

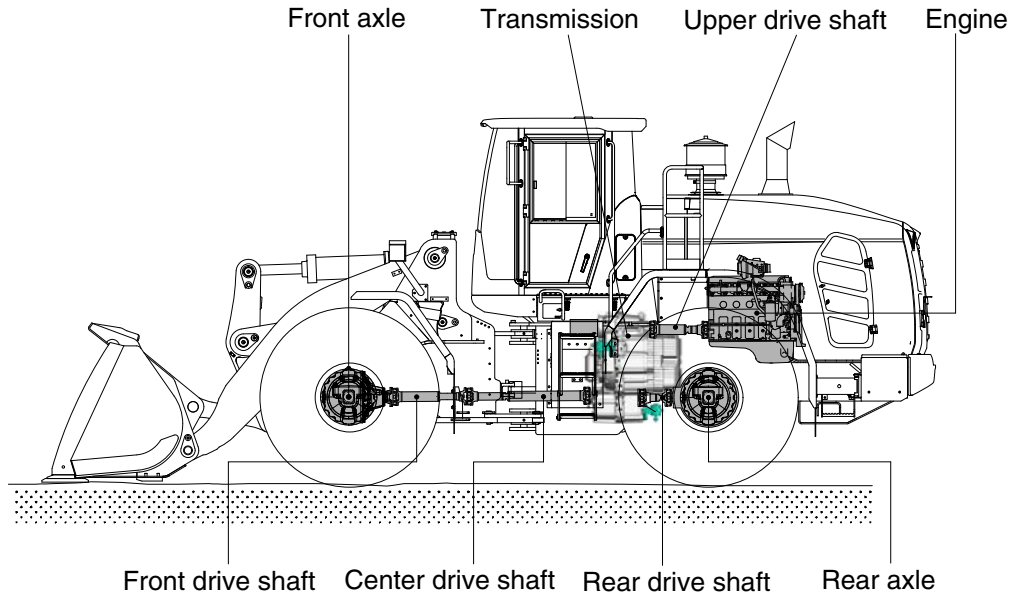
SECTION 3 POWER TRAIN SYSTEM

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SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. POWER TRAIN COMPONENT OVERVIEW



975CVT3PT01

The power train consists of the following components:

- Transmission
- Front, center, rear and upper drive shafts
- Front and rear axles

Engine power is transmitted to the transmission through the upper drive shaft.

The transmission transmits power in a combination of hydraulic power of the hydraulic pump/motor and mechanical rotational power through planetary gears.

A calliper-disc type parking brake is located on the transmission.

The transmission outputs through universal joints to three drive shaft assemblies. The front drive shaft is a telescoping shaft which drives the front axle. The front axle is mounted directly to the loader frame. The front axle is equipped with conventional differential as standard (option : Limited slip, Hyd lock differential).

The rear axle is equipped with conventional differential as standard (option : Limited slip differential).

The rear axle is mounted on an oscillating pivot.

The power transmitted to front axle and rear axle is reduced by the pinion gear and ring gear of differential. It then passes from the differential to the sun gear shaft (axle shaft) of final drive.

The power of the sun gear is reduced by a planetary mechanism and is transmitted through the planetary hub to the wheel.

2. TRANSMISSION

1) LAYOUT

Transmission is a hydrostatic-mechanical power-split continuously variable transmission for construction machinery.

The hydrostatic unit with double yoke is equipped with a variable displacement pump and a variable displacement motor.

The modification of the swivel angle controls power transmission in the two driving ranges.

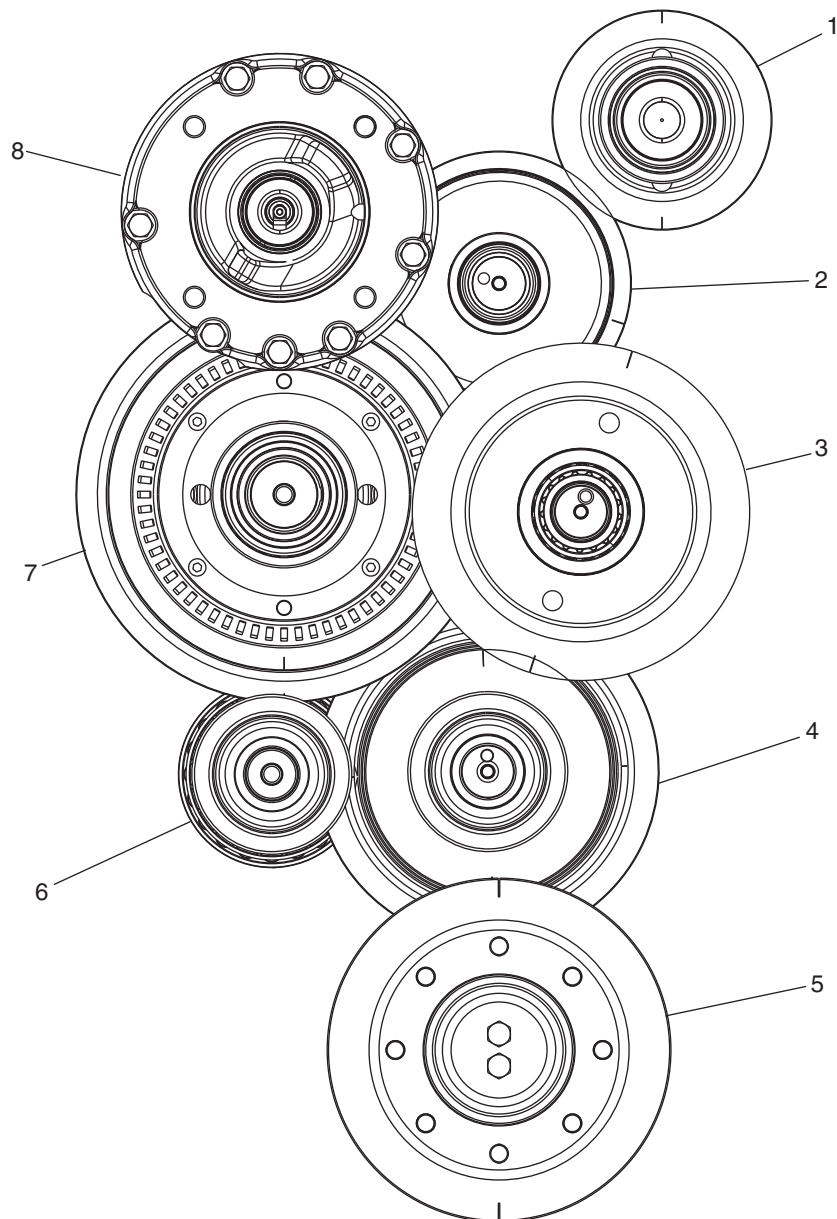
In the 1st driving range the hydrostatic unit swivels back to max. $\alpha = 44^\circ$. Power transmission in the summarizing planetary transmission occurs through power-split to the output. In the 2nd driving range pump and engine are interchanged. The hydrostatic unit swivels back to $\alpha = 0^\circ$. In the 3rd driving range the hydrostatic unit swivels back to max. $\alpha = 44^\circ$.

The power-split continuously variable technology allows hydraulic soft starts even when bearing heavy loads. At the same time fuel is saved, due to a greatest possible mechanical drive portion. Already from the start-up process, the majority of the input power comes from the mechanical part of the transmission. Lower engine speeds increase efficiency and driver comfort.

The control unit controls the transmission.

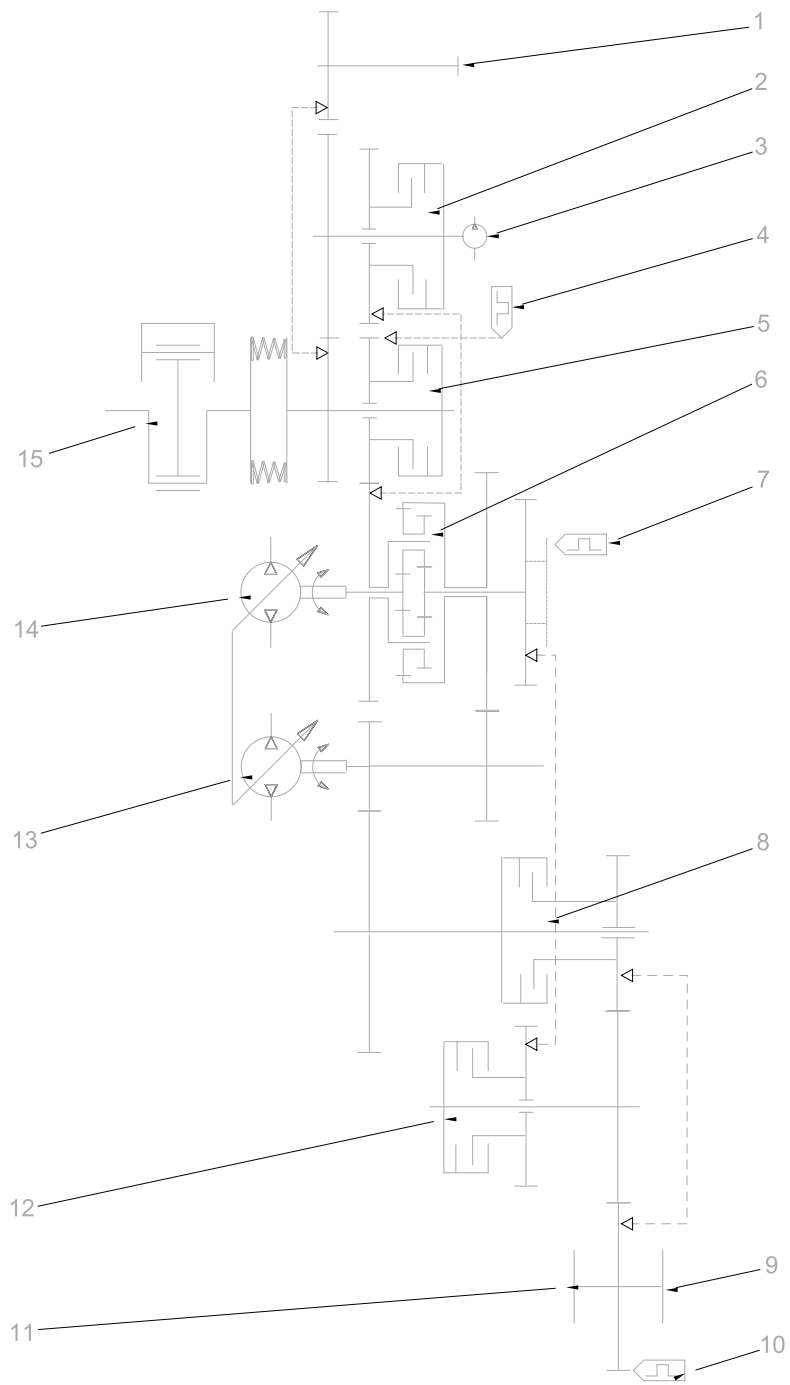
The continuously variable transmission has a center distance of 575 mm between input shaft and output

2) GEAR DIAGRAM



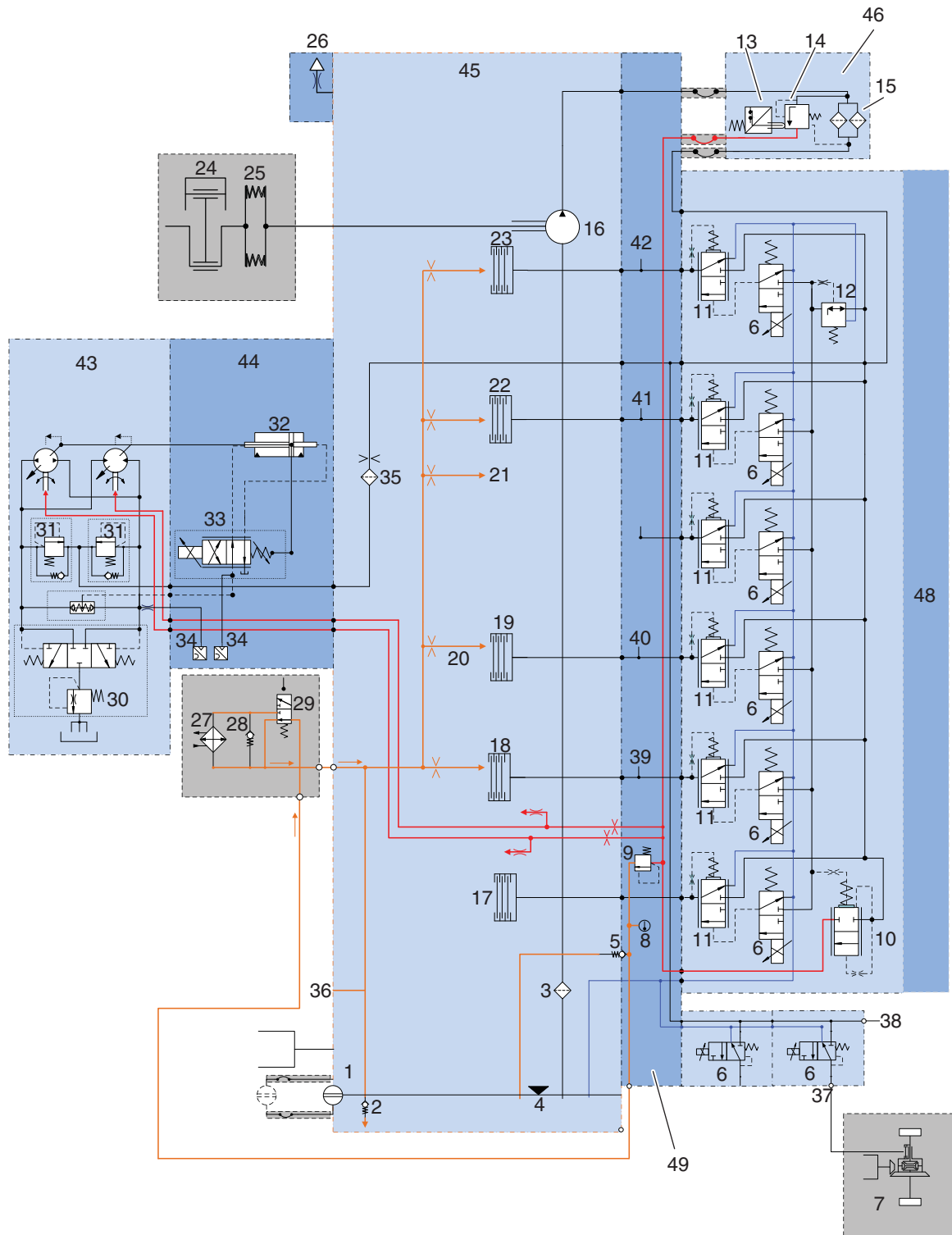
- 1 PTO 2
- 2 Clutch forward KV/ engine connection
- 3 Clutch K2
- 4 Clutch K1
- 5 Output
- 6 Input shaft
- 7 Planetary drive
- 8 Pressure oil pump / PTO 1 / clutch KR

975CVT3PT03



- | | | | |
|---|------------------------------------|----|---------------------------------|
| 1 | PTO 2 | 9 | Output |
| 2 | Clutch reverse KR | 10 | Hall sensor transmission output |
| 3 | PTO 1 | 11 | Output |
| 4 | Hall sensor transmission drive | 12 | Clutch K2 |
| 5 | Clutch forward KV | 13 | Hydrostatic unit |
| 6 | Summarizing planetary transmission | 14 | Hydrostatic unit |
| 7 | Hall sensor planet sun | 15 | Input |
| 8 | Clutch K1 | | |

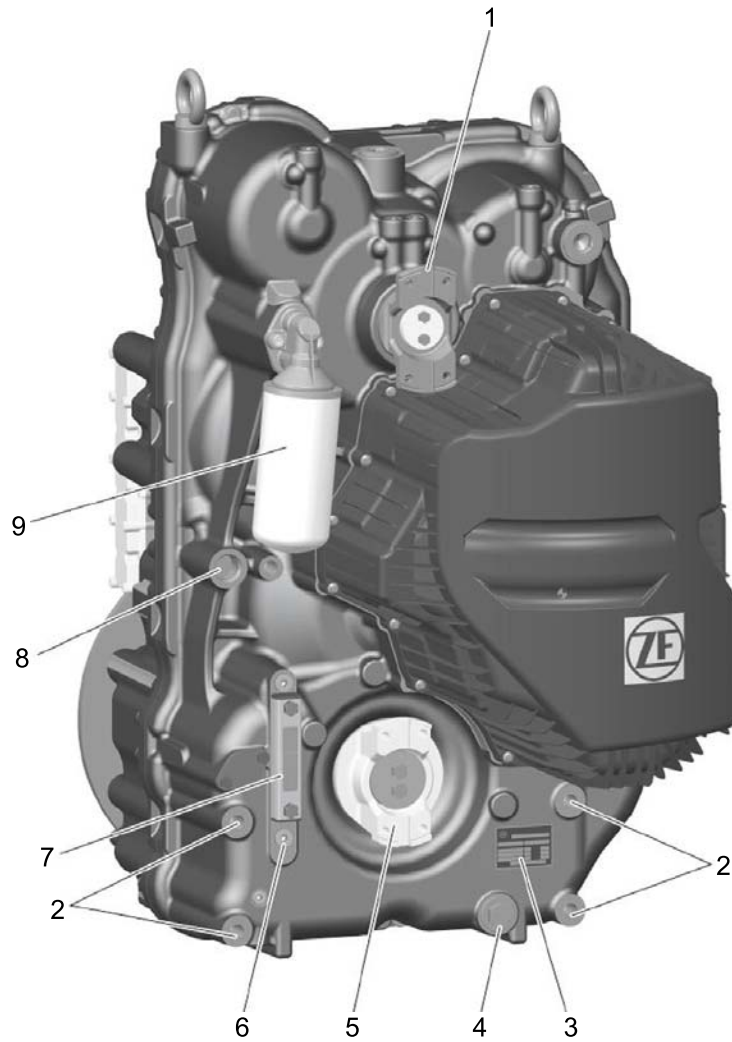
3) HYDRAULIC CIRCUIT



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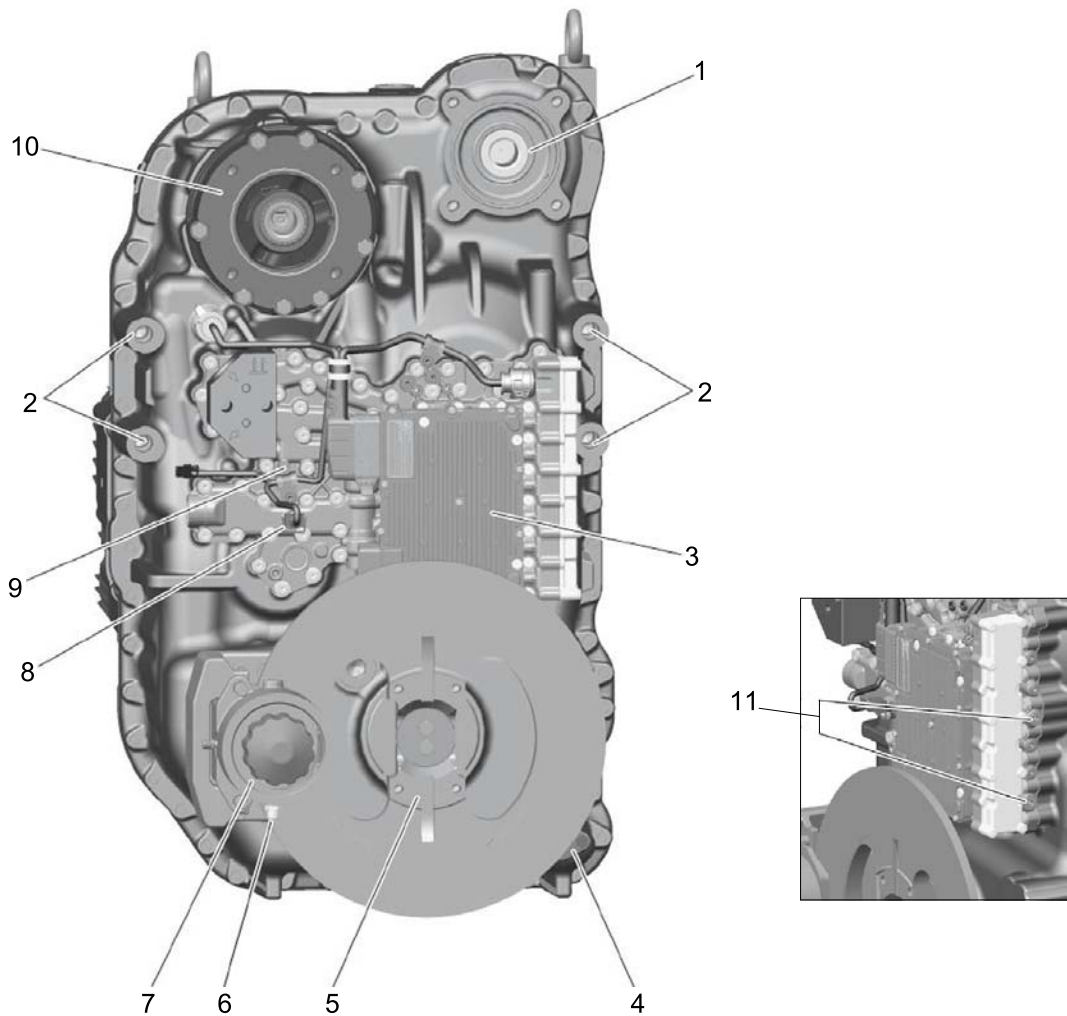
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|----|--------------------------------------|----|--|
| 1 | Oil sight glass | 26 | Breather |
| 2 | Lubrication bypass valve 0.7 bar | 27 | Heat exchanger |
| 3 | Suction filter | 28 | Heat exchanger bypass valve (3+1 bar) |
| 4 | Tank | 29 | Heat exchanger-control valve
(temperature-controlled) |
| 5 | Cooler safety valve (11+2 bar) | 30 | Flushing valve |
| 6 | Electrically actuated shift valve | 31 | High pressure valve (20+2.5 bar) |
| 7 | Differential lock optional 16/20 bar | 32 | Variable displacement cylinder |
| 8 | Temperature sensor | 33 | Position control valve speed |
| 9 | Lubrication pressure valve (4.5 bar) | 34 | High pressure sensor |
| 10 | Main pressure valve (20+2.5 bar) | 35 | Hydraulic module filter |
| 11 | Follow-on slide | 36 | Measuring point lubrication pressure after cooler |
| 12 | Pressure reducing valve (9 bar) | 37 | Measuring point shift pressure clutch K3 |
| 13 | Filter bypass switch | 38 | Measuring point/system pressure |
| 14 | Filter bypass valve | 39 | Measuring point shift pressure clutch K1 |
| 15 | Transmission pressure filter | 40 | Measuring point shift pressure clutch KR |
| 16 | Transmission pump | 41 | Measuring point shift pressure clutch KV |
| 17 | Clutch K3 (20 bar) | 42 | Measuring point shift pressure clutch K2 |
| 18 | Clutch K1 (20 bar) | 43 | Double yoke |
| 19 | Clutch KR (20 bar) | 44 | Fixture of hydrostatic unit |
| 20 | PTO 1 lubrication | 45 | Transmission housing |
| 21 | PTO 2 lubrication | 46 | Filter head |
| 22 | Clutch KV (20 bar) | 47 | Valve block |
| 23 | Clutch K2 (20 bar) | 48 | Control unit |
| 24 | Combustion engine | 49 | Channel plate |
| 25 | Torsional vibration damper | | |

4) INSTALLATION VIEW



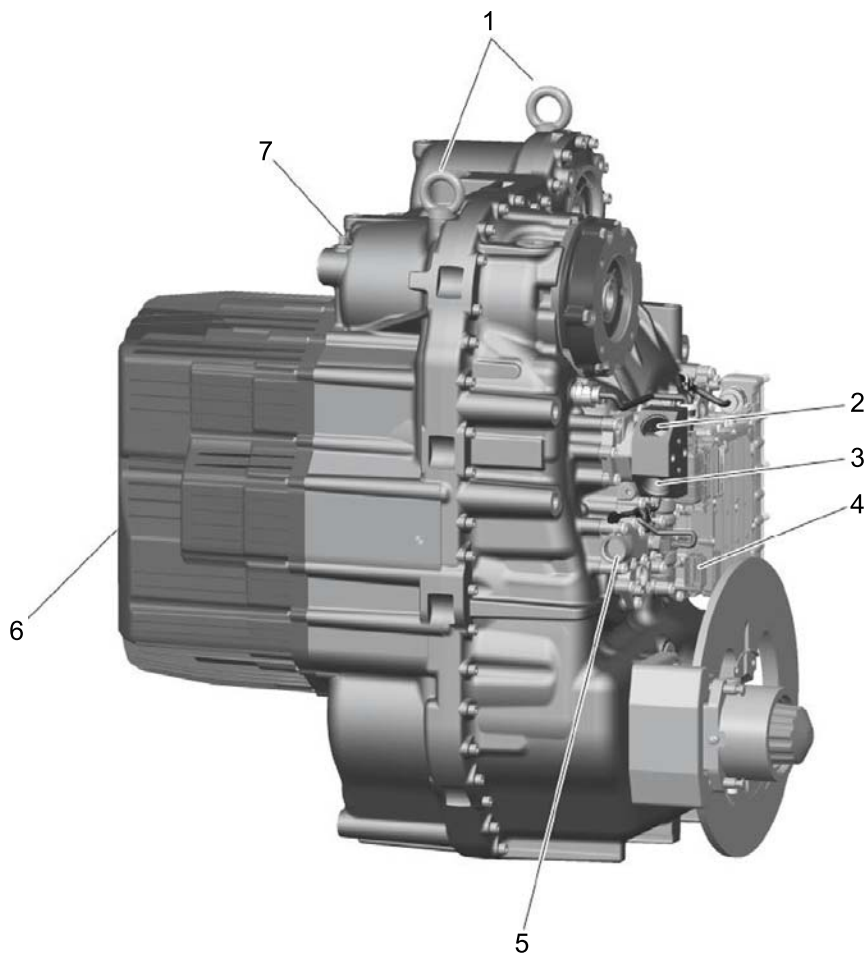
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- | | | | |
|---|-------------------------------|---|--------------------------------------|
| 1 | Input flange | 6 | Oil return into the sump (M18x1.5) |
| 2 | Transmission suspension holes | 7 | Oil level indicator |
| 3 | Type plate | 8 | Connection from heat exchanger |
| 4 | Oil drain plug (M38x1.5) | 9 | Hydrostatic filter / absorber volume |
| 5 | Output flange input-side | | |



975CVT3PT11

- | | | | |
|---|--------------------------------|----|--|
| 1 | PTO 2 | 7 | Parking brake |
| 2 | Transmission suspension holes | 8 | Temperature sensor |
| 3 | Control unit | 9 | Mounting point for strain relief clamp of the wiring harness |
| 4 | Connection for oil filling M27 | 10 | PTO 1 |
| 5 | Output flange PTO side | 11 | Differential lock pressure connection M14x1.5 :
Tightening torque : 2.3 kgf · m (17 lbf · ft) |
| 6 | Pressure connection brake | | |



975CVT3PT12

- | | | | |
|---|----------------------------|---|------------------------------|
| 1 | Lifting eye | 5 | Connection to heat exchanger |
| 2 | Connection from filter | 6 | Cover hydrostatic unit |
| 3 | Connection to filter | 7 | Breather transmission |
| 4 | Plug machine side 21 poles | | |

5) TRANSMISSION CONTROL UNIT

(1) Electronic Control unit

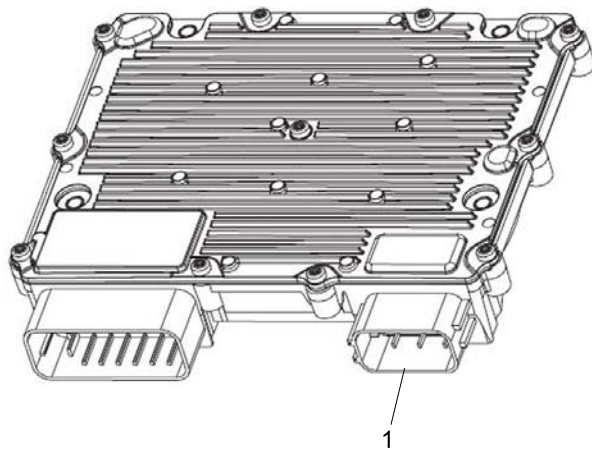
The electronic control unit is designed as on site electronics. Connection of the transmission electronics to the machine is made via the second slot in the TCU. The second plug connection (1) is closed with a cap upon delivery for protection against outside influences. Carefully remove the cap with a screwdriver or similar tool. Do not damage the detents on the plug.

In the following cases the TCU and the gear selector have to be de-energized. Switch off ignition and remove starting switch.

- For connection of the TCU to the power supply.
- To disconnect the battery from the power supply.
- For pulling off the control unit plug.

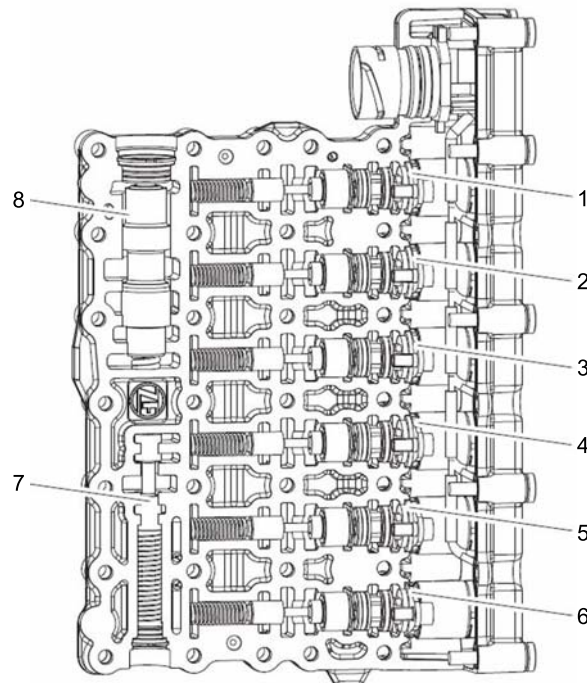
When performing the following operations, the plug must be pulled from the TCU :

- When performing electric welding operations.
- During insulation checks on the electrical system.
- At intentional external power supply via component plug in the wiring for testing and setting purposes.



975CVT3PT14

(2) Electronic Control unit



975CVT3PT15

- | | | | |
|---|------------------------------|---|---------------------------------------|
| 1 | Proportional valve Clutch K2 | 5 | Proportional valve Clutch K1 |
| 2 | Proportional valve Clutch KV | 6 | Proportional valve Clutch K3 / Option |
| 3 | Option | 7 | Pressure reducing valve (9 bar) |
| 4 | Proportional valve Clutch KR | 8 | Main pressure valve (20 + 2.5 bar) |

The multi-speed reversing transmission is continuously shiftable by hydraulically actuated multi-disk clutches.

It offers two forward driving ranges and two reverse driving ranges.

Gears, bearings and clutches are cooled and lubricated with oil. The continuously variable transmission is equipped with up to five multi-disk clutches (K1, K2, K3, KV, KR). When shifting, the respective diskpackage is compressed by a piston which is movable in axial direction. The piston is pressurized with pressure oil. A compression spring pushes the piston back and loosens the disk package.

The transmission pump provides hydrostatic unit and transmission control unit with oil. The pump takes the oil through the suction filter from the oil sump and transports it to the main pressure valve. If the passage through the fine filter (transmission pressure filter) is not guaranteed due to contamination or damage, the oil will be directly transported to the lubrication via a filter bypass valve. The five clutches of the transmission are controlled via the five proportional valves. The control pressure of 9bar for the actuation of the clutch valves is produced by the pressure reducing valve. Due to the direct proportional selection with separated pressure modulation for each clutch, the pressures will be controlled to the clutches. This way, a hydraulic overlap of the engaging and disengaging clutches becomes possible.

The main pressure valve limits the max. shift pressure to $p = 20 + 2.5$ bar and releases the main stream to the hydrostatic unit.

3. FAULT CODE

1-1) MACHINE FAULT CODE

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	S
101	3	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage > 3.95 V	●		
	4	10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage < 0.3 V	●		
	(Results / Symptoms) 1. Monitor – Hydraulic Oil temperature display failure 2. Control Function – No warming up operation, No fuel warmer function operation, High hydraulic oil temperature warning failure (Checking list) 1. CN-58B (#23) – CD-01 (#2) Checking Open/Short 2. CN-58B (#25) – CD-01 (#1) Checking Open/Short				
202	0	10 seconds continuous, Steering main pump pressure Measurement Voltage > 5.3 V	●		
	4	10 seconds continuous, Steering main pump pressure Measurement Voltage < 0.3 V	●		
	(Results / Symptoms) 1. Monitor – Steering main pump press. Display failure 2. Control Function – No automatic Emergency steering operation, ECO gauge display failure 3. RMS – Working hours accumulation failure (Checking list) 1. CN-58B (#35) – CD-39 (B) Checking Open/Short 2. CN-58A (#11) – CD-39 (A) Checking Open/Short 3. CN-58B (#25) – CD-39 (C) Checking Open/Short				
204	0	10 seconds continuous, Boom cylinder 'head' pressure Measurement Voltage > 5.3 V	●		
	4	10 seconds continuous, Boom cylinder 'head' pressure Measurement Voltage < 0.3 V	●		
	(Results / Symptoms) 1. Monitor – Boom cylinder 'head' press. display failure 2. Control Function – No Boom pressure calibration function operation, workload measurement sys. operation failure (Checking list) 1. CN-58B (#29) – CD-80 (B) Checking Open/Short 2. CN-58A (#11) – CD-80 (A) Checking Open/Short 3. CN-58B (#25) – CD-80 (C) Checking Open/Short				

G : General C : Cummins Engine application equipment S : Scania Engine application equipment

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	S
205	0	10 seconds continuous, Boom cylinder 'rod' pressure Measurement Voltage > 5.3V	●		
	4	10 seconds continuous, Boom cylinder 'rod' pressure Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Boom cylinder 'rod' press. display failure 2. Control Function – No Boom pressure calibration function operation, workload measurement sys. operation failure (Checking list) 1. CN-58B(#36) – CD-81(B) Checking Open/Short 2. CN-58A(#11) – CD-81(A) Checking Open/Short 3. CN-58B(#25) – CD-81(C) Checking Open/Short				
301	3	10 seconds continuous, Fuel level Measurement Voltage > 3.8V	●		
	4	10 seconds continuous, Fuel level Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Fuel level display failure 2. Control Function – Fuel level low warning operation failure (Checking list) 1. CN-58B (#22) – CD-02 (#2) Checking Open/Short 2. CN-58B (#25) – CD-02 (#1) Checking Open/Short				
318	8	(In the startup conditions) 30 seconds continuous, Fan speed < 10 rpm in the Remote cooling fan EPPR current reference value is in X Ma(differ by model)	●		
	(Results / Symptoms) 1. Monitor – Cooling Fan revolutions display failure (Checking list) 1. CN-58A (#15) – CD-73 (#1) Checking Open/Short 2. CN-58A (#18) – CD-73 (#2) Checking Open/Short				
339	3	10 seconds continuous, Accel pedal position 1 voltage Measurement Voltage > 5.0 V			●
	4	10 seconds continuous, Accel pedal position 1 voltage Measurement Voltage < 0.2 V			●
	(Results / Symptoms) 1. Monitor – Accel pedal position 1 voltage display failure 2. Control Function – Engine rpm control failure (Checking list) 1. CN-58B(#39) – CN-162(#2) Checking Open/Short 2. CN-58A(#6) – CN-162(#3) Checking Open/Short 3. CN-58A(#8) – CN-162(#1) Checking Open/Short				

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DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	S
343	3	10 seconds continuous, Accel pedal position 2 voltage Measurement Voltage > 5.0 V			●
	4	10 seconds continuous, Accel pedal position 2 voltage Measurement Voltage < 0.2 V			●
343	(Results / Symptoms) 1. Monitor – Accel pedal position 2 voltage display failure 2. Control Function – Engine rpm control failure (Checking list) 1. CN-58B (#40) – CN-162 (#5) Checking Open/Short 2. CN-58A (#7) – CN-162 (#6) Checking Open/Short 3. CN-58A (#9) – CN-162 (#4) Checking Open/Short				
503	0	10 seconds continuous, Brake oil pressure Measurement Voltage > 5.3V	●		
	4	10 seconds continuous, Brake oil pressure Measurement Voltage < 0.3V	●		
503	(Results / Symptoms) 1. Monitor – Brake oil press. display failure 2. Control Function – Brake oil pressure low warning display failure (Checking list) 1. CN-58B (#27) – CD-03 (B) Checking Open/Short 2. CN-58A (#11) – CD-03 (A) Checking Open/Short 3. CN-58B (#25) – CD-03 (C) Checking Open/Short				
507	0	10 seconds continuous, Parking oil pressure Measurement Voltage > 5.3V	●		
	4	10 seconds continuous, Parking oil pressure Measurement Voltage < 0.3V	●		
507	(Results / Symptoms) 1. Monitor – Parking oil Press. display failure 2. Control Function – No judgment Parking status (Checking list) 1. CN-58B (#34) – CD-26 (B) Checking Open/Short 2. CN-58A (#11) – CD-26 (A) Checking Open/Short 3. CN-58B (#25) – CD-26 (C) Checking Open/Short				
557	0	10 seconds continuous, Brake oil charging priority pressure Measurement Voltage > 5.3V	●		
	4	10 seconds continuous, Brake oil charging priority pressure Measurement Voltage < 0.3V	●		
557	(Results / Symptoms) 1. Monitor – Brake oil charging priority press. display failure 2. Control Function – Cooling fan revolutions control failure, Brake oil(Accumulator) charging failure (Checking list) 1. CN-58B (#38) – CD-31 (B) Checking Open/Short 2. CN-58A (#11) – CD-31 (A) Checking Open/Short 3. CN-58B (#25) – CD-31 (C) Checking Open/Short				

G : General C : Cummins Engine application equipment S : Scania Engine application equipment

DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	S
705	0	10 seconds continuous, Battery input Voltage > 35V	●		
	1	10 seconds continuous, Battery input Voltage < 18V	●		
	(Results / Symptoms) 1. Control Function – Disabled startup (Checking list) 1. Checking battery voltage 2. CN-58A (#1) – CN-36 (07 fuse) Checking Open/Short 3. CN-58A (#2) – CN-36 (07 fuse) Checking Open/Short				
707	1	(In the 500rpm or more) 10 seconds continuous, Alternator Node I Measurement Voltage < 18V	●		
	(Results / Symptoms) 1. Control Function – Battery charging circuit failure (Checking list) 1. CN-58B (#33) – CN-04 (#18) Checking Open/Short 2. CN-04 (#18) – CN-74 (#2) Checking Open/Short				
728	3	10 seconds continuous, Boom position sensor signal voltage Measurement Voltage > 5.0V	●		
	4	10 seconds continuous, Boom position sensor signal voltage Measurement Voltage < 0.3V	●		
	(Results / Symptoms) 1. Monitor – Boom position sensor signal voltage display failure 2. Control Function – No calibration angle sensor, No calibration boom pressure , Boom Detent operation failure, Soft end stop(Boom) operation failure, Lock-up clutch operation failure (Checking list) 1. CN-58B (#37) – CN-100 (B) Checking Open/Short 2. CN-58A (#5) – CN-100 (C) Checking Open/Short 3. CN-58B (#25) – CN-100 (A) Checking Open/Short				
729	3	10 seconds continuous, Bucket position sensor signal voltage Measurement Voltage > 5.0V	●		
	4	10 seconds continuous, Bucket position sensor signal voltage Measurement Voltage < 0.3V	●		
	(Results /Symptoms) 1. Monitor – Bucket position sensor signal voltage display failure 2. Control Function – No calibration angle sensor, Bucket Detent operation failure, Soft end stop(Bucket) operation failure (Checking list) 1. CN-58B(#30) – CN-101(B) Checking Open/Short 2. CN-58A(#5) – CN-101(C) Checking Open/Short 3. CN-58B(#25) – CN-101(A) Checking Open/Short				

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DTC		Diagnostic Criteria	Application		
HCESPN	FMI		G	C	S
831	2	(When mounting the A/C Controller) 10 seconds continuous, A/C controller Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – A/C Controller malfunction				
841	2	10 seconds continuous, ECM Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – ECM operation failure				
842	2	10 seconds continuous, TCU Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – TCU operation failure				
844	2	10 seconds continuous, Monitor Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – Monitor operation failure				
850	2	(When mounting the RMCU) 90 seconds continuous, RMCU Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – RMCU operation failure				
861	2	(When mounting the EHCU) 10 seconds continuous, EHCU Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – EHCU operation failure				
869	2	(When mounting the BKCU) 10 seconds continuous, BKCU Communication Data Error	●		
	(Results / Symptoms) 1. Control Function – BKCU operation failure				

G : General C : Cummins Engine application equipment S : Scania Engine application equipment

1-2) EHCU FAULT CODE

HCESPN	FMI	Description
2333	9	Communication timeout between EHCU and TCU
2331	9	Communication timeout between EHCU and MCU
2332	9	Communication timeout between EHCU and working joystick
2317	9	Communication timeout between EHCU and steering joystick
2319	2	Steering joystick position signal error
2320	2	Steering joystick - FNR enable switch error
2321	2	Steering joystick - foward switch error
2322	2	Steering joystick - neutral switch error
2323	2	Steering joystick - reverse switch error
2324	2	Steering joystick - kick down switch error
2325	2	Steering joystick - steering on switch error
2326	5	PVE coil power current below normal or open circuit
2326	6	PVE coil power current above normal or grounded circuit
2327	0	PVE coil PWM duty cycle input value above normal operation range
2327	1	PVE coil PWM duty cycle input value below normal operation range
2327	5	PVE coil PWM duty cycle current below normal or open circuit
2327	6	PVE coil PWM duty cycle current above normal or grounded circuit
2327	14	PVE coil PWM duty cycle control block parameter invalid
2311	2	Boom joystick position signal error
2311	0	Boom joystick position input value above normal operation range
2311	1	Boom joystick position input value below normal operation range
2311	3	Boom joystick position input voltage above normal or shorted to high source
2311	4	Boom joystick position input voltage below normal or shorted to low source
2311	13	Boom joystick position control block out of calibration
2311	14	Boom joystick position control block parameter invalid
2311	31	Boom joystick position signal redundancy lost
2313	2	Bucket joystick position signal error
2313	0	Bucket joystick position input value above normal operation range
2313	1	Bucket joystick position input value below normal operation range
2313	3	Bucket joystick position input voltage above normal or shorted to high source
2313	4	Bucket joystick position input voltage below normal or shorted to low source
2313	13	Bucket joystick position control block out of calibration
2313	14	Bucket joystick position control block parameter invalid
2313	31	Bucket joystick position signal redundancy lost
2315	2	Aux joystick position signal error
2315	0	Aux joystick position input value above normal operation range
2315	1	Aux joystick position input value below normal operation range

HCESPN	FMI	Description
2315	3	Aux joystick position input voltage above normal or shorted to high source
2315	4	Aux joystick position input voltage below normal or shorted to low source
2315	13	Aux joystick position control block out of calibration
2315	14	Aux joystick position control block parameter invalid
2315	31	Aux joystick position signal redundancy lost
2304	0	Boom up EPPR valve input value above normal operation range
2304	1	Boom up EPPR valve input value below normal operation range
2304	5	Boom up EPPR valve input current below normal or open circuit
2304	6	Boom up EPPR valve input current above normal or grounded circuit
2304	14	Boom up EPPR valve block parameter invalid
2305	0	Boom down EPPR valve input value above normal operation range
2305	1	Boom down EPPR valve input value below normal operation range
2305	5	Boom down EPPR valve input current below normal or open circuit
2305	6	Boom down EPPR valve input current above normal or grounded circuit
2305	14	Boom down EPPR valve block parameter invalid
2306	0	Bucket in EPPR valve input value above normal operation range
2306	1	Bucket in EPPR valve input value below normal operation range
2306	5	Bucket in EPPR valve input current below normal or open circuit
2306	6	Bucket in EPPR valve input current above normal or grounded circuit
2306	14	Bucket in EPPR valve block parameter invalid
2307	0	Bucket dump EPPR valve input value above normal operation range
2307	1	Bucket dump EPPR valve input value below normal operation range
2307	5	Bucket dump EPPR valve input current below normal or open circuit
2307	6	Bucket dump EPPR valve input current above normal or grounded circuit
2307	14	Bucket dump EPPR valve block parameter invalid
2308	0	Aux. Up EPPR valve input value above normal operation range
2308	1	Aux. Up EPPR valve input value below normal operation range
2308	5	Aux. Up EPPR valve input current below normal or open circuit
2308	6	Aux. Up EPPR valve input current above normal or grounded circuit
2308	14	Aux. Up EPPR valve block parameter invalid
2309	0	Aux. Down EPPR valve input data above normal operation range
2309	1	Aux. Down EPPR valve input data below normal operation range
2309	5	Aux. Down EPPR valve input current below normal or open circuit
2309	6	Aux. Down EPPR valve input current above normal or grounded circuit
2309	14	Aux. Down EPPR valve block parameter invalid
2328	0	EHCU sensor power voltage high
2328	1	EHCU sensor power voltage low
2328	3	EHCU sensor power voltage above normal or shorted to high source

HCESPN	FMI	Description
2328	4	EHCU sensor power voltage below normal or shorted to low source
2329	0	EHCU power voltage high
2329	1	EHCU power voltage low
2329	11	EHCU safety cpu error
739	2	Armrest switch signal error
2334	0	Steering pilot pressure sensor data above normal range
2334	1	Steering pilot pressure sensor data below normal range
2335	2	Steering proportional valve moving position error
2335	14	Steering proportional valve start position error

1-3) AAVM FAULT CODE

Fault Code	Description
A01	AAVM Communication Error -AAVM
A02	AAVM Communication Error -Front Camera
A03	AAVM Communication Error -Rear Camera
A04	AAVM Communication Error -Left Camera
A05	AAVM Communication Error -Right Camera
A06	Manual Setting Fail
A07	No MCU CID
A08	MCU CID Format Error
A09	AAVM Hardware Error -AAVM
A10	AAVM Hardware Error -Front Camera
A11	AAVM Hardware Error -Rear Camera
A12	AAVM Hardware Error -Left Camera
A13	AAVM Hardware Error -Right Camera
A14	MCU CID Model is not registered
A15	MCU CID Model can't be applied

2) ENGINE FAULT CODE

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
111 629 12	Engine control module critical internal failure - Bad intelligent device or component. Error internal to the ECM related to memory hardware failures or internal ECM voltage supply circuits.	Possible no noticeable performance effects, engine dying, or hard starting.
115 612 2	Engine magnetic crankshaft speed/position lost both of two signals - Data erratic, intermittent, or incorrect. The ECM has detected the primary and backup speed sensor signals are connected backwards.	The engine will shut down or will not start.
122 102 3	Intake manifold 1 pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the intake manifold pressure circuit.	Engine power derate.
123 102 4	Intake manifold 1 pressure sensor circuit - Voltage below normal, or shorted to low Source. Low signal voltage or open circuit detected at the intake manifold pressure circuit.	Engine power derate.
124 102 16	Intake manifold 1 pressure - Data valid but above normal operational range - Moderately severe level. Intake manifold pressure is above the maximum operating limit.	Engine power derate.
125 102 18	Intake Manifold 1 Pressure - Data valid but below normal operating range - Moderately severe level. Intake manifold pressure is below the minimum operating limit.	Engine power derate.
131 91 3	Accelerator pedal or lever position sensor 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at accelerator pedal position number 1 circuit.	The engine will operate in limp home mode.
132 91 4	Accelerator pedal or lever position sensor 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at accelerator pedal position number 1 signal circuit.	The engine will operate in limp home mode.
133 974 3	Remote accelerator pedal or lever position sensor 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at remote accelerator pedal position signal circuit.	Remote accelerator will not operate.
134 974 4	Remote accelerator pedal or lever position sensor 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at remote accelerator pedal position signal circuit.	Remote accelerator will not operate.
143 100 18	Engine oil rifle pressure - Data valid but below normal operational range - Moderately severe level. Engine oil pressure signal indicates engine oil pressure is below the engine protection warning limit.	Engine power derate.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
144 110 3	Engine coolant temperature 1 sensor circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit detected at engine coolant temperature circuit.	Fan will stay ON if controlled by ECM.
145 110 4	Engine coolant temperature 1 sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at engine coolant temperature circuit.	Fan will stay ON if controlled by ECM.
146 110 16	Engine coolant temperature - Data valid but above normal operational range - Moderately severe level. Engine coolant temperature is above engine protection warning limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red stop lamp starts flashing.
151 110 0	Engine coolant temperature - Data valid but above normal operational range - Most severe level. Engine coolant temperature signal indicates engine coolant temperature above engine protection critical limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red stop lamp starts flashing.
153 105 3	Intake manifold 1 temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at intake manifold air temperature circuit.	Fan will stay ON if controlled by ECM.
154 105 4	Intake manifold 1 temperature sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at intake manifold air temperature circuit.	Fan will stay ON if controlled by ECM.
155 105 0	Intake manifold 1 temperature - Data valid but above normal operational range - Most severe level. Intake manifold air temperature signal indicates intake manifold air temperature above engine protection critical limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red stop lamp starts flashing.
175 3464 3	Electronic throttle control actuator driver circuit - Voltage above normal, or shorted to high source. A short circuit to battery or open circuit has been detected in the engine intake air throttle actuator signal circuit.	Possible reduced engine performance.
176 3464 4	Electronic throttle control actuator driver circuit - Voltage below normal, or shorted to low source. A short circuit to ground has been detected in the engine intake air throttle actuator signal circuit.	Possible reduced engine performance.
177 3464 7	Electronic throttle control actuator - Mechanical system not responding or out of adjustment. The engine intake air throttle actuator has failed the auto zero span check.	Possible reduced engine performance.
187 3510 4	Sensor supply 2 circuit - Voltage below normal, or shorted to low source. Low voltage detected at the sensor supply number 2 circuit.	Engine power derate.
195 111 3	Coolant level sensor 1 circuit - Voltage above normal, or shorted to high source. High signal voltage detected at engine coolant level circuit.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
196 111 4	Coolant level sensor 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at engine coolant level circuit.	None on performance.
197 111 18	Coolant level - Data valid but below normal operational range - Moderately severe level. Low coolant level has been detected.	Engine power derate.
221 108 3	Barometric pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at barometric pressure circuit.	Engine power derate.
222 108 4	Barometric pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at barometric pressure circuit.	Engine power derate.
227 3510 3	Sensor supply 2 circuit - Voltage above normal, or shorted to high source. High voltage detected at sensor supply number 2 circuit.	Engine power derate.
234 190 0	Engine crankshaft speed/position - Data valid but above normal operational range - Most severe level. Engine speed signal indicates engine speed above engine protection limit.	Engine power derate.
238 3511 4	Sensor supply 3 circuit - Voltage below normal, or shorted to low source. Low voltage detected on the +5 volt sensor supply circuit to the engine speed sensor.	Engine may run rough, may stop running, may not start, or may be difficult to start.
239 3511 3	Sensor supply 3 circuit - Voltage above normal or shorted to high source. High voltage detected on the +5 volt sensor supply circuit to the engine speed sensor.	Engine may run rough, may stop running, may not start, or may be difficult to start.
241 84 2	Wheel-based vehicle speed - Data erratic, intermittent, or incorrect. The ECM lost the vehicle speed signal or is reading an erratic value.	Engine speed limited to ,maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work.
245 647 4	Fan control circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the fan control circuit when commanded on.	The fan may stay on continuously or not run at all.
249 171 3	Ambient air temperature sensor 1 circuit - Voltage above normal or shorted to high source. High signal voltage detected at ambient air temperature circuit.	Possible reduced engine performance.
256 171 4	Ambient air temperature sensor 1 circuit - Voltage below normal or shorted to low source. Low voltage detected at ambient air temperature circuit.	Possible reduced engine performance.
271 1347 4	Fuel pump pressurizing assembly 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the fuel pump actuator circuit.	Engine power derate.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
272 1347 3	Fuel pump pressurizing assembly 1 circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit detected at the fuel pump actuator circuit.	Engine may run rough, may stop running, may not start, or may be difficult to start.
285 639 9	SAE J1939 multiplexing PGN timeout error - Abnormal update rate. The ECM expected information from a multiplexed device but did not receive it soon enough or did not receive it at all.	At least one multiplexed device will not operate properly.
286 639 13	SAE J1939 multiplexing configuration error - Out of calibration. The ECM expected information from a multiplexed device but only received a portion of the necessary information.	At least one multiplexed device will not operate properly.
288 974 19	Sae J1939 multiplexing remote accelerator pedal or lever position sensor circuit - Received network data in error. The oem vehicle electronic control unit (VECM) detected a fault with the remote accelerator.	Remote accelerator will not operate.
295 108 2	Barometric pressure - Data erratic, intermittent, or incorrect. An error in the barometric pressure sensor signal was detected by the ECM.	Engine power derate.
322 651 5	Injector solenoid driver cylinder 1 circuit - Current below normal, or open circuit. Current detected at injector 1 when voltage is turned OFF.	Engine power derate.
323 655 5	Injector solenoid driver cylinder 5 circuit - Current below normal, or open circuit. Current detected at injector 5 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
324 653 5	Injector solenoid driver cylinder 3 circuit - Current below normal, or open circuit. Current detected at injector 3 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
325 656 5	Injector solenoid driver cylinder 6 circuit - Current below normal, or open circuit. Current detected at injector 6 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
331 652 5	Injector solenoid driver cylinder 2 circuit - Current below normal, or open circuit. Current detected at injector 2 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
332 654 5	Injector solenoid driver cylinder 4 circuit - Current below normal, or open circuit. Current detected at injector 4 when voltage is turned OFF.	The current to the injector is shut OFF. Engine power derate.
334 110 2	Engine coolant temperature - Data erratic, intermittent, or incorrect. The engine coolant temperature sensor is reading an erratic value at initial key ON.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
338 1267 3	Idle shutdown vehicle accessories relay driver circuit - Voltage above normal, or shorted to high source. Open circuit or short to voltage source detected at the idle shutdown vehicle accessory/ignition bus relay circuit.	Vehicle accessories or ignition bus loads controlled by the idle shutdown relay will not power up.
339 1267 4	Idle shutdown vehicle accessories relay driver circuit - Voltage below normal, or shorted to low source. Low voltage detected at the idle shutdown vehicle accessory or ignition bus relay circuit when commanded ON.	Vehicle accessories or ignition bus loads controlled by the idle shutdown relay will not power up.
343 629 12	Engine control module warning internal hardware failure - Bad intelligent device or component. ECM power supply errors have been detected.	Engine power derate.
346 630 12	Engine control module calibration memory software - Bad intelligent device or component. Invalid switch configuration adjustable parameter setting have been detected by the engine control module (ECM).	Various optional switch inputs to the ECM may not operate correctly.
351 627 12	Injector power supply - Bad intelligent device or component. The ECM measured injector boost voltage is low.	Engine power derate.
352 3509 4	Sensor supply 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at sensor supply number 1 circuit.	Engine power derate.
383 729 5	Engine intake air heater 1 circuit - Current below normal or open circuit. A malfunctioning engine intake air heater circuit has been detected.	Engine may not start or may be difficult to start.
386 3509 3	Sensor supply 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at sensor supply number 1 circuit.	Engine power derate.
415 100 1	Engine oil rifle pressure - Data valid but below normal operational range - Most severe level. Oil pressure signal indicates oil pressure below the engine protection critical limit.	Progressive power and/or speed derate increasing in severity from time of alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red stop lamp starts flashing.
418 97 15	Water in fuel indicator - Data valid but above normal operational range - Least severe level. water has been detected in the fuel filter.	None on performance.
427 639 9	J1939 data link - Abnormal update rate. Communication between the engine control module (ECM) and another device on the SAE J1939 data link has been lost.	Engine will only idle.
428 97 3	Water in fuel indicator sensor circuit - Voltage above normal, or shorted to high source. High voltage detected at the water in fuel circuit.	None on performance. No water in fuel warning available.
435 100 2	Engine oil rifle pressure - Data erratic, intermittent, or incorrect. The engine oil pressure sensor is reading an erratic value.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
436 105 2	Intake manifold 1 temperature - Data erratic, intermittent, or incorrect. The intake manifold temperature sensor is reading an erratic value at initial key on or while the engine is running.	Possible reduced engine performance.
441 168 18	Battery 1 voltage - Data valid but below normal operational range - Moderately severe level. ECM supply voltage is below the minimum system voltage level.	Engine may run rough, may stop running, may not start, or may be difficult to start.
442 168 16	Battery 1 Voltage - Data valid but above normal operational range - Moderately severe level. ECM supply voltage is above the maximum system voltage level.	None on performance.
451 157 3	Injector metering rail 1 pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the rail fuel pressure sensor circuit.	Power and/or speed derate.
452 157 4	Injector metering rail 1 pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the rail fuel pressure sensor circuit.	Power and/or speed derate.
483 1349 3	Injector metering rail 2 pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the fuel rail 2 pressure sensor circuit.	Possible reduced engine performance.
484 1349 4	Injector metering rail 2 pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the fuel rail 2 pressure sensor circuit.	Possible reduced engine performance.
515 3514 3	Sensor supply 6 circuit - Voltage above normal or shorted to high source. High voltage detected on the +5 volt sensor supply circuit to the fuel rail pressure sensor.	Engine power derate.
516 3514 4	Sensor supply 6 circuit - Voltage below normal or shorted to low source. Low voltage detected on the +5 volt sensor supply circuit to the fuel rail pressure sensor.	Engine power derate.
553 157 16	Injector metering rail 1 pressure - Data valid but above normal operational range - Moderately severe level. The ECM has detected that fuel pressure is higher than commanded pressure.	Possible reduced engine performance.
555 101 16	Crankcase pressure - Data valid but above normal operational range - Moderately severe level. The crankcase breather filter requires maintenance.	None on performance.
556 101 0	Crankcase pressure - Data valid but above normal operational range - Most severe level. The crankcase breather filter requires maintenance.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
559 157 18	Injector metering rail 1 pressure - Data valid but below normal operational range - Moderately severe level. The ecm has detected that fuel pressure is lower than commanded pressure.	Possibly hard to start or low power. Engine could possibly not start.
584 677 3	Starter relay driver circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at starter lockout circuit.	Either the engine will not start or the engine will not have starter lockout protection.
585 677 4	Starter relay driver circuit - Voltage below normal, or shorted to low source. Low voltage detected at starter lockout circuit.	Either the engine will not start or the engine will not have starter lockout protection.
595 103 16	Turbocharger 1 speed - Data valid but above normal operating range - Moderately severe level. High turbocharger speed has been detected by the ecm.	Engine power derate.
596 167 16	Electrical charging system voltage - Data valid but above normal operational range - Moderately severe level. High battery voltage detected by the battery voltage monitor feature.	None on performance.
597 167 18	Electrical charging system voltage - Data valid but below normal operational range - Moderately severe level. Low battery voltage detected by the battery voltage monitor feature.	None on performance.
649 1378 31	Engine oil change interval - Condition exists. Change engine oil and filter.	None on performance.
687 103 18	Turbocharger 1 speed - Data valid but below normal operational range - Moderately severe level. Low turbocharger speed detected by the ECM.	Engine power derate. The ECM uses an estimated turbocharger speed.
689 190 2	Engine crankshaft speed/position - Data erratic, intermittent, or incorrect. The ECM has detected an error in the engine speed signal.	Possible reduced engine performance.
691 1172 3	Turbocharger 1 compressor inlet temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at turbocharger compressor inlet air temperature circuit.	Engine power derate.
692 1172 4	Turbocharger 1 compressor inlet temperature circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at turbocharger compressor inlet air temperature circuit.	Engine power derate.
693 1172 2	Turbocharger 1 compressor intake temperature - Data erratic, intermittent, or incorrect. A temperature too high or low for the operating conditions has been detected by the turbocharger compressor intake temperature sensor.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
731 723 7	Engine speed / position camshaft and crankshaft misalignment - Mechanical system not responding properly or out of adjustment. Engine position signal from the crankshaft position sensor and camshaft position sensor do not match.	Engine power derate.
755 157 7	Injector metering rail 1 pressure - Mechanical system not responding or out of adjustment. The ecm has detected a difference in the 2 fuel rail pressure signals.	Possible reduced engine performance.
778 723 2	Engine camshaft speed / position sensor - Data erratic, intermittent, or incorrect. The ECM has detected an error in the camshaft position sensor signal.	Possible reduced engine performance.
784 1590 2	Adaptive cruise control mode - Data erratic, intermittent, or incorrect. Loss of communication with adaptive cruise control.	Adaptive cruise control will not operate. Standard cruise control may not operate.
1117 627 2	Power supply lost with ignition on - Data erratic, intermittent, or incorrect. Supply voltage to the ECM fell below 6.2 volts momentarily, or the ECM was not allowed to power down correctly (retain battery voltage for 30 seconds after key OFF).	Possible no noticeable performance.
1139 651 7	Injector solenoid driver cylinder 1 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1141 652 7	Injector solenoid driver cylinder 2 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1142 653 7	Injector solenoid driver cylinder 3 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1143 654 7	Injector solenoid driver cylinder 4 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1144 655 7	Injector solenoid driver cylinder 5 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1145 656 7	Injector solenoid driver cylinder 6 - Mechanical system not responding or out of adjustment. The ECM has detected an error with the injection timing or quantity.	Possible reduced engine performance.
1228 27 2	Egr valve position - Data erratic, intermittent, or Incorrect. The EGR valve is unable to meet commanded position.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1239 2623 3	Accelerator pedal or lever position sensor 2 circuit - Voltage above normal or shorted to high source. High voltage detected at accelerator pedal position number 2 signal circuit.	The engine will operate in limp home mode.
1241 2623 4	Accelerator pedal or lever position sensor 2 circuit - Voltage below normal or shorted to low source. Low voltage detected at accelerator pedal position number 2 signal circuit.	The engine will operate in limp home mode.
1242 91 2	Accelerator pedal or lever position sensor 1 and 2 - Data erratic, intermittent, or incorrect. Accelerator position sensor number 1 and number 2 are reading different values.	The engine will only idle.
1515 91 19	Sae J1939 multiplexed accelerator pedal or lever sensor system - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the multiplexed accelerator pedal.	The engine will only idle.
1654 1323 31	Engine misfire cylinder 1 - Condition exists. Engine misfire has been detected in cylinder number 1.	Possible reduced engine performance.
1655 1324 31	Engine misfire cylinder 2 - Condition exists. Engine misfire has been detected in cylinder number 2.	Possible reduced engine performance.
1656 1325 31	Engine misfire cylinder 3 - Condition exists. Engine misfire has been detected in cylinder number 3.	Possible reduced engine performance.
1657 1326 31	Engine misfire cylinder 4 - Condition exists. Engine misfire has been detected in cylinder number 4.	Possible reduced engine performance.
1658 1327 31	Engine misfire cylinder 5 - Condition exists. Engine misfire has been detected in cylinder number 5.	Possible reduced engine performance.
1659 1328 31	Engine misfire cylinder 6 - Condition exists. Engine misfire has been detected in cylinder number 6.	Possible reduced engine performance.
1668 1761 4	Aftertreatment diesel exhaust fluid tank level sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid tank level sensor circuit.	Possible reduced engine performance.
1669 1761 3	Aftertreatment diesel exhaust fluid tank level sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the catalyst tank level sensor circuit.	Possible reduced engine performance.
1673 1761 1	Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Most severe level. The aftertreatment diesel exhaust fluid tank level has fallen below the critical warning level.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1677 3031 4	Aftertreatment diesel exhaust fluid tank temperature sensor - Voltage below normal or shorted to low source. Low signal voltage detected at the diesel exhaust fluid tank temperature sensor circuit.	Possible reduced engine performance.
1678 3031 3	Aftertreatment diesel exhaust fluid tank temperature sensor - Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the diesel exhaust fluid tank temperature sensor circuit.	Possible reduced engine performance.
1679 3031 2	Aftertreatment diesel exhaust fluid tank temperature - Data erratic, intermittent, or incorrect. The diesel exhaust fluid tank temperature sensor has indicated a tank temperature too high or too low for the ambient conditions.	Possible reduced engine performance.
1682 3362 31	Aftertreatment diesel exhaust fluid dosing unit input lines - Condition exists. The aftertreatment diesel exhaust fluid dosing unit is unable to prime.	Possible reduced engine performance.
1683 3363 3	Aftertreatment diesel exhaust fluid tank heater - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid tank heater circuit.	Possible reduced engine performance.
1684 3363 4	Aftertreatment diesel exhaust fluid tank heater - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid tank heater circuit.	Possible reduced engine performance.
1691 100 18	Aftertreatment diesel oxidation catalyst conversion efficiency - Data valid but below normal operating range - Moderately severe level. The temperature increase across the aftertreatment catalyst is lower than expected.	Possible frequent need for aftertreatment regeneration.
1695 3513 3	Sensor supply 5 - Voltage above normal or shorted to high source. High voltage detected at sensor supply 5 circuit in the oem harness.	the engine will operate in limp home mode.
1696 3513 4	Sensor supply 5 - Voltage below normal or shorted to low source. Low voltage detected at sensor supply number 5 circuit in the oem harness.	the engine will operate in limp home mode.
1712 3363 18	Aftertreatment diesel exhaust fluid tank heater - Data valid but below normal operating range - Moderately severe level. The aftertreatment diesel exhaust fluid tank heater is unable to thaw the frozen diesel exhaust fluid.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1713 3363 16	Aftertreatment diesel exhaust fluid tank heater - Data valid but above normal operating range - Moderately severe level. The diesel exhaust fluid tank heater is continuously in the on position.	None on performance.
1718 1322 31	Engine misfire for multiple cylinders - Condition exists. Engine misfire has been detected in multiple cylinder numbers.	Possible reduced engine performance.
1776 2634 3	Power relay driver circuit - Voltage above normal or shorted to high source. High voltage detected at power relay driver circuit.	Possible reduced engine performance.
1777 2634 4	Power relay driver circuit - Voltage below normal or shorted to low source. An open circuit or low voltage has been detected at the power relay circuit.	Possible reduced engine performance.
1843 101 3	Crankcase pressure circuit - Voltage above normal or shorted to high source. High signal voltage detected at the crankcase pressure circuit.	None on performance.
1844 101 4	Crankcase pressure circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the crankcase pressure circuit.	None on performance.
1866 411 2	Exhaust gas recirculation valve delta pressure - Data erratic, intermittent, or incorrect. An error in the egr delta pressure signal was detected at initial key on or the sensor failed the autozero test.	possible reduced engine performance.
1867 412 2	Engine gas recirculation temperature - Data erratic, intermittent, or incorrect. Engine misfire has been detected in multiple cylinder numbers.	Possible reduced engine performance.
1879 3251 3	Aftertreatment diesel particulate filter differential pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment differential pressure sensor circuit.	possible reduced engine performance.
1881 3251 4	Aftertreatment diesel particulate filter differential pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage or open circuit detected at the aftertreatment differential pressure sensor circuit.	possible reduced engine performance.
1883 3251 2	Aftertreatment diesel particulate filter differential pressure sensor - Data erratic, intermittent, or incorrect. The aftertreatment diesel particulate filter differential pressure sensor is reading an erratic value at initial key on or during engine operation.	possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1885 3216 4	Aftertreatment intake NOx sensor circuit - Voltage below normal or shorted to low source. An internal circuit error has been detected by the aftertreatment intake NOx sensor.	Possible reduced engine performance.
1887 3226 4	Aftertreatment outlet NOx sensor circuit - Voltage below normal or shorted to low source. An internal circuit error has been detected by the aftertreatment outlet NOx sensor.	Possible reduced engine performance.
1896 2791 13	EGR valve controller - Out of calibration. The EGR valve has failed the automatic calibration procedure at initial key ON.	Possible reduced engine performance.
1921 3251 0	Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Moderately severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits.	Possible reduced engine performance.
1922 3251 0	Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Most severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits. Engine protection derate is enabled.	Possible reduced engine performance.
1938 3597 1	Ecu power output supply voltage 1 - Data valid but below normal operational range - Moderately severe level. Low battery voltage detected by the VGT actuator.	Possible reduced engine performance.
1942 101 2	Crankcase pressure - Data erratic, intermittent, or incorrect. The ECM has detected that the crankcase pressure signal is reading an erratic value at initial key ON or during engine operation.	None on performance.
1961 2791 0	EGR valve control circuit calculated over temperature - Data valid but above normal operational range - Least severe level. High EGR valve driver temperature has been detected.	Possible reduced engine performance.
1962 641 0	VGT Actuator driver over temperature (calculated) - Data valid but above normal operating range - Least severe level. High internal VGT actuator temperature has been detected.	None on performance.
1974 101 16	Crankcase pressure - Data valid but above normal operating range - Moderately severe level. The crankcase breather filter requires maintenance.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1993 4795 31	Aftertreatment diesel particulate filter missing - Condition exists. The aftertreatment diesel particulate filter in the exhaust system is not present.	Active aftertreatment diesel particulate filter regeneration will be disabled.
2185 3512 3	Sensor supply 4 circuit - Voltage above normal, or shorted to high source. High voltage detected at 5 VDC sensor supply circuit to the accelerator pedal position sensor.	Engine will only idle.
2186 3512 4	Sensor supply 4 circuit - Voltage below normal, or shorted to low source. Low voltage detected at 5 VDC sensor supply circuit to the accelerator pedal position sensor.	Engine will only idle.
2198 641 11	VGT Actuator driver circuit - Root cause not known. Intermittent communication between the smart VGT controller and the ECM has been detected. The VGT controller is not interpreting the J1939 message from the ECM correctly.	Possible reduced engine performance.
2272 27 4	EGR Valve position circuit - Voltage below normal or shorted to low source. Low signal voltage has been detected at the EGR valve position sensor circuit	Possible reduced engine performance.
2273 411 3	Exhaust gas recirculation valve delta pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the EGR differential pressure sensor circuit.	Possible reduced engine performance.
2274 411 4	Exhaust gas recirculation valve delta pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the EGR differential pressure sensor circuit.	Possible reduced engine performance.
2288 103 15	Turbocharger 1 speed - Data valid but above normal operating range - Least severe level. High turbocharger speed has been detected by the ECM.	Possible reduced engine performance.
2311 633 31	Electronic fuel injection control valve circuit - Condition exists. Fuel pump actuator circuit resistance too high or too low, or an intermittent connection has been detected.	Possible reduced engine performance.
2322 723 2	Engine camshaft speed / position sensor - Data erratic, intermittent, or incorrect. Camshaft engine speed sensor intermittent synchronization.	None on performance.
2349 2791 5	EGR Valve control circuit - Current below normal or open circuit. Motor terminal or motor coil open circuit has been detected by the ECM.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
2353 2791 6	EGR Valve control circuit - Current above normal or grounded circuit. A short circuit to ground has been detected in the EGR valve motor circuit.	Possible reduced engine performance.
2372 95 16	Fuel filter differential pressure - Data valid but above normal operational range - Moderately severe level. Excessive fuel flow restriction to the high pressure fuel pump has been detected.	Possible reduced engine performance.
2373 1209 3	Exhaust gas pressure sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the exhaust gas pressure circuit.	Possible reduced engine performance.
2374 1209 4	Exhaust gas pressure sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the exhaust gas pressure circuit.	Possible reduced engine performance.
2375 412 3	Exhaust gas recirculation temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at EGR temperature circuit.	Possible reduced engine performance.
2376 412 4	Exhaust gas recirculation temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at EGR temperature circuit.	Possible reduced engine performance.
2377 647 3	Fan control circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at the fan control circuit.	The fan can stay on continuously or not run at all.
2387 641 7	VGT Actuator driver circuit (motor) - Mechanical system not responding or out of adjustment. The smart VGT controller has detected incorrect stop limits, or the VGT is unable to move to the closed position.	Possible reduced engine performance.
2398 171 2	Ambient air temperature - Data erratic, intermittent, or incorrect. The ambient air temperature sensor is reading an erratic value.	Possible reduced engine performance.
2448 111 17	Coolant level - Data valid but below normal operational range - Least severe level. Low engine coolant level detected.	none on performance.
2449 641 13	Vgt actuator controller - Out of calibration. The VGT actuator has been installed incorrectly.	Possible reduced engine performance.
2468 102 3	Engine crankshaft speed/position - Data valid but above normal operating range - Moderately severe level. The engine speed has exceeded a critical limit.	Engine will be shut down.
2554 1209 2	Exhaust gas pressure - Data erratic, intermittent or incorrect. The exhaust gas pressure sensor is reading an erratic value.	possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
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.	The intake air heaters may be ON or OFF all the time.
2634 641 12	VGT Actuator controller - Bad intelligent device or component. An internal error has been detected by the smart VGT controller.	Possible reduced engine performance.
2636 641 9	VGT Actuator driver circuit - abnormal update rate. No communications on the J1939 data link between the engine ECM and the smart VGT controller.	Possible reduced engine performance.
2638 5298 17	Aftertreatment diesel oxidation catalyst conversion efficiency - Data valid but below normal operating range - Least severe level. The temperature increase across the aftertreatment diesel oxidation catalyst is lower than expected.	Possible frequent need for aftertreatment regeneration.
2639 3251 15	Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Least severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits.	Possible reduced engine performance.
2646 110 32	Engine coolant temperature - Condition exists. The EGR valve was closed to reduce engine coolant temperature.	Possible reduced engine performance.
2718 520325 31	Brake switch and accelerator pedal position incompatible - Condition exists. The ECM has detected the brake pedal and accelerator pedal were depressed simultaneously.	The engine will operate in limp home mode.
2771 3226 9	Aftertreatment outlet NOx sensor - Abnormal update rate. No communications or an invalid data transfer rate detected on the J1939 data link between the ECM and the aftertreatment outlet NOx sensor.	Possible reduced engine performance.
2777 3703 31	Particulate trap active regeneration inhibited due to inhibit switch - Condition exists. Regeneration of the diesel particulate filter has been prevented due to the permit switch being disabled.	Possible frequent need for aftertreatment regeneration.
2961 412 15	Exhaust gas recirculation temperature - Data valid but above normal operational range - Least severe level. EGR temperature has exceeded the engine protection limit.	Possible reduced engine performance.
2962 412 16	Exhaust gas recirculation temperature - Data valid but above normal operational range - Moderately severe level. EGR temperature has exceeded the engine protection limit.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
2963 110 15	Engine coolant temperature - Data valid but above normal operational range - Least severe level. Engine coolant temperature is above the engine protection warning limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
2964 105 15	Intake manifold 1 temperature - Data valid but above normal operational range - Least severe level. Intake manifold air temperature signal indicates intake manifold air temperature is above engine protection warning limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
2973 102 2	Intake manifold 1 pressure - Data erratic, intermittent, or incorrect. The intake manifold pressure sensor is reading an erratic value.	Possible reduced engine performance.
2976 3361 2	Aftertreatment diesel exhaust fluid dosing unit temperature - Data erratic, intermittent, or incorrect. An internal error has been detected in the aftertreatment diesel exhaust fluid dosing unit.	Possible reduced engine performance.
3133 3610 3	Aftertreatment diesel particulate filter outlet pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the aftertreatment diesel particulate filter outlet pressure sensor circuit.	Possible reduced engine performance.
3134 3610 4	Aftertreatment diesel particulate filter outlet pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment diesel particulate filter outlet pressure sensor circuit.	Possible reduced engine performance.
3135 3610 2	Aftertreatment diesel particulate filter outlet pressure - Data erratic, intermittent or incorrect. The aftertreatment diesel particulate filter outlet pressure sensor is reading an erratic value at initial key ON or during engine operation.	Possible reduced engine performance.
3146 4363 3	Aftertreatment SCR outlet temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the SCR outlet temperature sensor circuit.	Possible reduced engine performance.
3147 4363 4	Aftertreatment SCR outlet temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the SCR outlet temperature sensor circuit.	Possible reduced engine performance.
3148 4363 2	Aftertreatment SCR outlet temperature sensor - Data erratic, intermittent, or incorrect. The SCR outlet temperature sensor is not changing with engine operating conditions.	Possible reduced engine performance.
3151 4794 31	Aftertreatment SCR catalyst system missing - Condition exists. The aftertreatment SCR catalyst in the exhaust system is not present.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3165 4363 0	Aftertreatment SCR outlet temperature - Data valid but above normal operational range - Most severe level. The SCR outlet temperature sensor reading has exceeded the maximum engine protection temperature limit.	Possible reduced engine performance.
3168 3936 16	Aftertreatment diesel particulate filter system - Data valid but above normal operating range - Moderately severe level. The system has detected a malfunction in the filtering capability of the aftertreatment diesel particulate filter.	None on performance.
3186 1623 9	Tachograph output shaft speed - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the tachograph output shaft speed sensor.	None on performance.
3213 1623 19	Tachograph output shaft speed - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the tachograph output shaft speed sensor.	None on performance.
3228 3216 2	Aftertreatment Intake NOx sensor - Data erratic, intermittent, or incorrect. An incorrect NOx sensor reading has been detected by the aftertreatment intake NOx sensor.	Possible reduced engine performance.
3232 3216 9	Aftertreatment Intake NOx sensor - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the aftertreatment intake NOx sensor.	Possible reduced engine performance.
3235 4363 16	Aftertreatment SCR outlet temperature - Data valid but above normal operating range - Moderately severe level. The SCR outlet temperature sensor reading has exceeded the maximum temperature limit.	Possible reduced engine performance.
3237 4340 3	Aftertreatment diesel exhaust fluid line heater 1 circuit - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater 1 circuit.	Possible reduced engine performance.
3238 4340 4	Aftertreatment diesel exhaust fluid line heater 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater 1 circuit.	Possible reduced engine performance.
3239 4342 3	Aftertreatment diesel exhaust fluid line heater 2 circuit - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater 2 circuit.	Possible reduced engine performance.
3241 4342 4	Aftertreatment diesel exhaust fluid line heater 2 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater 2 circuit.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3242 3363 7	Aftertreatment diesel exhaust fluid tank heater - Mechanical system not responding or out of adjustment. The aftertreatment diesel exhaust fluid temperature did not increase when the aftertreatment diesel exhaust fluid tank heater was commanded ON.	Possible reduced engine performance.
3243 3060 18	Engine cooling system monitor - Data valid but below normal operating range - Moderately severe level. The engine is not warming up as expected.	None on performance.
3251 4765 16	Aftertreatment diesel oxidation catalyst intake temperature - Data valid but above normal operating range - Moderately severe level. The diesel oxidation catalyst intake temperature sensor reading has exceeded the maximum temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3253 3242 16	Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Moderately severe level. The aftertreatment diesel particulate filter intake temperature sensor reading has exceeded the maximum engine protection temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the Engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3254 3242 15	Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Least severe level. The aftertreatment diesel particulate filter intake temperature sensor reading has exceeded the maximum engine protection temperature limit.	Possible reduced engine performance.
3255 3246 16	Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Moderately severe level. The aftertreatment diesel particulate filter outlet temperature sensor reading has exceeded the maximum engine protection temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3256 3246 15	Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Least severe level. The aftertreatment diesel particulate filter outlet temperature sensor reading has exceeded the maximum engine protection temperature limit.	Possible reduced engine performance.
3258 4340 5	Aftertreatment diesel exhaust fluid line heater 1 circuit - Current below normal or open circuit. Open circuit detected in the diesel exhaust fluid line heater 1.	Possible reduced engine performance.
3261 4342 5	Aftertreatment diesel exhaust fluid line heater 2 circuit - Current below normal or open circuit. Open circuit detected in the diesel exhaust fluid line heater 2.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3311 3242 0	Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Most severe level. The aftertreatment diesel particulate filter intake temperature sensor reading has exceeded the maximum engine protection temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3312 3246 0	Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Most severe level. The aftertreatment diesel particulate filter outlet temperature sensor reading has exceeded the maximum engine protection temperature limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
3313 4765 4	Aftertreatment diesel oxidation catalyst intake temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the catalyst intake sensor circuit.	Possible reduced engine performance.
3314 4765 3	Aftertreatment diesel oxidation catalyst intake temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage detected at the catalyst intake temperature sensor circuit.	Possible reduced engine performance.
3315 4765 2	Aftertreatment diesel oxidation catalyst intake temperature - Data erratic, intermittent, or incorrect. The aftertreatment diesel oxidation catalyst intake temperature sensor is not changing with engine operating conditions.	Possible reduced engine performance.
3316 3242 4	Aftertreatment diesel particulate filter intake temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel particulate filter intake temperature sensor circuit.	Possible reduced engine performance.
3317 3242 3	Aftertreatment diesel particulate filter intake temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the aftertreatment diesel particulate filter intake temperature sensor circuit.	Possible reduced engine performance.
3318 3242 2	Aftertreatment diesel particulate filter intake temperature - Data erratic, intermittent, or incorrect. The aftertreatment diesel particulate filter intake temperature is not changing with engine operating conditions.	Possible reduced engine performance.
3319 3246 3	Aftertreatment diesel particulate filter outlet temperature sensor circuit - Voltage above normal or shorted to high source. High signal voltage or open circuit detected at the aftertreatment diesel particulate filter outlet temperature sensor circuit.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3321 3246 4	Aftertreatment diesel particulate filter outlet temperature sensor circuit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel particulate filter outlet temperature sensor circuit.	Possible reduced engine performance.
3322 3246 2	Aftertreatment diesel particulate filter outlet temperature - Data erratic, intermittent, or incorrect. The aftertreatment diesel particulate filter outlet temperature is not changing with engine operating conditions.	Possible reduced engine performance.
3326 91 9	SAE J1939 Multiplexed accelerator pedal or lever sensor system - Abnormal update rate. The ECM expected information from a multiplexed accelerator pedal or lever sensor but did not receive it soon enough or did not receive it at all.	Engine will only idle.
3328 191 9	Transmission output shaft speed - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the transmission output shaft speed sensor.	None on performance.
3342 4752 18	Engine exhaust gas recirculation cooler efficiency - Data valid but below normal operating range - Moderately severe level. The EGR cooler is not cooling the recirculated exhaust gas sufficiently.	None on performance.
3343 5285 18	Engine charge-air cooler efficiency - Data valid but below normal operating range - Moderately severe level. The engine charge air cooler is not cooling the intake air flow sufficiently.	None on performance.
3361 102 10	Intake manifold 1 pressure - Abnormal rate of change. The VGT position reading is stuck.	Possible reduced engine performance.
3366 111 18	Coolant level - Data valid but below normal operating range - Moderately severe level. Very low engine coolant level detected.	None on performance.
3374 1818 31	Roll over protection brake control active - Condition exists. The ECM received a message from the anti-lock braking (ABS) controller, inhibiting cruise control operation.	Cruise control could possibly not operate.
3375 5397 31	Aftertreatment diesel particulate filter regeneration too frequent - Condition exists. The system has detected the need for an active regeneration has occurred too soon following the last active regeneration.	None on performance.
3376 5319 31	Aftertreatment diesel particulate filter incomplete regeneration - Condition exists. The system has detected that the aftertreatment diesel particulate filter differential pressure is too high following an active regeneration.	Possible frequent need for aftertreatment regeneration.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3382 3058 18	Engine exhaust gas recirculation (EGR) system - Data valid but below normal operating range - Moderately severe level. Measured egr flow is lower than commanded.	Possible reduced engine performance.
3383 3058 16	Engine exhaust gas recirculation (EGR) system - Data valid but above normal operating range - Moderately severe Level. Measured EGR flow is higher than commanded.	Possible reduced engine performance.
3394 4766 18	Aftertreatment 1 diesel oxidation catalyst outlet gas temperature - Data valid but below normal operating range - Moderately severe level. The diesel oxidation catalyst outlet Temperature is below the operating limit	Possible frequent need for aftertreatment regeneration.
3396 3750 31	Diesel particulate filter 1 conditions not met for active regeneration - Condition exists. The aftertreatment temperatures are not warm enough for aftertreatment injection.	Possible frequent need for aftertreatment regeneration.
3418 191 19	Transmission output shaft speed - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the transmission output shaft speed sensor.	None on performance.
3422 4344 3	Aftertreatment diesel exhaust fluid line heater 3 circuit - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater 3 circuit.	Possible reduced engine performance.
3423 4344 4	Aftertreatment diesel exhaust fluid line heater 3 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater 3 circuit.	Possible reduced engine performance.
3425 4344 5	Aftertreatment diesel exhaust fluid line heater 3 circuit - Current below normal or open circuit. Open circuit detected in the diesel exhaust fluid line heater 3.	Possible reduced engine performance.
3488 563 9	Anti-lock braking (ABS) controller - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the anti-lock braking (ABS) controller.	None on performance.
3492 251 10	Real time clock - Abnormal rate of change. The real time clock indicates a stuck engine off timer.	None on performance.
3494 1081 7	Engine wait to start lamp - Mechanical system not responding or out of adjustment. Wait to Start lamp has malfunction.	None on performance.
3497 1761 17	Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Least severe level. The aftertreatment diesel exhaust fluid tank level is low.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3498 1761 18	Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Moderately severe level. The aftertreatment diesel exhaust fluid tank level is very low.	None on performance.
3525 84 19	Wheel-based vehicle speed - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the wheel-based vehicle speed sensor.	Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work.
3526 84 9	Wheel-Based vehicle speed - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the wheel-based vehicle speed sensor.	Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work.
3527 558 19	Accelerator pedal or lever idle validation switch - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the accelerator pedal or lever idle validation switch.	The engine will only idle.
3528 558 9	Accelerator pedal or lever idle validation switch - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the accelerator pedal or lever idle validation switch.	Engine will only idle.
3531 171 9	Ambient air temperature - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the ambient air temperature sensor.	Possible reduced engine performance.
3532 171 19	Ambient air temperature - Received network data in error. The J1939 multiplexing controller has indicated a malfunction of the ambient air temperature sensor.	Possible reduced engine performance.
3539 51 3	Engine intake throttle actuator position sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the engine intake air throttle position sensor circuit.	Possible reduced engine performance.
3541 51 4	Engine intake throttle actuator position sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the engine intake air throttle position sensor circuit.	Possible reduced engine performance.
3542 51 2	Engine intake throttle actuator position sensor - Data erratic, intermittent or incorrect. The engine intake air throttle position feedback is erratic or incorrect.	Possible reduced engine performance.
3545 3226 10	Aftertreatment outlet NOx sensor circuit - Abnormal rate of change. The aftertreatment outlet NOx sensor reading is not valid.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3547 4096 31	Aftertreatment diesel exhaust fluid tank empty - Condition exists. The diesel exhaust fluid tank is empty.	Possible reduced engine performance.
3555 1081 9	Engine wait to start lamp - Abnormal update rate. A loss of communication has been detected.	None on performance.
3556 1081 19	Engine wait to start lamp - Received network data in error. The ECM received an invalid signal on the SAE J1939 datalink.	None on performance.
3558 3361 3	Aftertreatment diesel exhaust fluid dosing unit - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit.	Possible reduced engine performance.
3559 3361 4	Aftertreatment diesel exhaust fluid dosing unit - Voltage below normal or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit.	Possible reduced engine performance.
3562 5491 3	Aftertreatment diesel exhaust fluid line heater relay - Voltage above normal or shorted to high source. High signal voltage detected at the diesel exhaust fluid line heater relay.	Possible reduced engine performance.
3563 5491 4	Aftertreatment diesel exhaust fluid line heater relay - Voltage below normal or shorted to low source. Low signal voltage detected at the diesel exhaust fluid line heater relay.	Possible reduced engine performance.
3567 5394 5	Aftertreatment diesel exhaust fluid dosing valve - Current below normal or open circuit. A circuit error has been detected in the aftertreatment diesel exhaust fluid dosing valve circuit.	Possible reduced engine performance.
3568 5394 7	Aftertreatment diesel exhaust fluid (DEF) Dosing valve - Mechanical system not responding or out of adjustment. A mechanical malfunction has been detected in the DEF dosing valve.	Possible reduced engine performance.
3571 4334 3	Aftertreatment diesel exhaust fluid pressure sensor - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid pressure sensor circuit.	Possible reduced engine performance.
3572 4334 4	Aftertreatment diesel exhaust fluid pressure sensor - Voltage below normal or shorted to low source. Low signal voltage detected at the diesel exhaust fluid pressure sensor circuit.	Possible reduced engine performance.
3574 4334 18	Aftertreatment diesel exhaust fluid pressure sensor - Data valid but below normal operating range - Moderately severe level. Low diesel exhaust fluid pressure has been detected in the dosing unit.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3575 4334 16	Aftertreatment diesel exhaust fluid pressure sensor - Data valid but above normal operating range - Moderately severe level. The diesel exhaust fluid dosing unit has detected a blockage in the diesel exhaust fluid return flow.	Possible reduced engine performance.
3577 4376 3	Aftertreatment diesel exhaust fluid return valve - Voltage above normal or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid return valve.	Possible reduced engine performance.
3578 4376 4	Aftertreatment diesel exhaust fluid return valve - Voltage below normal, or shorted to low source. Low signal voltage detected at the diesel exhaust fluid return valve.	Possible reduced engine performance.
3582 4364 18	Aftertreatment SCR catalyst conversion efficiency - Data valid but below normal operating range - Moderately severe level. NOx conversion across the SCR catalyst is too low.	Possible reduced engine performance.
3583 5031 10	Aftertreatment outlet NOx sensor heater - Abnormal rate of change. The aftertreatment outlet NOx sensor heater is unable to maintain its normal operating temperature.	None on performance.
3596 4334 2	Aftertreatment diesel exhaust fluid pressure sensor - Data erratic, intermittent, or incorrect. The diesel exhaust fluid pressure sensor has reported a reading too high or low for the operating conditions.	Possible reduced engine performance.
3649 5024 10	Aftertreatment Intake NOx sensor heater - Abnormal rate of change. The aftertreatment intake NOx sensor heater is unable to maintain its normal operating temperature.	None on performance.
3681 3228 2	Aftertreatment outlet NOx sensor power supply - Data erratic, intermittent, or incorrect. The aftertreatment outlet NOx sensor indicates that the power supply to the sensor is incorrect.	None on performance.
3682 3218 2	Aftertreatment Intake NOx sensor power supply - Data erratic, entermittent or encorrect. The aftertreatment intake NOx sensor indicates that the power supply to the sensor is incorrect.	None on performance.
3697 630 12	Engine control module calibration memory - Bad intelligent device or component. Error internal to the ECM related to engine software failures.	Engine may not start or may be difficult to start.
3712 5246 0	Aftertreatment SCR operator inducement - Data valid but above normal operational range - Most severe level. Critical SCR related fault codes have been active for an extended period of time and require immediate attention.	Vehicle speed will be limited to 8 km [5 miles] per hour.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3714 1569 31	Engine protection torque derate - Condition exists. Critical fault codes related to engine operation are active.	Possible reduced engine performance.
3715 188 16	Engine speed at idle - Data valid but below normal operating range - Moderately severe level. The engine speed at idle has exceeded the governed idle speed.	Possible reduced engine performance.
3716 188 18	Engine speed at idle - Data valid but below normal operational range - Moderately severe level. Engine is not maintaining the governed idle speed.	None on performance.
3717 3226 13	Aftertreatment outlet NOx sensor - Out of calibration. A calibration mismatch between the aftertreatment outlet NOx sensor and the ECM has been detected.	None on performance.
3718 3216 13	Aftertreatment intake NOx - Out of calibration. A calibration mismatch between the aftertreatment intake NOx sensor and the ECM has been detected.	None on performance.
3724 168 17	Battery 1 voltage - Data valid but below normal operating range - Least severe level. Low voltage to the EGR valve device driver has been detected.	Possible reduced engine performance.
3725 3216 10	Aftertreatment Intake NOx sensor - Abnormal rate of change. The aftertreatment intake NOx sensor reading is not valid.	None on performance.
3727 5571 7	High pressure common rail fuel pressure relief valve - Mechanical system not responding or out of adjustment. The fuel rail high-pressure relief valve has opened at a lower than expected pressure.	Possible reduced engine performance.
3737 1675 31	Engine starter mode overcrank protection - Condition exists. The starter motor has been temporarily disabled in order to prevent starter damage.	Starter operation is prohibited until the starter motor has adequately cooled.
3741 5571 0	High pressure common rail fuel pressure relief valve - Data valid but above normal operational range - Most severe level. The fuel rail pressure relief valve has opened due to high fuel rail pressure.	Engine may run rough, may stop running, may not start, or may be difficult to start.
3749 3226 20	Aftertreatment outlet NOx sensor - Data not rational - Drifted high. An offset in the outlet NOx sensor reading has been detected.	None on performance.
3838 2978 9	Estimated engine parasitic losses - Percent torque - Abnormal update rate. A loss of communication has been detected.	None on performance.
3843 5603 9	Cruise control disable command - Abnormal update rate. No communication or an invalid data transfer rate has been detected on the J1939 data link between the ECM and the cruise control.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
3844 5605 31	Cruise control pause command - Condition exists. The adaptive cruise control has dropped out and must be manually engaged.	Cruise control could possibly not operate.
3845 5603 31	Cruise control disable command - Condition exists. The adaptive cruise control has dropped out and must be manually engaged.	Cruise control could possibly not operate.
3899 5848 4	Aftertreatment 1 SCR Intermediate NH3 sensor - Voltage below normal, or shorted to low source. A circuit error has been detected in the NH3 sensor.	None on performance.
3911 5848 9	Aftertreatment SCR Intermediate NH3 sensor - Abnormal update rate. Loss of communication with the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3912 5853 10	Aftertreatment SCR Intermediate NH3 sensor heater - Abnormal rate of change. A malfunction of the aftertreatment SCR intermediate NH3 sensor heater has been detected.	Possible reduced engine performance.
3932 5851 16	Aftertreatment SCR Intermediate NH3 gas sensor power supply - Data valid but above normal operating range - Moderately severe level. High battery voltage supply detected at the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3933 5851 18	Aftertreatment SCR Intermediate NH3 gas sensor power supply - Data valid but below normal operating range - Moderately severe level. Low battery voltage supply detected at the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3934 5851 2	Aftertreatment SCR Intermediate NH3 gas sensor power supply - Data erratic, intermittent or incorrect. Intermittent battery voltage supply detected at the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3935 5848 13	Aftertreatment SCR Intermediate NH3 sensor - Out of calibration. Incorrect trim resistance has been detected in the aftertreatment SCR intermediate NH3 sensor.	Possible reduced engine performance.
3936 5848 12	Aftertreatment SCR Intermediate NH3 sensor - Bad intelligent device or component. An internal error of the aftertreatment SCR intermediate NH3 sensor has been detected.	Possible reduced engine performance.
3937 5848 10	Aftertreatment 1 SCR Intermediate NH3 sensor - Abnormal rate of change. The aftertreatment SCR intermediate NH3 sensor reading is NOT valid.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4149 2623 8	Accelerator pedal or lever position sensor 2 circuit frequency - Abnormal frequency or pulse width or period. The accelerator pedal position sensor reading is out of range.	The engine will operate in Limp Home mode.
4151 5742 9	Aftertreatment diesel particulate filter temperature sensor module - Abnormal update rate. No communications on the J1939 data link between the ECM and the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4152 5743 9	Aftertreatment selective catalytic reduction temperature sensor module - Abnormal update rate. No communications on the J1939 data link between the ECM and the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4155 5746 3	Aftertreatment 1 diesel exhaust fluid dosing unit heater relay - Voltage above normal, or shorted to high source. High signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit heater relay circuit.	Possible reduced engine performance.
4156 5746 4	Aftertreatment 1 diesel exhaust fluid dosing unit heater relay - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment diesel exhaust fluid dosing unit heater relay circuit.	Possible reduced engine performance.
4157 4376 7	Aftertreatment diesel exhaust fluid return valve - Mechanical system not responding or out of adjustment. A stuck aftertreatment diesel exhaust fluid return valve has been detected.	None on performance.
4158 5742 12	Aftertreatment diesel particulate filter temperature sensor module - Bad intelligent device or component. An internal error has been detected in the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4159 5743 12	Aftertreatment selective catalytic reduction temperature sensor module - Bad intelligent device or component. An internal error has been detected in the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4161 5742 3	Aftertreatment diesel particulate filter temperature sensor module - Voltage above normal, or shorted to high source. High battery supply voltage detected at the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4162 5742 4	Aftertreatment diesel particulate filter temperature sensor module - Voltage below normal, or shorted to low source. Low battery supply voltage detected at the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4163 5742 16	Aftertreatment diesel particulate filter temperature sensor module- Data valid but above normal operating range - Moderately severe level. High internal temperature detected in the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4164 5743 3	Aftertreatment selective catalytic reduction temperature sensor module - Voltage above normal, or shorted to high source. High battery supply voltage detected at the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4165 5743 4	Aftertreatment selective catalytic reduction temperature sensor module - Voltage below normal, or shorted to low source. Low battery supply voltage detected at the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4166 5743 16	Aftertreatment selective catalytic reduction temperature sensor module - Data valid but above normal operating range - Moderately severe level. High internal temperature detected in the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4168 5745 3	Aftertreatment diesel exhaust fluid dosing unit heater - Voltage above normal, or shorted to high source. The aftertreatment diesel exhaust fluid dosing unit heater is detected to be stuck on.	None on performance.
4169 5745 5	Aftertreatment diesel exhaust fluid dosing unit heater - Voltage below normal, or shorted to low source. The aftertreatment diesel exhaust fluid dosing unit heater is detected to be stuck off.	Possible reduced engine performance.
4171 5745 18	Aftertreatment diesel exhaust fluid dosing unit heater - Data valid but below normal operating range - Moderately severe level. The aftertreatment diesel exhaust fluid dosing unit failed to thaw.	Possible reduced engine performance.
4213 3695 2	Aftertreatment diesel particulate filter regeneration inhibit switch - Data erratic, intermittent or incorrect. The diesel particulate filter regeneration permit switch is stuck in the OFF or INHIBIT position.	Possible frequent need for aftertreatment regeneration.
4215 563 31	Anti-lock braking (ABS) Active - Condition exists. Cruise control was paused due to an anti-wheel slip message from the ABS controller.	Adaptive cruise control will not operate. Standard cruise control may not operate.
4244 4337 2	Aftertreatment diesel exhaust fluid dosing temperature - Data erratic, intermittent or incorrect. The aftertreatment diesel exhaust fluid dosing temperature is irrational.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4245 5798 2	Aftertreatment diesel exhaust fluid dosing unit heater temperature - Data erratic, intermittent or incorrect. The aftertreatment diesel exhaust fluid dosing unit heater temperature is irrational.	None on performance.
4249 4337 10	Aftertreatment diesel exhaust fluid dosing temperature - Abnormal rate of change. The aftertreatment diesel exhaust fluid dosing unit temperature is stuck.	None on performance.
4251 5798 10	Aftertreatment 1 diesel exhaust fluid dosing unit heater temperature - Abnormal rate of change. The aftertreatment diesel exhaust fluid dosing unit heater temperature sensor reading is stuck.	None on performance.
4252 1081 31	Engine wait to start lamp - Condition exists. The received signal does not match the commanded signal.	None on performance.
4259 5742 11	Aftertreatment diesel particulate filter temperature sensor module - Root cause not known. Intermittent battery voltage supply detected at the aftertreatment diesel particulate filter temperature sensor module.	Possible reduced engine performance.
4261 5743 11	Aftertreatment selective catalytic reduction temperature sensor module - Root cause not known. Intermittent battery voltage supply detected at the aftertreatment SCR temperature sensor module.	Possible reduced engine performance.
4279 5848 21	Aftertreatment 1 SCR Intermediate NH3 - Data not rational - Drifted low. An in range low failure has been detected.	Possible reduced engine performance.
4281 5848 2	Aftertreatment SCR Intermediate NH3 - Data erratic, intermittent or incorrect. The aftertreatment SCR intermediate NH3 sensor reading is stuck.	None on performance.
4284 5793 9	Desired engine fueling state - Abnormal update rate. A valid message from the transmission ECU has NOT been received.	Engine may not start or may be difficult to start.
4289 91 8	Accelerator pedal or lever position sensor 1 circuit frequency - Abnormal frequency or pulse width or period. The accelerator pedal position sensor reading is out of range.	The engine will operate in limp home mode.
4452 520668 31	Aftertreatment outlet NOx sensor closed loop operation - Condition exists. The maximum dosing adjustment has been reached.	Possible reduced engine performance.
4453 520669 31	Aftertreatment intermediate NH3 sensor closed loop operation - Condition exists. The maximum dosing adjustment has been reached.	None on performance.
4517 237 13	Vehicle Identification number - Out of calibration. The vehicle identification number has not been programmed into the ECM.	None on performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4518 5862 3	Aftertreatment SCR Intermediate gas temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the aftreatment SCR intermediate temperature sensor circuit.	Possible reduced engine performance.
4519 5862 4	Aftertreatment SCR Intermediate gas temperature sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the aftertreatment SCR intermediate temperature sensor circuit.	Possible reduced engine performance.
4521 5862 2	Aftertreatment SCR Intermediate gas temperature sensor - Data erratic, intermittent or incorrect. The aftertreatment SCR intermediate temperature sensor reading is irrational.	Possible reduced engine performance.
4524 5862 0	Aftertreatment SCR intermediate gas temperature - Data valid but above normal operational range - Most severe level. The aftertreatment SCR intermediate temperature sensor reading is above the engine protection limit.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
4525 5862 16	Aftertreatment 1 SCR intermediate gas temperature - Data valid but above normal operating range - Moderately severe level. High SCR Intermediate temperature detected.	Progressive power and/or speed derate increasing in severity from time of alert. If the engine protection shutdown feature is enabled, the engine will shut down 30 seconds after the red STOP lamps starts flashing.
4526 521 2	Brake pedal position - Data erratic, intermittent or incorrect. The values of the 2 brake switch signals do not match.	None on performance.
4572 3031 9	Aftertreatment diesel exhaust fluid tank temperature - Abnormal update rate. The ECM lost communication with the aftertreatment diesel exhaust fluid tank temperature sensor.	Possible reduced engine performance.
4584 3936 14	Aftertreatment diesel particulate filter system - Special instructions. The incorrect aftertreatment diesel particulate filter system has been installed with the engine.	Engine will be shut down.
4585 4792 14	Aftertreatment 1 SCR catalyst system - Special instructions. The incorrect SCR system has been Installed.	Engine will be shut down.
4612 520701 31	Engine intake manifold pressure system monitor - Condition exists. The engine is unable to meet the air handling system commands.	Possible reduced engine performance.
4658 4331 18	Aftertreatment SCR actual dosing reagent quantity - Data valid but below normal operating range - Moderately severe level. Low aftertreatment diesel exhaust fluid flow detected.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
4691 5585 18	Engine injector metering rail 1 cranking pressure - Data valid but below normal operating range - Moderately severe level. The fuel rail pressure during cranking is too low for the engine to start.	Engine may not start or may be difficult to start.
4713 5357 31	Engine fuel injection quantity error for multiple cylinders - Condition exists. A malfunction of all fuel injectors has been detected.	Engine may run rough, may stop running, may not start, or may be difficult to start.
4726 1239 16	Engine fuel leakage - Data valid but above normal operating range - Moderately severe level. Fuel rail pressure decay has been detected.	Engine may run rough, may stop running, may not start, or may be difficult to start.
4727 157 15	Injector metering rail 1 pressure - Data valid but above normal operating range - Least severe level. A self pumping condition has been detected in the fuel system.	Possible reduced engine performance.
4731 3031 13	Aftertreatment diesel exhaust fluid tank temperature sensor - Out of calibration. The received datalink message was not valid.	Possible reduced engine performance.
4732 1761 13	Aftertreatment diesel exhaust fluid tank level sensor - Out of calibration. The received datalink message was not valid.	None on performance.
4739 1761 11	Aftertreatment 1 diesel exhaust fluid tank level sensor - Root cause not known. An unknown error has been detected with the aftertreatment diesel exhaust fluid tank level sensor.	Possible reduced engine performance.
4769 1761 10	Aftertreatment 1 diesel exhaust fluid tank level sensor - Abnormal rate of change. A valid diesel exhaust fluid tank level reading has NOT been received.	Possible reduced engine performance.
4865 6303 3	Engine coolant level 2 sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the engine coolant level 2 circuit.	None on performance.
4866 6303 4	Engine coolant level 2 sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the engine coolant level 2 circuit.	None on performance.
4956 520750 13	Engine variable geometry turbo (VGT) software - Out of calibration. VGT software does not match application.	Possible reduced engine performance.
4957 520750 31	Engine variable geometry turbo (VGT) software - Condition exists. The VGT actuator and ECM software is not compatible.	Possible reduced engine performance.

※ Some fault codes are not applied to this machine.

3) DEFINITION OF OPERATING MODES

(1) Normal

There's no failure detected in the transmission system or the failure has no or slight effects on transmission control. TCU will work without or in special cases with little limitations. (See following table)

(2) Substitute clutch control

TCU can't change the gears or the direction under the control of the normal clutch modulation. TCU uses the substitute strategy for clutch control. All modulations are only time controlled. (Comparable with EST-25)

(3) Limp-home

The detected failure in the system has strong limitations to transmission control. TCU can engage only one gear in each direction. In some cases only one direction will be possible.

TCU will shift the transmission into neutral at the first occurrence of the failure. First, the operator must shift the gear selector into neutral position.

If output speed is less than a threshold for neutral to gear and the operator shifts the gear selector into forward or reverse, the TCU will select the limp-home gear.

If output speed is less than a threshold for reversal speed and TCU has changed into the limp-home gear and the operator selects a shuttle shift, TCU will shift immediately into the limp-home gear of the selected direction.

If output speed is greater than the threshold, TCU will shift the transmission into neutral. The operator has to slow down the vehicle and must shift the gear selector into neutral position.

(4) Transmission-shutdown

TCU has detected a severe failure that disables control of the transmission.

TCU will shut off the solenoid valves for the clutches and also the common power supply (VPS1).

Transmission shifts to neutral. The park brake will operate normally, also the other functions which use ADM1 to ADM8.

The operator has to slow down the vehicle. The transmission will stay in neutral.

(5) TCU-shutdown

TCU has detected a severe failure that disables control of system.

TCU will shut off all solenoid valves and also both common power supplies (VPS1, VPS2). The park brake will engage, also functions are disabled which use ADM 1 to ADM 8.

The transmission will stay in neutral.

※ Abbreviations

OC : Open circuit

SC : Short circuit

OP mode : Operating mode

TCU : Transmission control unit

EEC : Electronic engine controller

PTO : Power take off

4) TRANSMISSION(TM) FAULT CODES

SPN	FMI	Description	Fault reaction
523000	3	Battery overvoltage	TCU Shutdown
523000	1	Battery low undervoltage	TCU Shutdown
523000	4	Battery undervoltage	TM Shutdown
523001	1	Battery undervoltage during engine start	Normal
523010	3	EC-II internal 5V power supply overvoltage	TCU Shutdown
523010	4	EC-II internal 5V power supply undervoltage	TCU Shutdown
523011	4	EC-II internal 7V power supply undervoltage	TCU Shutdown
523020	3	Supply for speed sensors (AU3) overvoltage	TM Shutdown
523020	6	Supply for speed sensors (AU3) short to ground	TM Shutdown
523020	4	Supply for speed sensors (AU3) undervoltage	TM Shutdown
523021	3	Supply for temperature sensors, oil filter restriction switch and the ECIIb high pressure sensors (AU2) overvoltage	TM Shutdown
523021	6	Supply for temperature sensors, oil filter restriction switch and the ECIIb high pressure sensors (AU2) short to ground	TM Shutdown
523021	4	Supply for temperature sensors, oil filter restriction switch and the ECIIb high pressure sensors (AU2) undervoltage	TM Shutdown
523022	3	Voltage output 1 (AU1) overvoltage	TM Shutdown
523022	6	Voltage output 1 (AU1) short to ground	TM Shutdown
523022	4	Voltage output 1 (AU1) undervoltage	TM Shutdown
523030	3	Propvalve power supply 1 overvoltage	TCU Shutdown
523030	4	Propvalve power supply 1 undervoltage	TCU Shutdown
523031	3	Propvalve power supply 2 overvoltage	TCU Shutdown
523031	4	Propvalve power supply 2 undervoltage	TCU Shutdown
523040	0	TCU overtemperature	Limp Home
523040	2	TCU temperature invalid value	TCU Shutdown
523045	12	Internal TCU Error : CRC	TCU Shutdown
523046	12	Internal TCU Error : watchdog/power supply	TCU Shutdown
523047	12	Internal TCU Error : reset	TCU Shutdown
523048	12	Internal TCU Error : software robustness	TCU Shutdown
523049	12	Unknown transmission controller hardware detected	TCU Shutdown
523050	0	Invalid Transmission Identification	TCU Shutdown
523100	2	Unknown electrical component at nKR speed sensor input	TM Shutdown
523100	3	nKR speed sensor overvoltage	Limp Home
523100	6	nKR speed sensor open or short to ground	Limp Home
523100	7	nKR speed does not match with other speeds	Limp Home
523100	8	nKR direction of rotation unknown	Limp Home
523100	9	nKR speed unknown	Limp Home
523100	11	nKR direction of rotation does not match with other directions of rotation	Limp Home

SPN	FMI	Description	Fault reaction
523105	2	Unknown electrical component at nSo2 speed sensor input	TM Shutdown
523105	3	nSo2 speed sensor overvoltage	Limp Home
523105	6	nSo2 speed sensor open or short to ground	Limp Home
523105	7	nSo2 speed does not match with other speeds	Limp Home
523105	8	nSo2 direction of rotation unknown	Limp Home
523105	9	nSo2 speed unknown	Limp Home
523105	11	nSo2 direction of rotation does not match with other directions of rotation	Limp Home
523110	2	Unknown electrical component at output speed sensor input	TM Shutdown
523110	3	Output speed sensor overvoltage	TM Shutdown
523110	6	Output speed sensor open or short to ground	TM Shutdown
523110	7	Output speed does not match with other speeds	TCU Shutdown
523110	8	Output speed direction of rotation unknown	TM Shutdown
523110	9	Output speed unknown	TM Shutdown
523110	11	Output speed direction of rotation does not match with other directions of rotation	TCU Shutdown
523115	2	Unknown electrical component at speed sensor input 4	TM Shutdown
523125	2	Unknown electrical component at voltage input 1 (EU1)	TM Shutdown
523125	3	Overvoltage at voltage input 1 (EU1)	Limp Home
523125	6	Open circuit or short to gnd at voltage input 1 (EU1)	Limp Home
523130	2	Unknown electrical component at voltage input 2 (EU2)	TM Shutdown
523130	3	Overvoltage at voltage input 2 (EU2)	Limp Home
523130	6	Open circuit or short to gnd at voltage input 2 (EU2)	Limp Home
523140	2	Unknown electrical component at sump temperature input (input resistance 1)	TM Shutdown
523140	3	Sump temperature sensor open circuit or shorted to high source	Limp Home
523140	6	Sump temperature sensor short to ground	Limp Home
523140	5	Sump temperature sensor overvoltage	Limp Home
523145	2	Unknown component at resistance input 2	TM Shutdown
523155	2	Unknown electrical component at current input 2	TM Shutdown
523155	3	Oil Filter Restriction Switch overvoltage	Normal
523155	6	Oil Filter Restriction Switch open circuit or short to ground	Normal
523155	4	Oil Filter Restriction Switch undervoltage	Normal
523160	2	Unknown electrical component at voltage input 3 (EU3)	TM Shutdown
523160	3	Overvoltage at ECIIb high pressure sensor AB (EU3)	Limp Home
523160	6	Open circuit or short to gnd at ECIIb high pressure sensor AB (EU3)	Limp Home
523165	2	Unknown electrical component at voltage input 4 (EU4)	TM Shutdown
523165	3	Overvoltage at ECIIb high pressure sensor A (EU4)	Limp Home
523165	6	Open circuit or short to gnd at ECIIb high pressure sensor A (EU4)	Limp Home

SPN	FMI	Description	Fault reaction
523200	0	Clutch KV slipping unintentionally	TM Shutdown
523200	2	Unknown electrical component at current output 1	TM Shutdown
523200	3	Propvalve for Clutch KV short to battery	Limp Home
523200	5	Propvalve for Clutch KV open circuit	Limp Home
523200	6	Propvalve for Clutch KV short to ground	TCU Shutdown
523200	8	Propvalve for Clutch KV: short circuit to another valve	TCU Shutdown
523205	0	Clutch KR slipping unintentionally	TM Shutdown
523205	2	Unknown electrical component at current output 2	TM Shutdown
523205	3	Propvalve for Clutch KR short to battery	Limp Home
523205	5	Propvalve for Clutch KR open circuit	Limp Home
523205	6	Propvalve for Clutch KR short to ground	TCU Shutdown
523205	8	Propvalve for Clutch KR short circuit to another valve	TCU Shutdown
523210	2	Unknown electrical component at current output 3	TM Shutdown
523210	3	Propvalve for internal DiffLock : Short to battery	Limp Home
523210	5	Propvalve for internal DiffLock : open circuit	Normal
523210	6	Propvalve for internal DiffLock : short to ground	TM Shutdown
523210	8	Propvalve for internal DiffLock : short circuit to another valve	TCU Shutdown
523215	0	Clutch K1 slipping unintentionally	TM Shutdown
523215	2	Unknown electrical component at current output 4	TM Shutdown
523215	3	Propvalve for Clutch K1 short to battery	Limp Home
523215	5	Propvalve for Clutch K1 open circuit	TM Shutdown
523215	6	Propvalve for Clutch K1 short to ground	TCU Shutdown
523215	8	Propvalve for Clutch K1: short circuit to another valve	TCU Shutdown
523220	0	Clutch K2 slipping unintentionally	Limp Home
523220	2	Unknown electrical component at current output 5	TM Shutdown
523220	3	Propvalve for Clutch K2 short to battery	Limp Home
523220	5	Propvalve for Clutch K2 open circuit	Limp Home
523220	6	Propvalve for Clutch K2 short to ground	TCU Shutdown
523220	8	Propvalve for Clutch K2: short circuit to another valve	TCU Shutdown
523225	2	Unknown electrical component at current output 6	TM Shutdown
523225	3	Propvalve for internal Axle Disconnect (AA) short to battery	Limp Home
523225	5	Propvalve for internal Axle Disconnect (AA) open circuit	Limp Home
523225	6	Propvalve for internal Axle Disconnect (AA) short to ground	Limp Home
523225	8	Propvalve for internal Axle Disconnect (AA): short circuit to another valve	TCU Shutdown
523230	2	Unknown electrical component at current output 7	TCU Shutdown
523230	3	Propvalve for current output 7 (AIM7) short to battery	Limp Home

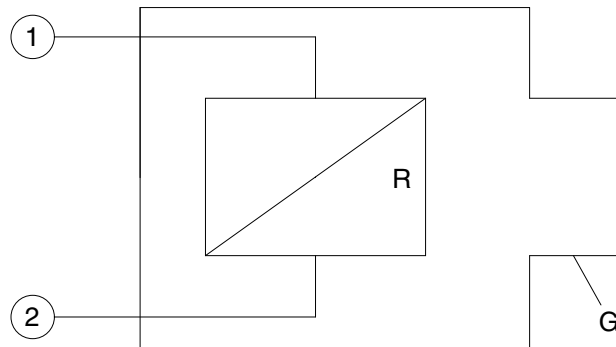
SPN	FMI	Description	Fault reaction
523230	5	Propvalve for current output 7 (AIM7) open circuit	Normal
523230	6	Propvalve for current output 7 (AIM7) short to ground	Normal
523230	8	Propvalve for current output 7 (AIM7) : short circuit to another valve	TCU Shutdown
523235	0	Clutch K3 slipping unintentionally	Limp Home
523235	2	Unknown electrical component at current output 8	TM Shutdown
523235	3	Propvalve for Clutch K3 short to battery	Limp Home
523235	5	Propvalve for Clutch K3 open circuit	Limp Home
523235	6	Propvalve for Clutch K3 short to ground	TCU Shutdown
523235	8	Propvalve for Clutch K3 : short circuit to another valve	TCU Shutdown
523240	2	Unknown electrical component at current output 9	TM Shutdown
523240	3	Propvalve for external Differential Lock (DL) short to battery	Limp Home
523240	5	Propvalve for external Differential Lock (DL) open circuit	Limp Home
523240	6	Propvalve for external Differential Lock (DL) short to ground	Limp Home
523240	8	Propvalve for external DL: short circuit to another valve	TCU Shutdown
523245	2	Unknown electrical component at current output 10	TM Shutdown
523245	3	Propvalve for external Axle Disconnect (AA) short to battery	Limp Home
523245	5	Propvalve for external Axle Disconnect (AA) open circuit	Limp Home
523245	6	Propvalve for external Axle Disconnect (AA) : short to ground	Limp Home
523245	8	Propvalve for external Axle Disconnect (AA) : short circuit to another valve	TCU Shutdown
523250	2	Unknown electrical component at current output 11	TCU Shutdown
523250	3	Propvalve for position control (PRV) short to battery	TCU Shutdown
523250	5	Propvalve for position control (PRV) open circuit	TCU Shutdown
523250	6	Propvalve for position control (PRV) short to ground	TCU Shutdown
523250	8	Propvalve for position control (PRV) short circuit to another valve	TCU Shutdown
523300	0	Transmission Sump Oil most severe overtemperature	Limp Home
523300	15	Transmission Sump Oil least severe overtemperature	Normal
523300	16	Transmission Sump Oil moderately severe overtemperature	Normal
523305	0	Oil Filter contaminated	Normal
523310	0	Transmission input torque too high	Normal
523320	15	Overspeed at transmission output	TM Shutdown
523321	9	Transmission Output speed gradient too high	TM Shutdown
523330	15	Overspeed at transmission input	TM Shutdown
523340	0	Implausible high pressure signals detected	Normal
523350	9	Hydrostat does not follow	TCU Shutdown
523351	13	Drift compensation of high pressure sensor AB not available	Normal
523352	13	Drift compensation of high pressure sensor A not available	Normal

SPN	FMI	Description	Fault reaction
523353	9	High pressure value too high	Normal
523355	15	Clutch KV less severe temperature exceeded	Normal
523355	0	Clutch KV more severe temperature exceeded	TM Shutdown
523356	15	Clutch KR less severe temperature exceeded	Normal
523356	0	Clutch KR more severe temperature exceeded	TM Shutdown
523360	9	Calibration Data Lost. TCU was not able to read correct calibration parameters	Normal
523365	0	Coldstart aborted unexpectedly	TCU Shutdown
523365	1	Sumptemperature too low for normal operation	TCU Shutdown
523365	2	High pressure failure while active cold start	TCU Shutdown
523365	3	Cold start phase time out	Limp Home
523365	4	Unexpected engine speed during cold start	TCU Shutdown
523370	0	Unexpected vehicle motion from standstill	TM Shutdown
523371	0	Driveline engagement failed	TM Shutdown
523400	9	Machine CAN failure	TM Shutdown
523401	9	Service CAN failure	Normal
523411	9	Message ZFTC1 invalid or timeout	TM Shutdown
523412	9	Message ZFTC8 invalid or timeout	TM Shutdown
523413	9	Message EEC1 invalid or timeout	TM Shutdown
523414	9	Message EEC2 invalid or timeout	TM Shutdown
523415	9	Message EEC3 invalid or timeout	TM Shutdown
523416	9	Message EC1 invalid or timeout	Normal
523417	9	Message B invalid or timeout	TM Shutdown
523418	9	Message EBC1 invalid or timeout	TM Shutdown
523420	9	Message CCVS invalid or timeout	TM Shutdown
523425	9	Message ZFIMPinvalid or timeout	Normal
523470	19	Operation Mode command invalid	TM Shutdown
523471	19	Transmission Control command invalid	TM Shutdown
523472	19	Hydrostatic Unit command invalid	TM Shutdown
523473	19	Axle Disconnect command invalid	Limp Home
523474	19	Difflock command invalid	Normal
523480	9	Machine Configuration invalid	Normal
523500	0	Overspeed engine	Normal
523501	0	Engine Speed Limitation is not effective	Normal
523502	0	Engine Speed Demand is not effective	Normal
523505	0	Neutral shift to protect engine from stalling	Normal
523600	0	Protection Function Error	TM Shutdown

SPN	FMI	Description	Fault reaction
523600	1	SF01 Avoid unwanted driveaway	TM Shutdown
523600	2	SF02 Safe Direction	TM Shutdown
523600	3	SF03 Safely limited acceleration	TM Shutdown
523600	5	SF05 Safe Output	TM Shutdown
523600	7	SF07 Safely limited speed	TM Shutdown
523600	10	SF10 Protection limited delayed get into gear	TM Shutdown
523600	11	SF11 Safe Lock	TM Shutdown
523600	12	SF12 Safe Transmission Output Shaft Speed	TM Shutdown
523600	14	SF14 Safe current on PRV valve	TCU Shutdown
523601	0	Protection related error in Transmission detected	TM Shutdown
523602	0	Protection related error in Vehicle Communication detected	TM Shutdown
523603	0	Protection Error Reaction failed	TCU Shutdown

5) MEASURING OF RESISTANCE AT ACTUATOR/SENSOR AND CABLE

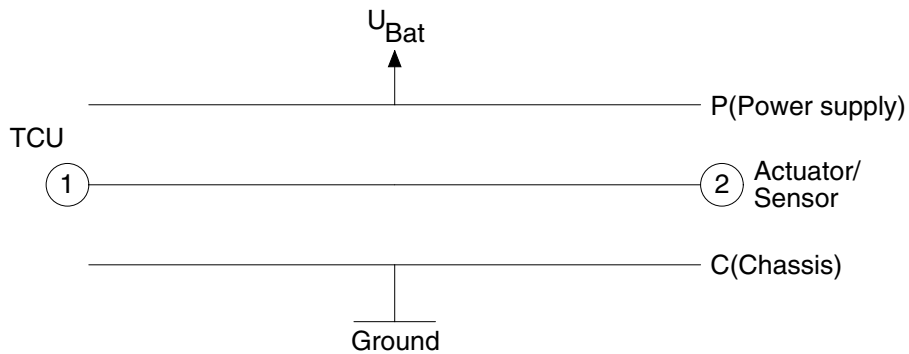
(1) Actuator



76043PT19

- Open circuit $R_{12} = R_{1G} = R_{2G} = \infty$
- Short cut to ground $R_{12} = R$; $R_{1G} = 0$, $R_{2G} = R$ or $R_{1G} = R$, $R_{2G} = 0$
 (For S.C. to ground, G is connected to vehicle ground)
- Short cut to battery $R_{12} = R$; $R_{1G} = 0$, $R_{2G} = R$ or $R_{1G} = R$, $R_{2G} = 0$
 (For S.C. to battery, G is connected to battery voltage)

(2) Cable



76043PT20

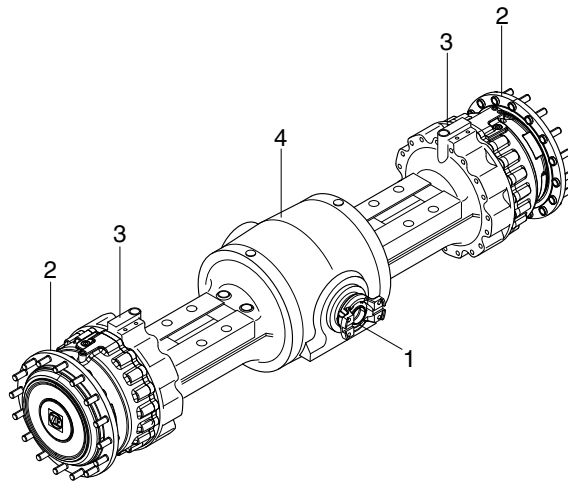
- Open circuit $R_{12} = R_{1P} = R_{1C} = R_{2P} = R_{2C} = \infty$
- Short cut to ground $R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = \infty$
- Short cut to battery $R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = 0$

5. AXLE

1) OPERATION

- The power from the engine passes through torque converter, transmission and drive shafts, and is then sent to the front and rear axles.
- Inside the axles, the power passes from the bevel pinion to the bevel gear and is sent at right angles. At the same time, the speed is reduced and passes through the both differentials to the axle shafts. The power of the axle shafts is further reduced by planetary-gear-type final drives and is sent to the wheels.

(1) Front axle



7709A3PT10

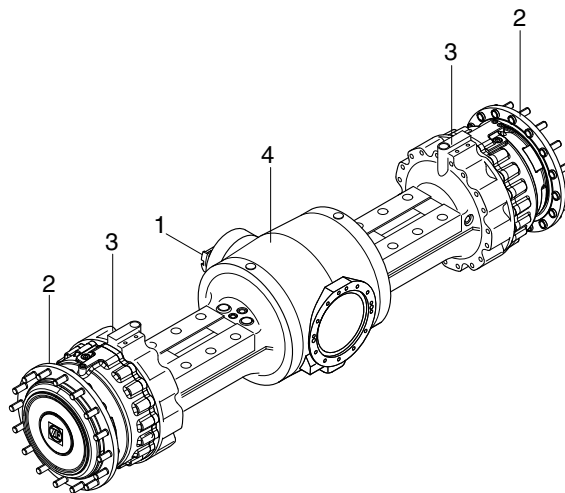
1 Input

2 Output

3 Brake

4 Axle housing

(2) Rear axle



7709A3PT11

1 Input

2 Output

3 Brake

4 Axle housing

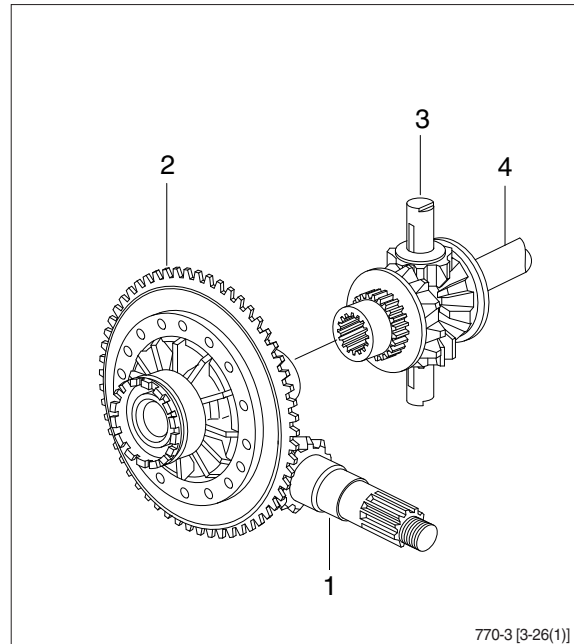
2) DIFFERENTIAL

(1) Description

When the machine makes a turn, the outside wheel must rotate faster than the inside wheel. A differential is a device which continuously transmits power to the right and left wheels while allowing them to turn at different speeds, during a turn.

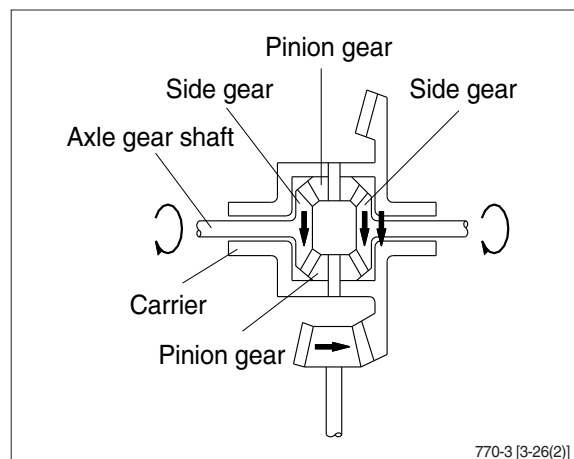
The power from the drive shaft passes through bevel pinion (1) and is transmitted to the bevel gear (2). The bevel gear changes the direction of the motive force by 90 degrees, and at the same time reduces the speed.

It then transmits the motive force through the differential (3) to the axle gear shaft (4).



(2) When driving straight forward

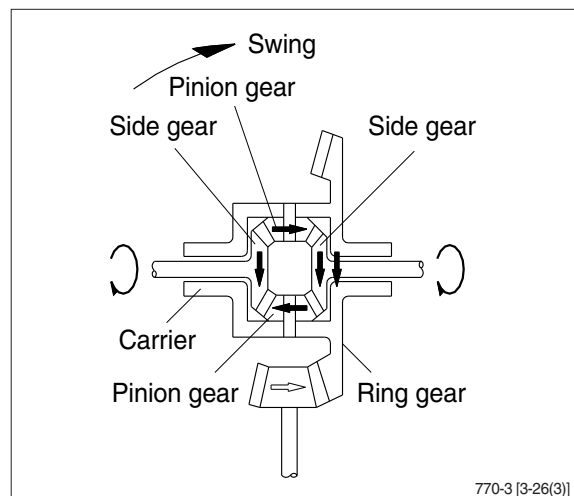
When the machine is being driven straight forward and the right and left wheels are rotating at the same speed, so the pinion gear inside the differential assembly do not rotate. The motive force of the carrier is sent through the pinion gear and the side gear, therefore the power is equally transmitted to the left and right axle gear shaft.



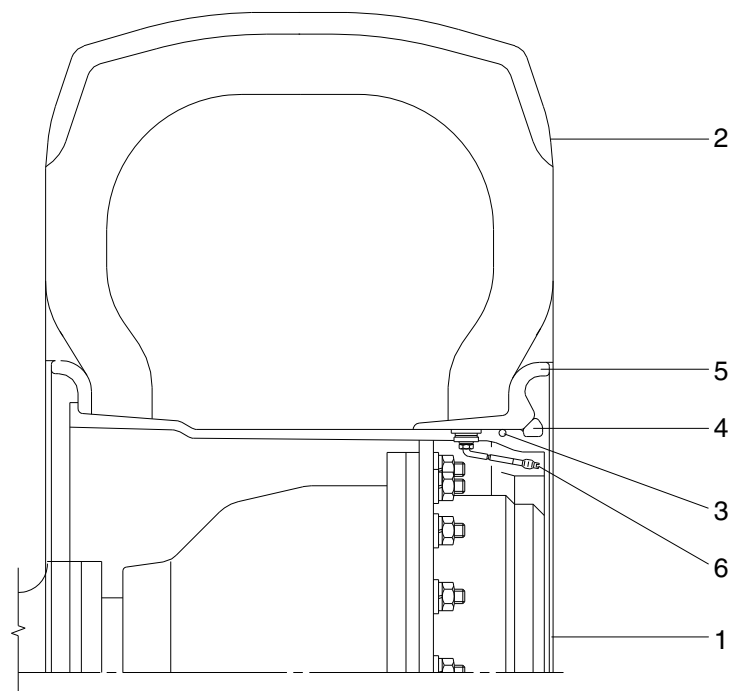
(3) When turning

When turning, the rotating speed of the left and right wheels is different, so the pinion gear and side gear inside the differential assembly rotate in accordance with the difference between the rotating speed of the left and right wheels.

The power of the carrier is then transmitted to the axle gear shafts.



6. TIRE AND WHEEL



7407APT10

- | | | | | | |
|---|-----------|---|-----------|---|----------------|
| 1 | Wheel rim | 3 | O-ring | 5 | Side ring |
| 2 | Tire | 4 | Lock ring | 6 | Valve assembly |

- 1) The tire acts to absorb the shock from the ground surface to the machine, and at the same time they must rotate in contact with the ground to gain the power which drives the machine.
- 2) Various types of tires are available to suit the purpose. Therefore it is very important to select the correct tires for the type of work and bucket capacity.

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. POWER TRAIN OPERATIONAL CHECKS

This procedure is designed so that the mechanic can make a quick check of the system using a minimum amount of diagnostic equipment. If you need additional information, read Structure and function, Group 1.

A location will be required which is level and has adequate space to complete the checks.

The engine and all other major components must be at operating temperature for some checks.

Locate system check in the left column and read completely, following the sequence from left to right. Read each check completely before performing.

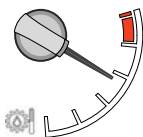



At the end of each check, if no problem is found(OK), that check is complete or an additional check is needed. If problem is indicated(NOT OK), you will be given repair required and group location.



If verification is needed, you will be given next best source of information :


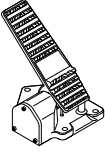
Chapter 2 : Troubleshooting

Group 3 : Tests and adjustments

※ Transmission oil must be at operating temperature for these checks.

Item	Description	Service action
<p>Transmission oil warm-up procedure</p>	 <p>Start engine. Apply service brakes and release parking brake.</p> <p>Move gear selector lever to 3rd speed.</p> <p>Move gear selector lever to forward "F" position.</p> <p>Increase engine speed to high idle for 30 seconds.</p> <p>Move gear selector lever to neutral "N" position and run for 15 seconds.</p>  <p>Repeat procedure until transmission temperature gauge arrow points to bar above dial.</p>	<p>OK Check completed.</p>
<p>Gear selector lever and neutral lock latch checks Engine OFF.</p>	 <p>Move gear selector lever to each position.</p> <p>NOTE : Gear selector lever position changes slightly as steering column is tilted.</p> <p>FEEL : Lever must move freely through all positions.</p> <p>Engage neutral lock.</p> <p>Apply slight effort to move lever into forward (F) and reverse (R).</p> <p>LOOK : Neutral lock must stay engaged.</p>	<p>OK Check completed.</p> <p>NOT OK Repair lock or replace switch.</p>
<p>Automatic shifting check</p>	<p>Automatic mode</p>  <p>Start engine.</p> <p>Move gear selector lever to 4th speed.</p> <p>LOOK : Automatic sign on cluster.</p> <p>Move gear selector lever to forward or reverse position.</p> <p>Increase engine rpm.</p> <p>LOOK : Speed on cluster must vary with machine speed.</p>	<p>OK Check completed.</p> <p>NOT OK Go to transmission fault code group at page 3-52~3-57. Repair or replace the monitor or harness.</p>

Item	Description	Service action
<p>Transmission noise check Engine running.</p>	<p>Run engine at approximately 1600 rpm.</p> <p>Drive unit with transmission in each forward and reverse speed.</p> <p>LISTEN : Transmission must not make excessive noise in any range.</p> <p>Engine rpm must not "lug down" as unit is shifted between gears.</p>	<p>OK Check completed.</p> <p>NOT OK Go to transmission makes excessive noise, chapter 2 in this group.</p>
<p>Transmission "quick shift" check Engine running.</p>	<div style="display: flex; flex-direction: column; align-items: center;"> <div style="margin-bottom: 20px;">  </div> <div style="margin-bottom: 20px;">  </div> </div> <p>Release parking brake.</p> <p>Drive machine at approximately 5km/h and press gear selector lever kick down switch or RCV levers switch once.</p> <p>LOOK/FEEL : Transmission must shift to and remain in 1st gear.</p> <p>Press gear selector lever kick down switch once.</p> <p>LOOK/FEEL : Transmission must shift back to 2nd gear.</p> <p>Shift to (3rd or 4th) gear and press gear selector lever kick down switch once.</p> <p>LOOK/FEEL : Transmission must not shift down.</p> <p>Drive machine at approximately 90% speed of max speed in each gear (2nd or 3rd or 4th).</p> <p>Shift to (2nd or 3rd or 4th) gear in each forward and reverse speed and press gear selector kick down lever switch or RCV lever switch once.</p> <p>LOOK/FEEL : This function decrease maximum machine speed down to 8 km/h.</p>	<p>OK Check completed.</p> <p>NOT OK Check connector at base of control valve.</p> <p>IF OK Go to transmission controller circuit in group 1.</p>

Item	Description	Service action
<p>Forward, reverse and 4th speed clutch pack drag check ※ Transmission must be warmed up for this check. Engine running.</p>	  <p>Park unit on level surface. Apply service brakes. Move gear selector lever to neutral. Move gear selector lever to 1st. Release parking brake and service brakes. Run engine at low idle. LOOK : Unit must not move in either direction. NOTE : If unit moves forward, either the forward pack or the 4th speed pack is dragging.</p>	<p>OK Check completed. NOT OK If unit moves, repair transmission.</p>
<p>Transmission shift modulation check Engine running.</p>	<p>Run engine at approximately 1300 rpm. Put transmission in 1st forward, shift several times from forward to reverse and reverse to forward. Repeat check in 2nd gear. LOOK : Unit must slow down and change direction smoothly.</p>	<p>OK Check completed. NOT OK Go to unit shifts too fast, chapter 2 in this group.</p>

2. TROUBLESHOOTING

1) TRANSMISSION

※ Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely, more difficult to verify. Remember the following steps when troubleshooting a problem :

Step 1. Operational check out procedure (See group 3 in section 1.)

Step 2. Operational checks (In this group.)

Step 3. Troubleshooting

Step 4. Tests and/or adjustments (See group 3.)

Problem	Cause	Remedy
Transmission slippage	<p>Low oil level.</p> <p>Wrong oil grade.</p> <p>Restricted transmission pump suction screen.</p> <p>Leak in transmission control valve or gasket.</p> <p>Low transmission pump flow due to worn pump.</p> <p>Weak or broken pressure regulating valve spring.</p>	<p>Add oil.</p> <p>Change oil.</p> <p>Remove and clean screen.</p> <p>Remove valve and inspect gaskets.</p> <p>Do transmission pump flow test.</p> <p>Do transmission system pressure test.</p>
Error code on display	Something wrong in transmission.	Go to transmission fault code group at page 3-52~3-57.

Problem	Cause	Remedy
Machine will not move	<p>Low oil level.</p> <p>Applied park brake.</p> <p>No power to transmission controller.</p> <p>Malfunctioning parking brake solenoid valve.</p> <p>Restricted orifice of PPC valve.</p> <p>Excessive leakage in transmission element.</p> <p>Worn clutch disks.</p> <p>Low or no transmission pressure.</p> <p>Service brake will not release.</p> <p>Broken shafts or gears.</p> <p>Broken drive shafts.</p> <p>Broken ring or pinion gear.</p>	<p>Add oil.</p> <p>Check parking brake fuse. Check continuity to parking brake switch.</p> <p>Check transmission controller fuse.</p> <p>Remove and inspect parking brake solenoid valve. Check for power to solenoid valve.</p> <p>Remove orifice and check for contamination and/or plugging. (Do not remove valve housing for this purpose.)</p> <p>Do transmission element leakage test using system pressure.</p> <p>Repair transmission.</p> <p>See transmission pressure is low in this group.</p> <p>Do brake pedal operational check. Do service and park system drag checks.</p> <p>Drain transmission to determine if large pieces of metal contamination are present.</p> <p>Inspect drive shafts and universal joints for external damage. Repair.</p> <p>If drive shaft rotate with transmission in gear but machine does not move, a differential failure is indicated. Repair.</p>
Machine does not engage in low gear	<p>Malfunctioning transmission control solenoid valve.</p> <p>Stuck spool in transmission control valve.</p> <p>Stuck PPC valve.</p> <p>Malfunctioning transmission speed sensor.</p>	<p>Check solenoid valve.</p> <p>Remove and inspect transmission control valve spools.</p> <p>Remove end cover to inspect PPC valve. Replace if necessary.</p> <p>Check speed sensor.</p>

Problem	Cause	Remedy
Transmission pressure is low (all gears)	Low oil level.	Check transmission oil level and refill if necessary.
	Failed transmission pressure switch.	Verify transmission system pressure. Do transmission system pressure test.
	Plugged suction strainer.	Transmission pump may be noisy if transmission suction screen is clogged. Drain transmission. Remove and clean suction screen. Also, check condition of transmission filter.
	Stuck transmission pressure regulating valve or broken spring.	Remove transmission pressure regulating valve. Inspect for damage (See transmission control valve).
	Failed control valve gasket.	Inspect transmission control valve for external leakage. Remove control valve. Inspect or replace gasket.
	Stuck PPC valve.	Remove end cover to inspect modulation spool and check torque on cap screws retaining control valve to transmission.
Transmission system pressure is low (one or two gears)	Failed transmission pump.	Do pump flow test.
	Failed transmission control valve gasket.	Inspect transmission control valve for external leakage. Remove control valve. Inspect or replace gasket.
	Leakage in clutch piston or seal ring.	Disassemble and repair.
Transmission shifts too low	Low oil level (aeration of oil).	Add oil.
	Low transmission pressure.	Do transmission system pressure test.
	Restricted transmission pump suction screen.	Remove and clean screen.
	Low transmission pump flow.	Do transmission pump flow test.
	Excessive transmission element leakage.	Do transmission element leakage test using system pressure.
	Stuck PPC valve.	Remove end cover to inspect modulation spool. Replace if necessary.
	Restricted PPC valve orifice.	Remove orifice and inspect for contamination and /or plugging.
	Restricted oil passages between control valve and transmission elements.	Remove control valve and inspect oil passage.
Incorrect transmission oil.	Change oil. Refer to operator's manual.	

Problem	Cause	Remedy
Transmission shifts too fast	Wrong transmission controller.	Check if transmission controller has been changed
	System pressure too high.	Do transmission system pressure test.
	Stuck PPC valve.	Remove and inspect PPC valve. Replace if necessary. Also remove end cover to inspect PPC valve and control valve housing. Replace if necessary.
	Stuck or missing check valves.	Inspect transmission control valve.
	Missing O-ring from end of modulation orifice.	Remove orifice and inspect port for O-ring.
	Broken piston return spring.	Disassemble and inspect clutch.
	Incorrect transmission oil.	Change oil. Refer to operator's manual.
Machine "creeps" in neutral	Warped disks and plates in transmission.	Check transmission.
Transmission hydraulic system overheats	High oil level.	Transmission overfilled or hydraulic pump seal leaking.
	Low oil level.	Add oil.
	Wrong oil grade.	Change oil.
	Park brake dragging.	Check for heat in park brake area.
	Pinched, restricted or leaking lube lines.	Check cooler lines.
	Machine operated in too high gear range.	Operate machine in correct gear range.
	Malfunction in temperature gauge or sensor.	Install temperature sensor the verify temperature. Do tachometer/temperature reader installation procedure.
	Restricted air flow through oil cooler or radiator.	Do radiator air flow test.
	Failed oil cooler bypass valve (In thermal bypass valve).	Disassemble and inspect.
	Failed thermal bypass valve.	Remove thermal bypass valve and check to see if machine still overheats. Do transmission oil cooler thermal bypass valve test.
	Internally restricted oil cooler.	Do oil cooler restriction test.
Leakage in transmission hydraulic system.	Do transmission system pressure, element leakage test.	
Malfunction in converter relief valve.	Do converter out pressure test.	
Low transmission pump output.	Do transmission pump flow test.	

Problem	Cause	Remedy
Excessive transmission noise (Under load or no load)	Too low engine low idle. Worn parts or damaged in transmission. Warped drive line between engine and torque converter. Low or no lube.	Check engine low idle speed. Remove transmission suction screen. Inspect for metal particles. Repair as necessary. Inspect drive line. Do converter-out and lube pressure test. Do transmission pump flow test.
Foaming oil	Incorrect type of oil. High oil level. Low oil level. Air leak on suction side of pump.	Change oil. Transmission overfilled or hydraulic pump seal leaking. Add oil. Check oil pickup tube on side of transmission.
Oil ejected from dipstick	Plugged breather.	Inspect breather on top of transmission. Replace.
Machine vibrates	Aerated oil. Low engine speed. Failed universal joints on transmission drive shaft or differential drive shafts.	Add oil. Check engine speed. Check universal joints.
Machine lacks power and acceleration	Engine high idle speed set too low. Incorrect transmission oil. Aerated oil. Low transmission pressure. Warped transmission clutch. Torn transmission control valve gasket. Brake drag. Failed torque converter. Low engine power.	Check high idle adjustment. Change oil. Add oil. Do transmission system pressure test. Do transmission clutch drag checks. Inspect gasket. Do brake drag check. Do torque converter stall speed test. Do engine power test.

Problem	Cause	Remedy
Transmission pressure light comes ON when shifting from forward to reverse (all other gears OK)	Low oil level. Cold oil. Leak in reverse pack.	Add oil. Warm oil to specification. Do transmission pressure, pump flow, and leakage check.
Transmission pressure light comes ON for each shift	Cold oil. No time delay in monitor. Restriction in modulation orifice. Stuck PPC valve. Low transmission pressure circuit. Leak in transmission pressure circuit. Failed transmission pump. Clogged filter.	Warm oil to specification. Do monitor check. Remove orifice and inspect for restriction and/or plugging. Remove and inspect. Do transmission system pressure test. Do converter out pressure test. Do transmission pump flow test. Inspect filter. Replace.

2) DIFFERENTIAL / AXLE

Problem	Cause	Remedy
Differential low on oil	External leakage.	Inspect axle and differential for leaks.
Excessive differential and/or axle noise	Low oil level in differential. Incorrect type of oil. Dragging brakes. Failed pinion bearing. Incorrect gear mesh pattern between ring and pinion gear. Failed differential pinion gears and/or cross shafts. Failed axle bearing. Mechanical failure in axle planetary.	Check oil. Remove drain plug and inspect for metal particles in differential case. Disassemble and determine cause. Change oil Do brake check. Remove and inspect pinion. Check to ensure pinion housing was indexed. Remove pinion gear housing and inspect ring and pinion gear. Remove differential housing drain plug and inspect for metal particles. Disassemble and inspect. Do axle bearing adjustment check. Remove differential. Inspect, repair.
Oil seeping from outer axle seal	Excessive end play in axle. Worn outer bearing and/or cup. Overfilled differential.	Do axle bearing adjustment check. Disassemble and inspect outer axle bearing, cup, spacer, and seal. Replace, if necessary. Check differential oil return system for excessive internal restriction.
Axle overheats	Low differential oil. Overfilled differential. Brake drag.	Add oil. See differential overfills with oil in this group. See brakes drag in this group.

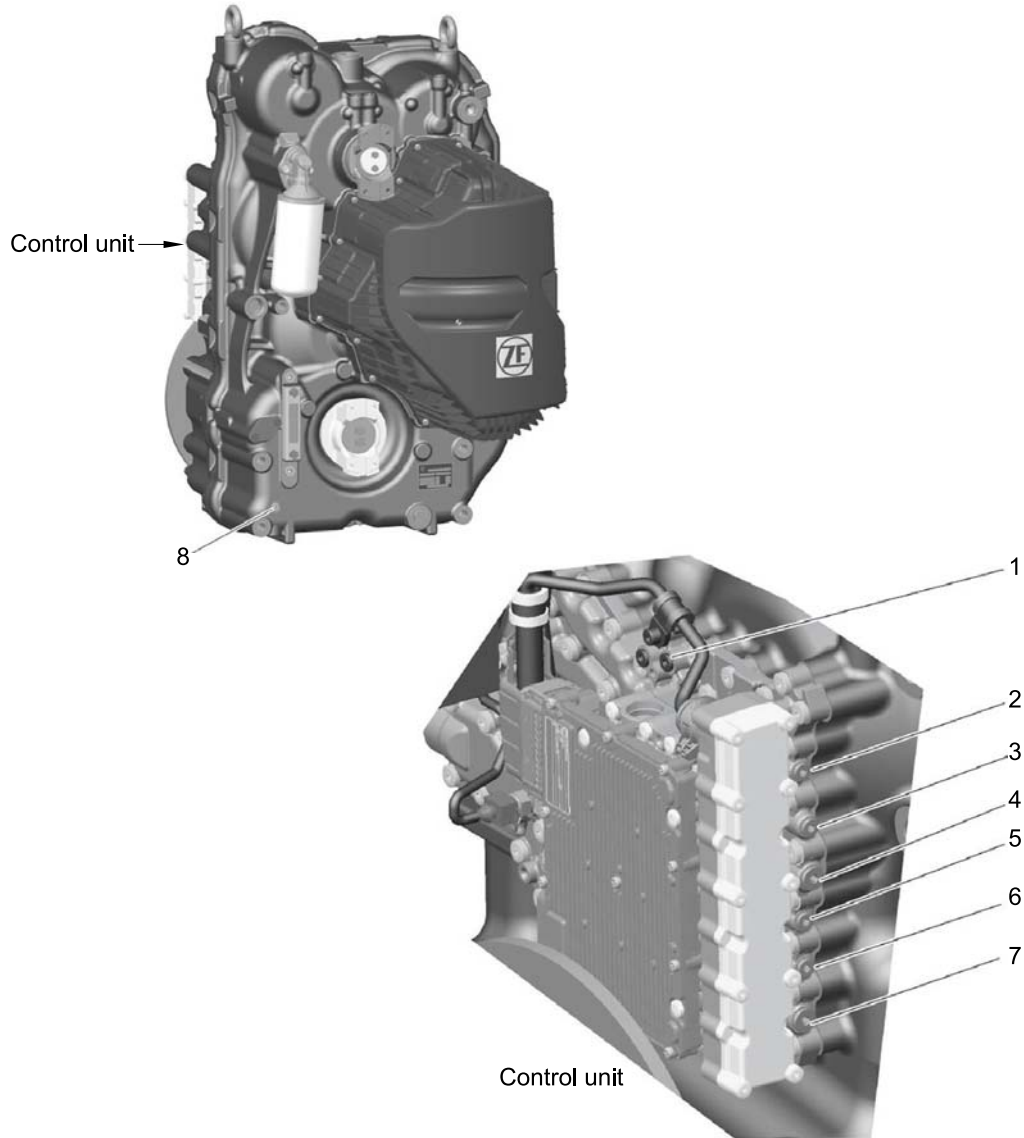
3) DRIVE LINE

Problem	Cause	Remedy
Excessive drive line vibration or noise	Yokes not in line on drive shafts.	Inspect. Align drive shaft yokes.
	Worn front drive line support bearing.	Inspect, repair.
	Bent drive shaft.	Inspect all drive shafts. Replace.
	Loose yoke retaining nuts (drive shafts wobble at high speed).	Inspect. Replace.
	Rear axle oscillating support.	Inspect, repair.
	Lack of lubrication.	Lubricate with proper grade of grease.

GROUP 3 TESTS AND ADJUSTMENTS

1. TRANSMISSION MEASURING POINTS AND CONNECTIONS

The measurements have to be carried out at hot transmission (about 80-95°C).



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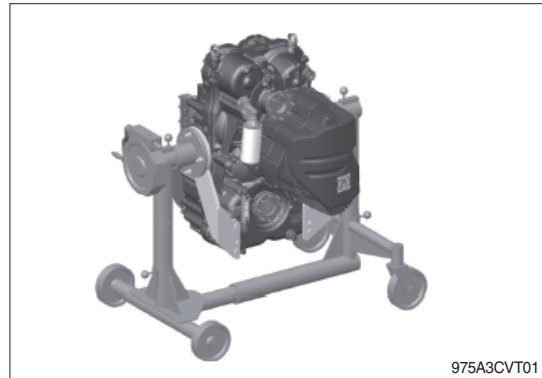
Port	Description /	Tightening torque	Size
1	System pressure (20+2.5 bar)	0.61 kgf · m (4.4 lbf · ft)	M10 × 1.0
2	Shift pressure clutch K2 (20 bar)	0.61 kgf · m (4.4 lbf · ft)	M10 × 1.0
3	Shift pressure clutch KV (20 bar)	0.61 kgf · m (4.4 lbf · ft)	M10 × 1.0
4	Pressure connection external	2.34 kgf · m (17.0 lbf · ft)	M14 × 1.5
5	Shift pressure clutch KR (20 bar)	0.61 kgf · m (4.4 lbf · ft)	M10 × 1.0
6	Shift pressure clutch K1 (20 bar)	0.61 kgf · m (4.4 lbf · ft)	M10 × 1.0
7	Shift pressure clutch K3 (20 bar)	2.34 kgf · m (17.0 lbf · ft)	M14 × 1.5
8	Lubrication pressure after cooler (0.7 bar)	3.57 kgf · m (25.8 lbf · ft)	M12 × 1.5

GROUP 4 DISASSEMBLY AND ASSEMBLY

1. DISASSEMBLY

1) Clamp transmission

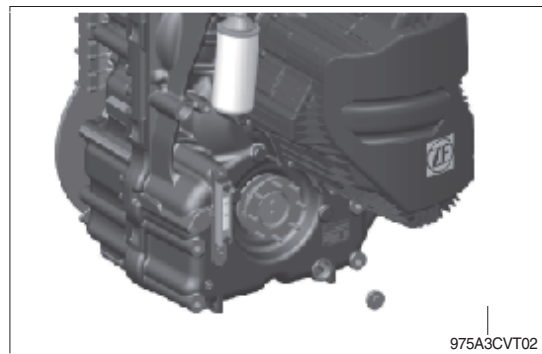
- ※ Special tool
- Assembly fixture AA00 854 658
- Assembly truck 5870 350 000



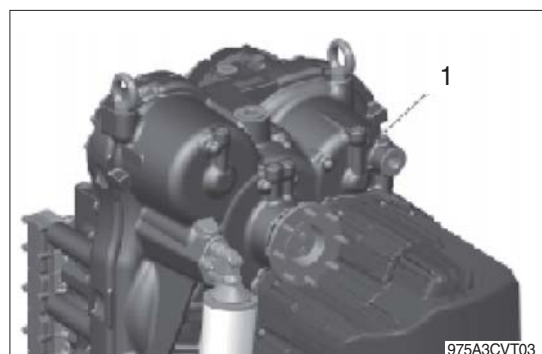
- (1) Fix transmission with assembly fixture to assembly truck.

2) Drain oil

- ※ **Observe the environmental regulations**
- (1) Loosen screw plug and drain oil from the transmission.



- (2) Loosen breather (1).

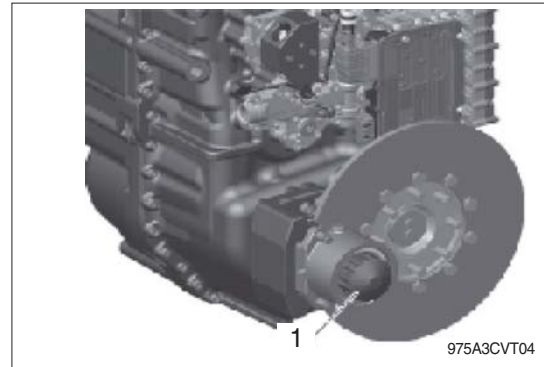


3) Remove parking brake

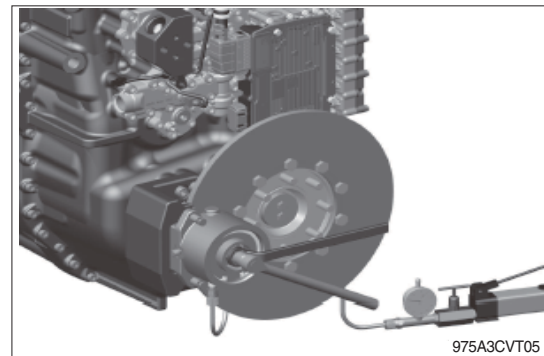
※ Special tool

Screw coupling	5870 950 102
High pressure pump	5870 287 007
Socket wrench	5870 656 047

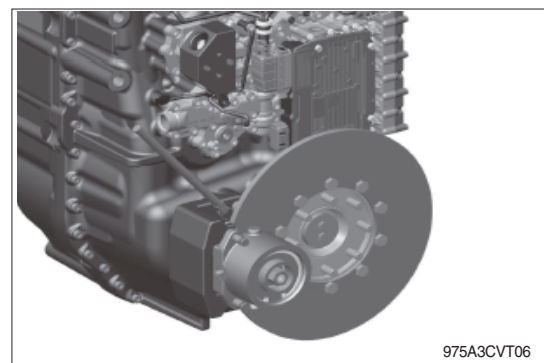
(1) Loosen screw cap (1).



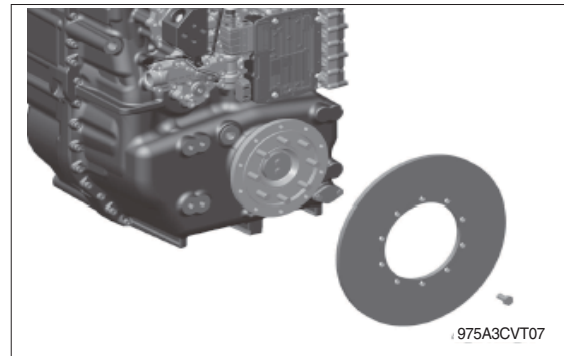
- (2) Screw in screw coupling and connect high pressure pump.
- (3) Apply pressure to brake until both brake lining carriers loosen from the brake disk.
- (4) Loosen hexagon nut.
- (5) Loosen adjusting screw counter-clockwise.



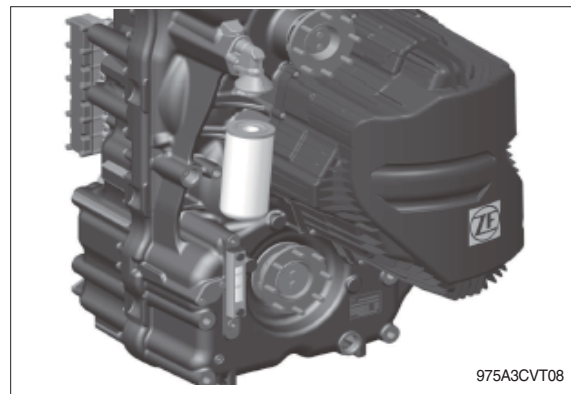
- (6) Loosen cylindrical screws with socket wrench and remove brake assy.



- (7) Loosen hexagon screws and remove brake disk.

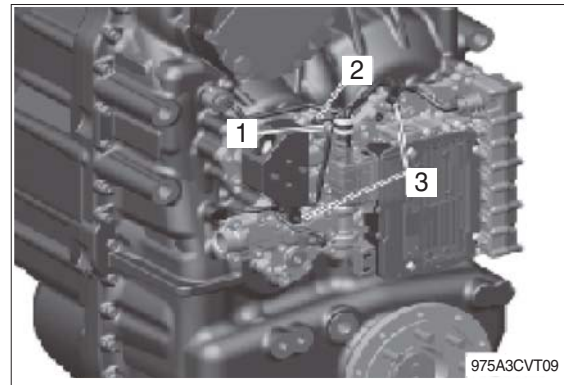


- 4) Remove pressure filter
- (1) Loosen white pressure filter.

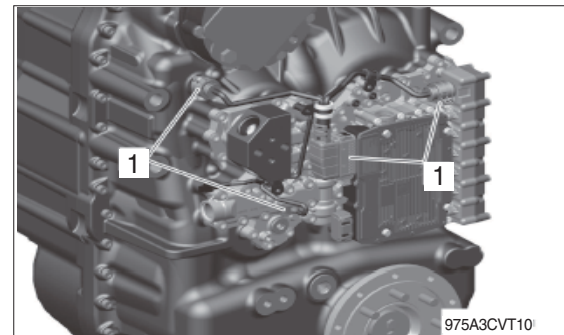


5) Remove control unit

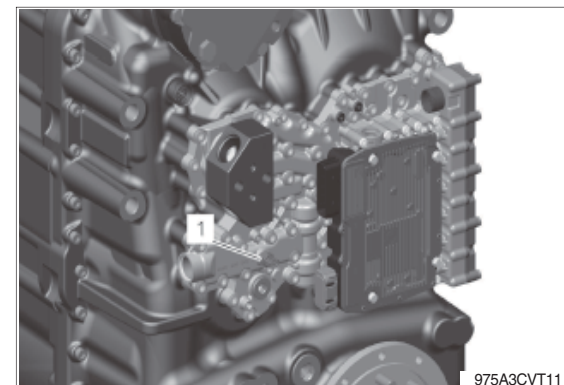
- (1) Loosen Torx screw (1) and remove the releasing bush (2).
- (2) Loosen cylindrical screws (3).



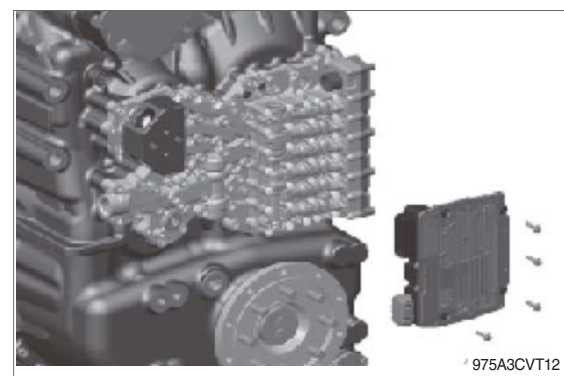
- (3) Pull off the plugs (1) and remove the wiring harness.



- (4) Remove temperature sensor (1).



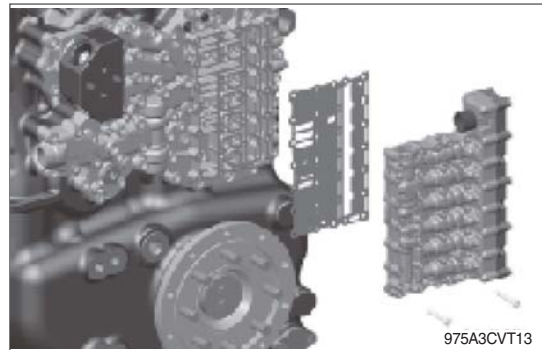
- (5) Loosen hexagon screws and remove the releasing control unit.



6) Remove and dismantle shift system

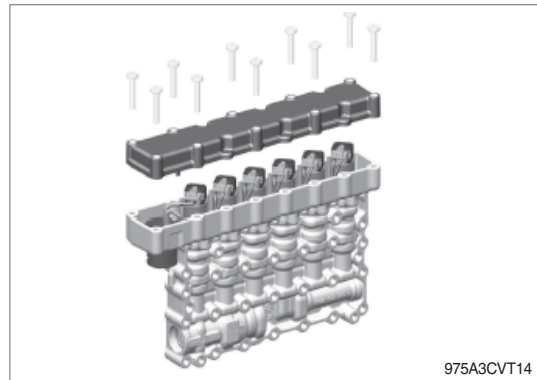
Remove shift system

- (1) Loosen torx screws and remove the shift system with intermediate plate.

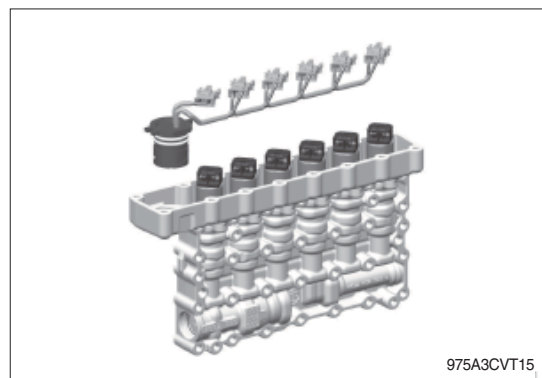


Disassemble the shift system

- (1) Loosen Torx screws and remove the cover.



- (2) Separate plug connections and remove wiring harness.

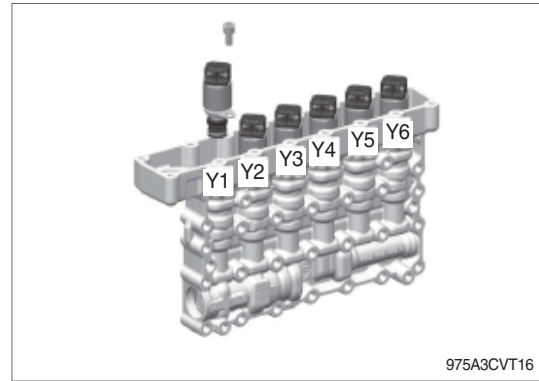


(3) Loosen cylindrical screw and remove clamping plate.

(4) Pull out pressure controllers.

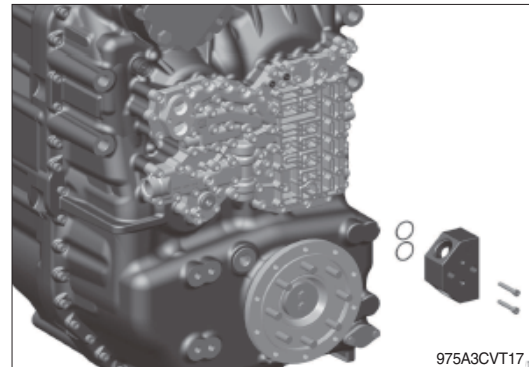
※ Positions pressure controllers

- Y1 = K2
- Y2 = KV
- Y3 = Optional
- Y4 = KR
- Y5 = K1
- Y6 = Optional

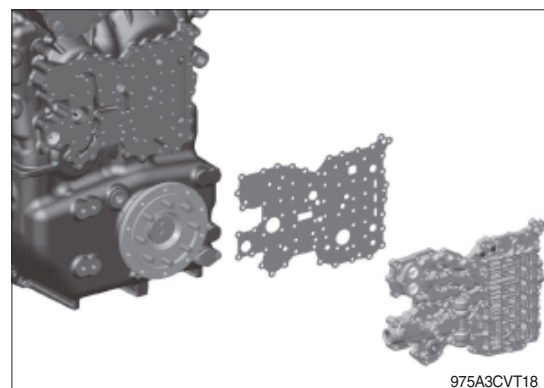


7) Remove duct plate

(1) Loosen cylindrical screws and remove the releasing adapter.

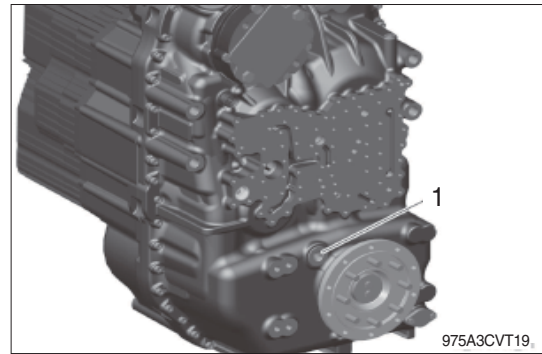


(2) Loosen Torx screws and remove duct plate with intermediate plate.



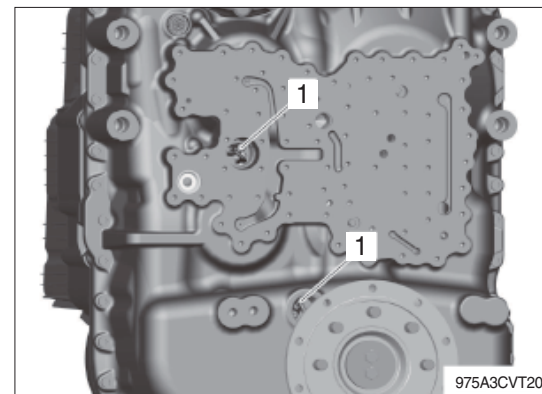
8) Remove speed sensors

(1) Loosen screw plug (1).

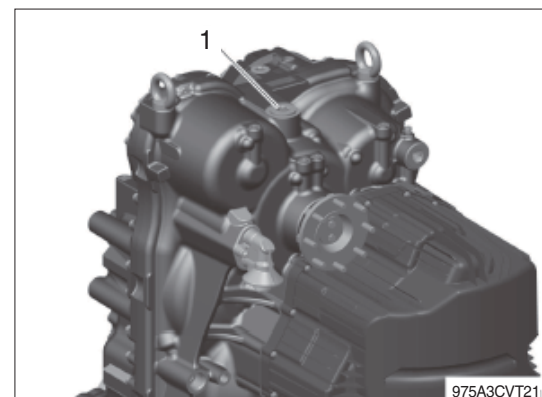


(2) Separate plug connections on the speed sensors (1).

(3) Loosen cylindrical screws and pull out speed sensors.

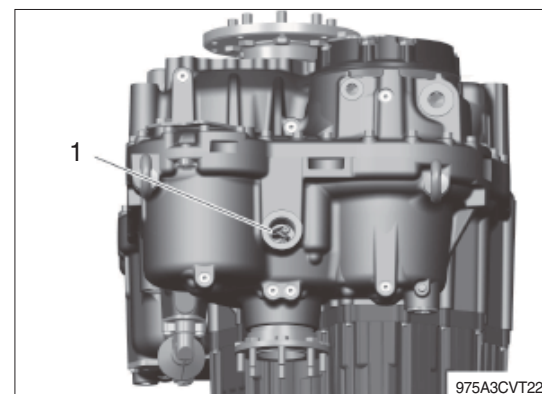


(4) Loosen screw plug (1).

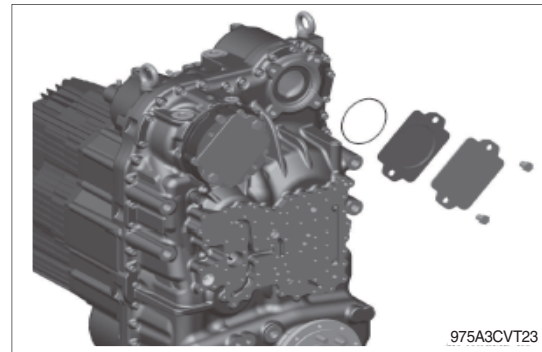


(5) Separate plug connection on the speed sensor (1).

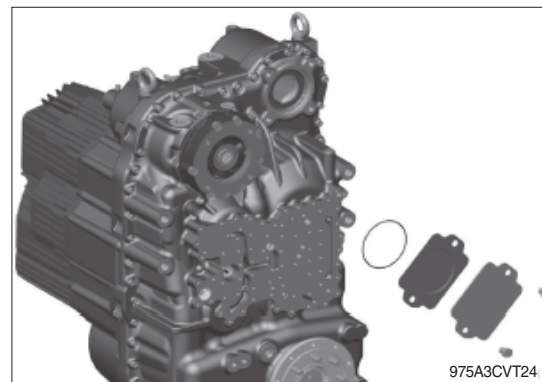
(6) Loosen cylindrical screws and pull out speed sensors.



- 9) Remove cover plates
- (1) Loosen hexagon screws.
- (2) Remove cover plate, intermediate plate and O-ring.

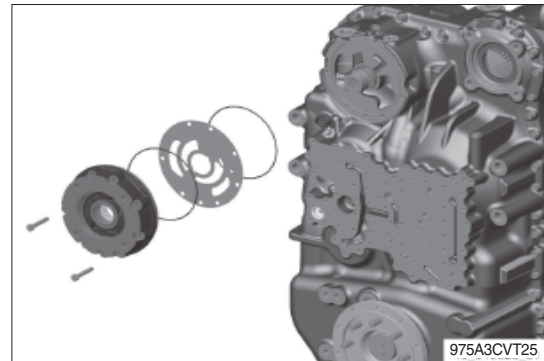


- (3) Loosen hexagon screws.
- (4) Remove cover plate, intermediate plate and O-ring.

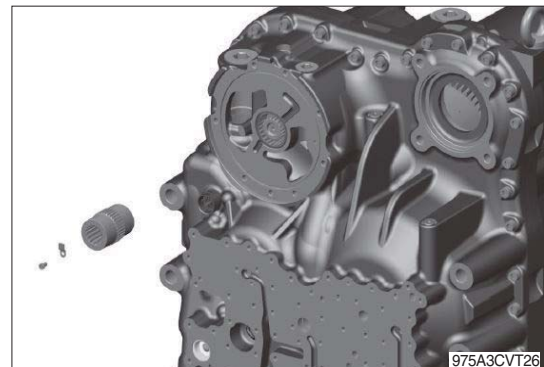


10) Remove hydraulic oil pump

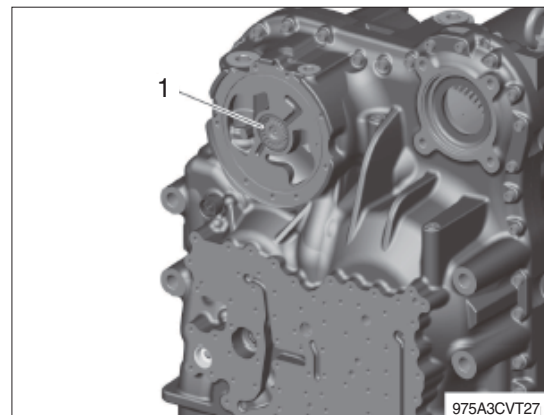
- (1) Loosen hexagon screws.
- (2) Remove gear pump, plate and O-rings.
- (3) Check gear pump and plate for wear marks.
If you detect signs of wear, gear pump and plate must be replaced.



- (4) Loosen cylindrical screw and remove fixing plate.
- (5) Pull out driver.

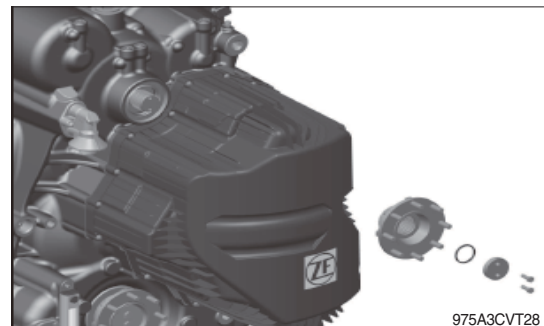


- (6) Pull needle sleeve (1) out of the housing hole.

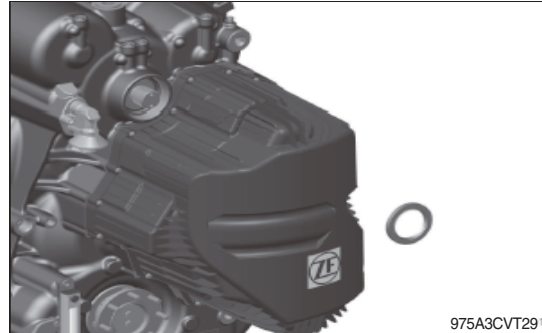


11) Remove engine connection

- (1) Loosen hexagon screws.
- (2) Remove disk and O-ring.
- (3) Pull off output flange.

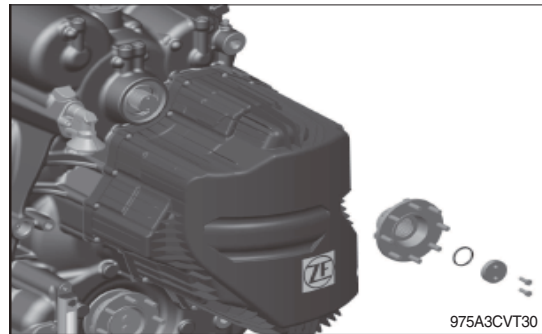


(4) Remove shaft seal from housing hole.

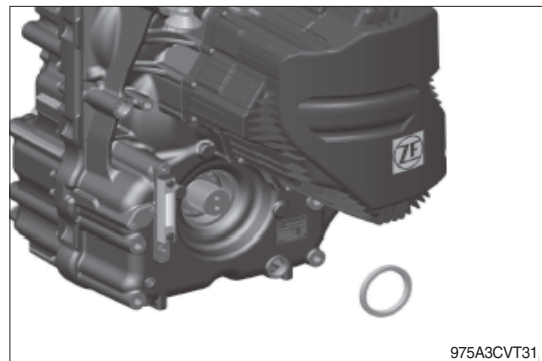


12) Remove output flanges

- (1) Loosen hexagon screws.
- (2) Remove disk and O-ring.
- (3) Pull off output flange.



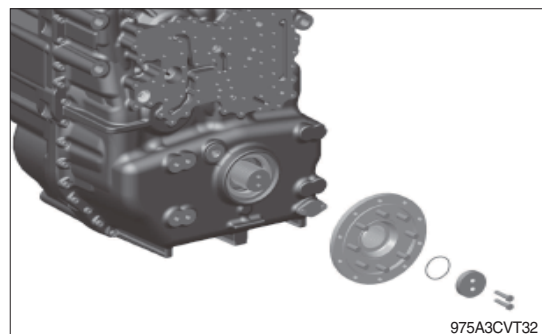
(4) Remove shaft seal from housing hole.



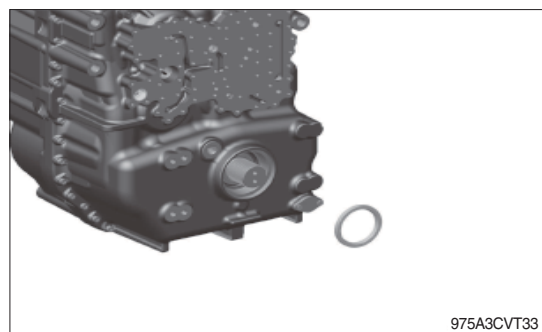
(5) Loosen hexagon screws.

(6) Remove disk and O-ring.

(7) Pull off output flange.

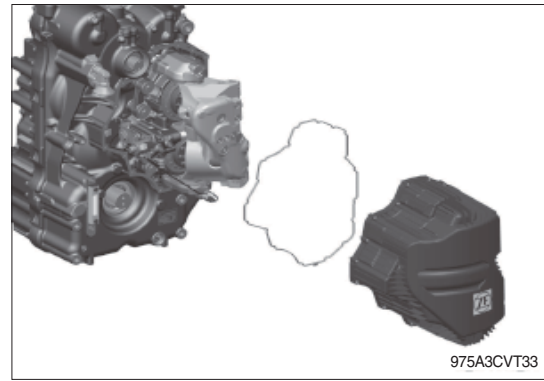


(8) Remove shaft seal from housing hole.



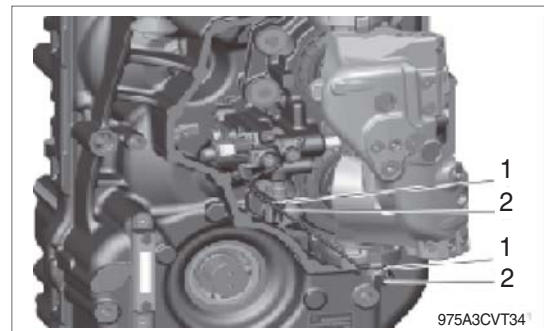
13) Remove cover hydrostatic unit

- (1) Loosen hexagon screws.
- (2) Remove cover with seal.



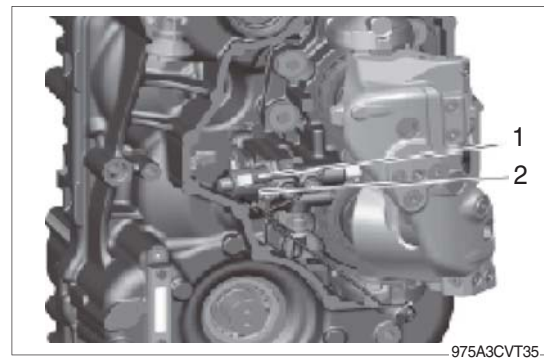
14) Remove pressure sensors

- (1) Remove cable clips (1).
- (2) Separate plug connections (2) of the pressure sensors.
- (3) Remove pressure sensors.



15) Remove solenoid (PRV)

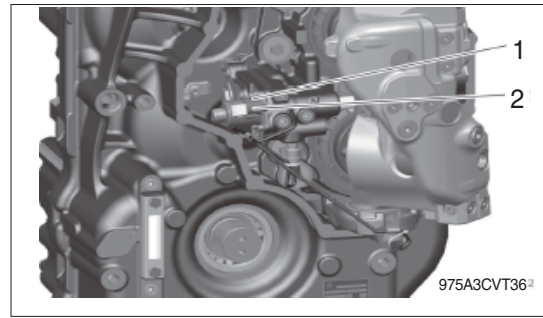
- (1) Separate plug connection (1).
- (2) Loosen cylindrical screws and remove solenoid (2).



2. ASSEMBLY

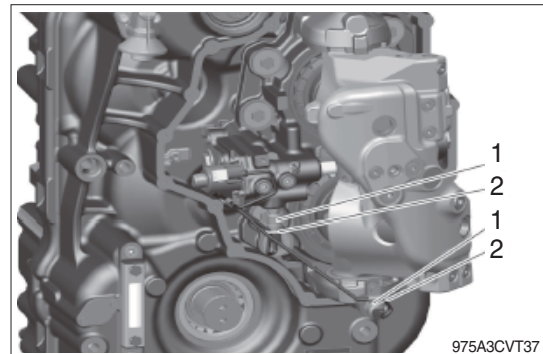
1) Install solenoid (PRV)

- (1) Fix solenoid (1) with four cylindrical screws.
 - Tightening torque : 0.97 kgf · m (7.08 lbf · ft)
- (2) Insert plug (2).



2) Rotate disc carrier by 90°.

- (1) Bolt in pressure sensors (1) and tighten.
 - Tightening torque : 4.6 kgf · m (33.2 lbf · ft)
- (2) Insert plug.
- (3) Fix cable with cable clip (2) to pressure sensors.

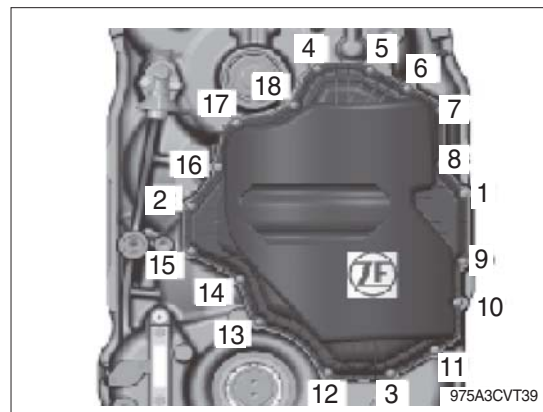


3) Install cover hydrostatic unit

- ※ Seal groove of the cover must be clean and dry.
- (1) Insert new seal into the seal groove of the cover.



- (2) Fix cover with hexagon screws in the specified order.
 - Tightening torque : 0.97 kgf · m (7.0 lbf · ft)



4) Install output flanges

※ Special tools :

Driver tool 5870 048 265

Press-in bush AA01 368 722

Operating supplies and auxiliary materials :

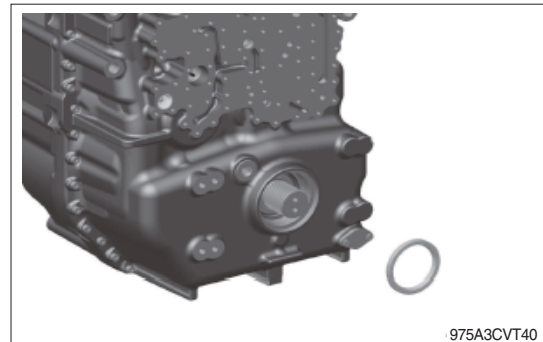
Spirit 0666 690 191

※ Carry out the following two work steps immediately one after the other.

(1) Apply spirit to the outer diameter of the shaft seal.

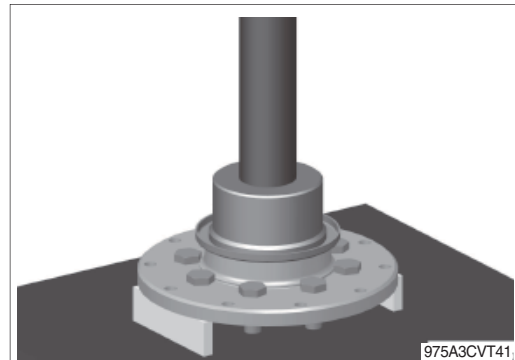
※ Insert shaft seal with the seal lip facing the oil chamber.

(2) Insert shaft seal with driver tool.



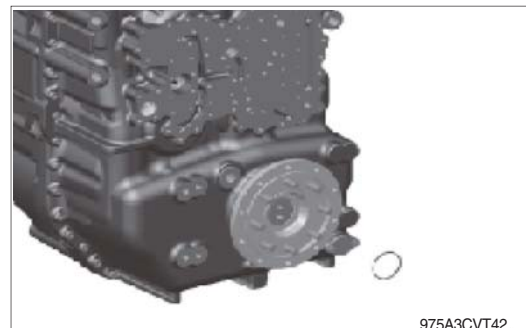
(3) Insert hexagon screws into the output flange.

(4) Press screen sheet with press-in bush onto the output flange until contact is obtained.



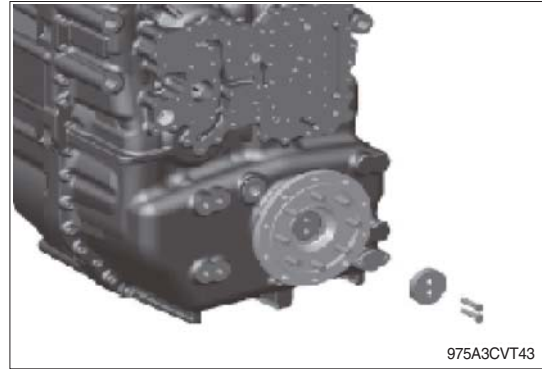
(5) Push output flange onto the shaft.

(6) Insert O-ring into the space between output flange and shaft.



(7) Fix output flange with disk and hexagon screws.

- Tightening torque : 4.7 kgf · m (33.9 lbf · ft)

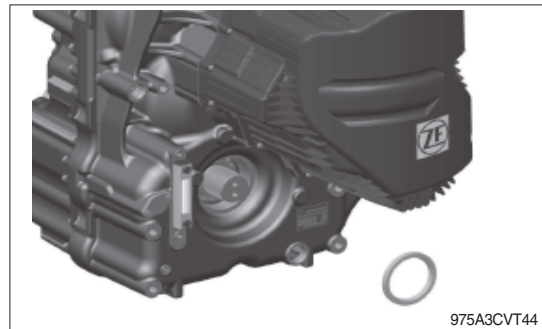


※ Carry out the following two work steps immediately one after the other.

(8) Apply Spirit to the outer diameter of the shaft seal.

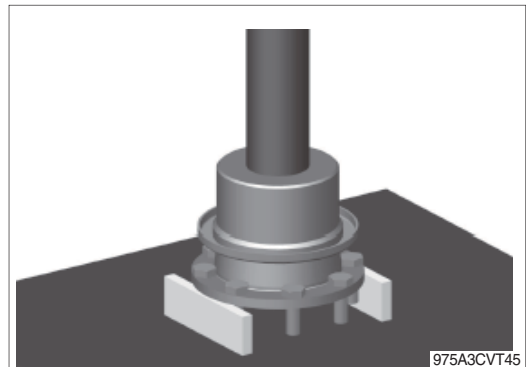
※ Insert shaft seal with the seal lip facing the oil chamber.

(9) Insert shaft seal with driver tool.



(10) Insert hexagon screws into the output flange.

(11) Press screen sheet with press-in bush onto the output flange until contact is obtained.



(12) Push output flange onto the shaft.

(13) Insert O-ring into the space between output flange and shaft.



- (14) Fix output flange with disk and hexagon screws.
 - Tightening torque : 4.7 kgf · m (33.9 lbf · ft)



5) Install engine connection

※ Special tool :

Driver tool 5870 048 057

※ Operating supplies and auxiliary materials :

Spirit 0666 690 191

※ Carry out the following two work steps immediately one after the other.

- (1) Apply spirit to the outerdiameter of the shaft seal.

※ Insert shaft seal with the seal lip facing the oil chamber.

- (2) Insert shaft seal with driver tool.



- (3) Insert hexagon screws into the output flange.

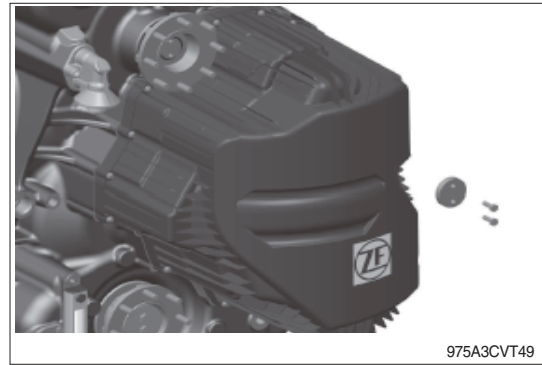
- (4) Push output flange onto the shaft.

- (5) Insert O-ring into the space between output flange and shaft.



- (6) Fix output flange with disk and hexagon screws.

- Tightening torque : 3.5 kgf · m (25.1 lbf · ft)



- 6) Install hydraulic oil pump

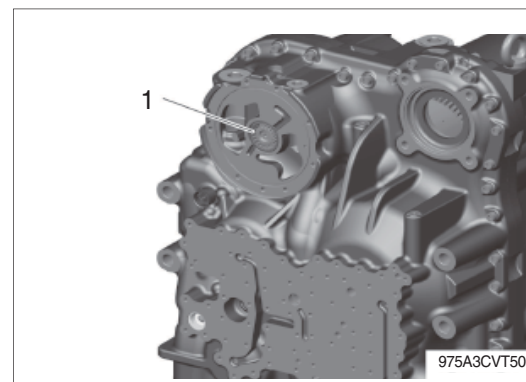
※ Special tool :

Fixation pin 5870 204 007

※ Operating supplies and auxiliary materials :

Grease 0671 190 016

- (1) Insert needle bearing (1) into the housing hole until contact is obtained.

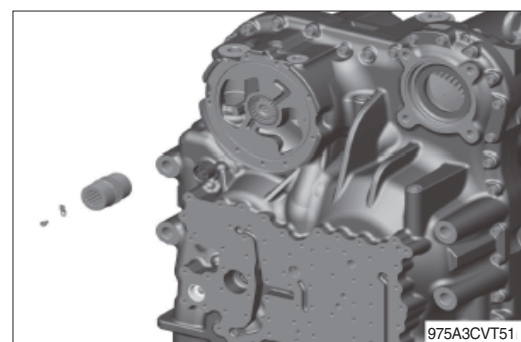


- (2) Apply grease to the bearing surface of the driver.

- (3) Insert driver into the needle bearing.

- (4) Fix driver with fixing plate and cylindrical screw.

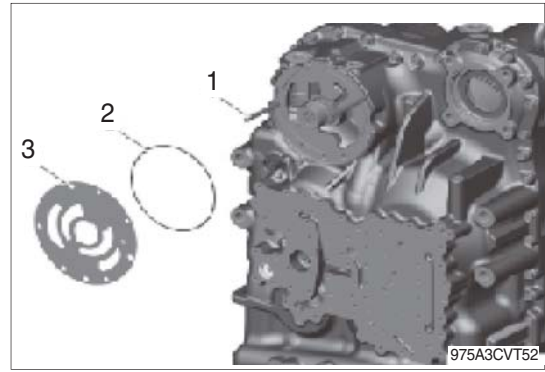
- Tightening torque : 0.97 kgf · m (7 lbf · ft)



(5) Bolt two pieces fixation pin (1) into the housing.

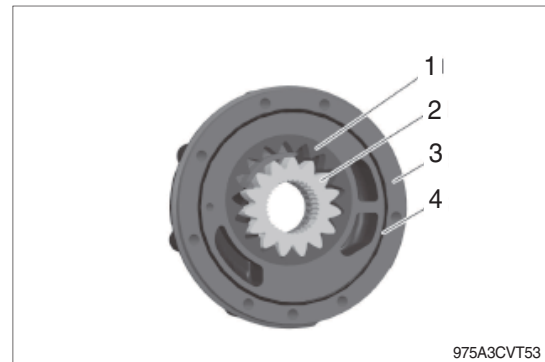
(6) Oil O-ring (2) and insert it into the annular groove of the housing.

(7) Slide on plate (3).



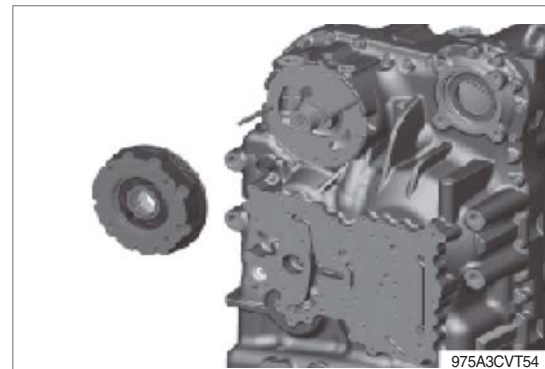
(8) Insert inner rotor (1) and outer rotor (2) with the chamfered tooth side facing downwards into the pump housing (3).

(9) Oil O-ring (4) and insert it into the annular groove.



(10) Slide pump onto the driver and fix with hexagon screws.

- Tightening torque : 6.6 kgf · m (47.9 lbf · ft)



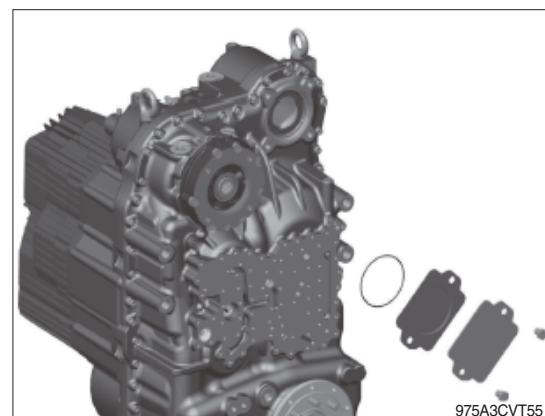
7) Install cover plates

(1) Place O-ring onto the intermediate plate.

(2) Fix intermediate plate and cover plate with hexagon screws to the housing.

- Tightening torque :

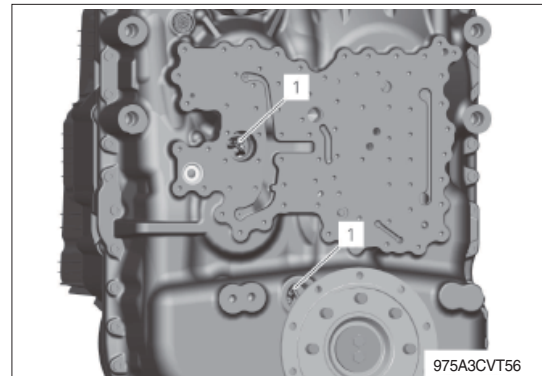
18.9 kgf · m (136 lbf · ft)



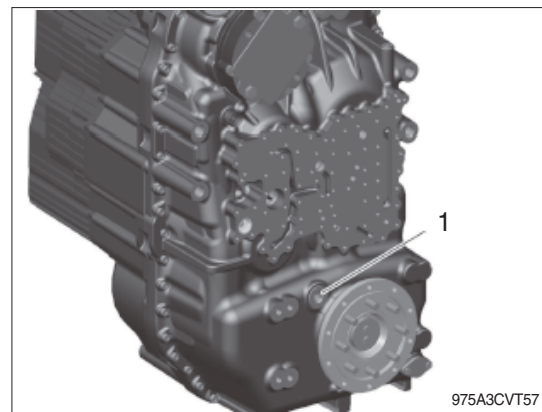
- (3) Place O-ring onto the intermediate plate.
- (4) Fix intermediate plate and cover plate with hexagon screws to the housing.
 - Tightening torque :
18.9 kgf · m (136 lbf · ft)

8) Install speed sensors

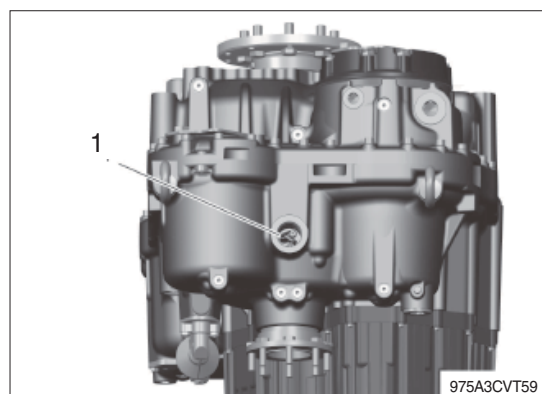
- (1) Insert speed sensors (1) into the housing holes.
- (2) Fix speed sensors with cylindrical screws.
 - Tightening torque :
0.97 kgf · m (7 lbf · ft)



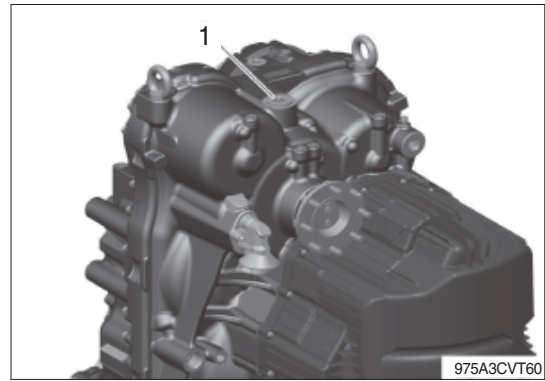
- (4) Bolt in screw plug with O-ring (1) and tighten.
 - Tightening torque: 15.3 kgf · m (111 lbf · ft)



- (5) Insert speed sensor (1) into the housing hole.
- (6) Fix speed sensor with cylindrical screw.
 - Tightening torque : 0.97 kgf · m (7 lbf · ft)
- (7) Establish plug connection.



- (8) Bolt in screw plug with O-ring (1) and tighten.
 - Tightening torque: 15.3 kgf · m (111 lbf · ft)



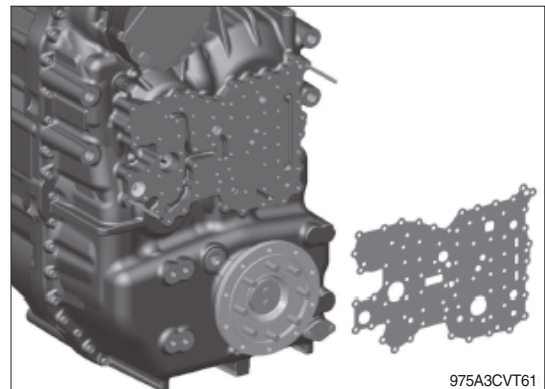
9) Install duct plate

※ Special tool

Fixation pin 5870 204 011

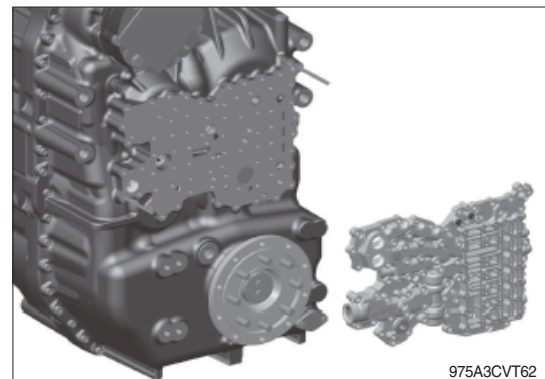
- (1) Bolt two pieces fixation pin into the housing.

- (2) Slide on intermediate plate.



- (3) Slide on duct plate and fix with Torx screws.

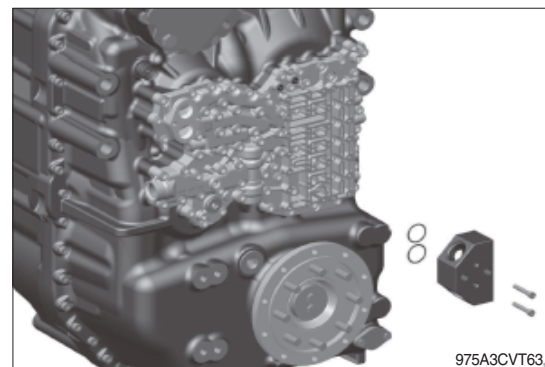
- Tightening torque : 2.3 kgf · m (17 lbf · ft)



- (4) Oil O-rings and insert into the annular grooves of the adapter.

- (5) Fix adapter with cylindrical screws.

- Tightening torque : 2.3 kgf · m (17 lbf · ft)



10) Assemble and install shift system

Assemble the shift system

※ Pay attention to radial installation position of the pressure controllers.

- (1) Insert pressure controllers into the valve block.
- (2) Fix pressure controllers with clamping plate and cylindrical screw.
 - Tightening torque: 0.97 kgf · m (7 lbf · ft)

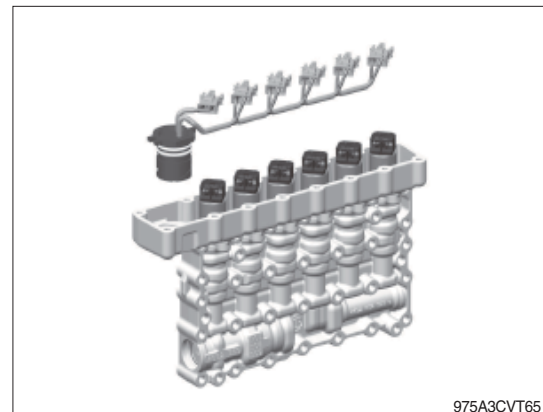
Positions pressure controllers

- Y1 = K2
- Y2 = KV
- Y3 = Optional
- Y4 = KR
- Y5 = K1
- Y6 = Optional



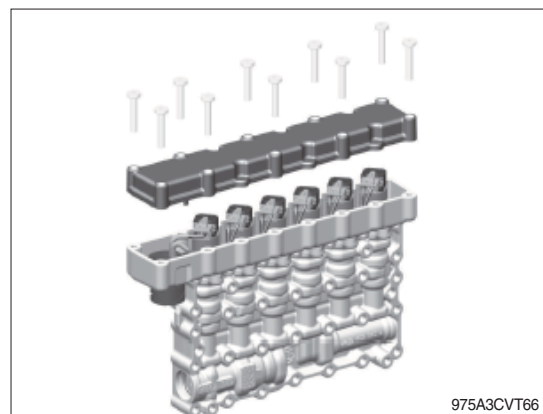
※ Ensure correct position of the two O-rings on the plug.

- (3) Insert plugs at the pressure controllers
- (4) Insert plug into the valve block.



※ When assembling the cover pay attention to the cable, risk of damage.

- (5) Place cover and fix with Torx screws.
 - Tightening torque: 0.97 kgf · m (7 lbf · ft)



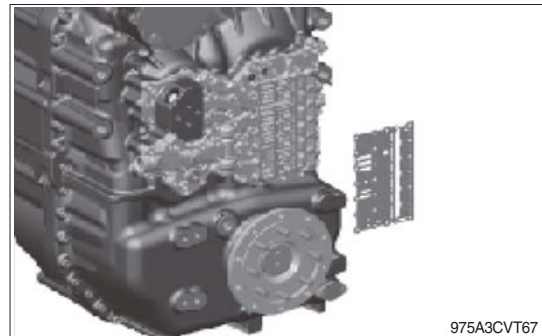
Install shift system

※ Special tools:

Fixation pin 5870 204 063

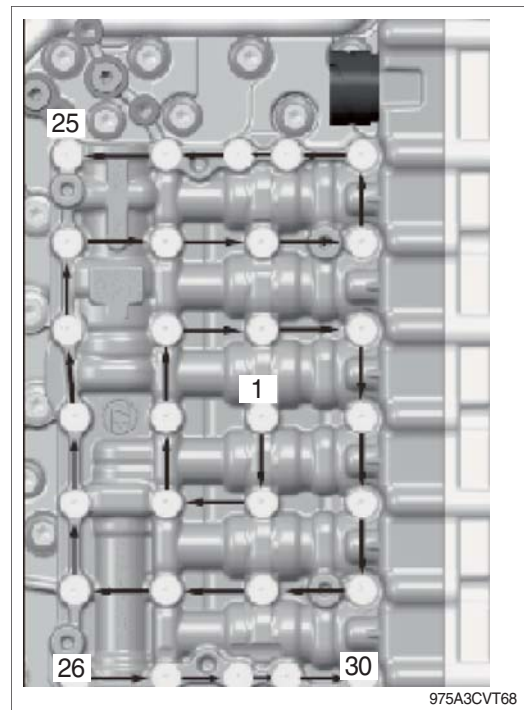
(1) Bolt in two pieces fixation pin into the duct plate.

(2) Slide on intermediate plate.



(3) Slide on shift system and fix with Torx screws in the specified order.

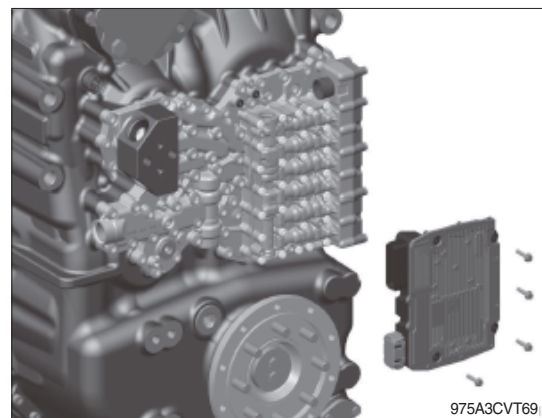
- Tightening torque: 0.97 kgf · m (7 lbf · ft)



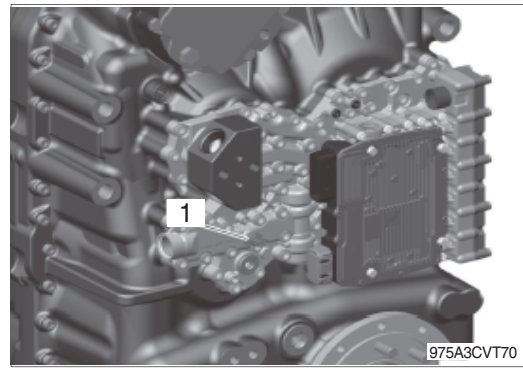
11) Install control unit

(1) Fix control unit with hexagon screws.

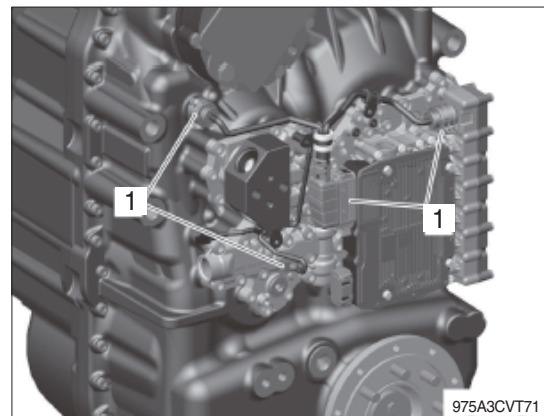
- Tightening torque: 0.97 kgf · m (7 lbf · ft)



- (2) Bolt in temperature sensor with O-ring (1) and tighten.
 - Tightening torque: 2.3 kgf · m (17 lbf · ft)

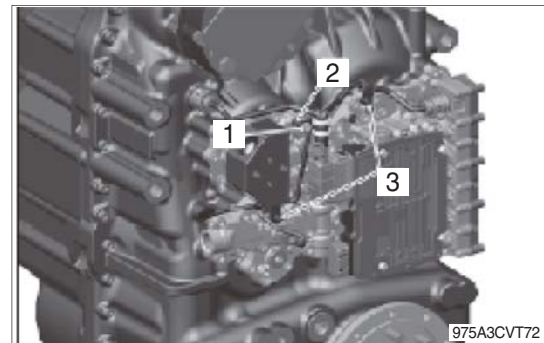


- (3) Route cable and insert plugs (1).



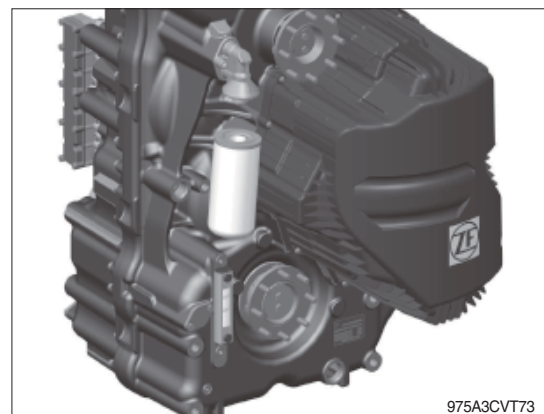
- (4) Fix cable to duct plate with clamp, Torx screw (1) and bush (2).
 - Tightening torque: 2.3 kgf · m (17 lbf · ft)

- (5) Fix cable with clamps and cylindrical screws (3).
 - Tightening torque: 2.3 kgf · m (17 lbf · ft)



12) Install pressure filter

- (1) Bolt on white pressure filter and tighten.
 - Tightening torque: 3.1 kgf · m (22.1 lbf · ft)



13) Install parking brake

※ Special tool

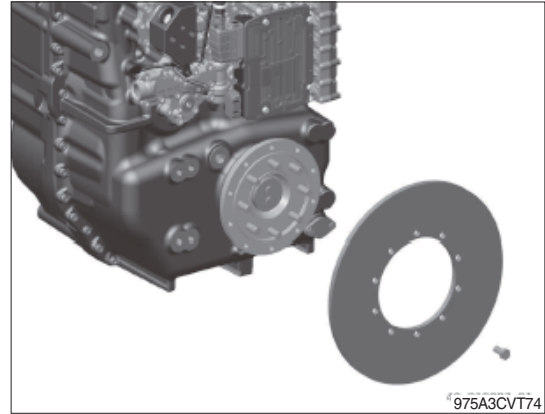
Socket wrench 5870 656 047

Screw coupling 5870 950 102

High pressure pump 5870 287 007

※ Observe the specifications of the brake manufacturer.

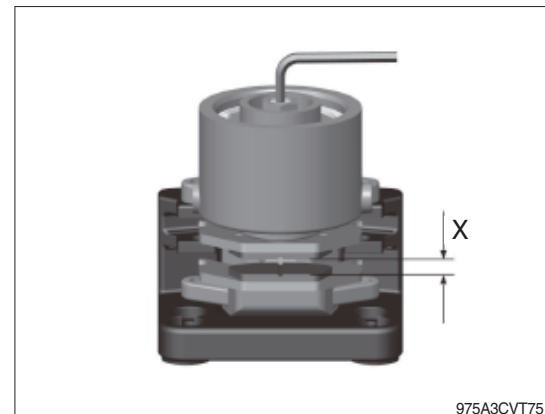
- (1) Fix brake disk with hexagon screws to output flange.
 - Tightening torque: 18.9 kgf · m (136 lbf · ft)



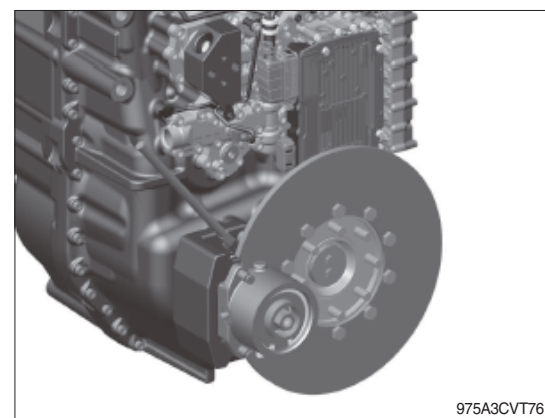
- (2) Remove screw cap.

- (3) Loosen hexagon nut.

- (4) Turn out threaded pin counterclockwise, until dimension X > 13.0 mm (thickness of brake disk) is achieved.



- (5) Position brake and fix with cylindrical screws.
Tighten cylindrical screws with socket wrench.
 - Tightening torque: 18.9 kgf · m (136 lbf · ft)

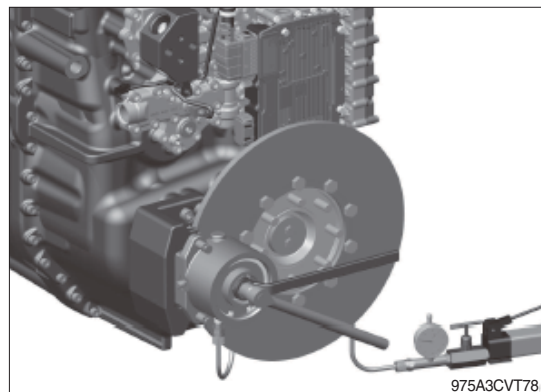
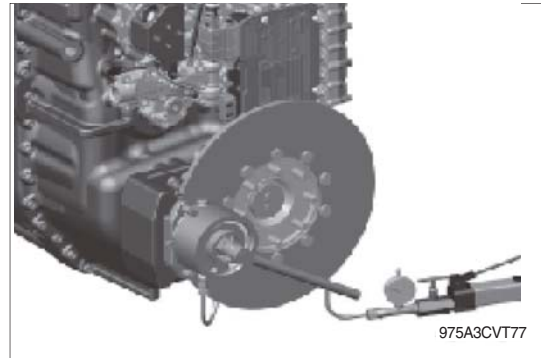


Setting of clearance

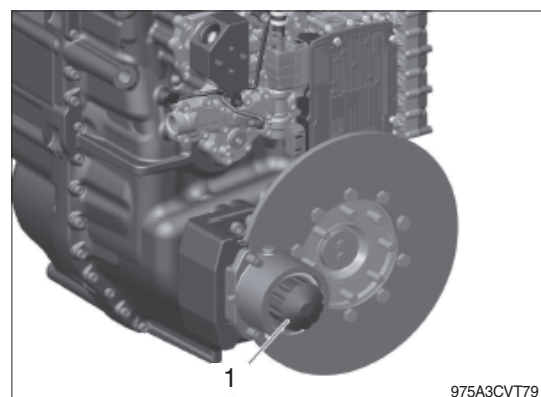
- (6) Screw in screw coupling and connect high pressure pump.
- (7) Apply required release pressure of 150 bar to brake.
- (8) Screw in adjusting screw clockwise until both brake lining carriers are in contact with the brake disk. It is then only possible to rotate the adjusting screw by applying much force.
- (9) Turn back adjusting screw 4/5 rotation counterclockwise.

A 4/5 rotation corresponds to nominal clearance 2.0 mm.

- (10) Hold adjusting screw and prevent with hexagon nut from turning.
 - Tightening torque: 9.2 kgf · m (66.4 lbf · ft)

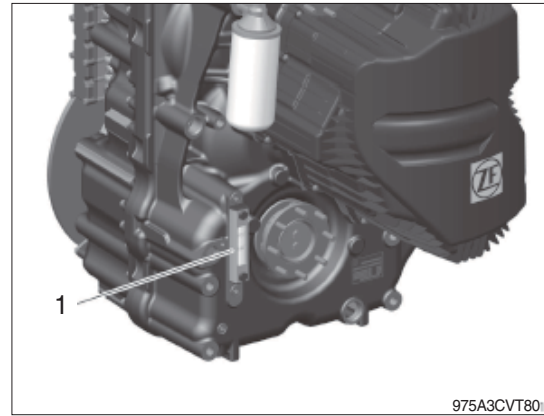


- (11) Manually bolt on screw cap with O-ring (1).

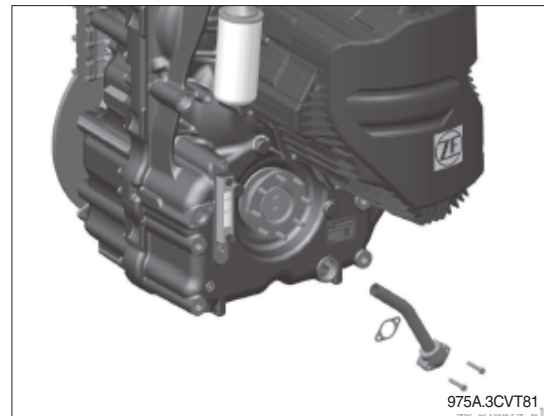


14) Install filler neck

- (1) Install oil level indicator (1).
- Tightening torque: 0.82 kgf · m (5.9 lbf · ft)

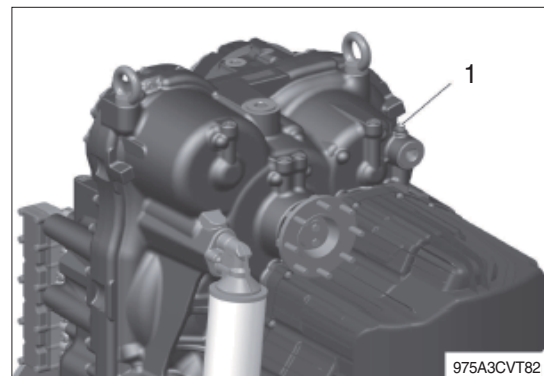


- (2) Put on seal and fix oil level tube with hexagon screws.
- Tightening torque: 2.35 kgf · m (17 lbf · ft)



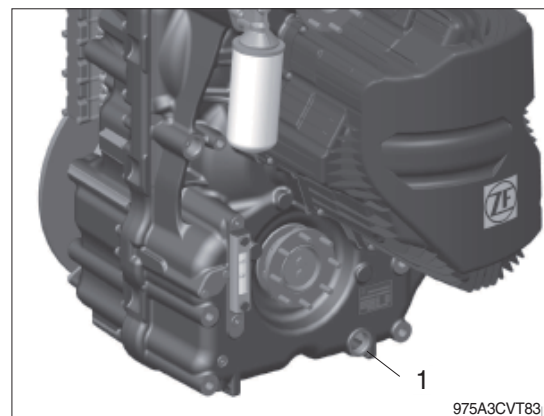
15. Add oil

- (1) Bolt in breather (1) and tighten.
- Tightening torque: 1.22 kgf · m (8.9 lbf · ft)



- (2) Bolt in screw plug with O-ring (1) and tighten.
- Tightening torque: 8.16 kgf · m (59 lbf · ft)

- (3) Prior to operation, fill transmission with oil according to operator's manual.



3. FRONT AXLE

1) DISASSEMBLY

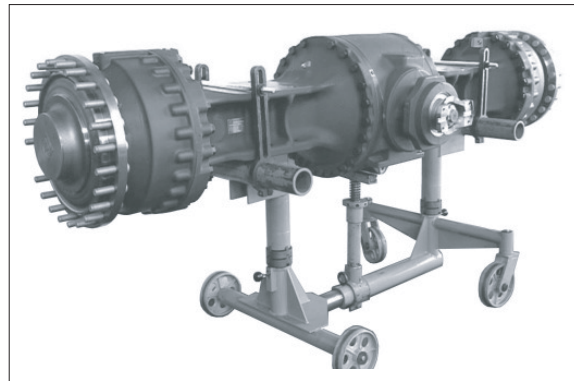
(1) Disassembly output and brake

① Fix axle to assembly truck.

Assembly truck	5870 350 000
Fixtures	5870 350 077
Clamping brackets	5870 350 075
Support	5870 350 125

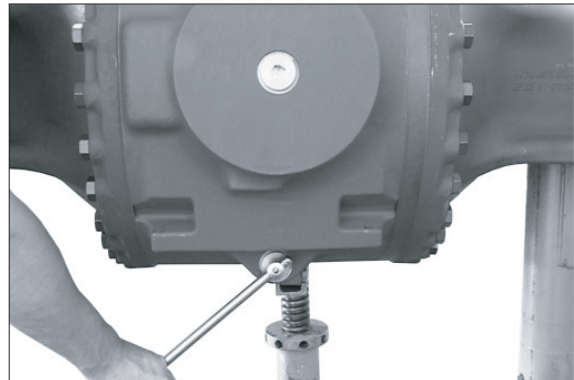
※ Before clamping the axle fully turn in the support.

Position axle first onto the two fixtures, secure with clamping brackets and then unbolt the support until contact with the axle is obtained.

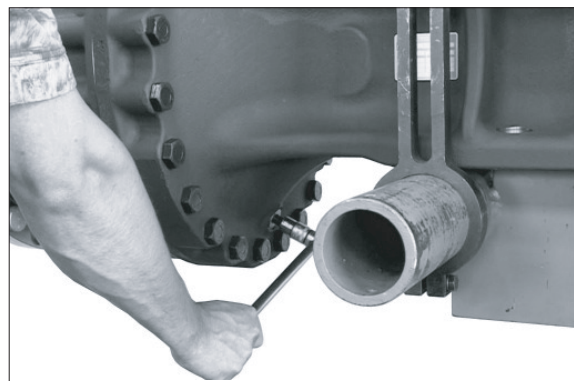


7809AX01

② Loosen screw plugs (3EA, see figure AX02 and AX03) and drain oil from the axle.



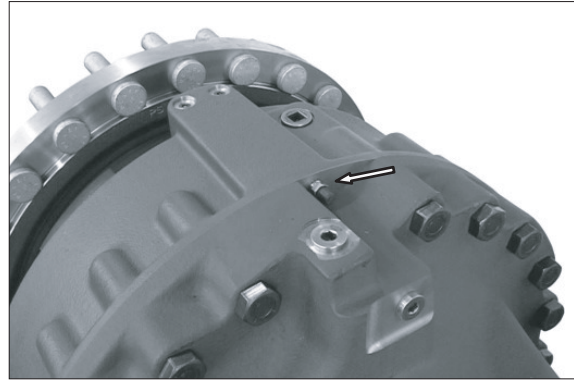
7809AX02



7809AX03

③ Remove the breather valve (see arrow).

※ To avoid any damage, the breather valve must be removed when separating the output.

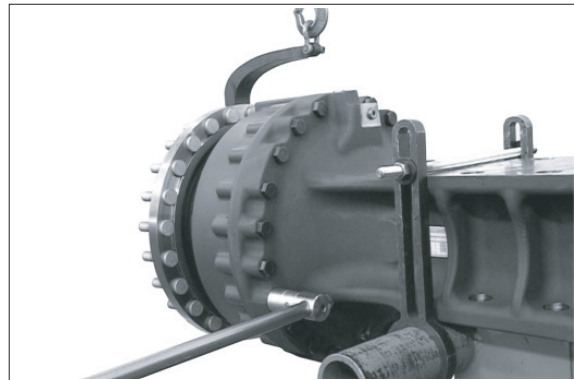


7809AX04

④ Secure the output with the lifting device and loosen hexagon screws. Then separate the output assy from the axle housing.

Load carrying device AA00 685 875

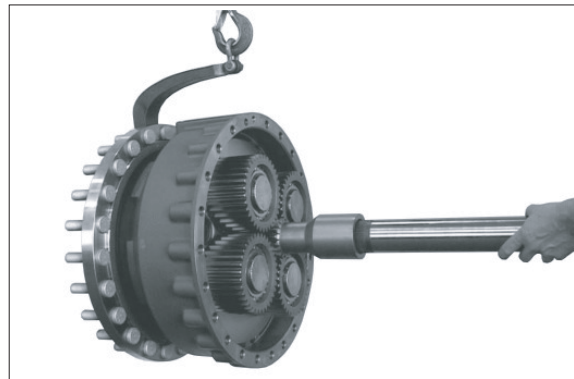
※ Fix the load carrying device with wheel nuts.



7809AX05

⑤ Pull stub shaft and sun gear shaft.

※ Pay attention to potentially releasing shim(s).

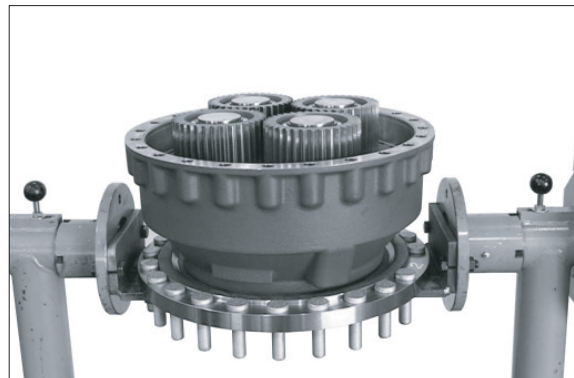


7809AX06

⑥ Fix output to assembly truck.

Assembly truck 5870 350 000

Fixtures (2EA) 5870 350 113



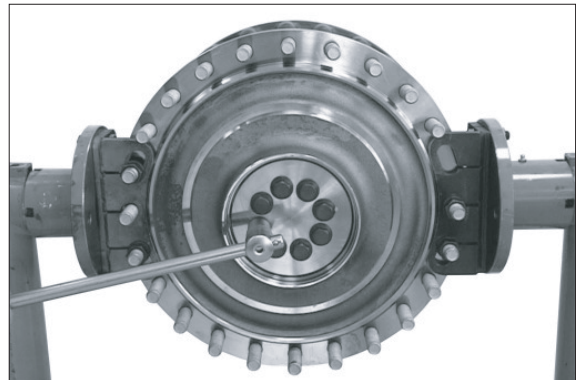
7809AX07

- ⑦ Use a lever to remove the cover from the output shaft.



7809AX08

- ⑧ Loosen locking screws and remove the releasing cover.



7809AX09

- ⑨ Lift the planetary carrier out of the brake housing by means of the lifting device.

- Planetary carrier with 3 planetary gears
- Internal extractor 5870 300 019
- Eye bolt 5870 204 073



7809AX10

- ⑩ Pull the tapered roller bearing from the planetary carrier.

- Rapid grip AA00 693 459
- Basic tool 5873 004 001
- Clamping cylinder 5873 003 016
- Pump 5870 287 010



7809AX70

⑪ Disengage retaining ring.



7809AX71

⑫ Pull off planetary gear.

Extractor	AA00 696 012
Clamping cylinder	5873 003 016
Pump	5870 287 010



7809AX72

⑬ Lift the end plate out of the brake housing.



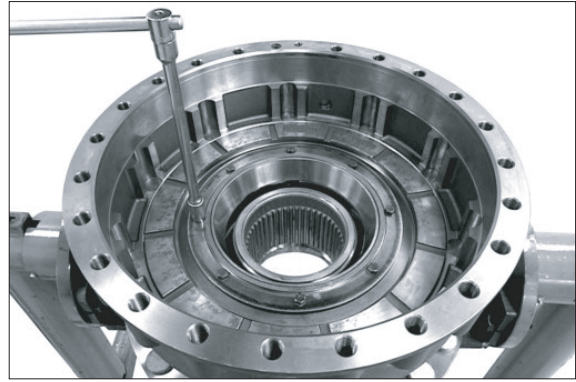
7809AX73

⑭ Lift the disk package out of the brake housing.



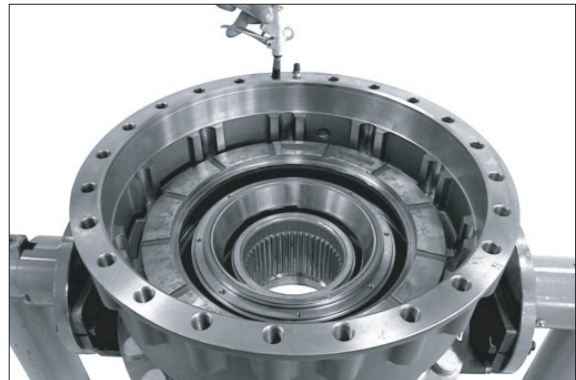
7809AX12

- ⑮ Loosen hexagon screws, remove releasing disk and cup spring.



7809AX13

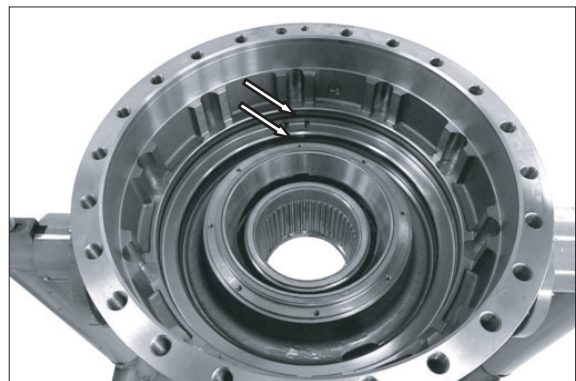
- ⑯ Mount breather valve and press piston out of the brake housing by means of compressed air.



7809AX14

- ⑰ If necessary, remove guide ring, back-up rings and grooved rings out of the annular grooves of the brake housing (see arrows).

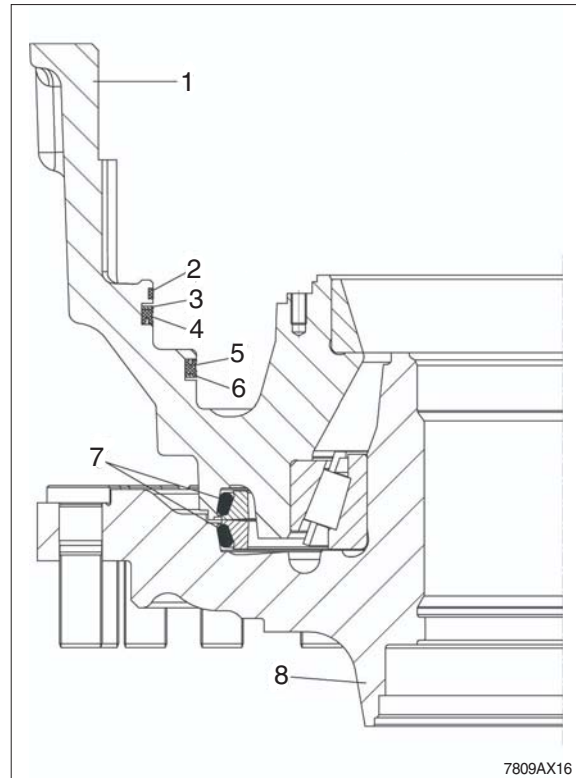
- ※ For the installation position of the single parts please also refer to the following sketch.



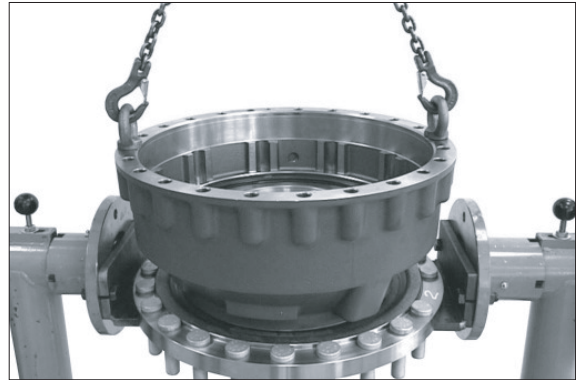
7809AX15

Legend to sketch :

- 1 = Brake housing
- 2 = Guide ring
- 3 = Back-up ring
- 4 = Grooved ring
- 5 = Grooved ring
- 6 = Back-up ring
- 7 = Slide ring seal
- 8 = Output shaft



- ⑱ Lift the brake housing from the output shaft by means of the lifting device.



- ⑲ Use a lever to remove the slide ring seal from the brake housing.

If necessary, force out both bearing outer rings.

Resetting device 5870 400 001



- ⑳ Use a lever to remove the slide ring seal from the output shaft.

Resetting device 5870 400 001



7809AX74

- ㉑ Pull the tapered roller bearing from the output shaft.

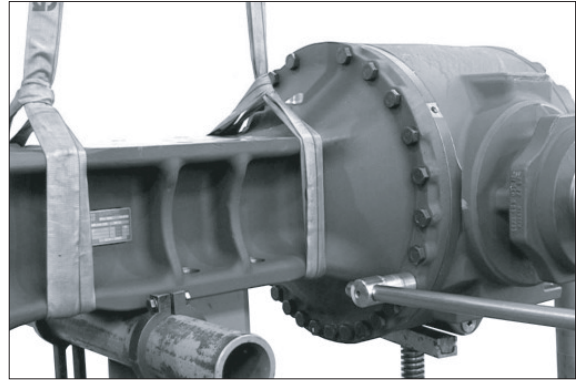
Gripping device AA00 633 495
Adapter ring AA00 633 500
Basic tool 5873 004 001
Pressure piece AA00 696 181
Clamping cylinder 5873 003 016
Pump 5870 287 010



7809AX75

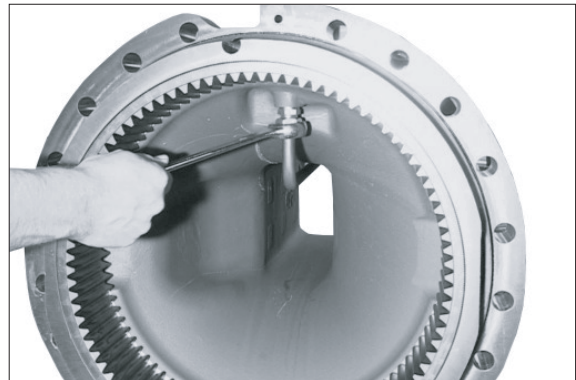
(2) Disassembly axle housing

- ① Secure axle housing with the lifting device and loosen the hexagon screws. Then separate the axle housing from the axle drive housing.



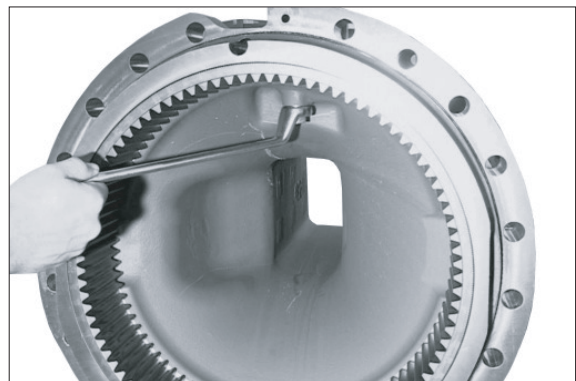
7809AX19

- ② Loosen the threaded connections and remove the releasing brake tube.



7809AX20

- ③ Loosen both screw necks.



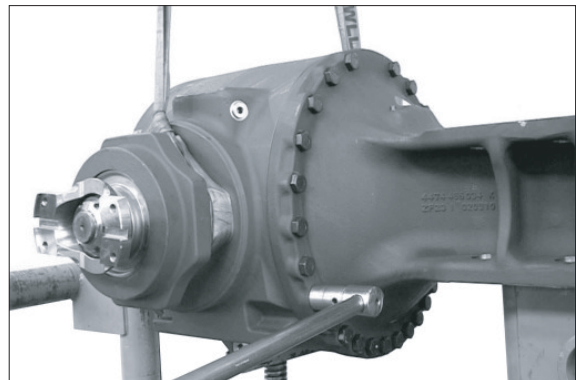
7809AX21

(3) Disassembly axle drive housing

- ① Secure axle drive housing with the lifting device and loosen the hexagon screws. Then separate the axle drive housing from the axle housing.

Eyebolt (M20)
Thread insert

5870 204 086
AA00 677 715



7809AX22

- ② Fix axle drive housing to the assembly truck.

Assembly truck	5870 350 000
Fixtures (2EA)	5870 350 113



7809AX76

- ③ Loosen cylindrical screws and lift the releasing bearing housing with the lifting device.

Inner extractor	5870 300 008
Eye bolt	AA00 680 376



7809AX77

- ④ Pull the bearing outer ring (see arrow) out of the bearing hole and remove the shim behind.



7809AX78

- ⑤ Press the piston out of the bearing housing by means of compressed air.



7809AX79

- ⑥ Lift differential out of the axle drive housing with the lifting device.

Inner extractor 5870 300 008
Eye nut AA00 680 376

- ※ Disassembly of the various differentials is described as of page 3-112.



7809AX80

- ⑦ Pull the bearing outer ring (see arrow) out of the bearing hole and remove the shim behind.



7809AX81

- ⑧ Heat slotted nut by means of hot-air blower.

- ※ Slotted nut is secured with Loctite # 262.



7809AX82

- ⑨ Loosen the slotted nut and remove the shim behind.

Wrench 5870 401 093
Fixing device AA00 695 905
Clamping device 5870 240 002



7809AX83

- ⑩ Pull input flange from the input pinion and use a lever to lift the shaft seal ring behind out of the axle drive housing.



7809AX84

- ⑪ Use a two-armed puller to press the input pinion out of the axle drive housing and remove the releasing tapered roller bearing.



7809AX85

- ⑫ Remove the spacer and pull the tapered roller bearing from the input pinion.

Gripping device	AA00 253 881
Basic tool	5873 003 000
Clamping cylinder	5873 003 016
Pump	5870 287 010



7809AX86

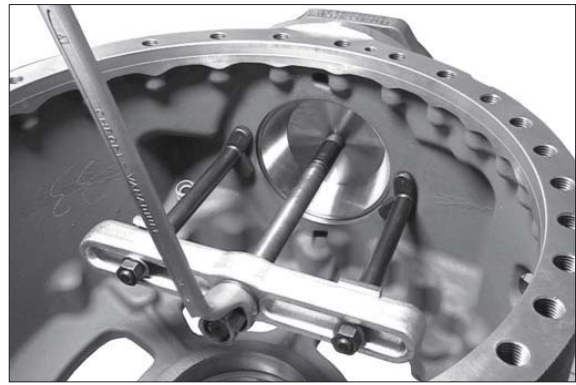
- ⑬ Loosen the threaded connection and remove the releasing oil tube.



7809AX87

- ⑭ If necessary pull the internal bearing outer ring out of the axle drive housing and remove the shim behind.

Assembly device AA00 696 770
Counter support 5870 300 020



7809AX88

- ⑮ If necessary pull the external bearing ring out of the axle drive housing.

Assembly device AA00 696 770
Counter support 5870 300 020



7809AX89

(4) Disassembly differentials

Disassembly multi-disk differential lock

- ① Remove axial roller cage (arrow).



7809AX90

- ② Pull both tapered roller bearings from the differential.

Crown wheel side

Rapid grip AA00 303 274

Basic tool 5873 004 001

Pressure piece AA00 694 360

Opposite side

Grab sleeve 5873 004 026

Basic tool 5873 004 001

Clamping cylinder 5873 003 016

Pump 5870 287 010



7809AX91

- ③ Preload the differential by means of the press and loosen the locking screws.

Pressure piece AA00 694 360



7809AX92

- ④ Lift the differential cover from the differential housing by means of the lifting device.

Inner extractor 5870 300 008

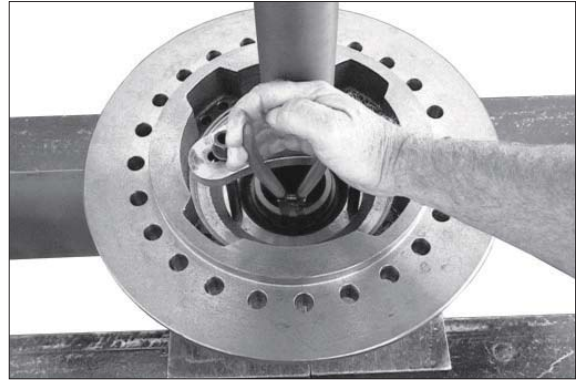
Eye nut AA00 680 376



7809AX93

- ⑤ Preload the compression spring by means of the press and disengage the retaining ring.

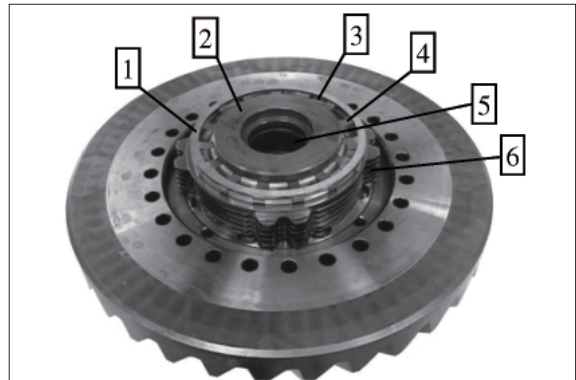
Then pull the sliding sleeve out of the differential cover and remove the releasing compression springs.



7809AX94

- ⑥ Remove single parts.

1 = Disk
2 = Pressure piece
3 = Cage
4 = Lever (15EA)
5 = Disk carrier
6 = Disk package



7809AX95

- ⑦ Loosen hexagon screws and remove the releasing disk.



7809AX96

- ⑧ Remove thrust washer and axle bevel gear from the differential housing.



7809AX97

⑨ Force out slotted pins (4EA).



7809AX98

⑩ Pull spider shafts (4EA) and remove the releasing spider gears with the thrust washers from the differential housing.



7809AX99

⑪ Remove the axle bevel gears and the shims behind.



7809AX100

⑫ Support the crown wheel and force out the differential housing.



7809AX101

2) ASSEMBLY

(1) Assembly differentials

Assembly multi-disk differential lock

- ① Mount two adjusting screws and press the heated crown wheel onto the differential housing until contact is obtained.

Adjusting screws 5871 204 040



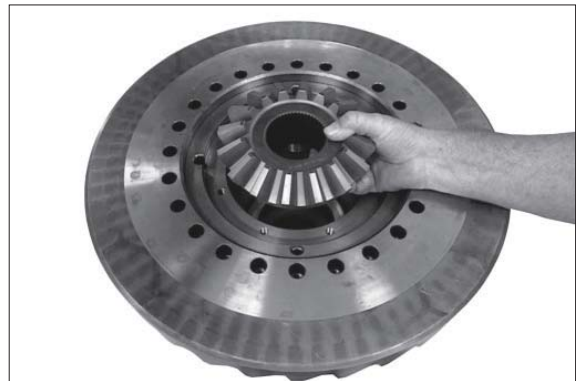
7809AX102

- ② Insert disk and thrust washer into the differential housing



7809AX103

- ③ Insert axle bevel gear.

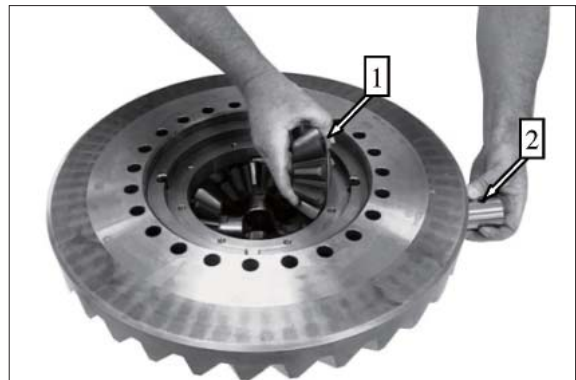


7809AX104

- ④ Insert spider gears with thrust washers into the differential housing and fix them with the spider shaft.

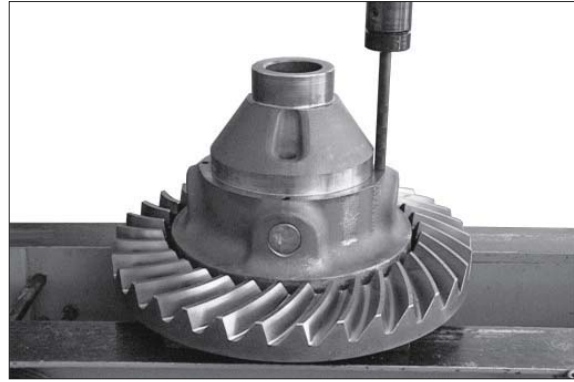
※ Thrust washers must be positioned with the tabs (see arrow 1) in the recesses of the differential housing.

Pay attention to radial installation position of the spider shafts (fixing holes, arrow 2).



7809AX105

- ⑤ Fix spider shafts with slotted pins (2 pieces / hole).
※ Press the slotted pins with 180° offset openings into flush position.



7809AX106

- ⑥ Mount second axle bevel gear and thrust washer.



7809AX107

- ⑦ Mount disk and fix it with hexagon screws.
· Tightening torque (M10/10.9) :
5.1 kgf · m (36.9 lbf · ft)

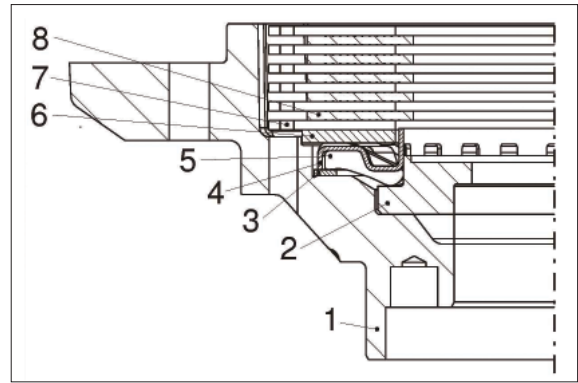


7809AX108

Setting of disk package

- ⑧ Premount single parts according to the adjacent sketch.

- 1 = Differential cover
- 2 = Pressure piece
- 3 = Disk
- 4 = Cage
- 5 = Lever (15EA)
- 6 = End plate
- 7 = Outer disks (optional)
- 8 = Inner disks



7809AX109

- ⑨ Preload disk package with an axial force of $F = 7$ ton.

Then check the **setting dimension A** = $15.5_{-0.2}$ mm from the mounting face of the differential cover to the plane face of the outer disk (see also below sketch).

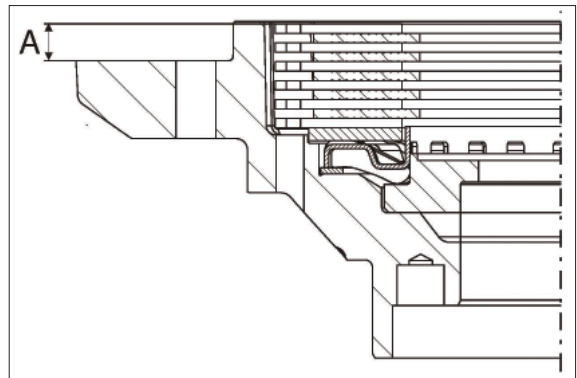
- ※ Any deviation from the specified setting dimension must be corrected with a corresponding outer disk.



7809AX110

Legend to sketch:

A = Setting dimension = $15.5_{-0.2}$ mm



7809AX111

- ⑩ Engage the snap ring (see arrow) into the annular groove of the disk carrier.



7809AX112

- ⑪ Insert the premounted disk carrier onto the axle bevel gear.



7809AX113

- ⑫ Mount outer and inner disks.
- ※ For the number of disks and disk arrangement please refer to the parts manual.
 - ※ Pay attention to the radial installation position of the disk package, as shown on the adjacent figure.



7809AX114

- ⑬ Insert end plate.



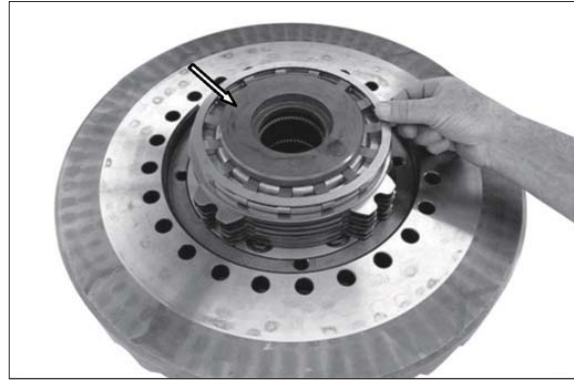
7809AX115

- ⑭ Mount cage and lever (15EA).



7809AX116

- ⑮ Insert pressure piece (see arrow) and install disk.



7809AX117

- ⑯ Insert compression springs (6EA) into the differential cover.



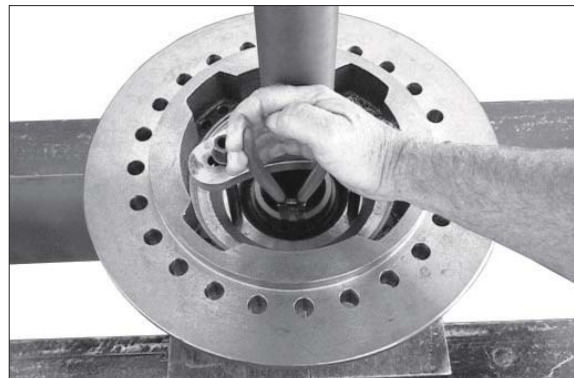
7809AX118

- ⑰ Insert sliding sleeve.



7809AX119

- ⑱ Preload the compression springs by means of the press and engage the retaining ring into the annular groove of the sliding sleeve.



7809AX120

- ① Mount two adjusting screws and insert the differential cover by means of the lifting device.

Adjusting screws	5870 204 040
Inner extractor	5870 300 008
Eye nut	AA00 680 376



7809AX121

- ② Preload the differential by means of the press and bolt with **new** locking screws.

· Tightening torque (M16/12.9) :
40.7 kgf · m (295 lbf · ft)

Pressure piece AA00 694 360



7809AX122

- ③ Heat both tapered roller bearings and insert until contact is obtained.

※ Adjust tapered roller bearing after cooling down.



7809AX123

- ④ Insert axial roller cage (see arrow).



7809AX124

(2) Assembly axle drive housing

※ If crown wheel or input pinion are damaged, both parts must be jointly replaced.

In case of a new installation of a complete bevel gear set pay attention to an identical mating number of input pinion and crown wheel.

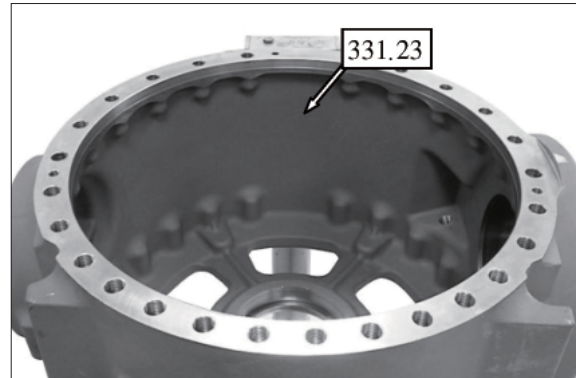
Determination of shim thickness to obtain a correct contact pattern

※ The following measuring procedures must be carried out with utmost accuracy.

Inaccurate measurements lead to an incorrect contact pattern requiring an additional disassembly and reassembly of input pinion and differential.

① Read dimension I from the axle drive housing.

Dimension I e.g 331.25 mm



7809AX125

② Read dimension II (pinion dimension).

Dimension II e.g 265.00 mm



7809AX126

- ③ Determine dimension III (bearing width).

Dimension III e.g. 63.60 mm

Calculation example A :

Dimension I 331.25 mm

Dimension II - 265.00 mm

Dimension III - 63.60 mm

Difference = shim s = 2.60 mm



7809AX127

Reassembly of input pinion

- ① Undercool the external bearing outer ring and insert it into the axle drive housing until contact is obtained.

Driver tool 5870 050 007

Handle 5870 260 004



7809AX128

- ② Insert the determined shim e.g. $s = 2.60$ mm into the housing hole.



7809AX129

- ③ Undercool the internal bearing outer ring and bring it into contact position in the housing hole by using the assembly fixture.

Assembly fixture AA00 623 955



7809AX130

- ④ Heat the tapered roller bearing and insert it into the input pinion until contact is obtained.



7809AX131

Setting of rolling torque of input pinion bearing 0.1~0.5 kgf·m (without shaft seal ring)

- ⑤ Insert spacer (e.g. $s = 7.13$ mm).
- ※ According to our experience the necessary rolling torque is obtained when reusing the spacer which has been removed during disassembly (e.g. $s = 7.13$ mm).
A later check of the rolling torque, however, is absolutely necessary.



7809AX132

- ⑥ Insert the preassembled input pinion into the axle drive housing and insert the heated tapered roller bearing until contact is obtained.



7809AX133

- ⑦ Press the protection plate onto the input flange (see arrow) until contact is obtained.
- ※ Do not fit the shaft seal ring until the contact pattern has been checked.



7809AX134

- ⑧ Insert input flange and fix it by means of disk and slotted nut.

· Tightening torque :

122 kgf · m (885 lbf · ft)

Wrench 5870 401 093

Fixing device AA00 695 905

Clamping device 870 240 002

- ※ Preliminarily mount slotted nut without Loctite.

- ※ While tightening rotate the input pinion several times in both directions.



7809AX135

- ⑨ Check rolling torque (0.15~0.51 kgf·m 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 (figure AX132) as specified below.
Insufficient rolling torque - install thinner spacer ring.

Excessive rolling torque - install thicker spacer ring.



7809AX136

- ⑩ Mount threaded connection.

· Tightening torque :

10.2 kgf · m (73.8 lbf · ft)



7809AX137

⑪ Mount oil tube.

- Tightening torque :
10.2 kgf · m (73.8 lbf · ft)



7809AX138

⑫ Grease O-rings (see arrows) and insert them into the annular grooves of the piston.



7809AX139

⑬ Insert piston (see arrow) into the bearing housing until contact is obtained.



7809AX140

Determination of shims for setting of bearing rolling torque (differential housing) and backlash (bevel gear set)

※ Determine the required shims on the basis of the read value (deviation/test dimension) and the corresponding specifications of the table below: (KRS – SET – RIGHT) (KRS = bevel gear set):

① Deviation see crown wheel rear side.

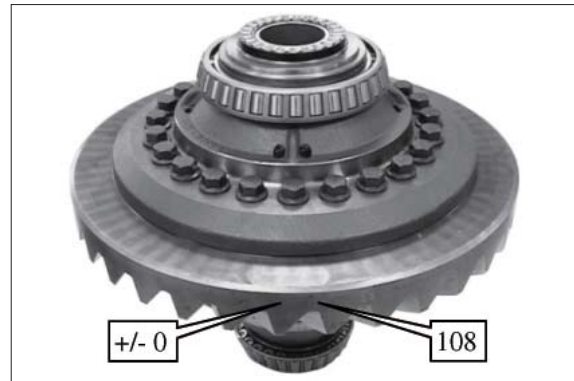
The test dimension 108 is stamped into the crown wheel rear side. If no + or – deviation is indicated, this value corresponds to the actual value 0 in the table below. According to this value, the required shims are allocated in the table below.

※ Any + or – deviation of the test dimension caused by production is also marked on the crown wheel rear side (e.g.- 20 or - 10 or 10 or 20) .

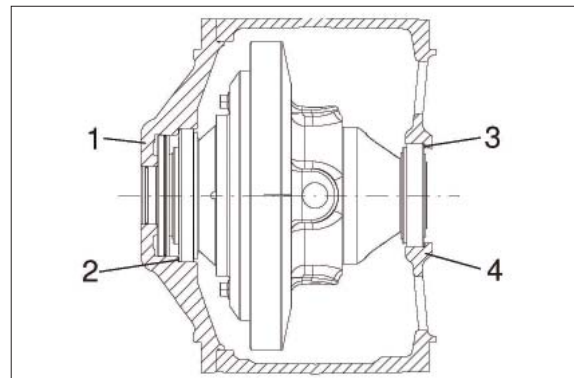
In accordance with this deviation, the required shims are allocated in the table below.

Legend to sketch:

- 1 = Bearing housing
- 2 = Shim (crown wheel side)
- 3 = Shim (differential carrier side)
- 4 = Axle drive housing



7809AX141



7809AX142

Shims for differential						
Crow wheel marking	- 30	- 20	- 10	0	10	20
Deviation	- 0.3	- 0.2	- 0.1	0	0.1	0.2
Shim diff cage side shim thickness	1.1	1.2	1.3	1.4	1.5	1.6
Shim P/No.	ZGAQ-03681	ZGAQ-03676	ZGAQ-03677	ZGAQ-03678	ZGAQ-03679	ZGAQ-03680
Shim crown wheel side shim thickness	1.7	1.6	1.5	1.4	1.3	1.2
Shim P/No.	ZGAQ-03687	ZGAQ-03686	ZGAQ-03685	ZGAQ-03684	ZGAQ-03683	ZGAQ-03682

- ② Insert the determined shim (e.g. $s = 1.4$ mm) into the hole of the axle drive housing and reset until contact with the bearing outer ring is obtained.



7809AX143

- ③ Cover some drive and coast flanks of the crown wheel with marking ink. Then insert the premounted differential into the axle drive housing.

Inner extractor 5870 300 008
Eye nut AA00 680 376



7809AX144

- ④ Insert the determined shim (e.g. $s = 1.4$ mm) into the bearing housing and reset the bearing outer ring until contact is obtained.



7809AX145

- ⑤ Place the premounted bearing housing onto the axle drive housing by means of the lifting device.

Inner extractor 5870 300 008
Eye nut AA00 680 376

- ※ Preliminarily mount the bearing housing without O-ring.



7809AX146

- ⑥ Fix the bearing housing by means of cylindrical screws (3EA).

· Tightening torque (M12/10.9) :
5.1 kgf · m (36.9 lbf · ft)



7809AX147

Leakage test of lock

- ⑦ Pressurize the lock ($p = 1$ bar), close shut-off valve and remove air line.

※ No noticeable pressure loss is allowed to occur within 10 sec.



7809AX148

- ⑧ By rotating the input flange, roll crown wheel over the input pinion in both directions several times.

Then remove the bearing housing again and lift the differential out of the axle drive housing.

Compare the obtained contact pattern with contact pattern.

※ In case of any contact pattern deviation, a measuring error was made when determining the shim (Figure AX129), which must be corrected by all means.



7809AX149

- ⑨ After the contact pattern check insert the differential again into the axle drive housing.



7809AX150

Reassembly of shaft seal ring (figure AX151~153)

- ⑩ Loosen slotted nut and pull the input flange from the input pinion.

Wrench	5870 401 093
Fixing device	AA00 695 905
Clamping device	5870 240 002



7809AX151

- ⑪ Mount the shaft seal ring with the seal lip showing to the oil chamber.

Driver tool	AA00 623 986
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- ※ The exact installation position of the shaft seal ring is obtained when using the specified driver tool.
- ※ Wet the outer diameter of the shaft seal ring with spirit directly before installation and fill the space between seal and dust lip with grease.



7809AX152

- ⑫ Insert input flange and finally tighten by means of disk and slotted nut.

· Tightening torque :
122 kgf · m (12.5 lbf · ft)

Wrench	5870 401 093
Fixing device	AA00 695 905
Clamping device	5870 240 002

- ※ Cover the thread of the slotted nut with loctite #262.



7809AX153

- ⑬ Grease O-ring (see arrow) and insert it into the annular groove of the bearing housing.



7809AX154

- ⑭ Insert the bearing housing by means of the lifting device and finally tighten it with cylindrical screws.

· Tightening torque (M12/10.9) :
5.1 kgf · m (36.9 lbf · ft)



7809AX155

- ⑮ Grease O-rings (see arrows) and insert them on both sides of the axle drive housing.



7809AX156

- ⑯ Mount two adjusting screws and bring axle drive housing in contact position with the axle housing by using the lifting device.

Then fix the axle drive housing with hexagon screws.

· Tightening torque (M20/10.9) :
57.1 kgf · m (413 lbf · ft)

Adjusting screws (M20) 5870 204 024

Eye bolt (M20) 5870 204 086

Thread insert AA00 677 715



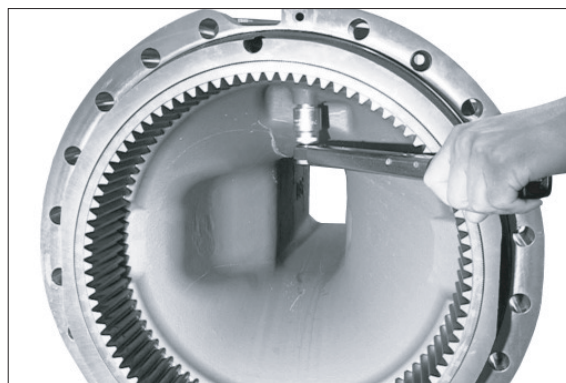
7809AX157

- ※ After mounting the axle drive housing unbolt the support until contact is obtained.

(3) Assembly axle housing

① Mount both fittings.

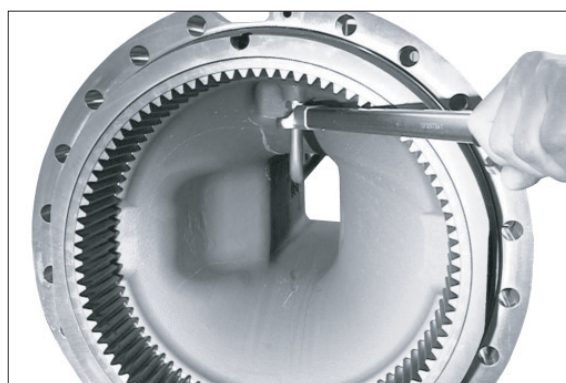
- Tightening torque : 3.67 kgf · m
(26.6 lbf · ft)



7809AX158

② Mount brake tube.

- Tightening torque : 10.2 kgf · m
(73.8 lbf · ft)



7809AX159

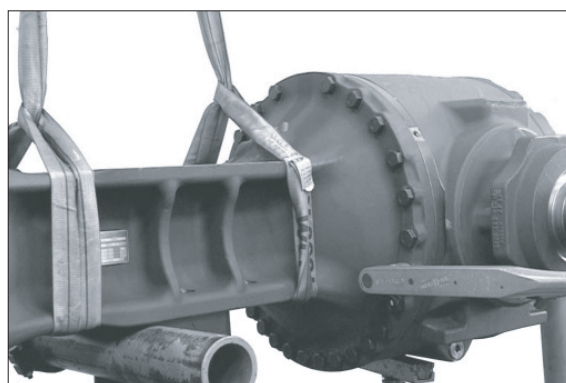
③ Mount two adjusting screws and bring the axle housing into contact position with the axle drive housing by using the lifting device.

Then fix the axle housing by means of hexagon screws.

- Tightening torque (M20/10.9) :
57.1 kgf · m (413 lbf · ft)

Adjusting screws (M20) 5870 204 024

- ※ After assembling the axle housing secure the axle with clamping brackets.



7809AX160

(4) Assembly output and brake

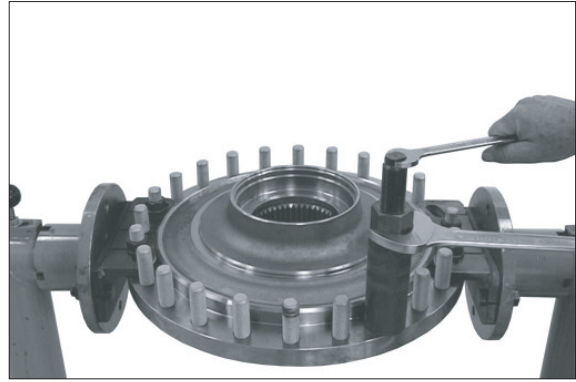
- ① Pull in wheel stud into the output shaft until contact is obtained.

Wheel stud puller - basic tool

5870 610 001

Insert (M22x1.5) 5870 610 002

- ※ Special tool may only be used for repair solution when exchanging individual wheel studs with mounted output shaft. When using a new output shaft, mount the wheel studs with the press.



7809AX28

- ② Heat tapered roller bearing and insert it into the output shaft until contact is obtained.



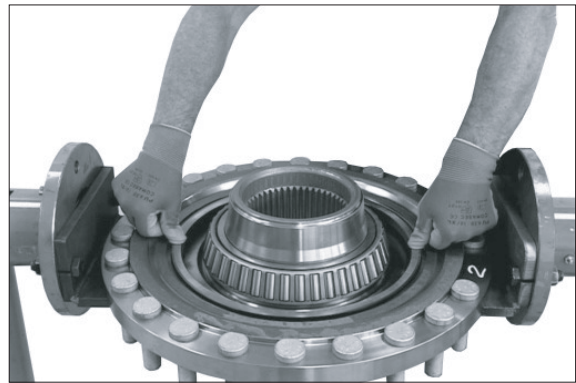
7809AX29

- ② Wet O-ring of the slide ring seal and locating hole with spirit. Snap **new** slide ring seal (1) into the output shaft. Then mount **new** slide ring seal (part 2) accordingly into the brake housing.

- ※ For the installation position of the seal please also refer to sketch AX34.

- ※ The surface of the slide ring seal may not have any grooves, scratches or other types of damage. Take care that the sealing surface is parallel to the housing face.

The O-rings must be mounted evenly into the locating hole and must not bulge out of the hole. Risk of injury - Metal rings have extremely sharp edges. Wear protective gloves.



7809AX30



7809AX31

③ Insert the premounted brake housing by means of the lifting device over the output shaft until contact is obtained.

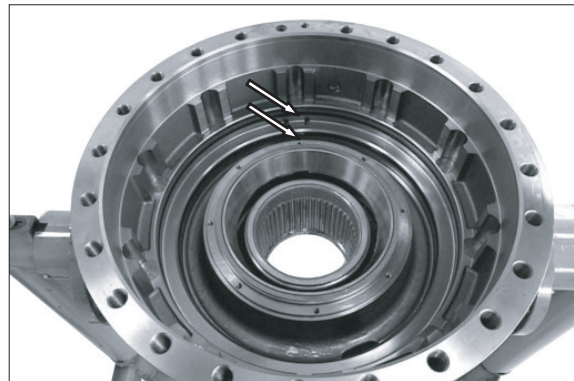
※ Before clamping the seal rings to installation dimension, clean the sliding surfaces and apply an oil film. We recommend to use a leather cloth soaked with oil.



7809AX31

④ Insert back-up rings and grooved rings into the annular grooves of the brake housing (see arrows).

※ Pay attention to the installation position; please also refer to sketch AX34, page 3-256.



7809AX32

⑤ Clean the annular groove of the brake housing with spirit.

Then insert the guide ring into the annular groove (see also the following sketch) and fix it with loctite #415 at its extremities (see arrows).

※ The full circumference of the guide ring must be in an exact contact position.

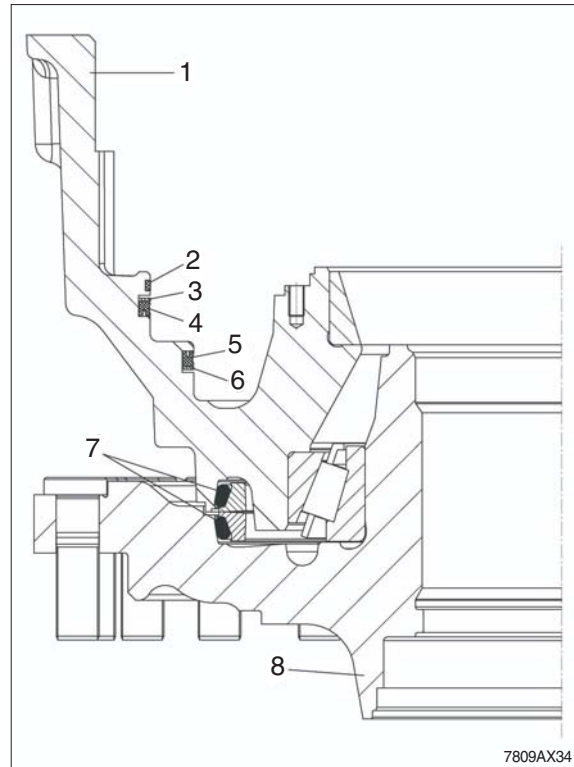
※ Upon installation the orifice of the guide ring must show upwards (12 o'clock).



7809AX33

Legend to sketch:

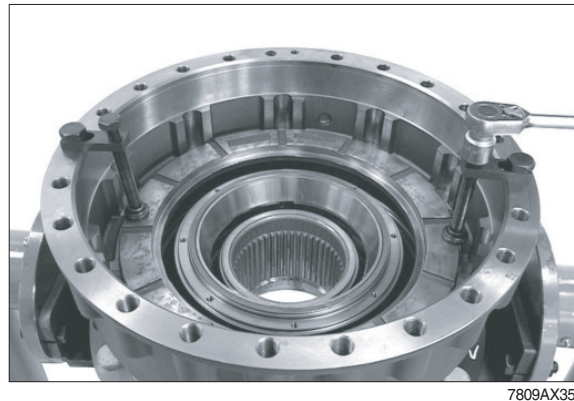
- 1 = Brake housing
- 2 = Guide ring
- 3 = Back-up ring
- 4 = Grooved ring
- 5 = Grooved ring
- 6 = Back-up ring
- 7 = Slide ring seal
- 8 = Output shaft



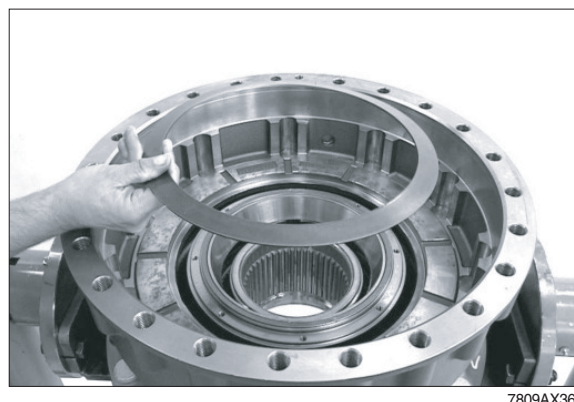
- ⑥ Insert the piston into the brake housing and carefully install with the fixing device until contact is obtained.

Fixing device AA00 680 530

- ※ Sufficiently oil seal surface of piston/back-up rings, grooved rings and guide ring (W-10 oils to be used).

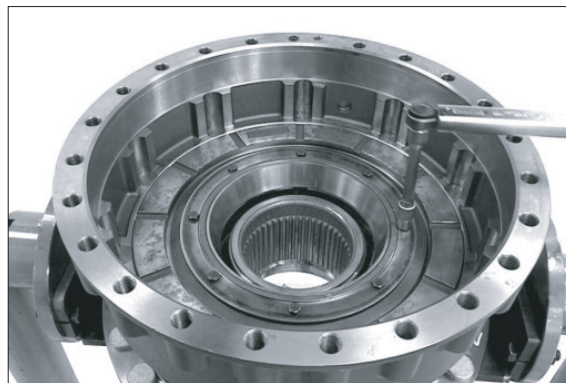


- ⑦ Insert cup spring into the piston with the convex side showing upwards.



- ⑧ Insert disk and fix it by means of hexagon screws.

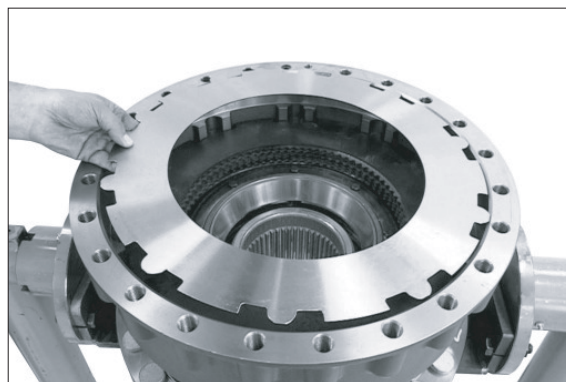
· Tightening torque (M8/10.9) :
3.47 kgf · m (25.1 lbf · ft)



7809AX37

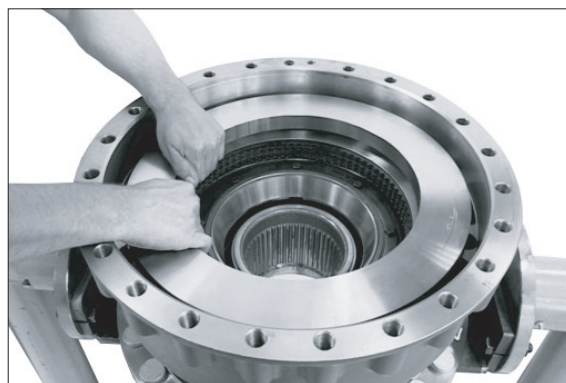
- ⑨ Mount outer and inner disks.

※ For the number of disks and the disk arrangement please refer to the relating spare parts list.



7809AX38

- ⑩ Insert end plate.



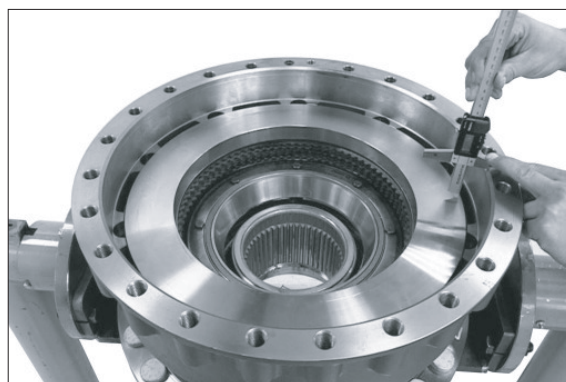
7809AX39

Setting of installation dimension 57.25~57.79 mm

- ⑪ Measure installation dimension from the mounting face of the brake housing to the front face of the end plate.

Installation dimension e.g 57.50 mm

※ Any deviation from the necessary installation dimension must be corrected with an appropriate outer disk (see spare parts manual).



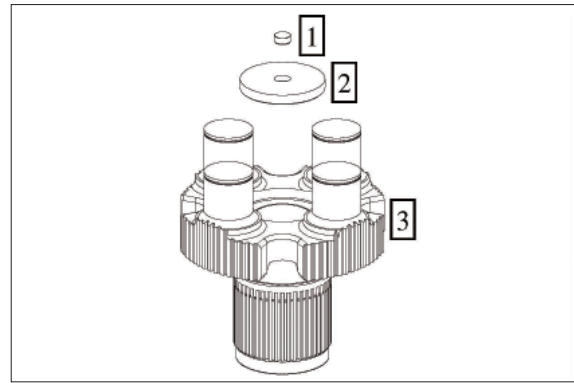
7809AX40

- ⑫ Press stop bolt into the cover until contact is obtained.

Then insert the premounted cover into the planetary carrier until contact is obtained.

Legend to sketch:

- 1 = Stop bolt
- 2 = Cover
- 3 = Planetary carrier

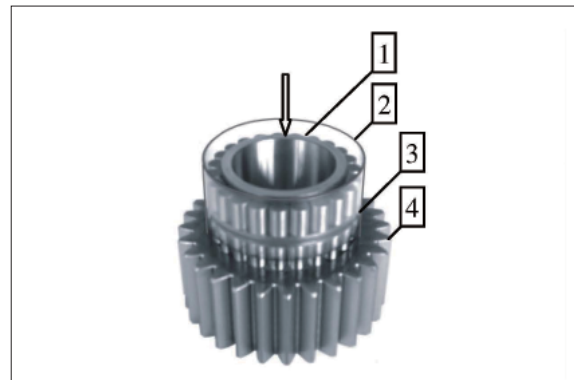


7809AX161

- ⑬ Insert the cylindrical roller bearing into the planetary gear – for this purpose press the cylindrical roller bearing through the packaging sleeve until the snap ring engages into the annular groove of the planetary gear.

※ Use packaging sleeve to facilitate assembly.

- 1 = Cylindrical roller bearing
- 2 = Packaging sleeve
- 3 = Snap ring
- 4 = Planetary gear



7809AX162

- ⑭ Heat bearing inner rings and insert the premounted planetary gears with large radius facing the planetary carrier (downwards) until contact is obtained.

※ Adjust bearing inner rings after cooling down.

Then fix planetary gears by means of retaining rings.



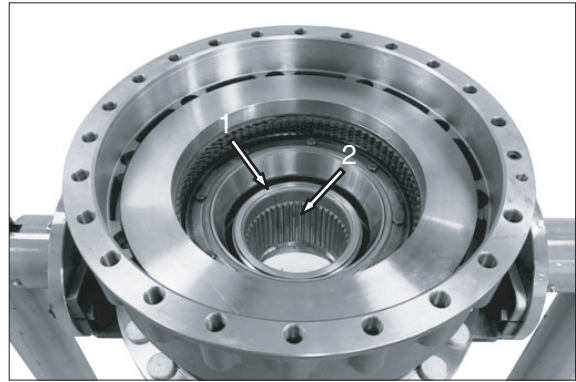
7809AX163

- ⑮ Heat tapered roller bearing and install it to the planetary carrier until contact is obtained.



7809AX164

- ⑩ Wet front face (contact face bearing inner ring, arrow 1) and profile (teeth, arrow 2) in the output shaft with anti-corrosive agent.



7809AX41

- ⑪ Align disk package centrally and radially. Then insert the planetary carrier by means of the lifting device into the teeth of the output shaft until contact is obtained.

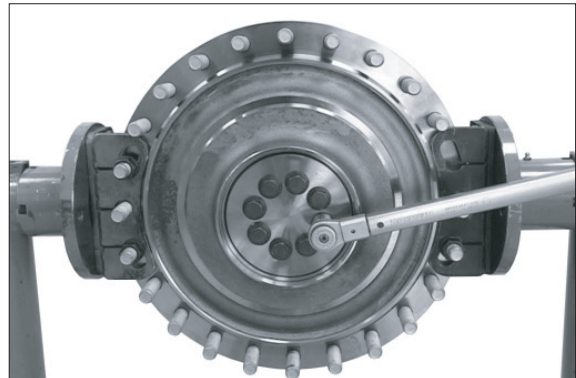
- Planetary carrier with 3 planetary gears
- Inner extractor 5870 300 019
- Eye bolt 5870 204 073



7809AX42

- ⑫ Pivot output 90°. Insert disk and fix planetary carrier with **new** locking screws.

- ※ Tighten locking screws successively with a tightening torque of 20.4 kgf · m (147.5 lbf · ft). Then retighten the locking screws successively with a tightening torque of 51 kgf · m (369 lbf · ft).



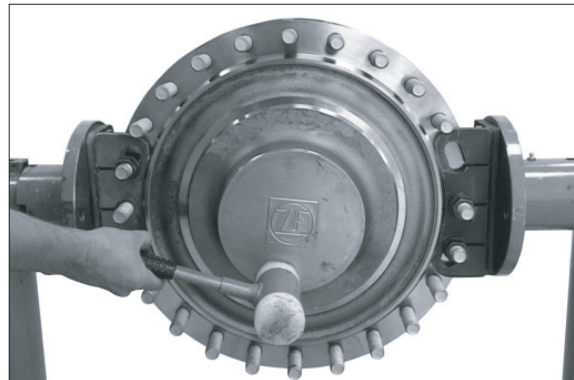
7809AX43

① Install O-ring (see arrow) to the cover.



7809AX44

② Insert the cover into the output shaft until contact is obtained.



7809AX45

**Set the axial play of the sun gear shaft
0.5~2.0 mm**

③ Determine dimension I, from the mounting face of the brake housing to the front face of the stop bolt.

Dimension I e.g. 58.60 mm

Gauge blocks 5870 200 066

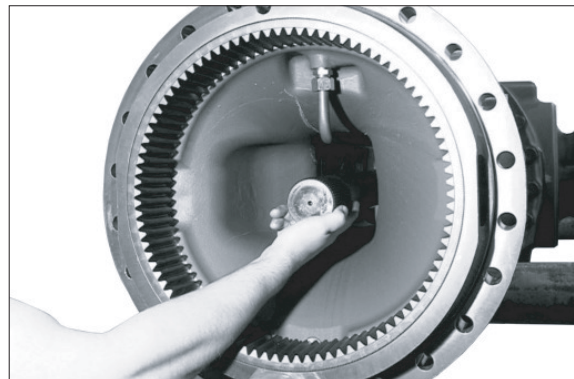
Straightedge 5870 200 022



7809AX46

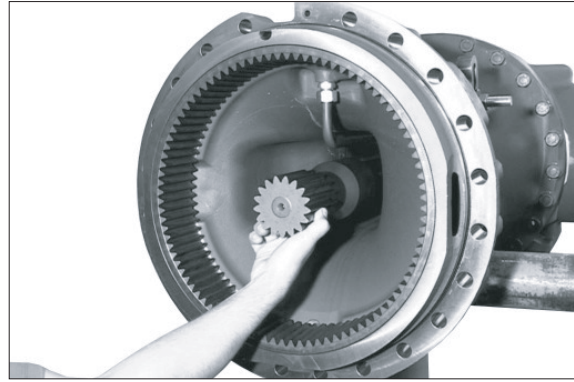
④ Insert stub shaft into the teeth of the axle bevel gear until contact is obtained.

※ Pay attention to the installation position;
mount the stub shaft with the long teeth
showing to the differential.



7809AX47

- ② Insert the sun gear shaft until contact is obtained.



7809AX48

- ③ Measure dimension II, from the front face of the sun gear shaft to the mounting surface of the axle housing.

Dimension II e.g. 56.60 mm

Straightedge 5870 200 022

Calculation example :

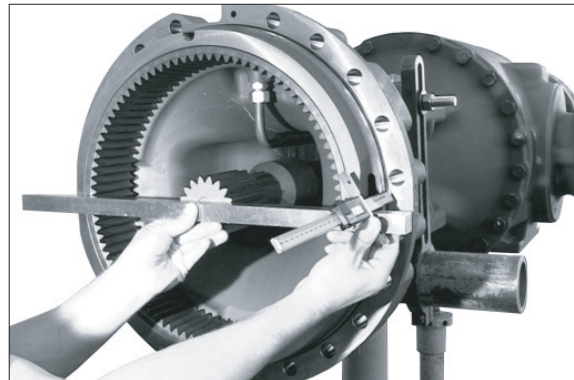
Dimension I 58.60 mm

Dimension II - 56.60 mm

Difference 2.00 mm

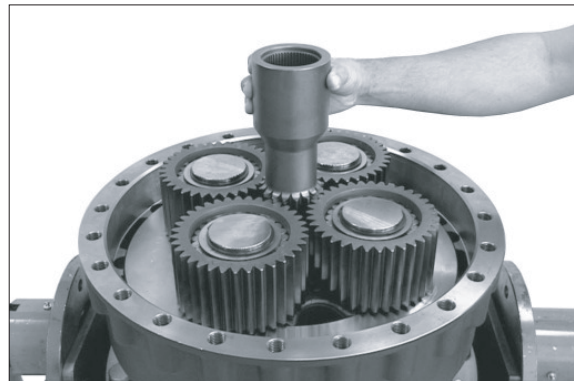
Required axial play e.g. - 1.00 mm

Difference = shim e.g. s = 1.00 mm



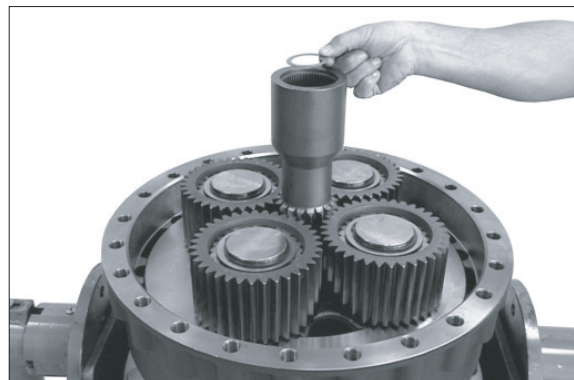
7809AX49

- ④ Insert sun gear shaft into the planetary carrier.



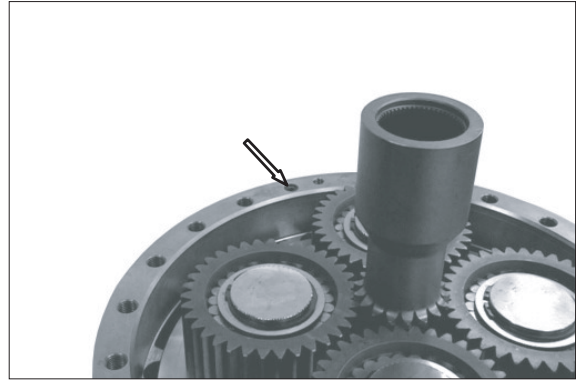
7809AX50

- ⑤ Fix determined shim e.g. $s = 1.00$ mm with grease into the sun gear shaft.



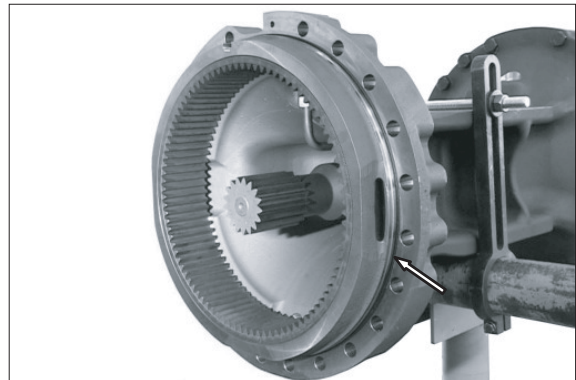
7809AX51

- ②⑥ Fix O-ring (see arrow) with grease into the countersink of the brake housing.



7809AX52

- ②⑦ Grease O-ring (see arrow) and install it to the axle housing.



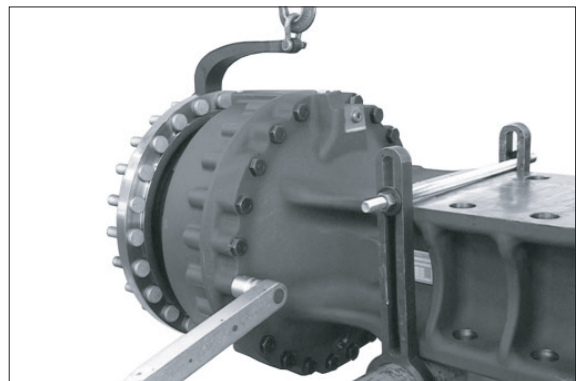
7809AX53

- ②⑧ Mount two adjusting screws and use the lifting device to bring the output into contact position with the axle housing. Then fix the output by means of hexagon screws.

- Tightening torque (M20/10.9) ;
57.1 kgf · m (413 lbf · ft)

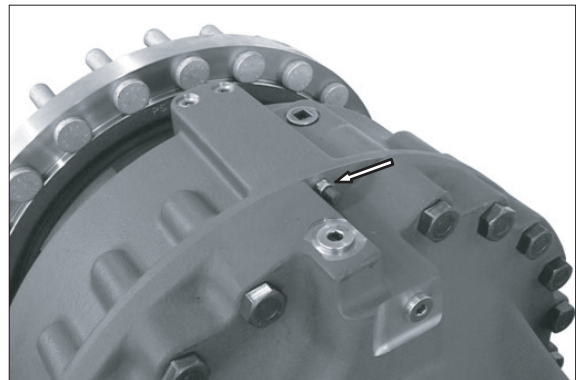
Adjusting screws (M20) 5870 204 024
Load-carrying device AA00 685 875

- ※ Fix load carrying device with wheel stud.



7809AX54

- ②⑨ Mount breather (see arrow).



7809AX55

③ Check brake hydraulics for leakages.

- ※ Before starting the test, completely breathe the brake hydraulics.
Then pressurize the brake temporarily (5EA) with $p = 100$ bar max.

High-pressure test :

Build up test pressure $p = 100_{-10}$ bar max. and close connection to HP pump via shut-off valve.

A pressure drop of max. 2 % (2 bar) is permissible during a 5 minute testing time.

Low-pressure test :

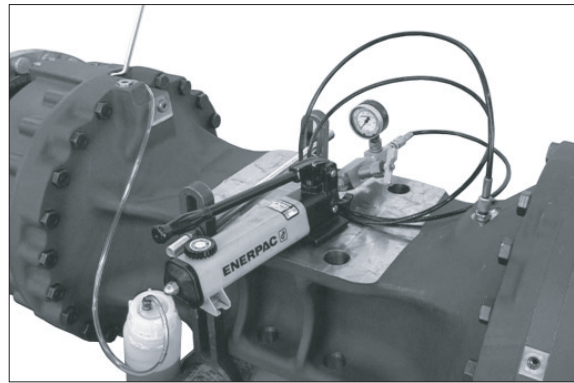
Reduce test pressure $p = 5$ bar and close shut-off valve.

No pressure drop is allowed during a 5 minute testing time.

Test media :

Engine oils SAE 10-W

HP pump	5870 287 007
Clutch	0501 207 939
Reduction (M18x1.5)	5870 950 161
Oil collector bottle	5870 286 072



7809AX56

③ Check operability of differential hydraulic lock

Build up pressure $p = 20$ bar max. and close connection to HP pump via shut-off valve.

Lock on:

When rotating the input flange, both outputs must have the same direction of rotation.

Lock off:

When rotating the input flange one side holds or has the opposite direction of rotation.

- ※ Prior to putting the axle into operation, fill it with oil according to the related lubrication and maintenance instructions.



7809AX165

4. REAR AXLE

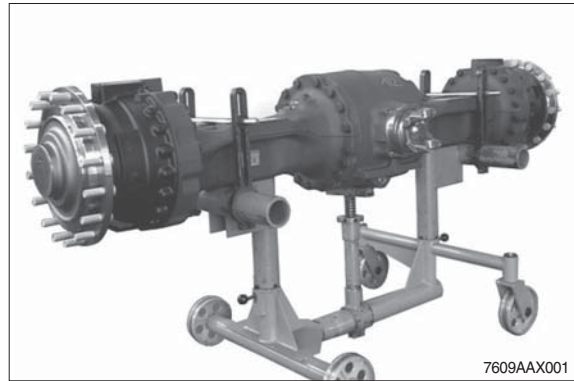
1) DISASSEMBLY

(1) Disassembly output and brake

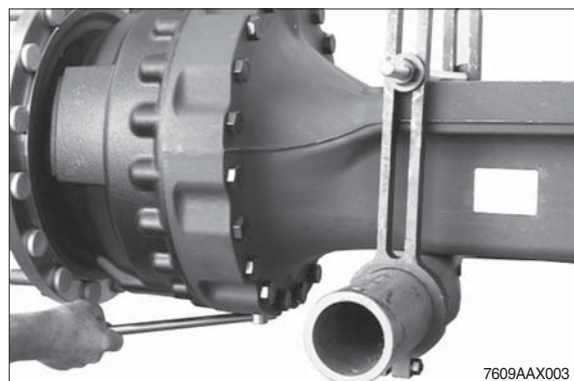
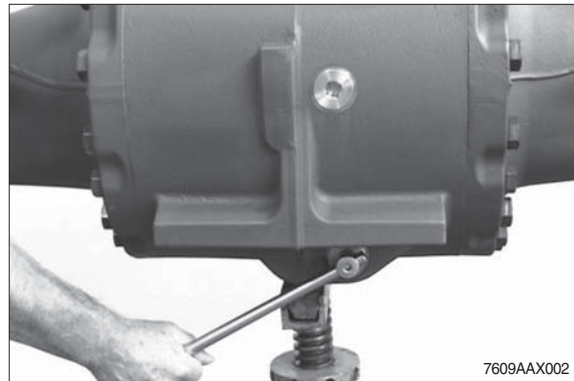
- ① Fix axle to assembly truck.

Assembly truck	5870 350 000
Fixtures	5870 350 077
Clamping brackets	5870 350 075
Support	5870 350 125

- ※ Before clamping the axle fully turn in the support. Position axle first onto the two fixtures, secure with clamping brackets and then unbolt the support until contact with the axle is obtained.

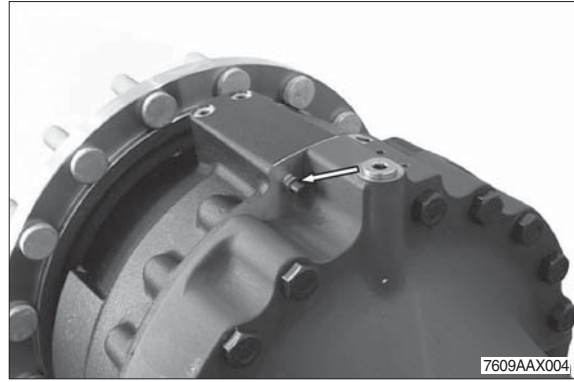


- ② Loosen screw plugs (3EA, see AX002 and AX003) and drain oil from the axle.



③ Remove the breather valve (see arrow).

※ To avoid any damage, the breather valve must be removed when separating the output.

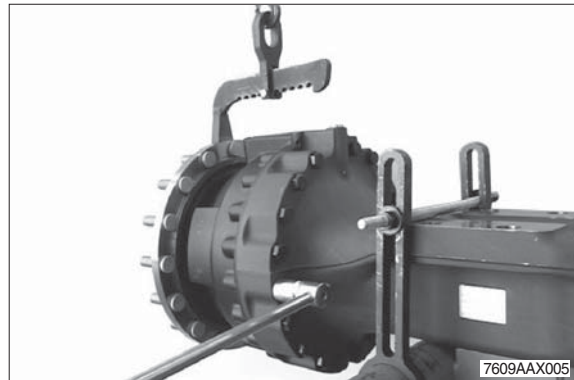


④ Secure the output with the lifting device and loosen hexagon screws.

Then separate the output assy from the axle housing.

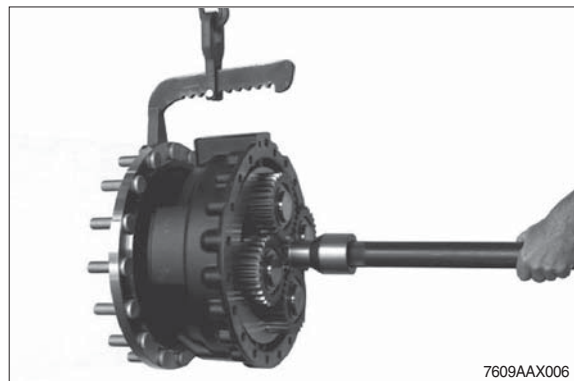
Load carrying device 5870 281 043

※ Fix the load carrying device with a wheel nut.



⑤ Pull stub shaft and sun gear shaft.

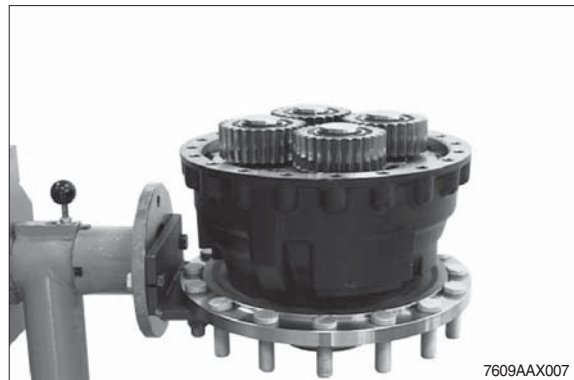
※ Pay attention to potentially releasing shim.



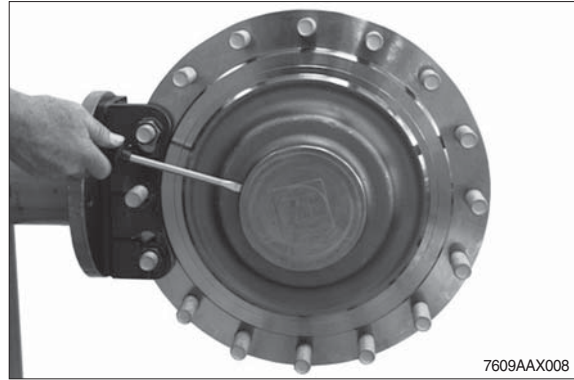
⑥ Fix output to assembly truck.

Assembly truck 5870 350 000

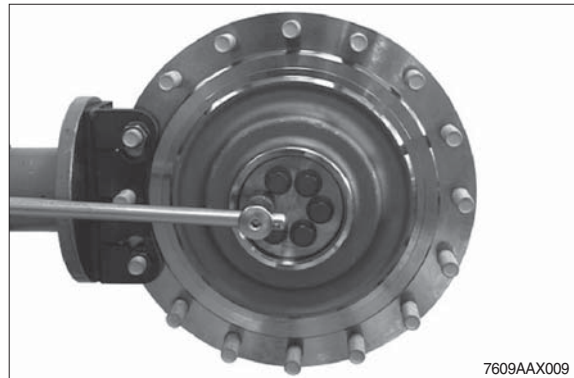
Fixture 5870 350 113



- ⑦ Use a lever to remove the cover from the output shaft.



- ⑧ Loosen locking screws and remove the releasing cover.

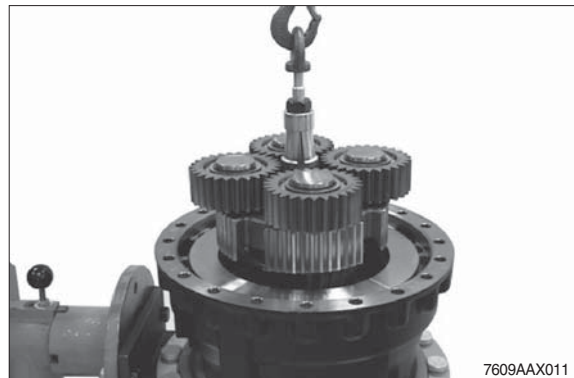


- ⑨ Press planetary carrier with a two-armed puller out of the profile of the output shaft.



- ⑩ Lift the planetary carrier out of the brake housing by means of the lifting device.

Inner extractor 5870 300 017
Eye nut 5870 204 076



- ⑪ Pull the tapered roller bearing from the planetary carrier.

Rapid grip

5873 014 016

Basic tool

5873 004 001



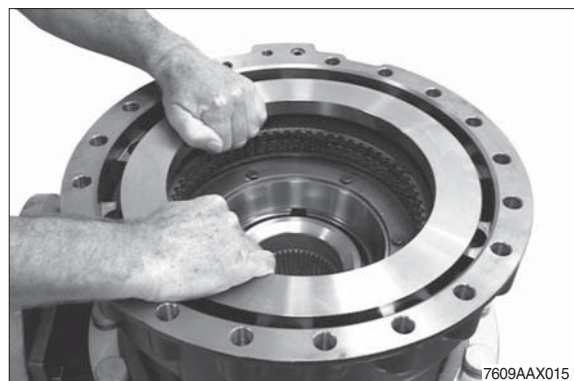
- ⑫ Disengage retaining ring.



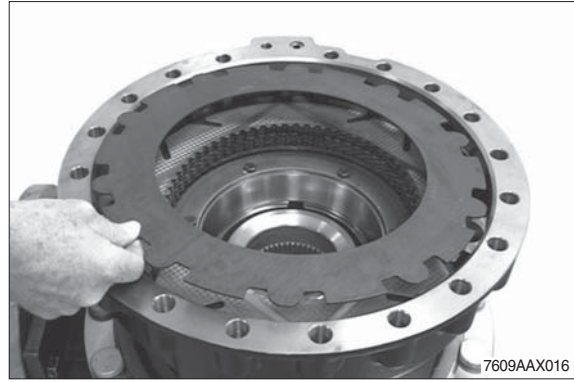
- ⑬ Pull off planetary gear.



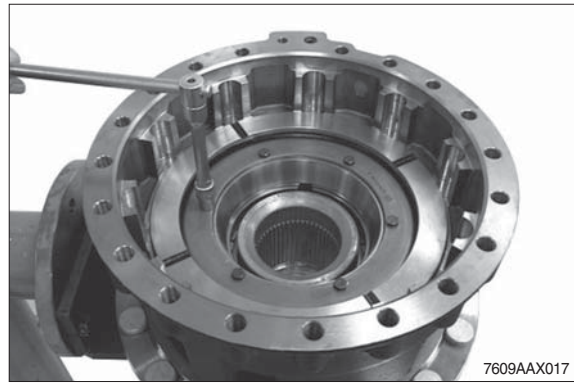
- ⑭ Lift the end plate out of the brake housing.



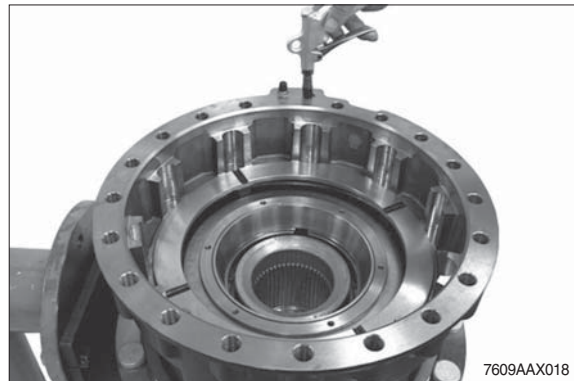
- ⑮ Lift the disk package out of the brake housing.



- ⑯ Loosen hexagon screws, remove releasing cover and cup spring.

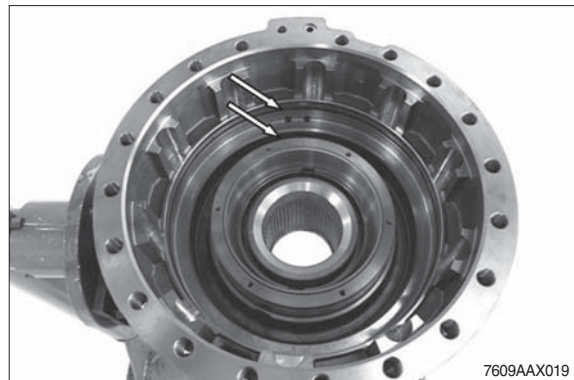


- ⑰ Mount breather valve and press piston out of the brake housing by means of compressed air.

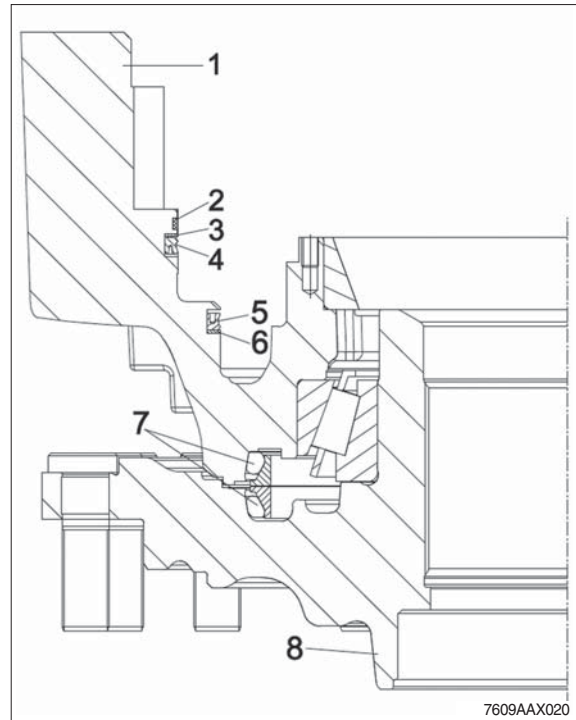


- ⑱ If necessary, remove guide ring, back-up rings and grooved rings out of the annular grooves of the brake housing (see arrows).

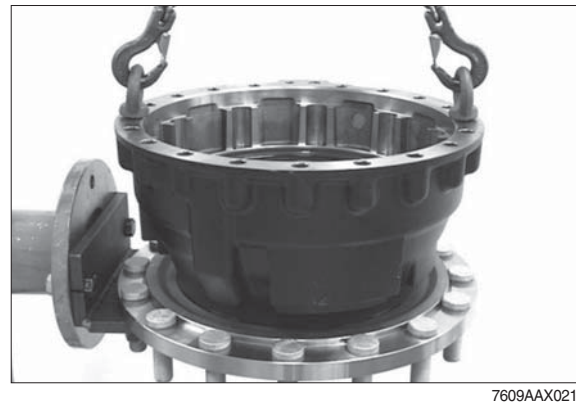
- ※ For the installation position of the single parts please also refer to the following sketch.



- 1 Brake housing
- 2 Guide ring
- 3 Back-up ring
- 4 Grooved ring
- 5 Grooved ring
- 6 Back-up ring
- 7 Slide ring seal
- 8 Output shaft



- ①⑨ Lift the brake housing from the output shaft by means of the lifting device.



- ②⑩ Use a lever to remove the slide ring seal from the brake housing.

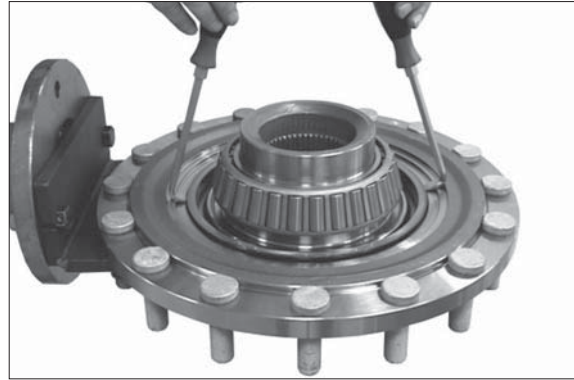
If necessary, force out both bearing outer rings.

Resetting device 5870 400 001



- ① Use a lever to remove the slide ring seal from the output shaft.

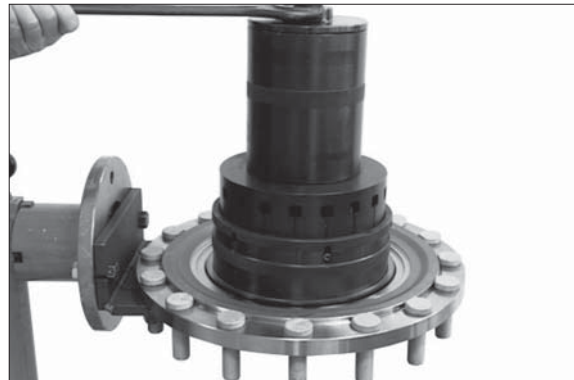
Resetting device 5870 400 001



7609AAX023

- ② Pull the tapered roller bearing from the output shaft.

Rapid grip AA00 693 459
Basic tool 5873 004 001
Pressure piece AA00 334 968



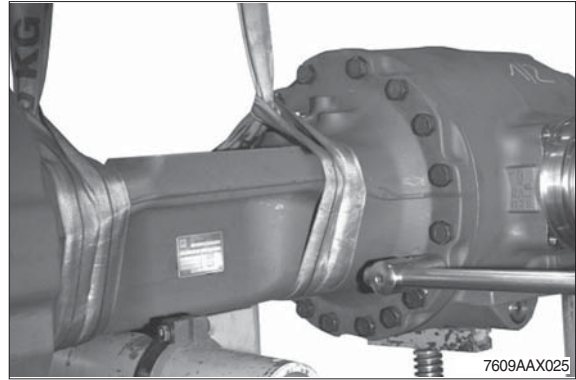
7609AAX024

(2) Disassembly axle housing

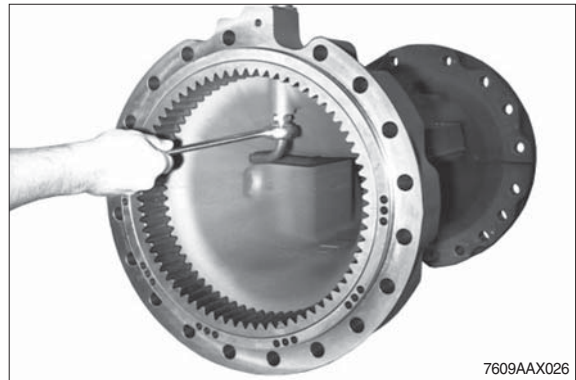
- ① Secure axle housing with the lifting device and loosen the hexagon screws.

Then separate the axle housing from the axle drive housing.

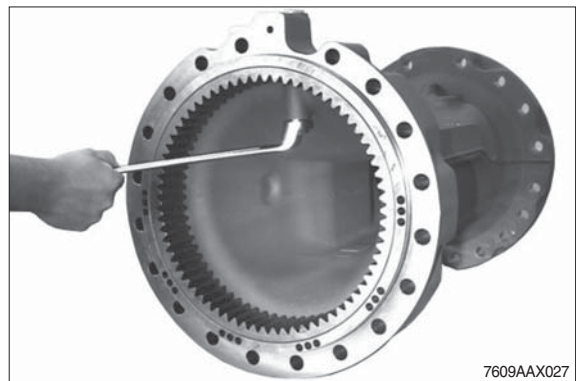
- ※ Pay attention to releasing differential.



- ② Loosen the threaded connections and remove the releasing brake tube.

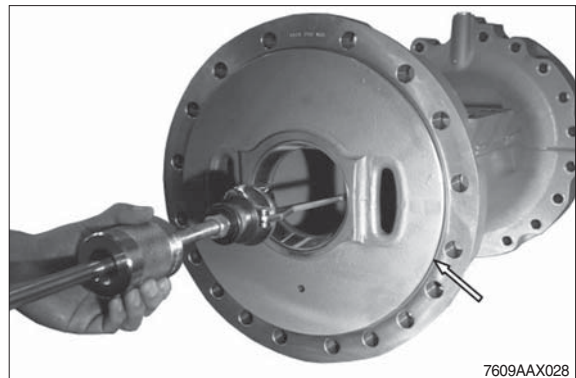


- ③ Loosen screw neck.



- ④ Pull the bearing outer ring out of the bearing hole and remove the shim behind.

Then remove the O-ring (see arrow).

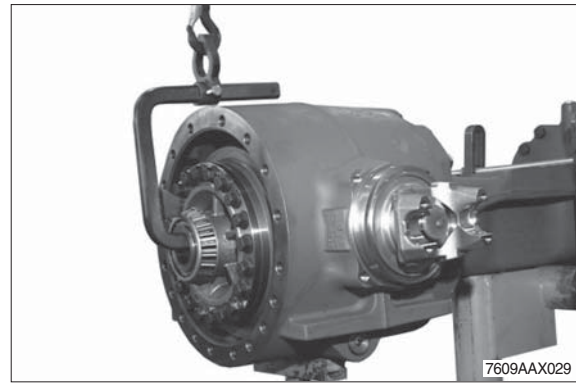


(3) Disassembly input

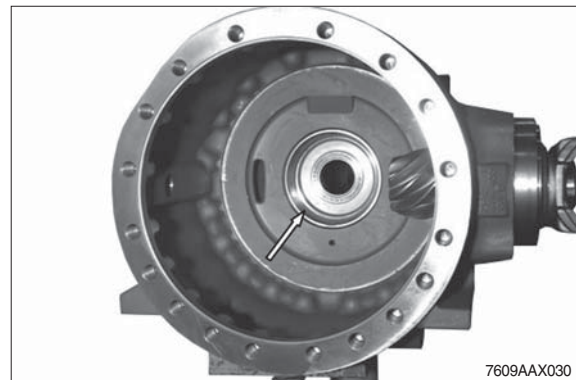
- ① Use the lifting device to lift the differential out of the axle drive housing.

Load carrying fixture 5870 281 083

- ※ Disassembly of the differential is described as of page 3-153.

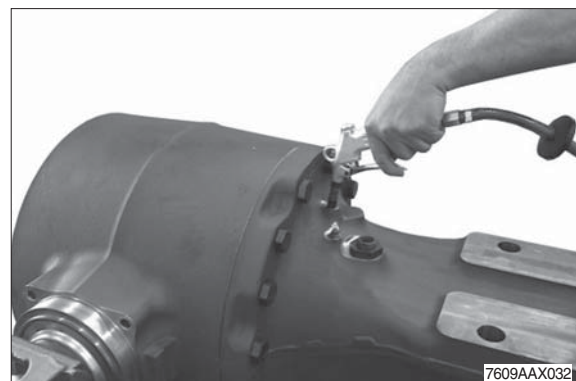
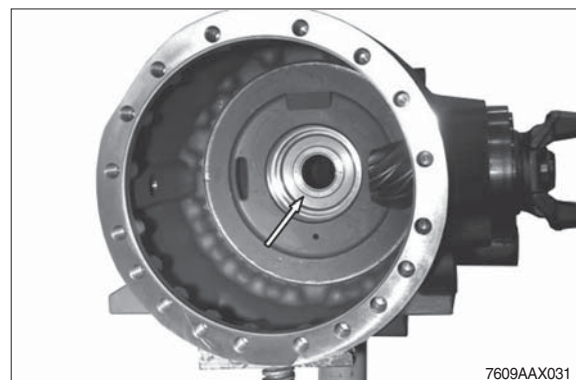


- ② Pull the bearing outer ring (see arrow) out of the housing hole and remove the shim behind.



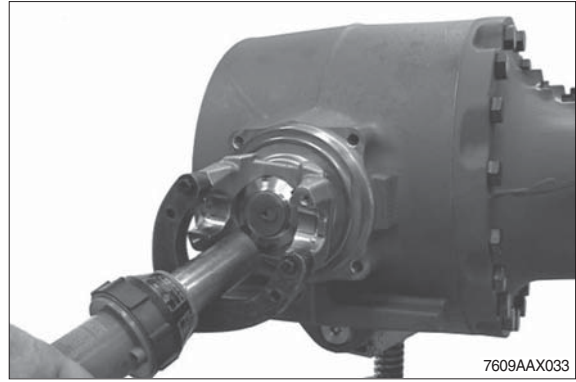
- ③ Press piston (see arrow) out of the axle housing (see subsequent figure) by means of compressed air.

- ※ This operation is only necessary for the hydraulic lock differential (option).



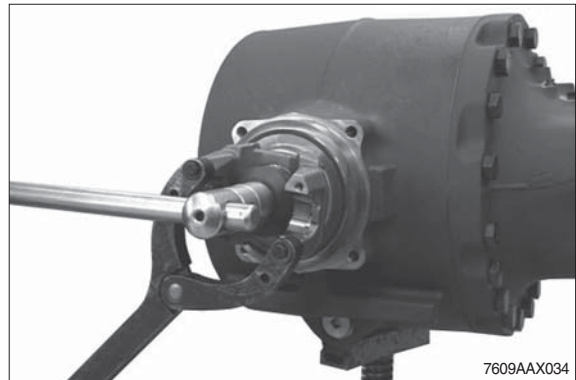
④ Heat slotted nut by means of hot air blower.

※ Slotted nut is secured with loctite (type No. : 262).

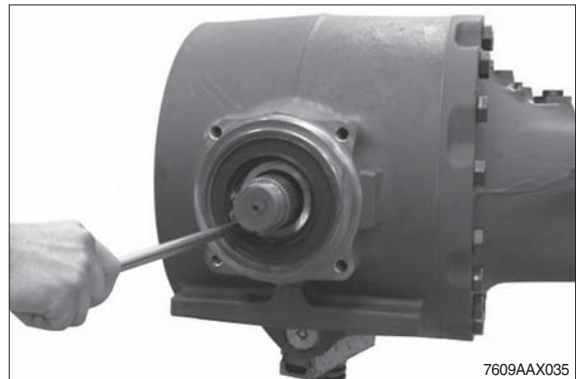


⑤ Loosen slotted nut and remove the shim behind.

Slotted nut wrench 5870 401 139
Clamping device 5870 240 002



⑥ Pull the input flange from the input pinion and use a lever to remove the shaft seal behind from the axle drive housing.



⑦ Press input pinion from the axle drive housing and remove the releasing tapered roller bearing.

Clamp (2EA) AA00 338 279



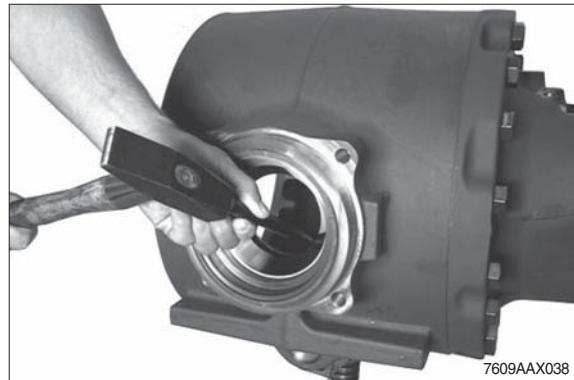
- ⑧ Remove spacer ring and pull the tapered roller bearing from the input pinion.

Gripping device 5873 002 030

Basic tool 5873 002 000



- ⑨ If necessary, force both bearing outer rings out of the axle drive housing.



(4) Disassembly differentials

Disassembly hydraulic lock differential (option)

- ① Remove axial roller cage (arrow).



- ② Pull both tapered roller bearings from the differential.

Crown wheel side

Grab sleeve 5873 012 016

Basic tool 5873 002 001

Opposite side

Grab sleeve 5873 003 029

Basic tool 5873 002 001

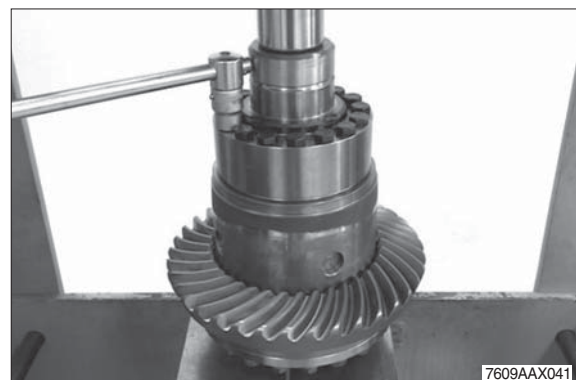
Reduction 5873 003 011

Pressure piece 5870 100 075



- ③ Preload the differential by means of the press, loosen the hexagon screws and remove the releasing housing cover.

Pressure piece 5870 100 075



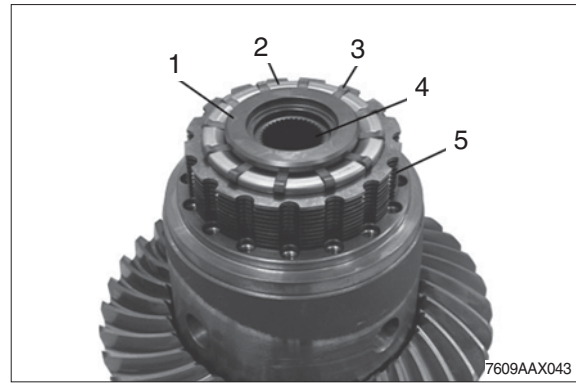
- ④ Preload the housing cover/compression spring by means of the press and disengage the retaining ring.

Then remove sliding sleeve and compression spring from the housing cover.

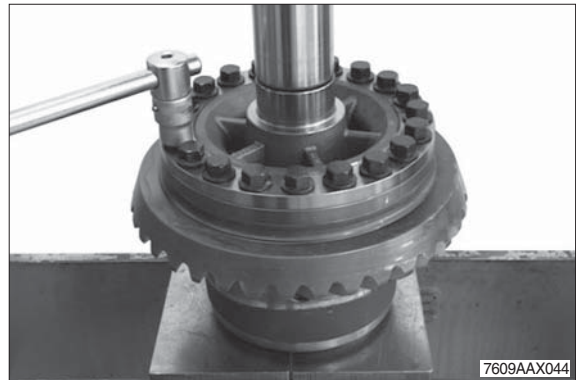


⑤ Remove single parts.

- 1 Pressure piece
- 2 Cage
- 3 Lever (12EA)
- 4 Disk carrier
- 5 Disk package



⑥ Preload differential by means of the press, loosen locking screws and housing cover.



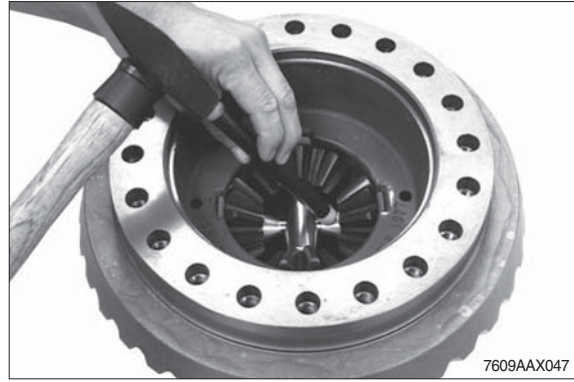
⑦ Remove axle bevel gear with thrust washers from the differential housing.



⑧ Force out both slotted pins.



- ⑨ Force out both differential axles (short) and remove the releasing spider gears with thrust washers from the differential housing.



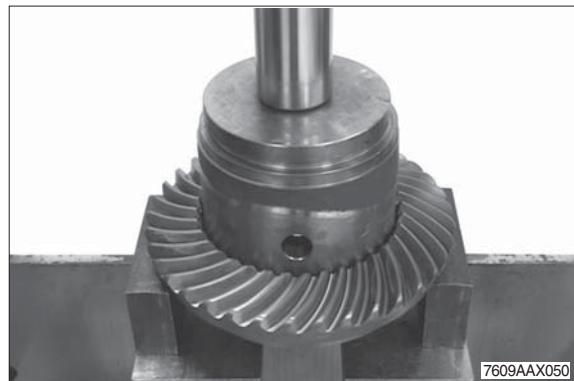
- ⑩ Pull the differential axle (long) and remove the releasing spider gears with thrust washers from the differential housing.



- ⑪ Remove the axle bevel gear and the shim behind.



- ⑫ Press crown wheel from the differential carrier.



Disassembly conventional differential (standard)

- ① Pull both tapered roller bearings from the differential.

Grab sleeve 5873 012 016

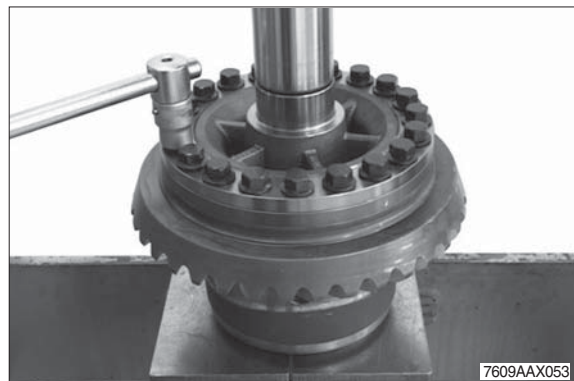
Basic tool 5873 002 001



- ② Preload the differential by means of the press, loosen the hexagon screws and remove the releasing housing cover.



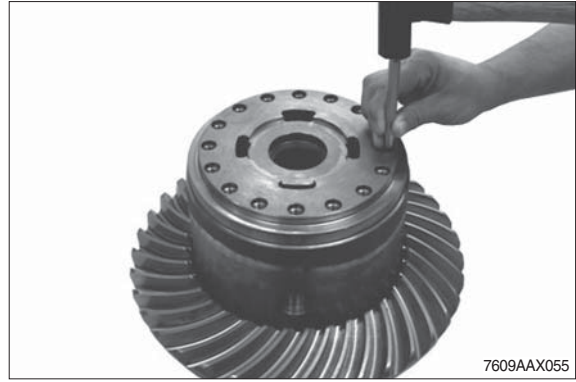
- ③ Preload the differential by means of the press, loosen locking screws and housing cover.



- ④ Remove axle bevel gear with thrust washers from the differential housing.



- ⑤ Force out both slotted pins.



- ⑥ Force out both differential axles (short) and remove the releasing spider gears with thrust washers from the differential housing.



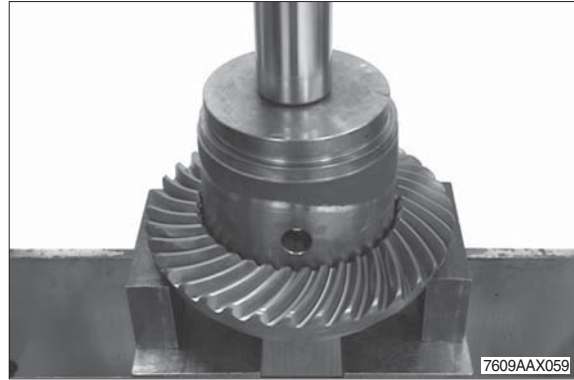
- ⑦ Pull the differential axle (long) and remove the releasing spider gears with thrust washers from the differential housing.



- ⑧ Remove the axle bevel gear and the shim behind.



- ⑨ Press crown wheel from the differential carrier.



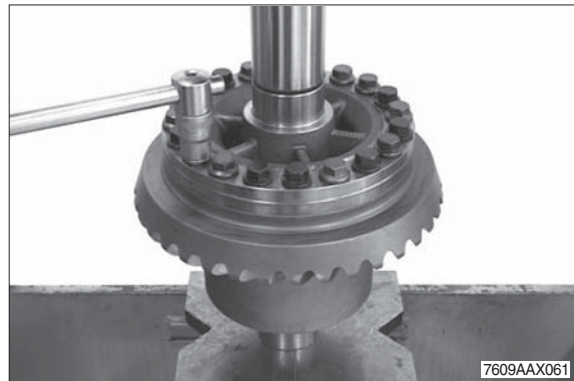
Disassembly limited slip differential (option)

- ① Pull both tapered roller bearings from the differential.

Grab sleeve 5873 012 016
Basic tool 5873 002 001



- ② Preload the differential by means of the press, loosen locking screws and housing cover.



- ③ Lift the axle bevel gear with pressure ring, disk package and thrust washers out of the differential housing.



- ④ Remove spider shafts and axle bevel gears (see figure) out of the differential housing.



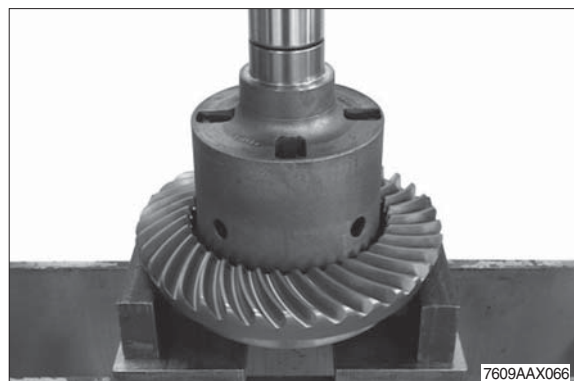
- ⑤ Remove the second axle bevel gear.



- ⑥ Lift the pressure ring out of the differential housing and remove the disk package and thrust washers behind.



- ⑦ Press crown wheel from the differential carrier.

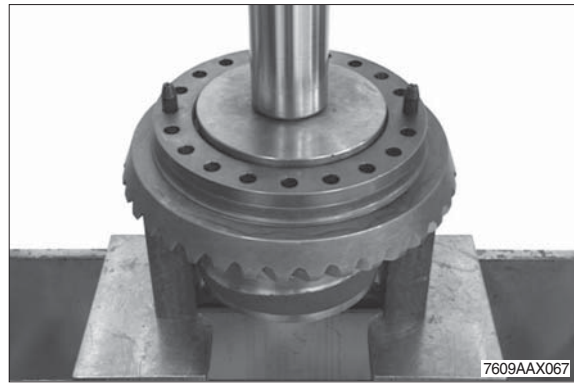


(5) Reassembly differentials

Reassembly hydraulic lock differential (option)

- ① Mount two locating pins and press the heated crown wheel onto the differential housing until contact is obtained.

Locating pins 5870 204 040



- ② Insert thrust washer into the differential housing.



- ③ Insert axle bevel gear.



- ④ Insert spider gears with thrust washers into the differential housing and fix them with the spider shaft (long).

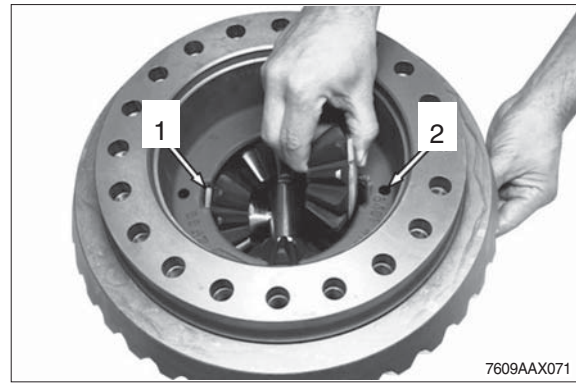
※ Thrust washers must be positioned with the tabs (see arrow) being located in the recesses of the differential housing.



⑤ Insert spider gears with thrust washers into the differential housing and fix them with the two spider shafts (short).

※ Thrust washers must be positioned with the tabs (see arrow 1) being located in the recesses of the differential housing.

※ Pay attention to radial installation position of the spider shafts (fixing holes, arrow 2).

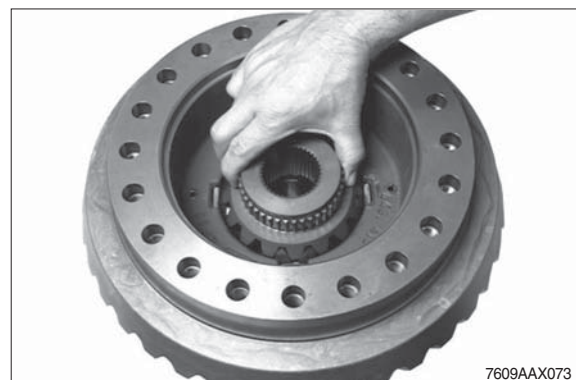


⑥ Fix spider shafts (short) with slotted pins.

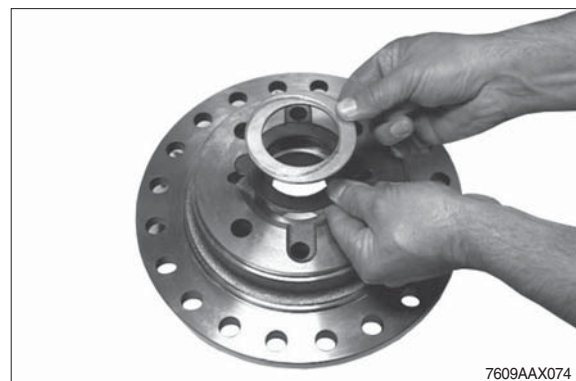
※ Flush mount slotted pins.



⑦ Mount second axle bevel gear.



⑧ Fix the thrust washers into the housing cover by means of grease.

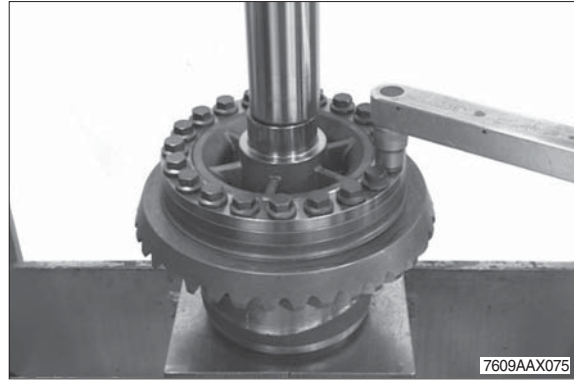


- ⑨ Mount two adjusting screws and insert the housing cover until contact with the differential housing is obtained.

Locating pins 5870 204 040

Preload the differential by means of the press and bolt with new locking screws.

- Tightening torque (M16/12.9) :
40.8 kgf · m (295 lbf · ft)



- ⑩ Install compression spring onto the sliding sleeve.



- ⑪ Insert the premounted sliding sleeve into the housing cover.

Preload the compression spring by means of the press and engage the retaining ring into the annular groove of the sliding sleeve.

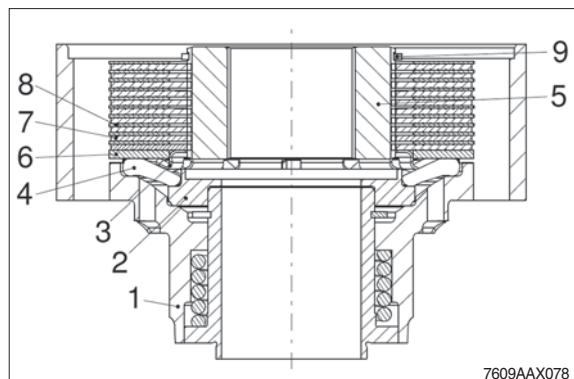


Setting of disk package

- ⑫ Premount single parts according to the adjacent sketch.

- 1 Housing cover
- 2 Pressure piece
- 3 Cage
- 4 Lever (12EA)
- 5 Disk carrier
- 6 Pressure ring
- 7 Inner disks
- 8 Outer disks (optional)
- 9 Snap ring

- ※ For the number of disks and the disk arrangement please refer to the relating parts manual.

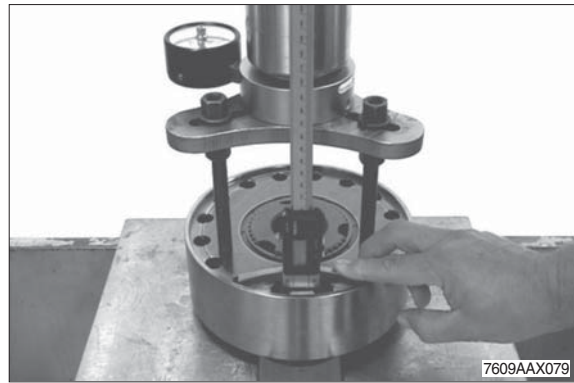


- ⑬ Preload disk package with an axial force of $F = 50^{+30}$ kN.

Then check the setting dimension "A" = 1.05 ± 0.1 mm from the collar of the differential cover to the plane face of the outer disk (see also below sketch).

Pressure piece 5870 100 069
Load cell 5870 700 004

- ※ Any deviation from the specified setting dimension must be corrected with a corresponding outer disk.

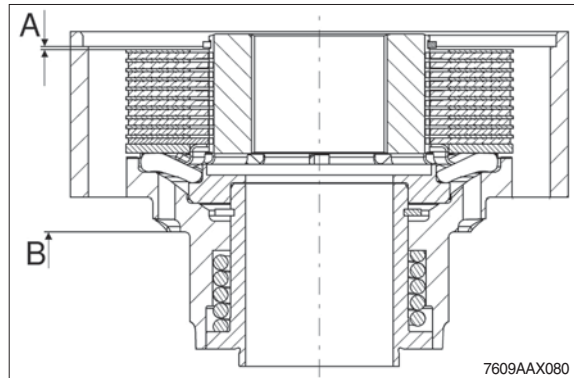


7609AAX079

A = Setting dimension = 1.05 ± 0.1 mm

B = Contact face

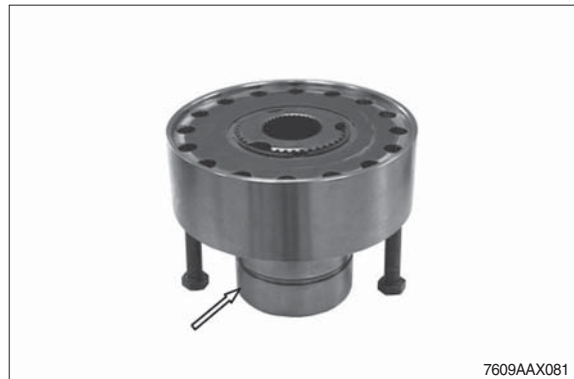
- ⑭ To obtain a correct measuring result :
The housing cover may only be supported on the contact face (B).
Ensure that the assembly fixture is only supported on the disk package and not on the disk carrier (5).



7609AAX080

- ⑮ Position housing cover onto pressure piece (see arrow).
Insert two hexagon screws into the housing cover to radially fix the disk package.

Pressure piece 5870 100 075



7609AAX081

- ⑯ Position the premounted differential with the lifting device onto the housing cover and preliminarily fix with hexagon screws.

Lifting device AA00 331 446



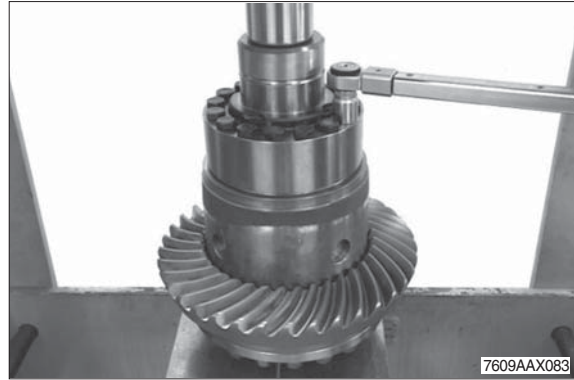
7609AAX082

- ⑰ Preload the differential by means of the press and the pressure piece.

Then finally tighten the housing cover with hexagon screws.

· Tightening torque (M14/10.9) :
18.9 kgf · m (136 lbf · ft)

Pressure piece 5870 100 075



- ⑱ Heat both tapered roller bearings and insert until contact is obtained.

※ Adjust tapered roller bearing after cooling down.



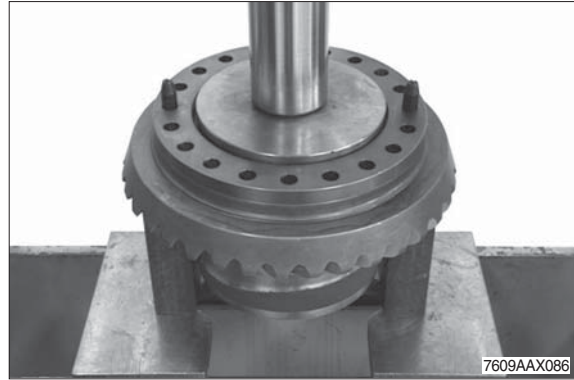
- ⑲ Fix axial roller cage (see arrow) to the sliding sleeve by means of grease.



Reassembly conventional differential (standard)

- ① Mount two locating pins and press the heated crown wheel onto the differential housing until contact is obtained.

Locating pins 5870 204 040



- ② Insert thrust washer into the differential housing.



- ③ Insert axle bevel gear.



- ④ Insert spider gears with thrust washers into the differential housing and fix them with the spider shaft (long).

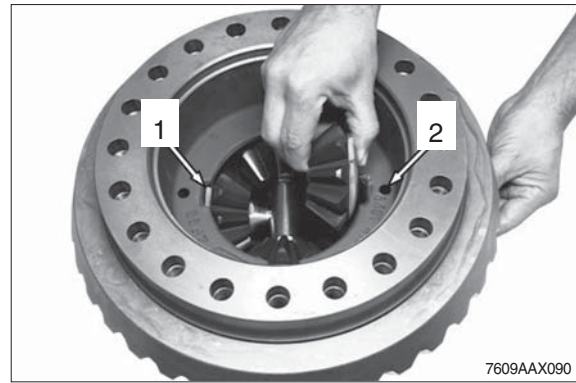
※ Thrust washers must be positioned with the tabs (see arrow) being located in the recesses of the differential housing.



⑤ Insert spider gears with thrust washers into the differential housing and fix them with the two spider shafts (short).

※ Thrust washers must be positioned with the tabs (see arrow 1) being located in the recesses of the differential housing.

※ Pay attention to radial installation position of the spider shafts (fixing holes, arrow 2).



⑥ Fix spider shafts (short) with slotted pins.

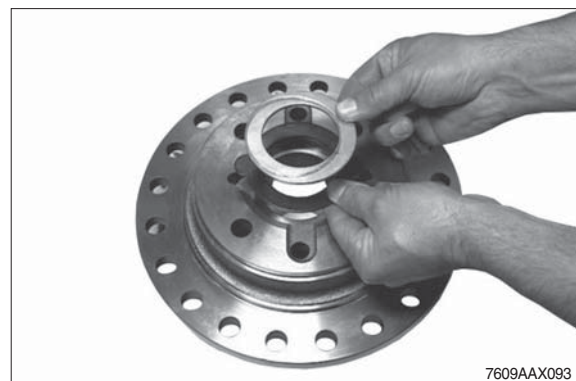
※ Flush mount slotted pins.



⑦ Mount second axle bevel gear.



⑧ Fix the thrust washers into the housing cover by means of grease.

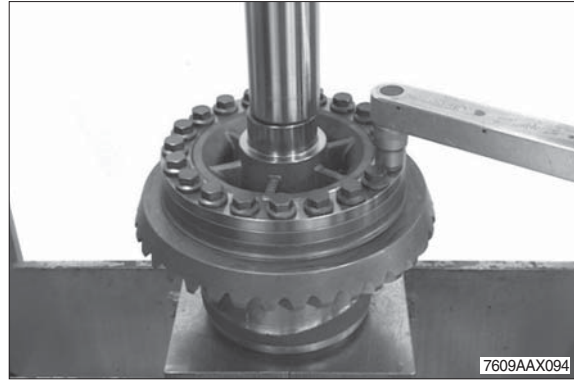


- ⑨ Mount two adjusting screws and insert the housing cover until contact with the differential housing is obtained.

Locating pins 5870 204 040

Preload the differential by means of the press and bolt with new locking screws.

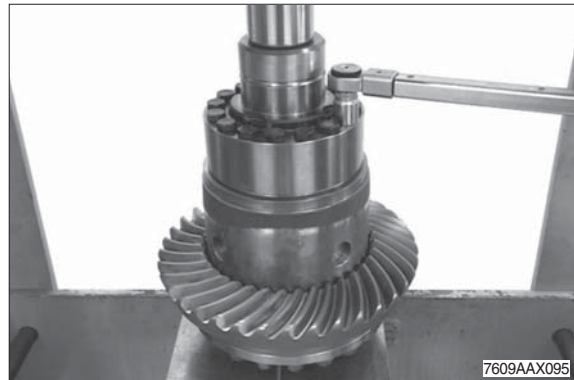
- Tightening torque (M16/12.9) :
40.8 kgf · m (295 lbf · ft)



- ⑩ Attach the housing cover and preload the differential with the press.

Then fix the housing cover with hexagon screws.

- Tightening torque (M14/10.9) :
18.9 kgf · m (136 lbf · ft)



- ⑪ Heat both tapered roller bearings and insert until contact is obtained.

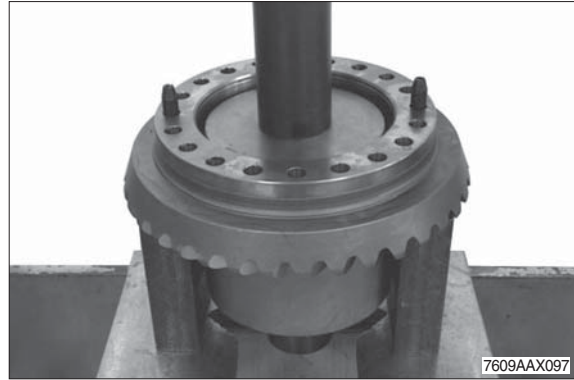
- ※ Adjust tapered roller bearing after cooling down.



Reassembly limited slip differential (option)

- ① Mount two locating pins and press the heated crown wheel onto the differential housing until contact is obtained.

Locating pins 5870 204 040



- ② Insert thrust washer into the differential housing.



- ③ Mount outer and inner disks in alternating order, starting with an outer disk.

※ The installation clearance of the internal parts is corrected by mounting outer disks with different thicknesses.

▲ The difference in thickness between the left and the right disk package must only be 0.1 mm at maximum.



- ④ Place the pressure ring.



- ⑤ Insert the axle bevel gear until contact is obtained and install the inner disks with the teeth.



- ⑥ Preassemble the differential spider and insert it into the differential housing/into the pressure ring.



- ⑦ Mount second axle bevel gear.



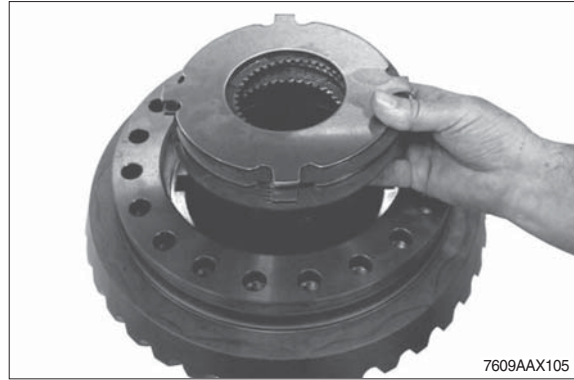
- ⑧ Insert the second pressure ring into the differential housing.



- ⑨ Mount outer and inner disks in alternating order, starting with an inner disk.

The installation clearance of the internal parts is corrected by mounting outer disks with different thicknesses.

- ▲ The difference in thickness between the left and the right disk package must only be 0.1 mm at maximum.



7609AAX105

Determine the installation clearance 0.2~0.7 mm

- ⑩ Measure dimension I, from the mounting face of the differential housing to the plane face of the outer disk.

Dimension I e.g. 44.30mm



7609AAX106

- ⑪ Measure dimension II, from the contact face of the outer disk to the mounting face on the housing cover.

Dimension II e.g. 43.95 mm

CALCULATION EXAMPLE :

Dimension I 44.30 mm

Dimension II - 43.95 mm

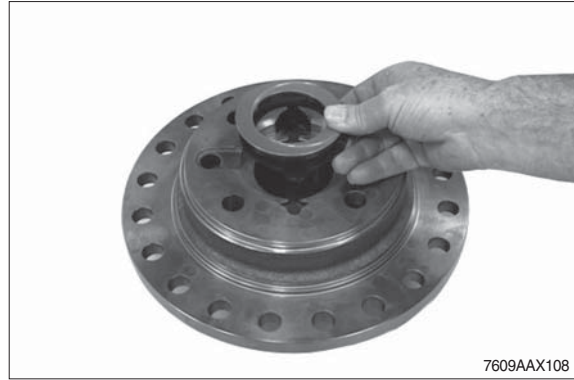
Difference = disk clearance = 0.35 mm



7609AAX107

- ※ Any deviation from the required installation clearance is to be corrected with corresponding outer disks (s = 2.7, s = 2.9, s = 3.0, s = 3.1, s = 3.2, s = 3.3 or s = 3.5 mm), taking care that the difference in thickness between the left and the right disk package must only be 0.1 mm at maximum.

- ⑫ Fix the thrust washers into the housing cover by means of grease.

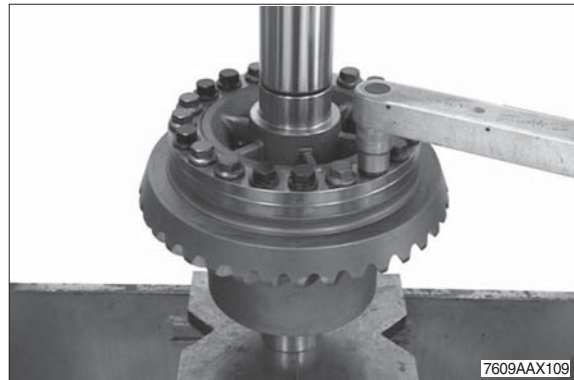


- ⑬ Mount two adjusting screws and insert the housing cover until contact with the differential housing is obtained.

Locating pins 5870 204 040

Preload the differential by means of the press and bolt with new locking screws.

- Tightening torque (M16/12.9) :
40.8 kgf · m (295 lbf · ft)



- ⑭ Heat both tapered roller bearings and insert until contact is obtained.

- ※ Adjust tapered roller bearing after cooling down.



(6) Reassembly input

※ If crown wheel or input pinion are damaged, both parts must be jointly replaced.

In case of a new installation of a complete bevel gear set pay attention to an identical mating number of input pinion and crown wheel.

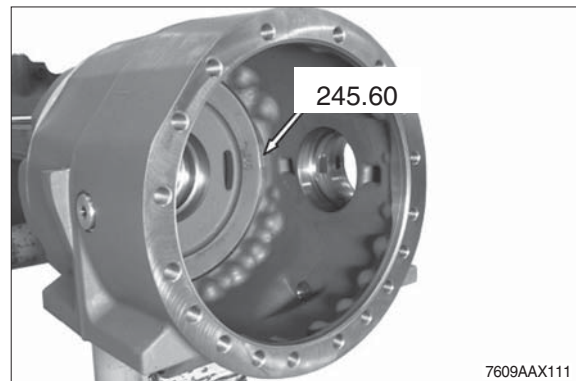
Determination of shim thickness to obtain a correct contact pattern

※ The following measuring procedures must be carried out with utmost accuracy.

Inaccurate measurements lead to an incorrect contact pattern requiring an additional disassembly and reassembly of input pinion and differential.

① Read dimension I from the axle drive housing.

Dimension I e.g. 245.60 mm



② Read dimension II (pinion dimension).

Dimension II e.g. 202.00 mm



- ③ Determine dimension III (bearing width).
Dimension III e.g. 42.50 mm

CALCULATION EXAMPLE "A₁":

Front axle

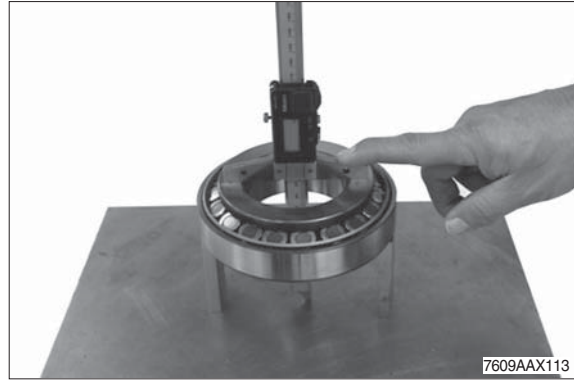
Dimension I 245.60 mm
Dimension II - 202.00 mm
Dimension III - 42.60 mm

Difference = shim s = 1.00 mm

Rear axle

Dimension I 221.10 mm
Dimension II - 181.00 mm
Dimension III - 39.10 mm

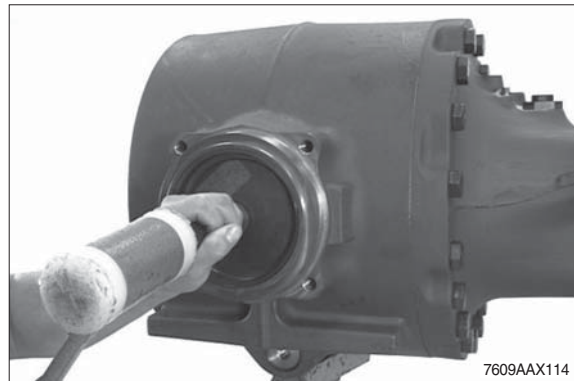
Difference = shim s = 1.00 mm



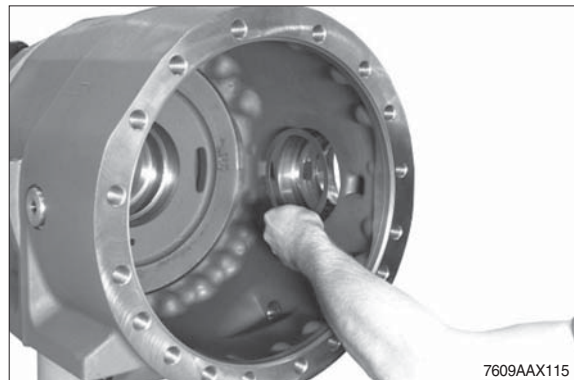
Reassembly of input pinion

- ④ Undercool the external bearing outer ring and insert it into the axle drive housing until contact is obtained.

Driver tool 5870 058 079
Handle 5870 260 004



- ⑤ Insert the determined shim e.g. s = 1.00 mm into the housing hole.



- ⑥ Undercool the internal bearing outer ring and bring it into contact position in the housing hole by using the assembly fixture.

Assembly fixture AA00 338 352



- ⑦ Heat the tapered roller bearing and insert it into the input pinion until contact is obtained.

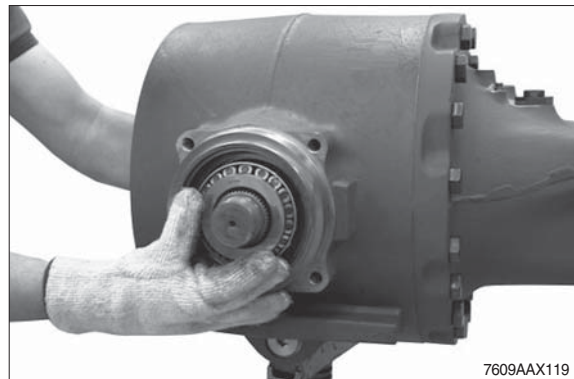


Setting of rolling torque of input pinion bearing 0.15~0.41 kgf · m (1.11~2.95 lbf · ft) (without shaft seal)

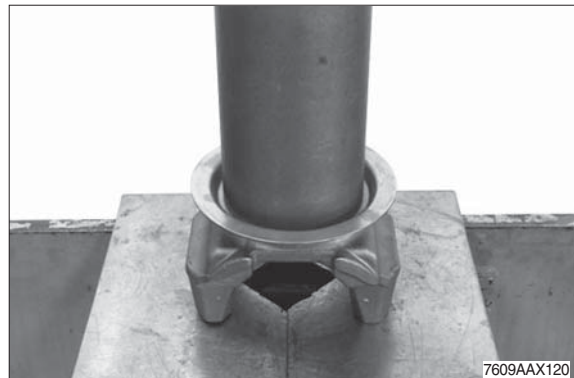
- ⑧ Insert spacer (e.g. $s = 8.18$ mm).
- ※ According to our experience the necessary rolling torque is obtained when reusing the spacer which has been removed during disassembly (e.g. $s = 8.18$ mm).
A later check of the rolling torque, however, is absolutely necessary.



- ⑨ Insert the preassembled input pinion into the axle drive housing and insert the heated tapered roller bearing until contact is obtained.



- ⑩ Press the protection plate onto the input flange (see arrow) until contact is obtained.
- ※ Do not fit the shaft seal until the contact pattern has been checked.



- ⑪ Insert input flange and fix it by means of disk and slotted nut.

· Tightening torque :

122 kgf · m (885 lbf · ft)

Slotted nut wrench 5870 401 139

Clamping device 5870 240 002

- ※ Preliminarily mount slotted nut without loctite.

▲ While tightening rotate the input pinion several times in both directions.

- ⑫ Check rolling torque (0.15~0.41 kgf · m without shaft seal).

- ※ 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 (AX118) as specified below.

Insufficient rolling torque

install thinner spacer ring

Excessive rolling torque

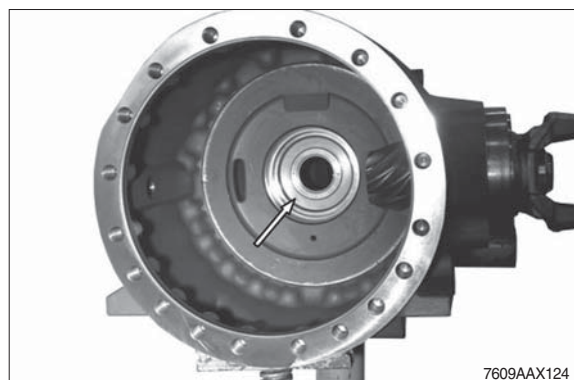
install thicker spacer ring

- ⑬ Grease O-rings (2EA, see arrows) and insert them into the annular grooves of the piston.

- ※ Operation figure AX123 and AX124 is only necessary for hydraulic lock differential (option).



- ⑭ Insert piston (see arrow) into the bearing housing until contact is obtained.



Determination of shims for setting of bearing rolling torque (differential housing) and backlash (bevel gear set)

※ Determine the required shims on the basis of the read value (deviation/test dimension) and the corresponding specifications of the table below :

(KRS – SET – RIGHT)

(KRS = bevel gear set)



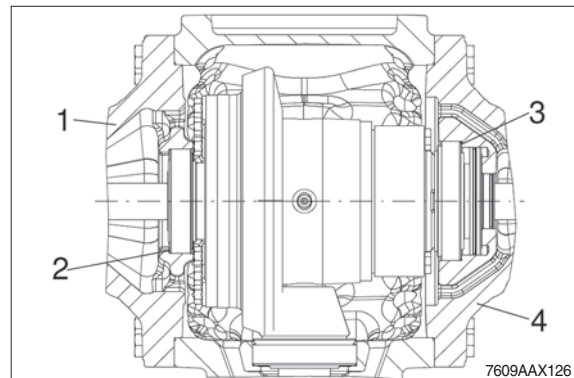
⑮ Deviation see crown wheel rear side.

※ The test dimension “101,, is stamped into the crown wheel rear side. If no + or – deviation is indicated, this value corresponds to the actual value “0” 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 or 10 or 20).

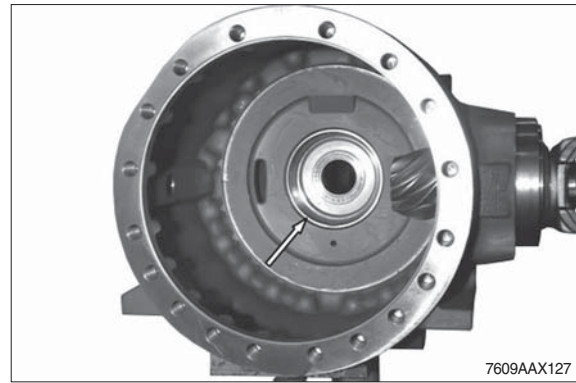
In accordance with this deviation, the required shims are allocated in the table below. (see parts manual for details)



- 1 Axle housing
- 2 Shim (crown wheel side)
- 3 Shim (differential carrier side)
- 4 Axle housing

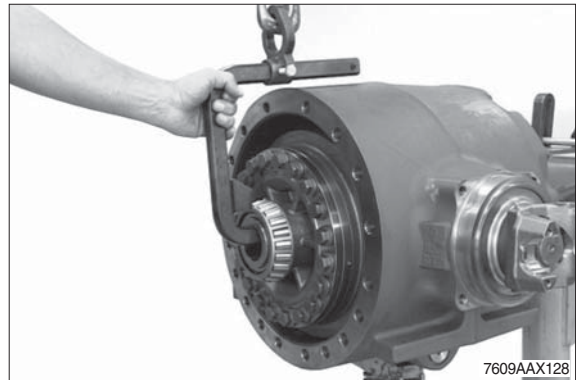
Shims for differential				
Crown wheel marking	- 20	- 10	-	10
Deviation	- 0.2	- 0.1	0	0.1
Shim Differential cage side Shim thickness	0.8	0.9	1.0	1.1
Shim Crown wheel side Shim thickness	1.2	1.1	1.0	0.9

- ⑩ Insert the determined shim (e.g. $s = 0.9 \text{ mm}$) into the hole of the axle housing and adjust the bearing outer ring (see arrow) until contact is obtained.

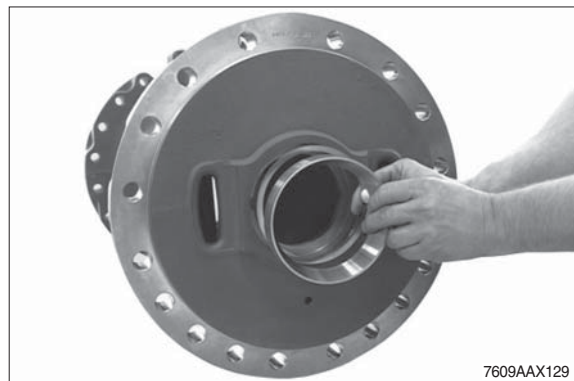


- ⑪ Cover some drive and coast flanks of the crown wheel with marking ink.
Then insert the premounted differential into the axle drive housing.

Load carrying device 5870 281 083



- ⑫ Insert the determined shim (e.g. $s = 1.1 \text{ mm}$) into the hole of the axle housing and adjust the bearing outer ring (see arrow) until contact is obtained.



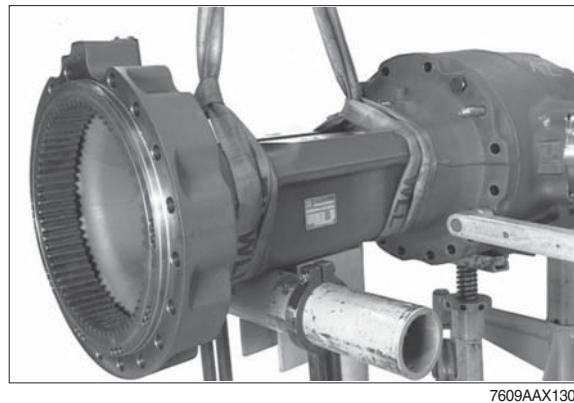
- ⑬ Mount two locating pins and bring the axle housing into contact position with the axle drive housing by means of the lifting device.

Locating pins 5870 204 024

Then preliminarily fix the axle housing with 4 hexagon screws.

- Tightening torque (M20/10.9) :
 $57.1 \text{ kgf} \cdot \text{m}$ (413 lbf · ft)

- ※ Preliminarily mount the axle housing without O-ring.

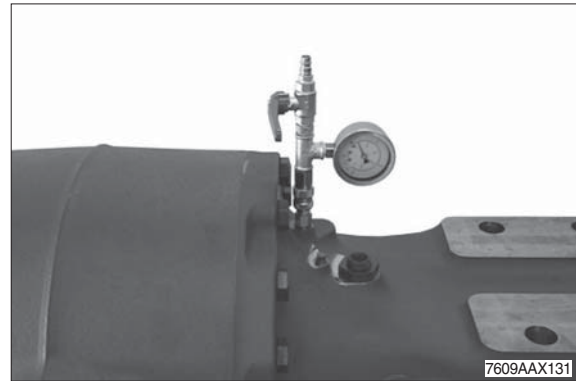


Leakage test of lock

⑩ Pressurize the lock ($p = 1 \text{ bar}$), close shut-off valve and remove air line.

▲ No noticeable pressure loss is allowed to occur within 10 sec.

※ This operation is only necessary for hydraulic lock differential (option).

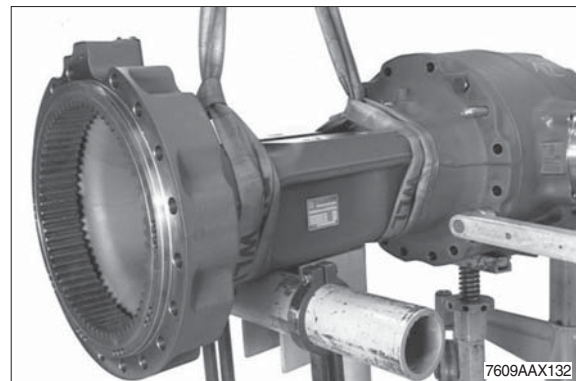


⑪ By rotating the input flange, roll crown wheel over the input pinion in both directions several times.

Then remove the axle housing again and lift the differential out of the axle drive housing.

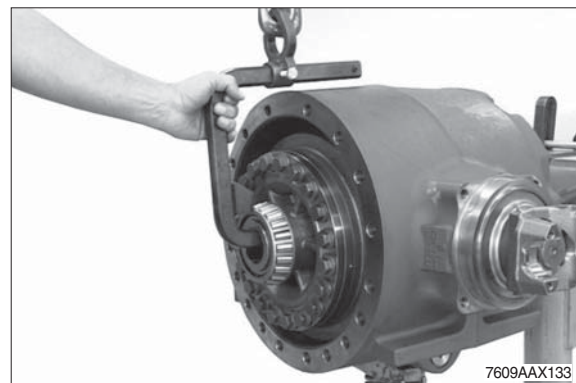
Compare the obtained contact pattern.

▲ In case of any contact pattern deviation, a measuring error was made when determining the shim (AX115), which must be corrected by all means.



⑫ After the contact pattern check insert the differential again into the axle drive housing.

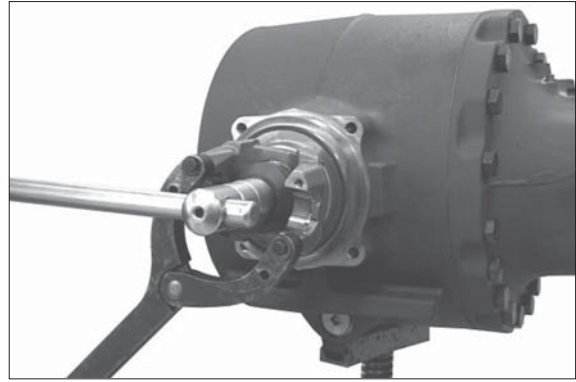
Load carrying device 5870 281 083



Reassembly of shaft seal (figure AX134~136)

- ②③ Loosen the slotted nut and pull the input flange from the input pinion.

Slotted nut wrench 5870 401 139
Clamping device 5870 240 002

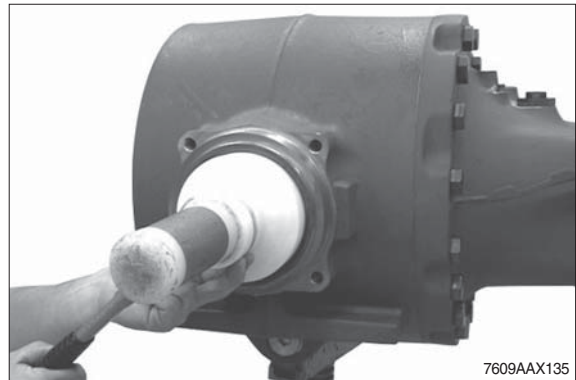


7609AAX134

- ②④ Mount the shaft seal with the seal lip showing to the oil chamber.

Driver tool 5870 048 233

- ※ The exact installation position of the shaft seal is obtained when using the specified driver tool.
- ※ Wet the outer diameter of the shaft seal with spirit directly before installation and fill the space between seal and dust lip with grease.



7609AAX135

- ②⑤ Insert input flange and finally tighten by means of disk and slotted nut.

· Tightening torque :
122 kgf · m (885 lbf · ft)

Slotted nut wrench 5870 401 139
Clamping device 5870 240 002

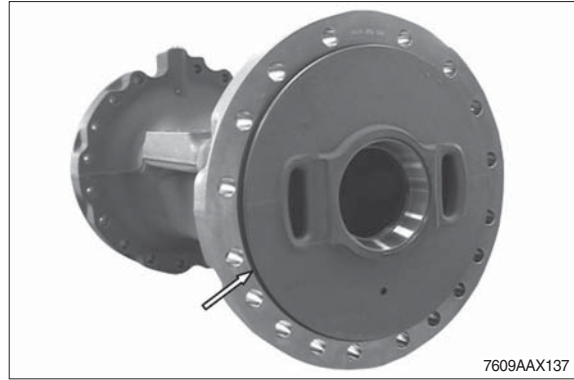
- ※ Cover the thread of the slotted nut with loctite (type no. : 262).



7609AAX136

(7) Reassembly axle housing

- ① Grease O-ring (see arrow) and insert it into the axle housing.

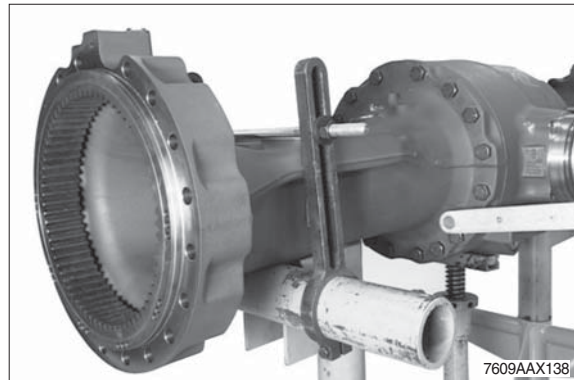


- ② Mount two locating pins and bring the axle housing into contact position with the axle drive housing by using the lifting device.

Then fix the axle housing by means of hexagon screws.

- Tightening torque (M20/10.9) :
57.1 kgf · m (413 lbf · ft)

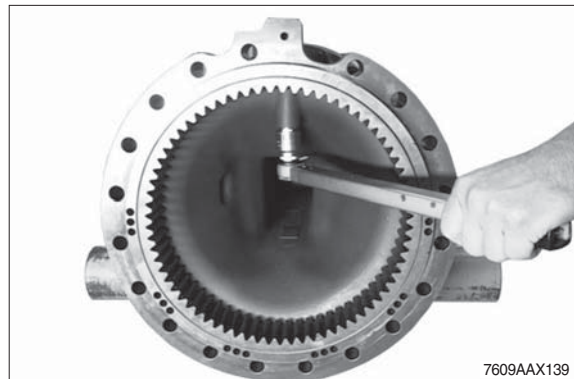
Locating pins 5870 204 024



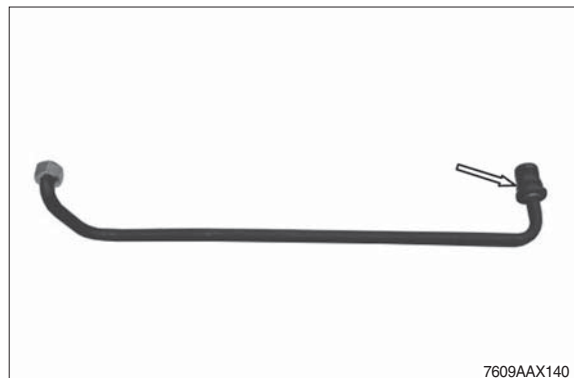
- ※ After assembling the axle housing secure the axle with clamping brackets.

- ③ Mount fitting.

- Tightening torque :
3.67 kgf · m (26.6 lbf · ft)

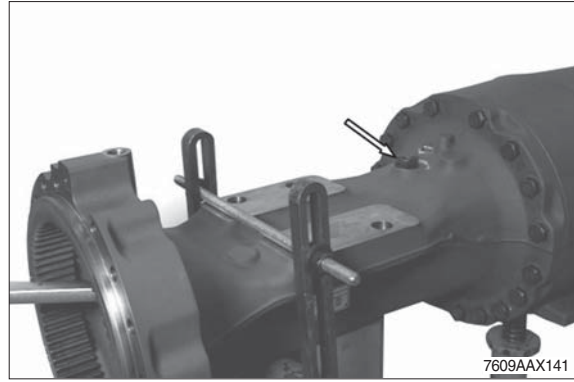


- ④ Grease O-ring and insert it into the annular groove of the brake tube (see arrow).



- ⑤ Mount brake tube with threaded connection and hexagon nut (see arrow).

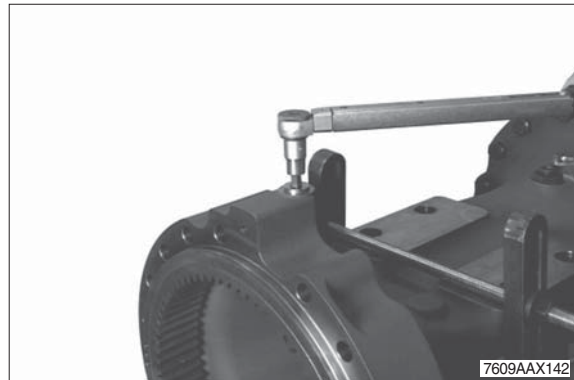
· Tightening torque :
10.2 kgf · m (73.8 lbf · ft)



- ⑥ Provide screw plug with a new O-ring and fit it.

Flush mount slotted pins.

· Tightening torque :
5.1 kgf · m (36.9 lbf · ft)



(8) Reassembly output and brake

- ① Pull in wheel stud into the output shaft until contact is obtained.

Wheel stud puller-basic tool

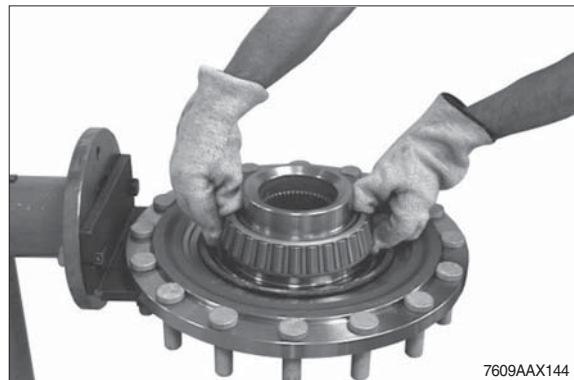
5870 610 001

Insert (M22 × 1.5) 5870 610 002

Special tool may only be used for repair solution when exchanging individual wheel studs with mounted output shaft. When using a new output shaft, mount the wheel studs with the press.



- ② Heat tapered roller bearing and insert it into the output shaft until contact is obtained.

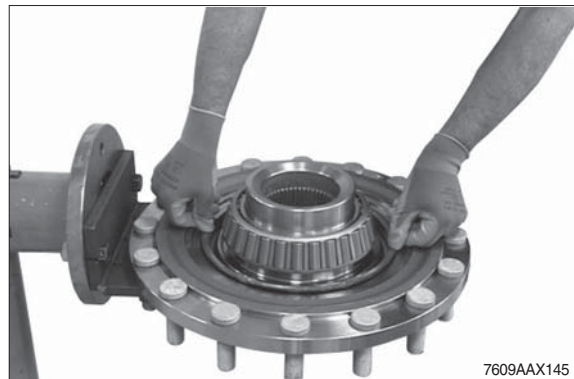


- ③ Wet O-ring of slide ring seal and locating hole with spirit.

Snap **new** slide ring seal (part 1) into the output shaft.

Then mount **new** slide ring seal (part 2) accordingly into the brake housing.

- ※ For the installation position of the seal please also refer to sketch, page 3-184.



- ※ The surface of the slide ring seal may not have any grooves, scratches or other types of damage.

Take care that the sealing surface is parallel to the housing face.

The O-rings must be mounted evenly into the locating hole and must not bulge out of the hole.

- ▲ **Risk of injury-Metal rings have extremely sharp edges. Wear protective gloves.**



- ④ Insert both bearing outer rings (see arrows) into the brake housing until contact is obtained.



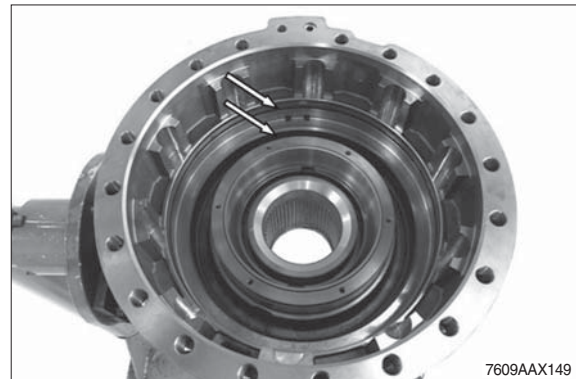
- ⑤ Insert the premounted brake housing by means of the lifting device over the output shaft until contact is obtained.

- ※ Before clamping the seal rings (slide ring seal) to installation dimension, clean the sliding surfaces and apply an oil film. We recommend to use a leather cloth soaked with oil.



- ⑥ Insert back-up rings and grooved rings into the annular grooves of the brake housing (see arrows).

- ※ Pay attention to the installation position.



- ⑦ Clean the annular groove of the brake housing with spirit.

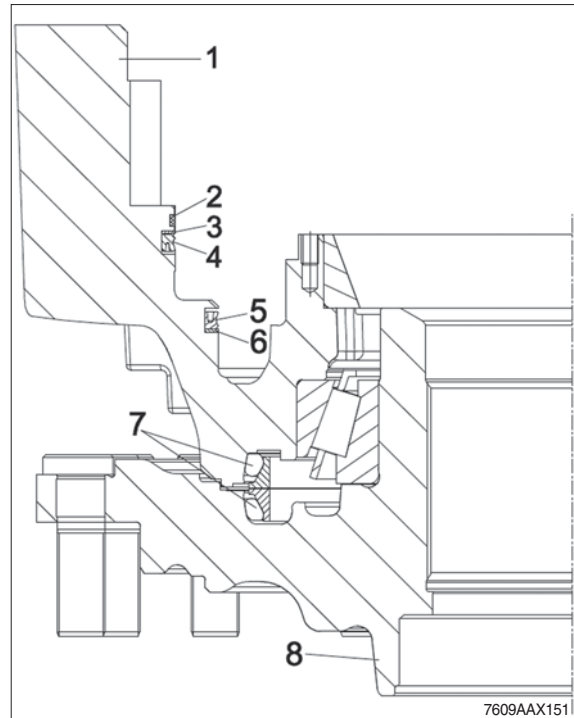
Then insert the guide ring into the annular groove (see also the following sketch) and fix it with loctite (type No. : 415) at its extremities (see arrows).

- ※ The full circumference of the guide ring must be in an exact contact position.

- ※ Upon installation the orifice of the guide ring must show upwards (12 o'clock).



- 1 Brake housing
- 2 Guide ring
- 3 Back-up ring
- 4 Grooved ring
- 5 Grooved ring
- 6 Back-up ring
- 7 Slide ring seal
- 8 Output shaft



7609AAX151

- ⑧ Flush-mount the slotted pins (6EA) into the holes of the piston.

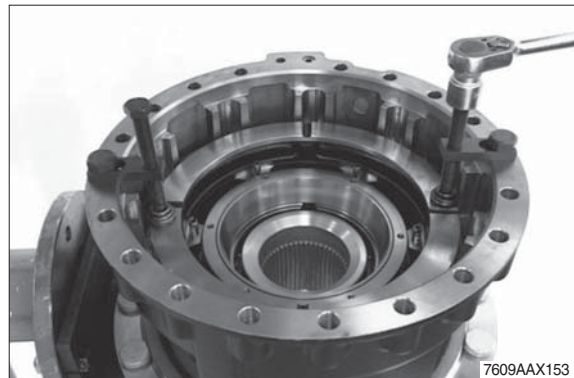


7609AAX152

- ⑨ Insert the piston into the brake housing and carefully install with the fixing device until contact is obtained.

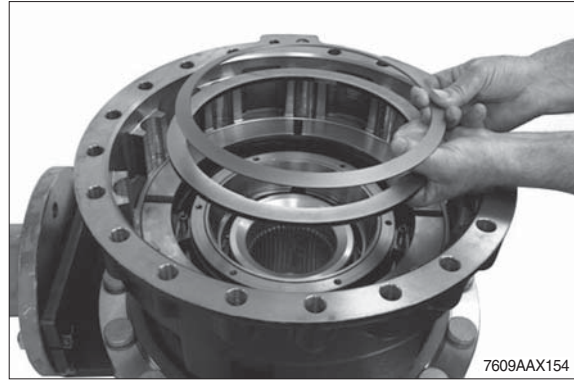
Fixing device AA00 680 530

- ※ Sufficiently oil seal surface of piston/
back-up rings, grooved rings and guide
ring.



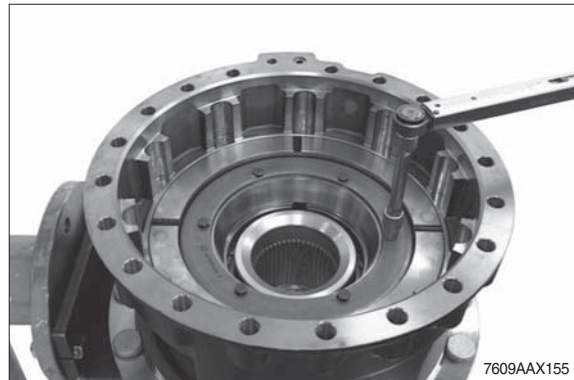
7609AAX153

- ⑩ Insert disk and cup spring with the convex side showing upwards into the piston.



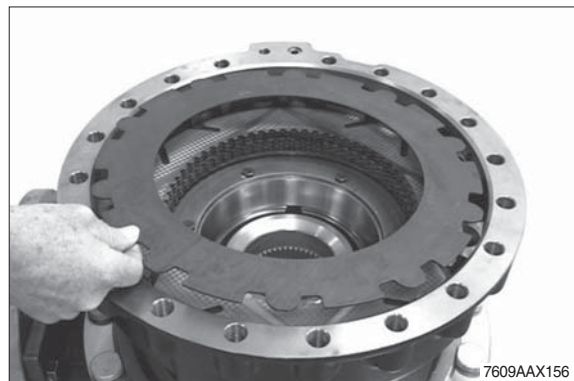
- ⑪ Insert cover and fix it by means of hexagon screws.

- Tightening torque (M8/10.9) :
3.47 kgf · m (25.1 lbf · ft)

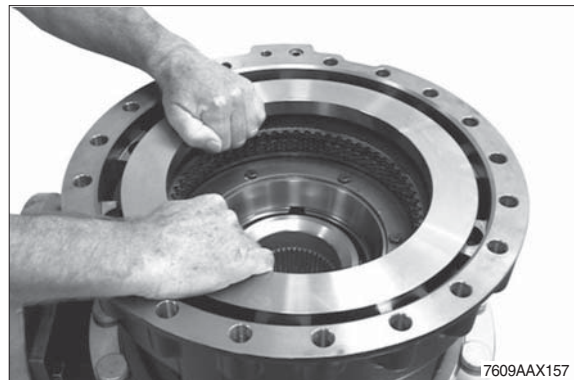


- ⑫ Mount outer and inner disks.

- ※ For the number of disks and the disk arrangement please refer to the relating parts manual.

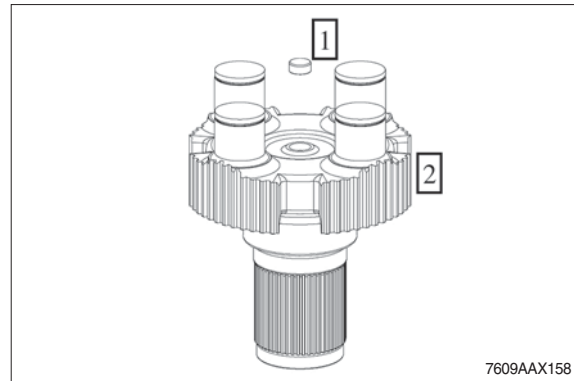


- ⑬ Insert end plate.



- ⑭ Press stop bolt into the planetary carrier until contact is obtained.

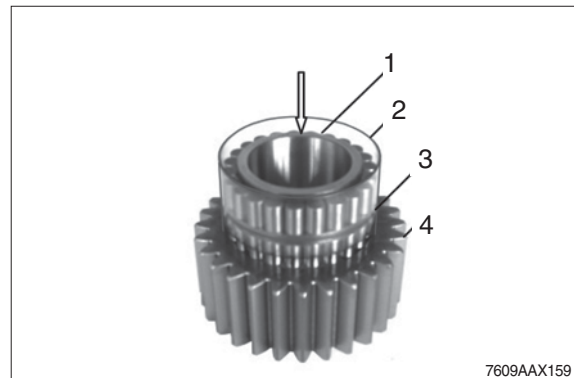
- 1 Stop bolt
- 2 Planetary carrier



- ⑮ Insert the cylindrical roller bearing into the planetary gear – for this purpose press the cylindrical roller bearing through the packaging sleeve until the snap ring engages into the annular groove of the planetary gear.

※ Use packaging sleeve to facilitate assembly.

- 1 Cylindrical roller bearing
- 2 Packaging sleeve
- 3 Snap ring
- 4 Planetary gear



- ⑯ Heat bearing inner rings and insert the premounted planetary gears with large radius facing the planetary carrier (downwards) until contact is obtained.

※ Adjust bearing inner rings after cooling down.

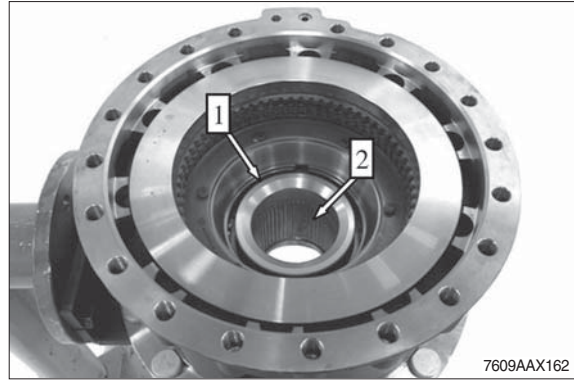
Then fix planetary gears by means of retaining rings.



- ⑰ Heat tapered roller bearing and install it to the planetary carrier until contact is obtained.

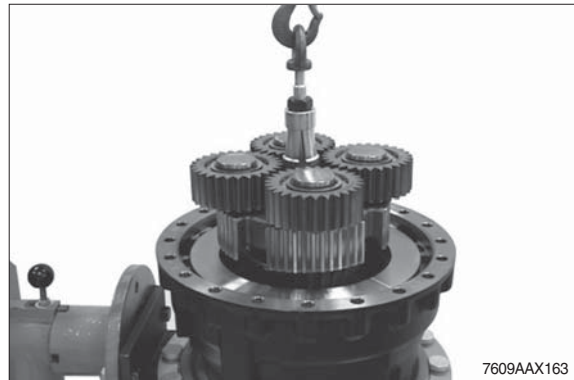


- ⑱ Wet front face (contact face bearing inner ring, arrow 1) and profile (teeth, arrow 2) in the output shaft with anti-corrosive agent.



- ⑲ Align disk package centrally and radially.
Then insert the planetary carrier by means of the lifting device into the teeth of the output shaft.

Inner extractor 5870 300 017
Eye nut 5870 204 076

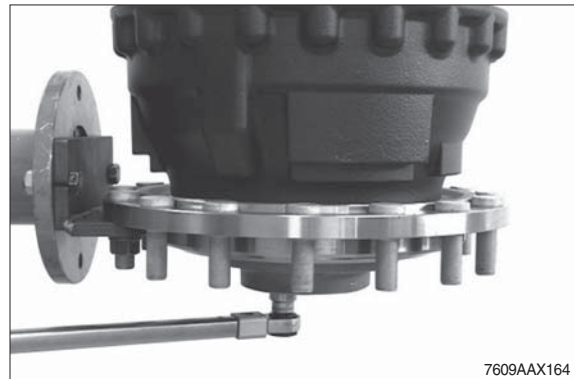


Setting of gap width output shaft / planetary carrier

- ⑳ Bring planetary carrier with measuring disk and three old locking screws, which were removed during disassembly, into contact position.

· Tightening torque :
20.4 kgf · m (148 lbf · ft)

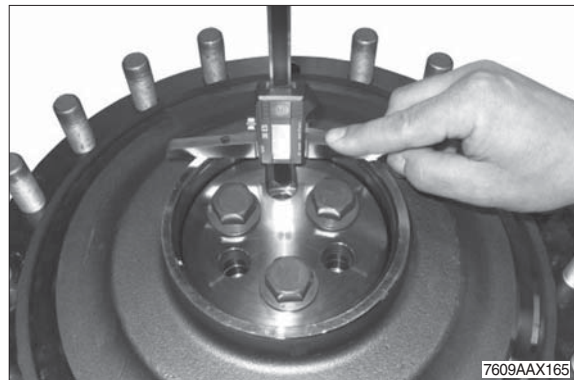
Measuring disk AA00 360 730



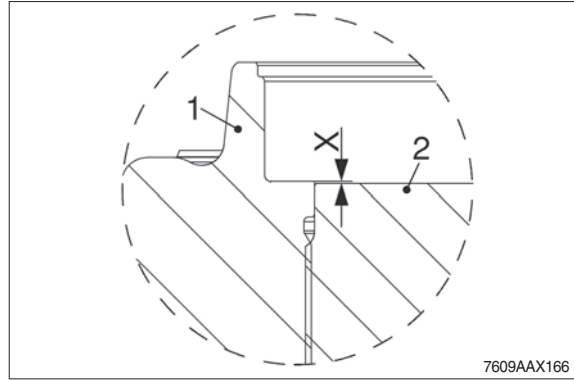
- ㉑ Pivot output 180° and measure gap width from the output shaft to the planetary carrier (see also subsequent sketch).

Gap width e.g. 0.21 mm

Then remove the locking screws and the measuring disk again.



- 1 Planetary carrier
- 2 Output shaft
- X Gap width



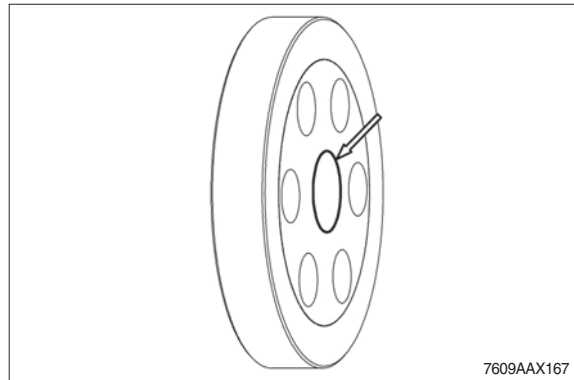
7609AAX166

② Select the cover (optional) on the basis of the following table.

Determined gap width (Delta)	Offset to be used on the cover	P/No.
0.30~0.24 mm	0.13 ± 0.01 mm	ZGAQ-04137
0.239~0.18 mm	0.07 ± 0.01 mm	ZGAQ-04370
0.179~0.10 mm	0.0 mm	ZGAQ-03909

※ Cover (ZGAQ-04370) has an offset of 0.07 mm on one side and an offset of 0.13 mm on the other side.

※ Offset 0.13 mm is visually marked with an annular groove (see arrow).



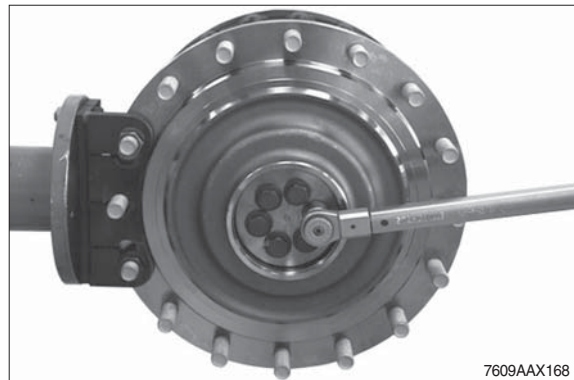
7609AAX167

③ Insert the cover with the offset e.g. 0.07 mm showing to the planetary carrier and tighten with **new** locking screws.

※ When using the cover with offset 0.07 mm, the groove (figure AX167) must be visible when the cover is installed.

※ Tighten locking screws successively with a tightening torque of 20.4 kgf · m (148 lbf · ft).

Then retighten the locking screws successively with a tightening torque of 51 kgf · m (369 lbf · ft).



7609AAX168

④ Install O-ring (see arrow 1) to the cover.

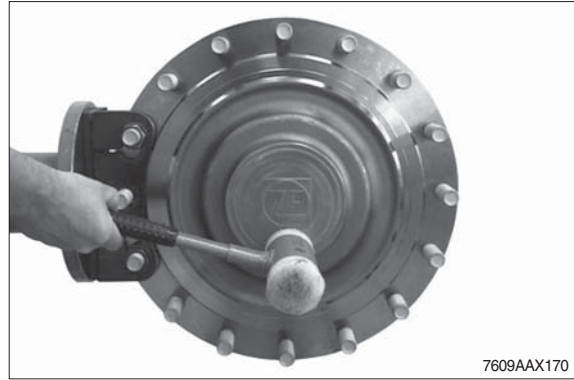
Then wet contact face (arrow 2).

※ Use new cover and O-ring.



7609AAX169

- ②5 Insert the cover into the output shaft until contact is obtained.



7609AAX170

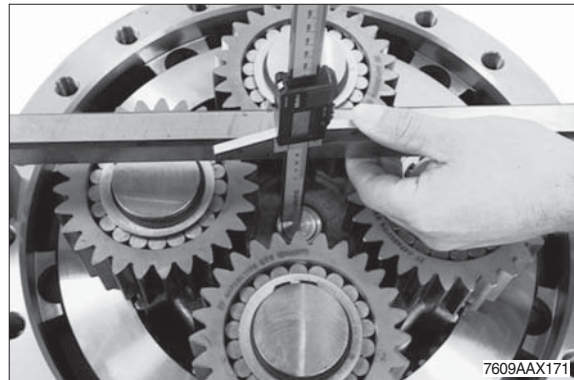
**Set the axial play of the sun gear shaft
0.5~2.0 mm**

- ②6 Determine dimension I, from the mounting face of the brake housing to the front face of the stop bolt.

Dimension I e.g. 40.80 mm

Gauge blocks 5870 200 066

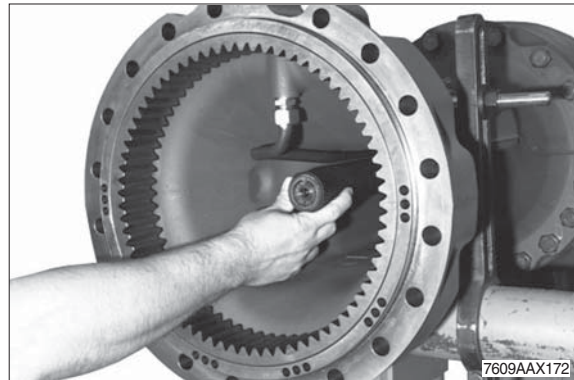
Straightedge 5870 200 022



7609AAX171

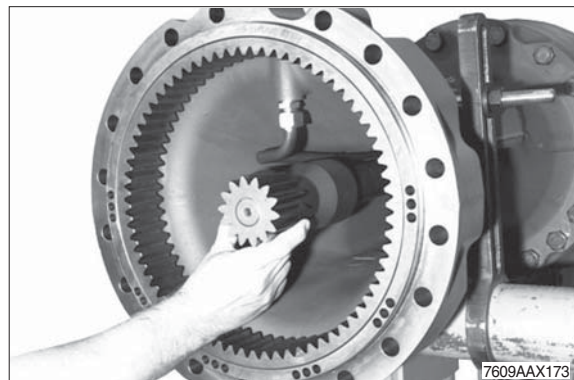
- ②7 Insert stub shaft into the teeth of the axle bevel gear until contact is obtained.

※ Pay attention to the installation position ;
mount the stub shaft with the long teeth
showing to the differential.



7609AAX172

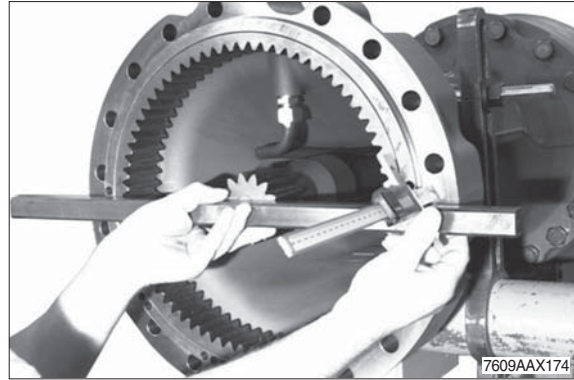
- ②8 Insert the sun gear shaft until contact is obtained.



7609AAX173

- ⑲ Measure dimension II, from the front face of the sun gear shaft to the mounting surface of the axle housing.

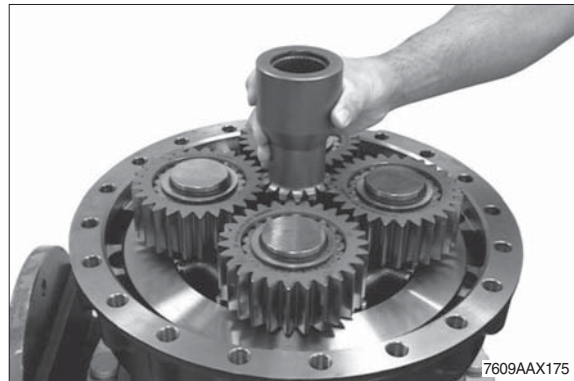
Dimension II e.g 38.20
 Straightedge 5870 200 022



CALCULATION EXAMPLE :

Dimension I 40.80 mm
 Dimension II - 38.20 mm
 Difference 2.60 mm
 Required axial play e.g. . . . - 1.00 mm
Difference = shim e.g. s = 1.60 mm

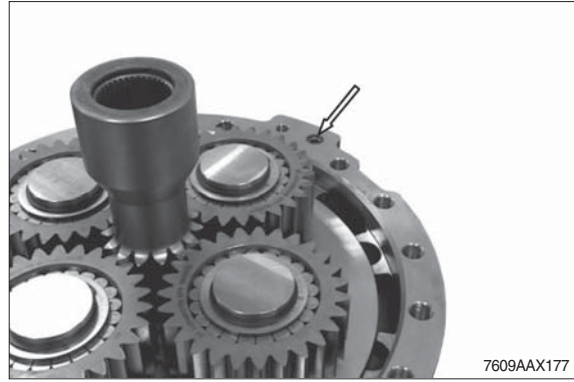
- ⑳ Insert sun gear shaft into the planetary carrier.



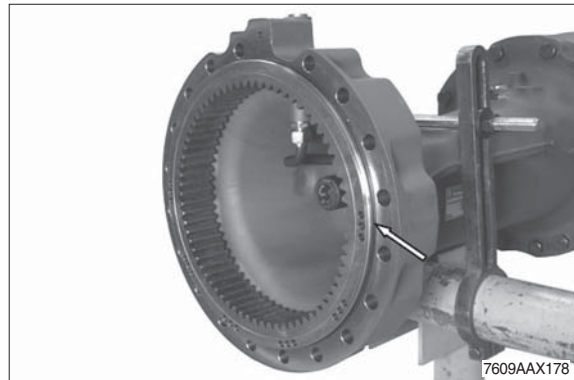
- ㉑ Fix determined shim (s) e.g. s = 1.60 mm with grease into the sun gear shaft.



- ③② Fix O-ring (see arrow) with grease into the countersink of the brake housing.



- ③③ Grease O-ring (see arrow) and install it to the axle housing.



- ③④ Mount two adjusting screws and use the lifting device to bring the output into contact position with the axle housing.

Then fix the output by means of hexagon screws.

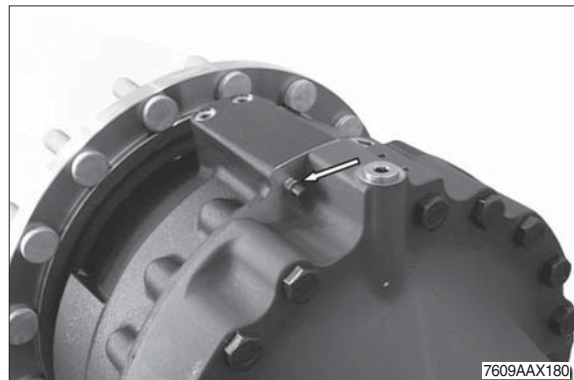
· Tightening torque :
(M20/10.9) 57.1 kgf · m (413 lbf · ft)

Adjusting screws 5870 204 024
Load carrying device 5870 281 043



- ※ Fix load carrying device with wheel stud.

- ③⑤ Mount breather (see arrow).



Check brake hydraulics for leakages

- ※ Before starting the test, completely breathe the brake hydraulics.

Then pressurize the brake temporarily (5EA) with $p = 100$ bar max.

High-pressure test :

Build up test pressure $p = 100-10$ bar max and close connection to HP pump via shut-off valve.

A pressure drop of max 2 % (2 bar) is permissible during a 5-minute testing time.

Low-pressure test :

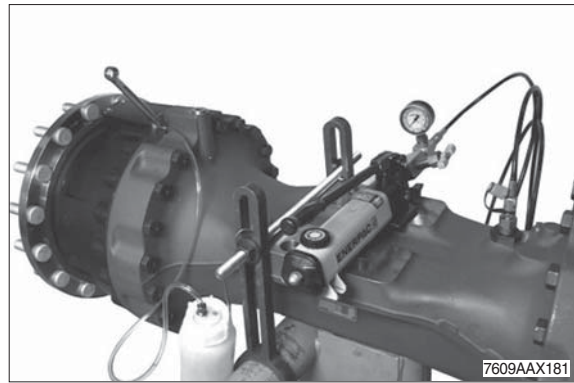
Reduce test pressure $p = 5$ bar and close shut-off valve.

No pressure drop is allowed during a 5-minute testing time.

Test media :

Engine oil SAE 10W

HP pump	5870 287 007
Clutch	0501 207 939
Reduction (M18 × 1.5)	5870 950 161
Oil collector bottle	5870 286 072



Check operability of hydraulic lock differential (opt)

Build up pressure $p = 20$ bar max and close connection to HP pump via shut-off valve.

Lock on :

When rotating the input flange, both outputs must have the same direction of rotation.

Lock off :

When rotating the input flange, one side has no movement or has the opposite direction of rotation.

Prior to putting the axle into operation, fill it with oil according to the related lubrication and maintenance instructions.

