SHOP MANUAL

KOMATSU

PC400, 400LC-6
PC450, 450LC-6

MACHINE MODEL	SERIAL NUMBER
PC400-6	**32001 and up**
PC400LC-6	**32001 and up**
PC450-6	**12001 and up**
PC450LC-6	**12001 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.

- PC400, 450-6 mount the SA6D125-2 engine.
  For details of the engine, see the 125-2 Series Engine Shop Manual.

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CONTENTS

The affected pages are indicated by the use of the following marks. It is requested that necessary actions be taken to these pages according to the table below.

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

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

LIST OF REVISED PAGE

Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision
●	00- 1	(8)		01- 1			10- 8			10-39			10-65	
	00- 2	(2)		01- 2	(5)		10- 9	(4)		10-40			10-66	
●	00- 2-1	(8)		01- 3	(4)		10-10			10-41			10-67	
●	00- 2-2	(8)		01- 3-1	(5)		10-12	(5)		10-42			10-68	
●	00- 2-3	(8)		01- 4	(5)		10-13	(4)		10-43			10-69	
●	00- 2-4	(8)		01- 5			10-14	(5)		10-44			10-70	
●	00- 2-5	(8)		01- 6			10-15	(5)		10-45			10-71	
●	00- 3			01- 7			10-16	(4)		10-46			10-72	
●	00- 4			01- 7-1	(5)		10-17			10-46-2	(5)		10-73	
●	00- 5			01- 7-2	(5)		10-18			10-46-3	(5)		10-74	
●	00- 6			01- 8	(5)		10-19			10-48			10-75	
●	00- 7			01- 9			10-20			10-49			10-76	
●	00- 8			01-10			10-21			10-50			10-77	
●	00- 9			01-11			10-22			10-51			10-78	
●	00-10			01-11-1	(5)		10-24			10-52			10-80	
●	00-11			01-11-2	(5)		10-25			10-53			10-81	
●	00-12			01-12	(4)		10-26			10-55			10-82	
●	00-13			01-13			10-27			10-56			10-84	
●	00-14						10-28			10-57			10-85	
●	00-15						10-29			10-58	(5)		10-86	
●	00-16			10- 1	(5)		10-30			10-59			10-88	
●	00-17			10- 2			10-31			10-59-1	(5)		10-89	
●	00-18			10- 3			10-32			10-59-2	(5)		10-90	
●	00-19			10- 4			10-33			10-60			10-92	
●	00-20			10- 5			10-34			10-61			10-93	
●	00-21			10- 6			10-35			10-62			10-94	
●	00-22			10- 7	(4)		10-36			10-63			10-96	
				10- 7-1	(4)		10-38	(5)		10-64			10-97	

Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision
	10-98			10-144			10-192			20- 9	(5)		20-119-1	(4)
	10-100			10-145			10-193			20- 9-1	(5)		20-119-2	(4)
	10-101			10-146			10-194			20- 9-2	(5)		20-120	(4)
	10-102			10-147			10-196			20- 9-3	(5)		20-121	(4)
	10-104			10-148			10-197	(6)		20- 9-4	(5)		20-122	(1)
	10-105			10-149			10-198			20- 9-5	(5)		20-123	(1)
	10-106			10-151			10-199			20- 9-6	(5)		20-124	(1)
	10-108			10-152			10-200			20- 9-7	(5)		20-125	(1)
	10-109			10-153			10-201			20- 9-8	(5)		20-126	(1)
	10-110			10-154			10-202			20-10	(1)		20-127	(1)
	10-112			10-155			10-203			20-11	(1)		20-128	(4)
	10-113			10-156			10-204			20-12	(6)		20-129	(1)
	10-114			10-157			10-205	(6)		20-13	(6)		20-130	(1)
	10-116			10-158			10-206			20-14	(6)		20-131	(1)
	10-117			10-159			10-207			20-15	(6)		20-132	(1)
	10-118			10-160			10-208	(6)		20-16	(1)		20-133	(1)
	10-120			10-162			10-209	(6)		20-17	(1)		20-134	(1)
	10-121			10-163	(4)		10-210	(6)		20-18	(1)		20-135	(1)
	10-122			10-164			10-212						20-136	(4)
	10-123			10-165			10-213			20-101	(1)		20-137	(7)
	10-124			10-166			10-214			20-102	(1)		20-138	(4)
	10-125			10-168			10-215			20-103	(4)		20-139	(1)
	10-126	(4)		10-169			10-216			20-104	(1)			
	10-127	(4)		10-170			10-217			20-105	(1)		20-201	(6)
	10-128			10-171			10-218			20-106	(1)		20-202	(1)
	10-129			10-172			10-219			20-107	(1)		20-203	(1)
	10-130			10-173	(6)		10-220			20-108	(1)		20-204	(1)
	10-131			10-178	(6)		10-221			20-109	(1)		20-205	(1)
	10-132			10-179	(6)		10-222			20-110	(1)		20-206	(1)
	10-133			10-180	(6)		10-223			20-111	(1)		20-207	(1)
	10-134			10-181	(6)					20-112	(1)		20-208	(1)
	10-135			10-182	(6)					20-113	(1)		20-209	(1)
	10-136			10-183			20- 1	(4)		20-114	(4)		20-210	(1)
	10-137	(4)		10-185			20- 2	(4)		20-114-1	(4)		20-211	(1)
	10-138	(4)		10-186			20- 3	(5)		20-115	(1)		20-212	(1)
	10-139			10-187			20- 4	(5)		20-116	(1)		20-214	(6)
	10-140			10-188	(6)		20- 5	(1)		20-117	(4)		20-215	(4)
	10-141			10-189			20- 6	(1)		20-117-1	(4)		20-216	(1)
	10-142			10-190			20- 7	(1)		20-118	(1)		20-217	(1)
	10-143			10-191			20- 8	(1)		20-119	(4)		20-218	(1)

Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision
	20-219	(1)		20-357	(1)		20-416	(1)		20-483	(6)		20-561	(1)
	20-220	(1)		20-358	(6)		20-417	(1)		20-484	(6)		20-562	(1)
	20-221	(1)		20-359	(6)		20-418	(1)		20-485	(6)		20-564	(1)
	20-222	(1)		20-360	(1)		20-419	(1)		20-486	(6)		20-565	(1)
	20-223	(1)		20-361	(1)		20-420	(1)		20-487	(6)		20-566	(1)
	20-224	(1)		20-362	(6)		20-421	(1)		20-488	(1)		20-567	(1)
	20-225	(1)		20-363	(6)		20-422	(1)		20-489	(6)		20-568	(1)
	20-226	(1)		20-364	(6)		20-423	(1)		20-490	(6)		20-569	(1)
	20-227	(1)		20-365	(6)					20-491	(6)		20-570	(1)
	20-228	(1)		20-366	(6)		20-451	(6)		20-492	(6)		20-571	(1)
	20-229	(6)		20-367	(6)		20-452	(1)		20-493	(6)		20-572	(1)
	20-230	(6)		20-368	(6)		20-454	(6)		20-494	(6)		20-573	(1)
	20-231	(1)		20-370	(1)		20-455	(1)		20-495	(1)		20-574	(1)
	20-232	(1)		20-371	(1)		20-456	(6)		20-496	(1)		20-575	(1)
	20-233	(6)		20-372	(1)		20-457	(1)					20-576	(1)
	20-234	(6)		20-373	(1)		20-458	(6)		20-501	(6)		20-577	(1)
	20-235	(6)		20-374	(1)		20-459	(1)		20-502	(4)		20-578	(1)
	20-236	(6)		20-375	(1)		20-460	(6)		20-503	(1)		20-579	(1)
	20-237	(1)		20-376	(1)		20-461	(1)		20-504	(6)		20-580	(1)
	20-238	(4)		20-377	(1)		20-462	(6)		20-505	(6)		20-581	(1)
	20-239	(6)		20-378	(1)		20-463	(6)		20-506	(6)		20-582	(1)
	20-240	(6)		20-379	(6)		20-464	(4)		20-507	(6)		20-583	(1)
	20-241	(6)		20-380	(6)		20-465	(1)		20-508	(1)		20-584	(1)
	20-242	(6)		20-381	(1)		20-466	(6)		20-509	(6)		20-585	(1)
	20-243	(6)					20-467	(6)		20-510	(6)			
	20-244	(6)		20-401	(1)		20-468	(6)		20-511	(6)		20-601	(1)
	20-245	(6)		20-402	(1)		20-469	(6)		20-512	(6)		20-602	(1)
	20-246	(1)		20-403	(1)		20-470	(6)		20-513	(6)		20-604	(4)
	20-247	(1)		20-404	(1)		20-471	(6)		20-514	(6)		20-605	(1)
	20-248	(1)		20-405	(1)		20-472	(6)					20-606	(4)
				20-406	(1)		20-473	(6)		20-551	(1)		20-607	(1)
	20-301	(1)		20-407	(1)		20-474	(6)		20-552	(1)		20-607-1	(4)
	20-302	(6)		20-408	(1)		20-475	(6)		20-553	(1)		20-607-2	(4)
	20-303	(6)		20-409	(1)		20-476	(6)		20-554	(1)		20-608	(1)
				20-410	(1)		20-477	(6)		20-555	(1)		20-609	(1)
	20-351	(6)		20-411	(1)		20-478	(1)		20-556	(1)		20-610	(1)
	20-352	(6)		20-412	(1)		20-479	(6)		20-557	(1)		20-611	(1)
	20-354	(1)		20-413	(1)		20-480	(1)		20-558	(1)		20-612	(1)
	20-355	(1)		20-414	(1)		20-481	(6)		20-559	(1)		20-613	(1)
	20-356	(6)		20-415	(1)		20-482	(6)		20-560	(1)		20-614	(1)

Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision
	20-615	(6)		30- 7	(3)		30-37	(2)		30-59-16	(3)		30-89	(2)
	20-616	(6)		30- 8	(3)		30-38	(2)		30-60	(2)		30-90	(2)
	20-617	(6)		30- 9	(3)		30-39	(2)		30-61	(2)		30-91	(2)
	20-618	(6)		30-9-1	(3)		30-40	(2)		30-61-1	(6)		30-92	(2)
	20-619	(6)		30-9-2	(3)		30-41	(4)		30-61-2	(6)		30-93	(4)
	20-620	(6)		30-9-3	(6)		30-42	(2)		30-61-3	(6)		30-94	(2)
	20-621	(6)		30-10	(2)		30-43	(2)		30-61-4	(6)		30-94-1	(3)
	20-622	(6)		30-10	(2)		30-44	(2)		30-61-5	(6)		30-94-2	(3)
	20-623	(6)		30-11	(2)		30-45	(2)		30-61-6	(6)		30-94-3	(3)
	20-624	(6)		30-11-1	(3)		30-46	(4)		30-61-7	(6)		30-94-4	(3)
	20-625	(6)		30-11-2	(3)		30-47	(4)		30-61-8	(6)		30-94-5	(3)
	20-626	(6)		30-11-3	(3)		30-47-1	(4)		30-61-9	(6)		30-94-6	(3)
	20-627	(1)		30-11-4	(6)		30-47-2	(4)		30-61-10	(6)		30-94-7	(3)
	20-628	(6)		30-11-5	(6)		30-48	(4)		30-62	(2)		30-94-8	(3)
	20-629	(6)		30-11-6	(6)		30-49	(2)		30-63	(2)		30-94-9	(3)
	20-630	(6)		30-12	(2)		30-50	(2)		30-64	(2)		30-94-10	(3)
	20-631	(6)		30-13	(2)		30-51	(2)		30-65	(2)		30-94-11	(3)
	20-632	(1)		30-14	(2)		30-52	(2)		30-66	(2)		30-94-12	(3)
	20-633	(1)		30-15	(2)		30-53	(2)		30-67	(2)		30-94-13	(3)
	20-634	(1)		30-16	(2)		30-54	(2)		30-68	(2)		30-94-14	(3)
	20-635	(1)		30-17	(2)		30-55	(2)		30-69	(2)		30-94-15	(3)
	20-636	(1)		30-18	(2)		30-56	(2)		30-70	(2)		30-94-16	(3)
	20-638	(1)		30-19	(2)		30-57	(2)		30-71	(2)		30-94-17	(3)
	20-639	(4)		30-20	(2)		30-58	(2)		30-72	(4)		30-94-18	(3)
	20-640	(4)		30-21	(2)		30-59	(2)		30-73	(4)		30-94-19	(3)
	20-641	(4)		30-22	(2)		30-59-1	(3)		30-74	(4)		30-94-20	(3)
	20-641-1	(4)		30-23	(2)		30-59-2	(3)		30-75	(2)		30-94-21	(3)
	20-642	(4)		30-24	(2)		30-59-3	(3)		30-76	(2)		30-95	(2)
	20-643	(4)		30-25	(2)		30-59-4	(3)		30-77	(2)		30-96	(2)
	20-644	(4)		30-26	(2)		30-59-5	(3)		30-78	(2)		30-97	(2)
	20-645	(4)		30-27	(2)		30-59-6	(3)		30-79	(4)		30-98	(2)
	20-646	(4)		30-28	(2)		30-59-7	(3)		30-80	(4)		30-99	(2)
				30-29	(2)		30-59-8	(3)		30-81	(2)		30-100	(2)
				30-30	(2)		30-59-9	(3)		30-82	(2)		30-101	(2)
	30- 1	(6)		30-31	(2)		30-59-10	(3)		30-83	(2)		30-102	(2)
	30- 2	(3)		30-32	(2)		30-59-11	(3)		30-84	(2)		30-103	(2)
	30- 3	(2)		30-33	(2)		30-59-12	(3)		30-85	(2)		30-104	(2)
	30- 4	(2)		30-34	(2)		30-59-13	(3)		30-86	(2)		30-105	(2)
	30- 5	(2)		30-35	(2)		30-59-14	(3)		30-87	(2)		30-106	(2)
	30- 6	(2)		30-36	(2)		30-59-15	(3)		30-88	(2)		30-107	(2)

Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision	Mark	Page	Time of revision
	30-108	(2)		30-148	(2)		40-23			90-15	(5)			
	30-109	(2)		30-149	(2)		40-24			90-17	(5)			
	30-110	(2)		30-150	(2)		40-25			90-19	(5)			
	30-111	(2)		30-151	(2)		40-26			90-21	(5)			
	30-112	(2)		30-152	(2)		40-27							
	30-113	(2)		30-153	(2)		40-28							
	30-114	(2)		30-154	(2)		40-29							
	30-115	(2)		30-155	(2)		40-30							
	30-116	(2)		30-156	(2)		40-31							
	30-117	(4)		30-157	(2)		40-32							
	30-118	(2)		30-158	(2)		40-33							
	30-119	(4)		30-159	(2)		40-34							
	30-120	(2)		30-160	(2)		40-35							
	30-121	(2)		30-161	(2)		40-36							
	30-122	(2)		30-162	(2)		40-37							
	30-123	(2)		30-163	(2)		40-38	(4)						
	30-124	(2)		30-164	(2)		40-40	(4)						
	30-125	(2)					40-40-1	(4)						
	30-126	(2)					40-41							
	30-127	(2)	●	40- 1	(8)		40-42	(5)						
	30-128	(2)		40- 2			40-43							
	30-129	(2)		40- 4			40-43-1	(5)						
	30-130	(2)		40- 5			40-44	(5)						
	30-131	(2)		40- 6	(4)		40-45							
	30-132	(2)		40- 7	(4)		40-45-1	(5)						
	30-133	(2)		40- 8			40-45-2	(5)						
	30-134	(2)		40- 9			40-46							
	30-135	(2)	○	40- 9-1	(8)		40-47							
	30-136	(2)	○	40- 9-2	(8)		40-48							
	30-137	(2)		40-10			40-49							
	30-138	(2)		40-12										
	30-139	(2)		40-13										
	30-140	(2)		40-14			90- 1	(5)						
	30-141	(2)		40-15			90- 3							
	30-142	(2)		40-16			90- 3-2	(5)						
	30-143	(2)		40-17			90- 5							
	30-144	(2)		40-18			90- 7							
	30-145	(2)		40-19			90- 9							
	30-146	(2)		40-20			90-11	(4)						
	30-147	(2)		40-22			90-13	(4)						

SAFETY

SAFETY NOTICE

IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for safe machine operation. The service and repair techniques recommended by Komatsu and described in this manual are both effective and safe. Some of these techniques require the use of tools specially designed by Komatsu for the specific purpose.

To prevent injury to workers, the symbol ⚠ is used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.

GENERAL PRECAUTIONS

Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions given on the decals which are fixed to the machine.
2. When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
    - Always wear safety glasses when hitting parts with a hammer.
    - Always wear safety glasses when grinding parts with a grinder, etc.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, hand shield, cap and other clothes suited for welding work.
4. When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.
5. Keep all tools in good condition and learn the correct way to use them.
6. Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

PREPARATIONS FOR WORK

7. Before adding oil or making any repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.
8. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground. If this is not possible, insert the safety pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.
9. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
10. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out.
    Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.
12. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned.
    Wait for the oil and water to cool before carrying out any work on the oil or water circuits.
13. Before starting work, remove the leads from the battery. Always remove the lead from the negative (–) terminal first.
14. When raising heavy components, use a hoist or crane.
    Check that the wire rope, chains and hooks are free from damage.
    Always use lifting equipment which has ample capacity.
    Install the lifting equipment at the correct places.
    Use a hoist or crane and operate slowly to prevent the component from hitting any other part.
    Do not work with any part still raised by the hoist or crane.
15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.
16. When removing components, be careful not to break or damage the wiring. Damaged wiring may cause electrical fires.
17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips onto the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip, or can even start fires.
18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.
19. Be sure to assemble all parts again in their original places.
    Replace any damaged parts with new parts.
    - When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is being operated.
20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. Also, check that connecting parts are correctly installed.
21. When assembling or installing parts, always use the specified tightening torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.
22. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.
23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.
24. Take care when removing or installing the tracks of track-type machines.
    When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.

FOREWORD

GENERAL

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

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

STRUCTURE AND FUNCTION

This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.
In addition, this section may contain hydraulic circuit diagrams, electric circuit diagrams, and maintenance standards.

TESTING AND ADJUSTING

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

DISASSEMBLY AND ASSEMBLY

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

MAINTENANCE STANDARD

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

OTHERS

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

NOTICE

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

HOW TO READ THE SHOP MANUAL

VOLUMES

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

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

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

DISTRIBUTION AND UPDATING

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

FILING METHOD

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

   10 - 3
   Item number (10. Structure and Function)
   Consecutive page number for each item.

   Example 2 (Engine volume):

   12 - 5
   Unit number (1. Engine)
   Item number (2. Testing and Adjusting)
   Consecutive page number for each item.

3. Additional pages: Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.
   Example:
   10-4 12-203
   10-4-1 12-203-1
   10-4-2 — Added pages — 12-203-2
   10-5 12-204

REVISED EDITION MARK

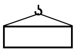
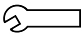
When a manual is revised, an edition mark ((1)(2)(3)....) is recorded on the bottom of the pages.

REVISIONS

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

SYMBOLS

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

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

HOISTING INSTRUCTIONS

HOISTING

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

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

WIRE ROPES

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

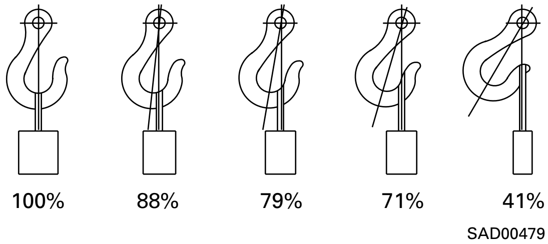
Wire ropes
(Standard "Z" or "S" twist ropes
without galvanizing)

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

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

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

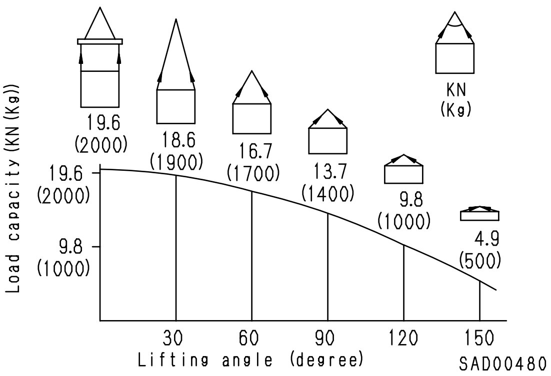
Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result. Hooks have maximum strength at the middle portion.



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

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

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



METHOD OF DISASSEMBLING, CONNECTING PUSH-PULL TYPE COUPLER

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

⚠ Even if the residual pressure is released from the hydraulic tank, some hydraulic oil flows out when the hose is disconnected. Accordingly, prepare an oil receiving container.

Disconnection

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

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

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

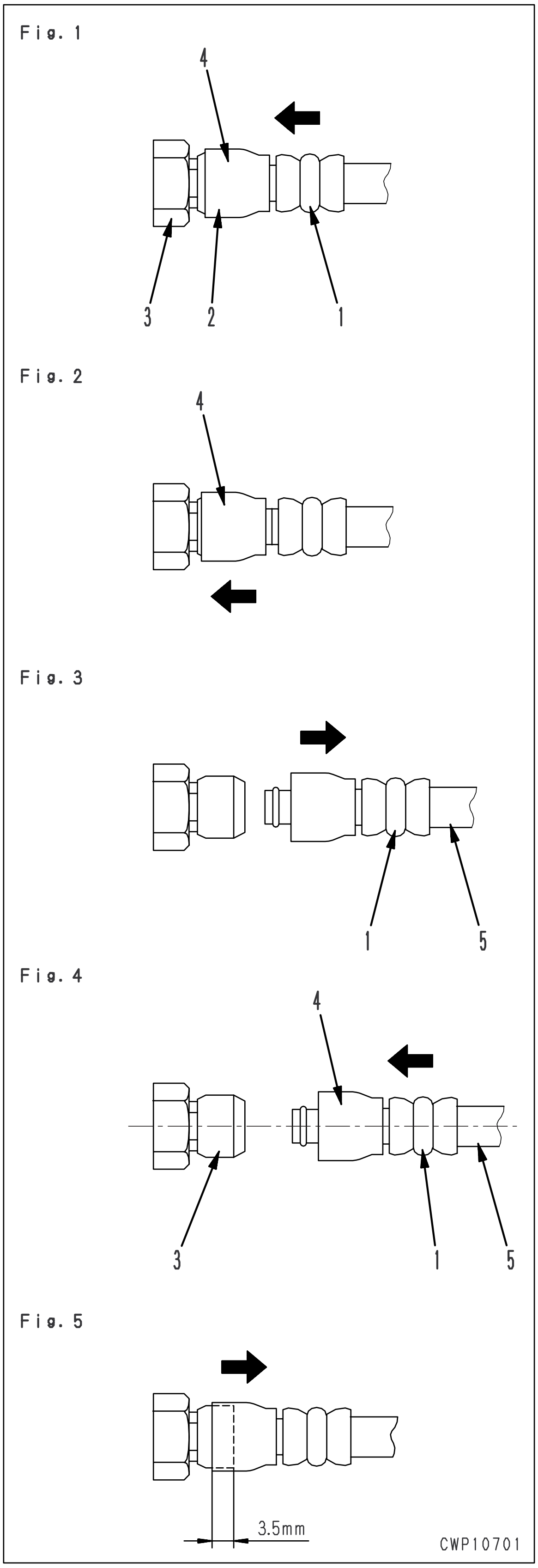
4) Hold hose adapter (1) or hose (5) and pull it out. (See Fig. 3)
   ★ Since some hydraulic oil flows out, prepare an oil receiving container.

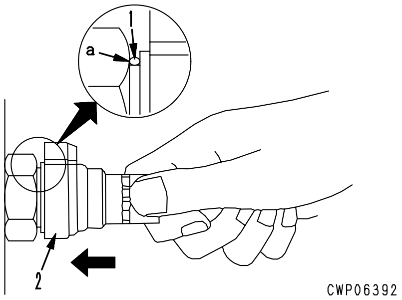
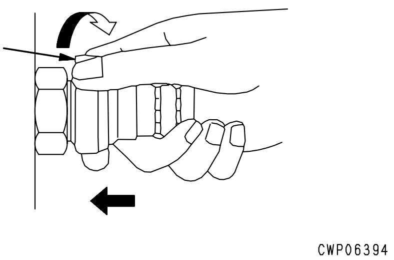
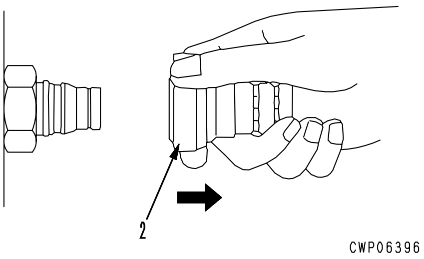
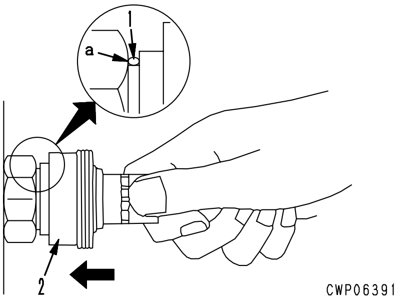
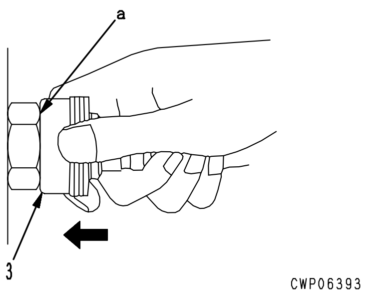
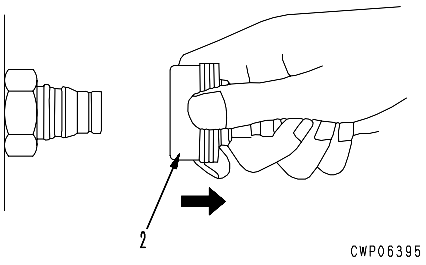
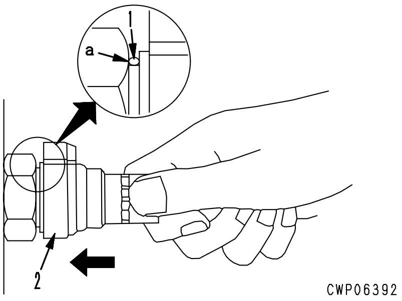
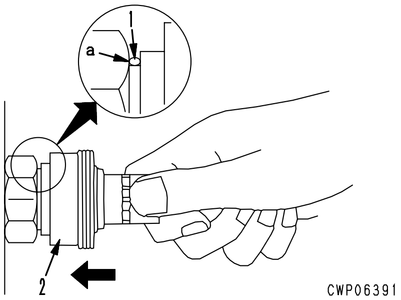
Connection

1) Hold hose adapter (1) or hose (5) and insert it in mating adapter (3), aligning them with each other. (See Fig. 4)
   ★ Do not hold rubber cap portion (4).

2) After inserting the hose in the mating adapter perfectly, pull it back to check its connecting condition. (See Fig. 5)
   ★ When the hose is pulled back, the rubber cap portion moves toward the hose about 3.5 mm. This does not indicate abnormality, however.

Type 1



	Type 2	Type 3
Disassembly	1) Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface **a** of the hexagonal portion at the male end.  2) Hold in the condition in Step 1), and turn lever (4) to the right (clockwise).  3) Hold in the condition in Steps 1) and 2), and pull out whole body (2) to disconnect it.  	1) Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface **a** of the hexagonal portion at the male end.  2) Hold in the condition in Step 1), and push until cover (3) contacts contact surface **a** of the hexagonal portion at the male end.  3) Hold in the condition in Steps 1) and 2), and pull out whole body (2) to disconnect it. 
Connection	• Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface **a** of the hexagonal portion at the male end to connect it.  	• Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface **a** of the hexagonal portion at the male end to connect it. 

COATING MATERIALS

★ The recommended coating materials such as adhesives, gasket sealants and greases used for disassembly and assembly are listed below.
★ For coating materials not listed below, use the equivalent of products shown in this list.

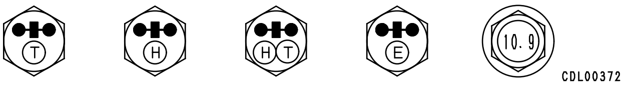
Category	Komatsu code	Part No.	Q'ty	Container	Main applications, featuresr
Adhesives	LT-1A	790-129-9030	150 g	Tube	• Used to prevent rubber gaskets, rubber cushions, and cock plug from coming out.
	LT-1B	790-129-9050	20 g (2 pcs.)	Polyethylene container	• Used in places requiring an immediately effective,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

Category	Komatsu code	Part No.	Q'ty	Container	Main applications, featuresr	
Molybdenum disulphide lubricant	LM-G	09940-00051	60 g	Can	• Used as lubricant for sliding portion (to prevent from squeaking).	
	LM-P	09940-00040	200 g	Tube	• Used to prevent seizure or scuffling of the thread when press fitting or shrink fitting. • Used as lubricant for linkage, bearings, etc.	
Grease	G2-LI	SYG2-400LI SYG2-350LI SYG2-400LI-A SYG2-160LI SYGA-160CNLI	Various	Various	• General purpose type	
	G2-CA	SYG2-400CA SYG2-350CA SYG2-400CA-A SYG2-160CA SYGA-160CNCA	Various	Various	• Used for normal temperature, light load bearing at places in contact with water or steam.	
	Molybdenum disulphide grease LM-G (G2-M)	SYG2-400M SYG2-400M-A SYGA-16CNM	400 g × 10 400 g × 20 16 kg	Bellows type Bellows type Can	• Used for heavy load portion	
	Hyper White Grease G2-T G0-T (*) *: For use in cold district	SYG2-400T-A SYG2-16CNT SYG0-400T-A (*) SYG0-16CNT (*)	400 g 16 kg	Bellows type Can	• Seizure resistance and heat resistance higher than molybdenum disulfide grease • Since this grease is white, it does not stand out against machine body.	
	Biogrease G2B G2-BT (*) *: For high temperature and large load	SYG2-400B SYGA-16CNB SYG2-400BT (*) SYGA-16CNBT (*)	400 g 16 kg	Bellows type Can	• Since this grease is decomposed by bacteria in short period, it has less effects on microorganisms, animals, and plants.	
Primer	SUNSTAR PAINT PRIMER 580 SUPER	417-926-3910	20 ml	Glass container	Adhesive for cab glass	• Used as primer for cab side (Using limit: 4 months)
	SUNSTAR GLASS PRIMER 580 SUPER		20 ml	Glass container		• Used as primer for glass side (Using limit: 4 months)
Adhesive	SUNSTAR PENGUINE SEAL 580 SUPER "S" or "W"		320 ml	Polyethylene container		• "S" is used for high-temperature season (April - October) and "W" for low-temperature season (November - April) as adhesive for glass. (Using limit: 4 months)
	Sika Japan, Sikaflex 256HV	20Y-54-39850	310 ml	Polyethylene container		• Used as adhesive for glass. (Using limit: 6 months)
Caulking material	SUNSTAR PENGUINE SEAL No. 2505	417-926-3920	320 ml	Polyethylene container		• Used to seal joints of glass parts. (Using limit: 4 months)
	SEKISUI SILICONE SEALANT	20Y-54-55130	333 ml	Polyethylene container		• Used to seal front window. (Using limit: 6 months)

STANDARD TIGHTENING TORQUE

STANDARD TIGHTENING TORQUE TABLE (WHEN USING TORQUE WRENCH)

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

Thread diameter of bolt	Width across flats	Tightening torque 	
mm	mm	Nm	kgm
6	10	11.8 – 14.7	1.2 – 1.5
8	13	27 – 34	2.8 – 3.5
10	17	59 – 74	6 – 7.5
12	19	98 – 123	10 – 12.5
14	22	153 – 190	15.5 – 19.5
16	24	235 – 285	23.5 – 29.5
18	27	320 – 400	33 – 41
20	30	455 – 565	46.5 – 58
22	32	610 – 765	62.5 – 78
24	36	785 – 980	80 – 100
27	41	1150 – 1440	118 – 147
30	46	1520 – 1910	155 – 195
33	50	1960 – 2450	200 – 250
36	55	2450 – 3040	250 – 310
39	60	2890 – 3630	295 – 370

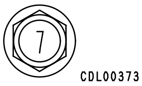
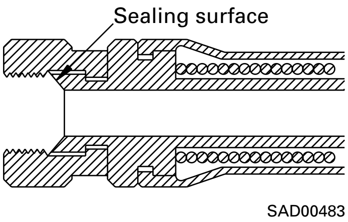
Thread diameter of bolt	Width across flats	Tightening torque 	
mm	mm	Nm	kgm
6	10	5.9 – 9.8	0.6 – 1.0
8	13	13.7 – 23.5	1.4 – 2.4
10	14	34.3 – 46.1	3.5 – 4.7
12	27	74.5 – 90.2	7.6 – 9.2

TABLE OF TIGHTENING TORQUES FOR FLARED NUTS

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



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

TABLE OF TIGHTENING TORQUES FOR SPLIT FLANGE BOLTS

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

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

TABLE OF TIGHTENING TORQUES FOR O-RING BOSS PIPING JOINTS

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

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

TABLE OF TIGHTENING TORQUES FOR O-RING BOSS PLUGS

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

Norminal No.	Thread diameter	Width across flat	Tightening torque (Nm {kgm})	
	mm	mm	Range	Target
08	08	14	5.88 – 8.82 {0.6 – 0.9}	7.35 {0.75}
10	10	17	9.8 – 12.74 {1.0 – 1.3}	11.27 {1.15}
12	12	19	14.7 – 19.6 {1.5 – 2.0}	17.64 {1.8}
14	14	22	19.6 – 24.5 {2.0 – 2.5}	22.54 {2.3}
16	16	24	24.5 – 34.3 {2.5 – 3.5}	29.4 {3.0}
18	18	27	34.3 – 44.1 {3.5 – 4.5}	39.2 {4.0}
20	20	30	44.1 – 53.9 {4.5 – 5.5}	49.0 {5.0}
24	24	32	58.8 – 78.4 {6.0 – 8.0}	68.6 {7.0}
30	30	32	93.1 – 122.5 {9.5 – 12.5}	107.8 {11.0}
33	33	—	107.8 – 147.0 {11.0 – 15.0}	124.4 {13.0}
36	36	36	127.4 – 176.4 {13.0 – 18.0}	151.9 {15.5}
42	42	—	181.3 – 240.1 {18.5 – 24.5}	210.7 {21.5}
52	52	—	274.4 – 367.5 {28.0 – 37.5}	323.4 {33.0}

TIGHTENING TORQUE FOR 102 ENGINE SERIES

1) BOLT AND NUTS

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

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

2) EYE JOINTS

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

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

3) TAPERED SCREWS

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

Thread diameter	Tightening torque	
inch	Nm	kgm
1 / 16	3 ± 1	0.31 ± 0.10
1 / 8	8 ± 2	0.81 ± 0.20
1 / 4	12 ± 2	1.22 ± 0.20
3 / 8	15 ± 2	1.53 ± 0.41
1 / 2	24 ± 4	2.45 ± 0.41
3 / 4	36 ± 5	3.67 ± 0.51
1	60 ± 9	6.12 ± 0.92

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

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

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

Nominal size of hose	Width across flats	Tightening torque (Nm {kgm})		Taper seal type	Face seal type	
		Range	Target	Thread size (mm)	Nominal thread size - Threads per inch, Thread series	Root diameter (mm) (Reference)
02	19	34 - 63 {3.5 - 6.5}	44 {4.5}	14	$\frac{9}{16}$ - 18UNF	14.3
03	22	54 - 93 {5.5 - 9.5}	74 {4.5}	–	$\frac{11}{16}$ - 16UN	17.5
	24	59 - 98 {6.0 - 10.0}	78 {8.0}	18	–	–
04	27	84 - 132 {8.5 - 13.5}	103 {10.5}	22	$\frac{13}{16}$ - 16UN	20.7
05	32	128 - 186 {13.0 - 19.0}	157 {16.0}	24	1 - 14UNS	25.4
06	36	177 - 245 {18.0 - 25.0}	216 {22.0}	30	$1\frac{3}{16}$ - 12UNF	30.3
(10)	41	177 - 245 {18.0 - 25.0}	216 {22.0}	33	–	–
(12)	46	197 - 294 {20.0 - 30.0}	245 {25.0}	36	–	–
(14)	55	246 - 343 {25.0 - 35.0}	294 {30.0}	42	–	–

ELECTRIC WIRE CODE

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

CLASSIFICATION BY THICKNESS

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

CLASSIFICATION BY COLOR AND CODE

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

CONVERSION TABLE

METHOD OF USING THE CONVERSION TABLE

The Conversion Table in this section is provided to enable simple conversion of figures. For details of the method of using the Conversion Table, see the example given below.

EXAMPLE

- Method of using the Conversion Table to convert from millimeters to inches

1. Convert 55 mm into inches.
    (1) Locate the number 50 in the vertical column at the left side, take this as Ⓐ, then draw a horizontal line from Ⓐ.
    (2) Locate the number 5 in the row across the top, take this as Ⓑ, then draw a perpendicular line down from Ⓑ.
    (3) Take the point where the two lines cross as Ⓒ. This point Ⓒ gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 inches.
2. Convert 550 mm into inches.
    (1) The number 550 does not appear in the table, so divide by 10 (move the decimal point one place to the left) to convert it to 55 mm.
    (2) Carry out the same procedure as above to convert 55 mm to 2.165 inches.
    (3) The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal point one place to the right) to return to the original value. This gives 550 mm = 21.65 inches.

Ⓑ

Millimeters to inches

1 mm = 0.03937 in

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

Millimeters to Inches

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
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90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1 kg = 2.2046 lb

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

Liter to U.S. Gallon

1ℓ = 0.2642 U.S. Gal

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

Liter to U.K. Gallon

1ℓ = 0.21997 U.K. Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.950	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.969	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.037	18.257	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

kgm to ft. lb

1 kgm = 7.233 ft. lb

	0	1	2	3	4	5	6	7	8	9
0	0	7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	296.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	1005.4
140	1012.6	1019.9	1027.1	1034.3	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

kg/cm^2 to lb/in^2

1kg/cm^2 = 14.2233 lb/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	1934	1949	1963	1977
140	1991	2005	2020	2034	2048	2062	2077	2091	2105	2119
150	2134	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2389	2404
170	2418	2432	2446	2460	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	2603	2617	2631	2646	2660	2674	2688
190	2702	2717	2731	2745	2759	2773	2788	2802	2816	2830
200	2845	2859	2873	2887	2901	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3343	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

Temperature

Fahrenheit-Centigrade Conversion ; a simple way to convert a Fahrenheit temperature reading into a Centigrade temperature reading or vice versa is to enter the accompanying table in the center or boldface column of figures.

These figures refer to the temperature in either Fahrenheit or Centigrade degrees.

If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

1°C = 33.8°F

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

UNITS

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

Example:

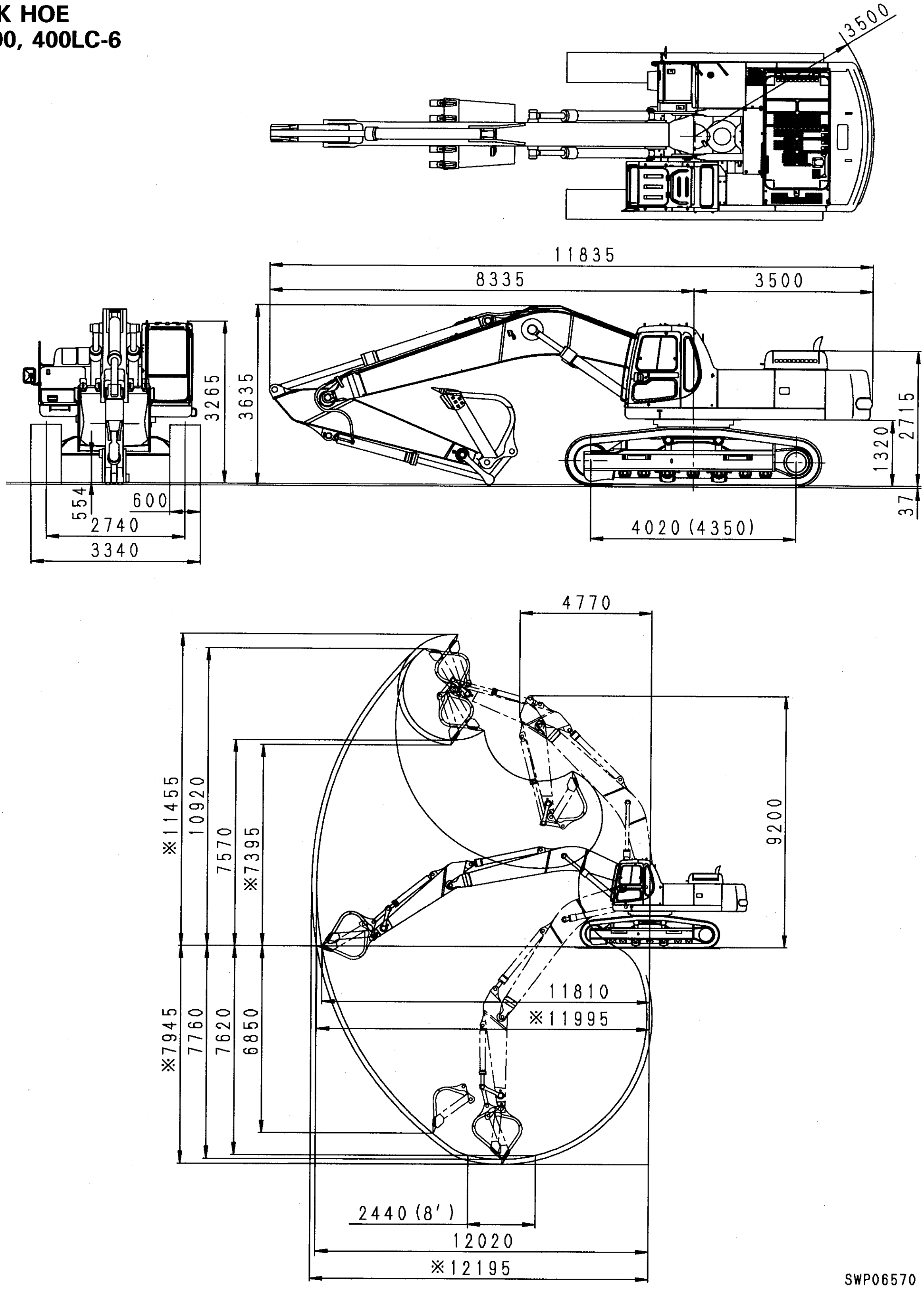
N {kg}
Nm {kgm}
MPa {kg/cm^2}
kPa {mmH$_2$O}
kPa {mmHg}
kW/rpm {HP/rpm}
g/kWh {g/HPh}

01 GENERAL

SPECIFICATION DRAWINGS

Unit: mm

BACK HOE
PC400, 400LC-6



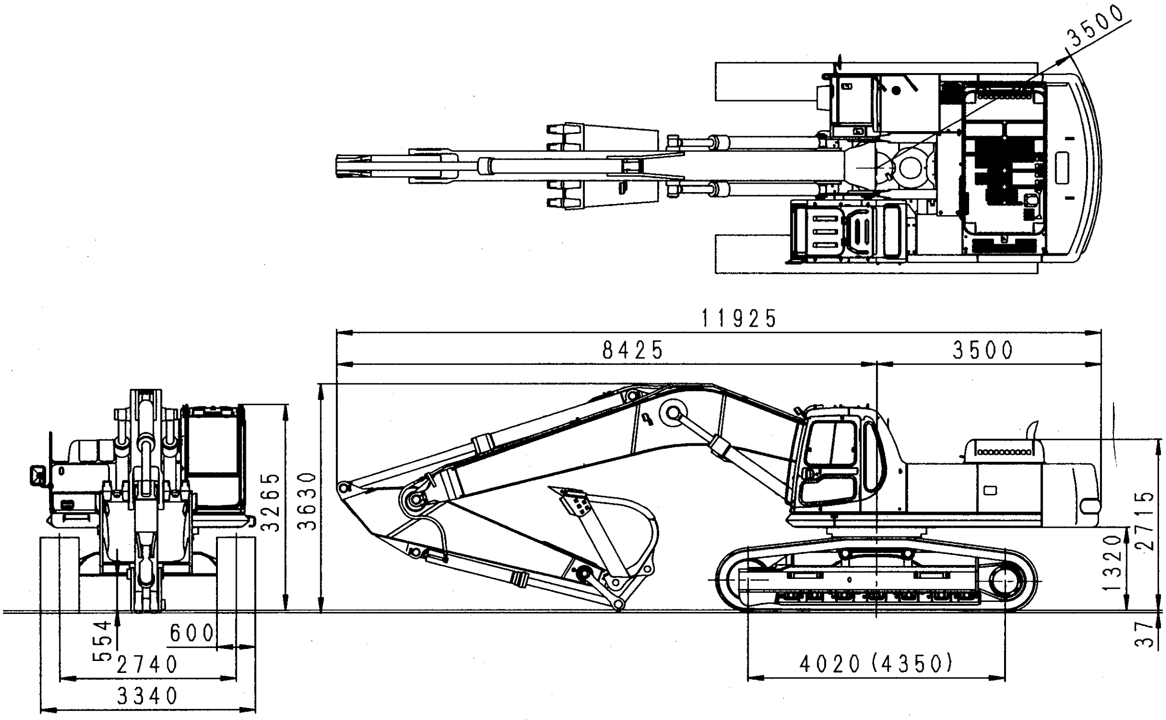
SWP06570

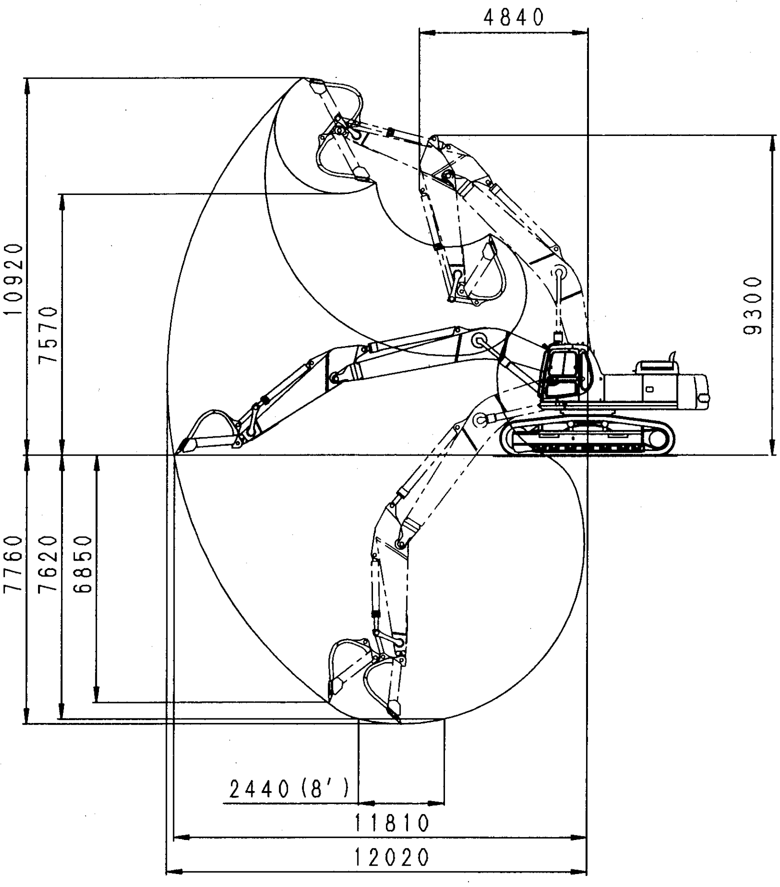
★ The figures in ( ) indicate the PC400LC-6.

★ The values marked ※ are for shovel operations.

PC450, 450LC-6

Unit: mm



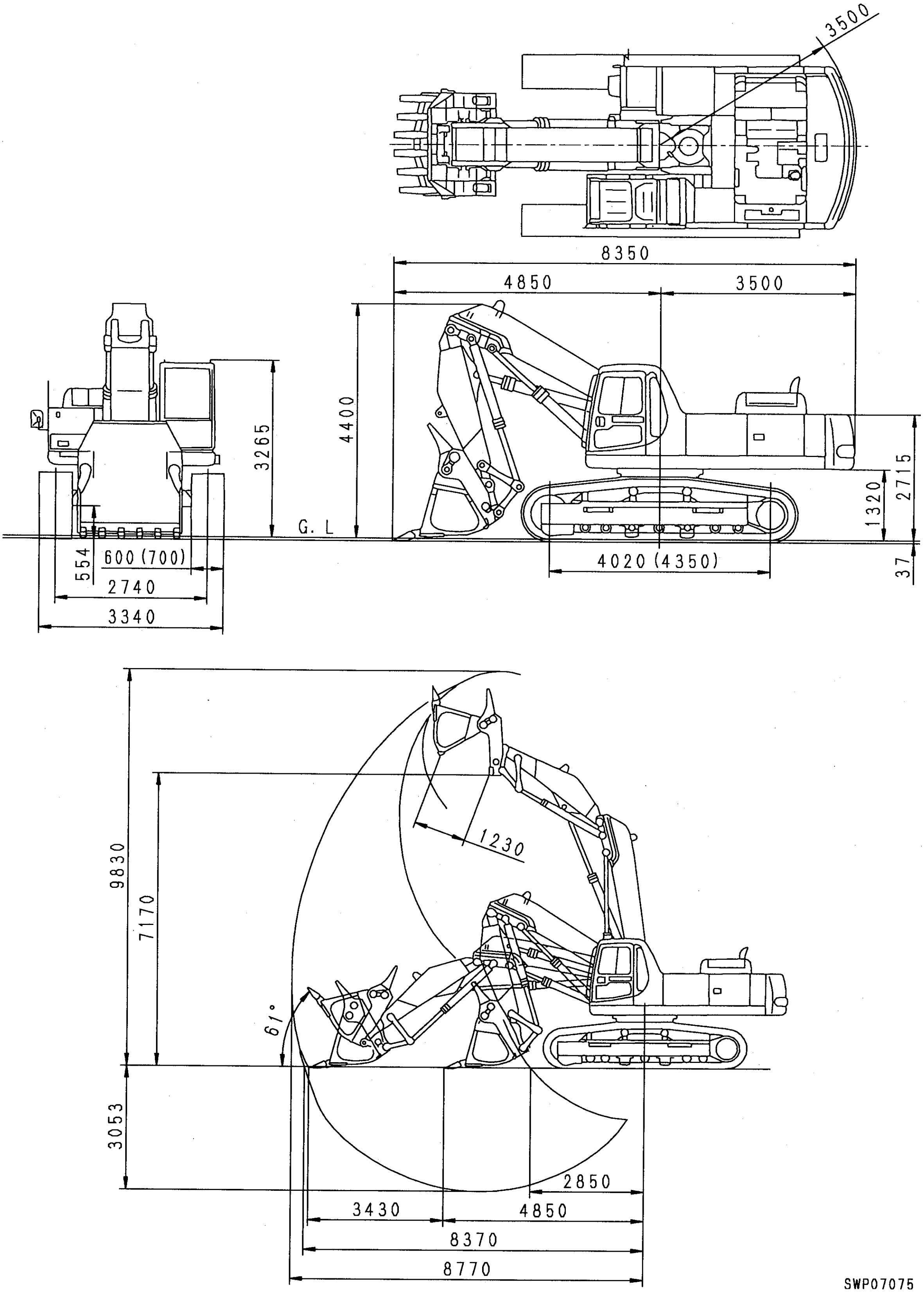


SWP06571

★ The figures in ( ) indicate the PC450LC-6.

LOADING SHOVEL
PC400, 400LC-6

Unit: mm



★ The figures in ( ) indicate the PC400LC-6.

SPECIFICATIONS

BACK HOE

PC400, 400LC-6

Machine model				PC400-6	PC400LC-6
Serial number				32001 and up	32001 and up
Bucket capacity			m^3	1.8	1.8
Operating weight			kg	41,400	42,600
Performance	Working ranges	Max. digging depth	mm	7,760	7,760
		Max. vertical wall depth	mm	6,850	6,850
		Max. digging reach	mm	12,020	12,020
		Max. reach at ground level	mm	11,810	11,810
		Max. digging height	mm	10,920	10,920
		Max. dumping height	mm	7,570	7,570
	Max. digging force (using power max. function)		kN{kg}	224.7 {22,900}	224.7 {22,900}
	Swing speed		rpm	9.3	9.3
	Swing max. slope angle		deg.	20.0	20.0
	Travel speed		km/h	Lo: 3.2 Mi: 4.5 Hi: 5.5	Lo: 3.2 Mi: 4.5 Hi: 5.5
	Gradeability		deg.	35	35
	Ground pressure [standard triple grouser shoe width]		kPa{kg/cm^2}	77.42 {0.79} [600 mm]	63.7 {0.65} [700 mm]
Dimensions	Overall length (for transport)		mm	11,835	11,835
	Overall width		mm	3,340	3,340
	Overall width of track		mm	3,340	3,340
	Overall height (for transport)		mm	3,635	3,635
	Overall height to top of cab		mm	3,265	3,265
	Ground clearance of counterweight		mm	1,320	1,320
	Min. ground clearance		mm	554	554
	Tail swing radius		mm	3,500	3,500
	Min. swing radius of work equipment		mm	4,770	4,770
	Height of work equipment at min. swing radius		mm	9,200	9,200
	Length of track on ground		mm	4,020	4,350
	Track gauge		mm	2,740	2,740
	Height of machine cab		mm	2,715	2,715

<table>
<tr><td colspan="4">Machine model</td><td colspan="3">PC400-6</td><td colspan="3">PC400LC-6</td></tr>
<tr><td colspan="4">Serial number</td><td colspan="3">32001 and up</td><td colspan="3">32001 and up</td></tr>
<tr><td>Engine</td><td></td><td>Model</td><td></td><td colspan="6">SA6D125-2</td></tr>
<tr><td></td><td></td><td>Type</td><td></td><td colspan="6">4-cycle, water-cooled, in-line, vertical, direct injection, with turbocharger and aftercooler (water cooled)</td></tr>
<tr><td></td><td></td><td>No. of cylinders – bore x stroke</td><td>mm</td><td colspan="6">6 – 125 x 150</td></tr>
<tr><td></td><td></td><td>Piston displacement</td><td>ℓ {cc}</td><td colspan="6">11.040 {11,040}</td></tr>
<tr><td></td><td>Performance</td><td>Flywheel horsepower</td><td>kW/rpm{HP/rpm}</td><td colspan="6">228/2,050 {305.7/2,050}</td></tr>
<tr><td></td><td></td><td>Max. torque</td><td>Nm/rpm{kgm/rpm}</td><td colspan="6">1,213/1,400 {123.7/1,400}</td></tr>
<tr><td></td><td></td><td>Max. speed at no load</td><td>rpm</td><td colspan="6">2,250</td></tr>
<tr><td></td><td></td><td>Min. speed at no load</td><td>rpm</td><td colspan="6">700</td></tr>
<tr><td></td><td></td><td>Min. fuel consumption</td><td>g/kW.h{g/HP.h}</td><td colspan="6">208 {155}</td></tr>
<tr><td></td><td></td><td>Starting motor</td><td></td><td colspan="6">24V, 7.5 kW</td></tr>
<tr><td></td><td></td><td>Alternator</td><td></td><td colspan="6">24V, 33A</td></tr>
<tr><td></td><td></td><td>Battery</td><td></td><td colspan="6">12V, 150 Ah x 2</td></tr>
<tr><td></td><td></td><td>Radiator core type</td><td></td><td colspan="6">CWX-4</td></tr>
<tr><td>Under-carriage</td><td></td><td>Carrier roller</td><td></td><td colspan="6">2 on each side</td></tr>
<tr><td></td><td></td><td>Track roller</td><td></td><td colspan="3">7 on each side</td><td colspan="3">8 on each side</td></tr>
<tr><td></td><td></td><td>Track shoe</td><td></td><td colspan="3">Assembly-type triple grouser, 46 on each side</td><td colspan="3">Assembly-type triple grouser, 49 on each side</td></tr>
<tr><td>Hydraulic system</td><td>Hydraulic pump</td><td>Type x No.</td><td></td><td colspan="6">HPV160+160, variable displacement piston type x 2</td></tr>
<tr><td></td><td></td><td>Delivery</td><td>ℓ/min.</td><td colspan="6">326 x 2</td></tr>
<tr><td></td><td></td><td>Set pressure</td><td>MPa{kg/cm^2}</td><td colspan="6">34.8 {355}</td></tr>
<tr><td></td><td>Control valve</td><td>Type x No.</td><td></td><td colspan="6">6-spool + 1-spool type + 1-service valve x 1</td></tr>
<tr><td></td><td></td><td>Control method</td><td></td><td colspan="6">Hydraulic</td></tr>
<tr><td></td><td>Hydraulic motor</td><td>Travel motor</td><td></td><td colspan="6">KMV280ADT, Piston type (with brake valve, shaft brake): x 2</td></tr>
<tr><td></td><td></td><td>Swing motor</td><td></td><td colspan="6">KMF160ABE-3, Piston type (with safety valve, shaft brake, reverse prevention valve): x 1</td></tr>
<tr><td></td><td>Hydraulic cylinder</td><td></td><td></td><td colspan="2">Boom</td><td colspan="2">Arm</td><td colspan="2">Bucket</td></tr>
<tr><td></td><td></td><td>Type</td><td></td><td colspan="2">Double-acting piston</td><td colspan="2">Double-acting piston</td><td colspan="2">Double-acting piston</td></tr>
<tr><td></td><td></td><td>Inside diameter of cylinder</td><td>mm</td><td colspan="2">160</td><td colspan="2">185</td><td colspan="2">160</td></tr>
<tr><td></td><td></td><td>Diameter of piston rod</td><td>mm</td><td colspan="2">110</td><td colspan="2">120</td><td colspan="2">110</td></tr>
<tr><td></td><td></td><td>Stroke</td><td>mm</td><td colspan="2">1,570</td><td colspan="2">1,820</td><td colspan="2">1,270</td></tr>
<tr><td></td><td></td><td>Max. distance between pins</td><td>mm</td><td colspan="2">3,830</td><td colspan="2">4,410</td><td colspan="2">3,265</td></tr>
<tr><td></td><td></td><td>Min. distance between pins</td><td>mm</td><td colspan="2">2,260</td><td colspan="2">2,590</td><td colspan="2">1,995</td></tr>
<tr><td></td><td></td><td>Hydraulic tank</td><td></td><td colspan="6">Box-shaped, sealed</td></tr>
<tr><td></td><td></td><td>Hydraulic filter</td><td></td><td colspan="6">Tank return side</td></tr>
<tr><td></td><td></td><td>Hydraulic cooler</td><td></td><td colspan="6">Air cooled</td></tr>
</table>

PC450, 450LC-6

		Machine model		PC450-6	PC450LC-6
		Serial number		12001 and up	12001 and up
		Bucket capacity	m^3	1.8	1.8
		Operating weight	kg	42,240	43,500
Performance	Working ranges	Max. digging depth	mm	7,760	7,760
		Max. vertical wall depth	mm	6,850	6,850
		Max. digging reach	mm	12,020	12,020
		Max. reach at ground level	mm	11,810	11,810
		Max. digging height	mm	10,920	10,920
		Max. dumping height	mm	7,570	7,570
		Max. digging force (using power max. function)	kN{kg}	224.7 {22,900}	224.7 {22,900}
		Swing speed	rpm	9.3	9.3
		Swing max. slope angle	deg.	20.0	20.0
		Travel speed	km/h	Lo: 3.2 Mi: 4.5 Hi: 5.5	Lo: 3.2 Mi: 4.5 Hi: 5.5
		Gradeability	deg.	35	35
		Ground pressure [standard triple grouser shoe width]	kPa{kg/cm^2}	79.38 {0.81} [600 mm]	76.44 {0.78} [600 mm]
Dimensions		Overall length (for transport)	mm	11,925	11,925
		Overall width	mm	3,430	3,430
		Overall width of track	mm	3,430	3,430
		Overall height (for transport)	mm	3,630	3,630
		Overall height to top of cab	mm	3,265	3,265
		Ground clearance of counterweight	mm	1,320	1,320
		Min. ground clearance	mm	554	554
		Tail swing radius	mm	3,500	3,500
		Min. swing radius of work equipment	mm	4,840	4,840
		Height of work equipment at min. swing radius	mm	9,300	9,300
		Length of track on ground	mm	4,020	4,350
		Track gauge	mm	2,740	2,740
		Height of machine cab	mm	2,715	2,715

<table>
<tr><td colspan="4">Machine model</td><td colspan="3">PC450-6</td><td colspan="3">PC450LC-6</td></tr>
<tr><td colspan="4">Serial number</td><td colspan="3">12001 and up</td><td colspan="3">12001 and up</td></tr>
<tr><td rowspan="13">Engine</td><td colspan="2">Model</td><td></td><td colspan="6">SA6D125-2</td></tr>
<tr><td colspan="2">Type</td><td></td><td colspan="6">4-cycle, water-cooled, in-line, vertical, direct injection, with turbocharger and aftercooler (water cooled)</td></tr>
<tr><td colspan="2">No. of cylinders – bore x stroke</td><td>mm</td><td colspan="6">6 – 125 x 150</td></tr>
<tr><td colspan="2">Piston displacement</td><td>ℓ {cc}</td><td colspan="6">11.040 {11,040}</td></tr>
<tr><td rowspan="5">Performance</td><td>Flywheel horsepower</td><td>kW/rpm{HP/rpm}</td><td colspan="6">228/2,050 {305.7/2,050}</td></tr>
<tr><td>Max. torque</td><td>Nm/rpm{kgm/rpm}</td><td colspan="6">1,213/1,400 {123.7/1,400}</td></tr>
<tr><td>Max. speed at no load</td><td>rpm</td><td colspan="6">2,250</td></tr>
<tr><td>Min. speed at no load</td><td>rpm</td><td colspan="6">700</td></tr>
<tr><td>Min. fuel consumption</td><td>g/kW.h{g/HP.h}</td><td colspan="6">208 {155}</td></tr>
<tr><td colspan="2">Starting motor</td><td></td><td colspan="6">24V, 7.5 kW</td></tr>
<tr><td colspan="2">Alternator</td><td></td><td colspan="6">24V, 33A</td></tr>
<tr><td colspan="2">Battery</td><td></td><td colspan="6">12V, 150 Ah x 2</td></tr>
<tr><td colspan="2">Radiator core type</td><td></td><td colspan="6">CWX-4</td></tr>
<tr><td rowspan="3">Under-carriage</td><td colspan="2">Carrier roller</td><td></td><td colspan="6">2 on each side</td></tr>
<tr><td colspan="2">Track roller</td><td></td><td colspan="3">7 on each side</td><td colspan="3">8 on each side</td></tr>
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<tr><td rowspan="17">Hydraulic system</td><td rowspan="3">Hydraulic pump</td><td>Type x No.</td><td></td><td colspan="6">HPV160+160, variable displacement piston type x 2</td></tr>
<tr><td>Delivery</td><td>ℓ/min.</td><td colspan="6">326 x 2</td></tr>
<tr><td>Set pressure</td><td>MPa{kg/cm^2}</td><td colspan="6">34.8 {355}</td></tr>
<tr><td rowspan="2">Control valve</td><td>Type x No.</td><td></td><td colspan="6">6-spool + 1-spool type + 1-service valve x 1</td></tr>
<tr><td>Control method</td><td></td><td colspan="6">Hydraulic</td></tr>
<tr><td rowspan="2">Hydraulic motor</td><td>Travel motor</td><td></td><td colspan="6">KMV280ADT, Piston type (with brake valve, shaft brake): x 2</td></tr>
<tr><td>Swing motor</td><td></td><td colspan="6">KMF160ABE-3, Piston type (with safety valve, shaft brake, reverse prevention valve): x 1</td></tr>
<tr><td rowspan="7">Hydraulic cylinder</td><td></td><td></td><td colspan="2">Boom</td><td colspan="2">Arm</td><td colspan="2">Bucket</td></tr>
<tr><td>Type</td><td></td><td colspan="2">Double-acting piston</td><td colspan="2">Double-acting piston</td><td colspan="2">Double-acting piston</td></tr>
<tr><td>Inside diameter of cylinder</td><td>mm</td><td colspan="2">160</td><td colspan="2">185</td><td colspan="2">160</td></tr>
<tr><td>Diameter of piston rod</td><td>mm</td><td colspan="2">110</td><td colspan="2">130</td><td colspan="2">110</td></tr>
<tr><td>Stroke</td><td>mm</td><td colspan="2">1,570</td><td colspan="2">1,985</td><td colspan="2">1,270</td></tr>
<tr><td>Max. distance between pins</td><td>mm</td><td colspan="2">3,830</td><td colspan="2">4,740</td><td colspan="2">3,265</td></tr>
<tr><td>Min. distance between pins</td><td>mm</td><td colspan="2">2,260</td><td colspan="2">2,755</td><td colspan="2">1,995</td></tr>
<tr><td colspan="2">Hydraulic tank</td><td></td><td colspan="6">Box-shaped, sealed</td></tr>
<tr><td colspan="2">Hydraulic filter</td><td></td><td colspan="6">Tank return side</td></tr>
<tr><td colspan="2">Hydraulic cooler</td><td></td><td colspan="6">Air cooled</td></tr>
</table>

LOADING SHOVEL
PC400, 400LC-6

Machine model				PC400-6	PC400LC-6
Serial number				32001 and up	32001 and up
Bucket capacity			m^3	2.6	2.6
Operating weight			kg	43,100	44,300
Performance	Working ranges	Max. digging depth	mm	3,053	3,053
		Max. digging reach	mm	8,770	8,770
		Max. reach at ground level	mm	8,370	8,370
		Max. digging height	mm	9,830	9,830
		Max. dumping height	mm	7,170	7,170
	Max. digging force (using power max. function)		kN{kg}	285.2 {29,100}	285.2 {29,100}
	Swing speed		rpm	9.1	9.1
	Swing max. slope angle		deg.	20.0	20.0
	Travel speed		km/h	Lo: 3.2 Hi: 5.5	Lo: 3.2 Hi: 5.5
	Gradeability		deg.	35	35
	Ground pressure [standard triple grouser shoe width]		kPa{kg/cm^2}	80.5 {0.82} [600 mm]	66.7 {0.68} [700 mm]
Dimensions	Overall length (for transport)		mm	8,350	8,350
	Overall width		mm	3,430	3,430
	Overall width of track		mm	3,340	3,440
	Overall height (for transport)		mm	4,400	4,400
	Overall height to top of cab		mm	3,265	3,265
	Ground clearance of counterweight		mm	1,320	1,320
	Min. ground clearance		mm	554	554
	Tail swing radius		mm	3,500	3,500
	Min. swing radius of work equipment		mm	4,780	4,780
	Height of work equipment at min. swing radius		mm	6,370	6,370
	Length of track on ground		mm	4,020	4,350
	Track gauge		mm	2,740	2,740
	Height of machine cab		mm	2,715	2,715

<table>
<tr><td colspan="4">Machine model</td><td colspan="2">PC400-6</td><td colspan="2">PC400LC-6</td></tr>
<tr><td colspan="4">Serial number</td><td colspan="2">32001 and up</td><td colspan="2">32001 and up</td></tr>
<tr><td rowspan="14">Engine</td><td colspan="2">Model</td><td></td><td colspan="4">SA6D125E-2</td></tr>
<tr><td colspan="2">Type</td><td></td><td colspan="4">4-cycle, water-cooled, in-line, vertical, direct injection, with turbocharger and aftercooler (water cooled)</td></tr>
<tr><td colspan="2">No. of cylinders – bore x stroke</td><td>mm</td><td colspan="4">6 – 125 x 150</td></tr>
<tr><td colspan="2">Piston displacement</td><td>ℓ {cc}</td><td colspan="4">11.040 {11,040}</td></tr>
<tr><td rowspan="5">Performance</td><td>Flywheel horsepower</td><td>kW/rpm{HP/rpm}</td><td colspan="4">228/1,950 {306/1,950}</td></tr>
<tr><td>Max. torque</td><td>Nm/rpm{kgm/rpm}</td><td colspan="4">1,213/1,400 {123.7/1,400}</td></tr>
<tr><td>Max. speed at no load</td><td>rpm</td><td colspan="4">2,150</td></tr>
<tr><td>Min. speed at no load</td><td>rpm</td><td colspan="4">800</td></tr>
<tr><td>Min. fuel consumption</td><td>g/kW.h{g/HP.h}</td><td colspan="4">208 {155}</td></tr>
<tr><td colspan="2">Starting motor</td><td></td><td colspan="4">24V, 7.5 kW</td></tr>
<tr><td colspan="2">Alternator</td><td></td><td colspan="4">24V, 33A</td></tr>
<tr><td colspan="2">Battery</td><td></td><td colspan="4">12V, 150 Ah x 2</td></tr>
<tr><td colspan="2">Radiator core type</td><td></td><td colspan="4">CWX-4</td></tr>
<tr><td colspan="3" style="display:none"></td></tr>
<tr><td rowspan="3">Under-carriage</td><td colspan="2">Carrier roller</td><td></td><td colspan="4">2 on each side</td></tr>
<tr><td colspan="2">Track roller</td><td></td><td colspan="2">7 on each side</td><td colspan="2">8 on each side</td></tr>
<tr><td colspan="2">Track shoe</td><td></td><td colspan="2">Assembly-type triple grouser, 46 on each side</td><td colspan="2">Assembly-type triple grouser, 49 on each side</td></tr>
<tr><td rowspan="18">Hydraulic system</td><td rowspan="3">Hydraulic pump</td><td>Type x No.</td><td></td><td colspan="4">HPV160+160, variable displacement piston type x 2</td></tr>
<tr><td>Delivery</td><td>ℓ/min.</td><td colspan="4">326 x 2</td></tr>
<tr><td>Set pressure</td><td>MPa{kg/cm²}</td><td colspan="4">34.8 {355}</td></tr>
<tr><td rowspan="2">Control valve</td><td>Type x No.</td><td></td><td colspan="4">6-spool + 1-spool + 1-spool + 1-spool type x 1</td></tr>
<tr><td>Control method</td><td></td><td colspan="4">Hydraulic</td></tr>
<tr><td rowspan="2">Hydraulic motor</td><td>Travel motor</td><td></td><td colspan="4">KMV280ADT, Piston type (with brake valve, shaft brake): x 2</td></tr>
<tr><td>Swing motor</td><td></td><td colspan="4">KMF160ABE-3, Piston type (with safety valve, shaft brake, reverse prevention valve): x 1</td></tr>
<tr><td rowspan="7">Hydraulic cylinder</td><td rowspan="2">Type</td><td rowspan="2"></td><td>Boom</td><td>Arm</td><td>Bucket</td><td>Bottom dump</td></tr>
<tr><td colspan="4">Double-acting piston</td></tr>
<tr><td>Inside diameter of cylinder</td><td>mm</td><td>160</td><td>185</td><td>135</td><td>130</td></tr>
<tr><td>Diameter of piston rod</td><td>mm</td><td>110</td><td>120</td><td>95</td><td>90</td></tr>
<tr><td>Stroke</td><td>mm</td><td>1,338</td><td>1,375</td><td>1,287</td><td>284</td></tr>
<tr><td>Max. distance between pins</td><td>mm</td><td>3,837</td><td>3,615</td><td>3,322</td><td>1,091</td></tr>
<tr><td>Min. distance between pins</td><td>mm</td><td>2,499</td><td>2,240</td><td>2,035</td><td>807</td></tr>
<tr><td colspan="2">Hydraulic tank</td><td></td><td colspan="4">Box-shaped, sealed</td></tr>
<tr><td colspan="2">Hydraulic filter</td><td></td><td colspan="4">Tank return side</td></tr>
<tr><td colspan="2">Hydraulic cooler</td><td></td><td colspan="4">SF-4 (Air cooled)</td></tr>
</table>

WEIGHT TABLE

⚠ This weight table is a guide for use when transporting or handling component.

BACK HOE

PC400, 400LC-6

Unit: kg

Machine model	PC400-6	PC400LC-6
Serial number	32001 and up	32001 and up
Engine assembly	1,500	1,500
• Engine	1,160	1,160
• Damper	14.7	14.7
• Hydraulic pump	210	210
Radiator, oil cooler assembly	186	186
Hydraulic tank, filter assembly (excl. hydraulic oil)	254	254
Fuel tank (excl. fuel)	231	231
Revolving frame	3,135	3,135
Operator's cab	287	287
Operator's seat	29	29
Counterweight	8,890	8,890
Swing machinery	535	535
Control valve (standard)	256	256
Swing motor	82	82
Travel motor	252 x 2	252 x 2
Center swivel joint	37	37
Track frame assembly	10,895	11,040
• Track frame	6,604	6,604
• Swing circle	605	605
• Idler	235	235
• Idler cushion	365 x 2	365 x 2
• Carrier roller	31 x 4	31 x 4
• Track roller	73 x 14	73 x 16
• Final drive (incl. travel motor)	788 x 2	788 x 2

Unit: kg

Machine model	PC400-6	PC400LC-6
Serial number	32001 and up	32001 and up
Track shoe assembly		
• Standard triple grouser shoe (600 mm)	4,410	4,700
• Standard triple grouser shoe (700 mm)	4,910	5,150
• Wide triple grouser shoe (800 mm)	5,330	5,600
• Wide triple grouser shoe (mm)	—	—
• Swamp shoe (mm)	—	—
• Flat shoe (mm)	—	—
• Road liner (rubber pad type) (mm)	—	—
Boom assembly	3,264	3,264
Arm assembly	2,120	2,120
Bucket assembly	1,300	1,300
Boom cylinder assembly	400 x 2	400 x 2
Arm cylinder assembly	580	580
Bucket cylinder assembly	345	345
Link assembly (large)	397	397
Link assembly (small)	—	—
Boom pin	93 + 20 x 2 + 73 + 24 + 54	93 + 20 x 2 + 73 + 24 + 54
Arm pin	17 + 24	17 + 24
Bucket pin	34 x 2	34 x 2
Link pin	38 x 2	38 x 2

PC450, 450LC-6

Unit: kg

Machine model	PC450-6	PC450LC-6
Serial number	12001 and up	12001 and up
Engine assembly	1,500	1,500
• Engine	1,160	1,160
• Damper	14.7	14.7
• Hydraulic pump	210	210
Radiator, oil cooler assembly	186	186
Hydraulic tank, filter assembly (excl. hydraulic oil)	254	254
Fuel tank (excl. fuel)	231	231
Revolving frame	3,269	3,269
Operator's cab	287	287
Operator's seat	29	29
Counterweight	8,890	8,890
Swing machinery	535	535
Control valve (standard)	256	256
Swing motor	82	82
Travel motor	252 x 2	252 x 2
Center swivel joint	37	37
Track frame assembly	11,100	11,245
• Track frame	6,811	6,811
• Swing circle	605	605
• Idler	235	235
• Idler cushion	365 x 2	365 x 2
• Carrier roller	31 x 4	31 x 4
• Track roller	73 x 14	73 x 16
• Final drive (incl. travel motor)	788 x 2	788 x 2

Unit: kg

Machine model	PC450-6	PC450LC-6
Serial number	12001 and up	12001 and up
Track shoe assembly		
• Standard triple grouser shoe (600 mm)	4,410	4,700
• Standard triple grouser shoe (700 mm)	4,910	5,150
• Wide triple grouser shoe (mm)	—	—
• Wide triple grouser shoe (mm)	—	—
• Swamp shoe (mm)	—	—
• Flat shoe (mm)	—	—
• Road liner (rubber pad type) (mm)	—	—
Boom assembly	3,450	3,450
Arm assembly	2,295	2,295
Bucket assembly	1,690	1,690
Boom cylinder assembly	400 x 2	400 x 2
Arm cylinder assembly	627	627
Bucket cylinder assembly	345	345
Link assembly (large)	397	397
Link assembly (small)	—	—
Boom pin	93 + 20 x 2 + 73 + 24 + 54	93 + 20 x 2 + 73 + 24 + 54
Arm pin	17 + 24	17 + 24
Bucket pin	34 x 2	34 x 2
Link pin	38 x 2	38 x 2

LOADING SHOVEL

PC400, 400LC-6

Unit: kg

Machine model	PC400-6	PC400LC-6
Serial number	32001 and up	32001 and up
Engine assembly	1,500	1,500
• Engine	1,160	1,160
• Damper	14.7	14.7
• Hydraulic pump	210	210
Radiator, oil cooler assembly	186	186
Hydraulic tank, filter assembly (excl. hydraulic oil)	254	254
Fuel tank (excl. fuel)	231	231
Revolving frame	3,170	3,170
Operator's cab	191	191
Operator's seat	13	13
Counterweight	8,890	8,890
Swing machinery	535	535
Control valve (standard)	256	256
Swing motor	82	82
Travel motor	252 x 2	252 x 2
Center swivel joint	37	37
Track frame assembly	10,526	11,202
• Track frame	5,692	6,222
• Swing circle	605	605
• Idler	235	235
• Idler cushion	365 x 2	365 x 2
• Carrier roller	31 x 4	31 x 4
• Track roller	73 x 14	73 x 16
• Final drive (incl. travel motor)	788 x 2	788 x 2

Unit: kg

Machine model	PC400-6	PC400LC-6
Serial number	32001 and up	32001 and up
Track shoe assembly • Standard triple grouser shoe (600 mm) • Standard triple grouser shoe (700 mm)	 4,410 —	 — 5,150
Boom assembly	2,355	2,355
Arm assembly	1,905	1,905
Bucket assembly	3,400	3,400
Boom cylinder assembly	395 x 2	395 x 2
Arm cylinder assembly	527	527
Bucket cylinder assembly	233 x 2	233 x 2
Bottom dump cylinder	99 x 2	99 x 2
Link assembly (large)	480	480
Link assembly (small)	—	—
Boom pin	92 + 20 x 2 + 13 x 2 + 30 x 2 + 23	92 + 20 x 2 + 13 x 2 + 30 x 2 + 23
Arm pin	23 + 26 x 2	23 + 26 x 2
Bucket pin	8 x 2 + 22 x 2 + 30 x 2	8 x 2 + 22 x 2 + 30 x 2
Link pin	26 x 2 + 15 x 2	26 x 2 + 15 x 2

FUEL, COOLANT AND LUBRICANTS

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE	CAPACITY (ℓ)	
		–22 –4 14 32 50 68 86 104°F –30 –20 –10 0 10 20 30 40°C	Specified	Refill
Engine oil pan	Engine oil	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40	38 41 (When bypass filter is installed)	34 37 (When bypass filter is installed)
Swing machinery case		SAE 30	21.5	21.5
Final drive case (each side)			12	11.5
Damper case			0.75	—
Idler (1 each)			0.34 – 0.36	0.34 – 0.36
Track roller (1 each)			0.28 – 0.31	0.28 – 0.31
Carrier roller (1 each)			0.45 – 0.50	0.45 – 0.50
Hydraulic system		SAE 10W SAE 10W-30 SAE 15W-40	490	270
Fuel tank	Diesel fuel	ASTM D975 No. 2 ASTM D975 No.1	605	—
Cooling system	Coolant	Add antifreeze	43.9	—

NOTE:

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

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

(2) When starting the engine in an atmospheric temperature of lower than 0°C, be sure to use engine oil of SAE10W, SAE10W-30 and SAE15W-40, even though an atmospheric temperature goes up to 10°C more or less in the day time.

(3) Use API classification CD as engine oil and if API classification CC, reduce the engine oil change interval to half.

(4) There is no problem if single grade oil is mixed with multigrade oil (SAE10W-30, 15W-40), but be sure to add single grade oil that matches the temperature in the table on the left.

(5) We recommend Komatsu genuine oil which has been specifically formulated and approved for use in engine and hydraulic work equipment applications.

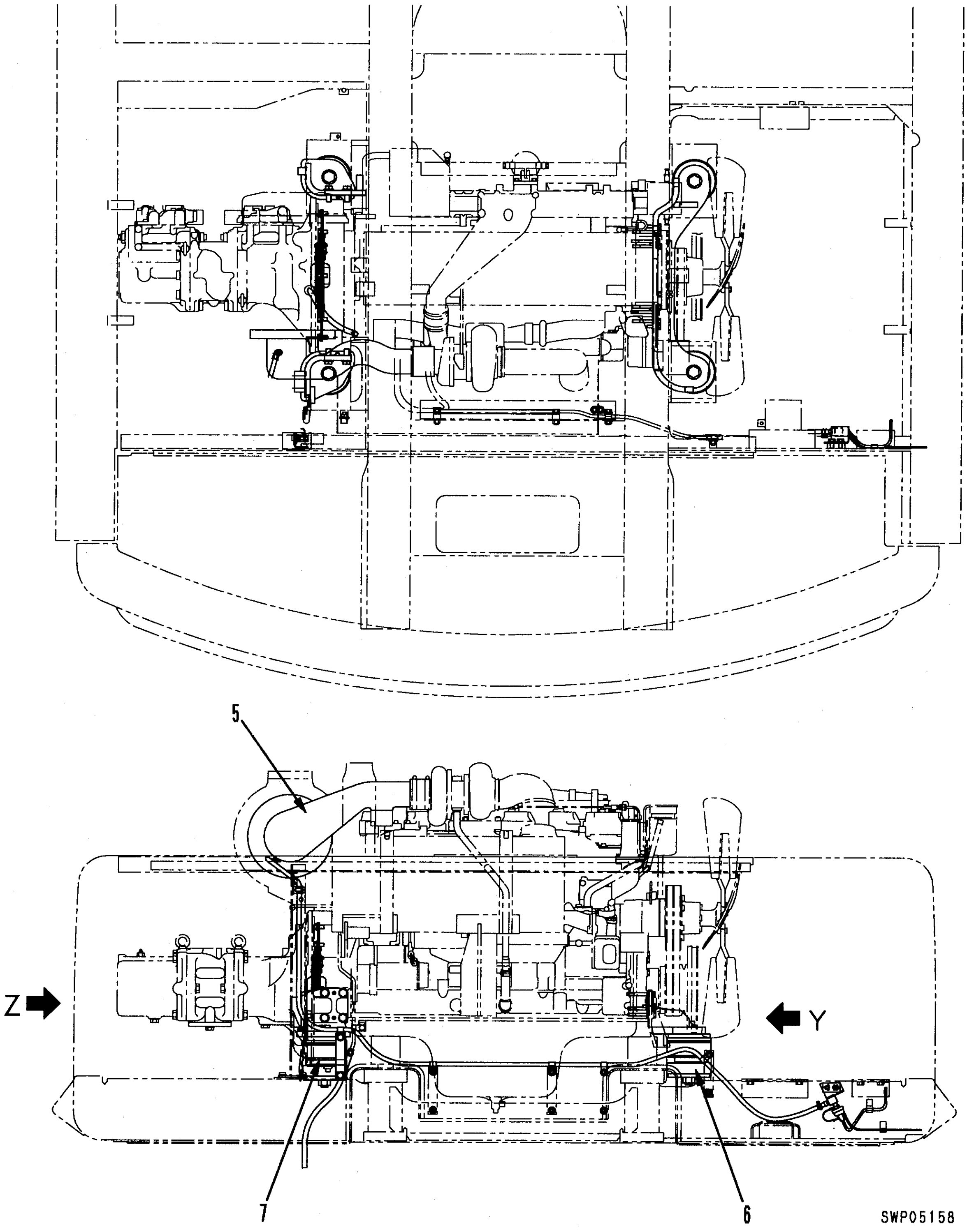
★ For the HO46-HM, use the oil recommended by Komatsu.

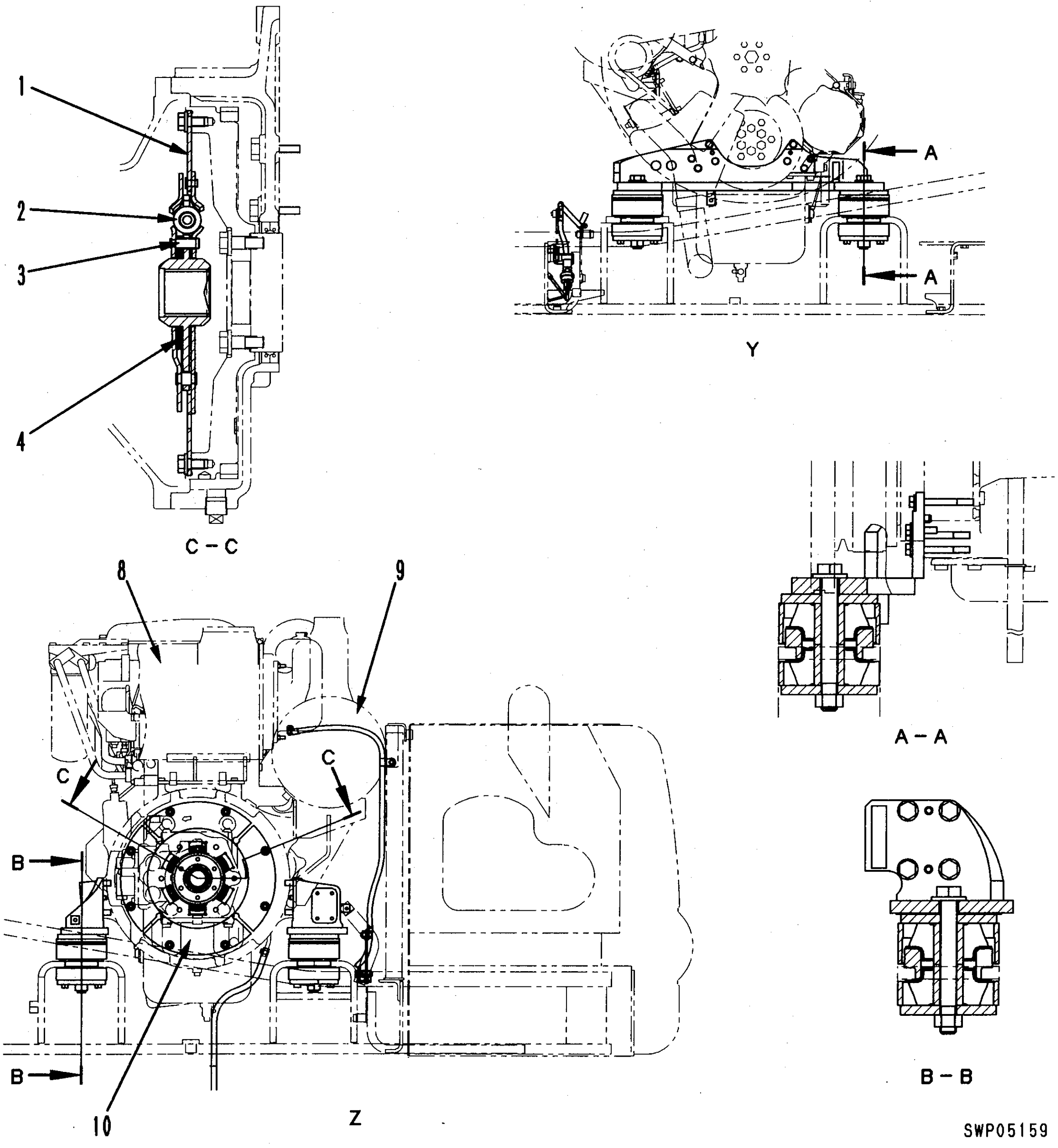
ASTM: American Society of Testing and Material
SAE: Society of Automotive Engineers
API: American Petroleum Institute

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

10 STRUCTURE AND FUNCTION

PARTS RELATED TO ENGINE



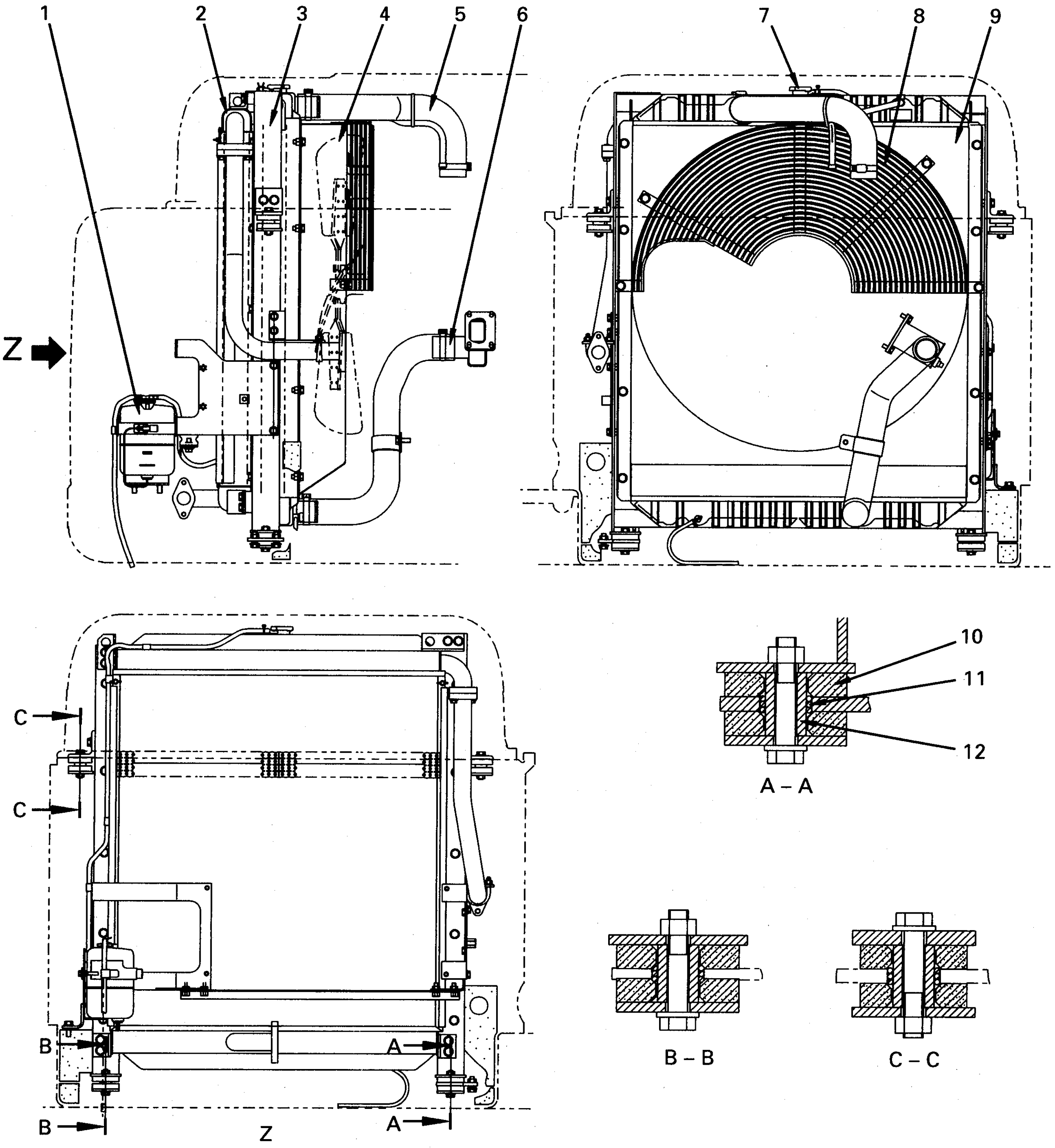


1. Drive plate
2. Torsion spring
3. Stopper pin
4. Friction plate
5. Intake connector
6. Front engine mount
7. Rear engine mount
8. Air cleaner
9. Muffler
10. Damper assembly

Outline

- The damper assembly is a wet type
  Oil capacity: 0.75 ℓ

RADIATOR, OIL COOLER

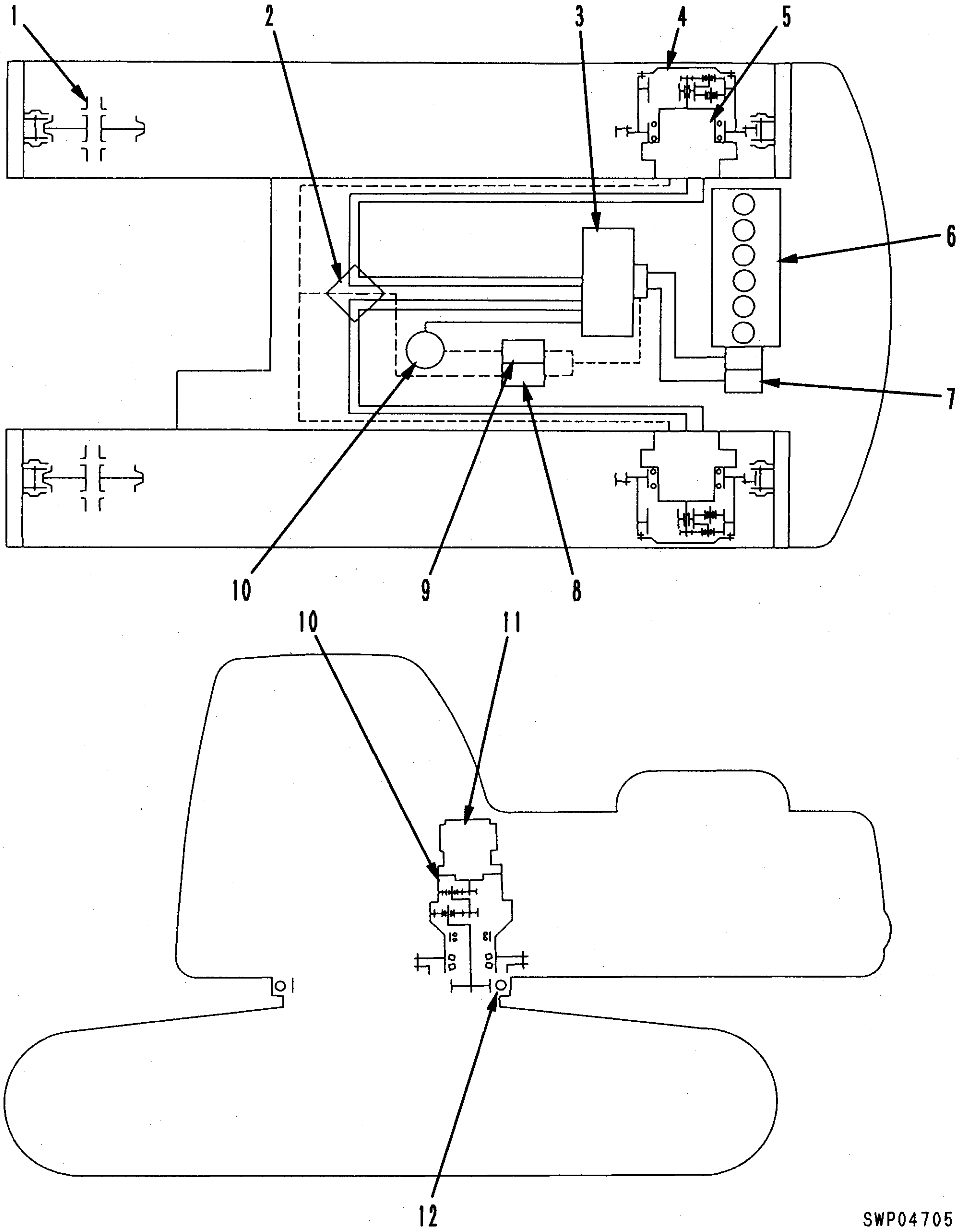


SAP00139

1. Reservoir tank
2. Oil cooler
3. Radiator
4. Fan
5. Radiator inlet hose
6. Radiator outlet hose
7. Radiator cap
8. Net
9. Shroud
10. Cushion
11. O-ring
12. Collar

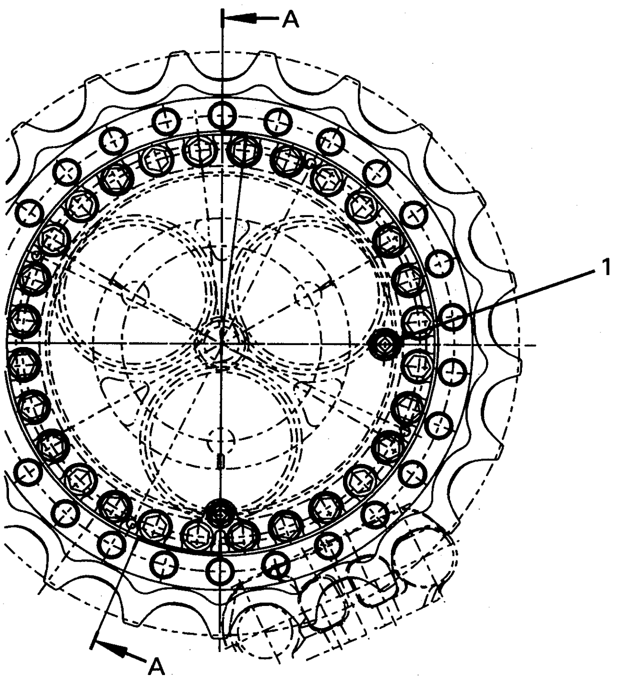
Specifications
Radiator: CWX-4
Oil cooler: SF-4

POWER TRAIN

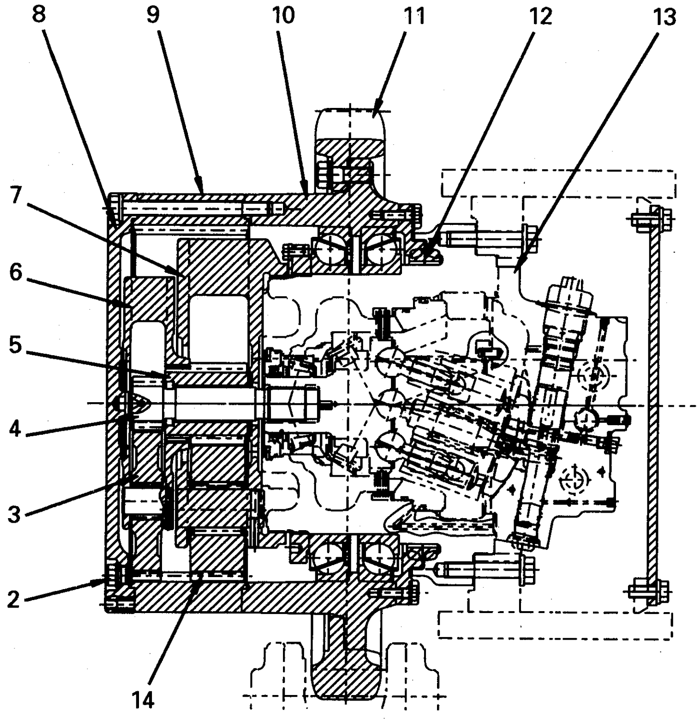


1. Idler
2. Center swivel joint
3. Control valve
4. Final drive
5. Travel motor (KMV280ADT)
6. Engine (SA6D125-2)
7. Hydraulic pump (HPV160+160)
8. Travel speed solenoid valve
9. Swing brake solenoid valve
10. Swing machinery
11. Swing motor (KMF160ABE-3)
12. Swing circle

FINAL DRIVE



1. Level plug
2. Drain plug
3. No. 1 planetary gear (No. of teeth: 38)
4. No. 1 sun gear (No. of teeth: 10)
5. No. 2 sun gear (No. of teeth: 17)
6. No. 1 planetary carrier
7. No. 2 planetary carrier
8. Cover
9. Ring gear (No. of teeth: 83)
10. Hub
11. Sprocket
12. Floating seal
13. Travel motor
14. No. 2 planetary gear (No. of teeth: 32)



A–A

SAP00142

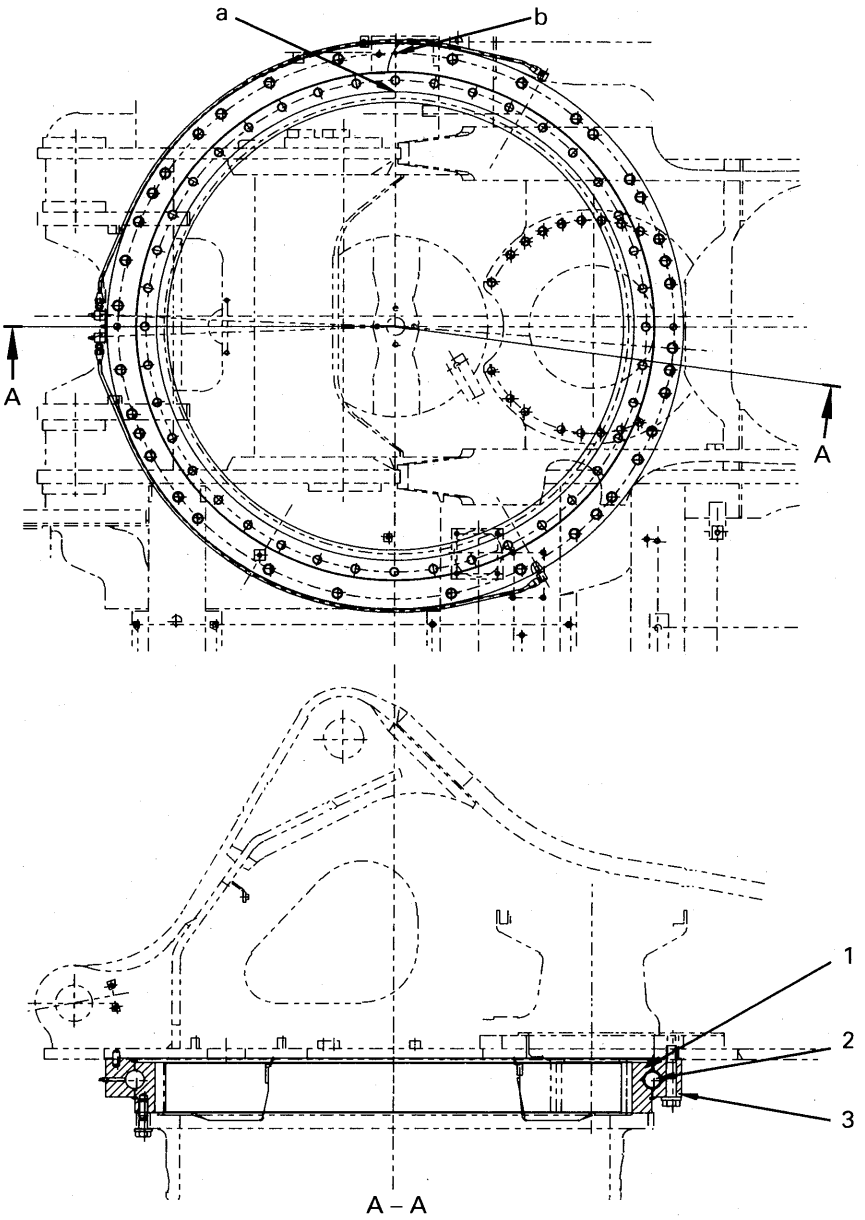
Specifications

Reduction ratio: $-\left(\frac{10+83}{10}\right)\times\left(\frac{17+83}{17}\right)+1$

$= -\ 53.706$

SWING CIRCLE

PC400-6 Serial No.: 32001 – 32249
PC450-6 Serial No.: 12001 – 12143



SAP00144

1. Swing circle inner race (No. of teeth: 90)
2. Ball
3. Swing circle outer race

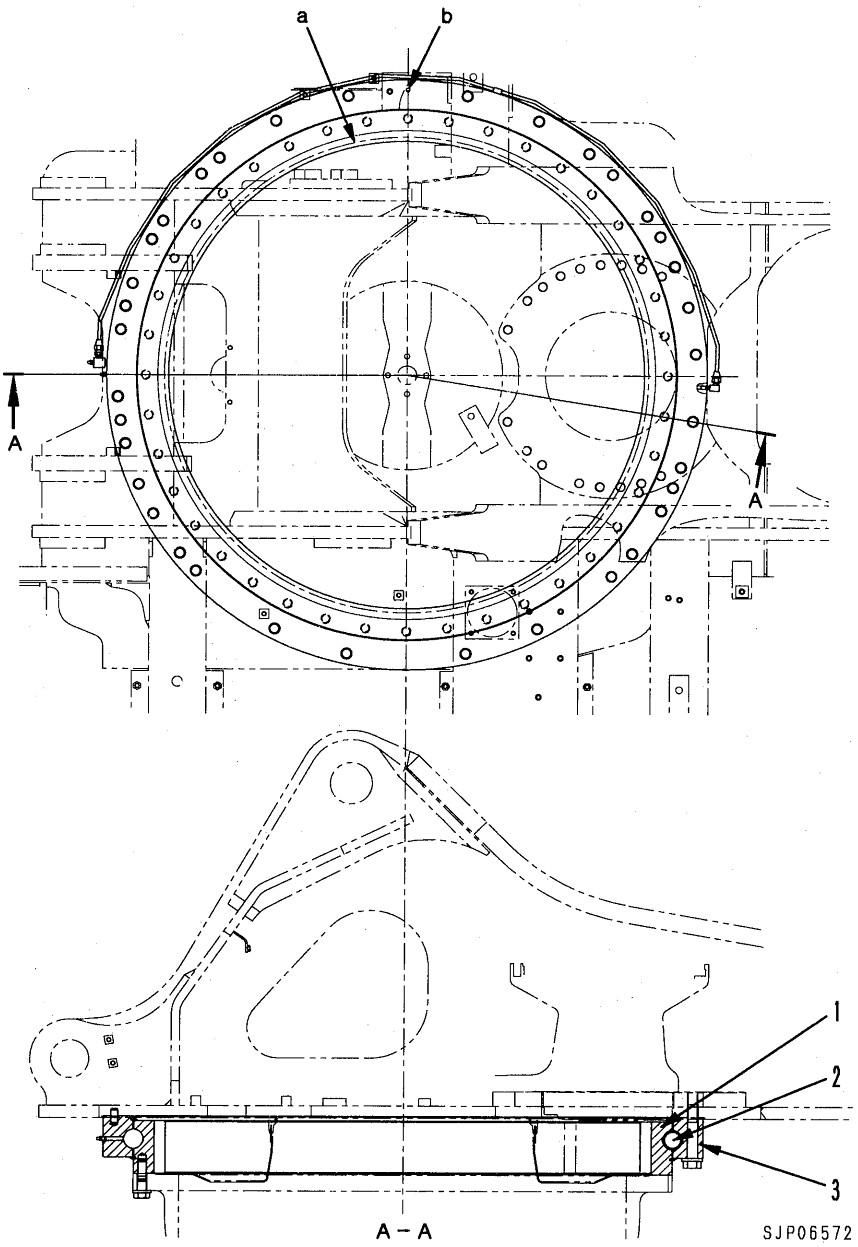
a. Inner race soft zone "S" position
b. Outer race soft zone "S" position

Specifications

Reduction ratio: $-\frac{84}{13} = -6.462$

Amount of grease: 33 ℓ (G2-LI)

PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up



1. Swing circle inner race (No. of teeth: 90)
2. Ball
3. Swing circle outer race

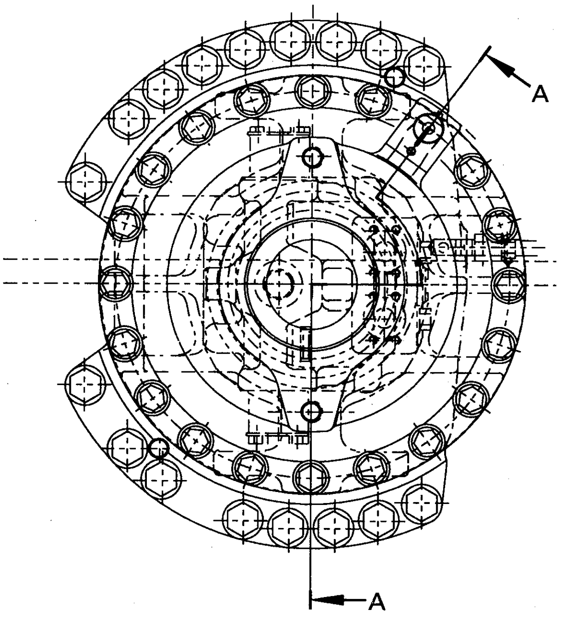
a. Inner race soft zone "S" position
b. Outer race soft zone "S" position

Specifications

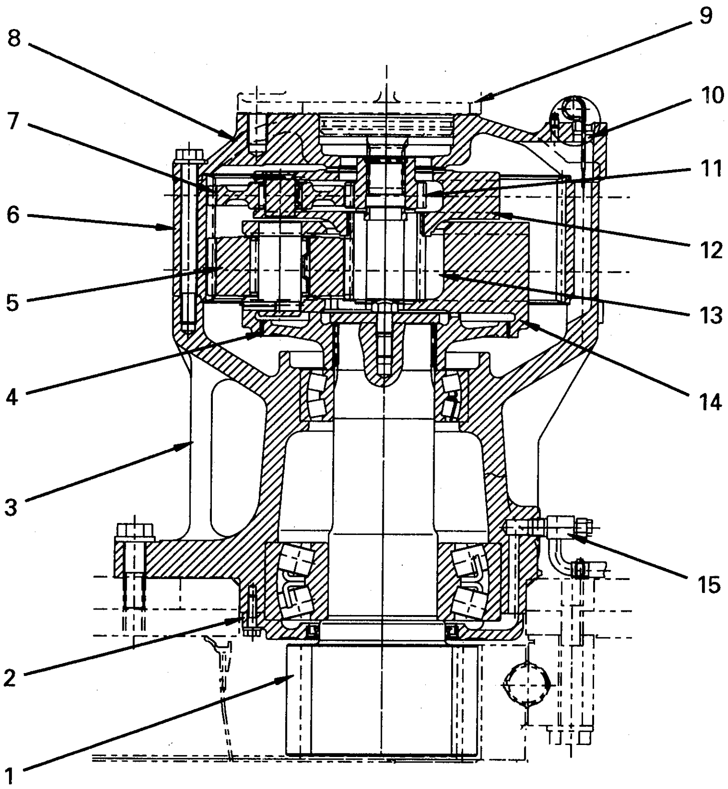
Reduction ratio: $-\frac{84}{13} = -6.462$

Amount of grease: 33 ℓ (G2-LI)

SWING MACHINERY



1. Swing pinion (No. of teeth: 13)
2. Cover
3. Case
4. Coupling
5. No. 2 planetary gear (No. of teeth: 35)
6. Ring gear (No. of teeth: 92)
7. No. 1 planetary gear (No. of teeth: 35)
8. Cover
9. Swing motor
10. Oil level gauge
11. No. 1 sun gear (No. of teeth: 19)
12. No. 1 planetary carrier
13. No. 2 sun gear (No. of teeth: 19)
14. No. 2 planetary carrier
15. Drain plug



A–A

SAP00146

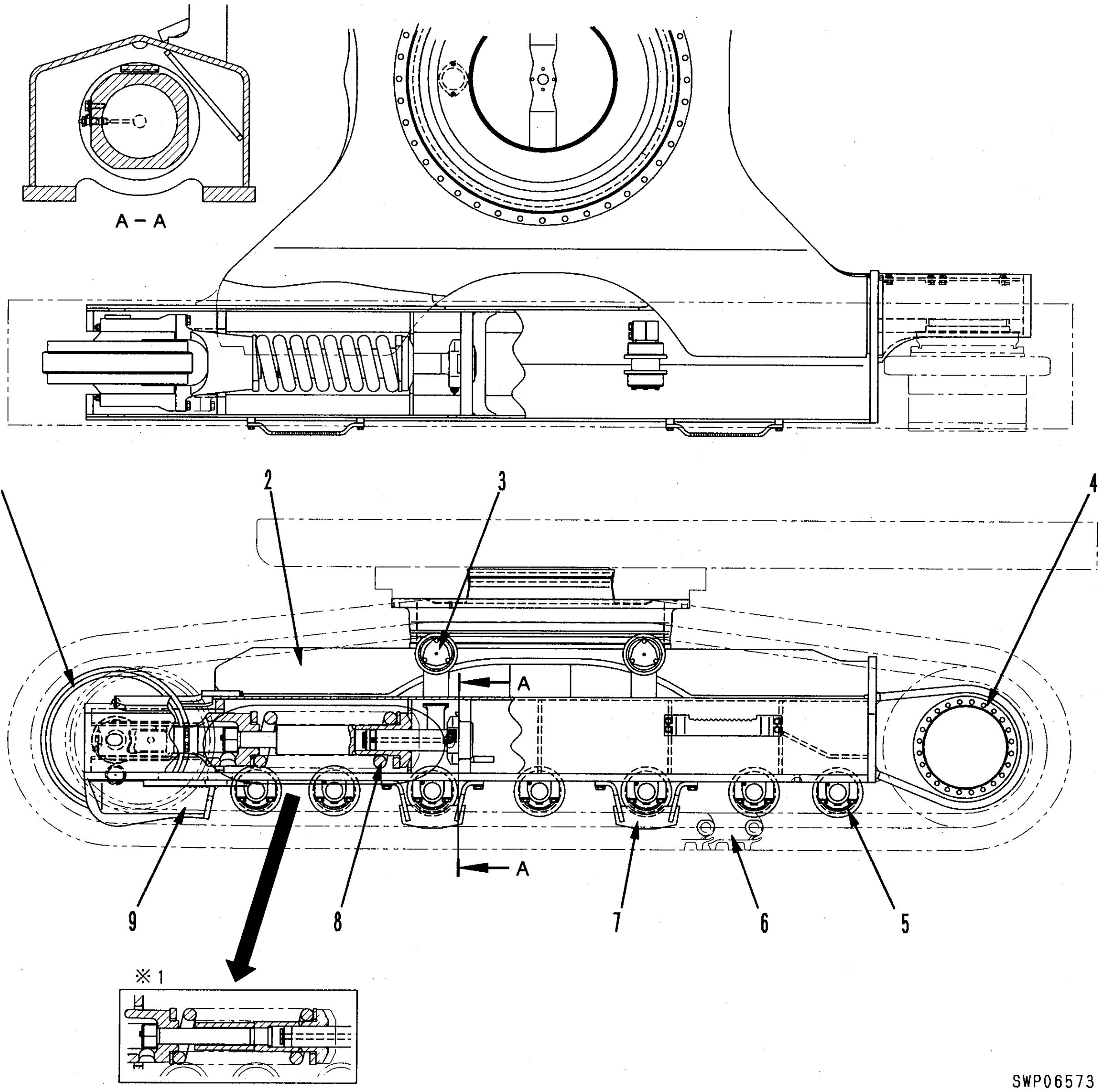
Specifications

Reduction ratio: $\frac{19+92}{19} \times \frac{19+92}{19}$

= 34.130

TRACK FRAME, RECOIL SPRING

★ The diagram shows the PC400-6



※1. PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up

1. Idler
2. Track frame
3. Carrier roller
4. Final drive
5. Track roller
6. Track shoe
7. Center guard
8. Recoil spring
9. Front guard

- The dimensions and number of track rollers may differ according to the model, but the basic structure is the same.
- No. of track rollers.

Model	No. of rollers (each side)
PC400, 450-6	7
PC400LC, 450LC-6	8

TRACK SHOE

Standard shoe

Item / Model	PC400-6	PC450-6	PC400LC-6	PC450LC-6
Shoe width (mm) (triple shoe)	600	600	700	600
Link pitch (mm)	228.6	228.6	228.6	228.6
No. of shoes (each side)	46	46	49	49

Selection of track shoe

- Select the most suitable track shoe from the following table

	PC400-6		PC450-6		PC400LC-6		PC450LC-6	
	Specifications	Category	Specifications	Category	Specifications	Category	Specifications	Category
Standard	600 mm triple	A	600 mm triple	A	700 mm triple	B	600 mm triple	A
Option	700 mm triple	B	700 mm triple	B	600 mm triple	A	700 mm triple	B
Option	800 mm triple	B			800 mm triple	B		

Category	Use	Precautions when using
A	Rocky ground, normal river soil	• Travel in Lo speed when traveling on rough ground with obstacles such as large boulders and fallen trees.
B	Normal soil, soft land	• Cannot be used on rough ground where there are large obstacles such as boulders and fallen trees. • Travel in Hi speed only on flat ground; when it is impossible to avoid traveling over obstacles, lower the travel speed to approx. half of Lo speed.
C	Extremely soft ground (swampy ground)	• Use only for ground where "A" and "B" sink and are impossible to use. • Cannot be used on rough ground where there are large obstacles such as boulders and fallen trees • Travel in Hi speed only on flat ground; when it is impossible to avoid traveling over obstacles, lower the travel speed to approx. half of Lo speed.
D	Paved surface	• The shoes are flat, so they have low gradeability
E	Paved surface	• The shoes are made of rubber, so be careful when traveling on rough ground

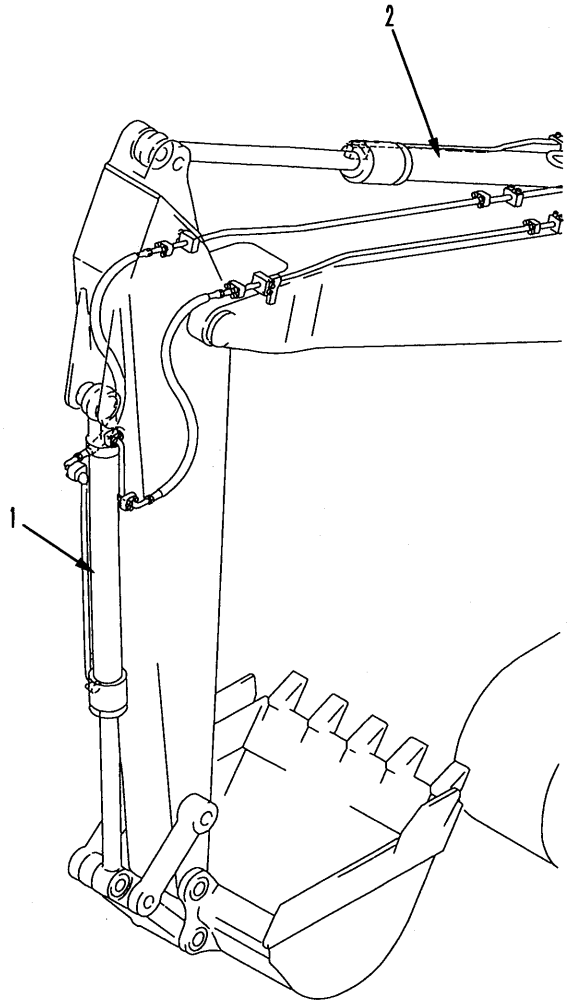
★ Categories "B" and "C" are wide shoes, so there are restrictions on their use. Therefore, before using, check the restrictions and consider carefully the conditions of use before recommending a suitable shoe width. If necessary, give the customer guidance in their use.

★ When selecting the shoe width, select the narrowest shoe possible within the range that will give no problem with flotation and ground pressure.
If a wider shoe than necessary is used, there will be a large load on the shoe, and this may lead to bending of the shoe, cracking of the links, breakage of the pins, loosening of the shoe bolts, or other problems.

HYDRAULIC PIPING DRAWING

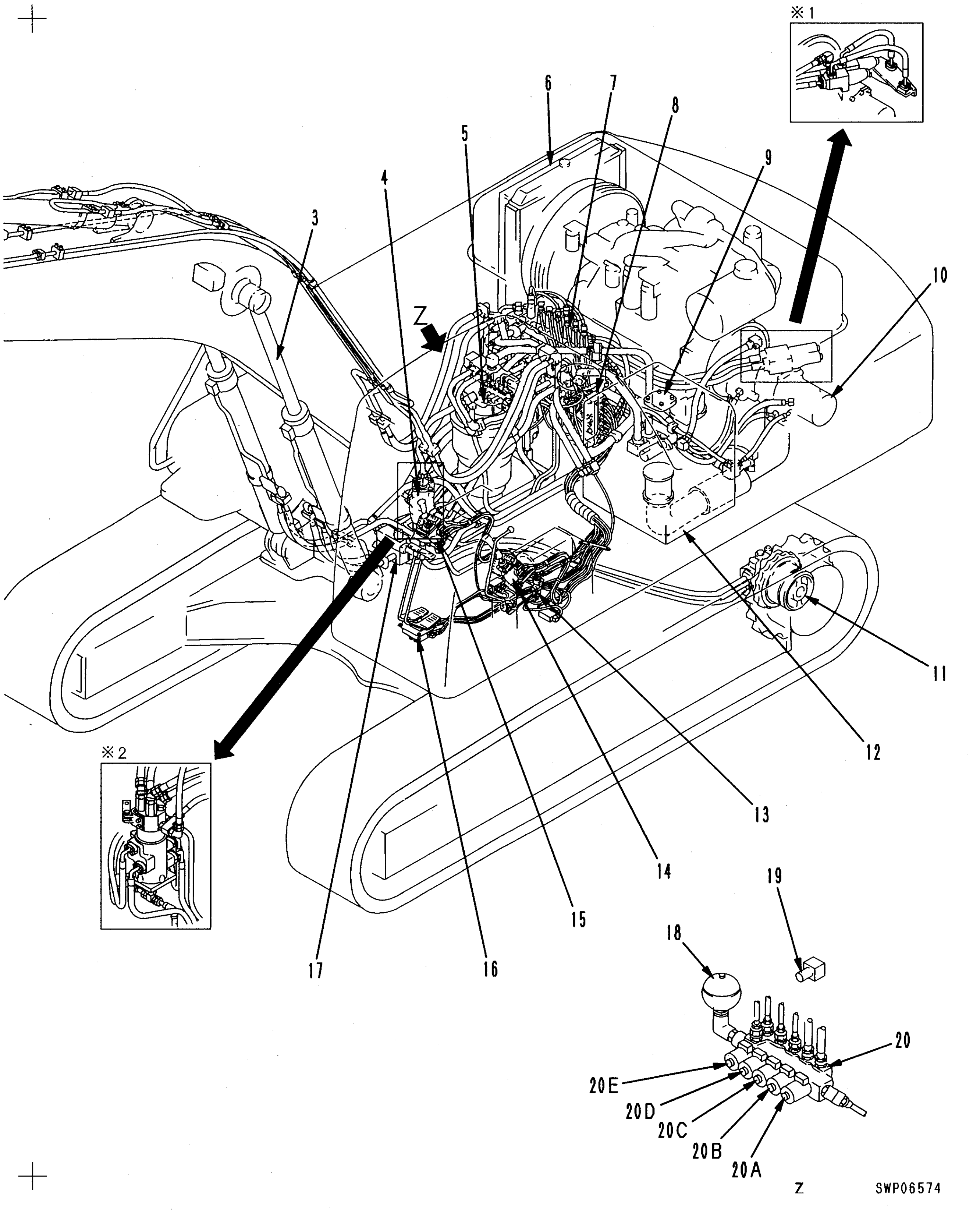
BACK HOE

1. Bucket cylinder
2. Arm cylinder
3. Boom cylinder
4. Center swivel joint
5. Swing motor
6. Oil cooler
7. Control valve
8. PPC shuttle valve
9. Hydraulic filter
10. Hydraulic pump
11. L.H. travel motor
12. Hydraulic tank
13. PPC safety lock valve
14. L.H. PPC valve
15. R.H. PPC valve
16. Travel PPC valve
17. Boom holding valve
18. Accumulator
19. Active mode solenoid valve (Swing)
20. Solenoid valve assembly
    - 20A. Swing brake solenoid valve
    - 20B. Travel speed solenoid valve
    - 20C. Merge/flow divider solenoid valve
    - 20D. Boom Hi 2-stage safety solenoid valve
    - 20E. Active mode solenoid valve (Boom)



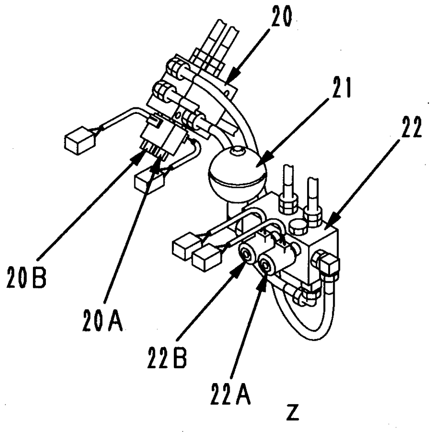
SWP05160

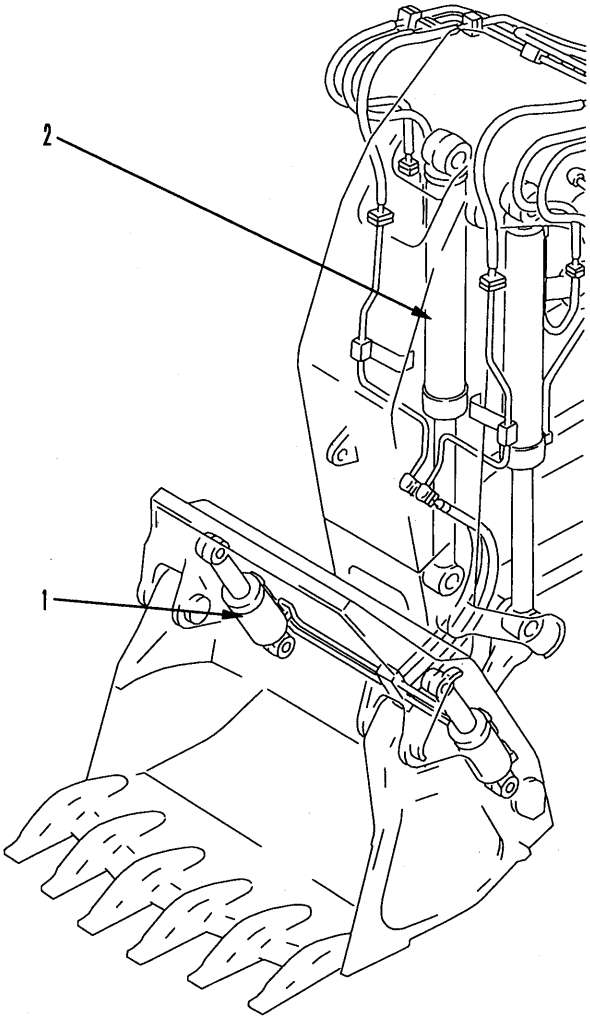
※1, ※2. PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up



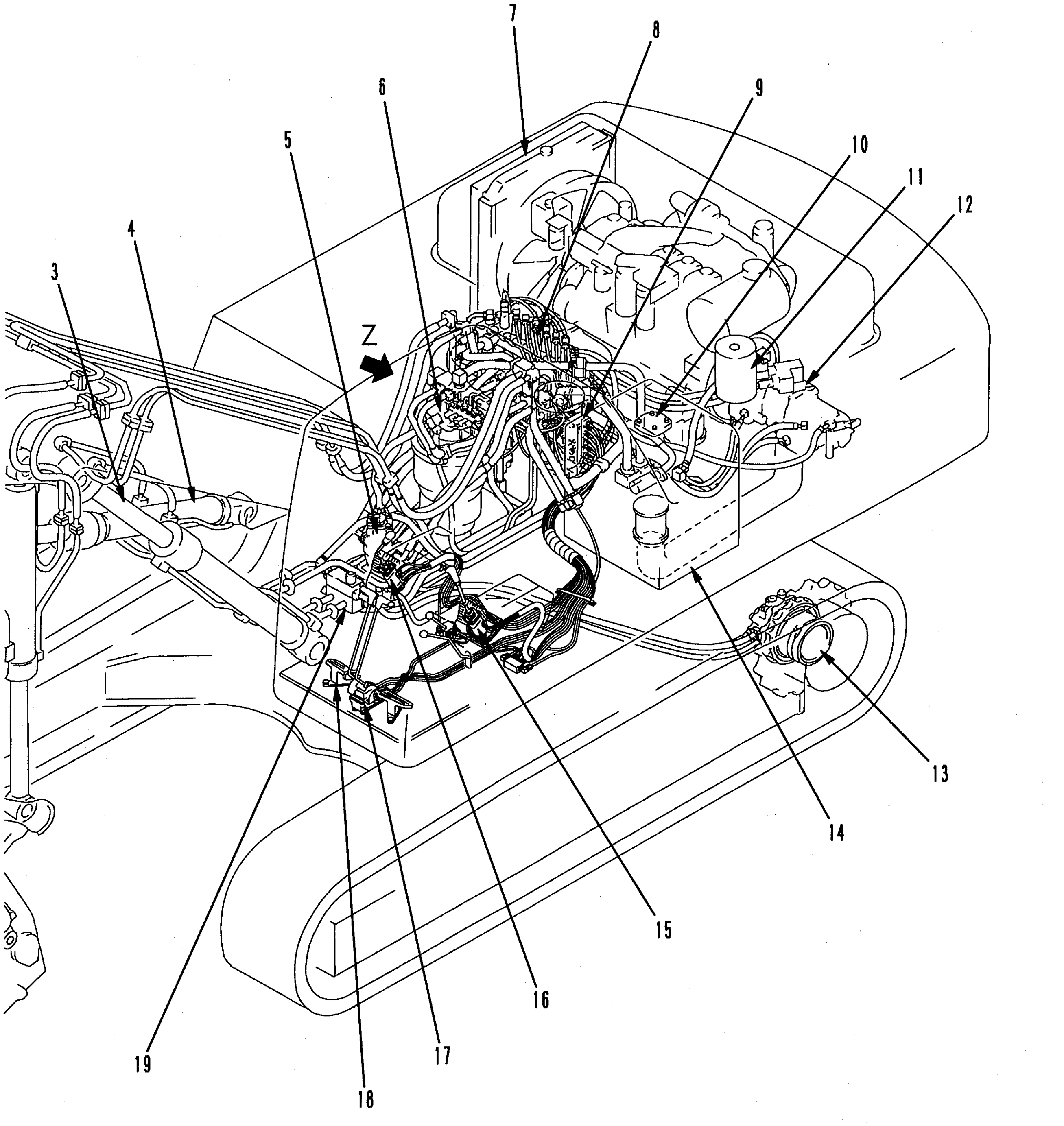
LOADING SHOVEL

1. Bottom dump cylinder
2. Bucket cylinder
3. Boom cylinder
4. Arm cylinder
5. Center swivel joint
6. Swing motor
7. Oil cooler
8. Control valve
9. PPC shuttle valve
10. Hydraulic filter
11. Bypass filter
12. Hydraulic pump
13. L.H. travel motor
14. Hydraulic tank
15. L.H. PPC valve
16. R.H. PPC valve
17. Travel PPC valve
18. Service PPC valve
19. Boom holding valve
20. Solenoid valve assembly
    20A. Pump merge/flow divider solenoid valve
    20B. Travel speed solenoid valve
21. Accumulator
22. Solenoid valve assembly
    22A. Swing brake solenoid valve
    22B. PPC lock solenoid valve



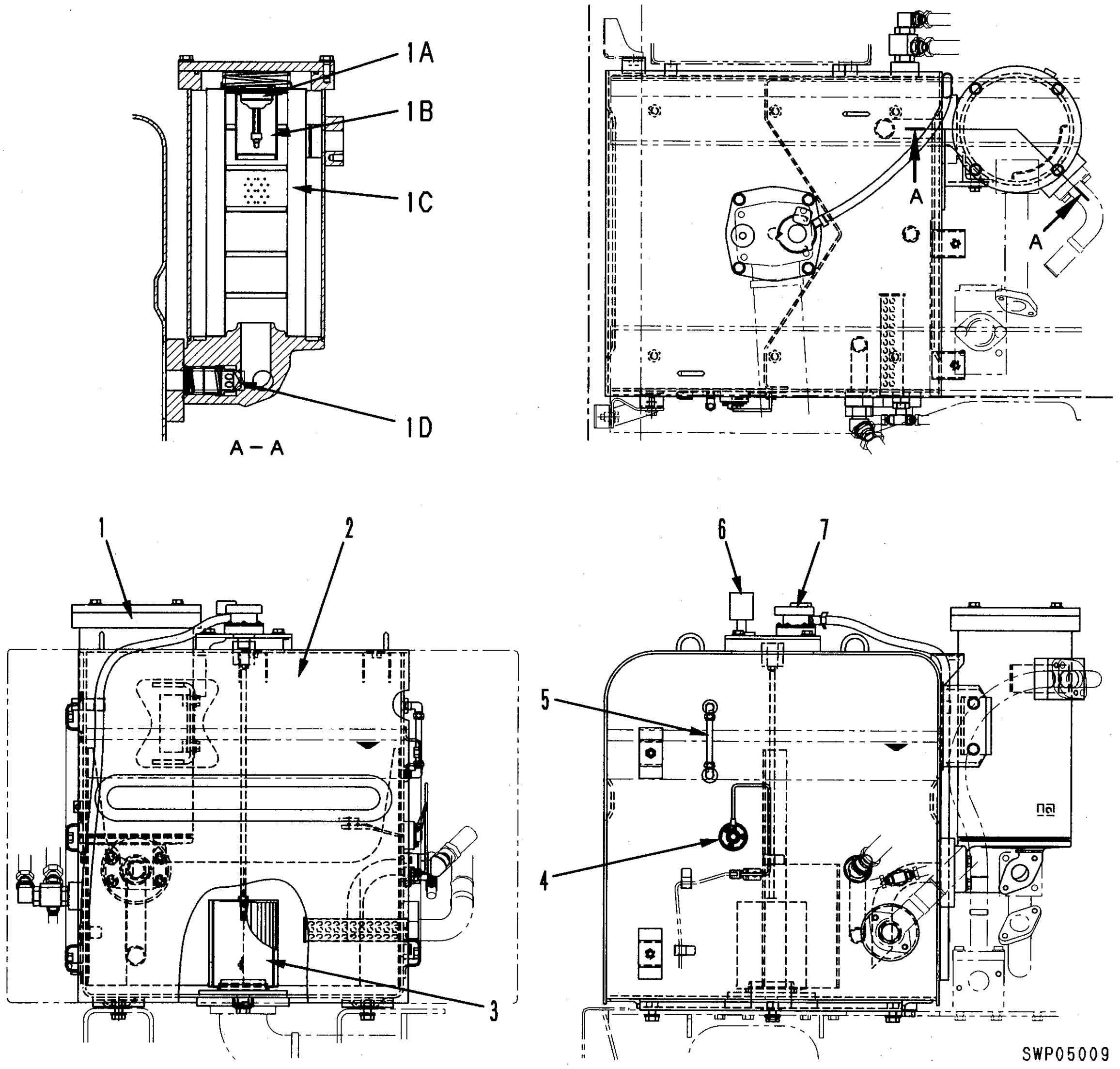


SWP07076



SWP07077

HYDRAULIC TANK, HYDRAULIC FILTER



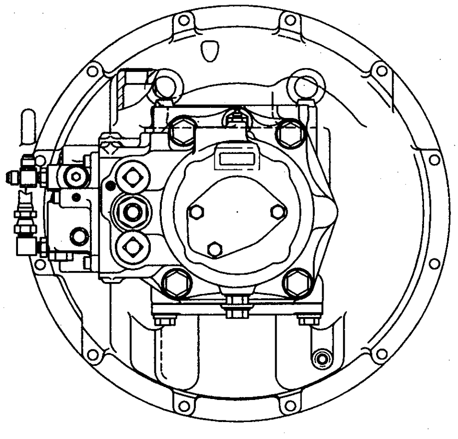
1. Hydraulic filter
    1A. Bypass valve
    1B. Strainer
    1C. Element
    1D. Cooler check valve
2. Hydraulic tank
3. Suction strainer
4. Hydraulic oil level sensor
5. Sight gauge
6. Breather
7. Oil filler cap

Specifications
Tank capacity: 358 ℓ
Amount of oil inside tank: 273 ℓ (at H level)

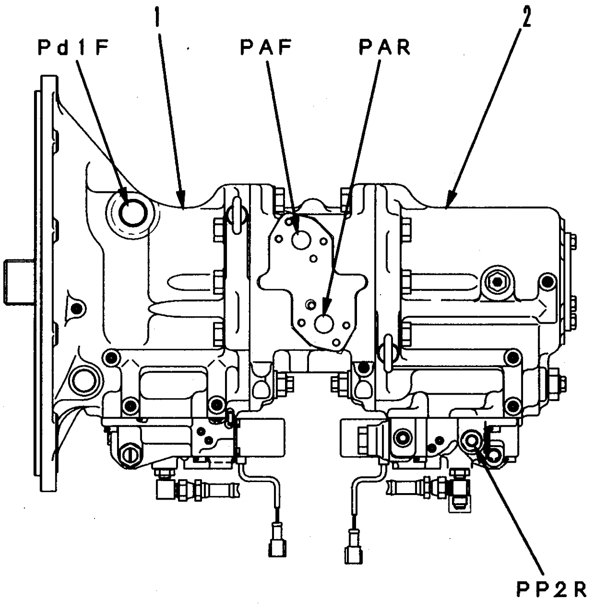
Safety valve

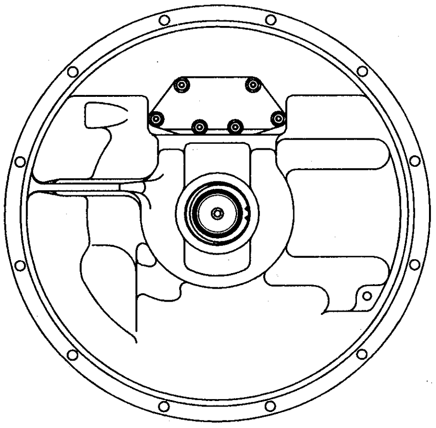
- Relief cracking pressure: 16.7 ± 6.9 kPa {0.17 ± 0.07 kg/cm^2}
- Suction cracking pressure: 0 – 0.49 kPa {0 – 0.005 kg/cm^2}
- Bypass valve set pressure: 102.9 ± 19.6 kPa {1.05 ± 0.2 kg/cm^2}

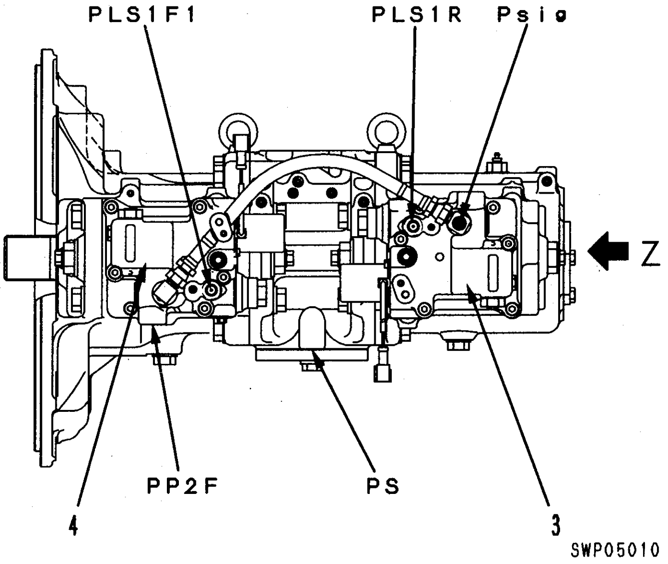
HYDRAULIC PUMP



Z





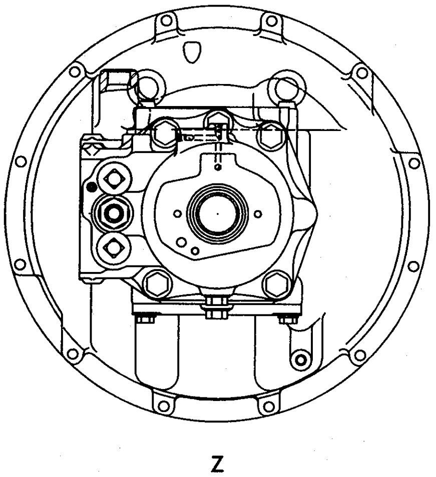


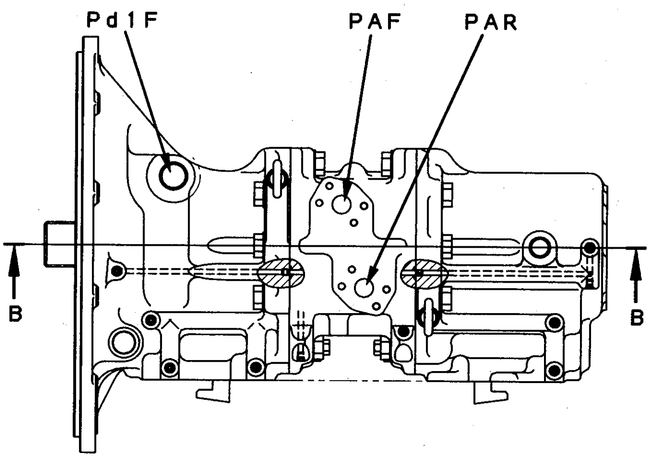
1. Front main pump
2. Rear main pump
3. Rear TVC, LS valve
4. Front TVC, LS valve

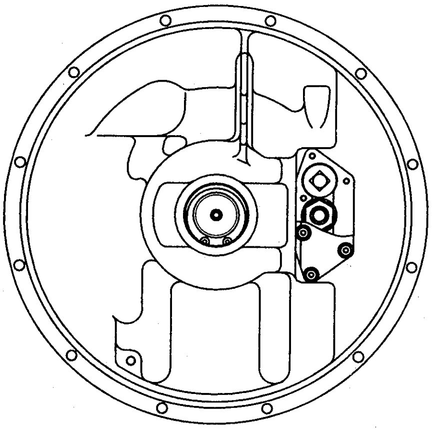
PS : Pump suction
PAF : Front delivery
PAR : Rear delivery
PP2F : Front pump delivery pressure
PP2R : Rear pump delivery pressure
PLS1R : Rear LS pressure
PLS1F1: Front LS pressure
Pd1F : Pump drain
Psig : LS control pressure EPC pressure

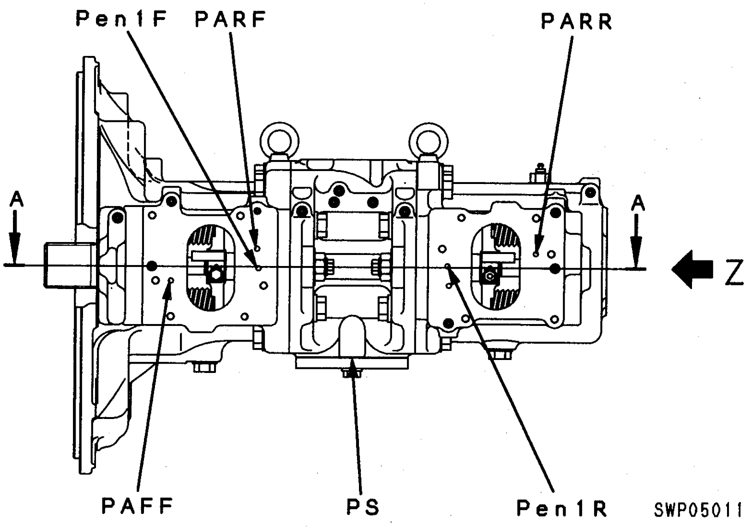
Outline
This pump consists of two variable displacement swash plate type piston pumps, TVC, LS valves and impeller pumps.

1. MAIN PUMP
HPV160 + 160



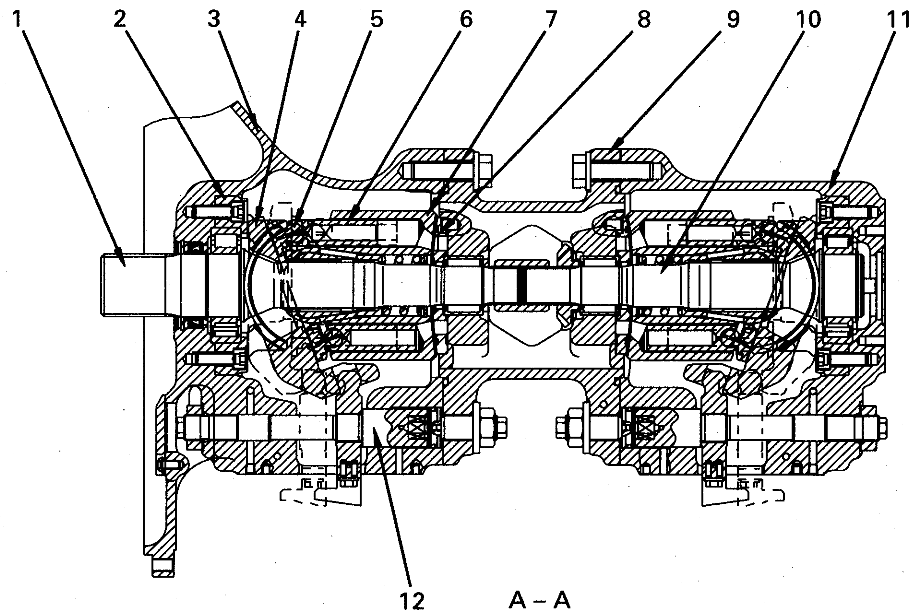




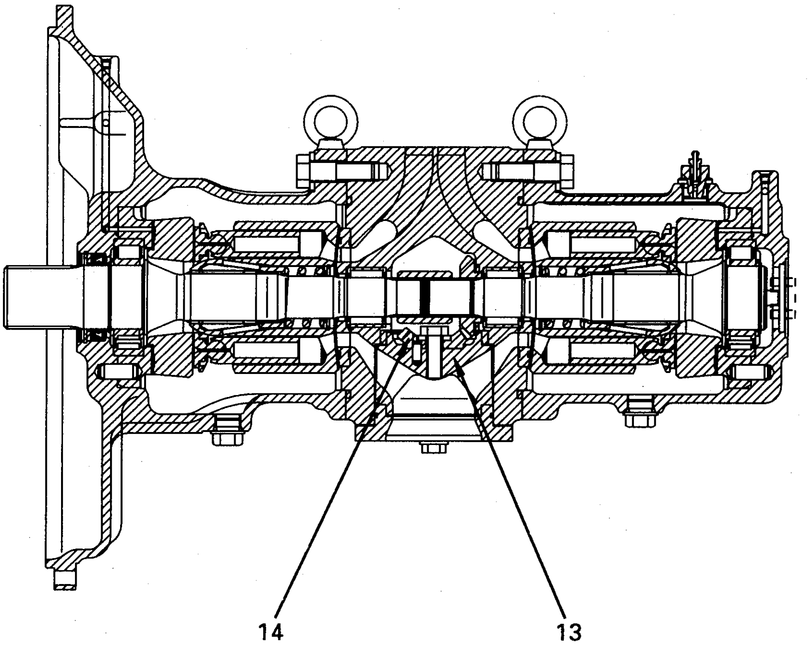


PS : Suction
PAF : Front pump delivery
PAR : Rear pump delivery
PAFF : Front delivery pressure
PARF : Rear delivery pressure

PARR : Rear delivery pressure
Pd1F : Pump drain
Pen1F : Front control pressure
Pen1R : Rear control pressure



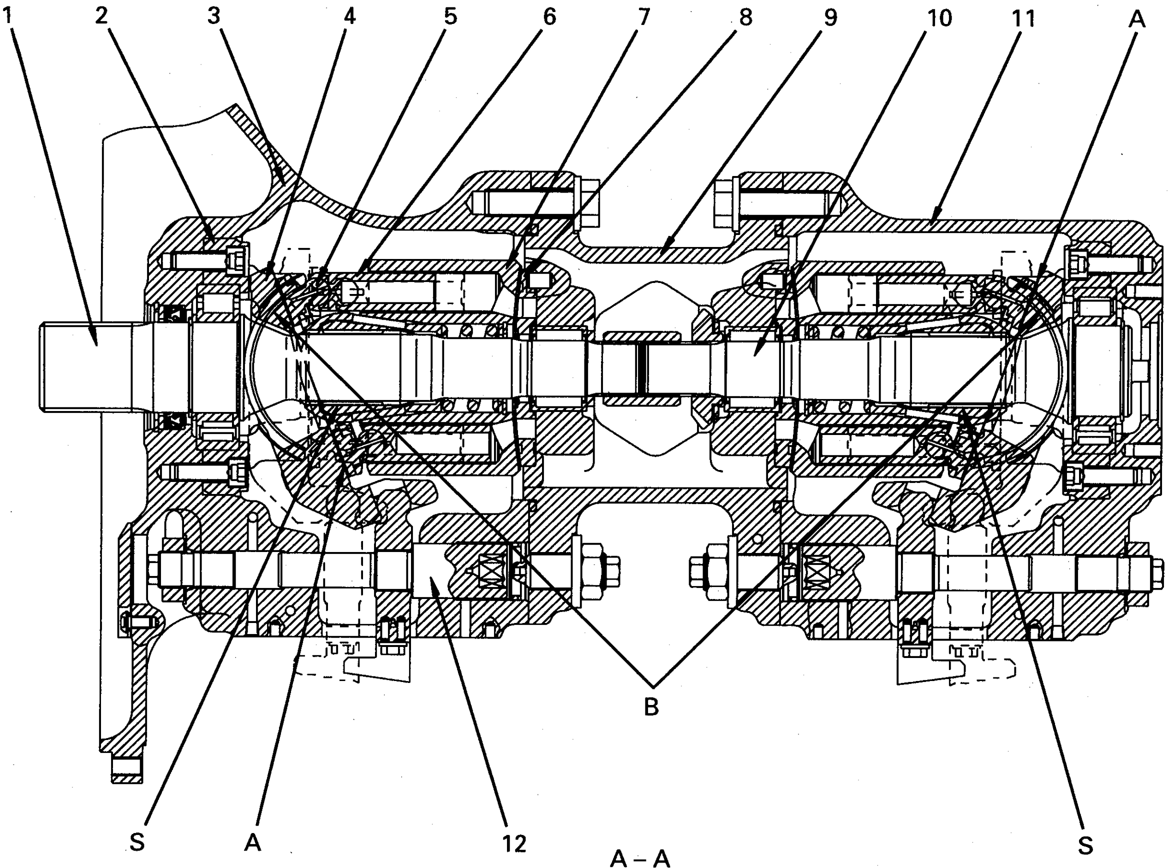
A – A



B – B

SAP00160

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. Shaft (rear)
11. Case (rear)
12. Servo piston
13. Impeller pump
14. Bevel gear



Function

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

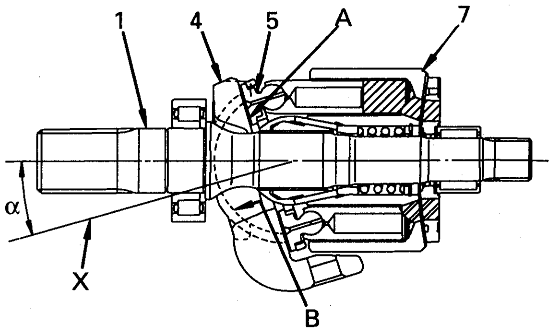
Structure

- Cylinder block (7) is supported to shaft (1) by spline **S**, 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 cylindrical 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).
- Impeller (13) is connected with shaft (1) through bevel gear (14) and rotates together with the shaft. The oil sucked in from the suction port is sent into the cylinder chamber by centrifugal force to make it easier to suck in.

Operation

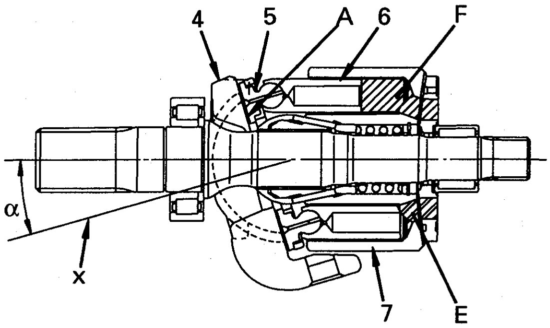
1. Operation of pump

- 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.)

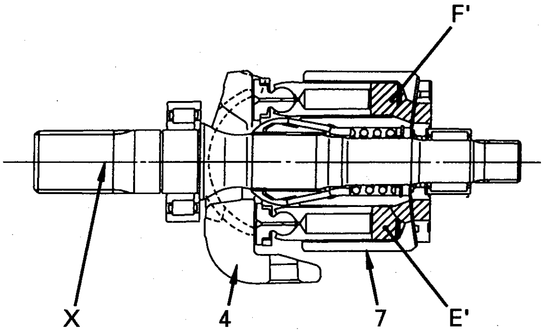


SLP00163

1) 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 volume **E** and **F** is created inside cylinder block (7). The suction and discharge is equal to 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.
2) 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.

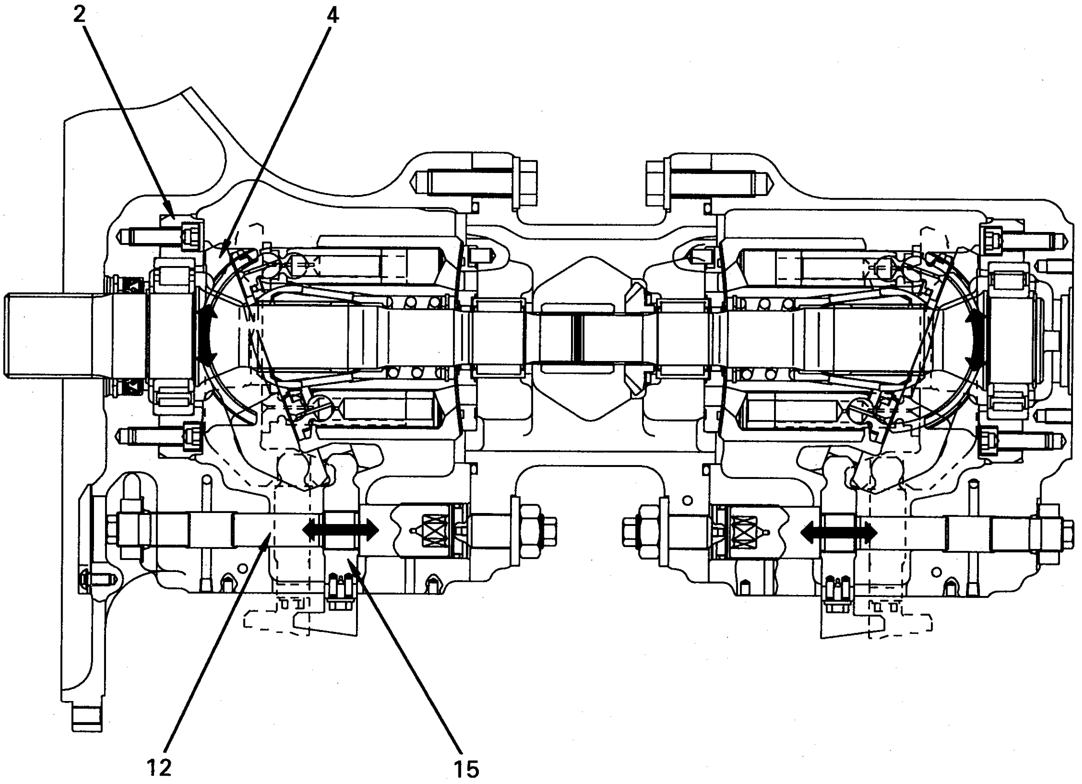


SLP00164



SLP00165

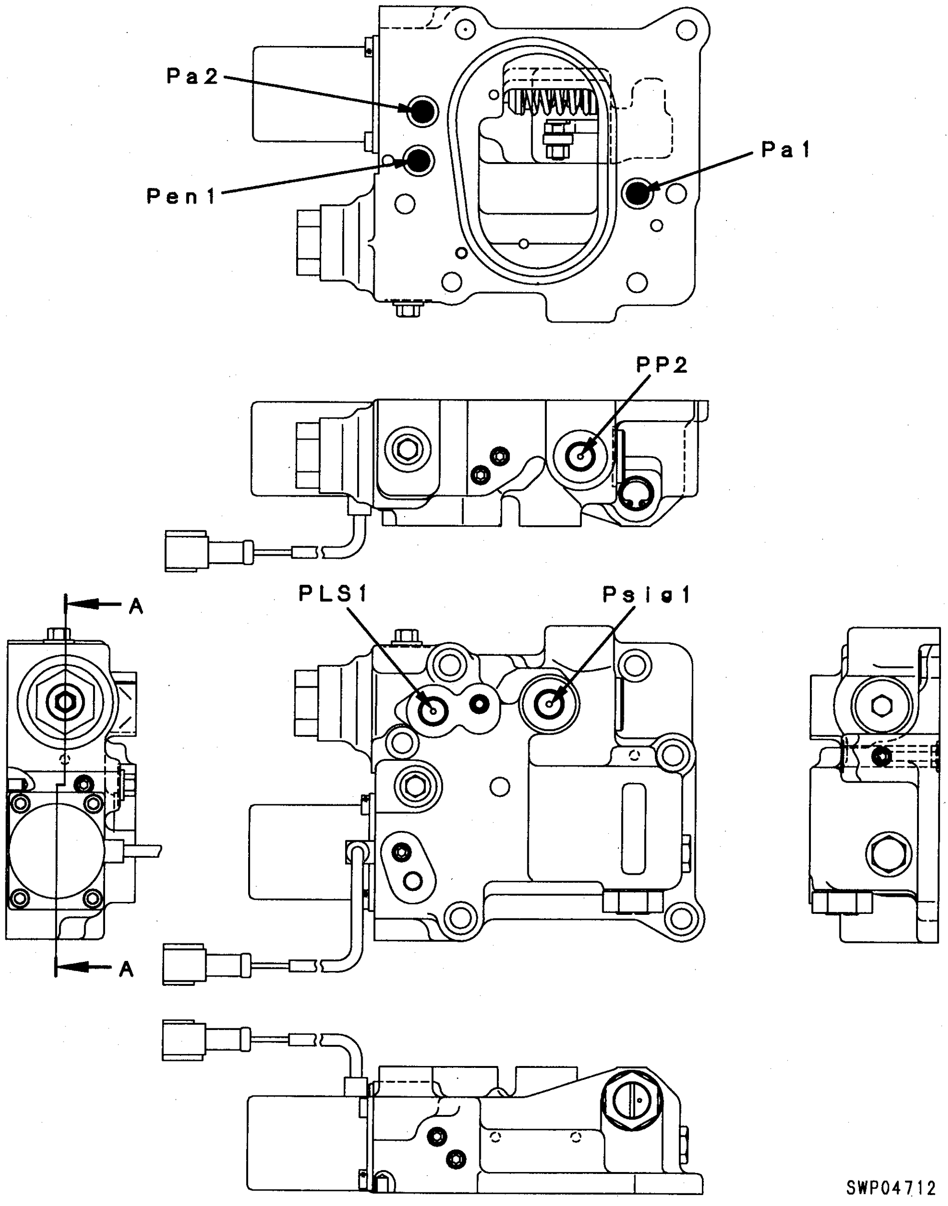
2. Control of discharge amount



SAP00167

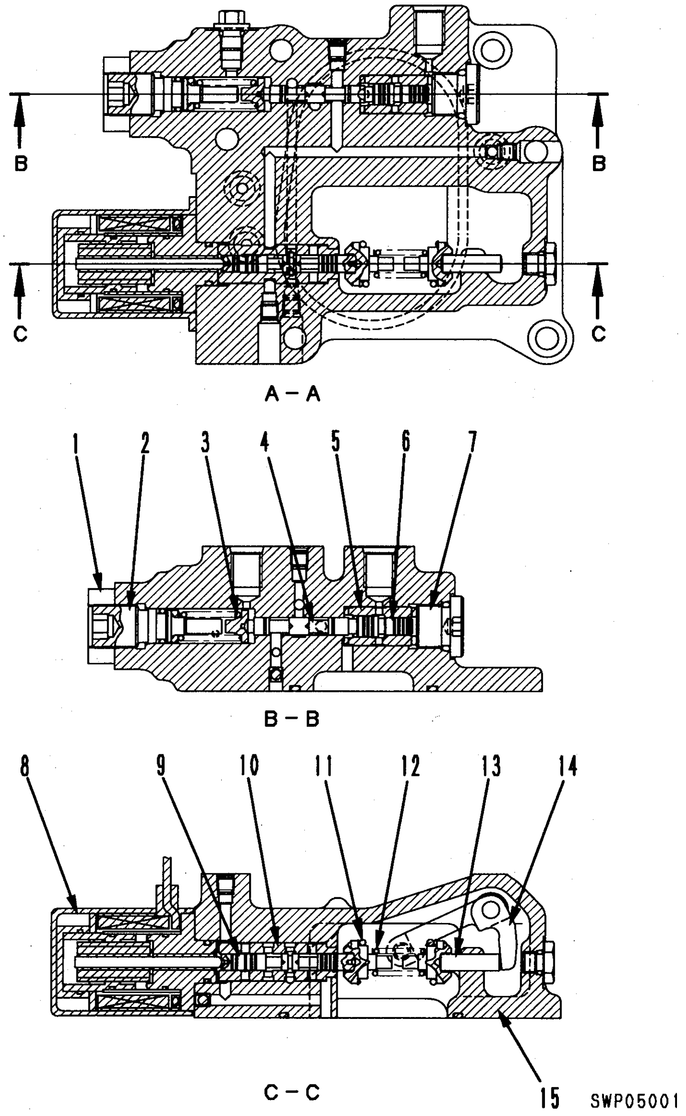
- If swash plate angle α becomes larger, the difference in volumes **E** and **F** becomes larger and discharge volume **Q** increases.
- Swash plate angle α is changed by servo piston (12).
- Servo piston (12) moves in a reciprocal movement (↔) according to the command from the control valve.
- This straight line movement is transmitted through rod (15) to rocker cam (4), and rocker cam (4), which is supported by the cylindrical surface to cradle (2), moves in a rocking movement on the cylindrical surface in (↕ direction).
- With servo piston (12), the area receiving the pressure is different on the left and right, so main pump discharge pressure (self pressure) **PP** is always connected to the chamber receiving the pressure on the small diameter piston side (the self-pressure is brought in). Output pressure **Pen** of the LS valve is brought to the chamber receiving the pressure at the large diameter piston end. The relationship in the size of self-pressure **PP** and the pressure at the small diameter piston end, and the ratio between the area receiving the pressure at the small diameter piston end and the large diameter piston end controls the movement of servo piston (12).

2. TVC, LS VALVE



PP2 : Pump pressure No.2 port
PLS1 : Control valve LS pressure inlet port
Pa1 : Front pump delivery pressure inlet port

Pa2 : Rear pump delivery pressure inlet port
Pen1 : Signal pressure output
Psig1 : LS-EPC pressure inlet port



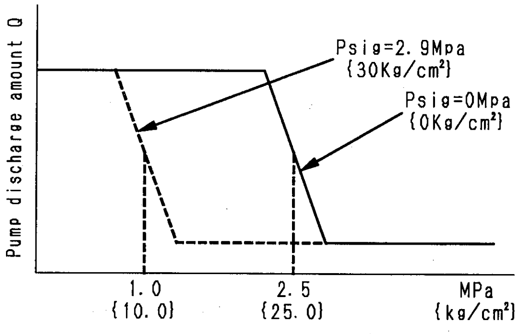
LS valve
1. Locknut
2. Plug
3. Spring
4. Spool
5. Sleeve
6. Piston
7. Plug

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

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 Δ**PLS** (=**PP2**–**PLS**) (the difference between main pump pressure **PP2** and control valve outlet port pressure **PLS**) (called the LS differential pressure).
- Main pump pressure **PP2** coming from the control valve inlet port, 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 Δ**PLS**, (the difference between main pump pressure **PP2** and LS pressure **PLS**) (=**PP2**–**PLS**) changes as shown in the diagram on the right according to LS selector pressure **Psig**.
- When **Psig** changes between 0 – 2.9 MPa {0 – 30 kg/cm²}, the spring load changes according to this, and the point for switching the pump discharge amount changes at the rated central value between 0.98 – 2.45 MPa {10.0 – 25.0 kg/cm²}.

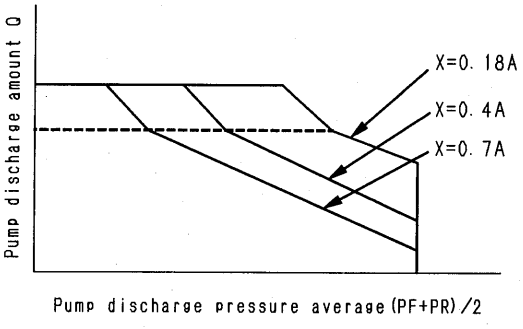


SWP05163

2. TVC valve

- When pump discharge pressure **Pa1** (self-pressure) and **Pa2** (other pump pressure) are high, the TVC valve controls the pump so that no more oil than the constant flow (in accordance with the discharge pressure) flows even if the stroke of the control valve becomes larger. In this way it carries out equal horsepower control so that the horsepower absorbed by the pump does not exceed the engine horsepower.
- In other words, if the load during the operation becomes larger and the pump discharge pressure rises, it reduces the discharge amount from the pump; and if the pump discharge pressure drops, it increases the discharge amount from the pump. The relationship between the average of the front and rear pump discharge pressures (**PF** + **PR**)/2 and pump discharge amount **Q** is shown on the right, with the current given to the TVC valve solenoid shown as a parameter.

  However, in the heavy-duty operation mode, there are cases where it is given the function of sensing 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 to the TVC valve solenoid from the controller increases according to the drop in the engine speed to reduce the pump swash plate angle.

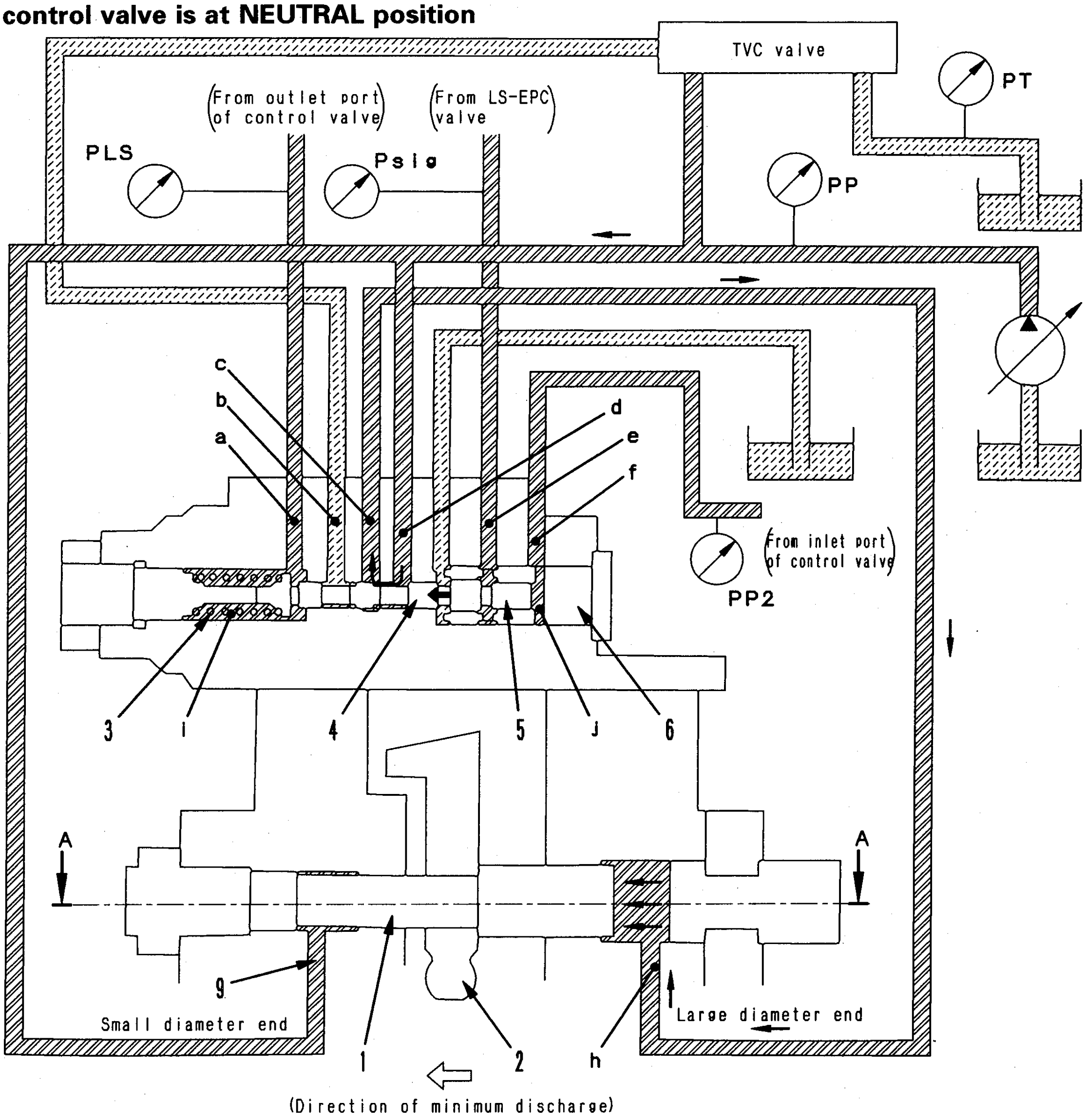


SWP05164

Operation

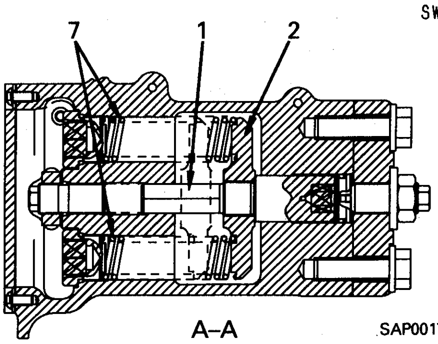
1. LS valve

1) When control valve is at NEUTRAL position



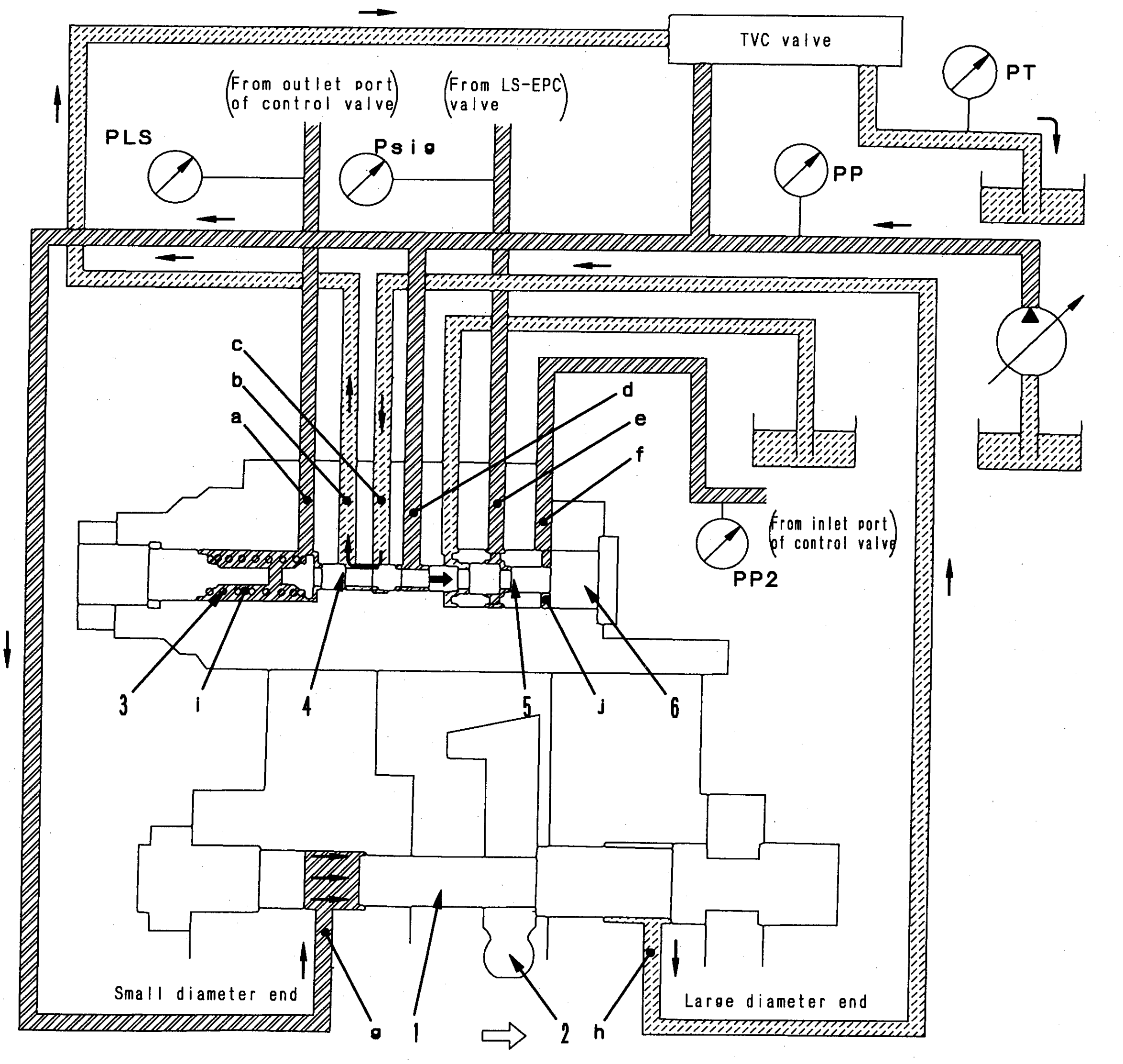
SWP05076

- The LS valve is a three-way selector valve, with pressure **PLS** (LS pressure) from the outlet port of the control valve brought to spring chamber **i**, and main pump discharge pressure **PP2** brought to chamber **j** of plug (6).
- The size of the force of this LS pressure **PLS** + force **F** of spring (3) and the main pump pressure (self pressure) **PP2** determines the position of spool (4). However, the size of the output pressure **Psig** (the LS selection pressure) of the EPC valve for the LS valve entering port **e** also changes the position of spool (4). (The set pressure of the spring changes.)
- Before the engine is started, servo piston (1) is pushed to the right by spring (7) installed to rod (2). (See the diagram on the right)
- When the engine is started and the control lever is at the NEUTRAL position, LS pressure **PLS** is 0 MPa {0 kg/cm²}. (It is interconnected with the drain circuit through the control valve spool.) At this point, spool (4) is pushed to the left, and port **d** and port **c** are connected. Pump pressure **PP** enters the large diameter end of the piston from port **h**, and the same pump pressure **PP** also enters the small diameter end of the piston, so the swash plate is moved to the minimum angle by the difference in area of piston (1).



SAP00173

2) Operation in maximum direction for pump discharge amount

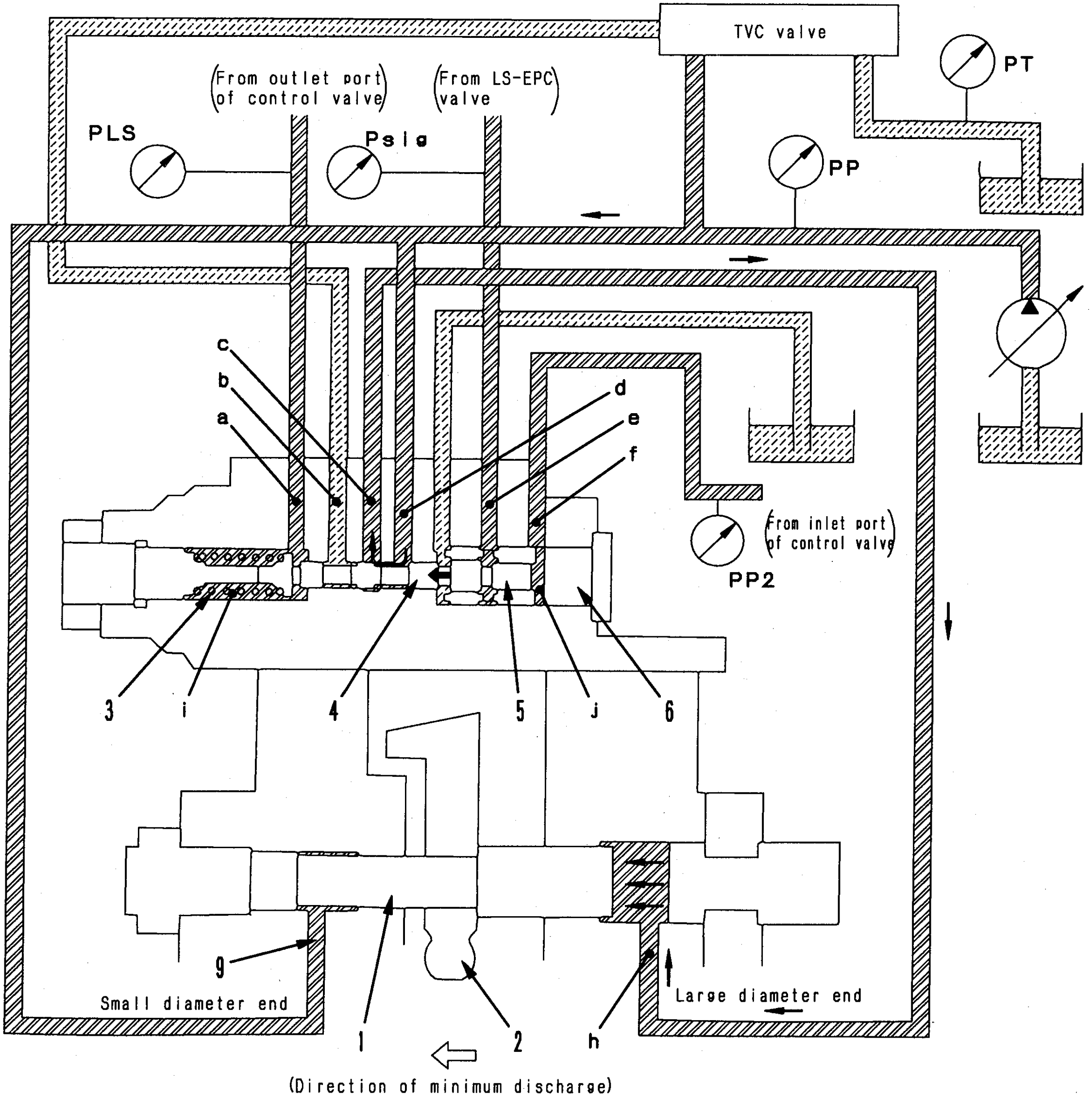


(Direction of maximum discharge)

SWP05077

- When the difference between main pump pressure **PP2** and LS pressure **PLS**, in other words, LS differential pressure **ΔPLS**, becomes smaller (for example, when the area of opening of the control valve becomes larger and pump pressure **PP** drops), spool (4) is pushed to the right by the combined force of LS pressure **PLS** and the force of spring (3).
- When spool (4) moves, port **b** and port **c** are joined and connected to the TVC valve. When this happens, the TVC valve is connected to the drain port, so circuit **c** – **h** becomes drain pressure **PT**. (The operation of the TVC valve is explained later.)
- For this reason, the pressure at the large piston diameter end of servo piston (1) becomes drain pressure **PT**, and pump pressure **PP** enters the small diameter end, so servo piston (1) is pushed to the right. Therefore, rod (2) moves to the right and moves the swash plate in the direction to make the discharge amount larger.
- If the output pressure **Psig** of the LS-EPC valve enters port **e**, this pressure creates a force to move piston (5) to the left. If piston (5) is pushed to the left, it acts to make the set pressure of spring (3) weaker, and the difference between **PLS** and **PP2** changes when ports **b** and **c** of spool (4) are connected.

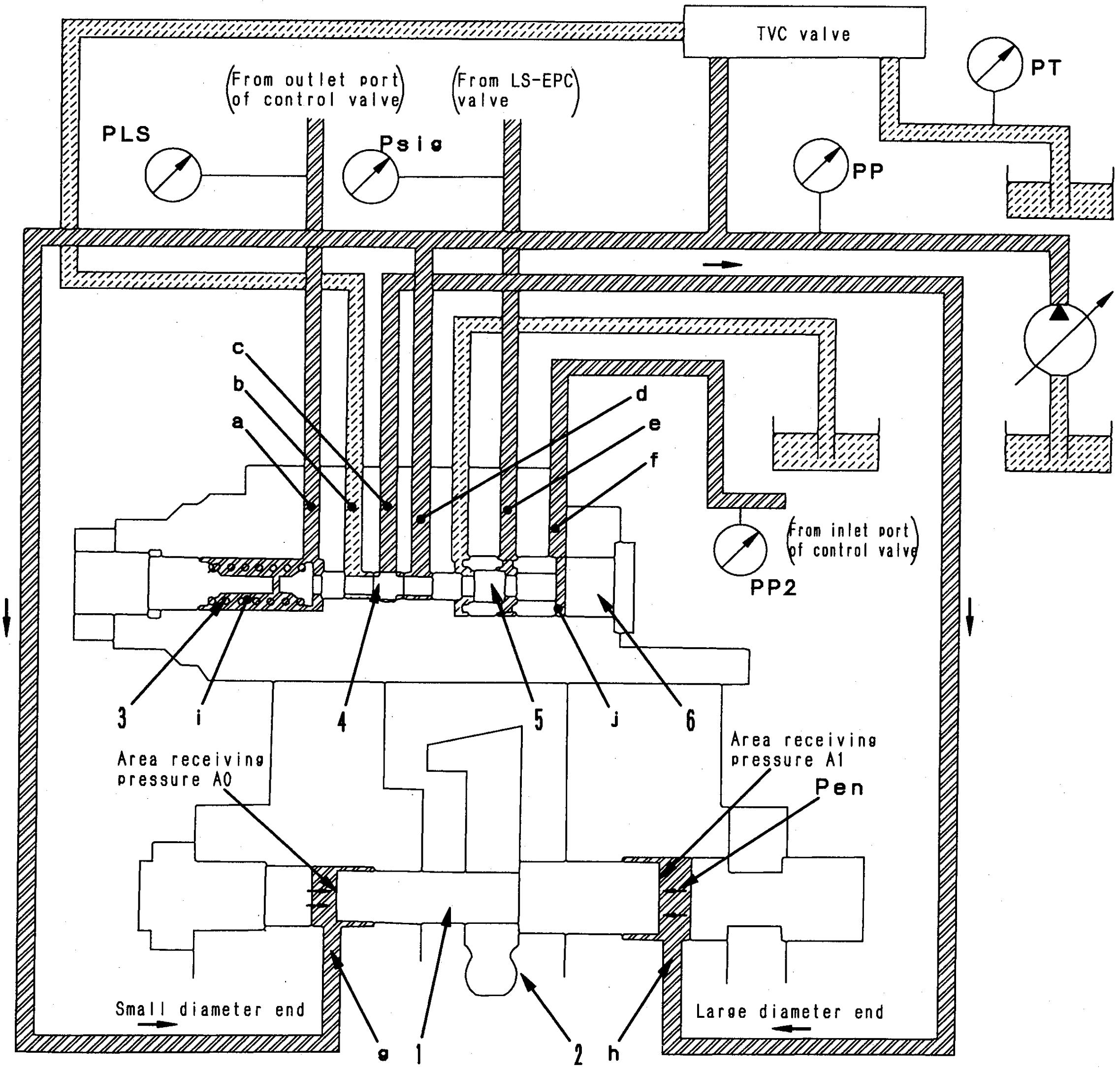
3) Operation in minimum direction for pump discharge amount



SWP05078

- The following explains the situation if servo piston (1) moves to the left (the discharge amount becomes smaller). When LS differential pressure ΔPLS becomes larger (for example, when the area of opening of the control valve becomes smaller and pump pressure **PP** rises), main pump discharge pressure **PP2** pushes spool (4) to the left.
- When spool (4) moves, main pump pressure **PP** flows from port **d** to port **c**, and from port **h**, it enters the large piston diameter end.
- Main pump pressure **PP** also enters the small piston diameter end, but because of the difference in area between the large piston diameter end and small piston diameter end of servo piston (1), servo piston (1) is pushed to the left.
  As a result, rod (2) moves in the direction to make the swash plate angle smaller.
- If LS selection pressure **Psig** enters port **e**, it acts to make the set pressure of spring (3) weaker.

4) When servo piston is balanced

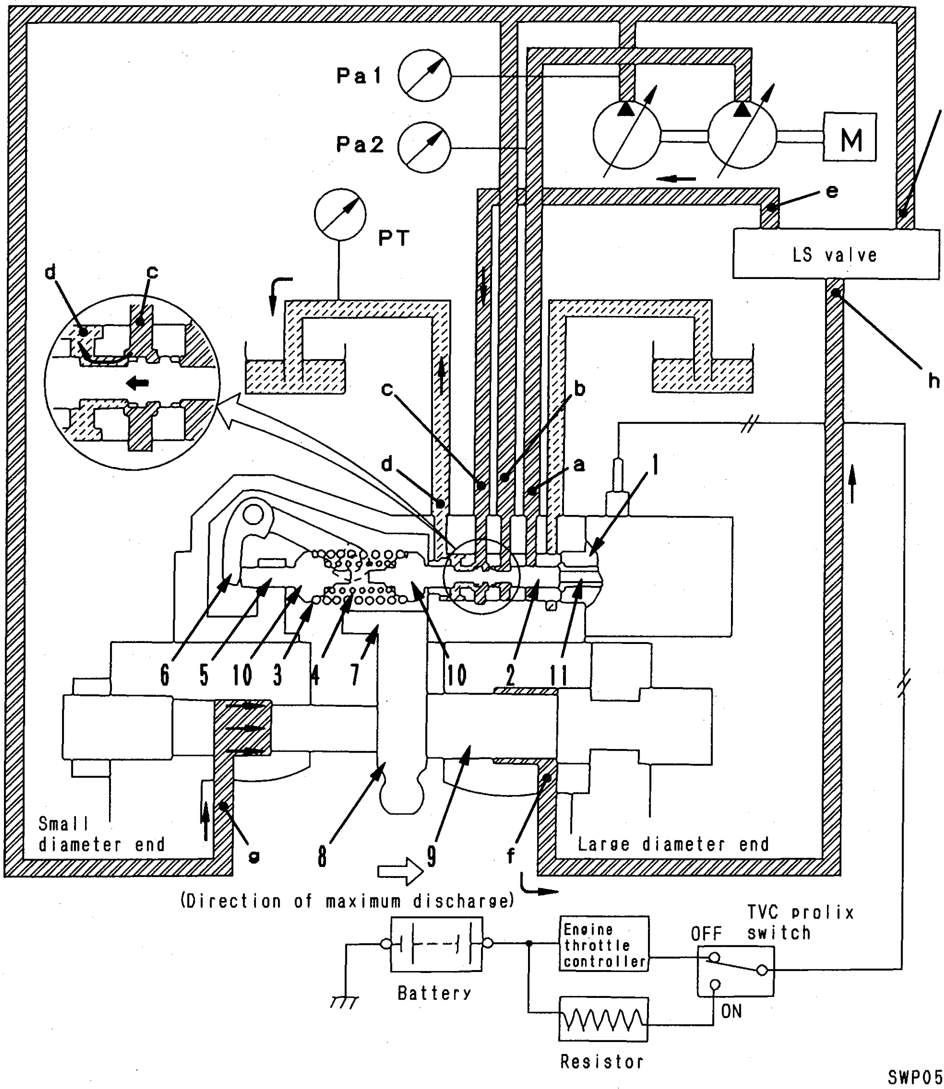


SWP05079

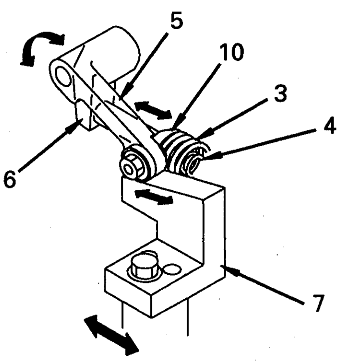
- Let us take the area receiving the pressure at the large piston diameter end as A1, the area receiving the pressure at the small diameter end as A0, and the pressure flowing into the large piston diameter end as **Pen**. If main pump discharge pressure **PP2** of the LS valve and the combined force of force **F** of spring (3) and LS pressure **PLS** are balanced, and the relationship is A0 x **PP** = A1 x **Pen**, servo piston (1) will stop in that position, and the swash plate will be kept at an intermediate position. (It will stop at a position where the opening of the throttle between port **b** and port **c** and between port **d** and port **c** of spool (4) is approximately the same. At this point, the pressure of port **c** is approx. 2/5 pump pressure **PP**.)
- At this point, the relationship between the area receiving the pressure at both ends of piston (1) is A0 : A1 = 2 : 5, so the pressure applied to both ends of the piston when it is balanced becomes **PP** : **Pen** = 5 : 2.
- The position where spool (4) is balanced and stopped is the standard center, and the force of spring (3) is adjusted so that it is determined when **PP2** – **PLS** = 2.45 MPa {25 kg/cm^2}. However, if **Psig** (the output pressure of 0 – 2.94 MPa {0 – 30 kg/cm^2} of the EPC valve of the LS valve) is applied to port **e**, the balance stop position will change in proportion to pressure **Psig** between **PP2** – **PLS** = 2.45 – 0.98 MPa {25 – 10 kg/cm^2}.

2. TVC valve

1) When governor, pump controller are normal



SWP05080



SBP00178

★ Other pump pressure
This is the pressure of the pump at the opposite end.
For the front pump, it is the rear pump pressure
For the rear pump, it is the front pump pressure

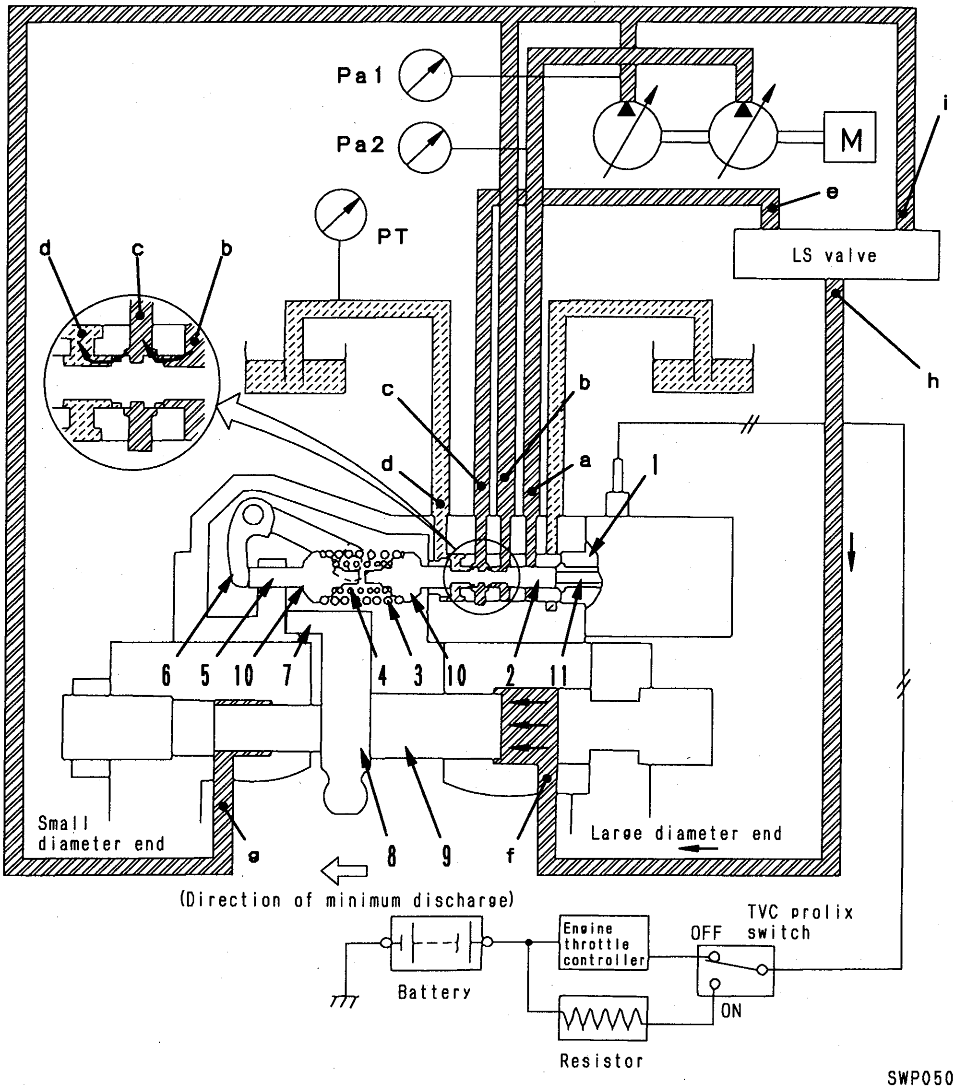
a. When the load on the actuator is small and pump pressures Pa1 and Pa2 are low

① Action of solenoid (1)

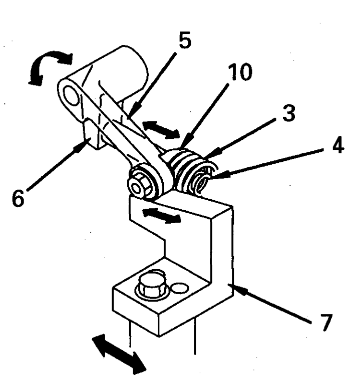
- Command current **x** from the governor, pump controller flows to solenoid (1). This command current changes the internal force pushing solenoid push pin (11).
- On the opposite side to the force pushing this solenoid push pin (11) is the spring set pressure of springs (3) and (4) and pump pressure **Pa1** and other pump pressure **Pa2** (see ★). Piston (2) stops at a position where the combined force pushing piston (2) is balanced, and the pressure (pressure of port **c**) output from the TVC valve changes according to this position.
- The size of command current **x** is determined by the nature of the operation (lever operation), the selection of the working mode, and the set value and actual value for the engine speed.

② Action of spring

- The spring load of springs (3) and (4) in the TVC valve is determined by the position of the swash plate.
- When servo piston (9) moves, cam (7), which is connected to rod (8), also moves. When this happens, lever (6) is rotated by the angle of cam (7), and piston (5) moves to the right or left.
- If piston (5) moves to the right, spring (3) is compressed; and if it moves further to the right, spring (4) contacts seat (10), so both spring (3) and spring (4) function. In other words, the spring load is changed by piston (5) extending or contracting springs (3) and (4).
- If command current **x** input to solenoid (1) changes further, the pushing force of solenoid push pin (11) changes, and the spring load of springs (3) and (4) also changes according to the value of the solenoid command current.
- Port **c** of the TVC valve is connected to port **e** of the LS valve (see 1. LS valve).
  Self pressure **Pa1** enters port **b** and the small piston diameter end of servo piston (9), and the other main pump pressure **Pa2** enters port **a**.
- When pump pressures **Pa1** and **Pa2** are small, piston (2) is on the right. At this point, port **c** and port **d** are connected, and the pressure entering the LS valve becomes drain pressure **PT**.
  If port **h** and port **e** of the LS valve are connected (see 1. LS valve), the pressure entering the large piston diameter end from port **f** becomes drain pressure **PT**, and servo piston (9) moves to the right. In this way, the pump discharge amount moves in the direction of increase.
- As servo piston (9) moves further, piston (5) is moved to the left by rod (8), cam (7), and lever (6). Springs (3) and (4) expand and the spring force becomes weaker. When the spring force becomes weaker, piston (2) moves to the left, so the connection between port **c** and port **d** is cut, and the pump discharge pressure port **b** is connected to port **c**. As a result, the pressure at port **c** rises, and the pressure at the large piston diameter end also rises, so the movement of piston (9) to the right is stopped. In other words, the stop position for piston (9) (= pump discharge amount) is decided at the point where the force of springs (3) and (4) and the pushing force from the solenoid and the pushing force created by pressures **Pa1** and **Pa2** acting on piston (2) are in balance.



SWP05081

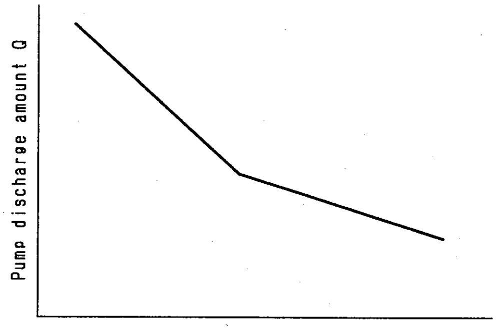


SBP00178

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

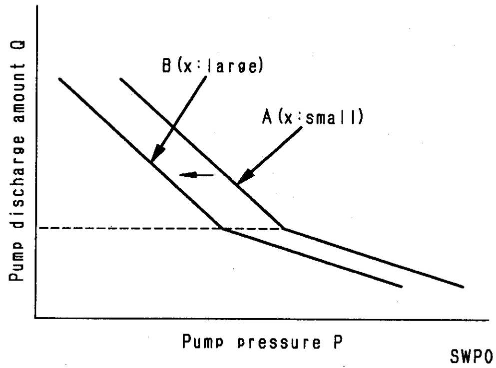
- When the load is large and pump discharge pressures **Pa1** and **Pa2** are high, the force pushing piston (2) to the left becomes larger and piston (2) moves to the position shown in the diagram above. When this happens, as shown in the diagram above, with the pressurized oil flowing from port **c** to the LS valve, part of the pressurized oil from port **b** flows out to port **d** and becomes approximately 2/5 main pump pressure **Pa1**.
- When port **h** and port **e** of the LS valve are connected (see 1. LS valve), the pressure from port **f** enters the large piston diameter end of servo piston (9), and servo piston (9) stops.
- If main pump pressures **Pa1** and **Pa2** increase further and piston (2) moves further to the left, main pump pressure **Pa1** flows to port **c** and acts to make the discharge amount the minimum. When piston (9) moves to the left, piston (5) is moved to the right by cam (7) and lever (6). For this reason, springs (3) and (4) are compressed and push back piston (2). Because of this force, piston (2) cuts off the connection from port **b** to port **c**, and port **c** and port **d** are connected. As a result, the pressure at port **c** (= **f**) drops, and piston (9) stops moving to the left. The position in which piston (9) stops when this happens is further to the left than the position when main pump pressures **Pa1** and **Pa2** are low.

- The relation of average main pump pressure **Pa1** + **Pa2** 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 average pump pressure **Pa1** + **Pa2** and pump discharge amount **Q** is shown in the figure on the right.



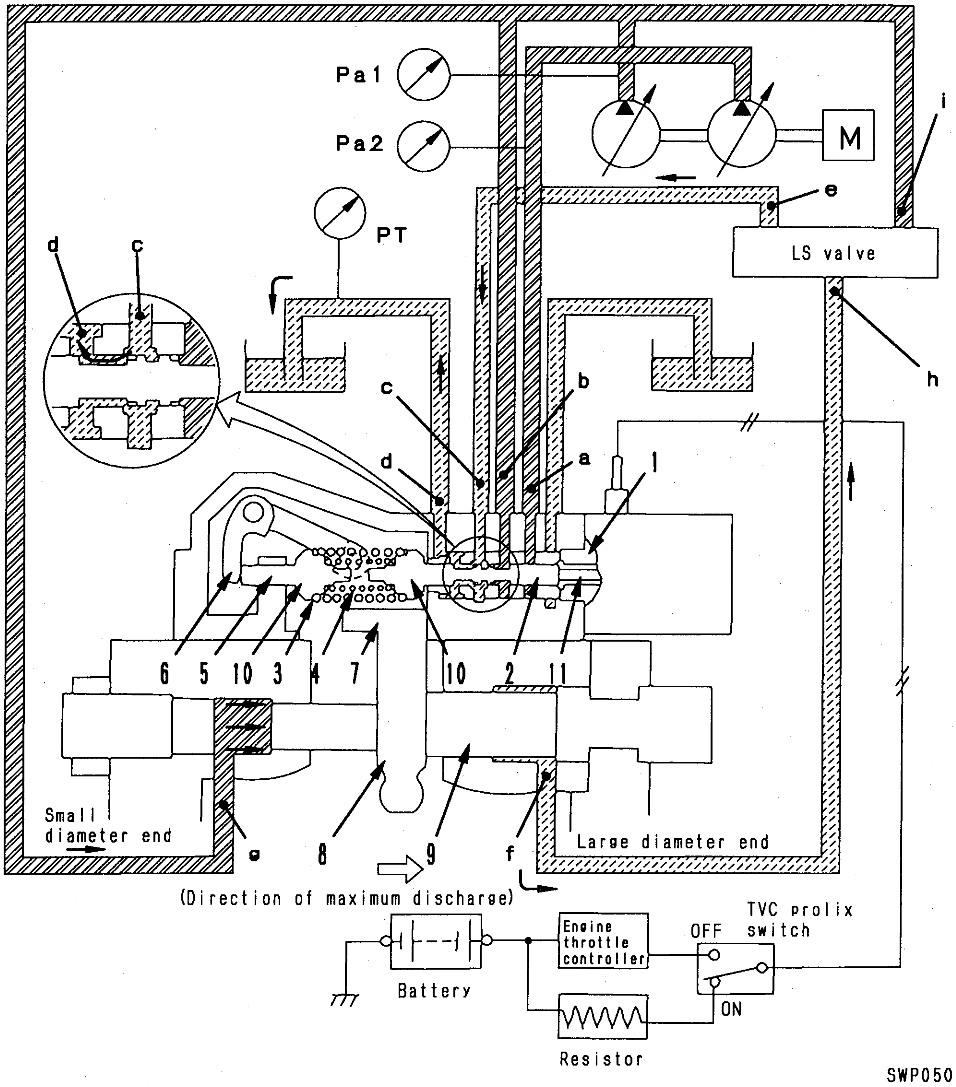
SWP05082

- If command voltage **X** sent to solenoid (1) increases further, the relationship between average pump pressure **Pa1** + **Pa2**, and 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 solenoid (1) is added to the force pushing to the left because of the pump pressure applied to the piston (2), the relationship between the average pump purresure **P** and **Q** moves from **A** to **B** in accordance with the increase in **X**.

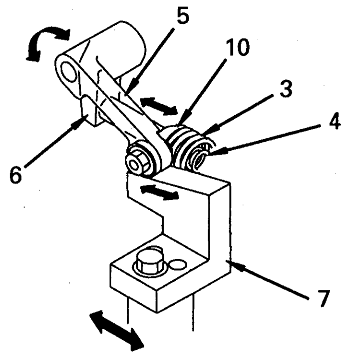


SWP05083

2) When governor, pump controller is abnormal and TVC prolix switch is ON



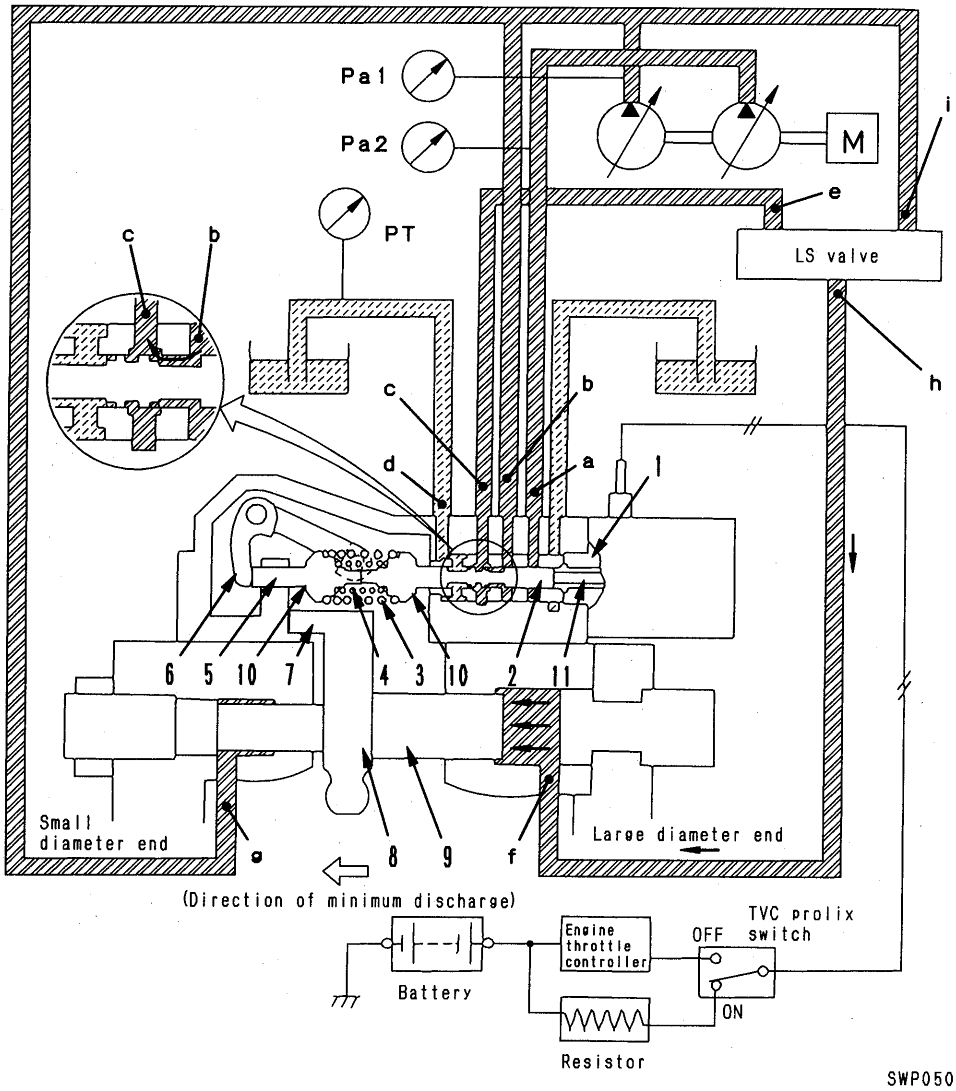
SWP05084

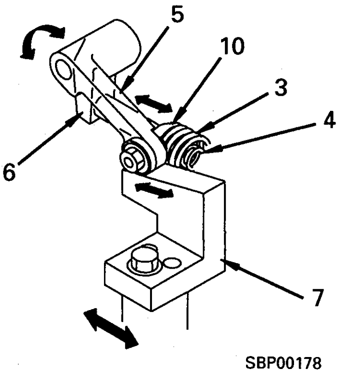


SBP00178

a. When load on main pump is light

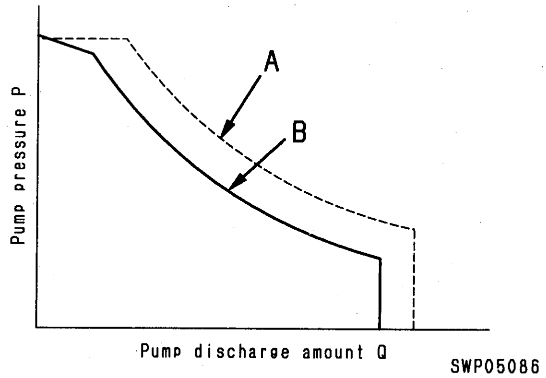
- If there is a failure in the governor, pump controller, turn TVC prolix switch ON to switch to the resistor side. In this case, the power source is taken directly from the battery. But if the current is used as it is, it is too large, so use the resistor to control the current flowing to solenoid (1).
- When this is done, the current becomes constant, so the force pushing solenoid push pin (11) is also constant.
- If main pump pressures **Pa1** and **Pa2** are low, the combined force of the pump pressure and the force of solenoid (1) is weaker than the spring set force, so piston (2) is balanced at a position to the right.
- At this point, port **c** is connected to the drain pressure of port **d**, and the large piston diameter end of servo piston (9) also becomes the drain pressure **PT** through the LS valve. When this happens, the pressure at the small piston diameter end is large, so servo piston (9) moves in the direction to make the discharge amount larger.





b. When load on main pump is heavy

- In the same way as in the previous item, when the TVC prolix switch is ON, the command current **x** sent to solenoid (1) becomes constant. For this reason, the force of solenoid push pin (11) pushing piston (2) is constant.
- If main pump pressures **Pa1** and **Pa2** increase, piston (2) moves further to the left than when the main pump load is light, and is balanced at a position towards the left.
- In this case, the pressure from port **b** flows to port **c**, so servo piston (9) moves to the left (to make the discharge amount smaller) by the same mechanism as explained in Item 2.1)-b, and stops at a position further to the left than when the load on the pump is light. In other words, even when the TVC prolix switch is ON, the curve for the pump pressure **P** and discharge amount **Q** is determined as shown in the diagram for the value of the current sent to the solenoid through the resistor.



- The curve when the TVC prolix switch is ON is curve **B**, which is to the left of curve **A** for when the governor, pump controller is normal.

CONTROL VALVE

BACK HOE

Name, port name

1. Cover 1
2. Cover 2
3. Service valve
4. Service valve
5. Service valve
6. Boom, arm Hi valve
7. Merge/flow divider valve
8. 6-spool valve

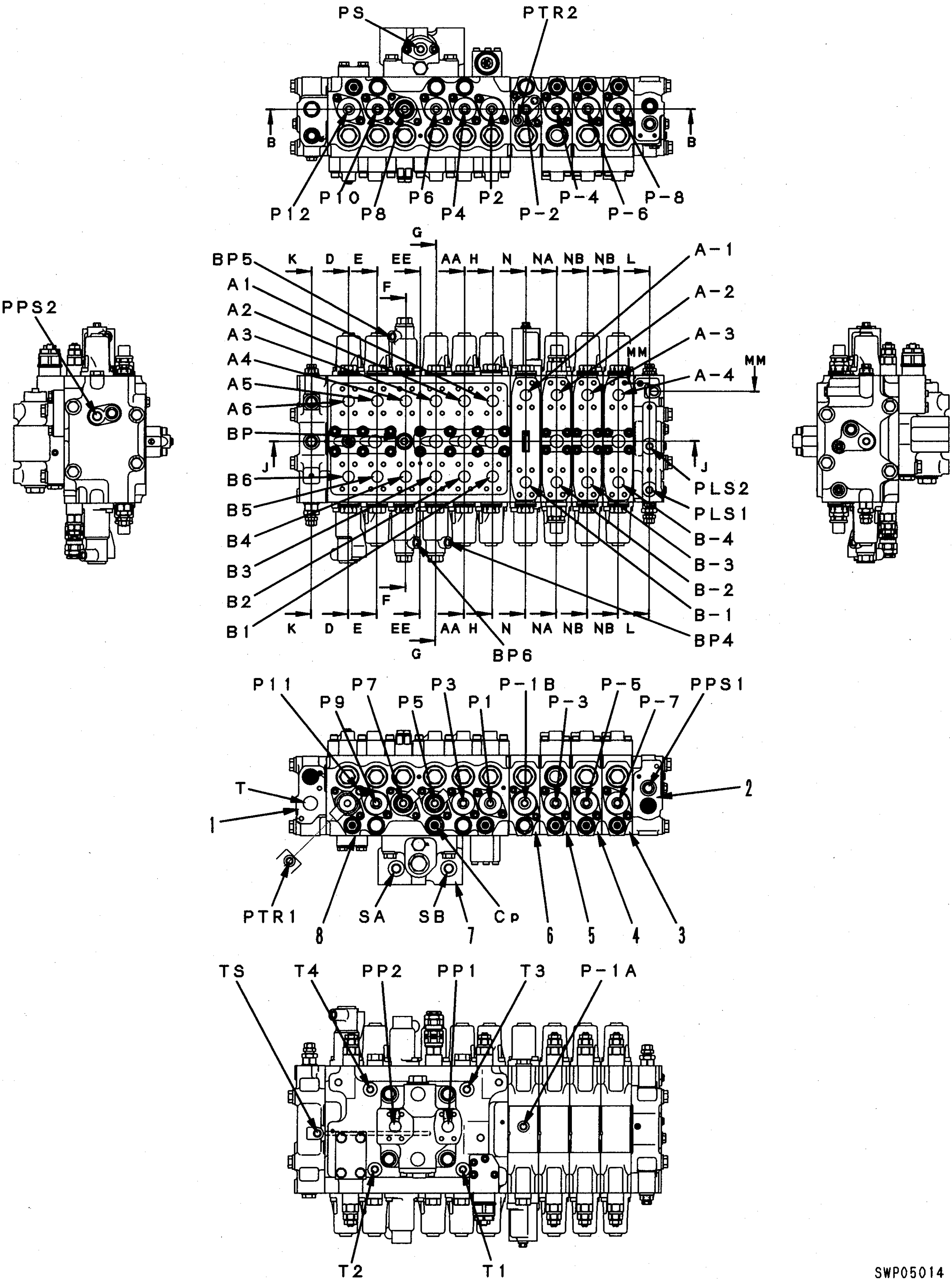
Outline

- This control valve consists of a 7-spool valve (the 6-spool valve + Hi valve) and 3 sets of service valves. The merge/flow divider valve is installed to this.
- All the valves are connected by a bolt to form one unit, and the passages are internally connected, so the structure is compact and is very easy to service.
- This control valve is designed to assist only the boom and arm valves with their large flow using the Hi valve, so it has a simple structure.

A1 : To bucket cylinder bottom
A2 : To R.H. travel motor
A3 : To boom cylinder bottom
A4 : To swing motor
A5 : To L.H. travel motor
A6 : To arm cylinder head
B1 : To bucket cylinder head
B2 : To R.H. travel motor
B3 : To boom cylinder head
B4 : To swing motor
B5 : To L.H. travel motor
B6 : To arm cylinder bottom
P1 : From bucket PPC valve
P2 : From bucket PPC valve
P3 : From R.H. travel PPC valve
P4 : From R.H. travel PPC valve
P5 : From boom PPC valve
P6 : From boom PPC valve
P7 : From swing PPC valve
P8 : From swing PPC valve
P9 : From L.H. travel PPC valve
P10: From L.H. travel PPC valve
P11: From arm PPC valve
P12: From arm PPC valve
T1 : To travel junction valve
T2 : To travel junction valve
T3 : To travel junction valve
T4 : To travel junction valve
A-1: To boom cylinder bottom
A-2: To attachment
A-3: To attachment
A-4: To attachment

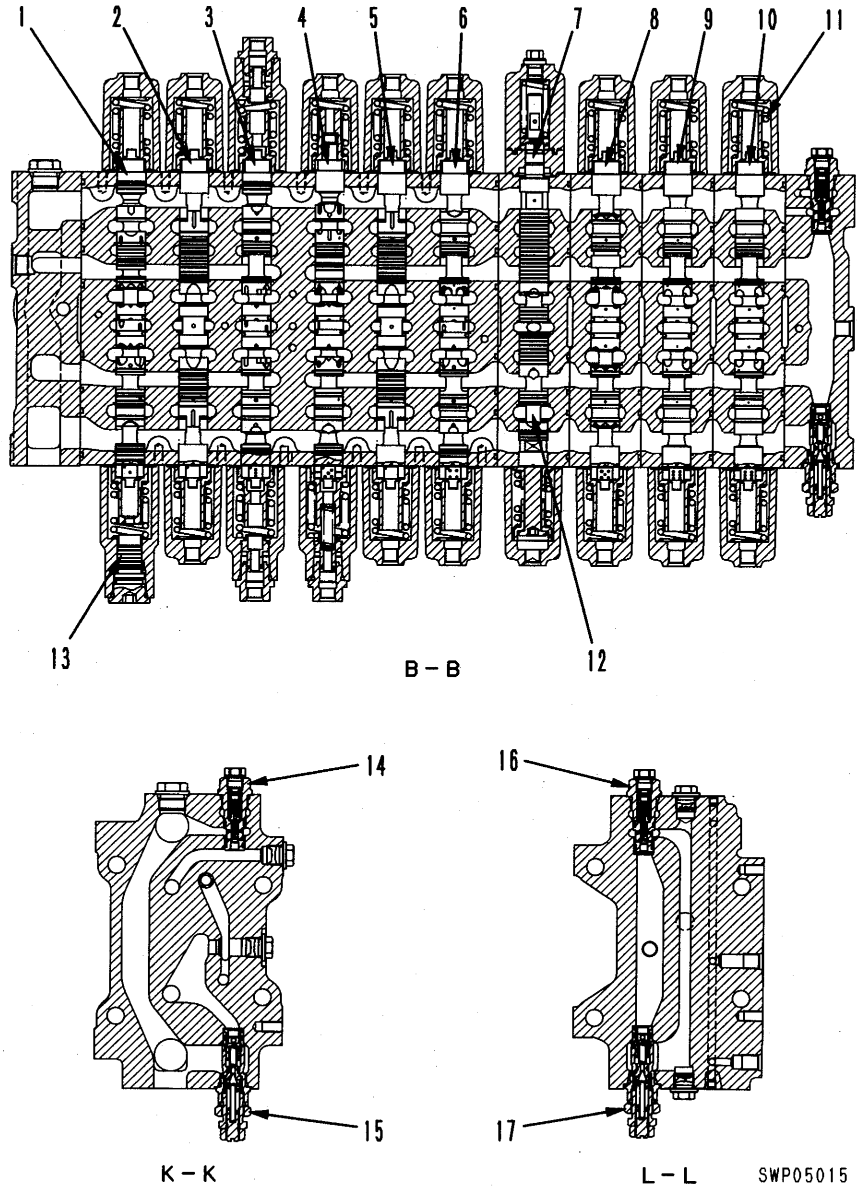
B-1 : To arm cylinder bottom
B-2 : To attachment
B-3 : To attachment
B-4 : To attachment
P-1A : From arm PPC valve
P-1B : From arm PPC valve
P-2 : From boom PPC valve
P-3 : From service PPC valve
P-4 : From service PPC valve
P-5 : From service PPC valve
P-6 : From service PPC valve
P-7 : From service PPC valve
P-8 : From service PPC valve
T : To tank
BP : From LS divider solenoid valve
CP : From 2-stage safety valve selector solenoid valve
PS : From merge/flow divider solenoid valve
SA : Pressure sensor mount port
SB : Pressure sensor mount port
TS : To tank
BP4 : From active mode selector solenoid valve
BP5 : From swing stroke control selector valve
BP6 : From swing stroke control selector valve
PP1 : From front main pump
PP2 : From rear main pump
PLS1 : To front pump control
PLS2 : To rear pump control
PPS1 : To front pump control
PPS2 : To rear pump control
PTR1 : To travel junction valve
PTR2 : To travel junction valve

10-spool valve (STD + service valve x 3)



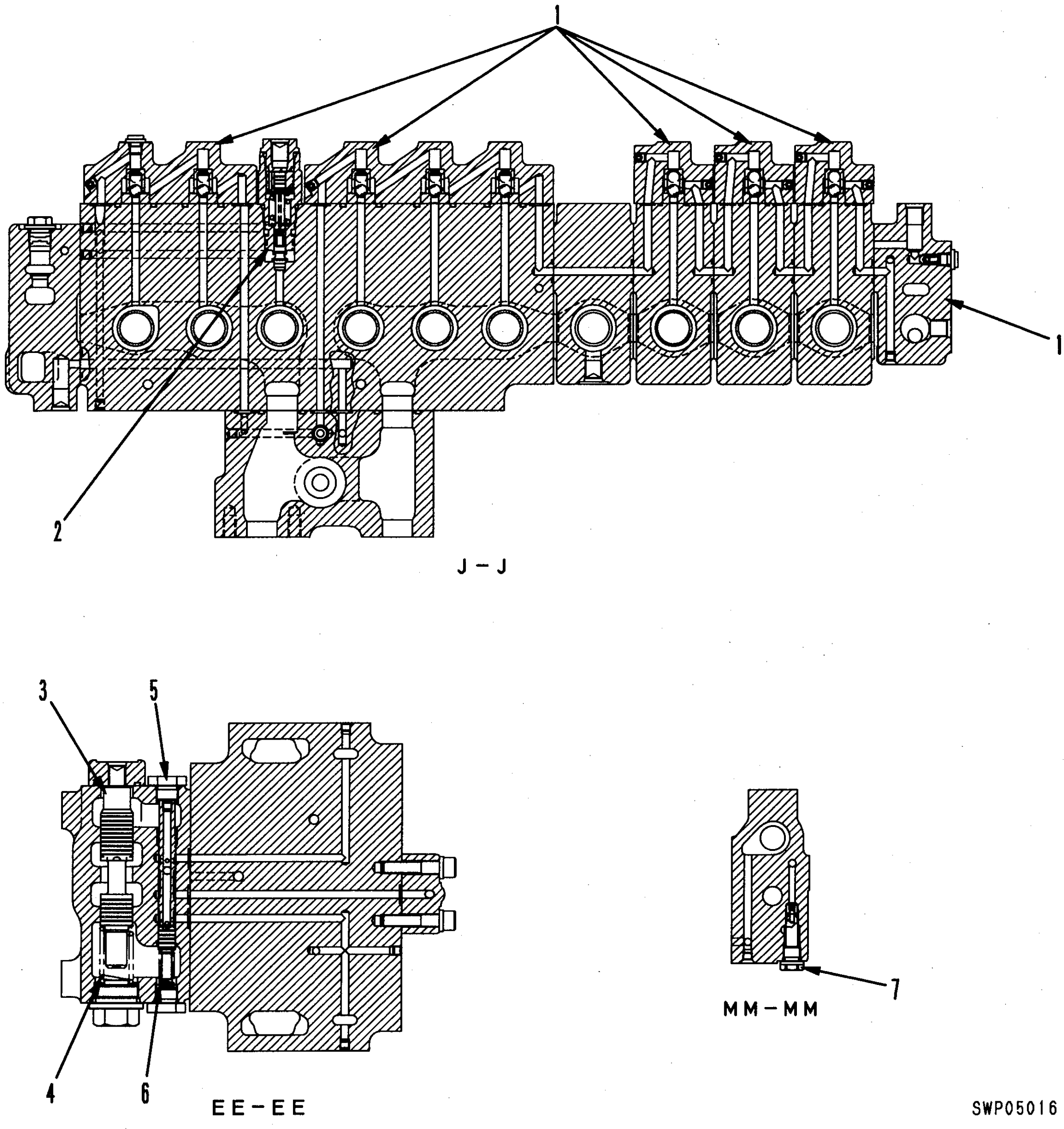
SWP05014

Main structure of 10-spool valve (1/3)



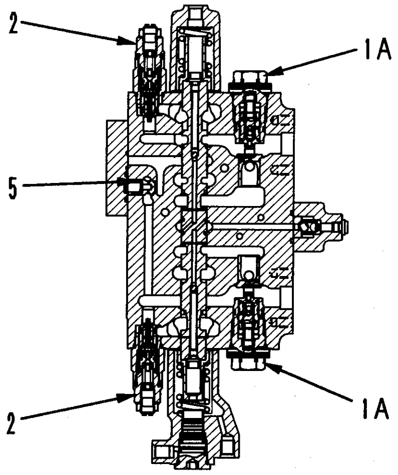
1. Spool (arm Lo)
2. Spool (L.H. travel)
3. Spool (swing)
4. Spool (boom Lo)
5. Spool (R.H. travel)
6. Spool (bucket)
7. Spool (boom Hi)
8. Spool (service)
9. Spool (service)
10. Spool (service)
11. Spool return spring
12. Spool (arm Hi)
13. Piston (arm Lo stroke control)
14. Unload valve (arm Lo)
15. Main relief valve (arm Lo)
16. Unload valve (bucket)
17. Main relief valve (bucket)

(2/3)

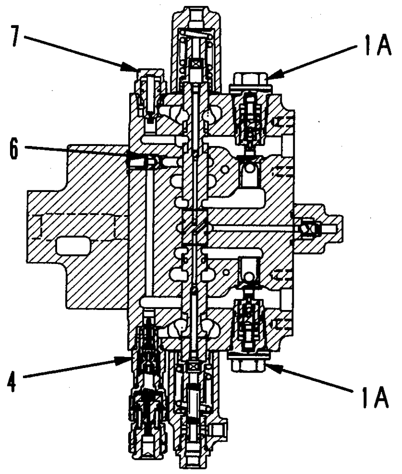


1. LS shuttle valve
2. LS divider valve
3. Merge/flow divider valve (main)
4. Return spring
5. Merge/flow divider valve (for LS)
6. Return spring
7. LS bypass valve

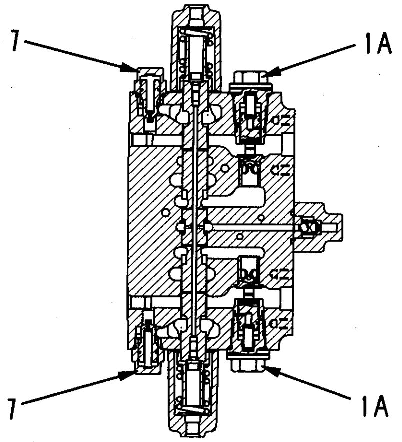
(3/3)



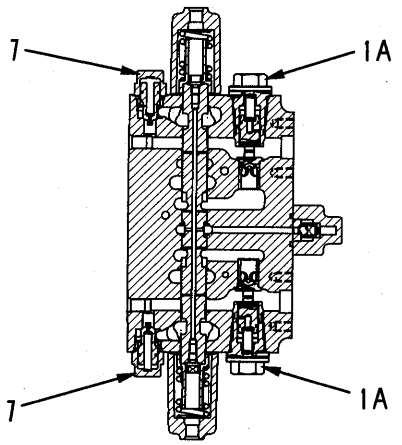
D – D



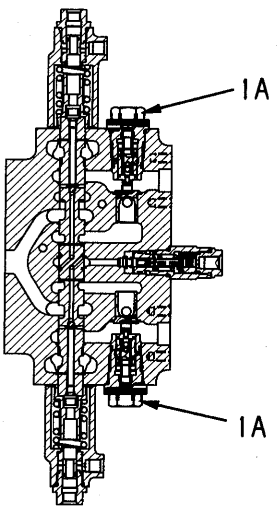
G – G



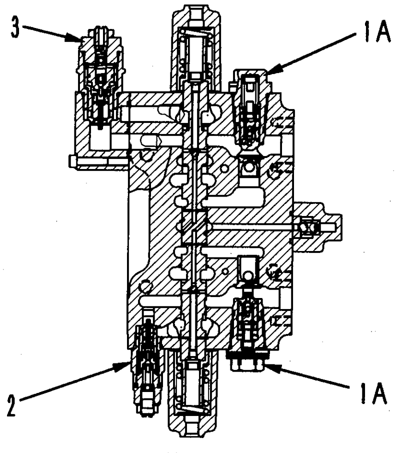
E – E



AA – AA

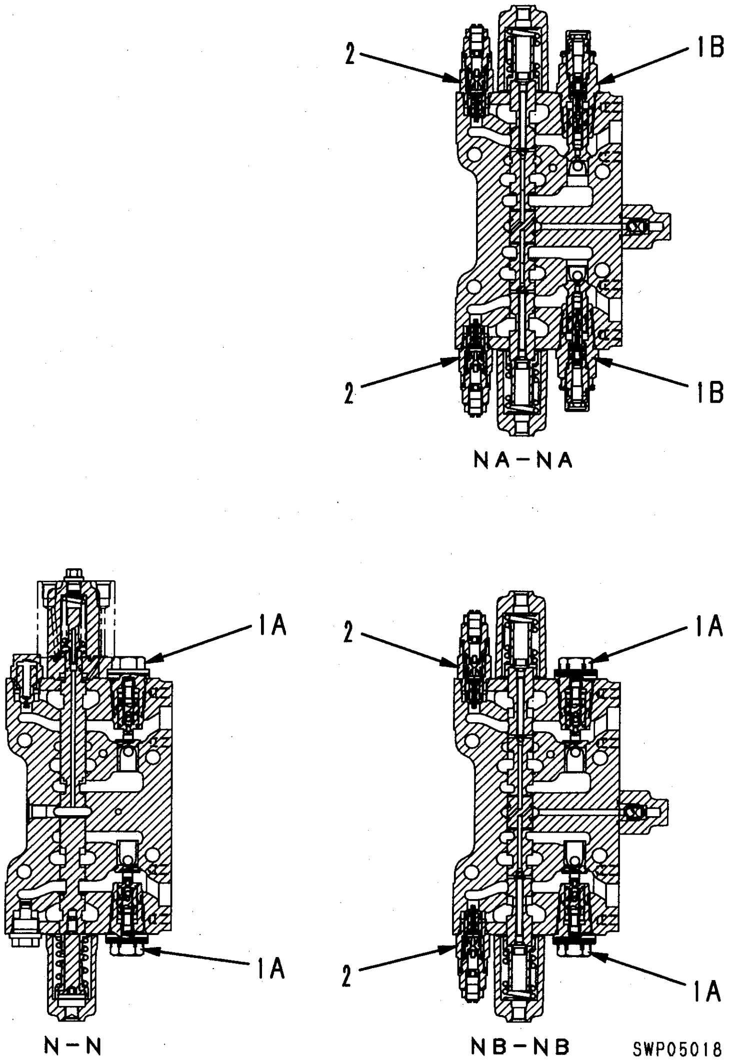


F – F



H – H

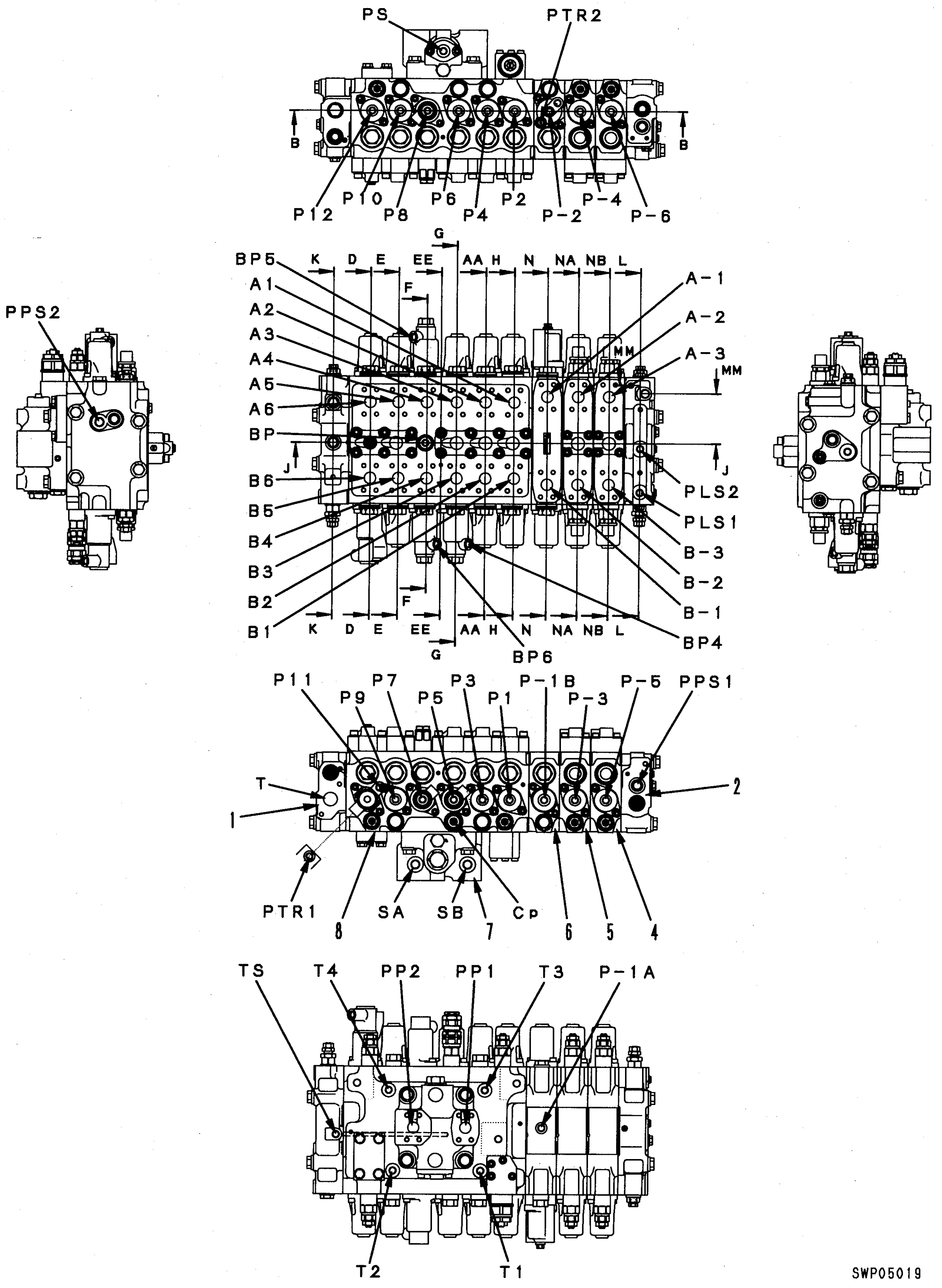
SWP05017



1A. Pressure compensation valve
1B. Variable type pressure compensation valve
2. Safety-suction valve
3. Safety-suction valve (for large flow)
4. Safety-suction valve (2-stage)
5. Check valve for regeneration circuit (arm)
6. Check valve for regeneration circuit (boom)
7. Suction valve

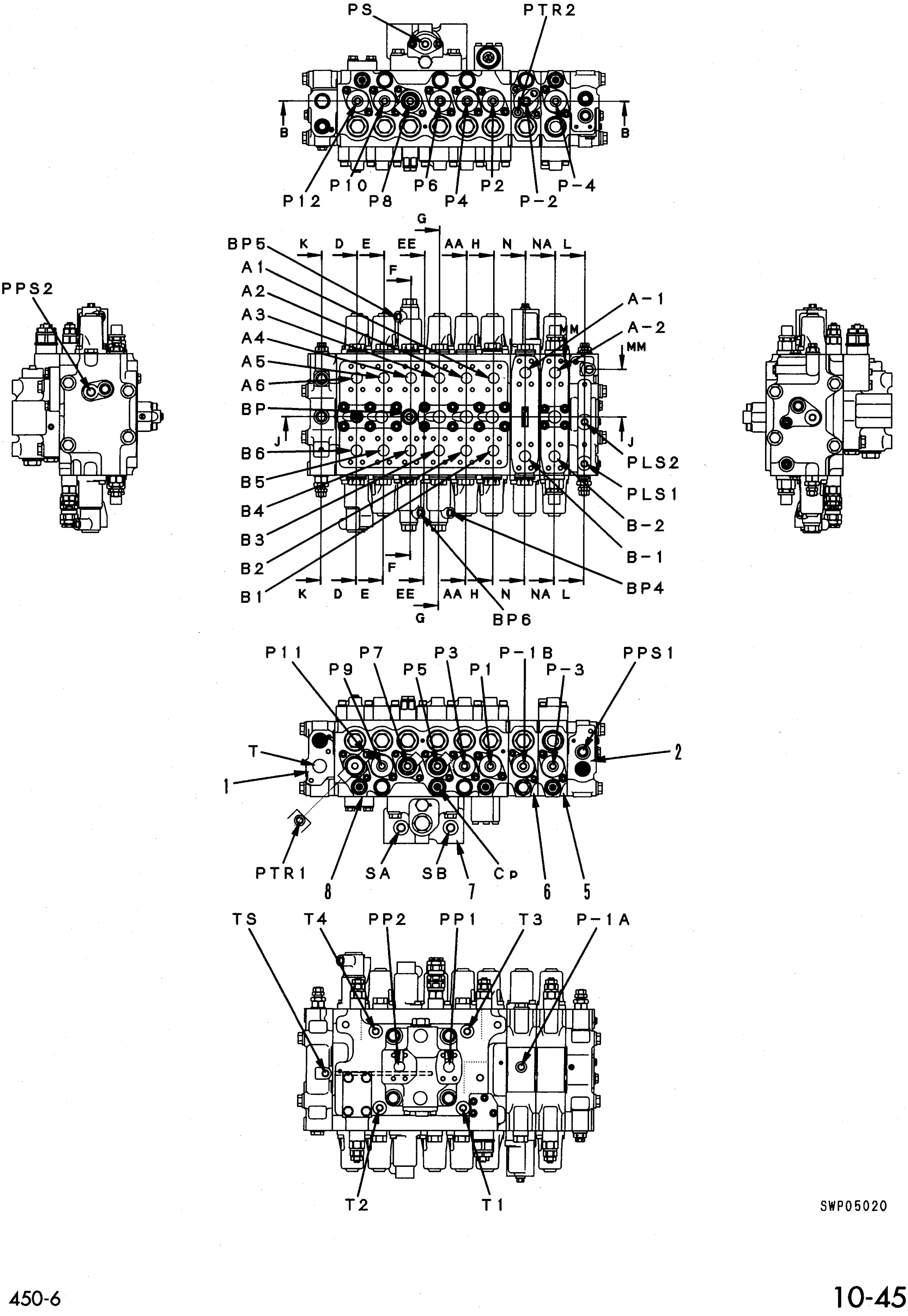
9-spool valve (STD + service valve x 2)

★ For details of the names of the ports and the main structure, see 10-SPOOL VALVE



8-spool valve (STD + service valve x 1)

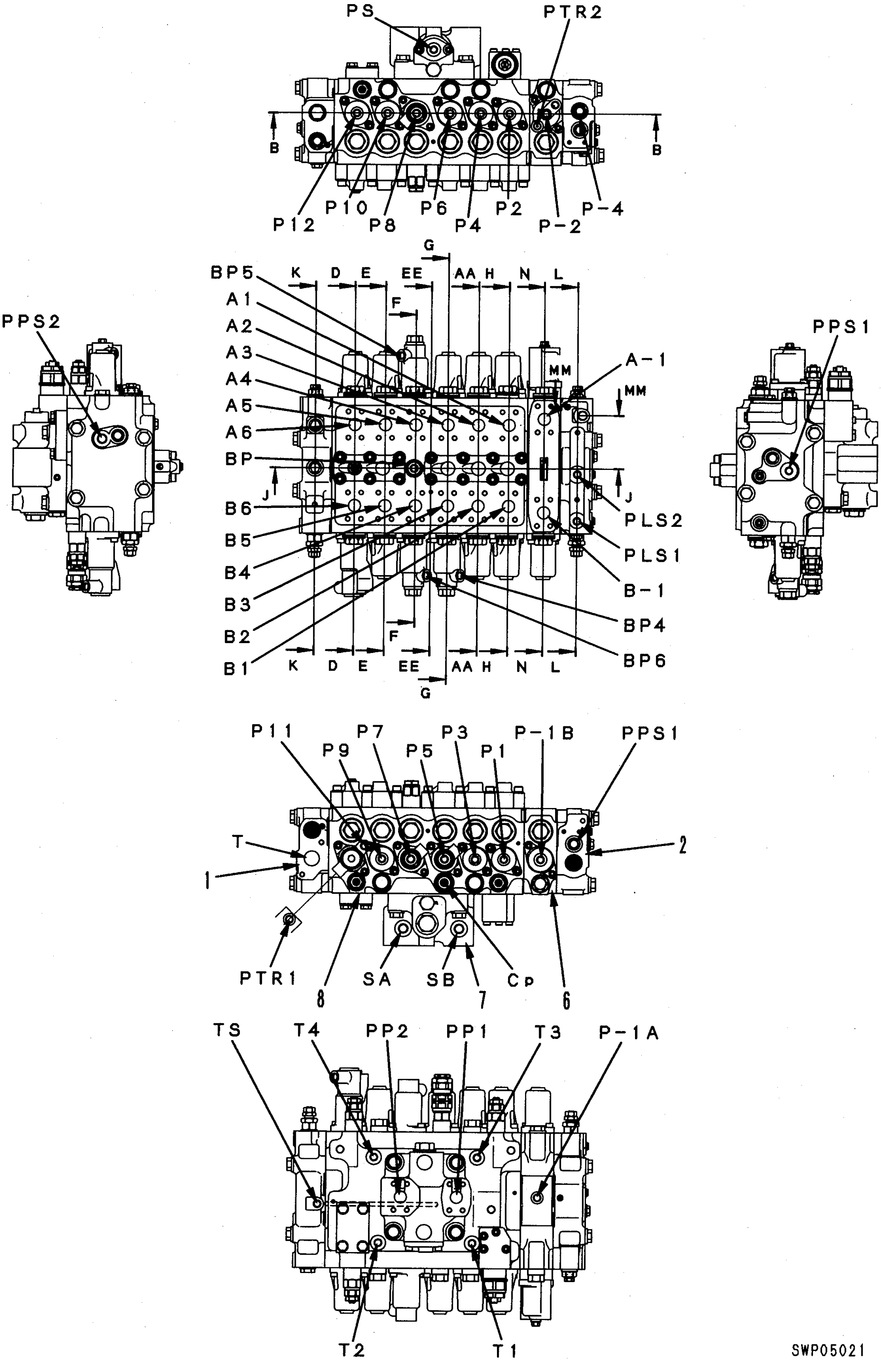
★ For details of the names of the ports and the main structure, see 10-SPOOL VALVE



SWP05020

7-spool valve (STD)

★ For details of the names of the ports and the main structure, see 10-SPOOL VALVE



LOADING SHOVEL

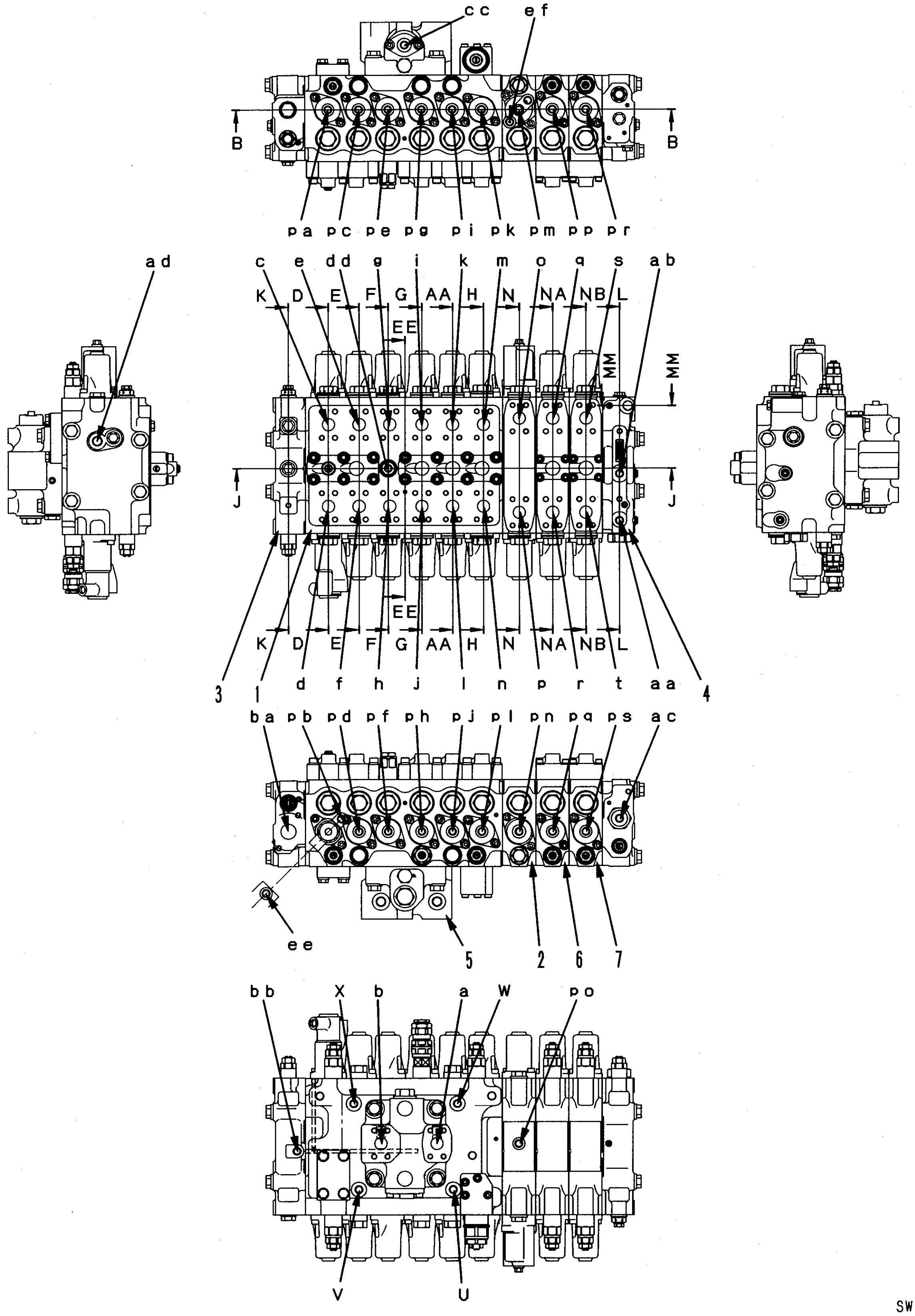
1. 6-spool valve
2. Boom, arm Hi valve
3. Cover 1
4. Cover 2
5. Merge/flow divider valve
6. Bottom dump valve
7. Service valve

Outline

- This control valve consists of a 7-spool valve (the 6-spool valve + Hi valve), bottom dump valve and service valve. The merge/flow divider valve is installed to this.
- All the valves are connected by a bolt to form one unit, and the passages are internally connected, so the structure is compact and is very easy to service.
- This control valve is designed to assist only the boom and arm valves with their large flow using the Hi valve, so it has a simple structure.

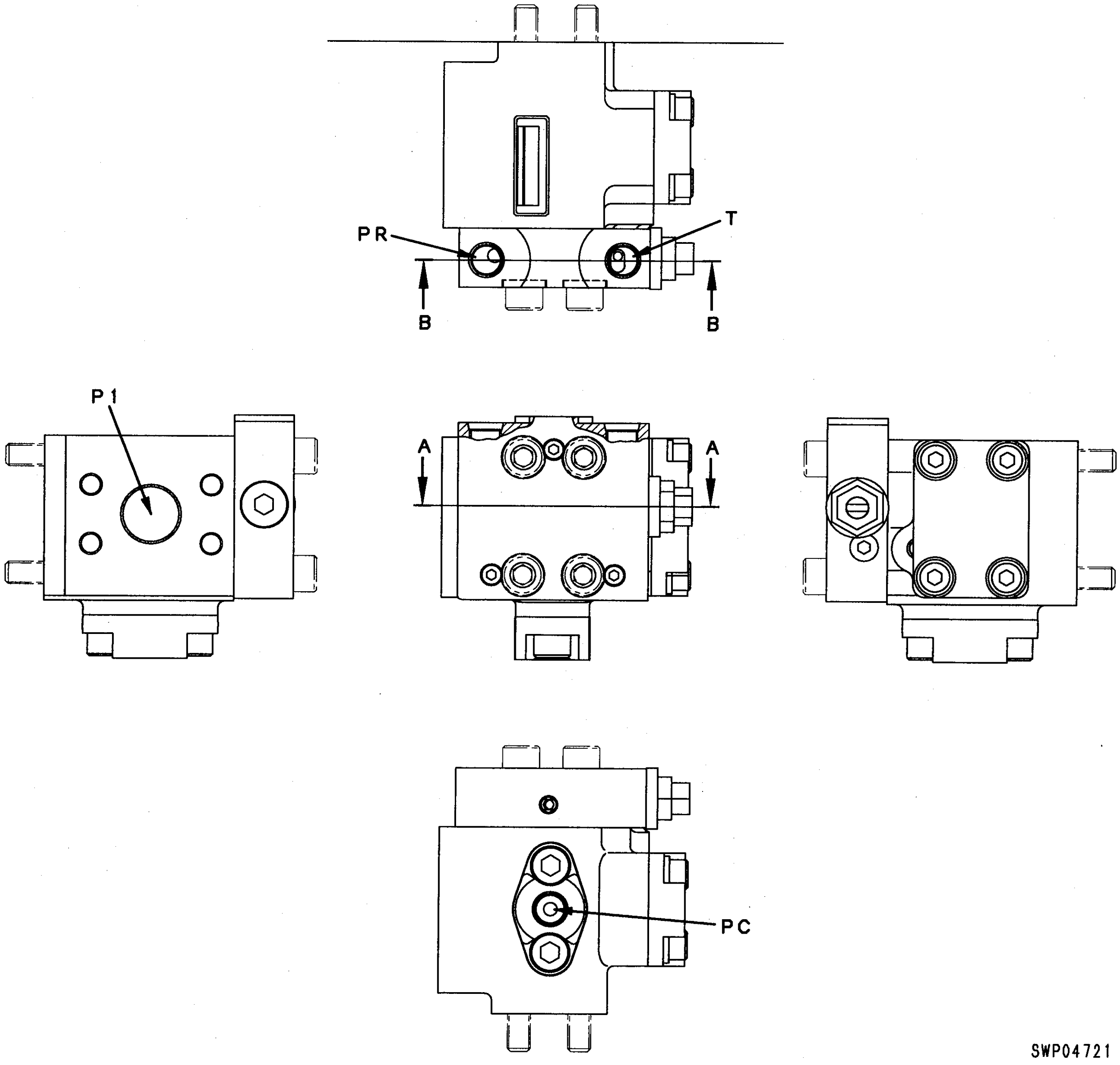
a. Port PP1 (from front main pump)
b. Port PP2 (from rear main pump)
c. Port A6 (to arm cylinder head)
d. Port B6 (to arm cylinder bottom)
e. Port A5 (to L.H. travel motor)
f. Port B5 (to L.H. travel motor)
g. Port A4 (to swing motor)
h. Port B4 (to swing motor)
i. Port A3 (to boom cylinder bottom)
j. Port B3 (to boom cylinder head)
k. Port A2 (to R.H. travel motor)
l. Port B2 (to R.H. travel motor)
m. Port A1 (to bucket cylinder bottom)
n. Port B1 (to bucket cylinder head)
o. Port A-1 (to boom cylinder bottom)
p. Port B-1 (to arm cylinder bottom)
q. Port A-2 (to bottom dump cylinder head)
r. Port B-2 (to bottom dump cylinder bottom)
s. Port A-3 (to attachment)
t. Port B-3 (to attachment)
u. Port T1 (to travel junction valve)
v. Port T2 (to travel junction valve)
w. Port T3 (to travel junction valve)
x. Port T4 (to travel junction valve)

aa. Port PLS1 (to front pump control)
ab. Port PLS2 (to rear pump control)
ac. Port PPS1 (to front pump control)
ad. Port PPS2 (to rear pump control)
ba. Port T (to tank)
bb. Port TS (to tank)
cc. Port PS (from merge/flow divider solenoid valve)
dd. Port BP (from shuttle valve)
ee. Port PTR1 (to travel junction valve)
ef. Port PTR2 (to travel junction valve)
pa. Port P12 (from arm PPC valve)
pb. Port P11 (from arm PPC valve)
pc. Port P10 (from L.H. travel PPC valve)
pd. Port P9 (from L.H. travel PPC valve)
pe. Port P8 (from swing PPC valve)
pf. Port P7 (from swing PPC valve)
pg. Port P6 (from boom PPC valve)
ph. Port P5 (from boom PPC valve)
pi. Port P4 (from R.H. travel PPC valve)
pj. Port P3 (from R.H. travel PPC valve)
pk. Port P2 (from bucket PPC valve)
pl. Port P1 (from bucket PPC valve)
pm. Port P-2 (from boom PPC valve)
pn. Port P-1B (from arm PPC valve)
po. Port P-1A (from arm PPC valve)
pp. Port P-4 (from bottom dump solenoid valve)
pq. Port P-3 (from bottom dump solenoid valve)
pr. Port P-6 (from service PPC valve)
ps. Port P-5 (from service PPC valve)

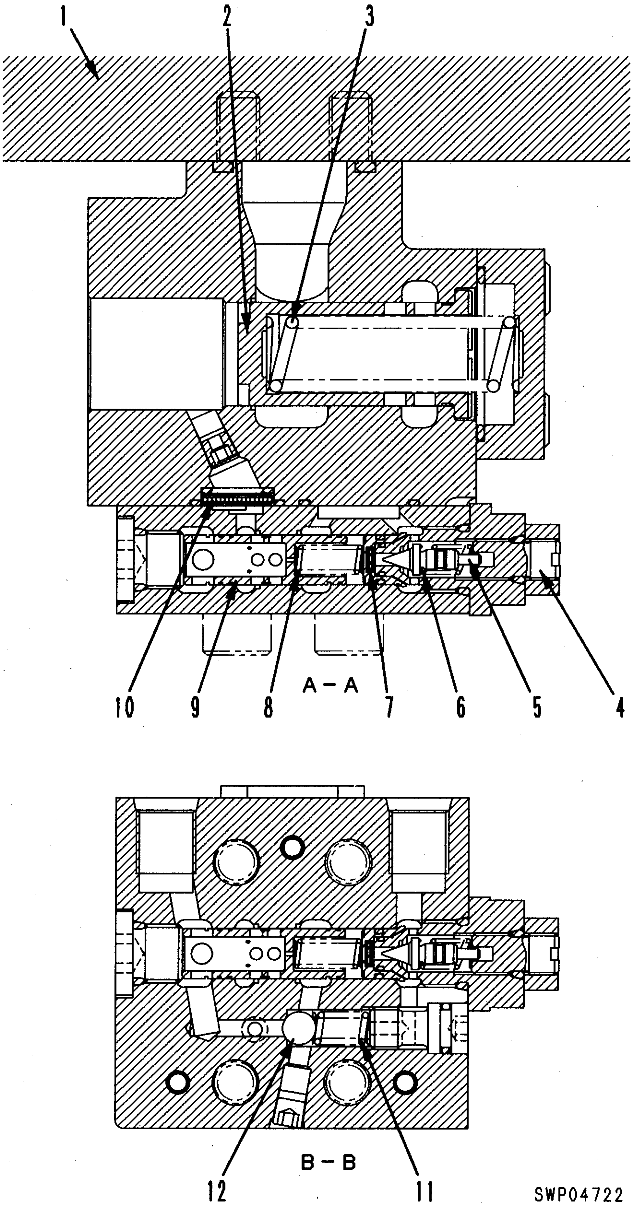

cc
ef
B
B
pa pc pe pg pi pk pm pp pr
ad
c e dd g i k m o q s ab
K D E F G AA H N NA NB L
EE
MM
MM
J
J
EE
K D E F G AA H N NA NB L
3 1 d f h j l n p r t aa 4
ba pb pd pf ph pj pl pn pq ps ac
ee
5 2 6 7
bb X b a W po
V U

SWP07078

SELF-REDUCING PRESSURE VALVE



P1 : From front pump
T : To hydraulic tank
PC : To front pump LS valve
PR : Supply to electromagnetic valve, PPC valve, solenoid valve



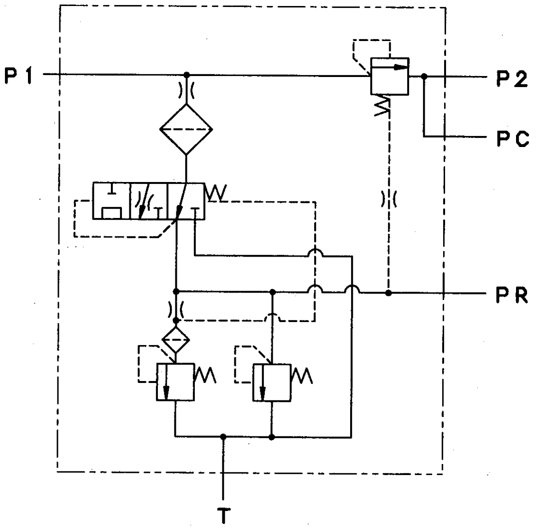
1. Control valve block
2. Valve (sequence valve)
3. Spring
4. Screw
5. Poppet
6. Spring (reducing valve pilot)
7. Filter
8. Spring (reducing valve main)
9. Spring (reducing valve)
10. Filter
11. Spring (safety valve)
12. Ball

Function

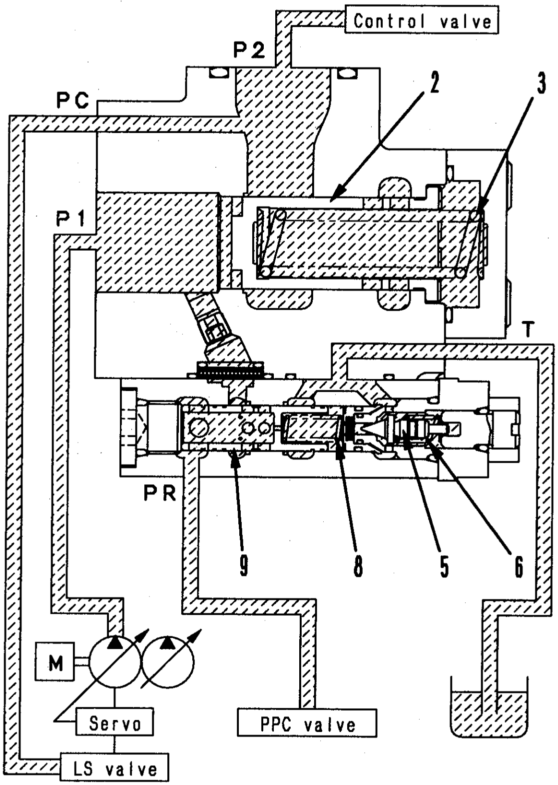
- This valve reduces the discharge pressure of the main pump and supplies it as the control pressure for the solenoid valve and PPC valve.

Operation

1. **When engine is stopped**
   - Poppet (5) is pushed against the seat by spring (6), and the passage from port **PR** → **T** is closed.
   - Valve (9) is pushed to the left by spring (8), and the passage from port **P1** → **PR** is open.
   - Valve (2) is pushed to the left by spring (3), so the passage between port **P1** → **P2** is closed. (See Fig. 1)



HYDRAULIC CIRCUIT DIAGRAM SWP05087



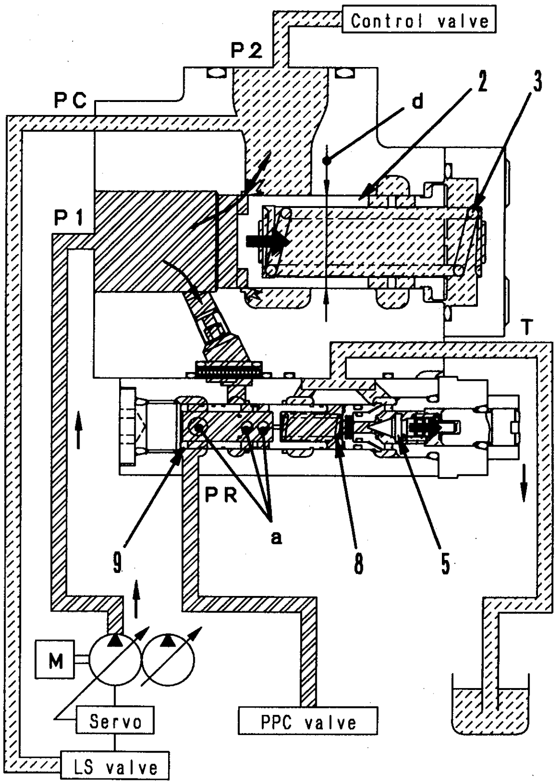
(Fig. 1) SWP05088

2. At neutral and When load pressure P2 is low (when moving down under own weight (boom LOWER or arm IN))

Note: When load pressure **P2** is lower than output pressure **PR** of the self-reducing pressure valve.

- Valve (2) receives force in the direction to close the passage from port **P1** → **P2** from spring (3) and pressure **PR** (when the engine is stopped, the pressure is 0 MPa {0 kg/cm^2}). However, when hydraulic oil flows in from port **P1**, the pressure is balanced so that pressure **P1** ≒ force of spring (8) + (area **ød** x pressure **PR**), and the opening from port **P1** → **P2** is adjusted so that pressure **P1** is kept at a certain value above pressure **PR**.
- When pressure **PR** goes above the set pressure, poppet (5) opens, and the hydraulic oil flows in the following circuit: port **PR** → hole **a** inside spool (9) → opening of poppet (5) → tank port **T**.

  As a result, a pressure difference is created on both sides of hole **a** inside spool (9), so spool (9) moves in the direction to close the opening from port **P1** → **PR**. Pressure **P1** is reduced to a certain pressure (set pressure) by the amount of opening at this point, and is supplied as pressure **PR**. (See Fig. 2)



(Fig. 2) SWP05089

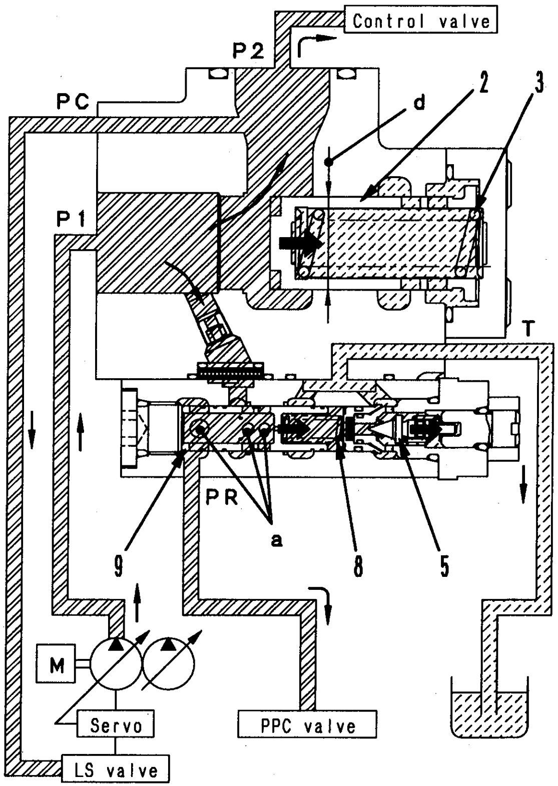
3. When load pressure P2 is high

If load pressure **P2** increases and the pump discharge amount also increases because of digging operations, pressure **P1** also increases (pressure **P1** > force of spring (8) + (area **ød** x pressure **PR**), so valve (2) moves to the right to the end of the stroke.

As a result, the amount of opening from port **P1** → **P2** increases and the resistance in the passage is reduced, so the loss of engine horsepower is reduced.

- If pressure **PR** goes above the set pressure, poppet (5) opens and the hydraulic oil flows in the following circuit: port **PR** → hole **a** inside spool (8) → opening of poppet (5) → tank port **T**.

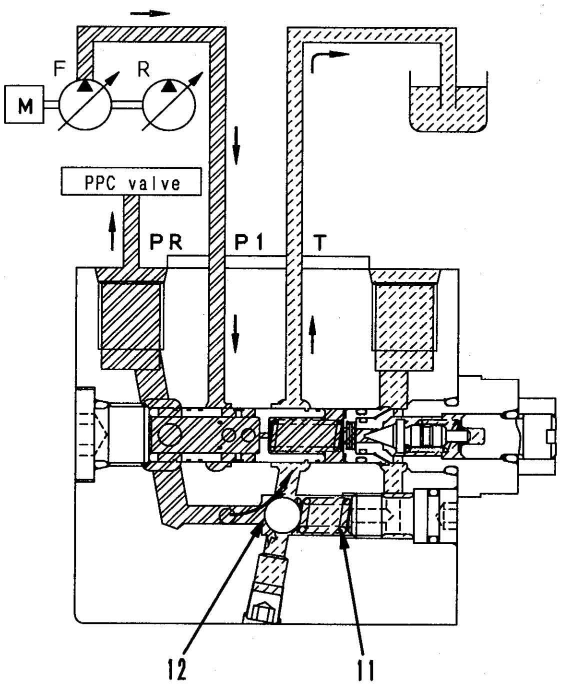
  As a result, a pressure difference is created on both sides of hole **a** is inside spool (9), so spool (9) moves in the direction to close the opening from port **P1** → **PR**. Pressure **P1** is reduced to a certain pressure (set pressure) by the amount of opening at this point, and is supplied as pressure **PR**. (See Fig. 3)



(Fig. 3) SWP05090

4. When there is abnormal high pressure

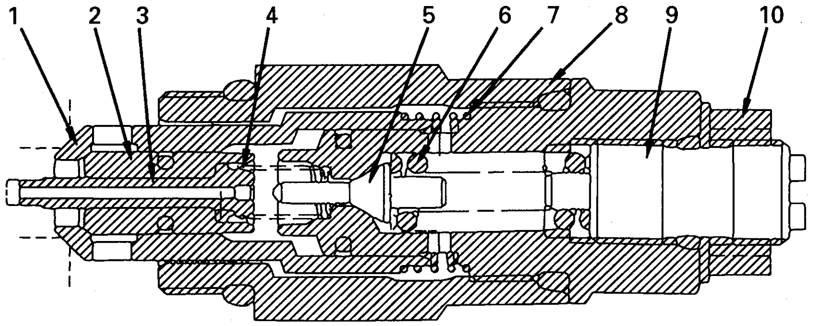
When pressure **PR** of the self-reducing pressure valve becomes abnormally high, ball (12) pushes against the force of spring (11), separates from the seat, and allows hydraulic oil to flow from output port **PR** → **T**, so pressure **PR** goes down. This action protects the equipment at the destination for the hydraulic pressure supply (PPC valve, electromagnetic valve, etc.) from abnormally high pressure. (See Fig. 4)



(Fig. 4) SWP05091

SUCTION SAFETY VALVE

FOR SERVICE VALVE



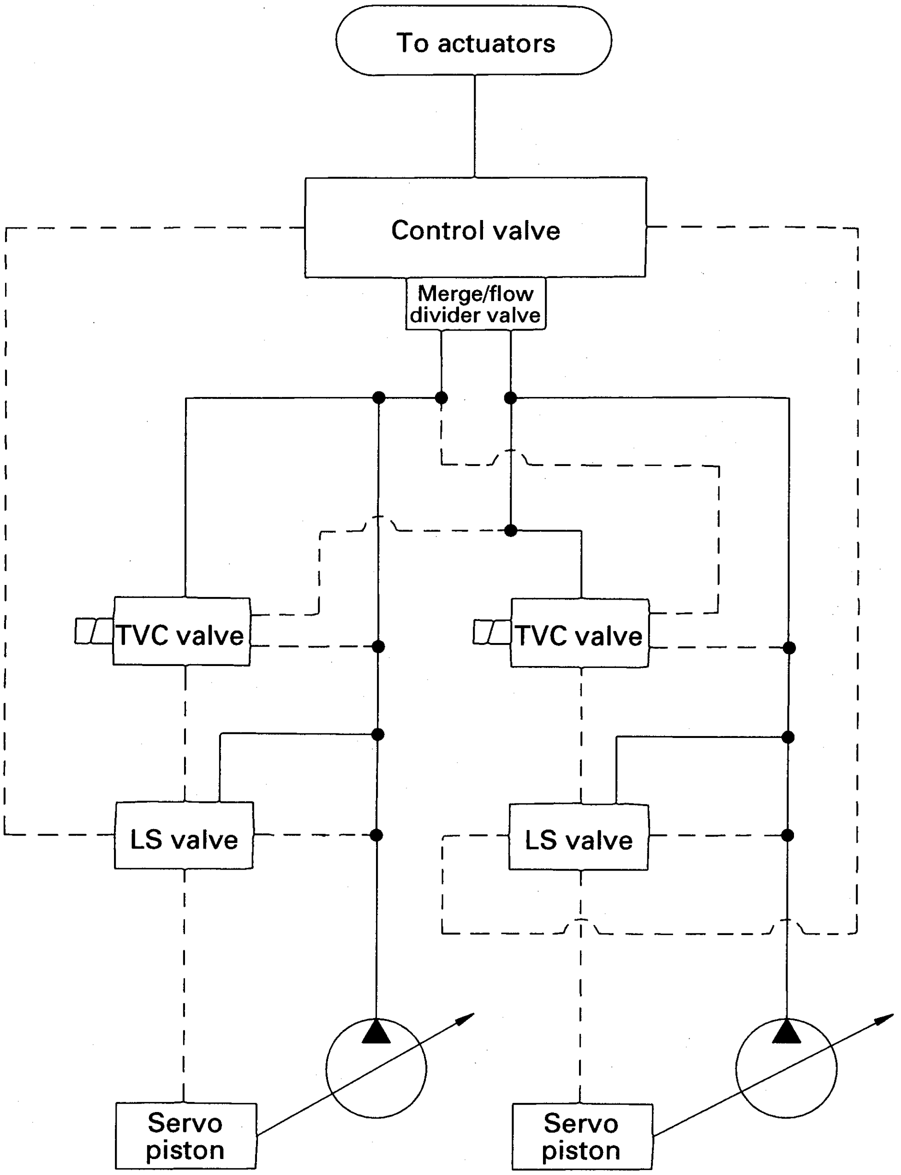
SBP00198

1. Suction valve
2. Main valve
3. Piston
4. Piston spring
5. Poppet
6. Poppet spring
7. Suction valve spring
8. Sleeve
9. Adjustment screw
10. Locknut

Part No.	Set pressure	Use
709-70-74800	20.6 MPa {210 kg/cm²} at 190ℓ/min	For breaker (Okada)
709-70-75100	20.1 MPa {205 kg/cm²} at 5ℓ/min	For breaker (Mitsubishi Krupp)
709-70-75300	16.7 MPa {170 kg/cm²} at 190ℓ/min	For breaker (Matsuda)
709-70-74600	24.5 MPa {250 kg/cm²} at 5ℓ/min	For crusher (Okada)

CLSS

Outline of CLSS



SBP00199

Outline

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

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

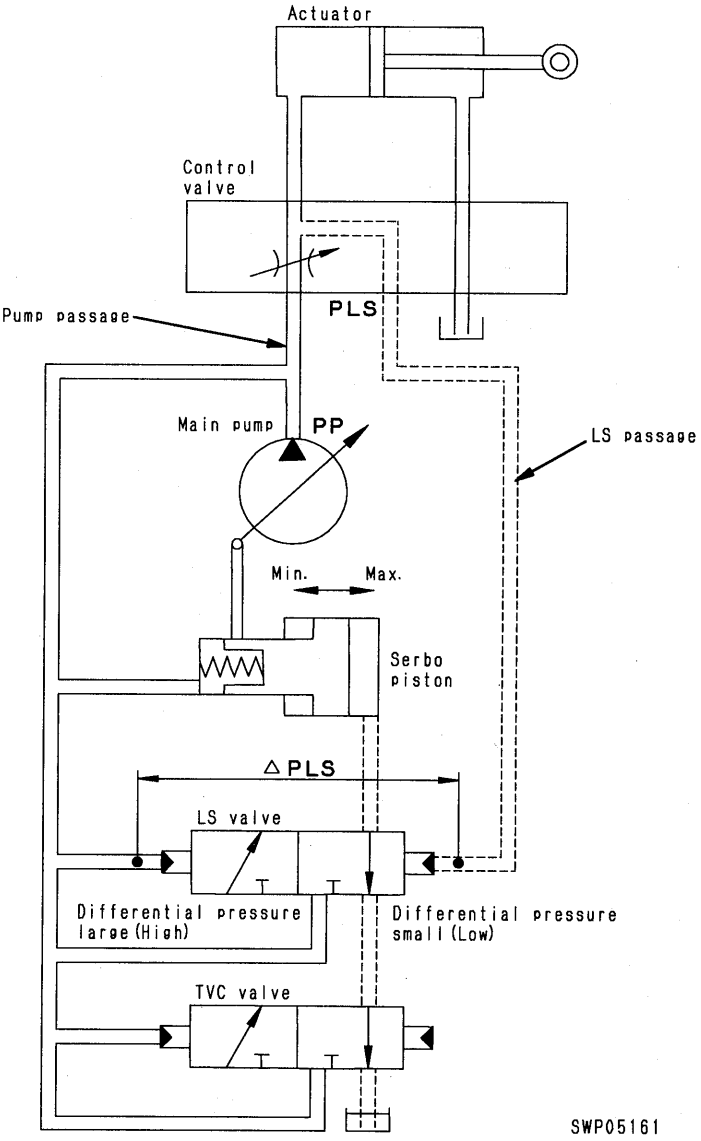
Structure

- The CLSS consists of a main pump (2 pumps), control valve, and actuators for the work equipment.
- The main pump consists of the pump itself, the TVC valve and LS valve.

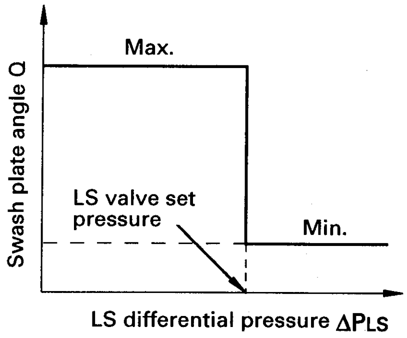
Basic principle

1) Control of pump swash plate angle

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

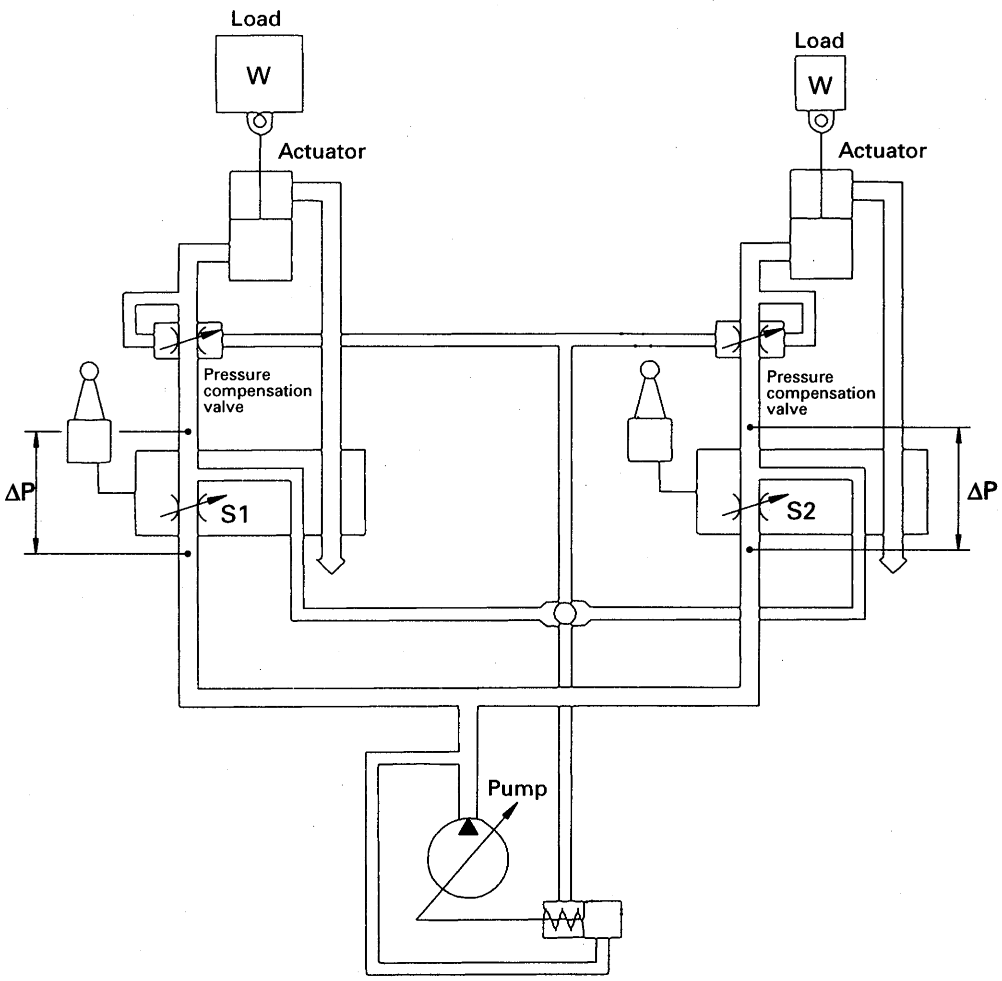


- If LS differential pressure ΔPLS becomes lower than the set pressure of the LS valve (when the actuator load pressure is high), the pump swash plate moves towards the maximum position; if it becomes higher than the set pressure of the LS valve (when the actuator load pressure is low), the pump swash plate moves towards the minimum position.



2) Pressure compensation

- A pressure compensation valve is installed to the outlet port side of the control valve to balance the load.
  When two actuators are operated together, this valve acts to make pressure difference Δ**P** between the upstream (inlet port) and downstream (outlet port) of the spool of each valve 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.

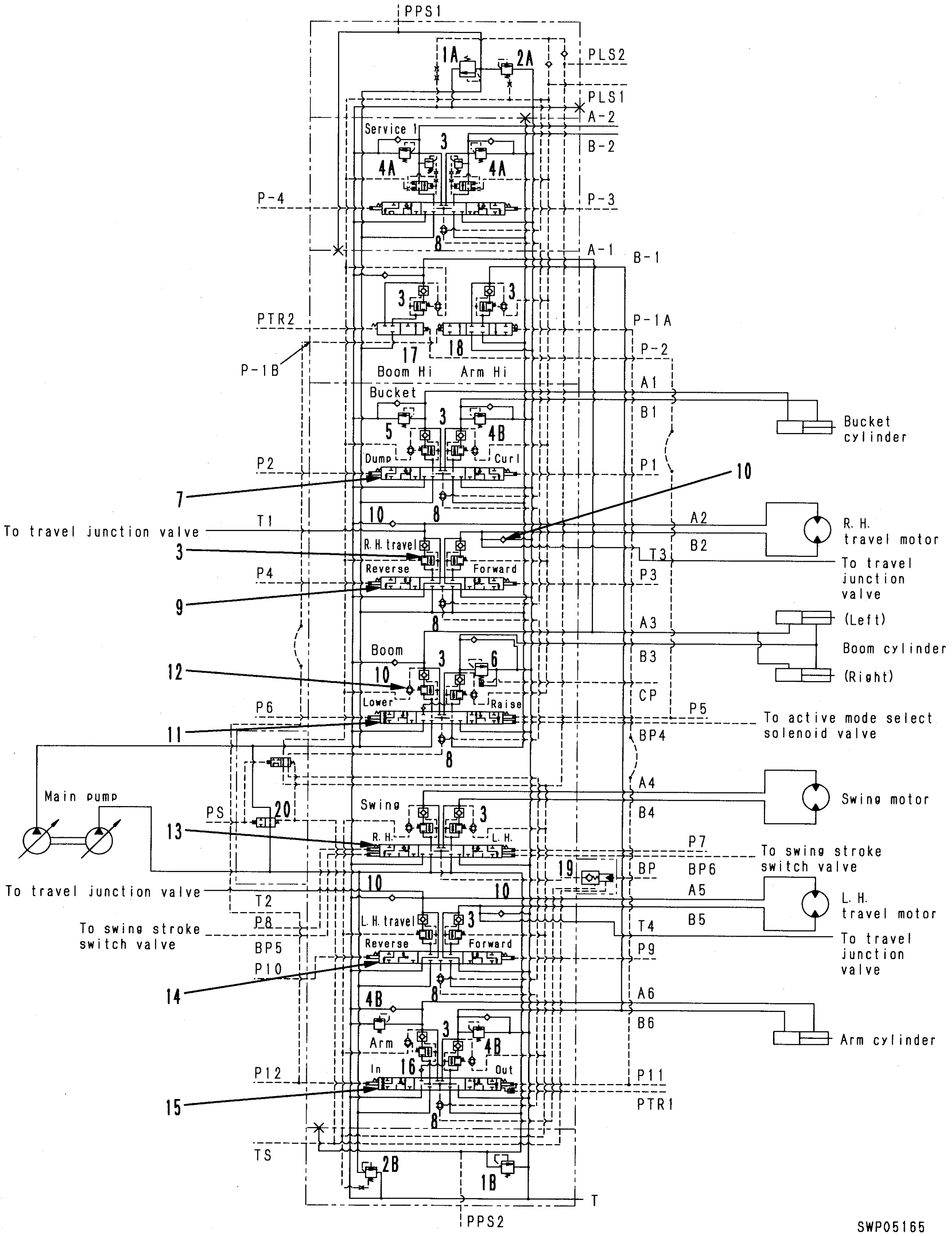


SBP00201

Operation for each function of CLSS

Hydraulic circuit diagram for system

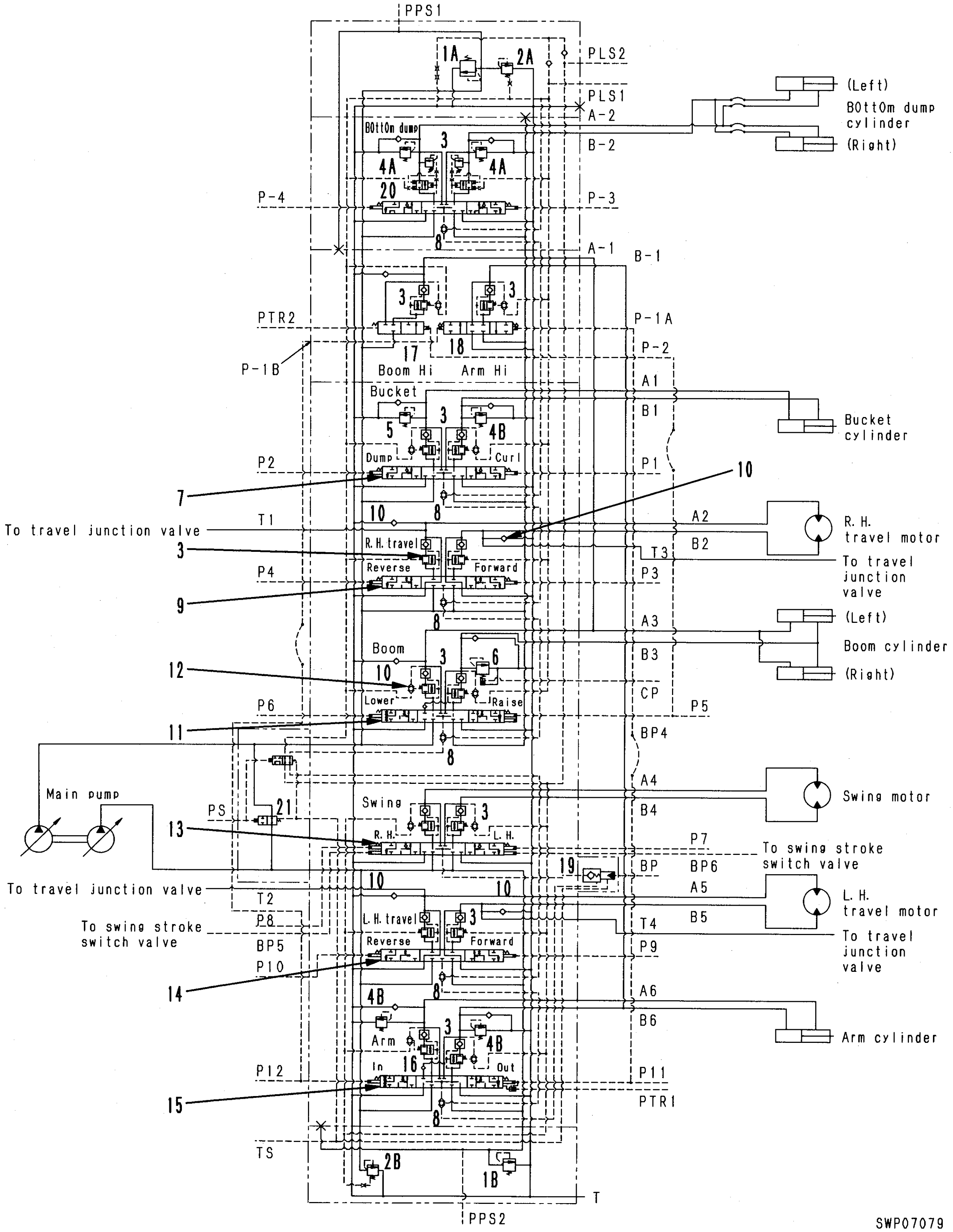
BACK HOE



SWP05165

1A. Main relief valve (bucket group)
    Set pressure: 34.8 ± 0.5 MPa {355 ± 5 kg/cm^2}
1B. Main relief valve (arm group)
    Set pressure: 34.8 ± 0.5 MPa {355 ± 5 kg/cm^2}
2A. Unload valve (bucket group)
    Clutch pressure: 2.9 ± 0.2 MPa {30 ± 2 kg/cm^2}
2B. Unload valve (arm group)
    Clutch pressure: 2.9 ± 0.2 MPa {30 ± 2 kg/cm^2}
3. Pressure compensation valve
4A. Safety-suction valve
    Set pressure: 17.2 ± 0.5 MPa {175 ± 5 kg/cm^2}
4B. Safety-suction valve
    Set pressure: 35.8 ± 0.5 MPa {365 ± 5 kg/cm^2}
5. Safety-suction valve (for large flow)
    Set pressure: 35.8 ± 0.5 MPa {365 ± 5 kg/cm^2}
6. Safety-suction valve (2-stage)
    Set pressure:
    1-stage: 28.4 ± 0.5 MPa {290 ± 5 kg/cm^2}
    2-stage: 14.7 ± 0.5 MPa {150 ± 5 kg/cm^2}
7. Bucket spool
8. LS shuttle valve
9. R.H. travel spool
10. Suction valve
11. Boom Lo spool
12. Check valve (for boom regeneration circuit)
13. Swing spool
14. L.H. travel spool
15. Arm Lo spool
16. Check valve (for arm regeneration circuit)
17. Boom Hi spool
18. Arm Hi spool
19. LS select valve
20. Merge/flow divider valve

LOADING SHOVEL

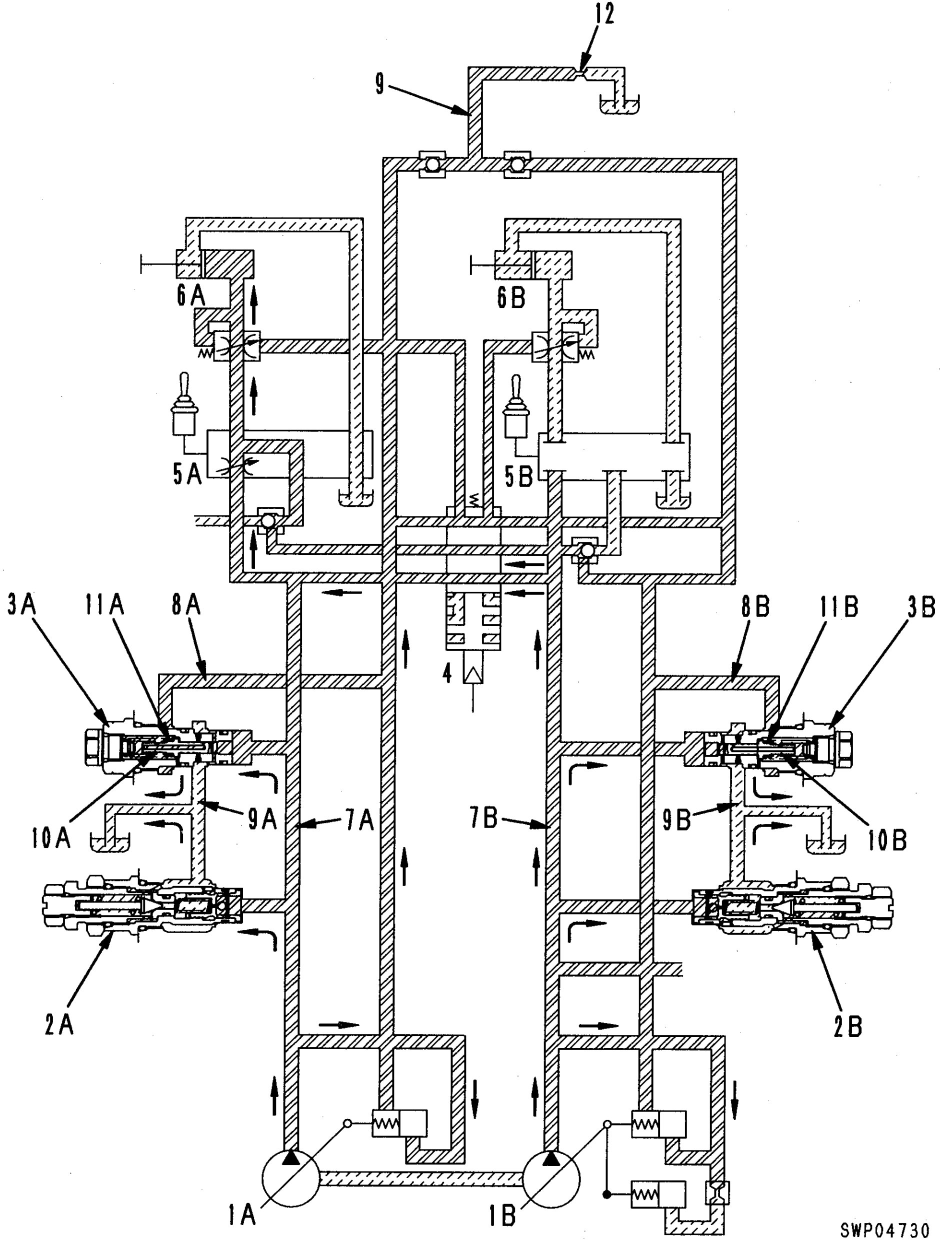


SWP07079

1A. Main relief valve (bucket group)
    Set pressure: 34.8 ± 0.5 MPa {355 ± 5 kg/cm^2}
1B. Main relief valve (arm group)
    Set pressure: 34.8 ± 0.5 MPa {355 ± 5 kg/cm^2}
2A. Unload valve (bucket group)
    Clutch pressure: 2.9 ± 0.2 MPa {30 ± 2 kg/cm^2}
2B. Unload valve (arm group)
    Clutch pressure: 2.9 ± 0.2 MPa {30 ± 2 kg/cm^2}
3. Pressure compensation valve
4A. Safety-suction valve
    Set pressure: 17.2 ± 0.5 MPa {175 ± 5 kg/cm^2}
4B. Safety-suction valve
    Set pressure: 35.8 ± 0.5 MPa {365 ± 5 kg/cm^2}
5. Safety-suction valve (for large flow)
    Set pressure: 35.8 ± 0.5 MPa {365 ± 5 kg/cm^2}
6. Safety-suction valve (2-stage)
    Set pressure:
    1-stage: 28.4 ± 0.5 MPa {290 ± 5 kg/cm^2}
    2-stage: 14.7 ± 0.5 MPa {150 ± 5 kg/cm^2}
7. Bucket spool
8. LS shuttle valve
9. R.H. travel spool
10. Suction valve
11. Boom Lo spool
12. Check valve (for boom regeneration circuit)
13. Swing spool
14. L.H. travel spool
15. Arm Lo spool
16. Check valve (for arm regeneration circuit)
17. Boom Hi spool
18. Arm Hi spool
19. LS select valve
20. Bottom dump spool
21. Merge/flow divider valve

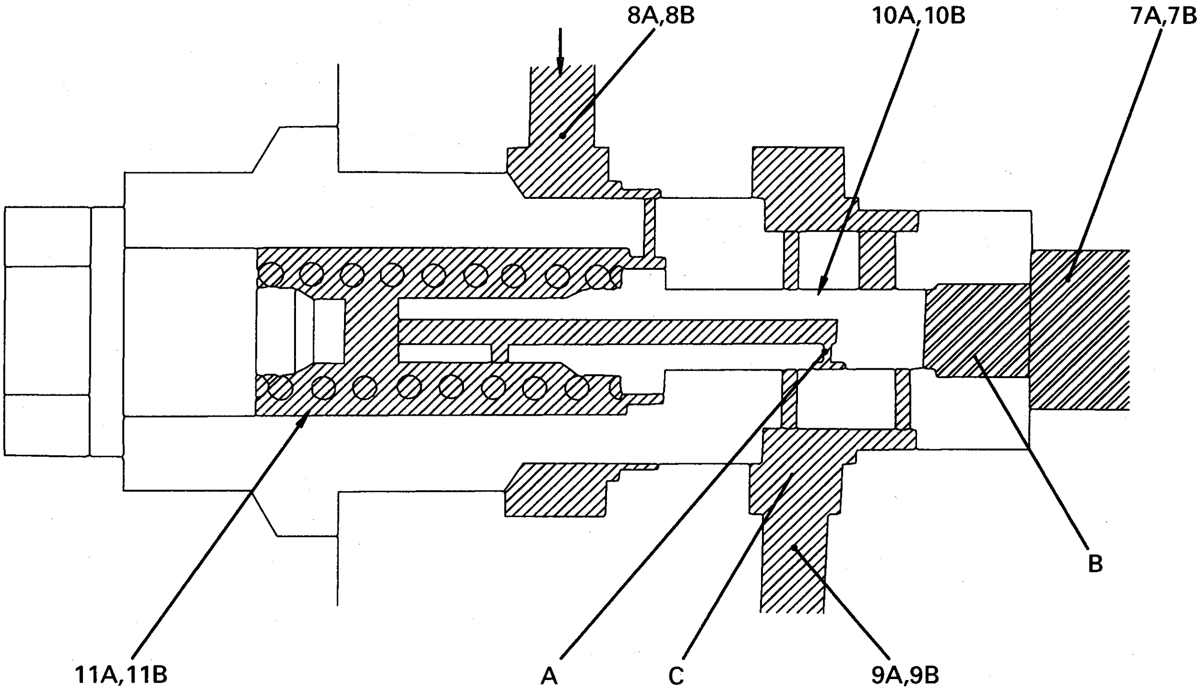
SYSTEM DIAGRAM

★ This shows actuator (6A) at stroke end relief in the merge mode.



1A. Main pump	5A. Control valve	9A. Tank passage
1B. Main pump	5B. Control valve	9B. Tank passage
2A. Main relief valve	6A. Actuator	10A. Valve
2B. Main relief valve	6B. Actuator	10B. Valve
3A. Unload valve	7A. Pump passage	11A. Spring
3B. Unload valve	7B. Pump passage	11B. Spring
4. Merge/flow divider valve	8A. LS circuit	12. LS bypass valve
	8B. LS circuit	

1. When unload valve is actuated

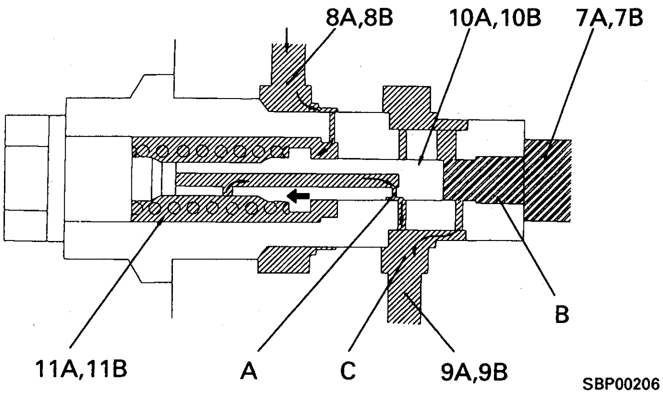


Function

- When all the control valves are at neutral, the oil discharged when the pump is at the minimum swash plate angle is drained. When this happens, the pump pressure becomes a pressure that matches the set load of springs (11A, 11B) inside the valve (**P1** pressure). The **LS** pressure is drained from LS bypass valve (12), so **LS** pressure ≒ tank pressure ≒ 0 MPa (0 kg/cm²).
- When operated (for operations in the discharge range for the minimum swash plate angle), the discharge pressure of the oil discharged with the pump at the minimum swash plate angle is **LS** pressure + **P1** pressure. In other words, the LS control differential pressure (Δ**PLS**) of the oil discharged at the minimum swash plate angle is the **P1** pressure.

Operation

- The pressure in pump passages (7A, 7B) is received by the end face of valves (10A, 10B). The control valve is at neutral, so the pressure in LS circuits (8A, 8B) is 0 MPa (0 kg/cm²).
- The pressurized oil in pump passages (7A, 7B) is stopped by valves (10A, 10B). There is no way for the pressurized oil discharged by the pump to escape, so the pressure rises. When this pressure becomes larger than the force of springs (11A, 11B), valves (10A, 10B) move to the left, ports **B** and **C** are connected and the pump pressure flows to tank passages (9A, 9B). In addition, the pressurized oil in LS circuits (8A, 8B) passes from orifice **A** through port **C**, and is drained to tank passages (9A, 9B). Therefore, when the valve is actuated, **LS** pressure ≒ tank pressure.
- When the unload operation is carried out, the differential pressure (pump discharge pressure – LS circuit pressure) is greater than the pump LS control pressure, so a signal is sent to move the pump swash plate to the minimum angle.

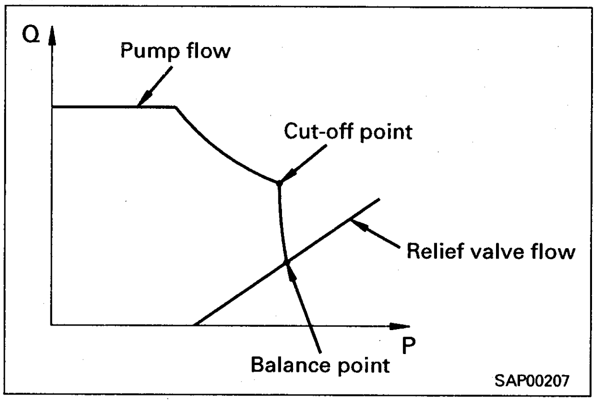


2. Operation of relief valve

(1) Cut-off control actuated

Function

- When cut-off control is being carried out on the pump by the TVC valve, the pump swash plate angle is at the minimum.
- The relief valve acts to relieve the oil flow when the pump is at the minimum swash plate angle in order to maintain the overall balance.



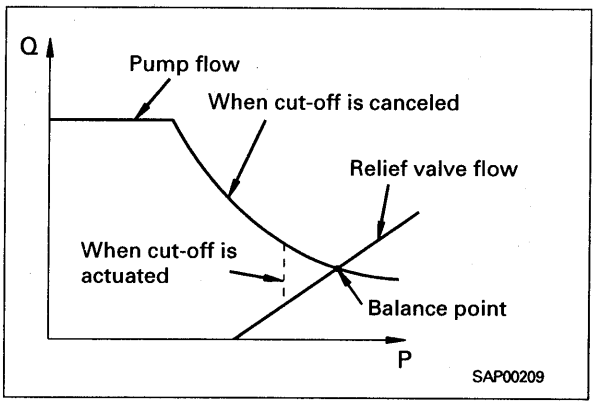
Operation

- When the cylinder reaches the end of its stroke, main relief valves (2A, 2B) open and pump discharge amount **Q** is relieved to tank passages (9A, 9B).
- When pump delivery pressure **PP** comes close to the relief pressure, the governor, pump controller sends a signal to the solenoid of the TVC valve and carries out the cut-off function to make pump discharge amount **Q** the minimum.
- The spool is at the end of its stroke, so there is no flow of oil upstream or downstream from the spool. As a result, pump delivery pressure **PP** and LS pressure **PLS** are almost the same pressure, and LS differential pressure Δ**PLS** becomes 0.
- LS differential pressure Δ**PLS** is lower than the LS set pressure of the LS valve, so the LS valve acts to try to move the pump swash plate angle to the maximum. However, because of the structure, the action of the TVC valve is given priority over the action of the LS valve, so the pump is held at the minimum swash plate angle by the cut-off function of the TVC valve.

(2) Cut-off canceled (power max. mode, fine control mode, travel)

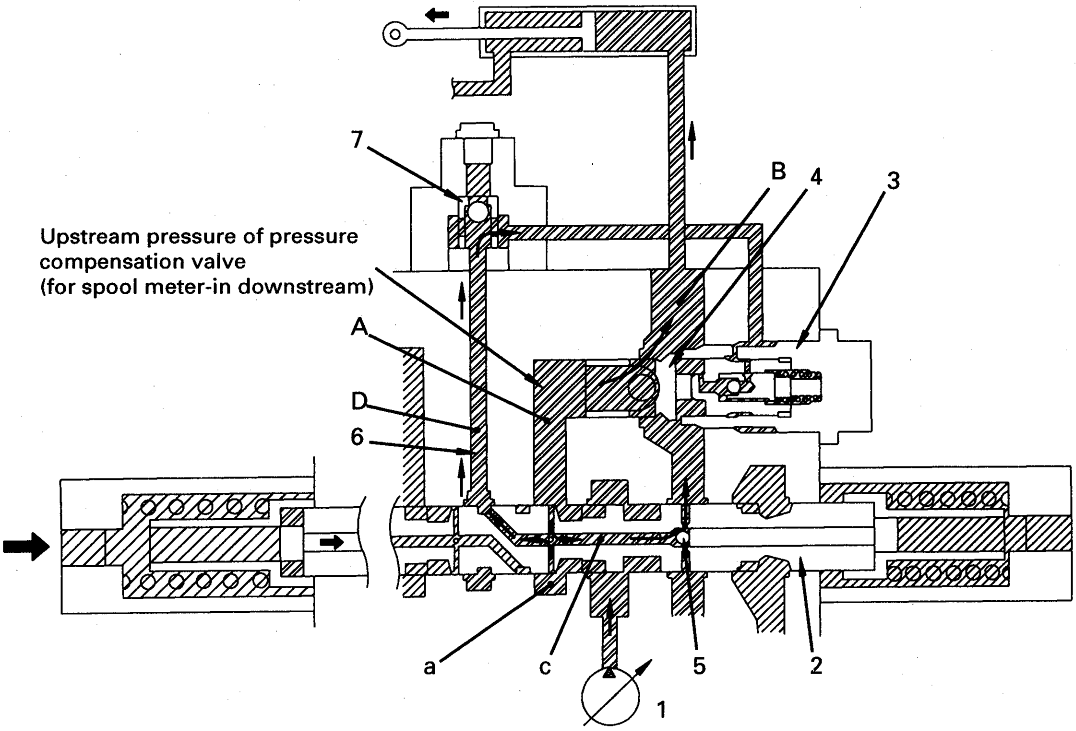
Function, operation

- In the power max. mode, fine control mode, or travel mode, the torque cut-off signal is not given, so the torque moves on the pump output curve.
- When this happens, the pump discharge amount is relieved from the relief valve, so the overall balance is maintained.



3. Introduction of LS pressure

★ The diagram shows the condition for arm IN.



SLP00210

1. Main pump
2. Main spool
3. Pressure compensation valve
4. Valve
5. Ball valve
6 LS circuit
7. LS shuttle valve

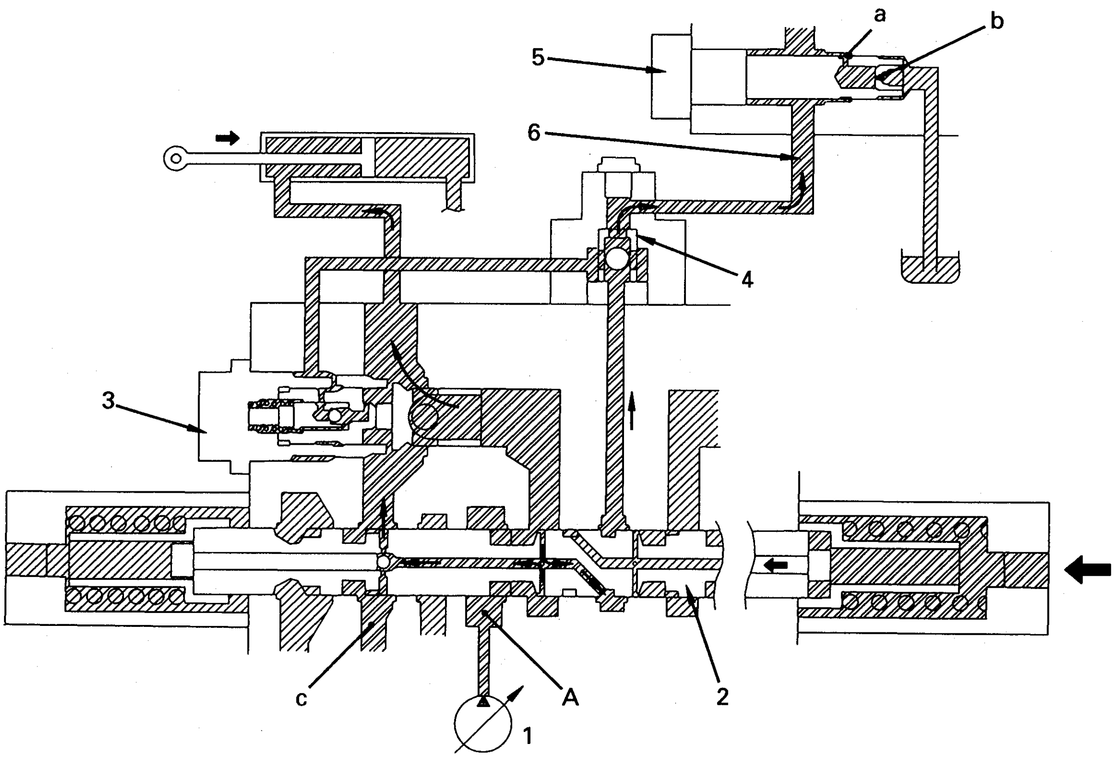
Function

- The upstream pressure (= spool meter-in downstream pressure) of pressure compensation valve (3) is introduced and goes to shuttle valve (7) as the **LS** pressure. When this happens, it is connected to port **B** of the actuator through valve (4), and **LS** pressure ≒ actuator load pressure. Introduction hole **a** inside the spool has a small diameter, so it also acts as a throttle.

Operation

- When spool (2) is operated, the pump pressure passes through introduction hole **a**, enters port **C**, and is taken to the LS circuit. When the pump pressure rises and reaches the load pressure of port **B**, ball valve (5) opens.

4. LS bypass valve

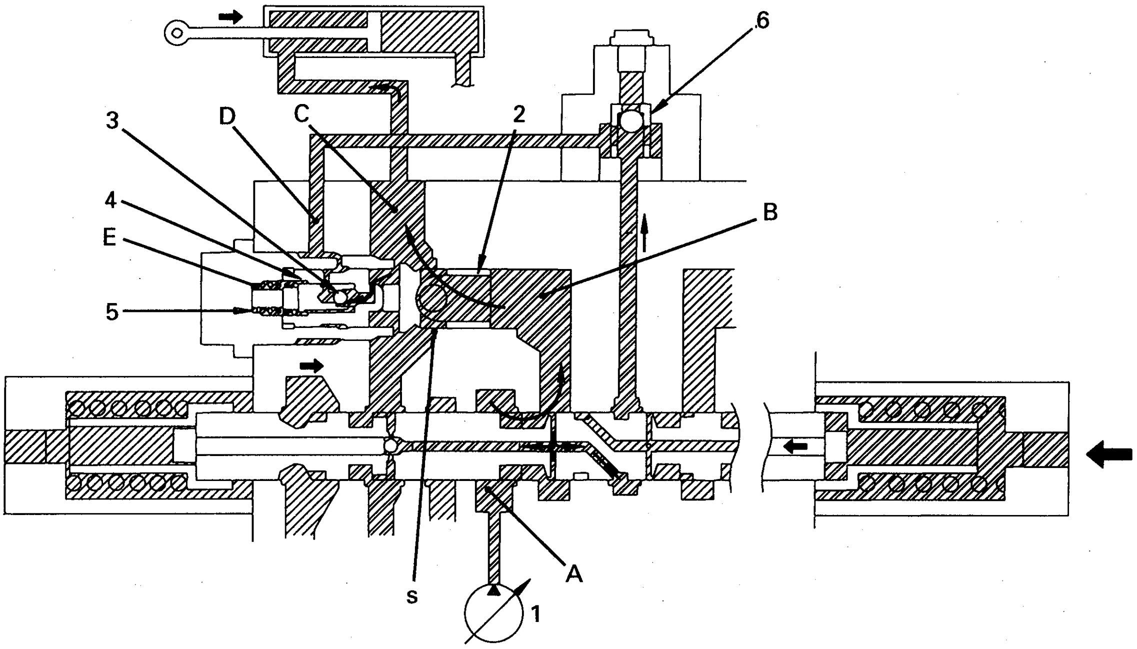


1. Main pump
2. Main spool
3. Pressure compensation valve
4. LS shuttle valve
5. LS bypass valve
6. LS circuit

Function

- The residual pressure in LS circuit (6) is released from orifices **a** and **b**.
- This reduces the speed of the rise in the LS pressure, and prevents any sudden change in the oil pressure. Furthermore, a pressure loss is generated by the circuit resistance between throttle **c** of main spool (2) and LS shuttle valve (4) according to the bypass flow from LS bypass valve (5). As a result, the effective LS differential pressure drops, and the dynamic stability of the actuator is increased.

5. Pressure compensation valve



1. Main pump
2. Valve
3. Shuttle valve
4. Piston
5. Spring
6. LS shuttle valve

Function

1) During independent operation and at maximum load pressure (during compound operations, when load pressure is higher than other work equipment)

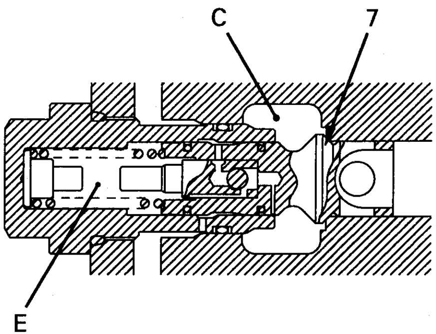
- The pressure compensation valve acts as a load check valve.

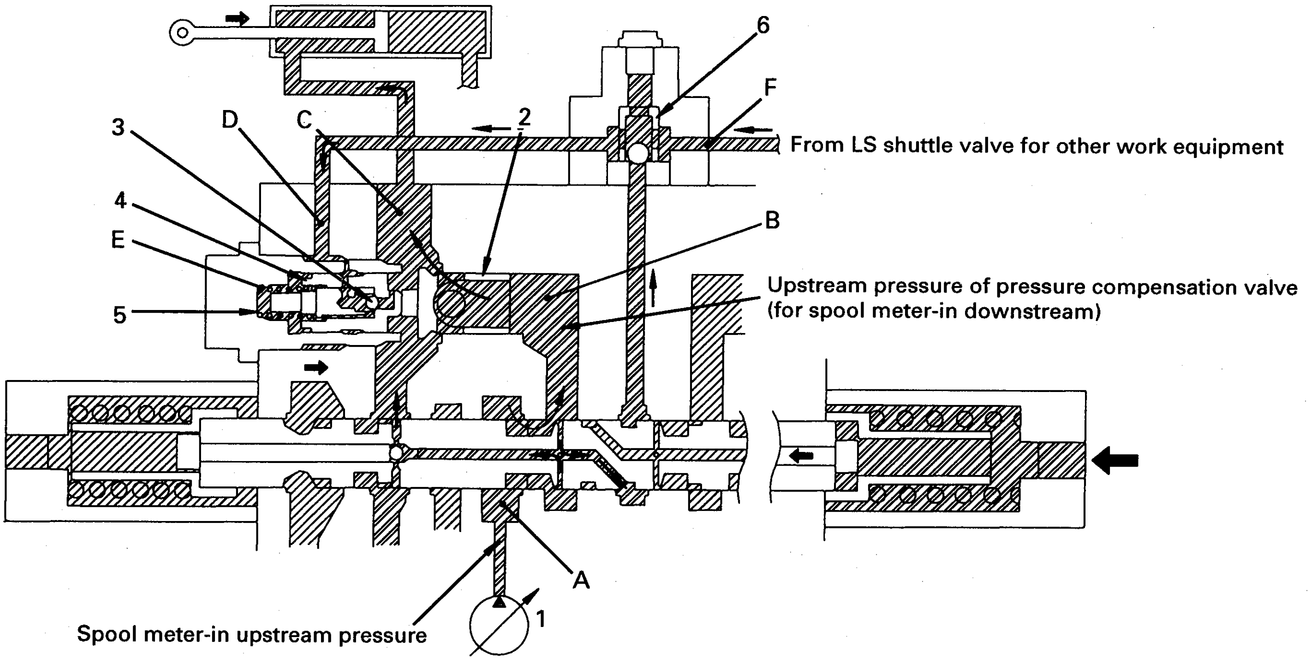
Operation

- If the pump pressure (LS pressure) is lower than the load pressure at port **C**, shuttle valve (3) inside pressure compensation valve piston (4) moves to interconnect spring chamber **E** and port **C**.
  From this condition, the force of spring (5) acts to move piston (4) and valve (2) in the direction of closing.

Reference: Integrated pressure compensation valve

- When high peak pressure is generated in the actuator circuit or when peak pressure is generated repeatedly over a continuous period (such as when using a breaker), valve (2) may hit valve chamber seat **s** and generate a high stress. To prevent this, an integrated pressure compensation valve combining valve (2) and piston (4) is used. On this machine, this is employed for the bucket valve (at the cylinder bottom) and service valve.
  With the integrated compensation valve, as a basic rule, port **C** and spring chamber **E** are not interconnected, so even if a high peak pressure is generated at port **C**, valve (7) does not hit the valve chamber.
  (However, the system is designed so that port **C** and spring chamber **E** are interconnected just before the bucket valve is seated.)





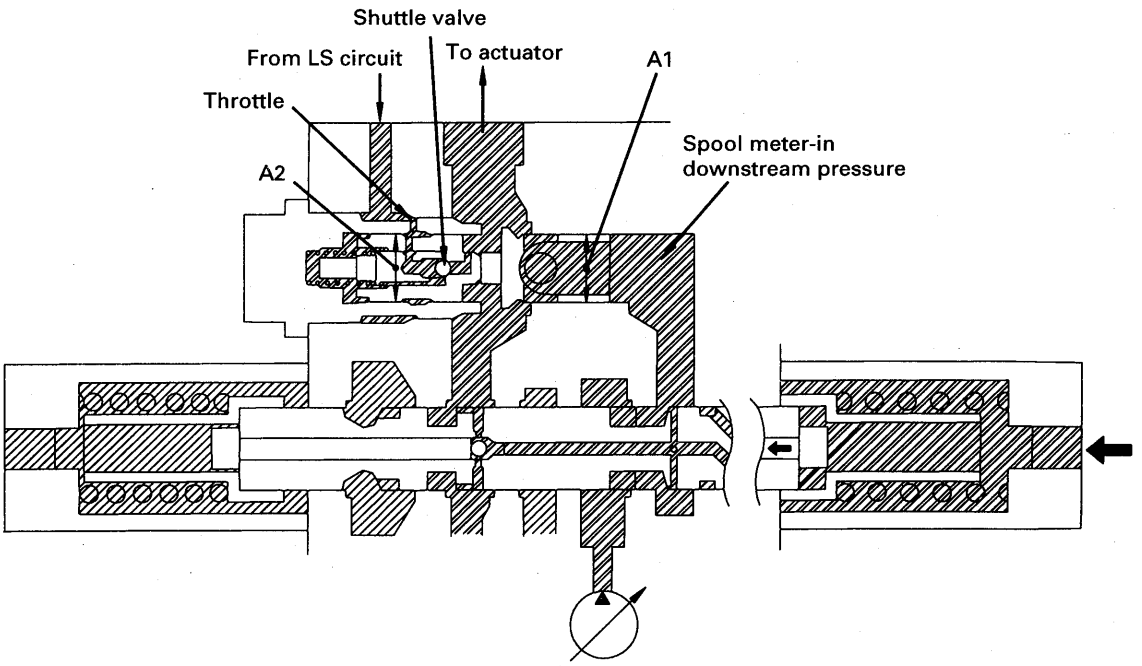
SLP00213

2) **When receiving compensation (during compound operations, when load pressure is lower than other work equipment)**

- The pressure compensation valve is closed by the LS pressure of port **D**, and the spool meter-in downstream pressure of port **B** becomes the same as the maximum pressure of the other work equipment. The spool meter-in upstream pressure of port **A** is the pump pressure, so spool meter-in differential pressure (upstream pressure (pressure of port **A**) – downstream pressure (pressure of port **B**)) becomes the same for all spools that are being operated. In this way, the pump flow is divided in proportion to the area of the meter-in opening.

Operation

- Spring chamber **E** is interconnected with port **D**. Piston (4) and valve (2) are actuated by the LS circuit pressure from the other work equipment at port **F** in the direction of closing (to the right). In other words, the valve upstream pressure of port **B** (= spool meter-in downstream pressure) is controlled by the **LS** pressure.



SLP00218

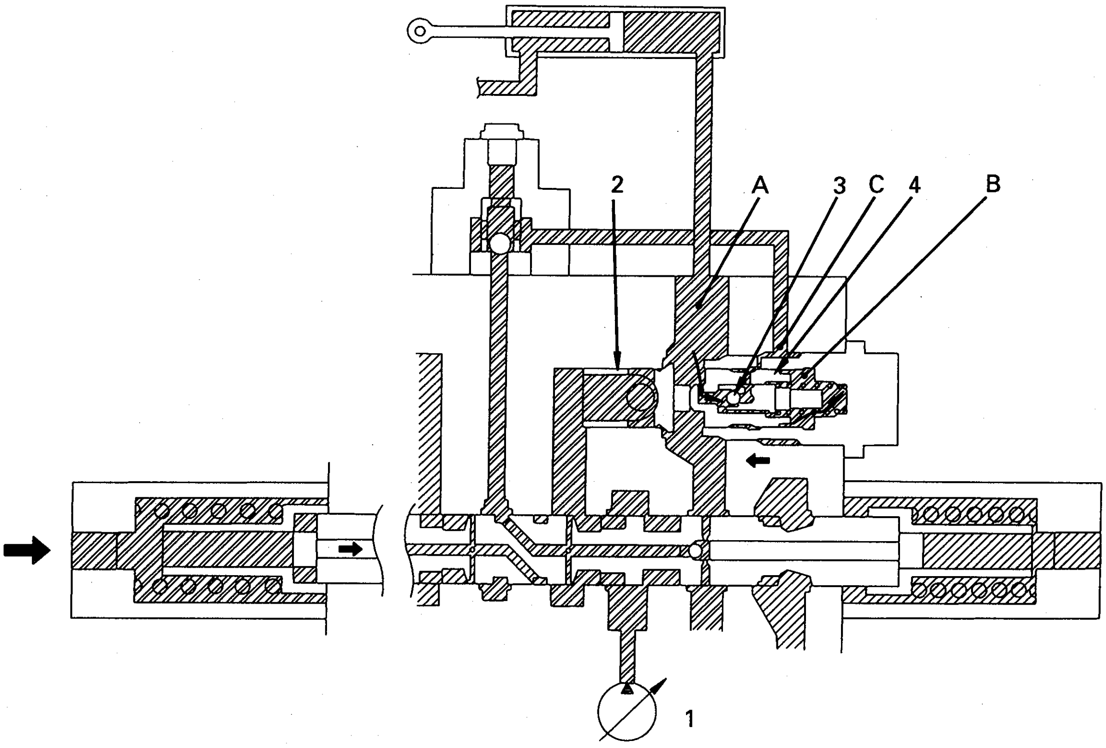
< Area ratio of pressure compensation valve >
The condition of the flow division changes according to the ratio of the areas of portion **A1** and portion **A2** of the pressure compensation valve.
Area ratio = **A2/A1**

- When area ratio = 1: Spool meter-in downstream pressure = Max. load pressure, and oil flow is divided in proportion to area of opening of spool.
- When ratio is more than 1: Spool meter-in downstream pressure > Max. load pressure, and a smaller oil flow is divided than the proportion between the areas of opening of the spool.
- When ratio is less than 1: Spool meter-in downstream pressure < Max. load pressure, and a larger oil flow is divided than the proportion between the areas of opening of the spool.

< Pressure compensation valve for service valve >

- The service valve uses a variable type pressure compensation valve, so it can adjust the division of the oil flow suitably to match the attachment installed.

6. Shuttle valve inside pressure compensation valve



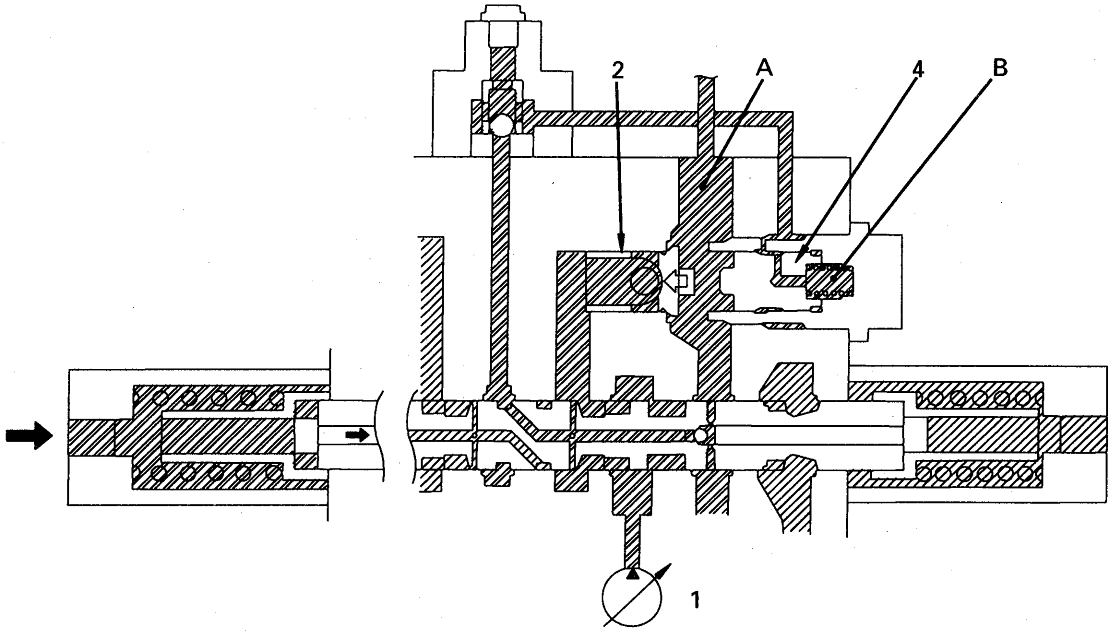
SLP00214

1. Main pump
2. Valve
3. Shuttle valve inside pressure compensation valve
4. Piston

Function

When holding pressure at port A > LS pressure in spring chamber B.

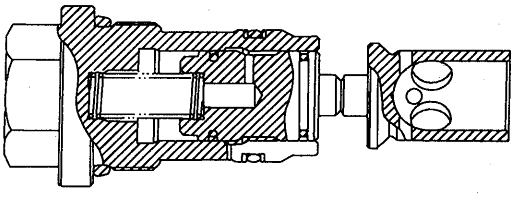
- Shuttle valve (3) is pushed to the right by the pressure of port **A**, and the circuit between ports **A** and **C** is shut off. In this condition, the holding pressure at port **A** is taken to spring chamber **B**, and pushes piston (4) to the left to prevent piston (4) and valve (2) from separating.



SLP00215

< For travel>

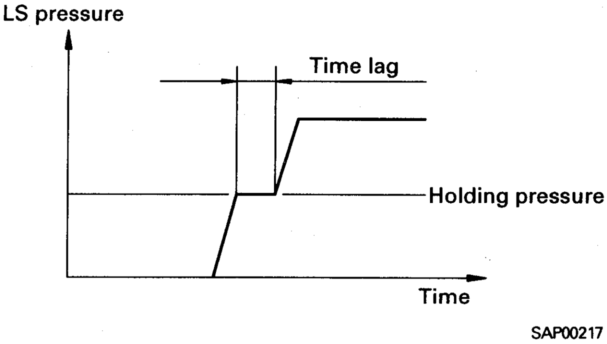
- No holding pressure is generated at port **A** in the travel circuit, so a pressure compensation valve without a shuttle valve is used.



SBP00216

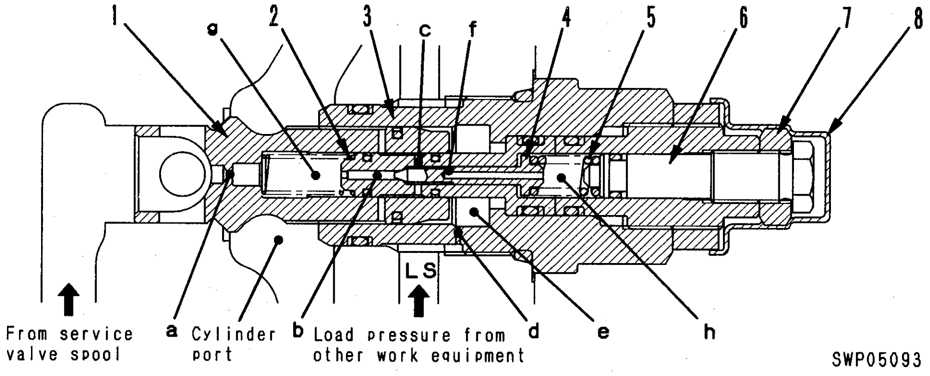
Reference: When there is no shuttle valve

- If there is no shuttle valve, piston (4) and valve (2) will separate. In this condition, if another actuator is operated, the piston acts as an accumulator, so there is a time lag.



SAP00217

7. Variable type pressure compensation valve (for service valve)



1. Valve
2. Spring
3. Sleeve
4. Poppet
5. Spring
6. Screw
7. Locknut
8. Plastic cap

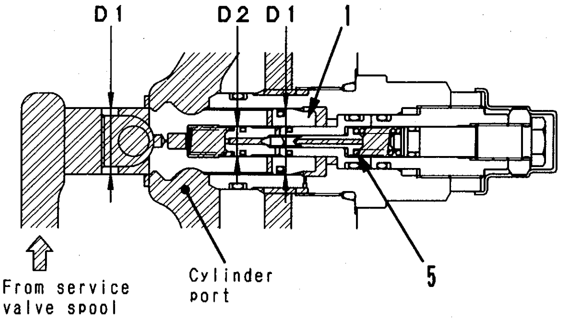
Function

- It is possible to adjust the division of the oil flow to the service valve when the service valve (for attachment) is operated together with the main control valve (boom RAISE, etc.).
  (Variable in proportion to surface area)
- The pump pressure leaving the service valve spool acts on the left end of valve (1), and at the same time passes through throttle **a** and enters chamber **g**.
  The maximum **LS** pressure passes through throttle **d** and enters chamber **e**. At the same time, the cylinder port pressure passes through passage **c** and throttle **f**, and goes to chamber **h**.
  In addition, the force of spring (2) acts on valve (1), and the force of spring (5) acts on poppet (4). The force of spring (5) can be adjusted with screw (6)

Operation

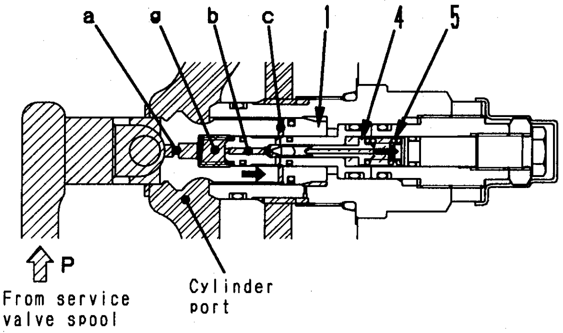
Simultaneous operation with work equipment under heavy load (boom RAISE, etc.)

1. The pump pressure and **LS** pressure are determined by the pressure of the other work equipment, but the cylinder port pressure becomes the actuating pressure of the attachment.
   When the difference between the pump pressure and the cylinder pressure is less than the force of spring (5), then balance of the force acting on valve (1) is as follows.
   P × A1 = P × A2 + LS (A2 – A1) + F
   A1: Cross-sectional area of diameter D1
   A2: Cross-sectional area of diameter D2
   F: Force of spring



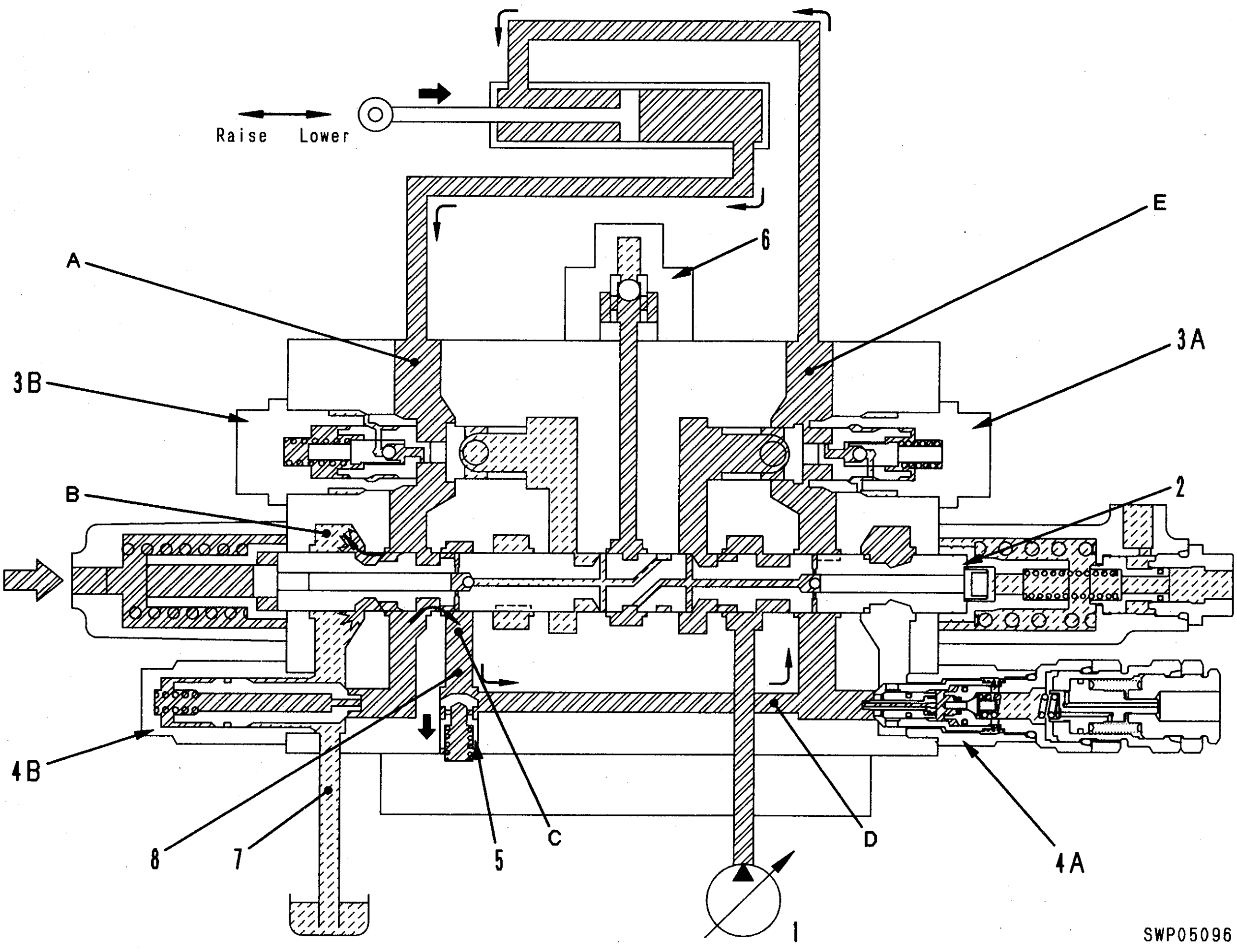
SWP05094

2. If the difference between pump pressure **P** and the cylinder pressure becomes greater than the force of spring (5), poppet (4) is pushed to the right and the passage opens, so the pump passage is connected to the cylinder port through throttle **a**, chamber **g**, and passages **b** and **c**, and the oil flows to the cylinder port. When this happens, a differential pressure is formed between the upstream and downstream sides of throttle **a**, and the pressure in chamber **g** goes down, so the force pushing valve (1) to the left is reduced. In other words, the area ratio becomes smaller, so valve (1) moves to the right and increases the flow from the pump to the cylinder.



SWP05095

8. Boom regeneration circuit



1. Main pump
2. Main spool
3A. Pressure compensation valve
3B. Pressure compensation valve
4A. Suction valve (with safety)
4B. Suction valve
5. Check valve
6. LS shuttle valve
7. Drain circuit
8. Regeneration circuit

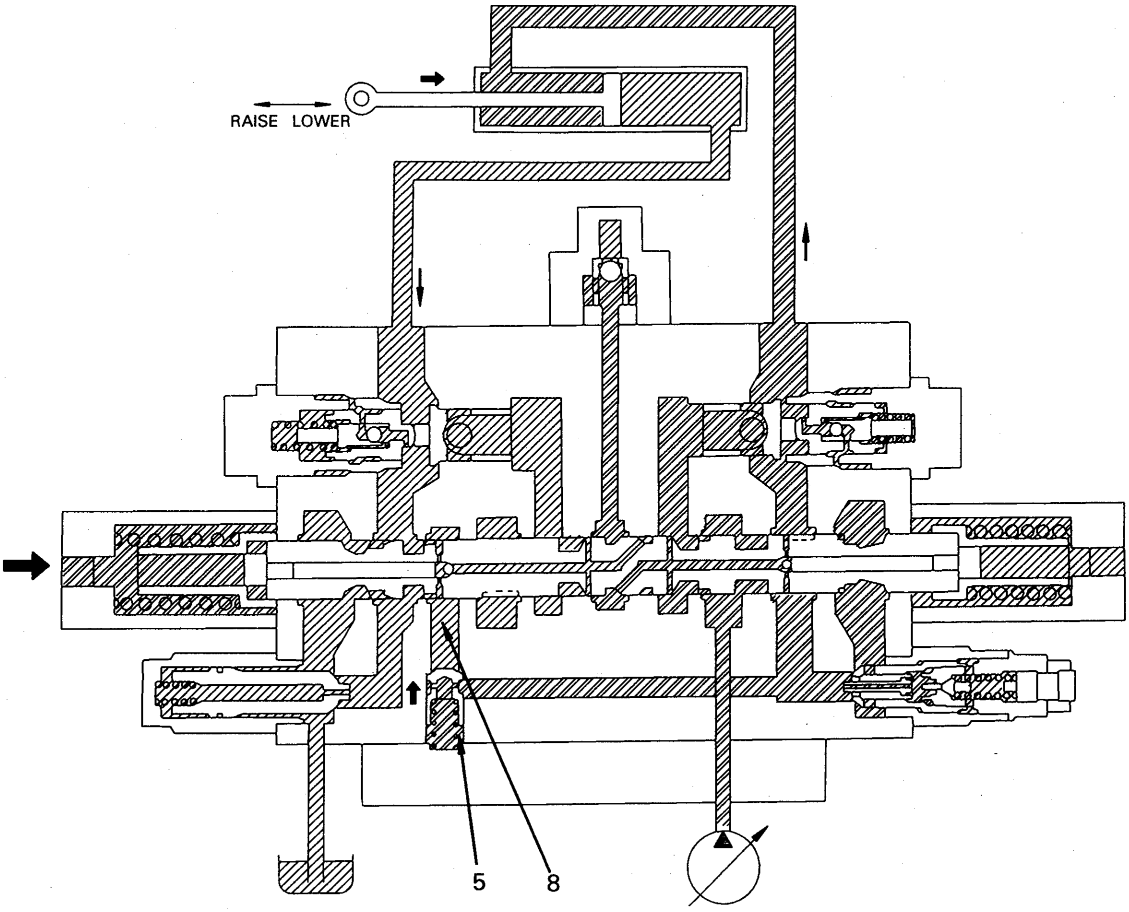
Function

1) Cylinder head pressure < cylinder bottom pressure (free fall, etc.)

- A return flow circuit is provided from the cylinder bottom to the cylinder head so that when the boom is lowered, the return flow can be used to increase the flow of oil from the pump to the cylinder bottom.

Operation

- When the cylinder head pressure < cylinder bottom pressure, part of the pressurized oil from the cylinder bottom passes through the notch in spool (2), goes through port **B**, and enters drain circuit (7). The rest of the oil goes from port **C**, enters regeneration circuit (8), opens check valve (5), and passes through ports **C** and **D** to flow back to the cylinder head.

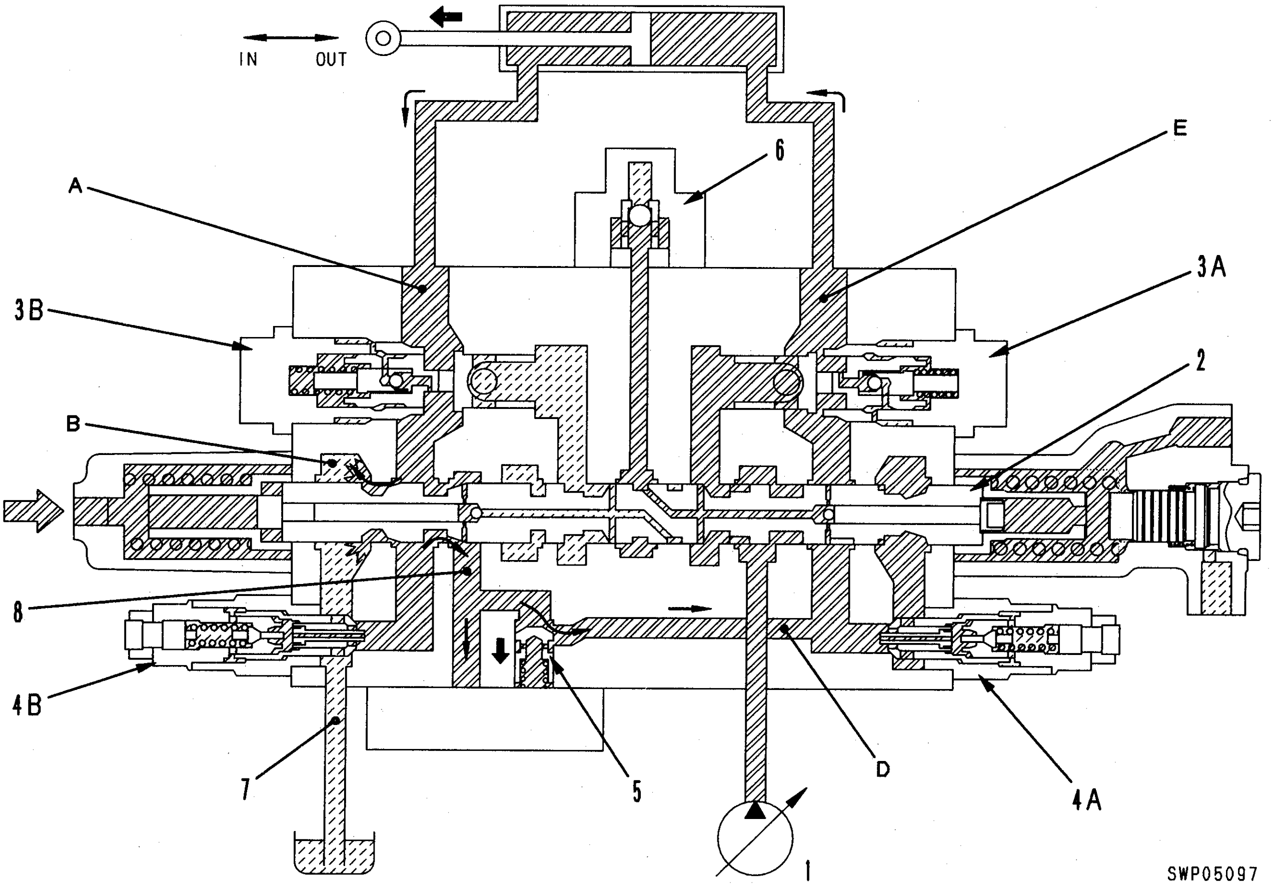


S LP00221

2) Cylinder head pressure > Cylinder bottom pressure (digging operations, etc.)

- Check valve (5) in regeneration circuit (8) acts to shut off the flow from the cylinder head to the cylinder bottom.

9. Arm regeneration circuit



1. Main pump
2. Main spool
3A. Pressure compensation valve
3B. Pressure compensation valve
4A. Safety valve
4B. Safety valve
5. Check valve
6. LS shuttle valve
7. Drain circuit
8. Regeneration circuit

Function

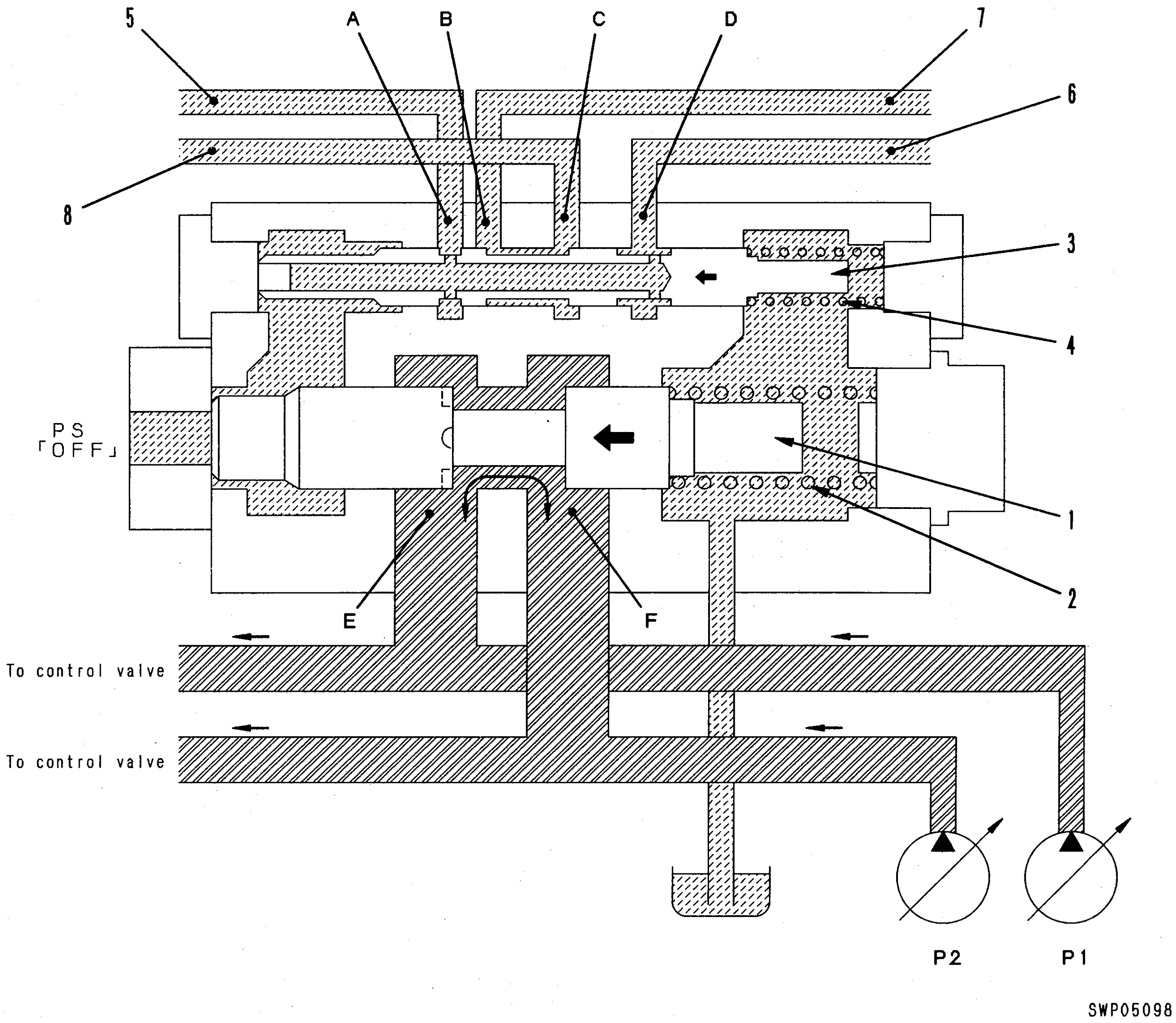
Cylinder head pressure > cylinder bottom pressure

- A return flow circuit is provided from the cylinder head to the cylinder bottom so that when the arm is moved IN, the flow of oil to the cylinder becomes the pump discharge amount + the return flow. This covers for any negative pressure at the cylinder bottom, and, as a result, increases the cylinder speed.

Operation

- When the cylinder head pressure > cylinder bottom pressure, the pressurized oil from the cylinder head passes through the notch in spool (2), enters port **C** and opens check valve (8), then passes through ports **D** and **E** to flow back to the cylinder bottom.

10. Merge/flow divider valve



1. Main spool
2. Spring
3. LS spool
4. Spring
5. LS circuit (bucket)
6. LS circuit (arm)
7. LS circuit (arm)
8. LS circuit (bucket)

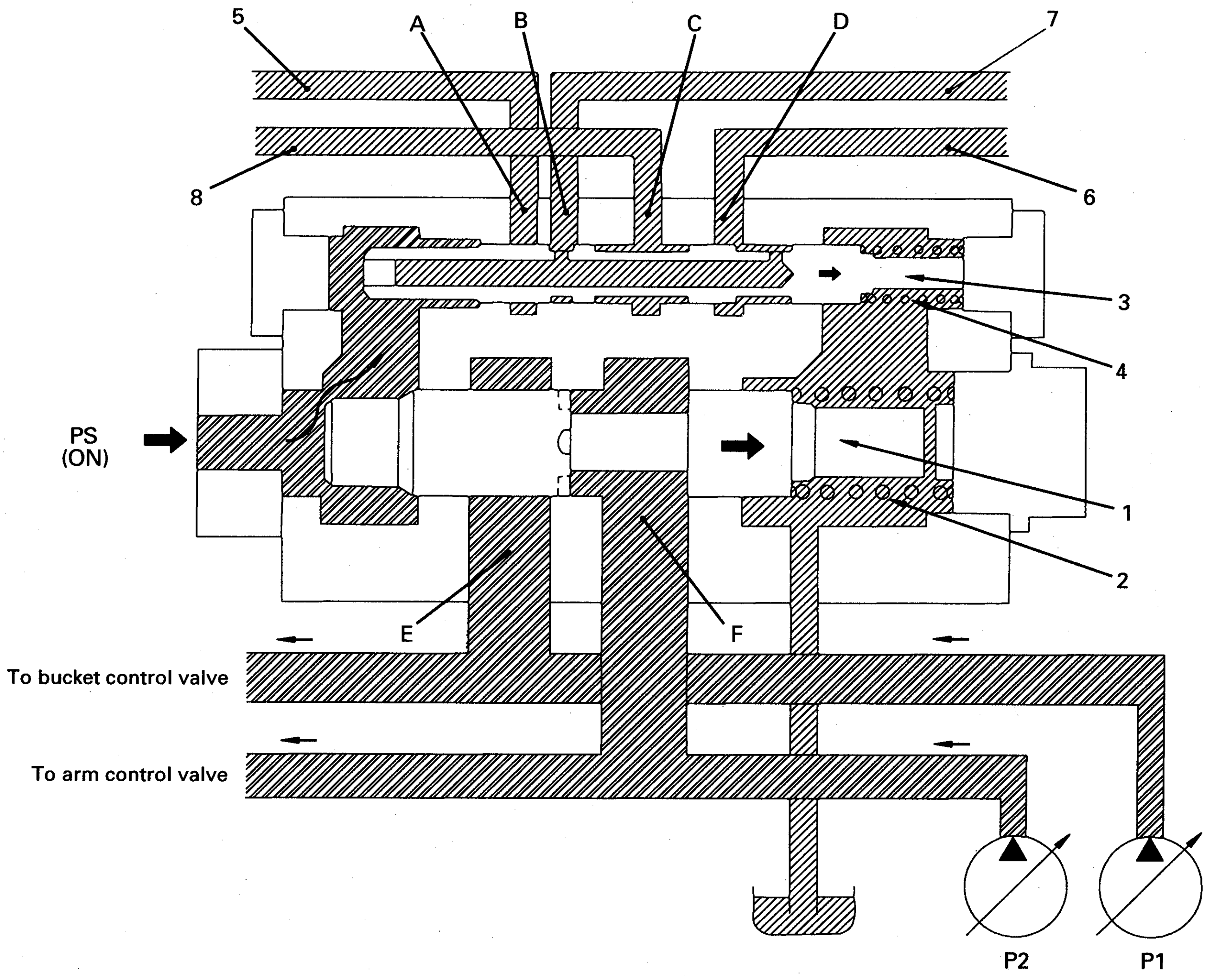
Function

- This acts to merge or divide (send each to its own control valve group) oil flows **P1** and **P2** of pressurized oil discharged from the two pumps.
- At the same time, it also carries out merging and dividing of the LS circuit pressure.

Operation

1) When merging pump flow (when pilot pressure PS is OFF)

- Pilot pressure **PS** is OFF, so main spool (1) is pushed fully to the left by spring (2), and ports **E** and **F** are interconnected.
  Therefore, pressurized oil flows **P1** and **P2** discharged from the two pumps are merged at ports **E** and **F**, and are sent to the control valve that demands the oil.
- In the same way, LS spool (3) is also pushed fully to the left by spring (4), so the ports are connected as follows.
  Connected ports: **A** ↔ **D**, **B** ↔ **C**
- Therefore, the **LS** pressure supplied from the spools of each control valve to LS circuits (5), (6), (7), and (8) is all sent to the pressure compensation valve and other valves.



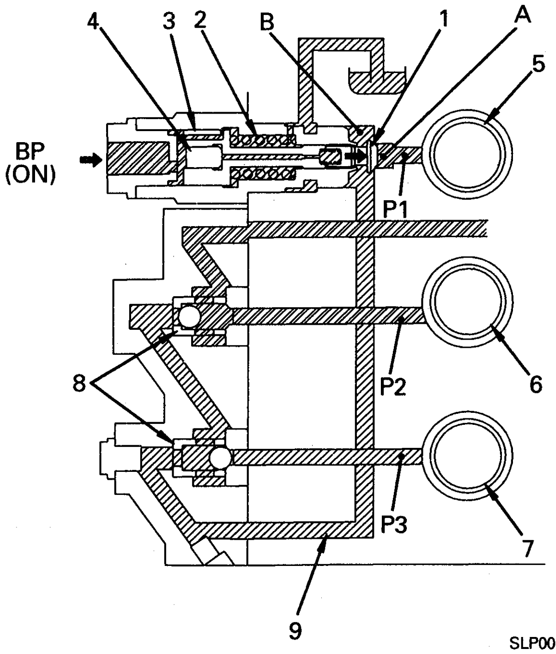
SLP00224

2) When dividing pump flow (when pilot pressure PS is ON)

- When pilot pressure **PS** is ON, main spool (1) is moved to the right by the **PS** pressure, and ports **E** and **F** are disconnected.
  Therefore, the pressurized oil discharged from each pump is sent to its own control valve group.
  Pressure **P1**: To bucket, R.H. travel, boom group
  Pressure **P2**: To swing, L.H. travel, arm group
- In the same way, LS spool (3) is also moved to the right by the **PS** pressure, and the ports are connected as follows.
  Connected ports: **B** ↔ **D**, others are not connected.
  Therefore, LS circuits (5), (6), (7), and (8) are all connected to their own control valve group.

11. LS select valve

★ The diagram shows the situation when the swing and left travel are operated at the same time. (BP pressure ON)



1. Valve
2. Spring
3. Piston
4. Piston
5. Swing spool
6. L.H. travel spool
7. Arm spool
8. LS shuttle valve
9. LS circuit

Function

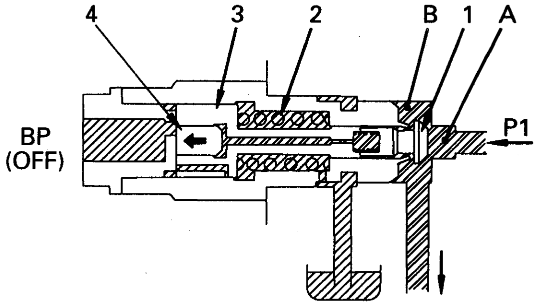
- This valve is used to increase the ease of operating the work equipmentIt prevents high pressure from being generated when the swing is operated. It also prevents the high **LS** pressure from the swing circuit from flowing into any other LS circuit when the swing is operated together with the work equipment.

Operation

1) When pilot pressure BP is OFF

- Pilot pressure **BP** is OFF, so piston (3) is pushed to the left by spring (2). If the swing is then operated, swing LS pressure **P1** passes through swing spool (5) and enters port **A**. It pushes valve (1) to the left and connects ports **A** and **B**.

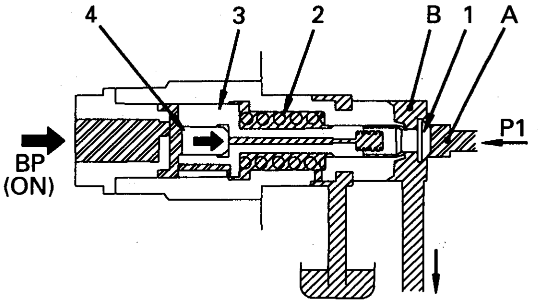
  Therefore, swing LS pressure **P1** flows to LS shuttle valve (8).



To LS shuttle valve

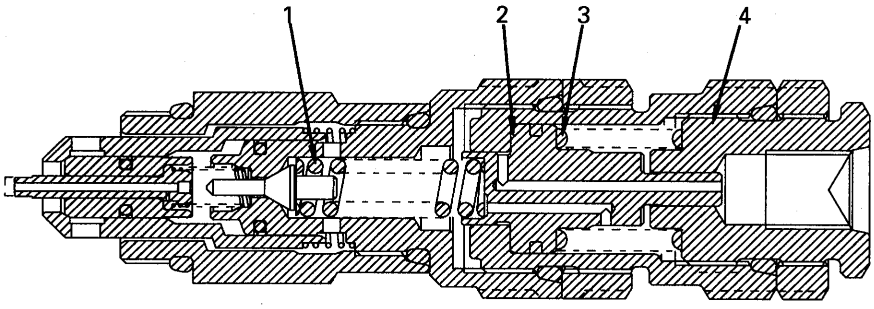
2) When pilot pressure BP is ON

- When pilot pressure **BP** is ON, piston (3) is moved to the right against spring (2) by the **BP** pressure. It pushes valve (1) to the right and closes the circuit between ports **A** and **B**. As a result, swing LS pressure **P1** stops flowing to LS shuttle valve (8), and even if swing LS pressure **P1** rises to a high pressure, it does not influence any other LS circuit.



To LS shuttle valve

12. 2-stage safety valve (installed to boom cylinder head)



SAP00228

1. Spring
2. Piston
3. Spring
4. Holder

Function

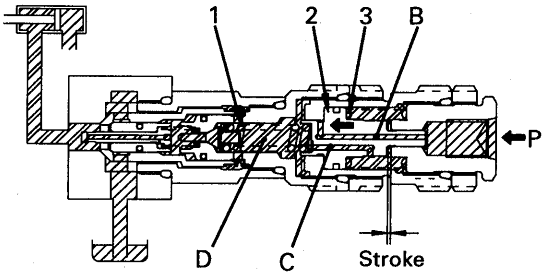
- The set pressure of the safety valve can be set to two stages and the low pressure setting can be made smaller. Because of this, when digging with boom, even if high pressure is brought to bear on the boom cylinder, it is possible to let the boom escape without operating the control lever. This makes it possible to carry out operations with high efficiency and with little vibration of the chassis.

Operation

- The set pressure of the safety valve is determined by the load pressure of spring (1).

1) **When pilot pressure P is OFF: high pressure setting**

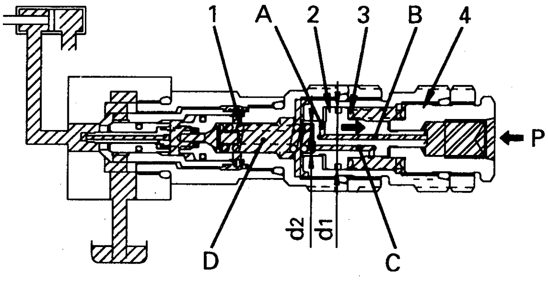
- Pilot pressure **P** is OFF, so piston (2) is pushed to the left by spring (3). (Installed load of spring (1) < installed load of spring (3)).
  When this happens, the installed load of spring (1) becomes the maximum, and the set pressure is set to high pressure.
  In addition, passage **B** is connected to the drain circuit through passage **C** and chamber **D**.



SAP00229

2) **When pilot pressure P is ON: low pressure setting**

- When pilot pressure **P** is ON, the pilot pressure goes to portion **A** through passage **B**, and piston (2) acts on the diameter of portion **A** receiving the pressure (**d2** – **d1**). Piston (2) is moved to the right against spring (3) by this pilot pressure.
  It moves the full stroke until it contacts holder (4). As a result, spring (1) extends, the installed load becomes the minimum, and the set pressure is set to low pressure.
  In addition, an amount of oil equivalent to the piston stroke passes through passage **C** and chamber **D**, and is drained.

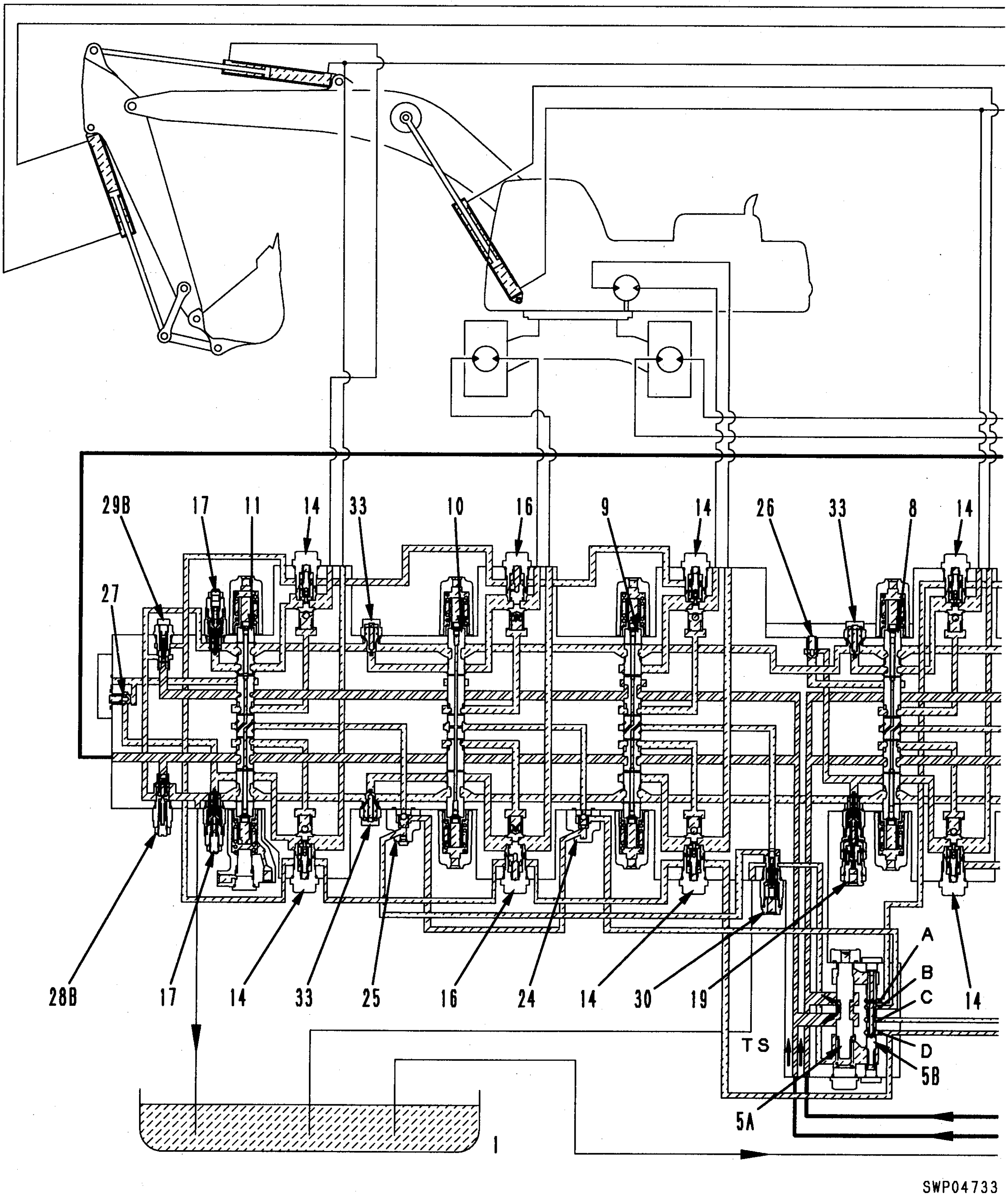


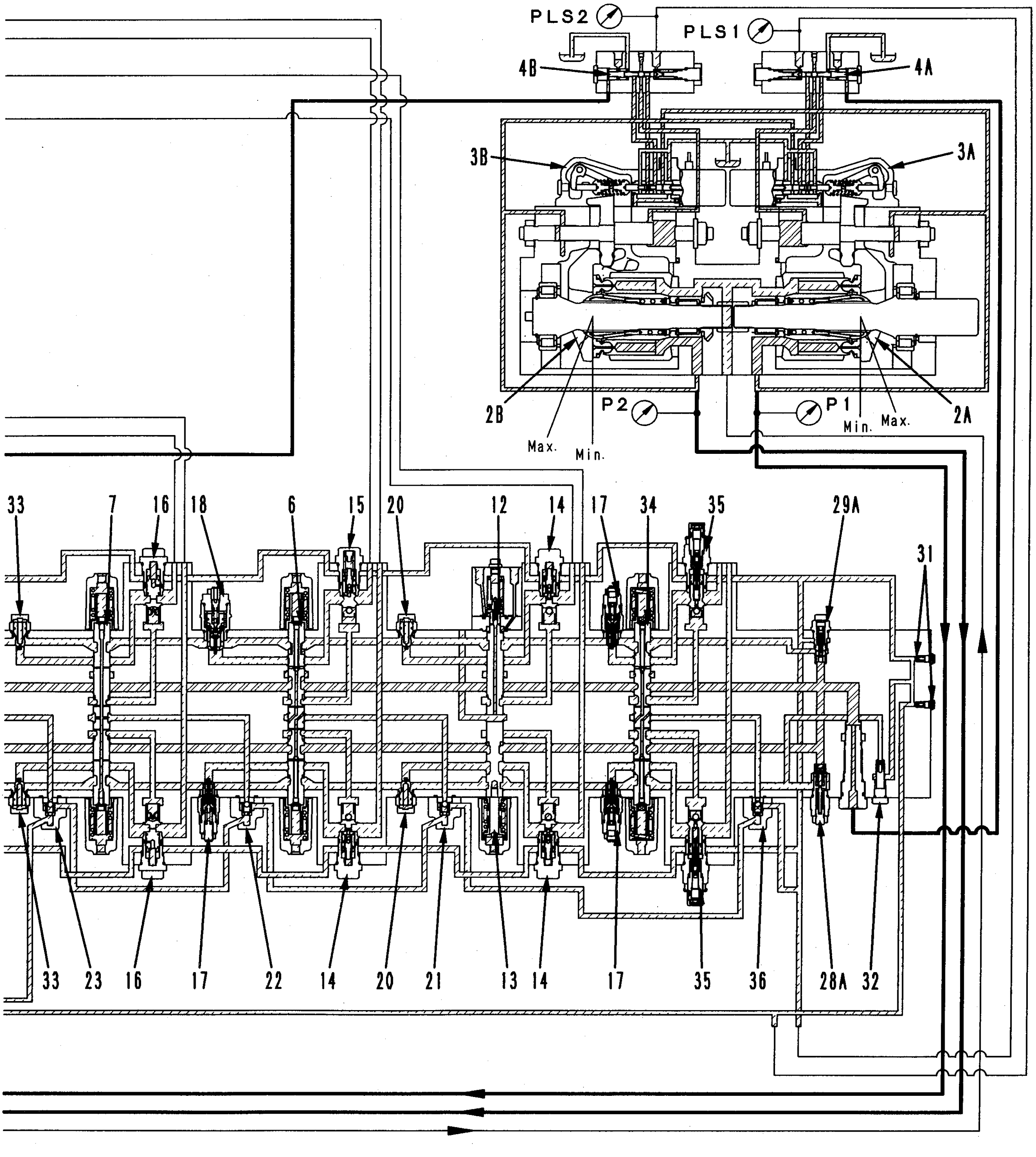
SAP00230

OPERATION OF CLSS SYSTEM AS A WHOLE

When all work equipment is at neutral

★ The valves and circuits that are not connected with the explanation of the operation of the CLSS hydraulic system have been omitted.




PLS2
PLS1
4B
4A
3B
3A
2B
2A
P2
P1
Max.
Min.
Min.
Max.
33
7
16
18
6
15
20
12
14
17
34
35
29A
31
33
23
16
17
22
14
20
21
13
14
17
35
36
28A
32
SWP04734

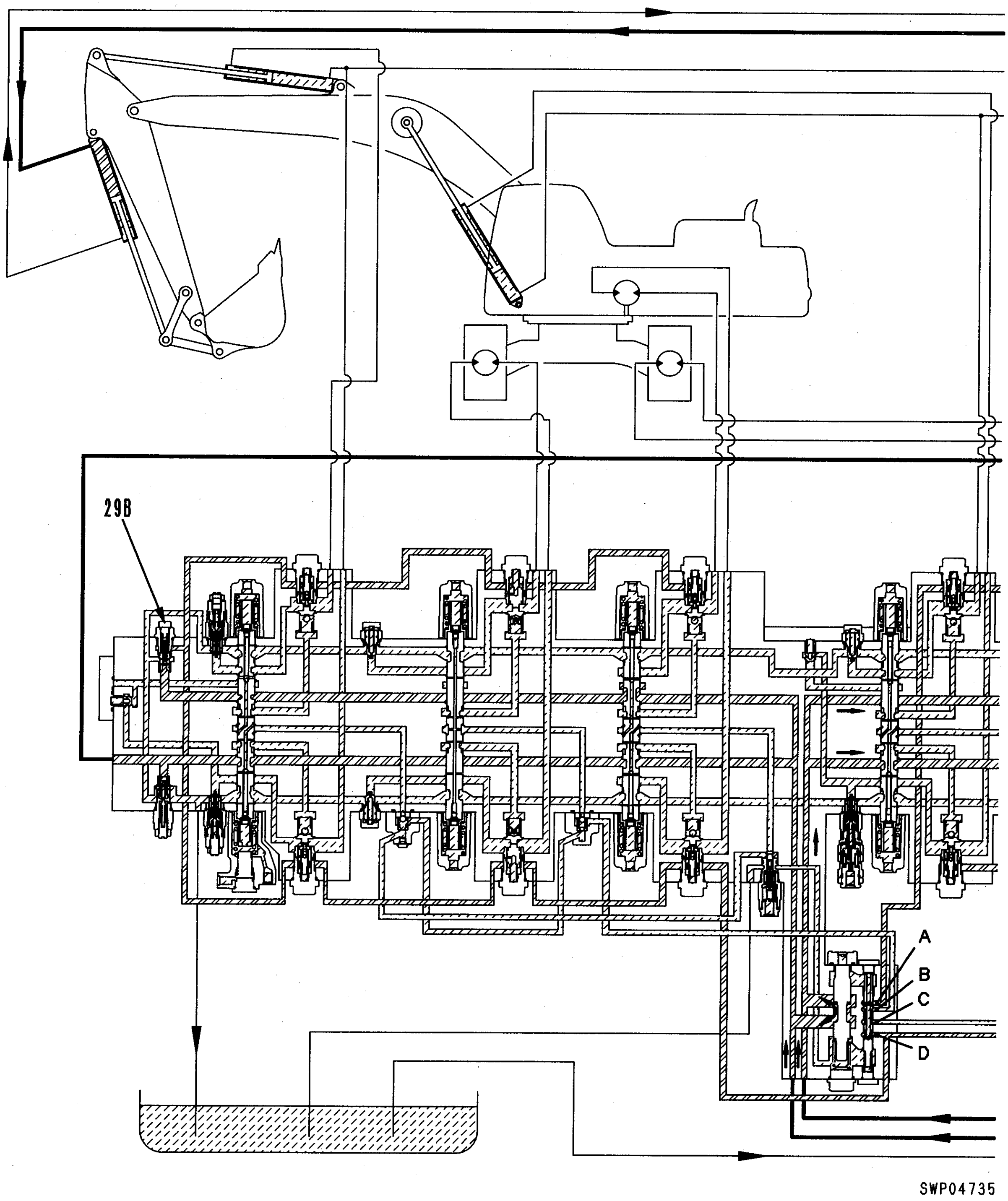
1. Hydraulic tank
2A. Main pump (front)
2B. Main pump (rear)
3A. TVC valve (front)
3B. TVC valve (rear)
4A. LS valve (front)
4B. LS valve (rear)
5A. Merge/flow divider valve (main)
5B. Merge/flow divider valve (for LS)
6. Bucket spool
7. R.H. travel spool
8. Boom Lo spool
9. Swing spool
10. L.H. travel spool
11. Arm Lo spool
12. Boom Hi spool
13. Arm Hi spool
14. Pressure compensation valve (with shuttle valve)
15. Pressure compensation valve (with shuttle valve, integrated type) (bucket CURL)
16. Pressure compensation valve (without shuttle valve) (travel)
17. Safety-suction valve
18. Safety-suction valve (bucket CURL)
19. 2-stage safety-suction valve (boom LOWER)
20. Plug
21. LS shuttle valve (bucket)
22. LS shuttle valve (R.H. travel)
23. LS shuttle valve (boom)
24. LS shuttle valve (L.H. travel)
25. LS shuttle valve (arm)
26. Check valve (for boom regeneration circuit)
27. Check valve (for arm regeneration circuit)
28A. Main relief valve (bucket group)
28B. Main relief valve (arm group)
29A. Unload valve (bucket group)
29B. Unload valve (arm group)
30. LS select valve
31. LS check valve
32. LS bypass valve
33. Suction valve
34. Service spool
35. Variable type pressure compensation valve
36. LS shuttle valve (service)

Note: Groups of control valves by main pump circuit
Bucket group: Bucket, R.H. travel, boom Lo, boom Hi, Arm Hi
Arm group: Swing, L.H. travel, arm Lo

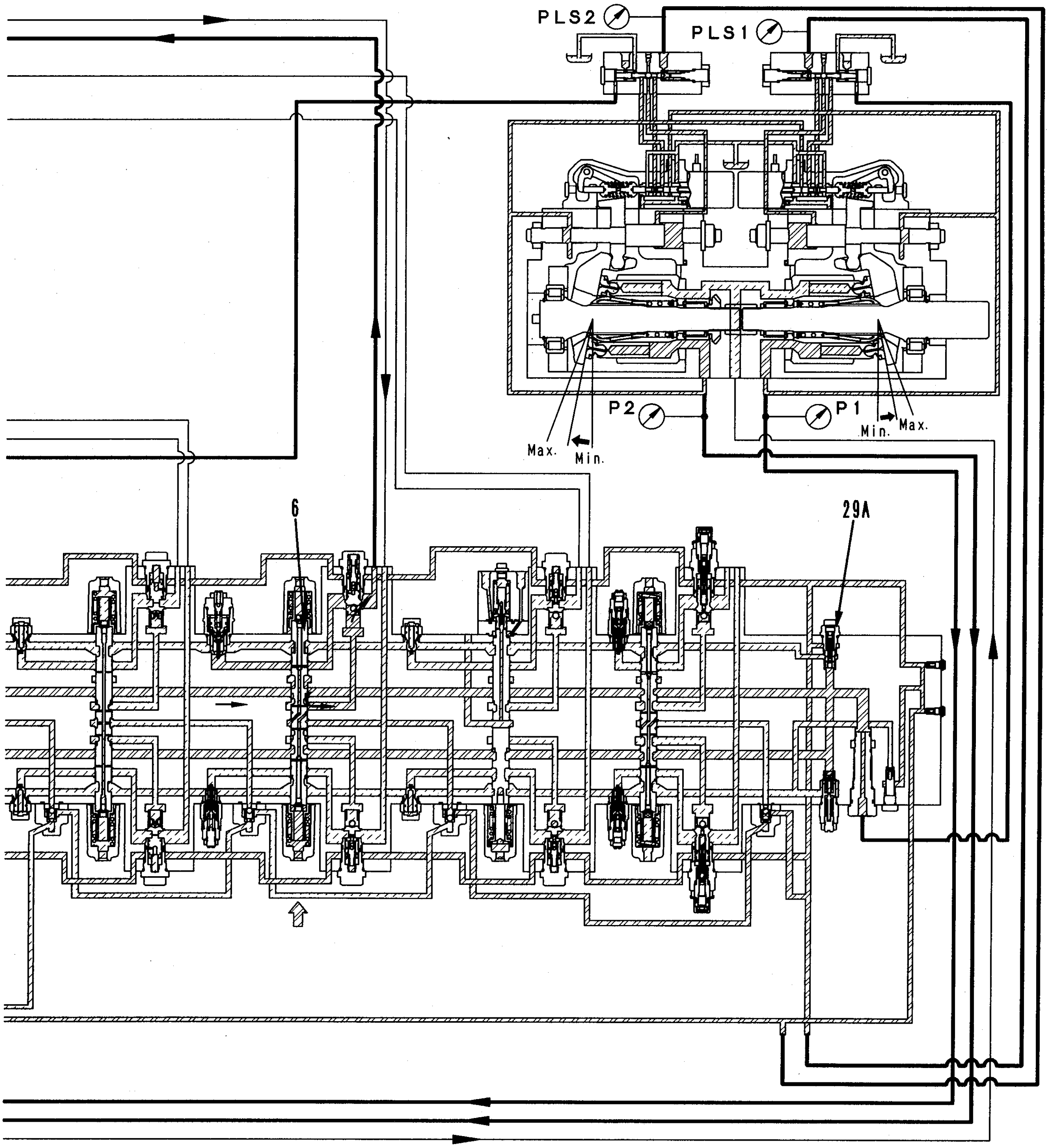
Operation (When all work equipment is at neutral)

- When the levers are at neutral, the pump is at the minimum swash plate angle, and the oil flow is drained from unload valves (29A, 29B).
- The LS pressure is connected to hydraulic tank (1) by LS bypass valve (32). The LS differential pressure Δ**PLS** (unload pressure – tank pressure) at this point is Δ**PLS** > pump LS control pressure, so the pump swash plate angle is the minimum.

When pump flow merged, bucket CURL operated independently



Connection of ports when pump flow is merged
Connected ports: A – D, B – C



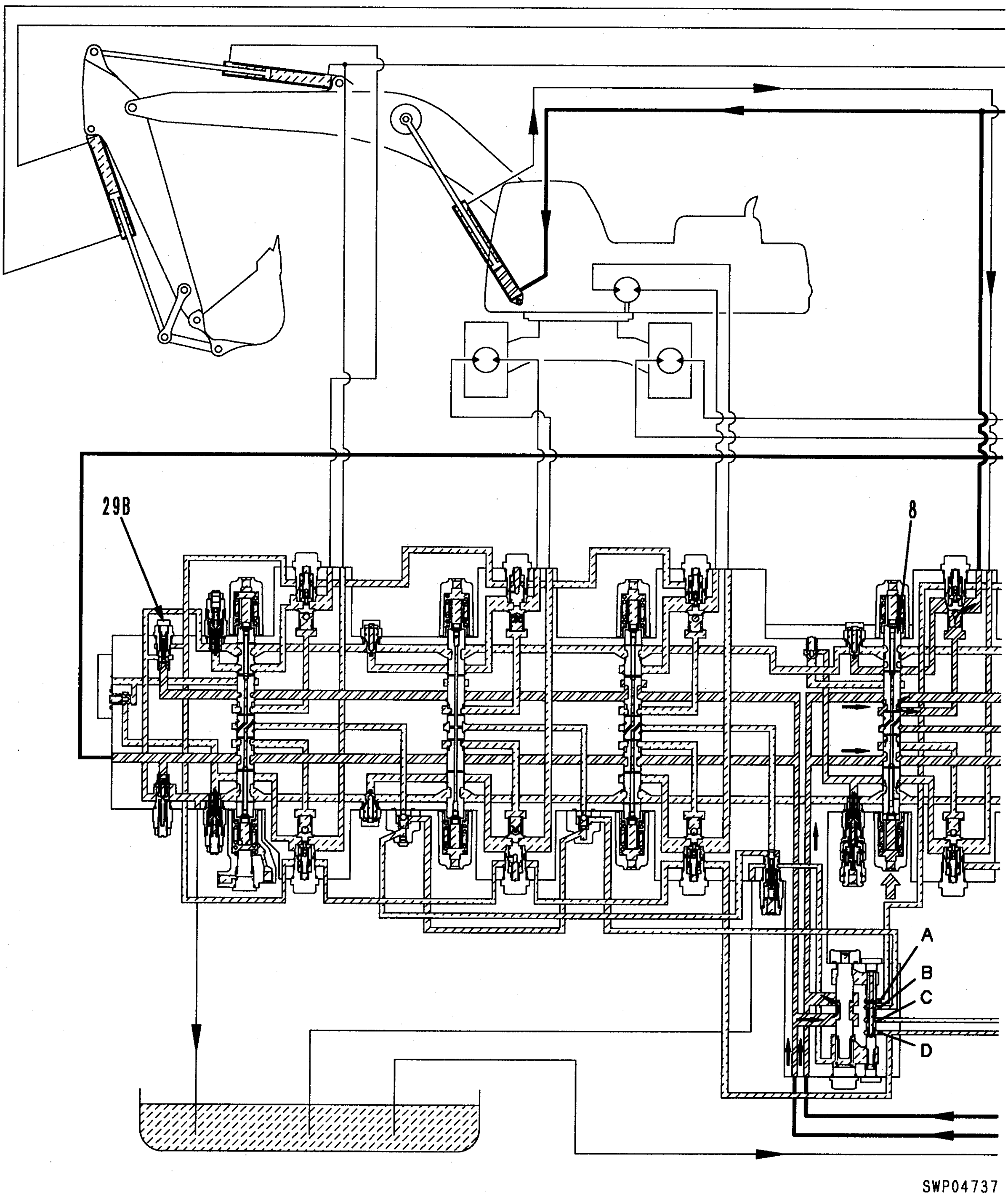
SWP04736

Operation (When pump flow merged, bucket CURL operated independently)

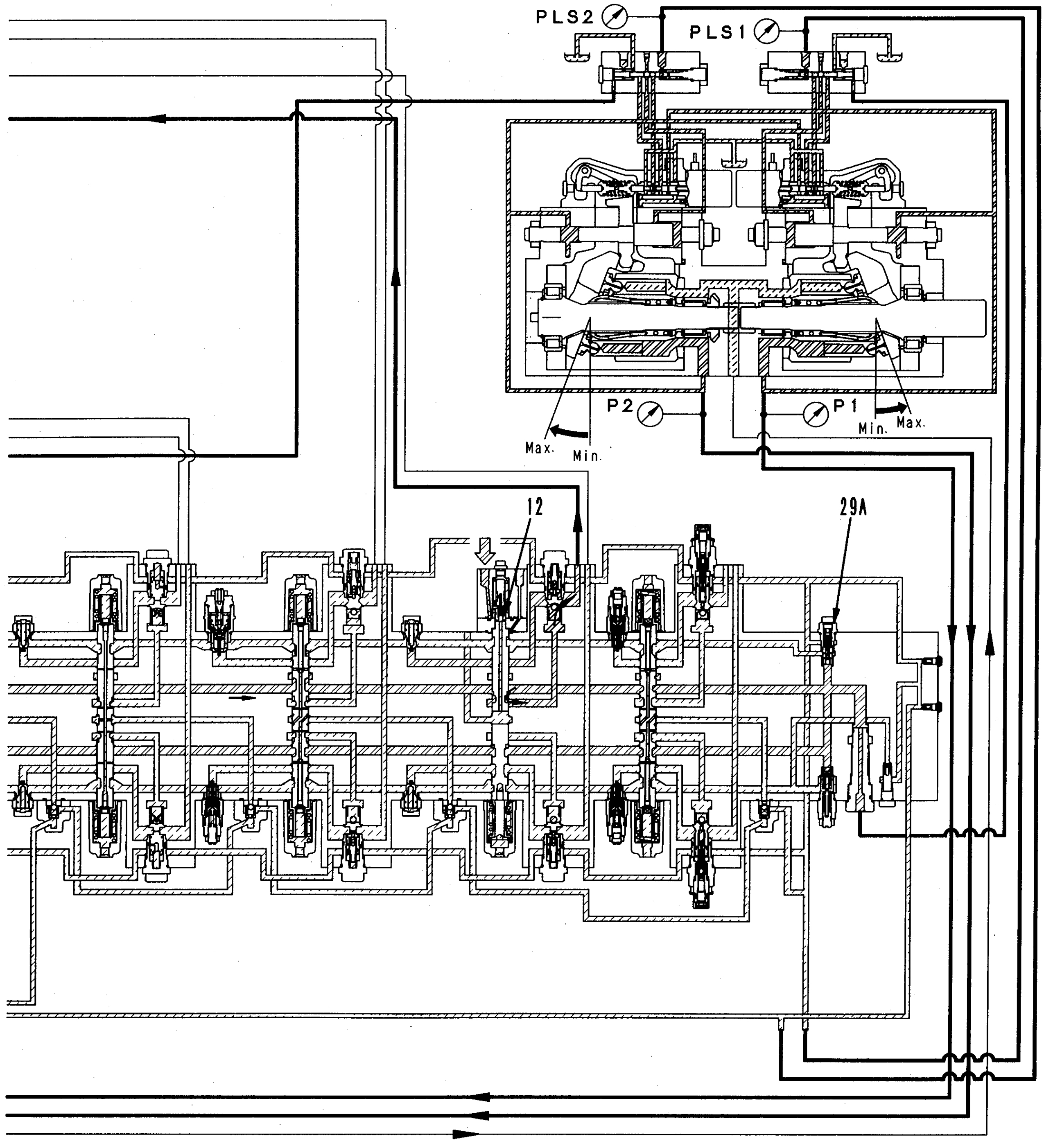
- When the bucket CURL is operated, unload valves (29A, 29B) are closed.
- The swash plate of the main pump is controlled (LS control) to match the area of the meter-in opening of bucket spool (6), so the pump swash plate is balanced at a position which matches the oil flow demanded by the spool meter-in.

(Δ**PLS** = pump LS control pressure)

When pump flow merged, boom RAISE operated independently (Boom Lo valve + boom Hi valve)



Connection of ports when pump flow is merged
Connected ports: A – D, B – C

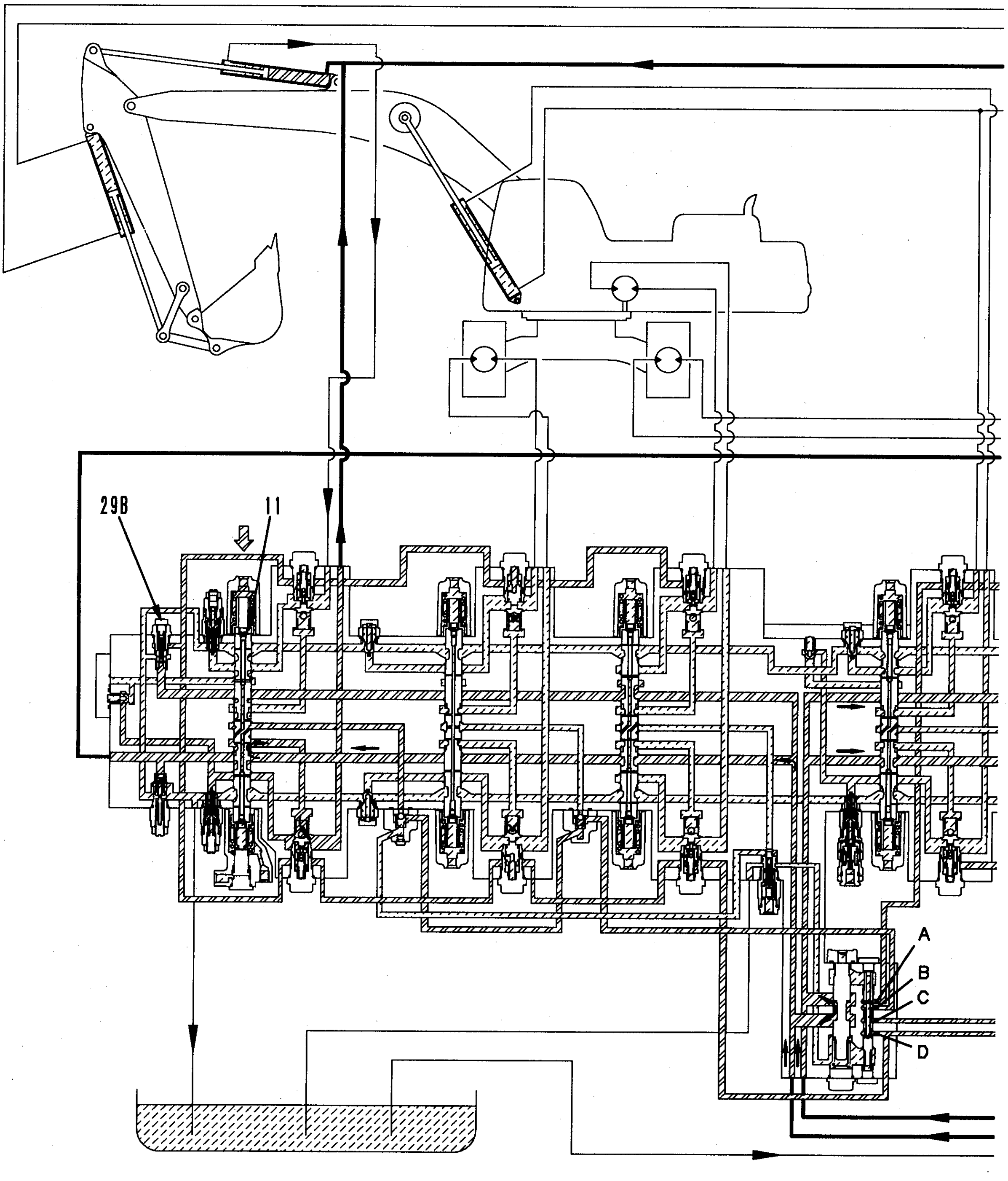


SWP04738

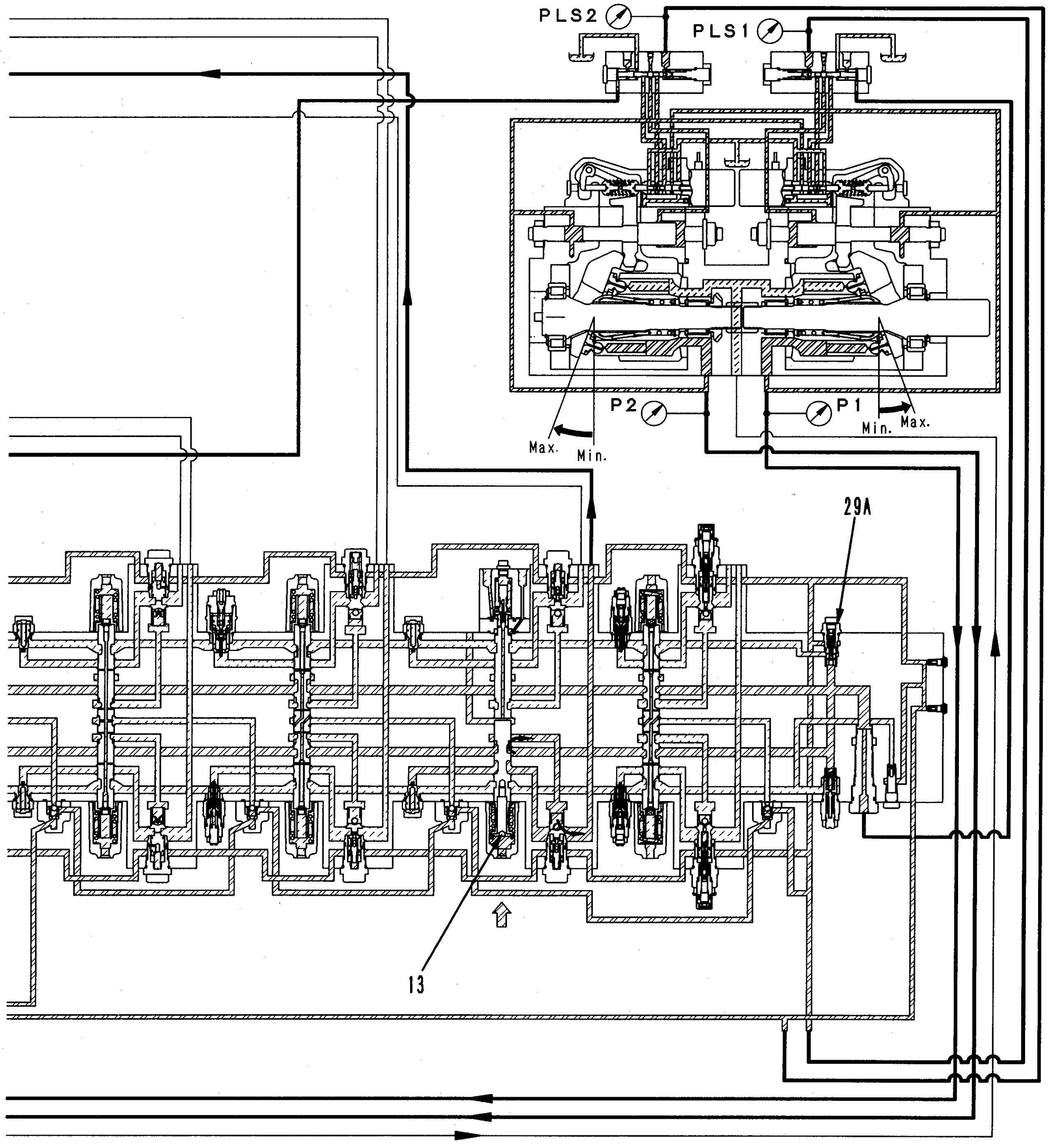
Operation (When pump flow merged, boom RAISE operated independently)

- When the boom RAISE is operated, unload valves (29A, 29B) are closed.
- The swash plate of the main pump is controlled (LS control) to match the total area of the meter-in opening of boom Lo spool (8) and boom Hi spool (12).
  (Δ**PLS** = pump LS control pressure)
- When the spool meter-in opening comes near the maximum, both pumps are at the maximum swash plate angle.
  (When the pump discharge is the maximum, the maximum area of opening of the spool is also large, so the LS differential pressure is smaller than the LS control pressure and the swash plate angle is always at the maximum.)
  (Δ**PLS** < pump LS control pressure)

When pump flow merged, arm IN operated independently (Arm Lo valve + arm Hi valve)



Connection of ports when pump flow is merged
Connected ports: A – D, B – C

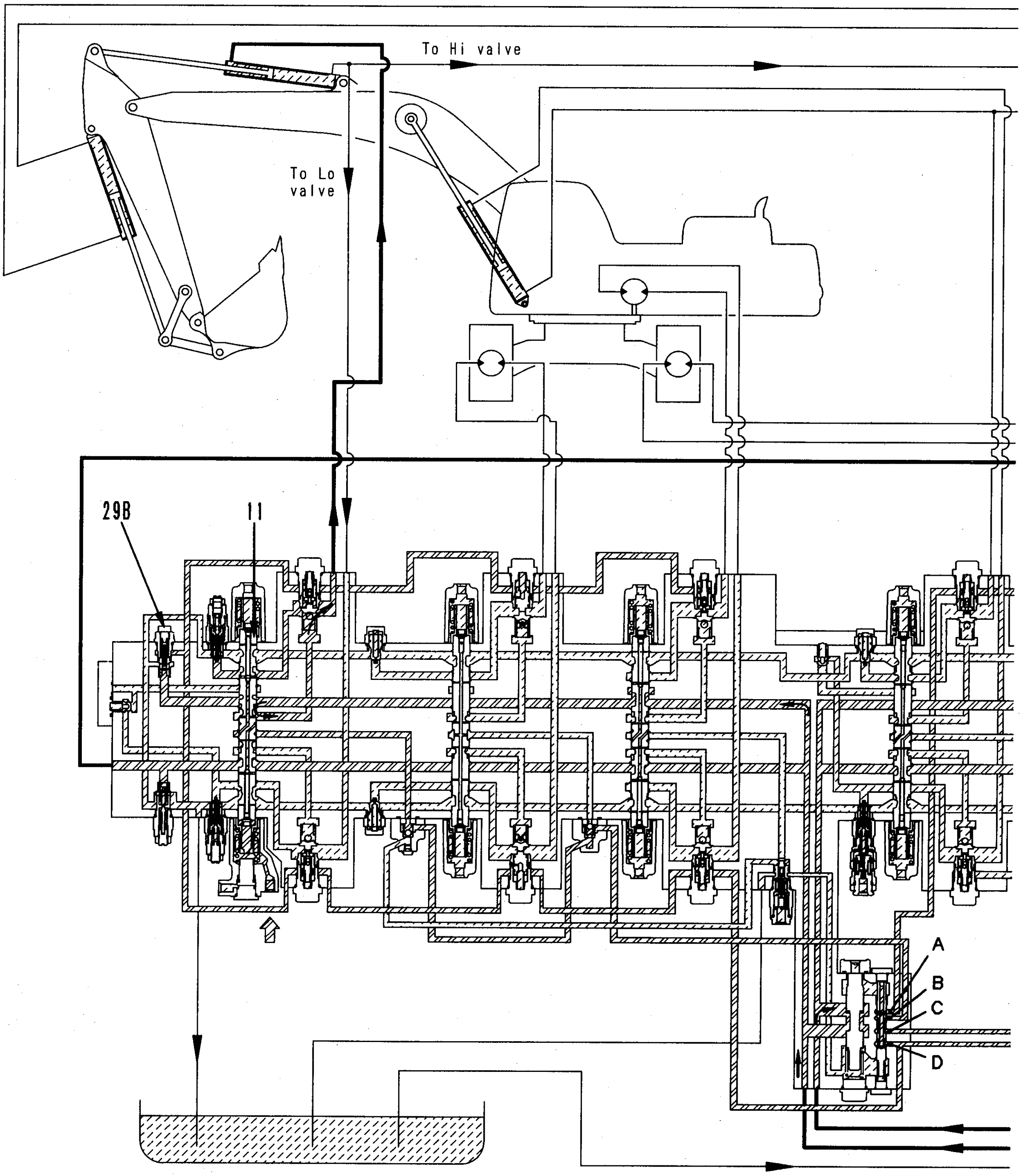


SWP04740

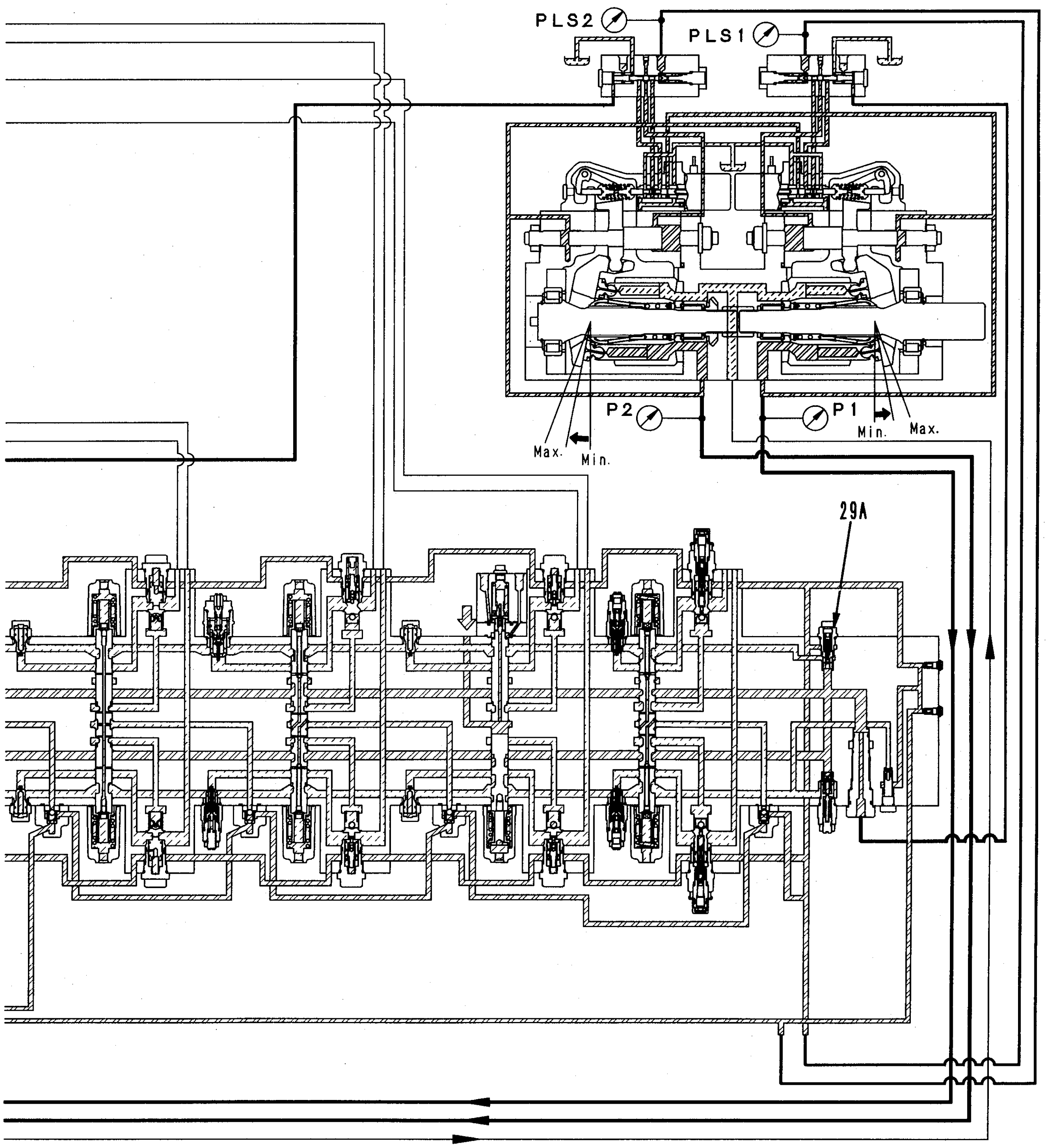
Operation (When pump flow merged, arm IN operated independently)

- When the arm IN is operated, unload valves (29A, 29B) are closed.
- The swash plate of the main pump is controlled (LS control) to match the total area of the meter-in opening of arm Lo spool (11) and arm Hi spool (13).
  (Δ**PLS** = pump LS control pressure)
- When the spool meter-in opening comes near the maximum, both pumps are at the maximum swash plate angle.
  (When the pump discharge is the maximum, the maximum area of opening of the spool is also large, so the LS differential pressure is smaller than the LS control pressure and the swash plate angle is always at the maximum.)
  (Δ**PLS** < pump LS control pressure)

When pump flow merged, arm OUT operated independently (Return circuit arm Lo + arm Hi)



Connection of ports when pump flow is merged
Connected ports: A – D, B – C

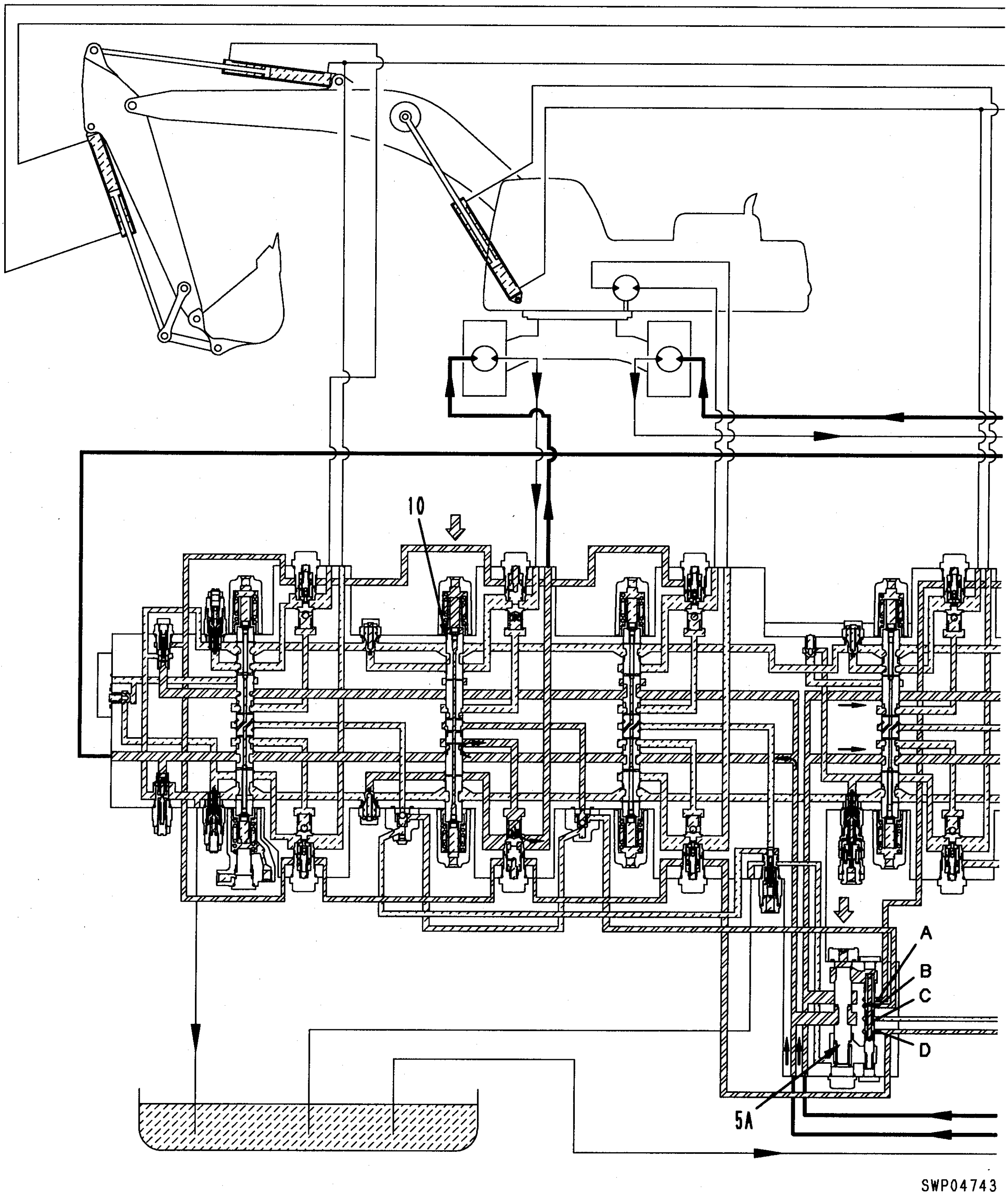


SWP04742

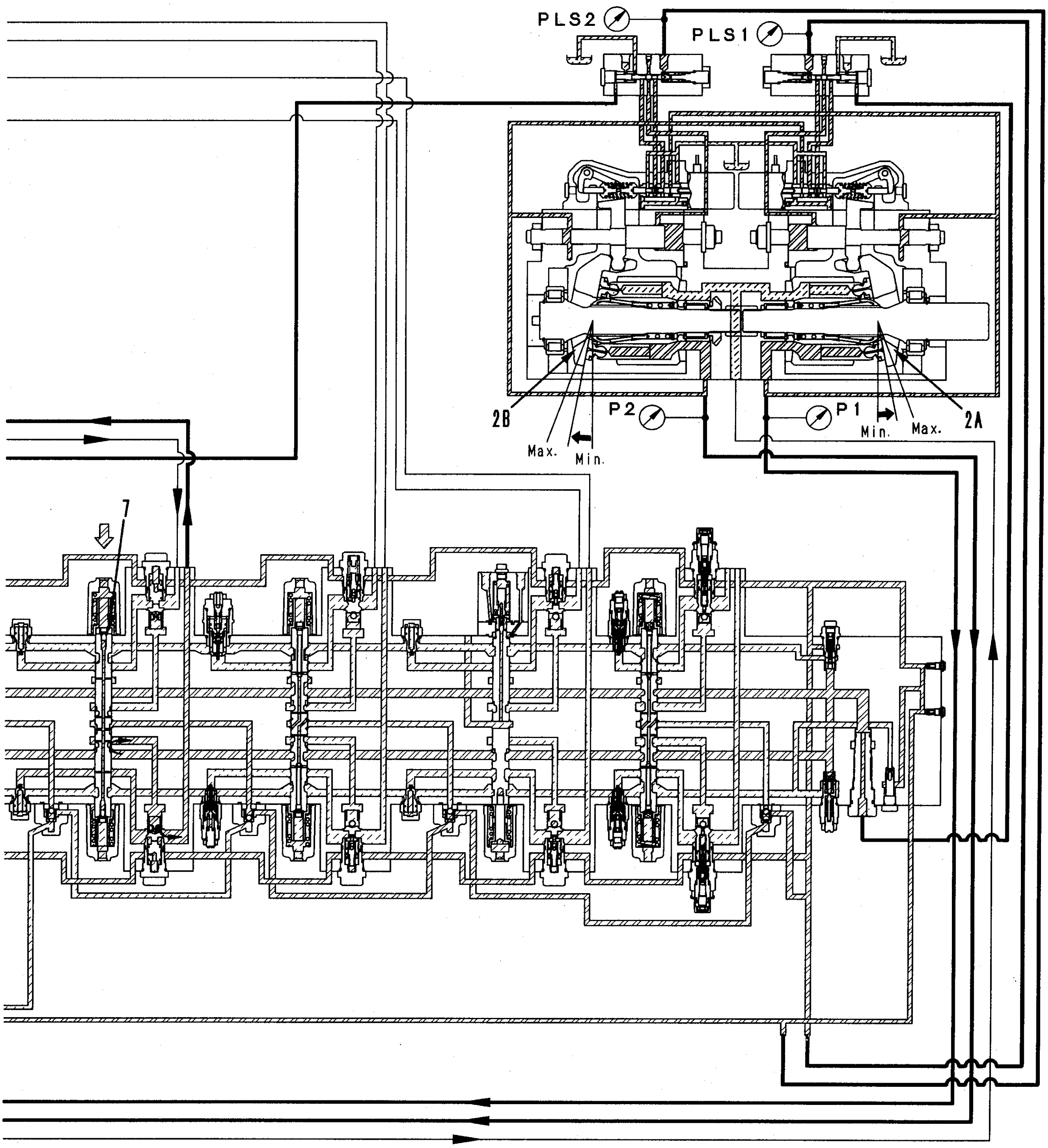
Operation (When pump flow merged, arm OUT operated independently)

- When the arm OUT is operated, unload valves (29A, 29B) are closed.
- The swash plate of the main pump is controlled (LS control) to match the area of the meter-in opening of arm Lo spool (11), so the pump swash plate is balanced at a position which matches the oil flow demanded by the spool meter-in.
  (Δ**PLS** = pump LS control pressure)
- When this happens, the oil from the cylinder bottom is divided, sent to the Lo and Hi spools, and then returned, so it is possible to keep the pressure loss in the circuit small.

When pump flow divided, travel operated independently



Connection of ports when pump flow is divided
Connected ports: B – D
Disconnected ports: A, C



SWP04744

Operation (When pump divided, travel operated independently)

- Pilot pressure **PA** of merge/flow divider valve (5A) ON

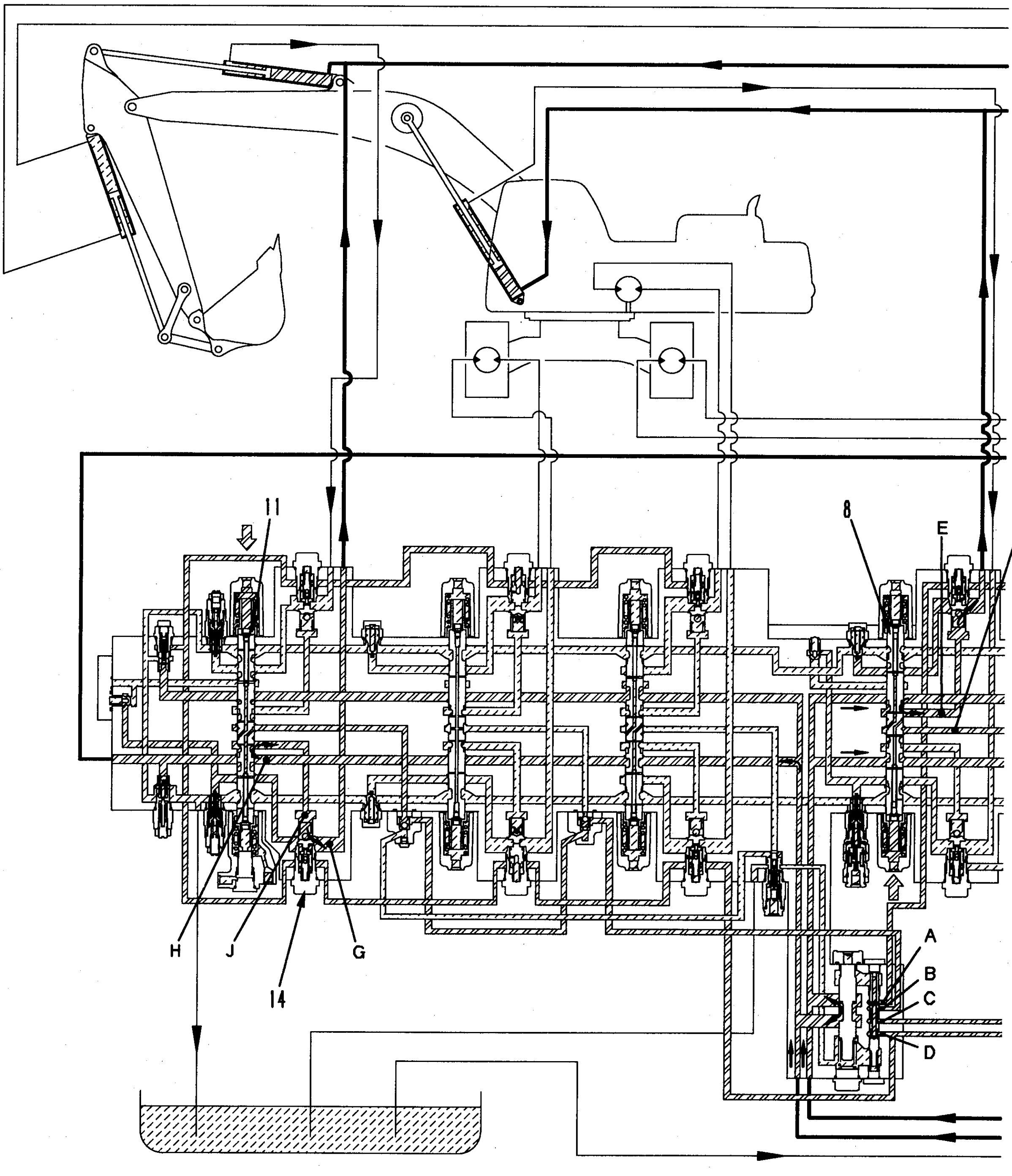
1)

- When the STRAIGHT TRAVEL is operated, a flow of oil is supplied from the main pump to match the stroke of the left and right travel spools (10) and (7).
  Flow of oil from main pump (2A):
    To L.H. spool (10) (arm group)
  Flow of oil from main pump (2B):
    To R.H. spool (7) (bucket group)
- The straight travel is compensated by the travel junction valve.

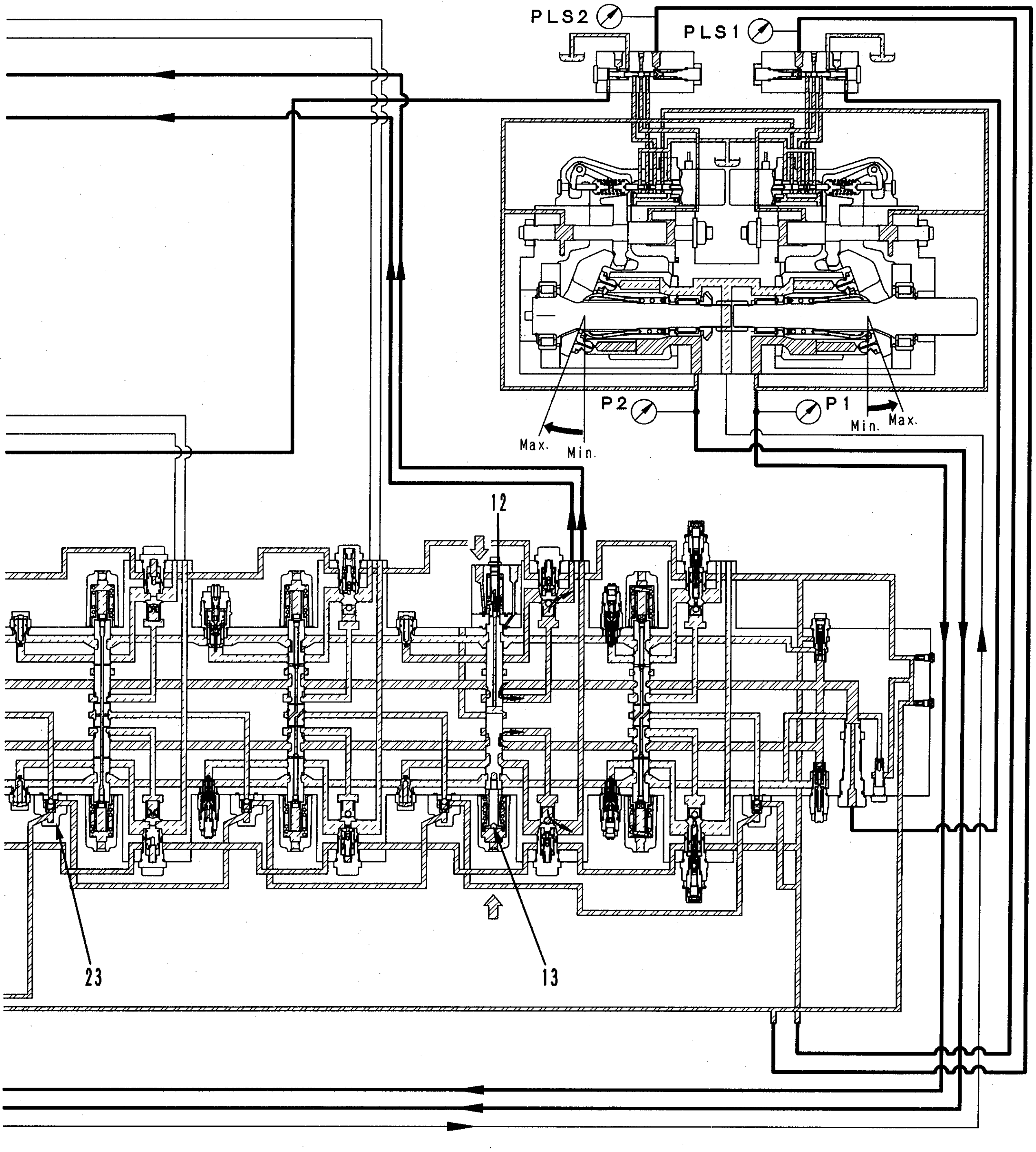
2)

- From the condition in 1) above, if the lever on the side being steered is returned (the oil flow becomes small) or the lever on the other side is operated in the opposite direction (the direction of travel is reversed), the oil flow from the pump is being divided, so the left and right travel circuits are controlled independently and the machine is steered.

When pump flow merged, arm IN + boom RAISE operated simultaneously



Connection of ports when pump flow is merged
Connected ports: A – D, B – C



SWP04746

Operation (When pump flow merged, arm IN + boom RAISE operated simultaneously)

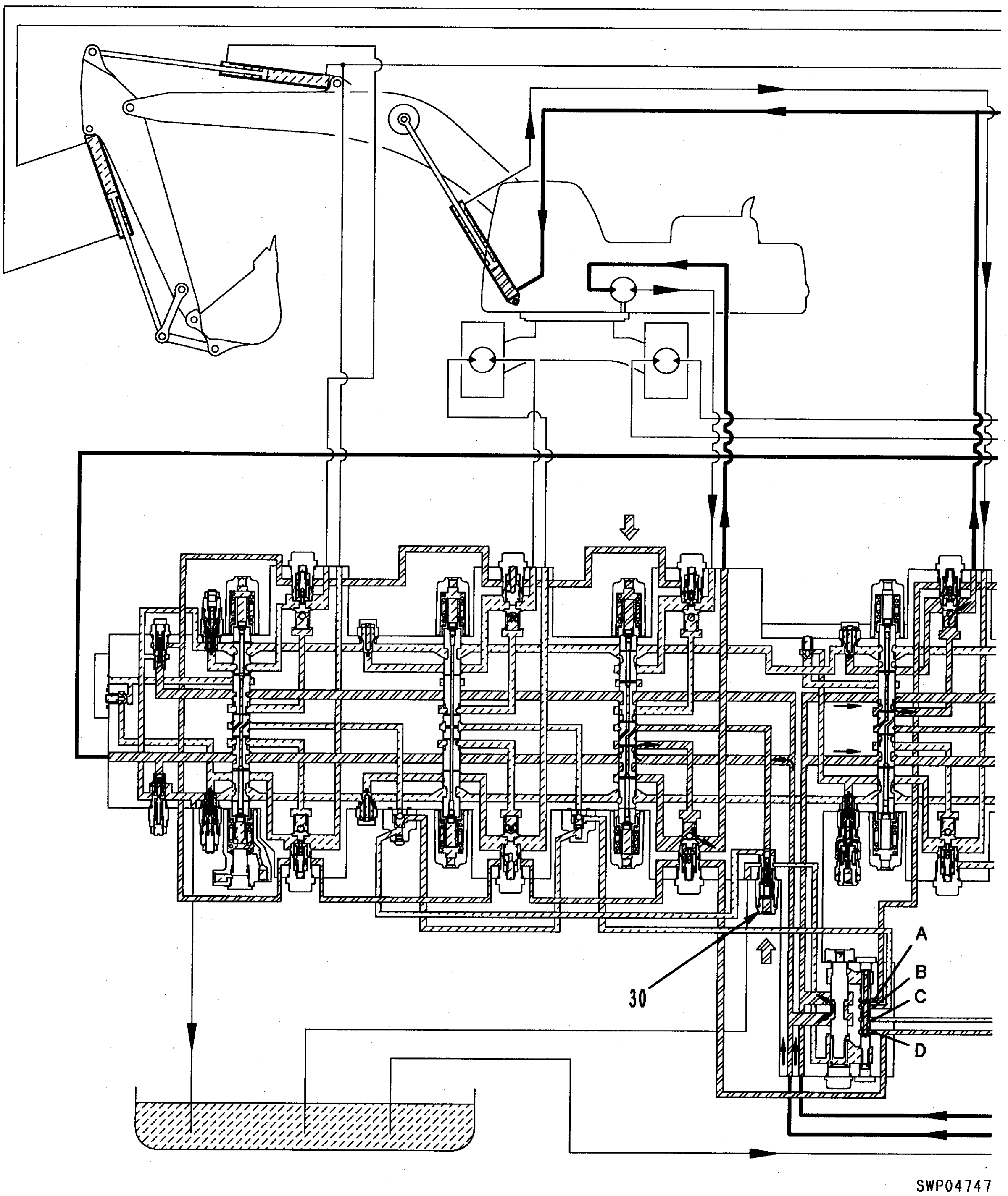
1)

- When the arm and boom are operated simultaneously, the swash plate angle for both pumps becomes the maximum.
- When this happens, the load pressure at the boom RAISE side is higher than at the arm side, so the LS pressure passes through ports **E** and **F** of boom Lo spool (8), enters boom LS shuttle valve (23) and is sent to the LS circuit. This LS pressure is transmitted to port **G** of pressure compensation valve (14), and acts to increase the set pressure of the pressure compensation valve. Because of this, the pressure between port **H** of arm Lo spool (11) and port **I** of pressure compensation valve (14) rises, and the spool meter-in LS differential pressure (pump pressure – LS pressure = Δ**PLS**) becomes the same as that at the boom end.

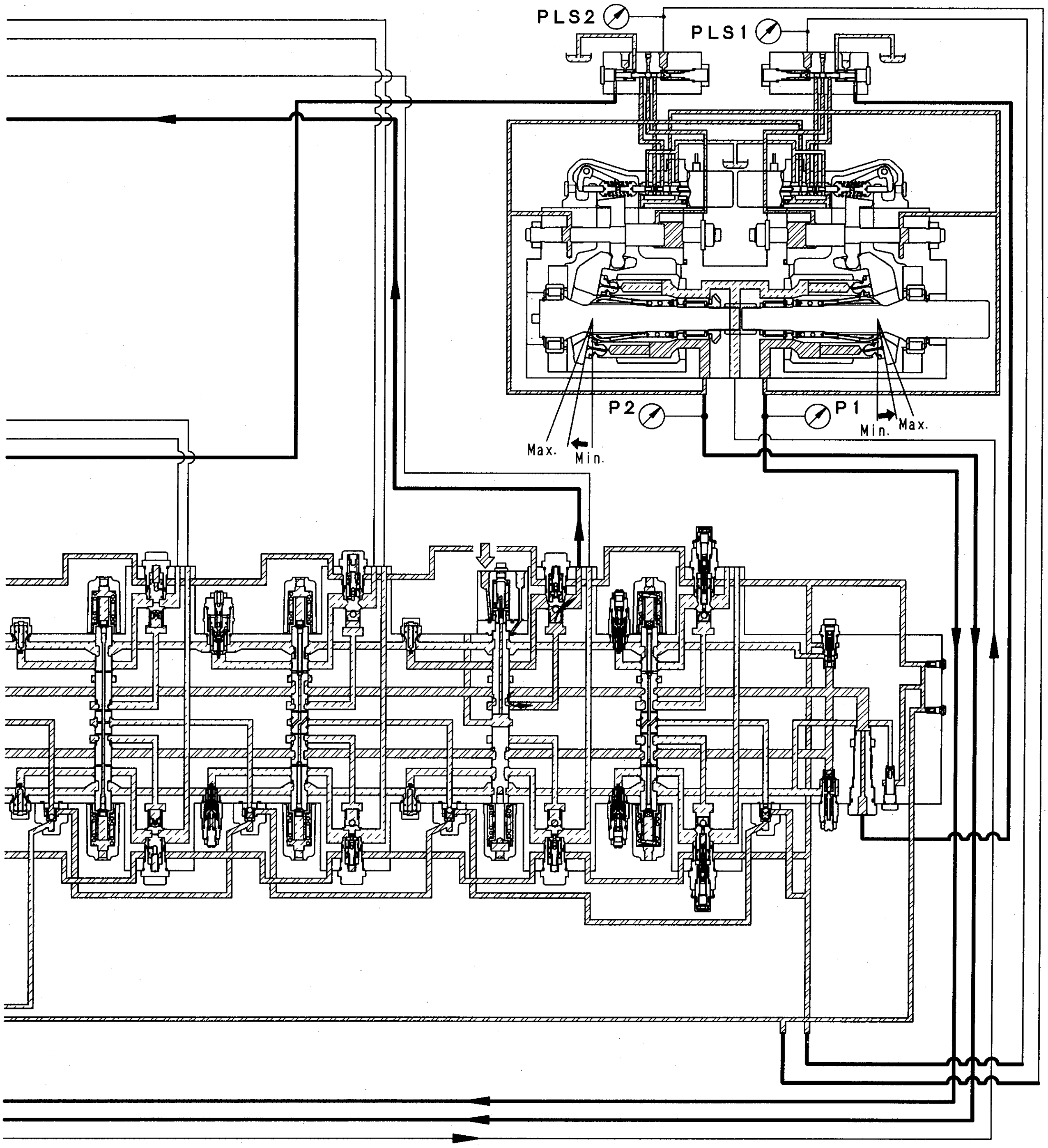
2)

- Because of the above operation, the oil flow is divided in proportion to the total area of opening of boom Lo spool (8) and boom Hi spool (12), and the total area of opening of arm Lo spool (11) and arm Hi spool (13).
- Meter-in LS differential pressure Δ**PLS** during boom RAISE + arm IN is Δ**PLS** < pump LS control pressure, so the main pump swash plate angle is set to maximum.

When pump flow merged, swing + boom RAISE operated simultaneously



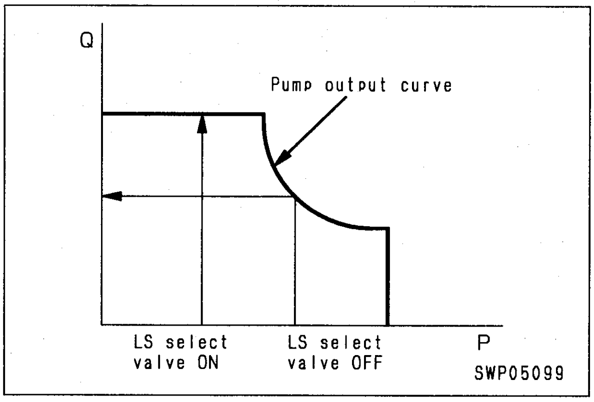
Connection of ports when pump flow is merged
Connected ports: A – D, B – C



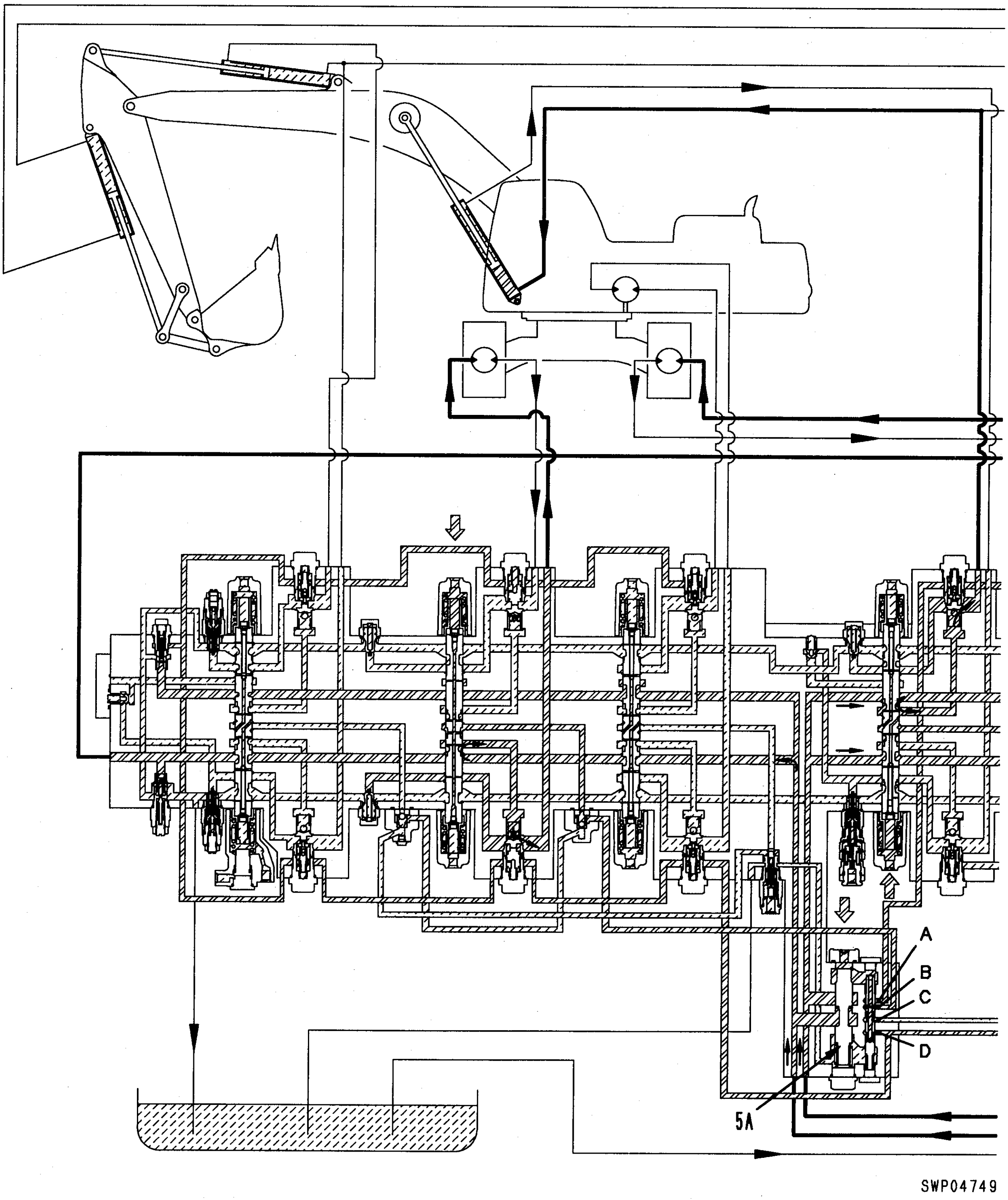
SWP04748

Operation (When pump flow merged, swing + boom RAISE operated simultaneously)

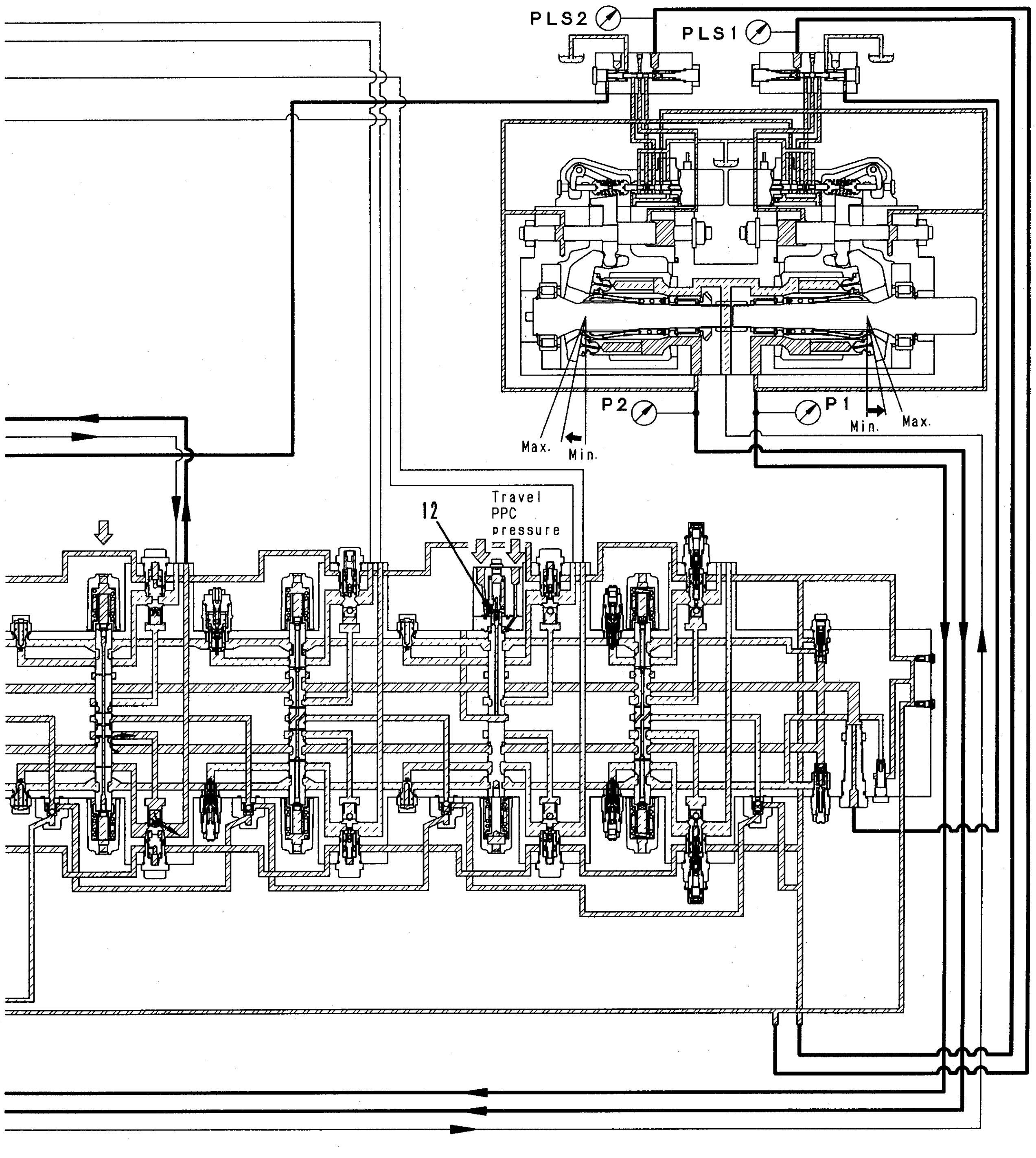
- When the boom RAISE is being operated in the heavy-duty digging mode the swing is operated simultaneously, the pilot pressure of LS divider valve (30) is turned ON.
- When this happens, the LS divider valve is shut off, and the high pressure generated when the swing is operated does not flow to the LS circuit, so the LS circuit pressure becomes the boom pressure.
  The swash plate of the main pump is controlled (LS control) by the difference in pressure between the boom and LS pressure.
- In addition, the pump pressure is determined by the boom pressure, so even if the swing drive pressure is high, the pump can deliver an ample flow of oil regardless of the pump output curve.



When pump flow divided (pump pressure: 19.6 MPa {200 kg/cm²} or above), travel + boom RAISE operated simultaneously



Connection of ports when pump flow is divided
Connected ports: B – D
Disconnected ports: A, C

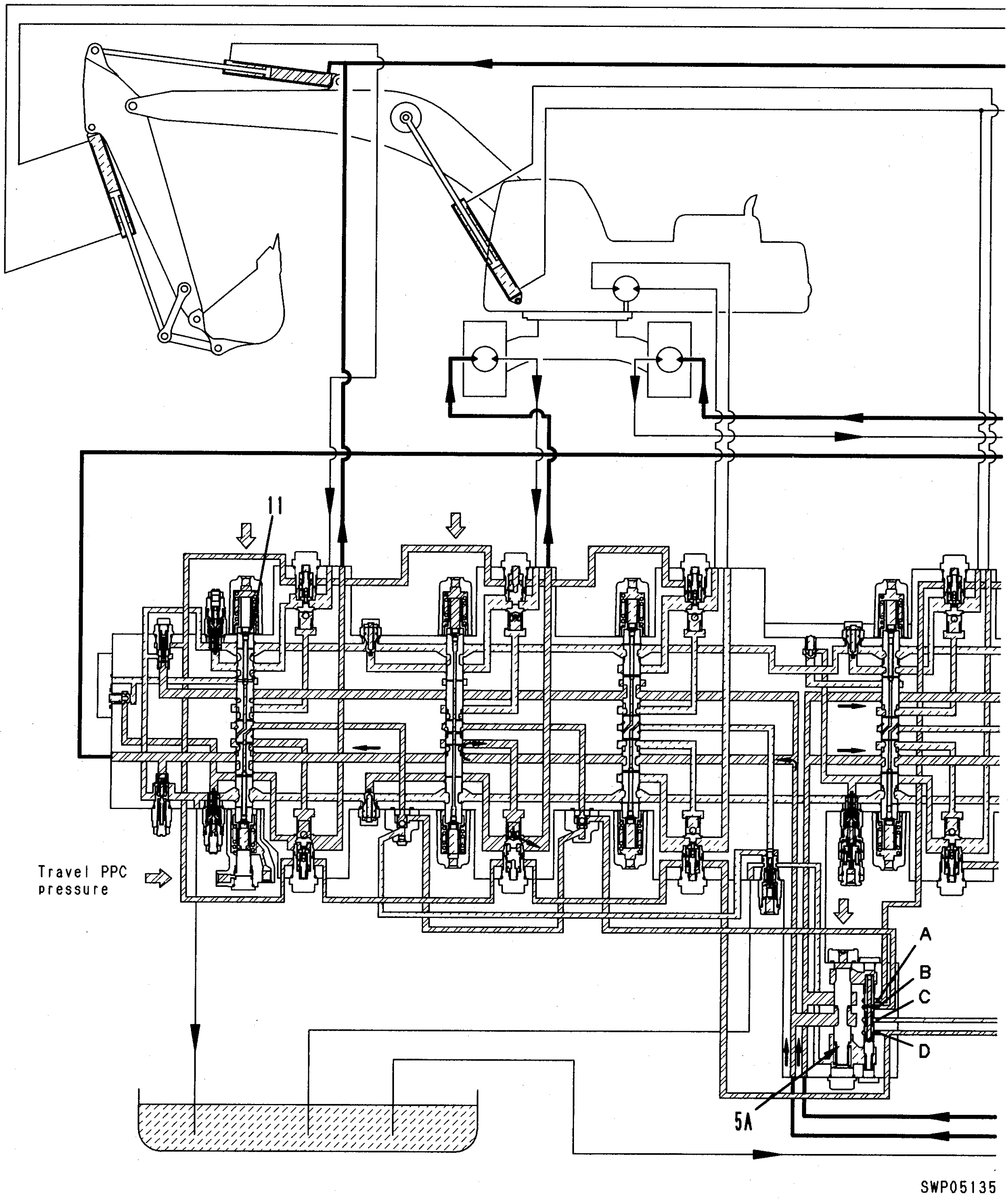


SWP05134

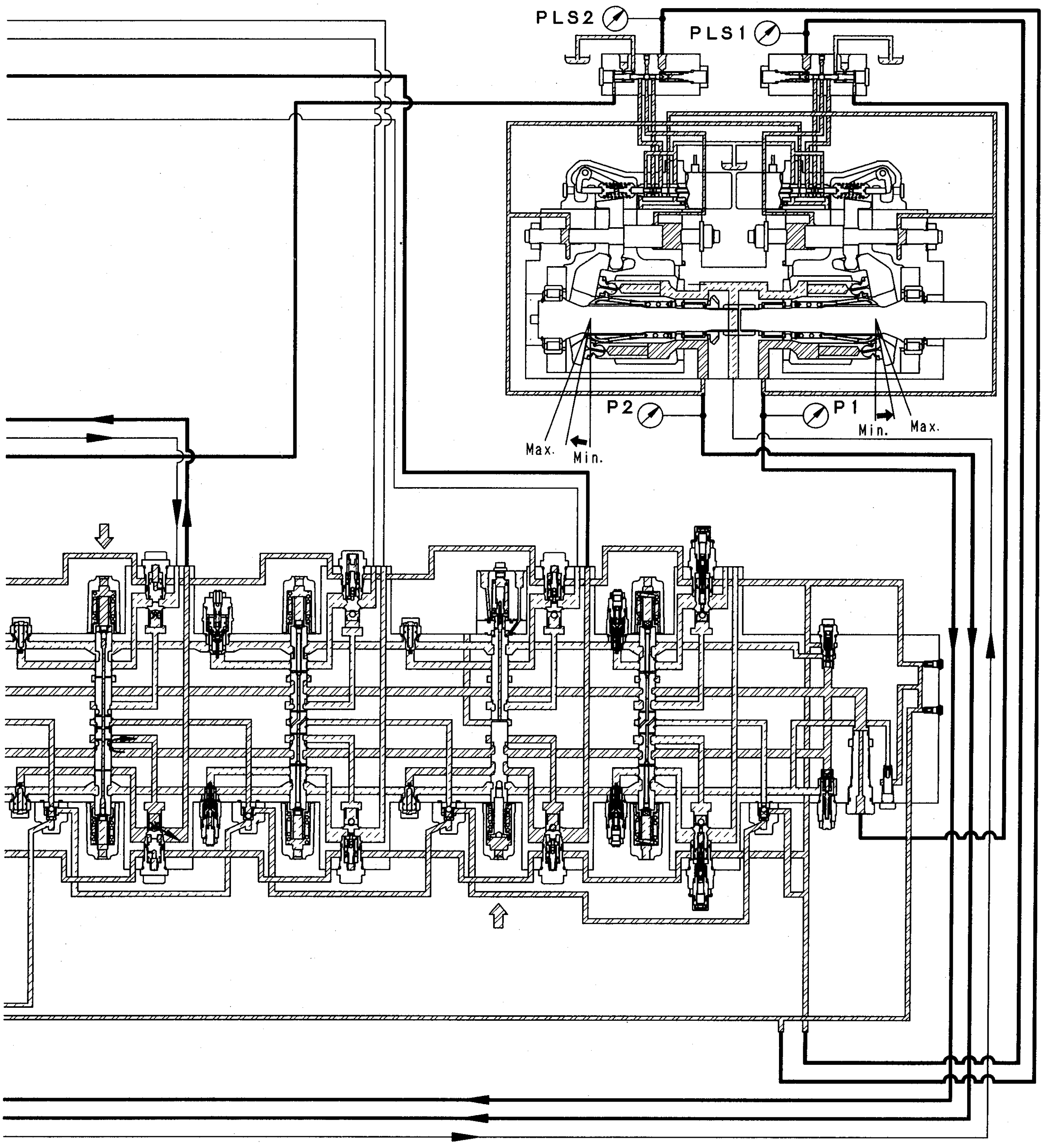
Operation (When pump flow divided (pump pressure: 19.6 MPa {200 kg/cm^2} or above), travel + boom RAISE operated simultaneously)

- When the travel and boom RAISE are operated simultaneously (such as when raising the boom before traveling up a steep slope), if the pump pressure rises to 19.6 MPa {200 kg/cm^2}, the merge/flow divider valve pilot is turned ON and the pump flow is divided.
- In addition, the boom Hi spool does not move because of the travel **PPC** pressure. The flow of oil to the boom at this point is restricted, so the travel pressure is maintained and it is possible to carry out compound operations easily.

When pump flow divided (pump pressure: 19.6 MPa {200 kg/cm²} or above), travel + arm IN operated simultaneously



Connection of ports when pump flow is divided
Connected ports: B – D
Disconnected ports: A, C



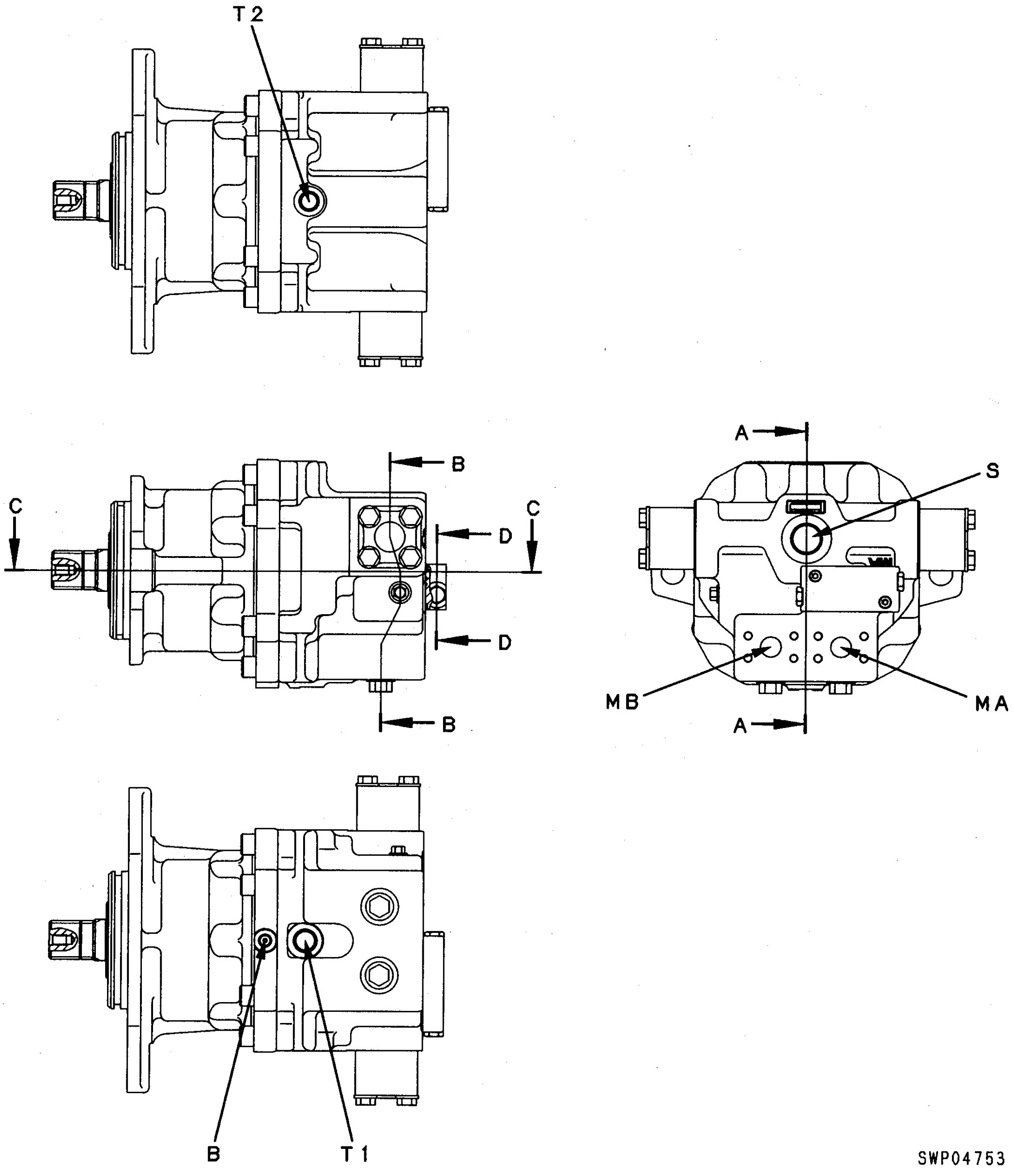
SWP04752

Operation (When pump flow divided (pump pressure: 19.6 MPa {200 kg/cm^2} or above), travel + arm IN operated simultaneously)

- When the travel and arm IN are operated simultaneously (such as when using the digging action of the arm to help the machine travel up a steep slope), if the pump pressure rises to 19.6 MPa {200 kg/cm^2}, the merge/flow divider valve pilot is turned ON and the pump flow is divided.
- In addition, the stroke of the arm Lo spool is restricted by the travel **PPC** pressure. The flow of oil to the arm at this point is restricted, so the travel pressure is maintained and it is possible to carry out compound operations easily.

SWING MOTOR

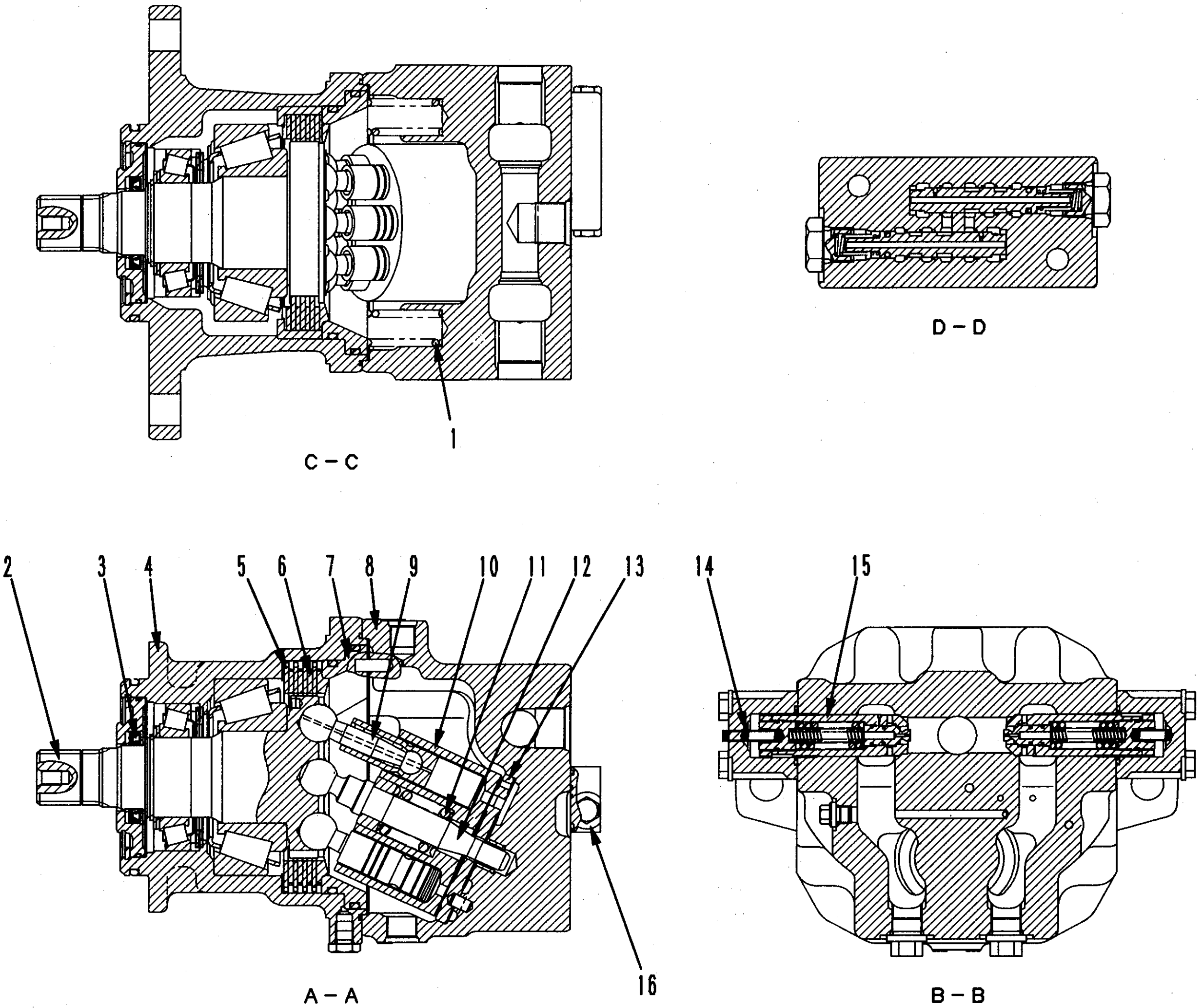
KMF160ABE-3



B : From swing brake solenoid valve
S : From lift check valve
MA: From control valve
MB: From control valve
T1 : To tank
T2 : To port **S**

Specifications

Model:	KMF160ABE-3
Theoretical delivery:	160.7 cc/rev
Safety valve set pressure:	$28.7^{+0.5}_{0}$ MPa {293^{+5}_{0} kg/cm^2}
Rated speed:	1,680 rpm
Brake releasing pressure:	1.8 ± 0.4 MPa {18.4 ± 4 kg/cm^2}



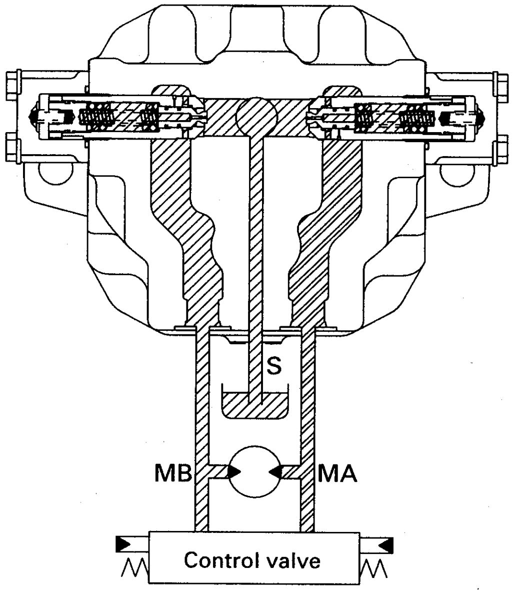
SWP04754

1. Spring
2. Output shaft
3. Oil seal
4. Case
5. Plate
6. Disc
7. Brake piston
8. Housing
9. Piston assembly
10. Cylinder block
11. Spring
12. Center shaft
13. Valve plate
14. Suction valve spring
15. Suction-safety valve
16. Reverse prevention valve

SUCTION-SAFETY VALVE

Function

- When the swing is stopped, the outlet port circuit of the motor is closed by the control valve, but the motor continues to be turned by the inertia of the swing. As a result, the pressure at the outlet port of the motor becomes abnormally high and there is danger that the motor will be damaged.
- The safety valve is installed to prevent this problem. It acts to release the abnormally high pressure oil from the outlet port of the motor to port **S**, and also functions as a swing brake.
- The suction valve supplies an amount of oil equivalent to the amount of oil released by the safety valve. It sends this oil from port **S** to the inlet port of the motor to prevent any cavitation.



SAP00245

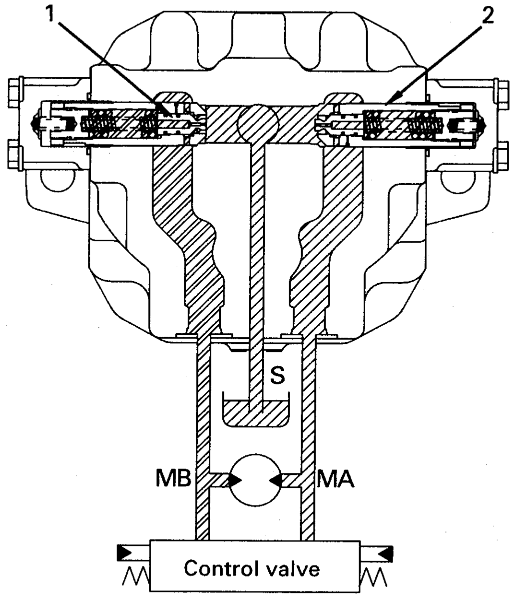
Operation

1. **When starting swing**

- If the swing control lever is operated to swing to the right, the pressurized oil from the pump passes through the control valve and it supplied to port **MA**.
- When this happens, the pressure at port **MA** rises and the starting force is generated in the motor, so the motor starts to turn.
  The oil from the outlet port of the motor flows from port **MB** through the control valve and returns to the tank.

2. **When stopping swing**

- When the swing control lever is returned to the neutral position, no more pressurized oil is supplied from the pump to port **MA**.
  At the same time, the oil from the outlet port of the motor returns from the control valve to the tank, and the circuit is closed.
- The pressure at port **MB** rises, and rotating resistance to the motor is generated, so the brake starts to take effect.
  If the pressure at port **MB** rises to the set pressure of safety valve (1), safety valve (1) opens and releases the pressurized oil at port **MB** to port **S**.
- No pressurized oil is supplied at port **MA**, but the swing continues, so negative force is generated.
  When this negative pressure drops to the set pressure of suction valve (2), suction valve (2) opens and oil is supplied from port **S** to prevent cavitation.

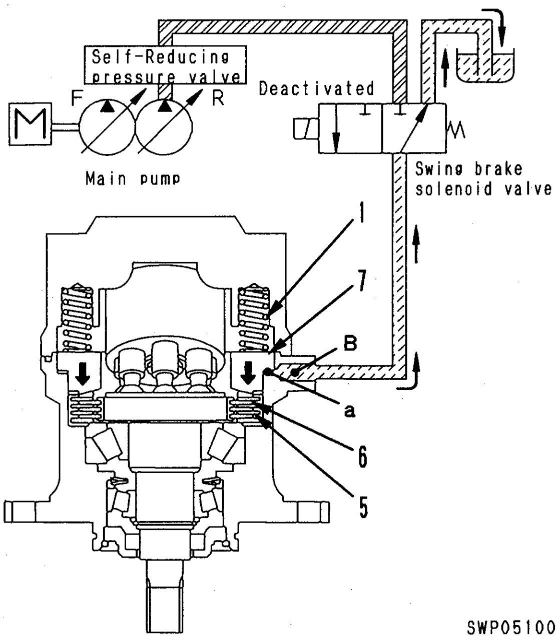


SAP00246

Operation of swing brake

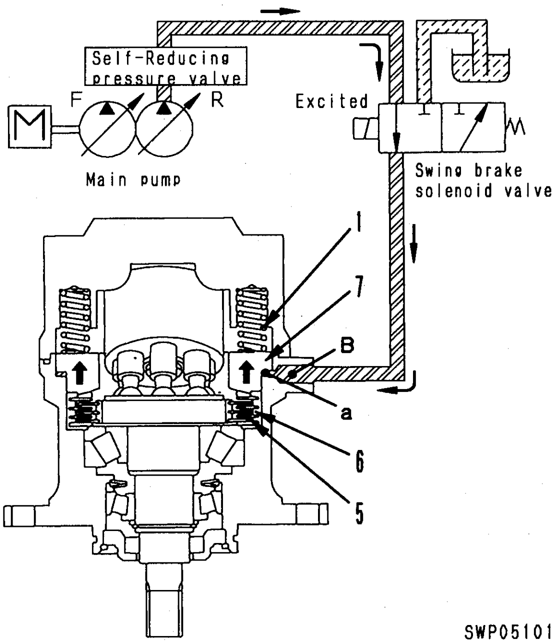
1) Swing brake solenoid valve de-energized

If the swing brake solenoid valve is de-energized, the flow of pressurized oil from the main 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), pushes disc (6) and plate (5) together, and the brake is applied.



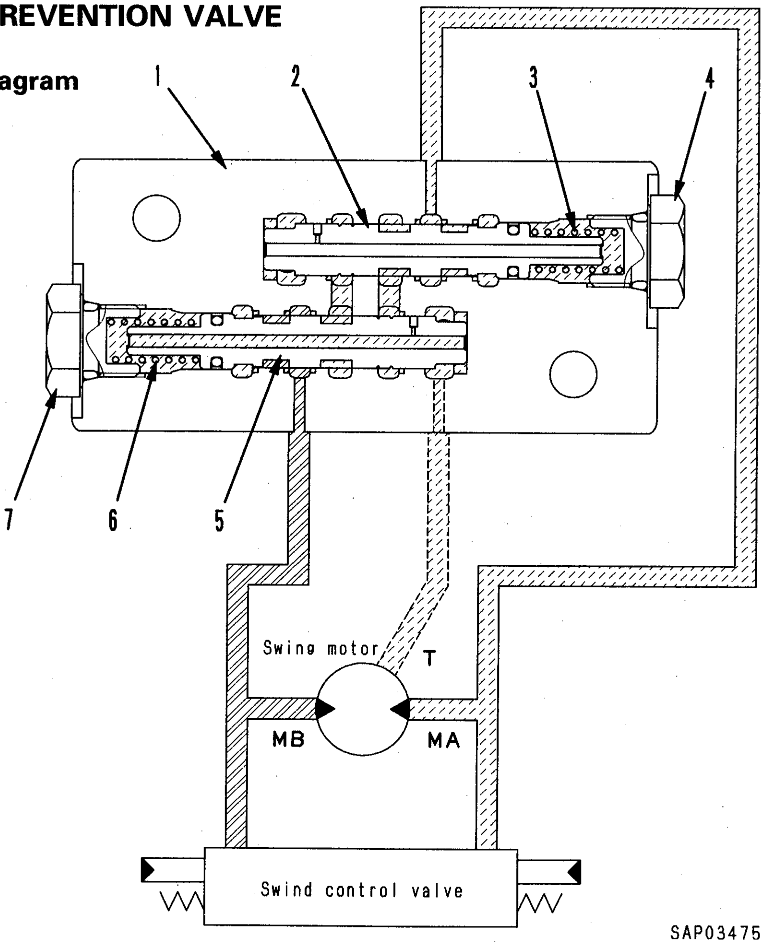
2) Swing brake solenoid valve energized

When the swing brake solenoid valve is energized, the valve is switched, and pressurized oil from the main pump enters port **B** and flows to brake chamber **a**.
The pressurized oil entering chamber **a** overcomes brake spring (1) and pushes brake piston (7) up. As a result, disc (6) and plate (5) are separated and the brake is released.



REVERSE PREVENTION VALVE

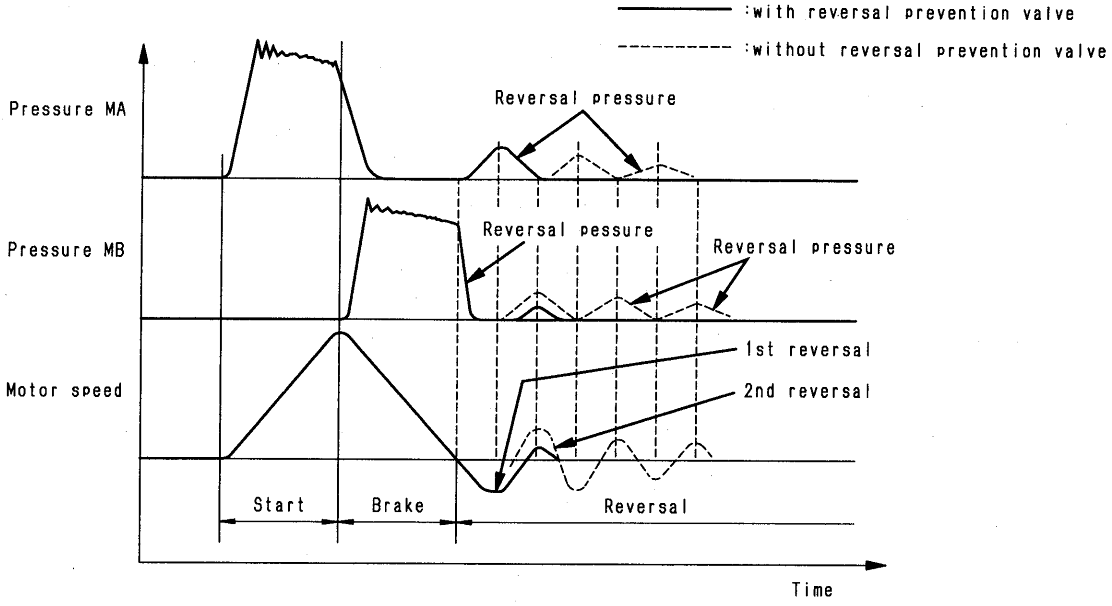
Operation diagram



1. Valve body
2. Spool (MA side)
3. Spring (MA side)
4. Plug
5. Spool (MB side)
6. Spring (MB side)
7. Plug

SAP03475

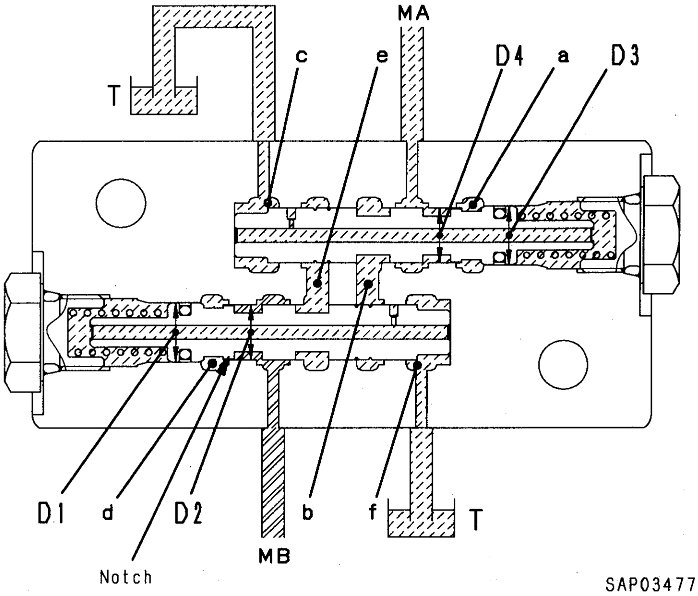
Explanation of effect



SAP03476

Outline

This valve reduces the swing back generated in the swing body by the inertia of the swing body, the backlash and rigidity of the machinery system, and the compression of the hydraulic oil when the swing is stopped. This is effective in preventing spillage of the load and reducing the cycle time when stopping the swing (the positioning ability is good and it is possible to move swiftly to the next job).



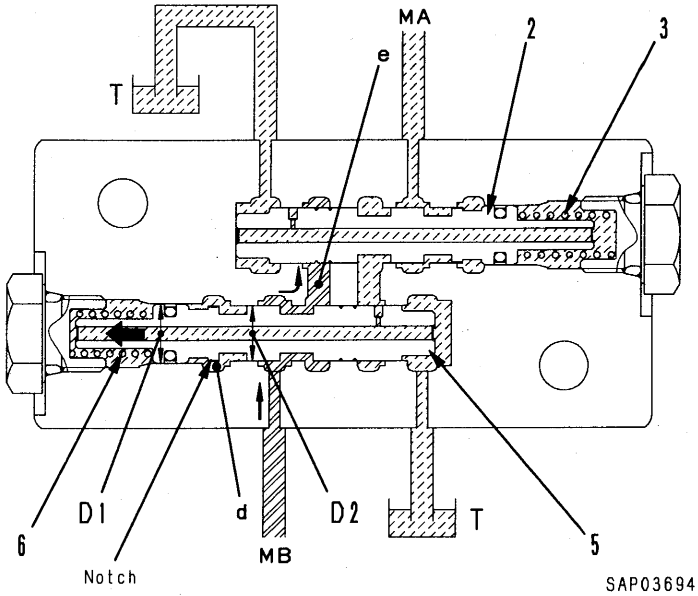
SAP03477

Operation

1) When brake pressure is being generated at port MB

- Pressure **MB** passes through the notch and goes to chamber **d**, spool (5) pushes spring (6) according to the difference in area **D1** > **D2**, moves to the left, and **MB** is connected to **e**.

  When this happens, pressure **MA** is below the set pressure of spring (3), so spool (2) does not move. For this reason, the pressure oil is closed by spool (2), and the braking force is ensured.

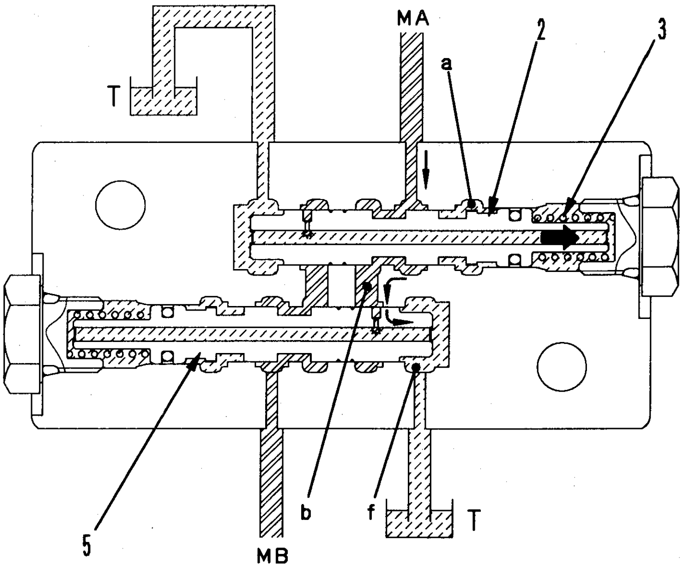


SAP03694

2) After motor stops

- The motor is reversed by the closing pressure generated at port **MB**. (1st reversal)

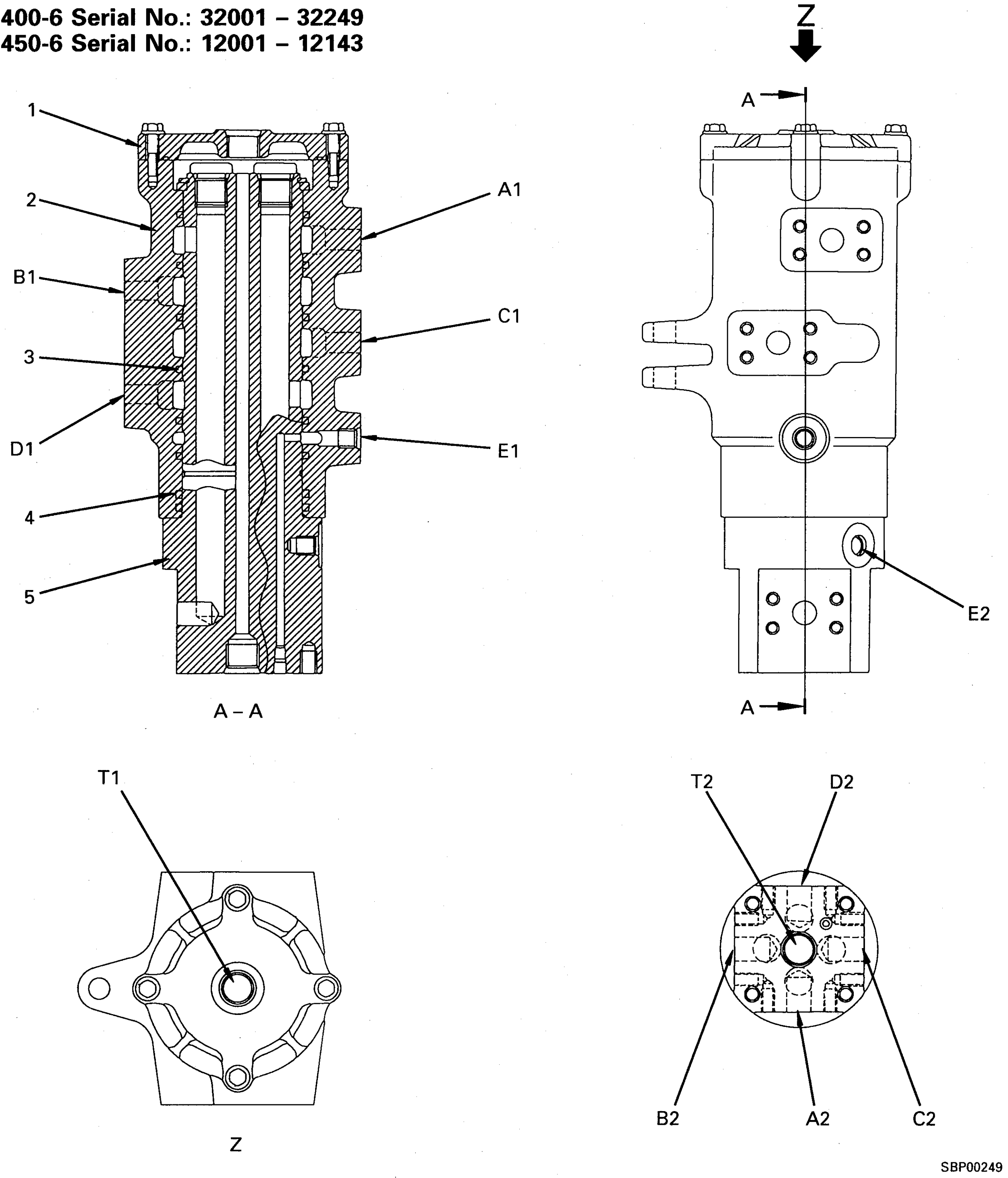
  When this happens, reversal pressure is generated at port **MA**. Pressure **MA** goes to chamber **a**, so spool (2) pushes spring (3) and moves to the right, and **MA** is connected to **B**. At the same time, **b** is connected to **f** through the drill hole in spool (5), so the reversal pressure at port **MA** is bypassed to port **T** to prevent the 2nd reversal.



SAP02642

CENTER SWIVEL JOINT

PC400-6 Serial No.: 32001 – 32249
PC450-6 Serial No.: 12001 – 12143

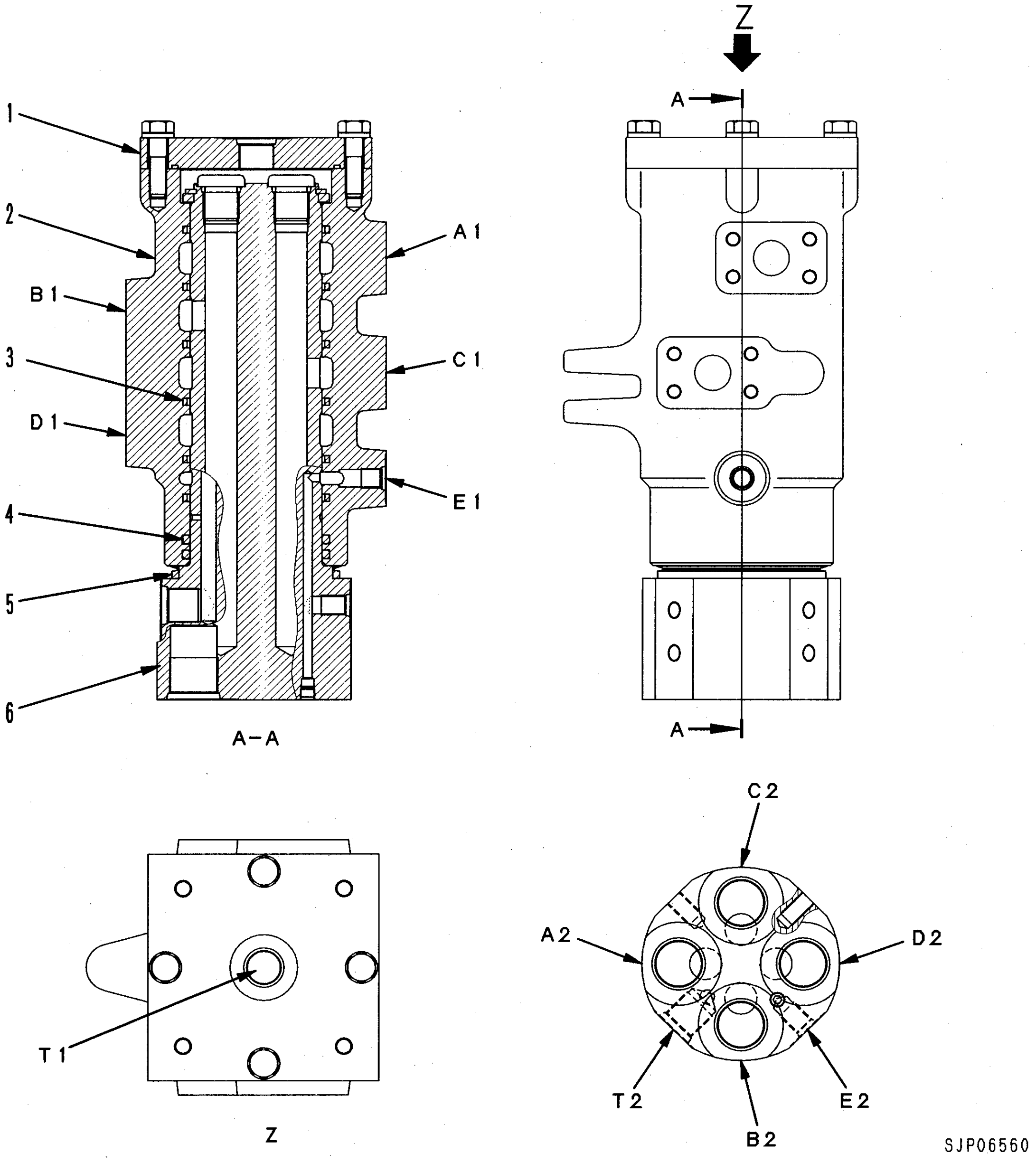


1. Cover
2. Body
3. Slipper seal
4. O-ring
5. Shaft

A1 : From control valve port **B2**
A2 : To R.H. travel motor port **PB**
B1 : From control valve port **B5**
B2 : To L.H. travel motor port **PA**
C1 : From control valve port **A2**
C2 : To R.H. travel motor port **PA**

D1 : From control valve port **A5**
D2 : To L.H. travel motor port **PB**
E1 : From travel speed EPC valve
E2 : To L.H. and R.H. travel motors port **P**
T1 : To tank
T2 : From L.H. and R.H. travel motors port **T**

PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up



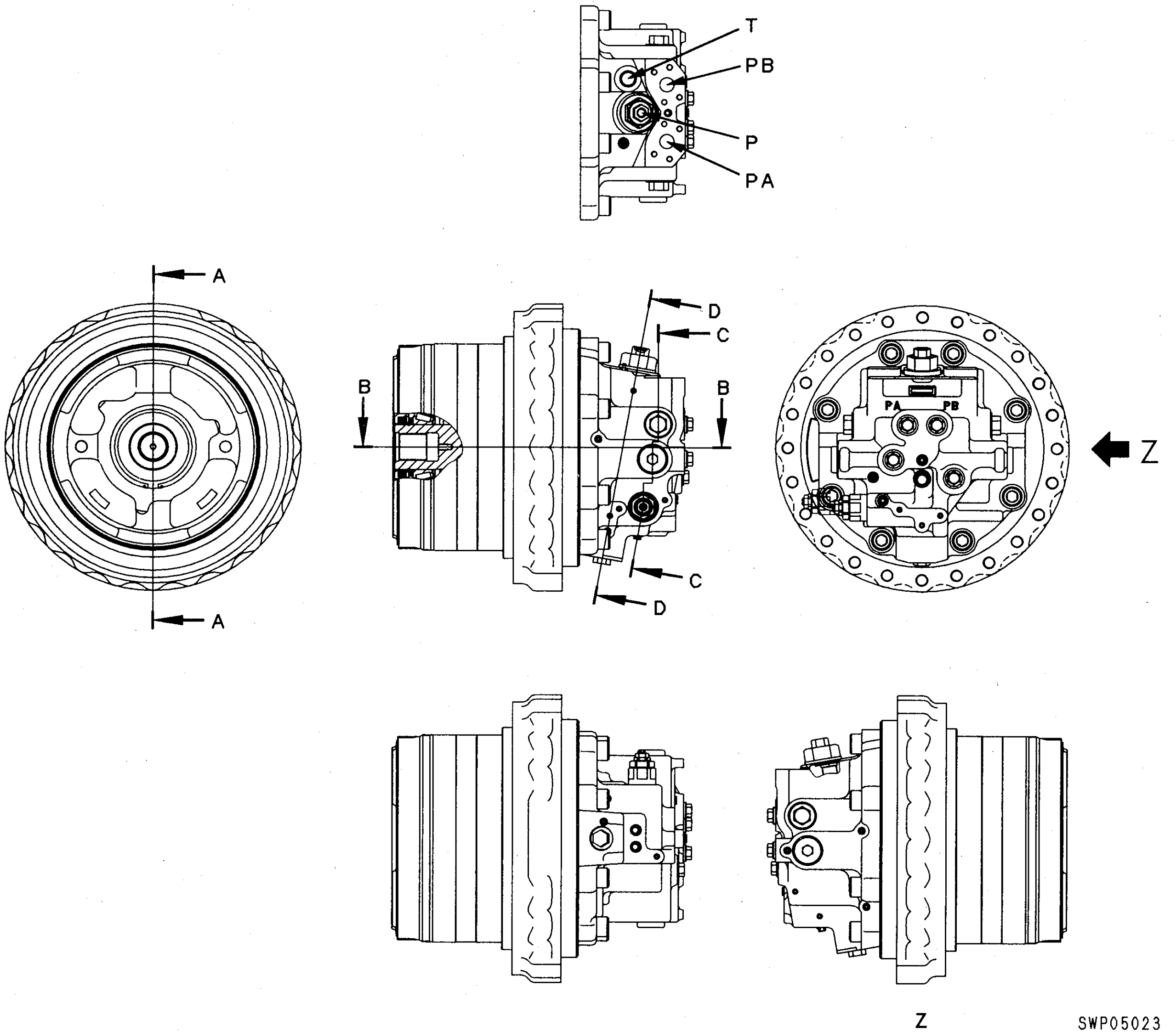
1. Cover
2. Body
3. Slipper seal
4. O-ring
5. Dust seal
6. Shaft

A1 : From control valve port **B2**
A2 : To R.H. travel motor port **PB**
B1 : From control valve port **B5**
B2 : To L.H. travel motor port **PA**
C1 : From control valve port **A2**
C2 : To R.H. travel motor port **PA**

D1 : From control valve port **A5**
D2 : To L.H. travel motor port **PB**
E1 : From travel speed EPC valve
E2 : To L.H. and R.H. travel motors port **P**
T1 : To tank
T2 : From L.H. and R.H. travel motors port **T**

TRAVEL MOTOR

KMV280ADT

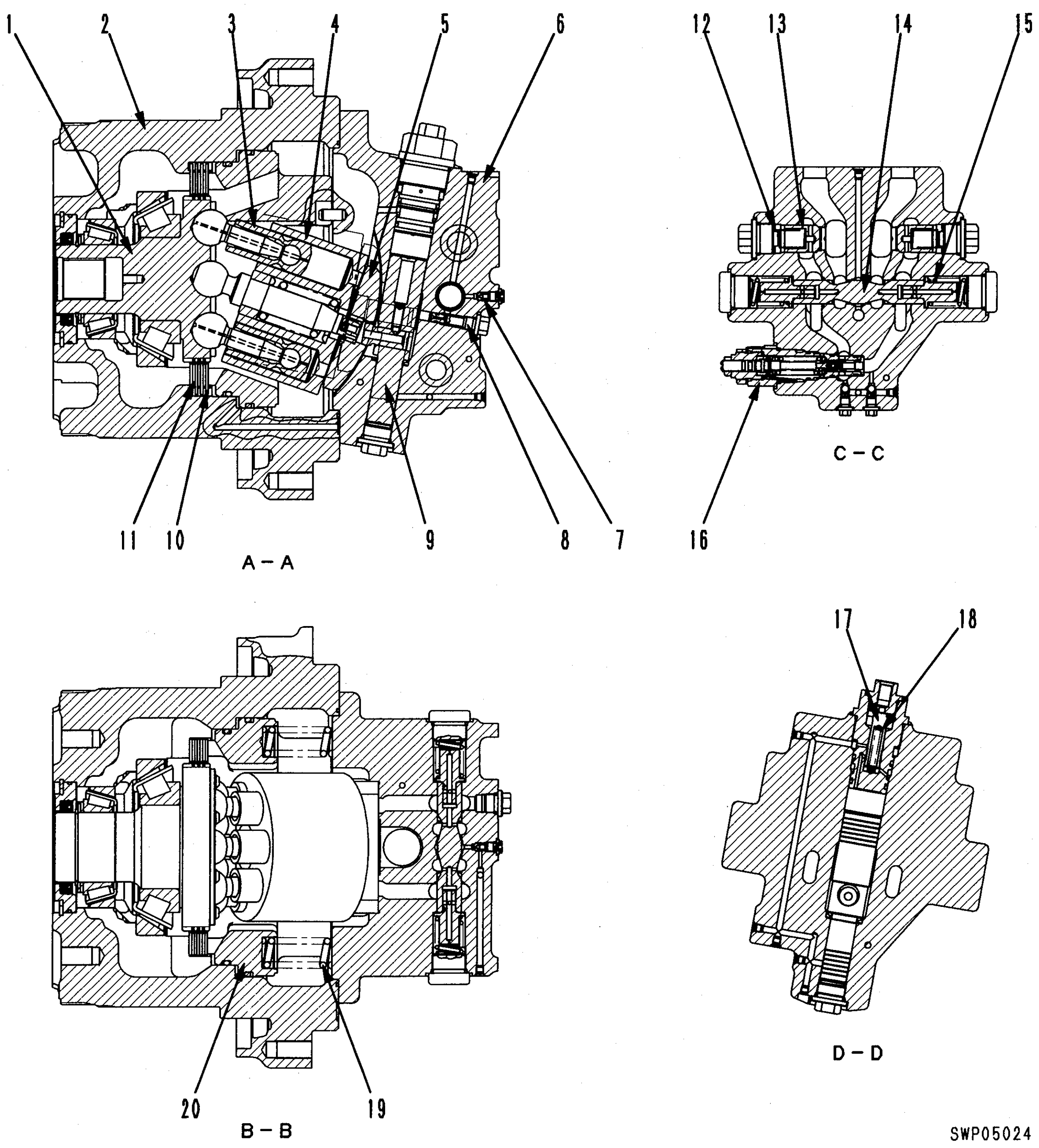


SWP05023

P : From travel speed solenoid valve
T : To tank
PA : From control valve
PB : From control valve

Specifications

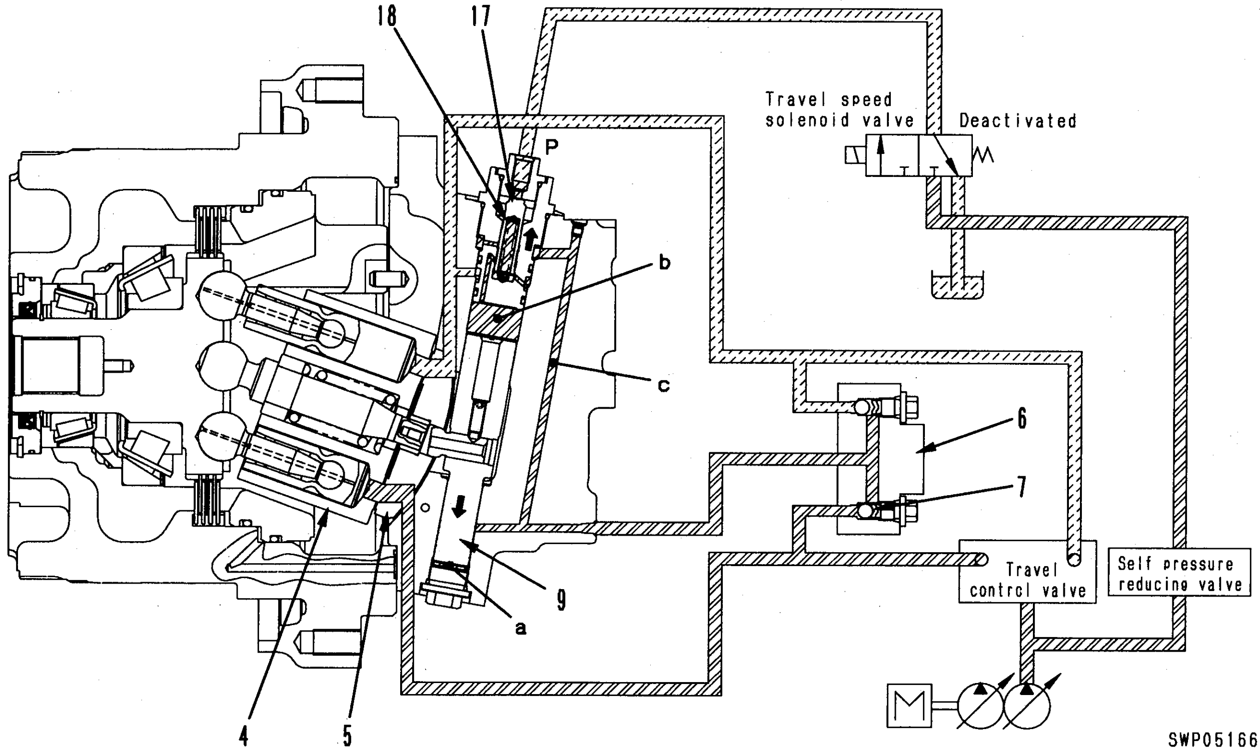
Model:	KMV280ADT
Theoretical delivery:	Min 158 cc/rpm Max 270 cc/rpm
Brake releasing pressure:	1.3 ± 0.4 MPa {13 ± 4 kg/cm^2}
Travel speed switching pressure:	0.8 $^{+0.4}_{-0.1}$ MPa {8 $^{+4}_{-1}$ kg/cm^2}



1. Output shaft
2. Motor case
3. Piston
4. Cylinder
5. Valve plate
6. End cover
7. Slow return valve
8. Plug
9. Regulator piston
10. Plate
11. Disc
12. Check valve spring
13. Check valve
14. Counterbalance valve
15. Spool return spring
16. Safety valve
17. Regulator valve
18. Spring
19. Brake spring
20. Brake piston

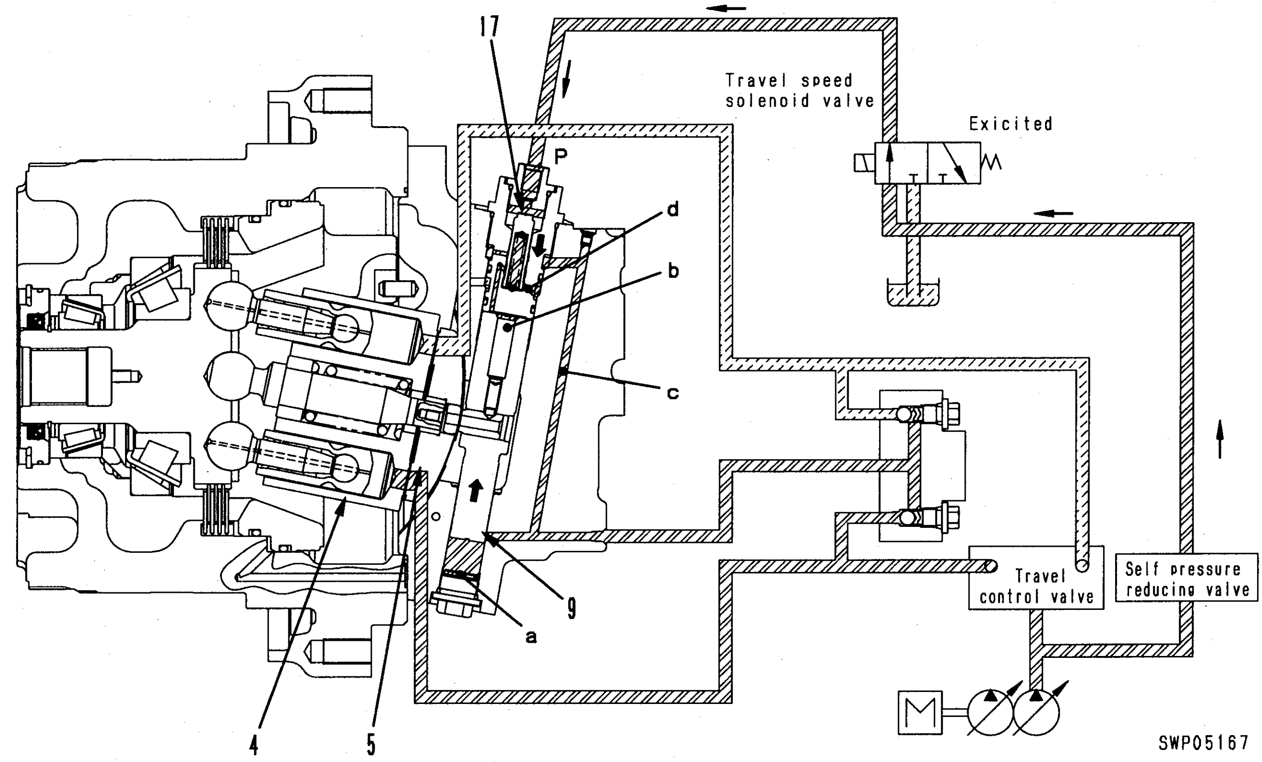
Operation of motor

1) At low speed (motor swash plate angle at maximum)



- The solenoid valve is de-energized, so the pilot pressure oil from the main pump does not flow to port **P**.
  For this reason, regulator valve (17) is pushed up by spring (18).
- The main pressure oil from the control valve pushes slow return valve (17), goes to end cover (6), and acts on chamber **a** of regulator piston (9).
- At the same time, the main pressure oil passes through orifice **c** in regulator valve (17) and acts also on chamber **b**.
- When this happens, the propulsion force of differential (**Ab** – **Aa**) between the area of chambers **a** and **b** of regulator piston (9) acts in a downward direction.
- As a result, valve plate (5) and cylinder block (4) move in the maximum swash plate angle direction, the motor capacity becomes maximum, and the system is set to low speed.

2) At high speed (motor swash plate angle at minimum)



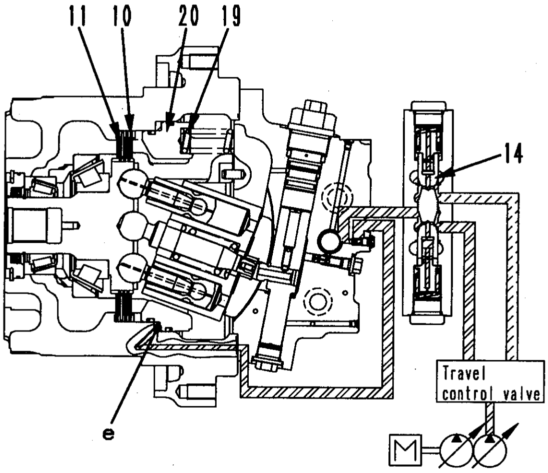
- When the solenoid valve is energized, the pilot pressure oil from the main pump flows to port **P**, and pushes regulator valve (17) down.
- When this happens, chamber **b** and the main pressure oil are shut off at regulator valve (17), and the oil at chamber **b** is drained inside the case.
- Because of this, the propulsion force of the pressure oil at chamber **a** of regulator piston (9) acts in a upward direction.
- As a result, valve plate (5) and cylinder block (4) move in the minimum swash plate angle direction, the motor capacity becomes minimum, and the system is set to high travel speed.

Operation of parking brake

1) **When starting to travel**

When the travel lever is operated, the pressurized oil from the pump actuates counterbalance valve spool (11), opens the circuit to the parking brake, and flows into chamber **e** of brake piston (20). It overcomes the force of spring (19), and pushes brake piston (20) to the right.

When this happens, the force pushing plate (10) and disc (11) together is lost, so plate (10) and disc (11) separate and the brake is released.



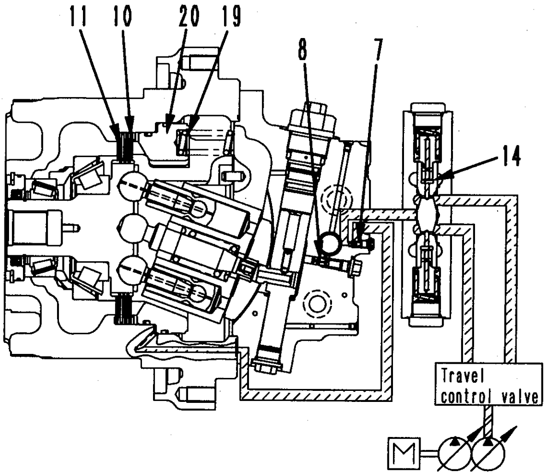
SWP05168

2) **When stopping travel**

When the travel lever is placed in neutral, counterbalance valve spool (14) returns to the neutral position and the circuit to the parking brake is closed.

The pressurized oil in chamber **e** of brake piston (20) passes through the throttle in slow return valve (7), is drained to the case from the orifice in plug (8), and brake piston (20) is pushed fully to the left by spring (19). As a result, plate (10) and disc (11) are pushed together, and the brake is applied.

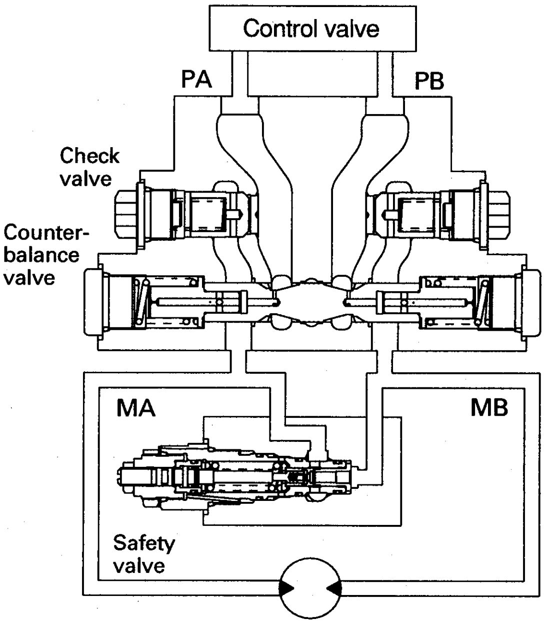
A time delay is provided by having the pressurized oil pass through a throttle in slow return valve (7) when the brake piston returns, and this ensures that the brake is applied after the machine stops.



SWP05169

Operation of brake valve

- The brake valve consists of a check valve, counterbalance valve, and safety valve in a circuit as shown in the diagram on the right. (Fig. 1)
- The function and operation of each component is as given below.



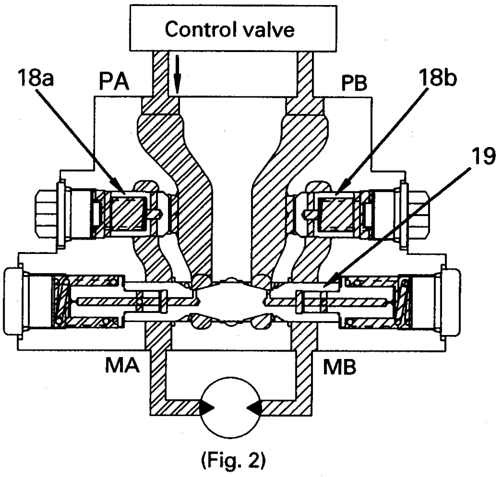
(Fig. 1)

SAP00262

1) Counterbalance valve, check valve

Function

- When traveling downhill, the weight of the machine makes it try to travel faster than the speed of the motor.
  As a result, if the machine travels with the engine at low speed, the motor will rotate without load and the machine will run away, which is extremely dangerous.
  To prevent this, these valves act to make the machine travel according to the engine speed (pump discharge amount).

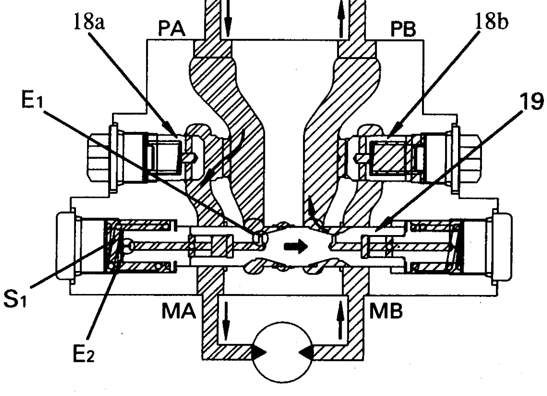


(Fig. 2)

SAP00263

Operation when pressurized oil is supplied

- When the travel lever is operated, the pressurized oil from the control valve is supplied to port **PA**. It pushes open check valve (18a) and flows from motor inlet port **MA** to motor outlet port **MB**.
  However, the motor outlet port is closed by check valve (18b) and spool (19), so the pressure at the supply side rises. (Fig. 2).
- The pressurized oil at the supply side flows from orifice **E1** in spool (19) and orifice **E2** in the piston to chamber **S1**. When the pressure in chamber **S1** goes above the spool switching pressure, spool (19) is pushed to the right. As a result, port **MB** and port **PB** are connected, the outlet port side of the motor is opened, and the motor starts to rotate. (Fig. 3).

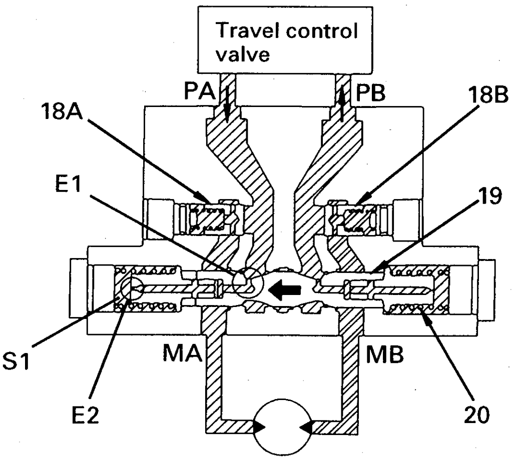


(Fig. 3)

SAP00264

Operation of brake when traveling downhill

- If the machine tries to run away when traveling downhill, the motor will turn under no load, so the pressure at the motor inlet port will drop, and the pressure in chamber **S1** through orifices **E1** and **E2** will also drop. When the pressure in chamber **S1** drops below the spool switching pressure, spool (19) is returned to the left by spring (20), and outlet port **MB** is throttled.
  As a result, the pressure at the outlet port side rises, resistance is generated to the rotation of the motor, and this prevents the machine from running away.
  In other words, the spool moves to a position where the pressure at outlet port **MB** balances the pressure at the inlet port and the force generated by the weight of the machine. It throttles the outlet port circuit and controls the travel speed according to the amount of oil discharged from the pump. (Fig. 4)



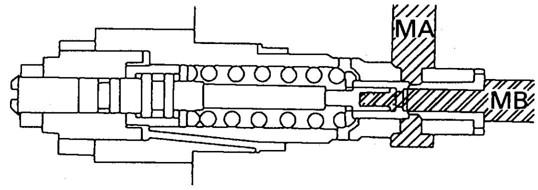
(Fig. 4)

SBP00265

2) Safety valve (2-direction operation, 2-stage set safety valve)

Function

- When travel is stopped (or when traveling downhill), the circuits at the inlet and outlet ports of the motor are closed by the counterbalance valve. However, the motor is rotated by inertia, so the pressure at the outlet port of the motor will become abnormally high and will damage the motor or piping. The safety valve acts to release this abnormal pressure and send it to the inlet port side of the motor to prevent damage to the equipment.



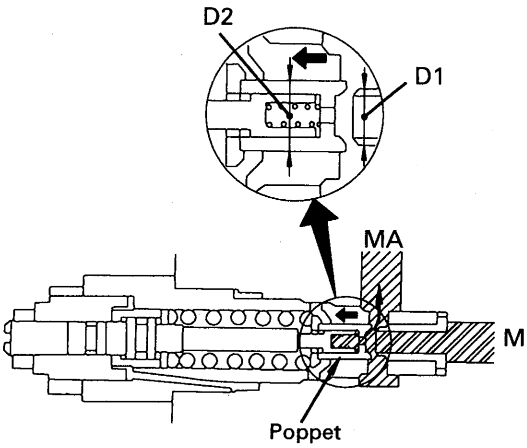
(Fig. 5)

SBP00266

Operation in both directions

1) When pressure in chamber MB has become high (when rotating clockwise)

- When the travel is stopped (or when traveling downhill), chamber **MB** in the outlet port circuit is closed by the check valve of the counterbalance valve, but the pressure at the outlet port rises because of inertia. (Fig. 5)
- If the pressure goes above the set pressure, the force produced by the difference in area between **D1** and **D2** [π4($D1^2$ – $D2^2$) x pressure] overcomes the force of the spring and moves the poppet to the left, so the oil flows to chamber **MA** in the circuit on the opposite side. (Fig. 6).

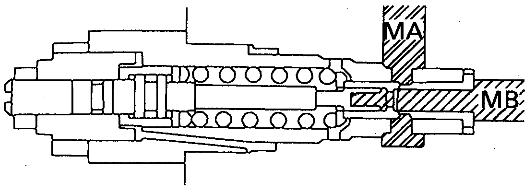


(Fig. 6)

SBP00267

2) **When pressure in chamber MA has become high (when rotating counterclockwise)**

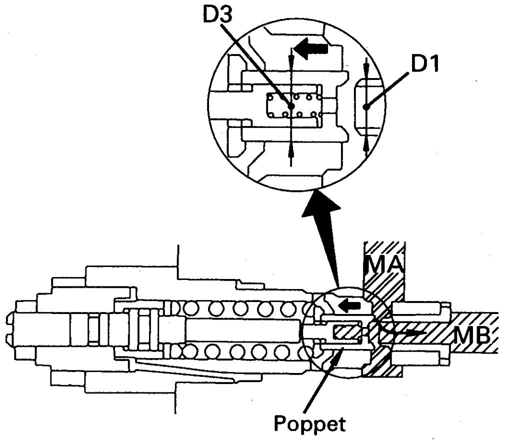
- When the travel is stopped (or when traveling downhill), chamber **MA** in the outlet port circuit is closed by the check valve of the counterbalance valve, but the pressure at the outlet port rises because of inertia. (Fig. 7)



(Fig. 7)

SBP00268

- If the pressure goes above the set pressure, the force produced by the difference in area between **D1** and **D3** [$\pi/4(D3^2 - D1^2)$ x pressure] overcomes the force of the spring and moves the poppet to the left, so the oil flows to chamber **MB** in the circuit on the opposite side. (Fig. 8)



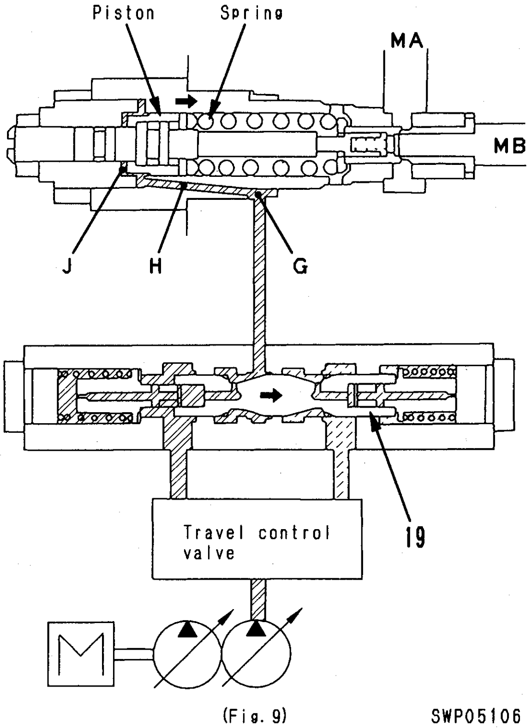
(Fig. 8)

SBP00269

Operation of mechanism for varying set pressure

1) **When starting travel (high-pressure setting)**

- When the travel lever is operated, the pressurized oil from the pump actuates counterbalance valve spool (19), and opens the pilot circuit to the safety valve. The oil passes from chamber **G** to passage **H** and flows into chamber **J**, pushes the piston to the right, and compresses the spring to make the set load larger. Because of this, the set pressure of the safety valve is switched to the high pressure setting, and a large drawbar pull is made available.



(Fig. 9)

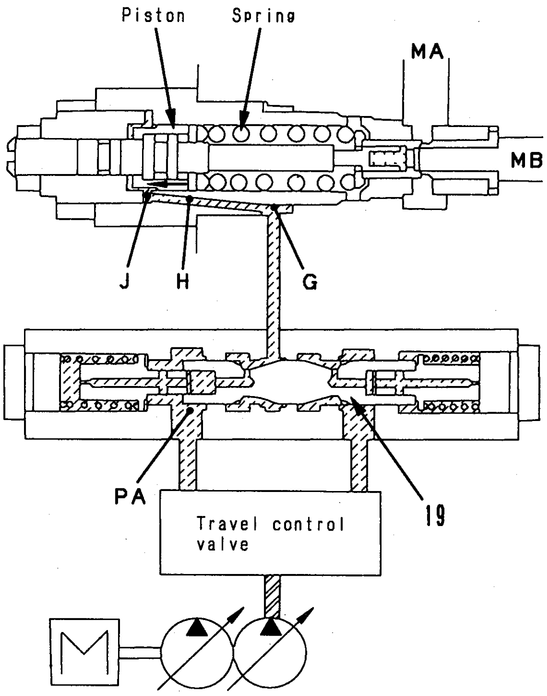
SWP05106

2) When stopping travel (low-pressure setting)

- When the travel lever is placed at neutral, the pressure in chamber **PA** drops and counterbalance valve spool (19) returns to the neutral position. While the counterbalance valve spool is returning to the neutral position, the pressurized oil in chamber **J** passes through passage **H**, and escapes to chamber **PA** from chamber **G**. The piston moves to the left, and the set load becomes smaller. Because of this, the set pressure of the safety valve is switched to the low-pressure setting and relieves the shock when reducing speed.

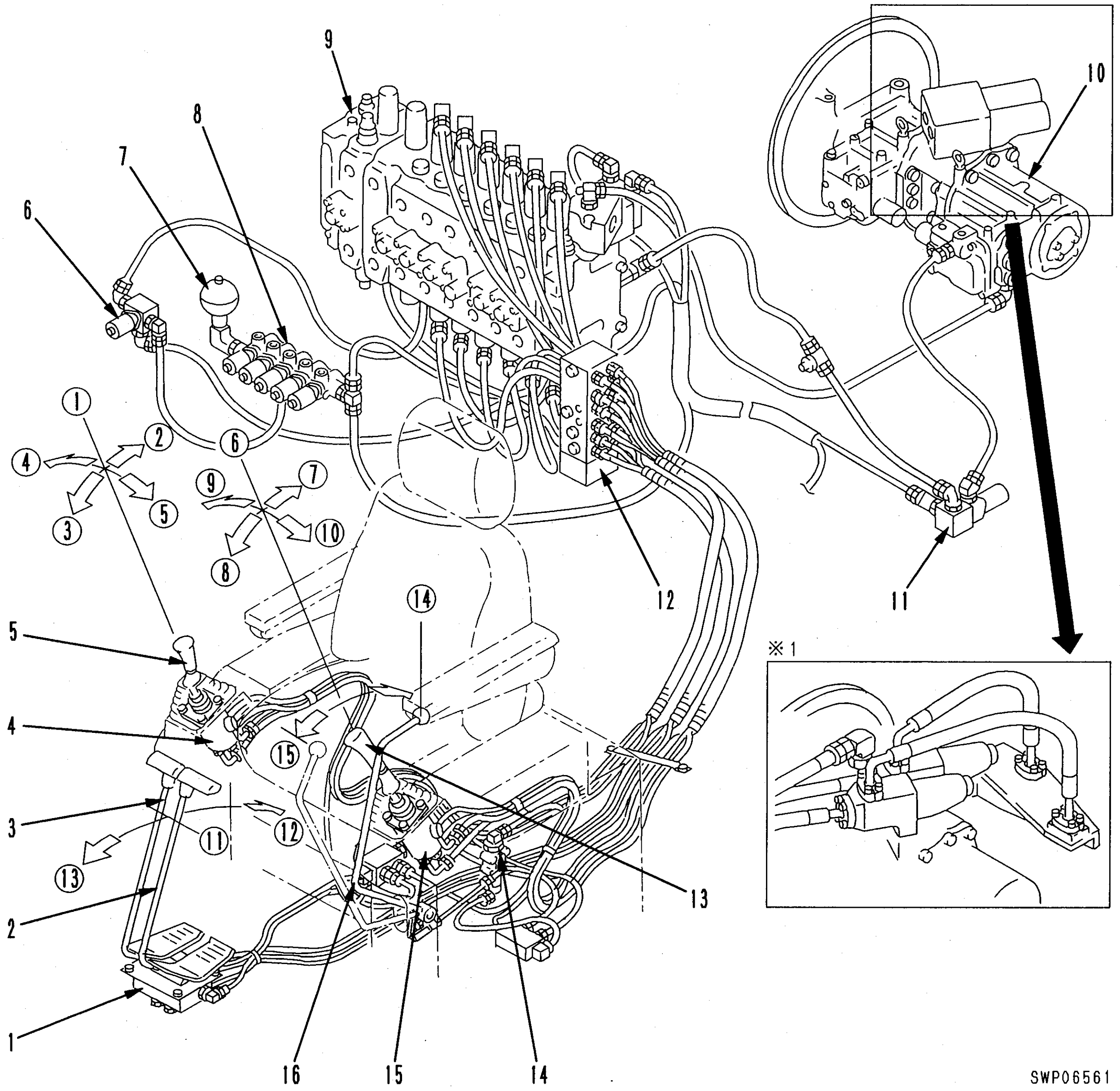
[Set pressure of safety valve]

When starting, when traveling } : High-pressure setting	When stopping: Low-pressure setting
37.8 MPa {385 kg/cm²}	27.5 MPa {280 kg/cm²}



(Fig. 10) SWP05107

VALVE CONTROL



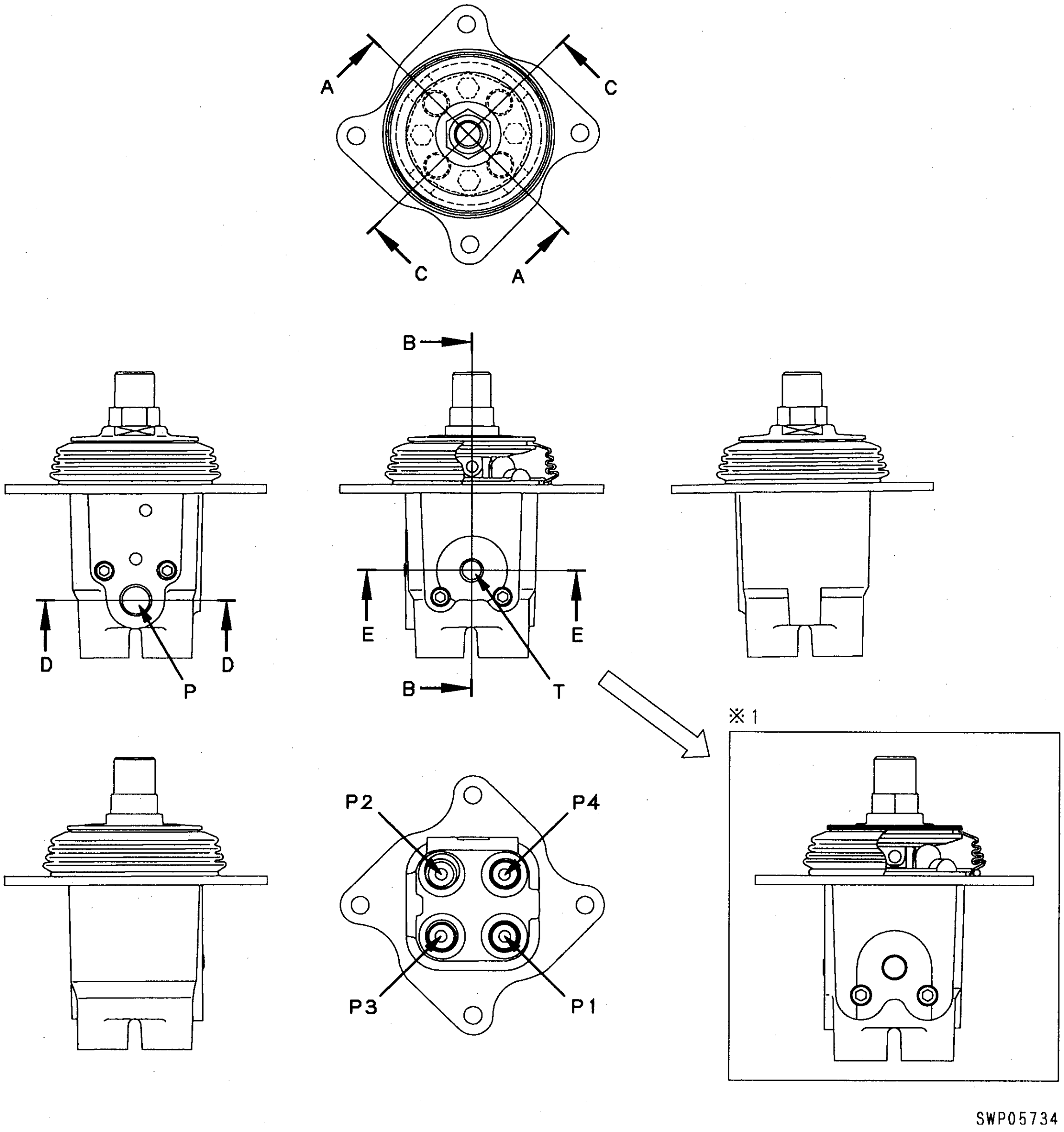
※1. PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up

1. Travel PPC valve
2. L.H. travel lever
3. R.H. travel lever
4. Right PPC valve
5. Right work equipment lever
6. Active solenoid valve (Swing)
7. Accumulator
8. Solenoid block
9. Control valve
10. Hydraulic pump
11. LS-EPC valve
12. PPC shuttle valve
13. Left work equipment lever
14. PPC safety lock valve
15. Left PPC valve
16. Safety lock lever

Lever positions

① : NEUTRAL
② : Boom RAISE
③ : Boom LOWER
④ : Bucket DUMP
⑤ : Bucket CURL
⑥ : NEUTRAL
⑦ : Arm IN
⑧ : Arm OUT
⑨ : Swing right
⑩ : Swing left
⑪ : NEUTRAL
⑫ : Travel REVERSE
⑬ : Travel FORWARD
⑭ : LOCK
⑮ : FREE

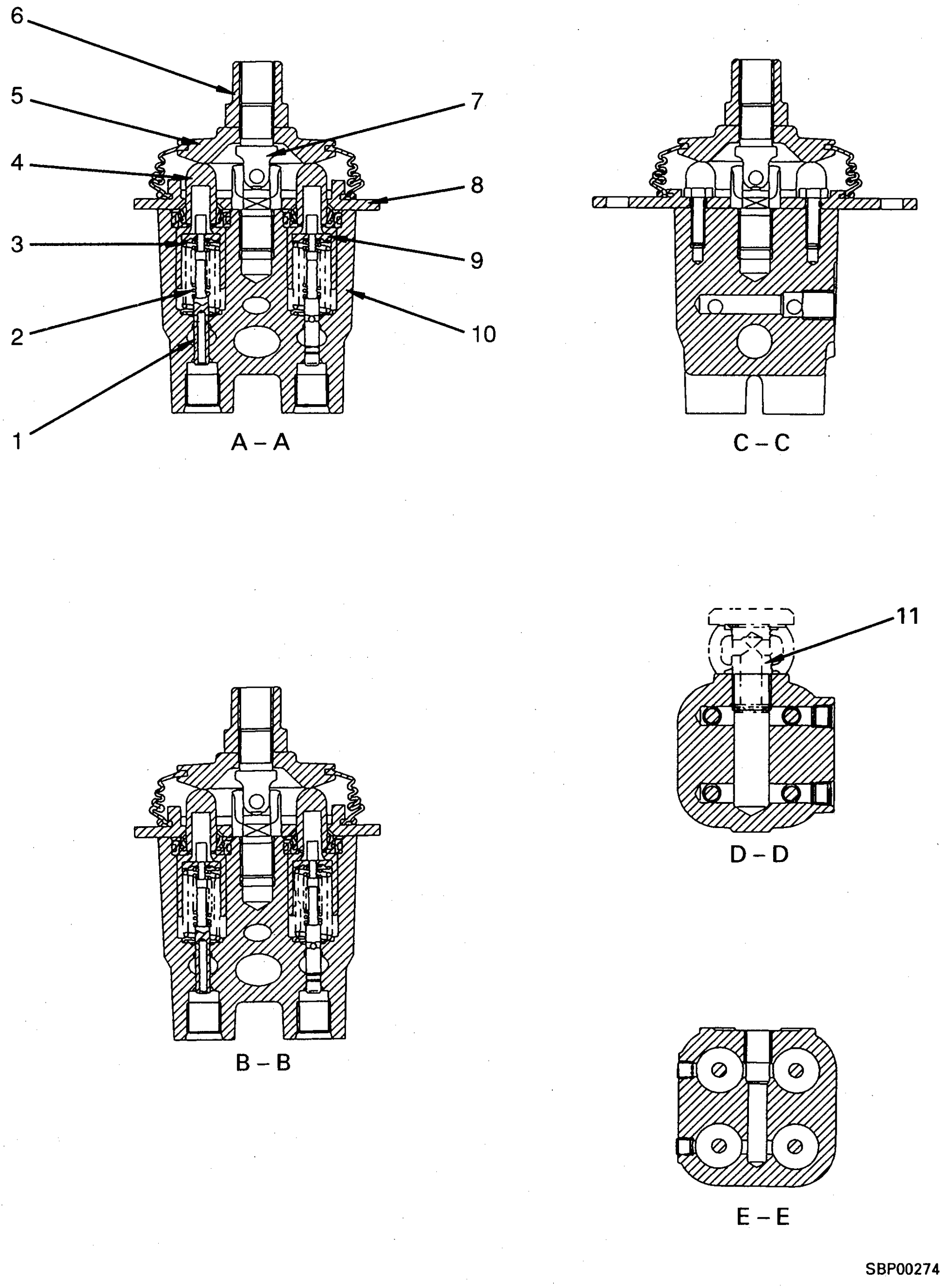
WORK EQUIPMENT • SWING PPC VALVE



※1. PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up

P : From main pump
T : To tank

P1 : L.H.• Arm OUT/R.H.• Boom LOWER
P2 : L.H.• Arm IN/R.H.• Boom RAISE
P3 : L.H.• Right swing/R.H.• Bucket CURL
P4 : L.H.• Left swing/R.H.• Bucket DUMP

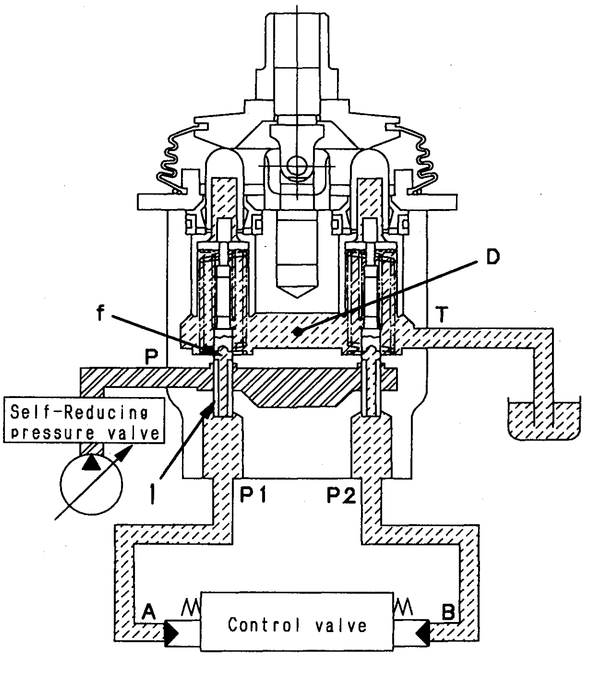


1. Spool
2. Metering spring
3. Centering spring
4. Piston
5. Disc
6. Nut (for connecting lever)
7. Joint
8. Plate
9. Retainer
10. Body
11. Filter

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)

SBP03493

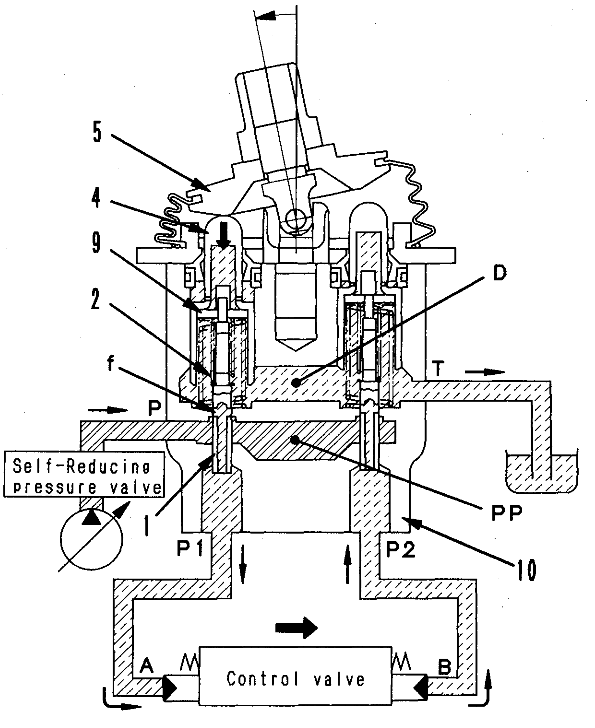
2) During fine control (neutral → fine control)

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 main pump 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)

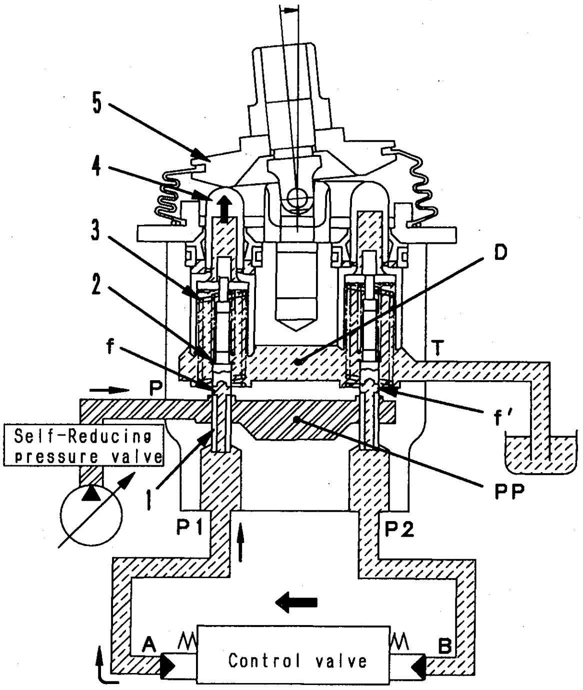


(Fig. 2)

SBP03494

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)

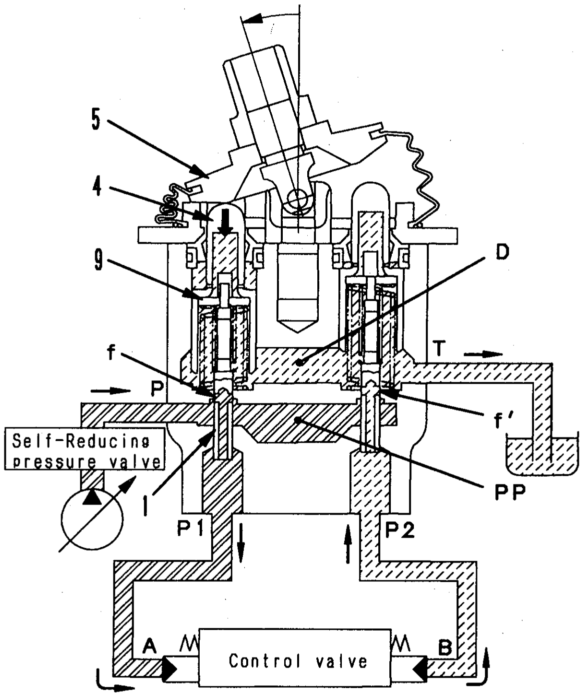


(Fig. 3)

SBP03495

4) At full stroke

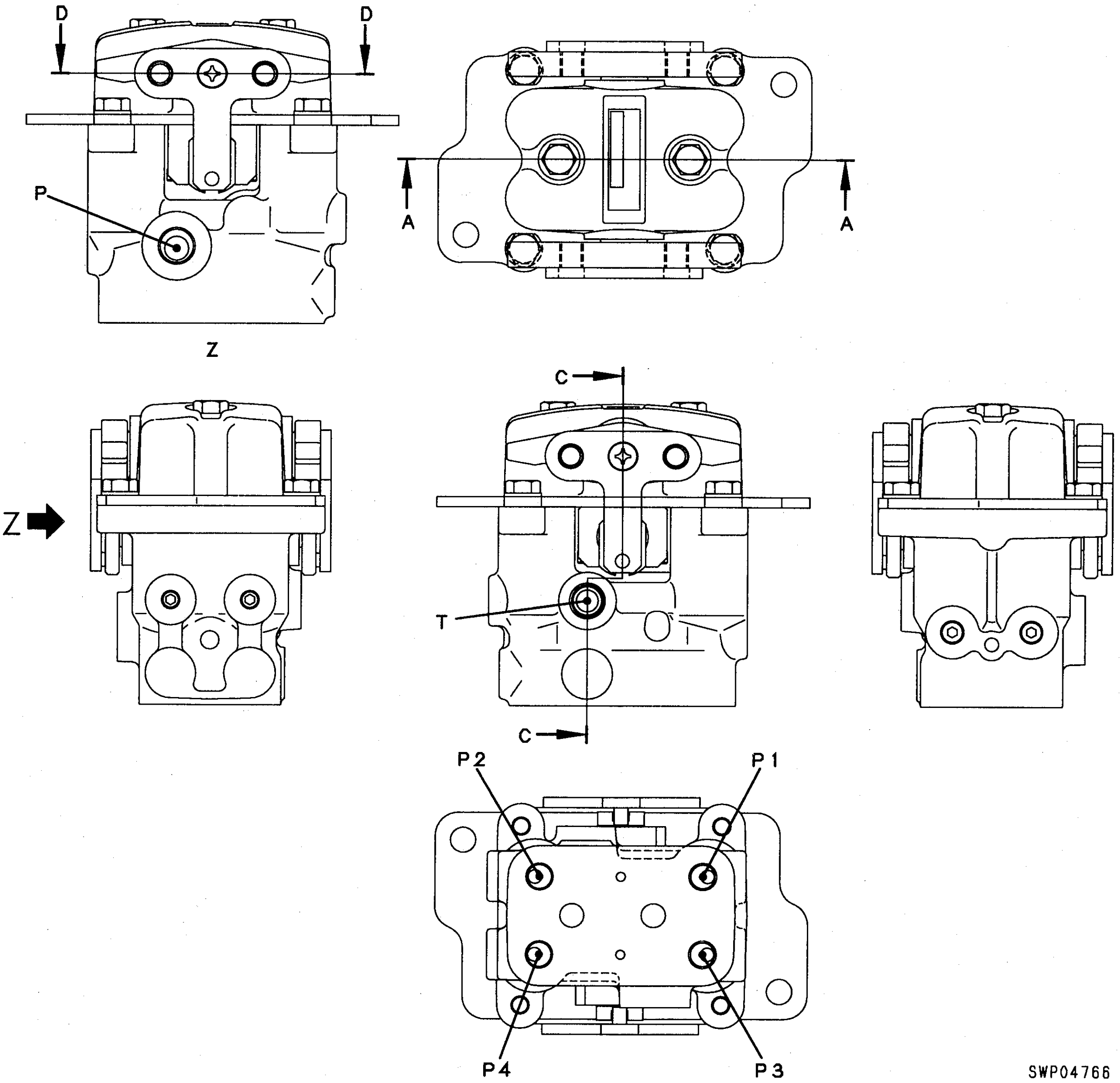
When disc (5) pushes down piston (4), and retainer (9) pushes down spool (1), fine control hole **f** is shut off from drain chamber **D**, and is connected with pump pressure chamber **PP**. Therefore, the pilot pressure oil from the main pump passes through fine control hole **f** and flows to chamber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



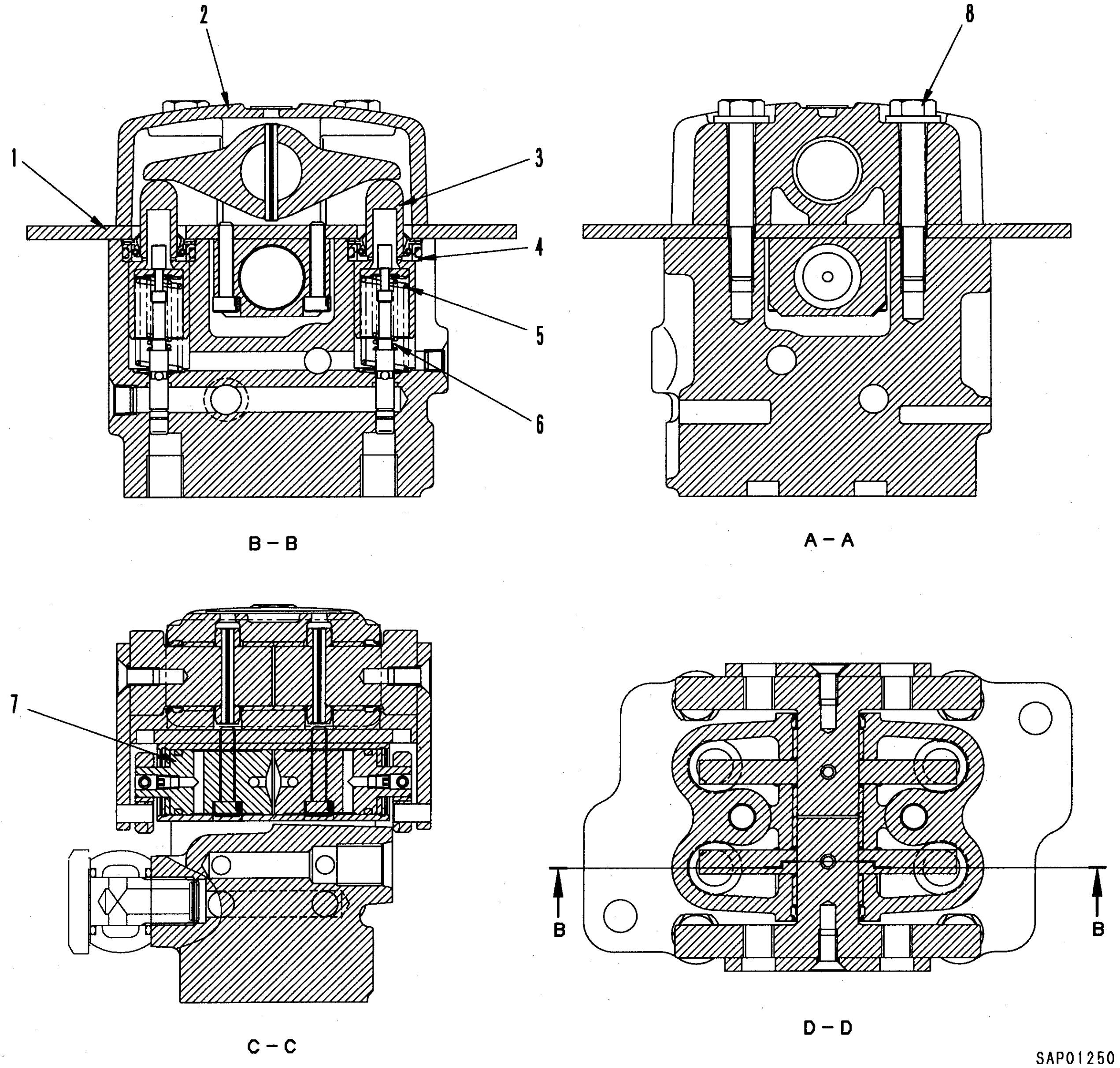
(Fig. 4)

SBP03496

TRAVEL PPC VALVE



P : From main pump
T : To tank
P1 : L.H. travel REVERSE
P2 : L.H. travel FORWARD
P3 : R.H. travel REVERSE
P4 : R.H. travel FORWARD

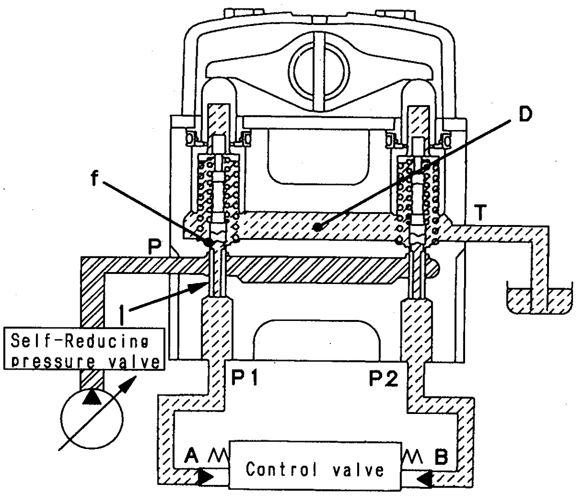


1. Plate
2. Body
3. Piston
4. Collar
5. Metering spring
6. Centering spring
7. Valve
8. Bolt

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)

SBP03497

2) Fine control (neutral → fine control)

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

When this happens, fine control hole **f** is shut off from drain chamber **D**. At almost the same time, it is connected to pump pressure chamber **PP**, and the pilot pressure of the main pump is sent from port **A** through fine control hole **f** to port **P1**.

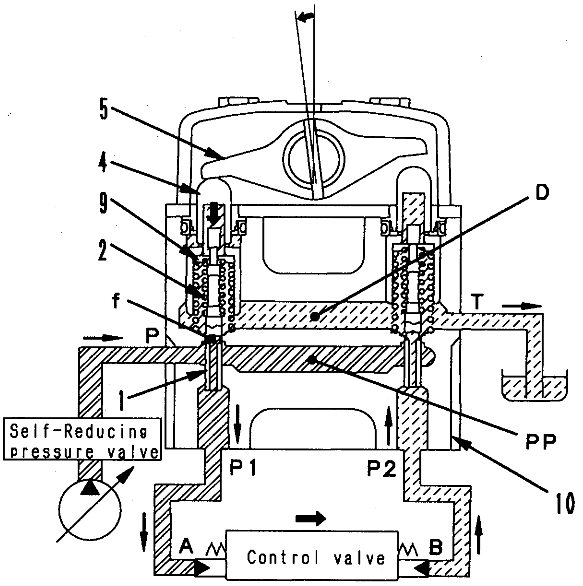
When the pressure at port **P1** rises, spool (1) is pushed back. Fine control hole **f** is shut off from pump pressure chamber **PP**. At almost the same time, it is connected to drain chamber **D**, so the pressure at port **P1** escapes.

As a result, spool (1) moves up and down until the force of metering spool (2) is balanced with the pressure of port **P1**.

The relationship of the position of spool (1) and body (10) (fine control hole **f** is in the middle between drain hole **D** and pump pressure chamber **PP**) does not change until retainer (9) contacts spool (1).

Therefore, metering spring (2) is compressed in proportion to the travel of the control lever, so the pressure at port **P1** also rises in proportion to the travel of the control lever.

In this way, the spool of the control valve moves to a position where the pressure of chamber **A** (same as pressure at port **P1**) and the force of the return spring of the control valve spool are balanced. (Fig.2)



(Fig. 2)

SBP03498

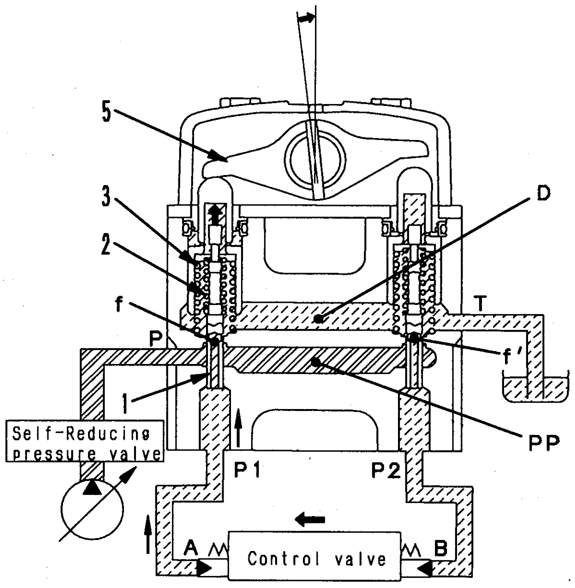
3) Fine control (control lever returned)

When disc (5) starts to be returned, spool (1) is pushed up by the force of centering spring (3) and the pressure at port **P1**.

Because of this, fine control hole **f** is connected to drain chamber **D**, and the pressurized oil at port **P1** is released.

If the pressure at port **P1** drops too much, spool (1) is pushed up by metering spring (2), so fine control hole **f** is shut off from drain chamber **D**. At almost the same time, it is connected to pump pressure chamber **PP**, so the pressure at port **P1** supplies the pump pressure until the pressure recovers to a pressure equivalent to the position of the lever.

When the control valve returns, oil in drain chamber **D** flows in from fine control hole **f'** of the valve on the side that is not moving. It passes through port **P2** and goes to chamber **B** to charge the oil. (Fig. 3)

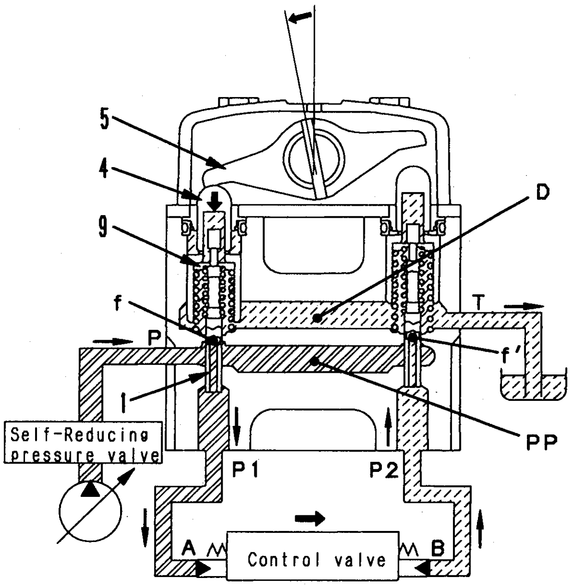


(Fig. 3)

SBP03499

4) At full stroke

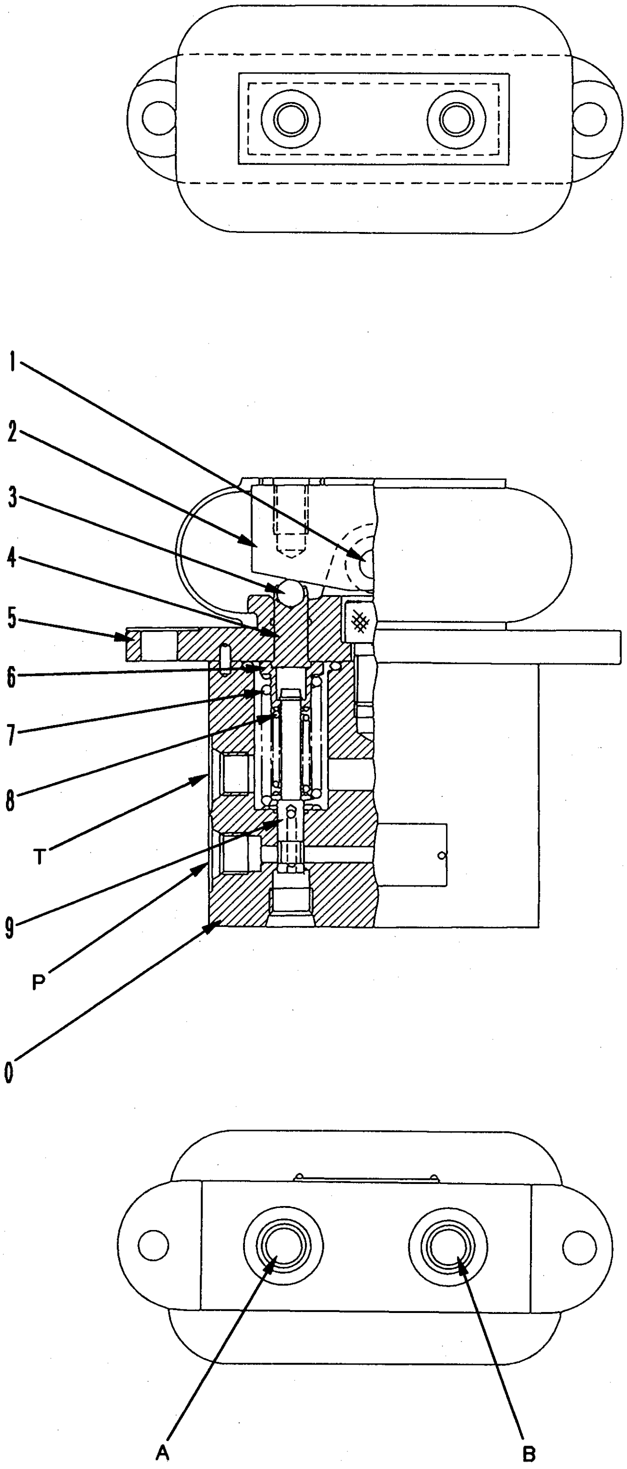
Disc (5) pushes down piston (4), and retainer (9) pushes down spool (1). Fine control hole **f** is shut off from drain chamber **D**, and is connected to pump pressure chamber **PP**. Therefore, the pilot pressure oil from the main pump passes through fine control hole **f** and flows to chamber **A**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



(Fig. 4)

SBP03695

SERVICE PPC VALVE



SWP04767

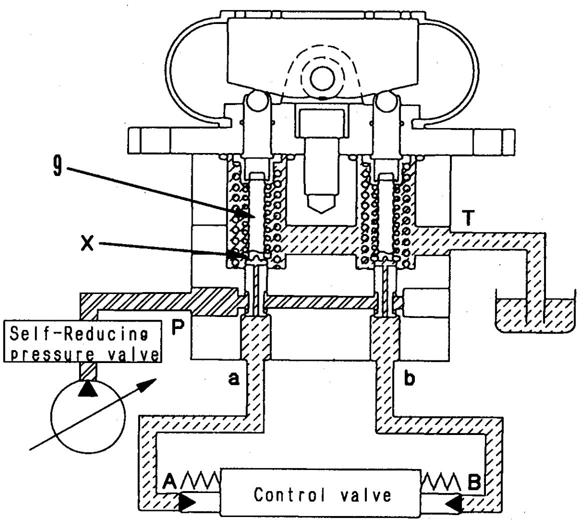
1. Pin
2. Cam
3. Ball
4. Piston
5. Cover
6. Sleeve
7. Centering spring
8. Metering spring
9. Spool
10. Body

A: To service valve **P-1**
B: To service valve **P-2**
P: From main pump
T: To tank

OPERATION

At neutral

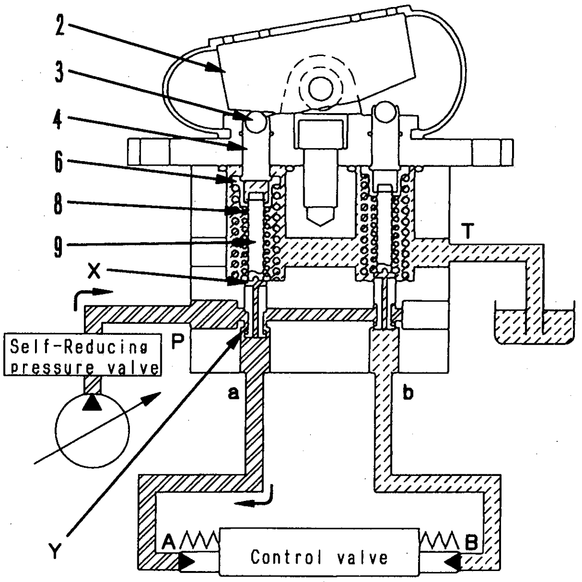
- The pressurized oil from the main pump enters from port **P** and is blocked by spool (9).
- Ports **A** and **B** of the control valve and ports **a** and **b** of the PPC valve are connected to drain port **T** through fine control hole **X** of spool (9).



SBP03500

When operated

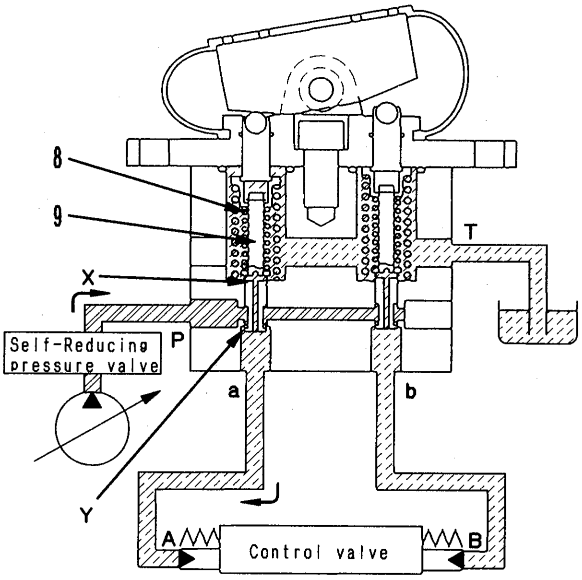
- When cam (2) is moved, metering spring (8) is pushed by ball (3), piston (4), and sleeve (6), and spool (9) is pushed down by this.
- As a result, fine control hole **X** is shut off from the drain circuit. At almost the same time, fine control portion **Y** is connected with port **a**, and the pressurized oil from port **P** flows from port **a** to port **A** of the control valve.



SBP03501

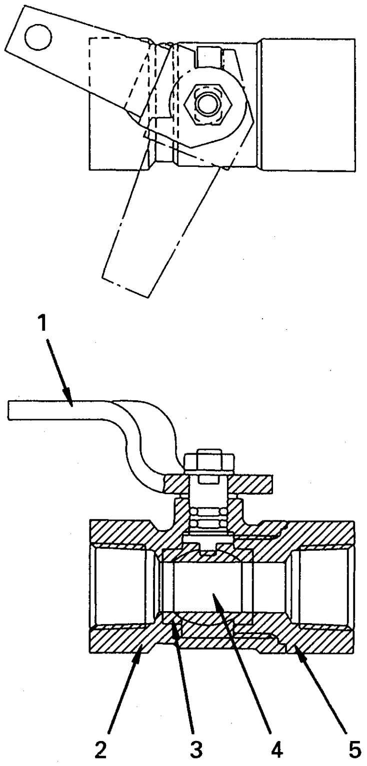
- When the pressure at port **a** becomes higher, spool (9) is pushed back by the force acting on the end of the spool. When fine control portion **Y** closes, fine control hole **X** is connected to the drain circuit at almost the same time.
- As a result, spool (9) moves up and down to balance the force at port **a** and the force at metering spring (8).
- Therefore, metering spring (8) 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.



SBP03502

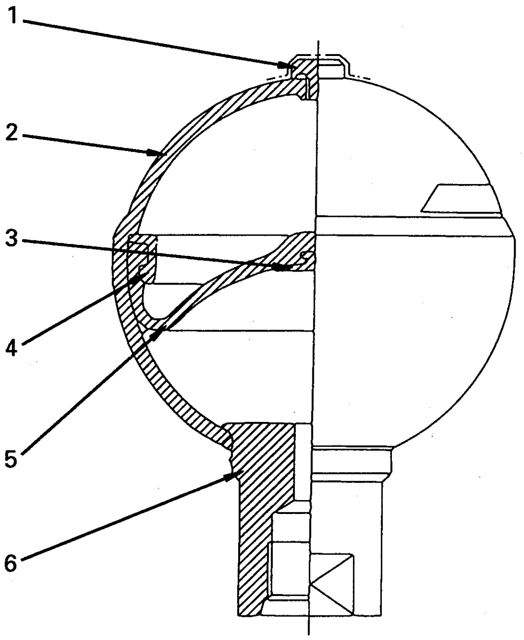
PPC SAFETY LOCK VALVE



SBP00289

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

PPC ACCUMULATOR

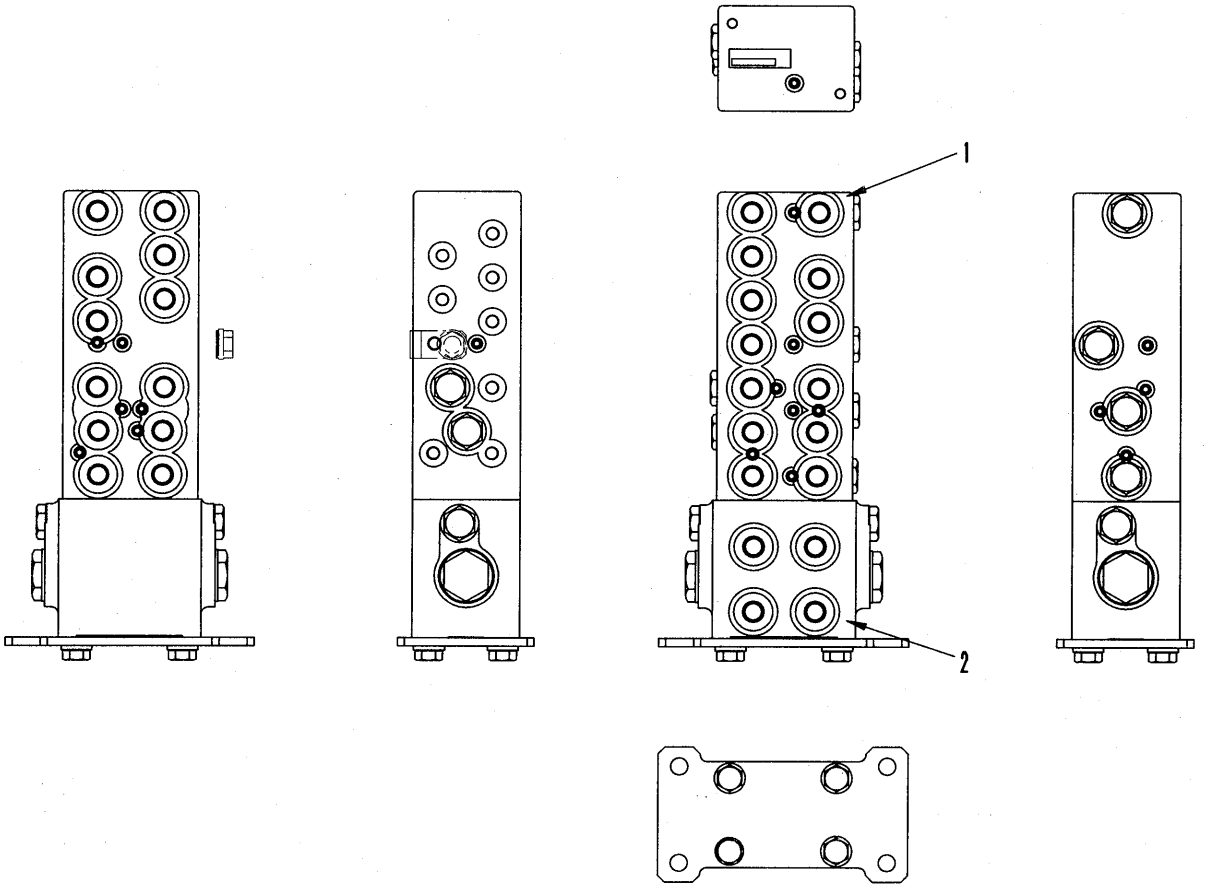


SBP00290

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

Specifications
Gas volume: 500 cc

PPC SHUTTLE VALVE, TRAVEL JUNCTION VALVE



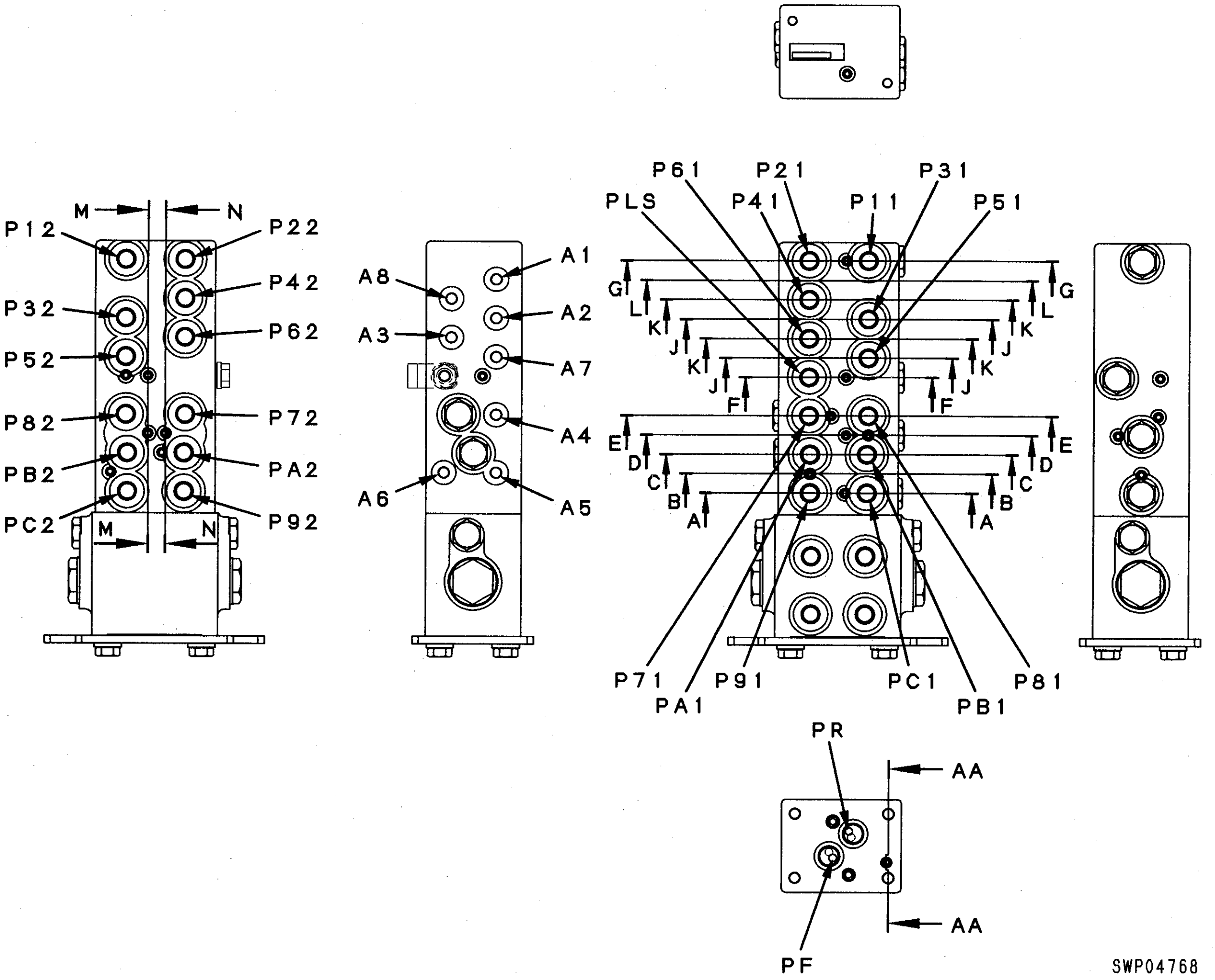
SDP01315

1. PPC shuttle valve
2. Travel junction valve

Outline

- The PPC shuttle valve and travel junction valve form a combined structure.

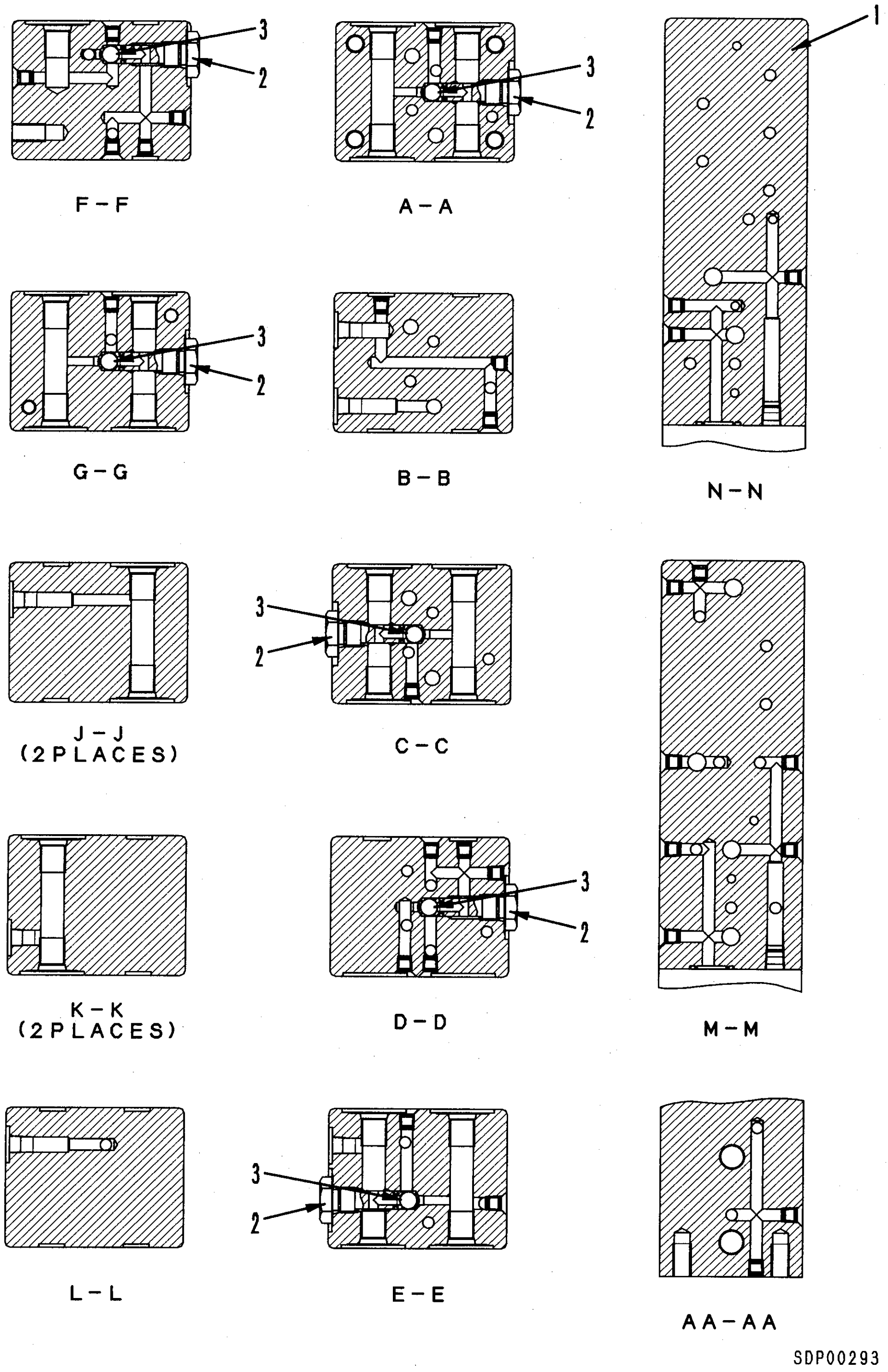
PPC SHUTTLE VALVE



Function

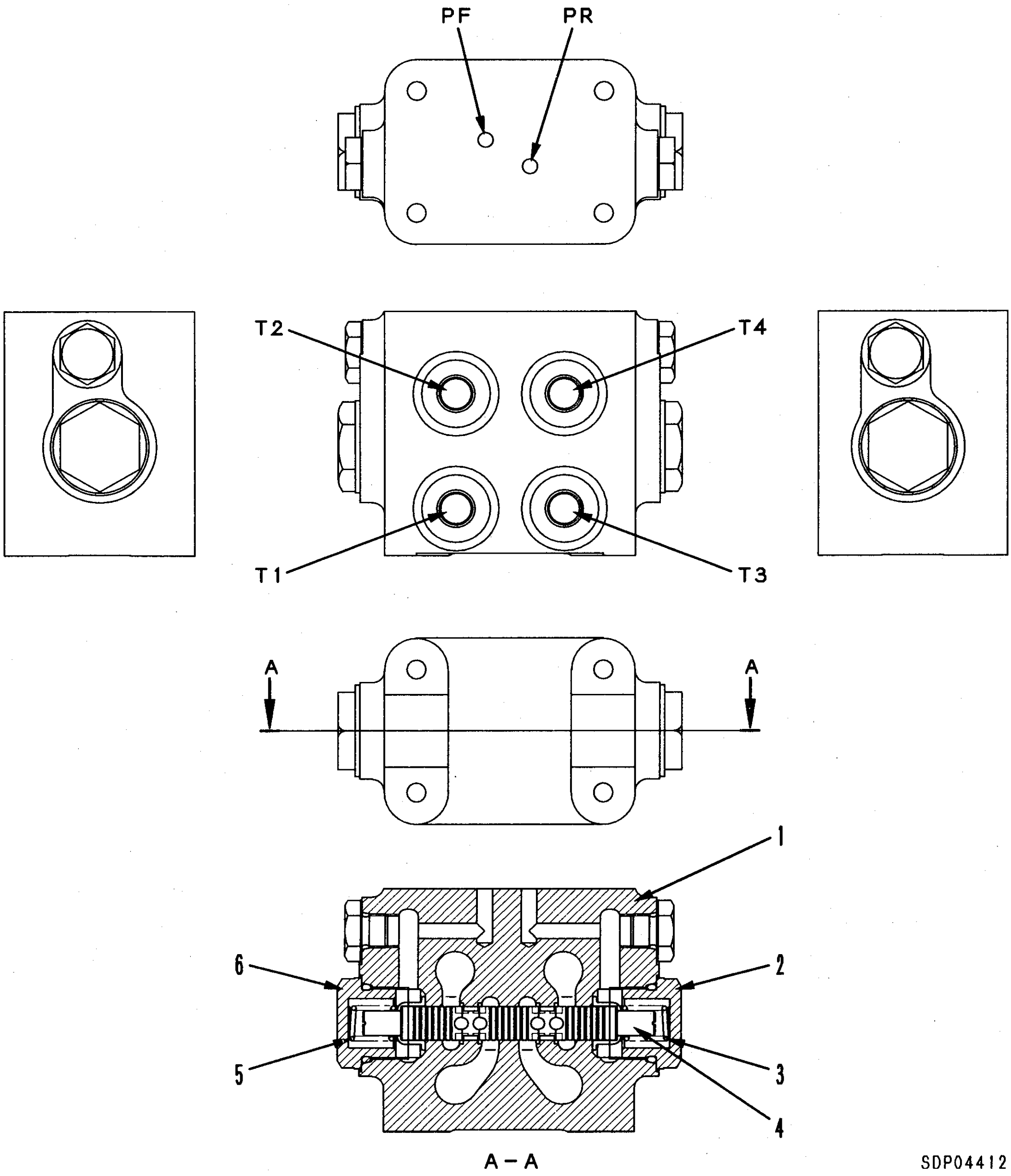
- The PPC shuttle valve sends the PPC valve output pressure to the control valve and travel junction valve. It is provided with a mount port for the pressure switch for detecting the pilot pressure.

A1 : Mount port for swing pressure switch
A2 : Mount port for bucket CURL pressure switch
A3 : Mount port for arm IN pressure switch
A4 : Mount port for arm OUT pressure switch
A5 : Mount port for boom RAISE pressure switch
A6 : Mount port for travel pressure switch
A7 : Mount port for boom LOWER pressure switch
A8 : Mount port for bucket DUMP pressure switch
P11 : To control valve (swing)
P12 : From swing PPC valve
P21 : To control valve (swing)
P22 : From swing PPC valve
P31 : To control valve (bucket)
P32 : From bucket PPC valve
P41 : To control valve (bucket)
P42 : From bucket PPC valve
P51 : To control valve (boom)
P52 : From boom PPC valve
P61 : To control valve (arm)
P62 : From arm PPC valve
P71 : To control valve (arm)
P72 : From arm PPC valve
P81 : To control valve (boom)
P82 : From boom PPC valve
P91 : To control valve (R.H. travel)
P92 : From R.H. travel PPC valve
PA1 : To control valve (R.H. travel)
PA2 : From R.H. travel PPC valve
PB1 : To control valve (L.H. travel)
PB2 : From L.H. travel PPC valve
PC1 : To control valve (L.H. travel)
PC2 : From L.H. travel PPC valve
PF : To travel junction valve
PR : To travel junction valve
PLS : From LS select valve



1. Body
2. Plug
3. Ball

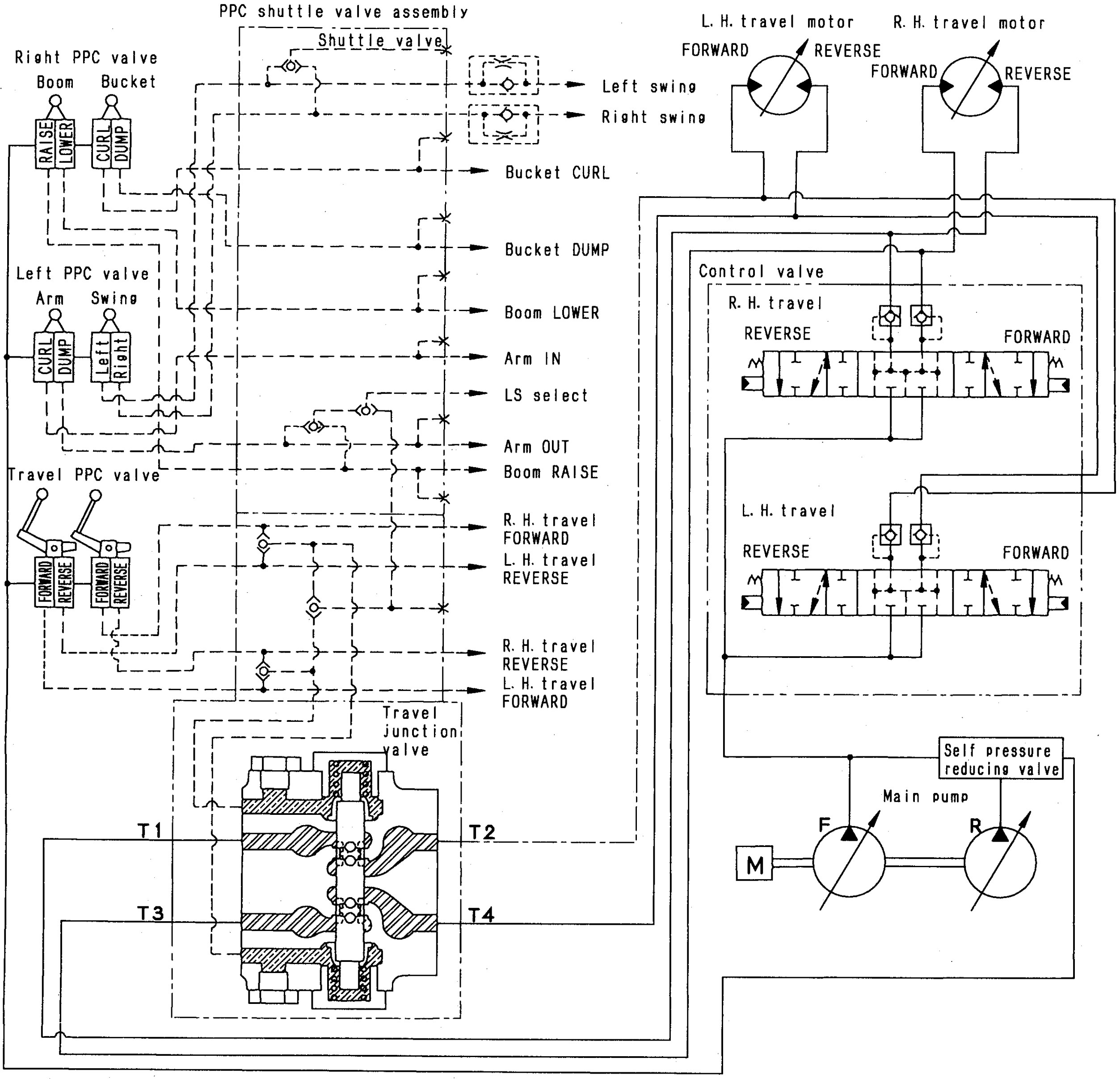
TRAVEL JUNCTION VALVE



1. Body
2. Plug
3. Spring
4. Spool
5. Spring
6. Plug

T1 : From L.H. travel control valve
T2 : From R.H. travel control valve
T3 : From L.H. travel control valve
T4 : From R.H. travel control valve
PF : From PPC shuttle valve
PR : From PPC shuttle valve

STRAIGHT-TRAVEL SYSTEM



SWP05108

Function

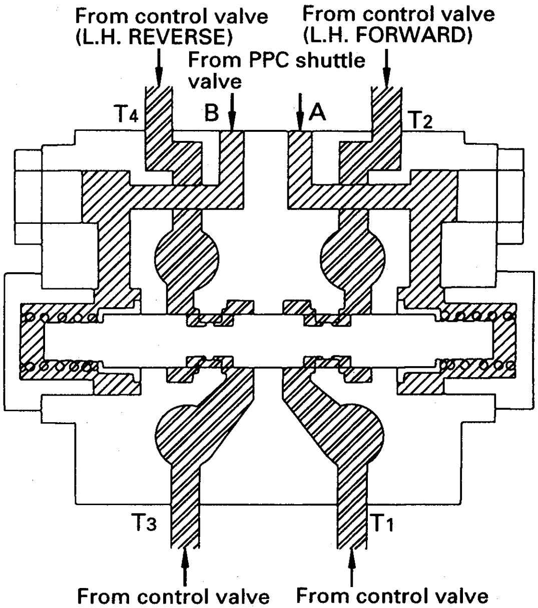
- A travel junction valve is installed between the travel valve and travel motor to compensate for any difference in the oil flow to the left and right travel circuits when traveling in a straight line.
- Because of this, the flow of oil to the left and right travel motors when traveling in a straight line is almost the same, so there is no travel deviation.
- The travel junction valve interconnects the travel circuits when the straight-travel is operated independently or when the straight travel + another actuator are operated simultaneously.
- When steering, if the difference in the movement of the travel levers is more than approx. 10 mm, the travel junction valve is switched, and the left and right travel circuits are shut off.

Operation

A: PPC output pressure (R.H. travel REVERSE or L.H. travel FORWARD)
B: PPC output pressure (R.H. travel FORWARD or L.H. travel REVERSE)

When traveling in a straight line in forward or reverse

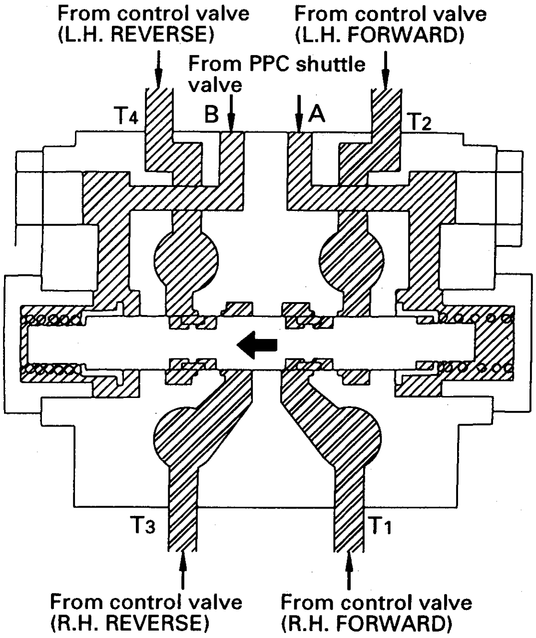
- When traveling forward (or in reverse), there is no difference in the pilot pressure from the PPC shuttle valve (the output pressure of each PPC valve), so the spool is balanced in the middle.
  In this condition, the R.H. FORWARD and L.H. FORWARD, and R.H. REVERSE and L.H. REVERSE are interconnected through the spool.



SBP00296

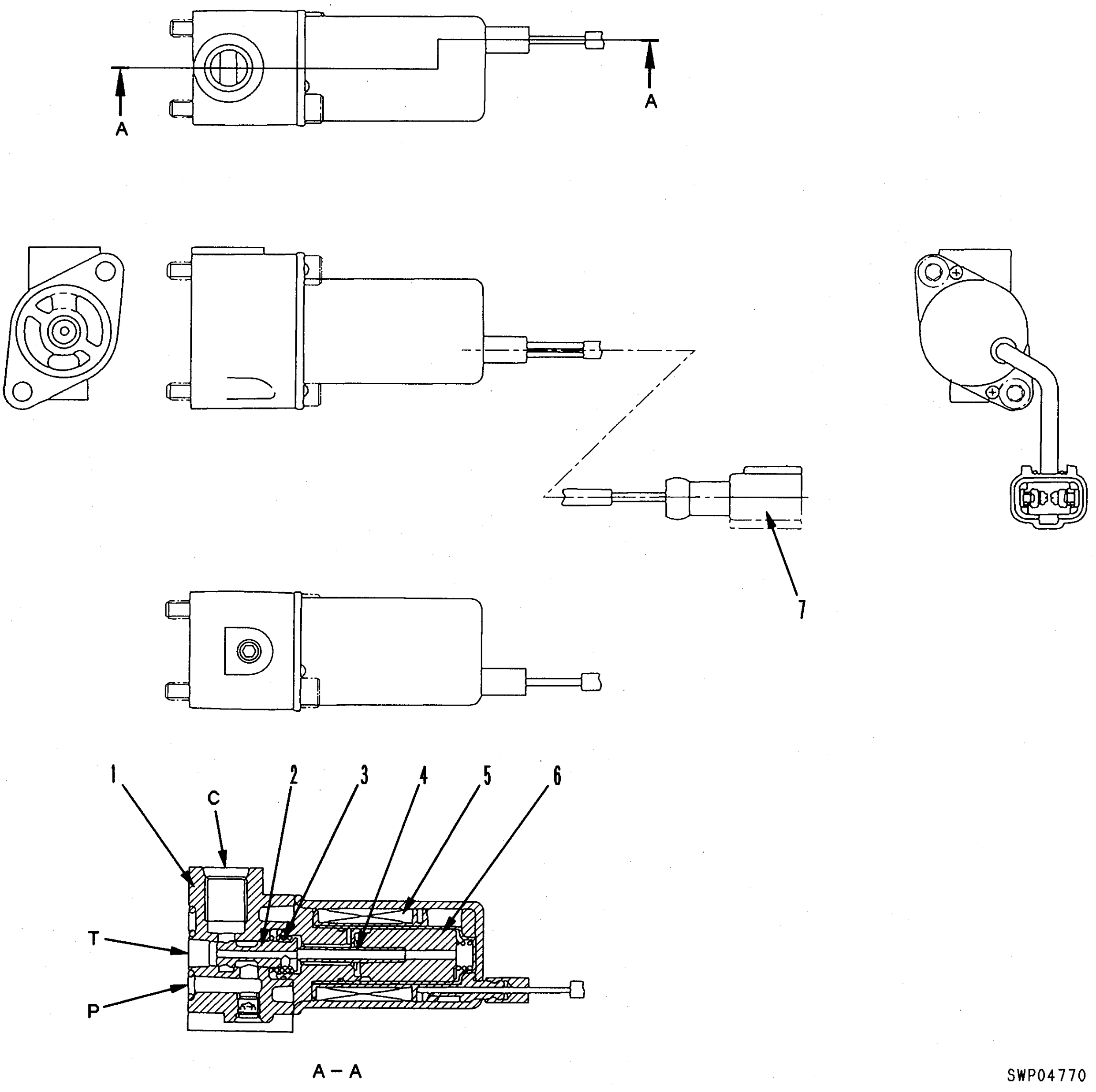
When steering in forward or reverse

- When the steering is operated in forward (or reverse), if the difference in the pilot pressure from the PPC shuttle valve becomes greater than the switching pressure (spring force), the spool moves to the right or left and the left and right forward and left and right reverse passages are separated. Because of this, a difference in pressure is created in the left and right circuits, and the steering can be operated.



SBP00297

LS-EPC VALVE

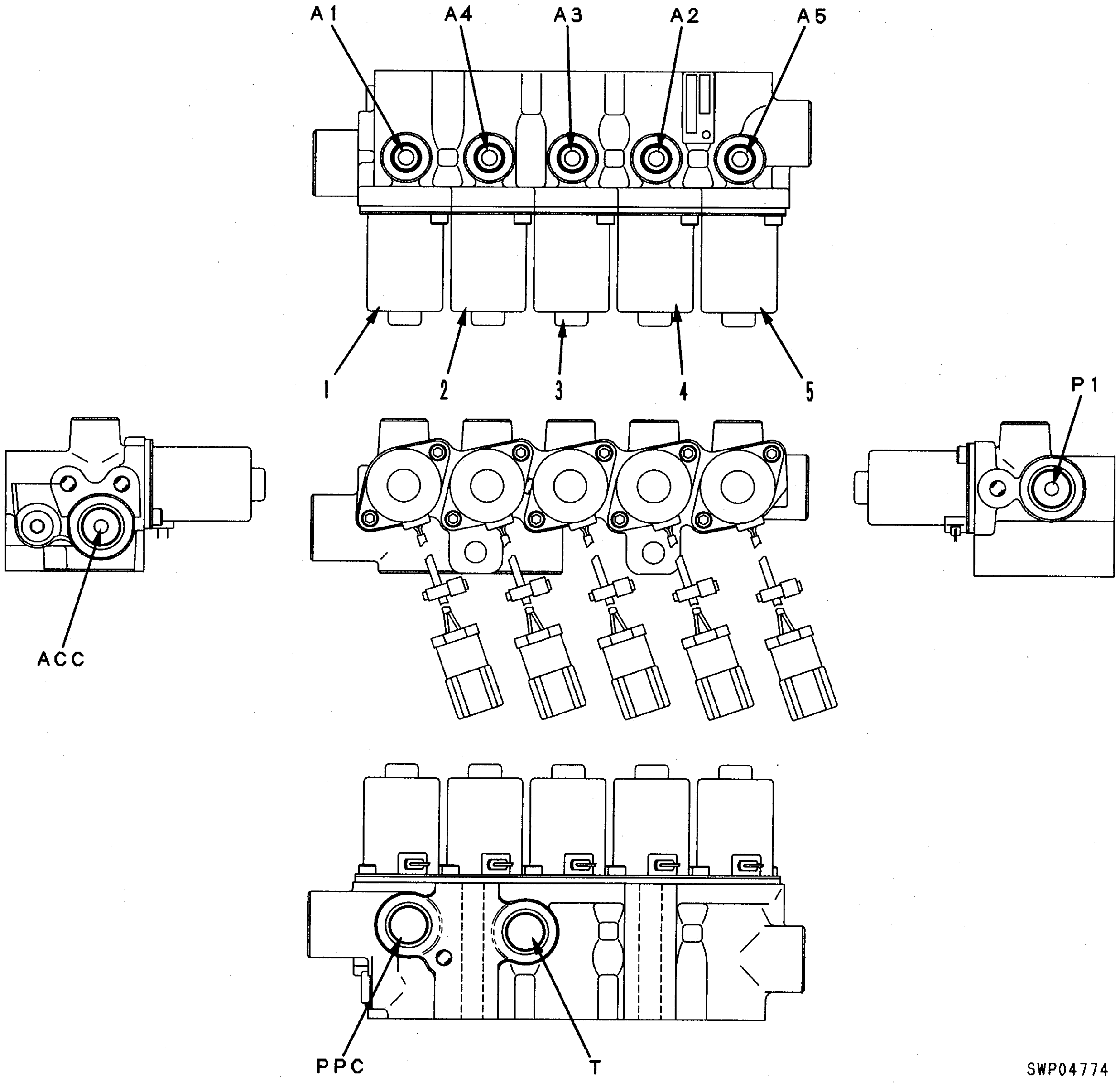


1. Body
2. Plug
3. Spring
4. Push pin
5. Coil
6. Pluger
7. Connector

C : To LS valve
T : To tank
P : From main pump

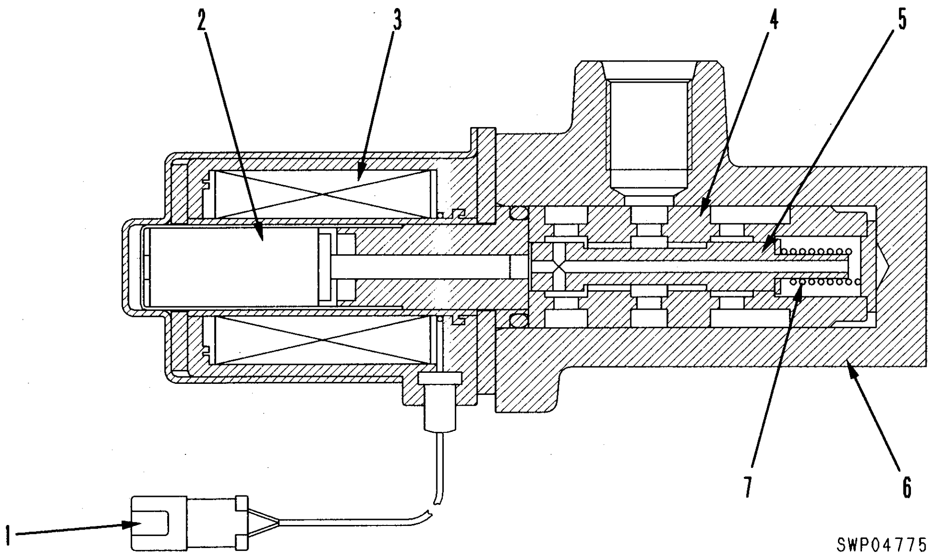
SOLENOID VALVE

FOR ACTIVE MODE, PUMP MERGE-DIVIDER, BOOM Hi 2-STAGE SAFETY VALVE, TRAVEL SPEED, SWING BRAKE SOLENOID VALVE



1. Active mode solenoid valve
2. Boom Hi 2-stage safety valve solenoid valve
3. Pump merge-divider solenoid valve
4. Travel speed solenoid valve
5. Swing brake solenoid valve

T : To tank
A1 : To main valve (active mode)
A2 : To L.H. and R.H. travel motor
A3 : To main valve (pump merge-divider valve)
A4 : To main valve (boom control valve)
A5 : To swing motor
P1 : From main pump
ACC: To accumulator
PPC: To PPC valve

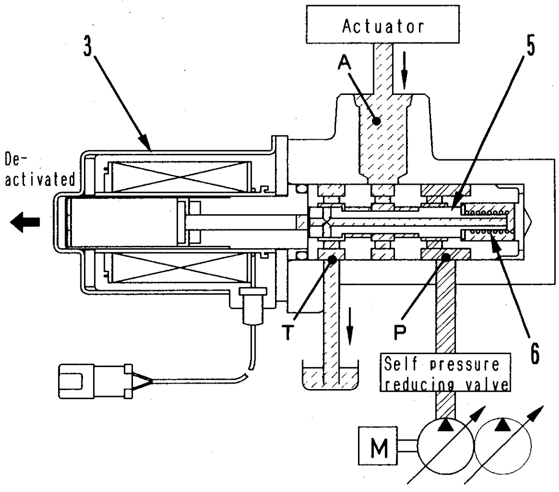


1. Connector
2. Movable core
3. Coil
4. Cage
   (PC400-6 Serial No.: 32001 – 32249
   PC450-6 Serial No.: 12001 – 12143)
5. Spool
6. Block
7. Spring

Operation

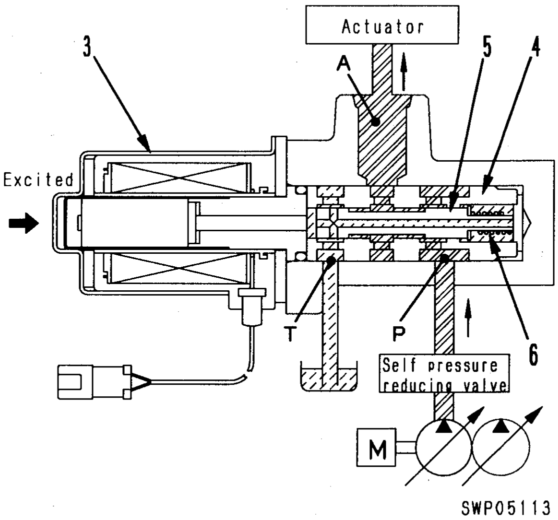
When solenoid is deactivated

- When the signal current does not flow from the PPC lock switch or swing lock switch, solenoid (3) is deactivated.
  For this reason, spool (5) is pushed fully to the right by spring (6).
  As a result, the circuit between ports **P** and **A** closes and the pressurized oil from the main pump does not flow to the actuator.
  At the same time, the pressurized oil from the actuator flows from port **A** to port **T**, and is then drained to the tank.

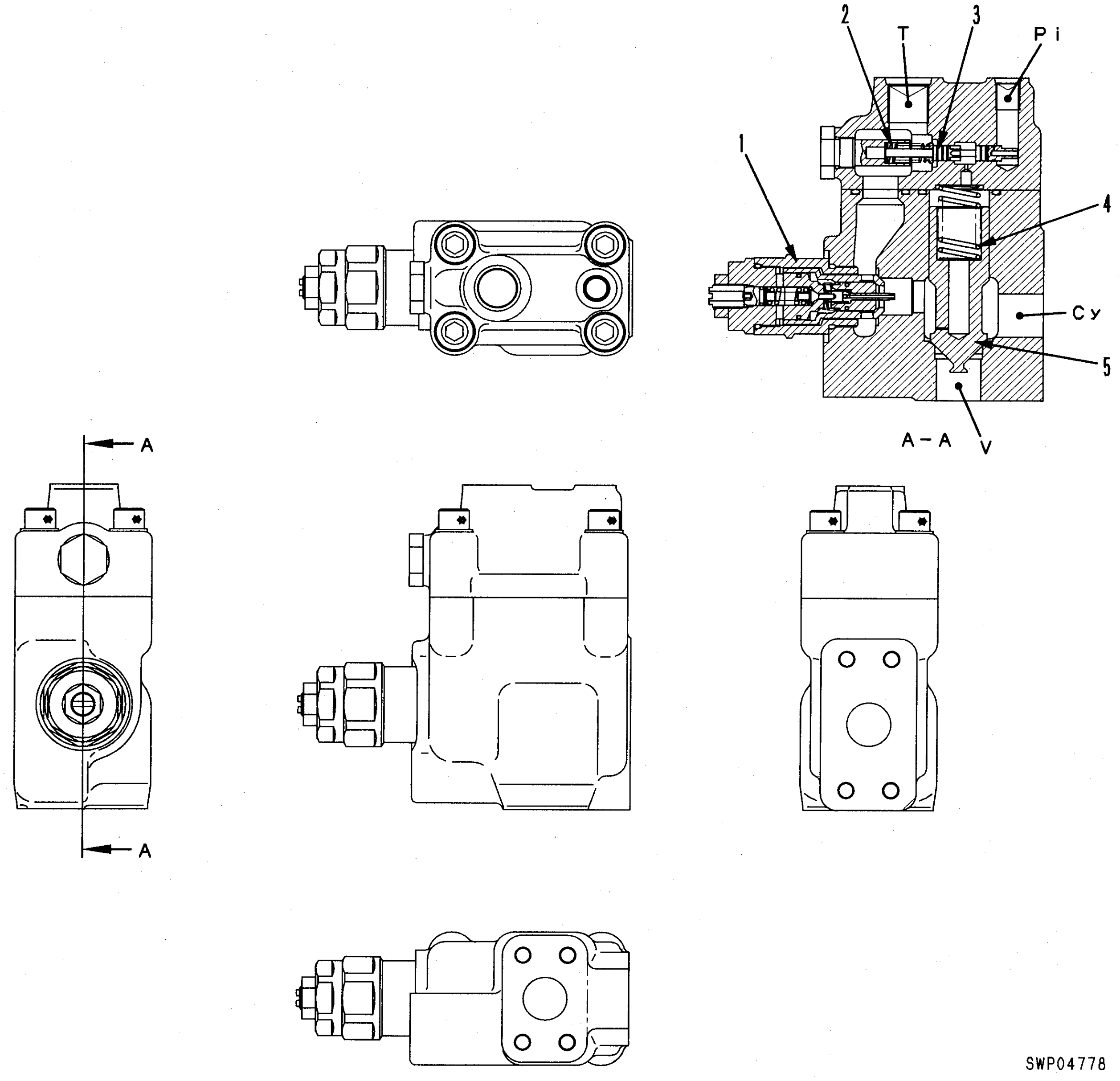


When solenoid is excited

- When the signal current flows from the PPC lock switch or swing lock switch to solenoid (3), solenoid (3) is excited.
  For this reason, spool (5) is pushed to the left in the direction of the arrow.
  As a result, the pressurized oil from the main pump flows from port **P** through the inside of spool (5) to port **A**, and then flows to the actuator. At the same time, port **T** is closed, and this stops the oil from flowing to the tank.



BOOM HOLDING VALVE



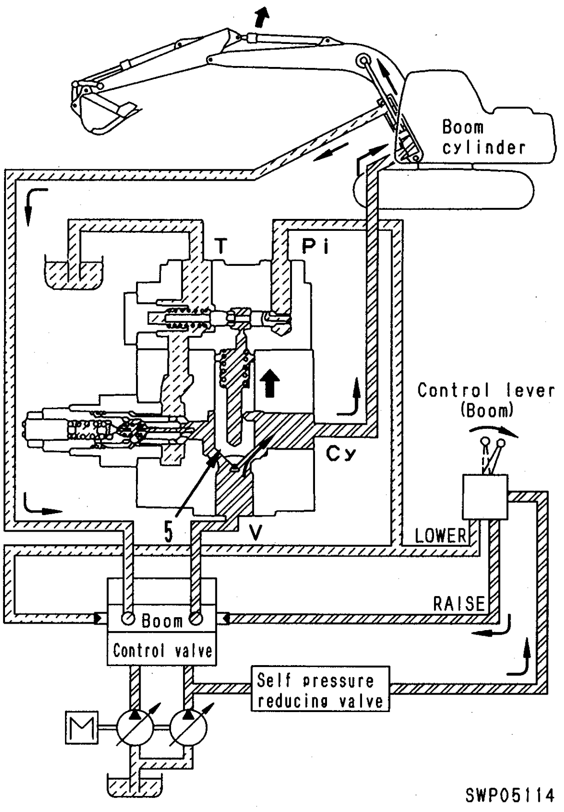
1. Safety-suction valve
2. Pilot spring
3. Pilot spool
4. Poppet spring
5. Poppet

T : To tank
V : From control valve
Cy : To boom cylinder bottom
Pi : From PPC valve (pilot pressure)

Operation

1) At boom RAISE

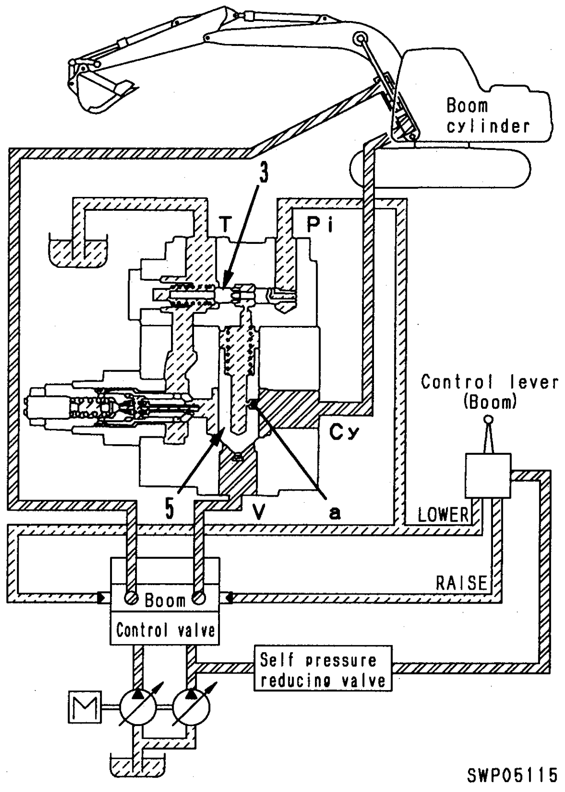
When the boom is raised, the main pressure from the control valve pushes poppet (5) up. Because of this, the main pressure from the control valve passes through the valve and flows to the bottom end of the boom cylinder.



2) Boom lever at HOLD

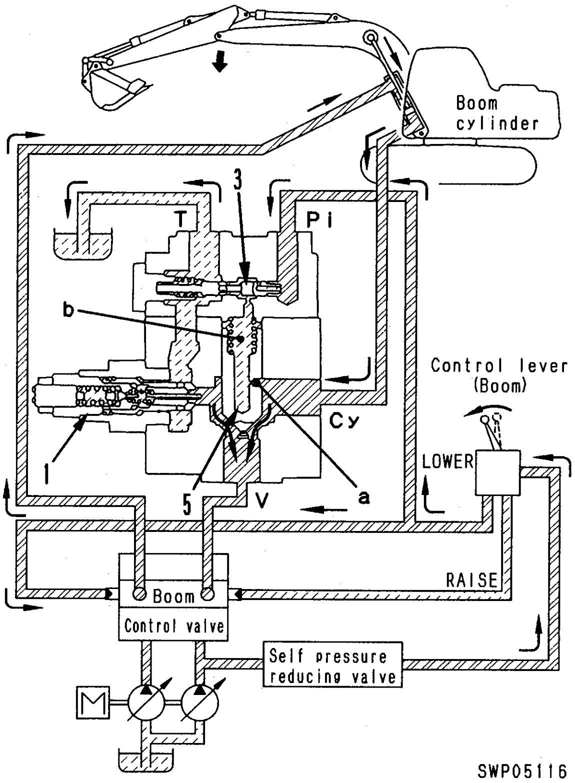
When the boom is raised and the control lever is returned to HOLD, the circuit for the holding pressure at the bottom end of the boom cylinder is closed by poppet (5). At the same time, the oil flowing into poppet (5) through orifice **a** of poppet (5) is closed by pilot spool (3).

As a result, the boom is held in position.



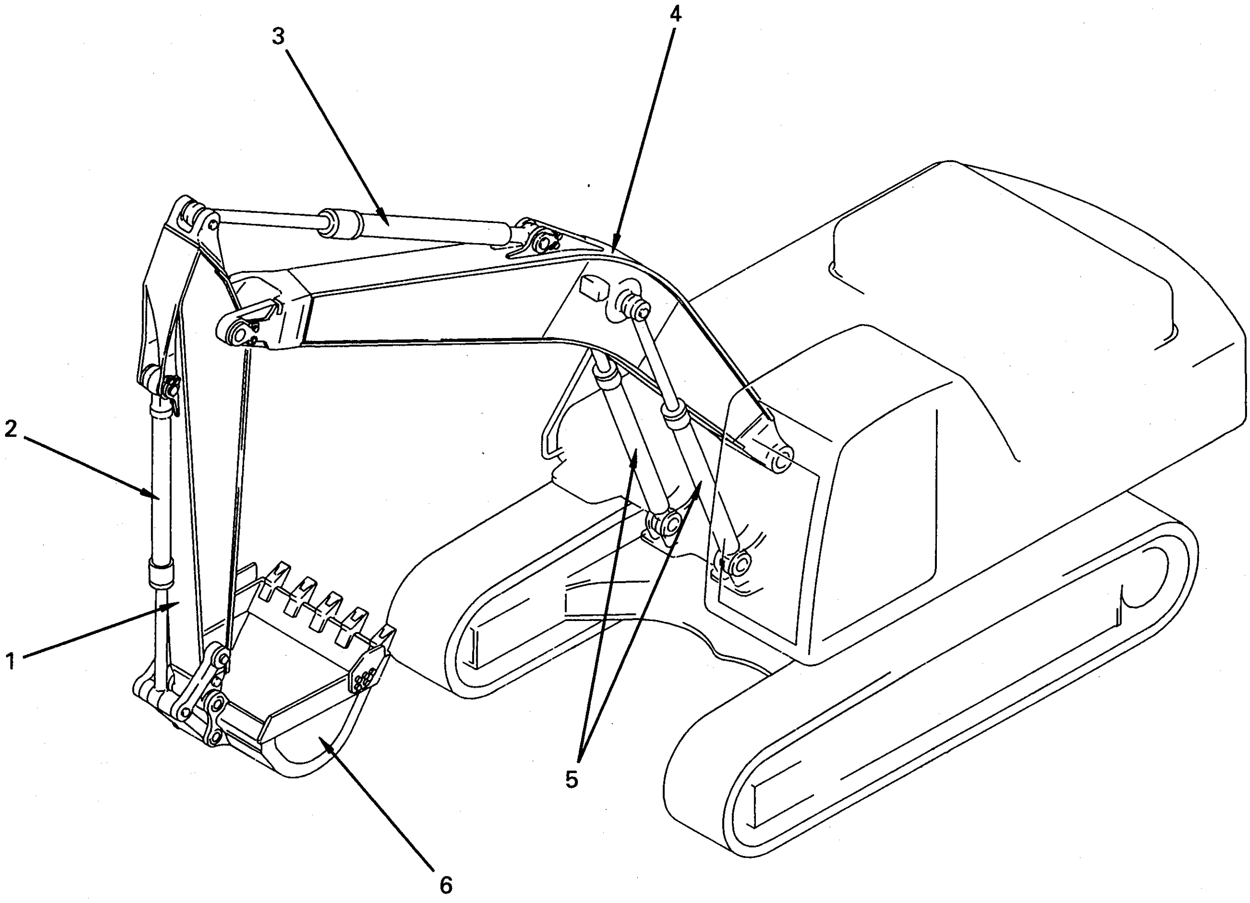
3) At boom LOWER

When the boom is lowered, the pilot pressure flows to port **Pi** from the PPC valve pushes pilot spool (3) and the pressurized oil in chamber **b** inside the poppet is drained.
When the pressure at port **Cy** rises because of the pressurized oil from the bottom end of the boom cylinder, the pressure of the pressurized oil in chamber **b** is lowered by orifice **a**.
If the pressure in chamber **b** drops below the pressure at port **V**, poppet (5) opens, the pressurized oil flows from port **Cy** to port **V**, and then flows to the control valve.
If any abnormal pressure is generated in the circuit at the bottom end of the boom cylinder, safety valve (1) is actuated and drain oil from port **Cy** to port **T**.



SWP05116

WORK EQUIPMENT

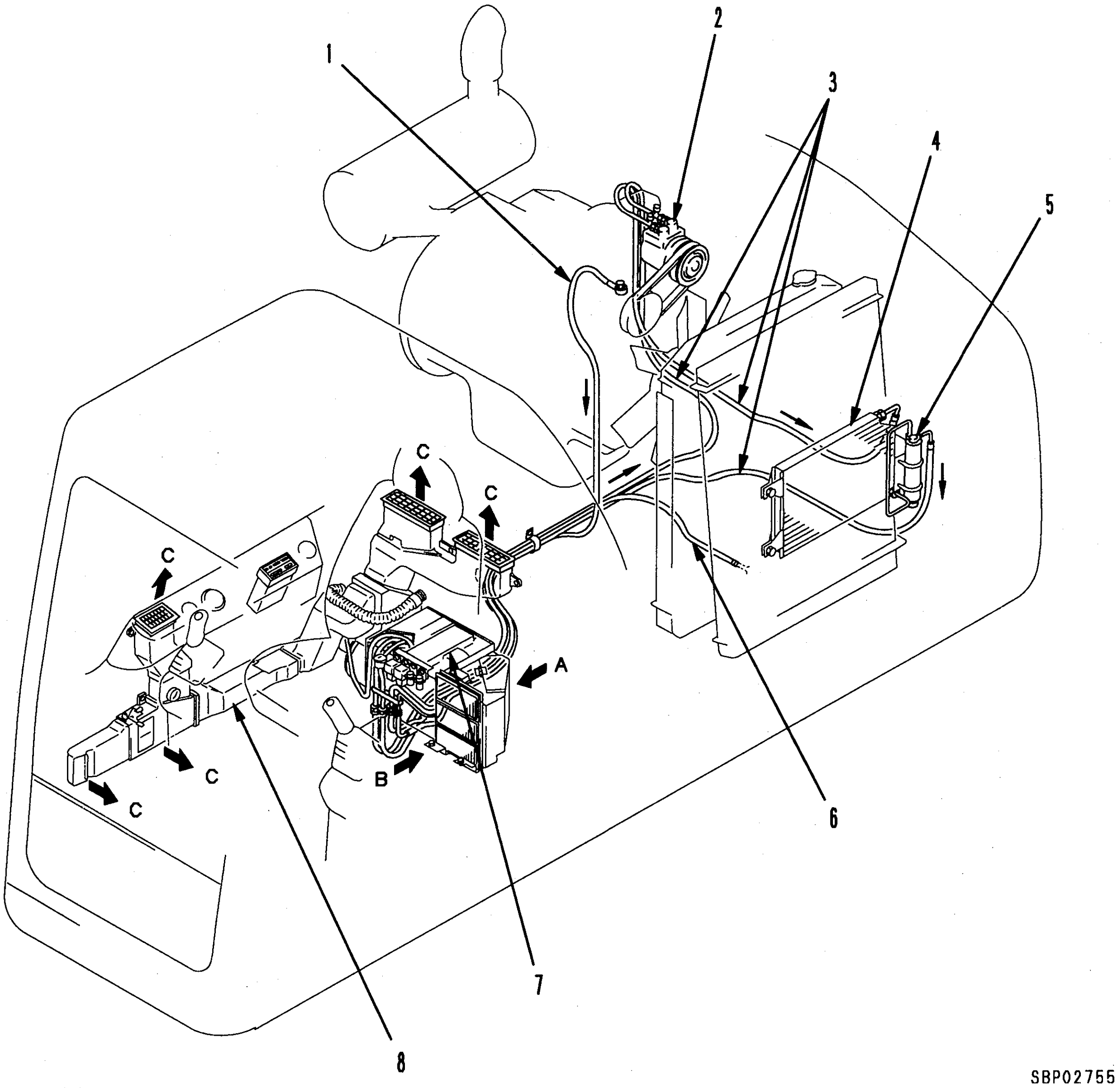


SBP00311

1. Arm
2. Bucket cylinder
3. Arm cylinder
4. Boom
5. Boom cylinder
6. Bucket

AIR CONDITIONER

AIR CONDITIONER PIPING

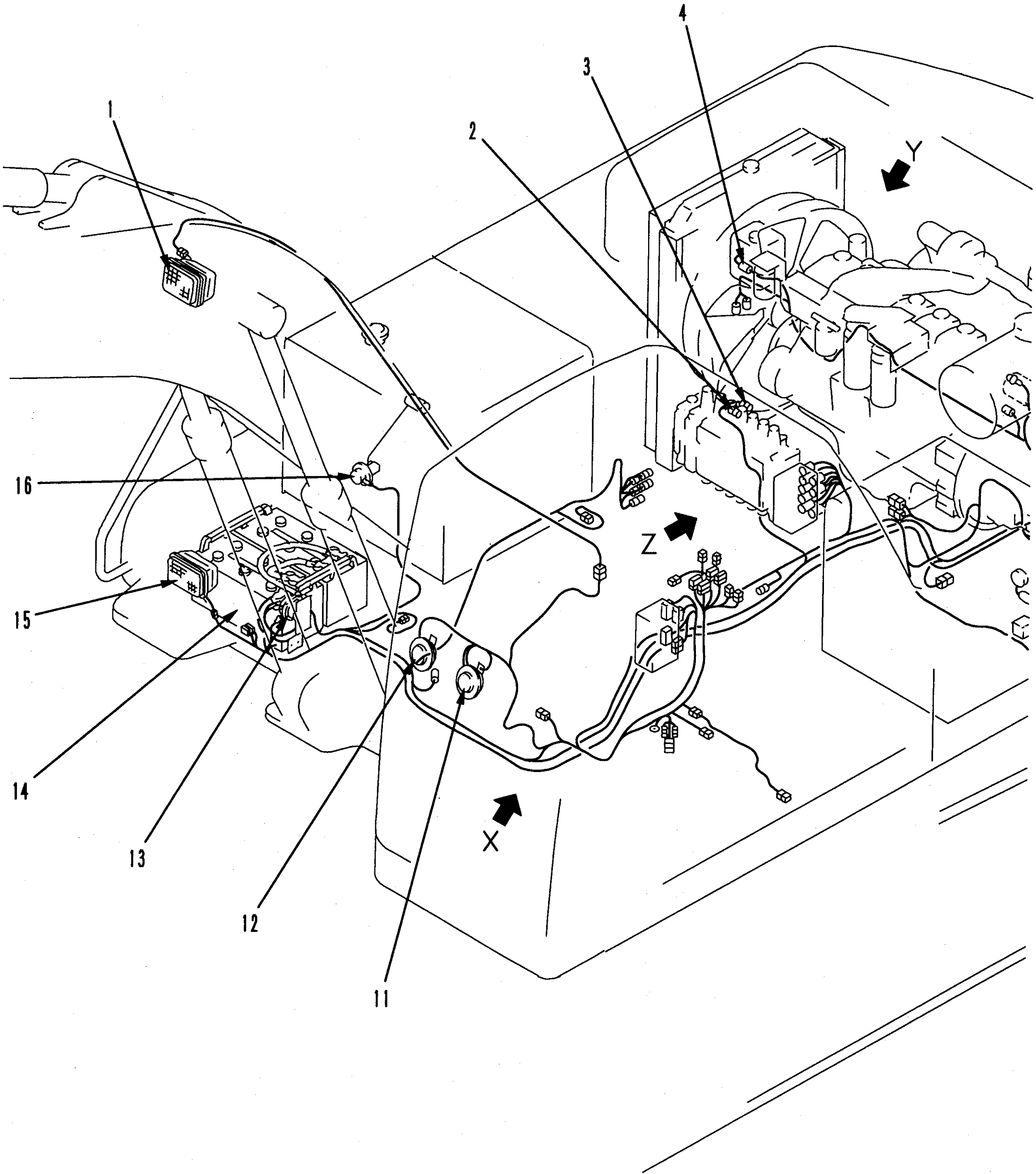


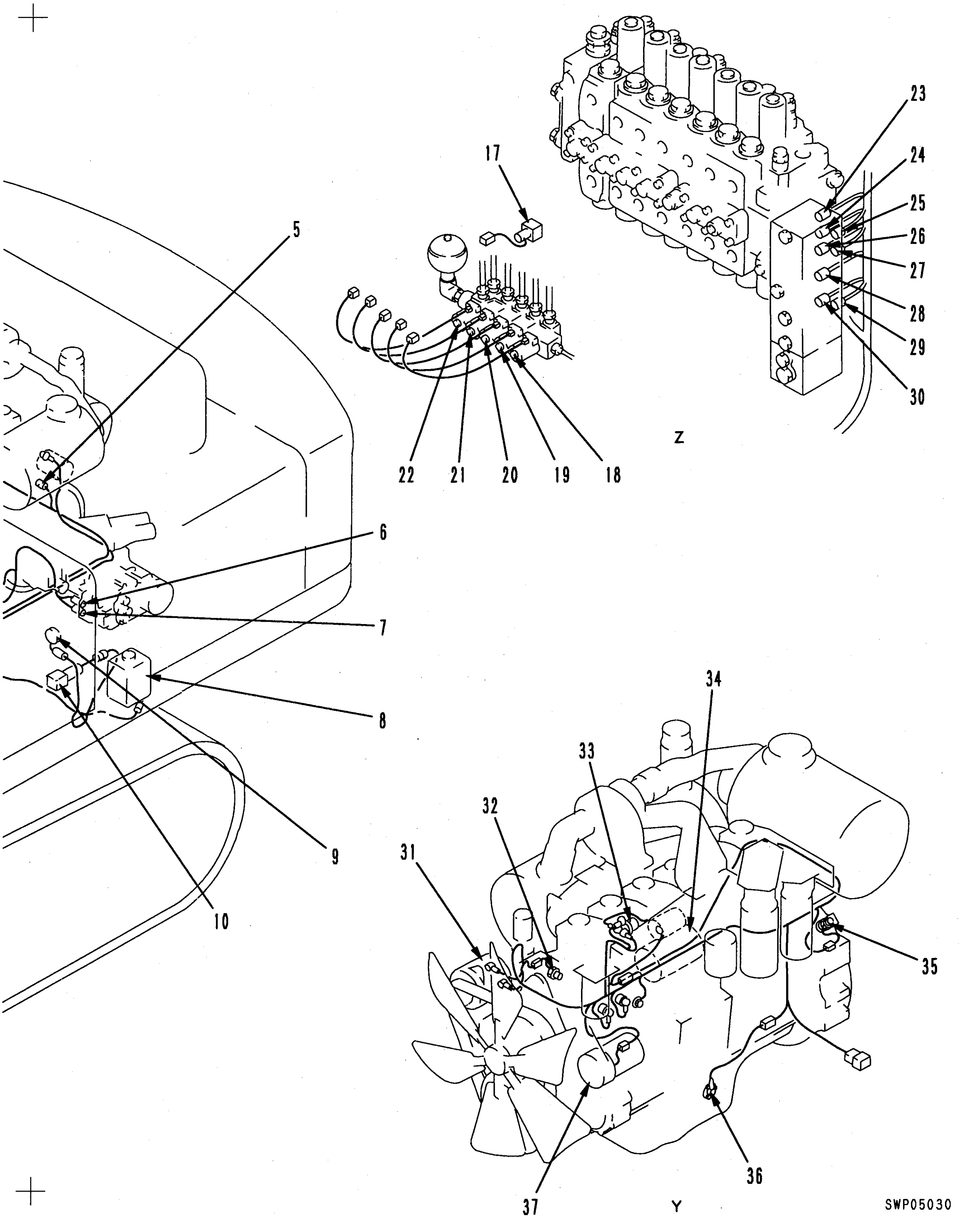
1. Hot water pickup piping
2. Air conditioner compressor
3. Refrigerant piping
4. Condenser
5. Receiver tank
6. Hot water return piping
7. Air conditioner unit
8. Duct

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

ACTUAL ELECTRIC WIRING DIAGRAM

(1/2)

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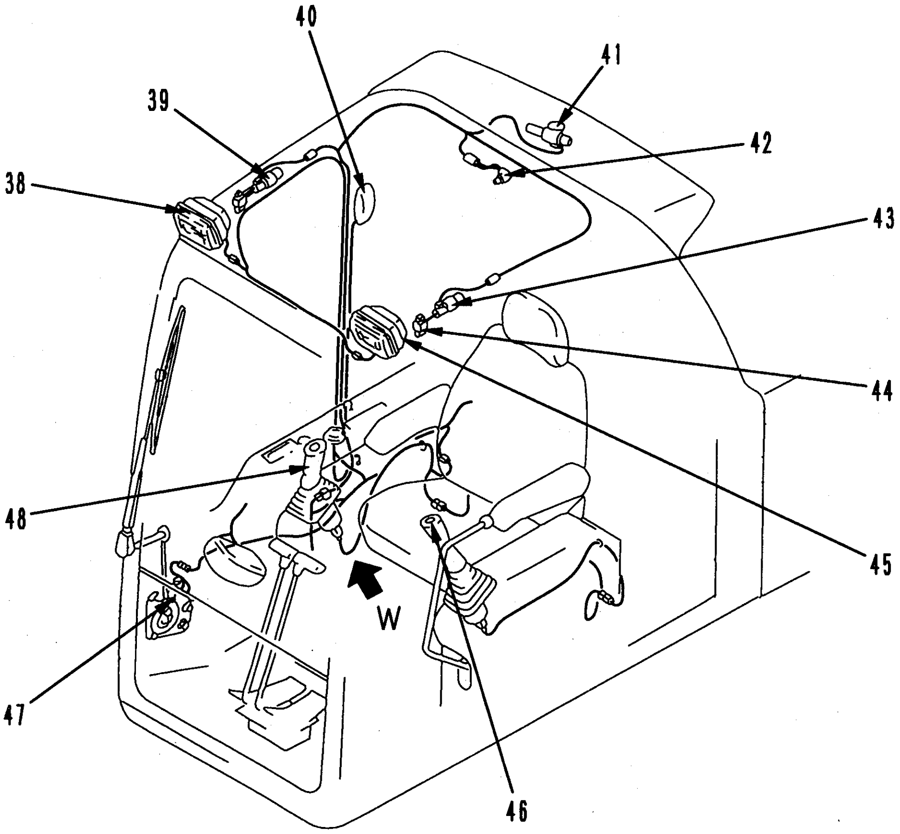
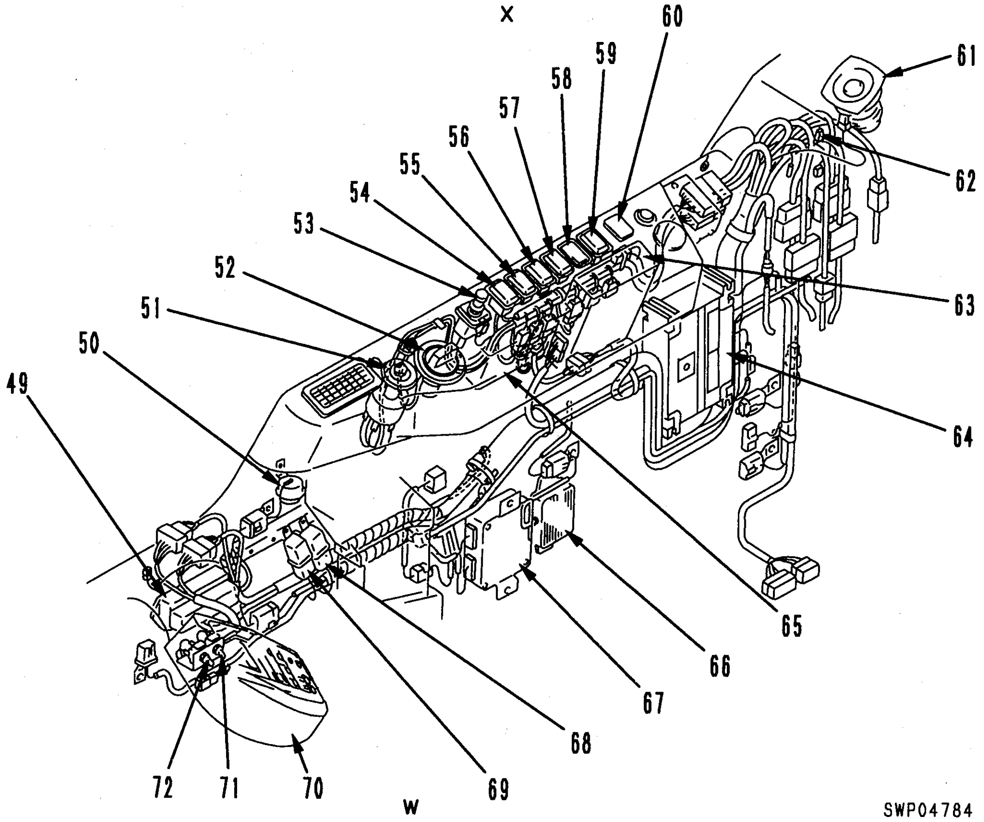
SWP05030

(2/2)



X

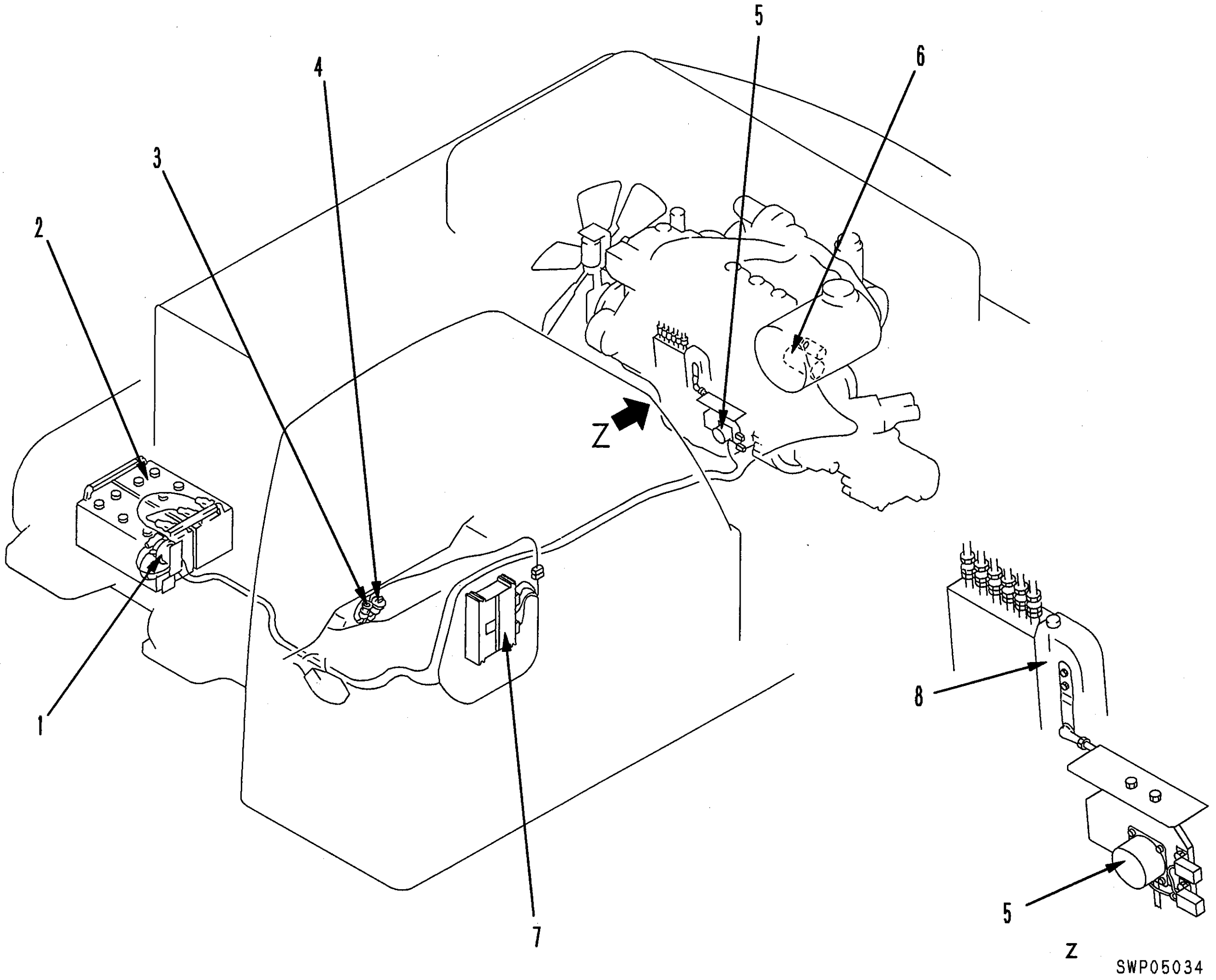


W

SWP04784

1. Working lamp
2. Front pump pressure sensor
3. Rear pump pressure sensor
4. Radiator water level sensor
5. Engine speed sensor
6. Front pump TVC solenoid
7. Rear pump TVC solenoid
8. Window washer tank
9. Hydraulic oil level sensor
10. LS-EPC valve
11. Horn (high tone)
12. Horn (low tone)
13. Battery relay
14. Battery
15. Right head lamp
16. Fuel level sensor
17. Active (swing) solenoid valve
18. Swing brake solenoid valve
19. Travel speed solenoid valve
20. Pump merge/divider solenoid valve
21. Boom Hi 2-stage safety solenoid valve
22. Active (boom) solenoid valve
23. Swing pressure switch
24. Bucket DUMP pressure switch
25. Bucket CURL pressure switch
26. Arm IN pressure switch
27. Boom LOWER pressure switch
28. Arm OUT pressure switch
29. Travel pressure switch
30. Boom RAISE pressure switch
31. Engine water temperature sensor
32. Electrical intake air heater
33. Engine oil pressure sensor
34. Starting motor
35. Air conditioner compressor
36. Engine oil level sensor
37. Alternator
38. Additional right head lamp
39. Right front lock
40. Room lamp
41. Auto pull-up motor
42. Window limit switch (rear)
43. Left front lock
44. Window limit switch (front)
45. Additional left head lamp
46. Left knob switch
47. Wiper motor
48. Horn switch
49. Fuse box
50. Alarm buzzer
51. Starting switch
52. Fuel control dial
53. Cigarette lighter
54. Swing lock switch
55. Wiper, washer switch
56. Lamp switch
57. Buzzer cancel switch
58. Car heater fan switch
59. Machine push-up switch
60. Front window auto pull-up switch
61. Speaker
62. Kerosene mode connector
63. Air conditioner control panel
64. Engine throttle, pump controller
65. Radio
66. TVC prolix resistor
67. Wiper motor controller
68. Lamp relay
69. Lamp relay
70. Monitor panel
71. Swing prolix switch
72. Pump prolix switch

ENGINE CONTROL



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

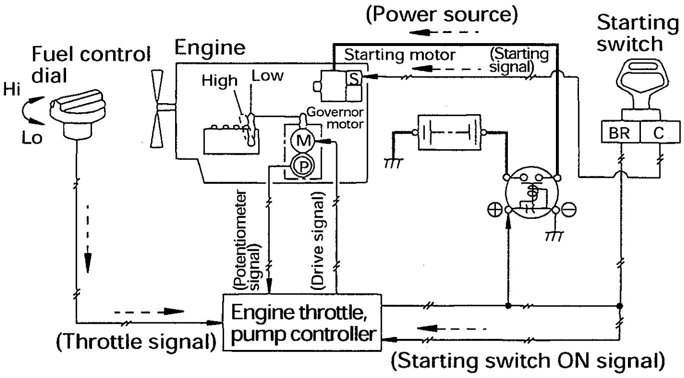
Function

- The engine can be started and stopped simply by using the starting switch (3).
- A dial-type engine control is used to control the engine speed. The engine throttle, pump controller (7) receives the control signal from the fuel control dial (4), sends a drive signal to the governor motor (5), and controls the angle of the governor lever in the fuel injection pump.

1. Operation of system

Starting engine

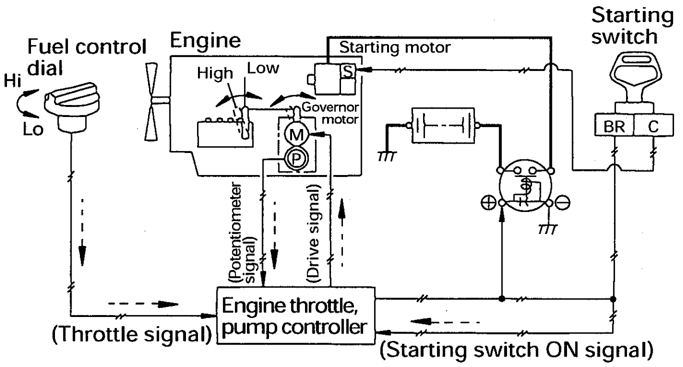
- When the starting switch is turned to the START position, the starting signal flows to the starting motor, and the starting motor turns to start the engine.
  When this happens, the engine throttle, pump controller checks the signal from the fuel control dial and sets the engine speed to the speed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



SBP00321

Engine speed control

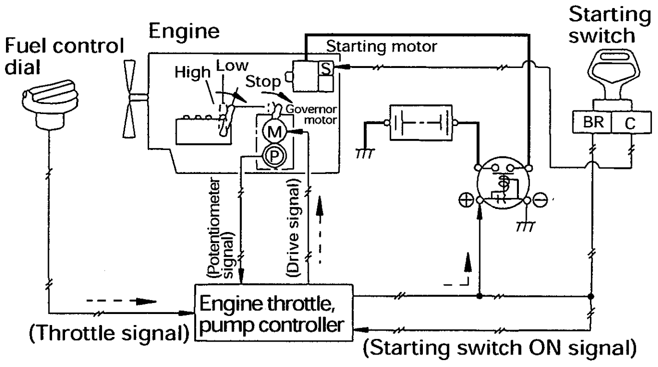
- The fuel control dial sends a signal to the engine throttle, pump controller according to the position of the dial.
  The engine throttle, pump controller calculates the angle of the governor motor according to this signal, and sends a signal to drive the governor motor so that it is at that angle.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



SBP00322

Stopping engine

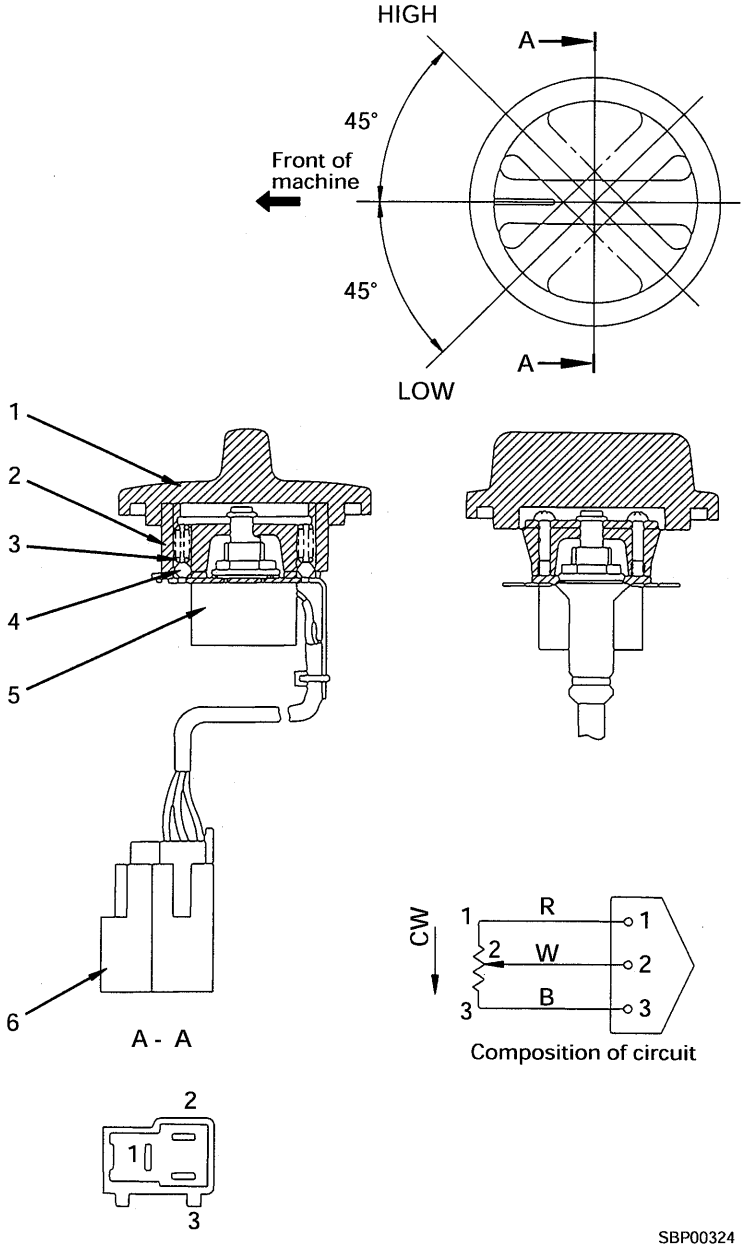
- When engine throttle, pump controller detects that the starting switch is turned to the STOP position, it drives the governor motor so that the governor lever is set to the NO INJECTION position.
- When this happens, to maintain the electric power in the system until the engine stops completely, the engine throttle, pump controller itself drives the battery relay.



SBP00323

2. Components of system

Fuel control dial

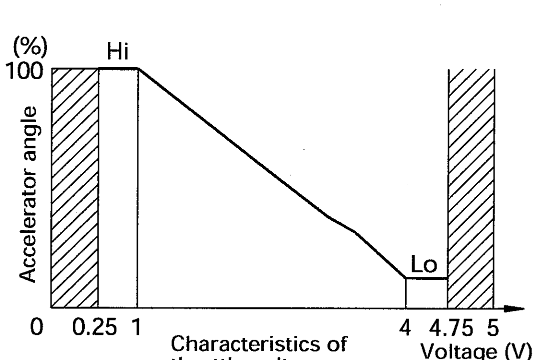


Composition of circuit

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

Function

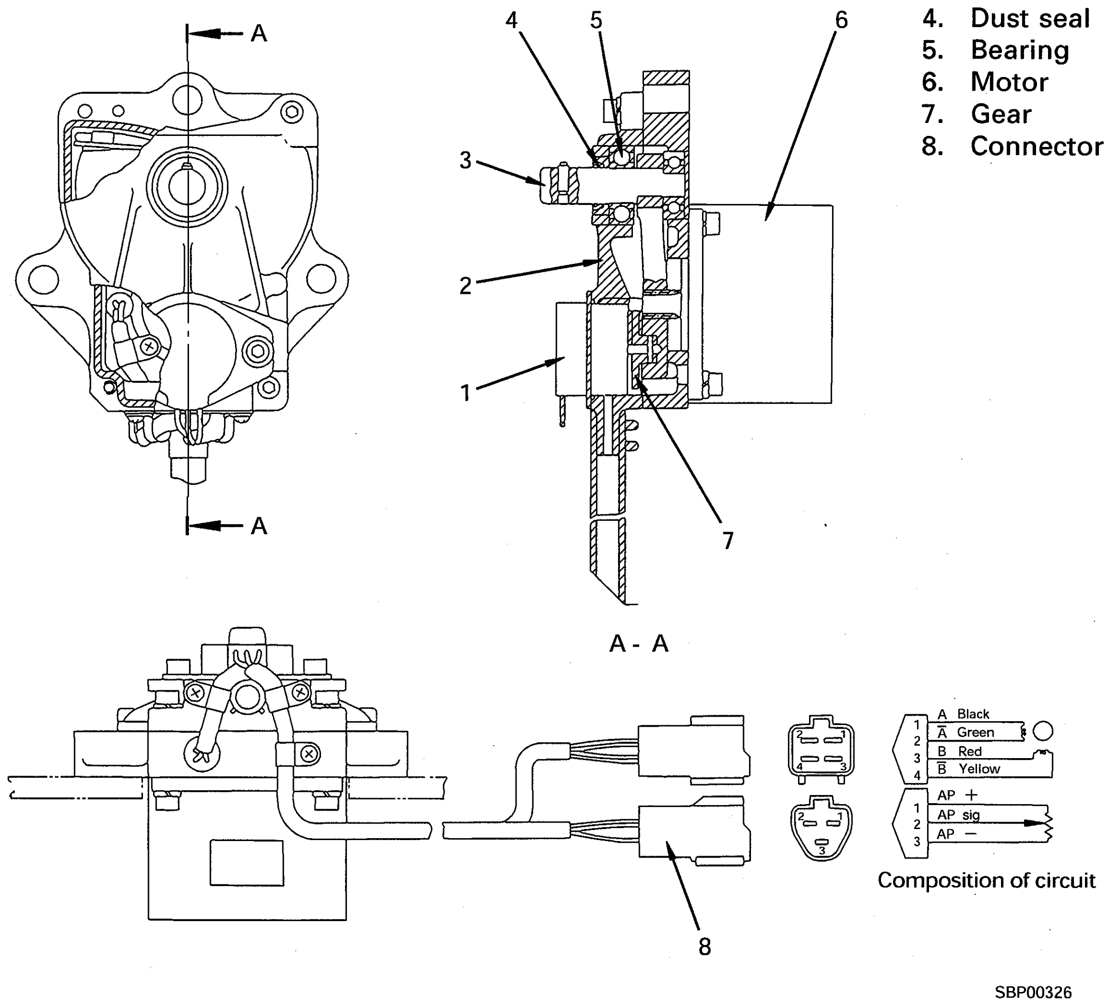
- The fuel control dial is installed at the bottom of the monitor panel. A potentiometer is installed under the knob, and when the knob is turned, it rotates the potentiometer shaft.
  When the shaft rotates, the resistance of the variable resistor inside the potentiometer changes, and the desired throttle signal is sent to the engine throttle, pump controller. The shaded area in the graph on the right is the abnormality detection area and the engine speed is set at low idling.



Characteristics of throttle voltage

Governor motor

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



Function

- The motor is rotated and the governor lever of the fuel injection pump is controlled by the drive signal from the engine throttle, pump controller.
  A stepping motor is used for the motor which provides the power.
- In addition, a potentiometer for giving feedback is installed to allow observation of the operation of the motor.
- The rotation of the motor is transmitted to the potentiometer through a gear.

Operation

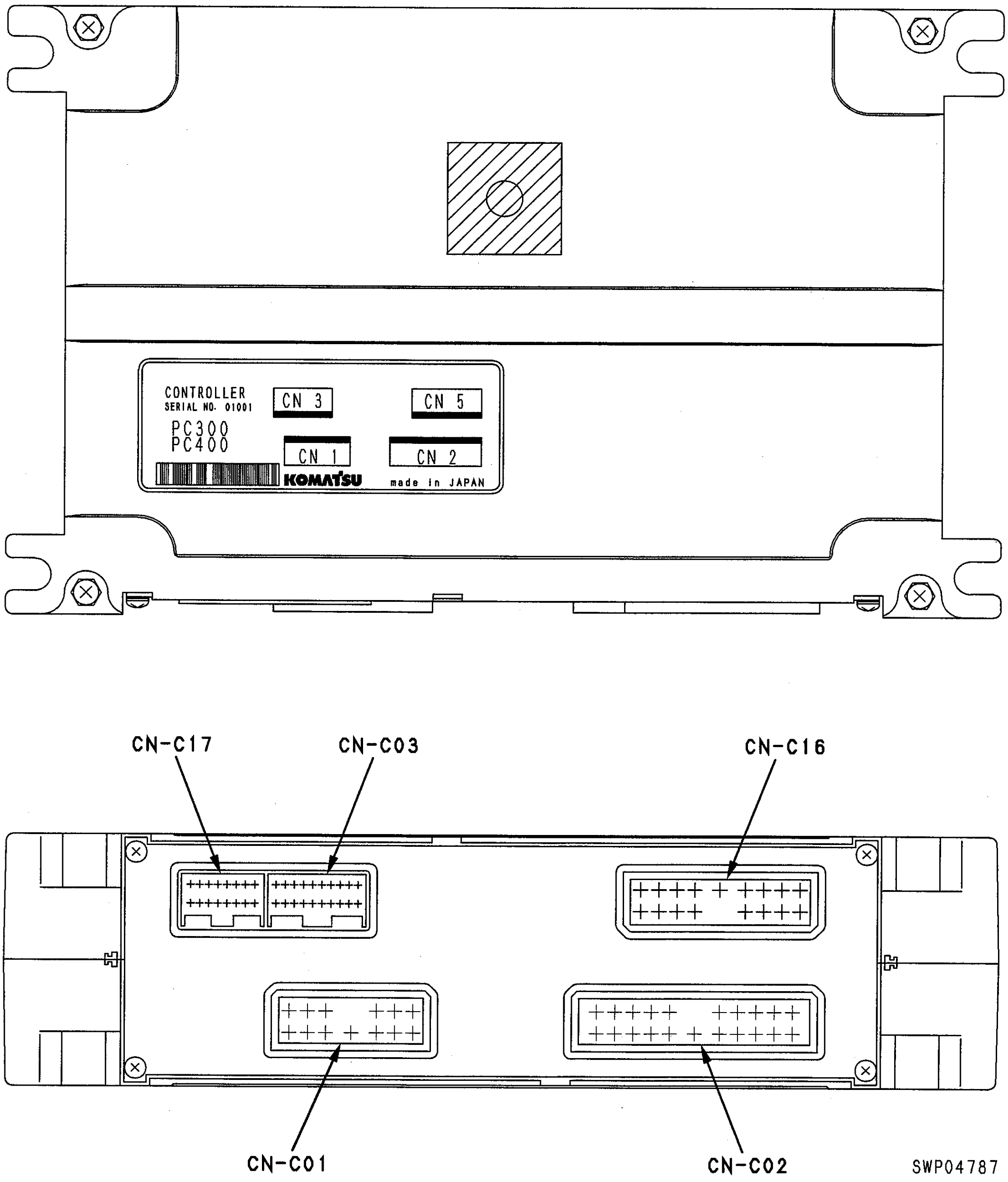
Motor stationary

- Both A phase and B phase of the motor are continuous, and a holding torque is generated in the motor.

Motor rotating

- A pulse current is applied to the A phase and B phase from the engine throttle, pump controller to give synchronous rotation with the pulse.

Engine throttle, pump controller



Input and output signals

CN-C01

Pin No.	Name of signal	Input/ output
1	Battery relay drive output	Output
2	Pump merge/divider solenoid/NC	Output
3	Swing holding brake solenoid	Output
4	NC	
5	NC	
6	GND	Input
7	Power source (+24V)	Input
8	Active mode solenoid (boom)	Output
9	Travel selector solenoid	Output
10	Active mode solenoid (swing)	Output
11	NC	
12	GND	Input
13	Power source (+24V)	Input

CN-C02

Pin No.	Name of signal	Input/ output
1	Solenoid power source (+24V)	Input
2	Governor motor phase A (+)	Output
3	Governor motor phase A (–)	Output
4	Governor motor phase B (+)	Output
5	Governor motor phase B (–)	Output
6	NC	
7	LS-EPC solenoid (+)	Output
8	TVC solenoid 1 (+)	Output
9	TVC solenoid 2 (+)	Output
10	NC	
11	PGND	Input
12	Solenoid power source (+24V)	Input
13	NC	
14	NC	
15	NC	
16	NC	
17	LS-EPC solenoid (–)	Output
18	TVC solenoid 1 (–)	Output
19	TVC solenoid 2 (–)	Output
20	NC	
21	PGND	Input

CN-C03

Pin No.	Name of signal	Input/ output
1	Engine water temperature sensor	Input
2	Fuel level sensor	Input
3	Pump F pressure input	Input
4	Throttle potentiometer input	Input
5	NC	
6	Pressure sensor power source (+24V)	Output
7	Potentiometer power source (+5V)	Output
8	Starting switch (ACC)	Input
9	Knob switch	Input
10	Hydraulic oil temperature sensor (monitor panel)	Input
11	Hydraulic oil temperature sensor (thermistor type)	Input
12	Battery charge (alternator terminal R)	Input
13	Pump R pressure input	Input
14	Feedback potentiometer input	Input
15	NC	Input
16	Pressure sensor GND	Input
17	Potentiometer GND	Input
18	Starting switch (terminal C)	Input
19	Automatic greasing controller abnormality	Input
20	Hydraulic filter sensor	Input

CN-C17

Pin No.	Name of signal	Input/ output
1	PPC pressure	Input
2	Boom RAISE pressure switch	Input
3	Arm IN pressure switch	Input
4	S-NET(+)	Input, output
5	Model selection 1	Input
6	Model selection 3	Input
7	Model selection 5	Input
8	Swing prolix switch	Input
9	Overload sensor	Input
10	Boom LOWER pressure switch	Input
11	Arm OUT pressure switch	Input
12	S-NET(+)	Input, output
13	Model selection 2	Input
14	Model selection 4	Input
15	Kerosene mode selection	Input
16	Swing lock switch	Input

CN-16

Pin No.	Name of signal	Input/ output
1	Engine speed sensor GND	Input
2	Engine speed sensor	Input
3	GND	Input
4	GND	Input
5	Swing pressure switch	Input
6	Service valve pressure switch	Input
7	Engine oil pressure sensor H	Input
8	Radiator water level sensor	Input
9	Hydraulic oil level sensor	Input
10	Engine speed sensor GND	Input
11	Bucket CURL pressure switch	Input
12	Bucket DUMP pressure switch	Input
13	Travel pressure switch	Input
14	NC	Input
15	Engine oil pressure sensor L	Input
16	Engine oil level sensor	Input
17	Air cleaner clogging sensor	Input

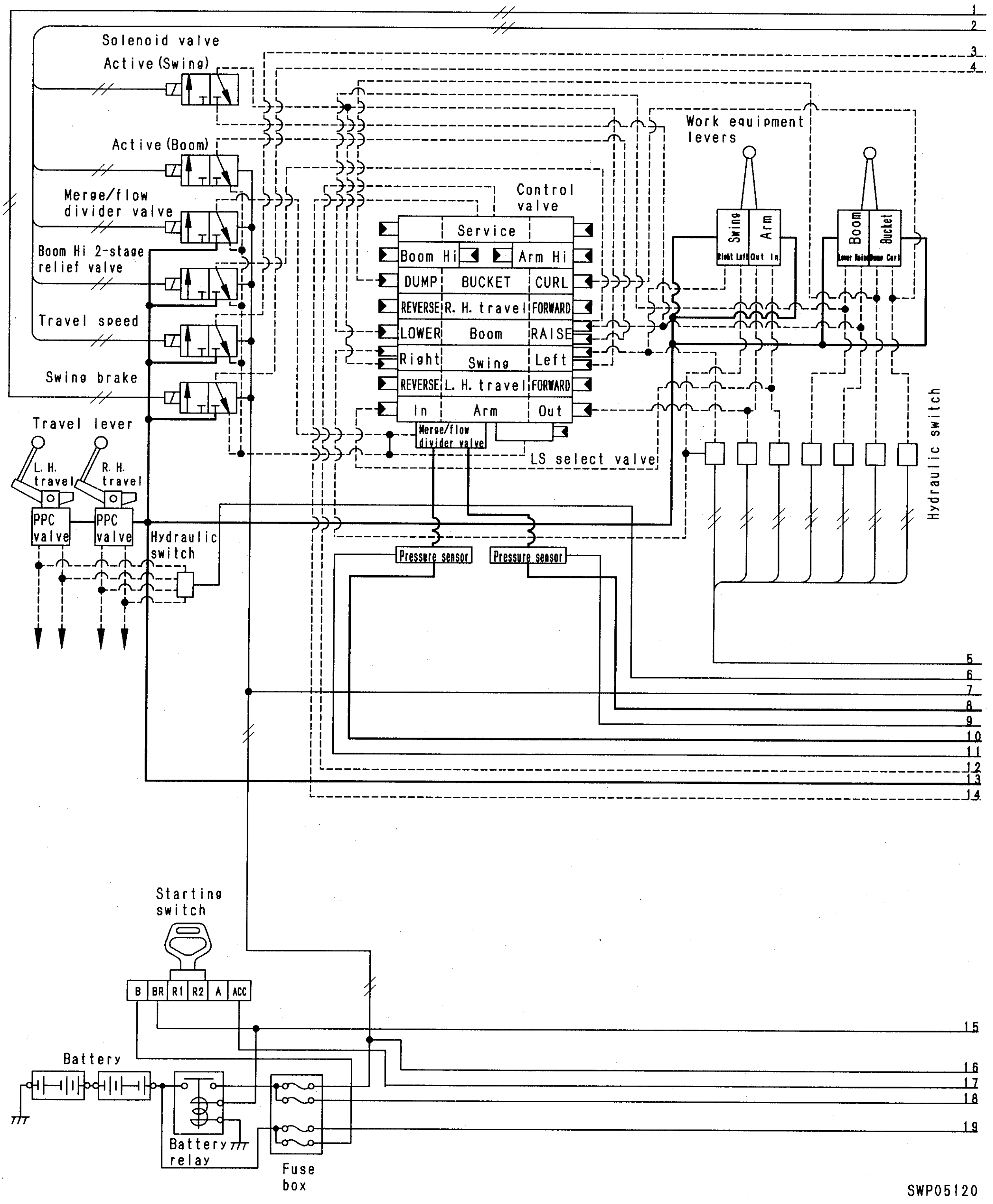
ELECTRONIC CONTROL SYSTEM

CONTROL FUNCTION

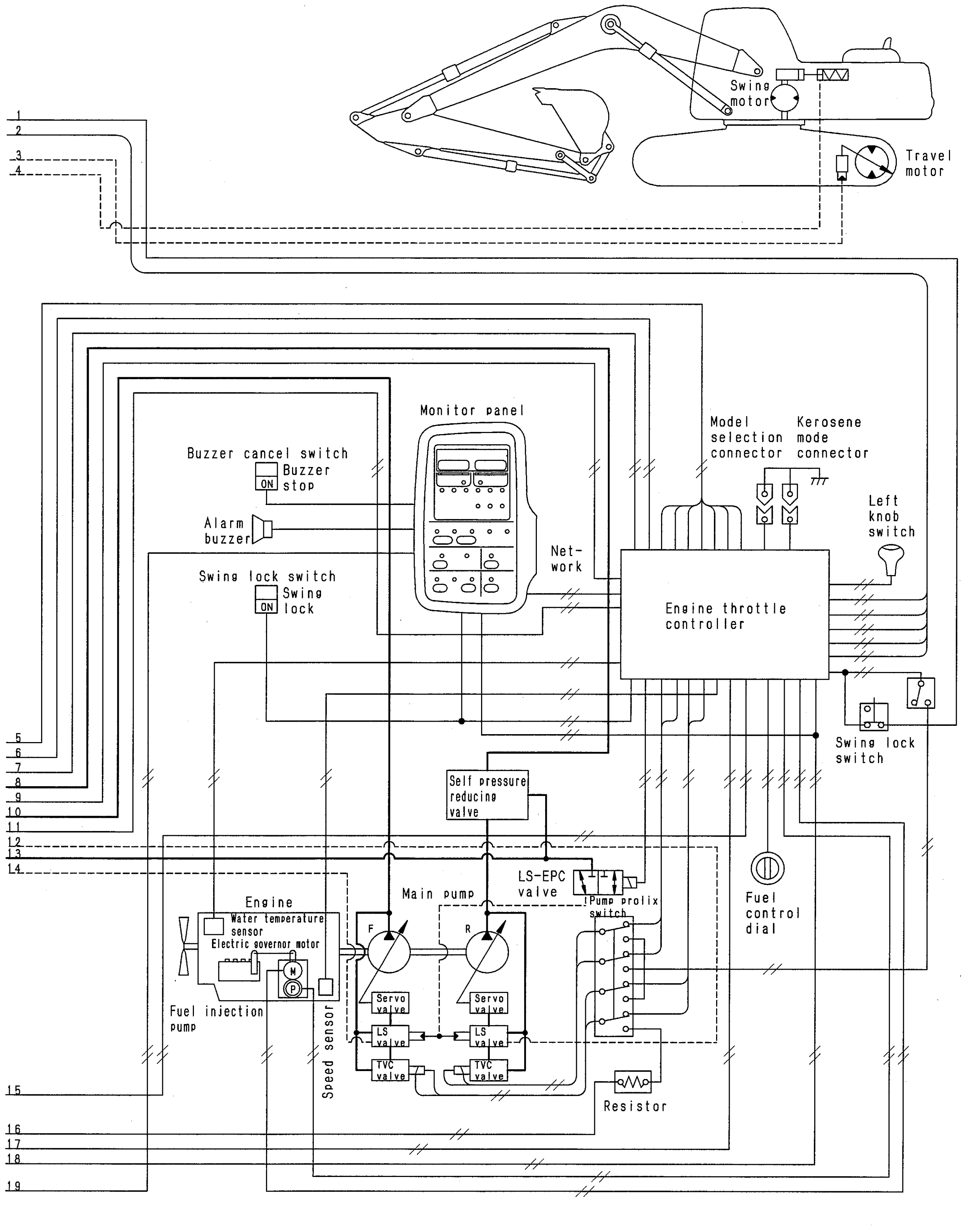
- Electronic control system
  - 1 Pump & Engine Mutual control function
  - 2 Pump and valve control function
  - 3 Power maximizing function
  - 3 Swift slow-down function
  - 4 Auto deceleration function
  - 5 Engine automatic warming-up, overheat prevention system
  - 6 Swing control function
  - 7 Travel control function
  - 8 Active mode system
  - Self-diagnostic function

★ For details of the self-diagnostic function, see TROUBLESHOOTING.

TOTAL SYSTEM DIAGRAM

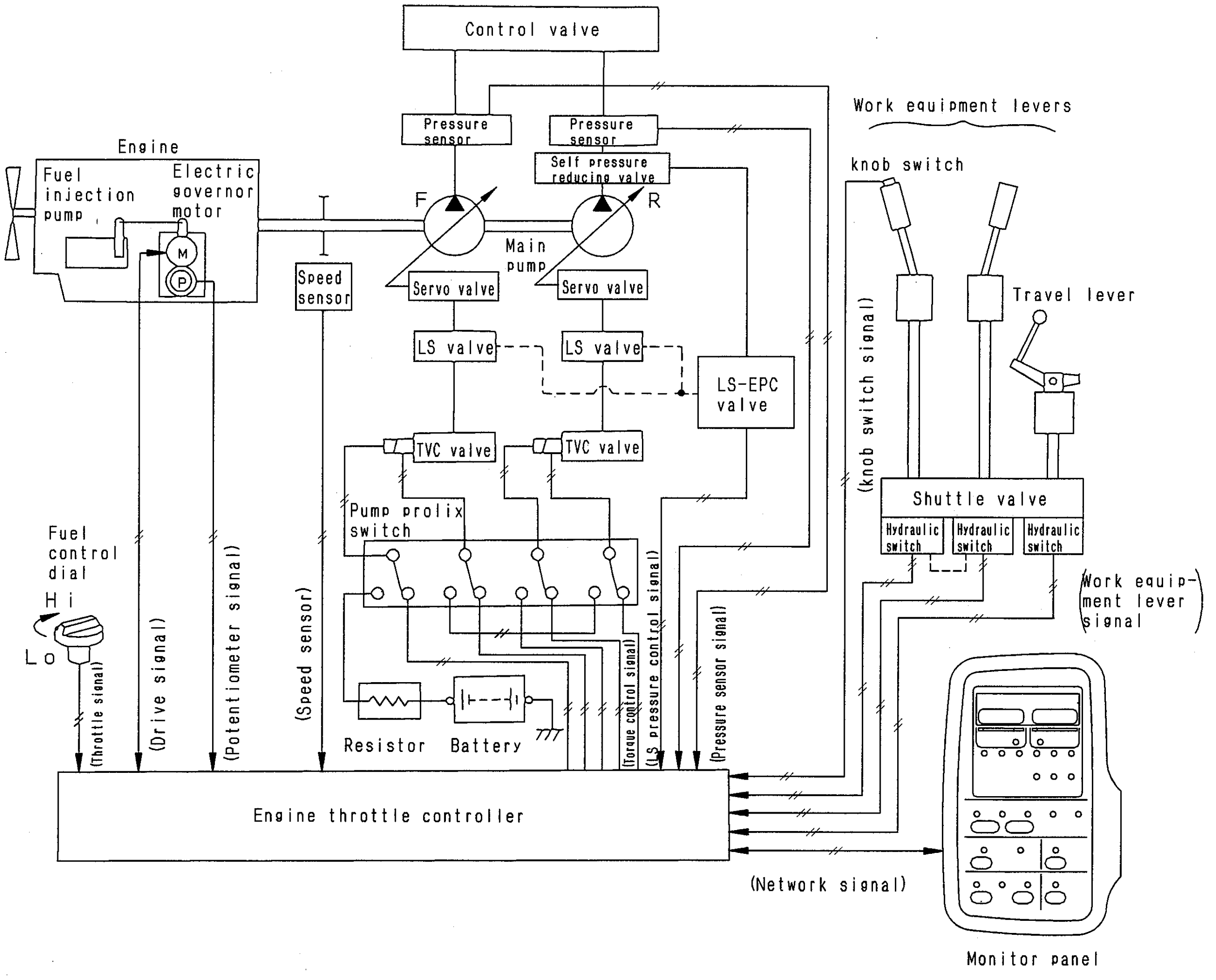


SWP05120


Swing motor
Travel motor
1
2
3
4
Monitor panel
Buzzer cancel switch
ON
Buzzer stop
Alarm buzzer
Swing lock switch
ON
Swing lock
Net-work
Model selection connector
Kerosene mode connector
Left knob switch
Engine throttle controller
Swing lock switch
5
6
7
8
9
10
11
Self pressure reducing valve
12
13
14
LS-EPC valve
Main pump
Engine
Water temperature sensor
Electric governor motor
M
P
F
R
Pump prolix switch
Fuel control dial
Servo valve
Servo valve
LS valve
LS valve
TVC valve
TVC valve
Fuel injection pump
Speed sensor
Resistor
15
16
17
18
19

SWP05121

1. Pump & Engine Mutual control system

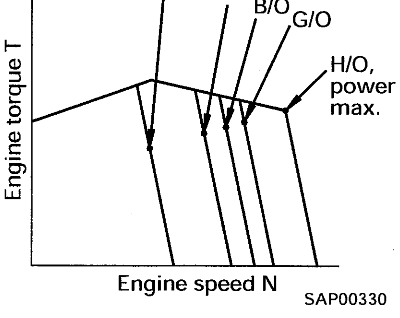


SWP05122

Function

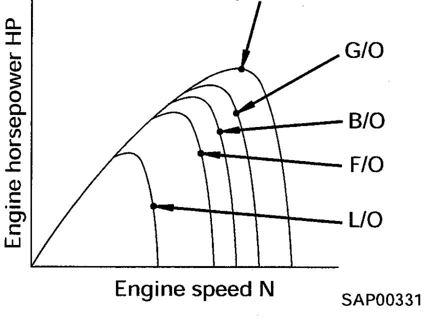
- There are five modes available for selection with the working mode switch on the monitor panel. These modes are the heavy-duty operation mode (H/O), general operation mode (G/O), finishing operation mode (F/O), lifting operation mode (L/O), and the breaker mode (B/O). It is possible to select the most suitable engine torque and pump absorption torque to match the nature of the work.
- The engine throttle, pump controller detects the actual engine speed and the speed set by the engine governor through the fuel control dial in accordance with the pump absorption torque set for each mode, and carries out control so that the pump absorbs all of the torque at each output point of the engine.

- Engine torque curve



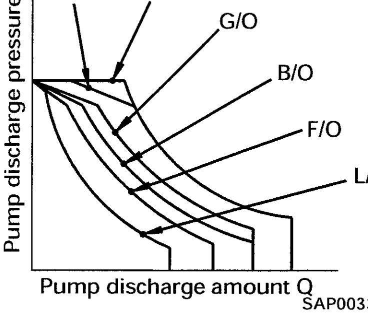
SAP00330

- Engine horsepower curve



SAP00331

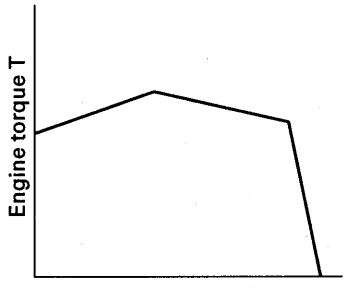
- Pump output curve



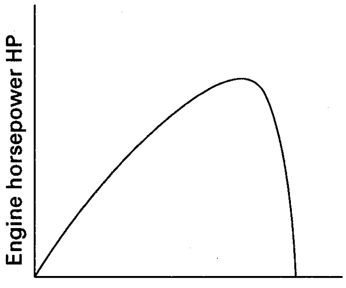
SAP00332

1) Control method in each mode

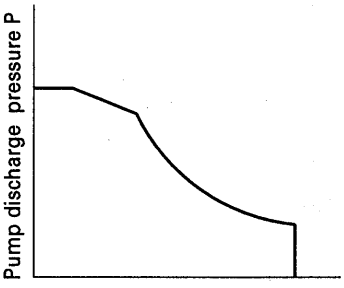
Heavy-duty operation mode



SAP00333



SAP00334



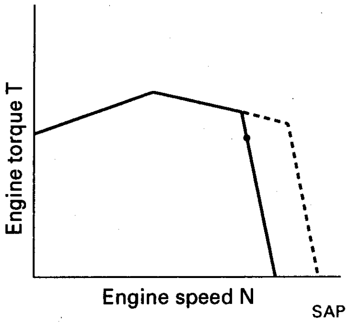
SAP00335

- Matching point in heavy-duty operation mode: Rated output point

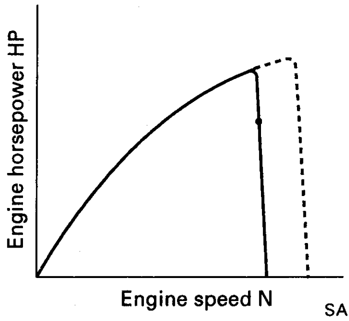
Model Mode	PC400, 450-6
Heavy-duty	228 kW {305.7 HP}/1,950 rpm

- When the load on the pump rises and the pressure rises, the engine speed goes down. When this happens, the pump discharge amount is reduced, and the engine speed is controlled so that it becomes near the rated output point.
  If the reverse happens and the pressure goes down, the system is controlled so that the pump discharge amount is increased until the engine speed becomes near the rated output point.
  By repeating this control, the engine can always be used at near the rated output point.

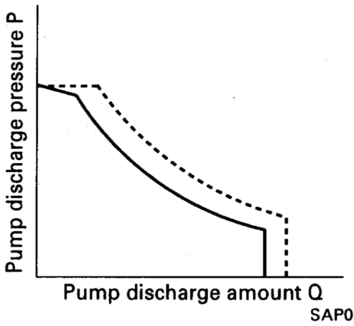
General, breaker, finishing operation mode



SAP00336



SAP00337



SAP00338

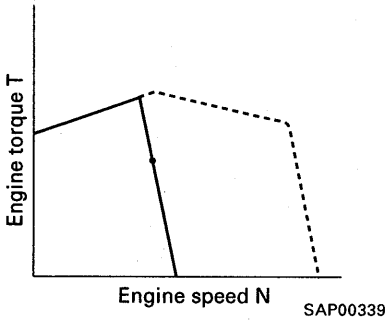
- Matching point

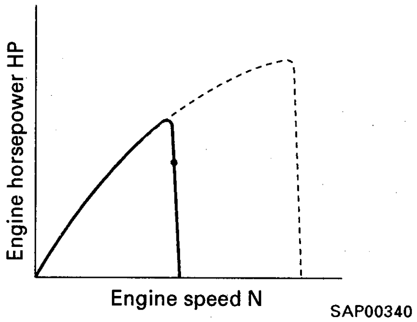
Mode	G/O	B/O	F/O
Partial output point	90%	85%	80%

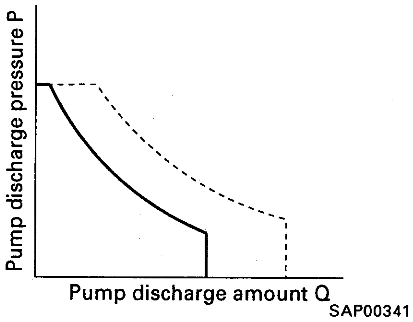
Model Mode	PC400, 450-6
G/O	205.9 kW {276.1 HP}/1,850 rpm
B/O	194.9 kW {261.3 HP}/1,850 rpm
F/O	183.9 kW {246.5 HP}/1,700 rpm

- When the load on the pump rises and the pressure rises, the engine speed goes down. When this happens, mutual control of the engine and pump is used to control the system so that the pump absorption torque follows the equal horsepower curve of the engine, and the engine speed is lowered while keeping the torque constant.
  In this way, the engine is used in a range which provides good fuel efficiency

Lifting operation mode





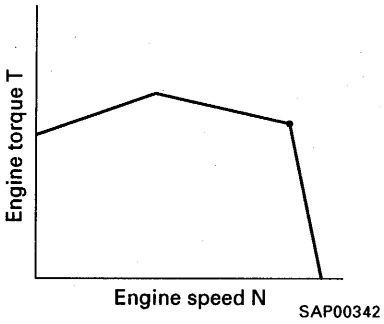


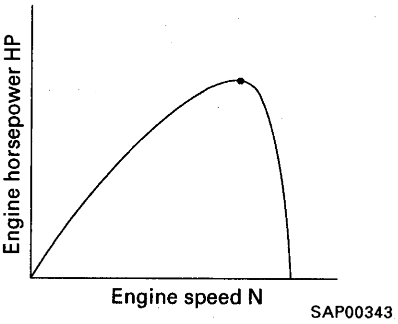
- Matching point in lifting operation mode: 60% partial output point

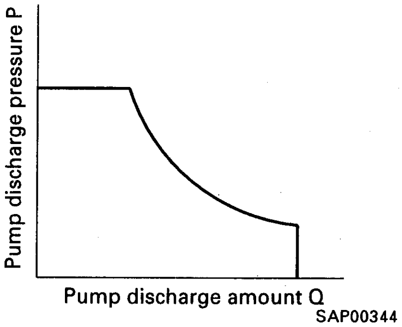
Mode \ Model	PC400, 450-6
L/O	143.4 kW {192.3 HP}/1,400 rpm

- When the lifting operation mode is selected, the engine speed is automatically lowered to the partial position.
  In this condition, control is carried out in the same way as for the general operation, finishing, and breaker operation modes to match the load on the pump.
  In this way, the fuel consumption is reduced and the fine control ability is improved.

Power max. mode, travel





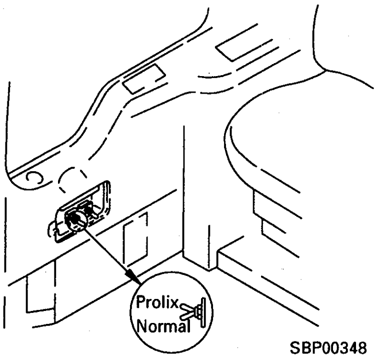


- Matching point in power max. mode: Rated output point

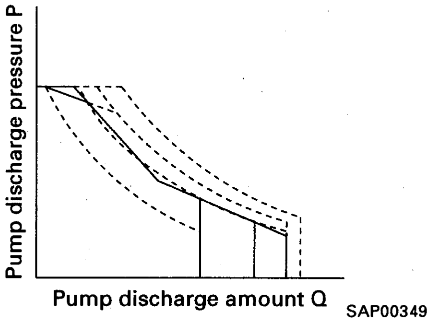
Mode \ Model	PC400, 450-6
Power max.	228 kW {305.7 HP}/1,950 rpm

- When the pump load increases, the engine speed drops.
  When this happens, the pump discharge is reduced to prevent the engine speed from going down and to ensure that the engine is used at near the rated output point.
  The cut-off at relief is canceled and the oil flow at relief is increased.

2) Control function when TVC prolix switch is ON

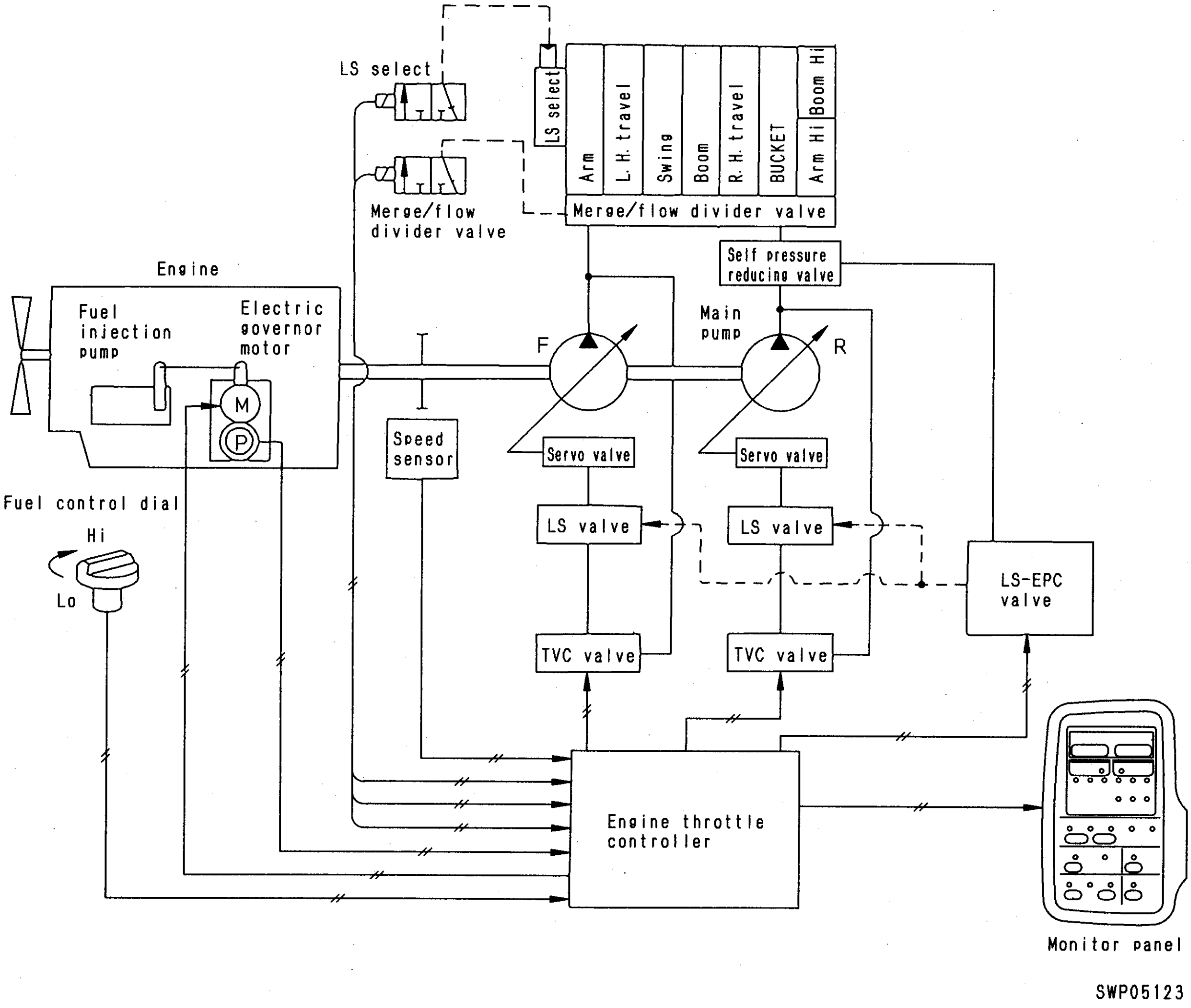


- Even if any abnormality should occur in the controller or sensor, the TVC prolix switch can be turned ON to provide an absorption torque more or less equivalent to the general operation mode, thereby allowing the machine to maintain its functions.



In this case, it is designed to allow a constant current to flow from the battery to the TVC valve, so oil pressure sensing is carried out only by the TVC valve.

2. Pump and valve control function

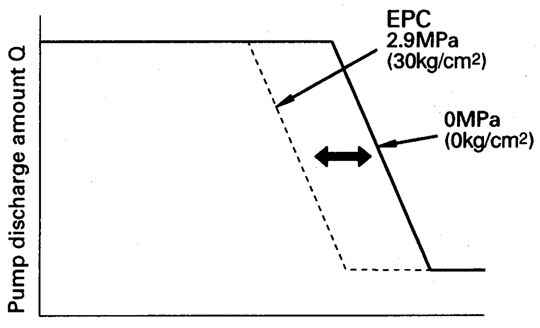


Function

- Optimum matching under various working conditions with the fine control mode function which reduces the hydraulic loss and improves the ease of fine control.

1) LS control function

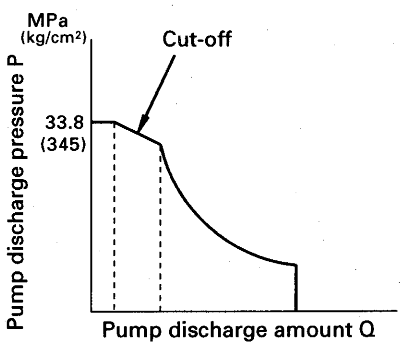
- The switching point (LS set differential pressure) for the pump discharge amount inside the LS valve is changed by changing the output pressure from the LS-EPC valve to the LS valve according to the operating condition of the actuator.
- Because of this, the timing for starting the discharge amount from the pump can be optimized, to give excellent ease of compound operation and fine control.



SAP00351

2) Cut-off function

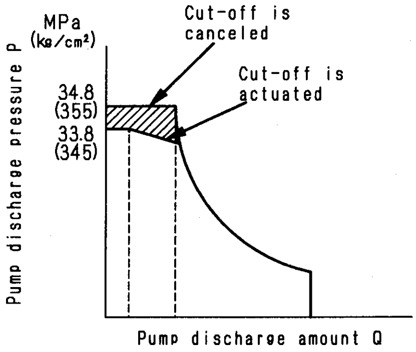
- If the load becomes large during the operation and the pump discharge pressure rises to a point close to the relief pressure, the pump pressure sensor detects this, and the controller sends a signal to the TVC valve to reduce the discharge amount in order to reduce the relief loss.



SAP00352

3) Cut-off cancel function

- The cut-off cancel function stops the actuation of the cut-off function in order to ensure the flow of oil from the pump near the relief pressure, thereby preventing any drop in speed.
- The relief pressure when the cut-off function is actuated is 33.8 MPa {345 kg/cm²}, but when the cut-off is canceled, the relief pressure rises to approx. 34.8 MPa {355 kg/cm²}. Because of this, the hydraulic pressure is increased by one stage.



SWP05124

- Switches and cut-off functions

	Working mode switch		Swing lock switch		Knob switch	
	Heavy digging	Digging	ON	OFF	ON	OFF
Cut-off function	Actuated	Actuated	Canceled	Actuated	Canceled	Actuated

※ When the swing lock switch is set to ON, hydraulic oil is quickly warmed, also when the swing lock switch is set to ON, the function is canceled. Under these conditions, when work equipment is relieved, hydraulic oil temperature goes up more quickly, and warming time is shortened.

4) Fine control mode function

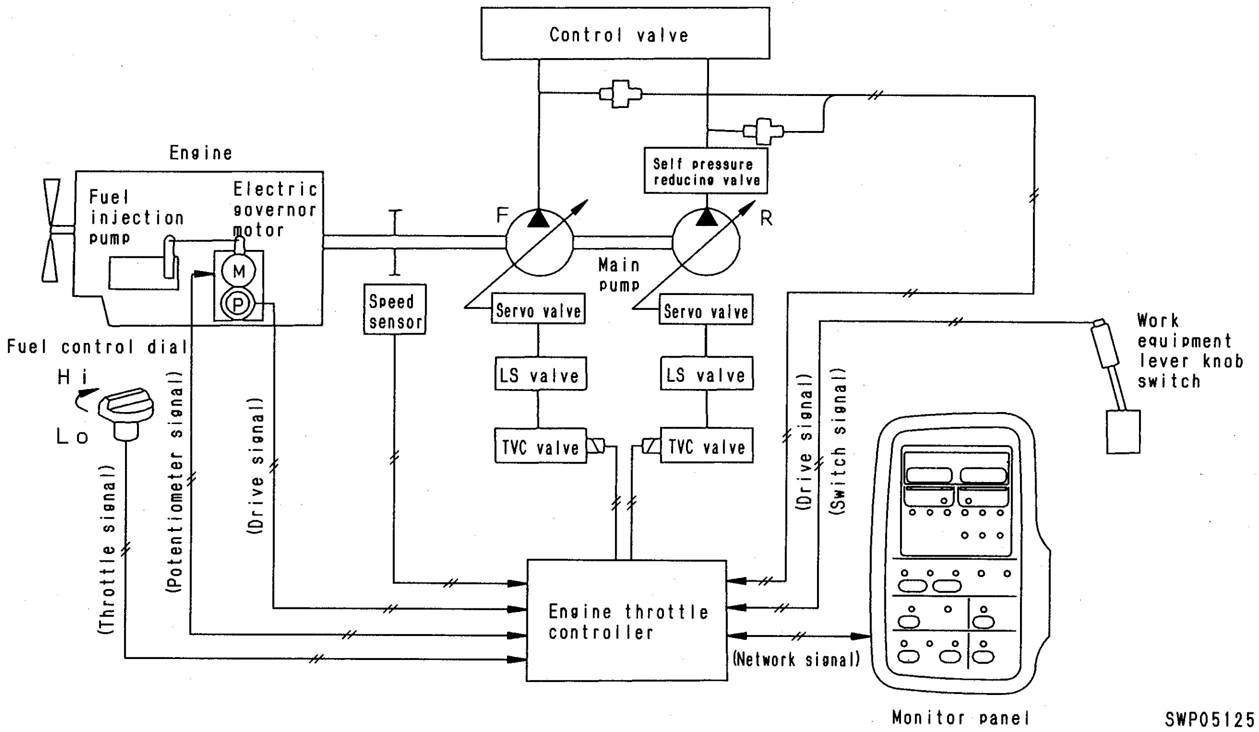
- When the finishing mode is selected as the working mode, the pump LS valve is controlled, and the pump discharge amount is reduced to improve the ease of fine control and the precision when finishing.

- Relationship between working mode and pump discharge amount (for independent operation)

Actuator / Working mode	Boom		Arm	Bucket		Swing	Breaker
	RAISE	LOWER		CURL	DUMP		
Heavy-duty operation (H/O)	100	30	100	75	60	55	—
General operation (G/O)							
Finishing operation (F/O)	80	30	80	60	50	45	—
Lifting mode (L/O)	75		75	55	45	40	—
Breaker (B/O)	100	30	100	75	60	55	45

★ In each working mode, the full flow of the pump at the set engine speed is taken as 100%.

3. Power max. function, swift slow-down function



Function

- This function provides an increase in the digging power for a certain time or switches the working mode to the fine operation to reduce the speed. It is operated using the L.H. knob switch to momentarily match the operating conditions.

★ The power max. function and swift slow-down function are operated with the same switch. Only one of these functions can be selected at any time; they cannot both be operated together.

1) Power max. function

- If the L.H. knob switch is kept pressed when the working mode is set to H/O or G/O, the cut-off function is canceled, and the canceled portion is added to the oil flow to increase the speed of the power max. function.
- Even if the L.H. knob switch is kept pressed, the increased speed of the power max. function is canceled after 8.5 seconds.
- If the L.H. knob switch is pressed ON when the working mode is at H/O or G/O, each function is automatically set as follows.

⇩

Working mode	Engine, pump control	Cut-off function	Actuating time
Heavy-duty operations	Matching at rated output point	Canceled	Automatically canceled after 8.5 sec

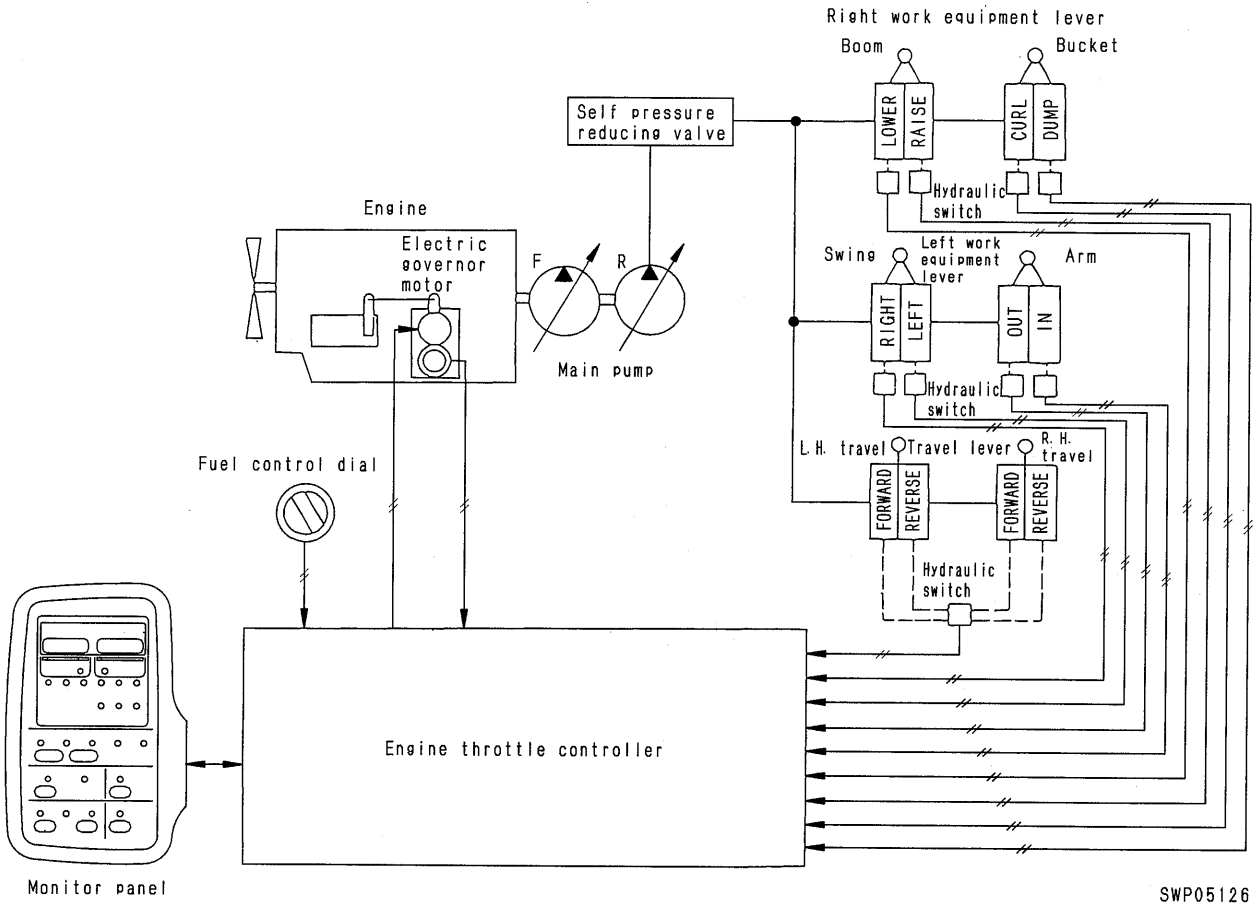
2) Swift slow-down function

- During normal operations, if it is desired to carry out lifting operations or finishing operations for a moment, the working mode can be switched to L/O by operating the L.H. knob switch.
- If the L.H. knob switch is pressed ON when the working mode is at H/O or G/O, each function is automatically set as follows.

⇩

Working mode	Actuating time
Lifting operation	While switch is kept pressed

4. Auto deceleration system



Function

- If all the control levers are at neutral when waiting for work or waiting for a dump truck, the engine speed is automatically reduced to a midrange speed to reduce fuel consumption and noise.
- If any lever is operated, the engine speed returns immediately to the set speed.

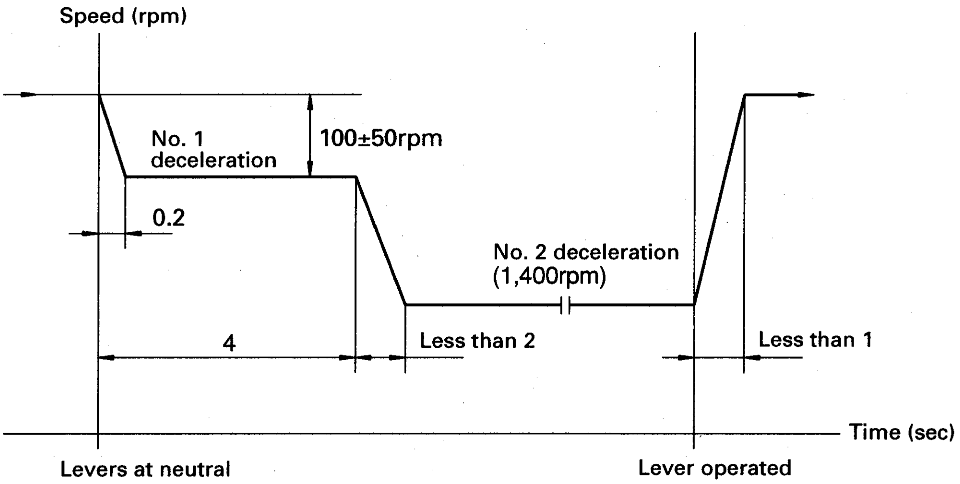
Operation

Control levers at neutral

- If the engine is running at above the deceleration actuation speed (approx. 1400 rpm), and all the control levers are returned to neutral, the engine speed drops immediately to approx. 100 rpm below the set speed to the No. 1 deceleration position.
- If another 4 seconds passes, the engine speed is reduced to the No. 2 deceleration position (approx. 1400 rpm), and is kept at that speed until a lever is operated.

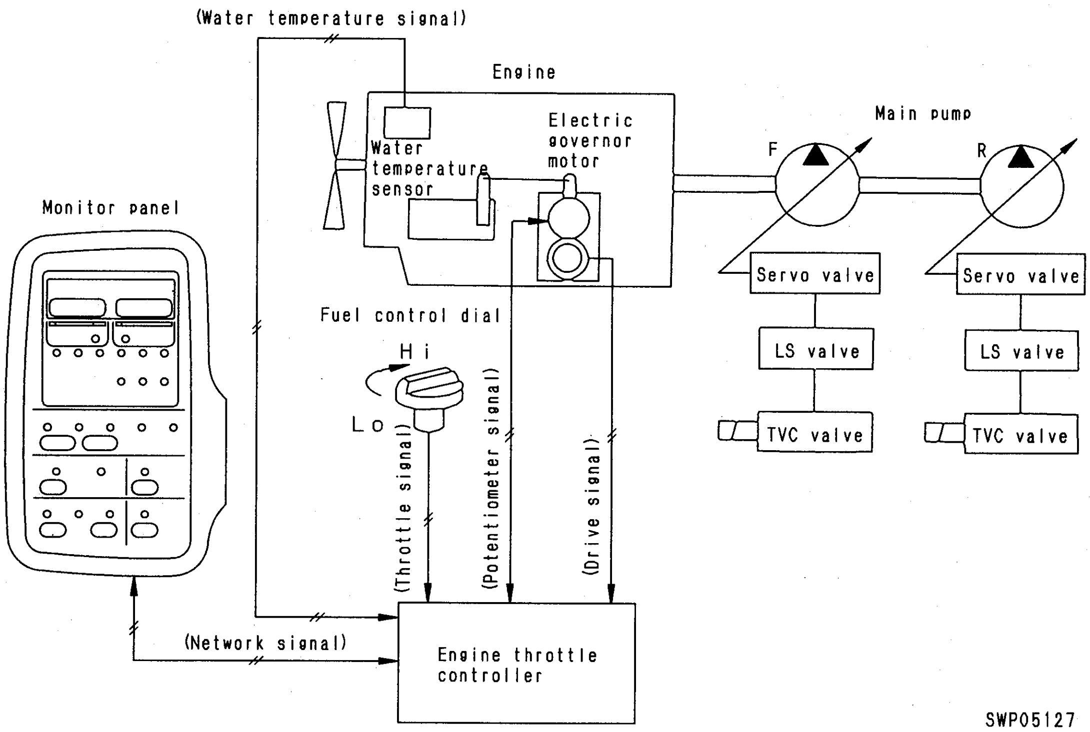
When control lever is operated

- If any control lever is operated when the engine speed is at No. 2 deceleration, the engine speed will immediately rise to the speed set by the fuel control dial.



SAP00356

5. Automatic warming-up and engine overheat prevention function



Function

- If the water temperature is low, this automatically raises the engine speed to warm up the engine after it is started. (Automatic warming-up function).
  In addition, if the water temperature rises too high during operations, it reduces the load of the pump to prevent overheating. (Engine overheat prevention function)

1) Engine automatic warming-up function

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

Conditions for actuation (both are necessary)	
Coolant temperature:	Less than 30°C
Engine speed:	Less than 1,250 rpm

Actuation
Engine speed: 1,250 rpm or below

Conditions for cancellation (any one)	
Automatic	Coolant temperature: 30°C or above
	Automatic warming-up time: 10 minutes or more
Manual	Fuel control dial: Held at more than 70% of full throttle for more than 3 seconds

Cancellation
Engine speed: As desired

2) Engine overheat prevention function

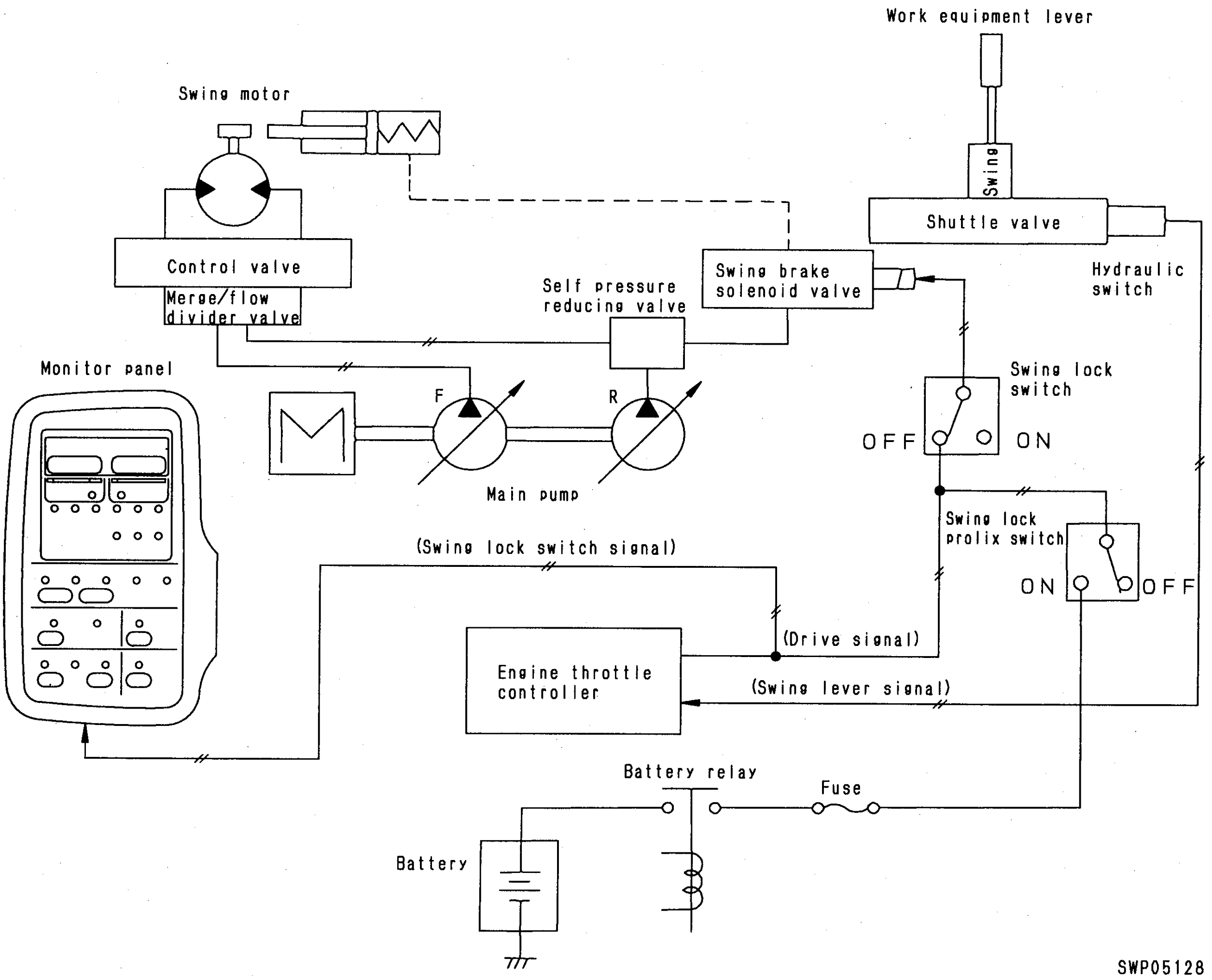
- This function protects the engine by lowering the pump load and engine speed to prevent overheating when the engine coolant temperature has risen too far.
- This system is actuated when the water temperature is 105°C and above.

Actuation condition
Water temperature: 105°C and above Water temperature gauge: Red range)

Actuation, remedy
Working mode: In any mode Engine speed: Low idling Monitor warning lamp: Lights up Alarm buzzer: Sounds

Cancel condition	
Water temperature:	Below 105°C
Fuel control dial:	Return temporarily to low idling position
• When the above conditions are met, the system returns to the condition before the overheat prevention function was actuated (manual reset)	

6. Swing control system



Function

- The system is provided with a swing lock and swing holding brake function.

1) Swing lock, swing holding brake function

- The swing lock (manual) can be locked at any desired position, and the swing holding brake (automatic) is interconnected with the swing, so it prevents any hydraulic drift after the swing is stopped.

※ Operation of swing lock prolix switch

- If any abnormality should occur in the controller, and the swing holding brake is not actuated normally and the swing cannot be operated, the swing lock prolix switch can be operated to cancel the swing lock and allow the swing to be operated.

★ Even when the swing lock prolix switch is turned ON, the swing lock switch stays ON and the swing brake is not canceled.

★ When the swing brake is canceled, the swing has only a hydraulic brake operated by the safety valve, so if the swing is stopped on a slope, there may be hydraulic drift.

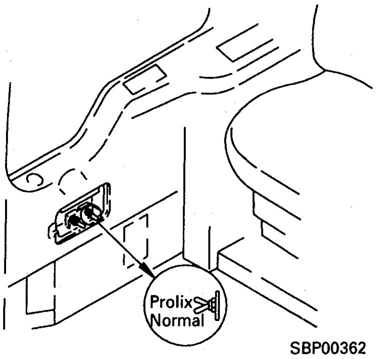
2) Hydraulic oil quick warm-up function when swing lock switch is ON

- When the swing lock switch is turned ON, the pump cut-off is canceled. If the work equipment is relieved in this condition, the hydraulic oil temperature will rise more quickly and the warming-up time can be reduced.

- Swing lock switch and swing lock, swing holding brake

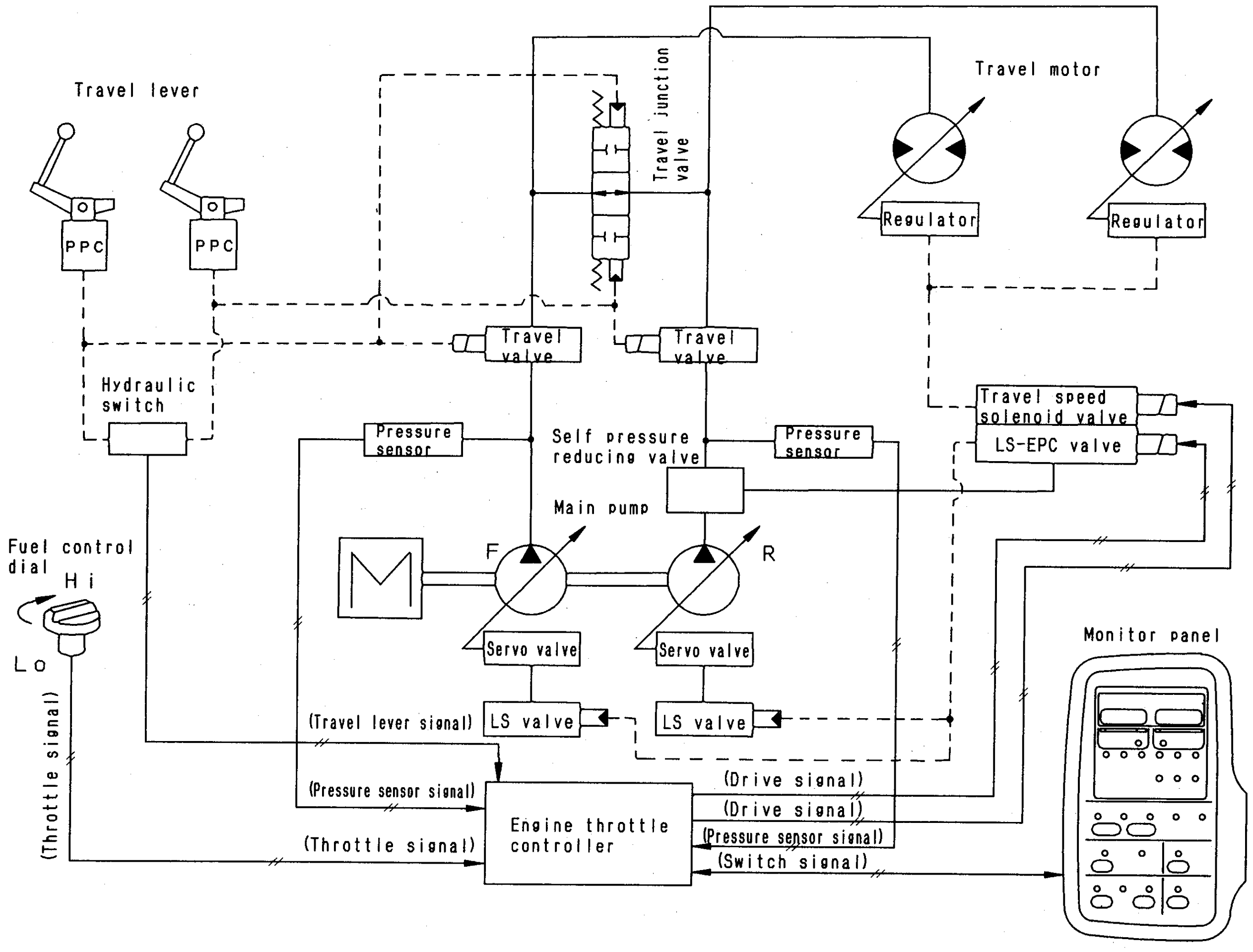
Lock switch	Lock lamp	Function	Operation
OFF	OFF	Swing holding brake	When swing lever is placed at neutral, swing brake is applied after approx. 5 sec; when swing lever is operated, brake is canceled and swing can be operated freely
ON	ON	Swing lock	Swing lock is actuated and swing is held in position. Even when swing lever is operated, swing lock is not canceled and swing does not move.

Swing lock prolix switch	ON (when controller is abnormal)		OFF (when controller is normal)	
Swing lock switch	ON	OFF	ON	OFF
Swing brake	Swing lock applied	Swing lock canceled	Swing lock applied	Swing holding brake applied



SBP00362

7. Travel control system



SWP05129

Function

- When traveling, the pump control is carried out, and the travel speed can be selected manually or automatically to give a travel performance that suits the nature of the work or the jobsite.

1) Pump control function when traveling

- If the travel is operated in any working mode other than the heavy-duty operation mode, this increases the pump absorption torque while keeping the working mode and engine speed as they are.

★ For details, see PUMP & ENGINE MUTUAL CONTROL.

2) Travel speed selection function

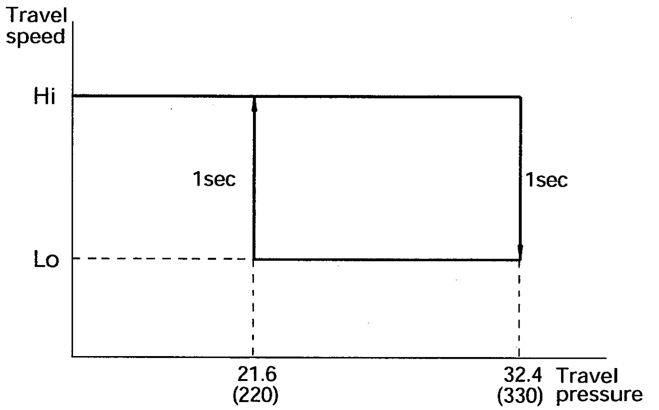
i) Manual selection using travel speed switch
If the travel speed switch is set to Lo, Mi, or Hi, the engine throttle, pump controller controls the pump flow and motor volume at each speed range as shown on the right to switch the travel speed.

Travel speed switch	Lo (Low speed)	Mi (Mid-range speed)	Hi (High speed)
Pump flow (%)	80	60	100
Motor volume	Max.	Min.	Min.
Travel speed (km/h)	3.2	4.5	5.5

ii) Automatic selection according to engine speed
If the engine speed is reduced to below 1,350 rpm by the fuel control dial:

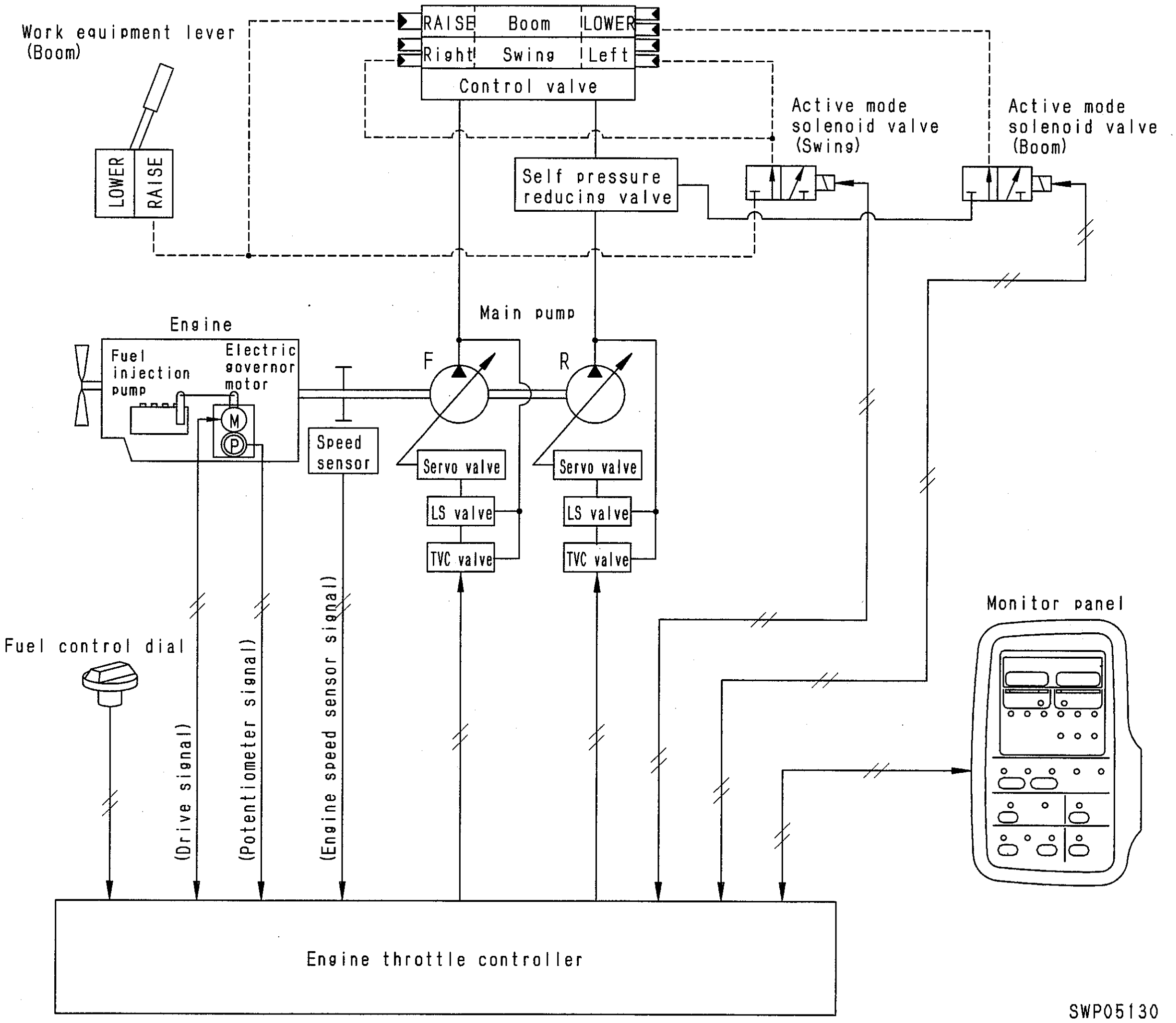
- If the machine is traveling in Lo, it will not shift even if Mi or Hi are selected.
- If the machine is traveling in Mi, it will not shift even if Hi is selected.
- If the machine is traveling in Hi, it will automatically shift to Lo.

iii) Automatic selection according to pump discharge pressure
If the machine is traveling with the travel speed switch at Hi, and the load increases, such as when traveling up a steep hill, if the travel pressure continues at 32.4 MPa (330 kg/cm^2) for more than 1.0 sec, the pump volume is automatically switched and the travel speed changes to Lo.
(The travel speed switch stays at Hi.)
The machine continues to travel in Lo, and when the load is reduced, such as when the machine travels again on flat ground or goes downhill, and the travel pressure stays at 21.6 MPa (220 kg/cm^2) or less for more than 1.0 sec, the pump volume is automatically switched and the travel speed returns to Hi.



SAP00364

8. ACTIVE MODE FUNCTION

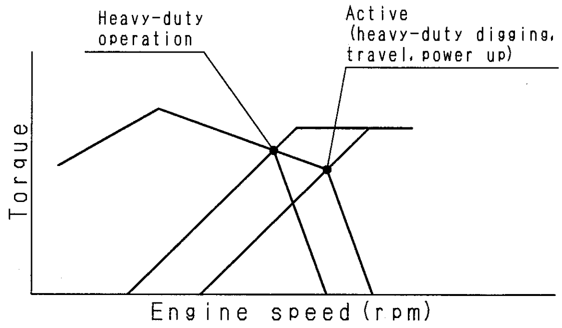


FUNCTION

- When the active mode switch on the monitor panel is ON (lighted up), the work equipment speed is increased. The bucket lift is also increased during swing + boom RAISE operations, so it is effective in loading dump trucks.
- The active mode is actuated only when the fuel control dial is at the Max. position. If the fuel control dial is not at the Max. position, the load sensing function is actuated but the pump discharge increase function is not actuated.

1) **Increase in engine speed**

The pump discharge amount is increased by the increase in the engine speed. This means that the cycle time can be reduced, giving increased production.



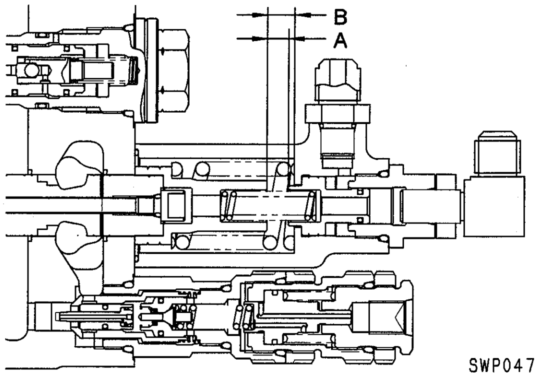
SWP05131

	Heavy-duty digging operations	Active
PC400	288kW/1,950rpm {305.7HP/1,950rpm}	228kW/2,050rpm {305.7HP/2,050rpm}
PC450	228kW/1,950rpm {305.7HP/1,950rpm}	228kW/2,050rpm {305.7HP/2,050rpm}

2) **2-stage boom lowering speed**

When the active mode switch is ON, the stroke of the boom LOWER spool is switched (9.0 mm → 11.5 mm) to increase the lowering speed.

Change in spool stroke:
A: 9.0 mm (active mode OFF)
B: 11.5 mm (active mode ON)

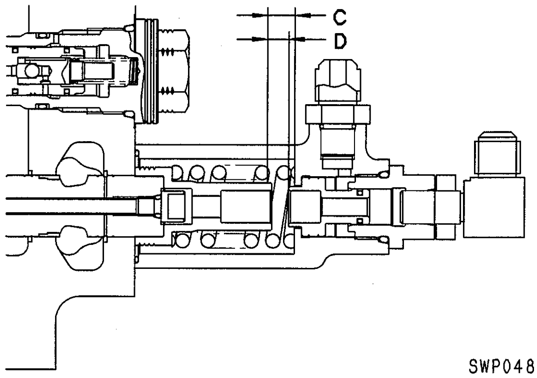


SWP04799

3) **2-stage stroke for swing spool**

When the active mode switch is ON and the boom is operated to RAISE, the stroke of the swing spool is switched (9.5 mm → 7.0 mm). This increases the bucket lift during swing + boom RAISE operations, so it is effective in loading dump trucks.

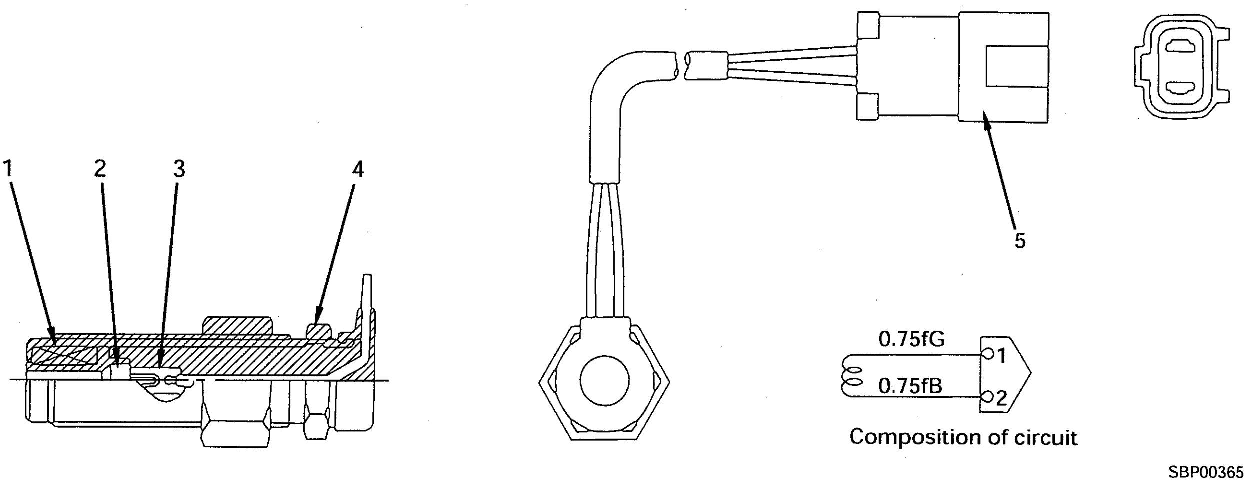
Change in spool stroke:
C: 9.5 mm (active mode OFF)
D: 7.0 mm (active mode ON)



SWP04800

9. Components of system

1) Engine speed sensor

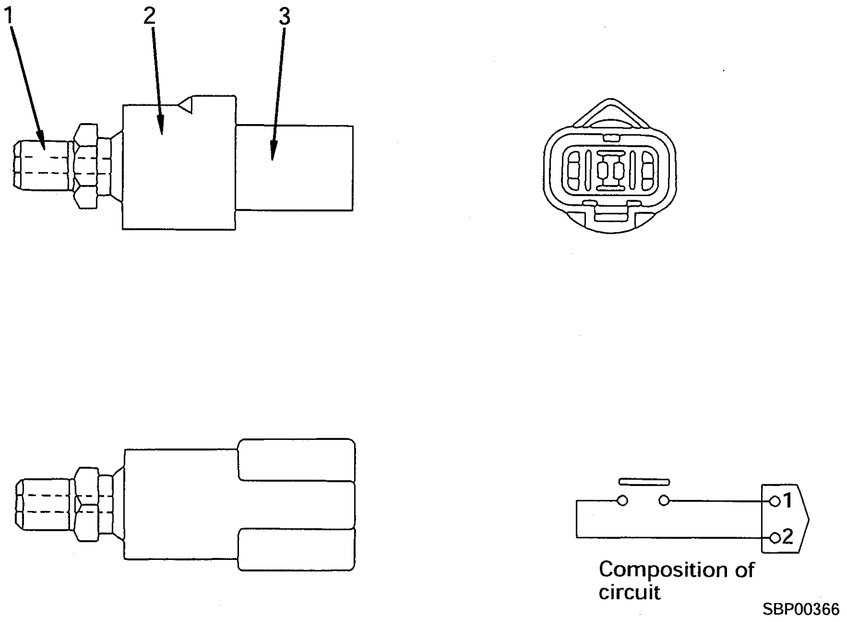


1. Wire
2. Magnet
3. Terminal
4. Housing
5. Connector

Function

- The engine speed sensor is installed to the ring gear portion of the engine flywheel. It counts electrically the number of gear teeth that pass in front of the sensor, and sends the results to the engine throttle, pump controller.
- This detection is carried out by a magnet, and an electric current is generated every time the gear tooth passes in front of the magnet.

2) PPC hydraulic switch



1. Plug
2. Switch
3. Connector

Specifications

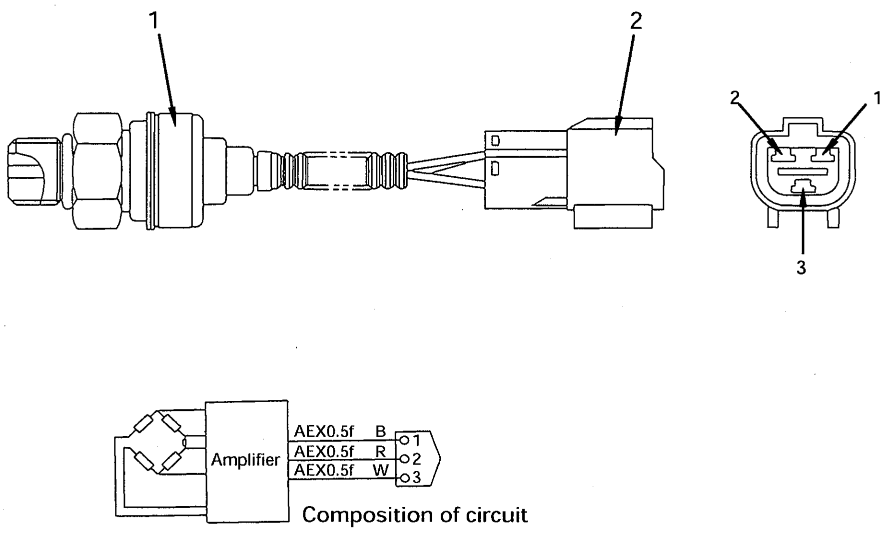
Composition of points:
Normal open points
Actuation (ON) pressure:
0.5 ± 0.1 MPa
{5.0 ± 1.0 kg/cm^2}
Reset (OFF) pressure:
0.3 ± 0.05 MPa
{3.0 ± 0.5 kg/cm^2}

Function

- There are 8 switches installed to the PPC shuttle valve. The operating condition of each actuator is detected from the PPC pressure, and this is sent to the engine throttle, pump controller.

3) Pump pressure sensor

1. Sensor
2. Connector



Composition of circuit

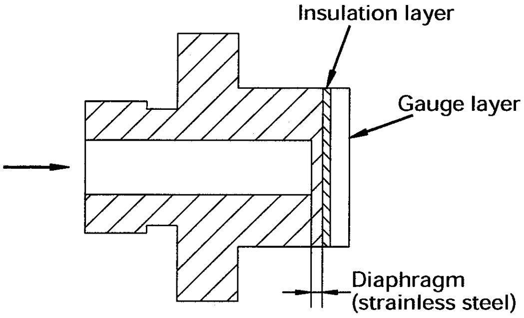
SBP00367

Function

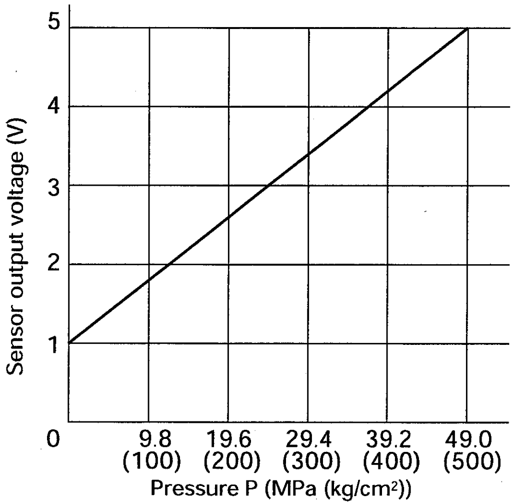
- This sensor is installed to the inlet port circuit of the control valve. It converts the pump discharge pressure to a voltage and sends this to the engine throttle, pump controller.

Operation

- When the pressurized oil entering from the pressure introduction portion pressurizes the diaphragm of the pressure detection portion, the diaphragm deflects and changes shape.
- A gauge layer is installed to the face opposite the diaphragm, and the resistance of the gauge layer converts the deflection of the diaphragm into an output voltage and sends it to the amp (voltage amplifier).
- The voltage is further amplified by the amplifier and is sent to the engine throttle, pump controller.
- Relationship between P pressure (MPa {kg/cm^2}) and output voltage (V).
  V = 0.008 x P + 1.0

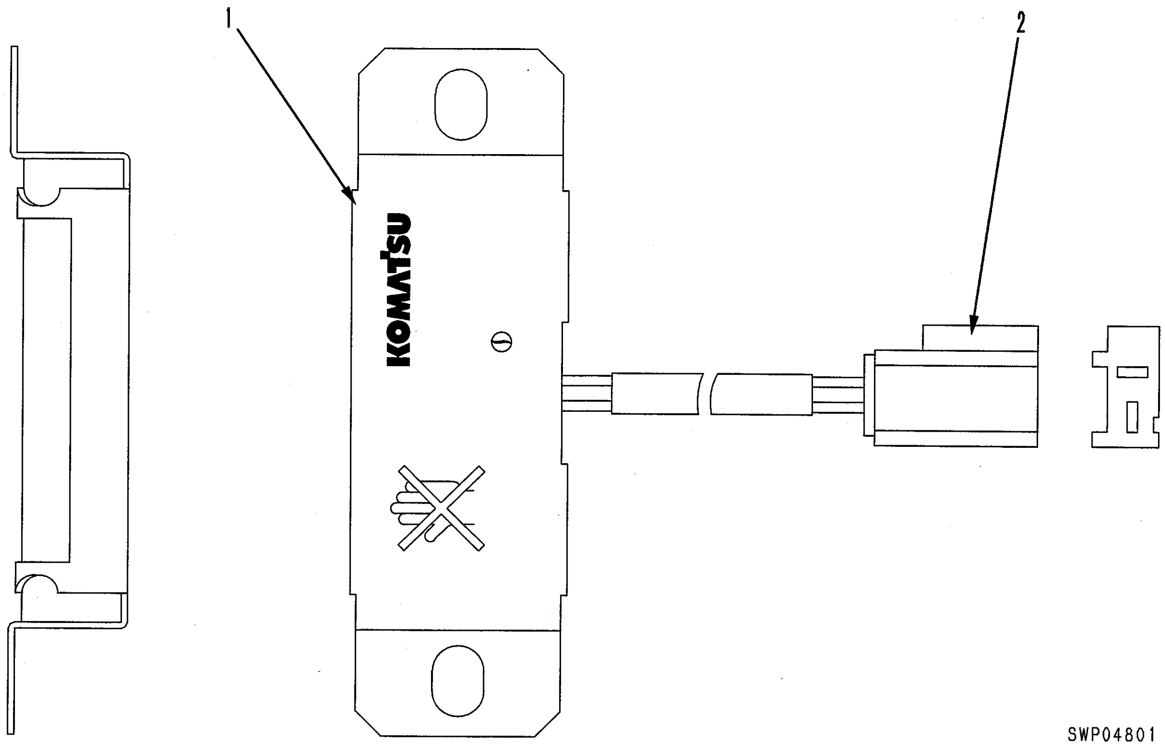


SAP00368



SAP00369

4) TVC prolix resistor



1. Resistor
2. Connector

Specification
Resistance: 8.5 Ω

Function

- This resistor acts to allow a suitable current to flow to the TVC solenoid when the TVC prolix switch is ON.
- No current flows when the TVC prolix switch is OFF.

5) Fuel control dial, governor motor, engine throttle, pump controller

★ See ENGINE CONTROL

6) Monitor panel

★ See MONITORING SYSTEM

7) TVC valve

★ See HYDRAULIC PUMP

8) LS-EPC valve

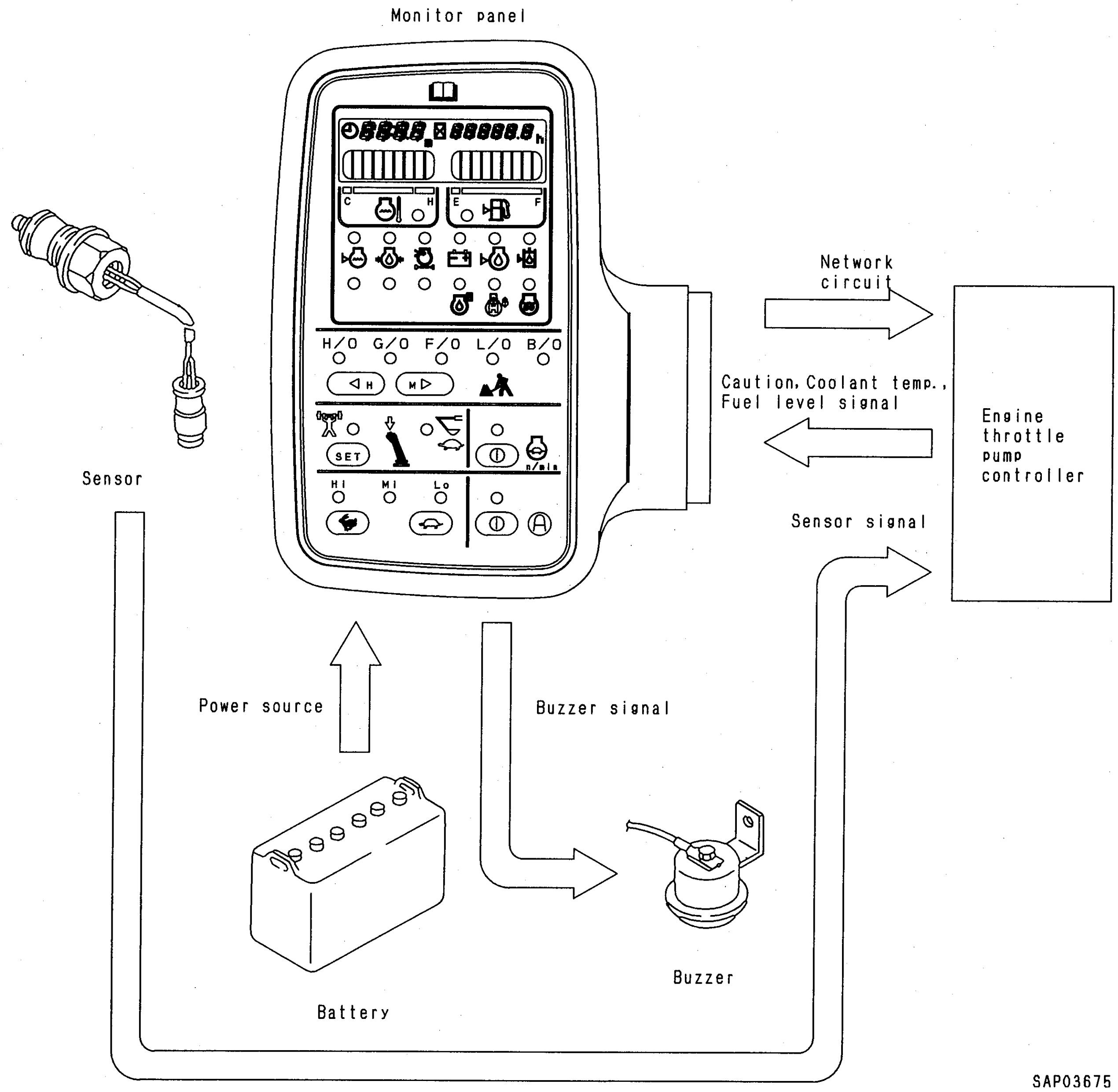
★ See LS-EPC VALVE

9) Solenoid valve

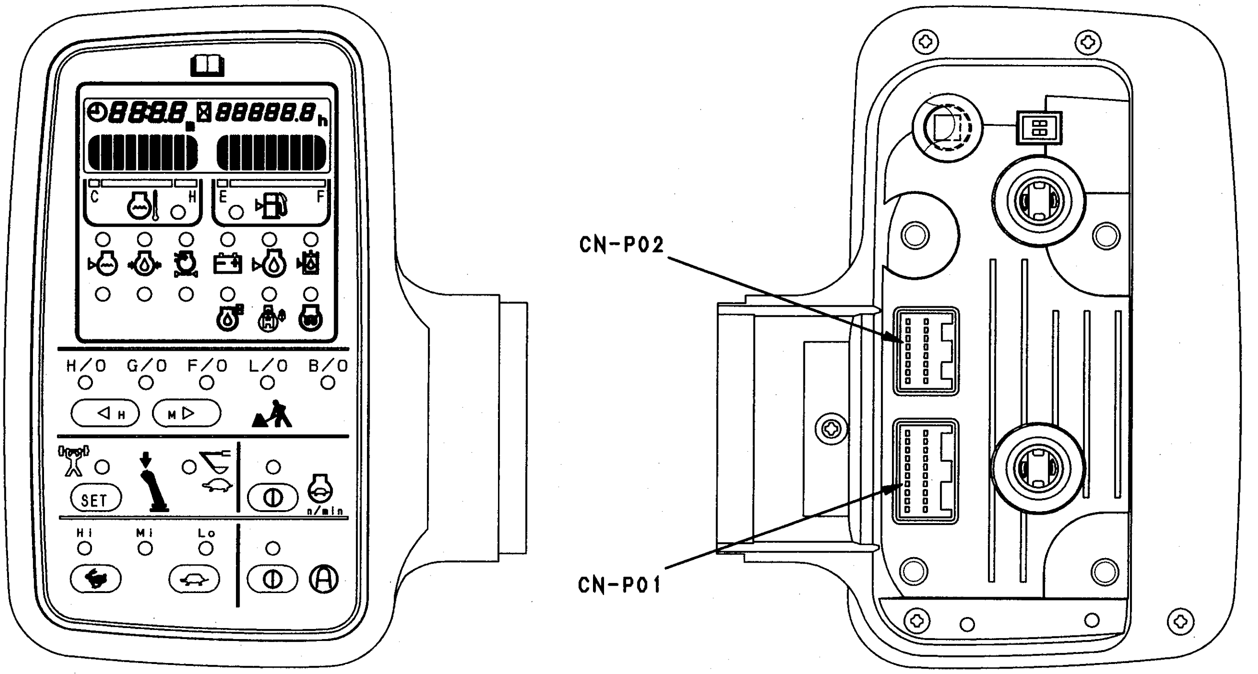
- Active solenoid valve (boom)
- Boom Hi 2-stage safety valve solenoid valve
- Merge/flow divider valve solenoid valve
- Travel speed solenoid valve
- Swing brake solenoid valve

★ See SOLENOID VALVE

MACHINE MONITOR SYSTEM



1. MONITOR PANEL



SAP03677

OUTLINE

- The monitor panel consists of the time display, monitor display, and mode selector switches.
- It has a built-in CPU (Central Processing Unit), and processes, displays, and outputs the data from the sensors and controllers.
- The monitor display and monitor display panels use a liquid crystal display (LCD) and LED lamp.
  The mode switches are flat sheet switches.

Input and output signals

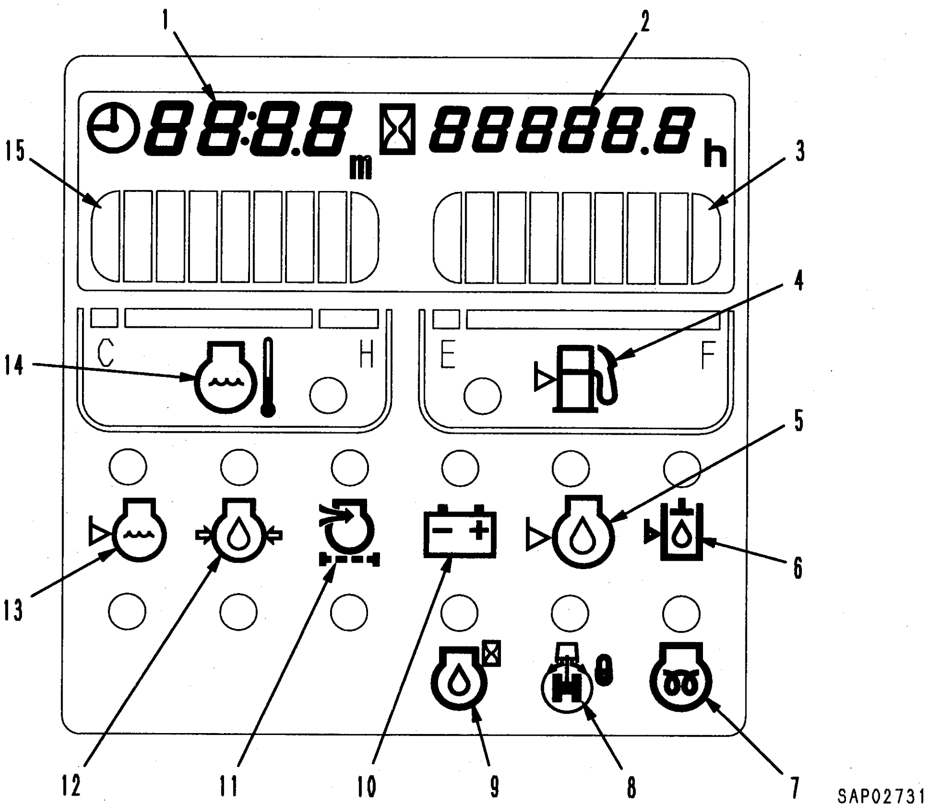
CN-P01

Pin No.	Name of signal
1	NC
2	NC
3	NC
4	Network signal
5	Swing lock
6	Buzzer cancel
7	Buzzer drive
8	Light
9	KEY ON signal
10	BR Terminal
11	Network signal
12	Network GND
13	NC
14	Network GND
15	NC
16	NC
17	NC
18	Preheating
19	Start signal
20	NC

CN-P02

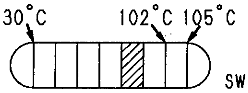
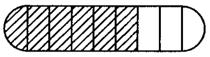
Pin No.	Name of signal
1	GND
2	Washer drive
3	Motor drive (Reverse)
4	Wiper switch (ON)
5	Wiper switch (Washer)
6	Limit switch
7	NC
8	+VB
9	GND
10	Washer drive
11	Motor drive (Normal)
12	Wiper switch (INT)
13	Limit switch (Window)
14	+VB
15	Limit switch (P)
16	NC

MONITOR DISPLAY



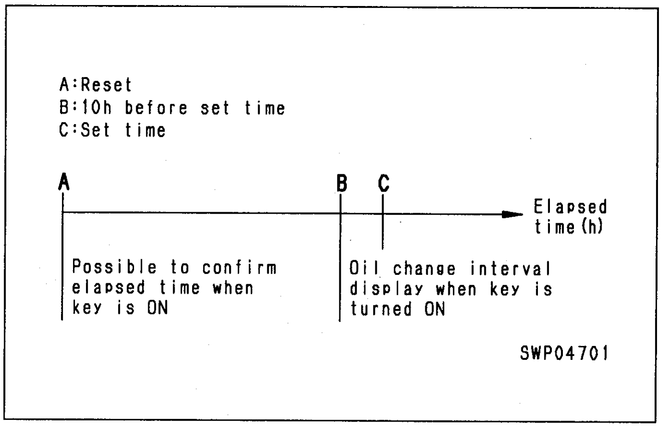
1. Clock
2. Service meter
3. Fuel level gauge
4. Fuel level caution lamp
5. Engine oil level caution lamp
6. Hydraulic oil level caution lamp
7. Preheating pilot lamp
8. Swing holding brake pilot lamp
9. Oil maintenance pilot lamp
10. Battery charge caution lamp
11. Air cleaner clogging caution lamp
12. Engine oil pressure caution lamp
13. Coolant level caution lamp
14. Coolant temperature caution lamp
15. Coolant temperature gauge

Content of display

Symbol	Display item	Display range	When engine is stopped	When engine is running
SAP00519	Coolant level	Below low level	Flashes when abnormal	Flashes and buzzer sounds when abnormal
SAP00520	Engine oil pressure	Below 1500 rpm: below 0.05 MPa {0.5 kg/cm²} Above 1500 rpm: above 0.15 MPa {1.5 kg/cm²}	Lights up when normal (goes out when engine starts)	Flashes and buzzer sounds when abnormal
SAP00521	Air cleaner clogging	When clogged	Flashes when abnormal	OFF
SAP00522	Charge level	When charging is defective	Lights up when normal (goes out when engine starts)	Flashes when abnormal
SAP00523	Engine oil level	Below low level	Flashes when abnormal	OFF
SAP00524	Hydraulic oil level	Below low level	Flashes when abnormal	OFF
SAT00098	Parking (Swing lock)	When swing is locked	Lights up when swing lock switch is ON, flashes when swing lock prolix switch is ON	
SAP02732	Oil maintenance	See next page OIL MAINTENANCE FUNCTION.		
SAP00526	Preheating	During preheating	Lights up for 30 seconds when starting switch is at HEAT, then flashes for 10 seconds to indicate that preheating is completed	
SAP00527	Coolant temperature	Flashes when above 102°C, flashes and buzzer sounds when above 105°C	 SWP04802	
SAP00528	Fuel level	Flashes when below low level	 SWP04803	

OIL MAINTENANCE FUNCTION

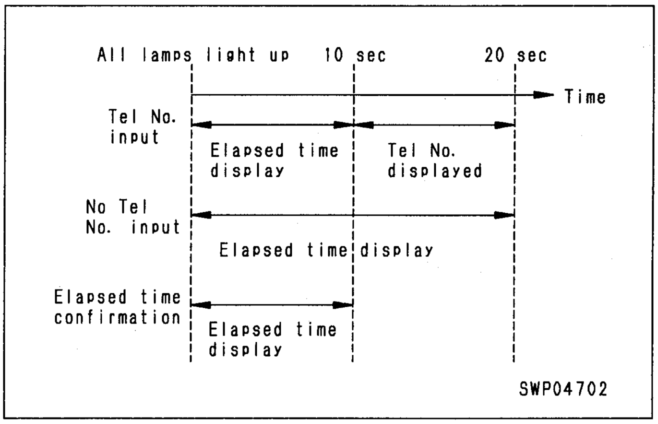
1. **Function, operation**
   The oil maintenance function uses LED lamps on the monitor panel to inform the operator at a fixed interval after the engine oil is changed that the oil change interval has been reached.
   At the same time, it also functions to display the service contact telephone number on the liquid crystal display.
   1) Confirmation of elapsed time
      Normally, no display is given until the elapsed time reaches the point **B** on the right diagram after reset. However, if the buzzer cancel switch is pressed and the key is turned to the ON position (with the buzzer cancel switch hold for 2.5 seconds), the elapsed time is displayed on the service meter display.
   2) Oil change display
      When the elapsed time has reached or passed the point **B** on the right diagram, the service meter display gives the elapsed time and the LED flashes when the key is turned ON.



2. **Setting change interval**
   1) The change interval can be set by using the interval setting mode. The time that can be set are [125 h], [250 h], [500 h], [no setting], and [demo mode]. The default setting is [no setting].
   2) To enter the change interval setting mode, keep the time switch and active mode switch (swing priority switch) pressed simultaneously for 2.5 seconds.
   3) If the buzzer cancel switch is pressed in the change interval setting mode, the time display will change from [...] → [125] → [250] → [500] → [d] ([...] indicates [no setting] and [d] indicates [demo mode]).
   4) To save the change interval time, set the monitor panel display to the desired time (mode), then keep the time switch and active mode switch (swing priority switch) pressed simultaneously for 2.5 seconds.

3. Display timing, content

1) Oil change display
   After all the lamps light up, the elapsed time is displayed for 10 seconds. For the next 10 seconds, the telephone number is displayed.
   However, if no telephone number has been input, the elapsed time is displayed for 20 seconds after all the lamps light up.
2) Elapsed time confirmation
   After all the lamps light up, the elapsed time is displayed for 10 seconds.



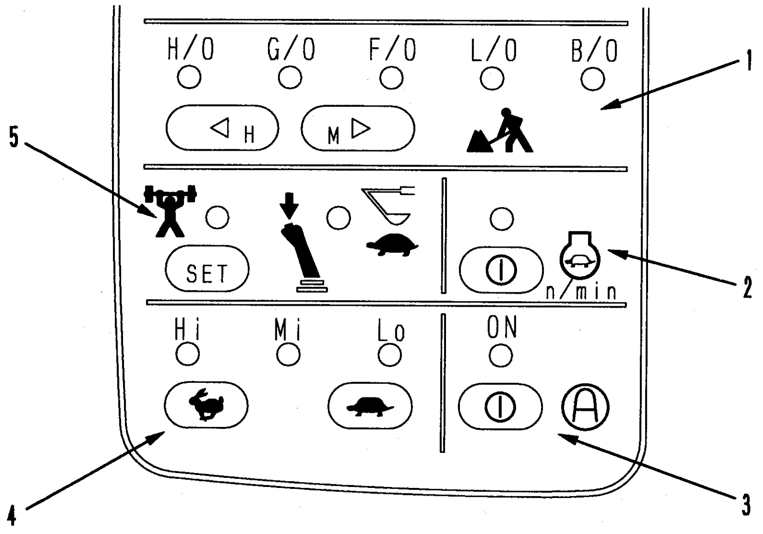
4. Elapsed time reset

1) During the oil change interval display and the elapsed time display, for 10 seconds after all lamps light up (during the elapsed time display), if the buzzer cancel switch is pressed and held for 3 seconds, the elapsed time is reset. When the elapsed time is reset, the elapsed time shows [0h] for 1 second.
2) When the set time is changed, the elapsed time is reset to 0h.

5. Demo mode

1) The set time in the demo mode is 250h and the elapsed time is set to 240h. When the key is turned ON, the oil change display is given. However, the elapsed time does not increase.
   It is also possible to carry out the reset operation during this display.
   In the demo mode, after the key is turned ON three times, the interval setting is automatically set to [no setting] from the 4th time. In addition, the elapsed time is reset to 0h and the elapsed time count starts.

MODE SELECTION SWITCHES



1. Working mode switch
2. Auto-deceleration switch
3. Active mode switch
4. Travel speed switch
5. Knob button switch

Switch actuation table

- The bold letters indicate the default position of the switch when the starting switch is turned ON.

Item	Action
WORKING MODE	→ H/O ↔ **G/O** ↔ F/O ↔ L/O ↔ B/O ←
AUTO DECEL	**ON** ↔ OFF (Note 1)
KNOB BUTTON	**POWER UP** ↔ SPEED DOWN
TRAVEL SPEED	Hi ↔ Mi ↔ **Lo**
ACTIVE MODE	**ON** ↔ OFF (Note 2)

Note 1: If the working mode is operated F/O → G/O or L/O → B/O, the auto-deceleration switch is automatically turned ON if it is OFF. (If it is already ON, it stays ON.)
Conversely, if it is operated G/O → F/O or B/O → L/O, the auto-deceleration switch is automatically turned OFF if it is ON.

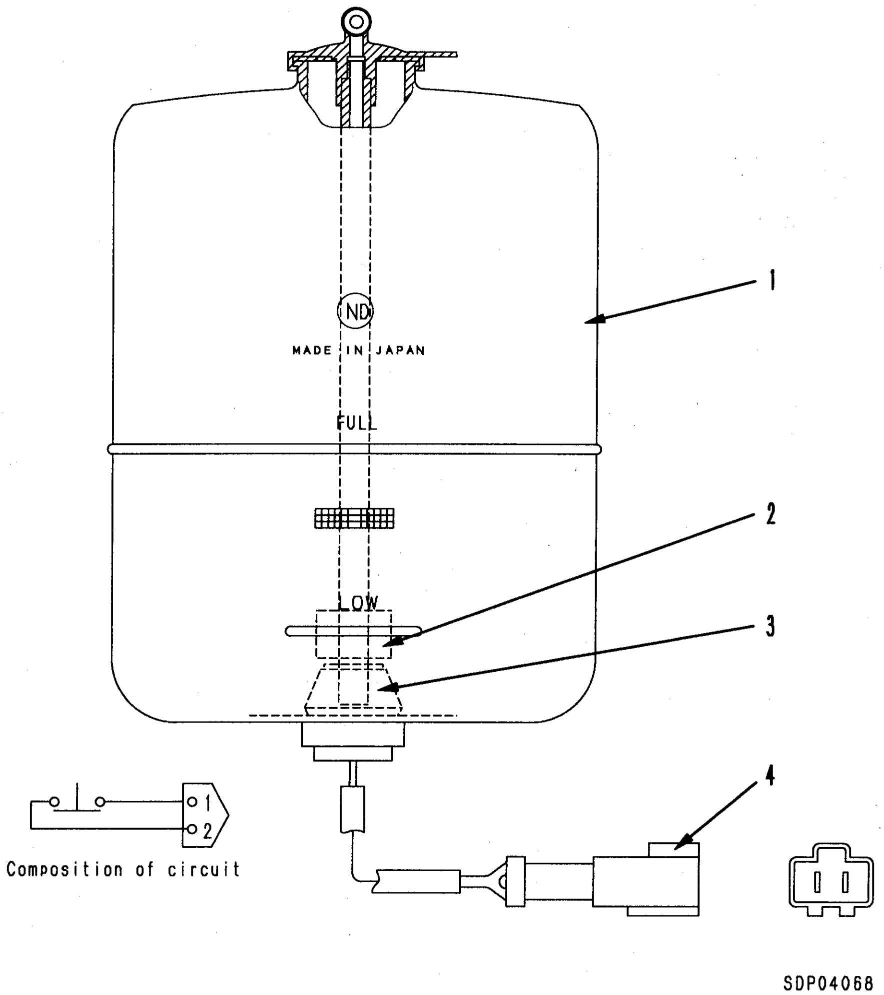
Note 2: Even if it is ON, when the working mode switch is pressed, it is automatically turned OFF.

2. Sensors

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

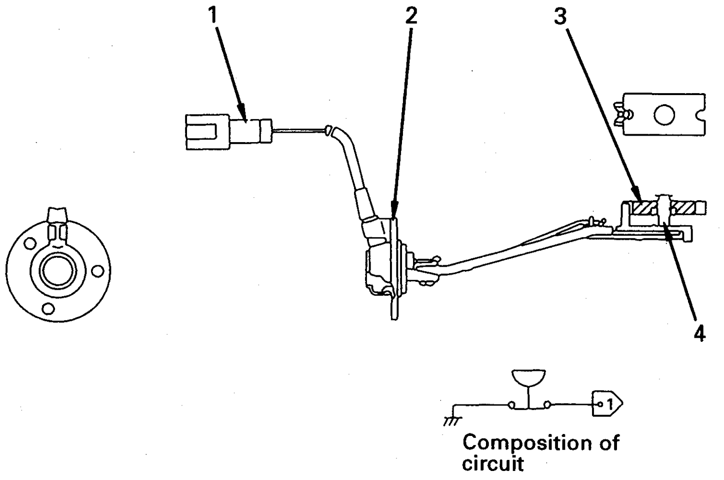
Name of sensor	Type of sensor	When normal	When abnormal
Coolant level	Contact type	ON (closed)	OFF (open)
Engine oil level	Contact type	ON (closed)	OFF (open)
Hydraulic oil level	Contact type	ON (closed)	OFF (open)
Engine oil pressure	Contact type	OFF (open)	ON (closed)
Coolant temperature	Resistance type	—	—
Fuel level	Resistance type	—	—
Air cleaner clogging	Contact type	OFF (closed)	ON (open)

Coolant level sensor



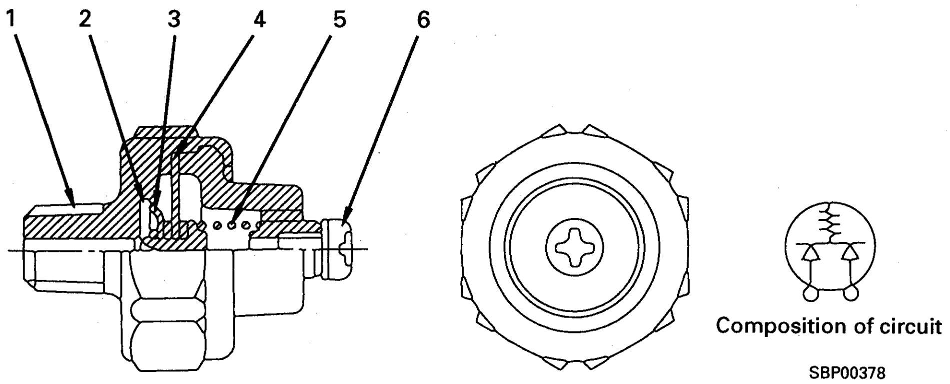
1. Sub-tank
2. Float
3. Sensor
4. Connector

Engine oil level sensor
Hydraulic oil level sensor



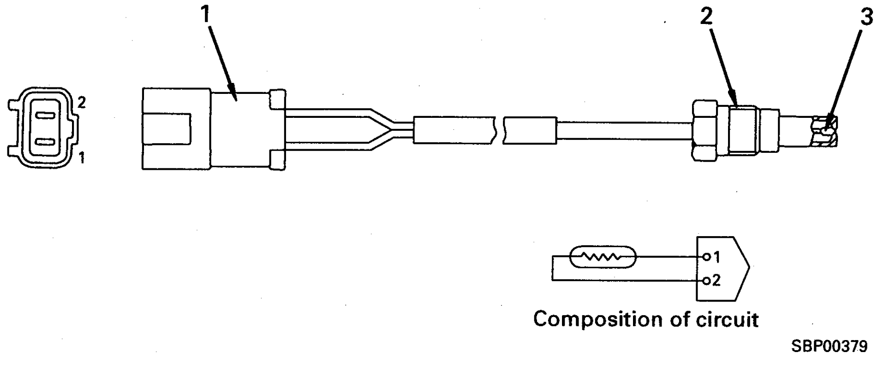
1. Connector
2. Bracket
3. Float
4. Switch

Engine oil pressure sensor (both Lo and Hi)



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

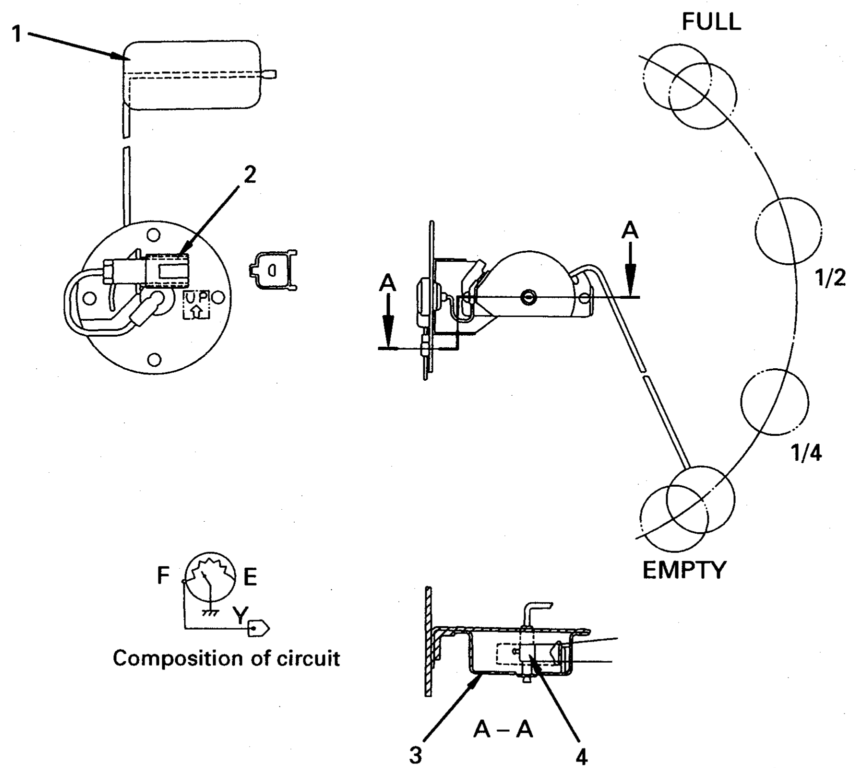
Coolant temperature sensor



1. Connector
2. Plug
3. Thermistor

Fuel level sensor

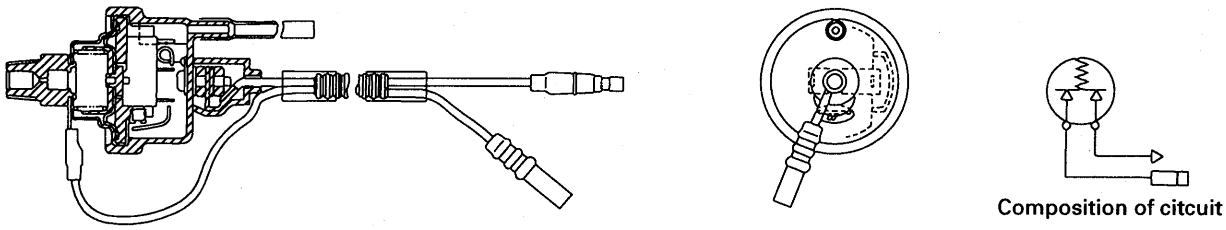
1. Float
2. Connector
3. Cover
4. Variable resistor



Composition of circuit

SBP00380

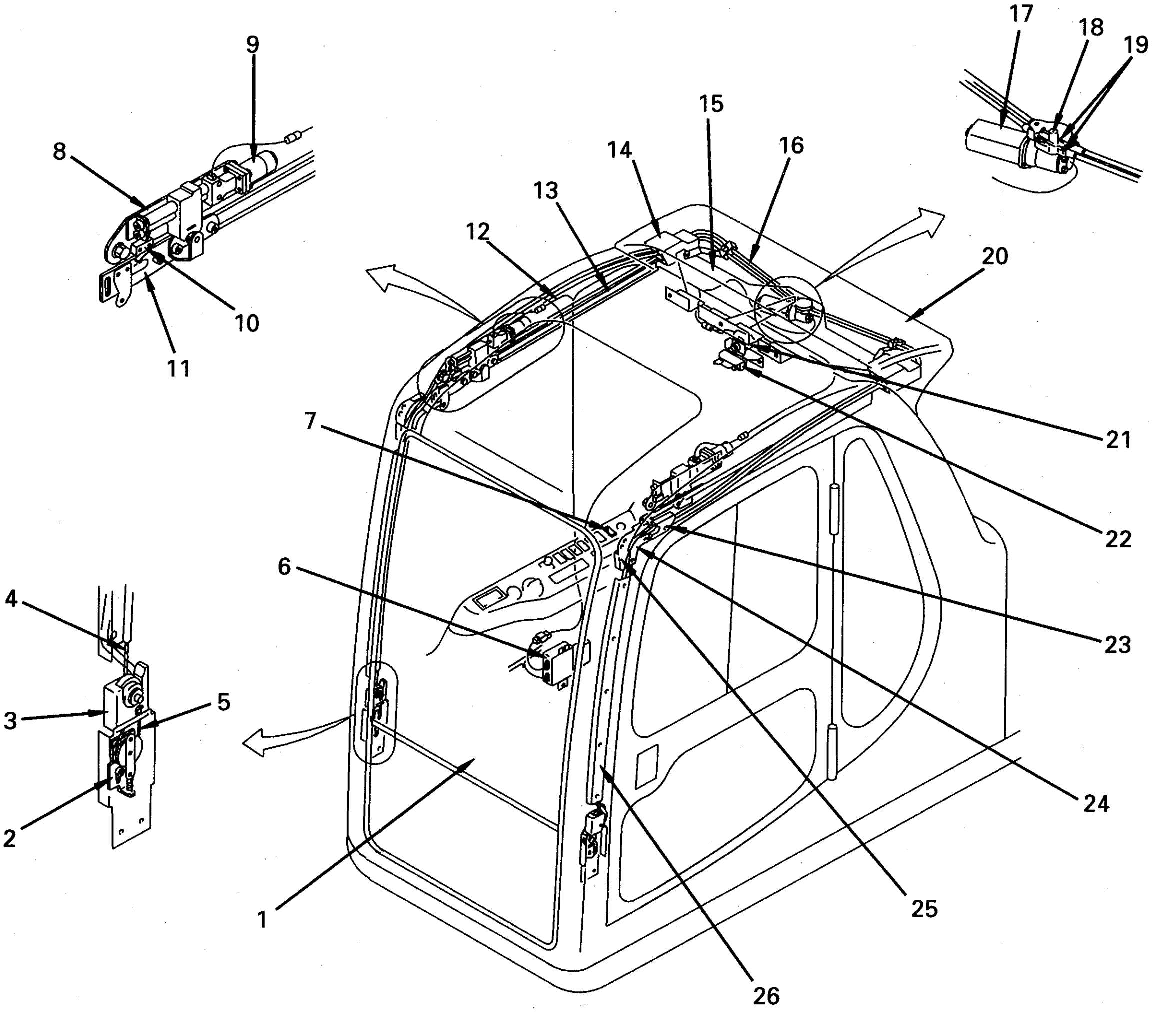
Air cleaner clogging sensor



Composition of citcuit

SBP00381

FRONT WINDOW AUTO PULL-UP SYSTEM



SBP00382

1. Front window assembly
2. Bracket assembly (tension roller)
3. Right block (roller support)
4. Right geared cable
5. Right return cable
6. Controller
7. Control switch
8. Right lock assembly
9. Right tightening motor
10. Limit switch (front)
11. Right bracket assembly (slide link)
12. Harness
13. Right rail
14. Rear cover
15. Bracket (for motor mount)
16. Cable assembly
17. Motor assembly (for lifting)
18. Motor output shaft
19. Geared cable assembly
20. Spoiler cover
21. Limit switch (rear lock)
22. Rear lock
23. Left block (dovetail)
24. Left block (return cable guide)
25. Left block (return cable holder)
26. Left cover (return cable holder)

Function

- An electric motor is used for the front glass (top) of the operator's cab. This makes it possible to open, close, or tighten simply by operating the switch.

Operation

1. Opening front window

1) Press the UP control switch.
2) When left and right front locks (8) are actuated in the OPEN direction, front window (1) is moved to the LOWER position by slide link (11). When the release operation is completed, the movement of front lock (8) stops.
3) After the movement of front lock (8) has been completed, operate lift motor (17) to the OPEN direction. Geared cable (19), which is meshed with motor output shaft (18), will move and pull up front window (1).
4) Front window (1) is set at the OPEN position, and lift motor (17) stops operating at the point where rear lock (12) is engaged.

2. Closing front window

1) Press the DOWN control switch, and push the release lever of rear lock (22) at the same time.
2) Lift motor (17) moves in the CLOSE direction and moves front window (1) down.
3) When front window (1) has moved down fully, lift motor (17) stops.
4) When the movement of lift motor (17) has been completed, front locks (8) are moved in the tightening direction by left and right tightening motors (9). When the tightening is completed, the motor stops.

20 TESTING AND ADJUSTING

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

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

⚠ **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.**

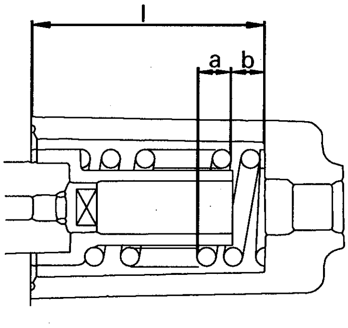
STANDARD VALUE TABLE FOR ENGINE RELATED PARTS

Applicable model			PC400, 450-6	
Engine			SA6D125E-2	
Item	Measurement conditions	Unit	Standard value for new machine	Service limit value
Engine speed	High idling (Active mode, lever operated slightly)	rpm	2,250 ± 70	2,250 ± 70
	Low idling		700	700
	Rated speed (Active mode)		2,050	—
Rated speed	Air supply pressure (boost pressure)	kPa {mmHg}	Min. 107 {Min. 800}	85.3 {640}
Exhaust gas color	At sudden acceleration	Bosch index	Max. 5.5	7.5
	At high idling		Max. 1.0	2.0
Valve clearance (normal temperaure)	Intake valve	mm	0.34	—
	Exhaust valve		0.71	—
Compression pressure (SAE oil)	Oil temperature: 40 – 60°C	MPa {kg/cm^2}	Min. 2.9 {30}	2.0 {20}
	(Engine speed)	(rpm)	(150 – 200)	(150 – 200)
Blowby pressure (SAE oil)	(Water temperature: Operating range) At rated output	kPa {mmH$_2$O}	Max. 0.98 {100}	1.96 {200}
Oil pressure	(Water temperature: Operating range)	kPa {kg/cm^2}		
	At high idling (SAE30)		294 – 490 {3.0 – 5.0}	206 {2.1}
	At high idling (SAE10W)		245 – 441 {2.5 – 4.5}	176 {1.8}
	At low idling (SAE30)		Min. 118 {1.2}	69 {0.7}
	At low idling (SAE10W)		Min. 98 {1.0}	69 {0.7}
Oil temperature	Whole speed range (inside oil pan)	°C	80 – 120	120
Fuel injection timing	Before top dead center	° (degree)	16 ± 0.75	16 ± 0.75
Belt tension	Deflection when pressed with finger force of approx. 58.8 N {6 kg}: Fan pulley-alternator	mm	8	6 – 10
	Deflection when pressed with finger force of approx. 58.8 N {6 kg}: Crankshaft pulley - air conditioner compressor		15 – 18	15 – 18

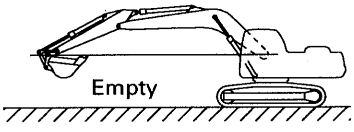
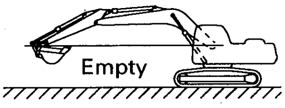
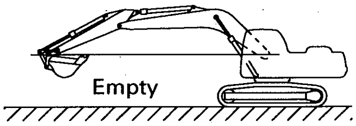
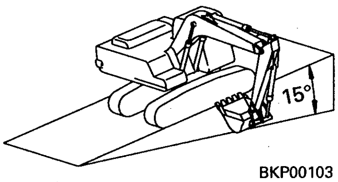
STANDARD VALUE TABLE FOR CHASSIS RELATED PARTS

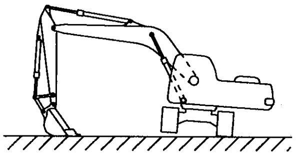
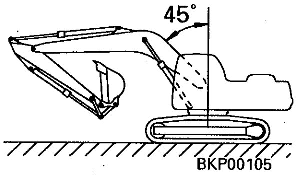
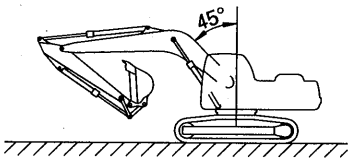
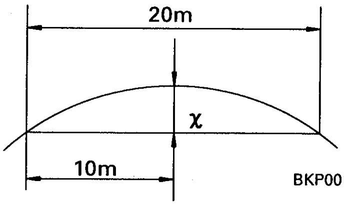
★ The Standard value for new machine and Service limit value in the table below are all values when measured in the heavy-duty mode.

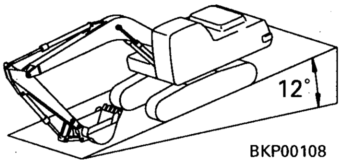
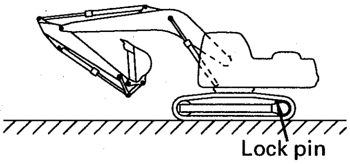
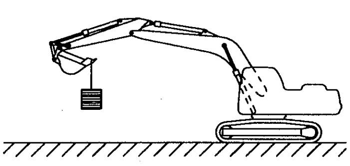
BACK HOE

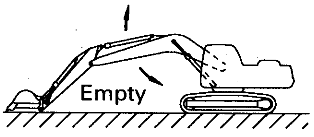
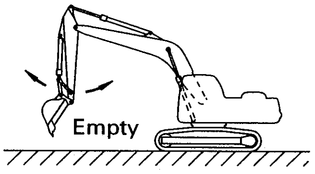
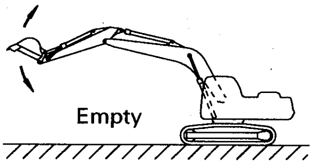
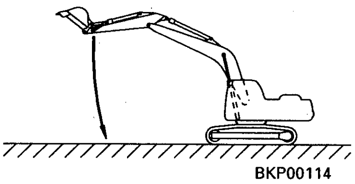
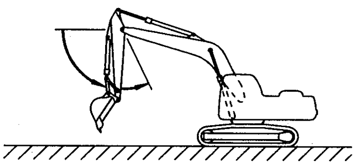
Applicable model				PC400, 450-6					
Category	Item	Measurement conditions	Unit	Standard value for new machine			Service limit value		
Engine speed	At 2-pump relief	· Engine water temperature: Within operating range · Hydraulic oil temperature: 45 – 55°C · Engine at full throttle · In heavy duty operation mode (H/O mode) · Arm IN relief	rpm	When swing lock switch is OFF: 2,020 ± 100			When swing lock switch is OFF: 2,020 ± 100		
				When swing lock switch is ON: 1,950 ± 100			When swing lock switch is ON: 1,950 ± 100		
	At 2-pump relief + power max.	· Engine at full throttle · In heavy duty operation mode (H/O mode) · Arm IN relief + power max. ON		1,950 ± 100			1,950 ± 100		
	Engine speed when auto-deceleration is actuated	· Auto-deceleration switch ON · Fuel control dial at MAX. · Control levers at neutral.		1,400 ± 100			1,400 ± 100		
Spool stroke			mm	ℓ	a	b	ℓ	a	b
	Boom Lo control valve	 BLP00101		—	9.5 ± 0.5 (Boom Lo LOWER only 11.5 ± 0.5)	9.5 ± 0.5	—	9.5 ± 0.5 (Boom Lo LOWER only 11.5 ± 0.5)	9.5 ± 0.5
	Boom Hi control valve								
	Arm Lo control valve								
	Arm Hi control valve								
	Bucket control valve								
	Swing control valve								
	Left travel control valve								
	Right travel control valve								
Travel of control levers	Boom control lever	· Center of lever knob · Read max. value to end of travel · Engine stopped · Exclude play at neutral.	mm	85 ± 10			Max. 95 Min. 75		
	Arm control lever			85 ± 10			Max. 95 Min. 75		
	Bucket control lever			85 ± 10			Max. 95 Min. 75		
	Swing control lever			85 ± 10			Max. 95 Min. 75		
	Travel control lever			115 ± 12			Max. 127 Min. 103		
	Play of control lever	Work equipment, swing		Max. 10			Max. 15		
		Travel		Max. 20			Max. 30		

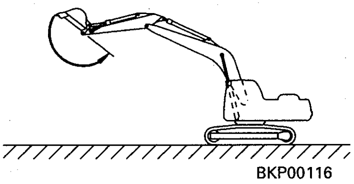
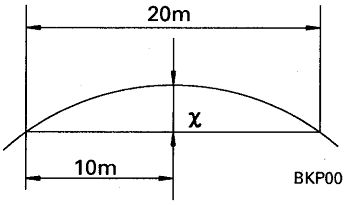
Applicable model					PC400, 450-6	
Category	Item	Measurement conditions		Unit	Standard value for new machine	Service limit value
Operating effort of control levers	Boom control lever	· Engine at full throttle · Oil temperature: 45 – 55°C · Fit push-pull scale to center of control lever knob or tip of pedal to measure · Measure max. value to end of travel		N {kg}	15.68 ± 3.92 {1.6 ± 0.4}	Max. 24.5 {2.5}
	Arm control lever				15.68 ± 3.92 {1.6 ± 0.4}	Max. 24.5 {2.5}
	Bucket control lever				12.74 ± 2.94 {1.3 ± 0.3}	Max. 21.56 {2.2}
	Swing control lever				12.74 ± 2.94 {1.3 ± 0.3}	Max. 21.56 {2.2}
	Travel control lever		Lever		24.5 ± 5.88 {2.5 ± 0.6}	Max. 39.2 {4.0}
			Pedal		74.48 ± 18.62 {7.6 ± 1.9}	Max. 107.8 {11}
Hydraulic pressure	Unload pressure	· Engine at full throttle · Oil temperature: 45 – 55°C · All levers at neutral · Pump outlet port pressure		MPa {kg/cm²}	3.92 ± 0.98 {40 ± 10}	3.92 ± 0.98 {40 ± 10}
	Boom	· Oil temperature: 45 – 55°C · Engine at full throttle · In heavy duty operation mode (H/O mode) · Pump outlet port pressure · Relieve only circuit being measured ★ The values in ( ) are the values when using the power max.	RAISE		33.81 ± 0.98 (34.79 ± 0.98) {345 ± 10 (355 ± 10)}	Max.35.77 (Max.36.26) Min.32.34 (Min.33.32) {Max.365 (Max.370) Min. 330 (Min.340)}
			LOWER At high-pressure setting		31.85 ± 1.47 {325 ± 15}	Max. 33.81 {345} Min. 29.89 {305}
			LOWER At low-pressure setting		19.11 ± 0.98 {195 ± 10}	Max. 20.58 {210} Min. 17.64 {180}
	Arm				33.81 ± 0.98 (34.79 ± 0.98) {345 ± 10 (355 ± 10)}	Max.35.77 (Max.36.26) Min.32.34 (Min.33.32) {Max.365 (Max.370) Min. 330 (Min.340)}
	Bucket				33.81 ± 0.98 (34.79 ± 0.98) {345 ± 10 (355 ± 10)}	Max.35.77 (Max.36.26) Min.32.34 (Min.33.32) {Max.365 (Max.370) Min. 330 (Min.340)}
	Swing				$30.38^{+0.98}_{-1.47}$ {310^{+10}_{-15}}	Max. 31.85 {325} Min. 27.93 {285}
	Left travel				$34.79^{+1.96}_{-0.98}$ {355^{+20}_{-10}}	Max. 37.24 {380} Min. 33.32 {340}
	Right travel				$34.79^{+1.96}_{-0.98}$ {355^{+20}_{-10}}	Max. 37.24 {380} Min. 33.32 {340}
	Self-reducing valve				3.23 ± 0.2 {33 ± 2}	Max. 3.53 {36} Min. 2.94 {30}
	LS differential pressure	· Oil temperature: 45 – 55°C · Engine at full throttle · In heavy duty operation mode (H/O mode) ★ LS differential pressure = Pump outlet port pressure – LS pressure	All levers at neutral		3.92 ± 0.98 {40 ± 10}	3.92 ± 0.98 {40 ± 10}
			Travel Hi under no load, travel lever at half-way position		2.45 ± 0.1 {25 ± 1}	2.45 ± 0.1 {25 ± 1}

Applicable model					PC400, 450-6			
Cate-gory	Item	Measurement conditions		Unit	Standard value for new machine		Service limit value	
					PC400	PC450	PC400	PC450
Swing	Overrun when stopping swing	Work equipment posture Max. reach  · Engine at full throttle · Hydraulic oil temperature: 45 – 55˚C · In heavy duty operation mode (H/O mode) · Stop after swinging one turn and measure distance that swing circle moves		Deg.	Max. 120	Max. 130	Max. 150	Max. 160
	Time taken to start swing	Work equipment posture Max. reach  · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · In heavy duty operation mode (H/O mode) · Time taken to swing 90° and 180° from starting position	90°	Sec	3.7 ± 0.4		Max. 4.6	
			180°		5.4 ± 0.5		Max. 6.4	
	Time taken to swing	Work equipment posture Max. reach  · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · In heavy duty operation mode (H/O mode) · Swing one turn, then measure time taken to swing next 5 turns			33.0 ± 1.7		Max. 38	
	Hydraulic drift of swing	 · Engine stopped · Hydraulic oil temperature: 45 – 55°C · Set machine on 15° slope, and set upper structure at 90° to the side. · Make match marks on swing circle outer race and track frame. · Measure distance that match marks move apart after 5 minutes.		mm	0		0	
	Leakage from swing motor	· Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · Swing lock switch ON · Relieve swing circuit.		ℓ/min	Max. 5.5		Max.11	

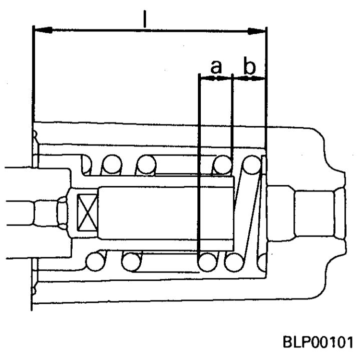
Applicable model					PC400, 450-6			
Category	Item	Measurement conditions		Unit	Standard value for new machine		Service limit value	
			Travel speed		STD	LC	STD	LC
Travel	Travel speed (1)	 BKP00104 · Engine at full throttle · Hydraulic oil temperature: 45 – 55° · In heavy duty operation mode (H/O mode) · Raise track on one side, rotate one turn, then measure time taken for next 5 turns with no load.	Lo	Sec	59.5 ± 6.0	63.5 ± 6.5	53.5 – 71.5	57.0 – 76.5
			Mi		42.0 ± 5.5	44.5 ± 6.0	36.5 – 51.0	38.5 – 56.5
			Hi		34.5 ± 3.5	36.5 ± 3.7	31.0 – 41.5	32.8 – 43.9
	Travel speed (2)	 BKP00105 · Engine at full throttle · Hydraulic oil temperature: 45 – 55° · In heavy duty operation mode (H/O mode) · Run up for at least 10 m, and measure time taken to travel next 20 m on flat ground.	Lo		22.5 ± 4.4		19.0 – 29.5	
			Mi		15.9 ± 2.1		13.8 – 20.1	
			Hi		13.1 ± 1.0		12.1 – 15.1	
	Travel deviation	 BKP00106 · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · In heavy duty operation mode (H/O mode) · Travel speed : Hi · Run up for at least 10 m, and measure deviation when traveling next 20 m on flat ground. ★ Use a hard flat ground.  BKP00107 ★ Measure dimension χ.		mm	Max. 200		Max. 300	

Applicable model					PC400, 450-6			
Category		Item	Measurement conditions	Unit	Standard value for new machine		Service limit value	
Travel		Hydraulic drift of travel	 BKP00108 · Engine stopped · Hydraulic oil temperature: 45 – 55°C · Stop machine on 12° slope with sprocket facing straight up the slope. · Measure the distance that machine moves in 5 minutes.	mm	0		0	
		Leakage of travel motor	 Lock pin BKP00109 · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · Lock shoes and relieve travel circuit.	ℓ/min	Max. 20		Max. 40	
Work equipment	Hydraulic drift of work equipment		Posture for measurement	mm	PC400	PC450	PC400	PC450
		Total work equipment (hydraulic drift at tip of bucket teeth)	 BKP00110		Max. 600	Max. 700	Max. 900	Max. 1,050
		Boom cylinder (amount of retraction of cylinder)	· Place in above posture and measure extension or retraction of each cylinder and downward movement at tip of bucket teeth. · Bucket: Rated load 21.2 kN {2160 kg} · Flat ground · Levers at neutral · Engine stopped · Hydraulic oil temperature: 45 – 55°C · Start measuring immediately after setting. · Measure hydraulic drift every 5 minutes, and judge from results for 15 minutes.		Max. 25	Max. 29	Max. 38	Max. 44
		Arm cylinder (amount of extension of cylinder)			Max. 85	Max. 100	Max. 128	Max. 150
		Bucket cylinder (amount of retraction of cylinder)			Max. 30	Max. 35	Max. 45	Max. 53

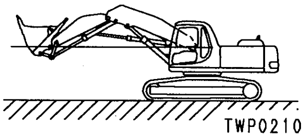
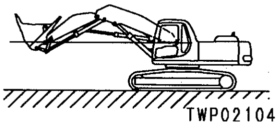
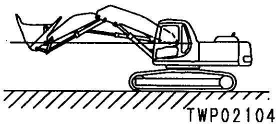
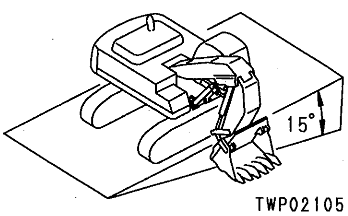
<table>
<tr><td colspan="6">Applicable model</td><td colspan="4">PC400, 450-6</td></tr>
<tr><td>Category</td><td colspan="2">Item</td><td colspan="2">Measurement conditions</td><td>Unit</td><td colspan="2">Standard value for new machine</td><td colspan="2">Service limit value</td></tr>
<tr><td rowspan="10">Work equipment</td><td rowspan="7">Work equipment speed</td><td rowspan="2">Boom
Bucket teeth in contact with ground
↕
Cylinder fully extended</td><td rowspan="2">
BKP00111
· Engine at full throttle
· Hydraulic oil temperature: 45 – 55°C
· In heavy duty operation mode (H/O mode)</td><td>RAISE</td><td rowspan="10">Sec</td><td colspan="2">4.2 ± 0.4</td><td colspan="2">Max. 5.0</td></tr>
<tr><td>LOWER</td><td colspan="2">3.4 ± 0.3</td><td colspan="2">Max. 3.9</td></tr>
<tr><td rowspan="3">Arm
Cylinder fully retracted
↕
Fully extended</td><td rowspan="3">
BKP00112
· Engine at full throttle
· Hydraulic oil temperature: 45 – 55°C
· In heavy duty operation mode (H/O mode)</td><td rowspan="2">IN</td><td>PC400</td><td>PC450</td><td>PC400</td><td>PC450</td></tr>
<tr><td>4.8 ± 0.5</td><td>5.2 ± 0.5</td><td>Max. 5.8</td><td>Max. 6.2</td></tr>
<tr><td>OUT</td><td>3.9 ± 0.4</td><td>3.9 ± 0.4</td><td>Max. 4.7</td><td>Max. 4.7</td></tr>
<tr><td rowspan="2">Bucket
Cylinder fully retracted
↕
Fully extended</td><td rowspan="2">
BKP00113
· Engine at full throttle
· Hydraulic oil temperature: 45 – 55°C
· In heavy duty operation mode (H/O mode)</td><td>CURL</td><td colspan="2">3.6 ± 0.4</td><td colspan="2">Max. 4.4</td></tr>
<tr><td>DUMP</td><td colspan="2">2.8 ± 0.3</td><td colspan="2">Max. 3.4</td></tr>
<tr><td rowspan="3">Time lag</td><td>Boom</td><td colspan="2">
BKP00114
· Lower boom and measure time taken from point where bucket contacts ground to point where chassis rises from ground
· Engine at low idling
· Hydraulic oil temperature: 45 – 55°C</td><td colspan="2">Max. 3.0</td><td colspan="2">Max. 5.0</td></tr>
<tr><td rowspan="2">Arm</td><td colspan="2" rowspan="2">
BKP00115
· Stop arm suddenly and measure stopping time.
· Engine at low idling
· Hydraulic oil temperature: 45 – 55°C</td><td>PC400</td><td>PC450</td><td>PC400</td><td>PC450</td></tr>
<tr><td>Max. 3.0</td><td>Max. 4.0</td><td>Max. 5.0</td><td>Max. 6.0</td></tr>
</table>

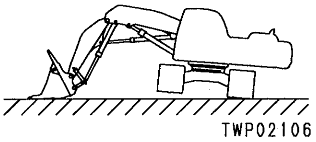
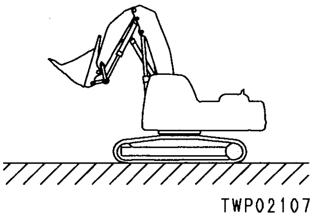
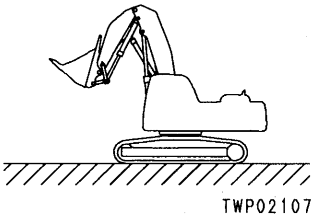
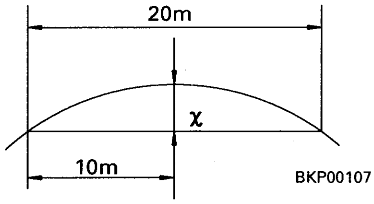
Applicable model					PC400, 450-6	
Cate-gory	Item		Measurement conditions	Unit	Standard value for new machine	Service limit value
Work equipment	Time lag	Bucket	 BKP00116 · Stop bucket suddenly and measure stopping time. · Engine at low idling · Hydraulic oil temperature: 45 – 55°C	Sec	Max. 3.0	Max. 5.0
	Internal leakage	Cylinders	· Hydraulic oil temperature: 45 – 55°C · Engine at full throttle · Relieve circuit to be measured	cc/min	Max. 4.5	Max. 20
		Center swivel joint			Max. 10	Max. 50
Performance in compound operation	Travel deviation when work equipment + travel are operated		· Hydraulic oil temperature: 45 – 55°C ★ Use a hard flat ground. ★ Measure dimension χ.  BKP00107 · Oil temperature: 45 – 55°C	mm	Max. 400	Max. 440
Performance of hydraulic pump	Hydraulic pump delivery	Piston pump	See 20-10 page	ℓ/min	See 20-10 page	

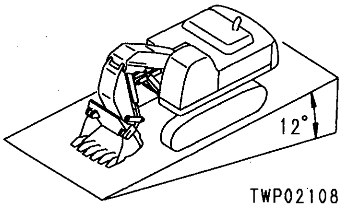
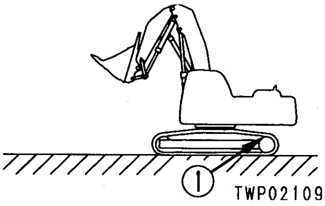
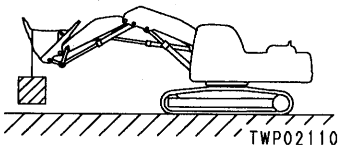
LOADING SHOVEL

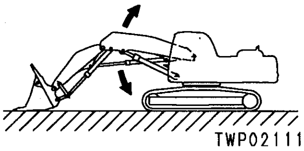
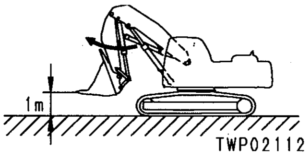
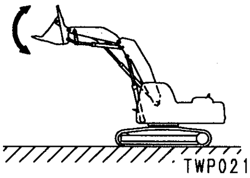
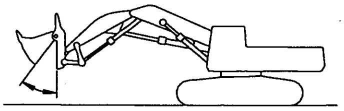
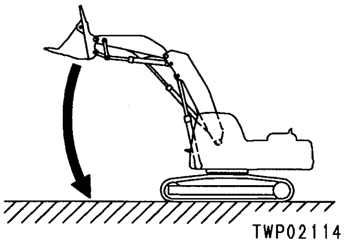
Applicable model				PC400-6					
Category	Item	Measurement conditions	Unit	Standard value for new machine			Service limit value		
Engine speed	At 2-pump relief	· Engine water temperature: Within operating range · Hydraulic oil temperature: 45 – 55°C · Engine at full throttle · In H/O mode · Arm IN relief	rpm	When swing lock switch is OFF: 2,150 $^{+50}_{-100}$			When swing lock switch is OFF: 2,150 $^{+50}_{-100}$		
				When swing lock switch is ON: 1,850 ± 100			1,850 ± 100		
	At 2-pump relief + power max.	· Engine at full throttle · In H/O mode · Arm IN relief + power max. ON		1,930 ± 50			1,930 ± 100		
	Engine speed when auto-deceleration is actuated	· Auto-deceleration switch ON · Fuel control dial at MAX. · Control levers at neutral.		1,400 ± 100			1,400 ± 100		
Spool stroke	Bottom dump		mm	ℓ	a	b	ℓ	a	b
	Boom Lo			— —	9.5 ± 0.5 Boom Lo LOWER only 8.7 ± 0.5	9.5 ± 0.5 Boom Lo LOWER only 8.7 ± 0.5	— —	9.5 ± 0.5 Boom Lo LOWER only 8.7 ± 0.5	9.5 ± 0.5 Boom Lo LOWER only 8.7 ± 0.5
	Boom Hi								
	Arm Lo								
	Arm Hi								
	Bucket								
	Swing								
	Left travel								
	Right travel								
Travel of control levers	Boom control lever	· Center of lever knob · Read max. value to end of travel · Engine stopped · Exclude play at neutral.	mm	85 ± 10			Max. 95 Min. 75		
	Arm control lever			85 ± 10			Max. 95 Min. 75		
	Bucket control lever			85 ± 10			Max. 95 Min. 75		
	Swing control lever			85 ± 10			Max. 95 Min. 75		
	Travel control lever			115 ± 12			Max. 127 Min. 103		
	Play of control lever	Work equipment, swing		Max. 10			Max. 15		
		Travel		Max. 20			Max. 30		

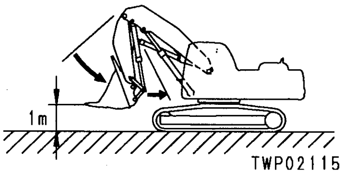
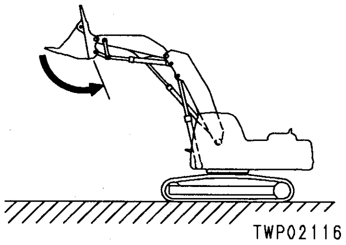
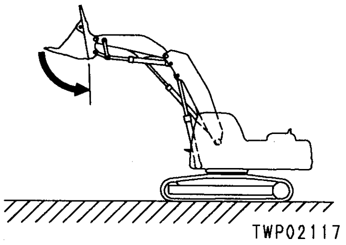
Applicable model					PC400-6	
Category	Item	Measurement conditions		Unit	Standard value for new machine	Service limit value
Operating effort of control levers	Boom control lever	· Engine at full throttle · Oil temperature: 45 – 55°C · Fit push-pull scale to center of control lever knob or tip of pedal to measure · Measure max. value to end of travel		N {kg}	15.68 ± 3.92 {1.6 ± 0.4}	Max. 24.5 {2.5}
	Arm control lever				15.68 ± 3.92 {1.6 ± 0.4}	Max. 24.5 {2.5}
	Bucket control lever				12.74 ± 2.94 {1.3 ± 0.3}	Max. 21.56 {2.2}
	Swing control lever				12.74 ± 2.94 {1.3 ± 0.3}	Max. 21.56 {2.2}
	Travel control lever		Lever		24.5 ± 5.88 {2.5 ± 0.6}	Max. 39.2 {4.0}
			Pedal		74.48 ± 18.62 {7.6 ± 1.9}	Max. 107.8 {11}
Hydraulic pressure	Unload pressure	· Engine at full throttle · Oil temperature: 45 – 55°C · All levers at neutral · Pump outlet port pressure		MPa {kg/cm²}	3.92 ± 0.98 {40 ± 10}	3.92 ± 0.98 {40 ± 10}
	Boom	· Oil temperature: · 45 – 55°C · Engine at full throttle · In heavy duty mode · Pump outlet port pressure · Relieve only circuit being measured ★ The values in ( ) are the values when using the power max.	RAISE		33.81 ± 0.98 (34.79 ± 0.98) {345 ± 10 (355 ± 10)}	Max.35.77 (Max.36.26) Min.32.34 (Min.33.32) {Max.365 (Max.370) Min. 330 (Min.340)}
			LOWER At high-pressure setting		28.4 ± 1.5 {290 ± 15}	Max. 30.4 {310} Min. 26.5 {270}
			At low-pressure setting		14.7 ± 1.0 {150 ± 10}	Max. 16.2 {165} Min. 13.2 {135}
	Arm		IN		31.8 {325} at 330 ℓ/min	Max. 33.8 {345} Min. 29.9 {305}
			OUT		28.4 {290} at 5 ℓ/min	Max. 30.4 {310} Min. 26.5 {270}
	Bucket		CURL		31.8 {325} at 330 ℓ/min	Max. 33.8 {345} Min. 29.9 {305}
			DUMP		28.4 {290} at 5 ℓ/min	Max. 30.4 {310} Min. 26.5 {270}
	Bottom dump		OPEN		28.4 ± 1.0 {290 ± 10} at 5 ℓ/min	Max. 30.4 {310} Min. 26.5 {270}
			CLOSE		24.5 ± 1.0 {250 ± 10} at 5 ℓ/min	Max. 26.0 {265} Min. 23.0 {235}
	Swing				$30.38^{+0.98}_{-1.47}$ $\{310^{+10}_{-15}\}$	Max. 31.85 {325} Min. 27.93 {285}
	Left travel				$34.79^{+1.96}_{-0.98}$ $\{355^{+20}_{-10}\}$	Max. 37.24 {380} Min. 33.32 {340}
	Right travel				$34.79^{+1.96}_{-0.98}$ $\{355^{+20}_{-10}\}$	Max. 37.24 {380} Min. 33.32 {340}
	Self-reducing valve				3.23 ± 0.2 {33 ± 2}	Max. 3.53 {36} Min. 2.94 {30}
	LS differential pressure	· Oil temperature: 45 – 55°C · Engine at full throttle · In heavy duty mode ★ LS differential pressure = Pump outlet port pressure – LS pressure	All levers at neutral		3.92 ± 0.98 {40 ± 10}	3.92 ± 0.98 {40 ± 10}
			Travel Hi under no load, travel lever at half-way position		2.45 ± 0.1 {25 ± 1}	2.45 ± 0.1 {25 ± 1}

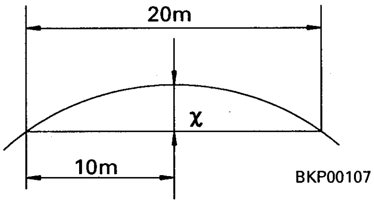
Applicable model					PC400-6	
Cate-gory	Item	Measurement conditions		Unit	Standard value for new machine	Service limit value
Swing	Overrun when stopping swing	Work equipment posture Max. reach  · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · In H/O mode · Stop after swinging one turn and measure distance that swing circle moves		Deg.	Max. 120	Max. 150
	Time taken to start swing	Work equipment posture Max. reach  · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · In H/O mode · Time taken to swing 90° and 180° from starting position	90°	Sec	3.7 ± 0.4	Max. 4.6
			180°		5.4 ± 0.5	Max. 6.4
	Time taken to swing	Work equipment posture Max. reach  · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · In H/O mode · Swing one turn, then measure time taken to swing next 5 turns			33.7 ± 1.7	Max. 38
	Hydraulic drift of swing	 · Engine stopped · Hydraulic oil temperature: 45 – 55°C · Set machine on 15° slope, and set upper structure at 90° to the side. · Make match marks on swing circle outer race and track frame. · Measure distance that match marks move apart after 5 minutes.		mm	0	0
	Leakage from swing motor	· Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · Swing lock switch ON · Relieve swing circuit.		ℓ/min	Max. 5.5	Max.11

Applicable model					PC400-6			
Cate-gory	Item	Measurement conditions		Unit	Standard value for new machine		Service limit value	
			Travel speed		STD	LC	STD	LC
Travel	Travel speed (1)	 · Engine at full throttle · Hydraulic oil temperature: 45 – 55° · Raise track on one side, rotate one turn, then measure time taken for next 5 turns with no load.	Lo	Sec	59.5 ± 6.0	62.5 ± 6.5	53.5 – 71.5	56.0 – 75.5
			Hi		34.5 ± 3.5	36.5 ± 3.7	31.0 – 41.5	32.8 – 43.9
	Travel speed (2)	 · Engine at full throttle · Hydraulic oil temperature: 45 – 55° · Run up for at least 10 m, and measure time taken to travel next 20 m on flat ground.	Lo		22.5 ± 3.5		19.0 – 29.5	
			Hi		13.1 ± 1.0		12.1 – 15.1	
	Travel deviation	 · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · Travel speed : Hi · Run up for at least 10 m, and measure deviation when traveling next 20 m on flat ground. ★ Use a hard flat ground.  ★ Measure dimension χ.		mm	Max. 200		Max. 300	

Applicable model					PC400-6	
Category		Item	Measurement conditions	Unit	Standard value for new machine	Service limit value
Travel		Hydraulic drift of travel	 · Engine stopped · Hydraulic oil temperature: 45 – 55°C · Stop machine on 12° slope with sprocket facing straight up the slope. · Measure the distance that machine moves in 5 minutes.	mm	0	0
		Leakage of travel motor	 · Fit lock pin ①. · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · Lock shoes and relieve travel circuit.	ℓ/min	Max. 20	Max. 40
Work equipment	Hydraulic drift of work equipment	Total work equipment (hydraulic drift at tip of bucket teeth)	Posture for measurement  · Place in above posture and measure extension or retraction of each cylinder and downward movement at tip of bucket teeth. · Bucket: Rated load 21.2 kN {2160 kg} · Horizontal, flat ground · Levers at neutral · Engine stopped · Hydraulic oil temperature: 45 – 55°C · Start measuring immediately after setting. · Measure hydraulic drift every 5 minutes, and judge from results for 15 minutes.	mm	Max. 600	Max. 900
		Boom cylinder (amount of retraction of cylinder)			Max. 25	Max. 38
		Arm cylinder (amount of extension of cylinder)			Max. 85	Max. 128
		Bucket cylinder (amount of retraction of cylinder)			Max. 30	Max. 45

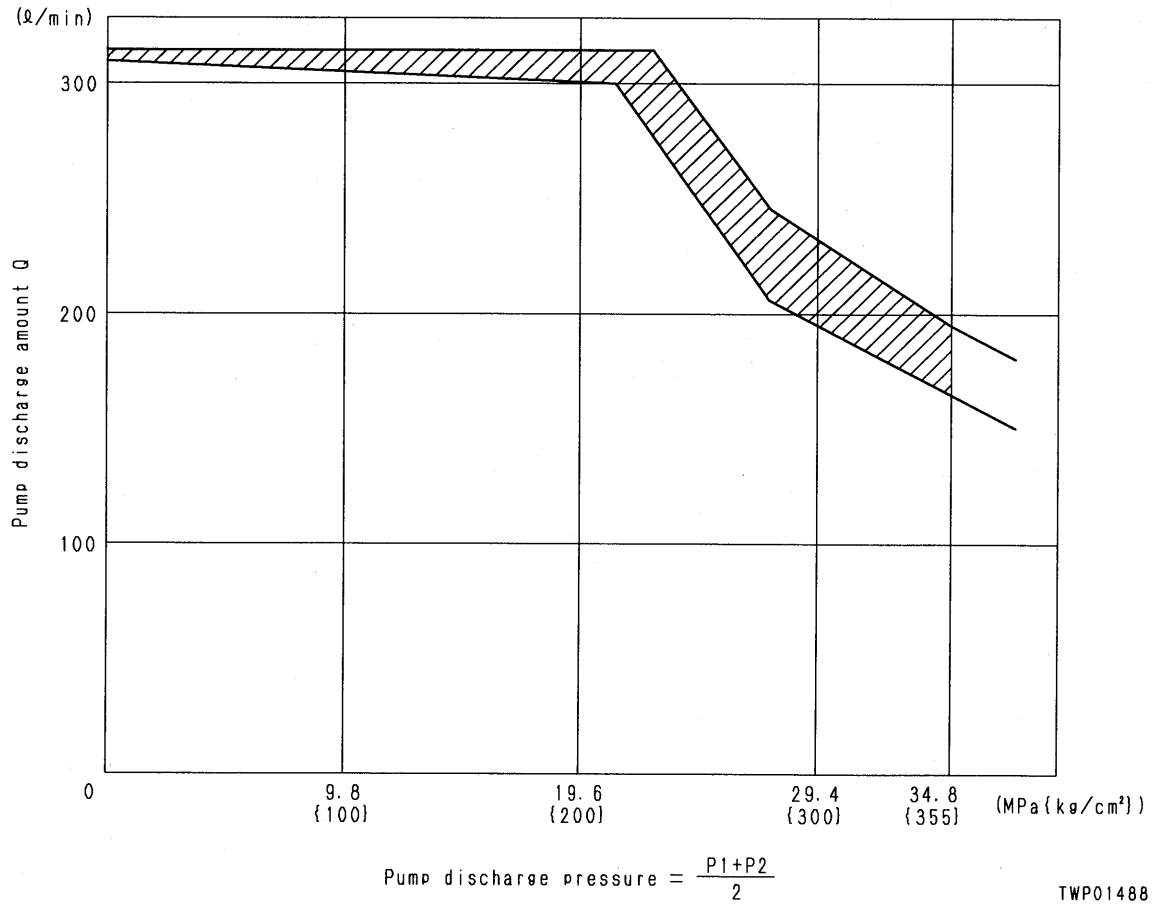
Applicable model						PC400-6	
Category		Item	Measurement conditions		Unit	Standard value for new machine	Service limit value
Work equipment	Work equipment speed	Boom Bucket teeth in contact with ground ↕ Cylinder fully extended	 · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · In H/O mode	RAISE	Sec	6.2 ± 0.6	7.2
				LOWER		4.5 ± 0.5	5.4
		Arm Cylinder fully retracted ↕ Fully extended	 · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · In H/O mode	IN		4.0 ± 0.4	4.7
				OUT		3.0 ± 0.3	3.6
		Bucket Cylinder fully retracted ↕ Fully extended	 · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C · In H/O mode	CURL		5.0 ± 0.5	5.9
				DUMP		3.3 ± 0.3	3.8
		Bttom dump Cylinder fully retracted ↕ Fully extended	 · Engine at full throttle · Hydraulic oil temperature: 45 – 55°C	OPEN		1.8 ± 0.2	Max. 2.2
				CLOSE		1.8 ± 0.2	Max. 2.2
	Time lag	Boom	 · Lower boom and measure time taken from point where bucket contacts ground to point where chassis rises from ground · Engine at low idling · Hydraulic oil temperature: 45 – 55°C			Max. 3.0	Max. 5.0

Applicable model					PC400-6	
Cate-gory	Item		Measurement conditions	Unit	Standard value for new machine	Service limit value
Work equipment	Time lag	Arm	 · Stop arm suddenly and measure time taken for arm to stop · Engine at low idling · Hydraulic oil temperature: 45 – 55°C	Sec	Max. 3.0	Max. 5.0
		Bucket	 · Stop bucket suddenly and measure time taken for bucket to stop at bottom and then start again · Engine at low idling · Hydraulic oil temperature: 45 – 55°C		Max. 3.0	Max. 5.0
		Bottom dump	 · Time taken for bottom dump to move again when operated from max. bottom open position to close position and stopped temporarily. · Engine at low idling · Hydraulic oil temperature: 45 – 55°C		Max. 3.0	Max. 5.0
	Internal leakage	Cylinders	· Hydraulic oil temperature: 45 – 55°C · Engine at full throttle · Relieve circuit to be measured	cc/ min	Max. 4.5	Max. 20
		Center swivel joint			Max. 10	Max. 50

<table>
<tr><th colspan="5">Applicable model</th><th colspan="2">PC400-6</th></tr>
<tr><th>Category</th><th colspan="2">Item</th><th>Measurement conditions</th><th>Unit</th><th>Standard value for new machine</th><th>Service limit value</th></tr>
<tr><td>Performance in compound operation</td><td colspan="2">Travel deviation when work equipment + travel are operated</td><td>· Hydraulic oil temperature: 45 – 55°C
★ Use a hard flat ground.
★ Measure dimension χ.

· Oil temperature: 45 – 55°C</td><td>mm</td><td>Max. 400</td><td>Max. 440</td></tr>
<tr><td>Performance of hydraulic pump</td><td>Hydraulic pump delivery</td><td>Piston pump</td><td>See next page</td><td>ℓ/min</td><td colspan="2">See next page</td></tr>
</table>

Category: Performance of hydraulic pump

PC400,450: Discharge amount of main piston pump (in heavy duty operation mode: H/O mode)



· Pump speed: At 1,950 rpm, TVC current 180 mA

Check point	Test pump discharge pressure (MPa {kg/cm²})	Discharge pressure of other pump (MPa {kg/cm²})	Average pressure (MPa {kg/cm²})	Standard value for discharge amount Q (ℓ/min)	Judgement standard lower limit Q (ℓ/min)
As desired	P1	P2	$\frac{P1 + P2}{2}$	See graph	See graph

★ As far as possible, bring pump discharge pressures P1 and P2 as close as possible to the average pressure when measuring.
The error is large near the point where the graph curves, so avoid measuring at this point.

★ 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.

STANDARD VALUE TABLE FOR ELECTRICAL PARTS

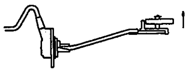
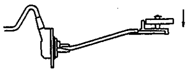
System	Name of component		Connector No.	Inspection method	Judgment table			Measurement conditions
Control system	Fuel control dial		E06 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal			1) Turn starting switch OFF. 2) Disconnect connector.
					Between (1) – (2)	0.25 – 7 kΩ		
					Between (2) – (3)	0.25 – 7 kΩ		
					Between (1) – (3)	4 – 6 kΩ		
	Governor motor	Potentiometer	E04 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal			1) Turn starting switch OFF. 2) Disconnect connector.
					Between (1) – (2)	0.25 – 7 kΩ		
					Between (2) – (3)	0.25 – 7 kΩ		
					Between (1) – (3)	4 – 6 kΩ		
		Motor	E05 (male)	Measure resistance	If the condition is as shown in the table below, it is normal			1) Turn starting switch OFF. 2) Disconnect connector.
					Between (1) – (2)	2.5 – 7.5 Ω		
					Between (3) – (4)	2.5 – 7.5 Ω		
					Between (1) – (3)	Min. 1 MΩ		
					Between (1) – chassis	Min. 1 MΩ		
					Between (3) – chassis	Min. 1 MΩ		
	Engine speed sensor		E7	Measure resistance	If the condition is within the range shown in the table below, it is normal			1) Turn starting switch OFF. 2) Disconnect connector.
					Between(male) (1) – (2)	500 – 1,000 Ω		
					Between(male) (2) – chassis	Min. 1 MΩ		
				Measure voltage	Measure with AC range			1) Start engine. 2) Insert T – adapter.
					Between (1) – (2)	0.5 – 3.0 V		
				Adjust	1) Screw in rotation sensor until it contacts ring gear, then turn back 1 ± 1/6 turns. 2) It must work normally when adjusted as above.			
	PPC oil pressure switch		Travel S01 boom RAISE S02 arm OUT S03 boom LOWER S04 arm IN S05 bucket CURL S06 bucket DUMP S07 swing S08	Measure resistance	If the condition is as shown in the table below, it is normal When boom, arm, and bucket levers are operated			1) Start engine (or with engine stopped and accumulator charged) 2) Disconnect connectors S01 – S08.
					Between (male) (1) – (2)	All levers at neutral	Min. 1 MΩ	
						Levers operated	Max. 1 Ω	
					Between (male) (1),(2) - chassis		Min. 1 MΩ	

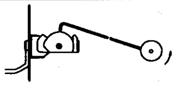
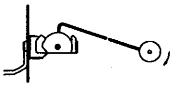
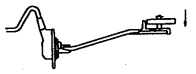
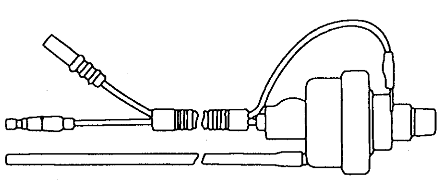
<table>
<tr><th>System</th><th>Name of component</th><th>Connector No.</th><th>Inspection method</th><th>Judgment table</th><th>Measurement conditions</th></tr>
<tr><td>Control system</td><td>Pump pressure sensor</td><td>C07 (male) (rear)
C08 (male) (front)</td><td>Measure voltage</td><td>If the condition is as shown in the table below, it is normal
<table>
<tr><td>Between (2) – (1)</td><td colspan="2">18 – 28 V</td></tr>
<tr><td rowspan="2">Between (3) – (1)</td><td>All levers at neutral</td><td>0.5 – 1.5 V</td></tr>
<tr><td>At arm IN relief</td><td>3.1 – 4.5 V</td></tr>
</table></td><td>1) Start engine.
2) Turn fuel control dial to MAX position.
3) Insert T – adapter.</td></tr>
<tr><td></td><td>Swing lock switch</td><td>X05 (male)</td><td>Measure resistance</td><td>If the condition is as shown in the table below, it is normal
<table>
<tr><td>Between (1) - (2)</td><td rowspan="2">When switch is OFF</td><td>Min. 1 MΩ</td></tr>
<tr><td>Between (3) - (4)</td><td>Max. 1 Ω</td></tr>
</table></td><td>1) Turn starting switch OFF.
2) Disconnect connector X05.</td></tr>
<tr><td></td><td>TVC solenoid</td><td>C04 (male)
C13 (male)</td><td>Measure resistance</td><td>If the condition is within the range shown in the table below, it is normal
<table>
<tr><td>Between (1) - (2)</td><td>10 – 22 Ω</td></tr>
<tr><td>Between(1), (2) - chassis</td><td>Min. 1 MΩ</td></tr>
</table></td><td>1) Turn TVC prolix switch OFF.
2) Turn starting switch OFF.
3) Disconnect connectors C04, C13.</td></tr>
<tr><td></td><td>Swing lock solenoid</td><td>V04 (male)</td><td>Measure resistance</td><td>If the condition is within the range shown in the table below, it is normal
<table>
<tr><td>Between (1) - (2)</td><td>20 – 60 Ω</td></tr>
<tr><td>Between(1), (2) - chassis</td><td>Min. 1 MΩ</td></tr>
</table></td><td>1) Turn starting switch OFF.
2) Disconnect connector V04.</td></tr>
<tr><td></td><td>Travel speed solenoid</td><td>V06 (male)</td><td>Measure resistance</td><td>If the condition is within the range shown in the table below, it is normal
<table>
<tr><td>Between (1) - (2)</td><td>20 – 60 Ω</td></tr>
<tr><td>Between(1), (2) - chassis</td><td>Min. 1 MΩ</td></tr>
</table></td><td>1) Turn starting switch OFF.
2) Disconnect connector V06.</td></tr>
<tr><td></td><td>Active boom solenoid</td><td>V02 (male)</td><td>Measure resistance</td><td>If the condition is within the range shown in the table below, it is normal
<table>
<tr><td>Between (1) - (2)</td><td>20 – 60 Ω</td></tr>
<tr><td>Between(1), (2) - chassis</td><td>Min. 1 MΩ</td></tr>
</table></td><td>1) Turn starting switch OFF.
2) Disconnect connector V02.</td></tr>
<tr><td></td><td>Merge/divider solenoid</td><td>V03 (male)</td><td>Measure resistance</td><td>If the condition is within the range shown in the table below, it is normal
<table>
<tr><td>Between (1) - (2)</td><td>20 – 60 Ω</td></tr>
<tr><td>Between(1), (2) - chassis</td><td>Min. 1 MΩ</td></tr>
</table></td><td>1) Turn starting switch OFF.
2) Disconnect connector V03.</td></tr>
<tr><td></td><td>Machine push-up solenoid (When engine throttle, pump controller does not carry out control)</td><td>V05 (male)</td><td>Measure resistance</td><td>If the condition is within the range shown in the table below, it is normal
<table>
<tr><td>Between (1) - (2)</td><td>20 – 60 Ω</td></tr>
<tr><td>Between(1), (2) - chassis</td><td>Min. 1 MΩ</td></tr>
</table></td><td>1) Turn starting switch OFF.
2) Disconnect connector V05.</td></tr>
</table>

System	Name of component		Connector No.	Inspection method	Judgment table		Measurement conditions
Control system	LS-EPC solenoid		C10 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal Between (1) – (2)	7 – 14 Ω	1) Turn starting switch OFF. 2) Disconnect connector C10.
					Between(1), (2) – chassis	Min. 1 MΩ	
	Engine throttle, pump controller	Power supply	C01 C02	Measure voltage	If the condition is within the range shown in the table below, it is normal Between C01 (7),(13) – (6),(12)	20 – 30 V	1) Turn starting switch ON. 2) Insert T – adapter.
					Between C02 (11),(21) - (6),(12)	20 – 30 V	
		Fuel control dial	C03	Measure voltage	If the condition is as shown in the table below, it is normal Between (7) – (17) (power source)	4.75 – 5.25 V	1) Turn starting switch ON. 2) Insert T – adapter.
					Between (4) – (17) (low idling)	4.0 – 4.75 V	
					Between (4) – (17) (high idling)	0.25 – 1.0 V	
		Potentiometer	C03	Measure voltage	If the condition is as shown in the table below, it is normal Between (14) – (17) (low idling)	2.9 – 3.3 V	1) Turn starting switch ON. 2) Insert T – adapter.
					Between (14) – (17) (high idling)	0.5 – 0.9 V	
					Between (7) – (17) (power source)	4.75 – 5.25 V	
		Water temperature sensor	P07 (male)	Measure resistance	If the condition is as shown in the table below, it is normal Normal temperature (25°C)	Approx. 37 – 50 kΩ	1) Turn starting switch OFF. 2) Disconnect connector P07. 3) Insert T – adapter. into connector at sensor end.
					100°C	Approx. 3.5 – 4.0 kΩ	
		Governor motor	C02	Measure voltage	If the condition is within the range shown in the table below, it is normal Between (2) – (3)	1.8 – 4.6 V	1) Turn starting switch ON. 2) Insert T – adapter.
					Between (4) – (5)	1.8 – 4.6 V	
		Battery relay	C01	Measure voltage	If the condition is within the range shown in the table below, it is normal Between (1) – (6)	20 – 30 V	1) Turn starting switch ON. 2) Insert T – adapter.
					★ This is only for 2.5 sec after the starting switch is operated ON → OFF; at other times it must be 0 V.		

Sys-tem	Name of component		Connector No.	Inspection method	Judgment table			Measurement conditions
Control system	Engine throttle, pump controller	Swing lock solenoid	C01	Measure voltage	If the condition is as shown in the table below, it is normal When either swing or work equipment control lever is operated (solenoid ON, swing lock canceled)	Between (3) – (6),(12)	20 – 30 V	1) Start engine. 2) Turn swing lock switch OFF. 3) Turn swing lock prolix switch OFF. 4) Insert T – adapter. ★ The lever can be operated slightly (without moving the equipment).
					Approx. 5 sec after swing lever and work equipment control levers are placed at neutral (solenoid OFF, swing lock applied)		0 – 3 V	
		Travel speed solenoid	C01	Measure voltage	If the condition is as shown in the table below, it is normal With travel speed switch at Hi or Mi (solenoid ON, travel motor swash plate angle min.)	Between (9) – (6),(12)	20 – 30 V	1) Start engine. 2) Insert T – adapter. 3) Turn fuel control dial to MAX position. 4) Operate the lever slightly not enough to move the machine. To check that the solenoid is OFF, measure with the fuel control dial at LOW (1200 rpm or below)
					When travel speed switch is at Lo (solenoid OFF, travel motor swash plate angle max.)		0 – 3 V	
		Active boom solenoid	C01	Measure voltage	If the condition is as shown in the table below, it is normal When active mode switch is OFF (solenoid ON, boom LOWER spool stroke 9 mm)	Between (8) – (6),(12)	20 – 30 V	1) Turn starting switch ON. 2) Insert T – adapter.
					When active mode switch is ON (solenoid OFF, boom LOWER spool stroke 11.5 mm)		0 – 3 V	
		Merge/divider valve solenoid	C01	Measure voltage	If the condition is as shown in the table below, it is normal. When travel is operated independently (solenoid ON, divided)	Between (2) – (6),(12)	20 – 30 V	1) Turn starting switch ON. 2) Insert T – adapter. ★ The lever can be operated slightly
					When levers and pedals are at neutral (solenoid OFF, merged)		0 – 3 V	

<table>
<tr><th>Sys-tem</th><th colspan="2">Name of component</th><th>Connector No.</th><th>Inspection method</th><th>Judgment table</th><th>Measurement conditions</th></tr>
<tr><td rowspan="7">Control system</td><td rowspan="7">Engine throttle, pump controller</td><td>TVC solenoid (default value)</td><td>C02</td><td>Measure current</td><td>If the condition is as shown in the table below, it is normal
· H/O mode<table><tr><td>Between front (8) – (18)</td><td rowspan="2">310 ± 100 mA</td></tr><tr><td>Between rear (9) – (19)</td></tr></table></td><td>1) Turn starting switch ON.
2) Turn fuel control dial to MAX position
3) Turn prolix switch OFF.
4) All levers at neutral</td></tr>
<tr><td>LS-EPC solenoid (default value)</td><td>C02</td><td>Measure current</td><td>If the condition is as shown in the table below, it is normal
· H/O mode<table><tr><td>Between (7) – (17)</td><td>900 ± 80 mA</td></tr></table></td><td>1) Turn starting switch ON.
2) Turn fuel control dial to MAX position
3) All levers at neutral.</td></tr>
<tr><td>L.H. knob switch</td><td>C03</td><td>Measure voltage</td><td>If the condition is as shown in the table below, it is normal<table><tr><td>When switch is ON</td><td rowspan="2">Between (9) – GND</td><td>20 – 28 V</td></tr><tr><td>When switch is OFF</td><td>0 – 1 V</td></tr></table></td><td>1) Turn starting switch ON.
2) Insertl T – adapter.</td></tr>
<tr><td>S-NET</td><td>C17</td><td>Measure voltage</td><td>If the condition is as shown in the table below, it is normal<table><tr><td>Between (4),(12) – GND</td><td>4 – 8 V</td></tr></table></td><td>1) Turn starting switch ON.
2) Insertl T – adapter.</td></tr>
<tr><td>Kerosene mode</td><td>C17</td><td>Measure voltage</td><td>If the condition is as shown in the table below, it is normal<table><tr><td>Standard mode (Light oil mode)</td><td rowspan="2">Between (15) – GND</td><td>20 – 28 V</td></tr><tr><td>Kerosene mode</td><td>0 – 2 V</td></tr></table></td><td>1) Turn starting switch ON.
2) Insertl T – adapter.</td></tr>
<tr><td>No. 2 throttle signal</td><td>Monitoring code 16</td><td>Engine speed</td><td>If the condition is as shown in the table below, it is normal
High idling (rpm)<table><tr><td>Active</td><td>Approx. 2,250 (during operation)
Approx. 2,150 (idling)</td></tr><tr><td>H/O</td><td>Approx. 2,150 (during operation)
Approx. 2,050 (idling)</td></tr><tr><td>G/O</td><td>Approx. 2,000 (during operation)
Approx. 1,900 (idling)</td></tr><tr><td>F/O</td><td>Approx. 1,900</td></tr><tr><td>L/O</td><td>Approx. 1,600</td></tr><tr><td>Power max. (H/O) (G/O)</td><td>Approx. 2,150</td></tr><tr><td>Swift slow-down (H/O) (G/O)</td><td>Approx. 1,600</td></tr></table></td><td>1) Start engine.
2) Set monitoring code to 10 or 16 (command value).
3) Operate working mode switch, active mode switch and L.H. knob switch.</td></tr>
<tr><td>Machine selection</td><td>C17 – C02</td><td>Continuity</td><td>If the condition is as shown in the table below, it is normal<table><tr><td>Between selection 1</td><td>C17(5) – C02(11)</td><td>No continuity</td></tr><tr><td>Between selection 2</td><td>C17(13) – C02(11)</td><td>Continuity</td></tr><tr><td>Between selection 3</td><td>C17(6) – C02(11)</td><td>Continuity</td></tr><tr><td>Between selection 4</td><td>C17(14) – C02(11)</td><td>No continuity</td></tr><tr><td>Between selection 5</td><td>C17(7) – C02(11)</td><td>No continuity</td></tr></table></td><td>1) Turn starting switch OFF.
2) Disconnect connector.
3) Connect T – adapter to wiring harness end.</td></tr>
</table>

<table>
<tr><th>System</th><th>Name of component</th><th>Connector No.</th><th>Inspection method</th><th colspan="3">Judgment table</th><th>Measurement conditions</th></tr>
<tr><td rowspan="18">Monitor</td><td rowspan="3">Air cleaner clogging switch</td><td rowspan="3">P11 (male)
P12 (female)</td><td rowspan="3">Continuity</td><td colspan="3">If the condition is as shown in the table below, it is normal</td><td rowspan="3">1) Start engine.
2) Disconnect P11, P12.</td></tr>
<tr><td>Air cleaner normal</td><td rowspan="2">Between P11 – P12</td><td>Continuity</td></tr>
<tr><td>Air cleaner clogged</td><td>No continuity</td></tr>
<tr><td rowspan="6">Engine speed sensor</td><td rowspan="6">E07</td><td rowspan="3">Measure resistance</td><td colspan="3">If the condition is within the range shown in the table below, it is normal</td><td rowspan="3">1) Turn starting switch OFF.
3) Disconnect connector.</td></tr>
<tr><td colspan="2">Between (1) – (2)</td><td>500 – 1000 Ω</td></tr>
<tr><td colspan="2">Between (1),(2) – chassis</td><td>Min. 1 MΩ</td></tr>
<tr><td rowspan="2">Measure voltage</td><td colspan="3">Measure with AC range</td><td rowspan="2">1) Start engine.
2) Insert T – adapter.</td></tr>
<tr><td colspan="2">Between (1) – (2)</td><td>0.5 – 3.0 V</td></tr>
<tr><td>Adjust</td><td colspan="3">1) Screw in rotation sensor until it contacts ring gear, then turn back 1 ± 1/6 turns
2) It must work normally when adjusted as above.</td><td></td></tr>
<tr><td rowspan="3">Water level switch</td><td rowspan="3">P08 (male)</td><td rowspan="3">Measure resistance</td><td colspan="3">If the condition is as shown in the table below, it is normal</td><td rowspan="3">1) Turn starting switch OFF.
2) Disconnect connector P08.
3) Insert T – adapter into connector at sensor end.</td></tr>
<tr><td colspan="2">Above LOW level in sub-tank</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="2">Below LOW level in sub-tank</td><td>Min. 1 MΩ</td></tr>
<tr><td rowspan="3">Engine oil level switch</td><td rowspan="3">P05 (male)</td><td rowspan="3">Measure resistance</td><td colspan="3">If the condition is as shown in the table below, it is normal</td><td rowspan="3">1) Turn starting switch OFF.
2) Disconnect connector P05.
3) Drain oil, then remove sensor.</td></tr>
<tr><td> BLP00002</td><td>Raise float</td><td>Max. 1 Ω</td></tr>
<tr><td> BLP00003</td><td>Lower float</td><td>Min. 1 MΩ</td></tr>
<tr><td rowspan="3">Water temperature sensor</td><td rowspan="3">P07 (male)</td><td rowspan="3">Measure resistance</td><td colspan="3">If the condition is as shown in the table below, it is normal</td><td rowspan="3">1) Turn starting switch OFF.
2) Disconnect connector P07.
3) Insert T – adapter. into connector at sensor end.</td></tr>
<tr><td colspan="2">Normal temperature (25°C)</td><td>Approx. 37 – 50 kΩ</td></tr>
<tr><td colspan="2">100°C</td><td>Approx. 3.5 – 4.0 kΩ</td></tr>
</table>

<table>
<tr><th>System</th><th>Name of component</th><th>Connector No.</th><th>Inspection method</th><th colspan="2">Judgment table</th><th>Measurement conditions</th></tr>
<tr><td rowspan="21">Monitor</td><td rowspan="6">Engine oil pressure switch</td><td rowspan="6">—</td><td rowspan="6">Measure resistance</td><td colspan="2">If the condition is as shown in the table below, it is normal
Low pressure end</td><td rowspan="6">1) Install oil pressure measurement gauge.
2) Remove wiring harness terminal.
3) Start engine.
4) Put tester in contact with terminal screw and chassis.</td></tr>
<tr><td>Engine oil pressure above 68.6 kPa {0.7 kg/cm^2}</td><td>Min. 1M Ω</td></tr>
<tr><td>Engine oil pressure below 29.4 kPa {0.3 kg/cm^2}</td><td>Max. 1 Ω</td></tr>
<tr><td colspan="2">High pressure end</td></tr>
<tr><td>Engine oil pressure above 166.6 kPa {1.7 kg/cm^2}</td><td>Min. 1M Ω</td></tr>
<tr><td>Engine oil pressure below 127.4 kPa {1.3 kg/cm^2}</td><td>Max. 1 Ω</td></tr>
<tr><td rowspan="3">Fuel level sensor</td><td rowspan="3">P06 (male)</td><td rowspan="3">Measure resistance</td><td colspan="2">If the condition is as shown in the table below, it is normal</td><td rowspan="3">1) Turn starting switch OFF.
2) Disconnect connector P06.
3) Drain fuel, then remove sensor.
4) Insert T – adapter into sensor.
★ Connect the T – adapter to the connector and sensor flange.</td></tr>
<tr><td> BLP00004 Raise float to stopper</td><td>Approx. 12 Ω or below</td></tr>
<tr><td> BLP00005 Lower float to stopper</td><td>Approx. 85 – 110 Ω</td></tr>
<tr><td rowspan="3">Hydraulic oil level switch</td><td rowspan="3">P09 (male)</td><td rowspan="3">Measure resistance</td><td colspan="2">If the condition is as shown in the table below, it is normal</td><td rowspan="3">1) Turn starting switch OFF.
2) Disconnect connector P09.
3) Drain oil, then remove sensor.
4) Insert T – adapter into sensor.</td></tr>
<tr><td> BLP00002 Raise float</td><td>Max. 1 Ω</td></tr>
<tr><td> BLP00003 Lower float</td><td>Min. 1 MΩ</td></tr>
<tr><td rowspan="4">Air cleaner clogging switch</td><td rowspan="4">P11
P12</td><td rowspan="4">Measure resistance</td><td colspan="2">If the condition is as shown in the table below, it is normal</td><td rowspan="4">1) Start engine.
2) Disconnect P11, P12.
3) Put tester in contact with connectors to measure.</td></tr>
<tr><td>Air cleaner normal</td><td>Max. 1 Ω</td></tr>
<tr><td>Air cleaner clogged</td><td>Min. 1 MΩ</td></tr>
<tr><td colspan="2"> BLP00006</td></tr>
</table>

<table>
<tr><th>Name of component</th><th>Connector No.</th><th>Inspection method</th><th>Judgment table</th><th>Measurement conditions</th></tr>
<tr><td>Alternator</td><td>Between alternator terminal R and chassis</td><td>Measure voltage</td><td>When engine is running (1/2 throttle or above)
27.5 – 29.5 V
★ If the battery is old, or after starting in cold areas, the voltage may not rise for some time.</td><td>1) Start engine.</td></tr>
<tr><td rowspan="2">Gauges</td><td colspan="3">
<table>
<tr><th rowspan="2"></th><th colspan="2">Position of gauge display</th><th>Display level resistance kΩ (Monitor panel input resistance)</th></tr>
<tr><th colspan="2">Starting switch ON</th><th>Starting switch OFF</th></tr>
<tr><td rowspan="11">Measure resistance between coolant temperature gauge C03 (female) (1) – C03 (female) (16)</td><td></td><td></td><td>Min. – Max.</td></tr>
<tr><td>Right side</td><td>All OFF(10)</td><td>– 0.646</td></tr>
<tr><td></td><td>9</td><td>0.575 – 0.342</td></tr>
<tr><td>↑</td><td>8</td><td>3.156 – 3.708</td></tr>
<tr><td></td><td>7</td><td>3.422 – 3.900</td></tr>
<tr><td>Display position</td><td>6</td><td>3.600 – 4.349</td></tr>
<tr><td></td><td>5</td><td>4.015 – 5.122</td></tr>
<tr><td></td><td>4</td><td>4.728 – 6.816</td></tr>
<tr><td>↓</td><td>3</td><td>6.294 – 10.774</td></tr>
<tr><td></td><td>2</td><td>9.946 – 36.535</td></tr>
<tr><td>Left side</td><td>1</td><td>33.725 –</td></tr>
</table>
★ Levels 8 and 9 flash.
</td><td>1) Insert a dummy resistance with the starting switch OFF, or measure the resistance of the sensor.
2) Check the display with the starting switch ON.</td></tr>
<tr><td colspan="3">
<table>
<tr><th rowspan="2"></th><th colspan="2">Position of gauge display</th><th>Display level resistance kΩ (Monitor panel input resistance)</th></tr>
<tr><th colspan="2">Starting switch ON</th><th>Starting switch OFF</th></tr>
<tr><td rowspan="11">Measure resistance between fuel level gauge C03 (female) (2) – chassis</td><td></td><td></td><td>Min. – Max.</td></tr>
<tr><td>Right side</td><td>9</td><td>– 13.82</td></tr>
<tr><td></td><td>8</td><td>11.71 – 21.25</td></tr>
<tr><td>↑</td><td>7</td><td>18.90 – 28.45</td></tr>
<tr><td></td><td>6</td><td>25.82 – 31.85</td></tr>
<tr><td>Display position</td><td>5</td><td>29.18 – 39.91</td></tr>
<tr><td></td><td>4</td><td>37.00 – 44.60</td></tr>
<tr><td></td><td>3</td><td>41.77 – 55.14</td></tr>
<tr><td>↓</td><td>2</td><td>50.42 – 77.07</td></tr>
<tr><td></td><td>1</td><td>72.98 – 691.5</td></tr>
<tr><td>Left side</td><td>All OFF(10)</td><td>638.00 –</td></tr>
</table>
★ Level 1 flashes.
</td><td>1) Insert a dummy resistance with the starting switch OFF, or measure the resistance of the sensor.
2) Check the display with the starting switch ON.</td></tr>
</table>

TESTING AND ADJUSTING

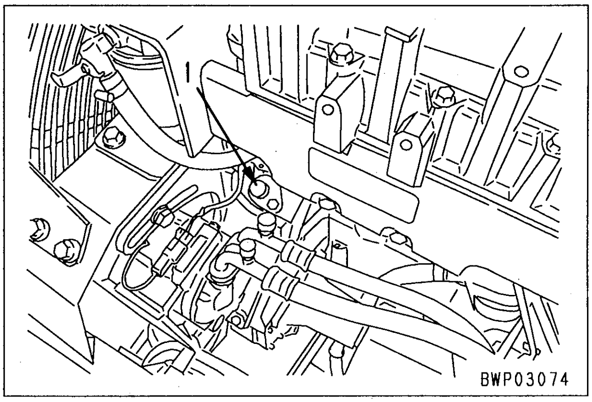
TOOLS FOR TESTING, ADJUSTING, AND TROUBLESHOOTING

Check or measurement item	Symbol		Part No.	Part Name	Remarks
Engine speed	A		799-203-8001	Multi-tachometer	Kit Part No.:799-203-9000 Digital display L: 60 – 2,000 rpm H: 60 – 19,999 rpm
Coolant and oil temperatures	B		799-101-1502	Digital temperature gauge	–50 – 1,200°C
Oil pressure	C	1	799-101-5002	Hydraulic tester	Pressure gauge 2.5, 5.9, 39.2, 58.8 MPa {25, 60, 400, 600 kg/cm^2}
			790-261-1203	Digital hydraulic tester	Pressure gauge 68.6 MPa {700 kg/cm^2}
		2	•799-101-5160	Nipple	PT1/8
			799-101-5220	Nipple	10 x1.25
			07002-11023	O ring	
		3	•790-261-1311	Adapter	Both male and female 14 x 1.5 (female PT 1/8)
			•790-261-1321		Both male and female 18 x 1.5 (female PT 1/8)
			•790-261-1331		Both male and female 22 x 1.5 (female PT 1/8)
		4	799-401-2701	Differential pressure gauge	
		5	790-261-1360	Adapter	Both male and female 14 x 1.5 (female PT 1/8)
			790-261-1370	Nut	For 14 x 1.5 blind
			07003-31419	Gasket	For blind
			07040-11409	Plug	For 14 x 1.5 blind
		6	799-401-2320	Hydraulic gauge	1.0 MPa {10 kg/cm^2}
Compression pressure	D	1	795-502-1360	Compression gauge	0 – 6.9 MPa {0 –70 kg/cm^2}
		2	795-502-1360	Adapter	Kit Part No.: 795-502-1205
Blowby pressure	E		799-201-1504	Blow-by checker	0 – 4.9 kPa {0 – 500 mmH$_2$O}
Air supply pressure (boost pressure)	F		799-201-2202	Pressure gauge	–101.3 – 200 kPa {–760 – 1500 mmHg}
Valve clearance	G		Commercially available	Feeler gauge	
Exhaust color	H	1	799-201-9000	Handy Smoke Checker	Discoloration 0 – 70% (with standard color) (Discoloration % x 1/10 = Bosch index)
		2	Commercially available	Smoke meter	
Operating effort	J		79A-264-0020	Push-pull scale	0 – 294N {30 kg}
			79A-264-0091		0 – 490N {50 kg}
Stroke, hydraulic drift	K		Commercially available	Scale	
Work equipment speed	L		Commercially available	Stop watch	
Measuring voltage and resistance values	M		79A-264-0211	Tester	
Troubleshooting of wiring harnesses and sensors	N	1	799-601-7100	T-adapter box	
		2	799-601-7070	Adapter	For SWP14
			799-601-7360		For relay 5P
Fuel injection timing	O		795-471-1200	Gauge ass'y	
Measuring wear of sprocket	P		796-627-1130	Wear gauge	

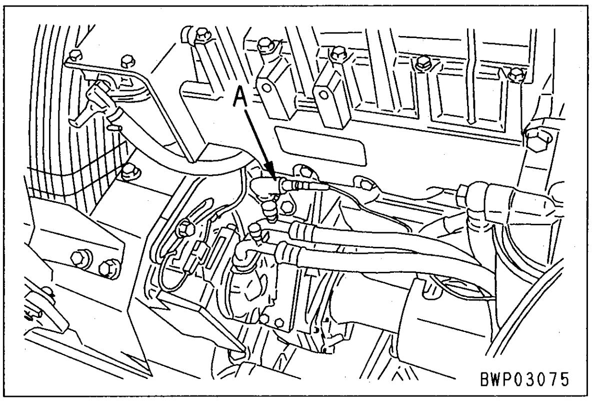
MEASURING ENGINE SPEED

⚠ When removing or installing the measuring equipment, be careful not to touch any high temperature parts.

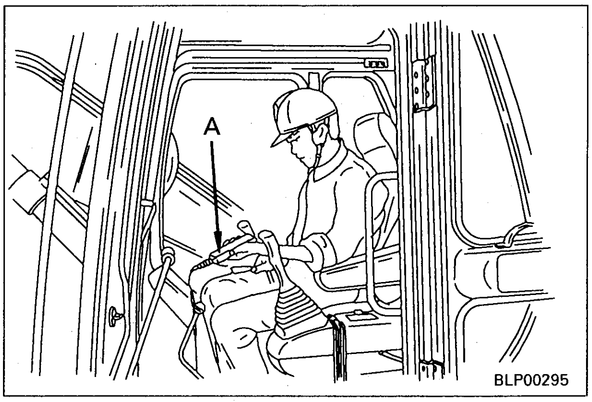
★ Measure the engine speed under the following conditions.
- Coolant temperature: Within operating range
- Hydraulic oil temperature : 45 – 55°C



1. Remove cover (1).



2. Install the sensor of multi-tachometer **A** to the speed pull out port, then connect it to multi-tachometer **A**.



3. Start the engine, and measure the engine speed when it is set to the conditions for measuring.
   1) Measuring low idling and high idling speeds
      Measure the engine speed with the fuel control dial set to low idling and high idling.
      ★ Measure in the H/O mode with the auto-deceleration OFF.
      ★ When measuring the high idling speed, place in the active mode and operate the lever slightly.
   2) Measure the speed at near the rated speed.
      i) Set the working mode the H/O mode, active mode.
      ii) Set the power max./swift slow-down switch to the power max. position.
      iii) Run the engine at full throttle, set the knob switch to the ON position, operate the arm lever, and measure the speed when the arm IN circuit is relieved.
         ★ Even if the L.H. knob switch is kept pressed, the power max. function is automatically turned off after approx. 8 seconds, so measure during the first 8 seconds.
         ★ Measuring speed when travel is operated: Knob switch ON
   3) Measuring speed at 2-pump relief:
      i) Set the working mode the H/O mode.
      ii) Run the engine at full throttle, operate the arm lever, and measure the engine speed when the arm IN circuit is relieved.

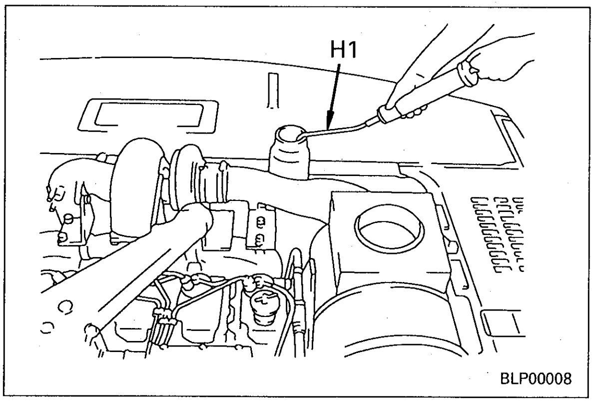
MEASURING EXHAUST COLOR

- When measuring in the field when there is no air or power supply, use handy smoker checker **H1**; when recording official data, use smoke meter **H2**.

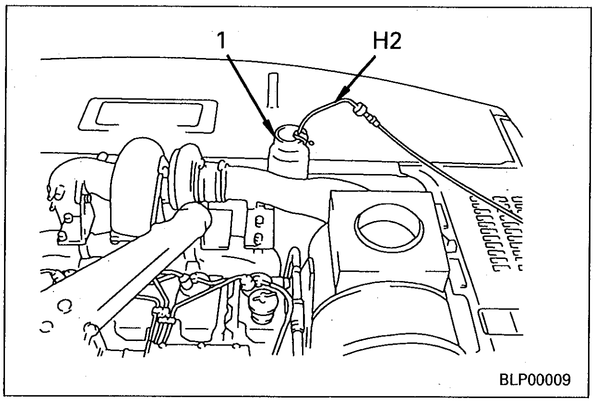
★ Raise the coolant temperature to the operating range before measuring.

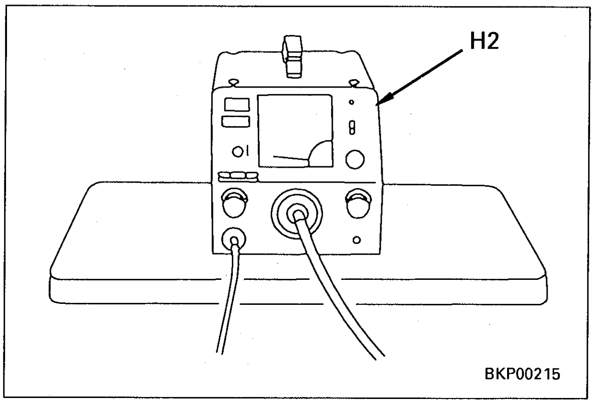
⚠ When removing or installing the measuring equipment, be careful not to touch any high temperature part.

1. **Measuring with handy smoke checker H1**
   1) Fit filter paper in tool **H1**.
   2) Insert the exhaust gas intake port into the exhaust pipe, accelerate the engine suddenly, and at the same time operate the handle of tool **H1** to catch the exhaust gas on the filter paper.
   3) Remove the filter paper and compare it with the scale provided to judge the condition.



2. **Measuring with smoke meter H2**
   1) Insert the probe of tool **H2** into the outlet port of exhaust pipe(1), then tighten the clip to secure it to the exhaust pipe.
   2) Connect the probe hose, accelerator switch plug, and air hose to tool **H2**.
      ★ The pressure of the air supply should be less than 1.47 MPa {15 kg/cm^2}.
   3) Connect the power cord to the AC power source socket.
      ★ When connecting the port, check first that the power switch of tool **H2** is OFF.
   4) Loosen the cap nut of the suction pump, then fit the filter paper.
      ★ Fit the filter paper securely so that the exhaust gas does not leak.
   5) Turn the power switch of tool **H2** ON.
   6) Accelerate the engine suddenly, and at the same time, depress the accelerator pedal of tool **H2** and catch the exhaust gas color on the filter paper.
   7) Lay the filter paper used to catch the exhaust gas color on top of unused filter papers (10 sheets or more) inside the filter paper holder, and read the indicated value.





ADJUSTING VALVE CLEARANCE

1. Remove the cylinder head cover.

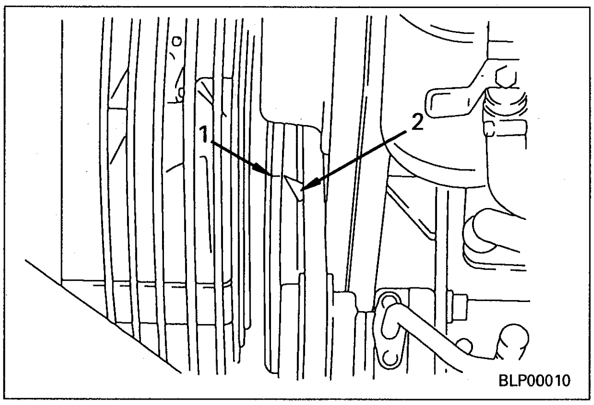
2. Rotate the crankshaft in the normal direction to align TOP 1.6 line on the vibration damper (1) with pointer (2) when the No. 1 cylinder is at compression top dead center. When rotating, check the movement of the intake valve of No. 6 cylinder.
   ★ When No. 1 cylinder is at compression top dead center, the No. 6 intake valve moves (is open).

3. Adjust the valves marked ● in the valve arrangement chart.
4. Next, rotate the crankshaft one turn (360°) in the normal direction and adjust the valve clearance of the remaining valves marked ○.

   ★ To adjust the valve clearance, loosen locknut (4) of adjustment screw (3), then insert feeler gauge **G** between crosshead (5) and rocker arm (6), and turn adjustment screw (3) until the clearance is a sliding fit.

5. Tighten locknut (4) to hold the adjustment screw in position.
   Locknut :
   66.6 ± 7.4 Nm {6.75 ± 0.75 kgm}

★ The firing order is as follows: 1 – 5 – 3 – 6 – 2 – 4
★ After adjusting No. 1 cylinder at compression top dead center, it is also possible to turn the crankshaft 120° each time and adjust the valve clearance of the intake and exhaust valves of each cylinder according to the firing order.
★ For details of the valve clearance, see the STANDARD VALUE TABLE for engine related parts.
★ After tightening the locknut, check the valve clearance again.



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Valve arrangement

Cylinder No.	1	2	3	4	5	6
Exhaust valve	●	○	●	○	●	○
Intake valve	●	●	○	●	○	○

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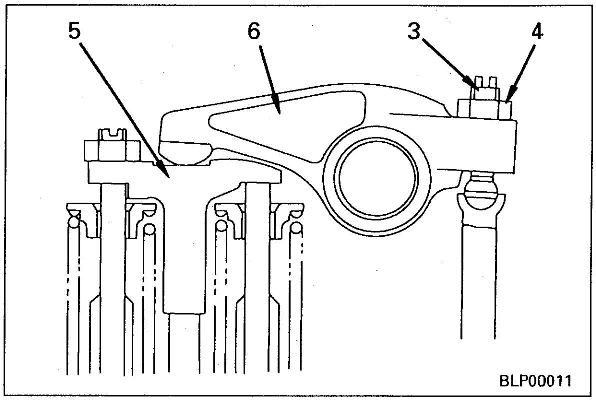
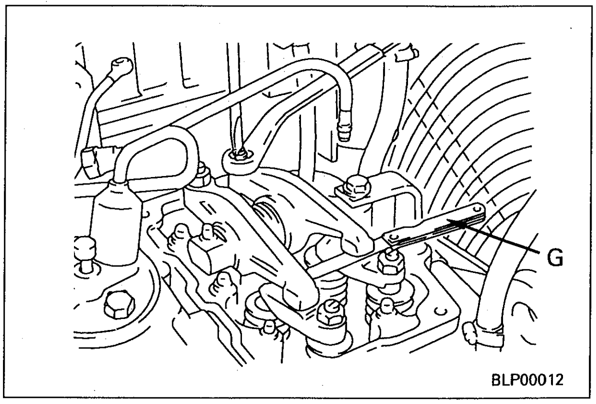


BLP00011



BLP00012

MEASURING COMPRESSION PRESSURE

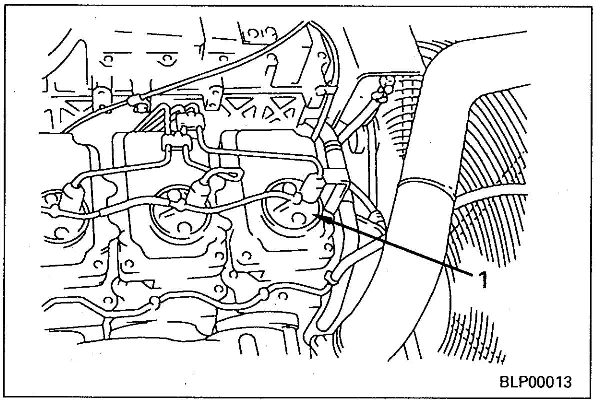
⚠ When measuring the compression pressure, be careful not to touch the exhaust manifold or muffler, or to get your clothes caught in the fan, fan belt or other rotating parts.

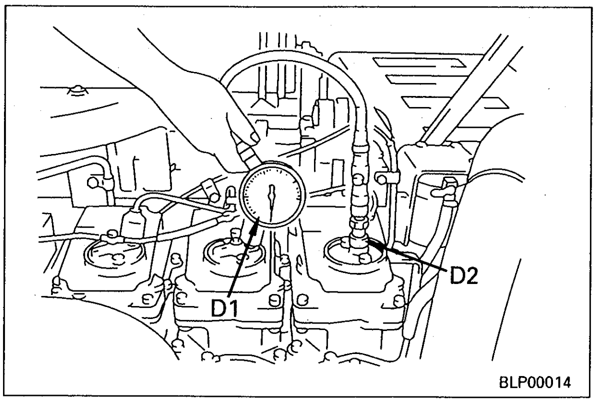
1. Adjust the valve clearance.
   For details, see ADJUSTING VALVE CLEARANCE.
2. Warm up the engine to make the oil temperature 40 – 60°C.
3. Remove nozzle holder assembly (1) from the cylinder to be measured.
4. Install adapter **D2** in the mount of the nozzle holder, then connect pressure gauge **D1**.
5. Set tachometer **A** in position.
6. Disconnect the fuel control rod, place the governor lever of the injection pump in the NO INJECTION position, then crank the engine with the starting motor and measure the compression pressure.

★ Measure the compression pressure at the point where the pressure gauge indicator remains steady.

★ When measuring the compression pressure, measure the engine speed to confirm that it is within the specified range.

★ After measuring the compression pressure, install nozzle holder assembly (1).



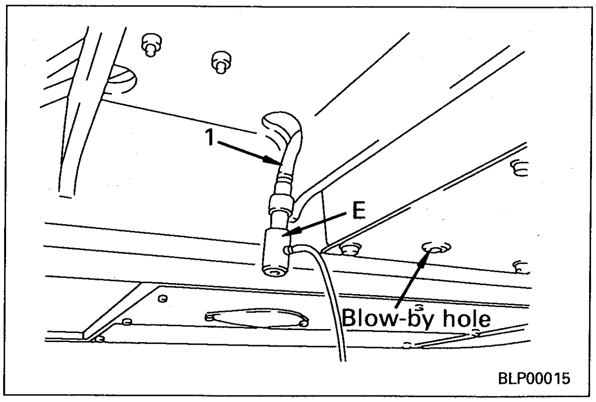


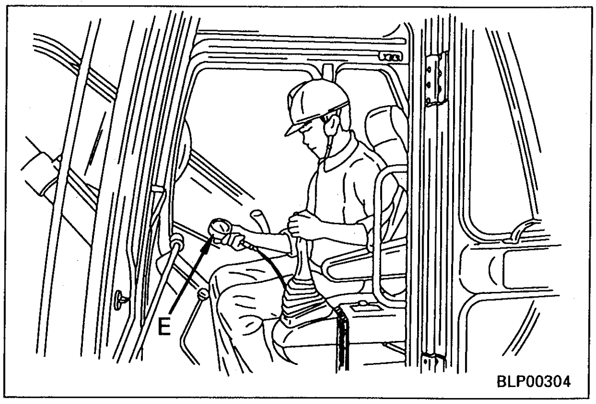
MEASURING BLOW-BY PRESSURE

★ Measure the blow-by pressure under the following conditions.
- Coolant temperature: Within operating range
- Hydraulic oil temperature: 50 – 80°C

1. Install the nozzle of blow-by checker **E** to blow-by hose (1).
2. Connect the nozzle and gauge with the hose.
3. Run the engine at near the rated output and read the gauge measurement.
   ★ Near rated output
   - Relieve the arm IN circuit in the H/O mode and power max. mode.

   ★ Measure the blow-by at the point where the gauge indicator remains steady.

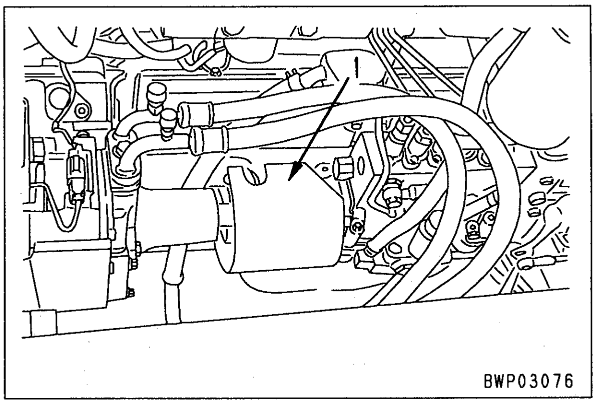




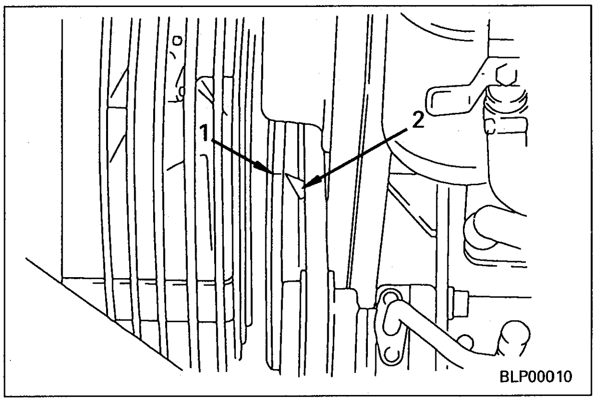
TESTING AND ADJUSTING FUEL INJECTION TIMING

1. Remove the No. 1 cylinder nozzle holder assembly.
   - ★ For details, see DISASSEMBLY AND ASSEMBLY, REMOVAL OF NOZZLE HOLDER ASSEMBLY.

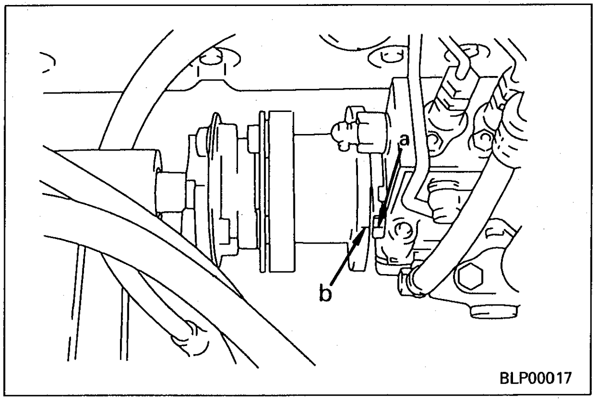
2. Remove coupling cover (1) of the fuel injection pump.



3. Align "1.6TOP" line (2) on the crankshaft pulley with pointer (3).

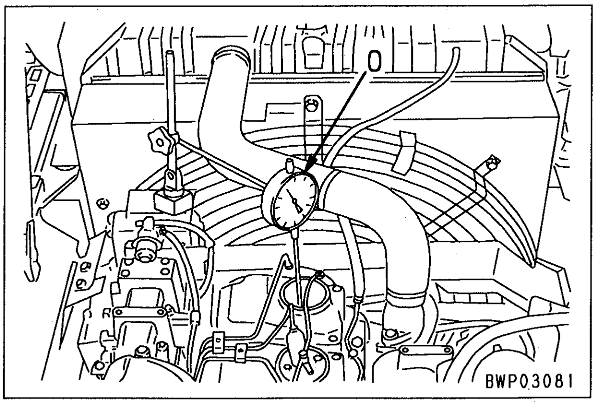


★ Check that line "**a**" on the fuel injection pump is near line "**b**" on the coupling. If the lines are not near each other (No. 1 cylinder exhaust top dead center), rotate the crankshaft pulley another 360° and align the lines again (No. 1 cylinder compression top dead center).



4. Install dial gauge **O** in the hole of the No. 1 nozzle holder, and set so that it contacts the top surface of the piston.

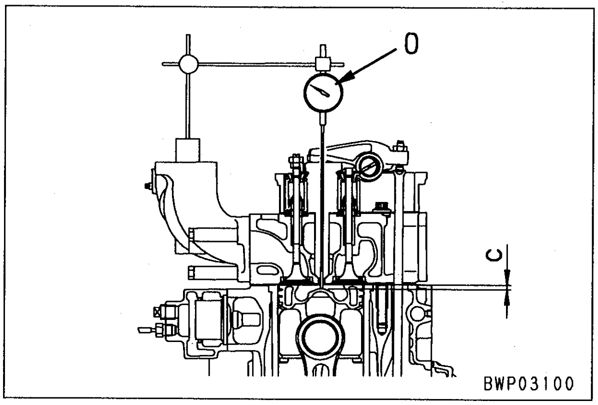
5. Set the scale on dial gauge **O** to 0 when the piston is at top dead center.
   - ★ Rotate the crankshaft in the normal direction and in the reverse direction to set to top dead center.
   - ★ Note down the value shown by the short hand on the dial gauge.



6. Rotate the crankshaft approx. 45°C in the reverse direction.

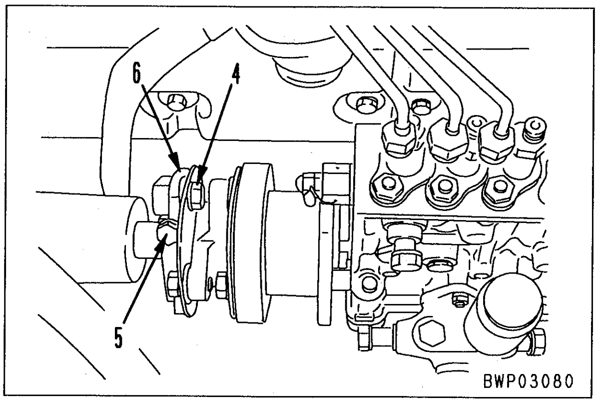
7. Rotate the crankshaft again in the normal direction until the dimension becomes specified dimension "**c**". (Always rotate the crankshaft in the normal direction to align the position.)
   - ★ Specified dimension **c**: 3.8 ± 0.2 mm
   - ★ When specified dimension "**c**" is correct, check that line "**a**" on the fuel injection pump body is aligned with line "**b**" on the coupling.

8. Rotate the crankshaft in the normal direction and check again that when the No. 1 cylinder reaches top dead center (the dial gauge indicator starts to move in the opposite direction), the dial gauge display is 0 ± 0.2 mm. If it is not 0 ± 0.2 mm, carry out the adjustment again from Step 5.



Adjusting

- ★ If the fuel injection timing is not correct, adjust as follows.
- ★ Set the crankshaft to specified dimension "**c**" (see Step 7 above) when adjusting.



1. Loosen 2 mounting bolts and nuts (4) and 1 mounting bolt (5), and set so that coupling (6) is free.

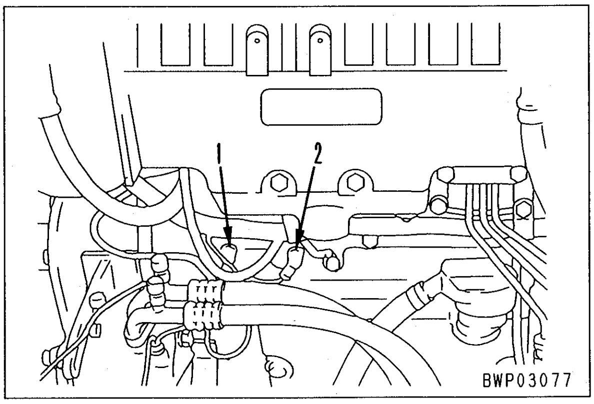
2. Align line "**a**" on the fuel injection pump with line "**b**" on the coupling.

3. Tighten 2 mounting bolts and nuts (4), then tighten 1 mounting bolt (5).
   kgm Mounting bolt, nut (4):
   58.8 – 63.7 Nm {6.0 – 6.5 kgm}
   kgm Mounting bolt (5):
   73.5 – 83.3 Nm {7.5 – 8.5 kgm}

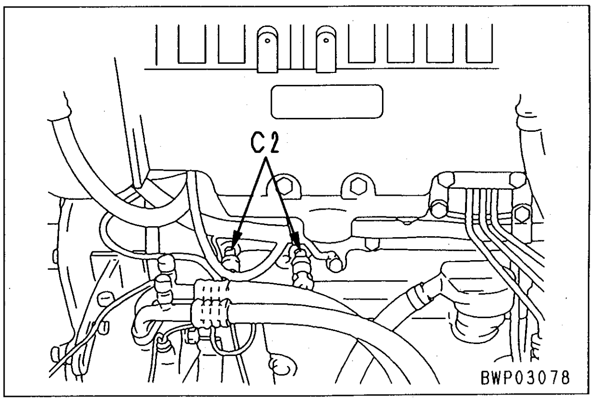
MEASURING ENGINE OIL PRESSURE

★ Measure the engine oil pressure under the following conditions.

- Coolant temperature: Within operating range

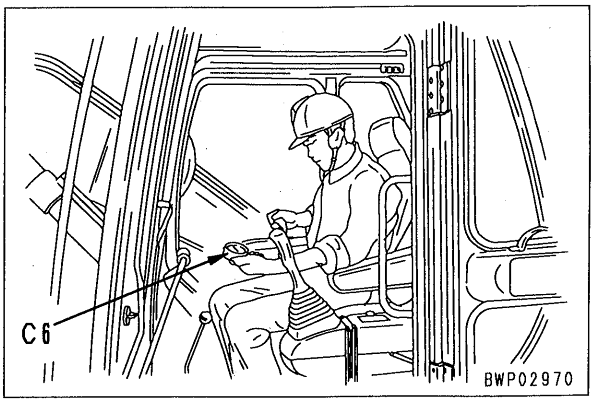


1. Remove engine oil low-pressure sensor (PT1/8) (1) and high-pressure sensor (PT1/8) (2), then install nipple **C2** and oil pressure gauge **C6** (1.0 MPa {10 kg/cm^2}).



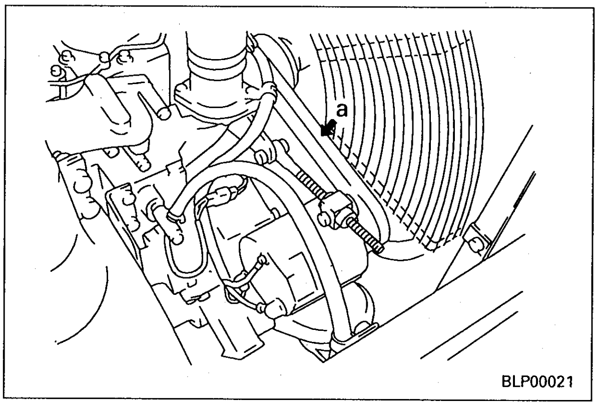
2. Start the engine, and measure the oil pressure with the engine at low idling and at high idling.

★ For low-pressure sensor (1), measure the engine oil pressure caution end with the engine at low idling, and for high-pressure sensor (2), measure the engine oil pressure caution end and the controller trouble data display end with the engine at high idling.



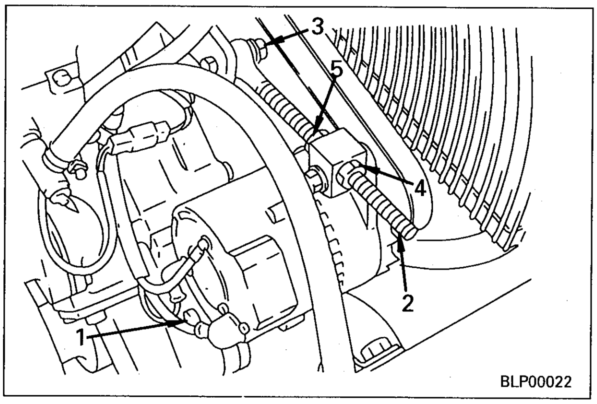
TESTING AND ADJUSTING FAN BELT TENSION

1. **Testing belt tension**
   Measure the deflection of the belt when it is pushed with a finger force (approx. 58.8 N {6 kg}) at point **a** midway between the fan pulley and the alternator pulley.



BLP00021

2. **Adjusting belt**
   1) Loosen alternator mount bolt (1), then loosen mounting bolt and nut (3) of adjustment screw (2).
   2) Loosen locknut (4), then turn adjustment nut (5) to adjust the tension of the belt.
   3) After adjusting the belt tension to the standard value with adjustment nut (5), tighten locknut (4), then tighten mounting bolt and nut (3) of adjustment screw (2) and alternator mount bolt (1).

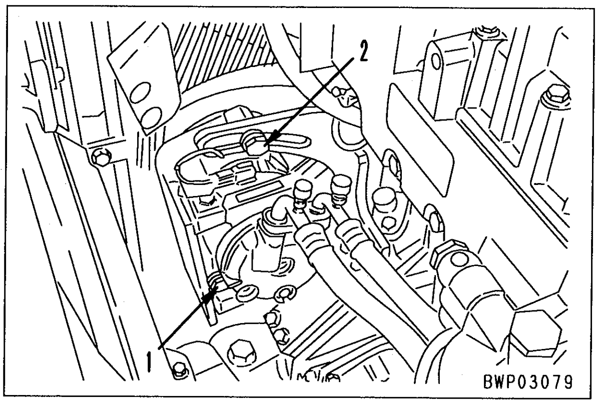


BLP00022

TESTING AND ADJUSTING BELT TENSION FOR AIR CONDITIONER COMPRESSOR

★ If the deflection of the belt when it is pressed at a point **a** midway between the drive pulley and the compressor pulley is not within the standard value, or when carrying out maintenance after replacing the belt, adjust the belt tension as follows.

1. Remove the 2 upper fan guard of the alternator.
2. Loosen 2 mount bolts (1) and adjustment plate bolt (2).
3. Move the position of compressor (3) to adjust the tension of the belt.
4. When the position of the compressor is fixed, tighten adjustment plate bolt (2) and mount bolts (1) to secure in position.
5. After adjusting the belt tension, repeat the above procedure to check that deflection **a** is within the standard value.



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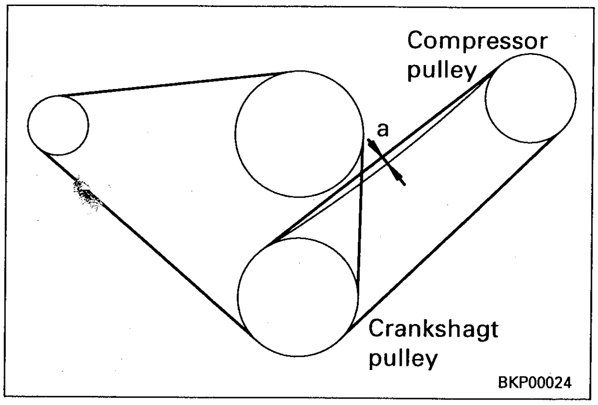


BKP00024

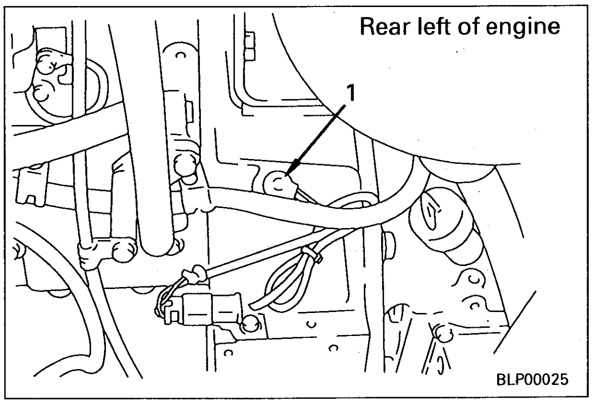
ADJUSTING ENGINE SPEED SENSOR

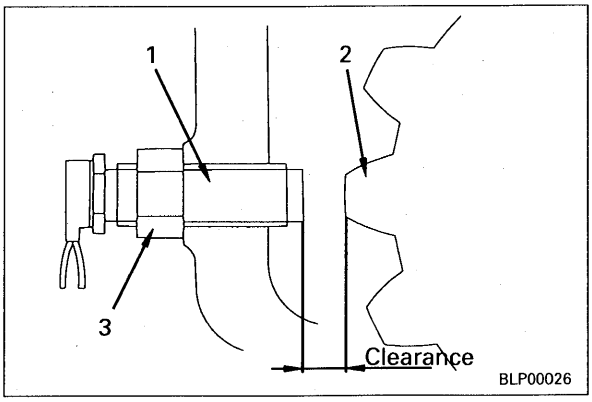
1. Screw in until the tip of sensor (1) contacts gear (2).

2. When gear (2) contacts sensor (1), turn back 1 ± 1/6 turns.

3. Tighten locknut (3).
   kgm Locknut : **58.8 ± 9.8 Nm {6 ± 1 kgm}**

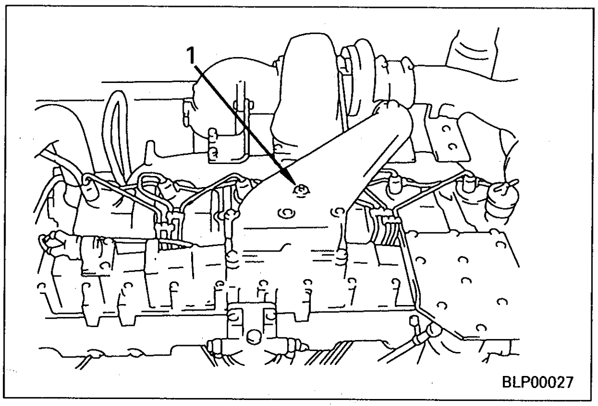
★ Be particularly careful when handling the sensor wiring to ensure that no excessive force is brought to bear on the wiring.
★ Be careful not to let the tip of the sensor be scratched or to let any iron particles stick to the sensor tip.

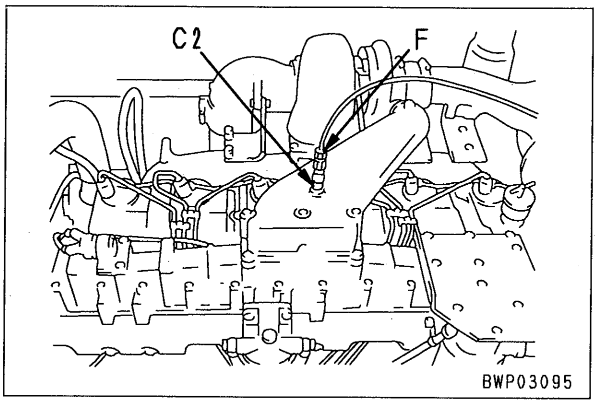




MEASURING AIR SUPPLY PRESSURE (BOOST PRESSURE)

⚠ When removing or installing the measuring equipment or when carrying out the measurements, be careful not to touch any high temperature parts or rotating parts.



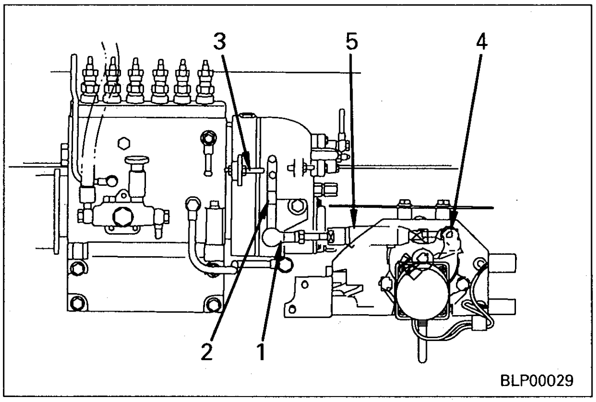


1. Remove air supply pressure measurement plug (1) (PT 1/8), then install the nipple **C2**.
2. Connect the oil pressure measurement hose to the coupler and pressure gauge **F** (–101.3 to +200 kPa {–760 to +1500 mmHg}).

   Note: Run the engine at a mid-range speed or above, and use the self-seal portion of the gauge to bleed the oil from inside the hose.
   - Insert the gauge about half way, and repeatedly open the self-seal portion to bleed the oil.
   - ★ The gauge does not work if there is any oil inside the hose, so always be sure to bleed all the oil.
3. Run the engine at near the rated speed and measure the pressure indicated by the gauge.
   - ★ Near rated output
   - Run the engine at near the rated output. For details, see the measurement of the engine speed when the arm IN circuit is relieved in the H/O mode and power max. mode.

★ The air supply pressure (boost pressure) should be measured with the engine running at rated output. However, when measuring in the field, a similar value can be obtained with the above conditions.

TESTING AND ADJUSTING GOVERNOR MOTOR LEVER STROKE



Testing

★ Use the governor motor adjustment mode.

1. Preparatory work
   1) Keep the monitor panel time switch + travel speed (R.H.) switch + working mode (R.H.) switch pressed for 2.5 seconds.
   2) Set the fuel control dial to MAX, and the auto-deceleration switch to OFF.
      ★ Any working mode can be used.
2. In this condition, check the governor lever and spring rod.
3. After checking, repeat the procedure in Step 1 to complete the governor motor adjustment mode.

Adjusting

1. Turn the starting switch OFF, then remove the nut and disconnect joint (1) from governor lever (2).
2. Repeat the procedure in Step 1 above to set to the governor motor adjustment mode.
3. Set governor lever (2) to a position where it contacts full speed stopper (3) of the fuel injection pump, then turn joints (1) and (4) to adjust the length of spring assembly (5) and adjust to the position of the hole of governor lever (2).
4. From the above position, shorten joints (1) and (4) a total of 2 turns (approx. 2.5 mm), and secure in position with the locknut.

Caution

★ When the spring assembly is removed and the starting switch is at the OFF position, if the governor motor lever is moved suddenly, the governor motor will generate electricity, and this may cause a failure in the governor controller.

★ When moving the governor motor lever, disconnect connector E05 first.

TESTING AND ADJUSTING HYDRAULIC PRESSURE IN WORK EQUIPMENT, SWING, TRAVEL CIRCUIT

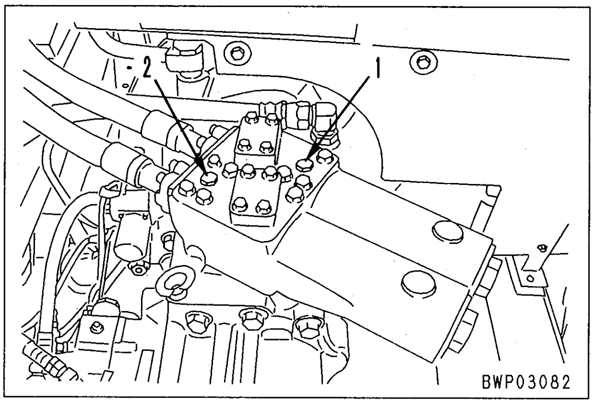
PC400-6 Serial No.: 32001 – 32249
PC450-6 Serial No.: 12001 – 12143

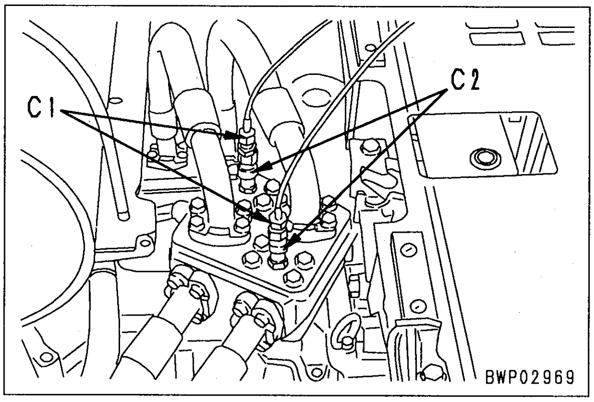
Measuring

★ Oil temperature when measuring: 45 – 55°C

⚠ Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then put the safety lock lever in the LOCK position.

1. Remove the upper cover of the main pump.
2. Remove pressure pick-up plug (1) or (2) (thread dia.=10mm, Pitch=1.25mm) from the circuit to be measured, then install the nipple **C2** and oil pressure gauge **C1** (58.8 MPa {600 kg/cm^2}).
3. **Measuring unload pressure**
   1) Run the engine at full throttle and measure in the H/O mode.
   2) Measure the hydraulic pressure when all levers are at neutral.
4. **Measuring main relief pressure**
   1) Run the engine at full throttle and measure in the H/O mode.
   2) Measure the hydraulic pressure when each actuator is relieved.
      ★ If the power max. switch is turned ON, the pressure will rise, so measure with both the switch OFF and ON.
      (When the switch is turned ON, it is automatically turned OFF after approx. 8 seconds, so measure during the first 8 seconds.)
      ★ Note that the set pressure of the safety valve for the swing motor and head end of the boom is lower than the LS relief pressure, so the value measured will be the relief pressure of the safety valve.
      ★ To check the operation of the safety valve at the boom LOWER end, measure the hydraulic pressure when the machine push-up switch is OFF (low pressure) and ON (high pressure).
      ★ When measuring the hydraulic pressure in the boom LOWER circuit, block the hose (fit blind plug) at the boom cylinder head end.
      ★ If the swing lock switch is turned ON, the pressure will rise, so always keep the lock switch OFF when measuring.
      ★ To relieve the travel circuit, put block under the track shoe grouser, or put block between the sprocket and frame to lock the track.





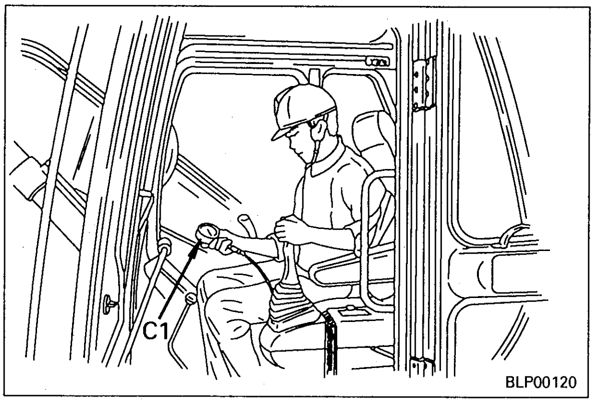


Table 1 Combination of pumps and actuators controlled when flow from front and rear pumps is divided

Plug	Pump	Controlled actuator
1	Front pump	Boom cylinder (Lo, Hi) Arm cylinder (Hi) Bucket cylinder R.H. travel motor Service
2	Rear pum	Arm cylinder (Lo) Swing motor L.H. travel motor

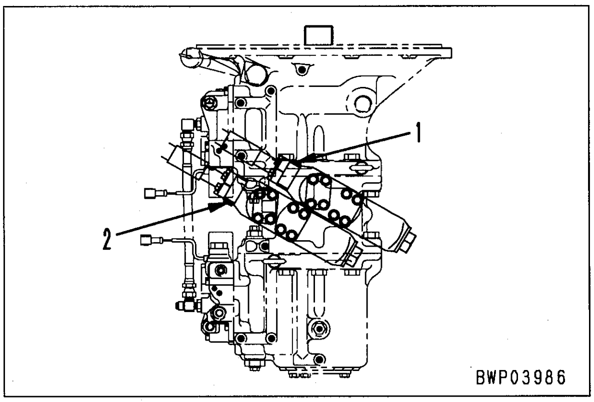
PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up

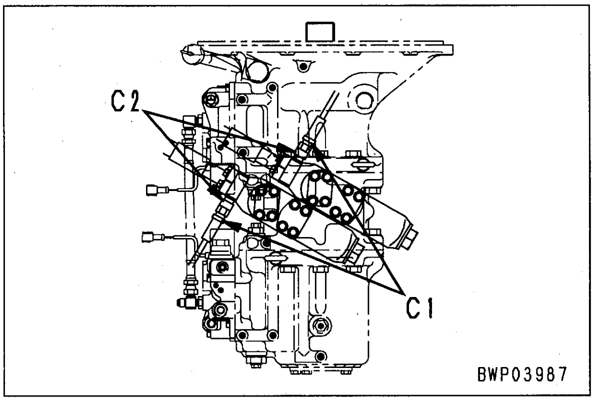
Measuring

★ Oil temperature when measuring: 45 – 55°C

⚠ Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then put the safety lock lever in the LOCK position.

1. Remove the upper cover of the main pump.
2. Remove pressure pick-up plug (1) or (2) (thread dia.=10mm, Pitch=1.25mm) from the circuit to be measured, then install the nipple **C2** and oil pressure gauge **C1** (58.8 MPa {600 kg/cm^2}).
3. **Measuring unload pressure**
   1) Run the engine at full throttle and measure in the H/O mode.
   2) Measure the hydraulic pressure when all levers are at neutral.
4. **Measuring main relief pressure**
   1) Run the engine at full throttle and measure in the H/O mode.
   2) Measure the hydraulic pressure when each actuator is relieved.
      ★ If the power max. switch is turned ON, the pressure will rise, so measure with both the switch OFF and ON.
      (When the switch is turned ON, it is automatically turned OFF after approx. 8 seconds, so measure during the first 8 seconds.)
      ★ Note that the set pressure of the safety valve for the swing motor and head end of the boom is lower than the LS relief pressure, so the value measured will be the relief pressure of the safety valve.
      ★ To check the operation of the safety valve at the boom LOWER end, measure the hydraulic pressure when the machine push-up switch is OFF (low pressure) and ON (high pressure).
      ★ When measuring the hydraulic pressure in the boom LOWER circuit, block the hose (fit blind plug) at the boom cylinder head end.
      ★ If the swing lock switch is turned ON, the pressure will rise, so always keep the lock switch OFF when measuring.
      ★ To relieve the travel circuit, put block under the track shoe grouser, or put block between the sprocket and frame to lock the track.





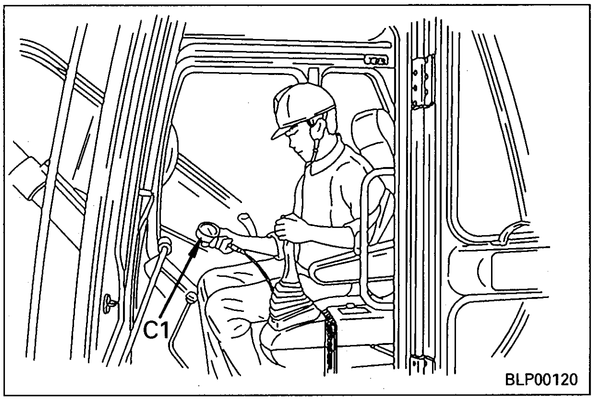


Table 1 Combination of pumps and actuators controlled when flow from front and rear pumps is divided

Plug	Pump	Controlled actuator
1	Front pump	Boom cylinder (Lo, Hi) Arm cylinder (Hi) Bucket cylinder R.H. travel motor Service
2	Rear pum	Arm cylinder (Lo) Swing motor L.H. travel motor

Adjusting

★ The unload valve cannot be adjusted.

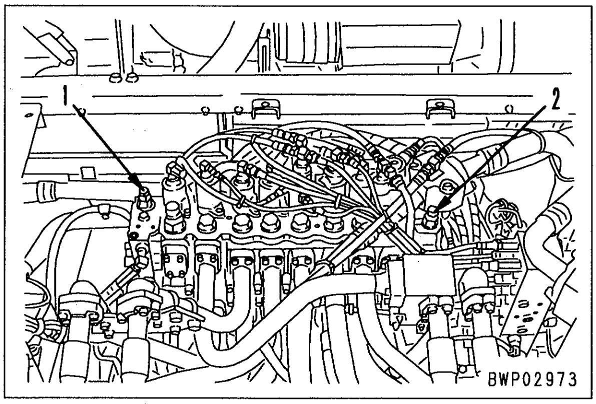
1. **Main relief valve**
   - (1): For front pump
   - (2): For rear pump

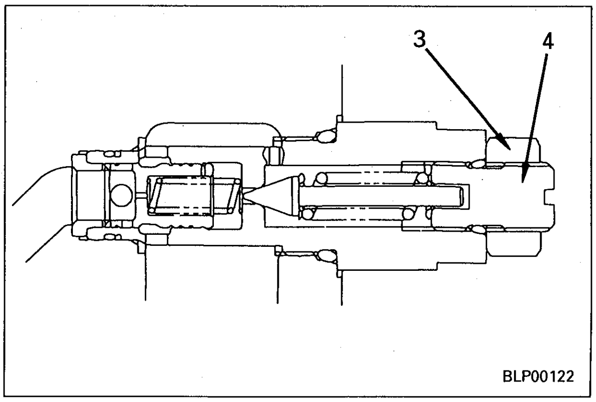
   Loosen locknut (3), then turn adjustment screw (4) to adjust.

   ★ Turn the adjustment screw to adjust as follows.
   - To INCREASE pressure, turn CLOCKWISE.
   - To DECREASE pressure, turn COUNTER-CLOCKWISE.

   ★ Amount of adjustment for one turn of adjustment screw:
   Approx. 12.6 MPa {128 kg/cm²}

   kgm Locknut : **29.4 – 39.2 Nm {3 – 4 kgm}**





2. **Boom cylinder head safety valve**

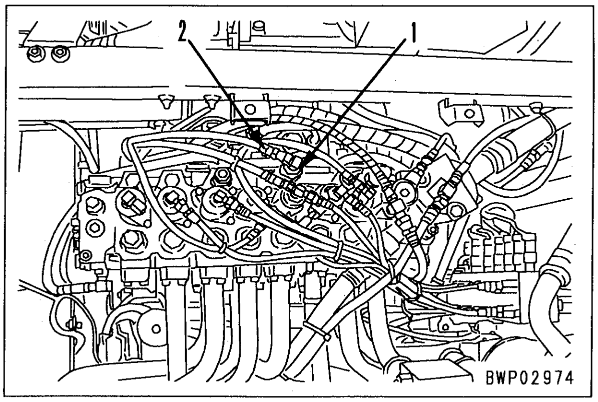
   ★ Adjust the safety valve at the high-pressure end first, then adjust the low-pressure end.
   - (1): Boom cylinder head (LOWER) end

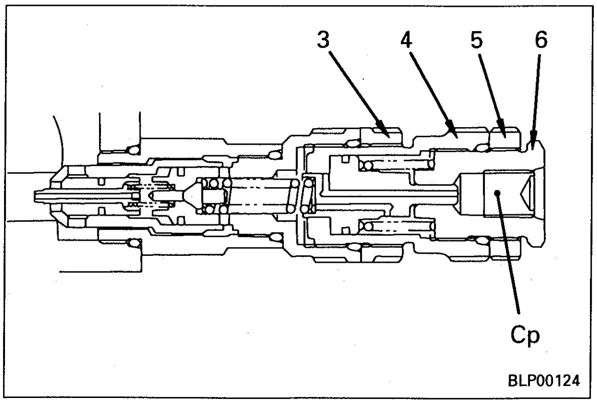
   1) Disconnect pilot hose (2).
   2) Adjusting high-pressure setting
      Loosen locknut (3), then turn holder (4) to adjust.
      kgm Locknut :
      93 – 123 Nm {9.5 – 12.5 kgm}
   3) Adjusting low-pressure setting
      Loosen locknut (5), then turn holder (6) to adjust.
      kgm Locknut : **78 – 93 Nm {8 – 9.5 kgm}**

   ★ Turn the holder to adjust as follows.
   - To INCREASE pressure, turn CLOCKWISE.
   - To DECREASE pressure, turn COUNTER-CLOCKWISE.

   ★ Amount of adjustment for one turn of holder:
   Approx. 21.8 MPa {222 kg/cm²}

   [Reference] The oil pressure acting on port **Cp** is as follows.
   Machine push-up switch ON (high pressure): 0 MPa {0 kg/cm²}
   Machine push-up switch OFF (low pressure): 2.74 MPa {28 kg/cm²}





3. Swing motor safety valve

- (1): For starting left swing (stopping right swing)
- (2): For starting right swing (stopping left swing)

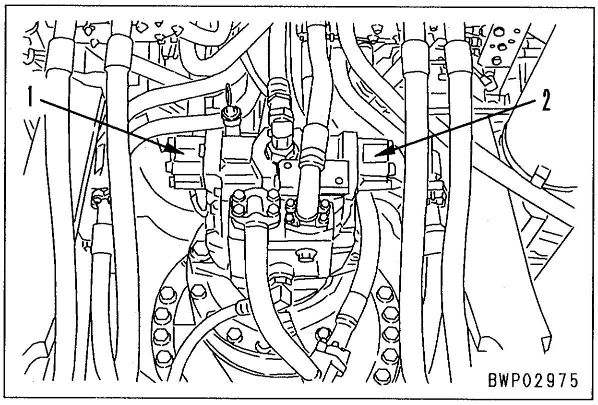
1) Remove the mounting bolts, then remove cover (3) and spring (4).
2) Loosen locknut (5), then turn adjustment screw (6) to adjust.
   - ★ Carry out the adjustment with the valve assembly installed to the motor.
   - ★ Turn the adjustment screw to adjust as follows.
     - To INCREASE pressure, turn CLOCKWISE.
     - To DECREASE pressure, turn COUNTERCLOCKWISE.
   - ★ Amount of adjustment for one turn of adjustment screw: Approx. 3.9 MPa {39.5 kg/cm^2}

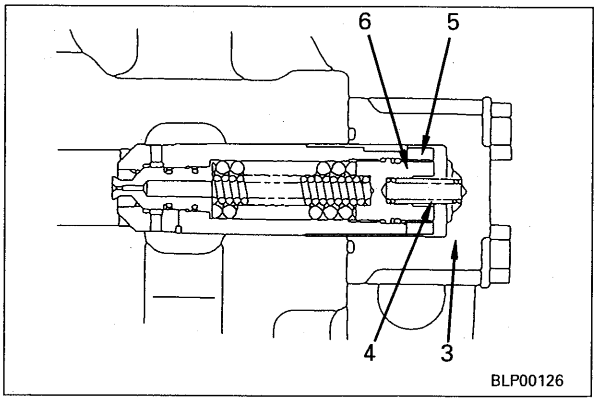
   kgm Locknut :

   118 – 147 Nm {12 – 15 kgm}
3) After completing the adjustment, install spring (4) and cover (3), then tighten the mounting bolts to the specified torque.

   kgm Cover mounting bolt :

   98 – 123 Nm {10.0 – 12.5 kgm}





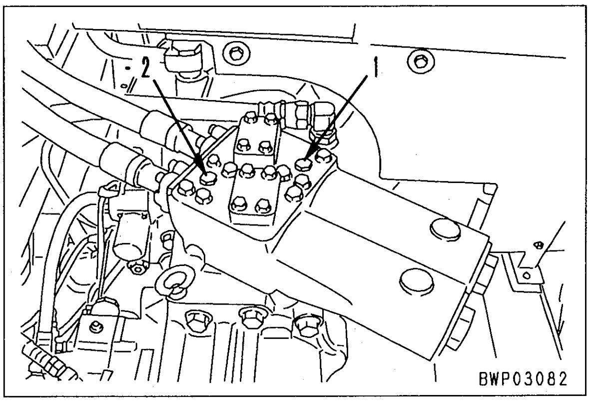
TESTING AND ADJUSTING TVC VALVE OUTPUT PRESSURE (SERVO PISTON INPUT PRESSURE)

PC400-6 Serial No.: 32001 – 32249
PC450-6 Serial No.: 12001 – 12143

Measuring

★ Oil temperature when measuring: 45 – 55°C

⚠ Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then put the safety lock lever in the LOCK position.

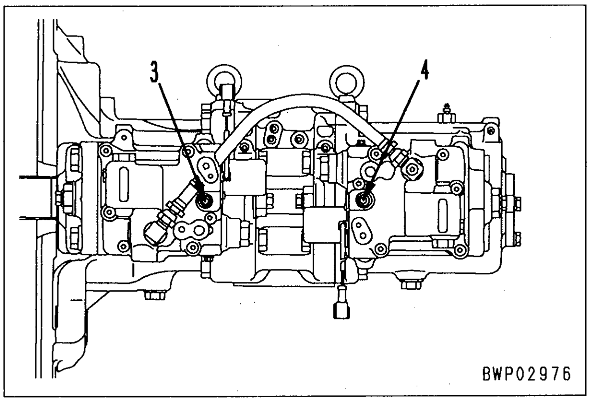


BWP03082

1. Remove pressure measurement plugs (1), (2), (3), and (4) (Thread dia.=10 mm, Pitch=1.25 mm), then install nipple **C2** and oil pressure gauge **C1**.
   ★ Plugs and measured pressure

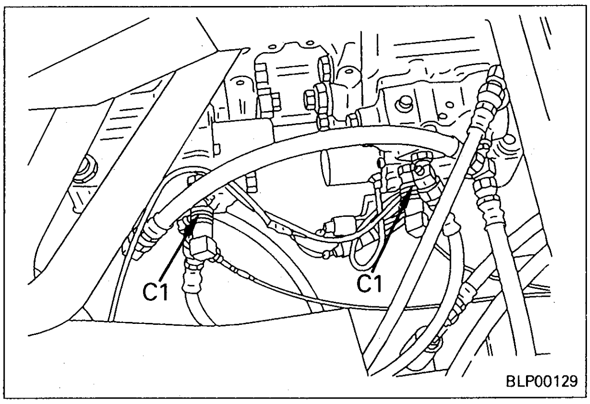
1	Front pump discharge pressure	3	Front servo piston input pressure
2	Rear pump discharge pressure	4	Rear servo piston input pressure

   ★ Install a 39.2 MPa {400 kg/cm^2}gauge to the servo valve end, and a 58.8 MPa {600 kg/cm^2} gauge to the pump outlet port end.



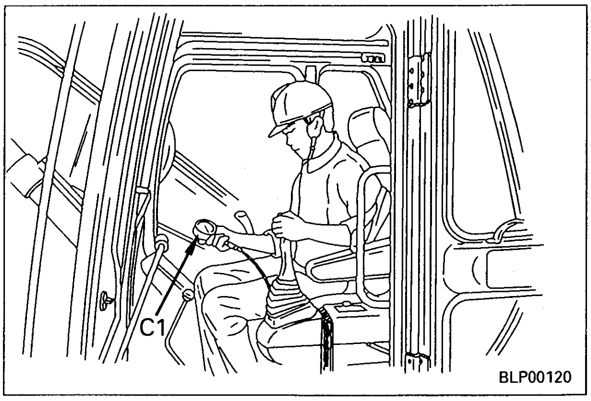
BWP02976

2. Turn the swing lock switch ON.
3. Set the working mode to H/O mode.
4. Run the engine at full throttle, turn the L.H. knob switch ON, and measure the oil pressure when the arm IN circuit is relieved.
   ★ For the front pump, measure the oil pressure at plugs (1) and (3) at the same time; for the rear pump, measure the oil pressure at plugs (2) and (4) at the same time.
   ★ Turn the swing lock switch ON and measure the oil pressure when the circuit is relieved (oil pressure when pressure is rising).
   ★ Check that the servo piston input pressure is 2/5 of the pump discharge pressure.



BLP00129

[Reference]
If there is any abnormality in the LS valve or servo piston, the servo piston input pressure will be almost the same or 0 of the pump discharge pressure.



BLP00120

PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up

Measuring

★ Oil temperature when measuring: 45 – 55°C

⚠ Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then put the safety lock lever in the LOCK position.

1. Remove pressure measurement plugs (1), (2), (3), and (4) (Thread dia.=10 mm, Pitch=1.25 mm), then install nipple **C2** and oil pressure gauge **C1**.
   ★ Plugs and measured pressure

1	Front pump discharge pressure	3	Front servo piston input pressure
2	Rear pump discharge pressure	4	Rear servo piston input pressure

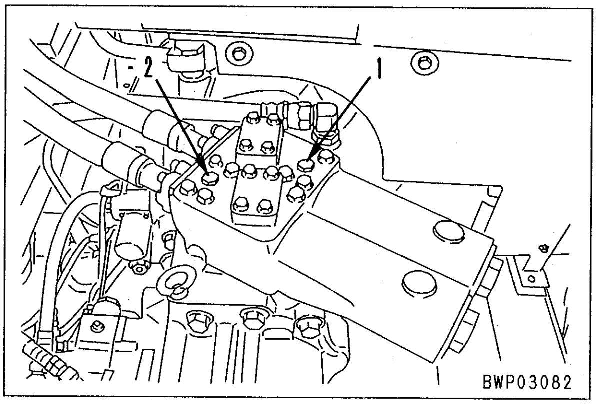
   ★ Install a 39.2 MPa {400 kg/cm^2}gauge to the servo valve end, and a 58.8 MPa {600 kg/cm^2} gauge to the pump outlet port end.

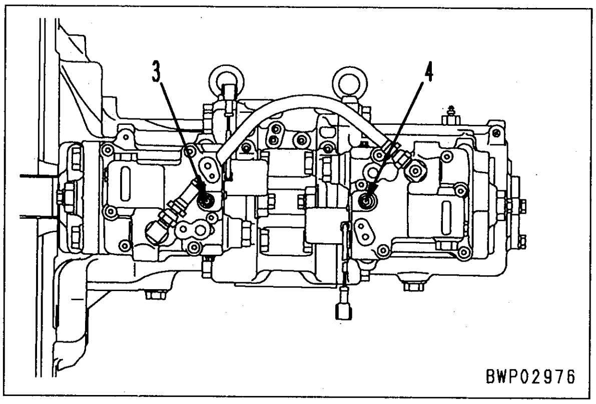
2. Turn the swing lock switch ON.

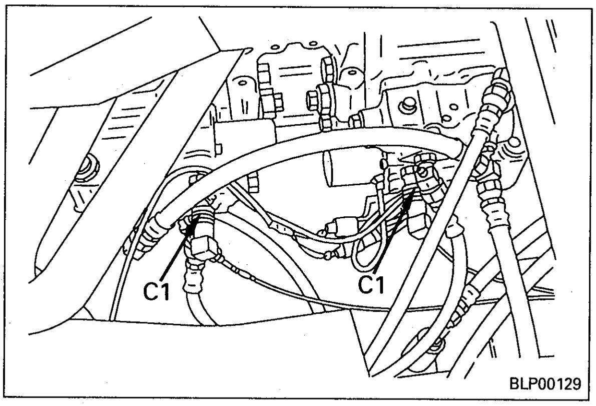
3. Set the working mode to H/O mode.

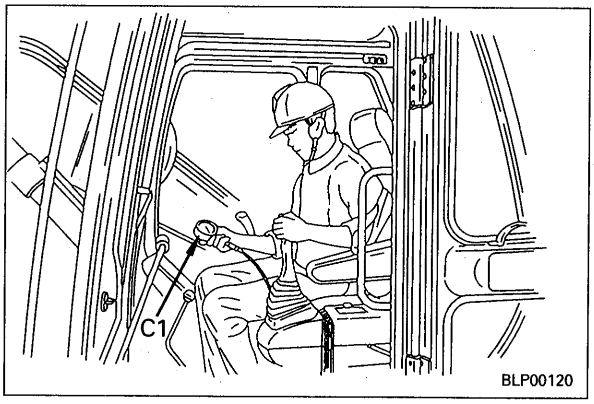
4. Run the engine at full throttle, turn the L.H. knob switch ON, and measure the oil pressure when the arm IN circuit is relieved.
   ★ For the front pump, measure the oil pressure at plugs (1) and (3) at the same time; for the rear pump, measure the oil pressure at plugs (2) and (4) at the same time.
   ★ Turn the swing lock switch ON and measure the oil pressure when the circuit is relieved (oil pressure when pressure is rising).
   ★ Check that the servo piston input pressure is 2/5 of the pump discharge pressure.

[Reference]
If there is any abnormality in the LS valve or servo piston, the servo piston input pressure will be almost the same or 0 of the pump discharge pressure.







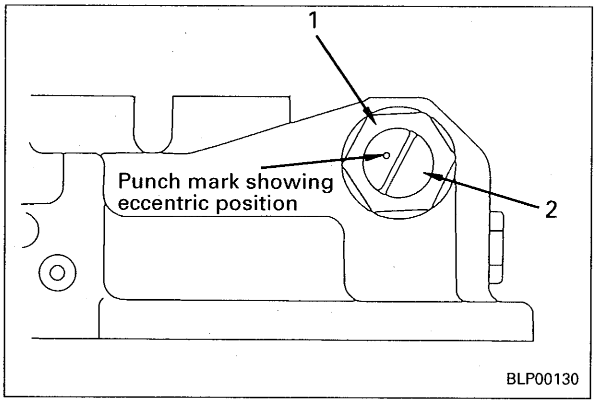


Adjusting

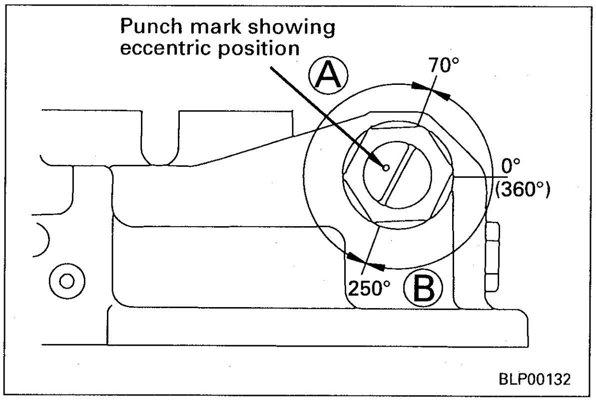
★ If the load becomes larger, the engine speed will drop. Or if the engine speed remains normal, the work equipment speed will drop. In such cases, if the pump discharge pressure and LS differential pressure are normal, adjust the TVC valve as follows.

1. Loosen locknut (1), and turn screw (2) to adjust.
   ★ The direction to turn differs according to the position of the eccentric position punch mark on the screw, so check the mark before turning.
   ★ Turn the screw as follows.
   - If work equipment is slow, turn in INCREASE direction
   - If engine speed drops, turn in DECREASE direction.

Punch mark	Increase	Decrease
Range Ⓐ	Within 90° in counterclockwise direction	Within 90° in clockwise direction
Range Ⓑ	Within 90° in clockwise direction	Within 90° in counterclockwise direction



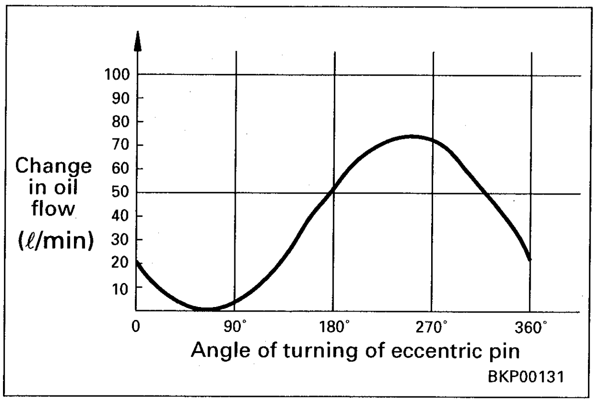
BLP00130



BLP00132

2. After completing the adjustment, tighten locknut (1).
   Locknut : **24.5 – 34.3 Nm {2.5 – 3.5 kgm}**

Note: The screw is an eccentric cam, so if it is turned from the 0 position in the graph, the stroke of the servo piston (change in oil flow) will move as shown in the graph.
If it is turned one full turn, it will return to the original position, but the screw will become looser, so there will be play in the screw.
Therefore, turn the screw a maximum of 90° to the left or right from the position set when the machine was shipped.



BKP00131

TESTING AND ADJUSTING LS VALVE OUTPUT PRESSURE (SERVO PISTON INPUT PRESSURE) AND LS DIFFERENTIAL PRESSURE

PC400-6 Serial No.: 32001 – 32249
PC450-6 Serial No.: 12001 – 12143

★ Oil temperature when measuring: 45 – 55°C

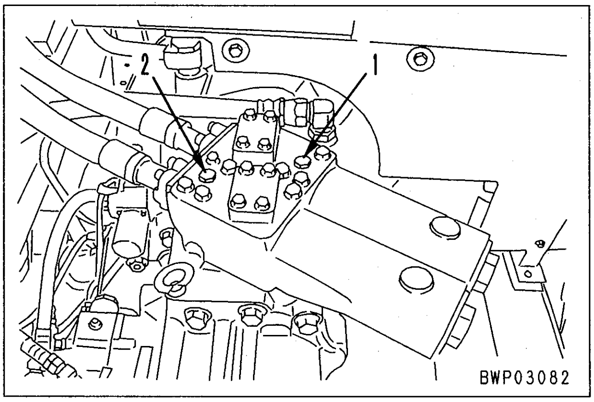
1. **Measuring LS valve output pressure (servo piston input pressure)**
   1) Remove pressure measurement plugs (1), (2), (3), and (4) (Thread dia.= 10 mm, Pitch=1.25 mm), and install nipple **C2** and oil pressure gauge **C1**.
      ★ Plugs and measured pressure

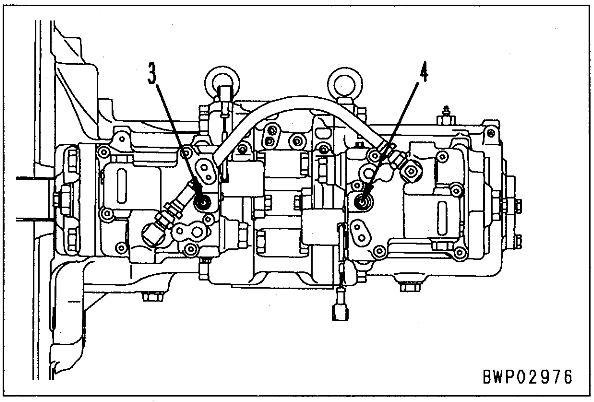
1	Front pump discharge pressure	3	Front servo piston input pressure
2	Rear pump discharge pressure	4	Rear servo piston input pressure

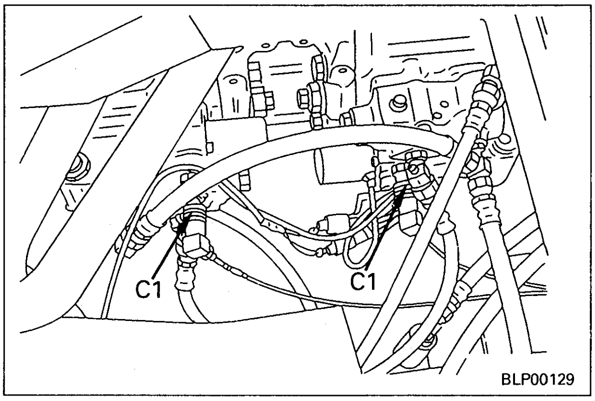
      ★ Install a 39.2 MPa {400 kg/cm^2} gauge to the servo valve end, and a 58.8 MPa {600 kg/cm^2} gauge to the pump outlet port end.
   2) Set the working mode to H/O mode, and turn the travel speed switch to Hi.
   3) Use the work equipment to raise the track assembly on one side.
      ★ When measuring the front pump, push up the right track; when measuring the rear pump, push up the left track.
   4) Run the engine at full throttle, set to the conditions shown in Table 1, and measure the pump discharge pressure and servo inlet pressure.
      ★ For the front pump, measure the oil pressure at plugs (1) and (3) at the same time; for the rear pump, measure the oil pressure at plugs (2) and (4) at the same time.

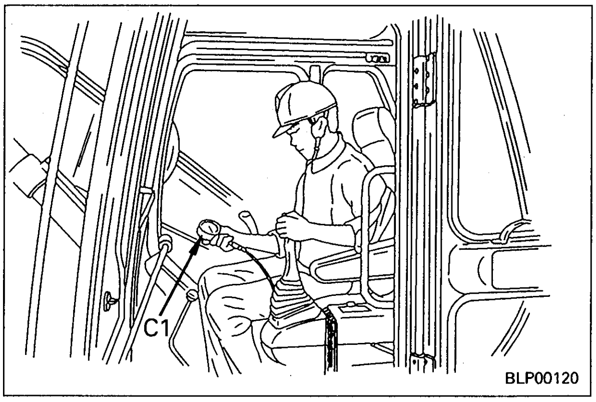
Table 1

Working mode	Travel lever	Pump pressure (MPa{kg/cm^2})	Servo inlet port pressure (MPa{kg/cm^2})	Remarks
H/O mode	Neutral	3.92 ± 1.0 {40 ± 10}	3.92 ± 1.0 {40 ± 10}	About same pressure
H/O mode	Half (travel circuit under no load)	Approx. 12.74 {130}	Approx. 4.9 {50}	About 2/5 of pressure









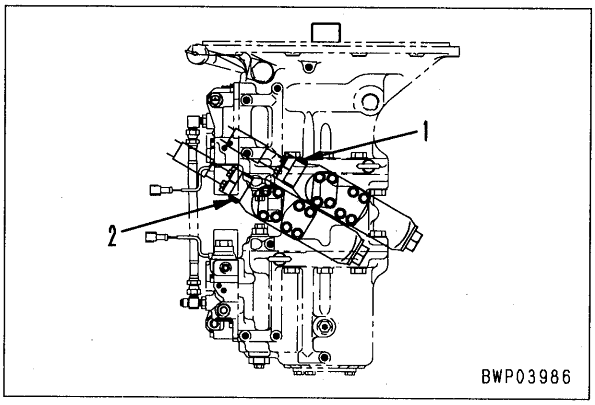
PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up

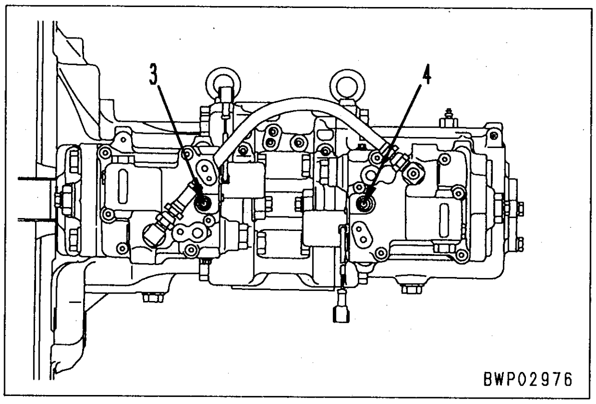
★ Oil temperature when measuring: 45 – 55°C

1. **Measuring LS valve output pressure (servo piston input pressure)**
   1) Remove pressure measurement plugs (1), (2), (3), and (4) (Thread dia.= 10 mm, Pitch=1.25 mm), and install nipple **C2** and oil pressure gauge **C1**.

      ★ Plugs and measured pressure

1	Front pump discharge pressure	3	Front servo piston input pressure
2	Rear pump discharge pressure	4	Rear servo piston input pressure





★ Install a 39.2 MPa {400 kg/cm²} gauge to the servo valve end, and a 58.8 MPa {600 kg/cm²} gauge to the pump outlet port end.

2) Set the working mode to H/O mode, and turn the travel speed switch to Hi.
3) Use the work equipment to raise the track assembly on one side.

   ★ When measuring the front pump, push up the right track; when measuring the rear pump, push up the left track.
4) Run the engine at full throttle, set to the conditions shown in Table 1, and measure the pump discharge pressure and servo inlet pressure.

   ★ For the front pump, measure the oil pressure at plugs (1) and (3) at the same time; for the rear pump, measure the oil pressure at plugs (2) and (4) at the same time.

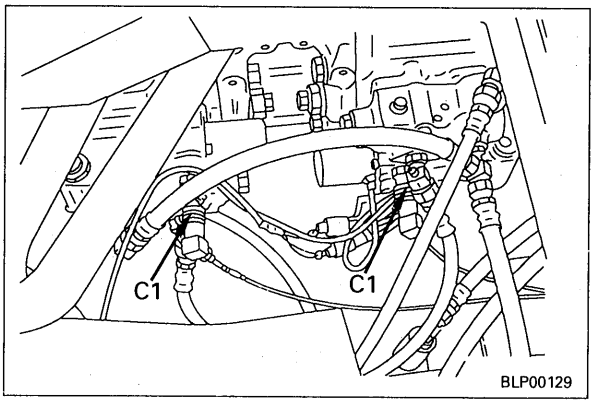
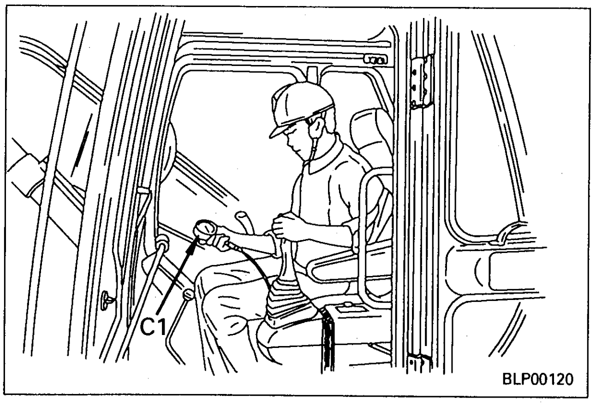


Table 1

Working mode	Travel lever	Pump pressure (MPa{kg/cm²})	Servo inlet port pressure (MPa{kg/cm²})	Remarks
H/O mode	Neutral	3.92 ± 1.0 {40 ± 10}	3.92 ± 1.0 {40 ± 10}	About same pressure
H/O mode	Half (travel circuit under no load)	Approx. 12.74 {130}	Approx. 4.9 {50}	About 2/5 of pressure



2. Measuring LS differential pressure

1) Measuring with a differential pressure gauge
   - i) Remove pressure measurement plugs (1), (2), (3), and (4) (Thread dia.=10mm, Pitch=1.25mm), and install nipple **C2** and differential pressure gauge **C4**.
     ★ Plugs and measured pressure

1	Front pump discharge pressure	3	Front LS pressure
2	Rear pump discharge pressure	4	Rear LS pressure

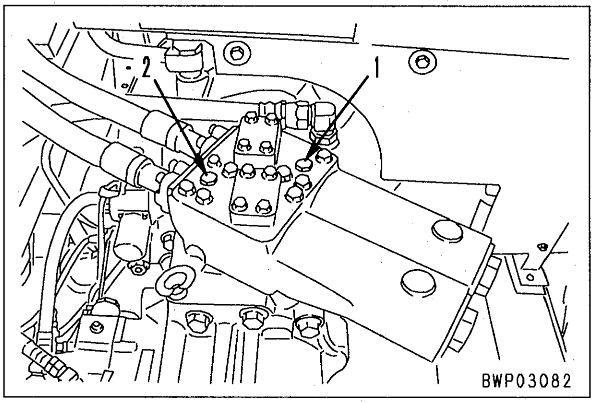
     ★ Connect the pump discharge pressure to the high-pressure side of the differential gauge and the LS pressure to the low-pressure side.
   - ii) Set the working mode to H/O mode, and turn the travel speed switch to Hi.
   - iii) Use the work equipment to raise the track assembly on one side.
     ★ When measuring the front pump, push up the right track; when measuring the rear pump, push up the left track.
   - iv) Run the engine at full throttle, set to the conditions shown in Table 2 and measure the LS differential pressure.

Table 2

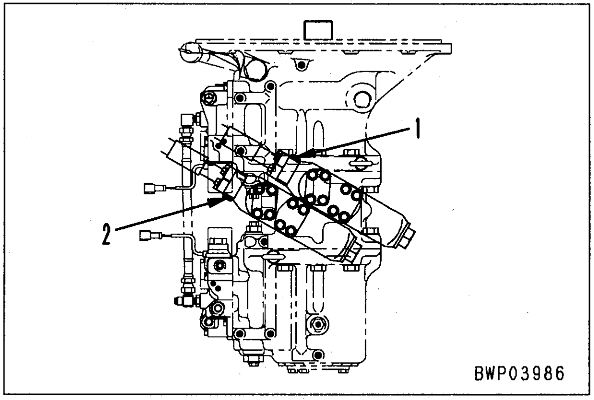
Working mode	Travel lever	LS differential pressure (MPa {kg/cm²})	Remarks
H/O mode	Neutral	3.92 ± 1.0 {40 ± 10}	(Note)
H/O mode	Half (travel circuit under no load)	2.45 ± 0.1 {25 ± 1}	

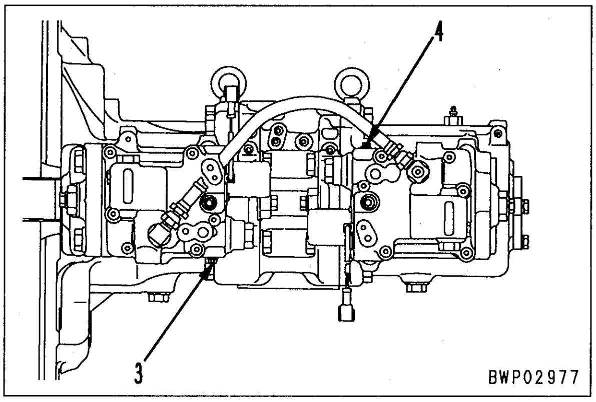
Note: When all control levers are at neutral, the LS differential pressure is the same as the unload pressure.

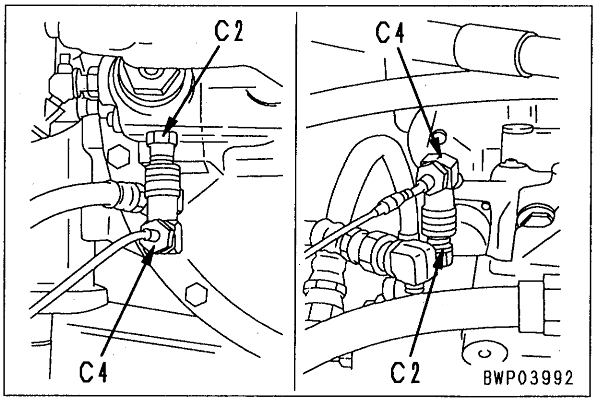
PC400-6 Serial No.: 32001 – 32249, PC450-6 Serial No.: 12001 – 12143



PC400-6 Serial No.: 32250 and up, PC450-6 Serial No.: 12144 and up

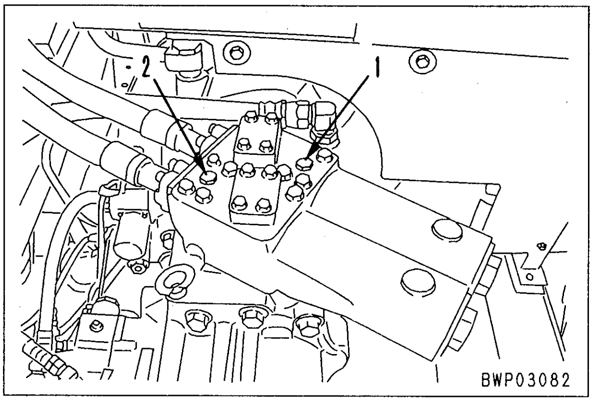




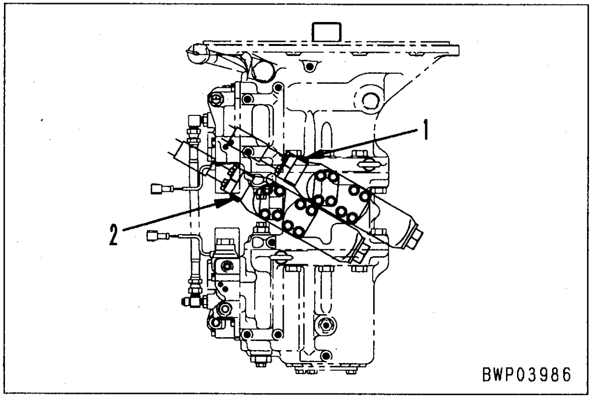


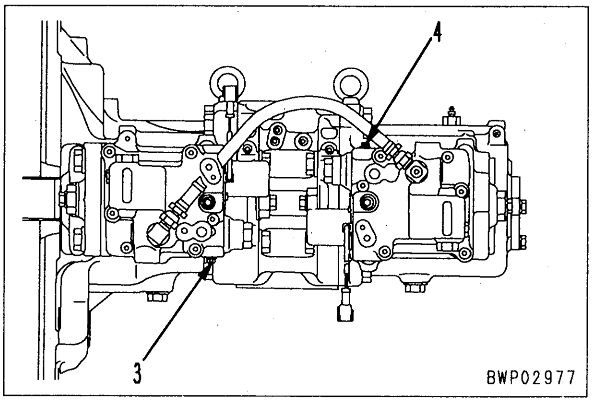
2) Measuring with oil pressure gauge
   ★ The maximum differential pressure is 2.94 ± 1.0 MPa {30 ± 10 kg/cm^2}, so measure with the same gauge.
   i) Remove pressure measurement plugs (1), (2), (3), and (4) (thread dia.=10mm, pitch=1.25mm), and install the nipple **C2**.
   ii) Set the working mode to H/O mode, and turn the travel speed switch to Hi.
   iii) Use the work equipment to raise the track assembly on one side.
      ★ When measuring the front pump, push up the right track; when measuring the rear pump, push up the left track.
   iv) Install oil pressure gauge **C1** (58.8 MPa {600 kg/cm^2}) to the measurement plug for the pump discharge pressure.
      ★ Use a gauge with a scale in units of 1.0 MPa {10 kg/cm^2}.
      (If no 58.8 MPa {600 kg/cm^2} pressure gauge is available, a 39.2 MPa {400 kg/cm^2} pressure gauge can be used.)
   v) Set to the conditions in Table 2 and measure the pump discharge pressure.
      ★ Stand directly in front of the indicator and be sure to read it correctly.
   vi) Remove oil pressure gauge **C1** and nipple **C2**, then install it to the LS pressure measurement plug.
   vii) Set to the conditions in Table 2 and measure the LS pressure.
      ★ Stand directly in front of the indicator and be sure to read it correctly.
      (Pump discharge pressure) – (LS pressure) = LS Differential pressure

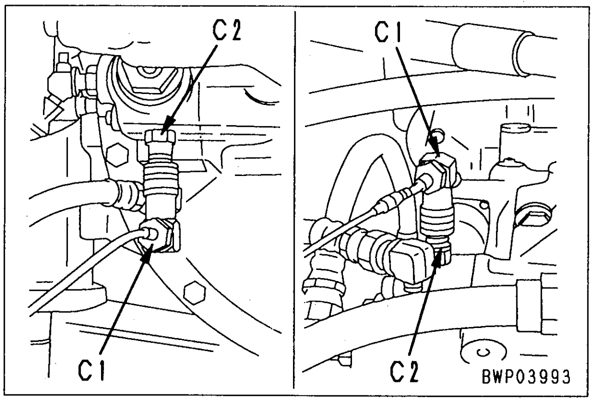
PC400-6 Serial No.: 32001 – 32249, PC450-6 Serial No.: 12001 – 12143



PC400-6 Serial No.: 32250 and up, PC450-6 Serial No.: 12144 and up







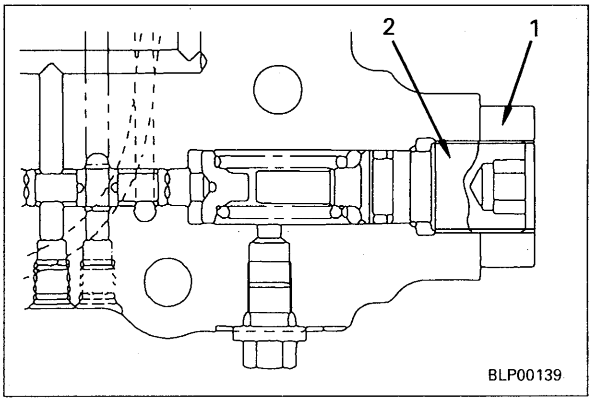
3. Adjusting LS valve

When the differential pressure is measured under the conditions above, and the results show that the differential pressure is not within the standard value, adjust as follows.

1) Loosen locknut (1) and turn screw (2) to adjust the differential pressure.
   ★ Turn the screw to adjust the differential pressure as follows.
   - To INCREASE pressure, turn CLOCKWISE
   - To DECREASE pressure, turn COUNTER–CLOCKWISE

   ★ Amount of adjustment for one turn of adjustment screw: Approx. 1.29 MPa {13.2 kg/cm^2}

   Note: Always measure the differential pressure while adjusting.
2) After adjusting, tighten locknut.
   kgm Locknut: **58.8 – 78.5 Nm {6 – 8 kgm}**



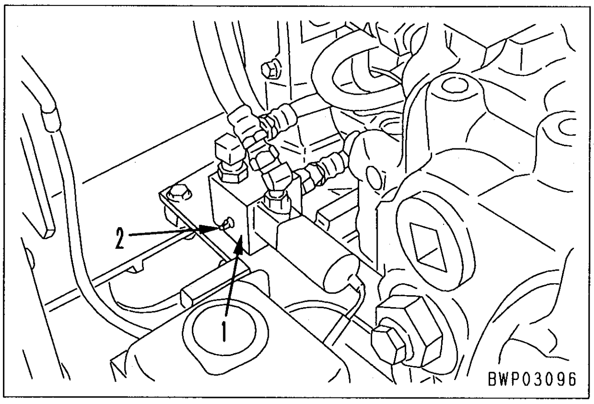
TESTING CONTROL CIRCUIT OIL PRESSURE (OIL PRESSURE WHEN SELF-PRESSURE IS REDUCED)

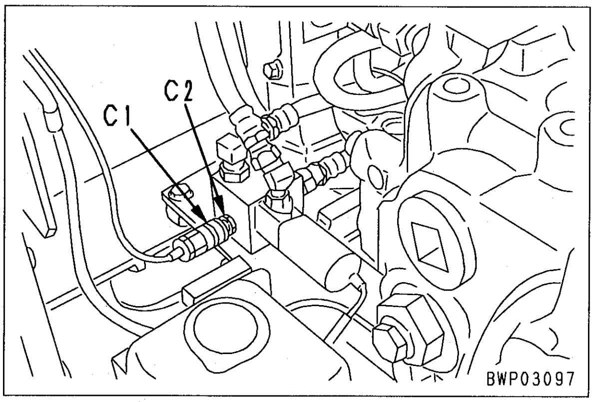
Measuring

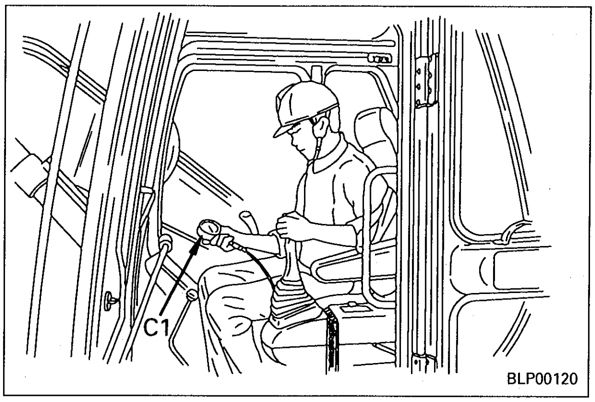
★ Oil temperature when measuring: 45 – 55°C

⚠ Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then put the safety lock lever in the LOCK position.

1. Remove oil pressure measurement plug (2) (PT1/8) from LS-EPC solenoid valve block (1).
2. Install nipple **C2**, then connect oil pressure gauge **C1** (5.8 MPa {60kg/cm²}).
3. Start the engine and measure with the engine at full throttle.







TESTING SOLENOID VALVE OUTPUT PRESSURE

★ Oil temperature when measuring: 45 – 55°C

1. **Measuring output pressure of LS-EPC solenoid valve**
   1) Disconnect output hose (1) of the LS-EPC solenoid valve.
   2) Install adapter **C3** and nipple **C2** in the oil pressure gauge kit, and install oil pressure gauge **C1** (5.8 MPa {60 kg/cm²})
   3) Measure the output pressure under the conditions in Table 1.

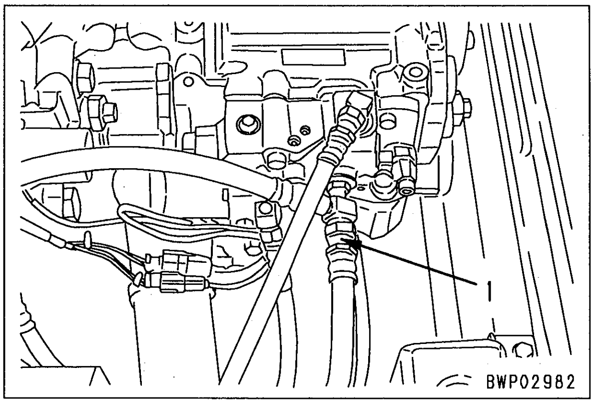
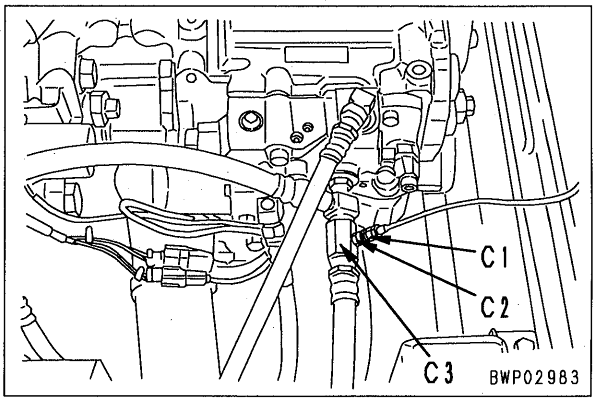
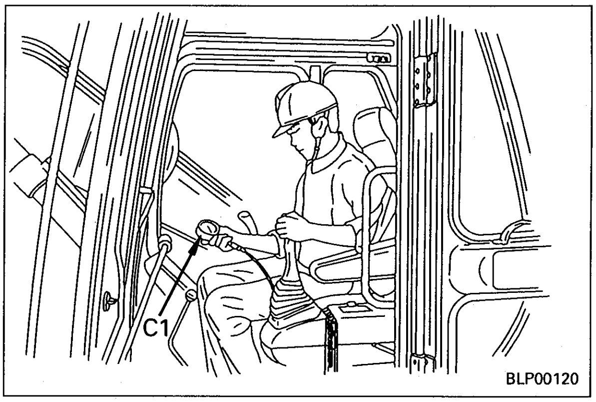


Table 1

Operation and working mode	Engine speed (rpm)	Output pressure (MPa{kg/cm²})	[Reference] Current (A)
• All control levers at neutral	Min. 1500	2.94 ± 0.2 {30 ± 2}	900 ± 30
• H/O mode or G/O mode • Operate any control lever with travel at neutral	Min. 1900	0 {0}	0 {0}

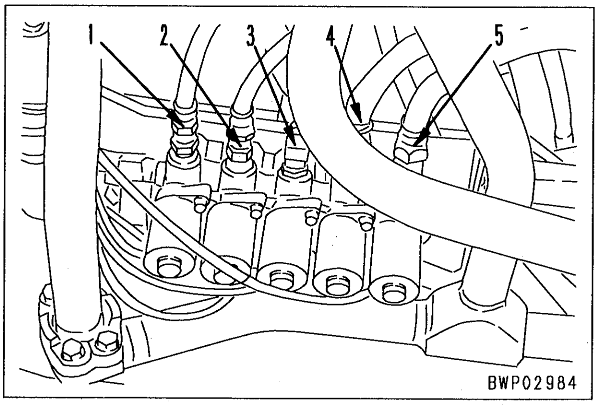


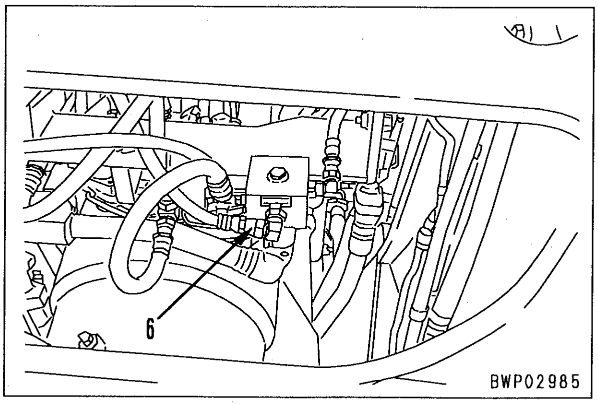
★ The engine speed and LS-EPC current can be measured using the monitoring code on the monitor panel.
- Engine speed : [10] or [40]
- LS-EPC current : [15]

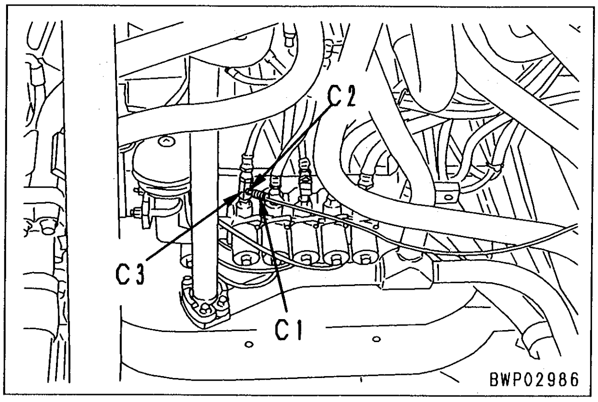


2. Measuring output pressure of ON/OFF solenoid valve

1) Disconnect outlet hoses (1), (2), (3), (4), (5) and (6) of the solenoid valve to be measured.
2) Install adapter **C3** and nipple **C2**, and install oil pressure gauge **C1** (5.8 MPa {60 kg/cm²}).
3) Measure the output pressure under the conditions in Table 2.







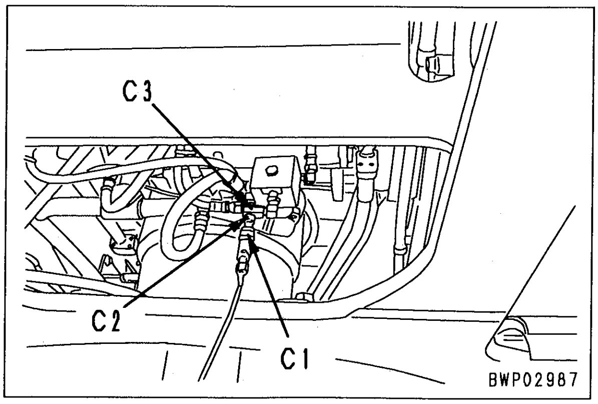


Table 2

Hose	Solenoid	Measurement conditions	Operating conditions	Condition of solenoid	Oil pressure (MPa {kg/cm^2})
1	Active	Active mode switch OFF	Boom under spool stroke 9 mm	ON	Min. 2.74 {28}
		Active mode switch ON	Boom under spool stroke 11.5 mm	OFF	0 {0}
2	Machine push-up	When machine push-up switch is at high-pressure setting	Safety valve at high-pressure setting	OFF	0 {0}
		When machine push-up switch is at low-pressure setting	Safety valve at low-pressure setting	ON	Min. 2.74 {28}
3	Pump merge/ divider valve	Travel operated independently	Flow from front and rear pumps divided	ON	Min. 2.74 {28}
		All levers at neutral	Flow from front and rear pumps merged	OFF	0 {0}
4	Travel speed	When operate travel lever with travel speed switch at Hi or Mi	Motor swash plate angle at MIN	ON	Min. 2.74 {28}
		Travel speed switch at Lo	Motor swash plate angle at MAX	OFF	0 {0}
5	Swing holding brake	Swing or work equipment lever operated	Brake canceled	ON	Min. 2.74 {28}
		All levers except travel at neutral (5 sec after returning to neutral)	Brake actuated	OFF	0 {0}
6	Active (swing)	Active mode switch OFF	Swing spool stroke 9.5 mm	OFF	0 {0}
		Active mode switch ON boom raise lever FULL (during operation)	Swing spool stroke 7.0 mm	ON	Min. 2.74 {28}

★ With monitoring code (23), check at the same time that the solenoid is switched ON/OFF electrically.
(The machine push-up solenoid is not displayed.)

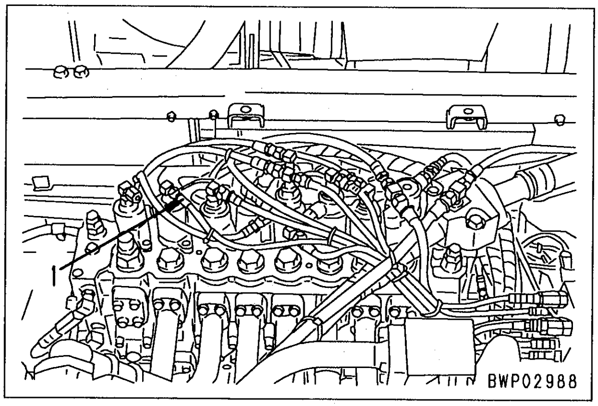
★ The measurement conditions in the table are typical conditions for measuring the output pressure. The solenoid valve may be actuated (ON/OFF) under conditions other than the measurement conditions given above.

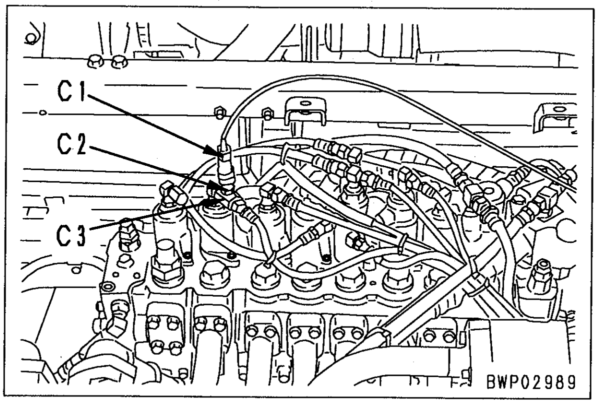
★ Operate the lever slightly not enough to move the machine.

MEASURING PPC VALVE OUTPUT PRESSURE AND TESTING PPC SHUTTLE VALVE

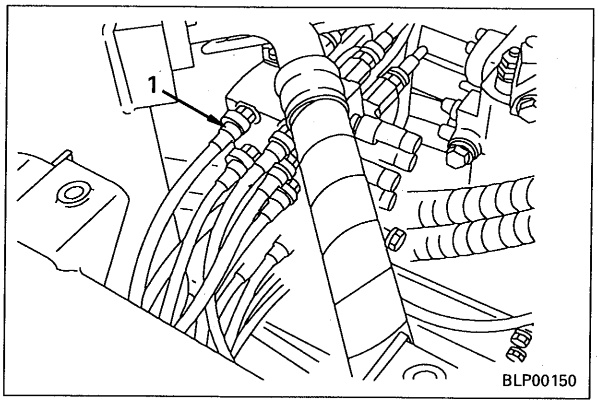
★ Oil temperature when measuring: 45 – 55°C

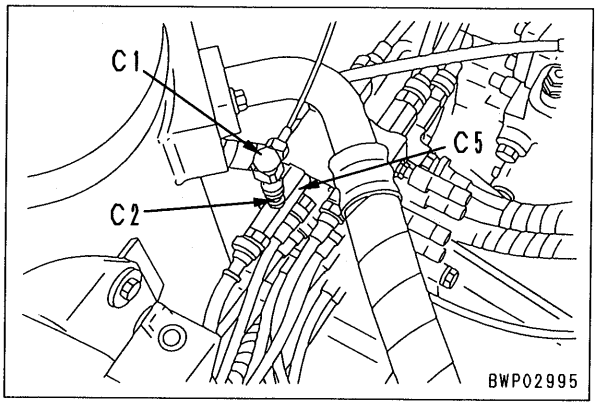
1. **Measuring PPC valve output pressure**
   1) Disconnect hose (1) of the circuit to be measured.
   2) Install adapter **C3** and nipple **C2**.
   3) Install oil pressure gauge **C1** (5.8 MPa {60 kg/cm^2}).
   4) Run the engine at full throttle, operate the control lever of the circuit to be measured, and measure the oil pressure.





2. **Checking PPC shuttle valve**
   ★ If the output pressure at the control valve end is low, check for leakage of oil from the PPC shuttle valve as follows.
   1) Disconnect hose (1) between the PPC valve and the shuttle valve of the circuit to be measured. Disconnect the hose from the shuttle valve together with the nipple.
   2) Install adapter **C5** and nipple **C2** to the tip of the hose, then install oil pressure gauge **C1** (5.8 MPa {60 kg/cm^2}).
      ★ Install a blind plug to the shuttle valve.
   3) Run the engine at full throttle, operate the control lever, and measure the output pressure.
      ★ If the output pressure becomes normal, there is leakage from the PPC shuttle valve; if there is no change, the PPC valve is defective.

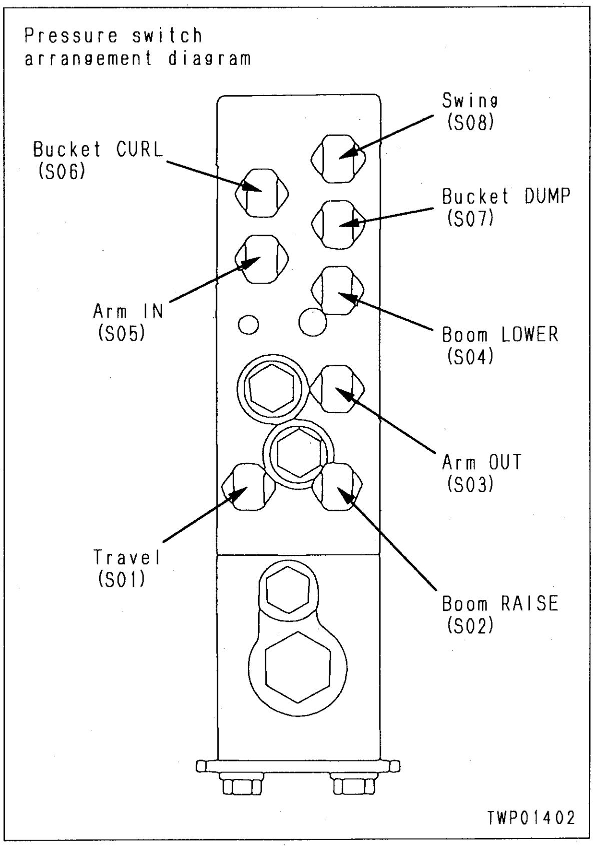


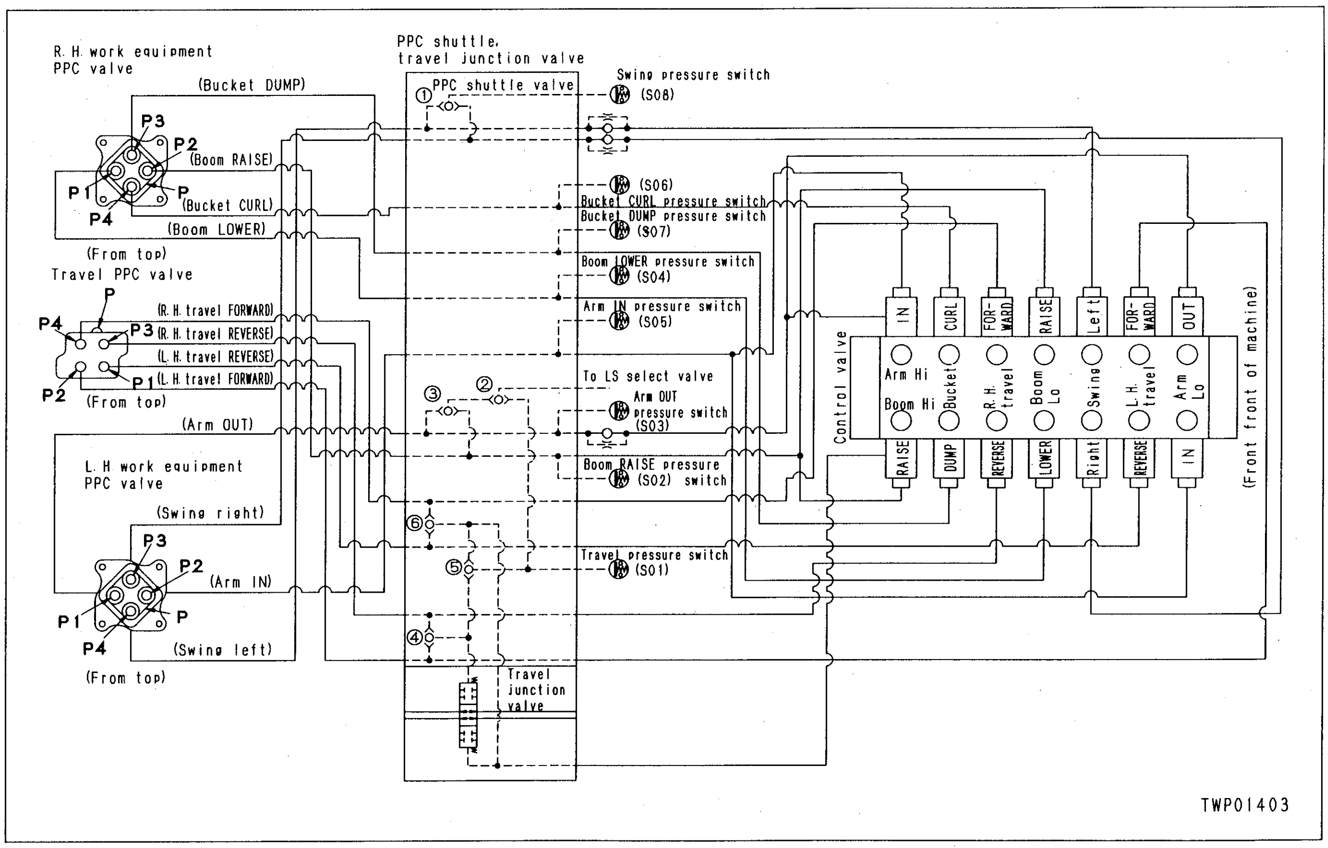


3. Checking defective operation of PPC shuttle valve

1) Remove the applicable oil pressure switch, then install nipple **C2** and oil pressure gauge **C1** (5.8 MPa {60 kg/cm^2}).
   - ★ Disconnect the outlet hose of the LS select shuttle valve before installing the oil pressure gauge.
2) Run the engine at full throttle, operate the applicable lever, and measure the output pressure.
   - ★ If output pressure is generated for all the applicable operations, the shuttle valve is normal.
   - ★ If no output pressure is generated all the applicable operations, the shuttle valve is defective.

①: Swing left, right shuttle valve
②: LS select shuttle valve (boom RAISE, arm OUT, all travel)
③: Boom RAISE, arm OUT shuttle valve
④: L.H. travel FORWARD, R.H. travel REVERSE shuttle valve
⑤: All travel shuttle valves (L.H., R.H. FORWARD, REVERSE)
⑥: L.H. travel REVERSE, R.H. travel FORWARD shuttle valve





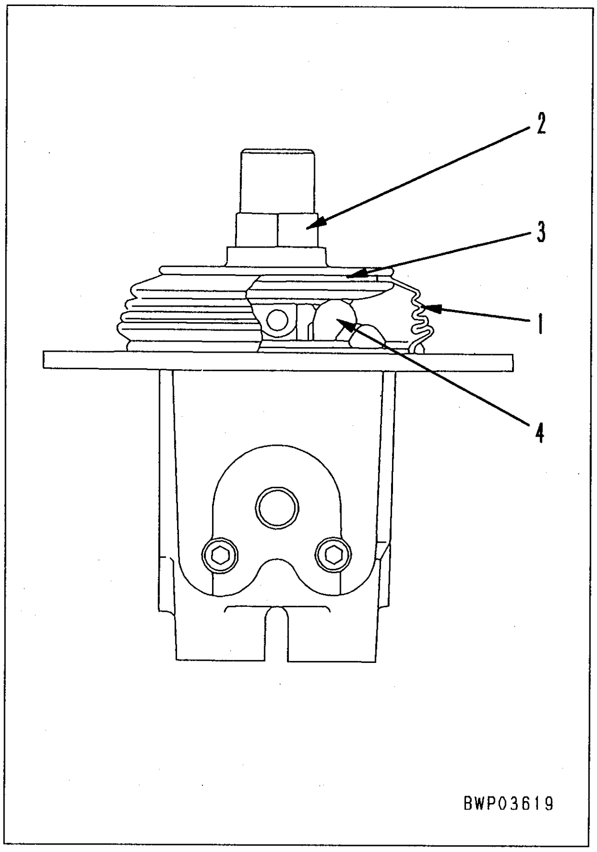
ADJUSTING WORK EQUIPMENT, SWING PPC VALVE

★ If there is excessive play in the work equipment or swing lever, adjust as follows.

⚠ Lower the work equipment to the ground and stop the engine. Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then set the safety lock lever to the LOCK position.

1. Remove the PPC valve assembly.
   For details, see DISASSEMBLY AND ASSEMBLY, Removal of work equipment PPC valve assembly.
2. Remove boot (1).
3. Loosen locknut (2), then screw in disc (3) until it contacts the 4 heads of piston (4).
   ★ When doing this, do not move the piston.
4. Secure disc (3) in position, then tighten locknut (2) to the specified torque.
   kgm Locknut : **98 – 127 Nm {10 – 13 kgm}**
5. Install boot (1).

★ With the above adjustment, the clearance between disc (3) and piston (4) becomes 0.

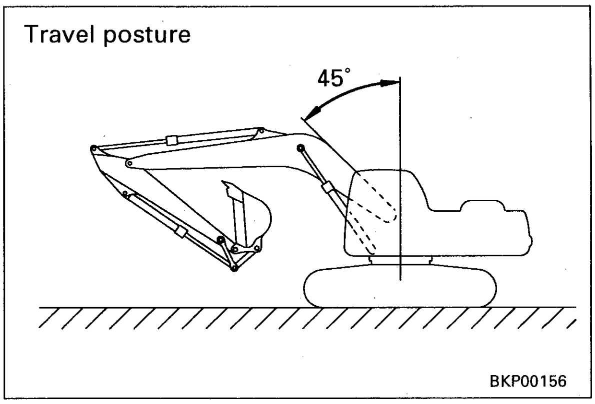


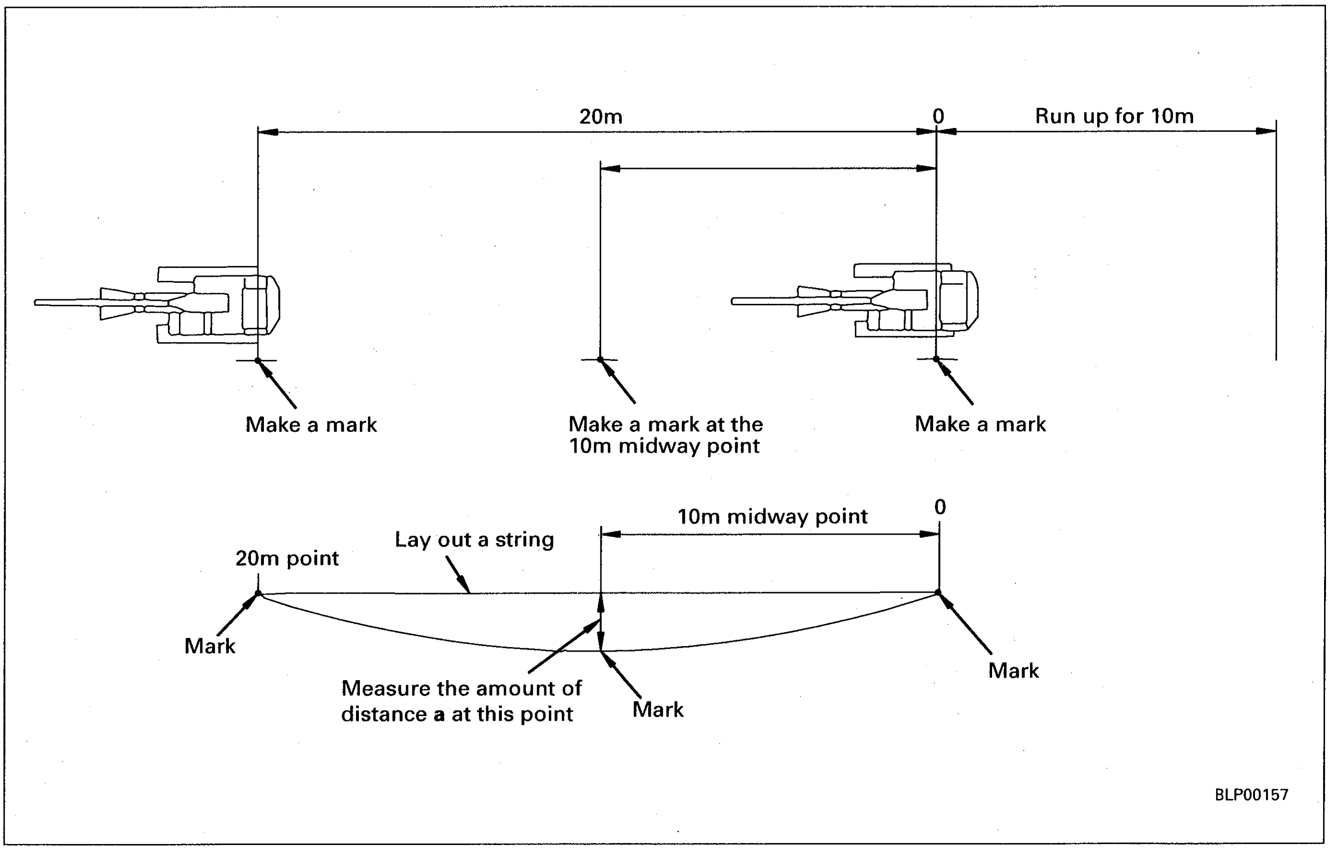
TESTING TRAVEL DEVIATION

★ When traveling on level ground.

1. Set the machine in the travel posture.
    ★ For the travel posture, extend the bucket and arm cylinder rods fully, and hold the boom angle at 45°.

2. Travel for 10 m, then measure the deviation when traveling for the next 20 m.
    ★ Set to H/O mode and measure with the engine at full throttle.
    ★ Install the hydraulic pressure gauge and measure the pump discharge pressure at the same time.

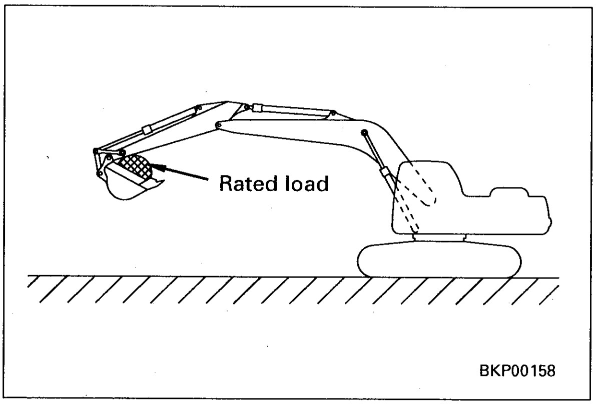


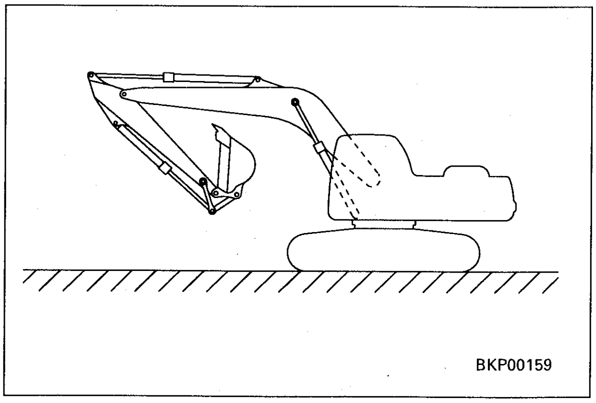


TESTING LOCATIONS CAUSING HYDRAULIC DRIFT OF WORK EQUIPMENT

★ If there is any hydraulic drift in the work equipment (cylinders), check as follows to determine if the cause is in the cylinder packing or in the control valve.

1. **Checking for defective cylinder packing**
   1) Checking boom and bucket cylinders
      i) Set in the same posture as when measuring hydraulic drift, and stop the engine.
      ii) Operate the boom control lever to RAISE or the bucket control lever to CURL.
         - If the lowering speed increases, the packing is defective.
         - If there is no change, the boom lock valve (boom) or the control valve (bucket) is defective.
   2) Checking arm cylinder
      i) Operate the arm cylinder to move the arm in fully, then stop the engine.
      ii) Operate the control lever to arm IN.
         - If the lowering speed increases, the packing is defective.
         - If there is no change, the control valve is defective.
         - ★ If the pressure in the accumulator has dropped, run the engine for approx. 10 seconds to charge the accumulator again before operating.





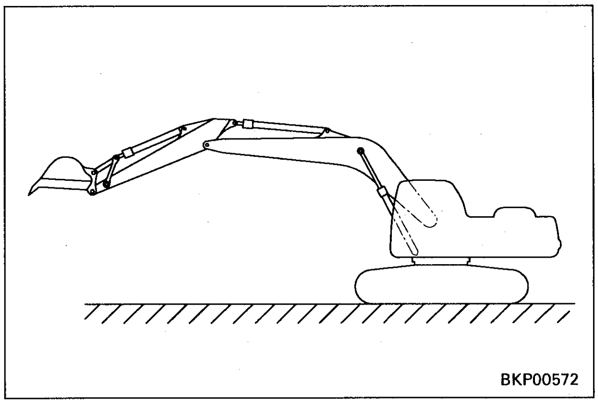
[Reference] If the cause of the hydraulic drift is in the packing, and the above operation is carried out, the downward movement becomes faster for the following reasons.

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 smaller than the volume at the bottom end by the volume of the rod, 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.

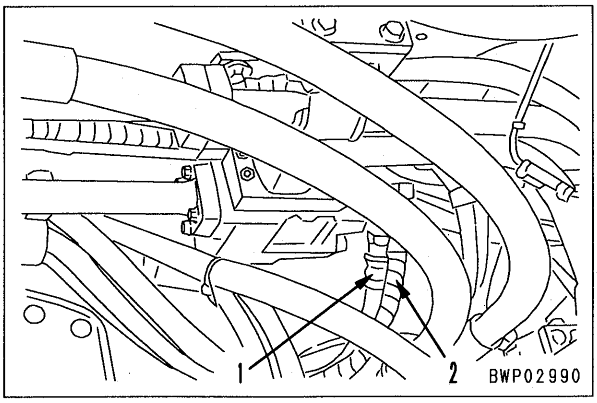
2. Checking boom lock valve

⚠ Set the work equipment at the maximum reach, and the top of the boom horizontal, then stop the engine.
Lock the work equipment control levers and release the pressure inside the hydraulic tank.

⚠ Do not enter under the work equipment.



1) Disconnect pilot hose (1) of the boom lock valve and drain hose (2), and install a blind plug in the hose.
   - ★ Pilot hose side blind plug: 07376-50315
   - ★ Blind plug for drain hose: 07376-50522
   - ★ Leave the boom lock valve end open.
2) Start the engine, charge the accumulator, then stop the engine.
3) Operate the boom control lever to the LOWER position.
   - ★ If any oil leaks from the port that is left open, the boom lock valve is defective.
   - ★ When disconnect hoses, take care to spout of oil and movement of work equipment, and loosen them gradually.



3. Checking PPC valve

If the hydraulic drift differs when the safety lock lever is in the LOCK or FREE position, (engine running), the PPC valve is defective.

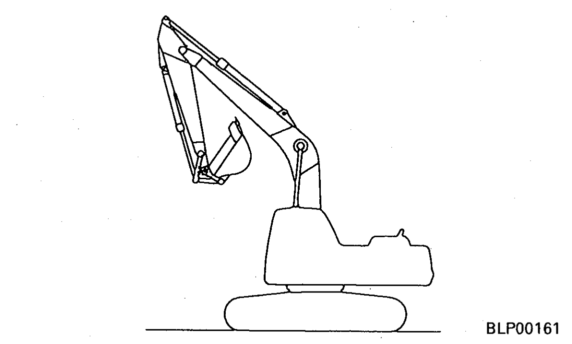
MEASURING OIL LEAKAGE

★ Oil temperature when measuring: 45 – 55°C

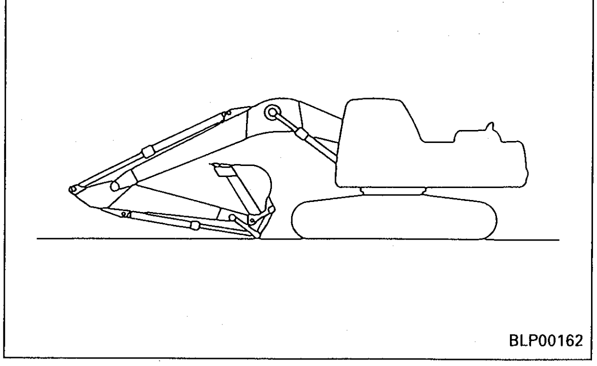
1. **Work equipment cylinder**
   - ★ If the hydraulic drift of the work equipment is outside the standard value, measure the leakage inside the cylinder as follows, and judge if the cause of the hydraulic drift is in the cylinder or in the control valve.
     - If the leakage is within the standard value, the problem is in the control valve.
     - If the leakage is greater than the standard value, the problem is in the cylinder.

1) Fully extend the rod of the cylinder to be measured, then stop the engine.
2) Disconnect piping (1) at the head end, then block the piping at the chassis end with a blind plug.
   ⚠ Be careful not to disconnect the piping at the bottom end.
3) Start the engine and apply the relief pressure to the bottom end of the cylinder with the engine at full throttle.
   ★ Boom cylinder : RAISE
   Arm cylinder : IN
   Bucket cylinder : CURL
4) Continue this condition for 30 seconds, then measure the oil leakage for the next one minute.

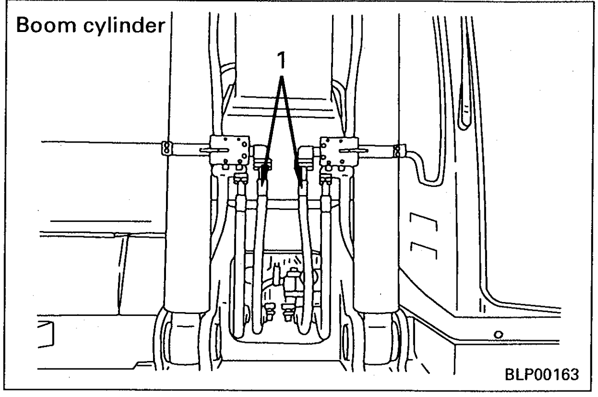
Posture for measuring boom cylinder



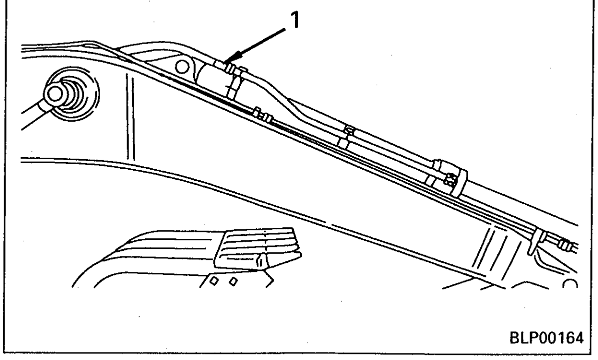
Posture for measuring arm, bucket cylinder

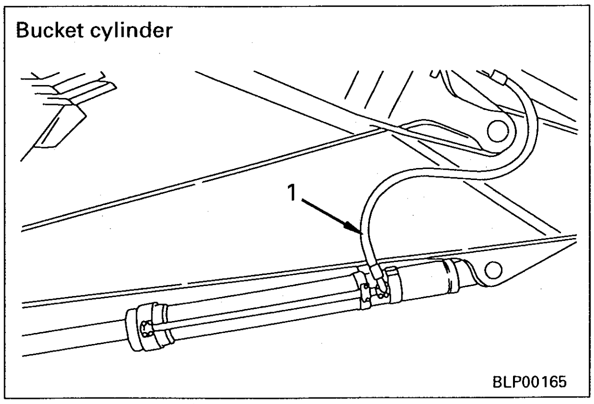


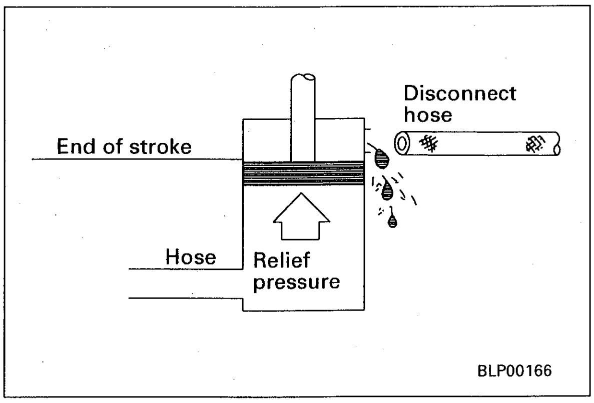
Boom cylinder



Arm cylinder

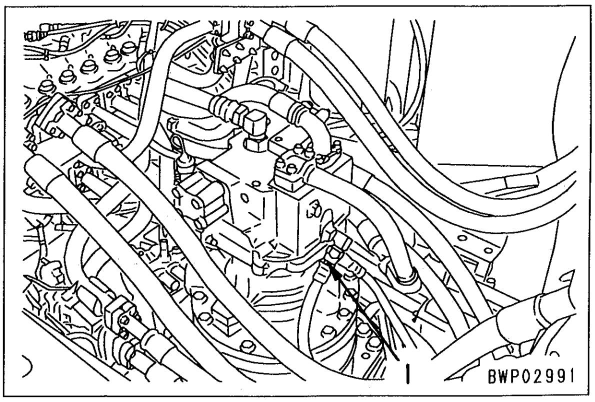


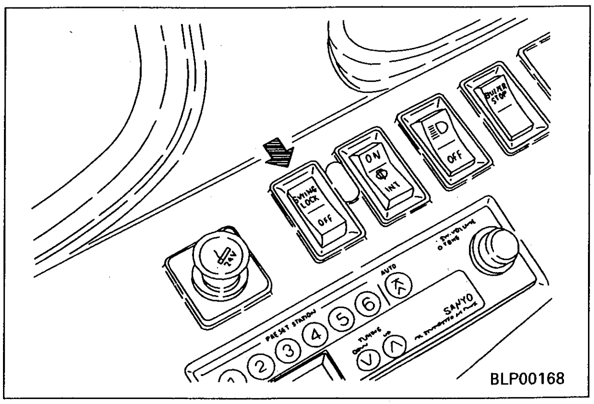




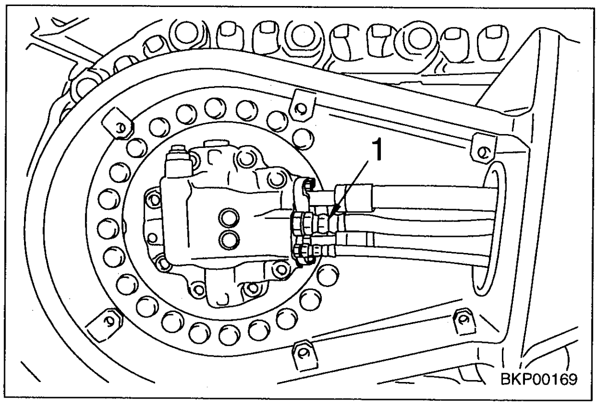
2. Swing motor

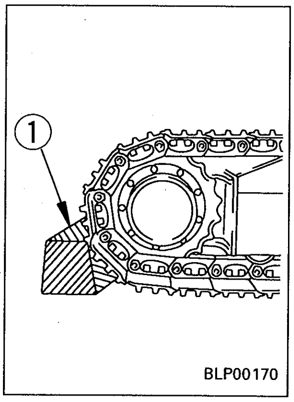
1) Disconnect drain hose (1) from the swing motor, then install a blind plug at the tank end.
2) Turn the swing lock switch ON.
3) Start the engine and operate the swing relief with the engine at full throttle.
4) Continue this condition for 30 seconds, then measure the oil leakage for the next one minute.
   ★ After measuring, swing 180° and measure again.

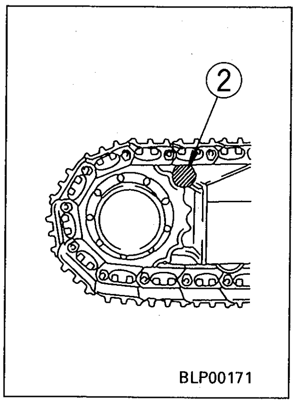




3. **Travel motor**
   1) Disconnect drain hose (1) from the travel motor, then fit a blind plug at the hose end.
   2) Fit block ① under the track shoe grouser, or fit block ② between the sprocket and frame to lock the track.
   3) Start the engine and operate the travel relief with the engine at full throttle.
      ⚠ When measuring the oil leakage from the travel motor, mistaken operation of the control lever may lead to a serious accident, so always use signals and check when carrying out this operation.
   4) Continue this condition for 30 seconds, then measure the oil leakage for the next one minute.
      ★ When measuring, move the motor slightly (to change the position between the valve plate and cylinder, and piston and cylinder), and measure several times.







RELEASING REMAINING PRESSURE IN HYDRAULIC CIRCUIT

★ If the piping between the hydraulic cylinder and the control valve is to be disconnected, release the remaining pressure from the circuit as follows.
The travel circuit is an open circuit, so there is no remaining pressure. It is enough to remove the oil filler cap.

1. Loosen the oil filler cap slowly to release the pressure inside the tank.

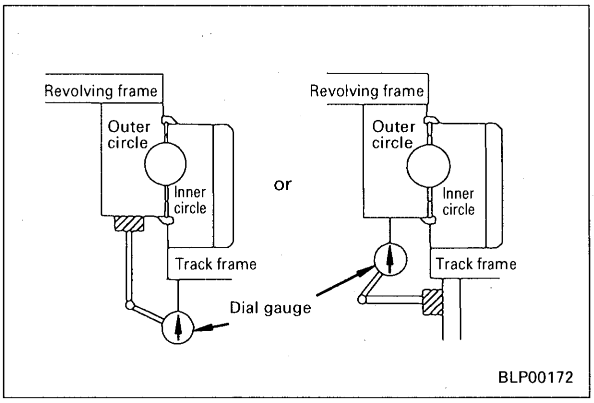
2. Operate the control levers.
   ★ When the levers are operated 2 – 3 times, the pressure stored in the accumulator is removed.

3. Start the engine, run at low idling for approx. 5 minutes, then stop the engine and operate the control levers.
   ★ Repeat the above operation 2 – 3 times to release all the remaining pressure.

TESTING CLEARANCE OF SWING CIRCLE BEARING

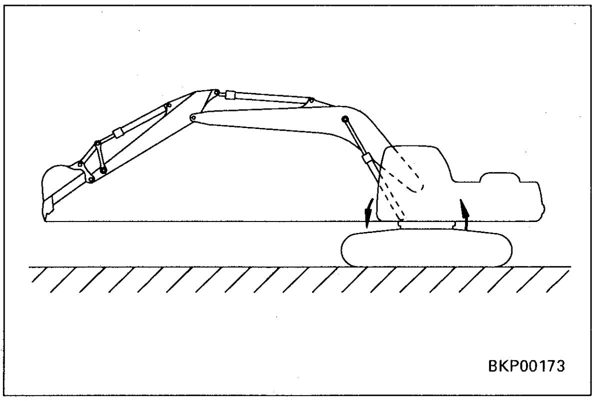
Method of testing clearance of swing circle bearing when mounted on machine

1. Fix a magnet-type dial gauge to the outer circle (or inner circle) of the swing circle, and put the tip of the probe in contact with the inner circle (or outer circle).
   Set the dial gauge at the front or rear.



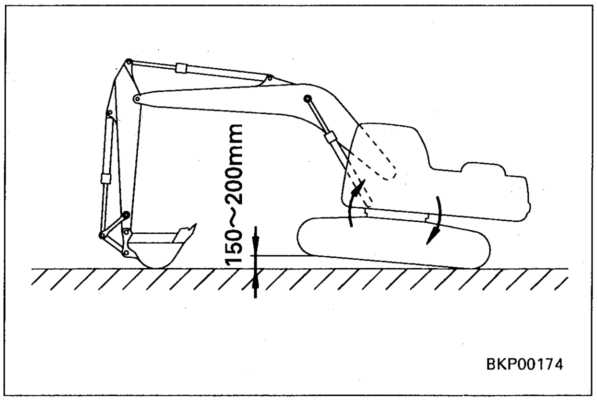
2. Extend the work equipment to the maximum reach, and set the tip of the bucket to the same height as the bottom of the revolving frame.
   When this is done, the upper structure will tilt forward, so the front will go down and the rear will rise.

3. Set the dial gauge to the zero point.



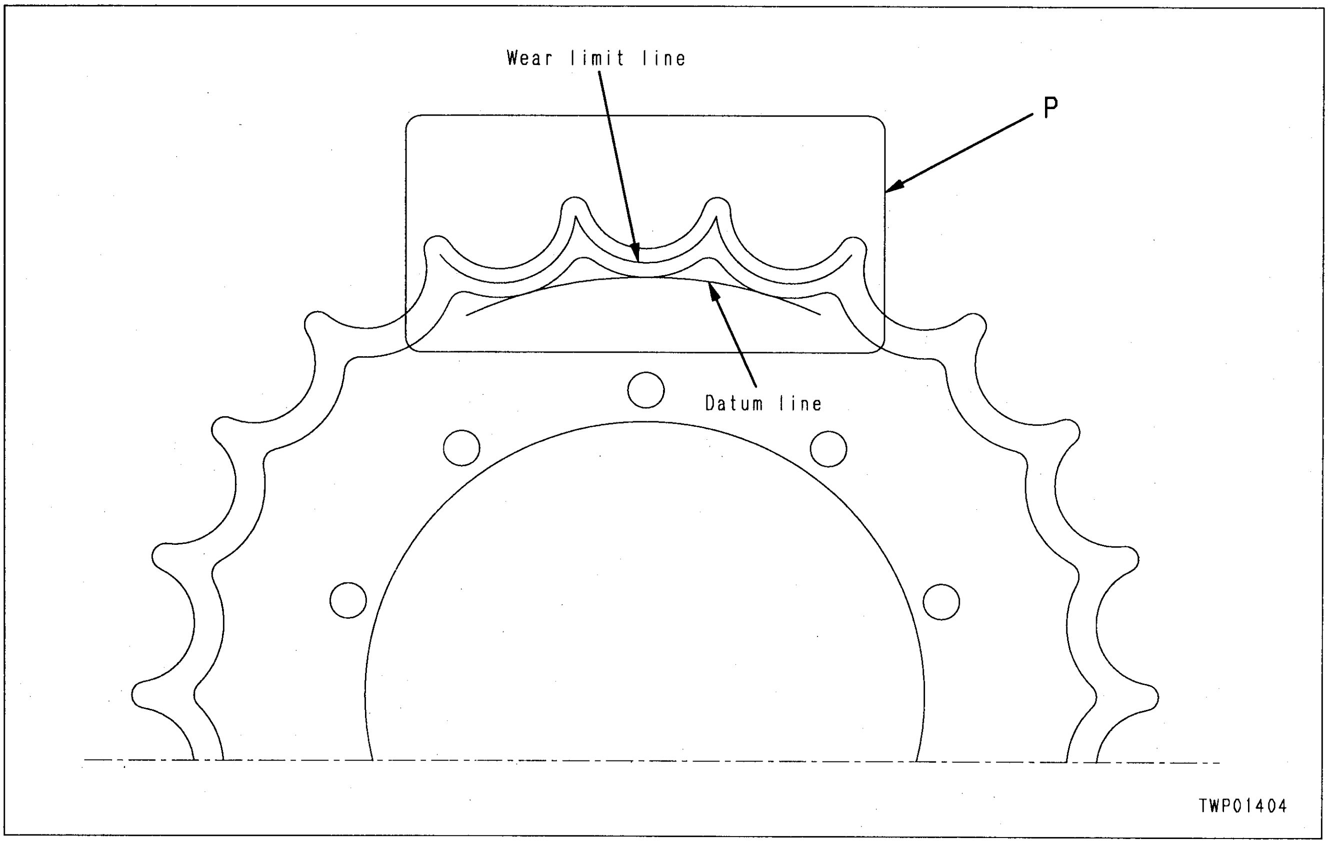
4. Set the arm more or less at right angles to the ground surface, then lower the boom until the front of the machine comes off the ground.
   When this is done, the upper structure will tilt back, so the front will rise and the rear will go down.

5. Read the value on the dial gauge at this point.
   The value on the dial gauge is the clearance of the swing circle bearing.
   ⚠ When carrying out the measurement, do not put your hand or feet under the undercarriage.



6. Return to the condition in Step 2, and check that the dial gauge has returned to the zero point. If it has not returned to the zero point, repeat Steps 3 to 5.

TESTING WEAR OF SPROCKET



1. Remove the track shoe assembly.
   ★ For details, see TESTING AND ADJUSTING, REMOVAL OF TRACK SHOE ASSEMBLY.

2. Align wear gauge **P** with the sprocket.
   ★ Align the datum line, then align the sprocket wave pattern and wear gauge wave pattern.

3. Judge the wear of the sprocket.
   ★ If the sprocket wave pattern is above the wear limit line, it is possible to use the sprocket as it is.
   ★ If the sprocket wave pattern has reached the wear limit line, replace the sprocket with a new part.

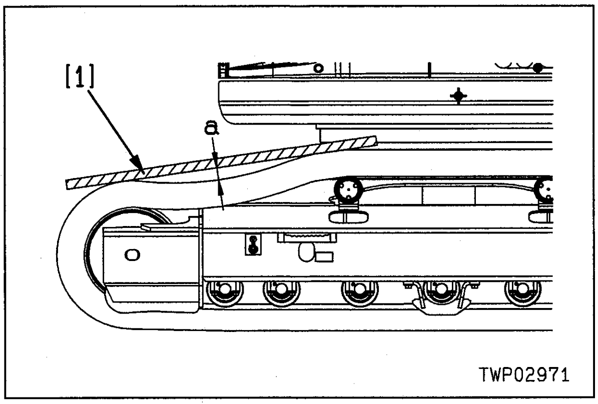
TESTING AND ADJUSTING TRACK SHOE TENSION

TESTING

1. Travel the machine forward by the length of track on ground, keeping the engine at low idling, and stop the machine slowly.

2. Place straight bar [1] on the track shoe between the idler and the 1st carrier roller.
   ★ L beam is recommended for bar [1], because of its deflection-free nature.

3. Measure max. clearance **a** between bar [1] and the track shoe.
   - Max. standard clearance **a**: 10 – 30 mm



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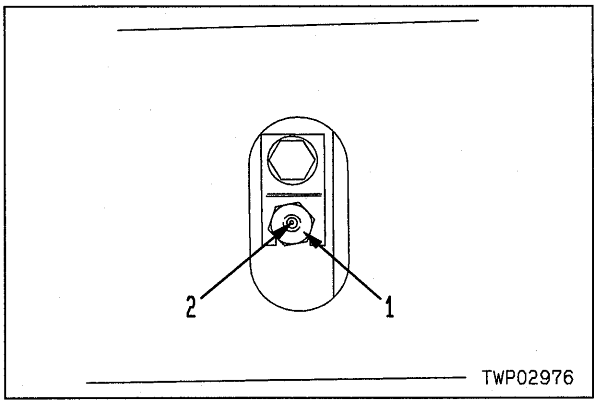
ADJUSTING

★ If the track shoe tension is not proper, adjust it in the following manner.

1 . **When the tension is too strong**
Discharge grease by loosening valve (1).
⚠ Do not loosen valve (1) by more than one turn, because grease will spurt due to its internal high pressure.

2 . **When the tension is too weak**
Add grease through grease fitting (2).
★ If the normal track shoe tension is not restored even after greasing, move the machine slowly back and forth.



TWP02976

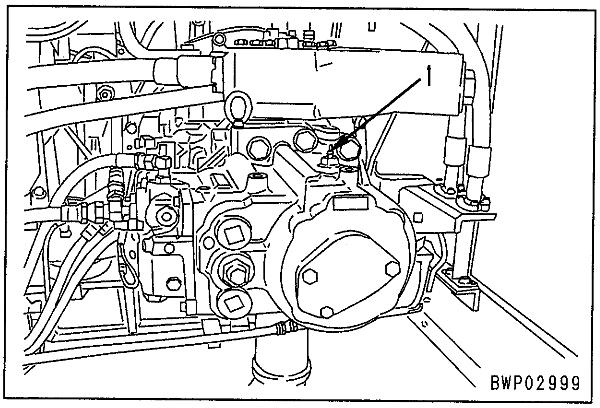
BLEEDING AIR

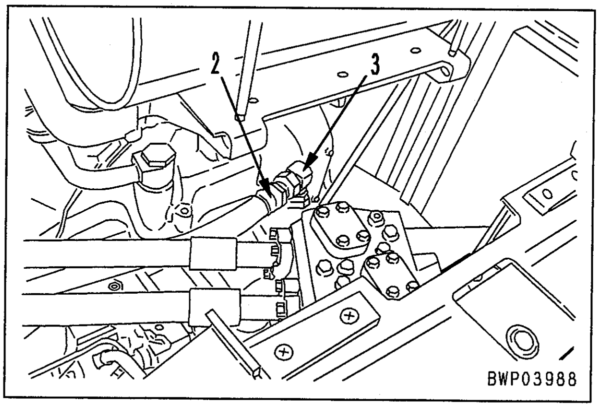
Order for operations and procedure for bleeding air

Air bleeding item / Nature of work	Air bleeding procedure					
	1	2	3	4	5	6
	Bleeding air from pump	Start engine	Bleeding air from cylinder	Bleeding air from swing motor	Bleeding air from travel motor	Start operations
• Change hydraulic oil • Clean strainer	○	→ ○	→ ○	→ ○ (note)	→ ○ (note)	→ ○
• Replace return filter element		○	→	→	→	→ ○
• Replace, repair pump • Remove suction piping	○	→ ○	→ ○	→	→	→ ○
• Replace, repair control valve		○	→ ○	→	→	→ ○
• Replace cylinder • Remove cylinder piping		○	→ ○	→	→	→ ○
• Reoplace swing motor • Remove swing motor piping		○	→	→ ○	→	→ ○
• Replace travel motor, swivel • Remove travel motor, swivel piping		○	→	→	→ ○	→ ○

Note: Bleed the air from the swing and travel motors only when the oil inside the motor case has been drained.

1. **Bleeding air from pump**
   1) Loosen air bleed plug (1), and check that oil oozes out from the plug.
   2) When oil oozes out, tighten plug(1).
      kgm Air bleed plug:
      7.8 – 9.8 Nm {0.8 – 1.0 kgm}
   ★ If no oil oozes out from the air bleed plug:
   3) Leave plug (1) loosened and remove drain hose (2) and elbow (3).
   4) Pour in oil through the elbow mount hole until oil oozes out from plug (1).
   5) Fit elbow (3) and install drain hose (2).
   6) Tighten air bleed plug (1).
      kgm Air bleed plug:
      7.8 – 9.8 Nm {0.8 – 1.0 kgm}
   ★ Precautions when starting the engine
   After completing the above procedure and starting the engine, run the engine at low idling for 10 minutes.
   ★ If the coolant temperature is low and automatic warming-up is carried out, cancel it by using the fuel control dial after starting the engine.

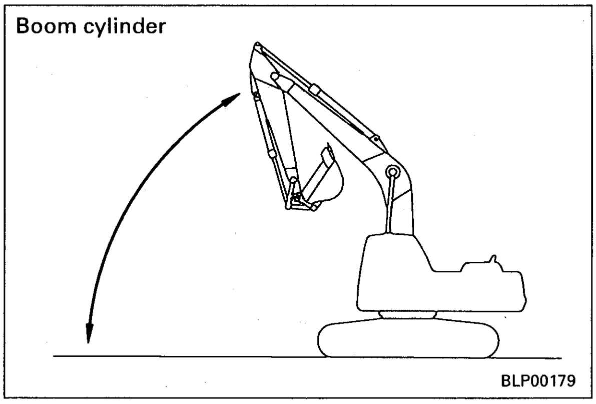




2. Bleeding air from hydraulic cylinders

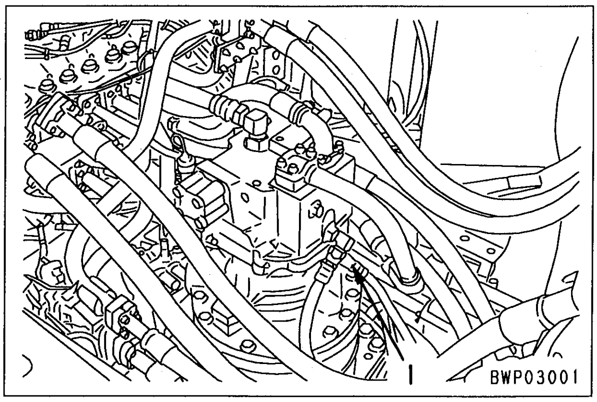
1) Start the engine and run at idling for approx. 5 minutes.
2) Run the engine at low idling, then raise and lower the boom 4 – 5 times in succession.
   ★ Operate the piston rod to approx. 100 mm before the end of its stroke. Do not relieve the circuit under any circumstances.
3) Run the engine at full throttle and repeat Step 2). After that, run the engine at low idling, and operate the piston rod to the end of its stroke to relieve the circuit.
4) Repeat Steps 2) and 3) to bleed the air from the arm and bucket cylinders.

★ When the cylinder has been replaced, bleed the air before connecting the piston rod. Be particularly careful not to operate the cylinder to the end of its stroke when the piston rod has been connected to the LOWER end of the boom cylinder.



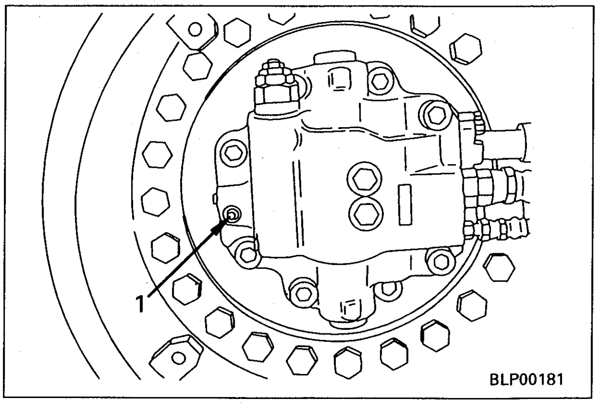
3. Bleeding air from swing motor

1) Inside motor case
   Run the engine at low idling for 5 minutes.
   ★ This operation will bleed the air inside the motor case automatically.
2) Inside brake case
   ★ Normally, the air inside the brake case is bled automatically, but if it feels that the brake is dragging when operating the swing, bleed the air as follows.
   Loosen the sleeve nut of brake hose (1), start the engine, and operate the swing prolix switch ON-OFF repeatedly. When oil oozes out, tighten the sleeve nut.



4. Bleeding air from travel motor

1) Run the engine at low idling, loosen air bleed plug (1), and check that oil oozes out from the plug.
2) When oil oozes out, tighten air bleed plug (1) again.
   kgm Air bleed plug:
   7.84 – 9.8 Nm {0.8 – 1.0 kgm}



TROUBLESHOOTING

POINTS TO REMEMBER WHEN TROUBLESHOOTING

⚠ Stop the machine in a level place, and check that the safety pin, blocks, and parking brake are securely fitted.

⚠ When carrying out the operation with two or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.

⚠ If the radiator cap is removed when the engine is hot, hot water may spurt out and cause burns, so wait for the engine to cool down before starting troubleshooting.

⚠ Be extremely careful not to touch any hot parts or to get caught in any rotating parts.

⚠ When disconnecting wiring, always disconnect the negative (–) terminal of the battery first.

⚠ When removing the plug or cap from a location which is under pressure from oil, water, or air, always release the internal pressure first. When installing measuring equipment, be sure to connect it properly.

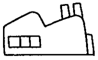
The aim of troubleshooting is to pinpoint the basic cause of the failure, to carry out repairs swiftly, and to prevent reoccurrence of the failure.
When carrying out troubleshooting, and important point is of course to understand the structure and function. However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible causes of the failure that would produce the reported symptoms.

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

   It will also cause a waste of manhours, parts, or oil or grease, and at the same time, will also lose the confidence of the user or operator.
   For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.
2. Points to ask user or operator
   1) Have any other problems occurred apart from the problem that has been reported?
   2) Was there anything strange about the machine before the failure occurred?
   3) Did the failure occur suddenly, or were there problems with the machine condition before this?
   4) Under what conditions did the failure occur?
   5) Had any repairs been carried out before the failure?
      When were these repairs carried out?
   6) Has the same kind of failure occurred before?
3. Check before troubleshooting
   1) Check the oil level
   2) Check for any external leakage of oil from the piping or hydraulic equipment.
   3) Check the travel of the control levers.
   4) Check the stroke of the control valve spool.
   5) Other maintenance items can be checked externally, so check any item that is considered to be necessary.
4. Confirming failure
   - Confirm the extent of the failure yourself, and judge whether to handle it as a real failure or as a problem with the method of operation, etc.
     ★ When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.
5. Troubleshooting
   - Use the results of the investigation and inspection in Items 2 – 4 to narrow down the causes of failure, then use the troubleshooting flowchart to locate the position of the failure exactly.
     ★ The basic procedure for troubleshooting is as follows.
       1) Start from the simple points.
       2) Start from the most likely points.
       3) Investigate other related parts or information.
6. Measures to remove root cause of failure
   - Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occur again.
     To prevent this, always investigate why the problem occurred. Then, remove the root cause.

SEQUENCE OF EVENTS IN TROUBLESHOOTING

Office, shop

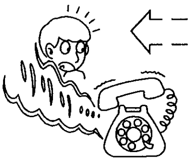


TEW00180

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.

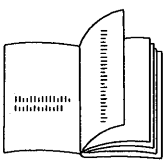


TEW00182

Step 2

Determining probable location of cause

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

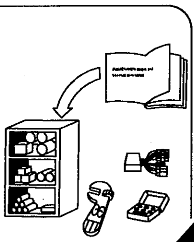


TEP01350

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.



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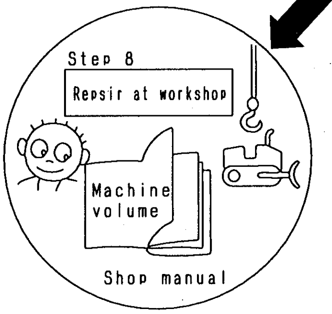
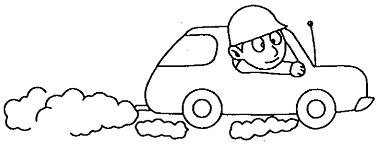


TEP01351

Step 4

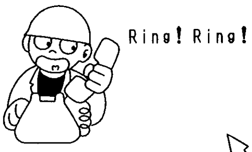
Go to jobsite

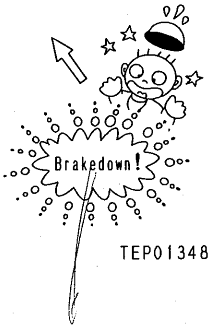


TEW00189

Jobsite

TEW00181





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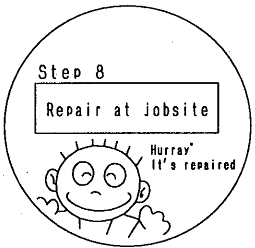
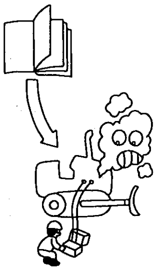


TEP01349

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

Step 6

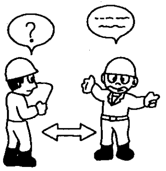
Re-enacting failure

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

Step 5

Ask operator questions to confirm details of failure.

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



TEW00190

POINTS TO REMEMBER WHEN CARRYING OUT MAINTENANCE

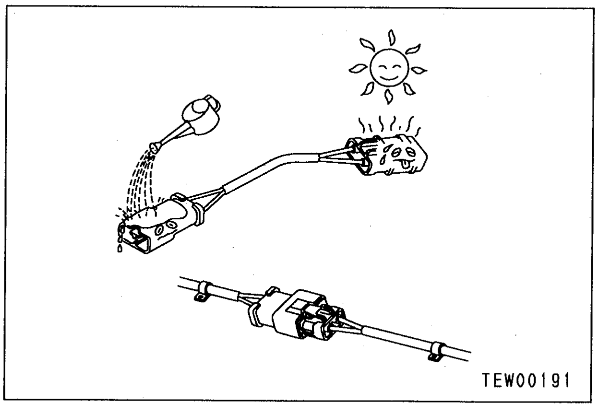
To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct operation, maintenance and inspection, troubleshooting, and repairs must be carried out. This section deals particularly with correct repair procedures for mechatronics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

1. POINTS TO REMEMBER WHEN HANDLING ELECTRIC EQUIPMENT

1) Handling wiring harnesses and connectors

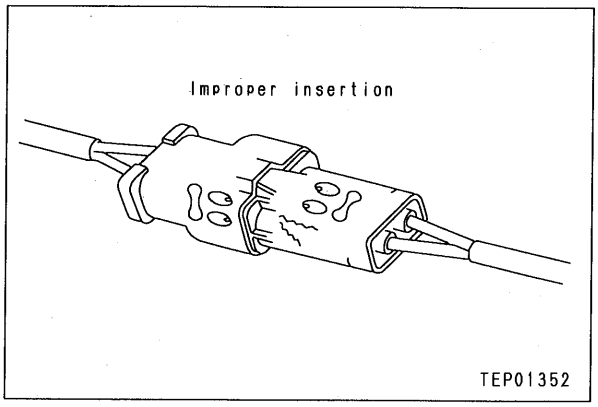
Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protectors or tubes used for protecting the wiring.

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


TEW00191

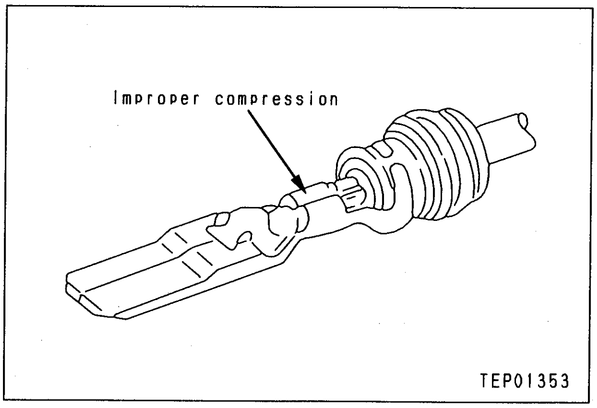
Main failures occurring in wiring harness

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



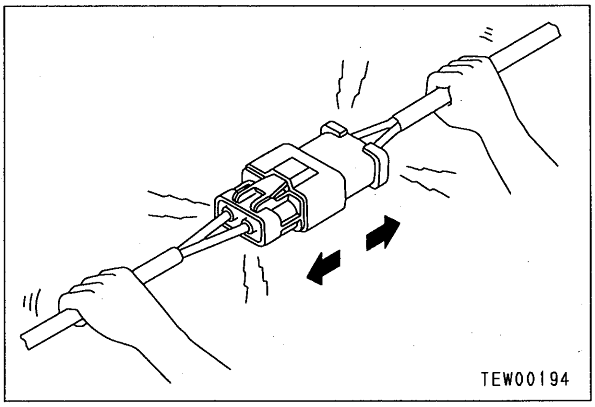
TEP01352

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

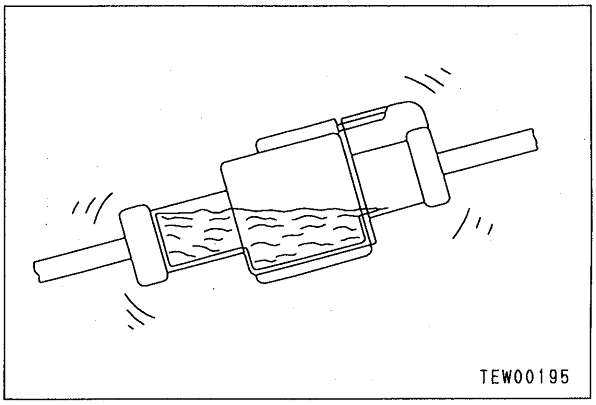


TEP01353

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.

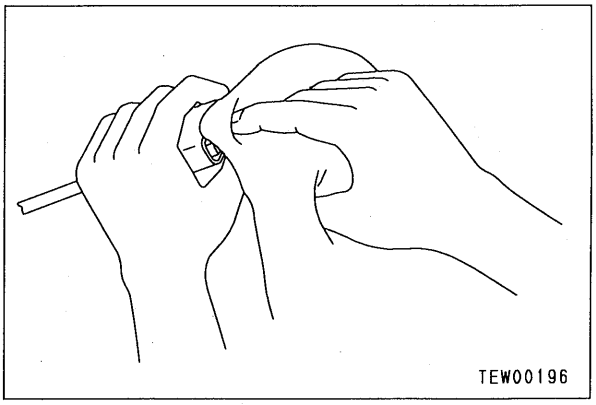


④ High-pressure water entering connector
The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector, depending on the direction of the water jet.
As already said, the connector 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.

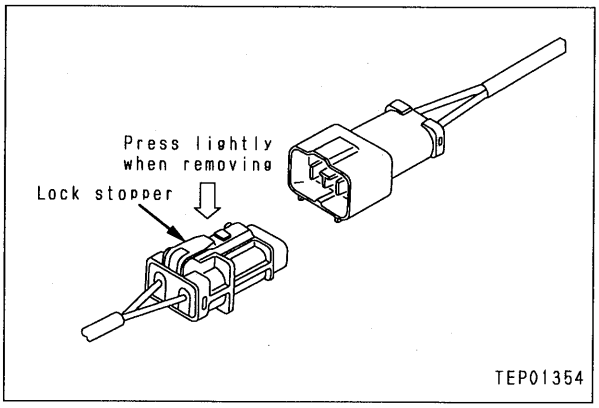
- ★ When wiping the mating portion of the connector, be careful not to use excessive force or deform the pins.
- ★ If there is oil or water in the compressed air, the contacts will become even dirtier, so remove the oil and water from the compressed air completely before cleaning with compressed air.



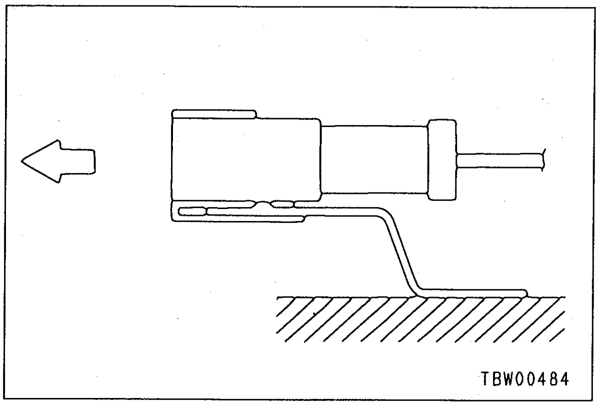
2) Removing, installing, and drying connectors and wiring harnesses

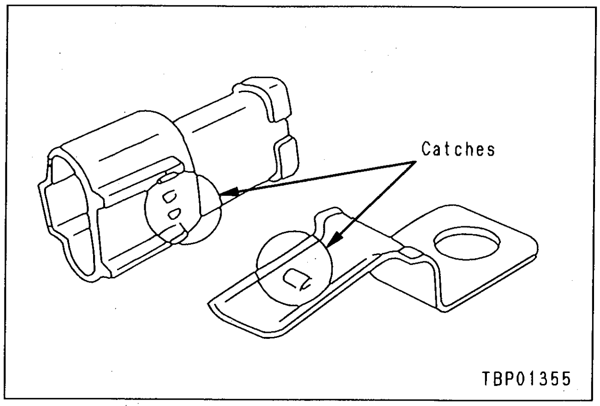
- **Disconnecting connectors**

  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.

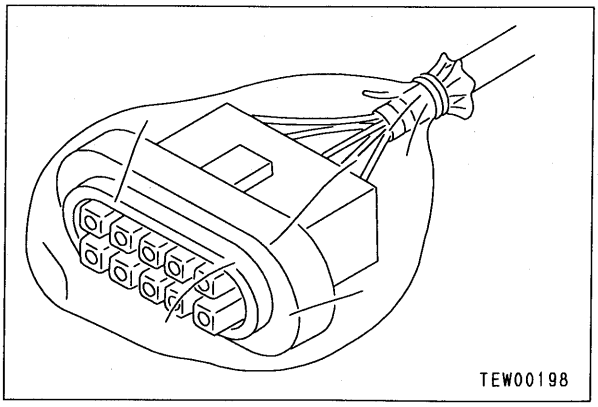


  ② When removing from clips
  When removing a connector from a clip, pull the connector in a parallel direction to the clip.
  ★ If the connector is twisted up and down or to the left or right, the housing may break.



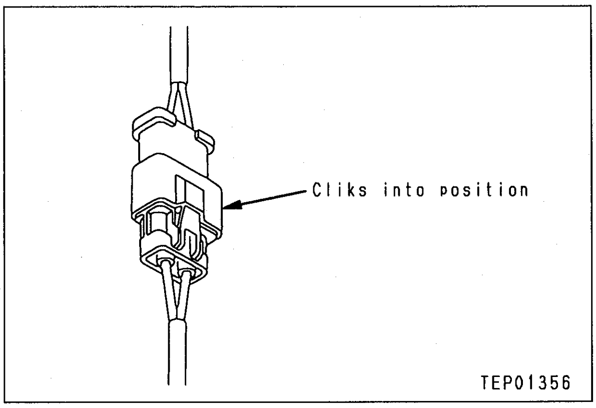


  ③ Action to take after removing connectors
  After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.
  ★ If the machine is left disassembled for a long time, it is particularly easy for improper contact to occur, so always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

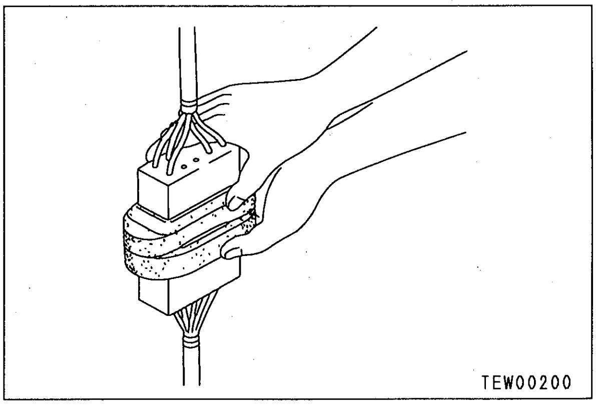


- **Connecting connectors**

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.

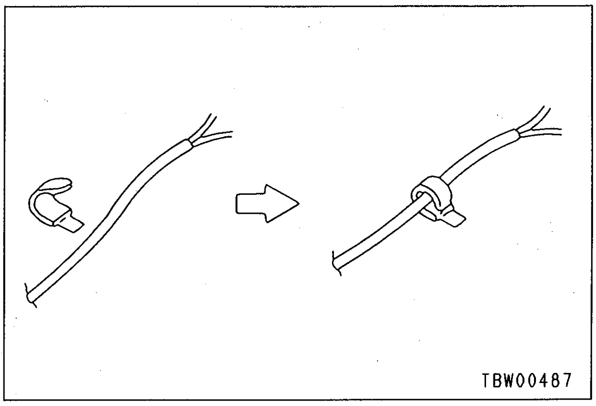


② Fix the connector securely.
Align the position of the connector correctly, then insert it securely.
For connectors with lock stopper, push in the connector until the stopper clicks into position.



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.

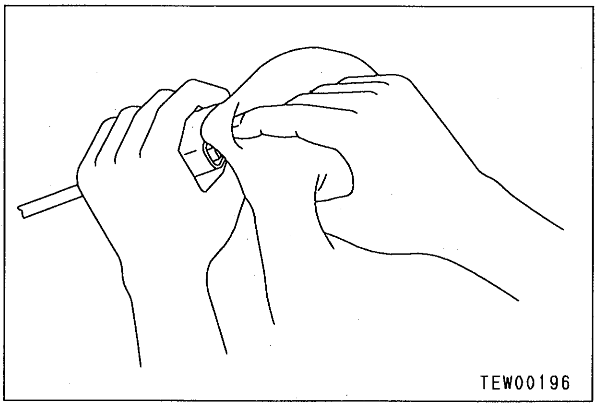
④ If the connector clamp has been removed, be sure to return it to its original position. Check also that there are no loose clamps.



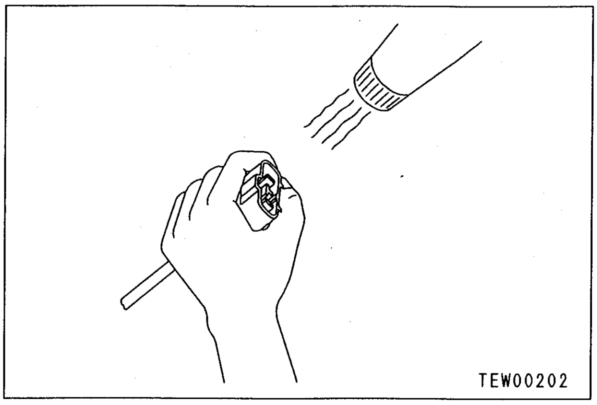
- **Drying wiring harness**
  If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high-pressure water or steam directly on the wiring harness.

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

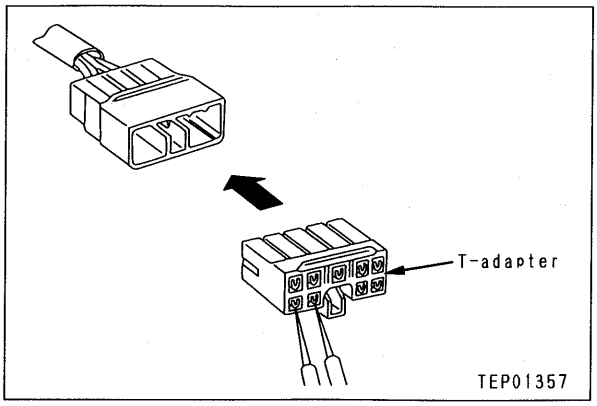
  ① Disconnect the connector and wipe off the water with a dry cloth.
  ★ If the connector is blown dry with compressed air, there is the risk that oil in the air may cause defective contact, so remove all oil and water from the compressed air before blowing with air.



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.



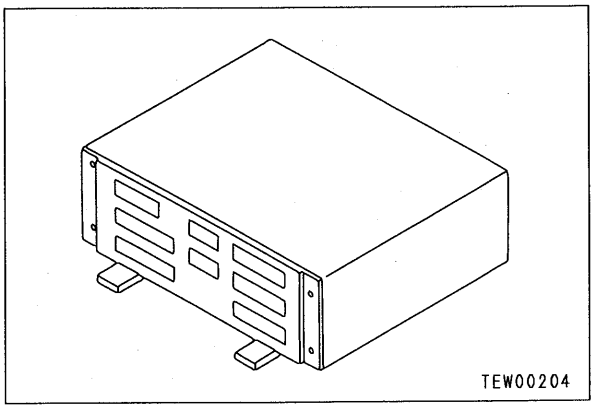
③ Carry out a continuity test on the connector. After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.
★ After completely drying the connector, blow it with contact restorer and reassemble.



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.

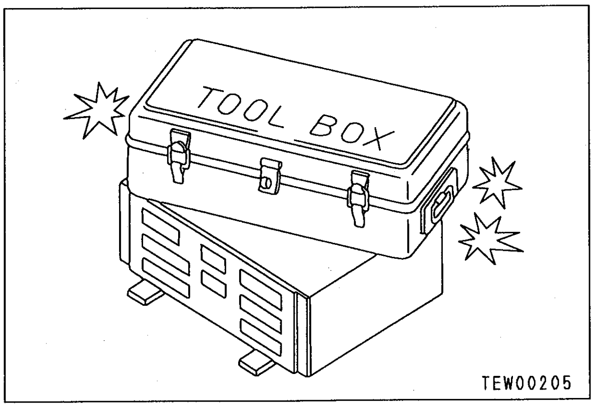
② Do not open the cover of the control box unless necessary.



③ Do not place objects on top of the control box.

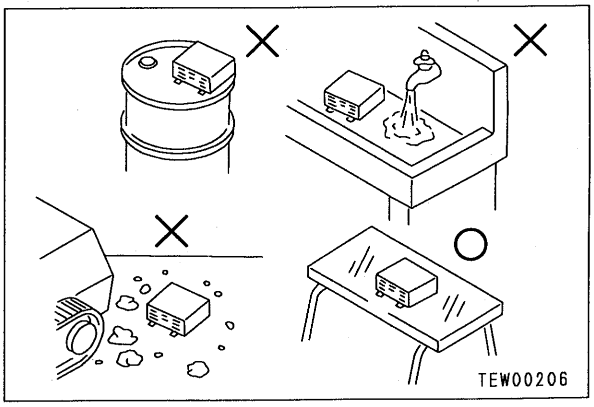
④ Cover the control connectors with tape or a vinyl bag.
Never touch the connector contacts with your hand.

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

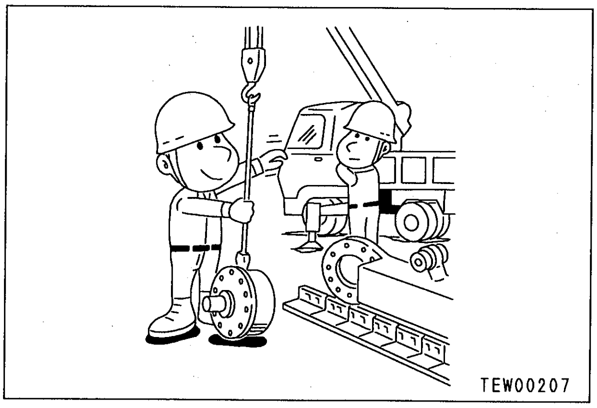
1) Always turn the power OFF before disconnecting or connect connectors.
2) Before carrying out troubleshooting, check that all the related connectors are properly inserted.
   - ★ Disconnect and connect the related connectors several times to check.
3) Always connect any disconnected connectors before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

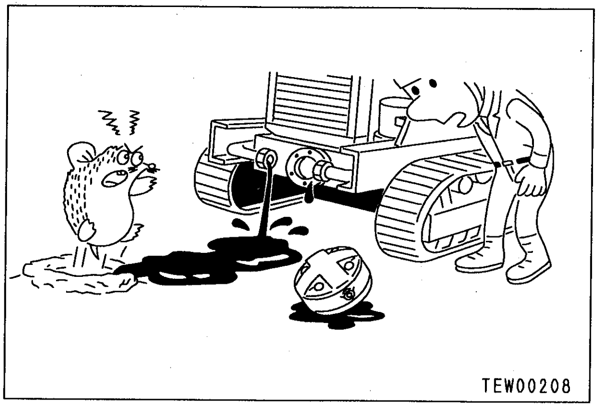
With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

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.

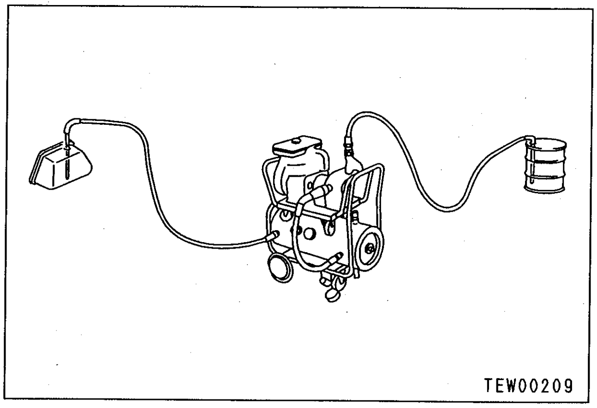
2) **Disassembly and maintenance work in the field**
If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to confirm the performance after repairs, so it is desirable to use unit exchange. Disassembly 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.


TEW00207

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.

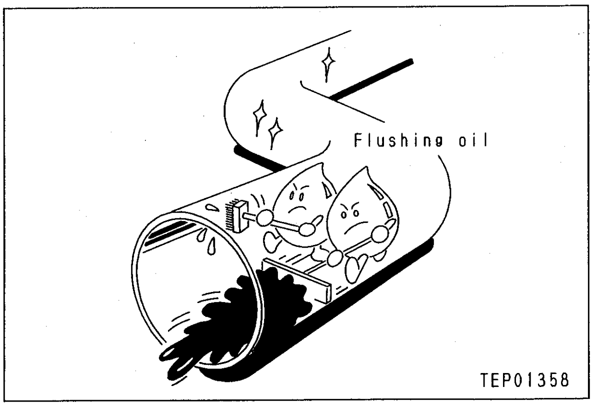

TEW00208

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.


TEW00209

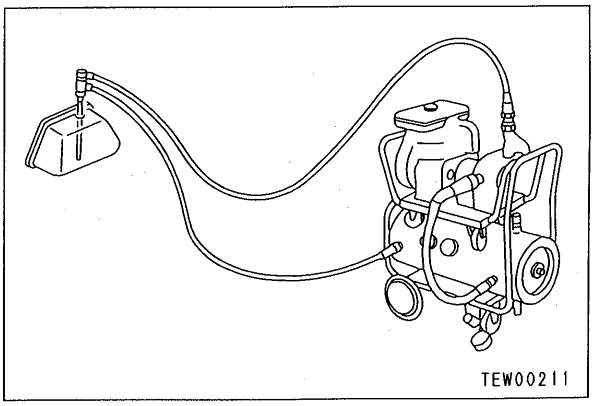
5) **Change hydraulic oil when the temperature is high.**
When hydraulic oil or other oil is warm, it flows easily. In addition, the sludge can also be drained out easily from the circuit together with the oil, so it is best to change the oil when it is still warm. When changing the oil, as much as possible 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.



TEP01358

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.



TEW00211

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 strainer	—	Clean, drain
	5. Check swing machinery oil level	—	Add oil
	6. Check engine oil level (oil pan oil level), type of oil	—	Add oil
	7. Check coolant level	—	Add water
	8. Check dust indicator for clogging	—	Clean or replace
	9. Check hydraulic filter	—	Replace
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 (when switch is turned ON/OFF)	—	Replace

CONNECTOR TYPES AND MOUNTING LOCATIONS

★ The Address column in the table above shows the address in the connector arrangement drawing (2-dimensional drawing).

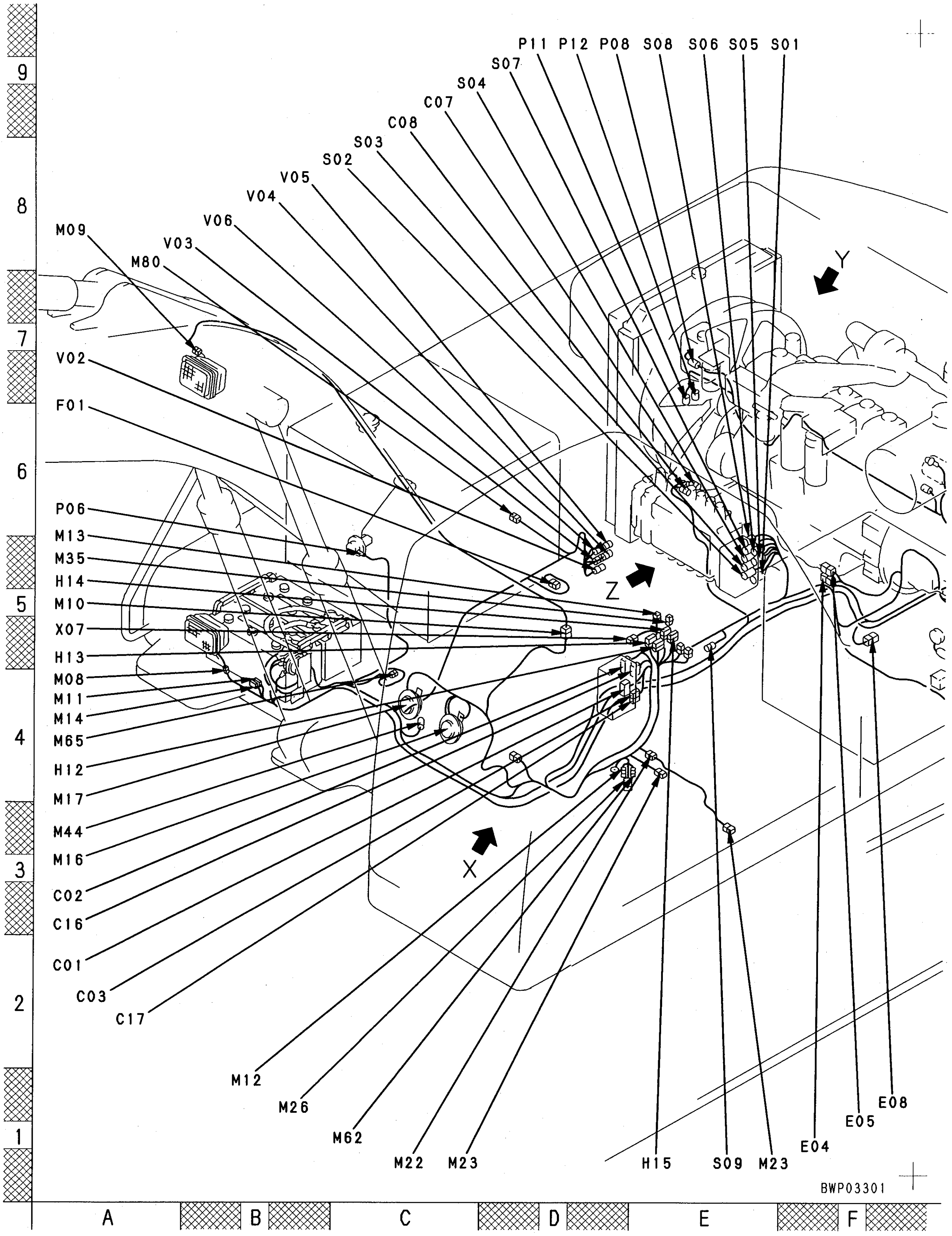
Connector No.	Type	No. of pins	Mounting location	Address
AC1	—	20	Air conditioner (external air system)	O-1
AC2	—	4	Air conditioner (control system)	O-1
C01	MIC	13	Engine throttle, pump controller	A-2
C02	MIC	21	Engine throttle, pump controller	A-3
C03	040	20	Engine throttle, pump controller	A-2
C04	X	2	Rear pump TVC solenoid valve	I-5
C05	S	10	Pump prolix circuit switch	N-1
C06	M	2	TVC prolix resistor	O-1
C07	X	3	Rear pump pressure sensor	C-9
C08	X	3	Front pump pressure sensor	C-9
C09	S	8	Model selection connector	P-2
C10	X	2	LS-EPC solenoid valve	I-5
C13	X	2	Front pump TVC solenoid valve	I-5
C16	MIC	17	Engine throttle, pump controller	A-3
C17	040	16	Engine throttle, pump controller	A-2
D01	KES1	2	Window washer circuit	—
D02	KES1	2	Active (swing) solenoid curcuit	—
D03	KES1	2	Active (boom) solenoid curcuit	—
D04	KES1	2	Pump merge/divider solenoid circuit	—
D05	KES1	2	Swing holding brake solenoid circuit	—
D06	KES1	2	Machine push-up solenoid circuit	—
D07	KES1	2	Travel speed selector solenoid circuit	—
D08	KES1	2	Heater circuit	—
D11	KES1	2	Alarm buzzer circuit	—
D13	KES1	2	Battery relay drive circuit	—
D14	KES1	2	Diode	—
D17	KES1	2	Diode	—
D26	KES1	2	Swing holding brake solenoid	—
E04	X	3	Governor potentiometer	F-1
E05	X	4	Governor motor	F-1
E06	M	3	Fuel control dial	M-4
E07	X	2	Engine speed sensor	L-4
E08	SWP	14	Intermediate connector	F-1 L-1

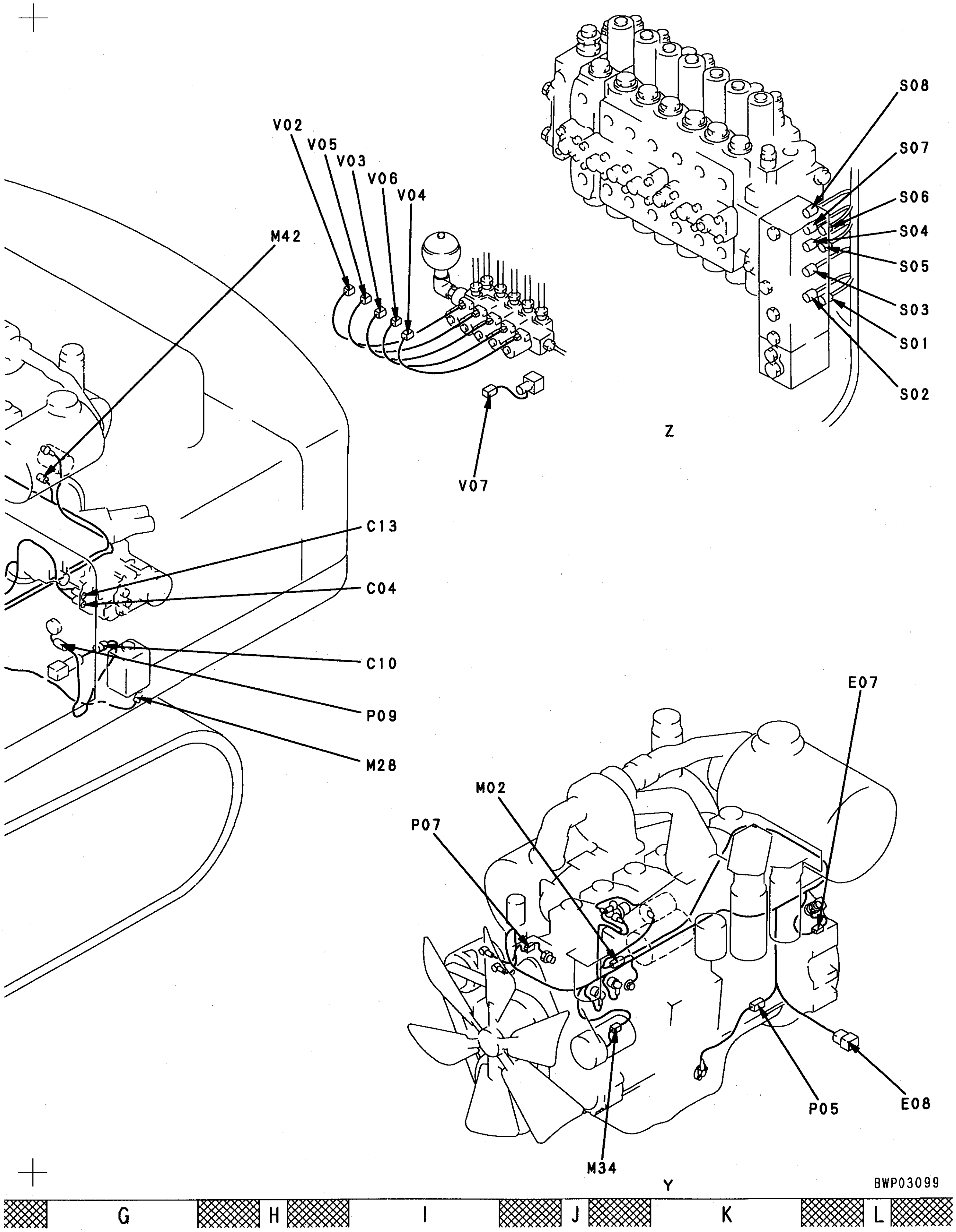
Connector No.	Type	No. of pins	Mounting location	Address
E11	X	2	Electrical intake air heater relay	—
F01	X	2	Travel alarm (option)	A-6
H12	S	16	Intermediate connector	A-4
H13	S	16	Intermediate connector	A-5
H14	M	6	Intermediate connector	A-5
H15	L	2	Intermediate connector	E-1
M02	X	2	Starting motor	I-6
M06	M	3	Heater fan switch (option)	—
M07	M	2	Light switch	N-4
M08	M	1	Right front light	A-4
M09	M	1	Working lamp (boom)	A-8
M10	M	1	Intermediate connector	A-4
M11	L	2	Fusible link	A-4
M12	KES1	3	Heater (option)	B-1
M13	KES0	2	Speaker	A-6 P-4
M14	L	2	Fusible link	A-4
M16	—	1	Horn (high tone)	A-3
M17	—	1	Horn (low tone)	A-4
M18	M	4	Wiper, washer switch	N-4
M20	—	—	Cigar lighter	M-4
M21	PA	9	Radio	O-2
M22	M	2	Intermediate connector	C-1 P-7
M23	M	2	L.H. knob switch	E-1 O-6
M23	M	2	Horn switch	C-1 N-5
M26	—	6	Air conditioner	B-1
M28	KES0	2	Window washer motor	I-4
M33	250	3	Power window switch	—
M34	X	1	Electromagnetic clutch for air conditioner compressor	J-1
M35	—	2	Condenser for air conditioner	A-5
M38	M	2	Machine push-up switch	N-5
M40	M	1	Right front light (option)	K-8
M41	M	1	Left front light (option)	K-7
M42	M	1	Rear working lamp	H-8

Connector No.	Type	No. of pins	Mounting location	Address
M44	SWP	6	Intermediate connector for automatic lubrication (option)	A-3
M45	M	3	Network bus	L-1
M46	M	3	For troubleshooting	K-3
M47	040	16	Troubleshooting (with power window)	L-4
M62	X	2	(Blind)	C-1
M65	M	2	Fusible link for automatic lubrication (option)	A-4
M66	—	1	Warning lamp for automatic lubrication	—
M67	—	1	Warning lamp for automatic lubrication	—
M68	SWP	6	Automatic lubrication system (option)	—
M71	—	1	Intermediate connector (room lamp)	K-7
M80	—	2	External air sensor (option)	A-8
P01	040	20	Monitor	L-3
P02	040	16	Monitor	L-3
P03	M	2	Buzzer cancel switch	N-4
P04	M	2	Alarm buzzer	L-3
P05	X	1	Engine oil level sensor	L-1
P06	X	1	Fuel level sensor	A-6
P07	X	2	Engine coolant temperature sensor	I-3
P08	X	2	Radiator water level sensor	D-9
P09	X	1	Hydraulic oil level sensor	I-4
P11	—	1	Air cleaner clogging sensor	D-9
P12	—	1	Air cleaner clogging sensor	D-9
R04	Shinagawa	6	Light relay (with power window)	N-1
R05	Shinagawa	6	Light relay (with power window)	N-1
S01	X	2	Travel pressure switch	E-9 L-7
S02	X	2	Boom RAISE pressure switch	B-8 L-6
S03	X	2	Arm OUT pressure switch	C-8 L-7
S04	X	2	Boom LOWER pressure switch	C-9 L-7
S05	X	2	Arm IN pressure switch	E-9 L-8
S06	X	2	Bucket CURL pressure switch	E-9 L-8
S07	X	2	Bucket DUMP pressure switch	D-9 L-8
S08	X	2	Swing pressure switch	E-9 L-9
S09	X	2	Service pressure switch (option)	E-1
SW1	—	20	Air conditioner control panel	P-2
V02	X	2	LS select solenoid valve	A-7 H-8
V03	X	2	Pump merge/divider solenoid valve	A-8 H-8
V04	X	2	Swing holding brake solenoid valve	B-8 I-8
V05	X	2	Machine push-up solenoid valve	B-8 H-8
V06	X	2	Travel speed selector solenoid valve	B-8 I-8
V07	X	2	Active (swing) solenoid	I-6
W01	KES1	4	Right front lock (option, with power window)	L-9
W02	KES1	4	Left front lock (option, with power window)	P-8
W03	1-pin connector	1	Intermediate connector	N-9
W04	M	6	Wiper motor	K-2 K-6
W05	KES1	2	Power window motor (with power window)	—
W06	070	14	Intermediate connector (with power window)	L-3 N-6
W07	KES1	2	Front limit switch (with power window)	—
W08	070	18	Wiper motor controller	N-1
W09	070	14	Wiper motor controller (with power window)	O-1
W10	M	4	Intermediate connector (with power window)	N-1
W12	—	3	Power window switch	—
X01	MIC	21	Intermediate connector	O-5
X05	M	4	Swing lock switch	M-4
X07	MIC	17	Intermediate connector	A-5 P-3

CONNECTOR ARRANGEMENT DIAGRAM

★ For details of this page, see Section 90.

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V05
V03
V06
V04
M42
S08
S07
S06
S04
S05
S03
S01
S02
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V07
C13
C04
C10
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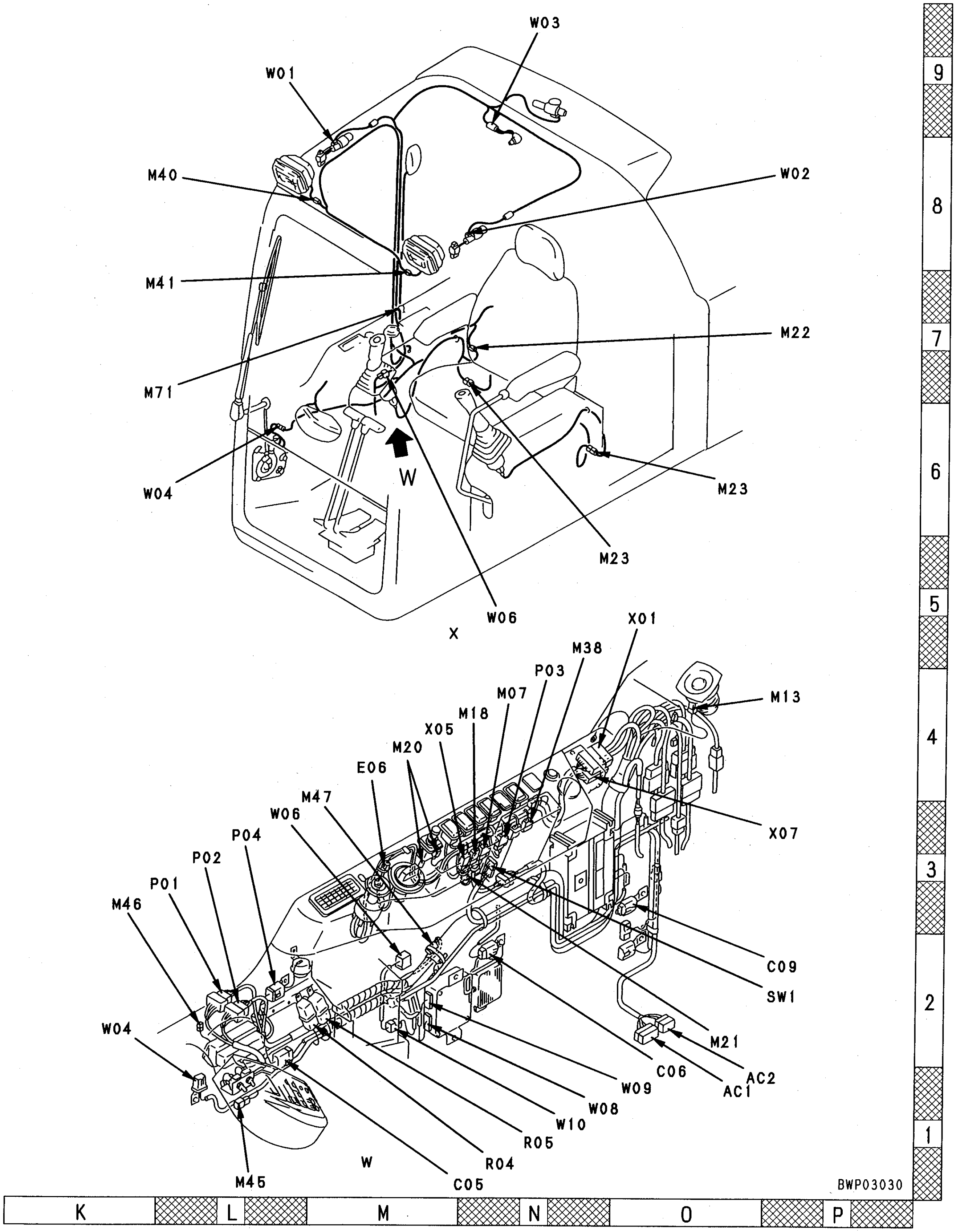
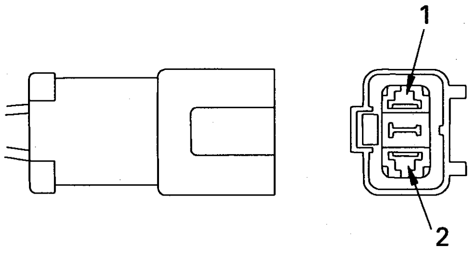
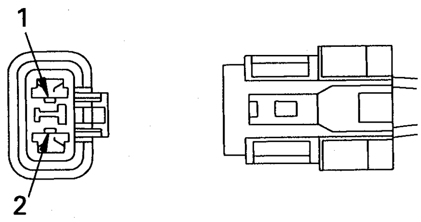
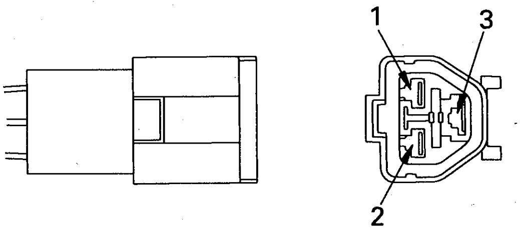
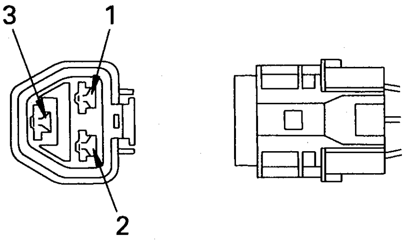
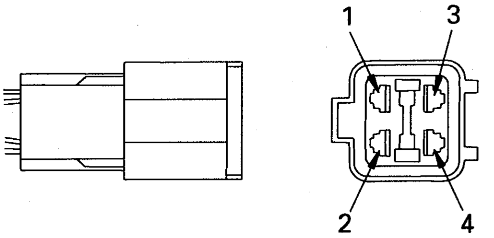
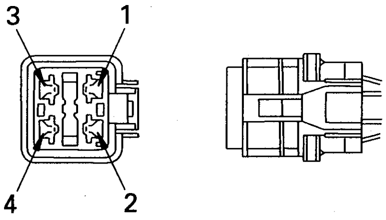
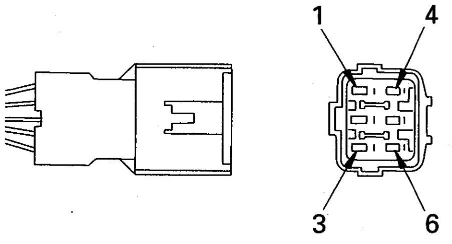
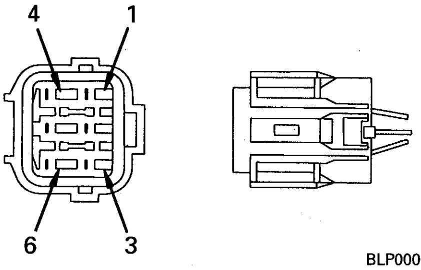
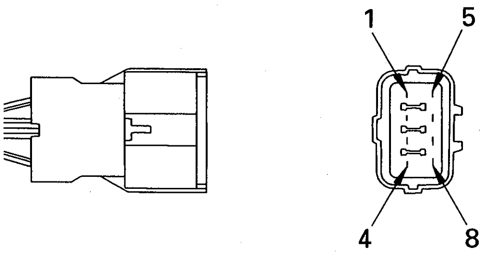
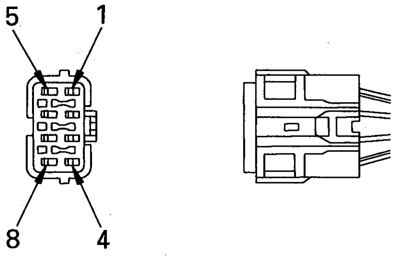
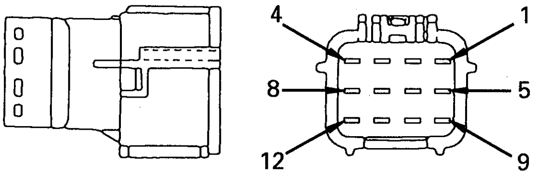
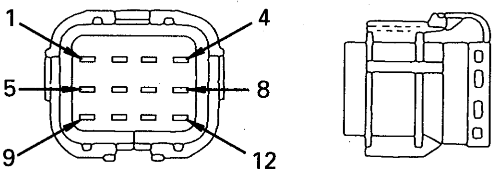
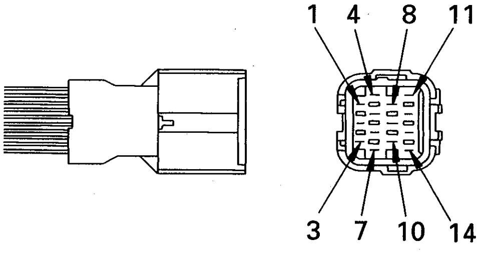
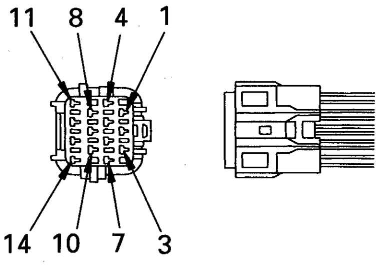
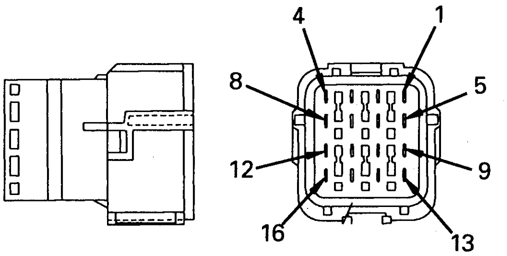
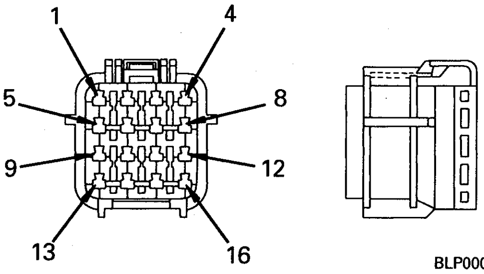
G
H
I
J
K
L

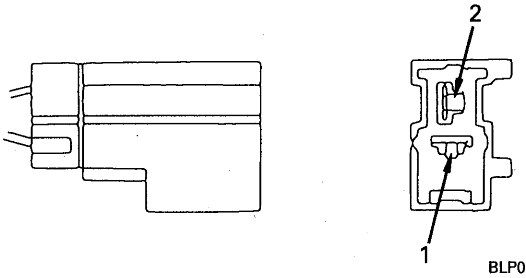
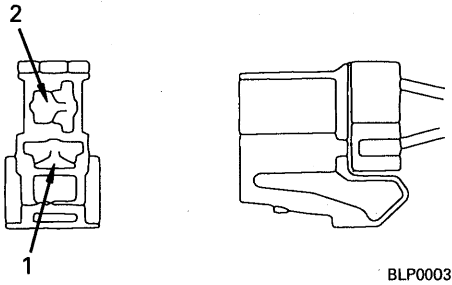
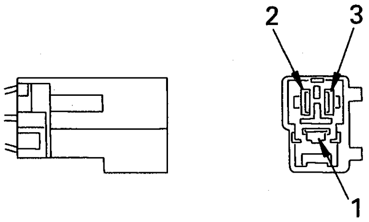
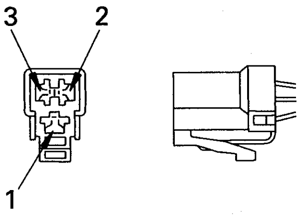
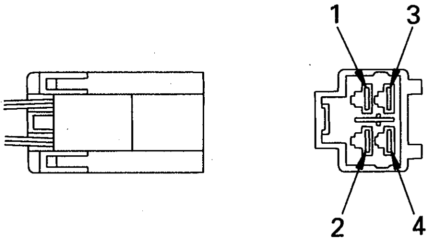
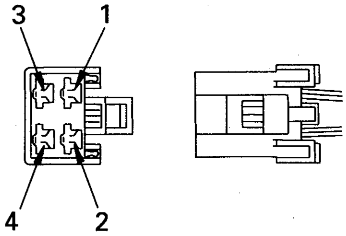
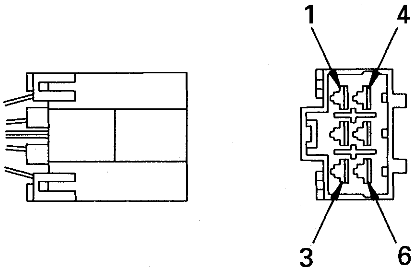
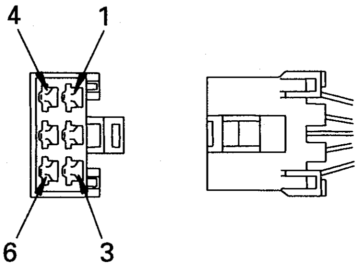
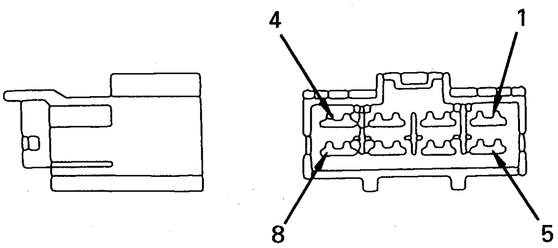
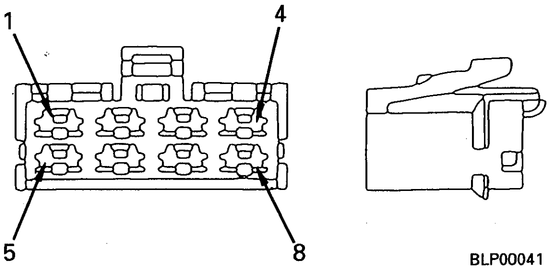

W03
W01
M40
W02
M41
M22
M71
W
W04
M23
M23
W06
X
X01
M38
P03
M13
M07
M18
X05
M20
E06
M47
W06
X07
P04
P02
P01
M46
C09
SW1
W04
M21
AC2
C06
AC1
W09
W08
W10
R05
R04
W
M45
C05
BWP03030
K
L
M
N
O
P
9
8
7
6
5
4
3
2
1

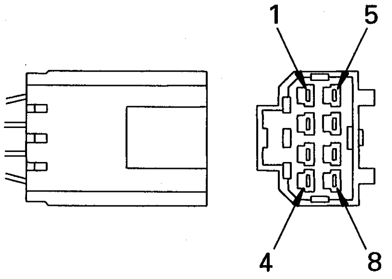
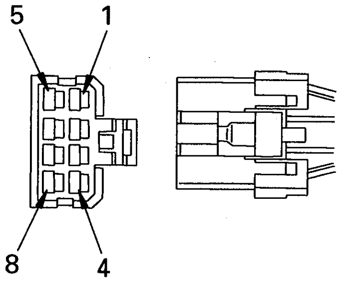
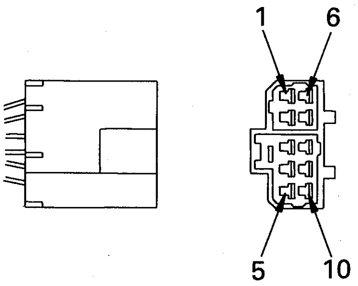
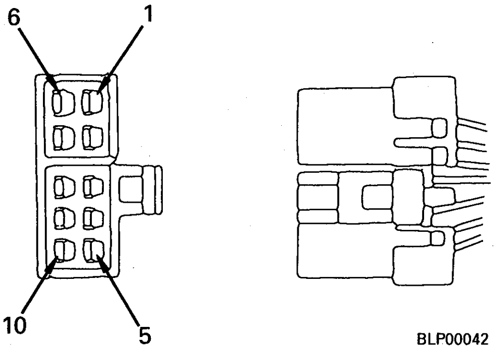
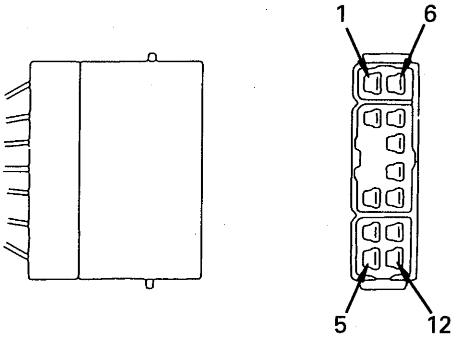
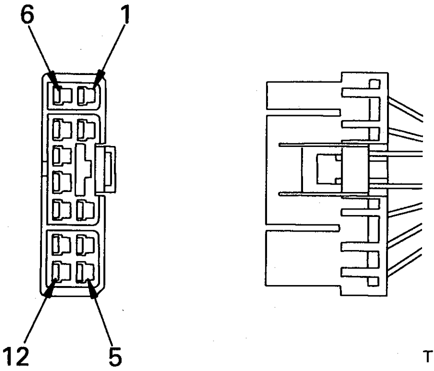
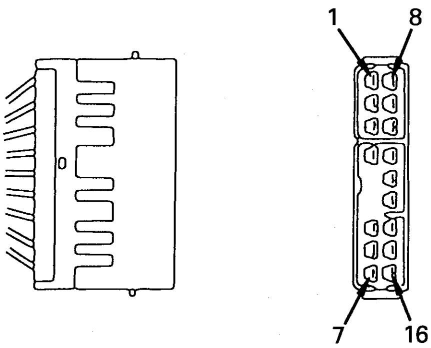
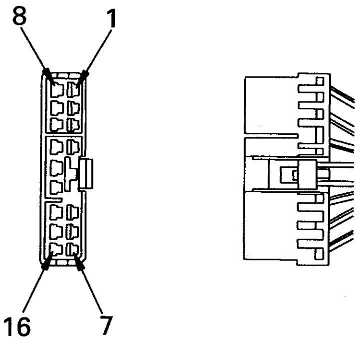
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

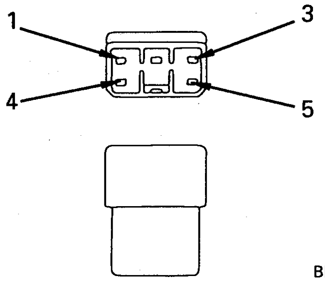
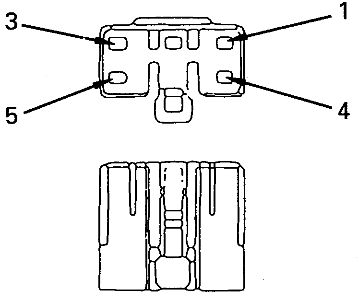
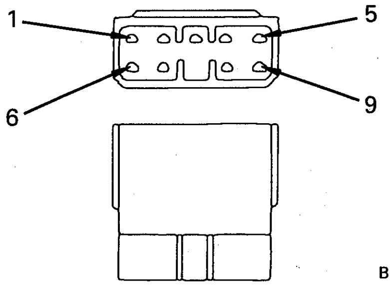
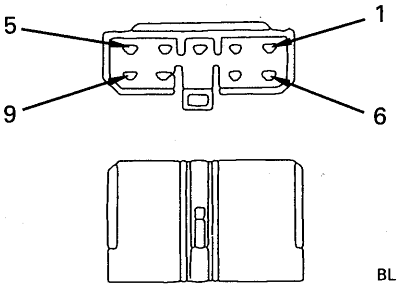
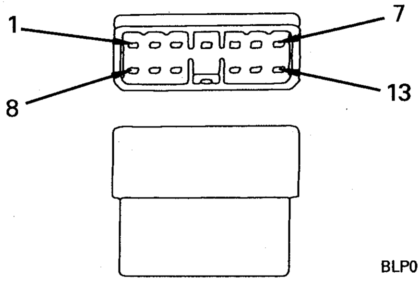
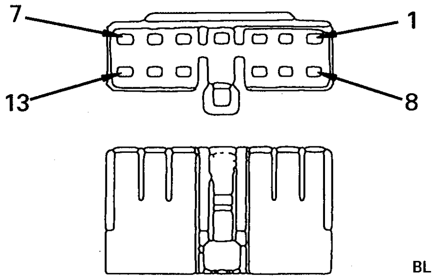
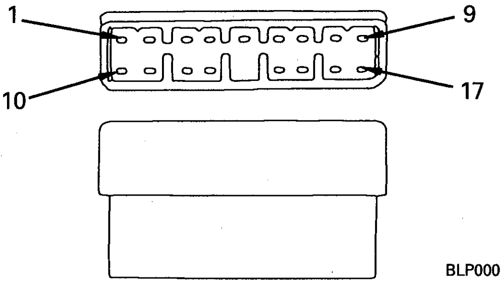
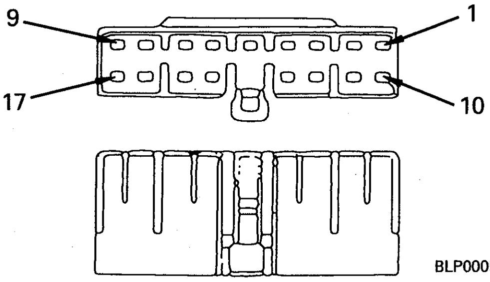
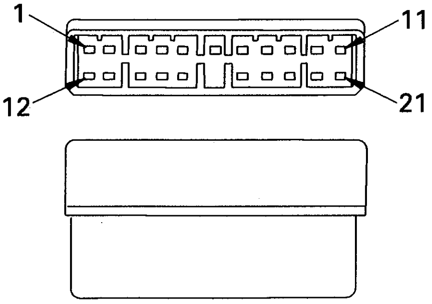
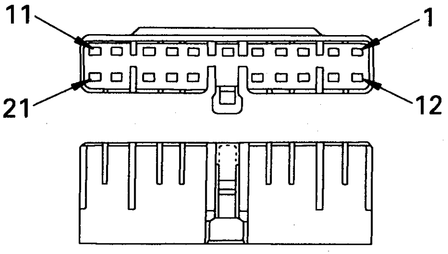
★ The terms male and female refer to the pins, while the terms male housing and female housing refer to the mating portion of the housing.

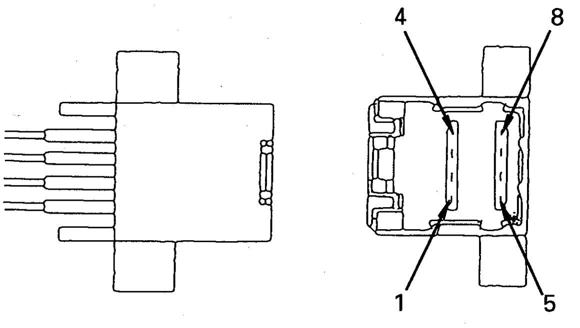
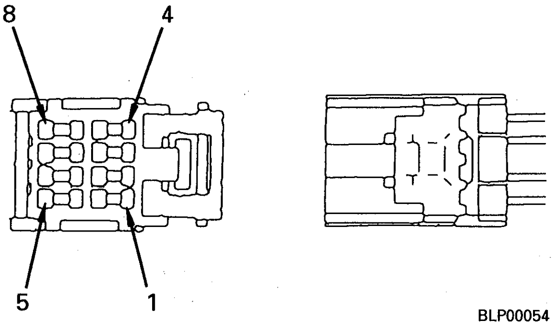
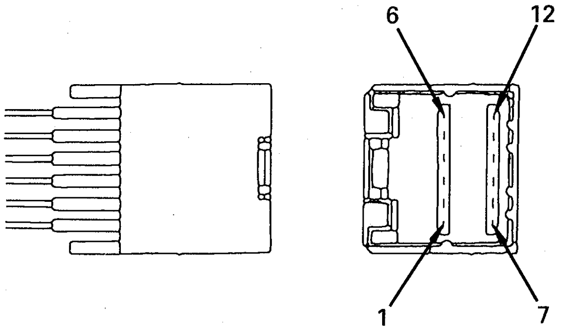
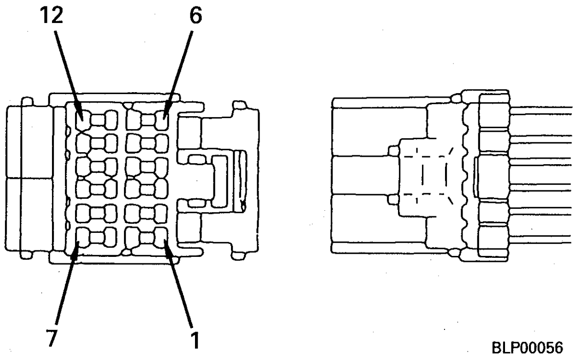
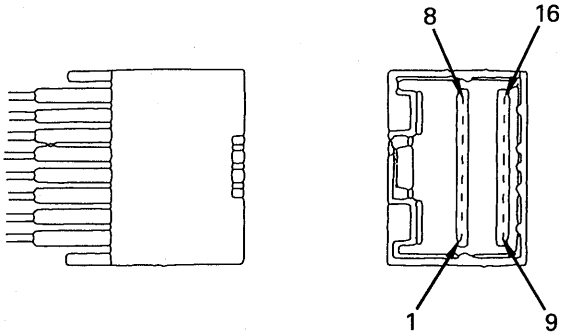
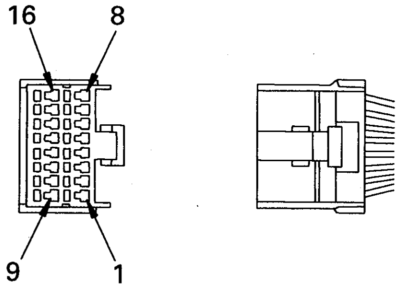
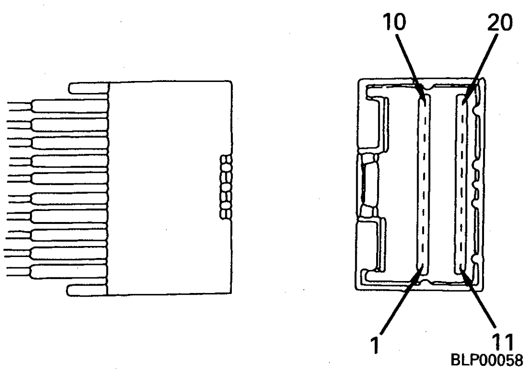
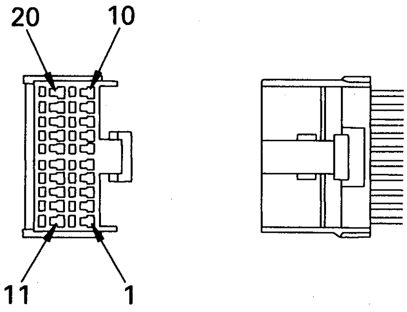
No. of pins	X type connector	
	Male (female housing)	Female (male housing)
2	 TEW00221	 TEW00222
3	 TEW00223	 TEW00224
4	 TEW00225	 TEW00226

No. of pins	SWP type connector	
	Male (female housing)	Female (male housing)
6	 TEW00235	 BLP00033
8	 TEW00237	 TEW00238
12	 BLP00034	 BLP00035
14	 TEW00239	 TEW00240
16	 BLP00036	 BLP00037

No. of pins	M type connector	
	Male (female housing)	Female (male housing)
2		
3		
4		
6		
8		

No. of pins	S type connector	
	Male (female housing)	Female (male housing)
8	 TEW00249	 TEW00250
10	 TEW00251	 BLP00042
12	 BLP00043	 TEW00254
16	 BLP00044	 TEW00256

No. of pins	MIC connector	
	Male (female housing)	Female (male housing)
5	 BLP00045	 BLP00046
9	 BLP00047	 BLP00048
13	 BLP00049	 BLP00050
17	 BLP00051	 BLP00052
21	 TEW00259	 TEW00260

No. of pins	AMP040 type connector	
	Male (female housing)	Female (male housing)
8	 BLP00053	 BLP00054
12	 BLP00055	 BLP00056
16	 BLP00057	 TEW00232
20	 BLP00058	 TEW00234

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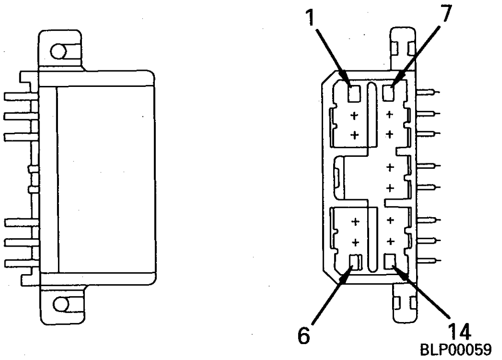

BLP00059
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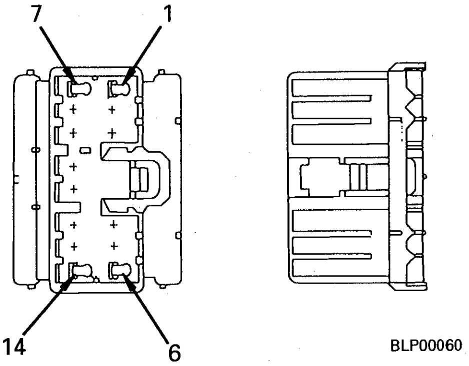

BLP00060
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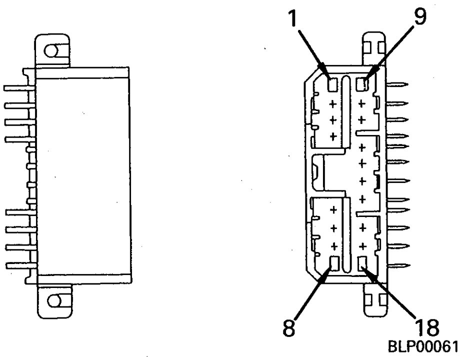

BLP00061
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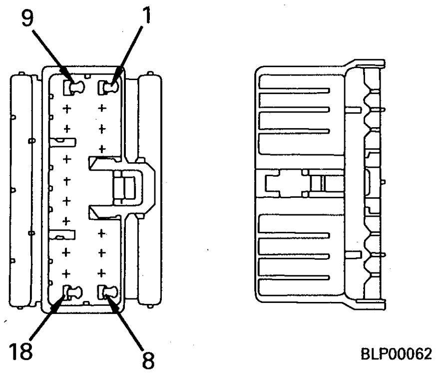

BLP00062
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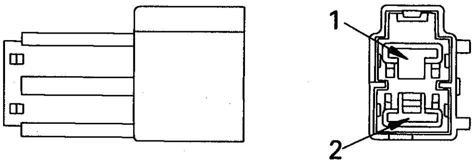
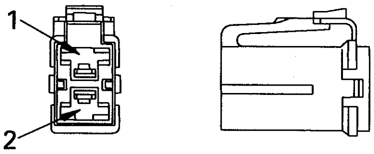
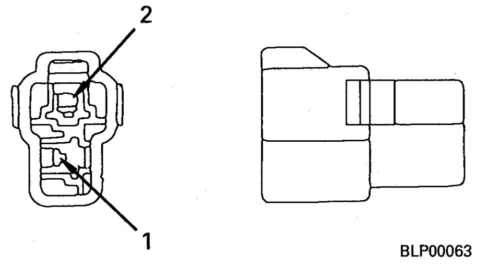
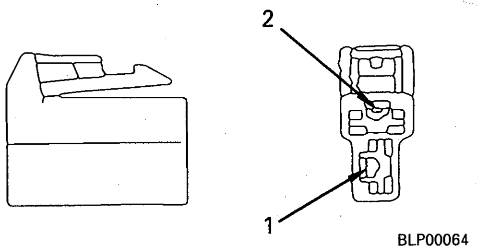
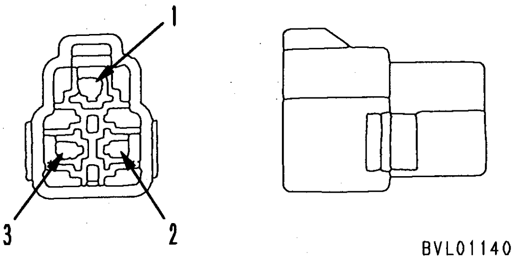
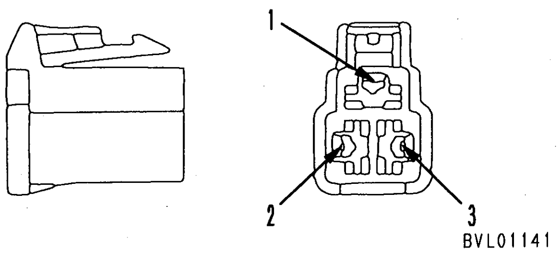
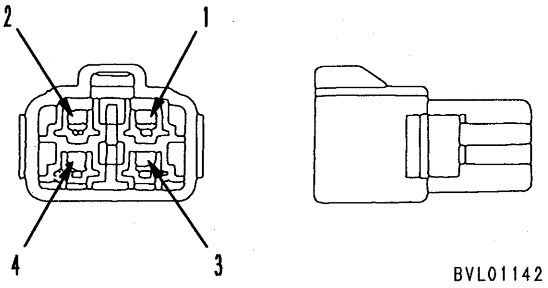
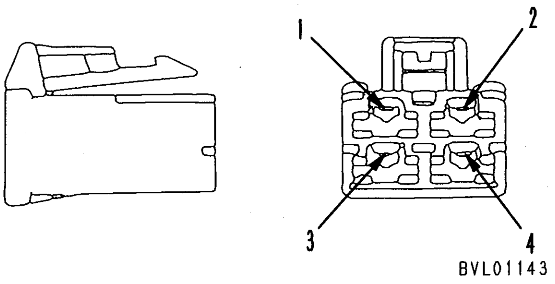
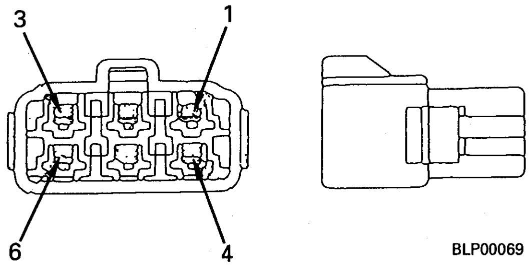
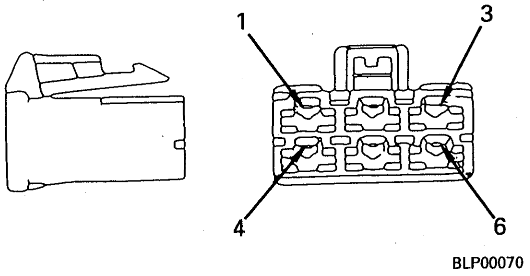
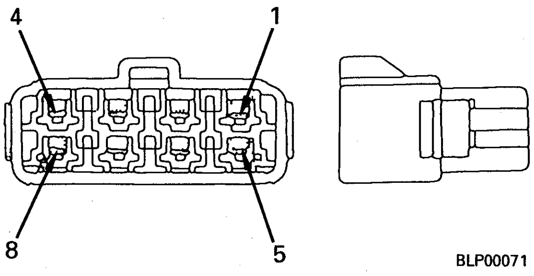
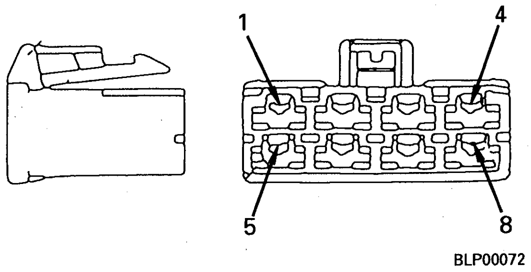
No. of pins	L type type connector	
	Male (female housing)	Female (male housing)
2	 TEW00257	 TEW00258

No. of pins	Automobile connector	
	Male (female housing)	Female (male housing)
2		
3		
4		
6		
8		

No. of pins	Relay connector	
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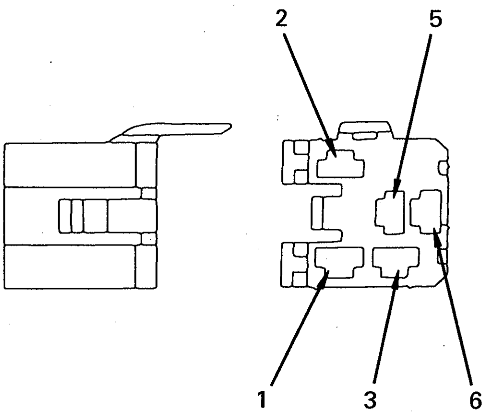
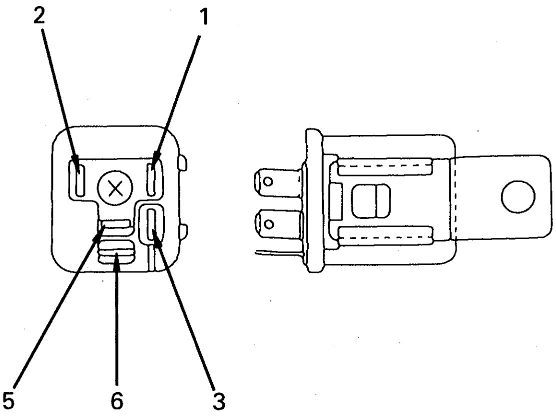
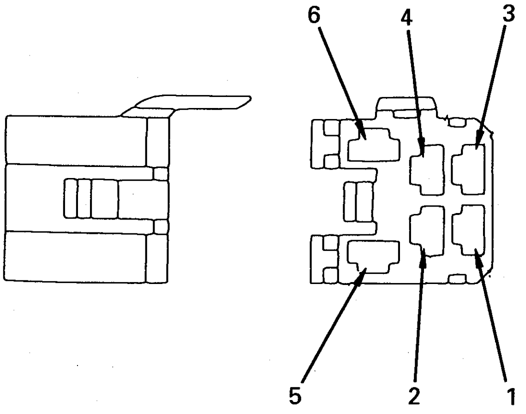
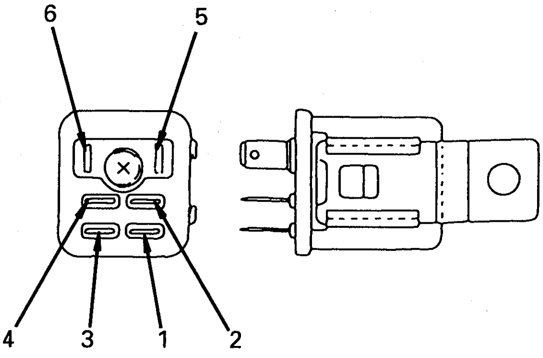
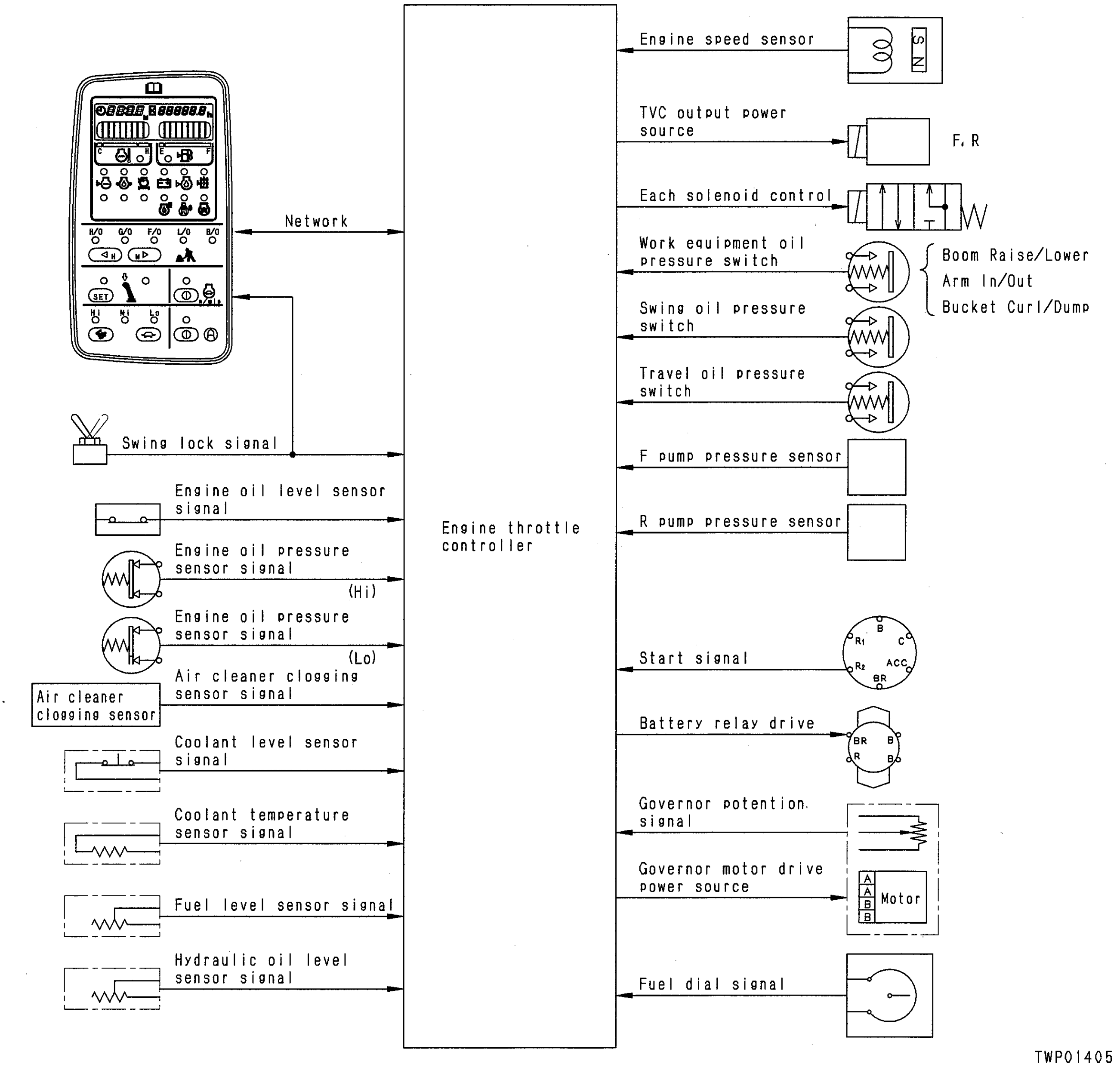
5	 BLP00073	 BLP00074
6	 BLP00075	 BLP00076

EXPLANATION OF CONTROL MECHANISM FOR ELECTRICAL SYSTEM

1. Explanation of machine control functions

The control mechanism for the electrical system consists of the monitor panel and engine throttle, pump controller. The monitor panel and the engine throttle, pump controller input the signals that are necessary, and together with the signals selected by the monitor panel, the engine throttle, pump controller outputs or inputs the necessary signals and control the pump absorption torque and engine output.



TWP01405

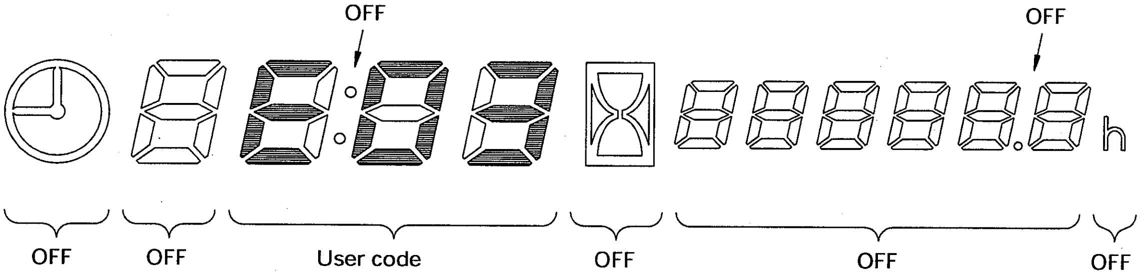
DISPLAY METHOD AND SPECIAL FUNCTIONS OF MONITOR PANEL

1. **Display on machine monitor**
   When the starting switch is turned on, all the monitor and gauge lamps light up for approx. 3 seconds, and the buzzer sounds for approx. 1 second. During this time, the monitor itself carries out self diagnosis, and after it has finished, it returns to the normal display.

2. **Recording of service codes and user code display function**
   1) All the abnormality data for the engine throttle, pump controller is sent to the monitor panel. When the monitor panel receives this data, it records the abnormality data, and at the same time, depending on the nature of the abnormality, it displays the user code on the time display panel to advise the operator of the action to take.
      However, in cases of abnormalities which are not urgent and do not require the user code to be displayed, only the content of the abnormality is recorded, and no display is given.

   2) Types of user code and system
      E02 (TVC system)
      E03 (Swing holding brake system)
      E05 (Governor motor system)
      ★ For details of the service codes included in the user code, see the action taken by the controller when an abnormality occurs, the symptoms on the machine or the judgement table.

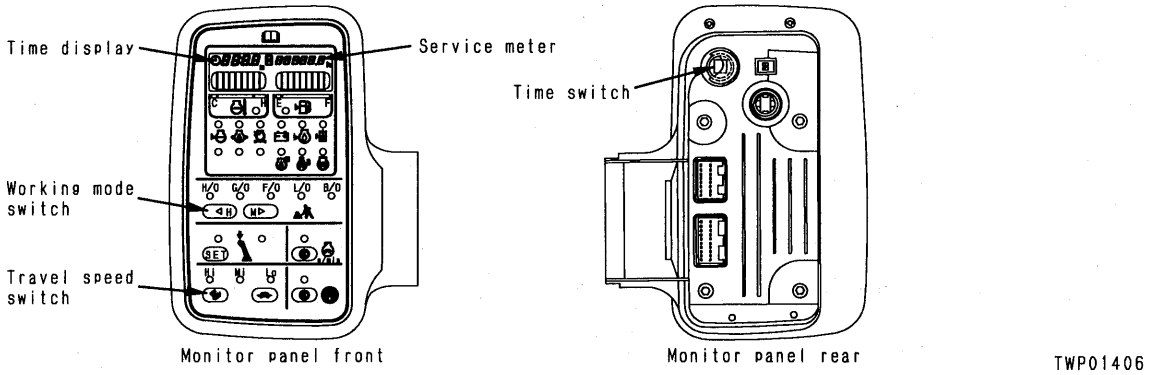
   3) Displaying user code
      If it becomes necessary to display the user code, the time displayed panel is automatically switched to advise the operator to take the necessary action.
      - Actual display (Example: Disconnection in the cancel solenoid system for the swing holding brake)



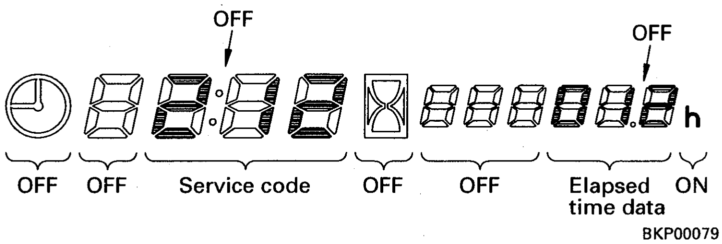
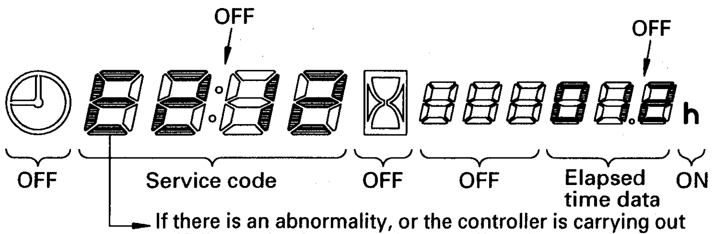
BKP00077

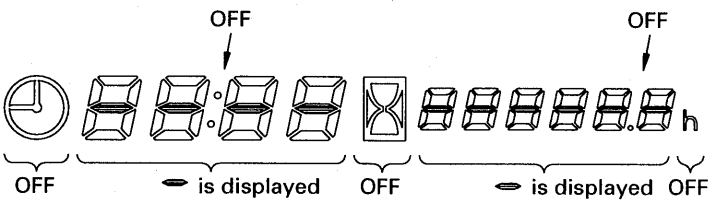
4) Display of trouble data
The monitor panel records both service codes which are included in the user code, and service codes which are not included. This data can be displayed on the time display as follows.

★ For details of the service codes that are not included in the user code, see ACTION TAKEN BY CONTROLLER WHEN ABNORMALITY OCCURS AND PROBLEMS ON MACHINE or the JUDGEMENT TABLE



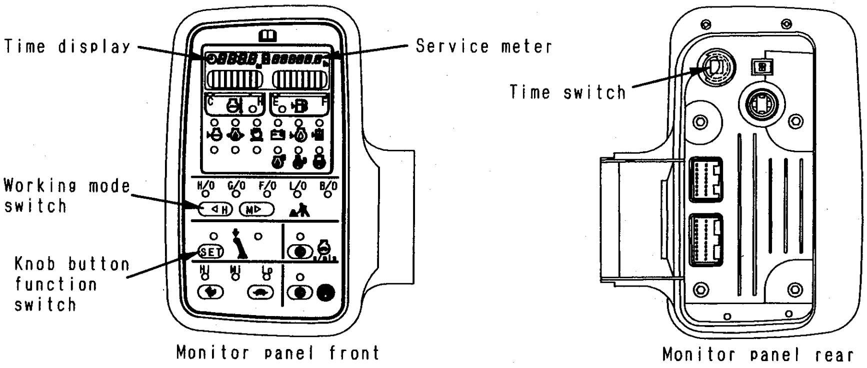
i) Method of displaying trouble data

Operation	Display
1. To set to the trouble data display mode, Keep the TIME switch + L.H. travel speed switch pressed for 2.5 seconds. Note: It is possible to call it up at the following times. 1) In the normal mode 2) In the user code display mode 3) In the machine data monitoring mode 4) In the time adjustment mode	1. On the time display and service meter display, the service code and number of hours (service meter hours) that have elapsed since the occurrence of the abnormality are displayed. • Example of display : When E212 has occurred 12 hours before (service meter) 1) Display of service code 2) Display of elapsed time 
2. To go to the next service code display, press the time switch + R.H. woking mode switch. 3. To go back to the previous service code display, press the time switch + L.H. woking mode switch.	3) If any abnormality exists at this time, the E mark is displayed.  If there is an abnormality, or the controller is carrying out self diagnosis, the output is shut off, and E is displayed.

Operation	Display
4. To finish with the trouble data display mode, keep the TIME switch + L.H. travel speed switch pressed for 2.5 seconds. 5. To erase the memory, keep the time switch pressed, turn the starting switch from OFF to ON, and keep the time switch pressed for 5 seconds.	4) If there is no abnormality code in memory  BKP00081

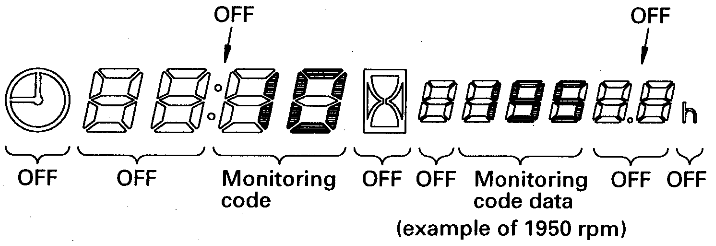
3. **Machine data monitoring function**

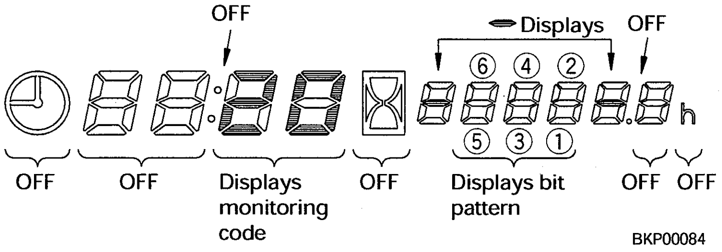
The input signals from the sensors and the output signals to drive the solenoid are displayed on the time display and service meter display.



TWP01407

1) Method of displaying monitoring code

Operation	Display
1. To set to the machine data monitoring mode, do as follows. Keep the time switch + knob button function switch pressed for 2.5 seconds. Note: This is possible at the following times. 1) During the normal mode 2) During the user code display mode 3) During the time adjustment mode 4) During the trouble data display mode	1. On the time display and service meter display, the monitoring code and data are displayed. • Example of display 1) When engine speed is monitored (monitoring code 10)  BKP00083

Operation	Display
2. To go to the next monitoring code display, press the time switch + R.H. working mode switch. 3. To go back to the previous monitoring code display, press the time switch + L.H. working mode switch. 4. To finish with the machine data monitoring code mode, keep the time switch + knob button function switch pressed for 2.5 seconds.	2) When displaying bit pattern • For monitoring codes 08, 20 – 24, 36, 37, 47 – 49, 4A, display the bit pattern. • Example of monitoring code 20  • The code No. is displayed in the monitoring code portion, and the display lights up to display bit patterns (1) – (6).

2) Table of machine data monitoring codes

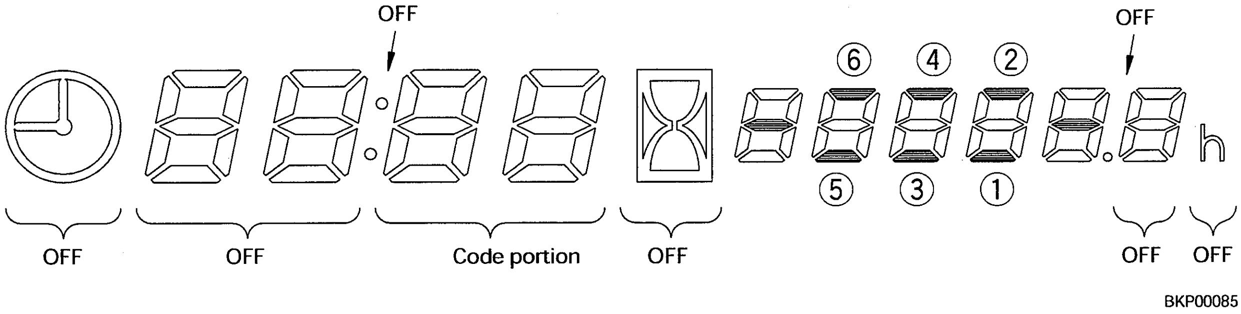
★ For details of the B in the Unit column, see the bit pattern chart in the next section.

No.	Item	Unit	Name of component
01	Monitor model code	—	Monitor panel
02	Engine throttle, pump controller model code	—	Engine throttle, pump controller
03	Engine throttle, pump controller model code	—	Engine throttle, pump controller
08	S-NET component condition display	B	Engine throttle, pump controller
10	Engine speed	10rpm	
11	Pump discharge pressure (F) input	MPa{kg/cm²}	Engine throttle, pump controller
12	Pump discharge pressure (R) input	MPa{kg/cm²}	Engine throttle, pump controller
13	TVC current (F) output	10mA	Engine throttle, pump controller
14	TVC current (R) output	10mA	Engine throttle, pump controller
15	LS-EPC current output	10mA	Engine throttle, pump controller
16	No. 2 throttle command	10mA	Engine throttle, pump controller
20	Engine throttle, pump controller PPC oil pressure switch input signal (1)	B	Engine throttle, pump controller
21	Engine throttle, pump controller PPC oil pressure switch input signal (2)	B	Engine throttle, pump controller
22	Engine throttle, pump controller PPC oil pressure switch input signal (3)	B	Engine throttle, pump controller
23	Engine throttle, pump controller solenoid actuation	B	Engine throttle, pump controller
24	Input condition of sensor for engine throttle, pump controller monitor warning	B	Engine throttle, pump controller
30	Fuel control dial input value	10mV	Engine throttle, pump controller
31	Potentiometer voltage	10mV	Engine throttle, pump controller
32	VBB voltage (battery voltage)	100mV	Engine throttle, pump controller

★ For details of the B in the Unit column, see the bit pattern chart in the next section.

No.	Item	Unit	Name of component
33	Governor motor A phase current	10mV	Engine throttle, pump controller
34	Governor motor B phase current	10mV	Engine throttle, pump controller
35	Battery relay output voltage	100mV	Engine throttle, pump controller
36	Engine throttle, pump controller input condition	B	Engine throttle, pump controller
37	Engine throttle, pump controller output condition	B	Engine throttle, pump controller
40	Engine speed	10rpm	Engine throttle, pump controller
41	Coolant temperature sensor voltage	10mV	Engine throttle, pump controller
42	Fuel sensor input voltage	10mV	Engine throttle, pump controller
43	Battery charge input voltage	100mV	Engine throttle, pump controller
47	Monitor panel output condition 1	B	Monitor panel
48	Monitor panel input condition 1	B	Monitor panel
49	Monitor panel input condition 2	B	Monitor panel
4A	Monitor panel input condition 3	B	Monitor panel
4C	Monitor panel input condition 4	B	Monitor panel

3) Bit pattern chart
As shown in the diagram below, the time display has bit numbers which light up to show that the signal is being transmitted. (For details, see METHOD OF DISPLAYING MONITORING CODE.)



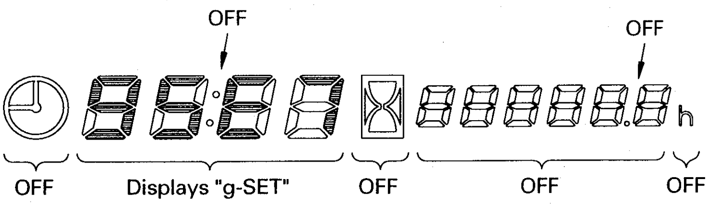
Code	Content	Bit	Details (condition when lighted up)
08	Connection of S-NET components	(1) (2) (3) (4) (5) (6)	Engine throttle, pump controller connected (ID=2) Engine throttle, pump controller connected (ID=3)
20	Input condition of engine throttle, pump controller PPC switches	(1) (2) (3) (4) (5) (6)	Swing switch ON Travel switch ON Boom LOWER switch ON Boom RAISE switch ON Arm IN switch ON Arm OUT switch ON
21	Input condition of engine throttle, pump controller PPC switches and other switches	(1) (2) (3) (4) (5) (6)	Bucket CURL switch ON Bucket DUMP switch ON Swing lock switch ON Service switch ON Model selection 5 Swing prolix switch ON
22	Input condition of engine throttle, pump controller model selection and other switches	(1) (2) (3) (4) (5) (6)	Model selection 1 GND connected Model selection 2 GND connected Model selection 3 GND connected Model selection 4 GND connected Kerosene mode input GND connected Knob switch ON
23	Drive condition of engine throttle, pump controller ON/OFF solenoid valves	(1) (2) (3) (4) (5) (6)	 Solenoid ON: Active mode (boom), OFF: Standard mode Swing holding brake ON Pump merge/divider solenoid ON Actve mode (swing) solenoid ON Travel speed selector solenoid ON

Code	Content	Bit	Details (condition when lighted up)
24	Input condition 1 of sensor for engine throttle, pump controller monitor warning	(1) (2) (3) (4) (5) (6)	Above engine oil pressure sensor Lo set pressure Above engine oil pressure sensor Hi set pressure Radiator water level sensor abnormal Engine oil level sensor abnormal Hydraulic oil level sensor abnormal Air cleaner clogging sensor abnormal
25	Input condition 2 of sensor for engine throttle, pump controller monitor warning	(1) (2) (3) (4) (5) (6)	 Auto greasing control abnormal
36	Input condition of engine throttle, pump controller	(1) (2) (3) (4) (5) (6)	 Starting switch ON
37	Output condition of engine throttle, pump controller	(1) (2) (3) (4) (5) (6)	Battery relay: Actuated
47	Monitor panel output condition 1	(1) (2) (3) (4) (5) (6)	 Alarm buzzer: when operated machine Wiper motor drive (R): when operated machine Wiper motor drive (L): when operated machine Window washer drive: when operated machine
48	Monitor panel input condition 1	(1) (2) (3) (4) (5) (6)	Wiper (ON) OFF Wiper (INT) OFF Wiper (washer) OFF Window limit switch OPEN Limit switch (P) OPEN Limit switch (W) OPEN
49	Monitor panel input condition 2	(1) (2) (3) (4) (5) (6)	KEY ON SW OFF Terminal BR Voltage Hi LIGHT SW OFF Preheating switch OFF START C Sometimes turns ON Monitor panel LED lighting output OFF

Code	Content	Bit	Details (condition when lighted up)	
4A	Monitor panel input condition 3	(1)	Time switch	OFF
		(2)	PPC oil pressure selector switch	OFF
		(3)	Overload selector switch	OFF
		(4)	STD/DLX selection	STD
		(5)	Swing lock switch	OFF
		(6)	Buzzer cancel switch	OFF
4C	Monitor panel input condition 4	(1)		
		(2)	Wiper motor normal rotation relay output: when specified voltage is abnormal	
		(3)	Wiper motor reverse rotation relay output: when specified voltage is abnormal	
		(4)	Window washer motor drive output	
		(5)		
		(6)		

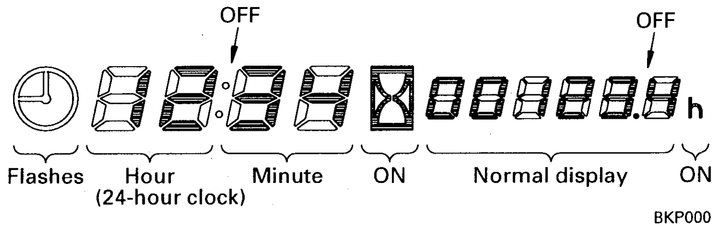
4. Governor motor adjustment mode

This is used when adjusting the linkage between the governor motor and the injection pump. (For details of the procedure, see TESTING AND ADJUSTING.)

Operation	Display
1. To set to the governor motor adjustment mode, press the time switch + R.H. travel speed switch + R.H. working mode switch.	1.  BKP00086
2. To return to the time display mode use the same procedure as in Step 1.	2. Buzzer sounds once a second

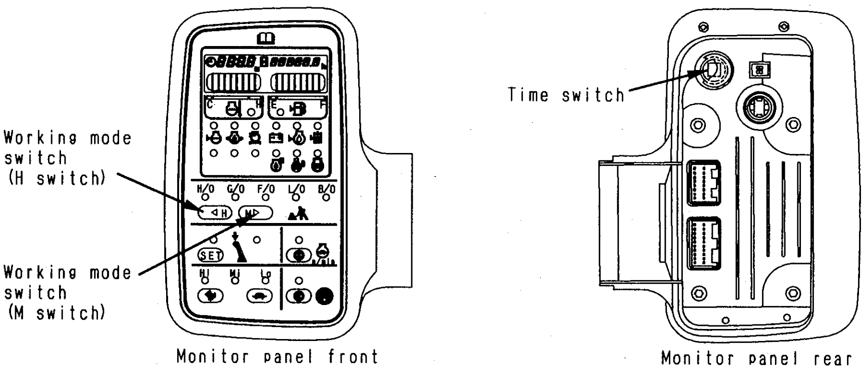
5. Time adjustment mode

To adjust the time, do as follows.

Operation	Display
1. To set to the time adjustment mode, keep the time switch depressed for 2.5 seconds. 2. Use the L.H. working mode switch to advance the hour. 3. Use the R.H. working mode switch to advance the minute. 4. To return to the time display mode use the same procedure as in Step 1.	1. The time mark portion flashes  BKP00087 ★ The example shows the situation when setting to 12:34.

6. Working mode default setting mode

The default (initial position) for the working mode can be changed as follows (the default can be changed for the working mode only).



1) Set to the working mode default setting mode.
   - i) Keep the TIME switch and WORKING MODE SWITCH (M SWITCH) pressed at the same time for at least 2.5 seconds.
   - ii) Check that one of the working mode LEDs is flashing.

2) Method of setting working mode default
   - i) Use the WORKING MODE SWITCH (H SWITCH) or WORKING MODE SWITCH (M SWITCH) to change the working mode and set the working mode to the default to be changed.
   - ii) Keep the TIME switch and WORKING MODE SWITCH (M SWITCH) pressed at the same time for at least 2.5 seconds.
   - iii) When the setting is completed, the buzzer "beeps" (when the system returns to the normal mode, the working mode LED lights up).
     - ★ Note that if the starting switch is turned OFF when the LED is flashing (default setting mode), the content of the working mode default is not changed.

4) Method of checking after setting working mode default
   - i) Check that the LED remains lighted up.
   - ii) Turn the starting switch OFF, then turn it ON again.
   - iii) Check that the working mode default has changed to the new setting.
     - ★ When the starting switch is turned ON, the auto- deceleration setting changes according to the working mode.

METHOD OF USING JUDGEMENT TABLE

This judgement table is a tool to determine if the problem with the machine is caused by an abnormality in the electrical system or by an abnormality in the hydraulic or mechanical system. The symptoms are then used to decide which troubleshooting table (E–○○, S–○○, N–○○, C–○○, F–○○, H–○○, M–○○) matches the symptoms.

The judgement table is designed so that it is easy to determine from the user code and service code which troubleshooting table to go to.

★ The abnormality display (warning) given by the monitor panel leads directly to troubleshooting of the machine monitor (M–○○). (See troubleshooting of the machine monitor system)

1. When using judgement table for engine throttle, pump controller (governor control system) and engine related parts

- If a service code is displayed on the monitor panel, go to the troubleshooting code at the bottom of the judgement table (E–○○).
  (A ● mark is put at the places where the failure mode and service code match.)
- If a problem has appeared but no service code is displayed on the monitor panel, go to the point where the failure mode matches the troubleshooting code on the right of the judgement table (E–○○ or S–○○).
  <Example> Failure mode "Engine does not start".
  Procedure: Check if the service code is being displayed on the monitor panel.

				Engine throttle, pump controller, engine related parts (E3: system)						Checking monitoring, check items							Machine monitor check item			Troubleshooting code if no service code display is given
				Self-diagnostic display													Is red range displayed?			
			Abnormality in engine throttle, pump controller power source	system	Abnormality in fuel control dial input value	Abnormality (disconnection) in motor drive system	Abnormality (short circuit) in motor drive system	Abnormality in feedback potentiometer system	Abnormality (short circuit) in battery relay output	Battery relay drive signal	No. 2 throttle command value	Fuel control dial command value	Governor motor potentiometer	Governor motor A phase current	Governor motor B phase current	Coolant temperature voltage	102°C or above	105°C or above	Does starting motor turn?	
Failure mode		User code		E05						Monitoring code										
		Service code		308	317	318	306	315	316	35	16	30	31	33	34	41		108		
1	Engine does not start easily																			S-1
2	Engine does not start																		○	S-2
3	Engine speed stays at low idling, and does not follow accelerator; or engine pickup is poor		●	●	●	●	●					※	※	※	※			○		S-3
4	Engine stops during operation																			S-4
5	Engine rotation is irregular	When idling speed is irregular																		E-9 a), S-5
		When there is hunting		●	●	●	●		●				※							E-9 a), S-5
6	Lack of output (engine high idling speed is too low)			●			●				※	※				○				E-10, S-6
7	Auto-deceleration does not work																			E-3 · E-4
8	Engine does not stop		●		●	●	●	●		○				※	※					E-11
9	Warming-up operation is defective															○		○		E-3 · E-4
10	Exhaust gas is black																			S-7
11	Oil consumption is excessive, or exhaust gas is blue																			S-8
12	Oil becomes dirty prematurely																			S-9
13	Fuel consumption is excessive, or exhaust gas is blue																			S-10
14	Oil is mixed in coolant																			S-11
15	Engine oil pressure caution lamp lights up																			S-12
16	Oil level rises																			S-13
17	Coolant temperature rises too high (overheating)															○	○			S-14
18	Abnormal noise is generated																			S-15
19	There is excessive vibration																			S-16
20	Engine speed does not change even when working mode is switched										※									E-3 · E-4
Troubleshooting code when service code is displayed			E-1	E-2	E-3	E-4	E-5	E-6	E-7	—	—	—	—	—	—	—	—	—	—	
Troubleshooting code when there is abnormality in monitoring or machine monitor check			—	—	—	—	—	—	—	E-12	—	—	—	—	—	M-14	M-13	M-13	E-8	

● : This shows applicable item for service code
※ : This shows item that needs only checking with monitoring

○ : This shows item to check with monitoring or machine monitor

[Judgement]

1) If a service code is being displayed on the monitor panel......go to troubleshooting [E3:○○] for the engine throttle, pump controller (governor control system).
2) If no service code is displayed on the monitor panel, and the engine does not start:

- Check that starting motor rotates
  - Starting motor rotates .... Go to troubleshooting S-2 of mechanical system
  - Starting motor does not rotate.... Go to troubleshooting E-8 of electrical system

2. When using judgement table for engine throttle, pump controller (governor control system) and hydraulic related parts

- If a service code is displayed on the monitor panel, go to the troubleshooting code at the bottom of the judgement table (C–○○).
  (A ● mark is put at the places where the failure mode and service code match.)
- If a problem has appeared but no service code is displayed on the monitor panel, go to the point where the failure mode matches the input signal, and check the display for the input signal (the display at the place with a ○ mark).
  - If it is displayed normally, go to the troubleshooting code on the right of the judgement table (H–○○).
  - If the input signal is not displayed on the monitor panel, go to the troubleshooting code at the bottom of the judgement table (F–○○).

<Example> Failure mode "Upper structure does not swing".
Procedure: Check if the service code is being displayed on the monitor panel.

Failure mode			Abnormality in controller power source	Engine throttle, pump controller (E2:XX system)																
				Self-diagnostic display																
				Short circuit in front pump TVC solenoid system	Disconnection in front pump TVC solenoid system	Short circuit in rear pump TVC solenoid system	Disconnection in rear pump TVC solenoid system	Short circuit in active mode (boom) solenoid system	Disconnection in active mode (boom) solenoid system	Short circuit in swing holding brake solenoid system	Disconnection in swing holding brake solenoid system	Short circuit in pump merge/divider solenoid system	Disconnection in pump merge/divider solenoid system	Short circuit in travel speed selector solenoid system	Disconnection in travel speed selector solenoid system	Model selection input error	Short circuit in LS-EPC solenoid system	Disconnection in LS-EPC solenoid system	Short circuit in active mode (swing) solenoid system	Disconnection in active mode (swing) solenoid system
		User code	LED	E02				—		E03		—								
		Service code	OFF	232	233	236	237	207	208	203	213	204	214	206	216	217	222	223	231	235
All work equipment, travel, swing	Speeds of all work equipment, swing, travel are slow or lack power			▲	▲	▲	▲									●		●		
	There is excessive drop in engine speed, or engine stalls			●	●	●	●									●				
	No work equipment, travel, swing move																			
	Abnormal noise generated (around pump)																			
	Auto-deceleration does not work		●																	
	Fine control ability is poor or response is poor																●	●		
Work equipment	Boom is slow or lacks power							●	●				●							
	Arm is slow or lacks power												●							
	Bucket is slow or lacks power																			
	Boom does not move																			
	Arm does not move																			
	Bucket does not move																			
	Excessive hydraulic drift																			
	Excessive time lag (engine at low idling)																	●		
	Other equipment moves when single circuit is relieved																			
	In L/O, F/O modes, work equipment speed is faster than specified speed											●	●				●	●		
	Machine push-up function does not work																			
Compound operations	In compound operations, work equipment with larger load is slow																			
	In swing + boom (RAISE), boom is slow																		●	●
	In swing + arm, arm is slow																			
	In swing + travel, travel speed drops excessively																			
Travel system	Travel deviation	Deviation is excessive during normal travel																		
		Deviation is excessive when starting																		
	Travel speed is slow																	●		
	Steering does not turn or lacks power											●	●							
	Travel speed does not switch or is faster than specified speed		●											●	●		●	●		
	Does not move (one side only)																			
Swing system	Does not swing	Both left and right								●	●									
		One direction only																		
	Swing acceleration is poor or swing speed is slow	Both left and right		●	●	●	●													
		One direction only																		
	Excessive overrun when stopping swing	Both left and right																		
		One direction only																		
	Excessive shock when stopping swing (one direction only)																			
	Excessive abnormal noise when stopping swing																			
	Excessive hydraulic drift of swing	When holding brake is released																		
		When holding brake is applied																		
	Swing speed is faster than specified swing speed											●	●				●	●		
Troubleshooting code when service code is displayed			C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10	C-11	C-12	C-13	C-14	C-15	C-16	C-22	C-23
Troubleshooting code when there is abnormality in monitoring check			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

▲:This shows applicable item for service code (simultaneous abnormality at front or rear)
●:This shows applicable item for service code
※:This shows item that needs only checking with monitoring
○:This shows item to check with monitoring or machine monitor

★ If service code E218 (abnormality in network system) is displayed, go to troubleshooting for N mode.

			Engine throttle, pump controller (E2:XX system)				Check items in monitoring mode																							Troubleshooting code if no service code is displayed
			Self-diagnostic display				Pressure switch											Actuation of solenoid												
			Abnormality in front pump pressure sensor system	Abnormality in rear pump pressure sensor system	Abnormality in pressure sensor power source system	Abnormality in engine speed sensor system	Swing (1)	Travel (2)	Boom LOWER (3)	Boom RAISE (4)	Arm IN (5)	Arm OUT (6)	Bucket CURL (1)	Bucket DUMP (2)	Swing lock switch (3)	Kerosene mode (5)	Knob switch (6)	Active mode (boom) (2)	Swing holding brake (3)	Pump merge/divider (4)	Travel speed (6)	Active mode (swing)	Model code	Engine speed input	Front pump discharge pressure input	Rear pump discharge pressure input	Front pump TVC current output	Rear pump TVC current output	LS-EPC current output	
							Bit pattern																Monitoring code							
			224	225	226	227	20						21			22		23					02	10	11	12	13	14	15	
All work equipment, travel, swing	Speeds of all work equipment, swing, travel are slow or lack power					●										○								※	※	※	※	※	※	H-1
	There is excessive drop in engine speed, or engine stalls					●																		※			※	※		H-2
	No work equipment, travel, swing move																													H-3
	Abnormal noise generated (around pump)																													H-4
	Auto-deceleration does not work					●	○	○	○	○	○	○	○	○																H-5
	Fine control ability is poor or response is poor																													H-6
Work equipment	Boom is slow or lacks power								○	○								※		※					※	※				H-7
	Arm is slow or lacks power										○	○								※					※	※				H-8
	Bucket is slow or lacks power												○	○											※	※				H-9
	Boom does not move																													H-10
	Arm does not move																													
	Bucket does not move																													
	Excessive hydraulic drift																													H-11
	Excessive time lag (engine at low idling)								○		○		○																※	H-12
	Other equipment moves when single circuit is relieved																													H-13
	In L/O, F/O modes, work equipment speed is faster than specified speed																			※									※	H-14
	Machine push-up function does not work																													H-15 C-21
Compound operations	In compound operations, work equipment with larger load is slow																													H-16
	In swing + boom (RAISE), boom is slow						※		※													※								H-17
	In swing + arm, arm is slow																													H-18
	In swing + travel, travel speed drops excessively																													H-19
Travel system	Travel deviation	Deviation is excessive during normal travel																												H-20
		Deviation is excessive when starting																												
	Travel speed is slow							○																				※		H-21
	Steering does not turn or lacks power							○												※										H-22
	Travel speed does not switch or is faster than specified speed		●	●	●	●		○													※			※	※	※		※		H-23
	Does not move (one side only)																													H-24
Swing system	Does not swing	Both left and right					○								○				※						※					H-25
		One direction only																												
	Swing acceleration is poor or swing speed is slow	Both left and right																							※					H-26
		One direction only																												
	Excessive overrun when stopping swing	Both left and right																												H-27
		One direction only																												
	Excessive shock when stopping swing (one direction only)																													H-28
	Excessive abnormal noise when stopping swing																													H-29
	Excessive hydraulic drift of swing	When holding brake is released																												H-30
		When holding brake is applied					※		※	※	※	※	※	※					※											
	Swing speed is faster than specified swing speed																			※									※	H-31
Troubleshooting code when service code is displayed			C-17	C-18	C-19	C-20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
Troubleshooting code when there is abnormality in monitoring check			–	–	–	–	F-1	F-2	F-3	F-4	F-5	F-6	F-7	F-8	F-9	F-10	F-11	–	–	–	–	–	–	–	–	–	–	–	–	

[Judgement]

1) If a service code is being displayed on the monitor panel......go to troubleshooting [E2:○○] for the engine throttle, pump controller (pump control system).
2) If no service code is displayed on the monitor panel, and the upper structure does not swing: .

- Check engine throttle, pump controller input signal (Check in monitoring mode)
  - There is a signal.... Go to troubleshooting H-25 of mechanical system
  - There is no signal . Go to troubleshooting F–○○ of engine throttle, pump controller input signal system (F mode for applicable system)

METHOD OF USING TROUBLESHOOTING CHARTS

1. Category of troubleshooting code number

Troubleshooting Code No.	Component	Service code
N-○○	Troubleshooting of communication abnormality system	E218 group
E-○○	Troubleshooting of electrical system for engine throttle, pump controller (governor control system)	E3-○○ group
S-○○	Troubleshooting of engine related parts	—
C-○○	Troubleshooting of electrical system for engine throttle, pump controller (pump control system)	E2-○○ group
F-○○	Troubleshooting of engine throttle, pump controller (input signal system)	—
H-○○	Troubleshooting of hydraulic, mechanical system	—
M-○○	Troubleshooting of machine monitor	E1-○○ group

2. Method of using troubleshooting table for each troubleshooting mode

1) Troubleshooting code number and problem
   The title of the troubleshooting chart gives the troubleshooting code, service code, and failure mode (problem with the machine). (See Example (1))
2) Distinguishing conditions
   Even with the same failure mode (problem), the method of troubleshooting may differ according to the model, component, or problem. In such cases, the failure mode (problem) is further divided into sections marked with small letters (for example, a), so go to the appropriate section to carry out troubleshooting. (See Example (2)) If the troubleshooting table is not divided into sections, start troubleshooting from the first check item in the failure mode.
3) Method of following troubleshooting chart
   - Check or measure the item inside $\square\!-\!\sqsubset^{\text{YES}}_{\text{NO}}$, and according to the answer follow either the YES line or the NO line to go to the next ▭. (Note: The number written at the top right corner of the ▭ is an index number; it does not indicate the order to follow.)
   - Following the YES or NO lines according to the results of the check or measurement will lead finally to the Cause column. Check the cause and take the action given in the Remedy column on the right. (See Example (3))
   - Below the ▭ there are the methods for inspection or measurement, and the judgement values. If the judgement values below the ▭ are correct or the answer to the question inside the ▭ is YES, follow the YES line; if the judgement value is not correct, or the answer to the question is NO, follow the NO line.
   - Below the ▭ is given the preparatory work needed for inspection and measurement, and the judgement values. If this preparatory work is neglected, or the method of operation or handling is mistaken, there is danger that it may cause mistaken judgement, or the equipment may be damaged. Therefore, before starting inspection or measurement, always read the instructions carefully, and start the work in order from Item 1).
4) General precautions
   When carrying out troubleshooting for the failure mode (problem), precautions that apply to all items are given at the top of the page and marked with ★ (See Example (4)) .
   The precautions marked ★ are not given in the ▭, but must always be followed when carrying out the check inside the ▭.
5) Troubleshooting tools
   When carrying out the troubleshooting, prepare the necessary troubleshooting tools. For details, see TOOLS FOR TESTING, ADJUSTING, AND TROUBLESHOOTING.

6) Installation position, pin number
A diagram or chart is given for the connector type, installation position, and connector pin number connection. When carrying out troubleshooting, see this chart for details of the connector pin number and location for inspection and measurement of the wiring connector number appearing in the troubleshooting flow chart for each failure mode (problem).

<Example>

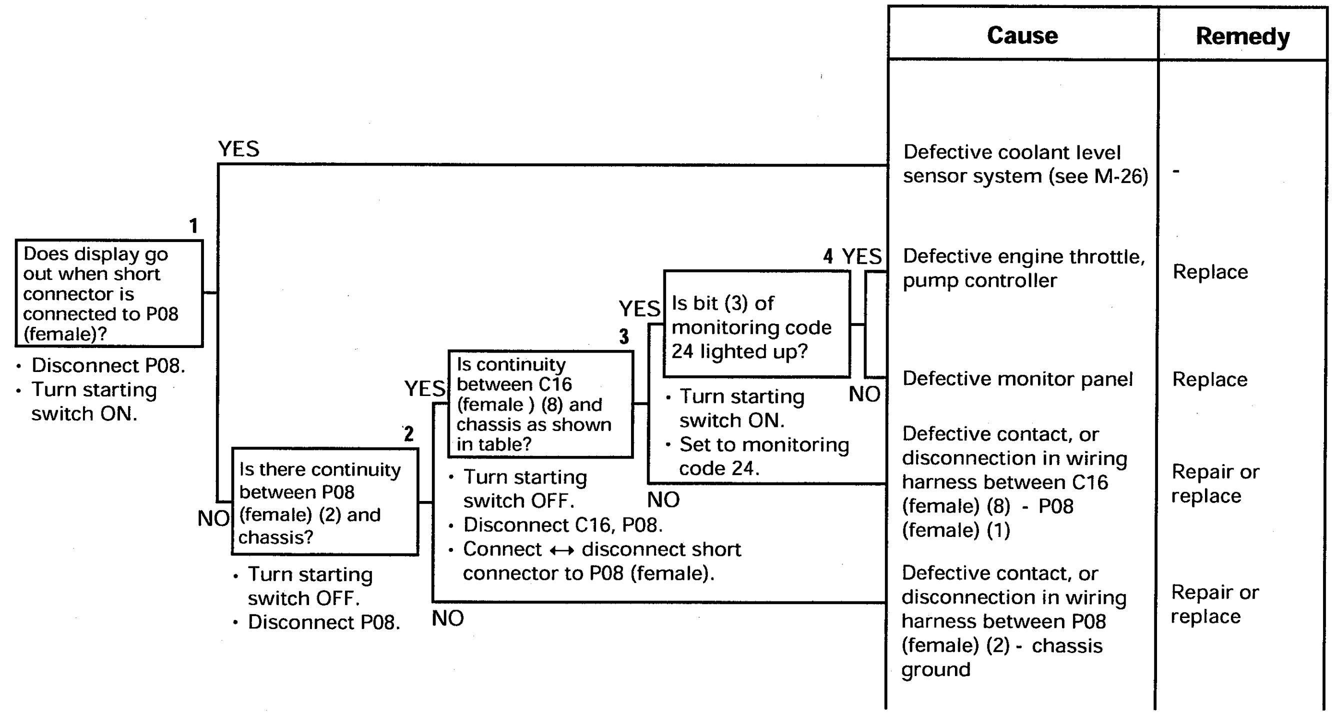
(1) **M-9 When starting switch is turned ON (engine stopped), basic check items flashes**

(4) ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.
★ Check that the coolant is at the specified level before carrying out troubleshooting

(2) a) (coolant level) flashes
SAP00519
b) (engine oil level) flashes
SAP00523

Divided into sections a) and b)

(3)



Table

Short connector	Continuity
Connected	Yes
Disconnected	No

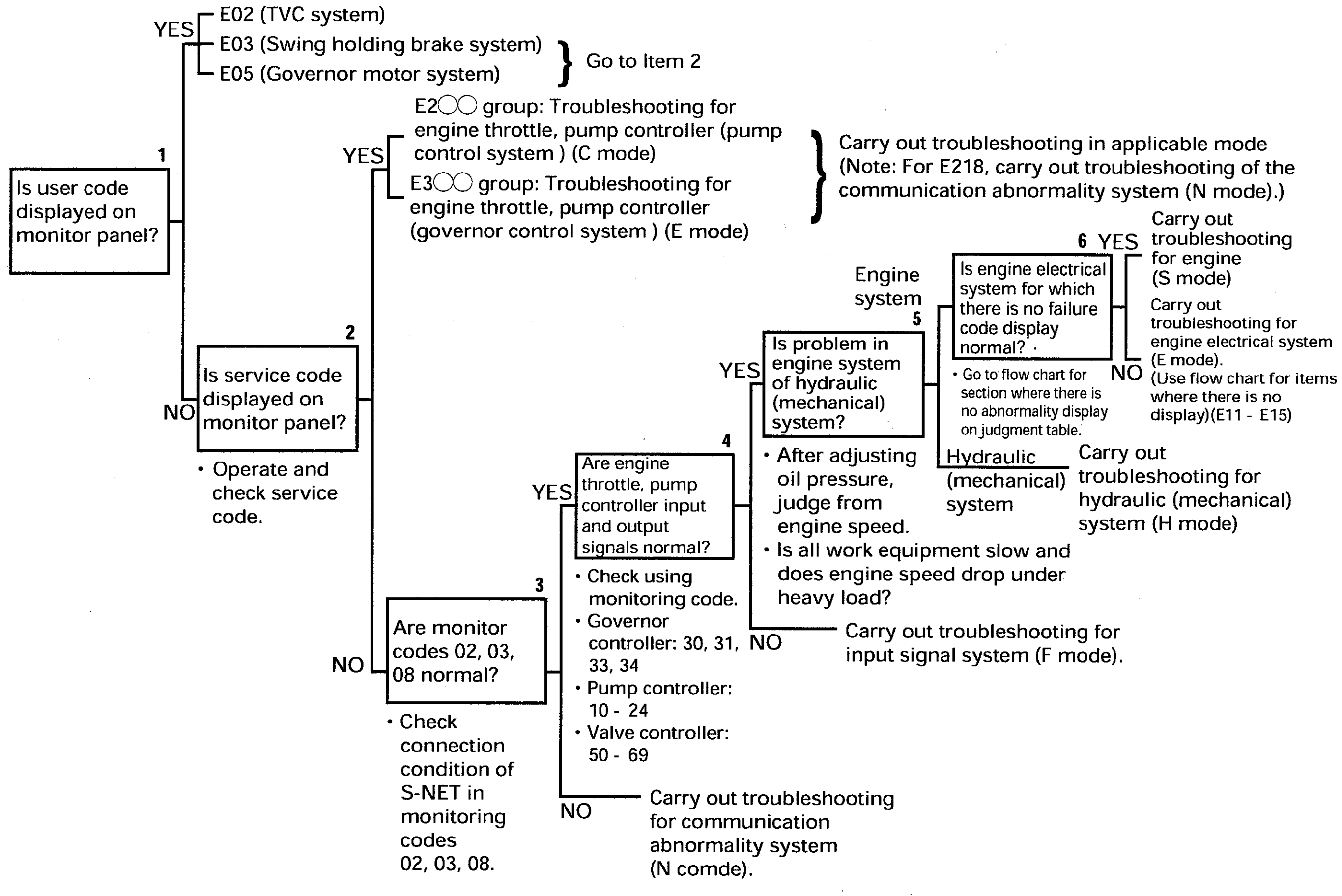
DETAILS OF TROUBLESHOOTING AND TROUBLESHOOTING PROCEDURE

If any abnormality should occur, it is necessary to go to the correct troubleshooting chart in accordance with the judgement table for that type of failure (engine throttle, pump controller (governor control system) and engine throttle, pump controller (pump control system). For details of the troubleshooting and troubleshooting procedure, refer to this flow chart.

When carrying out troubleshooting, ask the operator as much as possible about the condition of the machine, and check the following items before starting.

(1) Condition of controller connection (check with monitoring codes 02 – 03)
(2) Blown fuses
(3) Battery voltage (monitoring mode 32)
(4) Electricity generation (charge input) voltage (monitoring code 43)

The procedure for carrying out check items No. 3 and 4 in the flow chart below is given on the following pages.



★ For details, see engine throttle, pump controller (governor control system) (pump control system) in the JUDGEMENT TABLE.

If there is no abnormality display in the communications system transmitted in S-NET, it can be taken that the output signal from the monitor panel has been transmitted. However, even if there is no abnormality display, if the operation is defective, use the following procedure when checking directly. If any abnormality occurs in the S-NET system, the system is automatically switched to the following default mode, so be careful when carrying out troubleshooting.

Default Mode when communications cannot be carried out for the monitor and engine throttle, pump controller

Set mode		Pump control	Governor control
1	Working mode	G/O mode	H/O mode
2	Throttle signal	FULL	FULL
3	Auto-deceleration	ON (deceleration mode	ON (deceleration mode)
4	Coolant temperature signal	OFF	—
5	Active mode	OFF	—
6	Power max. mode	ON (power max. possible)	—
7	Travel speed	Lo	—
8	Automatic warming up	—	ON (automatic warming-up mode)

1. Procedure for checking monitor panel output signal

★ For details of operating the monitoring mode, see MONITOR PANEL DISPLAY AND SPECIAL FUNCTIONS.

1. Connection condition of components
   1) Set to the monitoring mode and display monitoring code 08.
   2) The time display (bits) will light up to display the components that are connected.
      ★ Engine throttle, pump controller (pump control system) (1) and engine throttle, pump controller (governor control system) (2) will light up.

2. Checking working mode signal {check No. 2 throttle signal (monitoring code 16) at the same time}
   1) Set to the monitoring mode and display monitoring code 10.
   2) Switch the working mode as shown in Table 1 and check that the engine speed changes.

Table 1

Working mode	High idling speed (rpm) [The figures in ( ) are the rated speed]
H/O	Approx. 2,150<during operation> Approx. 2,050 <idling> (1,950)
G/O	Approx. 2,000 <during operation> Approx. 1,900 <idling> (1,800)
F/O	Approx. 1,900 (1,700)
L/O	Approx. 1,600 (1,400)
Active	Approx. 2,300 <during operation> Approx. 2,050 <idling> (2,050)

3. Checking travel speed selection signal
   1) Set to the monitoring mode and display monitoring code 23.
   2) Change the speed selector switch to Hi or Mi and run the engine at 1500 rpm or above. Check that bit (6) lights up when traveling at Hi or Mi (front or rear pump oil pressure: 21.56 – 32.34 MPa {220 – 330 kg/cm^2}
4. Checking swing priority mode signal
   ★ If the travel oil pressure switch signal is not input to the controller, the flow from the front and rear pumps will remain divided.
   1) Set to the monitoring mode and display monitoring code 23.
   2) Check that bit (4) lights up when the travel is operated (even when operated slightly).
      ★ Check the operating condition of the pump merge/divider solenoid valve

2. Checking input signal of engine throttle, pump controller

★ Check the input signals for each controller as follows.

- Pump control system

1. Checking input signal
   1) Check hydraulic switch
      i) Set to the monitoring mode, and display monitoring codes 20 and 21.
      ii) Operate each work equipment lever, and check how the bit pattern lights up.
         ★ For details of the bit pattern chart, see MONITOR PANEL DISPLAY AND SPECIAL FUNCTIONS.
   2) Check speed sensor (check engine speed)
      i) Set to the monitoring mode, and display monitoring code 10.
      ii) Use the fuel control dial to change the speed, and measure the speed when this is done.
   3) Check pump discharge pressure sensor
      i) Set to the monitoring mode, and display monitoring codes 11 and 12.
         ★ Code 11 is for the front pump and code 12 is for the rear pump.
      ii) Refer to Table 2 and measure the hydraulic pressure at the front or rear pump.

Table 2 Pump merge/flow logic and pumps actuated by control levers

	Independent operation (basic flow merged)		Travel operated independently or compound operation together with travel※	
	Front pump	Rear pump	Front pump	Rear pump
L.H. travel		○		○
Swing	○	○		○
Arm	○	○		○
Boom	○	○	○	
Bucket	○	○	○	
R.H. travel	○		○	

※ Conditions for compound operation with travel.

(1) When measuring the oil pressure for any circuit other than travel, operate the travel lever slightly or connect a short connector (X-2P) to the travel oil pressure switch connector (CN-S01).

(2) The circuits merge when the pressure of the front pump or rear pump is more than 19.6 MPa {200 kg/cm^2}.

4) Check kerosene mode input signal
   i) Set to the monitoring mode, and display monitoring code 22.
   ii) Connect the CN-M36 connector and check that bit (5) lights up.
5) Check knob switch input signal .
   i) Set to the monitoring mode, and display monitoring code 22.
   ii) Turn the knob switch ON and check that bit (6) lights up.

2. Check output signals
   1) Check LS-EPC solenoid output current
      i) Set to the monitoring mode, and display monitoring code 15.
      ii) Run the engine at high idling with all the levers at neutral and in the G/O or H/O mode, and measure the current.
         ★ All levers at neutral: 900 ± 80 mA
         Engine at high idling, any lever operated (other than travel): 0 A
   2) No. 2 throttle signal
      i) Set to the monitoring mode, and display monitoring code 16.
      ii) Use the procedure in Item 2 for checking the monitor panel output signal, and measure the engine speed.
   3) Checking ON ↔ OFF solenoid condition
      i) Set to the monitoring mode, and display monitoring code 23.
      ii) Refer to Table 3 and check that the applicable bit lights up.

Table 3 Types of solenoid and conditions for actuation

Name of solenoid	Actuation condition	Bit that lights up
Active (boom)	Active mode switch OFF	(2)
Swing holding brake	Swing or work equipment lever operated	(3)
Pump merge/divider	Travel operated independently	(4)
Travel speed selector	Travel speed selector switch Hi or Mi	(6)
Active (swing)	Active mode switch ON + swing + boom raise lever operated simultaneously	(5)

★ Operate the lever slightly not enough to move the machine.

   4) Check TVC solenoid output current
      i) Set to the monitoring mode, and display monitoring codes 13 and 14.
      - Code 13 is for the front pump and code 14 is for the rear pump.
      ii) With the starting switch kept at the ON position (G/O mode), measure the current when the fuel control dial is turned to the MAX position.
      - Current with starting switch ON (G/O mode) and fuel control dial at MAX
        : 520 ± 80 (mA)

- **Governor control system**
  1. Check input signal
     1) Check fuel control dial input voltage
        i) Set to the monitoring mode, and display monitoring code 30.
        ii) Measure the voltage when the fuel control dial is turned from low idling to high idling.
            ★ Voltage: 0.25 – 4.75 V
     2) Check governor potentiometer voltage
        i) Set to the monitoring mode, and display monitoring code 31.
        ii) Measure the potentiometer voltage when the fuel control dial is turned from low idling to high idling.
            ★ Voltage: 0.5 – 3.3 V

  2. Check output signal
     1) Check governor motor drive current
        i) Set to the monitoring mode, and display monitoring codes 33 and 34.
           ★ Code 33 is the A phase (engine speed acceleration direction) and code 34 is the B phase (engine speed deceleration direction)
        ii) Measure the governor motor drive current when the fuel control dial is turned in the acceleration direction and deceleration direction.
            ★ Current: 700 ± 70 (mA)

     2) Measure battery relay drive output voltage
        i) Set to the monitoring mode, and display monitoring code 35.
        ii) Measure the battery relay drive output voltage when the starting switch is turned from ON to OFF.
            or
        iii) Set to the monitoring mode, and display monitoring code 37.
        iv) Check that bit (1) lights up when the starting switch is turned from ON to OFF.

SERVICE CODE TABLE

Service code	Abnormal system	User code
E101	Abnormality in error history data	
E102	Abnormality in time data	
E103	Short circuit in buzzer output, contact with 24V wiring harness for buzzer drive	
E104	Air cleaner clogging detected	
E106	Abnormality in engine oil pressure sensor (Hi) detected	
E108	Water temperature over 105°C	
E112	Short circuit in wiper motor drive normal rotation system	
E113	Short circuit in wiper motor drive reverse rotation system	
E114	Short circuit in window washer drive system	
E203	Short circuit in swing holding brake solenoid system	E03
E204	Short circuit in pump merge/divider solenoid system	
E206	Short circuit in travel speed solenoid system	
E207	Short circuit in active mode (boom) solenoid system	
E208	Disconnection in active mode (boom) solenoid system	
E213	Disconnection in swing holding brake solenoid system	E03
E214	Disconnection in pump merge/divider solenoid system	
E216	Disconnection in travel speed solenoid system	
E217	Error in model selection input	
E218	Network response overtime error	
E222	Short circuit in LS-EPC solenoid system	
E223	Disconnection in LS-EPC solenoid system	
E224	Abnormality in F pump pressure sensor system	
E225	Abnormality in R pump pressure sensor system	
E226	Abnormality in pressure sensor system power source	
E227	Abnormality in engine speed sensor	
E231	Short circuit in active mode (swing) solenoid system	
E232	Short circuit in F pump TVC solenoid system	E02
E233	Disconnection in F pump TVC solenoid system	E02
E235	Disconnection in active mode (swing) solenoid system	
E236	Short circuit in R pump TVC solenoid system	E02
E237	Disconnection in R pump TVC solenoid system	E02
E306	Abnormality in feedback potentiometer system	
E308	Abnormality in fuel control dial input value	E05
E313	Error in auto-greasing controller (option)	
E315	Short circuit in battery relay output system	
E316	Step-out in governor motor	
E317	Disconnection in governor motor system	E05
E318	Short circuit in governor motor system	E05

TROUBLESHOOTING OF COMMUNICATION ABNORMALITY SYSTEM
(N MODE)

N-1 [E218] Communication abnormality

★ This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code E is not displayed, the problem has been removed.

★ If the starting switch was turned off after the abnormality occurred, turn the starting switch on and check that the service code displays E. (If it is not displayed, the problem has been removed.)

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

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

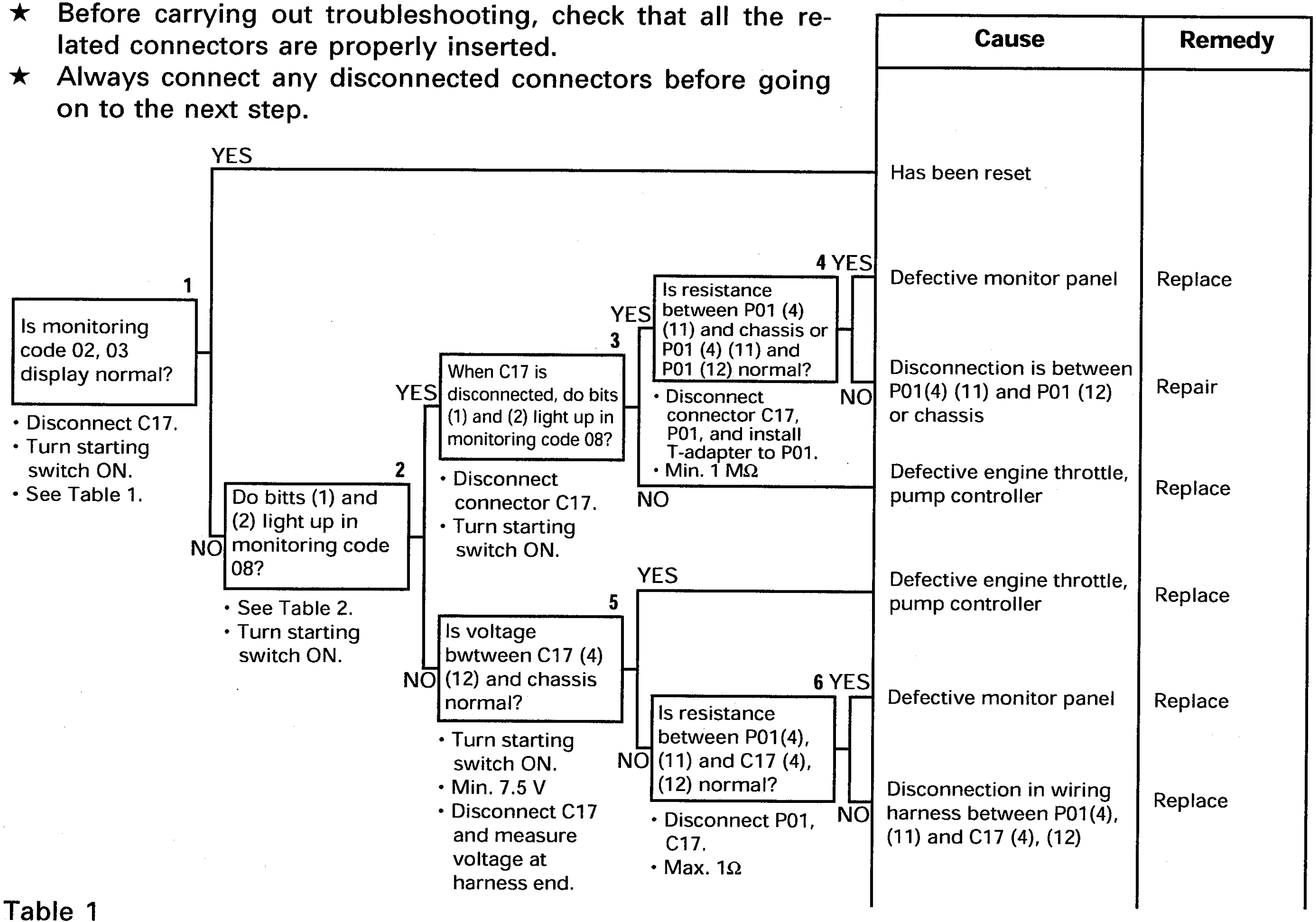
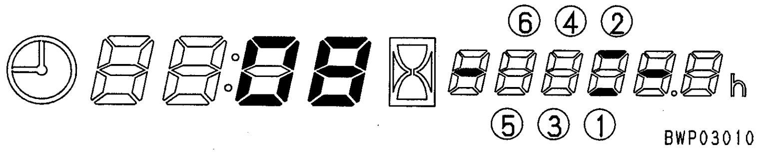


Table 1

Monitoring code		Display
01	Monitor panel model code	400
02	Engine throttle, pump controller model code	400
03	Engine throttle, pump controller model code	400

- When each controller is connected to the network, "—" is displayed. If the correct alphanumerics are not displayed (another model is displayed), each controller shows model selection abnormal.

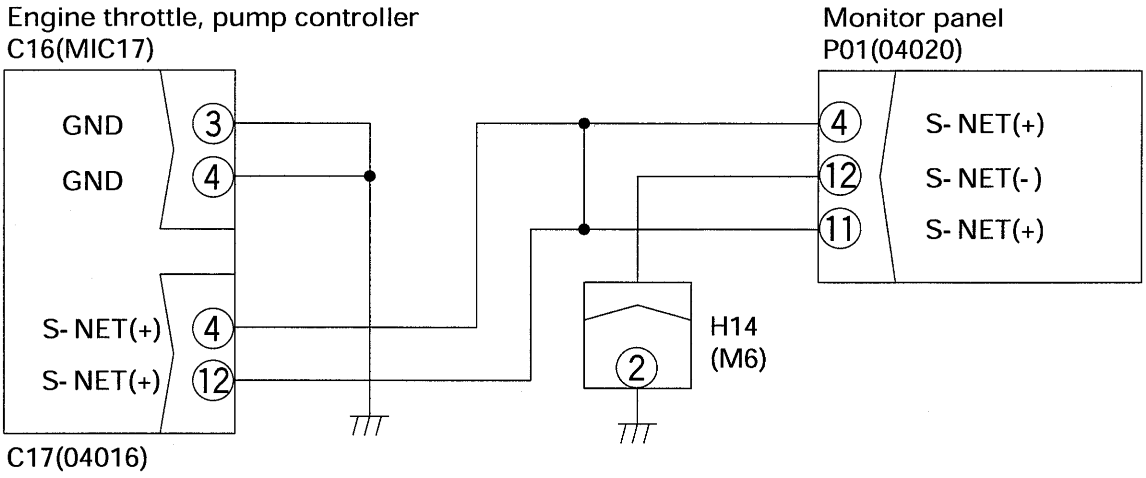
Table 2

Monitoring code		Display
08	Network connection condition	

- Light up when connected
  (1) Engine throttle, pump controller
  (2) Engine throttle, pump controller

- Note: Checks can be carried out with code 08 only when there is a disconnection. The display does not change when there is a short circuit.
  Therefore, checks when there is a short circuit should be carried out basically using Table 1.

N-1 Related electric circuit diagram



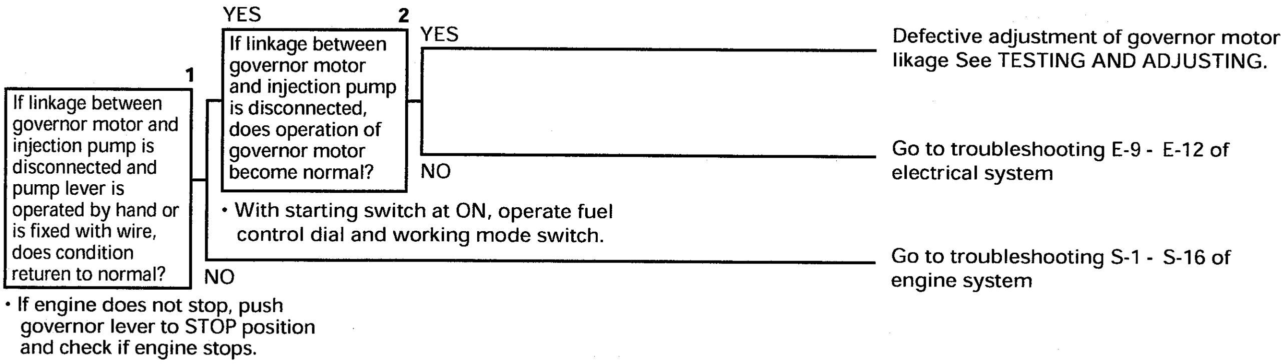
BKP00092

TROUBLESHOOTING OF ENGINE THROTTLE, PUMP CONTROLLER (GOVERNOR CONTROL SYSTEM) (E MODE)

POINTS TO REMEMBER WHEN CARRYING OUT TROUBLESHOOTING OF ENGINE THROTTLE, PUMP CONTROLLER SYSTEM

1. **Points to remember when there is abnormality which is not displayed by user code**
The engine is controlled by the engine throttle, pump controller.
The problems that may occur with this system include the following.
    1. Idling speed is too high (too low)
    2. High idling speed is too low
    3. Auto-deceleration speed is too high (too low)
    4. Engine speed for automatic warming-up operation is too high (too low)
    5. There is hunting
    6. Engine does not stop

If any abnormality occurs, and the abnormality is displayed on the time display portion of the monitor panel, use the troubleshooting table to determine the appropriate troubleshooting flow chart from E-1 to E-12.However, if there is any abnormality in the machine and no abnormality display is given, it is necessary to determine whether the problem is in the mechanical system or in the electrical system. If the linkage between the governor motor and the injection pump is not properly adjusted, problems 1 to 6 listed above may occur. Therefore, if there is no abnormality display, but one of problems 1 to 6 above has occurred, carry out troubleshooting as follows.



• With starting switch at ON, operate fuel control dial and working mode switch.

• If engine does not stop, push governor lever to STOP position and check if engine stops.

Disconnect the linkage as explained above, or check the adjustment and go to the troubleshooting flow chart for the mechanical system or electrical system.
For details of the procedure for adjusting the linkage, see TESTING AND ADJUSTING.

2. **Points to remember if abnormality returns to normal by itself**
In the following two cases, there is a high probability that the same problem will occur again, so it is desirable to follow up this problem carefully.
    1) If any abnormality returns to normal by itself, or
    2) If the connector is disconnected and the T-adapter is inserted, or if the T-adapter is removed and the connector is returned to its original position when carrying out troubleshooting of the failure, and the service code is no longer displayed, or if the monitor display returns to normal.
    3) After completing troubleshooting, always erase the service code from memory.

3. **User code memory retention function**
When displaying the abnormality code in memory and carrying out troubleshooting, note down the content of the display, then erase the display. After trying to re-enact the problem, carry out troubleshooting according to the failure code that is displayed.
(There are cases where mistaken operation or abnormalities that occur when the connector is disconnected are recorded by the memory retention function. Erasing the data in this way saves any wasted work.)

ACTION TAKEN BY CONTROLLER WHEN ABNORMALITY OCCURS AND PROBLEMS ON MACHINE

User code	Service code	Abnormal system	Nature of abnormality
E05	E308	Abnormality in fuel control dial input value	1. Short circuit in wiring harness between C03 (7) – (14), (7) – (17), (14) – (17) 2. Short circuit in wiring harness between E04 (1) – (2), (1) – (3), (2) – (3) 3. Short circuit in wiring harness between E06 (1) – (2), (1) – (3), (2) – (3) 4. Short circuit in wiring harness between C03 (7) – (4), (4) – (17) 5. Disconnection in wiring harness between C03 (7) – X07 (6) – E06 (1) 6. Disconnection in wiring harness between C03 (4) – X07 (5) – E06 (2) 7. Disconnection in wiring harness between C03 (17) – X07 (4) – E06 (3) 8. Defective fuel control dial 9. Defective contact of C03, X07, E06 connectors
	E317	Abnormality (disconnection) in motor drive system	1. Disconnection inside governor motor 2. Disconnection in wiring harness between C02 (2) – E05 (1) 3. Disconnection in wiring harness between C02 (4) – E05 (3) 4. Disconnection in wiring harness between C02 (3) – E05 (2) 5. Disconnection in wiring harness between C02 (5) – E05 (4) 6. Defective contact of E05 connector
	E318	Abnormality (short circuit) in motor drive system	1. Short circuit inside governor motor 2. Wiring harness between C02 (2) – E05 (1) and between C02 (4) – E05 (3) short circuiting with wiring harness between C02 (3) – E05 (2) 3. Wiring harness between C02 (4) – E05 (3) and between C02 (2) – E05 (1) short circuiting with wiring harness between C02 (5) – E05 (4) 4. Wiring harness in Items 2 and 3 short circuiting with ground

<table>
<tr><th>Condition when normal (voltage, current, resistance)</th><th>Action by controller when abnormality is detected</th><th>Problem that appears on machine when there is abnormality</th></tr>
<tr><td>
<table>
<tr><th>C03 (female)</th><th>E06 (male)</th><th>Resistance value</th></tr>
<tr><td>(7) – (4)</td><td>(1) – (2)</td><td>0.25 – 7kΩ</td></tr>
<tr><td>(4) – (17)</td><td>(2) – (3)</td><td>0.25 – 7kΩ</td></tr>
<tr><td>(7) – (17)</td><td>——</td><td>2 – 3kΩ</td></tr>
<tr><td>——</td><td>(1) – (3)</td><td>4 – 6kΩ</td></tr>
<tr><td>Between each pin and chassis</td><td>——</td><td>Min. 1 MΩ</td></tr>
</table>
</td><td>Maintains engine speed at position of fuel control dial immediately before abnormality occurred</td><td>1. Does not become partial speed when set at MAX position
2. Does not reach high idling when set at partial speed
3. There are cases of hunting
4. Lacks output (max. speed of engine is too low)</td></tr>
<tr><td>
<table>
<tr><th>E05 (male)</th><th>C02 (female)</th><th>Resistance value</th></tr>
<tr><td>(1) – (2)</td><td>(2) – (3)</td><td>0.25 – 7kΩ</td></tr>
<tr><td>(3) – (4)</td><td>(4) – (5)</td><td>0.25 – 7kΩ</td></tr>
<tr><td>(1) – (3)</td><td>(2) – (4)</td><td>Min. 1 MΩ</td></tr>
<tr><td>(1) – (4)</td><td>(2) – (5)</td><td>Min. 1 MΩ</td></tr>
<tr><td>Between pins (1), (2), (3), (4) and chassis</td><td>Between pins (2), (3), (4), and (5) and chassis</td><td>Min. 1 MΩ</td></tr>
</table>
Motor drive current: Hold: 0.7 A
Start: 0.84 A
</td><td>Takes no particular action</td><td>1. When there is a disconnection in both the A phase and B phase at the same time, the problem is the same as for a short circuit in the governor motor system
2. When there is a disconnection in only one of A phase or B phase
1) Engine does not stop
2) Stops moving at position immediately before failure, so engine speed cannot be controlled
3) There are cases of hunting</td></tr>
<tr><td>
<table>
<tr><th>E05 (male)</th><th>C02 (female)</th><th>Resistance value</th></tr>
<tr><td>(1) – (2)</td><td>(2) – (3)</td><td>0.25 – 7kΩ</td></tr>
<tr><td>(3) – (4)</td><td>(4) – (5)</td><td>0.25 – 7kΩ</td></tr>
<tr><td>(1) – (3)</td><td>(2) – (4)</td><td>Min. 1 MΩ</td></tr>
<tr><td>(1) – (4)</td><td>(2) – (5)</td><td>Min. 1 MΩ</td></tr>
<tr><td>Between pins (1), (2), (3), (4) and chassis</td><td>Between pins (2), (3), (4), and (5) and chassis</td><td>Min. 1 MΩ</td></tr>
</table>
Motor drive current: Hold: 0.7 A
Start: 0.84 A
</td><td>Sets motor drive current to 0</td><td>1. If during operation
1) Set to low idling
2) Engine does not stop
3) There are cases of hunting
2. When stopped
1) Engine starts, but stays at low idling
2) Engine does not stop after starting
3) There are cases of hunting</td></tr>
</table>

User code	Service code	Abnormal system	Nature of abnormality
—	E306	Abnormality in feedback potentiometer system	1. Short circuit in wiring harness between C03 (7) – (14), (7) – (17), (14) – (17) 2. Short circuit in wiring harness between E04 (1) – (2), (1) – (3), (2) – (3) 3. Short circuit in wiring harness between E06 (1) – (2), (1) – (3), (2) – (3) 4. Short circuit in wiring harness between C03 (7) – (4), (4) – (17) 5. Disconnection in wiring harness between C03 (7) – E04 (1) 6. Disconnection in wiring harness between C03 (14) – E04 (2) 7. Disconnection in wiring harness between C03 (17) – E04 (3) 8. Defective governor motor potentiometer 9. Defective contact of C03, E04 connectors
—	E315	Abnormality (short circuit) in battery relay output system	If excess current flows between C03 (1) and battery relay ★ This occurs only when turning starting switch to OFF and stopping engine
—	E316	Abnormality (step-out) in motor	1. Defective adjustment of rod or scuffing of loose spring
			2. Abnormality in governor motor
			3. Abnormality in engine throttle, pump controller

<table>
<tr><th>Condition when normal
(voltage, current, resistance)</th><th>Action by controller when abnormality is detected</th><th>Problem that appears on machine when there is abnormality</th></tr>
<tr><td><table>
<tr><th>C03
(female)</th><th>E04
(male)</th><th>Resistance value</th></tr>
<tr><td>(7) – (14)</td><td>(1) – (2)</td><td>0.25 – 7kΩ</td></tr>
<tr><td>(7) – (17)</td><td>(2) – (3)</td><td>0.25 – 7kΩ</td></tr>
<tr><td>(14) – (17)</td><td>——</td><td>2 – 3kΩ</td></tr>
<tr><td>——</td><td>(1) – (3)</td><td>4 – 6kΩ</td></tr>
<tr><td>Between each pin and chassis</td><td>——</td><td>Min. 1 MΩ</td></tr>
</table></td><td>Calculates position of motor and carries out control from value of voltage immediately before abnormality occurred</td><td>1. Precision of engine speed control may be reduced.
For example:
1) Engine does not rise to high idling speed (a little too low)
2) Engine does not go down to low idling speed (a little too high)
3) Defective engine speed for auto-deceleration or automatic warming-up
4) Engine may not stop
★ The governor motor moves in the direction to stop the engine, but the motor may not move completely to the position to stop the engine.
5) There are cases of hunting</td></tr>
<tr><td>Between C03 (1) and chassis: 20 – 30 V
★ Holds with the motor in the stop position for 2 – 2.5 sec, returns to the low idling position, then turns the battery relay OFF.</td><td>Sets battery relay drive current to 0</td><td>Engine does not stop</td></tr>
<tr><td>1. Linkage adjustment correct</td><td rowspan="3">1. Displays when returning from high idling to low idling
★ Starts again (repeats step-out)
2. In some cases it may not display when returning from partial speed to low idling</td><td rowspan="3">Engine speed cannot be controlled (particularly at high idling), so there is hunting</td></tr>
<tr><td>2. Must move lightly when connector is removed</td></tr>
<tr><td>3. Normal</td></tr>
</table>

JUDGEMENT TABLE FOR ENGINE THROTTLE, PUMP CONTROLLER (GOVERNOR CONTROL SYSTEM) AND ENGINE RELATED PARTS

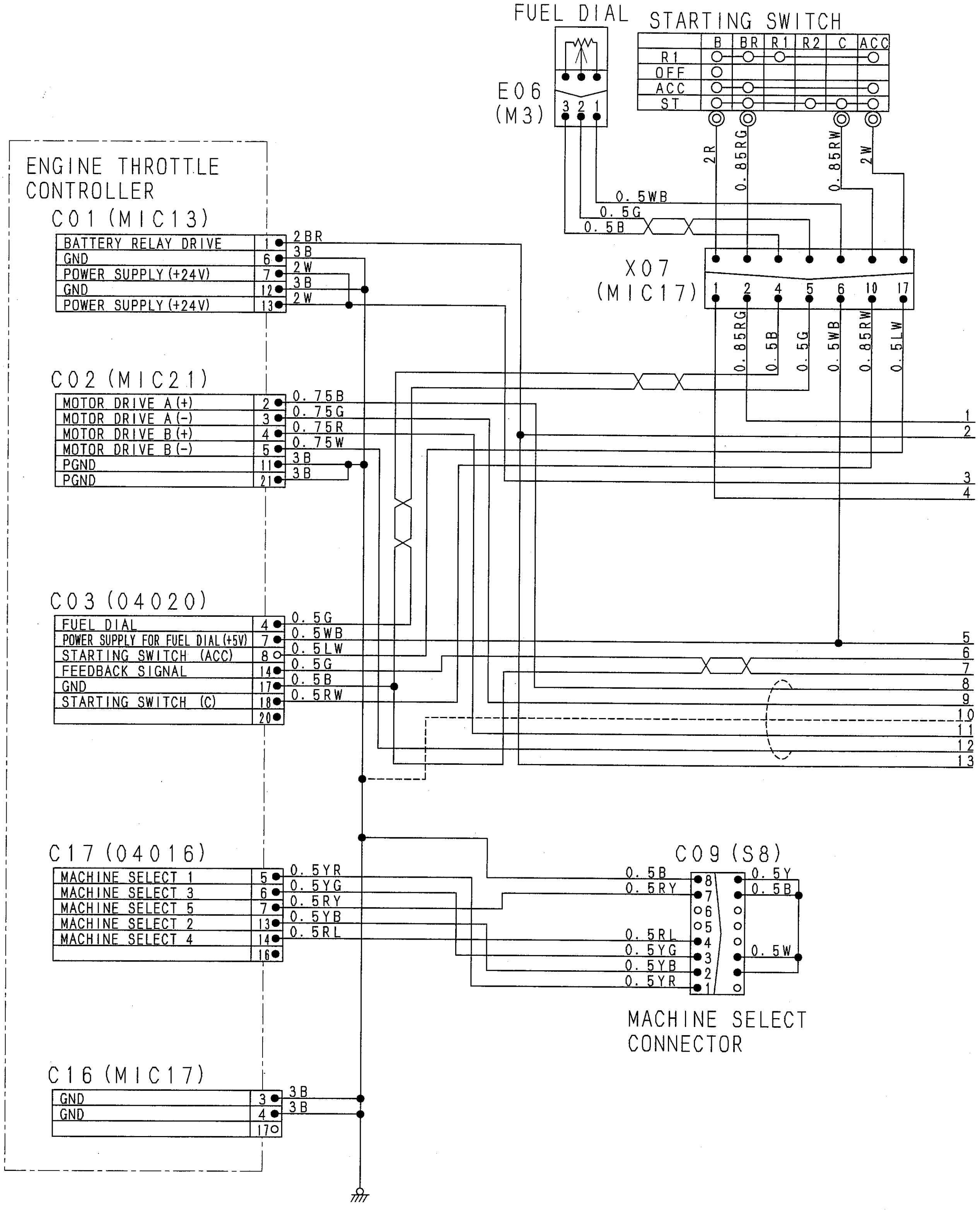
				Engine throttle, pump controller, engine related parts (E3: system)					
				Self-diagnostic display					
			Abnormality in engine throttle, pump controller power source	system	Abnormality in fuel control dial input value	Abnormality (disconnection) in motor drive system	Abnormality (short circuit) in motor drive system	Abnormality in feedback potentiometer system	Abnormality (short circuit) in battery relay output
Failure mode		User code		E05					
		Service code		308	317	318	306	315	316
1	Engine does not start easily								
2	Engine does not start								
3	Engine speed stays at low idling, and does not follow accelerator; or engine pickup is poor		●	●	●	●	●		
4	Engine stops during operation								
5	Engine rotation is irregular	When idling speed is irregular							
		When there is hunting		●	●	●	●		●
6	Lack of output (engine high idling speed is too low)			●			●		
7	Auto-deceleration does not work								
8	Engine does not stop		●		●	●	●	●	
9	Warming-up operation is defective								
10	Exhaust gas is black								
11	Oil consumption is excessive, or exhaust gas is blue								
12	Oil becomes dirty prematurely								
13	Fuel consumption is excessive, or exhaust gas is blue								
14	Oil is mixed in coolant								
15	Engine oil pressure caution lamp lights up								
16	Oil level rises								
17	Coolant temperature rises too high (overheating)								
18	Abnormal noise is generated								
19	There is excessive vibration								
20	Engine speed does not change even when working mode is switched								
Troubleshooting code when service code is displayed			E-1	E-2	E-3	E-4	E-5	E-6	E-7
Troubleshooting code when there is abnormality in monitoring or machine monitor check			—	—	—	—	—	—	—

● : This shows applicable item for service code
※ : This shows item that needs only checking with monitoring

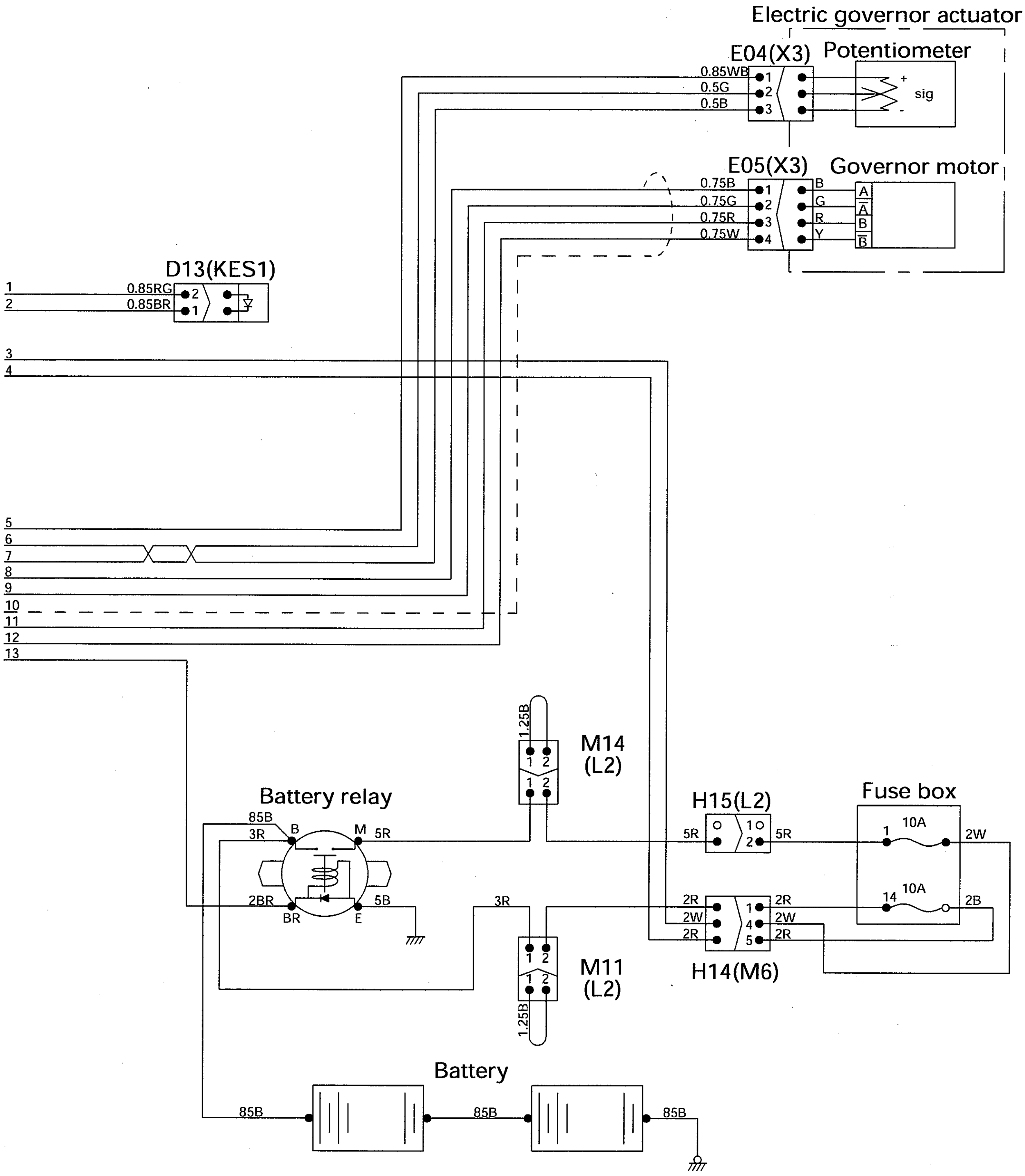
Checking monitoring, check items							Machine monitor check item			Troubleshooting code if no service code display is given
Battery relay drive signal	No. 2 throttle command value	Fuel control dial command value	Governor motor potentiometer	Governor motor A phase current	Governor motor B phase current	Coolant temperature voltage	Is red range displayed?		Does starting motor turn?	
							102°C or above	105°C or above		
Monitoring code										
35	16	30	31	33	34	41		108		
										S-1
									○	S-2
		※	※	※	※			○		S-3
										S-4
										E-9 a), S-5
			※							E-9 a), S-5
	※	※				○				E-10, S-6
										E-3 · E-4
○				※	※					E-11
						○		○		E-3 · E-4
										S-7
										S-8
										S-9
										S-10
										S-11
										S-12
										S-13
						○	○			S-14
										S-15
										S-16
	※									E-3 · E-4
—	—	—	—	—	—	—	—	—	—	
E-12	—	—	—	—	—	M-14	M-13	M-13	E-8	

○ : This shows item to check with monitoring or machine monitor

ELECTRICAL CIRCUIT DIAGRAM FOR E MODE SYSTEM



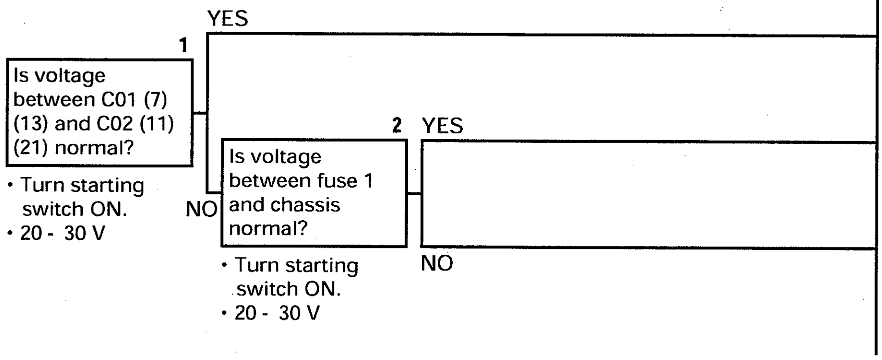
TWP01409


Electric governor actuator
E04(X3)
Potentiometer
0.85WB
0.5G
0.5B
1
2
3
+
sig
-
E05(X3)
Governor motor
0.75B
0.75G
0.75R
0.75W
1
2
3
4
B
G
R
Y
A
A
B
B
D13(KES1)
0.85RG
0.85BR
2
1
1
2
3
4
5
6
7
8
9
10
11
12
13
1.25B
M14
(L2)
1 2
1 2
Battery relay
85B
3R
B
M
5R
2BR
BR
5B
E
3R
H15(L2)
5R
1
2
5R
Fuse box
1
10A
2W
14
10A
2B
2R
2W
2R
1
4
5
2R
2W
2R
H14(M6)
M11
(L2)
1 2
1 2
1.25B
Battery
85B
85B
85B

BKP00095

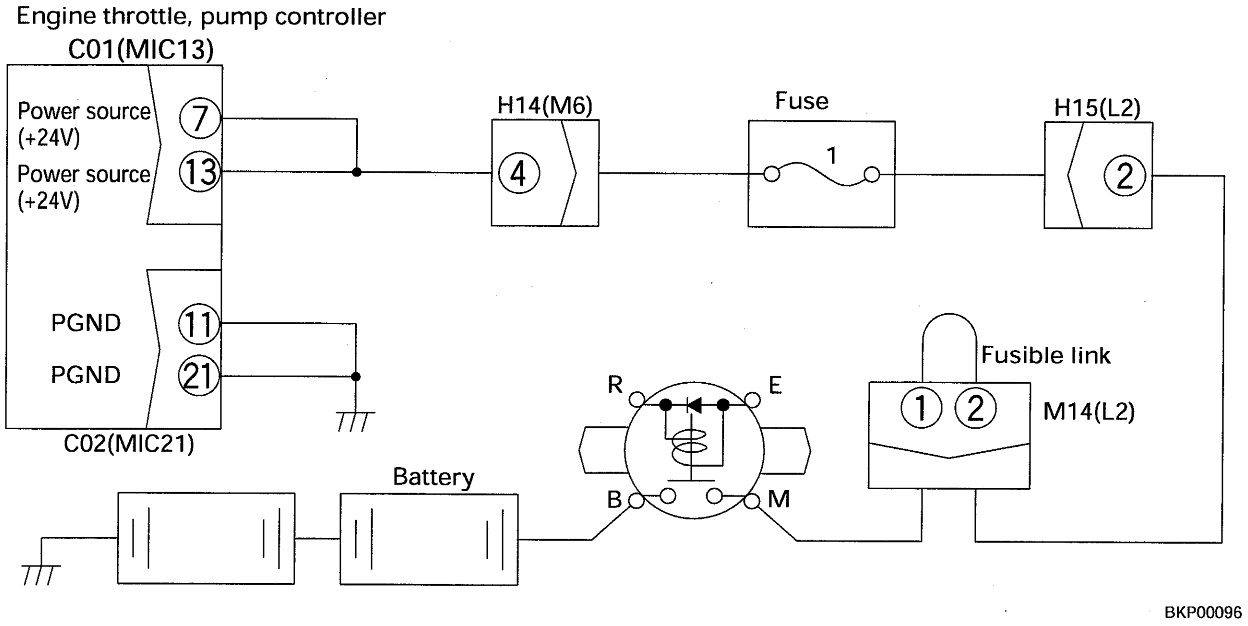
E-1 Abnormality in engine throttle, pump controller power source (controller LED is OFF)

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code E is not displayed, the problem has been removed.**
- ★ Check that fuse 1 is not blown.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.
- ★ When the starting motor rotates correctly. (If the starting motor also does not rotate, go to E-8.)



Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective contact, or disconnection in wiring harness between fuse 1 and C01 (female) (7) (13)	Repair or replace
Defective contact, or disconnection in wiring harness between fuse 1- H15 (2)- M14 (2) (1)- battery relay M	Repair or replace

E-1 Related electric circuit diagram

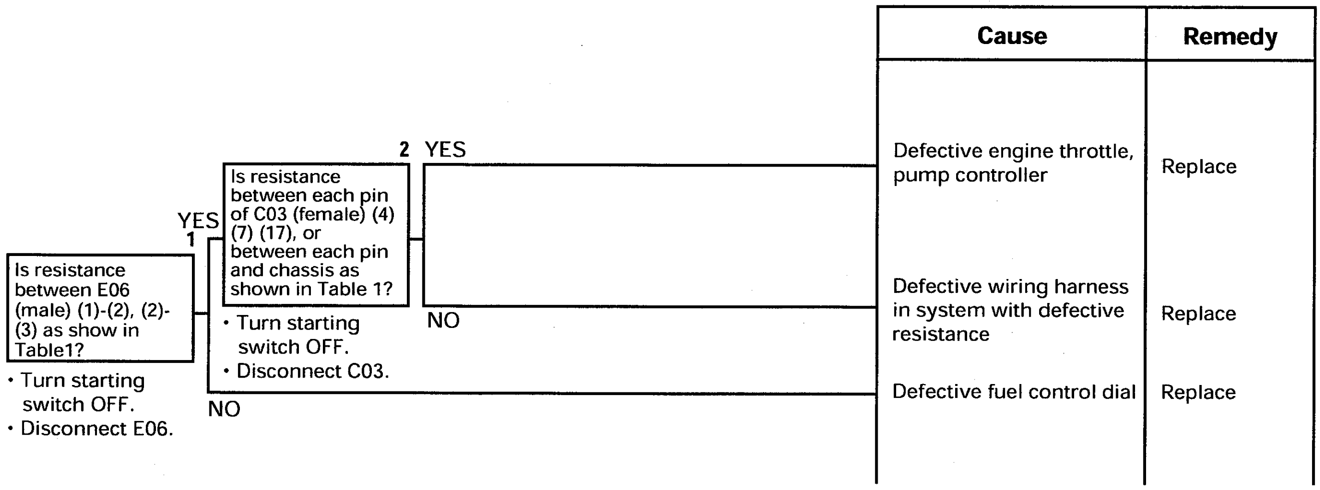


E-2 [E308] Abnormality in fuel control dial input value is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code E is not displayed, the problem has been removed.**

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

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



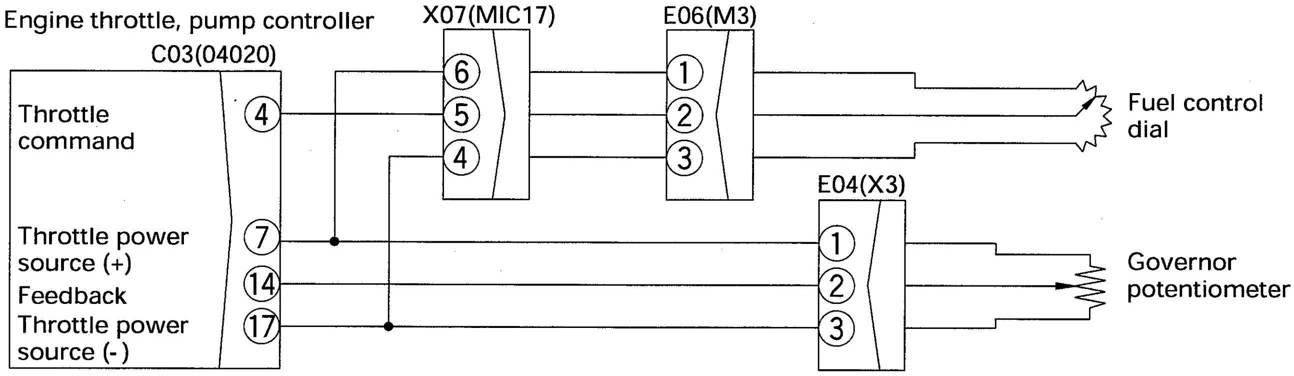
★ If E306 also occurs at the same time, check the wiring harness below.

- Wiring harness between C03 (female) (7) – E04 (female) (1) short circuiting with ground, or contact with other wiring harness

Table 1

C03 (female)	E04 (male)	Resistance value
(7) – (4)	(1) – (2)	0.25 – 7kΩ
(4) – (17)	(2) – (3)	0.25 – 7kΩ
(7) – (17)	——	2 – 3kΩ
——	(1) – (3)	4 – 6kΩ
Between each pin and chassis	——	Min. 1 MΩ

E-2 Related electric circuit diagram



BKP00097

E-3 [E317] Abnormality (disconnection) in motor drive system is displayed

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code E is not displayed, the problem has been removed.**
- ★ During operation, if there is
  1) a simultaneous disconnection in A phase and B phase:
     1) the engine will run at low idling
     2) the engine will not stop
  2) a disconnection in either A phase or B phase, the engine speed will remain the same as before the abnormality occurred
- ★ If the problem occurs when the engine is stopped,
  1) the engine can be started, but it stays in low idling, or 2) it will not stop after it is started.
- ⚠ Check with the engine stopped (push the fuel control lever of the fuel injection pump to the NO INJECTION position).
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.

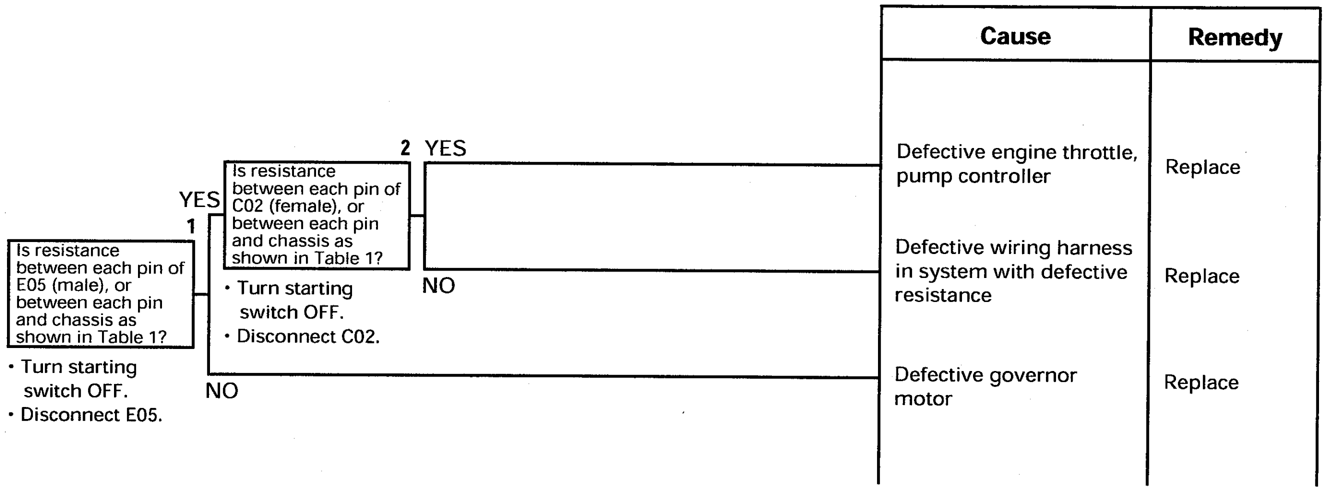
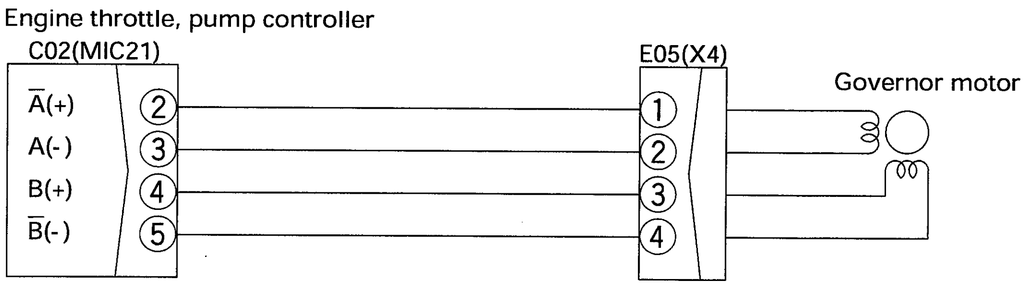


Table 1

E05 (male)	C02 (female)	Resistance value
(1) – (2)	(2) – (3)	2.5 – 7.5 Ω
(3) – (4)	(4) – (5)	2.5 – 7.5 Ω

E-3 Related electric circuit diagram



BKP00098

E-4 [E318] Abnormality (short circuit) in motor drive system is displayed

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code E is not displayed, the problem has been removed.**
- ★ If the abnormality occurs during operation, because of the force of the spring,
  1) the engine will run at low idling
  2) the engine will not stop
- ★ If the problem occurs when the engine is stopped,
  1) the engine can be started, but it stays in low idling, or 2) it will not stop after it is started.
- ⚠ Check with the engine stopped (push the fuel control lever of the fuel injection pump to the NO INJECTION position).
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.

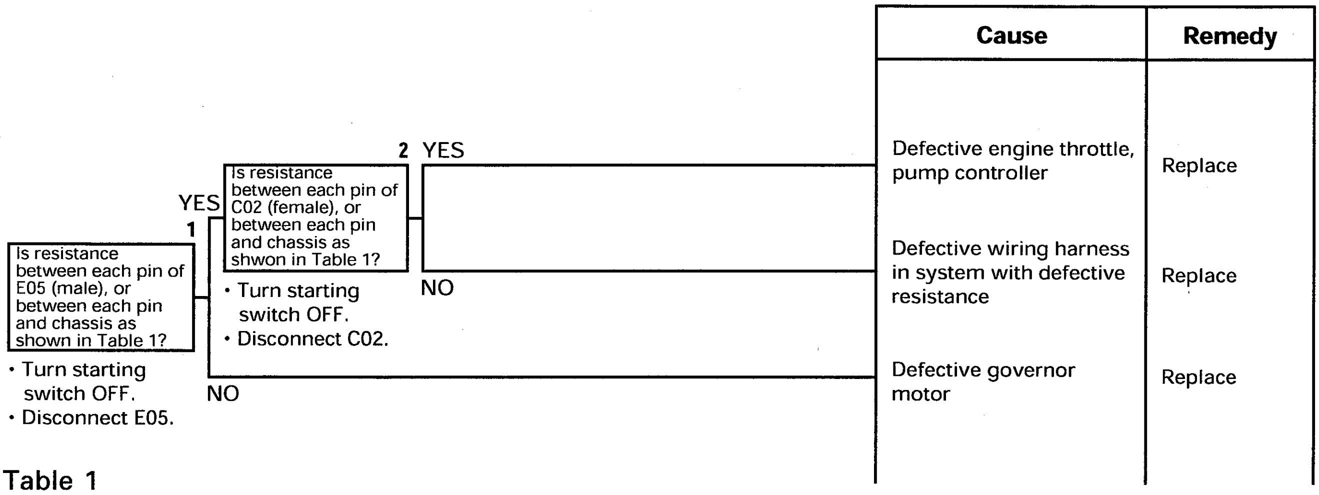
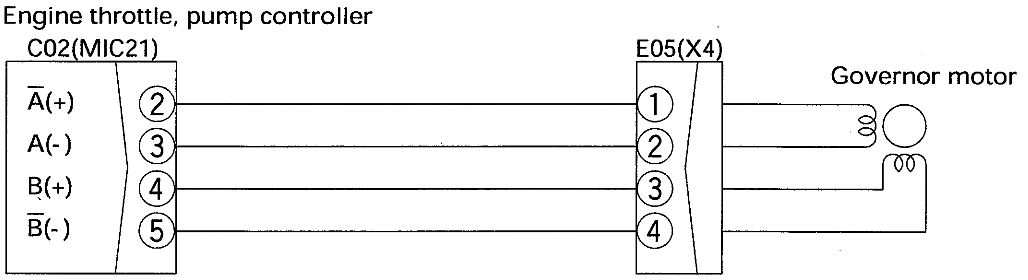


Table 1

E05 (male)	C02 (female)	Resistance value
(1) – (2)	(2) – (3)	2.5 – 7.5 Ω
(3) – (4)	(4) – (5)	2.5 – 7.5 Ω
(1) – (3)	(2) – (4)	Min. 1 MΩ
(1) – (4)	(2) – (5)	Min. 1 MΩ
Between chassis and pins (1)(2)(3)(4)	Between chassis and pins (2)(3)(4)(5)	Min. 1 MΩ

E-4 Related electric circuit diagram



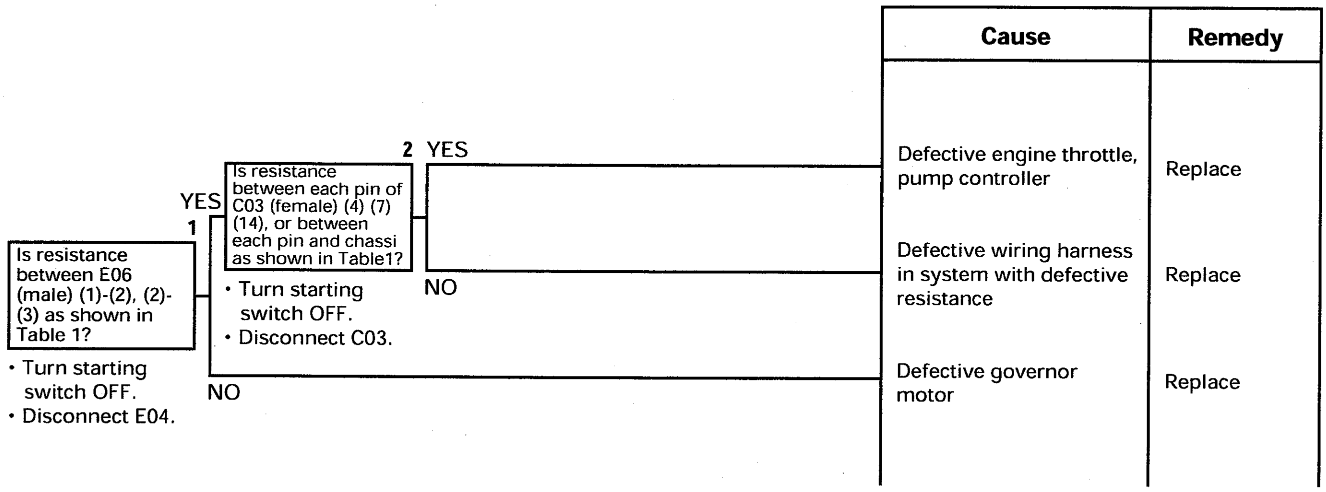
BKP00098

E-5 [E306] Abnormality in feedback potentiometer system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code E is not displayed, the problem has been removed.**

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

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

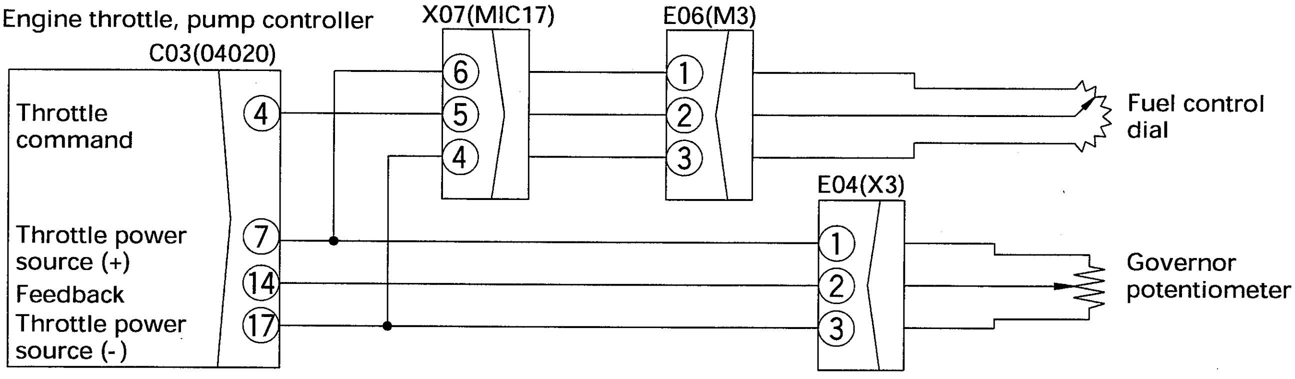


★ If E308 also occurs at the same time, check the wiring harness below.
- Wiring harness between C03 (female) (7) – X07 (6) – E06 (female) (1) short circuiting with ground, or contact with other wiring harness

Table 1

C03 (female)	E04 (male)	Resistance value
(7) – (4)	(1) – (2)	0.25 – 7kΩ
(14) – (17)	(2) – (3)	0.25 – 7kΩ
(7) – (17)	——	2 – 3kΩ
——	(1) – (3)	4 – 6kΩ
Between each pin and chassis	——	Min. 1 MΩ

E-5 Related electric circuit diagram



E-6 [E315] Abnormality (short circuit) in battery relay output system is displayed

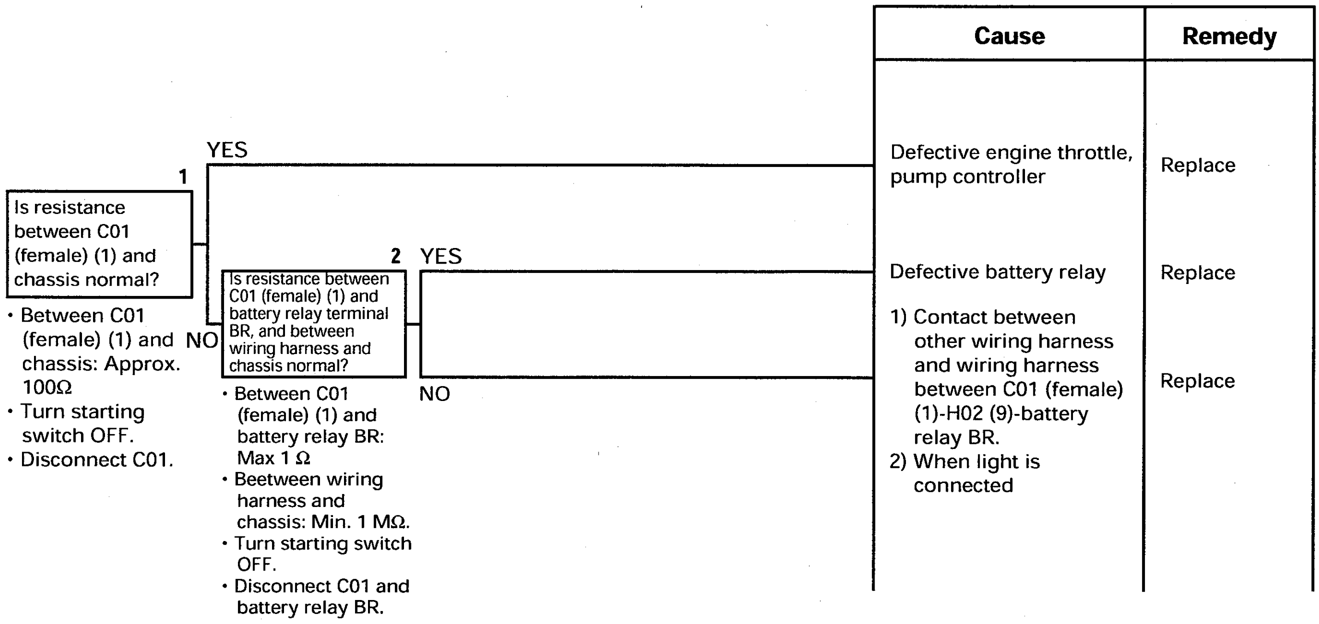
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code E is not displayed, the problem has been removed.**

⚠ Check with the engine stopped (push the fuel control lever of the fuel injection pump to the NO INJECTION position).

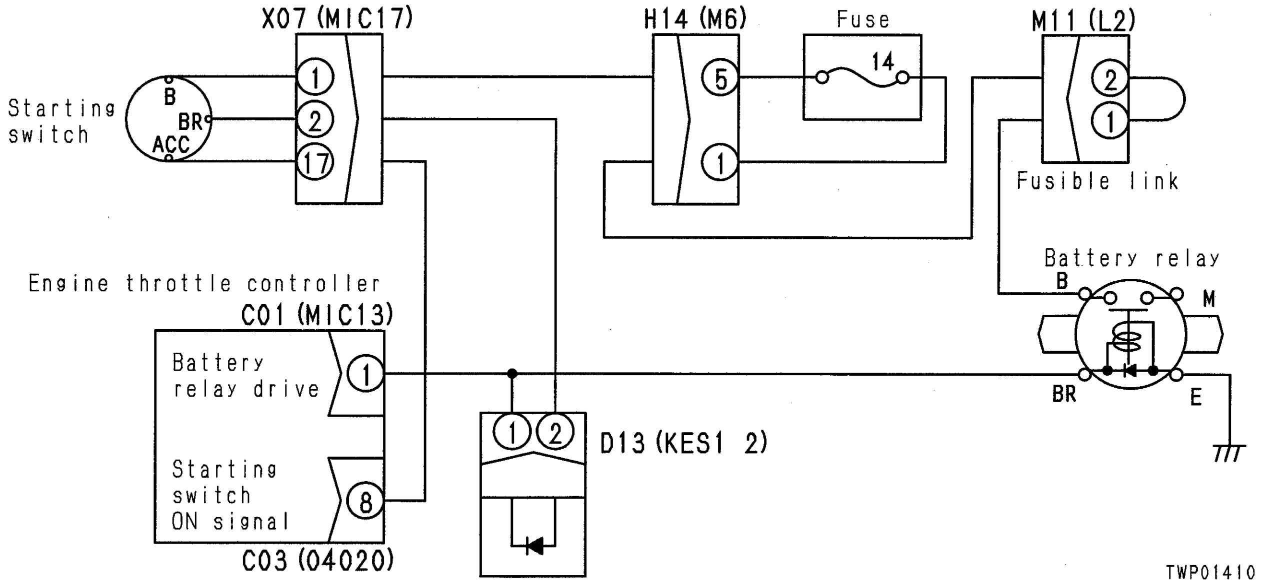
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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

★ This only occurs when the engine is stopped and the starting switch is turned OFF.

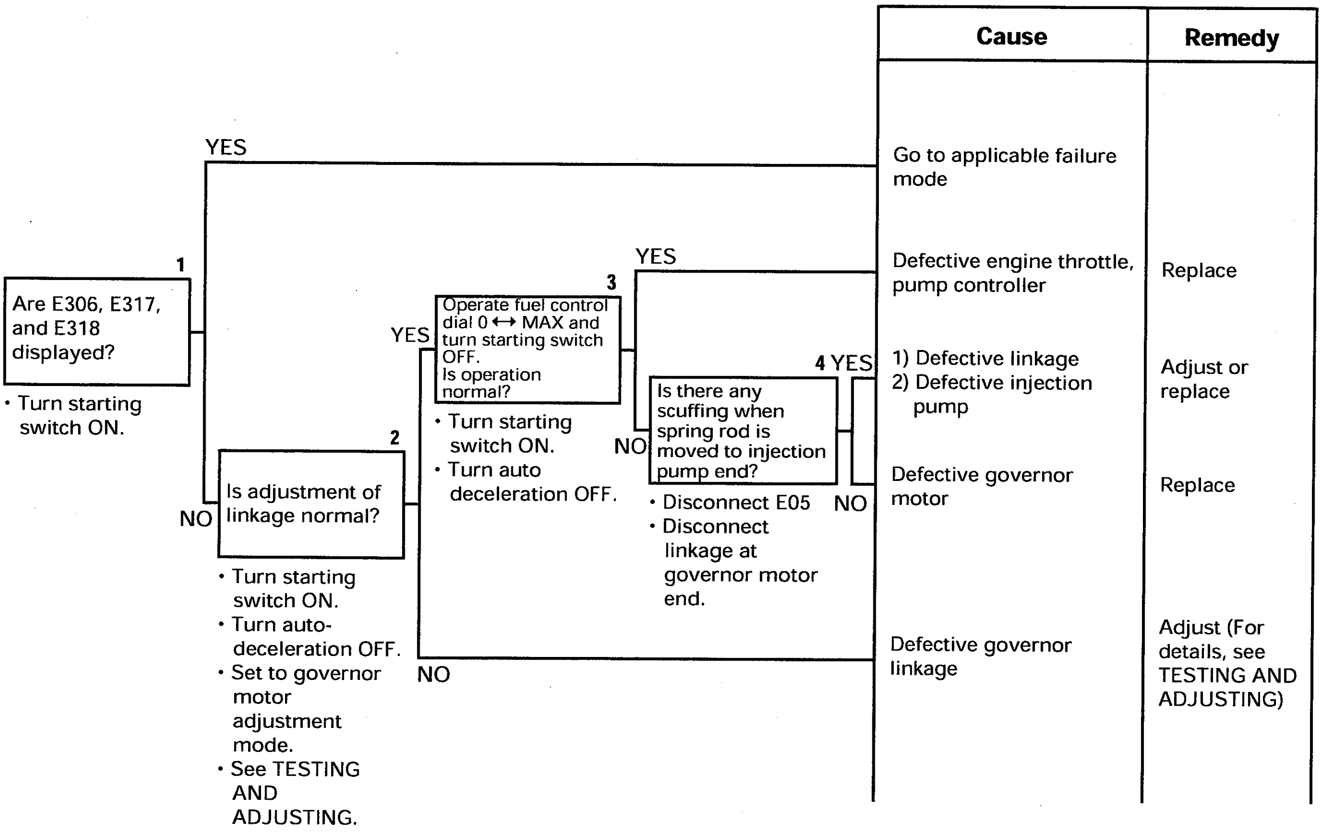


E-6 Related electric circuit diagram



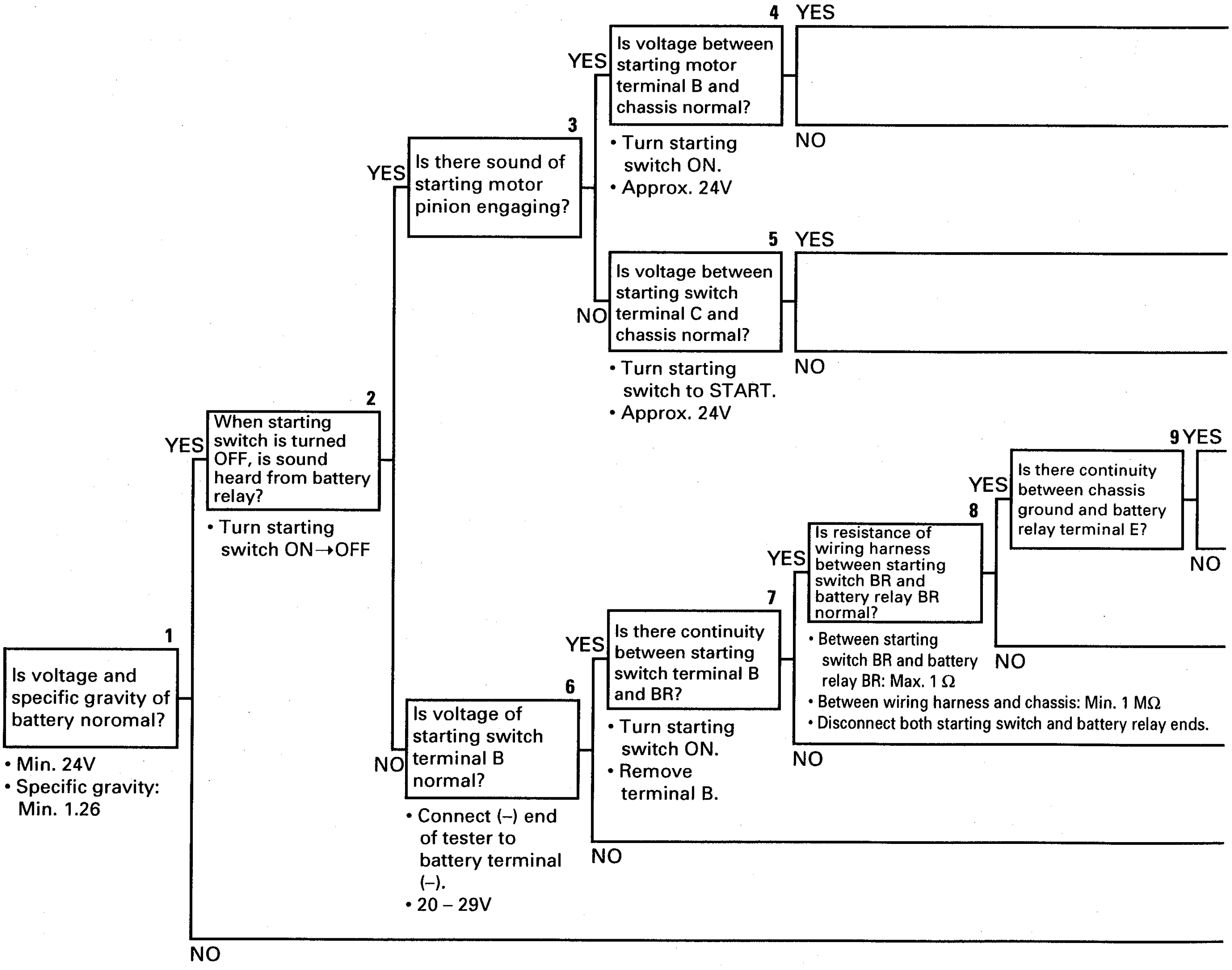
E-7 [E316] Abnormality (step-out) in motor is displayed

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the service code E is not displayed, the problem has been removed.**
- ★ If any other service code [E306] – [E318] has occurred at the same time, start troubleshooting from the code except code[E316].
- ★ Check that the fuse is normal.
- ★ Read the precautions given in TESTING AND ADJUSTING, "Adjusting travel of governor motor lever" before carrying out the troubleshooting.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.



E-8 Engine does not start

- ★ When starting motor does not rotate.
- ★ Check that fuse No. 14 is not blown before starting troubleshooting.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.



1 Is voltage and specific gravity of battery noromal?
- Min. 24V
- Specific gravity: Min. 1.26

2 When starting switch is turned OFF, is sound heard from battery relay?
- Turn starting switch ON→OFF

3 Is there sound of starting motor pinion engaging?

4 Is voltage between starting motor terminal B and chassis normal?
- Turn starting switch ON.
- Approx. 24V

5 Is voltage between starting switch terminal C and chassis normal?
- Turn starting switch to START.
- Approx. 24V

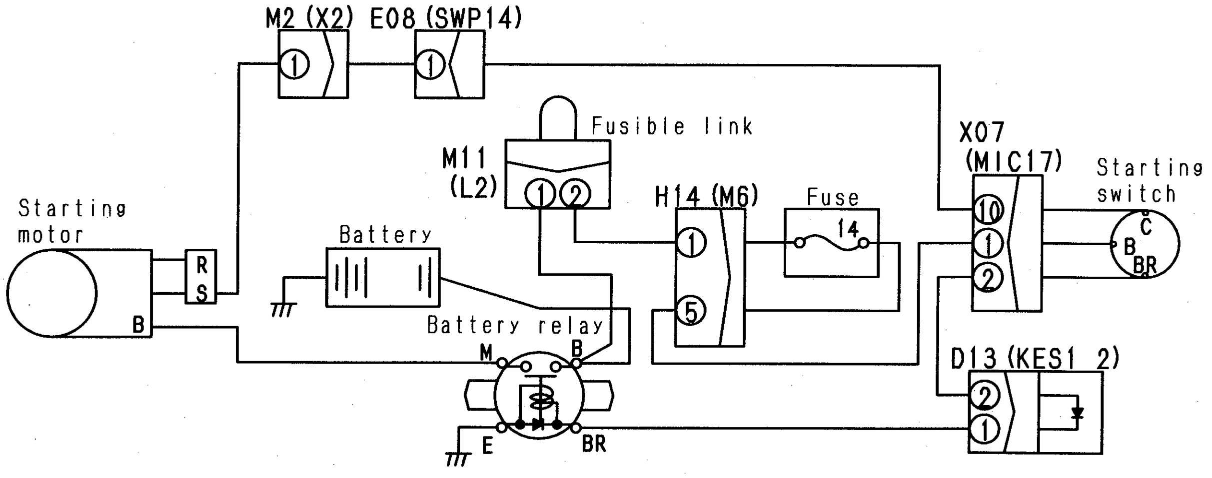
6 Is voltage of starting switch terminal B normal?
- Connect (–) end of tester to battery terminal (–).
- 20 – 29V

7 Is there continuity between starting switch terminal B and BR?
- Turn starting switch ON.
- Remove terminal B.

8 Is resistance of wiring harness between starting switch BR and battery relay BR normal?
- Between starting switch BR and battery relay BR: Max. 1 Ω
- Between wiring harness and chassis: Min. 1 MΩ
- Disconnect both starting switch and battery relay ends.

9 Is there continuity between chassis ground and battery relay terminal E?

E-8 Related electric circuit diagram



TWP01411

Cause	Remedy
Defective starting motor	Replace
Defective contact of wiring harness between battery (+)–battery relay B–battery relay M–starting motor terminal B (including battery relay)	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal C–X07 (10)–E08 (1) –M2 (1)–starting motor terminal S	Replace
Defective starting switch (between terminals B and C)	Replace
Defective battery relay	Replace
Defective contact of wiring harness between battery relay terminal E and revolving frame grond connection terminal	Replace
Defective contact, or disconnection in wiring harness between starting switch terminal BR–D13–battery relay terminal BR	Replace
Defective starting switch (between B and BR)	Replace
Defective contact, or disconnection in wiring harness between battery terminal (+)–M11–H05 (6)–X07 (1)-starting switch terminal B (including fusible link)	Replace
Lack of battery capacity	Charge or replace

E-9 Engine speed is irregular

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

a) Idling speed is irregular

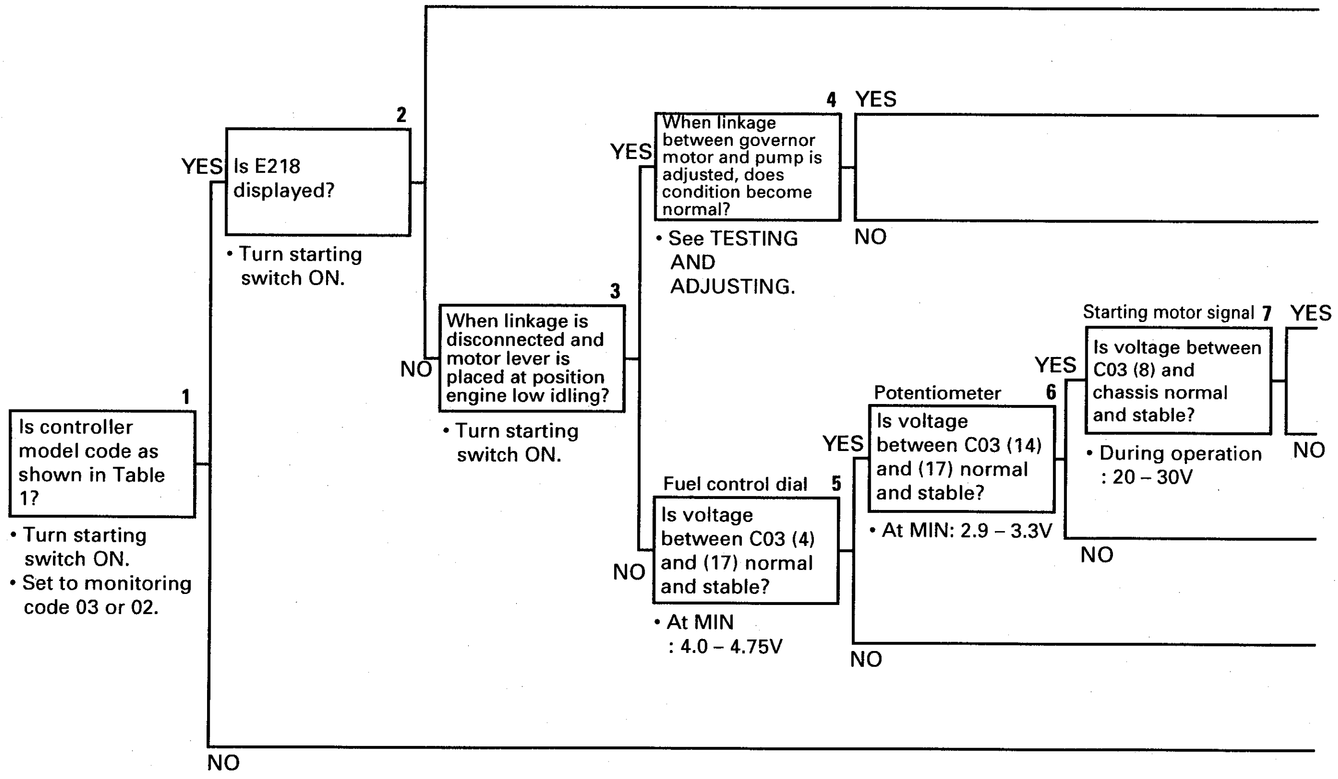


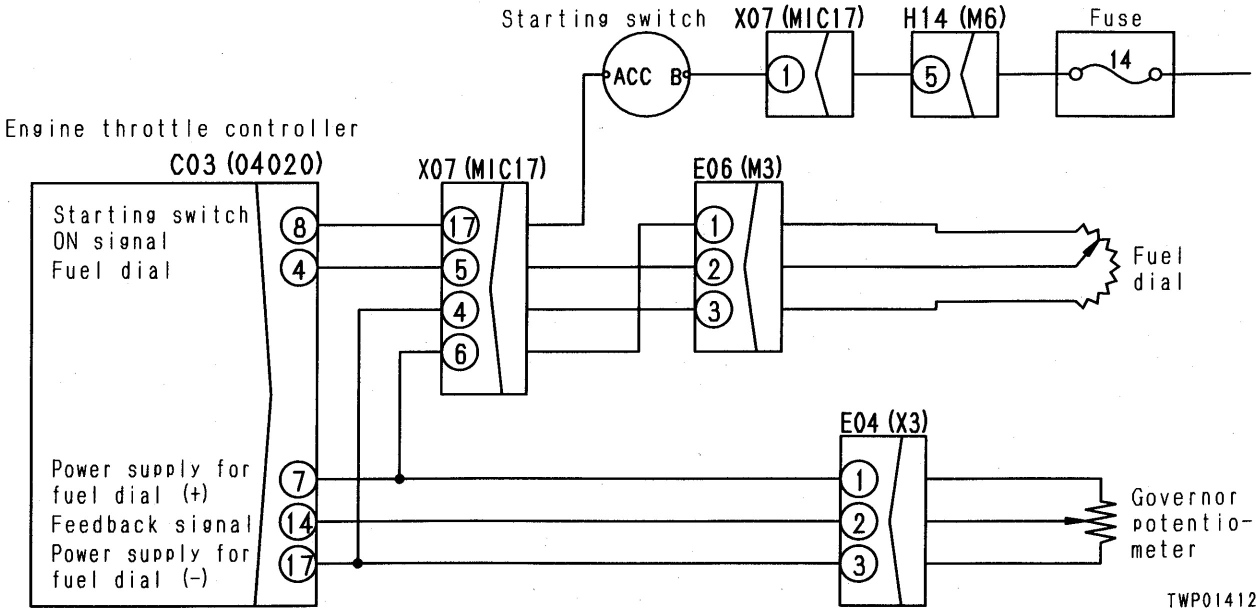
Table 1

Controller model code


★ The diagram shows monitoring code 03.

Cause	Remedy
See N mode	
Defective adjustment of linkage	Adjust
Defective injection pump	See S mode
Defective governor motor	Replace
Defective contact of wiring harness between starting switch ACC–X07 (17)–C03 (femal) (8), or defective starting switch	Repair or replace
See E-5	—
See E-2	—
See C-14	—

E-9 Related electric circuit diagram



b) There is hunting

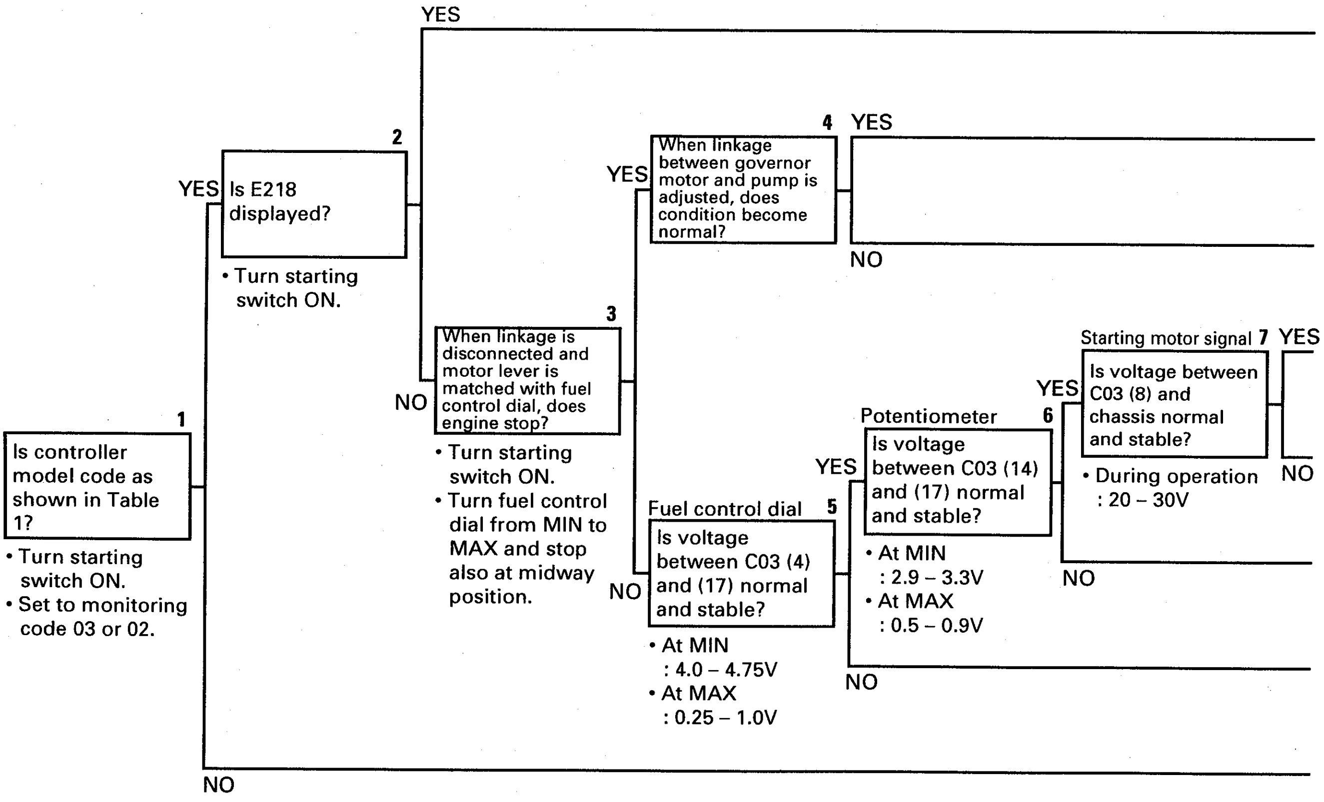


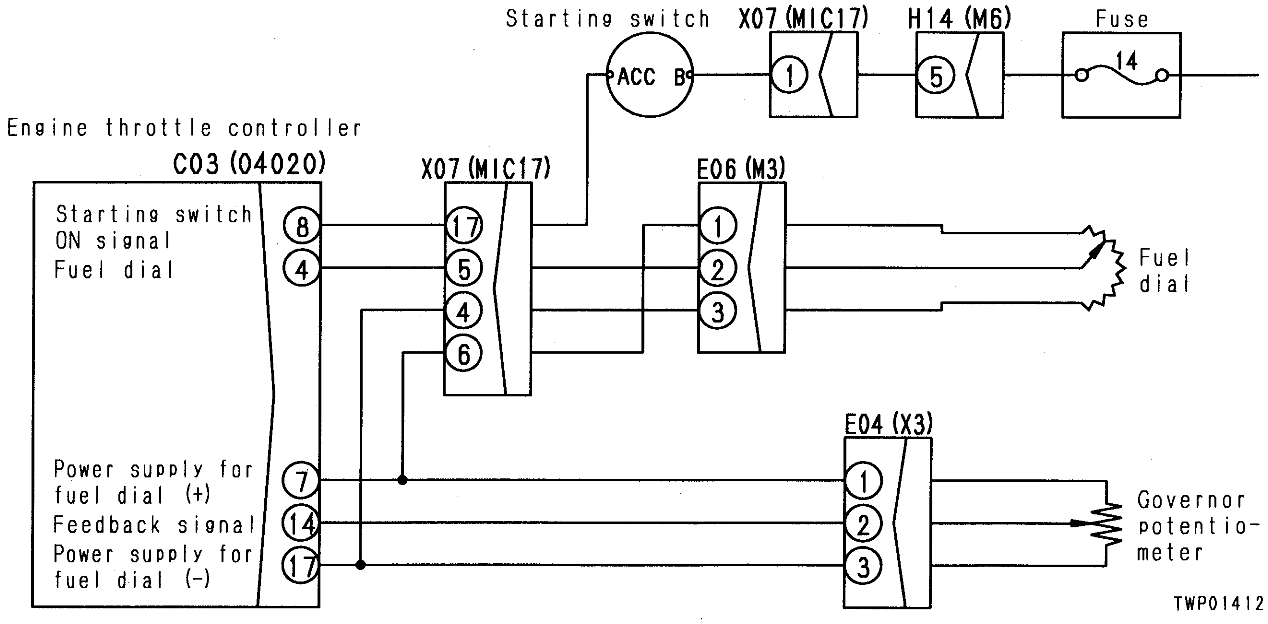
Table 1

Controller model code


★ The diagram shows monitoring code 03.

Cause	Remedy
See N mode	—
Defective adjustment of linkage	Adjust
Defective injection pump	See S mode
Defective governor motor	Replace
Defective contact of wiring harness between starting switch ACC – X07 (17) – C03 (female) (8), or defective starting switch	Repair or replace
See E-5	—
See E-2	—
See C-14	—

E-9 Related electric circuit diagram



TWP01412

E-10 Lack of output (engine high idling speed is too low)

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

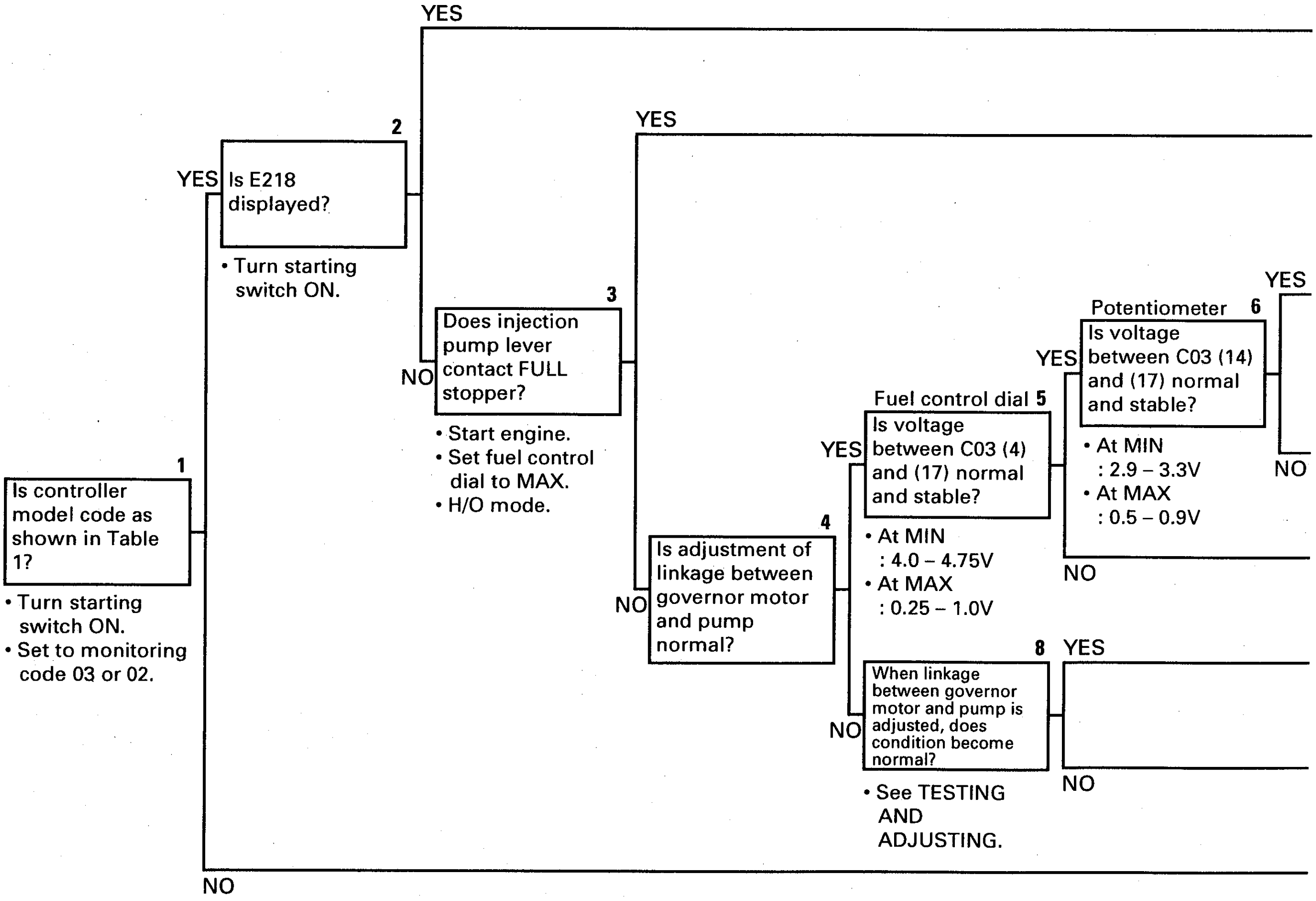


Table 1

Controller model code
03 400

BKP00209

★ The diagram shows monitoring code 03.

Starting motor signal

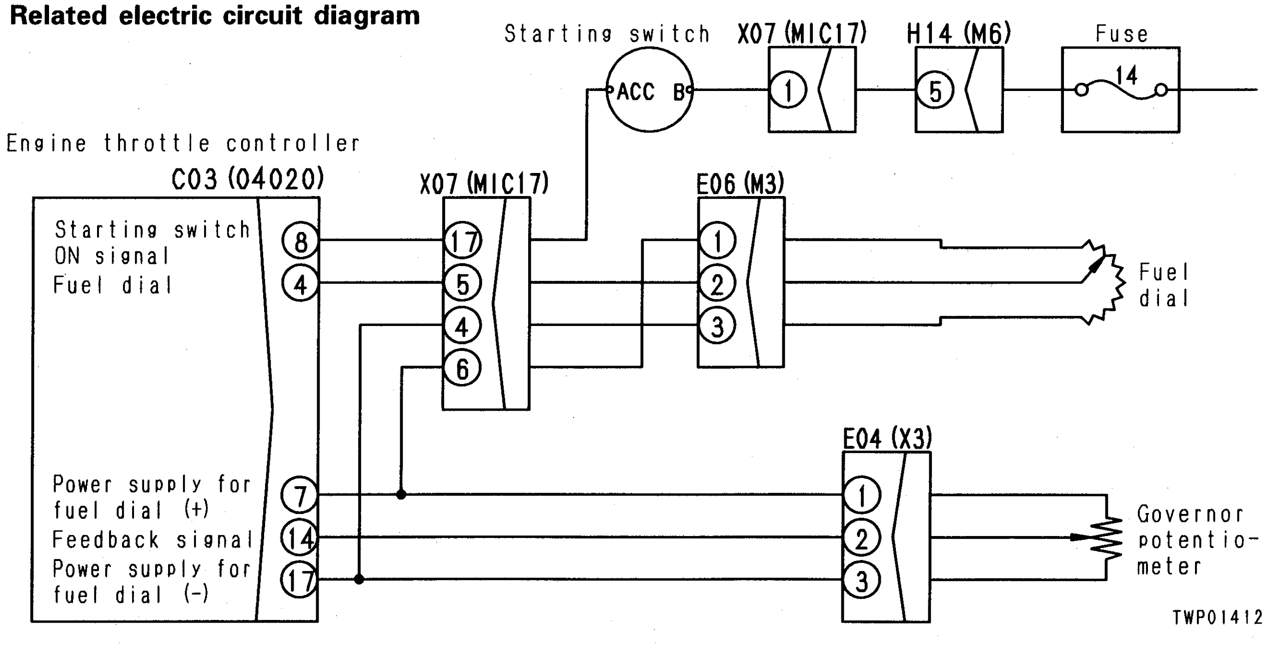
7 Is voltage between C03 (8) and chassis normal and stable?

- During operation: 20 – 30V

YES / NO

Cause	Remedy
See N mode	—
Defective injection pump	See S mode
Defective governor motor	Replace
Defective contact of wiring harness between starting switch ACC – X07 (17) – C03 (female) (8), or defective starting switch	Repair or replace —
See E-5	—
See E-2	—
Defective adjustment of governor motor linkage	Adjust
See S mode	—
See C-14	—

E-10 Related electric circuit diagram



E-11 Engine does not stop

⚠ Check with the engine stopped (push the fuel control lever of the fuel injection pump to the NO INJECTION position).

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

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

★ Read the precautions given in TESTING AND ADJUSTING, "Adjusting travel of governor motor lever" before carrying out the troubleshooting.

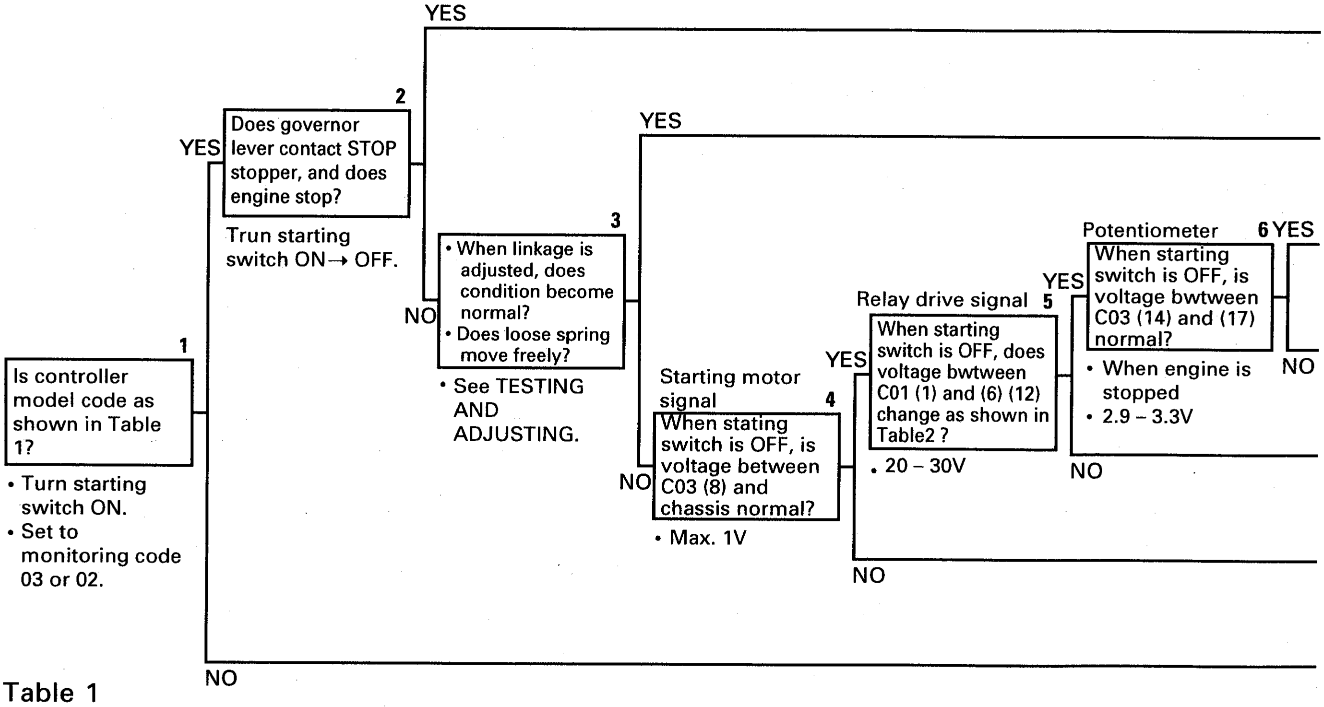
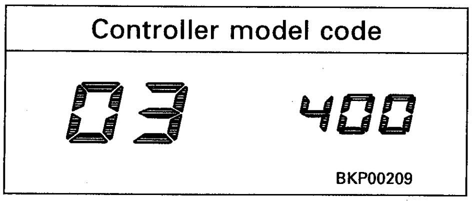
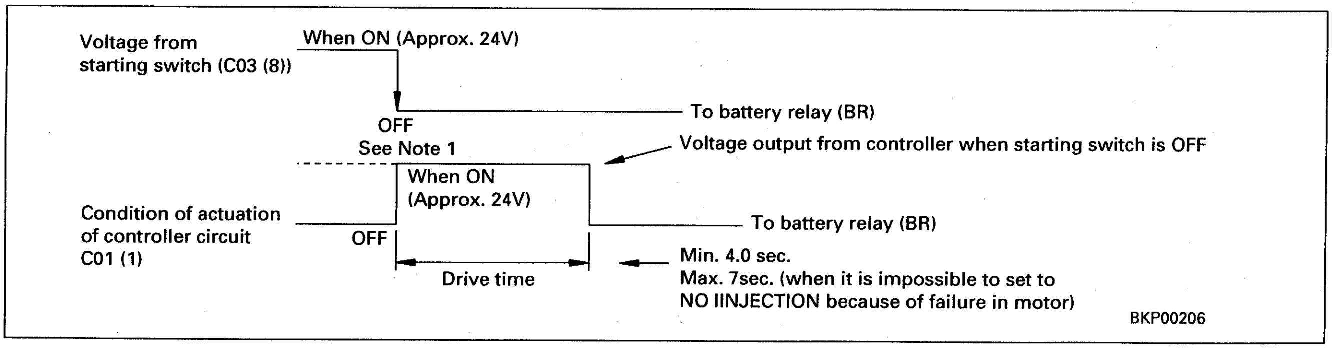


Table 1



★ The diagram shows monitoring code 03.

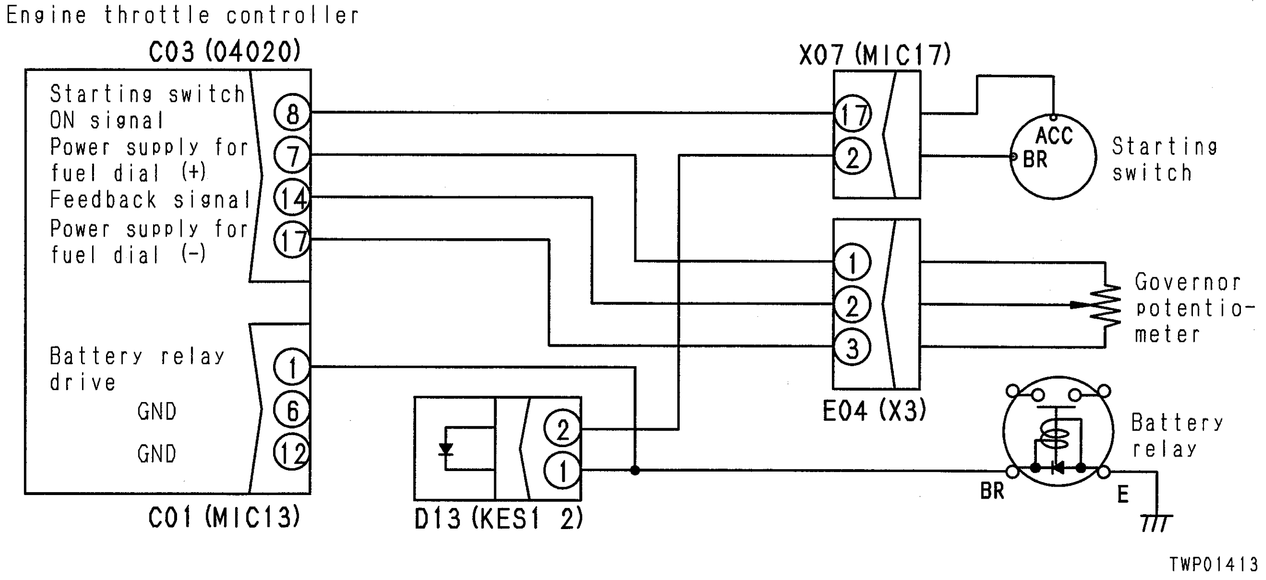
Table 2



Note 1: When the starting switch is ON, the controller end is OFF, but a voltage of approx. 20 – 30V is always flowing from starting switch BR, so if the voltage is measured at C01 (1), there is a voltage of 20 – 30V.

Cause	Remedy
Defective injection pump	See S mode
Defective adjustment of linkage	Adjust
Defective governor motor	Replace
See E-5	-
Defective engine throttle, pump controller	Replace
Contact with 24V wiring harness of wiring harness between starting switch ACC - X07 (17) - C03 (female) (8), or defective starting switch	Replace
See C-14	-

E-11 Related electric circuit diagram



E-12 Defective operation of battery relay system (engine does not stop)

★ This only occurs when the engine is stopped and the starting switch is turned OFF.

⚠ Check with the engine stopped (push the fuel control lever of the fuel injection pump to the NO INJECTION position).

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

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

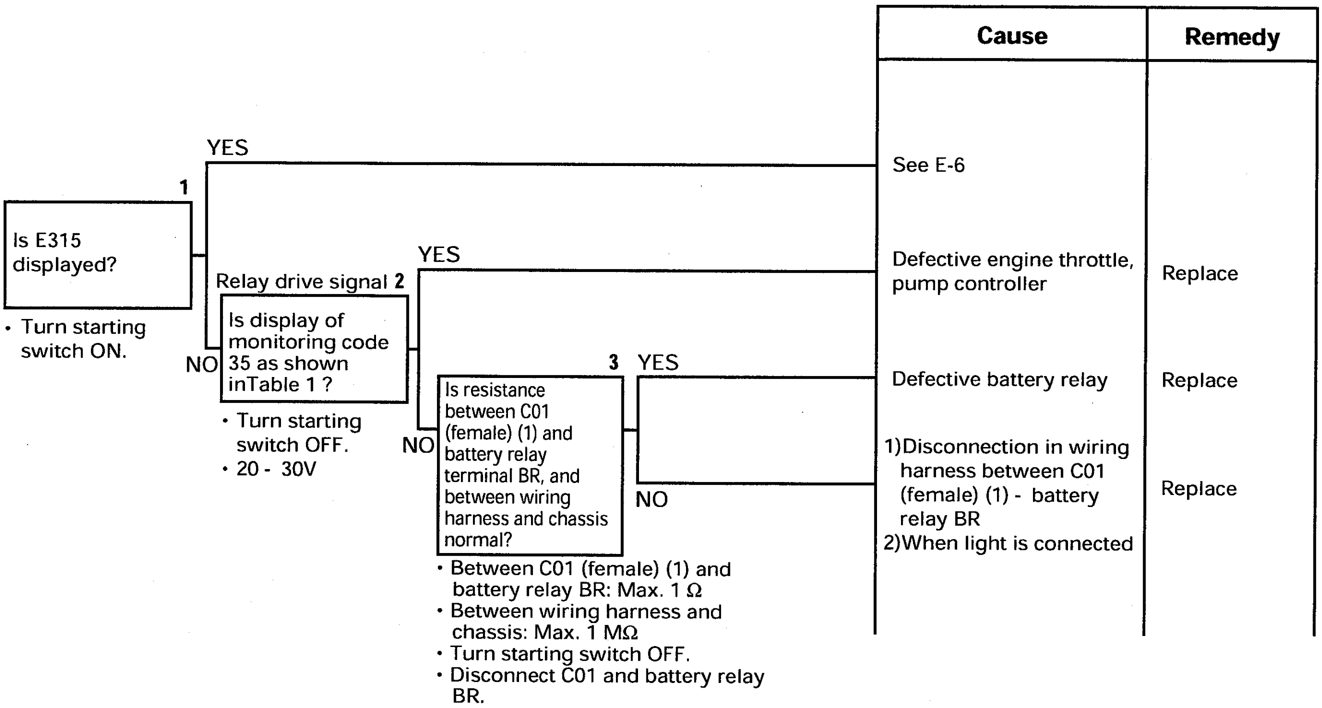
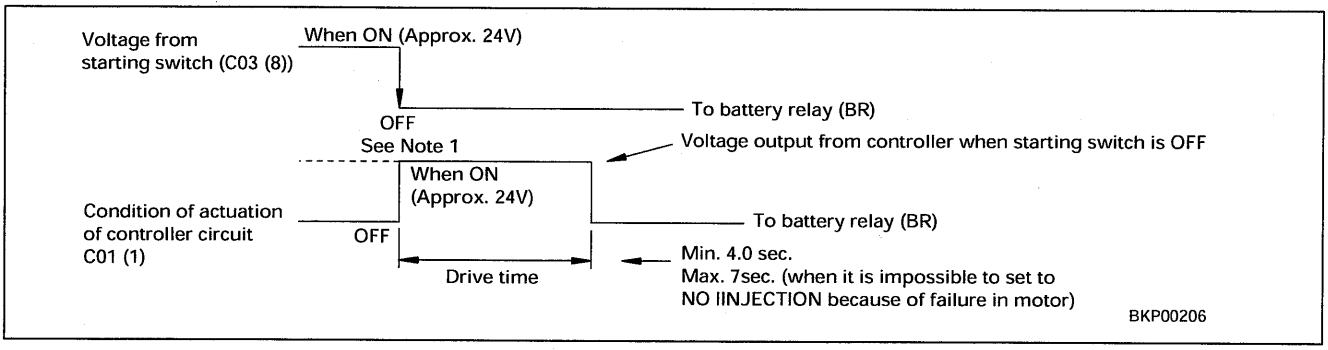
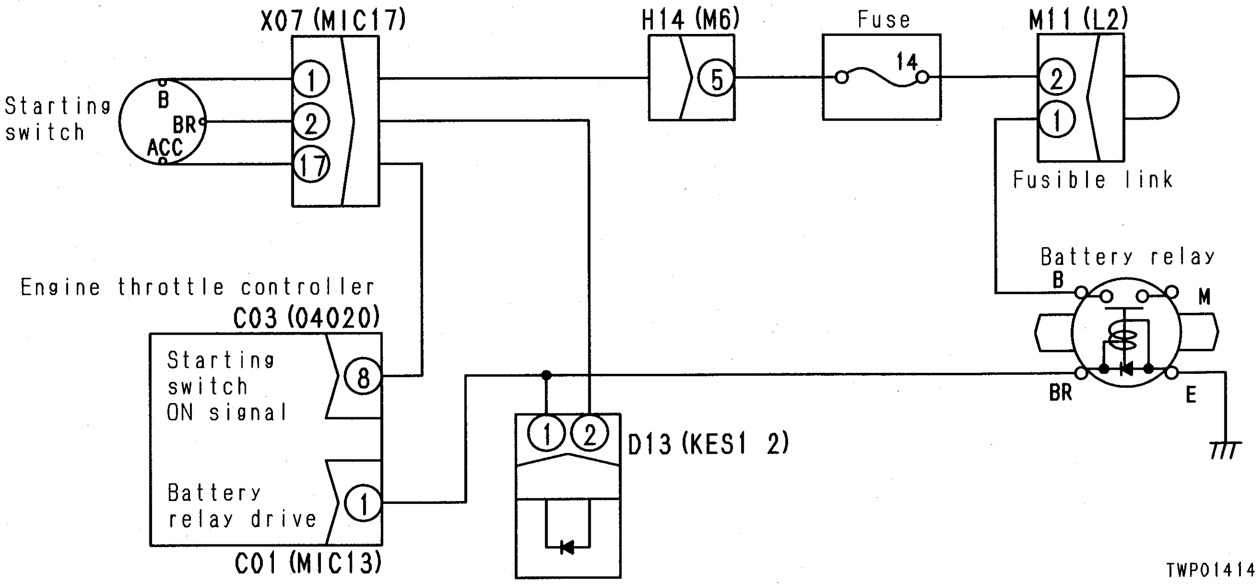


Table 1



Note 1: When the starting switch is ON, the controller end is OFF, but a voltage of approx. 20 – 30V is always flowing from starting switch BR, so if the voltage is measured at C01 (1), there is a voltage of 20 – 30V.

E-12 Related electric circuit diagram



TROUBLESHOOTING OF ENGINE SYSTEM
(S MODE)

METHOD OF USING TROUBLESHOOTING CHARTS

This troubleshooting chart is divided into three sections: **questions, check items, and troubleshooting.** The questions and check items are used to pinpoint high probability causes that can be located from the failure symptoms or simple inspeciton without using troubleshooting tools.

Next, troubleshooting tools or direct inspection are used to check the high probability causes to make final confirmation.

[Questions]

Sections Ⓐ + Ⓑ in the chart on the right corresponds to the items where answers can be obtained from the user. The items in Ⓑ are items that can be obtained from the user, depending on the user's level.

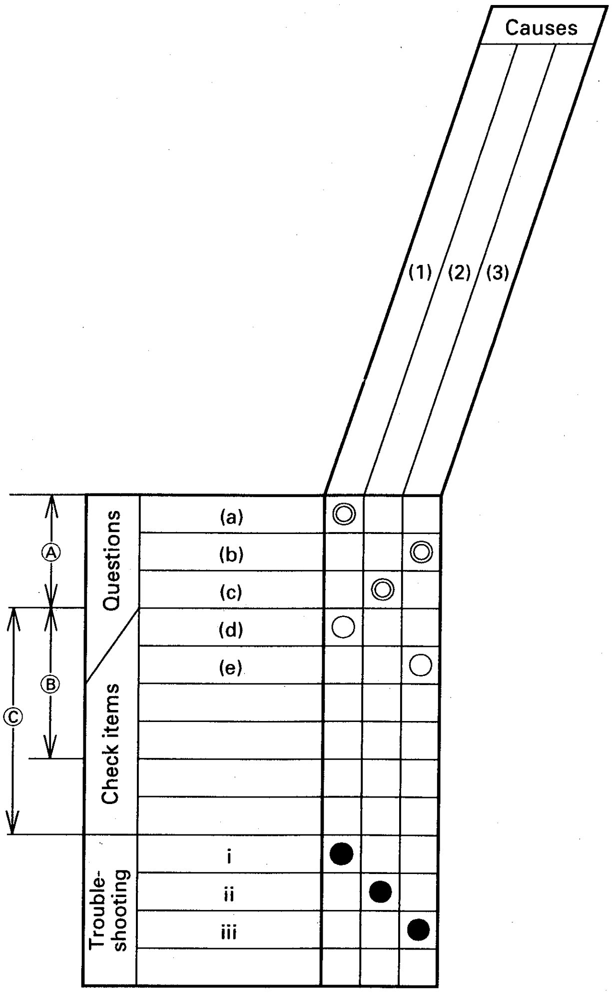
[Check items]

The serviceman carries out simple inspection to narrow down the causes. The items under Ⓒ in the chart on the right correspond to this.

The serviceman narrows down the causes from information Ⓐ that he has obtained from the user and the results of Ⓒ that he has obtained from his own inspection.

[Troubleshooting]

Troubleshooting is carried out in the order of probability, starting with the causes that have been marked as having the highest probability from information gained from **[Questions]** and **[Check items]**.



The basic method of using the troubleshooting chart is as follows.
Items listed for **[Questions]** and **[Check items]** that have a relationship with the Cause items are marked with ○, and of these, causes that have a high probability are marked with ◎.
Check each of the **[Questions]** and **[Check items]** in turn, and marked the ○ or ◎ in the chart for items where the problem appeared. The vertical column (Causes) that has the highest number of points is the most probable cause, so start troubleshooting for that item to make final confirmation of the cause.

※1. For **[Confirm recent repair history]** in the **[Questions]** Section, ask the user, and mark the Cause column with △ to use as reference for locating the cause of the failure. However, do not use this when making calculations to narrow down the causes.

※2. Use the △ in the Cause column as reference for **[Degree of use (Operated for long period)]** in the **[Questions]** section as reference. As a rule, do not use it when calculating the points for locating the cause, but it can be included if necessary to determine the order for troubleshooting.

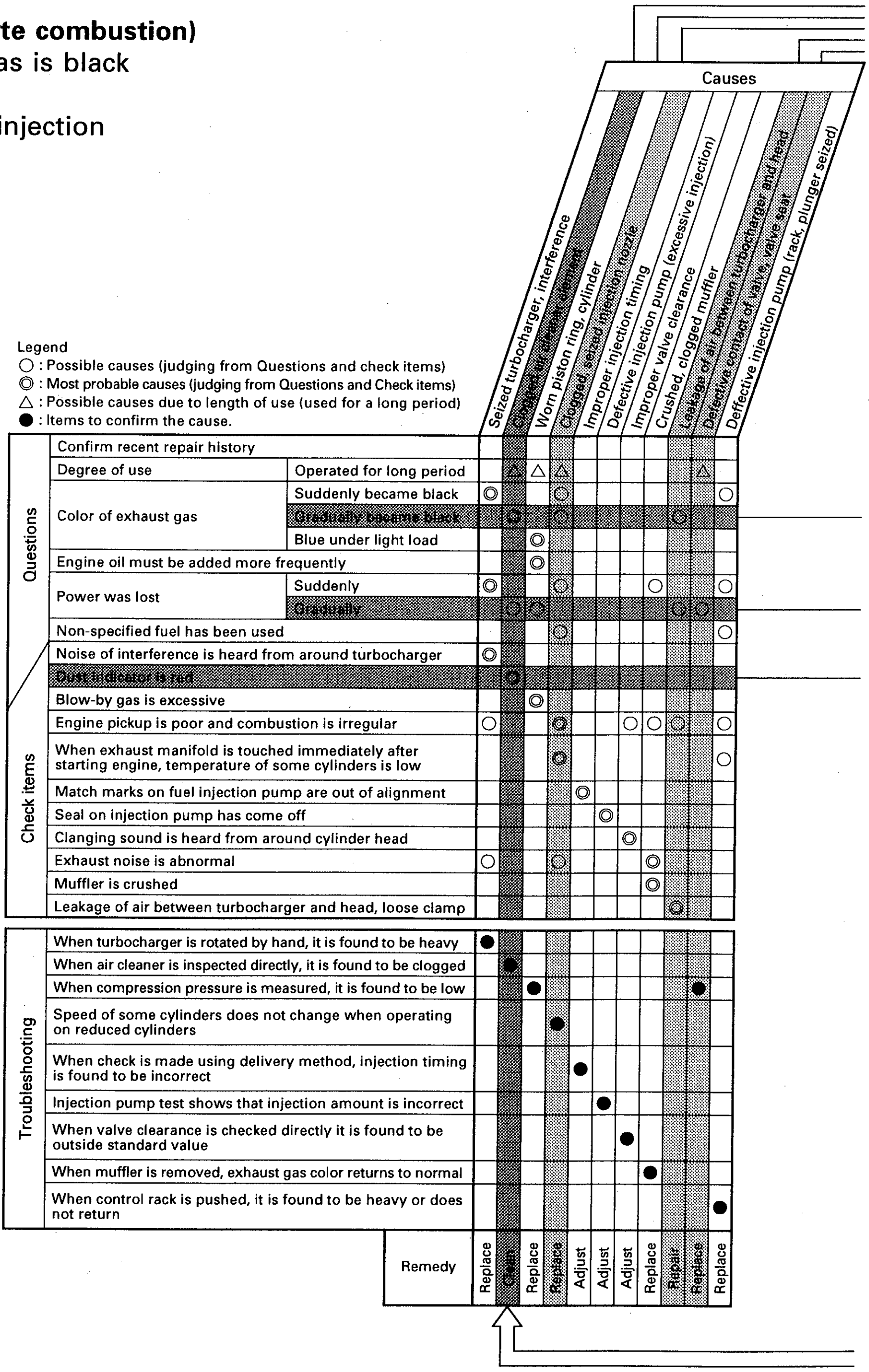
			Causes						
			Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)	
※1	Confirm recent repair history								
※2	Degree of use	Operatred for long period		△	△	△			

- **Example of troubleshooting when exhaust gas is black**
  Let us assume that [Clogged air cleaner] is taken to be the cause of black exhaust gas. Three symptoms have causal relationship with this problem: [Exhaust gas slowly became black], [Power slowly became weaker], and [Dust indicator is red].
  If we look from these three symptoms to find the causes, we find that there is a relationship with five causes. Let us explain here the method of using this causal relationship to pinpoint the most probable cause.

S-7 Exhaust gas is black (incomplete combustion)

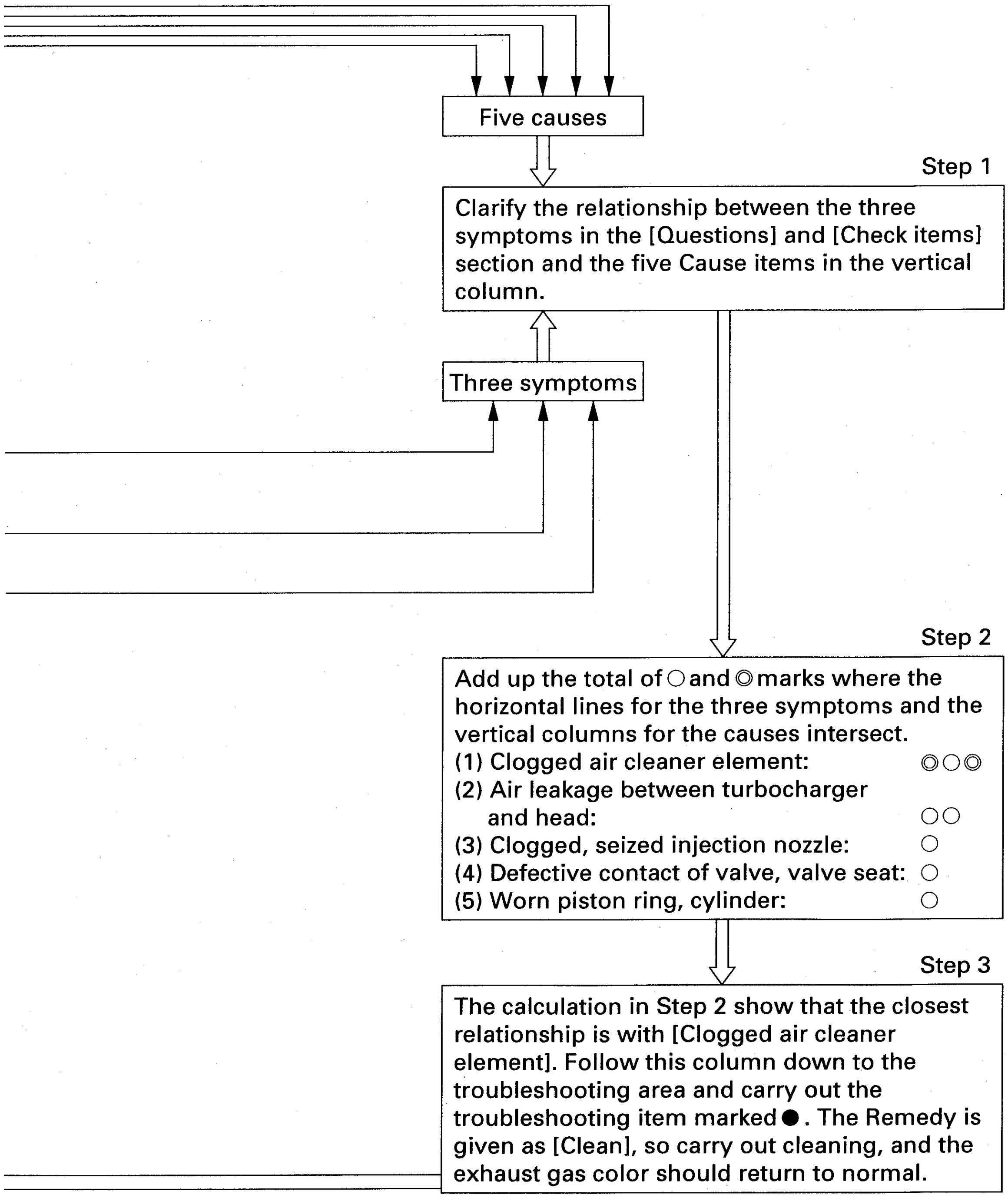
General causes why exhaust gas is black

- Insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel



Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)	Improper valve clearance	Crushed, clogged muffler	Leakage of air between turbocharger and head	Defective contact of valve, valve seat	Deffective injection pump (rack, plunger seized)
Questions	Confirm recent repair history												
	Degree of use	Operated for long period		△	△	△						△	
	Color of exhaust gas	Suddenly became black	◎			○							○
		Gradually became black		◎		○					○		
		Blue under light load			◎								
	Engine oil must be added more frequently				◎								
	Power was lost	Suddenly	◎			○				○			○
		Gradually		○	◎						○	◎	
	Non-specified fuel has been used					○							○
Check items	Noise of interference is heard from around turbocharger		◎										
	Dust indicator is red			◎									
	Blow-by gas is excessive				◎								
	Engine pickup is poor and combustion is irregular		○			◎			○	○	○		○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎							○
	Match marks on fuel injection pump are out of alignment						◎						
	Seal on injection pump has come off							◎					
	Clanging sound is heard from around cylinder head								◎				
	Exhaust noise is abnormal		○			○				◎			
	Muffler is crushed									◎			
	Leakage of air between turbocharger and head, loose clamp										◎		
Troubleshooting	When turbocharger is rotated by hand, it is found to be heavy		●										
	When air cleaner is inspected directly, it is found to be clogged			●									
	When compression pressure is measured, it is found to be low				●							●	
	Speed of some cylinders does not change when operating on reduced cylinders					●							
	When check is made using delivery method, injection timing is found to be incorrect						●						
	Injection pump test shows that injection amount is incorrect							●					
	When valve clearance is checked directly it is found to be outside standard value								●				
	When muffler is removed, exhaust gas color returns to normal									●			
	When control rack is pushed, it is found to be heavy or does not return												●
	Remedy		Replace	Clean	Replace	Replace	Adjust	Adjust	Adjust	Replace	Repair	Replace	Replace



Step 1

Clarify the relationship between the three symptoms in the [Questions] and [Check items] section and the five Cause items in the vertical column.

Step 2

Add up the total of ○ and ◎ marks where the horizontal lines for the three symptoms and the vertical columns for the causes intersect.

(1) Clogged air cleaner element: ◎○◎

(2) Air leakage between turbocharger and head: ○○

(3) Clogged, seized injection nozzle: ○

(4) Defective contact of valve, valve seat: ○

(5) Worn piston ring, cylinder: ○

Step 3

The calculation in Step 2 show that the closest relationship is with [Clogged air cleaner element]. Follow this column down to the troubleshooting area and carry out the troubleshooting item marked ●. The Remedy is given as [Clean], so carry out cleaning, and the exhaust gas color should return to normal.

S-1 Starting performance is poor (starting always takes time)

★ Check that the monitor panel does not display any abnormality in the governor control system.
General causes why exhaust smoke comes out but engine takes time to start

- Defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel
(At ambient temperature of 10°C or below, use ASTM D975 No. 1)

★ Battery charging rate

Charging rate Ambient temperature	100%	90%	80%	75%	70%
20°C	1.28	1.26	1.24	1.23	1.22
0°C	1.29	1.27	1.25	1.24	1.23
–10°C	1.30	1.28	1.26	1.25	1.24

- The specific gravity should exceed the value for the charging rate of 70% in the above table.
- In cold areas the specific gravity must exceed the value for the charging rate of 75% in the above table.

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause

		Causes	Worn piston ring, cylinder	Defective contact of valve, valve seat	Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump strainer	Starting aid Electrical intake air heater	Defective regulator	Defective alternator	Defective or deteriorated battery	Defective injection nozzle	Defective injection timing	Defective injection pump (rack, plunger stuck)	Leakage, clogging, air in fuel piping	Clogged air breather hole in fuel tank cap
Questions	Confirm recent repair history															
	Degree of use of machine	Operated for long period			△	△	△				△					
	Ease of starting	Gradually became worse	◎	◎	○	○	○									
		Starts when warm						◎			◎					
	Indicator lamp does not light up							◎								
	Engine oil must be added more frequently		◎													
	Replacement of filters has not been carried out according to Operation Manual				◎	◎	◎					○		○		
	Air cleaner clogging caution lamp flashes				◎											
	Non-specified fuel is being used					○	○					○		○		
Check items	Battery charge lamp is ON								◎	◎						
	Starting motor cranks engine slowly										◎					
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											◎				
	Engine does not pick up smoothly, and combustion is irregular		○	○								◎				
	Blow-by gas is excessive		◎													
	Match marks on fuel injection pump are out of alignment												◎			
	Mud is stuck to fuel tank cap															○
	When engine is cranked with starting motor,	1) Little fuel comes out even when injection pump sleeve nut is loosened												◎		
		2) Little fuel comes out even when fuel filter air bleed plug is loosened				◎	◎							◎		
	Leakage from fuel piping													○	◎	
	There is hunting from engine (rotation is irregular)					○	○								◎	○
Troubleshooting	When compression pressure is measured, it is found to be low		●	●												
	When air cleaner element is inspected directly, it is found to be clogged				●											
	When fuel filter, strainer are inspected directly, they are found to be clogged					●									●	
	When feed pump strainer is inspected directly, it is found to be clogged						●									
	Heater mount does not become warm							●								
	Is voltage 26 – 30V between alternator terminal R and terminal E with engine at low idling?	Yes ※							●							
		No								●						
	Either specific gravity of electrolyte or voltage of battery is low										●					
	Speed does not change when operation of certain cylinders is stopped											●				
	When check is made using delivery method, injection timing is found to be incorrect												●			
	When control rack is pushed, it is found to be heavy or does not return (when blind cover at rear of pump is removed, it can be seen that plunger control sleeve does not move)													●		
	When fuel cap is inspected directly, it is found to be clogged															●
		Remedy	Replace	Correct	Clean	Clean	Clean	Replace	Replace	Replace	Replace	Replace	Adjust	Replace	Correct	Clean

※ It is not permitted to replace only the regulator.

S-2 Engine does not start

(1) Engine does not turn

General causes why engine does not turn
- Internal parts of engine seized
  - ★ If internal parts of the engine are seized, carry out troubleshooting for "Engine stops during operations".
- Defective electrical system

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

		Causes:	Defective wiring of starting circuit	Defective or deteriorated battery	Defective starting motor	Broken ring gear	Defective safety relay or safety switch	Defective battery relay	Defective battery terminal connection	Defective starting switch
Questions	Confirm recent repair history									
	Degree of use of machine	Operated for long period		△		△				
	Condition of horn when starting switch is turned ON	Horn sounds	◎						○	○
		Horn does not sound or volume is low		◎						
Check items	When starting switch is turned to START, pinion moves out, but	Makes grating noise			◎	◎				
		Soon disengages again					◎			
		Makes rattling noise and does not turn	◎							
	When starting switch is turned to START, pinion does not move out									
	When starting switch is turned to ON, there is no clicking sound							◎		
	Battery terminal is loose								◎	
	When battery is checked, battery electrolyte is found to be low			◎						
Troubleshooting	Specific gravity of electrolyte, voltage of battery is low		Troubleshooting of electrical system	●						
	For the following conditions 1) - 5), turn the starting switch OFF, connect the cord, and carry out troubleshooting at ON 1) When terminal B and terminal C of starting switch are connected, engine starts									●
	2) When terminal B and terminal C of starting motor are connected, engine starts				●					
	3) When terminal B and terminal C of safety relay are connected, engine starts						●			
	4) When terminal of safety switch and terminal B of starting motor are connected, engine starts						●			
	5) There is no 24V between battery relay terminal M and terminal E							●		
	When ring gear is inspected directly, tooth surface is found to be chipped					●				
		Remedy	—	Replace	Replace	Replace	Replace	Replace	Connection	Replace

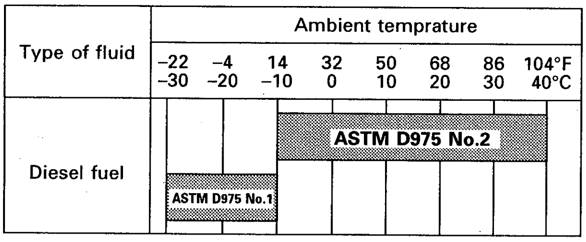
(2) Engine turns but no exhaust smoke comes out (fuel is not being injected)

★ Check that the monitor panel does not display any abnormality in the governor control system.

General causes why engine turns but no exhaust smoke comes out

- Supply of fuel impossible
- Supply of fuel is extremely small
- Improper selection of fuel (particularly in winter)

★ Standards for use of fuel



Legend

○: Possible causes (judging from Questions and check items)

◎: Most probable causes (judging from Questions and Check items)

△: Possible causes due to length of use (used for a long period)

●: Items to confirm the cause.

		Causes							
		Broken injection pump drive shaft, key	Defective injection pump (rack, plunger seized)	Seized, broken feed pump piston	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged, leaking fuel piping	Clogged air breather hole in fuel tank cap	Improper fuel used
Questions	Confirm recent repair history								
	Degree of use of machine | Operated for long period				△	△		△	
	Exhaust smoke suddenly stops coming out (when starting again)	◎	◎	◎					
	Replacement of filters has not been carried out according to Operation Manual				◎	◎			
	There is leakage from fuel piping						◎		
	Mud is stuck to fuel tank cap							◎	
Check items	When fuel filter is drained, fuel does not come out								◎
	When engine is cranked with starting motor, 1) Injection pump coupling does not turn	◎							
	2) No fuel comes out even when fuel filter air bleed plug is loosened	◎			○	○			○
	3) No fuel spurts out even when injection pipe sleeve nut is loosened	◎	◎	◎					
	Rust and water are found when fuel tank is drained				○	○			
Troubleshooting	Inspect injection pump directly	●							
	When control rack is pushed, it is found to be heavy, or does not return		●						
	Inspect feed pump directly			●					
	When fuel filter, strainer are inspected directly, they are found to be clogged				●				●
	When feed pump strainer is inspected directly, it is found to be clogged					●			
	When fuel cap is inspected directly, it is found to be clogged							●	
	Remedy	Replace	Replace	Replace	Clean	Clean	Correct	Correct	Replace

(3) Exhaust smoke comes out but engine does not start (Fuel is being injected)

★ General causes why exhaust smoke comes out but engine does not start

- Lack of rotating force due to defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel and oil

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes											
									Starting aid					
			Defective, broken valve system (valve, rocker lever, etc.)	Defective injection pump (rack, plunger stuck)	Worn piston ring, cylinder liner	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged air cleaner element	Electrical intake air heater	Defective or deteriorated battery	Leakage, clogging, air in fuel system	Clogged injection nozzle, defective spray	Clogged air breather hole in fuel tank cap	Improper fuel used
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period			△	△	△					△		
	Suddenly failed to start		◎	◎										
	When engine is cranked, abnormal noise is heard from around head		◎											
	Engine oil must be added more frequently				◎									
	Non-specified fuel is being used			○								○		
	Replacement of filters has not been carried out according to Operation Manual					◎	◎	◎						
	Rust and water are found when fuel tank is drained							◎						
Check items	Air cleaner clogging caution lamp flashes					◎	◎							
	Preheating indicator lamp does not light up								◎					
	Starting motor cranks engine slowly									◎				
	Mud is stuck to fuel tank cap												○	
	When fuel lever is placed at FULL position, it does not contact stopper			○										
	When engine is cranked with starting motor, 1) Little fuel comes out even when injection pump sleeve nut is loosened			◎										
	2) No fuel comes out even when fuel filter air bleed plug is loosened					◎	◎							○
	There is leakage from fuel piping										◎			
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low											◎		
	When fuel filter is drained, no fuel comes out													◎
Troubleshooting	Remove head cover and check directly		●											
	When control rack is pushed, it is found to be heavy, or does not return			●										
	When compression pressure is measured, it is found to be low				●									
	When fuel filter, strainer are inspected directly, they are found to be clogged					●								●
	When feed pump strainer is inspected directly, it is found to be clogged						●							
	When air cleaner element is inspected directly, it is found to be clogged							●						
	Heater mount does not become warm								●					
	Either specific gravity of electrolyte or voltage of battery is low									●				
	When feed pump is operated, operation is too light or too heavy										●			
	When injection nozzle is tested as individual part, spray condition is found to be poor											●		
	When fuel cap is inspected directly, it is found to be clogged												●	
	Remedy		Replace	Replace	Replace	Clean	Clean	Clean	Replace	Replace	Correct	Clean	Clean	Replace

S-3 Engine does not pick up smoothly (follow-up is poor)

★ Check that the monitor panel does not display any abnormality in the governor control system.

General causes why engine does not pick up smoothly
- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Improper fuel used

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes										
			Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged injection nozzle, defective spray	Seized injection pump plunger	Worn piston ring, cylinder liner	Seized turbocharger, interference	Improper valve clearance	Clogged air breather hole in fuel tank cap	Clogged, leaking fuel piping	Defective contact of valve and valve seat
Questions	Confirm recent repair history												
	Degree of use of machine	Operated for long period	△	△	△			△					△
	Replacement of filters has not been carried out according to Operation Manual		◎	◎	◎								
	Non-specified fuel is being used			◎	◎	◎	◎						
	Engine oil must be added more frequently							◎					
Check items	Rust and water are found when fuel tank is drained			◎	◎								
	Air cleaner clogging caution lamp flashes		◎										
	Noise of interference is heard from around turbocharger								◎				
	Engine pick-up suddenly became poor					○			◎		○	○	
	Color of exhaust gas	Blue under light load						◎					
		Black	◎			◎			◎				○
	Clanging sound is heard from around cylinder head									◎			
	Mud is stuck to fuel tank cap										◎		
	There is leakage from fuel piping											◎	
	High idling speed under no load is normal, but speed suddenly drops when load is applied			◎	◎						○		
	There is hunting from engine (rotation is irregular)			○	◎	○					○		
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎	○						
	Blow-by gas is excessive							◎					
Troubleshooting	When air cleaner element is inspected directly, it is found to be clogged		●										
	When fuel filter, strainer are inspected directly, they are found to be clogged			●									
	When feed pump strainer is inspected directly, it is found to be clogged				●								
	Speed does not change when operation of certain cylinders is stopped					●							
	When control rack is pushed, it is found to be heavy, or does not return						●						
	When compression pressure is measured, it is found to be low							●					●
	When turbocharger is rotated by hand, it is found to be heavy								●				
	When valve clearance is checked directly, it is found to be outside standard value									●			
	When fuel cap is inspected directly, it is found to be clogged										●		
	When feed pump is operated, operation is too light or too heavy											●	
	Remedy		Clean	Clean	Clean	Correct	Replace	Replace	Replace	Adjust	Clean	Correct	Replace

S-4 Engine stops during operations

★ Check that the monitor panel fuel level display shows that there is still fuel remaining.

General causes why engine stops during operations

- Seized parts inside engie
- Insufficient supply of fuel
- overheating

★ If there is overheating and the engine stops, carry out troubleshooting for overheating.

- Failure in main piston pump

★ If the engine stops because of a failure in the main piston pump, carry out troubleshooting for the hydraulic system (H MODE).

Legend

○ : Possible causes (judging from Questions and check items)

◎ : Most probable causes (judging from Questions and Check items)

△ : Possible causes due to length of use (used for a long period)

● : Items to confirm the cause.

			Broken, seized piston, connecting rod	Broken, seized crankshaft bearing	Broken valve system (valve, rocker lever, etc.)	Broken, seized gear train	Broken fuel pump drive shaft, key	Clogged fuel filter, strainer	Clogged feed pump strainer	Broken, seized feed pump piston	Clogged, leaking fuel piping	Clogged air breather hole in fuel tank cap	Defective injection pump (rack, plunger stuck)	Failure in main pump
			Causes											
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period						△	△					
	Condition when engine stopped	Abnormal noise was heard and engine stopped suddenly	◎	◎	◎	◎	◎			○			○	◎
		Engine stopped slowly						○	○					
		There was hunting and engine stopped						○	○			○		
		Engine overheated and stopped	◎	○										
	Replacement of filters has not been carried out according to Operation Manual							◎	◎					
	Non-specified fuel is being used							○	○	○			○	
	When feed pump is operated, operation is too light or too heavy							○	○	◎	○			
	Mud is stuck to fuel tank cap											◎		
	Try to turn by hand using barring tool	Does not turn at all	◎	◎										See troubleshooting of HYDRAULIC, MECHANICAL SYSTEM (H MODE)
		Turns in opposite direction			◎									
		Moves amount of backlash				◎								
	Rust and water are found when fuel tank is drained							◎	◎					
	Metal particles are found when oil is drained		◎	◎				○	○					
Troubleshooting	When oil pan is removed and inspection is made directly, it is found to be abnormal		●	●										
	When head cover is removed and inspection is made directly, it is found to be abnormal				●									
	When gear train is inspected, it does not turn					●								
	When fuel filter, strainer are inspected directly, they are found to be clogged							●						
	When feed pump strainer is inspected directly, it is found to be clogged								●					
	Inspect feed pump directly									●				
	When control rack is pushed, it is found to be heavy, or does not return												●	
	Remedy		Replace	Replace	Replace	Replace	Replace	Clean	Clean	Replace	Correct	Clean	Replace	—

S-5 Engine does not rotate smoothly (hunting)

★ Check that the monitor panel does not display any abnormality in the governor control system.

General causes why engine does not rotate smoothly

- Air in fuel system
- Defective governor mechanism
- Defective electric governor mechanism

★ If hunting does not occur when the rod between the governor motor and the injection pump is disconnected, troubleshoot by using the electrical system troubleshooting (E mode).

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes								
			Defective operation of governor	Defective adjustment of governor	Defective operation of control rack	Low idling speed is too low	Clogged feed pump strainer	Clogged fuel filter, strainer	Clogged, air in circuit between fuel tank and feed pump	Clogged, air in circuit between feed pump and nozzle	Clogged air breather hole in fuel tank cap
Questions	Confirm recent repair history										
	Degree of use of machine	Operated for long period					△	△			
	Condition of hunting	Occurs at a certain speed range	◎	◎	◎	○					
		Occurs at low idling	○			◎	○	○	○	○	
		Occurs even when speed is raised	○	○	○						○
	Replacement of filters has not been carried out according to Operation Manual						◎	◎			
	Rust, water are found when fuel tank is drained						○	○			
Check items	Leakage from fuel piping								◎	◎	
	When feed pump is operated, 1) No response, light, return is quick								◎	◎	
	2) No response, light, return is normal								◎		
	Engine speed sometimes rises too far		◎	◎							
	Engine is sometimes difficult to stop		◎		◎						
	Seal on injection pump has come off			◎		◎					
Troubleshooting	When governor lever is moved it is found to be stiff		●		●						
	When injection pump is tested, governor is found to be improperly adjusted			●							
	When control rack is pushed, it is found to be heavy, or does not return				●						
	When fuel cap is inspected directly, it is found to be clogged					●					●
	When feed pump strainer is inspected directly, it is found to be clogged						●				
	When fuel filter, strainer are inspected directly, they are found to be clogged							●			
	Remedy		Adjust	Adjust	Adjust	Adjust	Clean	Clean	Correct	Correct	Clean

S-6 Engine lacks output (no power)

★ Check that the monitor panel does not display any abnormality in the governor control system.

Measure the engine speed and judge if the cause is in the engine or in the chassis.

General causes why engine lacks output

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Improper fuel used
  (if non-specified fuel is used, output drops)
- Lack of output due to overheating

★ If there is overheating and insufficient output, carry out troubleshooting for overheating.

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes												
			Clogged air cleaner element	Seized turbocharger, interference	Worn piston ring, cylinder liner	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged injection nozzle, defective spray	Seized injection pump plunger	Improper valve clearance	Defective contact of valve and valve seat	Bent fuel control linkage, defective adjustment	Clogged, leaking fuel piping	Clogged air breather hole in fuel tank cap	Overheating
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period	△		△	△	△				△				
	Power was lost	Suddenly		◎											◎
		Gradually	○		○	○	○	○			○				
	Engine oil must be added more frequently				◎										
	Replacement of filters has not been carried out according to Operation Manual		◎			◎	◎								
	Non-specified fuel is being used					◎	◎	◎	◎						
Check items	Air cleaner clogging caution lamp flashes		◎												
	Color of exhaust gas	Black	◎	◎											
		Blue under light load			◎										
	Noise of interference is heard from around turbocharger			◎											
	Blow-by gas is excessive				◎										
	Engine pickup is poor and combustion is irregular			◎				◎					○	○	
	High idling speed under no load is normal, but speed suddenly drops when load is applied					◎	◎							○	
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low							◎	○						
	There is hunting from engine (rotation is irregular)					○	○						○	○	
	Clanging sound is heard from around cylinder head									◎					
	High idling speed of engine is low								○			◎			
	Leakage from fuel piping												◎		
	Water temperature gauge is in red range														◎
Troubleshooting	When air cleaner element is inspected directly, it is found to be clogged		●												Carry out troubleshooting for OVERHEATING
	When turbocharger is rotated by hand, it is found to be heavy			●											
	When compression pressure is measured, it is found to be low				●						●				
	When fuel filter, strainer are inspected directly, they are found to be clogged					●									
	When feed pump strainer is inspected directly, it is found to be clogged						●								
	Speed does not change when operation of certain cylinders is stopped							●							
	When control rack is pushed, it is found to be heavy, or does not return								●						
	When valve clearance is checked directly, it is found to be outside standard value									●					
	When lever is placed at FULL position, it does not contact stopper											●			
	When feed pump is operated, operation is too light or too heavy												●		
	When fuel cap is inspected directly, it is found to be clogged													●	
	Remedy		Clean	Replace	Replace	Clean	Clean	Correct	Replace	Adjust	Replace	Adjust	Correct	Clean	—

S-7 Exhaust smoke is black (incomplete combustion)

General causes why exhaust smoke is black
- Insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes										
			Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder liner	Clogged injection nozzle, defective spray	Improper injection timing	Defective injection pump (excessive injection)	Improper valve clearance	Crushed, clogged muffler	Leakage of air between turbocharger and head	Defective contact of valve and valve seat	Defective injection pump (rack, plunger seized)
Questions	Confirm recent repair history												
	Degree of use of machine	Operated for long period		△	△	△						△	
	Color of exhaust gas	Suddenly became black	◎										○
		Gradually became black		◎							○		
		Blue under light load			◎								
	Engine oil must be added more frequently				◎								
	Power was lost	Suddenly	◎			○				○			○
		Gradually		○	○						○	○	
	Non-specified fuel is being used					○							○
	Noise of interference is heard from around turbocharger		◎										
Check items	Air cleaner clogging caution lamp flashes			◎									
	Blow-by gas is excessive				◎								
	Engine pickup is poor and combustion is irregular		○			◎			○	○	○		○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎							○
	Match marks on fuel injection pump are out of alignment						◎						
	Seal on injection pump has come off							◎					
	Clanging sound is heard from around cylinder head								◎				
	Exhaust noise is abnormal		○			○				◎			
	Muffler is crushed									◎			
	Leakage of air between turbocharger and head, loose clamp										◎		
Troubleshooting	When turbocharger is rotated by hand, it is found to be heavy		●										
	When air cleaner is inspected directly, it is found to be clogged			●									
	When compression pressure is measured, it is found to be low				●							●	
	Speed does not change when operation of certain cylinders is stopped					●							
	When check is made using delivery method, injection timing is found to be incorrect						●						
	Injection pump test shows that injection amount is incorrect							●					
	When valve clearance is checked directly it is found to be outside standard value								●				
	When muffler is removed, exhaust color returns to normal									●			
	When control rack is pushed, it is found to be heavy, or does not return												●
	Remedy		Replace	Clean	Replace	Replace	Adjust	Adjust	Adjust	Replace	Correct	Replace	Replace

S-8 Oil consumption is excessive (or exhaust smoke is blue)

★ Do not run the engine at idling for more than 20 minutes continuously. (Both low and high idling)

General causes why oil consumption is excessive

- Abnormal combustion of oil
- External leakage of oil
- Wear of lubrication system

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes												
											Turbocharger				
			Broken piston ring	Worn piston ring, cylinder liner	Clogged breather or breather hose	Leakage from oil filter or oil cooler	Leakage from oil piping	Leakage from oil drain plug	Leakage from oil pan or cylinder head	Broken oil cooler	Worn seal at turbine end	Worn seal at blower end	Worn, broken rear seal, seal surface	Dust sucked in from intake system	Worn valve (stem, guide), broken seal
Questions	Confirm recent repair history														
	Degree of use of machine	Operated for long period		△							△	△			△
	Oil consumption suddenly increased		◎							○					
	Engine oil must be added more frequently			◎						○					
	Engine oil becomes contaminated quickly		○	◎	○										
Check items	Exhaust smoke is blue under light load		◎	◎											
	Amount of blow-by gas	Excessive	◎	◎								○			○
		None			◎										
	Area around engine is dirty with oil					◎	◎	◎	◎						
	There is oil in engine cooling water									◎					
	When exhaust pipe is removed, inside is found to be dirty with oil										◎				○
	When turbocharger air supply pipe is removed, inside is found to be dirty with oil											◎			
	Oil level in PTO chamber rises												◎		
	Clamps for intake system are loose													◎	
Check items	When compression pressure is measured, it is found to be low		●	●											
	When breather element is inspected, it is found to be clogged with dirty oil				●										
	There is external leakage of oil from engine					●	●	●	●						
	Pressure-tightness test of oil cooler shows there is leakage									●					
	Excessive play of turbocharger shaft										●	●			
	Inspect rear seal directly												●		
	When intake manifold is removed, dust is found inside													●	
	When intake manifold is removed, inside is found to be dirty with oil														●
	Remedy		Replace	Replace	Clean	Correct	Correct	Correct	Correct	Replace	Replace	Replace	Correct	Correct	Correct

S-9 Oil becomes contaminated quickly

General causes why oil becomes contaminated quickly

- Intake of exhaust gas due to internal wear
- Clogging of lubrication passage
- Improper fuel
- Improper oil used
- Operation under excessive load

Legend

○ : Possible causes (judging from Questions and check items)

◎ : Most probable causes (judging from Questions and Check items)

△ : Possible causes due to length of use (used for a long period)

● : Items to confirm the cause.

			Causes								
			Worn piston ring, cylinder liner	Clogged breather, breather hose	Clogged oil filter	Worn valve, valve guide	Clogged oil cooler	Clogged turbocharger drain pipe	Defective seal at turbocharger turbine end	Defective safety valve	Exhaust smoke is black
Questions	Confirm recent repair history										
	Degree of use of machine	Operated for long period	△			△			△		
	Engine oil must be added more frequently		◎								
	Non-specified oil is being used				○						
Questions / Check items	Color of exhaust gas	Blue under light load	◎								
		Black									◎
Check items	Amount of blow-by gas	Excessive	◎			○		○	○		Carry out troubleshooting for EXHAUST SOMKE IS BLACK.
		None		◎							
	When oil filter is inspected, metal particles are found		○		◎	○					
	When exhaust pipe is removed, inside is found to be dirty with oil					◎					
	Engine oil temperature rises quickly						◎				
Troubleshooting	When compression pressure is measured, it is found to be low		●			●					
	When breather element is inspected directly, hose is broken or is found to be clogged with dirty oil			●							
	When oil filter is inspected directly, it is found to be clogged				●						
	When oil cooler is inspected directly, it is found to be clogged						●				
	Turbocharger drain tube is clogged							●			
	Excessive play of turbocharger shaft								●		
	When safety valve is directly inspected, spring is found to be catching or broken									●	
		Remedy	Replace	Clean	Replace	Replace	Clean	Clean	Replace	Replace	—

S-10 Fuel consumption is excessive

General causes why fuel consumption is excessive

- Leakage of fuel
- Improper condition of fuel injection
- Excessive injection of fuel

Legend

○ : Possible causes (judging from Questions and check items)

◎ : Most probable causes (judging from Questions and Check items)

△ : Possible causes due to length of use (used for a long period)

● : Items to confirm the cause.

			Causes							
			Defective injection pump (excessive injection)	Defective nozzle holder spray	Defective injection pump plunger	Defective fuel injection timing	External leakage from fuel piping, fuel filter	Leakage of fuel inside head cover	Defective oil seal inside feed pump (piston)	Defective adjustment of fuel control linkage
Questions	Confirm recent repair history									
	Degree of use of machine	Operated for long period		△	△				△	
	Condition of fuel consumption	More than for other machines of same model	◎			○				
		Gradually increased		○	○					
		Suddenly increased					○	○		
Check items	Exhaust smoke color	Black	◎	○		○				○
		White						○		
	Seal on injection pump has come off		◎							
	There is irregular combustion			◎						
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low			◎	○					
	Match mark on injection pump is misaligned					◎				
	There is external leakage of fuel from engine						◎			
	Engine oil level rises and smells of diesel fuel		○					◎	◎	
	Engine low idling speed is high		○							◎
Troubleshooting	Injection pump measurement shows that injection amount is excessive		●							
	Speed does not change when operation of certain cylinders is stopped			●						
	When control rack is pushed, it is found to be heavy, or does not return				●					
	When check is made using delivery method, injection timing is found to be incorrect					●				
	Remove head cover and inspect directly							●		
	Remove feed pump and inspect directly								●	
	When engine speed is measured, low idling speed is found to be high									●
	Remedy		Adjust	Replace	Replace	Adjust	Correct	Correct	Correct	Adjust

S-11 Oil is in cooling water, or water spurts back, or water level goes down

General causes why oil is in cooling water

- Internal leakage in lubrication system
- Internal leakage in cooling system

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes				
			Broken oil cooler core, O-ring	Broken cylinder head, head gasket	Insufficient protrusion of liner	Broken liner O-ring, holes caused by pitting	Internal cracks in cylinder block
Questions	Confirm recent repair history						
	Degree of use of machine	Operated for long period	△			△	
	Oil level	Suddenly increased	○	○			
		Gradually increased				○	○
Check items	Hard water is being used as cooling water		○			○	
	Engine oil level has risen, oil is cloudy white		◎			○	○
	Excessive air bubbles inside radiator, spurts back			◎	◎		
Troubleshooting	Pressure-tightness test of oil cooler shows there is leakage		●				
	Pressure-tightness test of cylinder head shows there is leakage			●			
	Remove cylinder head and inspect directly				●		
	Remove oil pan and inspect directly					●	●
		Remedy	Replace	Replace	Replace	Replace	Replace

S-12 Oil pressure caution lamp lights up (drop in oil pressure)

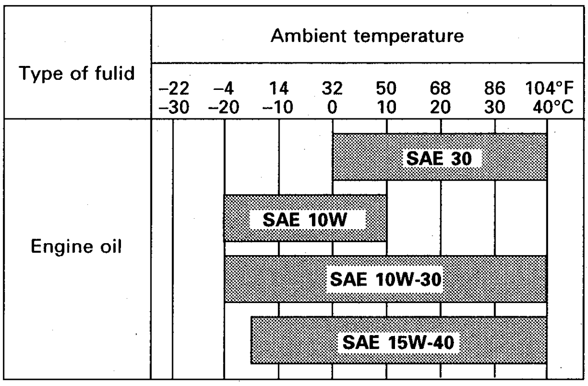
★ Check that the monitor panel engine oil level lamp is not lighted up.

★ When the oil pressure sensor is normal (see M mode).

General causes why oil pressure lamp lights up

- Leakage, clogging, wear of lubricating system
- Defective oil pressure control
- Improper oil used (improper viscosity)
- Deterioration of oil due to overheating

★ Standards for engine oil selection



Legend

○ : Possible causes (judging from Questions and check items)

◎ : Most probable causes (judging from Questions and Check items)

△ : Possible causes due to length of use (used for a long period)

● : Items to confirm the cause.

			Causes										
			Clogged oil filter	Worn bearing, journal	Clogged strainer inside oil pan	Clogged, broken oil pipe inside oil pan	Broken suction pipe brazing	Defective oil pump	Defective regulator valve	Defective main relief valve	Leaking, crushed hydraulic piping	Defective oil pressure sensor	Water, fuel in oil
Questions	Confirm recent repair history												
	Degree of use of machine	Operated for long period	△	△				△					
	Replacement of filters has not been carried out according to Operation Manual		◎										
	Non-specified oil is being used		○	○									
Check items	Condition when oil pressure lamp lights up	Lights up at low idling		◎						○			
		Lights up at low, high idling			◎	◎	◎	◎	○	○			
		Sometimes lights up							◎	◎		○	
	There is clogging, leakage from hydraulic piping (external)										◎		
	Metal particles are found when oil is drained			◎									
	Metal particles are stuck to oil filter element			◎				○					
	Oil is cloudy white or smells of diesel oil												◎
Troubleshooting	When oil filter is inspected directly, it is found to be clogged		●	●									Carry out troubleshooting for OIL LEVEL RISES.
	Remove oil pan and inspect directly				●	●	●						
	Oil pump rotation is heavy, there is play							●					
	There is catching of relief valve or regulator valve, spring or valve guide is broken								●	●			
	When oil pressure is measured, it is found to be within standard value											●	
		Remedy	Clean	Clean	Clean	Clean	Correct	Replace	Adjust	Adjust	Correct	Replace	—

S-13 Oil level rises (water, fuel in oil)

★ If there is oil in the cooling water, carry out troubleshooting for "Oil is in cooling water".

General causes why oil level rises

- Water in oil
- Fuel in oil (diluted, and smells of diesel fuel)
- Entry of oil from other component

Legend

○ : Possible causes (judging from Questions and check items)

◎ : Most probable causes (judging from Questions and Check items)

△ : Possible causes due to length of use (used for a long period)

● : Items to confirm the cause.

			Causes										
			Broken oil cooler core, O-ring	Defective nozzle holder sleeve	Broken cylinder head, head gasket (precombustion chamber)	Clogged water pump breather hole, defective seal	Worn, damaged rear seal surface	Defective main pump seal	Leakage of fuel inside head cover	Defective part inside injection pump (flange type)	Defective thermostat seat portion	Damaged liner O-ring, holes made by pitting · Defective thermostat seat	Cracks inside cylinder block
Questions	Confirm recent repair history												
	Degree of use of machine	Operated for long period		△		△	△	△				△	
	When engine is first started, drops of water come from muffler			◎									
	Exhaust smoke is white			◎					○		○		
Check items	There is oil in radiator cooling water		◎	○	○							○	○
	Leave radiator cap open. When engine is run at idling, an abnormal number of bubbles appear, or water spurts back				◎							○	
	Water pump breather hole is clogged with mud					◎							
	When water pump breather hole is cleaned, water comes out					◎							
	Oil level goes down in damper chamber						◎						
	Oil level goes down in hydraulic tank							◎					
	Engine oil smells of diesel fuel								◎	◎	◎		
	Fuel must be added more frequently								◎	◎	◎		
Troubleshooting	Pressure-tightness test of oil cooler shows there is leakage		●										
	Pressure-tightness test of cylinder head shows there is leakage			●									
	When compression pressure is measured, it is found to be low				●								
	Remove water pump and inspect directly					●							
	Remove rear seal and inspect directly						●						
	When main pump is removed, seal is found to be damaged							●					
	Remove head cover and inspect directly								●				
	Remove injection pump and inspect directly									●			
	Defective contact of thermostat seal valve										●		
	Remove oil pan and check directly											●	●
	Remedy		Replace	Replace	Replace	Replace	Correct	Replace	Correct	Replace	Replace	Replace	Replace

S-14 Water temperature becomes too high (overheating)

★ Check that the monitor panel coolant level caution lamp is not lighted up.

★ When the monitor panel water temperature gauge is normal, go to troubleshooting of machine monitor system (M mode).

General causes why water temperature becomes too high

- Lack of cooling air (deformation, damage of fan)
- Drop in heat dissipation efficiency
- Defective cooling circulation system

★ Carry out troubleshooting for chassis.

Legend

○: Possible causes (judging from Questions and check items)

◎: Most probable causes (judging from Questions and Check items)

△: Possible causes due to length of use (used for a long period)

●: Items to confirm the cause.

			Causes										
			Broken water pump	Clogged, crushed radiator fins	Clogged radiator core	Defective thermostat (does not open)	Defective water temperature gauge	Fan belt slipping, worn fan pulley	Clogged, broken oil cooler	Defective radiator pressure valve	Broken head, head gasket	Damaged liner O-ring, holes made by pitting	External leakage from cooling water piping
Questions	Confirm recent repair history												
	Degree of use of machine	Operated for long period		△	△						△	△	
	Condition of overheating	Suddenly overheated	◎					○					
		Always tends to overheat		◎	◎	○		○					
	Water temperature gauge	Rises quickly				◎							
		Does not go down					◎						
Check items	Fan belt whines under sudden load							◎					
	Cloudy white oil is floating on cooling water								◎				
	Cooling water flows out from overflow hose									◎			
	Excessive air bubbles inside radiator, water spurts back										◎		
	Engine oil level has risen, oil is cloudy white								○			◎	
	There is play when fan pulley is rotated		◎										
	Radiator shroud, inside of underguard are clogged with dirt or mud			◎									
	When light bulb is held behind radiator, no light passes through			◎									
	Water is leaking because of cracks in hose or loose clamps												◎
	When belt tension is inspected, it is found to be loose							◎					
Troubleshooting	Temperature difference between top and bottom radiator tanks is excessive		●										
	Temperature difference between top and bottom radiator tanks is slight			●									
	When water filler port is inspected, core is found to be clogged				●								
	When function test is carried out on thermostat, it does not open even at cracking temperature					●							
	When water temperature is measured, it is found to be normal						●						
	When oil cooler is inspected directly, it is found to be clogged								●				
	When measurement is made with radiator cap tester, set pressure is found to be low									●			
	When compression pressure is measured, it is found to be low										●		
	Remove oil pan and inspect directly											●	
	Remedy		Replace	Correct	Correct	Replace	Replace	Correct	Replace	Replace	Replace	Replace	Correct, replace

S-15 Abnormal noise is made

★ Judge if the noise is an internal noise or an external noise.

General causes why abnormal noise is made

- Abnormality due to defective parts
- Abnormal combustion
- Air sucked in from intake system

Legend

○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes											
			Excessive wear of piston ring, cylinder liner	Seized turbocharger, interference	Missing, seized bushing	Clogged, seized injection nozzle	Defective injection pump (rack, plunger seized)	Defective injection pump (excessive injection)	Deformed fan, fan belt interference	Defective adjustment of valve clearance	Broken dynamic valve system (valve, rocker lever, etc.)	Improper gear train backlash	Leakage of air between turbocharger and head	Defect inside muffler (dividing board out of position)
Questions	Confirm recent repair history													
	Degree of use of machine	Operated for long period	△											
	Condition of abnormal noise	Gradually occurred	○						○					
		Suddenly occurred		○	○						○			
	Non-specified fuel is being used					○	○							
	Engine oil must be added more frequently		◎											
	Color of exhaust gas	Blue under light load	◎											
		Black		◎						○			○	
Check items	Metal particles are found in oil filter		◎		◎									
	Blow-by gas is excessive		◎											
	Noise of interference is heard from around turbocharger			◎										
	Engine pickup is poor and combustion is abnormal					◎								
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎	○							
	Seal on injection pump has come off							◎						
	Abnormal noise is loud when accelerating engine					○	○	○	○	○		○		
	Clanging sound is heard from around cylinder head									◎	◎			
	Leakage of air between turbocharger and head, loose clamp												◎	
	Vibrating noise is heard from around muffler													◎
Troubleshooting	When compression pressure is measured, it is found to be low		●											
	When turbocharger is rotated by hand, it is found to be heavy			●										
	Remove gear cover and inspect directly				●							●		
	Speed does not change when operation of certain cylinders is stopped					●								
	When control rack is pushed, it is found to be heavy, or does not return						●							
	Injection pump test shows that injection amount is incorrect							●						
	Fan is deformed, belt is loose								●					
	When valve clearance is checked, it is found to be outside standard value									●				
	Remove cylinder head cover and inspect directly										●			
	When muffler is removed, abnormal noise disappears													●
	Remedy		Replace	Replace	Replace	Replace	Replace	Adjust	Correct	Adjust	Replace	Replace	Replace	Replace

S-16 Vibration is excessive

★ If there is abnormal noise together with the vibration, carry out troubleshooting for "Abnormal noise is made".

General causes why vibration is excessive

- Defective parts (abnormal wear, breakage)
- Improper alignment
- Abnormal combustion

Legend

○ : Possible causes (judging from Questions and check items)

◎ : Most probable causes (judging from Questions and Check items)

△ : Possible causes due to length of use (used for a long period)

● : Items to confirm the cause.

			Causes						
			Worn connecting rod, main bearing	Worn balancer, cam bushing	Loose engine mounting bolts, broken cushion	Broken part inside output shaft (damper)	Improper gear train backlash	Defective dynamic valve system (valve, rocker lever, etc.)	Defective injection pump (excessive injection)
Questions	Confirm recent repair history								
	Degree of use of machine	Operated for long period	△	△	△				
	Condition of vibration	Suddenly increased				○		○	
		Gradually increased	○	○	○				
	Non-specified oil is being used		○	○					
Check items	Metal particles are found in oil filter		◎	◎					
	Metal particles are found when oil is drained		◎	◎					
	Oil pressure is low at low idling		○	○					
	Vibration occurs at mid-range speed				○	○			
	Vibration follows engine speed				○	○	○		
	Exhaust smoke is black							◎	○
	Seal on injection pump has come off								◎
Troubleshooting	Remove oil pan and inspect directly		●						
	Remove side cover and inspect directly			●					
	Inspect directly for loose engine mounting bolts, broken cushion				●				
	Inspect inside of output shaft (damper) directly					●			
	Remove front cover and inspect directly						●		
	Remove head cover and inspect directly							●	
	Injection pump test shows that injection amount is incorrect								●
		Remedy	Replace	Replace	Replace	Replace	Correct	Replace	Adjust

TROUBLESHOOTING OF ENGINE THROTTLE, PUMP CONTROLLER (PUMP CONTROL SYSTEM) (C MODE)

POINTS TO REMEMBER WHEN TROUBLESHOOTING PUMP CONTROLLER SYSTEM

1. Points to remember if abnormality returns to normal by itself

In the following two cases, there is a high probability that the same problem will occur again, so it is desirable to follow up this problem carefully.

1) If any abnormality returns to normal by itself, or
2) If the connector is disconnected and the T-adapter is inserted, or if the T-adapter is removed and the connector is returned to its original position when carrying out troubleshooting of the failure, and the service code is no longer displayed, or if the monitor display returns to normal.
3) After completing troubleshooting, always erase the user code from memory.

2. User code memory retention function

When displaying the abnormality code in memory and carrying out troubleshooting, note down the content of the display, then erase the display. After trying to re-enact the problem, carry out troubleshooting according to the failure code that is displayed.

(There are cases where mistaken operation or abnormalities that occur when the connector is disconnected are recorded by the memory retention function. Erasing the data in this way saves any wasted work.)

ACTION TAKEN BY CONTROLLER WHEN ABNORMALITY OCCURS AND PROBLEMS ON MACHINE

User code	Service code	Abnormal system	Nature of abnormality
E02	E232	Short circuit in front pump TVC solenoid system	1. Short circuit with ground, short circuit inside front pump TVC solenoid 2. Short circuit with power source, short circuit with ground in wiring harness between controller C02 (8) and TVC solenoid C13 (1) ((+) side) 3. Short circuit with power source in wiring harness between controller C02 (18) and TVC solenoid C13 (2) ((-) side) 4. Defective engine throttle, pump controller
	E233	Disconnection in front pump TVC solenoid system	1. Disconnection, defective contact inside front pump TVC solenoid 2. Disconnection, defective contact in wiring harness between controller C02 (8) and TVC solenoid C13 (1) ((+) side) 3. Disconnection, defective contact, short circuit with ground in wiring harness between controller C02 (18) and TVC solenoid C13 (2) ((-) side) 4. Defective engine throttle, pump controller
	E236	Short circuit in rear pump TVC solenoid system	1. Short circuit with ground, short circuit inside rear pump TVC solenoid 2. Short circuit with power source, short circuit with ground in wiring harness between controller C02 (9) and TVC solenoid C04 (1) ((+) side) 3. Short circuit with power source in wiring harness between controller C02 (19) and TVC solenoid C04 (2) ((-) side) 4. Defective engine throttle, pump controller
	E237	Disconnection in rear pump TVC solenoid system	1. Disconnection, defective contact inside rear pump TVC solenoid 2. Disconnection, defective contactin wiring harness between controller C02 (9) and TVC solenoid C04 (1) ((+) side) 3. Disconnection, defective contact, short circuit with ground in wiring harness between controller C02 (19) and TVC solenoid C04 (2) ((-) side) 4. Defective engine throttle, pump controller
E03	E203	Short circuit in swing holding brake solenoid system	1. Short circuit with ground, short circuit inside swing holding brake solenoid 2. Short circuit with ground in wiring harness between controller C01 (3) and solenoid V04 (2) ((+) side) 3. Defective engine throttle, pump controller
	E213	Disconnection in swing holding brake solenoid system	1. Disconnection, defective contact inside swing holding brake solenoid 2. Disconnection, defective contact, short circuit with power source in wiring harness between controller C01 (3) and solenoid V04 (2) ((+) side) 3. Disconnection, defective contact in wiring harness between solenoid V04 (1) and chassis ground ((-) side) 4. Defective engine throttle, pump controller

Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
· Resistance of solenoid: 10 – 22 Ω	1. Makes output to TVC solenoid 0. 2. Displays user code E02 on monitor panel. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	1. No current flows to the front pump TVC solenoid. Therefore, when the load is large, there is a big drop in the engine speed which may result in the engine stalling. 2. The swing acceleration is poor
· Resistance of solenoid: 10 – 22 Ω · Current: 1000 mA (H/O mode, auto-deceleration ON, levers at neutral, fuel control dial at MAX.)	1. The current stops flowing to the TVC solenoid, so no particular action is taken. 2. If there is a short circuit with the ground at the (-) end, the current (min. 1A) continues to flow to the TVC solenoid. 3. It displays user code E02 on the monitor panel. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	1. In the case of 1, it is the same as E232. 2. In the case of 2, the current (min. 1A) continues to flow to the front pump TVC solenoid, so the output of the front pump TVC valve increases and the overall speed becomes slower.
· Resistance of solenoid: 10 – 22 Ω	1. Makes output to TVC solenoid 0. 2. Displays user code E02 on monitor panel. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Same as E232 (but for the rear pump)
· Resistance of solenoid: 10 – 22 Ω Current: 1000 mA (H/O mode, auto-deceleration ON, levers at neutral, fuel control dial at MAX.)	1. The current stops flowing to the TVC solenoid, so no particular action is taken. 2. If there is a short circuit with the ground at the (-) end, the current (min. 1A) continues to flow to the TVC solenoid. 3. It displays user code E02 on the monitor panel. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Same as E233 (but for the rear pump)
· Resistance of solenoid: 20 – 60 Ω	1. Makes output to TVC solenoid 0. 2. Displays user code E03 on monitor panel. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	When the swing is operated, the motor brake is not released, so the upper structure does not swing.
· Resistance of solenoid: 20 – 60 Ω	1. The current stops flowing to the solenoid, so no particular action is taken. 2. Displays user code E03 on monitor panel. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Same as display for E203

User code	Service code	Abnormal system	Nature of abnormality
—	E204	Short circuit in pump merge/divider solenoid system	1. Short circuit with ground, short circuit inside pump merge/divider solenoid 2. Short circuit with ground in wiring harness between controller C01 (2) and solenoid V03 (2) ((+) side) 3. Defective engine throttle, pump controller
—	E206	Short circuit in travel speed solenoid system	1. Short circuit with ground, short circuit inside travel speed solenoid 2. Short circuit with ground in wiring harness between controller C01 (9) and solenoid V06 (2) ((+) side) 3. Defective engine throttle, pump controller
—	E207	Short circuit in active mode (boom) solenoid system	1. Short circuit with ground, short circuit inside active mode (boom) solenoid 2. Short circuit with ground in wiring harness between controller C01 (8) and solenoid V02 (2) ((+) side) 3. Defective engine throttle, pump controller
—	E208	Disconnection in active mode (boom) solenoid system	1. Disconnection, defective contact inside active mode (boom) solenoid 2. Disconnection, defective contact, short circuit with power source in wiring harness between controller C01 (9) and solenoid V02 (2) ((+) side) 3. Disconnection, defective contact in wiring harness between solenoid V02 (1) and chassis ground ((-) side) 4. Defective engine throttle, pump controller
—	E214	Disconnection in pump merge/divider solenoid system	1. Disconnection, defective contact inside pump merge/divider solenoid 2. Disconnection, defective contact, short circuit with power source in wiring harness between controller C01 (2) and solenoid V03 (2) ((+) side) 3. Disconnection, defective contact in wiring harness between solenoid V03 (2) and chassis ground ((-) side) 4. Defective engine throttle, pump controller
—	E216	Disconnection in travel speed solenoid system	1. Disconnection, defective contact inside travel speed solenoid 2. Disconnection, defective contact, short circuit with power source in wiring harness between controller C01 (9) and solenoid V06 (2) ((+) side) 3. Disconnection, defective contact in wiring harness between solenoid V06 (1) and chassis ground ((-) side) 4. Defective engine throttle, pump controller
—	E217	Model selection input error	1. Disconnection, defective contact, short circuit with ground in model selection wiring harness C17(5) (6) (7) (13) (14) 2. Defective engine throttle, pump controller

Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
· Resistance of solenoid: 20 – 60 Ω	1. Makes output to solenoid 0. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	The pump merge/divider valve continues to merge the oil flow. 1. In the L/O and F/O modes, the work equipment and swing speeds become faster. 2. The steering is difficult to turn.
· Resistance of solenoid: 20 – 60 Ω	1. Makes output to solenoid 0. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Even if the travel speed is switched, the travel speed does not change (remains at Lo)
· Resistance of solenoid: 20 – 60 Ω	1. Makes output to solenoid 0. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	When mode is STD (active mode OFF), the boom lower speeds become faster.
· Resistance of solenoid: 20 – 60 Ω	1. The current stops flowing to the solenoid, so no particular action is taken. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Same content as display for E207
· Resistance of solenoid: 20 – 60 Ω	1. The current stops flowing to the solenoid, so no particular action is taken. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Same content as display for E204
· Resistance of solenoid: 20 – 60 Ω	1. The current stops flowing to the solenoid, so no particular action is taken. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Same content as display for E206
· Between C17 (6), (13) and chassis: Max. 1 Ω Between C17 (5),(7),(14) and chassis: Min. 1 MΩ	Detects abnormality in input 1) Retains data when starting switch is ON 2) Functions as PC100 when non-set conditions are input	1. Engine stalls, or 2. Work equipment, swing, travel speeds are all slow, and there is no power

User code	Service code	Abnormal system	Nature of abnormality
—	E218	Network response overtime error	1. Disconnection, short circuit, short circuit with ground in network wiring harness 2. Abnormality in engine throttle, pump controller 3. Abnormality in monitor
—	E222	Short circuit in LS-EPC solenoid system	1. Short circuit with ground, short circuit inside LS-EPC solenoid 2. Short circuit with power source, short circuit with ground in wiring harness between controller C02 (7) and solenoid C10 (1) ((+) side) 3. Short circuit with power source in wiring harness between controller C02 (17) and solenoid C10 (2) ((-) side) 4. Defective engine throttle, pump controller
—	E223	Disconnection in LS-EPC solenoid system	1. Disconnection, defective contact inside LS-EPC solenoid 2. Disconnection, defective contact in wiring harness between controller C02 (7) and solenoid C10 (1) ((+) side) 3. Disconnection, defective contact, short circuit with ground in wiring harness between controller C02 (17) and solenoid C10 (2) ((-) side) 4. Defective engine throttle, pump controller
—	E224	Abnormality in front pump pressure sensor system	1. Disconnection, defective contact, short circuit, short circuit with ground inside front pump pressure sensor 2. Disconnection, defective contact, short circuit in wiring harness between controller C03 (6) and pressure sensor C08 (2) ((+) side) and between C03 (16) and C08 (1) ((-) side) 3. Disconnection, defective contact, short circuit with power source, short circuit with ground in wiring harness between controller C03 (3) and pressure sensor C08 (3) (SIG side) 4. Defective engine throttle, pump controller
—	E225	Abnormality in rear pump pressure sensor system	1. Disconnection, defective contact, short circuit, short circuit with ground inside rear pump pressure sensor 2. Disconnection, defective contact, short circuit in wiring harness between controller C03 (6) and pressure sensor C07 (2) ((+) side) and between C03 (16) and C07 (1) ((-) side) 3. Disconnection, defective contact, short circuit with power source, short circuit with ground in wiring harness between controller C03 (13) and pressure sensor C07 (3) (SIG side) 4. Defective engine throttle, pump controller
—	E226	Abnormality in pressure sensor power source system	1. Short circuit, short circuit with ground inside front pump pressure sensor or rear pump pressure sensor 2. Short circuit, short circuit with ground in wiring harness between controller C03 (6) and front pressure sensor C08 (2) or rear pressure sensor C07 (2) ((+) side) 3. Defective engine throttle, pump controller
—	E227	Abnormality in speed sensor system	1. Disconnection, defective contact, short circuit inside engine speed sensor 2. Disconnection, defective contact, short circuit with ground in wiring harness between controller C16 (1) and speed sensor E07 (2) ((-) side) and between C16 (2) and E07 (1) (SIG side) 3. Defective engine throttle, pump controller

Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
	1. When communications are impossible with the monitor, control is carried out with the following settings. ① Working mode: G/O ② Priority mode: OFF ③ Travel speed: Lo ④ Auto-deceleration: ON ⑤ Power max. : ON (others are as usual)	1. ① Even when travel is operated, the power max. function does not work ② The swift speed-down function does not wor ③ The auto-deceleration cannot be canceled ④ The travel speed does not increase ⑤ The priority mode has no effect ⑥ The automatic mode has no effect
· Resistance of solenoid: 7 – 14 Ω	1. Makes output to LS-EPC solenoid 0. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	1. The Lo travel speed is too fast. 2. In L/O and F/O modes, the work equipment speed is too fast. 3. When the engine is running at low idling, the swing speed is too fast.
· Current: Approx. 705 mA (Levers at neutral, low idling)	1. The current stops flowing to the LS-EPC solenoid, so no particular action is taken. 2. If there is a short circuit with the ground at the (-) end, the current (min. 1A) continues to flow to the LS-EPC solenoid. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	1. In the case of 1, it is the same as E222 2. In the case of 2, electric current (min. 1A) continues to flow to the LS-EPC solenoid, so the work equipment, travel, and swing speeds are slow
· Between C03 (3) and (16): 0.5 – 4.5 V · Between C03 (6) and (16): 18 – 28 V · Between C03 (female) (3) and (16), (3) and chassis · Resistance: Min. 1 MΩ (Disconnect connectors C03 and C08.)	1. Takes front pump pressure as 0 MPa {0 kg/cm^2} when actuating. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	1. The travel speed does not automatically shift (it does not change from Hi to Lo). ★ If the button is operated manually, the panel display is switched.
· Between C03 (13) and (16): 0.5 – 4.5 V · Between C03 (6) and (16): 18 – 28 V · Between C03 (female) (13) and (16), (13) and chassis · Resistance: Min. 1 MΩ (Disconnect connectors C03 and C07.)	1. Takes rear pump pressure as 0 MPa {0 kg/cm^2} when actuating. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	1. The travel speed does not automatically shift (it does not change from Hi to Lo). ★ If the button is operated manually, the panel display is switched.
· Voltage between C03 (6) and (16): 18 – 28 V	1. Takes front pump and rear pump pressure as 0 MPa {0 kg/cm^2} when actuating. 2. When abnormality is detected, it switches the output OFF, and when all levers are returned to neutral, it outputs again. ★ This automatic resetting is repeated up to 3 times.	1. The travel speed does not automatically shift (it does not change from Hi to Lo). ★ If the button is operated manually, the panel display is switched.
· Resistance: 500 – 1000 Ω · Voltage (AC range) : 0.5 – 3.0 V (engine started)	1. It functions in the equivalent of the G/O mode (the speed rises)	It operates about the same as G/O mode (prolix) (the power is slightly lower)

User code	Service code	Abnormal system	Nature of abnormality
—	E231	Short circuit in active mode (swing) solenoid system	1. Short circuit with ground, short circuit inside active mode (swing) solenoid 2. Short circuit with ground in wiring harness between controller C01 (10) and solenoid V07 (2) ((+) side) 3. Defective engine throttle, pump controller
—	E235	Disconnection in active mode (swing) solenoid system	1. Disconnection, defective contact inside active mode (swing) solenoid 2. Disconnection, defective contact, short circuit with power source in wiring harness between controller C01 (10) and solenoid V07 (2) ((+) side) 3. Disconnection, defective contact in wiring harness between solenoid V07 (1) and chassis ground ((–) side) 4. Defective engine throttle, pump controller

Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
· Resistance of solenoid: 20 – 60 Ω	1. Makes output to solenoid 0. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	In active mode and heavy-duty mode, the rise in the bucket edge is the same in swing + boom RAISE. There is no priority.
· Resistance of solenoid: 20 – 60 Ω	1. The current stops flowing to the solenoid, so no particular action is taken. ★ If the abnormality is restored by the vibration of the machine, it resets the power source to restore to the proper condition. (However, the service code display does not go out.)	Same as E231

JUDGEMENT TABLE FOR ENGINE THROTTLE, PUMP CONTROLLER (PUMP CONTROL SYSTEM) AND HYDRAULIC RELATED PARTS

Failure mode			Abnormality in controller power source	Engine throttle, pump controller (E2:XX system)																
				Self-diagnostic display																
				Short circuit in front pump TVC solenoid system	Disconnection in front pump TVC solenoid system	Short circuit in rear pump TVC solenoid system	Disconnection in rear pump TVC solenoid system	Short circuit in active mode (boom) solenoid system	Disconnection in active mode (boom) solenoid system	Short circuit in swing holding brake solenoid system	Disconnection in swing holding brake solenoid system	Short circuit in pump merge/divider solenoid system	Disconnection in pump merge/divider solenoid system	Short circuit in travel speed selector solenoid system	Disconnection in travel speed selector solenoid system	Model selection input error	Short circuit in LS-EPC solenoid system	Disconnection in LS-EPC solenoid system	Short circuit in active mode (swing) solenoid system	Disconnection in active mode (swing) solenoid system
		User code	LED	E02				—		E03		—								
		Service code	OFF	232	233	236	237	207	208	203	213	204	214	206	216	217	222	223	231	235
All work equipment, travel, swing	Speeds of all work equipment, swing, travel are slow or lack power			▲	▲	▲	▲									●		●		
	There is excessive drop in engine speed, or engine stalls			●	●	●	●									●				
	No work equipment, travel, swing move																			
	Abnormal noise generated (around pump)																			
	Auto-deceleration does not work		●																	
	Fine control ability is poor or response is poor																●	●		
Work equipment	Boom is slow or lacks power							●	●				●							
	Arm is slow or lacks power												●							
	Bucket is slow or lacks power																			
	Boom does not move																			
	Arm does not move																			
	Bucket does not move																			
	Excessive hydraulic drift																			
	Excessive time lag (engine at low idling)																	●		
	Other equipment moves when single circuit is relieved																			
	In L/O, F/O modes, work equipment speed is faster than specified speed											●	●				●	●		
	Machine push-up function does not work																			
Compound operations	In compound operations, work equipment with larger load is slow																			
	In swing + boom (RAISE), boom is slow																		●	●
	In swing + arm, arm is slow																			
	In swing + travel, travel speed drops excessively																			
Travel system	Travel deviation	Deviation is excessive during normal travel																		
		Deviation is excessive when starting																		
	Travel speed is slow																	●		
	Steering does not turn or lacks power											●	●							
	Travel speed does not switch or is faster than specified speed		●											●	●		●	●		
	Does not move (one side only)																			
Swing system	Does not swing	Both left and right								●	●									
		One direction only																		
	Swing acceleration is poor or swing speed is slow	Both left and right		●	●	●	●													
		One direction only																		
	Excessive overrun when stopping swing	Both left and right																		
		One direction only																		
	Excessive shock when stopping swing (one direction only)																			
	Excessive abnormal noise when stopping swing																			
	Excessive hydraulic drift of swing	When holding brake is released																		
		When holding brake is applied																		
	Swing speed is faster than specified swing speed											●	●				●	●		
Troubleshooting code when service code is displayed			C-1	C-2	C-3	C-4	C-5	C-6	C-7	C-8	C-9	C-10	C-11	C-12	C-13	C-14	C-15	C-16	C-22	C-23
Troubleshooting code when there is abnormality in monitoring check			–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–

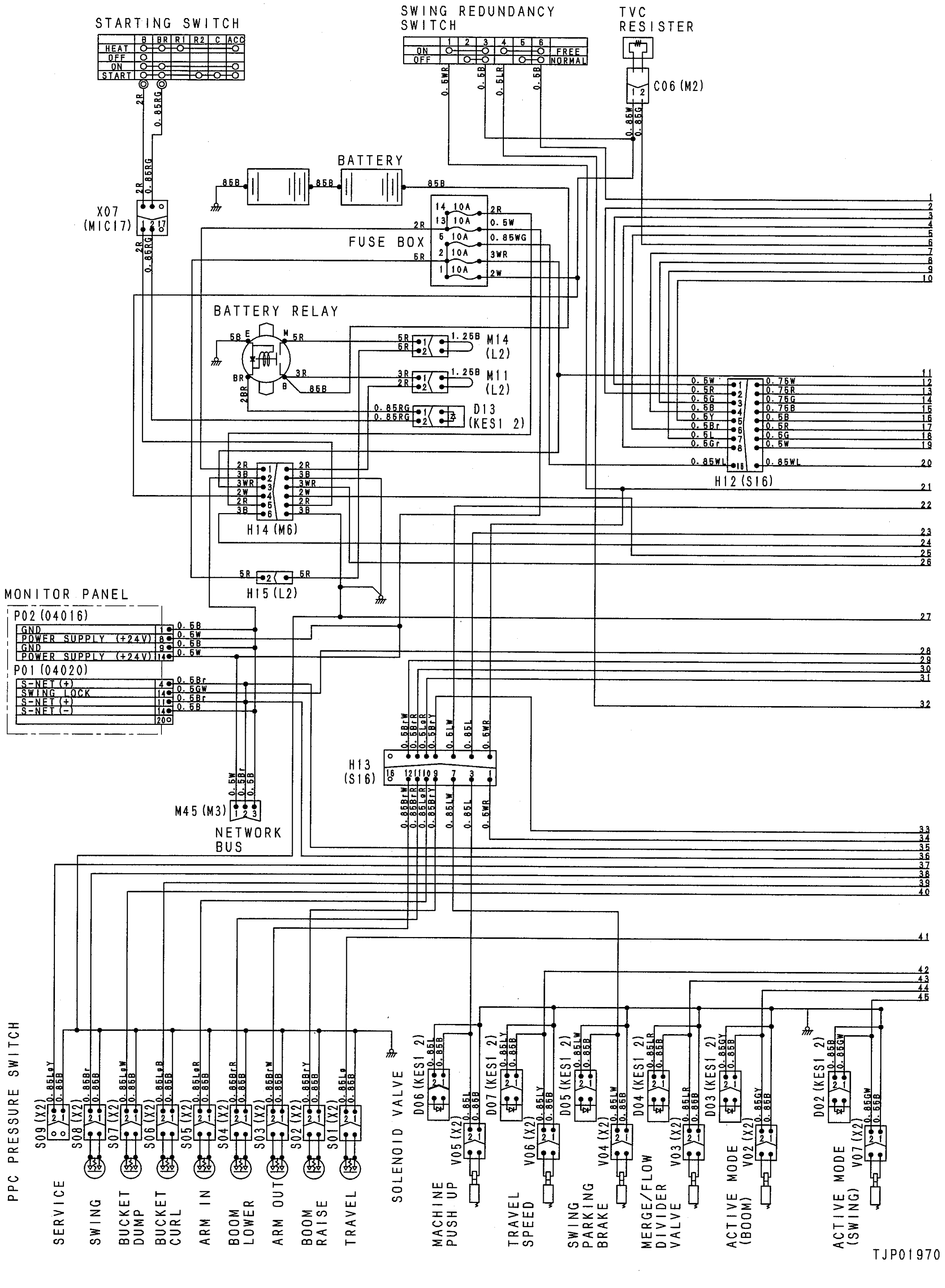
▲ :This shows applicable item for service code (simultaneous abnormality at front or rear)
● :This shows applicable item for service code
※ :This shows item that needs only checking with monitoring
○ :This shows item to check with monitoring or machine monitor

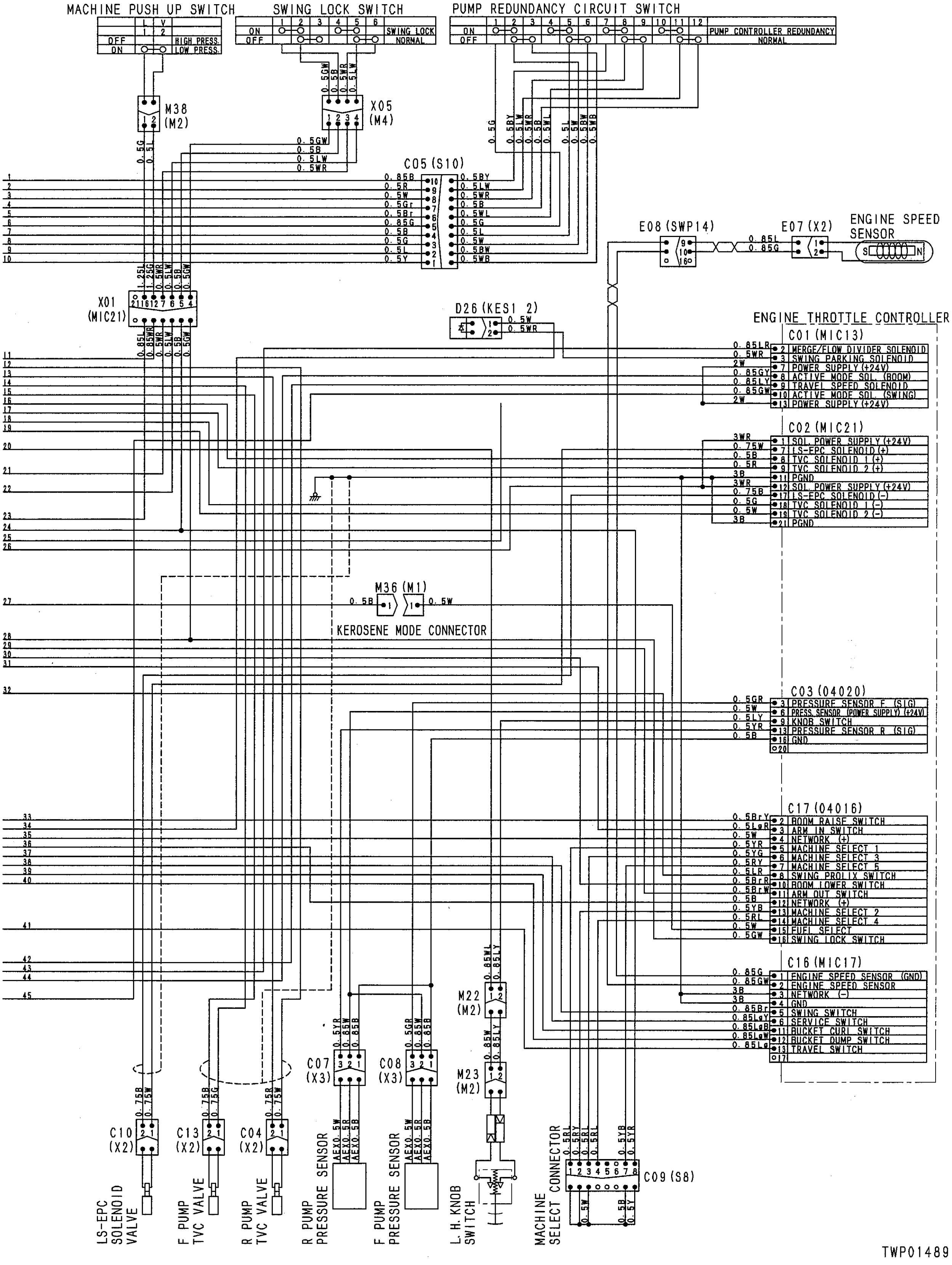
JUDGEMENT TABLE FOR ENGINE THROTTLE, PUMP CONTROLLER (PUMP CONTROL SYSTEM) AND HYDRAULIC RELATED PARTS

★ If service code E218 (abnormality in network system) is displayed, go to troubleshooting for N mode.

Engine throttle, pump controller (E2:XX system) Self-diagnostic display				Check items in monitoring mode																							Troubleshooting code if no service code is displayed
				Pressure switch											Actuation of solenoid												
Abnormality in front pump pressure sensor system	Abnormality in rear pump pressure sensor system	Abnormality in pressure sensor power source system	Abnormality in engine speed sensor system	Swing (1)	Travel (2)	Boom LOWER (3)	Boom RAISE (4)	Arm IN (5)	Arm OUT (6)	Bucket CURL (1)	Bucket DUMP (2)	Swing lock switch (3)	Kerosene mode (5)	Knob switch (6)	Active mode (boom) (2)	Swing holding brake (3)	Pump merge/divider (4)	Travel speed (6)	Active mode (swing)	Model code	Engine speed input	Front pump discharge pressure input	Rear pump discharge pressure input	Front pump TVC current output	Rear pump TVC current output	LS-EPC current output	
				Bit pattern																Monitoring code							
224	225	226	227	20						21			22		23					02	10	11	12	13	14	15	
			●										○								※	※	※	※	※	※	H-1
			●																		※			※	※		H-2
																											H-3
																											H-4
			●	○	○	○	○	○	○	○	○																H-5
																											H-6
						○	○								※		※					※	※				H-7
								○	○								※					※	※				H-8
										○	○											※	※				H-9
																											H-10
																											H-11
						○		○		○																※	H-12
																											H-13
																	※									※	H-14
																											H-15 C-21
																											H-16
				※		※													※								H-17
																											H-18
																											H-19
																											H-20
					○																				※		H-21
					○												※										H-22
●	●	●	●		○													※			※	※	※		※		H-23
																											H-24
				○								○				※						※					H-25
																						※					H-26
																											H-27
																											H-28
																											H-29
																											H-30
				※		※	※	※	※	※	※					※											
																	※									※	H-31
C-17	C-18	C-19	C-20	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	
–	–	–	–	F-1	F-2	F-3	F-4	F-5	F-6	F-7	F-8	F-9	F-10	F-11	–	–	–	–	–	–	–	–	–	–	–	–	

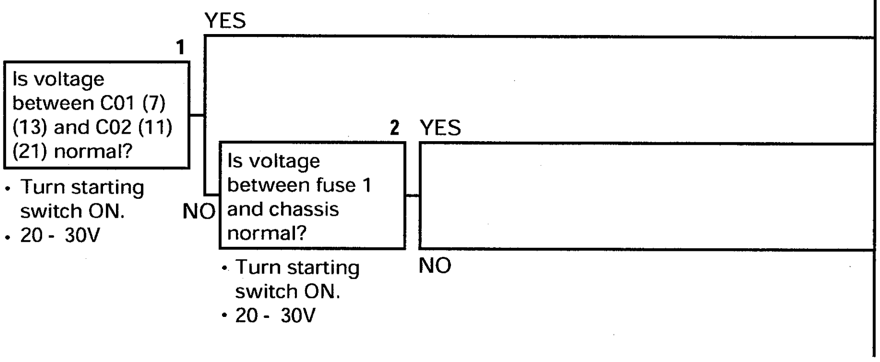
ELECTRICAL CIRCUIT DIAGRAM FOR C MODE




MACHINE PUSH UP SWITCH
OFF HIGH PRESS.
ON LOW PRESS.
SWING LOCK SWITCH
ON SWING LOCK
OFF NORMAL
PUMP REDUNDANCY CIRCUIT SWITCH
ON PUMP CONTROLLER REDUNDANCY
OFF NORMAL
M38 (M2)
X05 (M4)
C05 (S10)
X01 (MIC21)
E08 (SWP14)
E07 (X2)
ENGINE SPEED SENSOR
D26 (KES1 2)
ENGINE THROTTLE CONTROLLER
C01 (MIC13)
2 MERGE/FLOW DIVIDER SOLENOID
3 SWING PARKING SOLENOID
7 POWER SUPPLY (+24V)
8 ACTIVE MODE SOL. (BOOM)
9 TRAVEL SPEED SOLENOID
10 ACTIVE MODE SOL. (SWING)
13 POWER SUPPLY (+24V)
C02 (MIC21)
1 SOL. POWER SUPPLY (+24V)
7 LS-EPC SOLENOID (+)
8 TVC SOLENOID 1 (+)
9 TVC SOLENOID 2 (+)
11 PGND
12 SOL. POWER SUPPLY (+24V)
17 LS-EPC SOLENOID (−)
18 TVC SOLENOID 1 (−)
19 TVC SOLENOID 2 (−)
21 PGND
M36 (M1)
KEROSENE MODE CONNECTOR
C03 (04020)
3 PRESSURE SENSOR F (SIG)
6 PRESS. SENSOR (POWER SUPPLY) (+24V)
9 KNOB SWITCH
13 PRESSURE SENSOR R (SIG)
16 GND
20
C17 (04016)
2 BOOM RAISE SWITCH
3 ARM IN SWITCH
4 NETWORK (+)
5 MACHINE SELECT 1
6 MACHINE SELECT 3
7 MACHINE SELECT 5
8 SWING PROLIX SWITCH
10 BOOM LOWER SWITCH
11 ARM OUT SWITCH
12 NETWORK (+)
13 MACHINE SELECT 2
14 MACHINE SELECT 4
15 FUEL SELECT
16 SWING LOCK SWITCH
C16 (MIC17)
1 ENGINE SPEED SENSOR (GND)
2 ENGINE SPEED SENSOR
3 NETWORK (−)
4 GND
5 SWING SWITCH
6 SERVICE SWITCH
11 BUCKET CURL SWITCH
12 BUCKET DUMP SWITCH
13 TRAVEL SWITCH
17
M22 (M2)
M23 (M2)
C07 (X3)
C08 (X3)
C10 (X2)
C13 (X2)
C04 (X2)
C09 (S8)
LS-EPC SOLENOID VALVE
F PUMP TVC VALVE
R PUMP TVC VALVE
R PUMP PRESSURE SENSOR
F PUMP PRESSURE SENSOR
L.H. KNOB SWITCH
MACHINE SELECT CONNECTOR
TWP01489

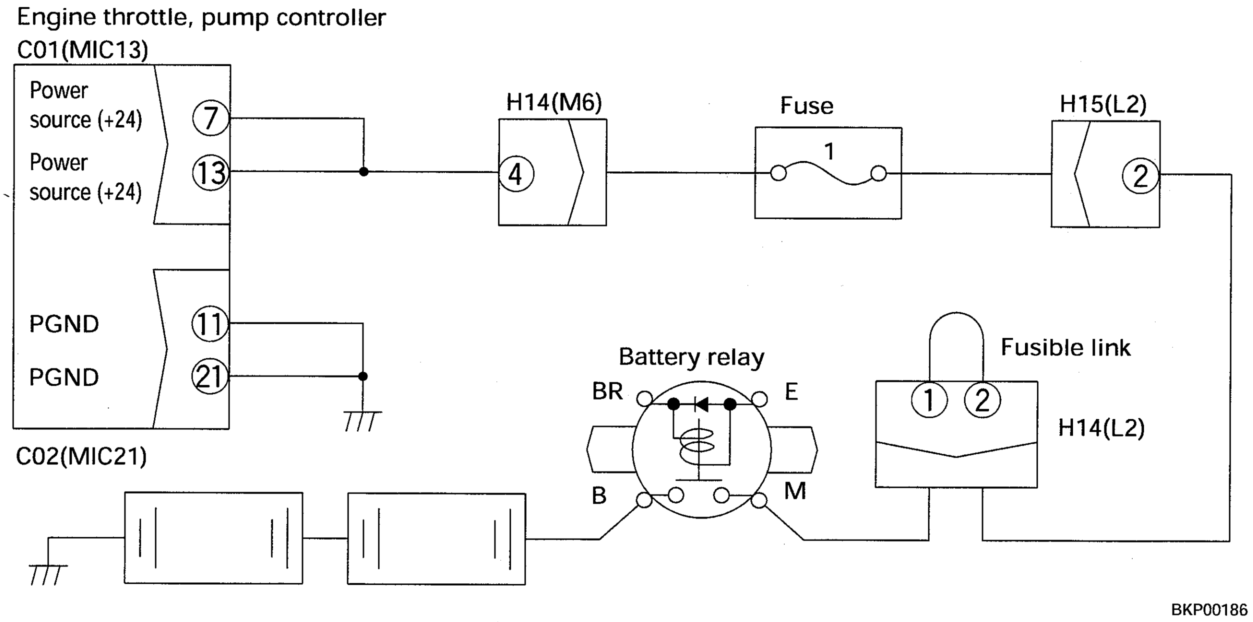
C-1 Abnormality in controller power source system (controller LED is OFF)

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
★ Check that fuse 1 is not blown.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.
★ When the starting motor rotates normally. (If the starting motor also does not rotate, go to E-8.)



Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective contact, or disconnection in wiring harness between fuse 1 and C01 (female) (7) (13)	Repair or replace
Defective contact, or disconnection in wiring harness between fuse 1 - H15 (2) - M14 (2) (1) - battery relay M	Repair or replace

C-1 Related electric circuit diagram



C-2 [E232] Short circuit in front pump TVC solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)

★ Always turn the TVC prolix switch OFF.

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

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

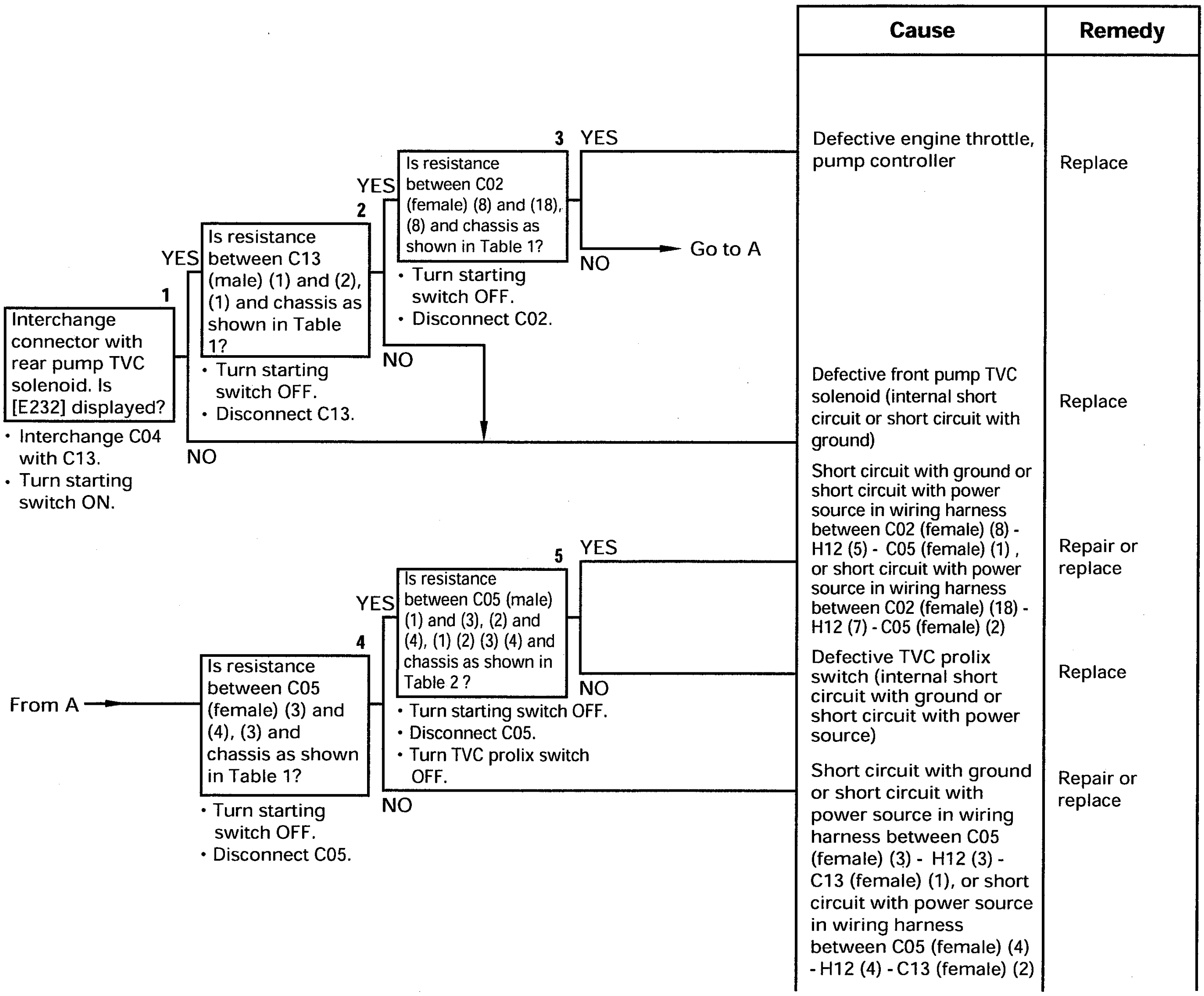


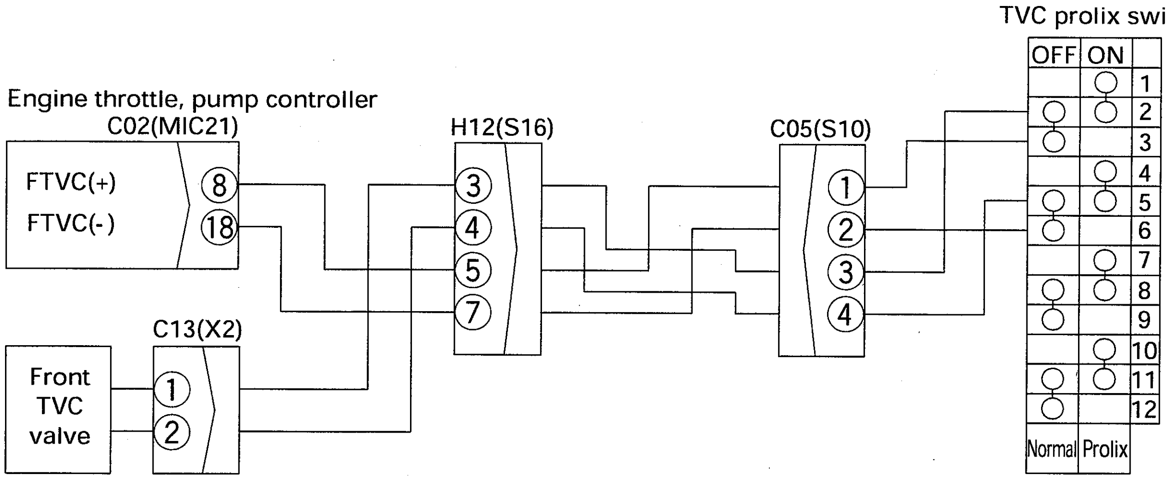
Table 1

Troubleshooting No. 2	Troubleshooting No. 3	Troubleshooting No. 4	Resistance value
Between C13 (male) (1) – (2)	Between C02 (female) (8) – (18)	Between C05 (female) (3) – (4)	10 – 22 Ω
Between C13 (male) (1) – chassis	Between C02 (female) (8) – chassis	Between C05 (female) (3) – chassis	Min. 1 MΩ

Table 2

Troubleshooting No. 5	Resistance value
Between C05 (male) (1) – (3), (2) – (4)	Max. 1 Ω
Between C05 (male) (1)(2)(3)(4) – chassis	Min. 1 MΩ

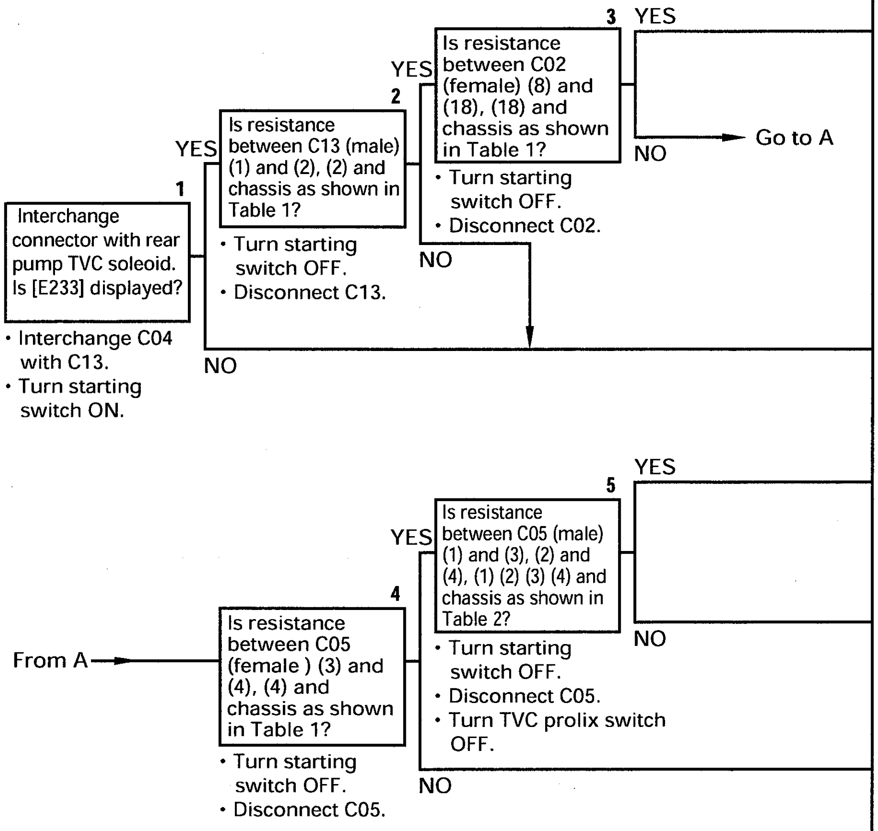
C-2 Related electric circuit diagram



BKP00187

C-3 [E233] Disconnection in front pump TVC solenoid system is displayed

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
- ★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
- ★ If there is a disconnection in the solenoid or wiring harness, no current flows to the solenoid. If the No. 2 pin of the solenoid is short circuiting with the ground, the current (approx. 1 A) continues to flow to the solenoid.
- ★ Always turn the TVC prolix switch OFF.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.



Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective front pump TVC solenoid (internal disconnection or defective contact)	Replace
Defective contact or disconnection in wiring harness between C02 (female) (8) - H12 (5) - C05 (female) (1), or defective contact, short circuit with grond, or disconnection in wiring harness between C02 (female) (18) - H12 (7) - C05 (female) (2)	Repair or replace
Defective TVC prolix switch (internal disconnection, defective contact, or short circuit wth ground)	Replace
Defective contact or disconnectio in wiring harness between C05 (female) (3) - H12 (3) - C13 (female) (1), or disconnection in wiring harness between C05 (female) (4) - H12 (4) - C13 (female) (2)	Repair or replace

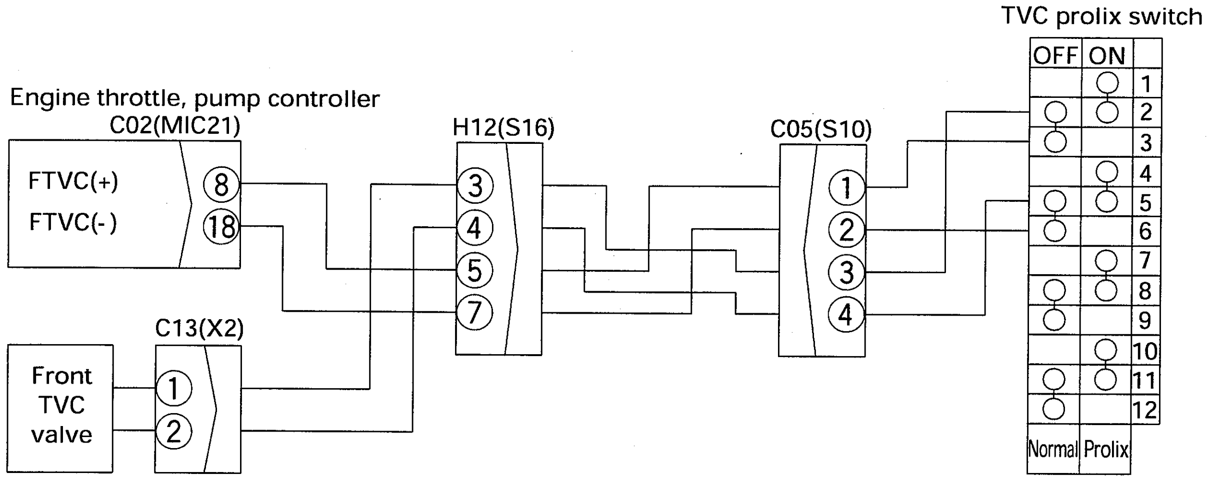
Table 1

Troubleshooting No. 2	Troubleshooting No. 3	Troubleshooting No. 4	Resistance value
Between C13 (male) (1) – (2)	Between C02 (female) (8) – (18)	Between C05 (female) (3) – (4)	10 – 22 Ω
Between C13 (male) (2) – chassis	Between C02 (female) (18) – chassis	Between C05 (female) (4) – chassis	Min. 1 MΩ

Table 2

Troubleshooting No. 5	Resistance value
Between C05 (male) (1) – (3), (2) – (4)	Max. 1 Ω
Between C05 (male) (1)(2)(3)(4) – chassis	Min. 1 MΩ

C-3 Related electric circuit diagram



BKP00187

C-4 [E236] Short circuit in rear pump TVC solenoid system is displayed

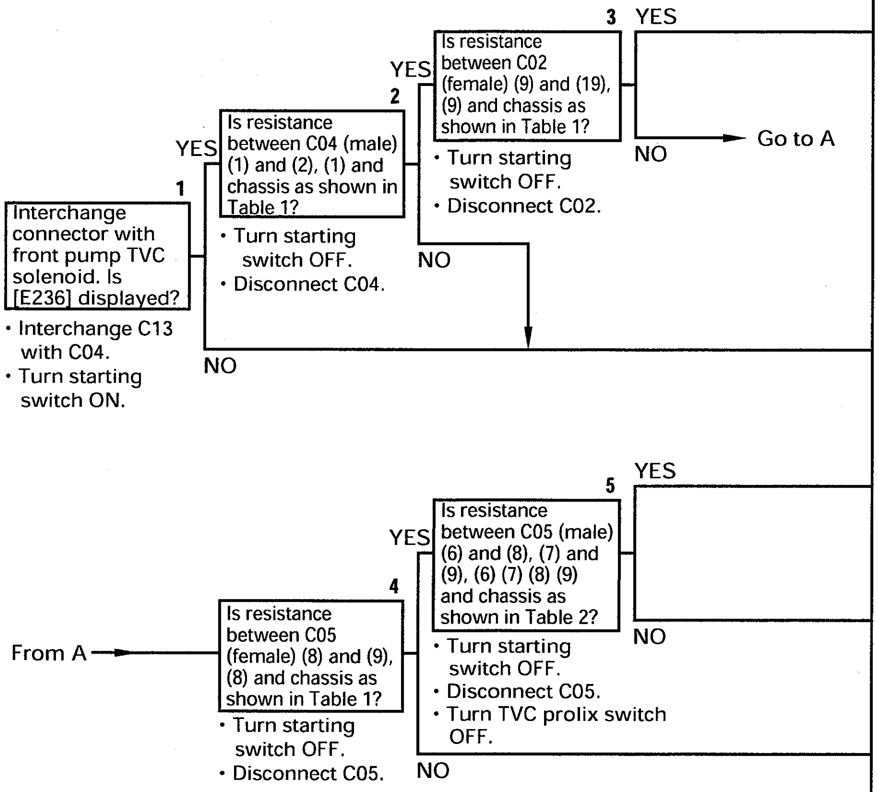
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)

★ Always turn the TVC prolix switch OFF.

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

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



Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective rear pump TVC soleoid (internal short circuit or short circuit with ground)	Replace
Short circuit with ground or short circuit with power source in wiring harness between C02 (female) (9) - H12 (6) - C05 (female) (6), or short circuit with power source in wiring harness between C02 (female) (19) - H12 (8) - C05 (female) (7)	Repair or replace
Defective TVC prolix switch (internal short circuit with ground or short circuit with power source)	Replace
Short circuit with ground or short circuit with power source in wiring harness between C05 (female) (8) - H12 (1) - C04 (female) (1), or short circuit with power source in wiring harness between C05 (female) (9) - H12 (2) - C04 (female) (2)	Repair or replace

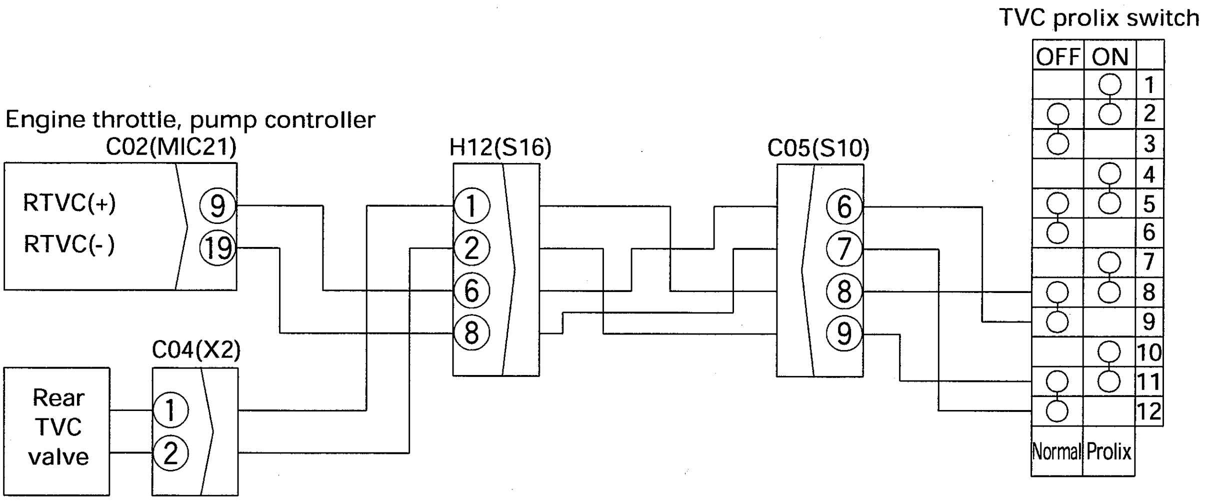
Table 1

Troubleshooting No. 2	Troubleshooting No. 3	Troubleshooting No. 4	Resistance value
Between C04 (male) (1) – (2)	Between C02 (female) (9) – (19)	Between C05 (female) (8) – (9)	10 – 22 Ω
Between C04 (male) (1) – chassis	Between C02 (female) (9) – chassis	Between C05 (female) (8) – chassis	Min. 1 MΩ

Table 2

Troubleshooting No. 5	Resistance value
Between C05 (male) (6) – (8), (7) – (9)	Max. 1 Ω
Between C05 (male) (6)(7)(8)(9) – chassis	Min. 1 MΩ

C-4 Related electric circuit diagram



BKP00188

C-5 [E237] Disconnection in rear pump TVC solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)

★ If there is a disconnection in the solenoid or wiring harness, no current flows to the solenoid. If the No. 2 pin of the solenoid is short circuiting with the ground, the current (approx. 1 A) continues to flow to the solenoid.

★ Always turn the TVC prolix switch OFF.

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

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

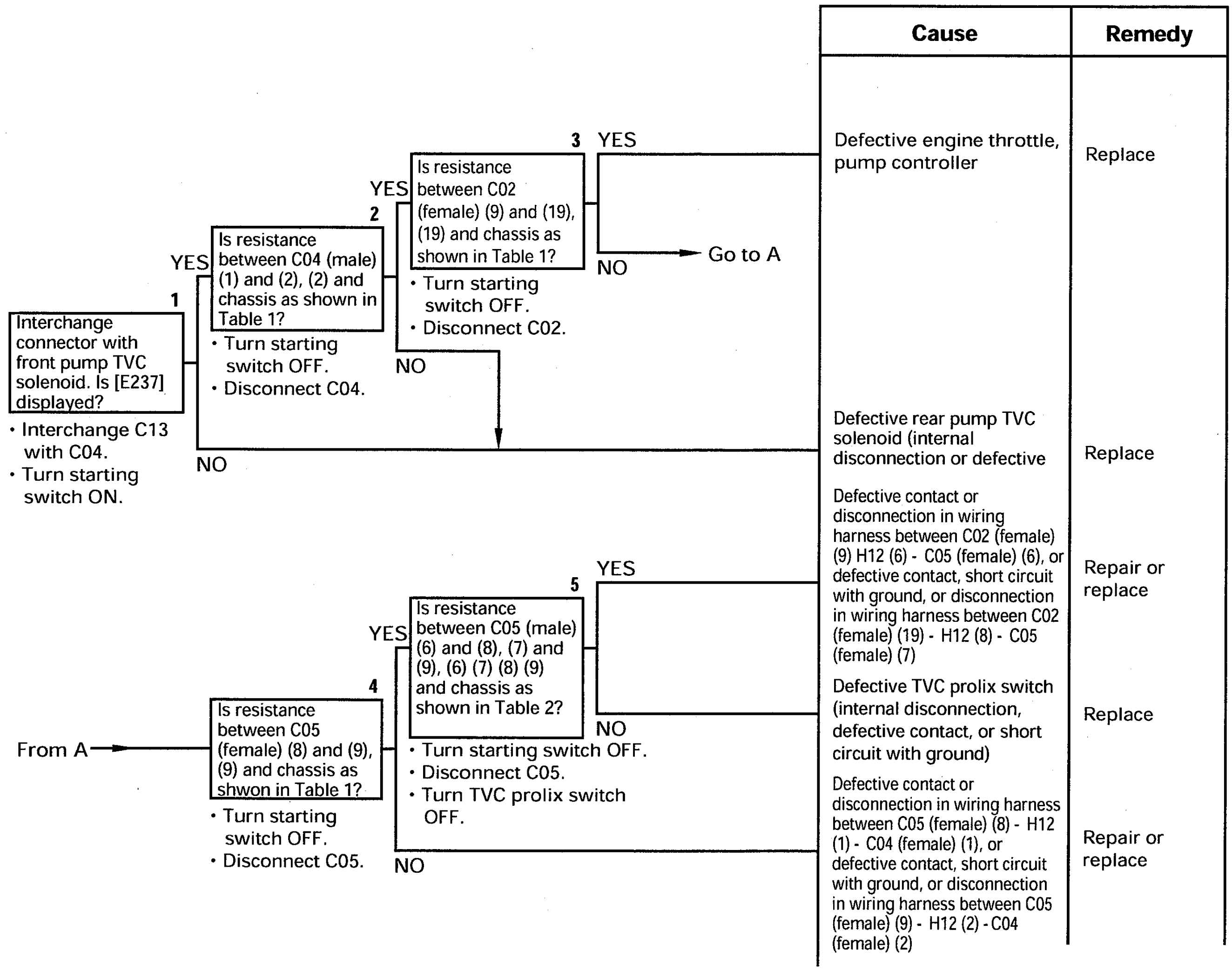


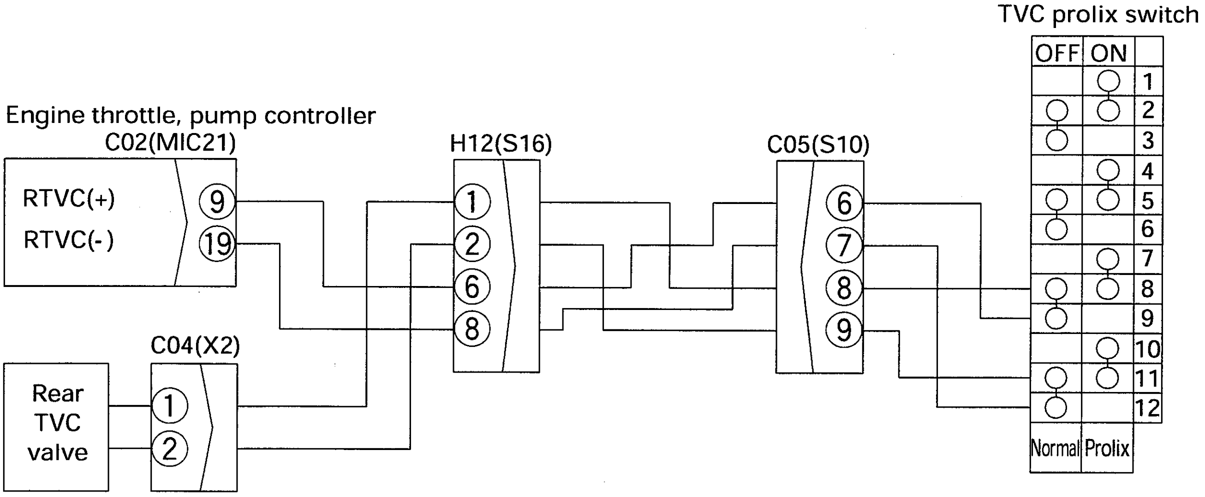
Table 1

Troubleshooting No. 2	Troubleshooting No. 3	Troubleshooting No. 4	Resistance value
Between C04 (male) (1) – (2)	Between C02 (female) (9) – (19)	Between C05 (female) (8) – (9)	10 – 22 Ω
Between C04 (male) (2) – chassis	Between C02 (female) (19) – chassis	Between C05 (female) (9) – chassis	Min. 1 MΩ

Table 2

Troubleshooting No. 5	Resistance value
Between C05 (male) (6) – (8), (7) – (9)	Max. 1 Ω
Between C05 (male) (6)(7)(8)(9) – chassis	Min. 1 MΩ

C-5 Related electric circuit diagram



BKP00188

C-6 [E207] Short circuit in active mode (boom) solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)

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

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

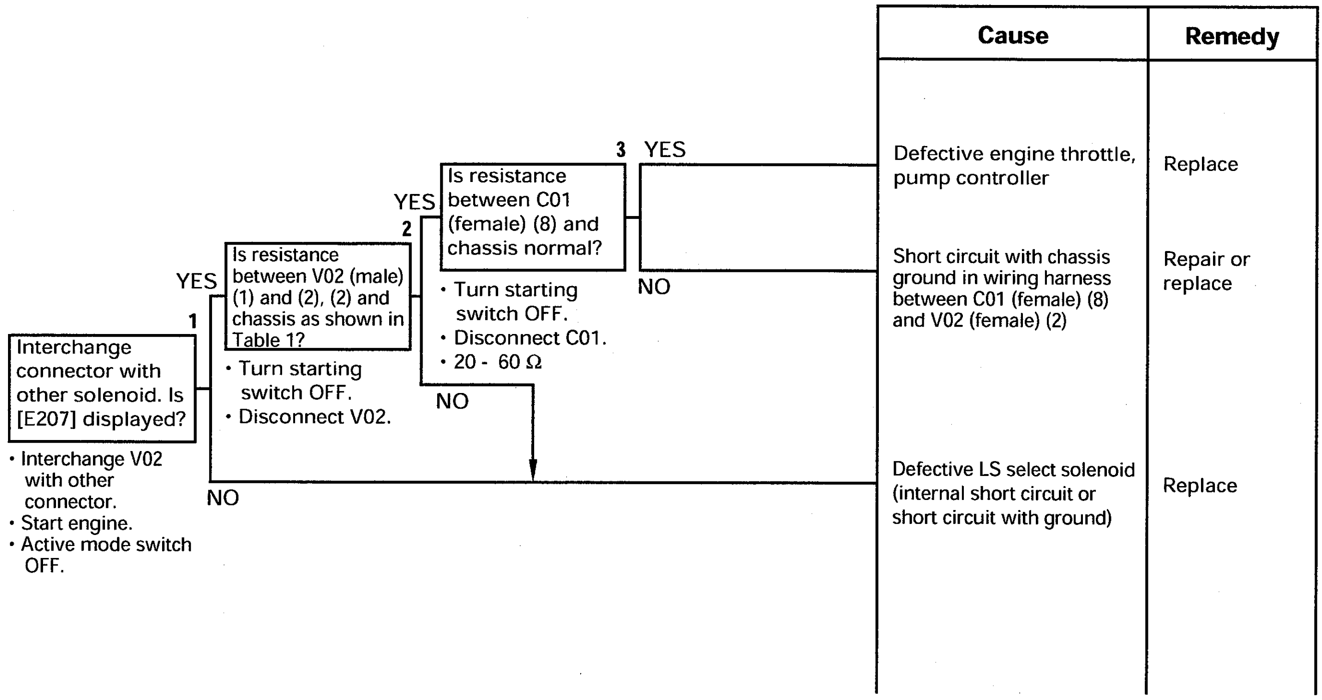
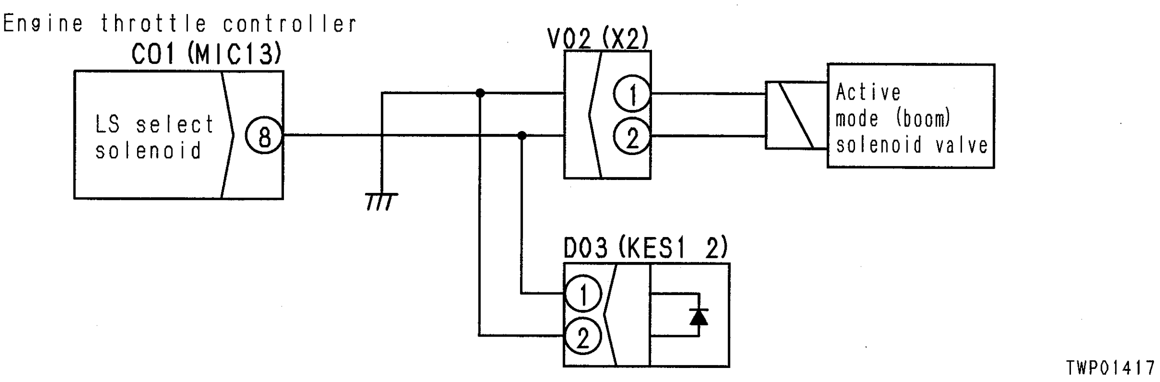


Table 1

Between V02 (male) (1) – (2)	20 – 60 Ω
Between V02 (male) (2) – chassis	Min. 1 MΩ

C-6 Related electric circuit diagram



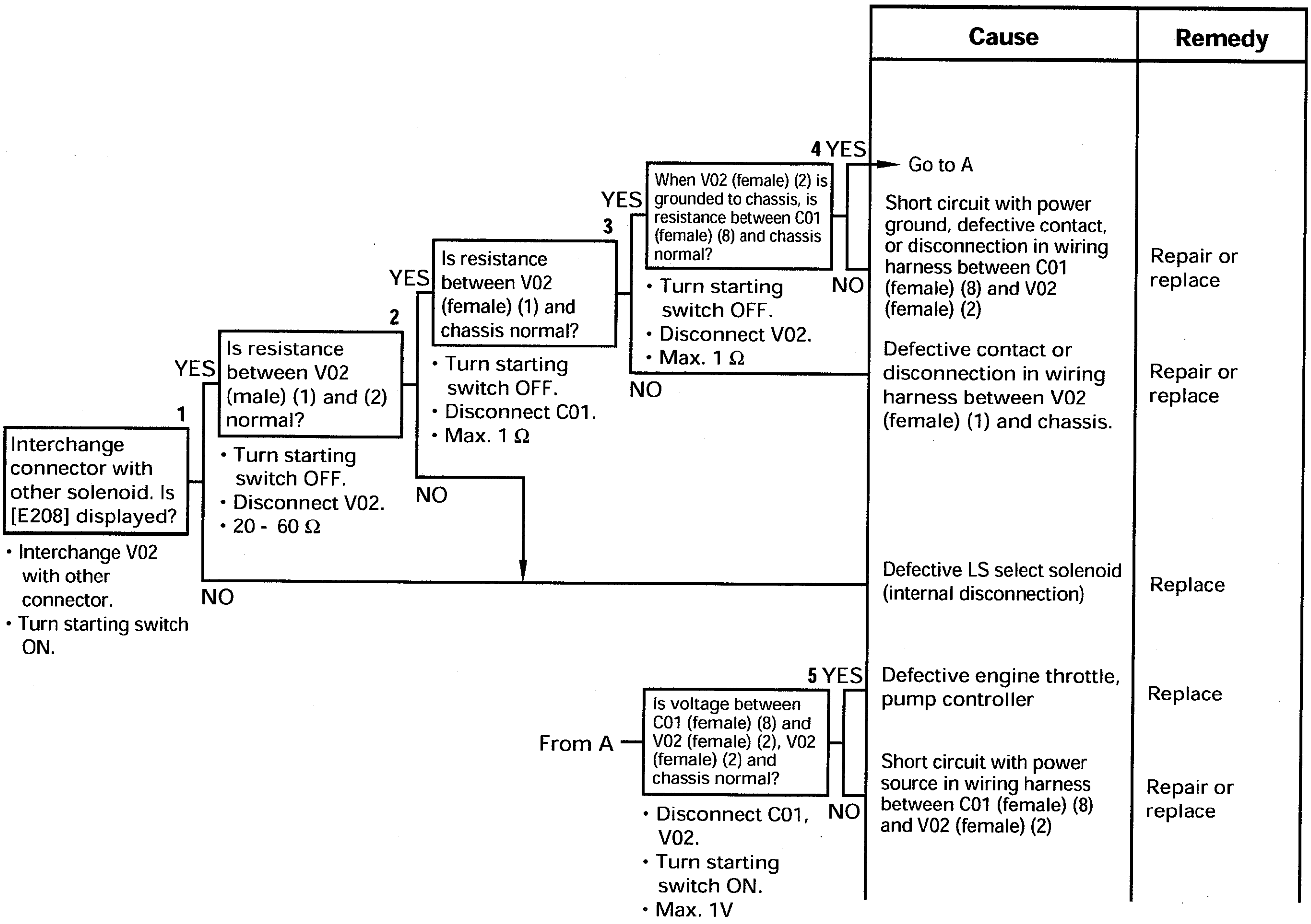
C-7 [E208] Disconnection in active mode (boom) solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)

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

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



1 Interchange connector with other solenoid. Is [E208] displayed?
- Interchange V02 with other connector.
- Turn starting switch ON.

2 Is resistance between V02 (male) (1) and (2) normal?
- Turn starting switch OFF.
- Disconnect V02.
- 20 - 60 Ω

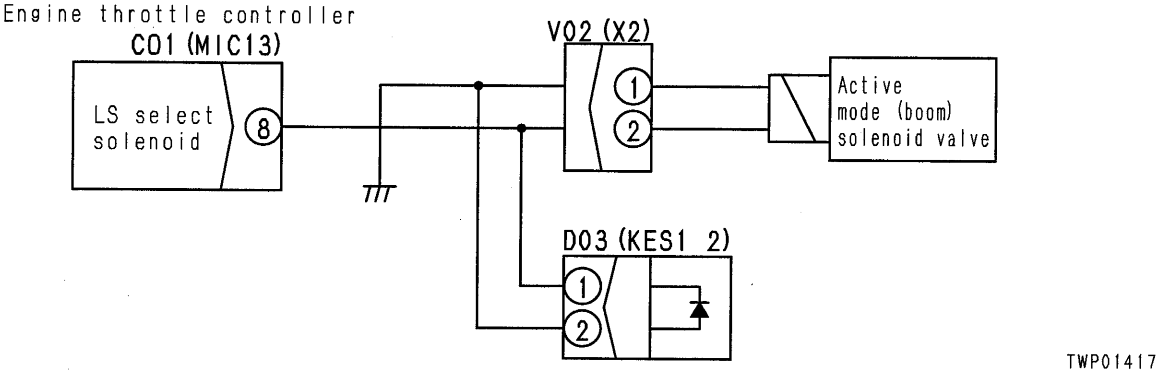
3 Is resistance between V02 (female) (1) and chassis normal?
- Turn starting switch OFF.
- Disconnect C01.
- Max. 1 Ω

4 When V02 (female) (2) is grounded to chassis, is resistance between C01 (female) (8) and chassis normal?
- Turn starting switch OFF.
- Disconnect V02.
- Max. 1 Ω

5 Is voltage between C01 (female) (8) and V02 (female) (2), V02 (female) (2) and chassis normal?
- Disconnect C01, V02.
- Turn starting switch ON.
- Max. 1V

	Cause	Remedy
4 YES	Go to A	
4 NO	Short circuit with power ground, defective contact, or disconnection in wiring harness between C01 (female) (8) and V02 (female) (2)	Repair or replace
3 NO	Defective contact or disconnection in wiring harness between V02 (female) (1) and chassis.	Repair or replace
1 NO, 2 NO	Defective LS select solenoid (internal disconnection)	Replace
From A, 5 YES	Defective engine throttle, pump controller	Replace
5 NO	Short circuit with power source in wiring harness between C01 (female) (8) and V02 (female) (2)	Repair or replace

C-7 Related electric circuit diagram



C-8 [E203] Short circuit in swing brake solenoid system is displayed

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
- ★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.
- ★ Always turn the swing lock prolix switch OFF, then turn the swing lock switch OFF before checking.

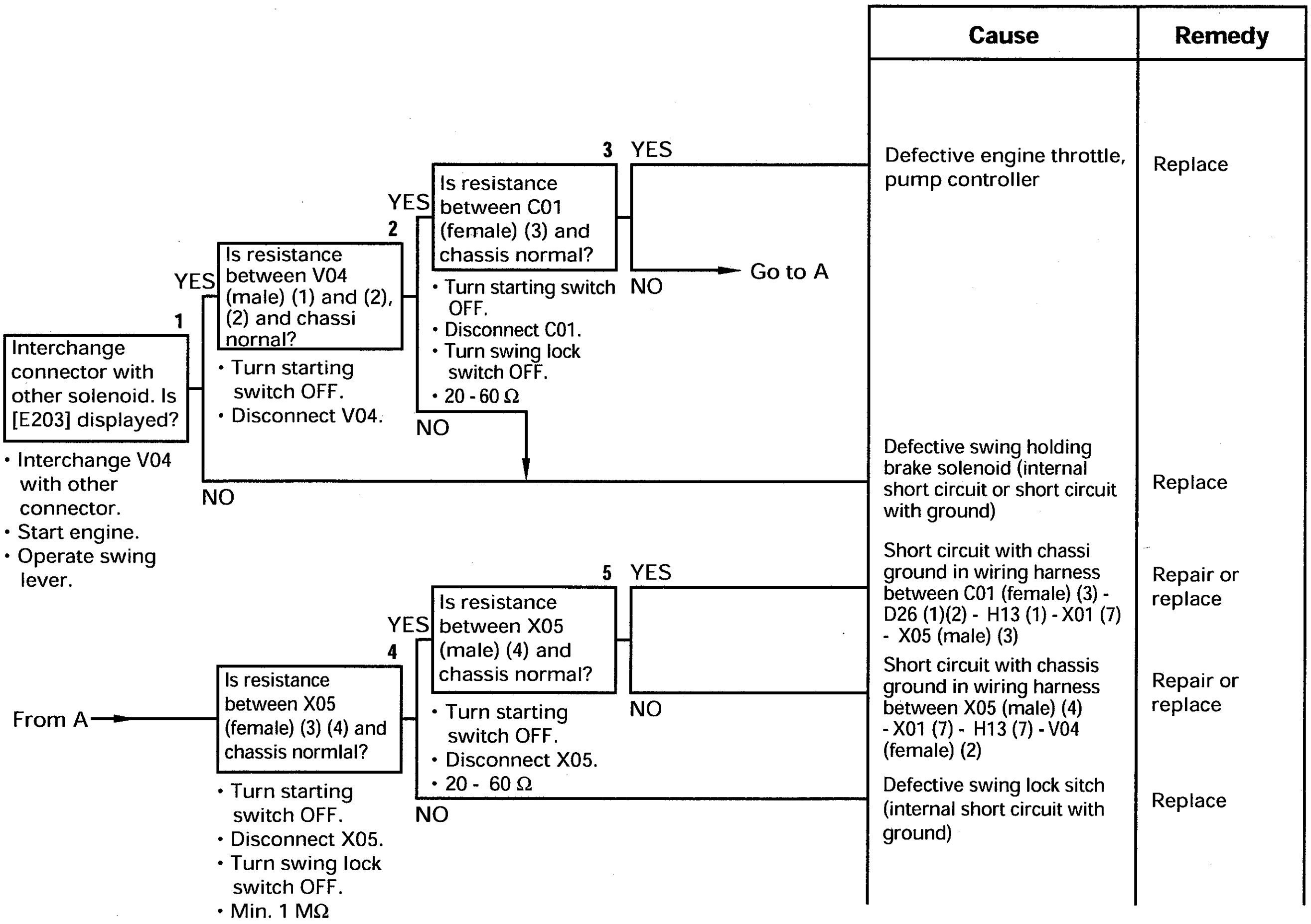
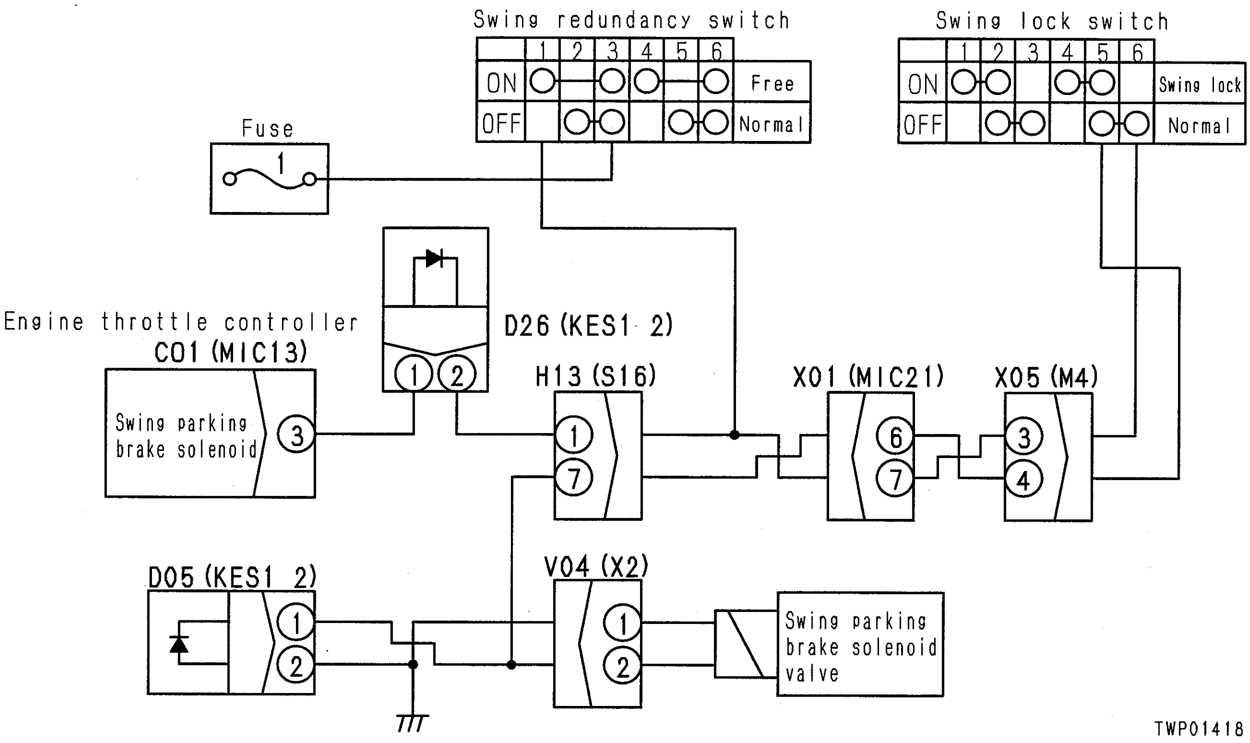


Table 1

Between V04 (male) (1) – (2)	20 – 60 Ω
Between V04 (male) (2) – chassis	Min. 1 MΩ

C-8 Related electric circuit diagram



C-9 [E213] Disconnection in swing brake solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)

★ Always turn the swing lock prolix switch OFF, then turn the swing lock switch OFF before checking.

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

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

Note: If the swing prolix switch is operated, this error [213] is detected, but it does not indicate a failure.

Note: When the swing prolix switch is operated, if error [213] occurs, carry out troubleshooting (F-9) for the swing lock signal input system.

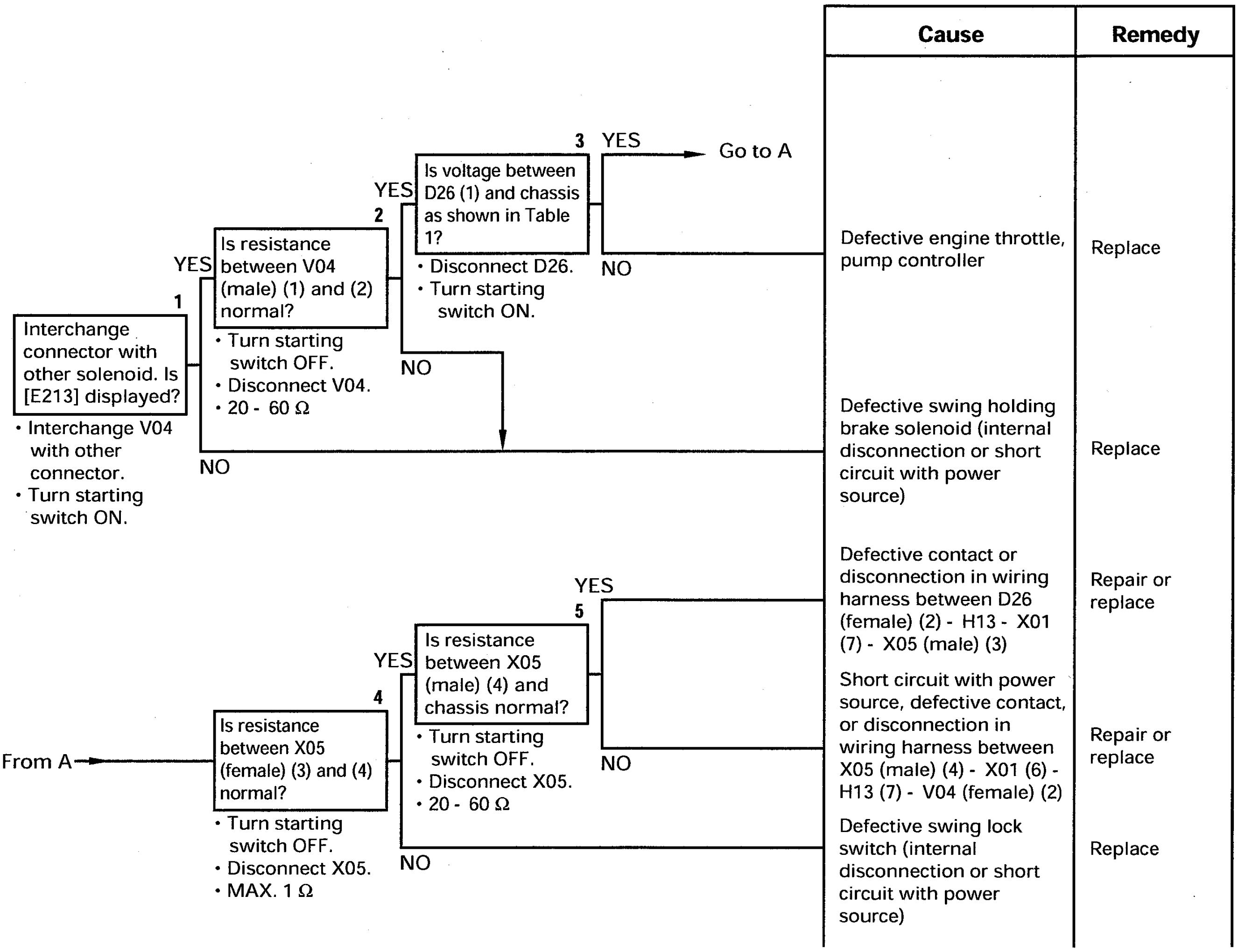
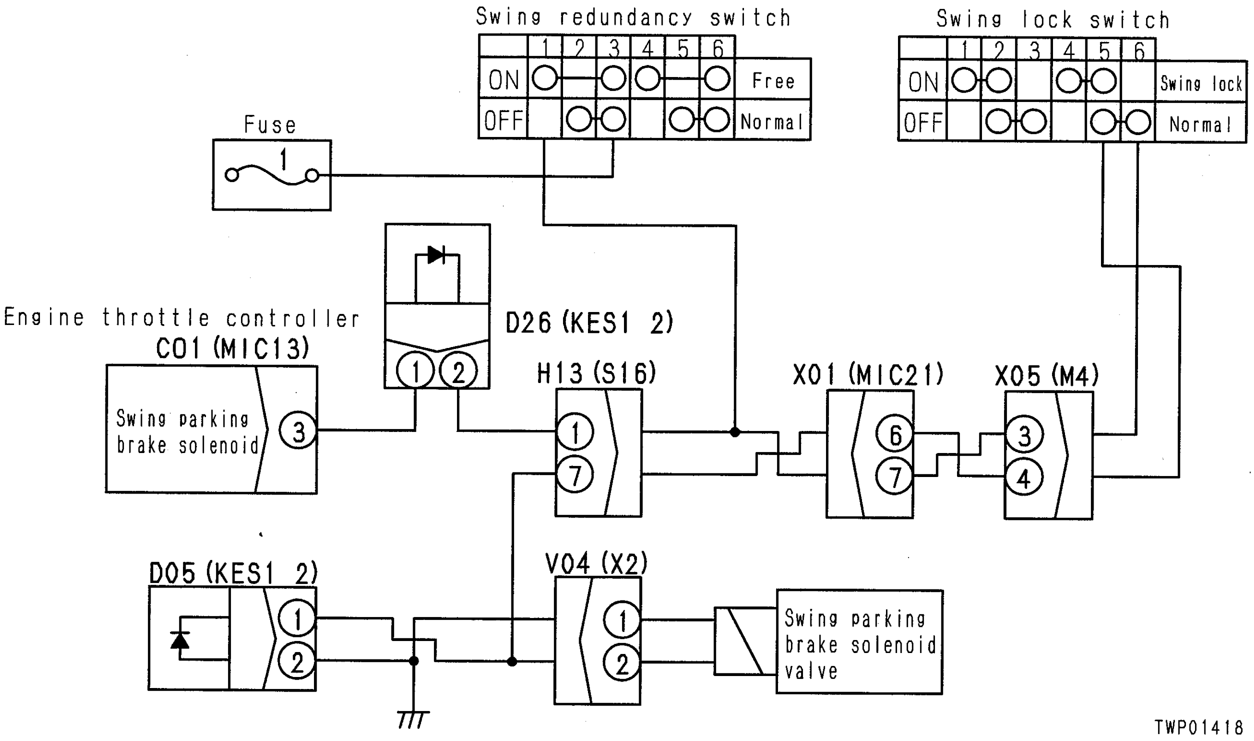


Table 1

Troubleshooting No. 3	Voltage	Measurement condition
Between D26 (1) – chassis	0 – 10 V	4 – 5 seconds after all levers are returned to neutral
	20 – 30 V	Swing lever or work equipment lever operated (operated in small movements)

C-9 Related electric circuit diagram



C-10 [E204] Short circuit in pump merge/divider solenoid system is displayed

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
- ★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.

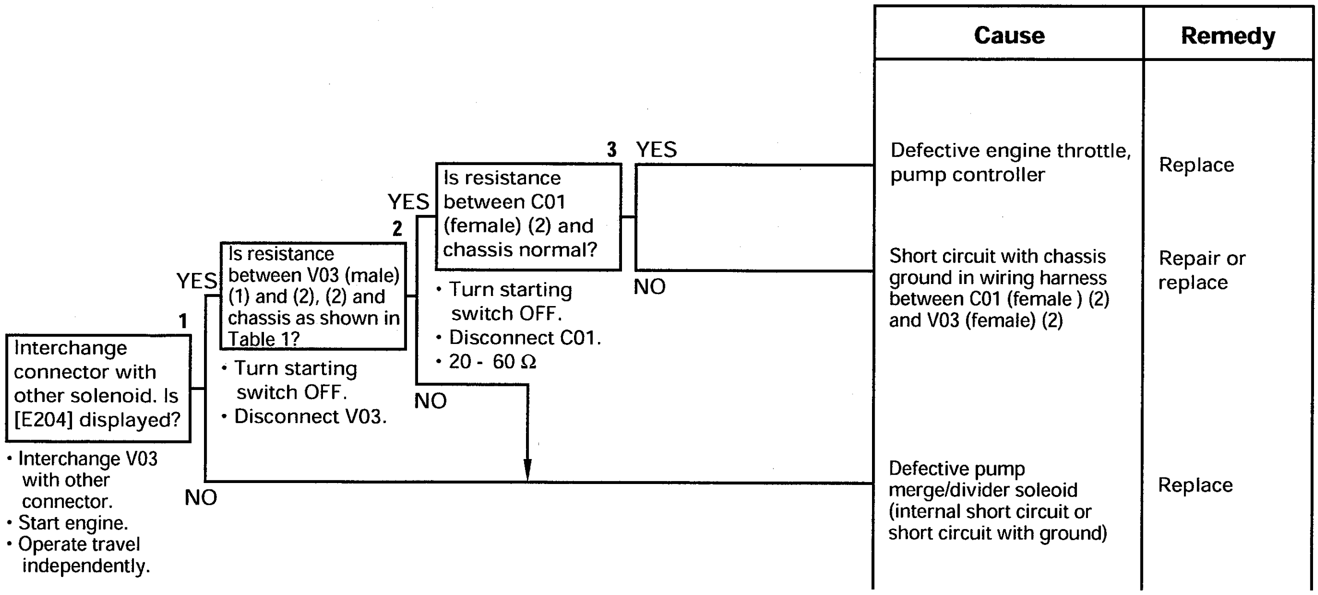
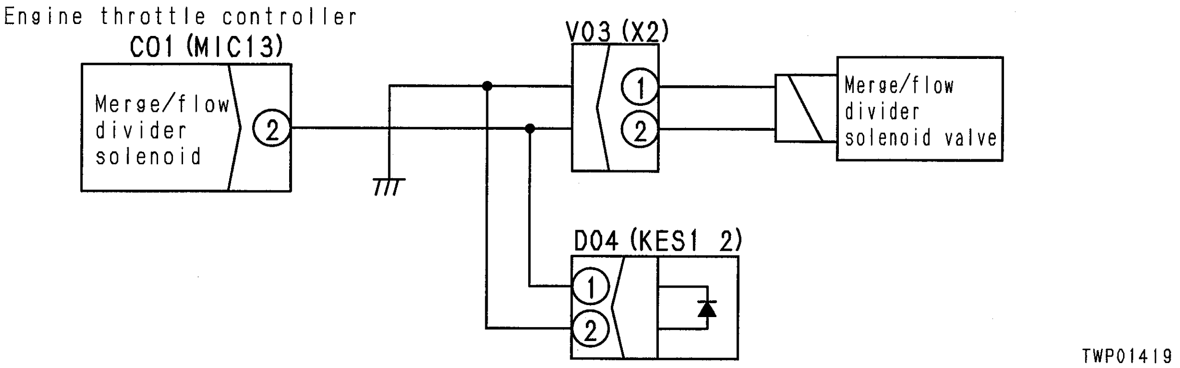


Table 1

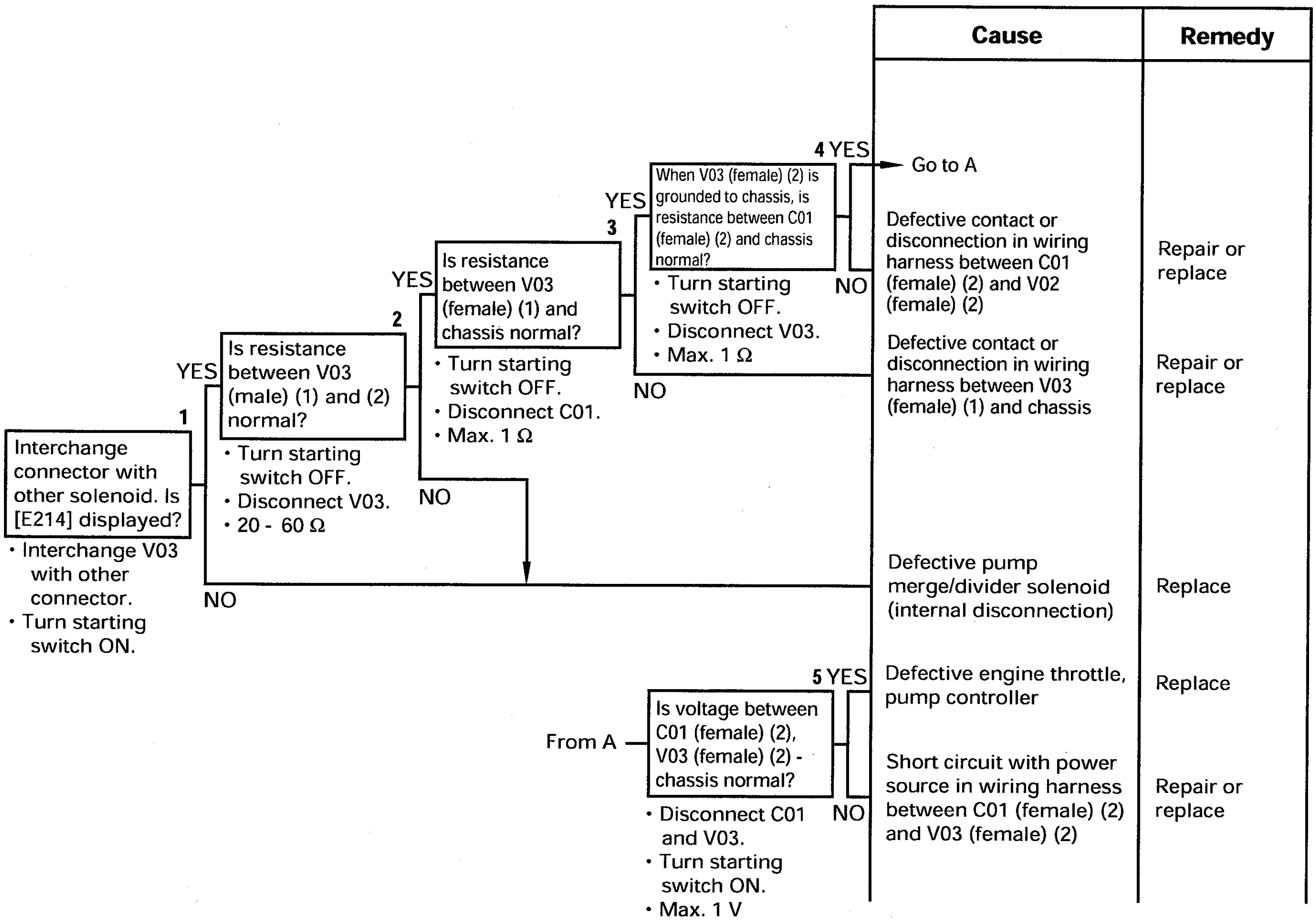
Between V03 (male) (1) – (2)	20 – 60 Ω
Between V03 (male) (2) – chassis	Min. 1 MΩ

C-10 Related electric circuit diagram

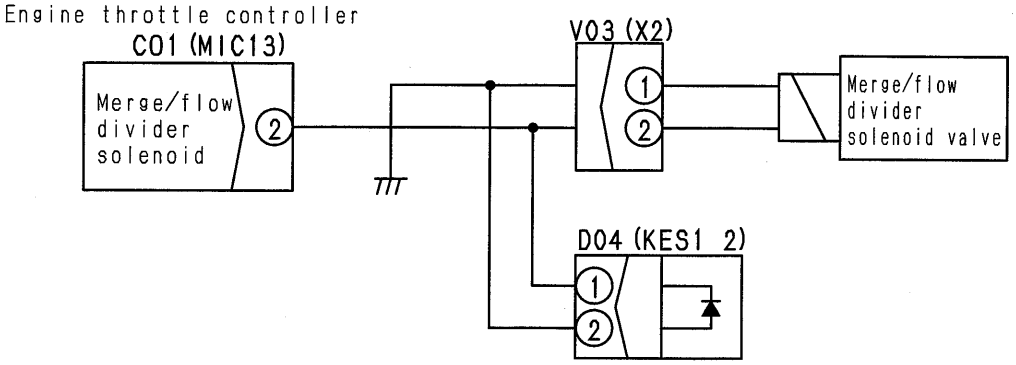


C-11 [E214] Disconnection in pump merge/divider solenoid system is displayed

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
- ★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.



C-11 Related electric circuit diagram



TWP01419

C-12 [E206] Short circuit in travel speed solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

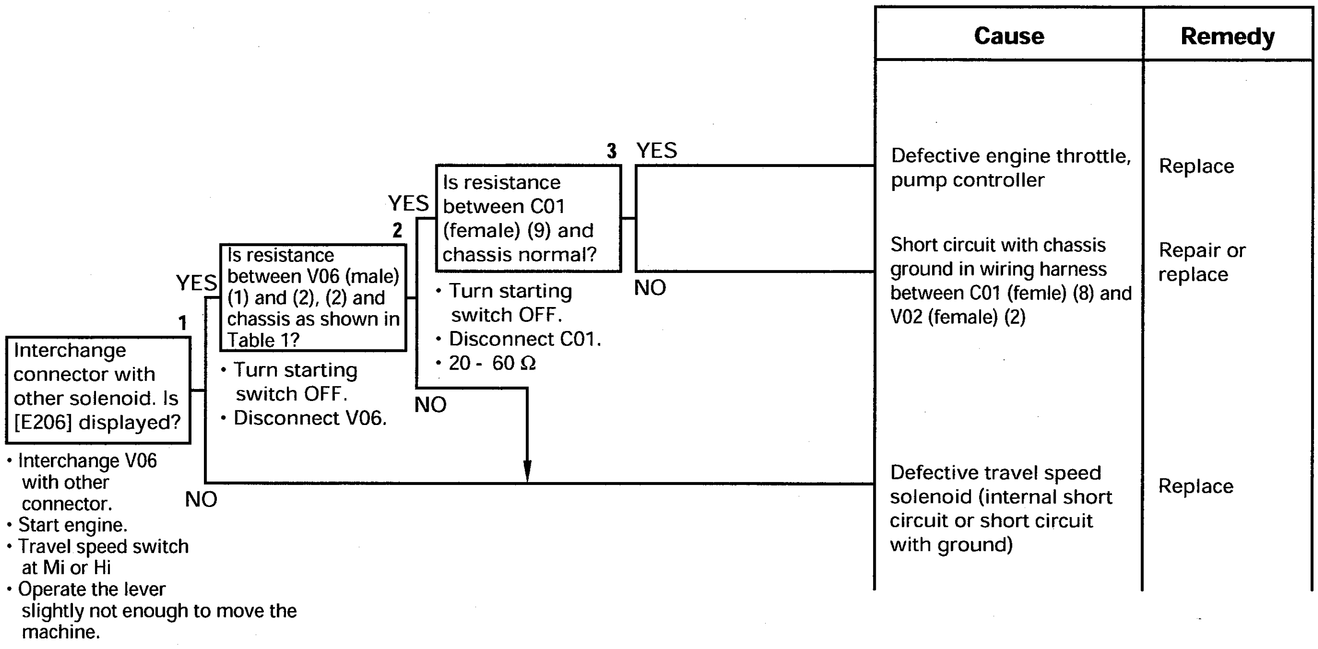
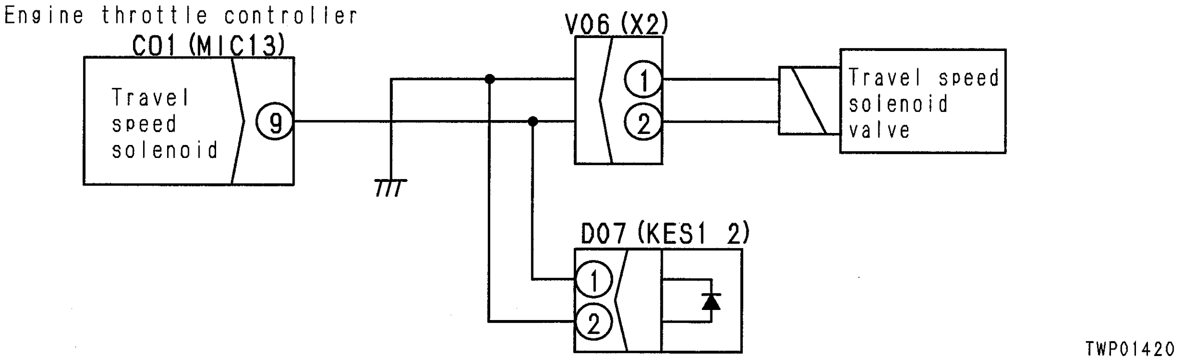


Table 1

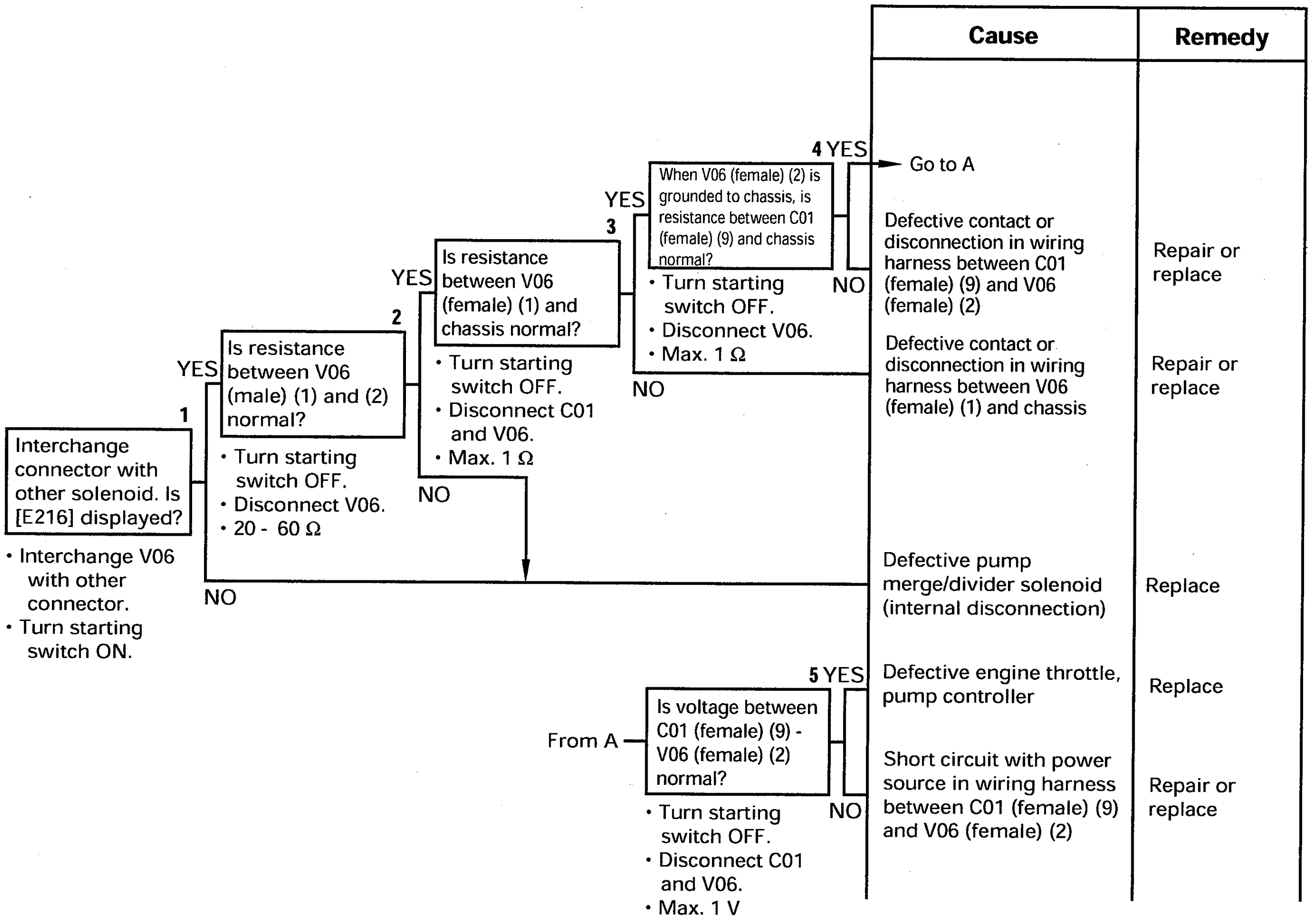
Between V06 (male) (1) – (2)	20 – 60 Ω
Between V06 (male) (2) – chassis	Min. 1 MΩ

C-12 Related electric circuit diagram

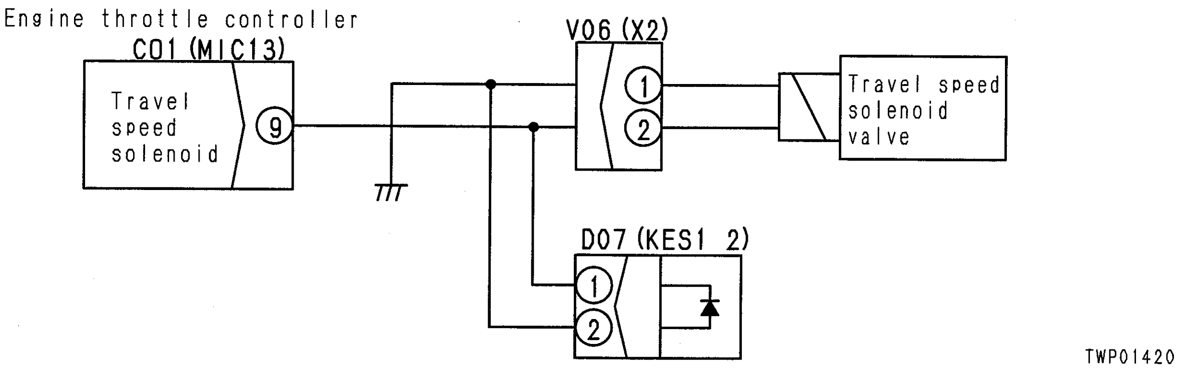


C-13 [E216] Disconnection in travel speed selector solenoid system is displayed

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
- ★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.



C-13 Related electric circuit diagram



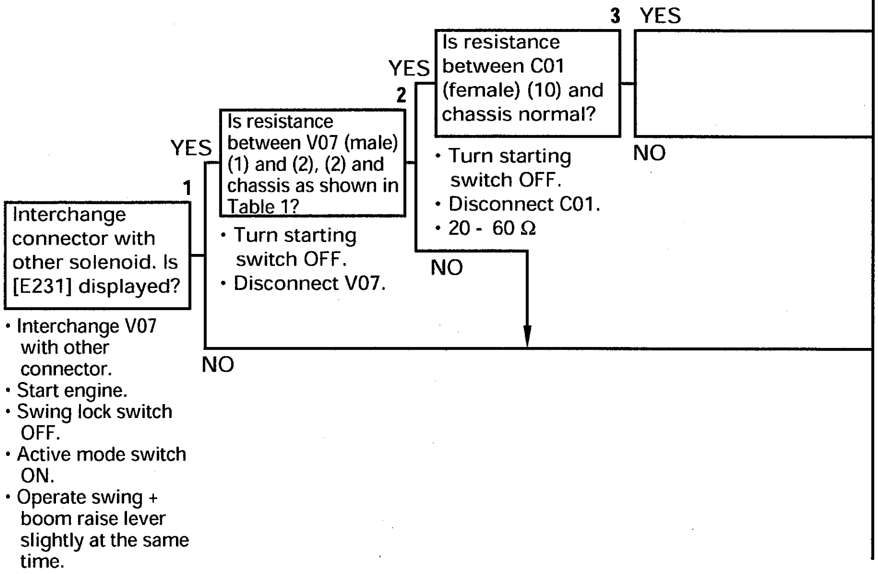
C-14 [E231] Short circuit in active mode (swing) solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)

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

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

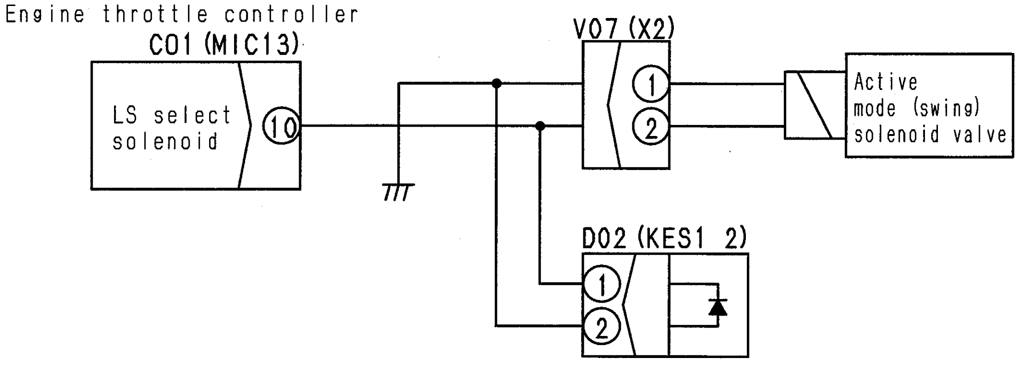


Cause	Remedy
Defective engine throttle, pump controller	Replace
Short circuit with chassis ground in wiring harness between C01 (female) (10) and V07 (female) (2)	Repair or replace
Defective LS select solenoid (internal short circuit or short circuit with ground)	Replace

Table 1

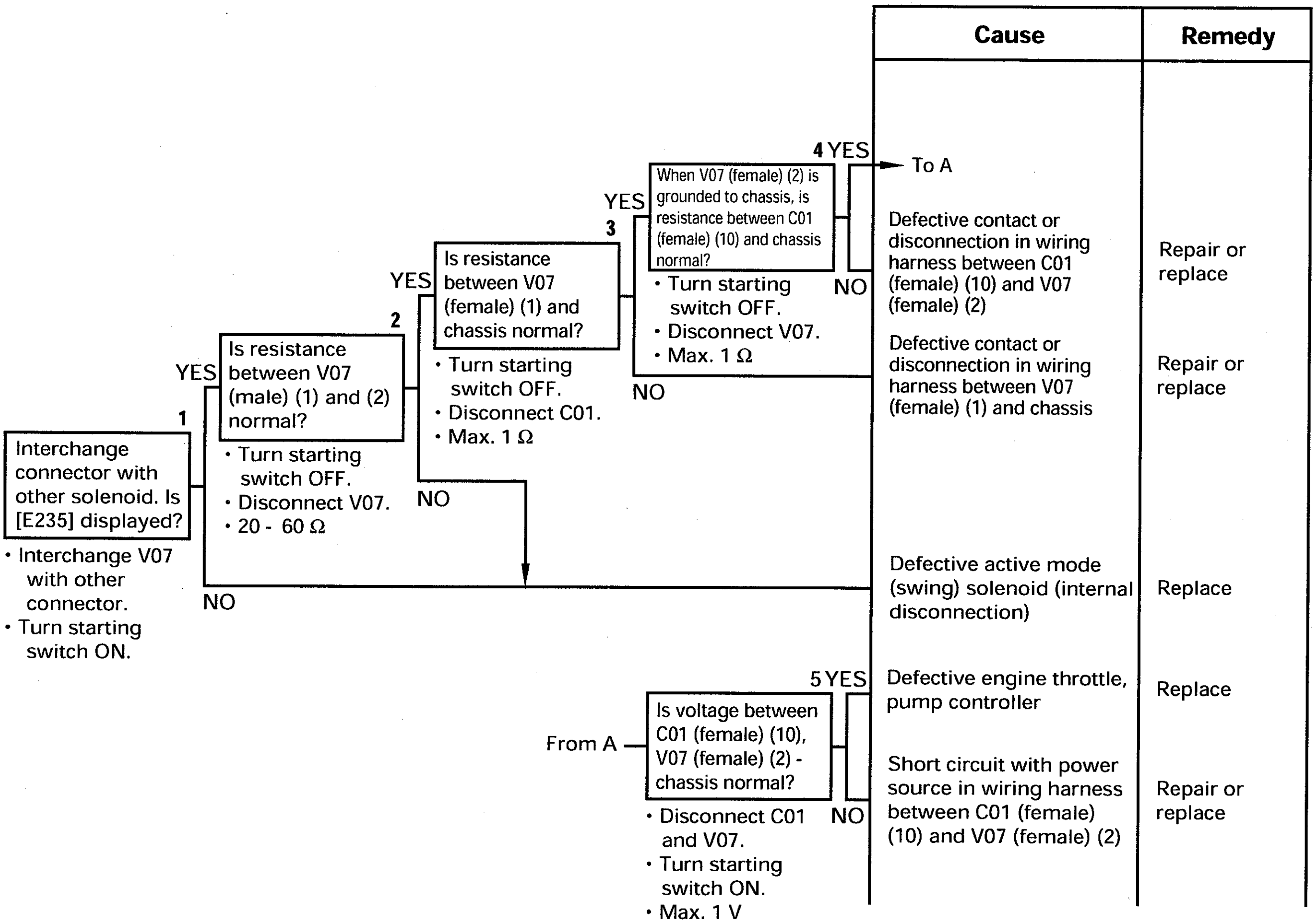
Between V07 (male) (1) – (2)	20 – 60 Ω
Between V07 (male) (2) – chassis	Min. 1 MΩ

C-14 Related electric circuit diagram

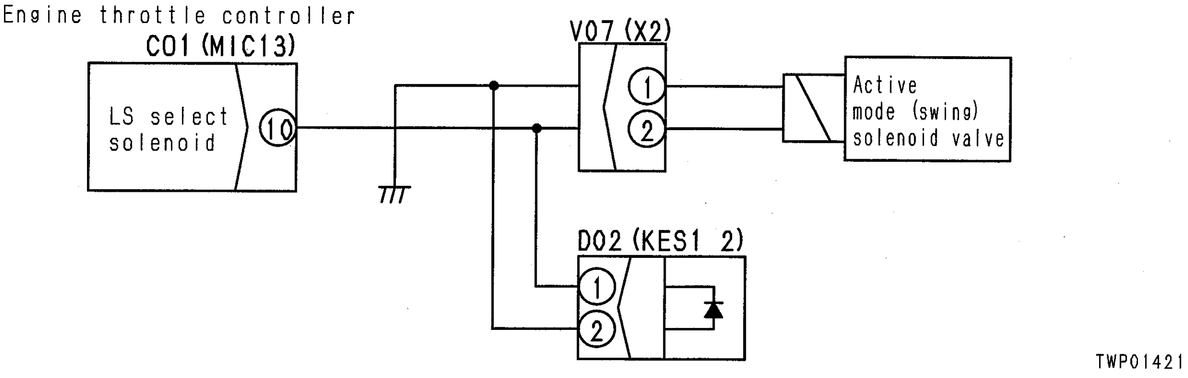


C-15 [E235] Disconnection in active mode (swing) solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.



C-15 Related electric circuit diagram



C-16 [E217] Model selection input error is displayed

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
- ★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.

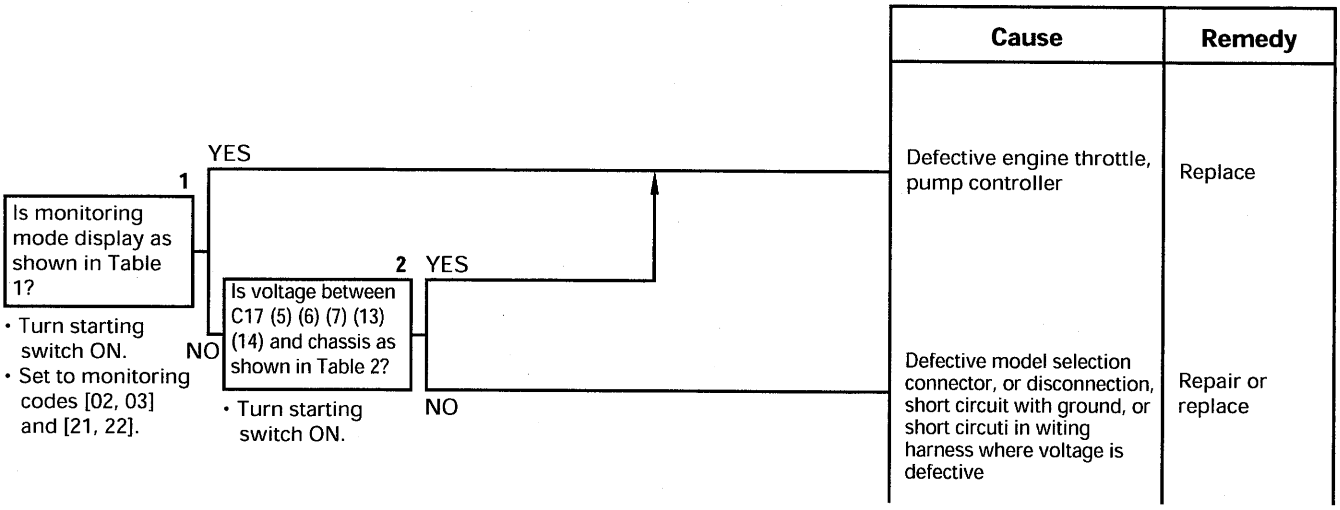
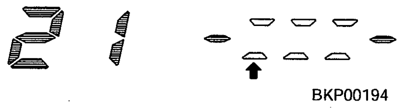
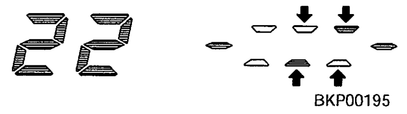


Table 1 Monitoring code display

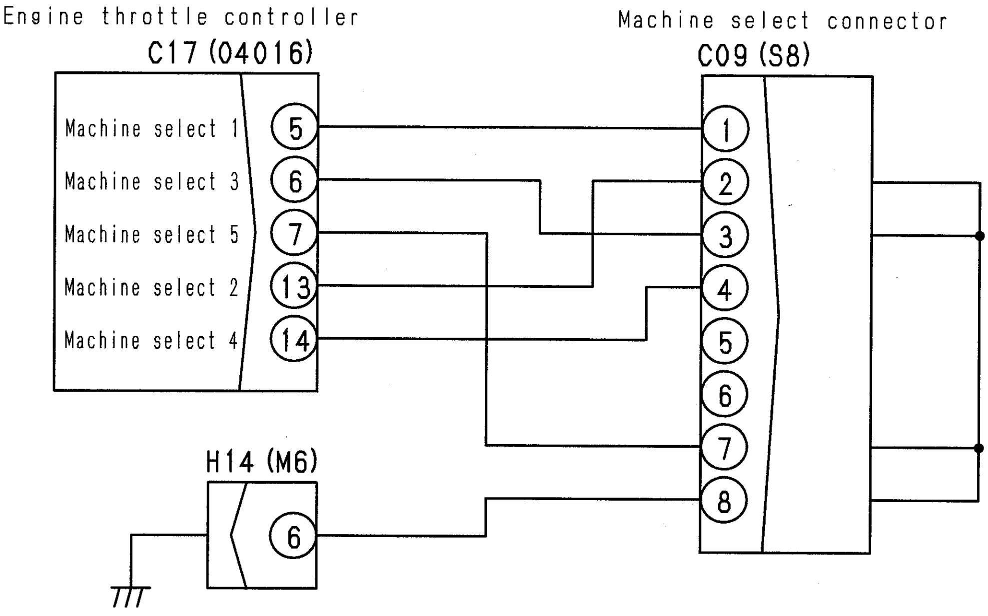
Model code display	Model selection signal input display	
Monitoring codes 02, 03	Monitoring code 21	Monitoring code 22
		

★ The diagram shows monitoring code 02.
★ Check the bit pattern display marked with ←.

Table 2 Voltage of wiring harness

C17	Between (5) – chassis	Between (6) – chassis	Between (7) – chassis	Between (13) – chassis	Between (14) – chassis
Voltage	20 – 30 V	Max. 1 V	Max. 1 V	Max. 1 V	20 – 30 V

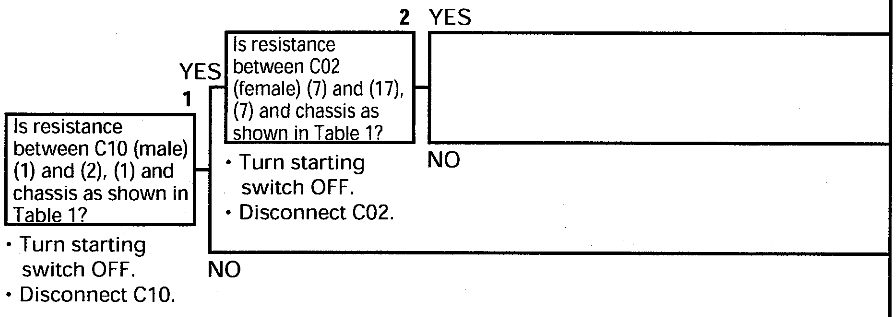
C-16 Related electric circuit diagram



TWP01422

C-17 [E222] Short circuit in LS-EPC solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.

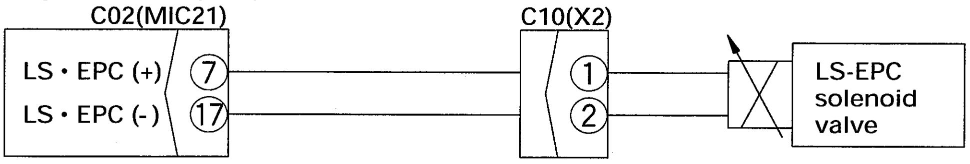


Cause	Remedy
Defective engine throttle, pump controller	Replace
Short circuit with ground or short circuit with power source in wiring harness between C02 (female) (7) - C10 (female) (1), or short circuit with power source in wiring harness between C02 (female) (17) - C10 (female) (2)	Repair or replace
Defective LS-EPC solenoid (internal short circuit with ground or short circuit with power source)	Replace

Table 1

Troubleshooting No. 1	Troubleshooting No. 2	Resistance value
Between C10 (male) (1) – (2)	Between C02 (female) (7) – (17)	7 – 14 Ω
Between C10 (male) (1) – chassis	Between C02 (female) (7) – chassis	Min. 1 MΩ

C-17 Related electric circuit diagram



BKP00251

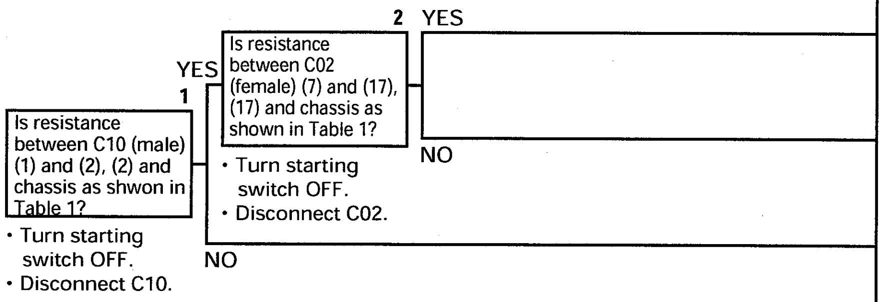
C-18 [E223] Disconnection in LS-EPC solenoid system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)

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

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

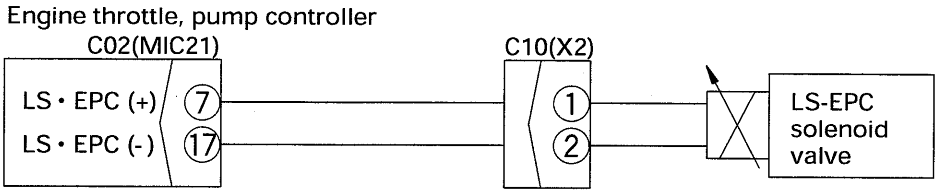


Cause	Remedy
Defective engine throttle, pump controller	Replace
Defect contact or short circuit with chassis ground in wiring harness between C02 (female) (7) and C10 (female) (1), or defective contact, short circuit with ground, or disconnection in wiring harness between C02 (female) (17) - C10 (female) (2)	Repair or replace
Defective LS-EPS solenoid (internal disconnection, defective contact, or short circuit with ground)	Replace

Table 1

Troubleshooting No. 1	Troubleshooting No. 2	Resistance value
Between C10 (male) (1) – (2)	Between C02 (female) (7) – (17)	7 – 14 Ω
Between C10 (male) (2) – chassis	Between C02 (female) (17) – chassis	Min. 1 MΩ

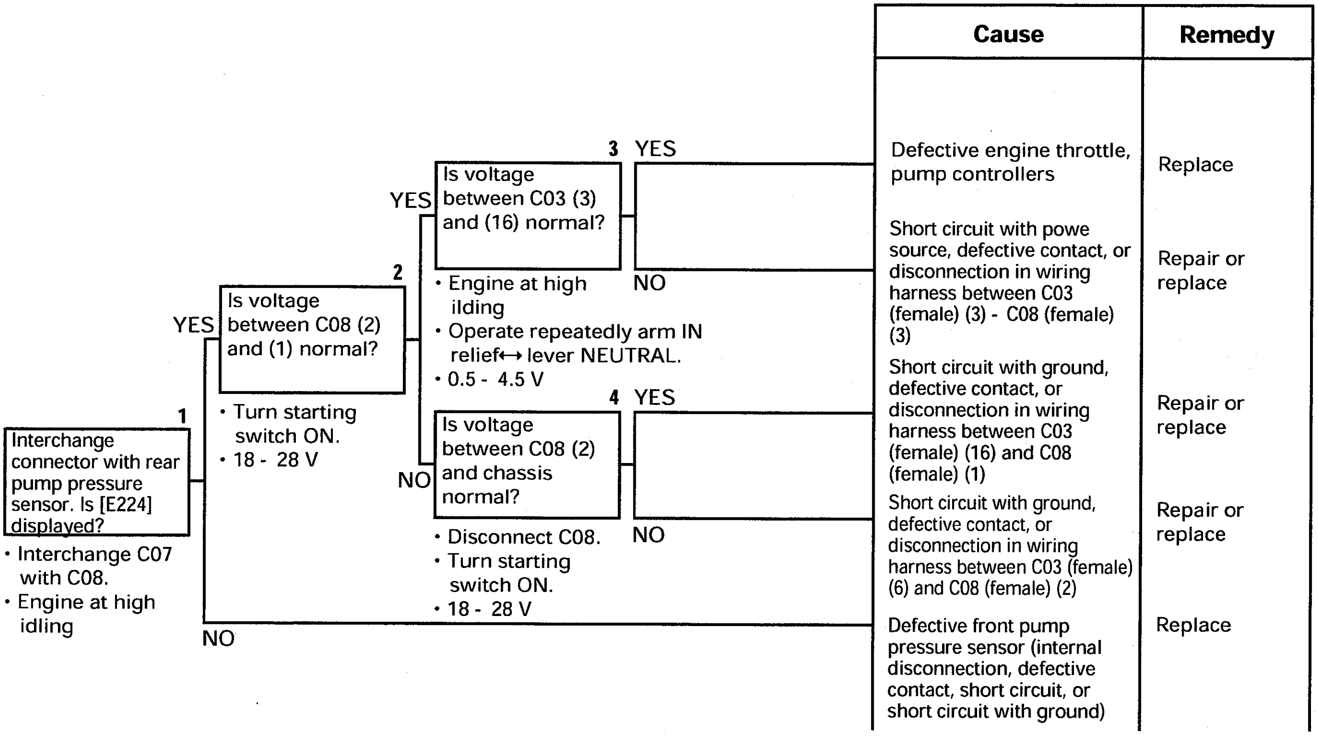
C-18 Related electric circuit diagram



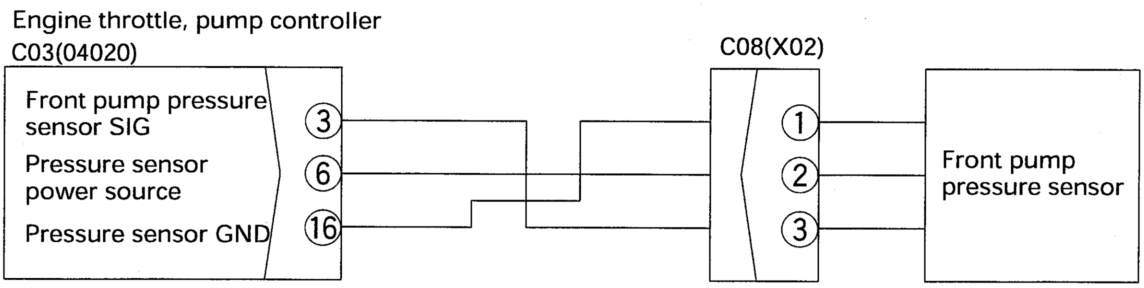
BKP00251

C-19 [E224] Abnormality in front pump pressure sensor system is displayed

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
- ★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.



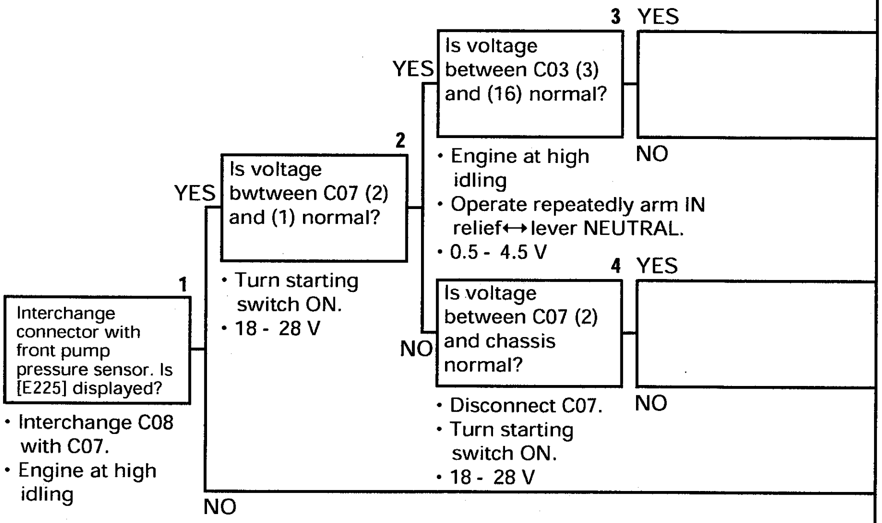
C-19 Related electric circuit diagram



BKP00252

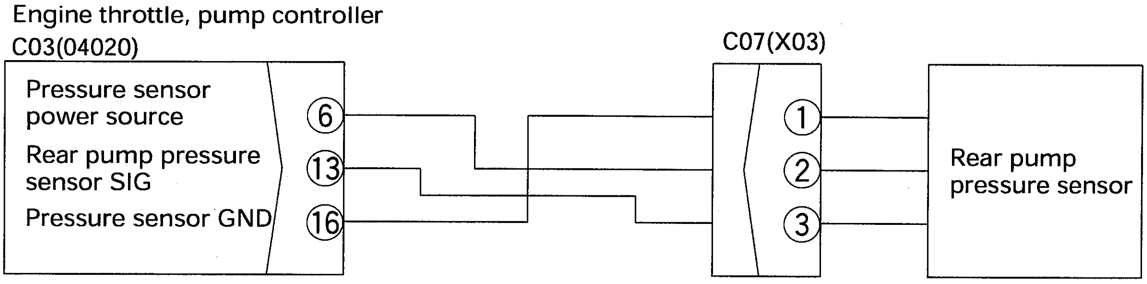
C-20 [E225] Abnormality in rear pump pressure sensor system is displayed

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
- ★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.



Cause	Remedy
Defective engine throttle, pump controller	Replace
Short circuit with power source, defective contact, or disconnection in wiring harness between C03 (female) (13) - C07 (female) (3)	Repair or replace
Short circuit with ground, defective contact, or disconnection in wiring harness bewtween C03 (female) (16) and C07 (female) (1)	Repair or replace
Short circuit with ground, defective contact, or disconnection in wiring harness between C03 (female) (6) and C07 (female) (2)	Repair or replace
Defective rear pump pressure sensor (internal disconnection, defective contact, short circuit, or short circuit with ground)	Replace

C-20 Related electric circuit diagram



BKP00253

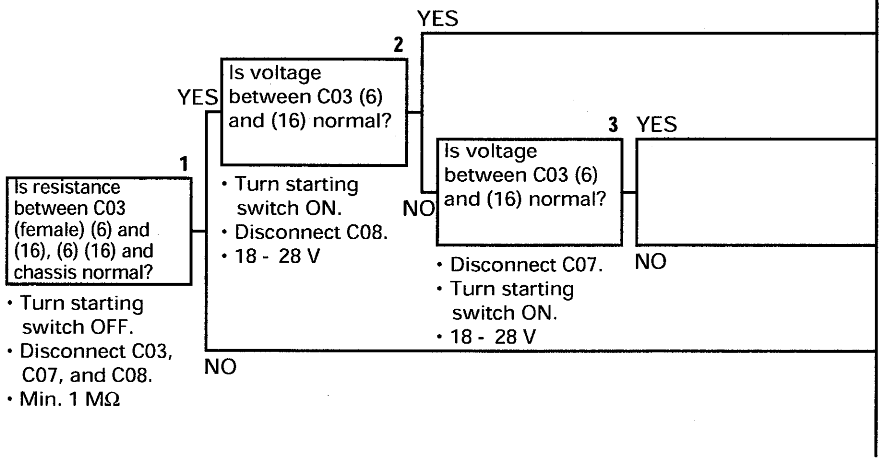
C-21 [E226] Abnormality in pressure sensor power source system is displayed

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)

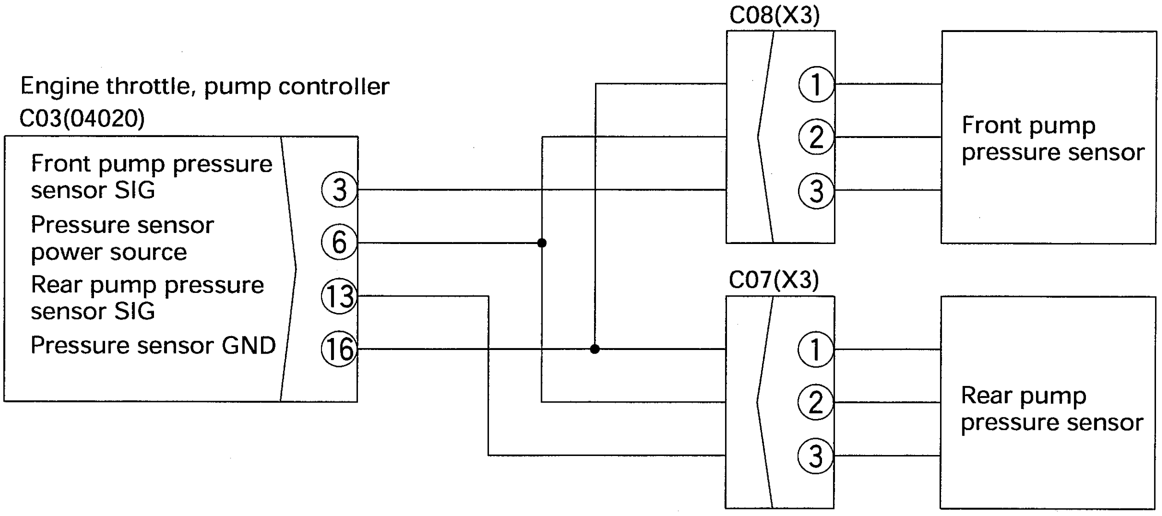
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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



Cause	Remedy
Defective front pump pressure sensor (internal short circuit or short circuit with ground)	Replace
Defective rear pump pressure sensor (internal short circuit or short circuit with ground)	Replace
Defective engine throttle, pump controller	Replace
Short circuit or short circuit with ground in wiring harness of system where resistance value is defective	Repair or replace

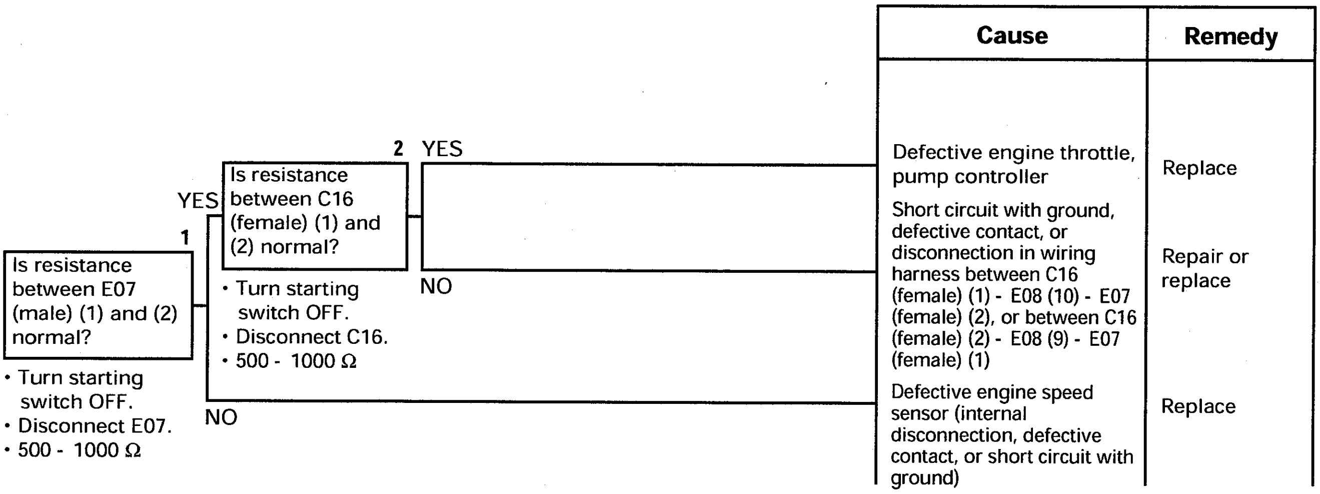
C-21 Related electric circuit diagram



BKP00254

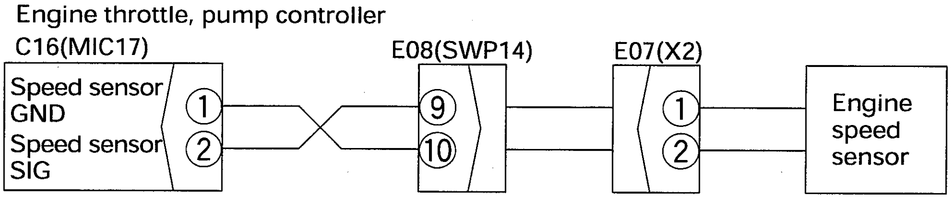
C-22 [E227] Abnormality in engine speed sensor system is displayed

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if an E service code is not displayed, the problem has been removed.**
- ★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the problem has been removed.)
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.



Cause	Remedy
Defective engine throttle, pump controller	Replace
Short circuit with ground, defective contact, or disconnection in wiring harness between C16 (female) (1) - E08 (10) - E07 (female) (2), or between C16 (female) (2) - E08 (9) - E07 (female) (1)	Repair or replace
Defective engine speed sensor (internal disconnection, defective contact, or short circuit with ground)	Replace

C-22 Related electric circuit diagram



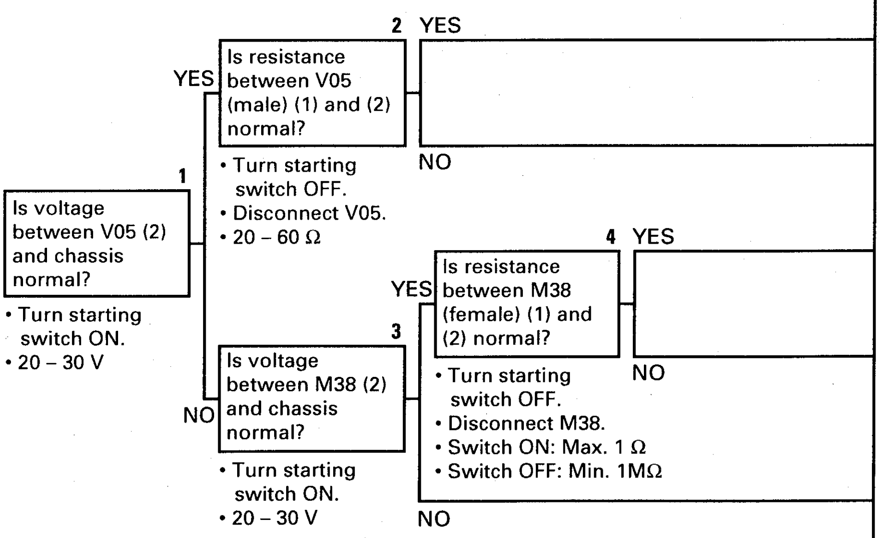
BKP00255

C-23 Abnormality in machine push-up solenoid system (no service code displayed)

★ Even if any abnormality occurs in the machine push-up solenoid system, the service code is not displayed on the monitor panel.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

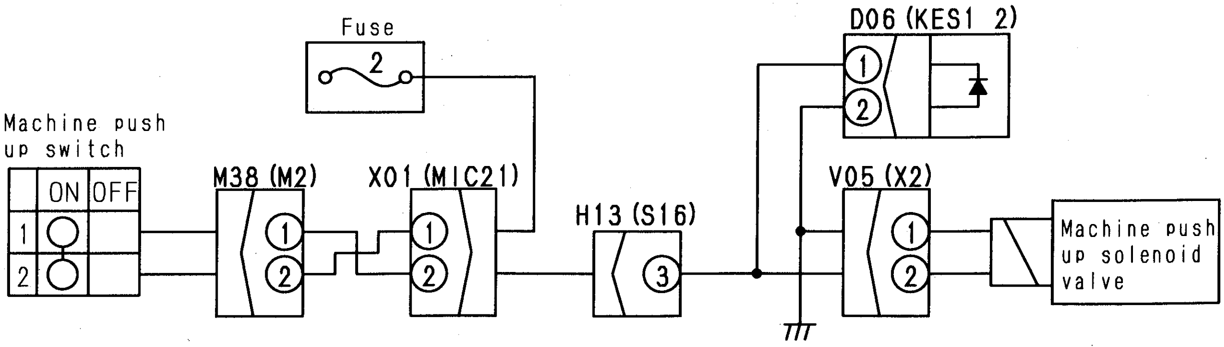
a) If solenoid is not actuated (turned ON) when machine push-up switch is set to low-pressure setting

★ Check that fuse No. 2 is not blown.
★ Carry out troubleshooting with the machine push-up switch at the low-pressure setting position.



Cause	Remedy
Defective contact or disconnection in wiring harness between V05 (female) (1) and chassis ground	Repair or replace
Defective machine push-up solenoid (internal disconnection or defective contact)	Replace
Short circuit with ground, defective contact, or disconnection in wiring harness between M38 (male) (1) – X01 (16) –H13 (3) – V05 (female) (2)	Repair or replace
Defective machine push-up switch (internal disconnection, defective contact, or short circuit with ground)	Replace
Defective fuse 2 or short circuit with ground, defective contact, or disconnection in wiring harness between fuse 2 – X01 (12) –M38 (male) (2)	Repair or replace

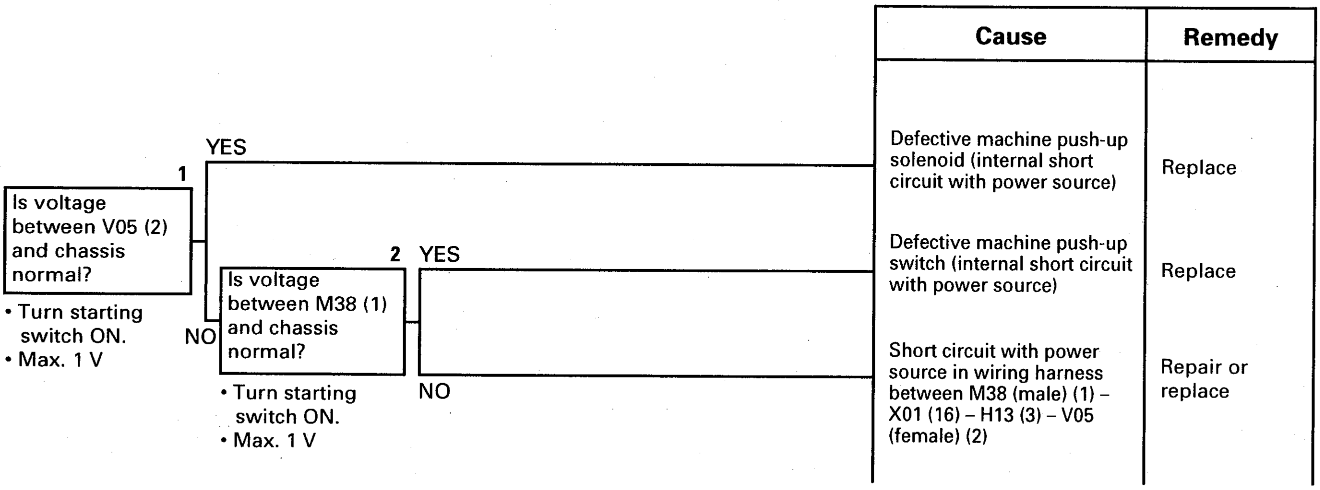
C-23 Related electric circuit diagram



TWP01423

b) If solenoid is not canceled (turned OFF) when machine push-up switch is set to high-pressure setting

★ Carry out troubleshooting with the machine push-up switch at the high-pressure setting position.



1 Is voltage between V05 (2) and chassis normal?
- Turn starting switch ON.
- Max. 1 V

YES → Defective machine push-up solenoid (internal short circuit with power source) — Replace

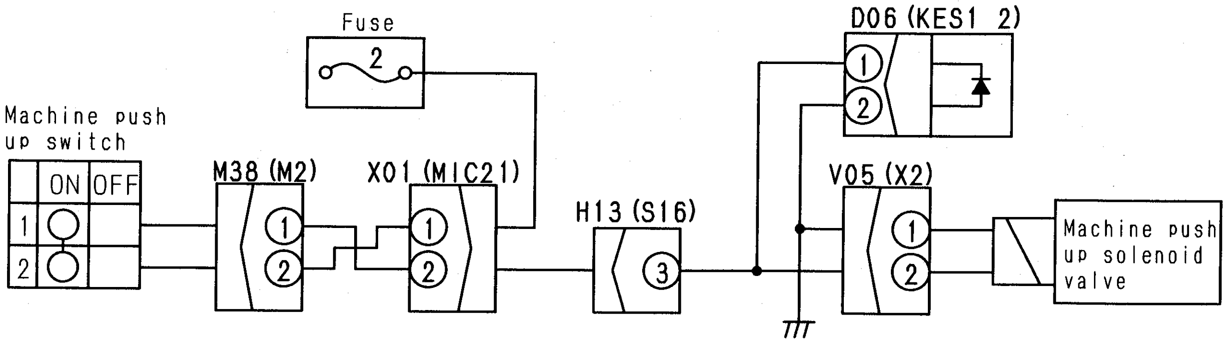
NO → 2 Is voltage between M38 (1) and chassis normal?
- Turn starting switch ON.
- Max. 1 V

2 YES → Defective machine push-up switch (internal short circuit with power source) — Replace

2 NO → Short circuit with power source in wiring harness between M38 (male) (1) – X01 (16) – H13 (3) – V05 (female) (2) — Repair or replace

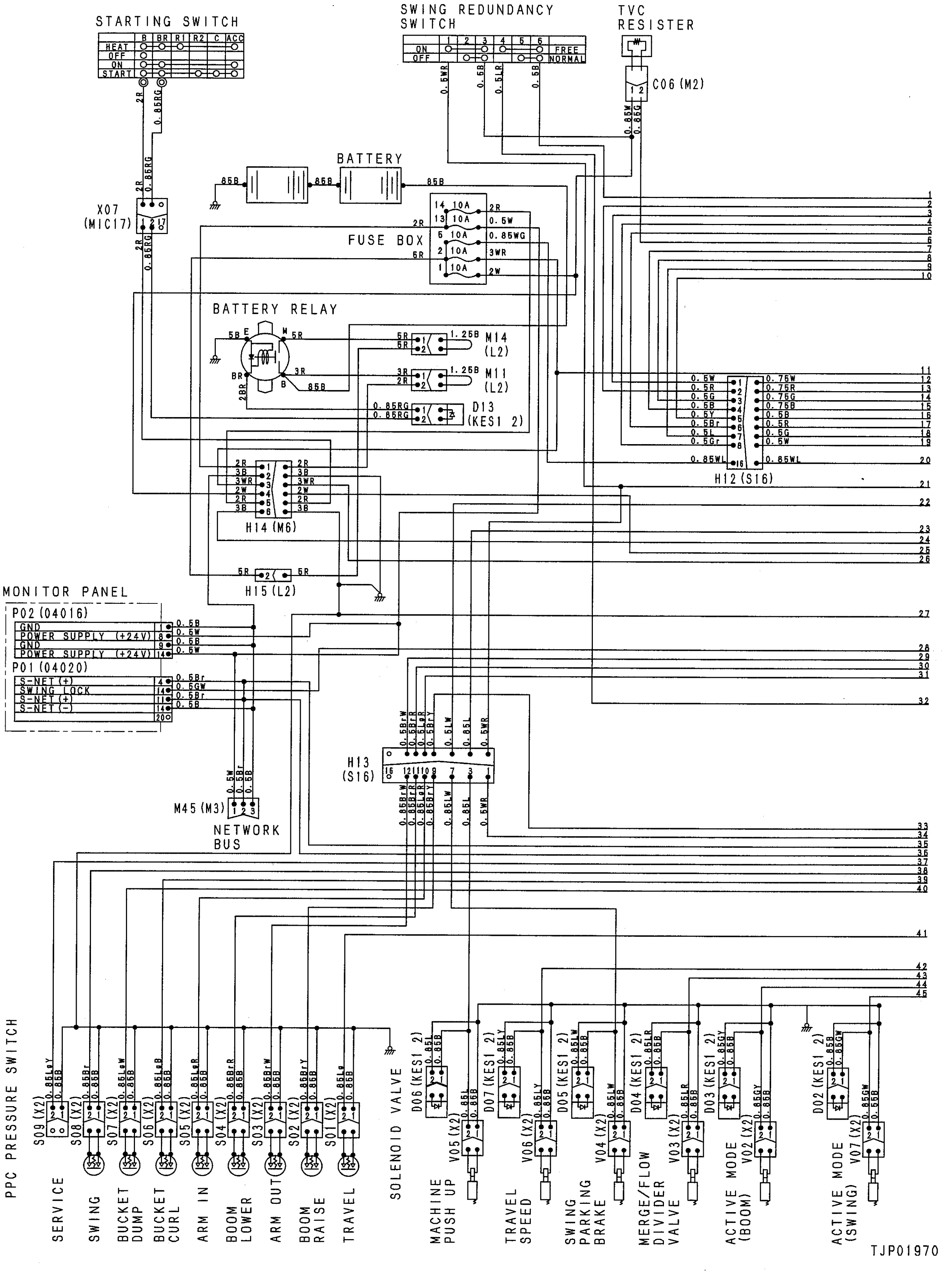
Cause	Remedy
Defective machine push-up solenoid (internal short circuit with power source)	Replace
Defective machine push-up switch (internal short circuit with power source)	Replace
Short circuit with power source in wiring harness between M38 (male) (1) – X01 (16) – H13 (3) – V05 (female) (2)	Repair or replace

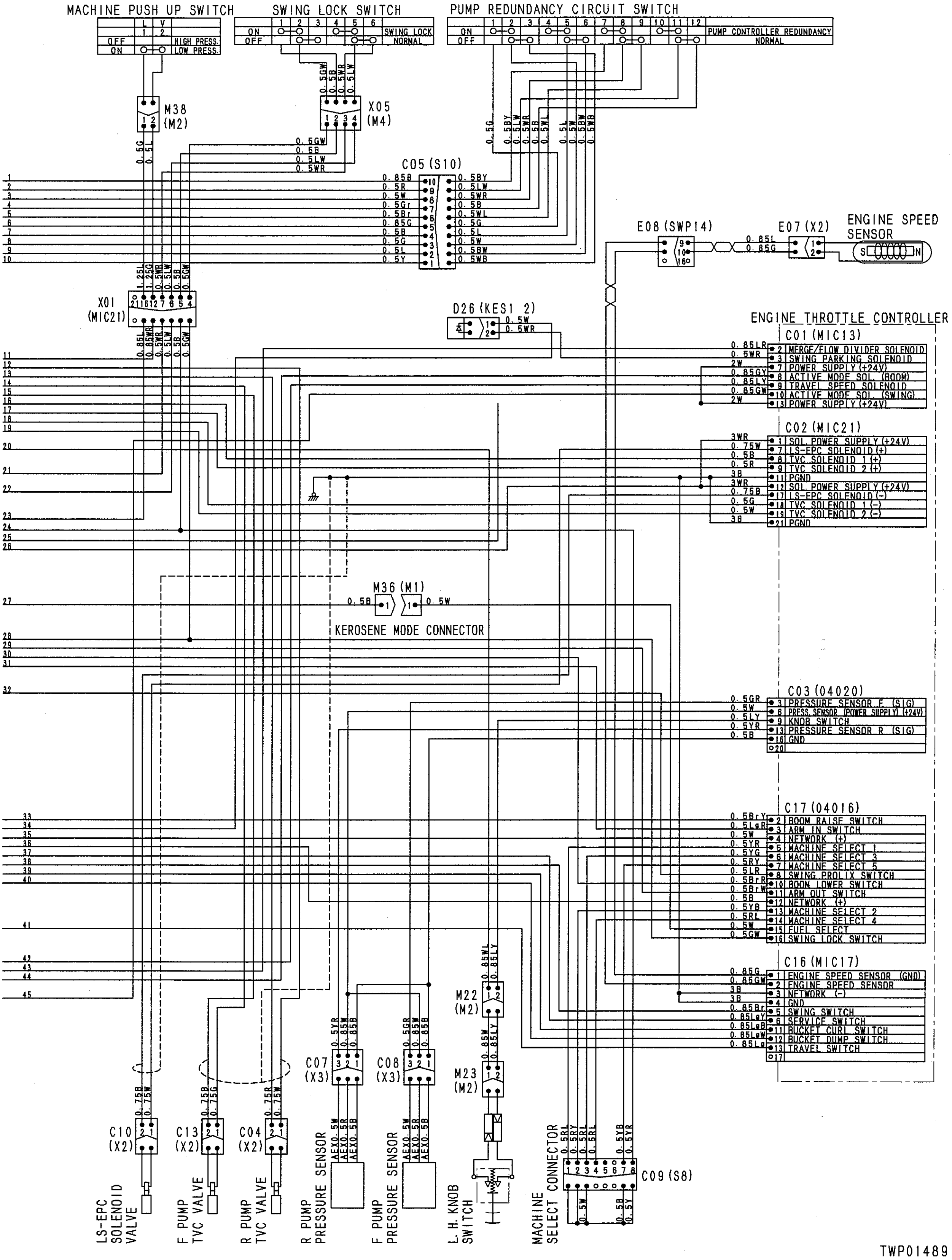
C-23 Related electric circuit diagram



TROUBLESHOOTING OF ENGINE THROTTLE, PUMP CONTROLLER (INPUT SIGNAL SYSTEM) (F MODE)

ELECTRICAL CIRCUIT DIAGRAM FOR F MODE




MACHINE PUSH UP SWITCH
L V
1 2
OFF HIGH PRESS.
ON LOW PRESS.
SWING LOCK SWITCH
1 2 3 4 5 6
ON SWING LOCK
OFF NORMAL
PUMP REDUNDANCY CIRCUIT SWITCH
1 2 3 4 5 6 7 8 9 10 11 12
ON PUMP CONTROLLER REDUNDANCY
OFF NORMAL
M38 (M2)
X05 (M4)
C05 (S10)
X01 (MIC21)
E08 (SWP14)
E07 (X2)
ENGINE SPEED SENSOR
D26 (KES1 2)
ENGINE THROTTLE CONTROLLER
C01 (MIC13)
2 MERGE/FLOW DIVIDER SOLENOID
3 SWING PARKING SOLENOID
7 POWER SUPPLY (+24V)
8 ACTIVE MODE SOL. (BOOM)
9 TRAVEL SPEED SOLENOID
10 ACTIVE MODE SOL. (SWING)
13 POWER SUPPLY (+24V)
C02 (MIC21)
1 SOL. POWER SUPPLY (+24V)
7 LS-EPC SOLENOID (+)
8 TVC SOLENOID 1 (+)
9 TVC SOLENOID 2 (+)
11 PGND
12 SOL. POWER SUPPLY (+24V)
17 LS-EPC SOLENOID (-)
18 TVC SOLENOID 1 (-)
19 TVC SOLENOID 2 (-)
21 PGND
M36 (M1)
KEROSENE MODE CONNECTOR
C03 (04020)
3 PRESSURE SENSOR F (SIG)
6 PRESS. SENSOR (POWER SUPPLY) (+24V)
9 KNOB SWITCH
13 PRESSURE SENSOR R (SIG)
16 GND
20
C17 (04016)
2 BOOM RAISE SWITCH
3 ARM IN SWITCH
4 NETWORK (+)
5 MACHINE SELECT 1
6 MACHINE SELECT 3
7 MACHINE SELECT 5
8 SWING PROLIX SWITCH
10 BOOM LOWER SWITCH
11 ARM OUT SWITCH
12 NETWORK (+)
13 MACHINE SELECT 2
14 MACHINE SELECT 4
15 FUEL SELECT
16 SWING LOCK SWITCH
C16 (MIC17)
1 ENGINE SPEED SENSOR (GND)
2 ENGINE SPEED SENSOR
3 NETWORK (-)
4 GND
5 SWING SWITCH
6 SERVICE SWITCH
11 BUCKET CURL SWITCH
12 BUCKET DUMP SWITCH
13 TRAVEL SWITCH
17
M22 (M2)
M23 (M2)
C07 (X3)
C08 (X3)
C10 (X2)
C13 (X2)
C04 (X2)
C09 (S8)
LS-EPC SOLENOID VALVE
F PUMP TVC VALVE
R PUMP TVC VALVE
R PUMP PRESSURE SENSOR
F PUMP PRESSURE SENSOR
L.H. KNOB SWITCH
MACHINE SELECT CONNECTOR
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TWP01489

F-1 Bit pattern 20-(1) (Swing oil pressure switch) does not light up

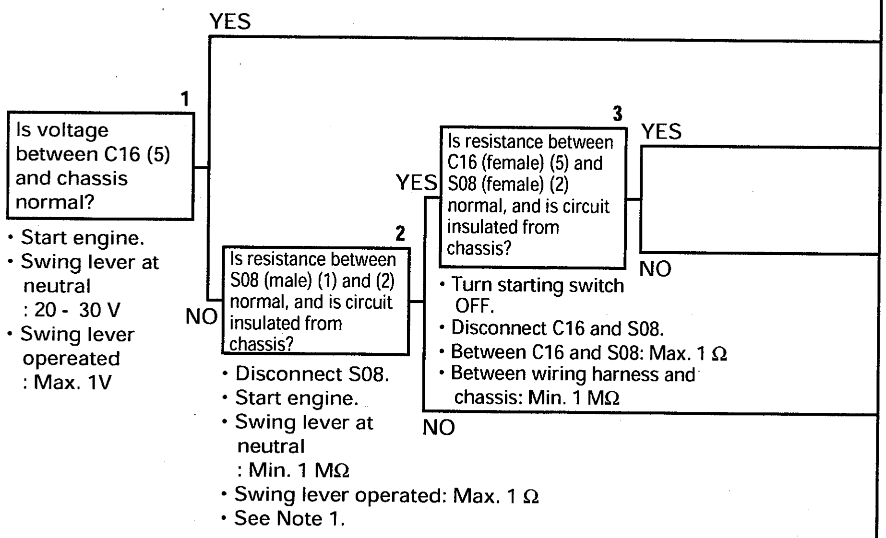
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**

⚠ Turn the swing lock switch ON before operating the swing lever.

★ If there is no display when the lever is operated on one side, the PPC shuttle valve is defective. (See H-5)
(When measuring with the engine stopped, charge the accumulator first.)

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

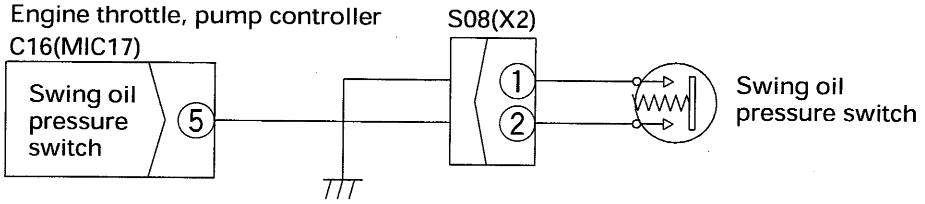
★ Always connect any disconnected connectors before going on to the next step.



Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective contact, or disconnection in wiring harness between S08 (female) (1) and chassis ground	Repair or replace
Defective contact, short circuit with ground, or disconnection in wiring harness between C16 (female) (5) and S08 (female) (2)	Repair or replace
Defective swing oil pressure switch (If the condition does not return to normal even when the switch is replaced, go to H-5.	Replace

Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C16 (5) and the chassis.
- If it is 20 - 30 V: Go to YES
- If it is less than 1 V: Go to NO

F-1 Related electric circuit diagram



BKP00257

F-2 Bit pattern 20-(2) (Travel oil pressure switch) does not light up

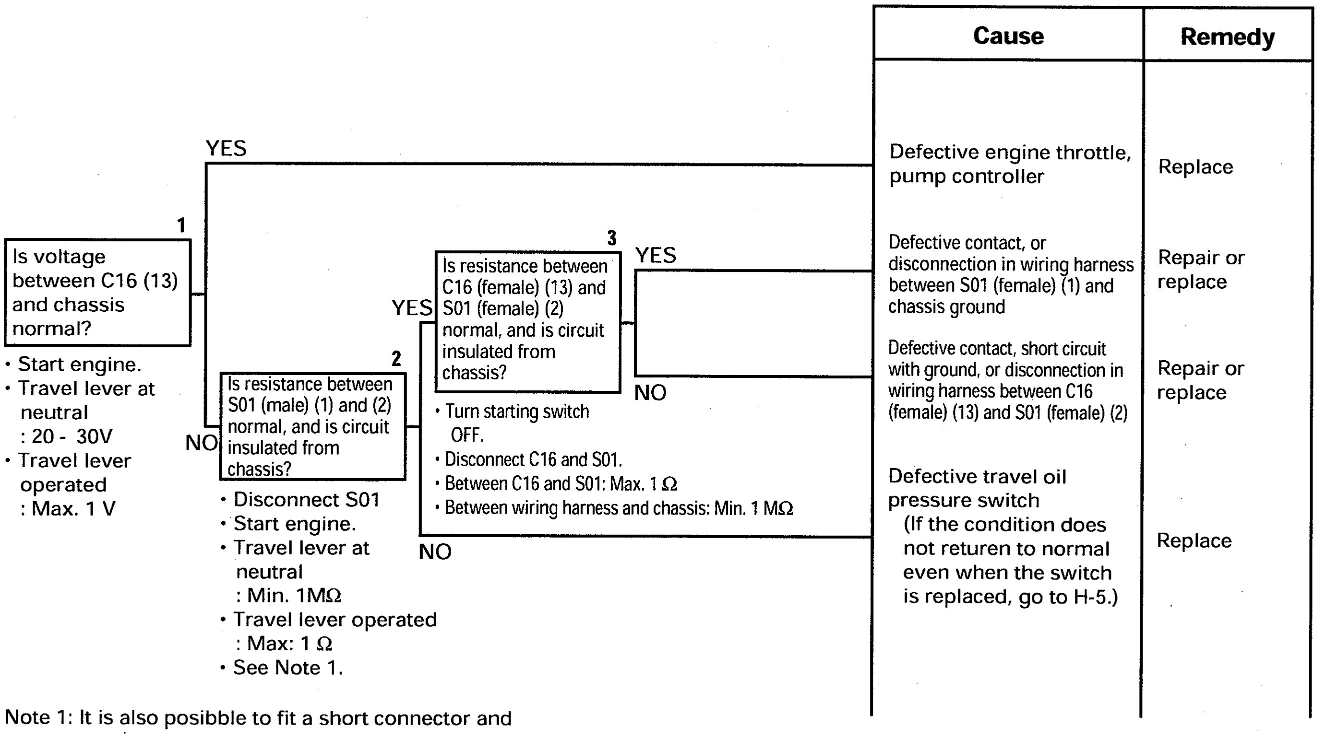
★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**

⚠ Before operating the travel lever, check that the surrounding area is safe.

★ If there is no display when the travel lever is operated on one side, the PPC shuttle valve is defective. (See H-5)
(When measuring with the engine stopped, charge the accumulator first.)

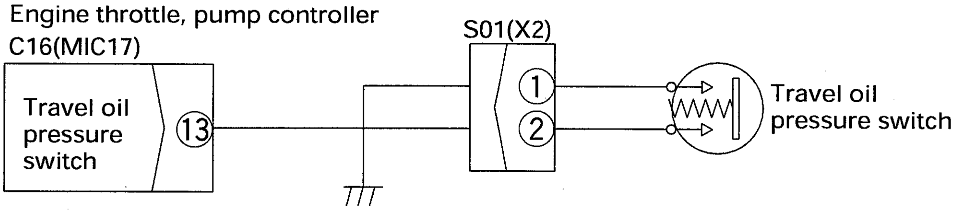
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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



Note 1: It is also posibble to fit a short connector and judge the condition. In this case, check the voltage between C16 (13) and the chassis.
- If it is 20 - 30 V: Go to YES
- If it is less than 1 V: Go to NO

F-2 Related electric circuit diagram



BKP00258

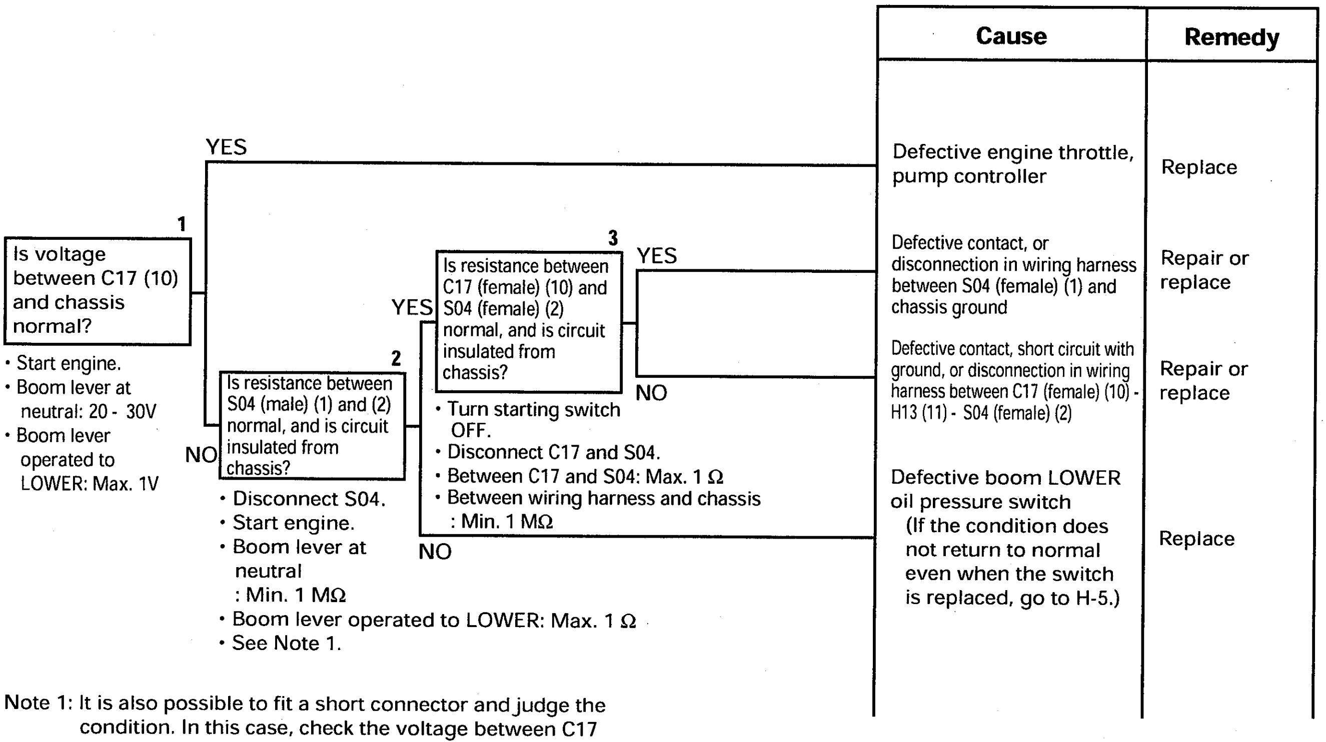
F-3 Bit pattern 20-(3) (Boom LOWER oil pressure switch) does not light up

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**

⚠ When measuring with the engine running, operate the lever slightly and make sure that the work equipment does not move.
(When measuring with the engine stopped, charge the accumulator first.)

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

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



1 Is voltage between C17 (10) and chassis normal?
- Start engine.
- Boom lever at neutral: 20 - 30V
- Boom lever operated to LOWER: Max. 1V

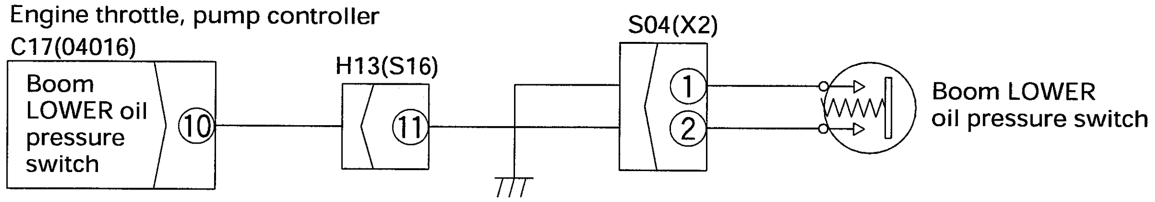
2 Is resistance between S04 (male) (1) and (2) normal, and is circuit insulated from chassis?
- Disconnect S04.
- Start engine.
- Boom lever at neutral : Min. 1 MΩ
- Boom lever operated to LOWER: Max. 1 Ω
- See Note 1.

3 Is resistance between C17 (female) (10) and S04 (female) (2) normal, and is circuit insulated from chassis?
- Turn starting switch OFF.
- Disconnect C17 and S04.
- Between C17 and S04: Max. 1 Ω
- Between wiring harness and chassis : Min. 1 MΩ

Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective contact, or disconnection in wiring harness between S04 (female) (1) and chassis ground	Repair or replace
Defective contact, short circuit with ground, or disconnection in wiring harness between C17 (female) (10) - H13 (11) - S04 (female) (2)	Repair or replace
Defective boom LOWER oil pressure switch (If the condition does not return to normal even when the switch is replaced, go to H-5.)	Replace

Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C17 (10) and the chassis.
- If it is 20 - 30 V: Go to YES
- If it is less than 1 V: Go to NO

F-3 Related electric circuit diagram



BKP00259

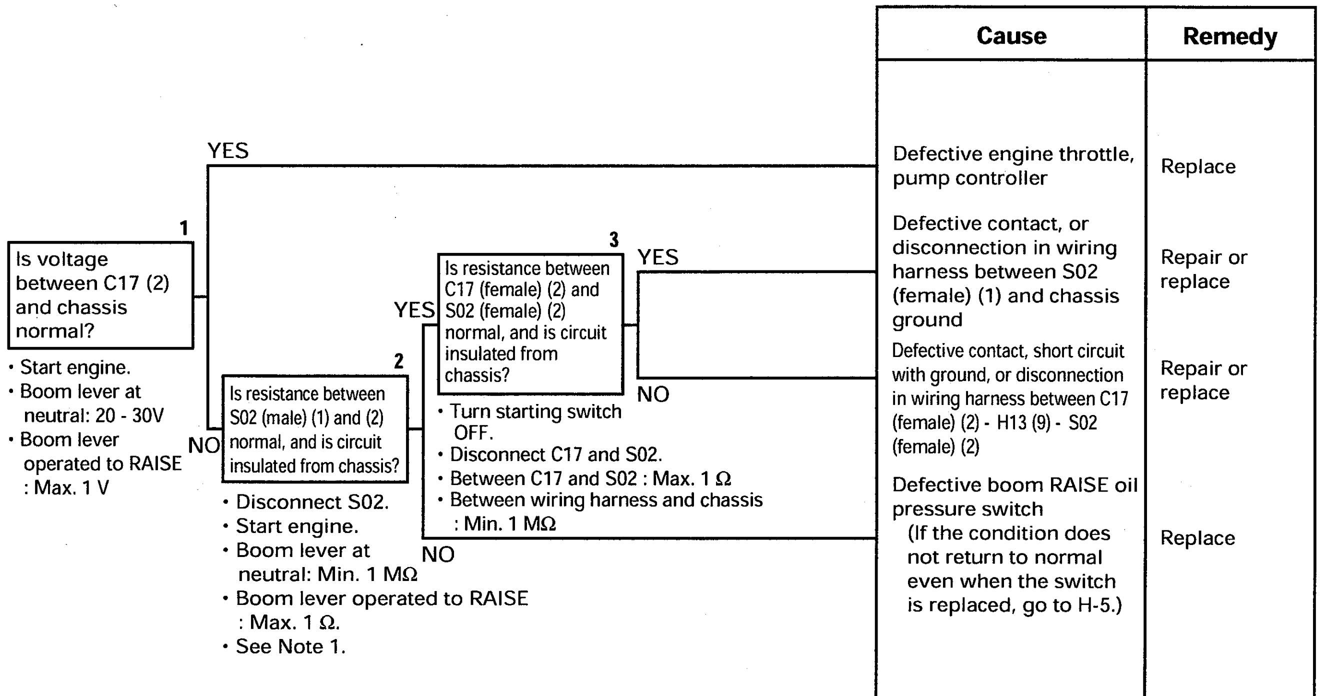
F-4 Bit pattern 20-(4) (Boom RAISE oil pressure switch) does not light up

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**

⚠ When measuring with the engine running, operate the lever slightly and make sure that the work equipment does not move.
(When measuring with the engine stopped, charge the accumulator first.)

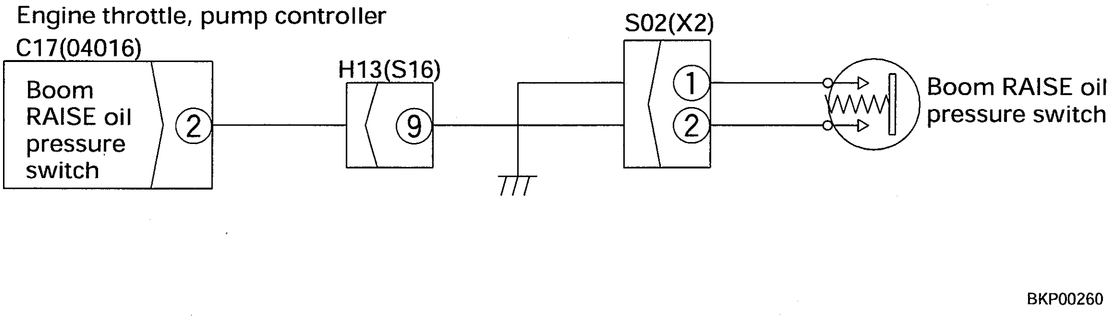
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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



Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C17 (2) and the chassis.
- If it is 20 - 30V: Go to YES
- If it is less than 1V: Go to NO

F-4 Related electric circuit diagram



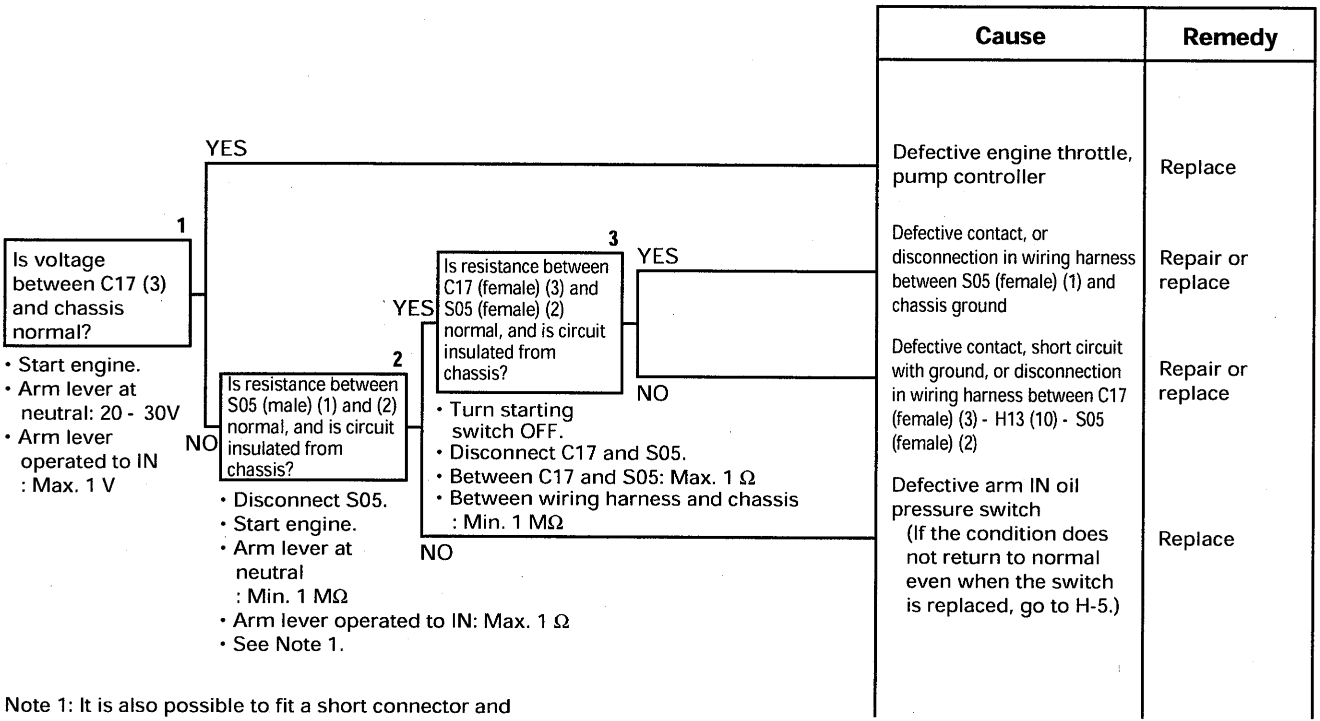
F-5 Bit pattern 20-(5) (Arm IN oil pressure switch) does not light up

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**

⚠ When measuring with the engine running, operate the lever slightly and make sure that the work equipment does not move.
(When measuring with the engine stopped, charge the accumulator first.)

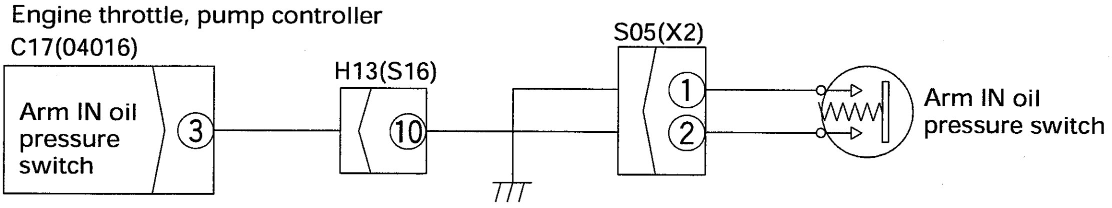
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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



Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C17 (3) and the chassis.
- If it is 20 - 30V: Go to YES
- If it is less than 1V: Go to NO

F-5 Related electric circuit diagram



BKP00261

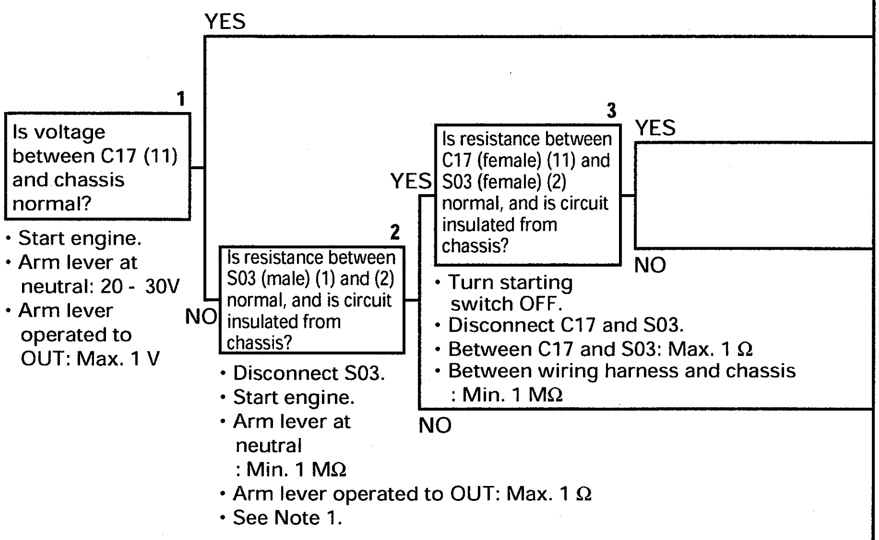
F-6 Bit pattern 20-(6) (Arm OUT oil pressure switch) does not light up

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**

⚠ When measuring with the engine running, operate the lever slightly and make sure that the work equipment does not move.
(When measuring with the engine stopped, charge the accumulator first.)

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

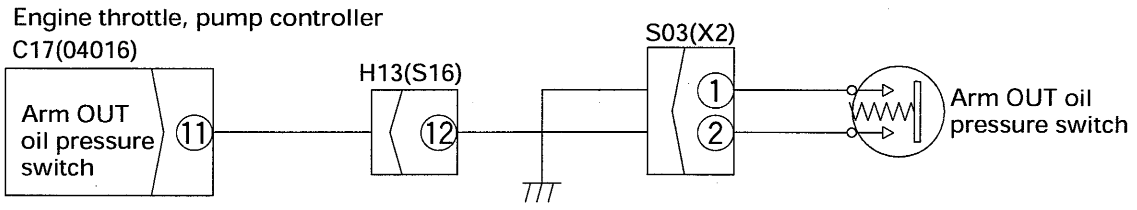
★ Always connect any disconnected connectors before going on to the next step.



Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective contact, or disconnection in wiring harness between S03 (female) (1) and chassis ground	Repair or replace
Defective contact, short circuit with ground, or disconnection in wiring harness between C17 (female) (11) - H13 (12) - S03 (female) (2)	Repair or replace
Defective arm OUT oil pressure switch (If the condition does not return to normal even when the switch is replaced, go to H-5.)	Replace

Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C17 (11) and the chassis.
- If it is 20 - 30V: Go to YES
- If it is less than 1V: Go to NO

F-6 Related electric circuit diagram



BKP00262

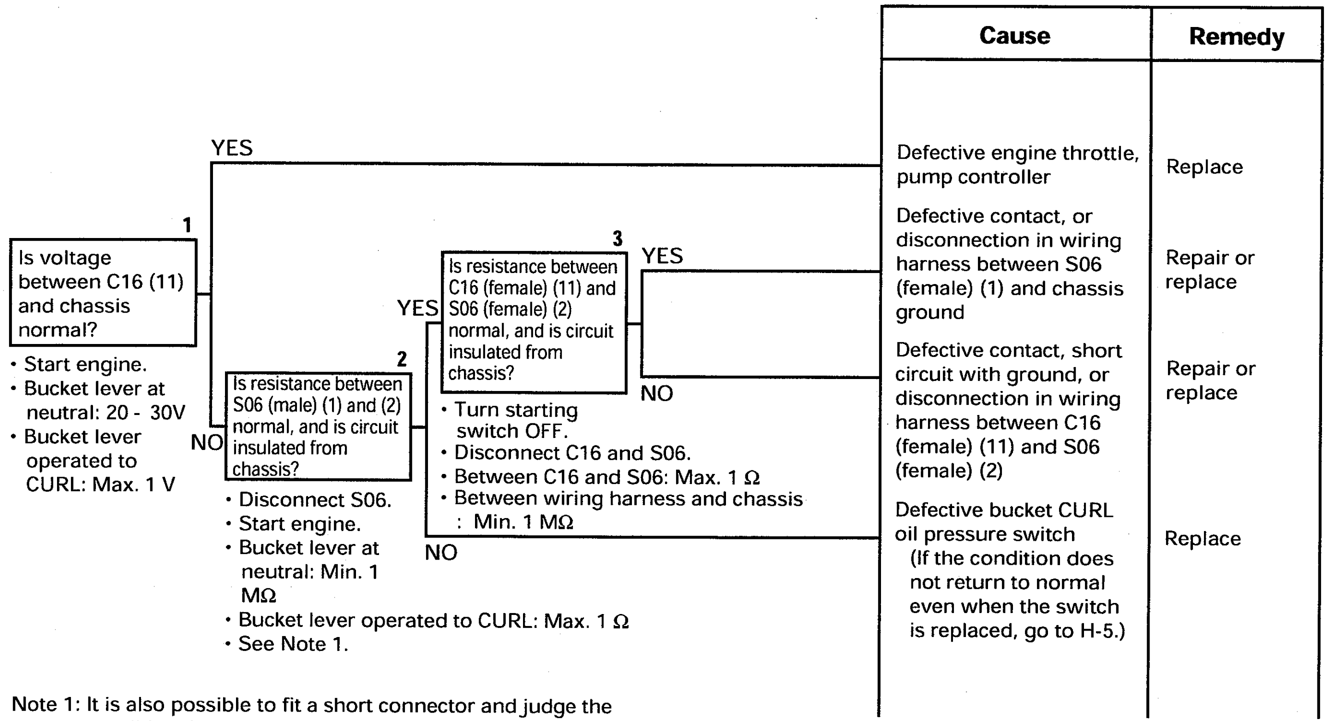
F-7 Bit pattern 21-(1) (Bucket CURL oil pressure switch) does not light up

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**

⚠ When measuring with the engine running, operate the lever slightly and make sure that the work equipment does not move.
(When measuring with the engine stopped, charge the accumulator first.)

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

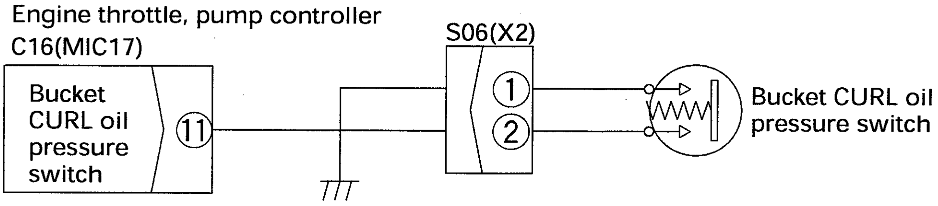
★ Always connect any disconnected connectors before going on to the next step.



Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective contact, or disconnection in wiring harness between S06 (female) (1) and chassis ground	Repair or replace
Defective contact, short circuit with ground, or disconnection in wiring harness between C16 (female) (11) and S06 (female) (2)	Repair or replace
Defective bucket CURL oil pressure switch (If the condition does not return to normal even when the switch is replaced, go to H-5.)	Replace

Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C16 (11) and the chassis.
- If it is 20 - 30V: Go to YES
- If it is less than 1V: Go to NO

F-7 Related electric circuit diagram



BKP00263

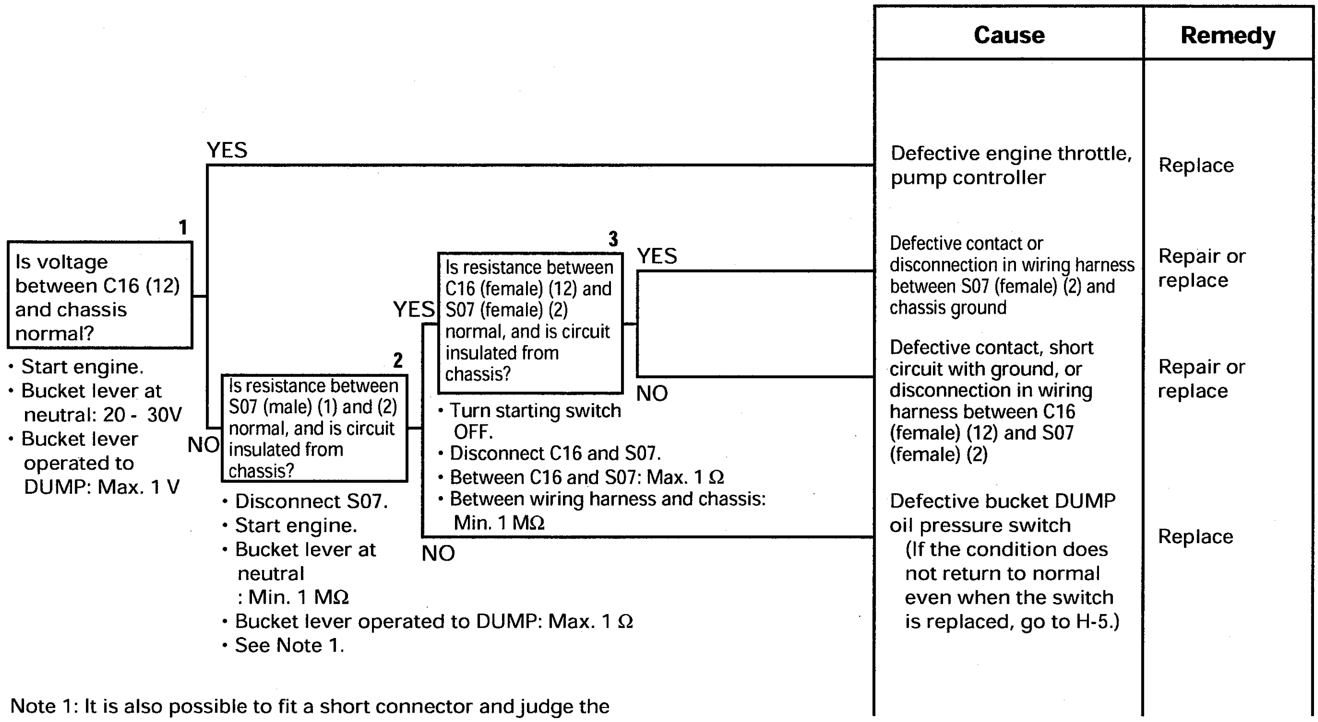
F-8 Bit pattern 21-(2) (Bucket DUMP oil pressure switch) does not light up

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**

⚠ When measuring with the engine running, operate the lever slightly and make sure that the work equipment does not move.
(When measuring with the engine stopped, charge the accumulator first.)

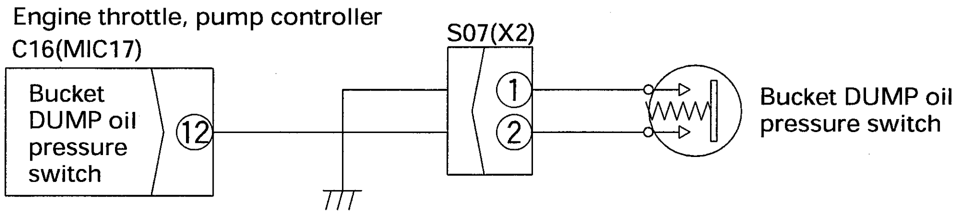
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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



Note 1: It is also possible to fit a short connector and judge the condition. In this case, check the voltage between C16 (12) and the chassis.
- If it is 20 - 30V: Go to YES
- If it is less than 1V: Go to NO

F-8 Related electric circuit diagram



BKP00264

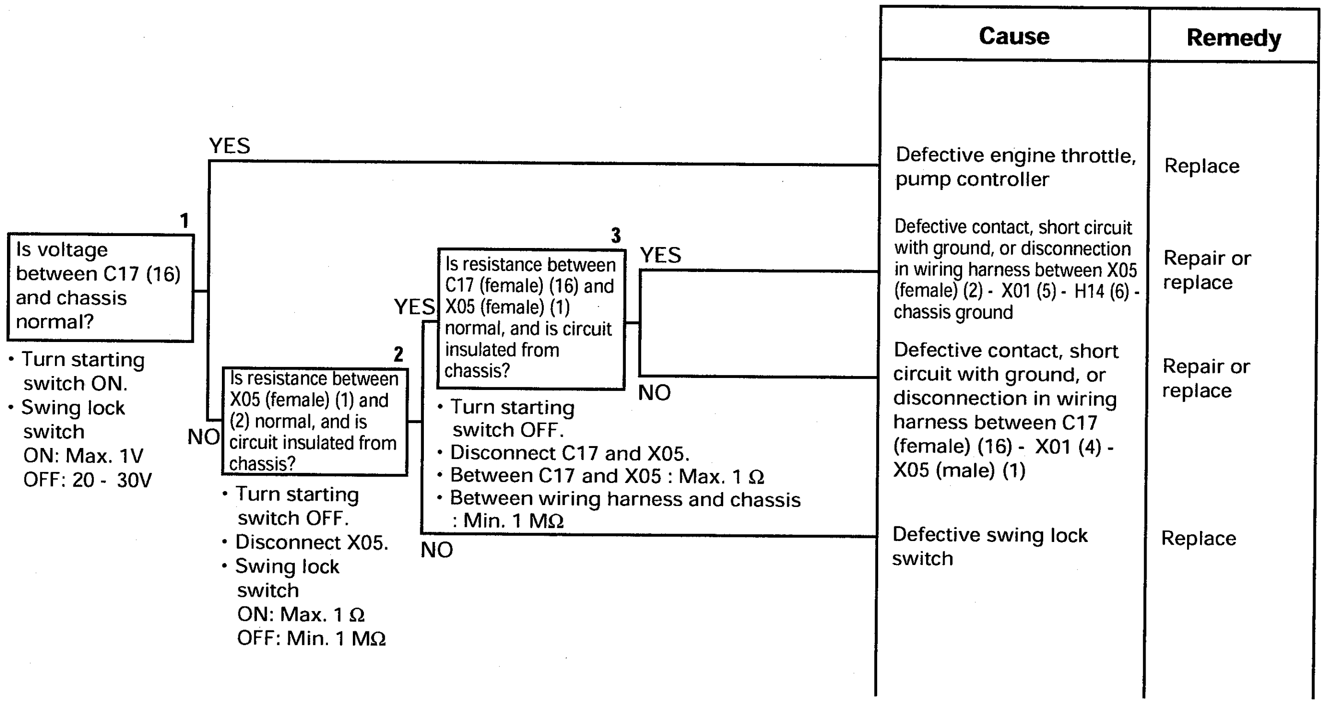
F-9 Bit pattern 21-(3) (Swing lock switch) does not light up

★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**

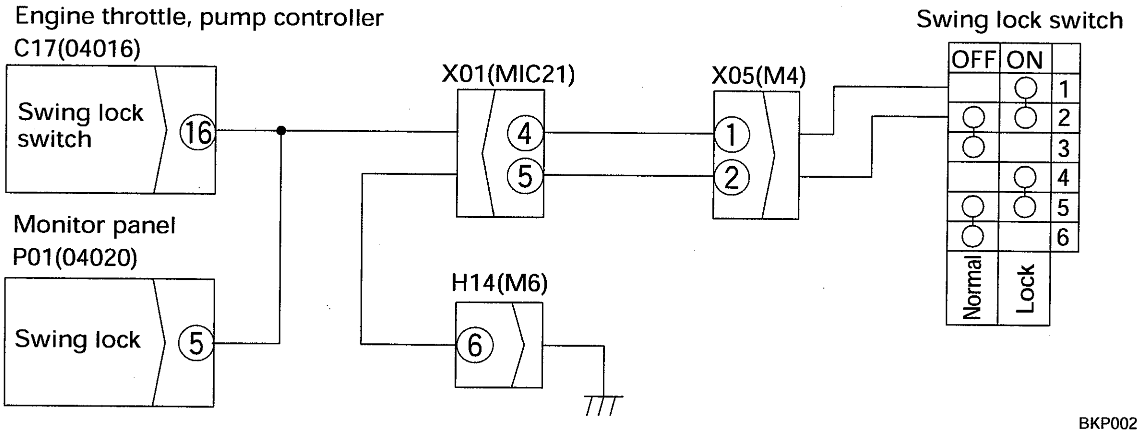
★ If the panel display is normal. (If the swing lock lamp does not light up, go to M-21.)

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

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



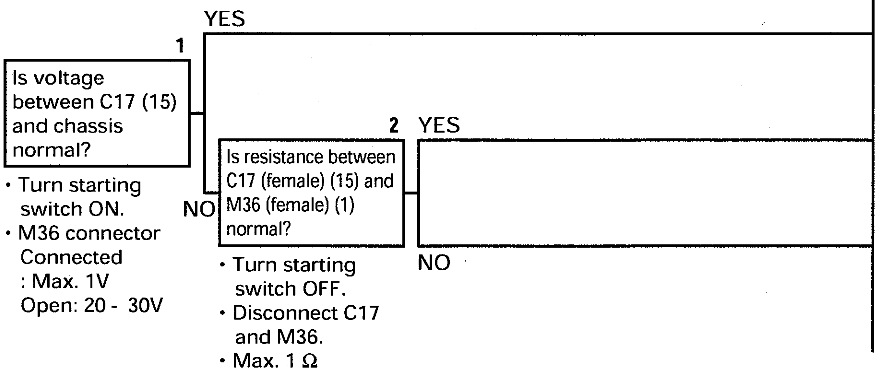
F-9 Related electric circuit diagram



BKP00265

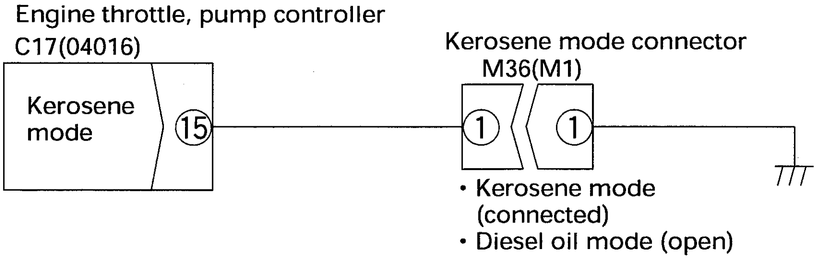
F-10 Bit pattern 22-(5) (Kerosene mode connection) does not light up

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.



Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective contact, or disconnection in wiring harness between M36 (male) (1) and chassis ground	Repair or replace
Defective contact or disconnection in wiring harness between C17 (female) (15) and M36 (female) (1)	Repair or replace

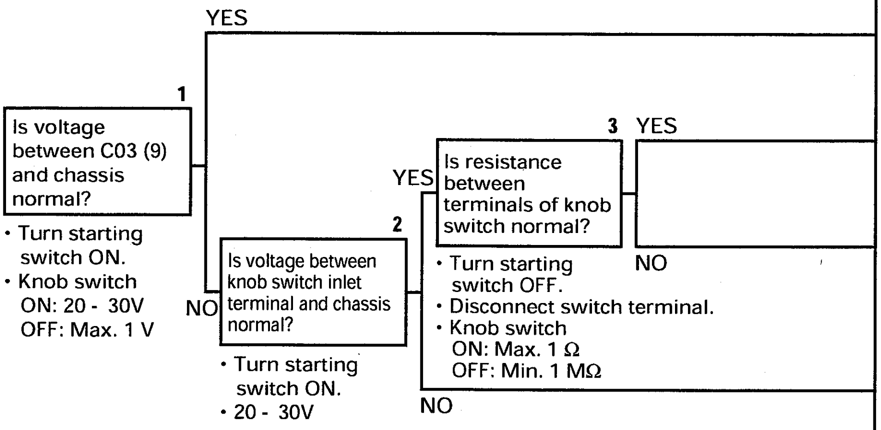
F-10 Related electric circuit diagram



BKP00266

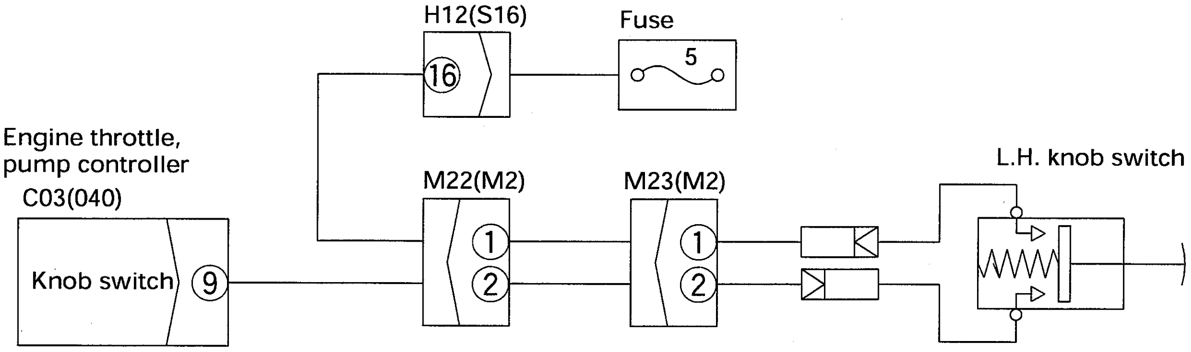
F-11 Bit pattern 22-(6) (L.H. knob switch) does not light up

- ★ **This troubleshooting is carried out when there is still an abnormality, so when disconnecting the connector and inserting the T-adapter, or when removing the T-adapter and returning the connector to its original position, if the monitor code display returns to normal, the problem has been removed.**
- ★ When fuse No. 5 is not blown.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.



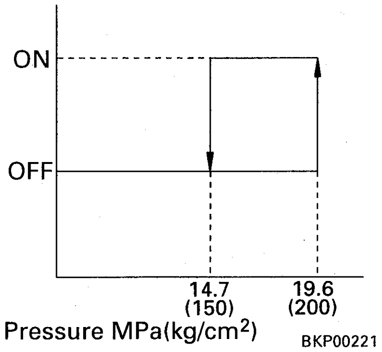
Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective contact, or disconnection in wiring harness between knob switch outlet - M23 (2) - M22 (2) - C03 (female) (9)	Repair wiring harness
Defective L.H. knob switch	Replace
Defective contact, or disconnection in wiring harness between fuse No. 5 - H12 (16) - M22 (1) - H23 (1) - knob switch inlet	Repair wiring harness

F-11 Related electric circuit diagram



TROUBLESHOOTING OF HYDRAULIC, MECHANICAL SYSTEM (H MODE)

PUMP MERGE/DIVIDER LOGIC

Divide (pump merge/divider solenoid ON)	Merge (pump merge/divider solenoid OFF)
1. Travel operated independently. 2. Travel + work equipment (any one of boom, arm, bucket, swing, or service) + front or rear pump oil pressure 19.6 MPa {200 kg/cm²} or above when raised or 14.7 MPa {150 kg/cm²} or above when lowered. (See diagram)  3. Breaker mode + service (breaker) valve pressure switch ON.	All operations except those on left.

SOLENOID ACTUATION TABLE

Name of solenoid	ON (energized)	OFF
Swing holding brake	Brake released	Brake applied
Travel speed	Travel motor swash plate angle at MIN	Travel motor swash plate angle at MAX
Active mode (boom)	STD mode	Active mode
Pump merge/divider valve	Divided flow	Merged flow
Machine push-up	Low pressure	High pressure
Active mode (swing)	Active mode	STD mode

TABLE OF FAILURE MODES AND CAUSES (1/2)

Failure mode		Parts causing failure	Piston pump											Control valve
			F				R							
			TVC valve	LS valve	Servo piston	Pump proper	TVC valve	LS valve	Servo piston	Pump proper	Control pump	Strainer	Damper	Spool
All work equipment, travel, swing	Speeds of all work equipment, swing, travel are slow or lack power		▲	▲	▲	▲	▲	▲	▲	▲	○			
	There is excessive drop in engine speed, or engine stalls		○	○	○		○	○	○					
	No work equipment, travel, swing move					△				△	○		○	
	Abnormal noise generated (around pump)					○				○		○		
	Auto-deceleration does not work													
	Fine control ability is poor or response is poor			○				○						
Work equipment	Boom is slow or lacks power													○
	Arm is slow or lacks power													○
	Bucket is slow or lacks power													○
	Boom does not move													○
	Arm does not move													○
	Bucket does not move													○
	Excessive hydraulic drift													○
	Excessive time lag (engine at low idling)													
	Other equipment moves when single circuit is relieved													
	In L/O, F/O modes, work equipment speed is faster than specified speed			○				○						
	Machine push-up function does not work													
Compound operations	In compound operations, work equipment with larger load is slow													
	In swing + boom (RAISE), boom is slow													
	In swing + arm, arm is slow													
	In swing + travel, travel speed drops excessively													
Travel system	Travel deviation	Deviation is excessive during normal travel												○
		Deviation is excessive when starting												
	Travel speed is slow													○
	Steering does not turn or lacks power													○
	Travel speed does not switch or is faster than specified speed													
	Does not move (one side only)			○				○						
Swing system	Does not swing	Both left and right												
		One direction only												○
	Swing acceleration is poor or swing speed is slow	Both left and right	○	○										
		One direction only												○
	Excessive overrun when stopping swing	Both left and right												
		One direction only												○
	Excessive shock when stopping swing (one direction only)													
	Excessive abnormal noise when stopping swing													
	Excessive hydraulic drift of swing	When brake ON												
		When brake OFF												○
	Swing speed is faster than specified swing speed			○				○						

★ In the failure modes, modes for compound operations are used when independent operations are normal

▲: When there is an abnormality for both front and rear

Control valve																PPC valve	PPC shuttle	Safety lock valve	Swing PPC slow return valve	Swivel joint	Engine system	Troubleshooting code
Front pump		Rear pump		Pressure compensation valve	Pump merge/divider valve		LS circuit check valve	LS shuttle valve	LS select valve	LS circuit throttle	Re-generation valve		Safety-suction valve	Suction valve	Slow return valve for pump merge/divider							
Main relief valve	Unload valve	Main relief valve	Unload valve		Main pump merge/divider valve	LS pump merge/divider valve					Boom	Arm										
▲	▲	▲	▲																			H-1
																					○	H-2
																		○				H-3
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										○												H-6
				○	○	○		○			○		○	○		○						H-7
				○	○	○		○				○	○			○						H-8
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																○			○			H-28
																						H-29
																						H-30
				○																		
					○	○																H-31

TABLE OF FAILURE MODES AND CAUSES (2/2)

Failure mode			Parts causing failure: Solenoid valve							Swing motor		
			Active mode (swing)	LS-EPC	Active mode (boom)	Pump merge/divider valve	Swing holding brake	Travel speed selector	Machine push-up	Holding brake	Safety-suction valve	Leakage, breakage inside body
All work equipment, travel, swing	Speeds of all work equipment, swing, travel are slow or lack power			○								
	There is excessive drop in engine speed, or engine stalls											
	No work equipment, travel, swing move											
	Abnormal noise generated (around pump)											
	Auto-deceleration does not work											
	Fine control ability is poor or response is poor											
Work equipment	Boom is slow or lacks power				○	○						
	Arm is slow or lacks power					○						
	Bucket is slow or lacks power											
	Boom does not move											
	Arm does not move											
	Bucket does not move											
	Excessive hydraulic drift											
	Excessive time lag (engine at low idling)			○								
	Other equipment moves when single circuit is relieved											
	In L/O, F/O modes, work equipment speed is faster than specified speed			○		○						
	Machine push-up function does not work								○			
Compound operations	In compound operations, work equipment with larger load is slow											
	In swing + boom (RAISE), boom is slow		○									
	In swing + arm, arm is slow											
	In swing + travel, travel speed drops excessively											
Travel system	Travel deviation	Deviation is excessive during normal travel										
		Deviation is excessive when starting										
	Travel speed is slow			○								
	Steering does not turn or lacks power					○						
	Travel speed does not switch or is faster than specified speed			○		○		○				
	Does not move (one side only)											
Swing system	Does not swing	Both left and right					○			○		○
		One direction only									○	
	Swing acceleration is poor or swing speed is slow	Both left and right										○
		One direction only									○	
	Excessive overrun when stopping swing	Both left and right										○
		One direction only									○	
	Excessive shock when stopping swing (one direction only)											
	Excessive abnormal noise when stopping swing										○	
	Excessive hydraulic drift of swing	When brake ON					○			○		
		When brake OFF									○	○
	Swing speed is faster than specified swing speed			○								

★ In the failure modes, modes for compound operations are used when independent operations are normal

▲: When there is an abnormality for both front and rear

Travel motor												Pressure switch								Pressure sensor		Troubleshooting code
												Boom		Arm		Bucket						
Safety valve	Counterbalance valve	Check valve	Travel speed selector servo piston	Leakage, breakage inside body	Swing machinery	Final drive	Hydraulic cylinder	Boom lock valve	Back pressure valve	Travel junction valve		RAISE	LOWER	IN	OUT	CURL	DUMP	Swing	Travel	Front pump	Rear pump	
																						H-1
																						H-2
																						H-3
																						H-4
												○	○	○	○	○	○	○	○			H-5
																						H-6
							○	○				○	○									H-7
							○							○	○							H-8
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					○													○				H-25
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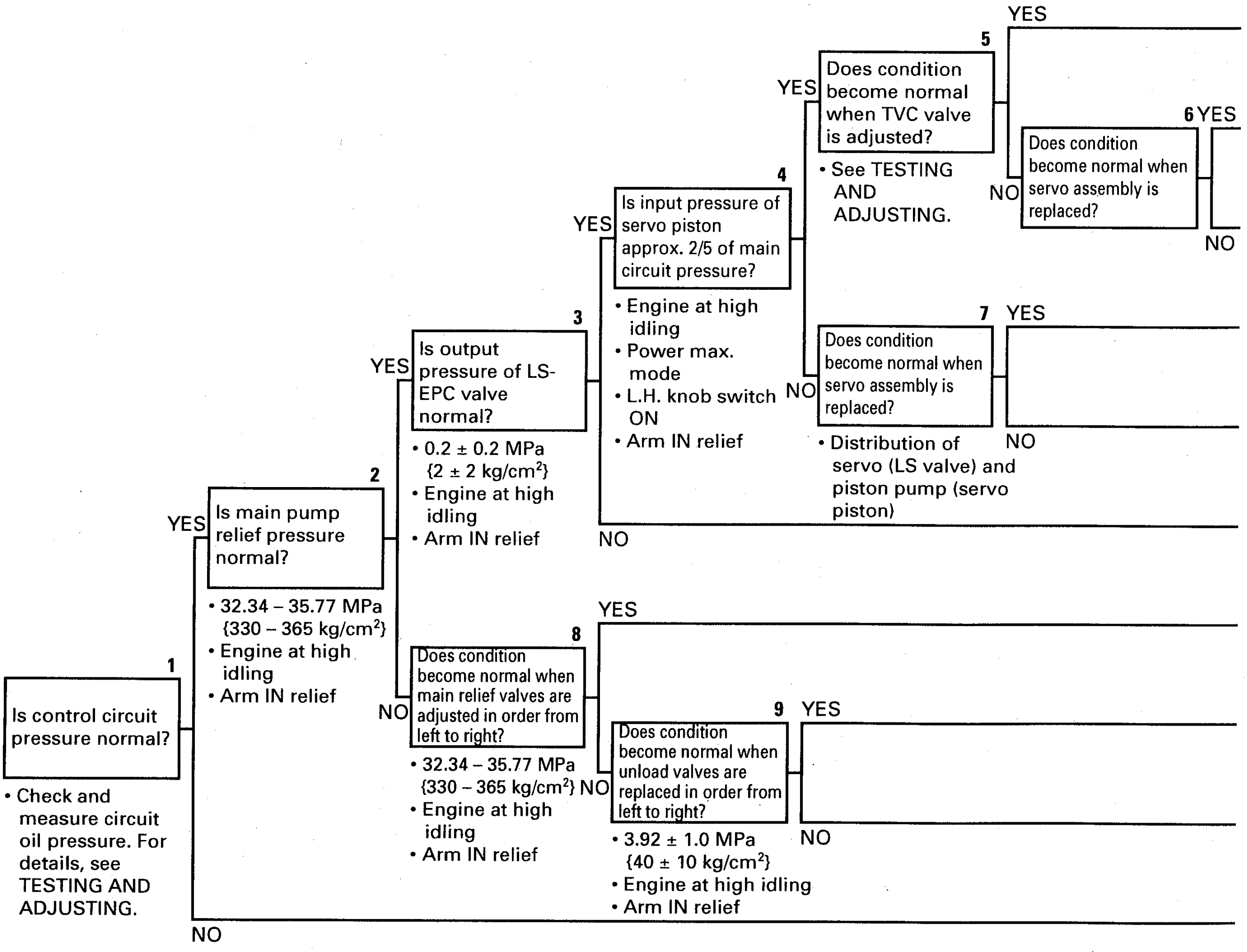
																						H-27
																						H-28
					○				○													H-29
																						H-30
																						H-31

H-1 Speeds of all work equipment, swing, travel are slow or lack power

★ Carry out troubleshooting in the H/O mode.

★ Check that no abnormal noise is being generated from the main pump before carrying out troubleshooting. (If there is any abnormal noise, carry out troubleshooting for H-4.)



※ The oil pressure in the control circuit is reduced by the self-pressure reducing valve.

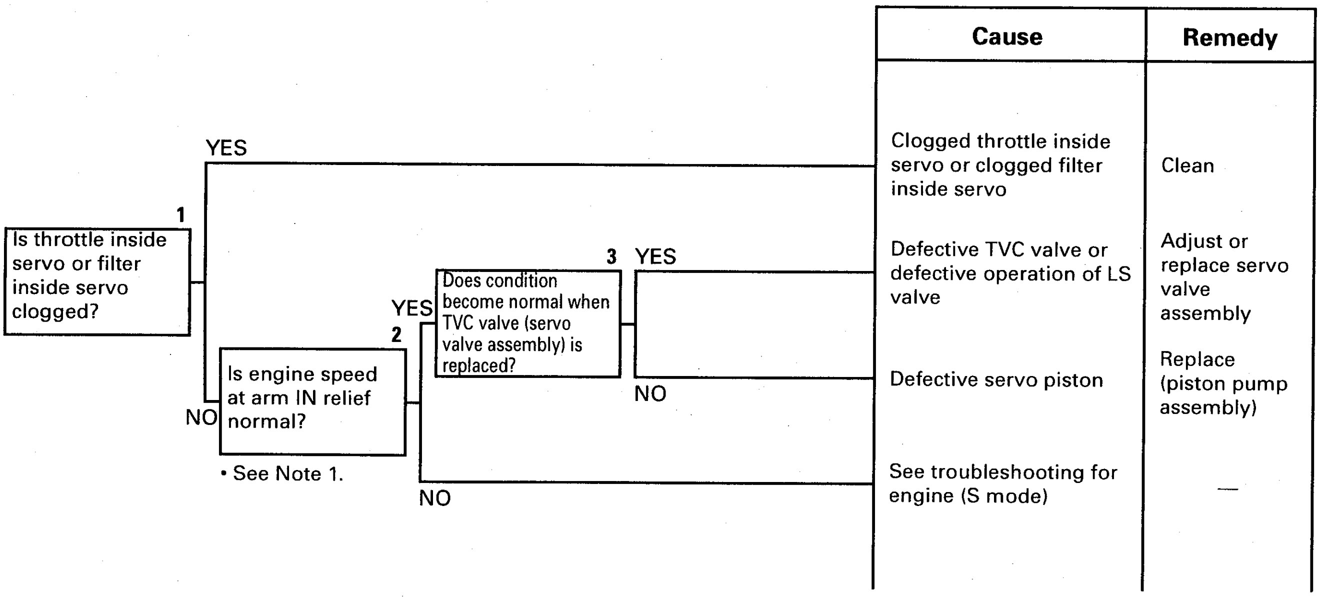
★ Measuring servo piston inlet port pressure in Item No. 4

- Measure the input pressure to the large diameter end of the servo piston when the arm is relieved in the power max. mode. (Approx. 12.74 MPa {130 kg/cm²})
  Basically, the pressure at the large diameter end is approx. 2/5 of the small diameter end. (For details, see TESTING AND ADJUSTING.)]

Cause	Remedy
Defective adjustment of TVC valve	Adjust
Defective servo assembly (defective TVC valve)	Repair or replace
Defective piston pump	Repair or replace
Defective servo assembly (defective LS valve)	Repair or replace
Defective piston pump (servo piston)	Repair or replace
Defective operation of LS-EPC solenoid valve	Replace
Defective operation of main relief assembly (valve which becomes normal when adjusted)	Adjust
Defective operation of unload valve (valve which becomes normal when replaced)	Replace
Defective operation of main relief valve	Replace
Defective self-reducing valve	Repair or replace

H-2 There is excessive drop in engine speed, or engine stalls

★ Carry out troubleshooting in the H/O mode.
★ Check that the main relief pressure is normal.

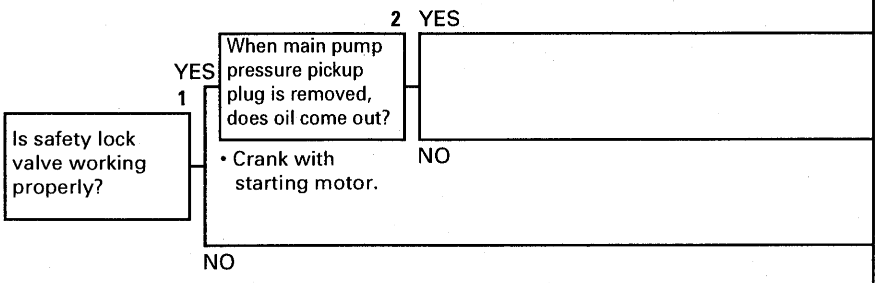


Note 1: Replace the servo valve assembly on the defective side with a new part, and if the engine speed is lower than the reference value below, carry out troubleshooting for S mode (engine). If it is higher, it can be judged that the TVC valve (servo valve assembly) is defective, so replace it.

★ Engine speed (reference) at arm IN relief when engine and pump are normal

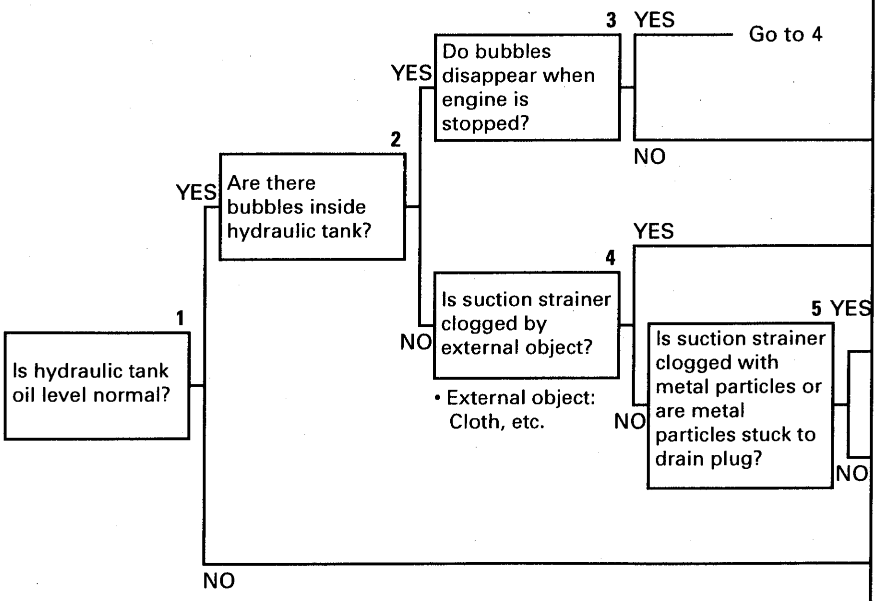
Engine speed at arm IN relief	Conditions
2,020 ± 100rpm	• Engine at high idling • Power max. mode • L.H. knob switch ON

H-3 No work equipment, travel, swing move



Cause	Remedy
Defective self-reducing valve, defective control circuit, or defective main piston pump	Replace
Defective damper	Replace
Defective operation of safety lock valve or safety linkage	Adjust

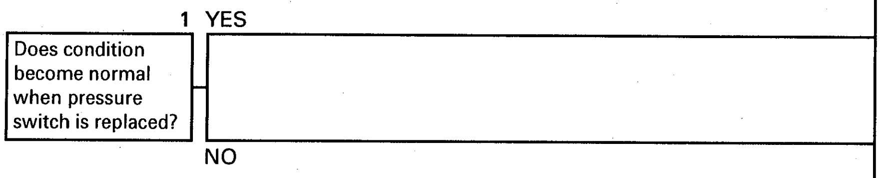
H-4 Abnormal noise generated (around pump)



Cause	Remedy
Improper hydraulic oil	Change hydraulic oil
Clogged by external object (cloth, etc.)	Remove
Defect inside pump	Repair or replace
Operate for a short time and watch for any change in symptoms	Inspect again (depending on changes in symptoms)
Lack of hydraulic oil	Add hydraulic oil

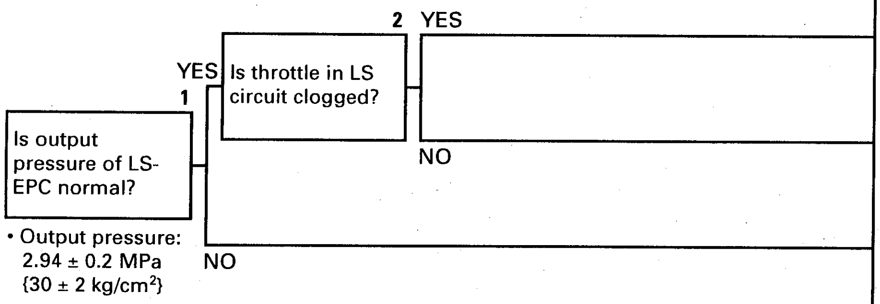
H-5 Auto-deceleration does not work (when PPC shuttle valve is cause)

★ The control pressure for the travel and swing passes through the PPC shuttle valve and is supplied to the pressure switch.



Cause	Remedy
Defective pressure switch	Replace
Defective operation of PPC shuttle valve in applicable system (swing or travel)	Repair or replace

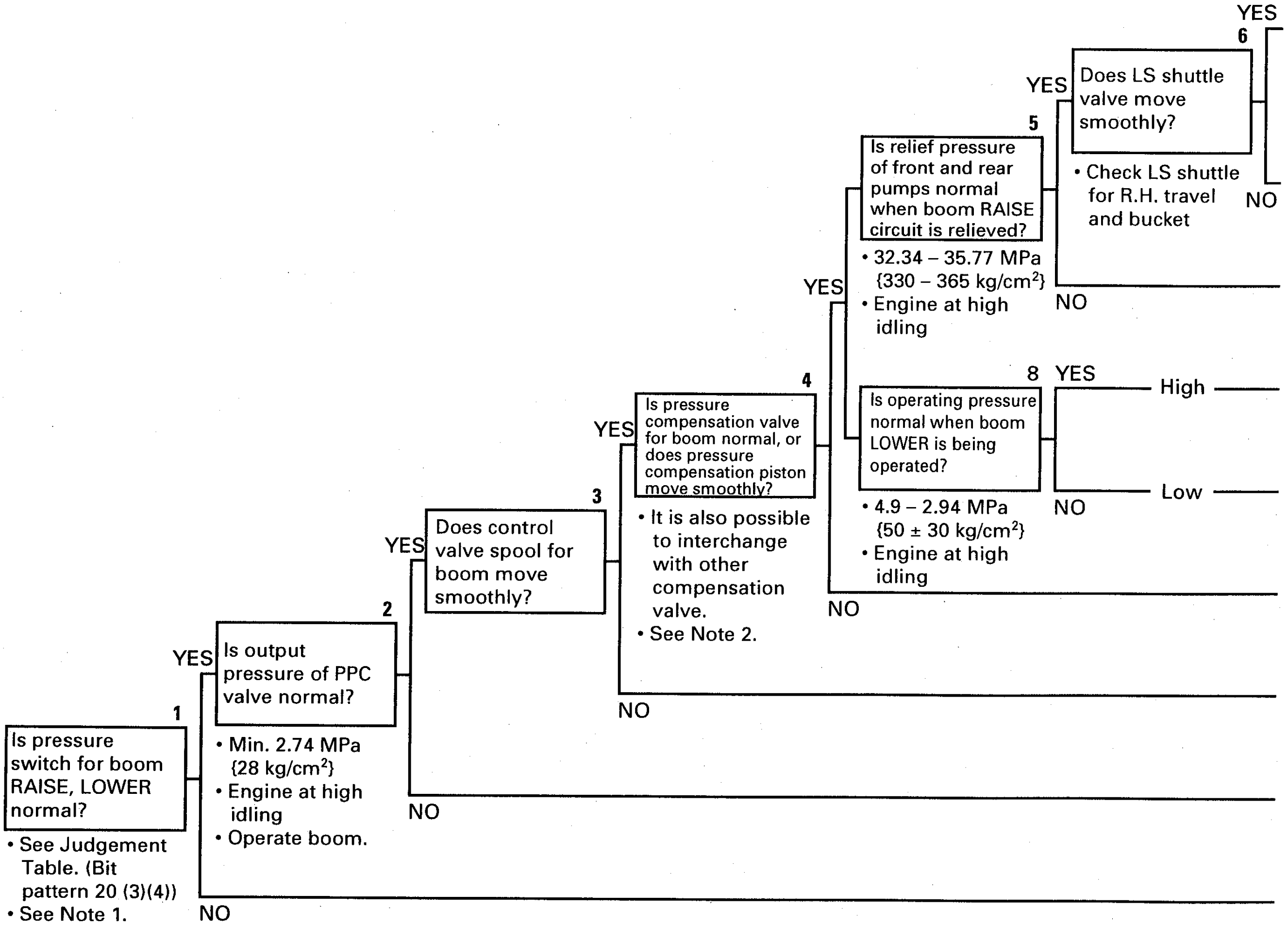
H-6 Fine control ability is poor or response is poor



Cause	Remedy
Clogged throttle in LS circuit	Clean
Defective servo valve assembly (LS valve), or defective servo piston	Replace
Defective LS-EPC valve	Repair or replace

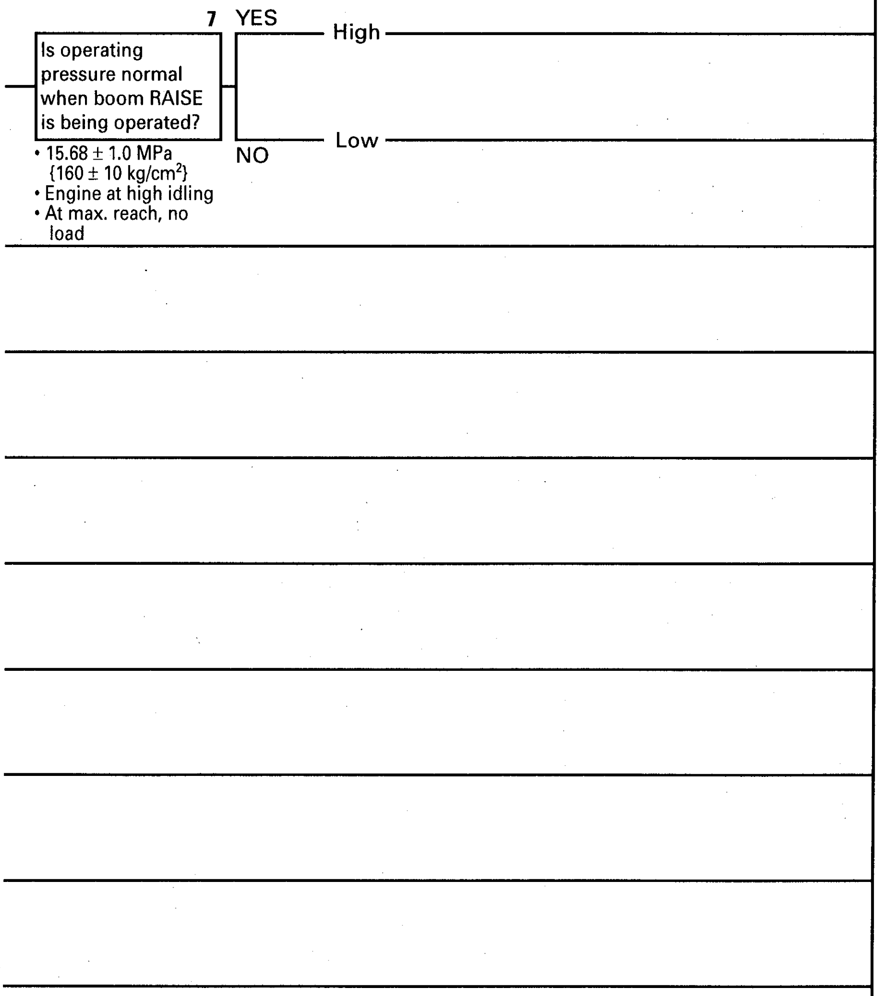
H-7 Boom is slow or lacks power

- ★ When travel and swing speeds are normal.
- ★ Carry out troubleshooting in the H/O mode.



Note 1: If auto-deceleration is canceled when boom RAISE or boom LOWER is operated, system is normal.

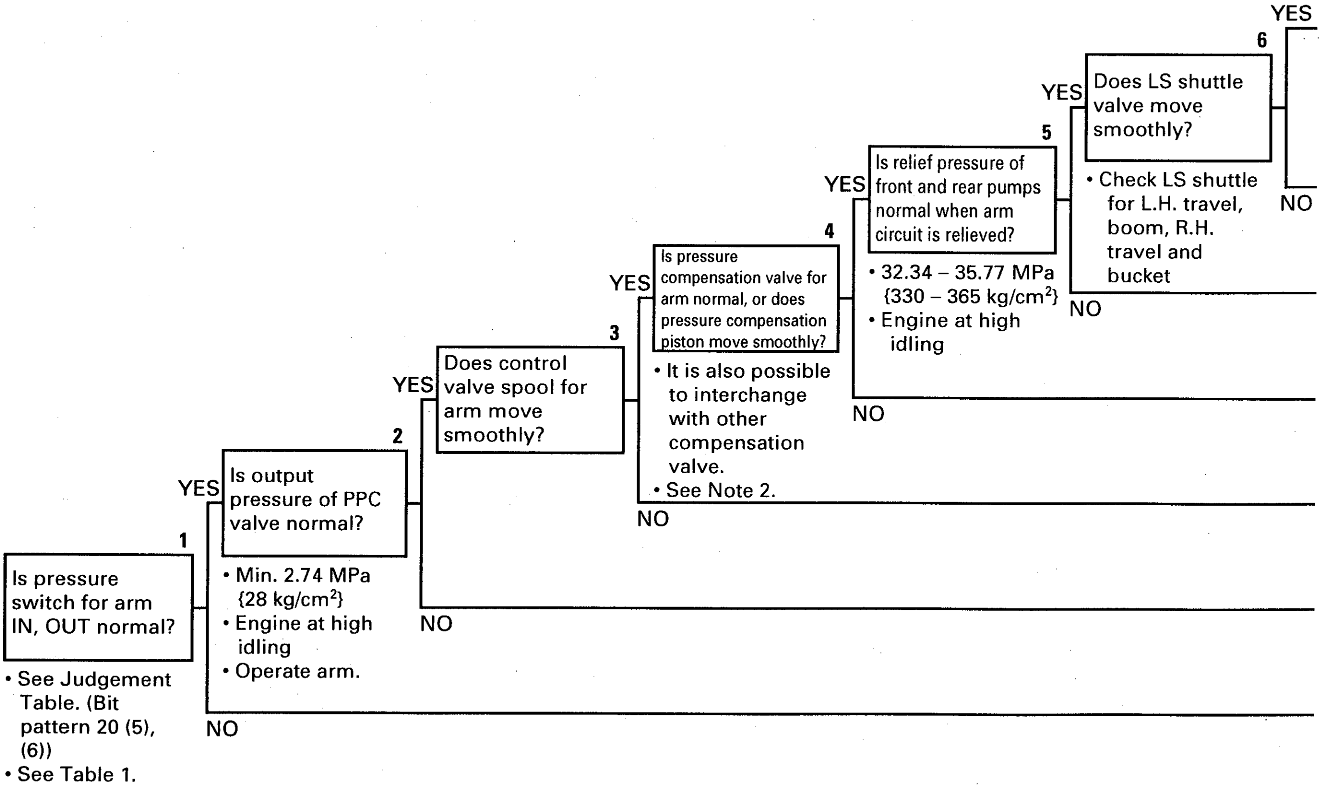
Note 2: After inspection, do not forget to return the interchanged valves to the original position.



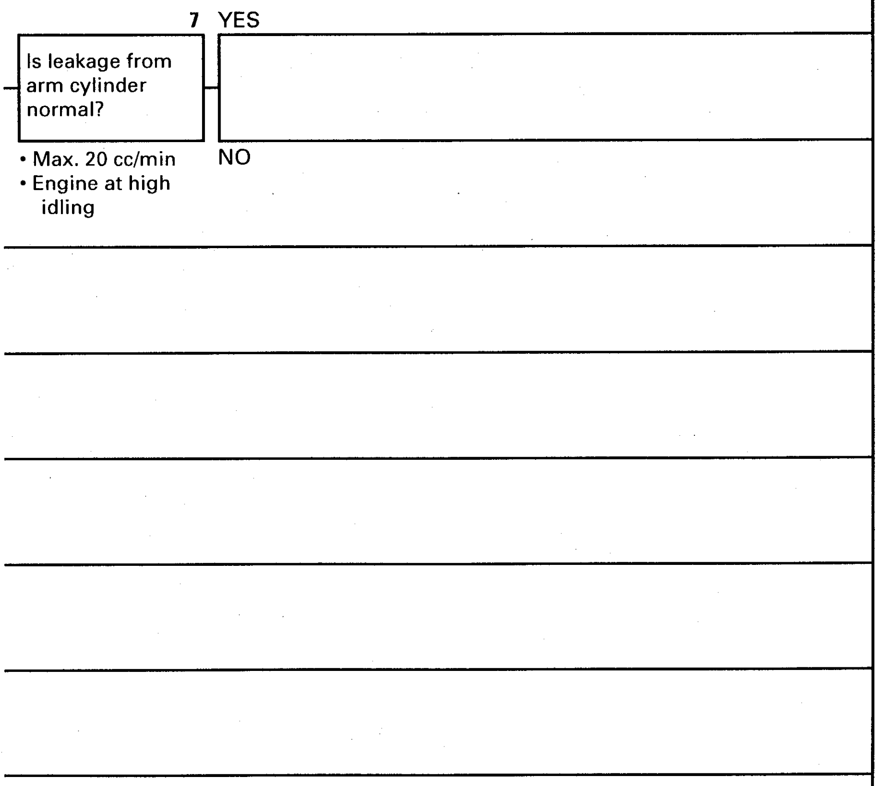
Cause	Remedy
Defective operation of boom lock valve	Repair or replace
Defective boom cylinder piston packing	Repair or replace
Defective operation of LS shuttle valve (LS shuttle for R.H. travel or bucket)	Repair or replace
Defective boom lock valve or suction valve for boom in control valve	Replace
Defective operation of boom lock valve	Repair or replace
Defective operation of boom regeneration valve	Repair or replace
Defective operation of boom pressure compensation valve or pressure compensation piston (for boom RAISE end, check boom Hi also)	Repair or replace
Defective operation of control valve spool (for boom RAISE end, check boom Hi spool also)	Repair or replace
Defective PPC valve	Replace
Defective boom RAISE or boom LOWER pressure switch	Replace

H-8 Arm is slow or lacks power

★ When travel and swing speeds are normal.
★ Carry out troubleshooting in the H/O mode.



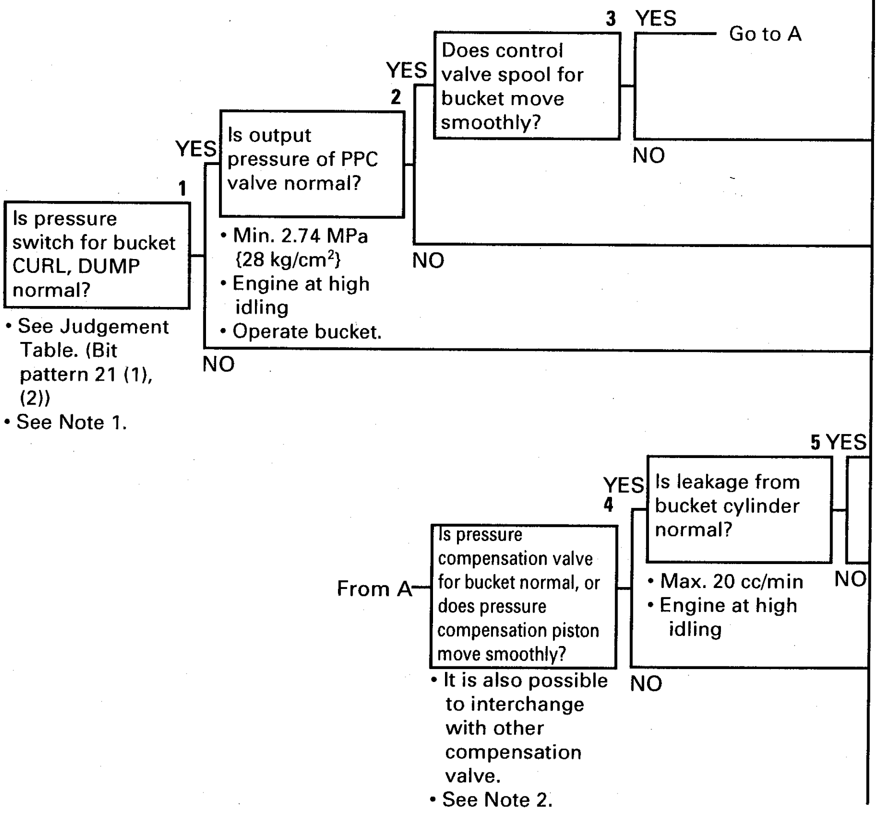
Note 1: If the auto-deceleration is canceled when arm IN or arm OUT is operated, the system is normal.
Note 2: After inspection, do not forget to return the interchanged valves to the original position.



Cause	Remedy
Defective operation of arm regeneration valve	Repair or replace
Defective arm cylinder piston packing	Repair or replace
Defective operation of LS shuttle valve (LS shuttle for L.H. travel, boom, R.H. travel or bucket)	Repair or replace
Defective safety-suction valve for arm	Replace
Defective operation of arm pressure compensation valve or pressure compensation piston (for arm Lo and arm Hi)	Repair or replace
Defective operation of control valve spool (for arm Lo and arm Hi)	Repair or replace
Defective PPC valve	Replace
Defective arm IN or arm OUT pressure switch	Replace

H-9 Bucket is slow or lacks power

★ When travel and swing speeds are normal.

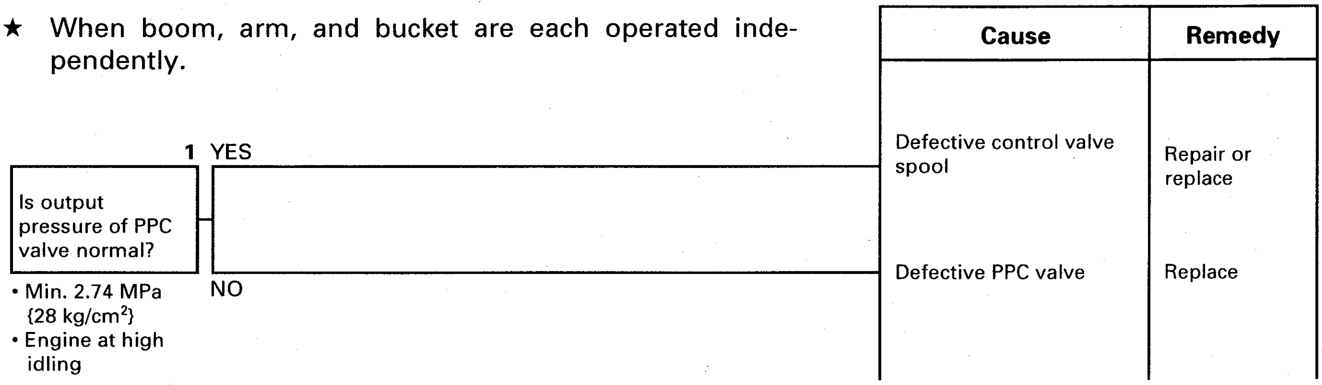


Cause	Remedy
Defective operation of control valve spool for bucket	Repair or replace
Defective PPC valve	Replace
Defective bucket CURL or bucket DUMP pressure switch	Replace
Defective operation of safety-suction valve for bucket	Repair or replace
Defective bucket cylinder piston packing	Repair or replace
Defective operation of pressure compensation valve for bucket or pressure compensation piston	Repair or replace

Note 1: If the auto-deceleration is canceled when bucket CURL or bucket DUMP is operated, the system is normal.
Note 2: After inspection, do not forget to return the interchanged valves to the original position.

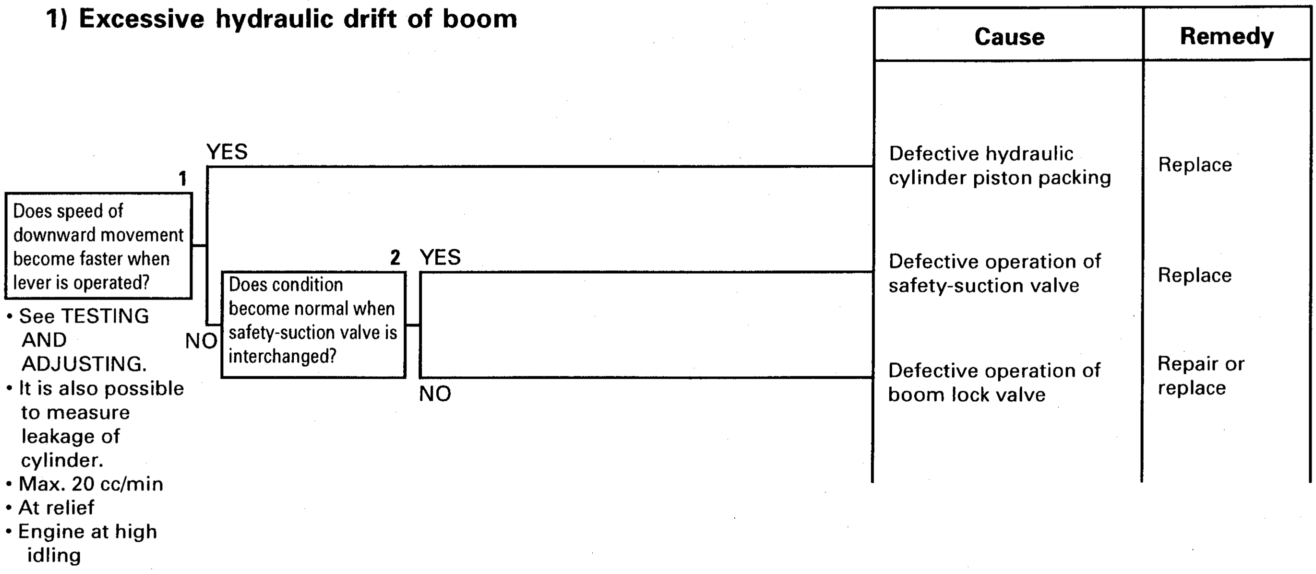
H-10 Work equipment (boom, arm, bucket) does not move (but travel and swing are normal)

★ When boom, arm, and bucket are each operated independently.

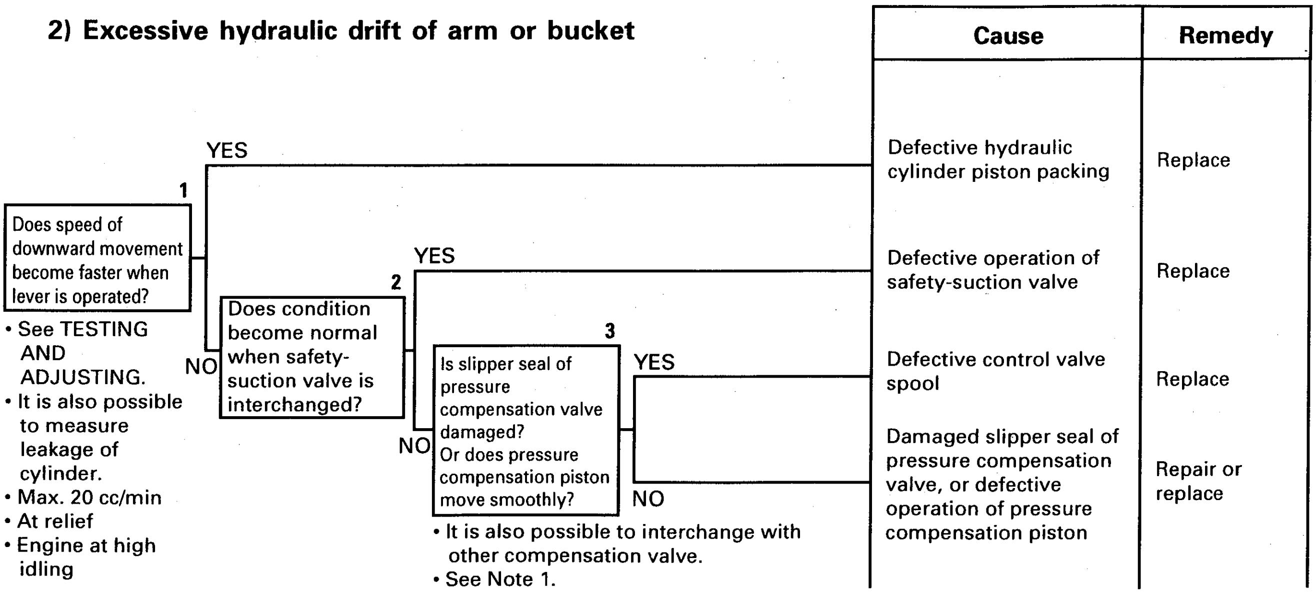


H-11 Excessive hydraulic drift (boom, arm, bucket)

1) Excessive hydraulic drift of boom

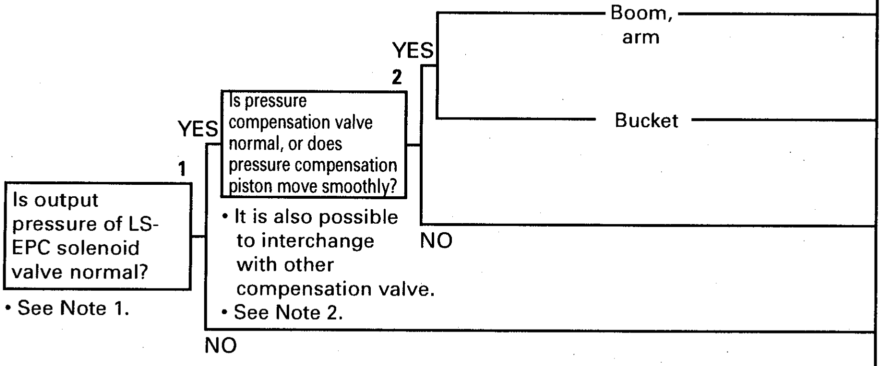


2) Excessive hydraulic drift of arm or bucket



Note 1: After inspection, do not forget to return the interchanged valves to the original position.

H-12 Excessive time lag (engine at low idling)



Cause	Remedy
Defective safety-suction valve, or defective regeneration valve	Replace
Defective safety-suction valve	Replace
Defective operation of pressure compensation valve or pressure compensation piston	Repair or replace
Defective operation of LS-EPC solenoid valve	Repair or replace

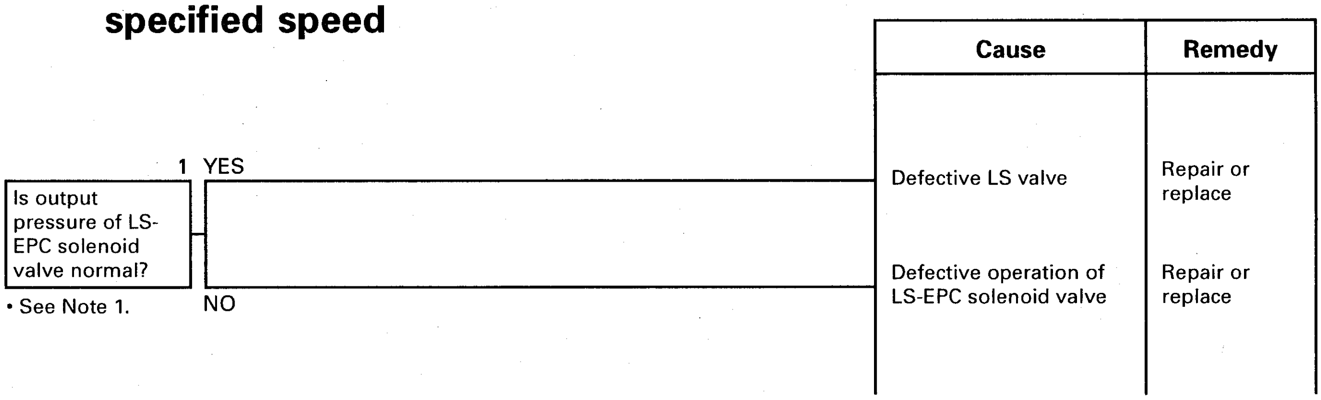
Note 1: Output pressure of LS-EPC solenoid
- 2.94 ± 0.2 MPa {30 ± 2 kg/cm^2} is output from the LS-EPC solenoid when the all lever are at neutral.

Note 2: After inspection, do not forget to return the interchanged valves to the original position.

H-13 Other equipment moves when single circuit is relieved

Cause	Remedy
Defective operation of pressure compensation valve slipper seal (The slipper seal in the pressure compensation valve of the circuit that moved is defective.)	Replace

H-14 In L/O, F/O modes, work equipment speed is faster than specified speed



Note 1: Output pressure of LS control EPC solenoid (travel OFF)

- 2.94 ± 0.2 MPa {30 ± 2 kg/cm²} is output from the LS-EPC solenoid when the all lever are at neutral.

H-15 Defective actuation of machine push-up function

★ When electrical system is normal.

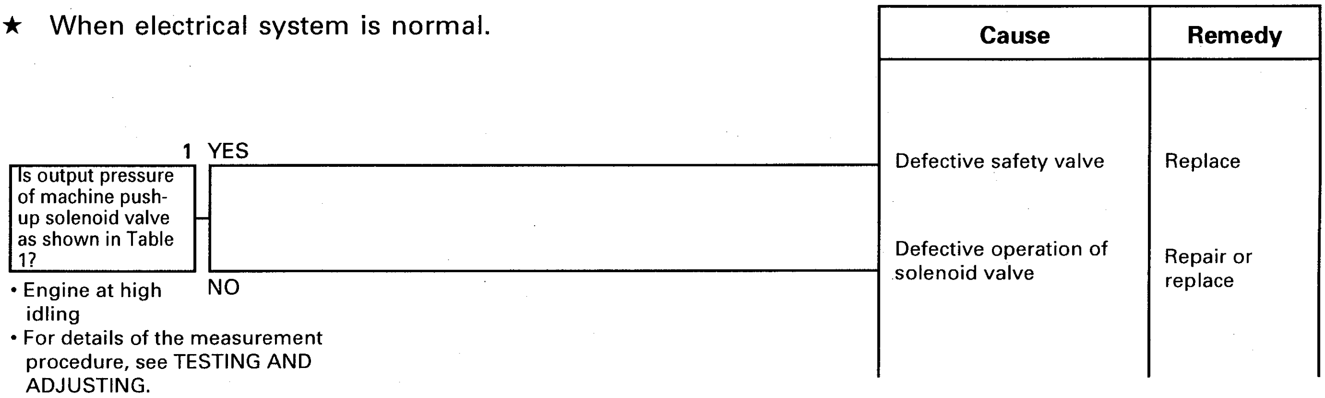


Table 1

Machine push-up switch	Oil pressure (MPa {kg/cm²})
① Low pressure setting	$2.94^{+0.49}_{-0.29}$ {30^{+5}_{-3}}
② High pressure setting	0 {0}

H-16 In compound operations, work equipment with larger load is slow

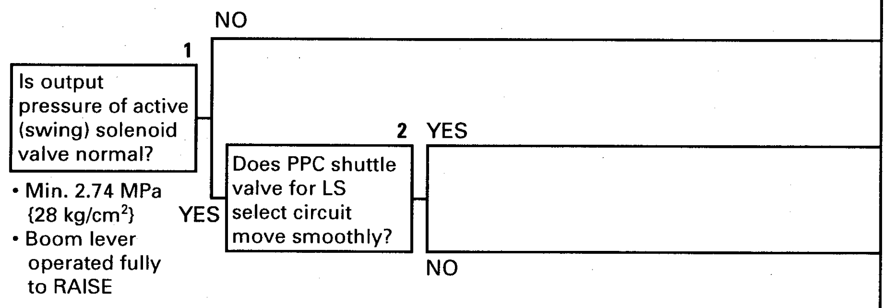
Cause	Remedy
Defective operation of pressure compensation valve	Replace (replace pressure compensation valve on side where load is lower)

	Combination of compound operation	Side where load is larger
1	Boom RAISE + arm IN	Boom RAISE
2	Boom RAISE + arm OUT	Arm OUT
3	Boom RAISE + bucket CURL	Boom RAISE
4	Arm OUT + bucket CURL	Arm OUT
5	Boom LOWER + arm OUT	Arm OUT

H-17 In swing + boom RAISE, boom RAISE is slow

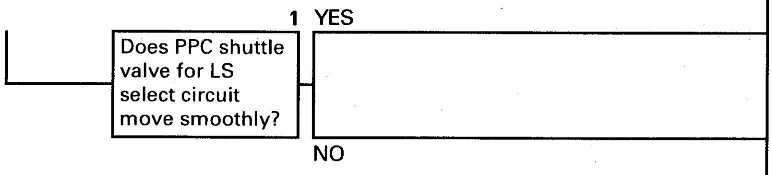
★ If swing and boom RAISE work normally when operated independently.

(1) In active mode



Cause	Remedy
Defective operation of active (swing) solenoid valve	Repair or replace
Defective operation of LS select valve	Repair or replace
Defective operation of PPC shuttle valve for LS select circuit (PPC shuttle for boom RAISE, LS select)	Repair or replace

(2) In other mode



Cause	Remedy
Defective operation of LS select valve	Repair or replace
Defective operation of PPC shuttle valve for LS select circuit (PPC shuttle for boom RAISE, LS select)	Repair or replace

H-18 In swing + arm, arm is slow

★ See H-17.

(If the operation is normal when the swing and arm are operated independently.
If the Cause column shows that there is defective operation of the LS shuttle valve, the cause is in the shuttle valve for the arm OUT, IN and LS select.)

H-19 In swing + travel, travel speed drops excessively

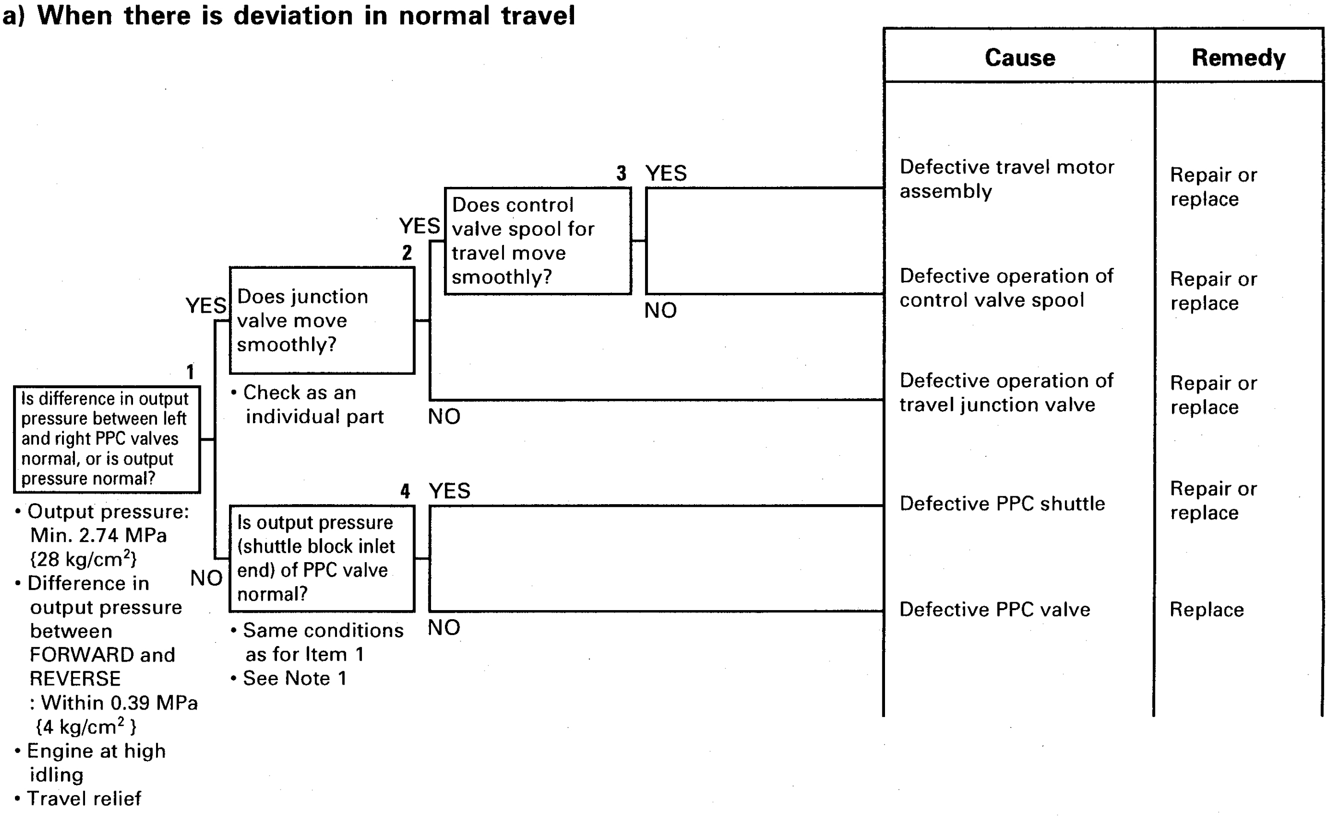
★ See H-17.

(If the operation is normal when the swing and travel are operated independently.
If the Cause column shows that there is defective operation of the PPC shuttle valve, the cause is in the shuttle valve for the LS select.)

H-20 Travel deviation

★ Carry out troubleshooting in the H/O mode.
★ When swing and work equipment speeds are normal.

a) When there is deviation in normal travel



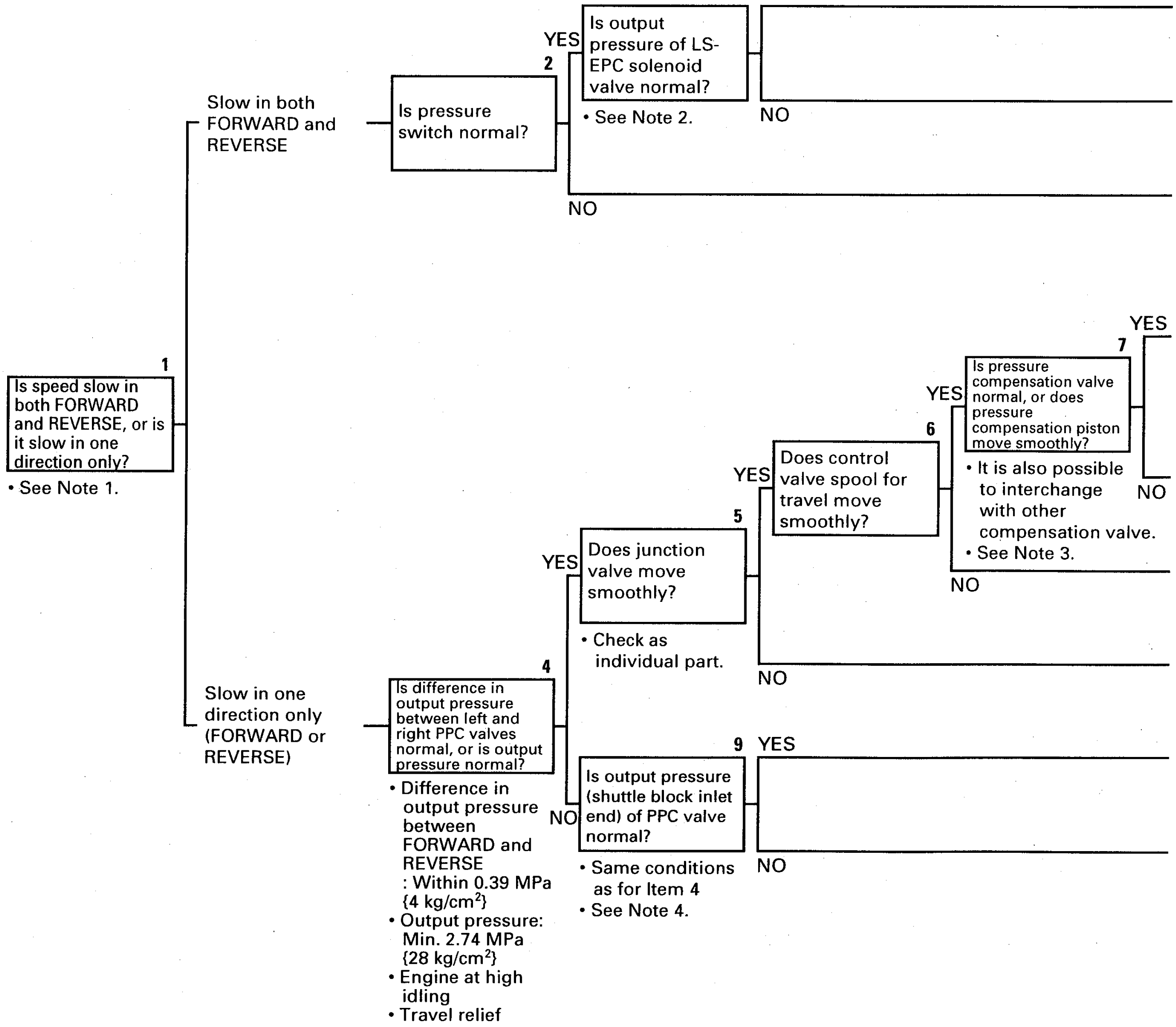
Note 1:
- Remove the PPC shuttle block inlet hose, fit an adapter, and block the tip.
- If the adapter for blocking the circuit is not available, interchange the travel PPC hoses with the PPC hoses for the bucket (CURL, DUMP), boom (LOWER), or arm (IN) at both the inlet and outlet ports of the shuttle block, and check operation.

b) Excessive travel deviation when starting

Cause	Remedy
Defective operation of travel counterbalance valve	Correct or replace
Clogging of throttle inside servo of front or rear pump	Correct or replace

H-21 Travel speed is slow

★ Check that the spool of the travel PPC valve is moving the full stroke before carrying out troubleshooting.
★ Carry out troubleshooting in the H/O mode.
★ When swing and work equipment speeds are normal.

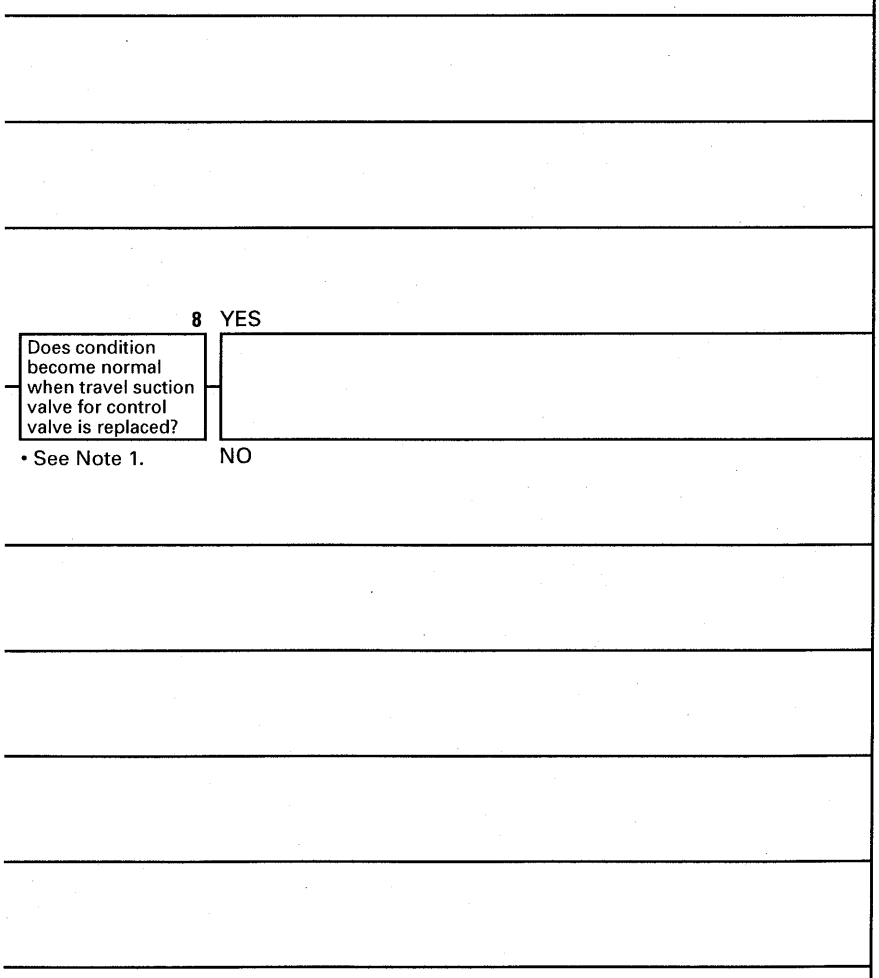


Note 1: • Measure the travel speed under no load or measure the time taken to travel 20 m. (See MAINTENANCE STANDARD FOR CHASSIS RELATED PARTS.)
• When measuring the speed of the travel motor under no load → Remove connector of LS control EPC solenoid, and measure travel speed in Lo and Hi.

Note 2: Output pressure of LS-EPC solenoid

Unit: MPa {kg/cm²}

Travel speed	Lo	Mi	Hi
LS-EPC output pressure	0.2 ± 0.2 {2.0 ± 2.0}	1.8 ± 0.2 {18.4 ± 2.0}	0.2 ± 0.2 {2.0 ± 2.0}
Remarks	• Engine at high idling • Operate travel lever slightly (auto-deceleration cancel position)		



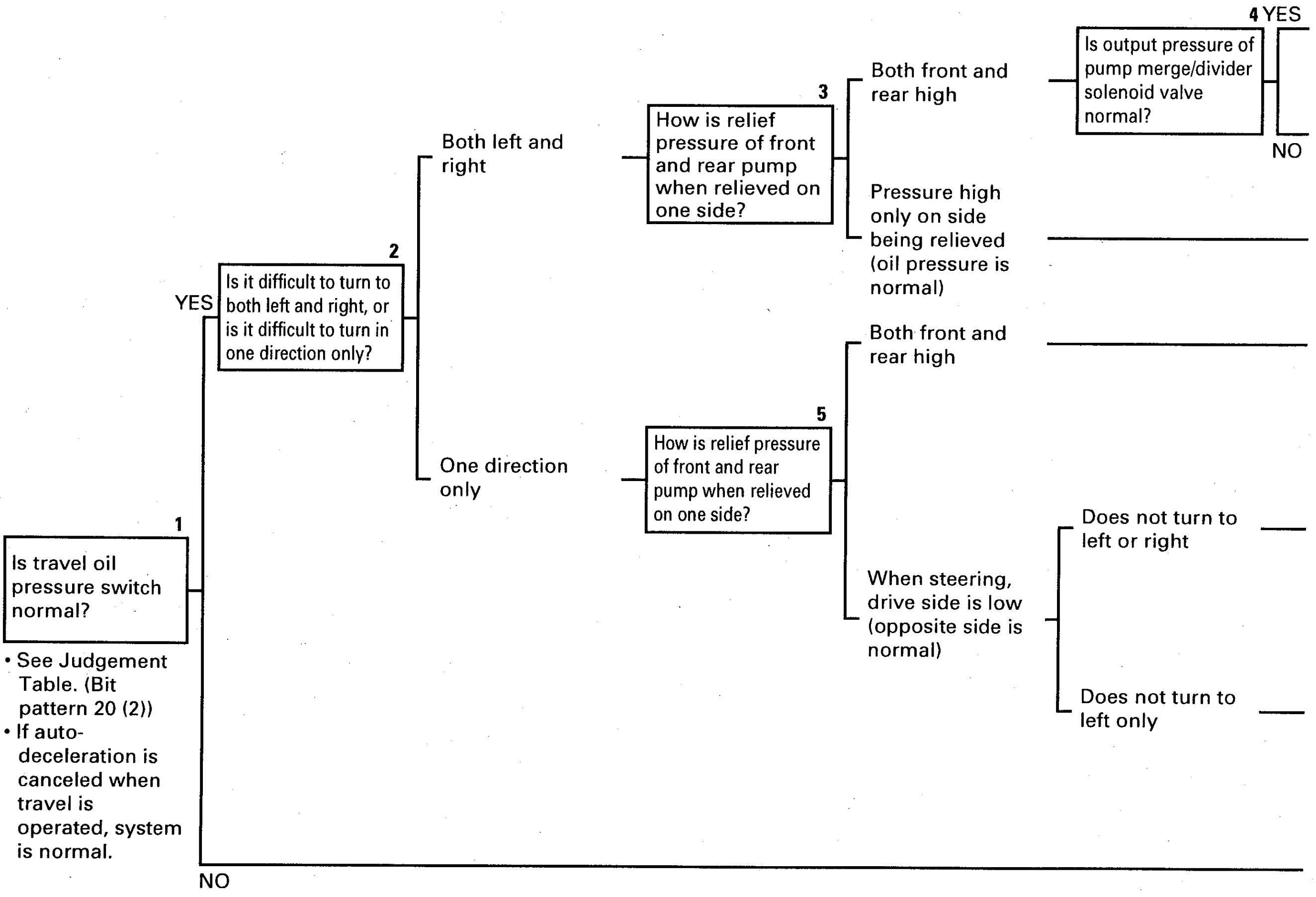
Cause	Remedy
Defective operation of LS shuttle valve (for bucket)	Repair or replace
Defective operation of LS-EPC solenoid valve	Repair or replace
Defective travel pressure switch	Replace
Defective operation of travel suction valve for control valve	Repair or replace
Defective travel motor assembly	Repair or replace
Defective pressure compensation valve, or defective operation of pressure compensation piston	Repair or replace
Defective operation of travel spool for control valve	Repair or replace
Defective operation of junction valve	Repair or replace
Defective PPC shuttle	Repair or replace
Defective PPC valve	Replace

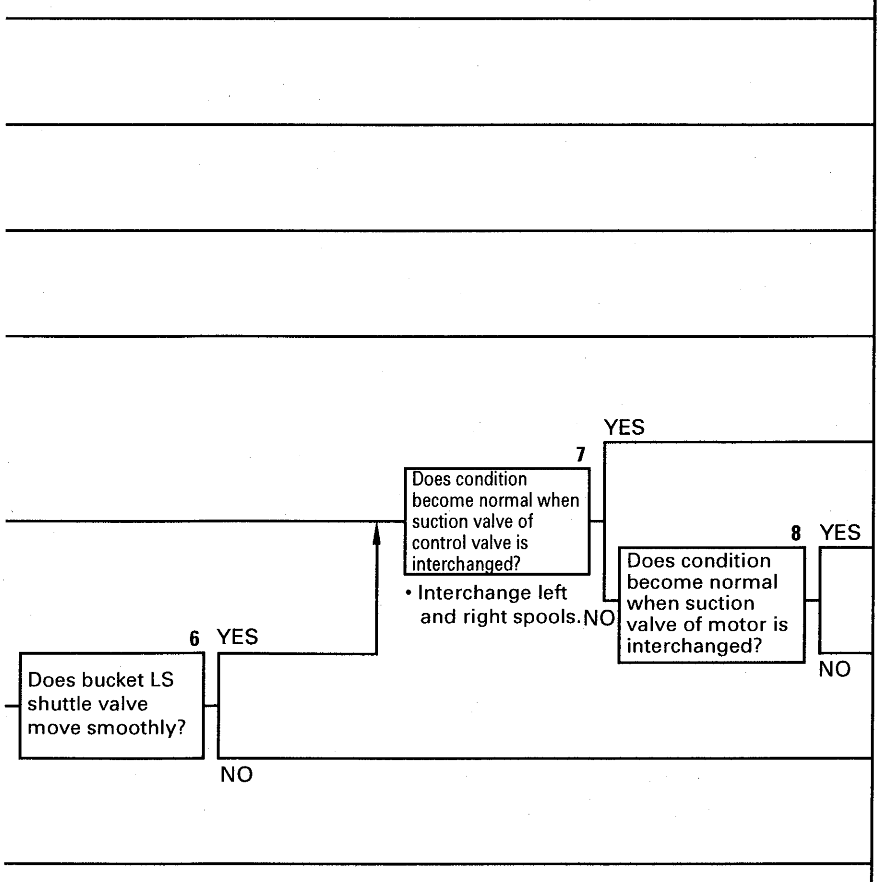
Note 3: After inspection, do not forget to return the interchanged valves to the original position.

Note 4:
- Remove the PPC shuttle block inlet hose, fit an adapter, and block the tip.
- If the adapter for blocking the circuit is not available, interchange the travel PPC hoses with the PPC hoses for the bucket (CURL, DUMP), boom (LOWER), or arm (IN) at both the inlet and outlet ports of the shuttle block, and check operation.

H-22 Steering does not turn easily or lacks power

★ Carry out troubleshooting in the H/O mode.





Cause	Remedy
Defective operation of pump merge/divider valve or LS pump merge/divider valve	Repair or replace
Defective operation of main pump merge/divider solenoid valve	Repair or replace
Defective operation of travel junction valve spool	Repair or replace
Defective operation of LS circuit check valve	Repair or replace
Defective control valve suction valve	Replace
Defective travel motor check valve	Repair or replace
Defective travel motor safety valve	Replace
Defective operation of LS shuttle valve for bucket	Repair or replace
Defective travel pressure switch	Replace

H-23 Travel speed does not switch or is faster than specified speed

★ Carry out troubleshooting in the H/O mode.

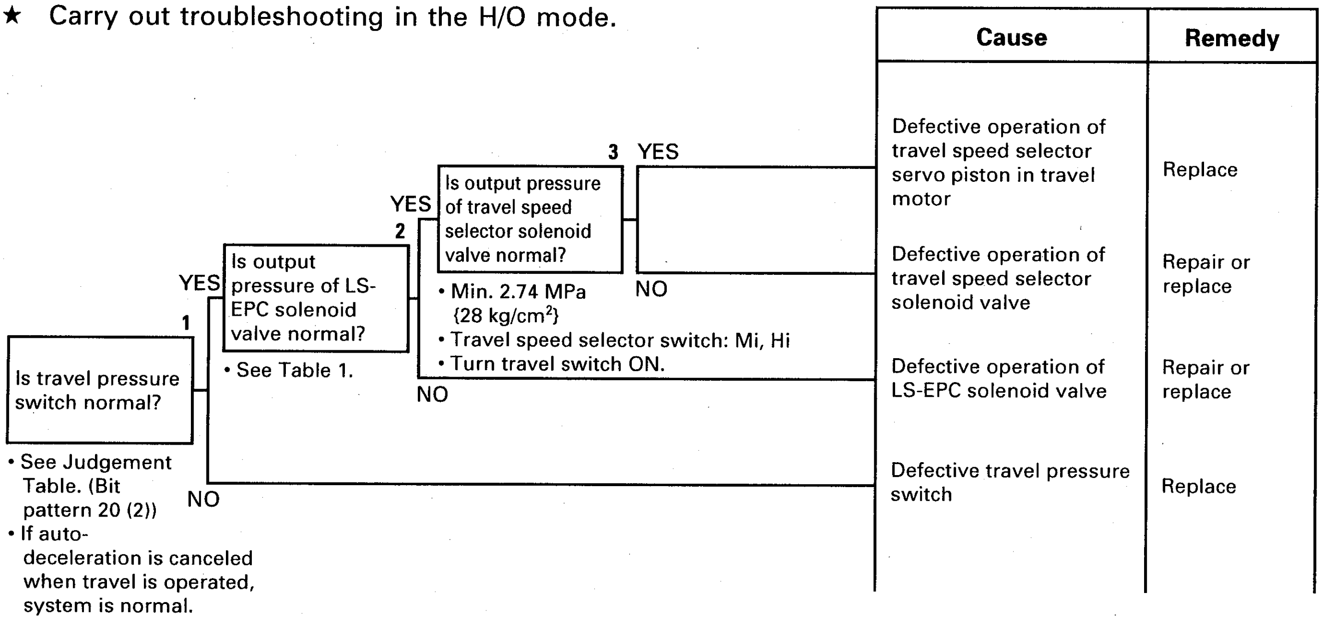
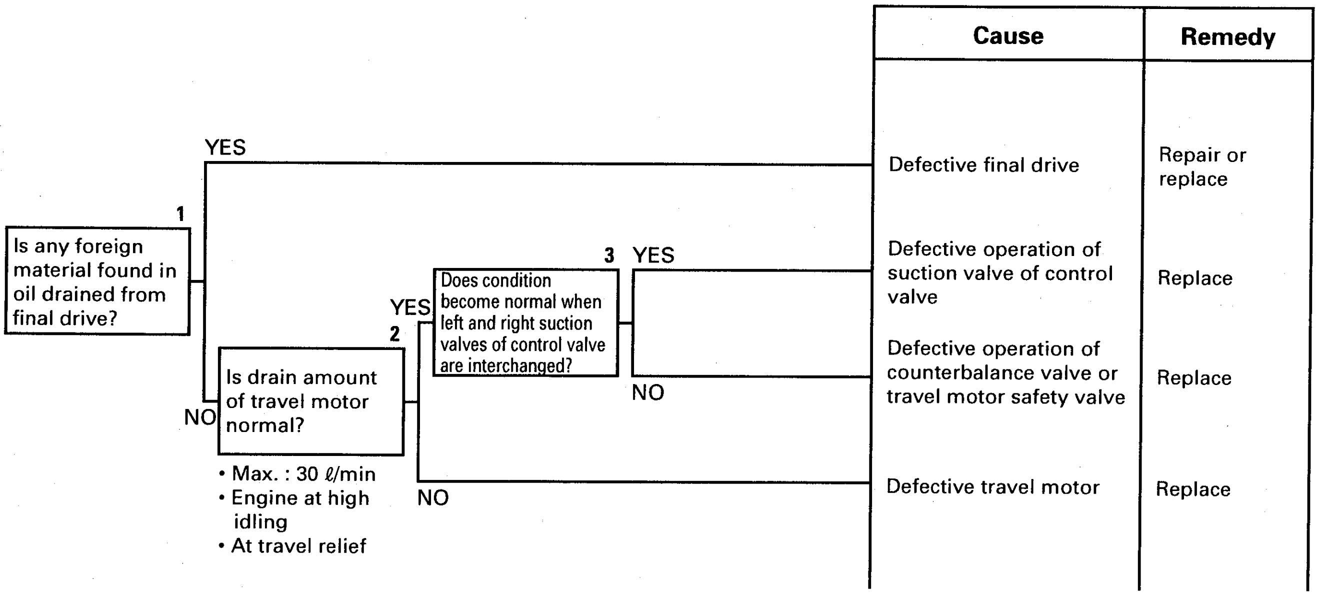


Table 1. Output pressure of LS-EPC solenoid

Unit: MPa {kg/cm²}

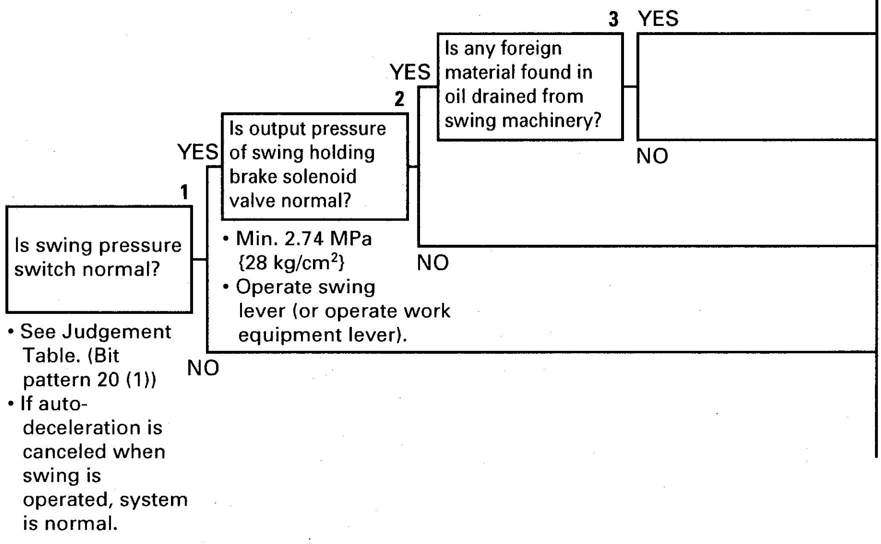
Travel speed	Lo	Mi	Hi
LS-EPC output pressure	0.2 ± 0.2 {2.0 ± 2.0}	1.8 ± 0.2 {18.4 ± 2.0}	0.2 ± 0.2 {2.0 ± 2.0}
Remarks	• Engine at high idling • Operate travel lever slightly (auto-deceleration cancel position)		

H-24 Travel does not move (one side only)



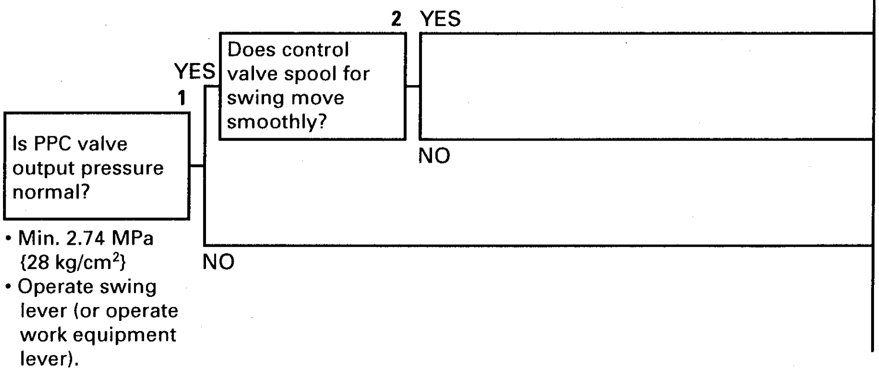
H-25 Does not swing

a) Does not swing to either left or right



Cause	Remedy
Defective swing machinery	Repair or replace
Defective swing holding brake or swing motor	Repair or replace
Defective operation of holding brake solenoid valve	Repair or replace
Defective swing pressure switch	Replace

b) Does not swing in one direction

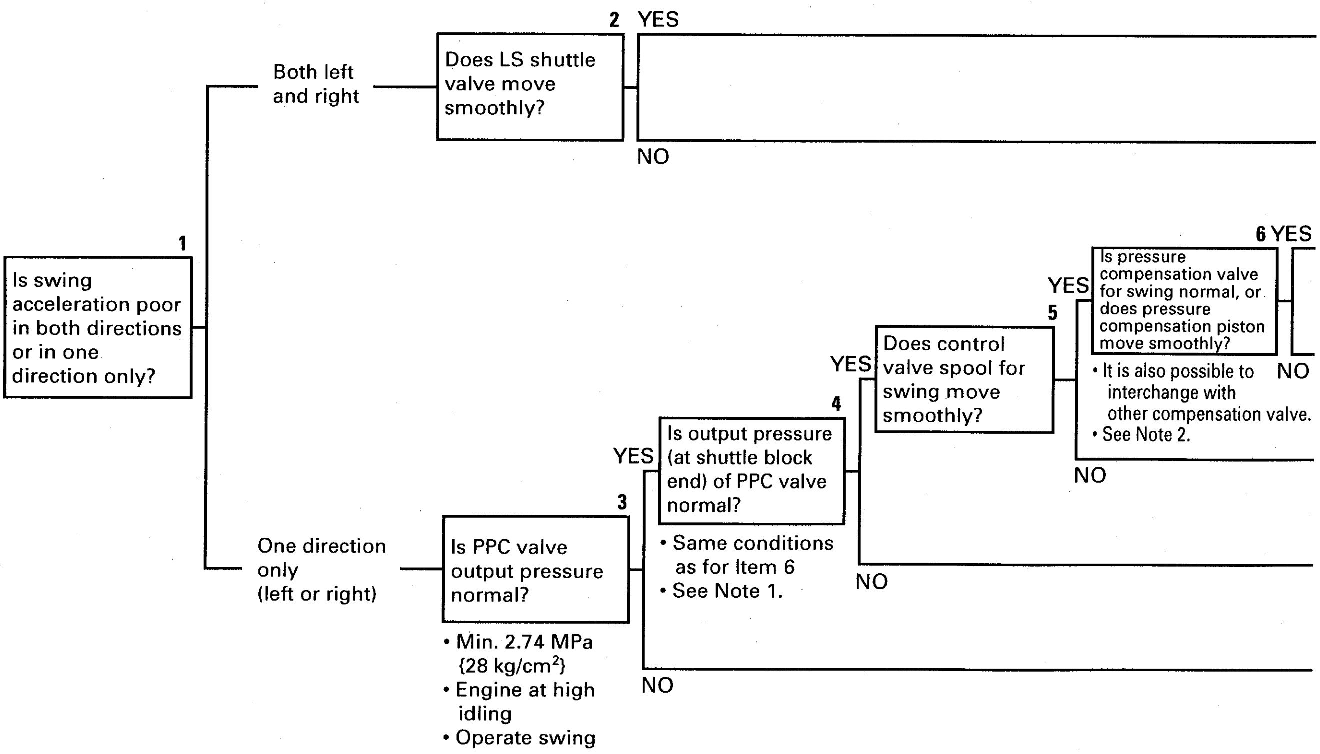


Cause	Remedy
Defective swing motor safety valve or suction valve	Replace
Defective operation of control valve spool for swing	Repair or replace
Defective PPC valve	Replace

H-26 Swing acceleration is poor or swing speed is slow

★ Carry out troubleshooting in the H/O mode.
★ If condition is normal when work equipment is operated independently.

a) Swing acceleration is poor



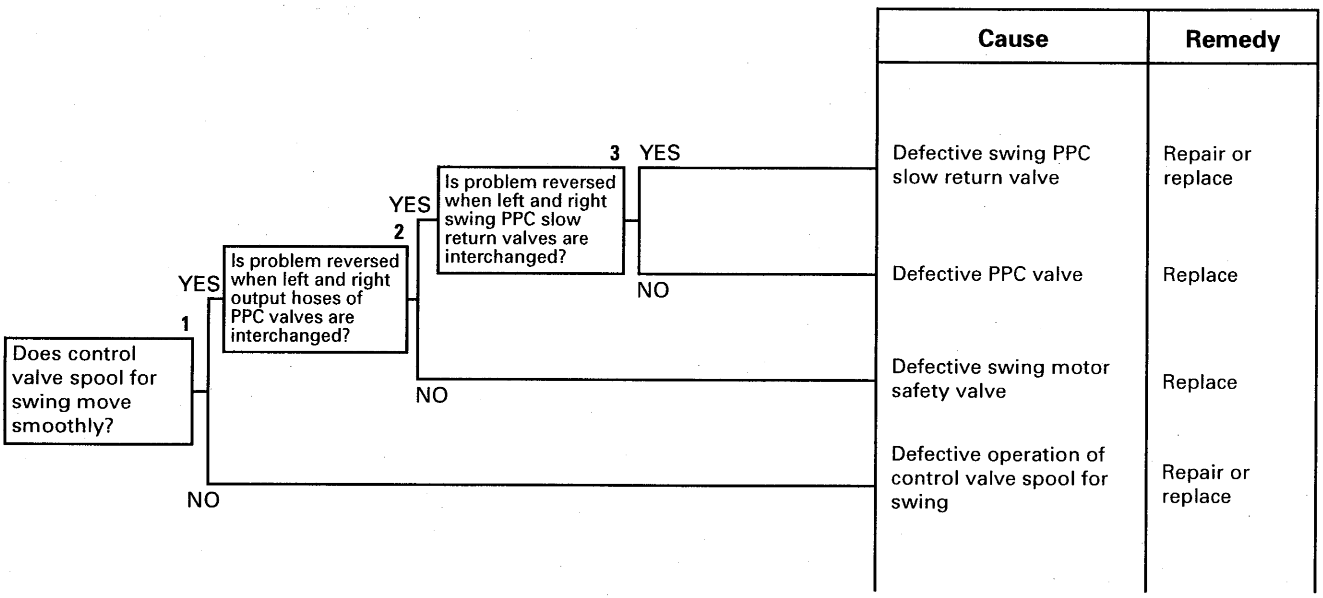
Note 1: • Remove the PPC shuttle block inlet hose, fit an adapter, and block the tip.
- If the adapter for blocking the circuit is not available, interchange the swing PPC hoses with the PPC hoses for the bucket (CURL, DUMP), at both the inlet and outlet ports of the shuttle block, and check operation.

Note 2: After inspection, do not forget to return the interchanged valves to the original position.

Cause	Remedy
Defective swing motor assembly	Replace
Defective operation of LS shuttle valve (all LS shuttles)	Repair or replace
Defective operation of swing motor safety-suction valve	Repair or replace
Defective operation of pressure compensation valve or compensation piston	Repair or replace
Defective operation of control valve spool for swing	Repair or replace
Defective operation of PPC shuttle valve	Repair or replace
Defective PPC valve	Replace

H-27 Excessive overrun when stopping swing

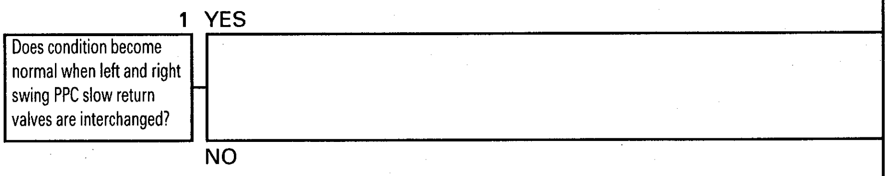
a) One direction only



b) Both directions

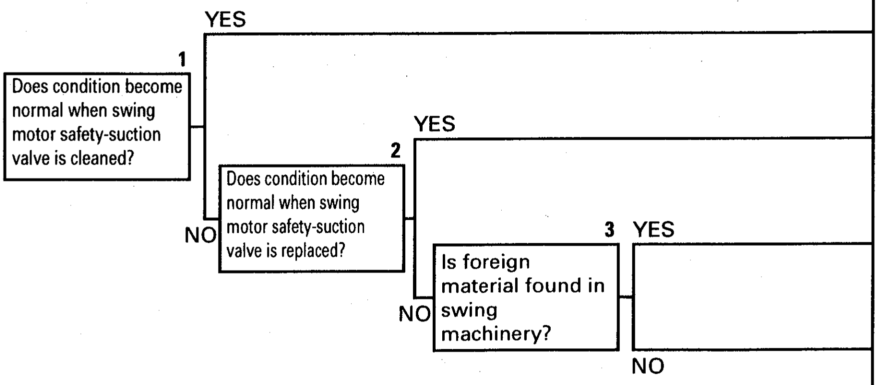
Cause	Remedy
Defective swing motor	Repair or replace

H-28 Excessive shock when stopping swing (one direction only)



Cause	Remedy
Defective swing PPC slow return valve (check valve)	Repair or replace
Defective PPC valve	Replace

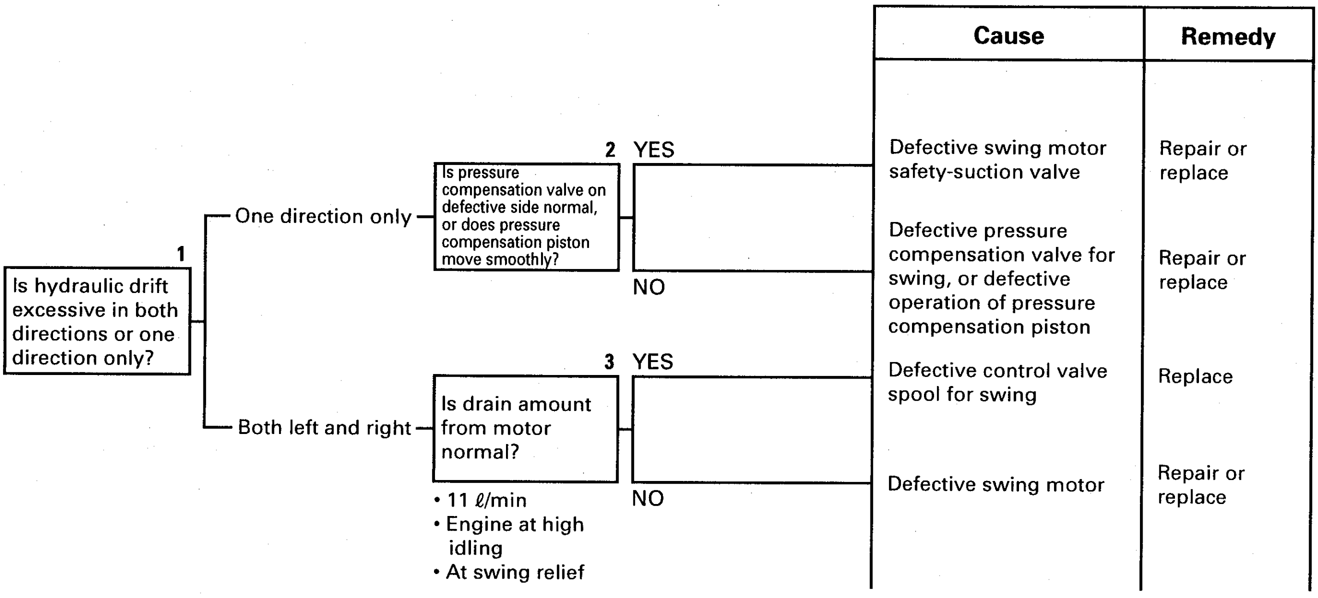
H-29 Excessive abnormal noise when stopping swing



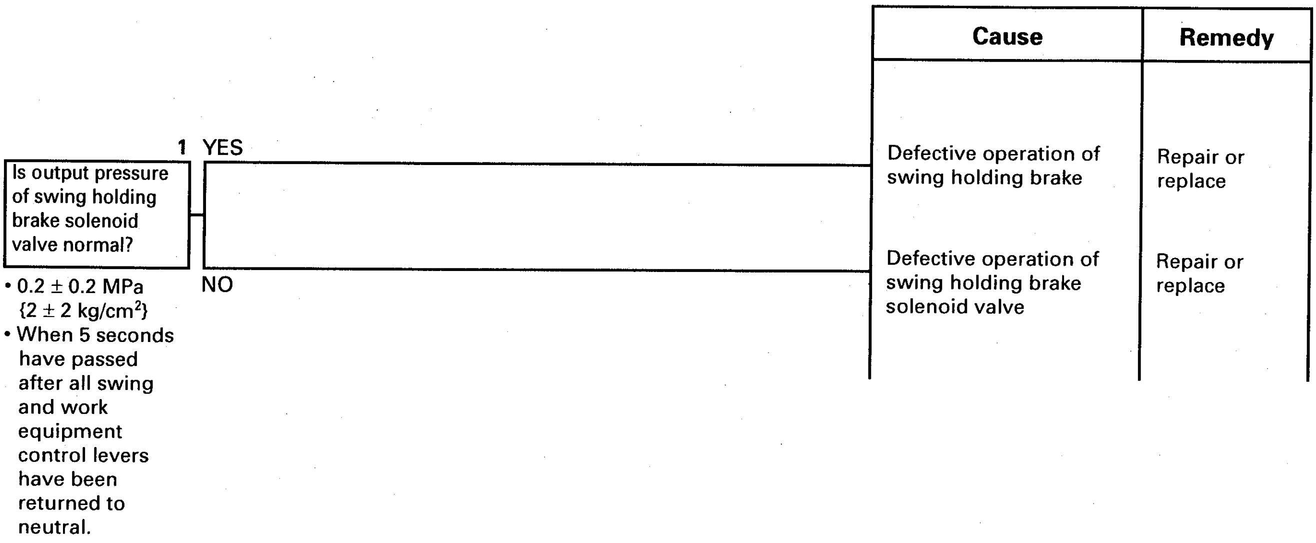
Cause	Remedy
Defective operation of swing motor safety-suction valve	Clean
Defective swing motor safety-suction valve	Replace
Defective swing machinery	Repair or replace
Defective back pressure valve	Repair or replace

H-30 Excessive hydraulic drift of swing

a) When swing holding brake is released



b) When swing holding brake is applied



H-31 Swing speed is faster than specified swing speed

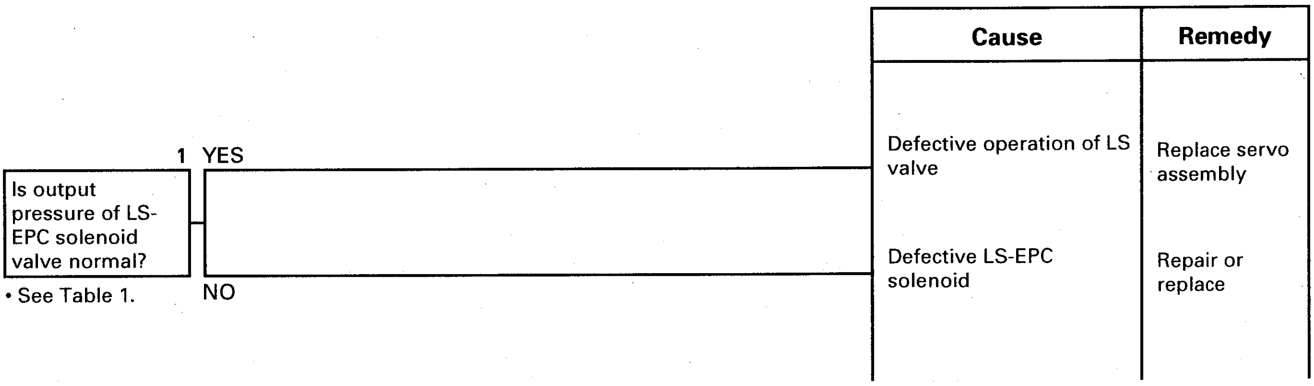


Table 1. Output pressure of LS-EPC solenoid valve

unit: MPa {kg/cm²}

H/O mode	G/O mode	F/O mode	L/O mode
0.2 ± 0.2 {2.0 ± 2.0}	0.2 ± 0.2 {2.0 ± 2.0}	1.51 ± 0.2 {15.4 ± 2.0}	2.17 ± 0.2 {22.0 ± 2.0}
• Engine at high idling • Travel OFF			

TROUBLESHOOTING OF MACHINE MONITOR SYSTEM (M MODE)

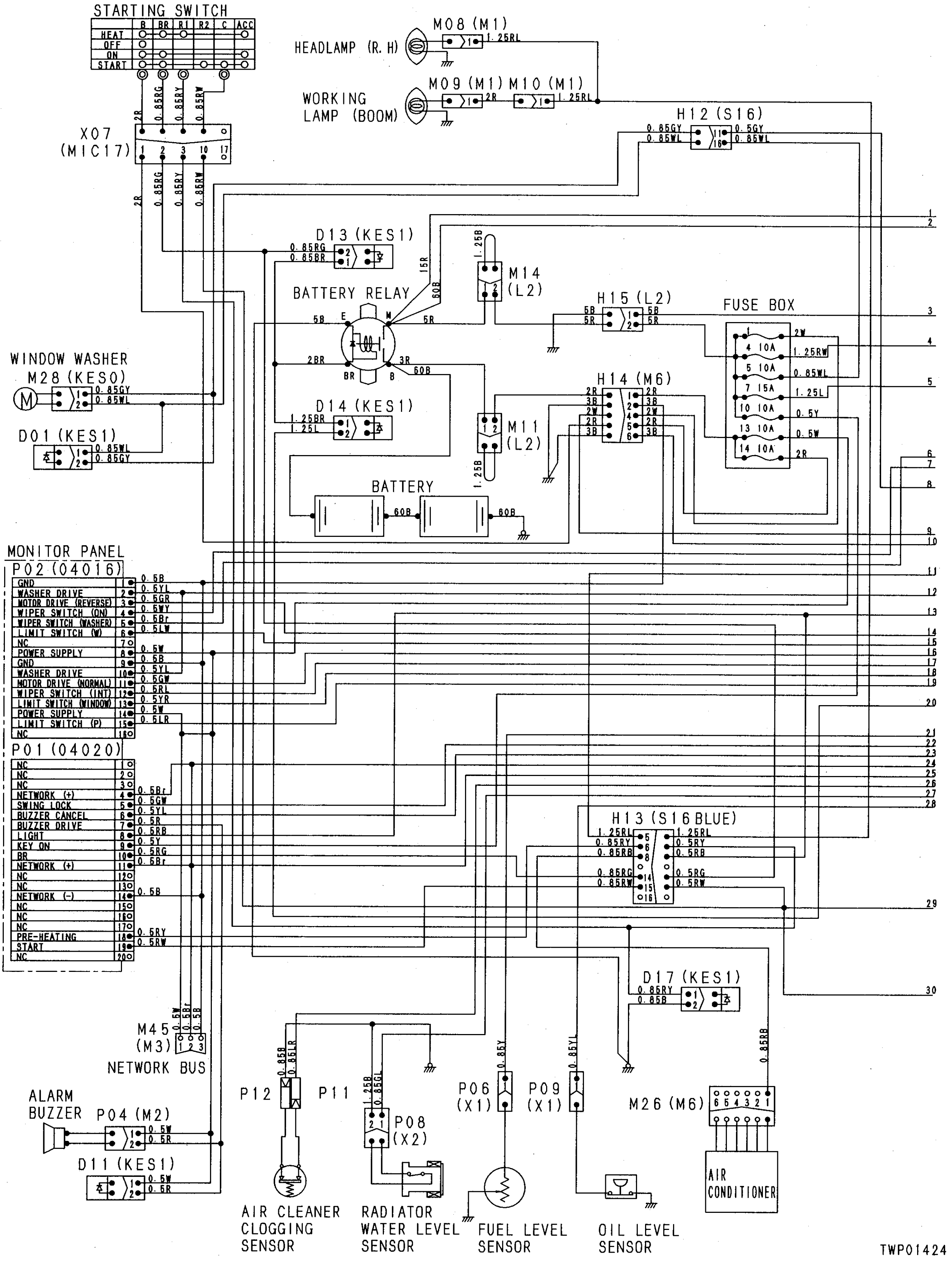
ACTION TAKEN BY MONITOR PANEL WHEN ABNORMALITY OCCURS AND PROBLEMS ON MACHINE

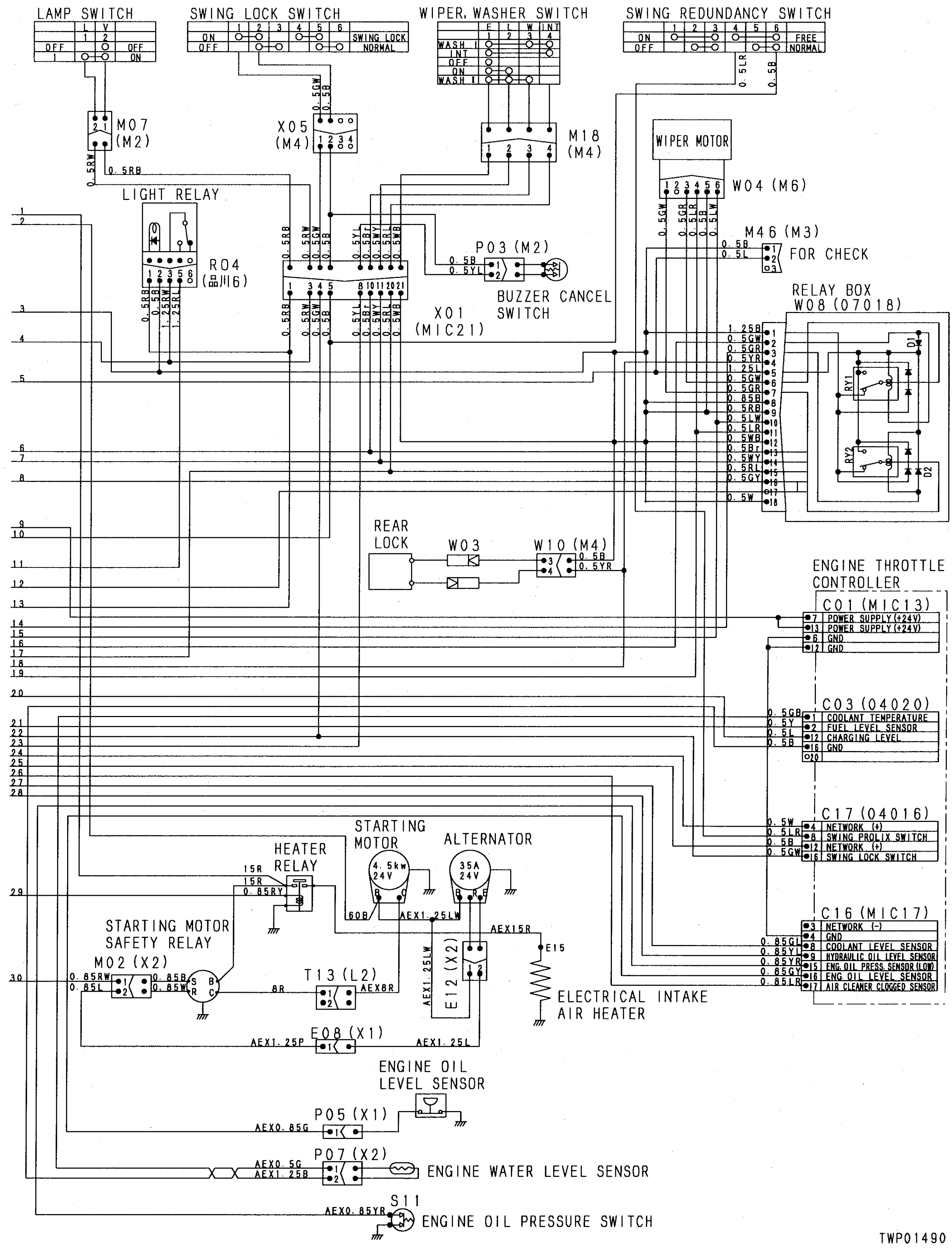
User code	Service code	Abnormal system	Nature of abnormality
—	E101	Abnormality in error data	1. Abnormality in internal memory 2. Excess voltage (more than 36V) has occurred 3. Low voltage (less than 12V) has occurred 4. Connector has separated
—	E102	Abnormality in clock data	1. Abnormality in internal clock function 2. Excess voltage (more than 36V) has occurred 3. Low voltage (less than 12V) has occurred 4. Connector has separated
—	E103	Short circuit in buzzer output system	1. Short circuit inside buzzer 2. Power line in contact with wiring harness between monitor (P01 (7) pin) and buzzer 3. Abnormality in monitor panel
—	E104	Air cleaner clogging detected is displayed	1. Air cleaner clogging sensor has detected clogging
—	E106	Drop in engine oil Hi pressure detected is displayed	1. Engine oil pressure Hi sensor has detected drop in oil pressure
—	E108	Engine water temperature 105°C detected is displayed	1. Coolant temperature gauge has detected water temperature of 105°C
—	E112	Short circuit in wiper motor drive normal rotation system	1. Short circuit with ground, short circuit inside wiper motor 2. Short circuit with ground, short circuit inside relay box 3. Short circuit with ground, short circuit in wiring harness between monitor P02 (11) and relay box W08 (2), or between W08 (6) and wiper motor W04 (3)
—	E113	Short circuit in wiper motor drive reverse rotation system	1. Short circuit with ground, short circuit inside wiper motor 2. Short circuit with ground, short circuit inside relay box 3. Short circuit with ground, short circuit in wiring harness between monitor P02 (3) and relay box W08 (3), or between W08 (7) and wiper motor W04 (1)
—	E114	Short circuit in window washer drive system	1. Short circuit inside washer motor 2. Short circuit inside relay box 3. Short circuit with power source in wiring harness between monitor P02 (2),(10) and relay box W08 (17), or between W08 (16) and M28 (1)

Condition when normal (voltage, current, resistance)	Action by controller when abnormality is detected	Problem that appears on machine when there is abnormality
· When starting switch is turned ON, keep time switch pressed for 5 seconds to actuate clear function	—	1. Service code cannot be cleared 2. Time becomes 00:00.
	—	1. Service code cannot be cleared 2. Time becomes 00:00. 3. Clock does not advance.
· Voltage between P01 (7) – chassis Buzzer ON: Max. 1V Buzzer OFF: 20 – 30V ★ When there is a disconnection, E103 is not displayed and the buzzer does not sound	—	1. Buzzer does not sound
· Resistance between P11 (male) – P12 (male): Min. 1 Ω (engine started)	—	1. If abnormality detection continues, air cleaner clogging caution lamp flashes and buzzer sounds
· Resistance between sensor terminal – chassis 1 MΩ (engine at mid-range speed or above)	—	1. If abnormality detection continues, engine oil pressure caution lamp flashes and buzzer sounds
· Resistance between P07 (1) – (2): Min. 3.156 kΩ (engine started)	—	1. If abnormality detection continues, coolant temperature caution lamp flashes and buzzer sounds 2. If abnormality detection continues, engine speed is reduced to low idling
• Voltage between W04 (3) and (5) : Max. 3 V ↕ 20 – 30 V ★ Repeats in regular cycle	1. Sets output to relay box to 0	1. Operation of wiper stops
• Voltage between W04 (1) and (5) : Max. 3 V ↕ 20 – 30 V ★ Repeats in regular cycle	Same as E112	Same as E112
• Resistance of motor :	1. Sets output to washer motor to 0	1. Operation of window washer stops

ELECTRICAL CIRCUIT DIAGRAM FOR M MODE SYSTEM

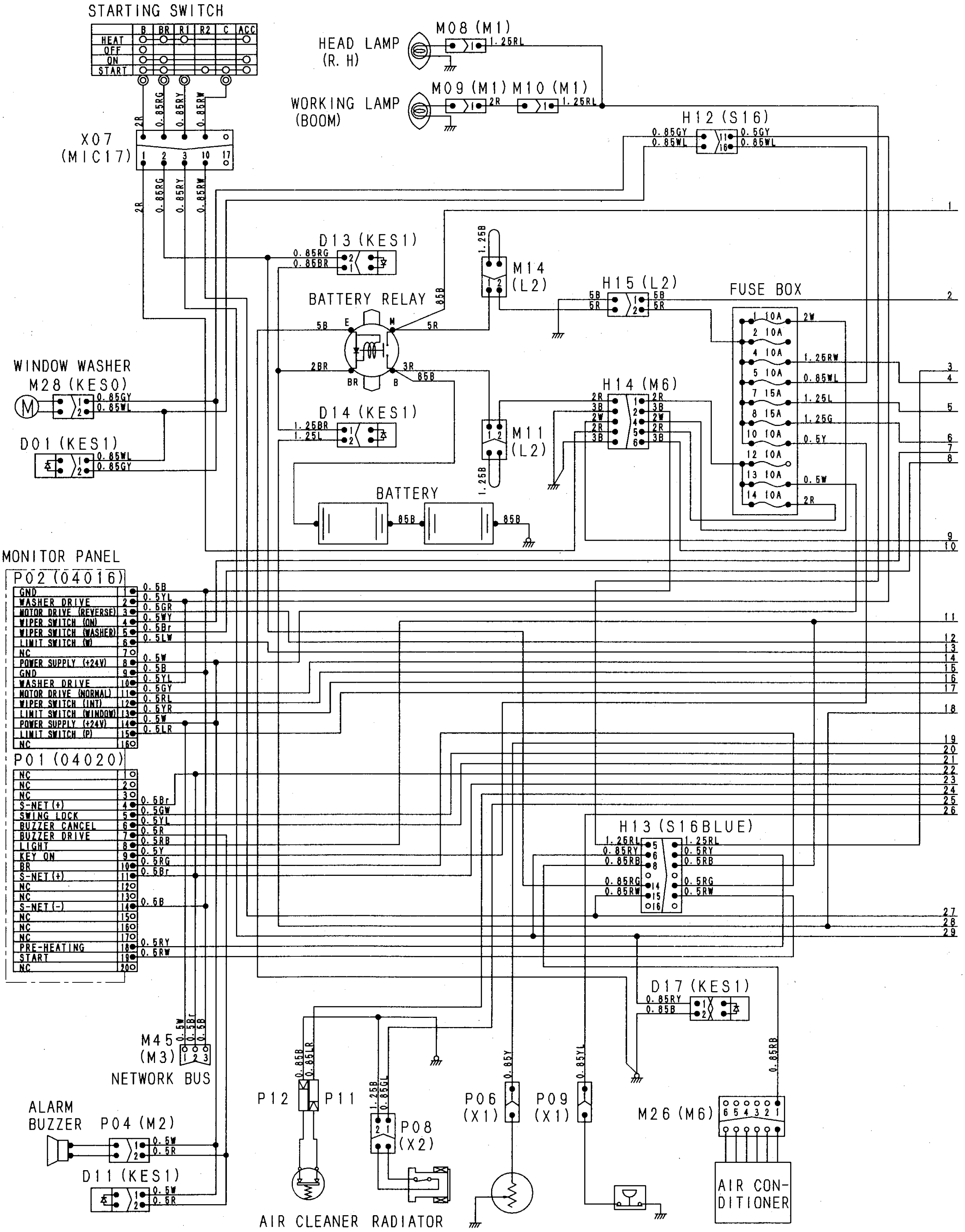
- **WITH POWER WINDOW**



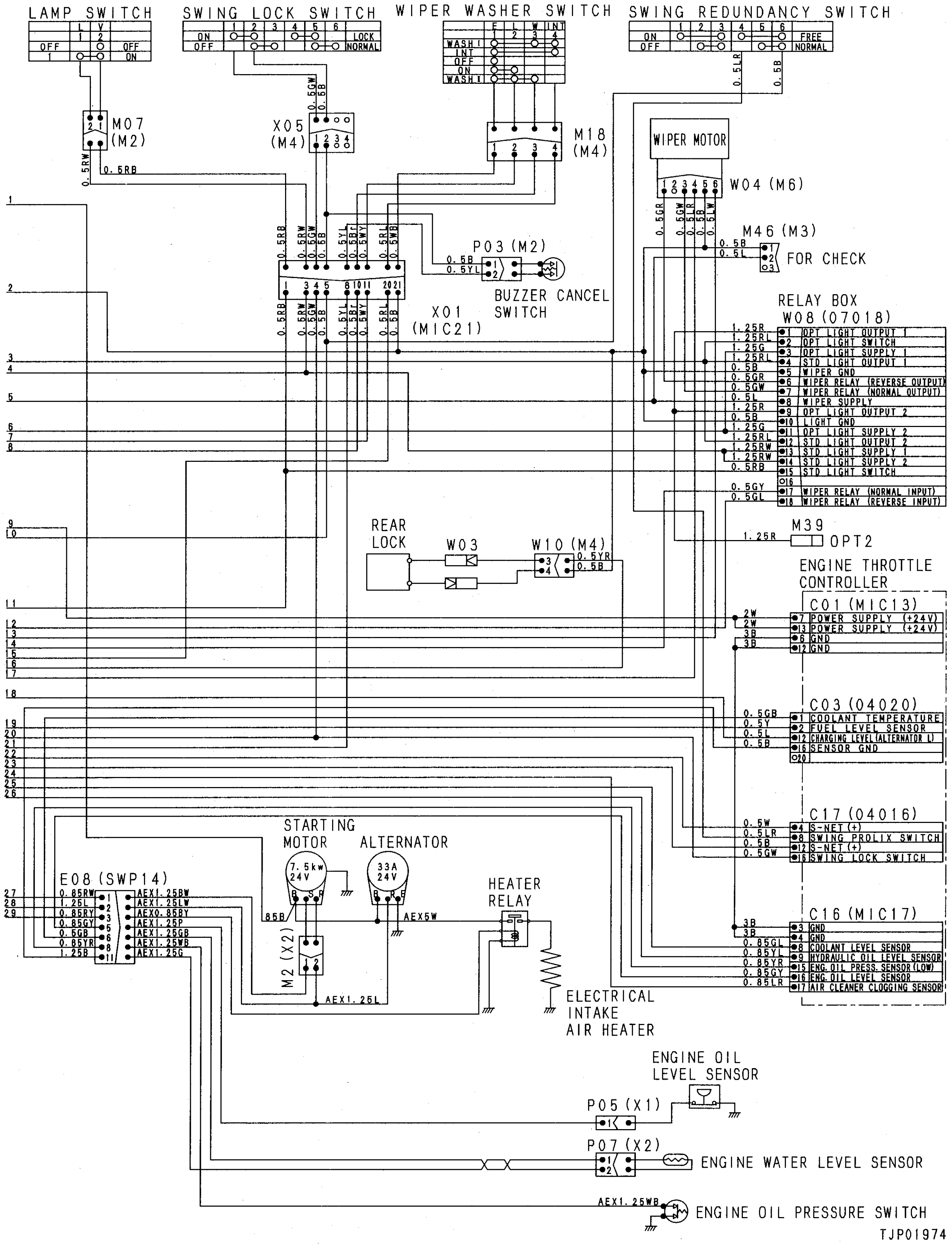

LAMP SWITCH
SWING LOCK SWITCH
WIPER, WASHER SWITCH
SWING REDUNDANCY SWITCH
M07 (M2)
X05 (M4)
M18 (M4)
LIGHT RELAY
R04
WIPER MOTOR
W04 (M6)
M46 (M3)
FOR CHECK
P03 (M2)
BUZZER CANCEL SWITCH
X01 (MIC21)
RELAY BOX
W08 (07018)
RY1
RY2
D1
D2
REAR LOCK
W03
W10 (M4)
ENGINE THROTTLE CONTROLLER
C01 (MIC13)
POWER SUPPLY (+24V)
POWER SUPPLY (+24V)
GND
GND
C03 (04020)
COOLANT TEMPERATURE
FUEL LEVEL SENSOR
CHARGING LEVEL
GND
C17 (04016)
NETWORK (+)
SWING PROLIX SWITCH
NETWORK (+)
SWING LOCK SWITCH
C16 (MIC17)
NETWORK (-)
GND
COOLANT LEVEL SENSOR
HYDRAULIC OIL LEVEL SENSOR
ENG. OIL PRESS. SENSOR (LOW)
ENG. OIL LEVEL SENSOR
AIR CLEANER CLOGGED SENSOR
STARTING MOTOR
4.5kw 24V
ALTERNATOR
35A 24V
HEATER RELAY
STARTING MOTOR SAFETY RELAY
M02 (X2)
T13 (L2)
E12 (X2)
E15
ELECTRICAL INTAKE AIR HEATER
E08 (X1)
ENGINE OIL LEVEL SENSOR
P05 (X1)
P07 (X2)
ENGINE WATER LEVEL SENSOR
S11
ENGINE OIL PRESSURE SWITCH
TWP01490

- **WITHOUT POWER WINDOW**

PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up



TJP01971


LAMP SWITCH
SWING LOCK SWITCH
WIPER WASHER SWITCH
SWING REDUNDANCY SWITCH
OFF
ON
LOCK
NORMAL
FREE
WASH
INT
M07 (M2)
X05 (M4)
M18 (M4)
WIPER MOTOR
W04 (M6)
M46 (M3)
FOR CHECK
P03 (M2)
BUZZER CANCEL SWITCH
X01 (MIC21)
RELAY BOX
W08 (07018)
OPT LIGHT OUTPUT 1
OPT LIGHT SWITCH
OPT LIGHT SUPPLY 1
STD LIGHT OUTPUT 1
WIPER GND
WIPER RELAY (REVERSE OUTPUT)
WIPER RELAY (NORMAL OUTPUT)
WIPER SUPPLY
OPT LIGHT OUTPUT 2
LIGHT GND
OPT LIGHT SUPPLY 2
STD LIGHT OUTPUT 2
STD LIGHT SUPPLY 1
STD LIGHT SUPPLY 2
STD LIGHT SWITCH
WIPER RELAY (NORMAL INPUT)
WIPER RELAY (REVERSE INPUT)
M39
OPT2
REAR LOCK
W03
W10 (M4)
ENGINE THROTTLE CONTROLLER
C01 (MIC13)
POWER SUPPLY (+24V)
GND
C03 (04020)
COOLANT TEMPERATURE
FUEL LEVEL SENSOR
CHARGING LEVEL(ALTERNATOR L)
SENSOR GND
C17 (04016)
S-NET (+)
SWING PROLIX SWITCH
SWING LOCK SWITCH
C16 (MIC17)
COOLANT LEVEL SENSOR
HYDRAULIC OIL LEVEL SENSOR
ENG. OIL PRESS. SENSOR (LOW)
ENG. OIL LEVEL SENSOR
AIR CLEANER CLOGGING SENSOR
STARTING MOTOR
ALTERNATOR
7.5kw 24V
33A 24V
E08 (SWP14)
M2 (X2)
HEATER RELAY
ELECTRICAL INTAKE AIR HEATER
ENGINE OIL LEVEL SENSOR
P05 (X1)
P07 (X2)
ENGINE WATER LEVEL SENSOR
ENGINE OIL PRESSURE SWITCH
TJP01974

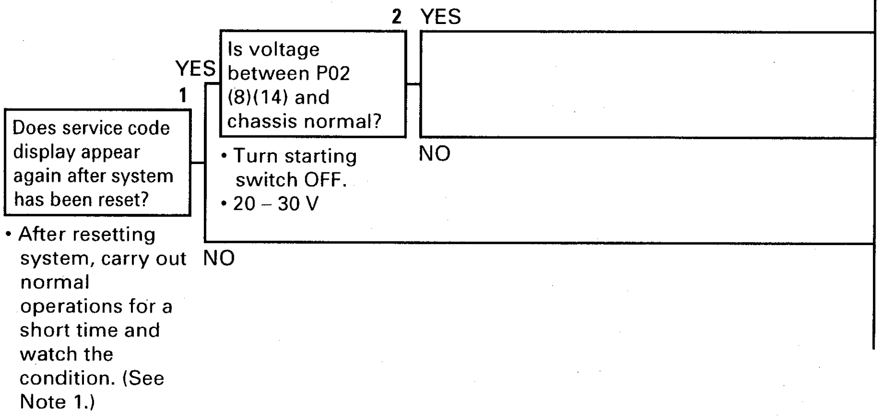
M-1 [E101] Abnormality in error data is displayed
[E102] Error in clock data is displayed

★ This is not an abnormality. It occurs during troubleshooting when disconnecting and connecting connector P02 (for the monitor panel electrical system), fuse No. 13, connector M14, connector M11, battery relay terminal B, or the battery terminal.
(When the monitor panel power source circuit is shut off with the starting switch turned OFF.)

★ If the service code display appears again after the system has been reset, carry out troubleshooting as follows.

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

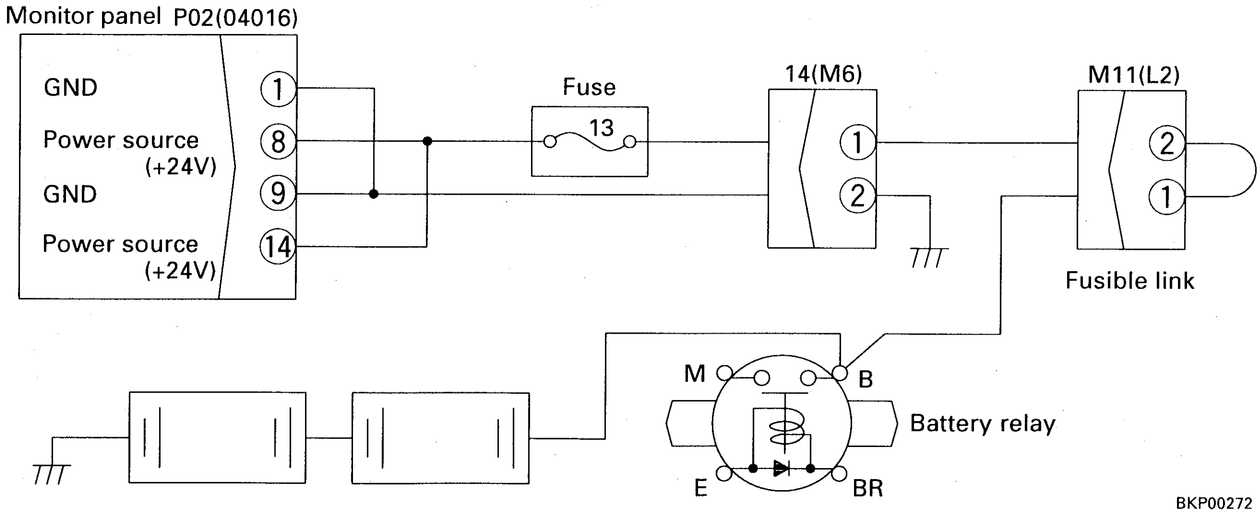
★ Always connect any disconnected connectors before going on the next step.



Cause	Remedy
Defective monitor panel	Replace
Disconnection, defective contact, short circuit with ground in wiring harness between battery – battery relay B – M11 (1)(2) – H14 (1) – fuse No. 13 – P02 (female) (8)(14)	Repair or replace
Normal	—

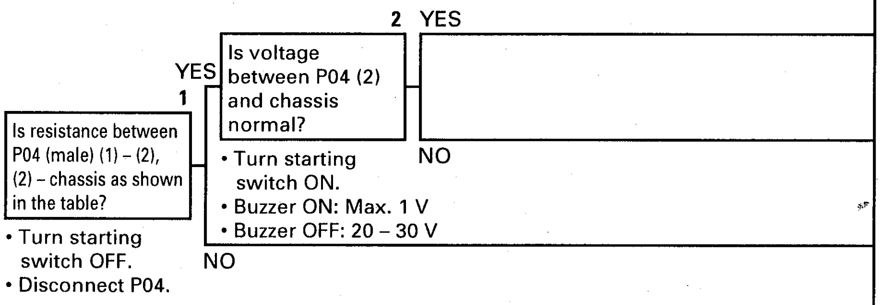
Note 1: Resetting operation:
Turn the starting switch OFF. Then keep the time switch at the back of the monitor panel depressed, switch the starting switch ON again, and keep the time switch depressed for 5 seconds to return the system to normal.
(With this operation, all the service codes in the internal memory are erased.)

M-1 Related electric circuit diagram



M-2 [E103] Short circuit in buzzer output or contact of 24V wiring harness with buzzer drive harness is displayed

★ If the starting switch is turned OFF after an abnormality occurs, turn the starting switch ON and check if an E service code is displayed. (If it is not displayed, the system has been reset.)
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

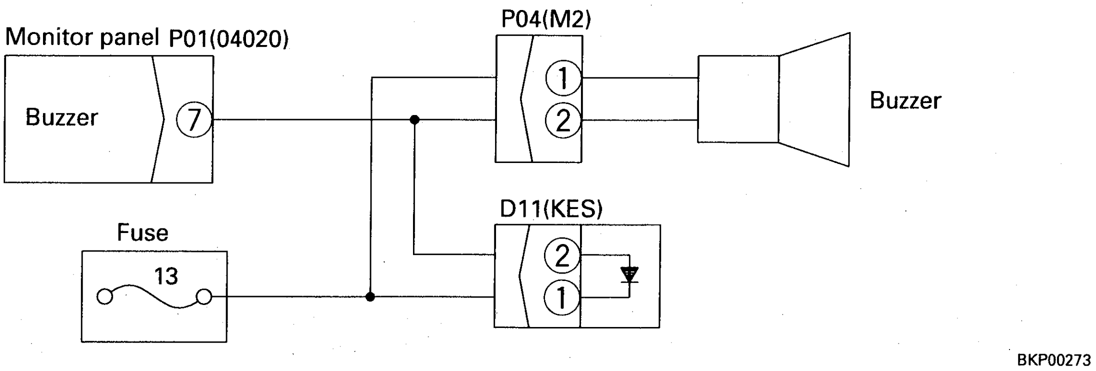


Cause	Remedy
Defective monitor panel	Replace
Short circuit with power source in wiring harness between P01 (female)(7) and P04 (female)(2) or short circuit in wiring harness between P04 (1) and (2)	Repair or replace
Defective buzzer	Replace

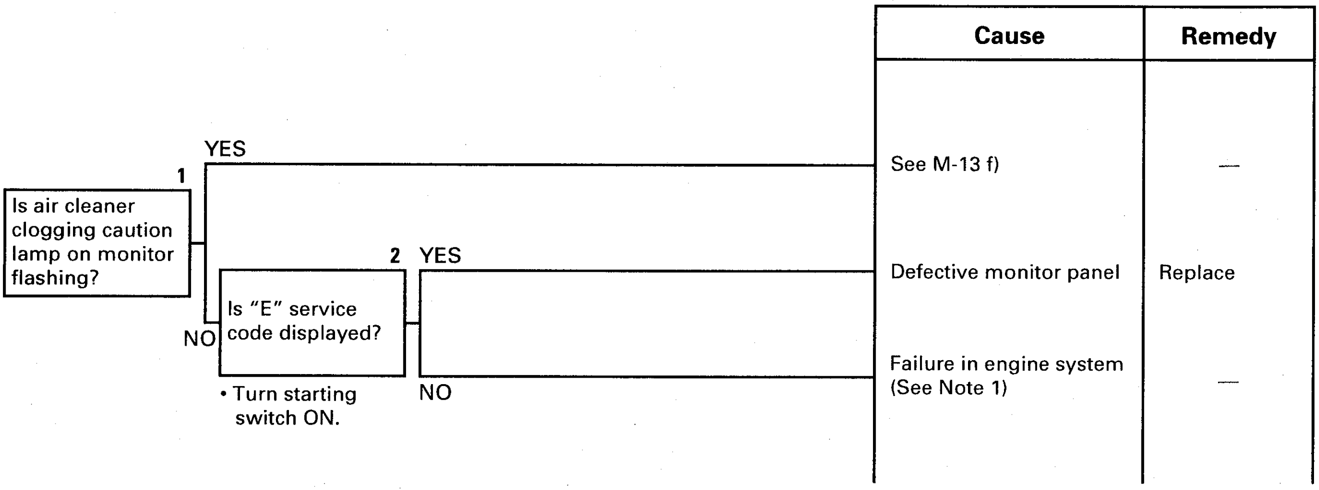
Table

P04 (male)	Resistance value
Between (1) and (2)	200 – 300 Ω
Between (2) and chassis	Min. 1 MΩ

M-2 Related electric circuit diagram

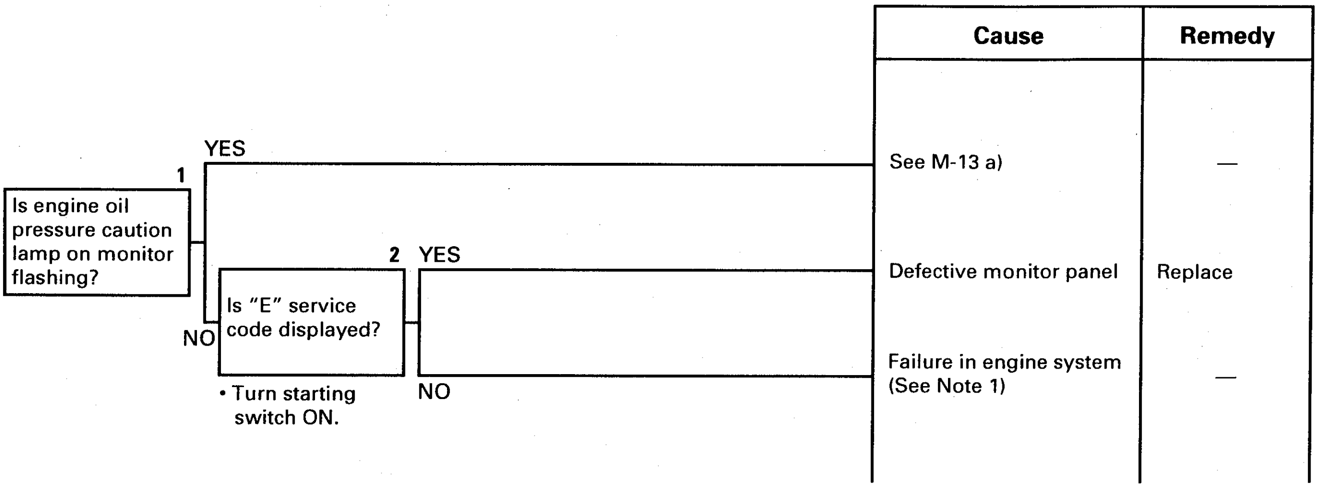


M-3 [E104] Air cleaner clogging detected is displayed



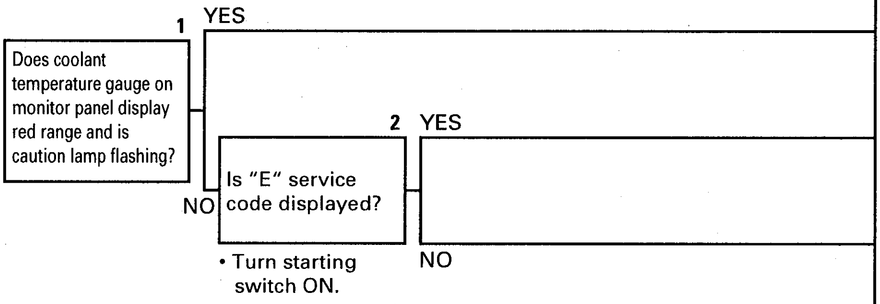
Note 1: The monitor panel display has returned to normal, but the air cleaner clogging sensor has detected symptoms of clogging in the past, so carry out troubleshooting of the engine to remove the problem.

M-4 [E106] Drop in engine oil Hi pressure detected is displayed



Note 1: The monitor panel display has returned to normal, but the engine oil pressure Hi sensor has detected symptoms of a drop in the oil pressure in the past, so carry out troubleshooting of the engine to remove the problem.

M-5 [E108] Engine water temperature 105°C detected is displayed



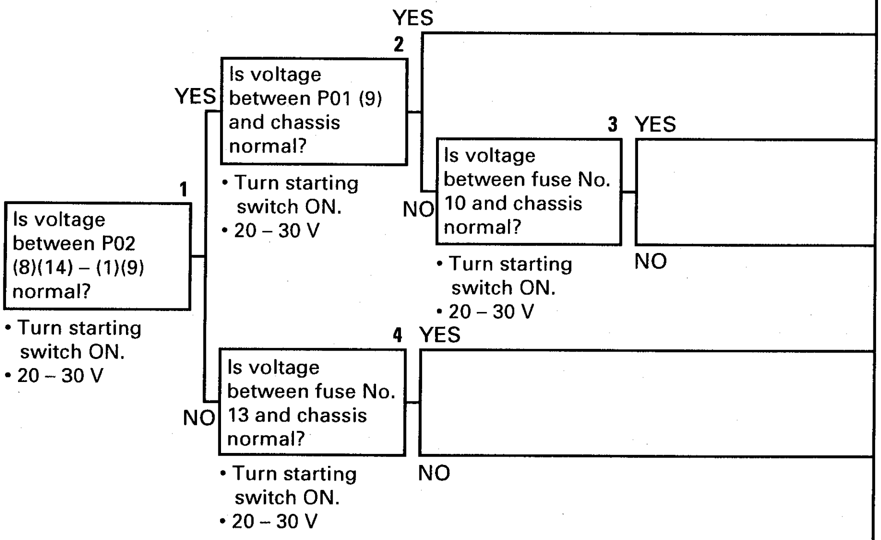
Cause	Remedy
See M-13 d)	—
Defective monitor panel	Replace
Failure in engine system (See Note 1)	

Note 1: The monitor panel display has returned to normal, but the coolant temperature sensor has detected symptoms of the coolant temperature reaching 105°C in the past, so carry out troubleshooting of the engine to remove the problem.

M-6 When starting switch is turned ON, none of lamps on monitor panel light up for 3 seconds

★ Check that fuses No. 10 and 13 are not blown.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.

a) None of lamps on monitor panel light up

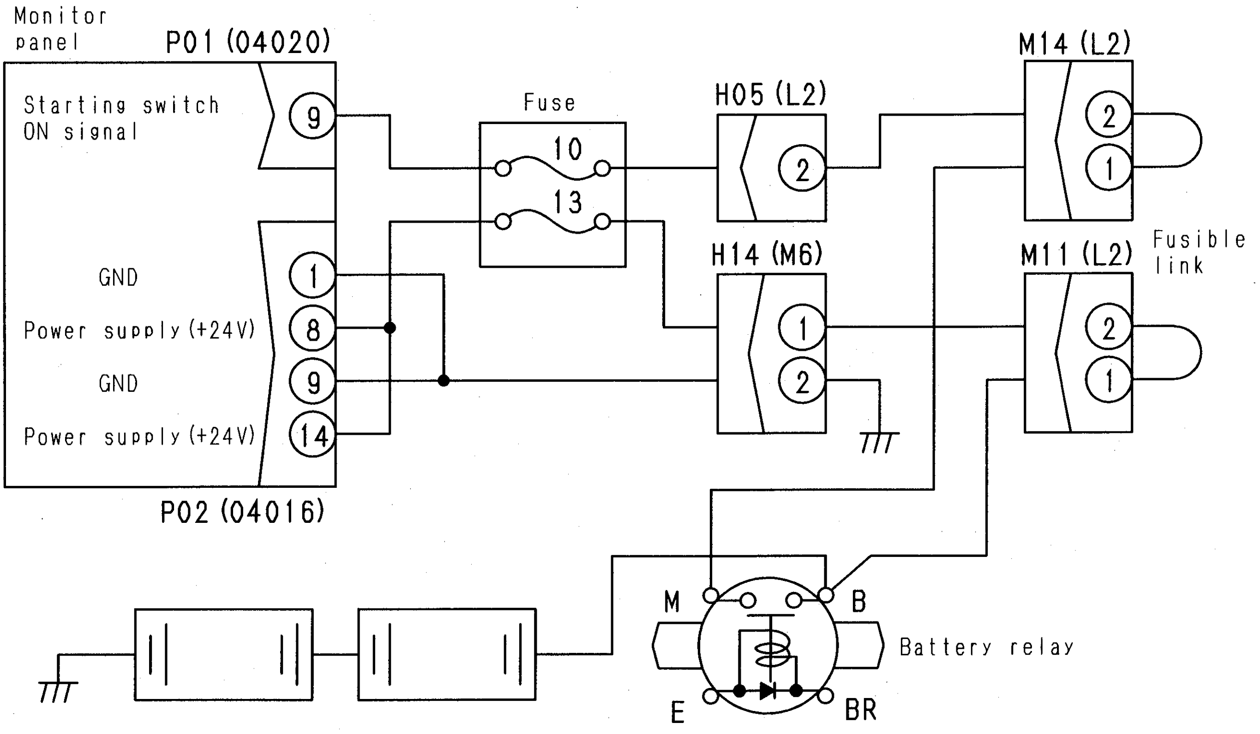


Cause	Remedy
Defective monitor panel	Replace
Disconnection, defective contact, short circuit with ground in wiring harness between P01 (female) (9) and fuse No. 10	Repair or replace
Disconnection, defective contact, short circuit with ground in wiring harness between fuse No. 10 – H05 (2) – M14 (2)(1) – battery relay M	Repair or replace
Disconnection, defective contact, short circuit with ground in wiring harness between P02 (female) (8)(14) and fuse No. 13	Repair or replace
Disconnection, defective contact, short circuit with ground in wiring harness between fuse No. 13 – H14 (2) – M11 (2)(1) – battery relay B	Repair or replace

b) Some of lamps on monitor panel do not light up

Cause	Remedy
Defective monitor panel	Replace

M-6 a) Related electric circuit diagram



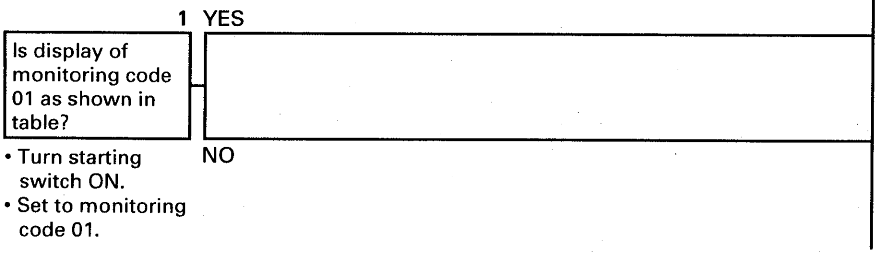
TWP01426

M-7 When starting switch is turned ON, monitor panel lamps all stay lighted up and do not go out

Cause	Remedy
Defective monitor panel	Replace

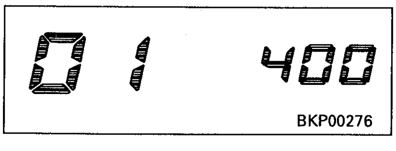
M-8 When starting switch is turned ON, items lighted up on monitor panel are different from actual machine (model)

★ Immediately after replacing the monitor panel, turn the starting switch OFF, then turn it ON again and check.



Cause	Remedy
Defective monitor panel	Replace
Go to troubleshooting for C mode (See C-14)	—

Table



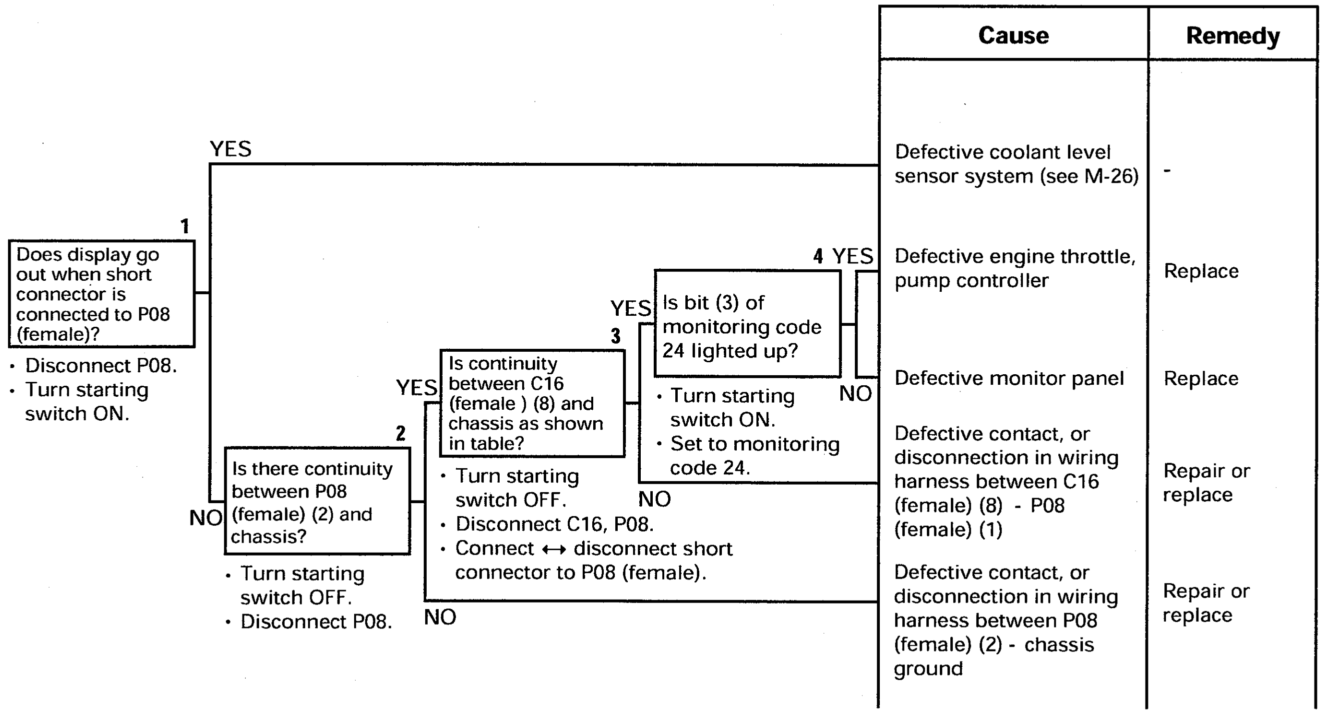
M-9 When starting switch is turned ON (engine stopped), basic check items flash

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

a) (coolant level) flashes

SAP00519

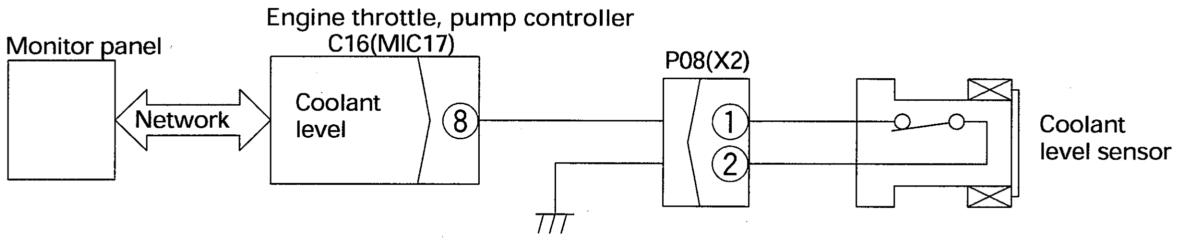
★ Check that the coolant is at the specified level before carrying out troubleshooting.



Table

Short connector	Continuity
Connected	Yes
Disconnected	No

M-9 a) Related electric circuit diagram

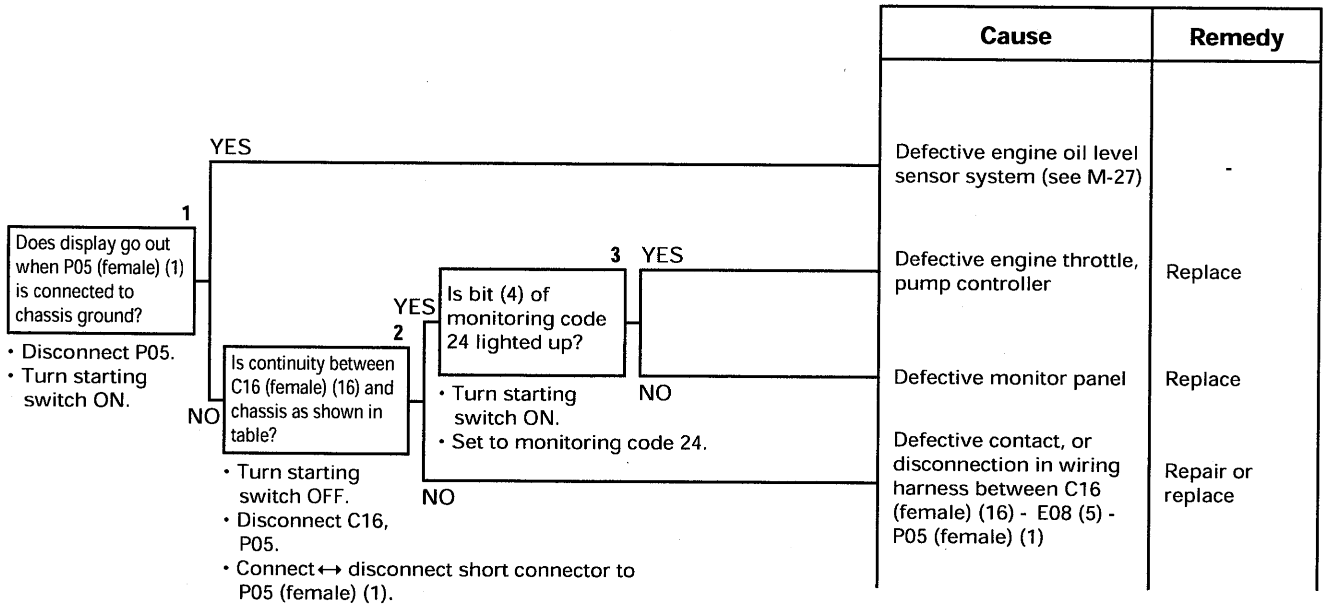


BKP00277

b) (engine oil level) flashes

SAP00523

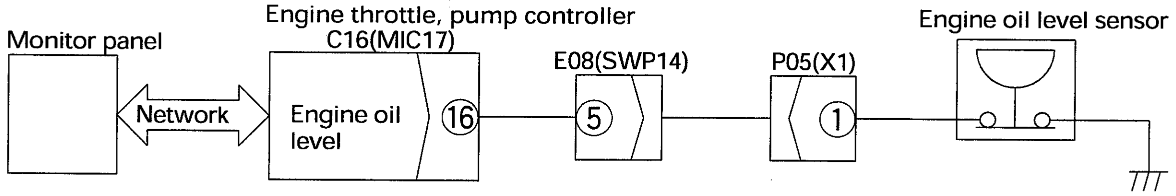
★ Check that the engine oil is at the specified level before carrying out troubleshooting.



Table

Chassis ground	Continuity
Connected	Yes
Disconnected	No

M-9 b) Related electric circuit diagram

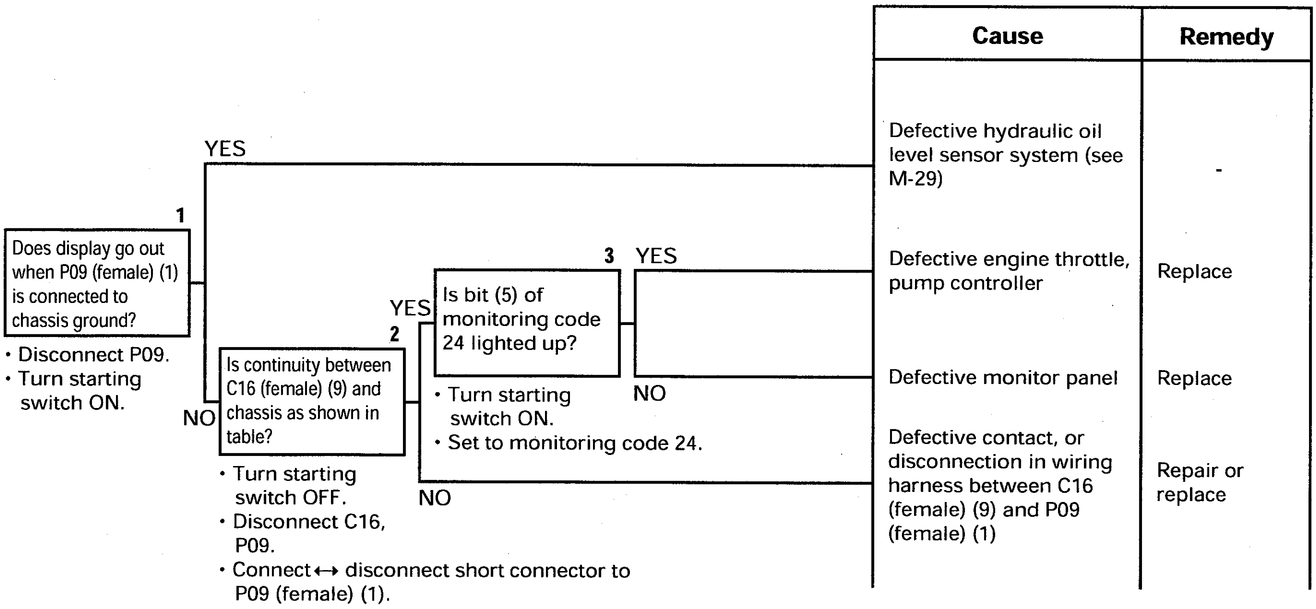


BKP00278

c) (hydraulic oil level) flashes

SAP00524

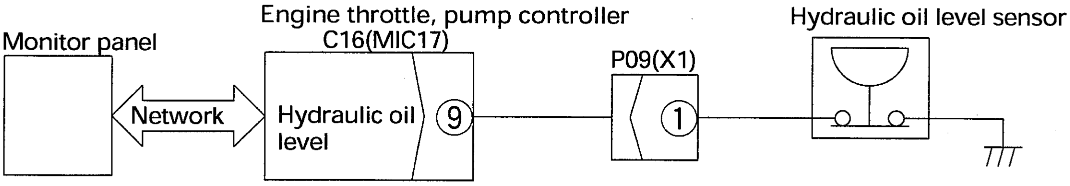
★ Check that the hydraulic oil is at the specified level before carrying out troubleshooting



Table

Chassis ground	Continuity
Connected	Yes
Disconnected	No

M-9 c) Related electric circuit diagram

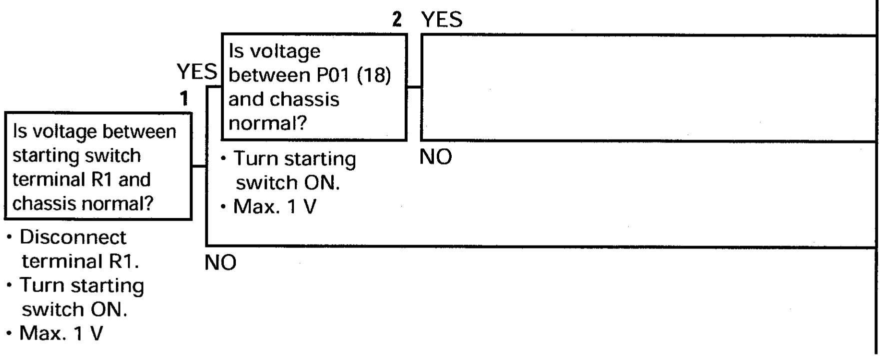


BKP00279

M-10 Preheating is not being used but (preheating monitor) lights up

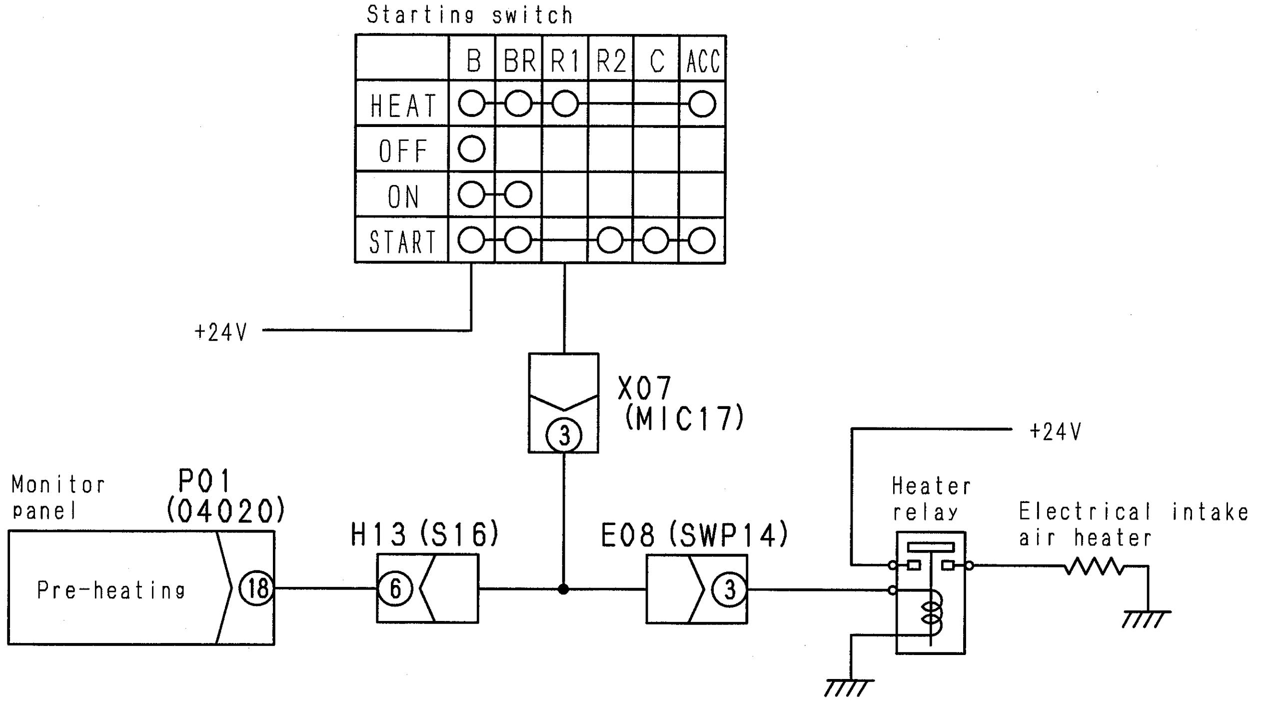
SAP00526

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



Cause	Remedy
Defective monitor panel	Replace
Short circuit with power source in wiring harness between starting switch R1 - X07 (3) - H13 (6) - P01 (female)(18) or E11 (female)(1) - E08 (3) - H13 (female)(6)	Repair or replace
Defective starting switch	Replace

M-10 Related electric circuit diagram



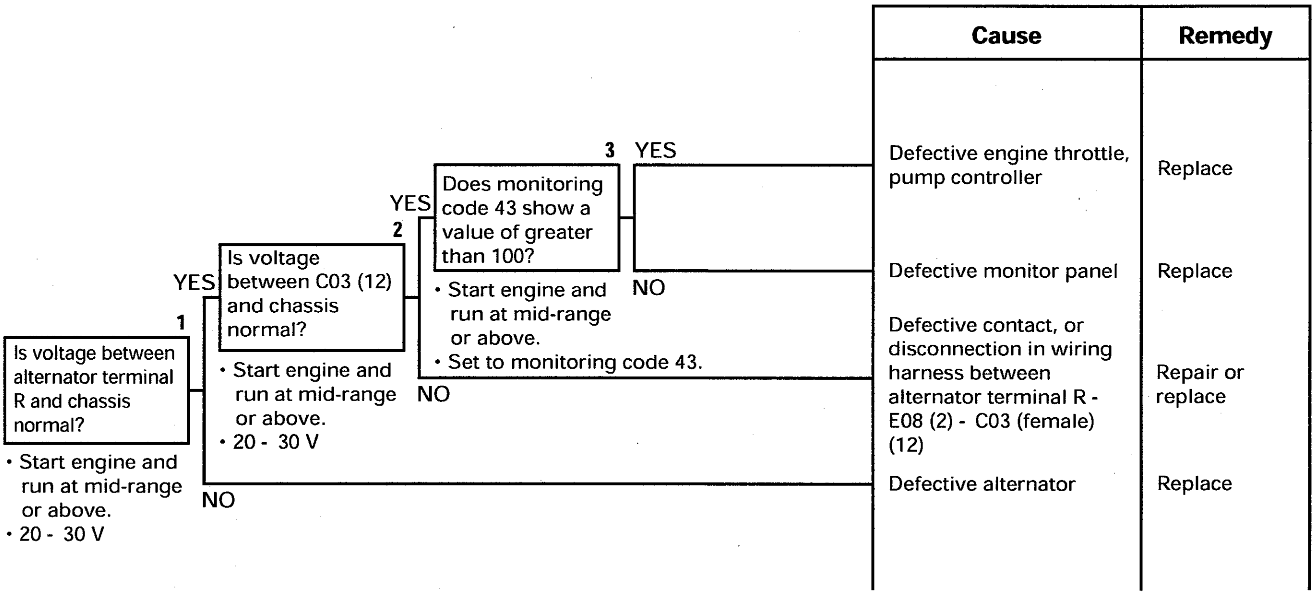
	B	BR	R1	R2	C	ACC
HEAT	○	○	○			○
OFF	○					
ON	○	○				
START	○	○		○	○	○

TWP01485

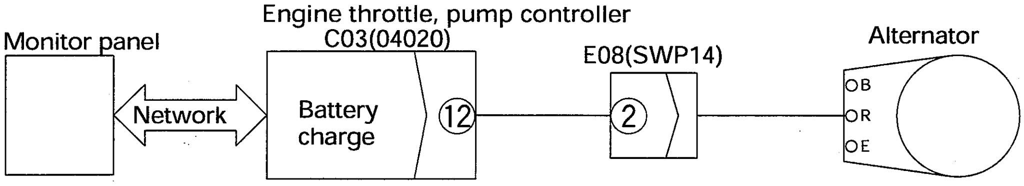
M-11 When starting switch is turned ON and engine is started, basic check items flash

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.
★ Check both the alternator system and the engine oil pressure system.

a) Alternator system



M-11 a) Related electric circuit diagram

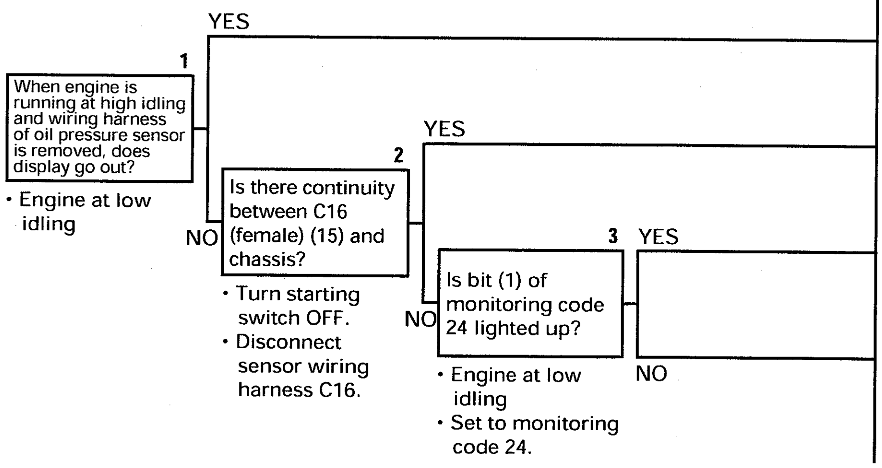


BKP00282

b) Engine oil pressure system

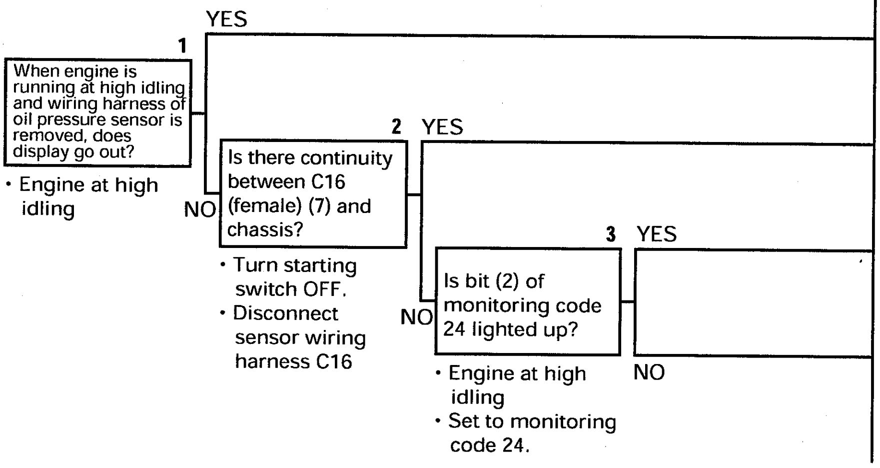
★ When engine oil pressure is normal.

1) Low-pressure sensor



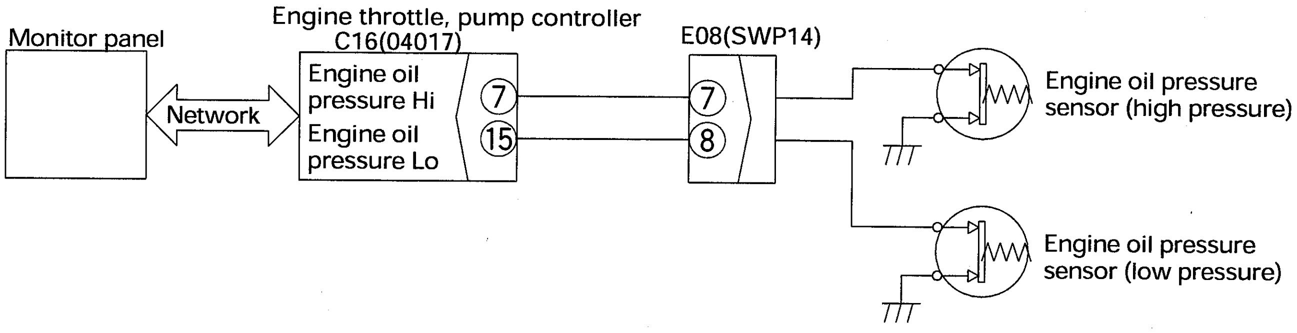
Cause	Remedy
Defective oil pressure sensor (for low pressure)	Replace
Contact of chassis ground with wiring harness beteen C16 (female) (15) - E08 (8) - sensor	Repair or repalce
Defective engine throttle, pump controller	Replace
Defective monitor panel	Replace

2) High-pressure sensor



Cause	Remedy
Defective oil pressure sensor (for high pressure)	Replace
Contact of chassis ground with wiring harness between C16 (female) (7) - E08 (7) - sensor	Repair or replace
Defective engine throttle, pump controller	Replace
Defective monitor panel	Replace

M-11 b) Related electric circuit diagram

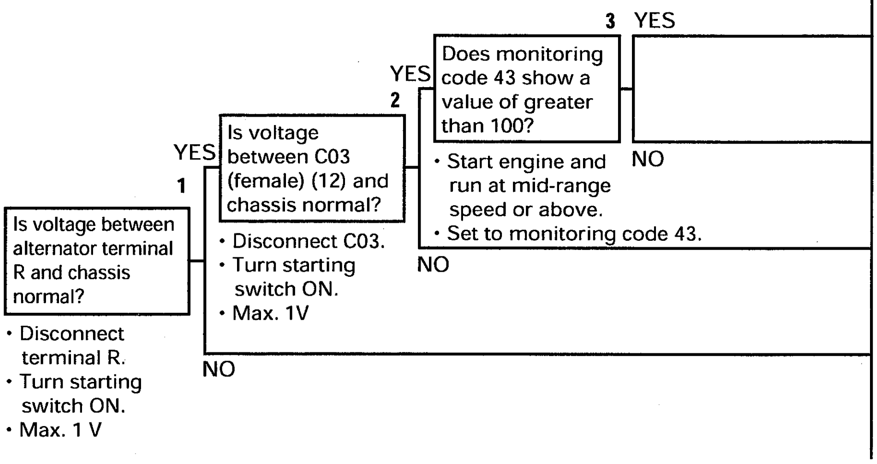


BKP00283

M-12 When starting switch is turned ON (engine stopped), caution items, emergency items flash (battery, engine oil pressure lamps do not light up)

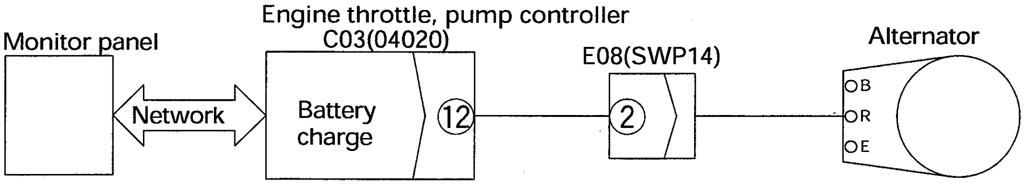
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.
- ★ Check both the alternator system and the engine oil pressure system.

a) Alternator system



Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective monitor panel	Replace
Short circuit with power source in wiring harness between C03 (female)(12) - E08 (2) - alternator R	Repair or replace
Defective alternator	Replace

M-12 a) Related electric circuit diagram

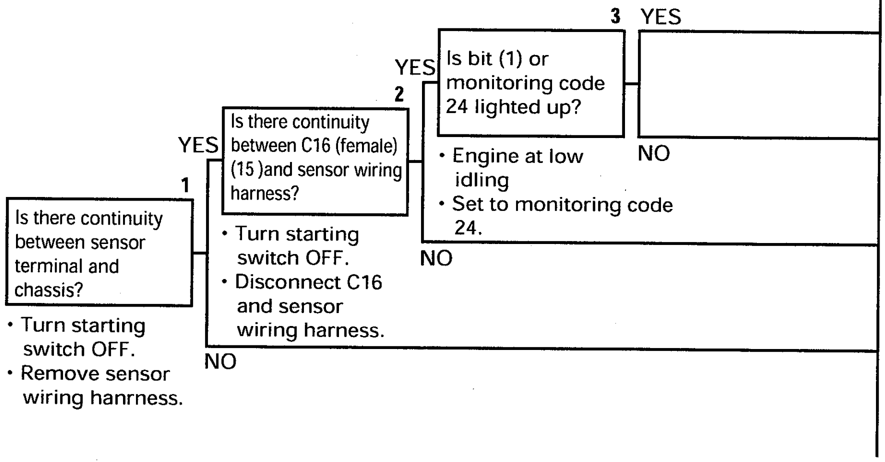


BKP00282

b) Engine oil pressure sensor system

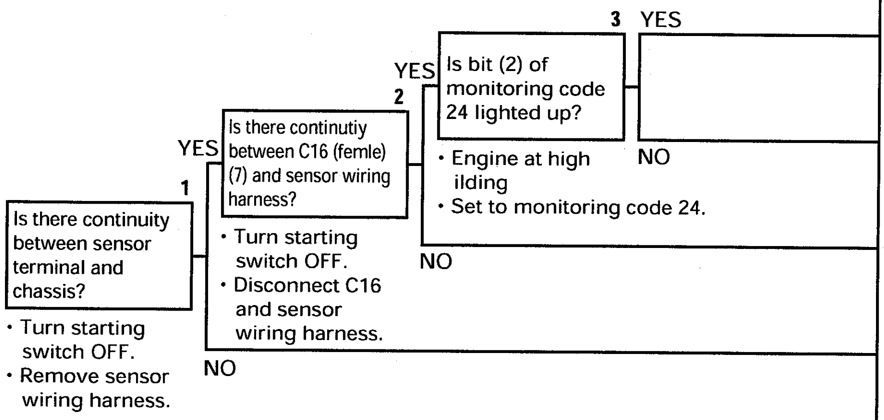
★ When engine oil pressure is normal.

1) Low-pressure sensor



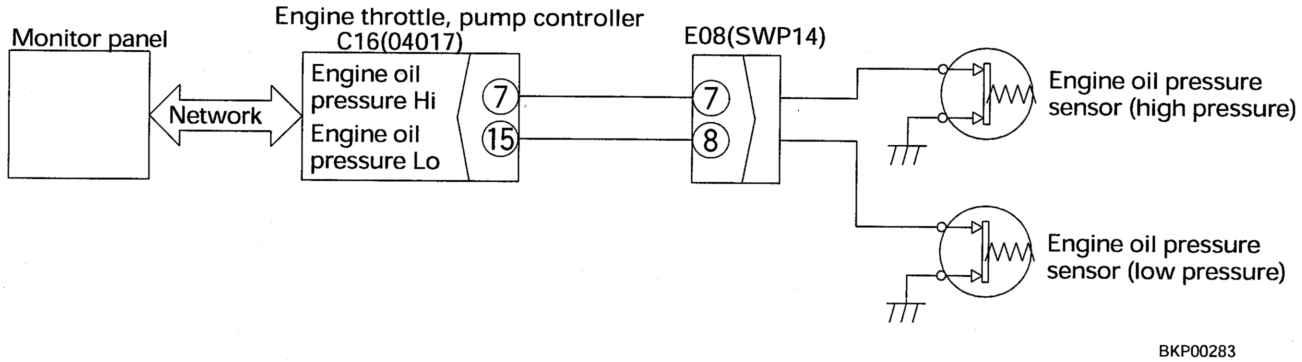
Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective monitor panel	Replace
Defective contact, or disconnection in wiring harness between C16 (female) (15) - E08 (8) - sensor	Repair or replace
Defective oil pressure sensor (low pressure)	Replace

2) High-pressure sensor



Cause	Remedy
Defective engine throttle, pump controller	Replace
Defective monitor panel	Replace
Defective contact, or disconnection in wiring harness between C16 (female) (7) - E08 (7) - sensor	Repair or replace
Defective oil pressure sensor (high pressure)	Replace

M-12 b) Related electric circuit diagram



M-13 When starting switch is turned ON and engine is started, caution items, emergency items flash (when there is no abnormality in engine or items to check before troubleshooting)

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

a)  **(engine oil pressure) flashes**

SAP00520

★ Check that the engine oil pressure is normal before carrying out troubleshooting.

Cause	Remedy
See M-11 b)	—

b)  **(coolant level) flashes**

SAP00519

★ Check that the coolant level is normal before carrying out troubleshooting.

Cause	Remedy
See M-9 a)	-

c)  **(battery charge) flashes**

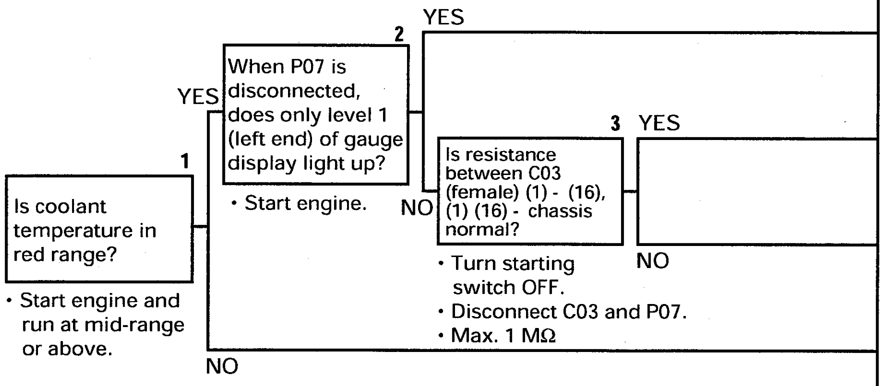
SAP00522

Cause	Remedy
See M-11 a)	-

d) (coolant temperature) flashes

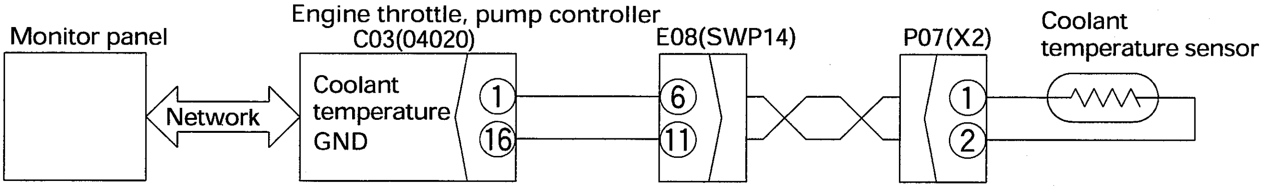
SAP00527

★ Check that the coolant temperature is normal before carrying out troubleshooting.



Cause	Remedy
Defective coolant temperature sensor system (see M-26)	-
Defective engine throttle, pump controller	Replace
Short circuit of wiring harness between C03 (female) (1) - E08 (6) - P07 (female) (1) and wiring harness between C03 (female) (16) - E08 (11) - P07 (female) (2)	Repair or replace
Defective monitor panel	Replace

M-13 d) Related electric circuit diagram

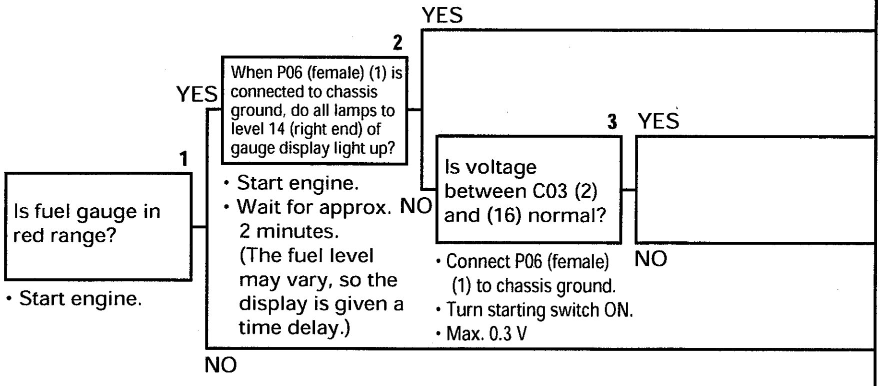


BKP00284

e) (fuel level) flashes

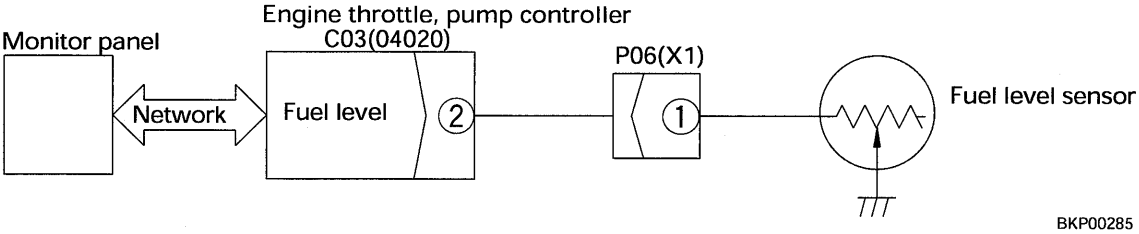
SAP00528

★ Check that there is fuel before carrying out troubleshooting.



Cause	Remedy
Defective fuel level sensor system (see M-25)	-
Defective engine throttle, pump controller	Replace
Defective contact or disconnection in wiring harness between C03 (female) (2) and P06 (female) (1)	Repair or replace
Defective monitor panel	Replace

M-13 e) Related electric circuit diagram

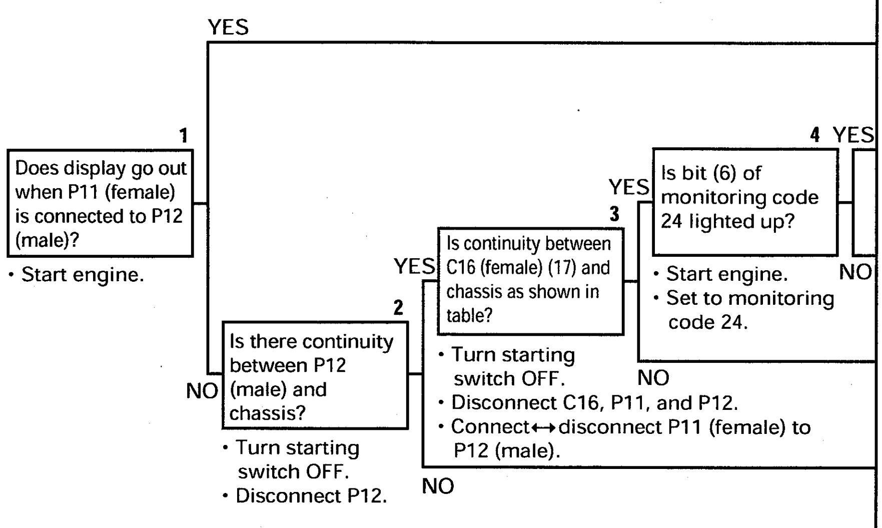


BKP00285

f) (air cleaner clogging) flashes

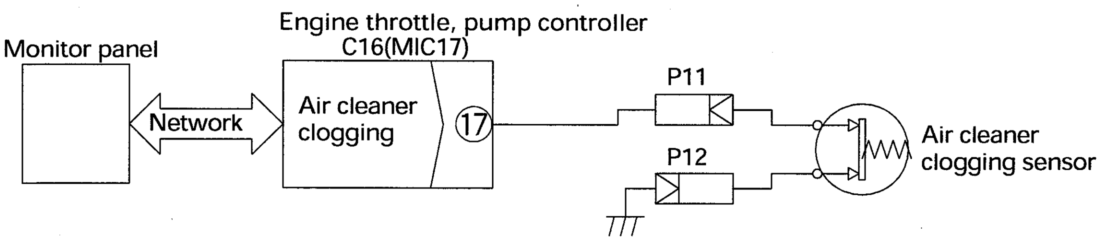
SAP00521

★ Check that the air cleaner is not clogged before carrying out troubleshooting.



Cause	Remedy
Defective air cleaner clogging sensor	Replace
Defective engine throttle, pump controller	Replace
Defective monitor panel	Replace
Defective contact or disconnection in wiring harness between C16 (female) (17) and P11 (female)	Repair or replace
Defective contact or disconnection in wiring harness between P12 (male) and chassis ground	Repair or replace

M-13 f) Related electric circuit diagram



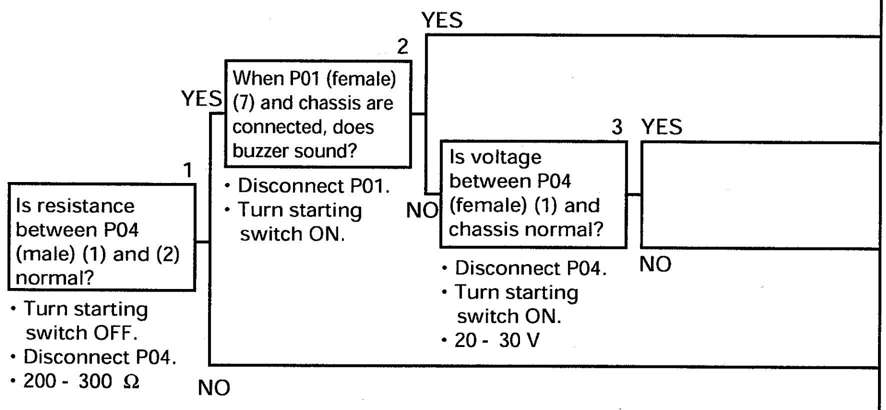
BKP00286

M-14 When starting switch is turned ON (engine stopped), buzzer does not sound for 1 second
Caution item flashes but buzzer does not sound

★ Of the caution items, the buzzer will not sound even if there is an abnormality in the battery charge or fuel level.

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

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



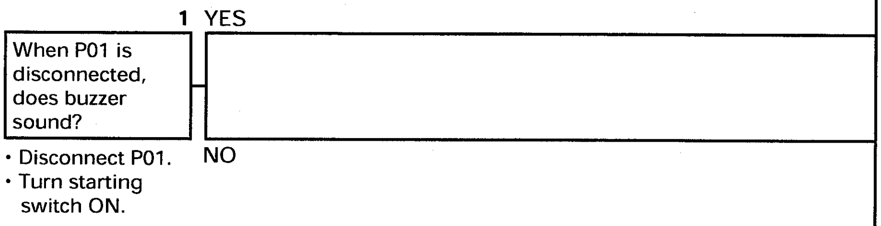
Cause	Remedy
Defective monitor panel	Replace
Defective contact or disconnection in wiring harness between P01 (female) (7) and P04 (female) (2)	Repair or replace
Disconnection, defective contact, short circuit with ground in wiring harness between P04 (female) (1) and fuse No. 13	Repair or replace
Defective buzzer	Replace

M-15 No abnormality is displayed on monitor but buzzer sounds

★ When the buzzer sounds continuously. If the buzzer sounds intermittently, carry out troubleshooting M-14.)

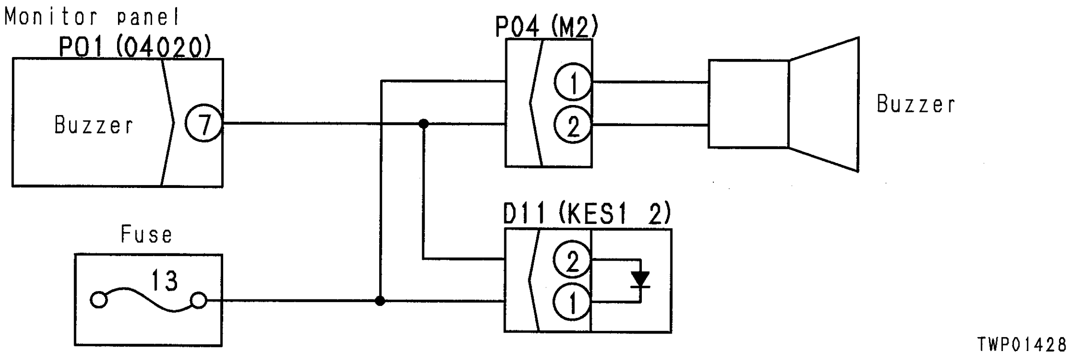
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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



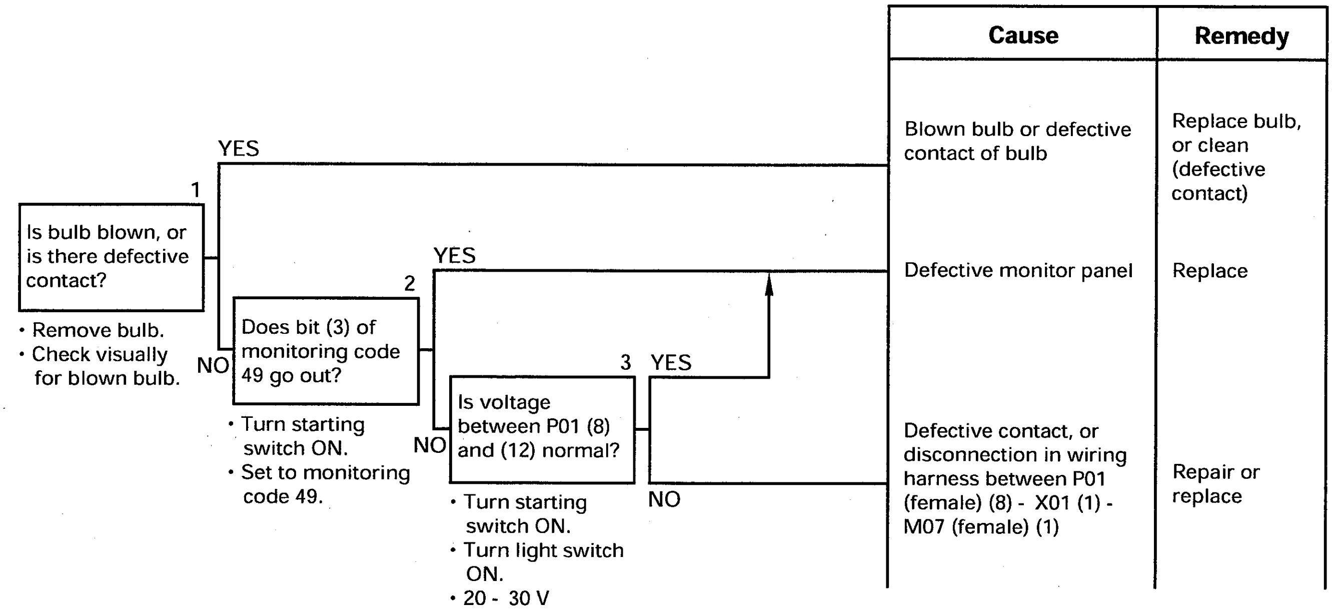
Cause	Remedy
Contact of chassis ground with wiring harness between P01 (female) (7) and P04 (female) (2), or defective buzzer	Repair or replace
Defective monitor panel	Replace

M-14, 15 Related electric circuit diagram



M-16 Night lighting on monitor panel does not light up (liquid crystal display is normal)

★ When the front lamp and working lamp light up normally.



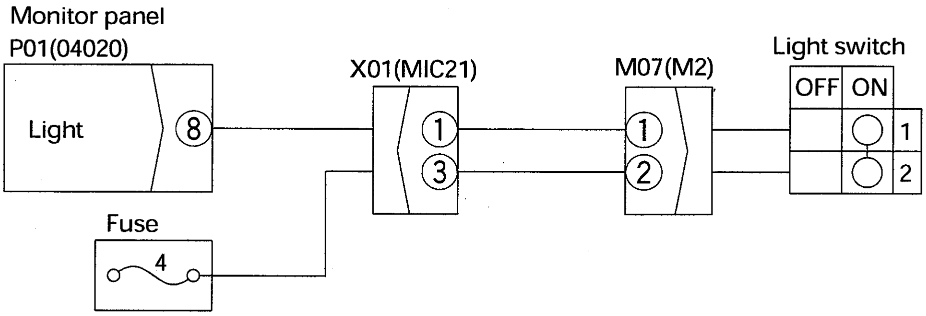
1 Is bulb blown, or is there defective contact?
- Remove bulb.
- Check visually for blown bulb.

2 Does bit (3) of monitoring code 49 go out?
- Turn starting switch ON.
- Set to monitoring code 49.

3 Is voltage between P01 (8) and (12) normal?
- Turn starting switch ON.
- Turn light switch ON.
- 20 - 30 V

Cause	Remedy
Blown bulb or defective contact of bulb	Replace bulb, or clean (defective contact)
Defective monitor panel	Replace
Defective contact, or disconnection in wiring harness between P01 (female) (8) - X01 (1) - M07 (female) (1)	Repair or replace

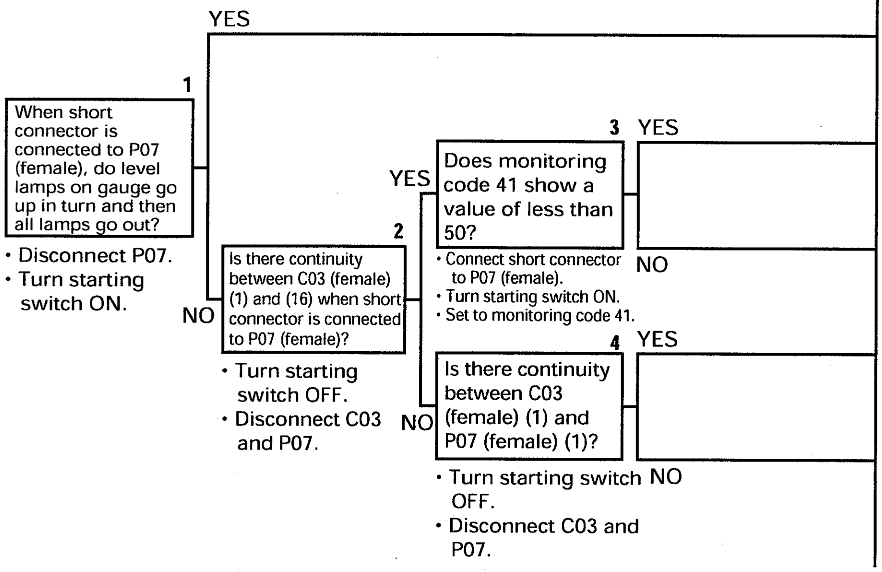
M-16 Related electric circuit diagram



BKP00287

M-17 Coolant temperature gauge does not rise

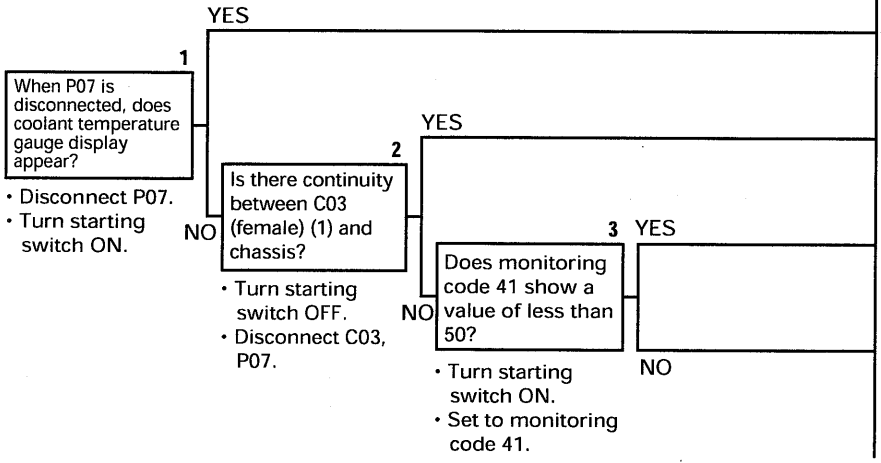
★ If the coolant temperature actually does not rise, check the engine system.
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on to the next step.



Cause	Remedy
Defective coolant temperature sensor system (see M-26)	-
Defective monitor panel	Replace
Defective engine throttle, pump controller	Replace
Defective contact, or disconnection in wiring harness between C03 (female) (16) - E08 (11) - P07 (female) (2)	Repair or replace
Defective contact or disconnection in wiring harness between C03 (female) (1) - E08 (6) - P07 (female) (1)	Repair or replace

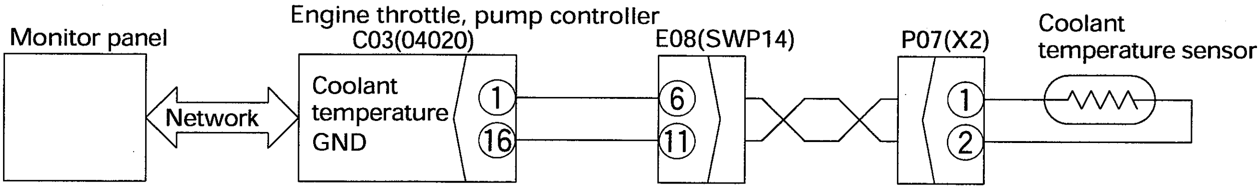
M-18 Coolant temperature gauge does not give any display (none of gauge lamps light up during operation)

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



Cause	Remedy
Defective coolant temperature sensor system (see M-26)	-
Contact of chassis ground with wiring harness between C03 (female) (1) - E08 (6) - P07 (female) (1)	Repair or replace
Defective engine throttle, pump controller	Replace
Defective monitor panel	Replace

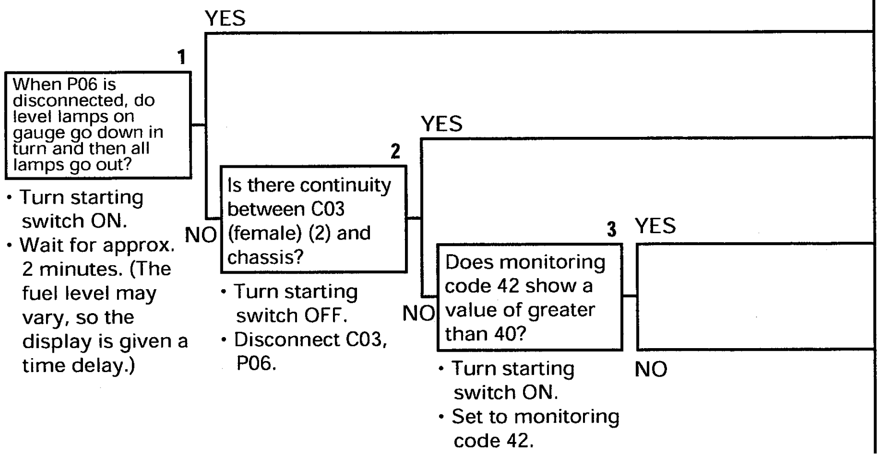
M-17, 18 Related electric circuit diagram



BKP00284

M-19 Fuel level gauge always displays FULL

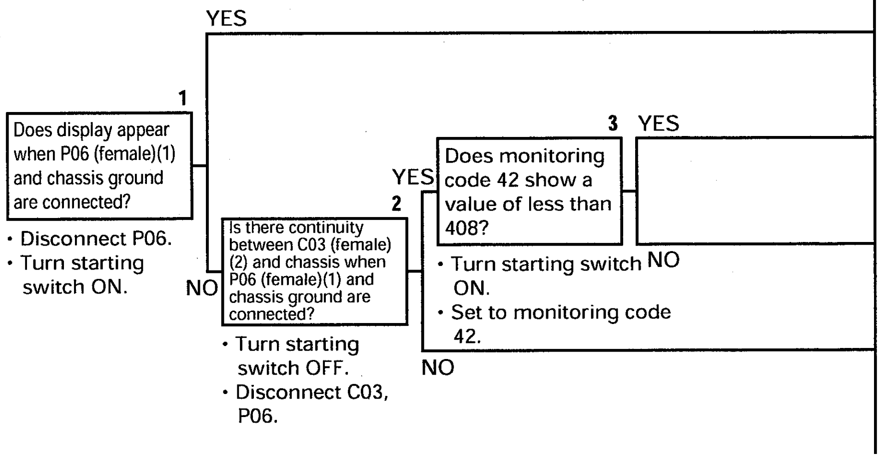
- ★ Check that there is actually remaining fuel before carrying out troubleshooting.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on to the next step.



Cause	Remedy
Defective fuel level sensor system (see M-25)	-
Contact of chassis ground with wiring harness between C03 (female) (2) and P06 (female) (1)	Repair or replace
Defective monitor panel	Replace
Defective engine throttle, pump controller	Replace

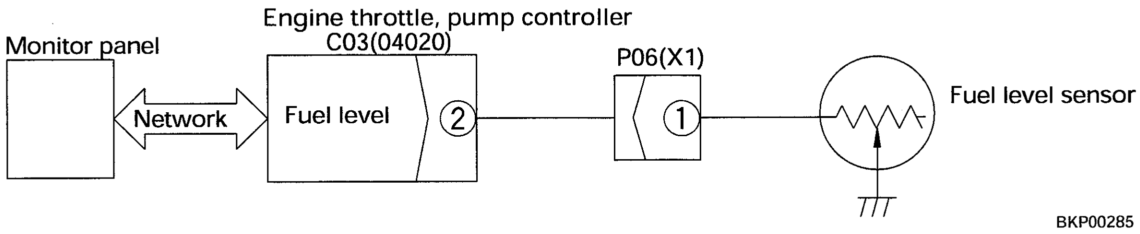
M-20 Fuel level gauge does not give display

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

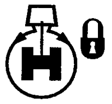


Cause	Remedy
Defective fuel level sensor system (see M-25)	-
Defective engine throttle, pump controller	Replace
Defective monitor panel	Replace
Defective contact, or disconnection in wiring harness between C03 (female) (2) and P06 (female) (1)	Repair or replace

M-19, 20 Related electric circuit diagram



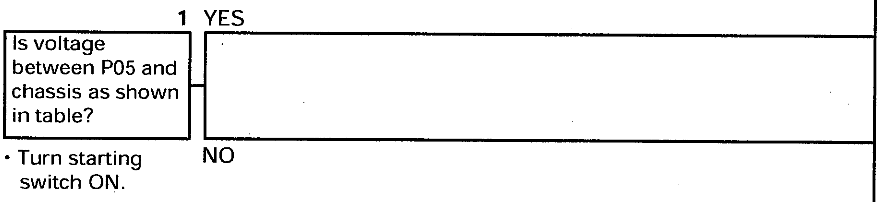
M-21 Swing lock switch is turned ON (LOCK) but (swing lock monitor) does not light up


SAT00098

★ Carry out this troubleshooting only if the swing lock is actually being actuated.

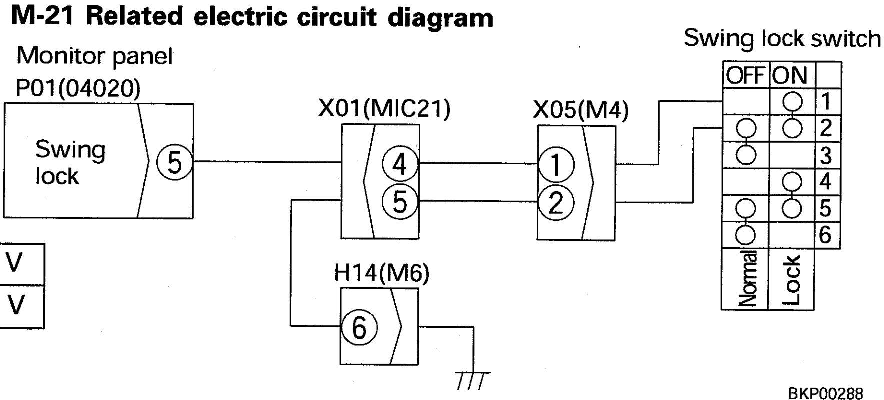
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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



Cause	Remedy
Defective monitor panel	Replace
Defective contact or disconnection in wiring harness between P01 (female) (5) - X01 (4) - X05 (male)	Repair or replace

M-21 Related electric circuit diagram

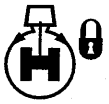


BKP00288

Table

Swing lock switch ON	Max. 1 V
Swing lock switch OFF	20 – 30 V

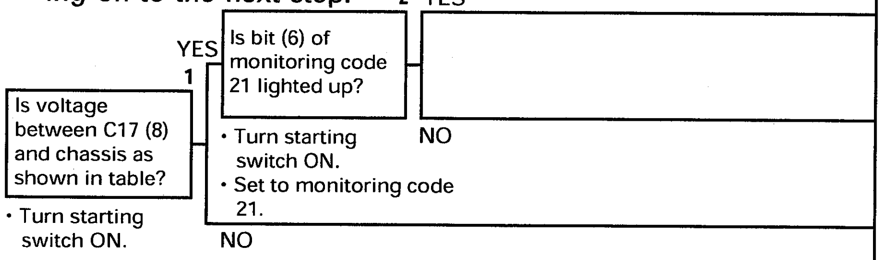
M-22 Swing prolix switch is turned ON (prolix), but (swing lock monitor) does not flash


SAT00098

★ Carry out this troubleshooting only if the swing prolix is actually being actuated.

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

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

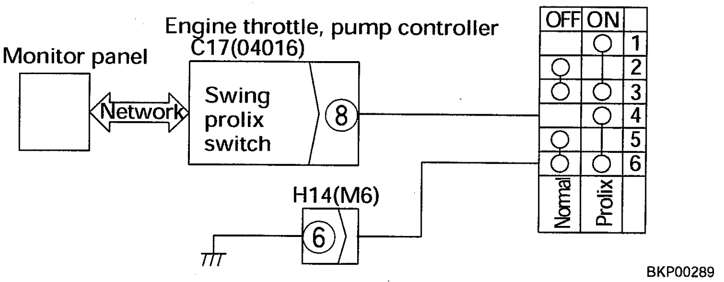


Cause	Remedy
Defective monitor panel	Replace
Defective engine throttle, pump controller	Replace
Defective contact or disconnection in wiring harness between C17 (female) (8) and prolix switch (4)	Repair or replace

Table

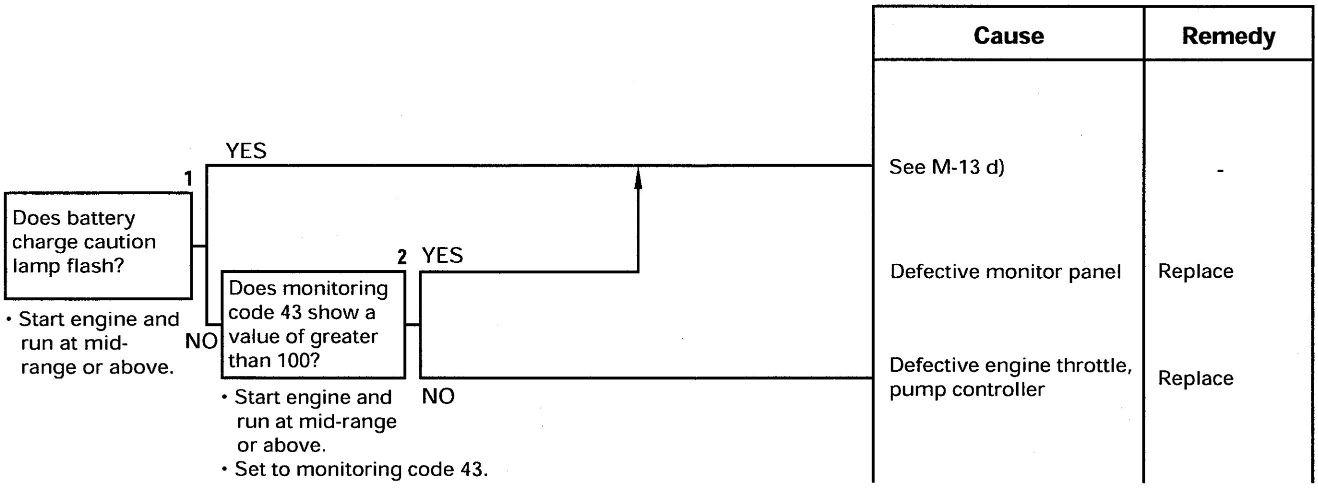
Swing prolix switch ON	Max. 1 V
Swing prolix switch OFF	20 – 30 V

M-22 Related electric circuit diagram

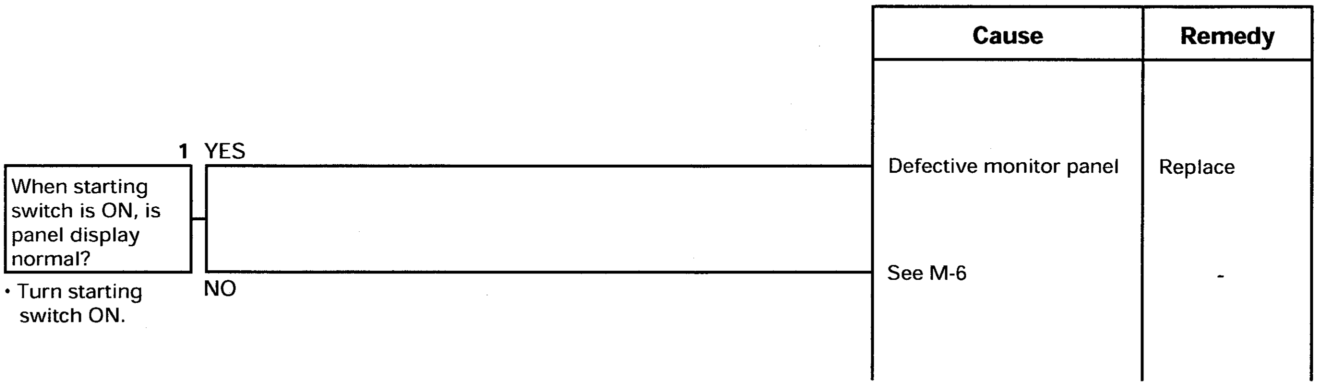


BKP00289

M-23 Service meter does not advance while engine is running

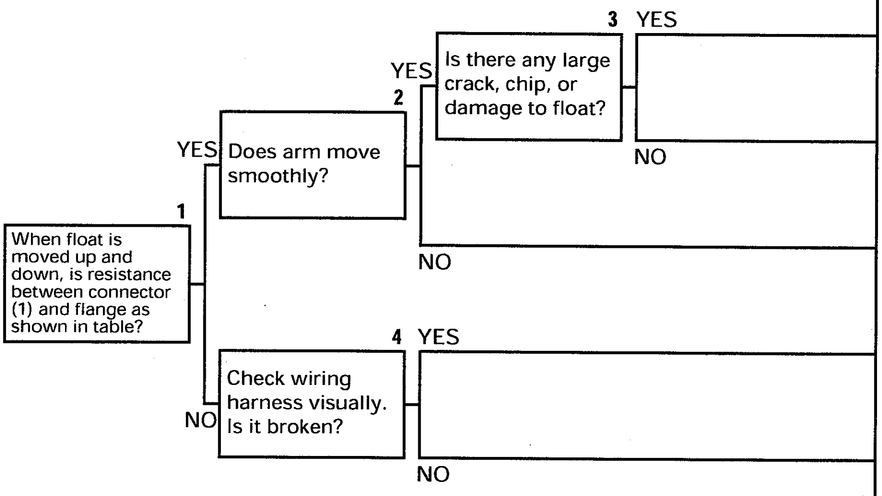


M-24 When starting switch is at OFF and time switch is pressed, time and service meter are not displayed



M-25 Defective fuel level sensor system

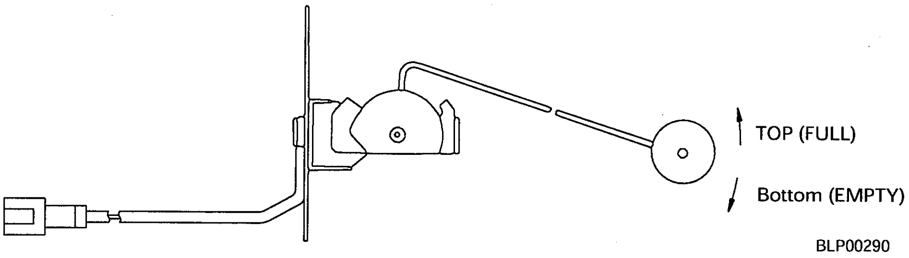
★ Remove the fuel level sensor when carrying out the troubleshooting.



Cause	Remedy
Interference with sensor inside tank	Replace (See Note 2)
Defective contact of connector	Clean connector or replace
Defective sensor (See Note 2)	Replace
Disconnection in wiring harness (See Note 3) (defective clamp) (external force applied)	Replace sensor
Defective sensor	Replace

Table

Top (FULL) stopper position	Approx. 12 Ω or below
Bottom (EMPTY) stopper position	Approx. 85 – 110 Ω

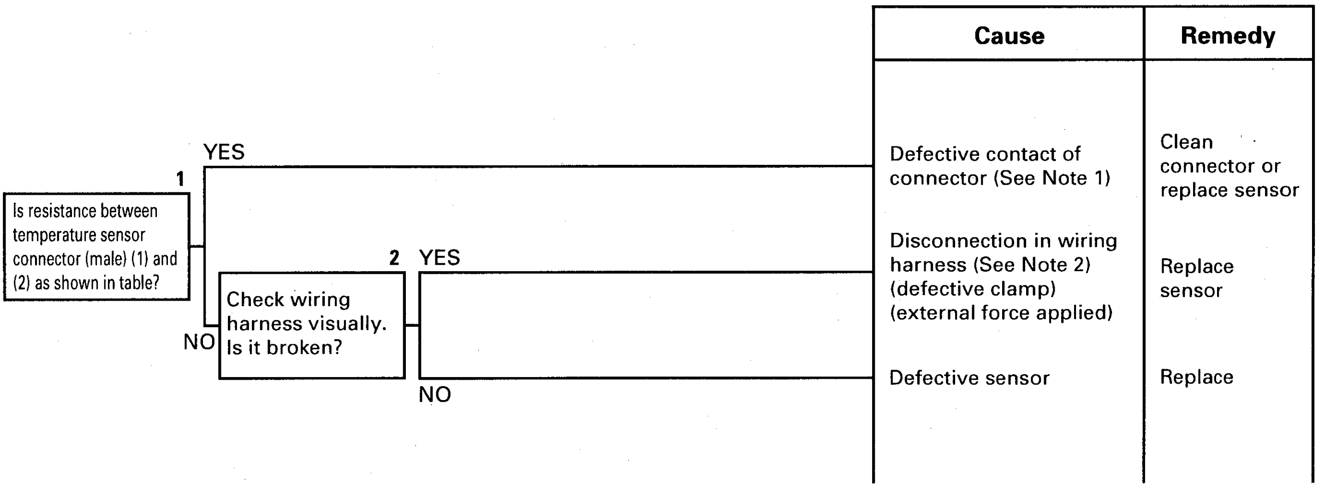


Note 1: Difference between fuel level and gauge display
For gauge display position 14 (FULL), the amount of fuel is 78-100%; and for display position 1 (EMPTY) it is below 14.5%. If the chassis is at an angle, the displayed amount of fuel will be different from the actual amount. Therefore, when checking, stop the machine at a horizontal place and wait for at least 2 minutes before checking the gauge. (The display is given a time delay so that the gauge can deal with sudden changes in the fuel level.)

Note 2: There is the possibility of defective installation or interference with the sensor inside the tank, so be careful when installing.

Note 3: Check for vibration at the connector mount. If there is excessive vibration, take the appropriate action.

M-26 Defective coolant temperature sensor system



Table

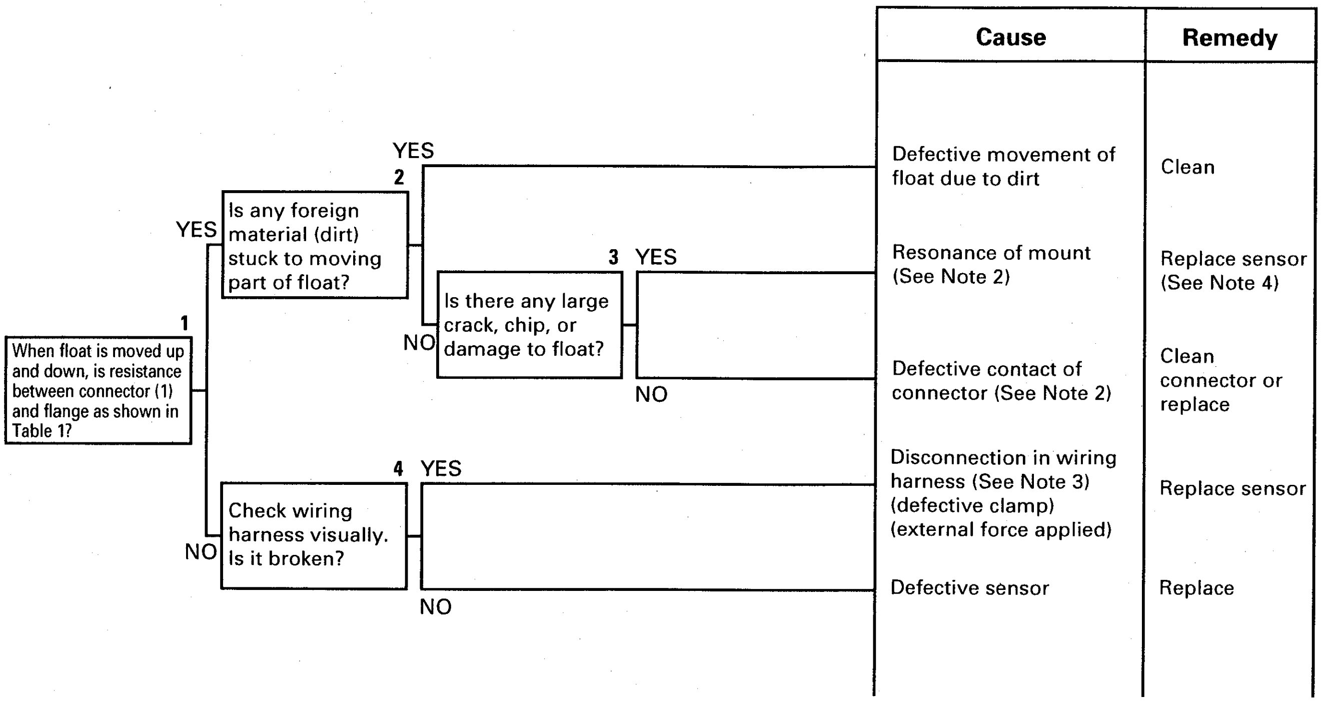
Normal temperature (25°C)	Approx. 37 – 50 kΩ
100°C	Approx. 3.5 – 4.0 kΩ

Note 1: If the problem occurs again, the connector (female) at the chassis end is probably defective, so check the connector and wiring harness at the chassis end.

Note 2: Check for vibration at the connector mount. If there is excessive vibration, take the appropriate action.

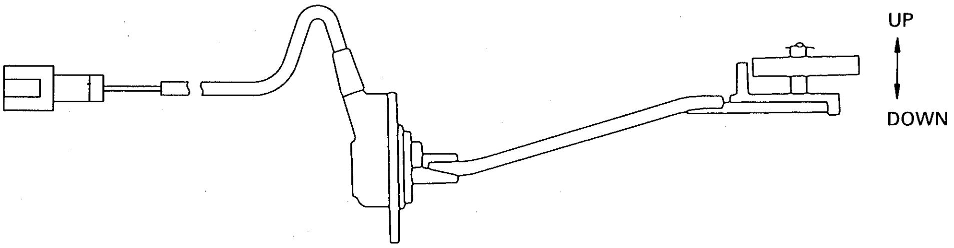
M-27 Defective engine oil level sensor system

★ Remove the engine oil level sensor when carrying out troubleshooting.



Table

Float UP	Max. 1 Ω
Float DOWN	Min. 1 MΩ



BLP00292

Note 1: Variations in oil level
The oil level may change according to the angle of the machine, the engine speed, or the temperature of the oil, so if there is any display, check the oil level again with the machine at a horizontal place.

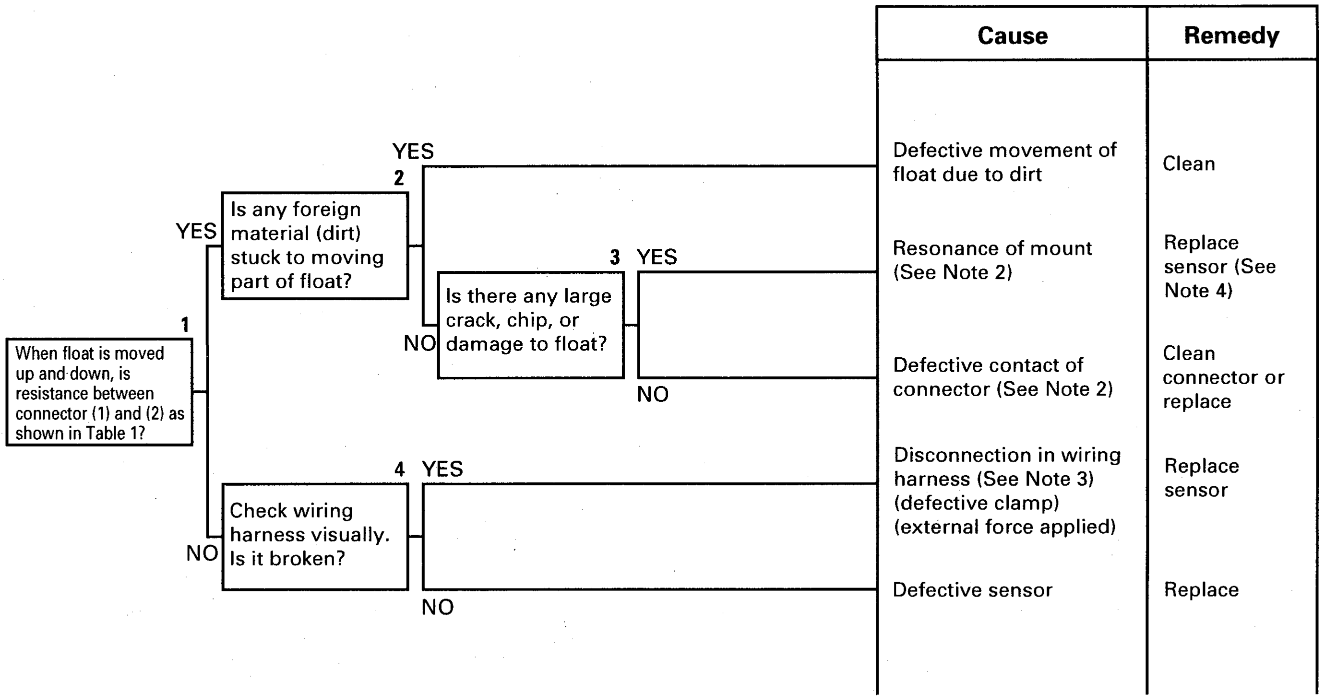
Note 2: If the problem occurs again, the connector (female) at the chassis end is probably defective, so check the connector and wiring harness at the chassis end.

Note 3: Check for vibration at the connector mount. If there is excessive vibration, take the appropriate action.

Note 4: Defective installation is a possible cause, so be careful when installing. If the problem occurs again, check for any vibration of the mount, and if there is excessive vibration, take the appropriate action.

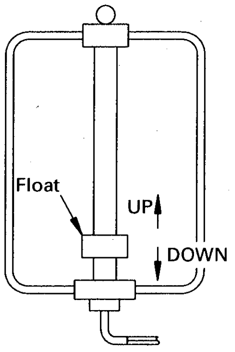
M-28 Defective coolant level sensor system

★ Remove the coolant level sensor when carrying out troubleshooting.



Table

Float UP	Max. 1 Ω
Float DOWN	Min. 1 MΩ



Note 1: Variations in coolant level
The coolant level may change according to the angle of the machine, or the swaying of the machine, so if there is any display, check the coolant level again with the machine at a horizontal place.

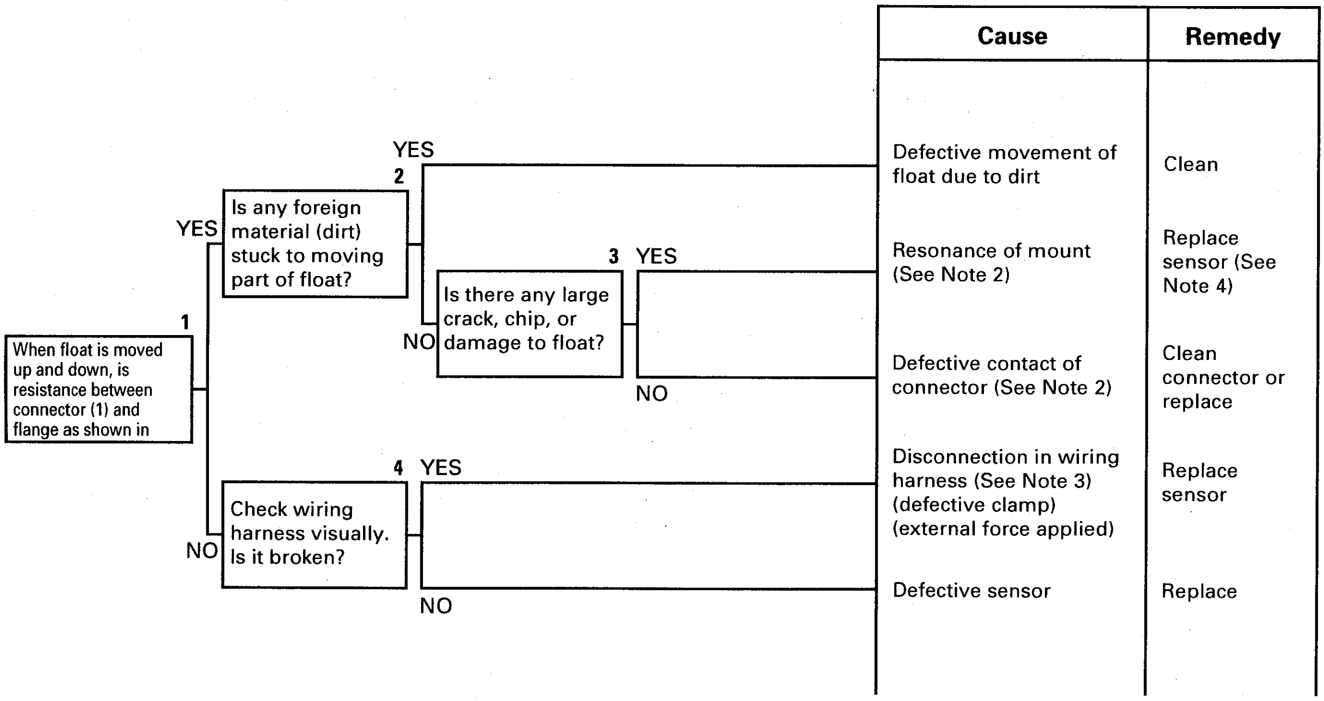
Note 2: If the problem occurs again, the connector (female) at the chassis end is probably defective, so check the connector and wiring harness at the chassis end.

Note 3: Check for vibration at the connector mount. If there is excessive vibration, take the appropriate action.

Note 4: Defective installation is a possible cause, so be careful when installing. If the problem occurs again, check for any vibration of the mount, and if there is excessive vibration, take the appropriate action.

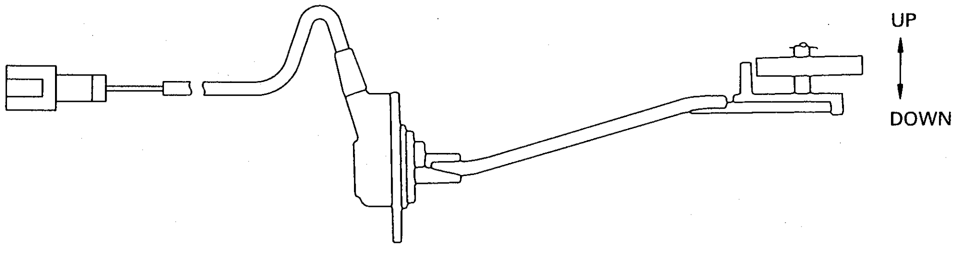
M-29 Defective hydraulic oil level sensor system

★ Remove the hydraulic oil level sensor when carrying out troubleshooting.



Table

Float UP	Max. 1 Ω
Float DOWN	Min. 1 MΩ



Note 1: Variations in hydraulic oil level
The hydraulic oil level may change according to the angle of the machine, or the swaying of the machine, so if there is any display, check the hydraulic oil level again with the machine at a horizontal place.

Note 2: If the problem occurs again, the connector (female) at the chassis end is probably defective, so check the connector and wiring harness at the chassis end.

Note 3: Check for vibration at the connector mount. If there is excessive vibration, take the appropriate action.

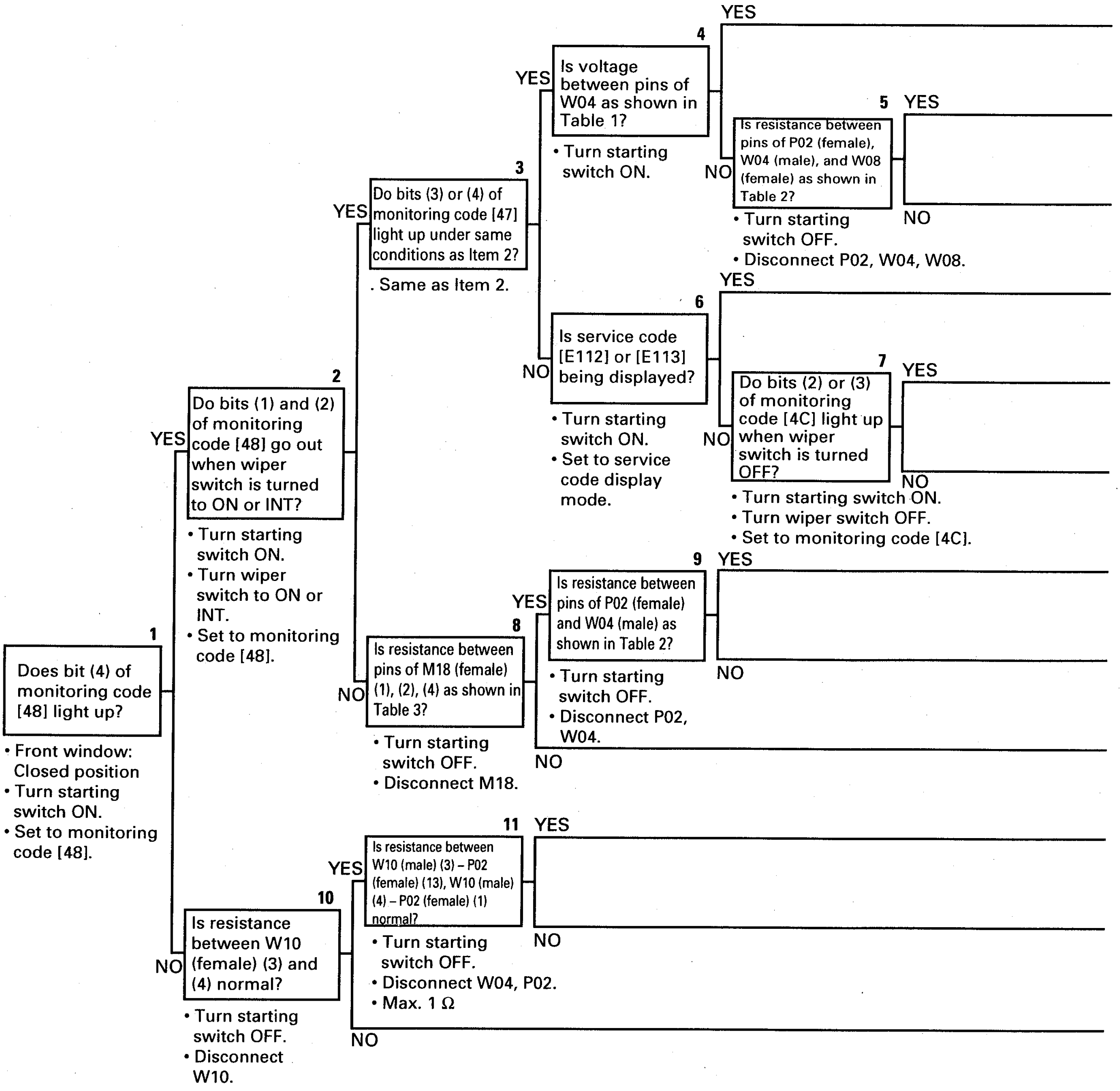
Note 4: Defective installation is a possible cause, so be careful when installing. If the problem occurs again, check for any vibration of the mount, and if there is excessive vibration, take the appropriate action.

M-30 Wiper does not work, or switch is not being used but wiper is actuated (include E112, E113)

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

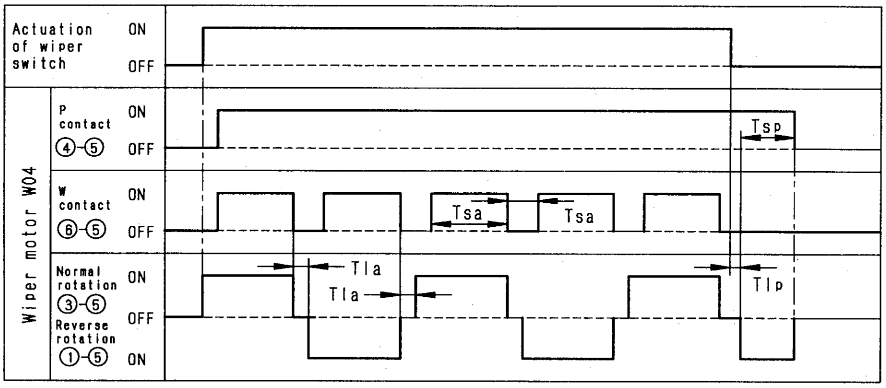
a) Wiper does not work

★ Check that fuse 7 is normal.
★ Carry out this troubleshooting if service code [E112] or [E113] is displayed.



Cause	Remedy
Defective wiper motor	Replace
Defective relay box	Replace
Defective contact or disconnection in wiring harness with defective resistance	Repair or replace
Short circuit with power source in wiring harness between P02 (female) (3) – W08 (female) (18) [(3)], or between P02 (female) (11) – W08 (female) (17) [(2)]	Repair or replace
Defective contact or disconnection in above wiring harness	Repair or replace
Defective monitor panel	Replace
Defective monitor panel	Replace
Defective contact or disconnection in wiring harness with defective resistance	Repair or replace
Defective wiper, washer switch	Replace
Defective monitor panel	Replace
Defective contact or disconnection in wiring harness between P02 (female) (13) and W10 (male) (3), or between P02 (female) (1) – H14 (2) – chassis, or between W10 (male) (4) – H15 (1) – chassis	Repair or replace
Defective rear limit switch, or front window is open	Inspect or replace

Table 1
Timing chart when wiper switch is at ON

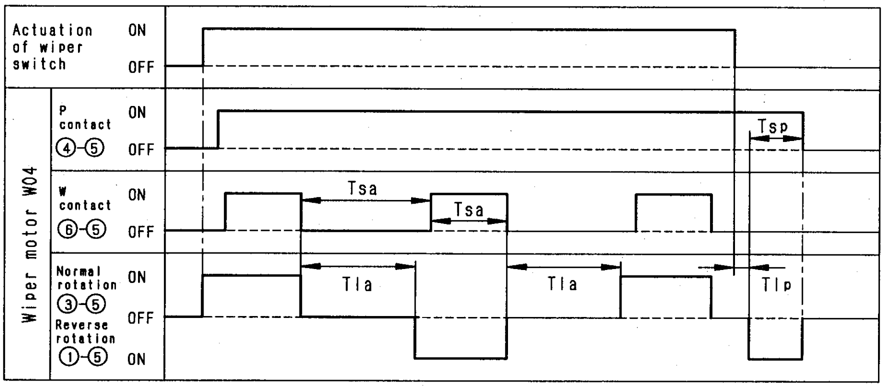


★ Motor valtage is max. 3V at contact OFF and 20-30V at contact ON.

TWP01486

Item	Symbol	Set time
Length of pause until next actuation	Tla	0.13sec
Safety circuit during operation of wiper [safety function (1)]	Tsa	10sec
Length of pause when stowing wiper blade	Tlp	1.5sec
Safety circuit during stowing of wiper [safety function (2)]	Tsp	10sec

Timing chart when wiper switch is at INT



★ Motor valtage is max. 3V at contact OFF and 20-30V at contact ON.

TWP01487

Item	Symbol	Set time
Length of pause until next actuation	Tla	4sec
Safety circuit during operation of wiper [safety function (1)]	Tsa	10sec
Length of pause when stowing wiper blade	Tlp	1.5sec
Safety circuit during stowing of wiper [safety function (2)]	Tsp	10sec

Table 2

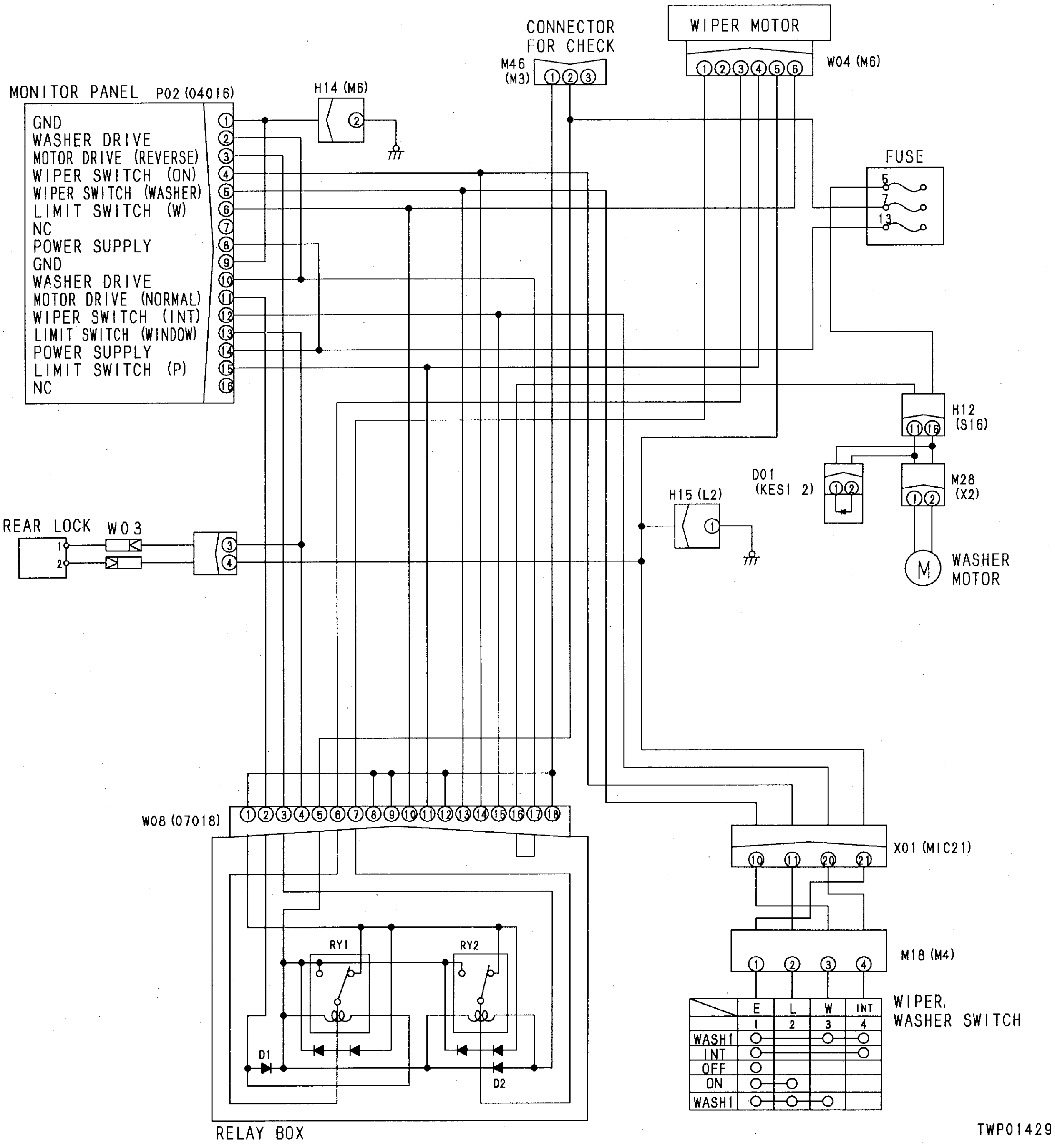
	Resistance value
Between W04 (female) (1) and W08 (female) (6) [(7)]	Max. 1 Ω
Between W04 (female) (3) and W08 (female) (7) [(6)]	
Between W04 (female) (4) and P02 (female) (5)	
Between W04 (female) (5) and P02 (female) (1)	
Between W04 (female) (6) and P02 (female) (6)	
Between W04 (female) (1),(3),(4),(5),(6) and GND	Min. 1 MΩ
Between W08 (female) (17) [(2)] and P02 (female) (11)	Max. 1 Ω
Between W08 (female) (18) [(3)] and P02 (female) (3)	

[ ]: For machines with power window specification

Table 3

Wiper switch	M18 (female)	P02 (female)	Resistance
INT mode	Between (1) – (2)	Between (1) – (4)	Min. 1 MΩ
	Between (1) – (4)	Between (1) – (12)	Max. 1 Ω
	Between (2) – (4)	Between (4) – (12)	Min. 1 MΩ
OFF mode	Between (1) – (2)	Between (1) – (4)	Min. 1 MΩ
	Between (1) – (4)	Between (1) – (12)	
	Between (2) – (4)	Between (4) – (12)	
ON mode	Between (1) – (2)	Between (1) – (4)	Max. 1 Ω
	Between (1) – (4)	Between (1) – (12)	Min. 1 MΩ
	Between (2) – (4)	Between (4) – (12)	

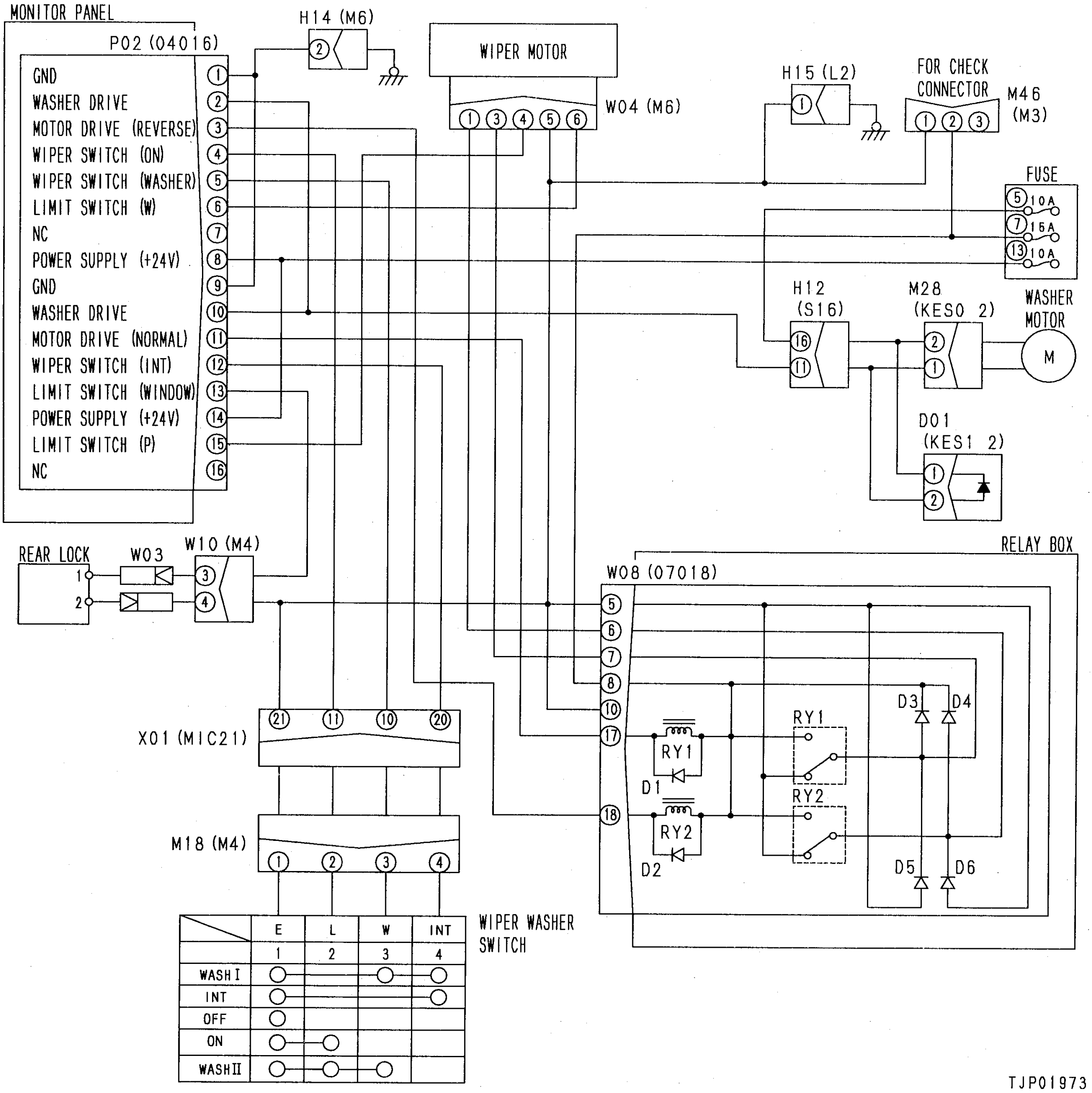
M-30 Related electric circuit diagram
- **with power window**



	E	L	W	INT
	1	2	3	4
WASH1	○		○	○
INT	○			○
OFF	○			
ON	○	○		
WASH1	○	○	○	

- **without power window**

PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up



	E	L	W	INT
	1	2	3	4
WASH I	○		○	○
INT	○			○
OFF	○			
ON	○	○		
WASH II	○	○	○	

b) Wiper switch is not being operated but wiper is actuated

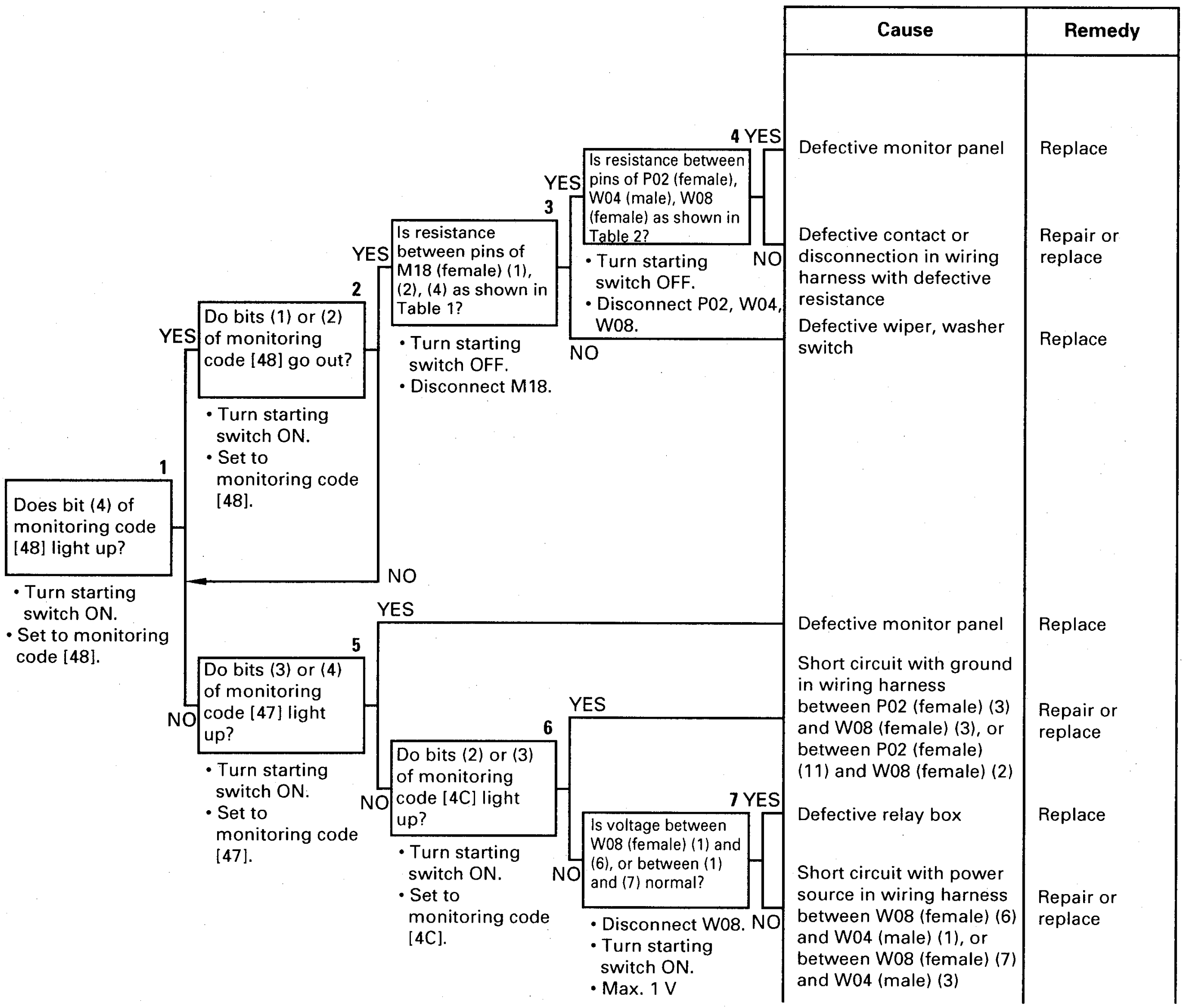


Table 2

	Resistance value
Between W04 (female) (1) and W08 (female) (6) [(7)]	Max. 1 Ω
Between W04 (female) (3) and W08 (female) (7) [(6)]	
Between W04 (female) (4) and P02 (female) (5)	
Between W04 (female) (5) and P02 (female) (1)	
Between W04 (female) (6) and P02 (female) (6)	
Between W04 (female) (1),(3),(4),(5),(6) and GND	Min. 1 MΩ
Between W08 (female) (17) [(2)] and P02 (female) (11)	Max. 1 Ω
Between W08 (female) (18) [(3)] and P02 (female) (3)	

[ ]: For machines with power window specification

Table 3

Wiper switch	M18 (female)	P02 (female)	Resistance
INT mode	Between (1) – (2)	Between (1) – (4)	Min. 1 MΩ
	Between (1) – (4)	Between (1) – (12)	Max. 1 Ω
	Between (2) – (4)	Between (4) – (12)	Min. 1 MΩ
OFF mode	Between (1) – (2)	Between (1) – (4)	Min. 1 MΩ
	Between (1) – (4)	Between (1) – (12)	
	Between (2) – (4)	Between (4) – (12)	
ON mode	Between (1) – (2)	Between (1) – (4)	Max. 1 Ω
	Between (1) – (4)	Between (1) – (12)	Min. 1 MΩ
	Between (2) – (4)	Between (4) – (12)	

M-31 Washer motor does not work, or switch is not being used but washer motor is actuated (include E114)

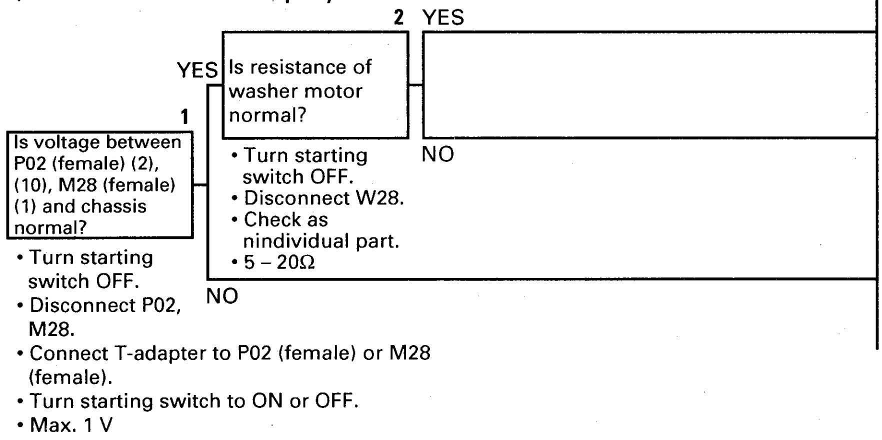
★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.

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

a) Washer motor does not work

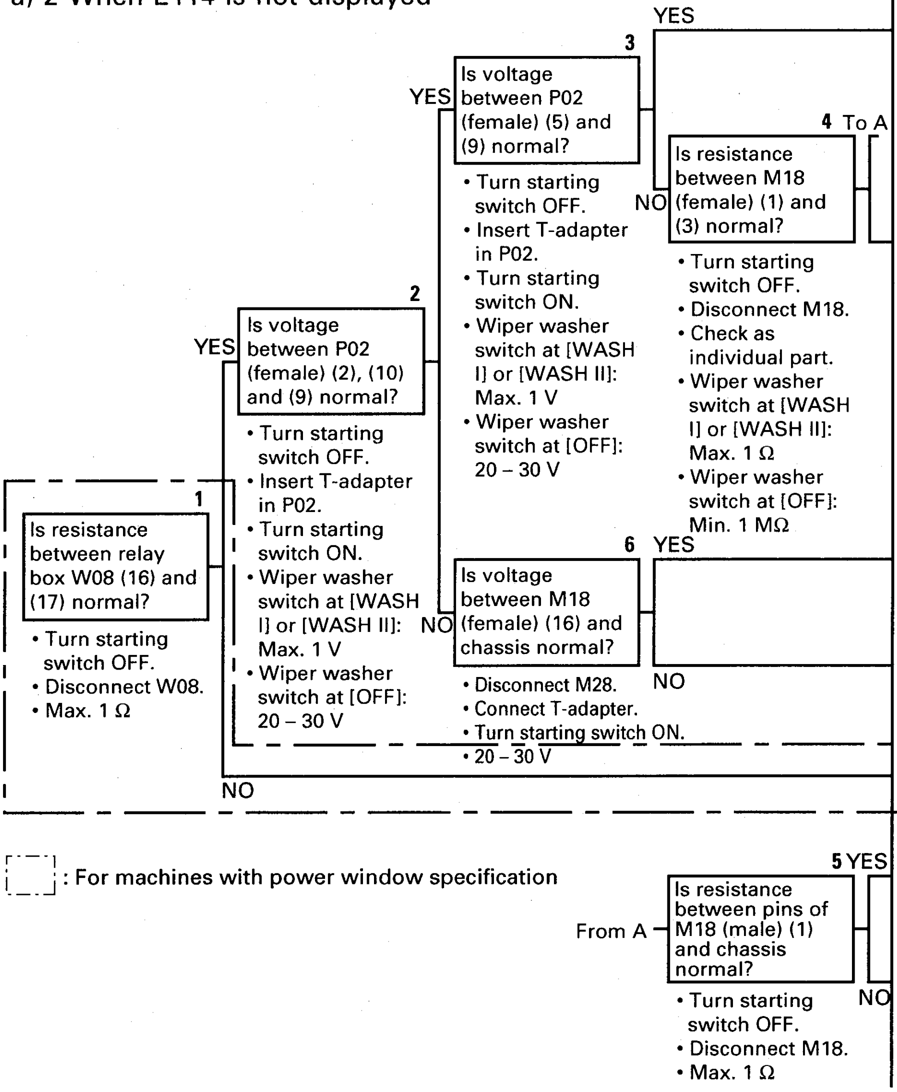
★ Check that fuse 5 is normal.

a)-1 When E114 is displayed



Cause	Remedy
Defective monitor panel	Replace
Defective washer motor (internal short circuit)	Replace
Short circuit in wiring harness between P02 (female) (2), (9) and M28 (female) (1)	Replace

a)-2 When E114 is not displayed



⁝ : For machines with power window specification

Cause	Remedy
Defective monitor panel	Replace
Defective wiper washer switch	Replace
Short circuit with ground or disconnection in wiring harness between P02 (female) (2), (10) and M28 (1)	Repair or replace
Short circuit with ground or disconnection in wiring harness between fuse 5 and M28 (16)	Repair or replace
Defective relay box (internal disconnection)	Replace
Short circuit with power source or defective contact in wiring harness between P02 (5) – X01 (10) – M18 (3)	Repair or replace
Disconnection in wiring harness between M18 (male) – X01 (21) – chassis ground	Repair or replace

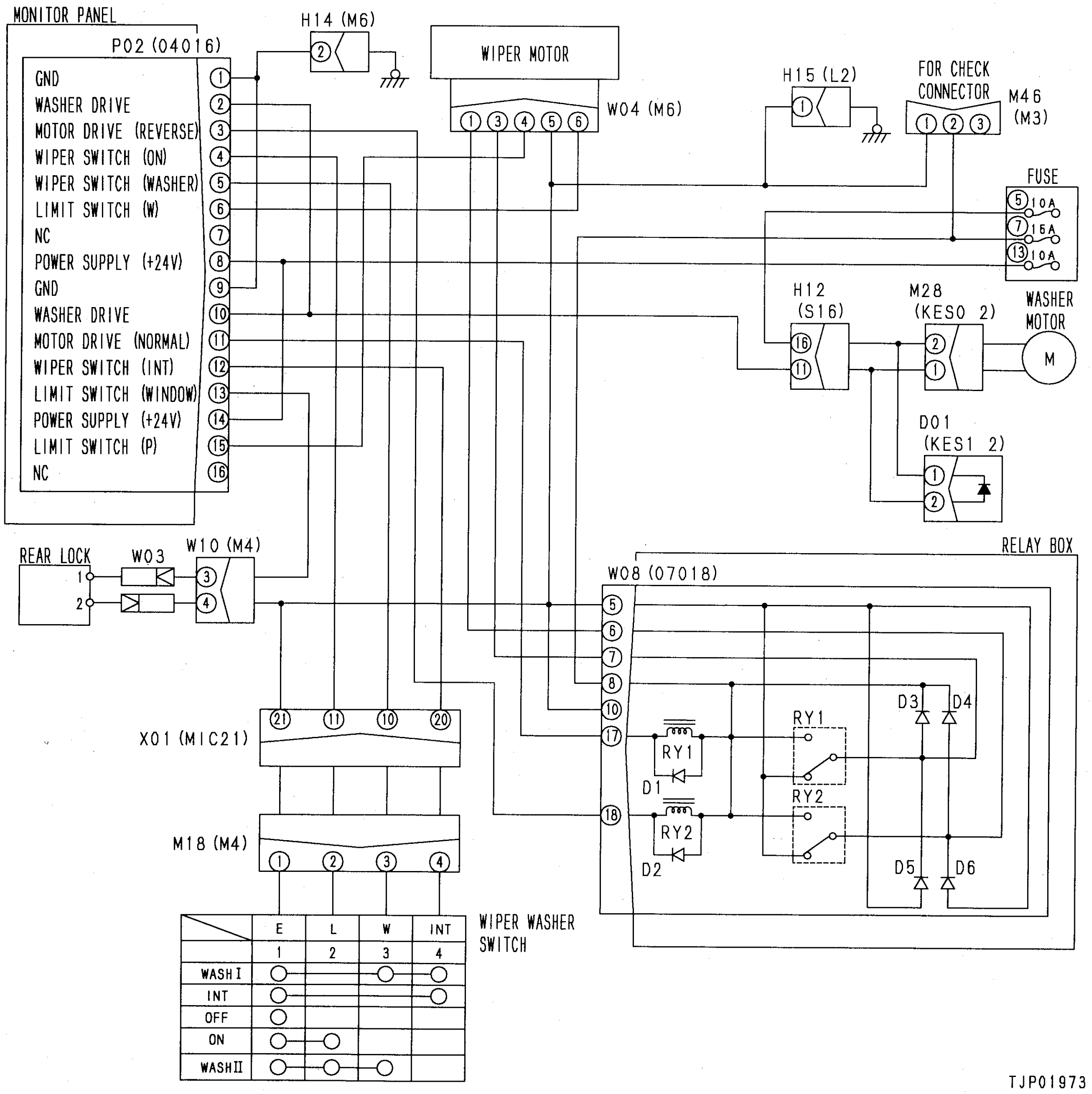
b) Switch is not being operated but washer is actuated

★ For this failure mode, E114 is not displayed.

		Cause	Remedy
1 Is resistance between P02 (female) (3), M18 (male) (3), W08 (13) and chassis normal? • Turn starting switch OFF. • Disconnect P02, M18, W08. • Min. 1 MΩ Cause Remedy	YES	Defective monitor panel	Replace
	NO	Short circuit with ground in wiring harness between P02 (female) (5) – M18 (male) – W08 (female) (13)	Repair or replace

M-31 Related electric circuit diagram

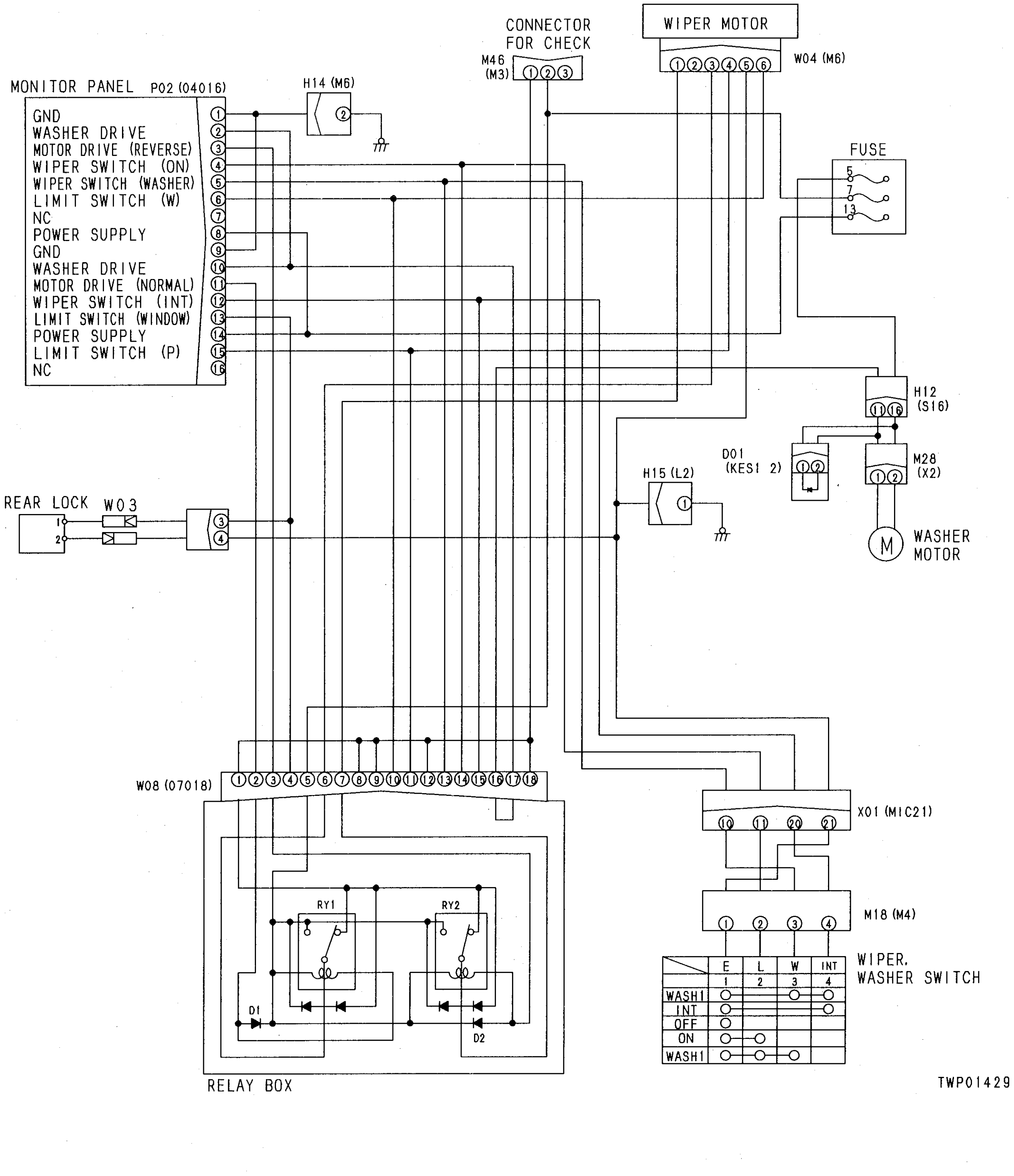
- **without power window**



	E	L	W	INT
	1	2	3	4
WASH I	○		○	○
INT	○			○
OFF	○			
ON	○	○		
WASH II	○	○	○	

TJP01973

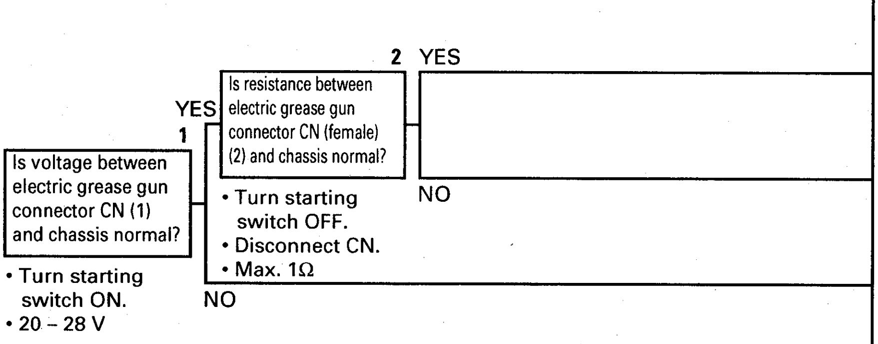
- **with power window**



	E	L	W	INT
	1	2	3	4
WASH I	○		○	○
INT	○			○
OFF	○			
ON	○	○		
WASH I	○	○	○	

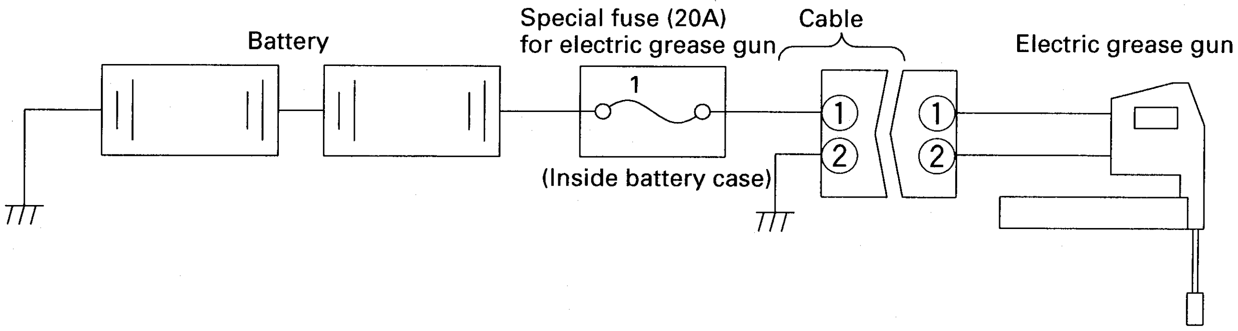
M-32 Electric grease gun does not work

★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
★ Always connect any disconnected connectors before going on the next step.
★ Check that there is grease before starting troubleshooting.
★ Check that fuse No. 1 for the electric grease gun is normal.



Cause	Remedy
Defective electric grease gun	Repair or replace
Defective contact or disconnection in wiring harness between CN (female) (2) and chassis	Repair or replace
Defective contact or disconnection in wiring harness between CN (female) (1) and fuse No.1	Repair or replace

M-32 Related electric circuit diagram



30 DISASSEMBLY AND ASSEMBLY

METHOD OF USING MANUAL

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

(Example)

REMOVAL OF ○○○○ ASSEMBLY........... Title of operation
⚠ .... Precautions related to safety when carrying out the operation
1. XXXX(1) .... Step in operation
   ★ .... Technique or important point to remember when removing XXXX (1).
2. △△△△ (2): .... ※1 Indicates that a technique is listed for use during installation
3. □□□□ assembly (3)
    .... Quantity of oil or water drained

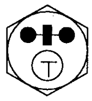
INSTALLATION OF ○○○○ ASSEMBLY ....Title of operation
- Carry out installation in the reverse order to removal.
  ※1 .... Technique used during installation
  ★ .... Technique or important point to remember when installing △△△△ (2).
- Adding water, oil .... Step in operation
  ★ .... Point to remember when adding water or oil
   .... Quantity when filling with oil and water

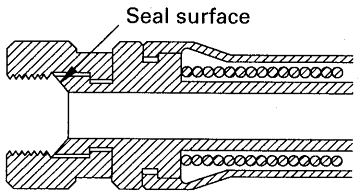
2. General precautions when carrying out installation or removal (disassembly or assembly) of units are given together as PRECAUTIONS WHEN CARRYING OUT OPERATION, so be sure to follow these precautions when carrying out the operation.

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

4. General tightening torque table (when using torque wrench)

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

Thread diameter	Width across flats	 SAD00481	 SAD00482
mm	mm	kgm	Nm
6	10	1.35 ± 0.15	13.2 ± 1.4
8	13	3.2 ± 0.3	31.4 ± 2.9
10	17	6.7 ± 0.7	65.7 ± 6.8
12	19	11.5 ± 1.0	112 ± 9.8
14	22	18.0 ± 2.0	177 ± 19
16	24	28.5 ± 3	279 ± 29
18	27	39 ± 4	383 ± 39
20	30	56 ± 6	549 ± 58
22	32	76 ± 8	745 ± 78
24	36	94.5 ± 10	927 ± 98
27	41	135 ± 15	1320 ± 140
30	46	175 ± 20	1720 ± 190
33	50	225 ± 25	2210 ± 240
36	55	280 ± 30	2750 ± 290
39	60	335 ± 35	3280 ± 340



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5. Table of tightening torques for flared nuts

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

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

6. Table of tightening torques for split flange bolts

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

Thread diameter	Width across flats	Tightening torque	
mm	mm	kgm	Nm
10	14	6.7 ± 0.7	65.7 ± 6.8
12	17	11.5 ± 1	112 ± 9.8
16	22	28.5 ± 3	279 ± 29

PRECAUTIONS WHEN CARRYING OUT OPERATION

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

1. Precautions when carrying out removal work

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

★ Precautions when handling piping during disassembly
Fit the following blind plugs into the piping after disconnecting it during disassembly operations.

1) Hoses and tubes using sleeve nuts

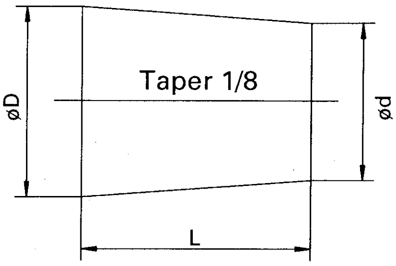
Nominal number	Plug (nut end)	Sleeve nut (elbow end) Use the two items below as a set
02	07376-50210	07221-20210 (Nut), 07222-00210 (Plug)
03	07376-50315	07221-20315 (Nut), 07222-00312 (Plug)
04	07376-50422	07221-20422 (Nut), 07222-00414 (Plug)
05	07376-50522	07221-20522 (Nut), 07222-00515 (Plug)
06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

2) Split flange type hoses and tubes

Nominal number	Flange (hose end)	Sleeve head (tube end)	Split flange
04	07379-00400	07378-10400	07371-30400
05	07379-00500	07378-10500	07371-30500

3) If the part is not under hydraulic pressure, the following corks can be used.

Nominal number	Part Number	Dimensions		
		D	d	L
06	07049-00608	6	5	8
08	07049-00811	8	6.5	11
10	07049-01012	10	8.5	12
12	07049-01215	12	10	15
14	07049-01418	14	11.5	18
16	07049-01620	16	13.5	20
18	07049-01822	18	15	22
20	07049-02025	20	17	25
22	07049-02228	22	18.5	28
24	07049-02430	24	20	30
27	07049-02734	27	22.5	34



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2. Precautions when carrying out installation work

- Tighten all bolts and nuts (sleeve nuts) to the specified (KES) torque.
- Install the hoses without twisting or interference.
- Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
- Bend the cotter pins and lock plates securely.
- When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2 – 3 drops of adhesive.
- When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
- Clean all parts, and correct any damage, dents, burrs, or rust.
- Coat rotating parts and sliding parts with engine oil.
- When press fitting parts, coat the surface with anti-friction compound (LM-P).
- After fitting snap rings, check that the snap ring is fitted securely in the ring groove.
- When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
- When using eyebolts, check that there is no deformation or deterioration, screw them in fully, and align the direction of the hook.
- When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.

★ When operating the hydraulic cylinders for the first time after reassembling cylinders, pumps and other hydraulic equipment removed for repair, always bleed the air as follows:

1. Start the engine and run at low idling.
2. Operate the work equipment control lever to operate the hydraulic cylinder 4 – 5 times, stopping the cylinder 100 mm from the end of its stroke.
3. Next, operate the hydraulic cylinder 3 – 4 times to the end of its stroke.
4. After doing this, run the engine at normal speed.

★ When using the machine for the first time after repair or long storage, follow the same procedure.

3. Precautions when completing the operation

- If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.
- If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
- If the piping or hydraulic equipment have been removed, always bleed the air from the system after reassembling the parts.
  ★ For details, see TESTING AND ADJUSTING, Bleeding air.
- Add the specified amount of grease (molybdenum disulphide grease) to the work equipment parts.

SPECIAL TOOL LIST

★ Tools with part number 79○T-○○○-○○○○ cannot be supplied (they are items to be locally manufactured).
★ Necessity: ■: Cannot be substituted, should always be installed (used).
●: Extremely useful if available, can be substituted with commercially available part.
★ New/remodel: N: Tools with new part numbers, newly developed for this model.
★ R: Tools with upgraded part numbers, remodeled from items already available for other models.
★ Blank: Tools already available for other models, used without any modification.
★ Tools marked ○ in the Sketch column are tools introduced in special sketches (See SKETCHES OF SPECIAL TOOLS).

Component	Symbol			Part No.	Part Name	Neces-sity	Q'ty	New/remodel	Sketch	Nature of work, remarks	
Engine assembly	A	1		795-931-1100	Seal puller assembly		1			Removal, installation	Installation of engine rear seal
		2		795-931-1210	Seal assembly tool		1				Press fitting of engine rear seal
				01050-31645	Bolt		3				
				01050-31625	Bolt		3				
		3		795-931-1220	Seal assembly tool		1				
				01050-31645	Bolt		3				
				01050-31625	Bolt		3				
		4		790-331-1110	Wrench		1				Tightening of cylinder head bolt
Swing machinery assembly	F			796T-626-1110	Push tool		1	N	○	Disassembly, assembly	Press fitting of bearing
Final drive assembly	J	1		796-627-1310	Wrench		1	N		Disassembly, assembly	Removal, installation of round nut
		2	1	796T-627-1330	Push tool		1	N	○		Pushing of bearing inner race
			2	790-101-2510	Block		1				
			3	790-101-2550	Leg		2				
			4	790-101-2740	Adapter		2				
			5	790-101-2560	Nut		2				
			6	790-101-2570	Washer		4				
			7	790-101-2102	Jack		1				
			8	790-101-1102	Pump		1				
		3		790-331-1110	Wrench		1				Tightening of cover bolt
		4		796-627-1020	Installer		1				Installation of floating seal
Idler assembly	L	1		791-575-1520	Installer		1			Disassembly, assembly	Installation of floating seal
		2		791-601-1000	Oil pump		1				Charging with oil
Track roller assembly		3		796-570-1020	Installer		1			Disassembly, assembly	Installation of floating seal
		4		791-601-1000	Oil pump		1				Charging with oil
Carrier roller assembly		5		790-302-1500	Wrench kit		1			Disassembly, assembly	Removal, installation of nut
				• 09003-05560	• Wrench		1				
		6		796-670-1020	Installer		1				Installation of floating seal
		7		796T-630-1130	Push tool		1	N	○		Press fitting of ring
		8		791-601-1000	Oil pump		1				Charging with oil

Component		Symbol			Part No.	Part Name	Neces-sity	Q'ty	New/ remodel	Sketch	Nature of work, remarks	
Recoil spring assembly		M	1		791-685-8005	Compressor (B)		1			Disassembly, assembly	Removal, installa-tion of recoil spring
					791-635-3160	Extension						
					790-101-1600	Cylinder (70 ton)						
					790-101-1102	Pump		1				
			2		790-201-1500	Push tool kit		1				Installation of piston dust seal
					• 790-201-1660	• Plate						
					• 790-101-5021	• Grip						
					• 01010-50816	• Bolt						
Track shoe assembly		R			791-646-3000	Remover & Installer		1			Removal, installation	Removal, press fitting of master pin
					790-101-1300	Cylinder		1				
					790-101-1102	Pump		1				
Main pump	Hydraulic pump assembly	S	1		796-660-1200	Oil stopper assembly		1	N		Removal, installation	Shutting off hydraulic oil
					• 796-460-1210	• Oil stopper		1				
					• 796-660-1210	• Rod		1	N			
					• 20Y-60-21330	• Rod assembly		1				
			2		790-201-2700	Push tool kit		1				Press fitting of shaft oil seal
					• 790-201-2740	• Spacer		1				
			3	1	790-501-5000	Unit repair stand (for 100 V)	■	1			Disassembly, assembly of pump assembly	
					790-501-5200	Unit repair stand (for 220, 240 V)						
				2	790-901-2110	Bracket	■	1				
				3	793-617-1110	Plate	■	1			For front pump	
				4	796-660-1430	Plate	■	1			For rear pump	
			4	1	799-201-3610	Bolt	■	1			Disassembly, assembly of cylinder block assembly	
				2	796-465-1110	Washer	■	1				
				3	01643-33080	Washer	■	1				
				4	01643-32060	Washer	■	2				
				5	01582-02016	Nut	■	1				
			5	1	796-720-2250	Screwdriver	■	1			Removal, installtion of cover	
				2	796-720-2220	Socket	■	1				
			6	1	791-463-1100	Holder	■	1			Removal, installtion of servo piston rod	
				2	791-463-1150	Plate	■	1				
				3	791-463-1160	Bolt	■	1				
			7		790-201-2700	Push tool kit	■	1			Press fitting of bearing	
					• 790-201-2740	Spacer	■	1				

Component		Symbol				Part No.	Part Name	Neces-sity	Q'ty	New/ remodel	Sketch	Nature of work, remarks
Main pump	Hydraulic pump assembly	S	8			796-660-1400	Gauge assembly	■	1			Positioning servo piston swash plate angle
						• 796-660-1440	• Plate	■	1			
						• 796-660-1460	• Plate	■	1			
						• 01010-51030	• Bolt	■	1			
						• 01010-51835	• Bolt	■	1			
			9			790-101-5201	Push tool kit	■	1			Press fitting of needle bearing
						• 790-101-5251	• Plate	■	1			
						• 790-101-5221	• Grip	■	1			
						• 01010-51225	• Bolt	■	1			
			10			796-730-2300	Wrench assembly	■	1			Measuring rotating torque of shaft
						• 796-730-2140	• Wrench	■	1			
						• 01306-00616	• Bolt	■	2			
			11			799-301-1600	Oil leak tester	■	1			Leak test of servo valve
			12			790-201-2700	Push tool kit	■	1			Press fitting of oil seal
						• 790-201-2740	Spacer	■	1			
Travel motor	Travel motor assembly		25	1		790-501-5000	Unit repair stand		1			For Japan
				2		790-501-5200	Unit repair stand		1			For Overseas
				3		790-901-2110	Bracket		1			Disassembly, assembly
				4		790-901-2121	Plate		1	N		
	End cover		26	1		796T-660-1550	Plate		1	N	○	Raising end cover
				2		01050-52035	Bolt		2			
				3		04530-11222	Eyebolt		1			
				4		01580-11210	Nut		1			
	Retainer screw		27	1		796-720-2250	Screwdriver		1			Tightening retainer screw
				2		796-720-2220	Socket		1			
	Brake piston		28			799-301-1600	Oil leak tester		1			Remove brake piston
	Drive shaft		29			796T-660-1310	Push tool		1	N	○	Disassembly, pulling out drive shaft
	Main bearing		30			791-685-8310	Push tool		1			Press fitting of main bearing
	Sub bearing inner race		31			790-201-2700	Push tool kit		1			Press fitting of sub bearing inner race
						• 790-101-2750	• Spacer		1			
	Drive shaft assembly		32	1		796T-660-1320	Guide		1	N	○	Assembly of drive shaft assembly
				2		796-660-1530	Eyebolt		1	N		
				3	1	796T-660-1330	Plate		1	N	○	
					2	01580-11008	Nut		1			
					3	790-201-3200	Bolt kit		1			
						• 790-201-3240	• Bolt		1			

Component		Symbol			Part No.	Part Name	Neces-sity	Q'ty	New/ remodel	Sketch	Nature of work, remarks	
Travel motor	Brake piston	S	33	1	796-660-1350	Positioner		1	N		Positioning of brake piston	
				2	796-660-1360	Plate		1	N			
				3	796-660-1370	Pin		2	N			
				4	796-660-1380	Pin		1	N			
	Dowel pin		34		796T-660-1340	Push tool		1	N	○	Knocking in dowel pin	
	Valve plate		35		796-660-1390	Pin		2	N		Securing valve plate	
	Case and end cover		36		796-660-1410	Pin		1	N		Assembly of case and end cover	
	Brake		37	1	796T-660-1480	Pump adapter		1	N	○	Releasing brake	
					• 790-101-1430	• Coupler assembly		1				
					• 796-660-1490	• Nipple		1	N			
					• 799-101-5130	• Gauge		1				
					• 799-101-5160	• Nipple		1				
					• 790-301-1190	• Nipple		1				
					• 790-301-1660	• Tee		1				
					• 205-70-51390	• Nipple		1				
					• 790-301-1271	• Joint		1				
					• 07002-01023	• O-ring		1				
				2	790-101-1102	Pump		1				
	Drive shaft		38		01435-01016	Bolt		1			Measuring drive shaft rotating torque	
	Oil seal		39		790-201-2700	Push tool kit		1			Press fitting of oil seal	
					• 790-201-2750	• Spacer		1				
Center swivel joint assembly		T			790-101-2501	Push tool kit		1			Disassembly, assembly	Disconnection of shaft and rotor
					• 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				
Hydraulic cylinder assembly		U	1		790-502-1003	Cylinder repair stand		1			Disassembly, assembly	Securing of cylinder
			2		790-720-1000	Expander		1				Installation of piston ring
			3		796-720-1680	Ring		1				Boom, bucket
					07281-01589	Clamp		1				
					796-720-1690	Ring		1				Arm
					07281-02169	Clamp		1				

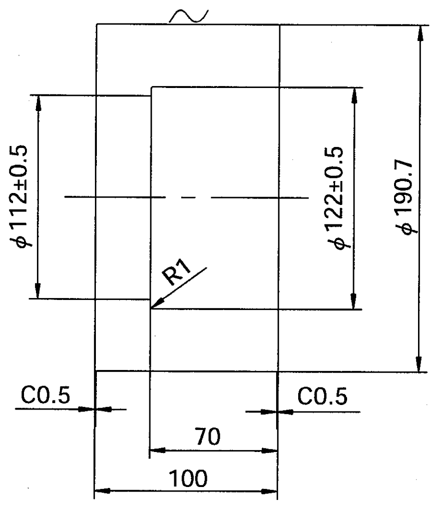
Component	Symbol		Part No.	Part Name	Neces-sity	Q'ty	New/ remodel	Sketch	Nature of work, remarks	
Hydraulic cylinder assembly	U	4	790-201-1702	Push tool kit		1			Disassembly, assembly	Press fitting of coil bushing
			• 790-201-1861	• Push tool		1				Boom, bucket
			• 790-101-5021	• Grip		1				
			• 01010-50816	• Bolt		1				
			• 790-445-4210	• Push tool		1				Arm (PC400-6)
			• 790-101-5421	• Grip		1				
			• 01010-51240	• Bolt		1				
			791-863-1130	• Push tool		1				Arm (PC450-6)
			790-101-5221	• Grip		1				
			01010-51225	• Bolt		1				
		5	790-201-1500	Push tool kit		1				Installation of dust seal
			• 790-201-1670	• Plate		1				Boom, bucket
			• 790-101-5021	• Grip		1				
			• 01010-50816	• Bolt		1				
			• 790-201-1970	• Plate		1	N			Arm (PC400-6)
			• 790-201-1680	• Plate		1				Arm (PC450-6)
		6	790-102-4300	Wrench assembly		1				Removal and installation of piston
			790-102-4310	Pin		1				
Work equipment assembly, boom assembly	V		796-670-1100	Remover assembly		1	N		Removal, installation	Removal of boom foot pin
			• 796-670-1110	• Sleeve		1	N			
			• 796-670-1120	• Plate		1	N			
			• 796-670-1130	• Screw		1	N			
			• 791-775-1150	• Adapter		1				
			• 01643-33080	• Washer	1					
			• 01803-13034	• Nut		1				
			790-101-4000	Puller		1				
			790-101-1102	Pump						
Components related to air conditioner	X		799-703-1200	Service tool kit		1			Removal, installation	Charging with freon gas (R134a)
			799-703-1100	Vacuum pump (100V)		1				
			799-703-1100	Vacuum pump (220V)		1				
			799-703-1120	Vacuum pump (240V)		1				
			799-703-1400	Gas leak detector		1				

Component	Symbol		Part No.	Part Name	Neces-sity	Q'ty	New/remodel	Sketch	Nature of work, remarks	
Swing motor assembly	Y	1	790-501-5200	Unit repair stand	●	1			Dis-assembly, assembly	Swing motor
			790-901-2110	Bracket	●	1				
			790-401-1470	Plate	●	1				
	Y	2	796-730-2120	Screwdriver	■	1			Removal, instal-lation	Removal, installation of retainer fitting screw
			796-720-2220	Socket	■	1				
	Y	3	796T-660-1510	Pump adapter	■	1		○	Dis-assembly, assembly	Release of brake
			• 790-101-1430	• Coupler assembly	■	1				
			• 796-660-1490	• Nipple	■	1				
			• 799-101-5130	• Gauge	■	1				
			• 799-101-5160	• Nipple	■	1				
			• 790-301-1190	• Nipple	■	1				
			• 790-301-1660	• T-piece	■	1				
			• 205-70-51390	• Nipple	■	1				
			• 790-301-1210	• Joint	■	1				
			• 07002-01423	O-ring	■	1				
			790-101-1102	Pump	■	1				
	Y	4	790-201-2850	Spacer	■	1				Press fit of main bearing inner race
	Y	5	790-201-2860	Spacer	■	1				Installation of sub bearing outer race
	Y	6	790-201-2840	Spacer	■	1				Press fit of sub bearing inner race
	Y	7	790-101-2510	Block	■	1				Pushing out of drive shaft
			791-600-1120	Bolt	■	2				
			01643-31845	Washer	■	6				
			01580-11613	Nut	■	6				
			790-105-2100	Jack	■	1				
			790-101-1102	Pump	■	1				
	Y	8	01435-01220	Bolt	■	1				Judgment of revolving torque of drive shaft
	Y	9	790-201-1500	Push tool kit	■	1				Press fit of oil seal
			• 790-201-1590	• Plate	■	1				
			• 790-101-5021	• Grip	■	1				
			• 01010-50816	• Bolt	■	1				
	Y	10	796T-660-1520	Plate	■	1		○		Fixing of housing
			01010-51020	Bolt	■	2				
			01010-51835	Bolt	■	4				
			01580-11815	Nut	■	4				
	Y	11	796T-660-1540	Push tool	■	1		○		Press fit of dowel pin
	Y	12	799-301-1600	Oil leak tester	■	1			Removal, installation	Removal of brake piston

SKETCHES OF SPECIAL TOOLS

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

F Push tool



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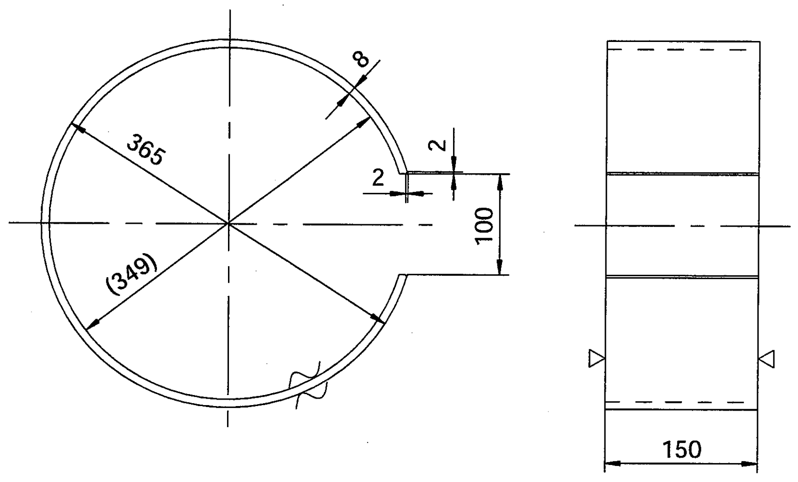
HEAT TREATMENT ---	MATERIAL STKM13A
PART NAME PUSH TOOL	QTY 1
796T-626-1110	△

J2-1 Push tool



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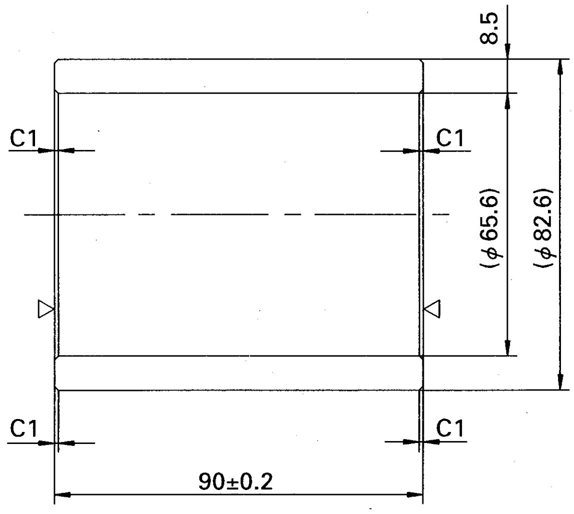
HEAT TREATMENT --	MATERIAL STKM13A
PART NAME PUSH TOOL	QTY 1
796T-627-1330	△

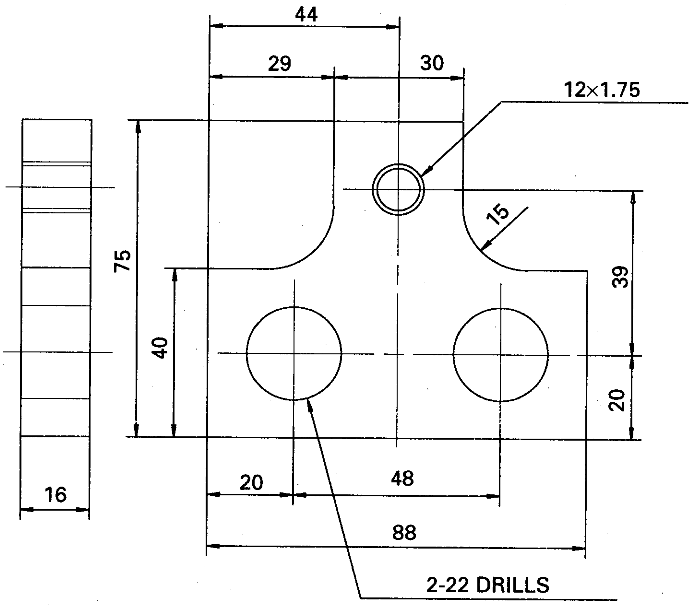
L7 Push tool



CDP00508

HEAT TREATMENT ---	MATERIAL STKM13A
PART NAME PUSH TOOL	QTY 1
796T-630-1130	△

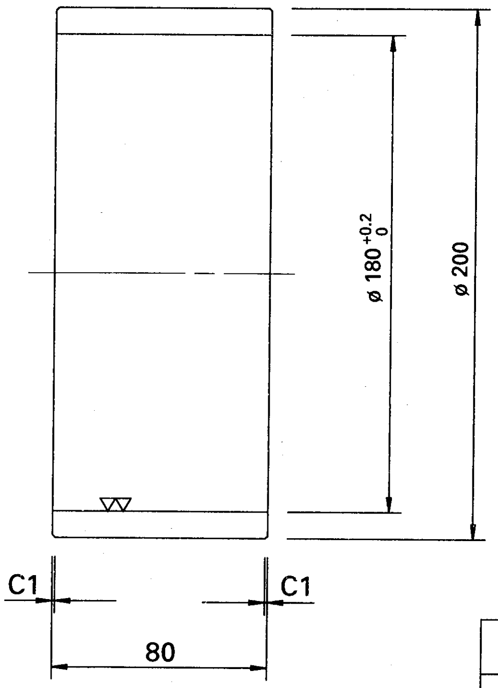
S26-1 Plate



CKP00789

HEAT TREATMENT	MATERIAL SS400P
PART NAME PLATE	Q'TY 1
PART NO. 796T-660-1550	

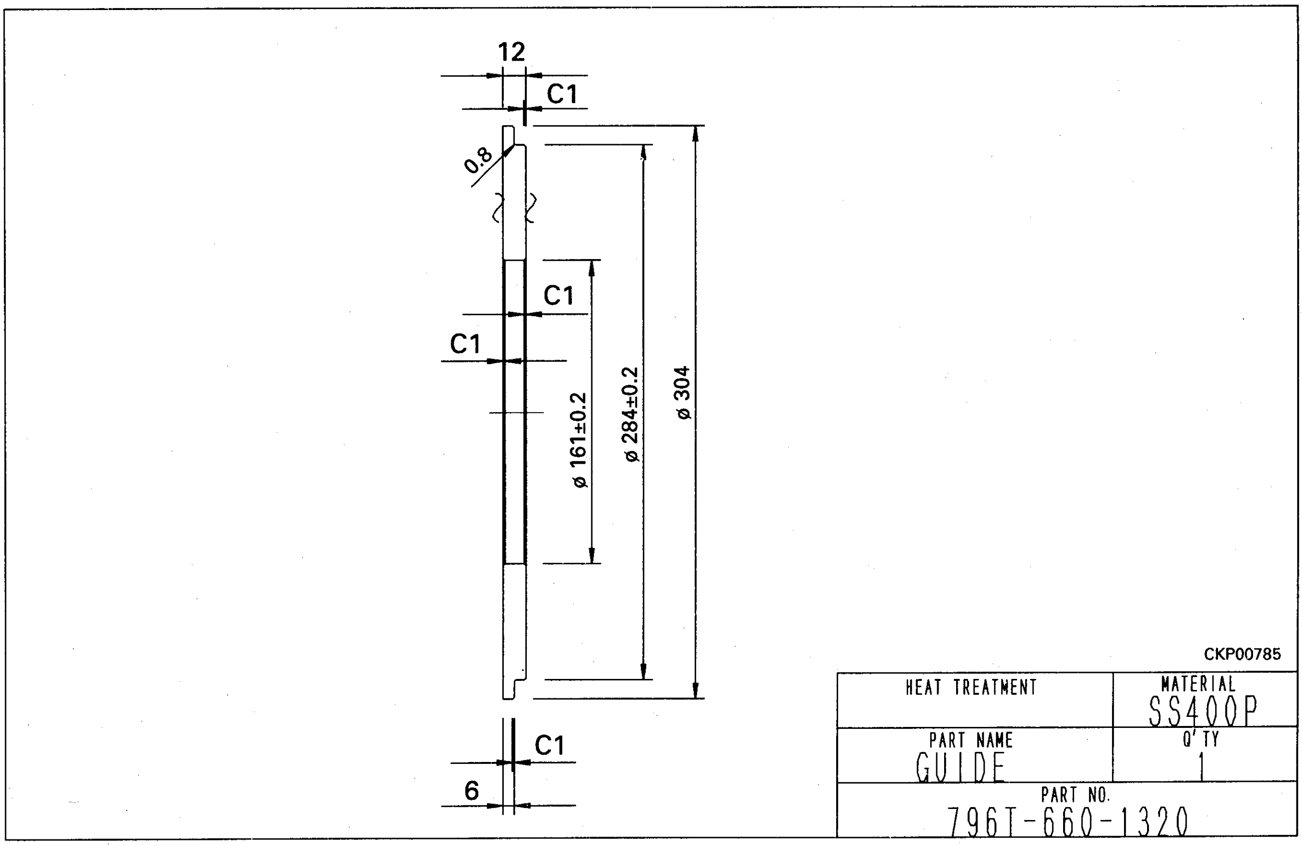
S29 Push tool



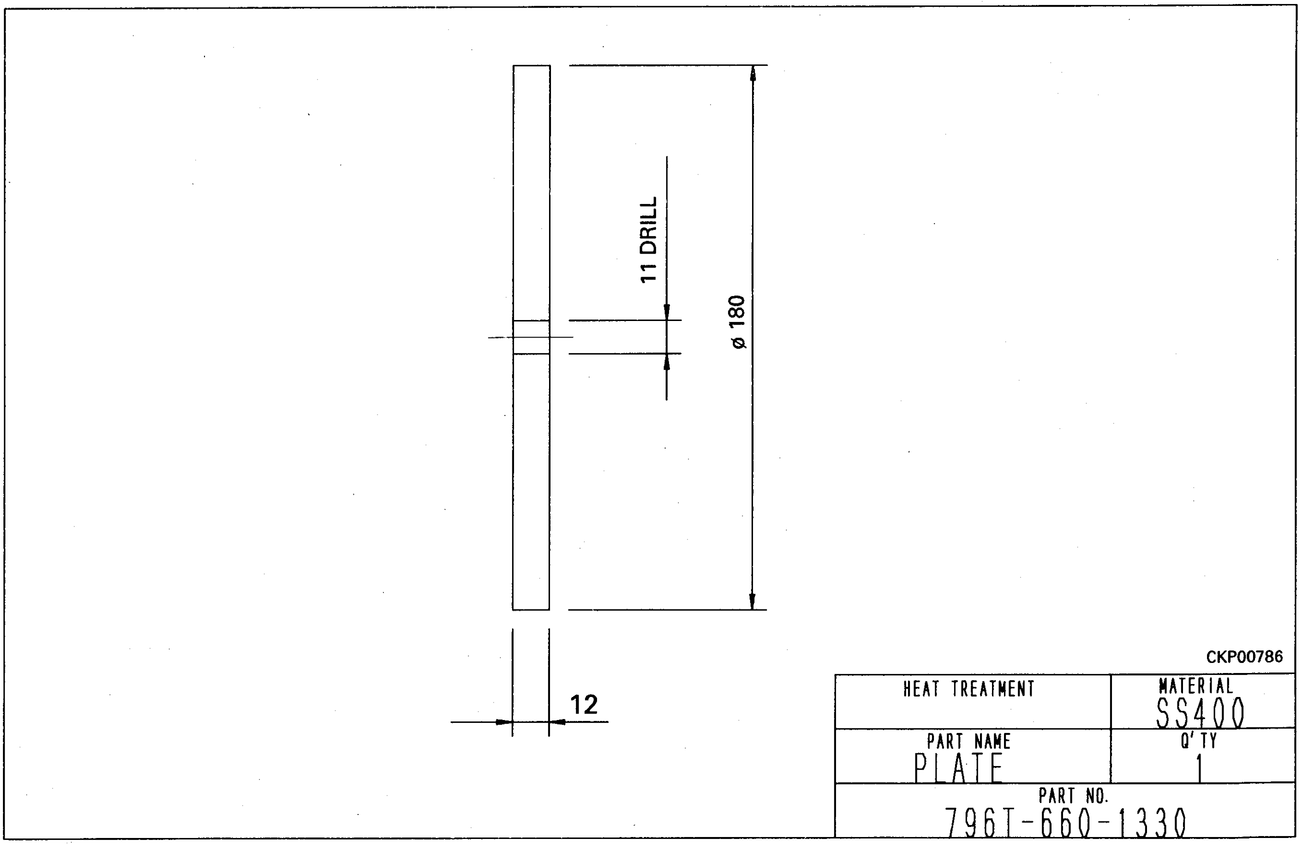
CKP00784

HEAT TREATMENT	MATERIAL STKM16A
PART NAME PUSH TOOL	Q'TY 1
PART NO. 796T-660-1310	

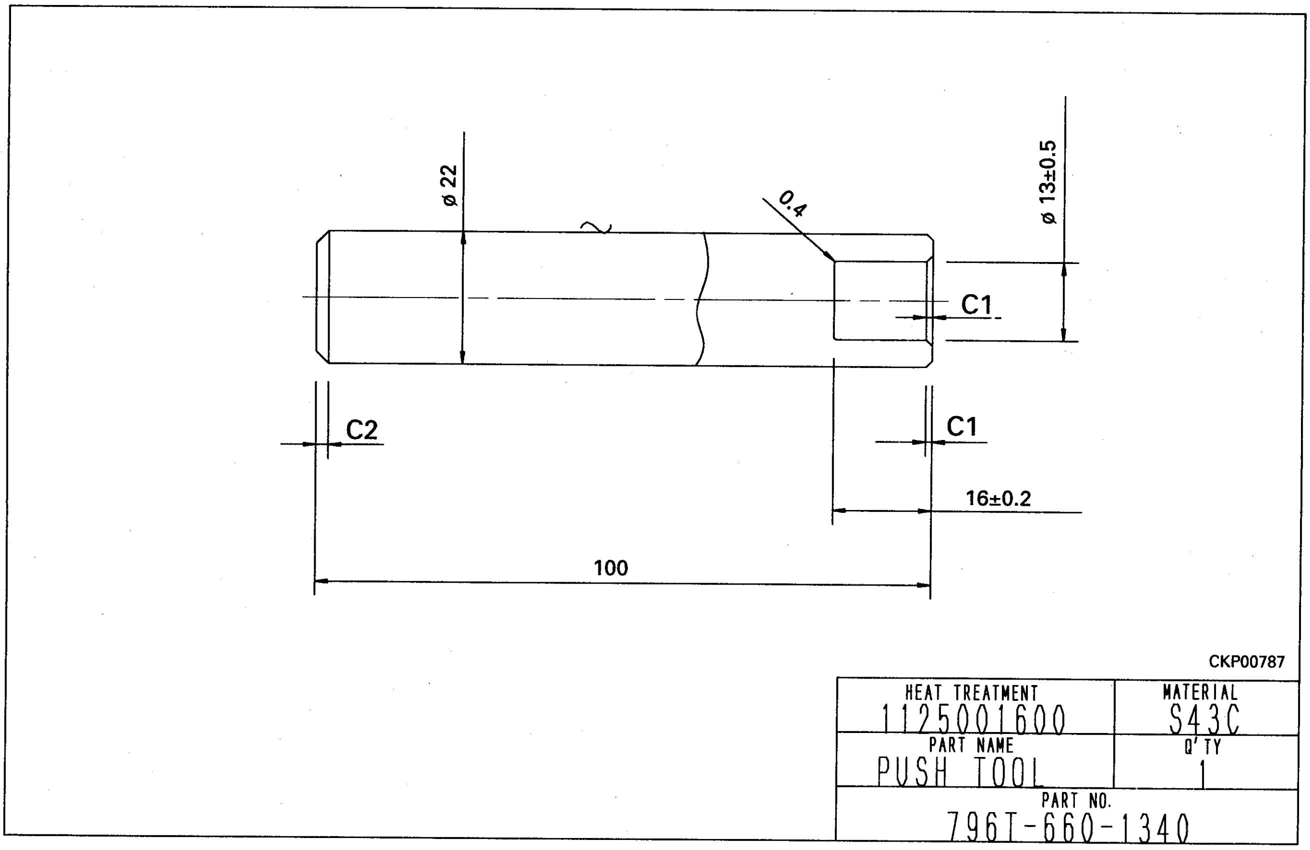
S32-1 Guide



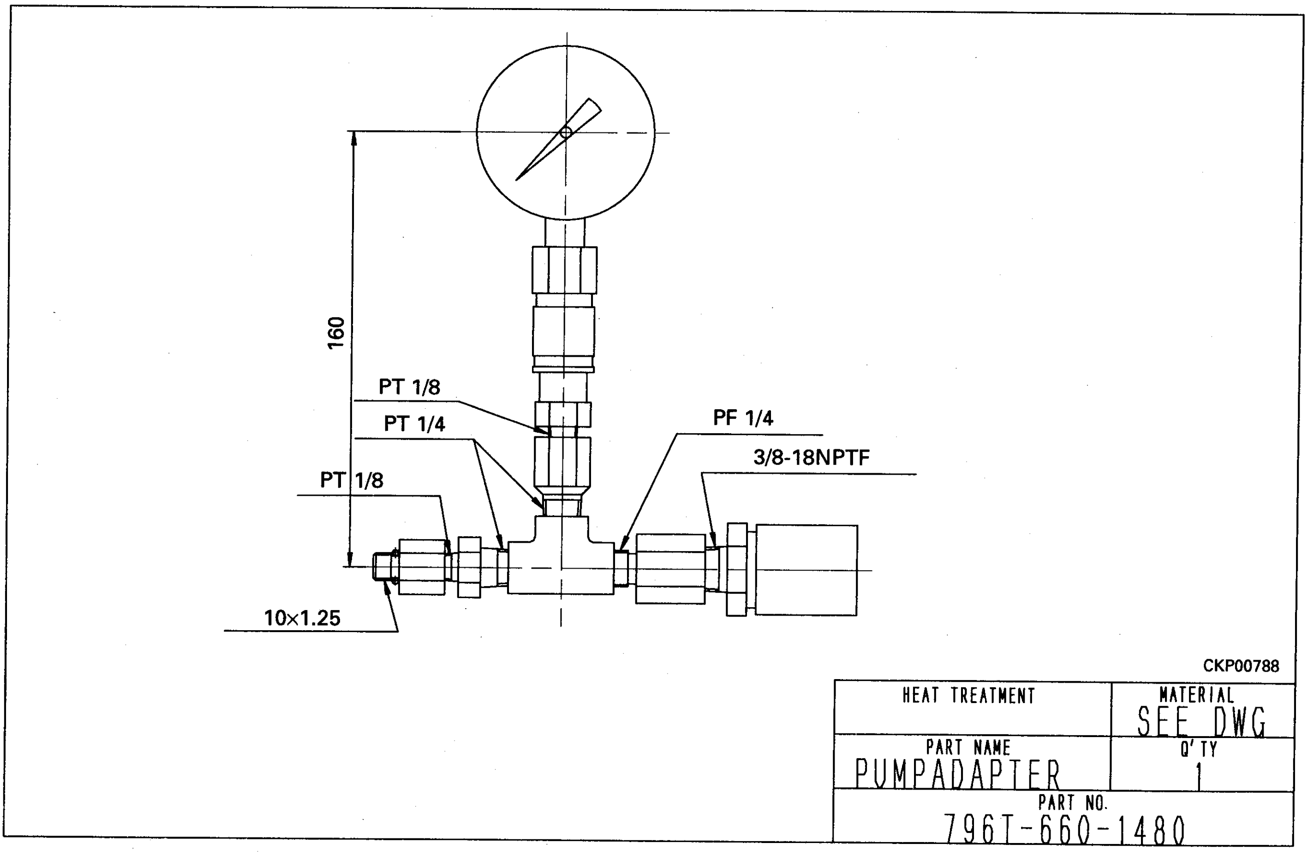
S32-3-1 Plate



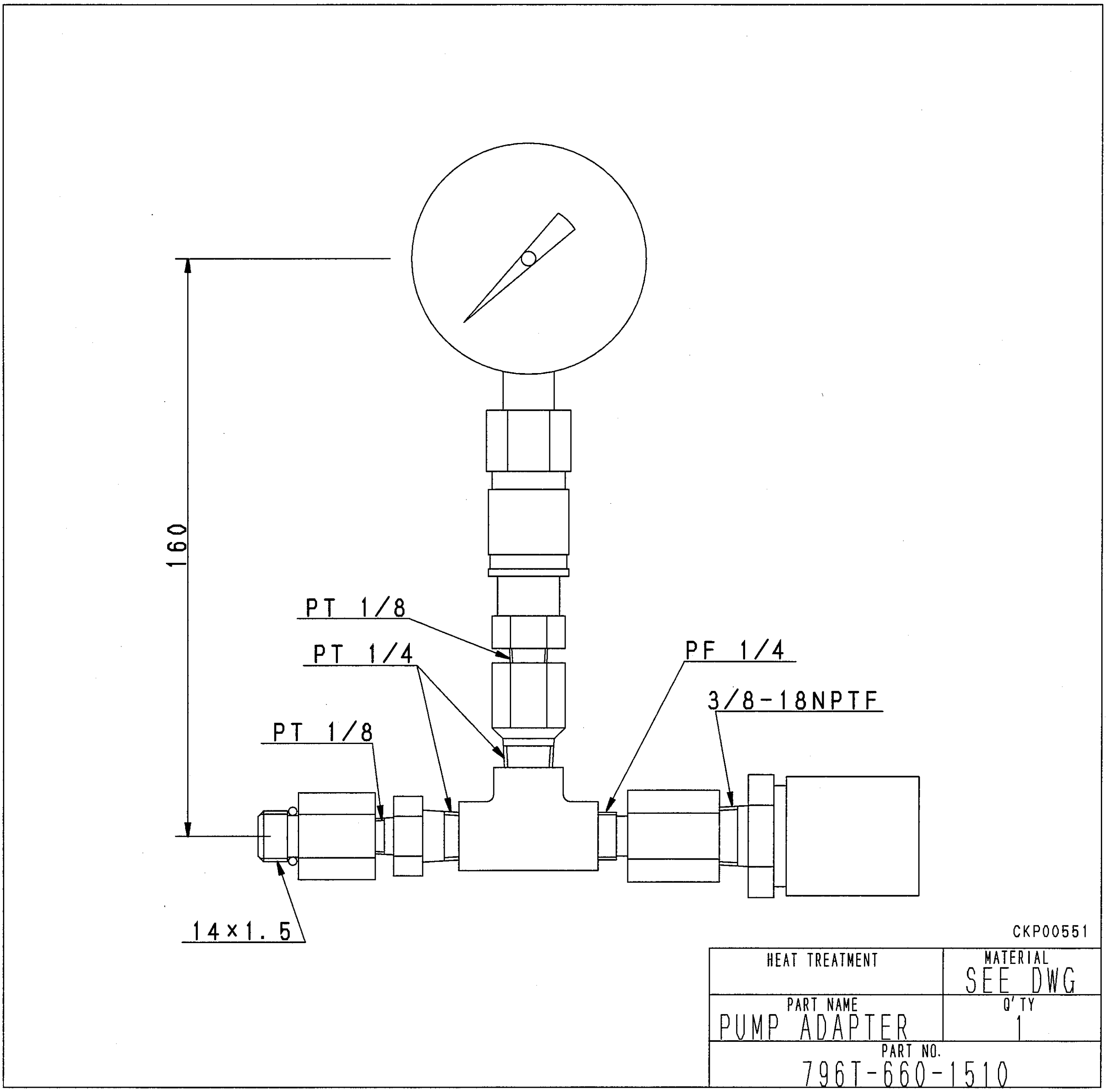
S34 Push tool



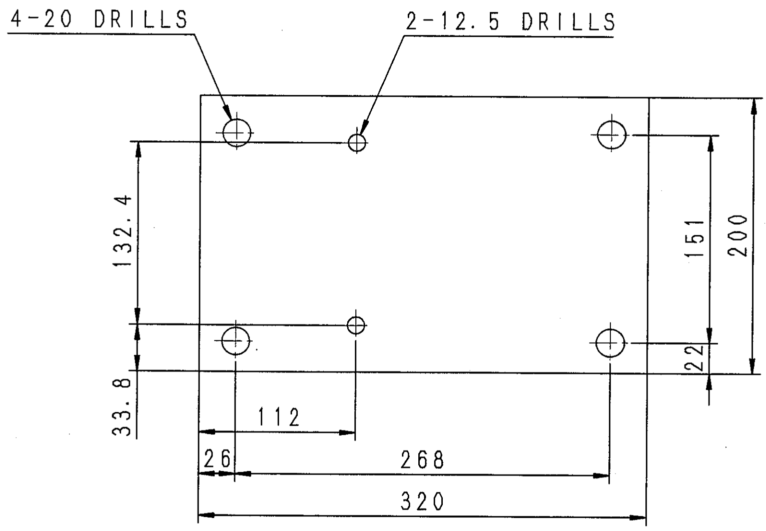
S37-1 Pump adapter



Y3 Pump adapter



Y10 Plate

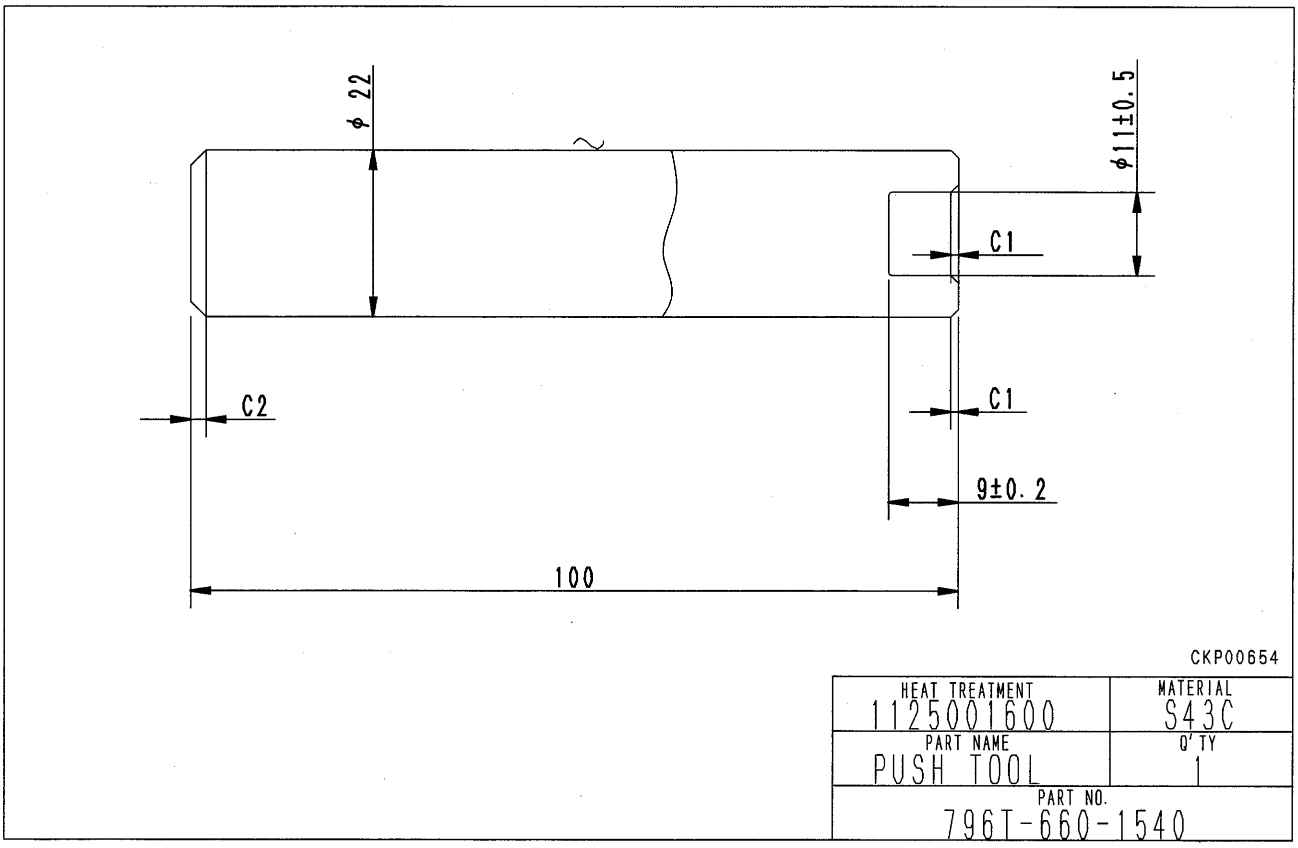


DWP01449

t9

HEAT TREATMENT ----	MATERIAL SS400P
PART NAME PLATE	QTY 1
796T-660-1520 △	

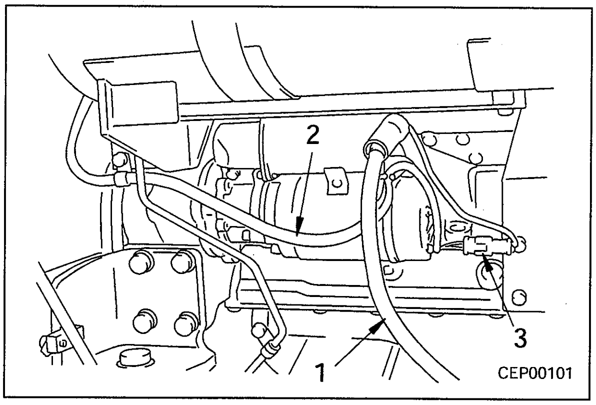
Y11 Push tool

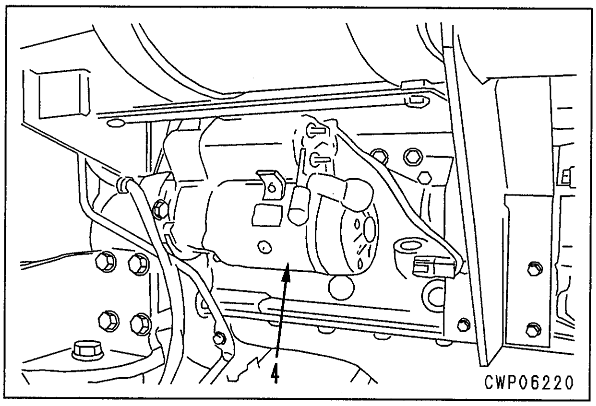


REMOVAL OF STARTING MOTOR ASSEMBLY

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

1. Remove undercover under engine.
2. Disconnect starting motor wiring (1) and (2), and connector (3) (CN-M2).
3. Remove mounting bolts of starting motor assembly (4), then remove starting motor assembly from undercover.

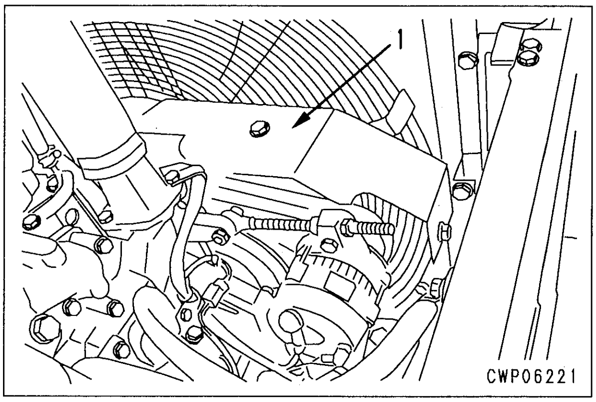




INSTALLATION OF STARTING MOTOR ASSEMBLY

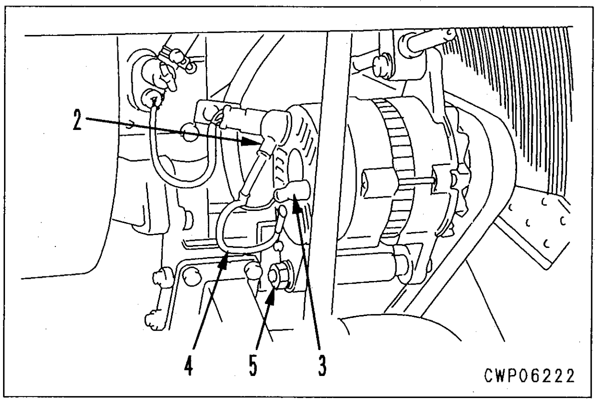
- Carry out installation in the reverse order to removal.

REMOVAL OF ALTERNATOR ASSEMBLY



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

1. Open engine hood.
2. Remove guard (1).
3. Disconnect alternator wiring (2) (terminal B), (3) (terminal R), (4) (terminal E).
4. Loosen mount bolt and nut (5).
5. Loosen locknut (6), then turn adjustment nut (7), and remove 2 bolts (8) from alternator (9). ※ 1
6. Remove mount bolt and nut (5), then remove alternator assembly (9).

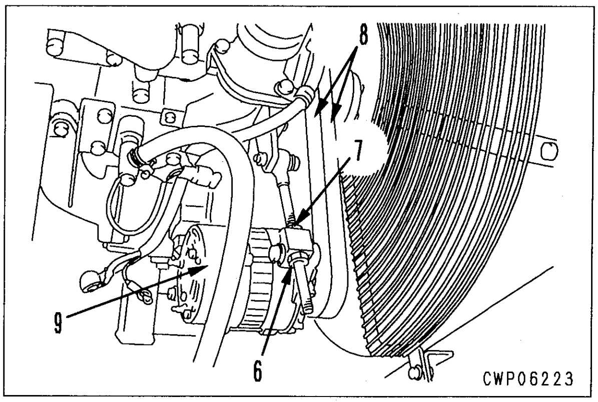


INSTALLATION OF ALTERNATOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

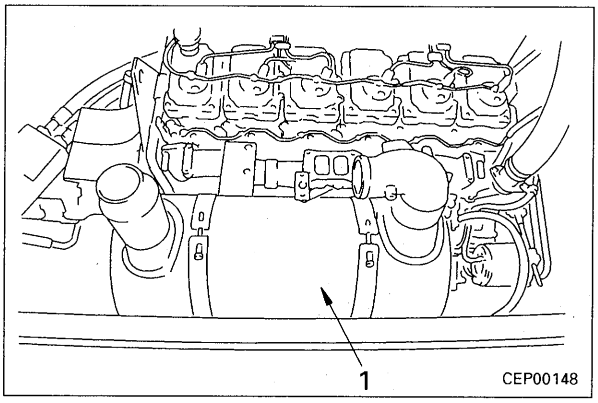
★ Adjust the fan belt tension.
For details, see TESTING AND ADJUSTING, Testing and adjusting fan belt tension.

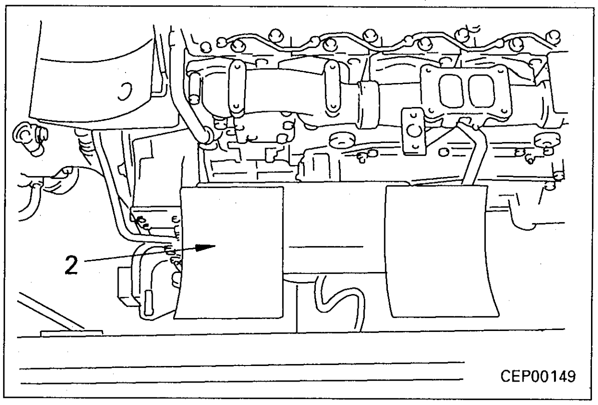


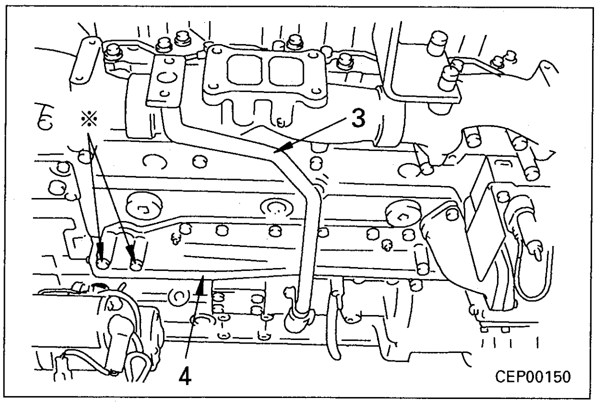
REMOVAL OF ENGINE OIL COOLER ASSEMBLY

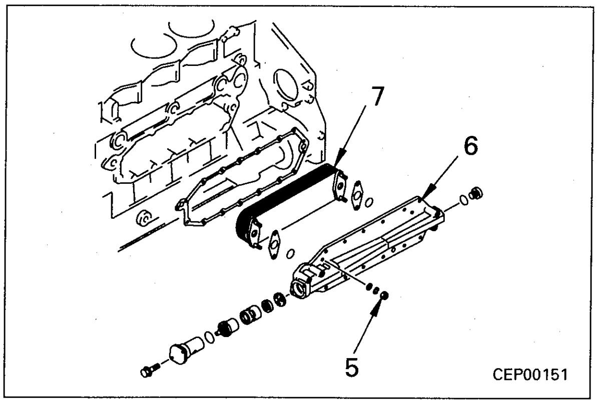
1. Drain coolant.
2. Remove turbocharger assembly.
   For details, see REMOVAL OF TURBOCHARGER ASSEMBLY.
3. Remove muffler assembly (1). ※ 1

   kg Muffler assembly: **45 kg**
4. Remove muffler bracket (2).
5. Remove turbocharger lubrication tube (3). ※ 2
6. Remove engine oil cooler assembly (4). ※ 3
7. Remove nut (5), then remove oil cooler core (7) from cover (6). ※ 4









INSTALLATION OF ENGINE OIL COOLER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

kgm Muffler band:
9.8 ± 2.0 Nm {1.0 ± 0.2 kgm}

※ 2

kgm Hose clamp:
4.4 ± 0.5 Nm {0.45 ± 0.05 kgm}

※ 3

★ 8-mm bolts are used for the 2 bolts marked ※, so be careful not to tighten them too far. (The other bolts are 10 mm bolts)

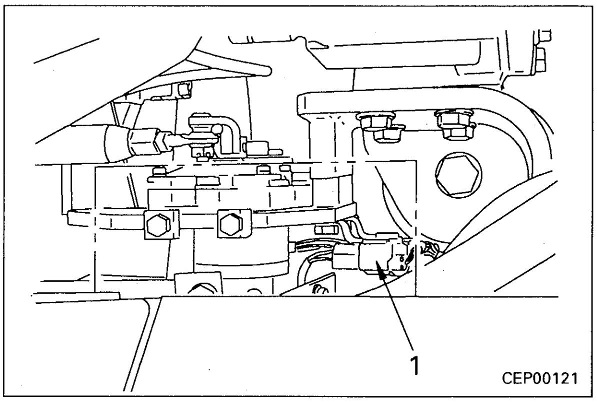
※ 4

kgm Cooler core mounting nut:
43.1 ± 15.7 Nm {4.4 ± 1.6 kgm}

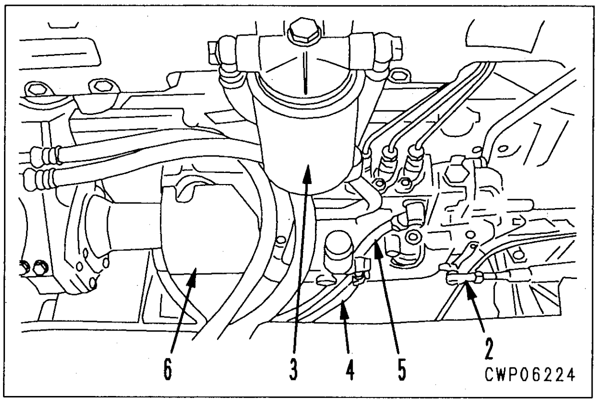
- **Refilling with water**
  Add water through water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.

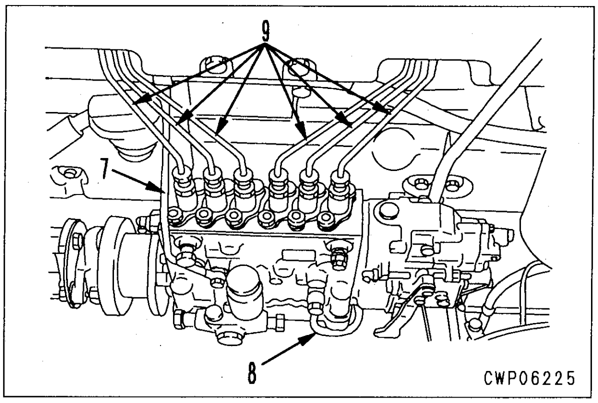
REMOVAL OF FUEL INJECTION PUMP ASSEMBLY

1. Open engine hood.
2. Adjust fuel injection timing.
   For details, see TESTING AND ADJUSTING, Testing, adjusting fuel injection timing.
   ⚠ After adjusting the fuel injection, disconnect the cable from the negative (–) terminal of the battery.
3. Disconnect governor motor wiring connector (1) (CN-E05) (top).

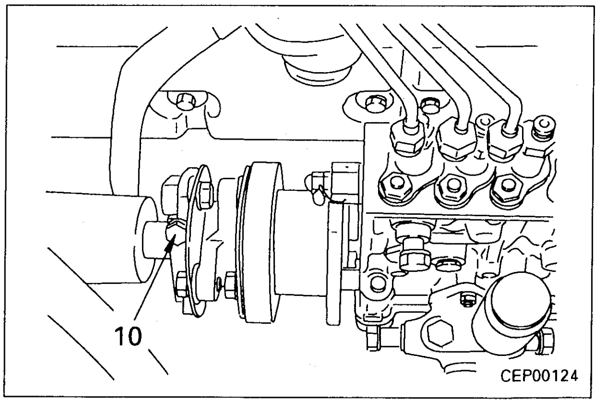


4. Disconnect governor motor spring rod (2). ※ 1
   - ★ Do not rotate the shaft of the governor motor suddenly.
   - ★ Always disconnect governor motor connector CN-E05 before disconnecting the rod.
   - ★ Check the position of the lever hole.
5. Remove fuel filter (3) together with bracket and hose.
   - ★ Disconnect the hose at the injection pump end. ※ 2
6. Disconnect fuel supply hose (4) and return hose (5). ※ 3
   - ★ There is no stop valve installed to the supply hose, so stop the fuel.
7. Remove cover (6) and injection pump lubrication tubes (7) and (8). ※ 4
8. Disconnect 6 delivery tubes (9). ※ 5



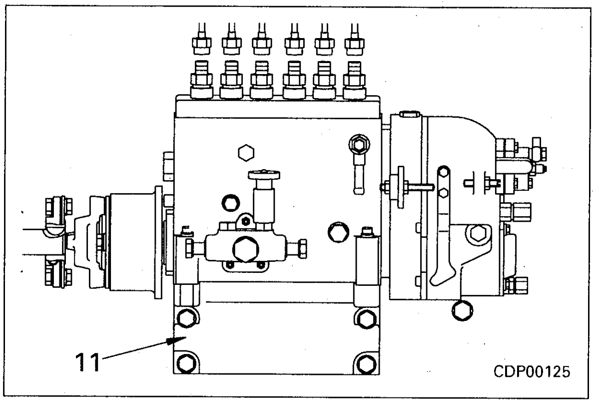


9. Loosen coupling bolt (10).

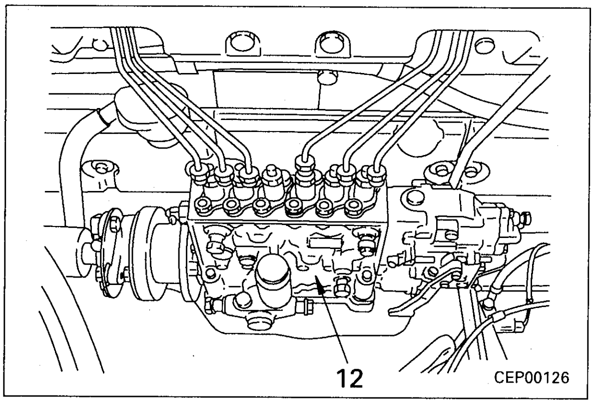


10. Remove engine undercover, then remove bracket (11) from below.

⚠ The bracket is secured by a dowel pin, so be extremely careful to ensure safety and hold it securely by hand to prevent it from falling when it is removed.



11. Pull out coupling portion slowly from shaft then pull fuel injection pump assembly (12) up to remove.



INSTALLATION OF FUEL INJECTION PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

★ Adjust the spring rod.
For details, see TESTING AND ADJUSTING, Adjusting governor motor lever stroke.

★ Connect the spring rod before connecting the connector.

※ 2

kgm Joint bolt:
22.1 ± 2.5 Nm {2.25 ± 0.25 kgm}

※ 3

kgm Joint bolt:
22.1 ± 2.5 Nm {2.25 ± 0.25 kgm}

※ 4

kgm Boost compensation tube nut

- Intake manifold end:
24.5 ± 9.8 Nm {2.5 ± 1.0 kgm}
- Injection pump end:
10.3 ± 2.5 Nm {1.05 ± 0.25 kgm}

kgm Lubrication tube joint bolt
: **27.0 ± 2.5 Nm {2.75 ± 0.25 kgm}**
(injection pump end)
: **29.4 ± 4.9 Nm {3.0 ± 0.5 kgm}**
(cylinder block end)

※ 5

kgm Delivery tube sleeve nut:
23.5 ± 1.0 Nm {2.4 ± 0.1 kgm}

※ 6

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

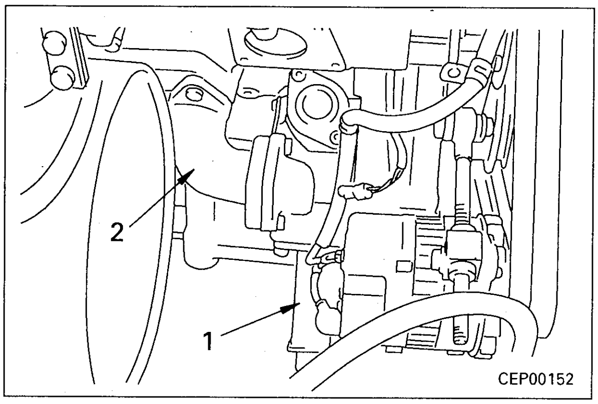
★ Bleed the air from the fuel circuit.

※ 7

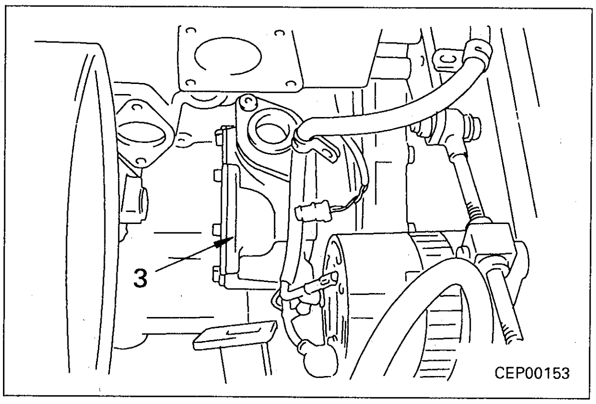
kgm Coupling bolt:
88.3 ± 4.9 Nm {9.0 ± 0.5 kgm}

REMOVAL OF WATER PUMP ASSEMBLY

1. Drain coolant.
2. Open engine hood.
3. Remove thermostat assembly.
   For details, see REMOVAL OF THERMOSTAT ASSEMBLY.
4. Remove inlet tube (1) and outlet tube (2).
5. Remove water pump assembly (3). ※1



CEP00152



CEP00153

INSTALLATION OF WATER PUMP ASSEMBLY

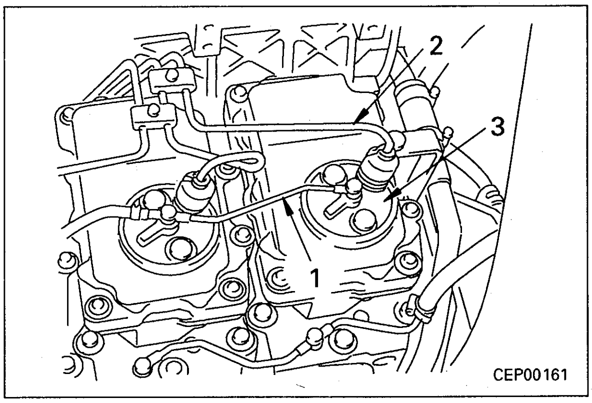
- Carry out installation in the reverse order to removal.

※1

kgm Water pump assembly mounting bolt:
66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}

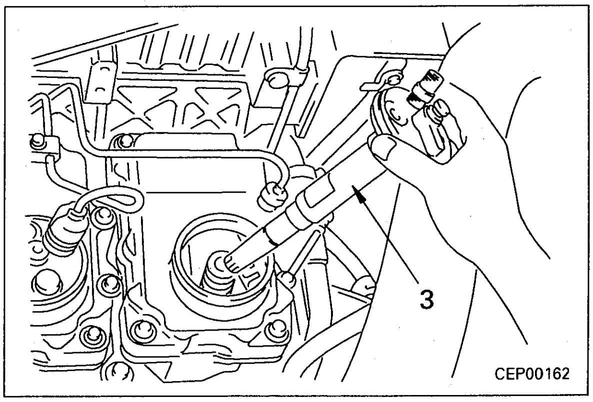
- **Refilling with water**
  ★ Add water through the water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.

REMOVAL OF NOZZLE HOLDER ASSEMBLY



1. Open engine hood.
2. Remove spill tube (1).
3. Disconnect delivery tube (2) of nozzle holder to be removed. ※1
4. Remove nozzle holder assembly (3). ※2

INSTALLATION OF NOZZLE HOLDER ASSEMBLY



- Carry out installation in the reverse order to removal.

※1

kgm Delivery tube mounting sleeve nut:
23.6 ± 1.0 Nm {2.4 ± 0.1 kgm}

※2

Coat the thread of the nozzle holder mounting bolt with **EO-30CD**.

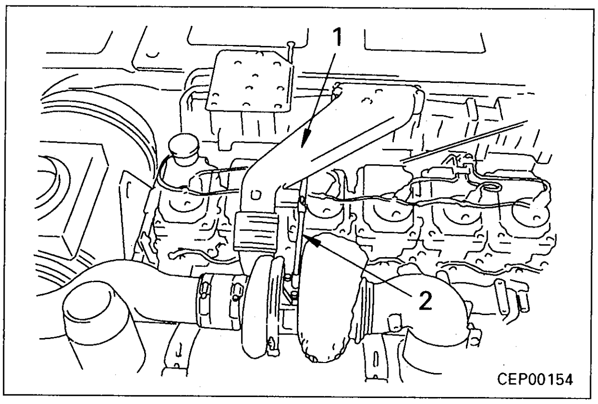
★ Tighten the nozzle holder mounting bolts uniformly in turn.

kgm Nozzle holder mounting bolt:
24.5 ± 4.9 Nm {2.5 ± 0.5 kgm}

REMOVAL OF TURBOCHARGER ASSEMBLY

1. Open engine hood.
2. Remove intake connector (1) and turbocharger lubrication inlet tube (2). ※1
3. Disconnect turbocharger lubrication outlet tube (3) from turbocharger (4).
4. Remove hydraulic pump top cover (5), then remove air cleaner assembly (6). ※2
   ★ The air cleaner band cannot be removed, so remove hydraulic pump top cover (5).

   kg Air cleaner assembly: **Approx. 30 kg**
5. Remove turbocharger assembly (7).



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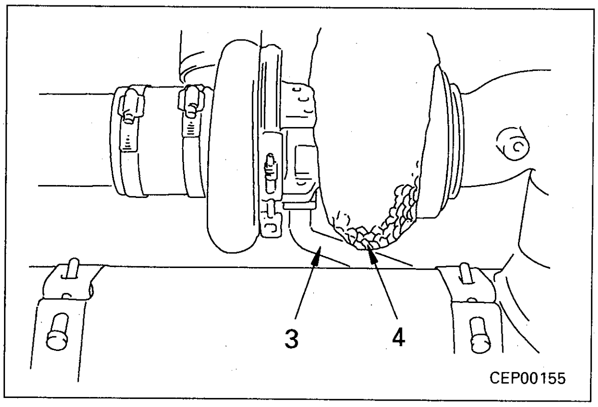


CEP00155

INSTALLATION OF TURBOCHARGER ASSEMBLY

- Carry out installation in the reverse order to removal.

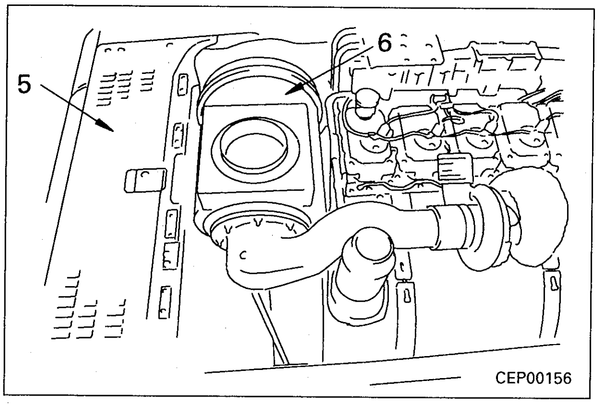
※1

kgm Lubrication tube joint bolt (cylinder block end): **29.4 ± 4.9 Nm {3.0 ± 0.5 kgm}**

kgm Intake connector hose clamp: **5.9 ± 0.5 Nm {0.60 ± 0.05 kgm}**

※2

kgm Turbocharger, air cleaner connecting hose clamp: **8.8 ± 0.5 Nm {0.90 ± 0.05 kgm}**



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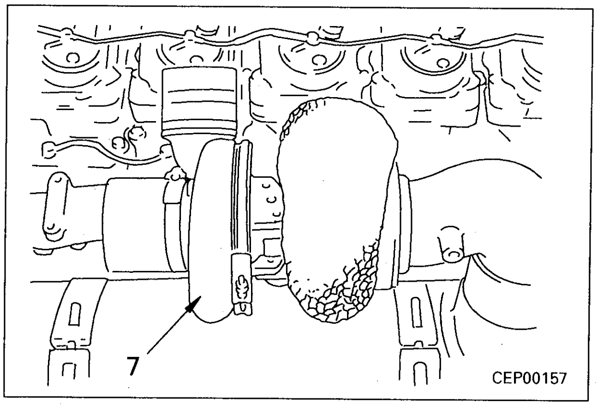
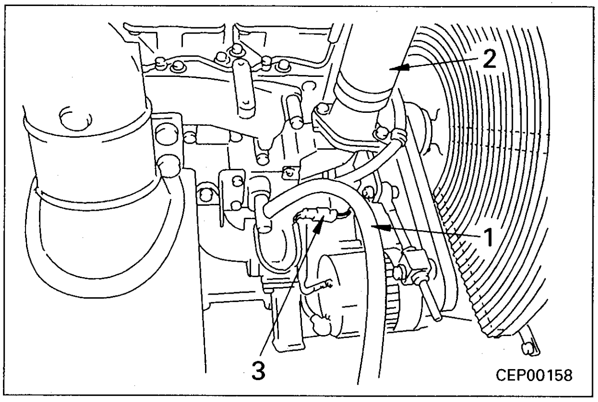


CEP00157

REMOVAL OF THERMOSTAT ASSEMBLY

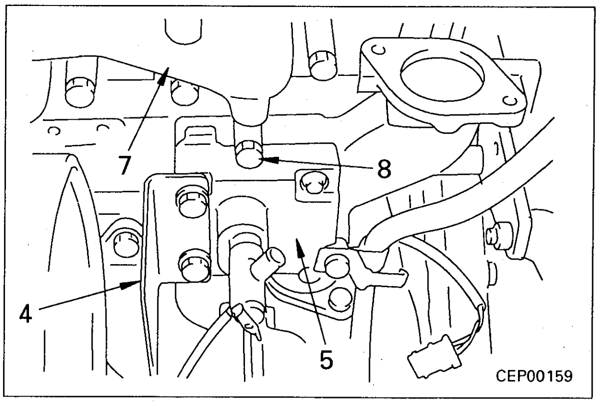
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Drain engine coolant.
2. Open engine hood, then remove alternator drive belt top cover.
3. Disconnect heater hose (1), radiator upper hose (2), and engine water temperature sensor connector (3) (CN-P7).



CEP00158

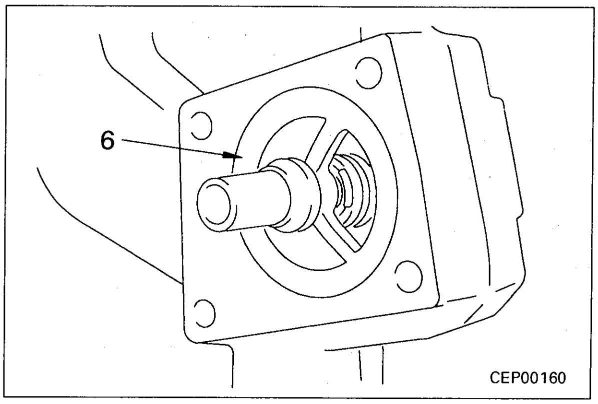
4. Remove adiabatic cover (4), then remove thermostat housing (5) together with thermostat (6).
   ★ Remove front bottom bolt (8) of exhaust manifold (7).
5. Remove thermostat (6).



CEP00159

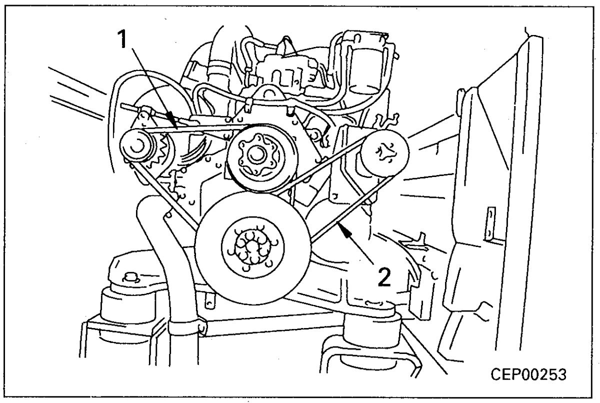
INSTALLATION OF THERMOSTAT ASSEMBLY

- Carry out installation in the reverse order to removal.
- **Refilling with water**
  ★ Add water through the water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.

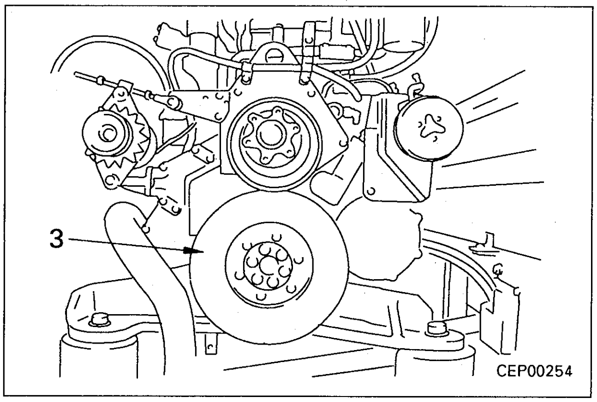


CEP00160

REMOVAL OF ENGINE FRONT SEAL

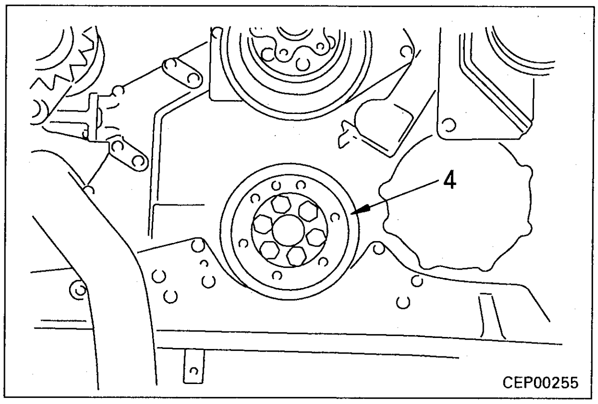


1. Remove radiator and hydraulic cooler assembly. For details, see REMOVAL OF RADIATOR, HYDRAULIC COOLER ASSEMBLY.
2. Loosen mount bolt and adjustment bolt of alternator assembly, and remove alternator and fan drive belt (1). ※ 1
3. Loosen air conditioner compressor adjustment bolt, and remove air conditioner drive belt (2). ※ 2
4. Remove damper (3). ※ 3
5. Remove pulley (4). ※ 4
6. Remove front seal (5). ※ 5



INSTALLATION OF ENGINE FRONT SEAL

- Carry out installation in the reverse order to removal.



※ 1

★ Adjust the belt tension.
For details, see TESTING AND ADJUSTING, Testing and adjusting fan belt tension.

※ 2

★ Adjust the belt tension.
For details, see TESTING AND ADJUSTING, Testing and adjusting air conditioner compressor belt tension.

※ 3

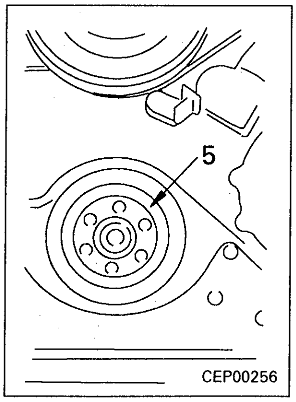
kgm Damper mounting bolt:
110.3 ± 12.3 Nm {11.25 ± 1.25 kgm}

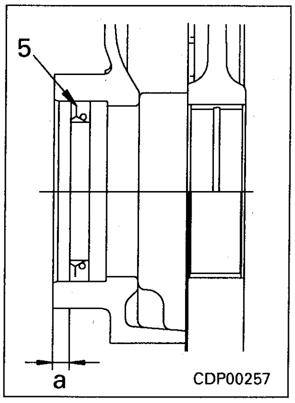
※ 4

kgm Pulley mounting bolt:
277.0 ± 31.9 Nm {28.25 ± 3.25 kgm}

※ 5

★ Fill the lip portion 50 – 80% with lithium grease (G2-LI), then assemble.
★ Dimension **a** for driving in seal: 11^{+1}_{-0} mm

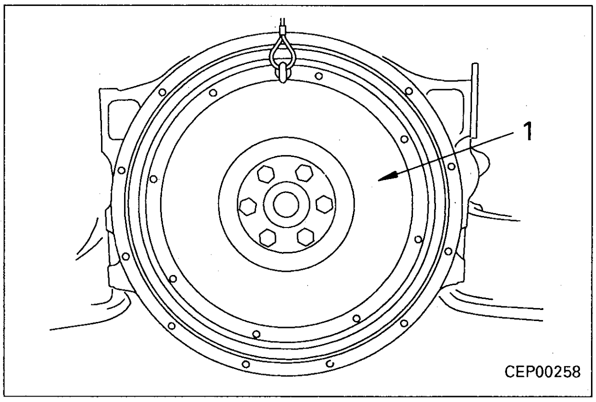




REMOVAL OF ENGINE REAR SEAL

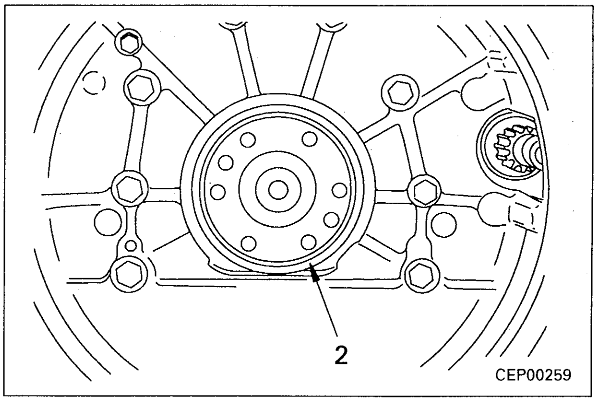
1. Remove damper assembly.
For details, see REMOVAL OF DAMPER ASSEMBLY.

2. Using eyebolts, sling flywheel (1), then remove mounting bolts, and lift off. ※ 1
⚠ The flywheel pilot is shallow and it may come off suddenly, so be careful not to get your fingers caught.

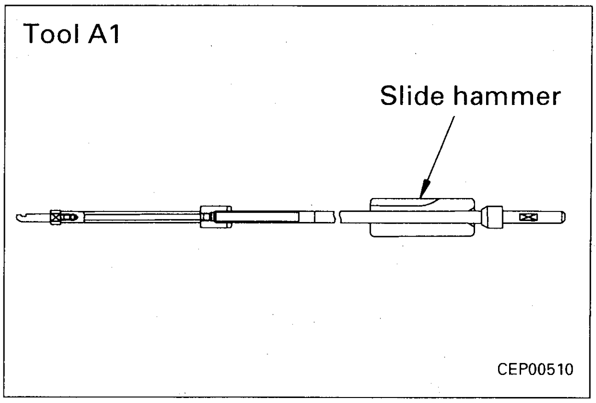


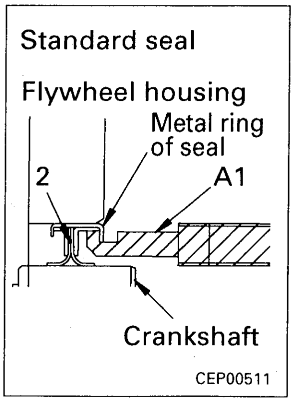
3. Rear seal ※ 2
Remove rear seal (2) as follows.

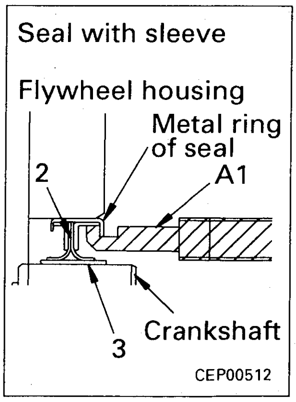
- Removing standard seal
  Hook puller tip of tool **A1** to metal ring of seal (2), and use impact force of a slide hammer to pull out.
  ★ Before pulling out, knock the oil seal in slightly. This separates the seal from the housing and makes it easier to pull out the seal.
  ★ Do not use a drill. The metal powder will get inside the engine.



- Removing seal with sleeve
  1) Hook puller tip of tool **A1** to metal ring of seal (2), and use impact force of a slide hammer to pull out.
     ★ Before pulling out, knock the oil seal in slightly. This separates the seal from the housing and makes it easier to pull out the seal.
  2) Use a chisel and hammer to cut and remove sleeve (3).
     ★ Be extremely careful not to damage the crankshaft.
     ★ Remove any metal powder that is formed.







INSTALLATION OF ENGINE REAR SEAL

- Carry out installation in the reverse order to removal.

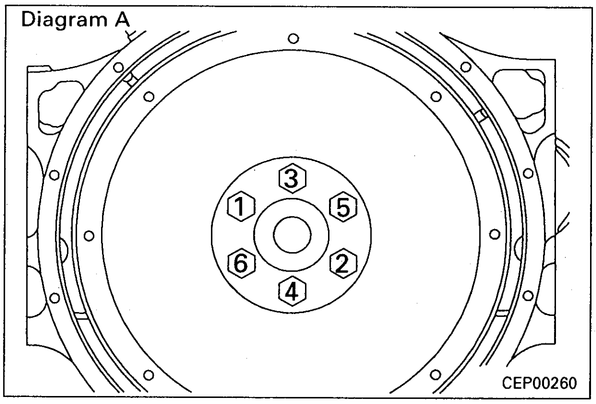
※ 1

★ When tightening the mounting bolts, follow the order in diagram A.

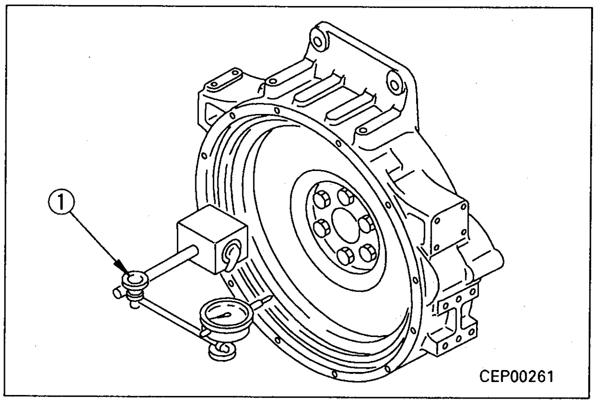
Mounting bolt: **Lubricating oil (EO30)**

Mounting bolt

	Nm	{kgm}
1st step	**127.5 – 166.7**	**{13 – 17}**
2nd step	**289.3 ± 19.6**	**{29.5 ± 2}**

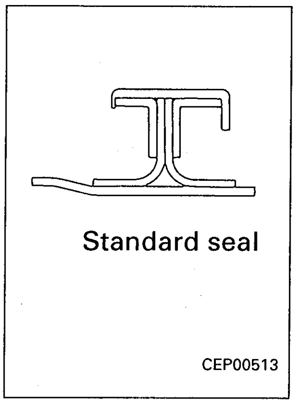


- Using dial gauge ①, measure radial and face runout of flywheel.
  ★ Face runout: 0.2 mm
  Radial runout: 0.15 mm

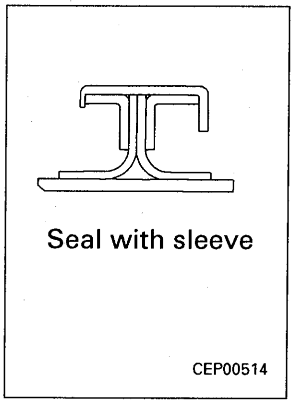


※ 2

★ With the Teflon seal (laydown lip seal), check the condition of the wear of the shaft, select either a standard seal or a seal with a sleeve, then assemble the seal.
The condition of wear is judged by the luster (depth of wear less than 10 µm when touched with the flat of a finger). If there are no scratches, assemble a standard seal; in all other cases, assemble a seal with a sleeve.

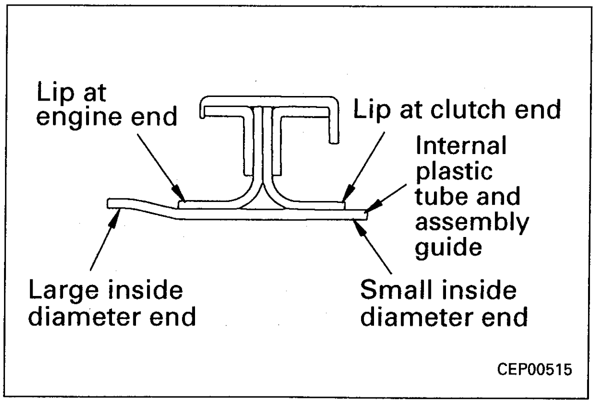


Standard seal

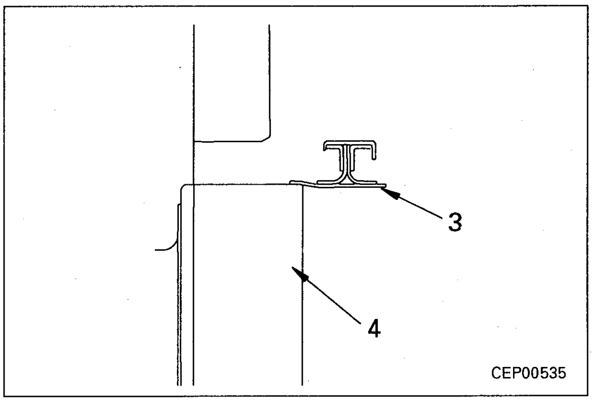


Seal with sleeve

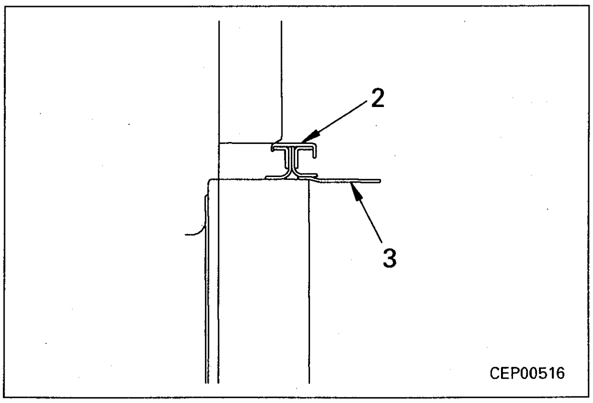
- **Procedure for assembling standard seal**
  ★ Before assembling the seal, check that there are no scratches, burrs, flashes, or rust on the housing, lip sliding surface, or at the corner of the end face of the crankshaft.
  ★ When assembling the seal, do not coat the shaft and seal lip with oil or grease, and wipe off all the oil from the shaft.
  ★ Do not remove the internal plastic tube from the standard seal until assembling the seal.



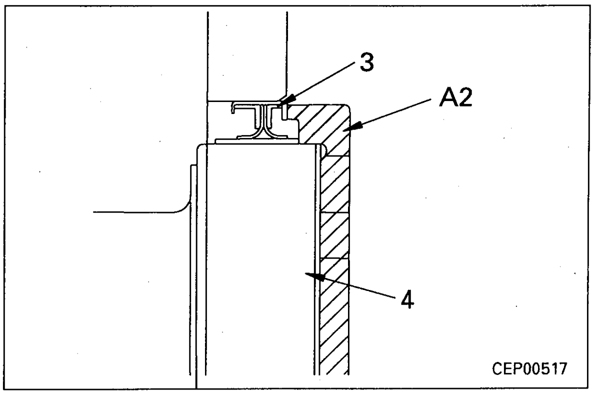
1) Put large inside diameter end of internal plastic tube (3) in contact with end of crankshaft (4).
   - ★ Be particularly careful to assemble facing in the correct direction.



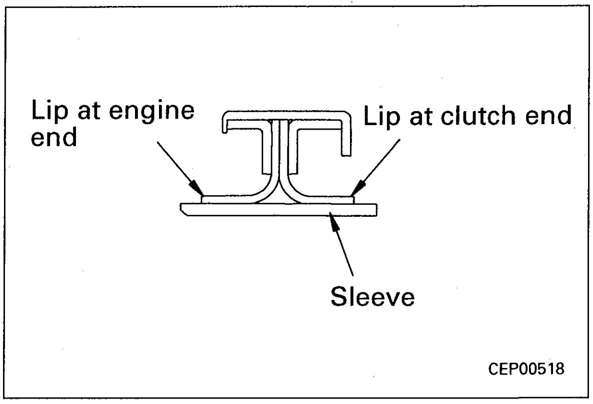
2) Hold metal ring of seal (2) with both hands and push in with force.
3) After pushing seal in, remove internal plastic cylinder (3).
   - ★ When removing, be particularly careful not to damage the seal lip.



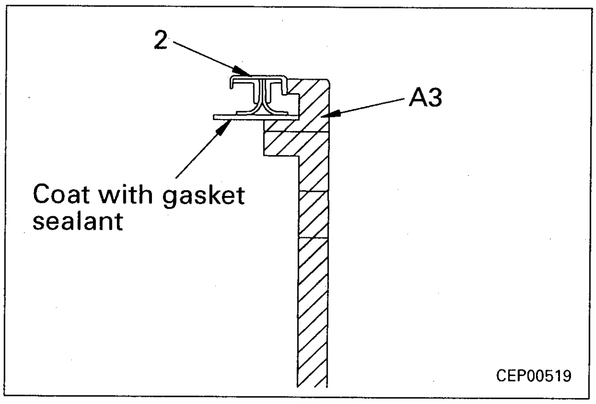
4) Tighten bolts of tool **A2** uniformly until end face of tool **A2** contacts end face of crankshaft (4) to press fit seal (2).
   - ★ When press fitting the seal, be extremely careful not to damage the lip at the clutch end when setting the tool.
   - ★ After press fitting the seal, remove all the remains of the red sealant on the outside circumference.



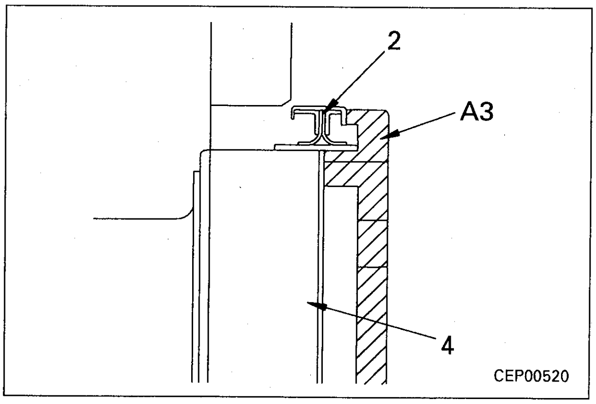
- **Assembly procedure for seal with sleeve**
  - ★ Before assembling the seal, check that there are no scratches, burrs, flashes, or rust on the housing, lip sliding surface, or at the corner of the end face of the crankshaft.
  - ★ When assembling the seal, do not coat the shaft and the area between the sleeve and seal lip with oil or grease, and wipe off all the oil from the crankshaft.
  - ★ Always handle the seal and sleeve as a set. Never disassemble it.



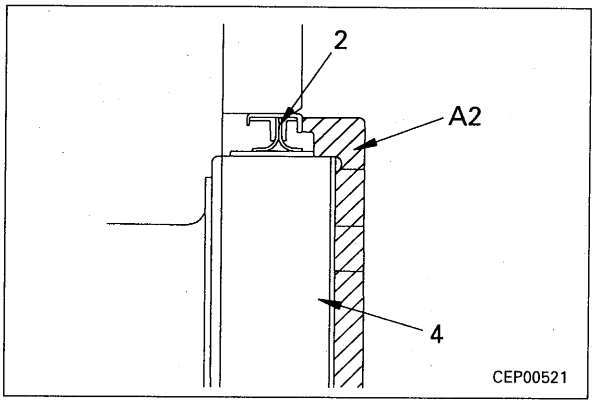
1) Set sleeve/seal (2) to tool **A3**.
   Inside surface of sleeve:
   Gasket sealant (LG-7)



2) Put sleeve of seal in contact with end face of crankshaft, then tighten bolts of tool **A3** uniformly until end face of tool **A3** contacts end face of crankshaft (4) to press fit sleeve/seal (2).



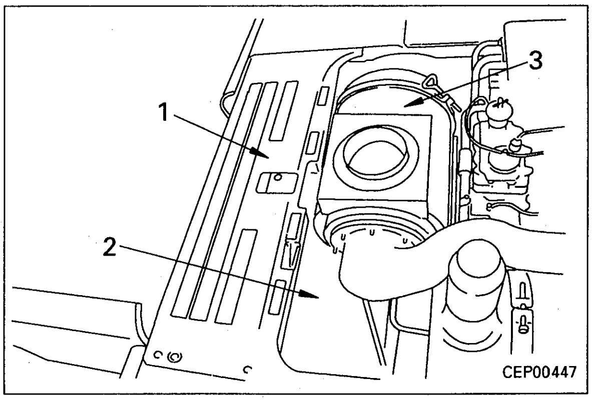
3) Remove tool **A3** and install tool **A2**.
4) Tighten bolts of tool **A2** uniformly until end face of tool **A2** contacts end face of crankshaft (4) to press fit sleeve/seal (2).
   ★ After press fitting the seal, remove all the remains of the red sealant on the outside circumference.



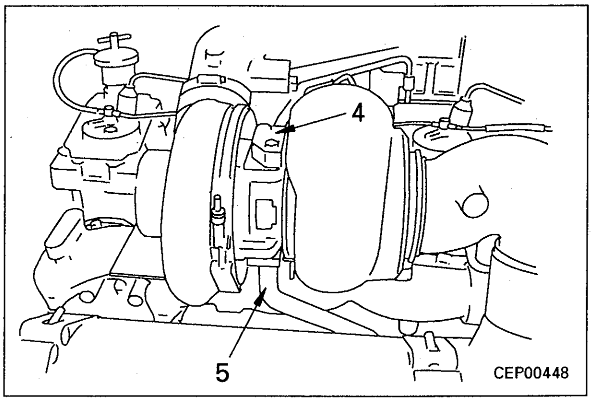
REMOVAL OF CYLINDER HEAD ASSEMBLY

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

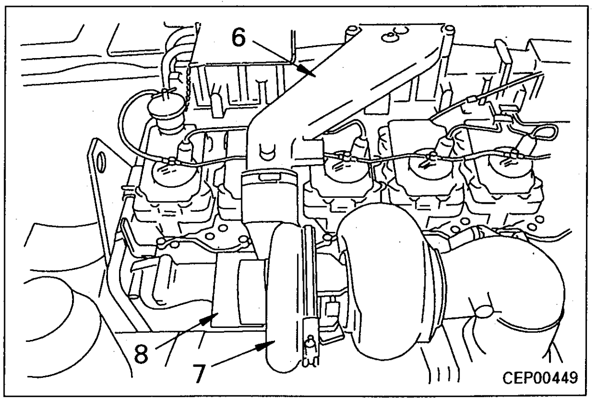
1. Remove cover (1), partition (2), and air cleaner assembly (3). ※1



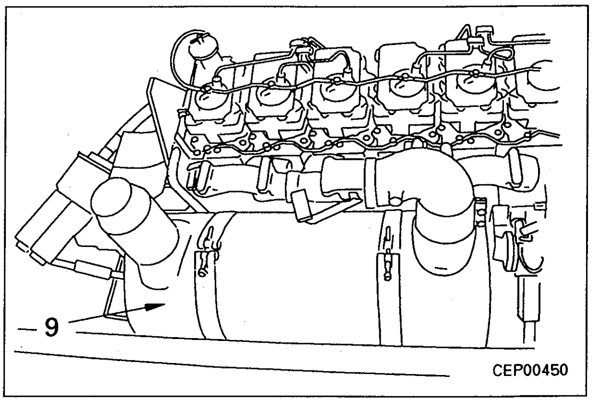
2. Remove turbocharger lubrication tube (4) and outlet tube (5).



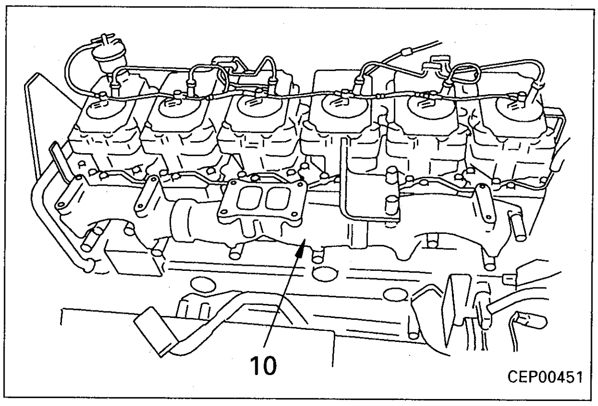
3. Remove intake connector (6), turbocharger assembly (7), and adiabatic cover (8). ※2



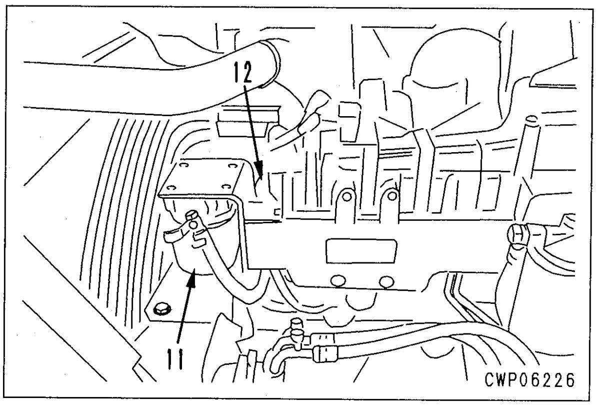
4. Remove 2 mounting bands of exhaust muffler assembly (9), and lift off muffler assembly.
   - ★ Pull out completely from the muffler water drain tube before removing. ※3



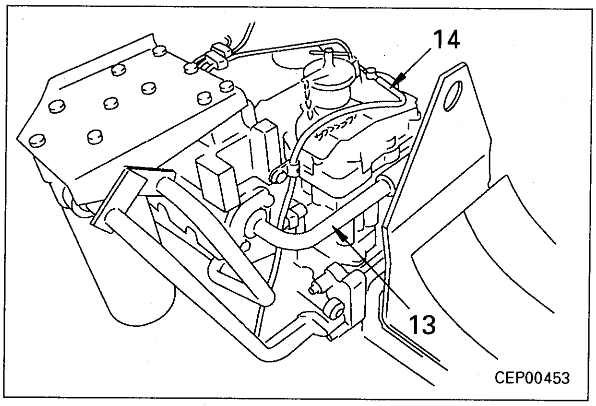
5. Remove exhaust manifold assembly (10). ※ 4



6. Disconnect corrosion resistor (11) together with mounting bracket end, then disconnect aftercooler inlet tube (12).

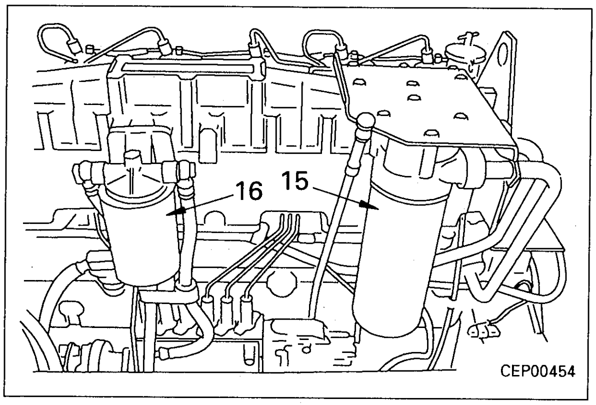


7. Remove aftercooler outlet tube (13), and disconnect spill tube (14).

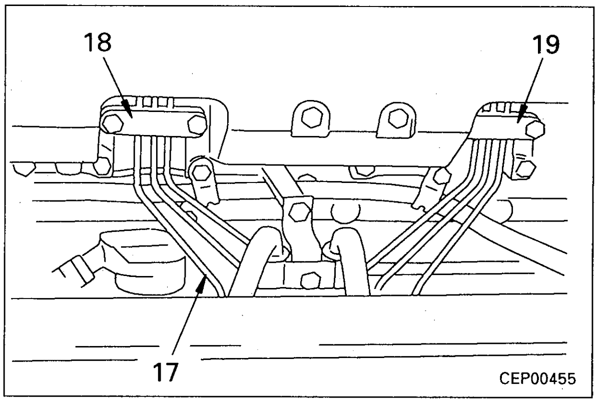


8. Remove oil filter assembly (15) together with mounting bracket.

9. Remove 2 mounting bolts of fuel filter assembly (16), then move towards control valve with hose still connected to fuel filter assembly.

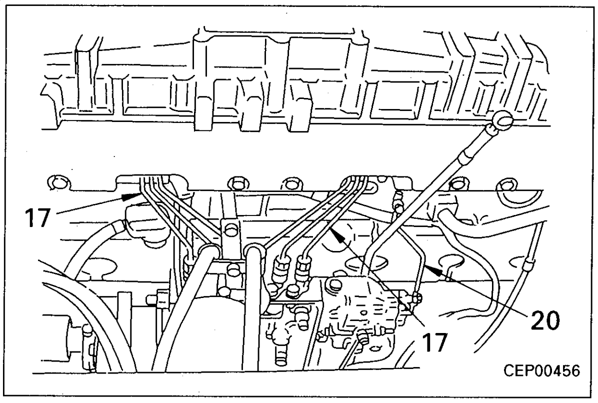


10. Remove clamps (18) and (19) of delivery tubes (17). ※ 5



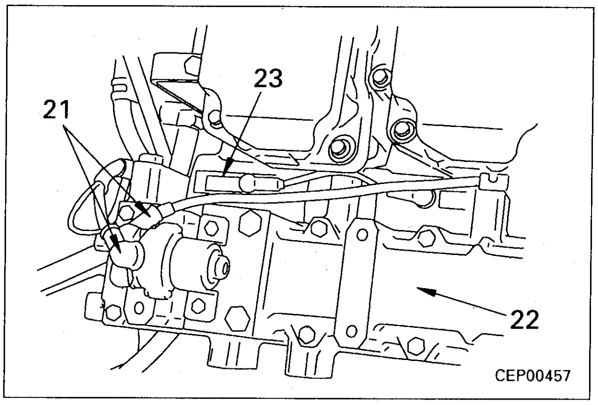
CEP00455

11. Remove 6 delivery tubes (17), then remove boost compensation tube (20). ※ 6



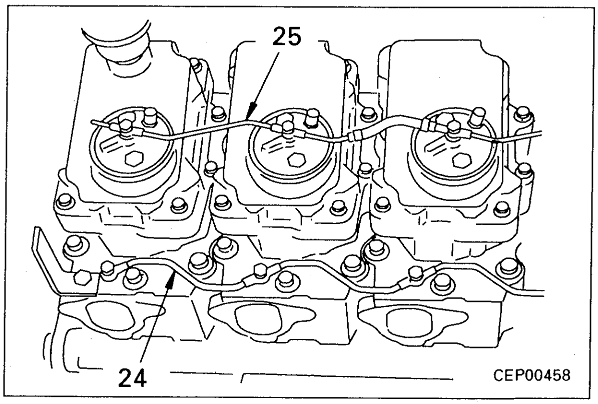
CEP00456

12. Disconnect heater wiring (21), and remove aftercooler assembly (22) and 6 electrical intake air heaters (23).



CEP00457

13. Remove aeration tube (24) and spill tube (25).



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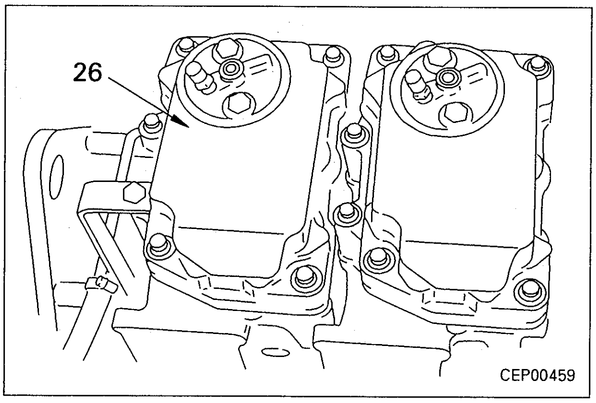
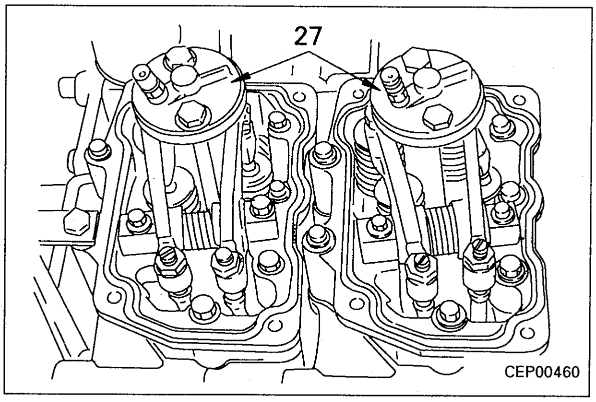
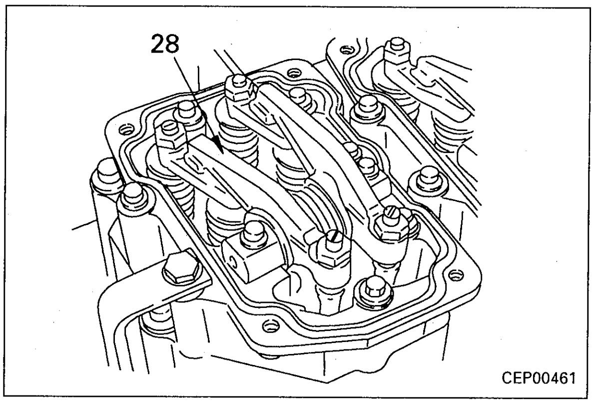
14. Remove head cover (26). ※ 7



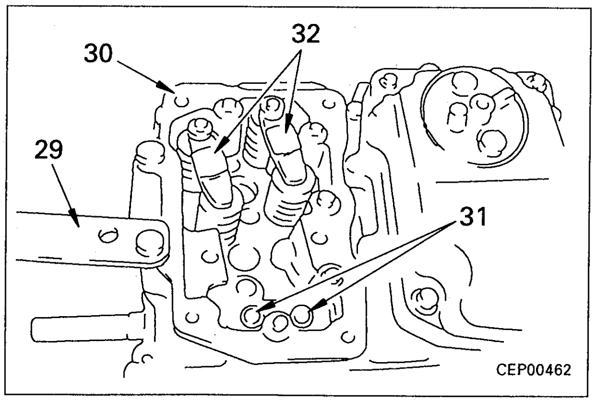
15. Remove nozzle holder assembly (27). ※ 8



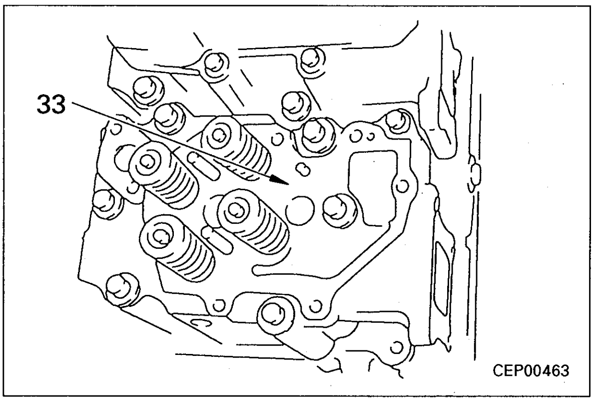
16. Remove rocker arm assembly (28).
  ★ Loosen the locknut, then loosen the adjustment screw 2 – 3 turns. ※ 9



17. Remove bracket (29), rocker arm housing (30), push rod (31), and crosshead (32).
  ★ Remove bracket (29) for the No. 1 cylinder head assembly only. ※ 10



18. Remove cylinder head assembly (33). ※ 11



INSTALLATION OF CYLINDER HEAD ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

kgm Hose clamp between air cleaner and turbocharger:
8.8 ± 0.5 Nm {0.9 ± 0.05 kgm}

※ 2

kgm Intake connector hose clamp:
5.9 ± 0.5 Nm {0.6 ± 0.05 kgm}

kgm Turbocharger assembly mounting bolt:
66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}

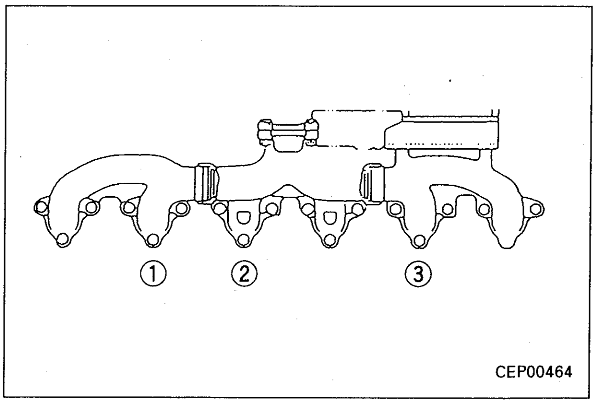
※ 3

kgm Exhaust muffler mounting band bolt:
9.8 ± 2.0 Nm {1.0 ± 0.2 kgm}

※ 4

★ Screw in the exhaust manifold mounting bolts 2 – 3 turns by hand, tighten bolts ① – ③, then tighten the other bolts.

kgm Exhaust manifold mounting bolt:
66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}



※ 5

kgm Delivery tube clamp (18) (19):
11.8 ± 2.9 Nm {1.2 ± 0.3 kgm}

※ 6

kgm Delivery tube sleeve nut:
23.5 ± 1.0 Nm {2.4 ± 0.1 kgm}

※ 7

kgm Head cover mounting bolt:
9.8 ± 1.0 Nm {1 ± 0.1 kgm}

※ 8

★ Tighten the nozzle holder mounting bolts uniformly in turn.

Thread of nozzle holder mounting bolt:
EO-30

kgm Nozzle holder mounting bolt:
21.6 ± 2.9 Nm {2.2 ± 0.3 kgm}

※ 9

★ Check that the ball of the adjustment screw is fitted properly into the socket of the push rod.

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

kgm Rocker arm assembly mounting bolt:
66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}

kgm Locknut:
66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}

※ 10

kgm Rocker arm housing mounting bolt:
66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}

★ Adjust the crosshead as follows.
i) Loosen the locknut and turn the adjustment screw back.
ii) Hold down the top of the crosshead lightly and screw in the adjustment screw.
iii) When the adjustment screw contacts the valve stem, tighten a further 20°.
iv) Tighten the locknut to hold in position.

kgm Locknut:
66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}

※11

- ★ If any rust of more than 5 mm square is found on the shaft or the thread of the bolt, replace the head bolt with a new bolt.
- ★ Be careful to check that there is no dirt or dust on the mounting surface of the cylinder head or inside the cylinder.
- ★ When installing the gasket, check that the grommets have not come out.
- ★ Coat the thread and seat of the bolt, and the seat of the cylinder head holes completely with molybdenum disulphide (LM-P).

Mounting bolt: **Anti-friction compound (LM-P).**

- ★ Tighten the cylinder head mounting bolts 2 – 3 turns by hand, then tighten in the order given in the diagram.

Cylinder head mounting bolt:

1. Tighten bolts ① – ⑥ in the diagram in turn as follows.

1st pass: Tighten to **98.1 ± 9.8 Nm {10 ± 1 kgm}**

2nd pass: Tighten to **137.3 ± 4.9 Nm {14 ± 0.5 kgm}**

3rd pass: 1. When using tool **A.**
- Using an angle tightening wrench, tighten bolt $90^{+30^\circ}_{0}$.

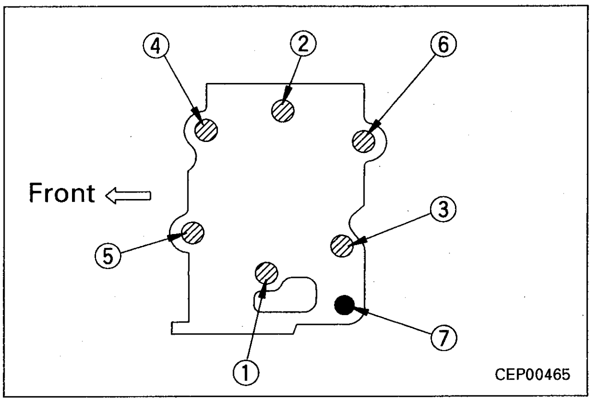
2. When not using tool **A.**
   1) Using the angle of the bolt head as the base, make start marks on the cylinder head and socket.
   2) Make an end mark at a point $90^{+30^\circ}_{0}$ from the start mark.
   3) Tighten so that the start mark on the socket is aligned with the end mark on the cylinder head at the $90^{+30^\circ}_{0}$ position.

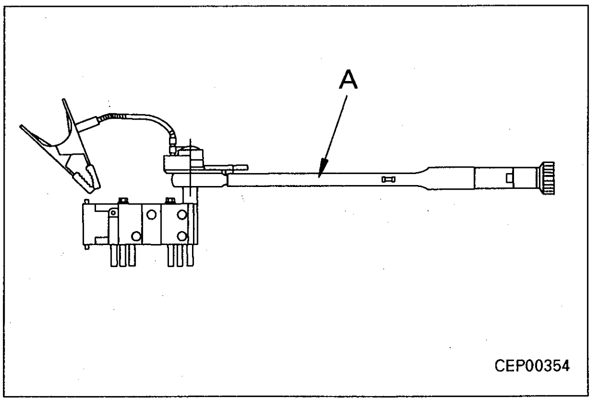
2. Tighten bolt ⑦ in the diagram using the torque method.

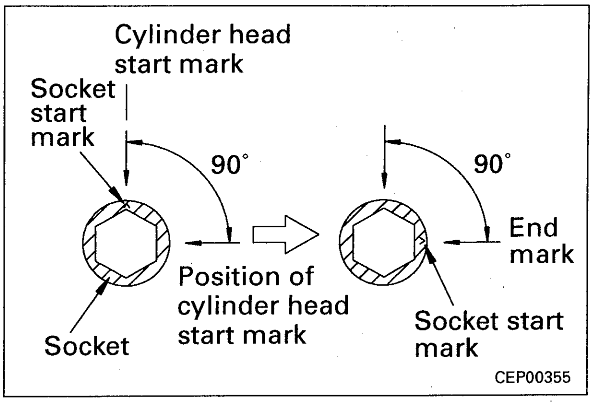
Cylinder head mounting bolt ⑦ : **66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}**

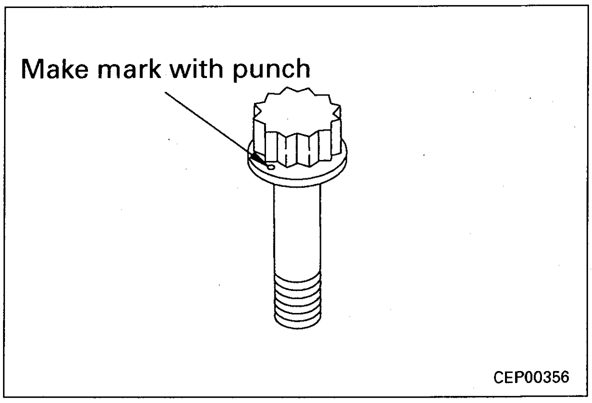
- ★ After tightening, make one punch mark on the bolt head to indicate the number of times it has been tightened.
- If any bolt already has five punch marks, do not reuse it. Replace it with a new bolt.

- **Refilling with water**
  Refill to the specified level, and run the engine to circulate the water through the system. Then check the water level again.





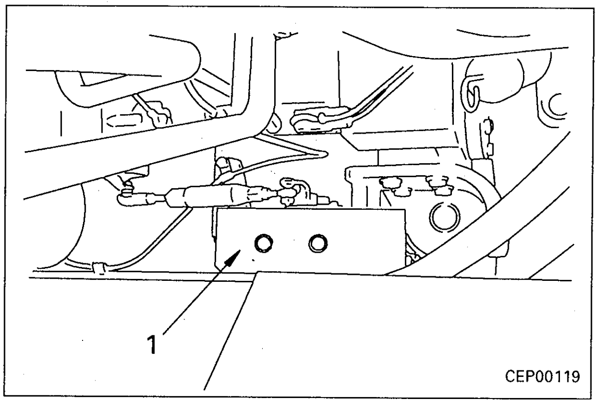


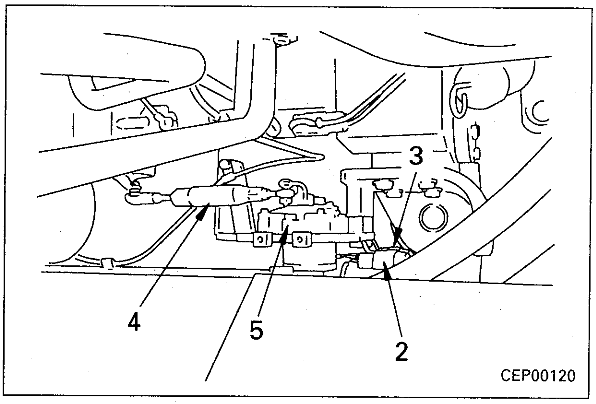


REMOVAL OF GOVERNOR MOTOR ASSEMBLY

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

1. Open engine hood.
2. Remove cover (1).
3. Disconnect wiring connectors (2) (CN-E05, bottom) and (3) (CN-E04, top).
4. Disconnect spring rod (4).
5. Remove governor motor assembly (5). ※ 1





INSTALLATION OF GOVERNOR MOTOR ASSEMBLY

- Carry out installation in the reverse order to removal.

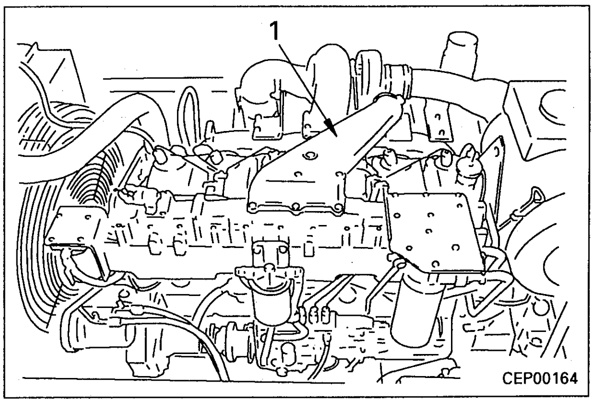
※ 1

★ Adjust the spring rod.
For details, see TESTING AND ADJUSTING, Testing and adjusting of governor motor lever stroke.

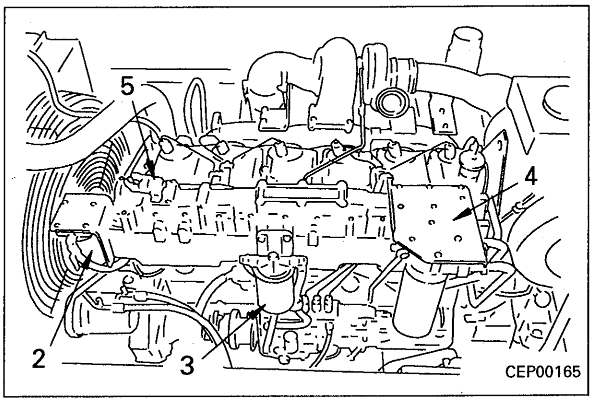
REMOVAL OF AFTERCOOLER CORE ASSEMBLY

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

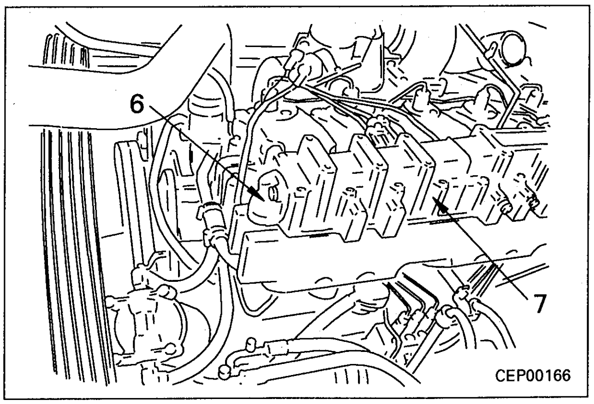
1. Drain coolant.
2. Remove intake connector (1). ※1



3. Remove corrosion resistor assembly (2), and move it towards fan.
4. Remove fuel filter assembly (3), and move it towards control valve.
5. Remove engine oil filter top cover (4).
6. Remove electrical intake air heater relay (5) together with bracket, and move it towards head cover.

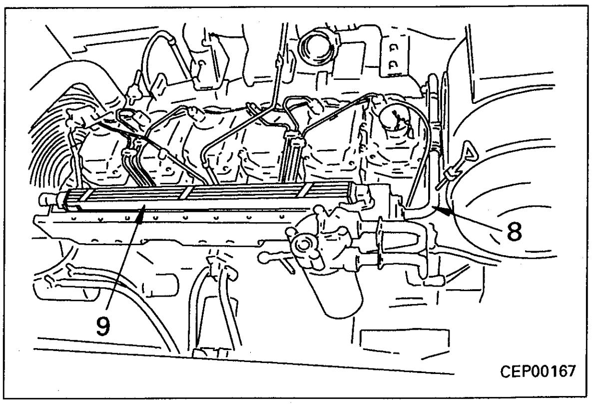


7. Disconnect water outlet tube (6), and move it towards fan.
8. Remove aftercooler cover (7).
9. Disconnect water outlet tube (8), and move it towards main piston pump.
10. Remove aftercooler core assembly (9).



INSTALLATION OF AFTERCOOLER CORE ASSEMBLY

- Carry out installation in the reverse order to removal.



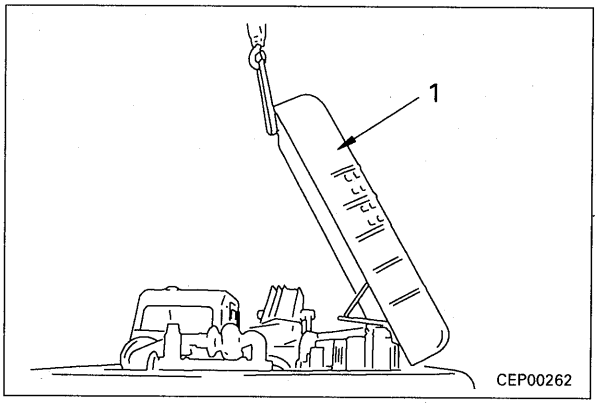
REMOVAL OF HYDRAULIC COOLER ASSEMBLY

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

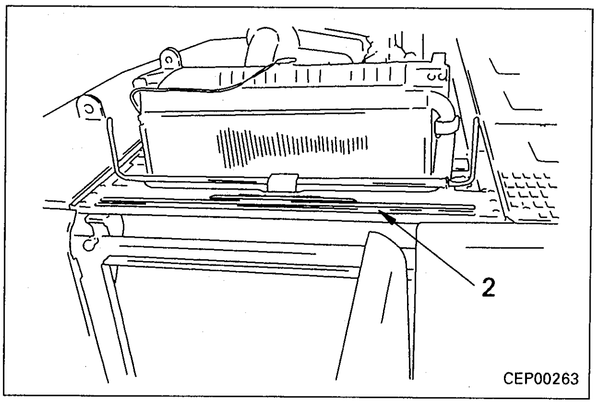
1. Drain oil from hydraulic tank.

   Hydraulic tank: **Approx. 270 ℓ**

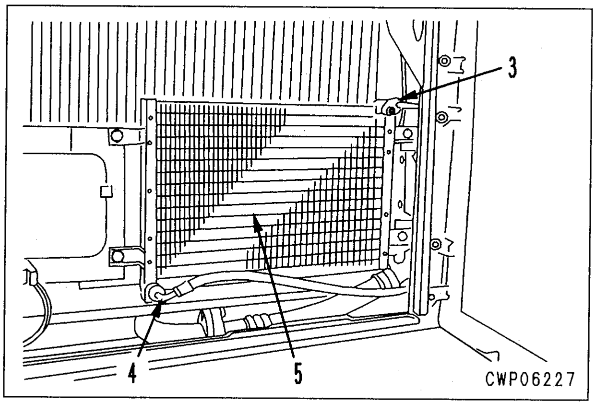
2. Lift off engine hood (1).



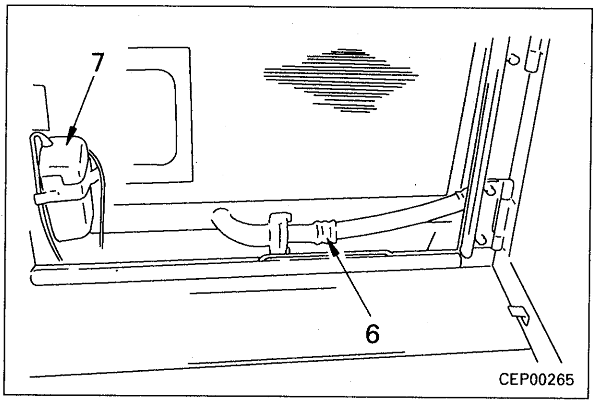
3. Remove frame and spring assembly (2).



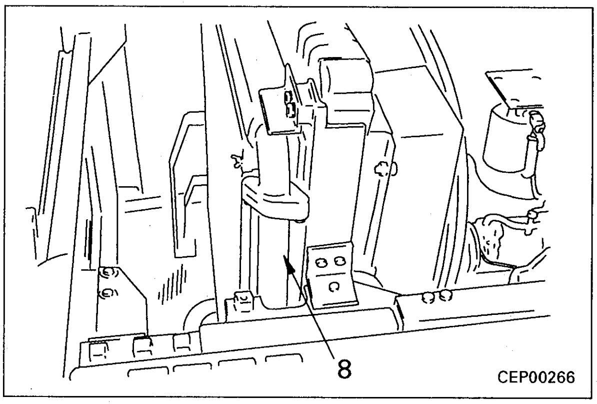
4. Disconnect air conditioner hose (3) and (4), remove condenser assembly (5), then remove bracket under condenser assembly.



5. Disconnect cooler outlet hose (6), and remove radiator sub-tank (7).

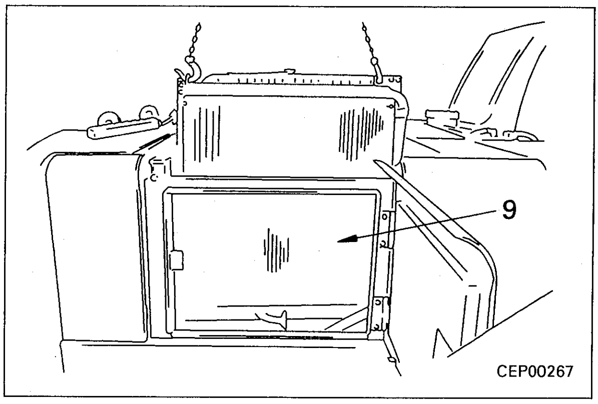


6. Disconnect cooler inlet tube (8).



7. Sling hydraulic cooler assembly (9), remove mounting bolts (bottom: left and right; top: left and right), then lift off hydraulic cooler assembly (9).

kg Hydraulic cooler assembly: **110 kg**

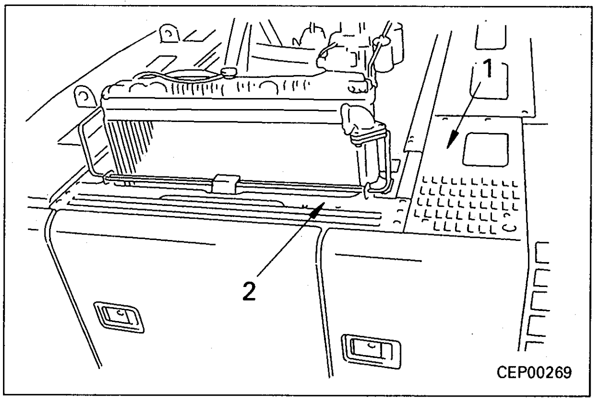


INSTALLATION OF HYDRAULIC COOLER ASSEMBLY

- Carry out installation in the reverse order to 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.

REMOVAL OF RADIATOR, HYDRAULIC COOLER ASSEMBLY

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



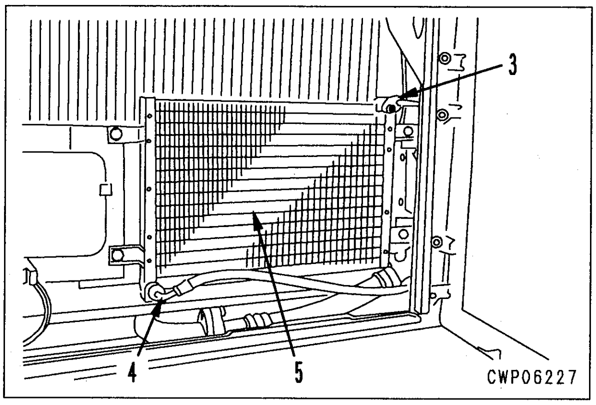
1. Drain oil from hydraulic tank.

   Hydraulic tank: **Approx. 270 ℓ**

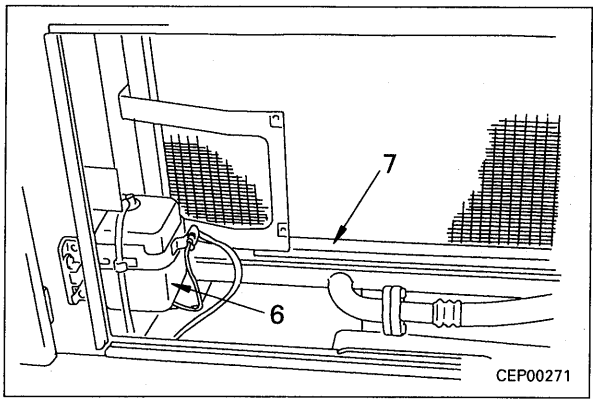
2. Drain coolant.

3. Lift off engine hood, then remove cover (1) and frame and spring assembly (2).

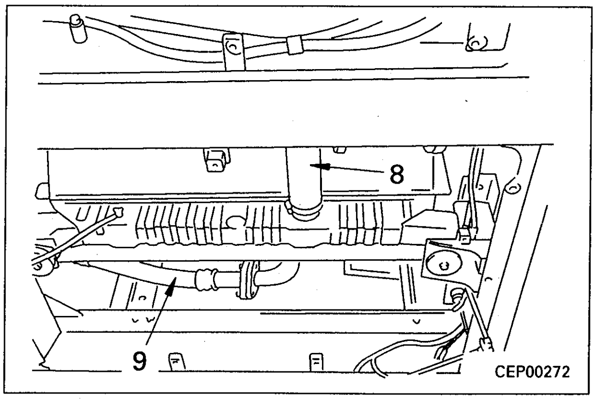
4. Disconnect air conditioner hose (3) and (4), and remove condenser assembly (5).
   - ★ Collect refrigerant (R134a).
     For details, see REMOVAL OF AIR CONDITIONER COMPRESSOR ASSEMBLY.



5. Remove radiator sub-tank (6), then remove bracket (7).

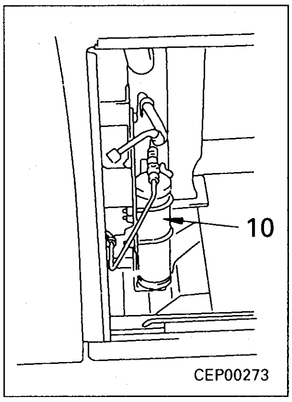


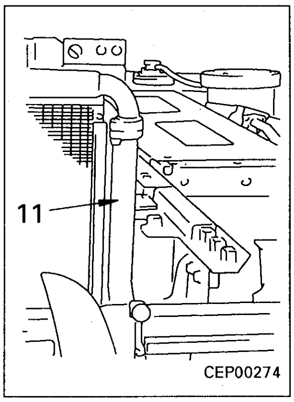
6. Remove undercover under radiator, and disconnect radiator lower hose (8) and cooler outlet hose (9).
   - ★ The radiator lower hose is clamped to the radiator, so be sure to disconnect the clamps.
   - ★ When the cooler outlet hose is disconnected, oil will flow out, so set a container under the machine to catch the oil, and disconnect the hose from the cover on the right side of the machine.



7. With hose still connected, disconnect receiver tank (10) together with bracket, and move towards chassis.

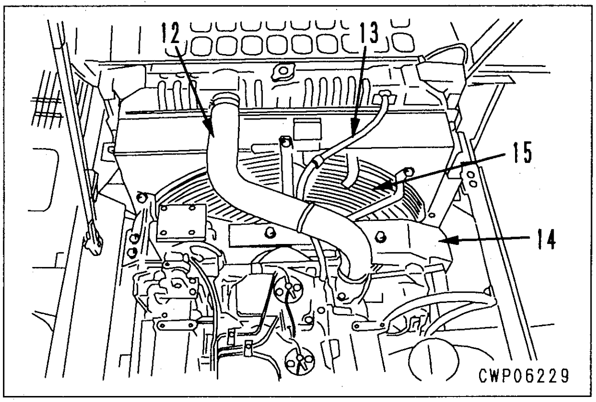
8. Disconnect hydraulic cooler inlet hose (11).





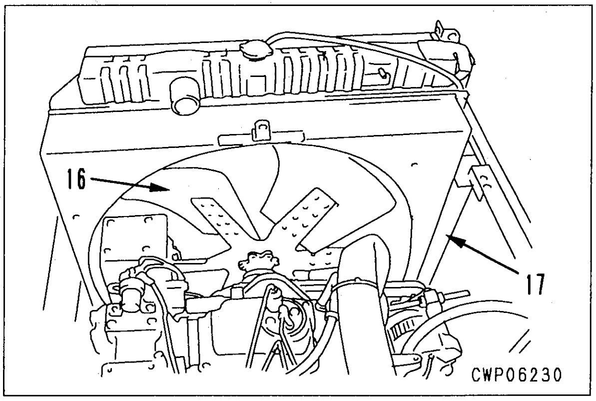
9. Disconnect radiator upper hose (12) and aeration hose (13) at radiator end, and move towards engine.

10. Remove cover (14), then remove fan guard (15).

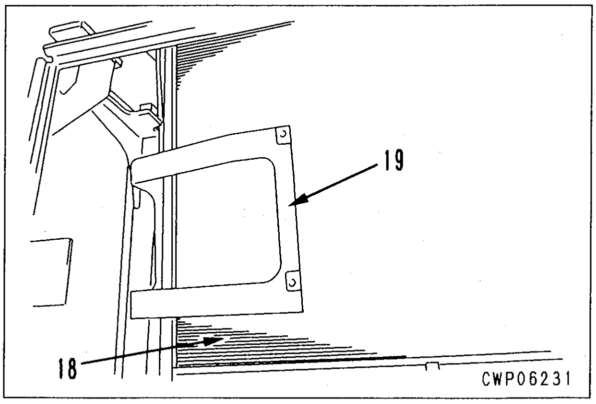


11. Remove fan (16), and move towards radiator.
    ★ Fit cardboard between the radiator core and fan (16) to prevent damage to the radiator core.

12. Remove right side cover (17) of radiator.

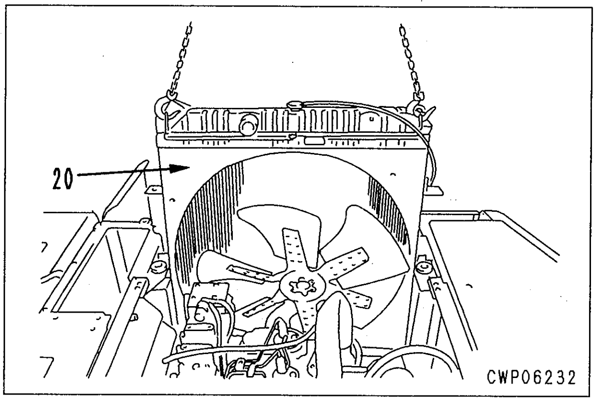


13. Sling radiator and hydraulic cooler assembly (18), remove mount bolts (top: 2; bottom: 2), raise to a position where condenser mount bracket (19) can be removed, then remove condenser mount bracket. When raising, be careful of the position in relation to the surrounding area. ※1



14. Lift off radiator and hydraulic cooler assembly (20).
★ When removing, be careful of the position in relation to the surrounding area.

kg Radiator, hydraulic cooler assembly: **190 kg**



INSTALLATION OF RADIATOR, HYDRAULIC COOLER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

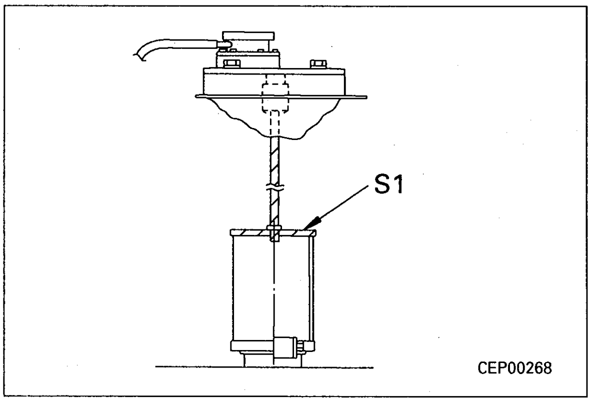
kgm Radiator mount bolt: **110.3 ± 12.3 Nm {11.25 ± 1.25 kgm}**

- **Refilling with water**
  ★ Add water through the water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.

- **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.

- **Charging air conditioner with gas**
  ★ Using tool **X**, charge the air conditioner circuit with refrigerant (R134a).

REMOVAL OF ENGINE, MAIN PUMP ASSEMBLY



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

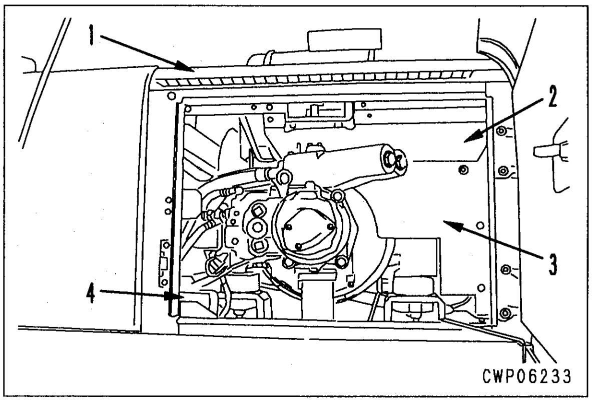
⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Remove hydraulic tank strainer, and using tool **S1**, stop oil.
   - When not using tool **S1**, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

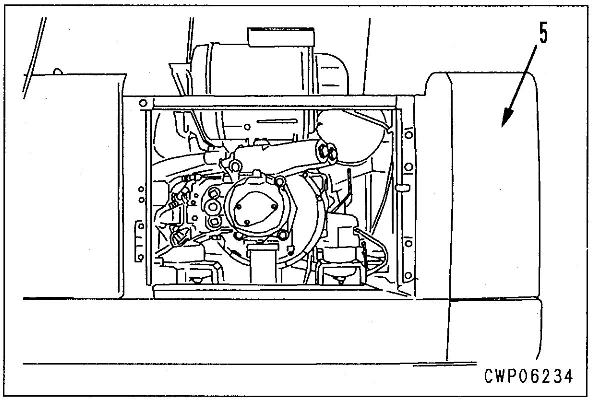
   Hydraulic tank: **Approx. 270 ℓ**

★ Mark all the piping with tags to prevent mistakes in the mounting position when installing.

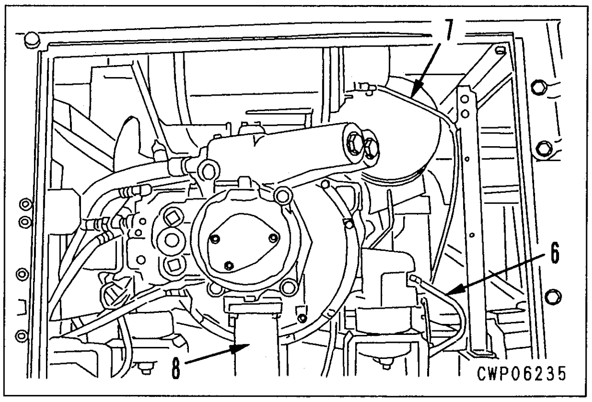
2. Drain coolant.
3. Remove main pump side cover, undercover, and engine undercover.
4. Open engine hood.
5. Remove main pump top cover (1), and partitions (2) and (3).



6. Remove washer tank (4), then remove main pump side cover (5).
   ★ Remove to prevent interference when raising the engine and main pump assembly.
   ★ Main pump side cover (5):
   PC400-6 Serial No.: 32001 – 32249
   PC450-6 Serial No.: 12001 – 12143



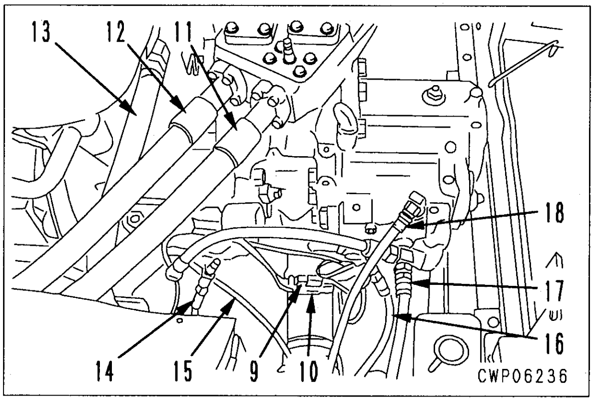
7. Disconnect chassis ground (6), then disconnect air cleaner clogging sensor hose (7) from air cleaner.
8. Disconnect main pump inlet tube (8).



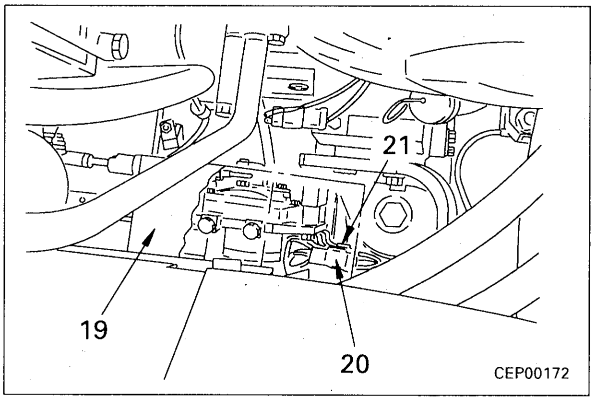
9. Disconnect TVC solenoid connectors (9) and (10) (CN-C04 and CN-C13).
  ★ Disconnect clamps at two places (pump and frame).

10. Disconnect main pump outlet hoses (11) and (12) and pump case drain hose (13).

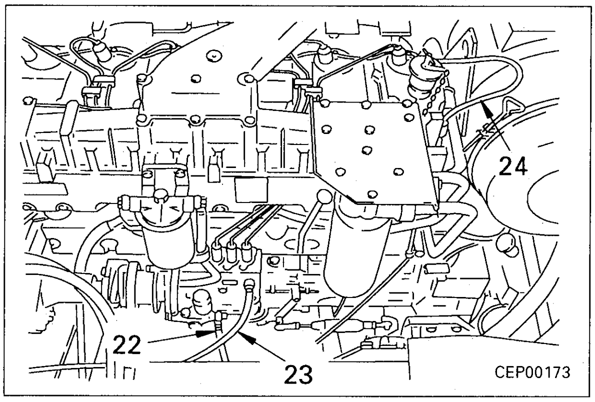
11. Disconnect 2 front pump servo valve hoses (14) and (15) and 3 rear pump servo valve hoses (16), (17) and (18).



12. Remove governor motor top cover (19) of governor motor, then disconnect governor motor connectors (20) (CN-E05) and (21) (CN-E04).

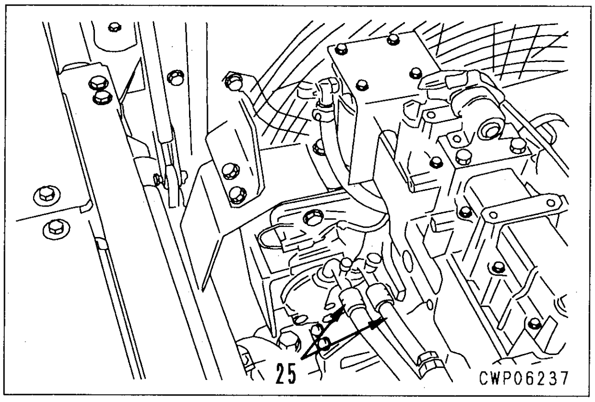


13. Disconnect fuel supply hose (22) and return hoses (23) and (24). ※ 1
  ★ Pull out the part of return hose (24) that is clamped to the engine, and move the hose towards the front of the machine.
  ★ There is no stop valve installed to the supply hose, so stop the fuel.



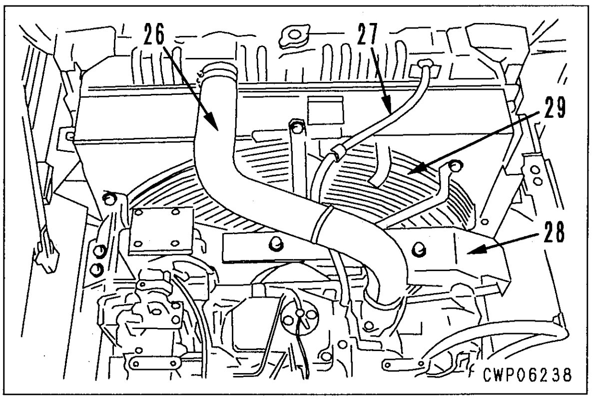
⚠ Collect refrigerant (R134a).
For details, see REMOVAL OF AIR CONDITIONER COMPRESSOR ASSEMBLY.

14. Disconnect air conditioner compressor hoses (25). ※ 2

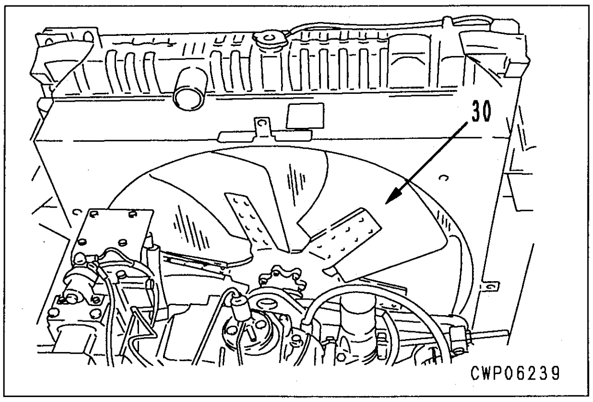


15. Disconnect radiator upper hose (engine water outlet hose) (26) and aeration hose (27). ※ 3

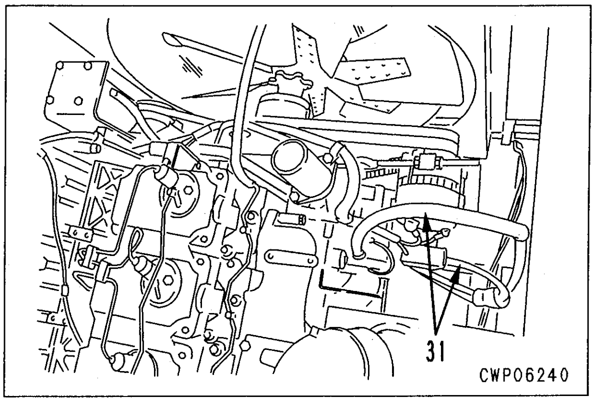
16. Remove guard (28) and fan guard (29).



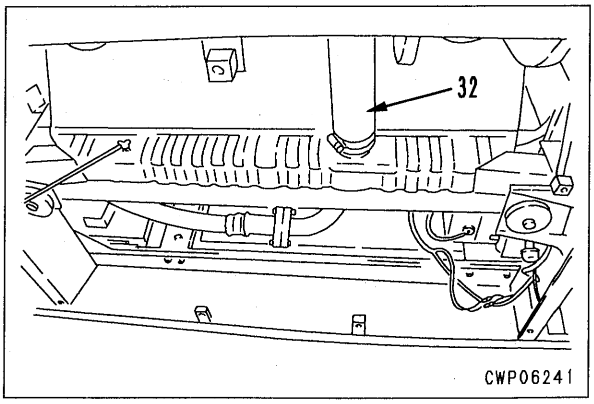
17. Remove fan (30), and move towards radiator.
- ★ The fan cannot be removed upward.
- ★ Be careful not to bend the radiator fin.



18. Disconnect 2 car heater hoses (31).



19. Disconnect radiator lower hose (32) at water pump end (engine end). ※ 4



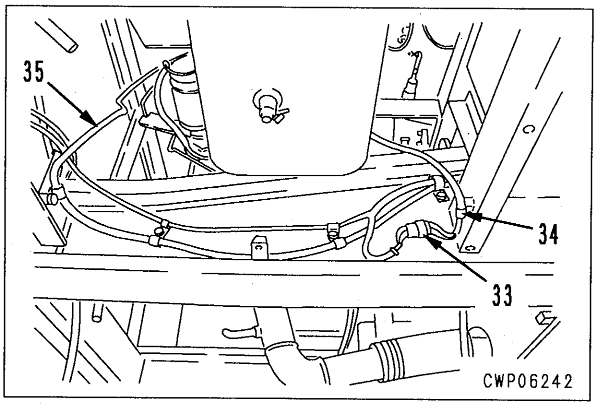
20. Disconnect intermediate connector (33) (CN-E08) to engine.
   ★ Remove frame clamp (34) and move towards the engine.

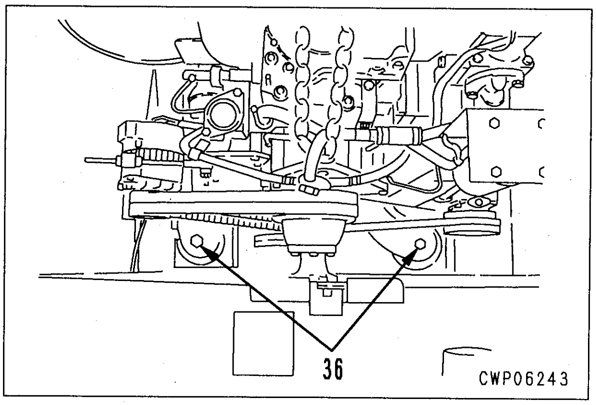
21. Disconnect wiring harness (35) from starting motor.

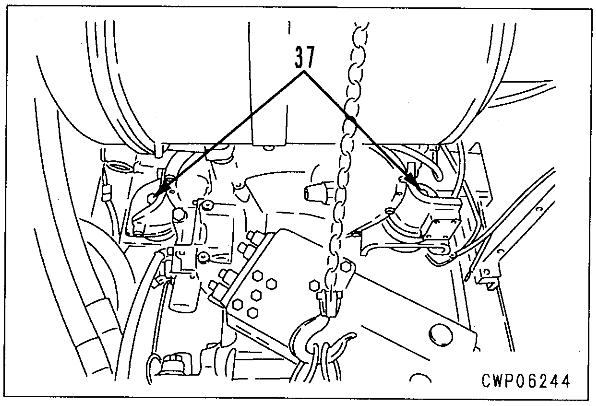
22. Remove engine mount bolts at front (36) and rear (37). ※ 5

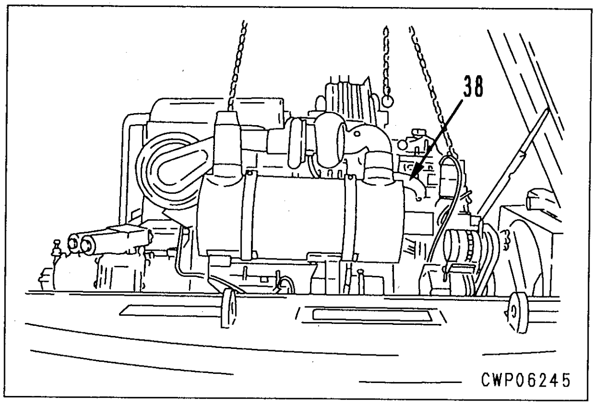
23. Lift off engine and main pump assembly (38).
   ★ Before lifting off, check carefully that all the piping and wiring has been disconnected.

kg Engine, main pump assembly:
Approx. 1500 kg









INSTALLATION OF ENGINE, MAIN PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

kgm Joint bolt:
17.2 ± 2.5 Nm {1.75 ± 0.25 kgm}

※ 2

★ Check that there is no damage or deterioration of the O-ring, then connect the hose.

※ 3 ※ 4

kgm Hose clamp bolt:
8.8 ± 1.0 Nm {0.9 ± 0.1 kgm}

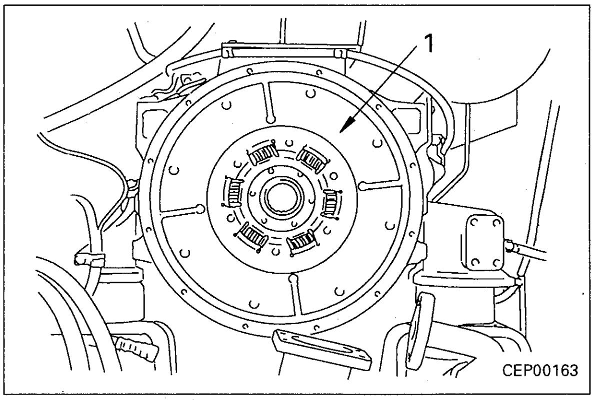
※ 5

Engine mount bolt (front) (rear):
Thread tightener (LT-2)

kgm Engine mount bolt (front) (rear):
926.7 ± 103.0 Nm {94.5 ± 10.5 kgm}

- **Refilling with water**
  ★ Add water through the water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.
- **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.
- **Charging air conditioner with gas**
  ★ Using tool **X**, charge the air conditioner circuit with refrigerant (R134a).
- **Bleeding air**
  ★ Bleed the air from the main pump.
  For details, see TESTING AND ADJUSTING.

REMOVAL OF DAMPER ASSEMBLY



1. Remove main pump assembly.
   For details, see REMOVAL OF MAIN PUMP ASSEMBLY.
2. Remove damper assembly (1). ※1

INSTALLATION OF DAMPER ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

Damper mounting bolt:
Thread tightener (LT-2)

REMOVAL OF FUEL TANK ASSEMBLY

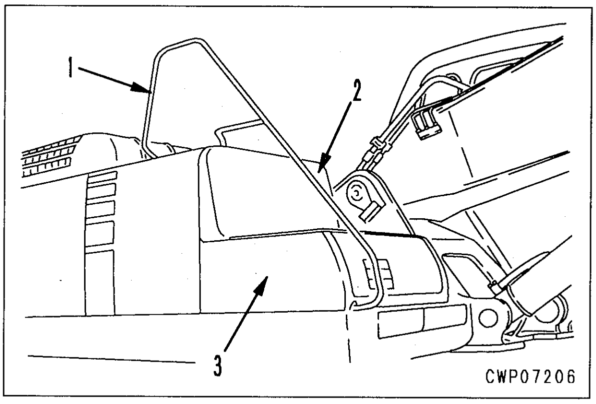
⚠ Disconnect the cable from the negative (–) terminal of the battery.

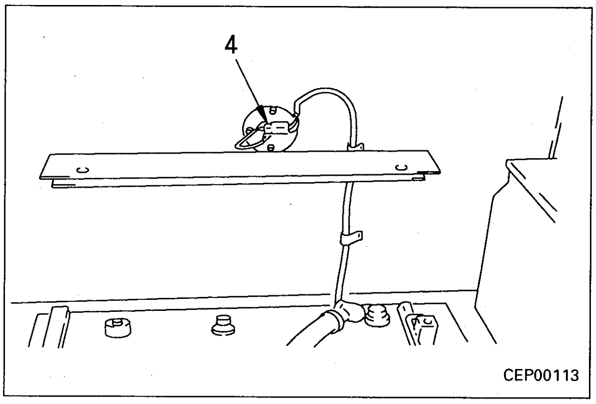
1. Open drain valve of fuel tank and drain fuel.

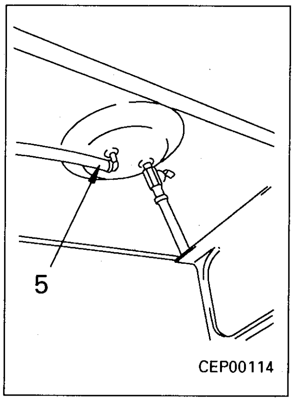
   Fuel tank: **Approx. 470 ℓ**
   (when tank is full)

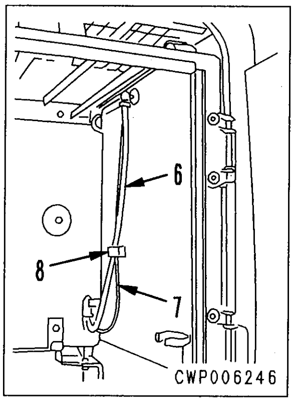
2. Remove air conditioner condenser top cover.
3. Remove handrail (1), front cover (2), and battery case cover (3).
4. Disconnect fuel level sensor connector (4) (CN-P06).
5. Disconnect fuel supply hose (5), return hose (6), spill hose (7), and clamp (8).
6. Remove mounting bolts, and lift off fuel tank assembly (9). ※1

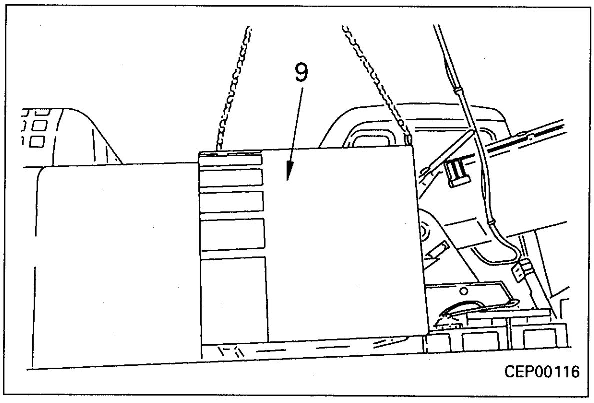
   kg Fuel tank assembly: **235 kg**











INSTALLATION OF FUEL TANK ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

kgm Fuel tank mounting bolt:
277.0 ± 31.9 Nm {28.25 ± 3.25 kgm}

REMOVAL OF CENTER SWIVEL JOINT ASSEMBLY

PC400-6 Serial No.: 32001 – 32249
PC450-6 Serial No.: 12001 – 12143

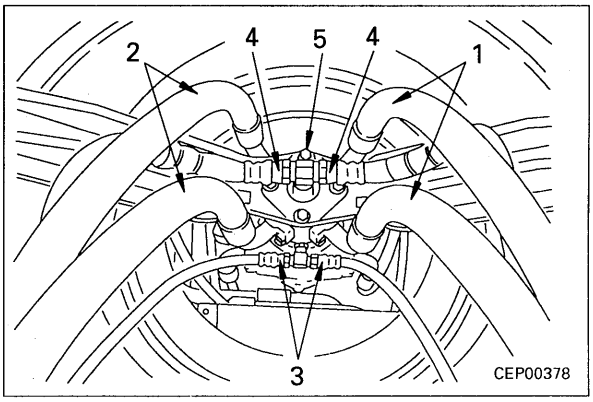
⚠ Release the remaining pressure in the hydraulic circuit.
For details, see TESTING AND ADJUSTING, Releasing remaining pressure from hydraulic circuit.

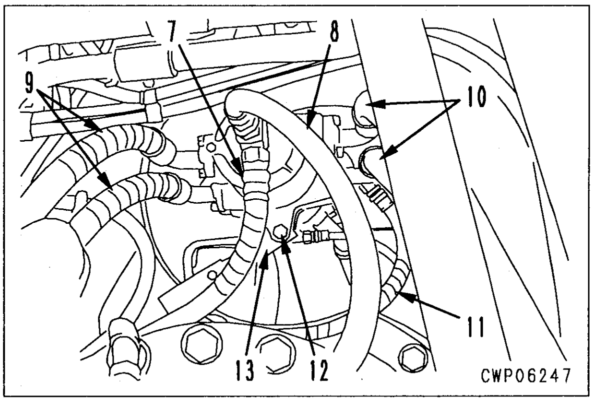
⚠ Loosen the hydraulic tank oil filler cap slowly to release the pressure inside the hydraulic tank.

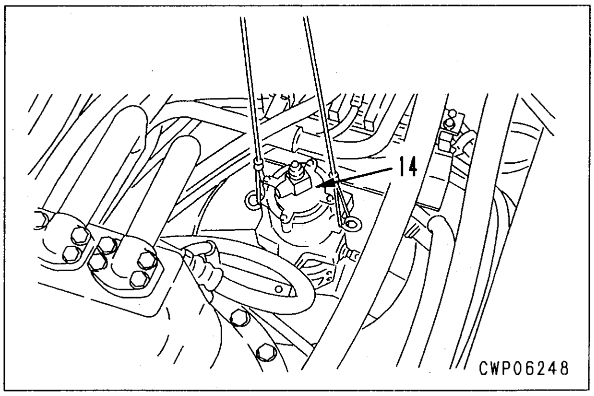
★ Mark all the piping with tags to prevent mistakes in the mounting position when installing.

1. Disconnect travel motor hoses (1) and (2).
2. Disconnect speed selector hose (3).
3. Disconnect drain hose (4), and remove elbow (5).
   ★ Install a blind plug in the drain hose.
4. Disconnect drain hoses (7) and (8).
   ★ Install a blind plug in the drain hose.
5. Disconnect travel hoses (9) and (10), and speed selector hose (11).
6. Pull out pin (12), and disconnect plate (13).
7. Sling center swivel joint assembly (14), remove mounting bolts from below, then lift off.

kg Center swivel joint assembly: **40 kg**







INSTALLATION OF CENTER SWIVEL JOINT ASSEMBLY

PC400-6 Serial No.: 32001 – 32249
PC450-6 Serial No.: 12001 – 12143

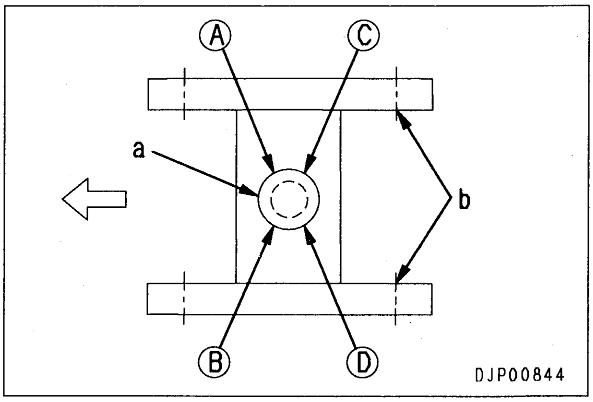
- Carry out installation in the reverse order to removal.

※ 1

★ Assemble the center swivel as shown in the diagram below.

- **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 travel motor.
  For details, see TESTING AND ADJUSTING, Bleeding air.



a: Center swivel
b: Sprocket

REMOVAL OF CENTER SWIVEL JOINT ASSEMBLY

PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up

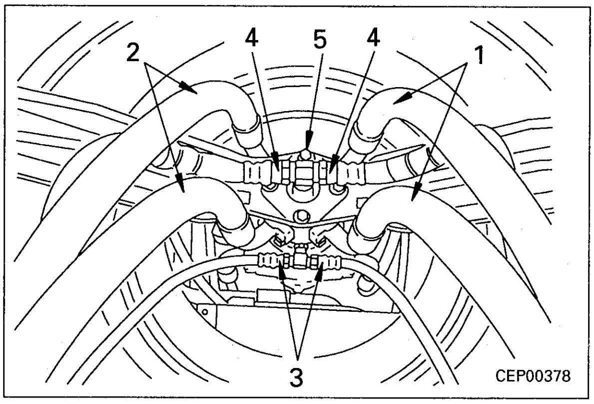
⚠ Release the remaining pressure in the hydraulic circuit.
For details, see TESTING AND ADJUSTING, Releasing remaining pressure from hydraulic circuit.

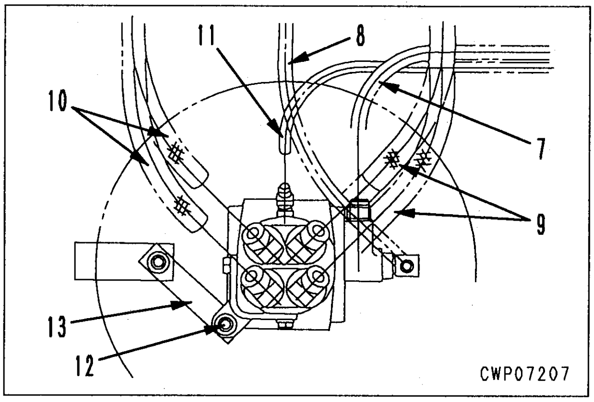
⚠ Loosen the hydraulic tank oil filler cap slowly to release the pressure inside the hydraulic tank.

★ Mark all the piping with tags to prevent mistakes in the mounting position when installing.

1. Disconnect travel motor hoses (1) and (2).
2. Disconnect speed selector hose (3).
3. Disconnect drain hose (4), and remove elbow (5).
   ★ Install a blind plug in the drain hose.
4. Disconnect drain hoses (7) and (8).
   ★ Install a blind plug in the drain hose.
5. Disconnect travel hoses (9) and (10), and speed selector hose (11).
6. Pull out pin (12), and disconnect plate (13).
7. Sling center swivel joint assembly (14), remove mounting bolts from below, then lift off.

kg Center swivel joint assembly: **40 kg**





INSTALLATION OF CENTER SWIVEL JOINT ASSEMBLY

PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up

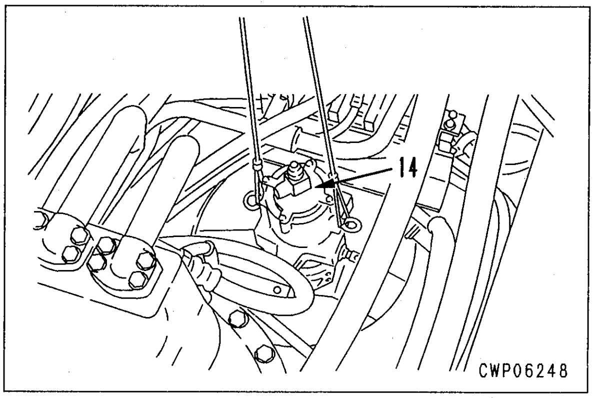
- Carry out installation in the reverse order to removal.

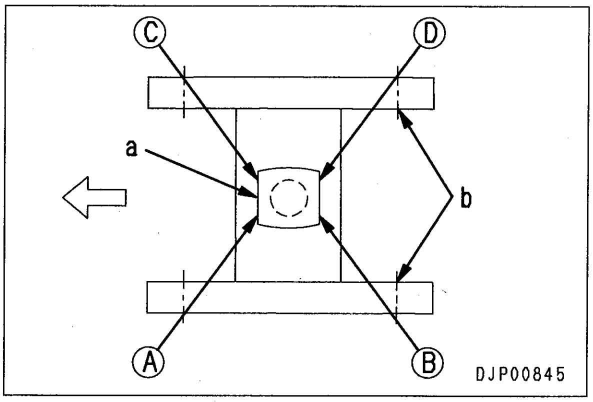
※1

★ Assemble the center swivel as shown in the diagram below.

- **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 travel motor.
  For details, see TESTING AND ADJUSTING, Bleeding air.





a: Center swivel
b: Sprocket

DISASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

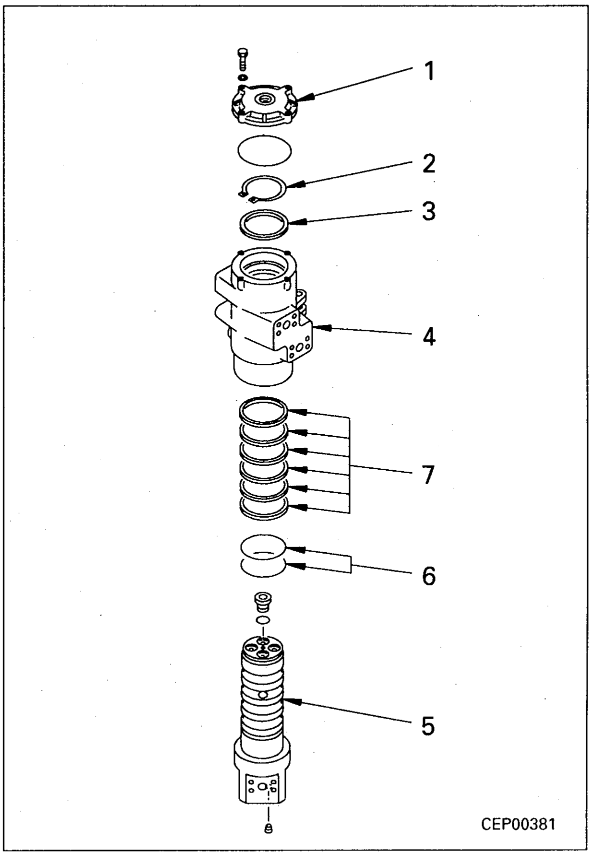
PC400-6 Serial No.: 32001 – 32249
PC450-6 Serial No.: 12001 – 12143

1. Remove cover (1).

2. Remove snap ring (2).

3. Using puller ①, pull out swivel rotor (4) and ring (3) from swivel shaft (5).

4. Remove O-ring (6) and slipper seal (7) from swivel rotor.



CEP00381

ASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

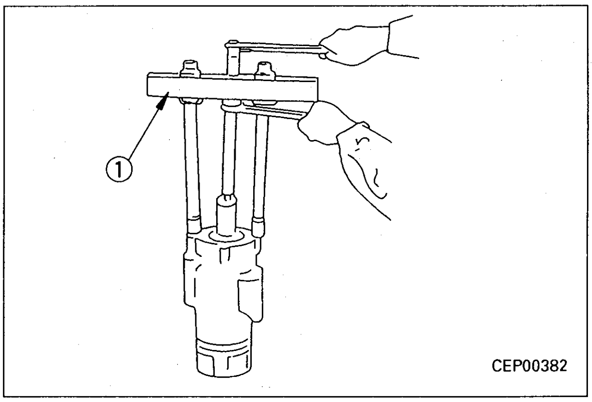
PC400-6 Serial No.: 32001 – 32249
PC450-6 Serial No.: 12001 – 12143

1. Assemble slipper seal (7) and O-ring (6) to swivel rotor.

2. Set swivel shaft (5) to block, then using push tool, tap swivel rotor (4) with a plastic hammer to install.
   Contact surface of rotor, shaft:
   Grease (G2-LI)
   ★ When installing the rotor, be extremely careful not to damage the slipper seal and the O-ring.

3. Install ring (3) and secure with snap ring (2).

4. Fit O-ring and install cover (1).
   Mounting bolt: **31.4 ± 2.9 Nm**
   {3.2 ± 0.3 kgm}

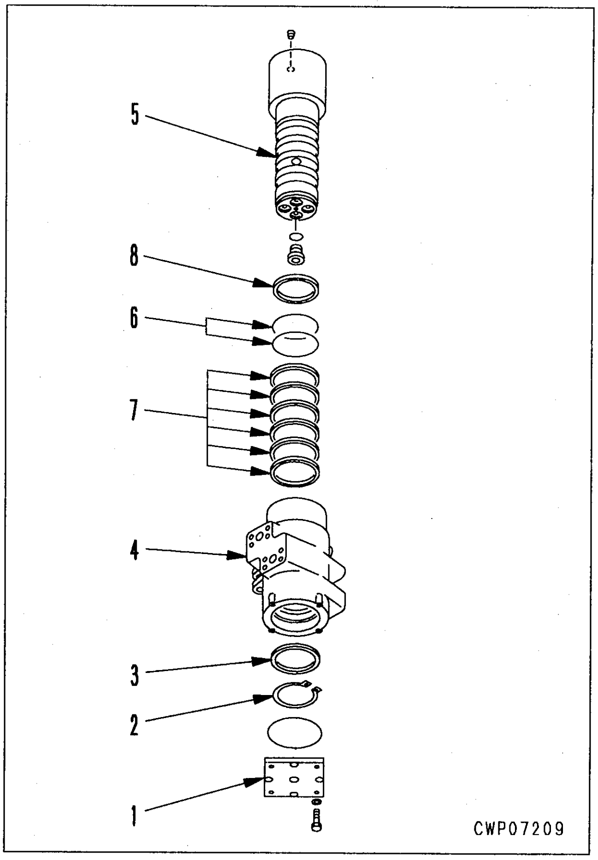


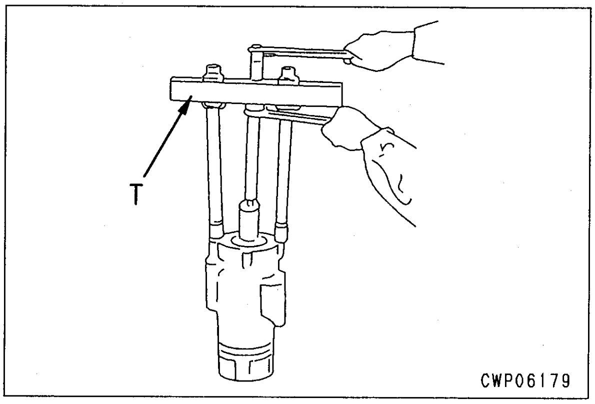
CEP00382

DISASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up

1. Remove cover (1).
2. Remove snap ring (2).
3. Using puller **T**, pull out swivel rotor (4) and ring (3) from swivel shaft (5).
4. Remove O-ring (6), dust seal (8) and slipper seal (7) from swivel rotor.





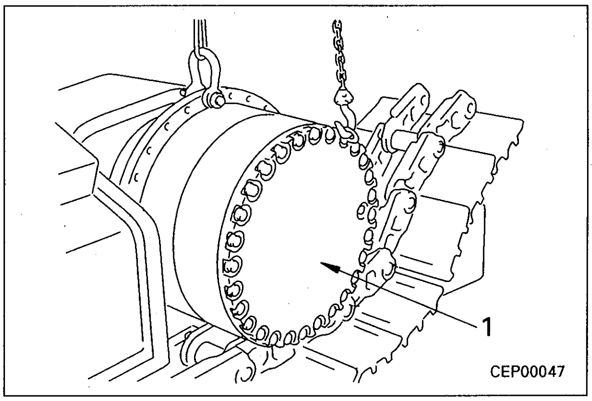
ASSEMBLY OF CENTER SWIVEL JOINT ASSEMBLY

PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up

1. Assemble slipper seal (7) and O-ring (6) to swivel rotor.
2. Set swivel shaft (5) to block, then using push tool, tap swivel rotor (4) with a plastic hammer to install.
   Contact surface of rotor, shaft:
   Grease (G2-LI)
   ★ When installing the rotor, be extremely careful not to damage the slipper seal and the O-ring.
3. Install ring (3) and secure with snap ring (2).
4. Fit O-ring and dust seal (8), and install cover (1).
   kgm Mounting bolt: **108 ± 14.5 Nm**
   {11.0 ± 1.5 kgm}

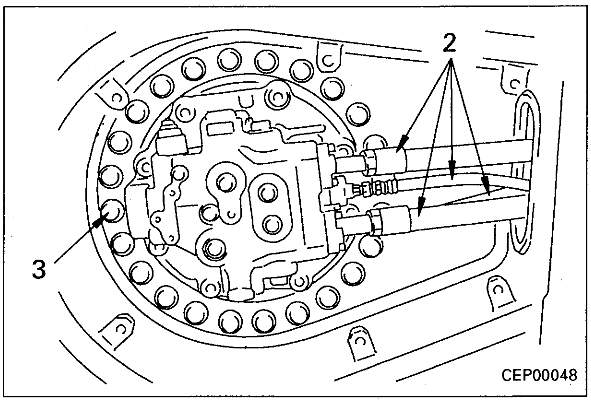
REMOVAL OF FINAL DRIVE ASSEMBLY

1. Remove sprocket.
   For details, see REMOVAL OF SPROCKET.
2. Sling final drive assembly (1).



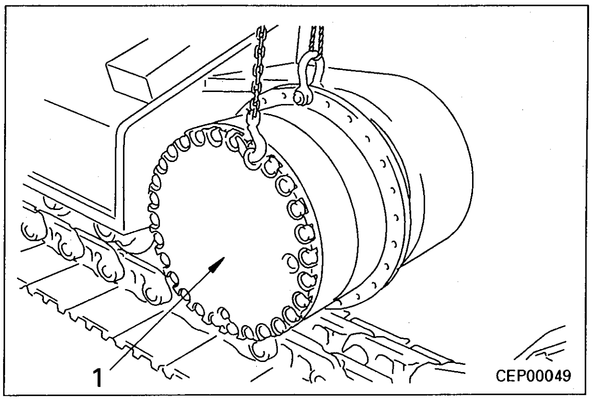
3. Remove cover, and disconnect 4 travel motor hoses (2).
4. Remove mounting bolts (3) of final drive and travel motor assembly. ※1
   ★ To maintain the lifting balance, leave two mounting bolts installed.
5. Adjust lifting balance of final drive assembly (1), remove 2 mounting bolts (3), then lift off final drive assembly (1).

   kg Final drive assembly: **800 kg**



INSTALLATION OF FINAL DRIVE ASSEMBLY

- Carry out installation in the reverse order to removal.



※1

Mounting bolt: **Thread tightener (LT-2)**

kgm Mounting bolt:
549.1 ± 58.8 Nm {56 ± 6 kgm}

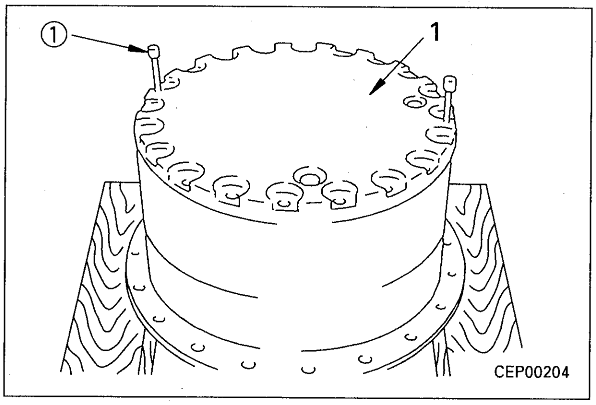
- **Refilling with oil (hydraulic tank)**
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.
- **Bleeding air**
  ★ Bleed the air from the travel motor.
  For details, see TESTING AND ADJUSTING, Bleeding air.

DISASSEMBLY OF FINAL DRIVE ASSEMBLY

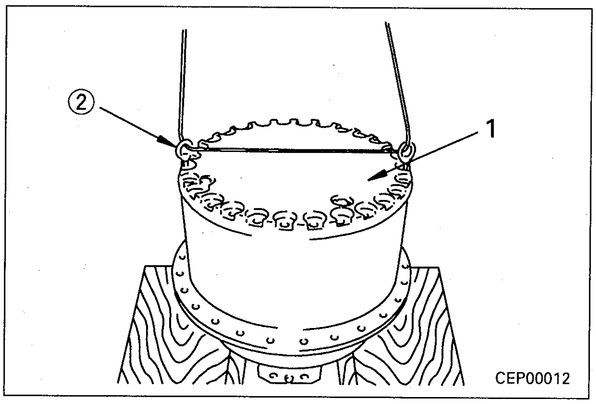
1. **Draining oil**
   Remove drain plug and drain oil from final drive case.

   Final drive case: **Approx. 12 ℓ**

2. **Cover**
   1) Remove mounting bolts, then use forcing screws ① to disconnect cover (1) from ring gear.

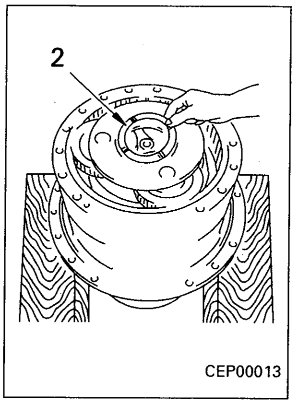


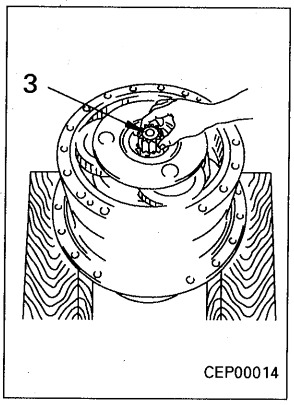
   2) Use eyebolts ② to remove cover (1).



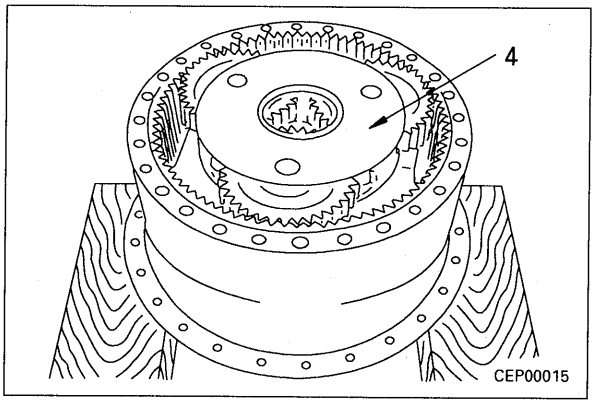
3. **Spacer**
   Remove spacer (2).

4. **No. 1 sun gear shaft**
   Remove No. 1 sun gear shaft (3).

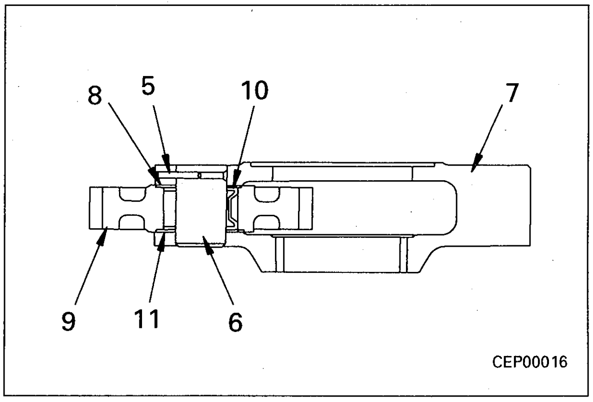




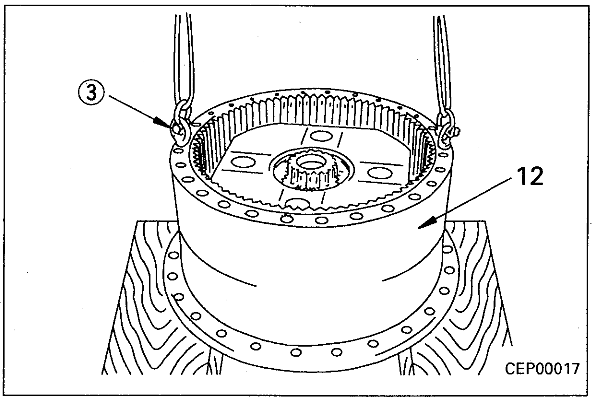
5. **No. 1 carrier assembly**
   1) Remove No. 1 carrier assembly (4).



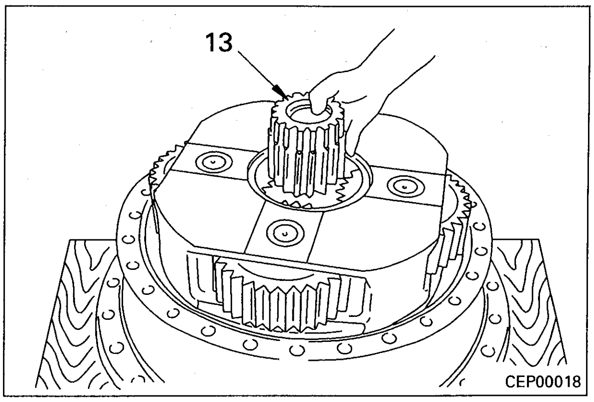
2) Disassemble No. 1 carrier assembly as follows.
   i) Push in pin (5), and knock out shaft (6) from carrier (7).
      ★ After removing the shaft, remove pin (5).
   ii) Remove thrust washer (8), gear (9), bearing (10), and thrust washer (11).



6. **Ring gear**
   Using eyebolts ③, remove ring gear (12).
   ★ After removing ring gear (12), remove the O-ring fitted to the face mating with the hub assembly.

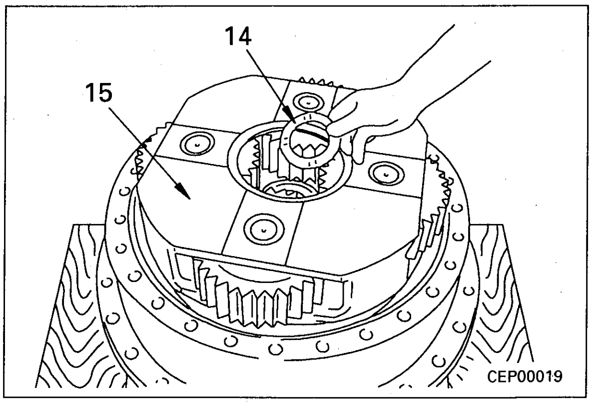


7. **No. 2 sun gear**
   Remove No. 2 sun gear (13).

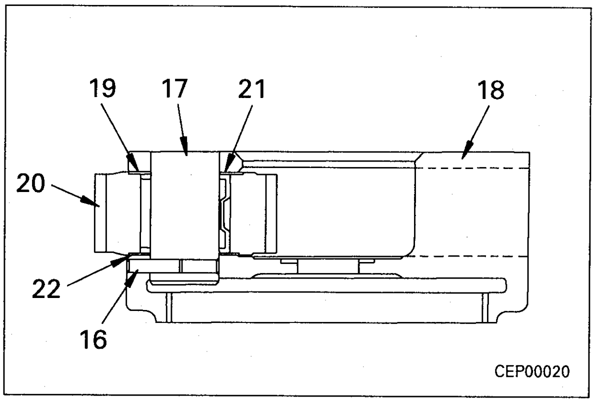


8. **Thrust washer**
   Remove thrust washer (14).

9. **No. 2 carrier assembly**
   1) Remove No. 2 carrier assembly (15).

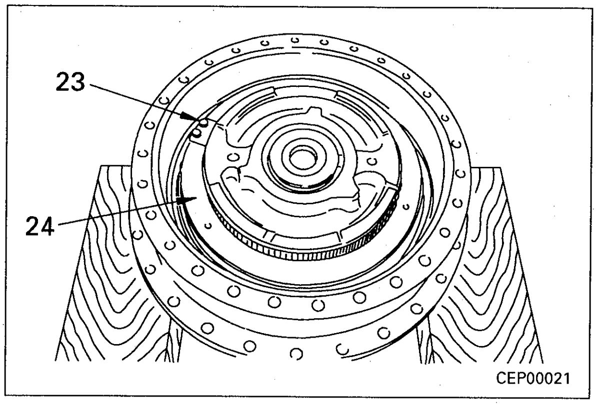


2) Disassemble No. 2 carrier assembly as follows.
   i) Push in pin (16) and pull out shaft (17) from carrier (18).
      ★ After removing the shaft, remove pin (16).
   ii) Remove thrust washer (19), gear (20), bearing (21), and thrust washer (22).

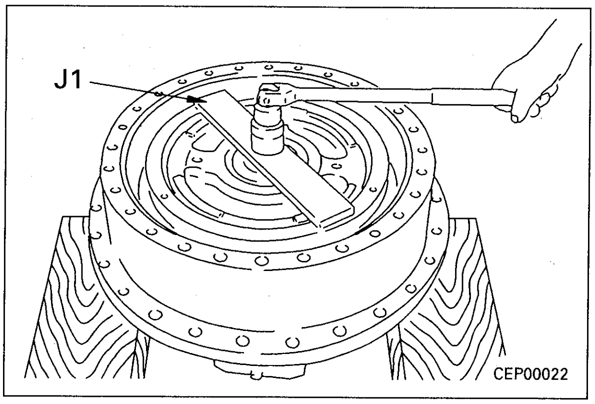


10. Nut

1) Remove lock plate (23).

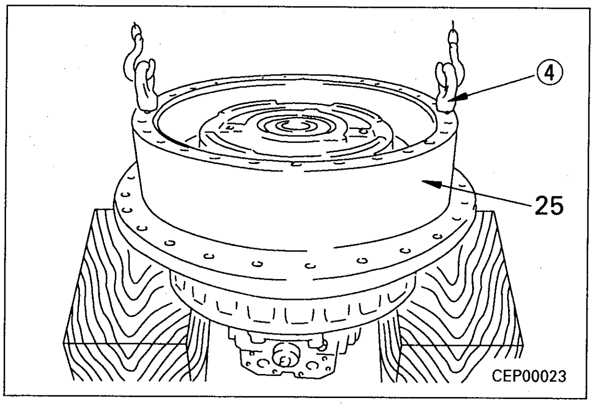


2) Using tool **J1**, remove nut (24).

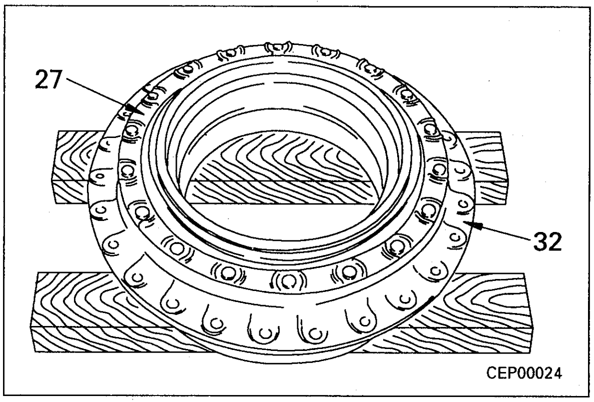


11. Hub assembly

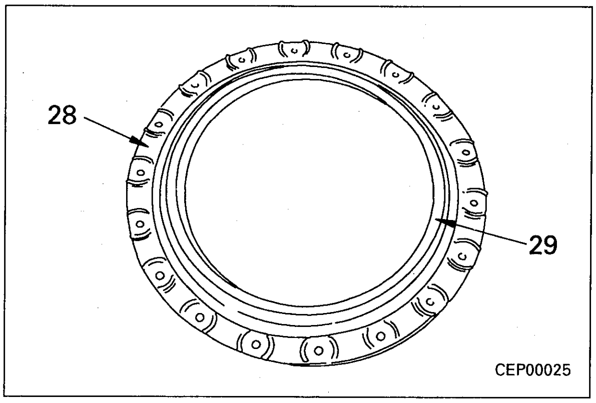
1) Using eyebolts ④, remove hub assembly (25) from travel motor.



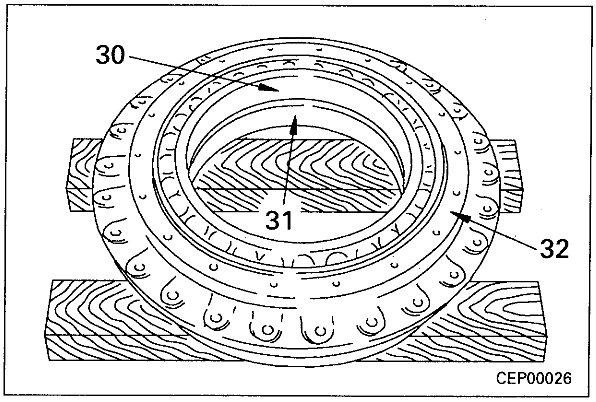
2) Disassemble hub assembly as follows.
   i) Remove floating seal and cage assembly (27) from hub (32).



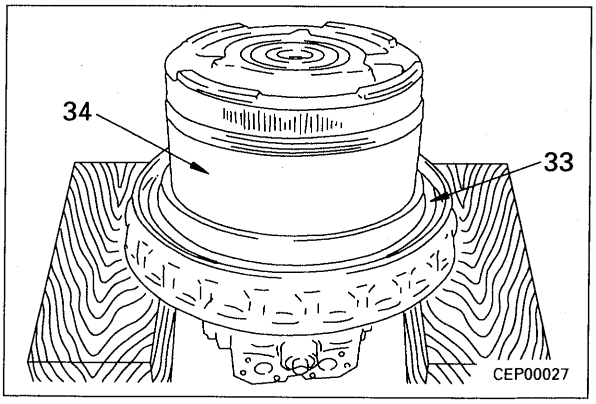
   ii) Remove floating seal (29) from cage (28).



   iii) Remove bearings (30) and (31) from hub (32).



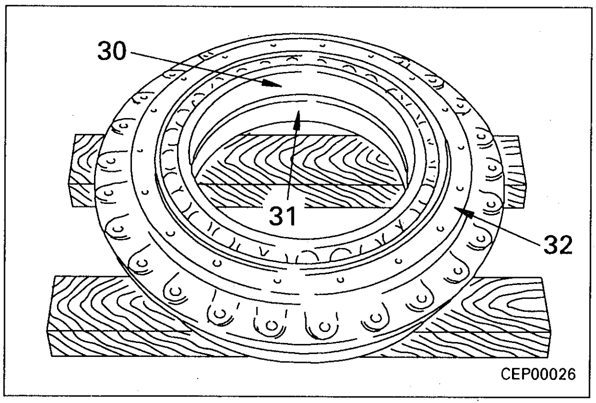
3) Remove floating seal (33) from travel motor (34).



ASSEMBLY OF FINAL DRIVE ASSEMBLY

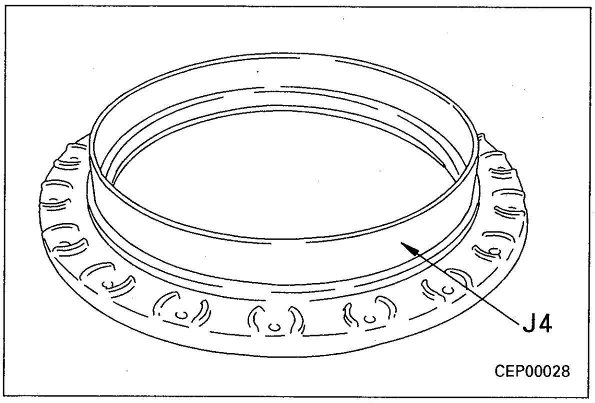
★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

1. **Hub assembly**
   1) Using push tool, press fit bearings (31) and (30) to hub (32).

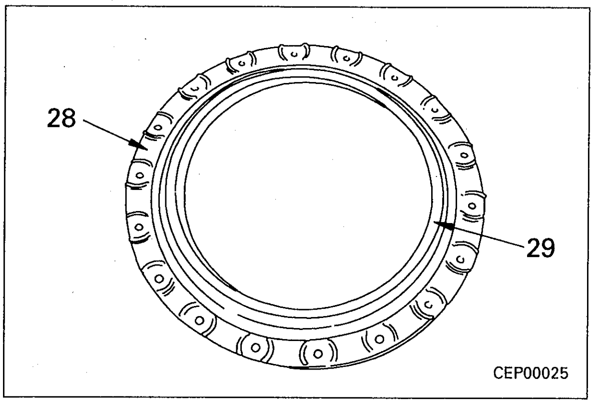


CEP00026

   2) Using tool **J4**, install floating seal (29) to cage (28).
      ★ Remove all oil and grease from the O-ring and O-ring contact surface, and dry the parts before installing the floating seal.
      ★ After installing the floating seal, check that the angle of the floating seal is within 1 mm.
      ★ After installing the floating seal, coat the sliding surface thinly with engine oil.

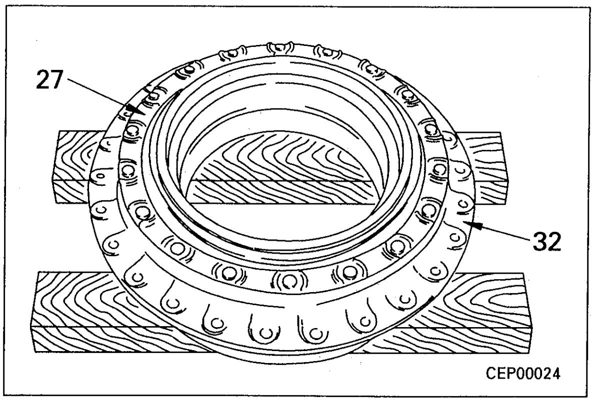


CEP00028



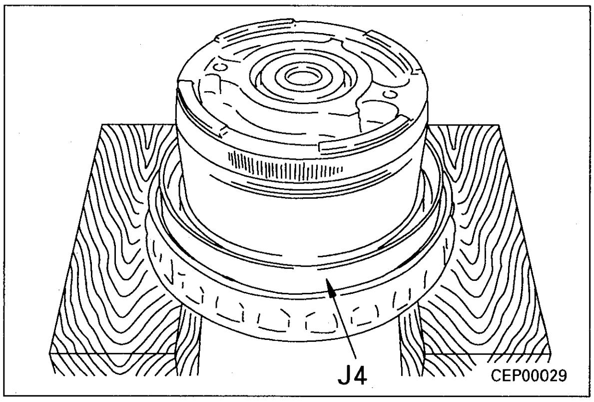
CEP00025

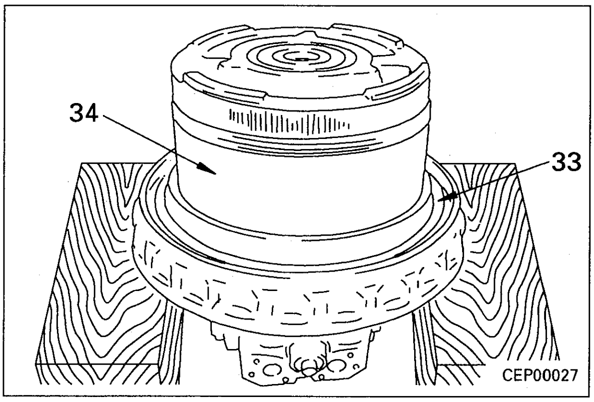
   3) Install floating seal and cage assembly (27) to hub (32).
      kgm Mounting bolt:
      66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}



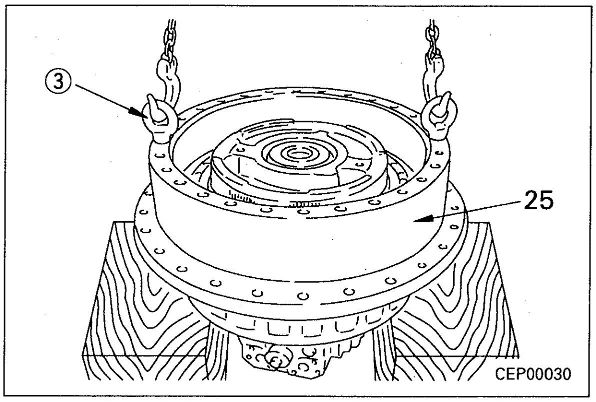
CEP00024

4) Using tool **J4**, install floating seal (33) to cage (34).
   - ★ Remove all oil and grease from the O-ring and O-ring contact surface, and dry the parts before installing the floating seal.
   - ★ After installing the floating seal, check that the angle of the floating seal is within 1 mm.
   - ★ After installing the floating seal, coat the sliding surface thinly with engine oil.



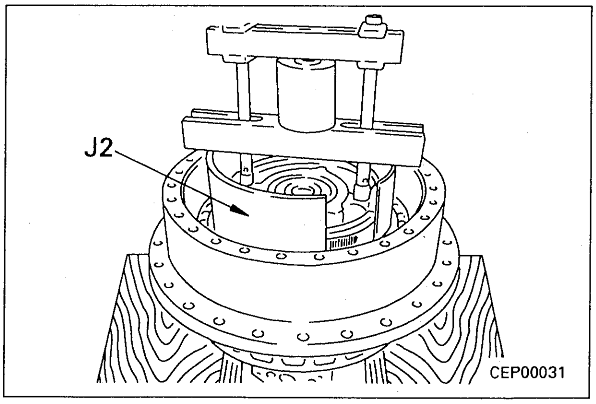


5) Using eyebolts ③, set hub assembly (25) to travel motor, then using push tool, tap to press fit bearing portion.

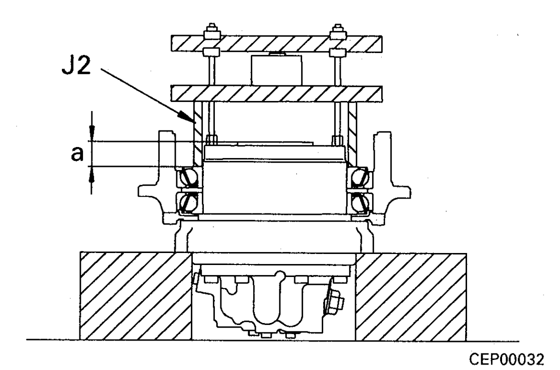


2. Nut

1) Install nut as follows.
   i) Using tool **J2**, push inner race portion of bearing.
   - ★ Pushing force:
     21.6 – 25.5 kN {2.2 – 2.6 ton}
   - ★ Rotate the hub 2 – 3 times before applying the pushing force to the bearing inner race.

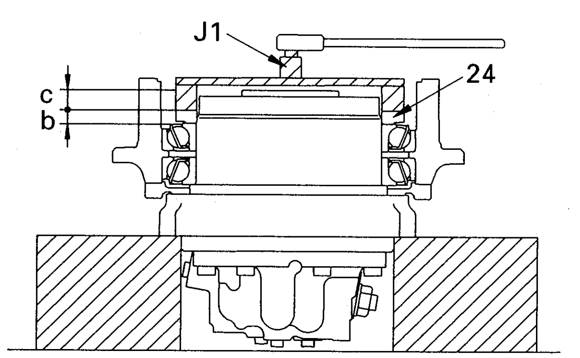


ii) Measure dimension **a** in the condition in Step i) above.



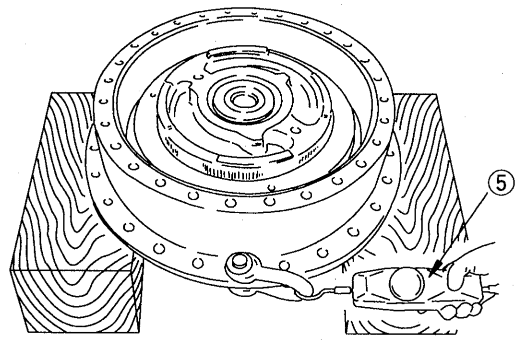
CEP00032

iii) Measure thickness **b** of nut (24) as an individual part.
iv) Calculate **a – b = c.**
v) Using tool **J1**, tighten nut (24) until **c** portion dimension is as follows.
c portion dimension = **c** $^{0}_{-0.1}$ mm.



CEP00033

vi) Using push-pull scale ⑤, measure tangential force in direction of rotation of hub in relation to motor case.
- ★ Tangential force: Max. 667 N (68 kg)
- ★ The tangential force is the maximum force when starting rotation.

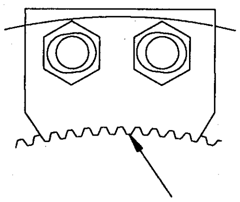


CEP00034

vii) Install lock plate (23).
★ Install the lock plate as shown in the diagram on the right.

Thread of mounting bolt:
Thread tightener (LT-2)

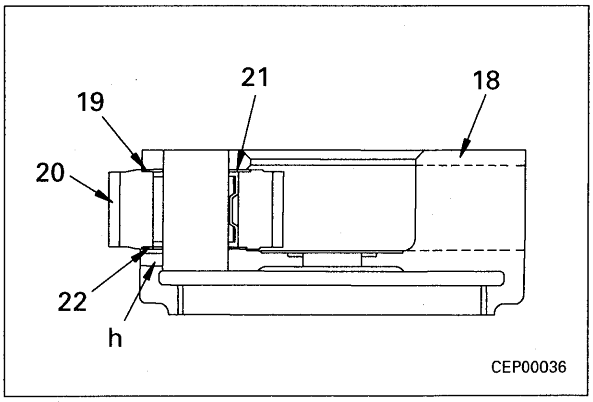
Mounting bolt:
66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}

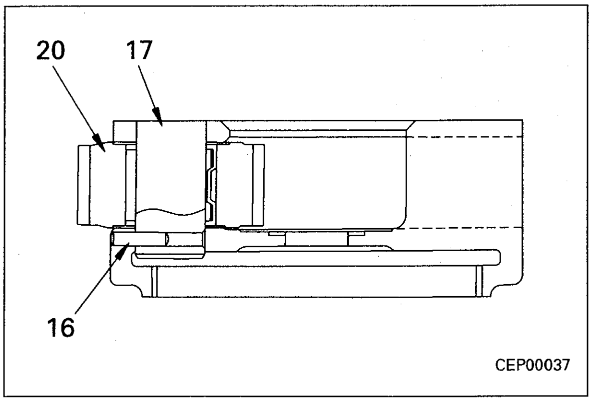


Bring lock plate and spline of motor into tight contact.

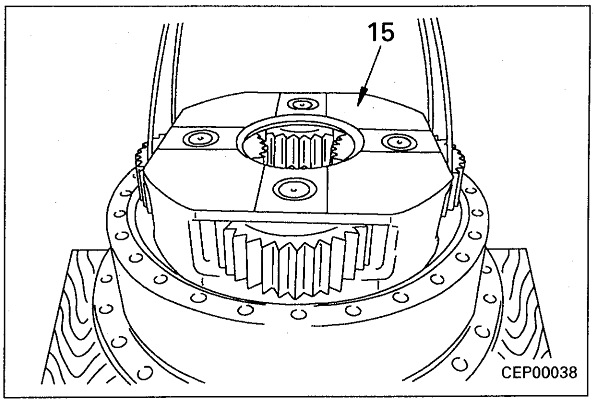
CEP00035

3. **No. 2 carrier assembly**
   1) Assemble No. 2 carrier assembly as follows.
      ★ There are the remains of the caulking when the pin is inserted at the end face of hole **h** at the side of the carrier, so remove the caulked metal from the inside diameter of the hole before starting to assemble.
      i) Assemble bearing (21) to gear (20), fit top and bottom thrust washers (19) and (22), and set gear assembly in carrier (18).
      ii) Align with position of pin holes of shaft and carrier, then tap with a plastic hammer to install shaft (17).
         ★ When installing the shaft, rotate the planetary gear, and be careful not to damage the thrust washer.
      iii) Insert pin (16).
         ★ After inserting the pin, caulk the pin portion of the carrier.
      ★ After assembling the carrier assembly, check that gear (20) rotates smoothly.

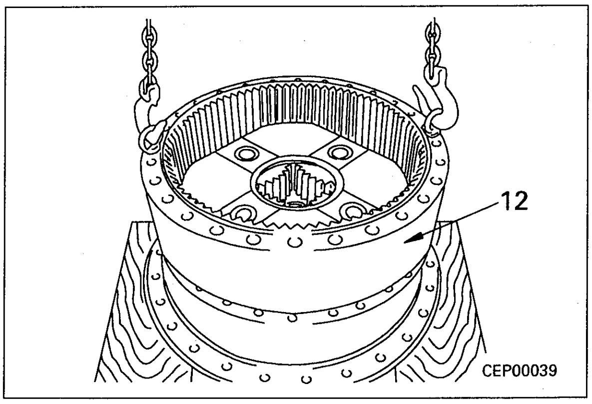




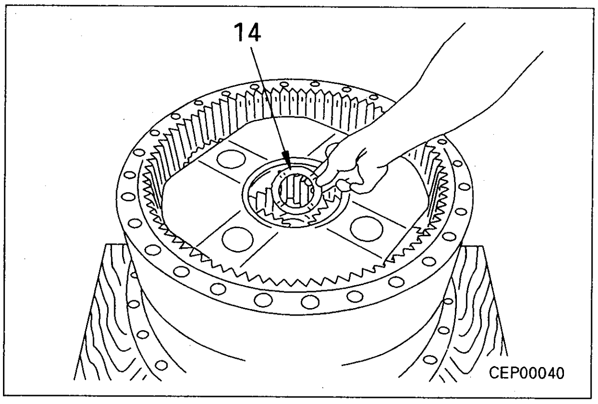
   2) Install No. 2 carrier assembly (15).
      ★ Align the position so that the four tips of the gear shafts of carrier assembly (15) enter the four hollows in the end face of the motor case, then install.



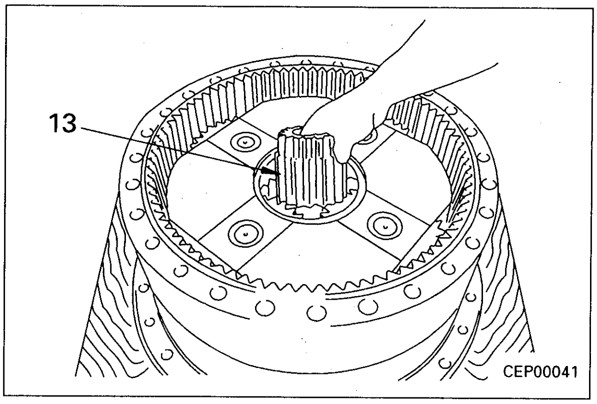
4. **Ring gear**
   Lift ring gear (12) and install.
   ★ Assemble an O-ring to the face mating with the hub assembly.
   ★ Remove all grease and oil from the mating surface of the ring gear and hub.
   ★ Do not put any gasket sealant on the mating surface of the ring gear and hub under any circumstances.



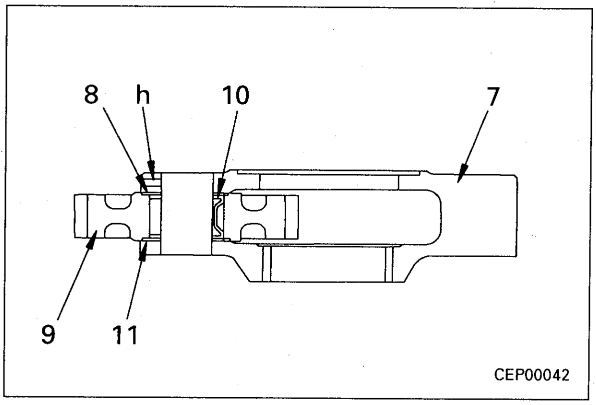
5. **Thrust washer**
   Install thrust washer (14).



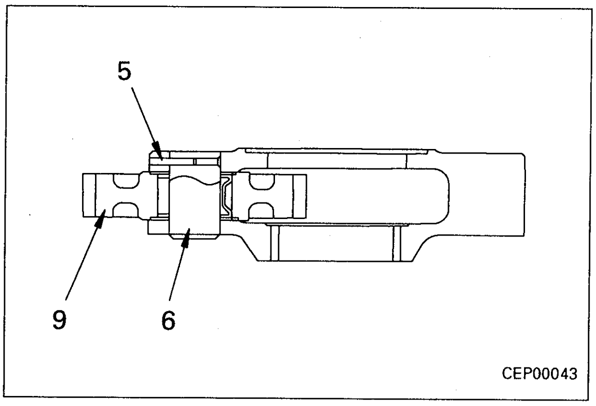
6. **No. 2 sun gear**
   Install No. 2 sun gear (13).



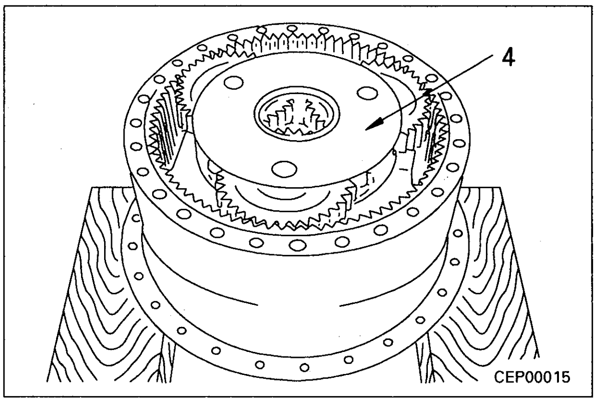
7. **No. 1 carrier assembly**
   1) Assemble No. 1 carrier assembly as follows.
      ★ There are the remains of the caulking when the pin is inserted at the end face of hole **h** at the side of the carrier, so remove the caulked metal from the inside diameter of the hole before starting to assemble.
      i) Assemble bearing (10) to gear (9), fit top and bottom thrust washers (8) and (11) and set gear assembly to carrier (7).



      ii) Align position of pin holes of shaft and carrier, then tap with a plastic hammer to install shaft (6).
         ★ When installing the shaft, rotate the planetary gear, and be careful not to damage the thrust washer.
      iii) Insert pin (5).
         ★ After inserting the pin, caulk the pin portion of the carrier.
      ★ After assembling the carrier assembly, check that gear (9) rotates smoothly.

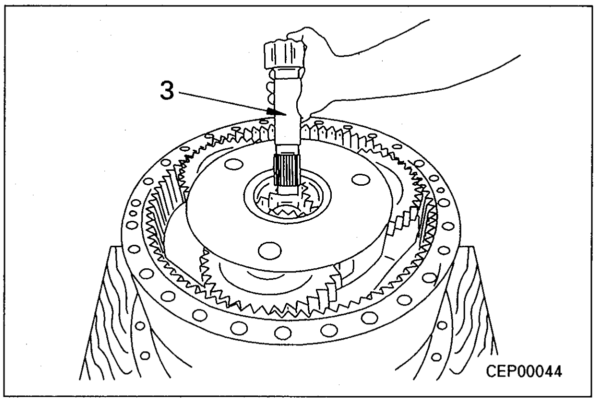


2) Install No. 1 carrier assembly (4).



8. No. 1 sun gear shaft

Install No. 1 sun gear shaft (3).



9. Spacer

Install spacer (2).

10. Cover

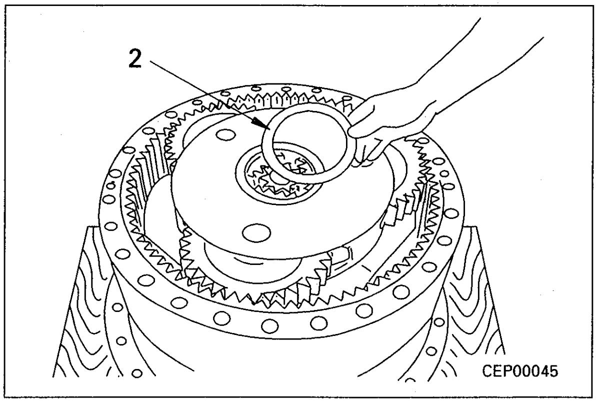
Using eyebolts ①, install cover (1), then using angle tightening wrench **J3**, tighten mounting bolts.

Mounting surface of cover: **Gasket sealant (LG-6)**

kgm Mounting bolt:

Initial torque: **98.1 Nm {10 kgm}**

Additional tightening angle: **115 – 125°**

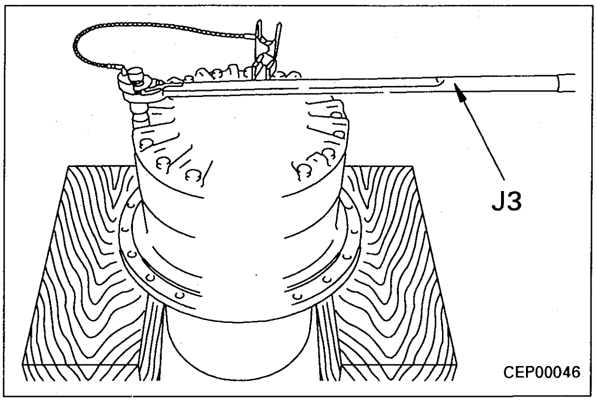


11. Refilling with oil

Tighten drain plug and add engine oil through oil filler.

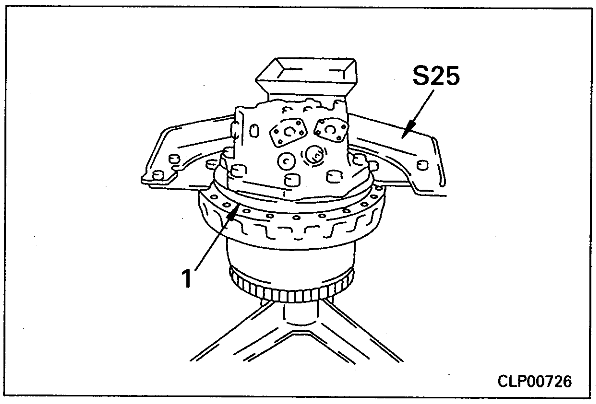
Final drive case: **Approx. 12 ℓ**

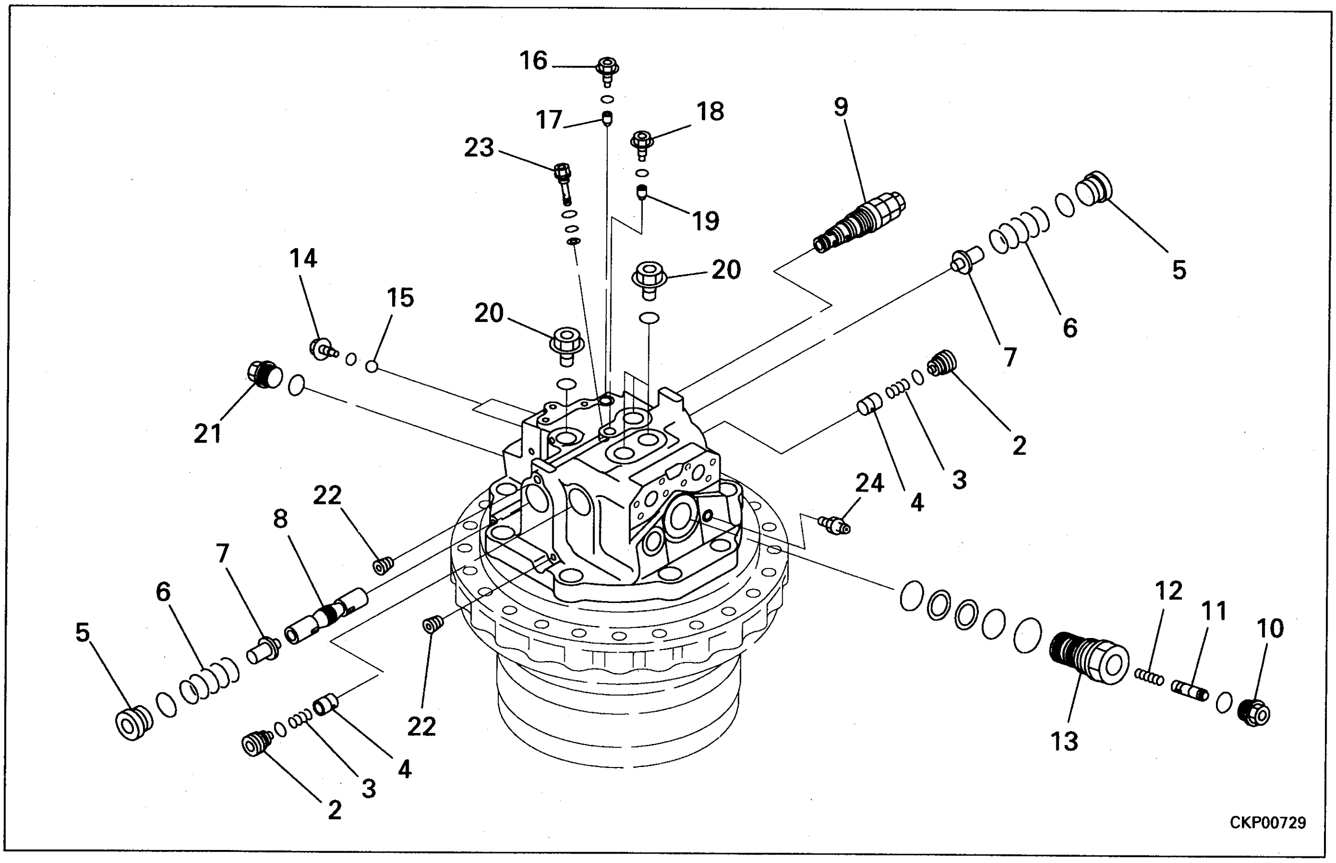
★ Carry out a final check of the oil level at the determined position after installing the final drive assembly to the chassis.



DISASSEMBLY OF TRAVEL MOTOR ASSEMBLY

1. **Travel motor assembly**
   Set travel motor assembly (1) to tool **S25**.





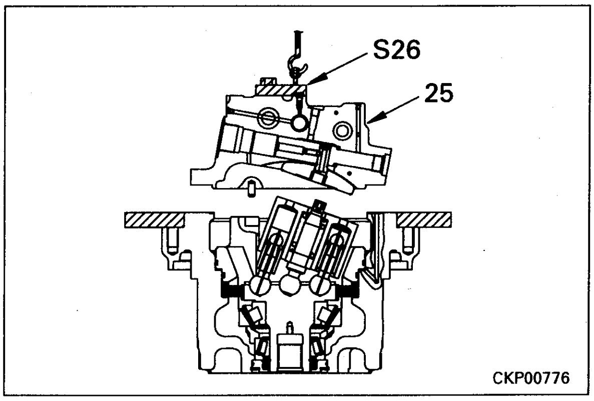
2. **Plugs, valve**
   1) Remove plug (2), then remove spring (3) and check valve (4).
   2) Remove plug (5), then remove spring (6), piston (7), and spool (8).
   3) Remove safety valve (9).
   4) Remove plug (10), then remove regulator valve (11) and spring (12).
   5) Remove plug (13).

6) Remove plug (14), then remove ball (15).
7) Remove plug (16), then remove valve (17).
8) Remove plug (18), then remove valve (19).
9) Remove plugs (20), (21), and (22), then remove sleeve (23) and bleeder (24).

3. End cover assembly

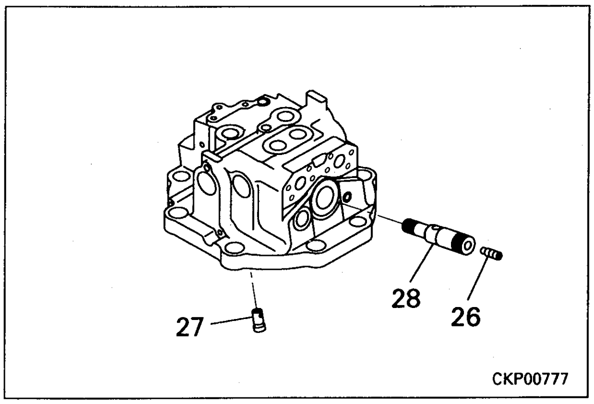
Using tool **S26**, lift off end cover assembly (25).

★ The valve plate may be stuck to the rear face, so be careful not to drop it.



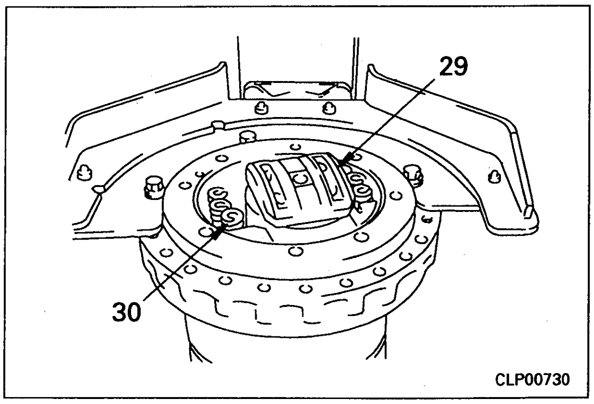
4. Regulator piston

Remove screw (26), pull out pin (27), then remove regulator pistons (28).

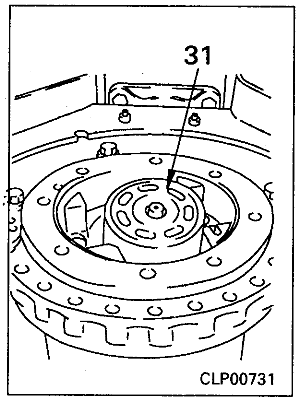


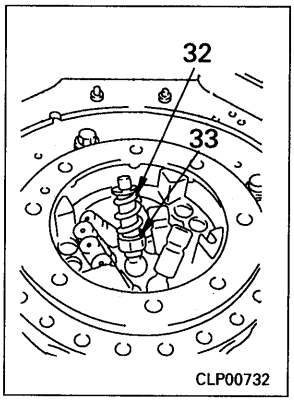
5. Valve plate, spring

1) Remove valve plate (29).
   ★ When using again, keep in a safe place and be careful not to scratch or damage the cylinder block contact surface.
2) Remove brake pistons (30).

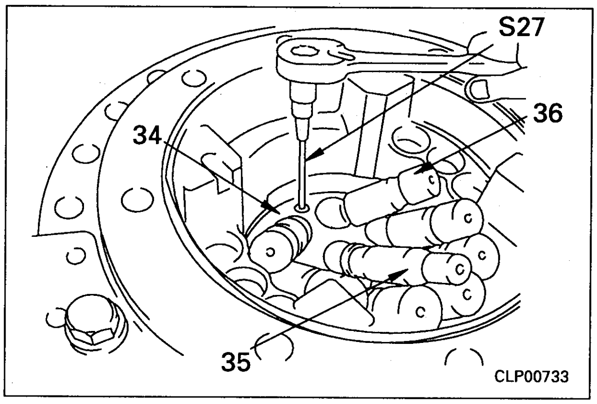


6. **Center shaft, piston**
   1) Remove cylinder block (31).
   2) Remove spring (32) and center ring (33).

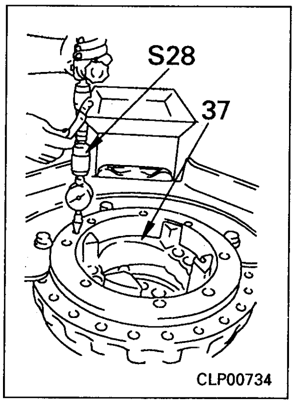


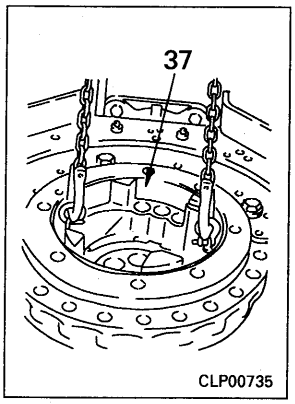


   3) Using tool **S27**, remove 7 mounting screws, then remove retainer (34), center shaft (35), and pistons (36) as one assembly.
   4) Remove center shaft (35) and pistons (36) from retainer (34).

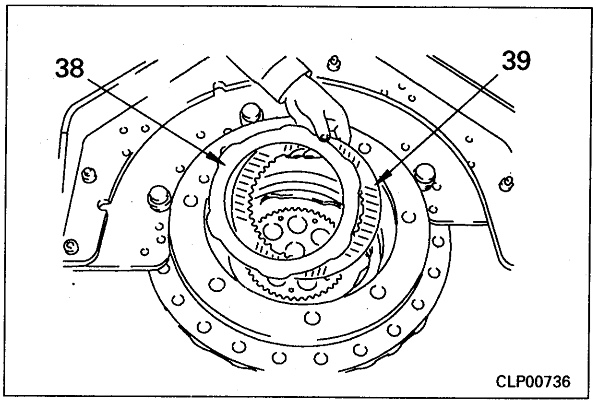


7. **Brake piston, discs, plates**
   1) Set tool **S28** to port hole for brake piston.
   2) Apply pressure gradually until brake piston (37) comes up.
      ★ Be careful that the air pressure is not too high. The brake piston will fly out.
   3) Lift off brake piston (37).



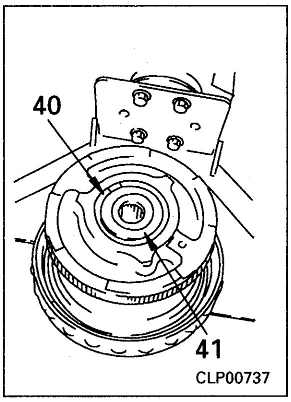


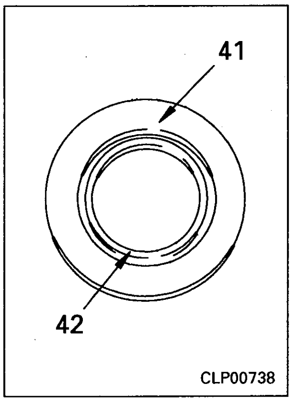
   4) Remove plates (38) and discs (39) in order.
      ★ Plates : 4
      ★ Discs : 3



8. Oil seal

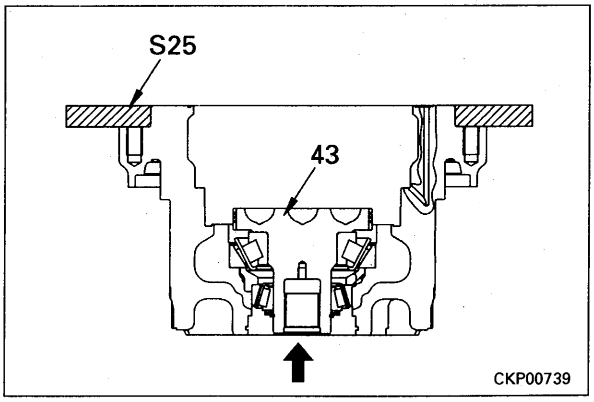
1) Turn over tool **S25**.
2) Remove snap ring (40), then remove cover (41).
3) Remove oil seal (42) from cover (41).





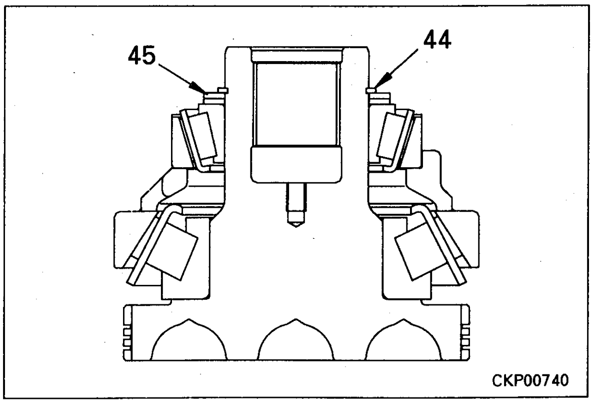
9. Drive shaft, bearing assembly

1) Rotate tool **S25** 90° and set opening of motor case facing side.
2) Tap end face of drive shaft with plastic hammer to remove drive shaft and bearing assembly (43).

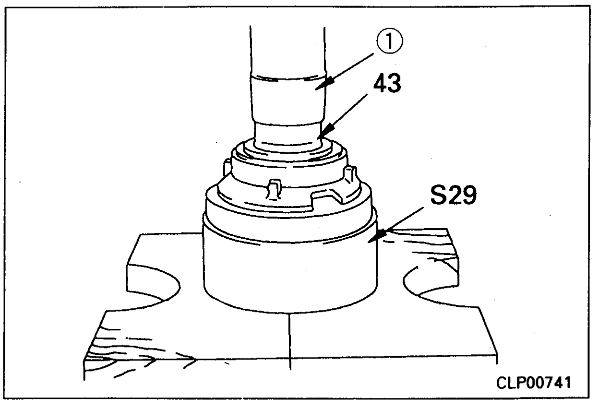


10. Disassembly of drive shaft, bearing assembly

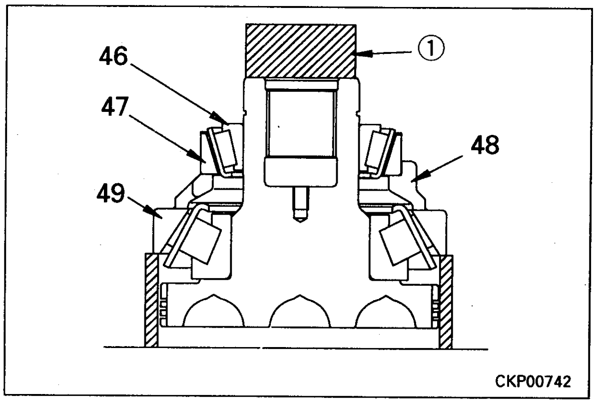
1) Remove snap ring (44), then remove 2 spacers (45).



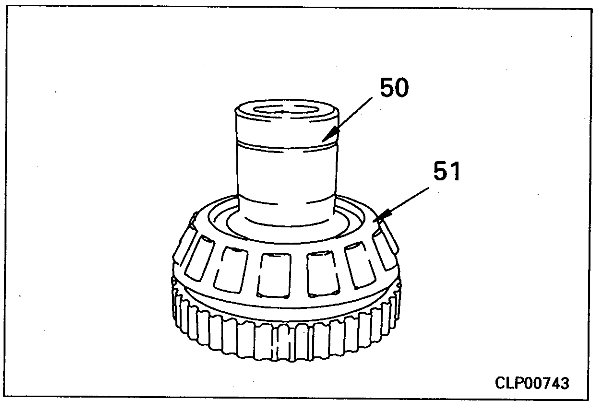
2) Set drive shaft and bearing assembly (43) to tool **S29**.
3) Set push tool ① to drive shaft, then push with press to remove drive shaft and main bearing inner race assembly.



4) Remove sub bearing inner race (46), outer race (47), retainer (48), and main bearing outer race (49).



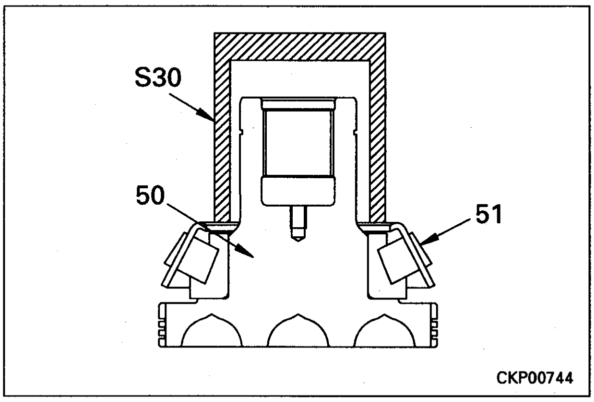
5) Remove main bearing inner race (51) from drive shaft (50).



ASSEMBLY OF TRAVEL MOTOR ASSEMBLY

Precautions when assembling

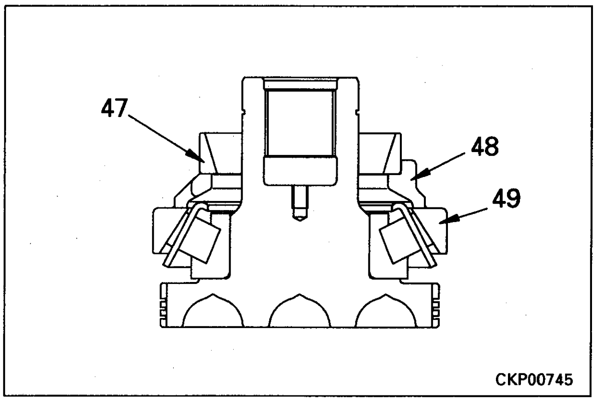
1) Clean all parts, remove all burrs, and check for dirt or damage.
2) Coat the rotating and sliding surfaces of all parts with engine oil (EO10-CD) before installing.
3) Before coating any part with thread tightener, remove all oil and grease from the thread and tap hole, and dry completely.



CKP00744

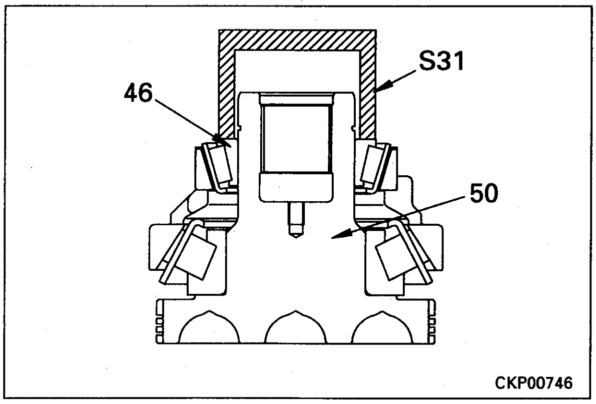
1. Drive shaft assembly

1) Using tool **S30**, press fit main bearing (51) to drive shaft (50).
   - ★ Press fit until the end face of the inner race is in tight contact with the end face of the drive shaft.
   - ★ Press-fitting load : **47.6 kN {4,850 kg}**
   - Press-fitting surface of bearing : **Lubricating oil (EO10-CD)**
2) Install main bearing outer race (49), retainer (48), and sub bearing outer race (47).



CKP00745

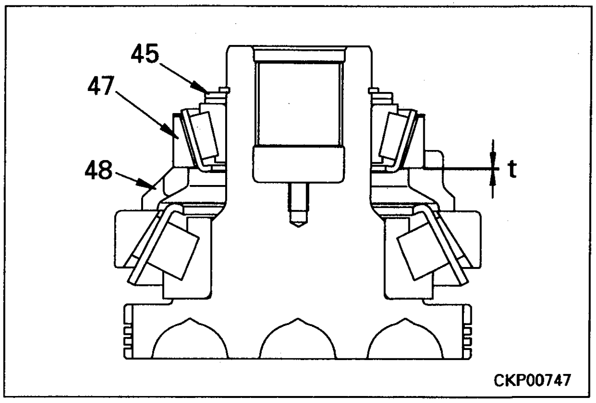
3) Using tool **S31**, press fit sub bearing inner race (46) to drive shaft (50).
   - ★ Press fit until the roller of the inner race is in tight contact with the outer race.
   - ★ Press-fitting load : **11.8 kN {1,208 kg}**
   - Press-fitting surface of bearing : **Lubricating oil (EO10-CD)**



CKP00746

2. Adjusting end play of shaft

1) Select 2 spacers (45) as follows, and adjust clearance "**t**" between retainer (48) and sub bearing outer race (47) to make clearance of 0.05 – 0.25 mm.

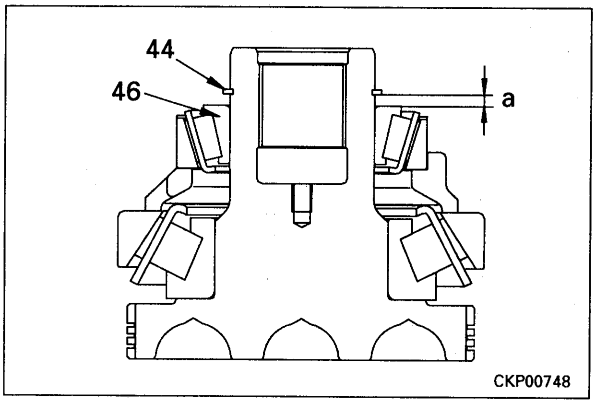


CKP00747

2) Measure dimension "**a**" between sub bearing inner race (46) and snap ring (44), and select 2 spacers (45) from table below.
   ★ Check that snap ring (44) is fitted securely in the mounting groove.

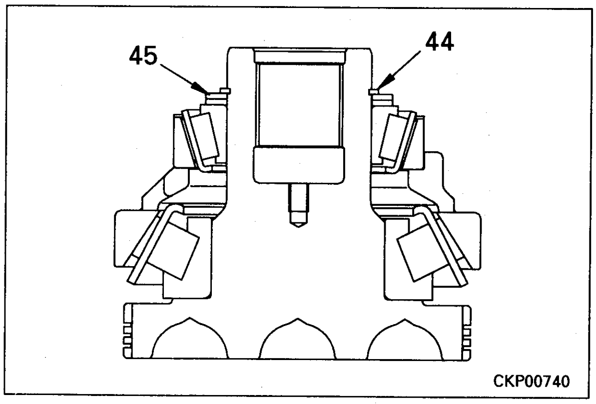
Unit: mm

No.	Measurement of dimension "a"	Necessary spacer thickness (including thickness of 2 spacers)	Necessary spacers: 2 spacers marked with ○ in table below		
			Spacer thickness: 2.9	3.1	3.3
1	5.850 – 6.049	5.8	○ ○		
2	6.050 – 6.244	6.0	○	○	
3	6.250 – 6.449	6.2		○ ○	
4	6.450 – 6.649	6.4		○	○
5	6.650 – 6.849	6.6			○ ○
Part No. of spacer			706-88-40440	706-88-40450	706-88-40460



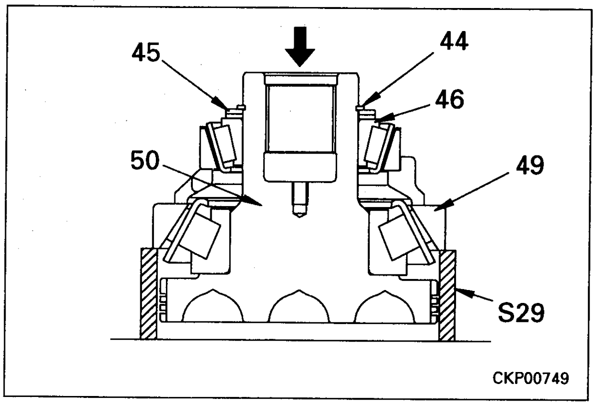
CKP00748

3) Install selected spacers (45), then install snap ring (44).
   ★ Check that snap ring (44) is fitted securely in the mounting groove.



CKP00740

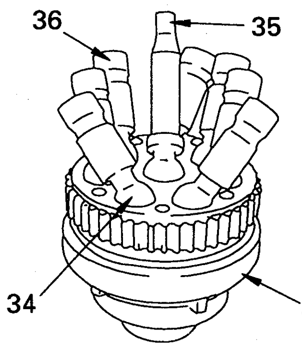
4) Push out drive shaft as follows.
   i) Support main bearing outer race (49) with tool **S29**.
   ii) Apply load to drive shaft (50) until top surface of sub bearing inner race (46), spacer (45), and snap ring (44) are all in tight contact with each other.
      ★ Load when pushing out:
      21.7 kN {2,208 kg}
   iii) Check that 2 spacers (45) are in tight contact and cannot be rotated by hand.
      ★ If the spacers can be rotated or are not fully in tight contact, adjust again from Step 2).



CKP00749

3. Shaft, center shaft, cylinder block

1) Set center shaft (35) and pistons (36) in position on retainer (34), then install drive shaft (43).

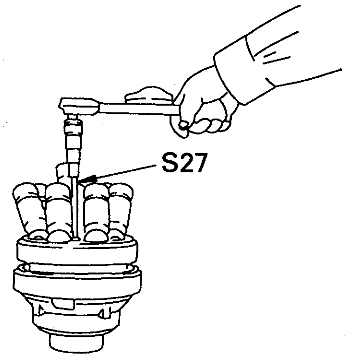


CLP00750

2) Using tool **S27**, tighten mounting screws.
   - ★ Replace the mounting screws with new parts.

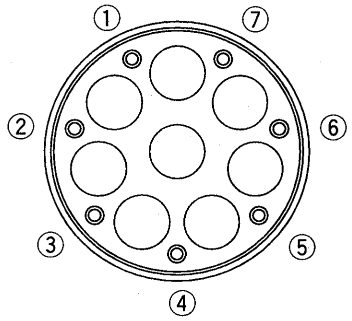
   Mounting screw :
   Thread tightener (LT-2)

   kgm Mounting screw:
   1st step :
   Max. 0.98 Nm {0.1 kgm}
   2nd step:
   7.8 – 9.8 Nm {0.8 – 1.0 kgm}
   3rd step:
   24.5 ± 1.9 Nm {2.5 ± 0.2 kgm}



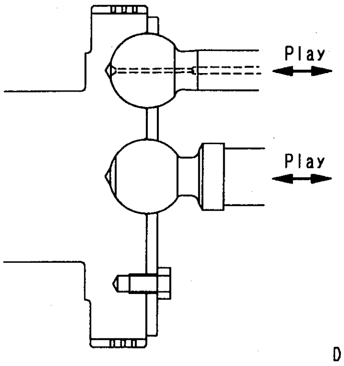
CLP00751

- ★ Order for tightening: ①-④-⑦-③-⑥-②-⑤ Tighten in three steps as shown above.
- ★ After tightening, wipe off any adhesive that has been squeezed out.
- ★ Check that the large ball of the piston and the center shaft move smoothly.



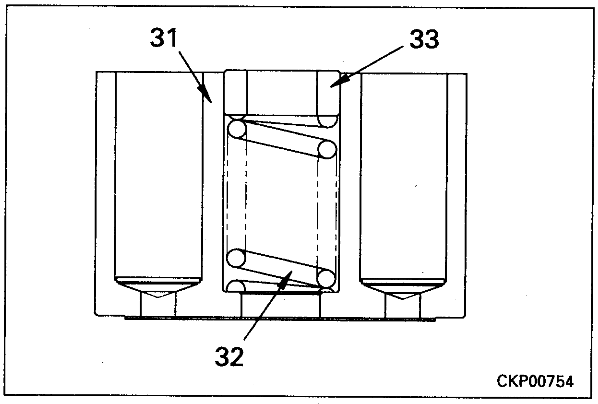
CKP00752

3) Measure play of piston (36) in axial direction.
   - ★ Standard play of piston in axial direction: Max. 0.35 mm

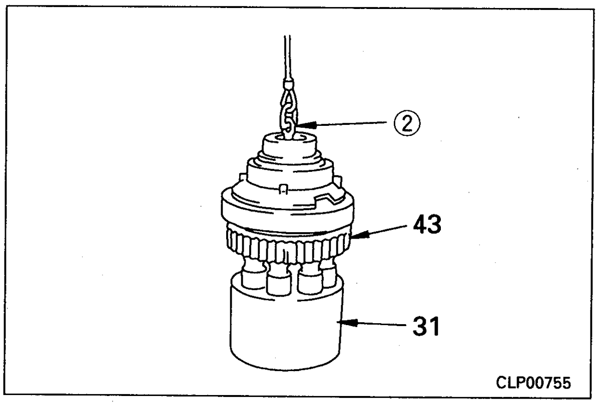


DVP00767

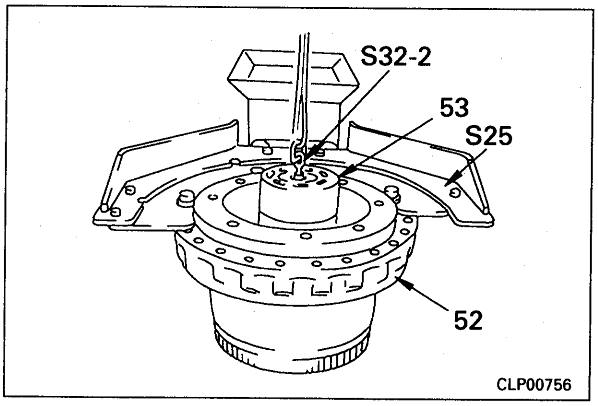
4) Assemble spring (32) and center ring (33) in turn in center shaft hole of cylinder block (31).



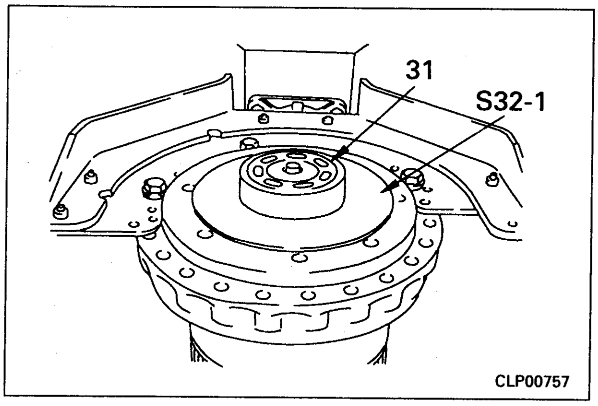
5) Turn over drive shaft assembly (43), and use eyebolt ② (10 x 1.5 mm, length below head: approx. 85 mm) to raise drive shaft assembly.
6) Align center shaft and piston with each hole in cylinder block (31), then install drive shaft (43).



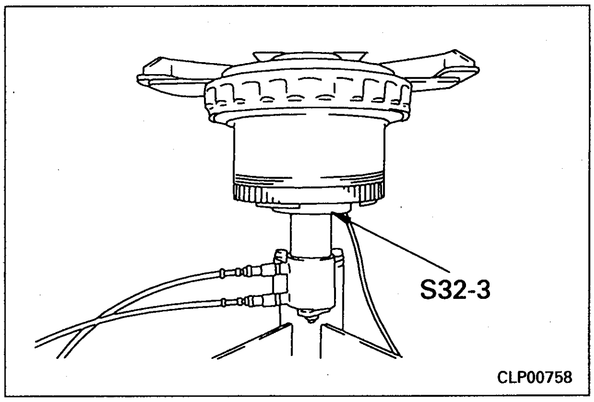
4. **Drive shaft, cylinder block assembly**
   1) Set motor case (52) to tool **S25.**
   2) Raise drive shaft and cylinder block assembly (53) with tool **S32-2** and install motor case (52).
      ★ Align the protrusions on the retainer (4 places around circumference) with the oil grooves in the case (4 places around circumference) and install.



3) Set tool **S32-1** in position and hold cylinder block (31) at center position.



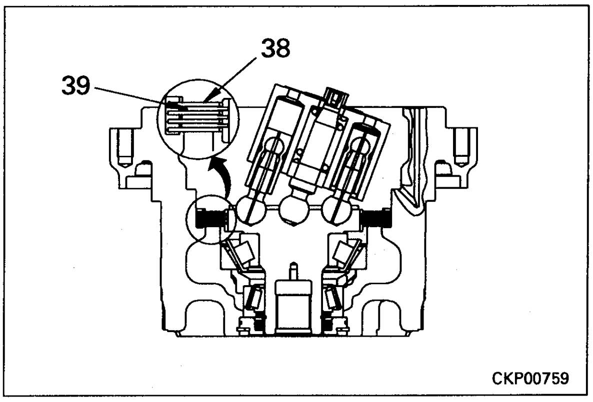
4) Install tool **S32-3** to drive shaft, then press fit until end face of main bearing outer race is in tight contact with case.
   - ★ Press-fitting load: **13.3 kN {1,360 kg}**



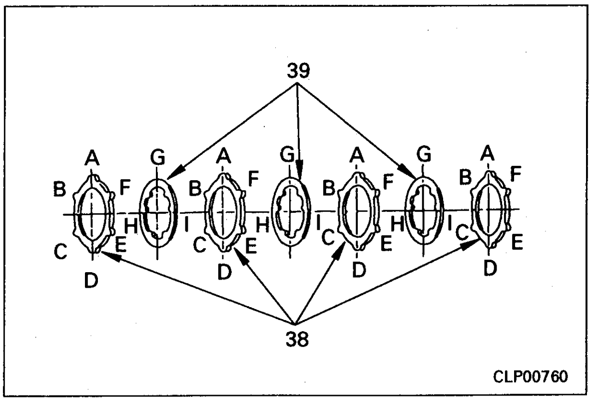
5. Plate, disc, piston

1) Assemble plates (38) and discs (39) in order.
   - ★ Plates : 4
   - ★ Discs : 3
   - ★ Do not wash the discs in trichlene or drizol, or blow strongly with air.

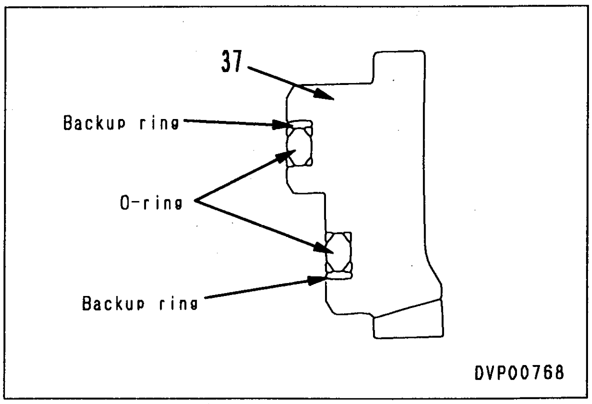
   Front face of disc:
   Lubricating oil (EO10-CD)



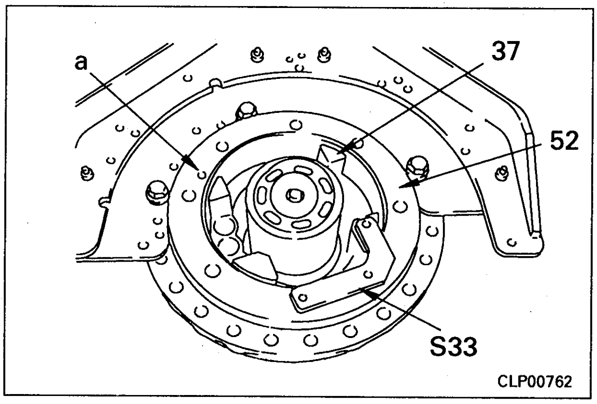
- **Method of placing plates and discs on top of each other.**
  - i) Align cutout arc teeth areas **G**, **H**, and **I** of discs (39).
  - ii) Protrusions **A, B, C, D, E,** and **F** on plates (38) can be set at any position in relation to positions **G, H,** and **I** of discs.



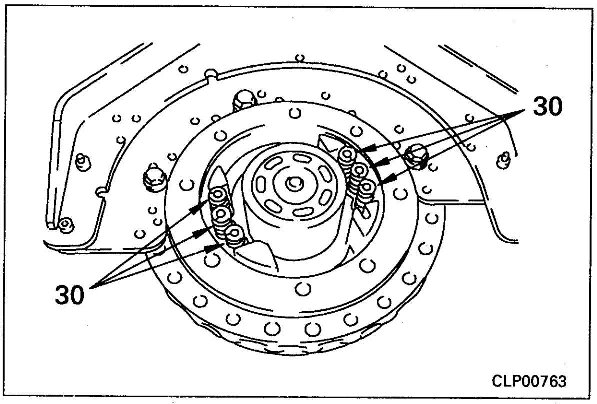
2) Fit O-ring and backup ring to brake piston (37).
   - ★ Assemble the backup ring in the direction shown in the diagram.



3) Install brake piston (37) to motor case (52), and determine position with tool **S33**.
   ★ Install tool **S33** in the position shown in the diagram on the right in relation to port hole "**a**" for the brake piston.

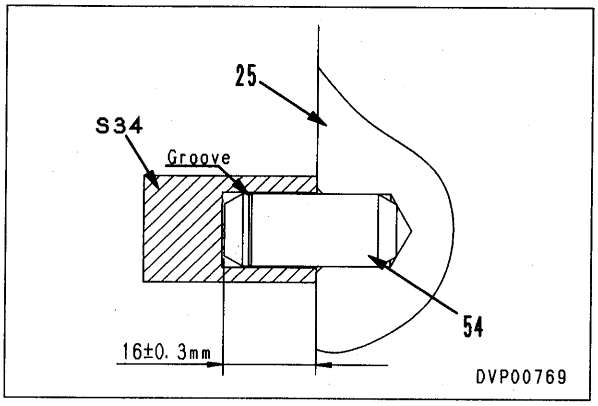


4) Install 6 brake springs (30).



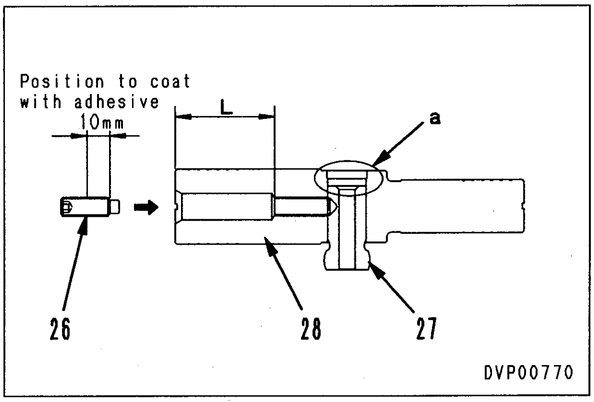
6. Dowel pin

Using tool **S34**, press fit dowel pin (54) to end cover (25) to dimension shown in diagram.
★ Install with the groove end at the brake piston end.

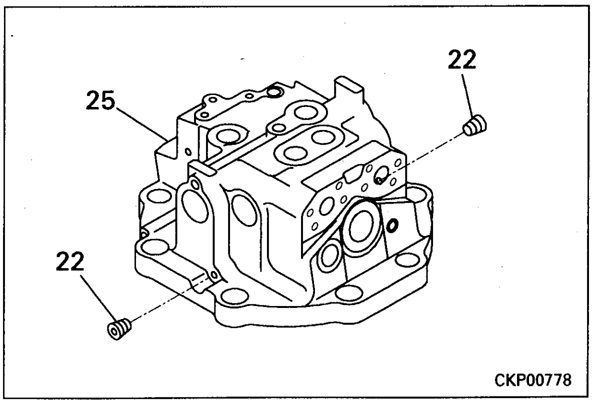


7. **Regulator piston**
   Insert regulator piston (28) in piston hole, then assemble pin (27) and secure with screw (26).
   ★ Assemble pin (27) from the opposite side to regulator piston counterbore "**a**".
   ★ Apply one drop of adhesive to screw (26) at the point shown in the diagram on the right.
   ★ Be careful not to apply too much adhesive.
   Screw: **Thread tightener (LT-2)**
   Screw: **28.4 ± 2.9 Nm {2.9 ± 0.3 kgm}**

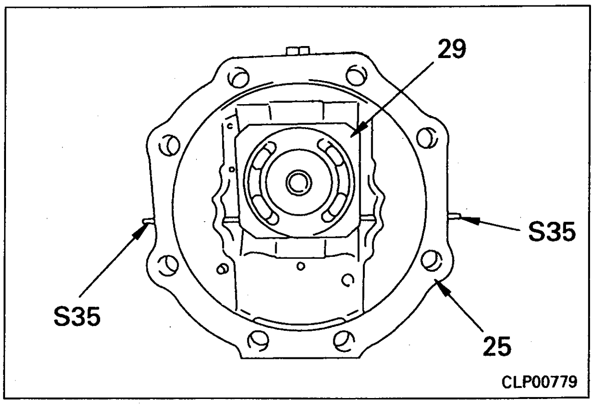
   ★ After assembling the screw, check dimension **L** between the end face of the piston and the rear end of the screw.
   ★ Dimension **L** : 50 – 52 mm



8. **Valve plate**
   1) Remove plugs (22) from end cover assembly (25).

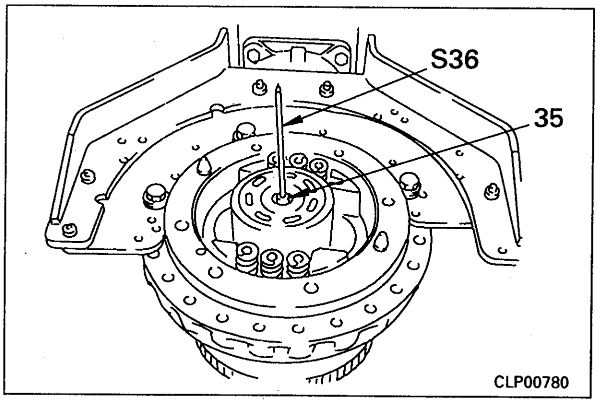


   2) Install valve plate (29) to end cover assembly (25).
      ★ Align the hole in the valve plate exactly with pin (27) of the regulator piston.
      ★ Check that the valve plate moves smoothly in the end cover mounting groove.
   3) Pass tool **S35** through plug hole and secure valve plate (29) in position.



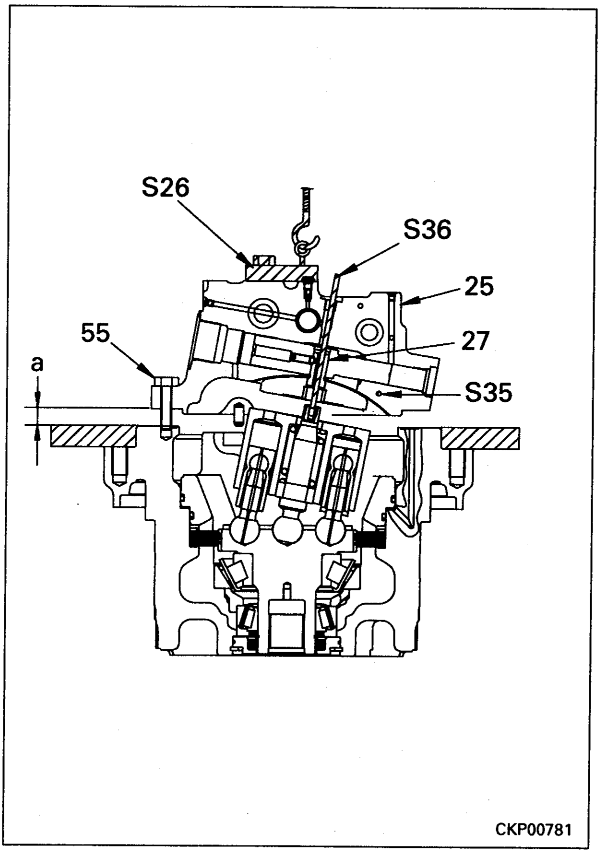
9. End cover

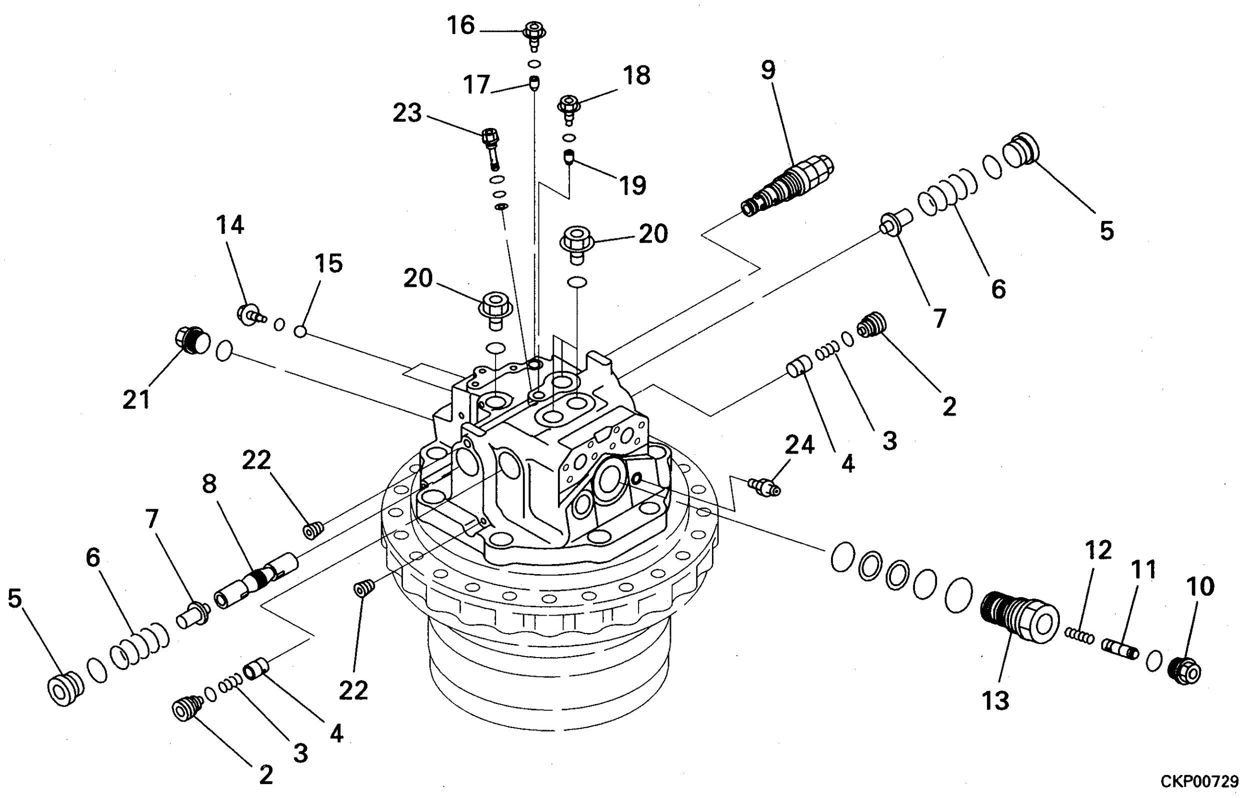
1) Set tool **S36** to center shaft (35).



2) Using tool **S26**, raise end cover assembly (25).
3) Lower end cover assembly (25) and pass tool **S36** through hole in pin (27) of regulator piston.
   ★ Check that the valve plate is in tight contact with the end cover.
4) Check that valve plate does not slip out of position and lower end cover assembly until it is in tight contact with cylinder block, then temporarily tighten 4 mounting bolts (55) on opposite sides to secure in position.
5) Tighten mounting bolts (55) uniformly until clearance "**a**" at mating surface is approx. 12 mm.
   ★ Measure the clearance at several places around the circumference to check that the motor case and end cover are parallel.
6) Remove tools **S35** and **S36**.
   ★ When doing this, check that the valve plate moves to the maximum end and makes a sound of contact.
   ★ Check that the regulator piston moves to the maximum end.
7) Tighten mounting bolts (55) uniformly until the plate is fixed firmly.
   ★ If the mounting bolts become heavy before they contact the seat, repeat the procedure again from Step 2).
8) Remove tool **S26**.
9) Tighten all mounting bolts (55).
   ★ Tighten the mounting bolts uniformly on opposite sides.

   kgm Mounting bolt :
   568.7 ± 49.0 Nm {58 ± 5 kgm}





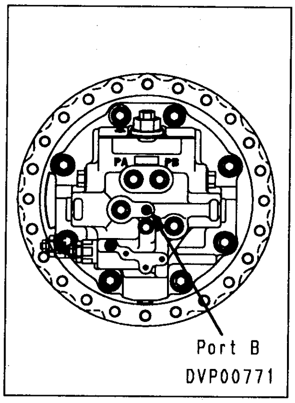
10. Valve, plugs

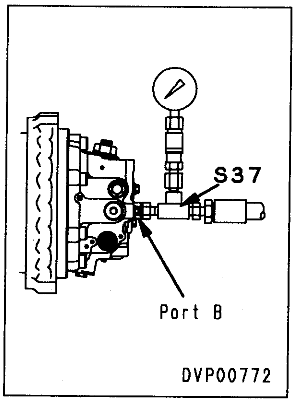
1) Install bleeder (24).
   kgm Bleeder:
   8.8 ± 0.98 Nm {0.9 ± 0.1 kgm}
2) Install sleeve (23).
   Sleeve :
   Thread tightener (Loctite 638 or 648)
   kgm Sleeve :
   39.2 ± 4.9 Nm {4.0 ± 0.5 kgm}
3) Install plug (21).
   Plug :
   Thread tightener (Loctite 638 or 648)
   kgm Plug : **215.72 ± 29.4 Nm {22 ± 3 kgm}**
4) Install plugs (20).
   Plug :
   Thread tightener (Loctite 638 or 648)
   kgm Plug : **39.2 ± 4.9 Nm {4.0 ± 0.5 kgm}**
5) Assemble plugs (19) and (17), then tighten plugs (18) and (16).
   Plug :
   Thread tightener (Loctite 638 or 648)
   kgm Plug : **39.2 ± 4.9 Nm {4.0 ± 0.5 kgm}**
6) Assemble ball (15), then tighten plug (14).
   Plug :
   Thread tightener (Loctite 638 or 648)
   kgm Plug : **23.5 ± 3.9 Nm {2.4 ± 0.4 kgm}**

7) Install plug (13).
   Plug :
   Thread tightener (Loctite 638 or 648)
   kgm Plug :
   985.5 ± 112.8 Nm {100.5 ± 11.5 kgm}
8) Assemble spring (12) and regulator valve (11), then tighten plug (10).
   kgm Plug :
   169.2 ± 75.9 Nm {17.25 ± 7.75 kgm}
9) Install safety valve (9).
   kgm Safety valve assembly :
   318.7 ± 24.5 Nm {32.5 ± 2.5 kgm}
10) Assemble spool (8), piston (7), and spring (6), then tighten plug (5).
11) Assemble check valve (4) and spring (3), then tighten plug (2).
   Plug :
   Thread tightener (Loctite 638 or 648)
   kgm Plug : **382.4 ± 58.8 Nm {39 ± 6 kgm}**
12) Tighten plugs (22).
   kgm Plug : **9.8 ± 1.9 Nm {1.0 ± 0.2 kgm}**

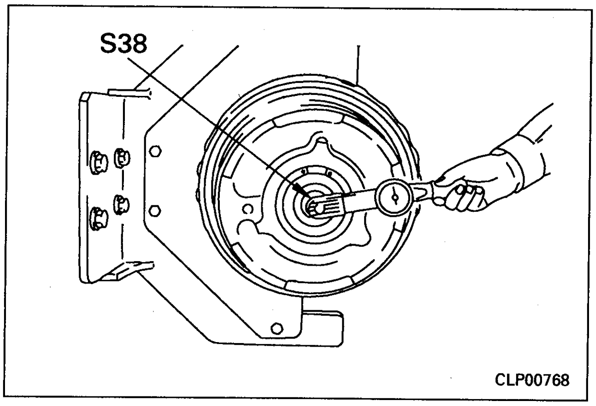
11. Measuring drive shaft rotating torque

1) Using tool **S37**, apply pressure through port **B** to release brake.
   ★ Brake release pressure : **2.5 ± 0.5 MPa {25 ± 5 kg/cm²}**





2) Using tool **S38**, rotate drive shaft at low speed (5 sec/1 turn) and measure rotating torque and variation.
   ★ Standard value for rotating torque :
   7.8 – 19.6 Nm {0.8 – 2.0 kgm}
   ★ Variation range :
   Max. 1.5 Nm {0.15 kgm}



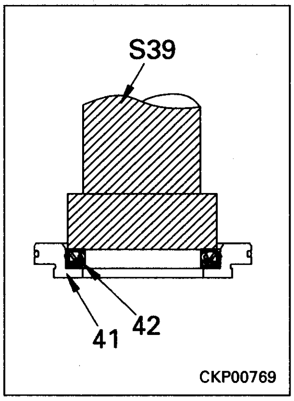
12. Oil seal

1) Using tool **S39**, press fit oil seal (42) to cover (41).

   Lip of oil seal : **Grease (G2-LI-S)**

2) Install cover (41), and secure with snap ring (40).

   ★ Check that the snap ring is fitted securely in the mounting groove.



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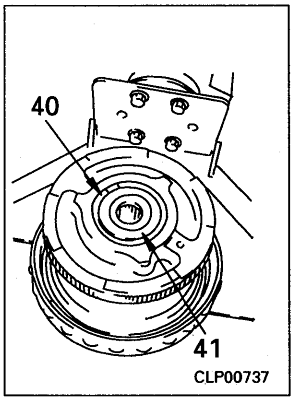


CLP00737

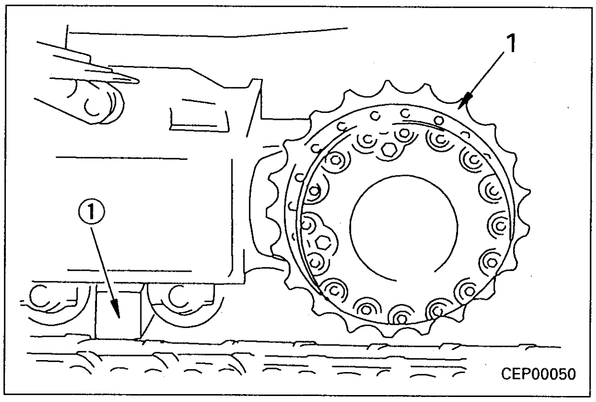
13. Checking performance

Carry out a bench test to check the performance.

REMOVAL OF SPROCKET

1. Remove track shoe assembly.
   For details, see REMOVAL OF TRACK SHOE ASSEMBLY.
2. Swing work equipment 90°, then push up chassis with work equipment and set block ① between track frame and track shoe.
3. Remove mounting bolts, then lift off sprocket (1). ※1

   kg Sprocket : **70 kg**



INSTALLATION OF SPROCKET

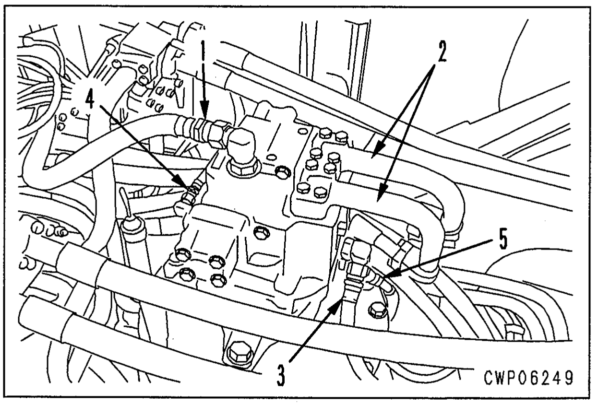
- Carry out installation in the reverse order to removal.

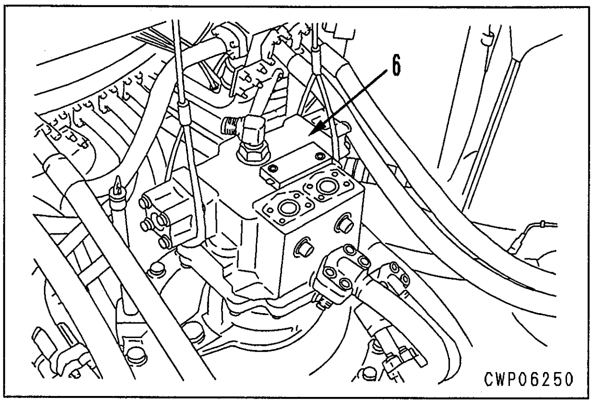
※1

Thread of sprocket mounting bolt:
Thread tightener (LT-2)

kgm Sprocket mounting bolt:
637.4 ± 49.0 Nm {65 ± 5 kgm}

REMOVAL OF SWING MOTOR ASSEMBLY





⚠ Release the remaining pressure in the hydraulic circuit.
For details, see TESTING AND ADJUSTING, Releasing remaining pressure from hydraulic circuit.

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

★ Fit blind plugs in the disconnected hoses and tubes.

1. Disconnect suction hose (1).
2. Disconnect swing hoses (2).
3. Disconnect drain hoses (3) and (4).
4. Disconnect swing holding brake hose (5).
5. Remove mounting bolts, and lift off swing motor assembly (6).

kg Swing motor assembly: **110 kg**

INSTALLATION OF SWING MOTOR ASSEMBLY

- Carry out installation in the reverse order to removal.

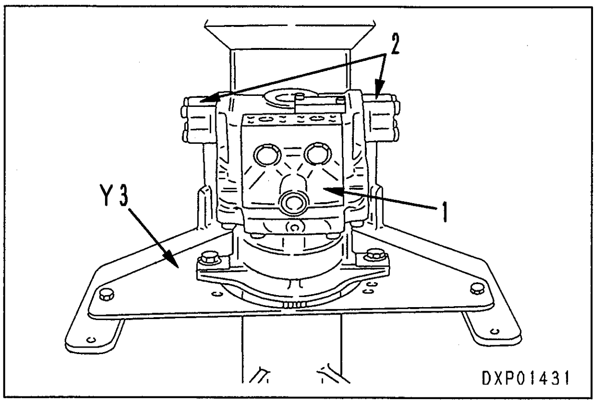
- **Refilling with oil (hydraulic tank).**
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

- **Bleeding air**
  ★ Bleed the air from the swing motor.
  For details, see TESTING AND ADJUSTING, Bleeding air.

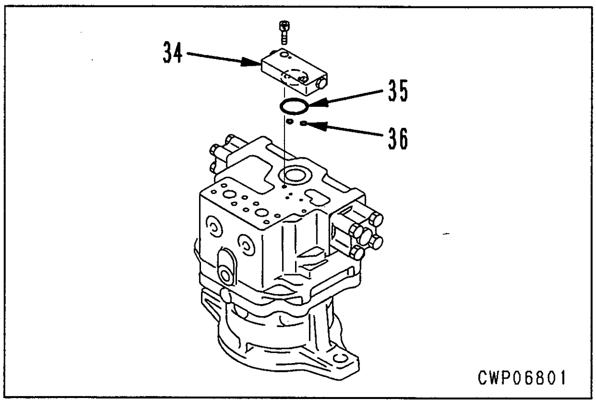
DISASSEMBLY OF SWING MOTOR ASSEMBLY

KMF160ABE-3 WITH BRAKE

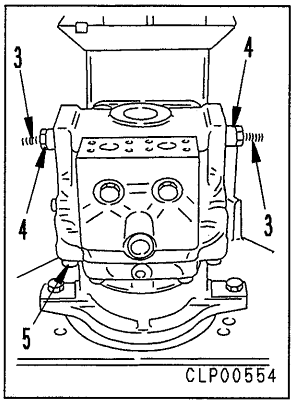
1. **Motor assembly**
   Set swing motor assembly (1) to tool **Y3**.

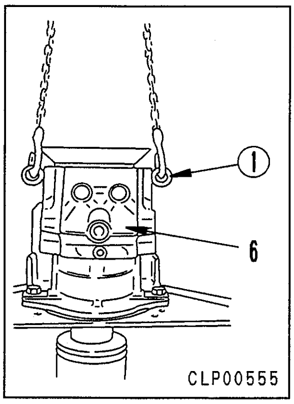


2. **Reverse prevention valve assembly**
   Remove reverse prevention valve assembly (34) and O-rings (35) and (36).



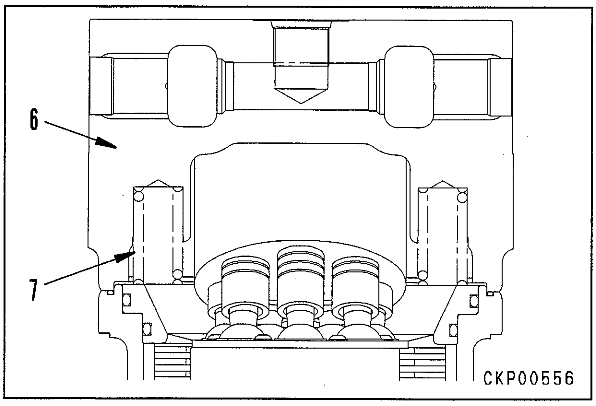
3. **Housing**
   1) Remove covers (2), springs (3), and safety-suction valve assemblies (4).
   2) Remove housing mounting bolts (5).
   3) Using hanging bolts ① (Thread dia. = 12 mm, Pitch = 1.75 mm), lift off housing (6).





★ When removing the housing, springs (7) may come off. Take care.

4) Remove 6 springs (7) from the valve case.

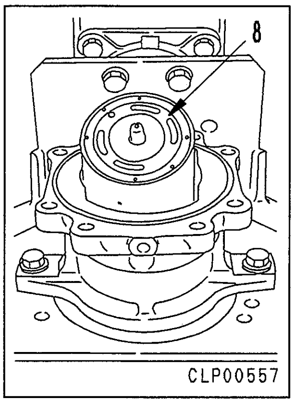


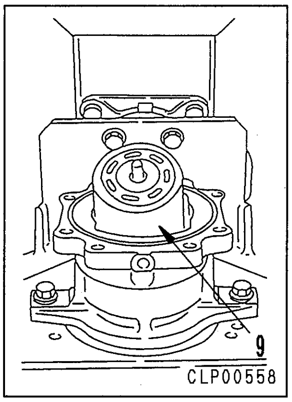
4. Valve plate

Remove valve plate (8).

5. Cylinder block

Remove cylinder block (9).





6. Spring

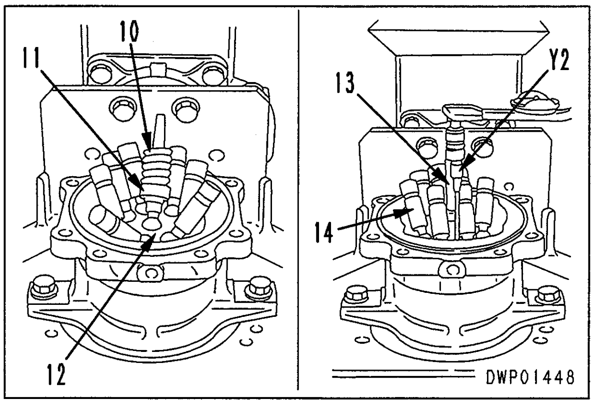
Remove spring (10) and center ring (11).

7. Retainer

Using tool **Y2**, remove 7 mounting screws and retainer (12).

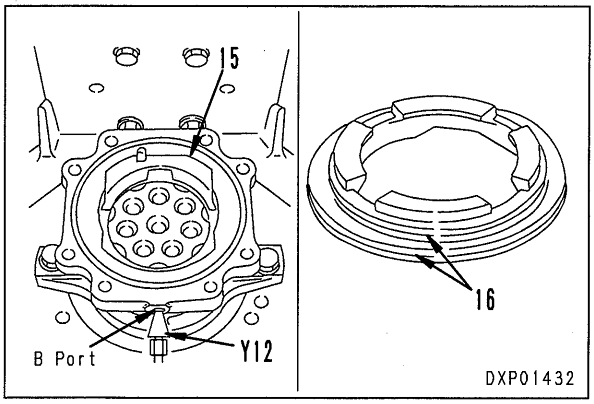
8. Shaft and pistons

Remove center shaft (13) and 7 pistons (14).



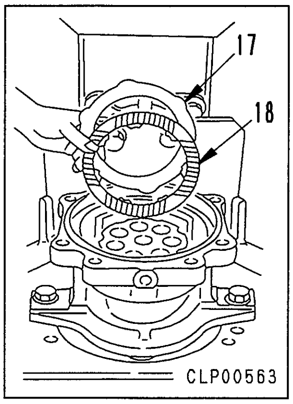
9. Brake piston

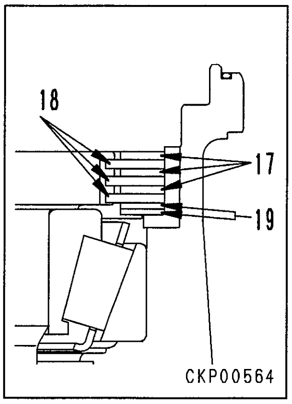
1) Using tool **Y12**, supply air through port **B** to remove brake piston (15).
   - ★ Air pressure: 0.2 MPa {2 kg/cm²}
   - ★ If the air pressure is high, the brake piston may jump out. Take care.
2) Remove O-rings (16) from the piston.



10. Plates and discs

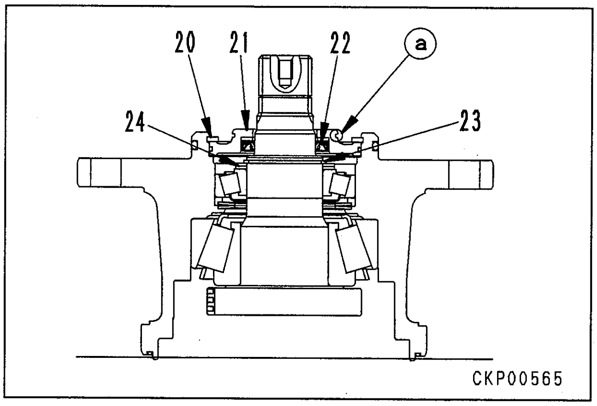
1) Remove plates (17) and discs (18).
2) Remove plates (19).
   - ★ Plates (17) and (19): 5 pieces
     Discs (18): 3 pieces



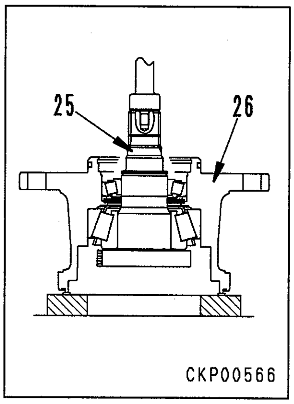


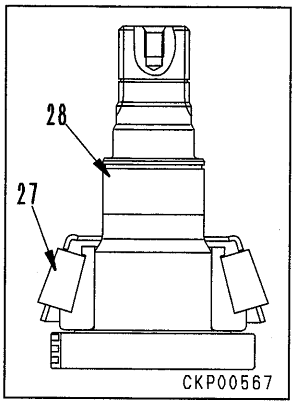
11. Cover
1) Remove the case assembly from tool **Y1** and turn it over.
2) Remove snap ring (20) and cover (21).
   ★ Apply a screwdriver, etc. to part ⓐ to remove cover (21).
3) Remove oil seal (22) from cover (21).

12. Shaft assembly
1) Remove snap ring (23) and 2 spacers (24).

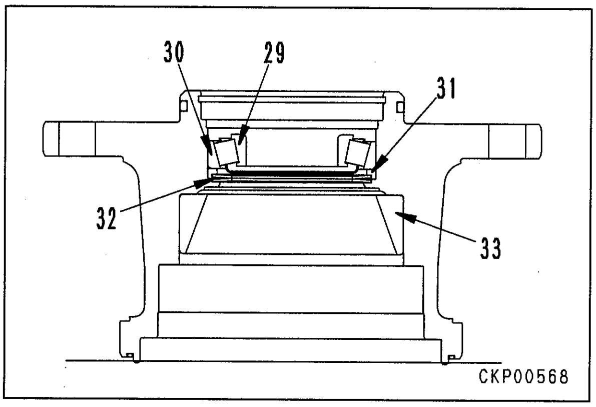


2) Set the case assembly to a press and remove shaft assembly (25) from case (26).
3) Remove bearing (27) from shaft (28).





13. Bearing, seat, and belleville spring
1) Remove bearing inner race (29) from the case.
2) Remove bearing outer race (30).
3) Remove seat (31) and belleville spring (32).
4) Remove main bearing outer race (33).

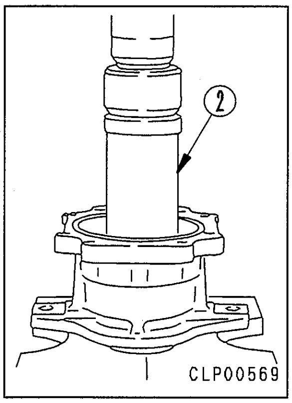


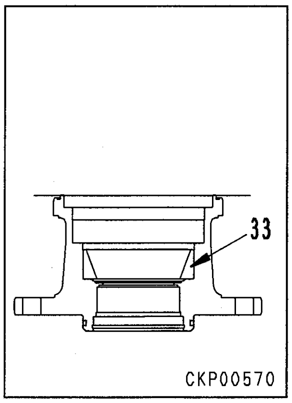
ASSEMBLY OF SWING MOTOR ASSEMBLY

KMF160ABE-3 WITH BRAKE

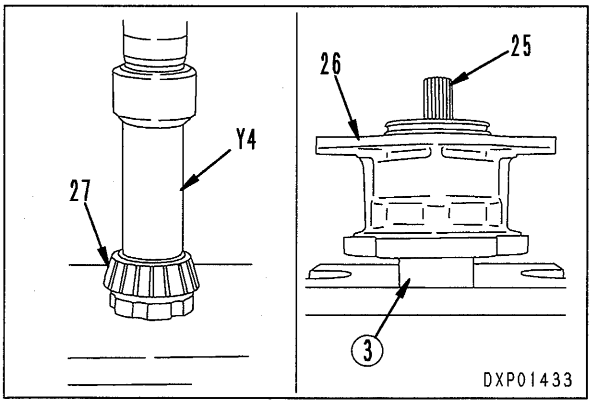
Clean the all parts and remove burrs, etc.
Coat the rotating and sliding parts with engine oil (EO10-CD) before installing. Remove the all lapping powder from the lapped parts with chromium oxide.

1. **Outer race**
   Using push tool ② (Outside diameter: 159 mm), press fit outer race (33) to the case.

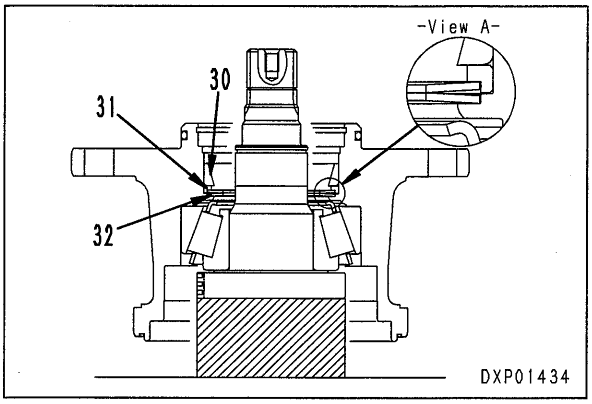




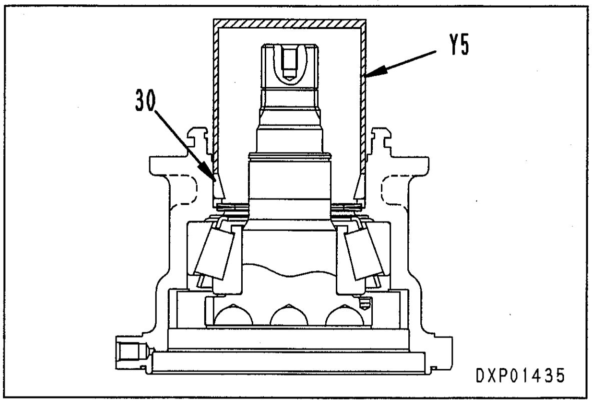
2. **Shaft assembly**
   1) Using tool **Y4**, press fit bearing (27) to the shaft.
      ★ Press fit the bearing until the inner race end is fitted to the shaft.
      Press fitting load:
      7.72 – 39.2 kN {787 – 4,000 kg}
   2) Set shaft assembly (25) to block ③ (130 mm in diameter and 50 mm in height), then install case (26).



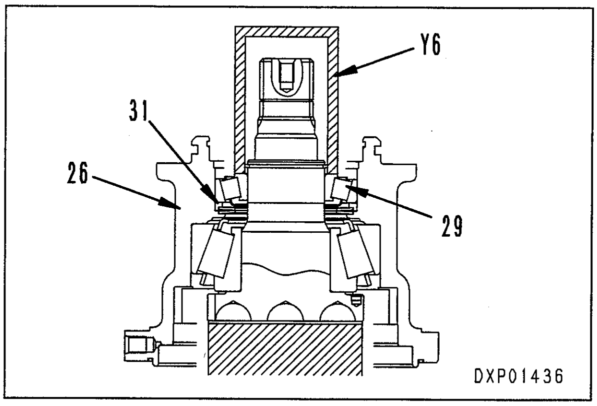
3. **Belleville spring, seat, and bearing**
   1) Install belleville spring (32) and seat (31).
      ★ Install the belleville spring as shown in View A.



   2) Using tool **Y5**, install outer race (30).



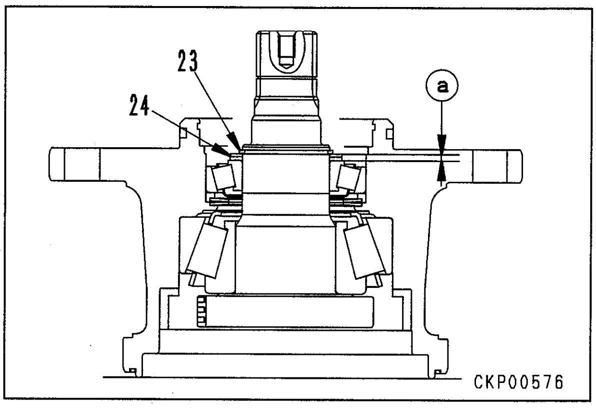
3) Using tool **Y6**, press fit bearing (29).
   ★ While press fitting the bearing, turn case (26) to check that the bearing turns smoothly.
   ★ Press fit the bearing until seat (31) is fitted to case (26).
   ★ Load to press fit bearing:
   3.92 – 20.0 kN {400 – 2,055 kg}



DXP01436

4. Spacer

1) Measure clearance ⓐ between the bottom of snap ring (23) and top of the bearing inner race. Then, select 2 spacers (24) having thickness equivalent to clearance ⓐ from the following table and install them.

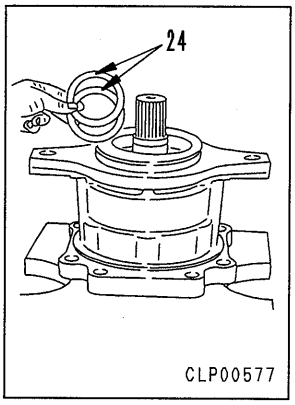


CKP00576

	Part No. of spacer (24)	Thickness
①	706-77-42440	2.3 mm
②	706-77-42450	2.5 mm
③	706-77-42460	2.7 mm

★ Standard thickness of spacers: 5.1 mm

2) After installing spacers (24), install snap ring (23).
   ★ Check that the snap ring is fitted to the snap ring groove securely.



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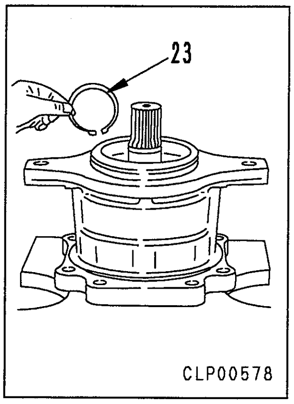
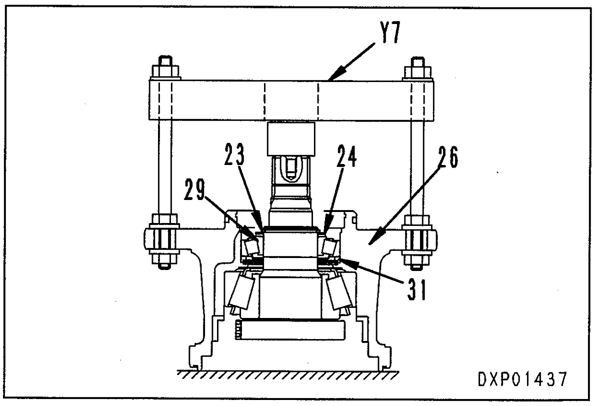


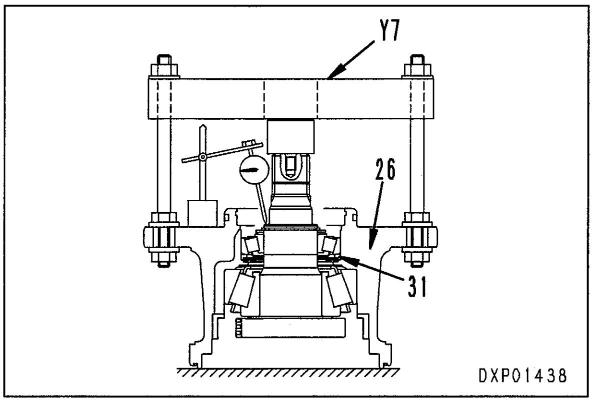
CLP00578

3) Pressing out drive shaft
   i) Set tool **Y7** to case (26) and press out the drive shaft with the following load until the end of bearing inner race (29) is fitted to snap ring (23).
      ★ Load to press out drive shaft:
      3.92 – 16.18 kN {400 – 1,650 kg}
   ii) After the bearing inner race is fitted, apply the load of 21.58 kN {2,200 kg} further and check that spacer (24) is fitted and cannot be turned with the hand.

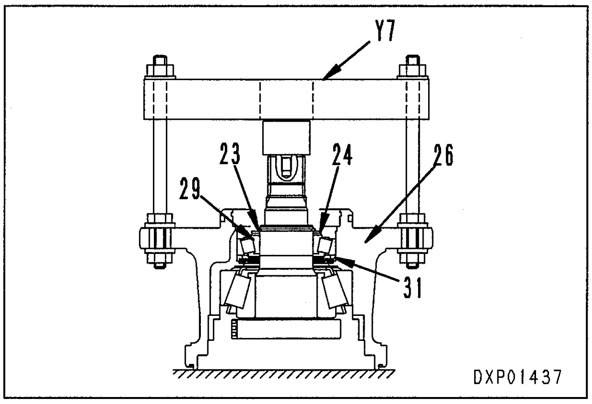


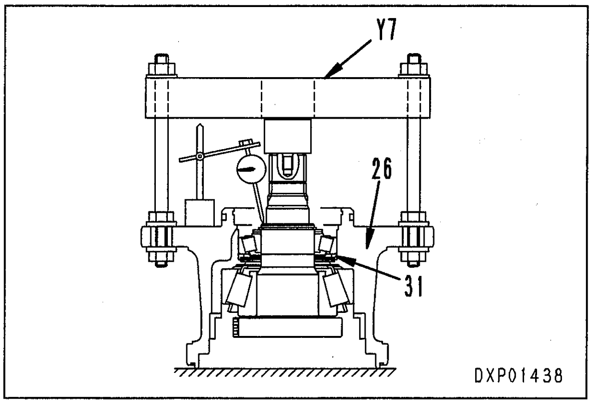
DXP01437

4) Check the axial clearance between case (26) and seat (31) according to the following procedure.
   i) Using tool **Y7**, apply a load of 4.90 – 21.6 kN {500 – 2,200 kg} to the drive shaft end and measure the moving distance of the drive shaft and check that it is in the standard range.
      ★ Moving distance of drive shaft:
      0.1 – 0.4 mm

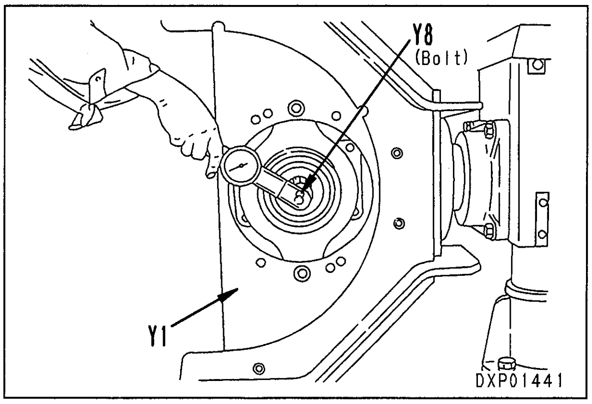


   ii) If the moving distance of the drive shaft is out of the standard range, replace the spacers as explained below.
      - When the clearance is less than 0.1 mm
        Replace the spacers with 706-77-42440 and install the snap ring.
      - When the clearance is larger than 0.4 mm
        Replace the spacers with 706-77-42460 and install the snap ring.
      - Measure the moving distance of the drive shaft according to steps 4-3) – 4) and check that the clearance is in the range of 0.1 – 0.4 mm.

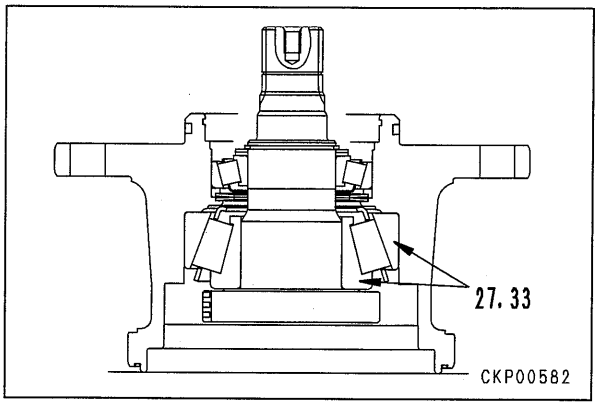




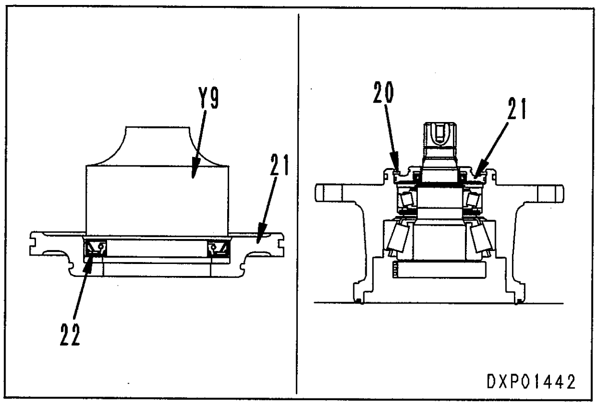
   iii) Set the motor case to tool **Y1** and measure the revolving torque of the drive shaft with tool **Y8**.
      ★ Revolving torque of drive shaft:
      1.47 – 4.90 Nm {0.15 – 0.50 kgm}
      ★ When measuring the revolving torque, supply sufficient oil to the bearing and turn the drive shaft at the speed of about 1 turn in 5 seconds.



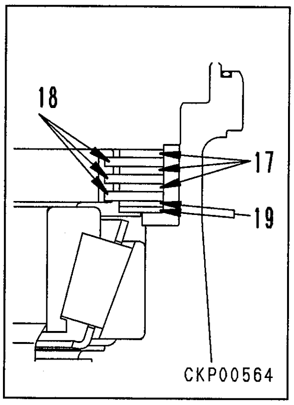
★ If the revolving torque is not in the range of 1.47 – 4.90 Nm {0.15 – 0.50 kgm}, replace bearings (27) and (33) with new ones and adjust again.

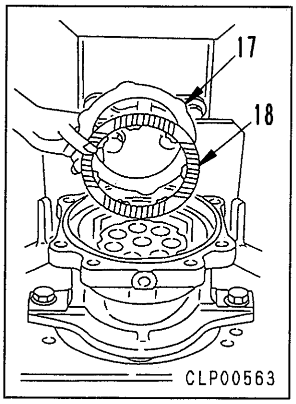


5. **Cover**
   1) Using tool **Y9**, press fit oil seal (22) to cover (21).
   2) Install cover (21) and snap ring (20).
      ★ When installing the cover, take care not to damage the oil seal lip.
      Oil seal lip: **Grease (G2-LI-S)**

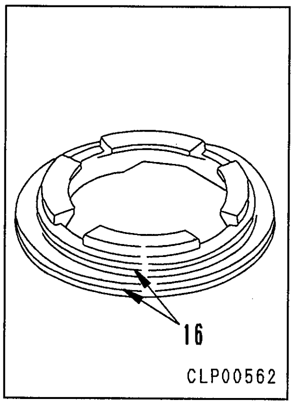


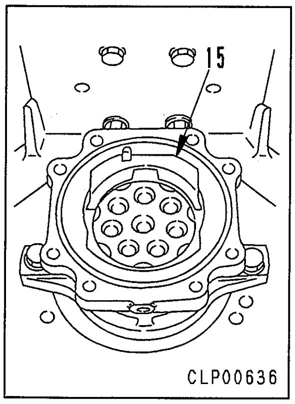
6. **Plates and discs**
   Install plates (19), discs (18), and plates (17) to the case.
   ★ Plates (17) and (19): 5 pieces
   Discs (18): 3 pieces
   ★ Before installing the discs, apply lubricating oil to their surfaces.
   ★ Do not clean the discs with trichloroethylene or denatured alcohol or blow air strongly against them.
   Disc surfaces:
   Lubricating oil (EO10-CD)





7. **Brake piston**
   1) Install O-rings (16) to the piston.
   2) Install brake piston (15).



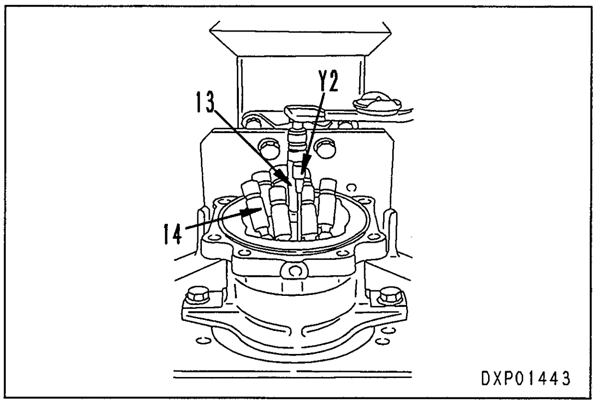


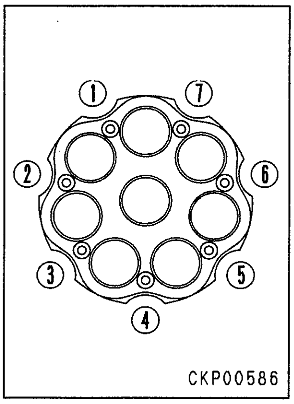
8. Pistons and shaft

1) Set 7 pistons (14) and center shaft (13).
2) Using tool **Y2**, tighten 7 retainer mounting screws.
   - ★ Replace the retainer mounting screws with new ones.

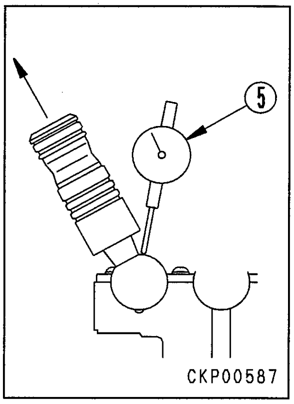
     Screw: **Liquid adhesive (LT-2, LOCTITE #262, or equivalent)**

     kgm Screw:
     1st time: Max. 0.9 Nm {Max. 0.1 kgm}
     2nd time:
     3.92 – 5.88 Nm {0.4 – 0.6 kgm}
     3rd time:
     11.77 – 14.7 Nm {1.2 – 1.5 kgm}
     (Target: 13.24 Nm {1.35 kgm})
   - ★ Degrease and dry the threaded parts (male and female) thoroughly.
   - ★ Tightening order: ① – ④ – ⑦ – ③ – ⑥ – ② – ⑤ in either direction
   - ★ After tightening the screw, check that liquid adhesive is not projected.
   - ★ After tightening the screws, check that the large sphere of piston (14) and center shaft (13) move smoothly.



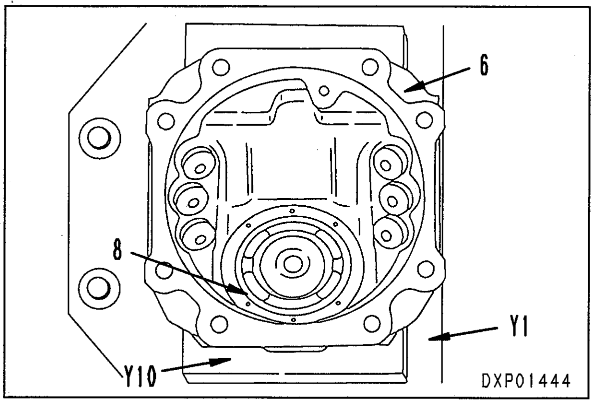


3) Measure the axial play of piston (14) with dial gauge ⑤.
   - ★ Axial play of piston: Max. 0.40 mm

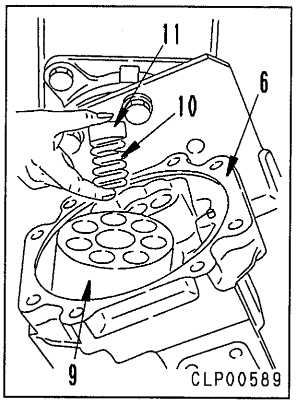


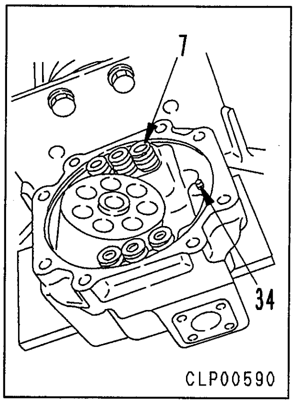
9. Spring

1) Set housing (6) to tools **Y10** and **Y1** and adjust its angle so that the valve plate mounting face will be level.
2) Install valve plate (8).

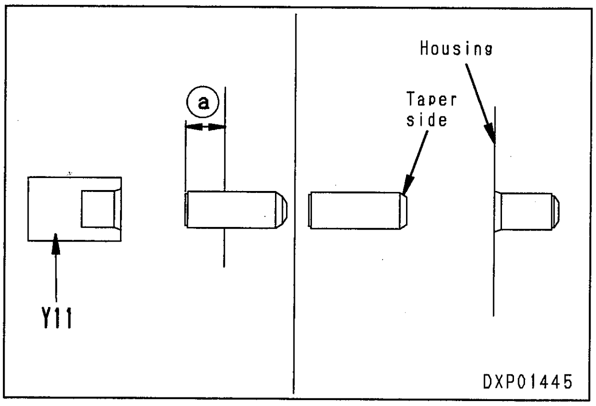


3) Install cylinder block (9) to housing (6).
4) Install spring (10) and center ring (11) to the cylinder block.
5) Install 6 springs (7) to the housing.
6) Press fit dowel pin (34).





★ Drive the dowel pin with tool **Y11** so that standard dimension ⓐ will be obtained.
★ Standard dimension ⓐ: 9 ± 1.0 mm
★ Fit the tapered side to the hole of the housing.
★ Take care not to damage the dowel pin and brake piston.

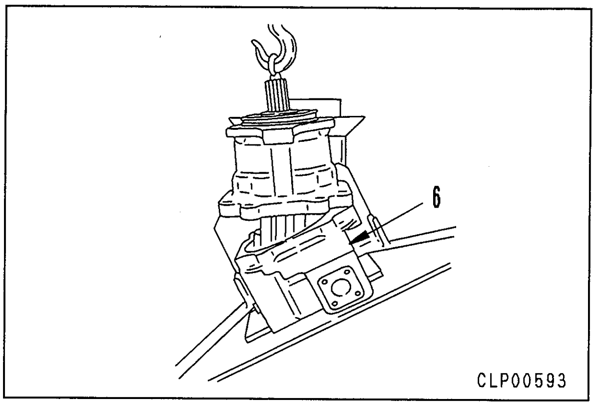


10. Sling the motor case assembly and lower it gradually, matching it to the housing and matching the 7 center shaft pistons to the holes of the cylinder block, and install it to housing (6).

Mating face of case:
Liquid adhesive [LG-7 (ThreeBond 1207C), LOCTITE #572, #575, or Sealend #242]

★ When installing the motor case, position it to the dowel pin securely.

Mounting bolt:
245 – 309 Nm {25.0 – 31.5 kgm}

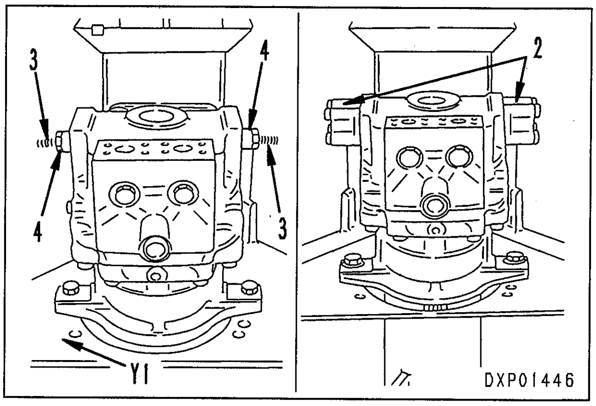


11. Set swing motor assembly (1) to tool **Y1**.

12. Install safety-suction valves (4), springs (3), and covers (2).

Mating face of cover:
Liquid adhesive [LG-7 (ThreeBond 1207C), LOCTITE #572, #575, or Sealend #242]

Cover mounting bolt:
98 – 123 Nm {10.0 – 12.5 kgm}



13. Reverse prevention valve assembly

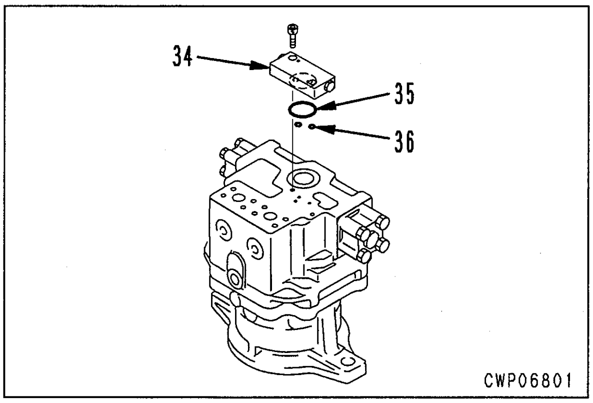
Fit O-rings (35) and (36) and install the reverse prevention valve assembly.

Mating face:
Gasket sealant (LOCTITE #222 or Sealend #242)

kgm Mounting bolt:
1st time: 15 – 20 Nm {1.5 – 2.0 kgm}
2nd time: 27 – 34 Nm {2.8 – 3.5 kgm}

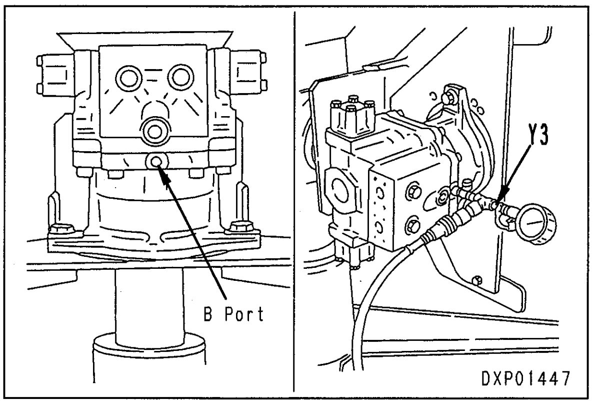
★ Tighten the mounting bolts in diagonal order.

★ Check that O-rings (35) and (36) are fitted securely.

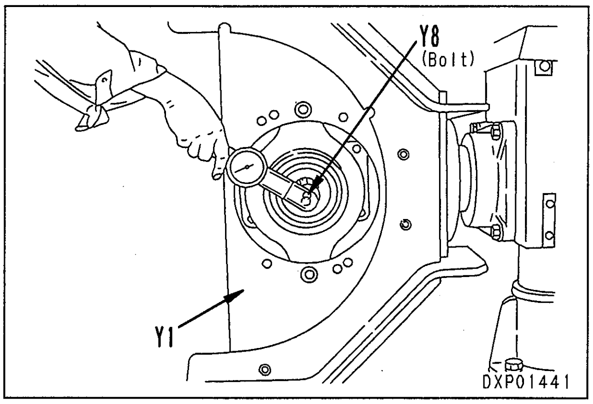


14. Check of revolving torque of drive shaft

1) Using tool **Y3**, apply hydraulic pressure of 2.94 ± 0.49 MPa {30 ± 5 kg/cm^2} through port **B** to release the brake.



2) Set tool **Y8** and measure the revolving torque.
   - ★ Check that the drive shaft revolves without uneven revolving torque.
     Unevenness of revolving torque:
     Max. 1.47 Nm {Max. 0.15 kgm}
     Revolving torque:
     5.9 – 15.2 Nm {0.60 – 1.55 kgm}
   - ★ If the revolving torque is out of the above range, repeat the adjustment from Step 4.



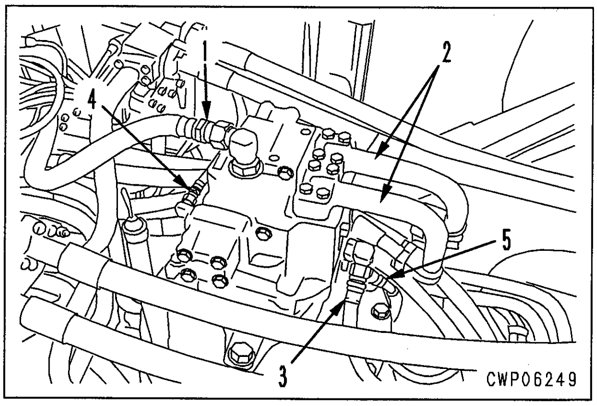
REMOVAL OF SWING MACHINERY ASSEMBLY

⚠ Release the remaining pressure in the hydraulic circuit.
For details, see TESTING AND ADJUSTING, Releasing remaining pressure from hydraulic circuit.

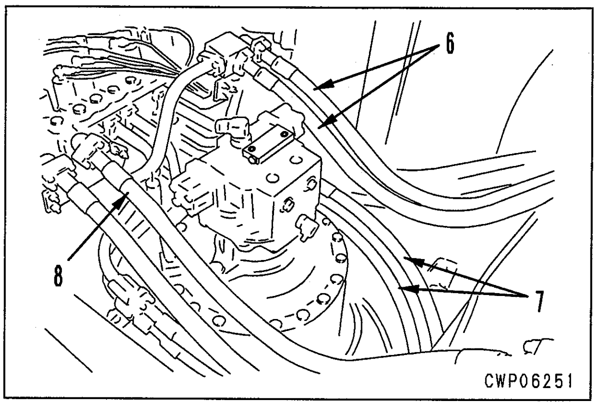
⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

★ Fit blind plugs in the disconnected hoses and tubes to prevent oil from flowing out.

1. Remove step on top of control valve.
2. Disconnect suction hose (1), swing hose (2), drain hoses (3) and (4), and swing holding brake hose (5) connected to swing motor assembly.



3. Disconnect arm hose (6), and let it hang down.
4. Disconnect L.H. travel hose (7) at control valve end and move towards boom.
   ★ Secure it to the boom with rope.
5. Disconnect bucket cylinder hose (8) at control valve end.



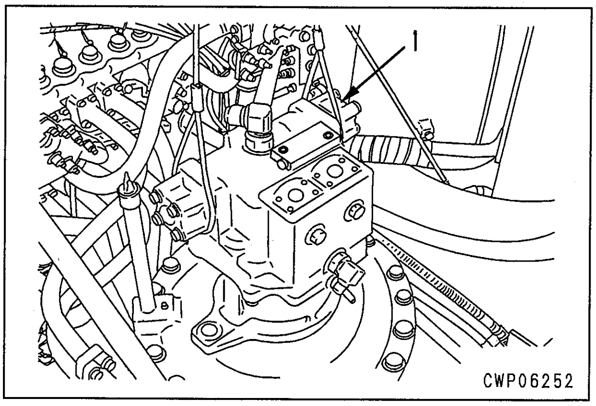
6. Lift off swing motor assembly (9).

kg Swing motor assembly: **110 kg**

7. Lift off swing machinery assembly (10). ※1

kg Swing machinery assembly: **550 kg**

★ After removing the R.H. travel hose clamp mounting bracket, remove the swing machinery assembly.

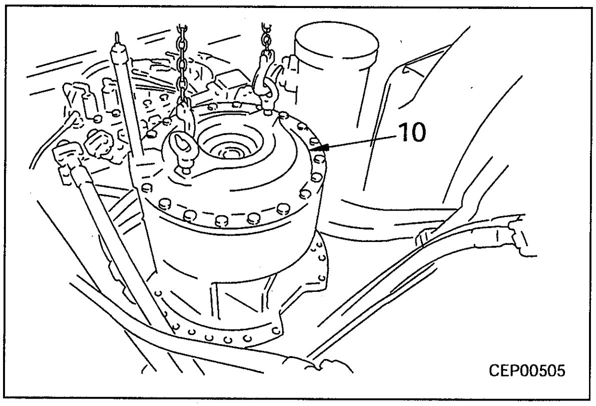


INSTALLATION OF SWING MACHINERY ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

kgm Swing machinery case mounting bolt:
926.7 ± 102.9 Nm {94.5 ± 10.5 kgm}

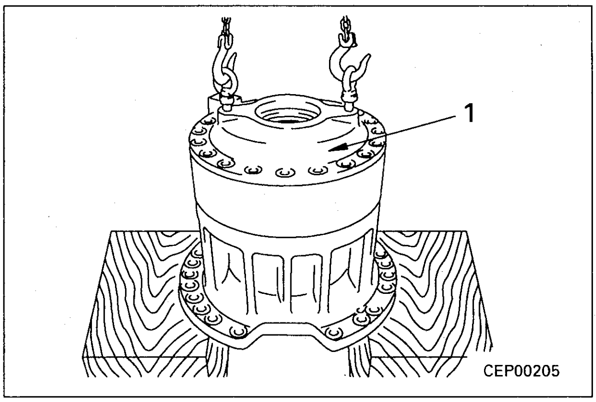


DISASSEMBLY OF SWING MACHINERY ASSEMBLY

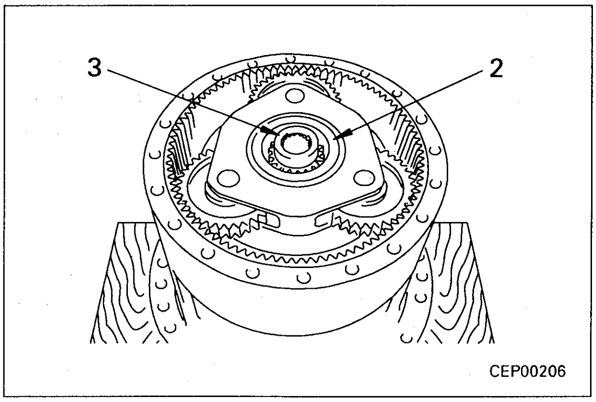
1. **Draining oil**
   Loosen drain plug and drain oil from swing machinery.

   Swing machinery case: **Approx. 21.5 ℓ**

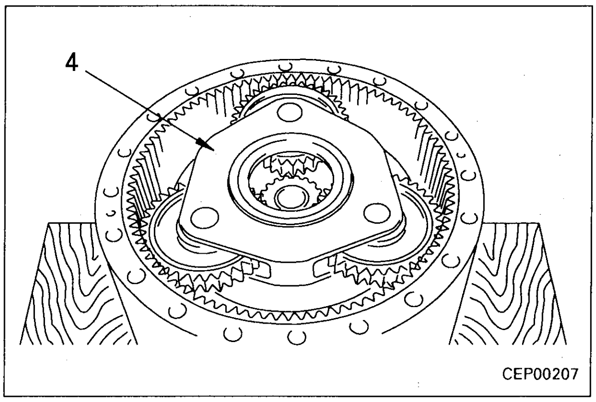
2. **Cover**
   Remove mounting bolts, then lift off cover (1).



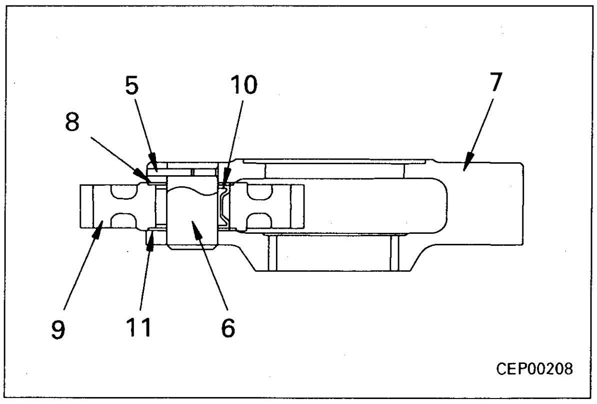
3. **No. 1 carrier assembly.**
   1) Remove thrust washer (2).
   2) Remove No. 1 sun gear (3).



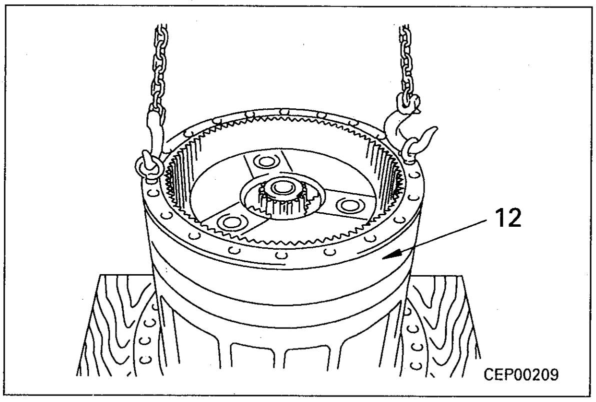
   3) Remove No. 1 carrier assembly (4).



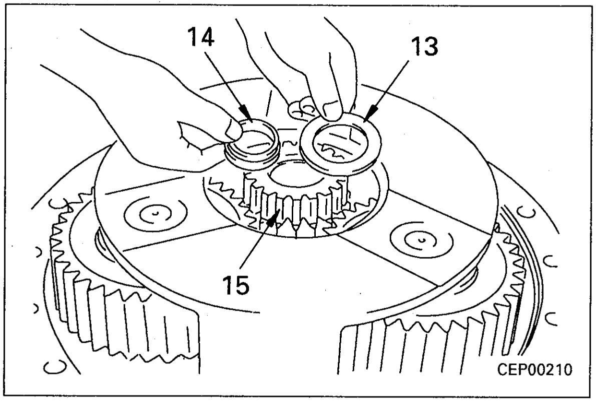
4. Disassemble No. 1 carrier assembly as follows.
   1) Push in pin (5), and knock out shaft (6) from carrier (7).
      ★ After removing the shaft, remove pin (5).
   2) Remove thrust washer (8), gear (9), bearing (10), and thrust washer (11).



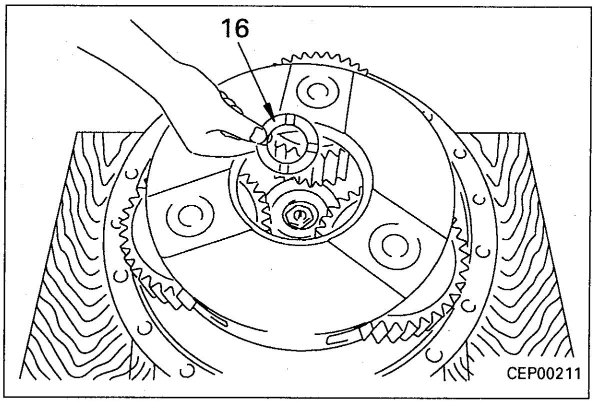
5. **Ring gear**
   Lift off ring gear (12).



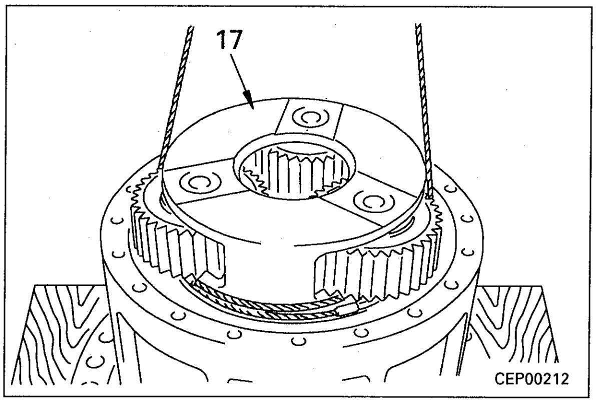
6. **No. 1 sun gear**
   1) Remove thrust washer (13) and collar (14).
   2) Remove No. 1 sun gear (15).



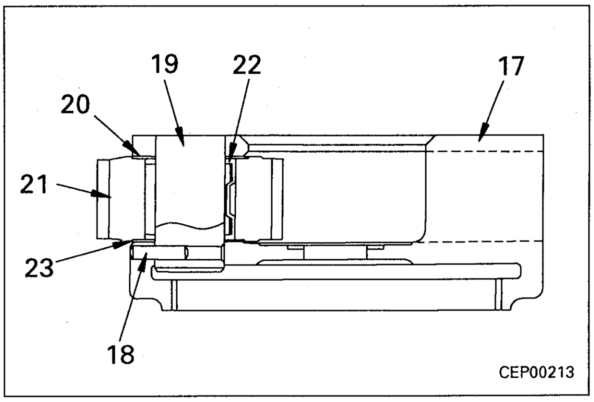
   3) Remove thrust washer (16).



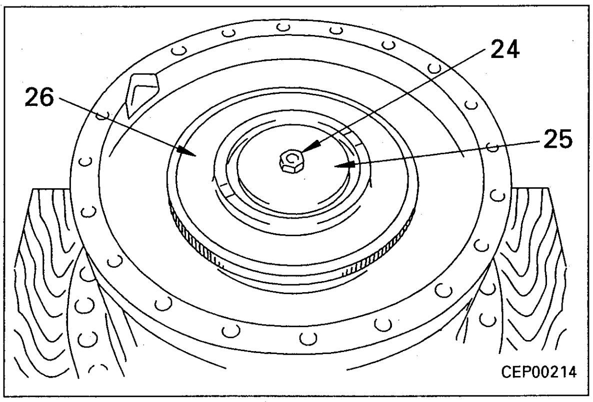
7. **No. 2 carrier assembly**
   Lift off No. 2 carrier assembly (17).



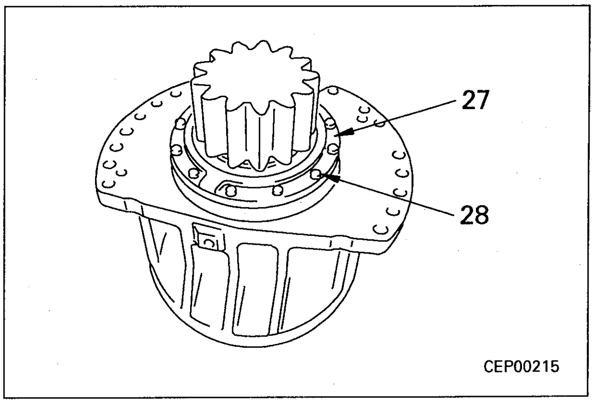
8. Disassemble No. 2 carrier assembly as follows.
   1) Push in pin (18), and knock out shaft (19) from carrier (17).
      ★ After removing the shaft, remove pin (18).
   2) Remove thrust washer (20), gear (21), bearing (22), and thrust washer (23).



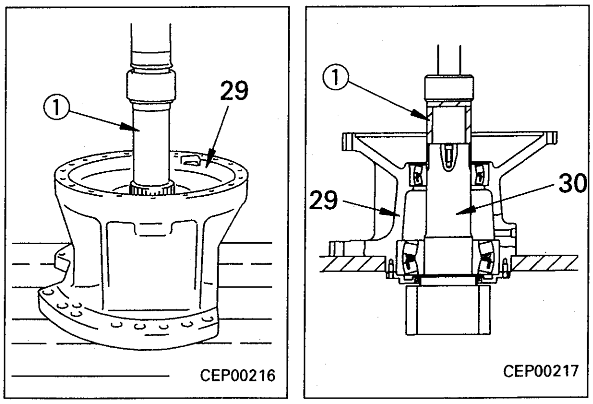
9. **Pinion shaft assembly.**
   1) Remove bolt (24), then remove holder (25).
   2) Remove gear (26).



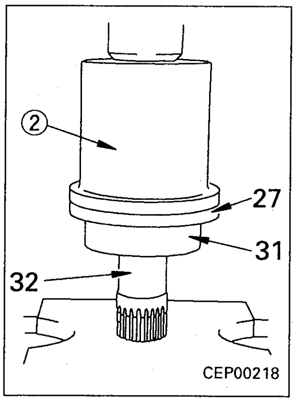
   3) Turn over case and pinion assembly, then remove mounting bolts (28) of cover assembly (27).

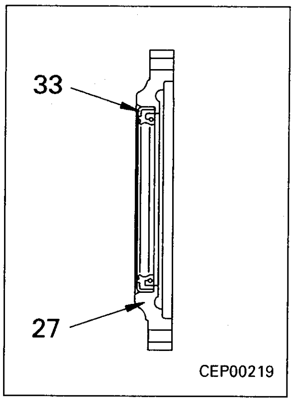


   4) Turn over case and pinion assembly (29), and set on press stand, then using push tool ①, remove pinion shaft assembly (30) with press.
      ★ Set a wooden block under the press, and be careful not to damage the pinion shaft assembly when removing it.

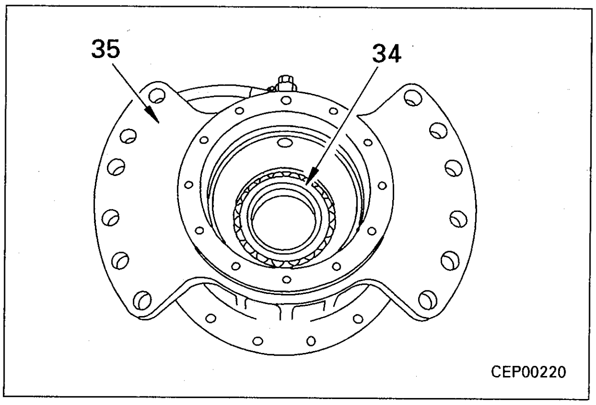


10. Disassemble pinion shaft assembly as follows.
  1) Using push tool ②, remove cover assembly (27) and bearing (31) from shaft (32).
  2) Remove oil seal (33) from cover (27).





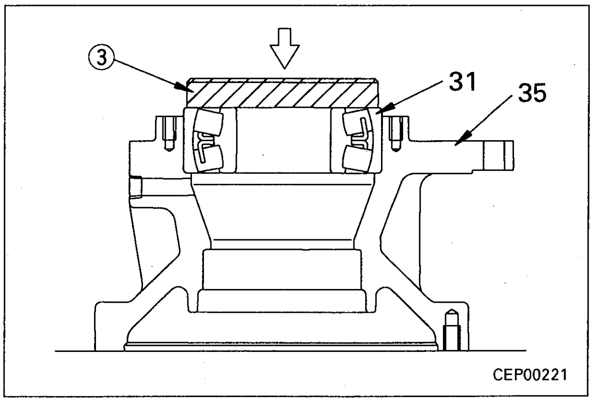
11. Bearing
Using push tool, remove bearing (34) from case (35).



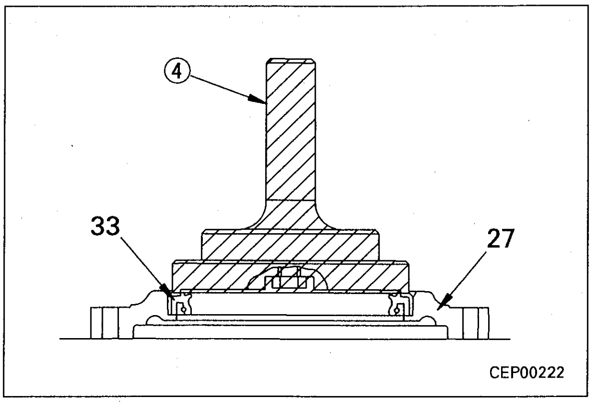
ASSEMBLY OF SWING MACHINERY ASSEMBLY

★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing.

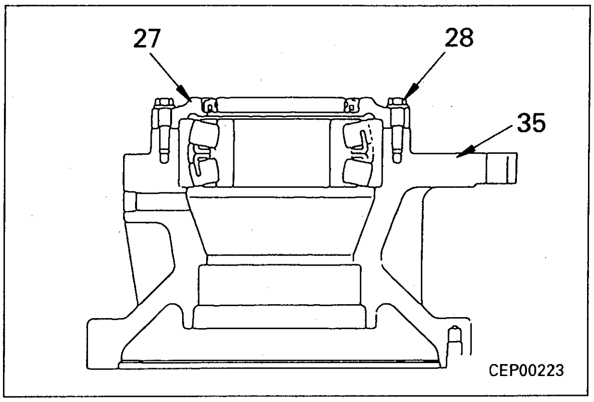
1. **Bearing**
   Using push tool ③, press fit bearing (31) to case (35).



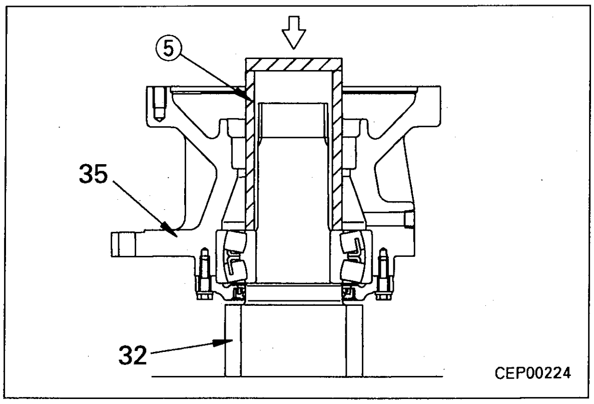
2. **Cover assembly**
   1) Using push tool ④, press fit oil seal (33) to cover (27).
      Outside circumference of oil seal: **Gasket sealant (LG-6)**
      ★ Be careful not to let the gasket sealant (LG-6) get on the oil seal lip when press fitting.



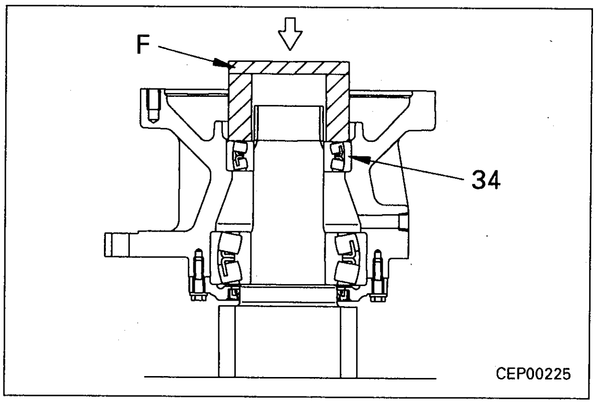
   2) Fit cover assembly (27) to case (35), and tighten mounting bolts (28).
      Cover mounting surface: **Gasket sealant (LG-6)**
      kgm Mounting bolt: **66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}**
      Lip of oil seal: **Grease (G2-LI)**



3. **Case assembly**
   1) Set case assembly (35) to shaft (32), then using push tool ⑤, press fit bearing inner race portion.
      ★ When setting the case assembly to the shaft, be extremely careful not to damage the oil seal.



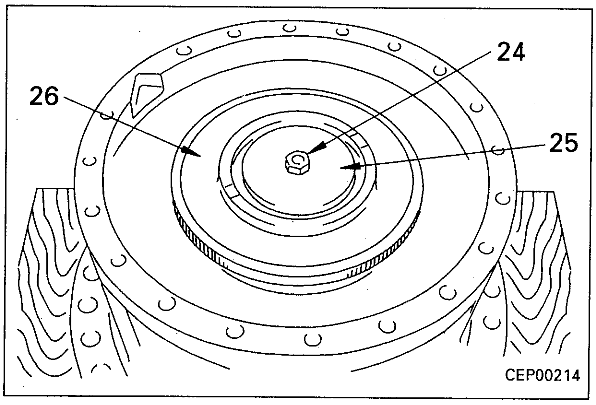
2) Bearing
Using tool **F**, press fit bearing (34).
- ★ Press the bearing inner race and outer race at the same time when press fitting. Do not press only the inner race when press fitting.
- ★ After press fitting the bearing, check that the case rotates smoothly.



3) Gear, holder
Assemble gear (26), then fit holder (25) and tighten bolt (24).

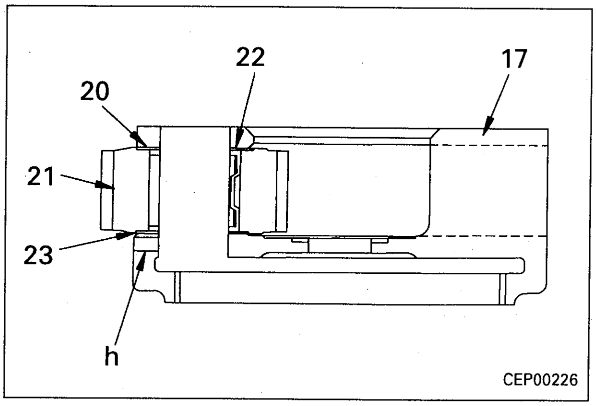
Mounting bolt: **Thread tightener (LT-2)**

kgm Mounting bolt: **380.0 ± 46.6 Nm {38.75 ± 4.75 kgm}**



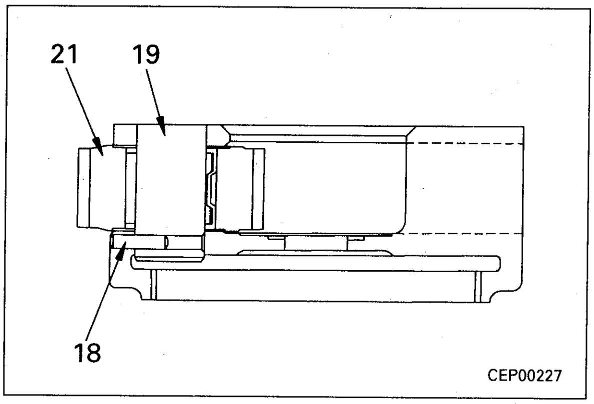
4. Assemble No. 2 carrier assembly as follows
- ★ There are the remains of the caulking when the pin is inserted at the end face of hole **h** at the side of the carrier, so remove the caulked metal from the inside diameter of the hole before starting to assemble.

1) Assemble bearing (22) to gear (21), fit top and bottom thrust washers (23) and (20) and set gear assembly to carrier (17).

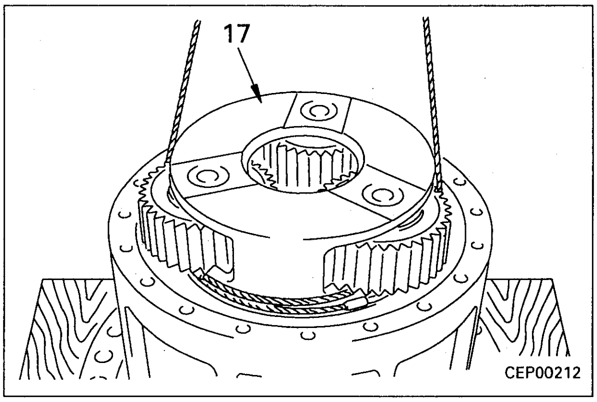


2) Align with position of pin holes of shaft and carrier, then tap with a plastic hammer to install shaft (19).
- ★ When installing the shaft, rotate the planetary gear, and be careful not to damage the thrust washer.

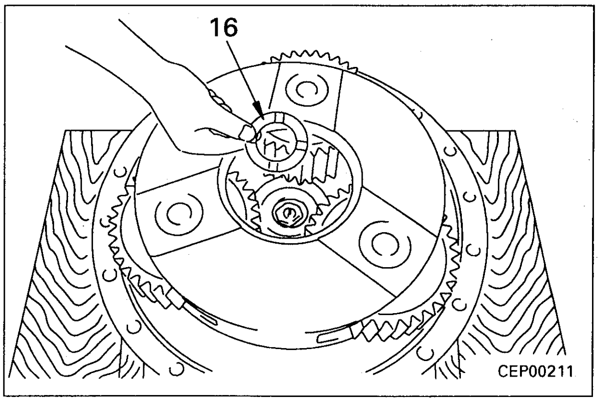
3) Insert pin (18).
- ★ After inserting the pin, caulk the pin portion of the carrier.
- ★ After assembling the carrier assembly, check that gear (21) rotates smoothly.



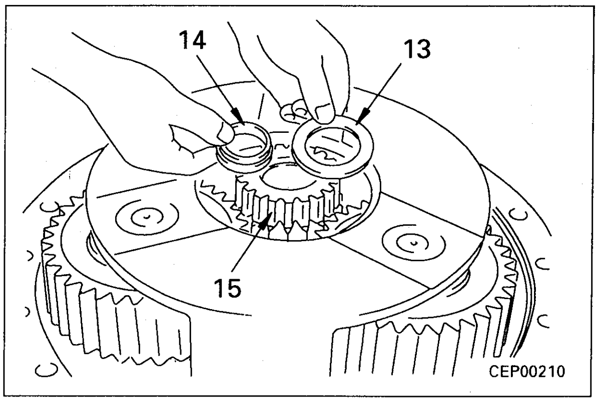
5. **No. 2 carrier assembly**
   Raise No. 2 carrier assembly (17) and install.



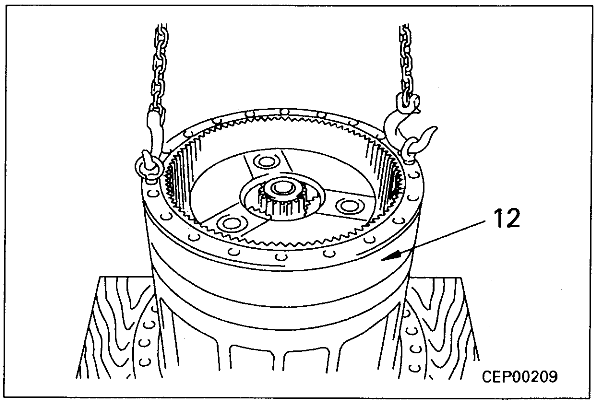
6. **No. 2 sun gear**
   1) Assemble thrust washer (16).



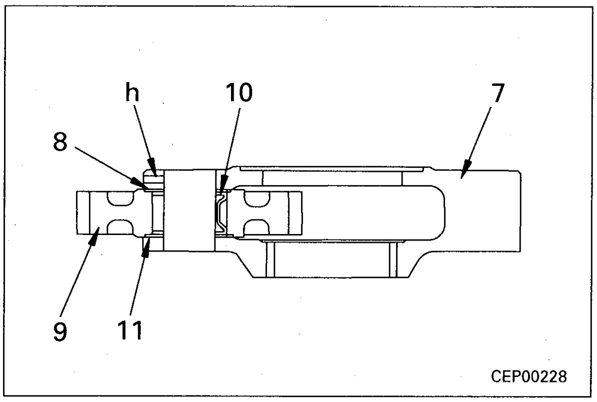
   2) Install No. 2 sun gear (15) to No. 2 carrier, then install collar (14) and thrust washer (13).



7. **Ring gear**
   Raise ring gear (12) and install.
   ★ Align with the drain hole and assemble.
   Mating surface of ring gear and case:
   Gasket sealant (LG-6)

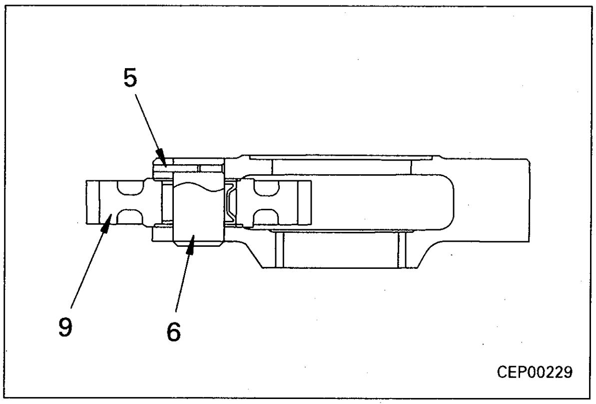


8. Assemble No. 1 carrier assembly as follows.
   ★ There are the remains of the caulking when the pin is inserted at the end face of hole **h** at the side of the carrier, so remove the caulked metal from the inside diameter of the hole before starting to assemble.
   1) Assemble bearing (10) to gear (9), fit top and bottom thrust washers (8) and (11) and set gear assembly to carrier (7).



CEP00228

   2) Align position of pin holes of shaft and carrier, then tap with a plastic hammer to install shaft (6).
      ★ When installing the shaft, rotate the planetary gear, and be careful not to damage the thrust washer.
   3) Insert pin (5).
      ★ After inserting the pin, caulk the pin portion of the carrier.
      ★ After assembling the carrier assembly, check that gear (9) rotates smoothly.



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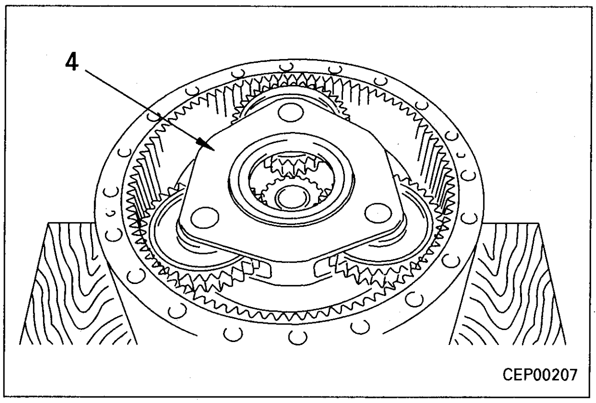
9. **No. 1 carrier assembly**
   Install No. 1 carrier assembly (4).



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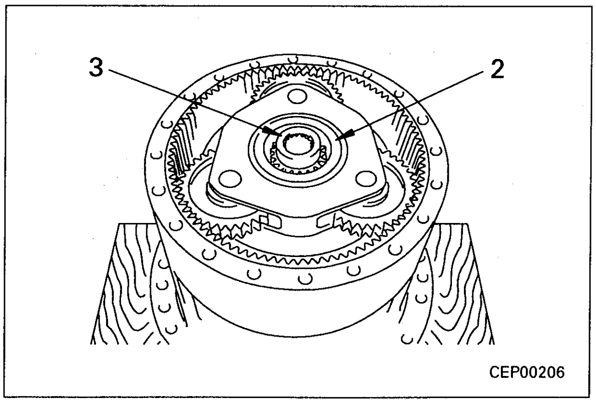
10. **No. 1 sun gear**
    1) Assemble No. 1 sun gear (3) to carrier assembly.
    2) Install thrust washer (2).



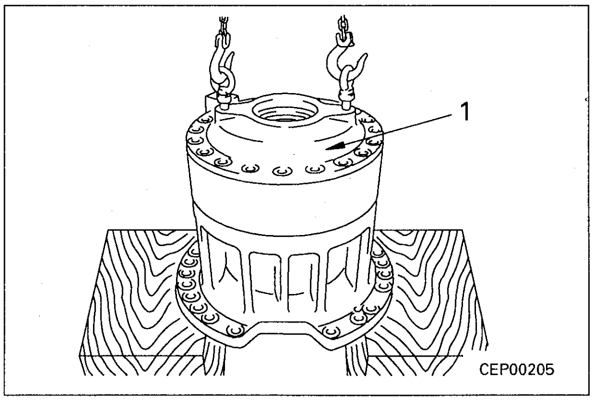
CEP00206

11. Cover

Install cover (1).

Cover mounting surface:
Gasket sealant (LG-6)

kgm Mounting bolt: 1st pass: **98.1 Nm {10 kgm}**
2nd pass: **120 ± 5°**

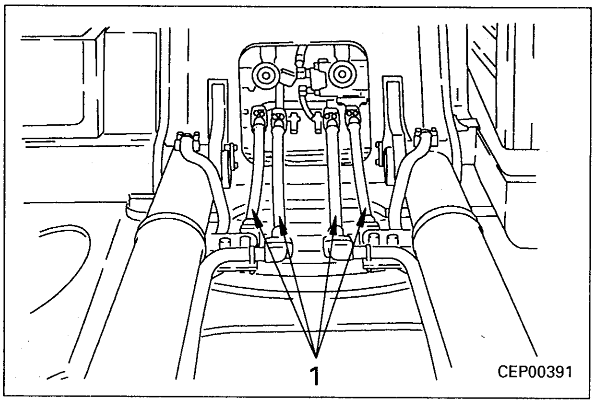


12. Refilling with oil

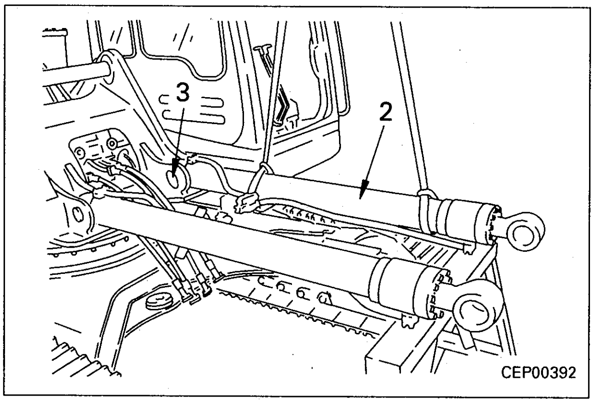
Tighten drain plug and add engine oil through oil filler.

Swing machinery case: **Approx. 21.5 ℓ**

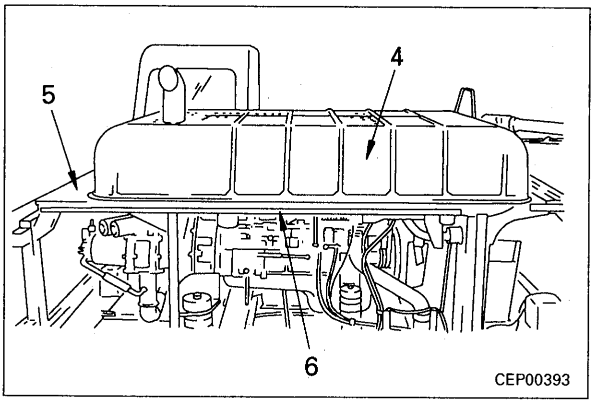
REMOVAL OF REVOLVING FRAME ASSEMBLY



1. Remove work equipment assembly.
   For details, see REMOVAL OF WORK EQUIPMENT ASSEMBLY.
   ⚠ When disconnecting the hydraulic hoses, release the remaining pressure in the hydraulic circuit. For details, see TESTING AND ADJUSTING, Releasing remaining pressure from hydraulic circuit.
2. Disconnect boom cylinder hoses (1).
   ★ Fit blind plugs in the hoses and make it possible to swing the upper structure.

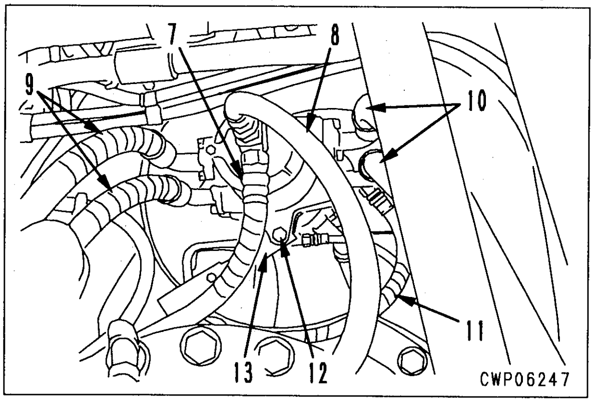


3. Raise boom cylinder assembly (2), then pull out foot pin (3) and lift off.
   ★ Remove the right cylinder assembly in the same way.
   kg Boom cylinder assembly: **410 kg**
4. Remove counterweight assembly.
   For details, see REMOVAL OF COUNTERWEIGHT ASSEMBLY.



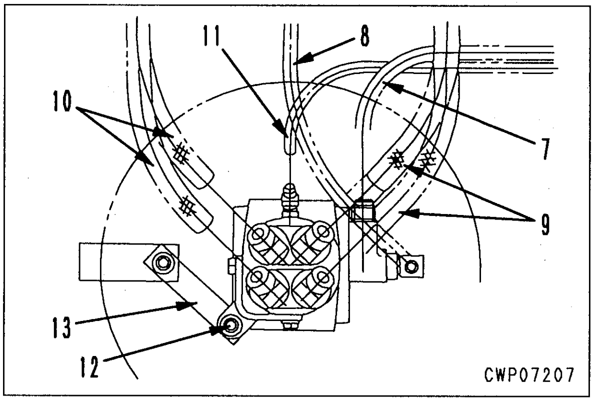
5. Remove engine hood (4), cover (5), and frame (6).
   ★ For details of the method of removing the engine hood, see REMOVAL OF HYDRAULIC COOLER ASSEMBLY.
6. Leave 3 mounting bolts each at front and rear of revolving frame, and remove other mounting bolts.
   ★ Swing the upper structure and set to a position where it is easy to remove the mounting bolts.

PC400-6 Serial No.: 32001 – 32249, PC450-6 Serial No.: 12001 – 12143



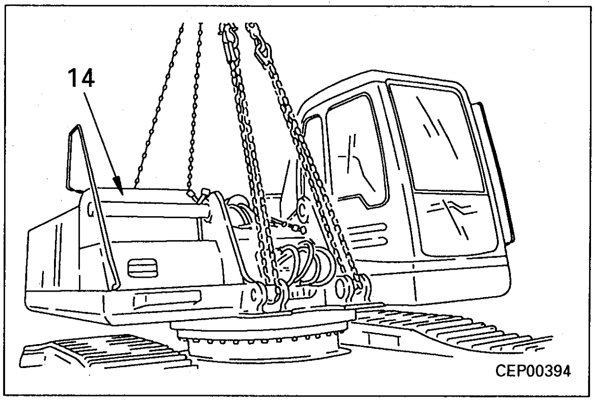
7. Disconnect drain hoses (7) and (8).
   ★ Install blind plugs in the drain hoses.
8. Disconnect travel hoses (9) and (10), and speed selector hose (11).
9. Pull out pin (12), and disconnect plate (13) from swivel joint.

PC400-6 Serial No.: 32250 and up, PC450-6 Serial No.: 12144 and up



10. Sling revolving frame assembly (14), then remove mounting bolts, and lift off revolving frame assembly.
- ★ Use 2 lever blocks.
- ★ Loosen the mounting bolts remaining at the front and rear and adjust the center of gravity with the lever block while lifting off.

kg Revolving frame assembly: **10,000 kg**



INSTALLATION OF REVOLVING FRAME ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

Mating surface of swing circle: **Gasket sealant (LG-4)**

Thread of revolving frame mounting bolt: **Thread tightener (LT-2)**

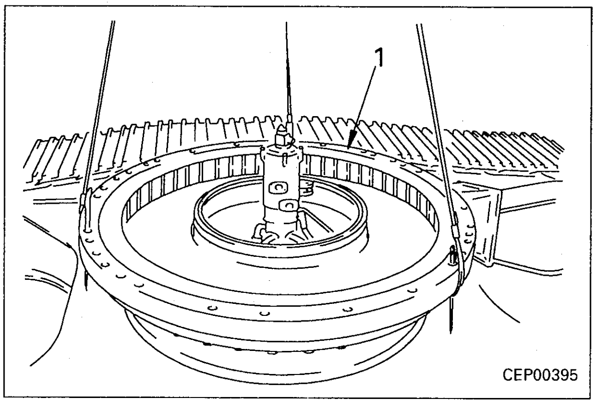
kgm Revolving frame mounting bolt: **926.8 ± 102.9 Nm {94.5 ± 10.5 kgm}**

REMOVAL OF SWING CIRCLE ASSEMBLY

1. Remove revolving frame assembly.
   For details, see REMOVAL OF REVOLVING FRAME ASSEMBLY.

2. Sling swing circle assembly (1) at three points, then remove mounting bolts, and lift off swing circle assembly.

   kg Swing circle assembly: **600 kg**



INSTALLATION OF SWING CIRCLE ASSEMBLY

- Carry out installation in the reverse order to removal.

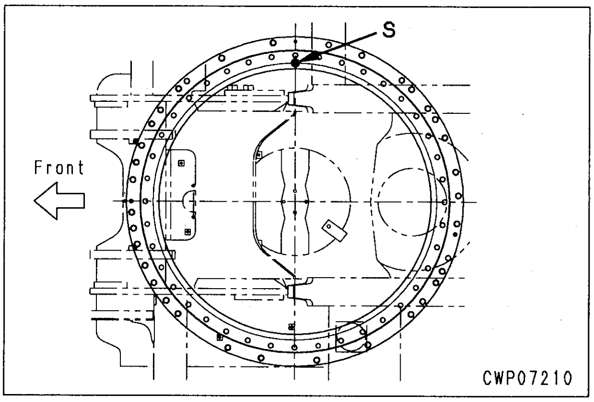
※ 1

Thread of swing circle mounting bolt:
Thread tightener (LT-2)

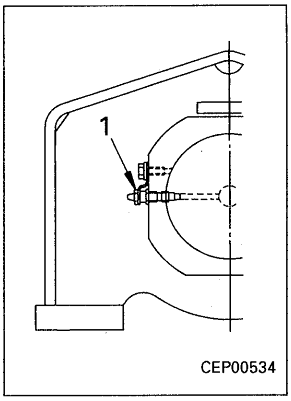
kgm Swing circle mounting bolt:
926.8 ± 102.9 Nm {94.5 ± 10.5 kgm}

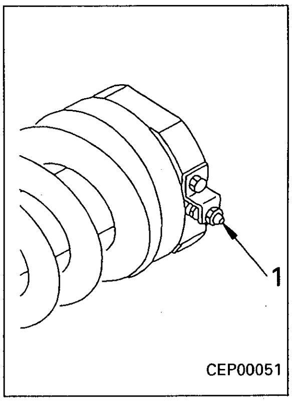
★ Set the soft zone **S** mark on the inside ring of the inner race facing the right side of the machine as shown in the diagram, then install to the track frame.

Swing circle: **Grease (G2-LI) 35 ℓ**

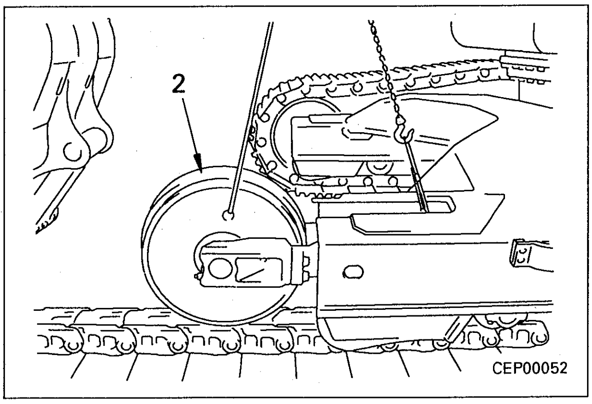


REMOVAL OF IDLER, RECOIL SPRING ASSEMBLY



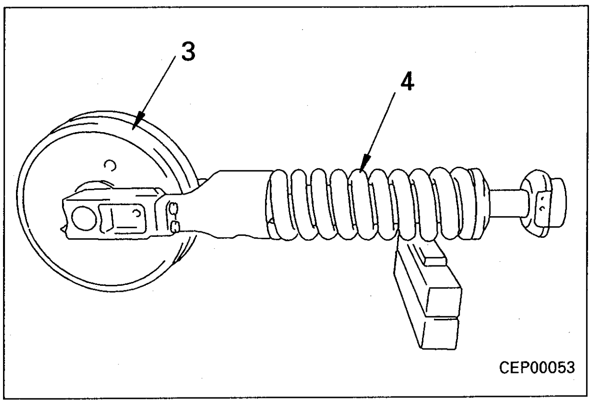


1. Remove track shoe assembly.
   For details, see REMOVAL OF TRACK SHOE ASSEMBLY.
   ★ Remove lubricator (1).



2. Sling idler and recoil spring assembly (2), and pull out to the front to remove.
   ★ Fit wire to the idler and spring of the idler and recoil spring assembly, and adjust the balance when removing.

   kg Idler, recoil spring assembly:
   Approx. 650 kg



3. Disconnect recoil spring assembly (4) from idler assembly (3).

   kg Idler assembly: **240 kg**

   kg Spring assembly: **370 kg**

INSTALLATION OF IDLER, RECOIL SPRING ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

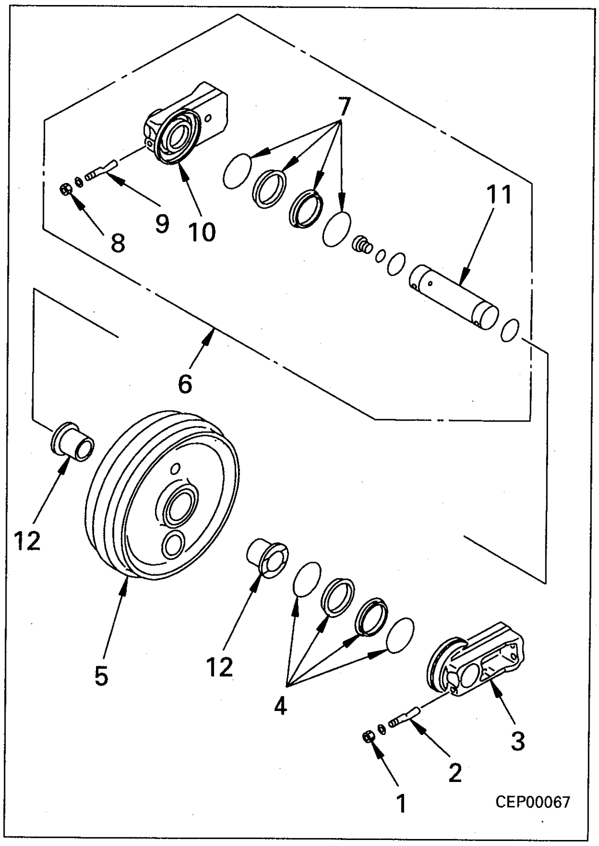
★ When installing the idler assembly and recoil spring assembly, assemble so that the position of the greasing plug on the idler is on the outside for the right side of the machine and on the inside for the left side of the machine.

DISASSEMBLY OF IDLER ASSEMBLY

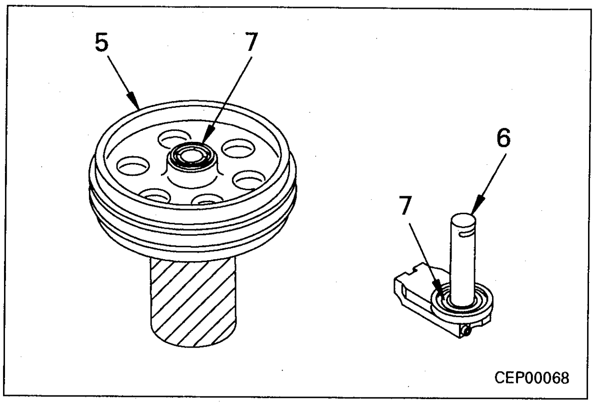
1. Remove nut (1), pull out bolt (2), then remove support (3).

2. Remove floating seal (4) from support (3) and idler (5).

3. Pull out shaft and support assembly (6) from idler (5).
   ★ It is filled with approx. 345 cc. of oil, so drain the oil at this point or lay a cloth to prevent the area from becoming dirty.

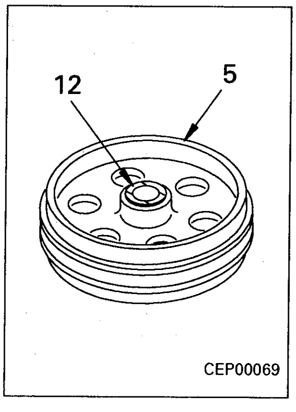


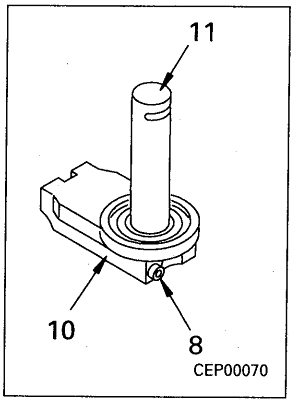
4. Remove floating seal (7) on opposite side from idler (5) and shaft and support assembly (6).



5. Remove nut (8), pull out bolt (9), then remove support (10) from shaft (11).

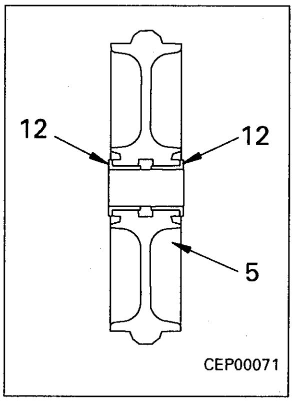
6. Remove bushing (12) from idler (5).
   ★ Turn over the idler and remove the bushing on the opposite side.

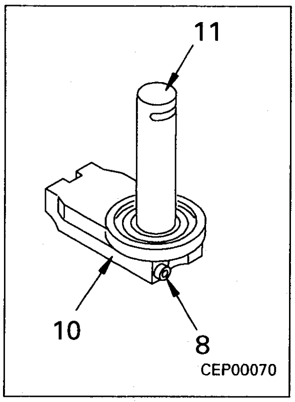




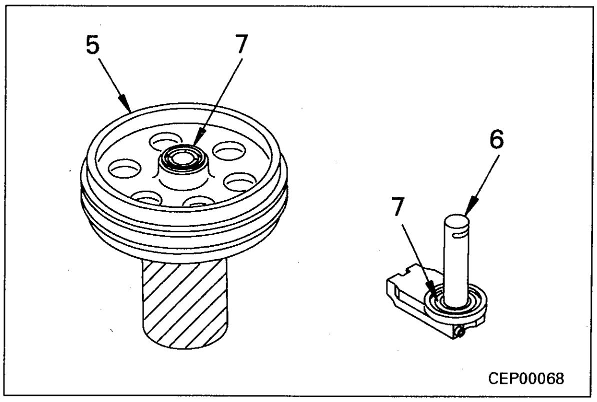
ASSEMBLY OF IDLER ASSEMBLY

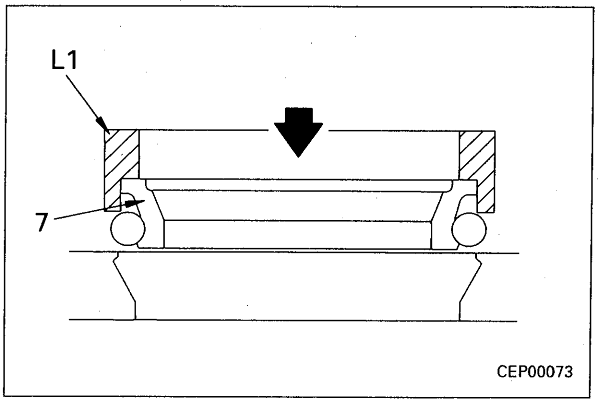
1. Press fit bushing (12) to idler (5) with press.
2. Fit O-ring and install support (10) to shaft (11), then install bolt (9) and tighten with nut (8).



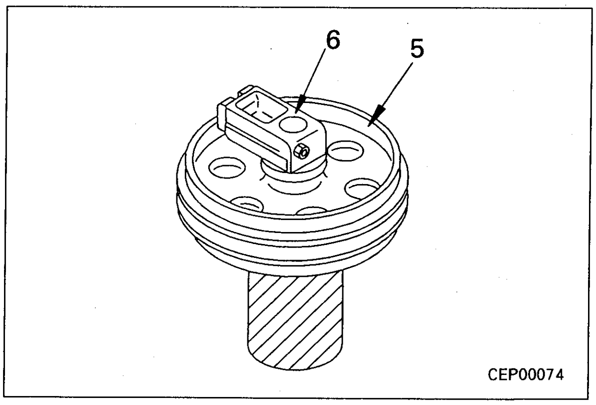


3. Using tool **L1**, install floating seal (7) to idler (5) and shaft and support assembly (6).
   - ★ Coat the sliding surface of the floating seal with oil, and be careful not to let any dirt or dust get stuck to it.
   - ★ Remove all grease and oil from the contact surface of the O-ring and the floating seal.

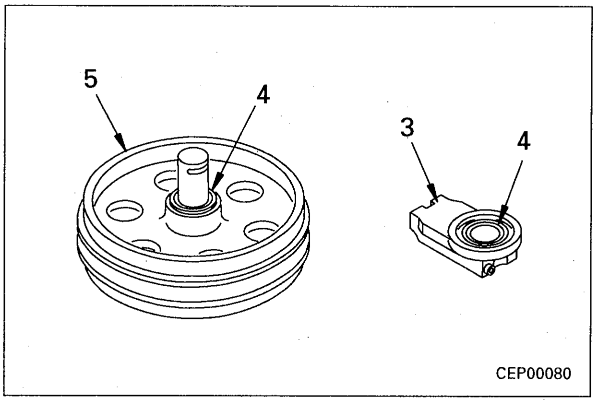


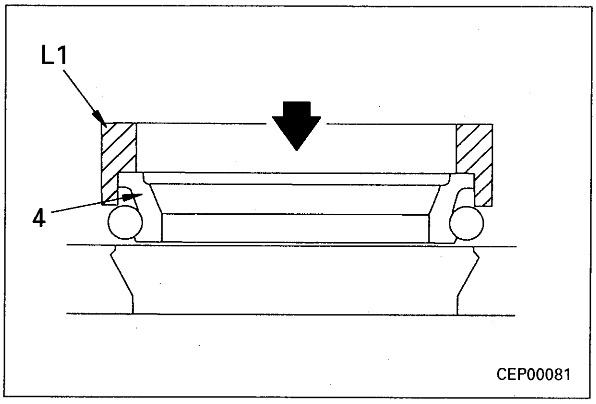


4. Assemble shaft and support assembly (6) to idler (5).



5. Using tool **L1**, install floating seal (4) to idler (5) and support (3).
   - ★ Coat the sliding surface of the floating seal with oil, and be careful not to let any dirt or dust get stuck to it.
   - ★ Remove all grease and oil from the contact surface of the O-ring and the floating seal.



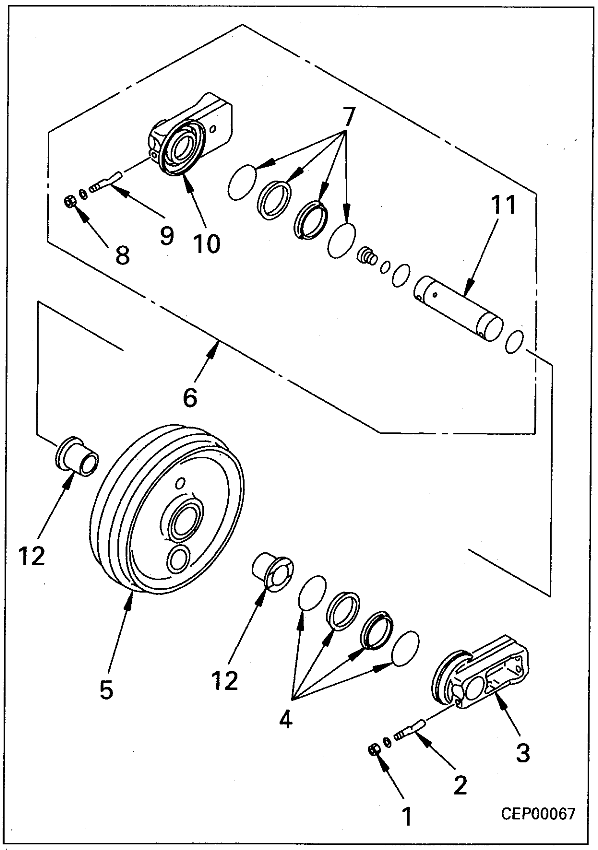


6. Fit O-ring and assemble support (3), then install bolt (2) and tighten nut (1).

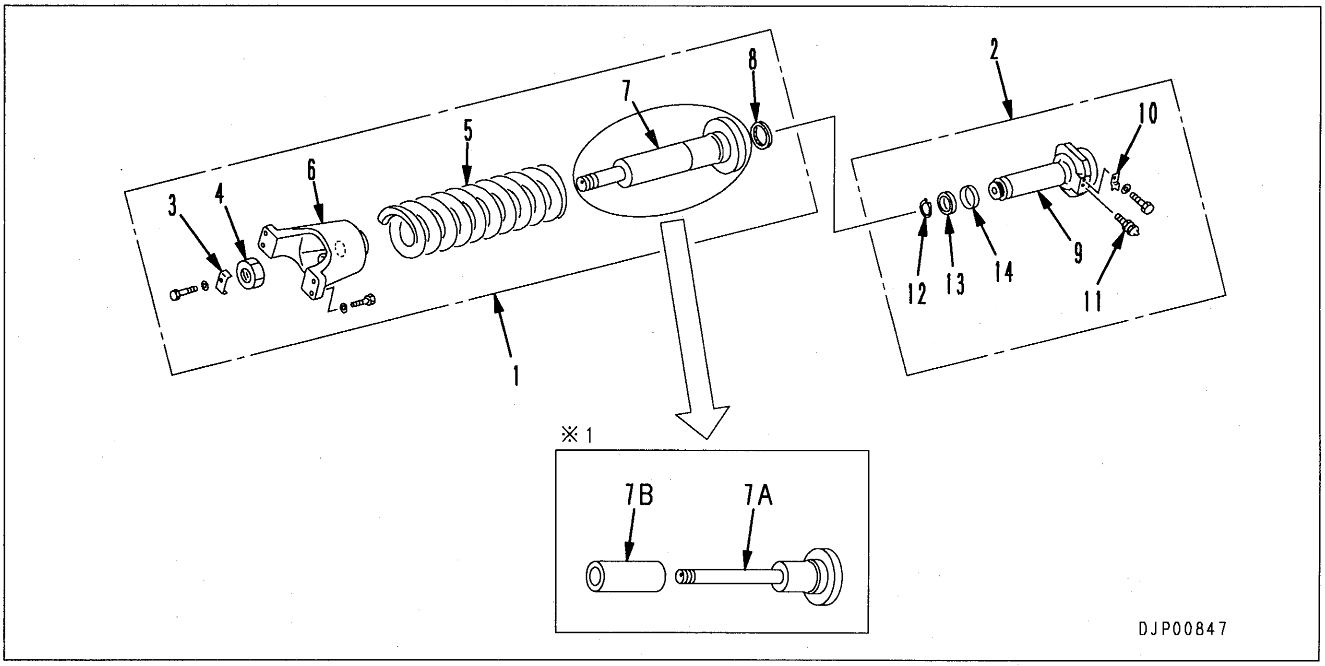
7. Add oil and tighten plug.

   Oil: **Approx. 345 cc (EO30-CD)**

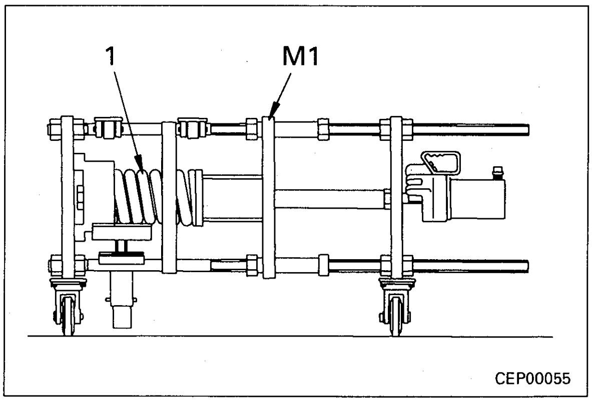
   kgm Plug: **152.0 ± 24.5 Nm {15.5 ± 2.5 kgm}**



DISASSEMBLY OF RECOIL SPRING ASSEMBLY



※1. PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up

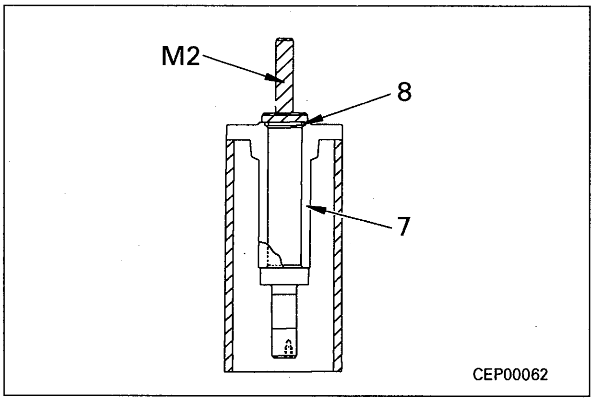


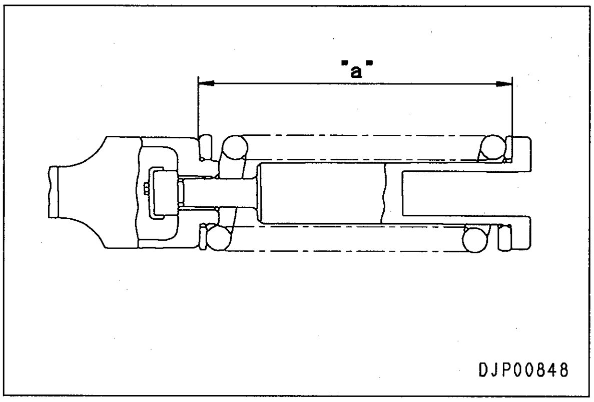
1. Remove piston assembly (2) from recoil spring assembly (1).

2. **Disassembly of recoil spring assembly**
   1) Set tool **M1** to recoil spring assembly (1).
      ⚠ The recoil spring is under large installed load, so be sure to set the tool properly. Failure to do this is dangerous.
      ★ Installed load of spring:
      238.9 kN {24,375 kg}
   2) Apply hydraulic pressure slowly to compress spring, then remove lock plate (3), and remove nut (4).
      ★ Compress the spring to a point where the nut becomes loose.
      ★ Free length of spring: Approx. 857 mm
   3) Remove yoke (6), cylinder (7A), collar (7B), and dust seal (8) from spring (5).
      ★ Collar (7B):
      PC400-6 Serial No.: 32250 and up
      PC450-6 Serial No.: 12144 and up

3. **Disassembly of piston assembly**
   1) Remove lock plate (10) from piston (9), then remove valve (11).
   2) Remove snap ring (12), then remove U-packing (13) and ring (14).

ASSEMBLY OF RECOIL SPRING ASSEMBLY





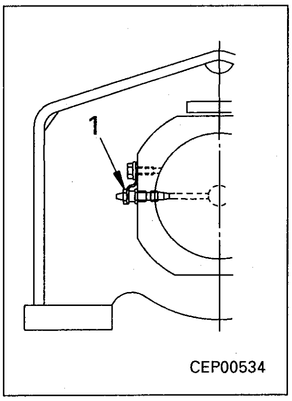
1. **Assembly of piston assembly**
   1) Assemble ring (14) and U-packing (13) to piston (9), and secure with snap ring (12).
   2) Tighten valve (11) temporarily, and secure with lock plate (10).

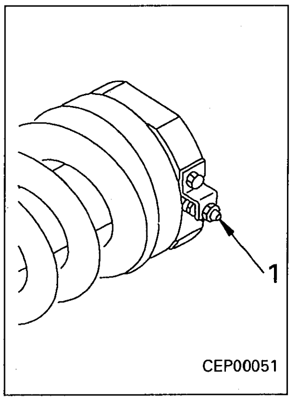
2. **Assembly of recoil spring assembly**
   1) Using tool **M2**, assemble dust seal (8) to cylinder (7).
   2) Assemble cylinder (7A), collar (7B), and yoke (6) to spring (5), then set to tool **M1**.
      ★ Collar (7B):
      PC400-6 Serial No.: 32250 and up
      PC450-6 Serial No.: 12144 and up
      Sliding portion of cylinder:
      Grease (G2-LI)
   3) Apply hydraulic pressure slowly to compress spring, and tighten nut (4) so that installed length of spring is dimension "**a**", then secure with lock plate (3).
      ★ Installed length "**a**" of spring: 707 mm
   4) Remove recoil spring assembly (1) from tool **M1**.

3. Assemble piston assembly (2) to recoil spring assembly (1).
   Piston sliding portion and wear ring:
   Grease (G2-LI)
   ★ Assemble the cylinder assembly so that the mounting position of the valve is 90° to the side.
   ★ Fill the inside of the cylinder with approx. 200 cc of grease (G2-LI), then bleed the air and check that grease comes out of the grease hole.

REMOVAL OF TRACK ROLLER ASSEMBLY

1. Lower work equipment to ground, then loosen lubricator (1), and relieve track tension. ※1
   ⚠ The adjustment cylinder is under extremely high pressure, so never loosen the lubricator more than one turn. If the grease does not come out easily, move the machine backwards and forwards.



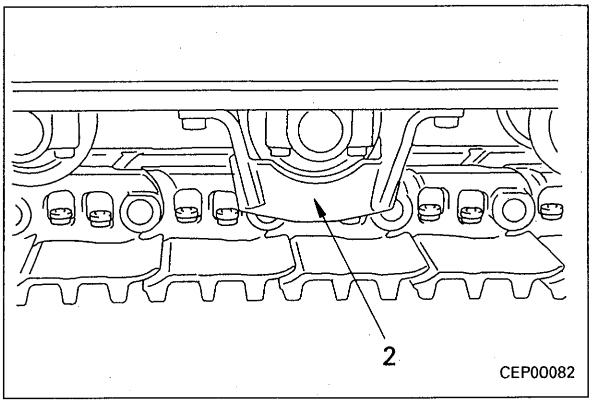


2. Remove mounting bolts of track roller guard (2), then swing work equipment 90°, jack up machine with work equipment, and remove track roller guard (2) towards outside of machine. ※2

   kg Track roller guard: **Approx. 45 kg**

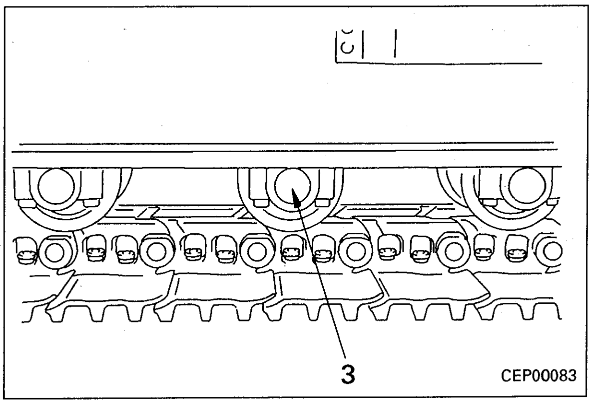
3. Lower chassis completely, remove mounting bolts of track roller assembly (3), then jack up machine with work equipment, and remove track roller assembly (3) to outside of machine. ※3

   kg Track roller assembly: **Approx. 75 kg**



INSTALLATION OF TRACK ROLLER ASSEMBLY

- Carry out installation in the reverse order to removal.



※1

★ Adjust the track tension.
For details, see TESTING AND ADJUSTING, Testing and adjusting track tension.

※2

Roller guard mounting bolt:
Thread tightener (LT-2)

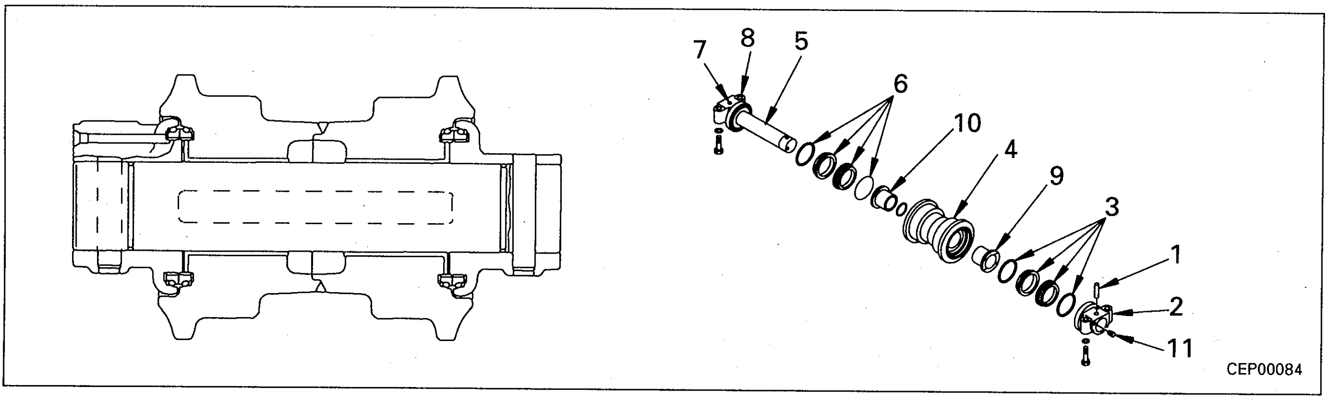
kgm Roller guard mounting bolt:
926.8 ± 102.9 Nm {94.5 ± 10.5 kgm}

※3

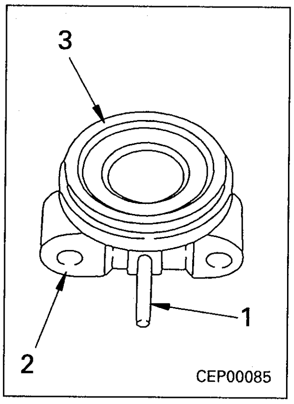
Track roller assembly mounting bolt:
Thread tightener (LT-2)

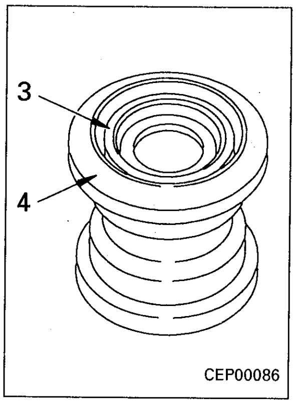
kgm Track roller assembly mounting bolt:
1st pass: **196.0 ± 19.6 Nm {20 ± 2 kgm}**
2nd pass:
Tighten an additional 105 ± 5°

DISASSEMBLY OF TRACK ROLLER ASSEMBLY

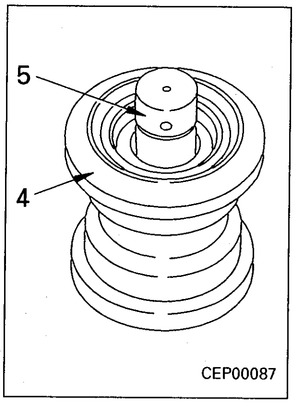


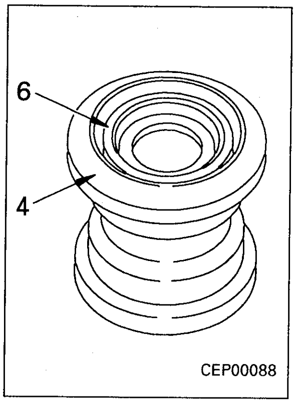
1. Remove pin (1), then remove collar (2).
2. Remove floating seal (3) from collar (2) and roller (4).
3. Pull out roller (4) from shaft (5).
   ★ It is filled with 280 – 310 cc. of oil, so drain the oil at this point or lay a cloth to prevent the area from becoming dirty.



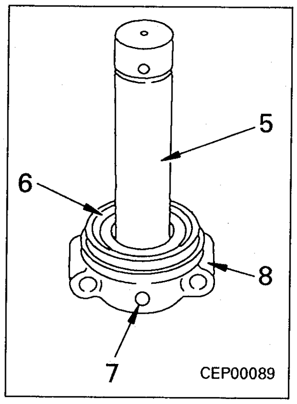


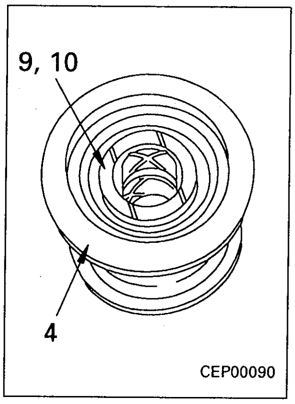
4. Remove floating seal (6) on opposite side from roller (4) and collar (8).





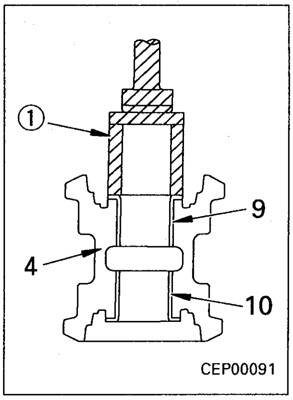
5. Remove pin (7), then remove collar (8) from shaft (5).
6. Remove bushings (9) and (10) from roller (4).



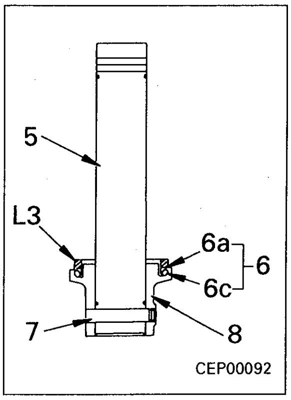


ASSEMBLY OF TRACK ROLLER ASSEMBLY

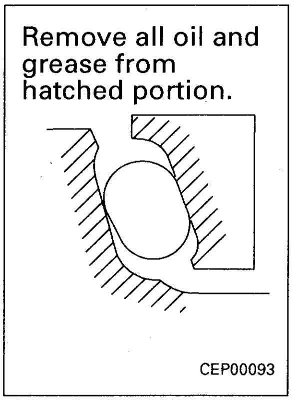
1. Using push tool ①, press fit bushings (9) and (10) to roller (4).
2. Assemble collar (8) to shaft (5), and install pin (7).
3. Using tool **L3**, install floating seal (6) to shaft (5).
   ★ When assembling the floating seal, clean the contact surface of O-ring (6c) and floating seal (6a), remove all grease and oil, and dry it. Make sure that no dirt or dust sticks to the contact surface of the floating seal.
   ★ After inserting the floating seal, check that the angle of the seal is less than 1 mm and that the protrusion of the seal is within a range of 5 – 7 mm.



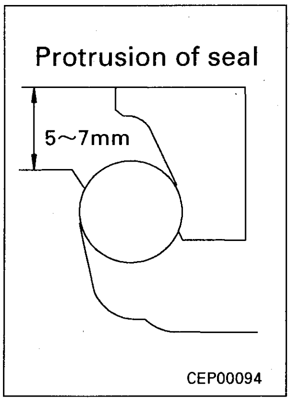
CEP00091



CEP00092

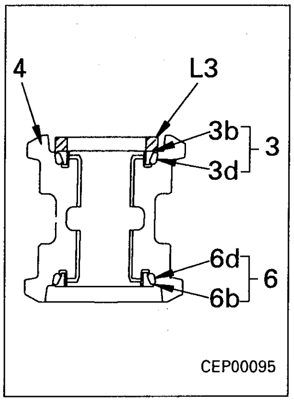

Remove all oil and grease from hatched portion.

CEP00093



CEP00094

4. Using tool **L3**, install floating seals (6) and (3) to roller (4).
   ★ For details of the precautions when installing floating seals (6b) and (6d), and (3b) and (3d), see the precautions marked ★ for Step 3.
5. Assemble shaft (5) to roller (4).



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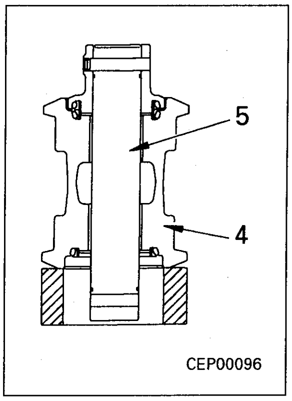
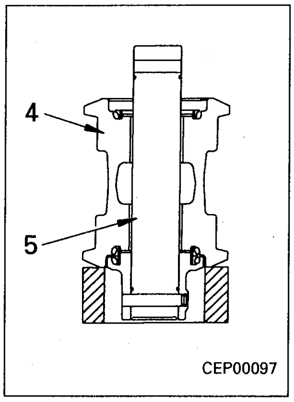


CEP00096

6. Turn over roller (4) and shaft (5) assembly.
7. Using tool **L3**, install floating seal (3) to collar (2).
   ★ For details of the precautions when installing floating seals (3a) and (3c), see the precautions marked ★ for Step 3.



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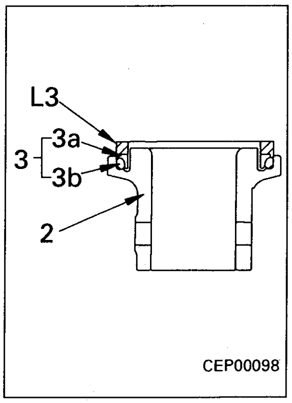
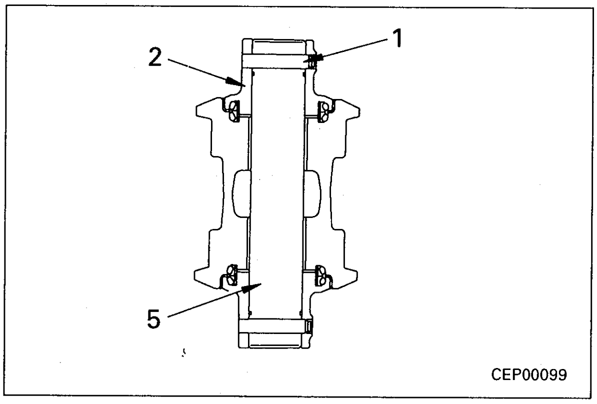
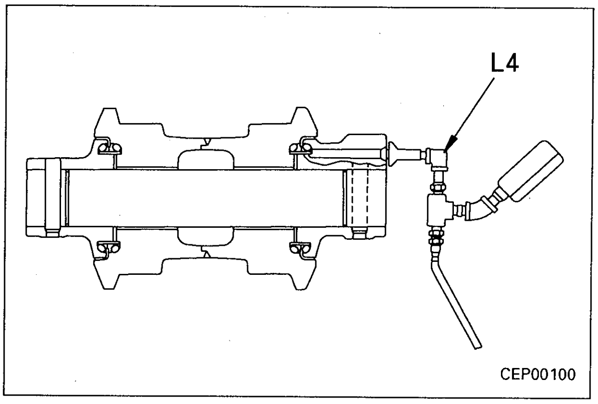


CEP00098

8. Assemble collar (2) to shaft (5), and install pin (1).



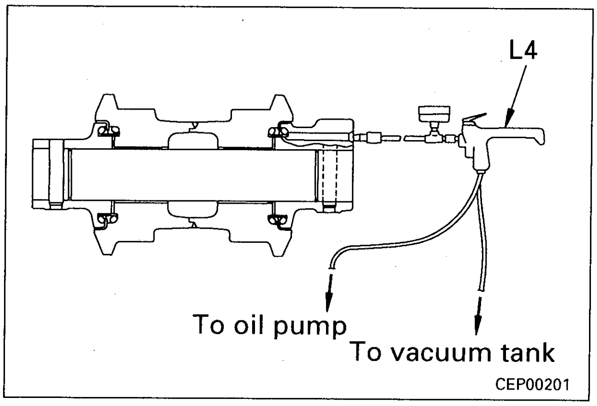
9. Using tool **L4**, apply standard pressure to roller oil filler port, and check for leakage of air from seal.
   ★ Standard pressure: 0.1 MPa {1 kg/cm^2}
   ★ Method of checking
   The standard pressure shall be maintained for 10 seconds and the indicator of the gauge shall not go down.

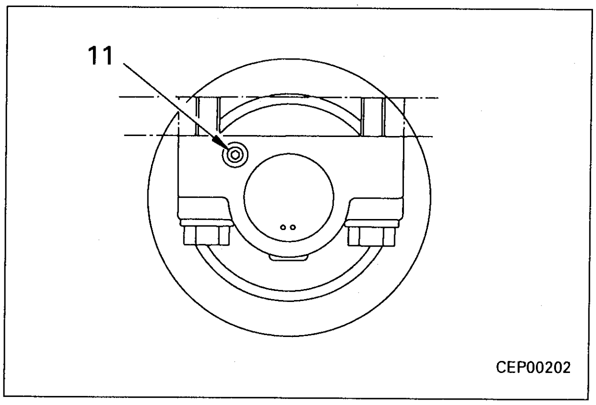


10. Using tool **L4**, fill track roller assembly with oil, then tighten plug (11).

   Track roller oil: **280 – 310 cc (EO30-CD)**

   kgm Plug: **14.7 ± 4.9 Nm {1.5 ± 0.5 kgm}**

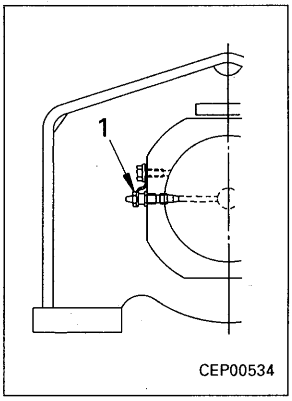


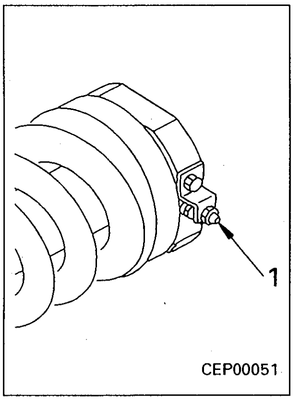


REMOVAL OF CARRIER ROLLER ASSEMBLY

1. Lower work equipment to ground, then loosen lubricator (1), and relieve track tension. ※ 1

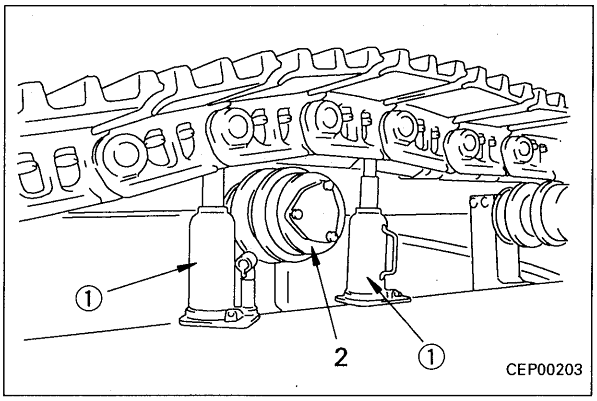
   ⚠ The adjustment cylinder is under extremely high pressure, so never loosen the lubricator more than one turn. If the grease does not come out, move the machine backwards and forwards.





2. Using hydraulic jacks ①, push up track to a position where carrier roller assembly can be removed, then remove carrier roller assembly (2). ※ 2

   kg Carrier roller assembly: **35 kg**



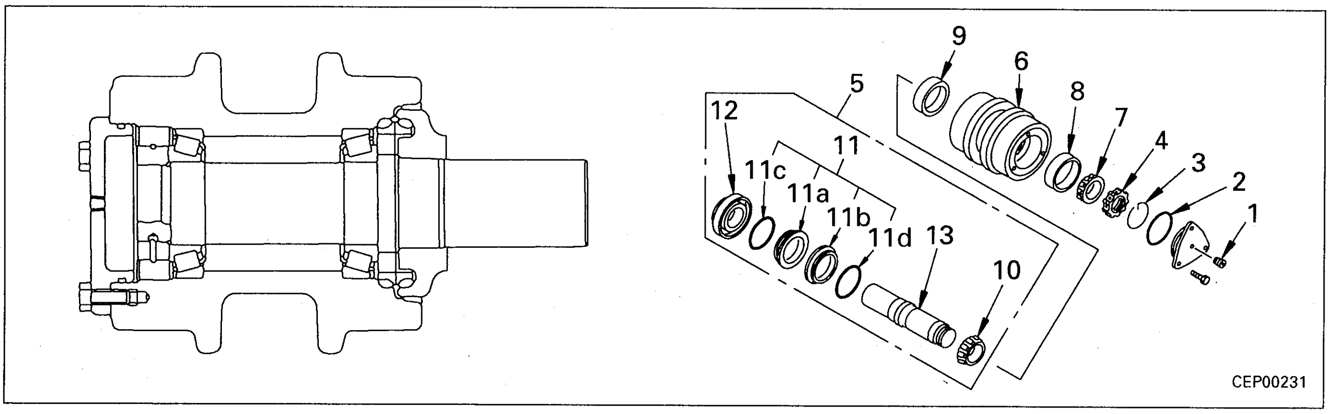
INSTALLATION OF CARRIER ROLLER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

★ Adjust the track tension.
For details, see TESTING AND ADJUSTING, Testing and adjusting track tension.

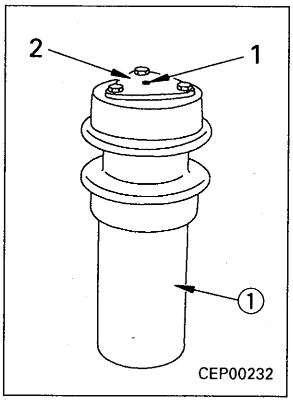
DISASSEMBLY OF CARRIER ROLLER ASSEMBLY

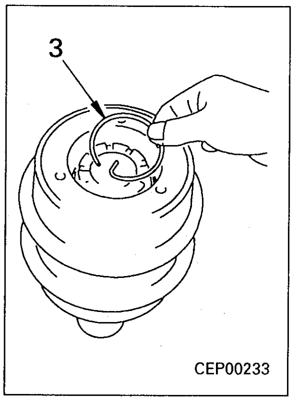


1. Remove plug (1) and drain oil.

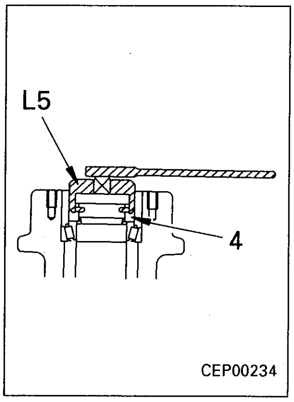
   Carrier roller assembly: **450 – 500 cc**

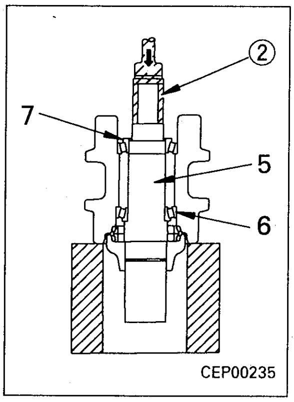
2. Set carrier roller assembly on stand ①.
3. Remove cover (2).
4. Remove ring (3).



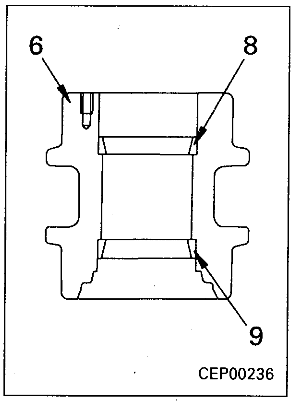


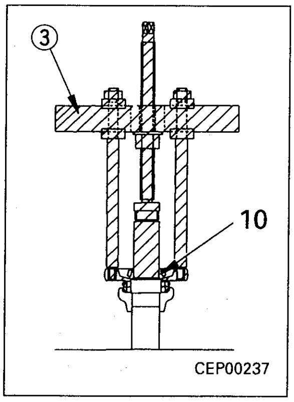
5. Using tool **L5**, remove nut (4).
6. Using push tool ②, pull out shaft assembly (5) from roller (6) with press, then remove inner race (7).



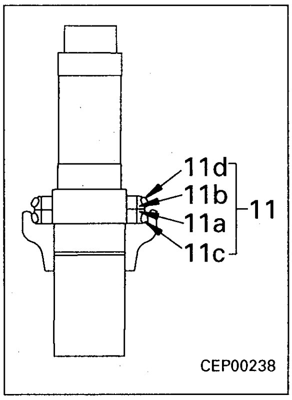


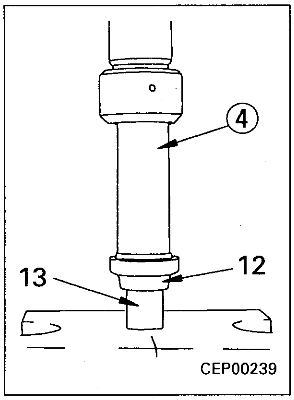
7. Remove outer races (8) and (9) from roller (6).
8. **Disassembly of shaft assembly.**
   1) Using puller ③, remove inner race (10).





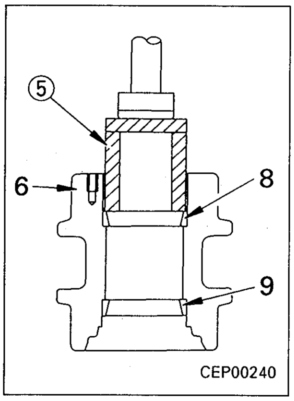
2) Remove floating seals (11).
3) Using push tool ④, remove collar (12) from shaft (13).





ASSEMBLY OF CARRIER ROLLER ASSEMBLY

1. Using push tool ⑤, press fit outer races (8) and (9) to roller (6).
2. **Assembly of shaft assembly.**
   1) Using tool **L7**, press fit collar (12) to shaft (13).
      ★ When press fitting, be careful that there is no scuffing.
      Fitting portion of shaft:
      Engine oil (EO30-CD)
   2) Using tool **L6**, assemble floating seals (11).
      ★ When assembling the floating seal, clean the contact surface of O-ring (11c) and floating seal (11a), remove all grease and oil, and dry it. Make sure that no dirt or dust sticks to the contact surface of the floating seal.
      ★ After inserting the floating seal, check that the angle of the seal is less than 1 mm and that the protrusion of the seal is within a range of 5 – 7 mm.
   3) Assemble floating seals (11), then using push tool ⑥, press fit inner race (10).
      ★ For details of the precautions when installing floating seals (11b) and (11d), see the precautions marked ★ for Step 2).



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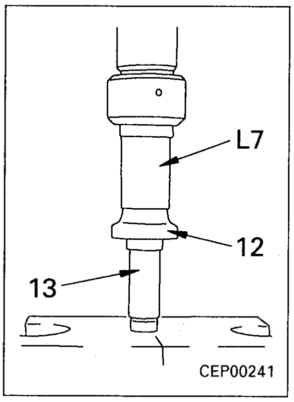

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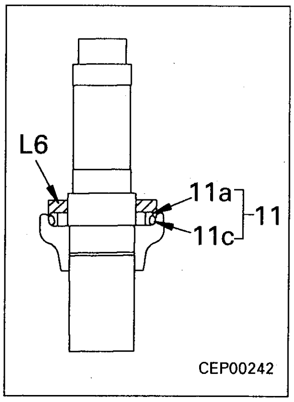

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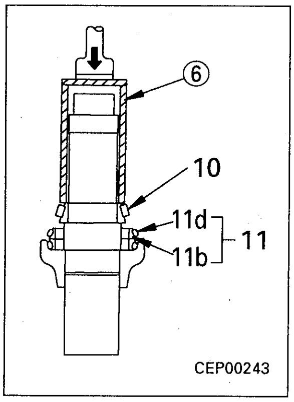
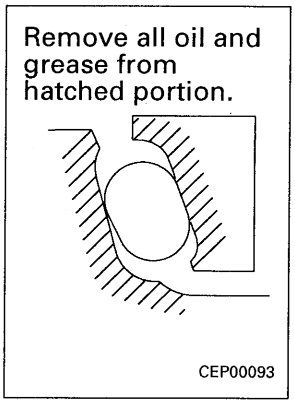
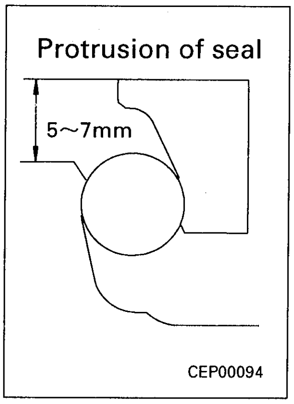


CEP00243

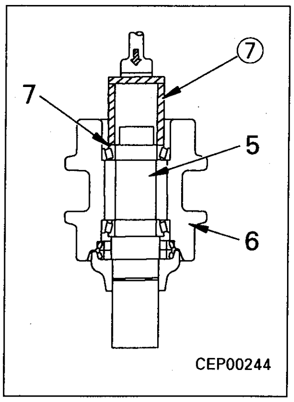

Remove all oil and grease from hatched portion.

CEP00093


Protrusion of seal

CEP00094

3. Assemble roller (6) to shaft assembly (5).
4. Using push tool ⑦, press fit inner race (7).
   ★ When press fitting the bearing, rotate the roller, and press fit to a point where the rotation becomes slightly heavier.
5. Using tool **L5**, tighten nut (4) to a point where drill hole in shaft is aligned with drill hole in nut.



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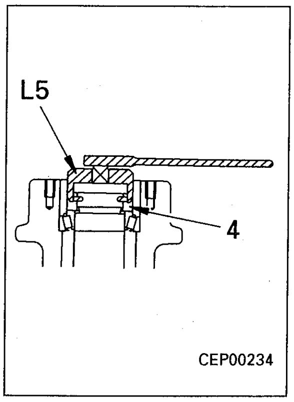
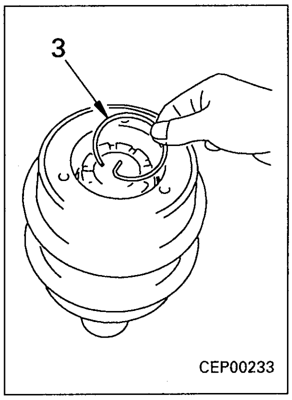
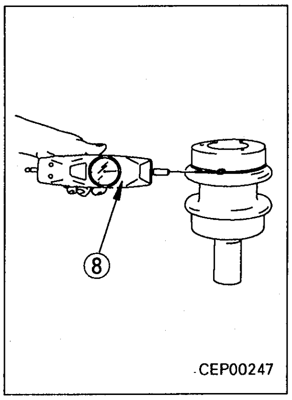


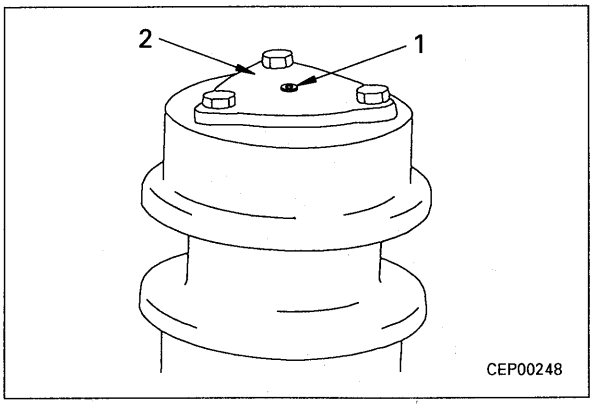
CEP00234

6. Install ring (3).
7. Using push-pull scale ⑧, check that roller rotates smoothly.

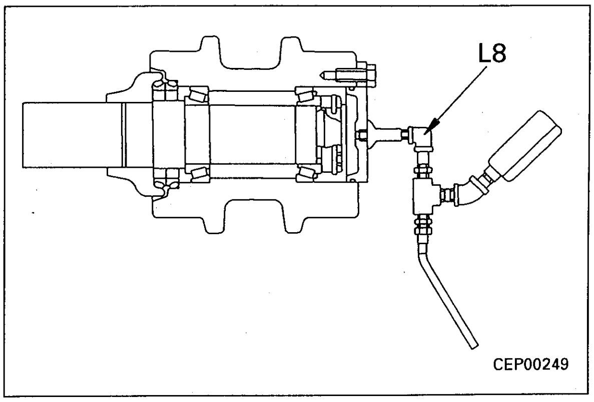




8. Fit O-ring and install cover (2).



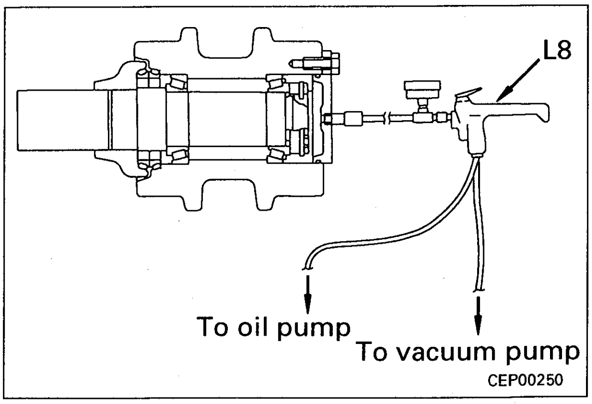
9. Using tool **L8**, apply standard pressure to roller oil filler port, and check for leakage of air from seal.
   - ★ Standard pressure: 0.1 MPa {1 kg/cm^2}
   - ★ Method of checking
     The standard pressure shall be maintained for 10 seconds and the indicator of the gauge shall not go down.



10. Using tool **L8**, fill carrier roller assembly with oil, then tighten plug (1).

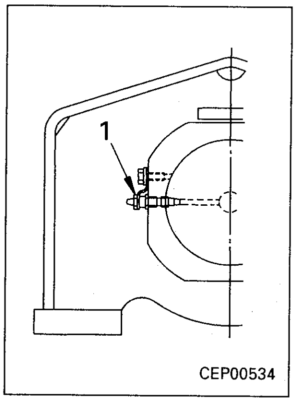
Carrier roller oil: **450 – 500 cc (EO30-CD)**

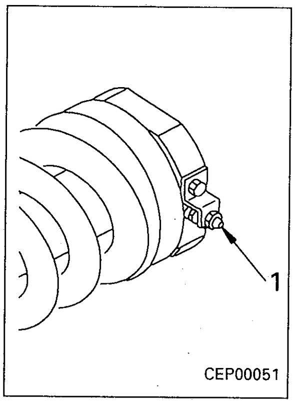
Plug: **14.7 ± 4.9 Nm {1.5 ± 0.5 kgm}**



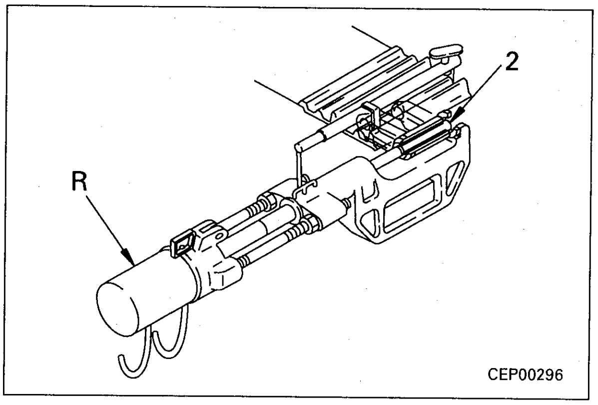
REMOVAL OF TRACK SHOE ASSEMBLY

1. **Positioning track shoe**
   - ★ Stop the machine at a point where it is easy to set master pin removal tool **R**, and where master pin is in the middle of the track frame, then loosen lubricator (1), and relieve the track tension. ※ 1
   - The adjustment cylinder is under extremely high pressure, so never loosen the lubricator more than one turn. If the grease does not come out, move the machine backwards and forwards.

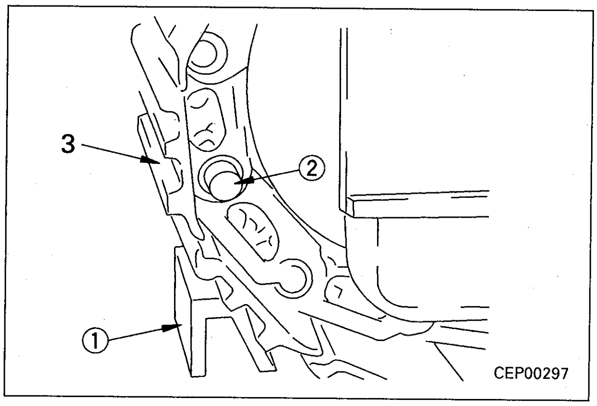




2. Using tool **R**, pull out master pin (2). ※ 2



3. Lay out track as follows.
   1) Move machine forward so that position of temporary pin is at front of idler, set block ① in position, then remove temporary pin ②, and remove dust seal. ※ 3
   2) Drive machine in reverse to lay out track.



INSTALLATION OF TRACK SHOE ASSEMBLY

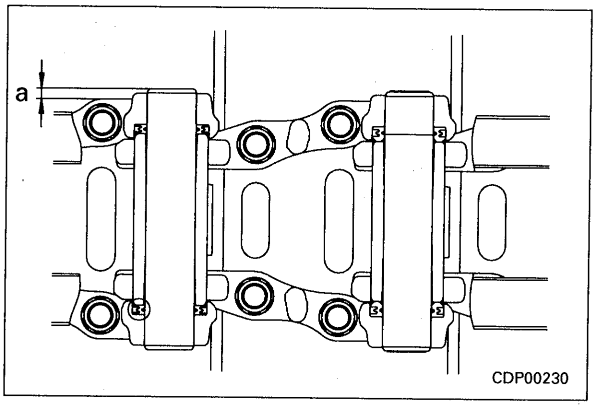
- Carry out installation in the reverse order to removal.

※ 1

Adjust the track tension.
For details, see TESTING AND ADJUSTING, Testing and adjusting track tension.

※ 2

★ Use tool **R** and press fit so that the protrusion of the master pin is dimension "**a**".
Protrusion "**a**" of master pin: 4.2 ± 2 mm



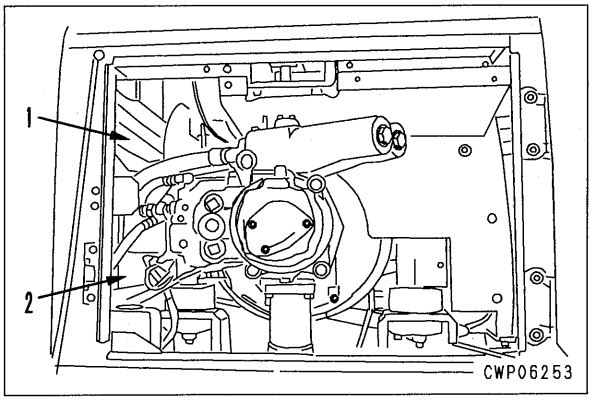
※ 3

When assembling the dust seal,coat the bushing contact surface with **grease (G2-LI)**.

REMOVAL OF HYDRAULIC TANK ASSEMBLY

- Swing the upper structure to set the position of the hydraulic tank drain and mounting bolt outside the track.

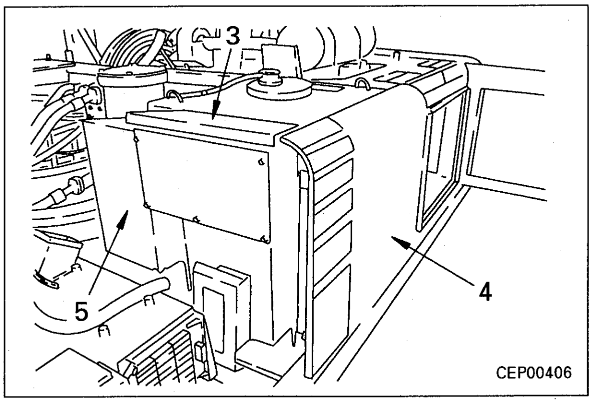
⚠ Loosen the hydraulic tank oil filler cap slowly to release the pressure inside the hydraulic tank.



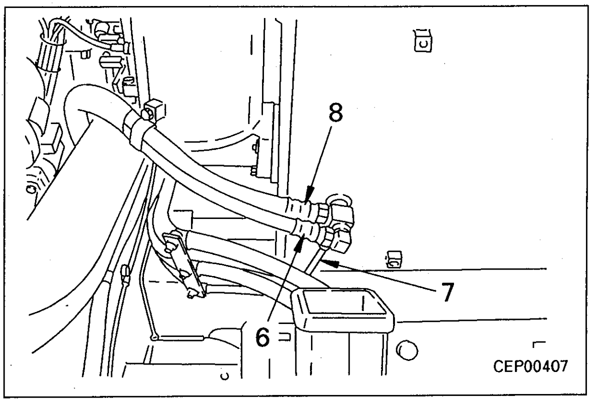
1. Drain oil from hydraulic tank.

   Hydraulic tank: **Approx. 270 ℓ**

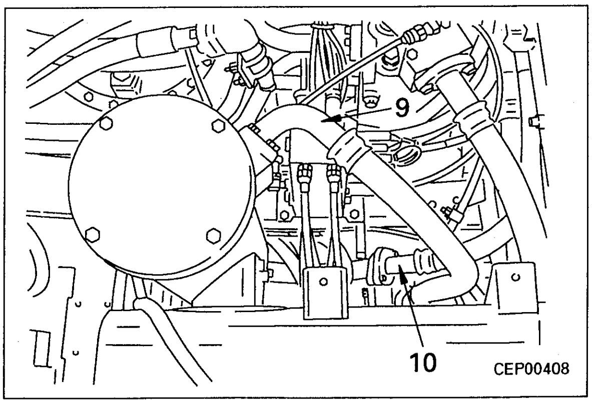
2. Remove operator's cab assembly.
   For details, see REMOVAL OF OPERATOR'S CAB ASSEMBLY.
3. Remove control valve top cover, hydraulic tank undercover, and main pump undercover.
4. Open main pump side cover, then remove partitions (1) and (2).
5. Remove covers (3) and (4).
6. Remove air conditioner air suction port (5).



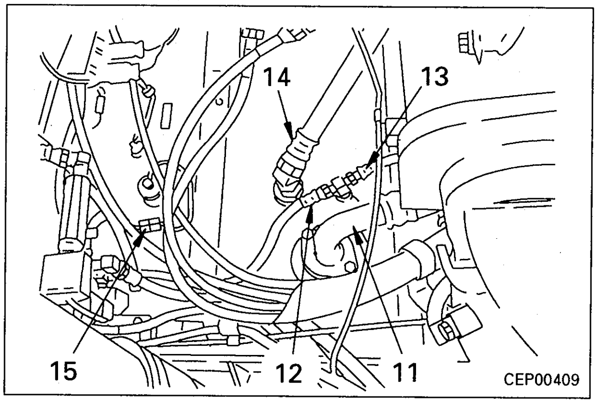
7. Disconnect drain hoses (6), (7), and (8).



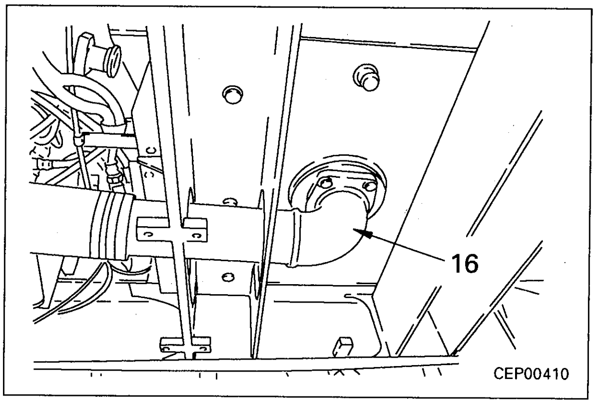
8. Disconnect hydraulic oil filter inlet hose (9) and outlet hose (10).



9. Disconnect hydraulic oil cooler return hose (11).
10. Disconnect drain hoses (12), (13), and (14).
11. Disconnect hydraulic oil level sensor connector (15) (CN-P09).

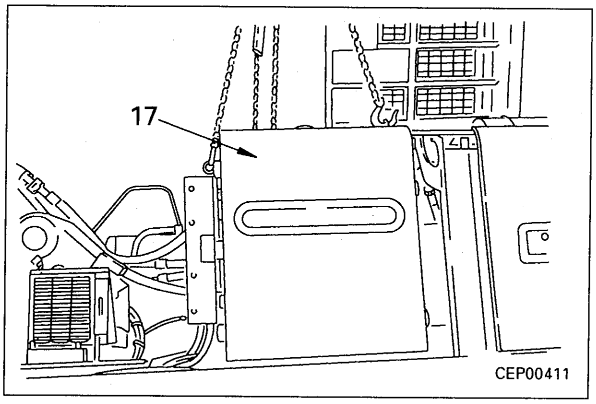


12. Remove main pump suction tube (16).
    ★ A box wrench cannot be fitted on the center rear mount bolt, so disconnect both sides of tube (16) and offset them.



13. Remove mounting bolts, and lift off hydraulic tank assembly (17). ※1

kg Hydraulic tank assembly: **260 kg**



INSTALLATION OF HYDRAULIC TANK ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

kgm Hydraulic tank mounting bolt:
277.0 ± 31.9 Nm {28.25 ± 3.25 kgm}

- **Refilling with oil (hydraulic tank)**
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.
- **Bleeding air**
  ★ Bleed the air.
  For details, see TESTING AND ADJUSTING, Bleeding air.

REMOVAL OF MAIN PUMP ASSEMBLY

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

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

★ Mark all the piping with tags to prevent mistakes when installing.

1. Remove hydraulic tank strainer, and using tool **S1**, stop oil.
   ★ When not using tool **S1**, remove the drain plug, and drain the oil from the hydraulic tank and inside the system.

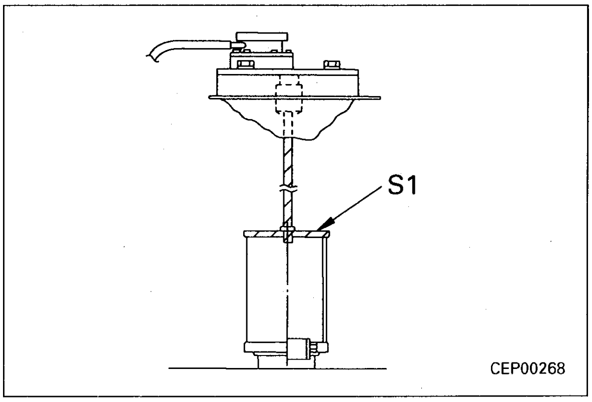
   Hydraulic tank: **Approx. 280 ℓ**

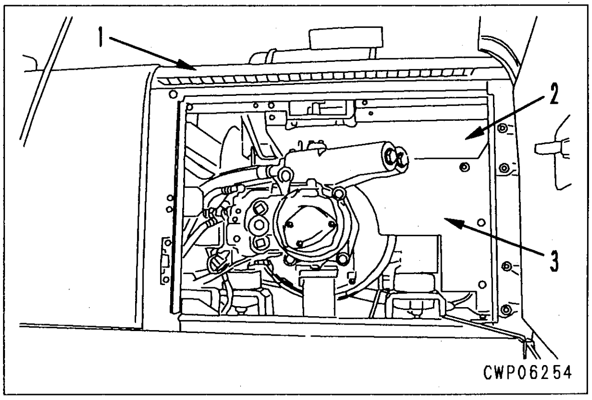
2. Remove main pump side cover and undercover, and open engine hood.
3. Drain oil from damper case.

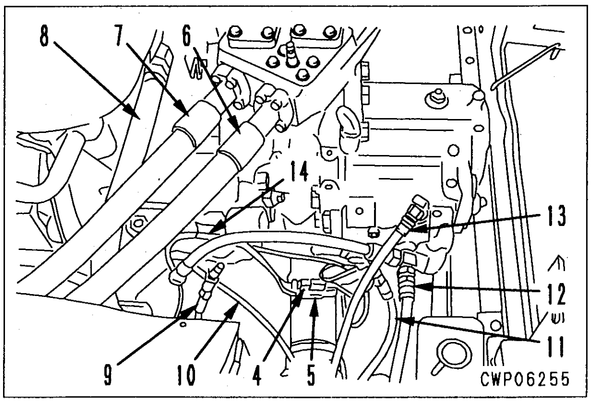
   Damper case: **Approx. 1.1 ℓ**

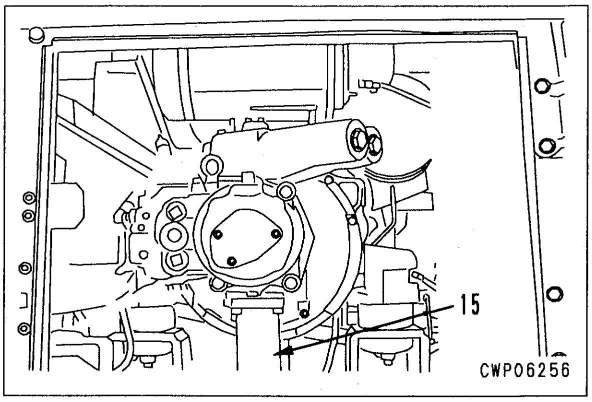
4. Remove main pump top cover (1), and partitions (2) and (3).
5. Disconnect TVC solenoid connectors (4) and (5) (CN-C04 and CN-C13).
   ★ There is a clamp (14) for the front servo valve.
6. Disconnect main pump outlet hoses (6) and (7).
   ★ On the PC400-6 (Serial No.: 33466 and up) and the PC450-6 (Serial No.: 12145 and up), there are spacers between the filter and hoses (6) and (7), so be careful not to lose them.
7. Disconnect pump case drain hose (8).
8. Disconnect front pump servo valve hoses (9) and (10).
9. Disconnect rear pump servo valve hoses (11), (12) and (13).

10. Disconnect main pump inlet tube (15).



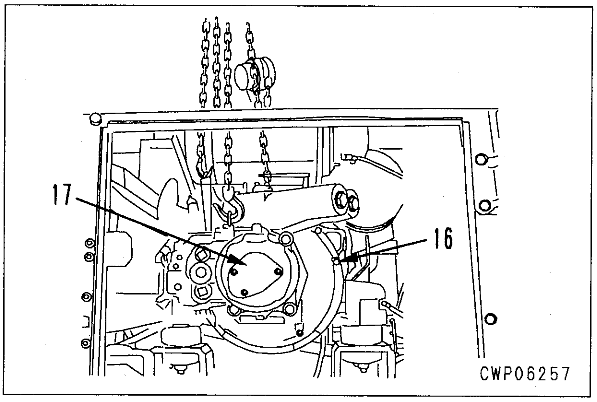






11. Sling main pump assembly (17), remove mounting bolts (16), then lift off.

    kg Main pump assembly: **250 kg**



INSTALLATION OF MAIN PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

Involute spline of main pump:
Anti-friction compound (LM-G)

Mating surface of main pump case:
Gasket sealant (LG-6)

- **Refilling with oil (damper case)**
  ★ Add engine oil through the oil filler to the specified level. Run the engine, then stop the engine, wait for 15 minutes, and check the oil level again.

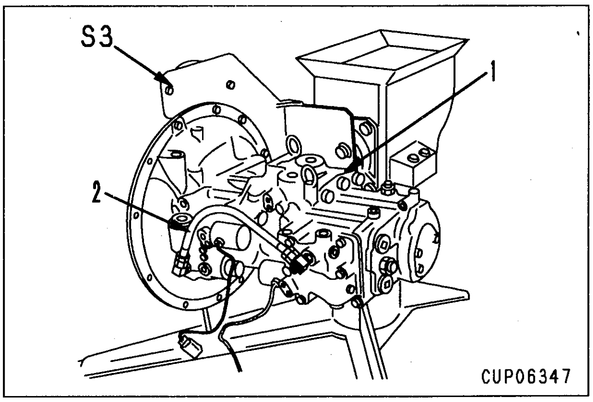
- **Refilling with oil (hydraulic tank)**
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

- **Bleeding air**
  ★ Bleed the air.
  For details, see TESTING AND ADJUSTING, Bleeding air.

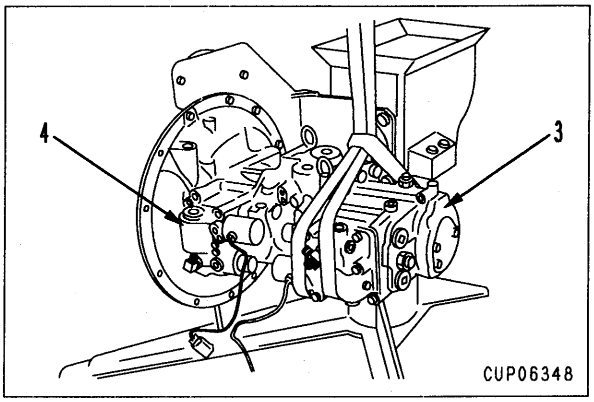
DISASSEMBLY OF MAIN PUMP ASSEMBLY

1. **Pump assembly**
   Set pump assembly (1) to tool **S3**.

2. **Hose**
   Remove hose (2), elbow, and tee.



3. **Rear pump assembly**
   1) Sling rear pump assembly (3).
   2) Remove 8 bolts at rear pump end, then remove rear pump assembly (3).
      ★ Leave the end cap at the front end.
      ★ Be careful not to drop the rear pump valve plate, cylinder block, piston assembly, or other parts.



- **Disassembly of front pump assembly**

4. **Servo valve assembly**
   1) Remove servo valve assembly (4).

   2) Disassembly of servo valve assembly

   - **TVC valve**
     i) Remove solenoid assembly (5), then remove sleeve (6) and spool (7).

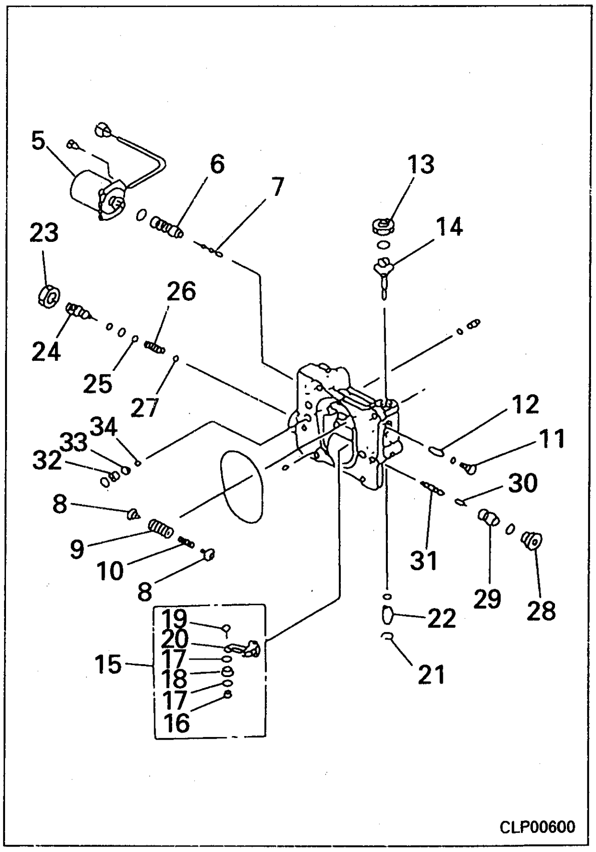
     ii) Remove seat (8), then remove springs (9) and (10).

     iii) Remove plug (11), then remove piston (12).

     iv) Remove locknut (13), then remove plug (14) and lever assembly (15).

     v) Remove nut (16) from lever assembly (15), then remove washer (17), bearing (18), pin (19), and lever (20).

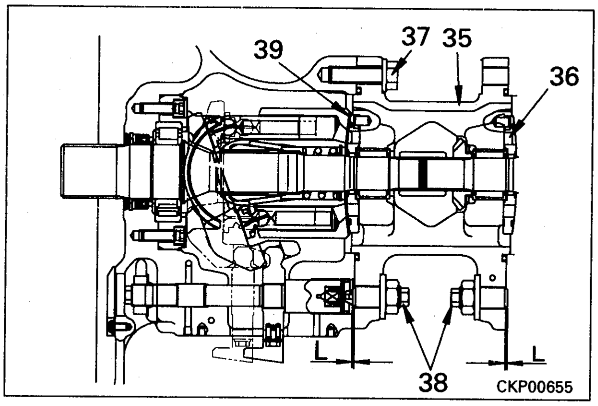
     vi) Remove snap ring (21), then remove plug (22).



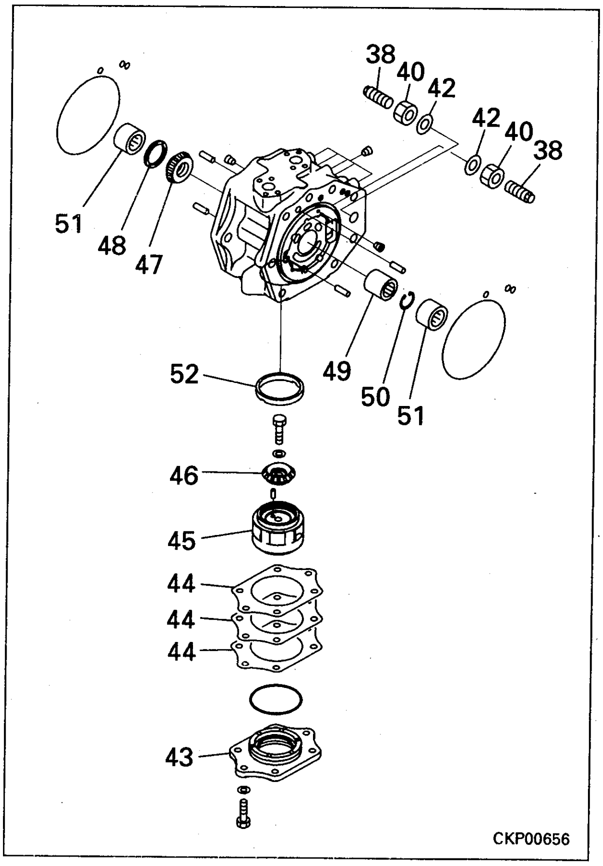
- **LS valve**
  - i) Remove locknut (23), then remove plug (24), seat (25), spring (26), and seat (27).
    - ★ Measure the dimension between the end face of locknut (23) and the end face of plug (24).
  - ii) Remove plug (28), then remove sleeve (29), piston (30), and spool (31).
- Remove filter (32), then remove spacer (33) and orifice (34).

5. Valve plate, end cap

1) Remove valve plate (36) from end cap (35).
2) Remove 8 mounting bolts (37), then lift off end cap (35).
   - ★ If the valve plate is stuck to the end cap, be careful not to drop it.
   - ★ Measure protrusion **L** of maximum swash plate angle adjustment screw (38).
3) Remove valve plate (39) from end cap (35).



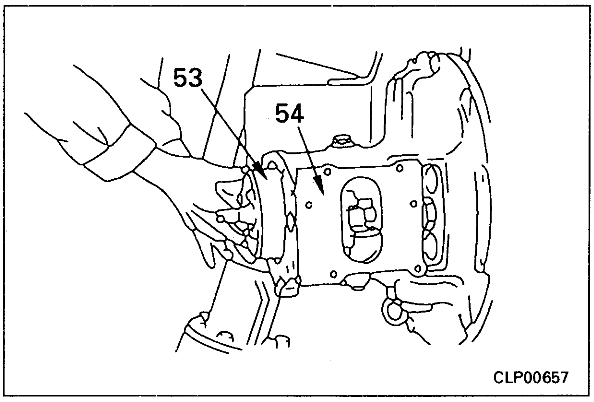
- **Disassembly of end cap**
  - i) Loosen locknut (40), and remove screw (38) and washer (42).
  - ii) Remove cover (43), then remove shim (44).
    - ★ Check the number and thickness of the shims, and keep in a safe place.
  - iii) Remove impeller (45).
  - iv) Remove bevel gear (46) from impeller (45).
  - v) Remove bevel gear (47), thrust bearing (48), and coupling (49) from inside of end cap.
  - vi) Remove snap ring (50) from coupling.
  - vii) Remove bearing (51) from end cap (35).
  - viii) Remove O-ring and bushing (52) from end cap (35).



6. Cylinder block, piston assembly

Remove cylinder block and piston assembly (53) from pump case (54).

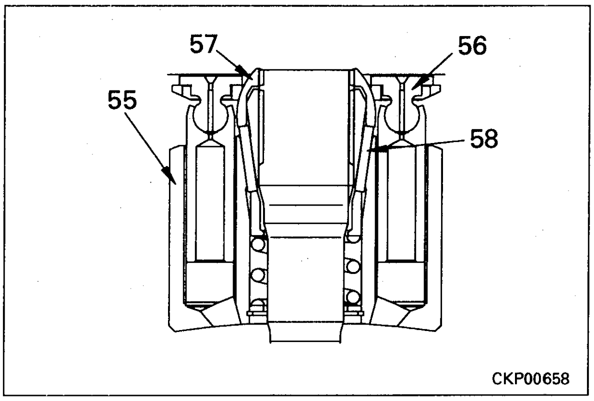
★ The cylinder block and piston assembly may come off separately, so be careful not to drop them.



- **Disassembly of cylinder block, piston assembly**

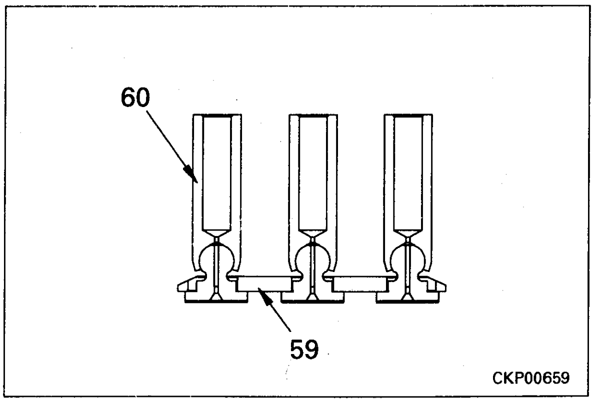
  Pull out piston assembly (56) from cylinder block (55), and remove retainer guide (57) and 3 preload pins (58).

  ★ When removing the piston assembly from the cylinder block, the preload pins may come out, so be careful not to lose them.



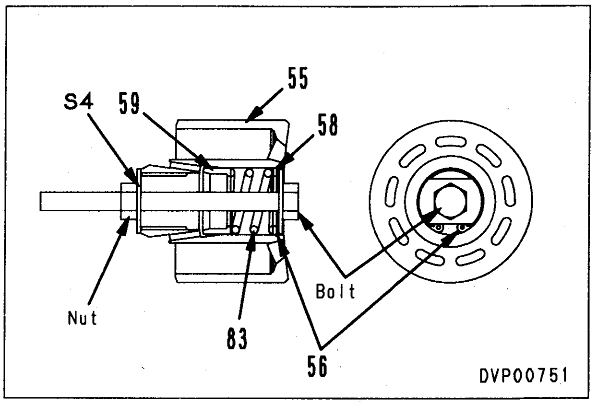
- **Disassembly of piston assembly**

  Pull out piston (60) from retainer shoe (59).



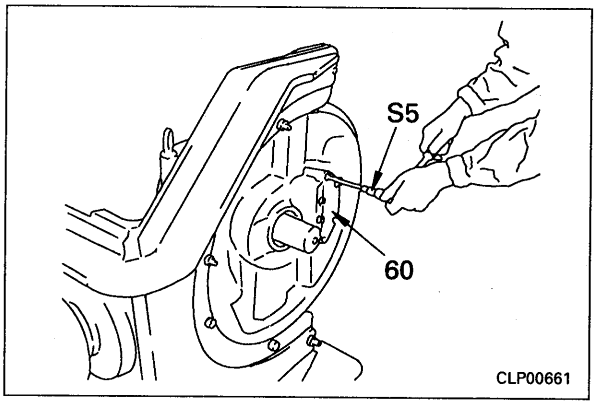
- **Disassembly of cylinder block**
  1) Set tool **S4** to cylinder block (55).
  2) Hold bolt of tool **S4** with wrench, tighten nut to compress spring, and remove snap ring (56).
  3) Loosen nut of tool **S4** slowly to release tension of spring (83), then remove tool **S4**.
  4) Remove seat (58), spring (83), and seat (59) from cylinder block (55).

     ★ Check the assembly direction of seat (59).

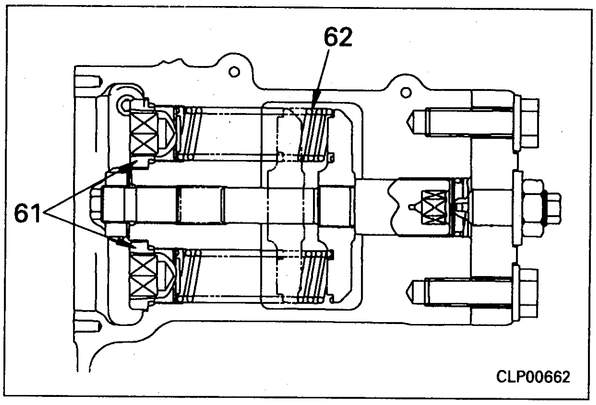


7. Servo piston assembly

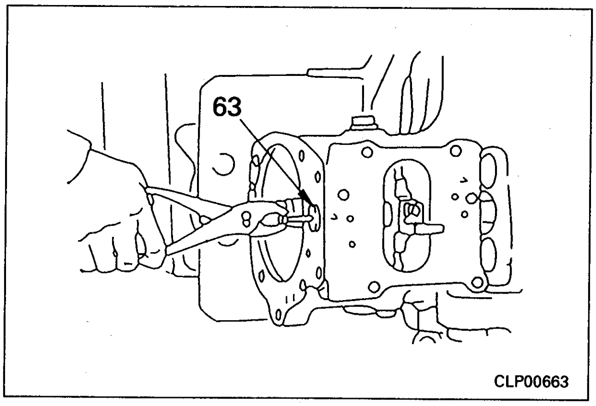
1) Remove mounting screws with tool **S5**, then remove cover (60). (Front pump only)



2) Remove plug (61), then remove spring (62).



3) Using bolt (6mm), remove stopper (63).



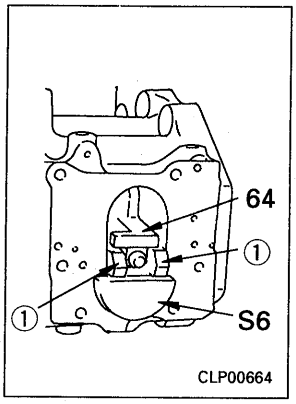
4) Set tool **S6** in position, and assemble spacers ① to both ends of rod (64).

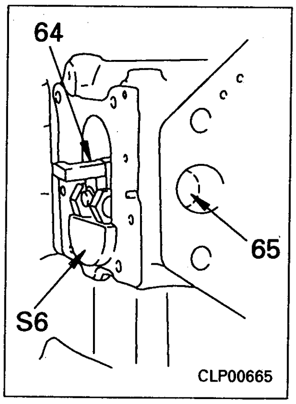
5) Move to side and loosen piston (65) so that width across flats of rocker cam comes off from width across flats of cradle.

★ Be careful not to let the bolt portion of tool **S6** come off the rod.

6) Remove piston (65), then remove rod (64).

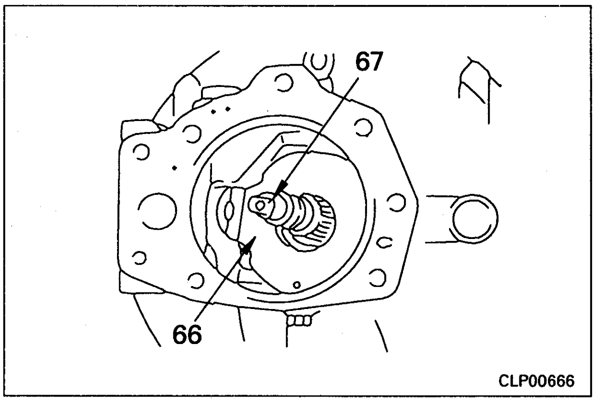
★ Check the assembly direction of rod (64).



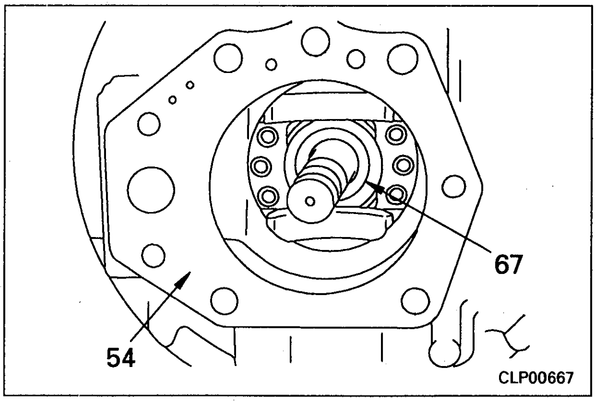


8. Shaft, cradle assembly

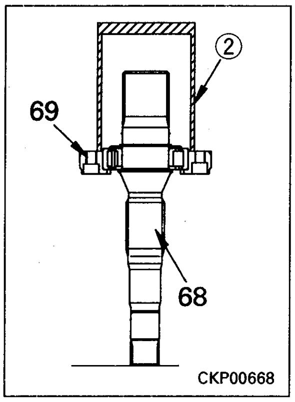
1) Remove rocker cam (66) from shaft and cradle assembly (67).

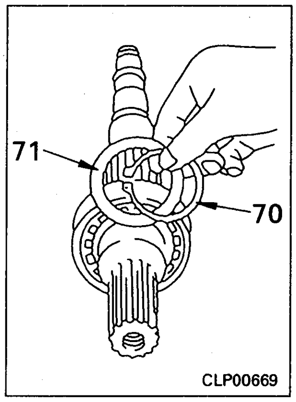


2) Remove 6 bolts, then remove shaft and cradle assembly (67) from front pump case (54).

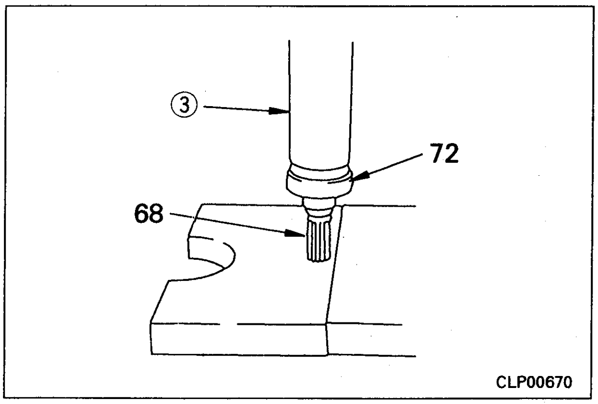


- **Disassembly of shaft, cradle assembly**
  1) Push cradle (69) with push tool ② to remove it from shaft (68). When removing, be careful to keep cradle (69) straight.
  2) Remove snap ring (70), then remove washer (71).



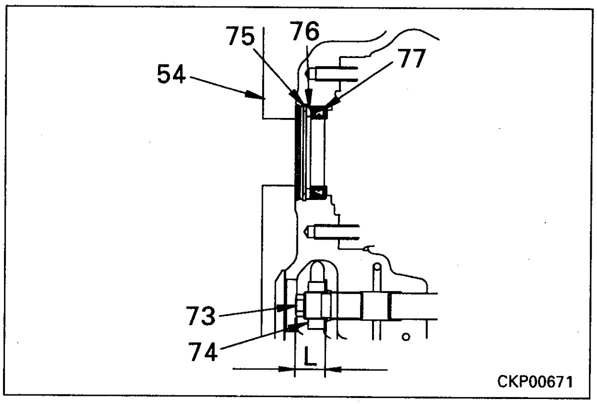


3) Using push tool ③, remove bearing (72) from shaft (68).
   - ★ Bearing (72) divides into the flange ring and the bearing, so be careful not to lose either part.
   - ★ Check the installation direction of the bearing.



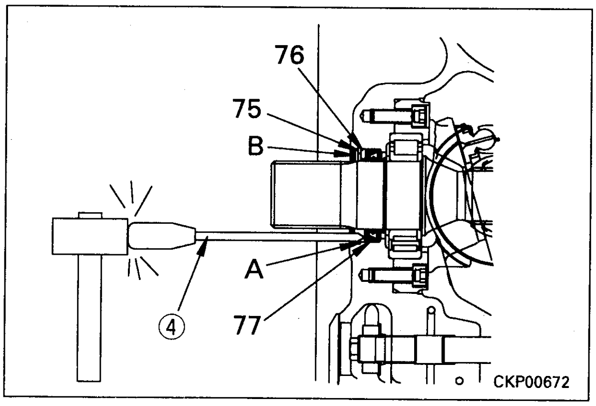
9. Disassembly of pump case

1) Loosen locknut (74) of minimum swash plate angle adjustment screw (73), and remove screw (73).
   ★ Before loosening the locknut, measure dimension **L** between the end face of the case and the end face of the screw.
2) Rotate tool **S3** 90°, remove snap ring (75) from front pump case (54), then remove spacer (76).
3) Remove oil seal (77).



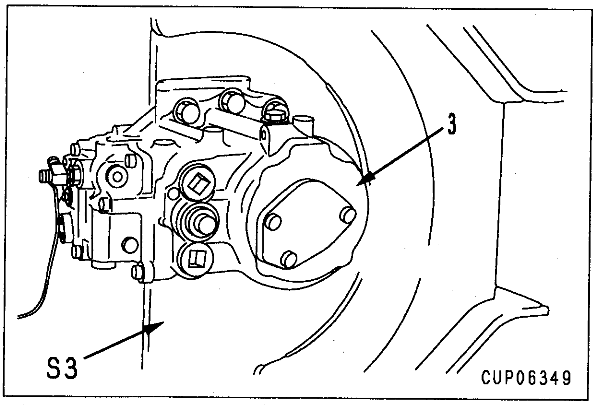
10. If above disassembly operation is not needed, and only oil seal is to be replaced, replace oil seal as follows.

1) Remove snap ring (75) and spacer (76).
2) Using bar ④ (hit end face with hammer), hit through to core of oil seal (77), then twist to remove.
   ★ Hit at a point midway between the inside and outside circumference of the oil seal, and twist at two places on opposite sides (**A** and **B** in diagram) to remove.
   ★ Be careful not to damage the shaft and pump case.



- **Disassembly of rear pump assembly**

11. Rear pump assembly
Set rear pump assembly (3) to tool **S3**.



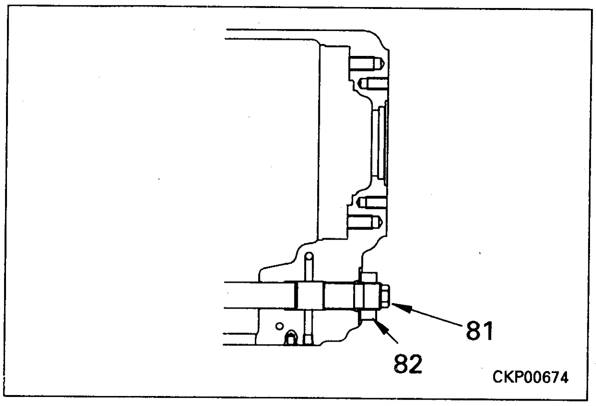
12. Servo valve assembly
Same operation as in Item 4.

13. Cylinder block, piston assembly
Same operation as in Item 6.

14. Servo piston assembly
Same operation as in Item 7.

15. Shaft, cradle assembly
Same operation as in Item 8.

16. Disassembly of pump case
Loosen locknut (82) of minimum swash plate angle adjustment screw (81), then remove screw (81).
★ Before loosening the locknut, measure the dimension between the end face of the locknut and the end face of the screw.



ASSEMBLY OF MAIN PUMP ASSEMBLY

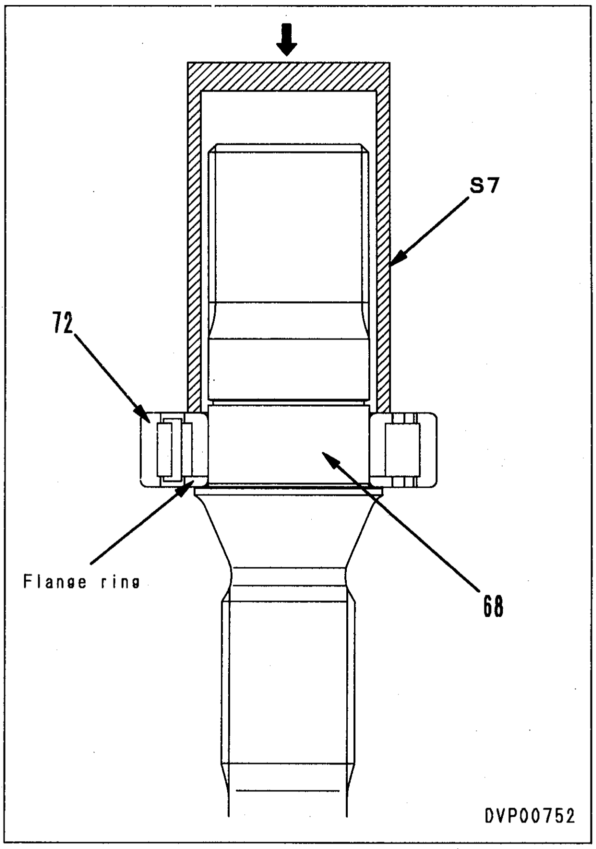
★ Clean all parts, remove all burrs, and check for dirt or damage. Coat the rotating and sliding surfaces of all parts with engine oil (EO10-CD) before installing.

Always check the following parts before assembling.
i) Check contact of cradle and rocker cam (for details, see procedure for checking contact).
ii) Check contact between cylinder block and valve plate (for details, see procedure for checking contact).
iii) Check contact between valve plate and end cap (for details, see procedure for checking contact).

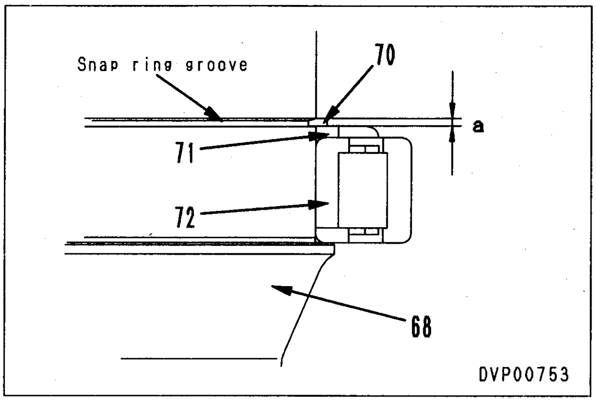
- **Assembly of front pump assembly**

1. Shaft, cradle assembly

- **Assembly of shaft and cradle assembly**
  1) Assemble flange ring to shaft (68), then use tool **S7** to press fit bearing (72).
     Press-fitting surface of bearing: **Grease (G2-LI)**
     ★ When press fitting the bearing, push the end face of the bearing inner race with tool **S7**.
  2) Assemble washer (71), and install snap ring (70).

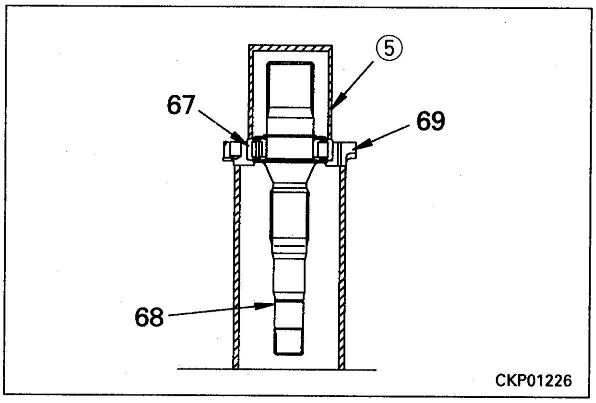


- **Method of selecting lock washer (71)**
  i) After press fitting bearing (72) to shaft (68), assemble washer (71) (removed during disassembly).
  ii) Measure clearance dimension "**a**" between end face of assembled washer (71) and snap ring groove.
     ★ Clearance dimension "**a**": **1.45 – 1.60 mm**
  iii) If clearance "**a**" is not within above standard value, select washer from table below and assemble.

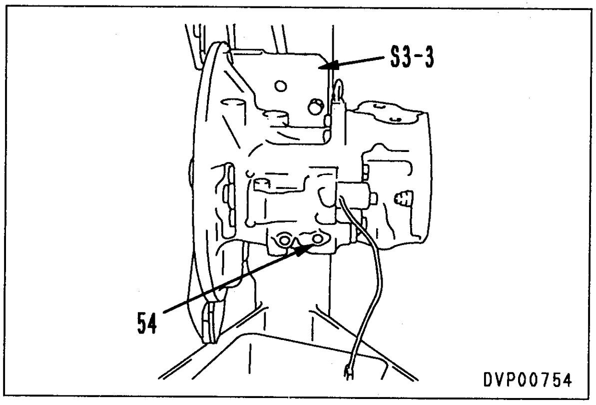


Washer Part No.	708-17-12750	708-17-12760	708-17-12770
Washer thickness (mm)	3.0	3.1	3.2

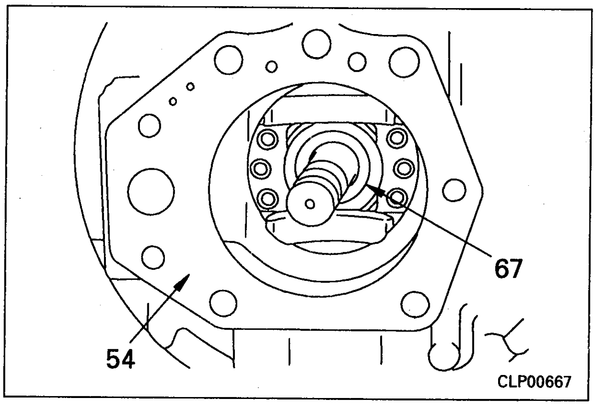
3) Using push tool ⑤, press fit cradle (69) to shaft (68) to make shaft and cradle assembly (67).
   Press-fitting surface of bearing:
   Grease (G2-LI)
   ★ When press fitting the bearing, push the end face of the bearing outer race with push tool ⑤.



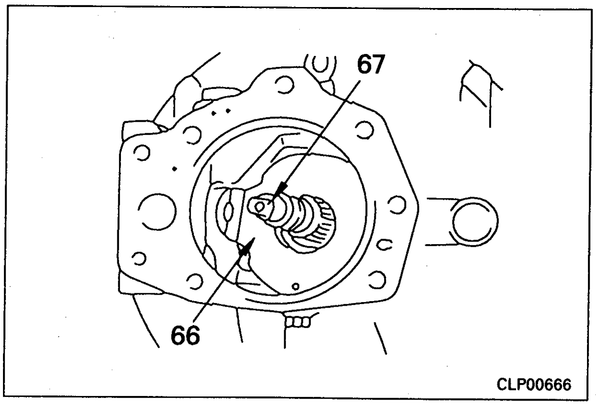
4) Set pump case (54) to tool **S3-3**.

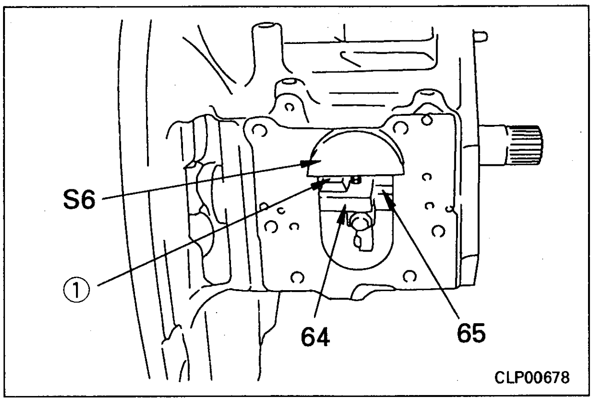


5) Fit dowel pin and O-ring to bottom surface of inside of pump case (54), then install shaft and cradle assembly (67).
   kgm Cradle mounting bolt:
   110.3 ± 12.3 Nm {11.25 ± 1.25 kgm}
   ★ Check that there is no rising and that the pin does not fall out.
   ★ Be extremely careful that the O-ring does not come out or get caught.



2. **Rocker cam**
   Assemble rocker cam (66) to shaft and cradle assembly (67).



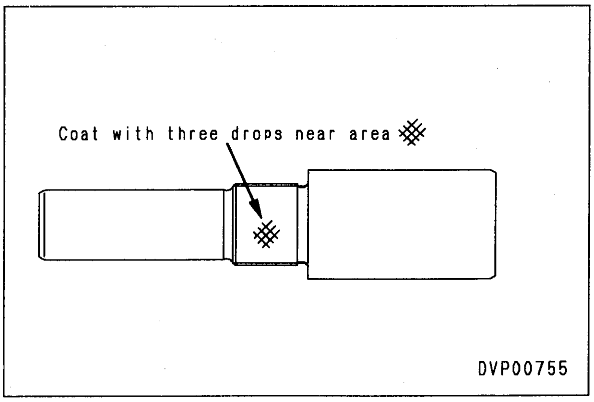


3. Servo piston assembly

1) Assemble spherical portion of rod (64) to rocker cam.
   - ★ When assembling the rod, assemble with the spring seat surface facing in the direction of assembly.
2) Fit piston (65), set tool **S6** on opposite side from when loosening, set spacer ① on front end of rod (64), and tighten piston (65).
   - ★ Before tightening piston (65), move to the side so that the width across flats of the rocker cam comes out from the width across flats of the cradle.
     (This is to prevent damage to the rocker cam and cradle when tightening the piston.)

     Near ❈ area of piston thread in diagram on right:
     Coat with three drops of adhesive (Loctite 648)

     kgm Piston:
     475.6 ± 34.3 Nm {48.5 ± 3.5 kgm}



4. Positioning minimum swash plate angle

1) Remove 2 dowel pins from servo valve assembly mounting surface.
2) Set tool **S8** in position.
3) Assemble O-ring and tighten screw (73) until it contacts piston (65).

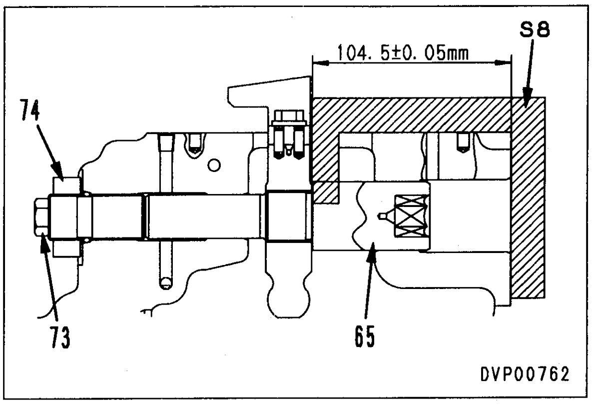
   kgm Screw:
   12.3 ± 2.5 Nm {1.25 ± 0.25 kgm}
4) Tighten locknut (74) to hold screw (73) in position.

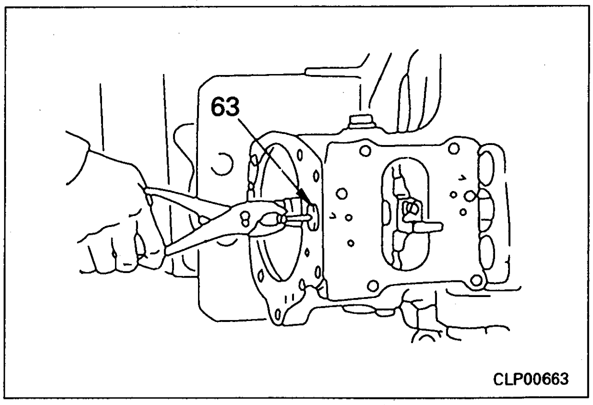
   kgm Locknut:
   254.9 ± 29.4 Nm {26 ± 3 kgm}

★ After completion of assembly, carry out a bench test to check the minimum flow.

★ Assemble the spring after measuring the rotating torque of the pump assembly.

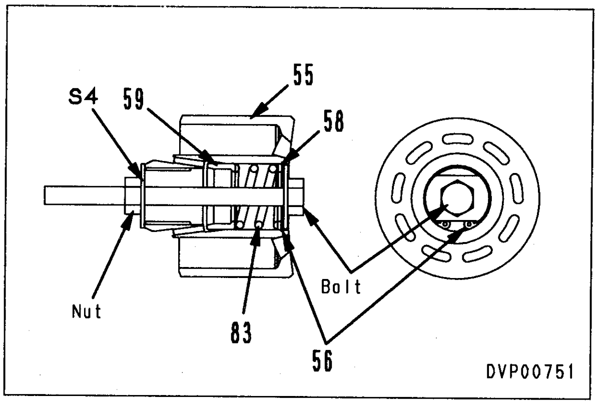
5) Assemble backup ring and O-ring to stopper (63), and install to case.





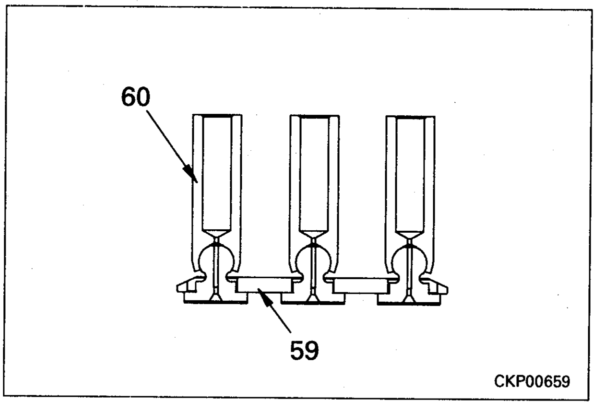
5. **Cylinder block, piston assembly**
   - **Assembly of cylinder block**

1) Assemble seat (59), spring (57), and seat (58) to cylinder block (55).
   ★ Assemble with the tapered portion on the inside of seat (59) facing down.
2) Set tool **S4** to cylinder block (55).
3) Hold bolt of tool **S4** with wrench, tighten nut to compress spring (83), then install snap ring (56).
   ★ Check that the snap ring is fitted securely in the groove.
4) Remove tool **S4**.



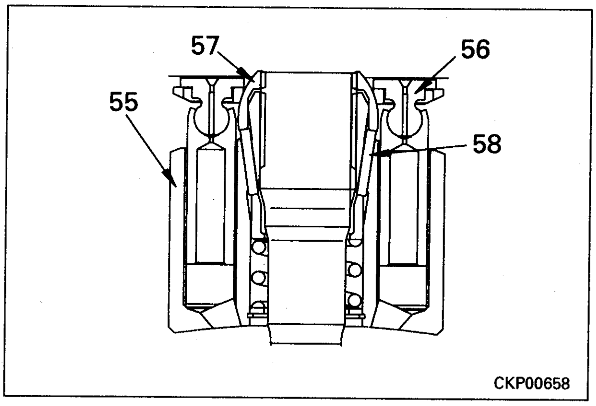
- **Assembly of piston assembly**

5) Assemble piston (60) to retainer shoe (59).



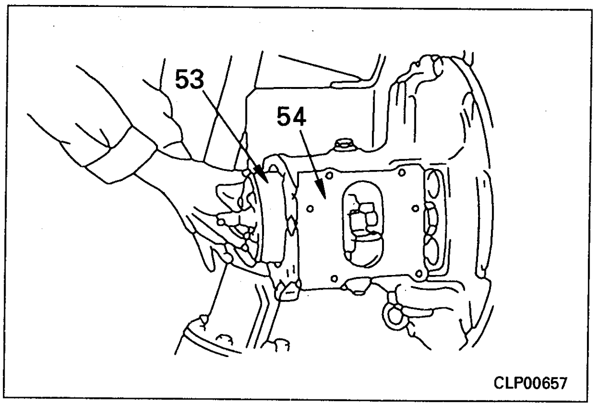
- **Assembly of cylinder block and piston assembly**

6) Assemble 3 preload pins (58) to cylinder block (55).
   ★ To prevent the preload pins from coming out, coat the pins with grease (G2-LI).
7) Assemble retainer guide (57) to cylinder block (55), then install piston assembly (56) to make cylinder block and piston assembly (53).
   ★ Align the spline for the cylinder block and retainer guide.



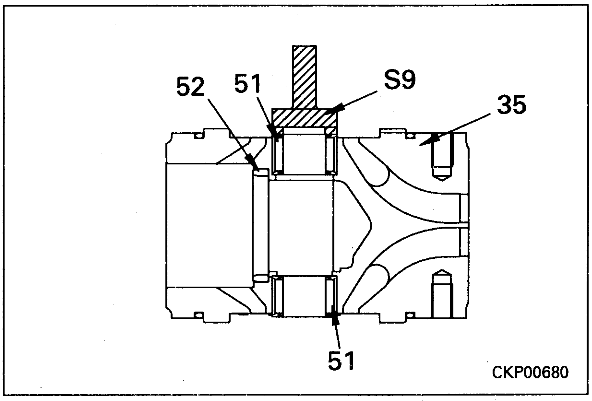
- **Installation of cylinder block and piston assembly**

8) Install cylinder block and piston assembly (53) to pump case (54).
   ★ Before assembling the cylinder block and piston assembly, assemble the width across flats of the rocker cam to the cradle securely.



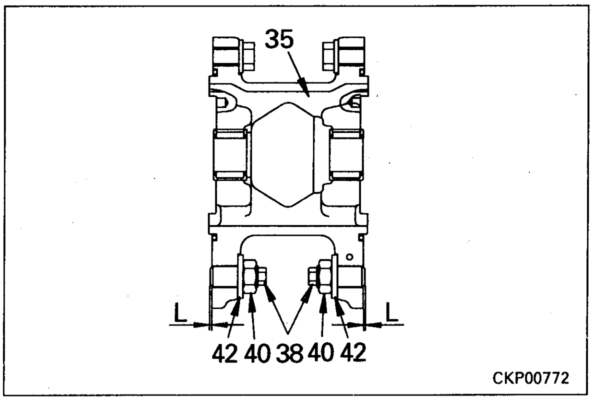
6. Assembly of end cap

1) Install bushing (52) to end cap.
2) Using tool **S9**, press fit bearing (51) until it comes into contact with end cap (35).
   Press-fitting surface of bearing:
   Grease (G2-LI)
3) Install 2 dowel pins for pump case and 2 dowel pins for valve plate to end cap.



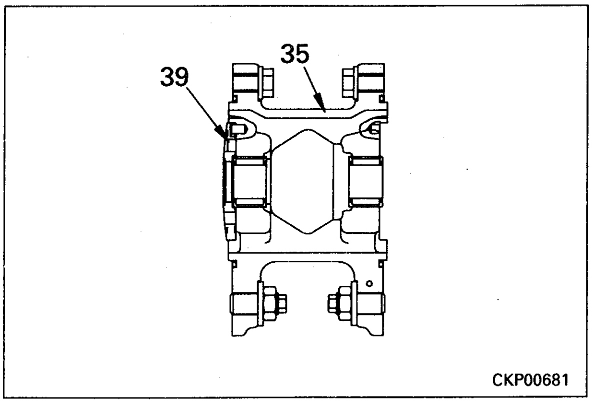
7. Positioning maximum swash plate angle

1) Install screw (38), locknut (40), and washer (42) to end cap.
   ★ Adjust so that the protrusion of screw (38) from the mating surface of the case with end cap (35) is dimension **L**.
   ★ Dimension **L**: 1.9 mm
2) Tighten locknut (40) to hold in position.
   kgm Locknut:
   254.9 ± 29.4 Nm {26 ± 3 kgm}

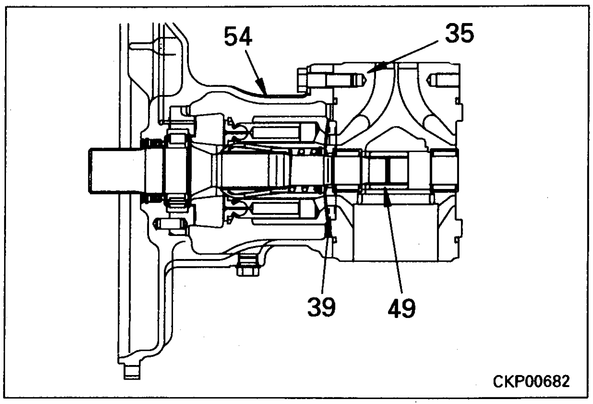


8. End cap assembly

1) Assemble valve plate (39) to end cap (35).
   ★ Align the dowel pin and pin hole to install.
   ★ Check that there is no interference with the bearing and dowel pin.
   ★ Check that the end cap and valve plate port holes are aligned.
   ★ Do not hit the valve plate or apply any impact when assembling.
   (There is danger that this will damage the sliding surface or cause distortion.)

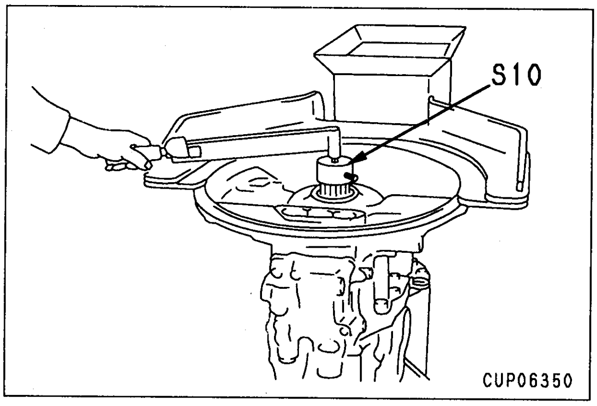


2) Sling end cap assembly (35) and install to front pump case (54).
   ★ Install coupling (49) to the front pump drive shaft from the impeller mounting hole.
   ★ Check that there is no rising and that the pin does not fall out.
   ★ Be extremely careful that the O-ring does not come out or get caught.
   Mating surface of pump case:
   Gasket sealant (LG-7 or LG-5)
   kgm Mounting bolt:
   384.9 ± 41.7 Nm {39.25 ± 4.25 kgm}



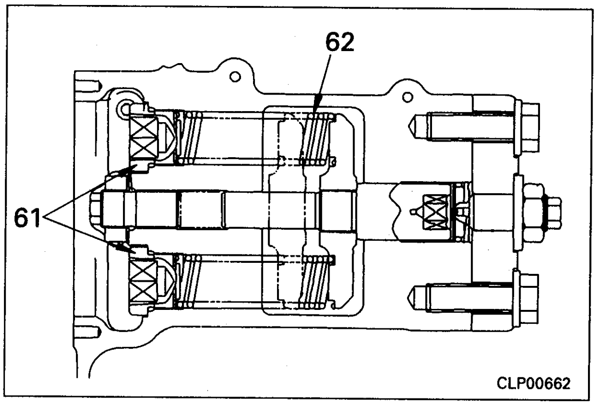
9. Measuring rotating torque of pump assembly

1) Set tool **S10** to pump shaft.
2) Set torque wrench to tool **S10**, rotate shaft at low speed (3 – 5 sec/1 turn) and measure rotating torque.
   - ★ When checking the rotating torque, check that the shaft rotates smoothly without any variation.
     - Variation range: Max. 2.9 Nm {0.3 kgm}
     - Rotating torque: Max. 24.5 Nm {2.5 kgm}
   - ★ If there is any abnormality in the rotating torque, disassemble again and check.

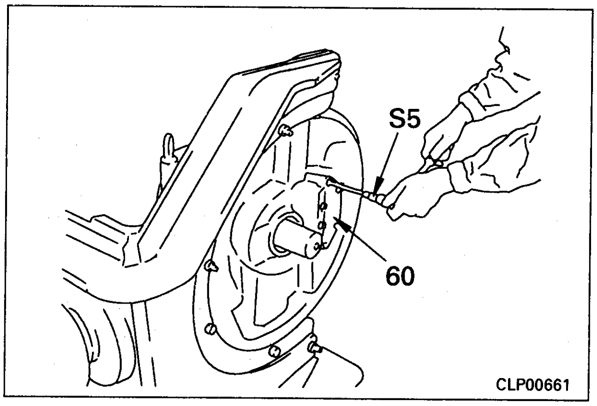


10. Servo piston spring

1) Assemble spring (62).
2) Fit O-ring and install plug (61).
   kgm Plug:
   151.9 ± 24.5 Nm {15.5 ± 2.5 kgm}



3) Using tool **S5**, tighten mounting screws for cover (60).
   kgm Mounting screw:
   30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}



11. Servo valve assembly

1) Assembly of servo valve assembly

- **LS valve**
  - i) Assemble spool (31), piston (30), and sleeve (29) to body, then fit O-ring and install plug (28).

    kgm Plug (28):

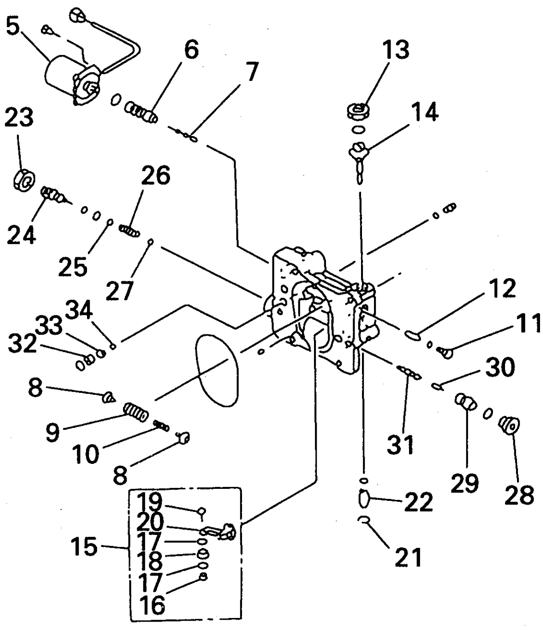
    110.3 ± 12.3 Nm {11.25 ± 1.25 kgm}

    ★ Check that the relative movements of the body and spool (31), and sleeve (29) and piston (30) are smooth.
  - ii) Assemble seat (27), spring (26), and seat (25), then fit backup ring and O-ring and install plug (24).
  - iii) Tighten locknut (23).

    kgm Locknut (23):

    68.6 ± 9.8 Nm {7 ± 1 kgm}

    ★ Install so that the dimension between the end face of locknut (23) and the end face of plug (24) is the dimension measured during disassembly.
  - iv) After completion of assembly, carry out a bench test of the performance and make final adjustment of plug (24).



CLP00600

- **TVC valve**
  - i) Fit O-ring and assemble plug (22), then install snap ring (21).
  - ii) Install pin (19), washer (17), bearing (18), and nut (16) to lever (20) to make lever assembly (15).

    kgm Nut (16):

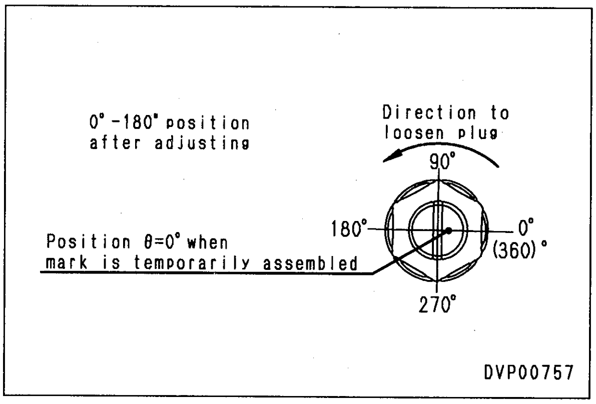
    10.8 ± 0.98 Nm {1.1 ± 0.1 kgm}

    Nut (16):

    Thread tightener (Loctite 648)

    ★ Check that the movement of lever (20) and bearing (18) is smooth.

iii) Fit O-ring to plug (14), then install to lever assembly (15) and body.
  ★ Tighten to a point where the tip of plug (14) is in contact with plug (22), then turn back at least 180° in the direction of loosening and move the mark to the position $\theta = 0°$ in the diagram on the right.
  ★ If the position of the mark is between the θ180° and 360° positions in the diagram on the right at the point where the tip of plug (14) contacts plug (22), turn back at least 1 turn to the temporary assembly position ($\theta = 0°$).



iv) Tighten locknut (13).
  kgm Locknut (13):
  29.4 ± 4.9 Nm {3 ± 0.5 kgm}
  ★ Check that the movement of lever (20) and plug (22) and plug (14) is smooth.

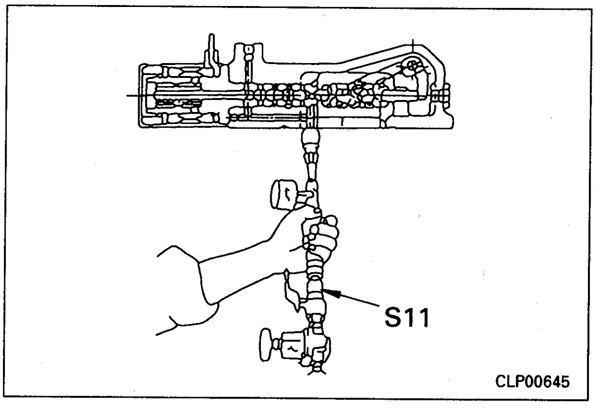
v) Assemble piston (12), then fit O-ring and install plug (11).
  kgm Plug (11):
  11.3 ± 1.5 Nm {1.15 ± 0.15 kgm}

vi) Assemble spool (7) to sleeve (6), then install to body together with seat (8), and springs (9) and (10).
  ★ Check that the relative movement of sleeve (7) and spool (6) is smooth.

vii) Install O-ring, then install solenoid assembly (5).
  kgm Solenoid assembly mounting bolt:
  13.2 ± 1.5 Nm {1.35 ± 0.15 kgm}
  Mating surface of solenoid assembly :
  Gasket sealant (LG-7 or LG-5 (Loctite 572/575))

viii) Using tool **S11**, check that there is no leakage of oil or air from mating surface of solenoid assembly.
  ★ Air pressure: 0.5 MPa {5 kg/cm^2}

ix) After completion of assembly, carry out a bench test to check performance, and make final adjustment of plug (14).



- Assemble orifice (34), and install spacer (33), filter (32), and O-ring.

  kgm Orifice (34):

  9.8 ± 1.9 Nm {1.0 ± 0.2 kgm}

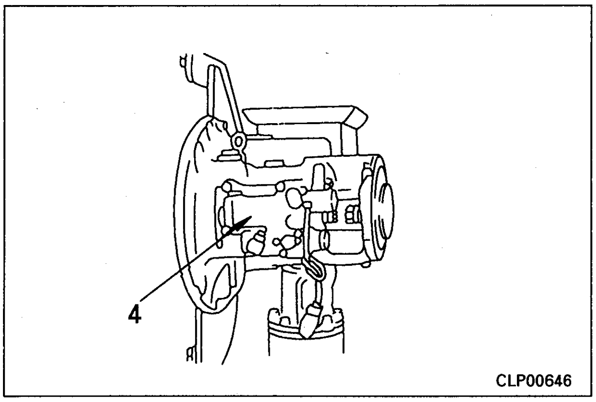
2) After completion of assembly, carry out bench test of servo valve assembly (4) as an individual part to check performance, and carry out adjustment.
3) Install 2 knock pins to pump end.
4) Fit O-ring and filter to servo valve assembly (4) and install to pump case.
   ★ Install the filter so that the mesh end is at the front face end of the valve body.
   ★ Be extremely careful that the O-ring and filter do not fall out.
   ★ Tighten the mounting bolts gradually in turn on opposite sides.

   kgm Mounting bolt:

   66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}

   Mating surface of servo valve:

   Gasket sealant (LG-7 or LG-5)



- **Assembly of rear pump assembly**

12. Shaft, cradle assembly

Same operation as in Item 1. (Set pump case to tool **S3-4.**)

13. Rocker cam

Same operation as in Item 2.

14. Servo piston assembly

Same operation as in Item 3.

15. Positioning minimum swash plate angle

Same operation as in Item 4.

16. Cylinder block, piston assembly

Same operation as in Item 5.

17. Positioning maximum swash plate angle

Same operation as in Item 7.

18. Servo piston spring

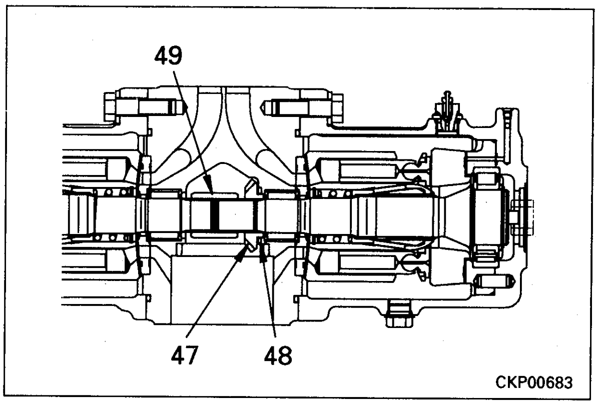
Same operation as in Item 10.

19. Servo valve assembly

Same operation as in Item 11.

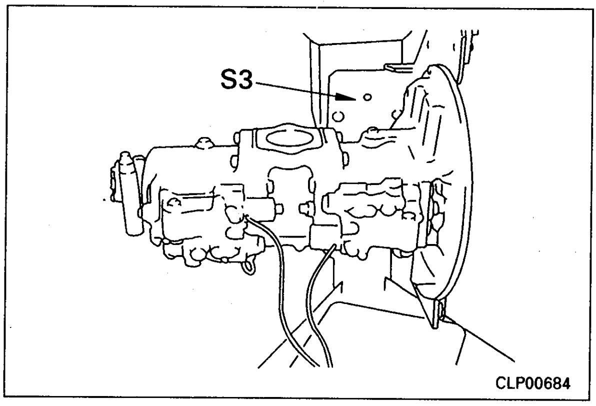
20. Rear pump assembly

1) Assemble dowel pin, valve plate, and O-ring to end cap.
2) Sling rear pump assembly.
   ★ When slinging, be careful not to drop the cylinder block, piston assembly, or other parts.

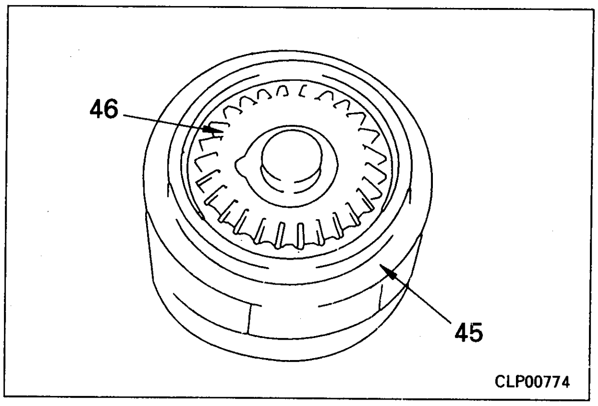


3) Hold thrust bearing (48) and bevel gear (47) inside end cap, align with spline of rear pump drive shaft, and assemble.
4) Align rear pump drive shaft with spline of coupling (49) and assemble.
5) Tighten mounting bolts of rear pump assembly.
   kgm Mounting bolt:
   384.9 ± 41.7 Nm {39.25 ± 4.25 kgm}
   Mating surface of pump case:
   Gasket sealant (LG-7 or LG-5)

21. Impeller assembly

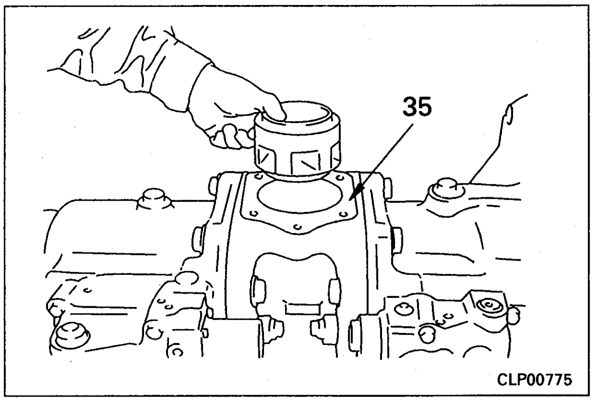


1) Turn over tool **S3** 180° and set with impeller mounting port facing up.



2) Fit bevel gear (46) to impeller (45) to make impeller assembly.
   Mounting bolt :
   Thread tightener (Loctite 648)
   kgm Mounting bolt:
   110.3 ± 12.3 Nm {11.25 ± 1.25 kgm}

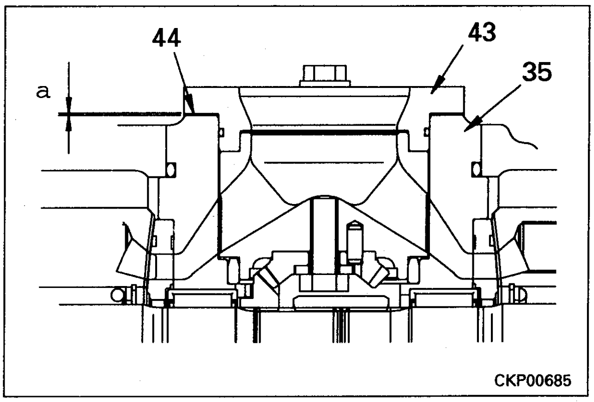
3) Assemble impeller assembly inside end cap (35).



4) Positioning impeller assembly
   i) Install cover (43) to end cap.
      ★ Do not install the O-ring.
   ii) Measure clearance **a** between end cap (35) and cover (43).
      ★ Measure at 3 places around the circumference of the cover and take the average.
   iii) Select shim (44) from table below to make thickness of (**a**+0.1) to (**a**+0.2), then install.

Part No.	708-2H-21710	708-2H-21720	708-2H-21730
Shim thickness (mm)	0.1	0.2	0.5

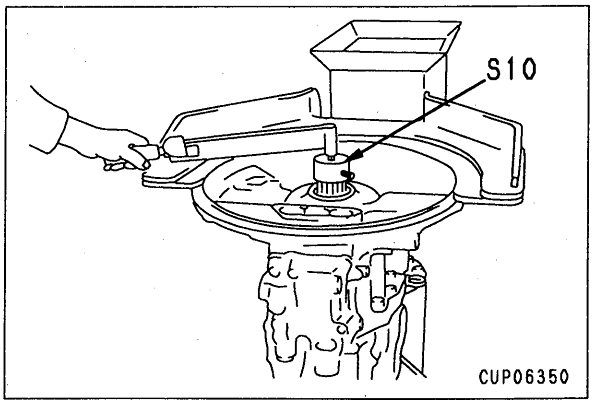
   iv) Fit O-ring to cover (43), then assemble selected shim (44) and install.
      kgm Mounting bolt:
      110.3 ± 12.3 Nm {11.25 ± 1.25 kgm}



22. Measuring rotating torque of pump assembly

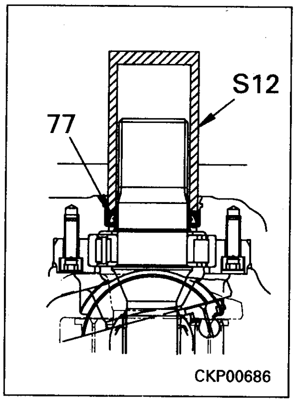
1) Set tool **S10** to pump shaft.
2) Set torque wrench to tool **S10**, rotate shaft at low speed (3 – 5 sec/1 turn) and measure rotating torque.
   ★ When checking the rotating torque, check that the shaft rotates smoothly without any variation.
   - Variation range:
     Max. 2.9 Nm {0.3 kgm}
   - Rotating torque:
     Max. 4.9 Nm {5.0 kgm}

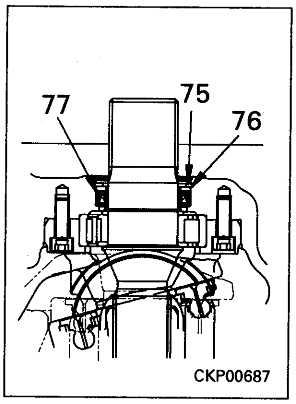
   ★ If there is any abnormality in the rotating torque, disassemble and adjust again.



23. Oil seal

1) Check that there are no burrs or flashes at corners of shaft.
2) Using tool **S12**, press fit oil seal (77).
3) Assemble spacer (76) and install snap ring (75).





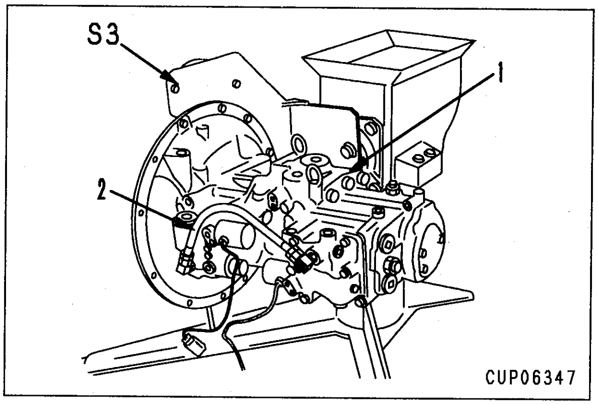
24. Hose

Install elbow, tee, and hose (2).

kgm Hose: **24.5 ± 4.9 Nm {2.5 ± 0.5 kgm}**

25. Pump assembly

Remove pump assembly (1) from tool **S3**.



CHECKING CONTACT BETWEEN CYLINDER BLOCK AND VALVE PLATE, ROCKER CAM AND CRADLE, VALVE PLATE AND END CAP

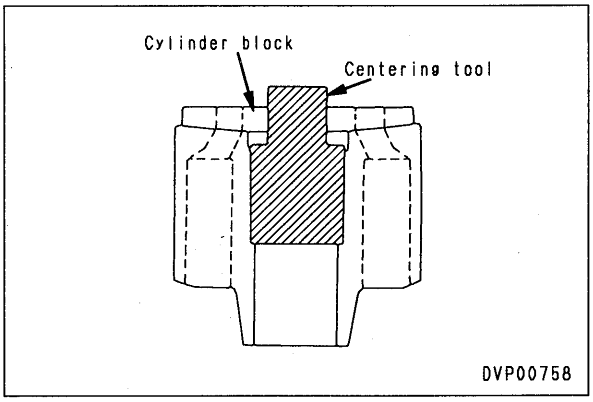
1. Checking contact between cylinder block and valve plate

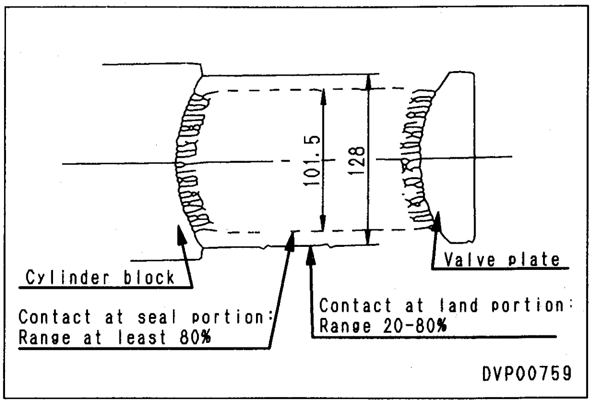
★ This check is unnecessary if both the cylinder block and valve plate are replacement parts (new parts).

★ This check applies if one of the parts is a replacement part or a restored part.

1) Make a centering tool for the cylinder block and valve plate.
   ★ The tool can be made from plastic, bakelite or any other soft material.
2) Remove all oil and grease from the parts to be checked.
   ★ Do not wipe with a cloth.
3) Set the tool in position, then paint the cylinder block with inspection paint.
   ★ Coat thinly with paint.
4) Push the valve plate with a force of 39 – 49 N (4 – 5 kg) against the cylinder block, turn the valve plate 90°, then turn it back to the original position. Repeat this process 2 or 3 times.
5) Remove the valve plate, transfer the contact surface to a tape, and check the contact surface.
   ★ The contact of the spherical surface of the valve plate and cylinder block must fulfill the conditions below and cover the whole circumference without any break.
   i) The contact at the seal portion (range from bottom to ø101.5 mm) must be at least 80%.
   ii) The contact at the land portion (range from ø101.5 mm to ø128 mm) must be 20 – 80%.

	Seal portion	Land portion
Valve plate	Min. 80%	20 – 80%
Cylinder block	Min. 80%	20 – 80%





2. Checking contact between rocker cam and cradle

★ This check is unnecessary if both the rocker cam and cradle are replacement parts (new parts).

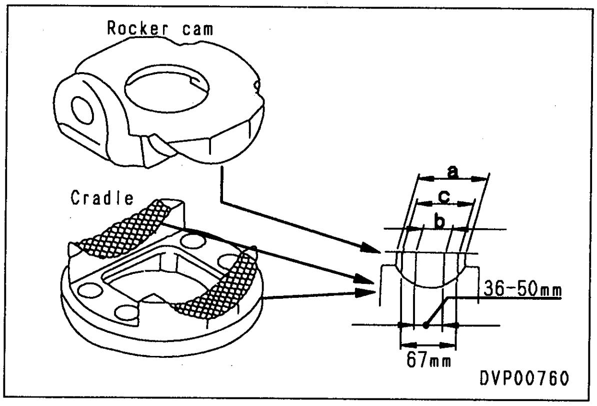
★ This check applies if one of the parts is a replacement part or a restored part.

1) Remove all oil and grease from the parts to be checked.
   ★ Do not wipe with a cloth.
2) Paint the cradle with inspection paint.
   ★ Coat thinly with paint.
3) Put the rocker cam on top, push with a force of 39 – 49 N {4 – 5 kg}, and move it between the maximum swash plate angle and the position where it contacts the stopper. Repeat this process 2 or 3 times.
4) Remove the rocker cam, transfer the contact surface to a tape, and check the contact surface.
   ★ The standard for the contact surface is as given below.

i) Contact within central portion (36 – 50 mm) must be at least 90%.
ii) Contact in range between central portion (36 – 50 mm) and 67 mm must be 50 – 90%.
iii) Contact of area outside 67 mm width must be less than 50%.
(It is not permitted to have contact only at the outside and no contact at the center.)

[Reference]
If the contact is not within the standard value, and lapping is carried out, it must always be carried out for both parts together.

★ Parts with any scratches or damage must not be used.



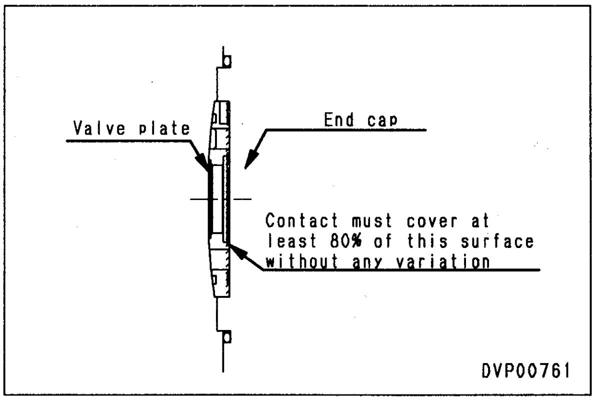
3. Checking contact between valve plate and end cap

★ This check is unnecessary if both the valve plate and end cap are replacement parts (new parts).

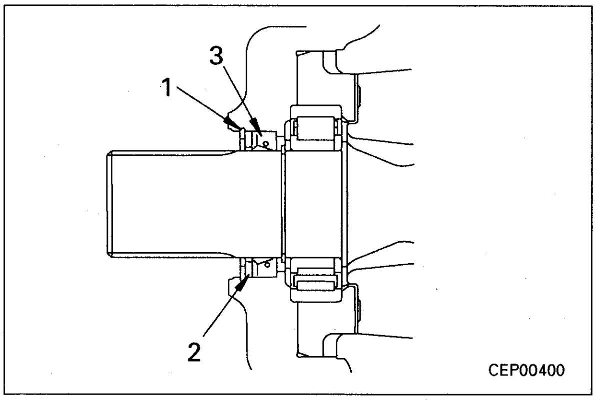
★ This check applies if one of the parts is a replacement part or a restored part.

★ If the contact is defective, use a surface plate and correct by lapping.

1) Remove all oil and grease from the parts to be checked.
   ★ Do not wipe with a cloth.
2) Paint the end cap with inspection paint.
   ★ Coat thinly with paint.
3) Push the valve plate with a force of 39 – 49 N {4 – 5 kg} against the end cap, turn the valve plate 90°, then turn it back to the original position. Repeat this process 2 or 3 times.
4) Remove the valve plate, transfer the contact surface to a tape, and check the contact surface.
   ★ The contact of the plane surface between the valve plate and end cap must cover at least 80% without any variation.
   ★ For details of the operation, see the Parts Judgement Guide.

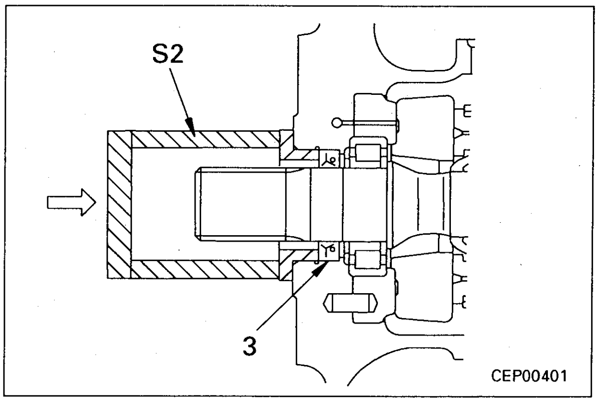


REMOVAL OF MAIN PUMP INPUT SHAFT OIL SEAL



1. Remove main pump assembly.
   For details, see REMOVAL OF MAIN PUMP ASSEMBLY.
2. Remove snap ring (1), then remove spacer (2).
3. Lever up oil seal (3) with a screwdriver to remove. ※ 1
   ★ When removing the oil seal, be extremely careful not to damage the shaft.

INSTALLATION OF MAIN PUMP INPUT SHAFT OIL SEAL



- Carry out installation in the reverse order to removal.

※ 1

Lip of oil seal: **Grease (G2-LI)**

Coat the outside circumference of the oil seal with **grease (G2-LI)** thinly, then press fit.

★ Using tool **S2**, press fit oil seal (3).

REMOVAL OF CONTROL VALVE ASSEMBLY

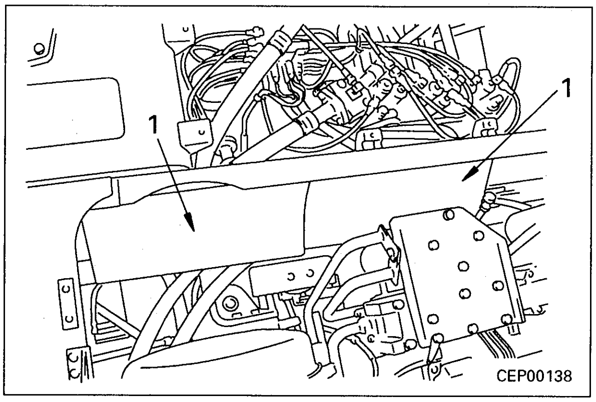
⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

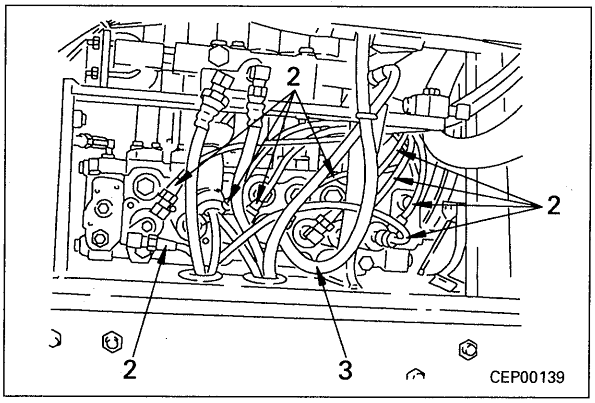
⚠ Release the remaining pressure in the hydraulic circuit.
For details, see TESTING AND ADJUSTING, Releasing pressure in hydraulic circuit.

★ Make match marks before disconnecting the PPC circuit hoses.

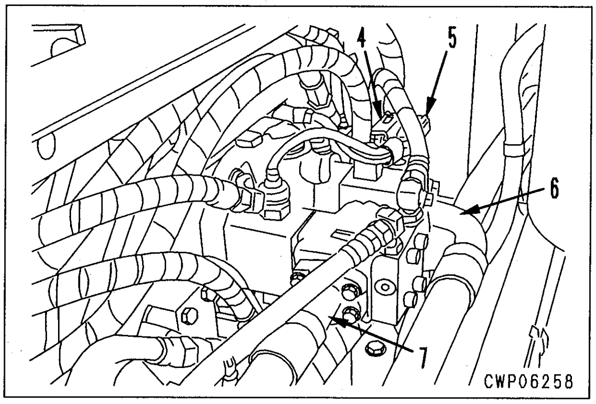
★ Fit blind plugs in the disconnected hoses and tubes.

1. Open engine hood.
2. Remove control valve top cover.
3. Remove partitions (1) (2 pieces).
4. Disconnect 9 bottom PPC hoses (2).
5. Disconnect pump merge/divider solenoid hose (3).

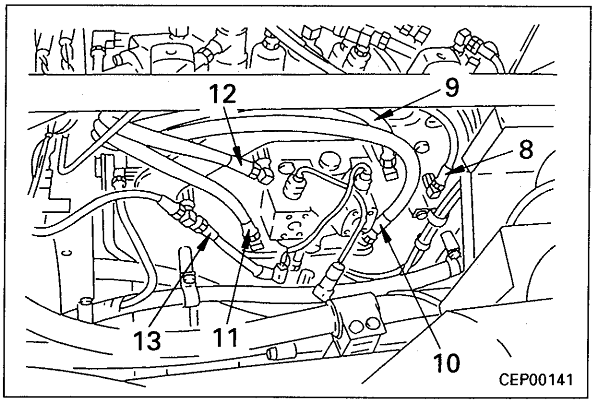




6. Disconnect pressure sensor connectors (4) and (5) (CN-C08 and CN-C07).
7. Disconnect main pump outlet hoses (6) and (7).

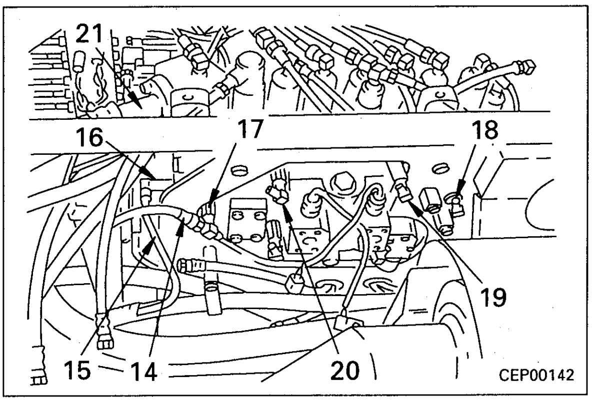


8. Disconnect hoses (8), (9), (10), (11), (12), and (13).
   ★ Hose (8): For arm Hi PPC
   Hoses (9) and (10): For R.H. straight travel
   Hoses (11) and (12): For L.H. straight travel
   Hose (13): For drain circuit

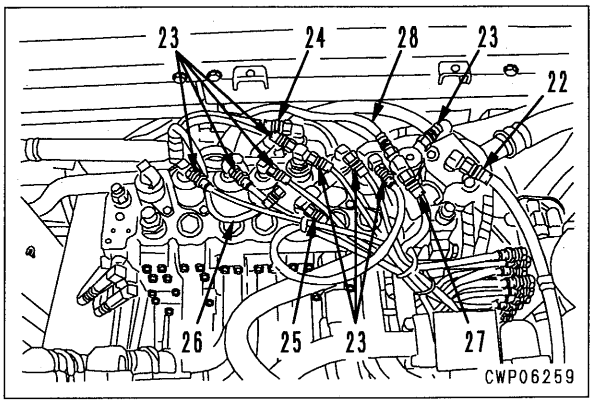


9. Disconnect hoses (14) and (15).
   - ★ Hose (14): For drain circuit
     Hose (15): For high-pressure circuit

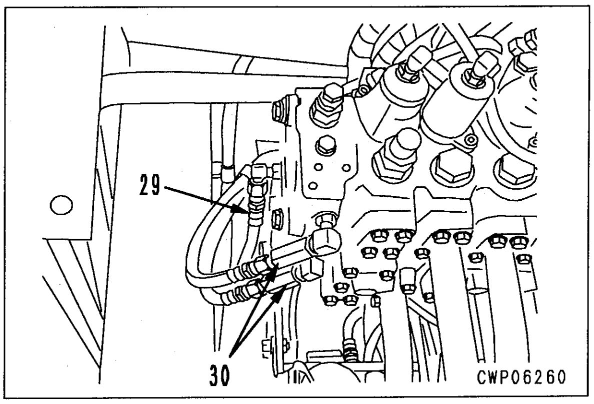
10. Remove elbows (16), (17), and (18).
11. Set hose mounts of elbows (19) and (20) facing down.
12. Disconnect control valve return hose (21).



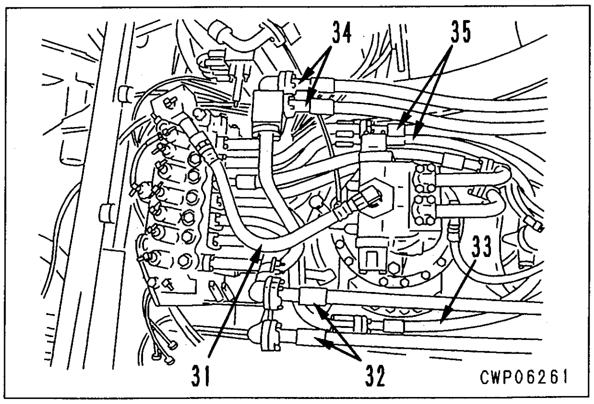
13. Disconnect drain hose (22).
14. Disconnect 10 top PPC hoses (23).
15. Disconnect safety valve hose (24).
16. Disconnect swing solenoid hose (25).
17. Disconnect shuttle valve hoses (26) and (27).
18. Disconnect control valve body hose (28).



19. Disconnect high pressure circuit hose (29) and LS pressure hose (30).



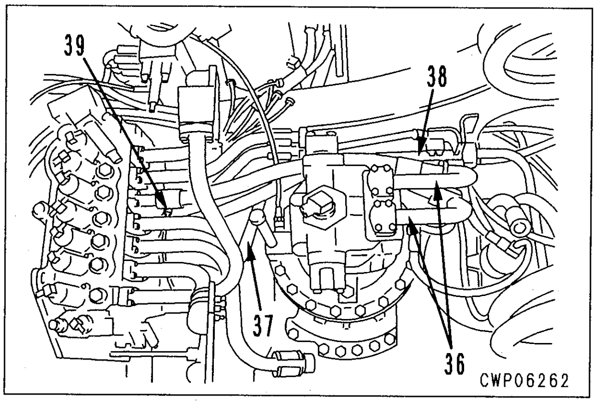
20. Disconnect swing motor suction hose (31).
21. Disconnect bucket hoses (32).
22. Disconnect 2 R.H. travel hoses (33).
23. Disconnect arm hoses (34).
24. Disconnect L.H. travel hoses (35).



25. Remove swing motor hoses (36).

26. Remove boom tubes (37) and (38).

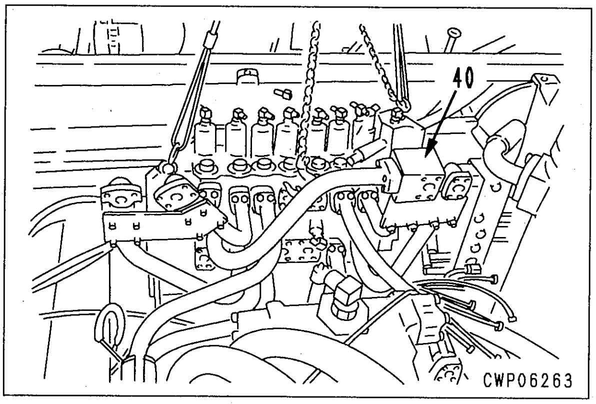
27. Disconnect LS select valve hose (39).



28. Sling control valve assembly (40), then remove mounting bolts, and lift off control valve assembly.

★ Move slightly to the front and pass through the bracket to lift off.

kg Control valve assembly: **260 kg**



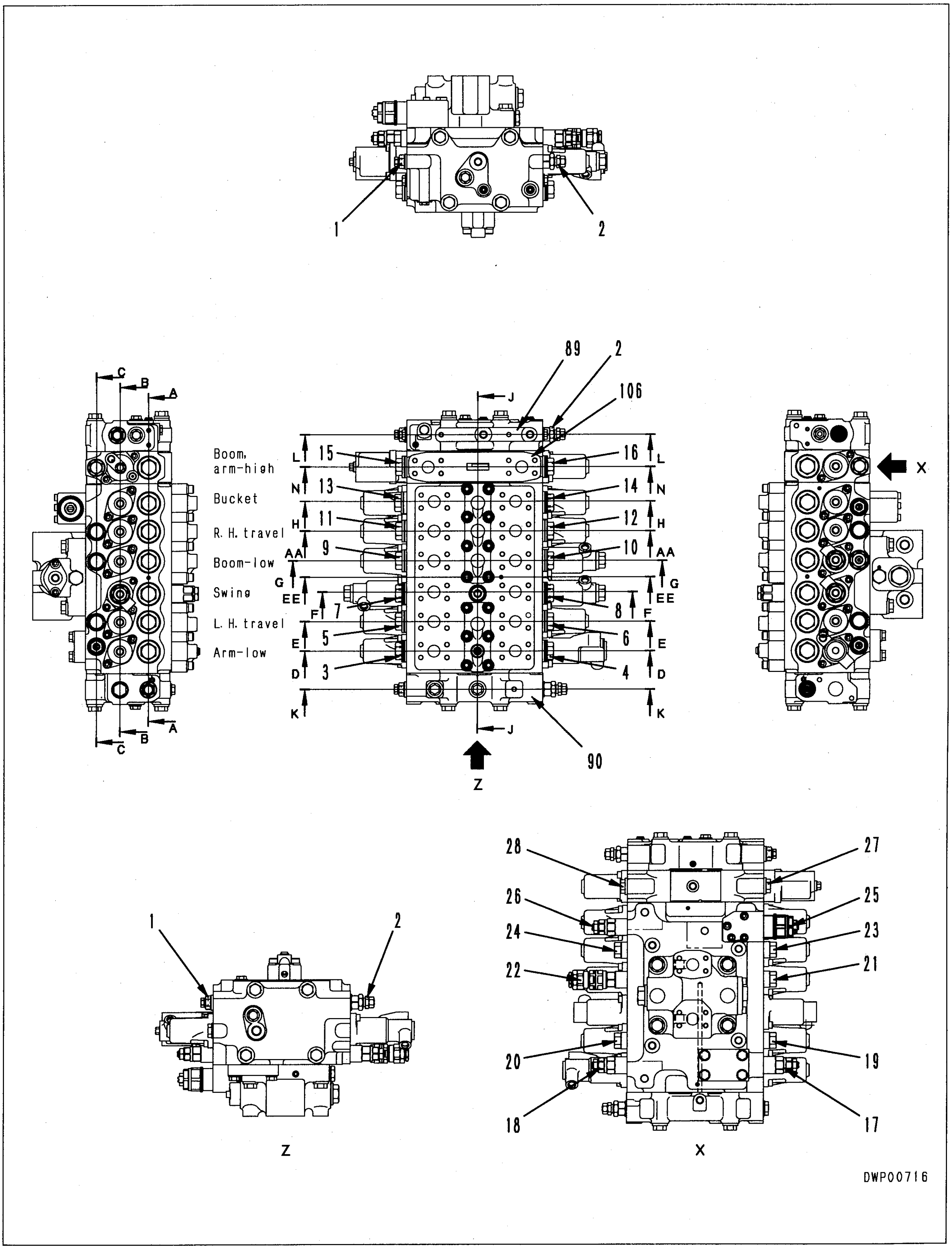
INSTALLATION OF CONTROL VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

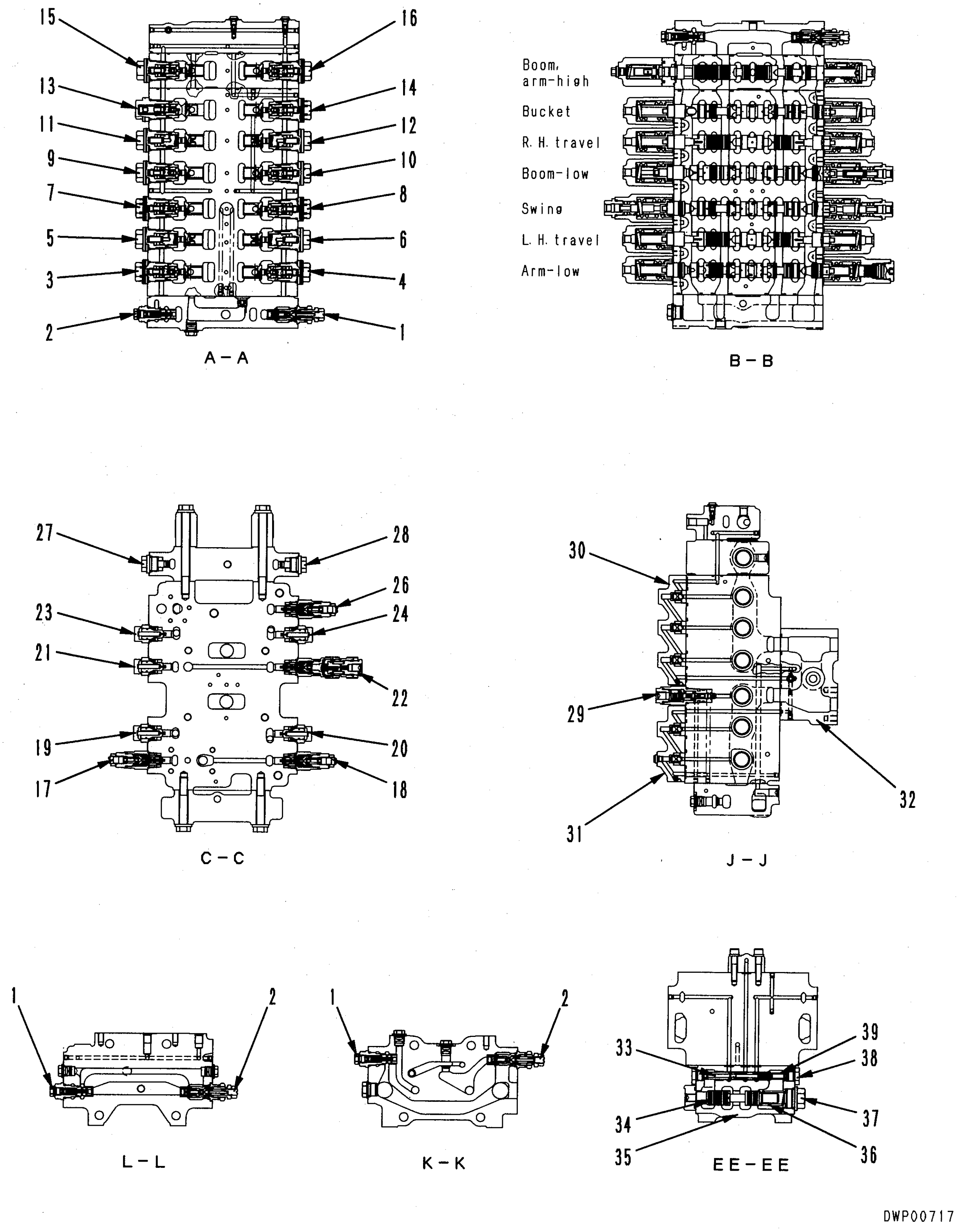
- **Refilling with oil (hydraulic tank)**
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

DISASSEMBLY OF CONTROL VALVE ASSEMBLY

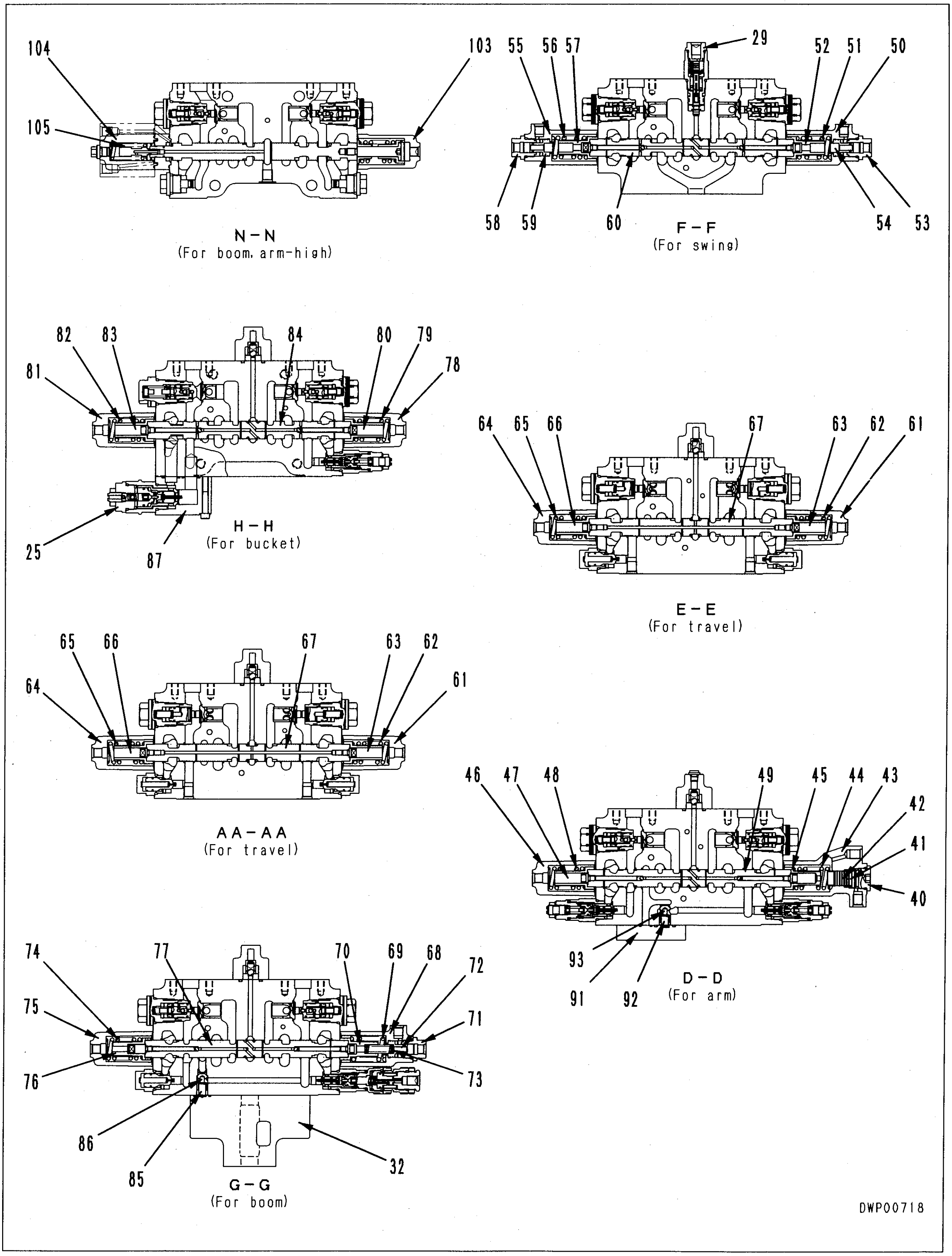
(1/3)



(2/3)


15
16
13
14
11
12
9
10
7
8
5
6
3
4
2
1
A – A
Boom, arm-high
Bucket
R. H. travel
Boom-low
Swing
L. H. travel
Arm-low
B – B
27
28
26
23
24
21
22
19
20
17
18
C – C
30
29
31
32
J – J
1
2
L – L
1
2
K – K
33
39
38
34
37
35
36
EE – EE
DWP00717

(3/3)


104
105
103
N – N
(For boom, arm-high)
29
55
56
57
52
51
50
58
59
60
54
53
F – F
(For swing)
82
83
84
80
79
81
78
25
87
H – H
(For bucket)
64
65
66
67
63
62
61
E – E
(For travel)
65
66
67
63
62
64
61
AA – AA
(For travel)
46
47
48
49
45
44
43
42
41
40
93
91
92
D – D
(For arm)
74
77
70
69
68
72
75
71
76
73
86
85
32
G – G
(For boom)
DWP00718

★ The set pressure of the safety valve cannot be adjusted when it is installed on the machine, so do not disassemble.

- The following procedure is for the 7-spool valve.

1. **Main relief valve**
   1) Remove main relief valve (2).

2. **Unload valve, safety-suction valve, suction valve, plug**
   1) Remove unload valve (1).
   2) Remove safety-suction valves (17), (18), (22), and (26).
   3) Remove suction valves (19), (20), (23), and (24).
   4) Remove plugs (27) and (28).

3. **Pressure compensation valves**
   ★ Before removing any pressure compensation valve, check and mark its mounting position.
   1) Remove arm Hi IN pressure compensation valve (15), bucket DUMP pressure compensation valve (13), R.H. travel REVERSE pressure compensation valve (11), boom RAISE pressure compensation valve (9), right swing pressure compensation valve (7), L.H. travel REVERSE pressure compensation valve (5), and arm OUT pressure compensation valve (3).
   2) Remove boom Hi RAISE pressure compensation valve (16), bucket CURL pressure compensation valve (14), R.H. travel FORWARD pressure compensation valve (12), boom LOWER pressure compensation valve (10), left swing pressure compensation valve (8), L.H. travel FORWARD pressure compensation valve (6), and arm IN pressure compensation valve (4).
      ★ After removing the pressure compensation valves, remove check valve (88) from each pressure compensation valve mount.

4. **LS select valve**
   Remove LS select valve (29).

5. LS shuttle valves, pump merge/divider valve, boom regeneration valve, block

1) Remove LS shuttle valves (30) and (31).
2) Remove pump merge/divider valve (32), then remove boom regeneration spring (85) and boom regeneration valve (86).
3) Remove merge/divider valve body (35) and plugs (37) and (38), then remove spools (33) and (34), and springs (36) and (39).
4) Remove block (87).

6. Arm control valve

1) Remove plug (40), then remove piston (42) and spring (41).
2) Remove case (43), then remove spring (44) and retainer (45).
3) Remove case (46), then remove spring (47) and retainer (48).
4) Remove spool assembly (49).
   ★ Do not disassemble spool assembly (49).

7. Swing control valve

1) Remove case (50), then remove spring (51) and retainer (52).
2) Remove plug (53), then remove piston (54).
3) Remove case (55), then remove spring (56) and retainer (57).
4) Remove plug (58), then remove piston (59).
5) Remove spool assembly (60).
   ★ Do not disassemble spool assembly (60).

8. R.H. travel control valve, L.H. travel control valve

1) Remove case (61), then remove spring (62) and retainer (63).
2) Remove case (64), spring (65), and retainer (66).
3) Remove spool assembly (67).
   ★ Do not disassemble spool assembly (67).

9. Boom control valve

1) Remove case (68), then remove spring (69) and retainer (70).
2) Remove plug (71), then remove piston (72) and spring (73).
3) Remove case (74), then remove spring (75) and retainer (76).
4) Remove spool assembly (77).
   ★ Do not disassemble spool assembly (77).

10. Bucket control valve

1) Remove case (78), then remove spring (79) and retainer (80).
2) Remove case (81), then remove spring (82) and retainer (83).
3) Remove spool assembly (84).
   ★ Do not disassemble spool assembly (84).

11. Arm regeneration valve

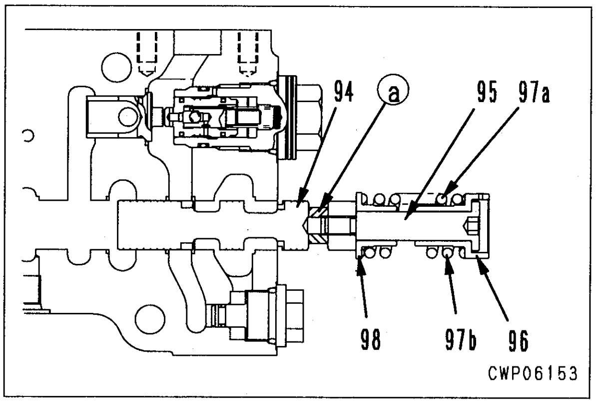
- Remove plate (91), then remove arm regeneration spring (92) and arm regeneration valve (93).

12. Boom Hi, arm Hi control valves

- **Arm Hi control valve**

  ★ Mark with tags to prevent mistakes in the mounting position when assembling the springs and spools.

1) Remove case (103), then pull out spool assembly to position shown in diagram on right.
2) To prevent damage to spool assembly, hold position ⓐ shown in diagram on right with a wrench (width across flats: 24mm), remove plug (95), then disassemble into retainer (96), springs (97a) and (97b), retainer (98), and spool (94).

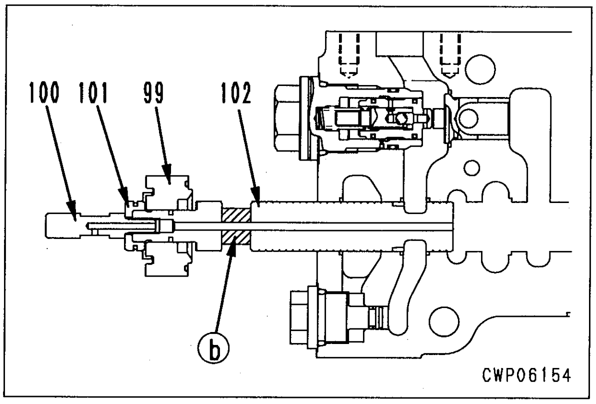


- **Boom Hi control valve**

  ★ Mark with tags to prevent mistakes in the mounting position when assembling the springs and spools.

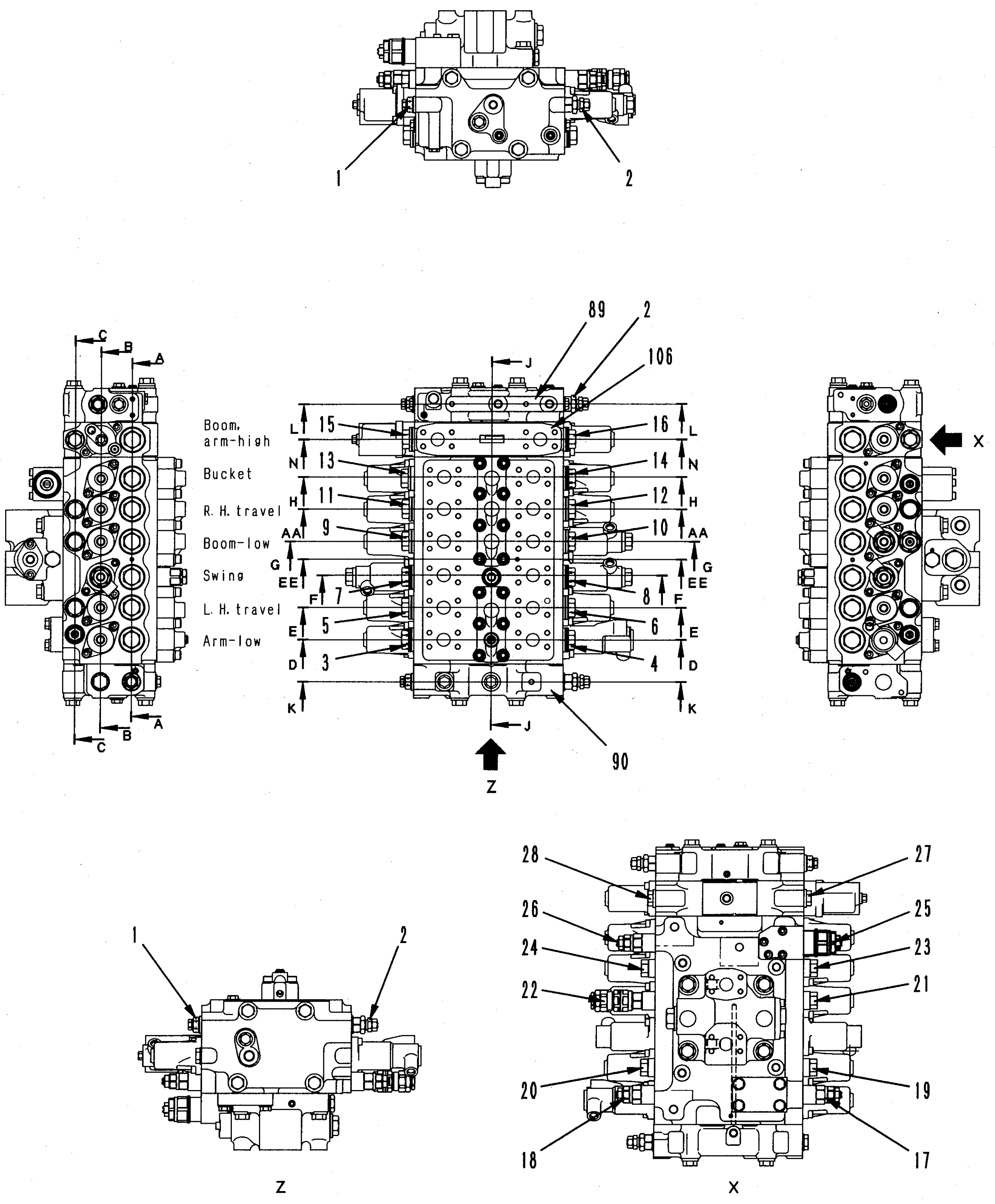
3) Remove case (104), then remove spring (105) and plate (99).
4) To prevent damage to spool assembly, hold position ⓑ shown in diagram on right with a wrench (width across flats: 24mm), remove plug (100), then disassemble into valve (101), plate (99), and spool (102).

13. Remove covers (89) and (90) and valve (106) from valve body.



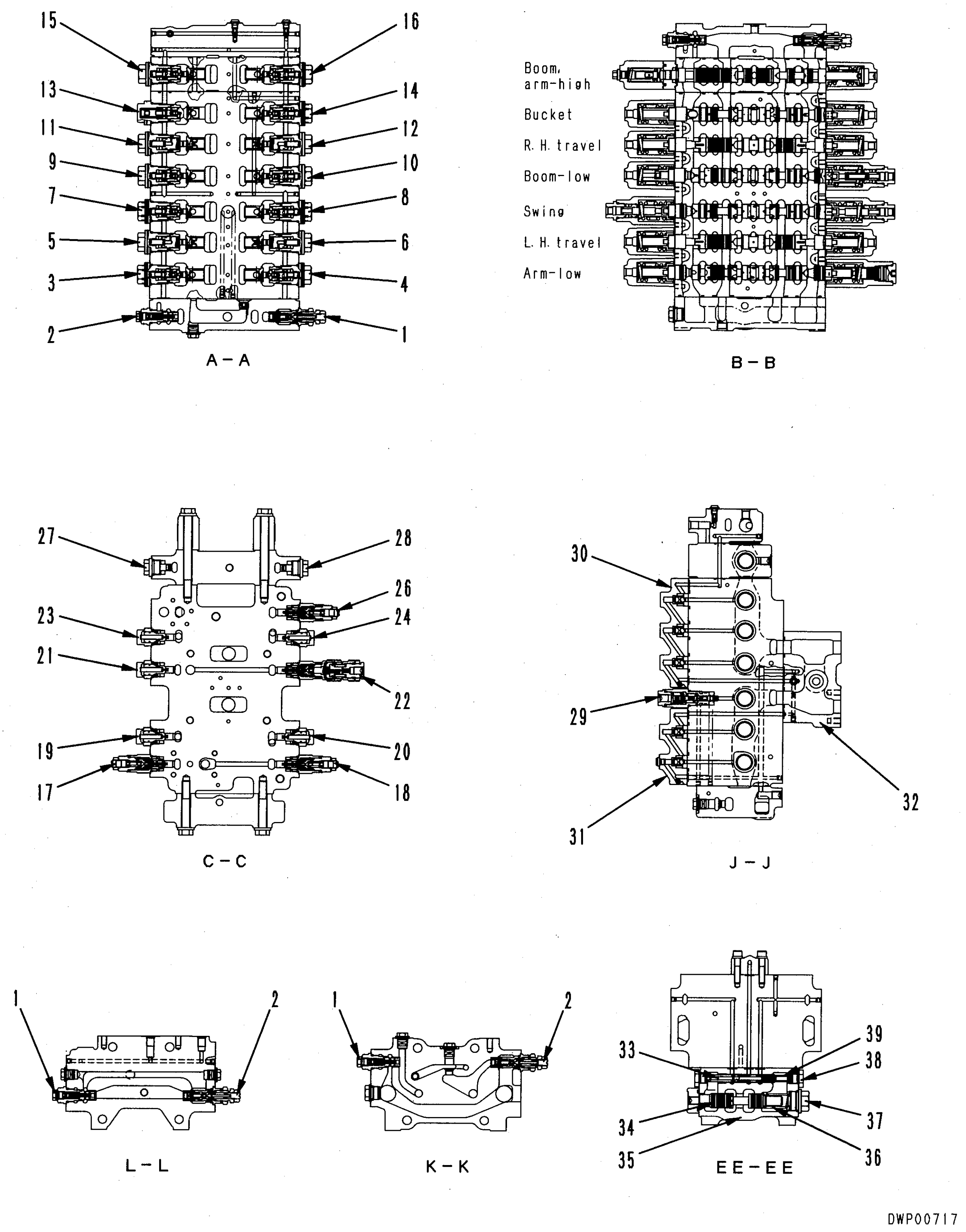
ASSEMBLY OF CONTROL VALVE ASSEMBLY

(1/3)

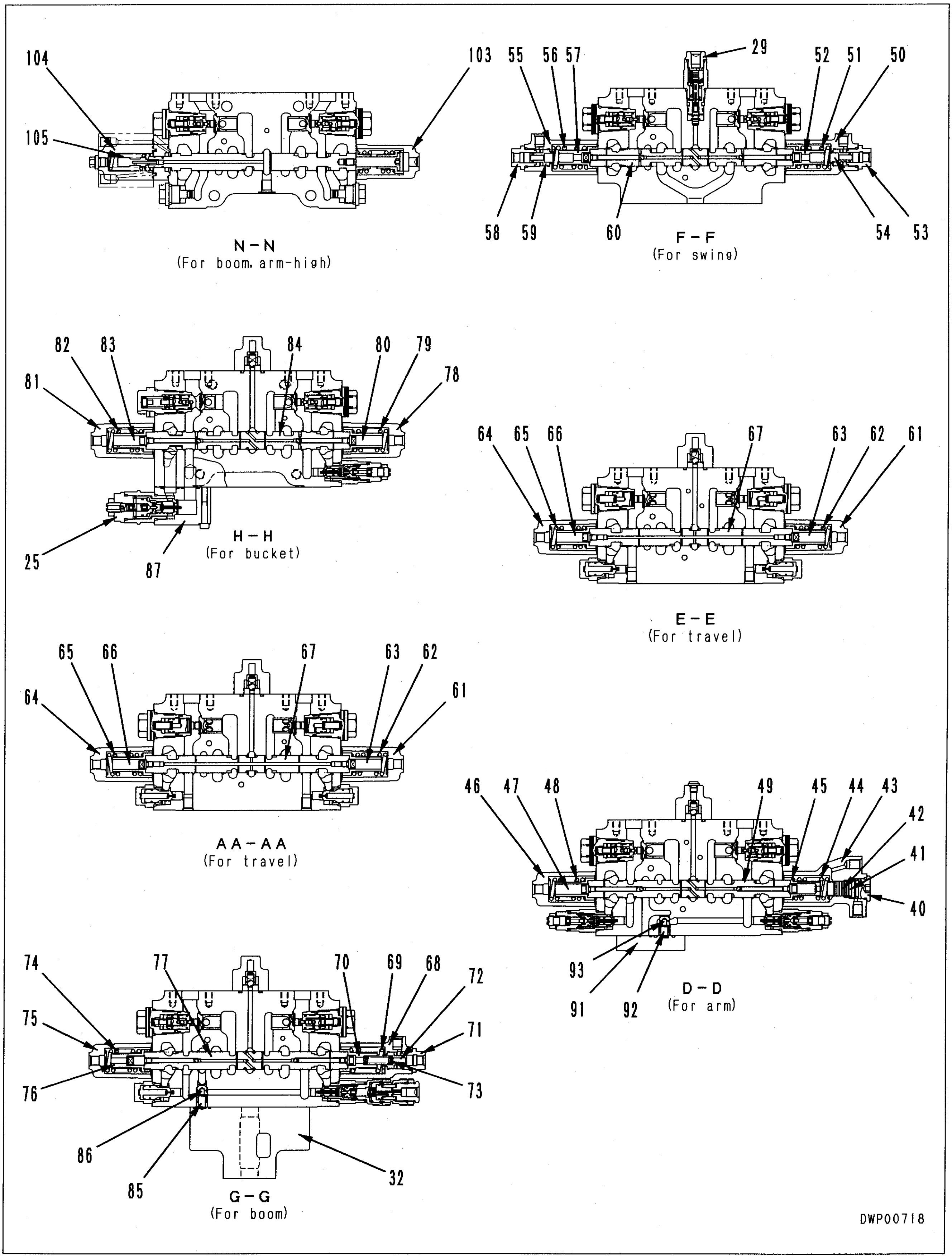


DWP00716

(2/3)


15
16
13
14
11
12
9
10
7
8
5
6
3
4
2
1
A – A
Boom, arm-high
Bucket
R. H. travel
Boom-low
Swing
L. H. travel
Arm-low
B – B
27
28
26
23
24
21
22
19
20
17
18
C – C
30
29
31
32
J – J
1
2
L – L
1
2
K – K
33
39
38
34
37
35
36
EE – EE
DWP00717

(3/3)



N－N
(For boom, arm-high)

F－F
(For swing)

H－H
(For bucket)

E－E
(For travel)

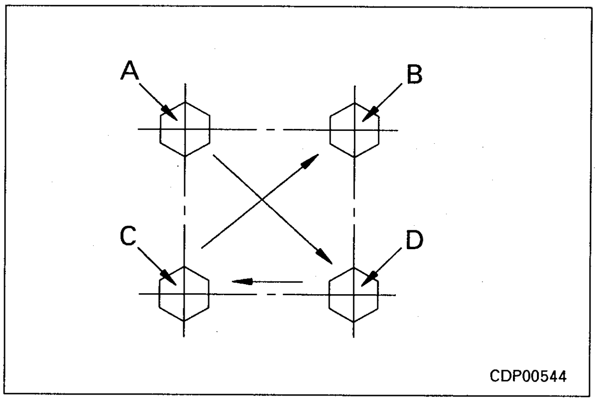
AA－AA
(For travel)

D－D
(For arm)

G－G
(For boom)

★ Check the spools and valves for dirt, damage, or burrs. Coat the sliding surfaces of all parts with engine oil before installing.

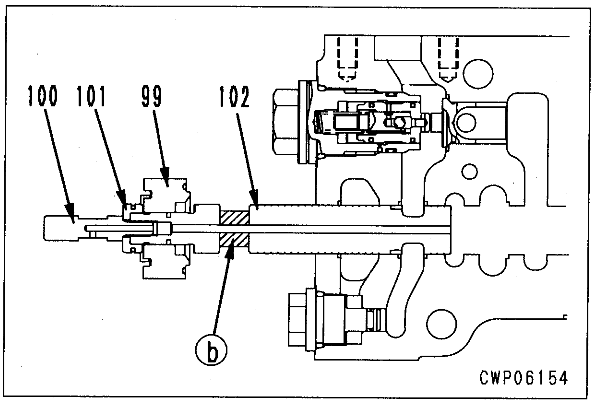
1. **Covers**
   Install valve (106), and covers (89) and (90) to valve body.
   ★ Check that there is no damage to the O-ring, then install securely to the mating surface of the cover and valve.
   ★ Tighten the mounting bolts of covers (89) and (90) in the order shown in the diagram on the right.
   kgm Cover mounting bolt:
   166.6 ± 9.8 Nm {17 ± 1 kgm}



CDP00544

2. **Boom Hi, arm Hi control valve spools**
   - **Boom Hi control valve spool**

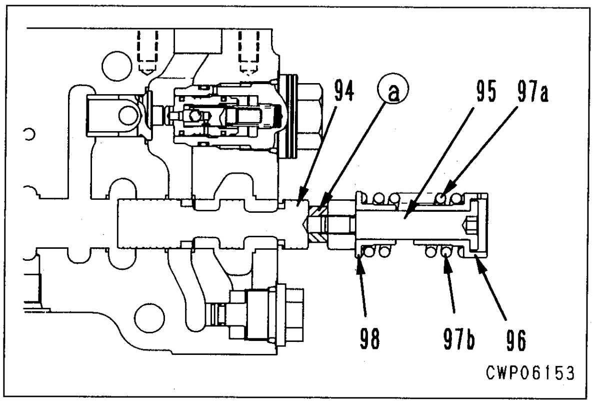
   ★ Check the mounting position of the spring and spool assembly carefully before installing.
   1) Fit seal to spool (102), and install seal to valve (101).
   2) Assemble spool (102) to position shown in diagram on right, install plate (99) and valve (101) to spool (102), then hold position ⓑ shown in diagram on right with a wrench (width across flats: 24mm), and tighten plug (41).
   kgm Plug: **13.2 ± 1.5 Nm {1.35 ± 0.15 kgm}**
   3) Push spool assembly into body, fit spring (105), then fit O-ring to case (104) and install.
   kgm Case mounting bolt:
   30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}



CWP06154

   - **Arm Hi control valve spool**

   ★ Check the mounting position of the spring and spool assembly carefully before installing.
   1) Assemble spool (94) to position shown in diagram on right, install retainer (98), springs (97a) and (97b), and retainer (96), then install plug (95).
   2) Hold spool (94) at position ⓐ shown in diagram on right with a wrench (width across flats: 24mm), and tighten plug (32).
   kgm Plug: **17.2 ± 2.5 Nm {1.75 ± 0.25 kgm}**
   3) Push spool assembly into body, then fit O-ring to case (103) and install.
   kgm Case mounting bolt:
   30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}



CWP06153

3. **Bucket control valve**
   1) Assemble spool assembly (84) to valve body.
   2) Assemble retainer (83) and spring (82), then fit O-ring to case (81) and install.
      kgm Case mounting bolt:
      30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}
   3) Assemble retainer (80) and spring (79), then fit O-ring to case (78) and install.
      kgm Case mounting bolt:
      30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}

4. **Boom control valve**
   1) Assemble spool assembly (77) to valve body.
   2) Assemble retainer (76) and spring (75), then fit O-ring to case (74) and install.
      kgm Case mounting bolt:
      30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}
   3) Assemble spring (73) and piston (72), and install plug (71).
      kgm Plug:
      107.8 ± 14.7 Nm {11.0 ± 1.5 kgm}
   4) Assemble retainer (70) and spring (69), then fit O-ring to case (68) and install.
      kgm Case mounting bolt:
      30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}

5. **R.H. travel control valve, L.H. travel control valve**
   1) Assemble spool assembly (67) to valve body.
   2) Assemble retainer (66) and spring (65), then fit O-ring to case (64) and install.
      kgm Case mounting bolt:
      30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}
   3) Assemble retainer (63) and spring (62), then fit O-ring to case (61) and install.
      kgm Case mounting bolt:
      30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}

6. **Swing control valve**
   1) Assemble spool assembly (60) to valve body.
   2) Assemble piston (59), and install plug (58).
      kgm Plug:
      107.8 ± 14.7 Nm {11.0 ± 1.5 kgm}
   3) Assemble retainer (57) and spring (56), then fit O-ring to case (55) and install.
      kgm Case mounting bolt:
      30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}
   4) Assemble piston (54), and install plug (53).
      kgm Plug:
      107.8 ± 14.7 Nm {11.0 ± 1.5 kgm}
   5) Assemble retainer (52) and spring (51), then fit O-ring to case (50) and install.
      kgm Case mounting bolt:
      30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}

7. **Arm control valve**
   1) Assemble spool assembly (49) to valve body.
   2) Assemble retainer (48) and spring (47), then fit O-ring to case (46) and install.
      kgm Case mounting bolt:
      30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}
   3) Assemble retainer (45) and spring (44), then fit O-ring to case (43) and install.
      kgm Case mounting bolt:
      30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}
   4) Assemble spring (41) and piston (42), and install plug (40).
      kgm Plug:
      107.8 ± 14.7 Nm {11.0 ± 1.5 kgm}

8. LS shuttle valve, pump merge/divider valve, boom regeneration valve, block

1) Assemble springs (36) and (39) and spools (33) and (34) in merge/divider valve (35), then install plugs (37) and (38).

   kgm Plug (38):
   39.2 ± 4.5 Nm {4.0 ± 0.5 kgm}

   kgm Plug (37):
   151.9 ± 24.5 Nm {15.5 ± 2.5 kgm}

2) Assemble boom regeneration valve (86) and spring (85) in valve body, then install merge/divider valve assembly (32).

   ★ Tighten the mounting bolts in the order shown in the diagram on the right.

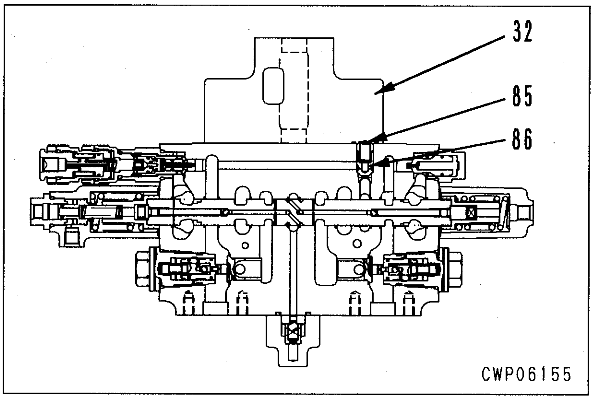
   kgm Mounting bolt:
   166.6 ± 9.8 Nm {17 ± 1 kgm}

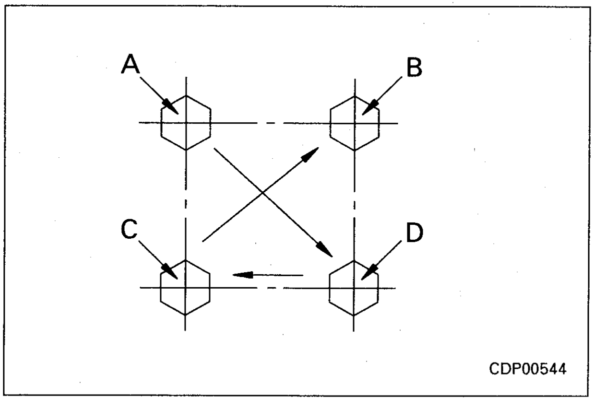
3) Install LS shuttle valves (30) and (31).

   kgm Mounting bolt:
   66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}

4) Install block (87).

   kgm Mounting bolt:
   30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}





9. LS select valve

Install LS select valve (29).

kgm LS select valve:
127.4 ± 19.6 Nm {13 ± 2 kgm}

10. Pressure compensation valves

- Check the marks made on each pressure compensation valve during disassembly, and install in the correct position.

1) Before installing pressure compensation valves below, install check valve (88).

2) Fit O-rings and install arm IN pressure compensation valve (4), L.H. travel FORWARD pressure compensation valve (6), left swing pressure compensation valve (8), boom LOWER pressure compensation valve (10), R.H. travel FORWARD pressure compensation valve (12), bucket CURL pressure compensation valve (14), and boom Hi RAISE pressure compensation valve (16).

   kgm Pressure compensation valve:
   392 ± 19.6 Nm {40 ± 2 kgm}

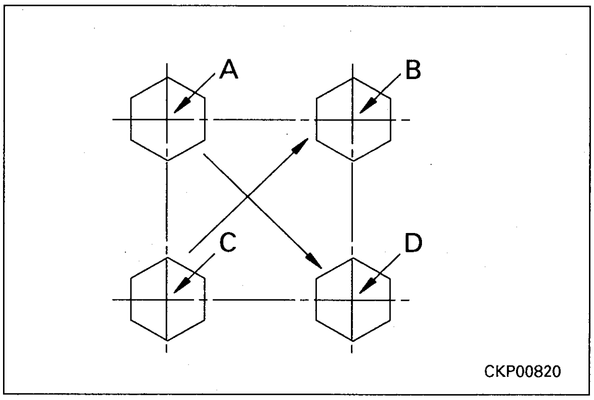
3) Fit O-rings and install arm OUT pressure compensation valve (3), L.H. travel FORWARD pressure compensation valve (5), right swing pressure compensation valve (7), boom RAISE pressure compensation valve (9), R.H. travel REVERSE pressure compensation valve (11), bucket DUMP pressure compensation valve (13), and arm Hi IN pressure compensation valve (15).

   kgm Pressure compensation valve:
   392 ± 19.6 Nm {40 ± 2 kgm}

11. Arm regeneration valve

- Assemble arm regeneration valve (93) and spring (92), then install plate (91).
  - ★ Tighten the mounting bolts in the order shown in the diagram on the right.

    kgm Plate mounting bolt:
    66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}



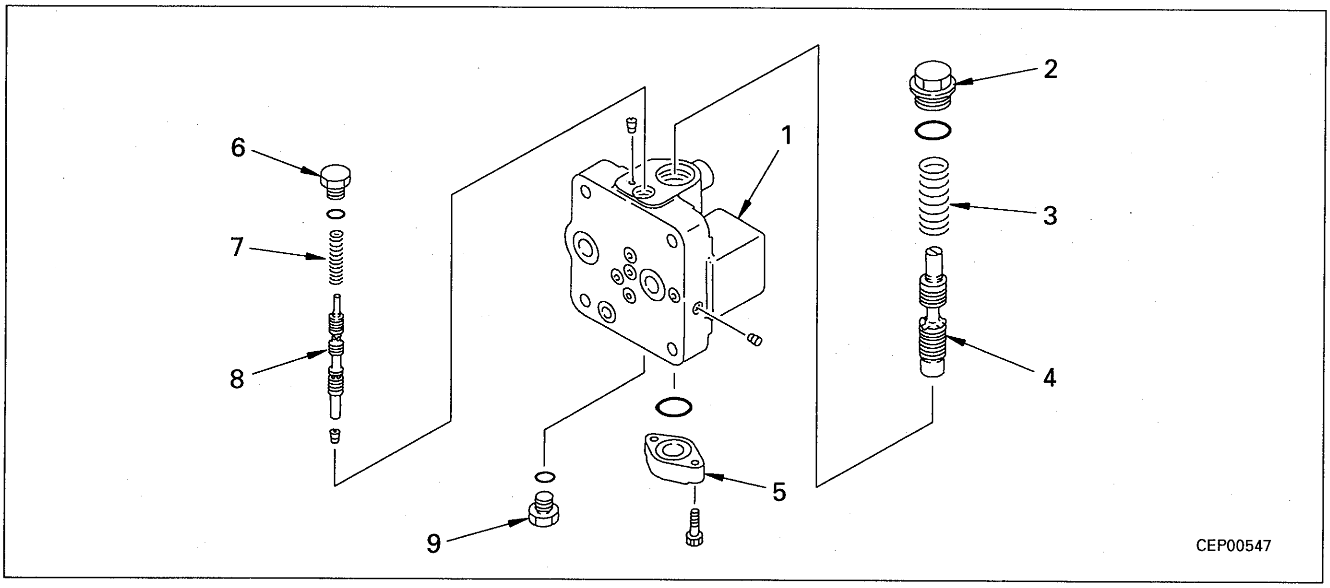
12. Unload valve, safety-suction valve, suction valve

1) Fit O-rings and install plugs (27) and (28).
   kgm Plug: **49 ± 9.8 Nm {5 ± 1 kgm}**
2) Fit O-rings and install suction valve assemblies (19), (20), (21), (23), and (24).
   kgm Suction valve:
   147 ± 9.8 Nm {15 ± 1 kgm}
3) Fit O-rings and install safety-suction valves (17), (18), (22), and (26).
   kgm Safety-suction valve assembly:
   147 ± 9.8 Nm {15 ± 1 kgm}
4) Fit O-ring and install unload valve assembly (1).
   kgm Unload valve assembly:
   166.6 ± 19.6 Nm {17 ± 2 kgm}

13. Main relief valve

- Fit O-ring and install main relief valve assembly (2).
  kgm Main relief valve assembly:
  53.9 ± 4.9 Nm {5.5 ± 0.5 kgm}

DISASSEMBLY OF PUMP MERGE/DIVIDER VALVE ASSEMBLY



1. Remove plug (2) from valve body (1), then remove spring (3) and spool (4).
2. Remove plate (5).
3. Remove plug (6), then remove spring (7) and spool (8).
4. Remove plug (9).

★ After disassembling, if there is any abnormality in body (1) or spools (4) or (8), replace the whole pump merge/divider valve assembly.

ASSEMBLY OF PUMP MERGE/ DIVIDER VALVE ASSEMBLY

- Before assembling, coat the sliding surface with engine oil.

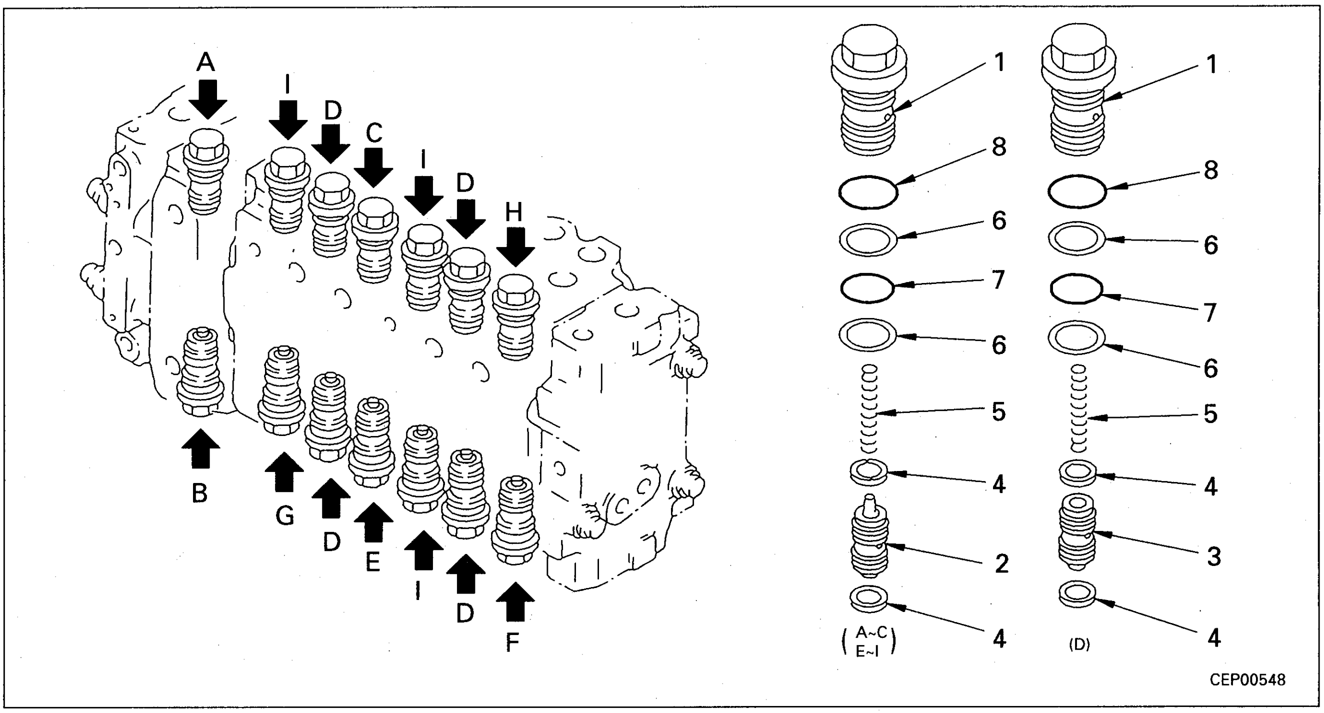
1. Fit O-ring to plug (9) and install to valve body (1).
   kgm Plug (9): **39.2 ± 5.9 Nm {4.0 ± 0.6 kgm}**

2. Assemble spool (8) and spring (7), then fit O-ring to plug (6) and install.
   kgm Plug (6): **39.2 ± 5.9 Nm {4.0 ± 0.6 kgm}**

3. Fit O-ring to plate (5) and install valve body.

4. Assemble spool (4) and spring (3), then fit O-ring to plug (2) and install.
   kgm Plug (2):
   152.0 ± 24.5 Nm {15.5 ± 2.5 kgm}

DISASSEMBLY OF PRESSURE COMPENSATION VALVE ASSEMBLY



- The structure of the parts for pressure compensation valves **A – I** is the same, but the part numbers for the component parts is different, so be careful when assembling.

1. Remove piston sub-assembly (2) and piston (3) from sleeve (1), then remove seal (4).
   ★ Sub-piston assembly (2) is assembled to pressure compensation valves **A-C, E-I,** and piston (3) is assembled to pressure compensation valves **D.**

2. Remove spring (5), then remove ring (6) and O-rings (7) and (8) from sleeve (1).
   ★ After disassembling, if there is any abnormality in sleeve (1), seal (4), piston sub-assembly (2), or piston (3), replace the whole pressure compensation valve assembly.

Pressure compensation valves
A: Arm IN Hi
B: Boom RAISE Hi
C: Boom LOWER
D: R.H. travel REVERSE, L.H. travel REVERSE
R.H. travel FORWARD, L.H. travel FORWARD
E. Boom RAISE
F: Arm OUT
G: Bucket CURL
H: Arm IN
I: Right swing, left swing, bucket dump

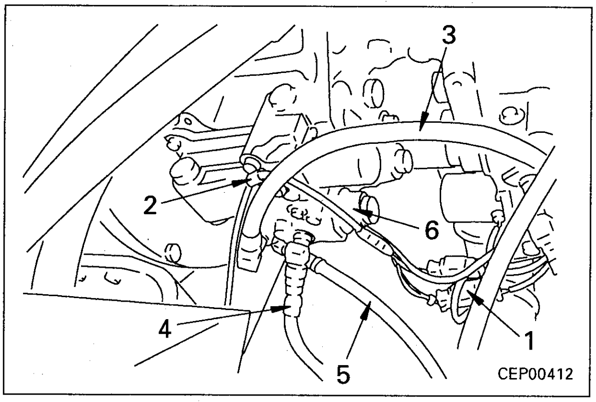
ASSEMBLY OF PRESSURE COMPENSATION VALVE ASSEMBLY

- Before assembling, coat the sliding surface with engine oil.

1. Install O-rings (8) and (7) and ring (6) to sleeve (1).

2. Assemble spring (5), then assemble seal (4) to piston sub-assembly (2) and piston (3), and install to sleeve.

REMOVAL OF SERVO VALVE ASSEMBLY FOR FRONT PUMP



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

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Disconnect TVC solenoid connector (1) (CN-C13).
2. Disconnect clamp (2).
3. Disconnect LS-EPC hose (3), LS pressure hose (4), and pump circuit pressure hose (5).
   ★ Fit blind plugs in the disconnected hoses.
4. Remove servo valve assembly (6) for front pump. ※1

INSTALLATION OF SERVO VALVE ASSEMBLY FOR FRONT PUMP

- Carry out installation in the reverse order to removal.

※1

★ Be careful not to let the O-ring or filter fall out when installing.

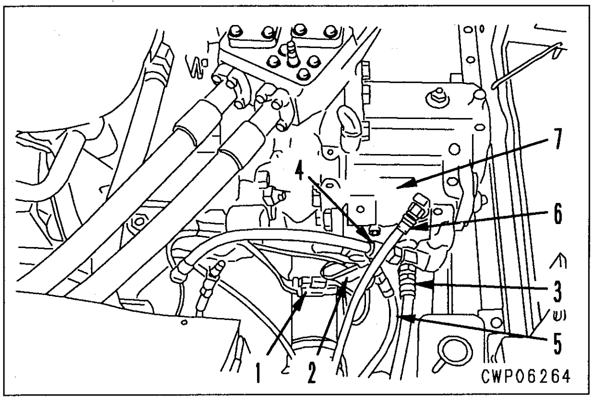
★ Tighten the mounting bolts gradually on opposite sides in turn.

kgm Servo valve mounting bolt:
66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}

★ Check the performance of the work equipment, travel, and swing.
For details, see TESTING AND ADJUSTING.

- **Refilling with oil (hydraulic tank)**
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

REMOVAL OF SERVO VALVE ASSEMBLY FOR REAR PUMP



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

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Disconnect TVC solenoid connector (1) (CN-C04).
2. Disconnect connector bracket (2) from servo valve.
3. Disconnect LS-EPC hoses (3) and (4), LS pressure hose (5), and pump circuit pressure hose (6).
   Fit blind plugs in the disconnected hoses.
4. Remove servo valve assembly (7) for rear pump.
   ※1

INSTALLATION OF SERVO VALVE ASSEMBLY FOR REAR PUMP

- Carry out installation in the reverse order to removal.

※1

★ Be careful not to let the O-ring or filter fall out when installing.

★ Tighten the mounting bolts gradually on opposite sides in turn.

kgm Servo valve mounting bolt:
66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}

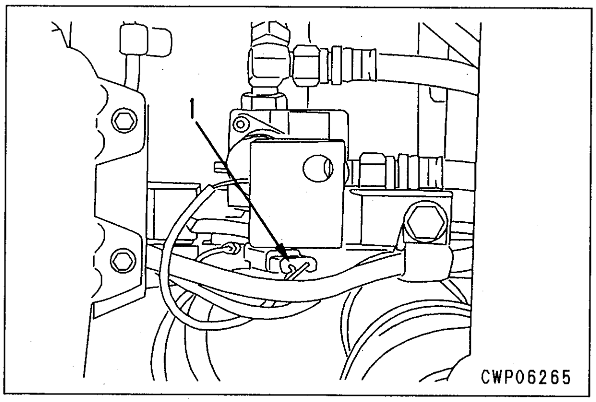
★ Check the performance of the work equipment, travel, and swing.
For details, see TESTING AND ADJUSTING.

- **Refilling with oil (hydraulic tank)**
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

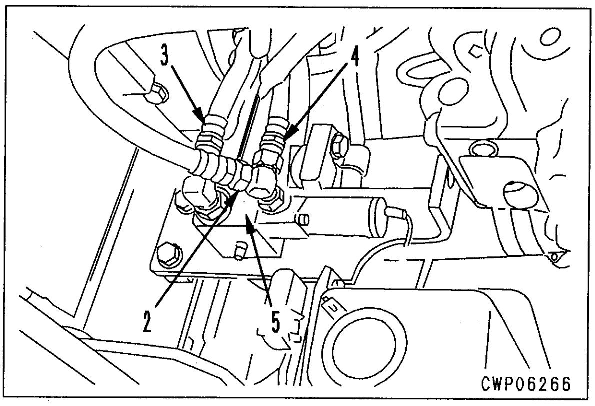
REMOVAL OF LS-EPC SOLENOID VALVE ASSEMBLY

⚠ Disconnect the cable from the negative (–) terminal of the battery.
⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Open main pump side cover.
2. Disconnect wiring connector (1) (CN-C10).
   ★ This is installed at the bottom of the EPC solenoid valve mounting bracket.



3. Disconnect hose (2) going to main pump.
4. Disconnect hose (3) going to hydraulic tank.
5. Disconnect hose (4) coming from solenoid valve.
   ★ After disconnecting the hose, fit a blind plug.
6. Remove LS-EPC solenoid valve assembly (5).



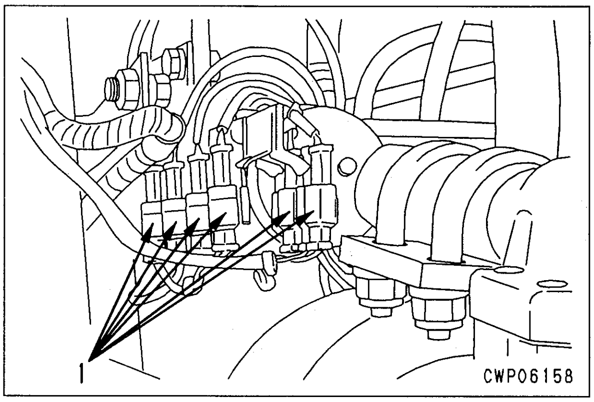
INSTALLATION OF LS-EPC SOLENOID VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

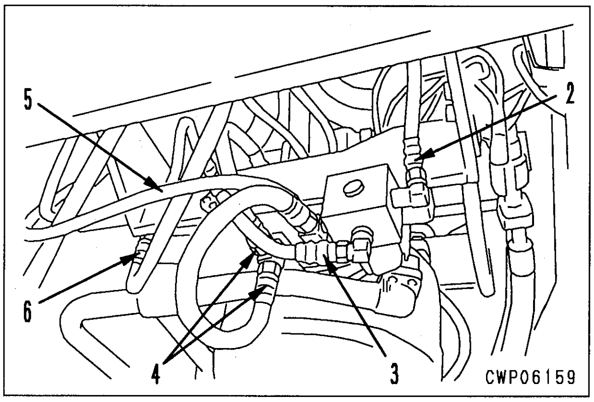
REMOVAL OF SOLENOID VALVE ASSEMBLY

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

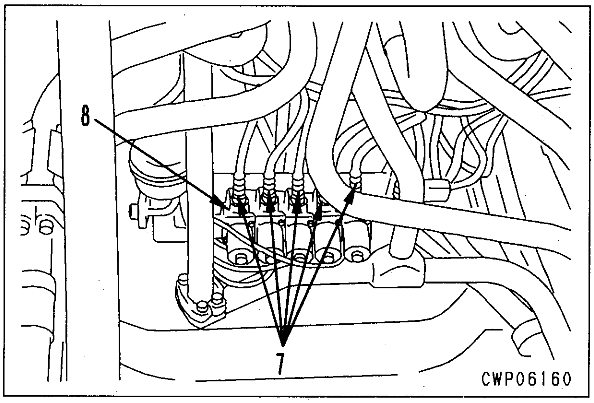
⚠ Loosen the hydraulic tank oil filler cap slowly to release the pressure inside the hydraulic tank.
- ★ Make match marks on the hoses and connectors.



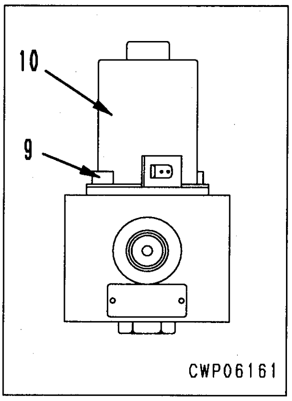
1. Disconnect solenoid wiring connectors (1).
   - ★ Disconnect all connectors (V02, 03, 04, 05, 06, and 07).

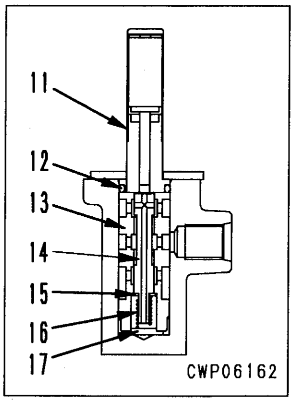


2. Disconnect hose (2) coming from PPC.
3. Disconnect hose (3) going to control valve.
4. Disconnect drain hose (4).
5. Disconnect hose (5) coming from accumulator.
6. Disconnect hose (6) coming from self-pressure reducing valve.
7. Disconnect outlet hoses (7) coming from each solenoid valve.
8. Remove mounting bolts, then remove solenoid valve assembly (8).



- When removing solenoid valve as an individual part
  1) Remove mounting bolts (9), then remove coil (10). ※ 1
  2) Remove movable iron core (11) and O-ring (12).
  3) Remove cage (13) and spool (14).
     - ★ Cage (13):
       PC400-6 Serial No.: 32001 – 32249
       PC450-6 Serial No.: 12001 – 12143
  4) Remove washer (15), spring (16), and stopper (17), then clean valves.





INSTALLATION OF SOLENOID VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

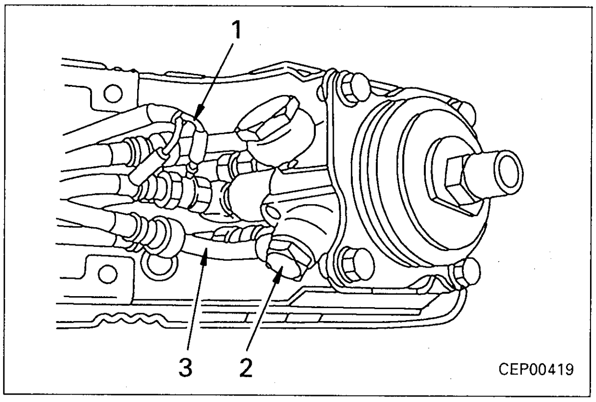
※ 1

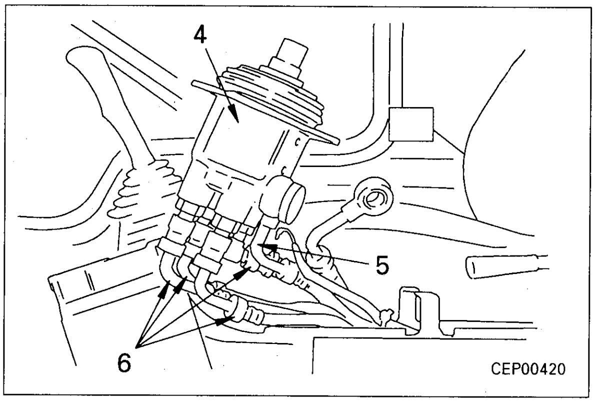
kgm Mounting bolt:
3.92 ± 0.4 Nm {0.4 ± 0.04 kgm}

REMOVAL OF WORK EQUIPMENT PPC VALVE ASSEMBLY

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

1. Remove case.
   For details, see REMOVAL OF CONTROL STAND CASE.
2. Disconnect wiring connector (1).
3. Remove joint bolt (2), and disconnect hose (3).
   ★ Make match marks on the hoses. ※1
4. Remove mounting bolts, raise PPC valve assembly (4), then disconnect hoses (5) and (6), and remove. ※2





INSTALLATION OF WORK EQUIPMENT PPC VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

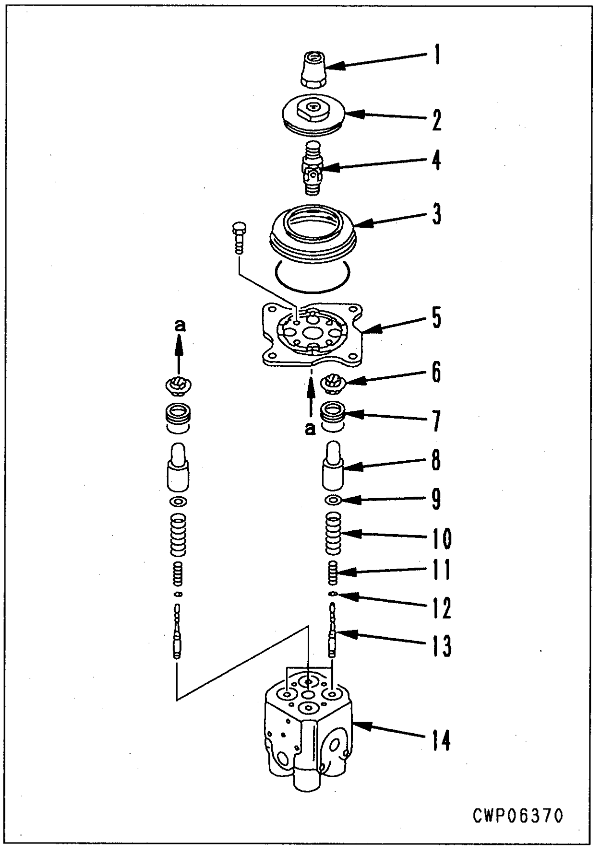
kgm Hose mount joint bolt:
29.4 ± 4.9 Nm {3.0 ± 0.5 kgm}

※2

kgm Hose mount joint bolt:
39.2 ± 4.9 Nm {4.0 ± 0.5 kgm}

★ If there is excessive play in the control levers, adjust the PPC valve.
For details, see TESTING AND ADJUSTING, Adjusting PPC valve.

DISASSEMBLY OF WORK EQUIPMENT PPC VALVE ASSEMBLY



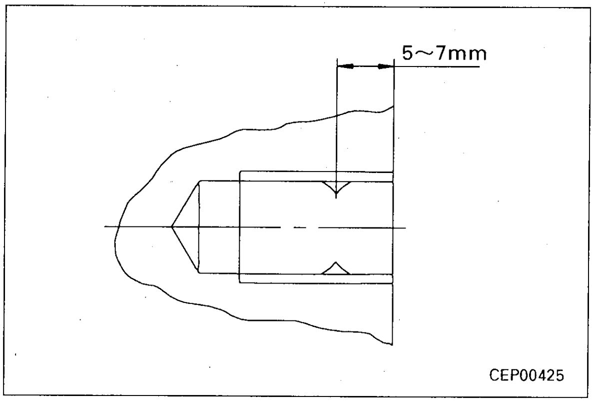
1. Remove nut (1), then remove disc (2) and boot (3).
2. Remove bolts, then remove plate (5).
   - ★ Do not remove joint (4) unless it is to be replaced.
3. Remove seal (6) and collar (7).
4. Pull out piston (8), and remove retainer (9), springs (10) and (11), and shim (12).
   - ★ Spring (10) consists of two springs each of two types with different installed loads, so check the mounting position (hydraulic port) and mark with tags to prevent mistakes when installing.
5. Pull out valve (13) from body (14).

ASSEMBLY OF WORK EQUIPMENT PPC VALVE ASSEMBLY

1. Assemble valve (13) to body (14).
2. Assemble shim (12) and spring (11) to valve (13).
   ★ When assembling spring (11), set the end with the small coil diameter (inside diameter) at shim (12) end.
3. Assemble spring (10), retainer (9), and piston (8).
   ★ The number of loops in the coil for spring (10) is different for each of the hydraulic ports below, so be careful when installing.

Position of port	Free length of spring (mm)
P1, P2	44.4
P3, P4	42.4

   ★ The position of each port is marked at the bottom of the valve body.
   Piston: **Grease (G2-LI)**
   ★ When assembling piston (8), coat the outside of the piston and the inside of the hole in the body with grease.
4. Fit O-ring to collar (7) and assemble in body (14), then install seal (6).
5. Install plate (5).
   kgm Mounting bolt:
   13.2 ± 1.5 Nm {1.35 ± 0.15 kgm}
6. Install joint (4).
   Sliding portion of joint: **Grease (G2-LI)**
   Female thread of body:
   Thread tightener (LT-2)
   ★ Coat two places on the female thread with one drop of Loctite each as shown in the diagram on the right.

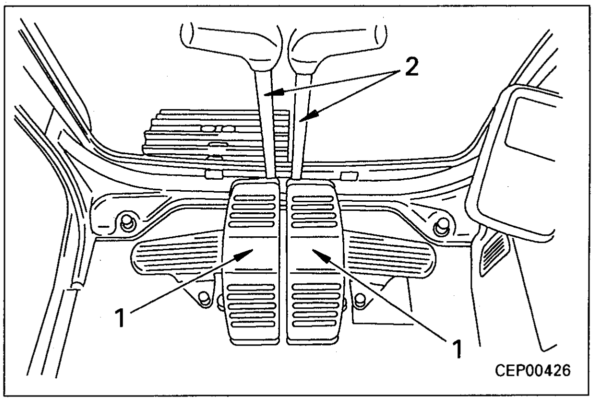


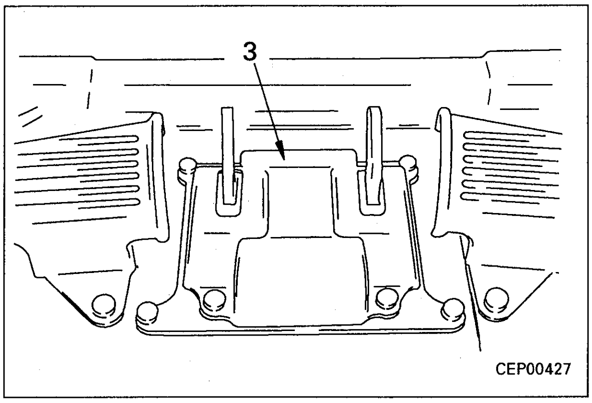
   kgm Joint: **44.1 ± 4.9 Nm {4.5 ± 0.5 kgm}**
   ★ Keep strictly to the tightening torque.
7. Assemble boot (3) and disc (2), and tighten with nut (1).
   kgm Nut: **112.8 ± 14.7 Nm {11.5 ± 1.5 kgm}**
   ★ After assembling the disc, adjust the height of the disc.
   For details, see TESTING AND ADJUSTING, Adjusting PPC valve.

REMOVAL OF TRAVEL PPC VALVE ASSEMBLY

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

1. Remove travel PPC valve undercover.
2. Remove floor mat.
3. Remove pedals (1) and levers (2).
4. Remove cover (3). ※1
5. Remove covers (4), then remove springs (5).
6. Disconnect 6 PPC hoses (7), and remove travel PPC valve assembly (8). ※2





INSTALLATION OF TRAVEL PPC VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

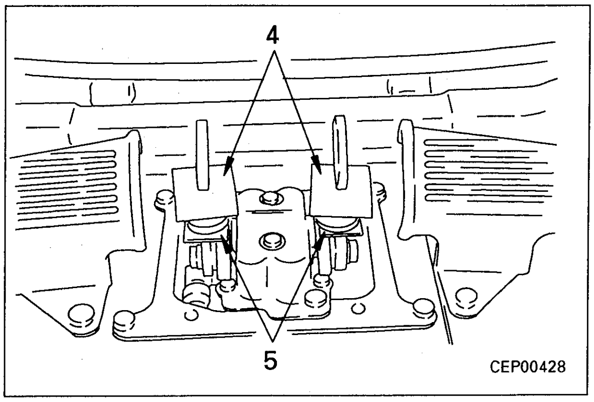
※1

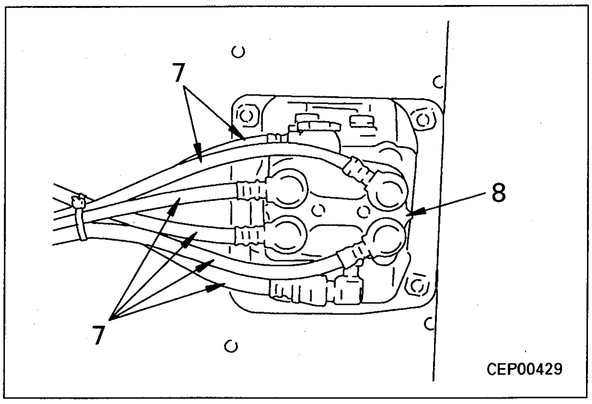
Cover mounting bolt:
19.6 ± 2.0 Nm {2.0 ± 0.2 kgm}

※2

Hose mounting joint bolt
(width across flats: 30mm):
39.2 ± 4.9 Nm {4.0 ± 0.5 kgm}

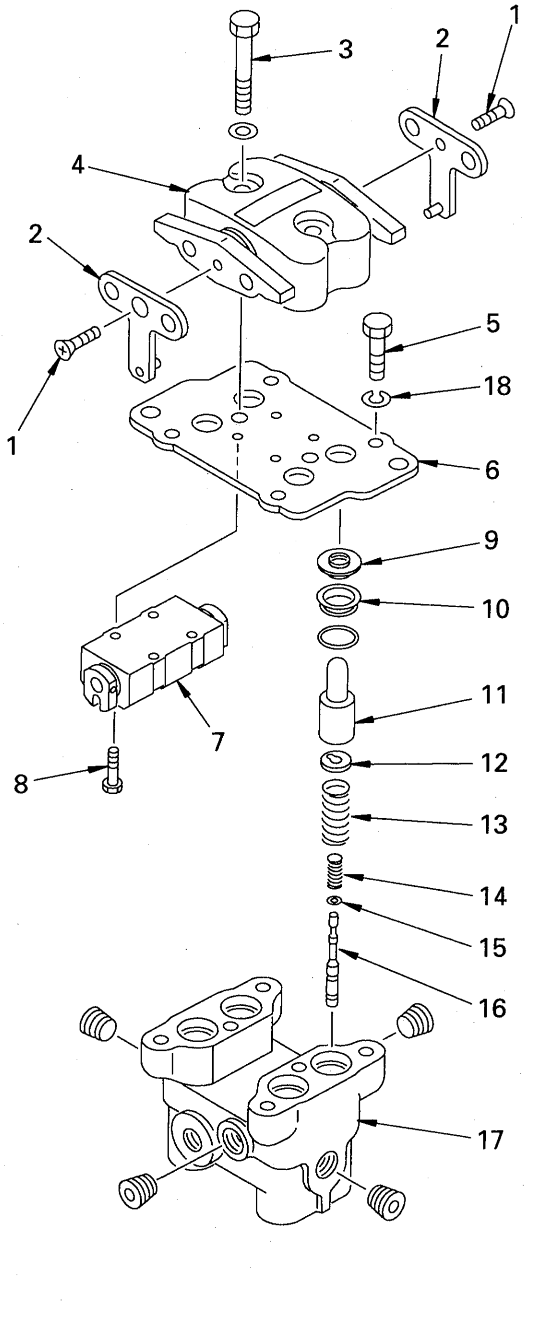
Hose mounting joint bolt
(width across flats: 22mm):
29.4 ± 4.9 Nm {3.0 ± 0.5 kgm}





DISASSEMBLY OF TRAVEL PPC VALVE ASSEMBLY

1. Remove screw (1), then remove lever (2).
2. Remove mounting bolts (3), then remove case and shaft assembly (4).
3. Remove mounting bolts (5), then remove plate (6) together with damper assembly (7).
   - ★ Check the thickness and mounting position of washer (18).
4. Remove mounting bolts (8), then remove damper assembly (7) from plate (6).
5. Remove seal (9) and collar (10).
6. Pull out piston (11), and remove retainer (12), springs (13) and (14), and shims (15).
   - ★ Check the number and thickness of shims (15) for each mounting position, and keep in a safe place.
7. Pull out valve (16) from body (17).

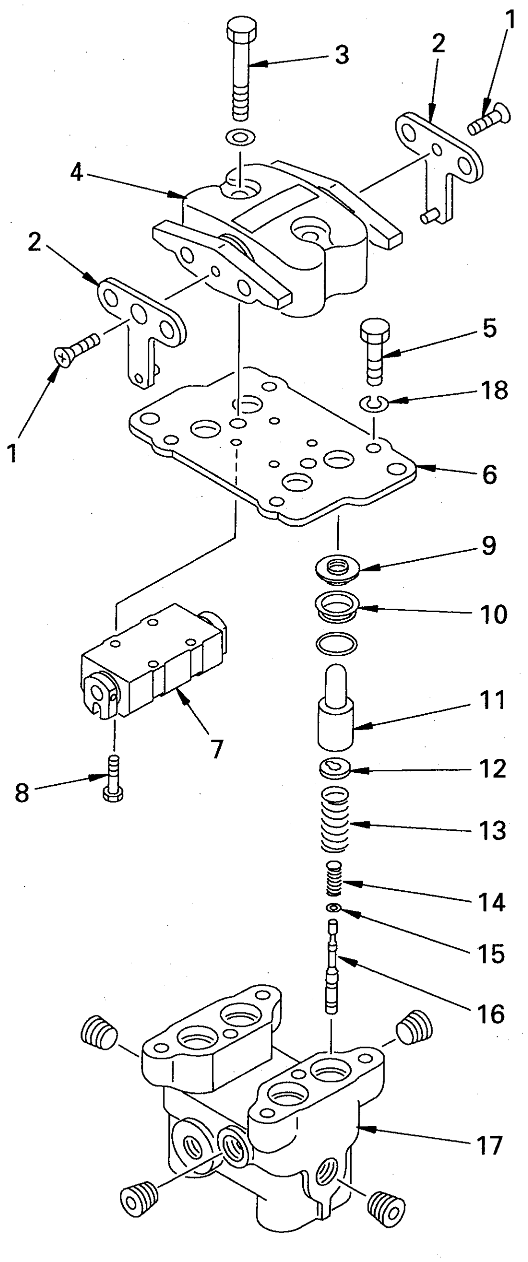


CEP00533

ASSEMBLY OF TRAVEL PPC VALVE ASSEMBLY

1. Assemble valve (16) in body (17).
2. Assemble shim (15) and spring (14) to valve (16).
   - ★ Assemble the same number and thickness of shim (15) as was removed during disassembly.
     Standard shim thickness: 0.3 mm
   - ★ Spring (14) is not symmetrical at the top and bottom, so assemble with the small coil diameter (inside diameter) at the shim end.
3. Assemble spring (13), retainer (12), and piston (11).
   Outside circumference of piston, body hole: **Grease (G2- LI)**
4. Fit O-ring to collar (10) and assemble in body (17), then install seal (9).
5. Install damper assembly (7) to plate (6), then tighten mounting bolts (8).
   Mounting bolt: **Thread tightener (LT-2)**
   kgm Mounting bolt:
   4.4 ± 0.5 Nm {0.45 ± 0.05 kgm}
6. Install plate (6) and damper assembly (7) as one unit, then tighten mounting bolts (5).
   - ★ Temporarily assemble standard washer (1.6 mm) for washer (18).
     After completing the assembly, measure the difference in the angle when the left and right levers are operated fully. If the angle is greater than 0.7°, change the thickness of washer (18) to make the difference less than 0.7°.
     - ★ Washer thickness: 1.0, 1.3, 1.6 mm
     - ★ If the washer is thinner by 0.3 mm, the angle of the full stroke is 0.39° greater.

   kgm Mounting bolt:
   30.9 ± 3.4 Nm {3.15 ± 0.35 kgm}
7. Install case and shaft assembly (4), then tighten mounting bolts (3).
   Rocking portion of shaft, contact portion of lever and piston: **Grease (G2-LI)**
   kgm Mounting bolt:
   27.9 ± 3.4 Nm {2.85 ± 0.35 kgm}
8. Install lever (2), then tighten screw (1).
   Rocking portion of lever pin and plate: **Grease (G2-LI)**
   kgm Screw: **8.8 ± 1.0 Nm {0.9 ± 0.1 kgm}**



CEP00533

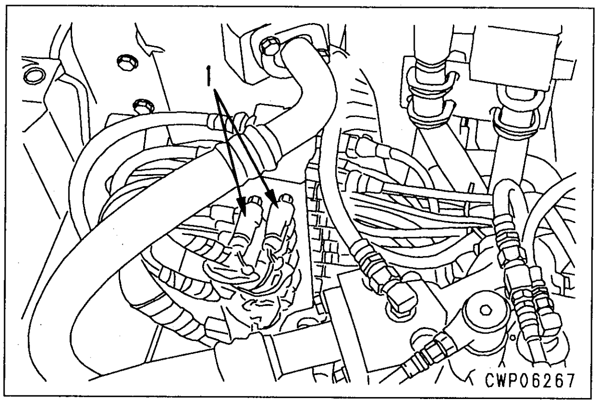
REMOVAL OF PPC SHUTTLE VALVE ASSEMBLY

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

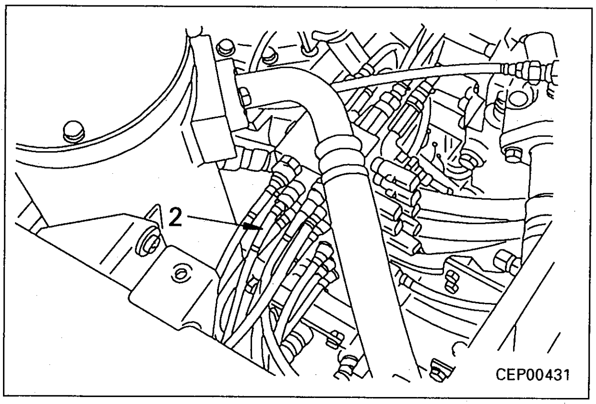
⚠ Disconnect the cable from the negative (–) terminal of the battery.

★ Make match marks at the male and female ends of the oil pressure switch connectors.

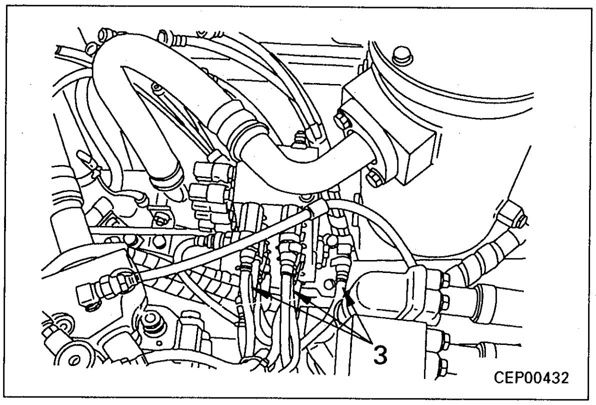
★ Before disconnecting any hoses, check the distinguishing tape stuck to the hose, or make match marks.



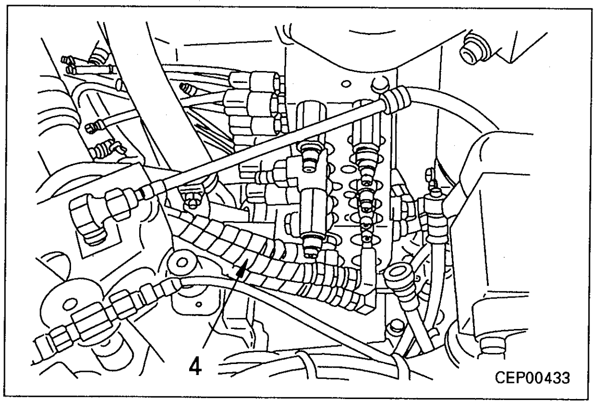
1. Disconnect 8 oil pressure switch connectors (1).
2. Disconnect 12 PPC hoses (2). ※1



3. Disconnect 15 control valve hoses (3) (quick joint connection). ※1

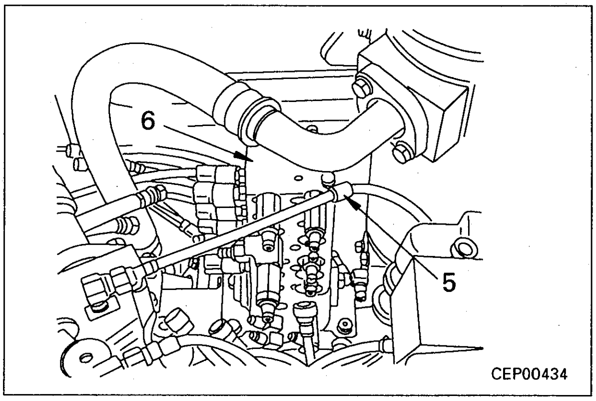


4. Disconnect 4 straight-travel hoses (4).
   ★ The elbows on the front two hoses are long, so hold the elbow with a wrench when disconnecting the hoses.



5. Disconnect clamp (5).

6. Remove mounting bolts, then remove PPC shuttle valve assembly (6).



INSTALLATION OF PPC SHUTTLE VALVE ASSEMBLY

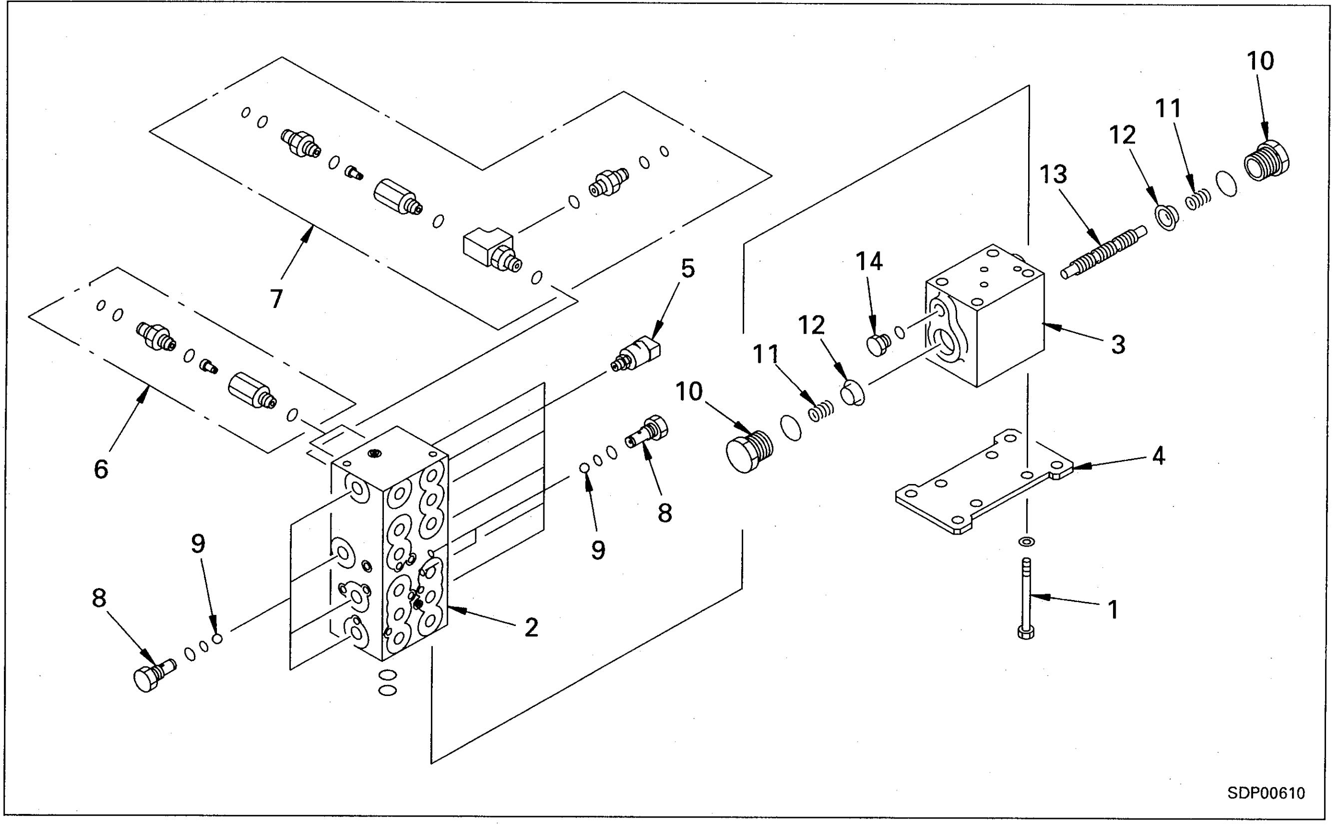
- Carry out installation in the reverse order to removal.

$\boxed{※ 1}$

- Check that the quick joint does not come out when the hose is pulled.

- **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.

DISASSEMBLY OF PPC SHUTTLE VALVE ASSEMBLY

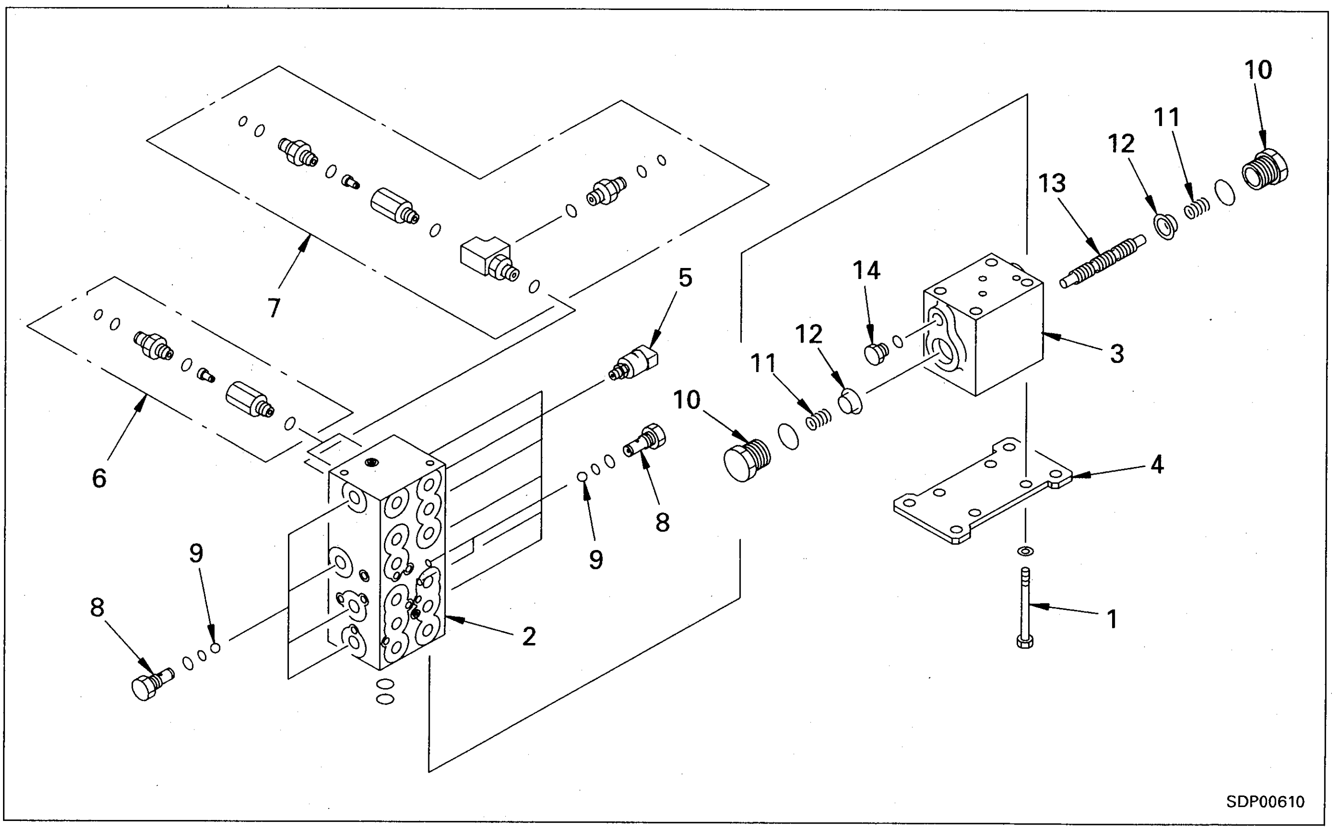


1. **Disconnection of valve**
   Remove mounting bolts (1), and disconnect shuttle valve assembly (2), travel junction valve assembly (3) and plate (4).

2. **Disassembly of shuttle valve assembly**
   1) Remove 8 oil pressure switches (5).
   2) Remove 2 slow return valves (6).
   3) Remove shuttle valve (7).
   4) Remove plugs (8), then remove balls (9).
      ★ There are 6 plugs and 6 balls.

3. **Disassembly of travel junction valve assembly**
   1) Remove 2 each of plug (10), spring (11), and retainer (12).
   2) Remove spool (13).
   3) Remove 2 plugs (14).

ASSEMBLY OF PPC SHUTTLE VALVE ASSEMBLY



1. **Assembly of travel junction valve assembly.**
   1) Fit O-ring and install 2 plugs (14).
      kgm Plug:
      17.2 ± 2.5 Nm {1.75 ± 0.25 kgm}
   2) Assemble spool (13), and install 2 retainers (12) and springs (11).
   3) Fit O-ring and install 2 plugs (10).
      kgm Plug:
      107.9 ± 14.7 Nm {11.0 ± 1.5 kgm}

2. **Assembly of shuttle valve assembly**
   1) Fit O-ring and assemble balls (9), then install plugs (8).
      ★ There are 6 plugs and 6 balls.
      kgm Plug:
      34.3 ± 4.9 Nm {3.5 ± 0.5 kgm}
   2) Fit O-ring and install shuttle valve (7).
      ★ If the shuttle valve has been disassembled, be careful of the direction of installation of the poppet when assembling.
   3) Fit O-ring and install 2 slow return valves (6).
      ★ If the slow return valve has been disassembled, be careful of the direction of installation of the poppet when assembling.
   4) Install 8 oil pressure switches (5).

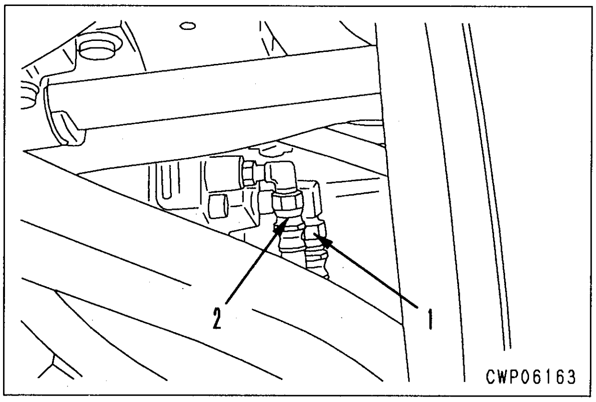
3. **Connection of valve**
   Fit O-ring and assemble shuttle valve assembly (2), travel junction valve assembly (3) and plate (4), then tighten mounting bolts (1).
   kgm Mounting bolt:
   66.2 ± 7.4 Nm {6.75 ± 0.75 kgm}

REMOVAL OF BOOM LOCK VALVE ASSEMBLY

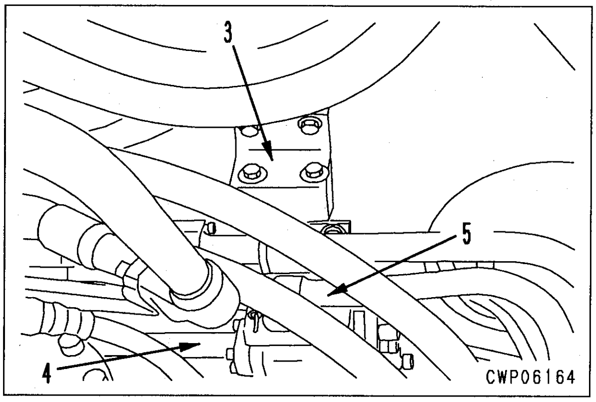
⚠ Lower the work equipment completely to the ground and stop the engine. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

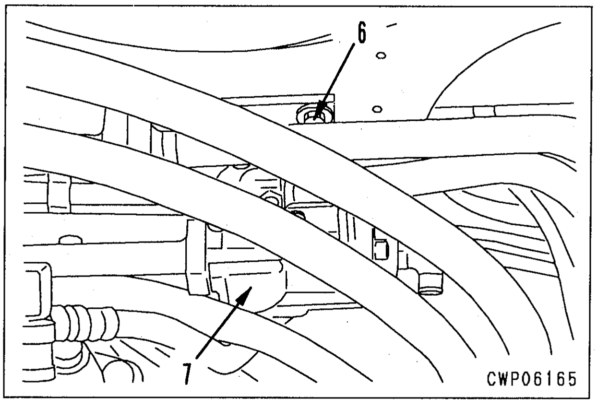
1. Drain hydraulic oil.

   Hydraulic oil: **Approx. 200 ℓ**



2. Disconnect drain hose (1) and PPC hose (2).
   ★ Install blind plugs in the disconnected hoses.
3. Remove tube clamp (3).
4. Disconnect tube (4) coming from control valve.
5. Disconnect tube (5) coming from boom cylinder.
6. Remove mounting bolts (6), then remove boom lock valve assembly (7).





INSTALLATION OF BOOM LOCK VALVE ASSEMBLY

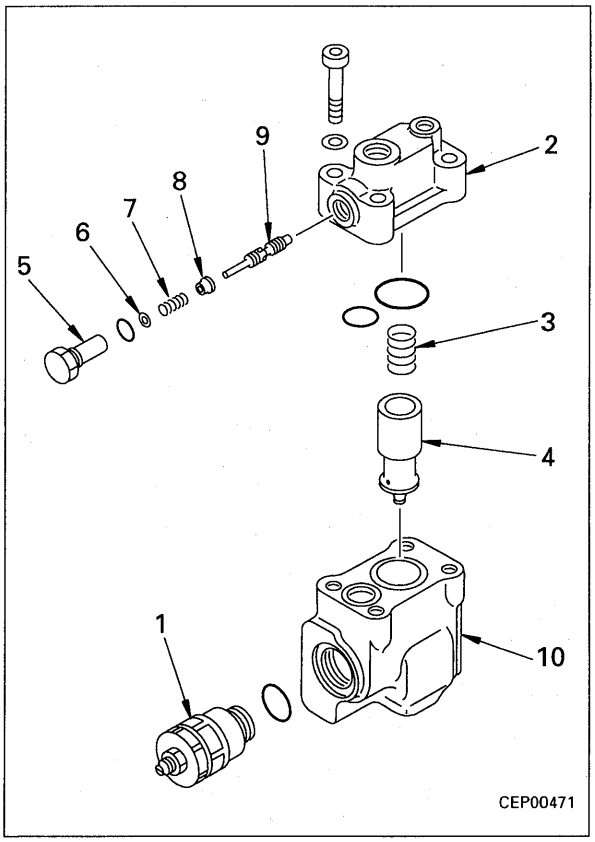
- Carry out installation in the reverse order to removal.
- **Refilling with oil**
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.
- **Bleeding air**
  ★ Bleed the air.
  For details, see TESTING AND ADJUSTING, Bleeding air.

DISASSEMBLY OF BOOM LOCK VALVE ASSEMBLY

1. Remove safety valve assembly (1).
   ★ The safety valve assembly cannot be adjusted when it is mounted on the machine, so do not disassemble it.

2. Remove body (2), then remove spring (3) and check valve (4).

3. Remove plug (5), then remove spacer (6), spring (7), seat (8), and spool (9).



ASSEMBLY OF BOOM LOCK VALVE ASSEMBLY

★ Coat the sliding parts with engine oil before assembling.

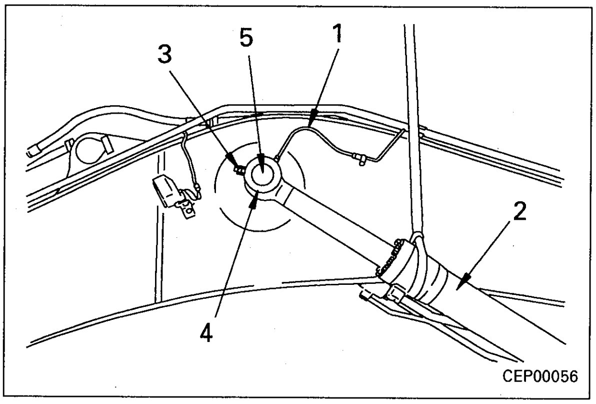
1. Assemble spool (9), seat (8), spring (7), and washer (6) to body (2), then fit O-ring and install plug (5).
   kgm Plug: **39.2 ± 4.9 Nm {4.0 ± 0.5 kgm}**

2. Assemble check valve (4) and spring (3) to body (10), then fit O-ring and install body (2).

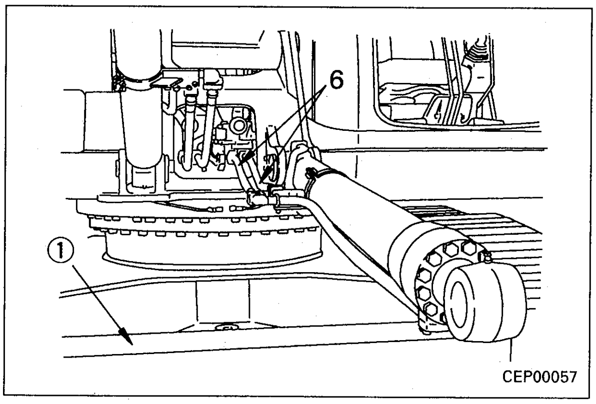
3. Fit O-ring and install safety valve assembly (1).
   kgm Safety valve:
   225.5 ± 9.8 Nm {23 ± 1 kgm}

REMOVAL OF BOOM CYLINDER ASSEMBLY

⚠ Extend the arm and bucket fully, lower the work equipment completely to the ground, and put the safety lock lever in the LOCK position.

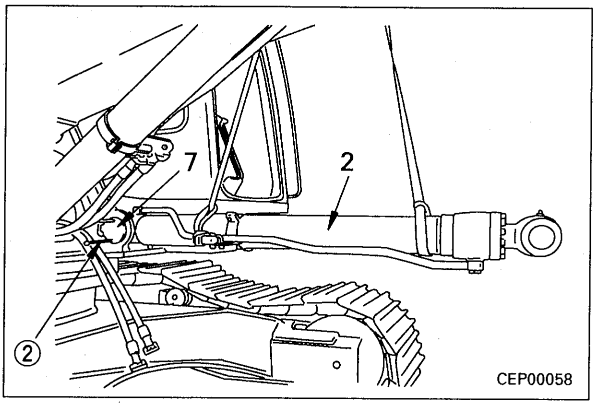


1. Disconnect grease hose (1).
2. Sling boom cylinder assembly (2), and remove lock bolt (3). ※ 1
3. Remove plate (4), then remove head pin (5). ※ 2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.
4. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ★ Set stand ① under the cylinder assembly, and adjust the position for slinging the cylinder assembly.
   ⚠ Release the remaining pressure in the hydraulic circuit.
   For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.



5. Disconnect hoses (6).
6. Remove plate, then using forcing screws ②, remove bottom pin (7), and remove boom cylinder assembly (2). ※ 3
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

kg Boom cylinder assembly: **410 kg**

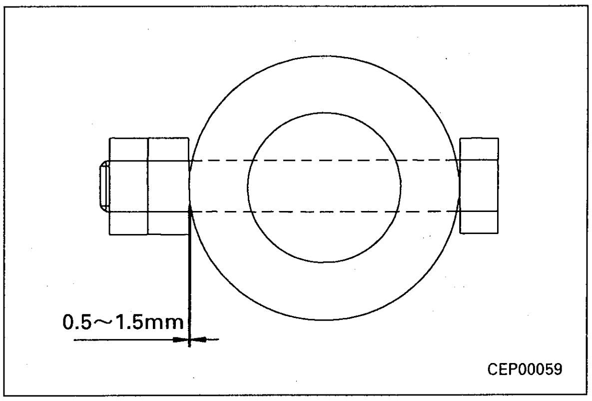


INSTALLATION OF BOOM CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 – 1.5 mm.



※ 2

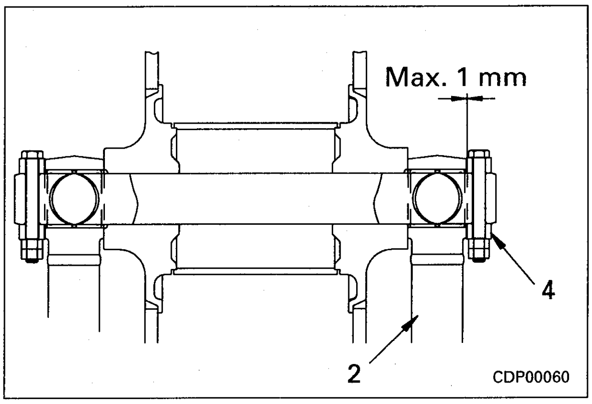
Inside surface of bushing when assembling pin: **Anti-friction compound (LM-P)**

Greasing after assembling pin: **Grease (LM-G)**

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between the end face of the rod of cylinder (2) and plate (4) is less than 1.0 mm.

- Standard shim thickness: 1.0 mm, 1.5 mm



※ 3

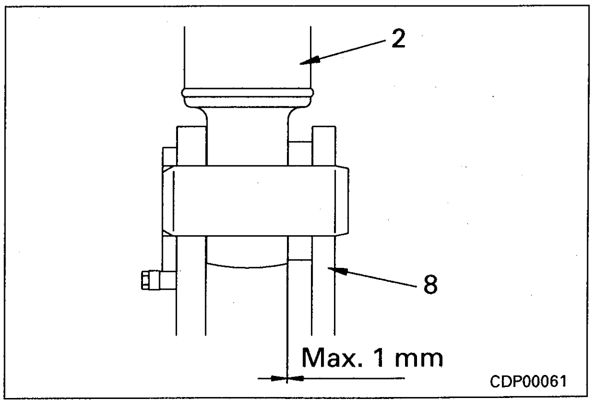
Inside surface of bushing when assembling pin: **Anti-friction compound (LM-P)**

Greasing after assembling pin: **Grease (LM-G)**

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between the end face of the bottom of cylinder (2) and bracket (8) is less than 1.0 mm.

- Standard shim thickness: 1.0 mm, 1.5 mm



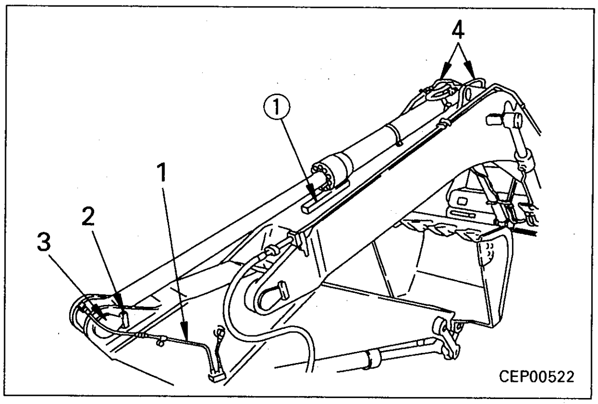
- **Bleeding air**

★ Bleed the air.
For details, see TESTING AND ADJUSTING, Bleeding air.

- **Refilling with oil (hydraulic tank)**

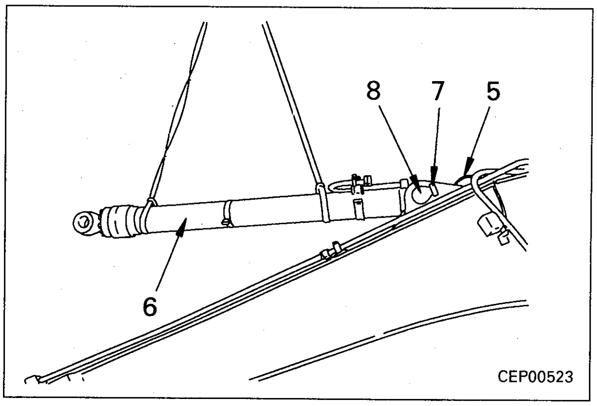
★ Add oil through the oil filler to the specified level.
Run the engine to circulate the oil through the system. Then check the oil level again.

REMOVAL OF ARM CYLINDER ASSEMBLY



⚠ Extend the arm cylinder piston rod to a point approx. 200 mm before the end of the IN stroke, lower the work equipment completely to the ground, then set the safety lock lever to the LOCK position.

1. Set block ① between arm cylinder and boom.
2. Disconnect grease hose (1).
3. Remove plate (2), then remove head pin (3). ※ 1
4. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ⚠ Release the remaining pressure in the hydraulic circuit.
   For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.
5. Disconnect hoses (4).
6. Disconnect grease hose (5).
7. Raise arm cylinder assembly (6), remove plate (7), then remove bottom pin (8), and remove arm cylinder assembly (6). ※ 2
   ★ There are shims installed, so check the number, thickness, and position, and keep in a safe place.



kg Arm cylinder assembly: **600 kg (PC400)**
650 kg (PC450)

INSTALLATION OF ARM CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

Inside surface of bushing when assembling pin: **Anti-friction compound (LM-P)**

Greasing after assembling pin: **Grease (LM-G)**

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

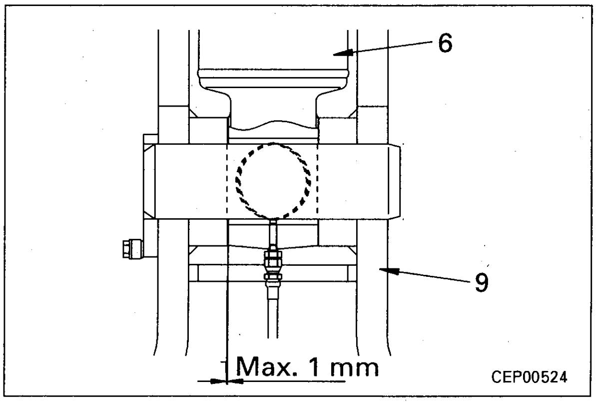
※ 2

Inside surface of bushing when assembling pin: **Anti-friction compound (LM-P)**

Greasing after assembling pin: **Grease (LM-G)**

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between the end face of the bottom of cylinder (6) and bracket (9) is less than 1.0 mm.
  - Standard shim thickness: 1.0 mm



- **Bleeding air**

  ★ Bleed the air.
  For details, see TESTING AND ADJUSTING, Bleeding air.

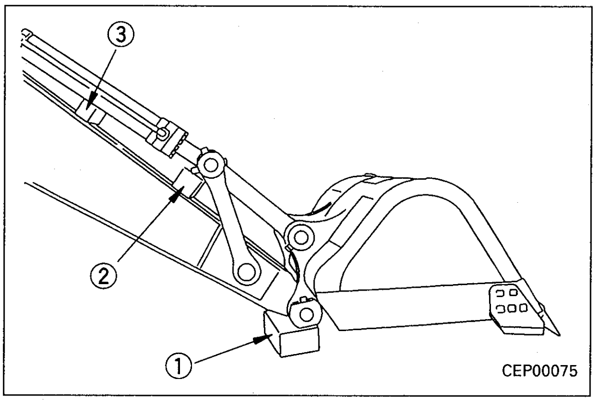
- **Refilling with oil (hydraulic tank)**

  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

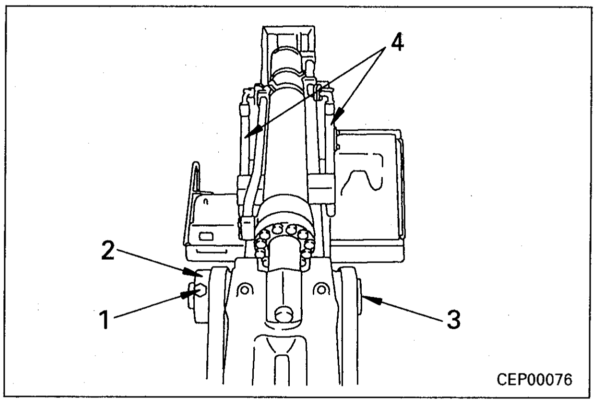
REMOVAL OF BUCKET CYLINDER ASSEMBLY

⚠ Extend the bucket cylinder piston rod to a point approx. 200 mm before the end of the DUMP stroke, lower the work equipment completely to the ground, then set the safety lock lever to the LOCK position.

1. Set block ① under arm top, block ② between link and arm, and block ③ between bucket cylinder and arm.

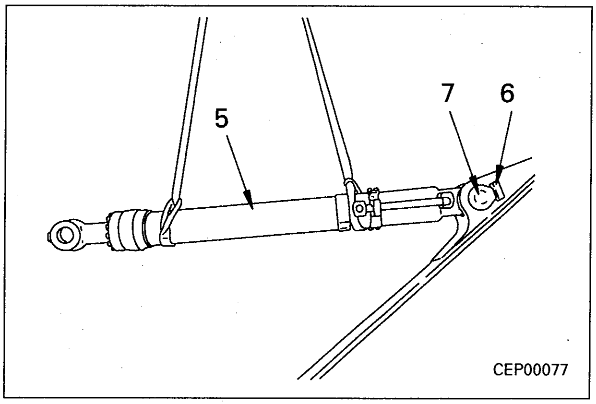


2. Remove lock bolt (1). ※ 1
3. Remove plate (2), then remove head pin (3). ※ 2
4. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ⚠ Release the remaining pressure in the hydraulic circuit.
   For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.



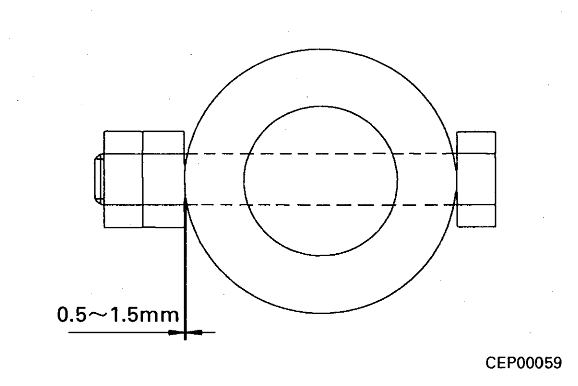
5. Disconnect hoses (4).
6. Raise bucket cylinder assembly (5), remove plate (6), then remove bottom pin (7), and remove bucket cylinder assembly (5). ※ 3
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

kg Bucket cylinder assembly: **350 kg**



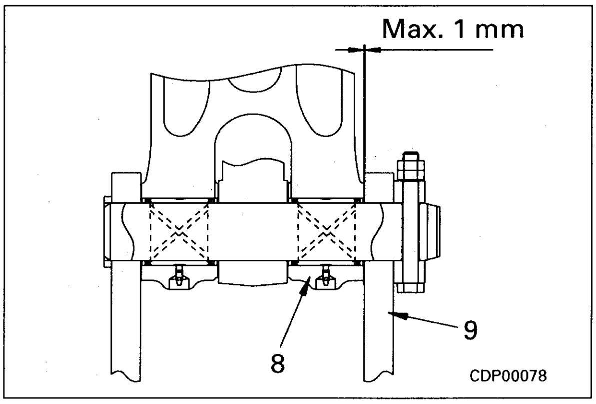
INSTALLATION OF BUCKET CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.



※ 1

★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 – 1.5 mm.



※ 2

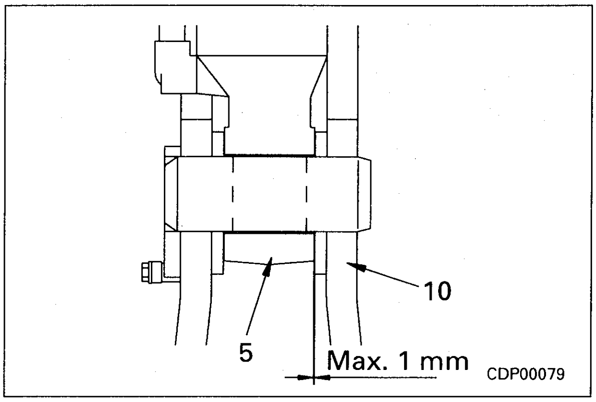
Inside surface of bushing when assembling pin: **Anti-friction compound (LM-P)**

Grease after assembling pin: **Grease (LM-G)**

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between link (8) and link (9) is less than 1.0 mm.

- Standard shim thickness: 0.8 mm



※ 3

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 in the pin hole.

★ Adjust the shim thickness so that the clearance between the end face of the bottom of cylinder (5) and bracket (10) is less than 1.0 mm.

- Standard shim thickness: 1.0 mm

- **Bleeding air**

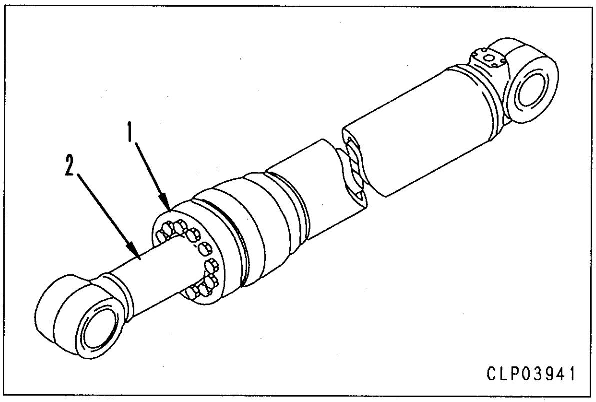
  ★ Bleed the air.
  For details, see TESTING AND ADJUSTING, Bleeding air.

- **Refilling with oil (hydraulic tank)**

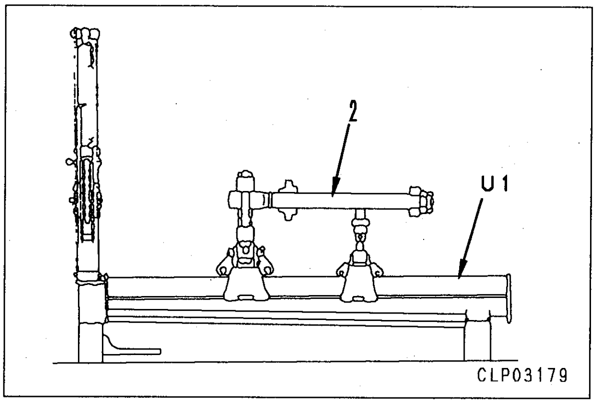
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

DISASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

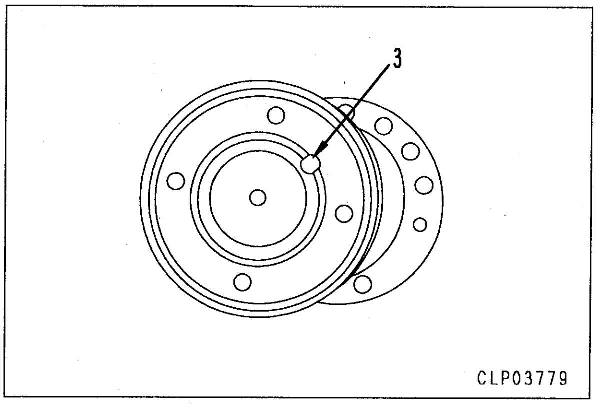
1. **Piston rod assembly**
   1) Remove piping from cylinder assembly.
   2) Remove mounting bolts, and disconnect head assembly (1).
   3) Pull out piston rod assembly (2).
      ★ Place a container under the cylinder to catch the oil.



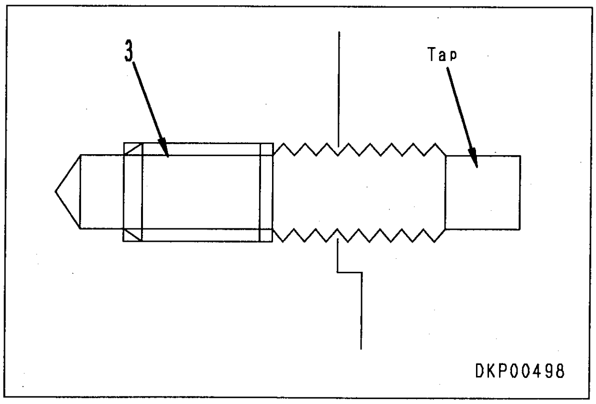
   4) Disassemble piston rod assembly as follows.
      i) Set piston rod assembly (2) to tool **U1**.



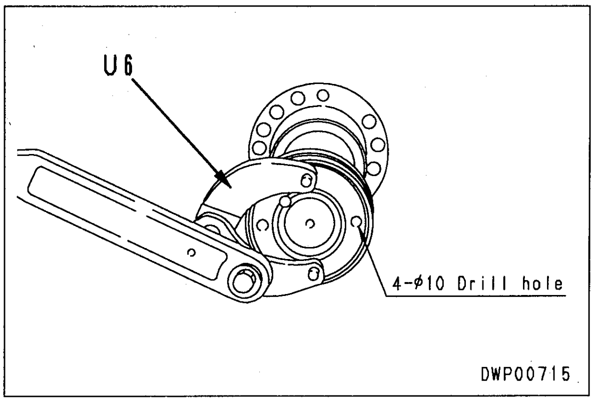
      ii) Remove piston assembly stopper screw (3).
      Screw size:
      M12 x pitch 1.75: Boom, Arm, Bucket



      ★ If screw (3) has been caulked strongly and cannot be removed, screw it in fully, then fit a tap to the thread and pull it out.



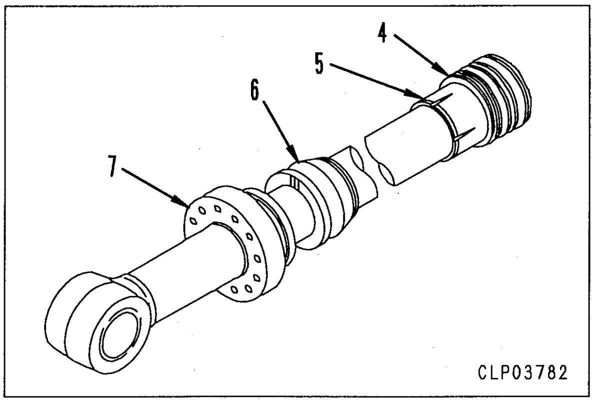
iii) Using tool **U6**, remove piston assembly (4).
   - When not using tool **U6**, use the drill holes (ϕ10: 4 places) and loosen the piston assembly.



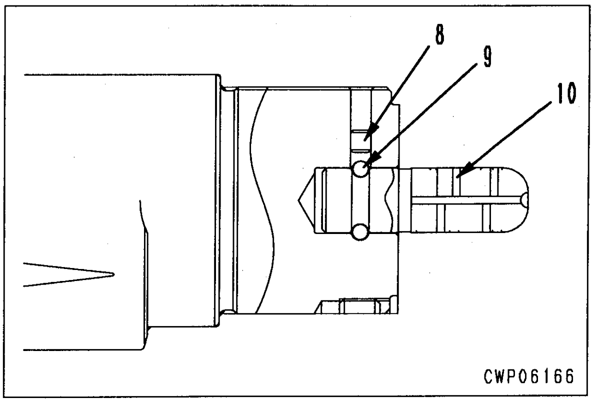
iv) Remove plunger (5).
   - Arm and boom cylinder only

v) Remove collar (6).
   - Arm and boom cylinder only

vi) Remove head assembly (7).

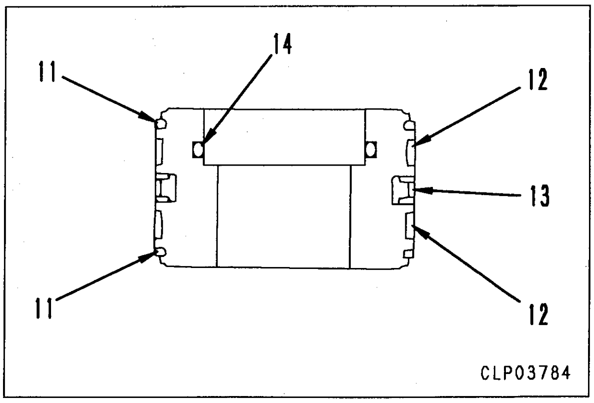


vii) Remove cap (8), and pull out 12 balls (9), then remove cushion plunger (10).
   - Arm cylinder only



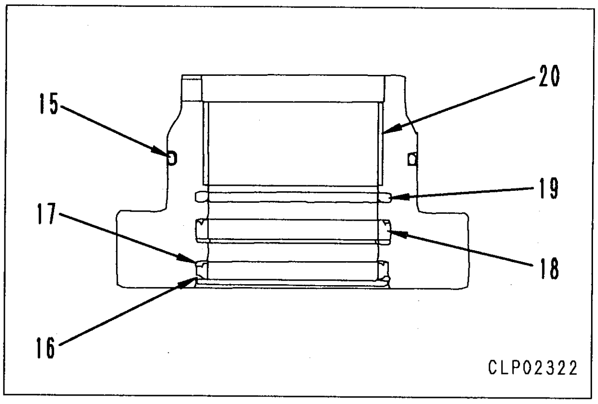
2. Disassembly of piston assembly

1) Remove ring (11).
2) Remove wear ring (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 bushing (20).

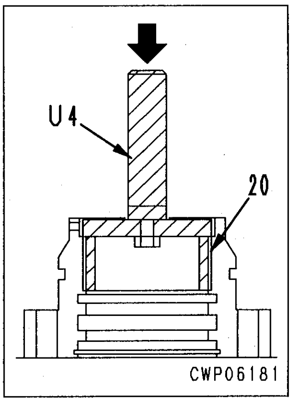


ASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

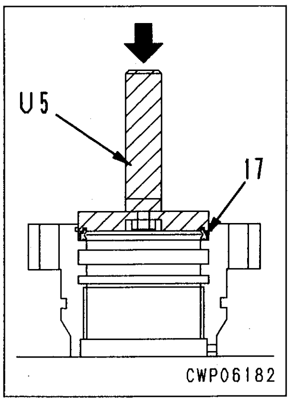
★ Be careful not to damage the packings, dust seals, and O-rings.

★ Do not try to force the backup ring into position. Warm it in warm water (50 – 60°C) before fitting it.

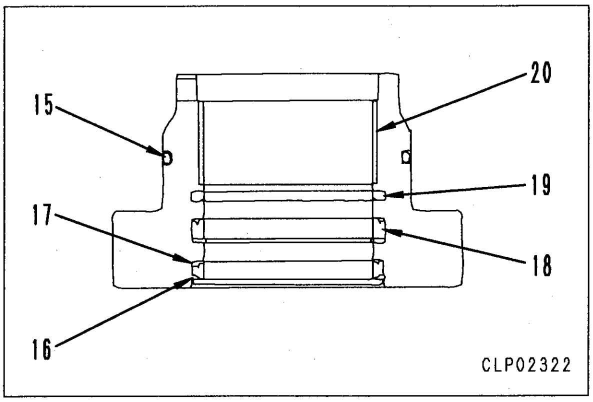
1. Assembly of cylinder head assembly
1) Using tool **U4**, press fit bushing (20).
2) Assemble buffer ring (19).
3) Assemble rod packing (18).
4) Using tool **U5**, install dust seal (17), and secure with snap ring (16).
5) Install backup ring and O-ring (15).



CWP06181

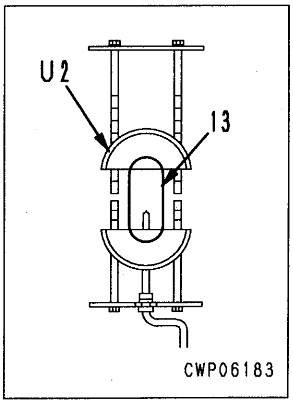


CWP06182

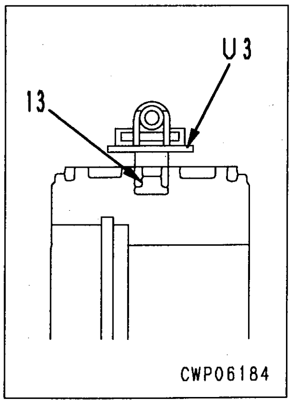


CLP02322

2. Assembly of piston assembly
1) Using tool **U2**, expand piston ring (13).
   ★ Set the piston ring on tool **U2**, and turn the handle 8 – 10 times to expand the ring.
2) Set tool **U3** in position, and compress piston ring (13).

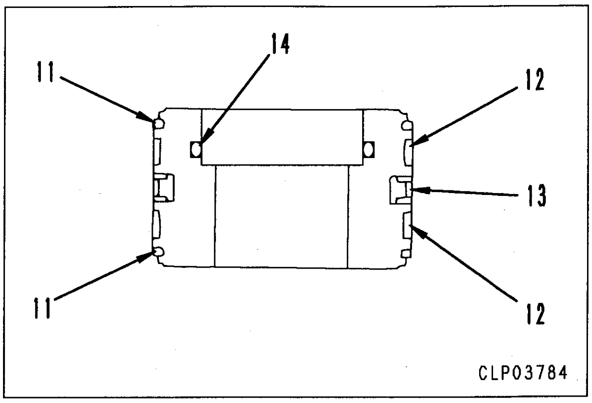


CWP06183



CWP06184

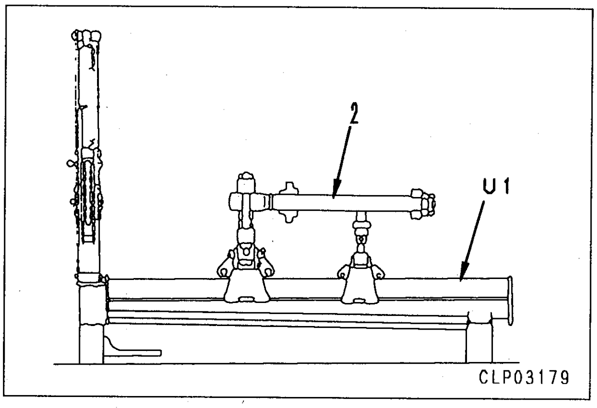
3) Install backup ring and O-ring (14).
4) Assemble wear ring (12).
5) Assemble ring (11).
   ★ Be careful not to open the end gap of the ring too wide.
   Ring groove : **Grease (G2-LI)**



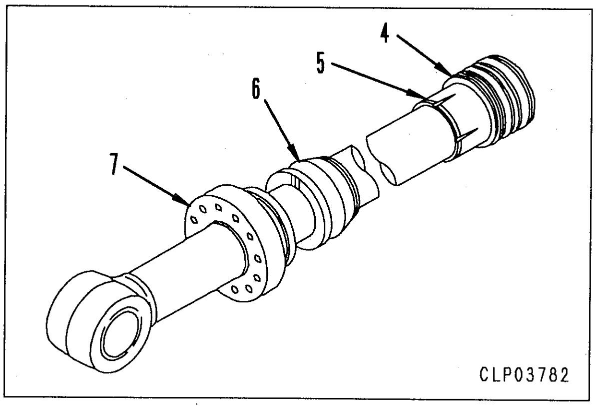
CLP03784

3. Piston rod assembly

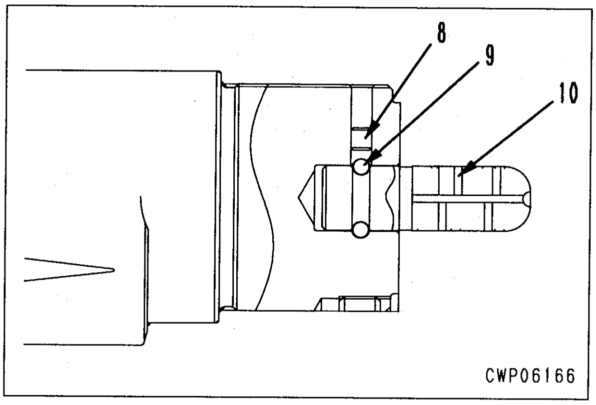
1) Set piston rod assembly (2) to tool **U1**.



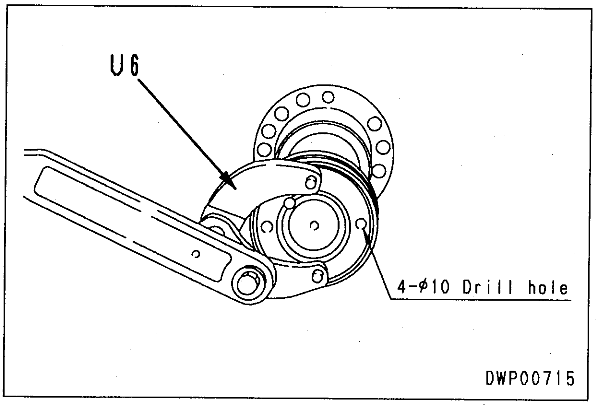
2) Assemble head assembly (7).
3) Fit O-ring and backup ring to collar (6), then assemble.
   - Boom and arm cylinder only
4) Assemble plunger (5).
- Boom and arm cylinder only
  ★ Check that there is a small amount of play at the tip of the plunger.



5) Set cushion plunger (10) to piston rod, then assemble 12 balls (9), and secure with cap (8).
   - Arm cylinder only

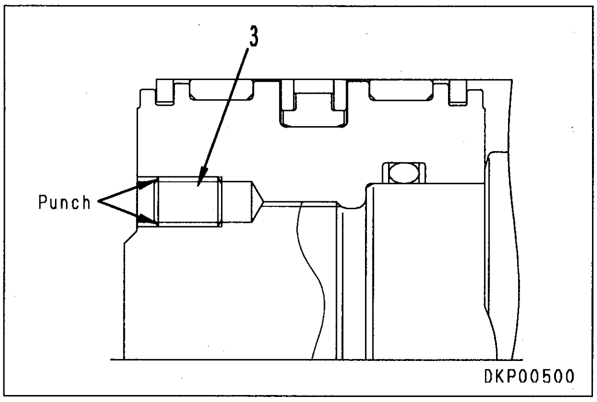


6) Assemble piston assembly (4) as follows.
   - When using rod and piston assembly (2) again
     ★ Wash thoroughly and remove all metal particles and dirt.
   i) Screw in piston assembly (4), then use tool **U6** to tighten piston assembly (2) so that position of screw thread hole matches.
      ★ Remove all burrs and flashes with a file.
   ii) Tighten screw (3).
      kgm Screw (3):
      66.2 ± 7.35 Nm {6.75 ± 0.75 kgm}



iii) Caulk thread at 2 places with punch.

- When using a new part for either or both of rod or piston assembly (2)
  - ★ For the rod with bottom cushion, mark the cushion plug position on the end face of the rod.
    - Arm cylinder only

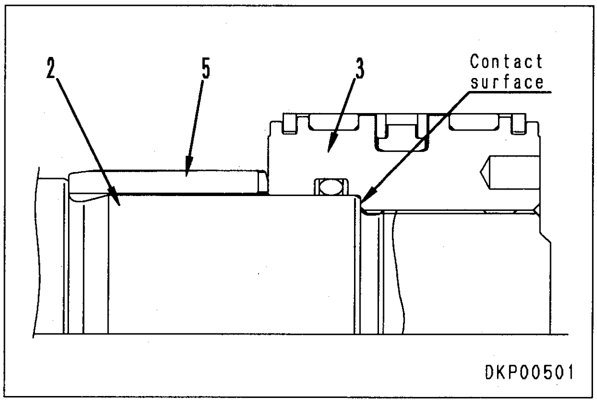


i) Screw in until piston assembly (4) contacts end face of rod, then use tool **U6** to tighten.

kgm Piston assembly (4):

294 ± 29.4 Nm {30 ± 3.0 kgm}

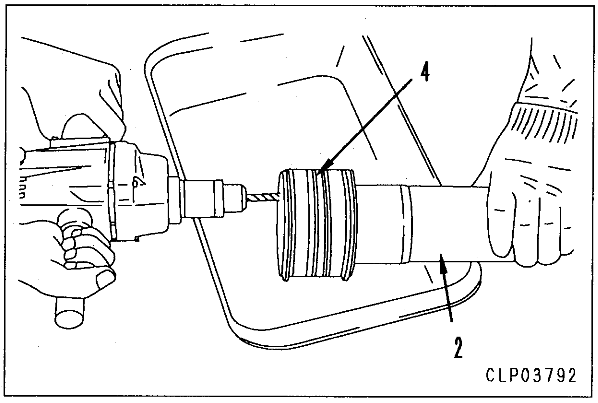
- ★ After tightening the piston, check that there is play in plunger (5).
- Boom, arm cylinder only



ii) Machine one hole 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	12×1.75	20



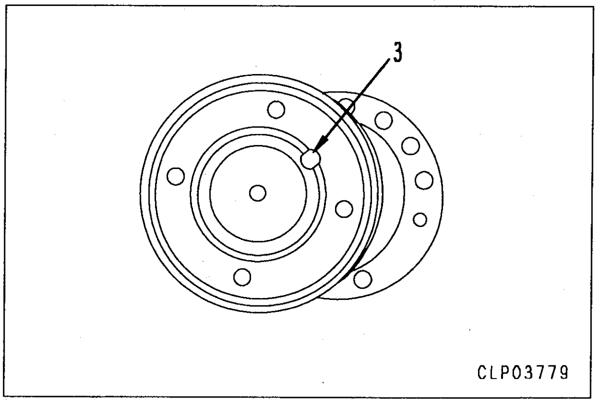
iii) After machining, wash thoroughly to remove all metal particles and dust.

iv) Tighten screw (3).

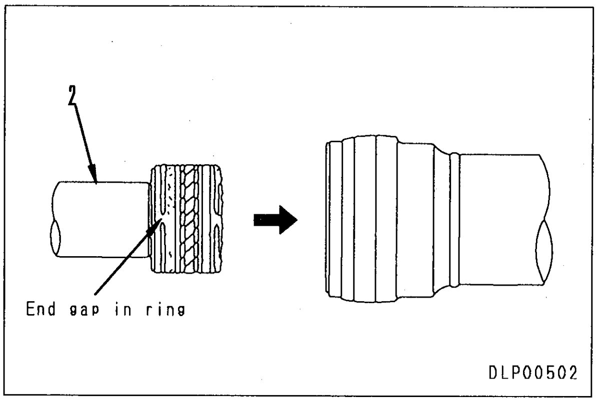
kgm Screw (3):

66.2 ± 7.35 Nm {6.75 ± 0.75 kgm}

v) Caulk thread at 2 places with punch.

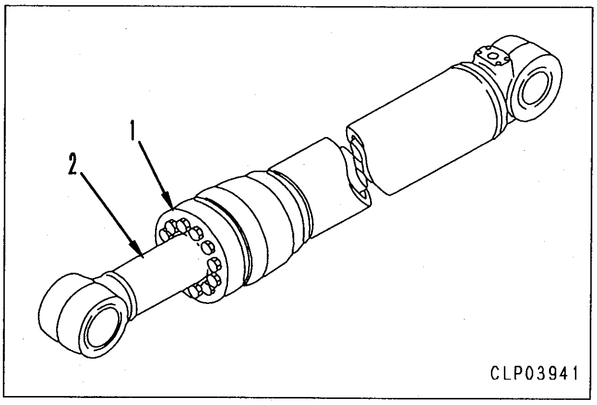


7) Assemble piston rod assembly (2).
   Seal portion: **Grease (G2-LI)**
   ★ Set the end gap of the ring at the horizontal (side) position, align the axial center of shaft and cylinder tube, then insert.
   ★ After inserting, check that the ring is not broken and has not come out, then push in fully.



8) Tighten head assembly (1) with mounting bolts.
   Mounting bolt :

Cylinder	Tightening torque
Bucket	**373 ± 54.0 Nm {38.0 ± 5.5 kgm}**
Arm	**530 ± 78.5 Nm {54.0 ± 8.0 kgm}**
Boom	**373 ± 54.0 Nm {38.0 ± 5.5 kgm}**



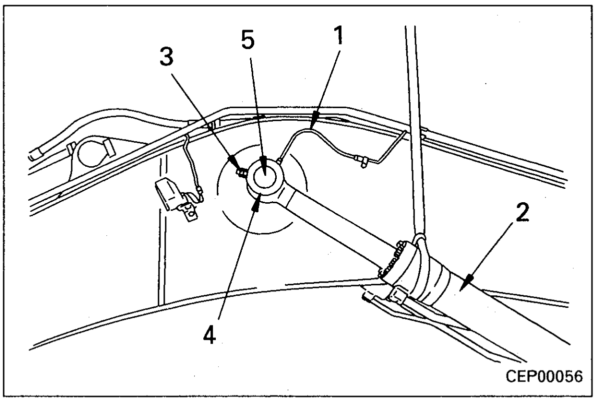
9) Install piping.

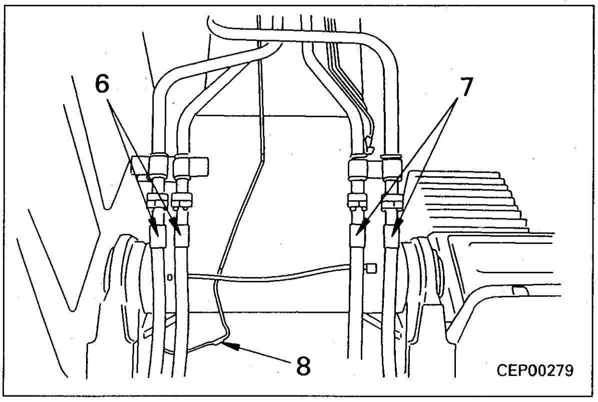
REMOVAL OF WORK EQUIPMENT ASSEMBLY

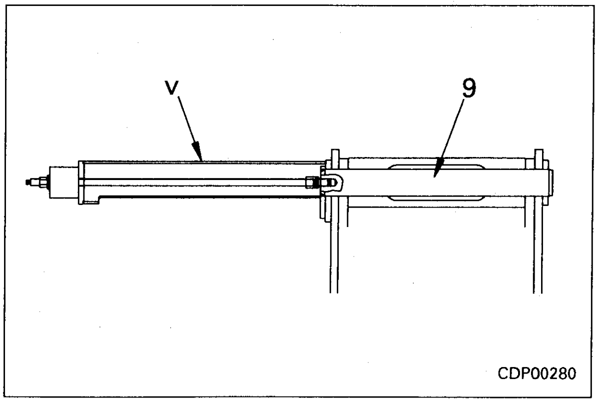
⚠ Extend the arm and bucket fully, lower the work equipment to the ground, and set the safety lock lever to the LOCK position.

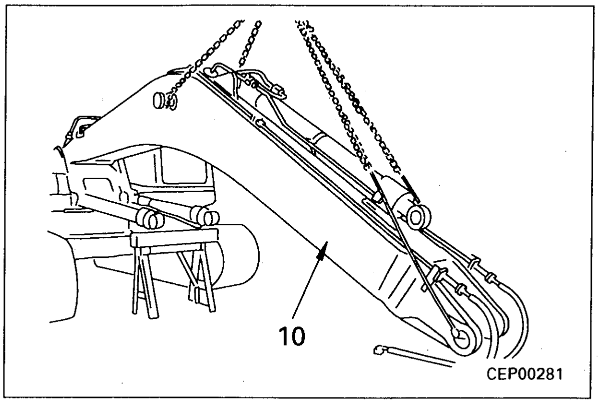
1. Disconnect grease hose (1).
2. Sling boom cylinder assembly (2), and remove lock bolt (3). ※1
3. Remove plate (4), then remove head pin (5). ※2
   - ★ There are shims installed, so check the number and thickness, and keep in a safe place.
4. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out, and lower cylinder onto stand.
   - ★ Disconnect the boom cylinder on the opposite side in the same way.
   - ⚠ Release the remaining pressure in the hydraulic circuit.
     For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.
5. Disconnect arm cylinder hoses (6) and bucket cylinder hoses (7), and secure to valve with rope.
6. Disconnect wiring connector (8) for working lamp.
7. Remove plate, and set tool **V** to boom foot pin (9).
8. Raise work equipment assembly (10), then remove boom foot pin (9) using tool **V**, and remove work equipment assembly (10). ※3
   - ★ There are shims installed, so check the number and thickness, and keep in a safe place.

kg Work equipment assembly: **7600 kg**



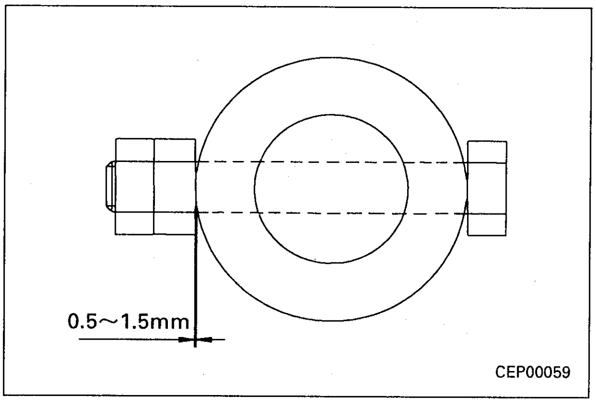






INSTALLATION OF WORK EQUIPMENT ASSEMBLY

- Carry out installation in the reverse order to removal.



※ 1

★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 – 1.5 mm.

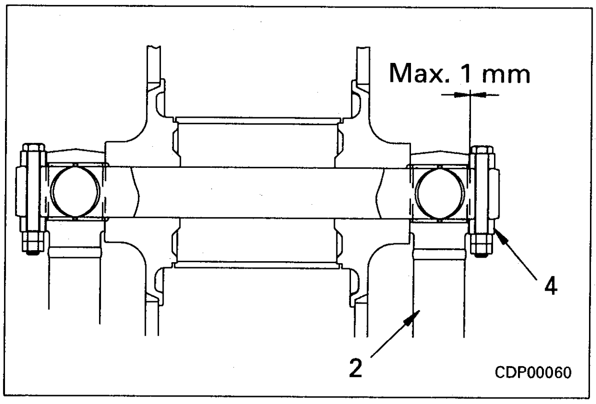
※ 2

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 in the pin hole.

★ Adjust the shim thickness so that the clearance between the end face of the rod of cylinder (2) and plate (4) is less than 1.0 mm.
- Standard shim thickness: 1.0 mm, 1.5 mm



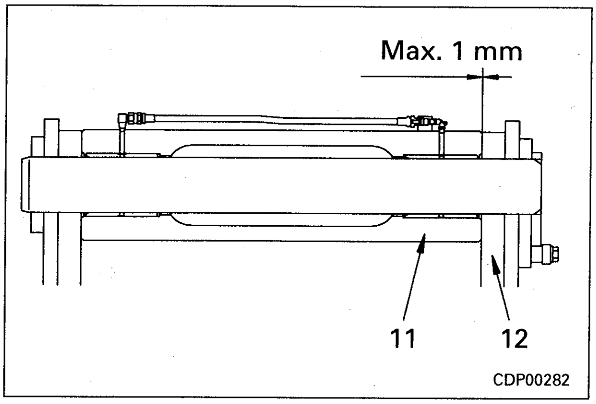
※ 3

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 in the pin hole.

★ Adjust the shim thickness so that the clearance between the end face of the foot of boom (11) and bracket (12) is less than 1.0 mm.
- Standard shim thickness: 0.8 mm, 1.5 mm



- **Bleeding air**

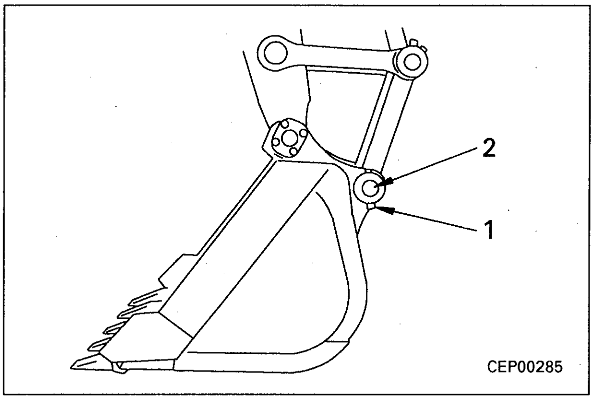
  ★ Bleed the air.
  For details, see TESTING AND ADJUSTING, Bleeding air.

- **Refilling with oil (hydraulic tank)**

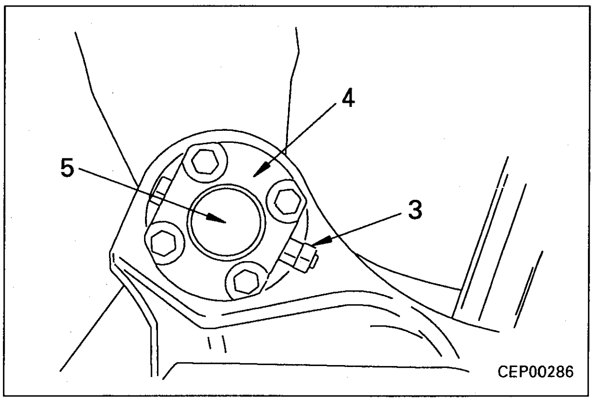
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

REMOVAL OF BUCKET ASSEMBLY

⚠ Set the back of the bucket facing down, lower the work equipment completely to the ground, and set the safety lock lever to the LOCK position.

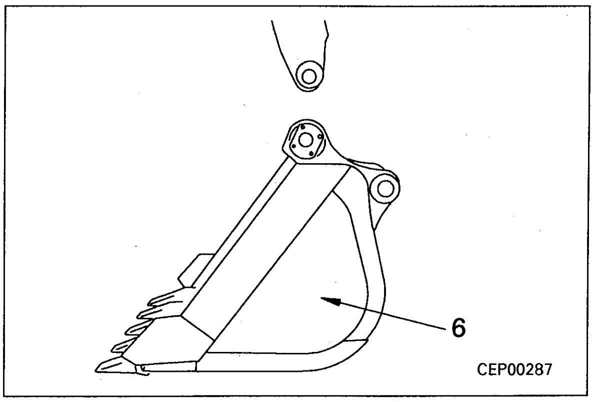


1. Remove lock bolt (1). ※ 1
2. Remove connecting pin (2) between link and bucket. ※ 2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.
3. Start engine, and retract piston rod, then tie link to arm with wire to prevent piston rod from coming out.
4. Remove lock bolt (3). ※ 3
5. Remove plate (4), then remove connecting pin (5) between arm and bucket. ※ 4
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.



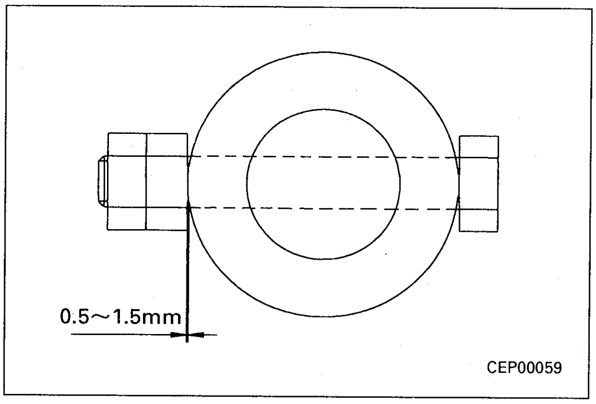
6. Start engine, then raise work equipment and swing to remove bucket assembly (6).

kg Bucket assembly: **1300 kg**



INSTALLATION OF BUCKET ASSEMBLY

- Carry out installation in the reverse order to removal.



※1, ※3

★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 – 1.5 mm.

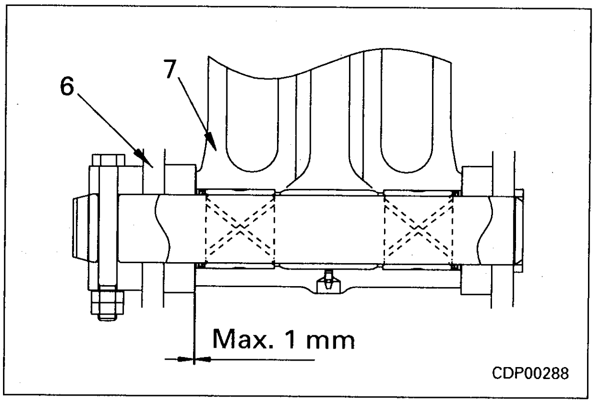
※2

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 in the pin hole.

★ Adjust the shim thickness so that the clearance between the end face of the boss of bucket (6) and link (7) is less than 1.0 mm.
  - Standard shim thickness: 0.8 mm



※4

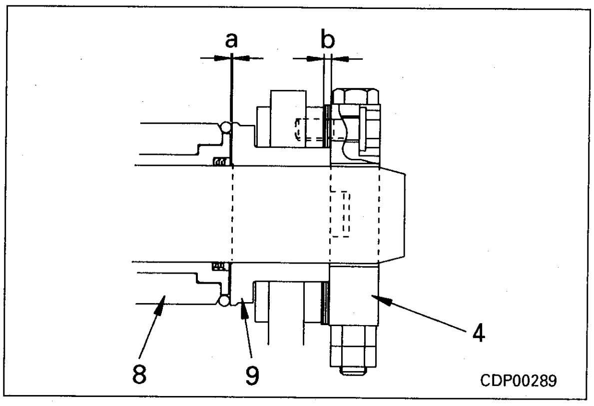
Inside surface of bushing when assembling pin: **Anti-friction compound (LM-P)**

Grease after assembling pin: **Grease (LM-G)**

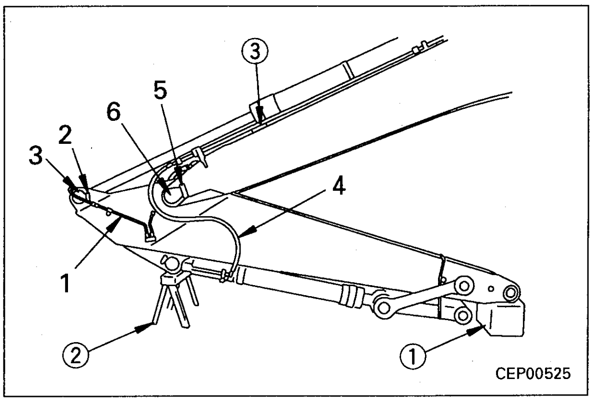
⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

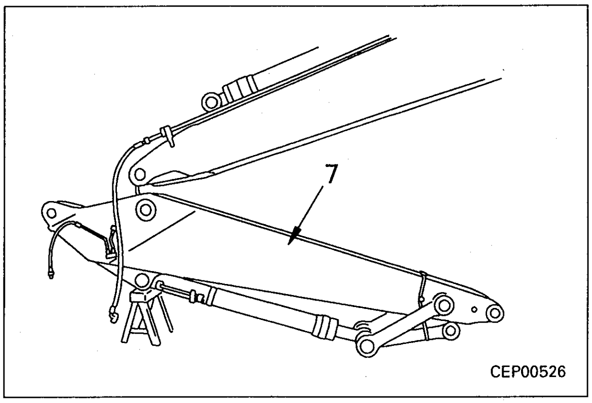
★ Insert the O-ring at the end face of the bucket boss securely.

★ Adjusting bucket clearance.
1) Measure clearance **a** between arm (8) and bushing (9).
   ★ It is easier to measure if the bucket is moved to one side so that all the play is in one place.
2) Select shim thickness **b** so that clearance **a** is 0.5 – 1.0 mm.
   ★ Standard shim thickness: 0.5 mm, 1.0 mm
3) Install selected shim, then install plate (4).



REMOVAL OF ARM ASSEMBLY





1. Remove bucket assembly.
   For details, see REMOVAL OF BUCKET ASSEMBLY.

2. Secure link to arm with wire.
   ⚠ Extend the arm cylinder piston rod to a point approx. 200 mm before the end of the IN stroke, then lower the arm on to block ① and stand ②, and set the safety lock lever to the LOCK position.

3. Set block ③ between arm cylinder and boom.

4. Disconnect grease hose (1).

5. Remove plate (2), then remove arm cylinder head pin (3). ※ 1

6. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ⚠ Release the remaining pressure in the hydraulic circuit.
   For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.

7. Disconnect 2 bucket cylinder hoses (4).

8. Remove plate (5), then remove connecting pin (6) between arm and boom. ※ 2
   ★ There are shims installed, so check the number, thickness, and position, and keep in a safe place.

9. Start engine, then raise boom, and swing to remove arm assembly (7).

   kg Arm assembly: **2100 kg**

INSTALLATION OF ARM ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

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 in the pin hole.

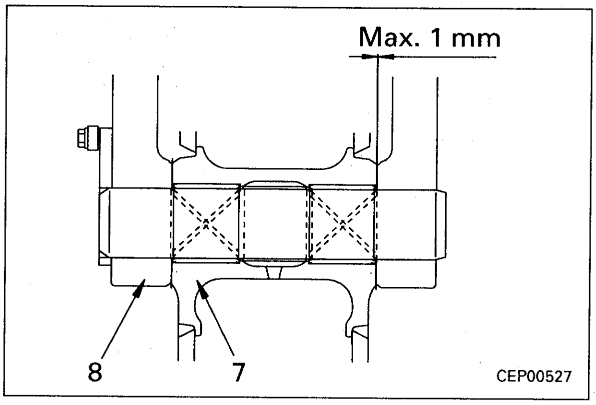
※ 2

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 in the pin hole.

★ Adjust the shim thickness so that the clearance between the end face of the bottom of arm (7) and boom (8) is below 1.0 mm.
  - Standard shim thickness: 1.0 mm



- **Bleeding air**

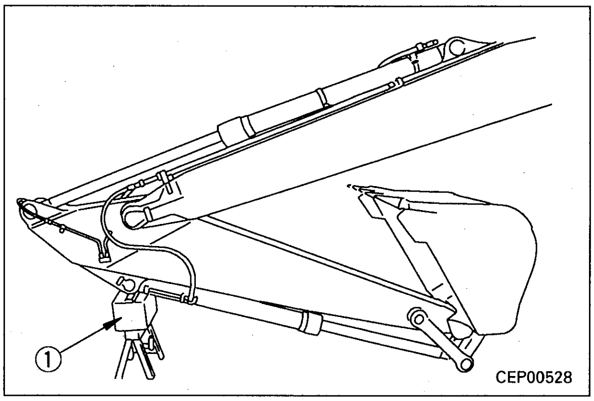
  ★ Bleed the air.
  For details, see TESTING AND ADJUSTING, Bleeding air.

- **Refilling with oil (hydraulic tank)**

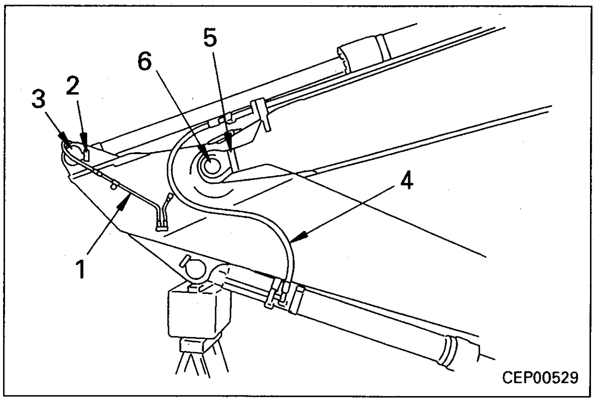
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

REMOVAL OF BUCKET, ARM ASSEMBLY

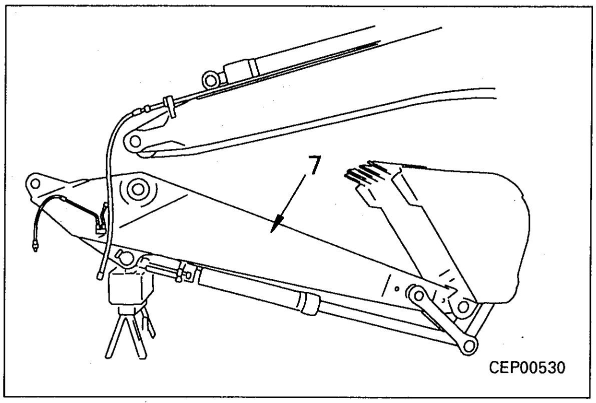
⚠ Extend the bucket cylinder piston rod to the end of the CURL stroke, and the arm cylinder piston rod to a point approx. 200 mm before the end of the IN stroke. Then lower the work equipment completely to the ground, and set the safety lock lever to the LOCK position.



1. Set block ① to bucket cylinder bottom mounting boss portion of arm.
2. Disconnect grease hose (1).
3. Remove plate (2), then remove arm cylinder head pin (3). ※ 1



4. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out.
   ⚠ Release the remaining pressure in the hydraulic circuit.
   For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.
5. Disconnect 2 bucket cylinder hoses (4).
6. Remove plate (5), then remove connecting pin (6) between arm and boom. ※ 2
   ★ There are shims installed, so check the number, thickness, and position, and keep in a safe place.



7. Start engine, then raise boom, and swing to remove bucket and arm assembly (7).

kg Bucket, arm assembly: **3450 kg**

INSTALLATION OF BUCKET, ARM ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

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 in the pin hole.

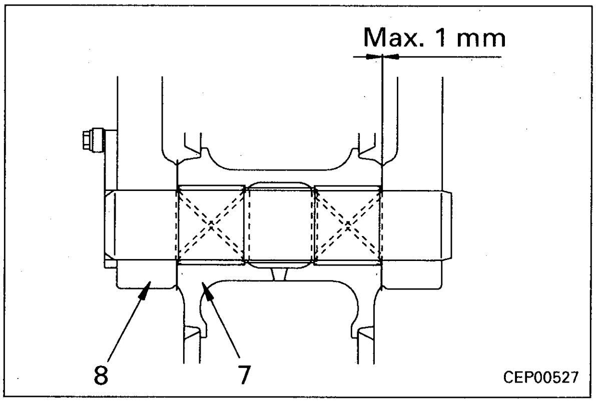
※ 2

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 in the pin hole.

★ Adjust the shim thickness so that the clearance between the end face of the bottom of arm (7) and boom (8) is less than 1.0 mm.
  - Standard shim thickness: 1.0 mm



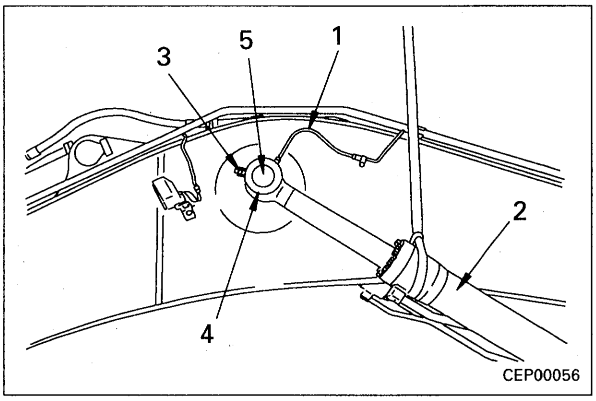
- **Bleeding air**

  ★ Bleed the air.
  For details, see TESTING AND ADJUSTING, Bleeding air.

- **Refilling with oil (hydraulic tank)**

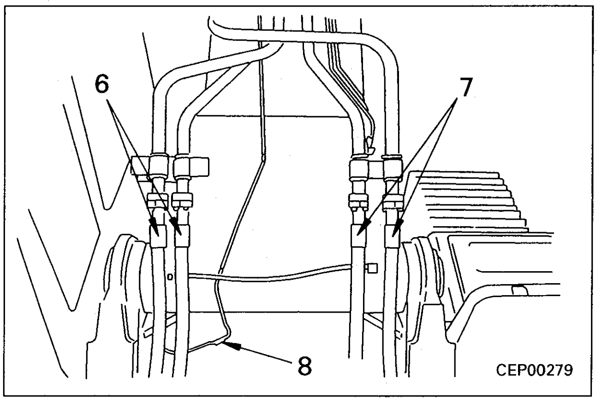
  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

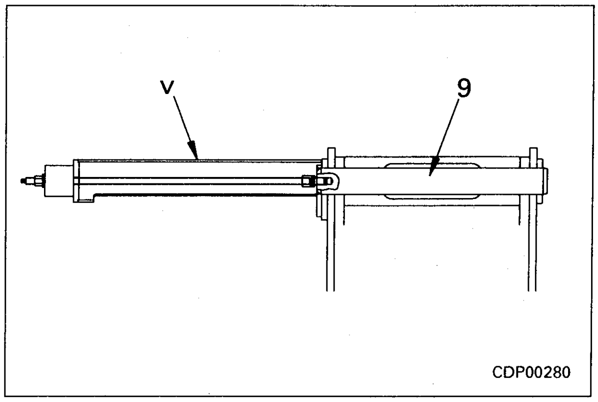
REMOVAL OF BOOM ASSEMBLY

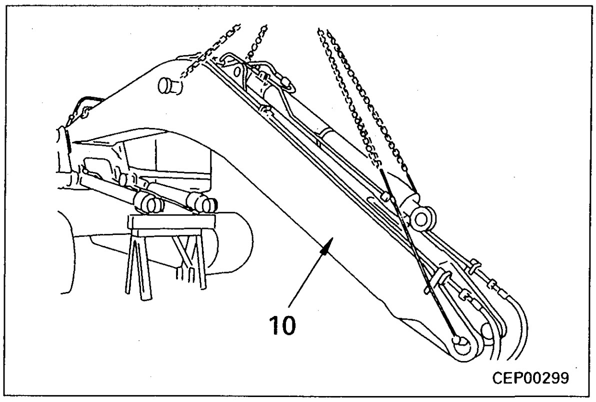


1. Remove bucket and arm assembly
   For details, see REMOVAL OF BUCKET, ARM ASSEMBLY.
   ⚠ Lower the boom assembly completely to the ground, and set the safety lock lever to the LOCK position.
2. Disconnect grease hose (1).
3. Sling boom cylinder assembly (2), and remove lock bolt (3). ※1
4. Remove plate (4), then remove head pin (5). ※2
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.
5. Start engine, and retract piston rod, then tie piston rod with wire to prevent it from coming out, and lower it onto stand.
   ★ Disconnect the boom cylinder on the opposite side in the same way.
   ⚠ Release the remaining pressure in the hydraulic circuit.
   For details, see TESTING AND ADJUSTING, Releasing remaining pressure in hydraulic circuit.
6. Disconnect arm cylinder hoses (6) and bucket cylinder hoses (7), and secure to valve with rope.
7. Disconnect wiring connector (8) for working lamp
8. Remove plate, and set tool **V** to boom foot pin (9).
9. Raise boom assembly (10), remove boom foot pin (9) using tool **V**, then remove boom assembly (10). ※3
   ★ There are shims installed, so check the number and thickness, and keep in a safe place.

kg Boom assembly: **3950 kg**

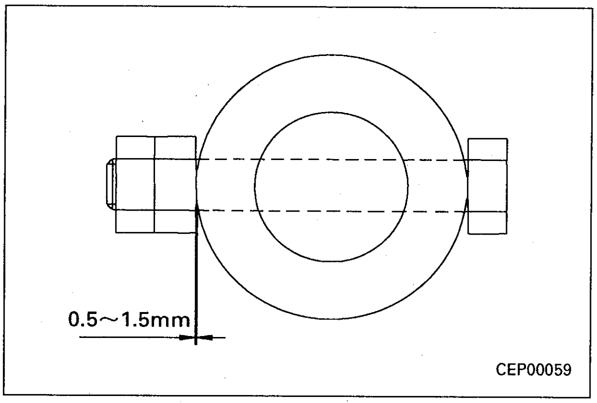






INSTALLATION OF BOOM ASSEMBLY

- Carry out installation in the reverse order to removal.



※ 1

★ When tightening the locknut, tighten so that the clearance between the plate and nut is 0.5 – 1.5 mm.

※ 2

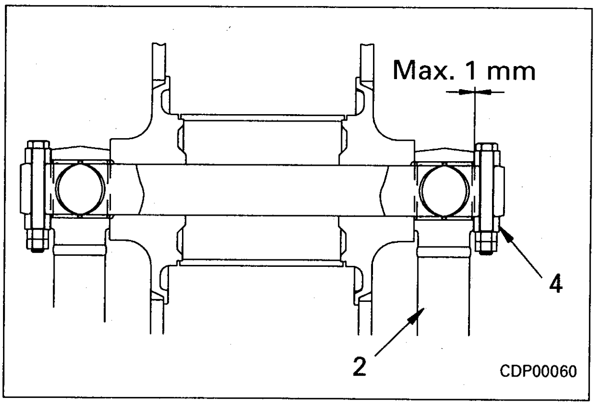
Inside surface of bushing when assembling pin: **Anti-friction compound (LM-P)**

Grease after assembling pin: **Grease (LM-G)**

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between the end face of the rod of cylinder (2) and plate (4) is less than 1.0 mm.

- Standard shim thickness: 1.0 mm, 1.5 mm



※ 3

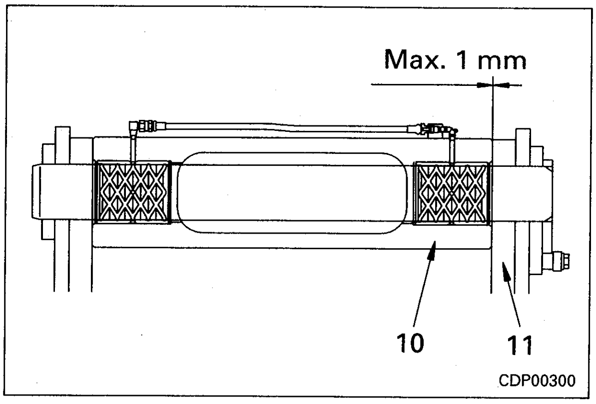
Inside surface of bushing when assembling pin: **Anti-friction compound (LM-P)**

Grease after assembling pin: **Grease (LM-G)**

⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

★ Adjust the shim thickness so that the clearance between the end face of the foot of boom (10) and bracket (11) is less than 1.0 mm.

- Standard shim thickness: 0.8 mm, 1.5 mm



- **Bleeding air**

  ★ Bleed the air.
  For details, see TESTING AND ADJUSTING, Bleeding air.

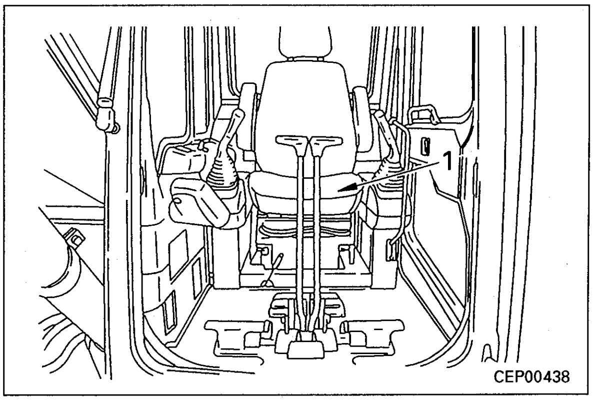
- **Refilling with oil (hydraulic tank)**

  ★ Add oil through the oil filler to the specified level.
  Run the engine to circulate the oil through the system. Then check the oil level again.

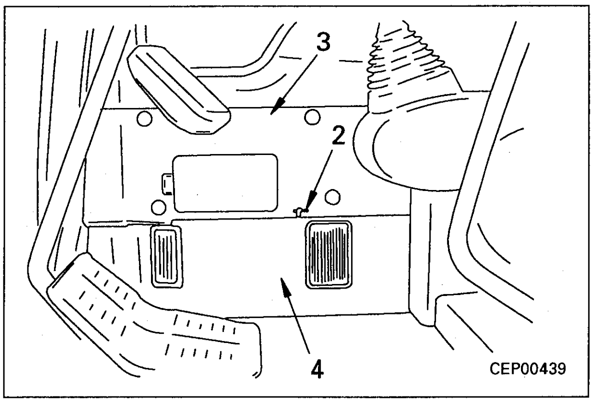
REMOVAL OF OPERATOR'S CAB ASSEMBLY

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

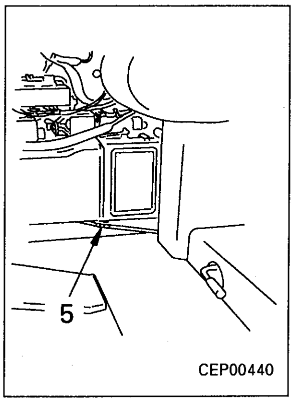
1. Remove floor mat.
2. Remove operator's seat (1).
   ★ Be careful not to damage the covers.

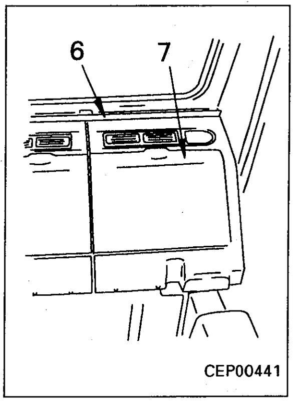


3. Remove knob (2).
4. Remove 4 bolts and 1 clip, then remove panels (3) and (4).

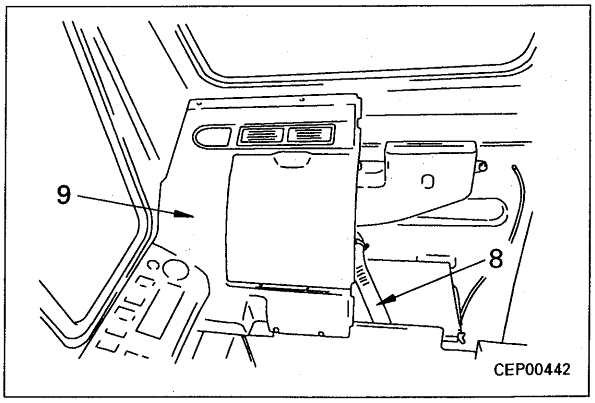


5. Disconnect window washer hose (5).
6. Remove plate (6), then remove left cover (7).





7. Disconnect hose (8) and speaker wiring connector, then remove right cover (9).
   ★ Lift up right cover (9) slightly before disconnecting the speaker wiring connector.

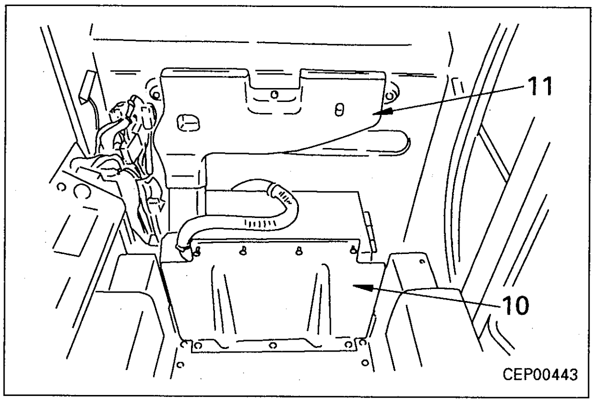


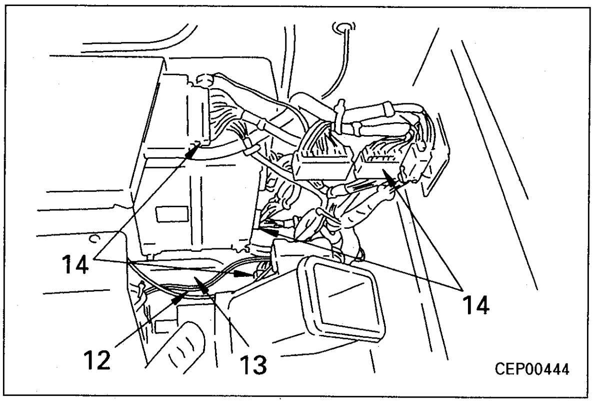
8. Remove cover (10) and duct (11).

9. Disconnect air conditioner cable (12).

10. Disconnect duct (13) at front.

11. Disconnect 11 connectors (14).
    ★ Panel: CN-X07 (MIC21)
    ★ Controller: CN-C01 (MIC13)
    : CN-C02 (MIC21)
    : CN-C03 (MIC20)
    : CN-C16 (MIC17)
    ★ Wiring harness intermediate
    : CN-H12 (S16) White
    : CN-H13 (S16) Blue
    : CN-H14 (M6)
    : CN-H15 (L2)
    ★ Speaker: CM-M13 (KES-2)
    ★ Air conditioner: No connector No.



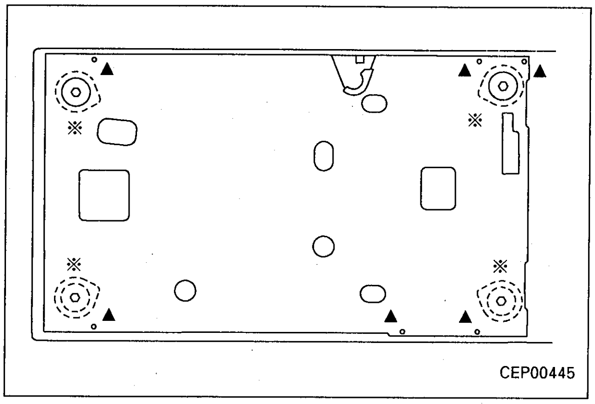


12. Remove 4 mounting nuts and 6 mounting bolts, then lift off operator's cab assembly (15). ※ 1

kg Operator's cab assembly: **300 kg**

- ※: Nut ▲: Bolt

★ Check the length of the bolts.

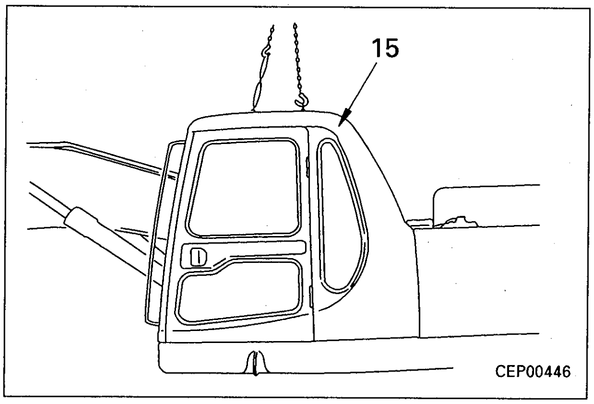


INSTALLATION OF OPERATOR'S CAB ASSEMBLY

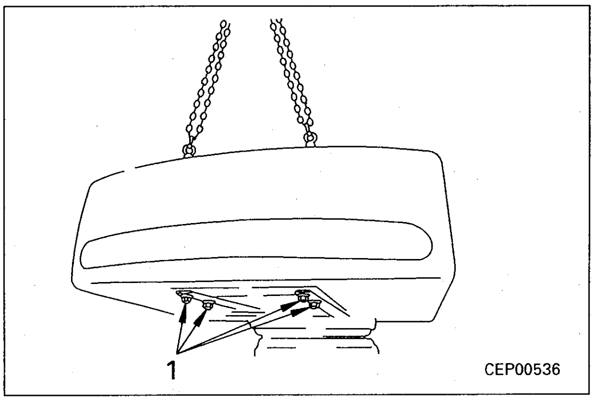
- Carry out installation in the reverse order to removal.

※ 1

kgm Mounting nut:
277.1 ± 31.9 Nm {28.25 ± 3.25 kgm}



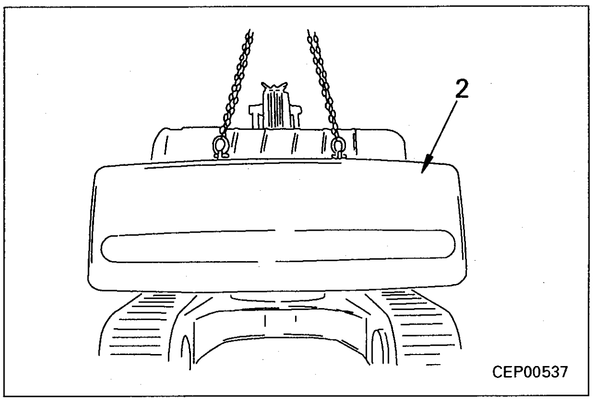
REMOVAL OF COUNTERWEIGHT ASSEMBLY



1. Set lifting hook chains of counterweight assembly in position, and sling.
2. Remove mounting bolts (1).
   ★ Check the location of the shims.
3. Lift off counterweight assembly (2). ※1

   kg Counterweight assembly: **9000 kg**

INSTALLATION OF COUNTERWEIGHT ASSEMBLY



- Carry out installation in the reverse order to removal.

※1

★ Adjust the stepped difference (top and bottom clearance) from the bodywork with shims.

★ Install so that the clearance between the door and counterweight and the clearance between the revolving frame and the counterweight are a uniform 10 ± 5 mm.

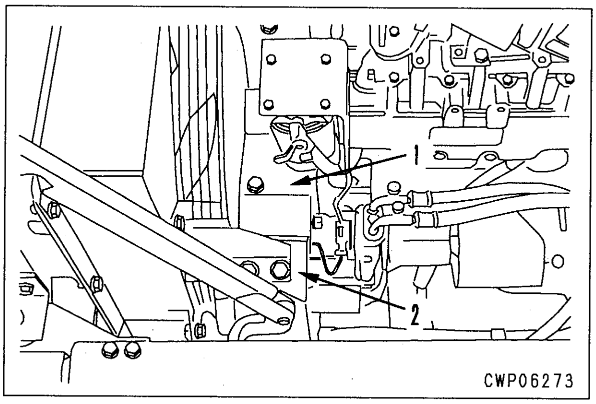
Thread of counterweight mounting bolt:
Thread tightener (LT-2)

kgm Counterweight mounting bolt:
3824.7 ± 392.3 Nm {390 ± 40 kgm}

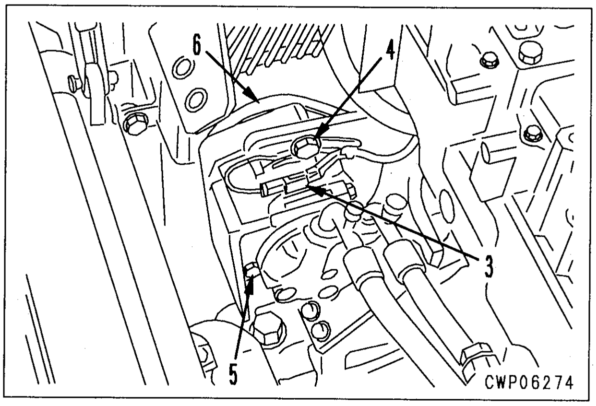
REMOVAL OF AIR CONDITIONER COMPRESSOR ASSEMBLY

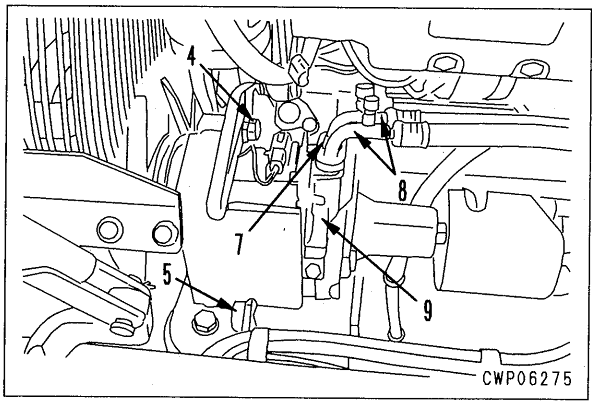
⚠ Disconnect the cable from the negative (–) terminal of the battery.

⚠ Open the engine hood, then set tool **X** to the valve of the air conditioner compressor hose and collect the refrigerant (R134a).



1. Remove covers (1) and (2).
2. Disconnect wiring connector (1) (CN-M34).
3. Loosen tension bolt (4) and lock bolt (5), and remove drive belt (6) from pulley. ※ 1
4. Remove bolt (7), and disconnect hose (8) from compressor. ※ 2
5. Loosen tension bolt (4) and lock bolt (5), then remove compressor assembly (9) together with bracket.





INSTALLATION OF AIR CONDITIONER COMPRESSOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

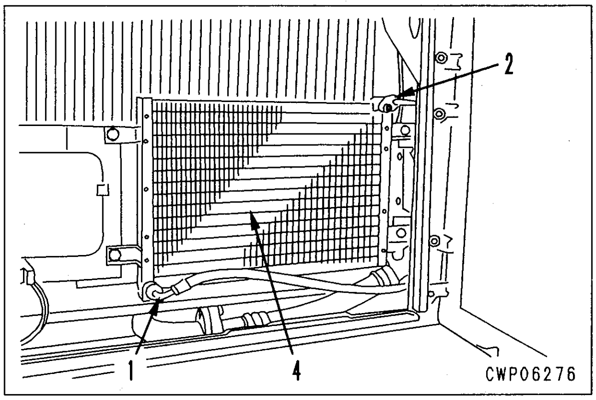
★ When installing the hoses, check that the O-ring is not damaged or deteriorated, then connect the hoses.

※ 2

★ Adjust the belt tension.
For details, see TESTING AND ADJUSTING, Testing and adjusting belt tension for air conditioner compressor.

- **Charging with refrigerant**
  ★ Using tool **X**, charge the air conditioner circuit with air conditioner gas (R134a).

REMOVAL OF CONDENSER ASSEMBLY



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

⚠ Open the engine hood, then set tool **X** to the valve of the air conditioner compressor hose and collect the refrigerant (R134a).

1. Open side cover at right side of machine.
2. Disconnect air conditioner hose (1) and tube (2) at condenser end. ※ 1
   ★ After disconnecting the hose and tube, fit blind plugs to prevent dirt, dust, or water from entering.
3. Remove 4 mounting bolts (3), then remove condenser assembly (4).

INSTALLATION OF CONDENSER ASSEMBLY

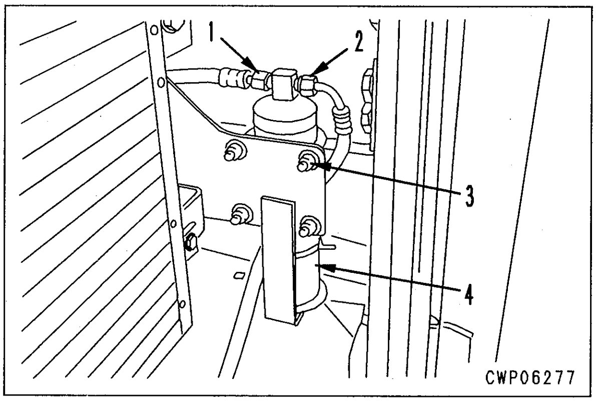
- Carry out installation in the reverse order to removal.

※ 1

★ Check that the O-ring is not damaged or deteriorated, then connect the hoses.

- **Charging with refrigerant**
  ★ Using tool **X**, charge the air conditioner circuit with air conditioner gas (R134a).

REMOVAL OF RECEIVER TANK ASSEMBLY



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

⚠ Collect refrigerant (R134a).
For details, see REMOVAL OF AIR CONDITIONER COMPRESSOR ASSEMBLY.

1. Open air conditioner condenser side cover.
2. Disconnect hose (1) going to air conditioner unit.
3. Disconnect hose (2) coming from air conditioner condenser. ※1
4. Remove 2 U-bolts (3), then remove receiver tank assembly (4).

INSTALLATION OF RECEIVER TANK ASSEMBLY

- Carry out installation in the reverse order to removal.

※1

★ Check that the O-rings are not damaged or deteriorated, then connect the hoses.

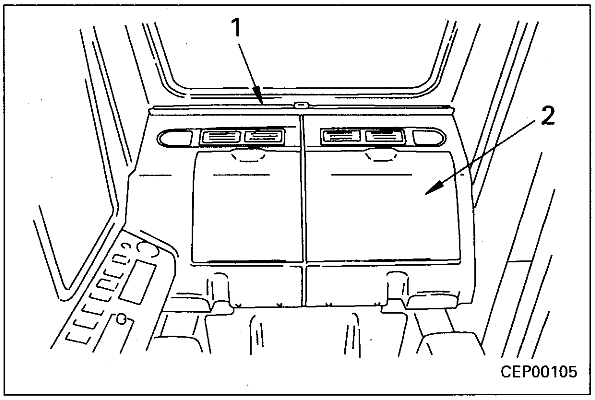
- **Charging air conditioner with gas**
  ★ Using tool **X**, charge the air conditioner circuit with refrigerant (R134a).

REMOVAL OF AIR CONDITIONER UNIT ASSEMBLY

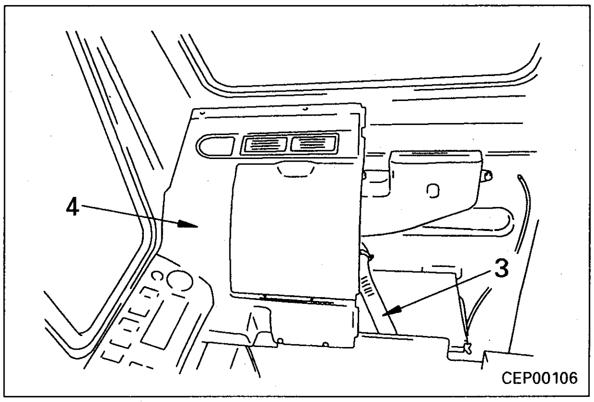
⚠ Disconnect the cable from the negative (–) terminal of the battery.

⚠ Open the engine hood, then push the valve of the air conditioner compressor hose slowly and release the refrigerant (R134a) gradually.

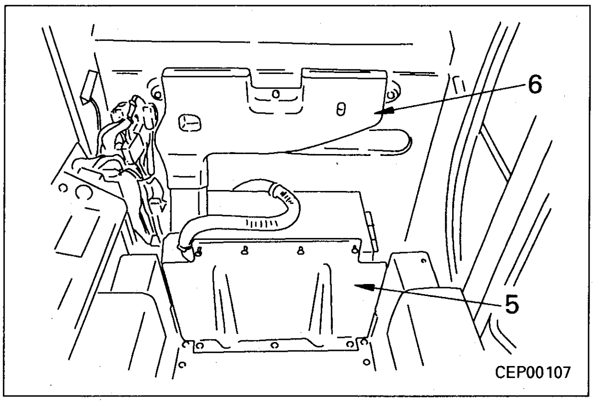
1. Drain coolant.
2. Slide operator's seat fully forward.
3. Remove plate (1), then remove left cover (2).



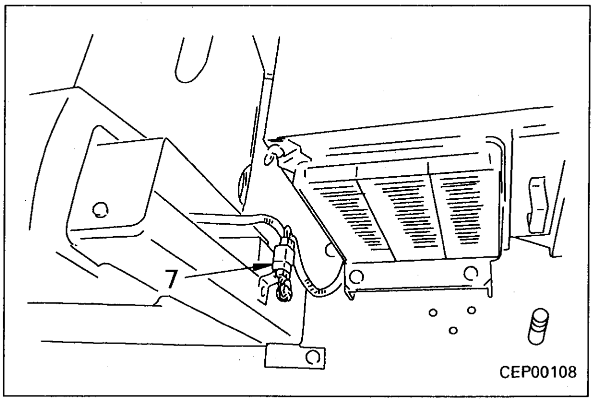
4. Disconnect hose (3) and speaker wiring connector, and remove right cover (4).
   - ★ Lift up the cover slightly before disconnecting the speaker wiring connector.



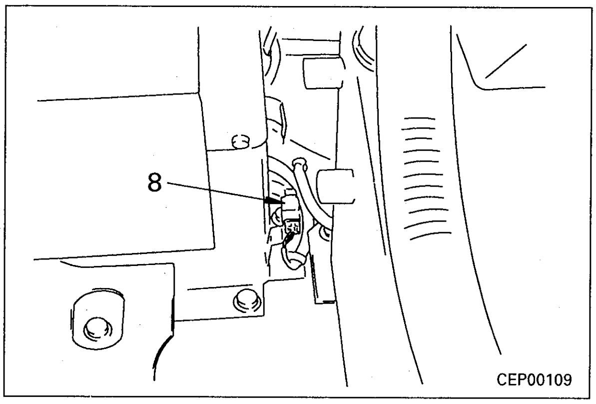
5. Remove cover (5) and duct (6).



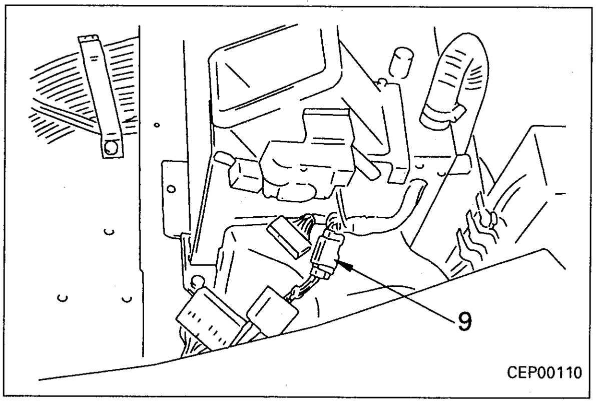
6. Disconnect wiring connector (7) (CN-M23).



7. Disconnect wiring connector (8) (CN-M23).

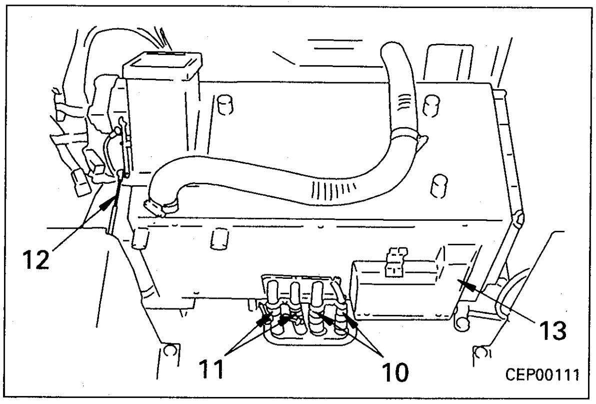


8. Disconnect wiring connector (9) (CN-M26).



9. Disconnect air conditioner hose (10), heater hose (11), and air conditioner wire (12).

10. Remove mounting bolts, then remove air conditioner unit assembly (13). ※ 1



INSTALLATION OF AIR CONDITIONER UNIT ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

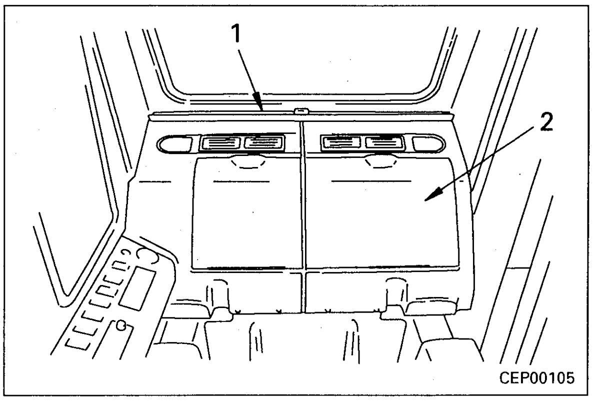
★ Insert duct (13) while installing.

- **Refilling with water**
  ★ Add water through water filler to the specified level.
  Run the engine to circulate the water through the system. Then check the water level again.
- **Charging with refrigerant**
  ★ Using tool **X**, charge the air conditioner circuit with air conditioner gas (R134a).

REMOVAL OF GOVERNOR, PUMP CONTROLLER ASSEMBLY

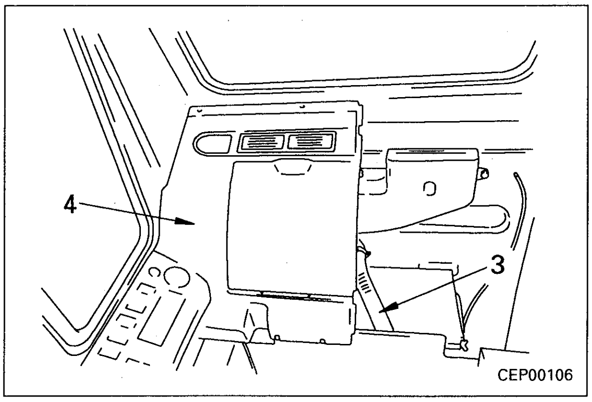
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Slide operator's seat fully forward.



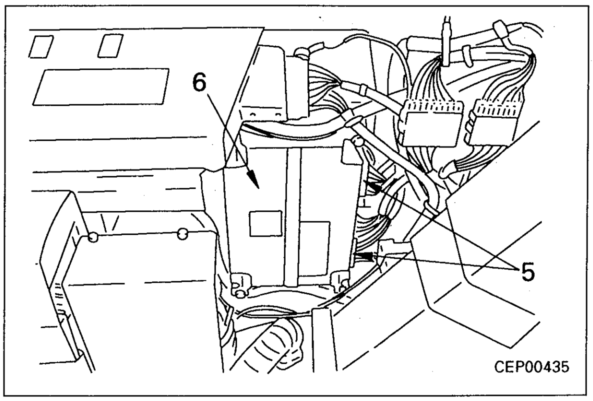
2. Remove plate (1), then remove left cover (2).

3. Disconnect hose (3) and speaker wiring connector, then remove right cover (4).
   ★ Lift up the cover slightly before disconnecting the speaker wiring connector.



4. Remove 5 connectors (5).

5. Remove governor and pump controller assembly. ※ 1



INSTALLATION OF GOVERNOR, PUMP CONTROLLER ASSEMBLY

- Carry out installation in the reverse order to removal.

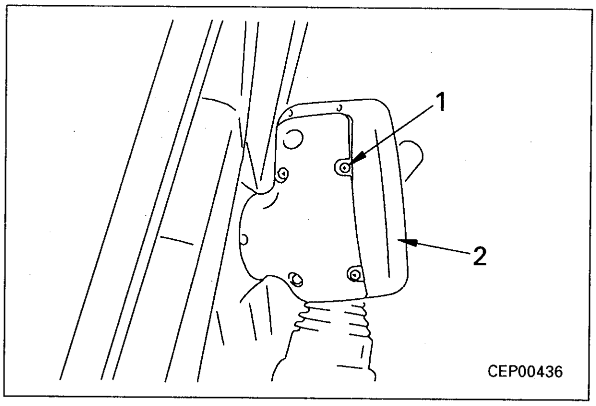
※ 1

- Check the performance of the work equipment, travel, and swing. For details, see TESTING AND ADJUSTING.

REMOVAL OF MONITOR PANEL ASSEMBLY

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

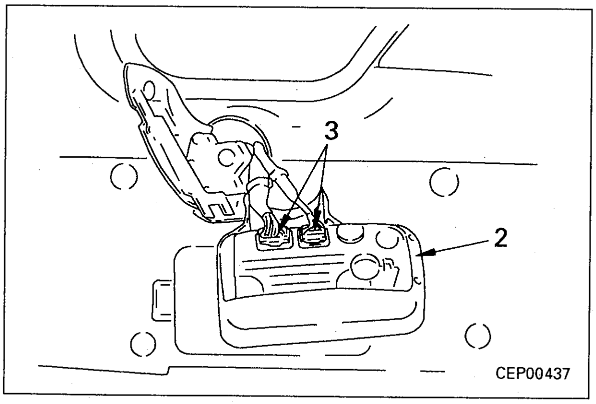
1. Remove 4 screws (1), and disconnect monitor panel assembly (2) from bracket.



2. Disconnect connectors (3), then remove monitor panel assembly (2). ※ 1

INSTALLATION OF MONITOR PANEL ASSEMBLY

- Carry out installation in the reverse order to removal.

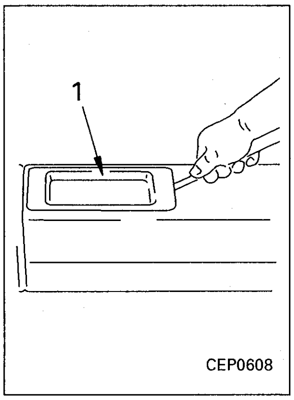


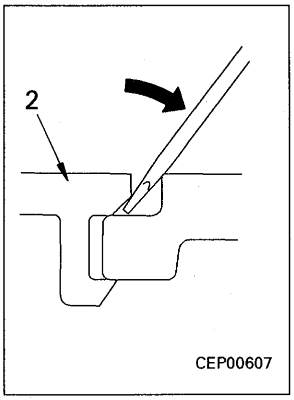
※ 1

- Check the mode setting and display function. For details, see TESTING, ADJUSTING, AND TROUBLESHOOTING.

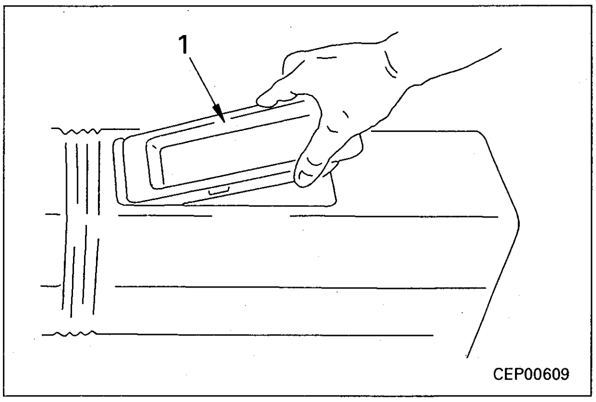
REMOVAL OF CONTROL STAND CASE

1. **Tray**
   1) Insert a thin flat-headed screwdriver into notch at rear of tray (1) and lever up lightly to release rear claw (2).
      ★ The claw can only be released from the rear.

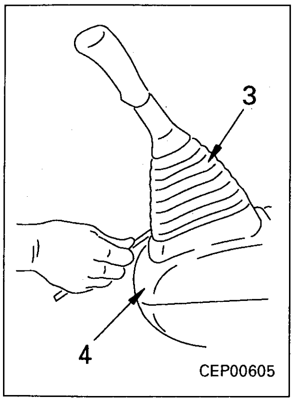


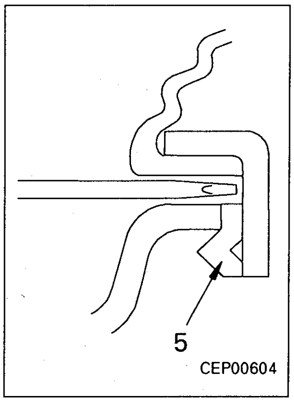


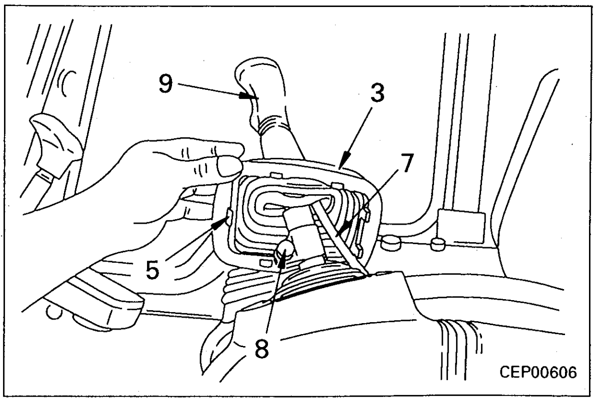
   2) Pull tray (1) to rear to remove. ※ 2



2. **Boot**
   1) Insert a thin flat-headed screwdriver between boot (3) and upper case (4), remove claw (5) at front of boot from upper case, then raise front.
   2) Pull boot (3) to front to remove claw at rear of boot. ※ 1
   3) Disconnect wiring connector (7) from hole for removed tray.
   4) Push boot up, remove bolt (8), then remove lever (9) and boot (3).
      ★ Check the direction of the lever.

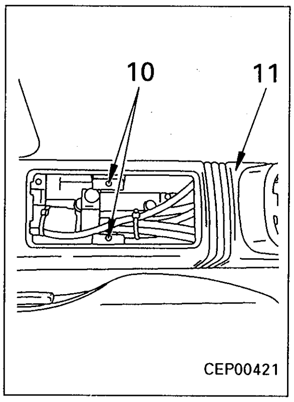


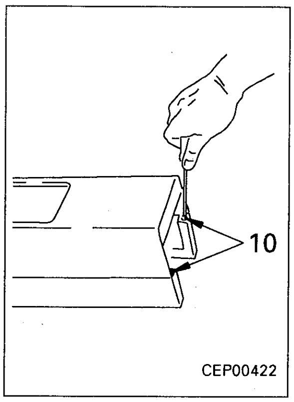




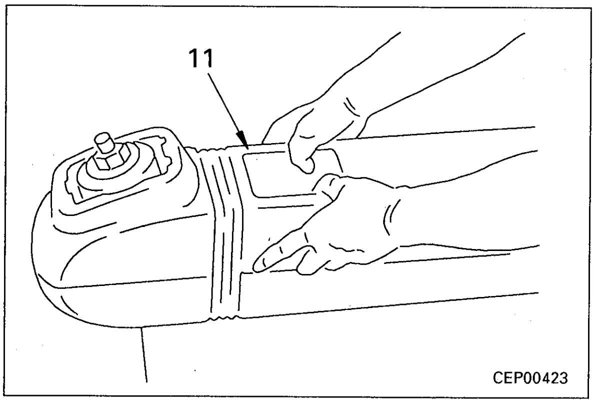
3. Upper case.

1) Remove 4 upper case mounting screws (10).



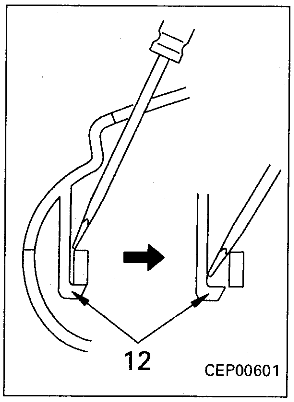


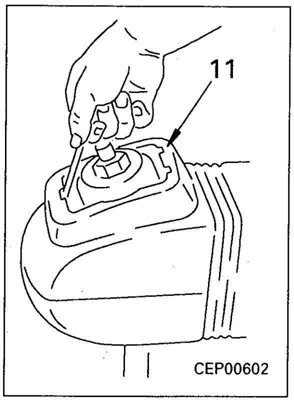
2) Push bottom center of upper case (11) from both sides, and lift up to release claws at both sides.



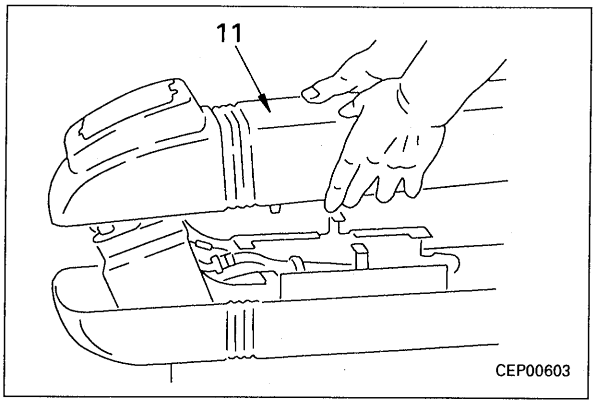
3) Use a screwdriver from front of upper case to release claws (12) at front of case.

4) Remove upper case (11).





INSTALLATION OF CONTROL STAND CASE



- Carry out installation in the reverse order to removal.

※1

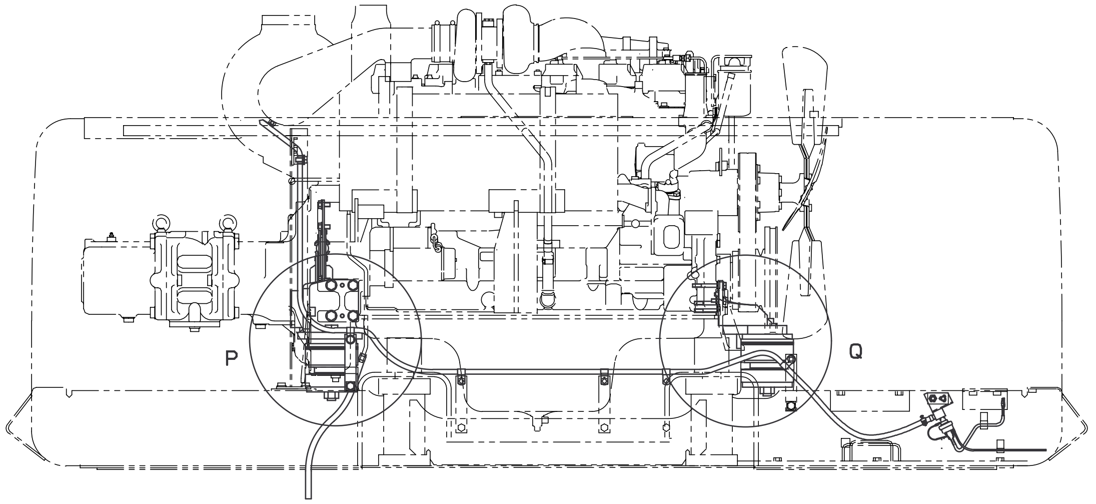
★ When installing the boot, insert the claw at the rear first.

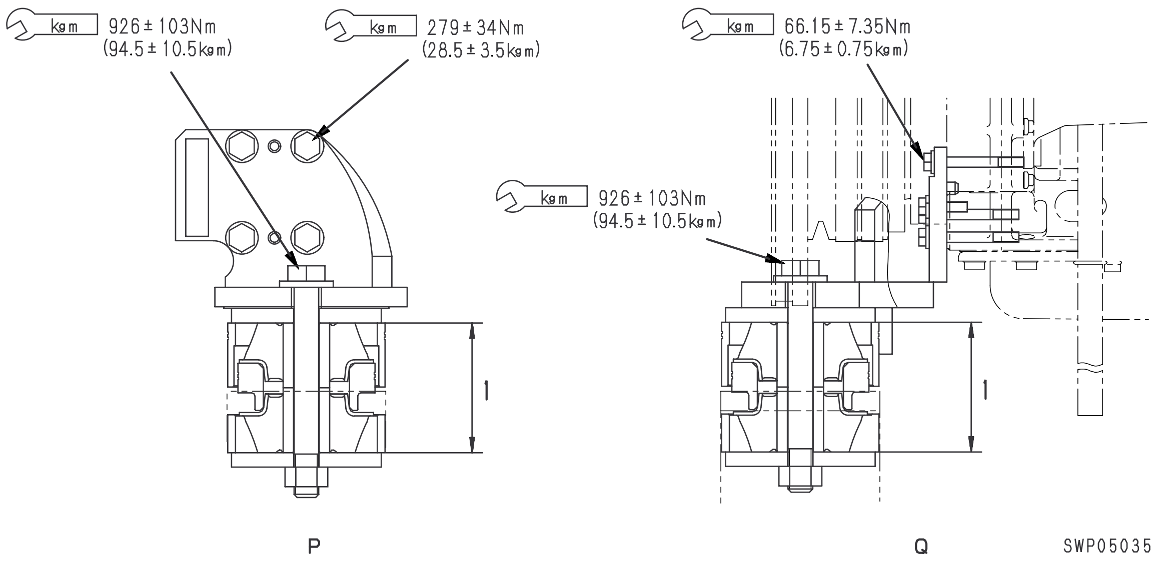
※2

★ When installing the tray and upper case, insert the claws at the front first.

40 MAINTENANCE STANDARD

ENGINE MOUNT

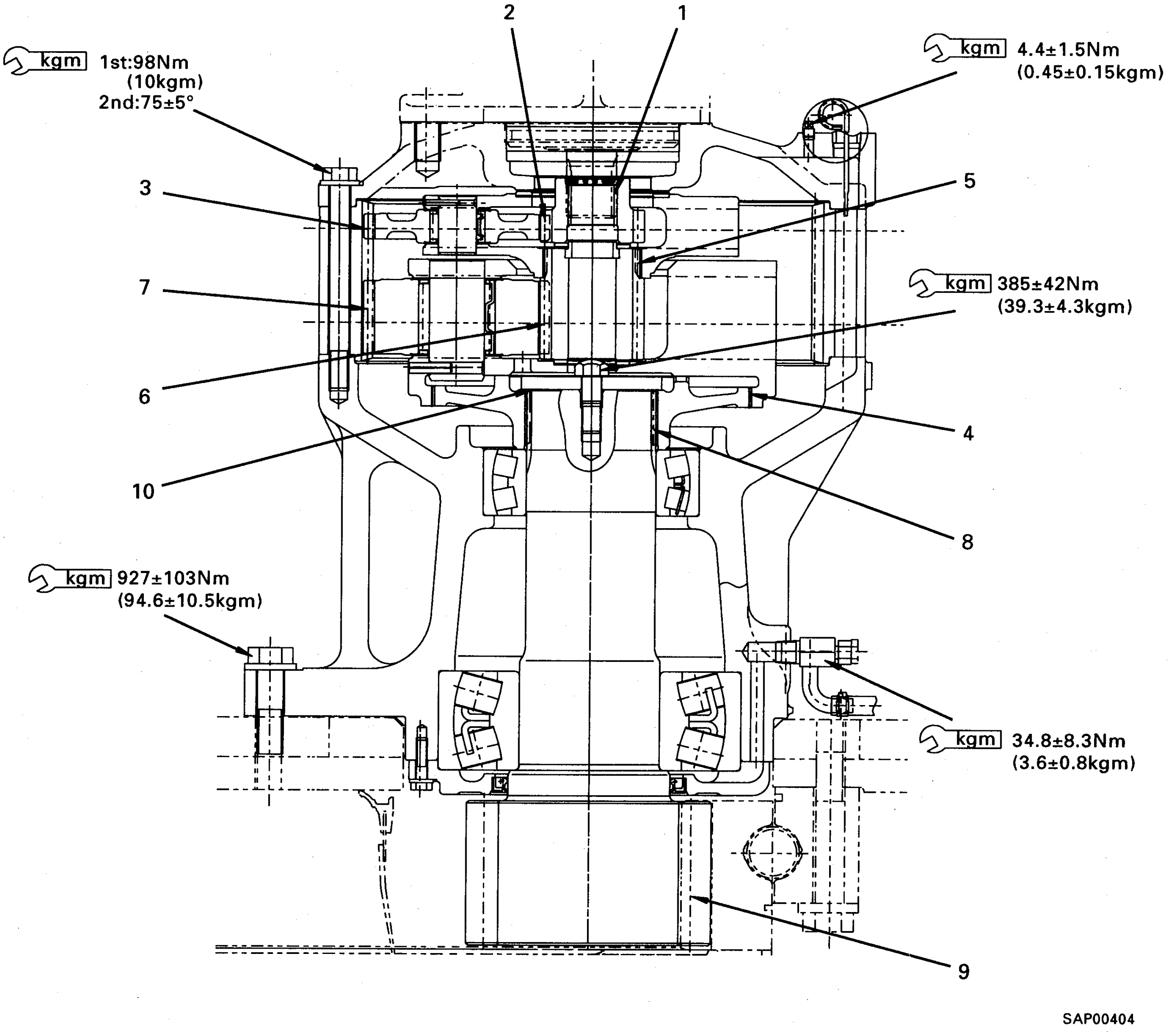




Unit: mm

No.	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Free height of front mount rubber	126	—	Replace

SWING MACHINERY

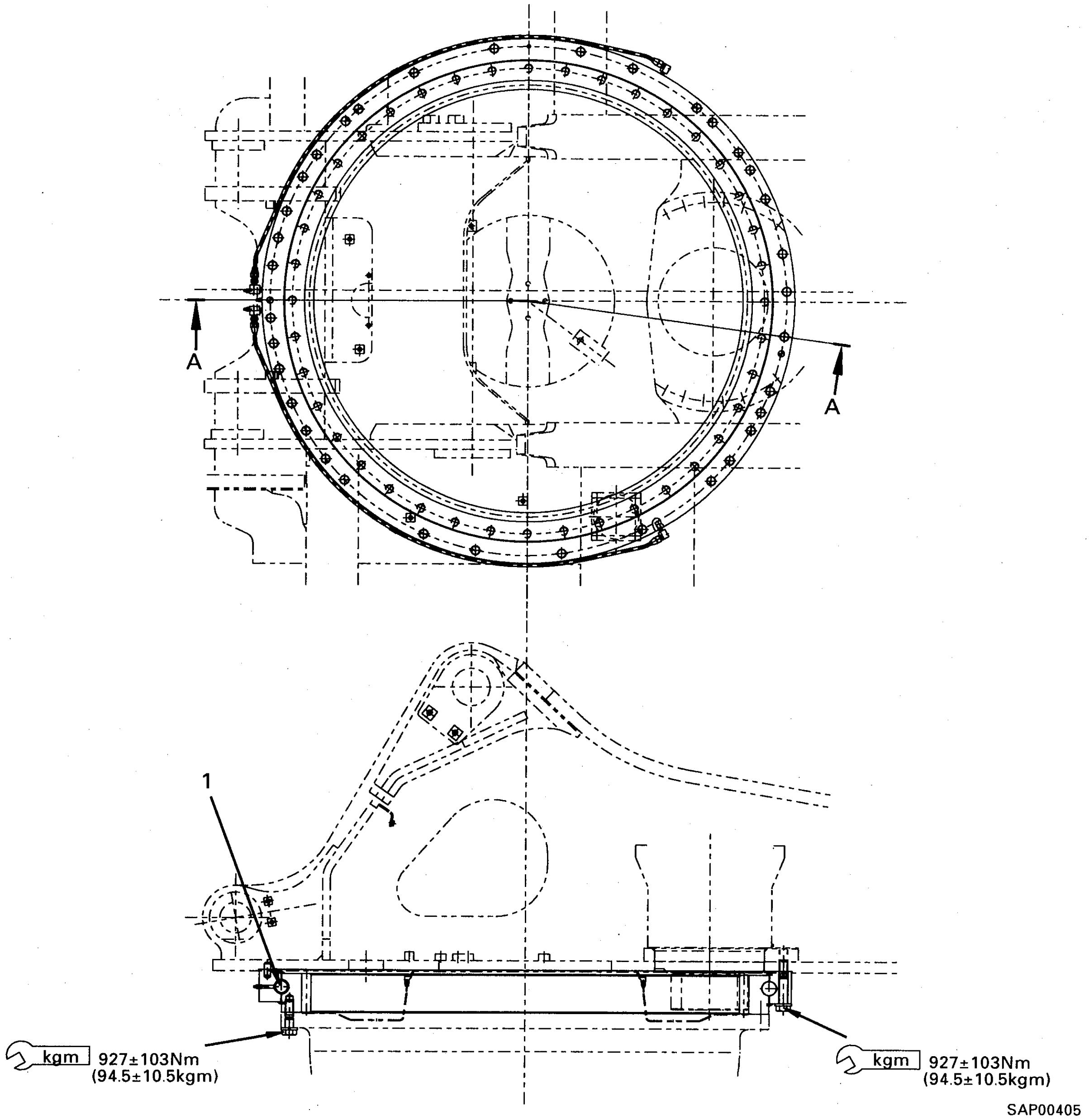


Unit: mm

No.	Check item	Criteria		Remedy
		Standard clearance	Clearance limit	
1	Backlash between swing motor shaft and No. 1 sun gear	0.19 – 0.29	—	Replace
2	Backlash between No. 1 sun gear and No. 1 planet gear	0.19 – 0.56	0.90	
3	Backlash between No. 1 planet gear and ring gear	0.24 – 0.70	0.90	
4	Backlash between No. 2 planet carrier and coupling	0.06 – 0.24	—	
5	Backlash between No. 1 planet carrier and No. 2 sun gear	0.40 – 0.71	1.10	
6	Backlash between No. 2 sun gear and No. 2 planet gear	0.19 – 0.56	1.00	
7	Backlash between No. 2 planet gear and ring gear	0.24 – 0.70	1.10	
8	Backlash between coupling and swing pinion	0.08 – 0.25	—	
9	Backlash between swing pinion and swing circle	0 – 1.21	2.00	
10	Clearance between plate and coupling	0.06 – 0.86	—	
		Standard size	Repair limit	
11	Wear of swing pinion oil seal contact surface	$150^{\ 0}_{-0.100}$	—	Repair hard chrome plating or replace

SWING CIRCLE

PC400-6 Serial No.: 32001 – 32249
PC450-6 Serial No.: 12001 – 12143



kgm 927±103Nm (94.5±10.5kgm)

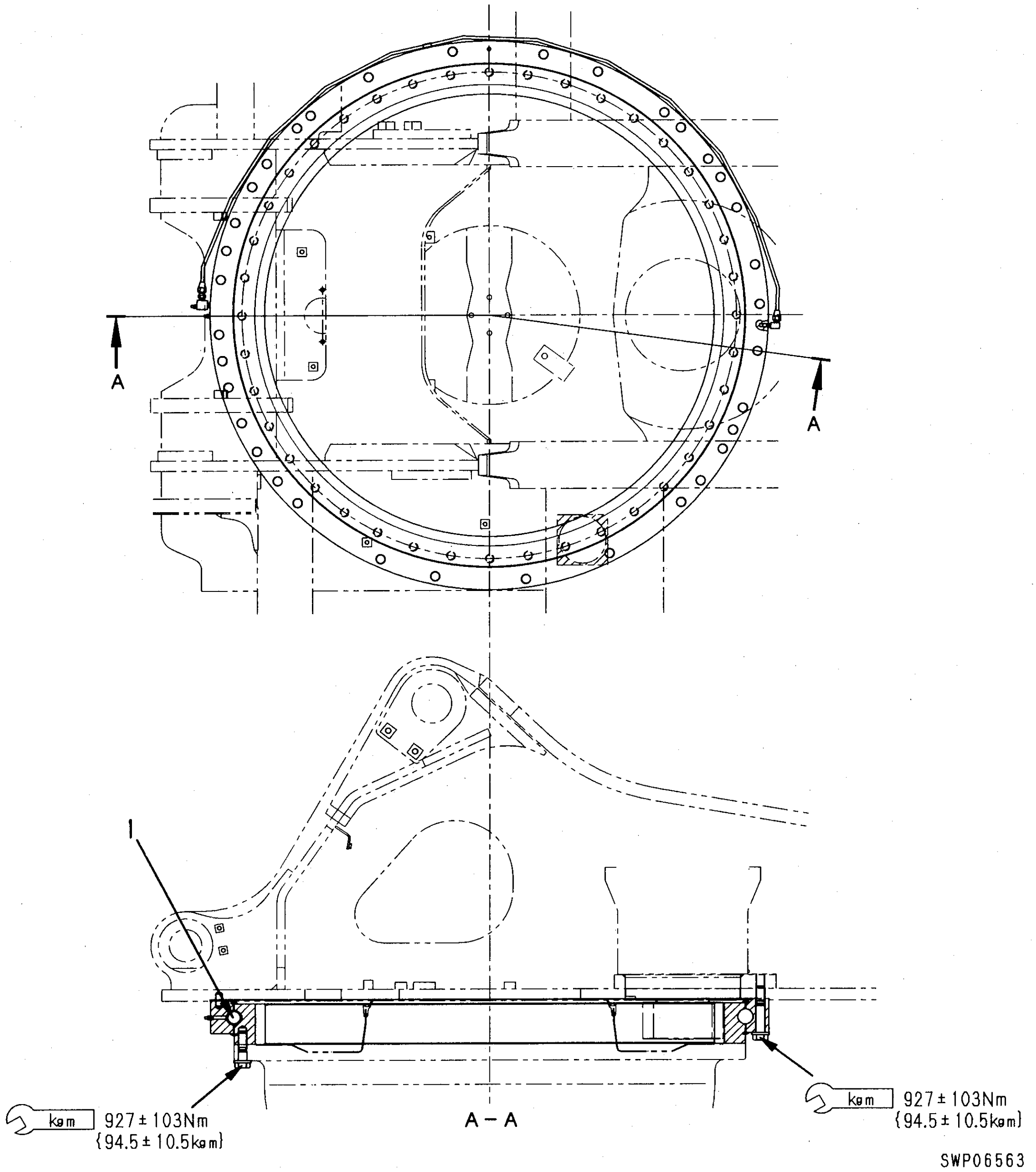
kgm 927±103Nm (94.5±10.5kgm)

SAP00405

Unit: mm

No.	Check item	Criteria		Remedy
		Standard clearance	Clearance limit	
1	Clearance of bearing in axial direction (when mounted on machine)	0.5 – 1.6	3.2	Replace

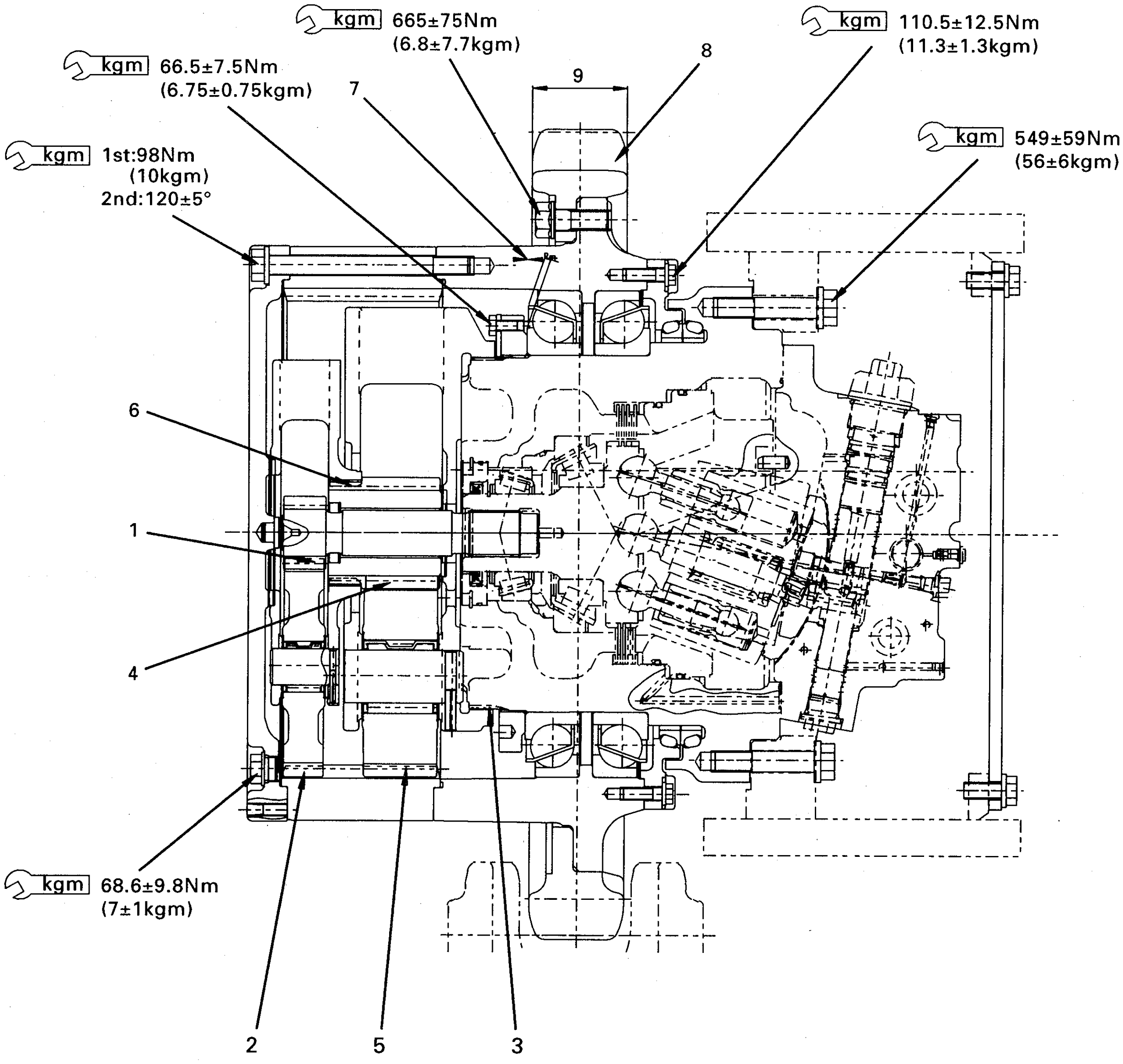
PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up



Unit: mm

No.	Check item	Criteria		Remedy
		Standard clearance	Clearance limit	
1	Clearance of bearing in axial direction (when mounted on machine)	0.5 – 1.6	3.2	Replace

FINAL DRIVE

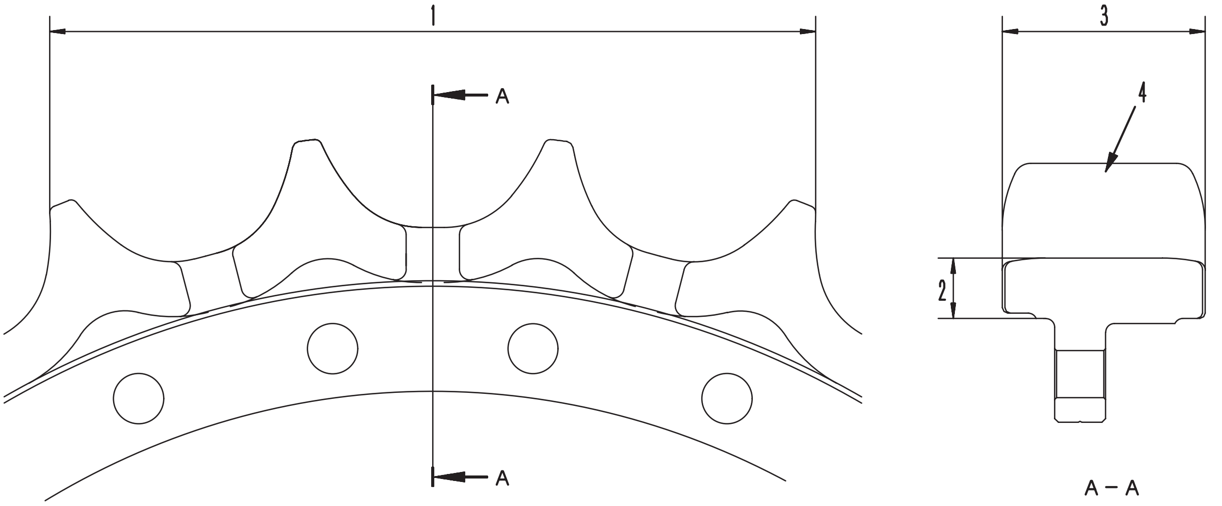


SAP00408

Unit: mm

No.	Check item	Criteria		Remedy
		Standard clearance	Clearance limit	
1	Backlash between No. 1 sun gear and No. 1 planet gear	0.20 – 0.61	1.00	Replace
2	Backlash between No. 1 planet gear and ring gear	0.24 – 0.70	1.10	
3	Backlash between No. 2 planet carrier and motor	0.06 – 0.24	—	
4	Backlash between No. 2 sun gear and No. 2 planet gear	0.20 – 0.63	1.00	
5	Backlash between No. 2 planet gear and ring gear	0.24 – 0.70	1.10	
6	Backlash between No. 1 planet gear and No. 2 sun gear	0.41 – 0.72	1.00	
7	End play of sprocket shaft	0.10 – 0.15	—	
8	Wear of sprocket teeth	Repair limit: 6		
		Standard size	Repair limit	
9	Sprocket tooth width	90	87	Rebuild or replace

SPROCKET

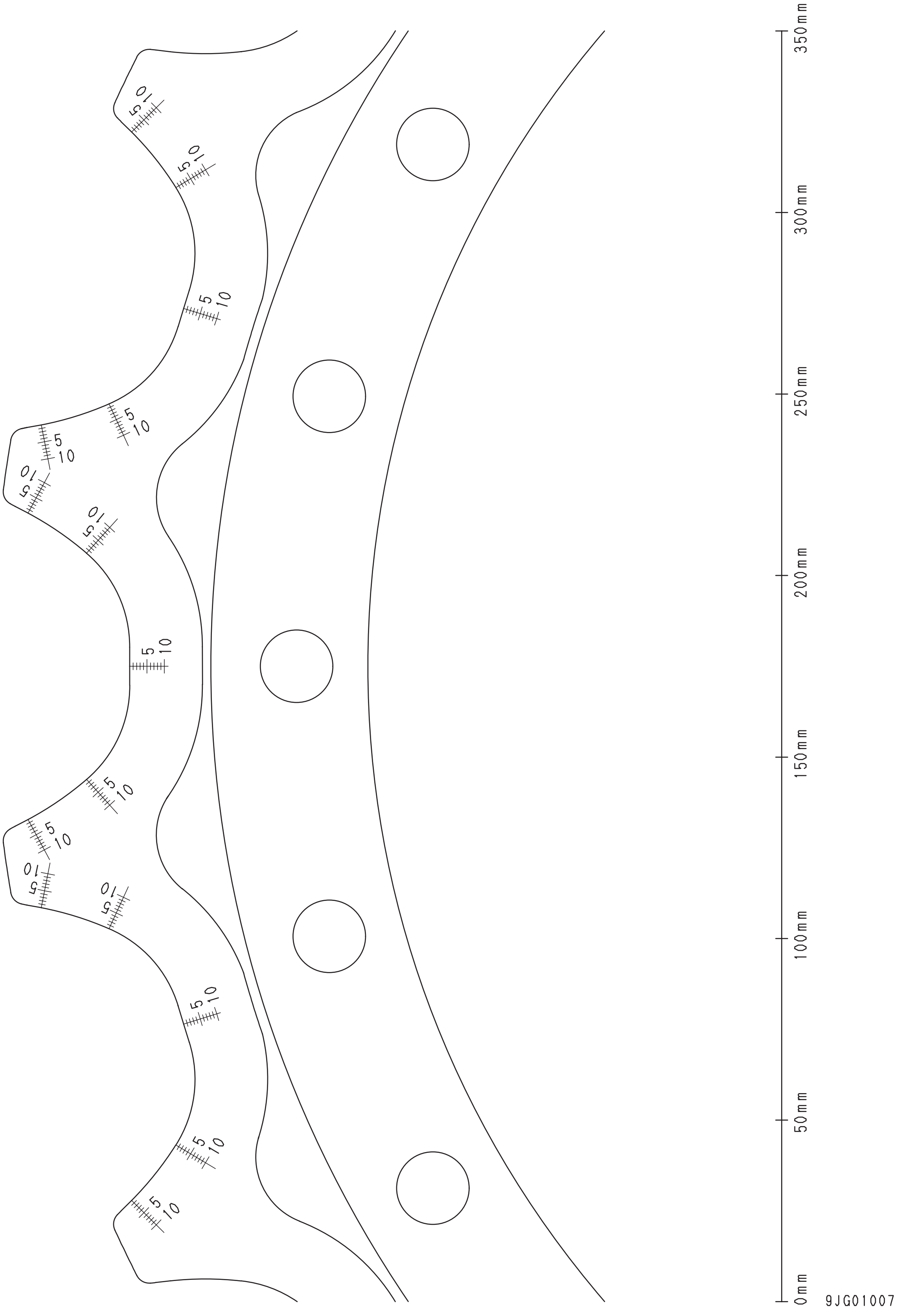


9JG01006

Unit: mm

No.	Check item	Criteria		Remedy
1	Wear of tooth tip	Standard size	Repair limit	Build-up welding or replace
		355	343	
2	Thickness of tooth root	20.8	14.8	
3	Width of tooth	90	87	
4	Wear of tooth shape	Repair limit: 6 (measure with sprocket tooth shape)		

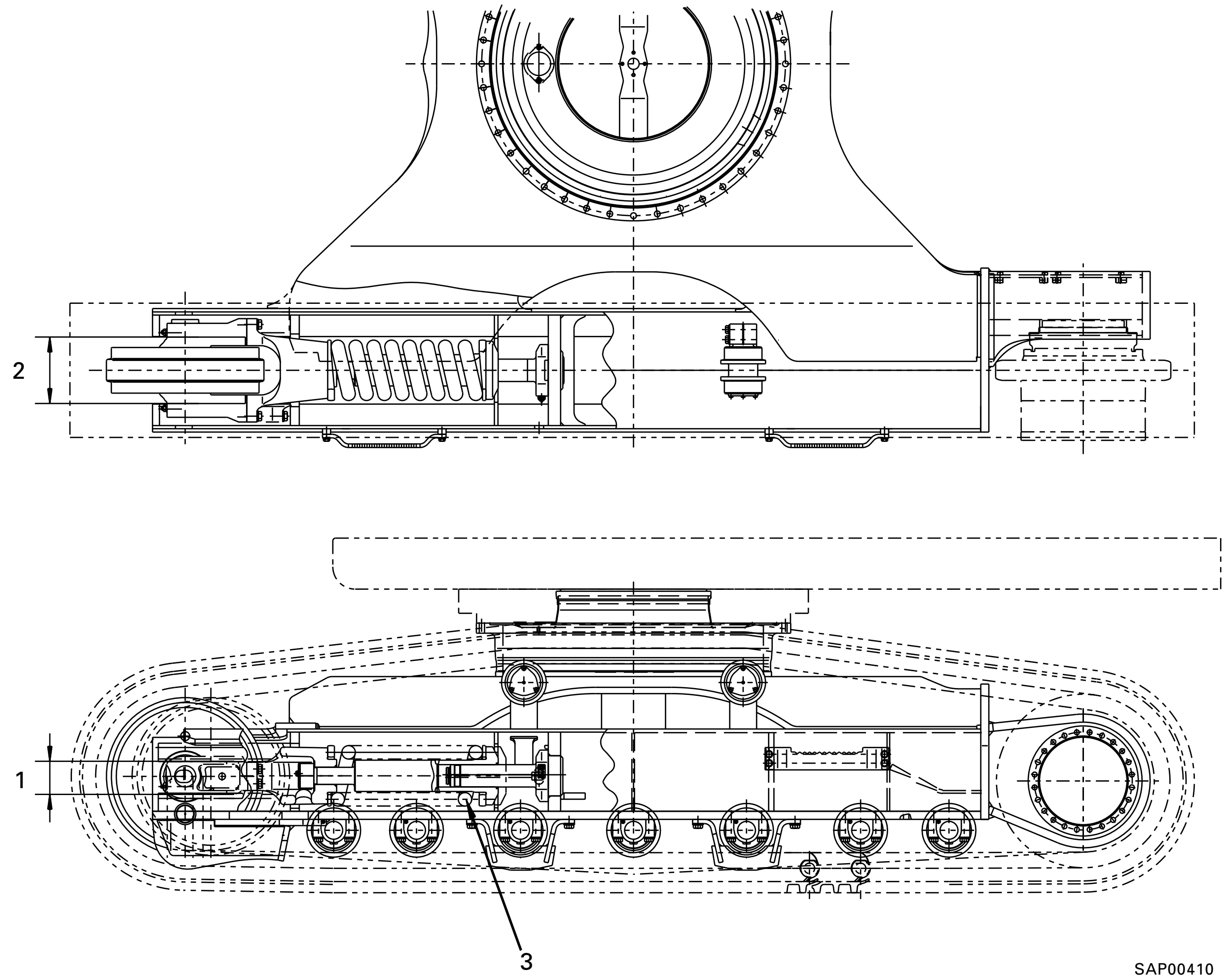
SPROCKET TOOTH SHAPE OF REAL DIMENSION



★ The above drawing is reduced to 61%. Enlarge it to 164% to return it to the full scale and make a copy on an OHP sheet.

TRACK FRAME AND RECOIL SPRING

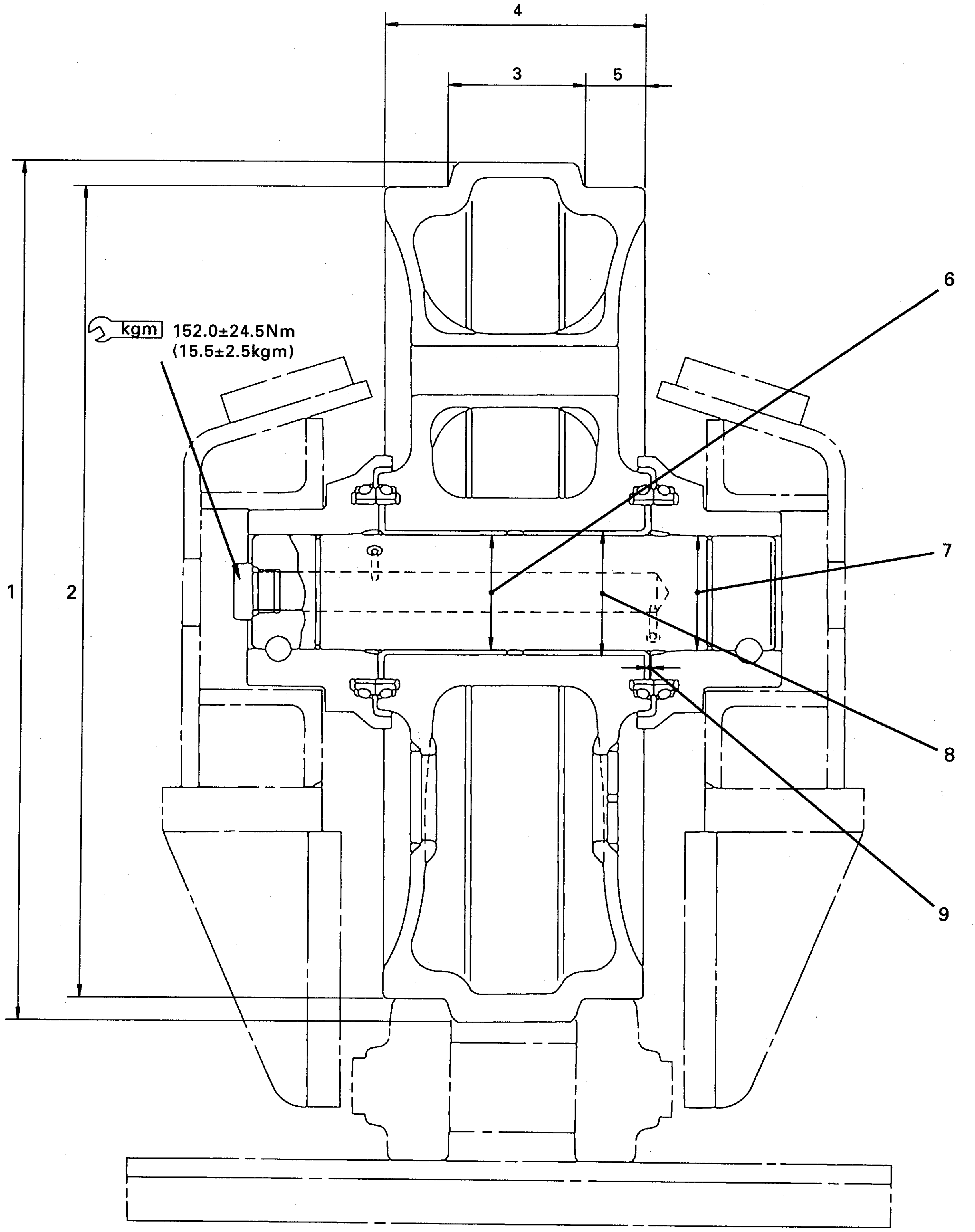
★ The diagram shows the PC400-6.



Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Top-to-bottom width of idler guide</td><td colspan="2"></td><td>Standard size</td><td>Tolerance</td><td>Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="2">Track frame</td><td>148</td><td>$^{+2}_{-1}$</td><td>152</td></tr>
<tr><td colspan="2">Idler support</td><td>145</td><td>±0.5</td><td>143</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Left-to-right width of idler guide</td><td colspan="2">Track frame</td><td>302</td><td>$^{+3}_{-1}$</td><td>307</td></tr>
<tr><td colspan="2">Idler support</td><td>297</td><td>—</td><td>295</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length x OD</td><td>Installed length</td><td>Installed load</td><td>Free length</td><td>Installed load</td></tr>
<tr><td>857 x 270</td><td>707</td><td>239 kN
(24,375 kg)</td><td>—</td><td>191 kN
(19,500 kg)</td></tr>
</table>

IDLER

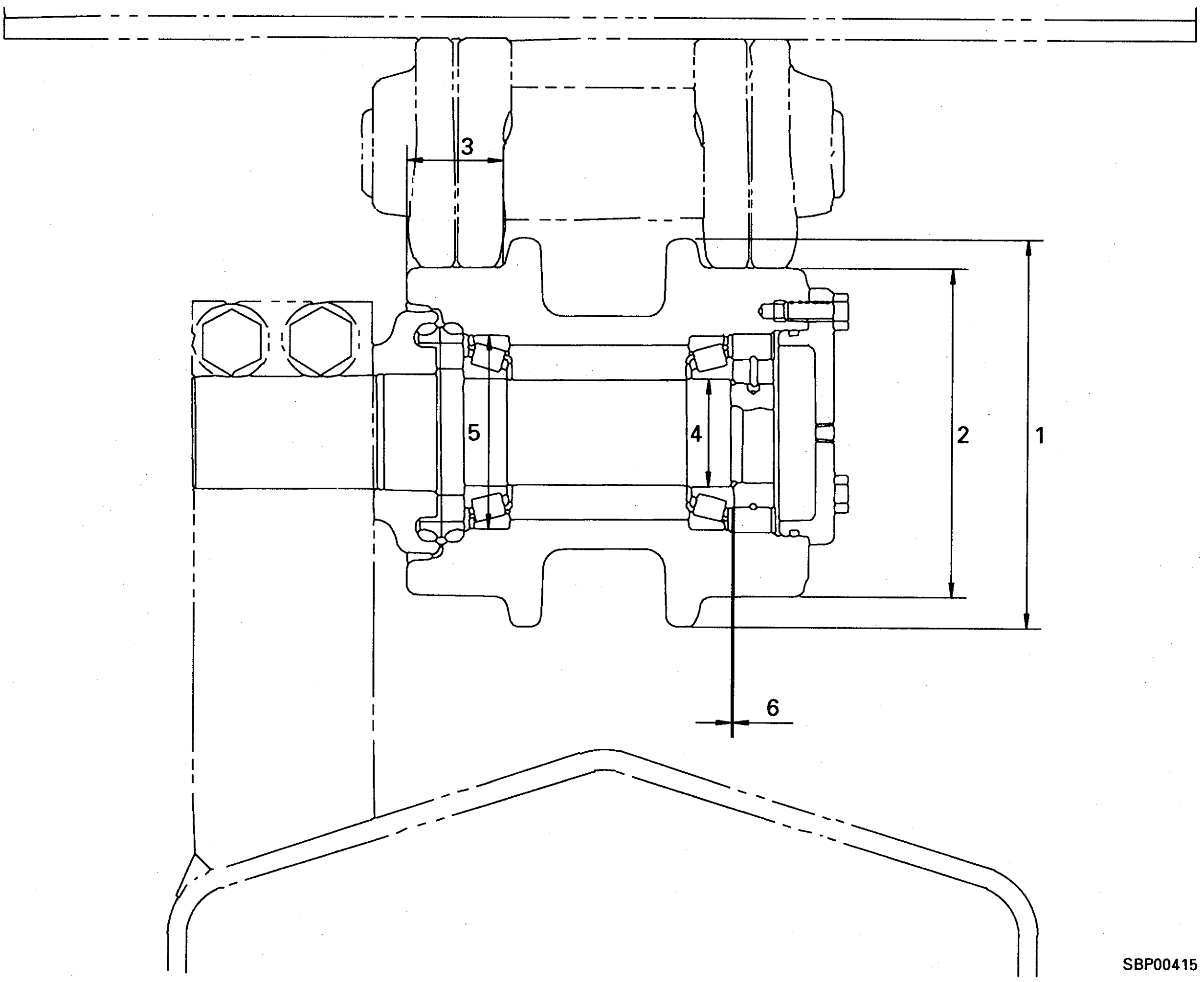


SBP00412

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of proruding portion</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="3">704</td><td colspan="2">—</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="3">660</td><td colspan="2">648</td></tr>
<tr><td>3</td><td>Width of protrusion</td><td colspan="3">105</td><td colspan="2">—</td></tr>
<tr><td>4</td><td>Overall width</td><td colspan="3">204</td><td colspan="2">—</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="3">49.5</td><td colspan="2">55.5</td><td rowspan="4">Replace bushing</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Clearance between shaft and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>95</td><td>–0.120
–0.207</td><td>+0.360
–0.220</td><td>0.340 – 0.567</td><td>1.5</td></tr>
<tr><td>7</td><td>Clearance between shaft and support</td><td>95</td><td>–0.120
–0.207</td><td>+0.035
0</td><td>0.120 – 0.242</td><td>—</td><td>Replace</td></tr>
<tr><td rowspan="3">8</td><td rowspan="3">Interference between idler and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td><td rowspan="2">Interference limit</td><td rowspan="5">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>102.6</td><td>+0.087
+0.037</td><td>–0.027
–0.062</td><td>0.064 – 0.149</td><td>—</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">Side clearance of idler (both sides)</td><td colspan="3">Standard clearance</td><td colspan="2">Clearance limit</td></tr>
<tr><td colspan="3">0.46 – 0.86</td><td colspan="2">1.5</td></tr>
</table>

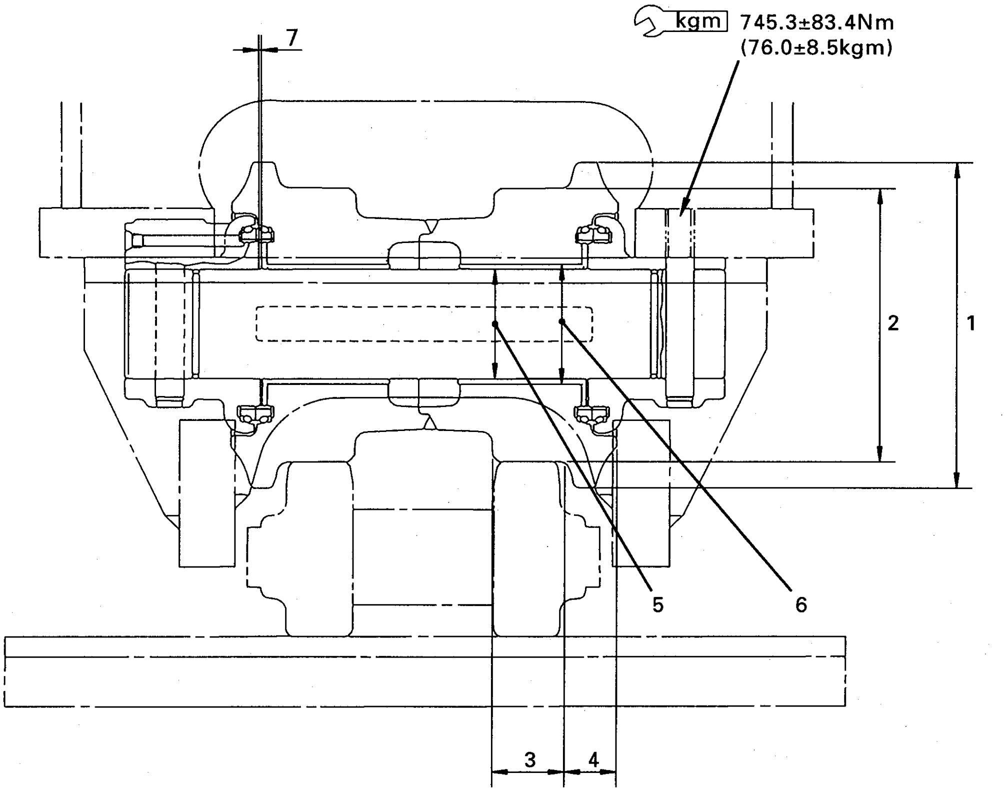
CARRIER ROLLER



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Outside diameter of flange (outside)	200			—		Rebuild or replace
2	Outside diameter of tread	168			158		
3	Width of tread	49.5			57.5		
		Standard size	Tolerance		Standard interference	Interference limit	Replace
			Shaft	Hole			
4	Interference between shaft and bearing	55	+0.021 +0.002	0 –0.015	0.002 – 0.036	—	
5	Interference between roller and bearing	100	0 –0.015	–0.024 –0.059	0.009 – 0.059	—	
		Standard size			Repair limit		
6	Side clearance of roller	0.01 – 0.24			—		

TRACK ROLLER



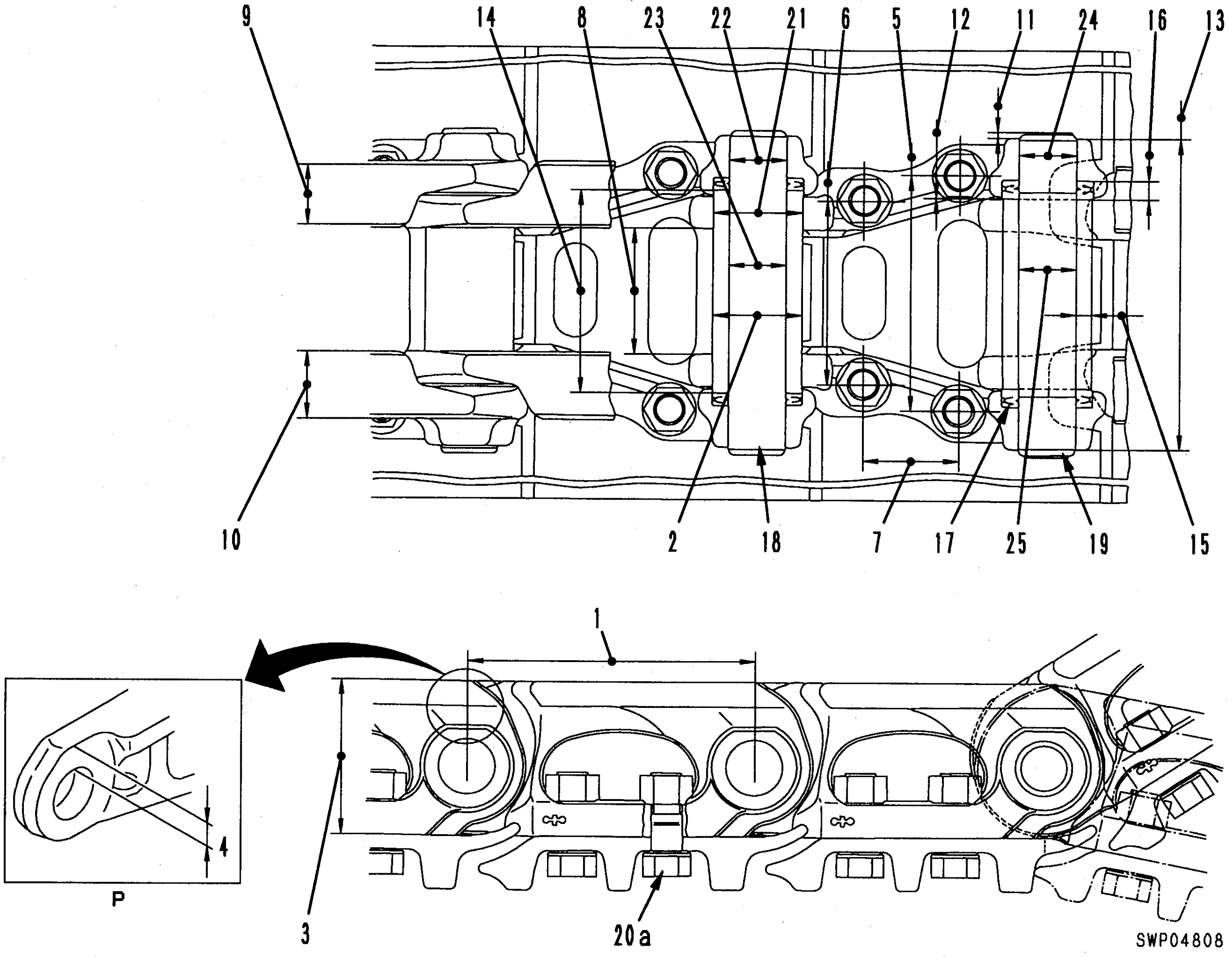
SBP00414

Unit: mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange (outside)</td><td colspan="2">Standard size</td><td colspan="3">Repair limit</td><td rowspan="4">Rebuild or replace</td></tr>
<tr><td colspan="2">240</td><td colspan="3">—</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">260</td><td colspan="3">188</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">54.6</td><td colspan="3">60.6</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="2">34.4</td><td colspan="3">—</td><td rowspan="7">Replace bushing</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>80</td><td>–0.250
–0.350</td><td>+0.174
–0.029</td><td>0.151 – 0.501</td><td>1.5</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Interference between roller and bearing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td><td rowspan="2">Interference limit</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>87.6</td><td>+0.087
+0.037</td><td>–0.022
–0.013</td><td>0.015 – 0.100</td><td>—</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">Side clearance of idler (both sides)</td><td colspan="2">Standard clearance</td><td colspan="3">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="2">0.41 – 0.95</td><td colspan="3">1.5</td></tr>
</table>

TRACK SHOE

TRIPLE GROUSER SHOE



★ P portion shows the link of bushing press fitting end.

Unit: mm

No.	Check item		Criteria			Remedy
1	Link pitch		Standard size	Repair limit		Reverse or replace
			228.9	231.9		
2	Bushing outside diameter		Standard size	When turned		
				Normal load	Impact load	
			71.5	—	66.5	
3	Link height		Standard size	Repair limit		Repair or replace
			129	119		
4	Thickness of link metal (bushing press-fitting portion)		34.5			Replace
5	Shoe bolt pitch		184			
6			76.2			
7			20			
8	Link	Inside width	106			Repair or replace
9		Overall width	51.6			
10		Tread width	44.5			
11	Protrusion of pin		4.4			Adjust or replace
12	Protrusion of regular bushing		5.25			
13	Overall length of pin		252			
14	Overall length of bushing		164.5			
15	Thickness of bushing metal		13.2			
16	Thickness of spacer		—			
17	Press-fitting force	Bushing	117.6 – 303.8 kN {12 – 31 ton}			—
18		Regular pin	186.2 – 460.6 kN {19 – 47 ton}			
※ 19		Master	137.2 – 284.2 kN {14 – 29 ton}			

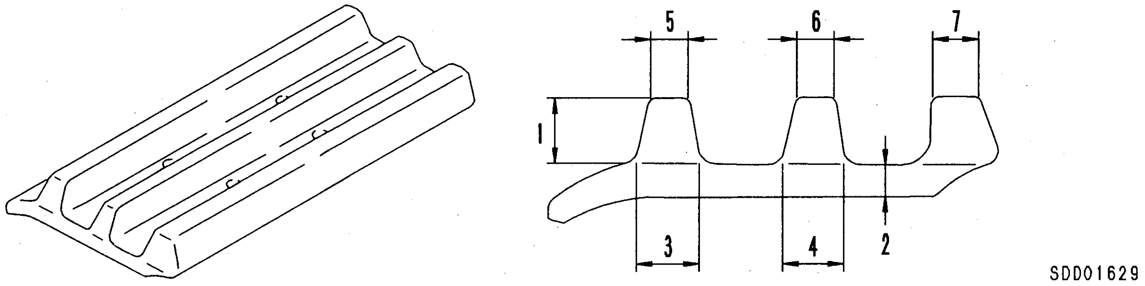
※ : Dry type track link

Unit: mm

<table>
<tr><th>No.</th><th colspan="2">Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="5">20</td><td rowspan="4">Shoe bolt</td><td rowspan="2">a. Regular link</td><td colspan="2">Tightening torque (Nm {kgm})</td><td colspan="2">Additional tightening angle (deg.)</td><td rowspan="4">Retighten</td></tr>
<tr><td>Triple shoe</td><td>392.3±39.2
{40±4}</td><td colspan="2">120±10</td></tr>
<tr><td rowspan="2">b. Master link</td><td colspan="2">Tightening torque (Nm {kgm})</td><td>Additional tightening angle (deg.)</td><td>Lower limit torque (Nm {kgm})</td></tr>
<tr><td colspan="2">—</td><td>—</td><td>—</td></tr>
<tr><td colspan="2">No. of shoes (each side)</td><td colspan="4">PC400, 450-6: 46
PC400, 450LC-6: 49</td><td>—</td></tr>
<tr><td rowspan="3">21</td><td colspan="2" rowspan="3">Interference between bushing and link</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td><td rowspan="14">Adjust or replace</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>71</td><td>+0.494
+0.454</td><td>+0.074
0</td><td>0.380 – 0.494</td></tr>
<tr><td>22</td><td colspan="2">Interference between regular pin and link</td><td>47</td><td>+0.235
+0.085</td><td>–0.218
–0.280</td><td>0.303 – 0.515</td></tr>
<tr><td rowspan="3">23</td><td colspan="2" rowspan="3">Clearance between regular pin and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>47</td><td>+0.235
+0.085</td><td>+0.915
+0.415</td><td>0.180 – 0.830</td></tr>
<tr><td rowspan="3">24</td><td colspan="2" rowspan="3">Interference between master pin and link</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard interference</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>47</td><td>+0.03
0</td><td>–0.218
–0.280</td><td>0.218 – 0.310</td></tr>
<tr><td rowspan="3">※
25</td><td colspan="2" rowspan="3">Clearance between master pin and bushing</td><td rowspan="2">Standard size</td><td colspan="2">Tolerance</td><td rowspan="2">Standard clearance</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>47</td><td>–0.250
–0.350</td><td>+0.915
+0.415</td><td>0.665 – 1.265</td></tr>
</table>

※ : Dry type track link

TRIPLE GROUSER SHOE

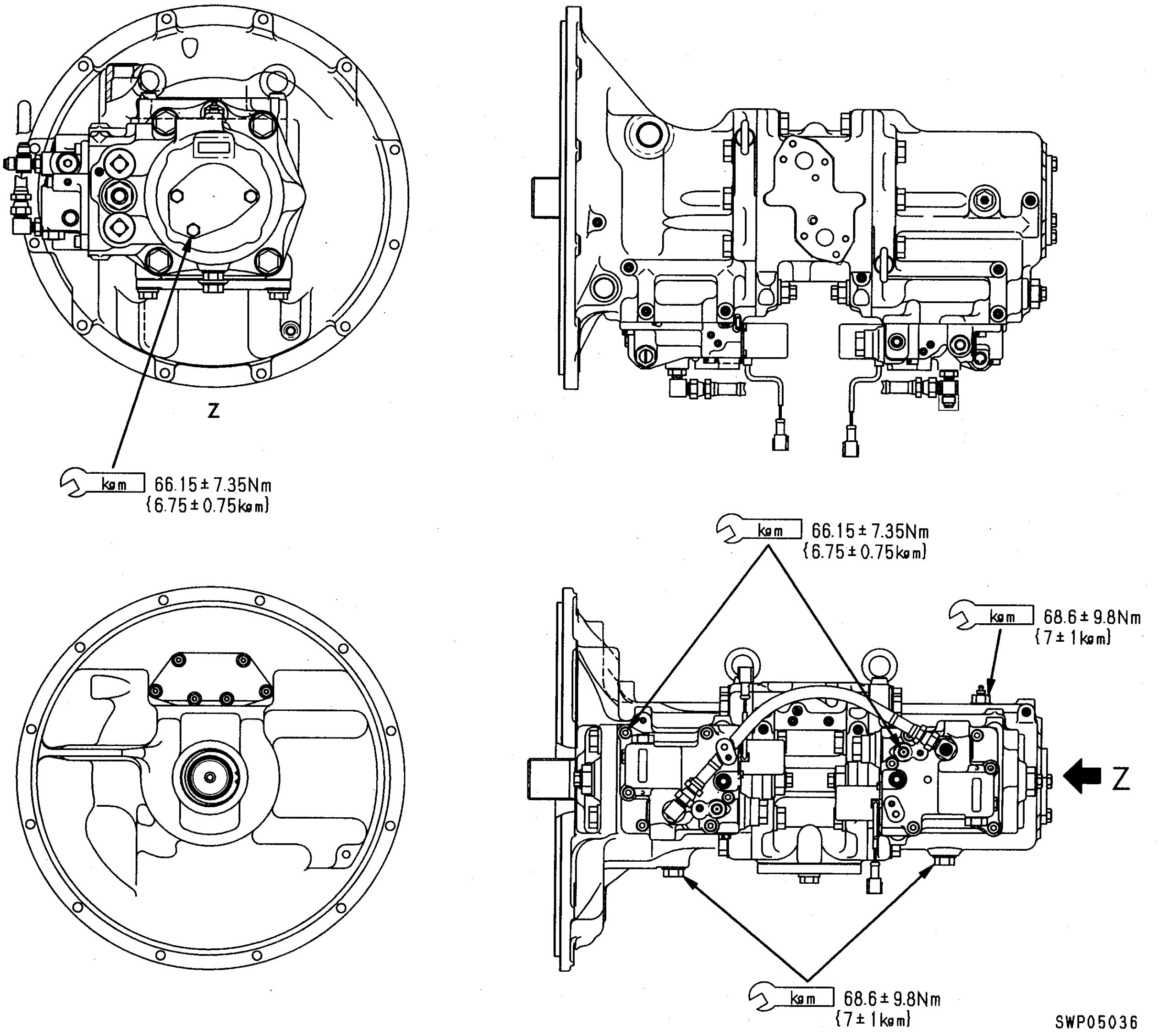


Unit: mm

No.	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Height	37	22	Rebuild or replace
2	Thickness	13		
3	Length of base	33		
4		27		
5	Length at tip	25		
6		17.5		
7		22.5		

HYDRAULIC PUMP

HPV160 + 160

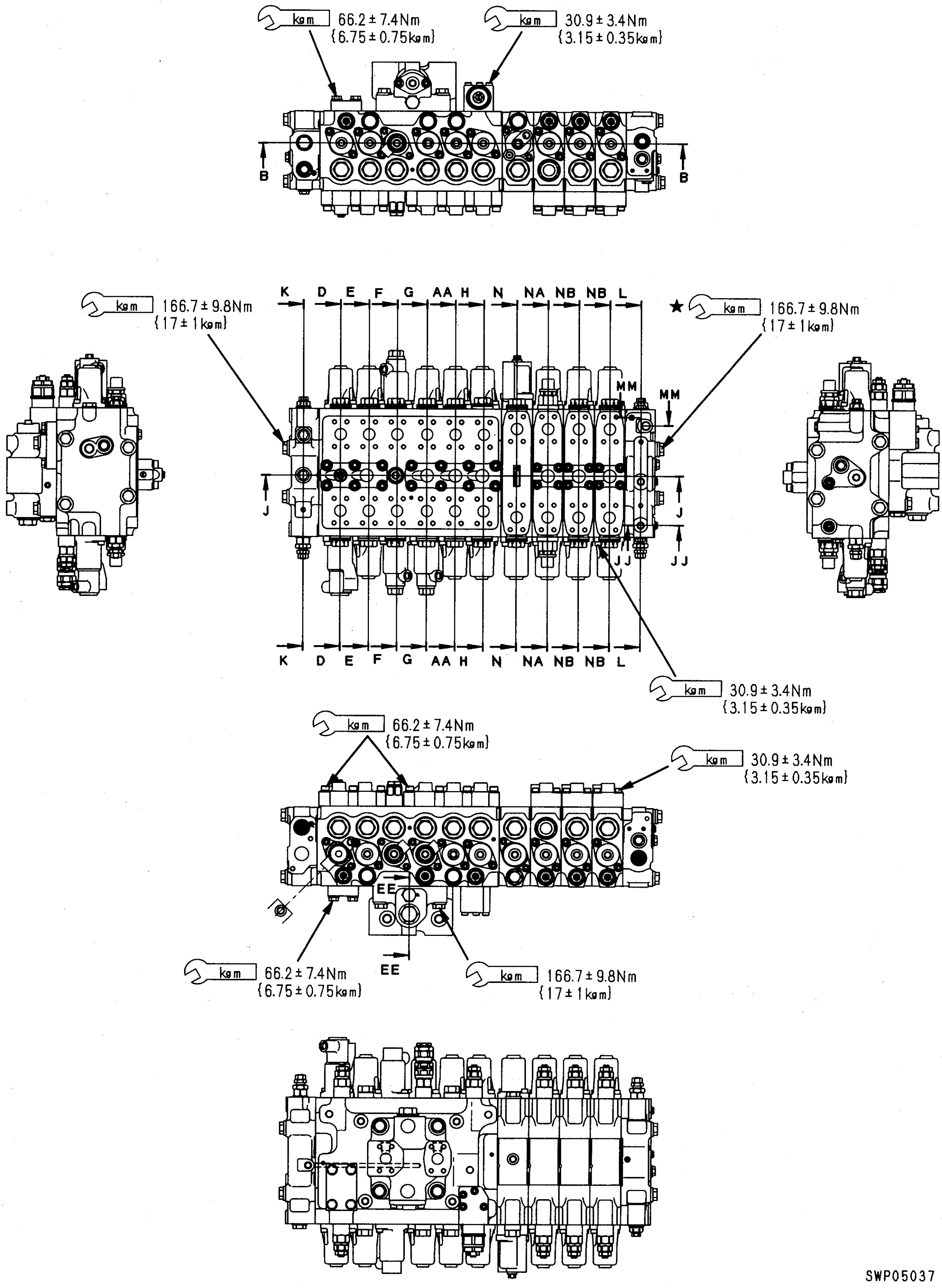


CONTROL VALVE

10-spool valve (1/6)

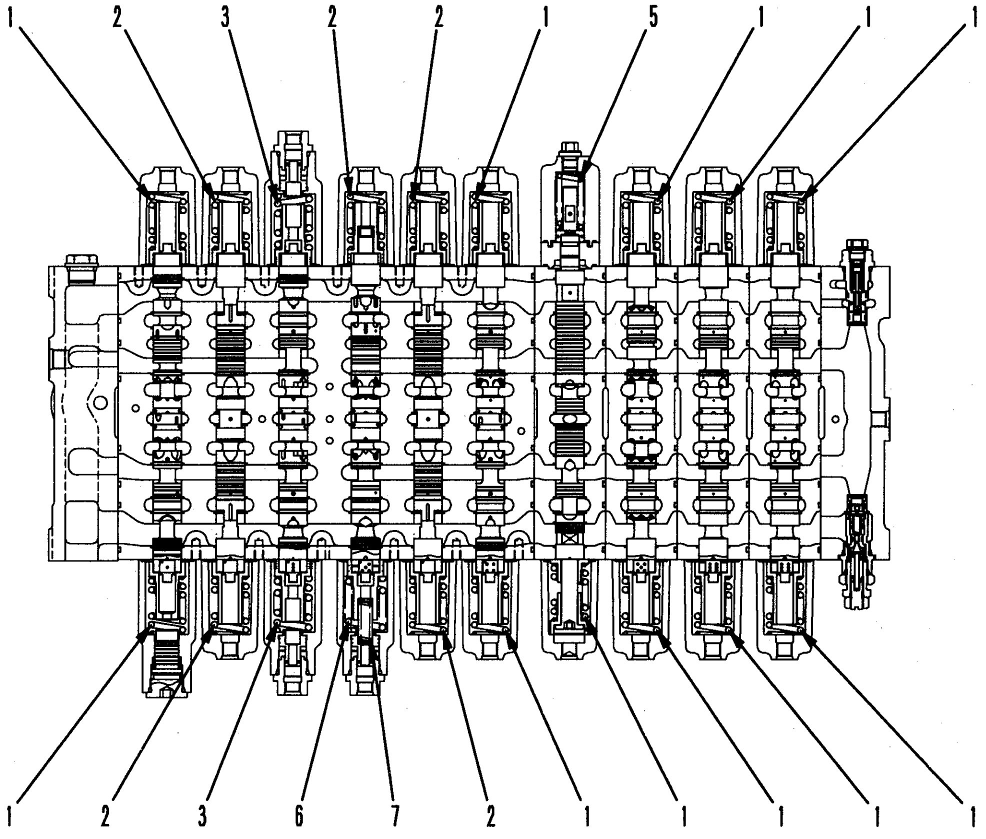
★ For details of the 9, 8, and 7-spool valves, see 10-SPOOL VALVE.

When tightening the bolts at the places marked ★, always use 2 washers on top of each other.



SWP05037

(2/6)

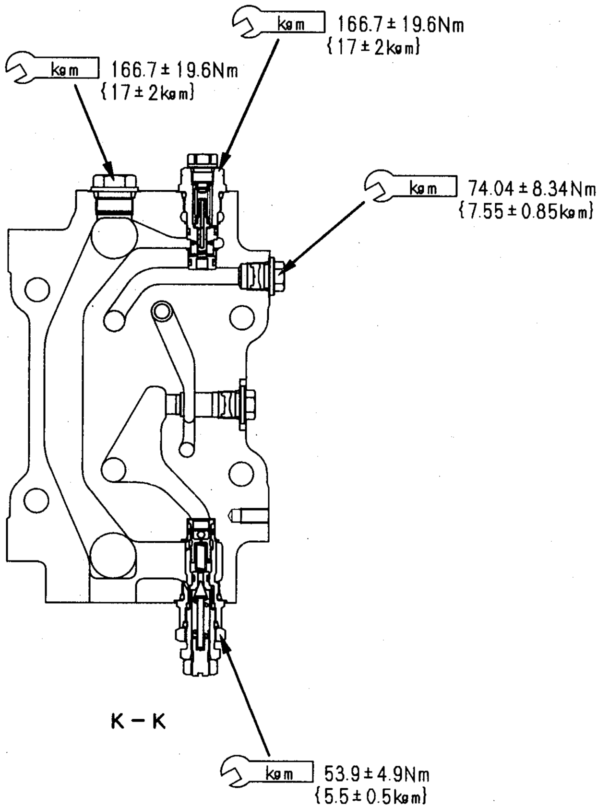


B – B

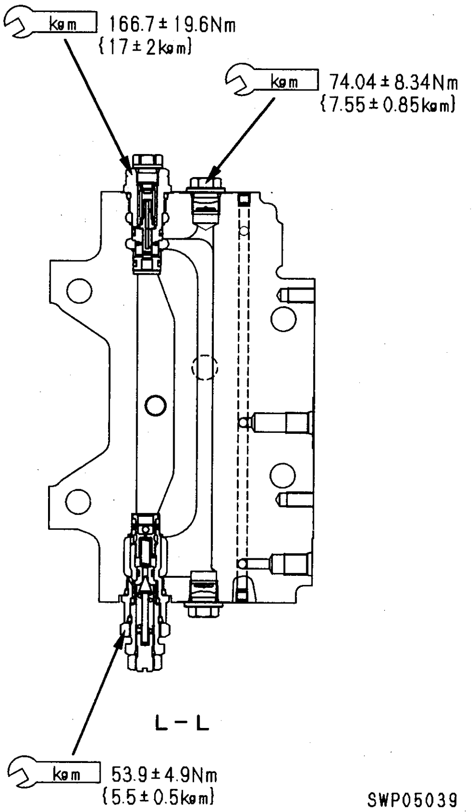
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
1	Spool return spring	54.5 x 34.8	51.2	393 N {40.1 kg}	—	314.6 N {32.1 kg}	Replace spring if there is damage or deformation
2	Spool return spring	54.2 x 34.8	51.2	416.5 N {42.5 kg}	—	338.1 N {34.5 kg}	
3	Spool return spring	52.6 x 34.8	49.2	432.1 N {44.0 kg}	—	345 N {35.2 kg}	
4	Spool return spring	54.4 x 34.8	51.2	411.6 N {42.0 kg}	—	333.2 N {34.0 kg}	
5	Spool return spring	54.9 x 24.2	51.2	250.9 N {25.6 kg}	—	200.9 N {20.5 kg}	
6	Spool return spring	53.3 x 37.1	49.5	358.7 N {36.6 kg}	—	287.1 N {29.3 kg}	
7	Spool return spring	40 x 12.3	38	50 N {5.1 kg}	—	40.2 N {4.1 kg}	

(3/6)



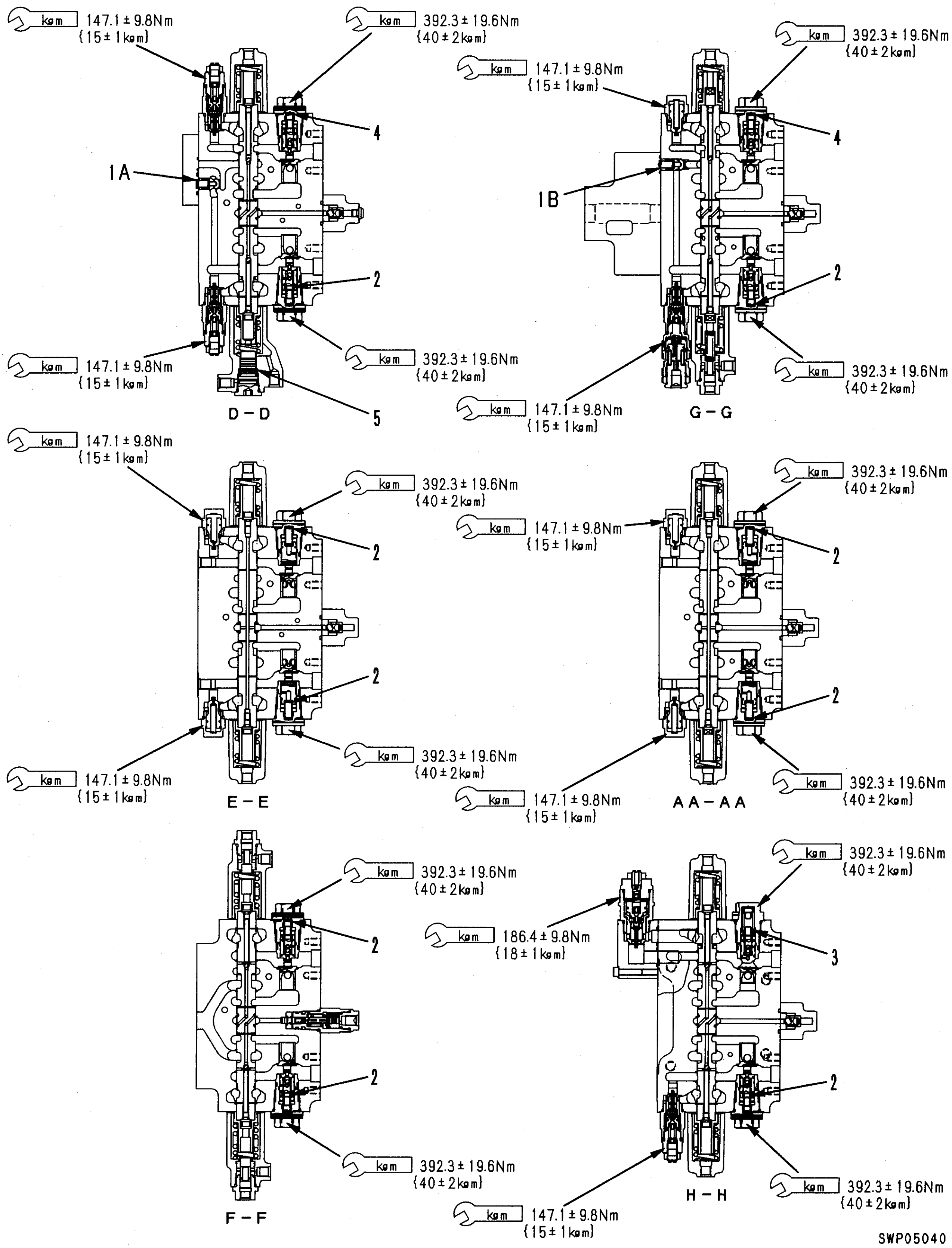
K – K



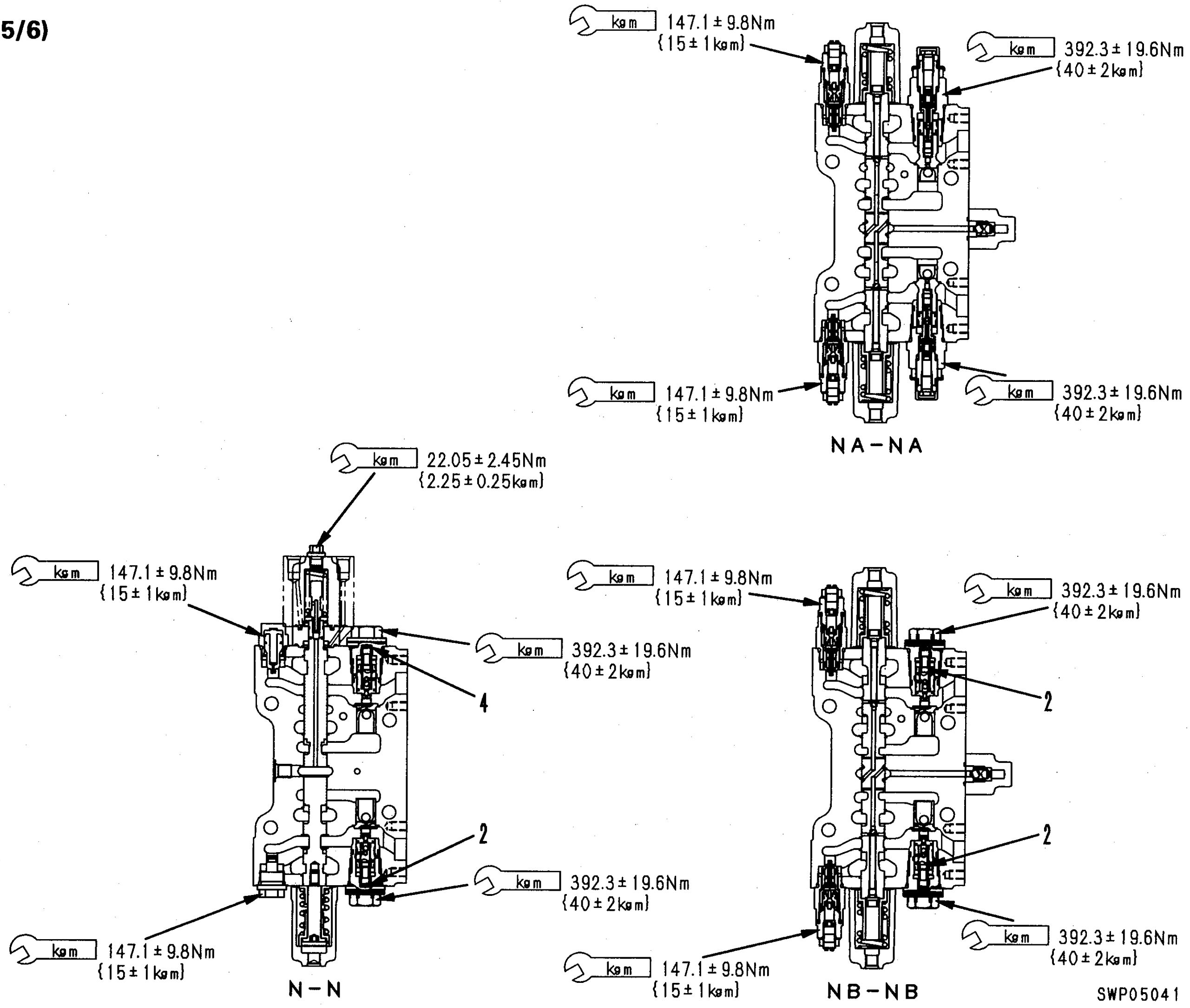
L – L

SWP05039

(4/6)


kgm 147.1 ± 9.8Nm {15 ± 1kgm}
kgm 392.3 ± 19.6Nm {40 ± 2kgm}
1A
4
2
kgm 147.1 ± 9.8Nm {15 ± 1kgm}
kgm 392.3 ± 19.6Nm {40 ± 2kgm}
5
D – D
kgm 147.1 ± 9.8Nm {15 ± 1kgm}
kgm 392.3 ± 19.6Nm {40 ± 2kgm}
4
1B
2
kgm 392.3 ± 19.6Nm {40 ± 2kgm}
kgm 147.1 ± 9.8Nm {15 ± 1kgm}
G – G
kgm 147.1 ± 9.8Nm {15 ± 1kgm}
kgm 392.3 ± 19.6Nm {40 ± 2kgm}
2
2
kgm 147.1 ± 9.8Nm {15 ± 1kgm}
kgm 392.3 ± 19.6Nm {40 ± 2kgm}
E – E
kgm 392.3 ± 19.6Nm {40 ± 2kgm}
kgm 147.1 ± 9.8Nm {15 ± 1kgm}
2
2
kgm 392.3 ± 19.6Nm {40 ± 2kgm}
kgm 147.1 ± 9.8Nm {15 ± 1kgm}
AA – AA
kgm 392.3 ± 19.6Nm {40 ± 2kgm}
2
2
kgm 392.3 ± 19.6Nm {40 ± 2kgm}
F – F
kgm 392.3 ± 19.6Nm {40 ± 2kgm}
kgm 186.4 ± 9.8Nm {18 ± 1kgm}
3
2
kgm 392.3 ± 19.6Nm {40 ± 2kgm}
kgm 147.1 ± 9.8Nm {15 ± 1kgm}
H – H
SWP05040

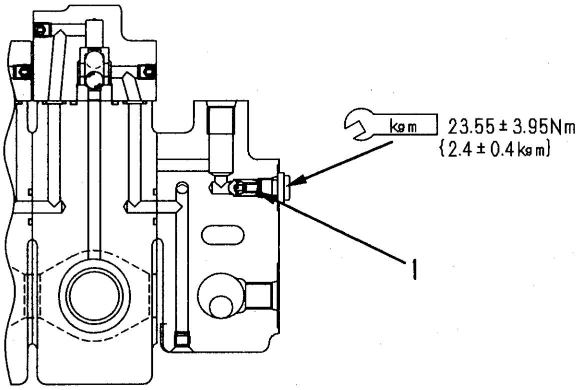
(5/6)



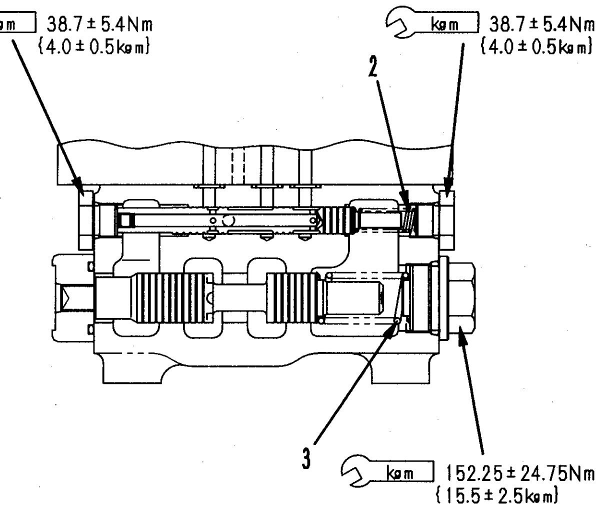
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
1A	Regeneration valve spring	31.5 x 10.3	19.5	5.9 N {0.6 kg}	—	4.4 N {0.45 kg}	Replace spring if there is damage or deformation
1B	Regeneration valve spring	x	21	5.1 N {0.53 kg}	—	—	
2	Piston return spring	48.1 x 10.8	28	17.4 N {1.78 kg}	—	13.9 N {1.42 kg}	
3	Piston return spring	50.4 x 17	39	158.8 N {16.2 kg}	—	142.1 N {14.5 kg}	
4	Piston return spring	x	—	29.4 N {3 kg}	—	—	
5	Piston return spring	24.5 x 25.2	12	2 N {0.2 kg}	—	1.5 N {0.15 kg}	

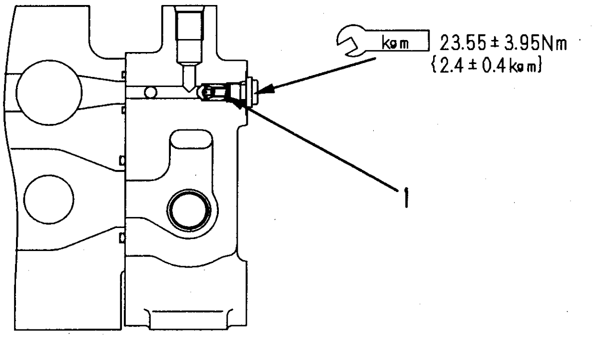
(6/6)



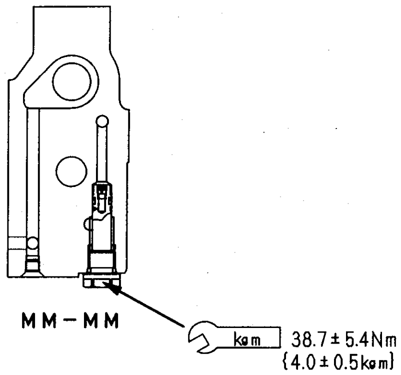
J – J



EE – EE



JJ – JJ



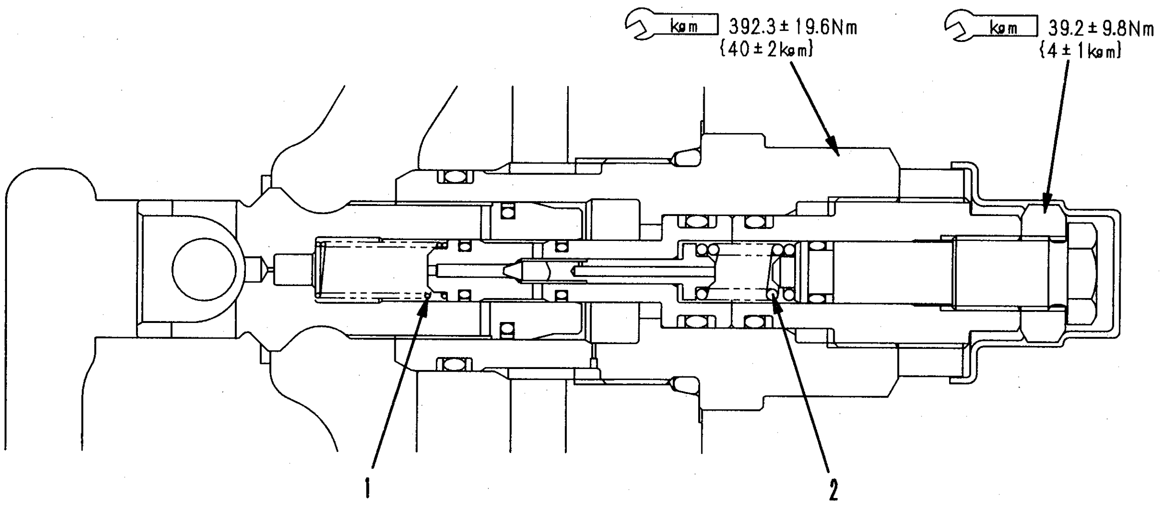
MM – MM

SWP05042

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
1	Check valve spring	11.5 x 4.6	8.5	1.5 N {0.15 kg}	—	1.2 N {0.12 kg}	Replace spring if there is damage or deformation
2	Spool return spring	65.5 x 27.2	50	167.6 N {17.1 kg}	—	134.3 N {13.7 kg}	
3	Spool return spring	13.6 x 5.5	10	2 N {0.2 kg}	—	1.5 N {0.15 kg}	

VARIABLE PRESSURE COMPENSATION VALVE

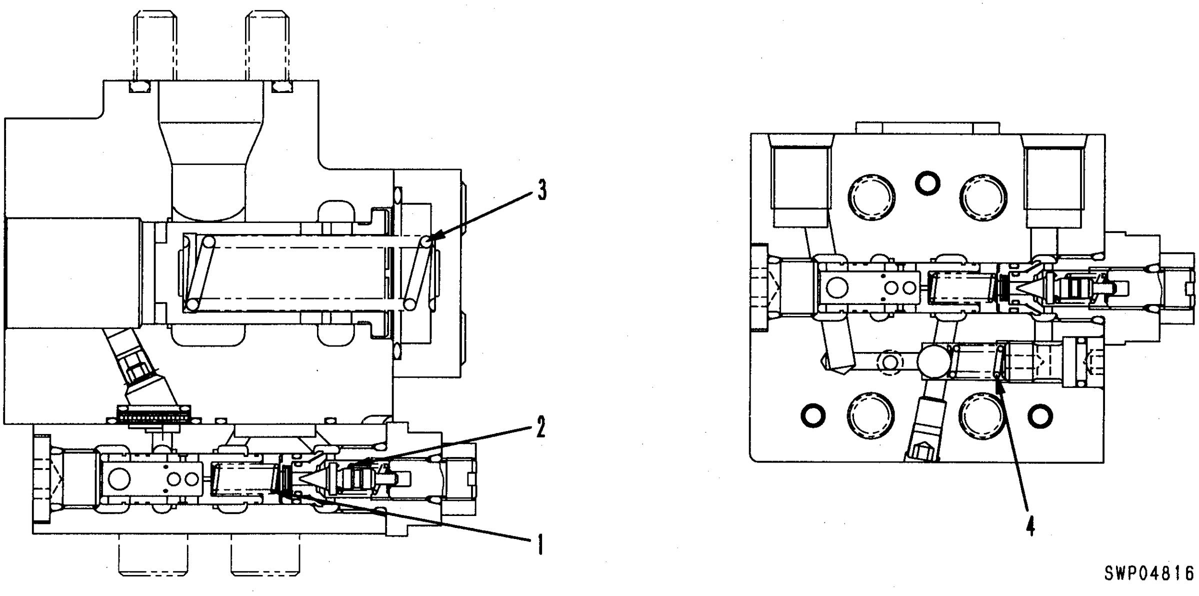


SDP01124

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
1	Piston return spring	Free length × O.D.	Installed length	Installed load	Free length	Installed load	Replace spring if any damages or deformations are found.
		32.76 × 8.5	20.5	9.8 N {1.0 kg}	—	7.8 N {0.8 kg}	
2	Relief valve spring	17.1 × 9	15.5	74.5 N {7.6 kg}	—	59.8 N {6.1 kg}	

SELF-REDUCING PRESSURE VALVE



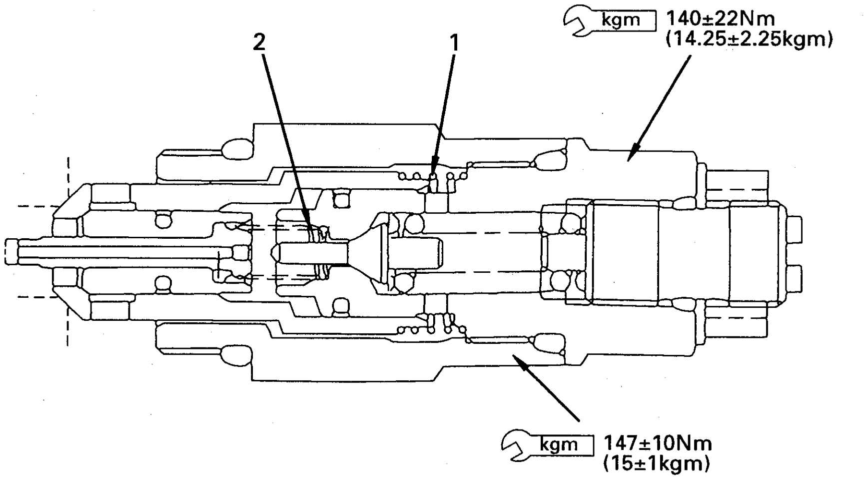
SWP04816

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length × O.D.	Installed length	Installed load	Free length	Installed load	
1	Spring (reducing pressure valve, main)	19.2 × 7.2	16.1	19.6 N {2 kg}	—	17.7 N {1.8 kg}	Replace spring if any damages or deformations are found.
2	Spring (reducing pressure valve, pilot)	16.5 × 7.2	12.7	20.6 N {2.1 kg}	—	18.6 N {1.9 kg}	
3	Spring	71 × 18	59	199.8 N {20.4 kg}	—	186.2 N {19 kg}	
4	Spring (safety valve)	16.1 × 7.8	13.4	61.7 N {6.3 kg}	—	58.8 N {6 kg}	

SUCTION-SAFETY VALVE

FOR SERVICE VALVE



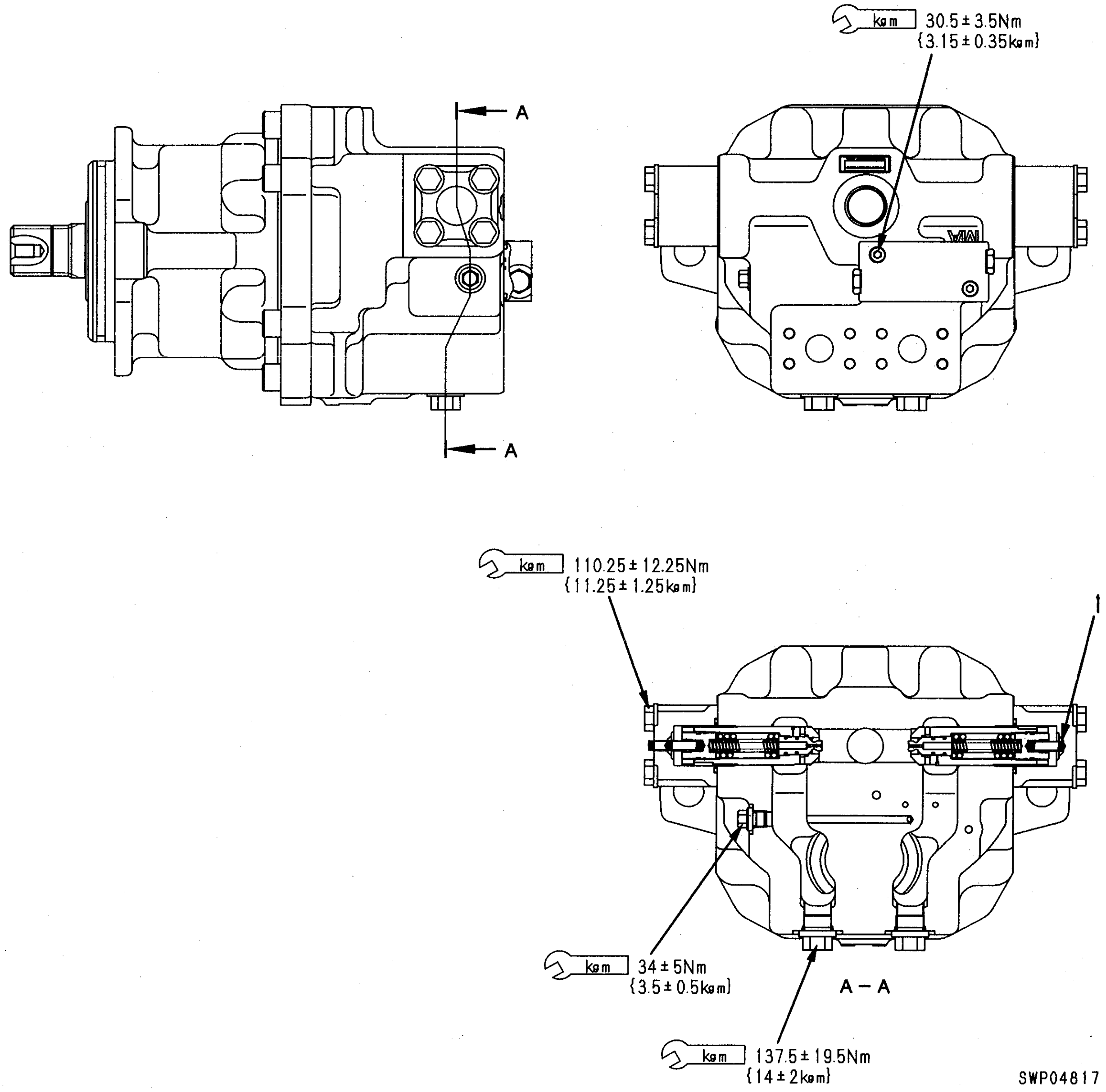
SBP00430

Unit: mm

No.	Check item	Criteria						Remedy
		Standard size				Repair limit		
		Wire diameter	Free length x O.D.	Installed length	Installed load	Free length	Installed load	
1	Suction valve spring	ϕ 0.9	16.3 x ϕ 21.3	9.5	2.1 N {0.21 kg}	—	1.6 N {0.16 kg}	Replace
2	Piston spring	ϕ 0.5	20 x ϕ 7	14	2.1 N {0.21 kg}	—	1.6 N {0.16 kg}	

SWING MOTOR

KMF160ABE-3

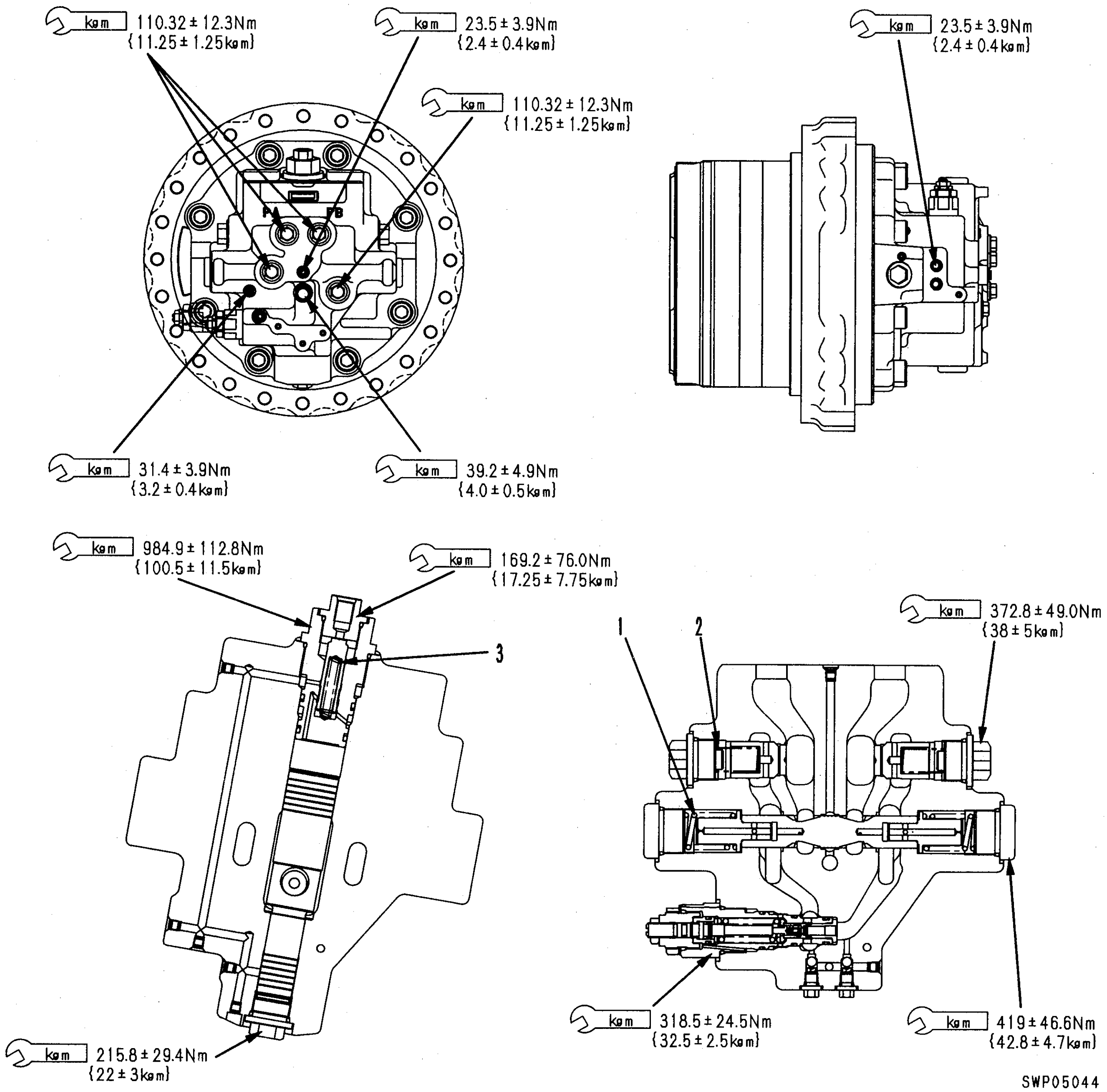


Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
1	Check valve spring	46.9 x 9.2	31	15 N {1.6 kg}	—	12.6 N {1.28 kg}	Replace spring if there is damage or deformation

TRAVEL MOTOR

KMV280ADT

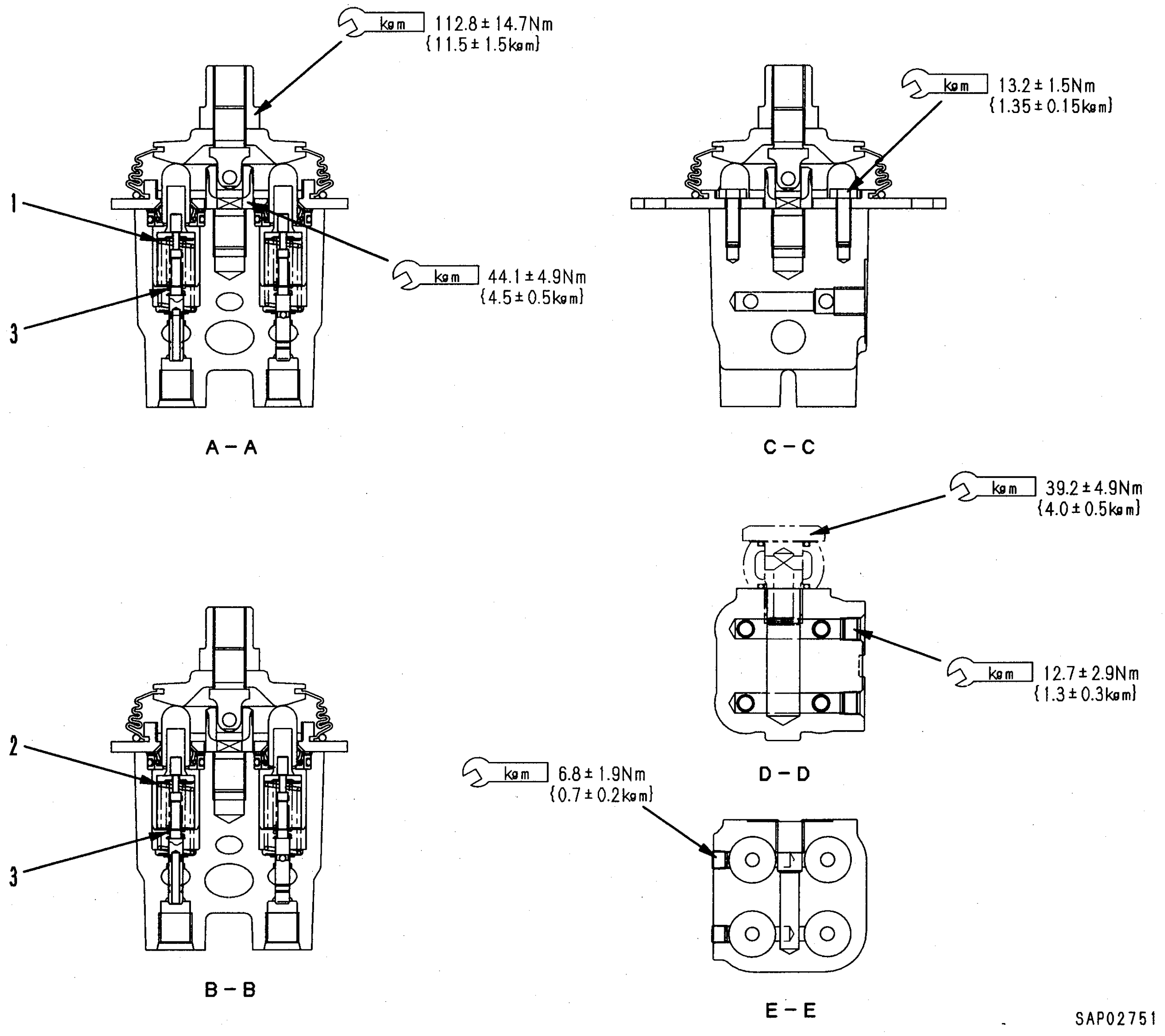


SWP05044

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x OD	Installed length	Installed load	Free length	Installed load	
1	Spool return spring	58.43 x 30.0	42.0	426.3 N (43.5 kg)	—	341.0 N (34.8 kg)	Replace spring if there is damage or deformation
2	Check valve spring	62.5 x 20.0	35.0	3.5 N (0.36 kg)	—	2.8 N (0.29 kg)	
3	Regulator piston spring	53.1 x 14.3	50.0	75.5 N (7.7 kg)	—	60.8 N (6.2 kg)	

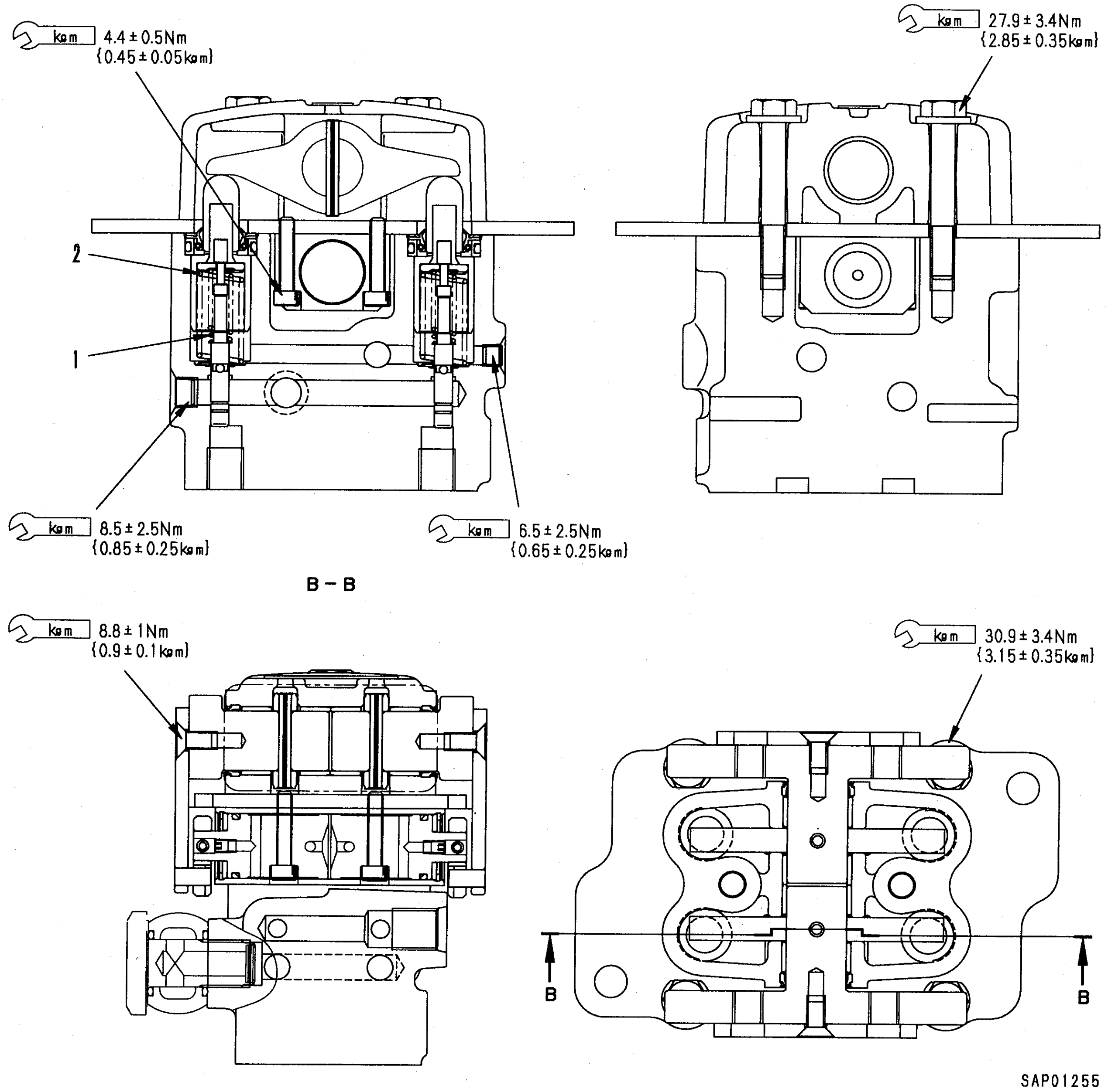
WORK EQUIPMENT • SWING PPC VALVE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
1	Centering spring (for P3, P4)	42.4 x 15.5	34	17.6 N {1.8 kg}	—	13.7 N {1.4 kg}	Replace spring if any damages or deformations are found.
2	Centering spring (for P1, P2)	44.4 x 15.5	34	29.4 N {3.0 kg}	—	23.5 N {2.4 kg}	
3	Metering spring	26.5 x 8.2	24.9	16.7 N {1.7 kg}	—	13.7 N {1.4 kg}	

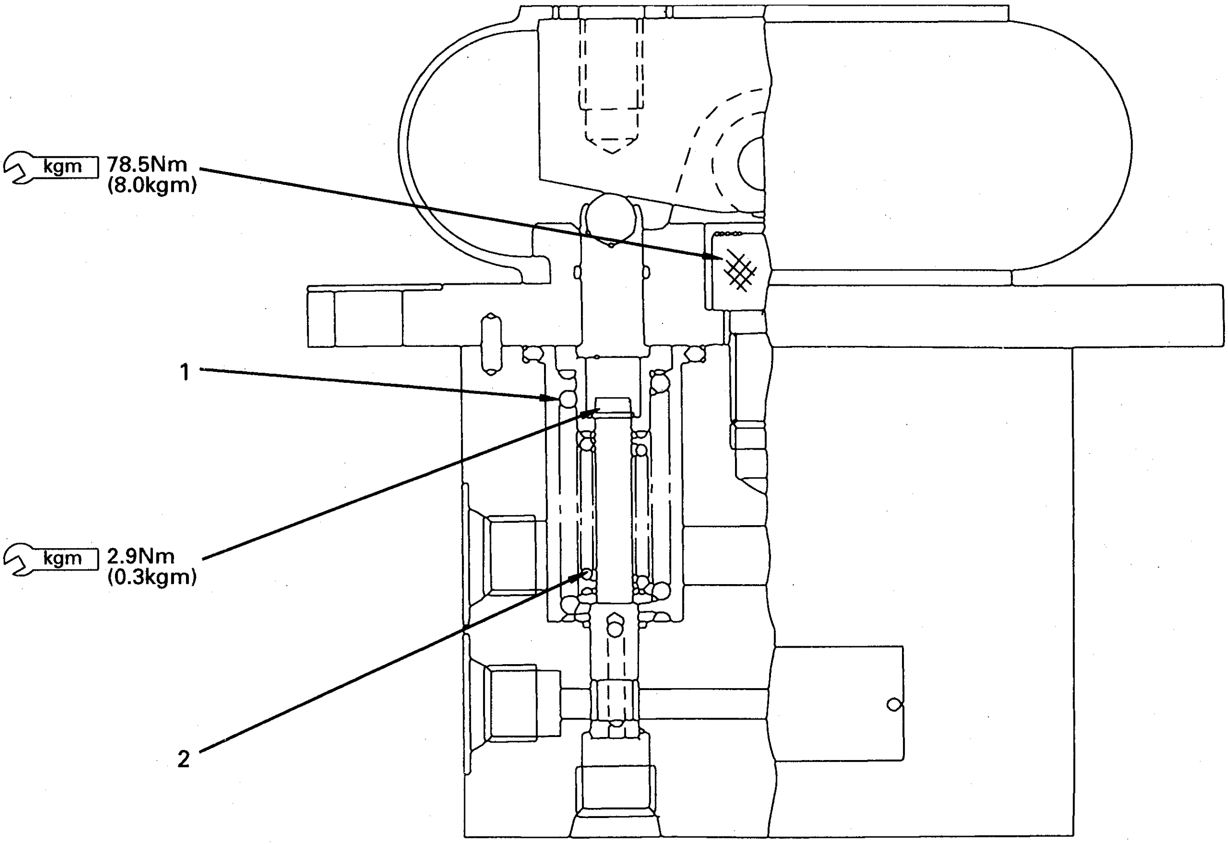
TRAVEL PPC VALVE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
1	Metering spring	26.5 x 8.15	24.9	16.7 N {1.7 kg}	—	13.7 N {1.4 kg}	Replace spring if there is damage or deformation
2	Centering spring	48.1 x 15.5	32.5	108 N {11 kg}	—	86.3 N {8.8 kg}	

SERVICE PPC VALVE

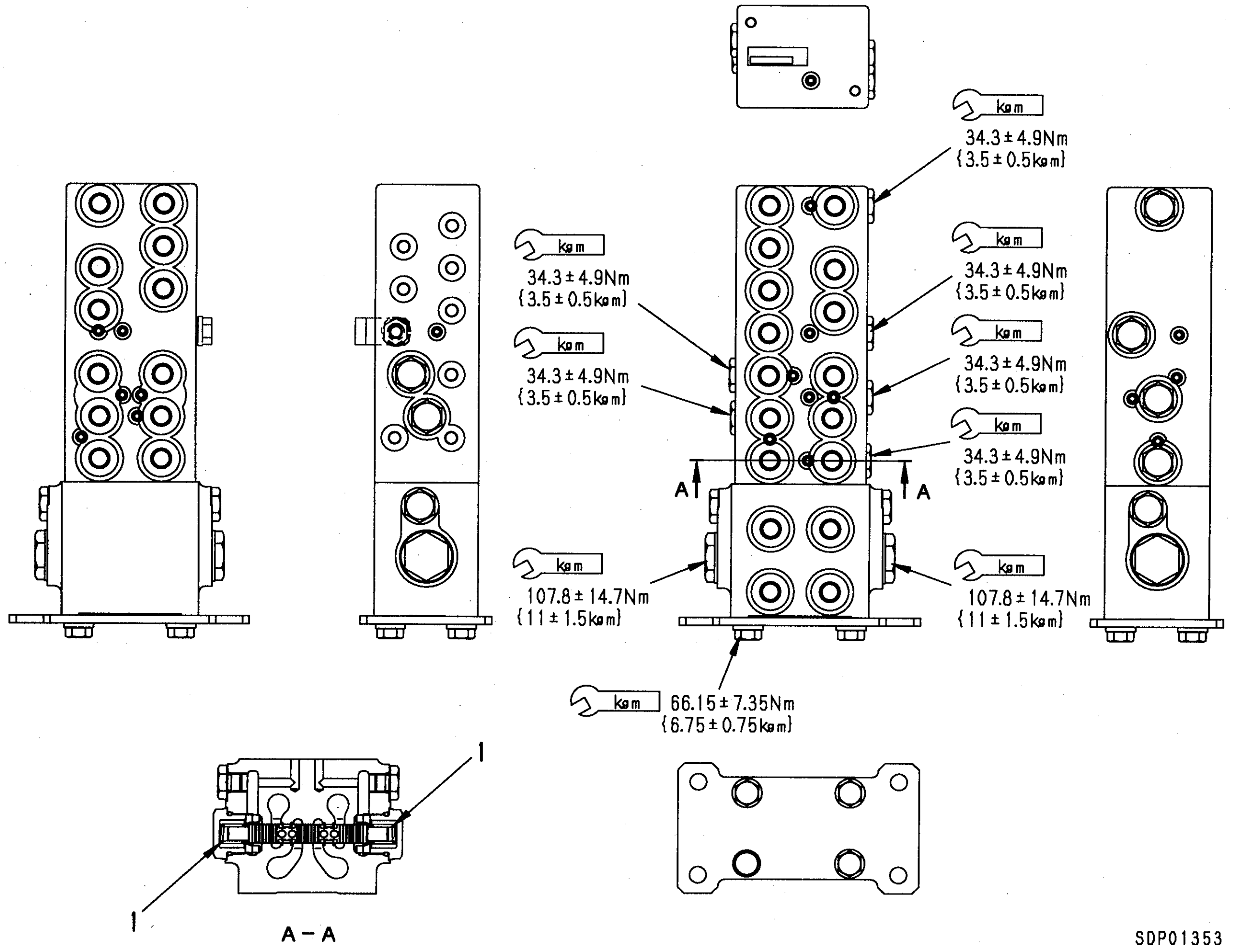


SBP00436

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
1	Centering spring	64.8 x 16.6	40.5	46.1 N {4.7 kg}	(62.9)	44.1 N {4.5 kg}	Replace spring if any damages or deformations are found.
2	Metering spring	26.0 x 10.5	25.0	25.5 N {2.6 kg}	(25.2)	24.5 N {2.5 kg}	

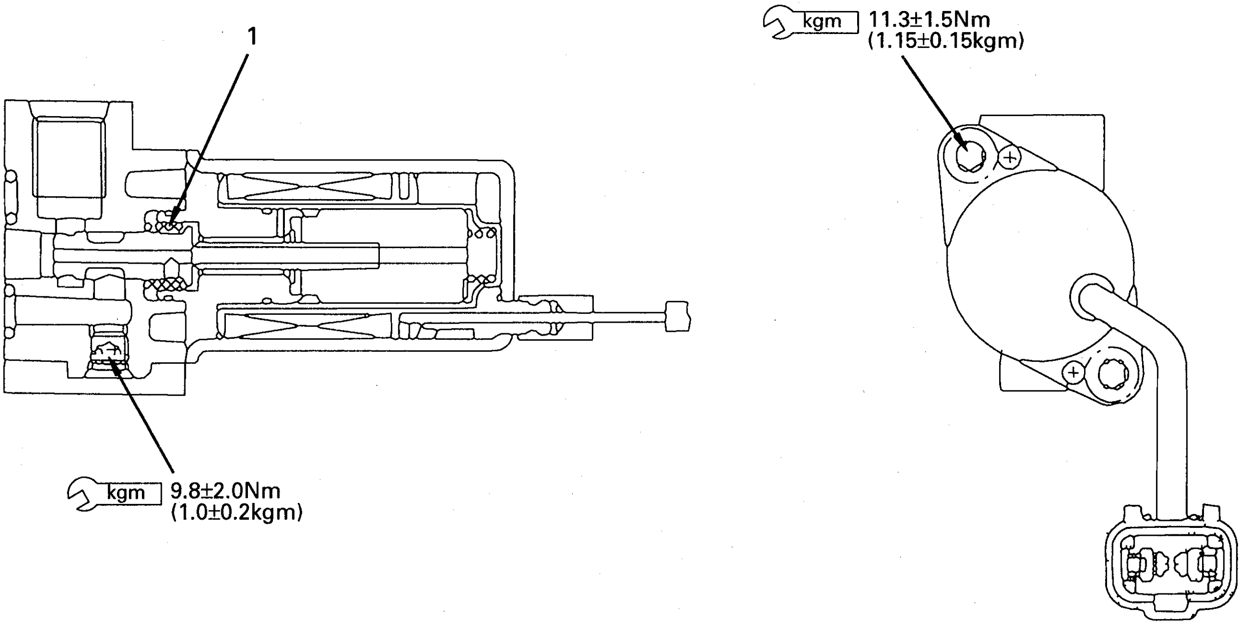
PPC SHUTTLE VALVE, TRAVEL JUNCTION VALVE



Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
1	Spool return spring	23.6 x 13.3	20	14.7 N {1.5 kg}	—	11.8 N {1.2 kg}	Replace spring if there is damage or deformation

LS-EPC VALVE

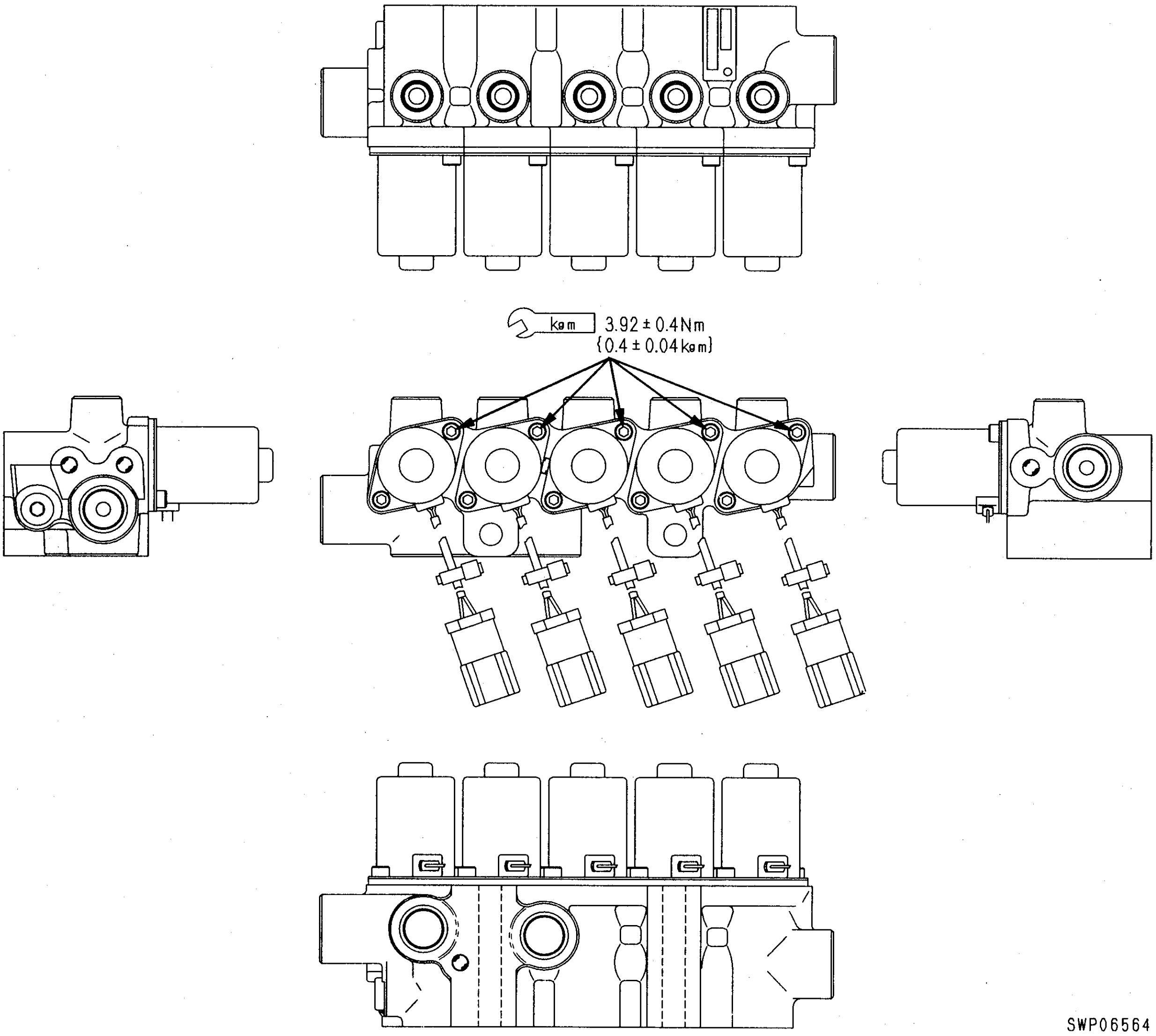


SBP00438

Unit: mm

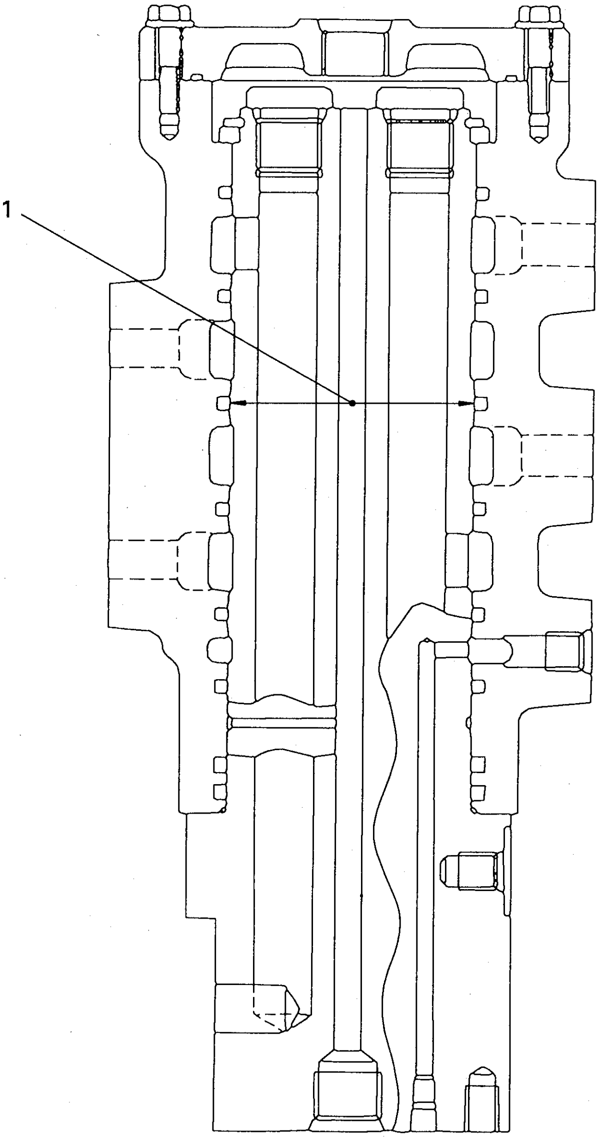
No.	Check item	Criteria					Remedy
1	Return spring	Standard size			Repair limit		Replace EPC valve ass'y if any damages or deformations are found.
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
		9.0 x 11.4	7.9	3.1 N {0.32 kg}	—	—	

SOLENOID VALVE



CENTER SWIVEL JOINT

PC400-6 Serial No.: 32001 – 32249
PC450-6 Serial No.: 12001 – 12143

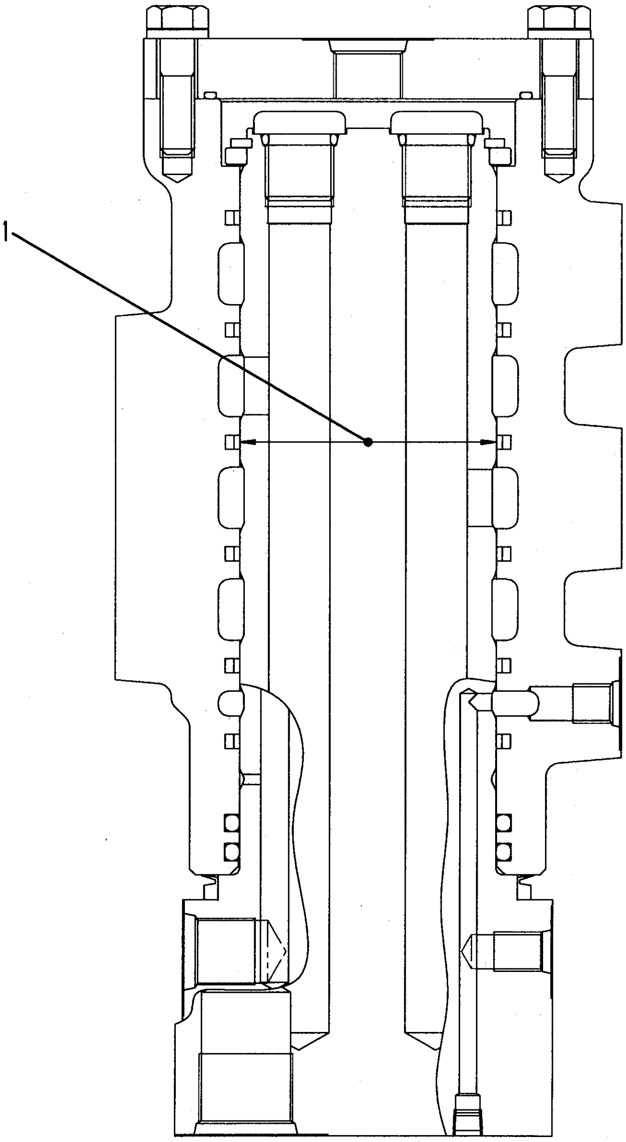


SBP00439

Unit: mm

No.	Check item	Criteria			Remedy
		Standard size	Standard clearance	Clearance limit	
1	Clearance between rotor and shaft	90	0.056 – 0.105	0.111	Replace

PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up

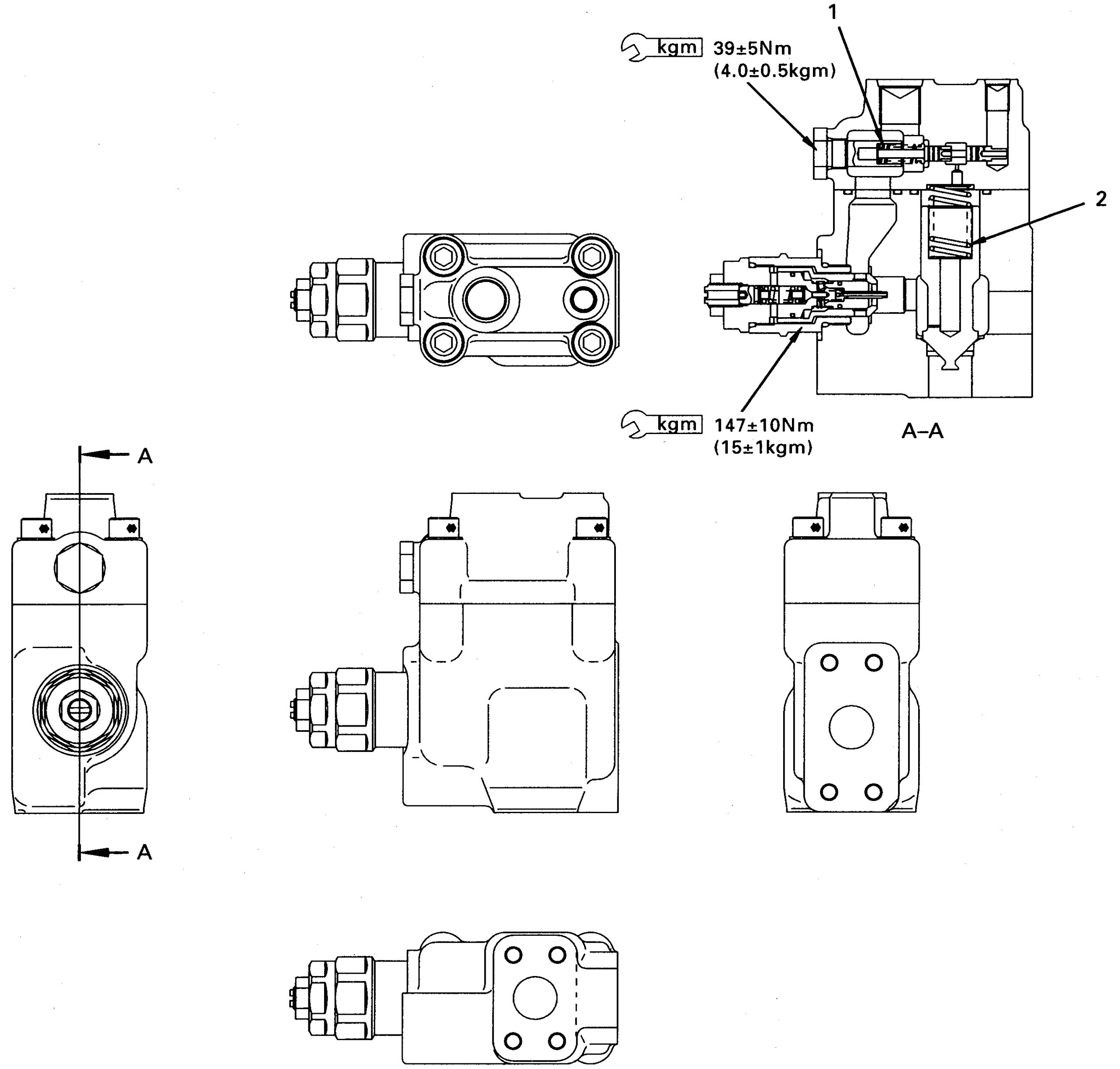


SJP06565

Unit: mm

No.	Check item	Criteria			Remedy
		Standard size	Standard clearance	Clearance limit	
1	Clearance between rotor and shaft	90	0.056 – 0.105	0.111	Replace

BOOM HOLDING VALVE



SAP00440

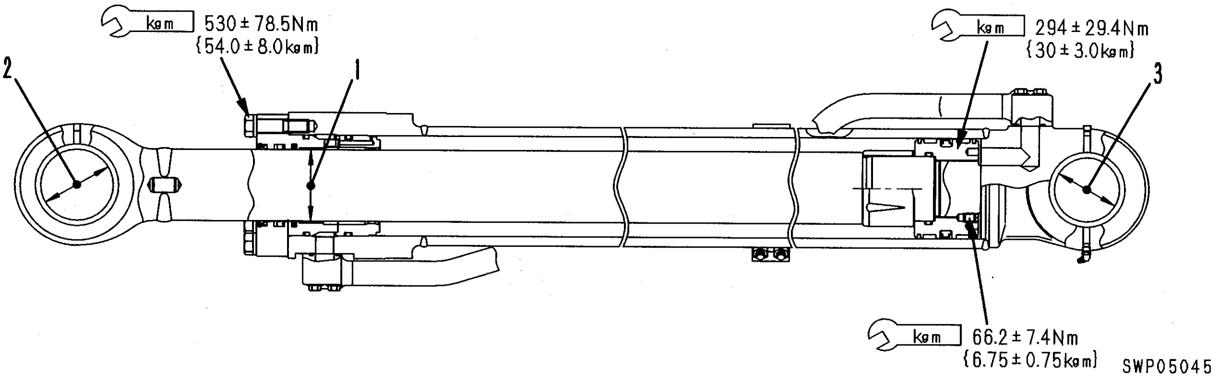
Unit: mm

No.	Check item	Criteria					Remedy
		Standard size			Repair limit		
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
1	Pilot valve spring	26.5 x 11.2	25.0	4.7 N {0.48 kg}	—	3.7 N {0.38 kg}	Replace spring if there is damage or deformation
2	Check valve spring	37.2 x 16.2	30.0	35.3 N {3.6 kg}	—	28.4 N {2.9 kg}	

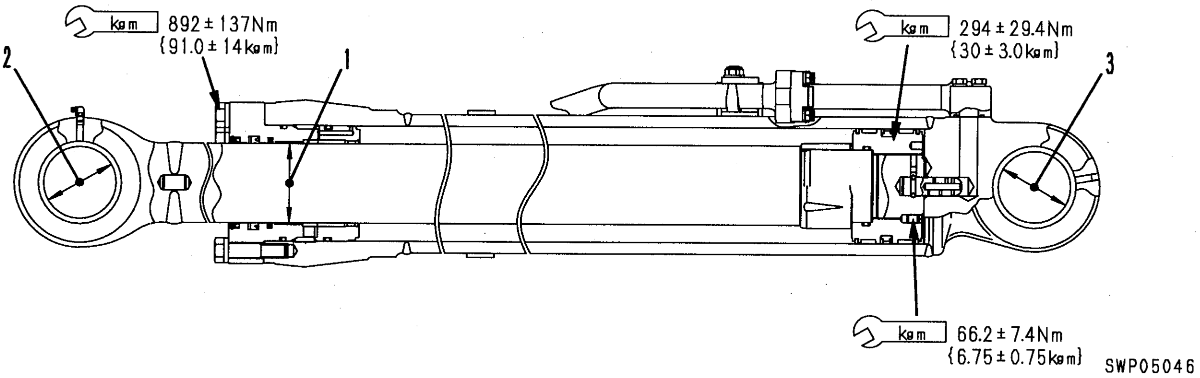
HYDRAULIC CYLINDER

BACK HOE

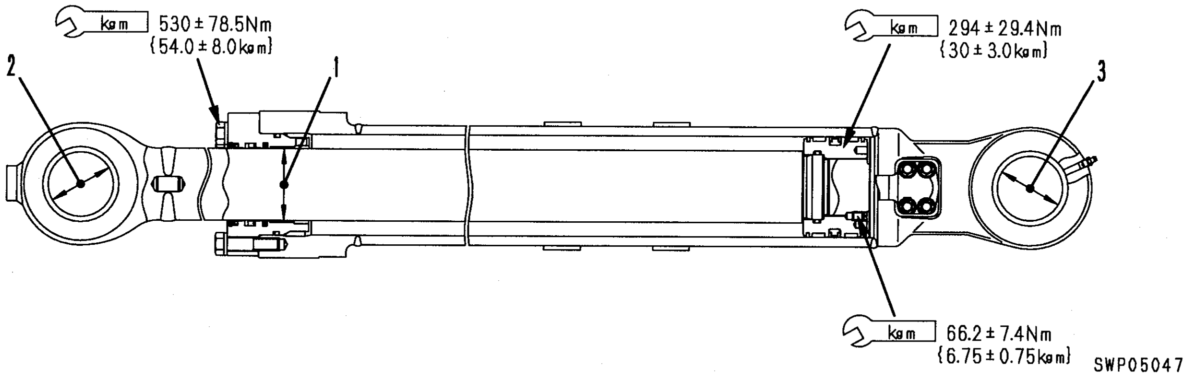
BOOM CYLINDER



ARM CYLINDER



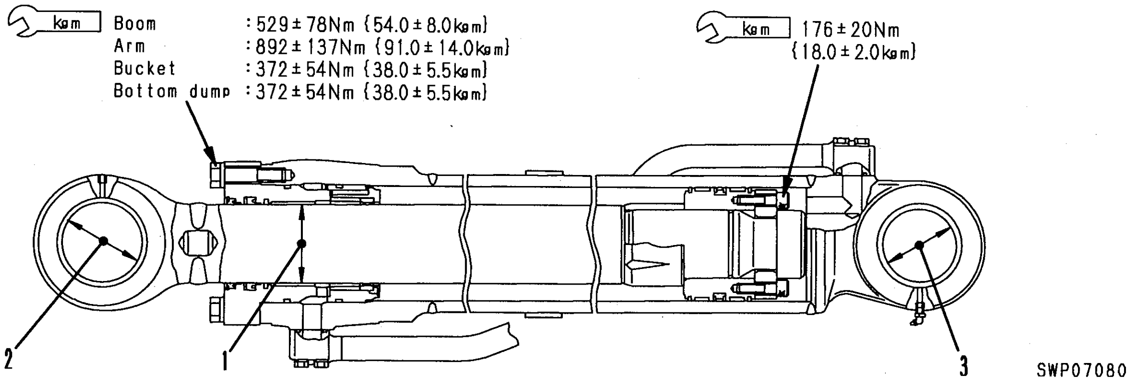
BUCKET CYLINDER



Unit: mm

No.	Check item		Criteria					Remedy
		Name of cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	110	–0.036 –0.090	+0.261 +0.047	0.083 – 0.351	0.451	Replace bushing
		Arm (for PC400)	120	–0.036 –0.090	+0.263 +0.048	0.083 – 0.353	0.453	
		Arm (for PC450)	130	–0.043 –0.106	+0.256 +0.040	0.083 – 0.362	0.462	
		Bucket	110	–0.036 –0.090	+0.261 +0.047	0.083 – 0.351	0.451	
2	Clearance between piston rod support shaft and bushing	Boom	110	—	+0.457 +0.370	—	1.0	Replace pin, bushing
		Arm (for PC400)	110	—	+0.457 +0.370	—	1.0	
		Arm (for PC450)	110	—	+0.457 +0.370	—	1.0	
		Bucket	100	—	+0.457 +0.370	—	1.0	
3	Clearance between cylinder bottom support shaft and bushing	Boom	100	—	+0.457 +0.370	—	1.0	
		Arm (for PC400)	110	—	+0.457 +0.370	—	1.0	
		Arm (for PC450)	110	—	+0.457 +0.370	—	1.0	
		Bucket	100	—	+0.457 +0.370	—	1.0	

LOADING SHOVEL

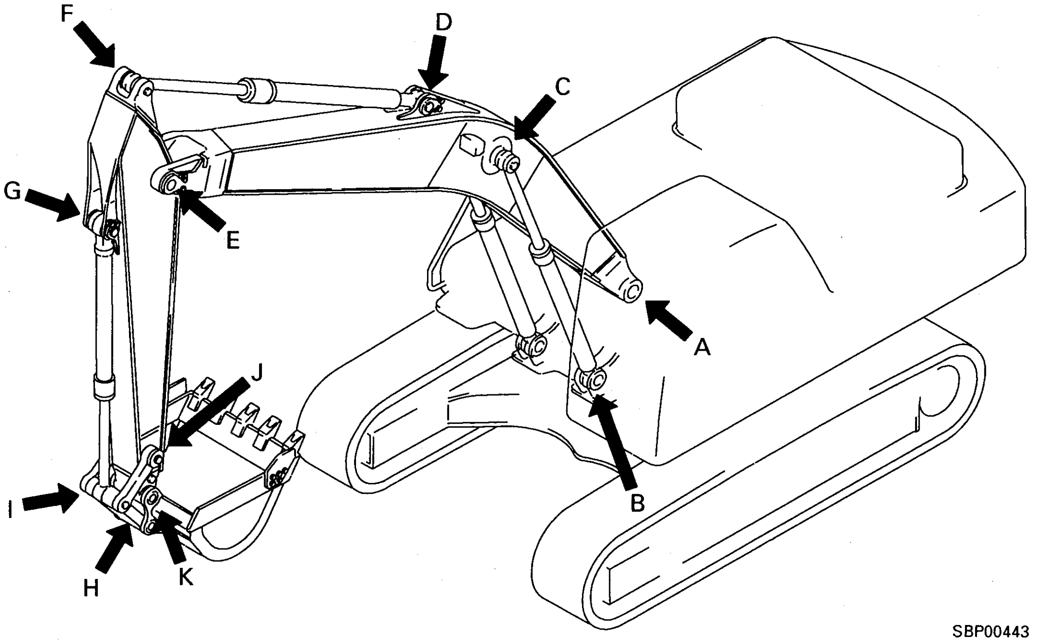


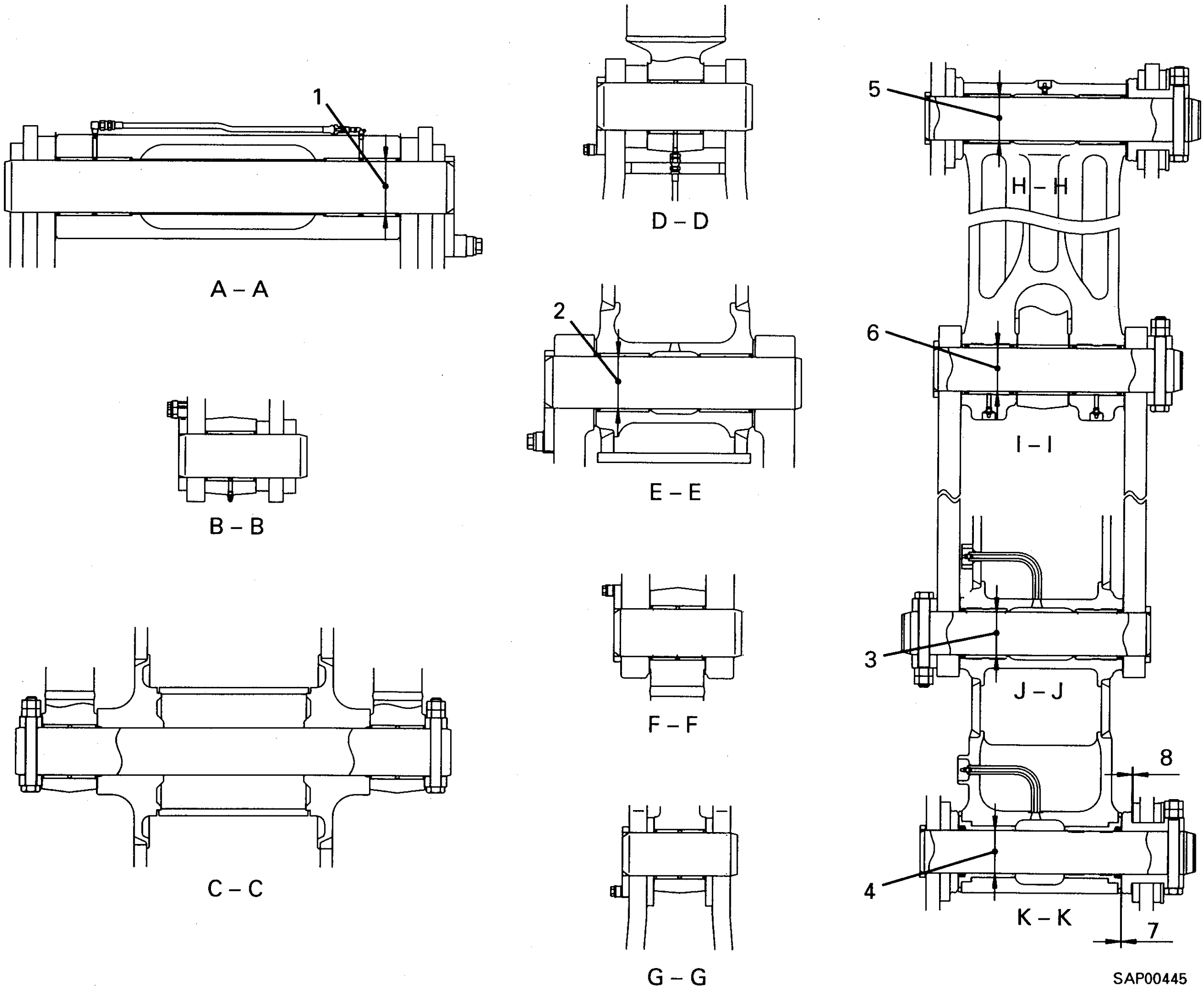
Unit: mm

No.	Check item		Criteria					Remedy
		Name of cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between piston rod and bushing	Boom	110	–0.036 –0.090	+0.261 +0.047	0.083 – 0.351	0.451	Replace bushing
		Arm	120	–0.036 –0.090	+0.263 +0.048	0.084 – 0.353	0.453	
		Bucket	95	–0.036 –0.090	+0.222 +0.047	0.083 – 0.312	0.412	
		Bottom dump	90	–0.036 –0.090	+0.257 +0.048	0.084 – 0.347	0.447	
2	Clearance between piston rod support and bushing	Boom	100	–0.036 –0.090	+0.457 +0.370	0.406 – 0.547	1.0	Replace pin, bushing
		Arm	110	–0.036 –0.090	+0.457 +0.370	0.406 – 0.547	1.0	
		Bucket	100	–0.036 –0.090	+0.457 +0.370	0.406 – 0.547	1.0	
		Bottom dump	80	–0.030 –0.076	+0.457 +0.370	0.400 – 0.533	1.0	
3	Clearance between cylinder bottom support and bushing	Boom	100	–0.036 –0.090	+0.457 +0.370	0.406 – 0.547	1.0	
		Arm	110	–0.036 –0.090	+0.457 +0.370	0.406 – 0.547	1.0	
		Bucket	80	–0.030 –0.076	+0.457 +0.370	0.400 – 0.533	1.0	
		Bottom dump	80	–0.030 –0.076	+0.457 +0.370	0.400 – 0.533	1.0	

WORK EQUIPMENT

BACK HOE

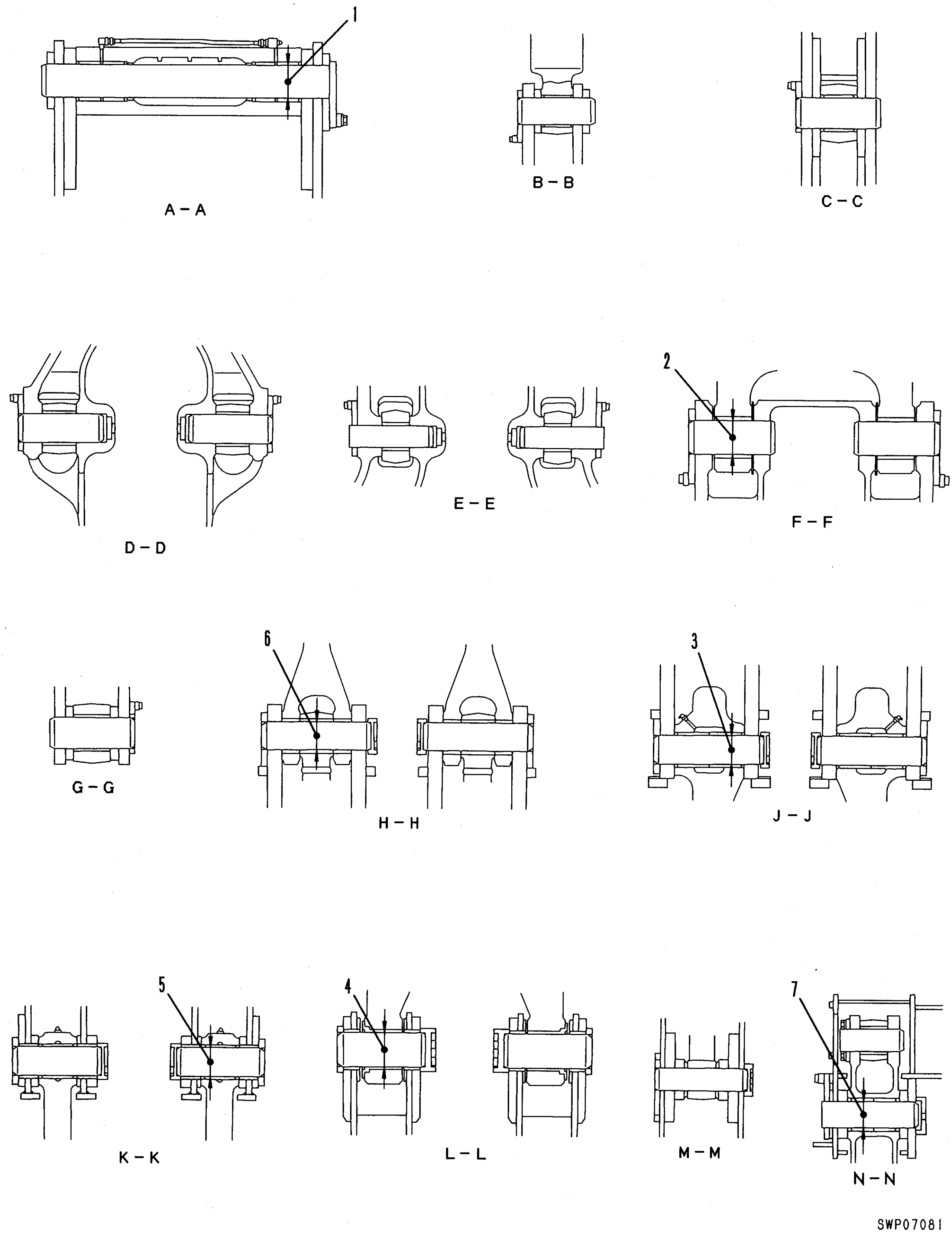


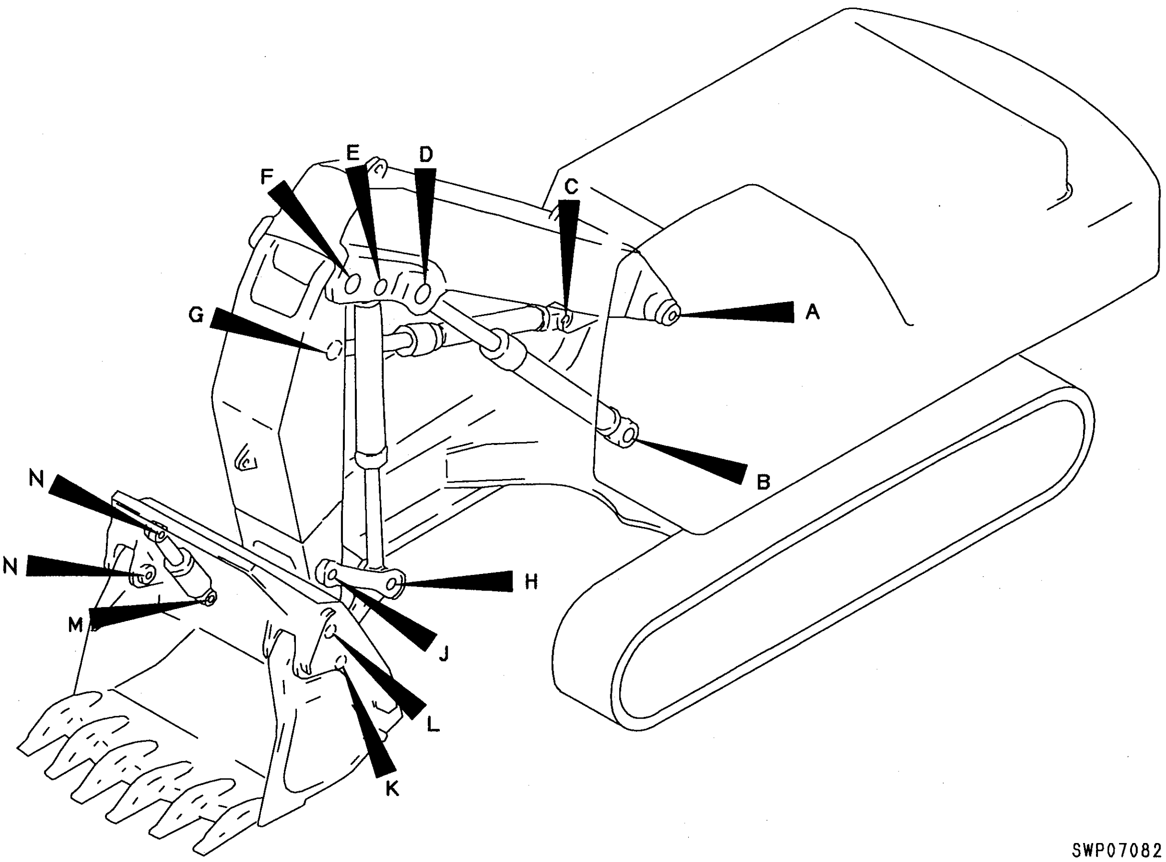


Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between bushing and mounting pin of boom and revolving frame	120	–0.036 –0.090	+0.161 +0.094	0.110 – 0.251	1.0	Replace
2	Clearance between bushing and mounting pin of boom and arm	120	–0.036 –0.071	+0.153 +0.097	0.133 – 0.224	1.0	
3	Clearance between bushing and mounting pin of boom and link	100	–0.036 –0.090	+0.338 +0.272	0.308 – 0.428	1.0	
4	Clearance between bushing and mounting pin of boom and bucket	100	–0.036 –0.090	+0.337 +0.271	0.307 – 0.427	1.0	
5	Clearance between bushing and mounting pin of link and bucket	100	–0.036 –0.090	+0.346 +0.275	0.311 – 0.436	1.0	
6	Clearance between bushing and mounting pin of link and link	100	–0.036 –0.090	+0.346 +0.275	0.311 – 0.436	1.0	
7	Bucket clearance (a)	0.5 – 1.0					Adjust shims
8	Bucket clearance (b)	2.0					

LOADING SHOVEL



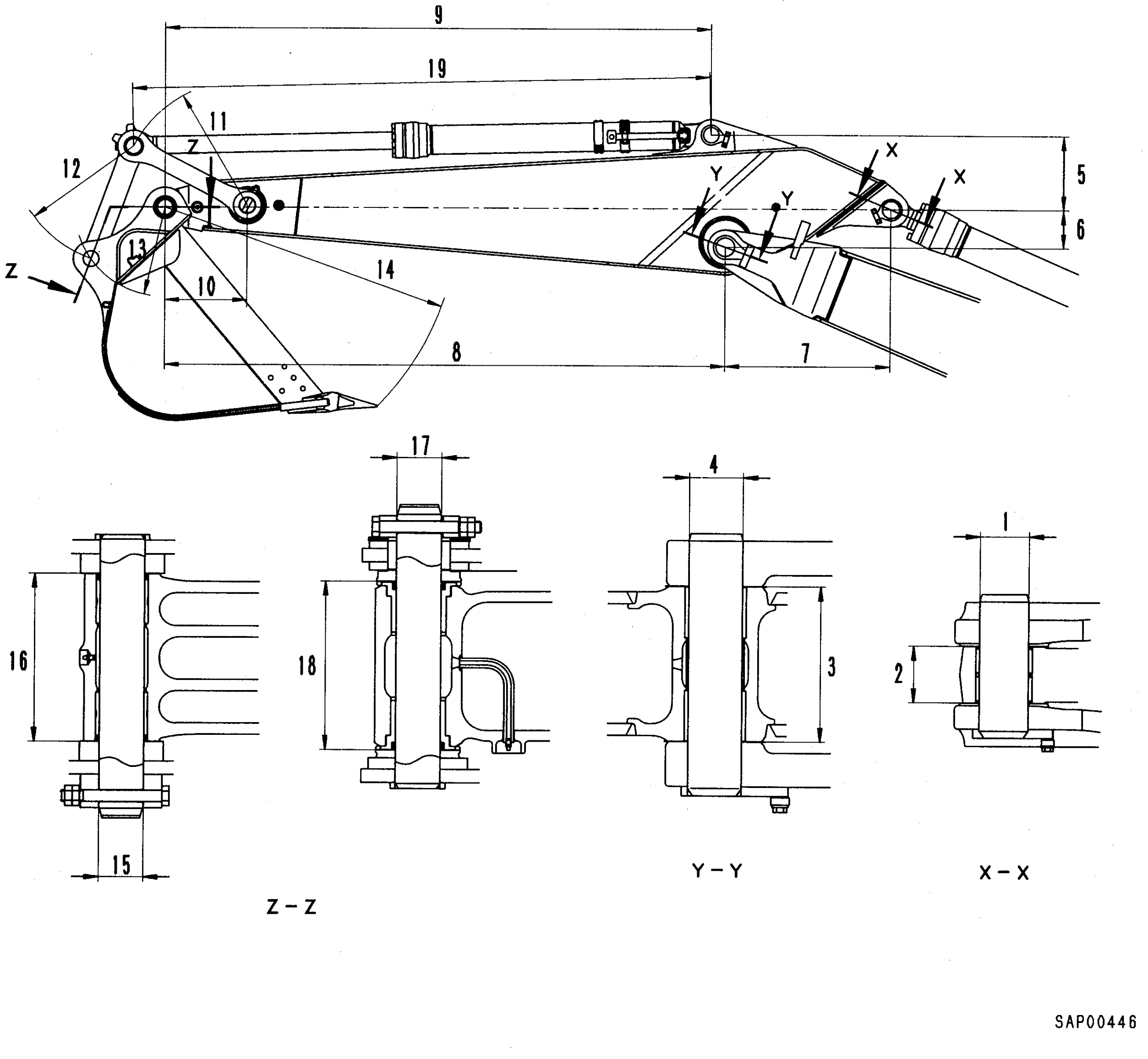


Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between bushing and connecting pin of revolving frame and boom	120	–0.036 –0.090	+0.351 +0.270	0.306 – 0.441	1.0	Replace
2	Clearance between bushing and connecting pin of boom and arm	120	–0.036 –0.090	+0.360 +0.283	0.319 – 0.450	1.0	
3	Clearance between bushing and connecting pin of arm and link	100	–0.036 –0.090	+0.352 +0.283	0.319 – 0.442	1.0	
4	Clearance between bushing and connecting pin of arm and bucket	120	–0.036 –0.090	+0.356 +0.278	0.314 – 0.446	1.0	
5	Clearance between bushing and connecting pin of link and bucket	100	–0.036 –0.090	+0.346 +0.278	0.314 – 0.436	1.0	
6	Clearance between bushing and connecting pin of link and link	100	–0.036 –0.090	+0.338 +0.284	0.320 – 0.428	1.0	
7	Clearance between bushing and connecting pin of front bucket and rear bucket	95	–0.036 –0.090	+0.344 +0.272	0.308 – 0.434	1.0	

DIMENSIONS OF WORK EQUIPMENT

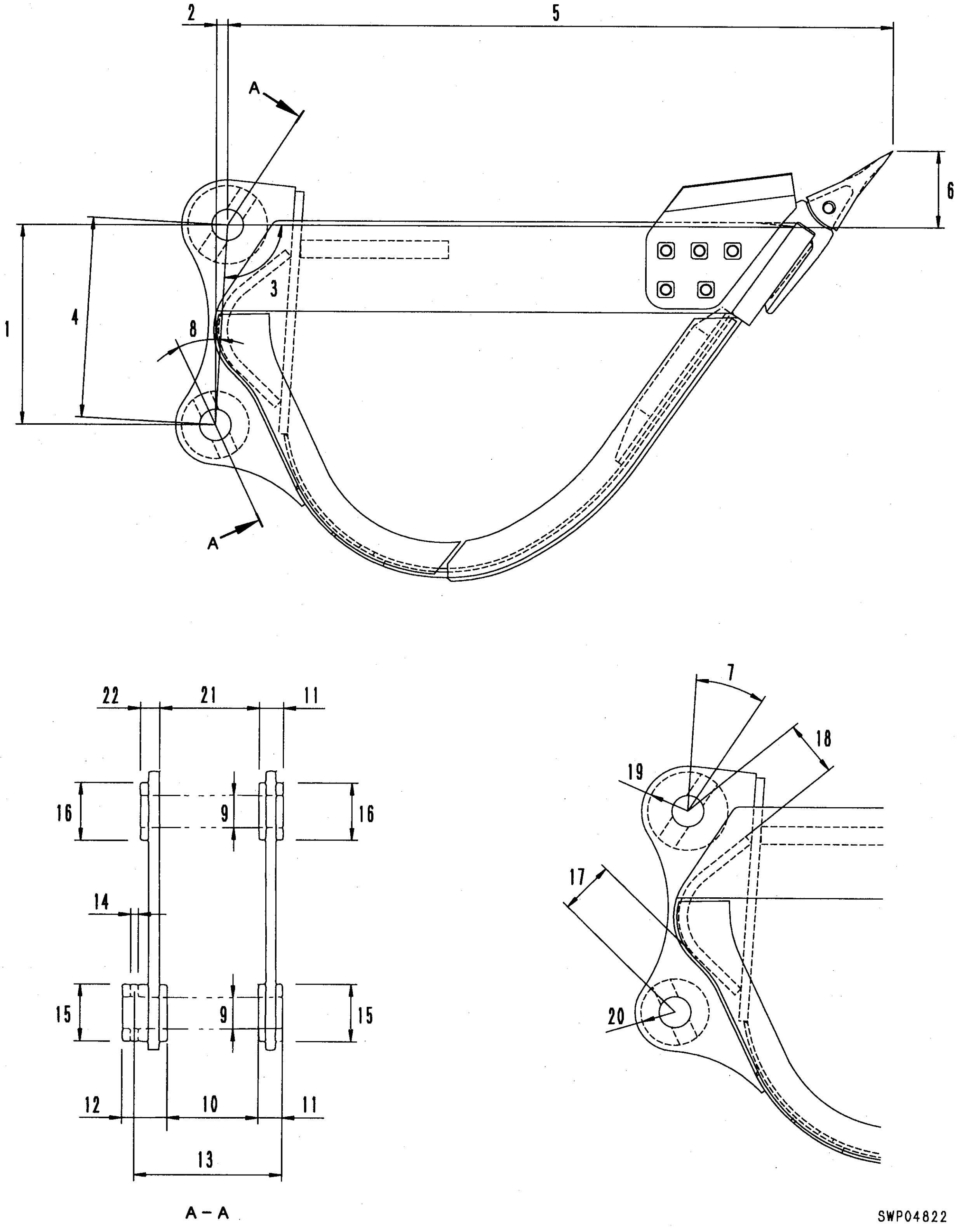
1. ARM



Unit: mm

Model No.		PC400-6	PC450-6
1		$\phi\ 110^{+0.1}_{0} / ^{-0.036}_{-0.090}$	$\phi\ 110^{+0.1}_{0} / ^{-0.036}_{-0.090}$
2		$\phi\ 127.3^{+1.5}_{0} / 126 \pm 1.2$	$\phi\ 127.3^{+1.5}_{0} / 126 \pm 1.2$
3		$355^{+0.5}_{0} / ^{-0.3}_{-0.8}$	$355^{+0.5}_{0} / ^{-0.3}_{-0.8}$
4		$\phi\ 120^{+0.1}_{0} / ^{+0.036}_{-0.090}$	$\phi\ 120^{+0.1}_{0} / ^{+0.036}_{-0.090}$
5		525.2 ± 1.0	583.6 ± 1.0
6		195.0 ± 0.5	208.2 ± 0.5
7		1038 ± 1	1132.2 ± 1.0
8		3375 ± 3	3375 ± 3
9		3102.2 ± 1.0	3099.4 ± 1.0
10		502 ± 1	506.8 ± 1.0
11		720.0 ± 0.2	720.0 ± 0.2
12		719.0 ± 0.5	719.0 ± 0.5
13		537.1	537.1
14		1850	1850
15		$\phi\ 100^{+0.2}_{0} / ^{-0.036}_{-0.090}$	$\phi\ 100^{+0.2}_{0} / ^{-0.036}_{-0.090}$
16		370.0 ± 0.5	370.0 ± 0.5
17		$\phi\ 100^{+0.2}_{0} / ^{-0.036}_{-0.090}$	$\phi\ 100^{+0.2}_{0} / ^{-0.036}_{-0.090}$
18	Arm as individual part	$355^{0}_{-0.5}$	$355^{0}_{-0.5}$
	When press fitting bushing	370	370
19	Min.	1995	1955
	Max.	3265	3265

2. BUCKET

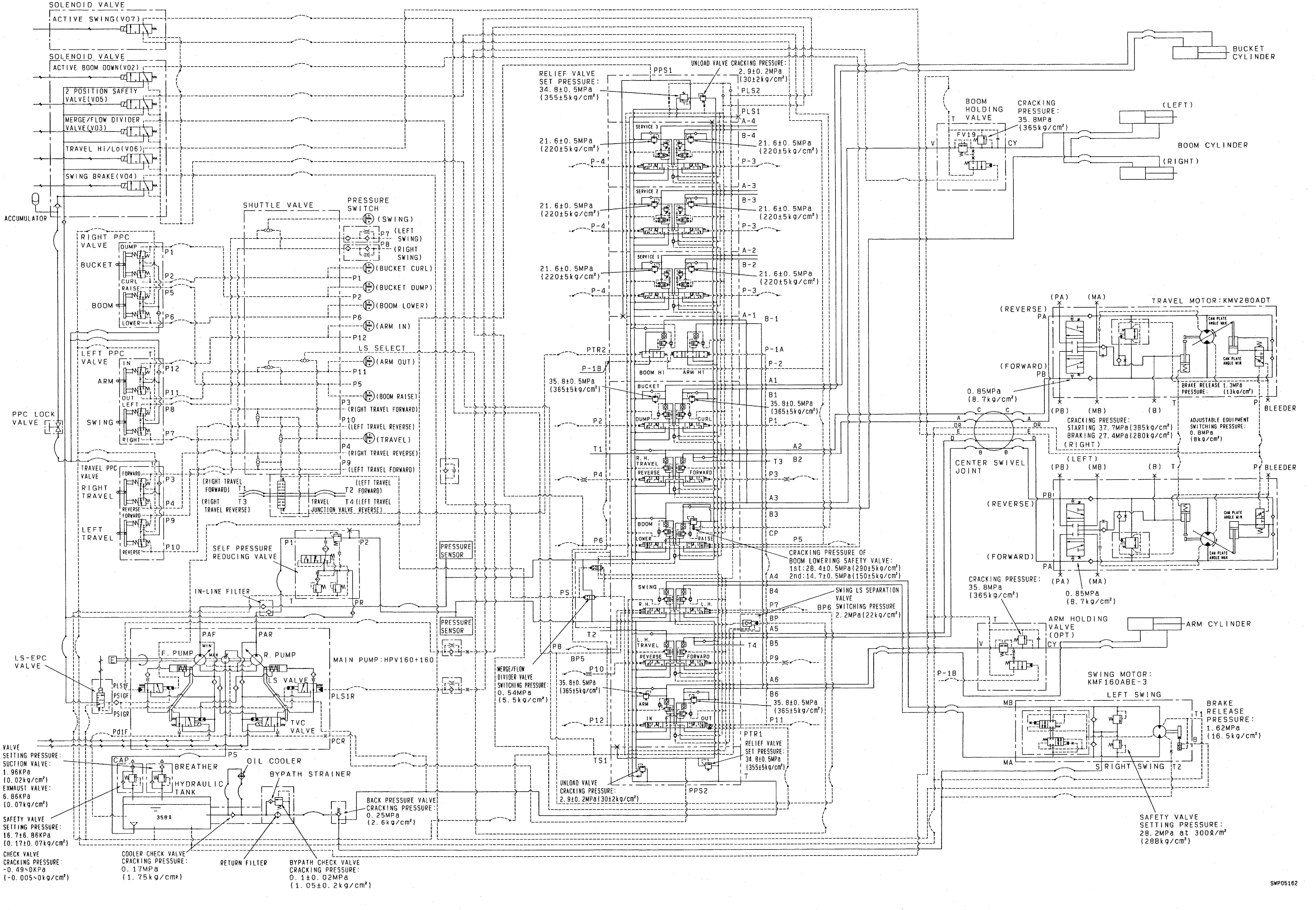

2
5
A
6
1
4
3
8
A
22
21
11
16
9
16
14
15
9
15
12
10
11
13
A – A
7
18
19
17
20
SWP04822

Unit: mm

Model No.	PC400-6	PC450-6
1	534.1 ± 0.5	534.1 ± 0.5
2	56.3 ± 0.5	56.3 ± 0.5
3	96°1′	94°32′
4	537.1	537.1
5	1839	1843
6	189.5	186
7	—	—
8	56°	40°
9	$\phi\ 100^{+0.2}_{0}$	$\phi\ 100^{+0.2}_{0}$
10	371^{+1}_{0}	371^{+1}_{0}
11	72	72
12	144	144
13	562.5 ± 0.5	562.5 ± 0.5
14	ϕ 26	ϕ 26
15	ϕ 180	ϕ 180
16	ϕ 230	ϕ 230
17	154.8	123.8
18	147.8	160.6
19	R130	R130
20	R108	R108
21	395^{+2}_{0}	395^{+2}_{0}
22	64	64

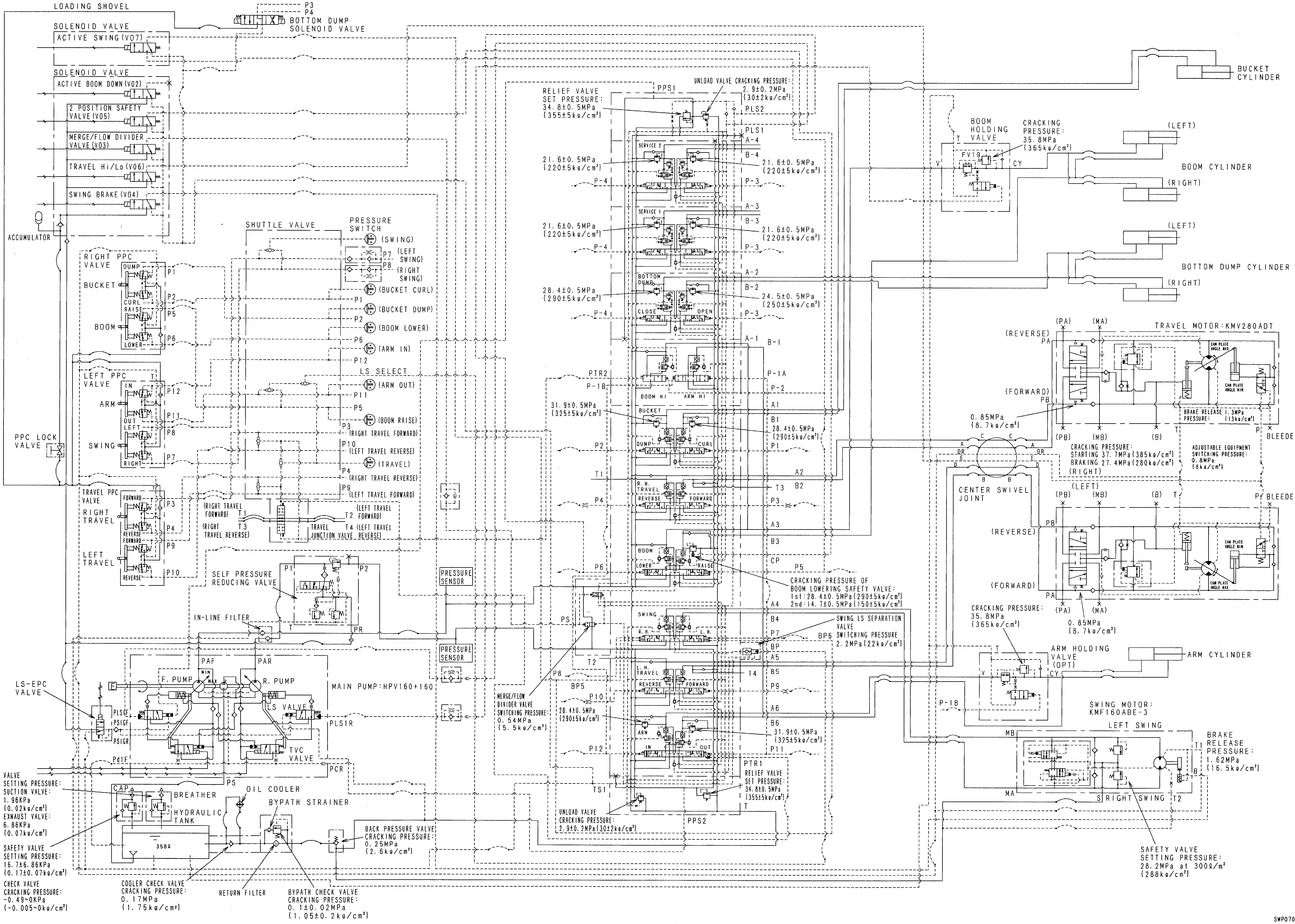
90 OTHERS

HYDRAULIC CIRCUIT DIAGRAM



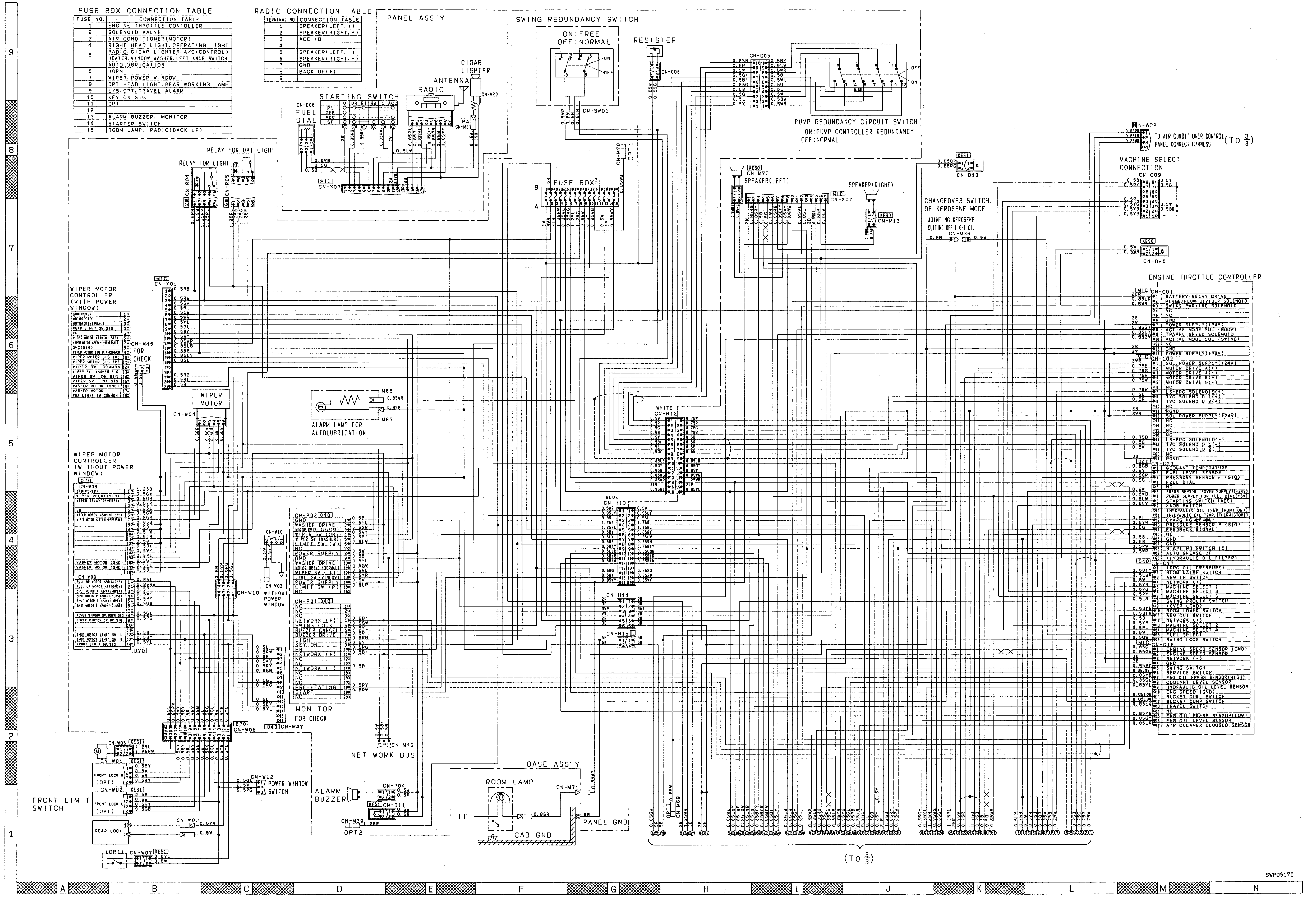
HYDRAULIC CIRCUIT DIAGRAM

LOADING SHOVEL



SWP07083

ELECTRIC CIRCUIT DIAGRAM (1/3)



FUSE BOX CONNECTION TABLE

FUSE NO.	CONNECTION TABLE
1	ENGINE THROTTLE CONTOLLER
2	SOLENOID VALVE
3	AIR CONDITIONER(MOTOR)
4	RIGHT HEAD LIGHT, OPERATING LIGHT
5	RADIO, CIGAR LIGHTER, A/C(CONTROL) HEATER, WINDOW WASHER, LEFT KNOB SWITCH AUTOLUBRICATION
6	HORN
7	WIPER, POWER WINDOW
8	OPT HEAD LIGHT, REAR WORKING LAMP
9	L/S, OPT, TRAVEL ALARM
10	KEY ON SIG.
11	OPT
12	
13	ALARM BUZZER, MONITOR
14	STARTER SWITCH
15	ROOM LAMP, RADIO(BACK UP)

RADIO CONNECTION TABLE

TERMINAL NO.	CONNECTION TABLE
1	SPEAKER(LEFT, +)
2	SPEAKER(RIGHT, +)
3	ACC +B
4	
5	SPEAKER(LEFT, -)
6	SPEAKER(RIGHT, -)
7	GND
8	BACK UP(+)
9	

ENGINE THROTTLE CONTROLLER

CN-C01

2BR	1	BATTERY RELAY DRIVE
0.85LR	2	MERGE/~~FLOW~~ DIVIDER SOLENOID
0.5WR	3	SWING PARKING SOLENOID
	4	NC
	5	NC
3B	6	GND
2W	7	POWER SUPPLY(+24V)
0.85GY	8	ACTIVE MODE SOL. (BOOM)
0.85LY	9	TRAVEL SPEED SOLENOID
0.85GW	10	ACTIVE MODE SOL. (SWING)
	11	NC
3B	12	GND
2W	13	POWER SUPPLY(+24V)

CN-C02

3WR	1	SOL. POWER SUPPLY(+24V)
0.75B	2	MOTOR DRIVE A(+)
0.75G	3	MOTOR DRIVE A(-)
0.75R	4	MOTOR DRIVE B(+)
0.75W	5	MOTOR DRIVE B(-)
	6	NC
0.75W	7	LS-EPC SOLENOID(+)
0.5B	8	TVC SOLENOID 1(+)
0.5R	9	TVC SOLENOID 2(+)
	10	NC
3B	11	GND
3WR	12	SOL. POWER SUPPLY(+24V)
	13	NC
	14	NC
	15	NC
	16	NC
0.75B	17	LS-EPC SOLENOID(-)
0.5G	18	TVC SOLENOID 1(-)
0.5W	19	TVC SOLENOID 2(-)
	20	NC
3B	21	PGND

CN-C03

0.5GB	1	COOLANT TEMPERATURE
0.5Y	2	FUEL LEVEL SENSOR
0.5GR	3	PRESSURE SENSOR F (SIG)
0.5G	4	FUEL DIAL
	5	NC
0.5W	6	PRESS. SENSOR (POWER SUPPLY)(+24V)
0.5WB	7	POWER SUPPLY FOR FUEL DIAL(+5V)
0.5LW	8	STARTING SWITCH (ACC)
0.5LY	9	KNOB SWITCH
	10	(HYDRAULIC OIL TEMP. (MONITOR))
	11	(HYDRAULIC OIL TEMP. (THERMISTOR))
0.5L	12	CHARGING ~~LEVEL~~
0.5YR	13	PRESSURE SENSOR R (SIG)
0.5G	14	FEEDBACK SIGNAL
	15	NC
0.5B	16	GND
0.5B	17	GND
0.5RW	18	STARTING SWITCH (C)
0.5WR	19	AUTO GREASE-UP
	20	(HYDRAULIC OIL FILTER)

CN-C17

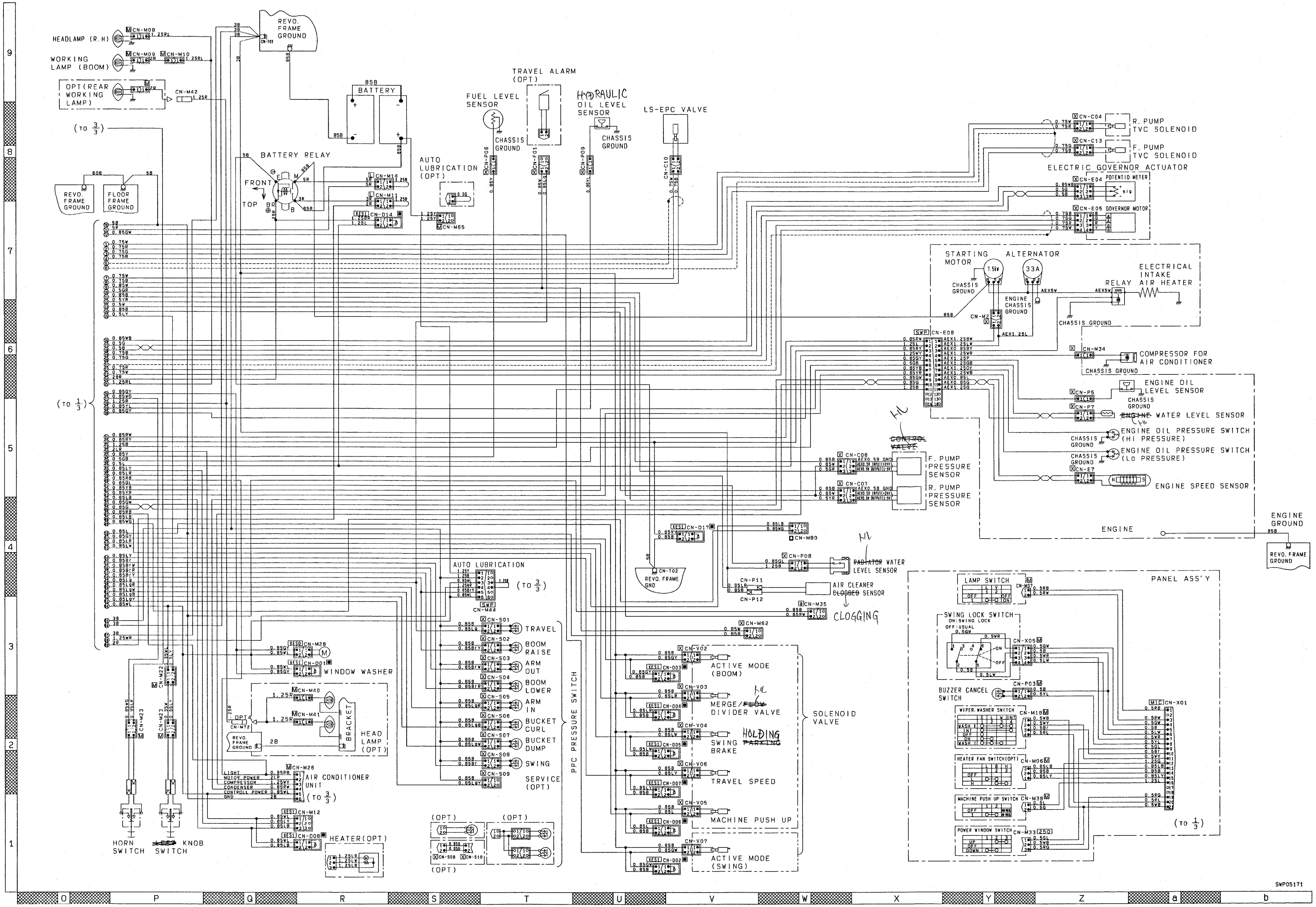
	1	(PPC OIL PRESSURE)
0.5BrY	2	BOOM RAISE SWITCH
0.5LgR	3	ARM IN SWITCH
0.5W	4	NETWORK (+)
0.5YR	5	MACHINE SELECT 1
0.5YG	6	MACHINE SELECT 3
0.5RY	7	MACHINE SELECT 5
0.5LR	8	SWING PROLIX SWITCH
	9	(OVER LOAD)
0.5BrR	10	BOOM LOWER SWITCH
0.5BrW	11	ARM OUT SWITCH
0.5B	12	NETWORK (+)
0.5YB	13	MACHINE SELECT 2
0.5RL	14	MACHINE SELECT 4
0.5W	15	FUEL SELECT
0.5GW	16	SWING LOCK SWITCH

CN-C16

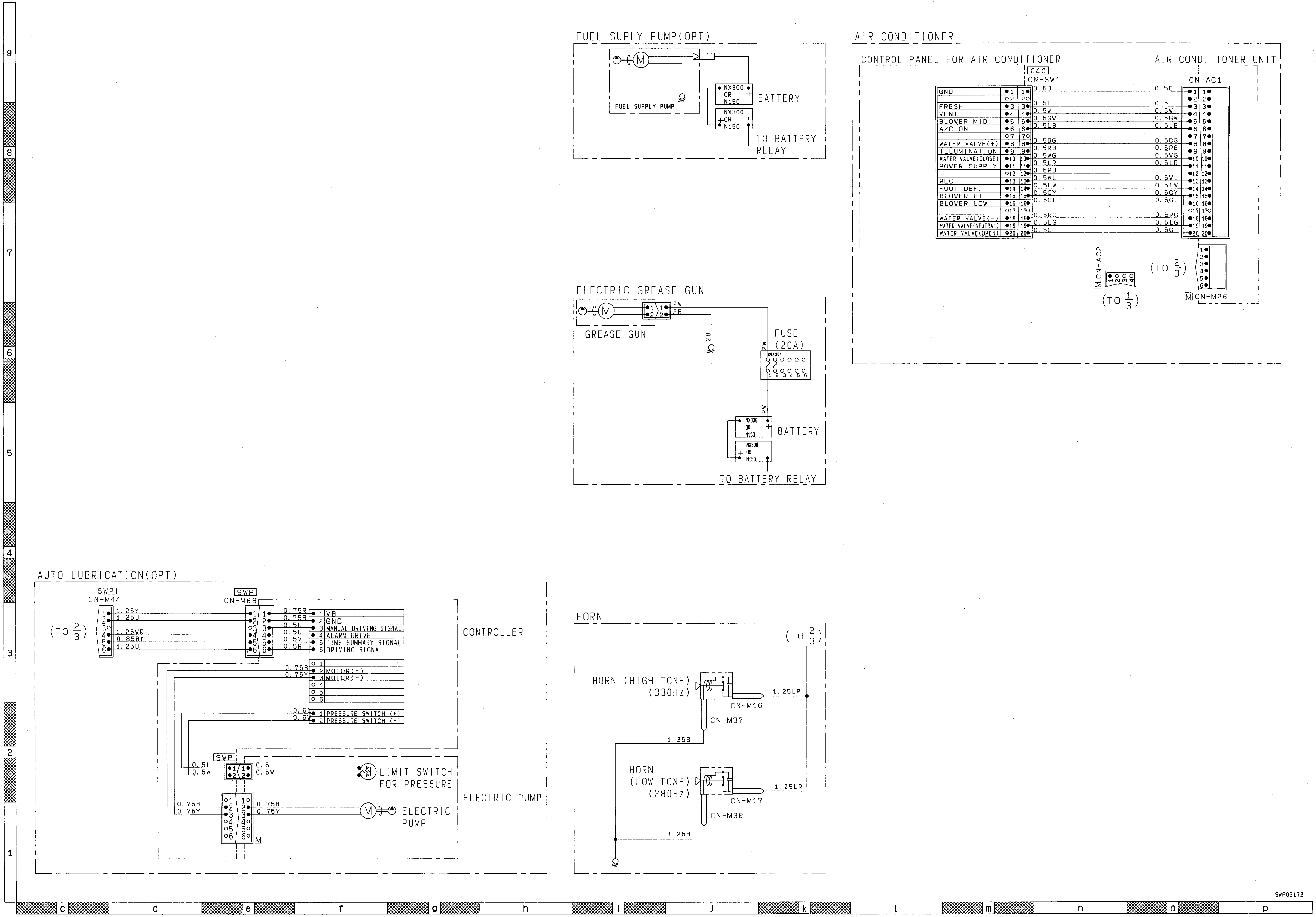
0.85G	1	ENGINE SPEED SENSOR (GND)
0.85GW	2	ENGINE SPEED SENSOR
3B	3	NETWORK (-)
3B	4	GND
0.85Br	5	SWING SWITCH
0.85LgY	6	SERVICE SWITCH
0.85YB	7	ENG. OIL PRESS. SENSOR(HIGH)
0.85GL	8	COOLANT LEVEL SENSOR
0.85YL	9	HYDRAULIC OIL LEVEL SENSOR
	10	ENG. SPEED (GND)
0.85LgB	11	BUCKET CURL SWITCH
0.85LgW	12	BUCKET DUMP SWITCH
0.85Lg	13	TRAVEL SWITCH
	14	NC
0.85YR	15	ENG. OIL PRESS. SENSOR(LOW)
0.85GY	16	ENG. OIL LEVEL SENSOR
0.85LR	17	AIR CLEANER CLOGGED SENSOR

SWP05170

ELECTRIC CIRCUIT DIAGRAM (2/3)



ELECTRIC CIRCUIT DIAGRAM (3/3)



ELECTRIC CIRCUIT DIAGRAM (1/3)

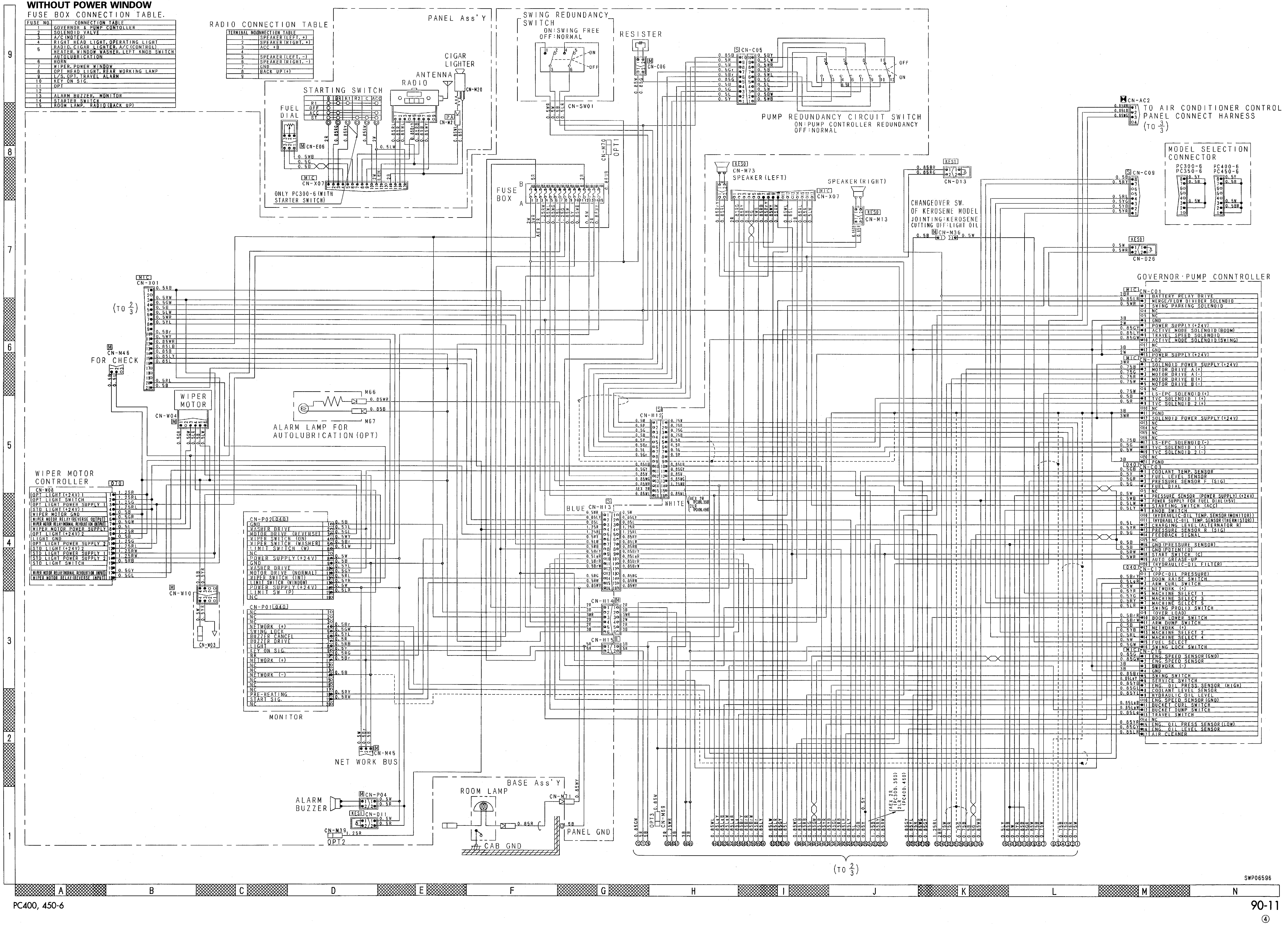
PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up
WITHOUT POWER WINDOW

FUSE BOX CONNECTION TABLE.

FUSE NO.	CONNECTION TABLE
1	GOVERNOR & PUMP CONTOLLER
2	SOLENOID VALVE
3	A/C (MOTER)
4	RIGHT HEAD LIGHT, OPERATING LIGHT
5	RADIO, CIGAR LIGHTER, A/C (CONTROL) HEATER, WINDOW WASHER, LEFT KNOB SWITCH AUTOLUBRICATION
6	HORN
7	WIPER, POWER WINDOW
8	OPT HEAD LIGHT, REAR WORKING LAMP
9	L/S, OPT, TRAVEL ALARM
10	KEY ON SIG.
11	OPT
12	
13	ALARM BUZZER, MONITOR
14	STARTER SWITCH
15	ROOM LAMP, RADIO (BACK UP)

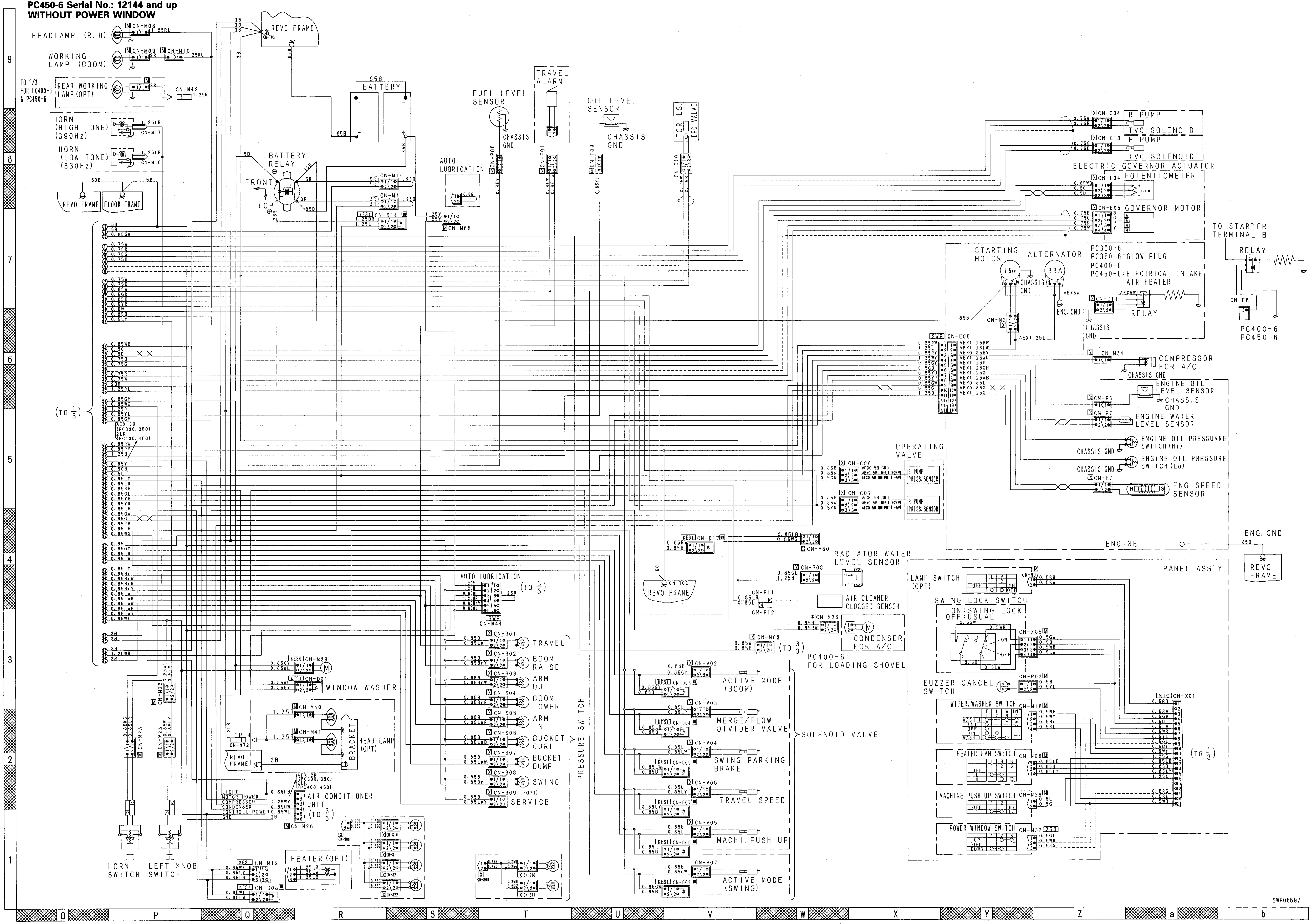
RADIO CONNECTION TABLE

TERMINAL NO	CONNECTION TABLE
1	SPEAKER (LEFT, +)
2	SPEAKER (RIGHT, +)
3	ACC +B
4	
5	SPEAKER (LEFT, -)
6	SPEAKER (RIGHT, -)
7	GND
8	BACK UP (+)
9	



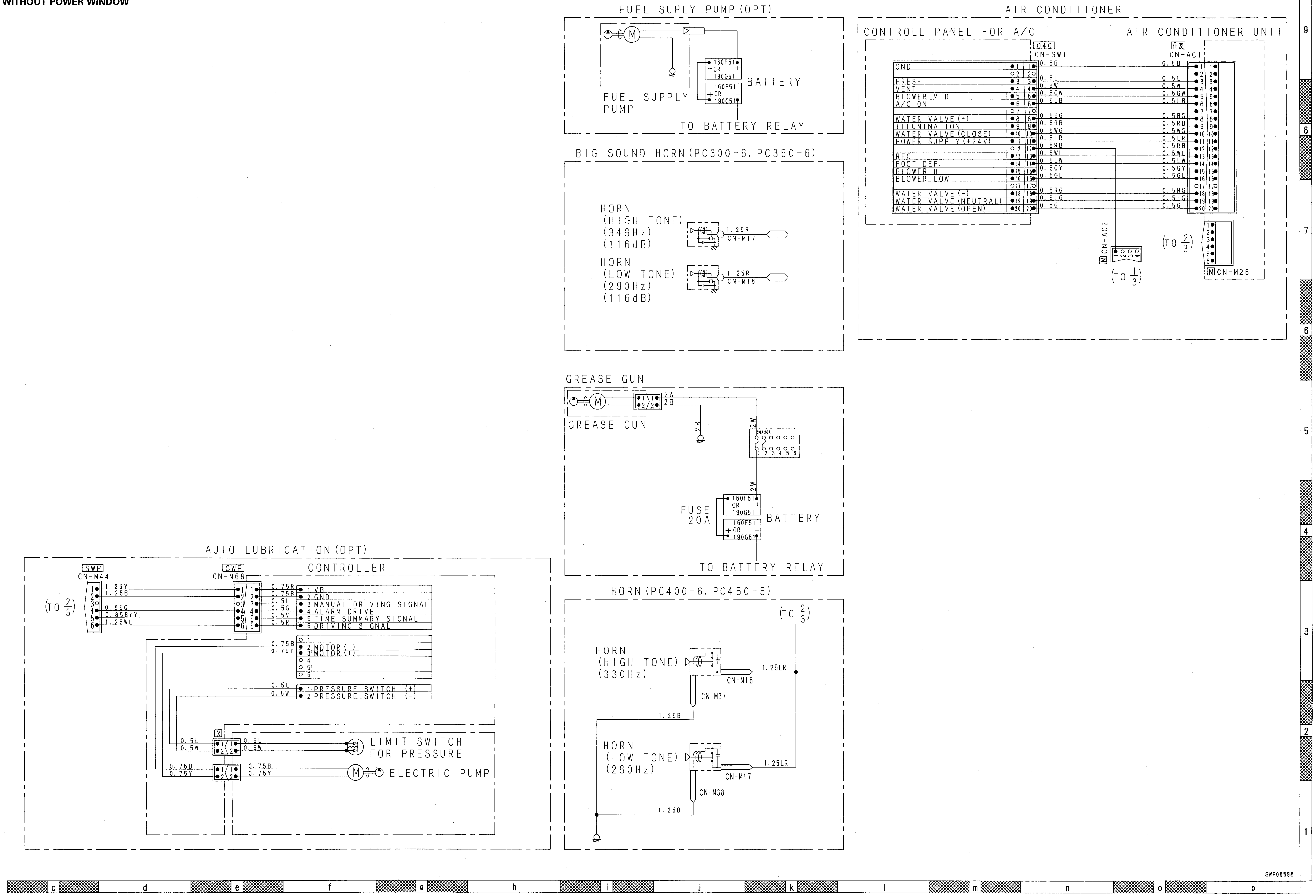
ELECTRIC CIRCUIT DIAGRAM (2/3)

PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up
WITHOUT POWER WINDOW



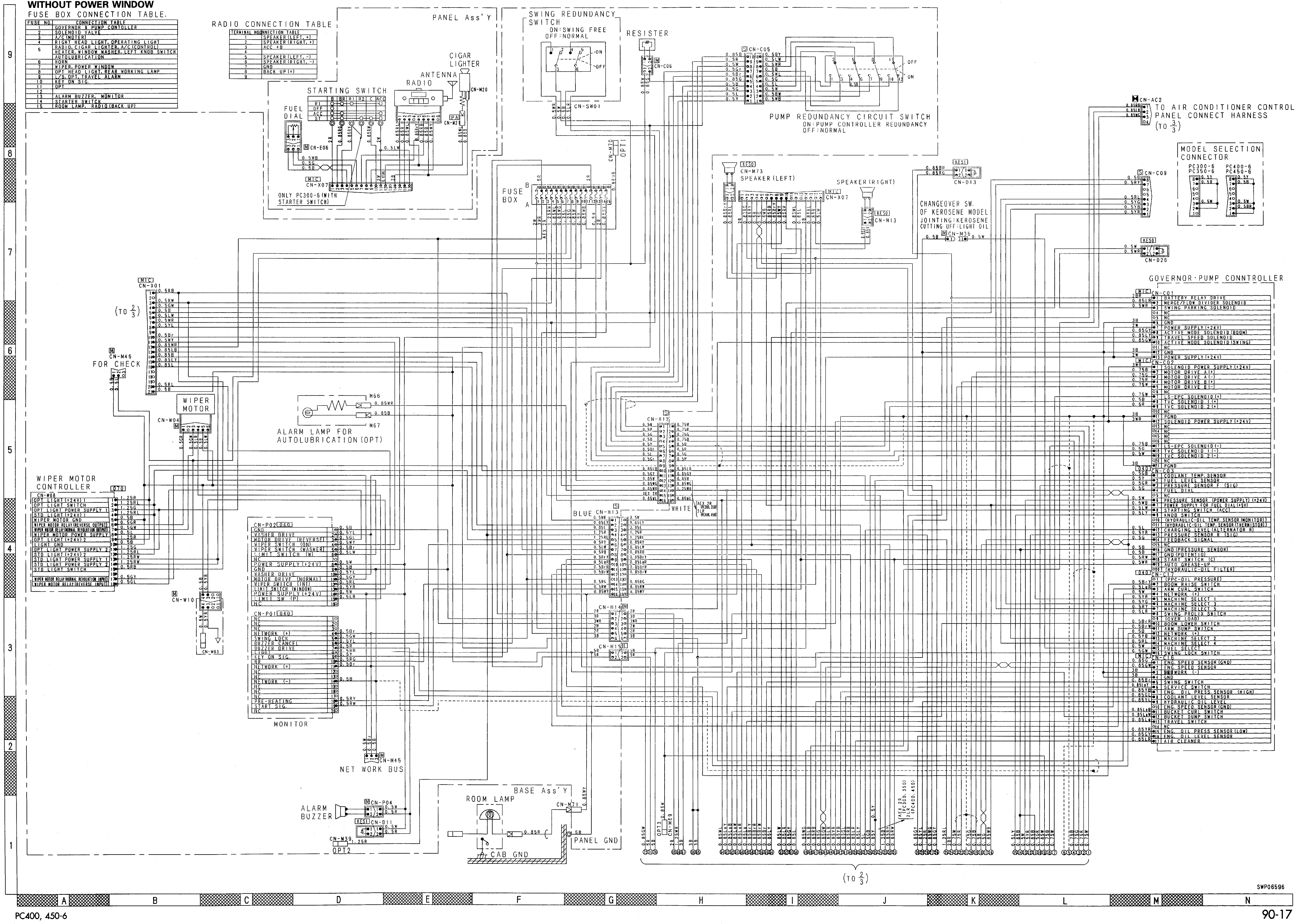
ELECTRIC CIRCUIT DIAGRAM (3/3)

PC400-6 Serial No.: 32250 and up
PC450-6 Serial No.: 12144 and up
WITHOUT POWER WINDOW



ELECTRIC CIRCUIT DIAGRAM (1/3)

LOADING SHOVEL
PC400-6 Serial No.: 32001 and up
WITHOUT POWER WINDOW



FUSE BOX CONNECTION TABLE.

FUSE NO.	CONNECTION TABLE
1	GOVERNOR & PUMP CONTOLLER
2	SOLENOID VALVE
3	A/C (MOTER)
4	RIGHT HEAD LIGHT, OPERATING LIGHT
5	RADIO, CIGAR LIGHTER, A/C (CONTROL) HEATER, WINDOW WASHER, LEFT KNOB SWITCH AUTOLUBRICATION
6	HORN
7	WIPER, POWER WINDOW
8	OPT HEAD LIGHT, REAR WORKING LAMP
9	L/S, OPT, TRAVEL ALARM
10	KEY ON SIG.
11	OPT
12	
13	ALARM BUZZER, MONITOR
14	STARTER SWITCH
15	ROOM LAMP, RADIO (BACK UP)

RADIO CONNECTION TABLE

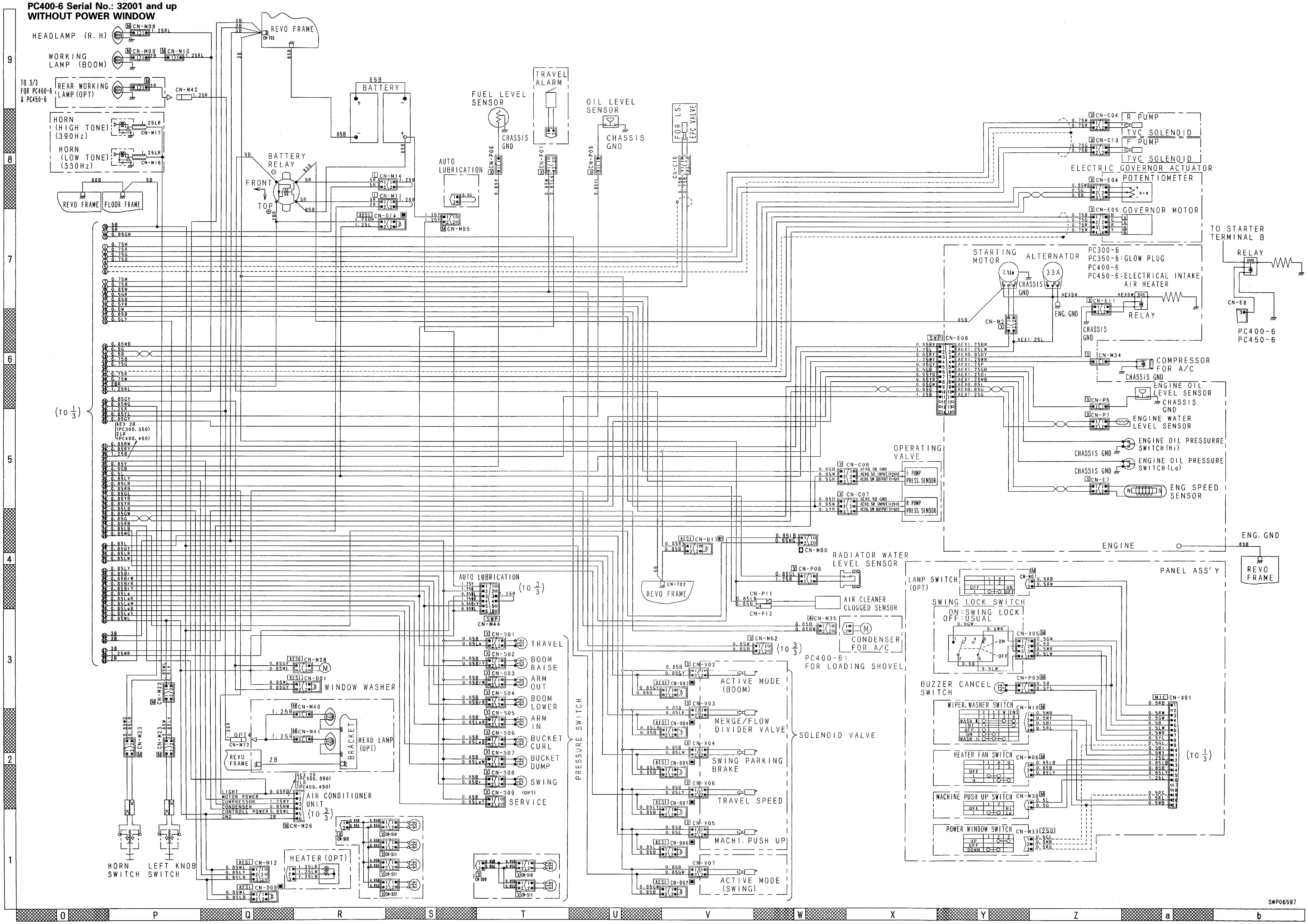
TERMINAL NO.	CONNECTION TABLE
1	SPEAKER (LEFT, +)
2	SPEAKER (RIGHT, +)
3	ACC +B
4	
5	SPEAKER (LEFT, −)
6	SPEAKER (RIGHT, −)
7	GND
8	BACK UP (+)
9	

ELECTRIC CIRCUIT DIAGRAM (2/3)

LOADING SHOVEL

PC400-6 Serial No.: 32001 and up

WITHOUT POWER WINDOW



ELECTRIC CIRCUIT DIAGRAM (3/3)

LOADING SHOVEL
PC400-6 Serial No.: 32001 and up
WITHOUT POWER WINDOW