SERVICE MANUAL

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COMFORT INTELLIGENCE M

R150WVS PRO HD HYUNDAI CONSTRUCTION EQUIPMENT

HYDRAULIL EXCAVATOR

R150WVS PRO

HD HYUNDAI CONSTRUCTION EQUIPMENT

Printed in Korea (2021. 11)

HD HYUNDAI CONSTRUCTION EQUIPMENT

kgf/cm² to lbf/in²

1 kgf / cm² = 14.2233 lbf / in²

	0	1	2	3	4	5	6	7	8	9
		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	2863	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	5603	2617	2631	2646	2660	2674	2688
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

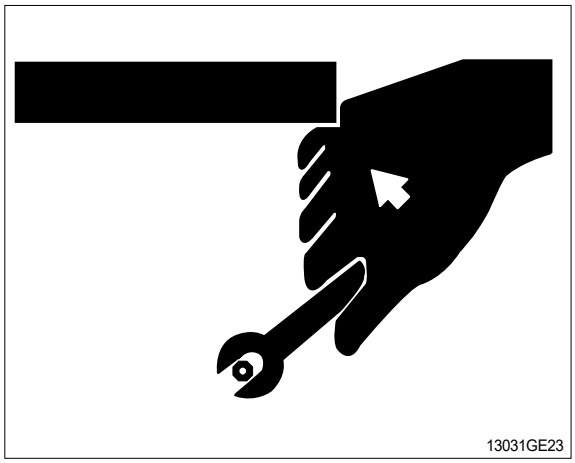
USE TOOLS PROPERLY

Use tools appropriate to the work. Makeshift tools, parts, and procedures can create safety hazards.

Use power tools only to loosen threaded tools and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only recommended replacement parts. (See Parts manual.)

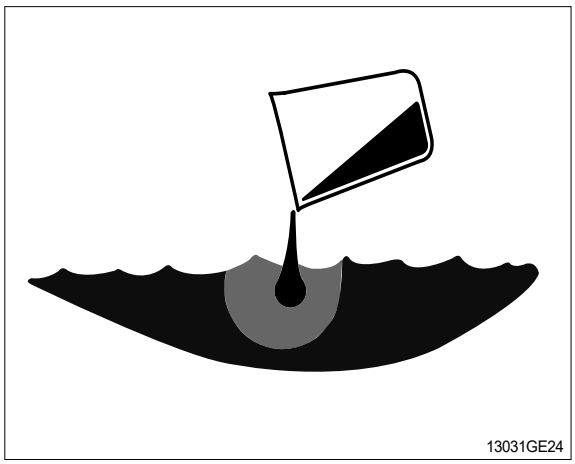


DISPOSE OF FLUIDS PROPERLY

Improperly disposing of fluids can harm the environment and ecology. Before draining any fluids, find out the proper way to dispose of waste from your local environmental agency.

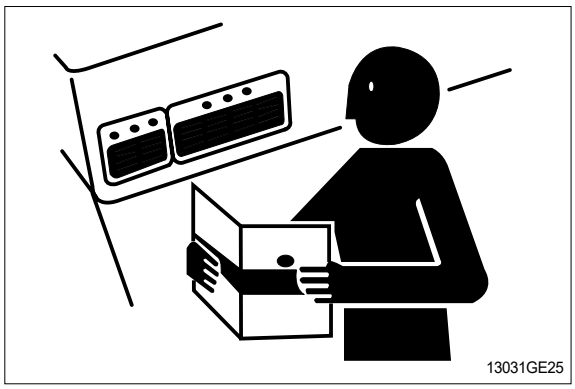
Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



REPLACE SAFETY SIGNS

Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.



LIVE WITH SAFETY

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

10) BUCKET

Item	Capacity		Tooth quantity	Width	
	SAE heaped	CECE heaped		Without side cutter	With side cutter
Standard	※ 0.58 m^3 (0.76 yd^3)	0.50 m^3 (0.65 yd^3)	5	1030 mm (39.4")	1130 mm (44.5")
Option	0.23 m^3 (0.30 yd^3)	0.20 m^3 (0.26 yd^3)	3	520 mm (20.5")	620 mm (24.4")
	0.40 m^3 (0.52 yd^3)	0.35 m^3 (0.46 yd^3)	4	760 mm (29.9")	860 mm (33.9")
	0.46 m^3 (0.60 yd^3)	0.40 m^3 (0.52 yd^3)	4	850 mm (33.5")	950 mm (37.4")
	0.52 m^3 (0.68 yd^3)	0.45 m^3 (0.59 yd^3)	5	935 mm (36.8")	1035 mm (40.7")
	0.65 m^3 (0.85 yd^3)	0.55 m^3 (0.72 yd^3)	5	1110 mm (43.7")	1210 mm (47.6")
	0.71 m^3 (0.93 yd^3)	0.60 m^3 (0.78 yd^3)	5	1205 mm (47.4")	1305 mm (51.4")
	◎ 0.55 m^3 (0.72 yd^3)	0.45 m^3 (0.59 yd^3)	-	1800 mm (70.9")	-
	★ 0.45 m^3 (0.59 yd^3)	0.40 m^3 (0.52 yd^3)	-	1520 mm (59.8")	-

◎ : Slope finishing bucket

★ : Ditch cleaning bucket

(3) Valve block group

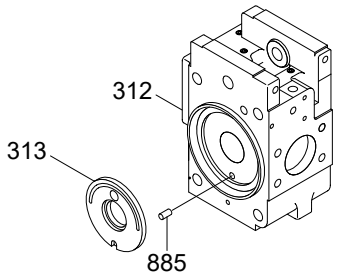
The valve block group consists of valve block (312), valve plate (313) and valve plate pin (885).

The valve plate having two melon-shaped ports is fixed to the valve block and feeds and collects oil to and from the cylinder block.

The oil changed over by the valve plate is connected to an external pipeline by way of the valve block.

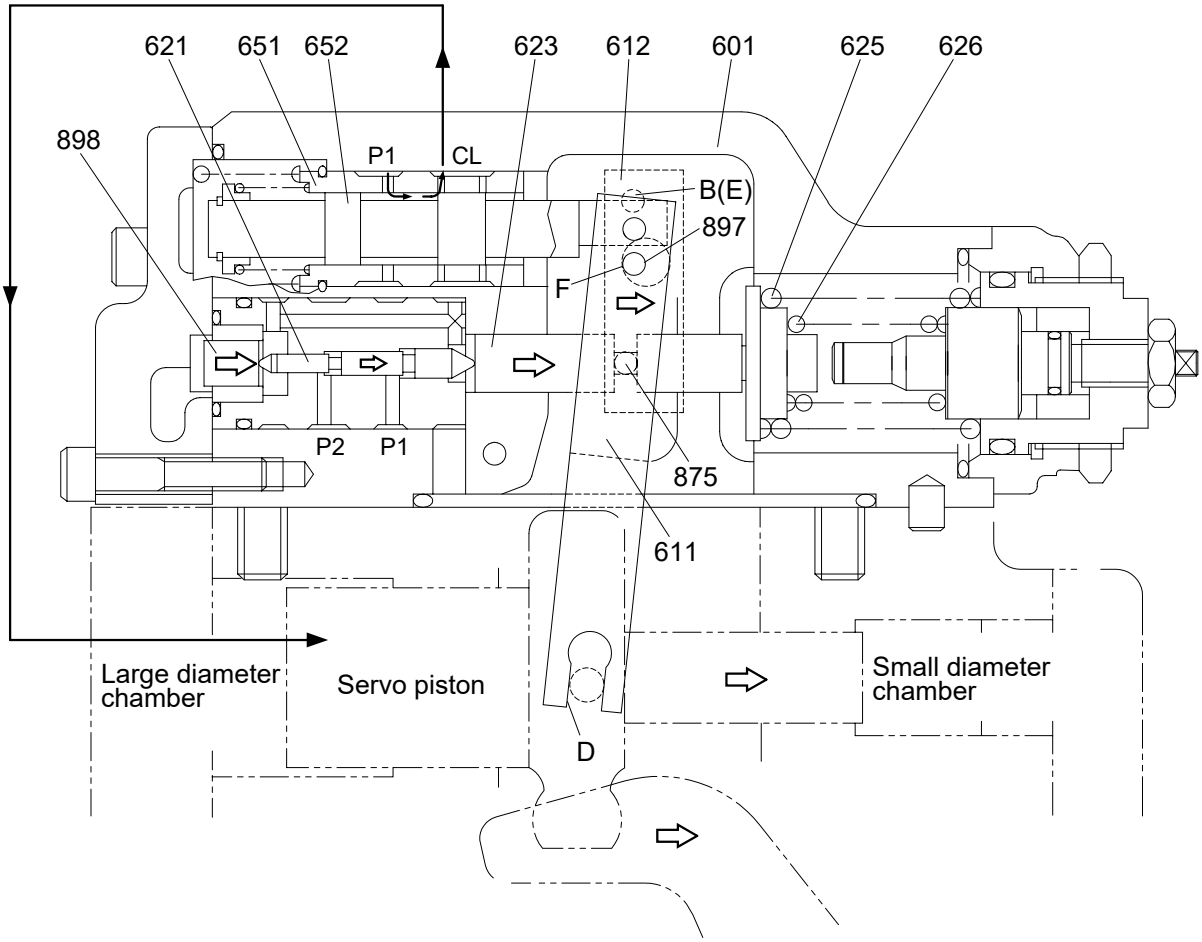
Now, if the drive shaft is driven by a prime mover (electric motor, engine, etc), it rotates the cylinder block via a spline linkage at the same time. If the swash plate is tilted as in Fig (previous page) the pistons arranged in the cylinder block make a reciprocating motion with respect to the cylinder block, while they revolve with the cylinder block.

If you pay attention to a single piston, it performs a motion away from the valve plate (oil sucking process) within 180 degrees, and makes a motion towards the valve plate (or oil discharging process) in the rest of 180 degrees. When the swash plate has a tilting angle of zero, the piston makes no stroke and discharges no oil.



21092MP07

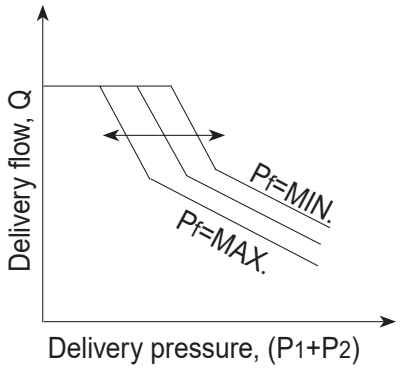
(3) Power shift control



The set horsepower valve is shifted by varying the command current level of the proportional pressure reducing valve attached to the pump.

Only one proportional pressure reducing valve is provided.

However, the secondary pressure Pf (power shift pressure) is admitted to the horsepower control section of each pump regulator through the pump's internal path to shift it to the same set horsepower level.



This function permits arbitrary setting of the pump output power, thereby providing the optimum power level according to the operating condition.

The power shift pressure Pf controls the set horsepower of the pump to a desired level, as shown in the figure.

As the power shift pressure Pf rises, the compensating rod (623) moves to the right via the pin (898) and compensating piston (621).

This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

(2) BOOM DOWN OPERATION

During the boom lowing operation, the pilot pressure from RCV is supplied to the port Pb20 of the spring opposite side and shifts the boom 1 spool in the right direction.

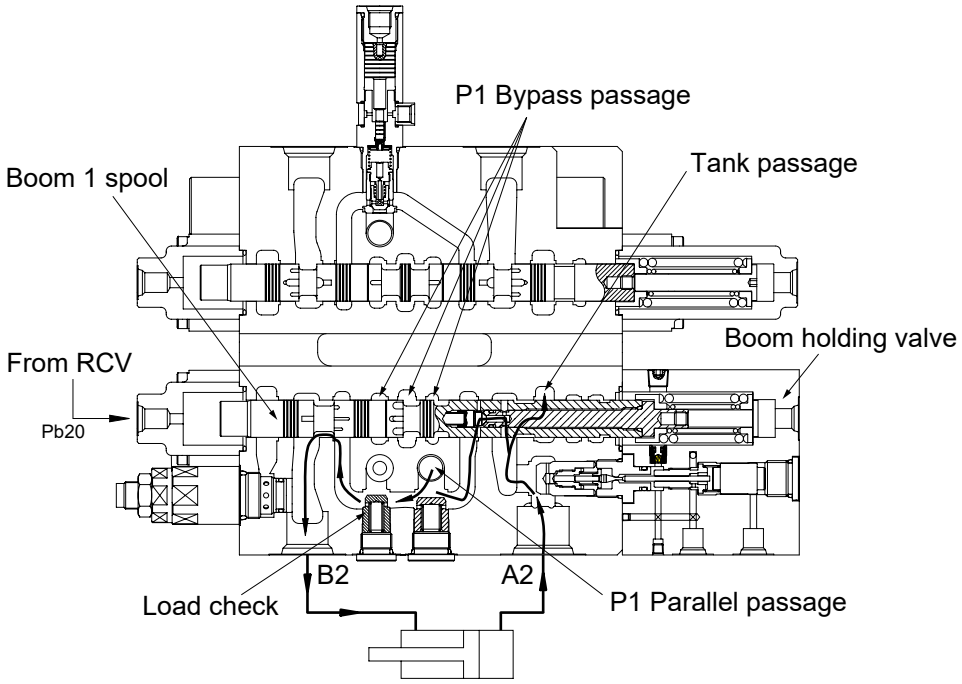
The bypass passage is shut off by the movement of the boom 1 spool and the hydraulic fluid from the pump A2 enters the parallel passage and is directed to the port B2 through the load check. Following this, it flows into the rod side of the boom cylinder.

At the same time, the return flow from the head side of the boom cylinder returns to the port A2 and boom holding valve. And it is directed to the hydraulic oil tank through opened tank passage by movement of the boom 1 spool.

Meanwhile some of return flow is directed to P1 parallel passage through the internal passage of the boom 1 spool. (boom regeneration)

In this case, the holding valve is open condition, for details of the boom holding valve, see page following page.

During the boom lowering operation, the fluid from A1 pump is not summation.



(2) ARM OUT OPERATION

During arm out operation, the pilot secondary pressure from RCV is supplied to the port Pd40 of spring side and shifts arm 1 spool in the left direction.

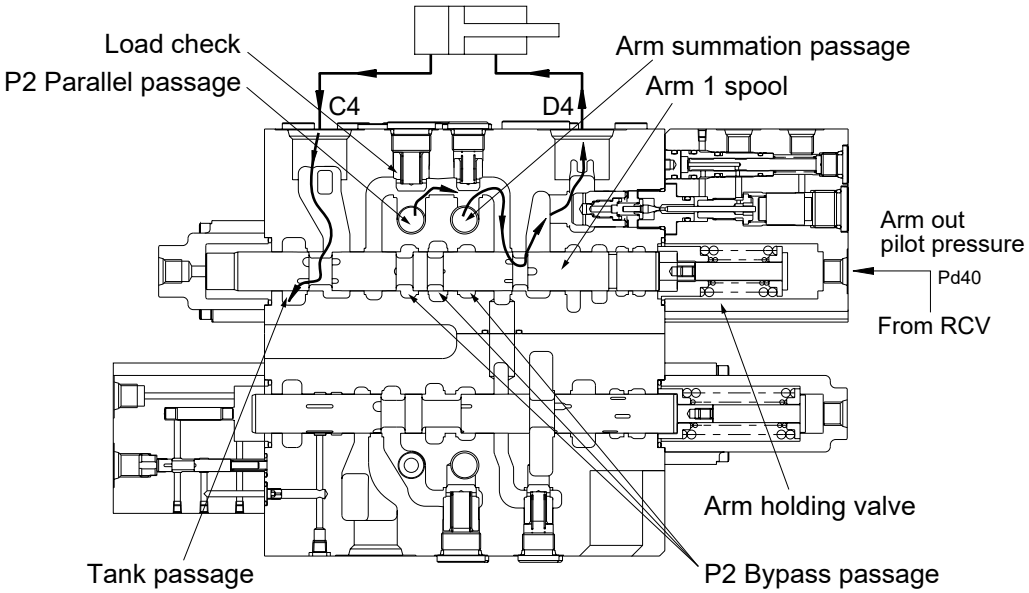
The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic fluid from pump A1 flows into arm 1 spool through the P2 parallel passage. Then it enters into the arm cylinder rod side through the load check, bridge passage, arm holding valve and the port D4.

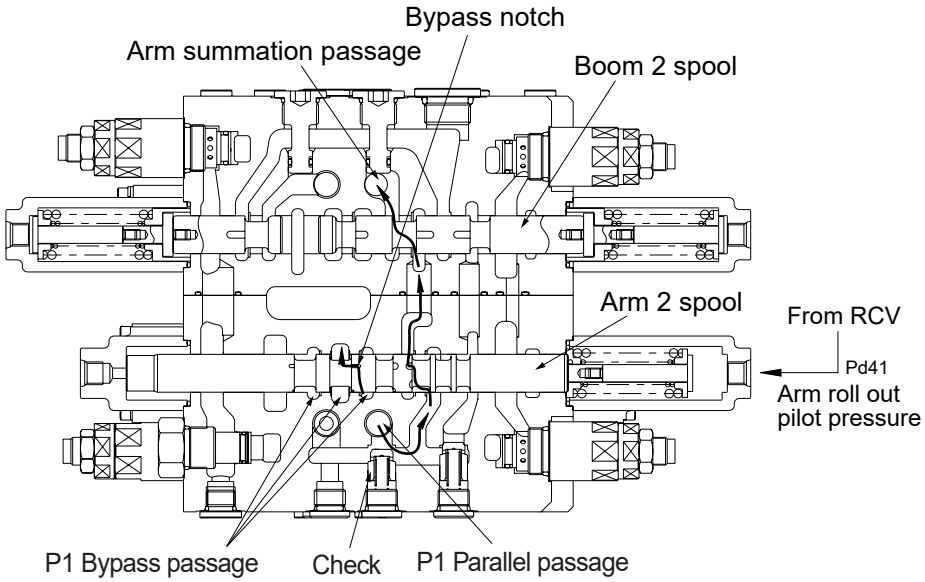
Also, the pilot secondary pressure from RCV is supplied to the port Pd41 of spring side and shifts arm 2 spool in the left direction.

The bypass passage is shut off by the movement of the arm 2 spool and some of the hydraulic fluid from pump A2 bypassed through bypass notch. The rest of hydraulic fluid from pump A2 flows into the arm summation passage through P1 parallel passage, the check valve, arm 2 spool and boom 2 spool.

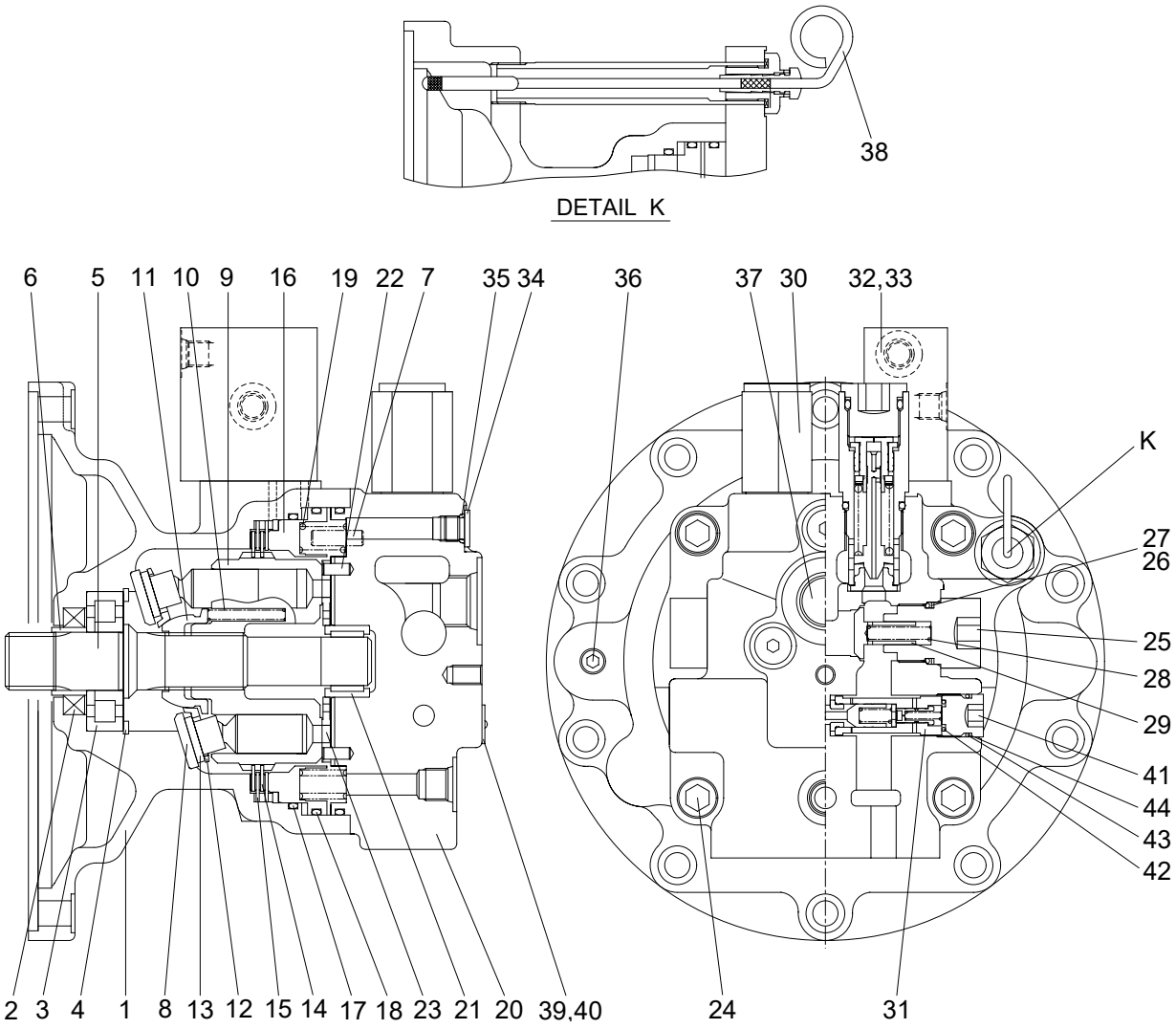
Then it enters into the arm cylinder rod side with the fluid from the arm 1 spool.

The return flow from the arm cylinder head side returns to the hydraulic tank through the port C4, the arm 1 spool and tank passage.



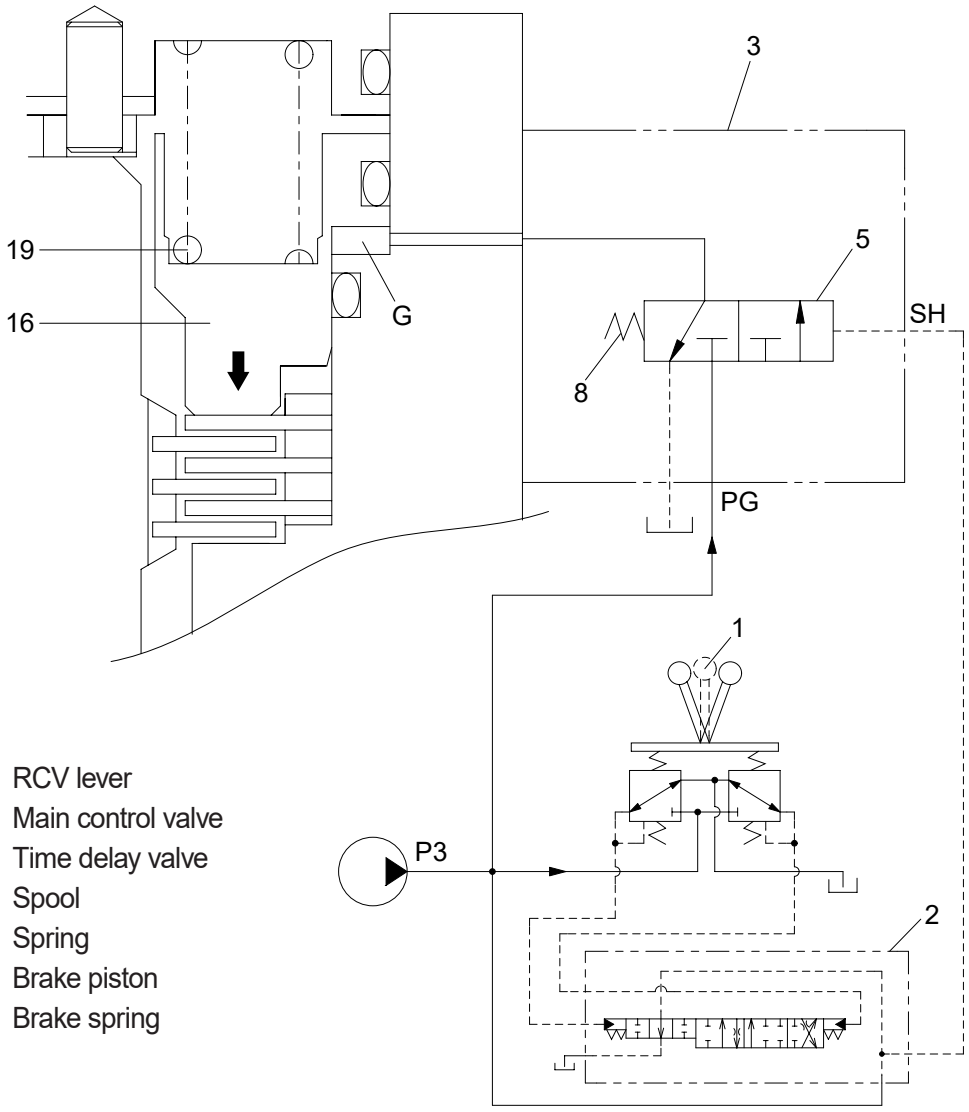


1) SWING MOTOR



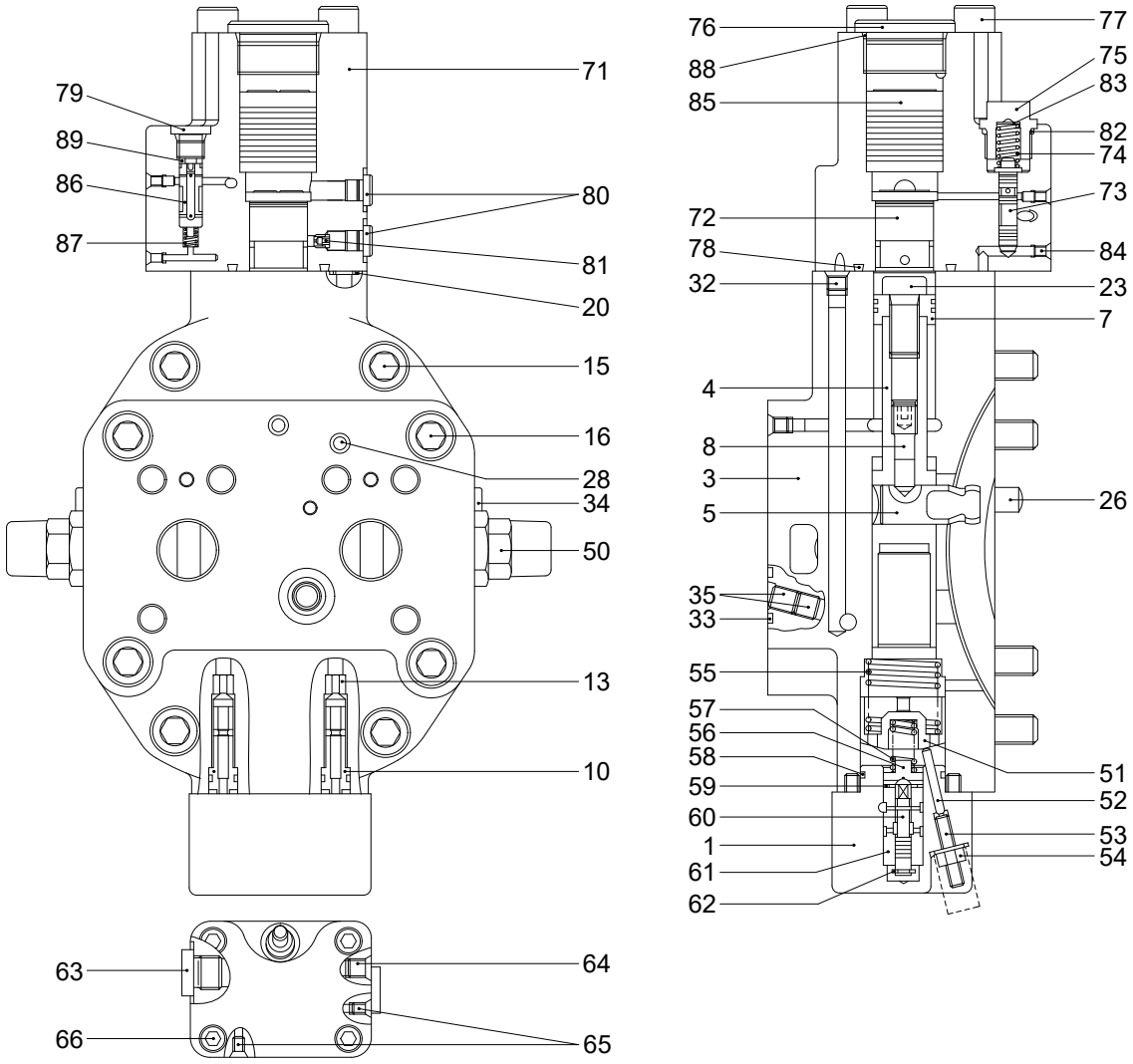
1	Body	16	Brake piston	31	Anti-rotating valve
2	Oil seal	17	O-ring	32	Time delay valve
3	Roller bearing	18	O-ring	33	Wrench bolt
4	Snap ring	19	Brake spring	34	Plug
5	Drive shaft	20	Rear cover	35	O-ring
6	Bushing	21	Needle bearing	36	Plug
7	Pin	22	Pin	37	Plug
8	Shoe plate	23	Valve plate	38	Level gauge
9	Cylinder block	24	Wrench bolt	40	Rivet
10	Spring	25	Plug	41	Plug
11	Ball guide	26	Back up ring	42	O-ring
12	Set plate	27	O-ring	43	O-ring
13	Piston assembly	28	Spring	44	Back up ring
14	Friction plate	29	Check		
15	Separate plate	30	Relief valve		

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to right.
Then, the piston (16) is moved lower by spring force and the return oil from the chamber G flows back to tank port.
At this time, the brake works.



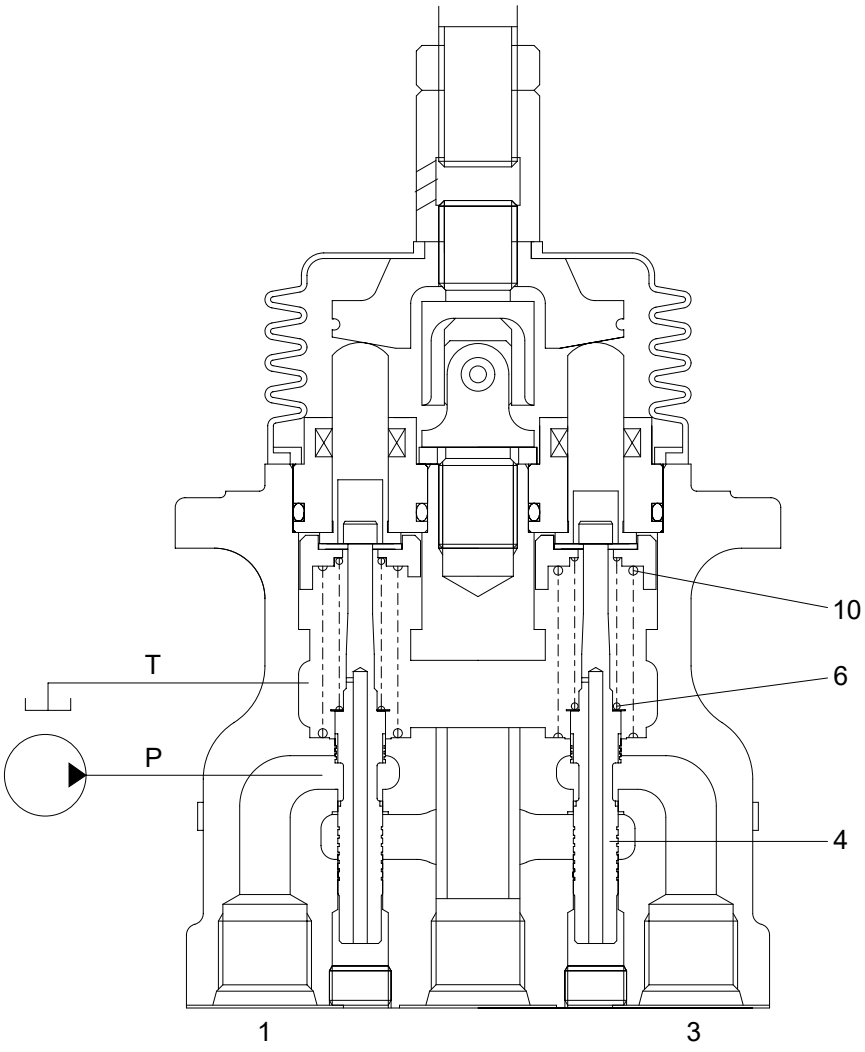
1 RCV lever
2 Main control valve
3 Time delay valve
5 Spool
8 Spring
16 Brake piston
19 Brake spring

2) REGULATOR



1	Control housing	50	Relief valve	72	Piston
2	Stroke limiter	51	Adjusting bushing	73	Control piston
3	Port plate	52	Cylinder pin	74	Pressure spring
4	Positioning piston	53	Threaded pin	75	Locking screw
5	Positioning trunnion	54	Seal lock nut	76	Locking screw
7	Piston	55	Pressure spring	77	Socket head screw
8	Threaded pin	56	Spring collar	78	O-ring
10	Check valve	57	Pressure spring	79	Locking screw
13	Valve seat	58	O-ring	80	Locking screw
15	Socket head screw	59	Retaining ring	81	Orifice
16	Socket head screw	60	Control piston	82	O-ring
20	O-ring	61	Control bushing	83	Shim
23	Socket head screw	62	Retaining disc	84	Double break off pin
26	Cylinder pin	63	Locking screw	85	Piston
28	Double break off pin	64	Double break off pin	86	Control piston
32	Double break off pin	65	Double break off pin	87	Pressure spring
33	O-ring	66	Socket head screw	88	O-ring
34	Locking screw	71	Housing	89	Shim

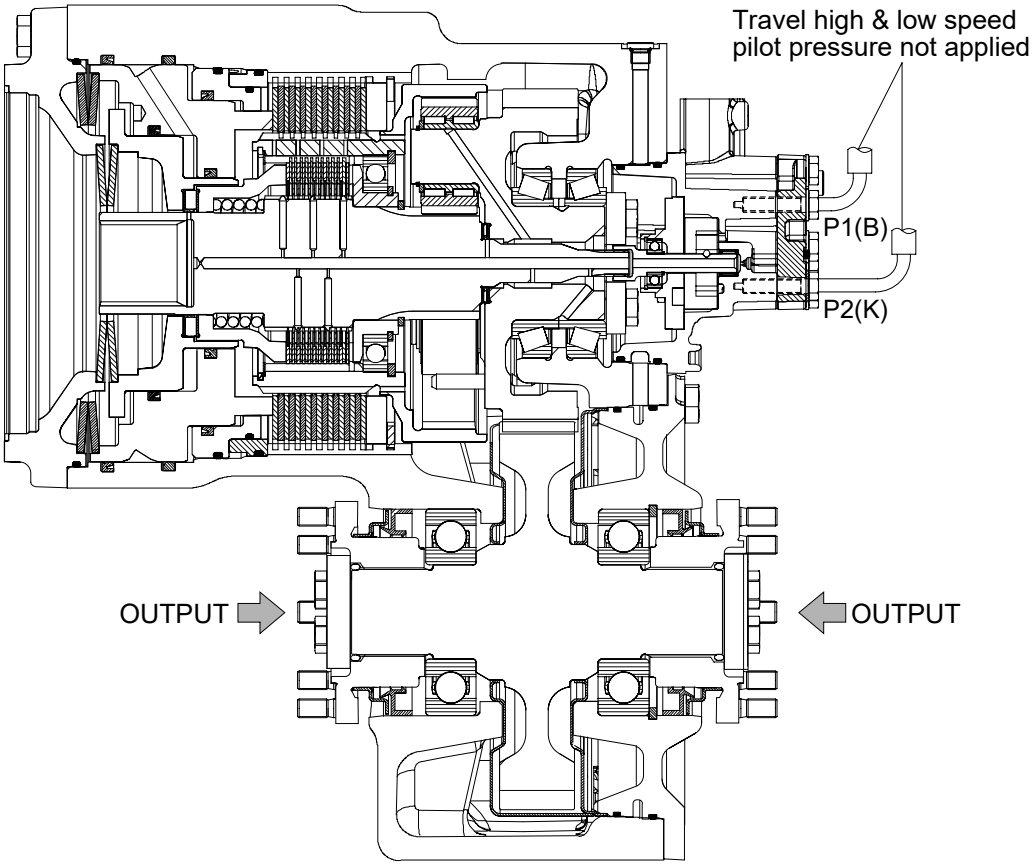
(1) Case where handle is in neutral position



21092RL03

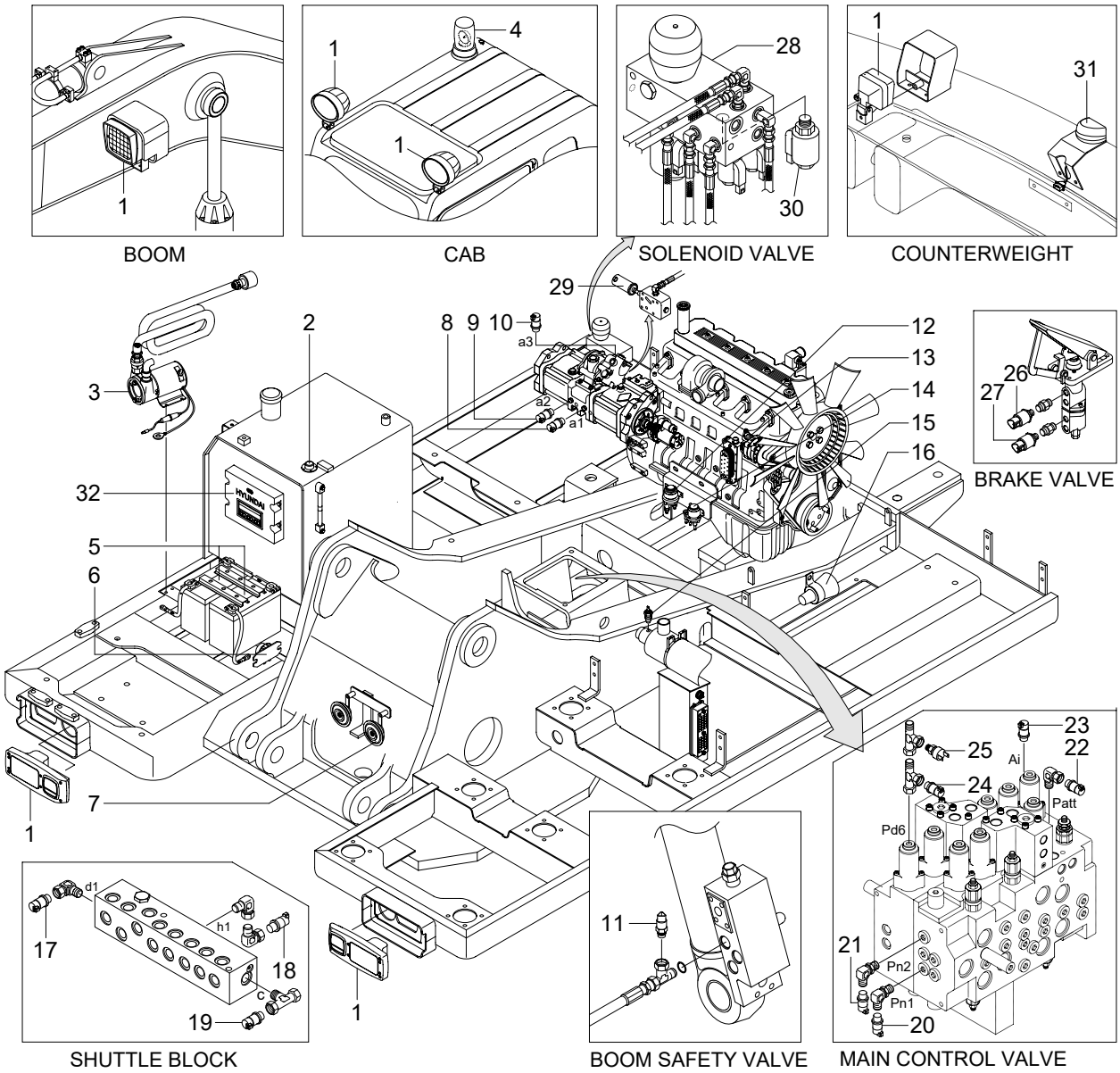
The force of the spring (6) that determines the output pressure of the pilot valve is not applied to the spool (4). Therefore, the spool is pushed up by the spring (10) to the position of port (1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

4) BRAKES



When the travel high/low speed pilot pressure is not applied in the piston space, the piston compress against the multi disk pack due to the spring force. Thus the parking brake is engaged.

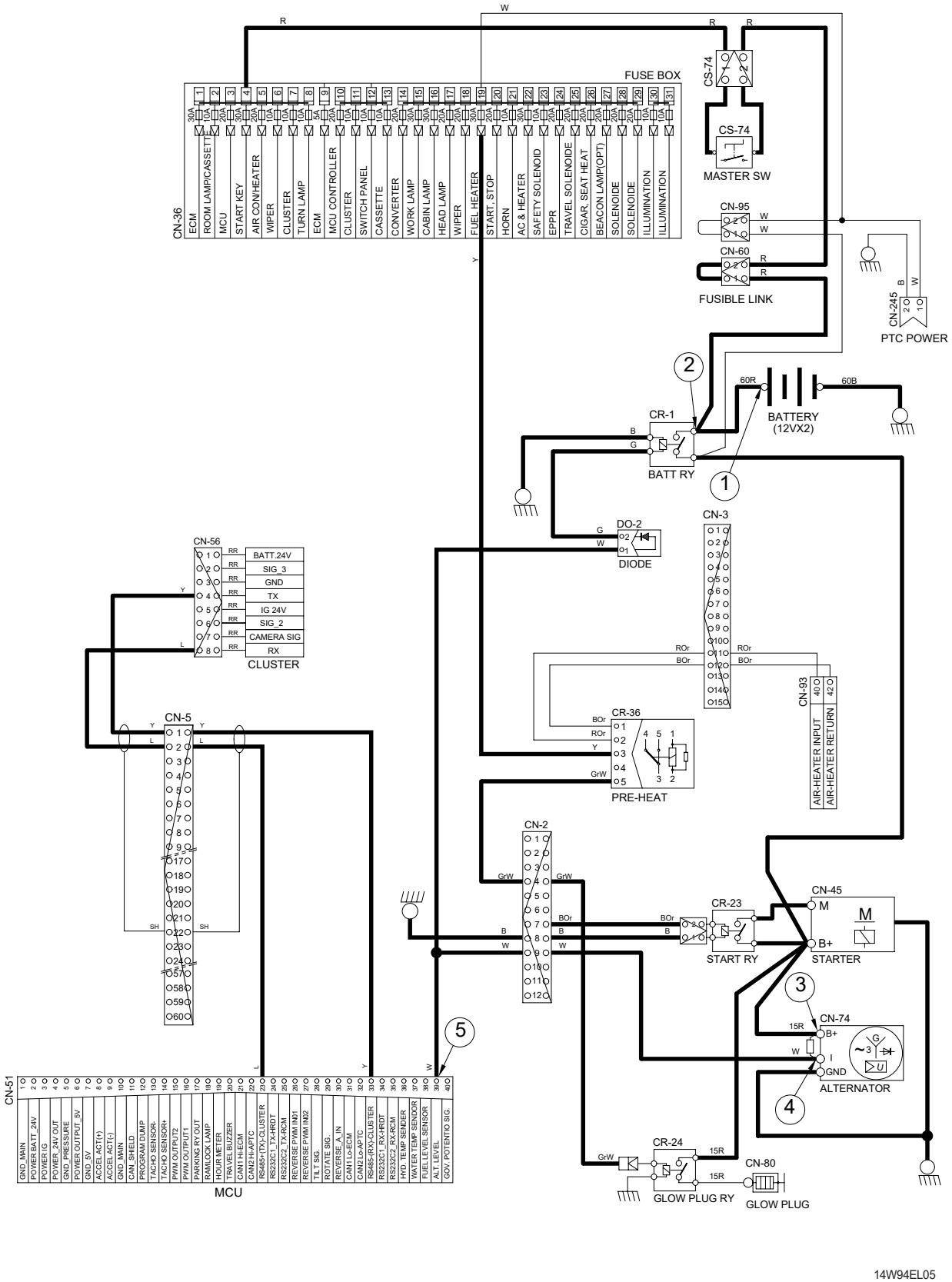
2. LOCATION 2



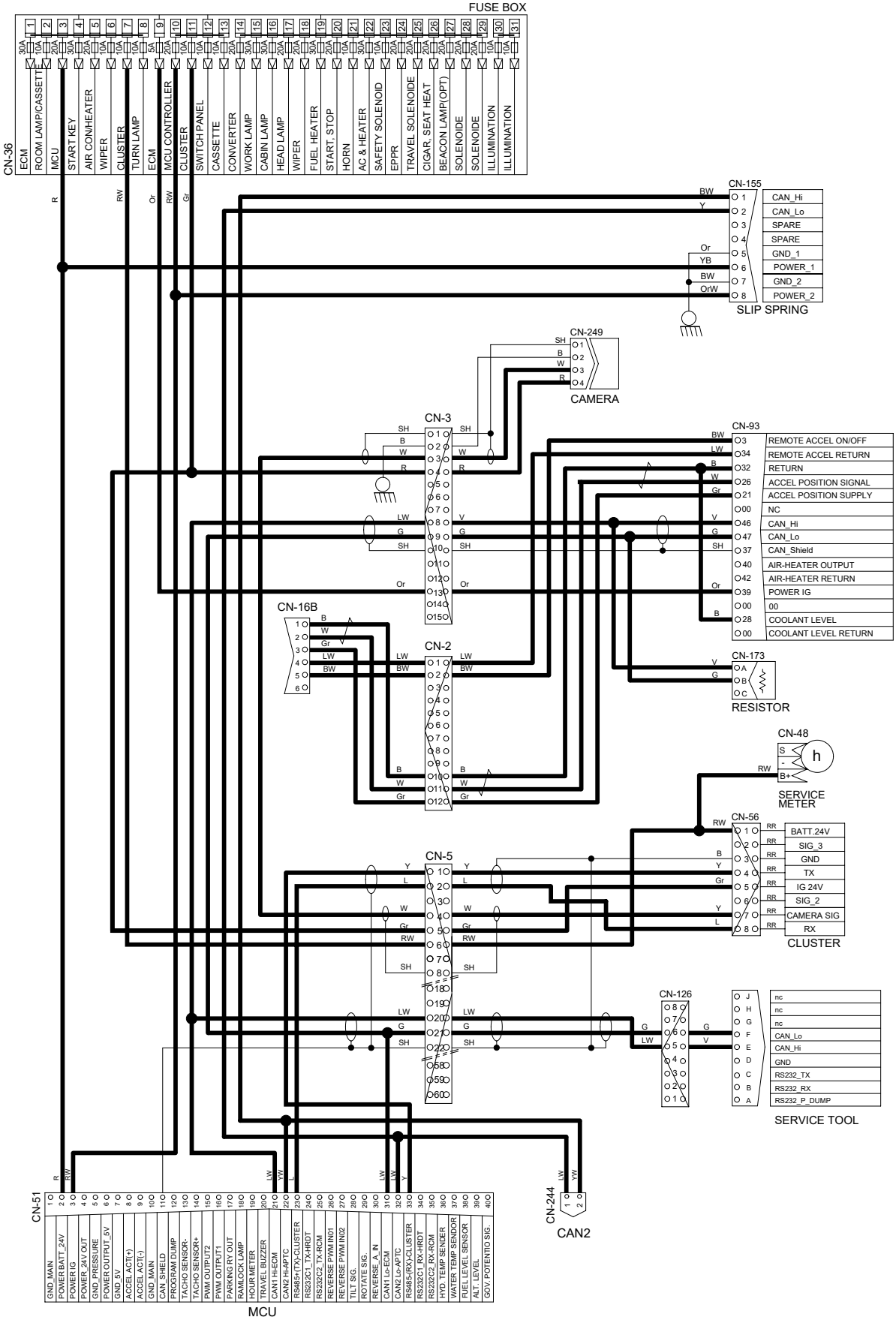
14W94EL02

1	Lamp	12	Start relay	23	Travel pressure sensor
2	Fuel sender	13	Alternator	24	Dozer pressure sensor
3	Fuel filler pump	14	Heater relay	25	Dozer pressure switch
4	Beacon lamp	15	Air cleaner switch	26	Working pressure sensor
5	Battery	16	Travel alarm buzzer	27	Brake lamp pressure sensor
6	Battery relay	17	Arm/Bucket in pressure sensor	28	Solenoid valve
7	Horn	18	Boom up pressure sensor	29	Pump EPPR valve
8	P1 pressure sensor	19	Swing pressure sensor	30	Boom priority EPPR valve
9	P2 pressure sensor	20	Nega 1 pressure sensor	31	Rear camera
10	P3 pressure sensor	21	Nega 2 pressure sensor	32	MCU
11	Overload pressure sensor	22	Attach pressure sensor		

CHARGING CIRCUIT



MONITORING CIRCUIT

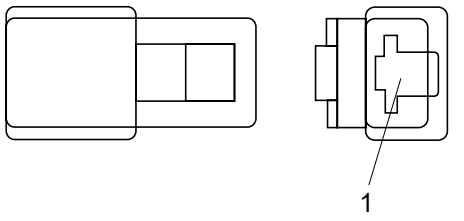
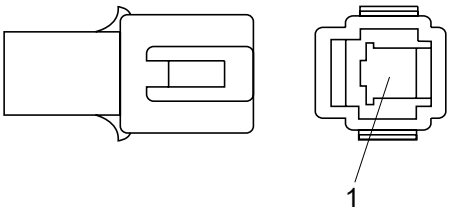
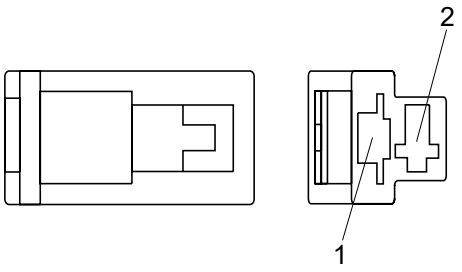
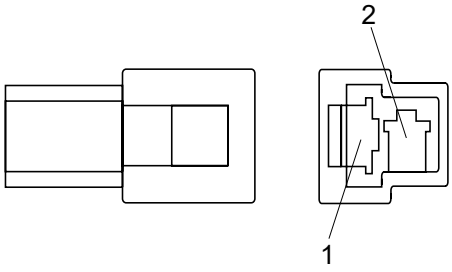
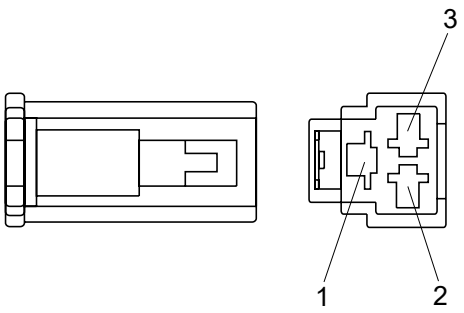
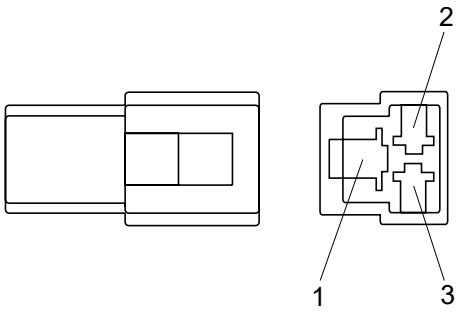
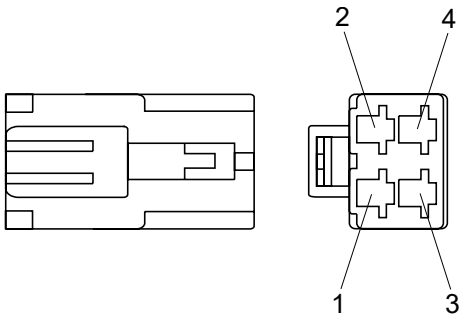
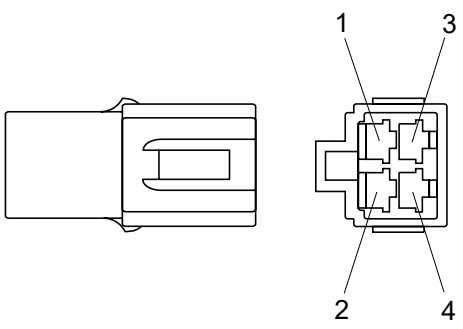


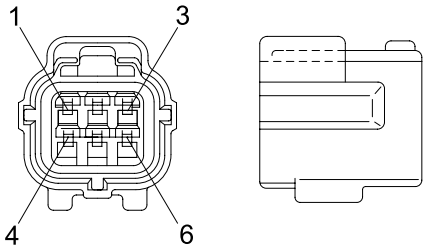
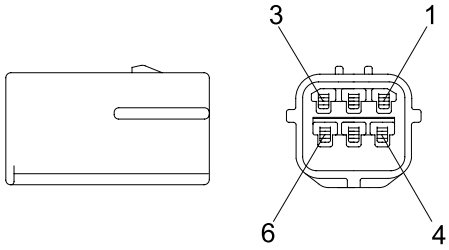
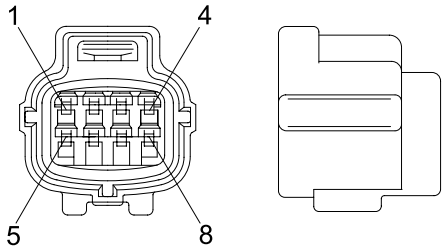
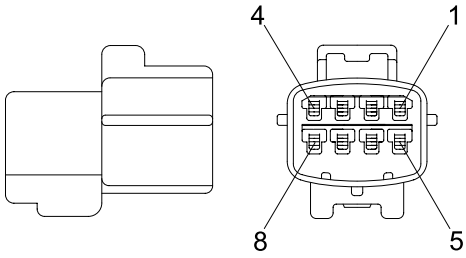
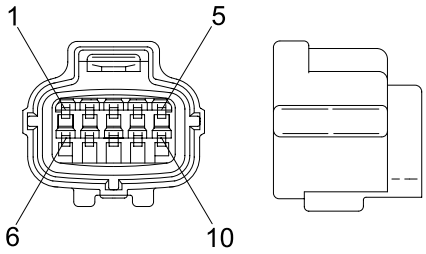
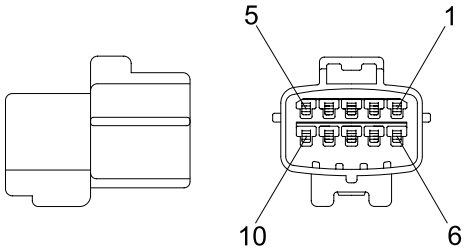
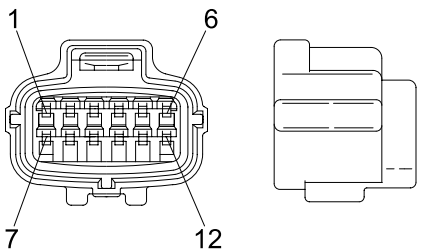
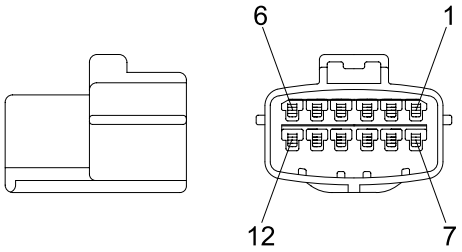
GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

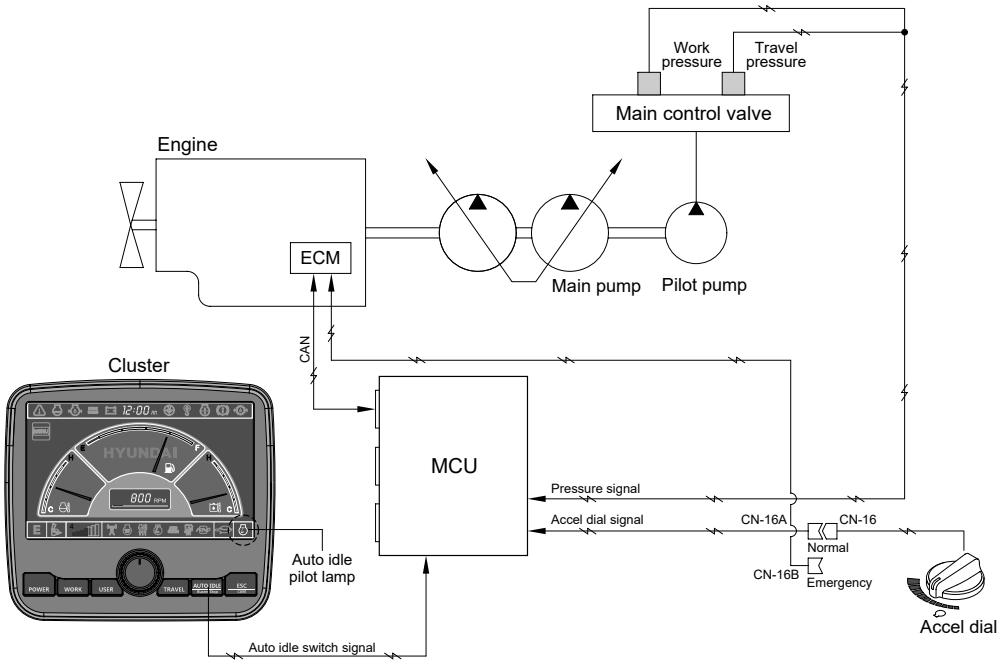
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	10	I/conn (Frame harness-Pump PS harness)	S816-010002	S816-110002
CN-2	AMP	12	I/conn (Frame harness-Engine harness)	S816-012002	S816-112002
CN-3	AMP	15	I/conn (Frame harness-Engine harness)	2-85262-1	368301-1
CN-4	AMP	16	I/conn (Console harness LH-Frame harness)	368047-1	368050-1
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB14-60PAE-L018
CN-7	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	368050-1
CN-8	AMP	12	I/conn (Console harness RH-Frame harness)	S816-012002	S816-112002
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12P-BE02
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S-EP06	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-14	AMP	8	I/conn (Frame harness-Attachment harness)	S816-008002	S816-108002
CN-15	AMP	10	I/conn (Frame harness-Two way harness)	S816-010002	S816-110002
CN-16	AMP	6	Emergency engine start & speed control	S816-006002	S816-106002
CN-17	DEUTSCH	8	I/conn (Wiper motor harness-Side harness RH)	DT06-8S-EP06	DT04-8P
CN-20	MOLEX	2	Horn	36825-0211	-
CN-21	AMP	6	Wiper motor	925276-0	-
CN-22	KET	2	Washer pump	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	36825-0211	-
CN-27	KUM	16	Radio & CD/MP3 player	PK145-16017	-
CN-28	KUM	1	Aircon compressor	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	21Q7-10910	-
CN-45	RING-TERM	-	Starter motor B^+	S820-308000	-
CN-48	KET	1	Service meter	2-520193-2	-
CN-51	DEUTSCH	40	MCU	DRC26-40SA	-
CN-52	DEUTSCH	40	MCU	DRC26-40SB	-
CN-53	DEUTSCH	40	MCU	DRC26-40SC	-
CN-56	AMP	8	Cluster	-	S816-108002
CN-60	AMP	2	Fusible link	21N4-01320	S813-130201
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	-
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-69	DEUTSCH	2	Ram lock solenoid	DT06-2S-EP06	-

4) CN TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

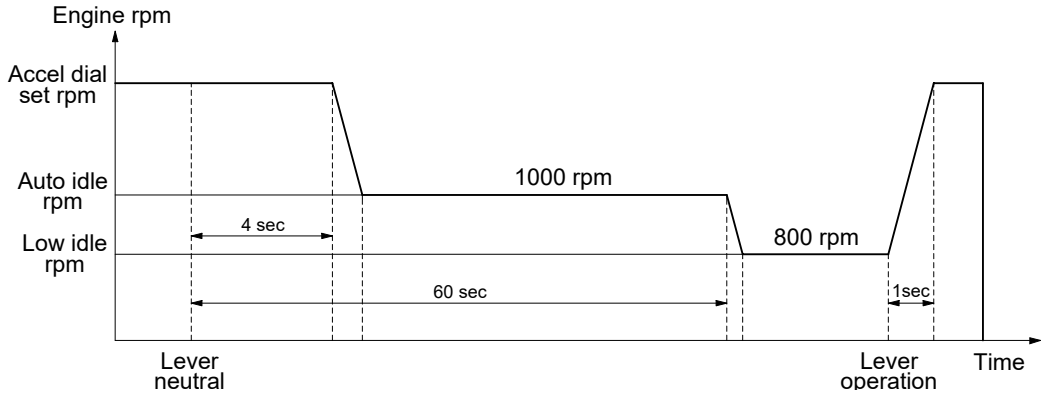
GROUP 3 AUTOMATIC DECELERATION SYSTEM



1. WHEN AUTO IDLE PILOT LAMP ON

When all of the work equipment control levers including swing and travel levers are at neutral for 4 seconds, MCU sends throttle command to ECM to reduce the engine speed to 1000 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 800 rpm. As the result of reducing the engine speed, fuel consumption and noise are effectively cut down during non-operation of the control levers.

When the Auto idle pilot lamp is turned off by pressing the switch or any control lever is operated, the reduced engine speed rises upto the speed before deceleration in a second.



2. WHEN AUTO IDLE PILOT LAMP OFF

The engine speed can be set as desired using the accel dial switch, and even if the control levers are neutral, the engine speed is not reduced.

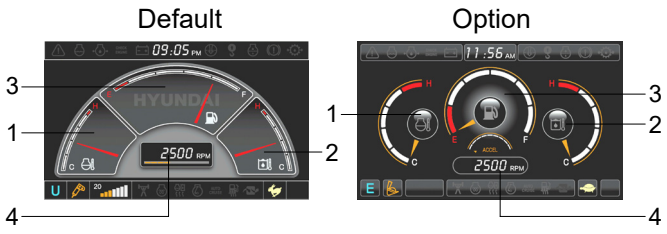
※ Auto idle function can be activated when accel dial position is over 4.

Error code		Description
HCESPN	FMI	
135	0	Swing pilot pressure sensor data above normal range.
	1	Swing pilot pressure sensor data below normal range.
	2	Swing pilot pressure sensor data error.
	4	Swing pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
138	0	Attachment pilot pressure sensor data above normal range.
	1	Attachment pilot pressure sensor data below normal range.
	2	Attachment pilot pressure sensor data error.
	4	Attachment pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
140	5	Pump EPPR valve circuit - Current below normal, or open circuit.
	6	Pump EPPR valve circuit - Current above normal.
141	5	Boom priority EPPR valve circuit - Current below normal, or open circuit.
	6	Boom priority EPPR valve circuit - Current above normal.
143	5	Travel EPPR valve circuit - Current below normal, or open circuit.
	6	Travel EPPR valve circuit - Current above normal.
144	5	Attachment flow EPPR valve circuit - Current below normal, or open circuit.
	6	Attachment flow EPPR valve circuit - Current above normal.
145	5	Remote cooling fan EPPR valve circuit - Current below normal, or open circuit.
	6	Remote cooling fan EPPR valve circuit - Current above normal.
150	5	Left rotate EPPR valve circuit - Current below normal, or open circuit.
	6	Left rotate EPPR valve circuit - Current above normal.
151	5	Right rotate EPPR valve circuit - Current below normal, or open circuit.
	6	Right rotate EPPR valve circuit - Current above normal.
152	5	Left tilt EPPR valve circuit - Current below normal, or open circuit.
	6	Left tilt EPPR valve circuit - Current above normal.
153	5	Right tilt EPPR valve circuit - Current below normal, or open circuit.
	6	Right tilt EPPR valve circuit - Current above normal.
166	5	Power max solenoid circuit - Current below normal, or open circuit.
	6	Power max solenoid circuit - Current above normal.
167	5	Travel speed solenoid circuit - Current below normal, or open circuit.
	6	Travel speed solenoid circuit - Current above normal.
168	5	Attachment pressure solenoid circuit - Current below normal, or open circuit.
	6	Attachment pressure solenoid circuit - Current above normal.
169	5	Attachment conflux solenoid circuit - Current below normal, or open circuit.
	6	Attachment conflux solenoid circuit - Current above normal.
170	5	Arm regeneration solenoid circuit - Current below normal, or open circuit.
	6	Arm regeneration solenoid circuit - Current above normal.
171	5	Attachment safety solenoid circuit - Current below normal, or open circuit.
	6	Attachment safety solenoid circuit - Current above normal.
181	5	Remote cooling fan reverse solenoid circuit - Current below normal, or open circuit.
	6	Remote cooling fan reverse solenoid circuit - Current above normal.
301	3	Fuel level sensor circuit - Voltage above normal, or shorted to high source.
	4	Fuel level sensor circuit - Voltage below normal, or shorted to low source.
304	3	Engine coolant temperature sensor circuit - Voltage above normal, or shorted to high source.
	4	Engine coolant temperature sensor circuit - Voltage below normal, or shorted to low source.
310	8	Engine speed signal error - Abnormal frequency or pulse width.
322	3	Engine preheat relay circuit - Voltage above normal, or shorted to high source.
	4	Engine preheat relay circuit - Voltage below normal, or shorted to low source.
325	3	Fuel warmer relay circuit - Voltage above normal, or shorted to high source.
	4	Fuel warmer relay circuit - Voltage below normal, or shorted to low source.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
2384 641 4	VGT actuator driver circuit - Voltage below normal, or shorted to low source. Low voltage detected at turbocharger control valve circuit.	Variable geometry turbocharger may be in either the open or closed position.
2385 641 3	VGT actuator driver circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at turbocharger control valve circuit.	The intake air heaters may be ON or OFF all the time.
2555 729 3	Intake air heater 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at the intake air heater signal circuit.	The intake air heaters may be ON or OFF all the time.
2556 729 4	Intake air heater 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at the intake air heater signal circuit.	Can not control transmission.
2557 697 3	Auxiliary PWM driver 1 circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the analog torque circuit.	Can not control transmission.
2558 697 4	Auxiliary PWM driver 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the analog torque circuit.	Power derate and possible engine shutdown if engine protection shutdown feature is enabled.
2973 102 2	Intake manifold 1 pressure - Data erratic, intermittent, or incorrect. The ECM has detected an intake manifold pressure signal that is too high or low for current engine operating conditions.	

2) GAUGE

(1) Operation screen

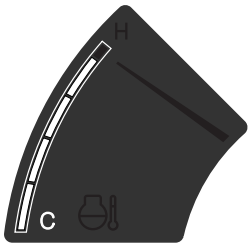


21093CD07A

1 Engine coolant temperature gauge
2 Hydraulic oil temperature gauge
3 Fuel level gauge
4 RPM / Tripmeter display

※ **Operation screen type can be set by the screen type menu of the display. Refer to page 5-54 for details.**

(2) Engine coolant temperature gauge



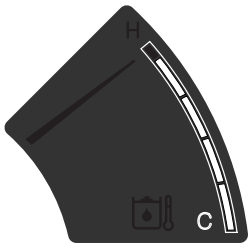
21093CD07G

① This gauge indicates the temperature of coolant.
- White range : 40-107°C (104-225°F)
- Red range : Above 107°C (225°F)

② If the indicator is in the red range or lamp blinks in red, turn OFF the engine and check the engine cooling system.

※ If the gauge indicates the red range or lamp blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.

(3) Hydraulic oil temperature gauge



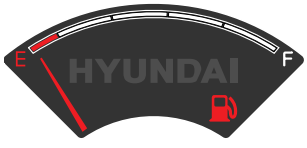
21093CD07E

① This gauge indicates the temperature of hydraulic oil.
- White range : 40-105°C (104-221°F)
- Red range : Above 105°C (221°F)

② If the indicator is in the red range or lamp blinks is red, reduce the load on the system. If the gauge stays in the red range, stop the machine and check the cause of the problem.

※ **If the gauge indicates the red range or lamp blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

(4) **Fuel level gauge**



21093CD07F

① This gauge indicates the amount of fuel in the fuel tank.

② Fill the fuel when the red range, or lamp blinks in red.

※ **If the gauge indicates the red range or lamp blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

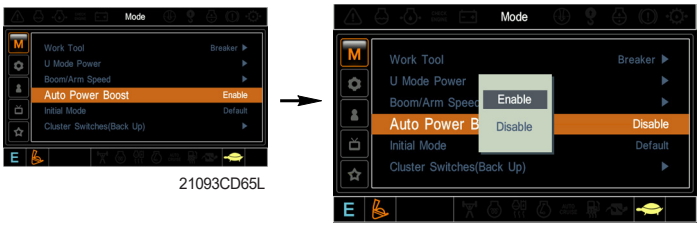
(5) RPM / Tripmeter display

21093CD02D

① This displays the engine speed or the tripmeter.

※ Refer to page 5-54 for details.

④ Auto power boost

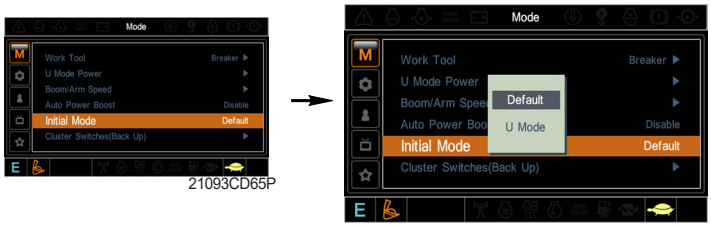


21093CD65L

21093CD65M

- The power boost function can be activated or cancelled.
- Enable - The digging power is automatically increased as working conditions by the MCU. It is operated max 8 seconds.
- Disable - Not operated.

⑤ Initial mode

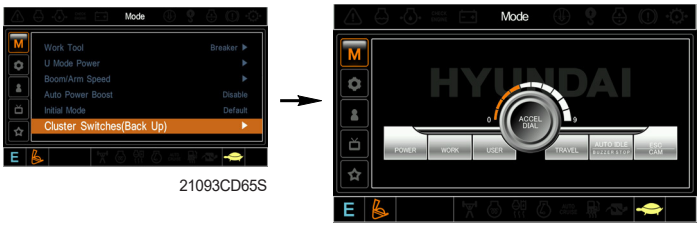


21093CD65P

21093CD65Q

- Default - The initial power mode is set E mode when the engine is started.
- U mode - The initial power mode is set U mode when the engine is started.

⑥ Cluster switch (back up)



21093CD65S

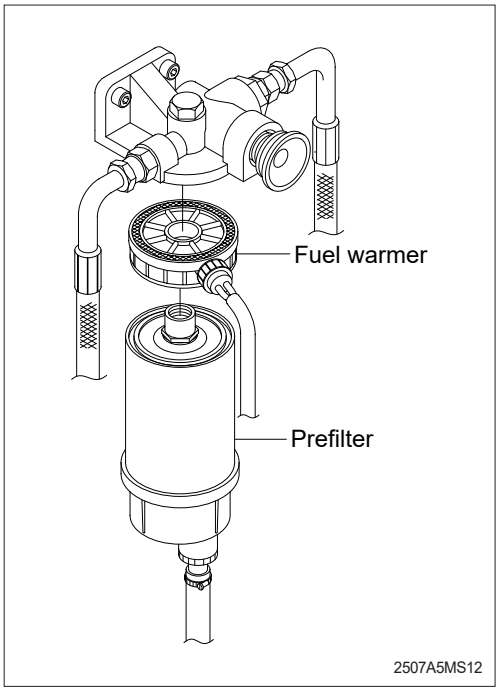
21093CD65T

- The cluster switch can be selected and changed by this menu when the switches are abnormal on the cluster.
- In order to exit "Cluster switch" mode, please put the cursor on the ESC/CAM switch by turning the select switch and push the select switch.
- In "Cluster switch", other switches except "Select switch" do not work.

GROUP 15 FUEL WARMER SYSTEM

1. SPECIFICATION

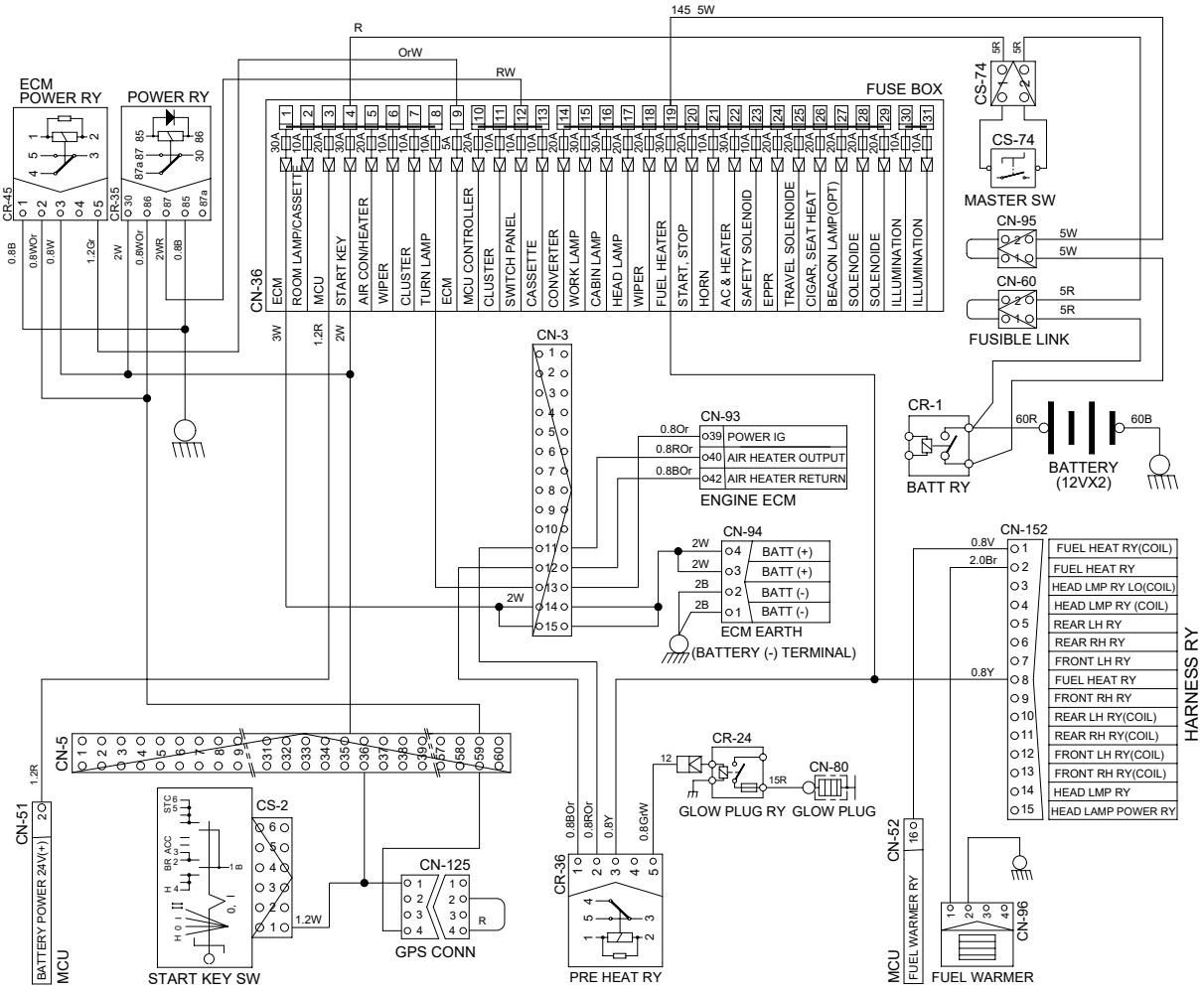
1) Operating voltage : 24 ± 4 V
2) Power : 350 ± 50 W
3) Current : 15 A



2. OPERATION

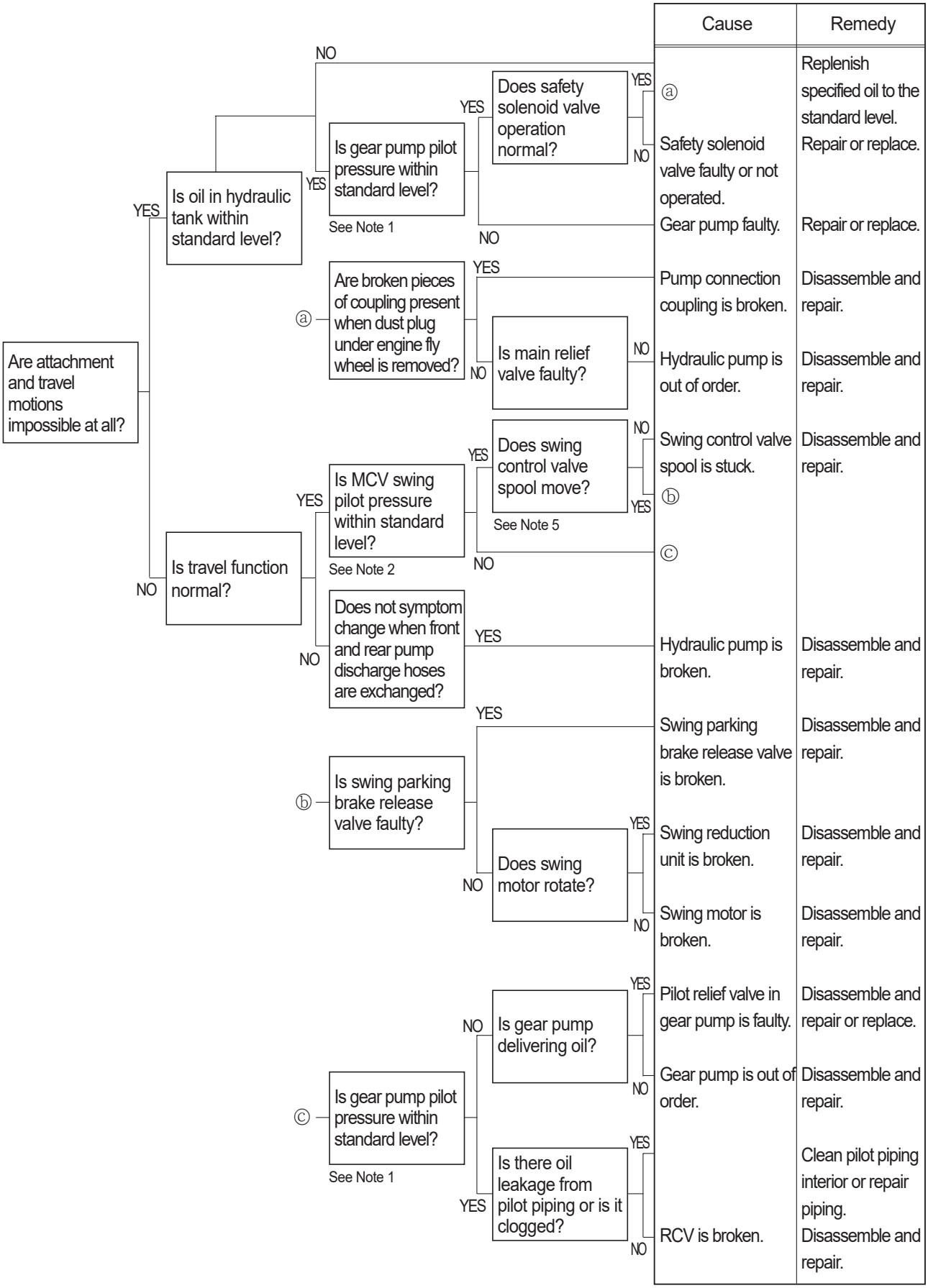
1) The current of fuel warmer system is automatically controlled without thermostat according to fuel temperature.
2) At the first state, the 15 A current flows to the fuel warmer and engine may be started in 1~2 minutes.
3) If the fuel starts to flow, ceramic-disk in the fuel warmer heater senses the fuel temperature to reduce the current as low as 1.5 A.
   So, fuel is protected from overheating by this mechanism.

3. ELECTRIC CIRCUIT

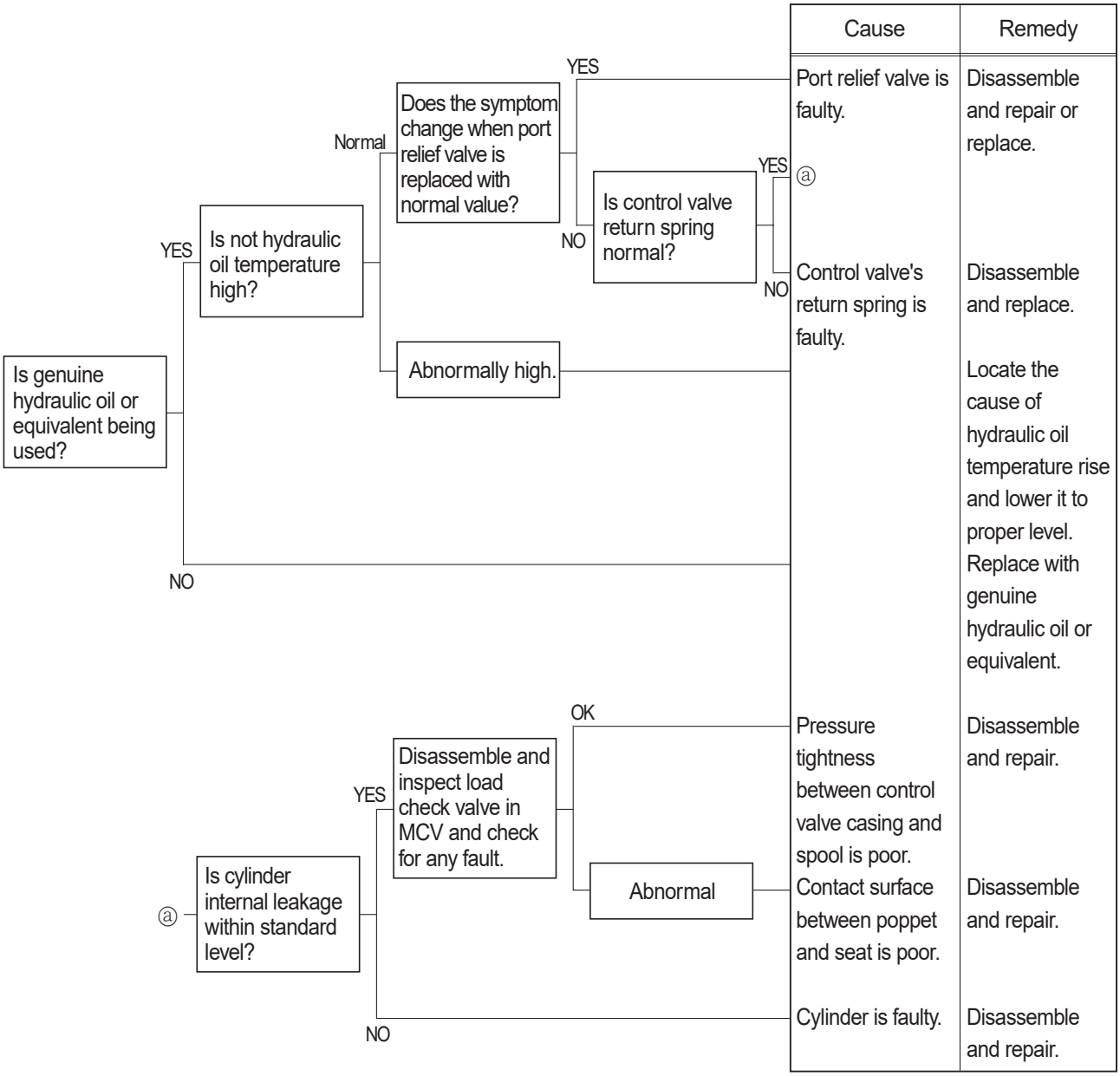


4. SWING SYSTEM

1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



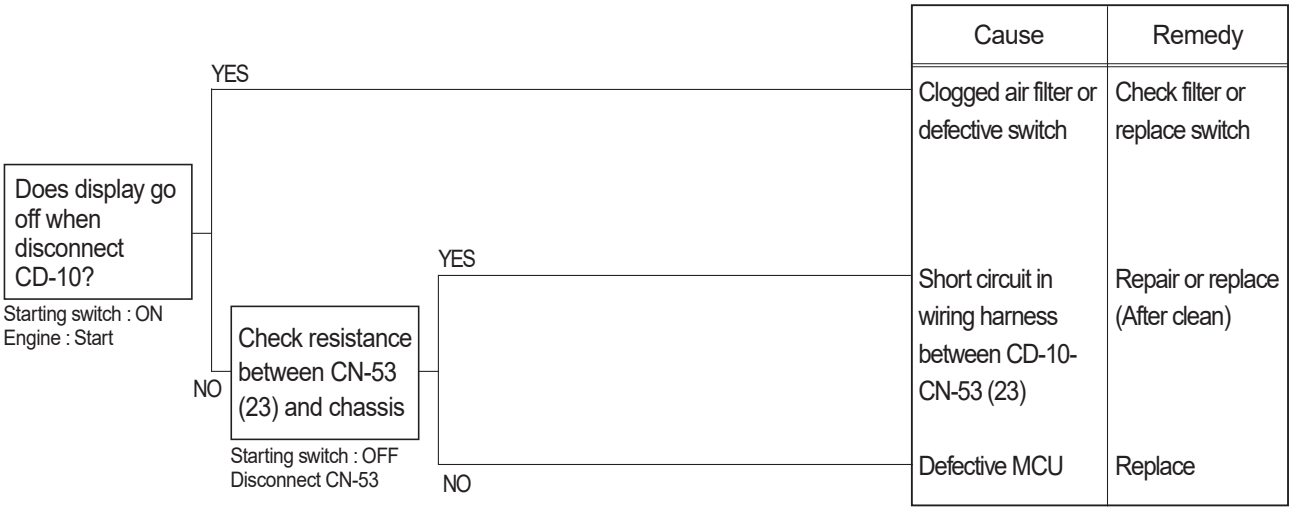
3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
ⓐ	
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level. Replace with genuine hydraulic oil or equivalent.
Pressure tightness between control valve casing and spool is poor.	Disassemble and repair.
Contact surface between poppet and seat is poor.	Disassemble and repair.
Cylinder is faulty.	Disassemble and repair.

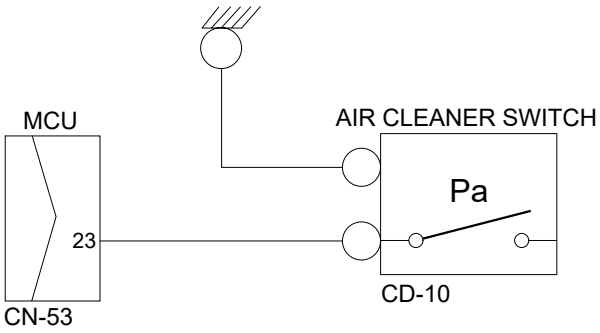
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Check resistance

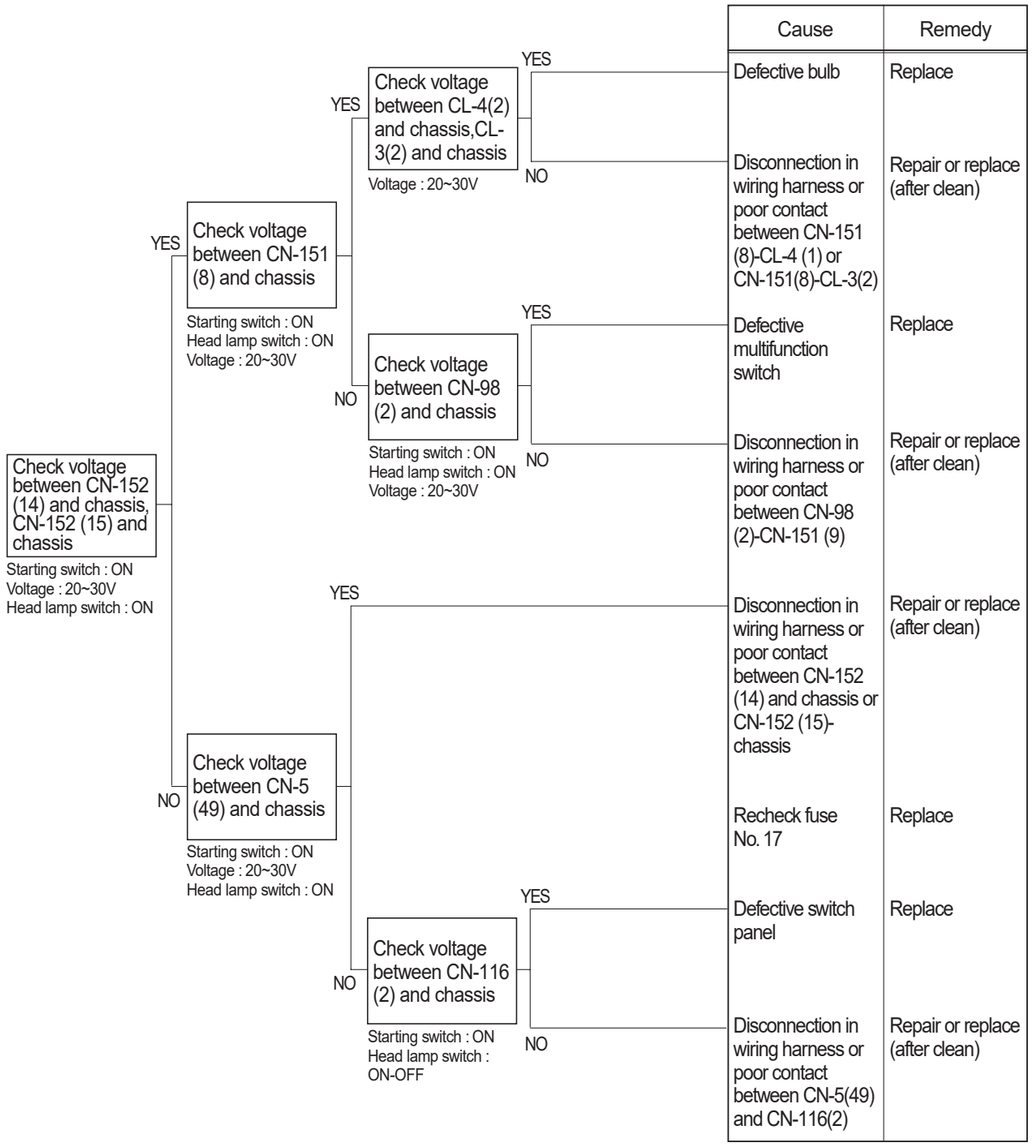
YES	MAX 1Ω
NO	MIN 1MΩ

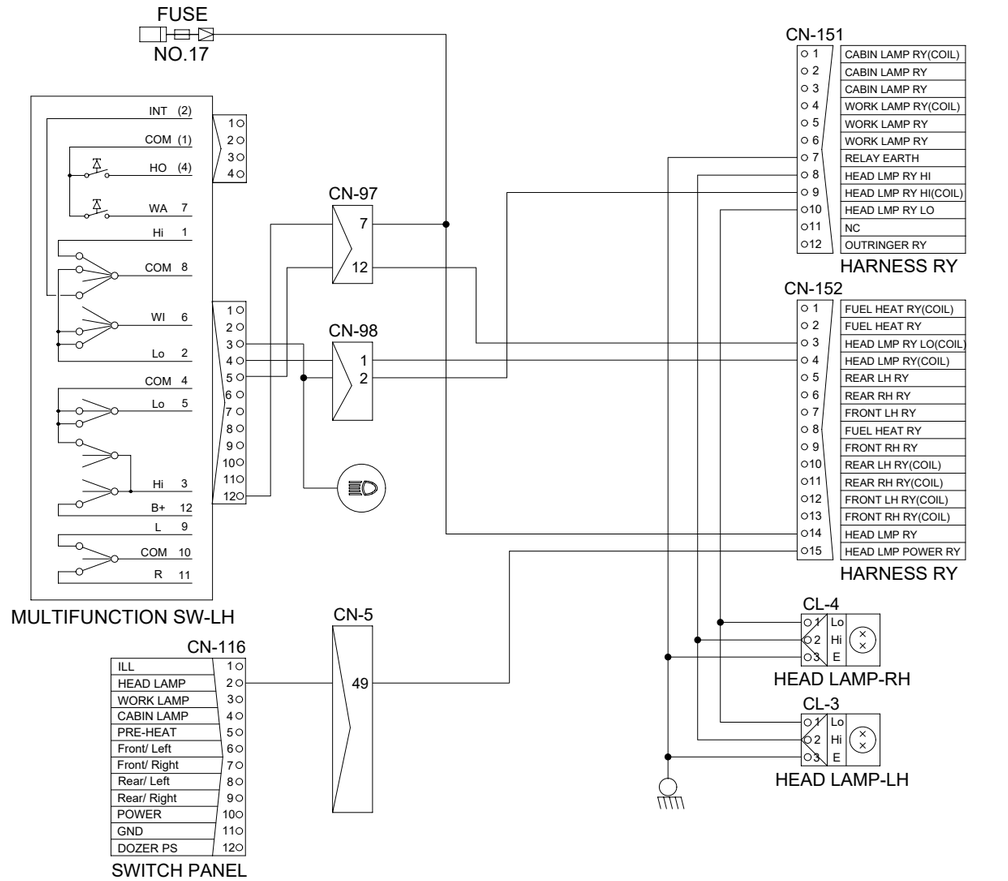


21096ES05

15. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.17.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





14W96ES15

2) TEST PROCEDURE

(1) Test 7 : Check voltage at CN-52(26) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (26) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

(2) Test 8 : Check voltage at CN-52(35)and ground.

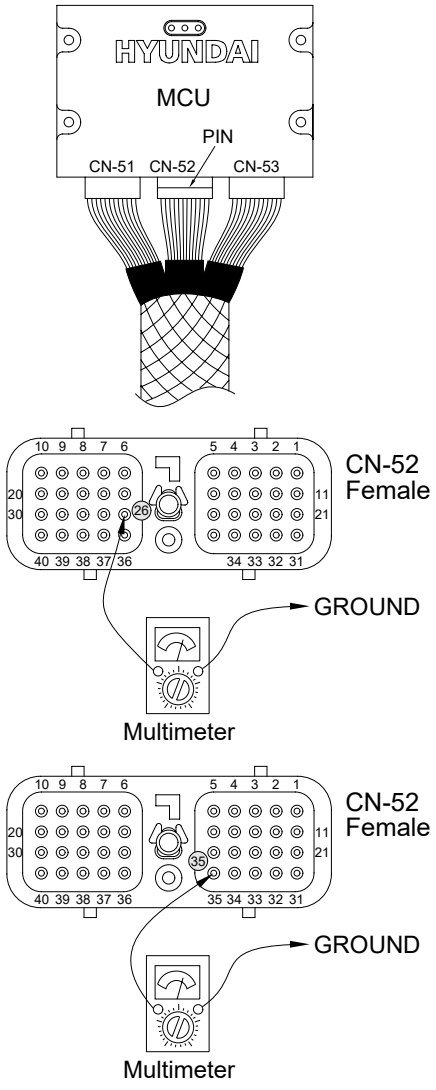
① Prepare 1 piece of thin sharp pin, steel or copper

② Insert prepared pin to rear side of connectors : One pin to (35) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-52(27) and ground.

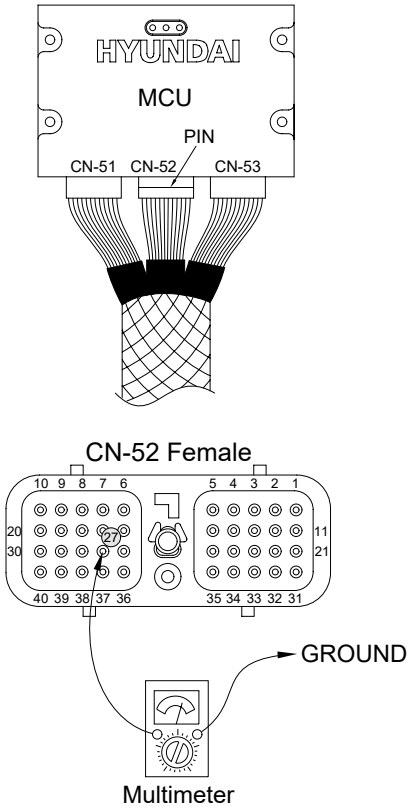
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (27) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



21096MS10A

2) TEST PROCEDURE

(1) Test 18 : Check voltage at CN-52(33) and ground.

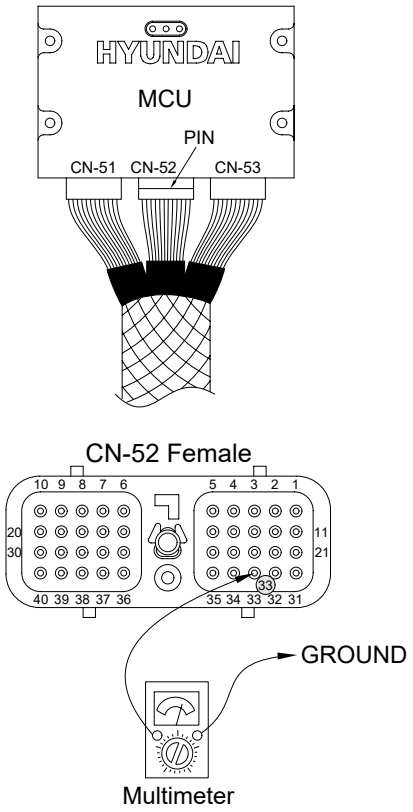
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (33) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



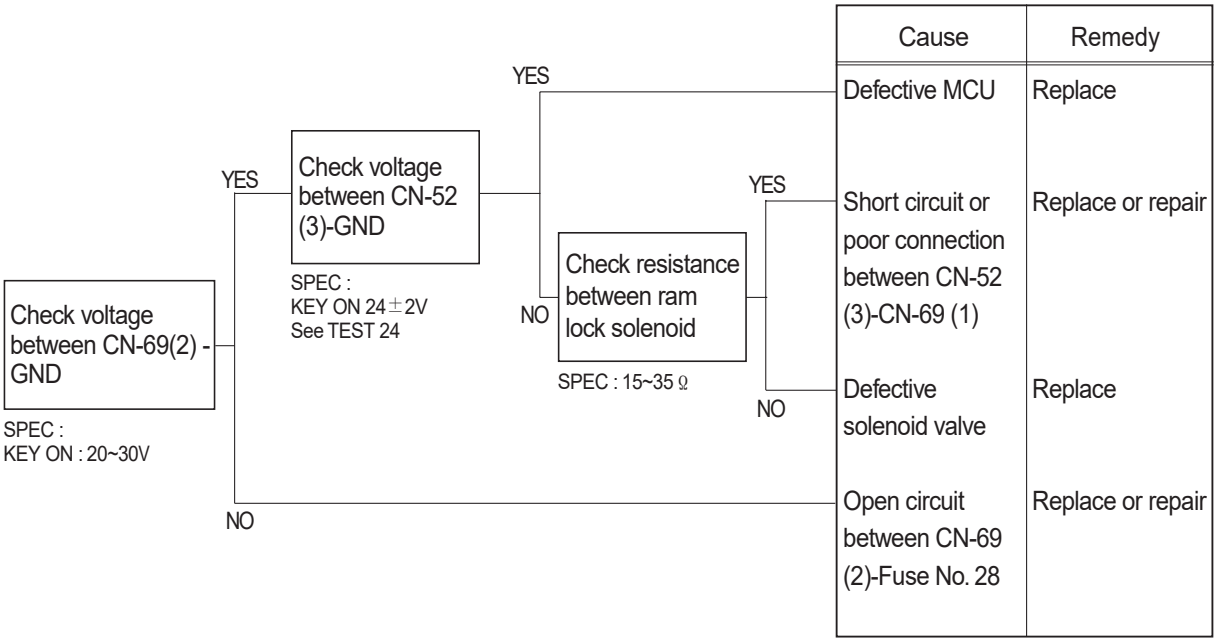
14W96MS21A

21. MALFUNCTION OF RAM LOCK SOLENOID

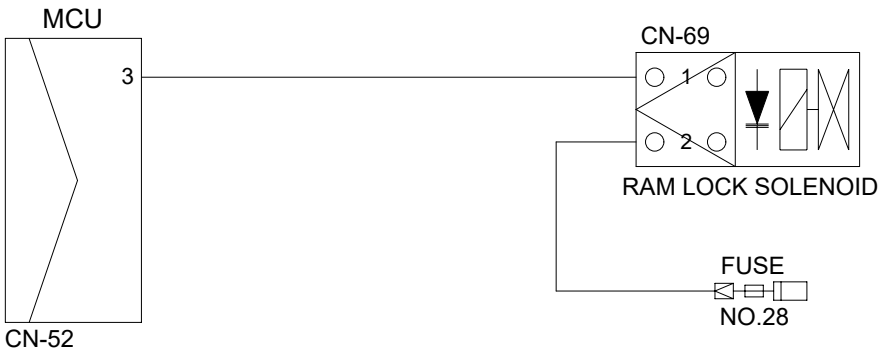
· Fault code : HCESPN 525, FMI 5 or 6

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



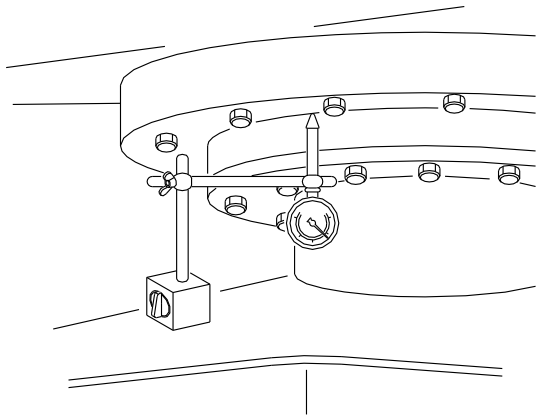
Wiring diagram



14W96MS25

6) SWING BEARING PLAY

(1) Measure the swing bearing play using a dial gauge to check the wear of bearing races and balls.



7-10(1) 140-7

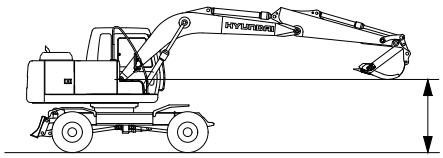
(2) Preparation

① Check swing bearing mounting cap screws for loosening.
② Check the lubrication of the swing bearing. Confirm that bearing rotation is smooth and without noise.
③ Install a dial gauge on the track frame as shown, using a magnetic base.
④ Position the upperstructure so that the boom aligns with the tracks facing towards the front axle.
⑤ Position the dial gauge so that its needle point comes into contact with the bottom face of the bearing outer race.
⑥ Bucket should be empty.

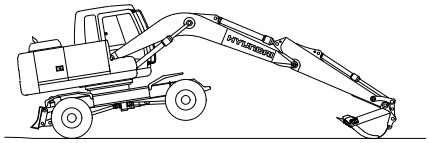
(3) Measurement

① With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin.
Record the dial gauge reading (h1).
② Lower the bucket to the ground and use it to raise the front axle 50㎝.
Record the dial gauge reading (h2).
③ Calculate bearing play (H) from this data (h1 and h2) as follows.
H=h2-h1

Measurement : (h1)



Measurement : (h2)



14W97MS08

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HW150VSPRO	0.5 ~ 1.5	3.0	

15) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

① Keep the hydraulic oil temperature at 50±5℃.

(2) Measurement

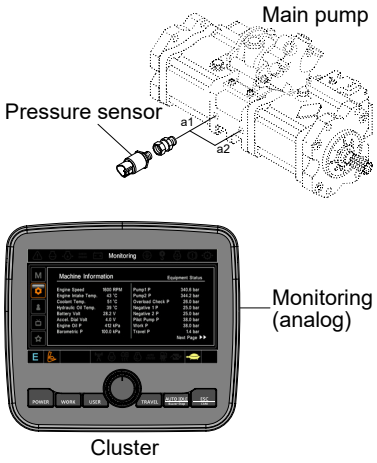
① Select the following switch positions.

- Power mode switch : P mode

② Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.

③ In the swing function, place bucket against an immovable object and measure the relief pressure.

④ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.



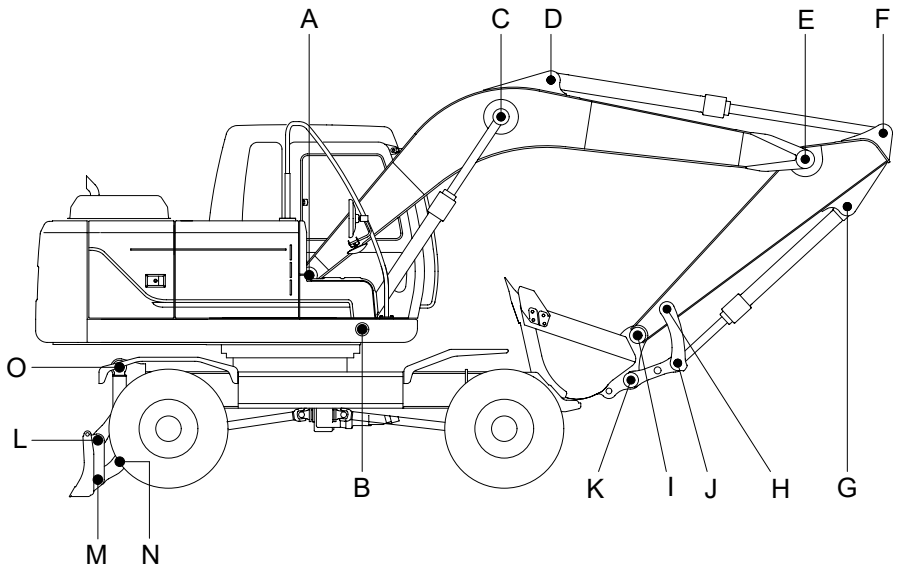
(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm²

Model	Function to be tested	Standard	Port relief setting at 20lpm
HW150VSPRO	Boom, Arm, Bucket	350 (380)±10	400±10
	Travel	400±10	-
	Swing	285±10	-

( ) : Power boost

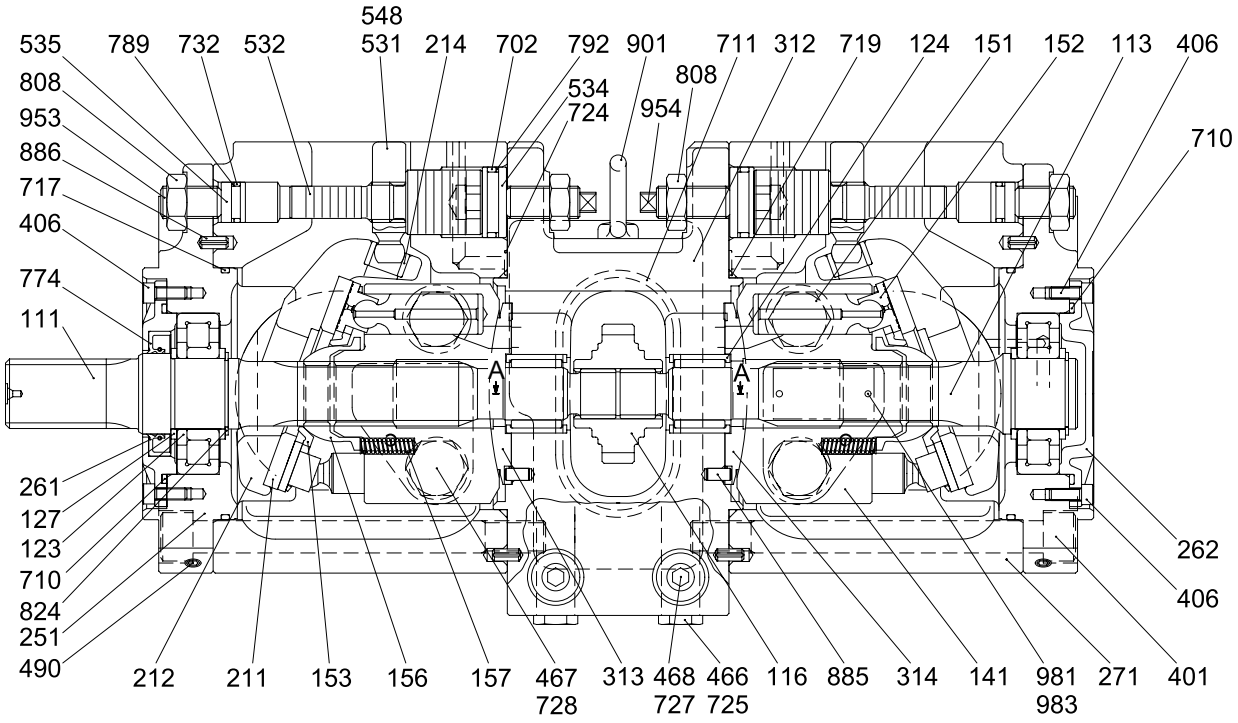


Unit : mm

Mark	Measuring point (pin and bushing)	Normal value	Pin		Bushing		Remedy & Remark
			Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	
A	Boom rear	70	69	68.5	70.5	71	Replace
B	Boom cylinder head	70	69	68.5	70.5	71	〃
C	Boom cylinder rod	70	69	68.5	70.5	71	〃
D	Arm cylinder head	70	69	68.5	70.5	71	〃
E	Boom front	70	69	68.5	70.5	71	〃
F	Arm cylinder rod	70	69	68.5	70.5	71	〃
G	Bucket cylinder head	70	69	68.5	70.5	71	〃
H	Arm link	65	64	63.5	65.5	66	〃
I	Bucket and arm link	65	64	63.5	65.5	66	〃
J	Bucket cylinder rod	70	69	68.5	70.5	71	〃
K	Bucket link	65	64	63.5	65.5	66	〃
L	Dozer link (B)	55	54	53.5	55.5	56	〃
M	Dozer link (A)	55	54	53.5	55.5	56	〃
N	Dozer cylinder rod	65	64	63.5	65.5	66	〃
O	Dozer cylinder head	65	64	63.5	65.5	66	〃

2. MAIN PUMP (1/2)

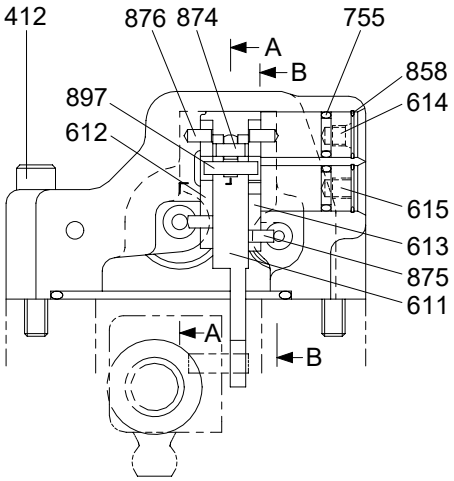
1) STRUCTURE

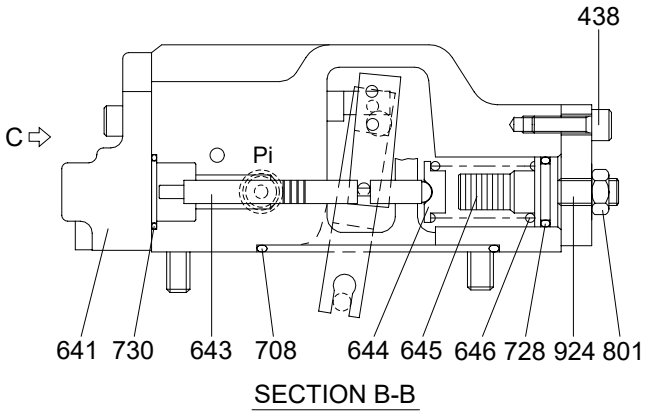


111	Drive shaft (F)	312	Valve block	724	O-ring
113	Drive shaft (R)	313	Valve plate (R)	725	O-ring
116	Gear	314	Valve plate (L)	727	O-ring
123	Roller bearing	401	Hexagon socket bolt	728	O-ring
124	Needle bearing	406	Hexagon socket bolt	732	O-ring
127	Bearing spacer	466	VP Plug	774	Oil seal
141	Cylinder block	467	VP Plug	789	Back up ring
151	Piston	468	VP Plug	792	Back up ring
152	Shoe	490	Plug	808	Hexagon head nut
153	Push-plate	531	Tilting pin	824	Snap ring
156	Bushing	532	Servo piston	885	Pin
157	Cylinder spring	534	Stopper (L)	886	Spring pin
211	Shoe plate	535	Stopper (S)	901	Eye bolt
212	Swash plate	548	Pin	953	Set screw
214	Bushing	702	O-ring	954	Set screw
251	Support	710	O-ring	981	Plate
261	Seal cover (F)	711	O-ring	983	Pin
262	Seal cover (R)	717	O-ring		
271	Pump casing	719	O-ring		

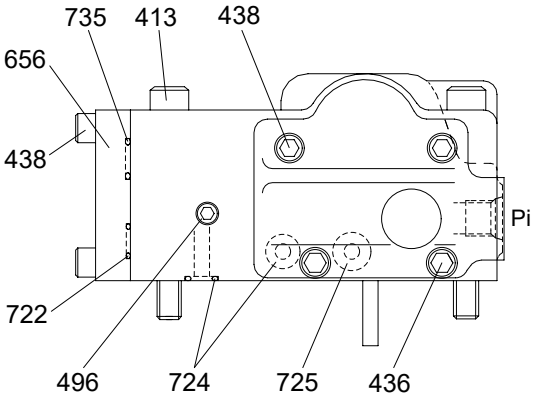
3. REGULATOR

1) STRUCTURE (1/2)

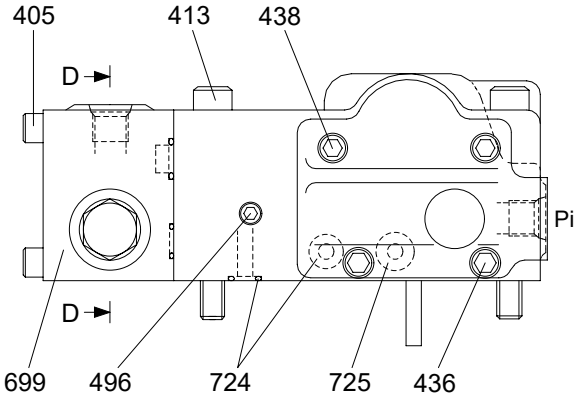




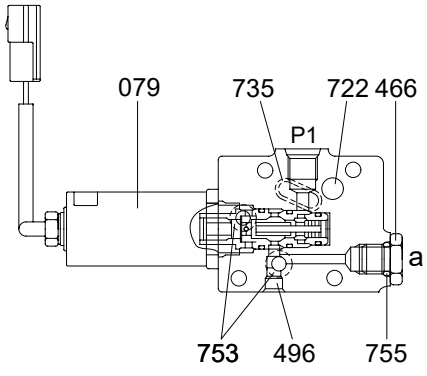
SECTION B-B



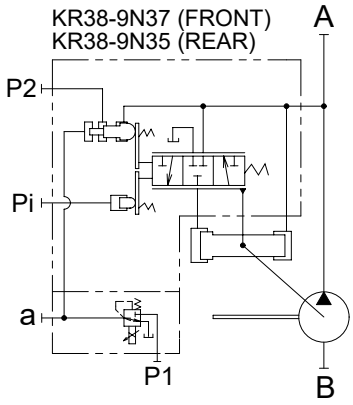
VIEW C (FRONT)



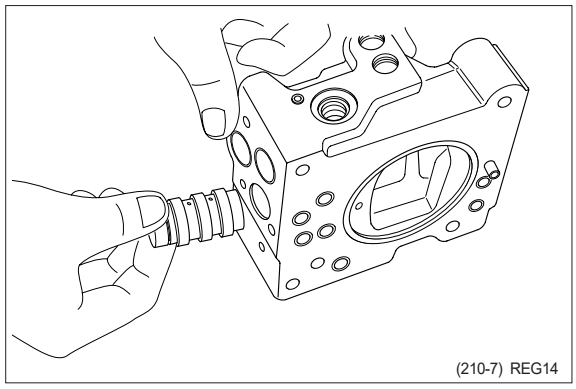
VIEW C (REAR)



SECTION D-D(REAR)

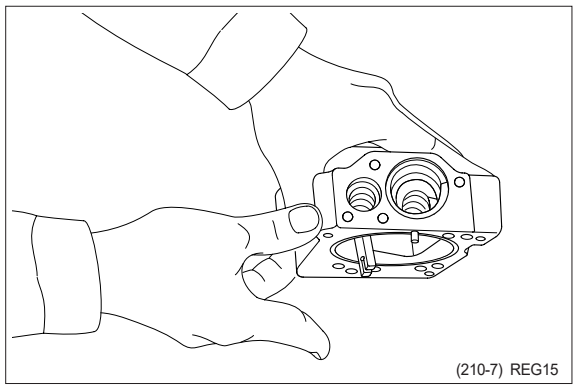


(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.
Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).


(210-7) REG14

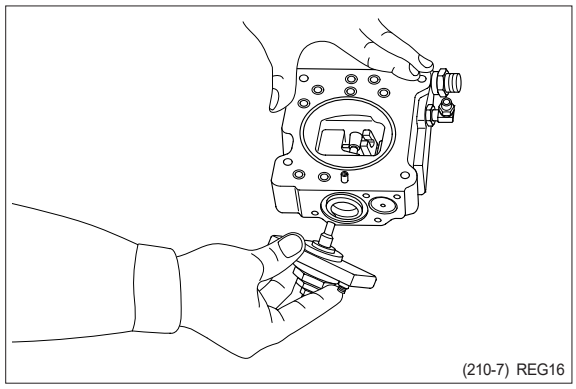
(12) Put spring seat (644), pilot spring (646) and adjusting ring (Q, 645) into pilot hole.
Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.

※ When fitting spring seat, take care not to mistake direction of spring seat.


(210-7) REG15

(13) Install cover (C, 629) fitted with adjusting screws (628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).
Then tighten them with hexagonal socket head screws (438).

This completes assembly.


(210-7) REG16

(4) Disassembly of the load check valve and the negative relief valve

① The load check valve

a. Fix the body to suitable work bench.

※ Pay attention not to damage the body.

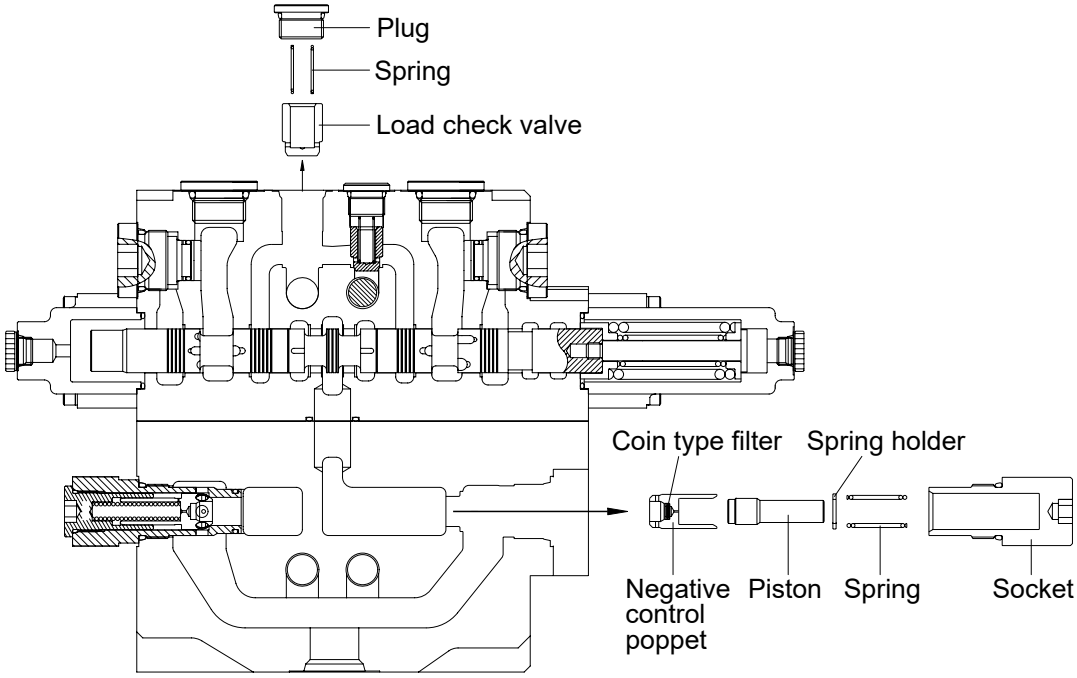
b. Loosen the plug (hexagon wrench : 10 ㎜).

c. Remove the spring and the load check valve with pincers or magnet.

② The negative relief valve

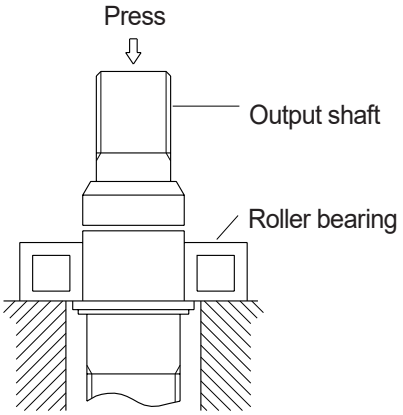
a. Loosen the socket (spanner : 32 ㎜).

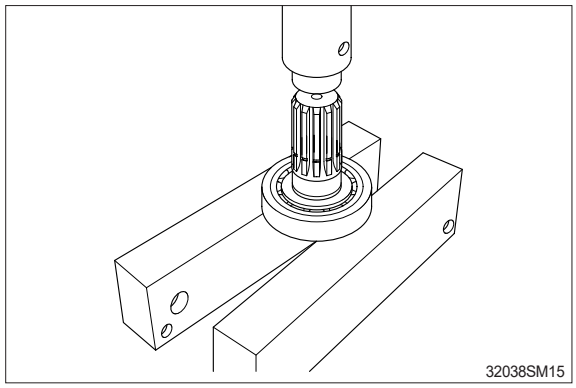
b. Remove the spring, spring holder, piston and negative control poppet.



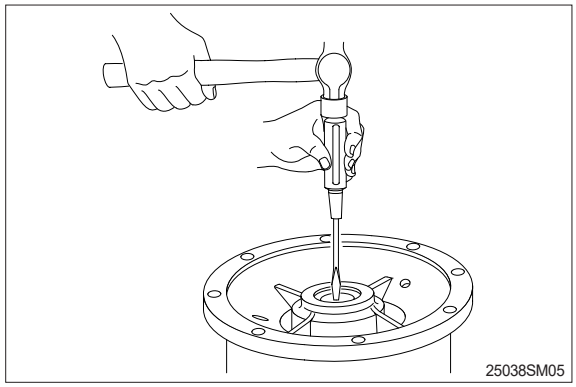
(13) Remove the cone of roller bearing (3) by press.

※ Do not reuse bearings.

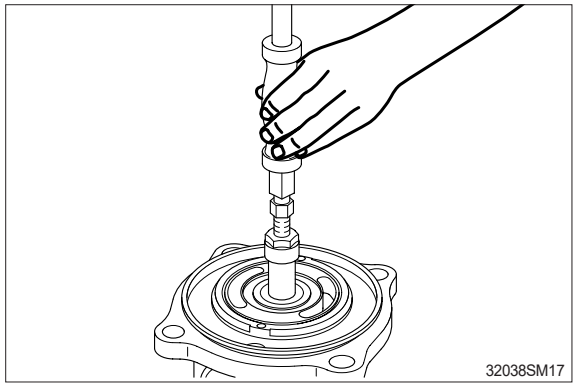




(14) Remove bushing (6) and oil seal (2) from body (1).



(15) Remove the needle bearing (21) from the rear cover (20) by using slide hammer bearing puller.



(5) Disassembling carrier 1 (12) assembly.

① Remove stop ring (18).

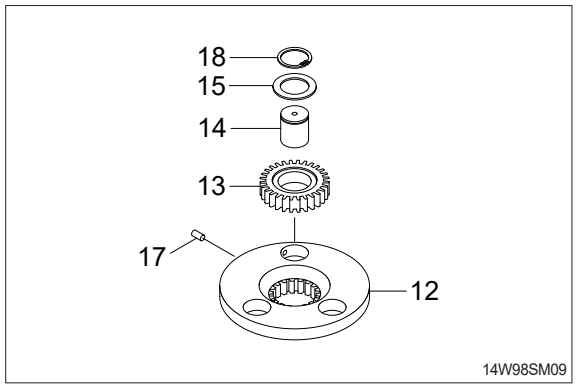
② Remove thrust washer (15) and planet gear 1(13) from the carrier 1 (12).

③ Using M8 solid drill, crush spring pin (17) so that the pin 1 (14) can be removed by hammering.

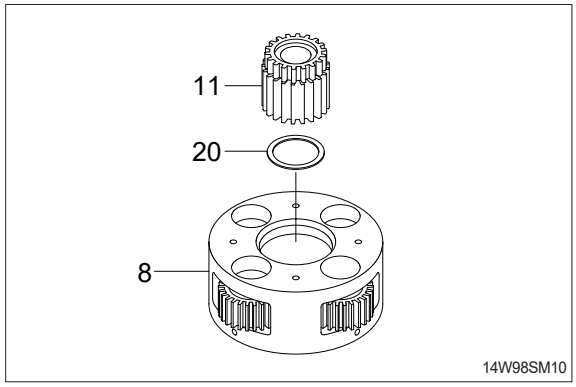
※ Do not reuse spring pin (17).

※ Do not remove pin 1 (14), carrier 1 (12) and spring pin(17) but in case of replacement.

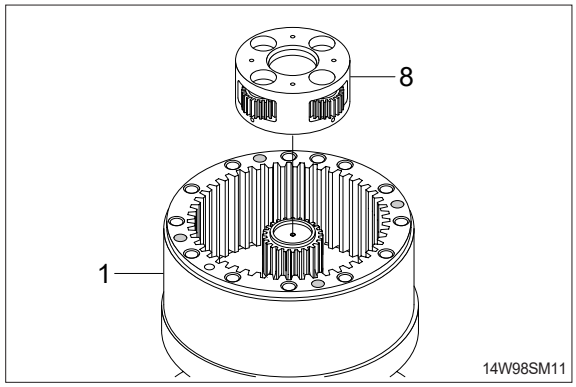
※ Put matching marks on the planet gear 1 (13) and the pin 1(14) for easy reassembly.



(6) Remove sun gear 2 (11) and side plate 1 (20) from carrier 2 (8).



(7) Remove carrier 2 (8) assembly from casing (1).



3. TIGHTENING TORQUE

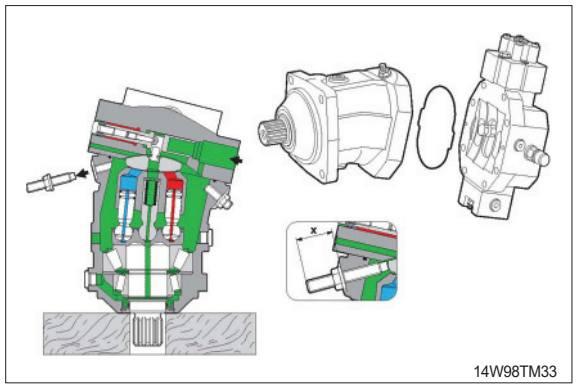
The torques given are standard figures. Any figures specifically described in the procedure has priority.

Page	Item	Size	kgf · m	lbf · ft
8-66	8	M22 × 1.5	6.1	44
	13	M26 × 1.5	7.1	51
	18	M12	7.0	50.9
	28	M 6 × 20	1.4	10.3
8-67	76	-	32.6	236
	77	M10 × 1.0	5.2	37.6
	78	M12 × 1.5	3.6	25.8
8-68	20	-	66.3	479
	21	-	66.3	479

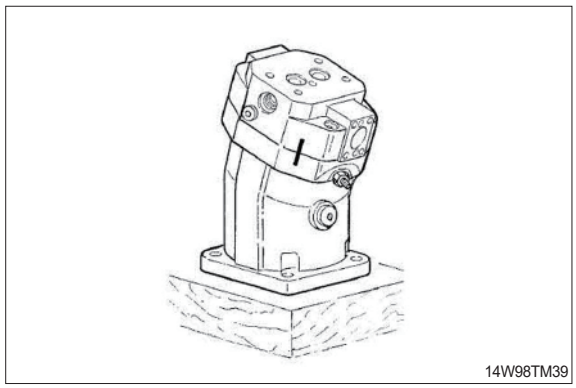
7) DISASSEMBLY OF THE PORT PLATE

- Note dimension X
- Remove Q_{min} screw
- Swivel rotary group to zero P

※ For disassembly of the port plate, swivel always rotary group to zero position. Piston rings to hang out of the cylinder boring.

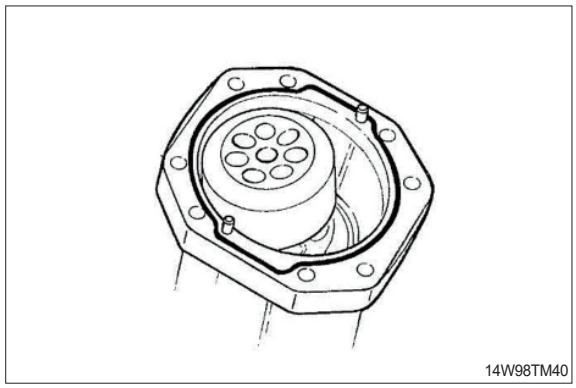


(1) Port plate.
Mark position. Loosen screws.
Removal.



(2) Check O-ring.

※ Stick new O-ring with some grease.
Do not swivel rotary group.
Piston rings to hang out from the cylinder boring.



1. REMOVAL AND INSTALL

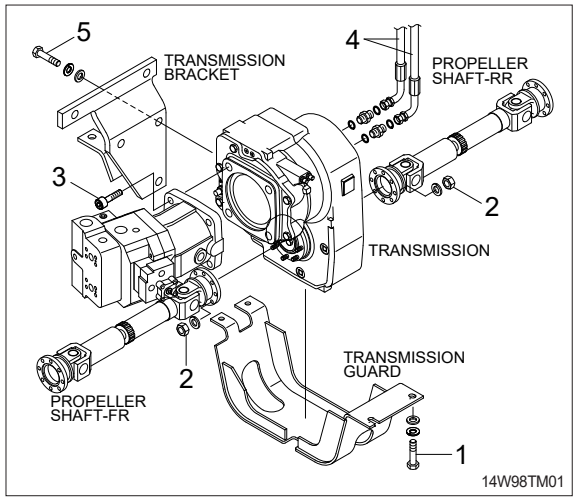
1) REMOVAL

(1) Swing the work equipment 90˚and lower it completely to the ground.
(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.
(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ Escaping fluid under pressure can penetrate the skin causing serious injury.

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove the transmission guard plate mounting bolt (1).
(5) Remove the propeller shaft mounting nuts (2).
· Tightening torque : 5.9±0.6 kgf · m (42.7±4.3 lbf · ft)
(6) Remove the travel motor mounting bolt (3).
· Tightening torque : 29.7±4.5 kgf · m (215±32.5 lbf · ft)
(7) Remove the hoses (4).
Fit blind plugs to the disconnected hoses.
(8) Remove the mounting bolts (5), then remove the transmission device assembly.
· Weight : 140 kg (310 lb)
· Tightening torque : 58.4±6.4 kgf · m (422±46.3 lbf · ft)

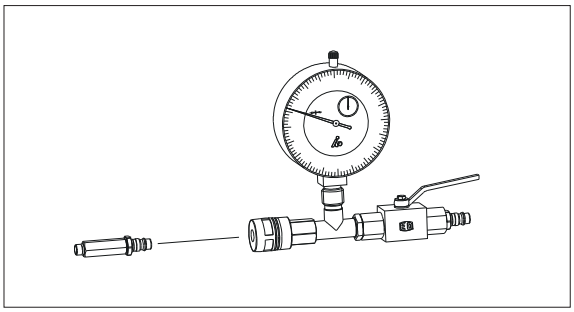


2) INSTALL

(1) Carry out installation in the reverse order to removal.
(2) Bleed the air from the transmission.
① Remove the air vent plug.
② Pour in hydraulic oil until it overflows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling, and check oil come out from plug.
⑤ Tighten plug fully.
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

36) Air connection

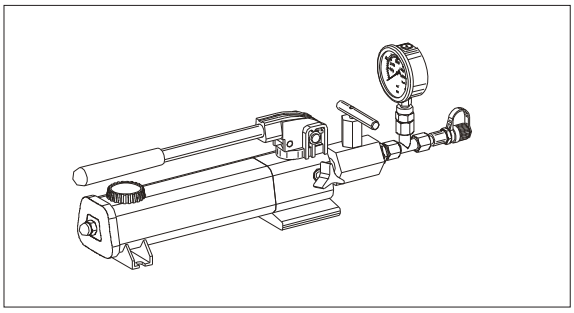
5870 505 012



14WF8TM36

37) HP pump

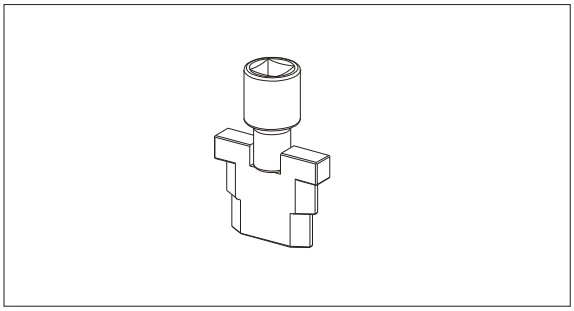
5870 287 007



14WF8TM37

38) Spline mandrel

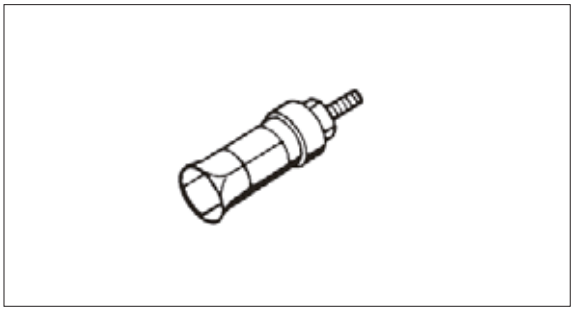
5870 510 039



14WF8TM38

39) Inner extractor

5870 300 012



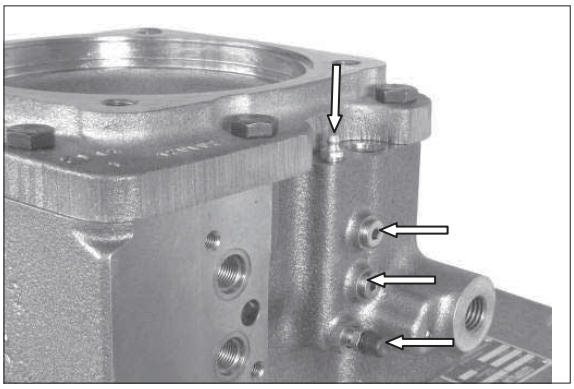
14WF8TM39

40) Counter support

5870 300 011

14WF8TM40

8) Remove lubrication nipple, both screw plugs and breather valve – see arrow.



14WF8TM72

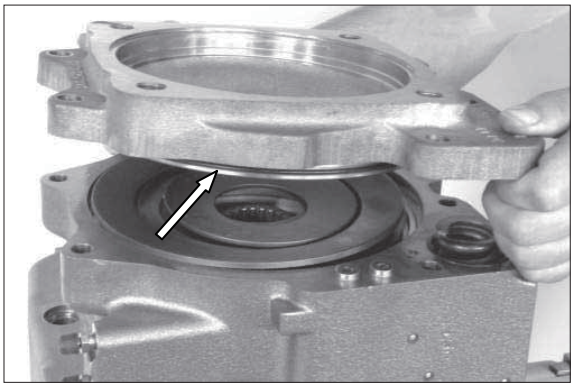
Input housing and modulation valve

9) Loosen threaded joint of input housing evenly.

※ Input housing is subject to cup spring and compression spring preload.

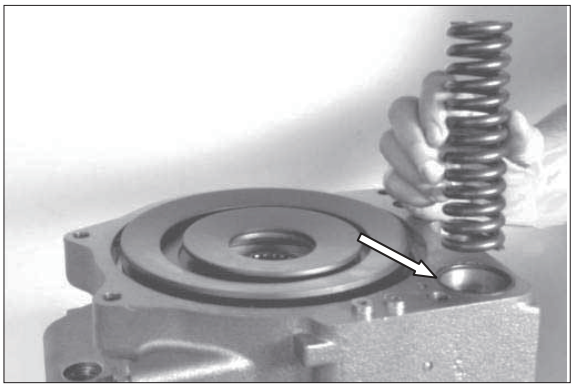
14WF8TM73

10) Take off input housing and remove O-ring (arrow).



14WF8TM74

11) Remove compression spring and O-ring (arrow).



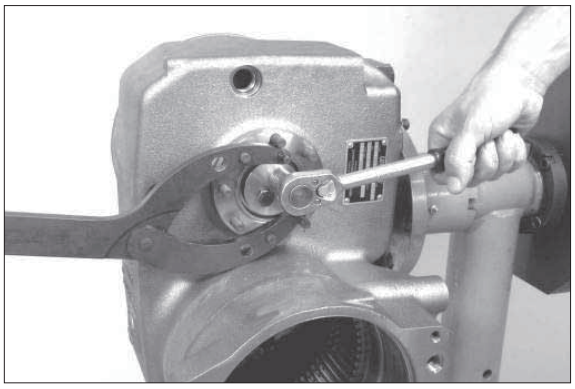
14WF8TM75

7. DISASSEMBLY - OUTPUT

Version "Axle attachment"

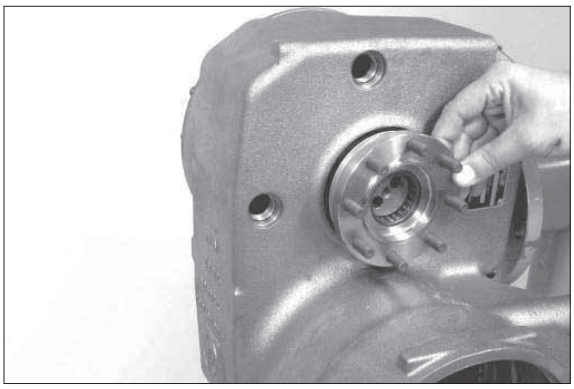
1) Loosen threaded joint, remove cover and O-ring.

※ (S) Clamping fork 5870 240 025



14WF8TM108

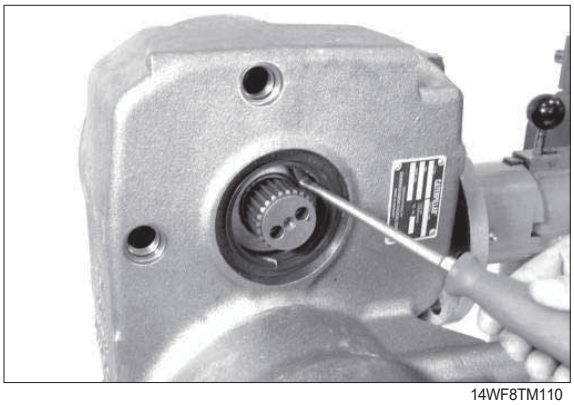
2) Pull off flange.



14WF8TM109

3) Remove shaft seal with a lever.

※ (S) Resetting device 5870 400 001

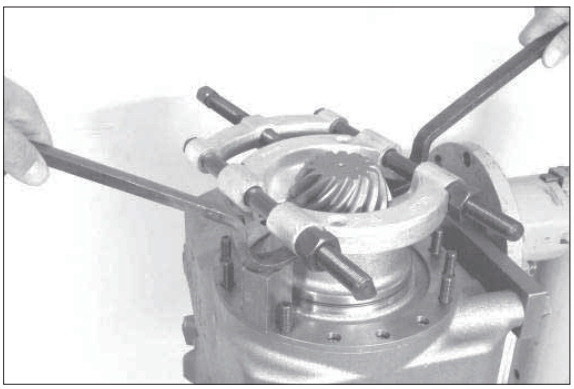


14WF8TM110

4) Fix pinion with fixture and press off.

(S) Cut-off device 5870 300 028
(S) Assembly lever 5870 345 036
(S) Solenoid block 5870 450 003

※ Pay attention to releasing bearing inner ring and adjusting ring (rolling torque/pinion bearing) behind.

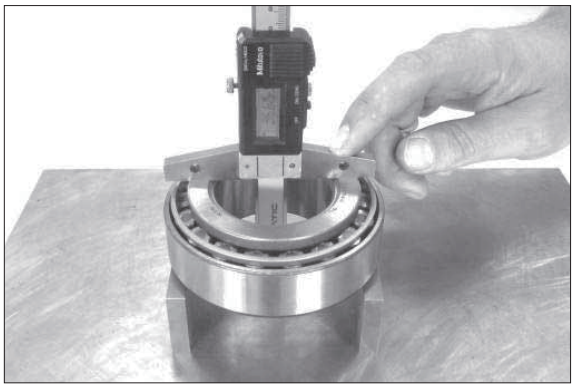


14WF8TM111

12) Determine dim. B bearing width, paying attention that rollers are seated without clearance (roller setting – rotate bearing inner ring in both directions several times).

※ Since installed roller bearing is subject to preload in installation position, deduction of empirical value of – 0.1 mm must be considered.

Dim. B = e.g. 36.65 mm - 0.1 mm → 36.55 mm

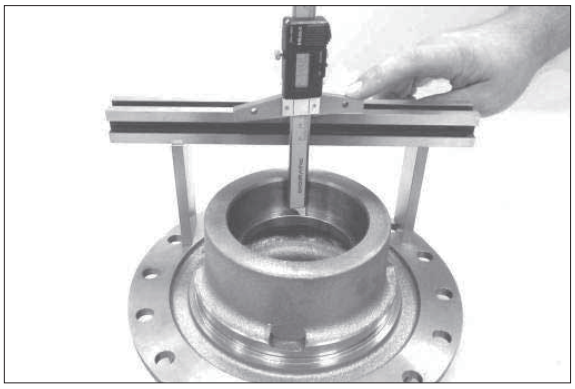


14WF8TM143

13) Determine dim. D (contact surface/bearing cover to contact/bearing hole).

Dim. D = e.g. 35.10 mm

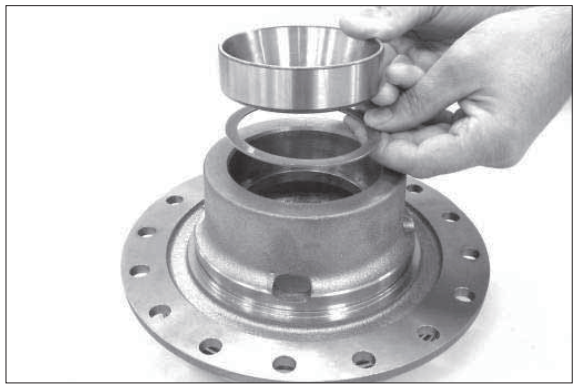
(S) Straightedge (2 sets) 5870 200 066



14WF8TM144

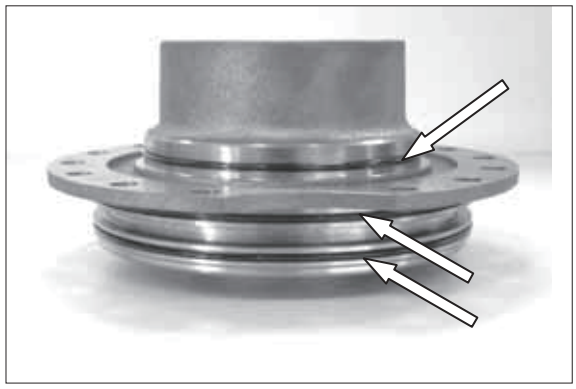
14) Insert determined shim(s) S = e.g. 1.35 mm and install bearing outer ring until contact.

(S) Driver tool 5870 058 078
(S) Handle 5870 260 002



14WF8TM145

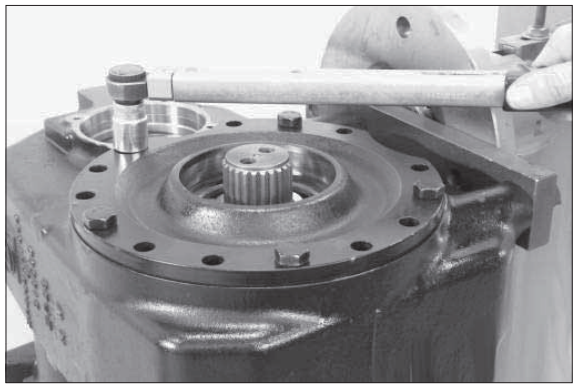
15) Oil O-rings (arrows) and insert them into annular grooves of bearing cover.



14WF8TM146

48) Fix bearing cover by means of hexagon screws.

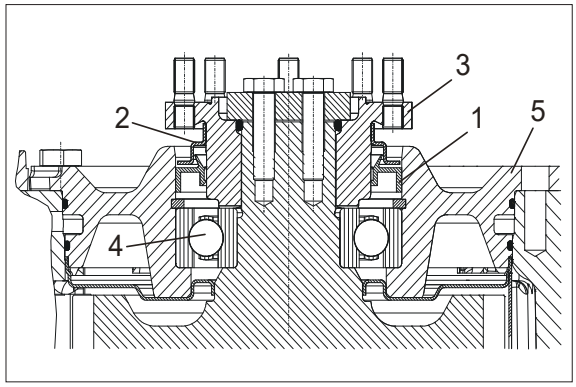
Tightening torque (M 12/8.8) M_A = 80 Nm



14WF8TM181

Shaft seal output flange

49) 1 = Shaft seal
2 = Metal sheet
3 = Output flange
4 = Ball bearing
5 = Bearing cover

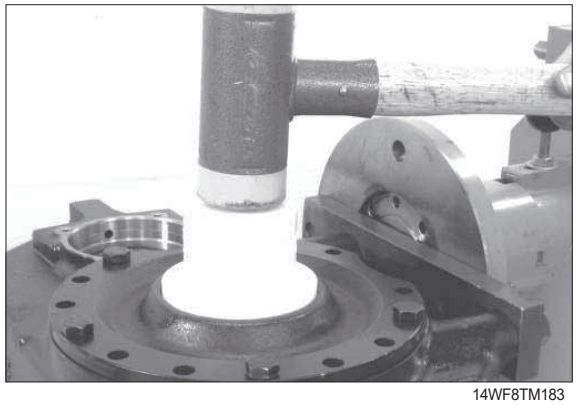


14WF8TM182

50) Install new shaft seal.

(S) Driver tool 5870 048 279

※ For reassembly wet shaft seal on outer diameter with spirit.
※ Pay attention to installation position of shaft seal, seal lip showing to oil sump.
※ Use of specified driver tool ensures exact installation position of shaft seal.

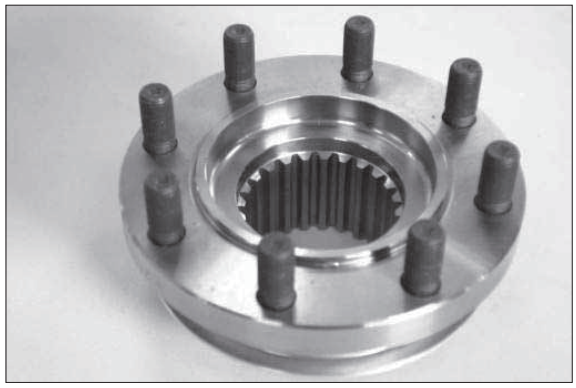


14WF8TM183

51) Install stud bolts.

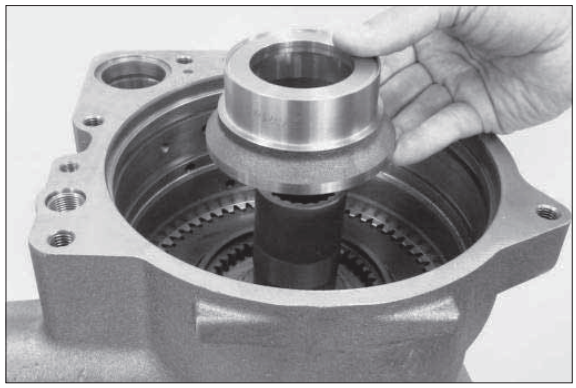
Tightening torque (M10 × 1) M_A = 20 Nm

※ Pay attention to installation position.
Install stud bolts with short thread length into flange.



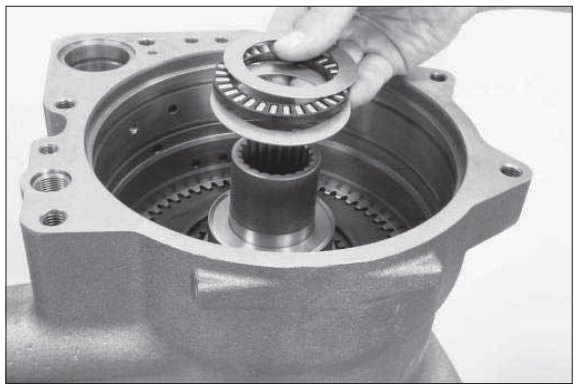
14WF8TM184

29) Mount pressure piece (without compression spring).



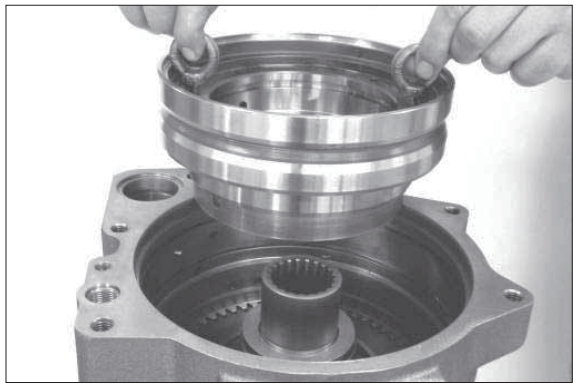
14WF8TM219

30) Oil axial roller cage and mount it with both axial washers (1x each, positioned underneath and onto axial needle cage).



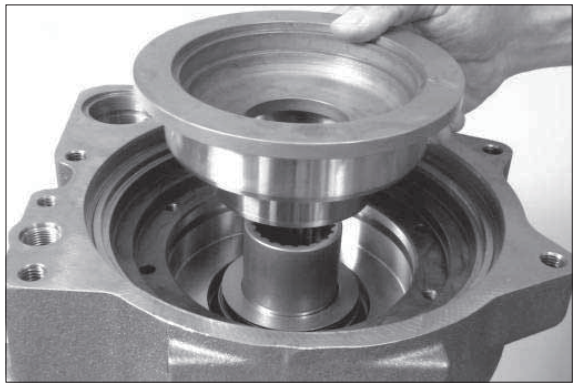
14WF8TM220

31) Insert piston (brake) – without mounted sealing elements.



14WF8TM221

32) Insert piston (clutch) – without mounted sealing elements.



14WF8TM222

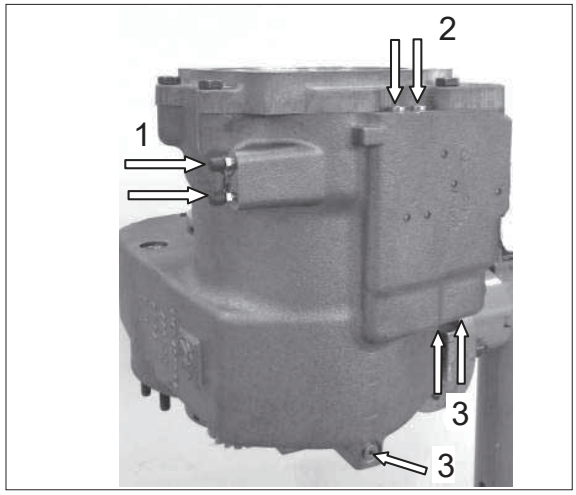
Check emergency release for leak tightness

69) Illustration shows version transmission installation position Vertical.

※ For version transmission installation position Horizontal connections and positions of breather valves/lubrication nipple etc. must be considered as shown on illustration of 14WF8TM261.

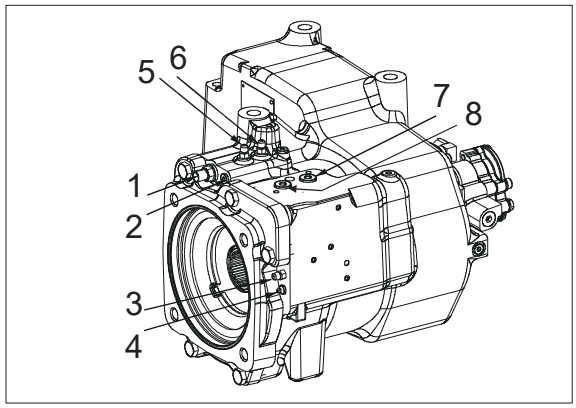
Install both breather valves (1), screw plugs (2) with new seal rings and screw plugs (3) with new O-rings.

Breather valve (M 10×1) M_A = 15 Nm
Screw plug (M 10×1 with seal ring) M_A = 20 Nm
Screw plug (M 10×1 with O-ring) M_A = 20 Nm



14WF8TM260

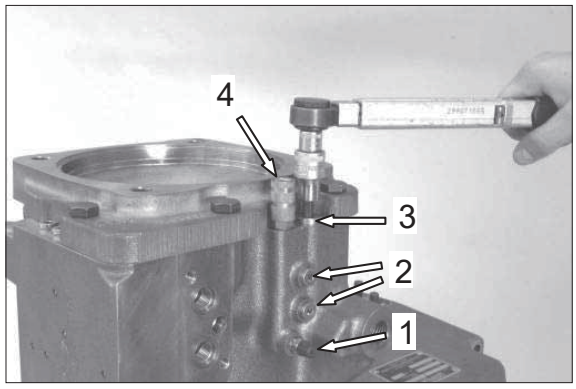
70) 1 = Breather/Pressure relief-valve
(emergency release –parking brake)
2 = Screw plug
3 = Breather valve
(emergency release – parking brake)
4 = Lubrication nipple
(emergency release – parking brake)
5 = Breather valve (multi-disk clutch)
6 = Breather valve (mulit-disk brake)
7 = Pressure oil connection – multi-disk brake
8 = Pressure oil connection – multi-disk clutch



14WF8TM261

71) Install breather valve (1), screw plugs (2), screw plug (3) with new O-ring and compressed air connection piece (4).

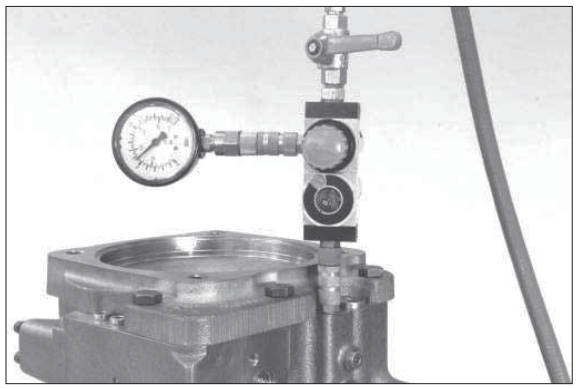
Breather valve (M 10×1) M_A = 15 Nm
Screw plug (M 10×1 with O-ring) M_A = 20 Nm
Screw plug (M 18×1.5 with O-ring) M_A = 35 Nm
Compressed air connect. piece (M 10×1) with seal ring M_A = 20 Nm



14WF8TM262

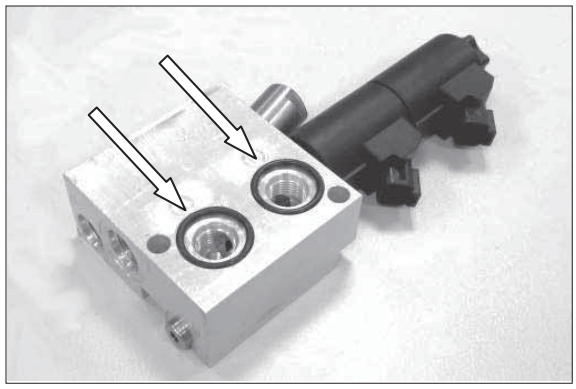
72) Pressurize emergency release with compressed air p = 5 + 1bar and close shut-off valve. During a test duration of 3 minutes no pressure drop is allowed.

(S) Air connection 5870 505 012


14WF8TM263

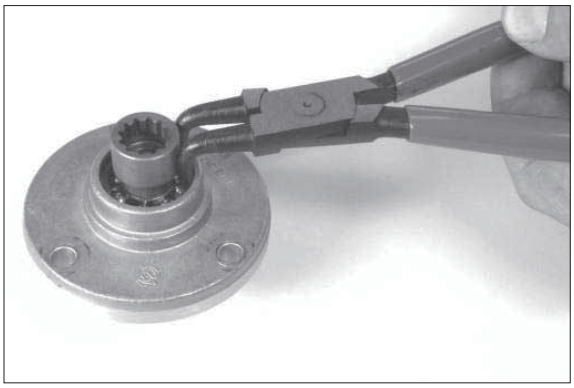
27) Remove both O-rings (see arrows).

※ Do not further disassemble. Valve block may only be replaced as component.



14WF8TM298

13) Press preassembled pump shaft into pump cover and fix it by engaging retaining ring into annular groove of pump cover.

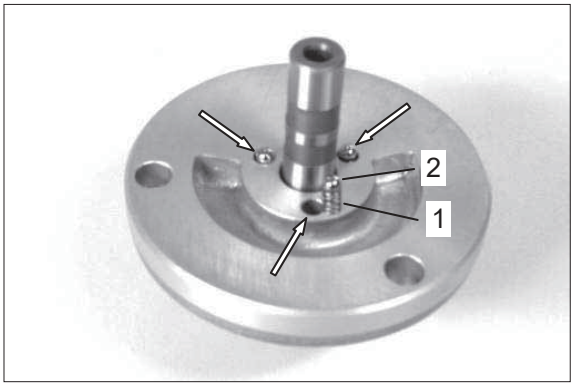


14WF8TM332

14) Insert compression springs (1) and ball (2) into holes (see arrows - 3x).

⚠ **Prior to installation, oil single parts of pump/ rotor set (control housing, inner and outer rotor) – use oil (lubrication)**

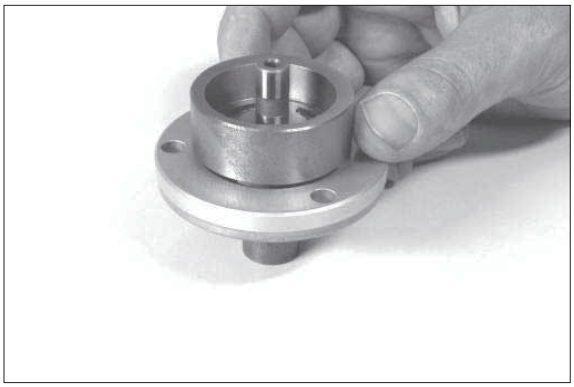
※ Keep preassembled single parts in vertical position – pay attention to position of inserted balls and compression springs (see work steps 14WF8TM333 ~14WF8TM338).



14WF8TM333

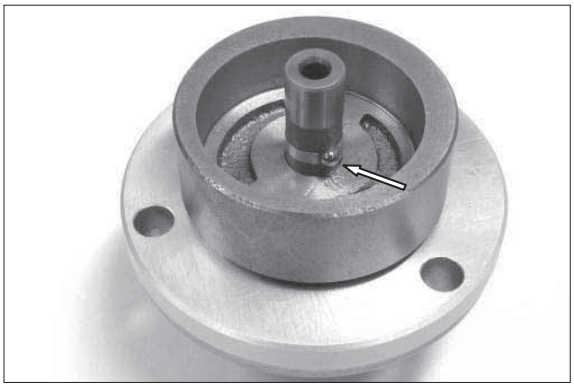
15) Mount control housing.

※ Control housing, inner and outer rotor = rotor set



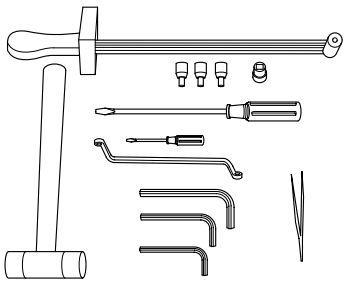
14WF8TM334

16) Position ball – (see arrow –engagement for inner rotor) with grease into countersink of pump shaft



14WF8TM335

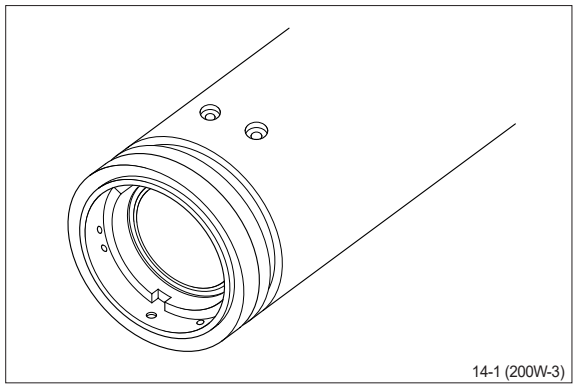
(5) Torque wrench : 0~7.1 kgf · m
(0~54.4 lbf · ft)
13 mm socket spanner.
6, 8 mm and 12 mm hexagon sockets.
12 mm screwdriver.
2 mm screwdriver.
13 mm ring spanner.
6,8 mm and 12 mm hexagon socket spanners.
Plastic hammer.
Tweezers.



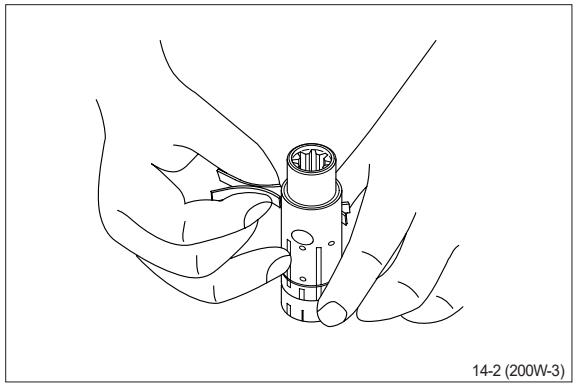
3-3 (200W-3)

5) ASSEMBLY

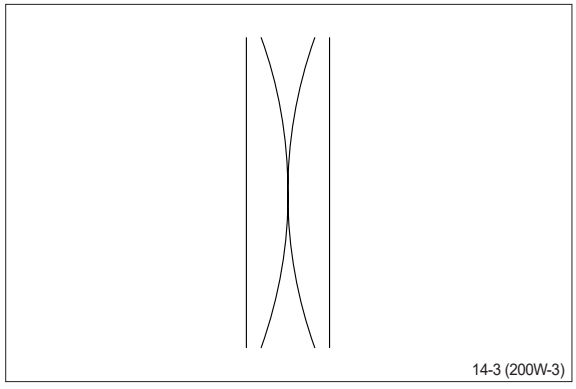
(1) Assemble spool and sleeve.
When assembling spool and sleeve only one of two possible ways of positioning the spring slots is correct. There are three slots in the spool and three holes in the sleeve in the end of the spool / sleeve opposite to the end with spring slots.
Place the slots and holes opposite each other so that parts of the holes in the sleeve are visible through the slots in the spool.


14-1 (200W-3)

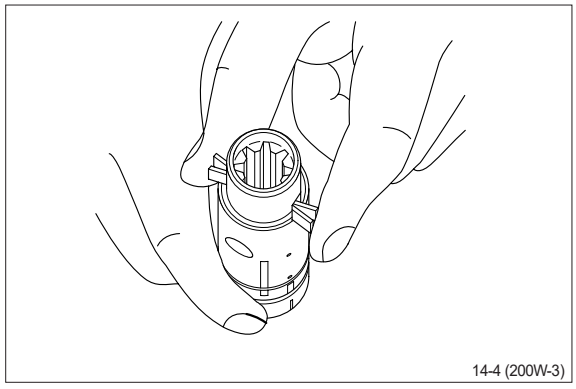
(2) Place the two flat neutral position springs in the slot.
Place the curved springs between the flat ones and press them into place (see assembly pattern).


14-2 (200W-3)

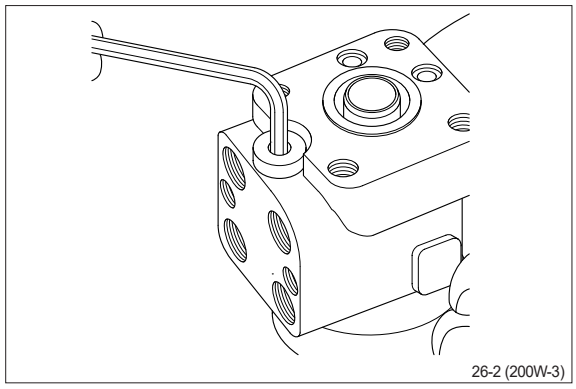
※ Assembly pattern.
· Part no : 150N4035


14-3 (200W-3)

(3) Line up the spring set.

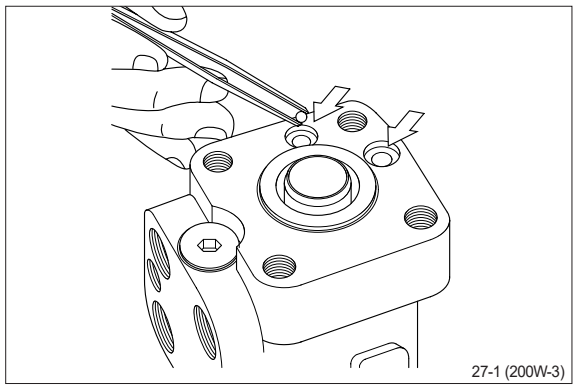

14-4 (200W-3)

(38) Screw plug with dust seal into the housing using an 8㎜ hexagon socket spanner.
・Tightening torque : 5.1±1.0 kgf・m
(36.9±7.2 lbf・ft)

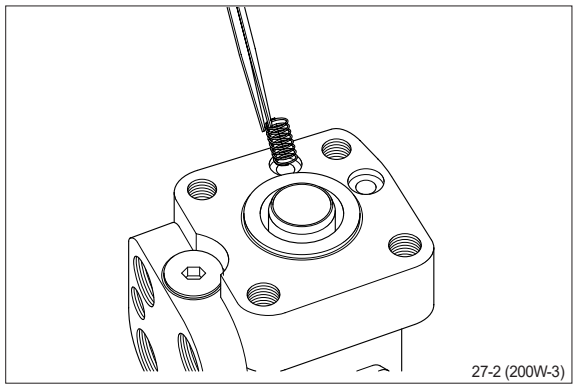

26-2 (200W-3)

Assembly of the dual shock valve

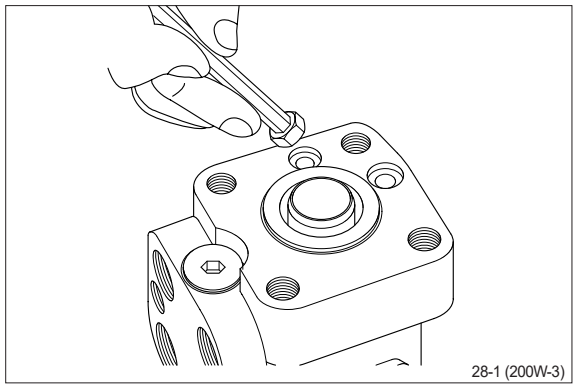
(39) Put a ball in the two holes indicated by the arrows.


27-1 (200W-3)

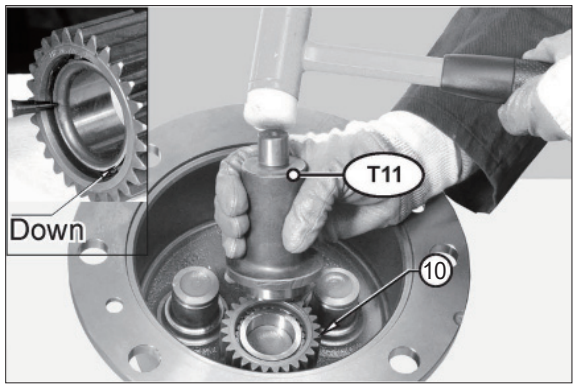
(40) Place springs and valve cones over the two balls.


27-2 (200W-3)

(41) Screw in the two setting screws using a 6㎜ hexagon socket spanner. Make the pressure setting on a panel or the machine.

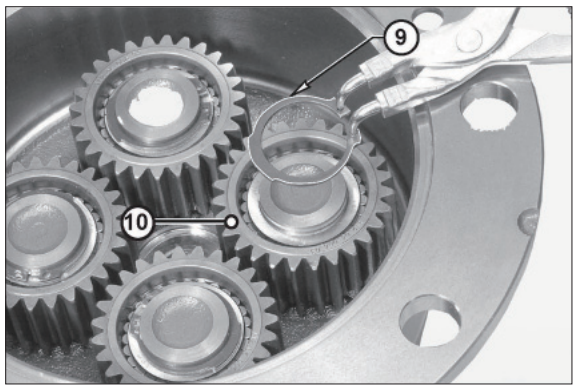

28-1 (200W-3)

(4) With the help of tool T11, insert the planet wheel gears (10) into the cover (4). Accurately check the orientation.



14W98FA025

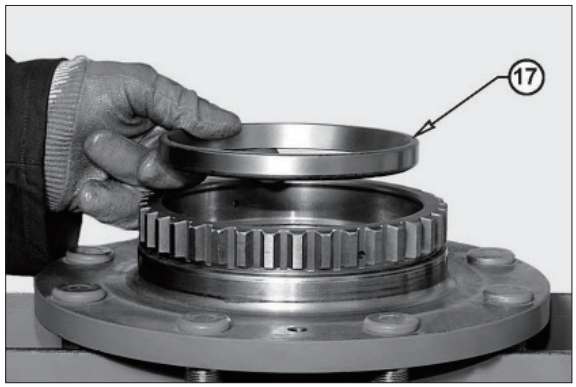
(5) Lock the gears (10) into position by fitting the snap rings (9).



14W98FA026

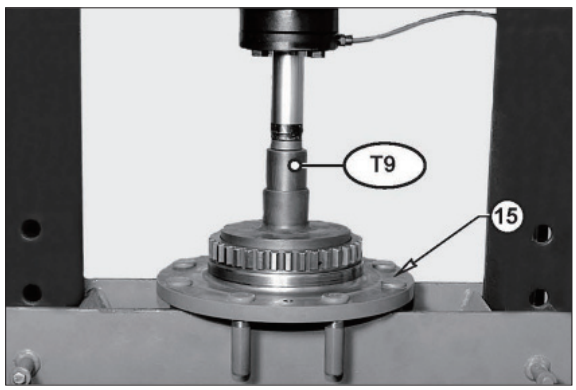
(6) Position the thrust block of the internal bearing (17).

※ Check that the thrust block is correctly oriented.



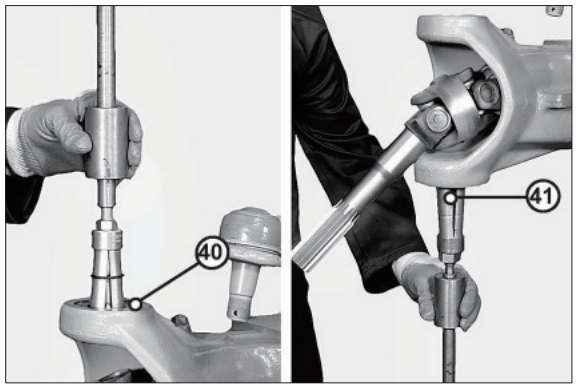
14W98FA027

(7) Position the upper part of tool T9 and press the thrust block into the hub (15) all the way down.



14W98FA028

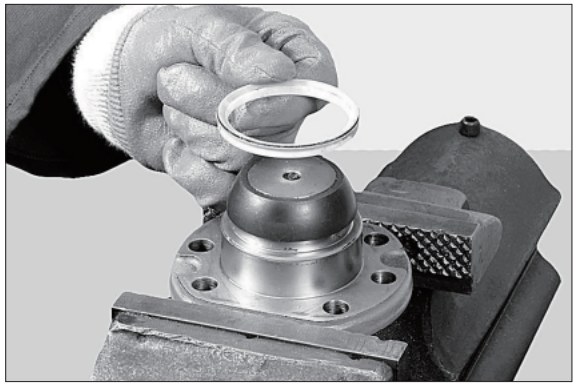
(17) Using a puller for inner parts, remove the top bush (40) and the bottom ball-bush (41).



14W98FA063

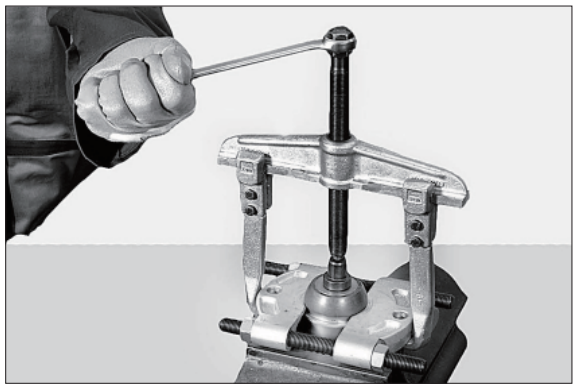
(18) Remove the articulation pins (41) and the front sealing rings (43).

※ Note down the side for assembly.

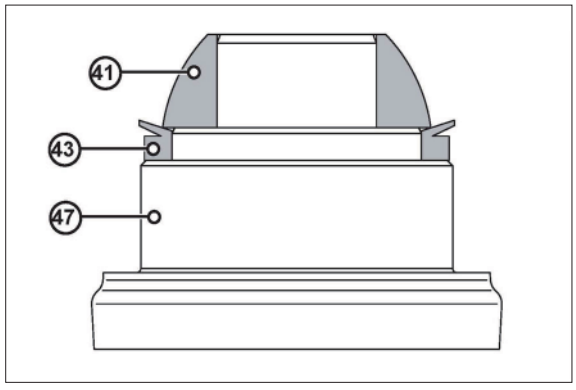


14W98FA064

(19) If the ball cover needs replacing, remove it from the bottom articulation pin.

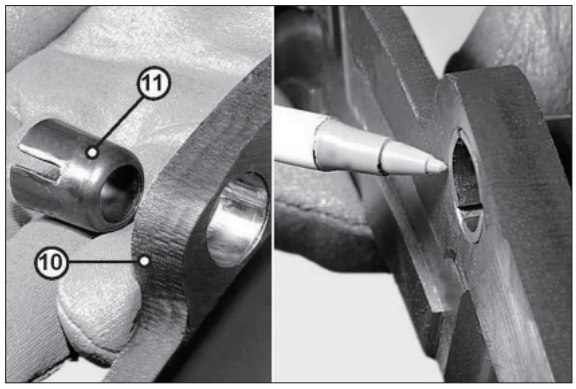


14W98FA065



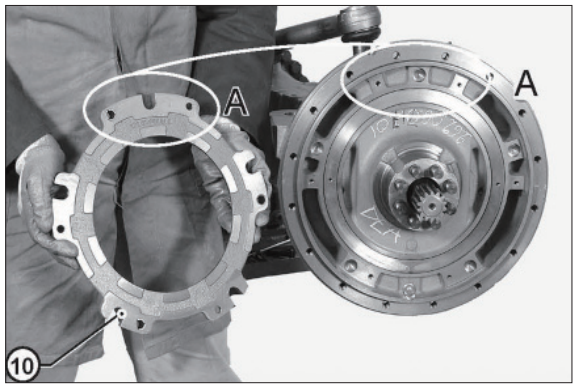
14W98FA066

(14) Before installing the intermediate disk, insert the stroke automatic regulation springs (11) ; place them in line with the intermediate disk (10).



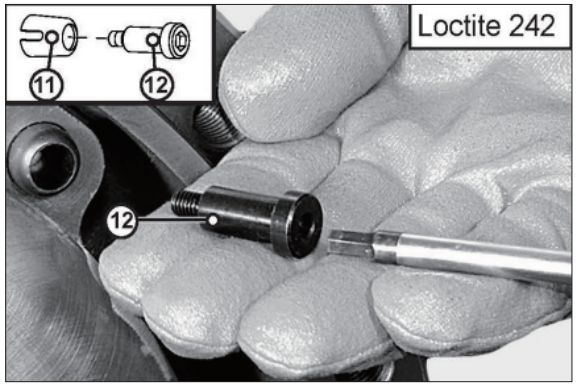
14W98FA101

(15) Install the intermediate disk (10) with the sign position (A).



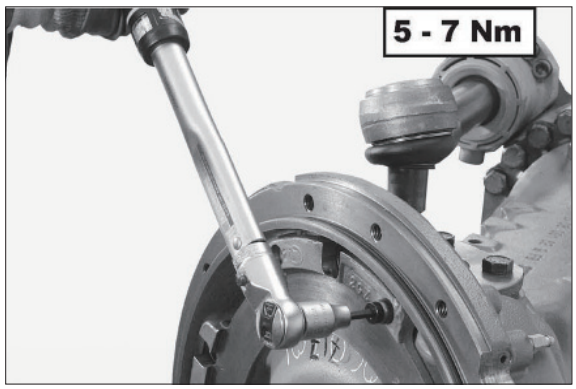
14W98FA102

(16) Apply loctite 270 to the thread, fit the pin screws (12).



14W98FA103

(17) Use a torque wrench setting of 5~7 Nm.

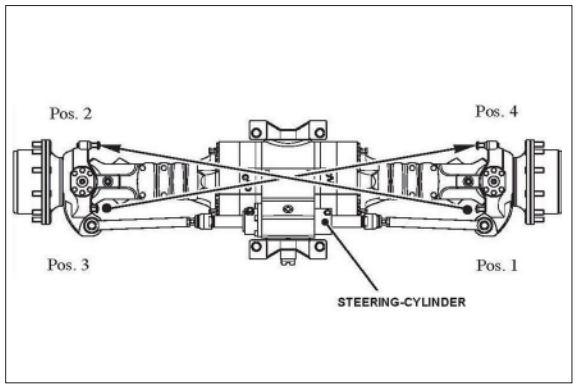


14W98FA104

(16) ADJUSTMENT THE STEERING ANGLE

※ Form the same operations on both sides see diagram.

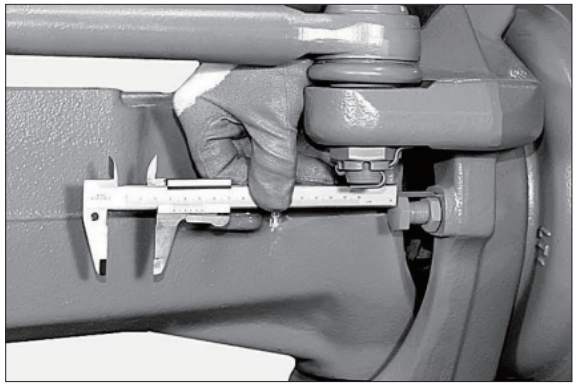
① Loosen the nut of one of the adjusting screw on cylinder side.



14W98FA138

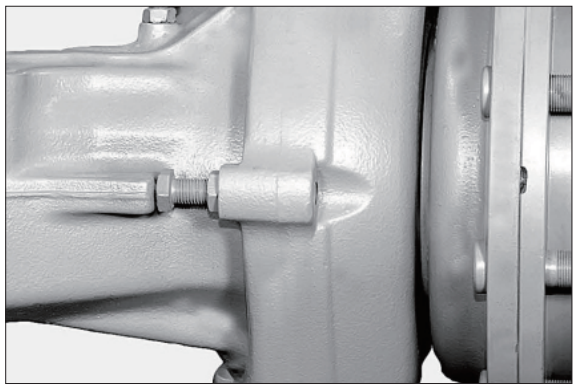
② Adjust the jutting portion of the screw according to data shown in the table.
Lock into the position with nut tightening to max 148 Nm.

Steering angle	43°	45°	35°	55°	40°	40°
Distance (mm)	58.5	53.5	51.6	23.8	36.6	38.2



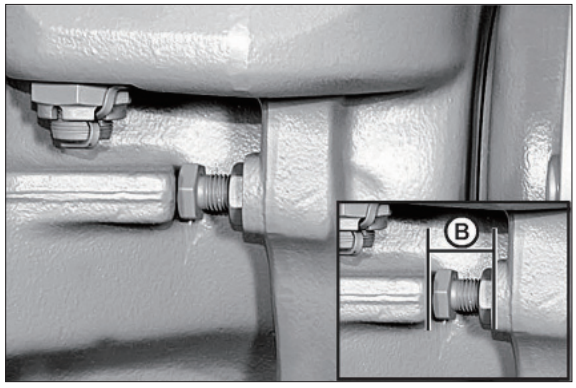
14W98FA139

③ Perform one full steering operation until the adjusted screw leans against the arm stop.



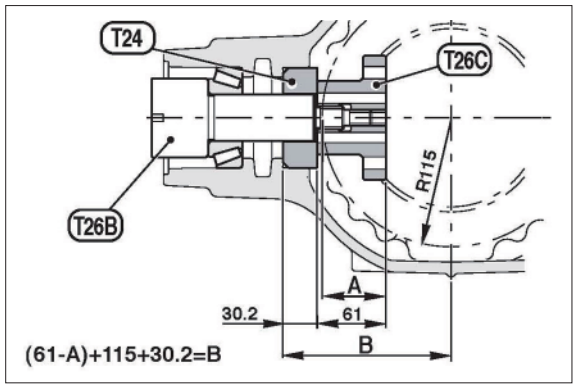
14W98FA140

④ Adjust the jutting portion.



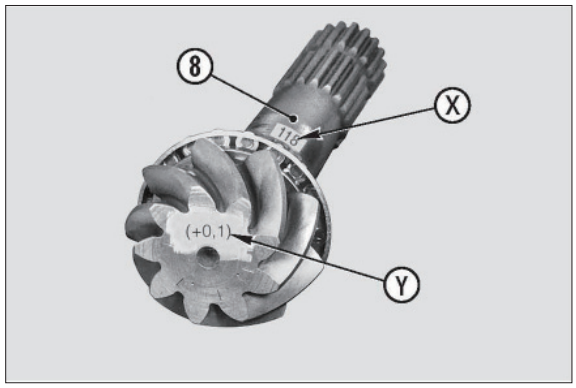
14W98FA141

(9) Calculate size "B" which will be the first useful value for calculating the size of the shims (14) that are to be inserted under the thrust block of the internal bearing (9).



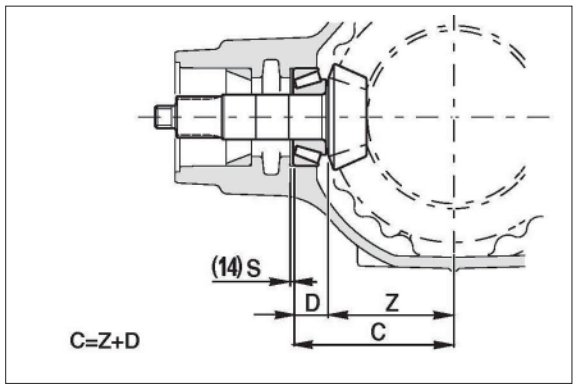
14W98FA179

(10) Check the nominal size (X) marked on the pinion and add or subtract the indicated variation (Y) so as to obtain size "Z".
e.g. : Z =118 + 0.1 = 118.1
Z = 118 - 0.2 = 117.8



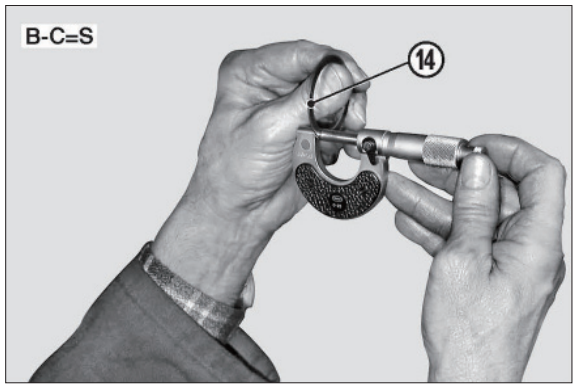
14W98FA180

(11) Calculate size "C" which represents the second value for calculating the size of the shims "S" that are to be placed under the thrust block of the internal bearing (9).



14W98FA181

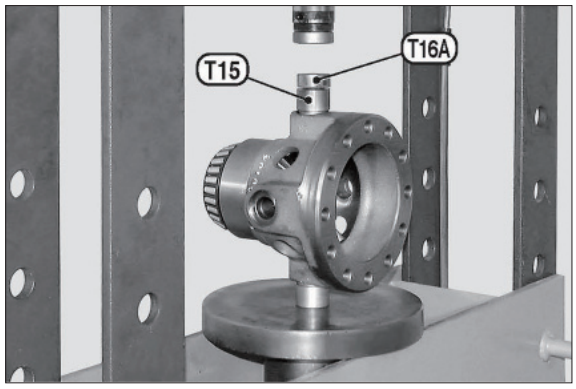
(12) Calculate the difference between sizes "B" and "C" so as to obtain the size "S" of the shim (14) that will go under the thrust block of the internal bearing (9).



14W98FA182

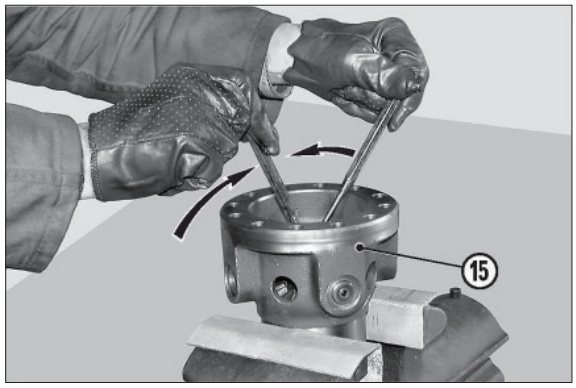
(17) Remove gudgeon T16A and bush T15.

※ In this condition the tool T14 contains pin (17)



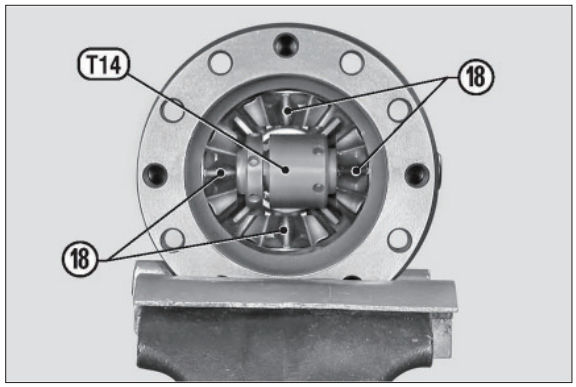
14W98FA218

(18) Remove tool T14 together with the pin (17) of the planet wheel.



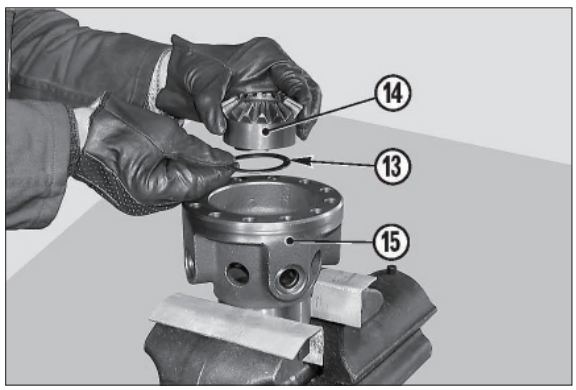
14W98FA219

(19) Leave the released planetary gear in position and again lock tool T14.
Repeat the operations for the extraction of the 2nd planet wheel (17).
Repeat the operations for all other pins.



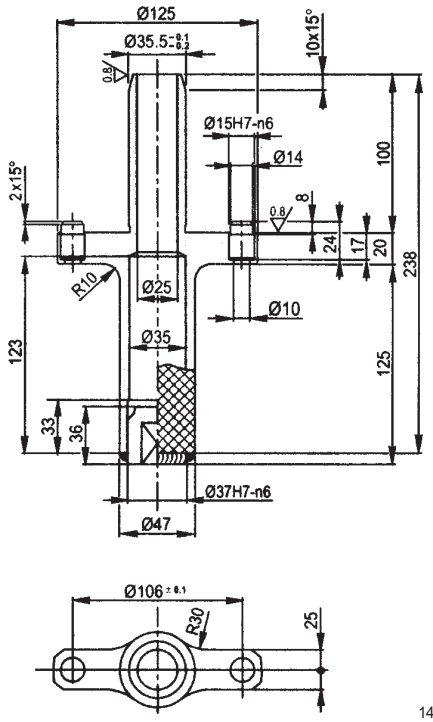
14W98FA220

(20) Remove tool T14 and remove the last two planet wheel gears (18), the 2nd differential unit gear (14) and the relative shim washer (13) from the differential carrier.



14W98FA221

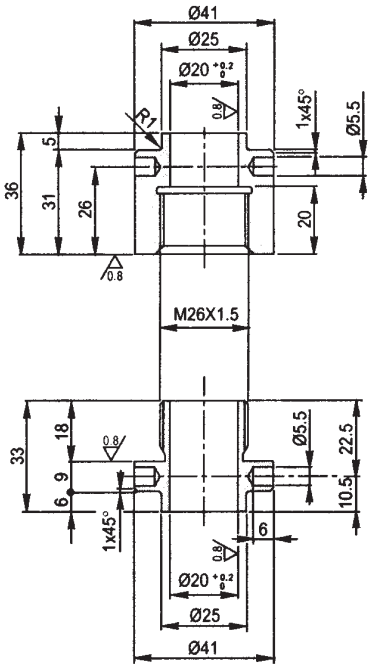
T13



3333

14W7FA264

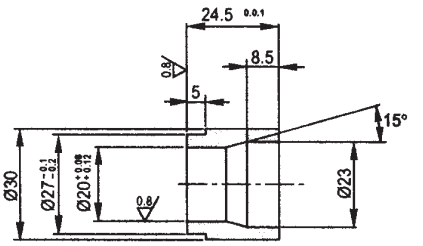
T14



3708

14W7FA265

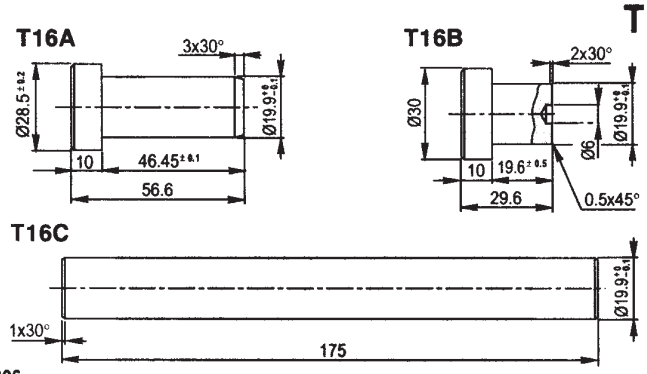
T15



3424

14W7FA266

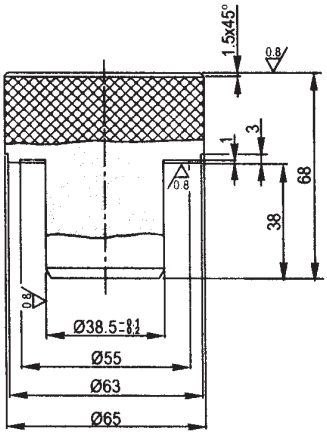
T16



2306

14W7FA267

T17

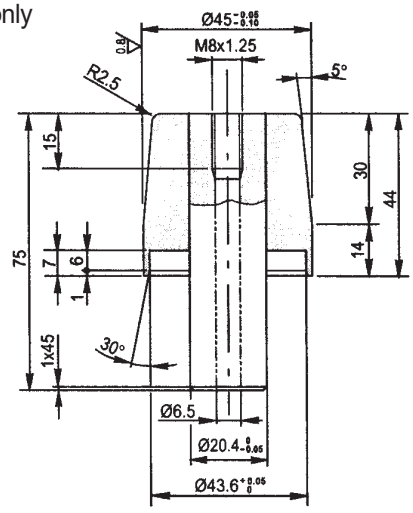


3332

14W7FA268

T18

Front only



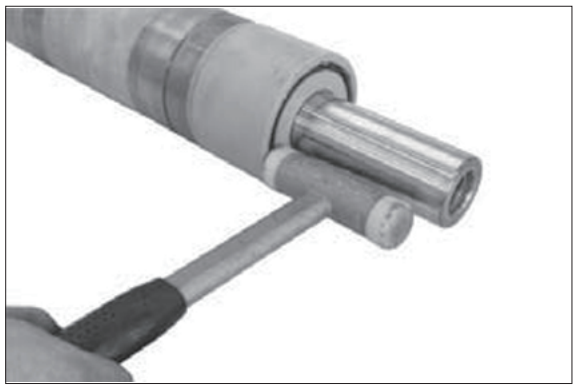
2724

14W7FA269

(9) Unsnap retaining ring.

17W98FA009

(10) Push/force the brake head into the cylinder tube, until the retaining ring (see figure FA011) can be removed.



17W98FA010

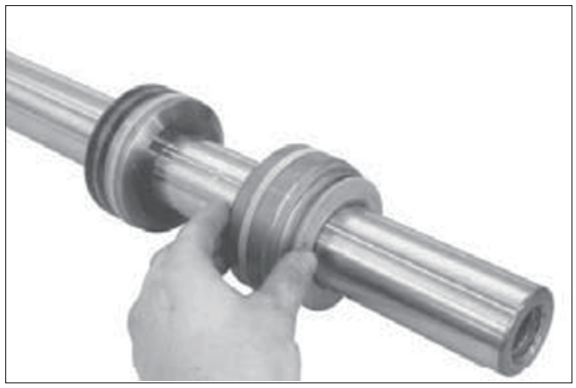
(11) Unsnap retaining ring.

Then drive out piston rod together with brake head from cylinder tube.

17W98FA011

(12) Pull off brake head from the piston rod.

Then remove all sealing elements from piston rod, brake head and cylinder tube.



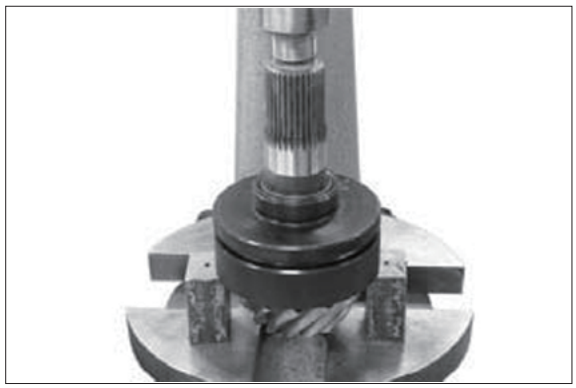
17W98FA012

(9) Remove spacer ring.

17W98FA049

(10) Press roller bearing from input pinion.

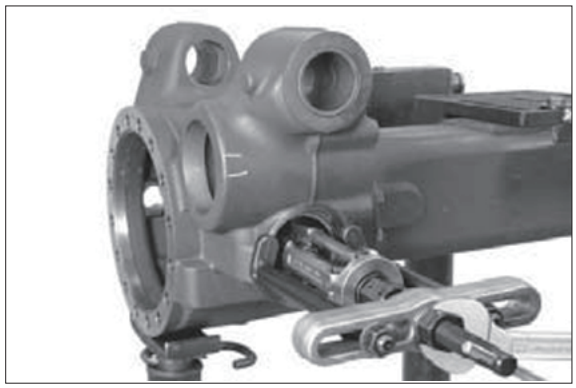
(S) Grab sleeve 5873 001 037



17W98FA050

(11) Pull off outer bearing outer ring from bearing hole.

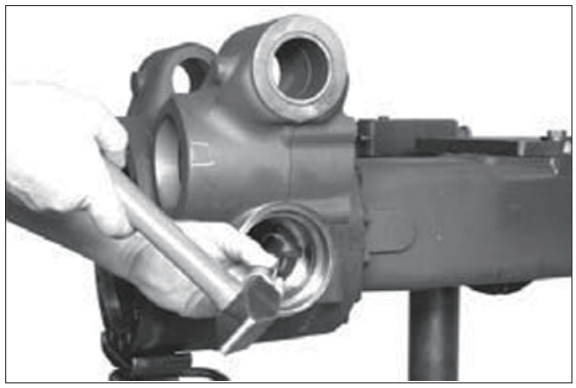
(S) Internal extractor 5870 300 019
(S) Counter support 5870 300 020



17W98FA051

(12) Force out bearing outer ring from the inner bearing hole pay attention to the shim behind.

※ Mark shim (with regard to position/bearing allocation) assembly aid.



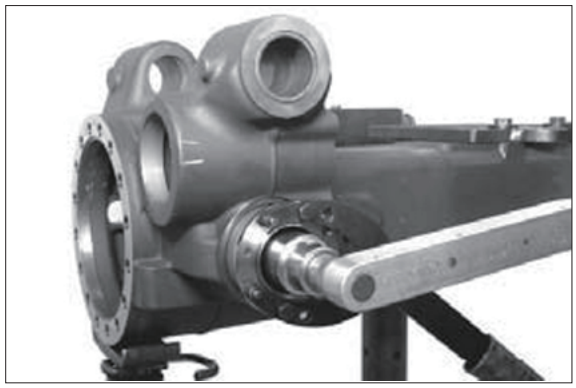
17W98FA052

(12) Mount input flange, fix with disk and hexagon nut.

Tightening torque (M30x1,5) . . . . . MA = 600 Nm

(S) Clamping fork 5870 240 025

※ During the tightening process rotate the input pinion several times in both directions.



17W98FA087

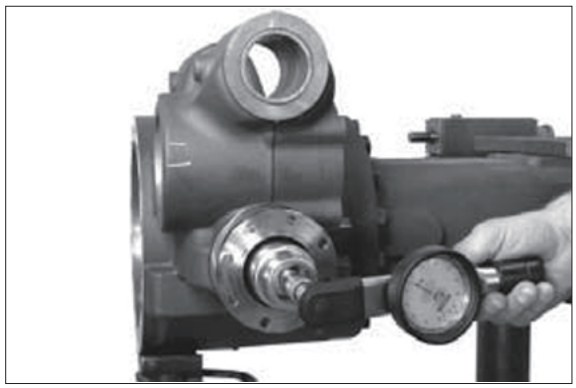
(13) Check rolling torque (1.0 ... 3.0 Nm without shaft seal ring).

※ When installing new bearings try to achieve the upper value of the rolling torque.

※ In case of deviations from the necessary rolling torque correct with a corresponding spacer ring (Figure FA084) as specified below.

Insufficient rolling torque
install thinner spacer ring

Excessive rolling torque
install thicker spacer ring.

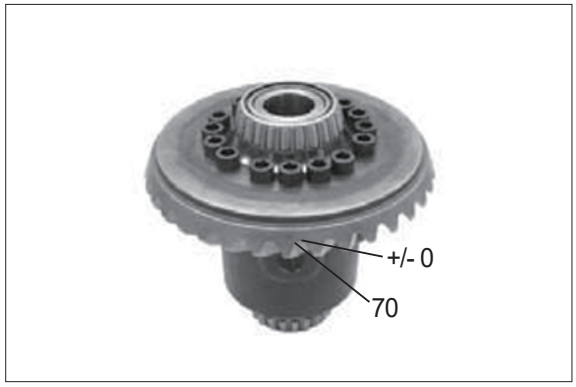


17W98FA088

(14) Determine shim for setting the bearing rolling torque (differential bearing) and backlash (bevel gear set).

※ The required shims must be determined on the basis of the read value (test dimension / crown wheel) and the corresponding specifications of the table next page : (KRS – SET – RIGHT) :
Read test dimension from crown wheel rear.

※ Test dimension "70" is stamped into the crown wheel rear. Without + or deviation specification, this corresponds to test dimension / Actual value "70" in the table below.
According to this value the necessary shims are allocated in the table next page.

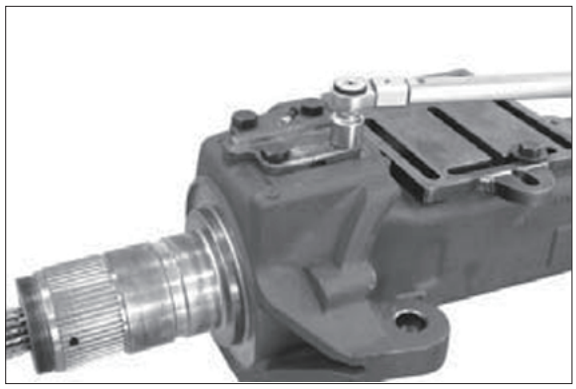


17W98FA089

(18) Fix both bearing pins definitely.

※ Tightening torque (M 16 / 10.9T) . .. . MA = 280 Nm

※ Use of new locking screw is imperative.



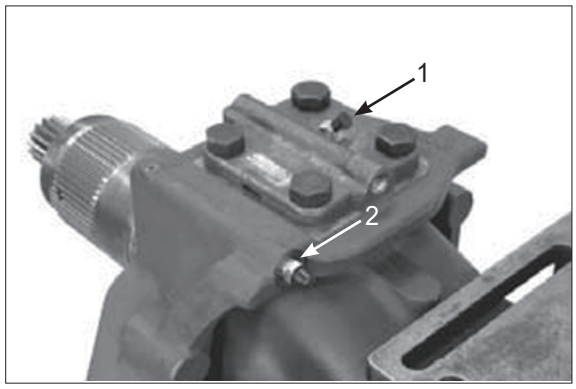
17W98FA120

(19) Mount lubrication nipple in both bearing pins (arrow 1 showing to the axle centre) and apply grease to the pivot bearing.

Tightening torque (M 10 × 1.0) . . . . . MA = 3 Nm

Mount breather valve (arrow 2, position depending on version : integrated in the knuckle housing or in the bearing lid) and provide with dust cap.

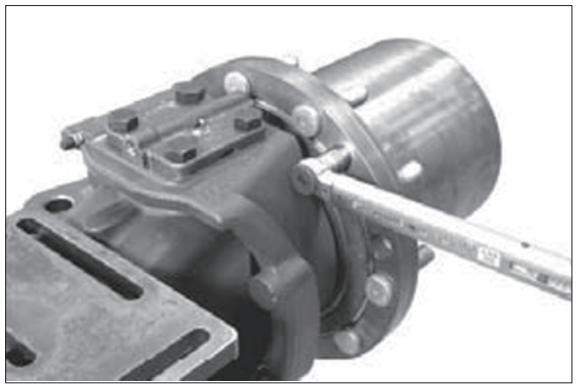
Tightening torque (M 14 × 1.5) . . . . . MA = 20Nm



17W98FA121

(5) Install preassembled planetary carrier and fix with hexagon screws.

Tightening torque (M12/8.8) . . . . . MA = 55 Nm



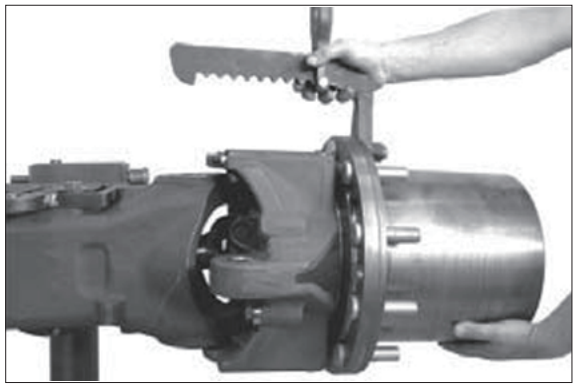
17W98FA155

(6) Output assy

Locate output assy on the axle by means of the lifting bracket (S) by installing the u-joint shaft in the axle bevel gear toothing.

(S) Lifting bracket 5870 281 043

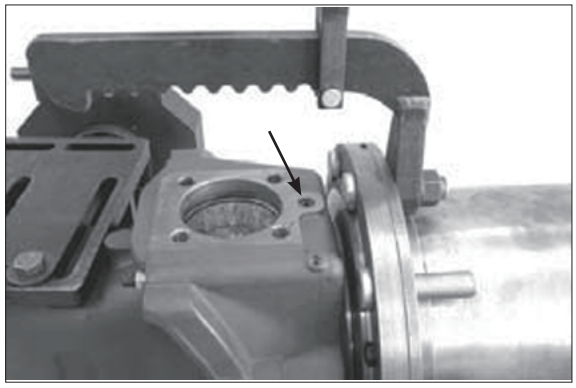
※ Pay attention to shaft seal ring in the axle housing risk of damage.



17W98FA156

(7) Insert O-ring (see arrow) or O-rings into the countersink (s) of the knuckle housing.

1 pc for version with breather valve in knuckle housing.
2 pcs. for version with breather valve in bearing pin.



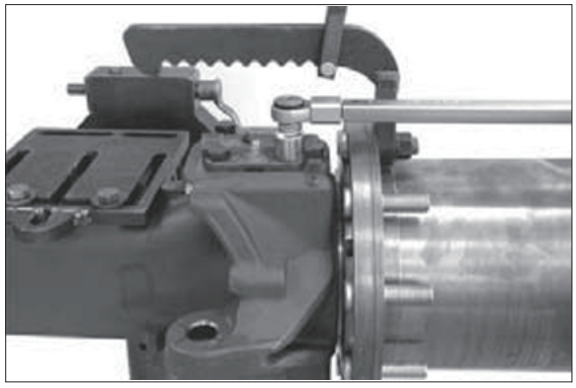
17W98FA157

(8) Mount both bearing pins and fix with hexagon screws or locking screws.

Tightening torque (M16/10.9T) . . . . . MA = 280 Nm

※ Observe installation position, mount upper bearing pin with oil supply holes showing to axle centre.

※ Use of new locking screw is imperative.



17W98FA158

2. GENERAL INSTRUCTIONS

1) GENERAL WORKING INSTRUCTIONS

(1) This manual has been developed for the skilled serviceman, trained by the ZF-Passau.

(2) During all operations, pay attention to cleanliness and skilled working.
Therefore, axle removed from the machine, must be cleaned prior to open them.

(3) We assume that the special tools, specified by ZF, will be used.
The special tools are available from ZF-Passau.

(4) After the disassembly, all components must be cleansed, especially corners, cavities and recesses of housing and covers.

(5) The old sealing compound must be carefully removed.

(6) Check lubricating holes, grooves and pipes for free passage. They must be free of residues, foreign material or protective compounds.

(7) The latter refers especially to new parts.

(8) Parts which have been inevitably damaged in a disassembly operation, must be generally replaced by new ones, e.g. rotary seal rings, O-rings, U-section rings, cap boots, protective caps etc..

(9) Components such as roller bearings, thrust washers, synchronizing parts etc. which are subject to normal wear in automotive operation, must be checked by the skilled Serviceman.
He will decide if the parts can be reused.

(10) For the heating of bearings etc., hot plates, rod heaters or heating furnaces must be used.

(11) Never heat parts directly with the flame. An auxiliary solution would be to immerse the bearing in a vessel filled with oil, which is then heated with the flame.
In this way, damage to the bearings could be avoided.

(12) Ball bearings, covers, flanges and parts like that must be heated to about 90 to 100°C.

(13) Hot-mounted parts must be reset after cooling in order to assure a proper contact.

(14) Before pressing shafts, bearings etc. in position, both parts must be lubricated.

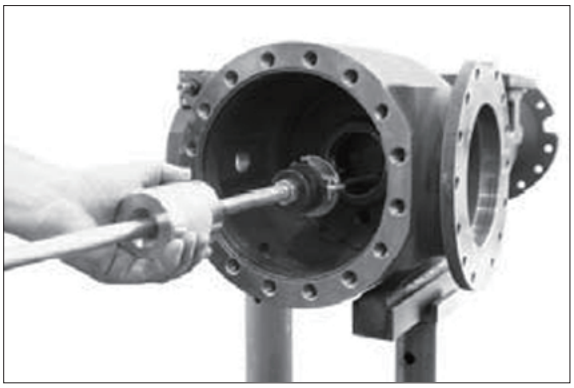
(15) During to reassembly, all specified adjustment values, testing specifications and tightening torque must be respected.

(16) After the repair, units are filled up with oil.

(17) After the oil filling, the oil level plugs and oil drain plugs must be tightened to the specified tightening torque.

(7) Use striker (S) to pull bearing outer ring out of the bearing hole (axle housing) and remove the releasing shim.

(S) Striker 5870 650 004

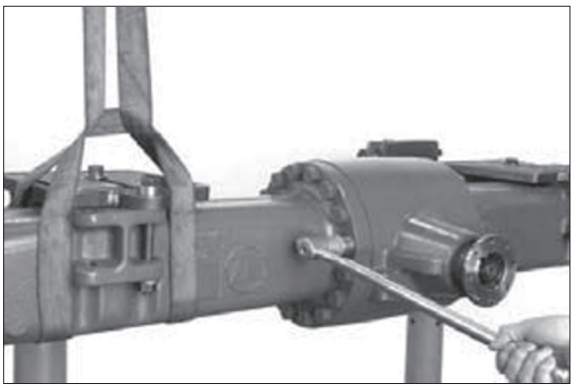


17W98RA029

(8) Secure axle housing (on crown wheel side, part II) by means of lifting tackle and loosen threaded joint.

Then separate axle housing (part II) from the axle drive housing.

※ Pay attention that the differential does not drop.

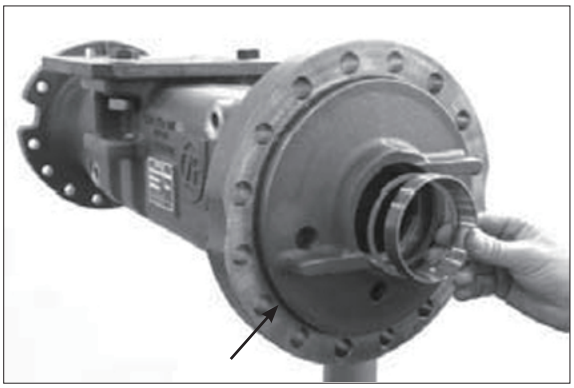


17W98RA030

(9) Pull bearing outer ring out of the bearing hole and remove the releasing shim.

Then remove O-ring (see arrow).

(S) Striker 5870 650 004

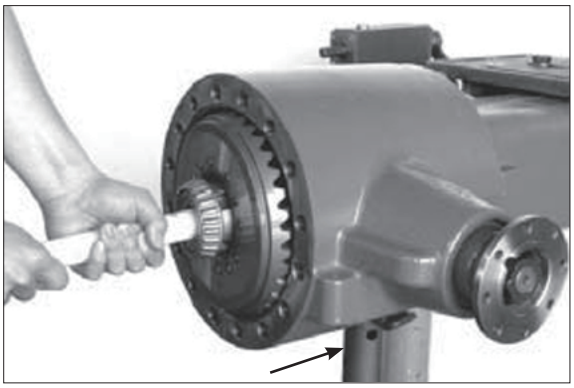


17W98RA031

(10) Support axle at the axle drive housing (see arrow).

Then lift differential out of the axle drive housing.

※ Disassembly of the differential see description on page 8-241 and following.

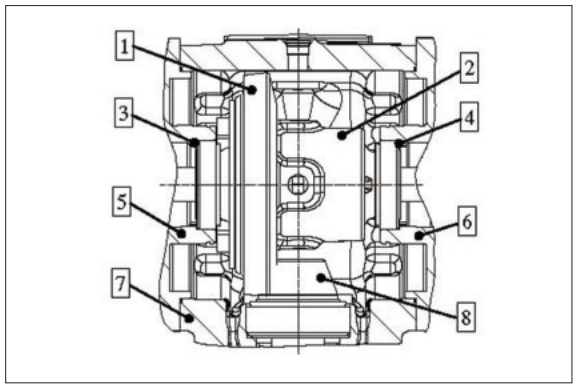


17W98RA032

(2) Test dimension see crown wheel rear side.

※ The test dimension "70" is stamped into the crown wheel rear side. If no + or deviation is indicated, this value corresponds with the test dimension/ actual value "70" in the table below. According to this value, the required shims are allocated in the table below.

Any + or - deviation of the test dimension caused by production is also marked on the crown wheel rear side (e.g. 20 or – 10 / 10 or 20) . In accordance with this deviation, the required shims are allocated in the table below.



17W98RA066

· Legend to sketch:

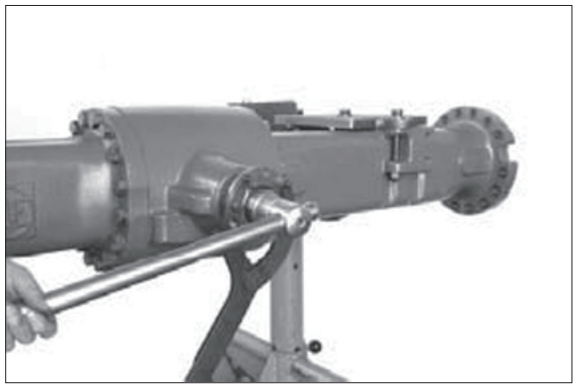
1 = Crown wheel
2 = Differential carrier
3 = Shim (crown wheel side)
4 = Shim (diff. carrier side)
5 = Axle housing
6 = Axle housing
7 = Axle drive housing
8 = Input pinion

Setting disks for differential					
Test dimension/crown wheel marking 70 and deviation	-20	-10	0	10	20
results in→test dim. / actual value	69.80	69.90	70.0	70.10	70.20
Shim/ diff. carrier side Required shim thickness	0.95	1.05	1.15	1.25	1.35
Shim No.	0730 006 518	0730 006 519	0730 006 521	0730 006 522	0730 006 524
Shim/crown wheel side Required shim thickness	1.35	1.25	1.15	1.05	0.95
Shim No.	0730 006 524	0730 006 522	0730 006 521	0730 006 519	0730 006 518

(23) Fitting of shaft seal ring (input flange)

Loosen hexagon nut and pull input flange off the input pinion.

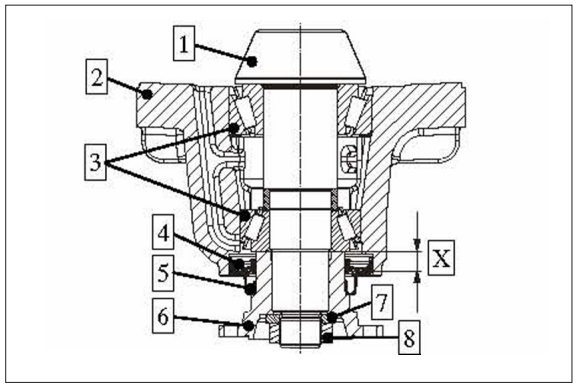
(S) Clamping fork 5870 240 025



17W98RA099

(24) Legend to sketch:

1 = Input pinion
2 = Axle drive housing
3 = Tapered roller bearing
4 = Shaft seal ring
5 = Screen sheet
6 = Input flange
7 = Washer
8 = Hexagon nut
X = Installation dimension → 13.5 +0. 2 mm



17W98RA100

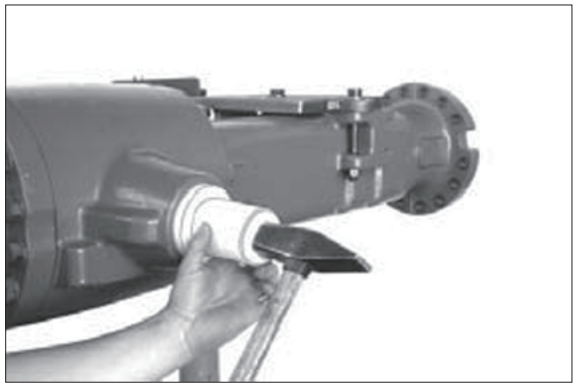
(25) Mount shaft seal ring with the sealing lip facing the oil chamber.

(S) Driver tool 5870 048 286

※ Use of the specified driver tool (S) ensures the exact installation position of the shaft seal ring.

※ Just before fitting, apply lubricant to the contact face of shaft seal ring/axle drive housing.

Apply grease to seal and dust lip of the shaft seal ring.



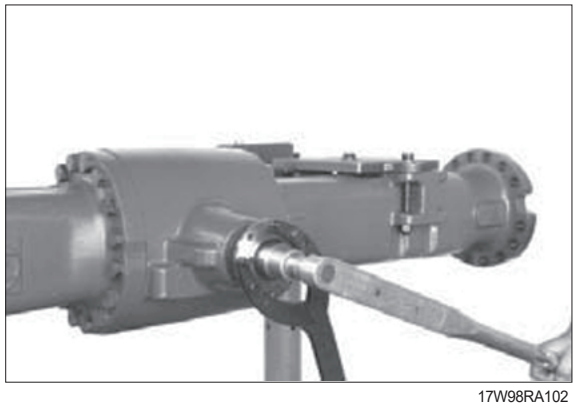
17W98RA101

(26) Mount input flange and finally fix it with washer and hexagon nut.

Tightening torque (M30x1.5) . . . . . MA = 600 Nm

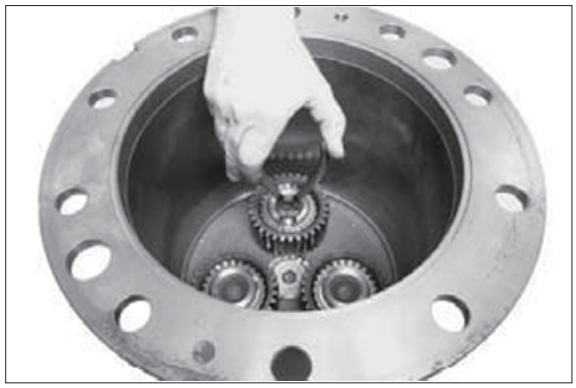
(S) Clamping fork 5870 240 025

※ Wet thread of hexagon nut with Loctite no. 262.



17W98RA102

(34) Fix planetary gear by means of retaining ring.



17W98RA136

(35) Mount preassembled planetary carrier and fix it with hexagon screws.

Tightening torque (M12/8.8) . . . . . MA = 55 Nm

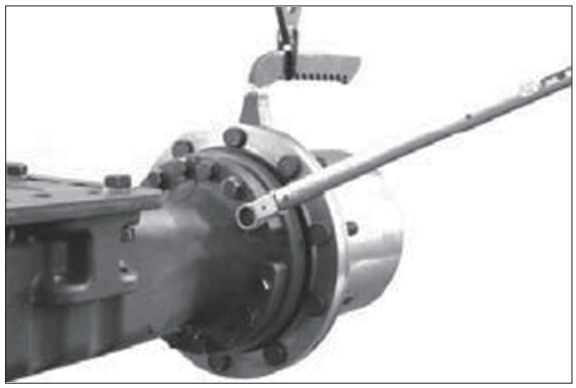
17W98RA137

(36) Output assy

Use lifting tackle (S) to locate the output assy at the axle, mount stub shaft into the teeth of the axle bevel gear and fix output assy with hexagon screws.

Tightening torque (M 16/10.9) . . . . . MA = 280 Nm

(S) Lifting bracket 5870 281 043



17W98RA138

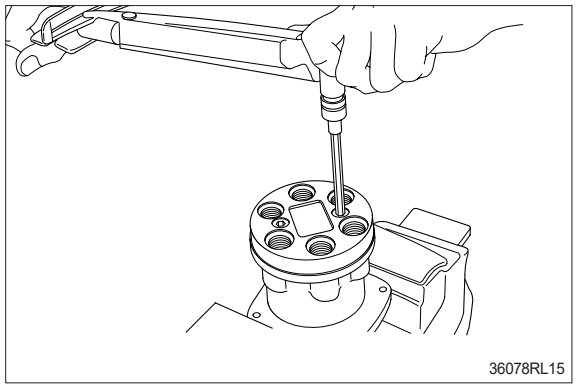
※ Prior to putting the axle into operation, fill in oil.

Observe the vehicle manufacturer's instructions and specifications for the installation and commissioning of the unit.

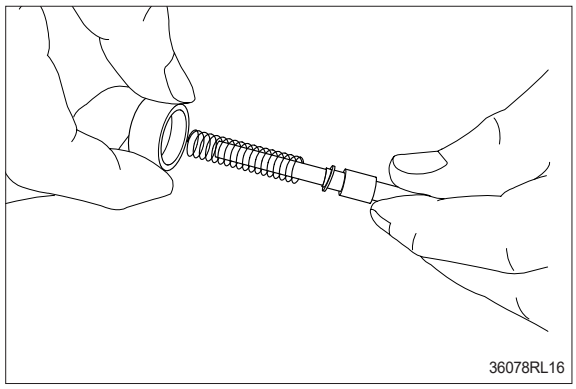
4) ASSEMBLY

(1) Tighten hexagon socket head plug (2) to the specified torque.

※ Tighten two bolts alternately and slowly.

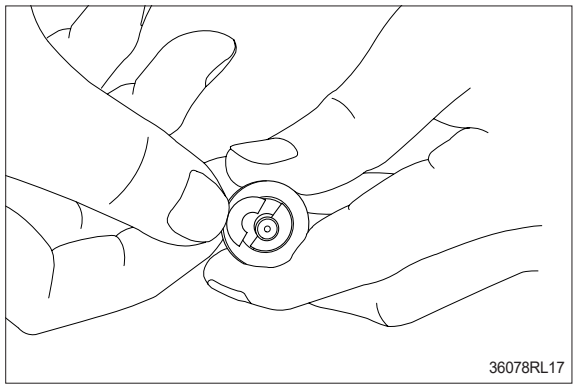


(2) Put shim (5), springs (6) and spring seat (7) onto spool (4) in this order.



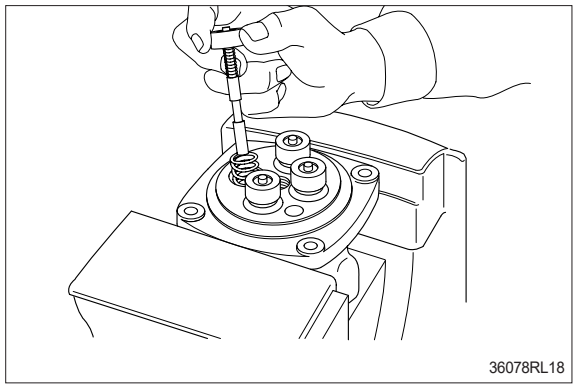
(3) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper (8) on spring seat without piling them on.

※ Assemble stopper (8) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.



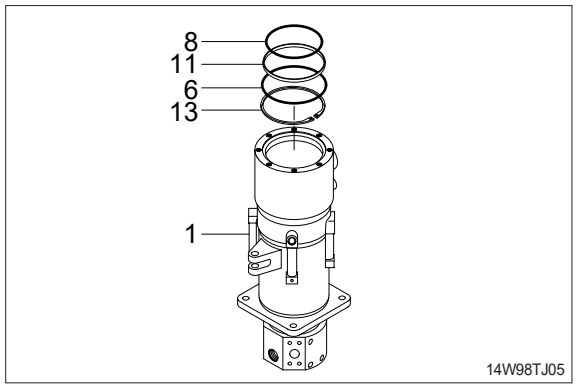
(4) Assemble spring (10) into casing (1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.

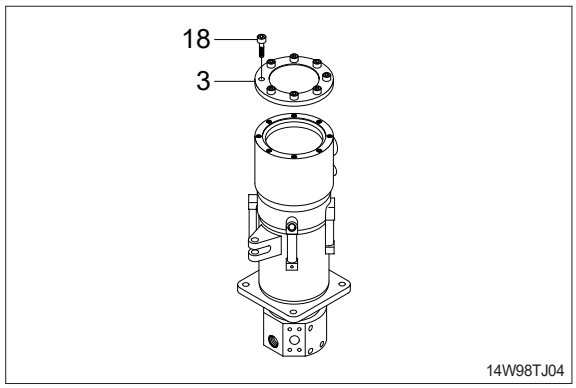


(5) Fit retainer ring (13), O-ring (6) and wear ring (11) to shaft (2).

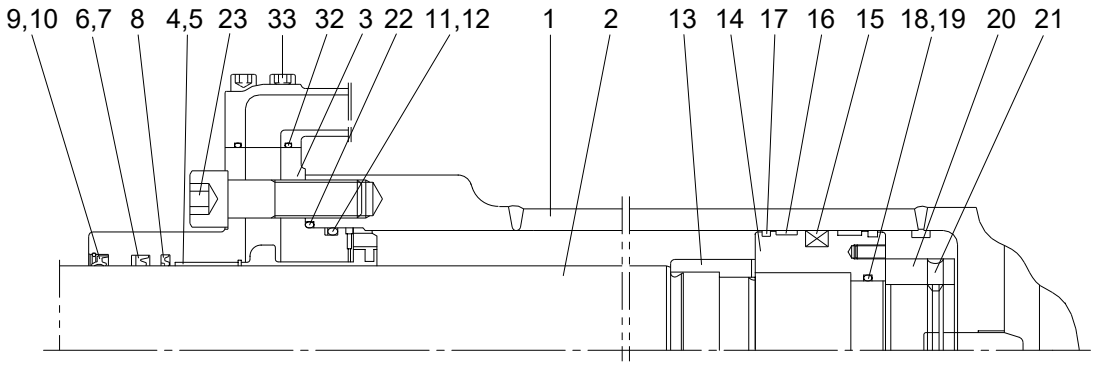
(6) Fit O-ring (8) to hub (1).



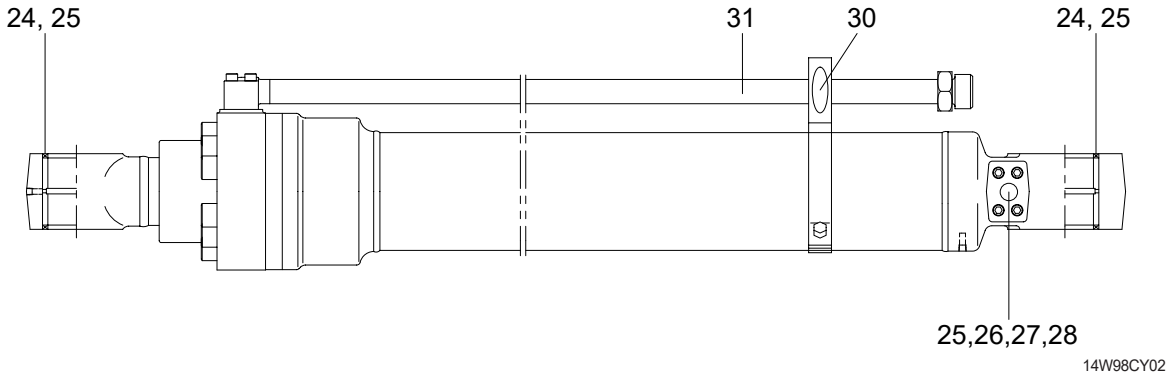
(7) Install cover (3) to hub and tighten bolts (18).
- Torque : 2.35±0.35 kgf · m
  (17.0±2.5 lbf · ft)



(2) Arm cylinder



Internal detail



1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Dust seal
4	DD2 bushing	15	Piston seal	26	Check valve
5	Snap ring	16	Wear ring	27	Coil spring
6	Rod seal	17	Dust ring	28	O-ring
7	Back up ring	18	O-ring	29	Plug
8	Buffer ring	19	Back up ring	30	Band assembly
9	Dust wiper	20	Lock nut	31	Pipe assembly-R
10	Snap ring	21	Hexagon socket set screw	32	O-ring
11	O-ring	22	O-ring	33	Hexagon socket head bolt