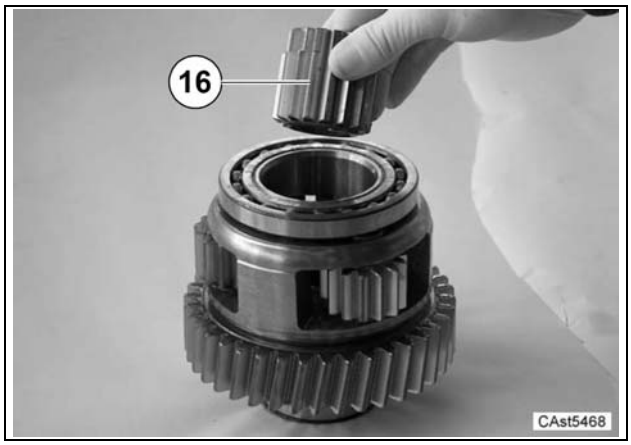
50. The dimension X= A-(B+S) determines the value of the shims (18) to be fitted, with a tolerance of 0.5 - 0.7.



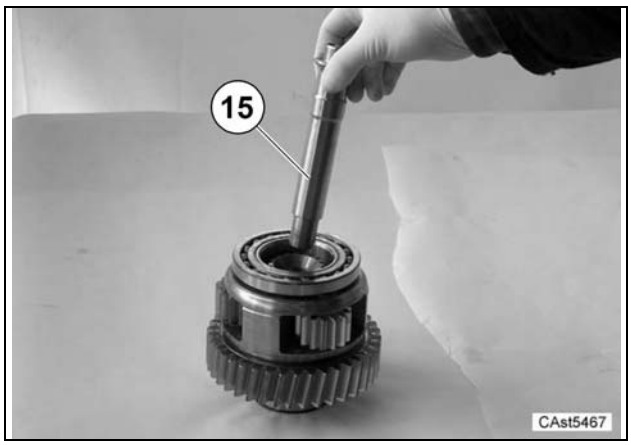
51. Apply Loctite® 638 on inner race of bearing (17) and assemble it.



52. Assemble gear (16).



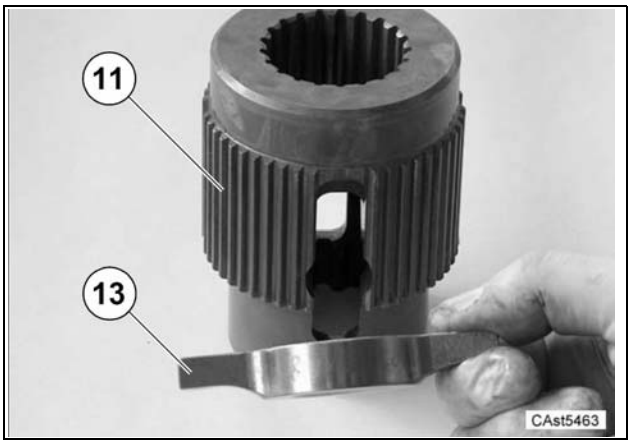
53. Assemble shaft (15).



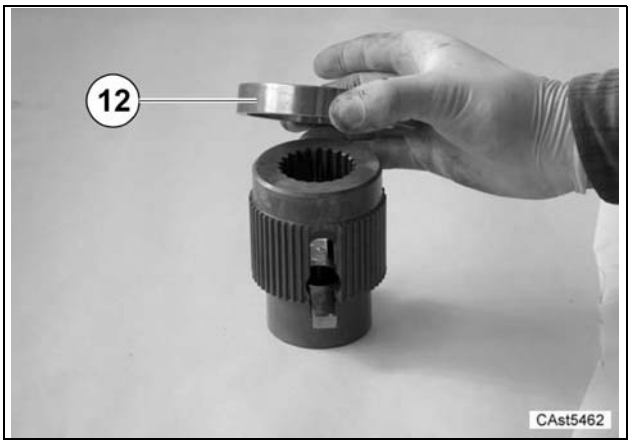
54. Assemble the planetary gears carrier.



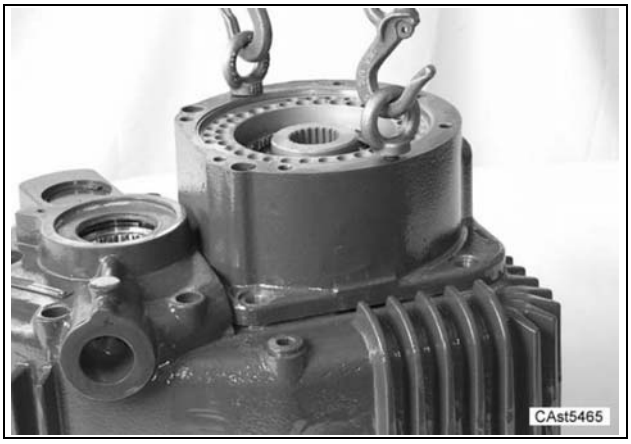
55. Assemble bush (11) and thrust plate (13).
Note:pay attention to assembly direction.



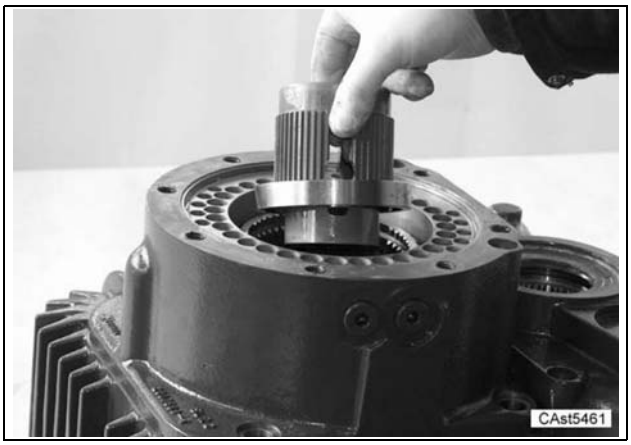
56. Install thrust ring (12).



57. Assemble the complete box.



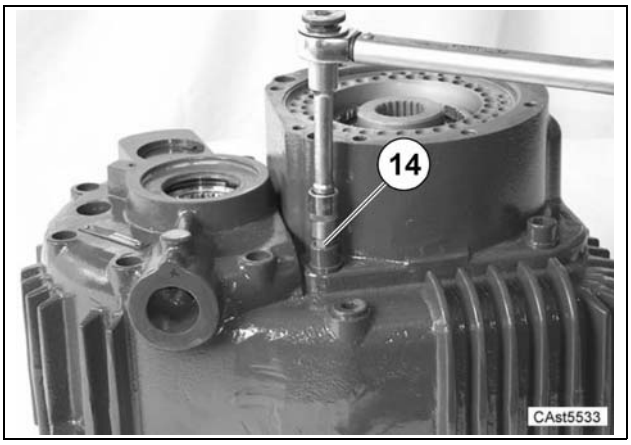
58. Assemble the complete bush.



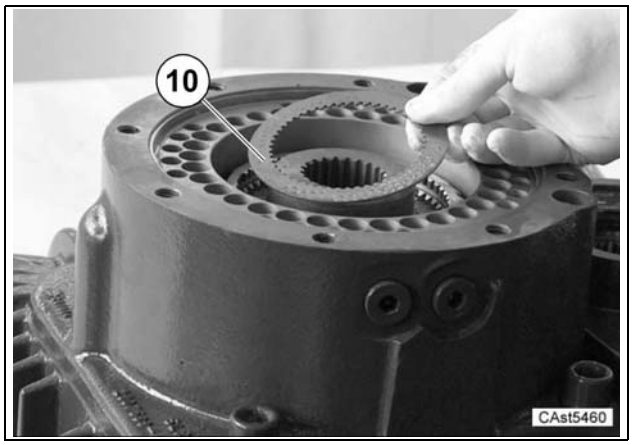
59. Apply Loctite® 242 on screws (14).



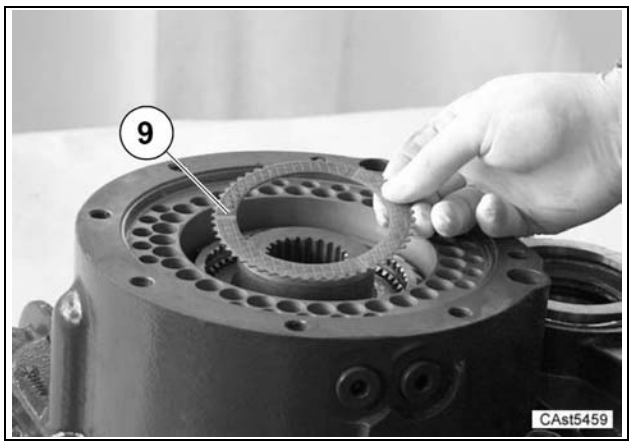
60. Assemble screws (14).
Screw in screws to tightening torque - 117Nm.



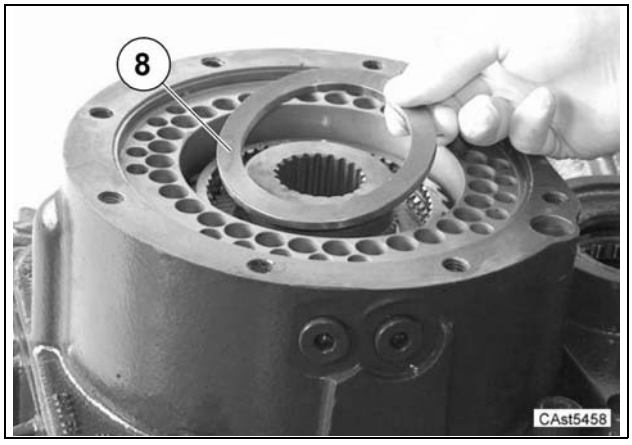
61. Assemble disc (10).



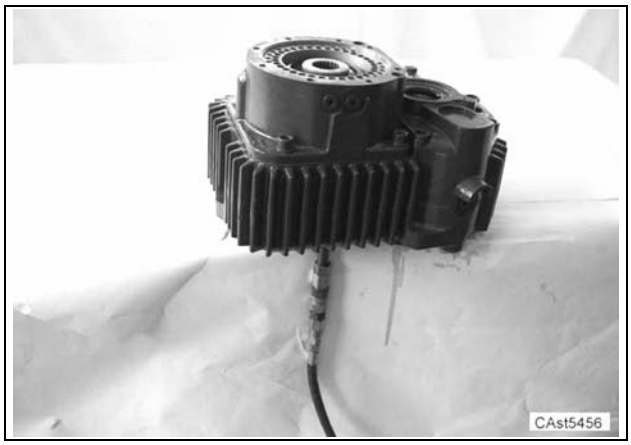
62. Assemble disc (9).



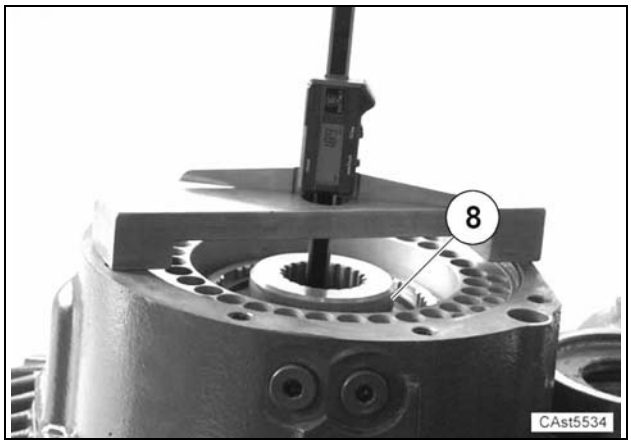
63. Assemble the ring (8).



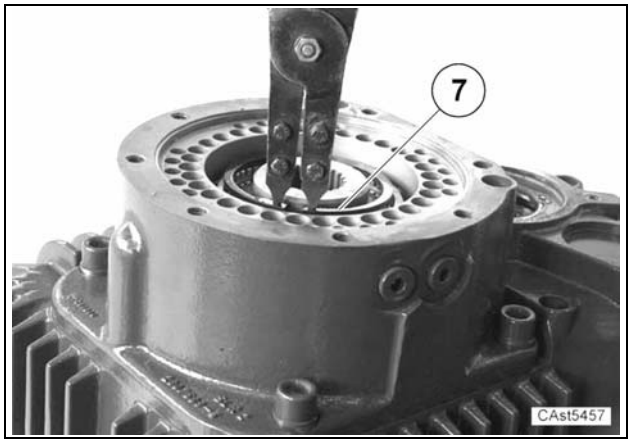
64. Unlock the clutch by pressing 50 - 100 bar.



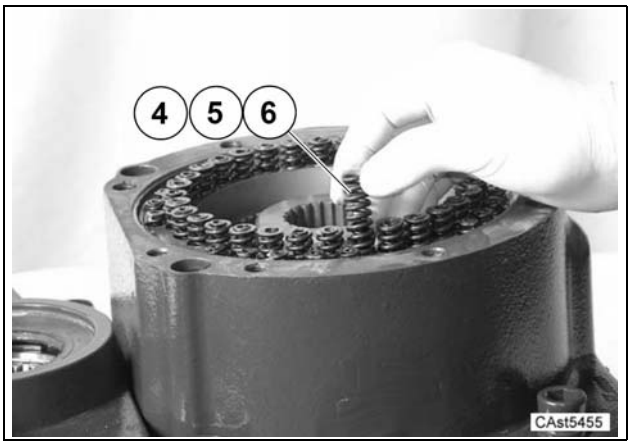
65. Measure the lowering of the discs using a digital gauge. the stroke should be between 1.7 and 1.9 mm. Otherwise replace the ring (8) with one of different thickness.



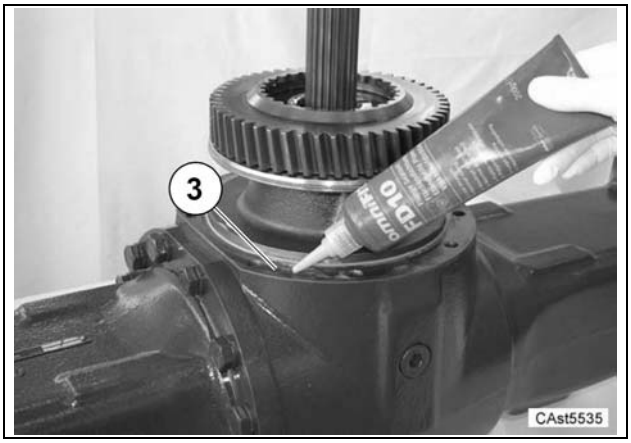
66. Assemble snap ring (7).



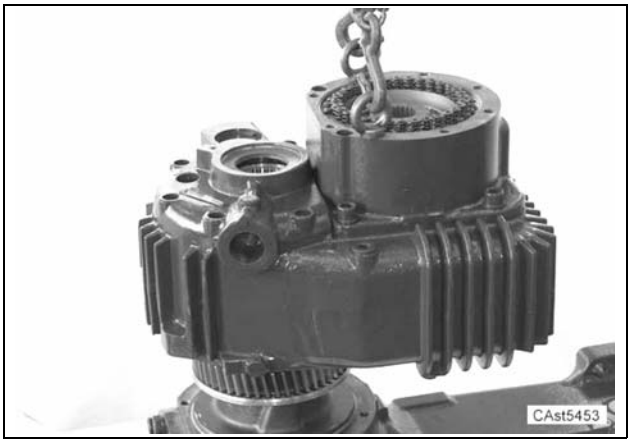
67. Assemble springs (4), (5) and (6).



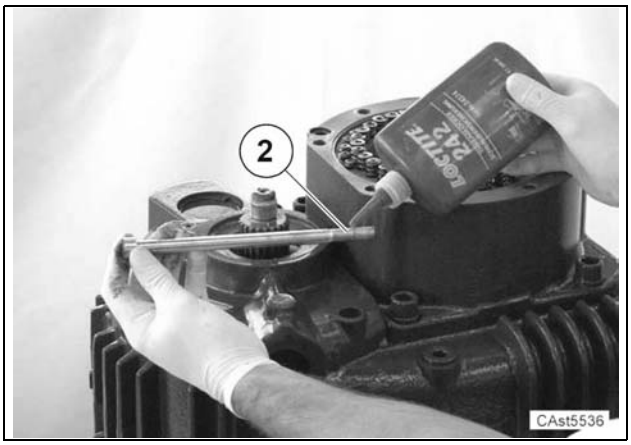
68. Assemble O-ring (3).
Apply Loctite® 510.



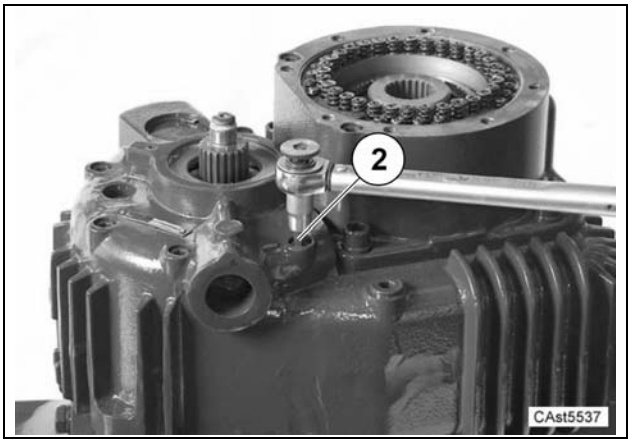
69. Assemble transmission box.



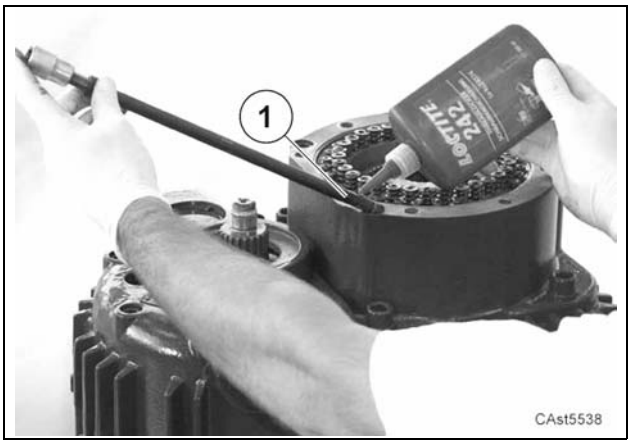
70. Apply Loctite® 242 on screws (2).



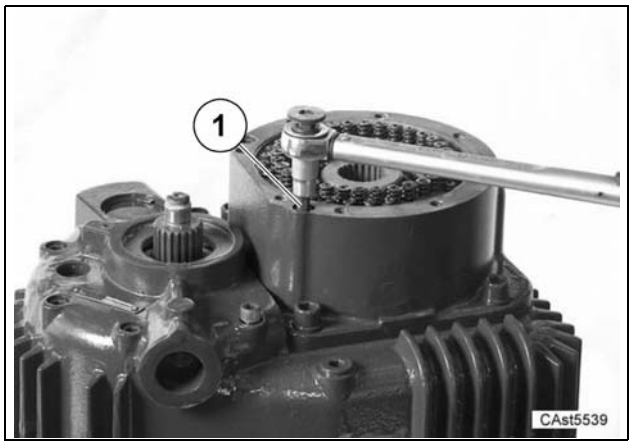
71. Assemble screws (2).
(Tightening torque - 70Nm)



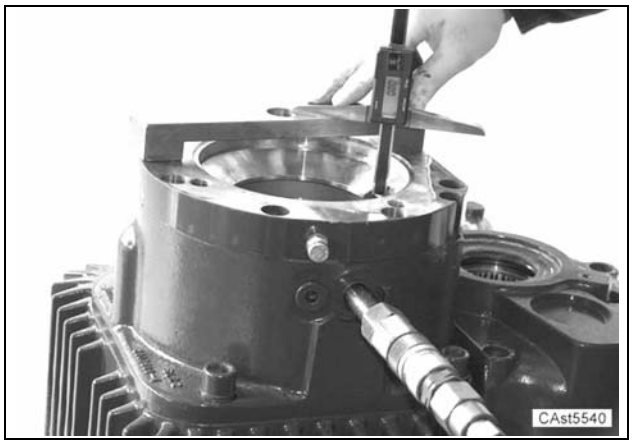
72. Apply Loctite® 242 on screws (1).



73. Assemble screws (2).
(Tightening torque - 285Nm)



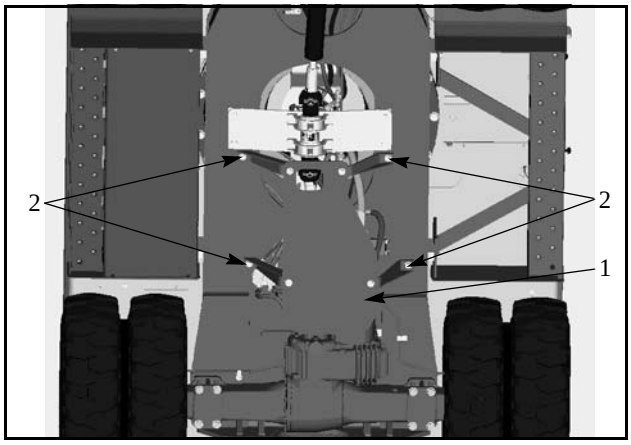
74. Drain clutch by pressing with 50 - 100 bar. Measure the lowering of discs using a digital gauge. The stroke should be between 2.2 and 2.4 mm.



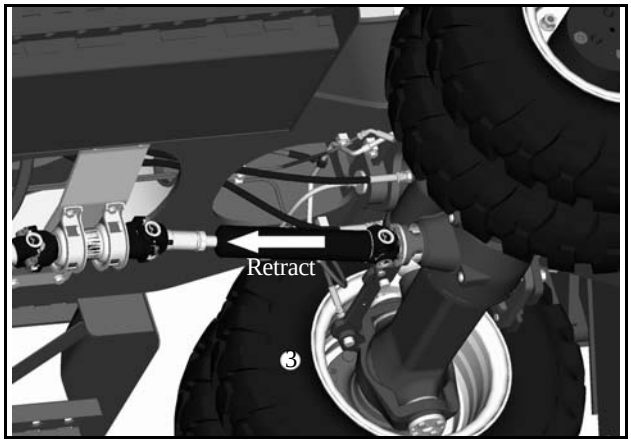
REMOVAL AND INSTALLATION OF PROPSHAFT

Removal

1. Remove cover (1) {if fitted} by removing 4 bolts (2).

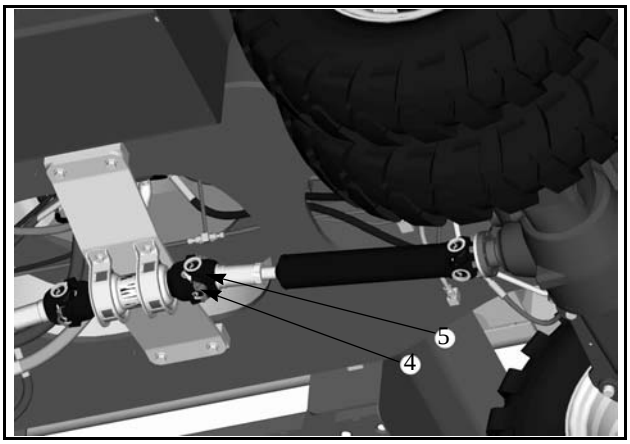


2. Remove nuts (3), then retract the front propshaft clear of studs on axle housing.



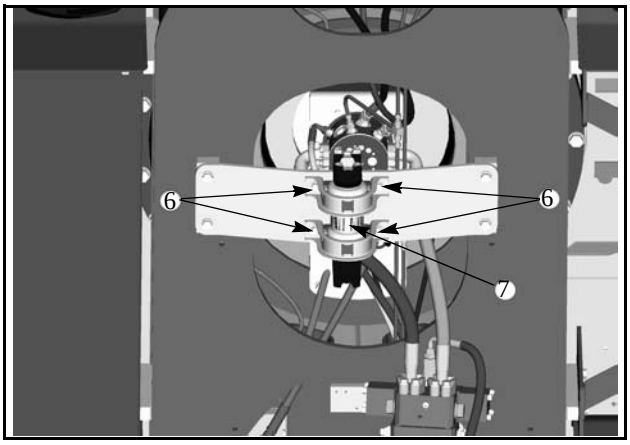
3. Remove the 4 coupling bolts (4) from the coupling assembly. Then remove the clamps (5) and then remove the propshaft.

   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

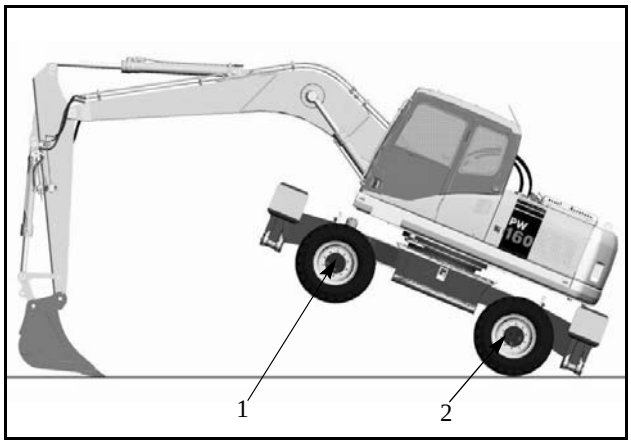
- Install in reverse order of removal.
- Tightening torque of propshaft nuts (58.8-73.5 Nm).
- Four new coupling bolts required for installation (20G-20-31130). Order from Komatsu supplier.
- Tightening torque of coupling bolts {torque heads} (61 ~ 81Nm)

REMOVAL AND INSTALLATION OF WHEEL

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.

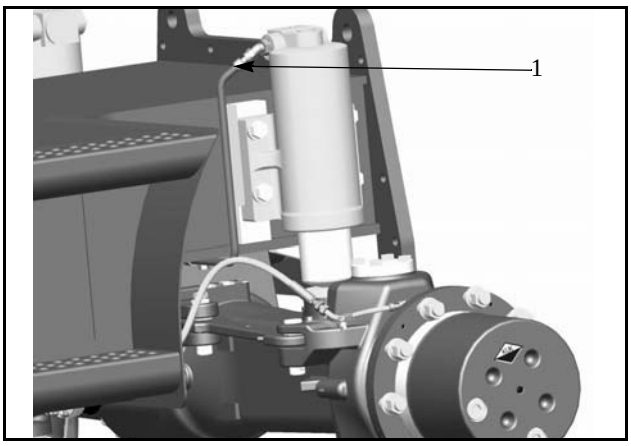
REMOVAL AND INSTALLATION OF SUSPENSION LOCK CYLINDER

SPECIAL TOOLS

REMOVAL

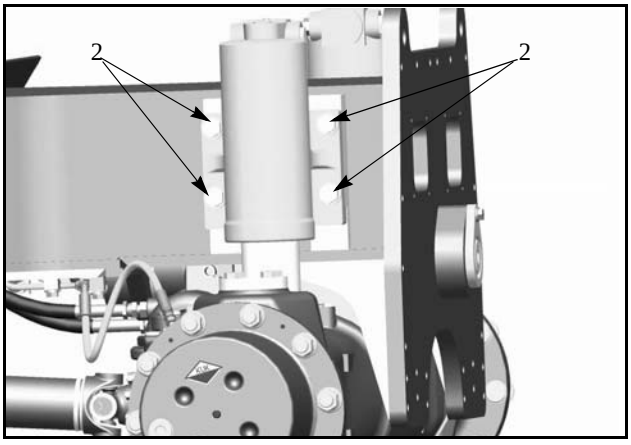
1. Remove front wheels See “WHEEL ASSEMBLY” on page 20-176.

2. Remove tube (1).



3. Remove the 4 bolts (2) attaching the suspension lock cylinders to the chassis.

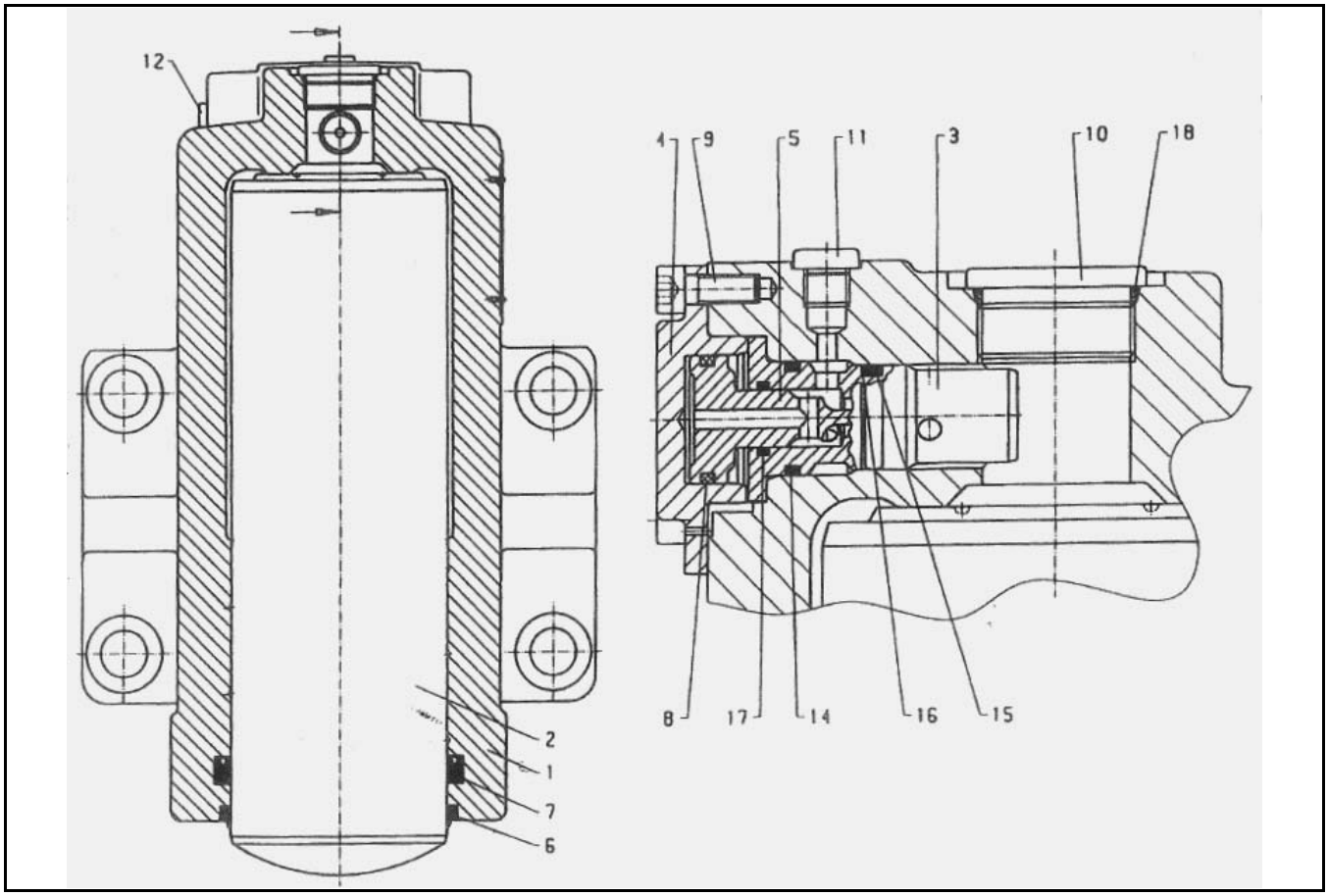
kg Suspension cylinder assembly: 57Kg



INSTALATION

- 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!

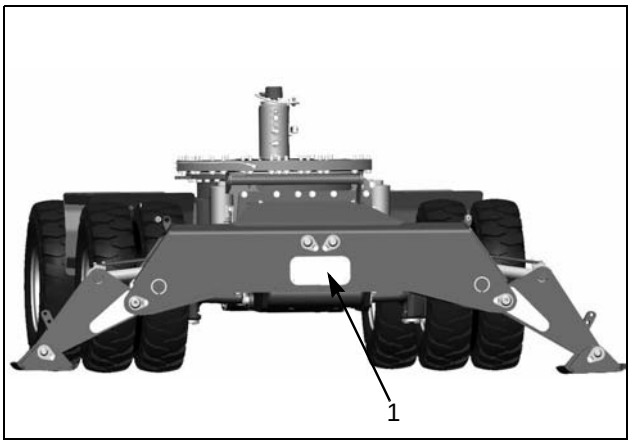
4. Insert new U -ring in a reniform squeezed state and press it into the groove ensuring that there are no kinks.
5. Investigate wiper ring position 6 with respect to damages, if necessary replace it.
6. Grease the seals.
7. Mount the rod.

WARNING! With all repairs pay attention to extreme cleanliness!

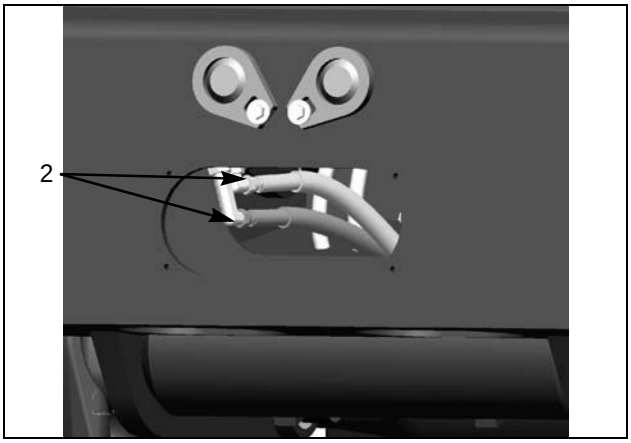
REMOVAL AND INSTALLATION OF OUTRIGGER

R**REMOVAL**

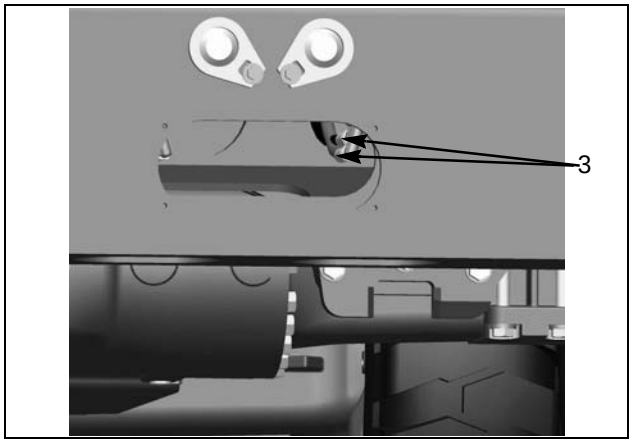
1. Lower outriggers untill they just touch the ground but do not take any of the weight of the machine.
2. Turn off engine.
3. Depressurise the outrigger hydraulic circuit.
4. Remove cover (1).



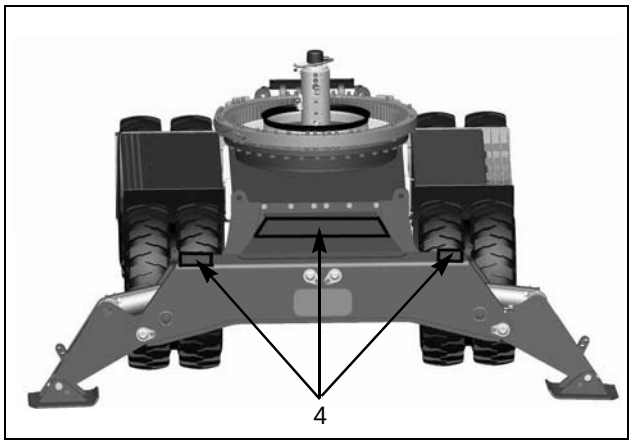
5. Remove 2 pipes (2).



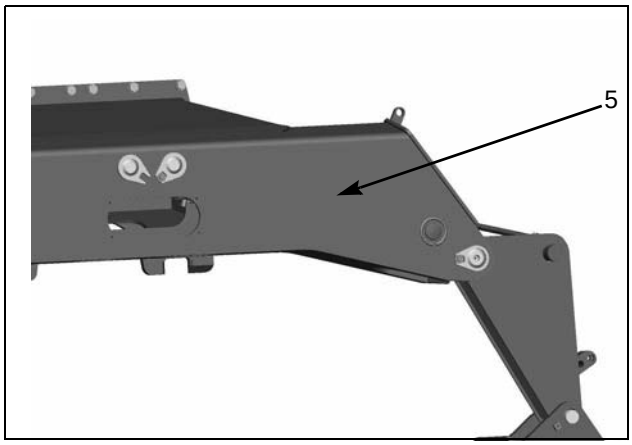
6. Remove 2 pipes (3).



7. Sling outrigger assembly at points marked (4).



8. Remove all bolts (5) and remove outriggers.



INSTALLATION

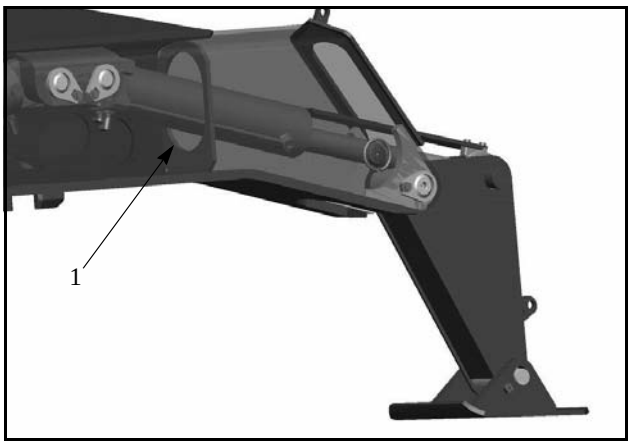
- Install in reverse order of removal.
- Grease all pins and cylinders before installing.

DISASSEMBLY AND ASSEMBLY OF OUTRIGGER

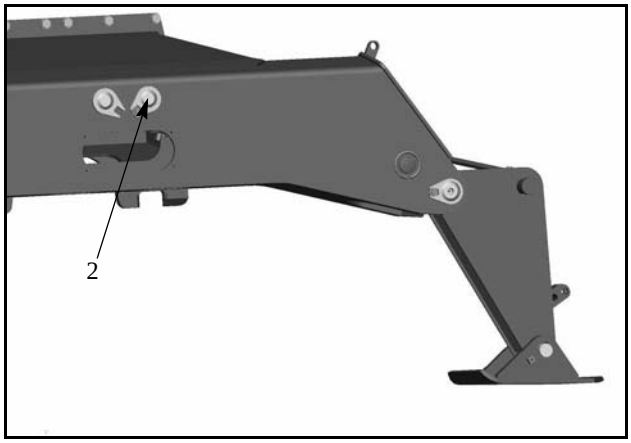
DISASSEMBLY

1. Insert plugs into oil connectors to prevent dirt blocking connectors.

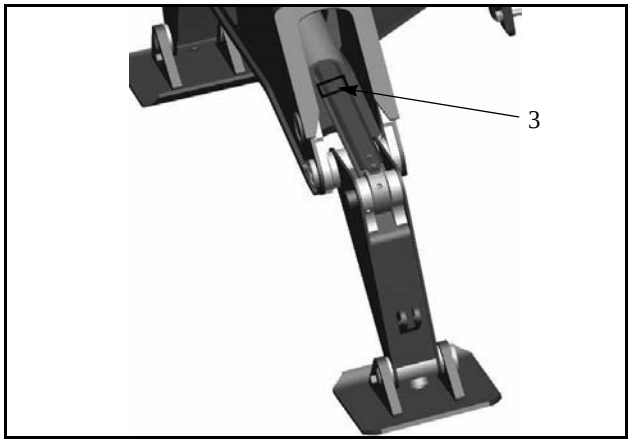
2. Insert support block below cylinder at (1).



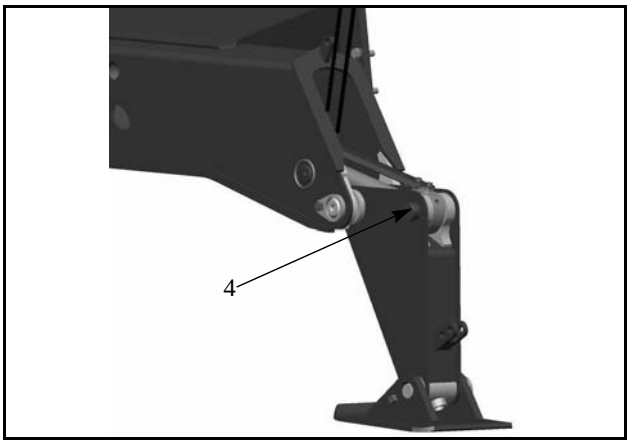
3. Remove pin (2).



4. Attach sling to cylinder at location (3).



5. Remove pin (4).



6. Slowly sling cylinder and remove from outrigger.

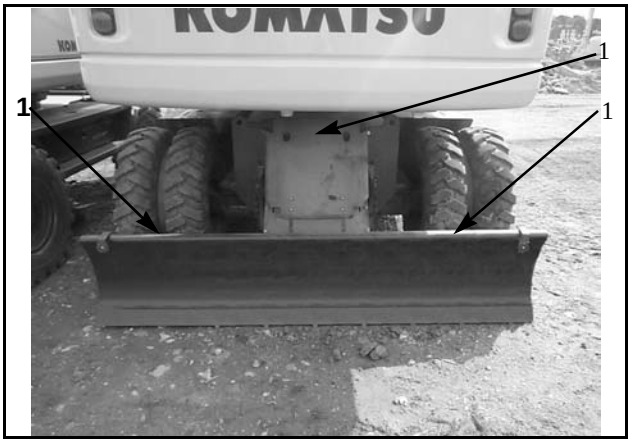
ASSEMBLY

- 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).

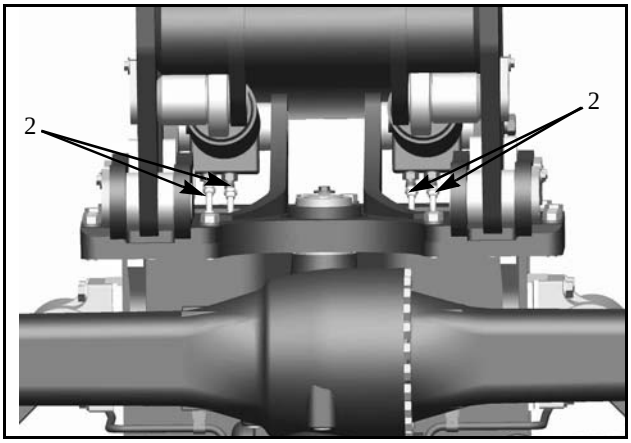


2. Lower dozer blade until it just touches the ground, but don't take any of the weight of the machine.

3. Turn off engine.

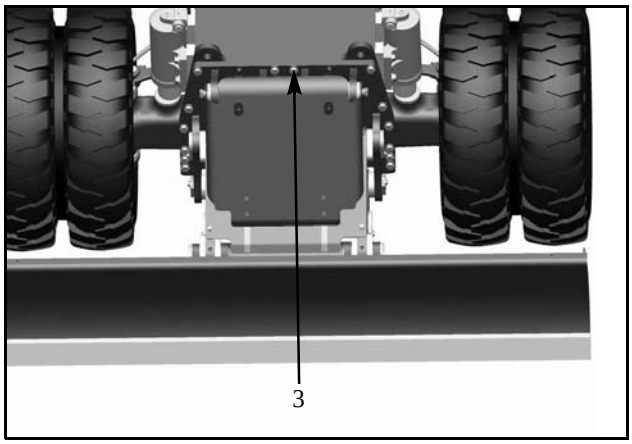
4. Depressurise dozer blade circuit.

5. Remove 4 pipes (2).



6. Attach lifting tackle.

7. Remove bolts (3) and remove dozer blade assembly.



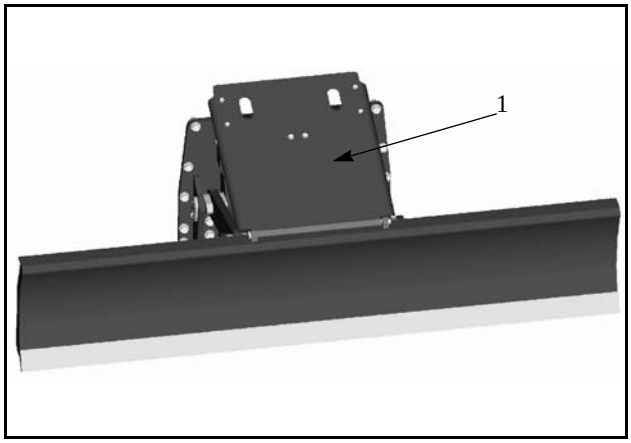
INSTALLATION

- Install in reverse order to removal.
- Grease all pins and cylinders.

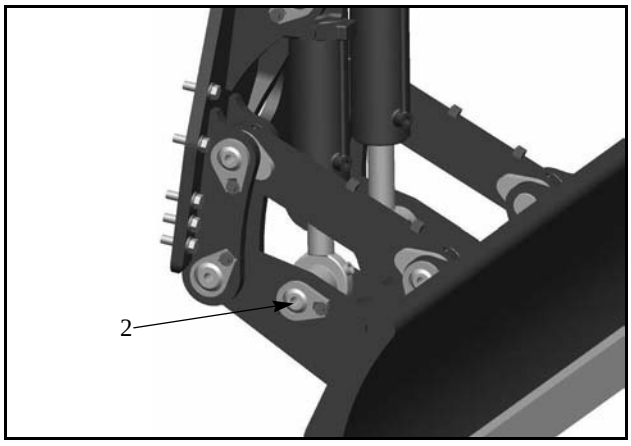
DISASSEMBLY AND ASSEMBLY OF DOZER BLADE

DISASSEMBLY

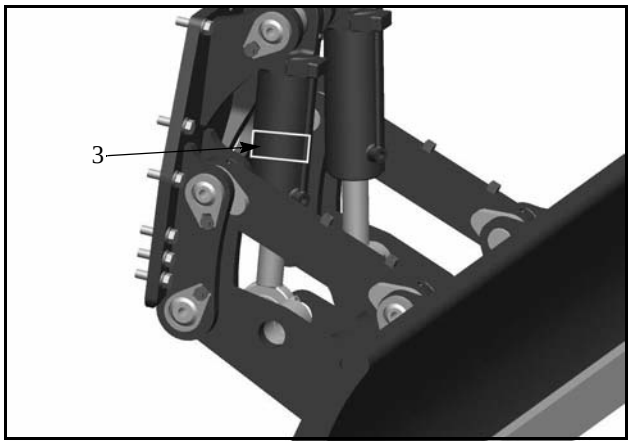
1. Remove plate (1).



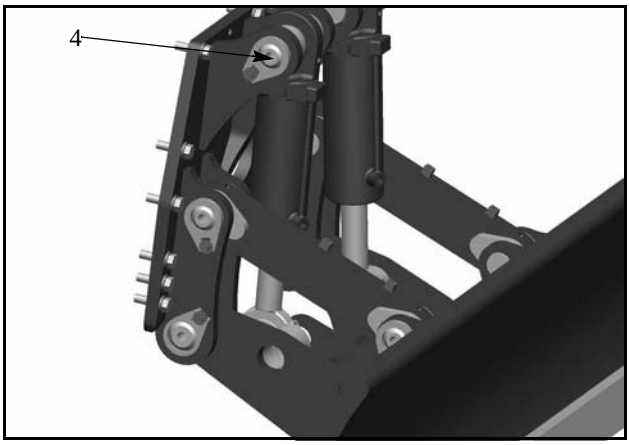
2. Remove pin (2).



3. Attach lifting tackle to cylinder at location (3).



4. Remove pin (4).



5. Slowly sling cylinder and remove from dozer.

ASSEMBLY

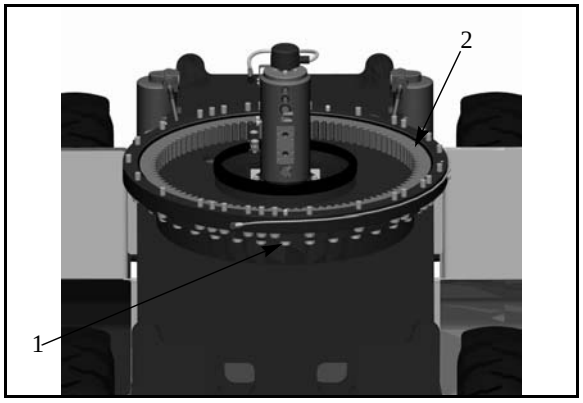
- Install in reverse order of removal.
- Grease all pins and cylinders before installing.
- Grease bearing points after assembly.

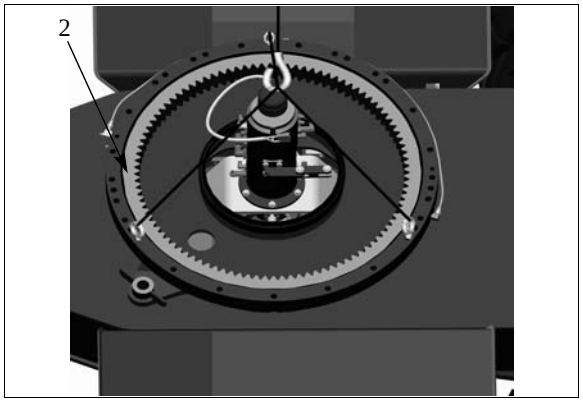
REMOVAL AND INSTALLATION OF SWING CIRCLE ASSEMBLY

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)

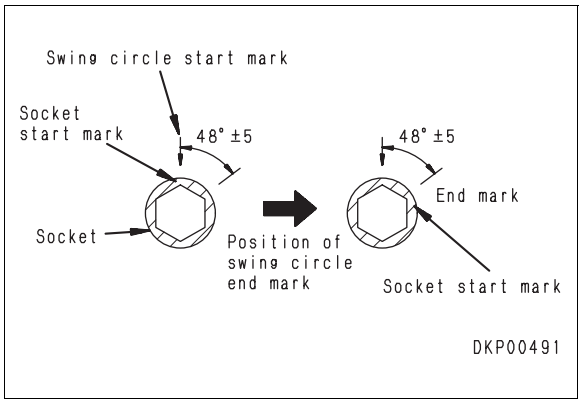
N·m Swing circle mounting bolt:

1st pass:

Tighten to 191.2 ± 19.6 Nm {19.5 ± 2 kgm}

2nd pass:

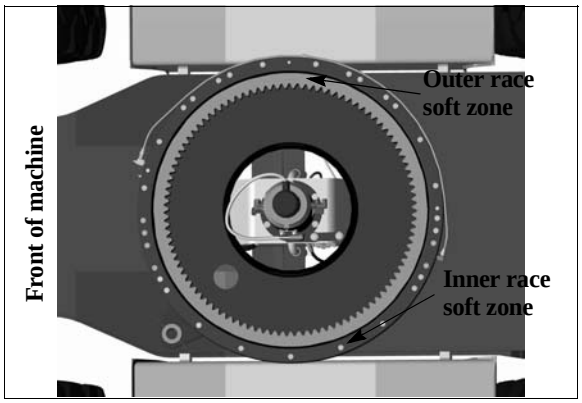
1) Using the angle of the bolt head as the base, make start marks on the swing circle and socket.
2) Make an end mark at a point (on swing circle) 48 ± 5° from the start mark.
3) Tighten so that the start mark on the socket is aligned with the end mark on the swing circle at the 48 ± 5° position.



※2

➧ Set the soft zone **S** mark on the inside ring of the inner race facing the right side as shown in the diagram. Then install to the chassis.

Swing circle:
Grease (G2-L1) 14.6 l

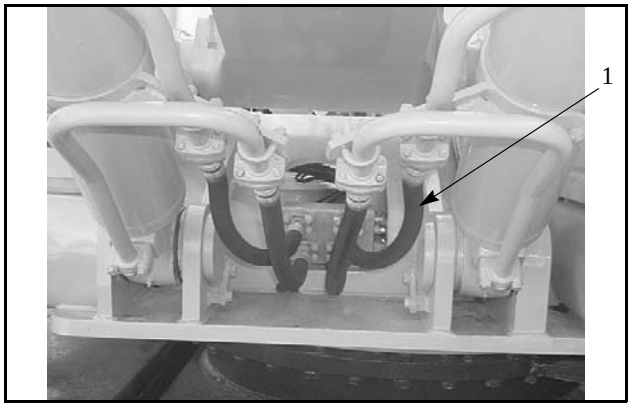


REMOVAL AND INSTALLATION OF REVOLVING FRAME ASSEMBLY

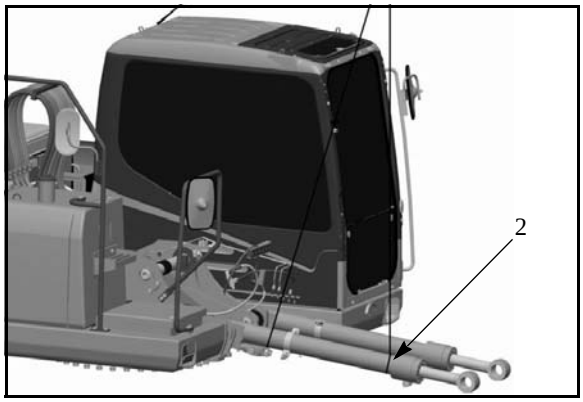
REMOVAL

. 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 20-218.
3. Remove the counter weight. See “COUNTER-WEIGHT ASSEMBLY” on page 20-228.
4. Disconnect boom cylinder hoses (1) and plug the hoses to prevent flow of oil.



5. Sling boom cylinders (2).

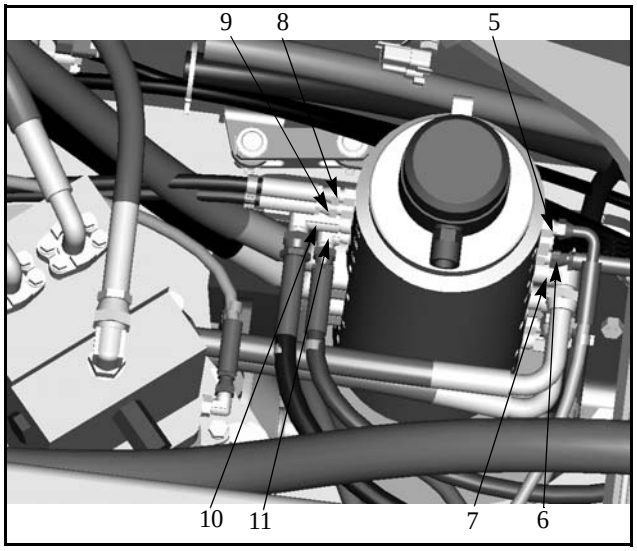


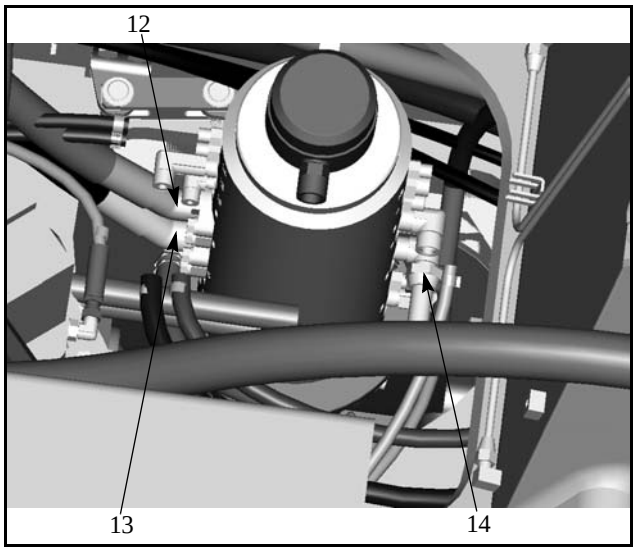
6. Remove plate (3) and pin (4) and lift off boom cylinder assembly (2) to remove it.
   - Remove the boom cylinder assembly on the opposite side in the same manner.

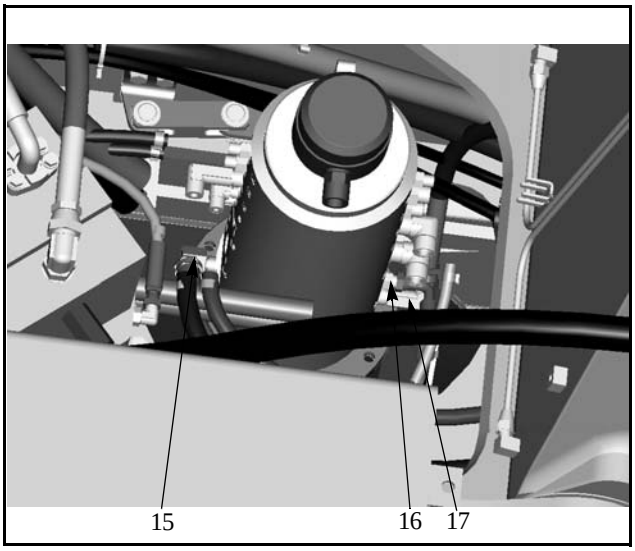
kg Boom cylinder assembly: 180 kg



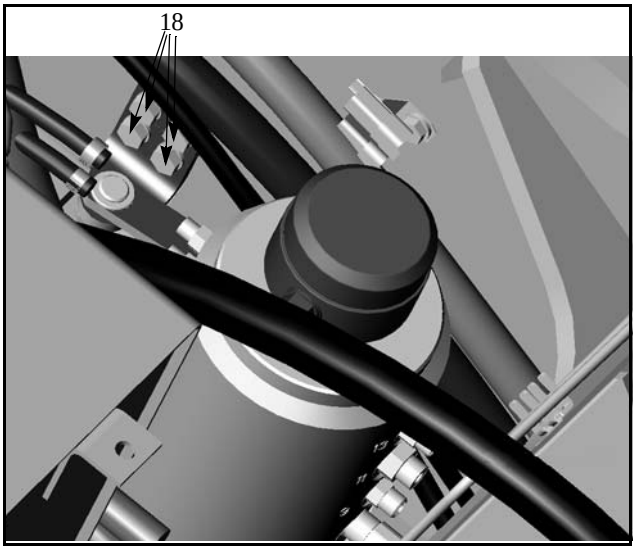
7. Disconnect the 14 hoses on the swivel joint assembly at the swivel joint side.
   (5): Suspension lock
   (6): Brake 2
   (7): Attachment bottom
   (8): 2nd clutch
   (9): 1st clutch
   (10): Steer right
   (11): Brake 1
   (12): Travel B
   (13): Travel A
   (14): Attachment Head
   (15): Drain
   (16): Motor volume pilot
   (17): Steer left



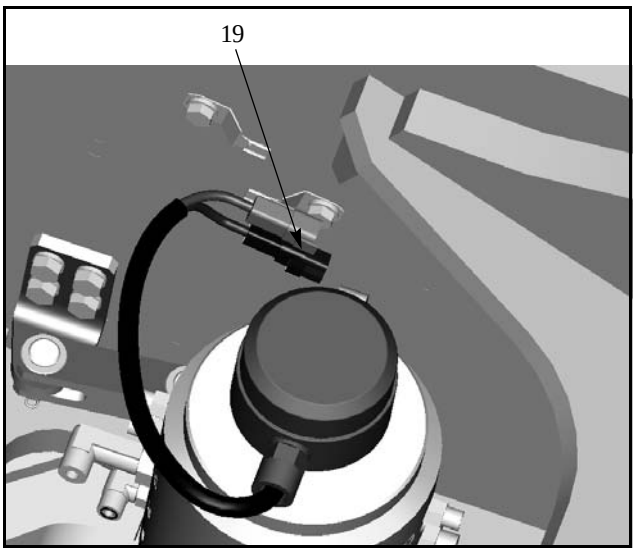




8. Remove 4 bolts (18) from revolving frame.



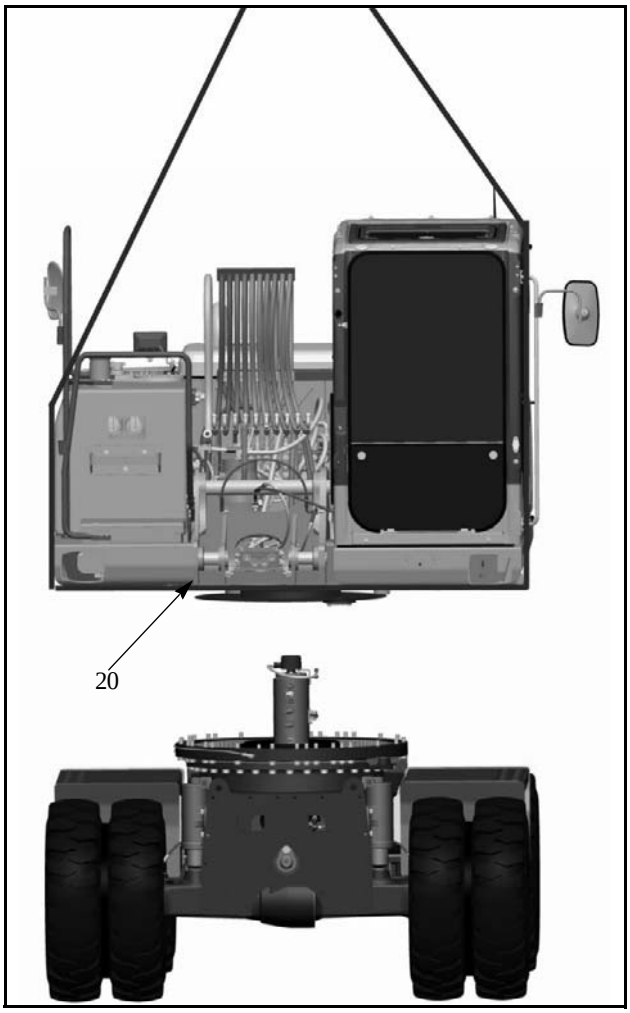
9. Disconnect connector (19).



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.

    ⚠ 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

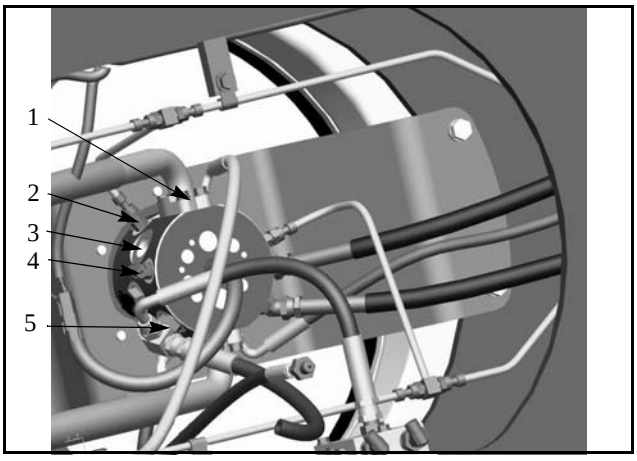
REMOVAL

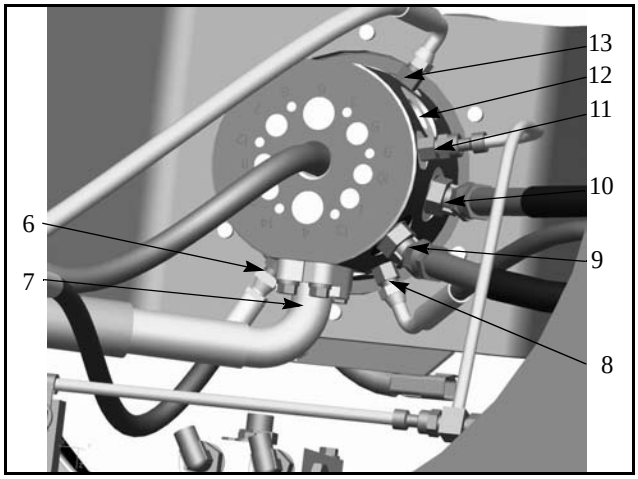
Release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, release of remaining pressure in hydraulic circuit.

1. Remove oil from hydraulic tank and drain oil from system.

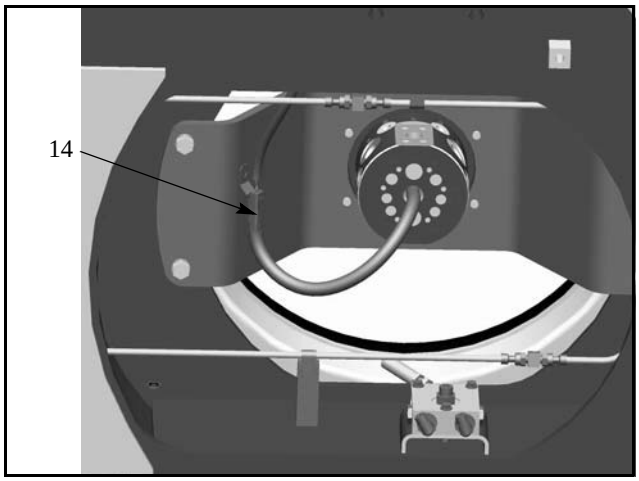
2. Disconnect 14 hoses (1) through (14).
   - When removing hoses mark all hoses with tags to prevent mistakes when installing.

- (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



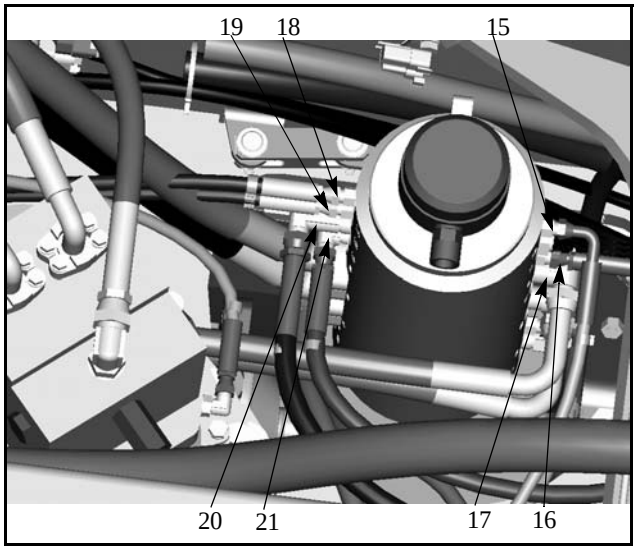


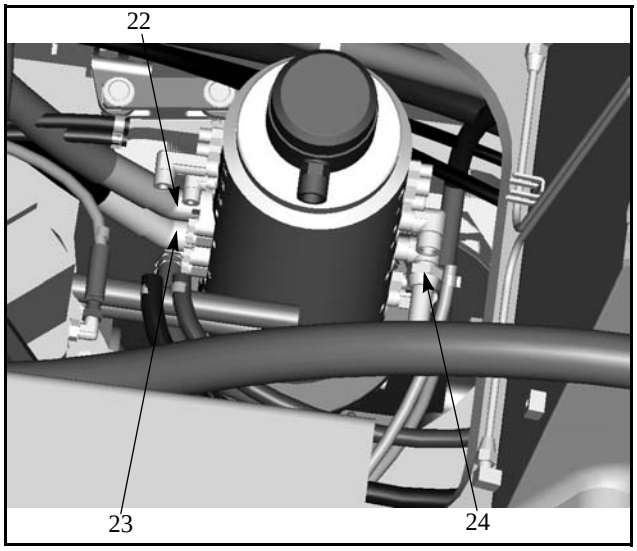
3. Disconnect connector (14)

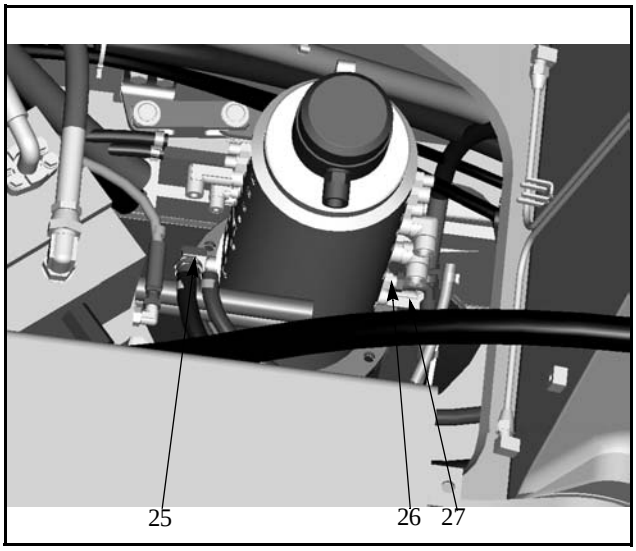


4. Disconnect 14 hoses (15) through (27).

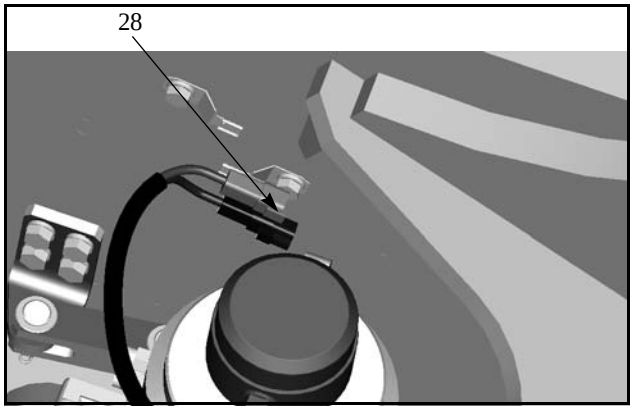
- (15): Suspension lock
- (16): Brake 2
- (17): Attachment bottom
- (18): 2nd clutch
- (19): 1st clutch
- (20): Steer right
- (21): Brake 1
- (22): Travel B
- (23): Travel A
- (24): Attachment Head
- (25): Drain
- (26): Motor volume pilot
- (27): Steer left



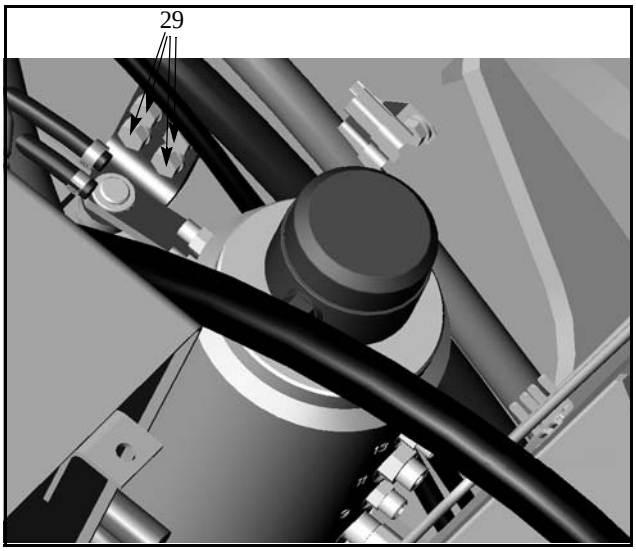




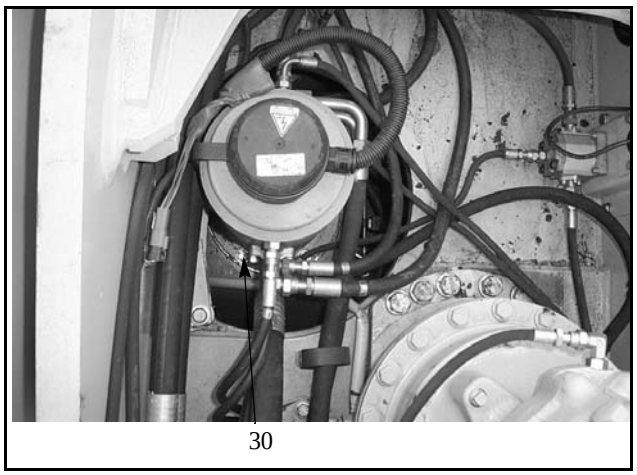
5. Disconnect connector (28).



6. Remove 4 bolts attached to revolving frame (29).



7. Remove 4 of the 6 mounting bolts (30).

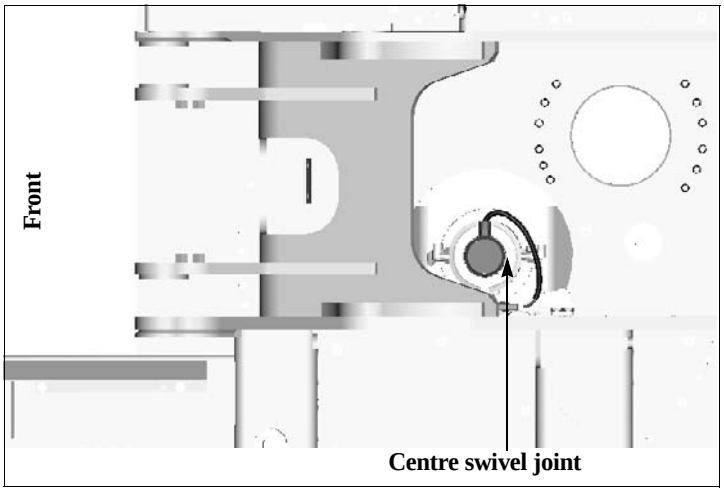


8. Sling centre swivel joint then remove 2 remaining mounting bolts (30) and remove.

kg Center swivel joint assembly: **95 kg**

INSTALLATION

- Install in reverse order of removal.
  Install the center swivel joint facing in the direction shown in the diagram.
  (The diagram shows the machine as seen from above)



- **Refilling with oil (hydraulic tank)**
  - Add oil through the oil filter to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- **Bleeding air**
  - Bleed the air from the travel motor. For details see TESTING AND ADJUSTING, Air Bleeding of Various Parts.

DISASSEMBLY AND ASSEMBLY OF CENTRE SWIVEL JOINT

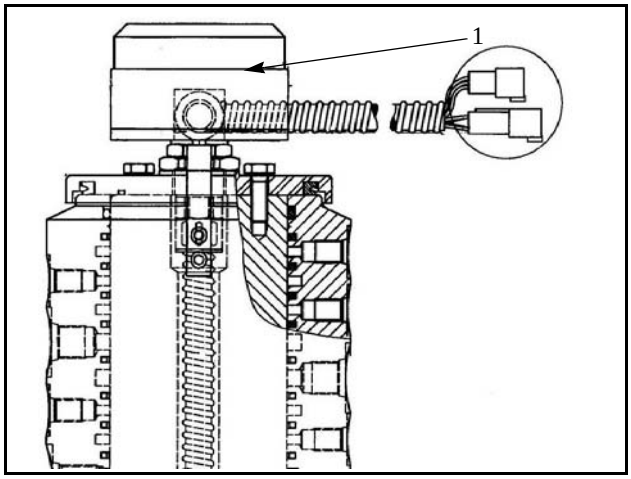
SPECIAL TOOLS

Mark		Part No.	Part Name	Necessity	Qty	Distinction*	Sketch
E		790-101-2501	Push puller	●	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		

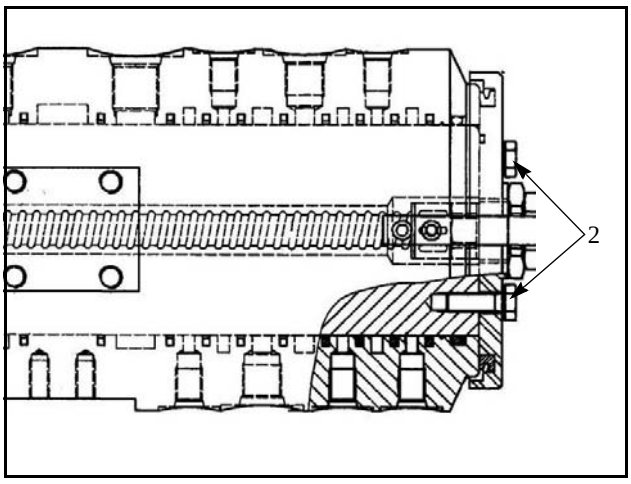
*Distinction between new and existing part.

DISASSEMBLY

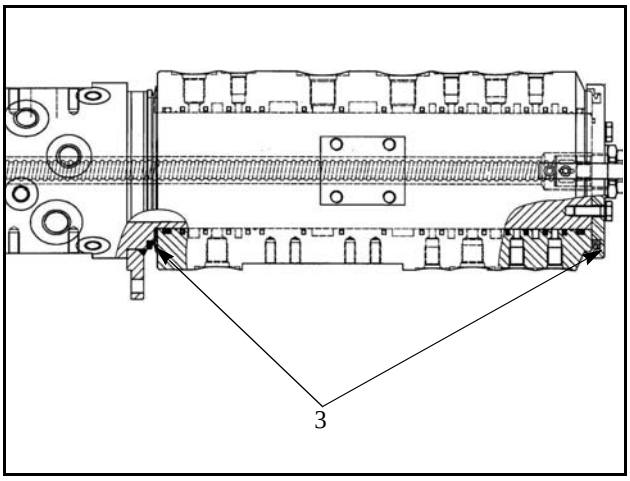
1. Remove the electric slipring (1) on the enclosure flange.



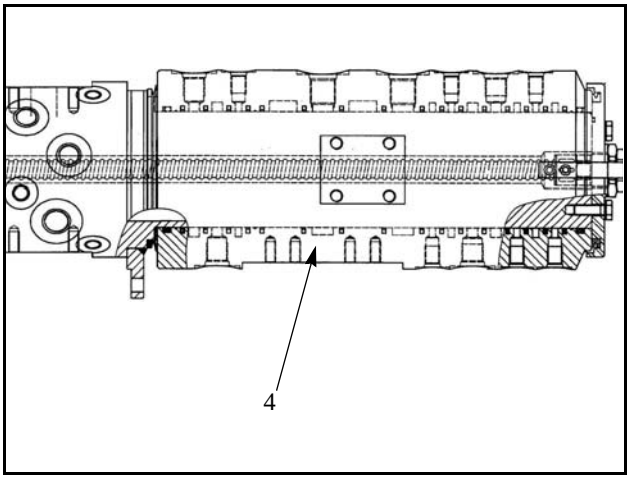
2. Remove all 4 screws (2) TE M10 x 30 on enclosure flange.



3. Remove the end cover and protection seal (3) VA130.

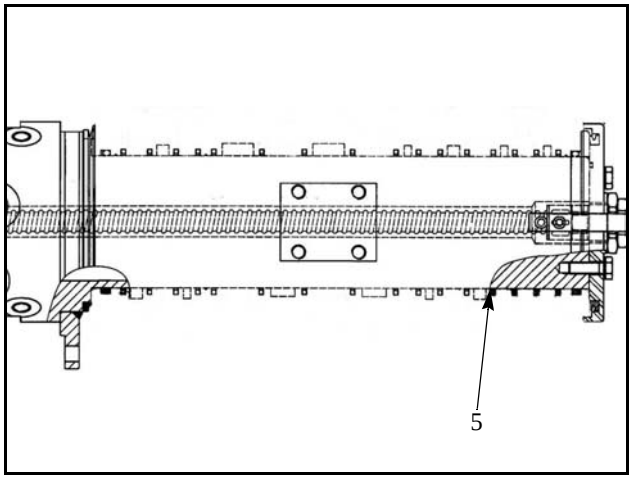


4. Remove housing (4) with appropiate tools.

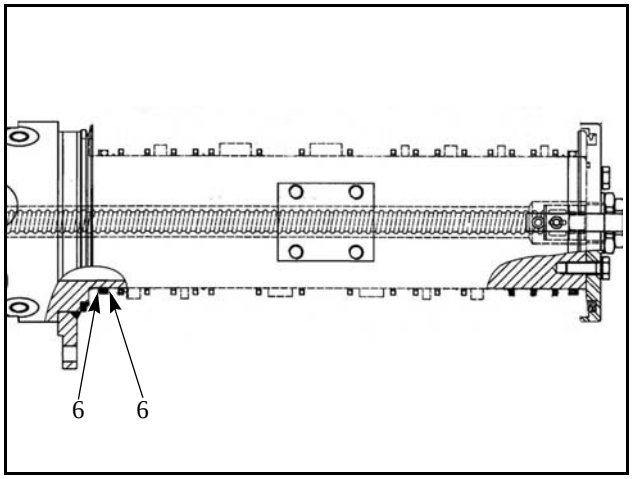


5. Prevent any possibility of damage on chromium plated surface of spool.

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)

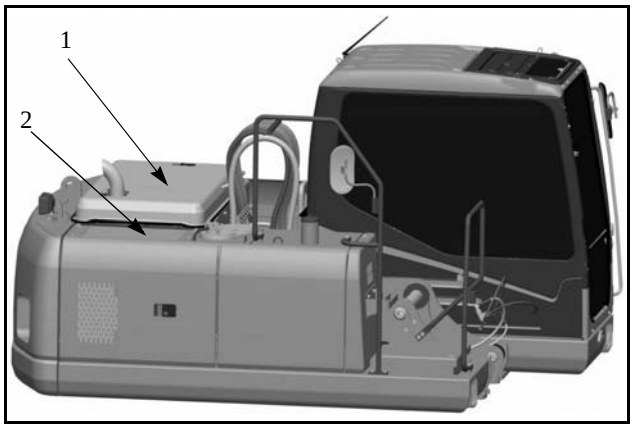
REMOVAL AND INSTALLATION OF HYDRAULIC TANK

REMOVAL

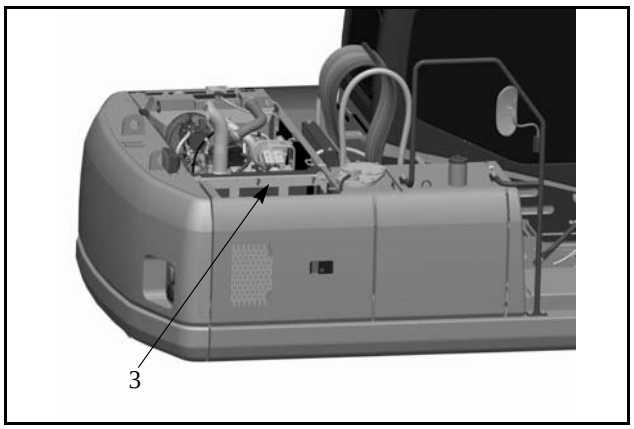
1. Drain oil from hydraulic tank. ※1

Hydraulic oil: 160 l

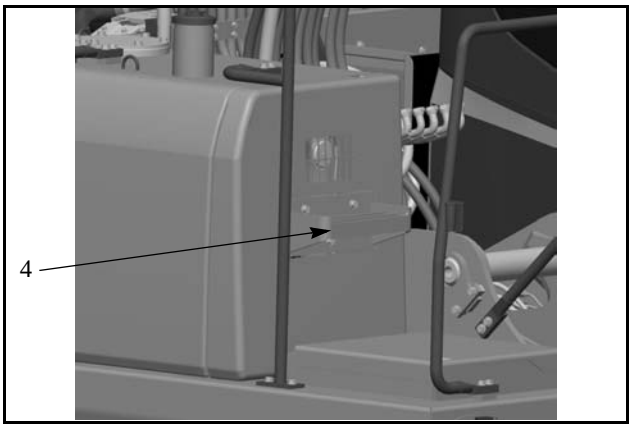
2. Open up the engine hood.
3. Remove engine hood (1) (see page 30- 30) and cover (2).



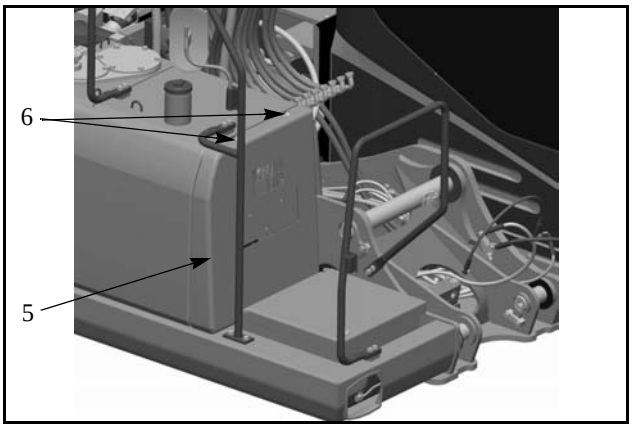
4. Remove support (3).



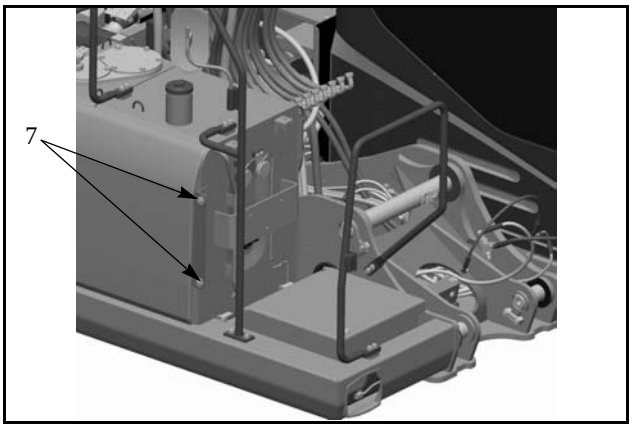
5. Remove step (4).



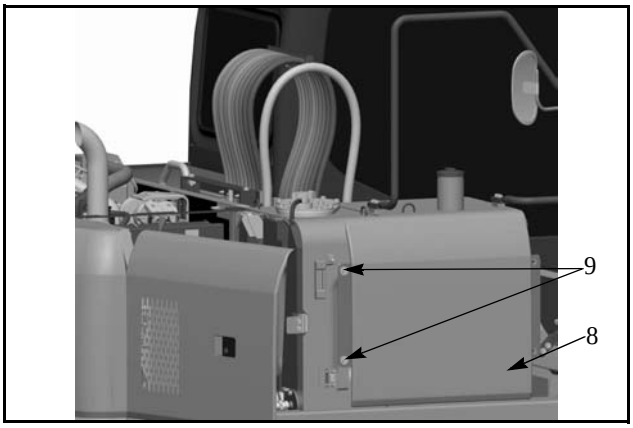
6. Remove cover (5) by removing 2 bolts (6).



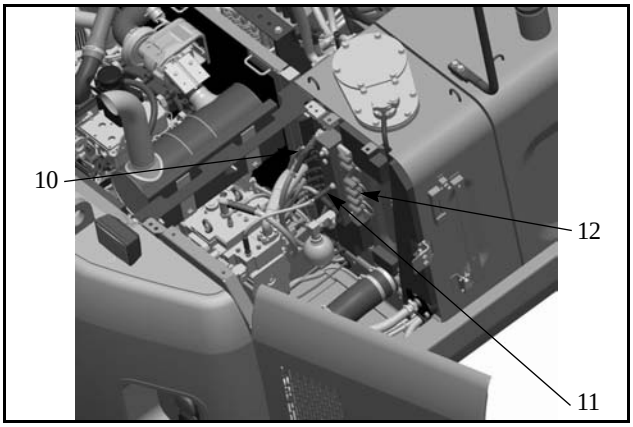
7. Remove bolts (7).



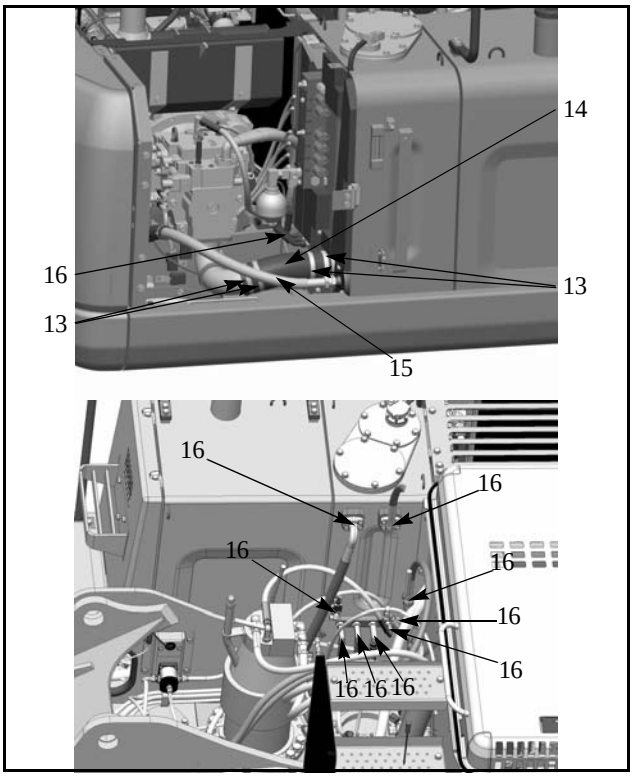
8. To remove cover (8) remove bolts (9).



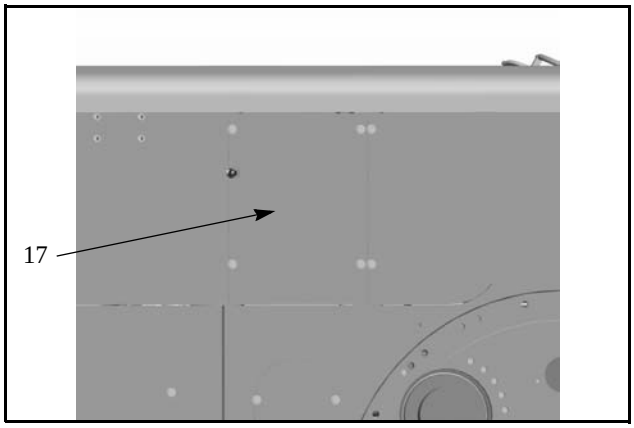
9. Disconnect the all hoses and connectors at points (10, 11, 12).



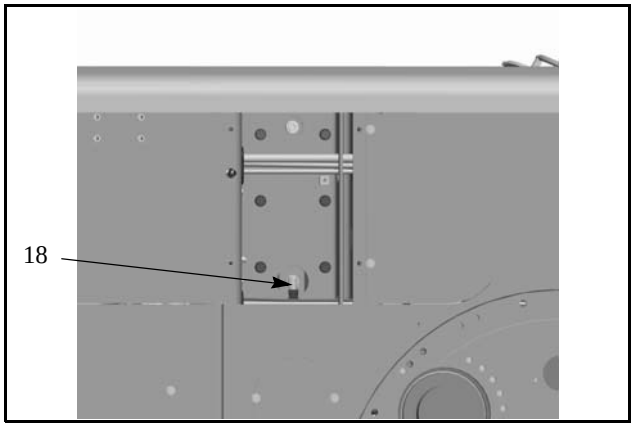
10. Remove jubilee clips (13), then remove hoses (14), (15), (16).



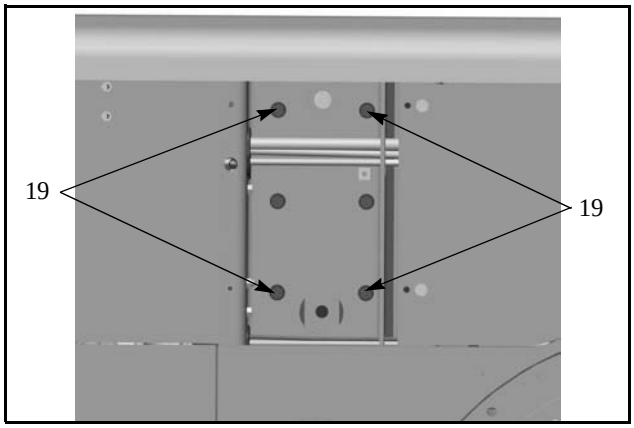
11. Remove cover (17).



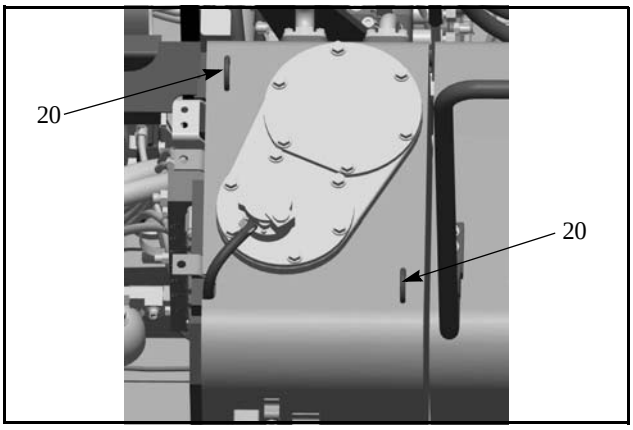
12. Disconnect hose (18).



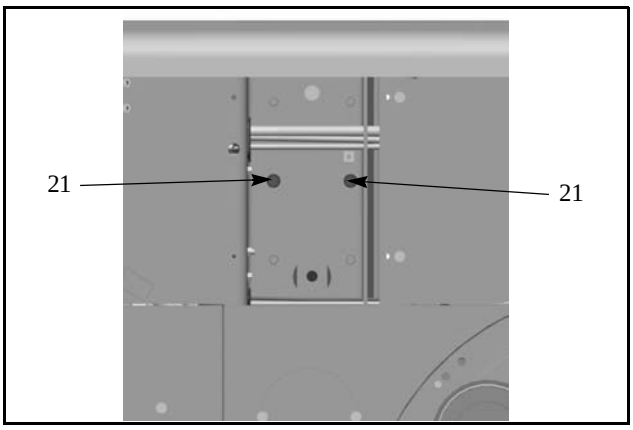
13. Remove 4 of 6 mounting bolts (19)



14. Sling at points (20).



15. Remove remaining 2 mounting bolts (21).



16. Remove hydraulic tank.

kg Hydraulic tank assembly: 124 kg

INSTALLATION

✕ Install in reverse order of removal.

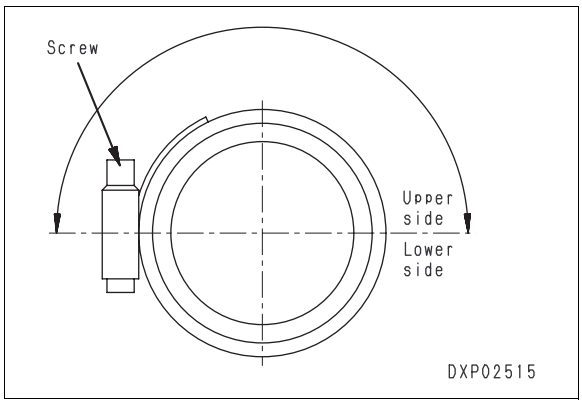
※1

N·m Hydraulic tank drain plug:
58.8 - 78.5 Nm
{6.0 - 8.0 kgm}

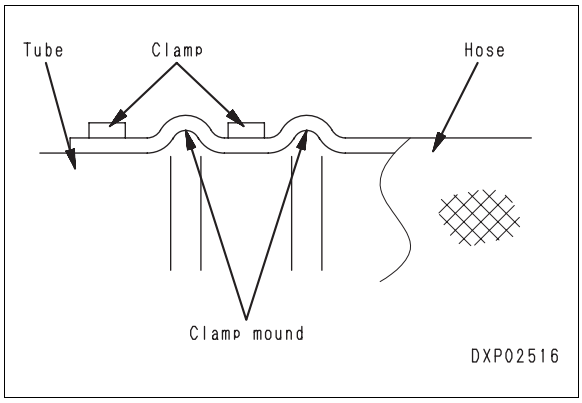
※2

➲ After tightening the suction hose clamp screw, check that the screw is located within the range shown in the diagram.

N·m 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

N·m 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. 160 l**

✕ Bleeding air

- Bleed the air.
  For details, see TESTING AND ADJUSTING. Air Bleeding of Various Parts.

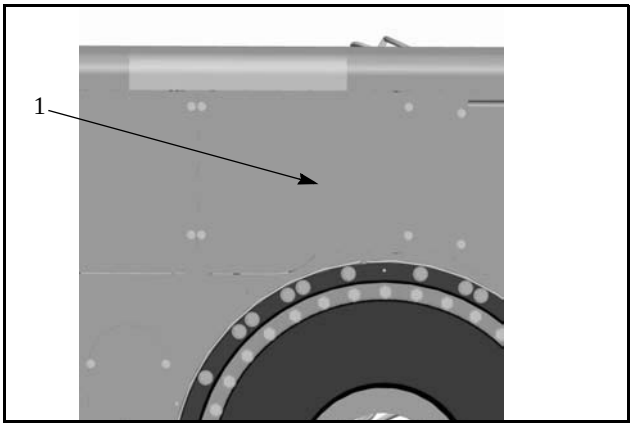
REMOVAL AND INSTALLATION OF FUEL TANK

REMOVAL

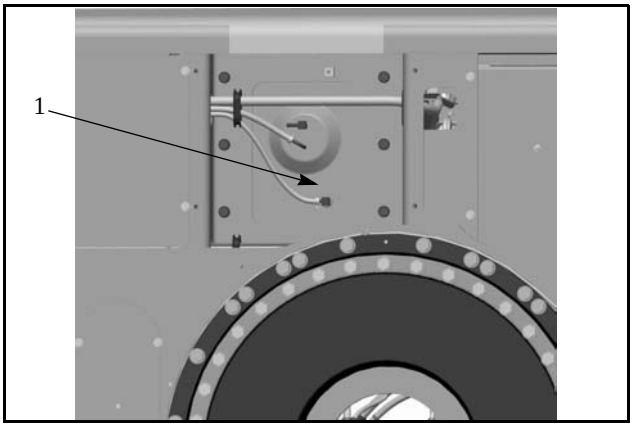
1. Empty fuel tank.

Fuel Tank: 290 l

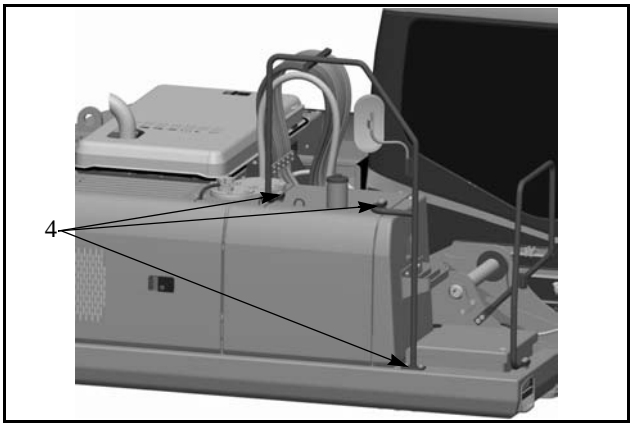
2. Remove cover (1).



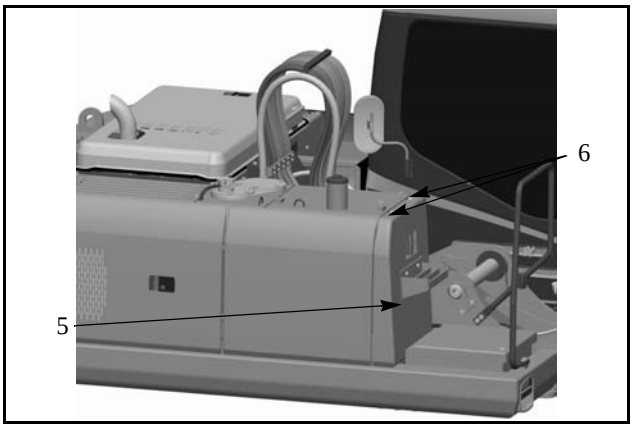
3. Disconnect hoses (2) and (3).



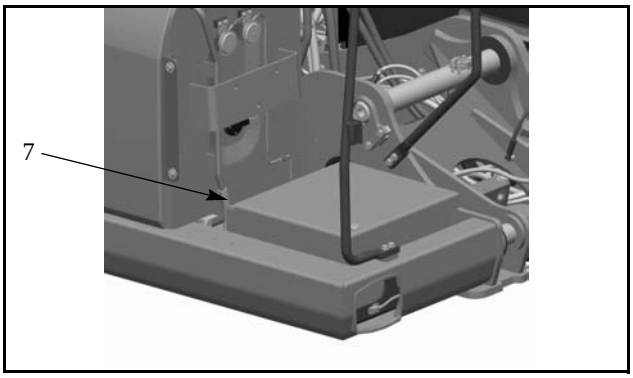
4. Remove handrail at points (4).



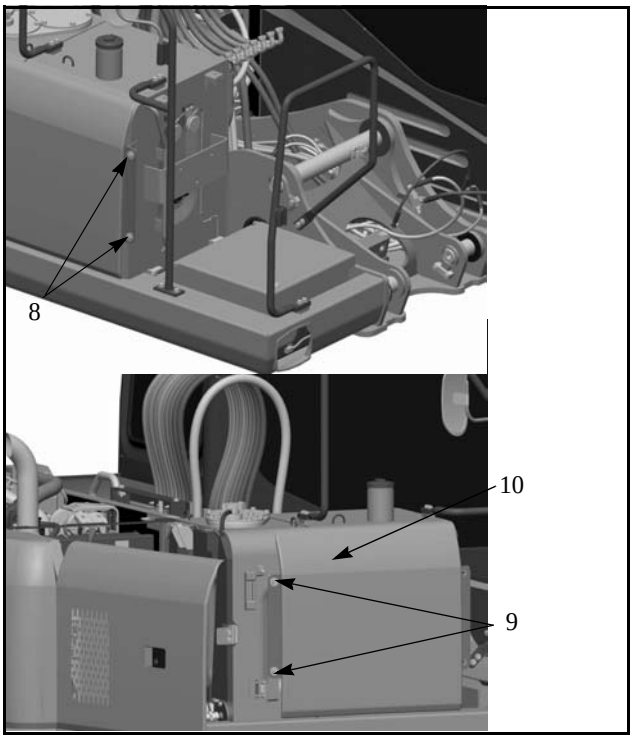
5. Remove cover (5) by removing bolts (6).



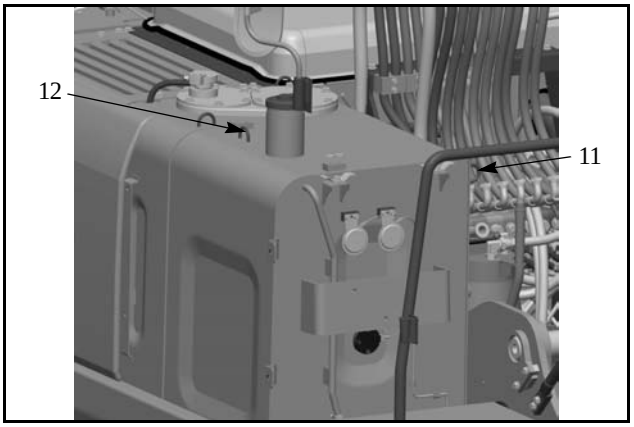
6. Remove hose (8).



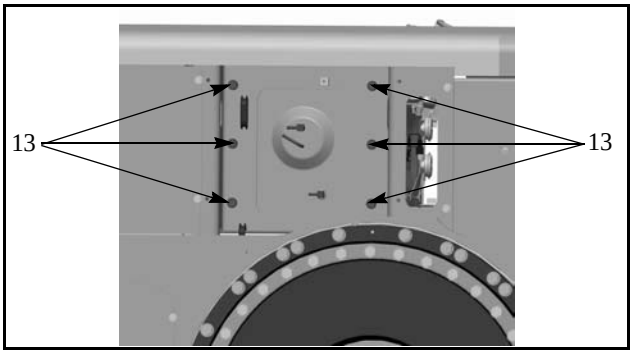
7. Remove cover (10) by first removing 2 bolts (7) and then removing bolts (8).



8. Sling at points (13) and (14).



9. Remove mounting bolts (15).



10. 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**

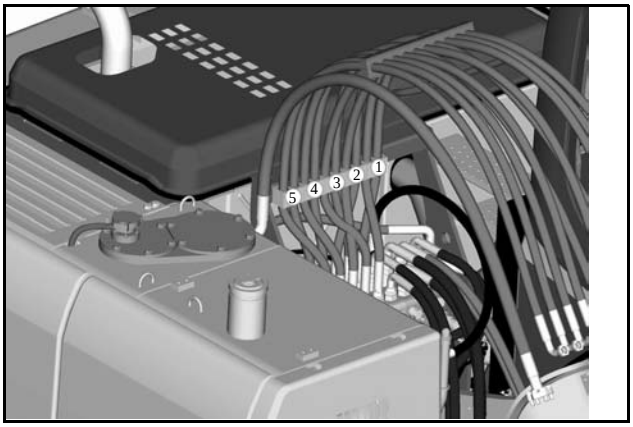
REMOVAL AND INSTALLATION OF CONTROL VALVE

REMOVAL

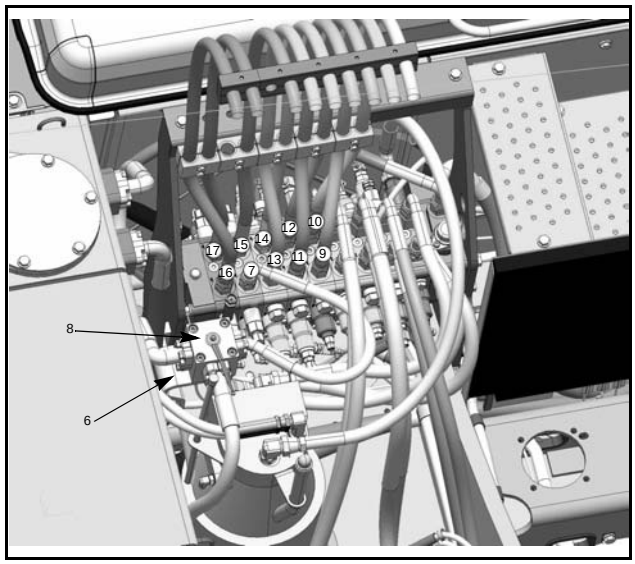
⚠ Lower the work equipment to the ground for safety and stop the engine. Unscrew the oil filler cap on the hydraulic tank slowly to release pressure inside the tank. Then move the safety lock lever to the LOCK position.

✗ 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).

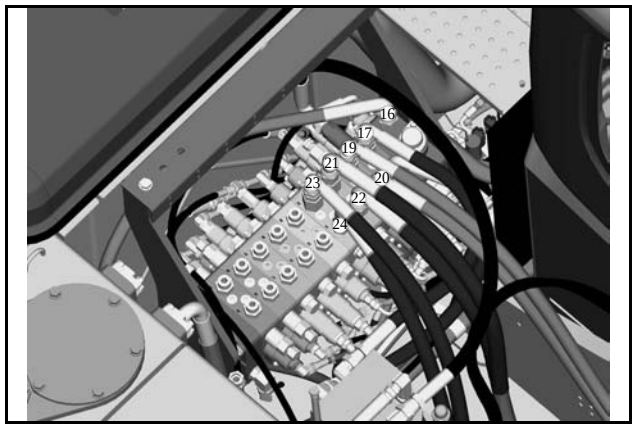


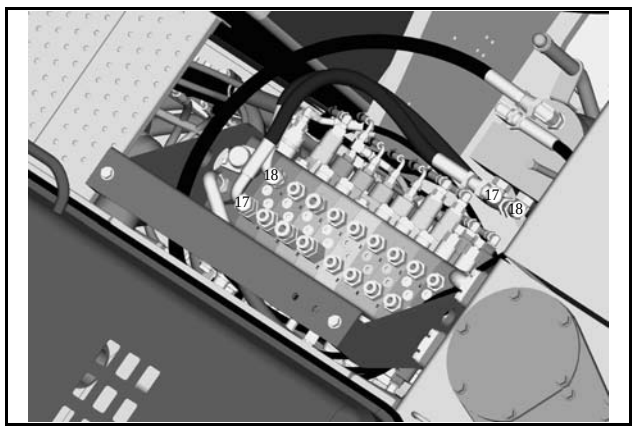
5. Disconnect bracket (6) and hose (7) from control valve from and move valve (8) away from working area.
6. Disconnect hoses (9 through 14, also 15 through 17 if fitted).



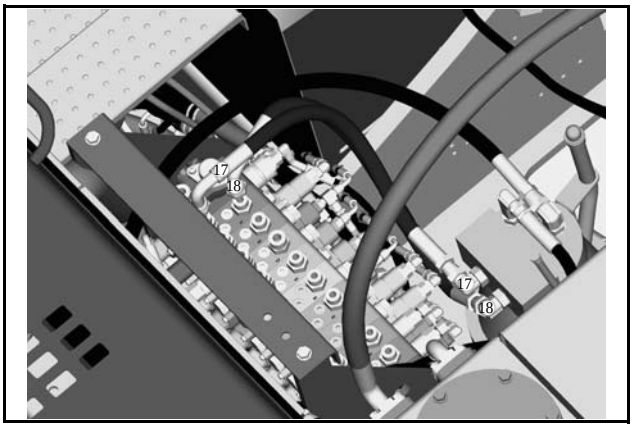
Note: Valve (8) is not shown in the following images to enhance image clarity.

7. Disconnect hoses (16 through 24) from top of control valve.

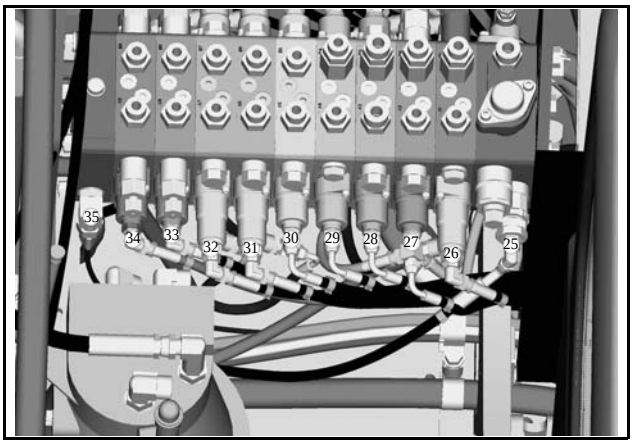




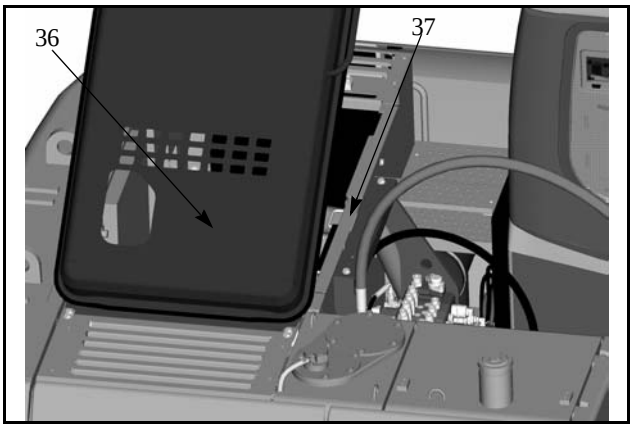
8. Also disconnect hoses 17 and 18 from swing machinery to aid removal of control valve and improve accessibility.



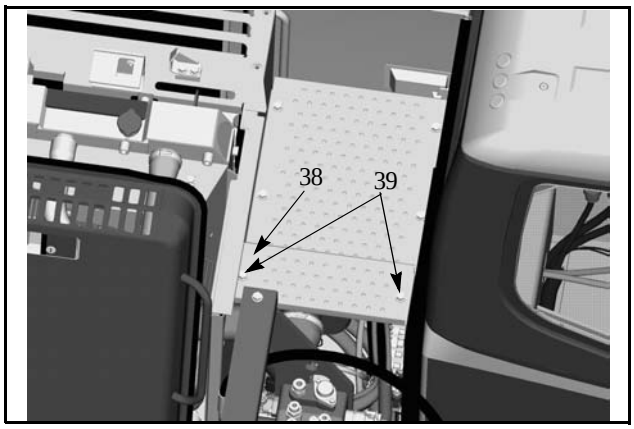
9. Disconnect hoses (25 through 32, also 33 and 34 if fitted). Also disconnect electrical connector (35).



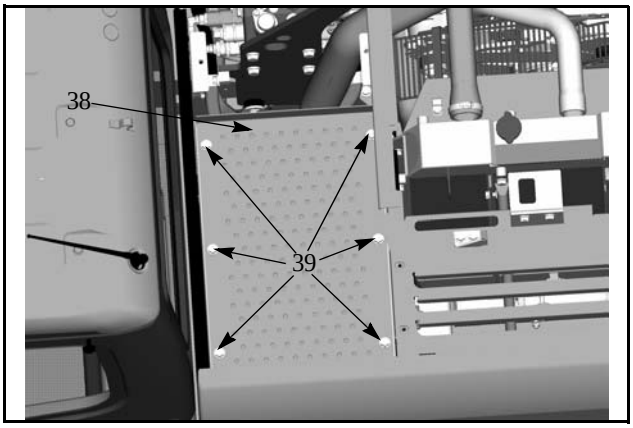
10. Open hood (36) and remove centre partition (37).



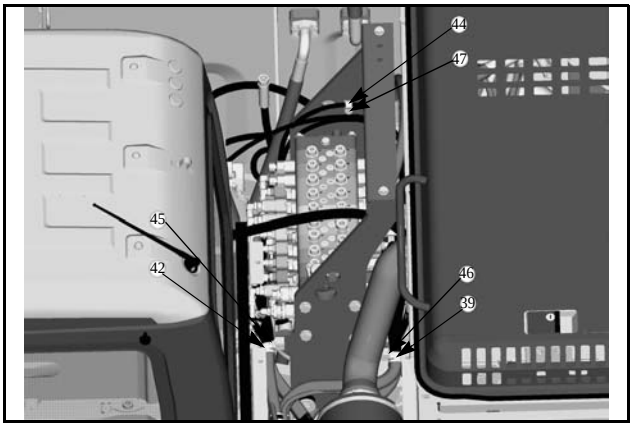
11. Step removal. Remove top step (38), by removing 2 bolts (39) and lifting step out.



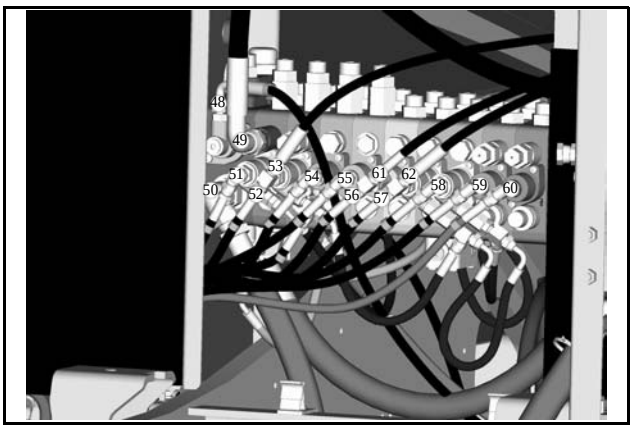
Middle step removal (40), by removing 6 bolts (41) and lifting out (optional).



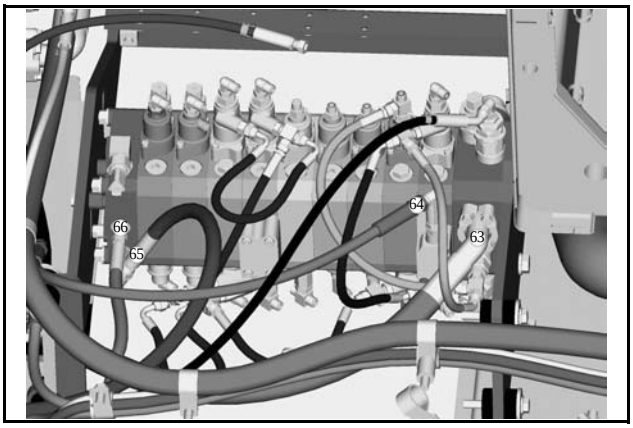
12. Remove clips (42, 43 and 44), by removing retaining bolts (45, 46 and 47).



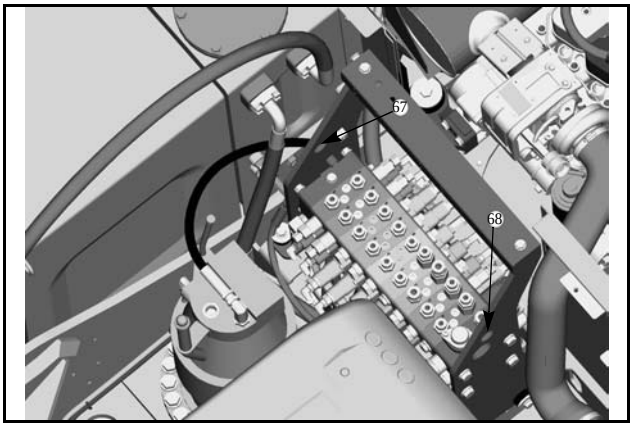
13. Disconnect hoses (48 through 58, also 59, 60, 61 and 62 if fitted).



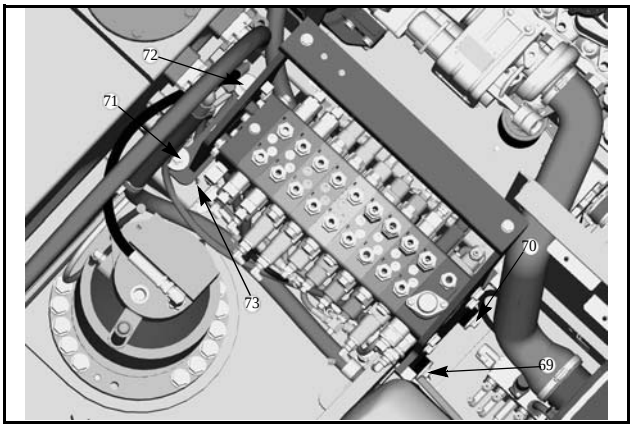
14. Disconnect hoses (63 through 66).



15. Attach lifting shackles to points indicated (67 and 68).

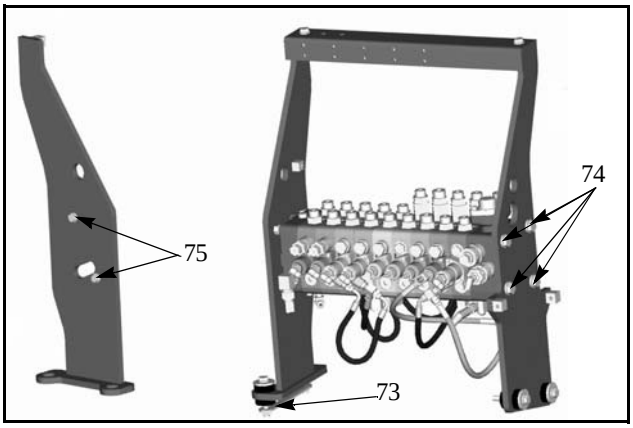


16. Slacken bolts indicated (69 through 72), then sling/support weight of the control valve.



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

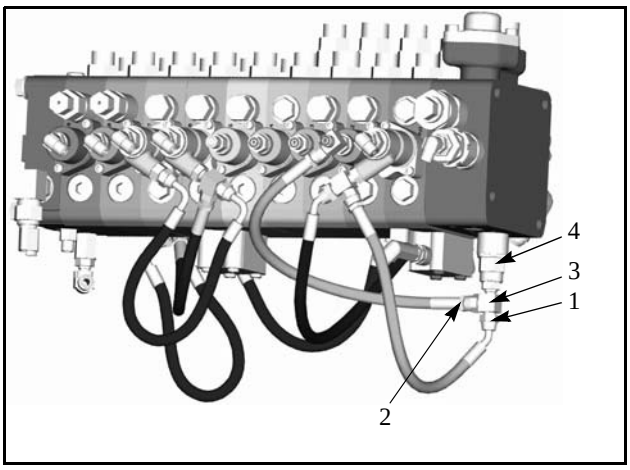
INSTALLATION

- 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.



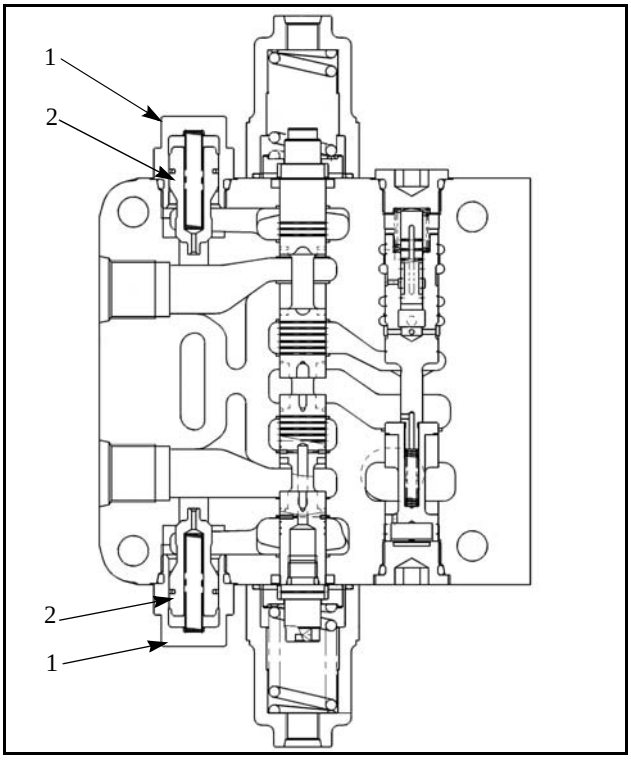
INSTALLATION

- 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).



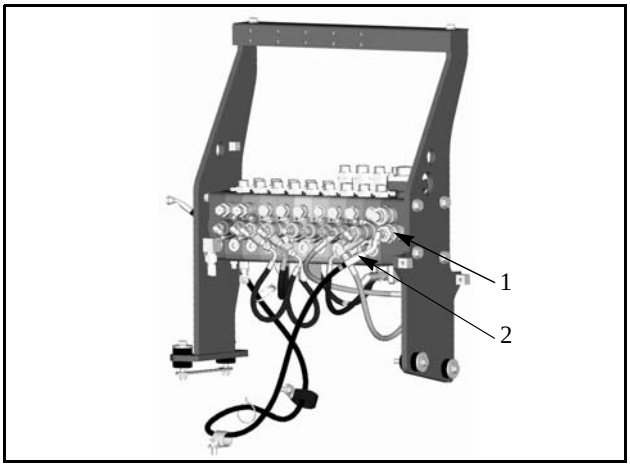
INSTALLATION

- 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).



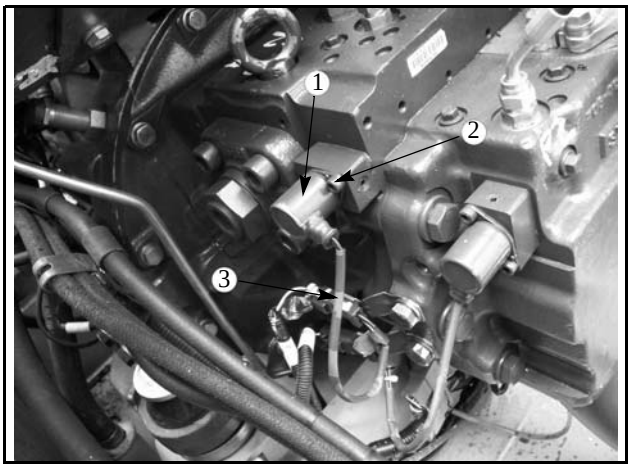
INSTALLATION

- 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.



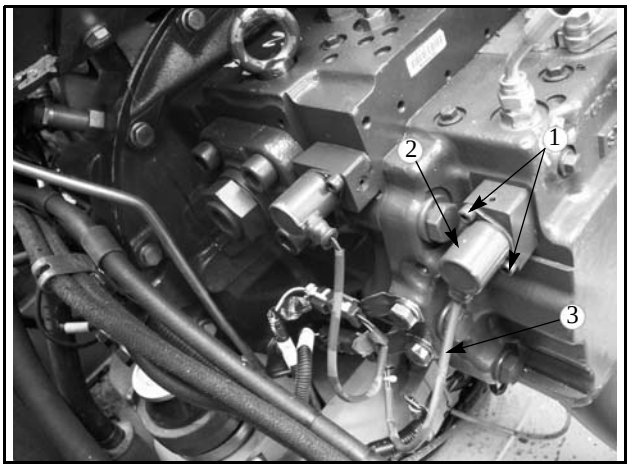
INSTALLATION

- 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.



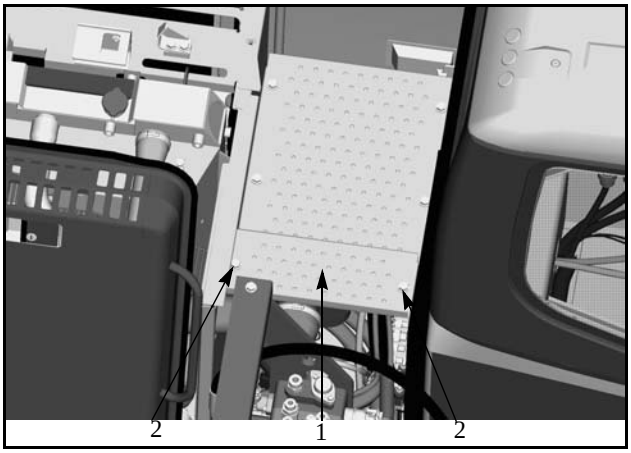
INSTALLATION

- Install in reverse order of removal.
- Tightening torque for EPC solenoid valve bolts (1): 11.8 - 14.7 Nm.

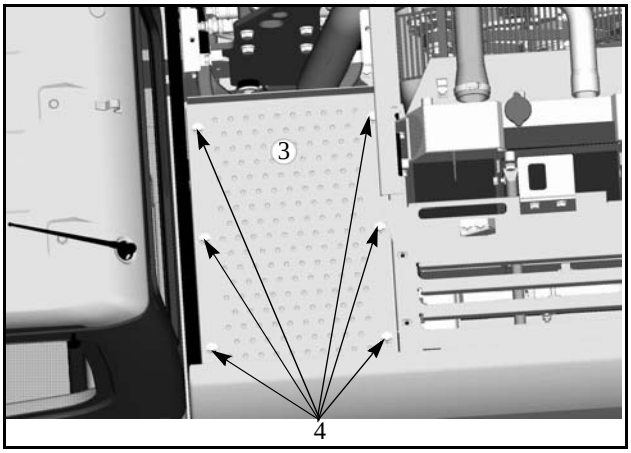
REMOVAL AND INSTALLATION OF PPC SOLENOID VALVE BLOCK ASSEMBLY

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.

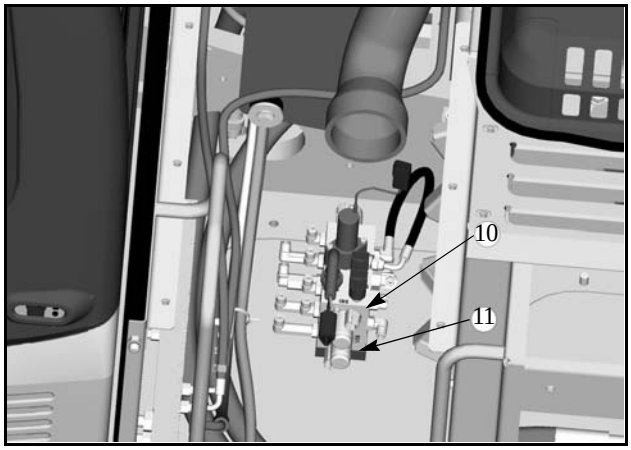


4. Remove all hoses and electrical connections.

5. Remove 4 securing bolts (9).



6. Remove PPC solenoid valve block (10) and spacer block (11).



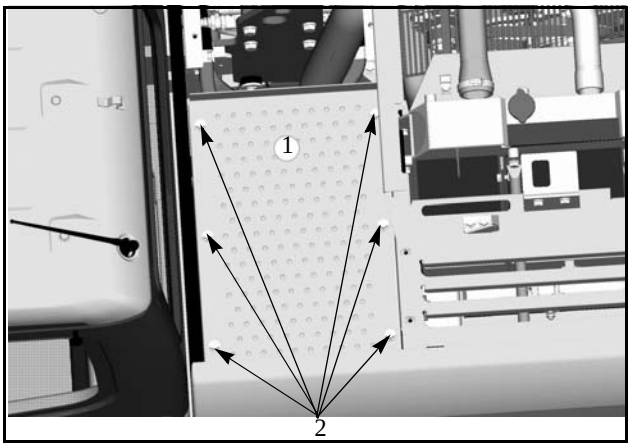
INSTALLATION

✔ Install in reverse order of removal.

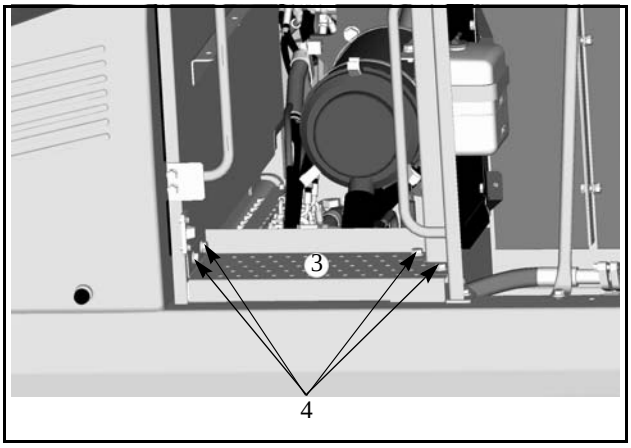
REMOVAL AND INSTALLATION OF MANIFOLD BLOCK ASSEMBLY

REMOVAL

1. Remove middle step (1), by removing 6 bolts (2) and lifting step out.



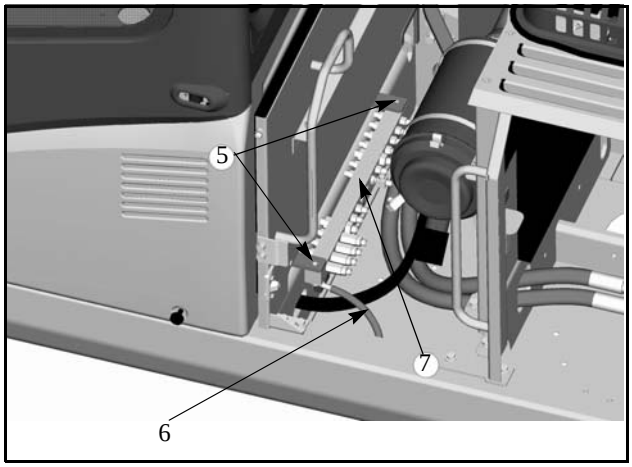
Remove bottom step (3), by removing 4 bolts (4) lifting step out.



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

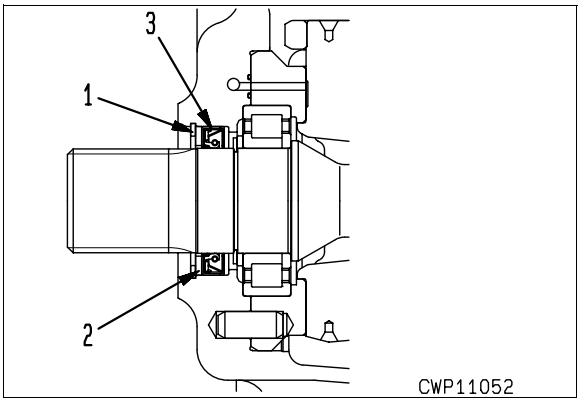
SPECIAL TOOLS

Mark	Part No.	Part Name	Necessity	Qty	Distinction*	Sketch
N	790-201-2000	Push tool	■	1		
	790-201-2740	Spacer	■	1		

*Distinction between new and existing part.

REMOVAL

1. Remove the hydraulic pump assembly. Refer to “ENGINE AND HYDRAULIC PUMP ASSEMBLIES<$paranumonly>-20 -30
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.

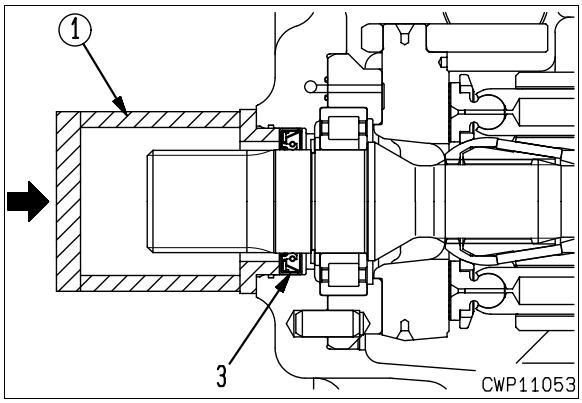


INSTALLATION

- Install in reverse order of removal.

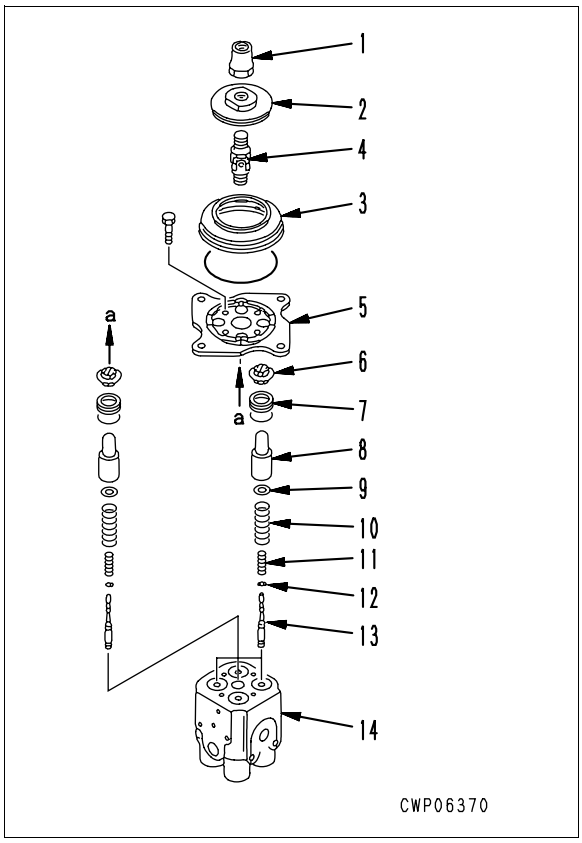
※1

- 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)

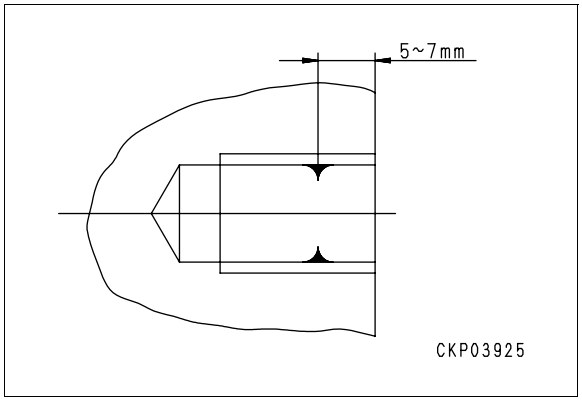
Joint (4) sliding surface:
Grease 2 - 4 cc (G2-LI)

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

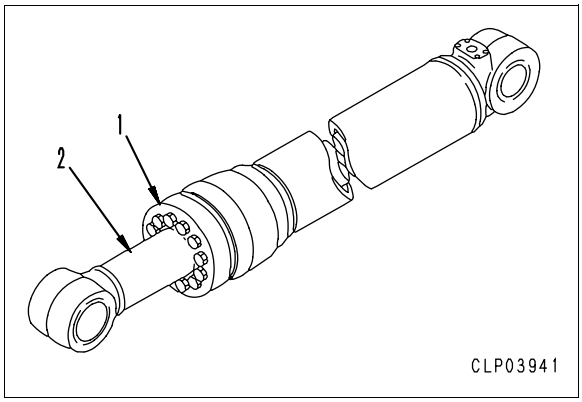
Mark		Part No.	Part Name	Necessity	Qty	Distinction*	Sketch
Q	1	790-502-1003	Cylinder repair stand	●	1		
		790-101-1102	Pump	●			
	2	790-102-4300	Wrench Assembly	■	1		
		790-102-4310	Pin	■	2		
	3	790-720-1000	Expander	●	1		
	4	796-720-1670	Rubber Band (for boom and arm)	●	1		
		07281-01279	Clamp	●	1		
		796-720-1660	Rubber band (for bucket)	●	1		
		07281-01159	Clamp	●	1		
	5	790-201-1702	Push tool kit	■	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)	●	1		
		• 790-201-1640	Push tool		1		
		• 790-101-5021	Grip		1		
		• 01010-50816	bolt		1		
		790-201-1980	Plate (for boom)	●	1		
		790-201-1990	Plate (for arm)	●	1		
		790-101-5021	Grip	●	1		
		01010-50816	Bolt	●	1		

*Distinction between new and existing part.

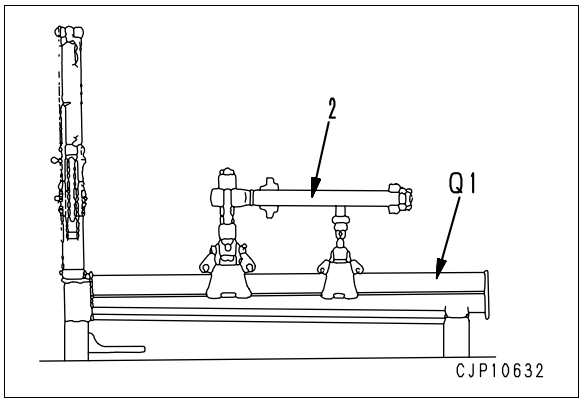
DISASSEMBLY OF ARM AND BUCKET CYLINDERS

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.

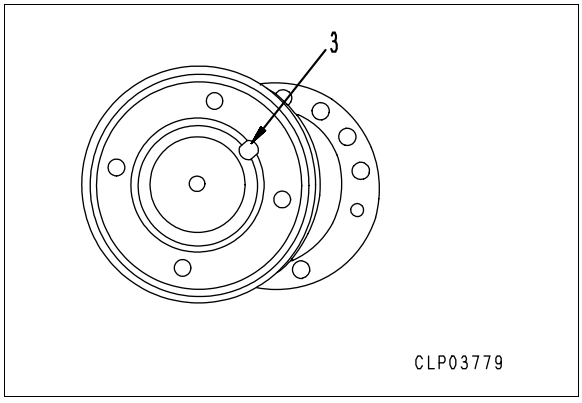


4) Disassemble piston rod assembly as follows.
   Set piston rod assembly (2) in tool **Q1.**

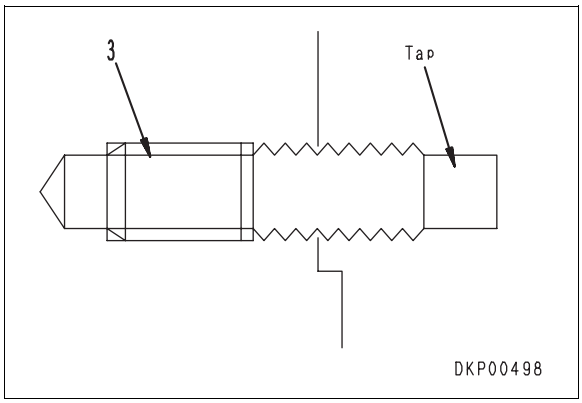


Remove stopper screw (3) of piston assembly.

✔ Common screw size for boom, arm, and bucket cylinder: M12 x Pitch 1.75.

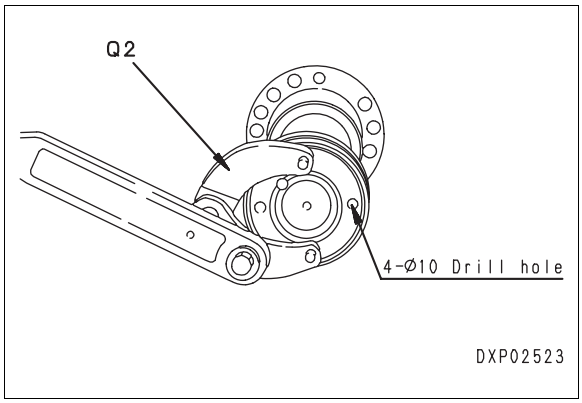


✔ If the caulking of screw (3) is too strong and it cannot be removed, tighten the screw fully, then fit a tap to the thread and remove the screw.



Using tool **Q2**, remove piston assembly (4).

✔ When not using tool **Q2**, use the drill holes (∅ 10, 4 places) and loosen the piston assembly.



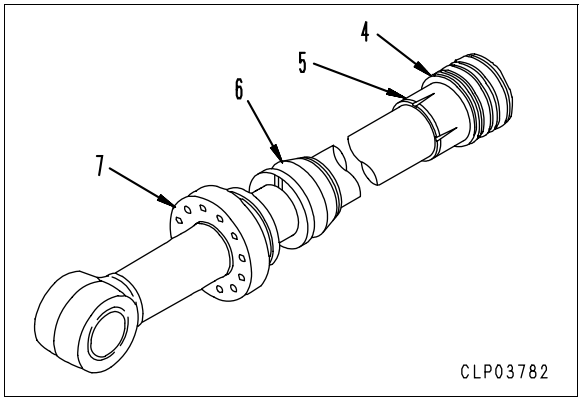
Remove plunger (5).

✔ Boom and arm cylinder only

Remove collar (6).

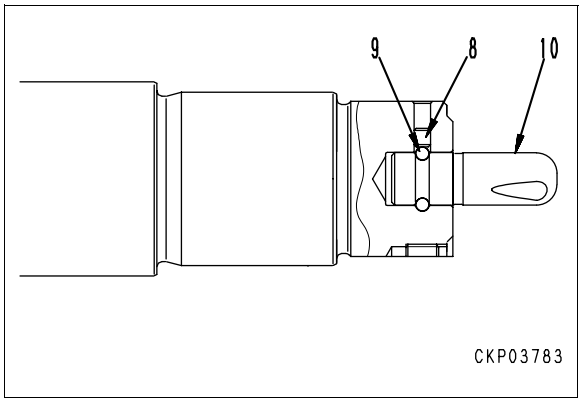
✔ Boom and arm cylinder only

Remove head assembly (7).



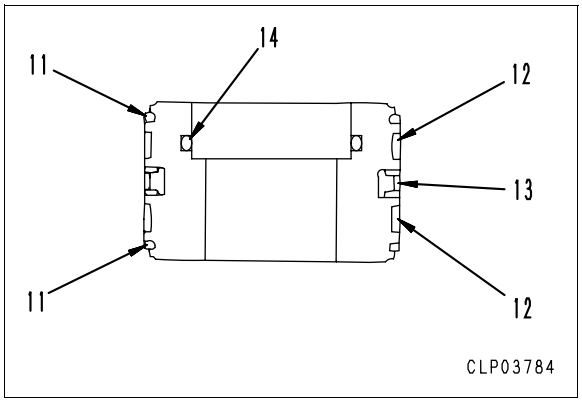
Remove cap (8), and pull 12 balls (9), then remove plunger (10).

✔ Arm cylinder only



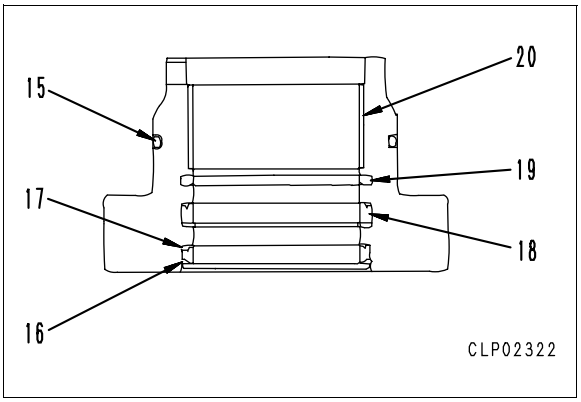
2. Disassembly of piston assembly

1) Remove rings (11).
2) Remove wear rings (12).
3) Remove piston ring (13).
4) Remove O-ring and backup ring (14).



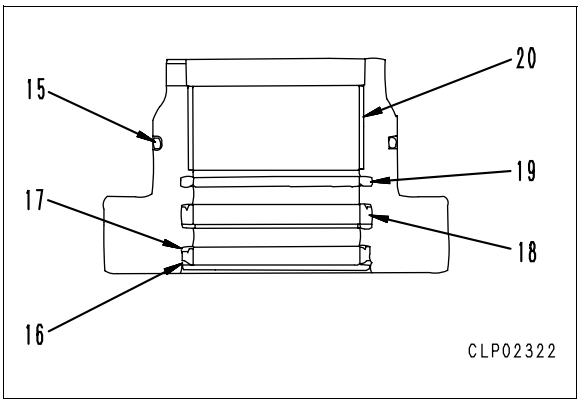
3. Disassembly of cylinder head assembly

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).



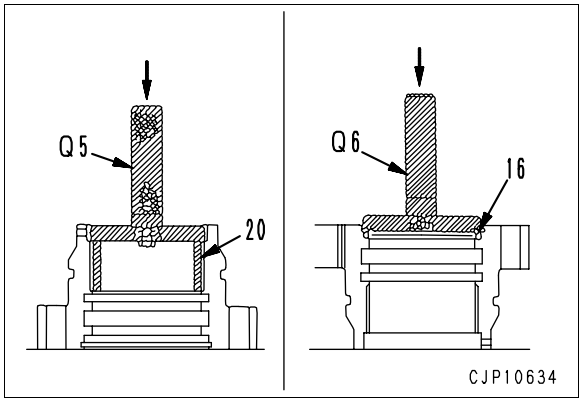
ASSEMBLY

- 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.



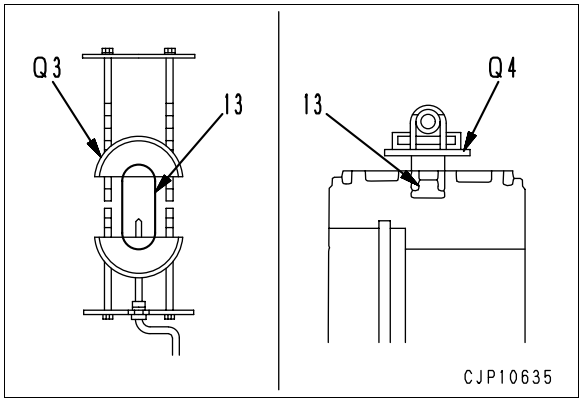
1. Assembly of head assembly

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).



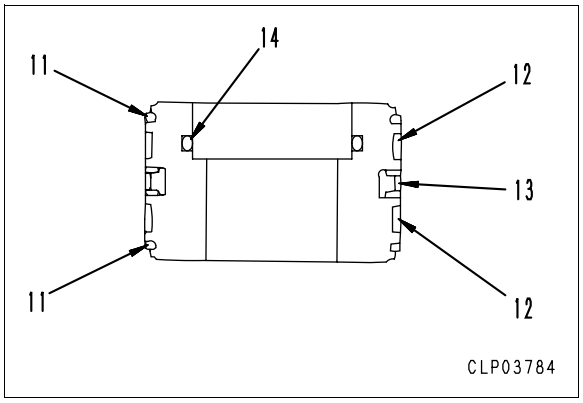
2. Assembly of piston assembly

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).



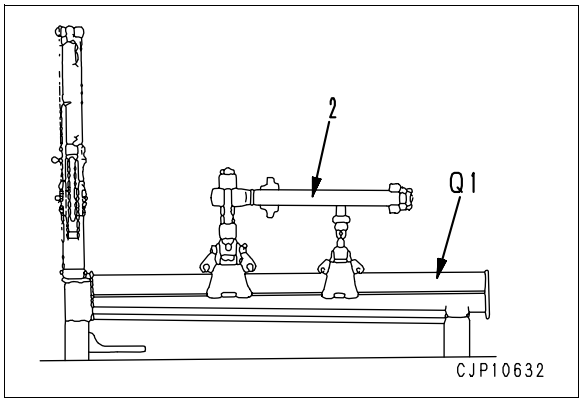
3) Install backup ring and O-ring (14).
4) Assemble wear ring (12).
5) Assemble ring (11).
   ✔ Be careful not to open the end gap of the ring too wide.

Ring grove: **Grease (G2-L1)**

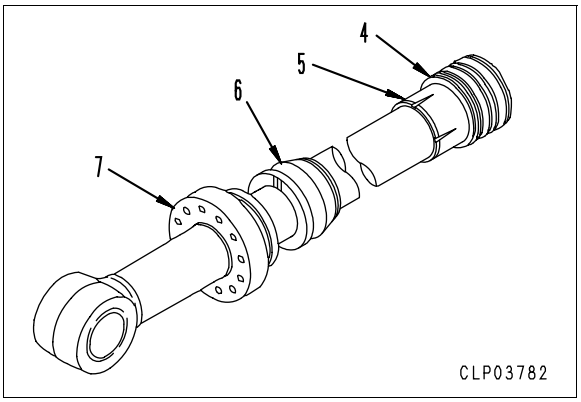


3. Piston rod assembly

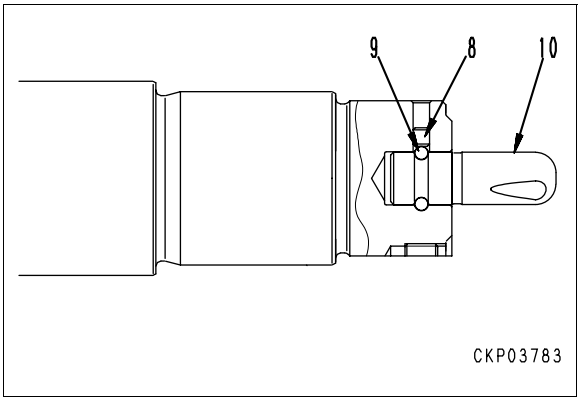
1) Set piston rod assembly (2) to tool **Q1**.



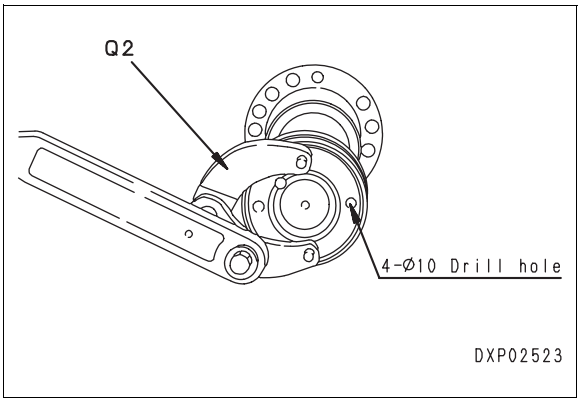
2) Assemble head assembly (7).
3) Fit O-ring and backup ring to collar (6), then assemble.
   ✔ Boom and arm cylinder only
4) Assemble plunger (5).
   ✔ Boom and arm cylinder only



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.

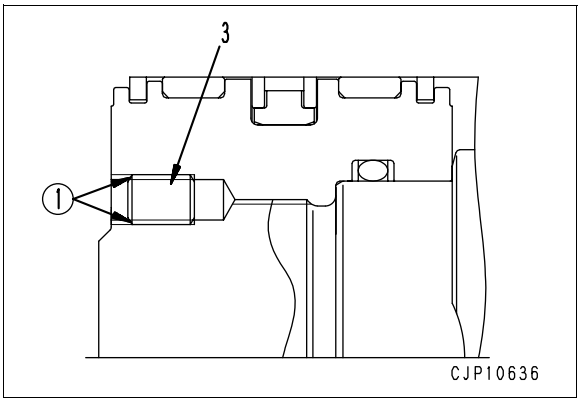


ii) Tighten screw (3).

Screw thread: Loctite No. 262

N·m Screw: 58.9 - 73.6 Nm {6 - 7.5 kgm}

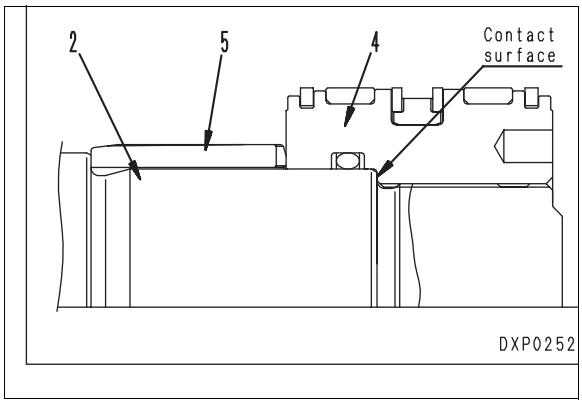
iii) Caulk thread at 2 places with punch.



- ✔ 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.

N·m Piston assembly: **294 ± 29.4 Nm {30 ± 3.0 kgm)**

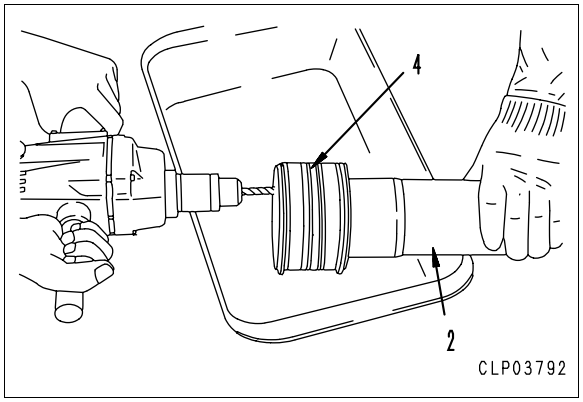
- ✔ After tightening the piston, check that there is play in plunger (5).
- ✔ Boom, arm cylinder only



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

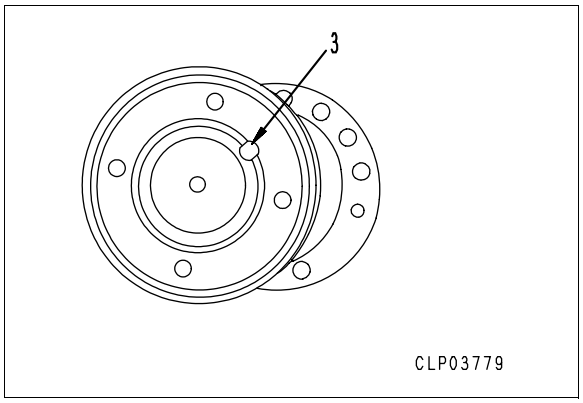
iii) After machining, wash thoroughly to remove all metal particles and dust.



iv) Tighten screw (3).

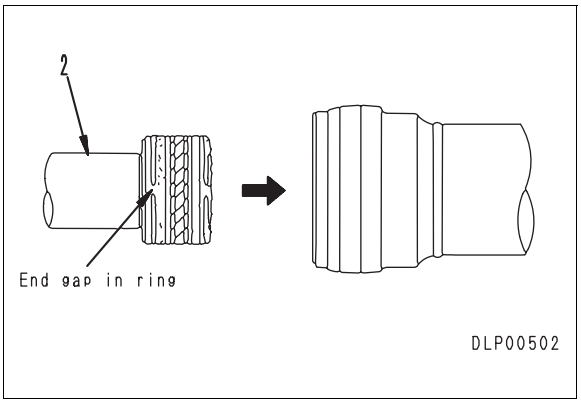
N·m Screw: 58.9 - 73.6 Nm {6 - 7 kgm}

v) Caulk thread at 4 places with punch.



7) Assemble piston rod assembly (2).

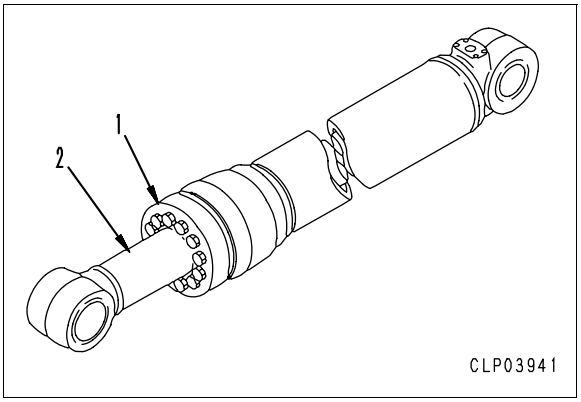
- Set the end gap of the ring horizontally (at the side position), align axial center of cylinder tube, then insert.
- After inserting, check that the ring is not broken and has not come out, then push in fully.



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 OF MONOBOOM WORK EQUIPMENT

SPECIAL TOOLS

Mark	Part No.	Part Name	Necessity	Qty	Distinction*	Sketch
R	796-900-1200	Remover	■	1		
	790-101-4000	Puller (490 kN 50-T-long)	■	1		
	790-101-1102	Pump (294 kN 30 T)	■	1		

*Distinction between new and existing part.

REMOVAL

⚠ Extend the arm and bucket fully. Lower the work equipment to the ground and set the safety lock lever to the lock position.

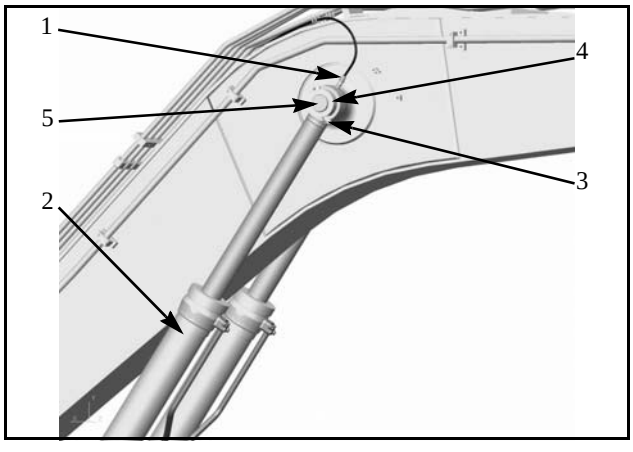
⚠ Release the residual pressure in the hydraulic circuit. Refer to the Release of Remaining Pressure in Hydraulic Circuit section in the TESTING AND ADJUSTING chapter of this manual.

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.

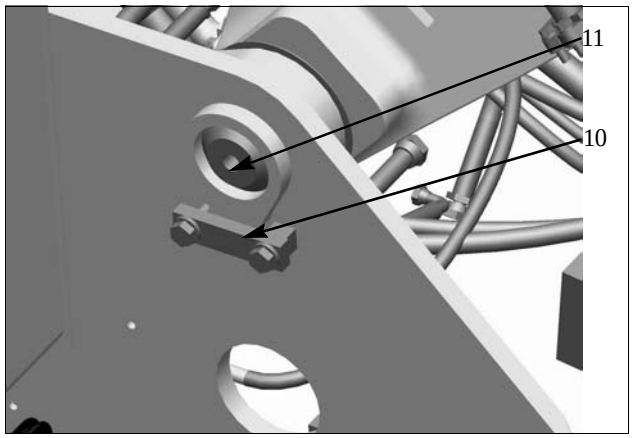
5. Disconnect stabilizer hoses (6), arm cylinder hoses (7), boom cylinder hoses (8) two for each.

   ➧ 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.

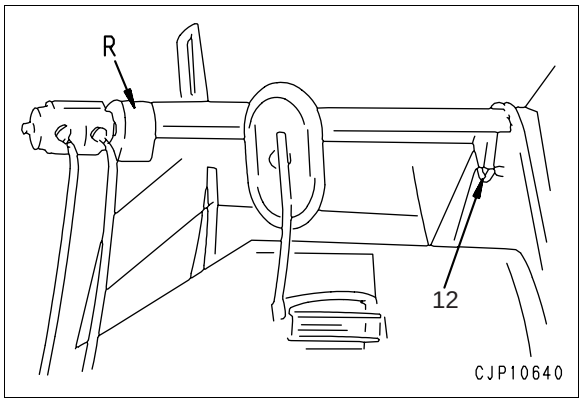


7. Support with sling the work equipment and remove plate (10) and then pin (11) at the fo ※2



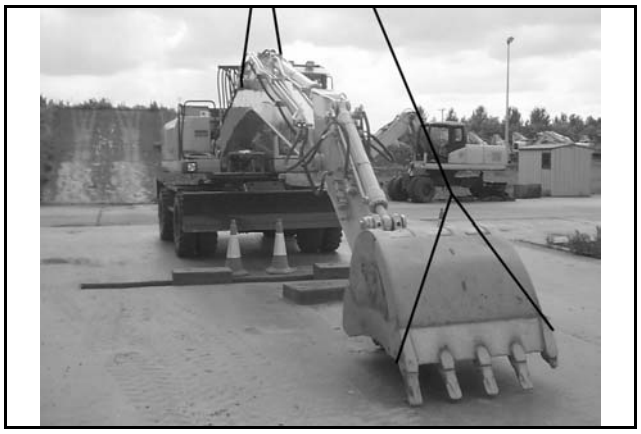
   ✕ When removing them, first remove plate (10) and then remove pin (11) at the foot, using Tool **R**.

   ➧ 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

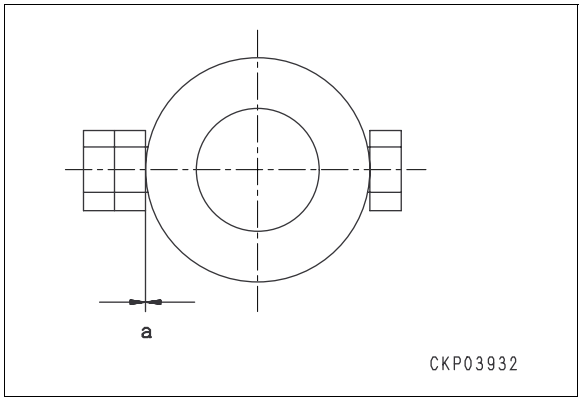


INSTALLATION

✔ 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.



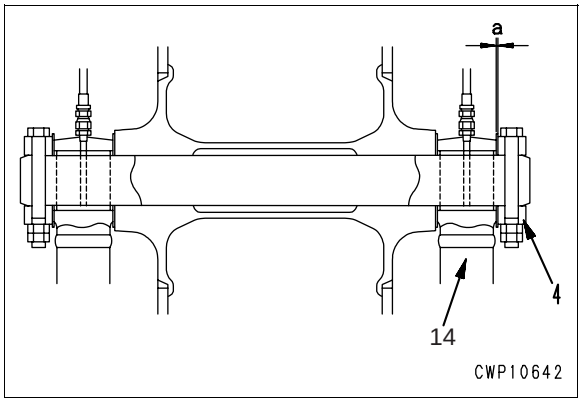
Inside surface of bushing when assembling pin:
Anti-friction compound (LM-P)

Grease after assembling pin:
Grease (LM-G)

⚠ 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)


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	■	1		
	790-101-4000	Puller (490 kN 50-T-long)	■	1		
	790-101-1102	Pump (294 kN 30 T)	■	1		

*Distinction between new and existing part.

REMOVAL

⚠ Extend the arm and bucket fully. Lower the work equipment to the ground and set the safety lock lever to the lock position.

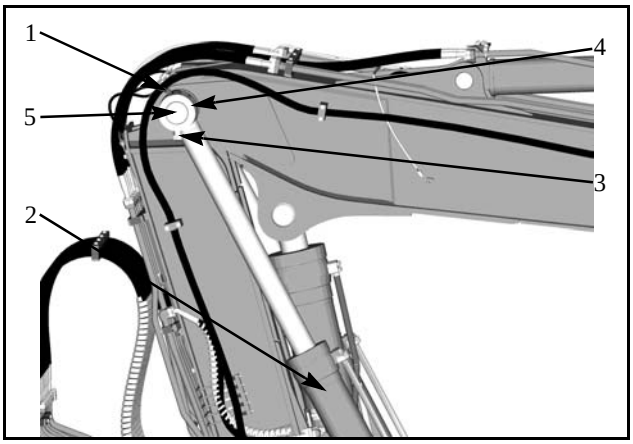
⚠ Release the residual pressure in the hydraulic circuit. Refer to the Release of Remaining Pressure in Hydraulic Circuit section in the TESTING AND ADJUSTING chapter of this manual.

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

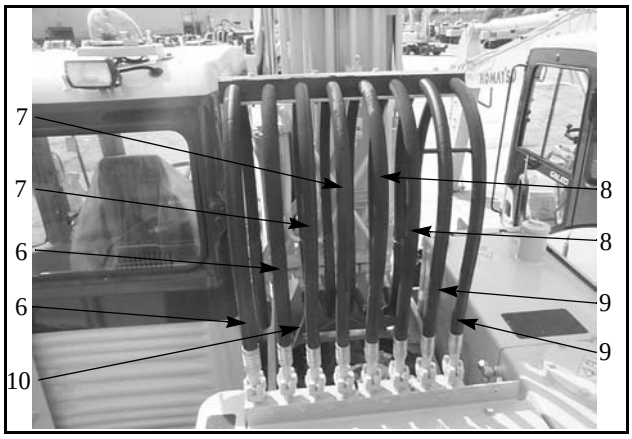
   ➧ There are shims installed, so check the number and thickness, and keep them in a safe place.



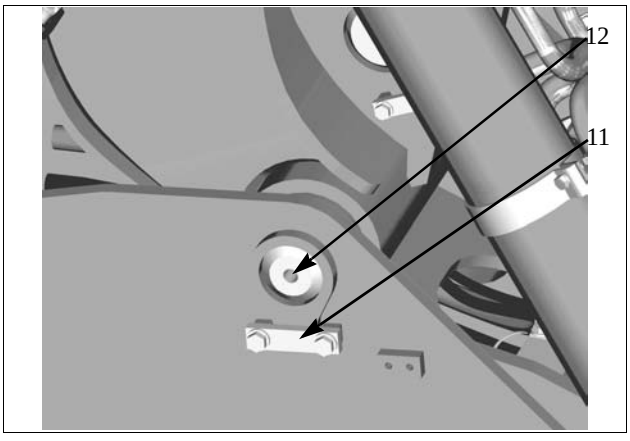
4. Start the engine and retract the piston rod.
   ➧ Fasten the piston rod with wire so that it will not slip out and lower the cylinder onto a stand, or place a support under the bottom of the cylinder to support it. In the latter case, remove the grease fitting on the bottom side first.
   ➧ Remove 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.

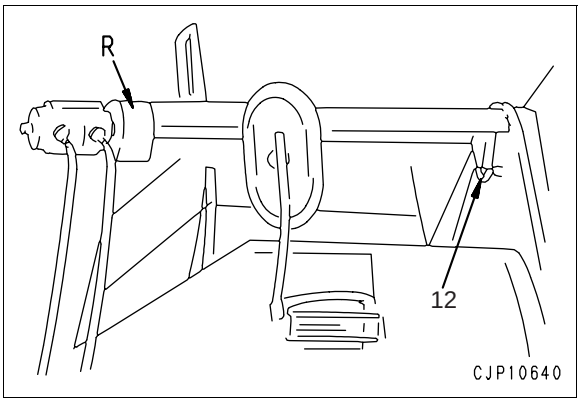
6. Disconnect intermediate connector CN-A86 (10) for a working lamp.



7. Support with sling the work equipment and remove plate (11) and then pin (12) at the fo ※2

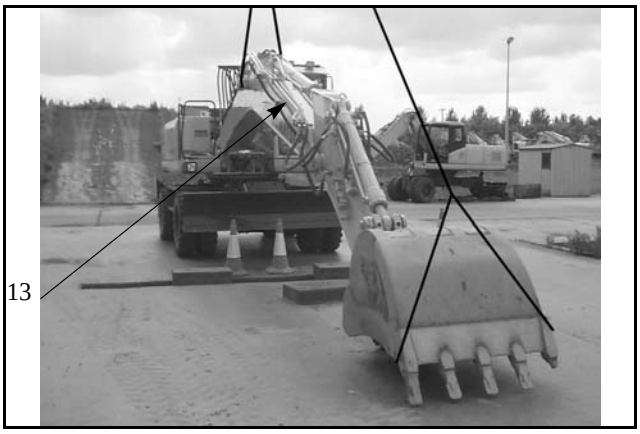


✕ When removing them, first remove plate (11) and then remove pin (12) at the foot, using Tool **R**.
➧ Shims are installed, so do not forget to check their number and each location of installation.



8. Lift off work equipment assembly (13) and disassemble it.

kg Work equipment assembly
PW160: 1,926 kg

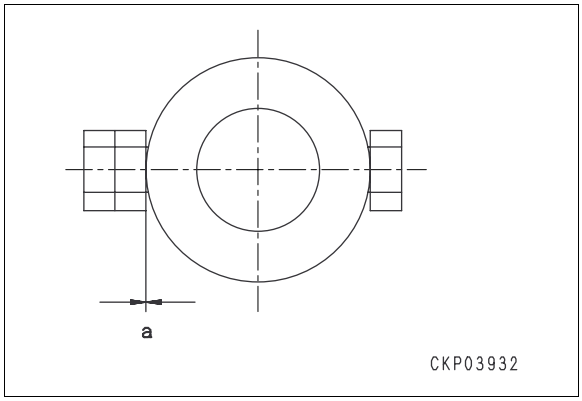


INSTALLATION

✔ 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.



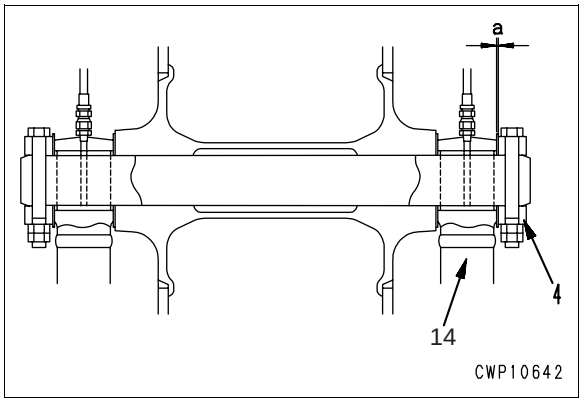
Inside surface of bushing when assembling pin:
Anti-friction compound (LM-P)

Grease after assembling pin:
Grease (LM-G)

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)

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	■	1		
	799-703-1100	Vacuum Pump (100 V)	■	1		
	799-703-1110	Vacuum Pump (220 V)	■	1		
	799-703-1120	Vacuum Pump (240 V)	■	1		
	799-703-1400	Gas leak tester	■	1		

*Distinction between new and existing part.

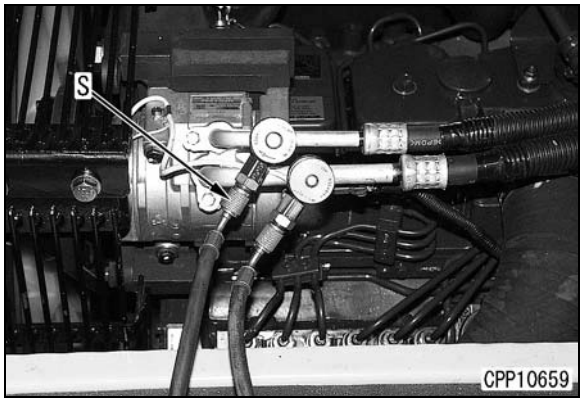
REMOVAL

First, disconnect the cable from the negative terminal (-) of the battery.

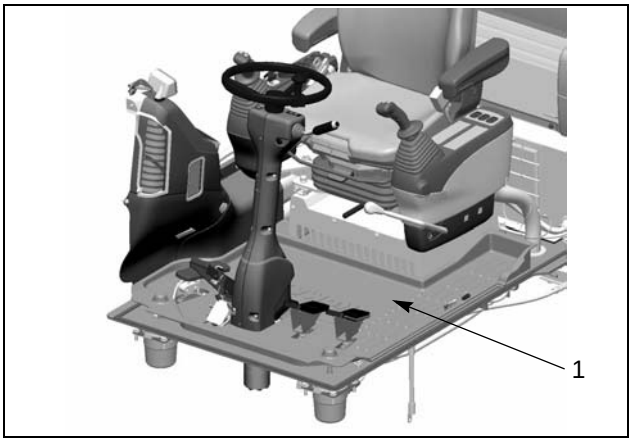
1. Drain cooling water.

Cooling water: Approx. 22.8 l

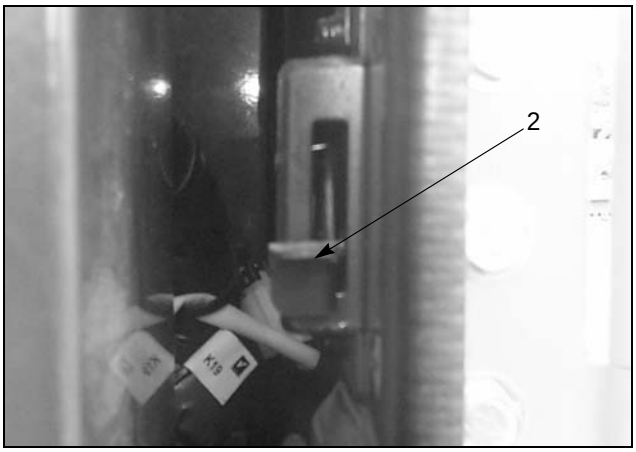
2. Bleed gas from the air conditioner, using tool **S**.



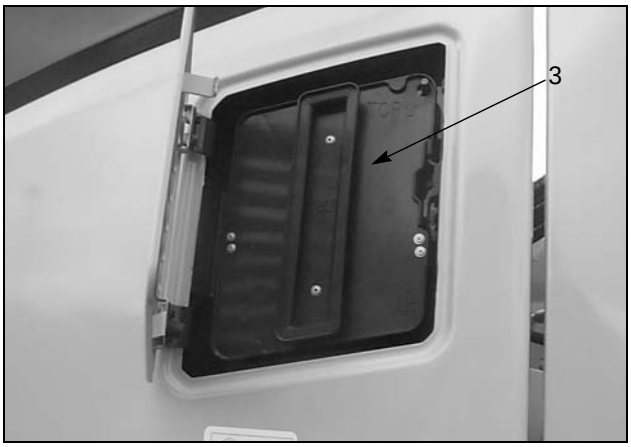
3. Remove floor mat (1).



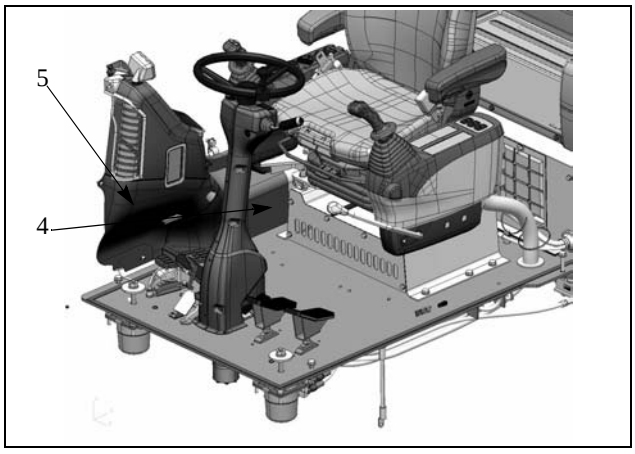
4. Pull down outside air filter cover opening-closing lever (2).



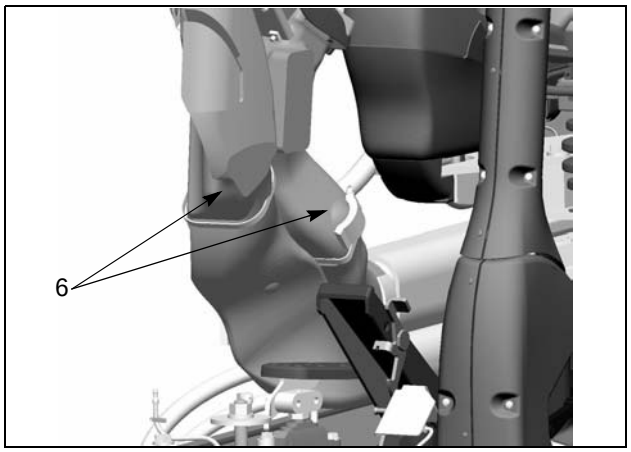
5. Remove outside air filter (3).



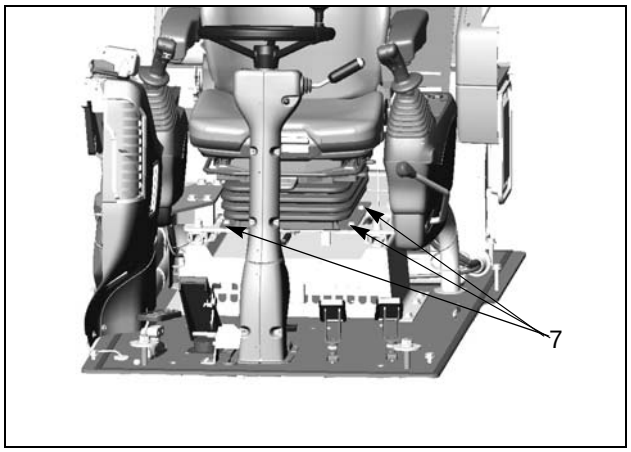
6. Remove monitor panel lower covers (4) and (5).
   - When removing cover (4), first remove the M19 wiring for cigarette lighter.



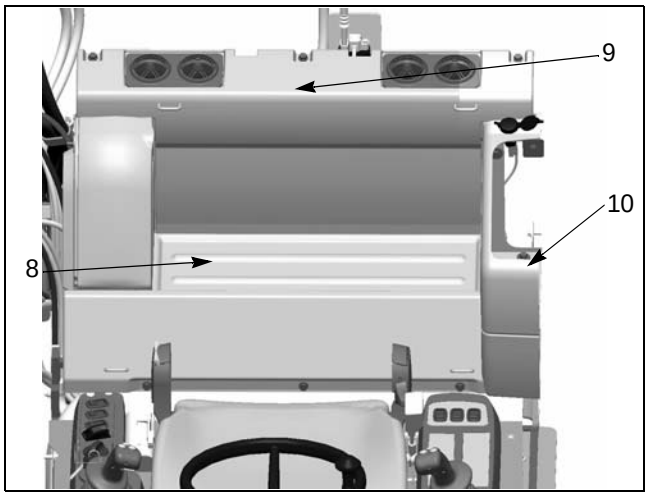
7. Remove duct (6) on the right side.



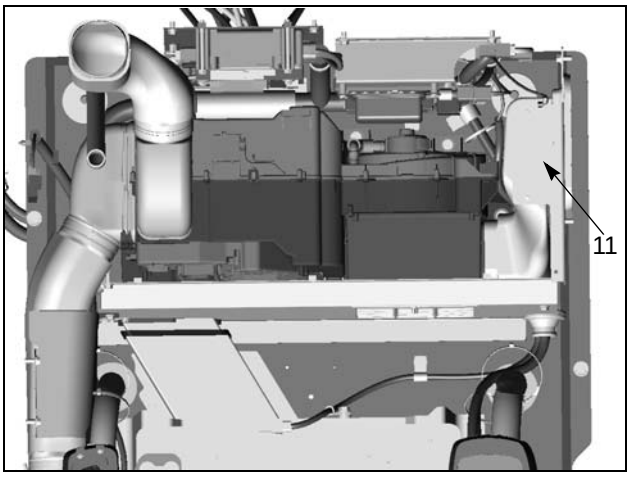
8. Remove operator seat by removing 4 mounting bolts (7). When removing the seat be sure to disconnect connector G33 (if fitted), then remove carefully.



9. Remove rear covers (8), (9) and (10).

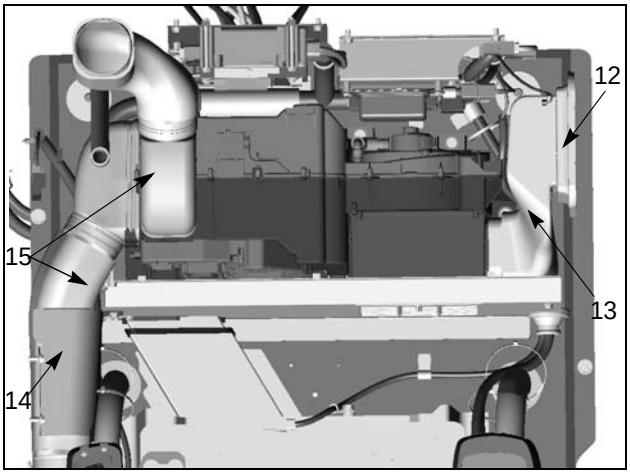


10. Remove plate (11).



11. Remove plate (12) and then remove duct (13).

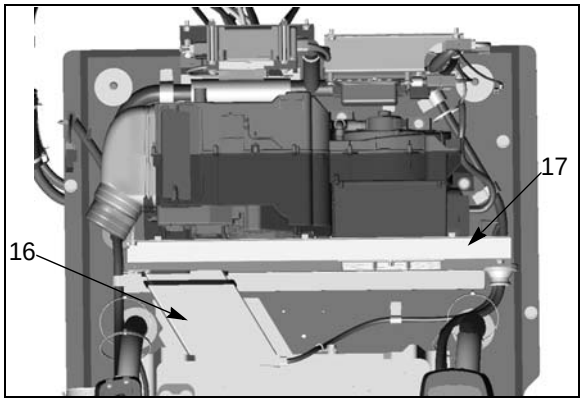
12. Remove plate (14) and right duct (15).



13. Disconnect cab intermediate connectors at the following two points. (Refer to TROUBLESHOOTING section on “CONNECTOR LOCATION CHART AND ELECTRICAL CIRCUIT DIAGRAM BY SYSTEM<$paranumonly>-20 -218)
    - H09: Upper side
    - H08: Lower side

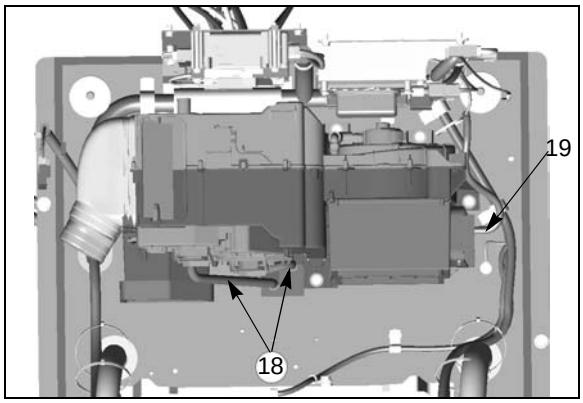
14. Remove duct (16).

15. Remove cover (17).

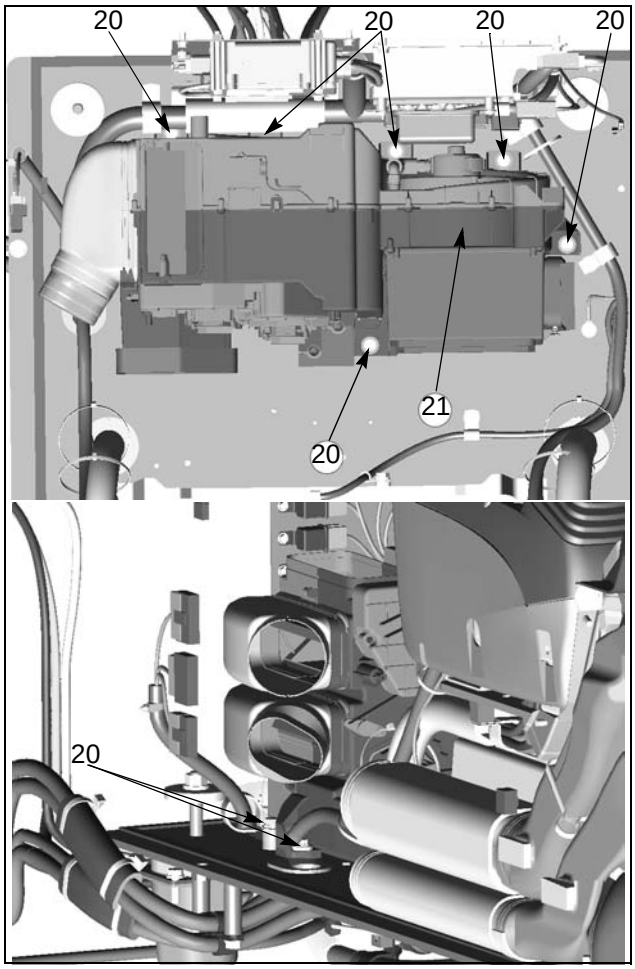


16. Disconnect connectors at the following seven points. (Refer to TROUBLESHOOTING section on “CONNECTOR LOCATION CHART AND ELECTRICAL CIRCUIT DIAGRAM BY SYSTEM<$paranumonly>-20 -218)
    - D01
      (Assembled-type diode connector)
    - D02
      (Assembled-type diode connector)
    - C09 (Model selection switch connector)
    - Air conditioner unit connector
      From top to bottom, M26, M27, M28 and M33 option power source connector

17. Remove 2 hoses (18) and remove connector (19).



18. Remove the 8 mounting bolts (20) and remove air conditioner unit assembly (21) carefully.
    - When removing the air conditioner unit assembly, do not forget to disconnect the two air conditioner hoses connected to the bottom.



INSTALLATION

- Install in reverse order of removal.

✕ Install hoses in the air conditioner circuit with care so that dirt, dust, water, etc. may not enter them.

✕ Install air conditioner hoses only after checking that an O-ring is in place at the connecting part.

✕ Check that there is no damage on O-rings, or that they have not deteriorated.

※1

➽ Coat the threads of the refrigerant piping at the connecting part with compressor oil (ND-OIL8), and then tighten the piping with a double-ended spanner.

N·m Hose clamp screw:
8.83 - 14.7 Nm (0.9 - 1.5 kgm)

N·m Hose screw M16 x 1.5:
11.8 - 14.7 Nm (1.2 - 1.5 kgm)

N·m Hose screw M24 x 1.5:
29.4 - 34.3 Nm (3.0 - 3.5 kgm)

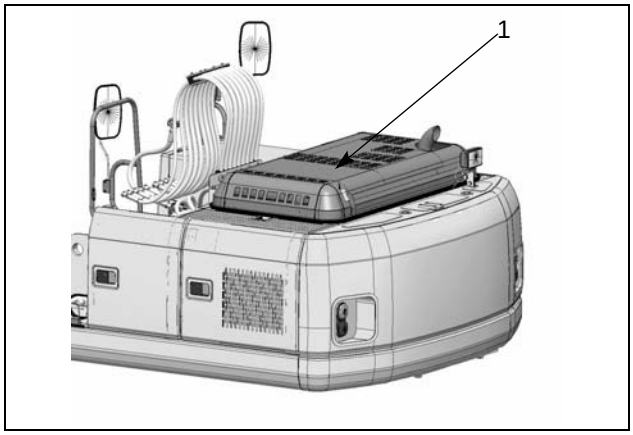
- Filling air conditioner gas
  Fill the air conditioner circuit with air conditioner gas (R134a), using tool **S**.

REMOVAL AND INSTALLATION OF COUNTERWEIGHT

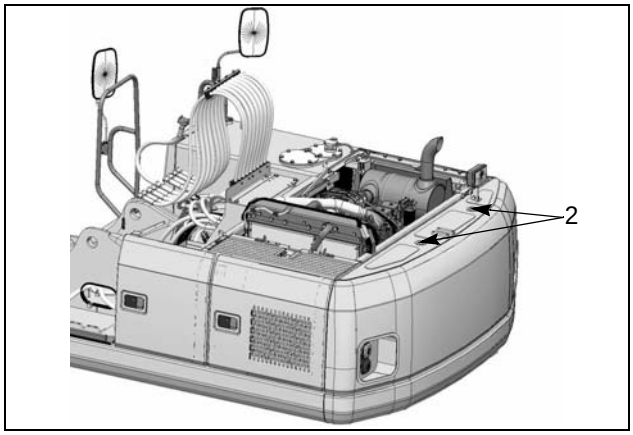
★ Before beginning with removal of all the counterweight make sure all electrical connectors are disconnected.
★ Attach tags to all wires to avoid confusion when installing counterweight.

REMOVAL

1. Open hood (1) and remove (see page 30- 27).

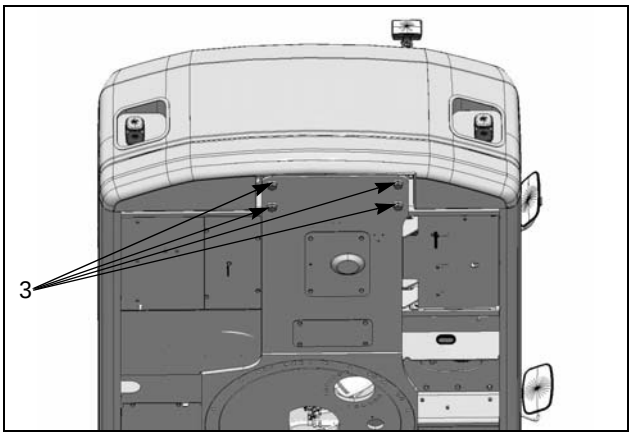


2. Remove caps (2) from counterweight.



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

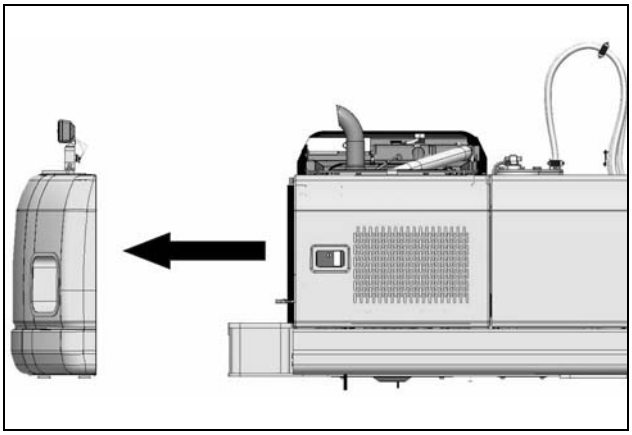
4. Loosen 4 bolts (3).



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)

N·m 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.

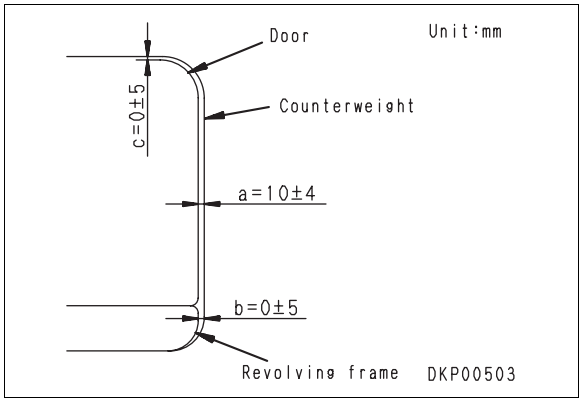
✔ Clearance from revolving frame:
10 ± 5 mm (left and right)

✔ 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



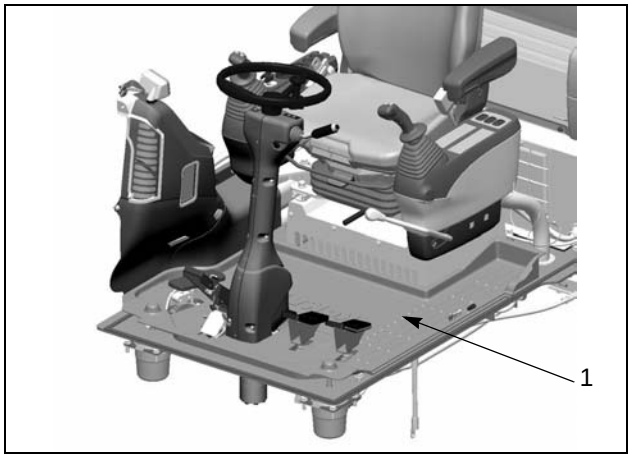
REMOVAL AND INSTALLATION OF OPERATOR CAB ASSEMBLY

REMOVAL

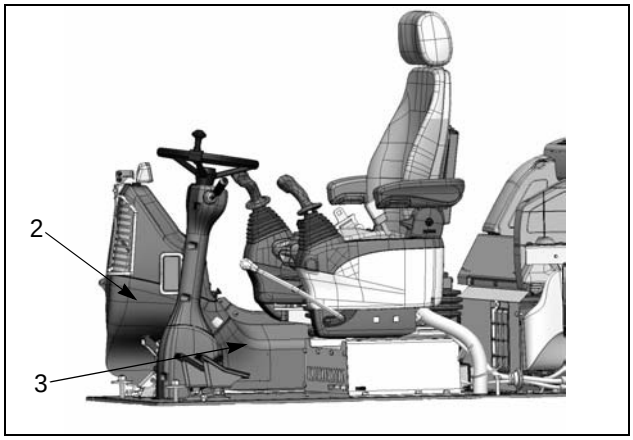
⚠ First, disconnect the cable from the negative terminal (-) of the battery.

⚠ 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).

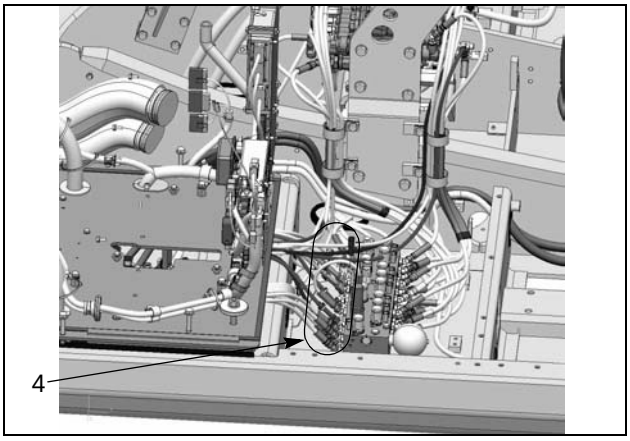


2. Remove covers (2) and (3) under the monitor panel.
   - When removing cover (2), first disconnect the M19 wiring for cigarette lighter.

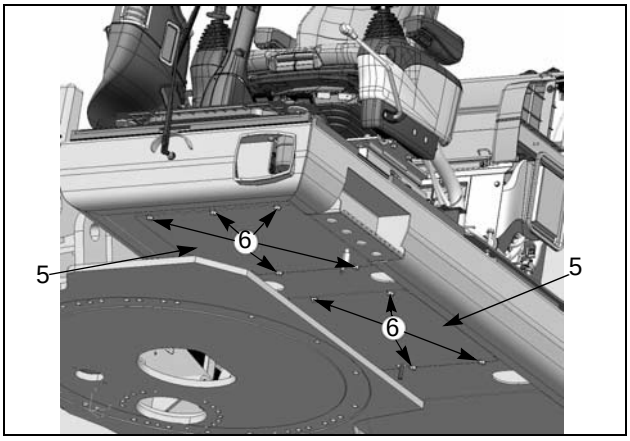


3. Remove air conditioner unit, for details See “AIR CONDITIONER UNIT ASSEMBLY” on page 20-224.

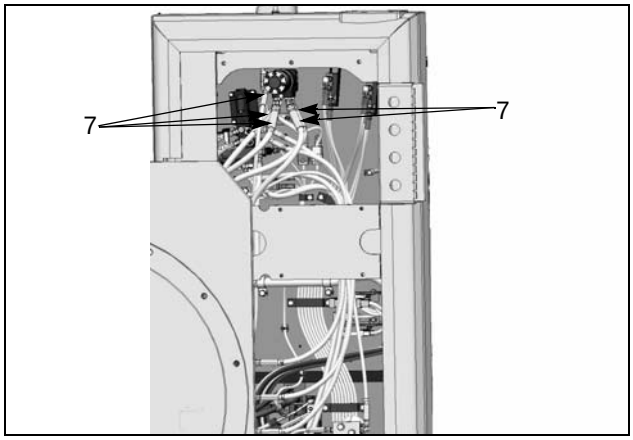
4. Disconnect all hoses at (4).



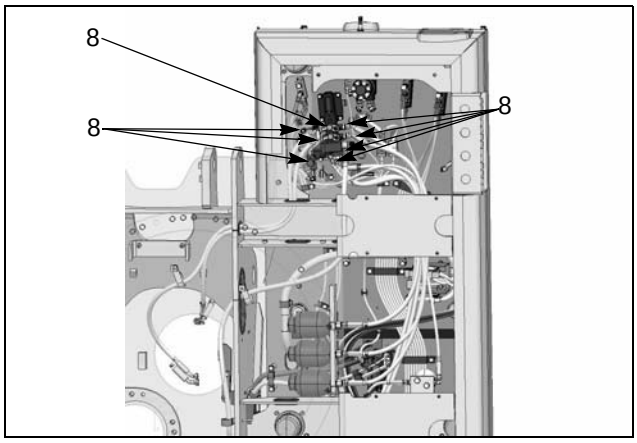
5. Remove plate (5) by removing bolts (6).



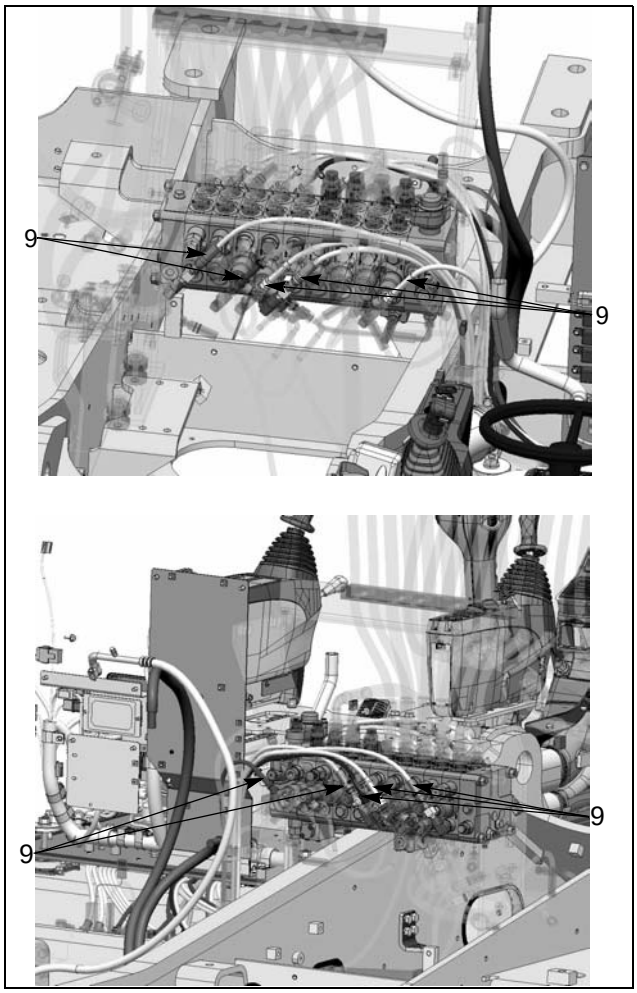
6. Disconnect hoses (7) from orbitrol valve.



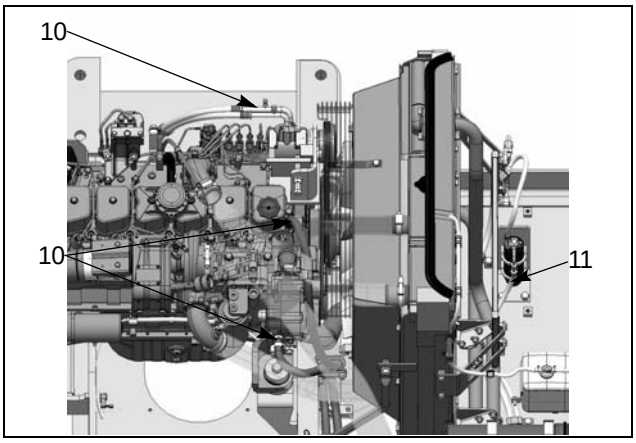
7. Disconnect hoses (8) from brake valve.



8. Remove 10 hoses from control valve (9).



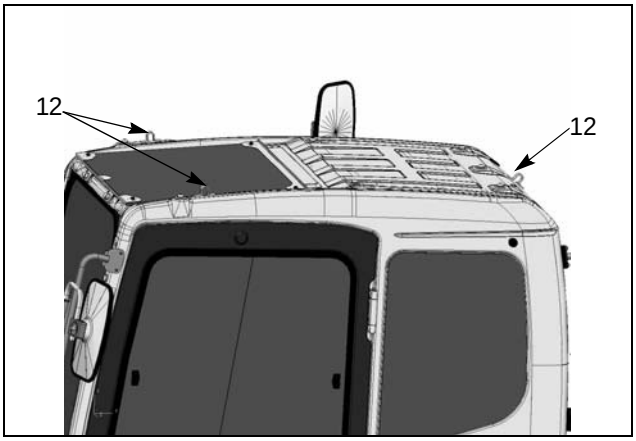
9. Remove 3 hoses (10) from engine and 1 hose from the dryer (11).



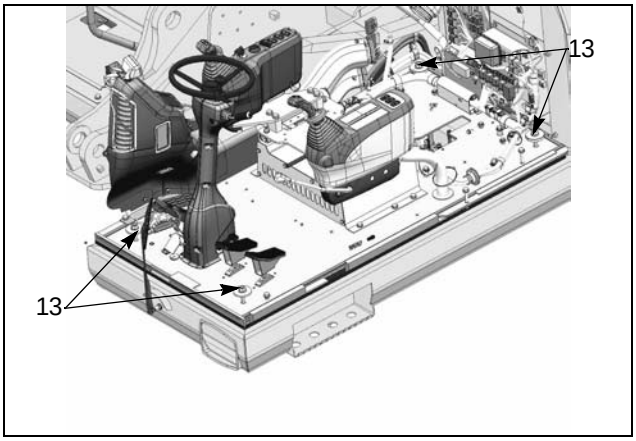
10. Ensure door is securely fastened.

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

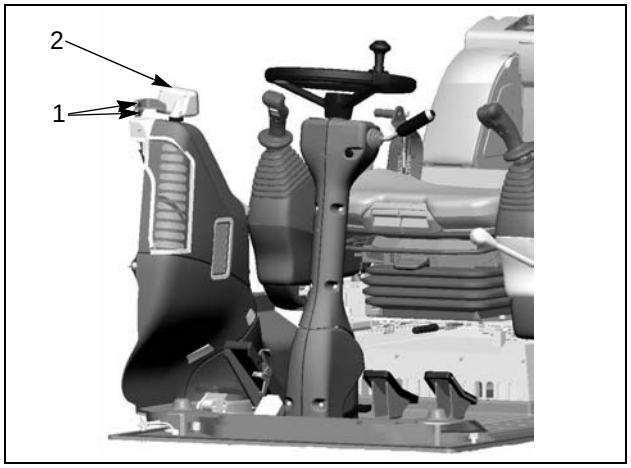
- Install in reverse order of removal.

REMOVAL AND INSTALLATION OF MONITOR ASSEMBLY

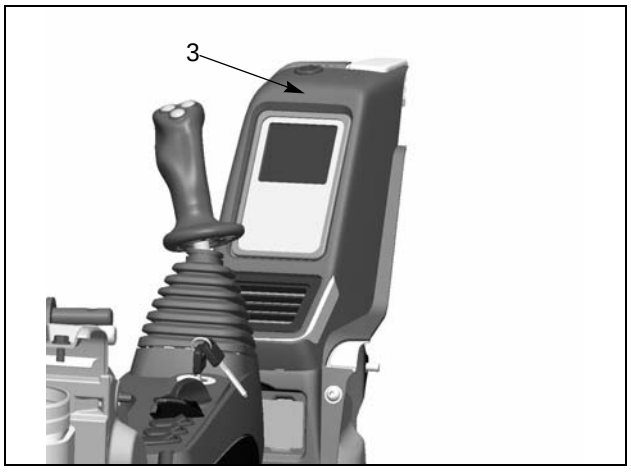
REMOVAL

⚠ First, disconnect the cable from the negative terminal (-) of the battery.

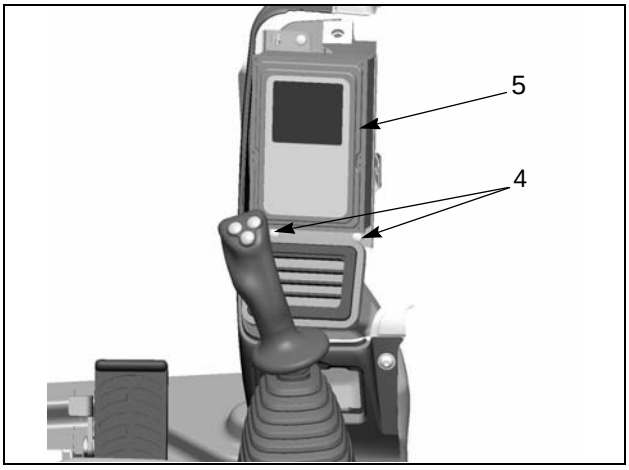
1. Remove 2 bolts (1) from cab wall to remove monitor assembly (2).



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.

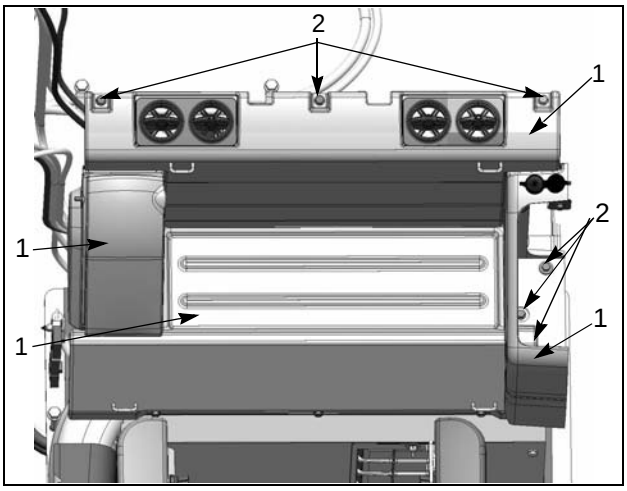
REMOVAL AND INSTALLATION OF GOVERNOR / PUMP CONTROLLER ASSEMBLY

REMOVAL

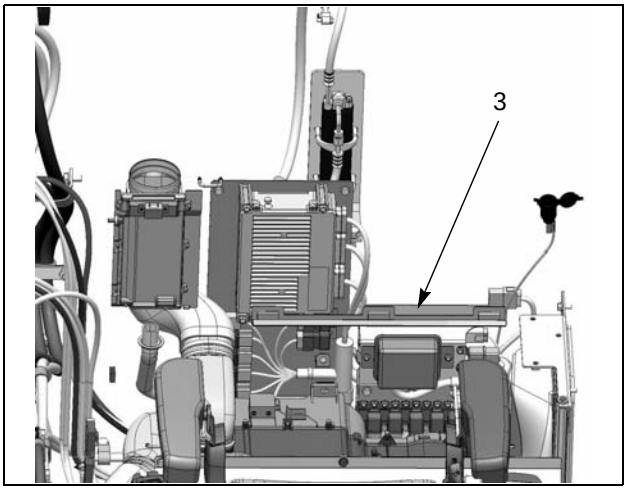


First, disconnect the cable from the negative terminal (-) of the battery. Then disconnect the cable from positive terminal (+) of the battery.

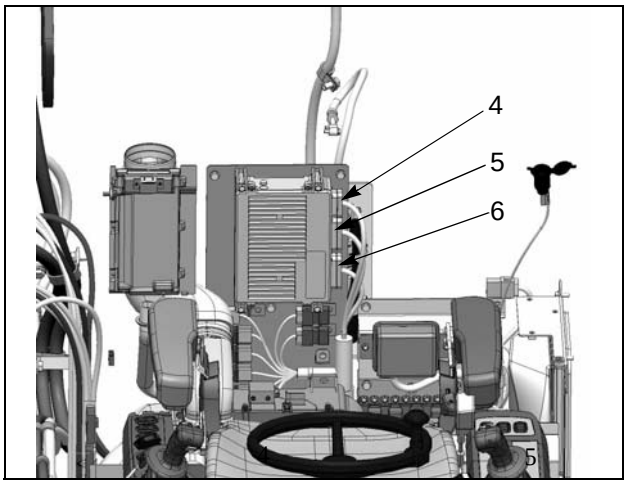
1. Remove covers (1) by removing bolts (2).



2. Remove plate (3).

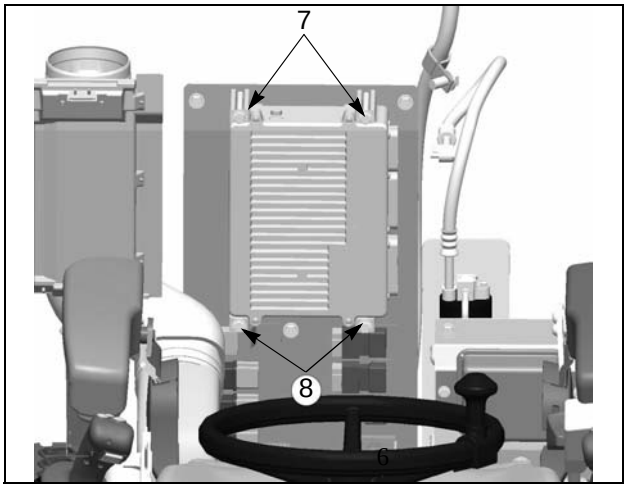


3. Disconnect 3 electrical connectors C01 (4), C02 (5), C03 (6).



4. Make sure controller is fully supported.

5. Remove bolts (7) then remove bolts (8).



6. Carefully remove controller from cab.

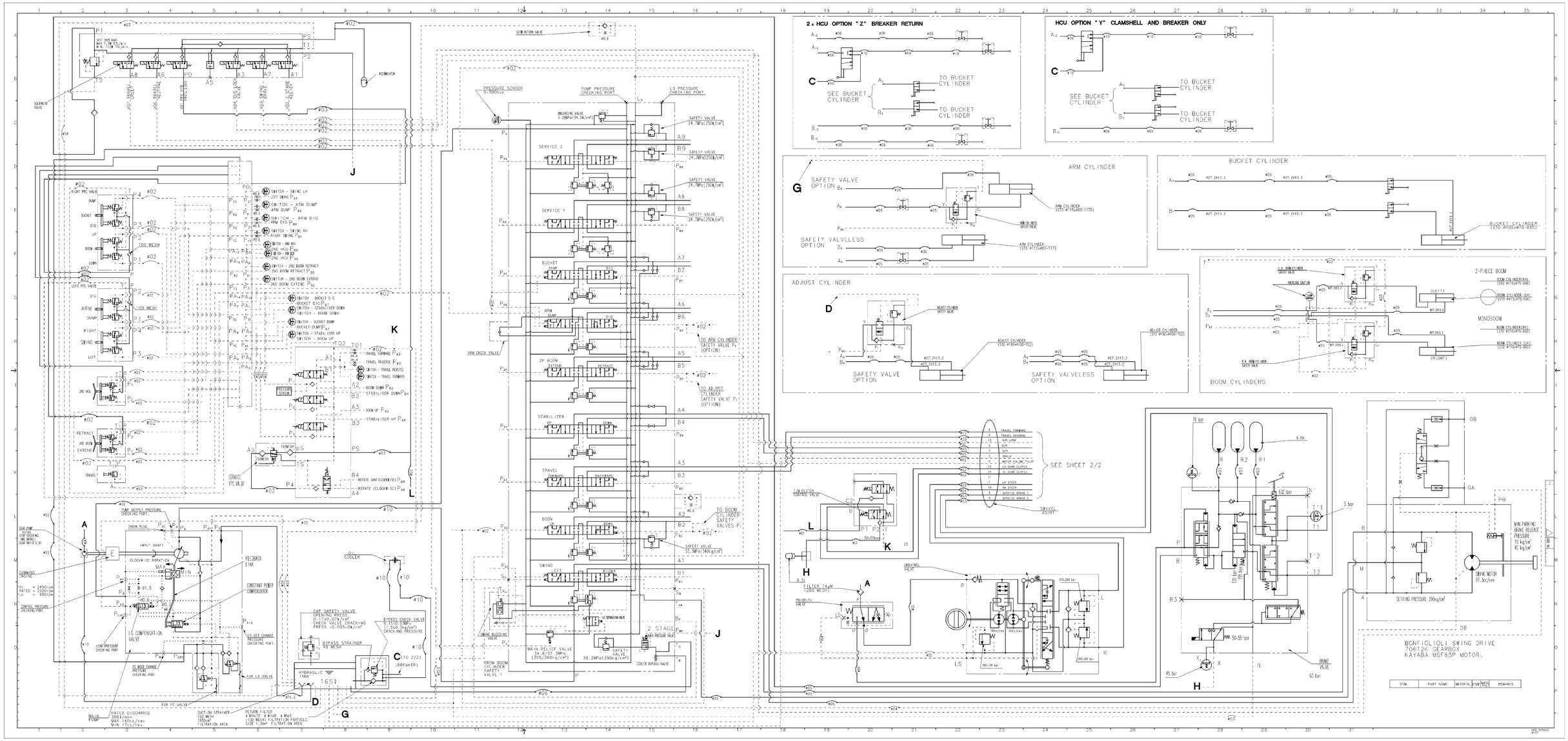
Installation

- Install in reverse order of removal.

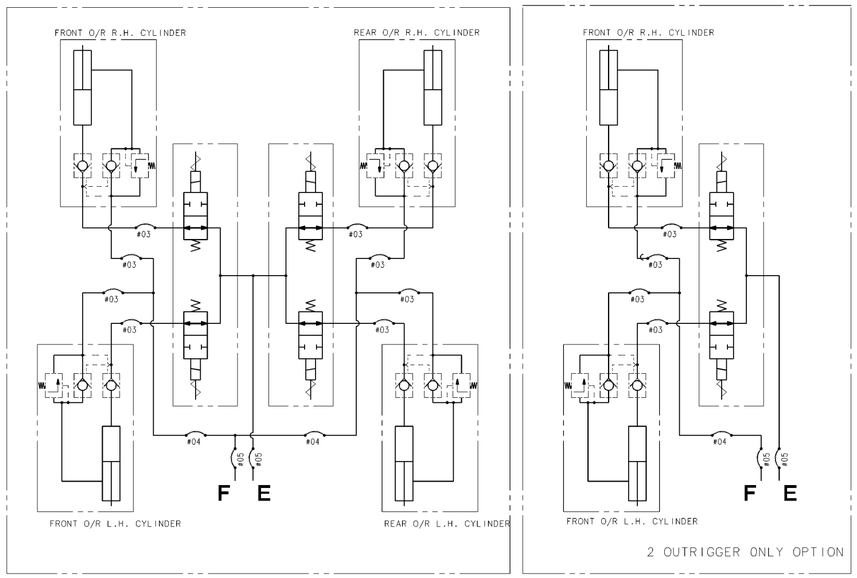
90 OTHERS

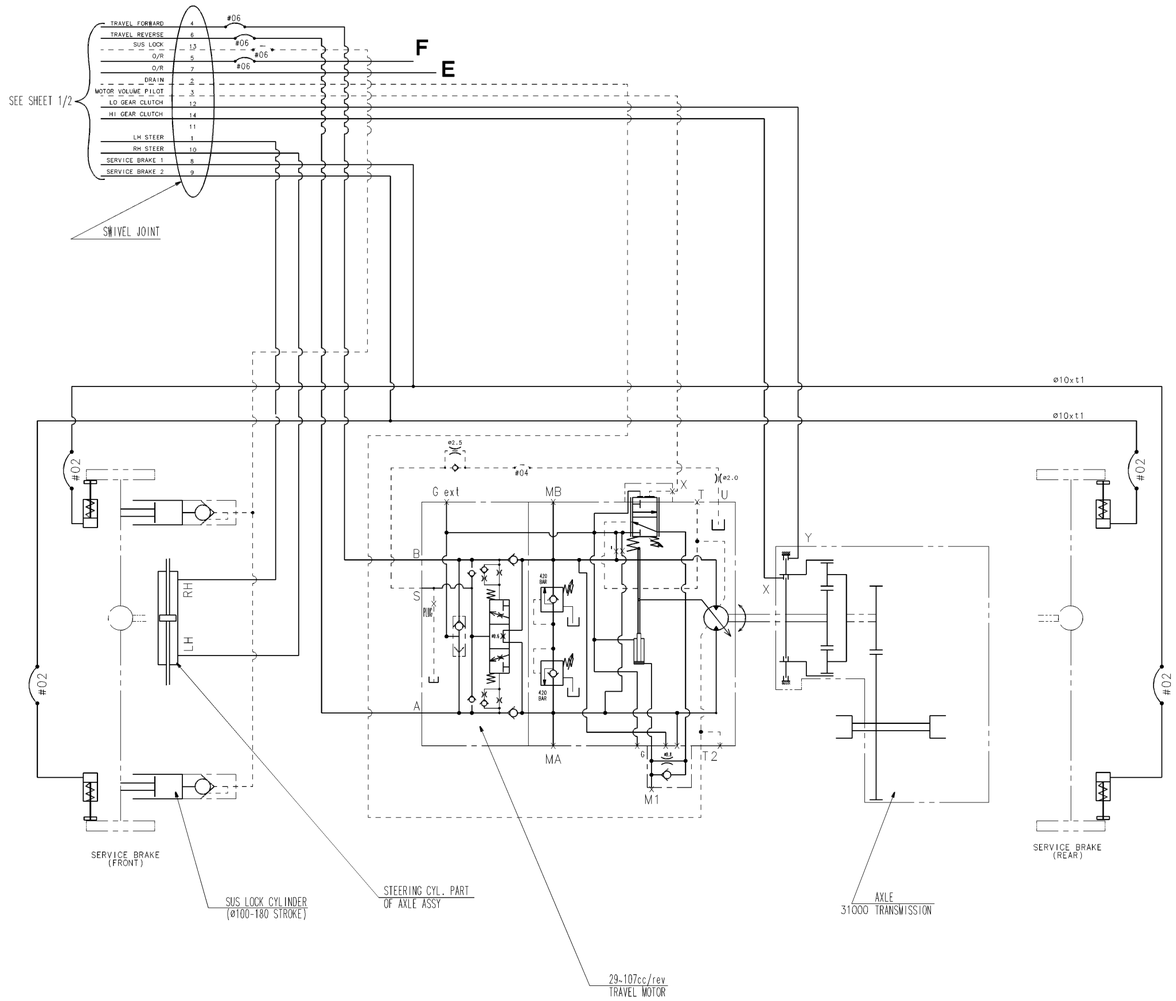
Hydraulic circuit diagram 1/3 90-3
Hydraulic circuit diagram 2/3 90-5
Hydraulic circuit diagram 3/3 90-7
Electrical circuit diagram 1/5. 90-9
Electrical circuit diagram 2/5. 90-11
Electrical circuit diagram 3/5. 90-13
Electrical circuit diagram 4/5. 90-15
Electrical circuit diagram 5/5. 90-17

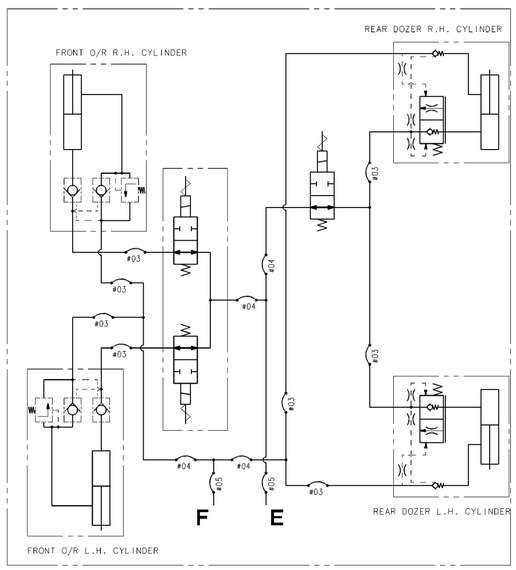
HYDRAULIC CIRCUIT DIAGRAM 1/3

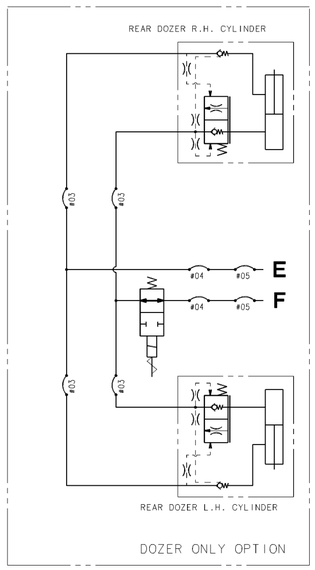


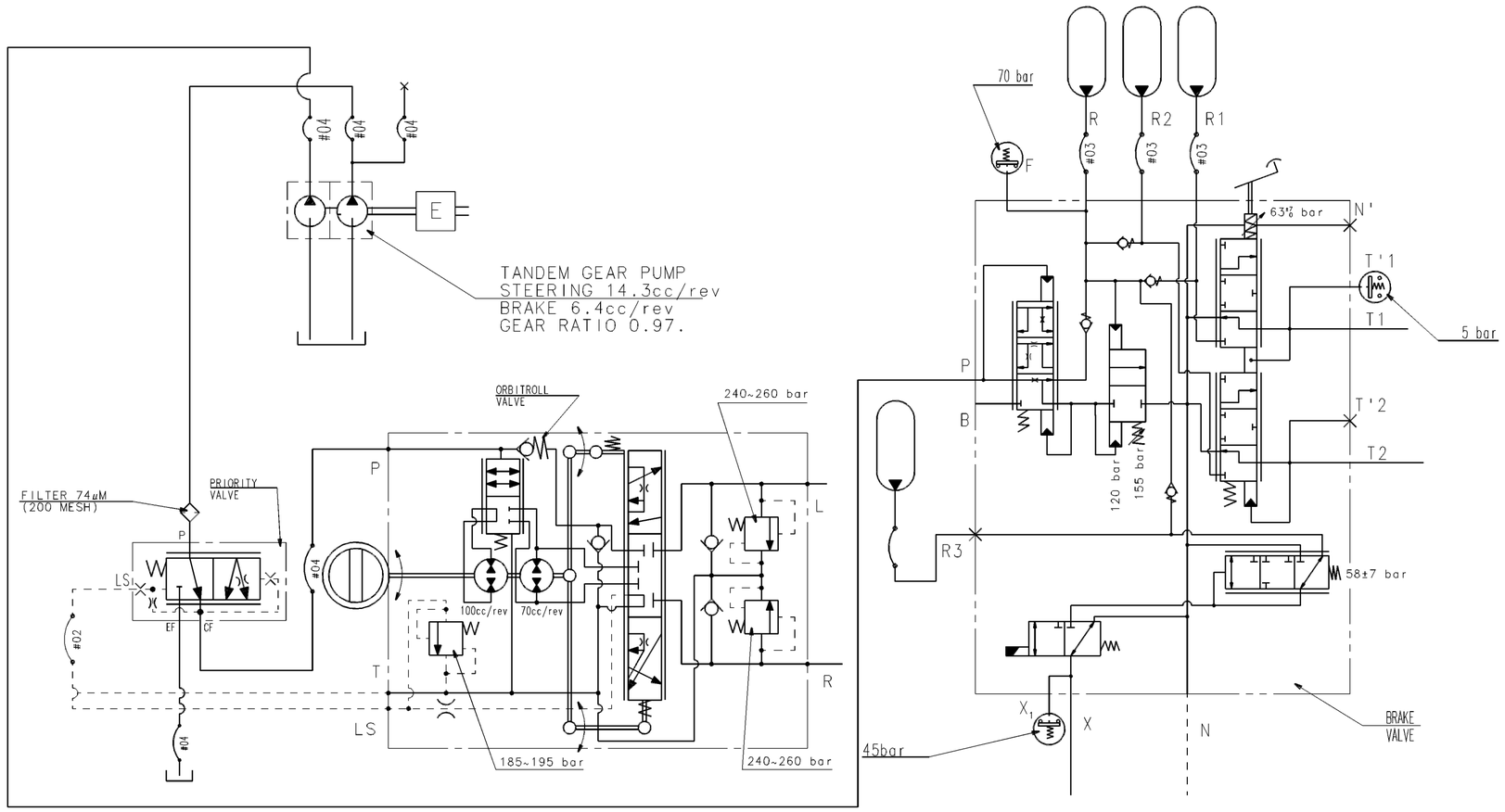
HYDRAULIC CIRCUIT DIAGRAM 2/3





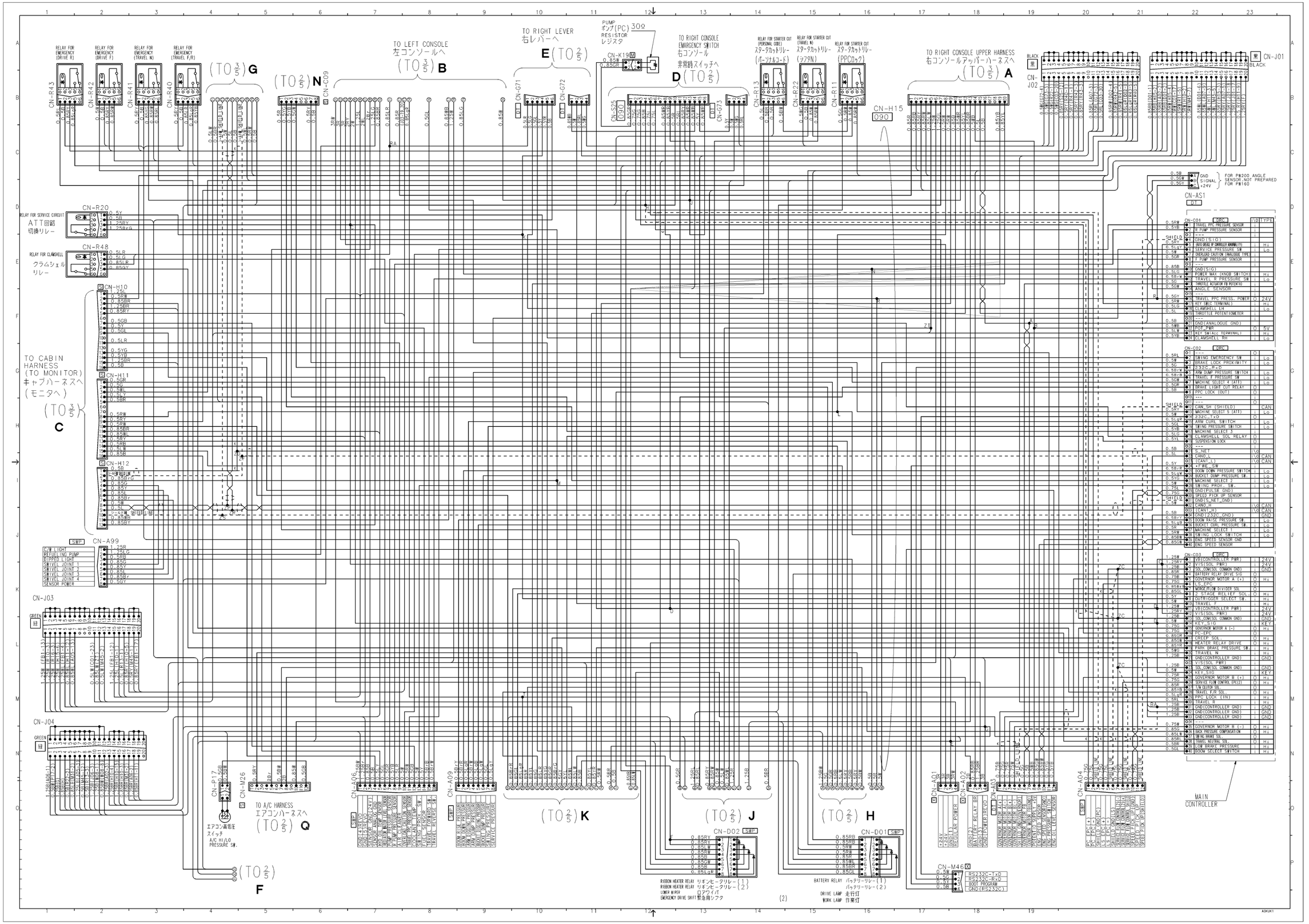




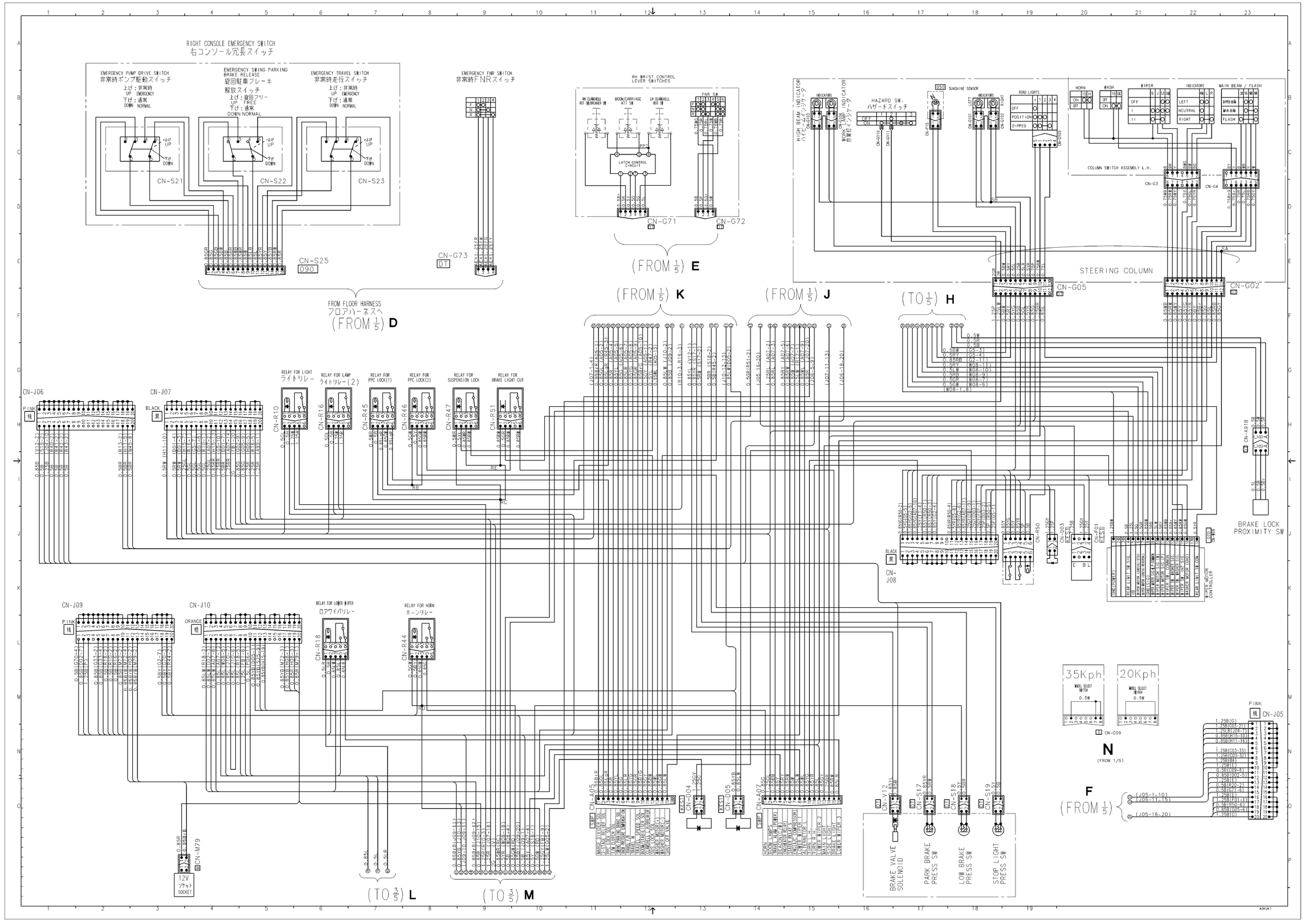


ITALIAN SPEC BRAKE/STEER PIPING

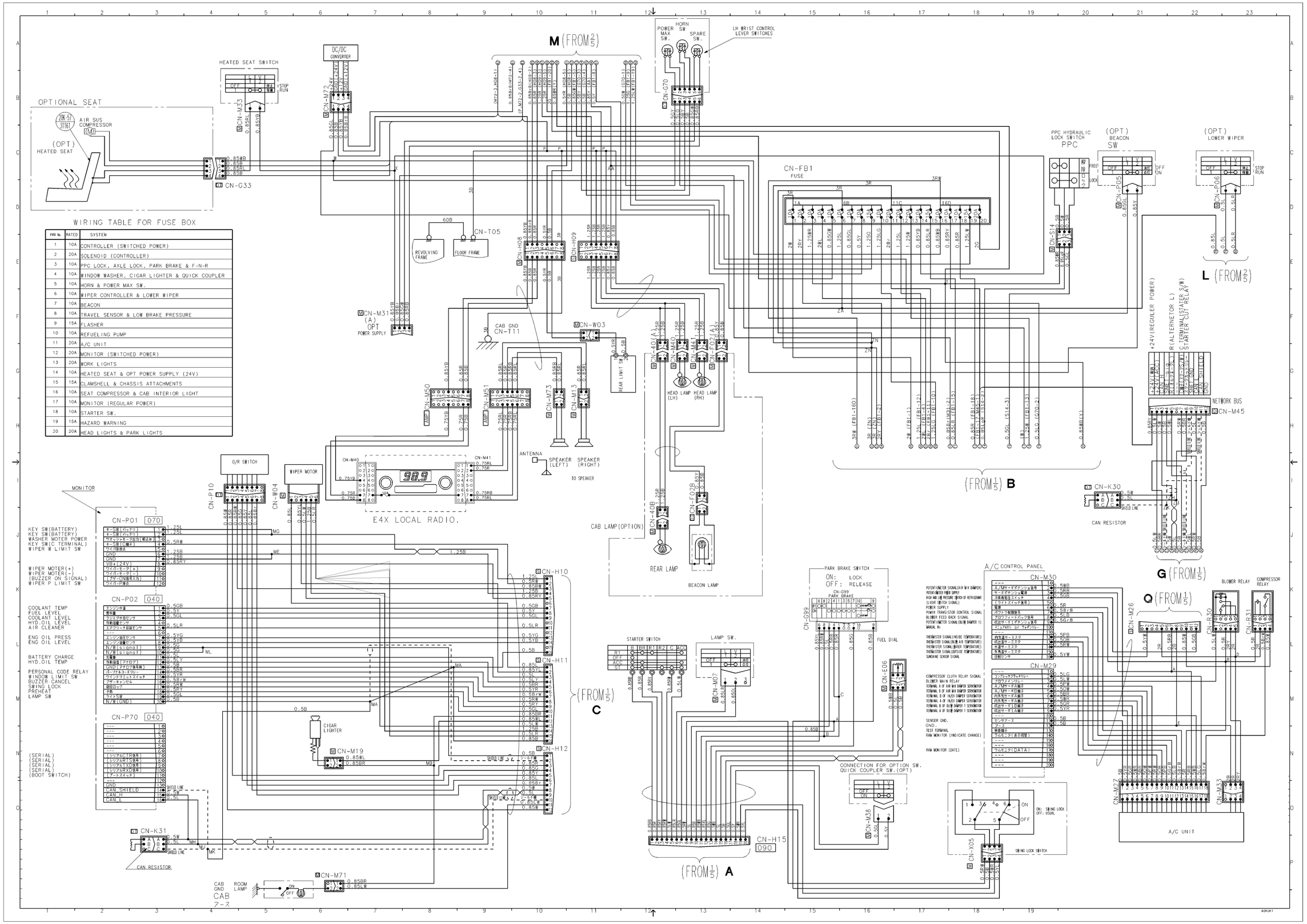
ELECTRICAL CIRCUIT DIAGRAM 1/5



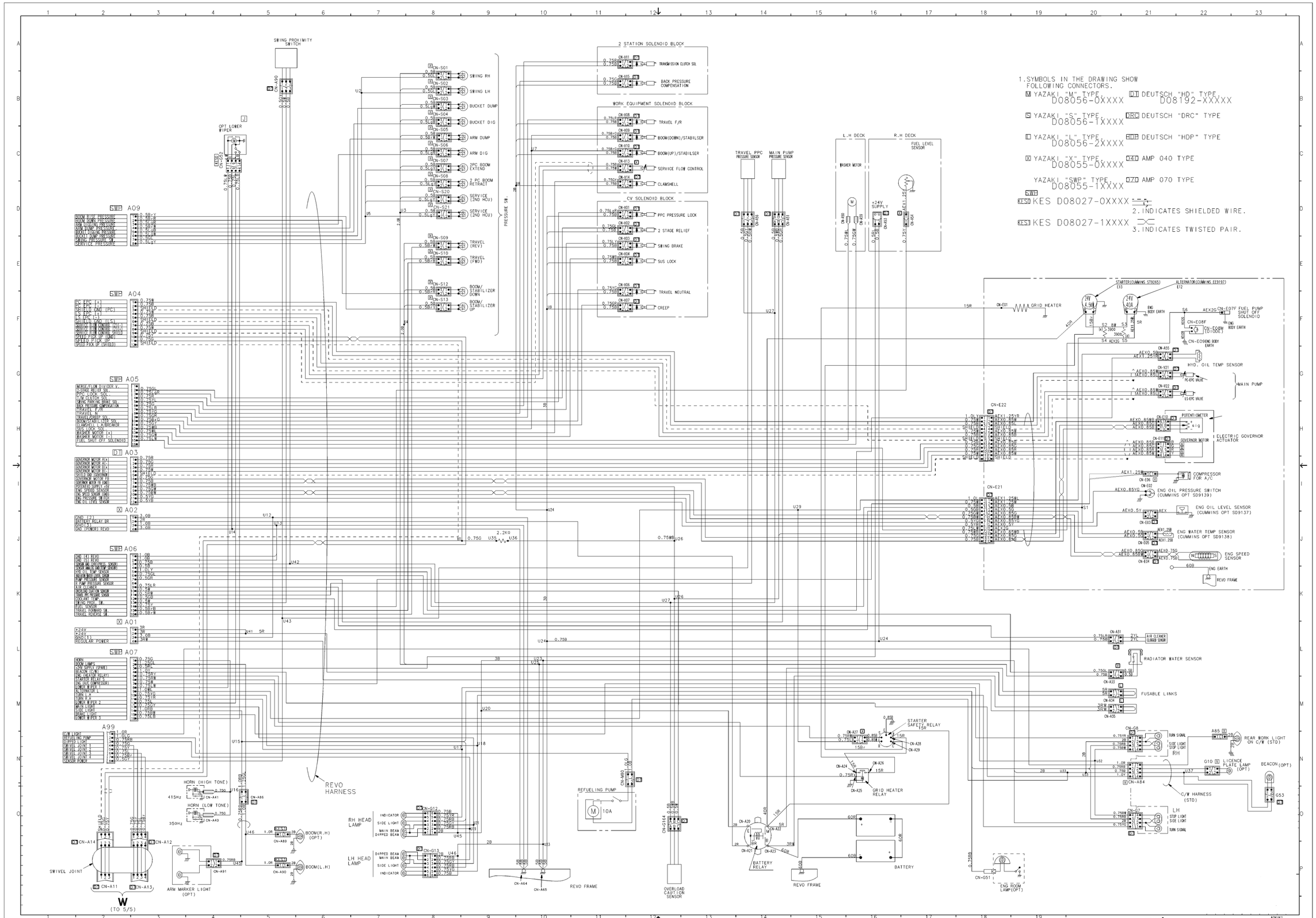
ELECTRICAL CIRCUIT DIAGRAM 2/5



ELECTRICAL CIRCUIT DIAGRAM 3/5



ELECTRICAL CIRCUIT DIAGRAM 4/5



ELECTRICAL CIRCUIT DIAGRAM 5/5

