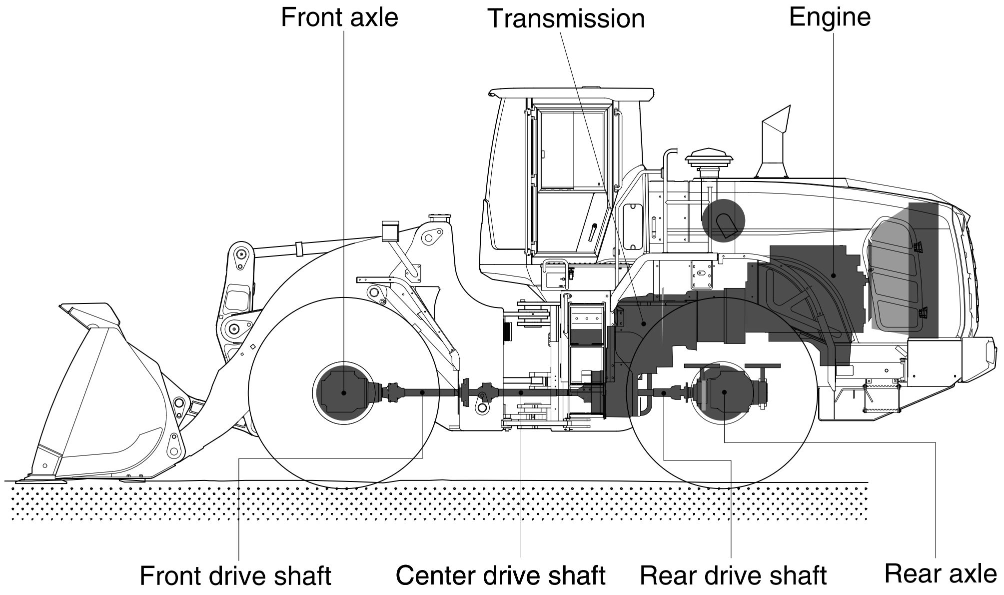
SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. POWER TRAIN COMPONENT OVERVIEW



985A3PT01

The power train consists of the following components:

· Transmission
· Front, center and rear drive shafts
· Front and rear axles

Engine power is transmitted to the transmission through the torque converter.

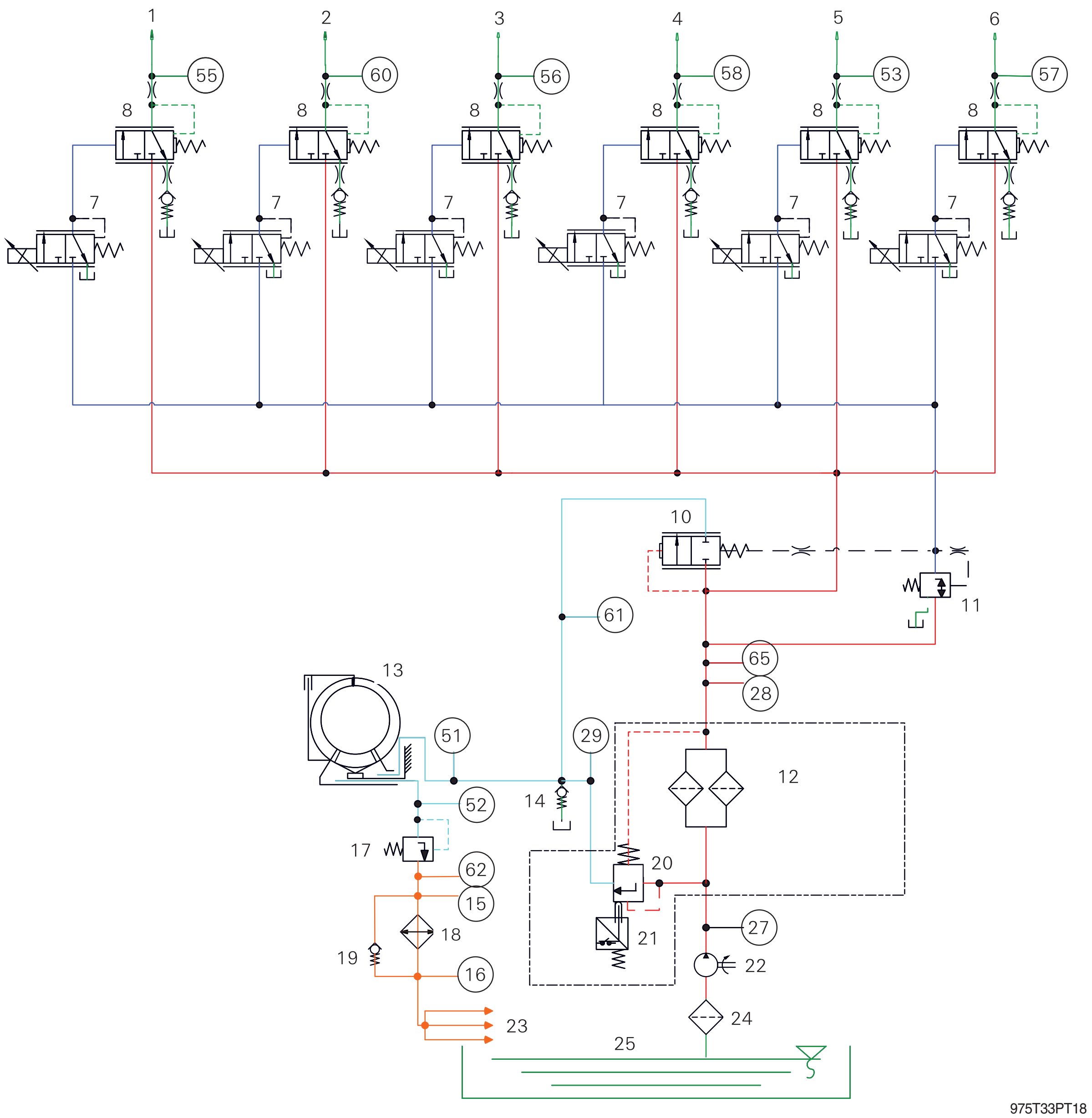
The transmission is a hydraulically engaged five speed forward, three speed reverse countershaft type power shift transmission. A calliper-disc type parking brake is located on the transmission.

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 hydraulic lock differential as standard.
The rear axle is equipped with conventional differential as standard.
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.

HYDRAULIC CIRCUIT



1	Return flow to sump
2	Pilot pressure
3	Main pressure
4	Lubrication
5	Converter pressure

Positions 15, 16, 27, 28, 29, 51, 52, 53, 55, 56, 57, 58, 60, 61, 62, 65 correspond to the numbers on the installation drawing.

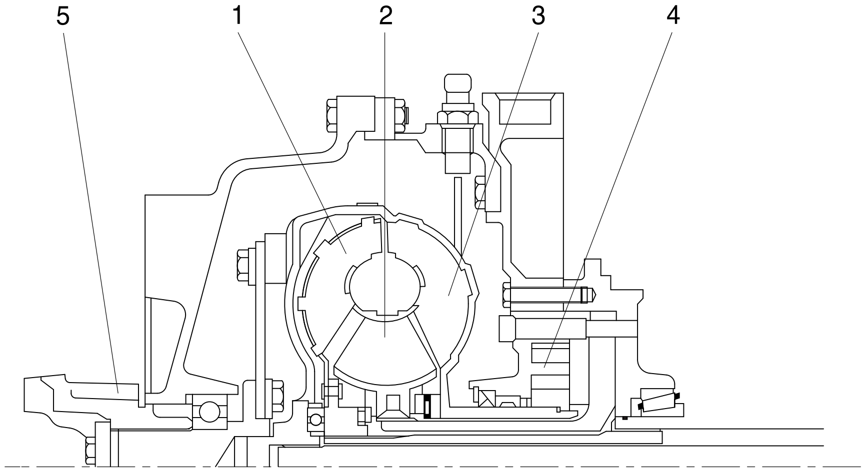
1 Clutch K1
2 Clutch KV (clutch forward)
3 Clutch K2
4 Clutch K3
5 Clutch K4
6 Clutch KR (clutch reverse)
7 Pilot valve
8 Downstream valve
10 Main pressure valve
11 Pressure reduction valve
12 Transmission pressure filter
13 Converter
14 Converter safety valve
15 Connection of pressure oil to oil cooler
16 Connection of pressure oil from oil cooler
17 Converter counter-pressure valve
18 Oil cooler (heat exchanger)
19 Oil cooler bypass valve
20 Filter bypass valve
21 Filter bypass switch
22 Transmission pump
23 Lubrication
24 Suction filter
25 Tank
27 Connection of pressure oil to filter
28 Connection of pressure oil from filter
29 Filter bypass connection
51 Measuring point of oil pressure before converter
52 Measuring point of oil pressure after converter
53 Measuring point of clutch pressure K4
55 Measuring point of clutch pressure K1
56 Measuring point of clutch pressure K2
57 Measuring point of clutch pressure KR
58 Measuring point of clutch pressure K3
60 Measuring point of clutch pressure KV
61 Temperature sensor for sump temperature
62 Temperature sensor for oil temperature after the converter
65 Measuring point of system pressure

Assignment of clutch and solenoid valve

		Live solenoid								
		Forward					Reverse			Neutral
Clutch	Solenoid valve	1	2	3	4	5	1	2	3	
KV	Y2	X	X		X					
KR	Y6						X	X	X	
K1	Y1	X					X			
K2	Y3		X	X				X		
K3	Y4			X	X				X	
K4	Y5		X		X					

2. TORQUE CONVERTER

1) FUNCTION



73033TM00

1	Turbine	3	Pump	5	Input flange
2	Stator	4	Transmission pump		

The converter is working according to the Trilok-system, i.e. it assumes at high turbine speed the characteristics, and with it the favorable efficiency of a fluid clutch.
The converter is designed according to the engine power so that the most favorable operating conditions are obtained for each installation case.

The Torque converter is composed of 3 main components :
Pump wheel - turbine wheel - stator (reaction member)

These 3 impeller wheels are arranged in such a ring-shape system that the fluid is streaming through the circuit components in the indicated order.

Pressure oil from the transmission pump is constantly streaming through the converter. In this way, the converter can fulfill its task to multiply the torque of the engine and at the same time, the heat created in the converter is dissipated via the escaping oil.
The oil which is streaming out of the pump wheel, enters the turbine wheel and is there inversed in the direction of flow.

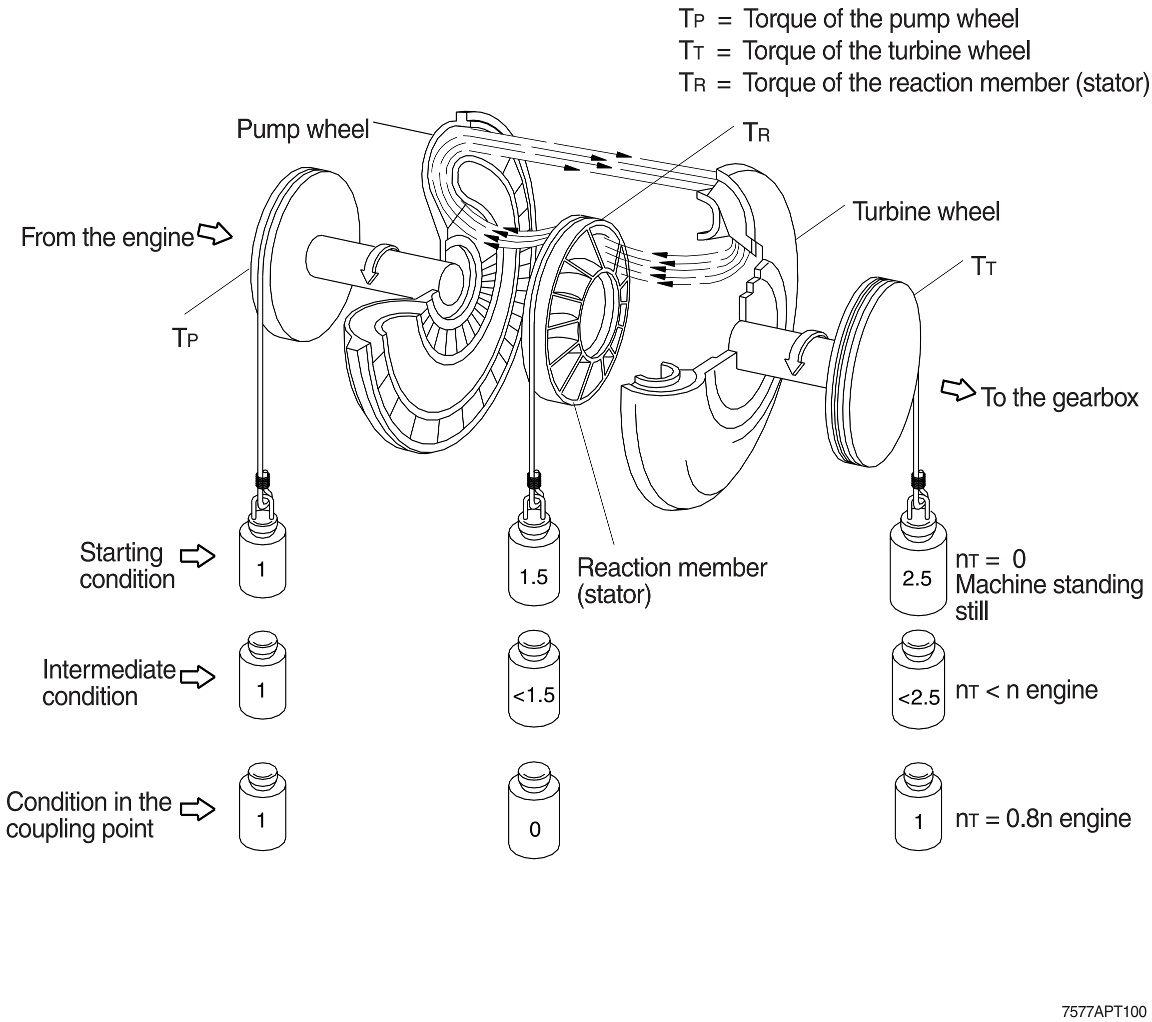
According to the rate of reversion, the turbine wheel and with it also the output shaft is receiving a more or less high reaction torque. The stator (reaction member), following the turbine, has the task to reverse the oil streaming out of the turbine once more and to deliver it under the suitable discharge direction to the pump wheel.
Due to the reversion, the stator receiving a reaction torque.
The relation turbine torque/pump torque is called torque multiplication.
This is the higher, the greater the speed difference of pump wheel and turbine wheel will be.

Therefore, the maximum torque multiplication is created at stationary turbine wheel.
With increasing output speed, the torque multiplication is decreasing. The adaption of the output speed to a certain required output torque will be infinitely variable and automatically achieved by the torque converter.

When the turbine speed is reaching about 80% of the pump speed, the torque multiplication becomes 1.0 i.e. the turbine torque becomes equal to that of the pump torque.
From this point on, the converter is working similar to a fluid clutch.

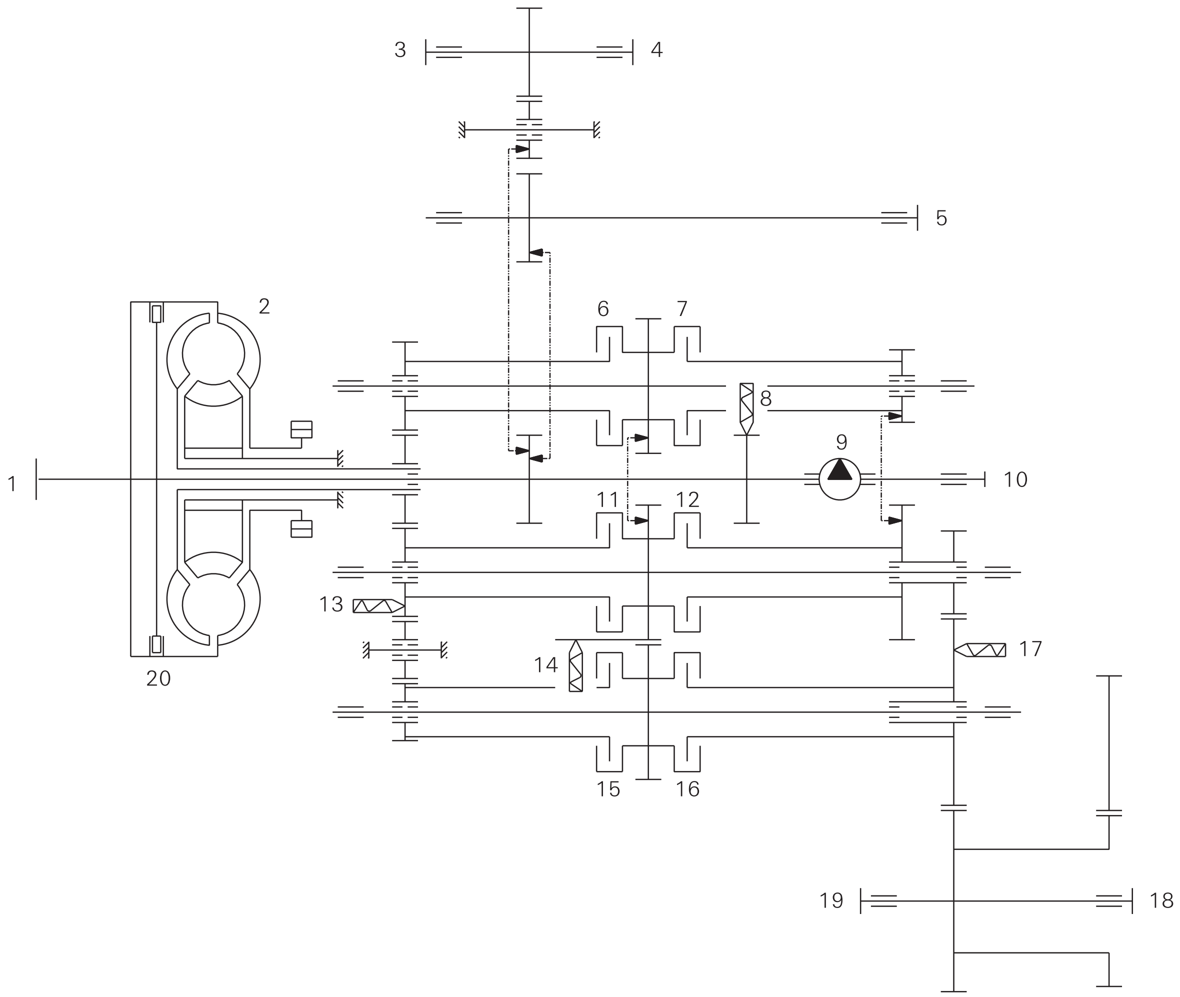
A stator freewheel serves to improve the efficiency in the upper driving range, in the torque multiplication range it is backing-up the torque upon the housing, and is released in the clutch range.
In this way, the stator can rotate freely.

Function of a hydrodynamic torque converter (schematic view)



3. TRANSMISSION

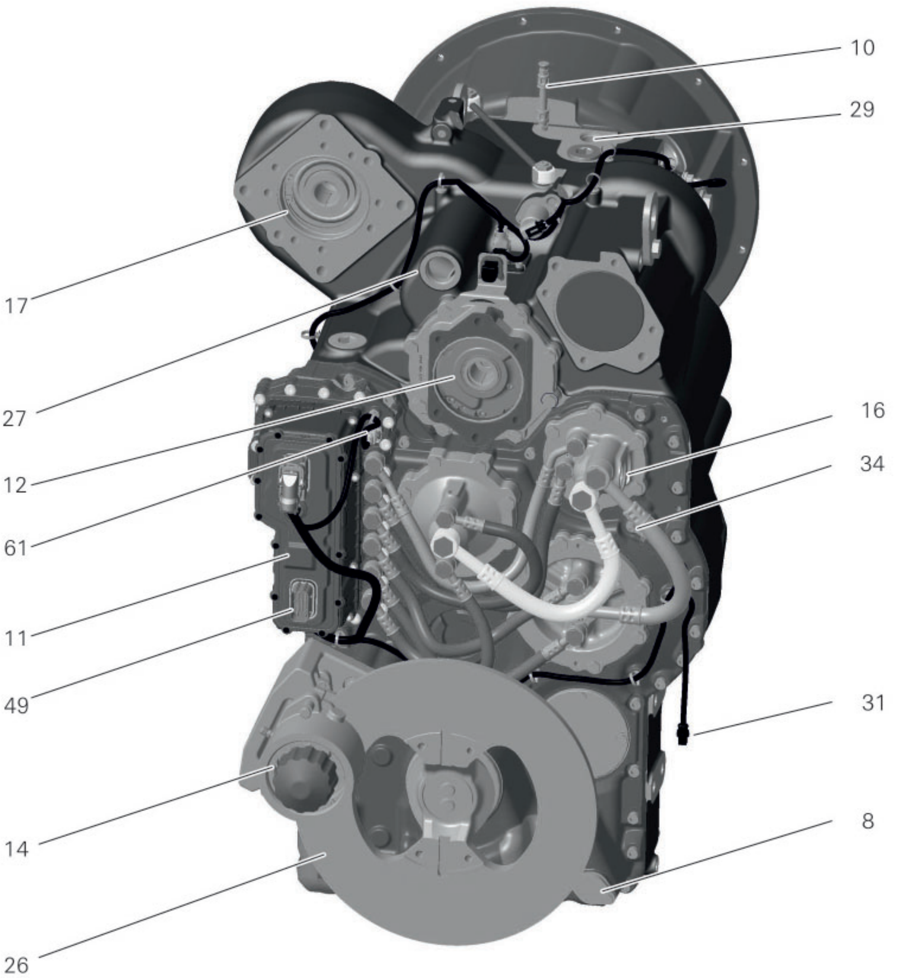
1) DIAGRAM



975T33PT10

1	Input	2	Converter
3	PTO (if equipped)	4	PTO (if equipped)
5	PTO (if equipped)	6	Clutch KV (clutch forward)
7	Clutch K1	8	Inductive sensor for engine speed
9	Pump	10	Engine-dependent PTO
11	Clutch KR (clutch reverse)	12	Clutch K2
13	Inductive sensor for turbine speed	14	Inductive sensor for speed of central gear chain
14	Emergency steering pump (optional)		
15	Clutch K4	16	Clutch K3
17	Inductive sensor for the output speed	18	Output
19	Output	20	Lock-up clutch (not used)

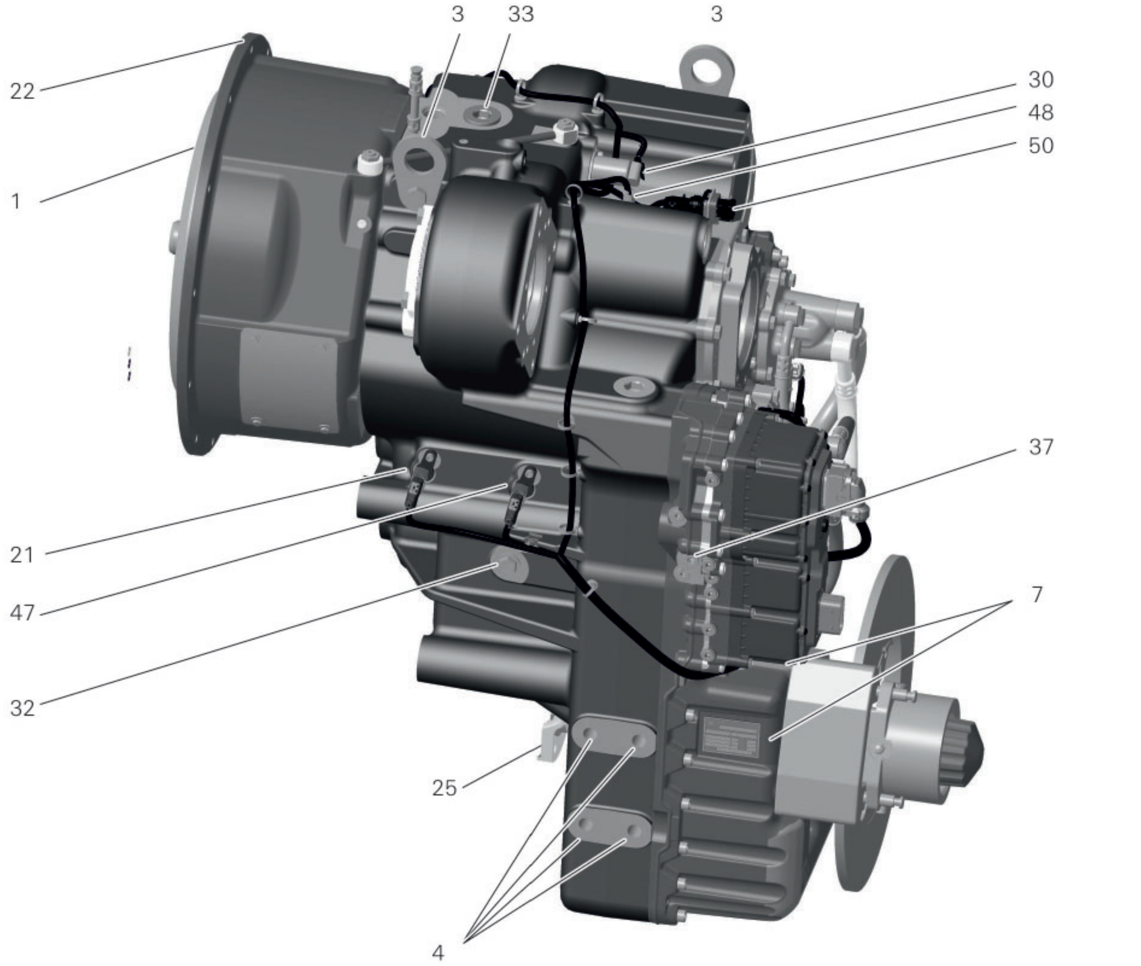
2) INSTALLATION VIEW



975T33PT11

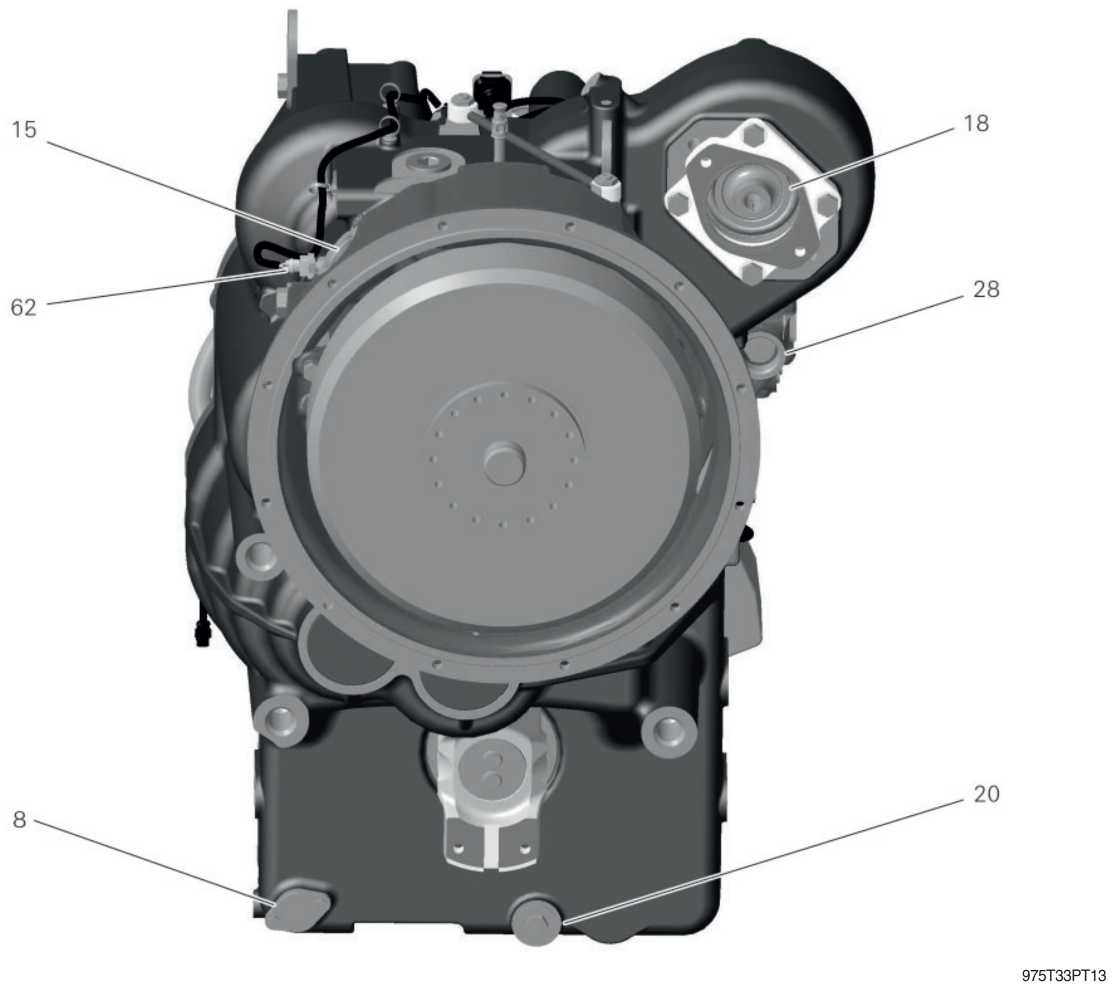
8	Connection for oil level gauge	31	Connector for filter bypass valve
10	Breather	34	Inductive sensor for output speed
11	Electro hydraulic transmission control unit	39	Connection of return flow to sump
12	Engine-dependent PTO	49	Machine connector
14	Parking brake - disc brake	61	Temperature sensor for oil temperature in sump
16	Connection from oil cooler		
17	PTO (if equipped)		
26	Output flange		
27	Connection to filter		
29	Connection from filter bypass		

INSTALLATION VIEW



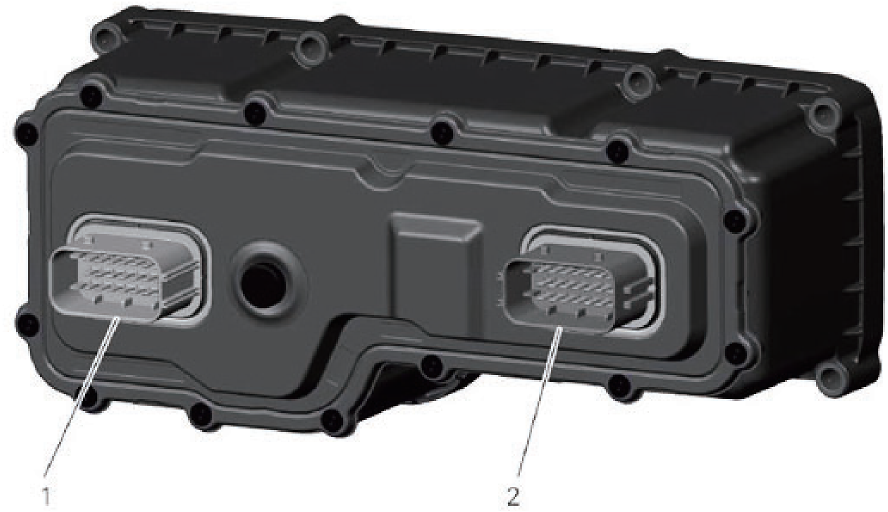
1	Converter	30	Solenoid valve for converter clutch (not used)
3	Lifting eye	32	Connection of return flow to sump M26X1.5
4	Transmission suspension holes	33	Oil filler plug M42X2 (Tightening torque 145 Nm)
7	Name plate	37	Connection for system pressure M16X1.5
15	Connection to heat exchanger	47	Inductive sensor for speed of central gear chain
21	Inductive sensor for turbine speed	48	Inductive sensor for engine speed
22	Connection to engine	50	Plug
25	Output flange		

INSTALLATION VIEW



8 Connection for oil level gauge
15 Connection to oil cooler
18 PTO (if equipped)
20 Oil drain plug M38X1.5
(Tightening torque 80 Nm)
28 Connection from filter
62 Temperature sensor for oil temperature after converter

3) ELECTRONIC TRANSMISSION CONTROL UNIT



960T33PT13

1 Transmission connector
2 Machine connector

The electronic transmission control unit controls the electro-hydraulic transmission control unit.

The electronic control unit (EC4A) is designed as on-site electronics. An internal plug connection and awiring harness (plug-in connector 1) connect the electronic transmission control unit and the internal elements of the transmission. A second slot is provided for the connection of the transmission to the machine (plug-in connector 2). This plug connection is responsible for the power supply via on-board supply system and the connection to the CAN communication network. At delivery the second plug connection is closed with a cap for protection against outside influences. Carefully remove the cap with as crewdriver or similar tool. Do not damage the detents on the plug.

4. FAULT CODE

1-1) MACHINE FAULT CODE

<table>
<tr><th colspan="2">DTC</th><th rowspan="2">Diagnostic Criteria</th><th colspan="3">Application</th></tr>
<tr><th>HCESPN</th><th>FMI</th><th>G</th><th>C</th><th>S</th></tr>
<tr><td rowspan="3">101</td><td>3</td><td>10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage > 3.95 V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Hydraulic Oil Temp. Measurement Voltage < 0.3 V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="3">202</td><td>0</td><td>10 seconds continuous, Steering main pump pressure Measurement Voltage > 5.3 V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous, Steering main pump pressure Measurement Voltage < 0.3 V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
<tr><td rowspan="3">204</td><td>0</td><td>10 seconds continuous,
Boom cylinder ‘head’ pressure Measurement Voltage > 5.3 V</td><td>●</td><td></td><td></td></tr>
<tr><td>4</td><td>10 seconds continuous,
Boom cylinder ‘head’ pressure Measurement Voltage < 0.3 V</td><td>●</td><td></td><td></td></tr>
<tr><td colspan="5">(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</td></tr>
</table>

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	●		
205	4	10 seconds continuous, Boom cylinder 'rod' pressure Measurement Voltage < 0.3V	●		
205		(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	●		
301	4	10 seconds continuous, Fuel level Measurement Voltage < 0.3V	●		
301		(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)	●		
318		(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			●
339	4	10 seconds continuous, Accel pedal position 1 voltage Measurement Voltage < 0.2 V			●
339		(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			

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

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			●
	(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	●		
	(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	●		
	(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	●		
	(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				

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

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 joysitck 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 joysitck 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 joysitck 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 recircuilation 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 posistion 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 ㎞ [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 exhasut 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 exhasut 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 teh 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 FAULT CODES

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
523000	1	Battery low undervoltage	Trm Shutdown	The control unit detects a voltage of < 7.00 volt (12 V device) or < 9.00 volt (24 volt device) on the supply input of terminal 30. 1. The alternator control unit has an internal defect. 2. Vehicle battery not sufficiently charged. 3. Wiring or plug connection defective (supply or ground cable). 4. Control unit parameters incorrectly set.	The cause of the missing or insufficient voltage on terminal 30 must be located. 1. Check the fuse of the terminal 30 control units. 2. If the error occurs after a (sluggish) vehicle start, check the vehicle battery. Recharge the battery to ensure that it is sufficiently charged. 3. Make sure that the control unit has a stable voltage supply. Check the stability of the voltage with Testman. 4. Check the wiring between the alternator and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. Pay special attention to the ground wiring. 5. Check the function of the alternator as well as the settings of the alternator control unit and replace both if necessary.
523000	3	Battery overvoltage	Trm Shutdown	The control unit detects a voltage of > 18.00 volt (12 volt device) or > 32.50 volt (24 volt device) on the supply input terminal 30. 1. The alternator control unit has an internal defect. 2. Wiring or plug connection defective (supply or ground cable). 3. Control unit parameters incorrectly set.	The cause of the excessive voltage on terminal 30 must be located. 1. Make sure that the control unit has a stable voltage supply. Check the voltage on the terminal tester with a voltmeter. · Target voltage ignition ON: Vehicle power supply. · Target voltage ignition OFF: Vehicle power supply. 2. With the ignition off, use a voltmeter to check the voltage on the connection of terminal 30 (steady plus) to terminal 31 (ground). The measured voltage must correspond to the vehicle power supply. 3. With the engine running, check the voltage in the same manner as described in the point above. The measured voltage must correspond to the vehicle power supply. 4. Check the wiring between the alternator and the

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. Pay special attention to the ground wiring. 5. Check the function of the alternator as well as the settings of the alternator control unit and replace both if necessary.
523000	4	Battery undervoltage	Trm Shutdown	The control unit detects a voltage of < 9.00 volt (12 V device) or < 16.00 volt (24 volt device) on the supply input terminal 30. 1. The alternator control unit has an internal defect. 2. Vehicle battery not sufficiently charged. 3. Wiring or plug connection defective (supply or ground cable). 4. Control unit parameters incorrectly set.	The cause of the missing or insufficient voltage on terminal 30 must be located. 1. Check the fuse of the terminal 30 control units. 2. If the error occurs after a (sluggish) vehicle start, check the vehicle battery. Recharge the battery to ensure that it is sufficiently charged. 3. Make sure that the control unit has a stable voltage supply. Check the stability of the voltage with Testman. 4. Check the wiring between the alternator and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. Pay special attention to the ground wiring. 5. Check the function of the alternator as well as the settings of the alternator control unit and replace both if necessary.
523020	3	EC3: Supply for speed sensors (AU3) overvoltage	Trm Shutdown	The measured voltage is too high. 1. Wiring or plug connection is defective. 2. Sensor has an internal defect. 3. Control unit has an internal defect.	The cause of the incorrect voltage must be located. 1. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the correct wiring of the pins. 3. Check the function of the sensor or replace the sensor. 4. Replace the control unit if the error continues to occur.
523020	4	EC3: Supply for speed	Trm Shutdown	The measured voltage is too low.	The cause of the incorrect voltage must be located.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
		sensors (AU3) undervoltage		1. Wiring or plug connection is defective. 2. Sensor has an internal defect. 3. Control unit has an internal defect.	1. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the correct wiring of the pins. 3. Check the function of the sensor or replace the sensor. 4. Replace the control unit if the error continues to occur.
523020	6	EC3: Supply for speed sensors (AU3) short to ground	Trm Shutdown	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect. Note: If this error occurs, calculations are partially being made with replacement values. The transmission functions are limited and the shifting quality is reduced.	1. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 2. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the function of the connected component and replace it if needed. 4. Replace the control unit if the error continues to occur.
523021	3	EC3: Supply for temperature sensors and oil filter restriction switch (AU2) overvoltage EC4: Supply for speed sensors (AU2) overvoltage	Trm Shutdown	The measured voltage is too high. 1. Wiring or plug connection is defective. 2. Sensor has an internal defect. 3. Control unit has an internal defect.	The cause of the incorrect voltage must be located. 1. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the correct wiring of the pins. 3. Check the function of the sensor or replace the sensor. 4. Replace the control unit if the error continues to occur.
523021	4	EC3: Supply for temperature sensors	Trm Shutdown	The measured voltage is too low. 1. Wiring or plug connection is defective.	The cause of the incorrect voltage must be located. 1. Check the wiring, in particular with regard to

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
		and oil filter restriction switch (AU2) undervoltage EC4: Supply for speed sensors (AU2) undervoltage		2. Sensor has an internal defect. 3. Control unit has an internal defect.	defective plug connections such as corroded or damaged plug contacts. 2. Check the correct wiring of the pins. 3. Check the function of the sensor or replace the sensor. 4. Replace the control unit if the error continues to occur.
523021	6	EC3: Supply for temperature sensors and oil filter restriction switch (AU2) short to ground EC4: Supply for speed sensors (AU2) short to ground	Trm Shutdown	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect. Note: If this error occurs, calculations are partially being made with replacement values. The transmission functions are limited and the shifting quality is reduced.	1. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 2. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the function of the connected component and replace it if needed. 4. Replace the control unit if the error continues to occur.
523022	3	EC4: Supply for oil filter restriction switch (AU1) overvoltage	Limp Home	The measured voltage is too high. 1. Wiring or plug connection is defective. 2. Sensor has an internal defect. 3. Control unit has an internal defect.	The cause of the incorrect voltage must be located. 1. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the correct wiring of the pins. 3. Check the function of the sensor or replace the sensor. 4. Replace the control unit if the error continues to occur.
523022	4	EC4: Supply for oil filter restriction switch (AU1) undervoltage	Limp Home	The measured voltage is too low. 1. Wiring or plug connection is defective. 2. Sensor has an internal defect.	The cause of the incorrect voltage must be located. 1. Check the wiring, in particular with regard to defective plug connections such as corroded or

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				3. Control unit has an internal defect.	damaged plug contacts. 2. Check the correct wiring of the pins. 3. Check the function of the sensor or replace the sensor. 4. Replace the control unit if the error continues to occur.
523022	6	EC4: Supply for oil filter restriction switch (AU1) short to ground	Limp Home	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 2. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the function of the connected component and replace it if needed. 4. Replace the control unit if the error continues to occur.
523030	3	Propvalve power supply 1 (VPS1) overvoltage	TCU Shutdown	The measured voltage is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	The cause of the incorrect voltage must be located. 1. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the correct wiring of the pins. 3. Check the function of the connected component or replace the component. 4. Replace the control unit if the error continues to occur.
523031	3	Propvalve power supply 2 (VPS2) overvoltage	TCU Shutdown	The measured voltage is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	The cause of the incorrect voltage must be located. 1. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the correct wiring of the pins.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					3. Check the function of the connected component or replace the component. 4. Replace the control unit if the error continues to occur.
523040	0	TCU overtemperature	TCU Shutdown	The measured temperature on the control unit of the transmission is too high. 1. Overheating due to outside influences. 2. Temperature sensor has an internal defect.	The cause of the increased temperature input in the control unit must be located. 1. Check if outside influences have caused the excessive temperature. 2. If the error continues to occur then the control unit needs to be replaced.
523040	2	TCU temperature invalid value	TCU Shutdown	The measured temperature on the control unit of the transmission is invalid. 1. Control unit has an internal defect.	1. Replace the control unit.
523044	12	Internal TCU Error 5	TCU Shutdown	There are 3 startup self-tests concerning power lines 1. Watch dog cut-off test – WD chip allow VPS to be enabled only if it is activated (armed) and disable all VPSs before it resets MCU. The self-test check it. 2. VPS cut off test – SW is able to control VPS via power supply manager component – self test check it 3.. OCG off test – it check if when VPS is on and OCG/AIM channels are disable (requested current = 0), there really is no current on the lines.	The cause of the incorrect behavour must be located. 1.Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2.Check the correct wiring of the pins. 3.Check the function of the connected component or replace the component. 4.Replace the control unit if the error continues to occur.
523045	12	Internal TCU Error 1	TCU Shutdown	The control unit detects an internal error.	Read out the operating data with Testman and send them to your ZF contact.
523046	12	Internal TCU Error 2	TCU Shutdown	The control unit detects an internal error.	Read out the operating data with Testman and send them to your ZF contact.
523049	12	Unknown transmission	TCU Shutdown	Wrong TCU mounted. The TCU doesn't fit to the	Contact your ZF representative.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
		controller hardware detected		application.	
523100	3	Speed sensor input 1 (EF1) overvoltage: Turbine speed	Limp Home	The measured voltage at the input is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	The cause of the incorrect voltage must be located. 1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the correct wiring of the pins. 4. Check the function of the connected component or replace the component. 5. Replace the control unit if the error continues to occur.
523100	6	Speed sensor input 1 (EF1) open or short to ground: Turbine speed	Limp Home	The measured line resistance between the connected component and the control unit is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 2. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the function of the connected component and replace it if needed. 4. Replace the control unit if the error continues to occur.
523100	8	Speed sensor input 1 (EF1) direction of rotation unknown: Turbine speed	Limp Home	The control unit does not recognize the rotational direction at the input. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance sensor – sensor ring too large. 4. Sensor has an internal defect.	The cause of the unknown rotational direction must be located. 1. Check the wiring from the sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
523100	9	Speed sensor input 1 (EF1) speed unknown: Turbine speed	Limp Home	The control unit does not recognize the speed at the input. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance speed sensor – sensor ring too large. 4. Speed sensor has an internal defect.	The cause of the unknown speed must be located. 1. Check the wiring from the speed sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523105	3	Speed sensor input 2 (EF2) overvoltage: Internal speed	Limp Home	The measured voltage at the input is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	The cause of the incorrect voltage must be located. 1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the correct wiring of the pins. 4. Check the function of the connected component or replace the component. 5. Replace the control unit if the error continues to occur.
523105	6	Speed sensor input 2 (EF2) open or short to ground: Internal speed	Limp Home	The measured line resistance between the connected component and the control unit is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 2. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the function of the connected component and replace it if needed. 4. Replace the control unit if the error continues to occur.
523105	8	Speed sensor input 2 (EF2) direction of	Limp Home	The control unit does not recognize the rotational direction at the input.	The cause of the unknown rotational direction must be located.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
		rotation unknown: Internal speed		1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance sensor – sensor ring too large. 4. Sensor has an internal defect.	1. Check the wiring from the sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523105	9	Speed sensor input 2 (EF2) speed unknown: Internal speed	Limp Home	The control unit does not recognize the speed at the input. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance speed sensor – sensor ring too large. 4. Speed sensor has an internal defect.	The cause of the unknown speed must be located. 1. Check the wiring from the speed sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523110	3	Speed sensor input 3 (EF3) overvoltage: Output speed	Limp Home	The measured voltage at the input is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	The cause of the incorrect voltage must be located. 1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the correct wiring of the pins. 4. Check the function of the connected component or replace the component. 5. Replace the control unit if the error continues to occur.
523110	6	Speed sensor input 3 (EF3) open or short to ground: Output speed	Limp Home	The measured line resistance between the connected component and the control unit is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 2. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the function of the connected component and

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					replace it if needed. 4. Replace the control unit if the error continues to occur.
523110	8	Speed sensor input 3 (EF3) direction of rotation unknown: Output speed	Limp Home	The control unit does not recognize the rotational direction at the input. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance sensor – sensor ring too large. 4. Sensor has an internal defect.	The cause of the unknown rotational direction must be located. 1. Check the wiring from the sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523110	9	Speed sensor input 3 (EF3) speed unknown: Output speed	Limp Home	The control unit does not recognize the speed at the input. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance speed sensor – sensor ring too large. 4. Speed sensor has an internal defect.	The cause of the unknown speed must be located. 1. Check the wiring from the speed sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523115	3	Speed sensor input 4 (EF4) overvoltage: Engine speed	Limp Home	The measured voltage at the input is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	The cause of the incorrect voltage must be located. 1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the correct wiring of the pins. 4. Check the function of the connected component or replace the component. 5. Replace the control unit if the error continues to occur.
523115	6	Speed sensor input 4 (EF4) open or short to ground: Engine speed	Limp Home	The measured line resistance between the connected component and the control unit is too high.	1. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	2. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the function of the connected component and replace it if needed. 4. Replace the control unit if the error continues to occur.
523115	8	Speed sensor input 4 (EF4) direction of rotation unknown: Engine speed	Limp Home	The control unit does not recognize the rotational direction at the input. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance sensor – sensor ring too large. 4. Sensor has an internal defect.	The cause of the unknown rotational direction must be located. 1. Check the wiring from the sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523115	9	Speed sensor input 4 (EF4) speed unknown: Engine speed	Limp Home	The control unit does not recognize the speed at the input. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance speed sensor – sensor ring too large. 4. Speed sensor has an internal defect.	The cause of the unknown speed must be located. 1. Check the wiring from the speed sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523140	3	Resistance sensor input 1 (ER1) open circuit or short to high source: Sump temperature	Normal	The measured line resistance between the connected component and the control unit is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 2. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the function of the connected component and replace it if needed.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					4. Replace the control unit if the error continues to occur.
523140	6	Resistance sensor input 1 (ER1) short to ground: Sump temperature	Normal	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 2. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the function of the connected component and replace it if needed. 4. Replace the control unit if the error continues to occur.
523155	3	Current sensor input 2 (EI2) overvoltage: Oil Filter Restriction Switch	Normal	The measured voltage at the input is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	The cause of the incorrect voltage must be located. 1. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the correct wiring of the pins. 3. Check the function of the connected component or replace the component. 4. Replace the control unit if the error continues to occur.
523155	6	Current seonsr input 2 (EI2) open circuit or short to ground: Oil Filter Restriction Switch	Normal	The measured line resistance between the connected component and the control unit is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 2. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the function of the connected component and replace it if needed.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					4. Replace the control unit if the error continues to occur.
523160	3	Voltage sensor input 3 (EU3) overvoltage	TCU Shutdown	The measured voltage at the sensor input 3 is too high: cable is defective and is contacted to battery voltage clutch cut off / inch pedal sensor has an internal defect connector pin is contacted to battery voltage.	check the cable from TCU to the sensor check the connectors 3 check the sensor
523160	6	Voltage sensor input 3 (EU3) open or short to ground	TCU Shutdown	The measured voltage at the sensor input 3 is too low: cable is defective and is contacted to vehicle ground cable has no connection to TCU clutch cut off / inch pedal sensor has an internal defect connector pin is contacted to vehicle ground or is broken.	1 check the cable from TCU to the sensor 2 check the connectors 3 check the sensor
523160	12	Voltage sensor input 3 (EU3) defect	TCU Shutdown	The measured sensor voltage is out of the allowed thresholds.	check the cable from TCU to the sensor check the connectors check the sensor 4 Change the sensor
523165	3	Voltage sensor input 4 (EU4) overvoltage	Normal	The measured voltage at the sensor input 3 is too high: cable is defective and is contacted to battery voltage clutch cut off / inch pedal sensor has an internal defect connector pin is contacted to battery voltage.	1 check the cable from TCU to the sensor 2 check the connectors 3 check the sensor
523165	6	Voltage sensor input 4 (EU4) open or short to ground	Normal	The measured voltage at the sensor input 3 is too low: cable is defective and is contacted to vehicle ground cable has no connection to TCU clutch cut off / inch pedal sensor has an internal defect connector pin is contacted to vehicle ground or is broken.	1 check the cable from TCU to the sensor 2 check the connectors 3 check the sensor
523165	12	Voltage sensor input 4	Normal	The measured sensor voltage is out of the	check the cable from TCU to the sensor check the

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
		(EU4) defect		allowed thresholds.	connectors check the sensor 4 Change the sensor
523200	2	Current output driver 1 (AIM01) unknown electrical component	Trm Shutdown	If this error occurs, then an electrical component has been connected at the output although the input should not be used.	1. Using the circuit diagram, check if a component is assigned to the output. 2. Check the wiring, in particular that it is wired correctly. 3. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts 4. Replace the control unit if the error continues to occur.
523200	3	Current output driver 1 (AIM01) short to battery	Limp Home	The measured line resistance between the proportional valve and the control unit is too high or the voltage on the control unit output is too high. 1. Wiring or plug connection contacts battery voltage. 2. Proportional valve has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523200	5	Current output driver 1 (AIM01) open circuit	Limp Home	The measured line resistance between the connected component and the control unit is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523200	6	Current output driver 1 (AIM01) short to ground	TCU Shutdown	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523200	8	Current output driver 1 (AIM01) short to another valve	Trm Shutdown	The measured line resistance between the proportional valve and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts another proportional valve. 2. Proportional valve has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Check if the error occurs with an additional proportional valve or with which valve the error is bypassed. 3. Check the wiring between the proportional valve and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Switch the ignition off, unplug the control unit, and measure the resistance of the proportional valve using a terminal tester. 5. Check the function of the proportional valve and

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					replace it if needed. 6. Replace the control unit if the error continues to occur.
523205	2	Current output driver 2 (AIM02) unknown electrical component	Trm Shutdown	If this error occurs, then an electrical component has been connected at the output although the input should not be used.	1. Using the circuit diagram, check if a component is assigned to the output. 2. Check the wiring, in particular that it is wired correctly. 3. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts 4. Replace the control unit if the error continues to occur.
523205	3	Current output driver 2 (AIM02) short to battery	Limp Home	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too high. 1. Wiring or plug connection contacts battery voltage. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523205	5	Current output driver 2 (AIM02) open circuit	Limp Home	The measured line resistance between the connected component and the control unit is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523205	6	Current output driver 2 (AIM02) short to ground	TCU Shutdown	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523205	8	Current output driver 2 (AIM02) short circuit to another valve	Trm Shutdown	The measured line resistance between the proportional valve and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts another proportional valve. 2. Proportional valve has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Check if the error occurs with an additional proportional valve or with which valve the error is bypassed. 3. Check the wiring between the proportional valve and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Switch the ignition off, unplug the control unit, and measure the resistance of the proportional valve using

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					a terminal tester. 5. Check the function of the proportional valve and replace it if needed. 6. Replace the control unit if the error continues to occur.
523210	2	Current output driver 3 (AIM03) unknown electrical component	Trm Shutdown	If this error occurs, then an electrical component has been connected at the output although the input should not be used.	1. Using the circuit diagram, check if a component is assigned to the output. 2. Check the wiring, in particular that it is wired correctly. 3. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts 4. Replace the control unit if the error continues to occur.
523210	3	Current output driver 3 (AIM03) short to battery	Limp Home	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too high. 1. Wiring or plug connection contacts battery voltage. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523210	5	Current output driver 3 (AIM03) open circuit	Limp Home	The measured line resistance between the connected component and the control unit is too high. 1. Wiring or plug connection is defective.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				2. Component has an internal defect. 3. Control unit has an internal defect.	using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523210	6	Current output driver 3 (AIM03) short to ground	TCU Shutdown	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523210	8	Current output driver 3 (AIM03) short circuit to another valve	Trm Shutdown	The measured line resistance between the proportional valve and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts another proportional valve. 2. Proportional valve has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Check if the error occurs with an additional proportional valve or with which valve the error is bypassed. 3. Check the wiring between the proportional valve and the control unit, in particular with regard to defective plug connections such as corroded or defective plug connections such as corroded or damaged plug contacts.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					4. Switch the ignition off, unplug the control unit, and measure the resistance of the proportional valve using a terminal tester. 5. Check the function of the proportional valve and replace it if needed. 6. Replace the control unit if the error continues to occur.
523215	2	Current output driver 4 (AIM04) unknown electrical component	Trm Shutdown	If this error occurs, then an electrical component has been connected at the output although the input should not be used.	1. Using the circuit diagram, check if a component is assigned to the output. 2. Check the wiring, in particular that it is wired correctly. 3. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts 4. Replace the control unit if the error continues to occur.
523215	3	Current output driver 4 (AIM04) short to battery	Limp Home	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too high. 1. Wiring or plug connection contacts battery voltage. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523215	5	Current output driver 4 (AIM04) open circuit	Limp Home	The measured line resistance between the connected component and the control unit is too	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523215	6	Current output driver 4 (AIM04) short to ground	TCU Shutdown	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523215	8	Current output driver 4 (AIM04) short circuit to another valve	Trm Shutdown	The measured line resistance between the proportional valve and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts another proportional valve. 2. Proportional valve has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Check if the error occurs with an additional proportional valve or with which valve the error is bypassed. 3. Check the wiring between the proportional valve and the control unit, in particular with regard to

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				3. Control unit has an internal defect.	defective plug connections such as corroded or damaged plug contacts. 4. Switch the ignition off, unplug the control unit, and measure the resistance of the proportional valve using a terminal tester. 5. Check the function of the proportional valve and replace it if needed. 6. Replace the control unit if the error continues to occur.
523220	2	Current output driver 5 (AIM05) unknown electrical component	Trm Shutdown	If this error occurs, then an electrical component has been connected at the output although the input should not be used.	1. Using the circuit diagram, check if a component is assigned to the output. 2. Check the wiring, in particular that it is wired correctly. 3. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts 4. Replace the control unit if the error continues to occur.
523220	3	Current output driver 5 (AIM05) short to battery	Limp Home	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too high. 1. Wiring or plug connection contacts battery voltage. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
523220	5	Current output driver 5 (AIM05) open circuit	Limp Home	The measured line resistance between the connected component and the control unit is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523220	6	Current output driver 5 (AIM05) short to ground	TCU Shutdown	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523220	8	Current output driver 5 (AIM05) short circuit to another valve	Trm Shutdown	The measured line resistance between the proportional valve and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts another	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Check if the error occurs with an additional proportional valve or with which valve the error is bypassed.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				proportional valve. 2. Proportional valve has an internal defect. 3. Control unit has an internal defect.	3. Check the wiring between the proportional valve and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Switch the ignition off, unplug the control unit, and measure the resistance of the proportional valve using a terminal tester. 5. Check the function of the proportional valve and replace it if needed. 6. Replace the control unit if the error continues to occur.
523225	2	Current output driver 6 (AIM06) unknown electrical component	Trm Shutdown	If this error occurs, then an electrical component has been connected at the output although the input should not be used.	1. Using the circuit diagram, check if a component is assigned to the output. 2. Check the wiring, in particular that it is wired correctly. 3. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts 4. Replace the control unit if the error continues to occur.
523225	3	Current output driver 6 (AIM06) short to battery	Limp Home	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too high. 1. Wiring or plug connection contacts battery voltage. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					5. Replace the control unit if the error continues to occur.
523225	5	Current output driver 6 (AIM06) open circuit	Limp Home	The measured line resistance between the connected component and the control unit is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523225	6	Current output driver 6 (AIM06) short to ground	TCU Shutdown	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523225	8	Current output driver 6 (AIM06) short circuit to another valve	Trm Shutdown	The measured line resistance between the proportional valve and the control unit is too high or the voltage on the control unit output is	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Check if the error occurs with an additional

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				too low. 1. Wiring or plug connection contacts another proportional valve. 2. Proportional valve has an internal defect. 3. Control unit has an internal defect.	proportional valve or with which valve the error is bypassed. 3. Check the wiring between the proportional valve and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Switch the ignition off, unplug the control unit, and measure the resistance of the proportional valve using a terminal tester. 5. Check the function of the proportional valve and replace it if needed. 6. Replace the control unit if the error continues to occur.
523230	2	Current output driver 7 (AIM07) unknown electrical component	Trm Shutdown	If this error occurs, then an electrical component has been connected at the output although the input should not be used.	1. Using the circuit diagram, check if a component is assigned to the output. 2. Check the wiring, in particular that it is wired correctly. 3. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts
523230	3	Current output driver 7 (AIM07) short to battery	Limp Home	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too high. 1. Wiring or plug connection contacts battery voltage. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					5. Replace the control unit if the error continues to occur.
523230	5	Current output driver 7 (AIM07) open circuit	Limp Home	The measured line resistance between the connected component and the control unit is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523230	6	Current output driver 7 (AIM07) short to ground	TCU Shutdown	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too low. 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 3. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Check the function of the connected component and replace it if needed. 5. Replace the control unit if the error continues to occur.
523230	8	Current output driver 7 (AIM07) short circuit to another valve	Trm Shutdown	The measured line resistance between the proportional valve and the control unit is too high or the voltage on the control unit output is	1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. 2. Check if the error occurs with an additional

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				too low. 1. Wiring or plug connection contacts another proportional valve. 2. Proportional valve has an internal defect. 3. Control unit has an internal defect.	proportional valve or with which valve the error is bypassed. 3. Check the wiring between the proportional valve and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 4. Switch the ignition off, unplug the control unit, and measure the resistance of the proportional valve using a terminal tester. 5. Check the function of the proportional valve and replace it if needed. 6. Replace the control unit if the error continues to occur.
523280	3	Digital current output driver 1 (ADM1) short to battery	Trm Shutdown	TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage cable is defective and is contacted to battery voltage device has an internal defect connector pin is contacted to battery voltage	check the cable from TCU to the device at ADM1 check the connectors check the resistance of the device at ADM1
523280	5	Digital current output driver 1 (ADM1) open circuit	Trm Shutdown	TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin cable is defective and has no connection to TCU device has an internal defect connector has no connection to TCU	check the cable from TCU to the device at ADM1 check the connectors check the resistance of the device at ADM1
523280	6	Digital current output driver 1 (ADM1) short to ground	Trm Shutdown	TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground cable is defective and is contacted to vehicle ground device has an internal defect connector pin is contacted to vehicle ground	check the cable from TCU to the device at ADM1 check the connectors check the resistance of the device at ADM1
523280	12	Digital current output driver 1 (ADM1) defect	Trm Shutdown	TCU detected overtemperature or an internal error at the digital output	Change TCU
523281	3	Digital current output	Trm Shutdown	TCU detected a wrong voltage at the output pin,	check the cable from TCU to the device at ADM2 check

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
		driver 2 (ADM2) short to battery		that looks like a s.c. to battery voltage cable is defective and is contacted to battery voltage device has an internal defect connector pin is contacted to battery voltage	the connectors check the resistance of the device at ADM2
523281	5	Digital current output driver 2 (ADM2) open circuit	Trm Shutdown	TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin cable is defective and has no connection to TCU device has an internal defect connector has no connection to TCU	check the cable from TCU to the device at ADM2 check the connectors check the resistance of the device at ADM2
523281	6	Digital current output driver 2 (ADM2) short to ground	Trm Shutdown	TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground cable is defective and is contacted to vehicle ground device has an internal defect connector pin is contacted to vehicle ground	check the cable from TCU to the device at ADM2 check the connectors check the resistance of the device at ADM2
523281	12	Digital current output driver 2 (ADM2) defect	Trm Shutdown	TCU detected overtemperature or an internal error at the digital output	Change TCU
523145	3	Resistance sensor input 2 (ER2) open circuit or short to high source: Torque converter temperature	Normal	The measured line resistance between the connected component and the control unit is too high. 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect.	1. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 2. Check the wiring between the connected component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the function of the connected component and replace it if needed. 4. Replace the control unit if the error continues to occur.
523145	6	Resistance sensor input 2 (ER2) short to ground: Torque converter temperature	Normal	The measured line resistance between the connected component and the control unit is too high or the voltage on the control unit output is too low.	1. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 2. Check the wiring between the connected

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect 3. Control unit has an internal defect.	component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 3. Check the function of the connected component and replace it if needed. 4. Replace the control unit if the error continues to occur.
523125	3	Voltage sensor input 1 (EU1) overvoltage	Limp Home	The measured voltage at the sensor input 1 is too high: cable is defective and is contacted to battery voltage clutch cut off / inch pedal sensor has an internal defect connector pin is contacted to battery voltage	check the cable from TCU to the sensor check the connectors check the sensor
523125	6	Voltage sensor input 1 (EU1) open or short to ground	Limp Home	The measured voltage at the sensor input 1 is too low: cable is defective and is contacted to vehicle ground cable has no connection to TCU clutch cut off / inch pedal sensor has an internal defect connector pin is contacted to vehicle ground or is broken	check the cable from TCU to the sensor check the connectors check the sensor
523125	12	Voltage sensor input 1 (EU1) defect	Limp Home	The measured voltage from sensor output signal 1 and output signal 2 don’t match or are out of range. 1. Cable is defective 2. Sensor has an internal defect	check the cable from TCU to the sensor check the connectors check the sensor
523023	3	Supply for temperature sensors (AU_ER) overvoltage	Limp Home	The measured voltage is too high. 1. Wiring or plug connection is defective. 2. Sensor has an internal defect.	The cause of the incorrect voltage must be located. 1. Check the wiring, in particular with regard to defective plug connections such as corroded or

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				3, Control unit has an internal defect.	damaged plug contacts. 2. Check the correct wiring of the pins. 3. Check the function of the sensor or replace the sensor. 4. Replace the control unit if the error continues to occur.
523023	4	Supply for temperature sensors (AU_ER) undervoltage	Limp Home	The measured voltage is too low. 1. Wiring or plug connection is defective. 2. Sensor has an internal defect. 3. Control unit has an internal defect.	The cause of the incorrect voltage must be located. 1. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the correct wiring of the pins. 3. Check the function of the sensor or replace the sensor. 4. Replace the control unit if the error continues to occur.
523130	3	Voltage sensor input 2 (EU2) overvoltage	Limp Home	The measured voltage at the sensor input 2 is too high: cable is defective and is contacted to battery voltage clutch cut off / inch pedal sensor has an internal defect connector pin is contacted to battery voltage	check the cable from TCU to the sensor check the connectors check the sensor
523130	6	Voltage sensor input 2 (EU2) open or short to ground	Limp Home	The measured voltage at the sensor input 2 is too low: cable is defective and is contacted to vehicle ground cable has no connection to TCU clutch cut off / inch pedal sensor has an internal defect connector pin is contacted to vehicle ground or is broken	1. Check the cable from TCU to the sensor 2. Check the connectors 3. Check the sensor

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
523130	12	Voltage sensor input 2 (EU2) defect	Limp Home	The measured voltage from sensor output signal 1 and output signal 2 don't match or are out of range. 1. Cable is defective 2. Sensor has an internal defect	1. Check the cable from TCU to the sensor 2. Check the connectors 3. Check the sensor
523050	0	Internal TCU Error 6	TCU Shutdown		
523047	12	Internal TCU Error 3	TCU Shutdown	The control unit detects an internal error.	Read out the operating data with Testman and send them to your ZF contact.
523300	0	Transmission sump oil most severe overtemperature	Normal	The measured temperature in the oil sump of the transmission is too high. 1. The oil level is incorrect. 2. The cooling system is faulty. 3. Load is permanently too high.	The cause of the increased temperature input in the transmission must be located. 1. Check the oil level and correct it as needed. 2. Check the function of the cooler fan. 3. Check the transmission oil cooler for contaminants and damage. 4. Check the connection lines from the transmission to the transmission oil cooler for damage. 5. Check the transmission oil temperature using the diagnosis unit. If the measured oil temperature does not drop when the vehicle is operated at idle even after a longer period of time, then the temperature sensor needs to be replaced.
523300	16	Transmission sump oil moderately severe overtemperature	Normal	The measured temperature in the oil sump of the transmission is too high. 1. The oil level is incorrect. 2. The cooling system is faulty. 3. Load is permanently too high.	The cause of the increased temperature input in the transmission must be located. 1. Check the oil level and correct it as needed. 2. Check the function of the cooler fan. 3. Check the transmission oil cooler for contaminants and damage. 4. Check the connection lines from the transmission to the transmission oil cooler for damage. 5. Check the transmission oil temperature using the diagnosis unit. If the measured oil temperature does

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					not drop when the vehicle is operated at idle even after a longer period of time, then the temperature sensor needs to be replaced.
523305	0	Oil Filter contaminated	Normal	1. Filter clogged. 2. Sensor has an internal defect.	If this error occurs while driving, then remain at a standstill, switch the ignition off, then on again and wait another 40 seconds. 1. Replace the filter. 2. Check the wiring of the switch, in particular with regard to defective plug connections such as corroded or damaged plug contacts.
523310	0	Transmission input torque too high	Normal	The control unit receives a transmission input torque via the CAN bus that exceeds the permissible maximum. 1. Engine torque too high. 2. CAN bus signal is faulty.	1. Reduce the applied engine torque. 2. If this error continues to occur, please contact your vehicle manufacturer.
523311	0	Transmission input power too high	Normal	TCU calculates an transmission input power above the defined thresholds	engine controller may ignore Torque or speedlimit command from TCU via TSC1 message
523320	15	Transmission output speed too high	Normal	The speed at the transmission output exceeds the permissible maximum.	The speed at the transmission output exceeds the permissible maximum.
523330	15	Transmission input speed too high	Trm Shutdown	The speed at the transmission input exceeds the permissible maximum.	Reduce the engine speed. In order to prevent long-term damage, stay within the permissible speed range.
523340	0	Transmission output torque too high	Trm Shutdown	The control unit calculates a torque at the transmission output that exceeds the permissible maximum. 1. Engine torque too high.	Reduce the applied engine torque.
523360	9	Clutch adjustment data invalid	Normal	The clutch calibration was not performed.	Perform the clutch calibration.
523361	13	Clutch calibration process failed	TCU Shutdown	The clutch calibration did fail	Check oil level and run calibration again.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
523400	9	Vehicle CAN failure	Trm Shutdown	An electrical error exists on the vehicle CAN bus. 1. Malfunction on the CAN bus. 2. ZF control unit has an internal defect.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error. Check the following points only when the error is active. 1. Check the CAN connection for interruptions, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Replace the ZF control unit. 3. Check the terminating resistor of the CAN connection (CAN 1). Using an ohmmeter, also determine the resistance on the control unit and on the adapter when the ignition is off. The resistance value must be 120 Ohm ± 10 Ohm for each. 4. If this error continues to occur, please contact the vehicle manufacturer.
523402	9	ECU connection loss	Limp Home	The control unit no longer transfers any information. 1. Engine control unit has an internal defect.	The cause of the missing connection must be located. 1. If error vehicle can failure occurs, then repair this first. 2. If this error continues to be active, please contact your vehicle manufacturer.
523403	9	VCU connection loss	Trm Shutdown	No communication to the Vehicle Controller	Check CAN Connection, check source Adress of the VCU
523405	9	I/O-Extension connection loss	Trm Shutdown	The extension no longer transfers any information. 1. I/O extension has an internal defect.	The cause of the missing connection must be located. 1. If error vehicle can failure occurs, then repair this first. 2. If this error continues to be active, please contact your appropriate ZF service partner.
523411	9	Message ZFTC1 invalid or timeout	Trm Shutdown	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error or an excessive bus load. 1. If error VCU Connection loss occurs, then repair this

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	first. 2. If this error continues to be active, please contact your vehicle manufacturer.
523413	9	Message EEC1 invalid or timeout	Limp Home	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded. 3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error or an excessive bus load. 1. If error ECU Connection lost occurs, then repair this first. 2. If this error continues to be active, please contact your vehicle manufacturer.
523414	9	Message EEC2 invalid or timeout	Limp Home	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded. 3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error or an excessive bus load. 1. If error ECU Connection lost occurs, then repair this first. 2. If this error continues to be active, please contact your vehicle manufacturer.
523415	9	Message EEC3 invalid or timeout	Limp Home	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded. 3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error or an excessive bus load. 1. If error ECU Connection lost occurs, then repair this first. 2. If this error continues to be active, please contact your vehicle manufacturer.
523416	9	Message EC1 invalid or timeout	Limp Home	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded. 3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error or an excessive bus load. 1. If error ECU Connection lost occurs, then repair this first. 2. If this error continues to be active, please contact your vehicle manufacturer.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
523417	9	Message B invalid or timeout	Normal	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded. 3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error or an excessive bus load. 1. If error VCU connection lost occurs, then repair this first. 2. If this error continues to be active, please contact your vehicle manufacturer.
523418	9	Message EBC1 invalid or timeout	Normal	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded. 3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	1. If error VCU connection lost occurs, then repair this first. 2. If this error continues to be active, please contact your vehicle manufacturer.
523419	9	Signal actual engine torque or signal engine speed (EEC1) are defective	Limp Home	One or more signals of the messages from engine controller contains faulty data. 1. Incorrect software on the transmission control unit. 2. Incorrect software on the engine controller.	1. Check the software version of the transmission control unit and program the current software version if required. 2. If this error continues to occurs, please contact your vehicle manufacturer.
523420	9	Message CCVS invalid or timeout	Normal	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded. 3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error or an excessive bus load. 1. If error Vehicle CAN error occurs, then repair this first. 2. If this error continues to be active, please contact your vehicle manufacturer.
523426	9	Message JBERC1 invalid or timeout	Limp Home	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded. 3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error or an excessive bus load. 1. If error Vehicle CAN error occurs, then repair this first. 2. If this error continues to be active, please contact

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					HCE.
523427	9	Message JBRC invalid or timeout	Limp Home	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded. 3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error or an excessive bus load. 1. If error Vehicle CAN error occurs, then repair this first. 2. If this error continues to be active, please contact HCE.
523470	19	Operation Mode command invalid	Trm Shutdown	The operating mode assigned by the vehicle control unit is invalid for the transmission. 1. Incorrect software on the transmission control unit. 2. Incorrect software on the vehicle computer.	1. Check the software version of the transmission control unit and program the current software version if required. 2. If this error continues to occurs, please contact HCE.
523471	19	Transmission command invalid	Trm Shutdown	The transmission mode assigned by the vehicle control unit is invalid for the transmission. 1. Incorrect software on the transmission control unit. 2. Incorrect software on the vehicle computer.	1. Check the software version of the transmission control unit and program the current software version if required. 2. If this error continues to occurs, please contact HCE.
523480	9	Machine configuration invalid	TCU Shutdown	The startup handshake has not been successful.	Check version of vehicle controller (it has to support handshaking).
523481	0	Testmode requested but conditions not complied	Trm Shutdown	The conditions for Testmode are not fulfilled	Take back the test mode request, set the conditions to the allowed thresholds and request the Test Mode again
523500	0	Overspeed engine	Normal	The control unit receives an engine speed via the CAN bus that exceeds the permissible maximum. 1. Engine speed too high. 2. CAN bus signal is faulty.	1. Reduce the engine speed. 2. If this error continues to occur, please contact your vehicle manufacturer. Note: In order to prevent permanent damage, stay within the permissible speed range.
523501	0	Engine speed limit request does not take effect	Normal	The transmission control unit requires a limited engine speed; the engine does not maintain the limit;	If this error continues to be active, please contact HCE.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
523502	0	Engine speed control request does not take effect	Normal	The transmission control unit requires a certain engine speed; the engine controller does not set this speed;	If this error continues to be active, please contact HCE.
523503	0	Engine torque limit request does not take effect	Normal	The transmission control unit requires a limited engine torque; the engine does not maintain the limit;	If this error continues to be active, please contact HCE.
523504	0	Engine torque control request does not take effect	Normal	The transmission control unit requires a certain engine torque;the engine controller does not set this torque;	If this error continues to be active, please contact HCE.
523600	0	Protection related error detected	Trm Shutdown	The control unit detects a safety-relevant error.	Read out the operating data with Testman and send them to your ZF contact.
523600	1	Protection Function 1 (SF01) Unwanted driveaway	TCU Shutdown	Unexpected vehicle movement detected	Read out the operating data with Testman and send them to your ZF contact.
523600	2	Protection Function 2 (SF02) Unwanted driving direction	Trm Shutdown	Driving in the wrong direction detected	Read out the operating data with Testman and send them to your ZF contact.
523600	3	Protection Function 3 (SF03) Safely limited acceleration (blocked Transmission)	Trm Shutdown	Transmission blocking detected	Read out the operating data with Testman and send them to your ZF contact.
523600	4	Protection Function 4 (SF04) Safely limited acceleration (Downshift)	Trm Shutdown	Unalowed speeds at transmission input detected	Read out the operating data with Testman and send them to your ZF contact.
523600	5	Protection Function 5 (SF05) Safe Output at reverse driving	Trm Shutdown	Wrong Reverse signal broadcasted	Read out the operating data with Testman and send them to your ZF contact.
523600	6	Protection Function 6 (SF06) Safely limited	Trm Shutdown	Unalowed speed or gear in Reverse detected	Read out the operating data with Testman and send them to your ZF contact.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
		speed in Reverse			
523600	7	Protection Function 7 (SF07) Unwanted direction change	Trm Shutdown	Unwanted change of driving direction detected	Read out the operating data with Testman and send them to your ZF contact.
523600	8	Protection Function 8 (SF08)	Trm Shutdown	Safely limited torque	Read out the operating data with Testman and send them to your ZF contact.
523600	9	Protection Function 9 (SF09) Safely limited torque	Trm Shutdown	Unalowed engine control request detected	Read out the operating data with Testman and send them to your ZF contact.
523600	10	Protection Function 10 (SF10) Delayed gear engagement	Trm Shutdown	Unalowed delayed get into gear detected	Read out the operating data with Testman and send them to your ZF contact.
523600	11	Protection Function 11 (SF11) Safe Difflock	Trm Shutdown	Unalowed Difflock acutation at too high speeds detected	Read out the operating data with Testman and send them to your ZF contact.
523600	12	Protection Function 12 (SF12) Safe Transmission Output Signals	TCU Shutdown	Safe Transmission Output	Read out the operating data with Testman and send them to your ZF contact.
523600	16	Protection Function 16 (SF16) Safe Inching Exit	TCU Shutdown	Safe Inchen Exit	Read out the operating data with Testman and send them to your ZF contact.
523600	18	Protection Function 18 (SF18) Safe Speedlimit	Trm Shutdown	Unallowed speed limit overrun	Read out the operating data with Testman and send them to your ZF contact.
523601	0	Protection related error in transmission detected	TCU Shutdown	The control unit detects a clutch shift although no gear change is requested. 1. Energization proportional valve faulty. 2. Proportional valve faulty. 3. Control unit has an internal defect.	1. Check the proportional valves. 2. If this error continues to occur, contact your ZF representative and give us the error code and the conditions under which the error occurs. Read out the operating data with Testman and send them to us.
523602	0	Protection related error in vehicle communication	TCU Shutdown	The control unit detects a faulty check sum, a faulty message counter, or a faulty requirement from the vehicle control unit.	1. Check if the TC1 CAN bus message is present. In addition, create a CAN bus measurement on the vehicle CAN.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
		detected		1. CAN bus message is faulty.	2. If this error continues to occur, please contact HCE.
523603	0	Protection error reaction failed	TCU Shutdown	The control unit requires that the internal supply voltage is switched off but this does not happen. 1. Control unit has an internal defect.	1. Replace the control unit.
523421	9	No response to request of Time and Date message	Normal	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded. 3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error or an excessive bus load. 1. If error Vehicle CAN error occurs, then repair this first. 2. If this error continues to be active, please contact your dealer.
523423	9	Message VehcCFG invalid or timeout	Trm Shutdown	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded. 3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error or an excessive bus load. 1. If error Vehicle CAN error occurs, then repair this first. 2. If this error continues to be active, please contact your dealer.
523424	9	Message CCSS or ZFCCSS invalid or timeout	Trm Shutdown	The control unit does not receive the CAN message or the message contains faulty data. 1. Sporadic electrical error. 2. CAN bus overloaded. 3. Sending control unit has an internal defect. 4. Receiving control unit has an internal defect.	If the control unit resets the error itself, then this is a matter of a sporadically occurring error or an excessive bus load. 1. If error Vehicle CAN error occurs, then repair this first. 2. If this error continues to be active, please contact your dealer.
523482	9	Application program verification failed	TCU Shutdown	The control unit does not receive the ZFVI or VI message or the message contains faulty data.	Read out the operating data with Testman and send them to your ZF contact.
523100	7	EF1 speed does not match with other speeds	Trm Shutdown	The control unit measures a speed at the input which does not agree with the other speeds. 1. Wiring or plug connection is defective.	The cause of the different speeds must be located. 1. Check the wiring from the speed sensor to the control unit, in particular with regard to defective plug

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				2. Wiring or plug connection has a poor contact. 3. Distance speed sensor – sensor ring too large. 4. Speed sensor has an internal defect.	connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523100	11	EF1 direction of rotation does not match with other directions of rotation	Limp Home	The control unit recognizes a rotational direction at the input, which does not agree with the other rotational directions. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance speed sensor – sensor ring too large. 4. Speed sensor has an internal defect.	The cause of the different rotational directions must be located. 1. Check the wiring from the sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523105	7	EF2 speed does not match with other speeds	Trm Shutdown	The control unit measures a speed at the input which does not agree with the other speeds. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance speed sensor – sensor ring too large. 4. Speed sensor has an internal defect.	The cause of the different speeds must be located. 1. Check the wiring from the speed sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523105	11	EF2 direction of rotation does not match with other directions of rotation	Limp Home	The control unit recognizes a rotational direction at the input, which does not agree with the other rotational directions. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance speed sensor – sensor ring too large. 4. Speed sensor has an internal defect.	The cause of the different rotational directions must be located. 1. Check the wiring from the sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523110	7	EF3 speed does not match with other speeds	Trm Shutdown	The control unit measures a speed at the input which does not agree with the other speeds. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance speed sensor – sensor ring too large. 4. Speed sensor has an internal defect.	The cause of the different speeds must be located. 1. Check the wiring from the speed sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary,

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					replace it.
523110	11	EF3 direction of rotation does not match with other directions of rotation	Trm Shutdown	The control unit recognizes a rotational direction at the input, which does not agree with the other rotational directions. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance speed sensor – sensor ring too large. 4. Speed sensor has an internal defect.	The cause of the different rotational directions must be located. 1. Check the wiring from the sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523115	7	EF4 speed does not match with other speeds	Limp Home	The control unit measures a speed at the input which does not agree with the other speeds. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance speed sensor – sensor ring too large. 4. Speed sensor has an internal defect.	The cause of the different speeds must be located. 1. Check the wiring from the speed sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523115	11	EF4 direction of rotation does not match with other directions of rotation	Normal	The control unit recognizes a rotational direction at the input, which does not agree with the other rotational directions. 1. Wiring or plug connection is defective. 2. Wiring or plug connection has a poor contact. 3. Distance speed sensor – sensor ring too large. 4. Speed sensor has an internal defect.	The cause of the different rotational directions must be located. 1. Check the wiring from the sensor to the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts. 2. Check the function of the sensor and, if necessary, replace it.
523302	0	Torque converter oil temperature critical	Normal	The measured oil temperature at the converter is too high. 1. The oil level is incorrect. 2. The cooling system is faulty. 3. Load is permanently too high.	The cause of the increased temperature at the converter must be located. 1. Check the oil level and correct it as needed. 2. Check the function of the cooler fan. 3. Check the transmission oil cooler for contaminants and damage. 4. Check the connection lines from the transmission to the transmission oil cooler for damage. 5. Check the transmission oil temperature using the

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
					diagnosis unit. If the measured oil temperature does not drop when the vehicle is operated at idle even after a longer period of time, then the temperature sensor needs to be replaced.
523302	16	Torque converter oil overtemperature	Normal	The measured oil temperature at the converter is too high. 1. The oil level is incorrect. 2. The cooling system is faulty. 3. Load is permanently too high.	The cause of the increased temperature at the converter must be located. 1. Check the oil level and correct it as needed. 2. Check the function of the cooler fan. 3. Check the transmission oil cooler for contaminants and damage. 4. Check the connection lines from the transmission to the transmission oil cooler for damage. 5. Check the transmission oil temperature using the diagnosis unit. If the measured oil temperature does not drop when the vehicle is operated at idle even after a longer period of time, then the temperature sensor needs to be replaced.
523450	19	Engine reference torque signal invalid	Limp Home	Signal 'Engine Reference Torque from engine controller contains faulty data. 1 .Incorrect software on the transmission control unit. 2. Incorrect software on the engine controller.	1.Check the software version of the transmission control unit and program the current software version if required. 2.If this error continues to occurs, please contact HCE.
523451	19	Actual engine torque signal invalid	Limp Home	Signal 'Actual Engine Torque' from engine controller contains faulty data. 1 .Incorrect software on the transmission control unit. 2. Incorrect software on the engine controller.	1.Check the software version of the transmission control unit and program the current software version if required. 2.If this error continues to occurs, please contact HCE.
523452	19	Engine nominal friction torque signal invalid	Normal	Signal 'Engine Nominal Friction Torque' from engine controller contains faulty data. 1 .Incorrect software on the transmission control unit.	1.Check the software version of the transmission control unit and program the current software version if required. 2.If this error continues to occurs, please contact your

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				2. Incorrect software on the engine controller.	HCE.
523454	19	Launch gear request invalid	Normal	Signal ‘Requested Launch Gear’ from vehicle controller contains faulty data. 1 .Incorrect software on the transmission control unit. 2. Incorrect software on the vehicle controller.	1.Check the software version of the transmission control unit and program the current software version if required. 2.If this error continues to occurs, please contact HCE.
523455	19	Message ZFSL1 invalid or timed out	Trm Shutdown	Shift Lever message is missing or provides wrong signals	Check CAN Bus, Check Shift Lever
523456	19	Invalid FNR extension switches signal	Trm Shutdown	Invalid output signals from FNR switch	Check Shift Lever, FNR switch
523650	0	Neutral selected while vehicle moves with overspeed	Normal	Shift Lever message is missing or provides wrong signals	Check CAN Bus, Check Shift Lever
523700	0	Clutch K1 slipping unintendedly	Limp Home	The TCU calculates a speed difference although the clutch is closed. If this value is too high, it is interpreted as slip on the clutch. 1. Insufficient pressure on the clutch. 2. Insufficient system pressure. 3. Filter clogged. 4. Clutch faulty. 5. Transmission input speed signal faulty. 6. Transmission output speed signal faulty. 7. Distance speed sensor – sensor ring too large. 8. Significant oscillation of the engine speed.	The cause of the occurring speed difference must be located. 1. Check the existing system pressure. 2. Check the filter and replace it if needed (compare error 195). 3. Check the function of the clutch. 4. Check the function of the proportional valves and replace them if needed. 5. Check if all speeds are present and correct. 6. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts.
523705	0	Clutch K2 slipping unintendedly	Limp Home	The TCU calculates a speed difference although the clutch is closed. If this value is too high, it is interpreted as slip on the clutch. 1. Insufficient pressure on the clutch. 2. Insufficient system pressure. 3. Filter clogged.	The cause of the occurring speed difference must be located. 1. Check the existing system pressure. 2. Check the filter and replace it if needed (compare error 195). 3. Check the function of the clutch.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				4. Clutch faulty. 5. Transmission input speed signal faulty. 6. Transmission output speed signal faulty. 7. Distance speed sensor – sensor ring too large. 8. Significant oscillation of the engine speed.	4. Check the function of the proportional valves and replace them if needed. 5. Check if all speeds are present and correct. 6. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts.
523710	0	Clutch K3 slipping unintendedly	Limp Home	The TCU calculates a speed difference although the clutch is closed. If this value is too high, it is interpreted as slip on the clutch. 1. Insufficient pressure on the clutch. 2. Insufficient system pressure. 3. Filter clogged. 4. Clutch faulty. 5. Transmission input speed signal faulty. 6. Transmission output speed signal faulty. 7. Distance speed sensor – sensor ring too large. 8. Significant oscillation of the engine speed.	The cause of the occurring speed difference must be located. 1. Check the existing system pressure. 2. Check the filter and replace it if needed (compare error 195). 3. Check the function of the clutch. 4. Check the function of the proportional valves and replace them if needed. 5. Check if all speeds are present and correct. 6. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts.
523715	0	Clutch KV slipping unintendedly	Limp Home	The TCU calculates a speed difference although the clutch is closed. If this value is too high, it is interpreted as slip on the clutch. 1. Insufficient pressure on the clutch. 2. Insufficient system pressure. 3. Filter clogged. 4. Clutch faulty. 5. Transmission input speed signal faulty. 6. Transmission output speed signal faulty. 7. Distance speed sensor – sensor ring too large. 8. Significant oscillation of the engine speed.	The cause of the occurring speed difference must be located. 1. Check the existing system pressure. 2. Check the filter and replace it if needed (compare error 195). 3. Check the function of the clutch. 4. Check the function of the proportional valves and replace them if needed. 5. Check if all speeds are present and correct. 6. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts.
523720	0	Clutch K4 slipping	Limp Home	The TCU calculates a speed difference although	The cause of the occurring speed difference must be

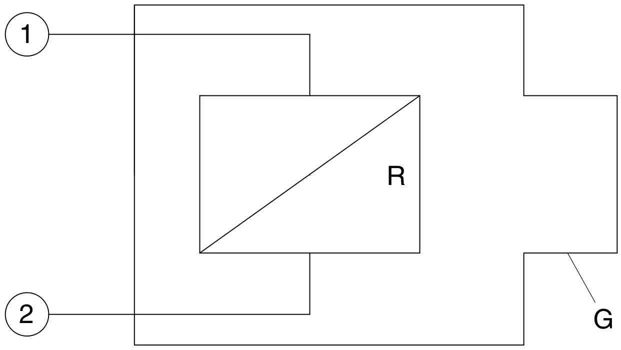
SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
		unintendedly		the clutch is closed. If this value is too high, it is interpreted as slip on the clutch. 1. Insufficient pressure on the clutch. 2. Insufficient system pressure. 3. Filter clogged. 4. Clutch faulty. 5. Transmission input speed signal faulty. 6. Transmission output speed signal faulty. 7. Distance speed sensor – sensor ring too large. 8. Significant oscillation of the engine speed.	located. 1. Check the existing system pressure. 2. Check the filter and replace it if needed (compare error 195). 3. Check the function of the clutch. 4. Check the function of the proportional valves and replace them if needed. 5. Check if all speeds are present and correct. 6. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts.
523725	0	Clutch KR slipping unintendedly	Limp Home	The TCU calculates a speed difference although the clutch is closed. If this value is too high, it is interpreted as slip on the clutch. 1. Insufficient pressure on the clutch. 2. Insufficient system pressure. 3. Filter clogged. 4. Clutch faulty. 5. Transmission input speed signal faulty. 6. Transmission output speed signal faulty. 7. Distance speed sensor – sensor ring too large. 8. Significant oscillation of the engine speed.	The cause of the occurring speed difference must be located. 1. Check the existing system pressure. 2. Check the filter and replace it if needed (compare error 195). 3. Check the function of the clutch. 4. Check the function of the proportional valves and replace them if needed. 5. Check if all speeds are present and correct. 6. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts.
523730	0	LUC slipping unintendedly	Normal	The TCU calculates a speed difference although the clutch is closed. If this value is too high, it is interpreted as slip on the clutch. 1. Insufficient pressure on the clutch. 2. Insufficient system pressure. 3. Filter clogged. 4. Clutch faulty. 5. Transmission input speed signal faulty.	The cause of the occurring speed difference must be located. 1. Check the existing system pressure. 2. Check the filter and replace it if needed (compare error 195). 3. Check the function of the clutch. 4. Check the function of the proportional valves and replace them if needed.

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
				6. Transmission output speed signal faulty. 7. Distance speed sensor – sensor ring too large. 8. Significant oscillation of the engine speed.	5. Check if all speeds are present and correct. 6. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts.
523385	0	Upshift by engine overspeed not supported in limphome	Trm Shutdown	Normally an upshift would have been necessary to protect the motor due to the increased motor speed. Since no shift can be performed in mode Limp Home, transmission shifts to neutral instead.	Do not overspeed engine in Limp Home. Use service brakes.
523355	0	Clutch KV temperature critical	Trm Shutdown	Failure related to overheated clutch KV	1. Wait for 20s to cool down clutches 2. Train operator to avoid unnecessary direction changes
523356	0	Clutch KR temperature critical	Trm Shutdown	Failure related to overheated clutch KR	1. Wait for 20s to cool down clutches 2. Train operator to avoid unnecessary direction changes
523171	12	CCO or inch pedal signals missmatch	Normal	The measured voltage of CCO and CCO2 signals don't match or are out of range. Or received signals via CAN do not correlate. 1. Cable is defective 2. Sensor has an internal defect	1. Check the cable from TCU to the sensor 2. Check connectors 3. Check sensor
523171	13	Inchpedal calibration failed	Normal	TCU was not able to read correct inchpedal adjustment parameters 1. Interference during saving data on non volatile memory 2. TCU is brand new, the inchpedal calibration was not performed	Perform the inchpedal calibration process.
523118	11	More than one internal speed sensors are defective	Trm Shutdown	More than one internal speed sensor is not working properly. In this case limp home mode is not possible anymore.	1. Check transmission harness, cables between TCU and speed sensors 2. Check connectors 3. Check sensor

SPN	FMI	FaultDescription	OpMode	Cause	PossibleSteptoRepair
523431	19	Message ZFTC2 invalid or timed out	Trm Shutdown	ZFTC2 message is missing or provides wrong signals.	1. Check CAN bus 2. Check the software version of the transmission control unit and program the current software version if required. 3. If this error continues to occurs, please contact your vehicle manufacturer.
523432	19	Message ZFSL1_FNR invalid or timed out	Trm Shutdown	Shift Lever message is missing or provides wrong signals.	1. Check CAN bus 2. Check shift lever 3. Check the software version of the transmission control unit and program the current software version if required. 4. If this error continues to occurs, please contact your vehicle manufacturer.
523171	11	CCO or inch pedal signal fault during CCO or inching	Limp Home	A problem with the signals required for CCO or inching occured while the vehicle was in CCO or inching operation.	1. Check cable from TCU or the sensor 2. Check connectors 3. Check sensor

5) MEASURING OF RESISTANCE AT ACTUATOR/SENSOR AND CABLE

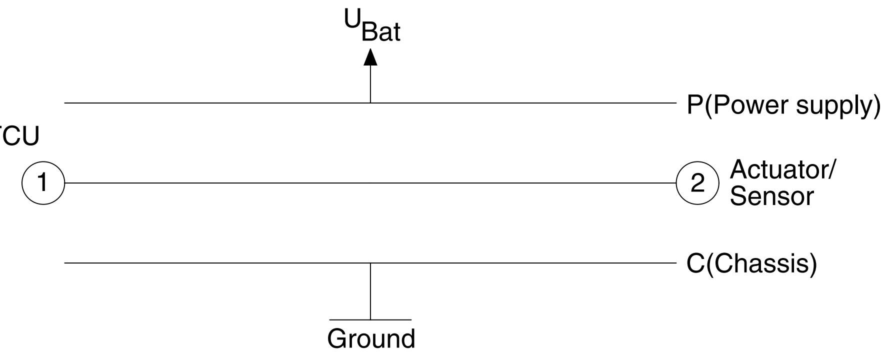
(1) Actuator



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	$R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = 0$

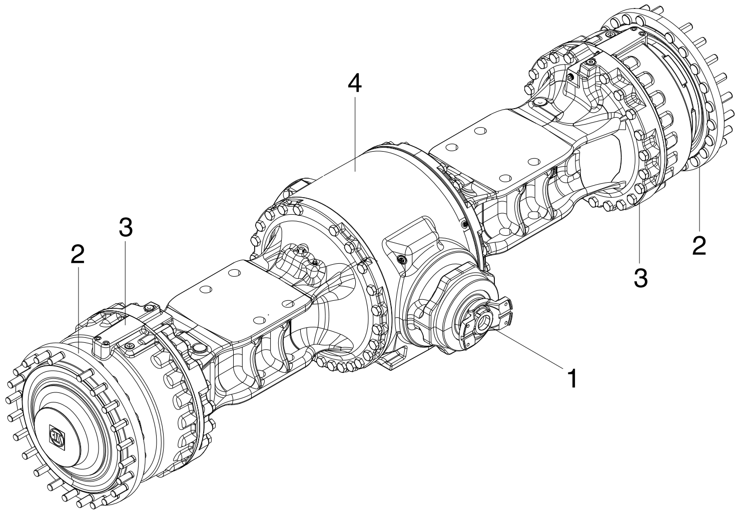
5. AXLE

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.

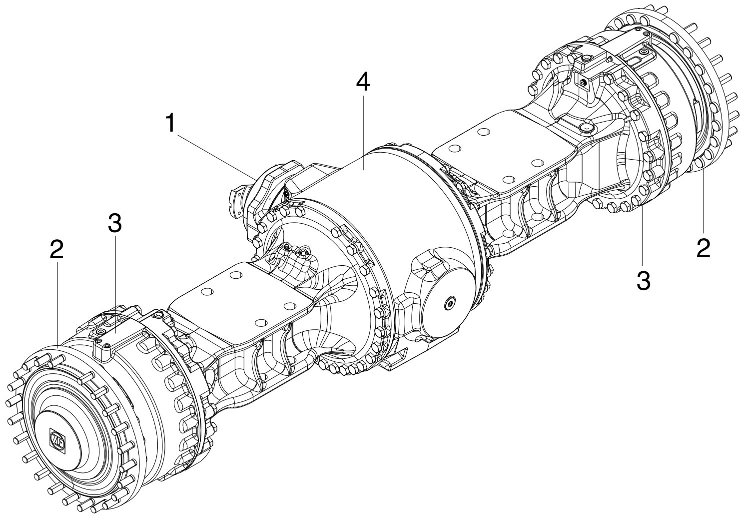
(1) Front axle



78093PT14

1	Input	2	Output	3	Brake
4	Axle housing				

(2) Rear axle



78093PT15

1	Input	2	Output	3	Brake
4	Axle housing				

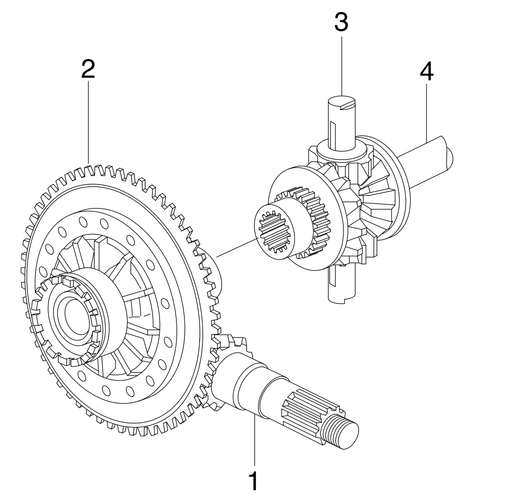
2) DIFFERENTIAL

(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 a 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 degree, and at the same time reduces the speed.

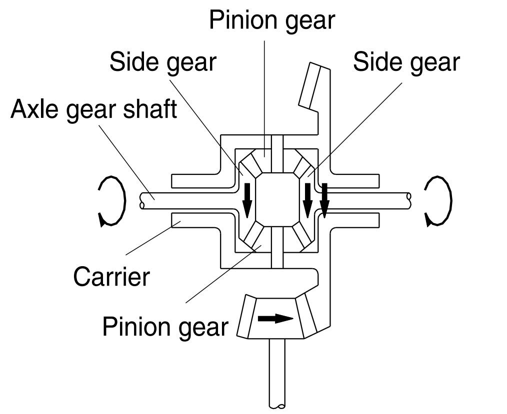
It then transmits the motive force through the differential (3) to the axle gear shaft (4).



770-3 [3-26(1)]

(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 send through the pinion gear and the side gear, therefore the power is equally transmitted to the left and right axle gear shaft.

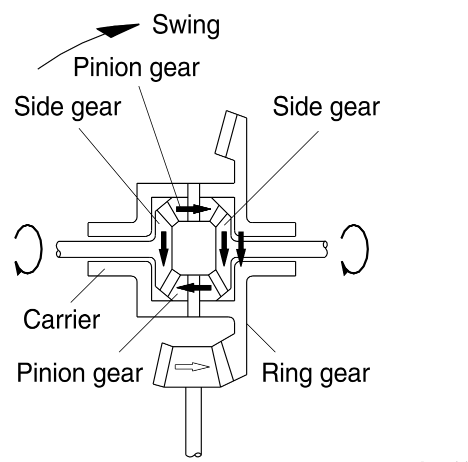


770-3 [3-26(2)]

(3) When turning

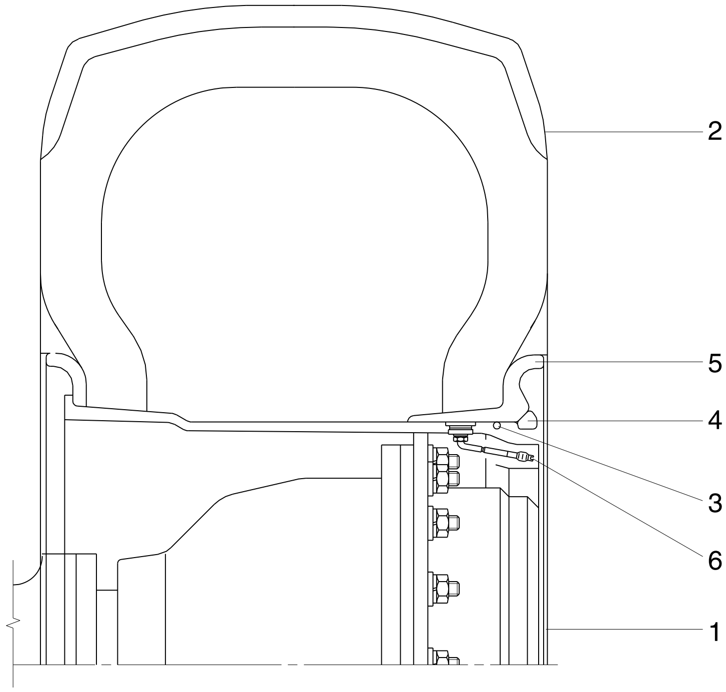
When turning, the rotating speed of the left and right wheels is different, so the pinion gear and side gear inside the differential assembly rotate in accordance with the difference between the rotating speed of the left and right wheels.

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



770-3 [3-26(3)]

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.

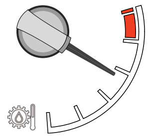
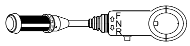
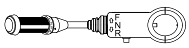
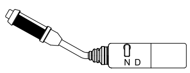
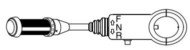
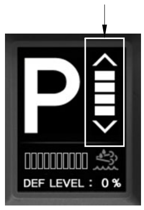
The engine and all other major components must be at operating temperature for some checks.

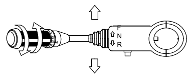
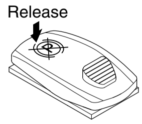
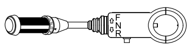
Locate system check in the left column and read completely, following the sequence from left to right. Read each check completely before performing.

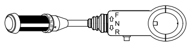
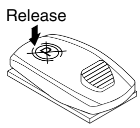
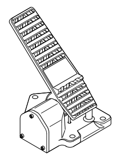
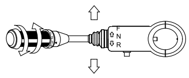
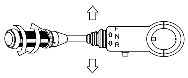
At the end of each check, if no problem is found(OK), that check is complete or an additional check is needed. If problem is indicated(NOT OK), you will be given repair required and group location.
If verification is needed, you will be given next best source of information :

Chapter 2 : Troubleshooting
Group 3 : Tests and adjustments

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

Item	Description		Service action
Transmission oil warm-up procedure	 MANUAL mode  	Start engine. Apply service brakes and release parking brake. Select T/M shift mode to MANUAL mode. Move gear selector lever to 3rd speed. Move gear selector lever to forward "F" position. Increase engine speed to high idle for 30 seconds. Move gear selector lever to neutral "N" position and run for 15 seconds. Repeat procedure until transmission temperature gauge arrow points to bar above dial.	OK Check completed.
Gear selector lever and neutral lock latch checks Engine OFF.	 	Move gear selector lever to each position. NOTE : Gear selector lever position changes slightly as steering column is tilted. FEEL : Lever must move freely through all positions. Engage neutral lock. Apply slight effort to move lever into forward (F) and reverse (R). LOOK : Neutral lock must stay engaged.	OK Check completed. NOT OK Repair lock or replace switch.
Automatic shifting check	 AL mode  Automatic mode 	Start engine. Move gear selector lever to 4th speed. Select T/M shift mode to AL (auto light) mode. LOOK : Automatic sign on cluster. Move gear selector lever to forward or reverse position. Increase engine rpm. LOOK : Speed on cluster must vary with machine speed.	OK Check completed. NOT OK Go to transmission fault code group at page 3-50~3-66-31. Repair or replace the monitor or harness.

Item	Description	Service action
Transmission noise check Engine running.	 Run engine at approximately 1600 rpm. Drive unit with transmission in each forward and reverse speed. LISTEN : Transmission must not make excessive noise in any range. Engine rpm must not "lug down" as unit is shifted between gears.	OK Check completed. NOT OK Go to transmission makes excessive noise, chapter 2 in this group.
Transmission "quick shift" check Engine running.	 MANUAL mode   AL mode  Release parking brake and select T/M shift mode to MANUAL mode. Shift to 2nd forward. Drive machine at approximately 5km/h and press gear selector lever kick down switch or RCV levers switch once. LOOK/FEEL : Transmission must shift to and remain in 1st gear. Press gear selector lever kick down switch once. LOOK/FEEL : Transmission must shift back to 2nd gear. Shift to (3rd or 4th) gear and press gear selector lever kick down switch once. LOOK/FEEL : Transmission must not shift down. Select T/M shift mode to AL (auto light) mode. Drive machine at approximately 90% speed of max speed in each gear (2nd or 3rd or 4th). 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. LOOK/FEEL : If shift down quickly from current gear to one step lower speed and recover to original speed quickly when push the switch one more time. (mode 1) If shifts down from current gear to one step lower speed when push the switch everytime and recover when push the switch in 1st gear. (mode 2)	OK Check completed. NOT OK Check connector at base of control valve. IF OK Go to transmission controller circuit in group 1.

Item	Description	Service action
Forward, reverse and 4th speed clutch pack drag check ※ Transmission must be warmed up for this check. Engine running.	   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.	OK Check completed. NOT OK If unit moves, repair transmission.
Transmission shift modulation check Engine running.	 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.	OK Check completed. NOT OK Go to unit shifts too fast, chapter 2 in this group.
Torque converter check	 Start engine. Apply service brakes and release parking brake. Move gear selector lever to 3rd speed. Move gear selector control lever to forward "F" position. Increase engine speed to high idle. LOOK : Torque converter stall rpm must be within the following range. Stall rpm : 2100±100 rpm Move gear selector control lever to neutral "N" position and run for 15 seconds.	OK Check completed. NOT OK If stall rpm are too low or too high, problem may be engine power or torque converter. IF OK Replace transmission torque converter.

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	Low oil level.	Add oil.
	Wrong oil grade.	Change oil.
	Restricted transmission pump suction screen.	Remove and clean screen.
	Leak in transmission control valve or gasket.	Remove valve and inspect gaskets.
	Low transmission pump flow due to worn pump.	Do transmission pump flow test.
	Weak or broken pressure regulating valve spring.	Do transmission system pressure test.
Error code on display	Something wrong in transmission.	Go to transmission fault code group at page 3-50~3-66-31.

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

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 (SAE 10W-30/15W-40)

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 (SAE 10W-30/15W-40).
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.	Check engine low idle speed.
	Worn parts or damaged in transmission.	Remove transmission suction screen. Inspect for metal particles. Repair as necessary.
	Warped drive line between engine and torque converter.	Inspect drive line.
	Low or no lube.	Do converter-out and lube pressure test. Do transmission pump flow test.
Foaming oil	Incorrect type of oil.	Change oil.
	High oil level.	Transmission overfilled or hydraulic pump seal leaking.
	Low oil level.	Add oil.
	Air leak on suction side of pump.	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.	Add oil.
	Low engine speed.	Check engine speed.
	Failed universal joints on transmission drive shaft or differential drive shafts.	Check universal joints.
Machine lacks power and acceleration	Engine high idle speed set too low.	Check high idle adjustment.
	Incorrect transmission oil.	Change oil.
	Aerated oil.	Add oil.
	Low transmission pressure.	Do transmission system pressure test.
	Warped transmission clutch.	Do transmission clutch drag checks.
	Torn transmission control valve gasket.	Inspect gasket.
	Brake drag.	Do brake drag check.
	Failed torque converter.	Do torque converter stall speed test.
	Low engine power.	Do engine power test.
Torque converter stall RPM too high	Aerated oil.	Put clear hose on thermal bypass outlet port. Run machine to check for bubbles in oil.
	Stuck open converter relief valve.	Do converter-out pressure test.
	Leakage in torque converter seal.	Do converter-out pressure test.
	Torque converter not transferring power (Bent fins, broken starter).	Replace torque converter.

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

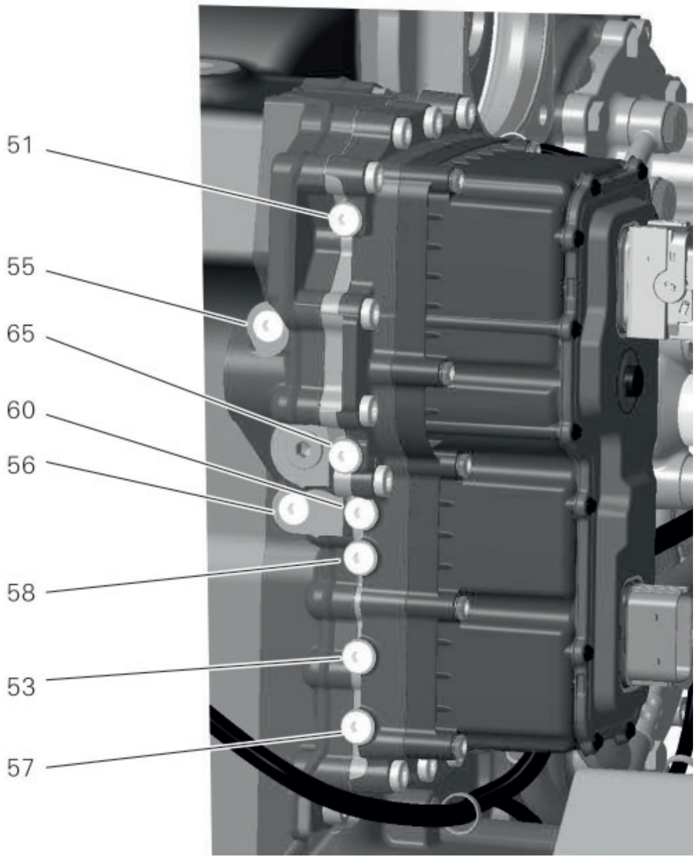
3) DRIVE LINE

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.

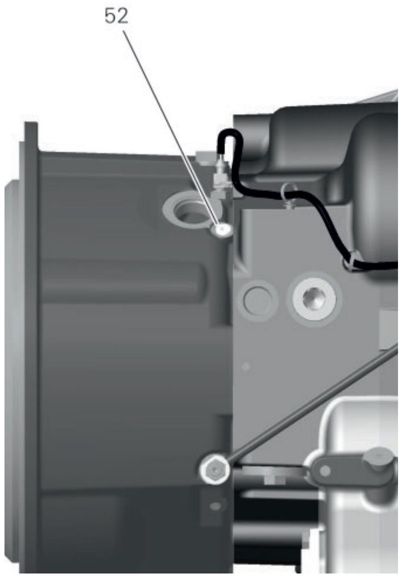
GROUP 3 TESTS AND ADJUSTMENTS

1. TRANSMISSION MEASURING POINTS AND CONNECTIONS

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



975T33PT14



975T33PT15

Port	Description	Size
51	Pressure before converter (maximum 9+2 bar)	M12×1.5
52	Pressure after converter (5 bar)	M12×1.5
53	Shift pressure clutch K4 (16+2 bar)	M12×1.5
55	Shift pressure clutch K1 (16+2 bar)	M12×1.5
56	Shift pressure clutch K2 (16+2 bar)	M12×1.5
57	Shift pressure clutch KR (16+2 bar)	M12×1.5
58	Shift pressure clutch K3 (16+2 bar)	M12×1.5
60	Shift pressure clutch KV (16+2 bar)	M12×1.5
65	System pressure (16+2.5 bar)	M12×1.5

1.TRANSMISSION

Preparatory Activities

Mounting transmission on assembly truck

Special tools:
- 5870.350.071 Clamping bracket
- 5870.350.000 Assembly truck

1\. ⚠ **WARNING**

Risk of injury due to uncontrolled motion of the load.
Death or serious injury possible.
- ⇨ Only use the suspension points intended for transportation purposes.
- ⇨ Only use secure, permitted, and tested means of transport, chain hoist, and lifting equipment with sufficient load capacity and suitable lifting technology.
- ⇨ Ensure that lifting equipment such as ropes and belts are not in contact with sharp edges and are not knotted or twisted.
- ⇨ Properly attach lifting appliances to load.
- ⇨ Observe the load's center of gravity! The crane hook must be located above the load's center of gravity.
- ⇨ Lift load slowly and observe whether the load tilts or swivels out laterally. If required, immediately put down load and modify attachment.
- ⇨ Keep distance.
- ⇨ Do not walk under suspended loads.
- ⇨ Only ever move load under supervision.

Fix the transmission with 5870.350.071 [Clamping bracket] to 5870.350.000 [Assembly truck].

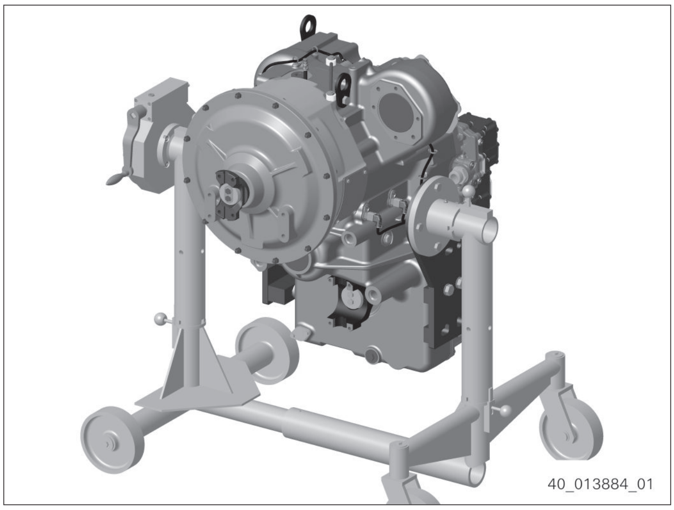


Fig. 21

Draining oil

⚠ Observe the environmental regulations *(refer to Section General safety instructions, page 8)*.

1. Loosen screw plug (1).

2. Loosen the screw plug (2) and drain oil.

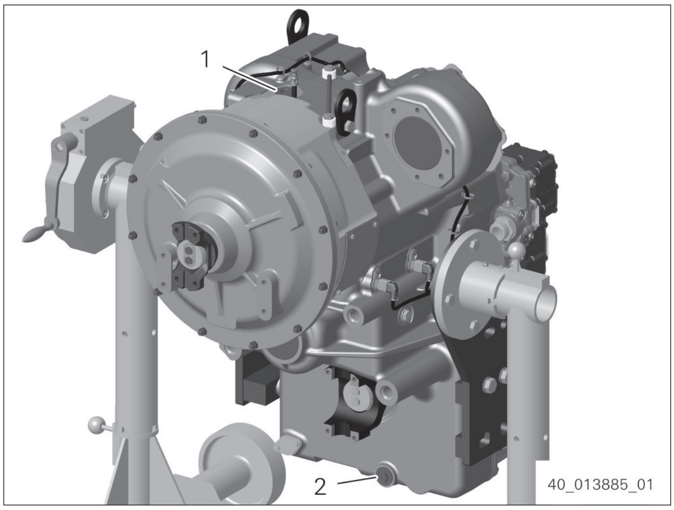


Fig. 22

Dismantling

Removing the pressure filters

1. Loosen the pressure filters (1)from the filter head.

2. Loosen the plunger switch (2).
   ※ The filter head is located near the transmission.

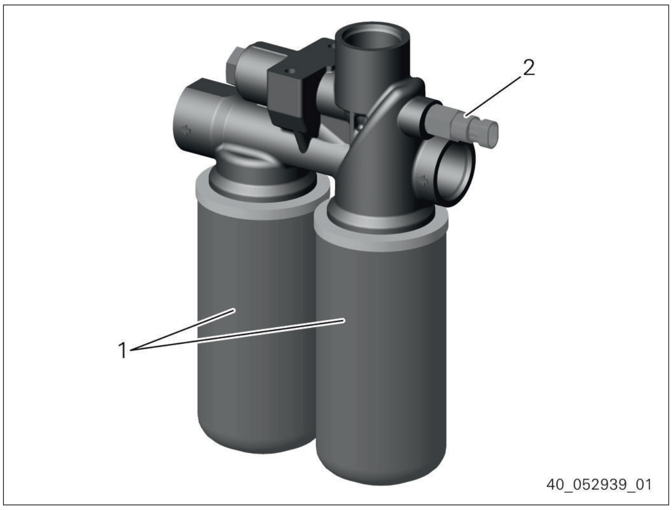


Fig. 23

Removing cover sheets (filler neck)

1. Loosen hexagon screws and remove cover sheet with seal (1).

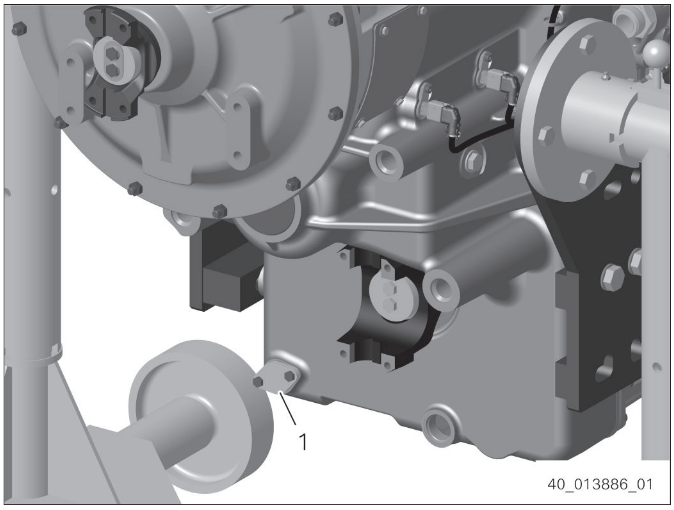


Fig. 24

2. Loosen hexagon screws and remove cover sheet with seal (1).

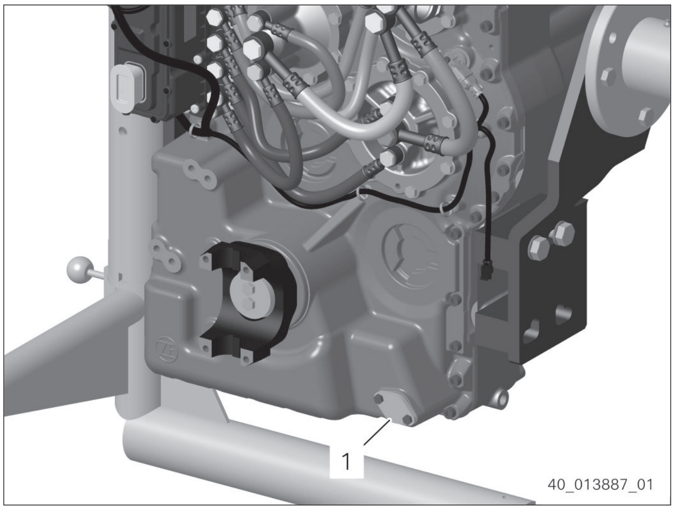


Fig. 25

Removing tube

1. Loosen hollow screws (1) and remove tube (2).

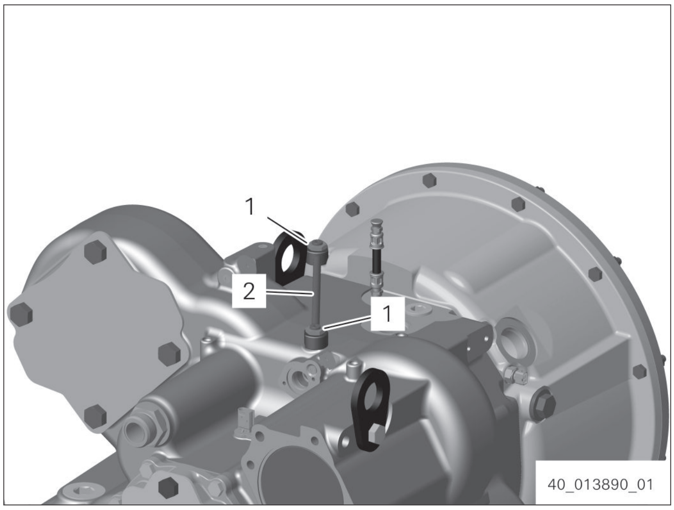


Fig. 28

Removing the hose assemblies

1. Loosen hollow screws and hose assemblies.

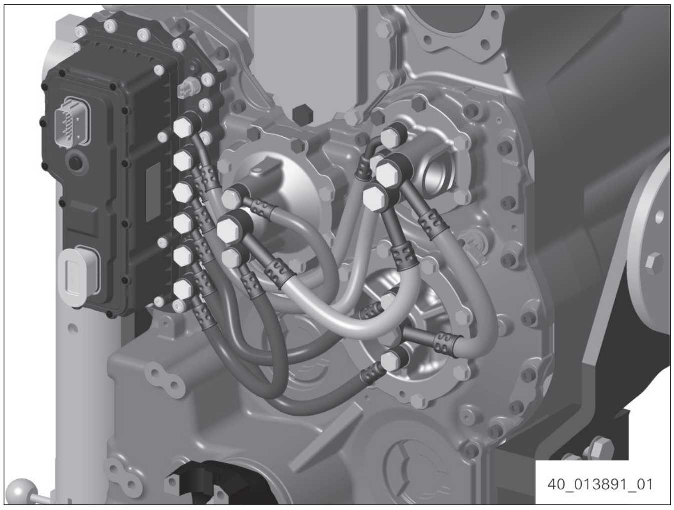


Fig. 29

Removing the speed sensors

1. Loosen the cap screw.

2. Pull the speed sensor (1) out of the cover.

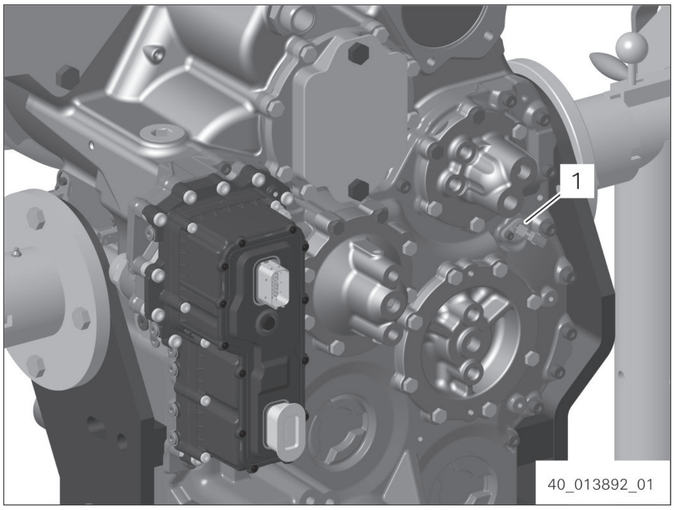


Fig. 30

3. Loosen cap screws.

4. Pull speed sensors (1) out of the housing.

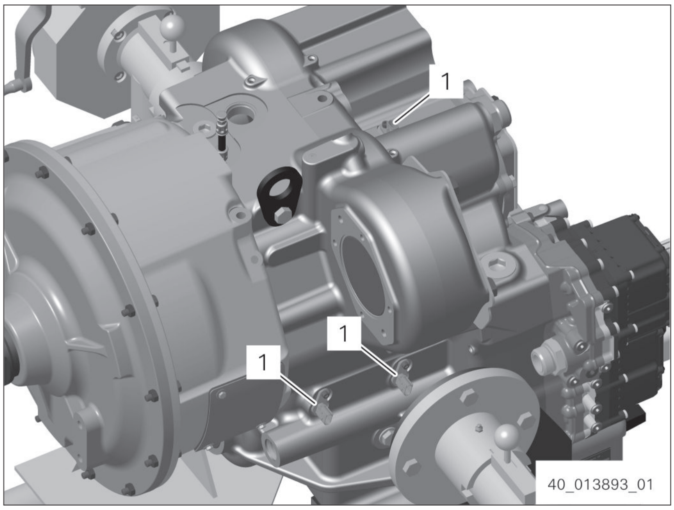


Fig. 31

Removing the temperature sensors and the breather

1. Loosen breather (1).
2. Loosen the temperature sensors (2).

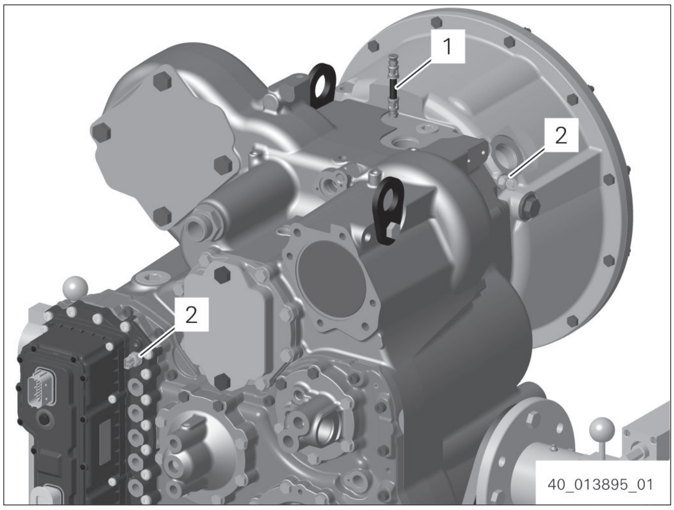


Fig. 32

Removing the converter pressure back-up valve

1. Loosen screw plug (1).

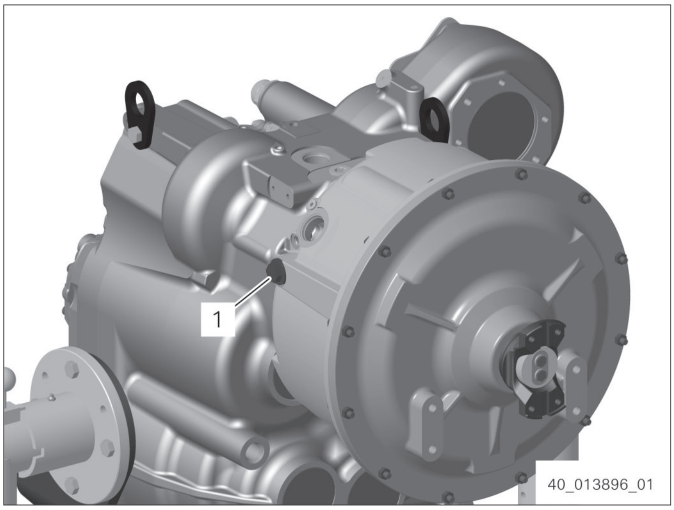


Fig. 33

2. Remove compression spring (1).

3. Pull the piston (2) from the torque converter bell housing.

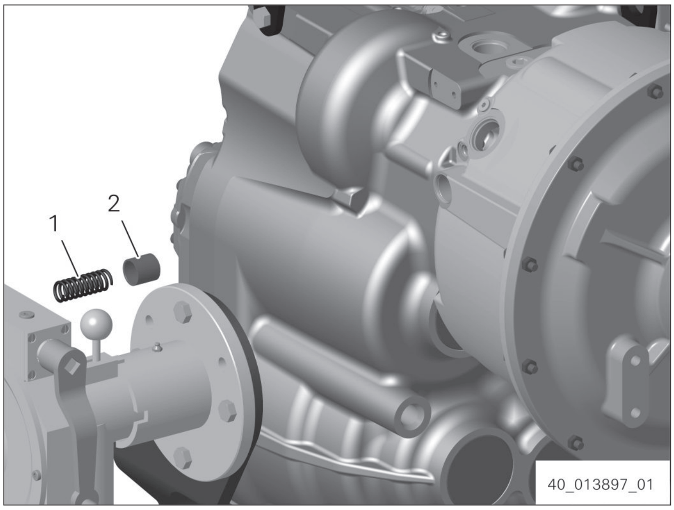


Fig. 34

Removing and dismantling shift system

Removing control unit (ECA4)

1. Loosen internal hexalobular bolts.

2. Remove control unit (1).

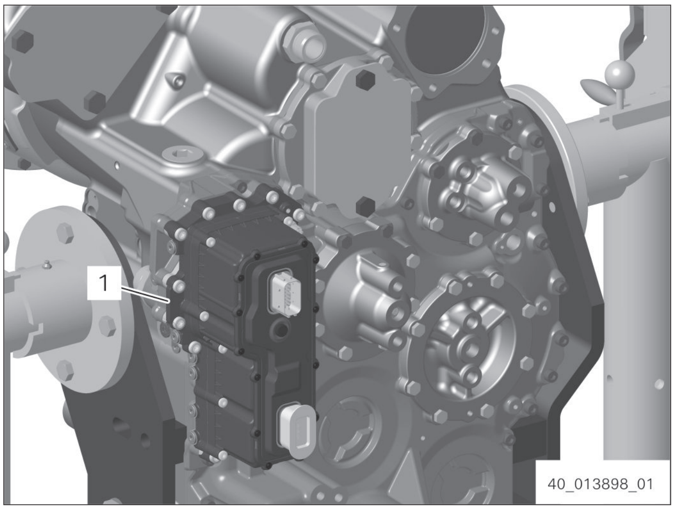


Fig. 35

Removing the pressure controllers

1. Separate plug connections (1) on the pressure controllers.

2. Loosen internal hexalobular bolts and remove fixing plate (3).

3. Remove cable (2).

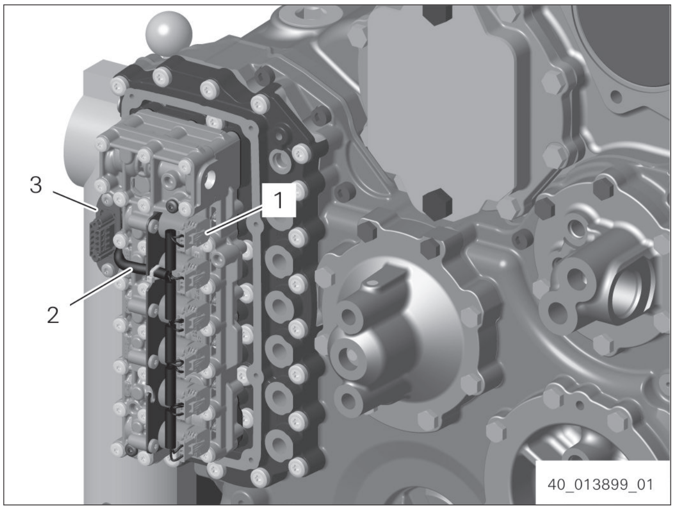


Fig. 36

4. Loosen internal hexalobular bolts and remove clamping plate (2).

5. Pull out the pressure controllers (1).

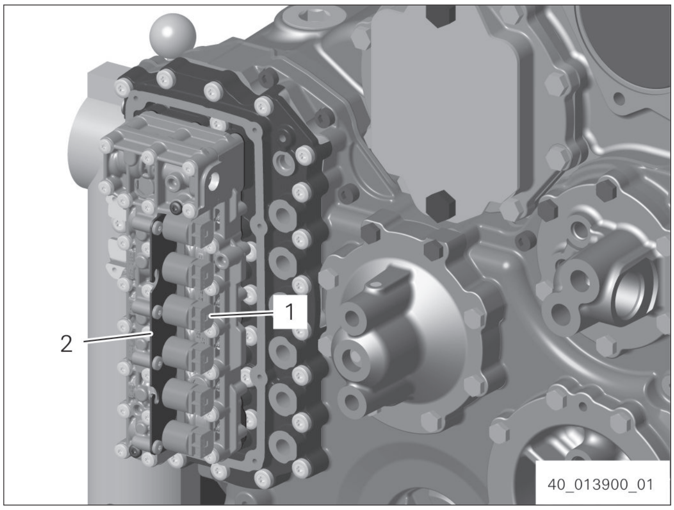


Fig. 37

Removing and dismantling valve blocks

Special tools:

- AA02.414.200 Driver tool
- AA02.416.754 Driver tool
- AA02.416.230 Driver tool

1. Loosen internal hexalobular bolts.
   Remove valve block (1) and intermediate plate.

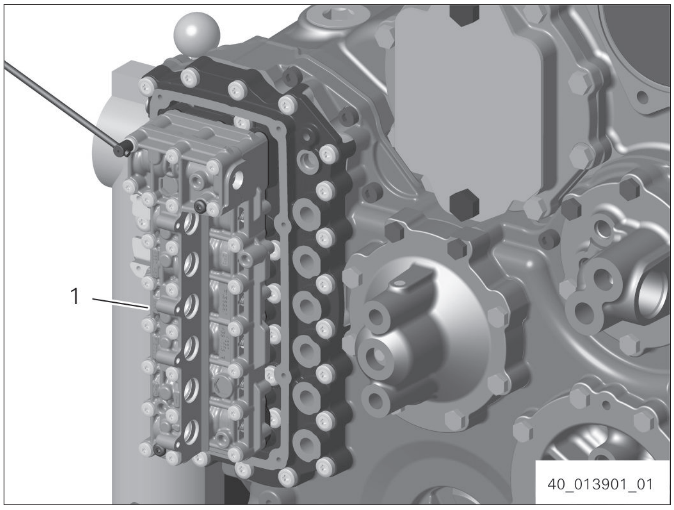


Fig. 38

2. Press the piston inwards with AA02.414.200 [Driver tool] and remove the fixing plate (1).

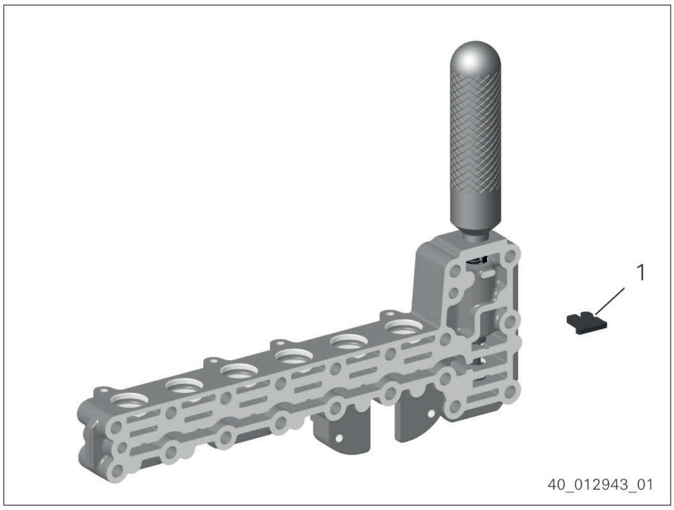


Fig. 39

3. Remove compression spring (2) and piston (1) from the hole.

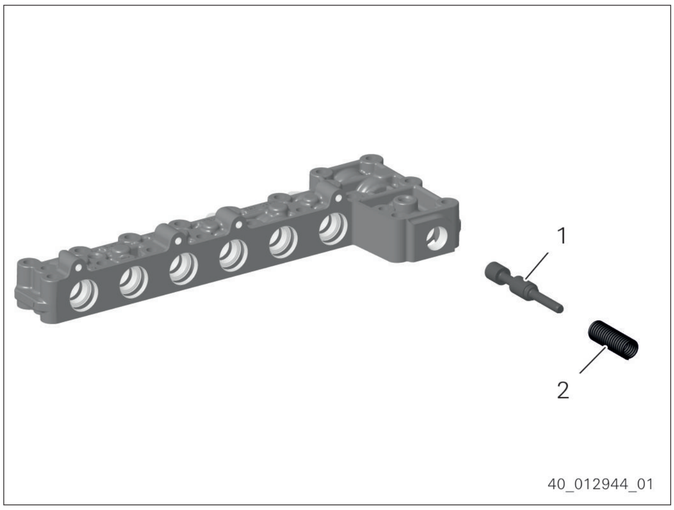


Fig. 40

4. Loosen internal hexalobular bolts.
   Remove valve block (1) and intermediate plate.

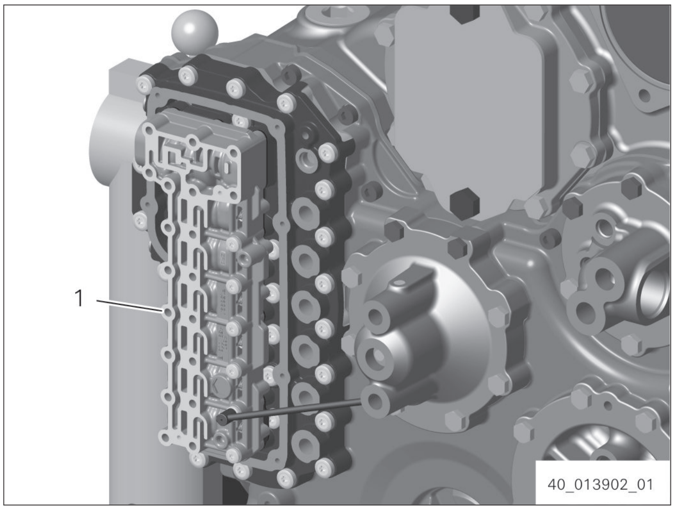


Fig. 41

5. Press the plug inwards with AA02.416.754 [Driver tool] and remove the spring clip (1).

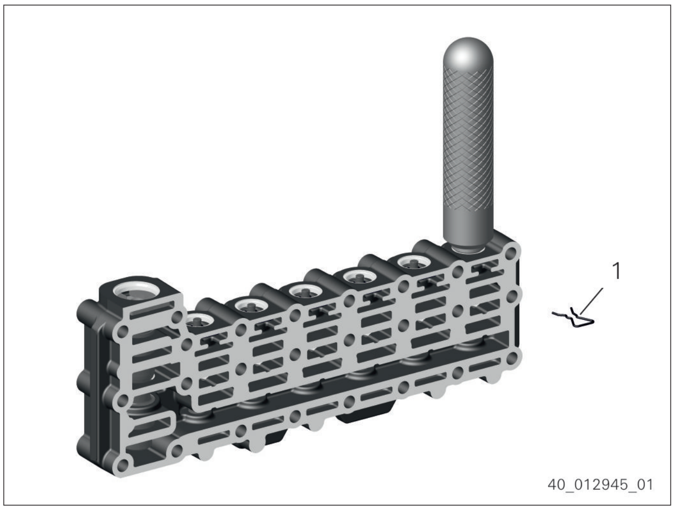


Fig. 42

6. Pull the plug (3) out of the hole.

7. Remove control piston (2) and compression spring (1) from the hole.

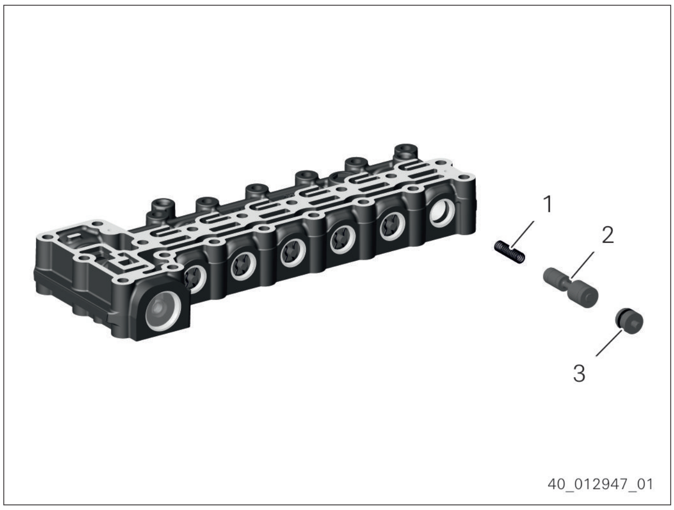


Fig. 43

8. Press the plug inwards using AA02.416.230 [Driver tool] and remove fixing plate (1).

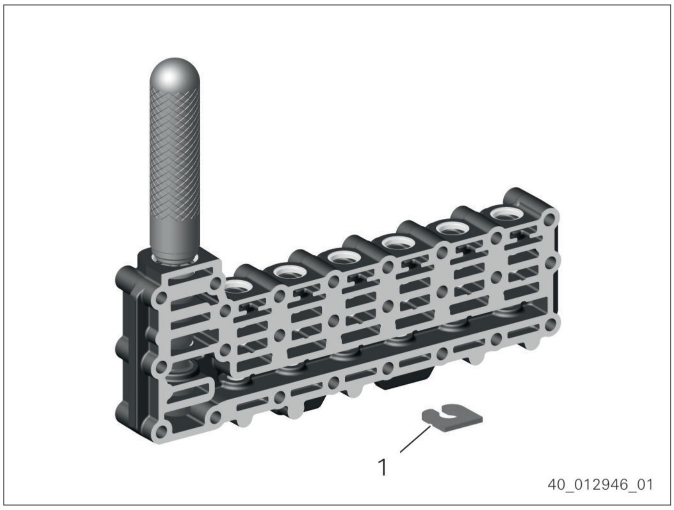


Fig. 44

9. Pull the plug (3) out of the hole.

10. Remove compression spring (2) and control piston (1) from the hole.

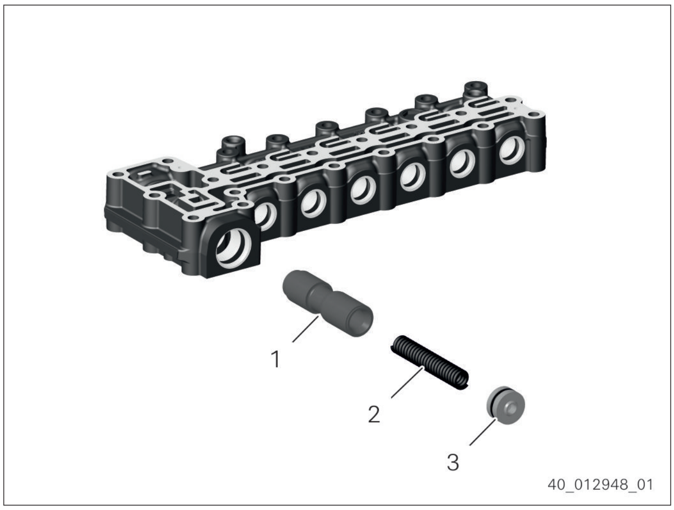


Fig. 45

Removing duct plate

1. Remove valves (1) from duct plate.

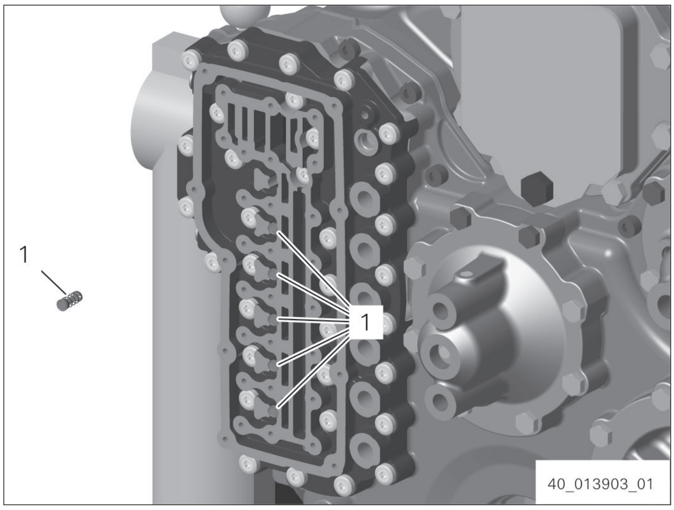


Fig. 46

2. Loosen internal hexalobular bolts. Remove duct plate (1) and seal.

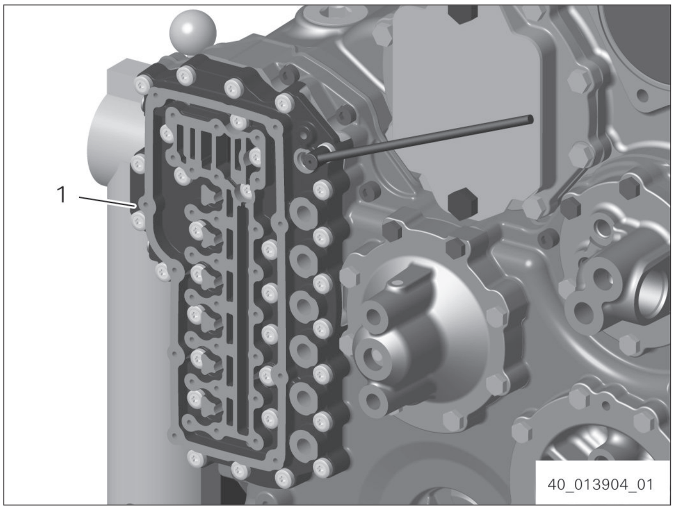


Fig. 47

3. Remove screw plugs (1) from duct plate.

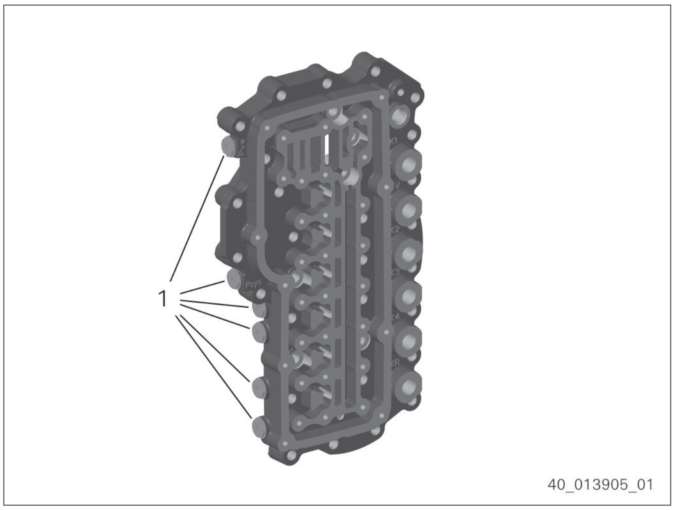


Fig. 48

Removing fixing plates

1. Loosen hexagon screws and remove fixing plates (1).

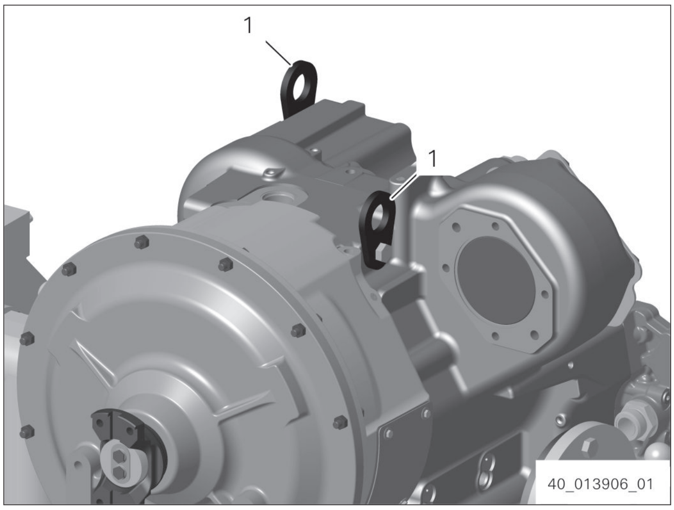


Fig. 49

Removing engine connection and converter

Special tools:

- AA02.676.915 Load ring

1. Mark installation position of the cover towards the torque converter bell housing.

2. Loosen hexagon nuts (1) and remove hexagon screws (2).

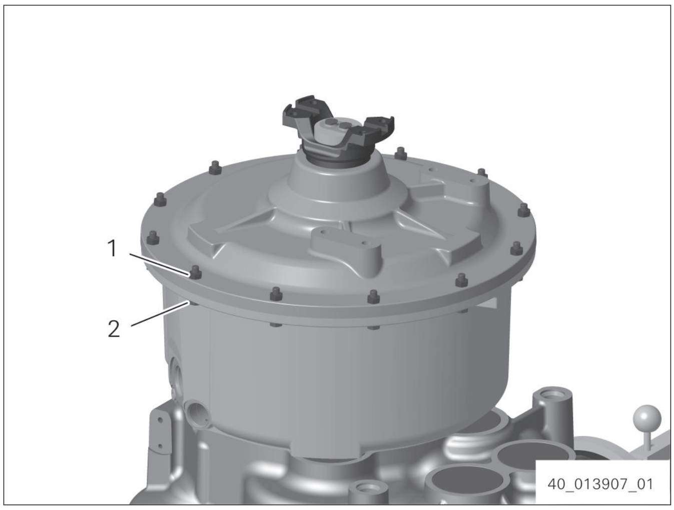


Fig. 50

3. ⚠ **CAUTION**

   Risk of crushing due to moving parts.
   Slight or moderate injury possible.
   ⇨ Do not reach into danger area!

   Lift off the cover and the converter using two AA02.676.915 [Load ring] and the crane.

Fig. 51

4. Remove locking plate (1).

5. Loosen hexagon screws (2).

6. Remove washer (3).

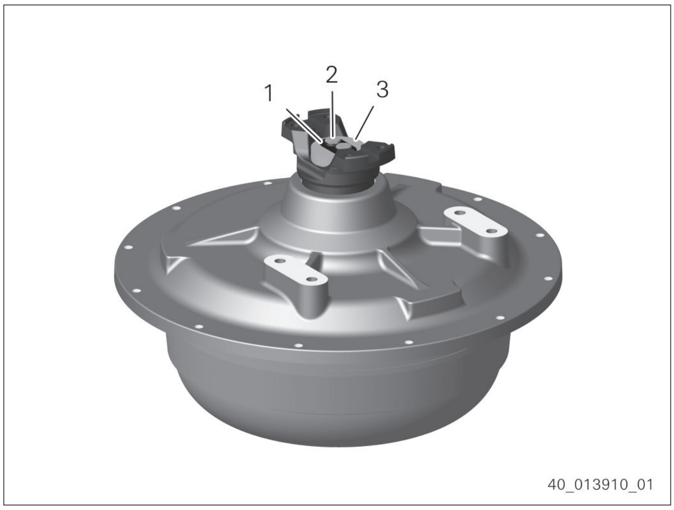


Fig. 52

7. Use two-armed extractor to pull output flange from flange shaft.

Fig. 53

8.

⚠ CAUTION

Risk of crushing due to hydraulic tool.
Slight to moderate injury possible.
⇨ Do not reach into danger area.

Force flange shaft and converter out of the cover.

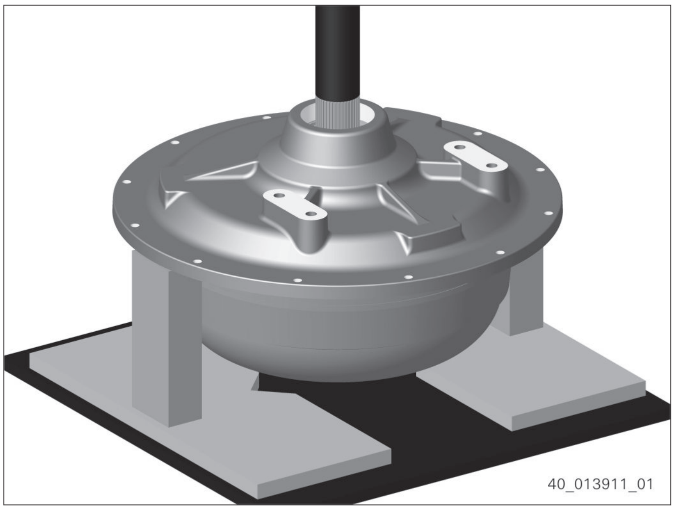


Fig. 54

9. Remove V-ring (1).

10. Pull the ball bearing (2) out of the cover.

Fig. 55

11. Remove R-ring (1).

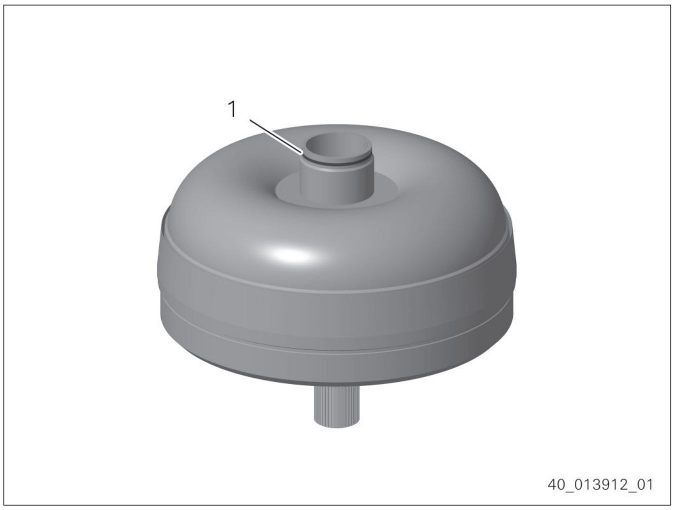


Fig. 56

12. Loosen hexagon screws (1).

13. Remove flange shaft (2).

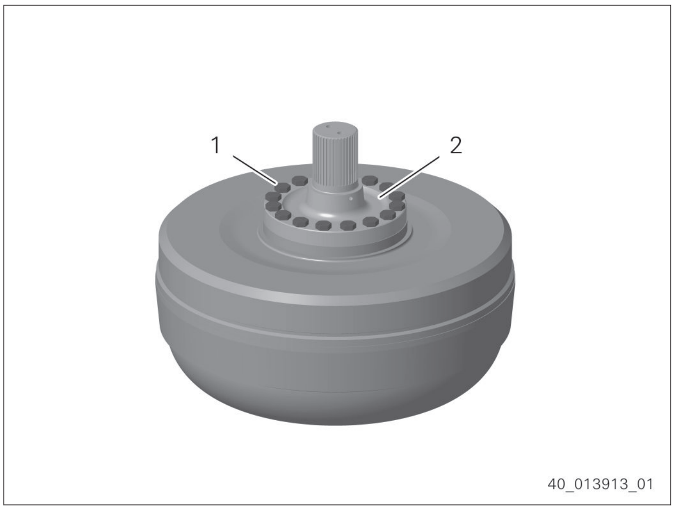


Fig. 57

Dismantling drive

Special tools:
- 5870.204.005 Hexagon screw
- 5870.000.089 Press-out device
- 5870.345.036 Pry bar
- AA02.247.426 Eyebolt

1. Loosen hollow screws (2).

2. Remove oil tube (1).

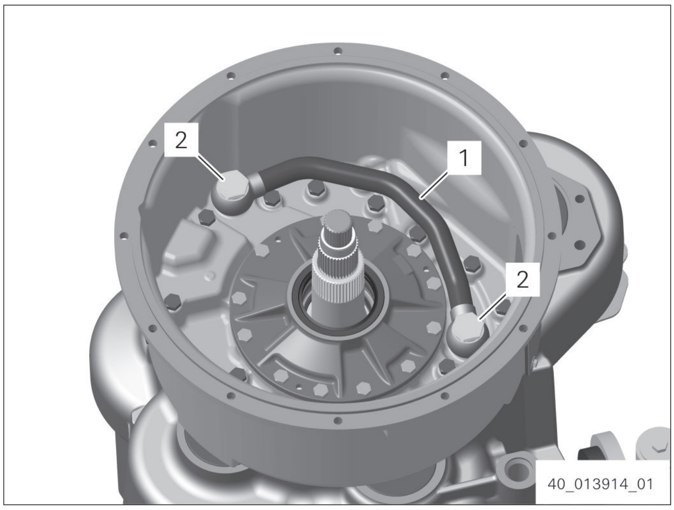


Fig. 58

3. Loosen hexagon screws.

4. Evenly pull off bearing cover with three 5870.204.005 [Hexagon screw].

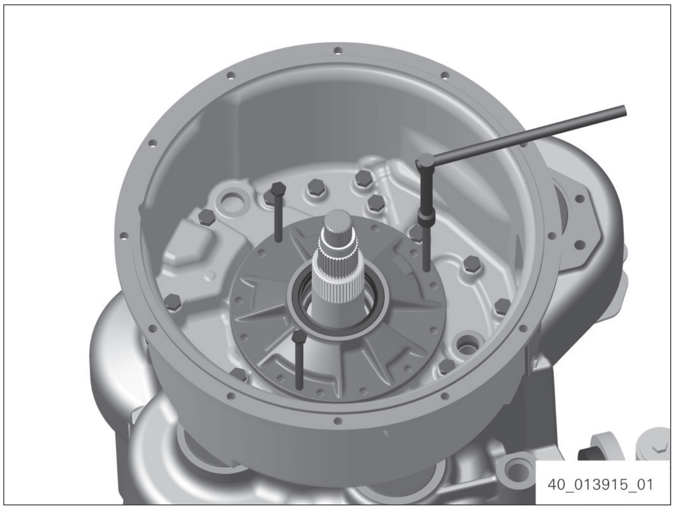


Fig. 59

5. Remove shaft sealing ring (1) from bearing cover.

6. Remove needle sleeve (2).

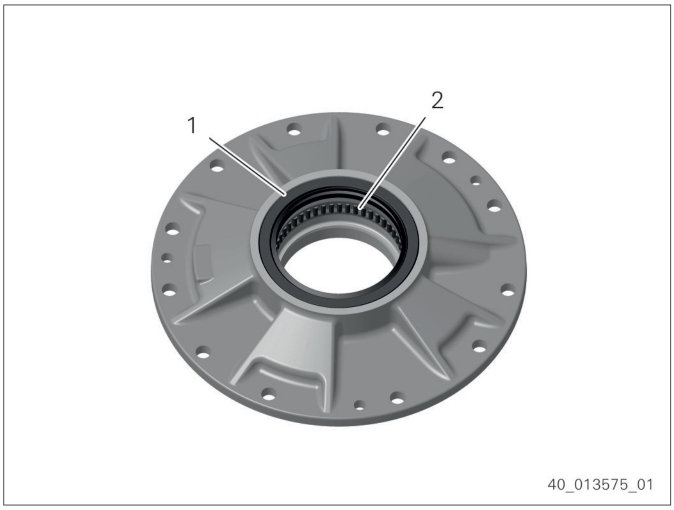


Fig. 60

7. Fasten 5870.000.089 [Press-out device] to the oil feed flange with two cap screws M12 x 50.

8. Pull oil feed flange evenly out of torque converter bell housing by means of 5870.000.089 [Press-out device].

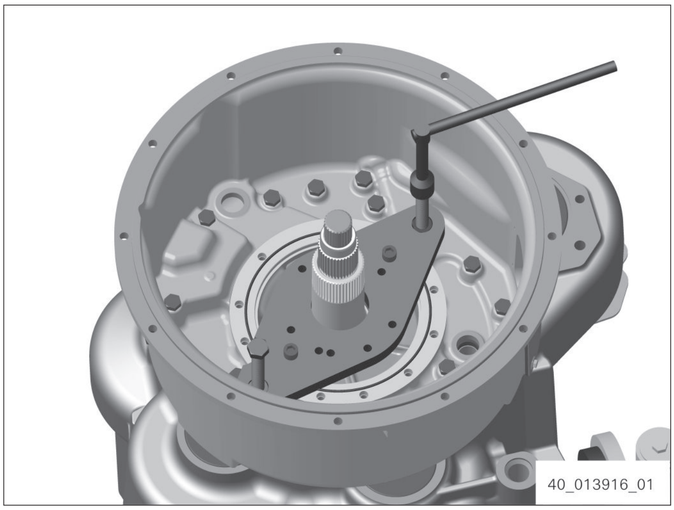


Fig. 61

9. Remove slotted pin (1).

10. Remove converter safety valve (2).

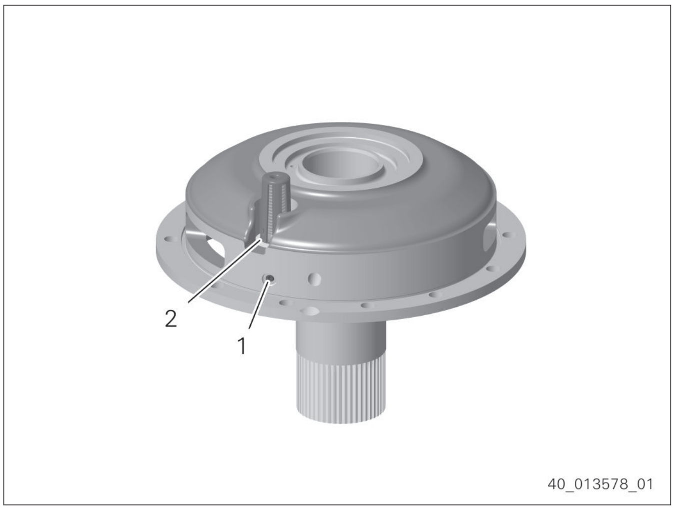


Fig. 62

11. Loosen hexagon screws.

12. Remove torque converter bell housing using 5870.345.036 [Pry bar], two AA02.247.426 [Eyebolt] and a crane.

13. Remove seal.

Fig. 63

14. Remove R-rings (1) from input shaft.

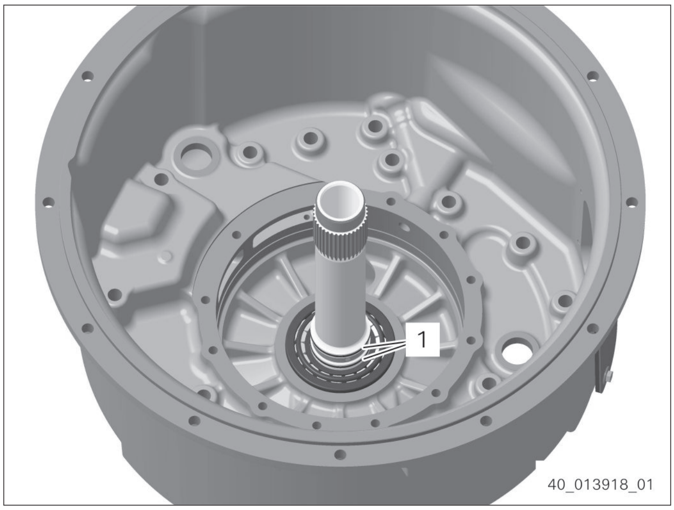


Fig. 64

15. ⚠ **CAUTION**

Risk of crushing due to hydraulic tool.
Slight to moderate injury possible.
⇨ Do not reach into danger area.

Press out the input shaft.

16. Remove bearing inner ring (1).

17. Remove helical gear (2).

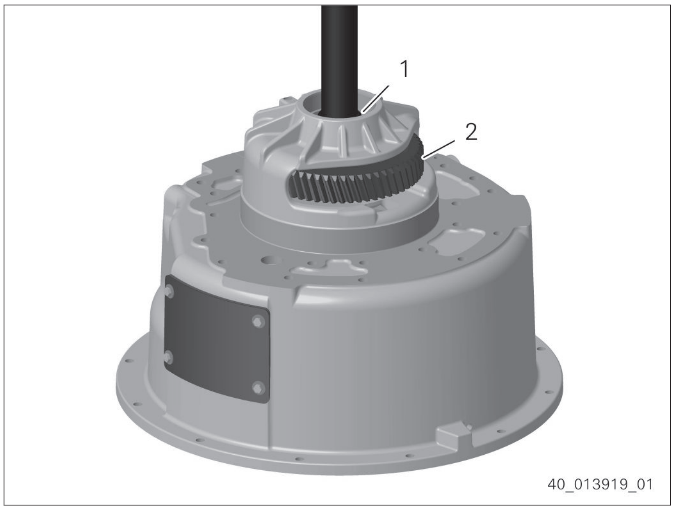


Fig. 65

18. Force bearing inner ring from input shaft.

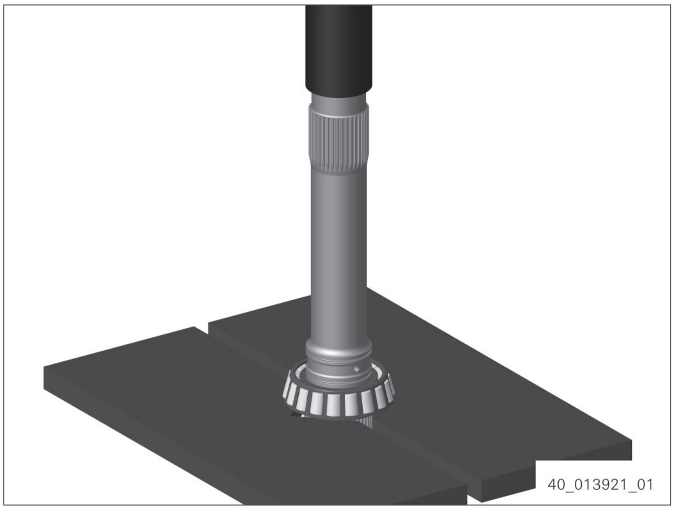


Fig. 66

19. Remove bearing outer rings (1).

20. Loosen the hexagon screws and remove the cover sheet (2) and the cover plate (3).

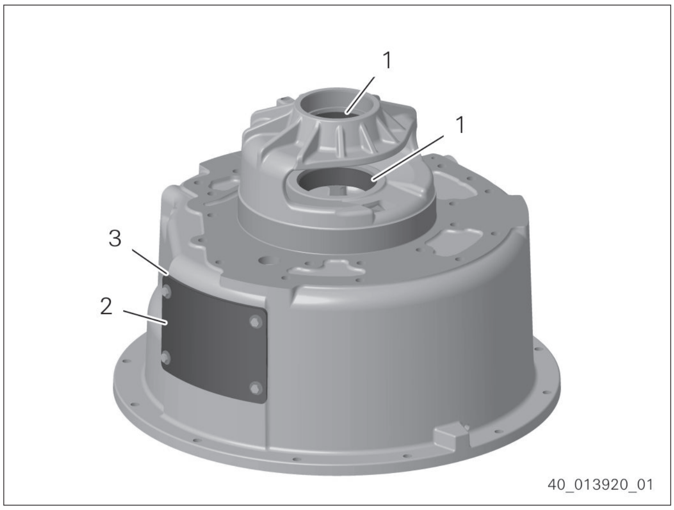


Fig. 67

21. Remove protection caps (1).

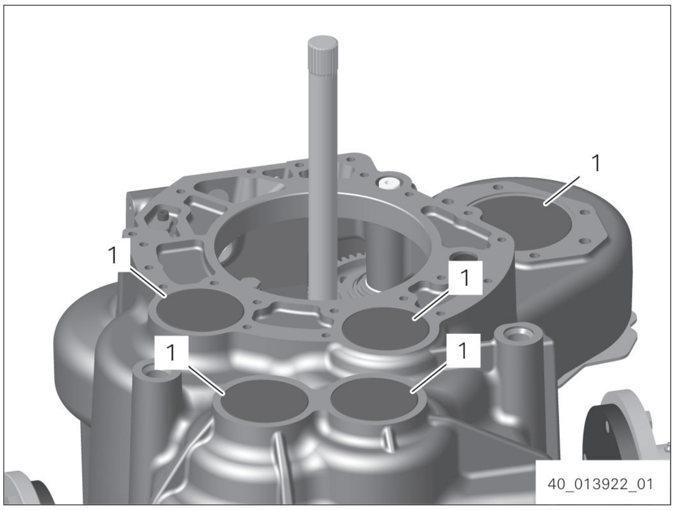


Fig. 68

Removing and dismantling the power take-offs (variant with PTO) 1, 3 and 4)

Removing shaft

Special tools:

- 5873.001.020 Gripping device
- 5873.001.000 Basic tool

1. Loosen hexagon screws and remove the cover (1).

2. Remove O-ring.

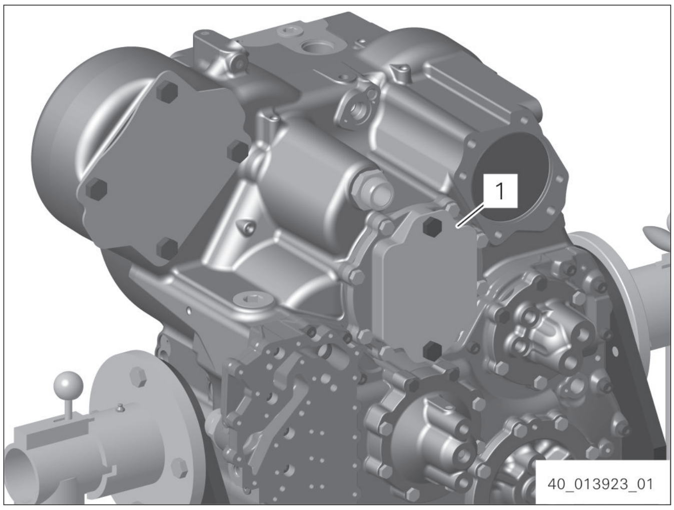


Fig. 69

3. Remove shaft with gear (1) from the transmission.

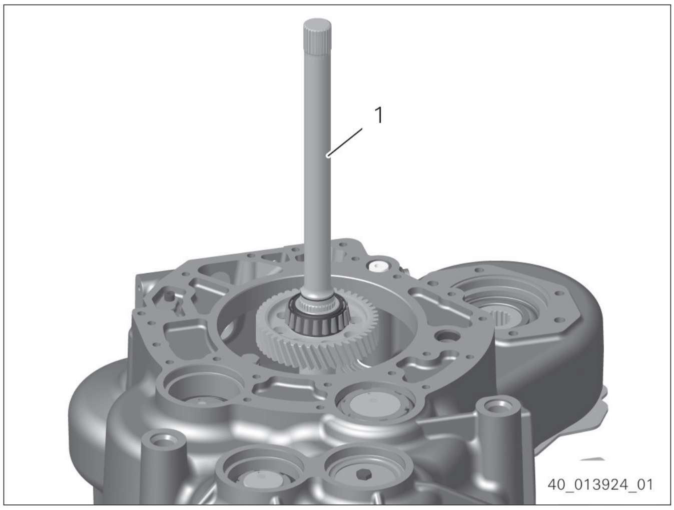


Fig. 70

4. Remove R-ring (1) from annular groove of the shaft.

5. Remove parallel key (2).

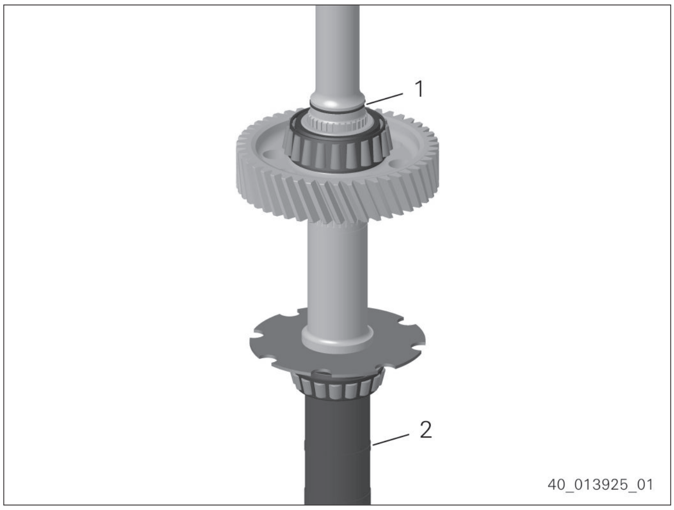


Fig. 71

6. Pull off gear (1).

7. Remove retaining ring (2).

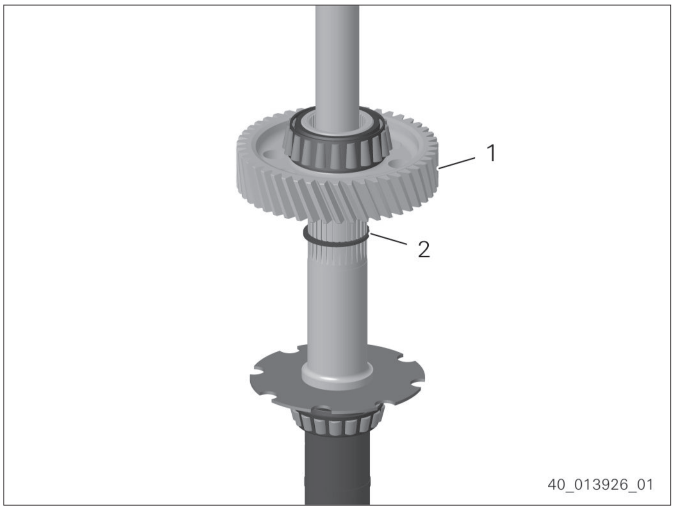


Fig. 72

8. Pull off bearing inner ring with 5873.001.020 [Gripping device] and 5873.001.000 [Basic tool] from gear.

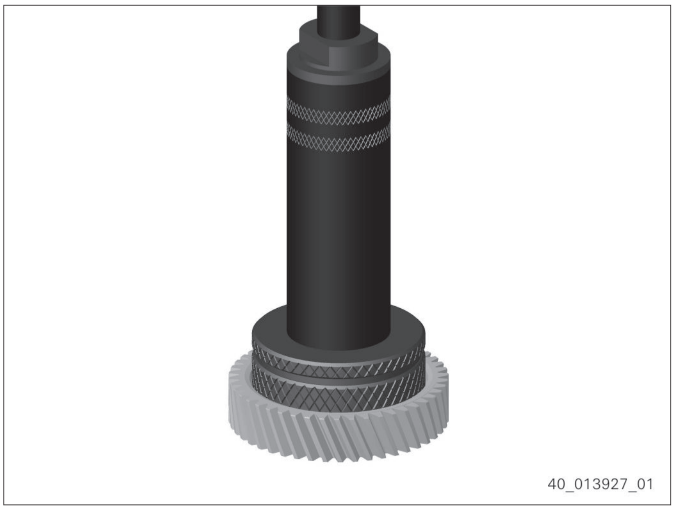


Fig. 73

9. Use protective chucks made from aluminum.

   Fix shaft in the vise.

10. Loosen the cap screw.

11. Remove spring washer.

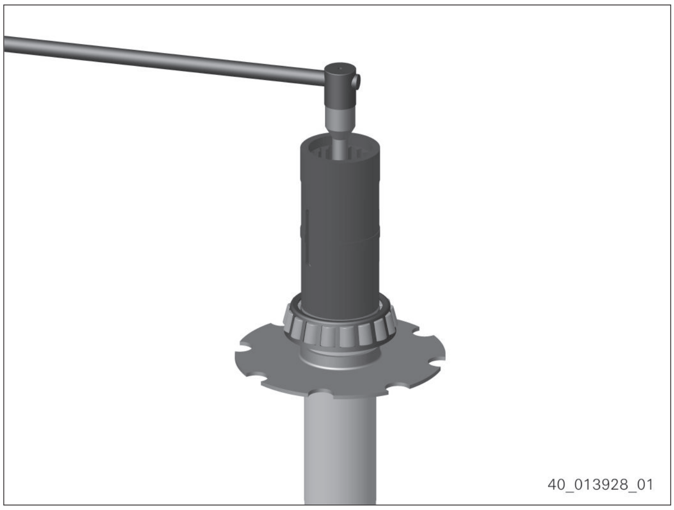


Fig. 74

12. Pull off bearing inner ring and driver with three-armed extractor from the shaft.

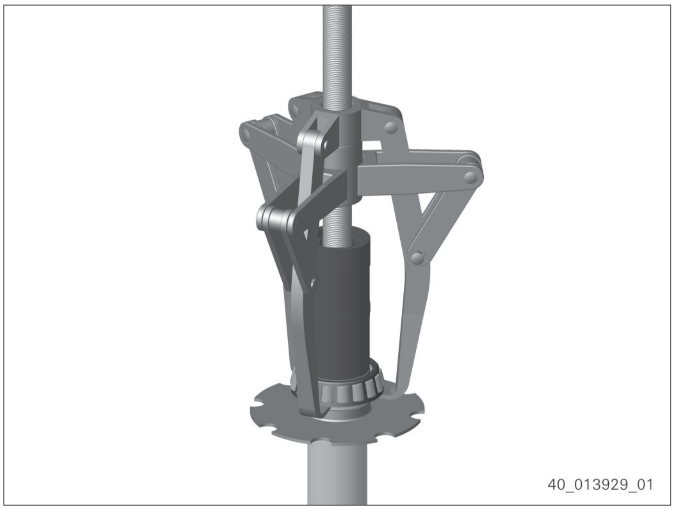


Fig. 75

13. Pull off the bearing inner ring and discs from the driver.

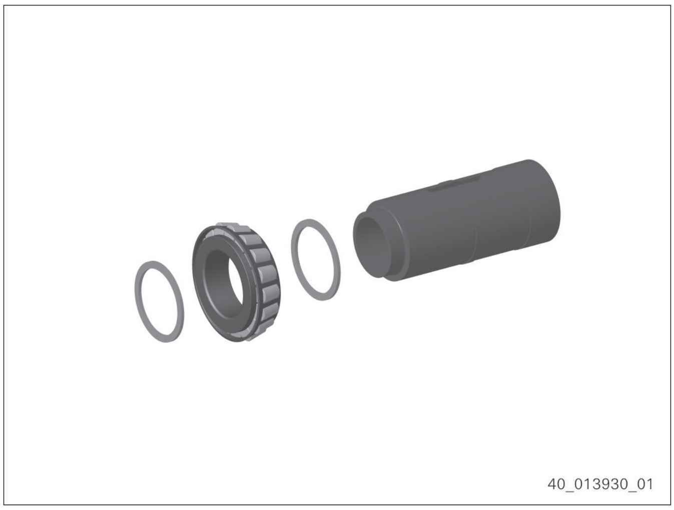


Fig. 76

Removing pressure oil pump

Special tools:

- AA02.813.910 Puller

1. Loosen hexagon screws.
2. Remove pump flange (1).
3. Remove O-ring.

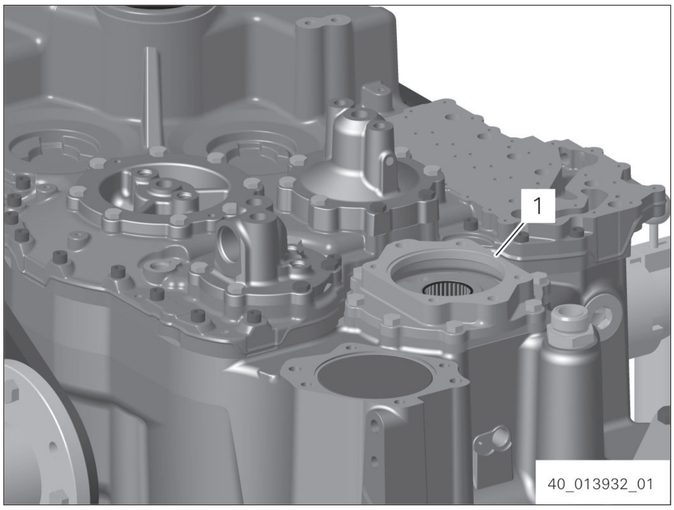


Fig. 77

4. Loosen cap screws (1).

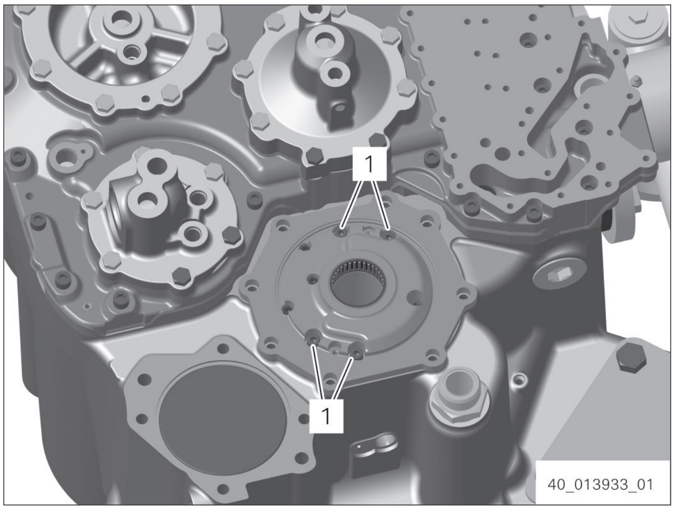


Fig. 78

5. Fasten AA02.813.910 [Puller] to gear pump with four cap screws M8 x 65.

6. Pull gear pump evenly out of housing hole by means of AA02.813.910 [Puller].

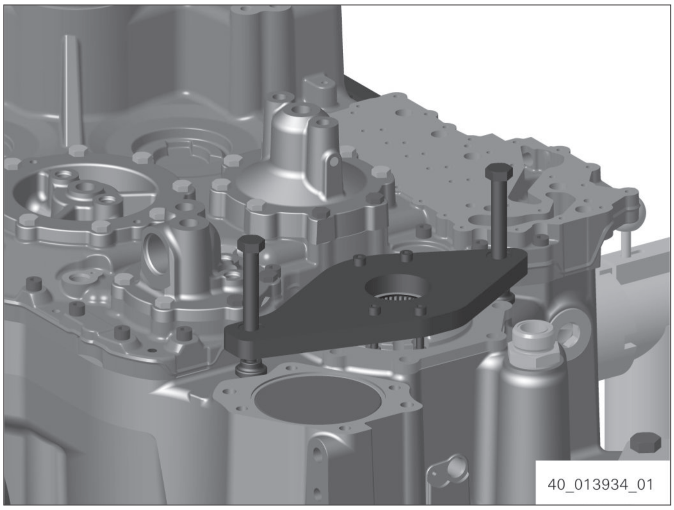


Fig. 79

7. Pull bearing outer ring (1) out of the gear pump.

8. Remove O-ring (2).

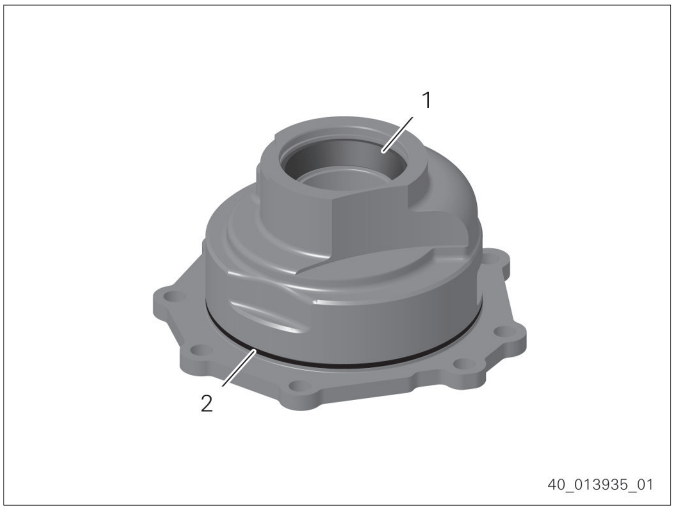


Fig. 80

Checking gear pump

9. Check individual parts of the gear pump for wear marks before assembling the transmission.

   The gear pump is only available as a complete unit.

   Loosen cap screws.

10. Remove cover (1).

11. Check the cover, outer rotor, inner rotor and the pump housing for wear marks.
    In case of any damage, install new gear pump.

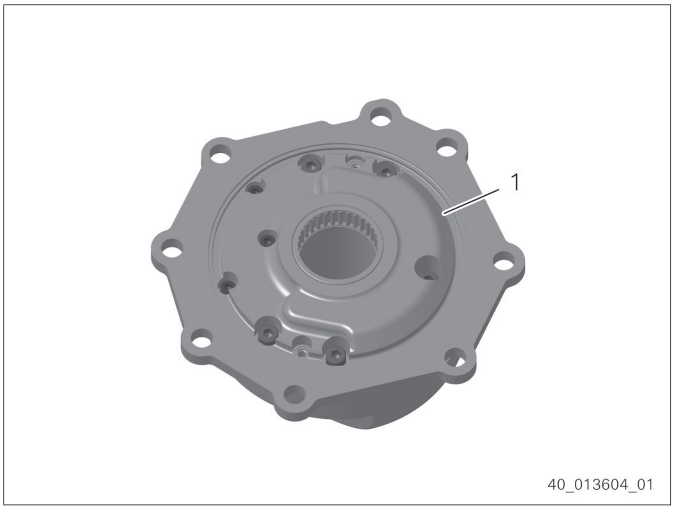


Fig. 81

12. Insert outer rotor and inner rotor, with the chamfered tooth side facing the pump housing.

13. Insert cylindrical pins until contact is obtained.

14. Place the cover.

15. Bolt in and tighten cap screws.
    Tightening torque: 23 Nm
    Tightening torque: 9.5 Nm

Removing PTOs 3 and 4

Special tools:
- AA02.242.247 Extracting device
- AA02.571.771 Adapter

1. Loosen hexagon screws and remove cover (1).

2. Remove O-ring.

3. Remove sealing cap (2) from the housing hole.

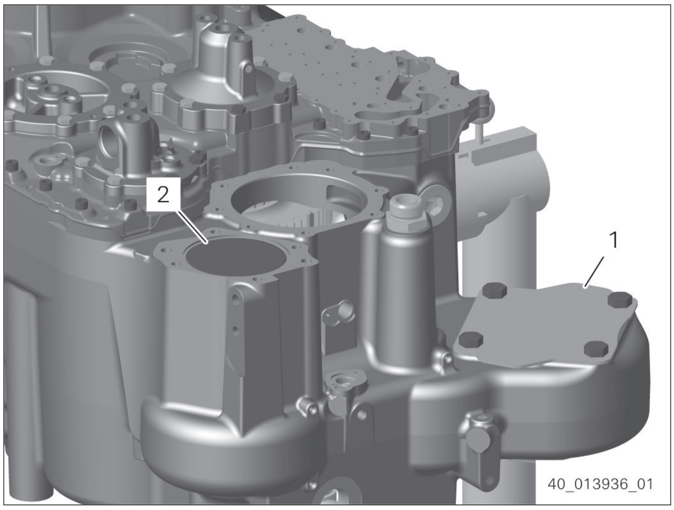


Fig. 82

4. Pull pin (1) with AA02.242.247 [Extracting device] and AA02.571.771 [Adapter] out of the housing hole.
   Remove gear (2), bearing inner rings and shim.

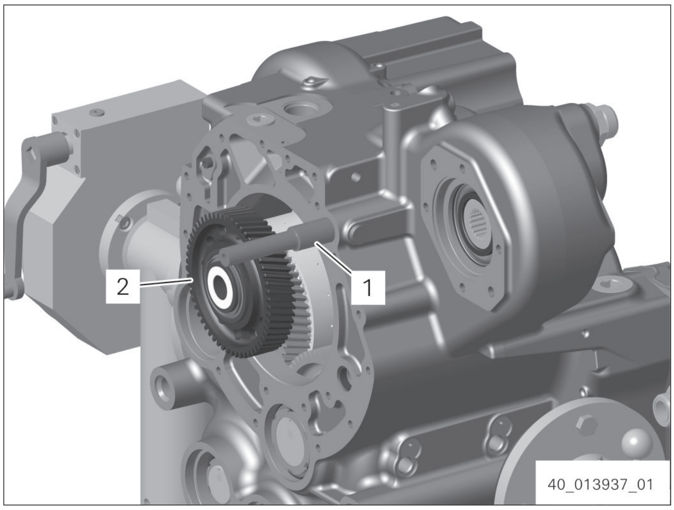


Fig. 83

5. Remove retaining ring (1).

6. Remove shim.

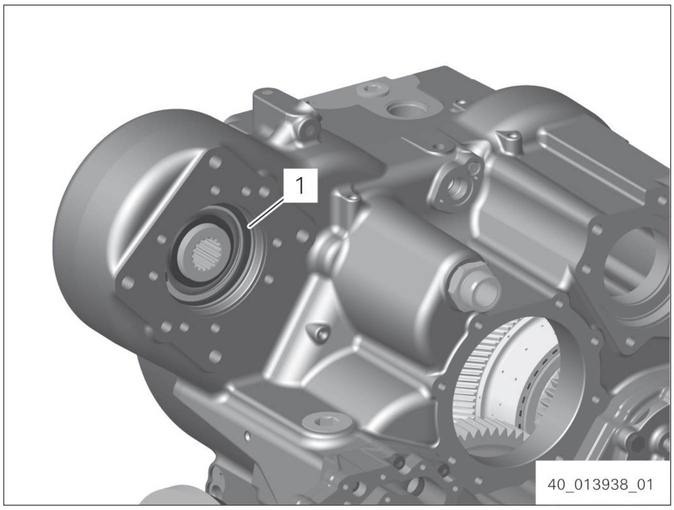


Fig. 84

7. Force out driver (1) and remove gear.

8. Remove both ball bearings.

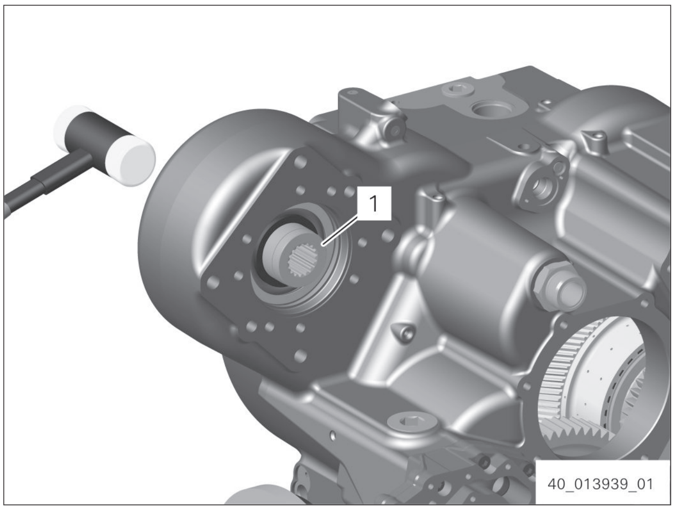


Fig. 85

Removing countershaft

Special tools:
- AA02.242.247 Extracting device
- AA02.242.584 Adapter

1. Remove cover.

2. Loosen hexagon screw (1).

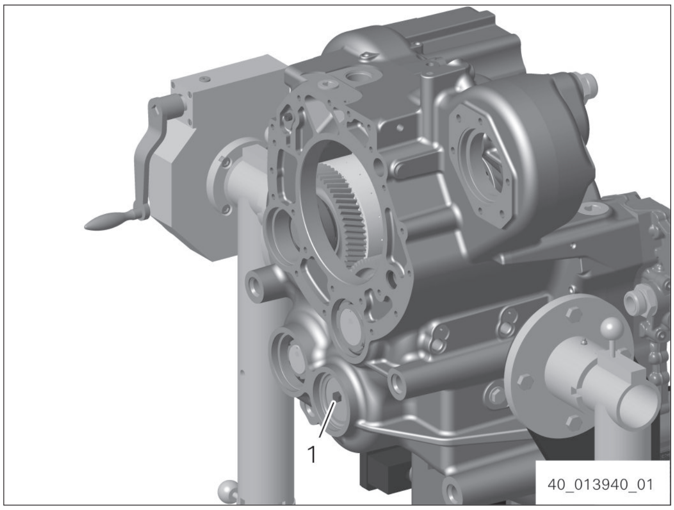


Fig. 86

3. Use AA02.242.247 [Extracting device] and AA02.242.584 [Adapter] to pull axle out of housing.

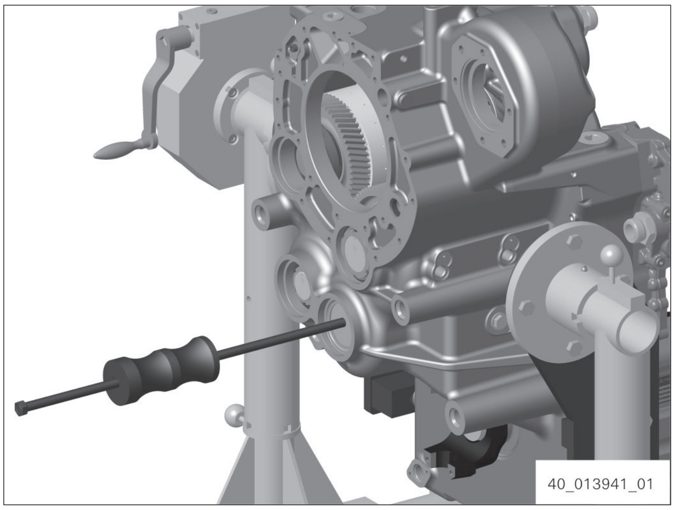


Fig. 87

Removing yokes

Removing yoke on converter side

1. Remove locking plate (1).
2. Loosen hexagon screws (2).
3. Remove washer (3).

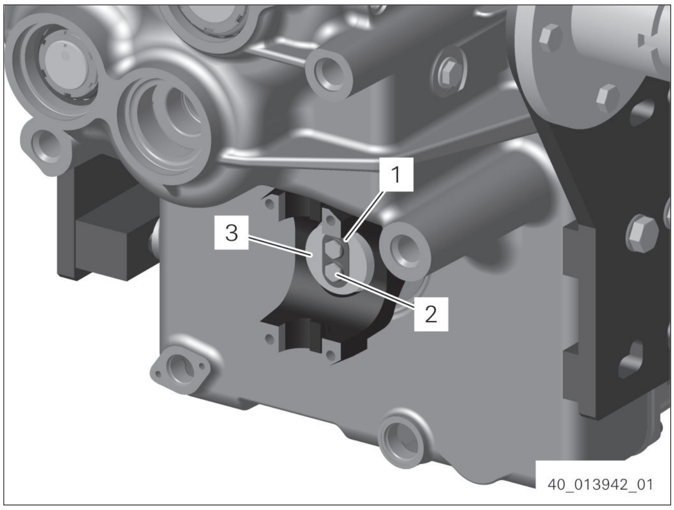


Fig. 88

4. Remove washer (1).
5. Remove O-ring (2).

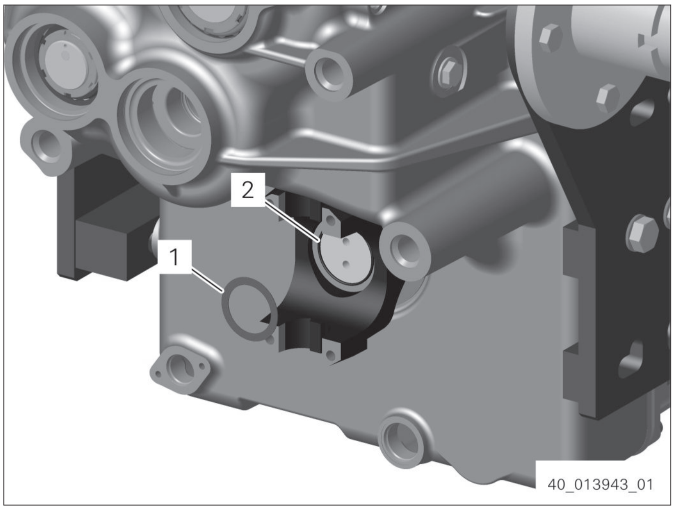


Fig. 89

6. Pull off yoke (1).

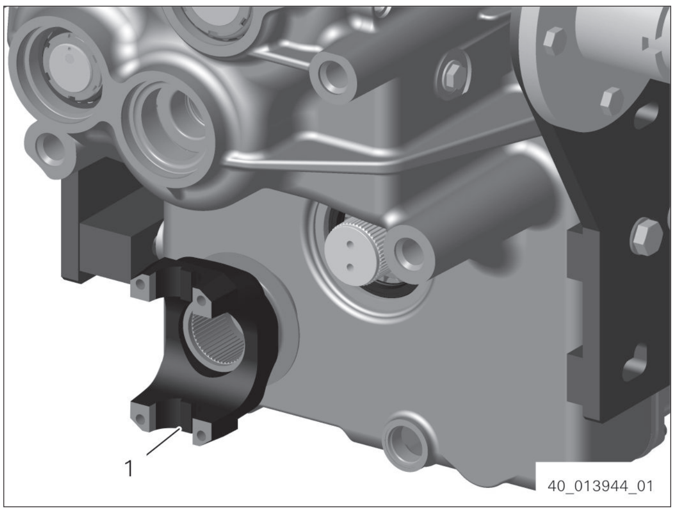


Fig. 90

7. Remove shaft sealing ring (1) from housing hole.

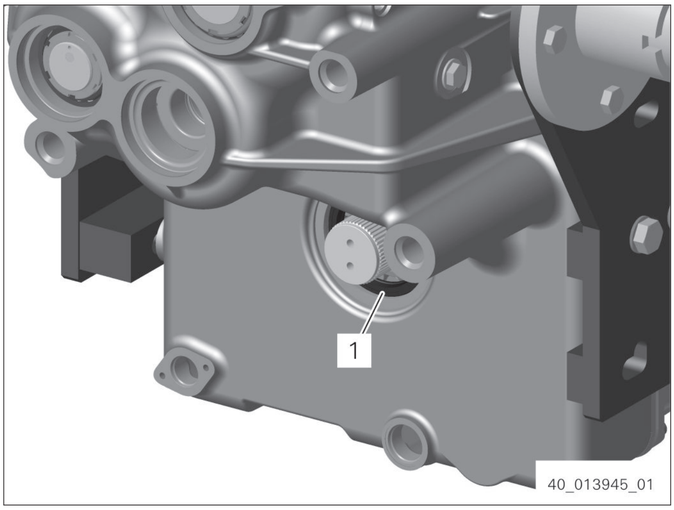


Fig. 91

Installing the yoke on the output side

8. Remove locking plate (1).

9. Loosen hexagon screws (2).

10. Remove washer (3).

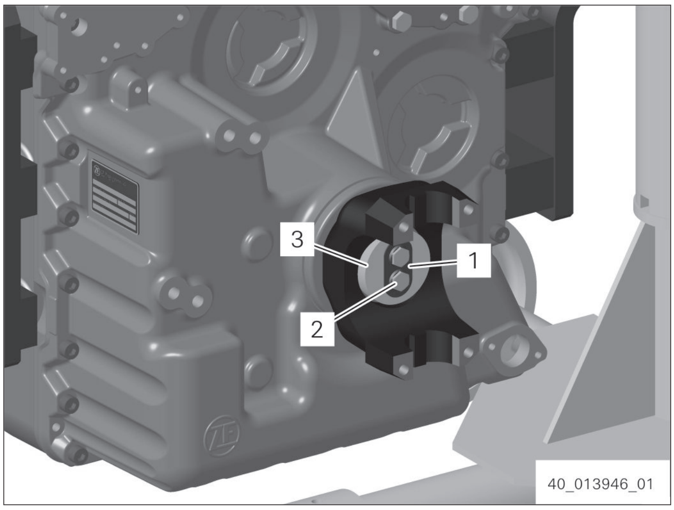


Fig. 92

11. Remove washer (2).

12. Remove O-ring (1).

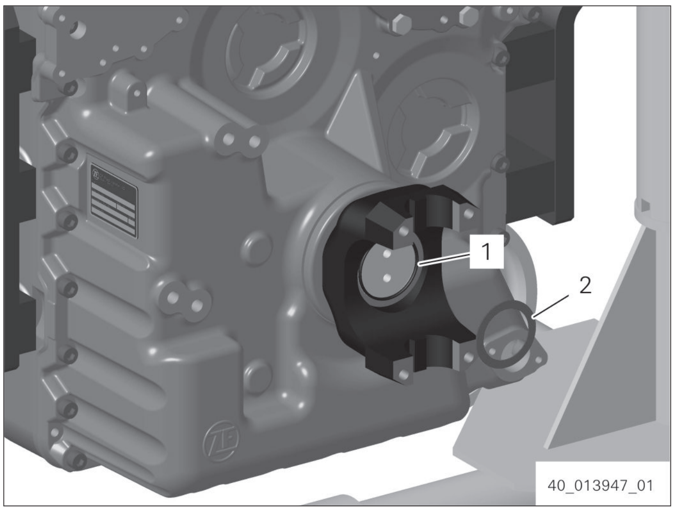


Fig. 93

13. Pull off yoke (1).

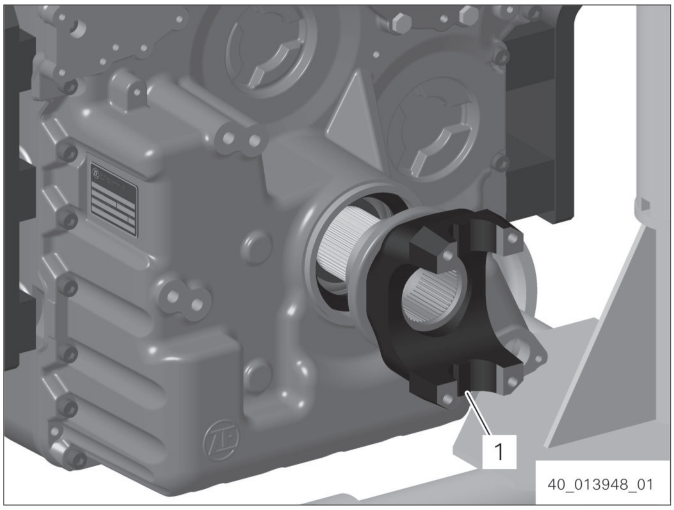


Fig. 94

14. Remove shaft sealing ring (1) from housing hole.

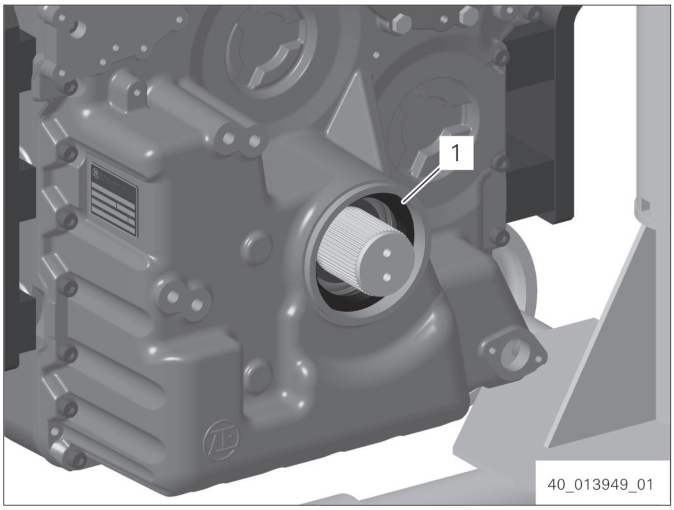


Fig. 95

Removing and dismantling clutches and output

Removing bearing cover and the covers

Special tools:

- 5870.204.069 Thread insert
- 5870.650.014 Extracting device
- 5870.204.005 Hexagon screw

1. Loosen hexagon screws.

2. Pull bearing cover K1/KV (1) with 5870.204.069 [Thread insert] and 5870.650.014 [Extracting device] out of cover hole.

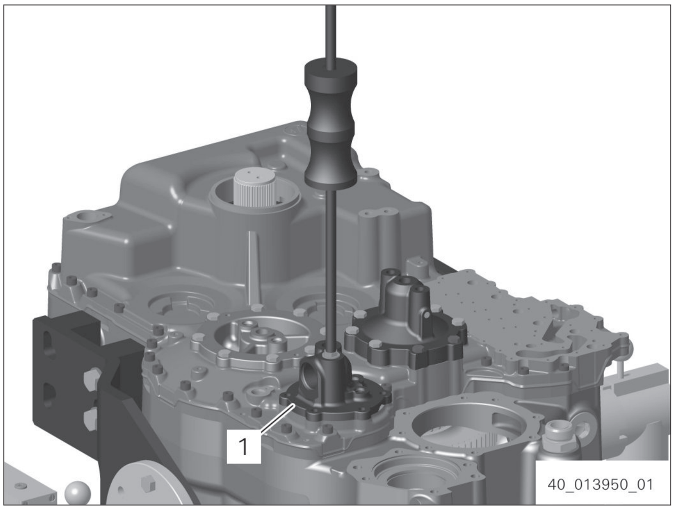


Fig. 96

3. Pull bearing outer ring (1) out of bearing cover.

4. Remove shim and ring.

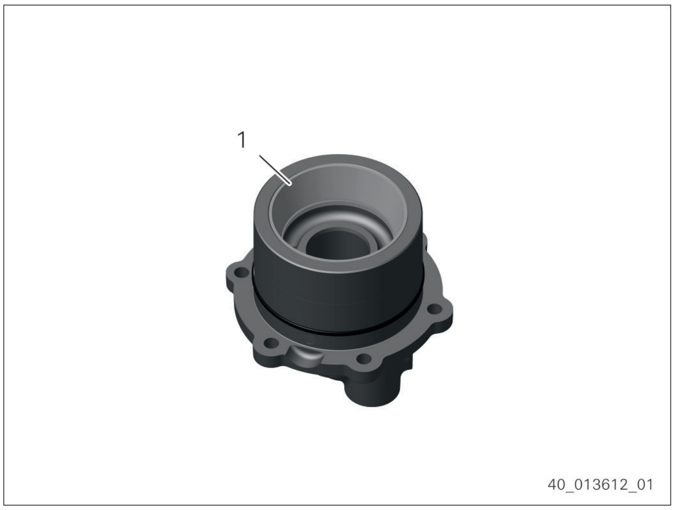


Fig. 97

5. Loosen hexagon screws.

6. Pull off cover K2/KR (1) using 5870.204.069 [Thread insert] and 5870.650.014 [Extracting device].

7. Remove shim and O-ring.

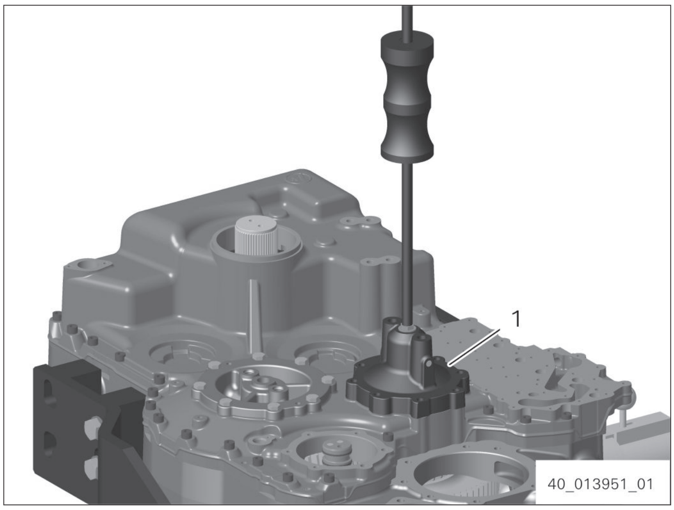


Fig. 98

8. Loosen hexagon screws.

9. Evenly pull cover K3/K4 (1) out of cover hole with two 5870.204.005 [Hexagon screw].

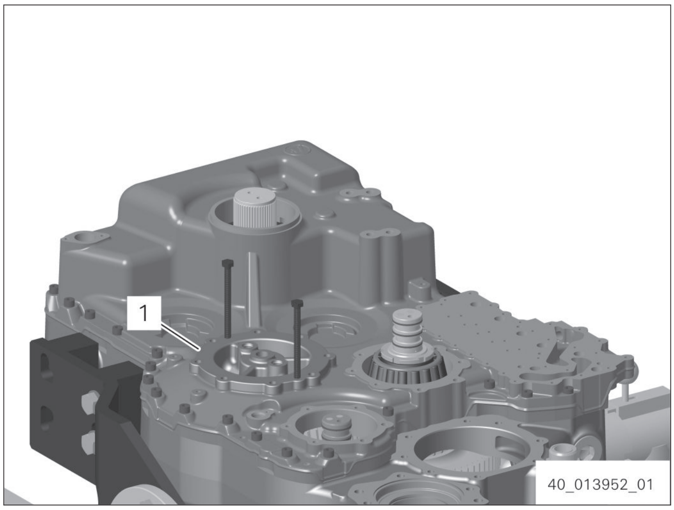


Fig. 99

10. Pull off bearing inner ring from cover using three-armed extractor.

11. Remove spacer washer.

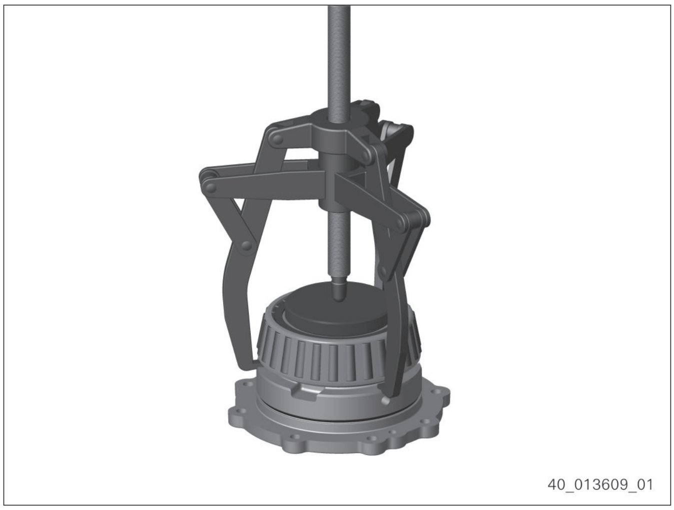


Fig. 100

Removing and dismantling the cover

Special tools:

- 5870.281.061 Load-lifting equipment
- 5870.204.005 Hexagon screw

1. Loosen cap screws.

2. Mount 5870.281.061 [Load-lifting equipment] (3) to cover (1).
Turn hexagon screw (4) into output shaft until contact is obtained.

3. Turn two 5870.204.005 [Hexagon screw] (2) into the cover until contact is obtained.

4. Separate the cover evenly from the housing by means of two 5870.204.005 [Hexagon screw] and 5870.281.061 [Load-lifting equipment].

5. Lift off cover using 5870.281.061 [Load-lifting equipment] and a crane.

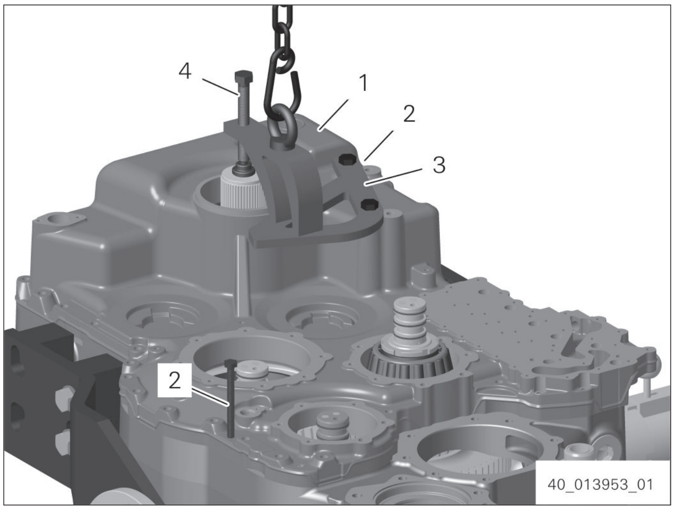


Fig. 101

6. Loosen the adapter (1).

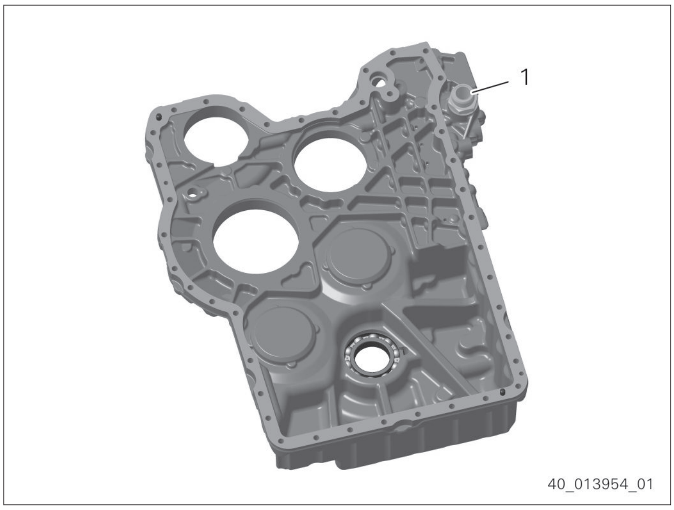


Fig. 102

7. Remove retaining ring (1).

8. Pull ball bearing (2) out of the cover hole.

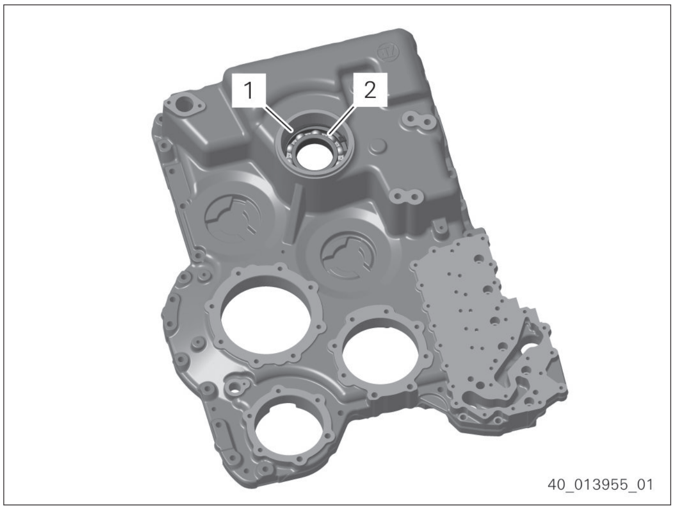


Fig. 103

Removing suction tube

1. Loosen cap screws (2).
2. Remove suction tube (1).

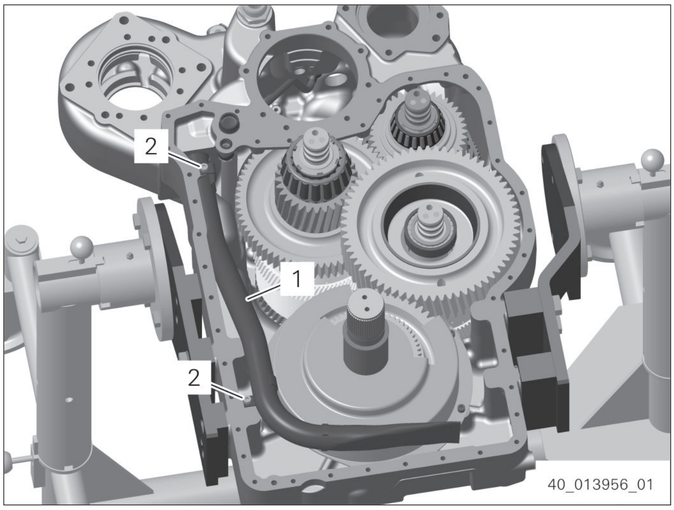


Fig. 104

Removing output shaft and output gear

Special tools:
- 5870.100.054 Stop washer
- 5870.204.002 Eyebolt

1. Remove shim (1).

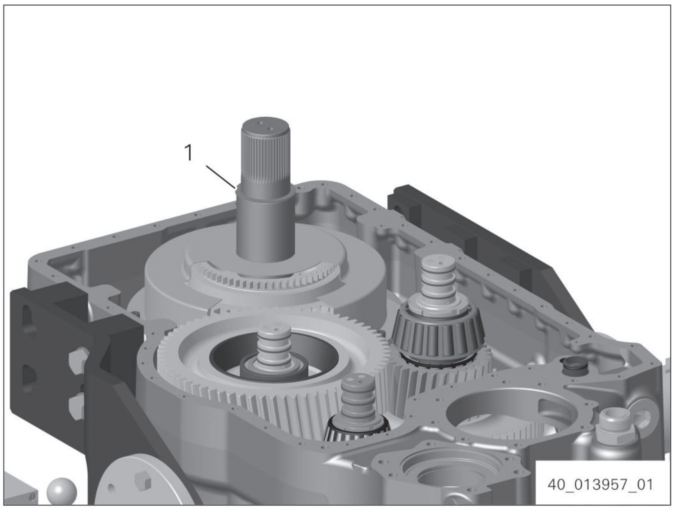


Fig. 105

2. Force output shaft (1) out of gear by means of a plastic hammer.

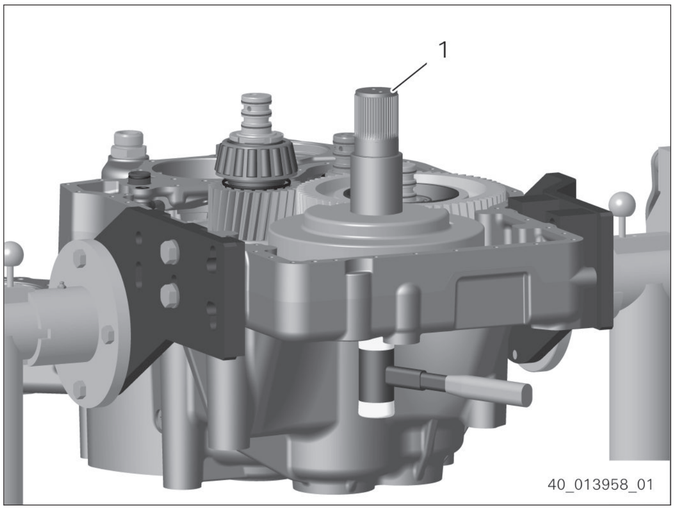


Fig. 106

3. Loosen cap screws.

4. Remove cover sheet (1).

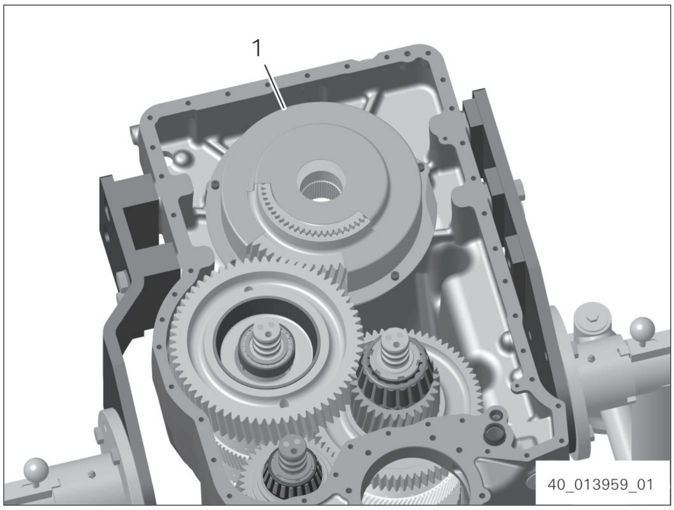


Fig. 107

5. ⚠ **CAUTION**

Risk of crushing due to moving load.
Slight to moderate injury possible.
⇨ Move load slowly and carefully.
⇨ Do not reach into danger area.

Use 5870.100.054 [Stop washer], 5870.204.002 [Eyebolt] and crane to lift gear out of housing.

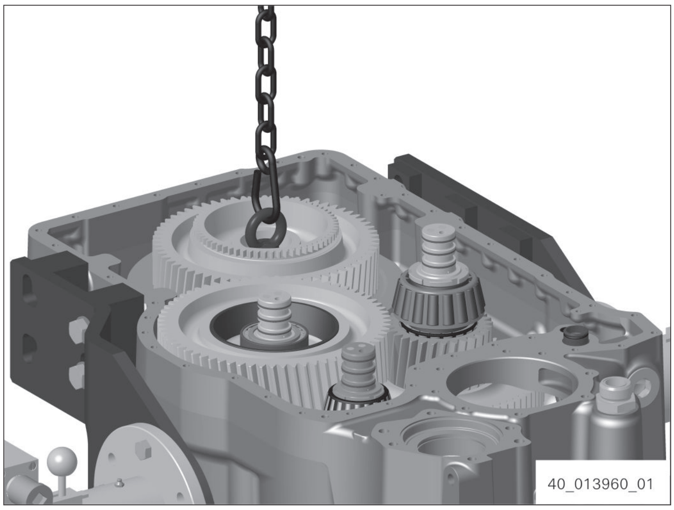


Fig. 108

6. Pull bearing inner ring from gear using a three-armed extractor and 5870.100.054 [Stop washer].

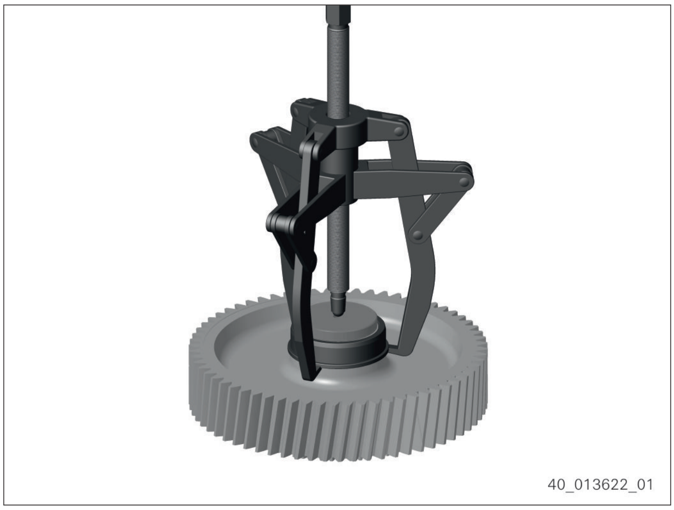


Fig. 109

7. Remove cover sheet (1).

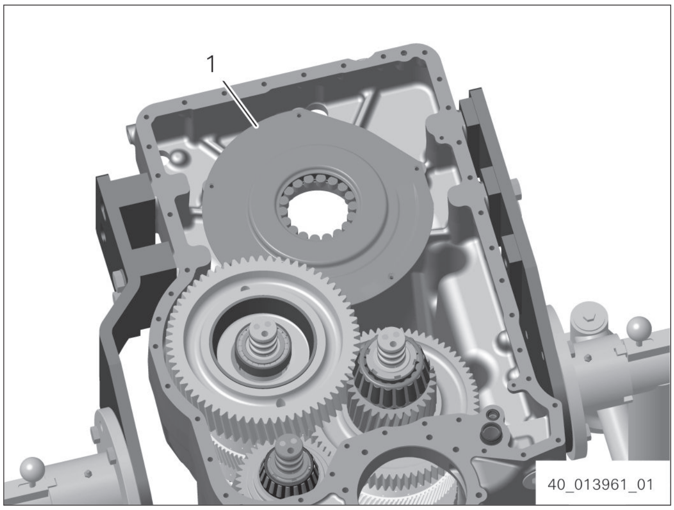


Fig. 110

8. Remove cylindrical roller bearing (1) from housing hole.

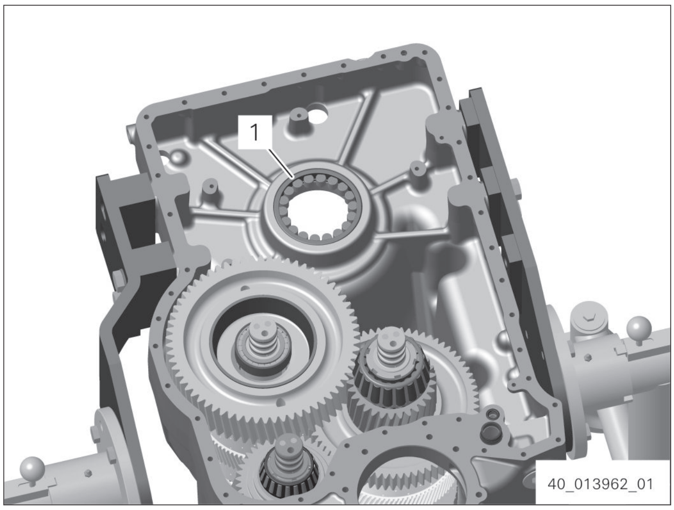


Fig. 111

Removing clutches

Special tools:
- 5870.204.002 Eyebolt

1. ⚠ **CAUTION**

   Risk of crushing due to moving load.
   Slight to moderate injury possible.
   ⇨ Move load slowly and carefully.
   ⇨ Do not reach into danger area.

   Slightly lift clutch KR/K2 (2) and move in direction of arrow.

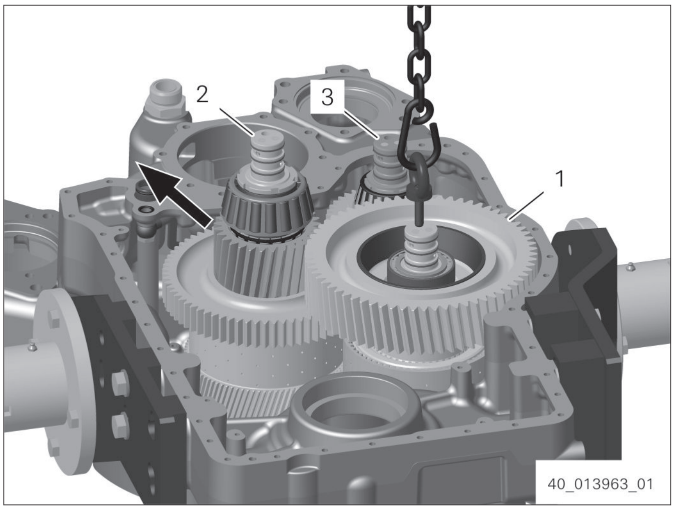


Fig. 112

2. Remove clutch K3/K4 (1) out of housing using 5870.204.002 [Eyebolt] and a crane.
3. Remove clutch KR/K2 (2) out of housing using 5870.204.002 [Eyebolt] and a crane.
4. Remove clutch KV/K1 (3) out of housing using 5870.204.002 [Eyebolt] and a crane.
5. Figure shows the disassembled clutches.
   - 1 = Clutch K1
   - 2 = Clutch KV
   - 3 = Clutch K2
   - 4 = Clutch KR
   - 5 = Clutch K3
   - 6 = Clutch K4

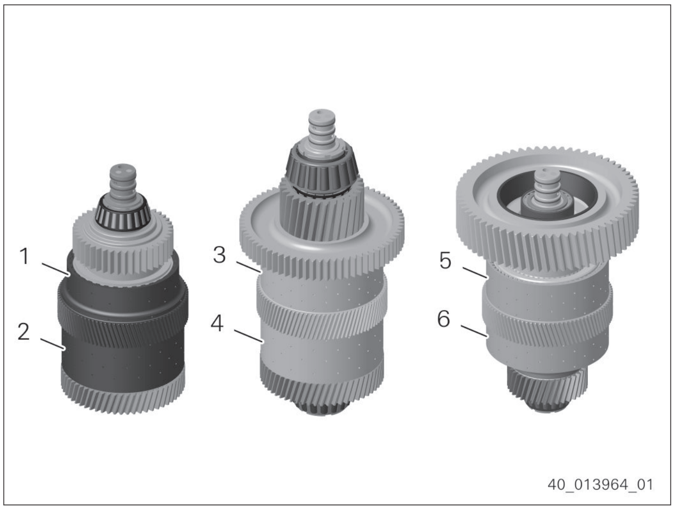


Fig. 113

Dismantling clutch K3/K4

Special tools:
- 5870.350.000 Assembly truck
- 5870.654.033 Assembly fixture
- AA02.778.672 Rapid grip
- 5873.002.001 Basic tool
- 5870.401.118 Groove nut wrench

- 5870.401.115 Groove nut wrench
- 5873.002.033 Gripping device
- 5870.345.072 Assembly fixture

1. Fasten clutch K3/K4 to 5870.350.000 [Assembly truck] by means of 5870.654.033 [Assembly fixture].

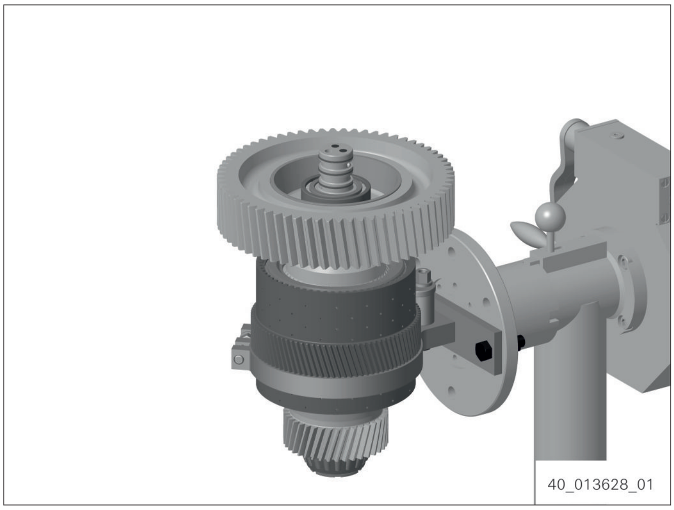


Fig. 114

2. Remove R-rings (1).

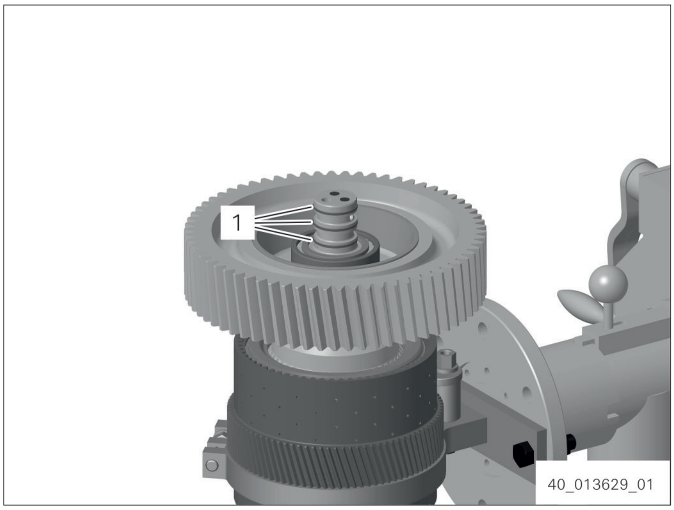


Fig. 115

Dismantling clutch K3

3. Pull roller bearing from disk carrier using a three-armed extractor.

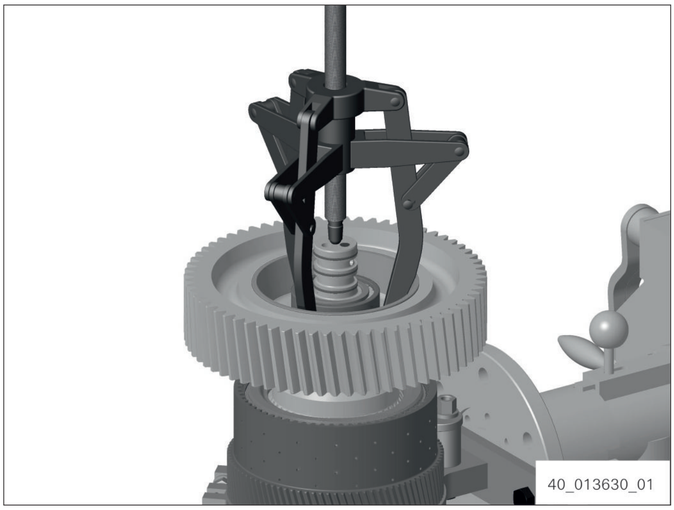


Fig. 116

4. Remove spur gear (1).

5. Remove bearing outer ring (2) from spur gear.

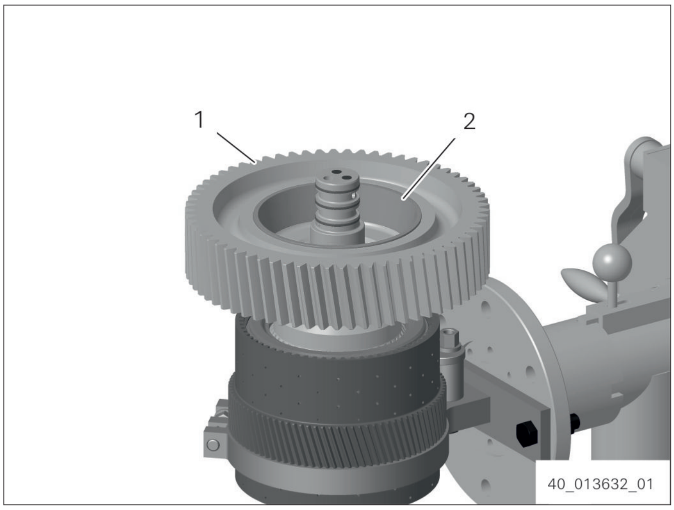


Fig. 117

6. Pull off bearing inner ring with AA02.778.672 [Rapid grip] and 5873.002.001 [Basic tool].

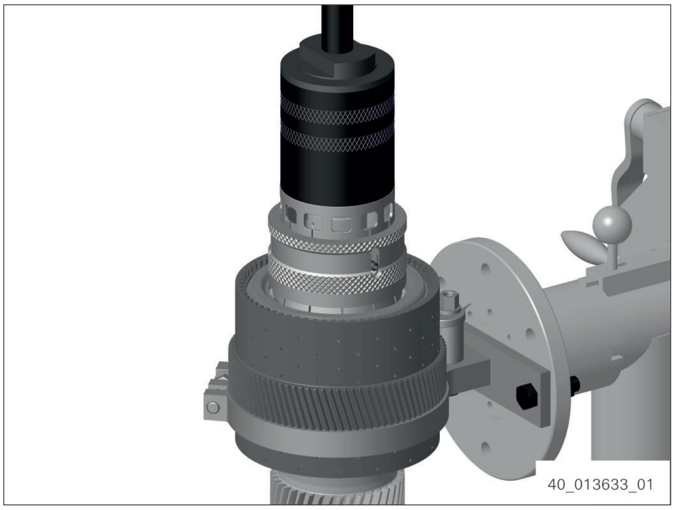


Fig. 118

7. Remove snap ring (1).

8. Remove end shim (2) from disk carrier.

9. Remove disk package (3).

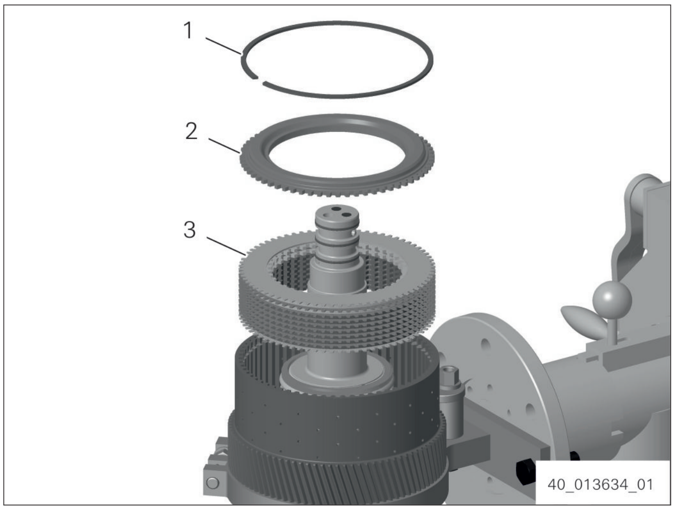


Fig. 119

Dismantling clutch K4

10. Turn disk carrier by 90°.

11. Loosen slotted nut with
5870.401.118 [Groove nut wrench] and
5870.401.115 [Groove nut wrench].

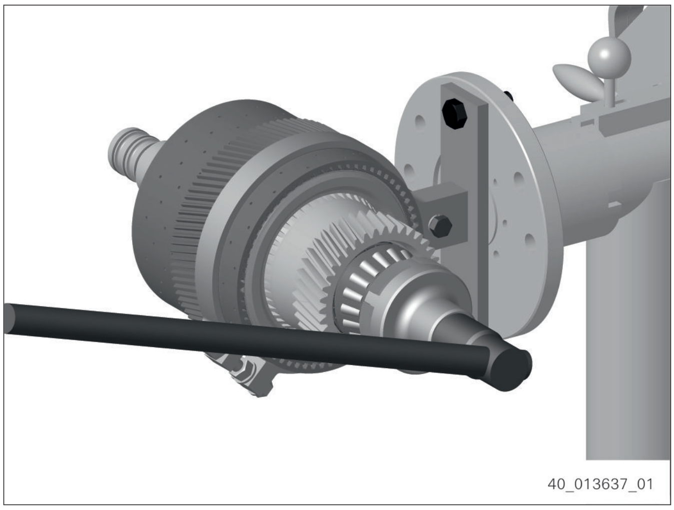


Fig. 120

12. Turn disk carrier by 90°.

13. Pull helical gear, bearing inner ring and taper roller bearing from disk carrier using the three-armed extractor.

14. Remove bearing outer rings from helical gear.

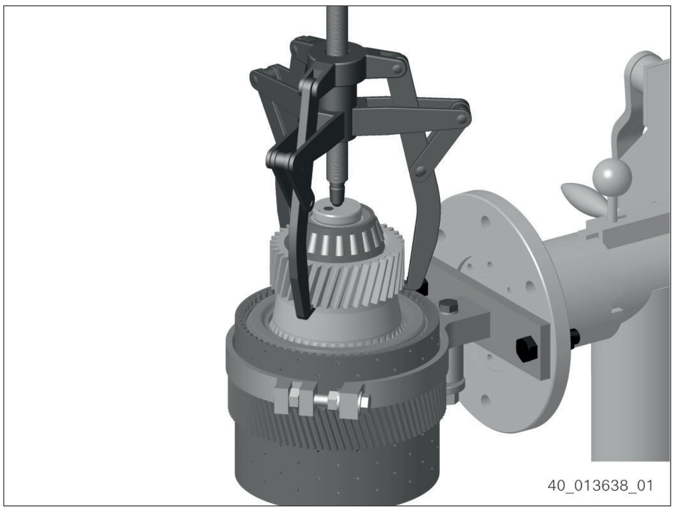


Fig. 121

15. Remove washer.

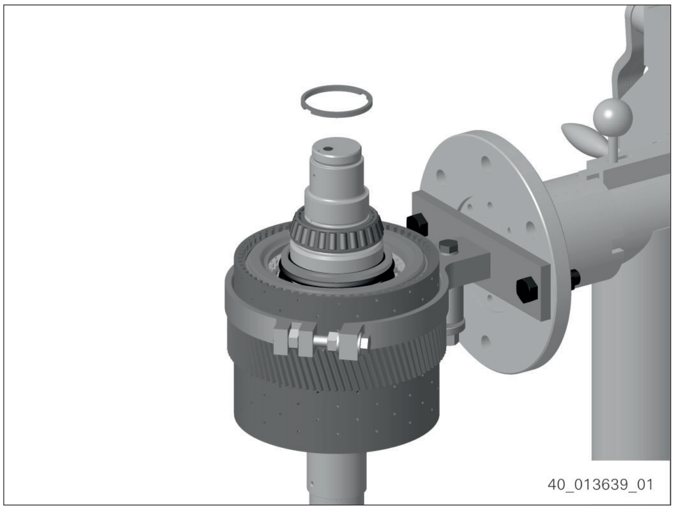


Fig. 122

16. Pull off bearing inner ring with 5873.002.033 [Gripping device] and 5873.002.001 [Basic tool].

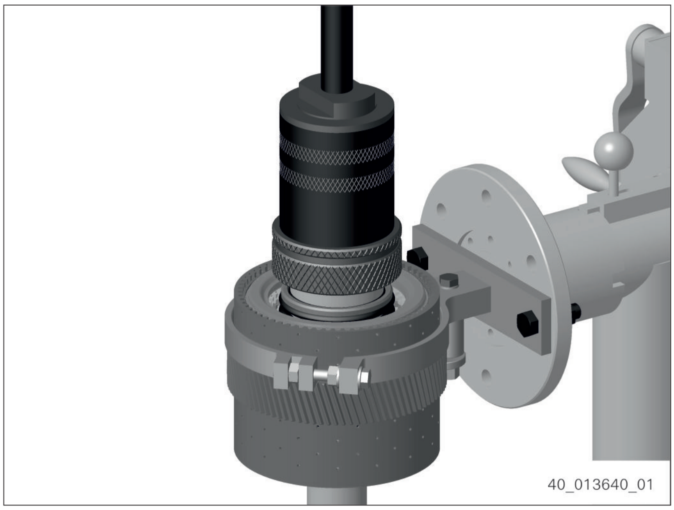


Fig. 123

17. Remove snap ring (1).

18. Remove end shim (2) from disk carrier.

19. Remove disk package (3).

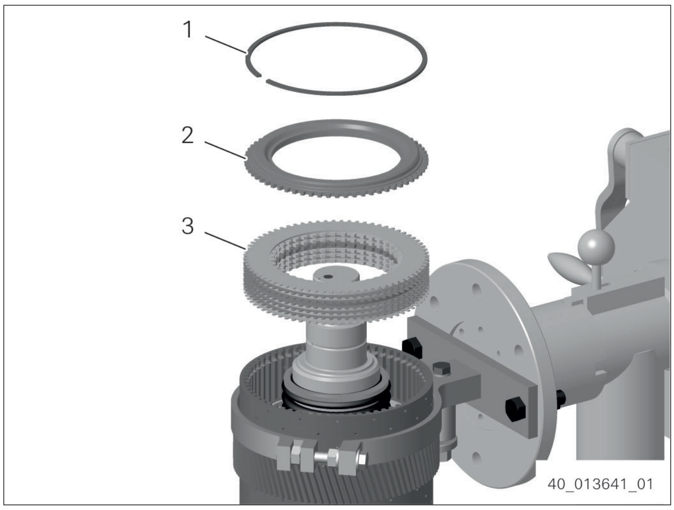


Fig. 124

20. Press guide ring downwards with 5870.345.072 [Assembly fixture] and hand-operated press and hold it there.

21. Remove snap ring.

22. Release hand-operated press.

23. Remove guide ring, compression spring and intermediate washer.

24. Turn disk carrier by 180°.

25. Press guide ring downwards with 5870.345.072 [Assembly fixture] and hand-operated press and hold it there.

26. Remove snap ring.

27. Release hand-operated press.

28. Remove guide ring, compression spring and intermediate washer.

29. Press both pistons out of disk carrier using compressed air.

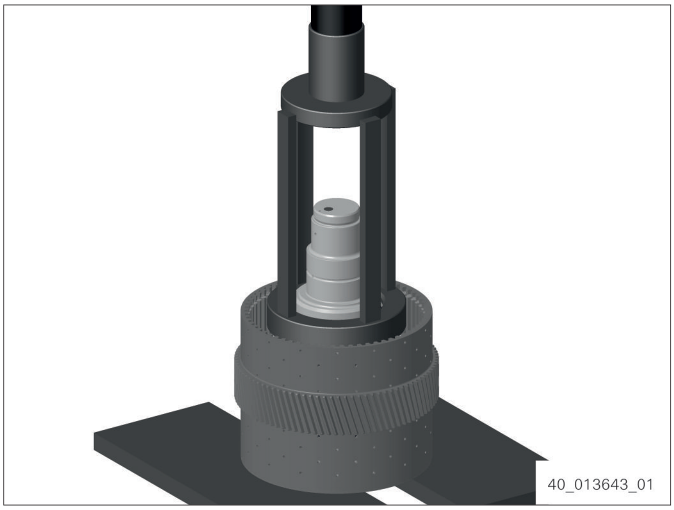


Fig. 125

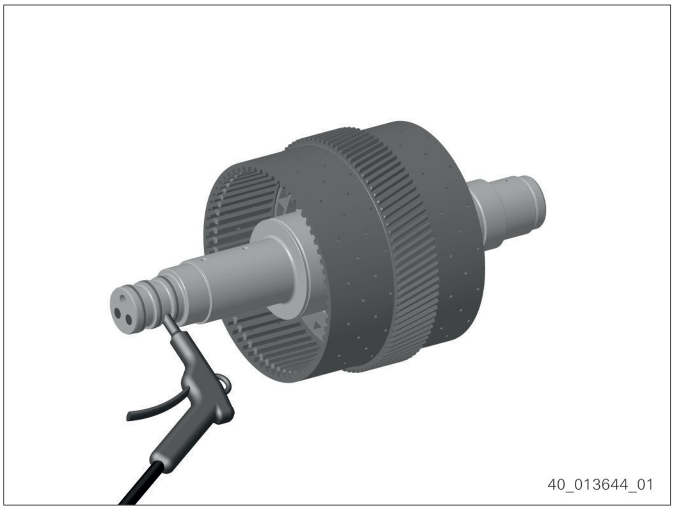


Fig. 126

Dismantling clutch KR/K2

Special tools:

- 5870.350.000 Assembly truck
- 5870.654.033 Assembly fixture
- AA02.769.745 Slotted nut wrench
- 5873.012.018 Rapid grip
- 5873.002.001 Basic tool

- 5873.012.019 Rapid grip
- 5873.002.000 Basic tool
- 5870.401.099 Groove nut wrench
- 5873.002.044 Gripping device
- 5870.654.045 Assembly fixture
- 5873.012.013 Rapid grip
- 5870.345.072 Assembly fixture

1. Fasten clutch KR/K2 to

   5870.350.000 [Assembly truck] using 5870.654.033 [Assembly fixture].

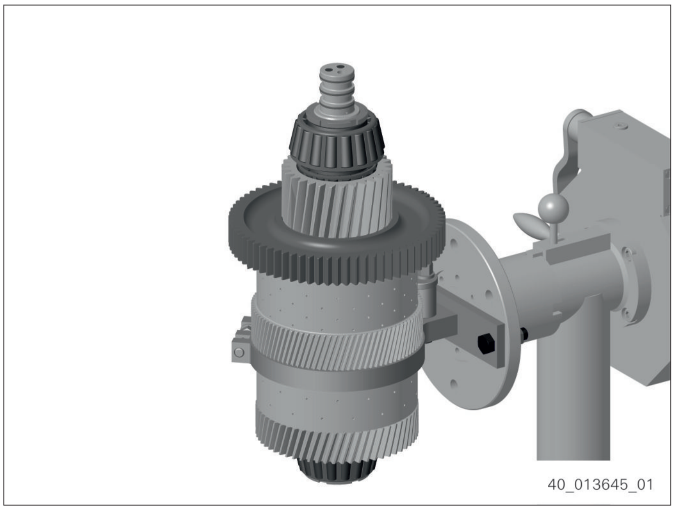


Fig. 127

2. Remove R-rings (1).

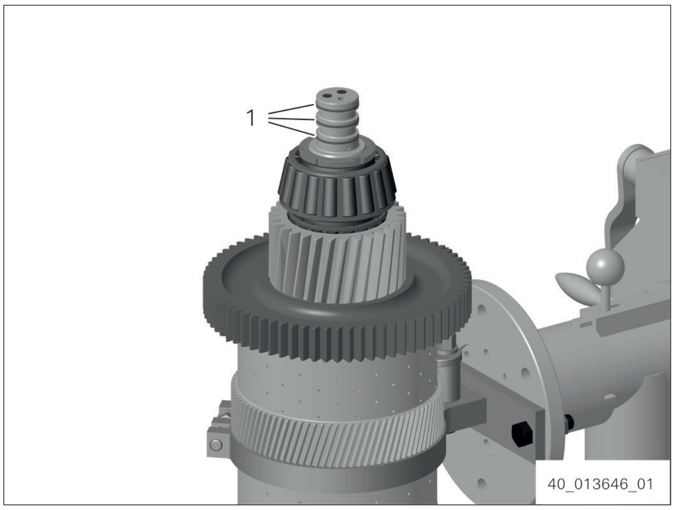


Fig. 128

Dismantling clutch K2

3. Turn disk carrier by 90°.

4. Loosen slotted nut with AA02.769.745 [Slotted nut wrench].

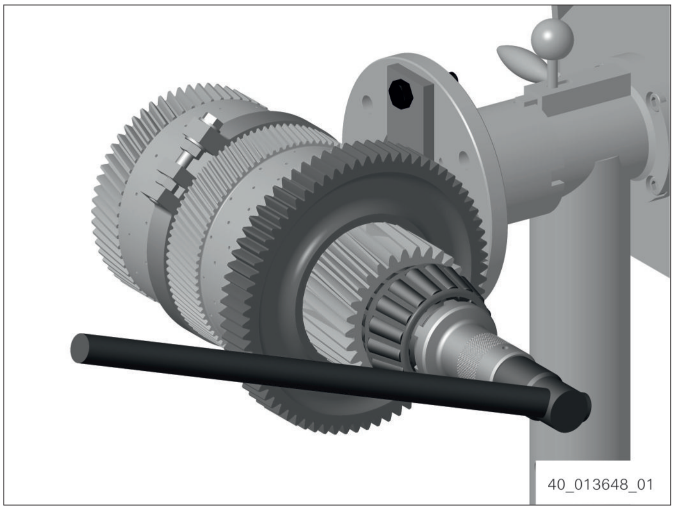


Fig. 129

5. Turn disk carrier by 90°.

6. Pull off bearing inner ring with 5873.012.018 [Rapid grip] and 5873.002.001 [Basic tool].

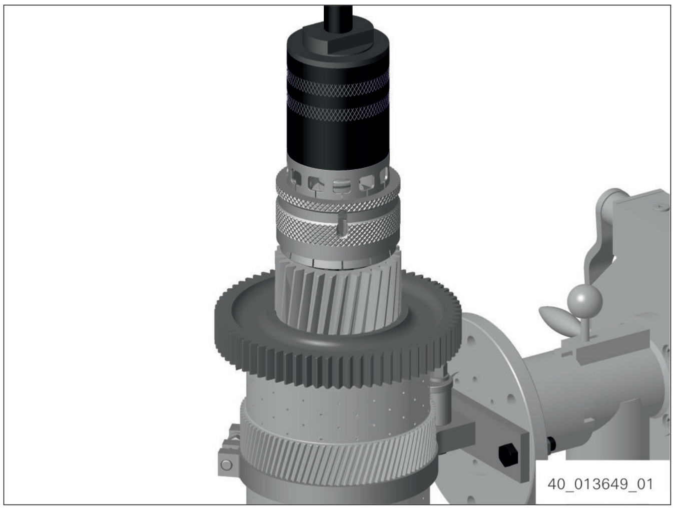


Fig. 130

7. Pull both gears and bearing inner ring from disk carrier using two-armed extractor.

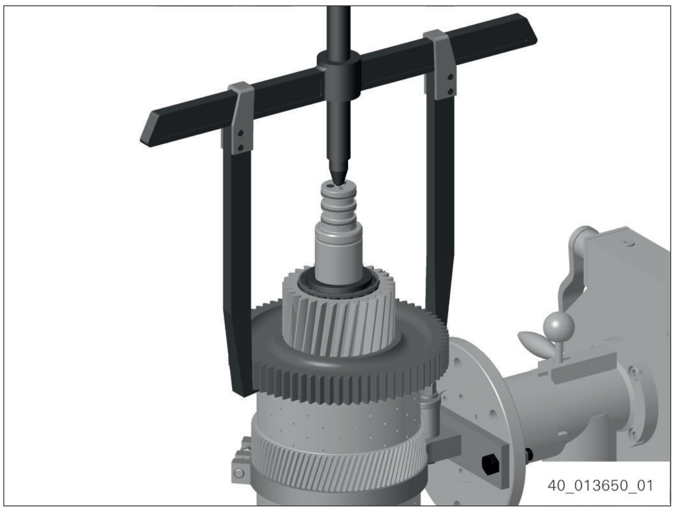


Fig. 131

8. Pull off bearing inner ring with 5873.012.019 [Rapid grip] and 5873.002.000 [Basic tool].

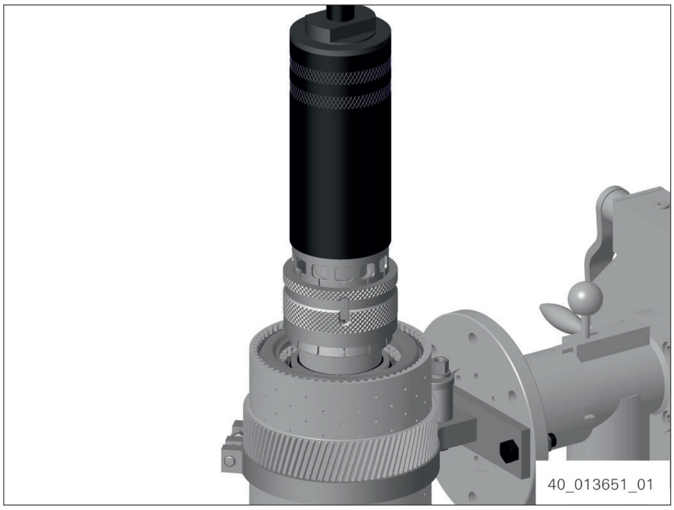


Fig. 132

9. Remove snap ring (1).

10. Remove end shim (2) from disk carrier.

11. Remove disk package (3).

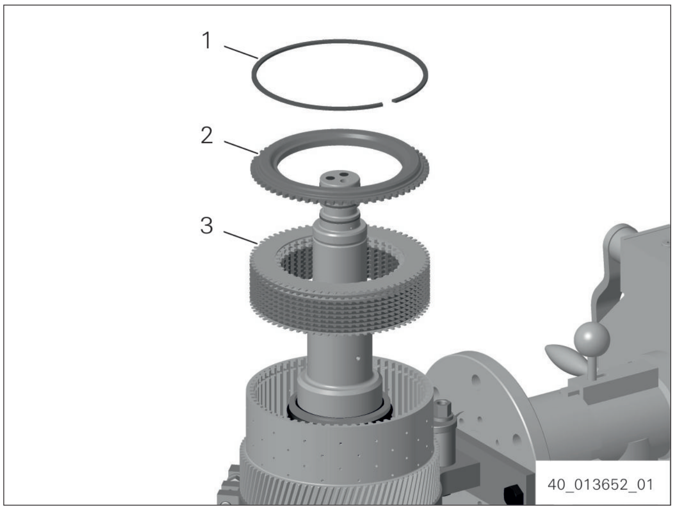


Fig. 133

Dismantling KR clutch

12. Turn disk carrier by 90°.

13. Loosen slotted nut with 5870.401.099 [Groove nut wrench].

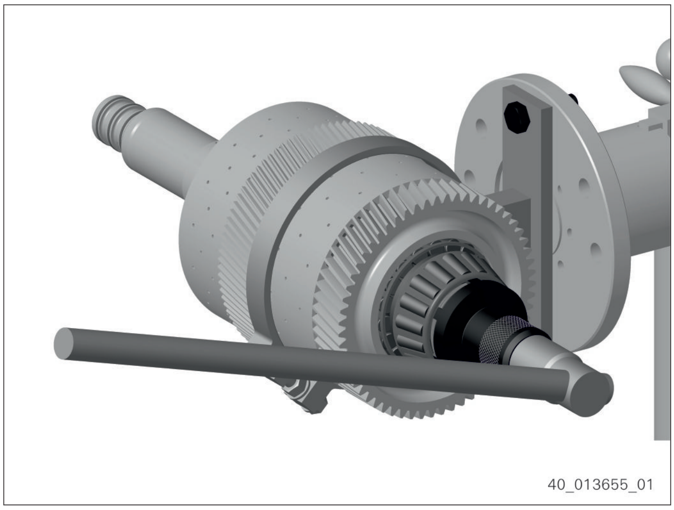


Fig. 134

14. Turn disk carrier by 90°.

15. Pull off bearing inner ring with 5873.002.044 [Gripping device] and 5873.002.001 [Basic tool].

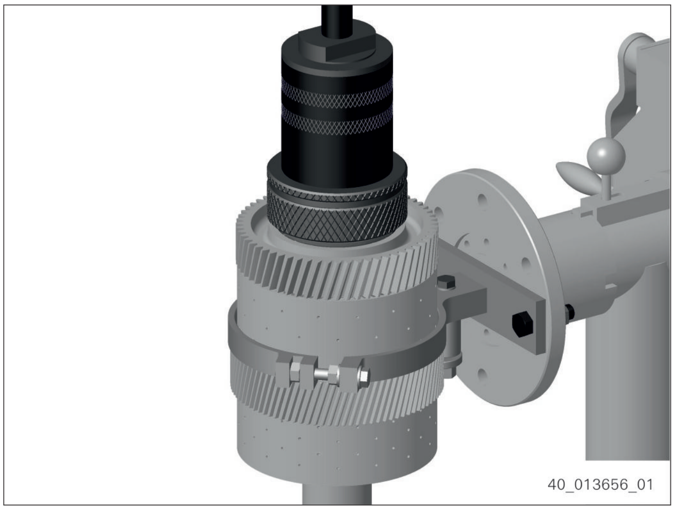


Fig. 135

16. Pull spur gear and bearing inner ring from disk carrier using 5870.654.045 [Assembly fixture] and three-armed puller.

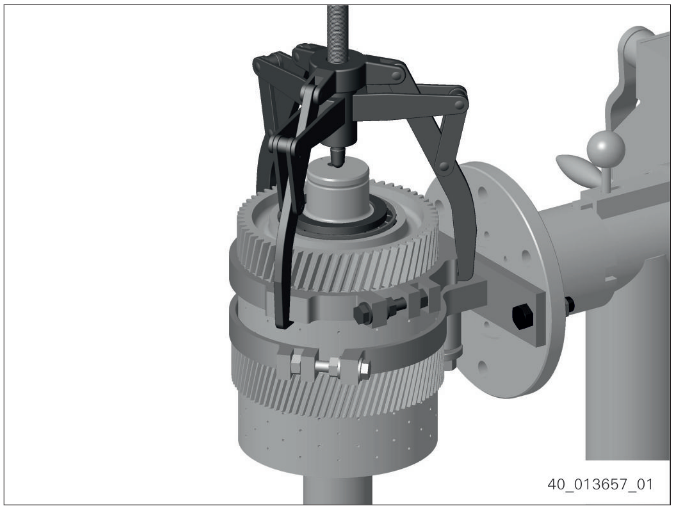


Fig. 136

17. Remove ring.

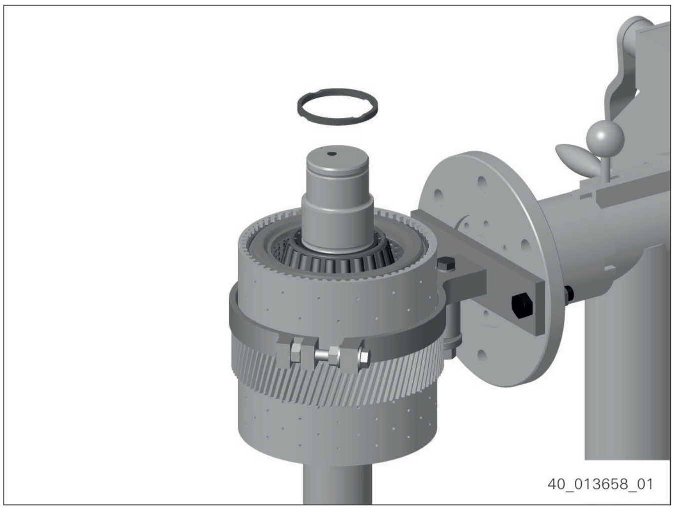


Fig. 137

18. Remove snap ring (1).

19. Remove end shim (2) from disk carrier.

20. Remove disk package (3).

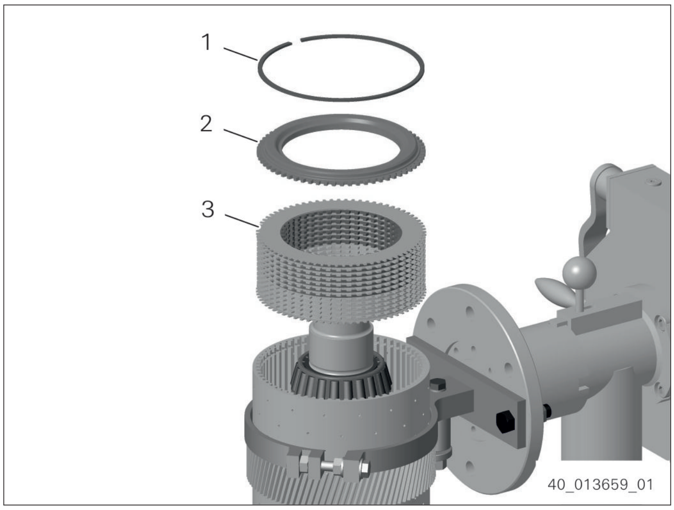


Fig. 138

21. Pull off bearing inner ring with 5873.012.013 [Rapid grip] and 5873.002.001 [Basic tool].

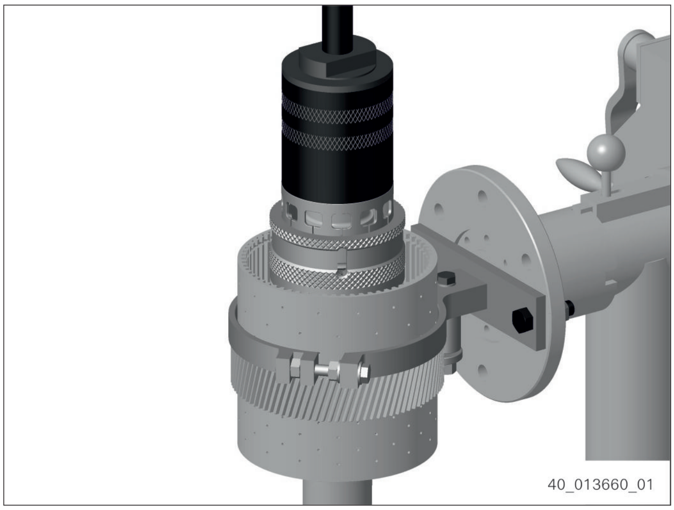


Fig. 139

22. Press guide ring downwards with 5870.345.072 [Assembly fixture] and hand-operated press and hold it there.

23. Remove snap ring.

24. Release hand-operated press.

25. Remove guide ring, compression spring and intermediate washer.

26. Turn disk carrier by 180°.

27. Press guide ring downwards with 5870.345.072 [Assembly fixture] and hand-operated press and hold it there.

28. Remove snap ring.

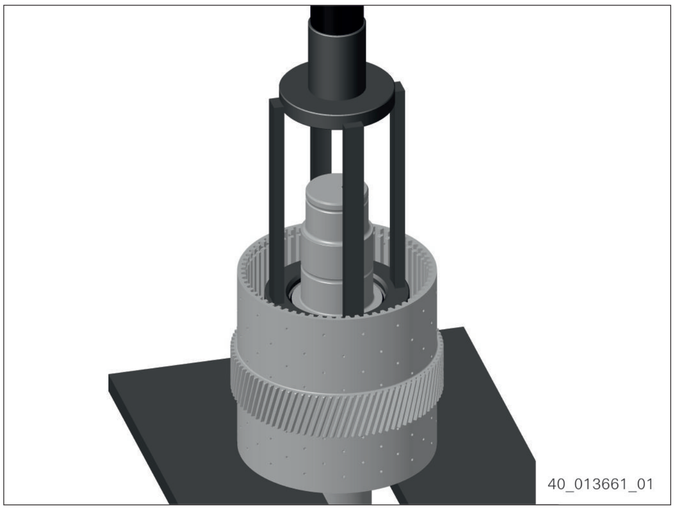


Fig. 140

29. Release hand-operated press.

30. Remove guide ring, compression spring and intermediate washer.

31. Press both pistons out of disk carrier using compressed air.

Fig. 141

Dismantling clutch KV/K1

Special tools:

- 5870.350.000 Assembly truck
- 5870.654.033 Assembly fixture
- 5870.401.118 Groove nut wrench
- 5870.401.115 Groove nut wrench
- 5873.001.023 Gripping device
- 5873.001.000 Basic tool
- 5870.345.036 Pry bar
- 5873.001.034 Gripping device
- 5870.654.045 Assembly fixture
- 5870.345.072 Assembly fixture

1. Fasten clutch KV/K1 to 5870.350.000 [Assembly truck] using 5870.654.033 [Assembly fixture].

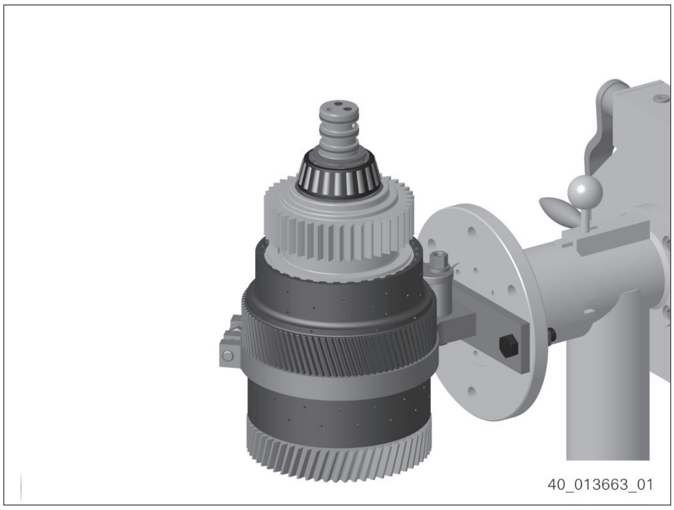


Fig. 142

2. Remove R-rings (1).

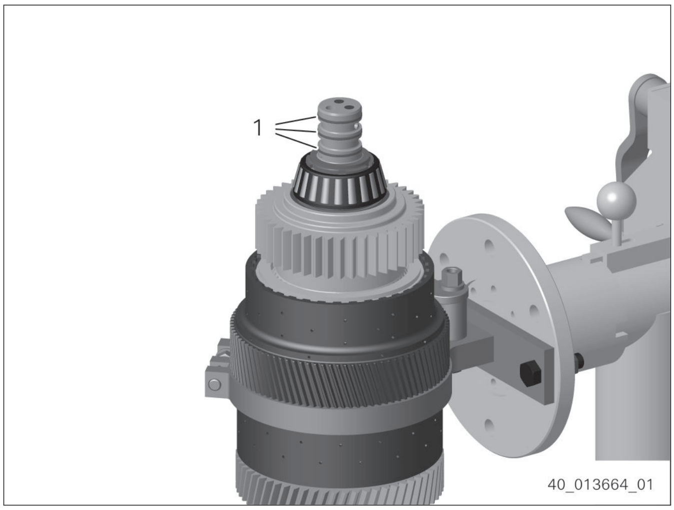


Fig. 143

Dismantling clutch K1

3. Turn disk carrier by 90°.

4. Loosen slotted nut with 5870.401.118 [Groove nut wrench] and 5870.401.115 [Groove nut wrench].

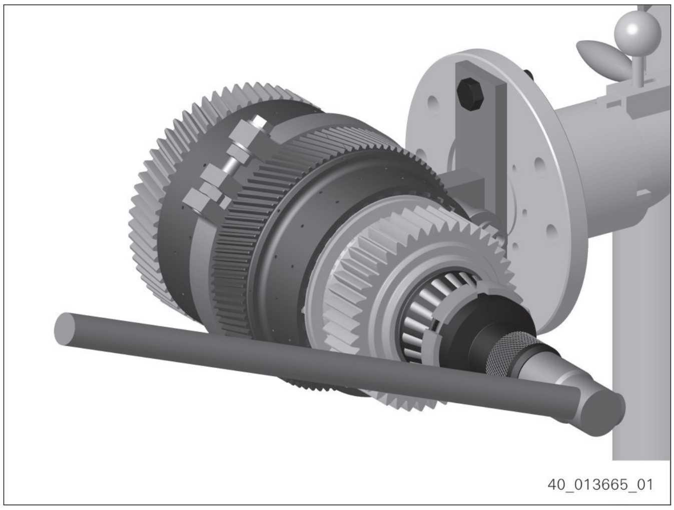


Fig. 144

5. Turn disk carrier by 90°.

6. Pull off bearing inner ring with 5873.001.023 [Gripping device] and 5873.001.000 [Basic tool].

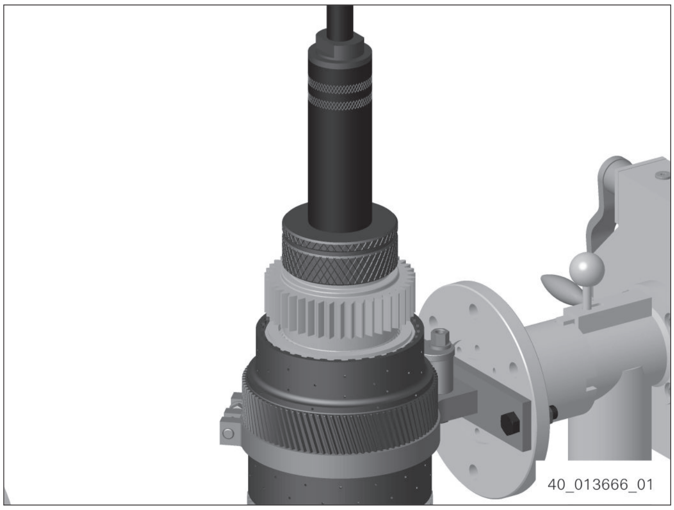


Fig. 145

7. Remove washer.

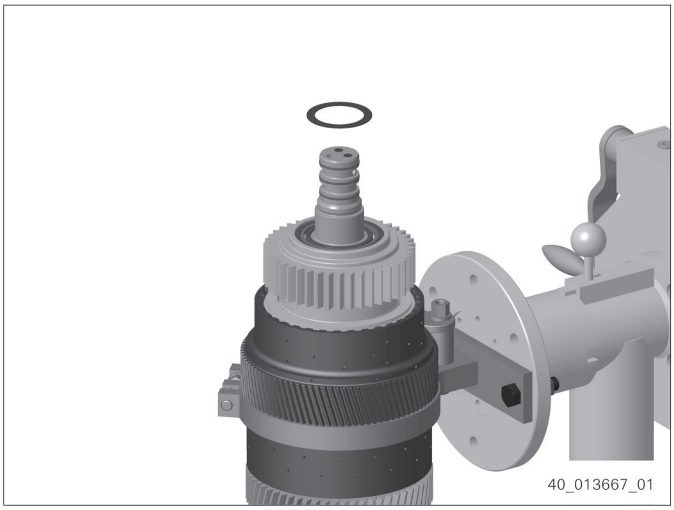


Fig. 146

8. Pull gear and parts of the angular ball bearing from disk carrier using the three-armed extractor.

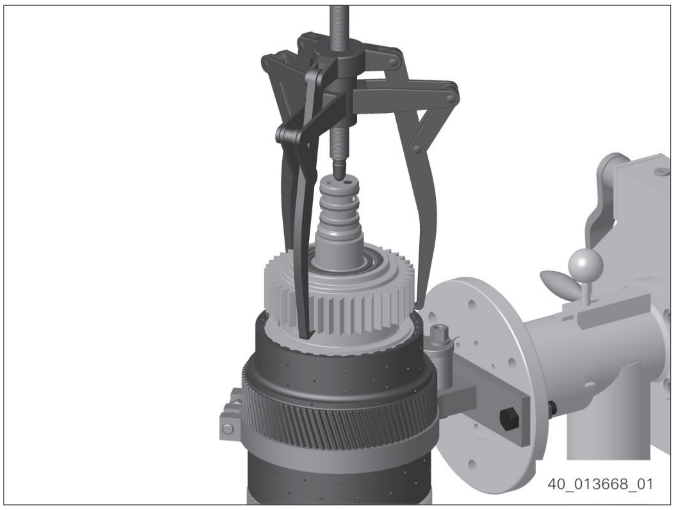


Fig. 147

9. Figure shows single parts of gear bearing.
   - 1 = angular ball bearing
   - 2 = Snap ring
   - 3 = gear

   The angular ball bearing is only available as complete unit.

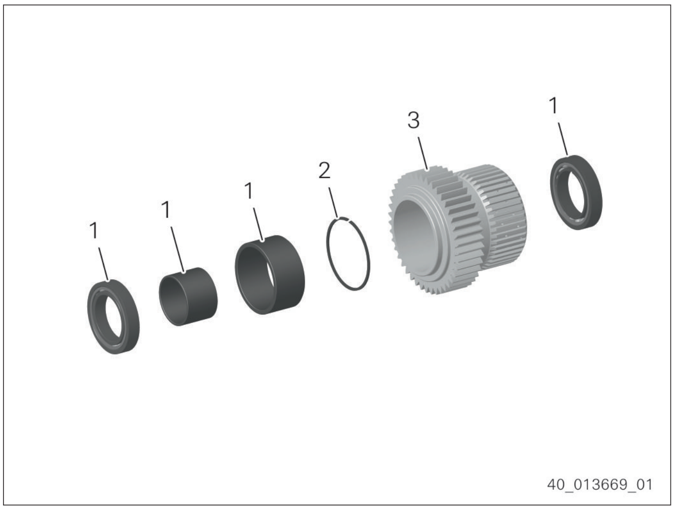


Fig. 148

10. Remove intermediate ring of angular ball bearing.

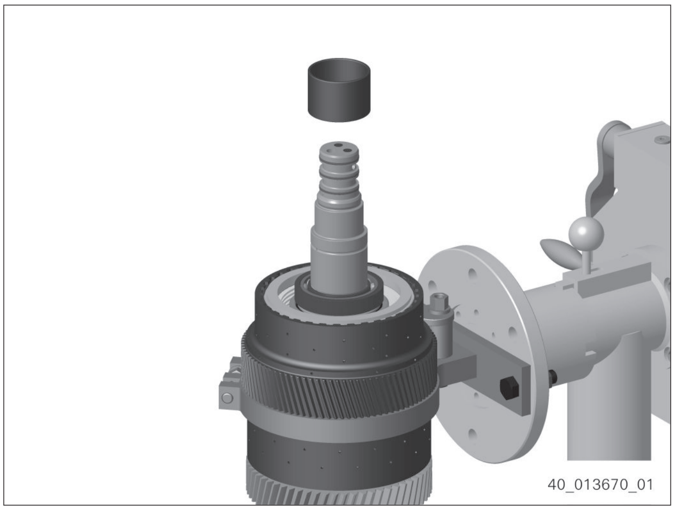


Fig. 149

11. Remove snap ring (1).

12. Remove end shim (2) from disk carrier.

13. Remove disk package (3).

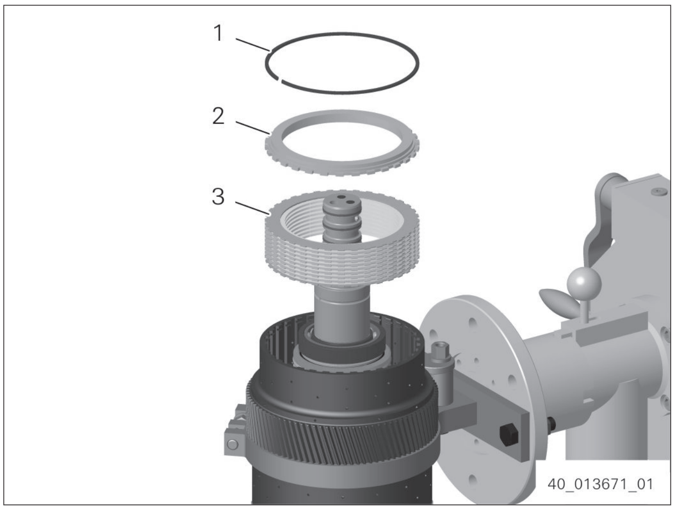


Fig. 150

14. Use 5870.345.036 [Pry bar] to pull the lower ball bearing of the angular ball bearing from the disk carrier and remove releasing balls.

→ The ball bearing is destroyed.

The angular ball bearing is only available as complete unit.

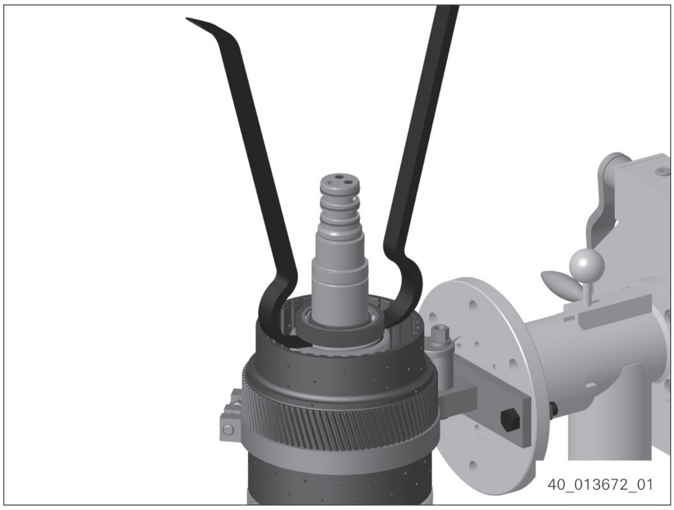


Fig. 151

Dismantling clutch KV

15. Turn disk carrier by 90°.

16. Loosen slotted nut with 5870.401.118 [Groove nut wrench] and 5870.401.115 [Groove nut wrench].

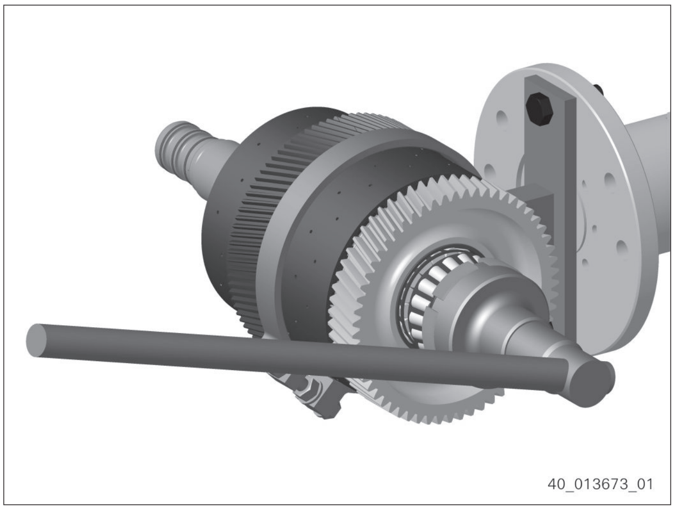


Fig. 152

17. Turn disk carrier by 90°.

18. Pull off bearing inner ring with 5873.001.034 [Gripping device] and 5873.001.000 [Basic tool].

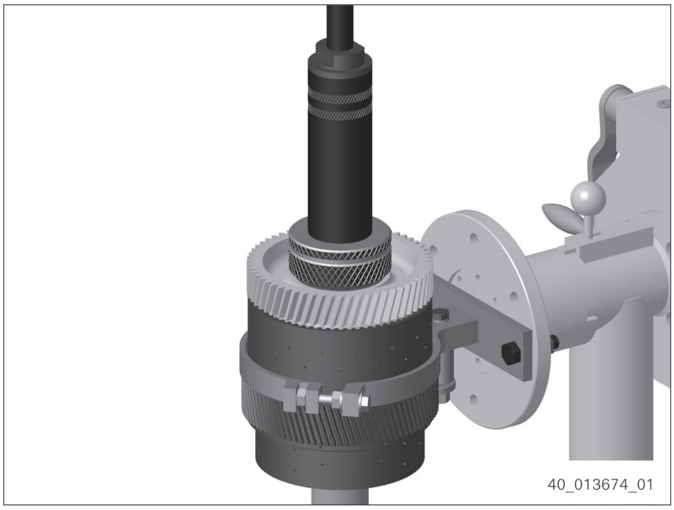


Fig. 153

19. Pull spur gear and bearing inner ring from disk carrier using 5870.654.045 [Assembly fixture] and three-armed puller.

20. Remove bearing outer rings from spur gear.

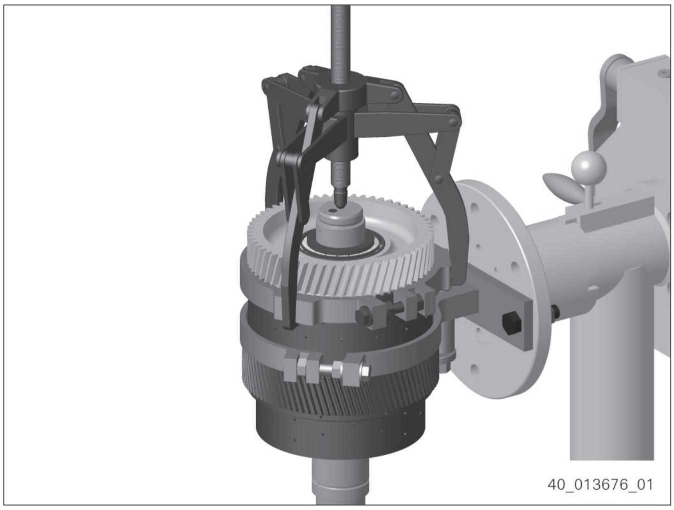


Fig. 154

21. Remove ring.

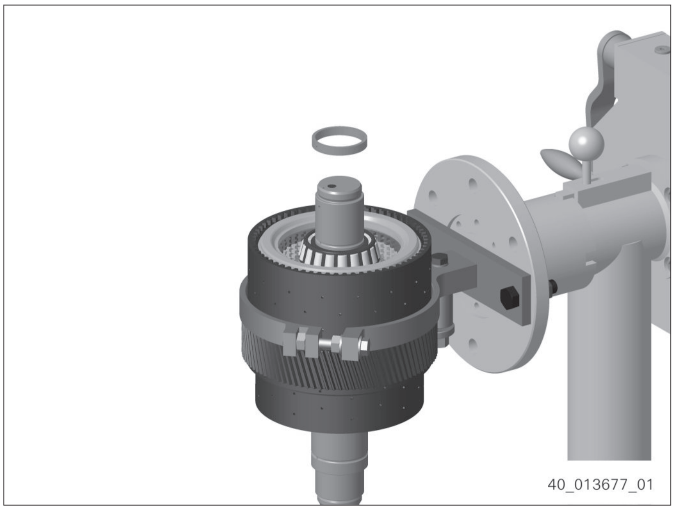


Fig. 155

22. Remove snap ring (1).

23. Remove end shim (2) from disk carrier.

24. Remove disk package (3).

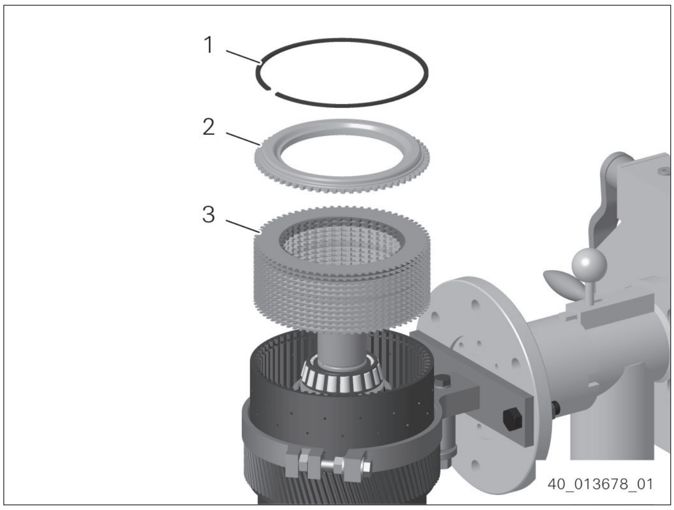


Fig. 156

25. Pull off bearing inner ring with 5873.001.034 [Gripping device] and 5873.001.000 [Basic tool].

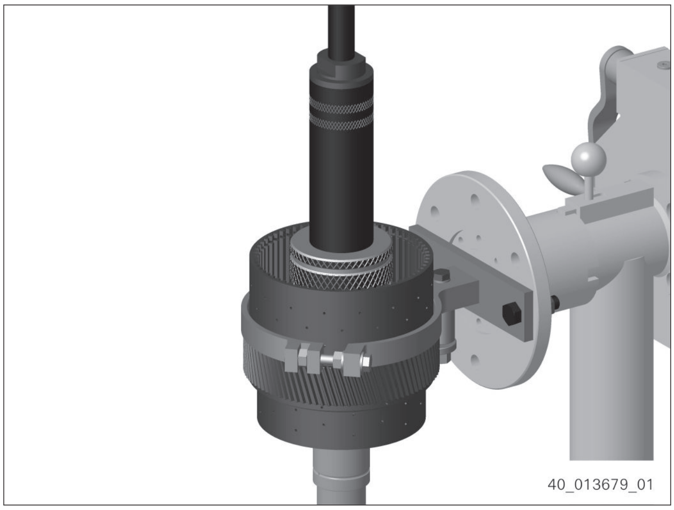


Fig. 157

26. Press guide ring downwards with 5870.345.072 [Assembly fixture] and hand-operated press and hold it there.

27. Remove snap ring.

28. Release hand-operated press.

29. Remove guide ring, compression spring and intermediate washer.

30. Turn disk carrier by 180°.

31. Press guide ring downwards with 5870.345.072 [Assembly fixture] and hand-operated press and hold it there.

32. Remove snap ring.

33. Release hand-operated press.

34. Remove guide ring, compression spring and intermediate washer.

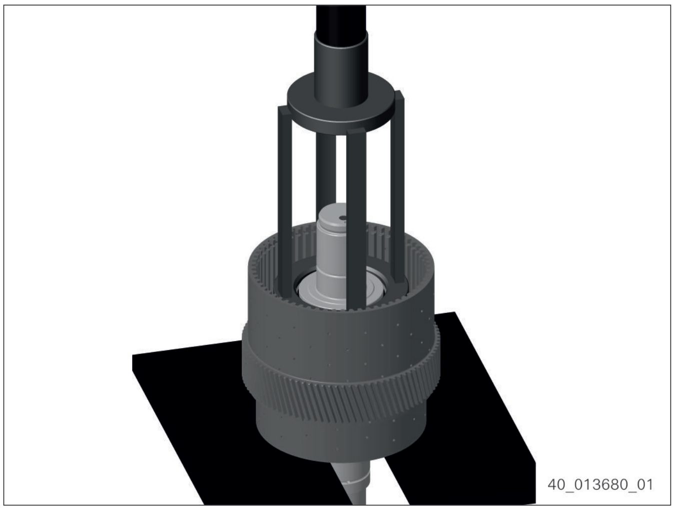


Fig. 158

35. Press both pistons out of disk carrier using compressed air.

Fig. 159

Disassembling the housing

1. Pull bearing outer rings out of housing holes. Figure shows the positions of the bearing outer rings.
   - 1 = clutch KV/K1
   - 2 = clutch K3/K4
   - 3 = clutch KR/K2

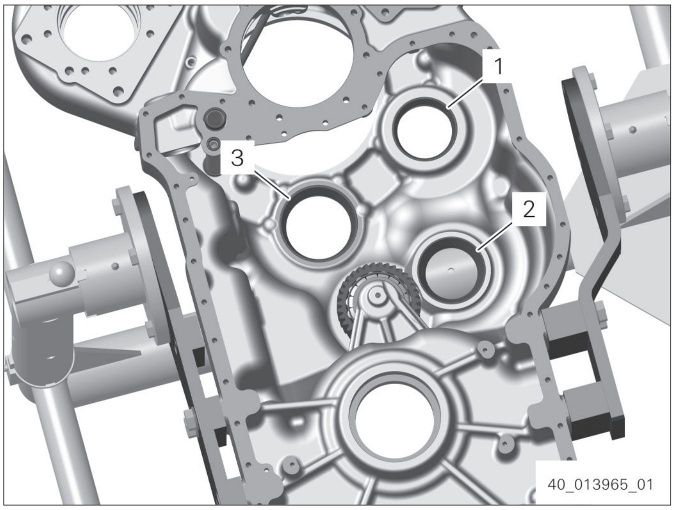


Fig. 160

2. Remove gear (1) with both tapered roller bearings (layshaft gear).

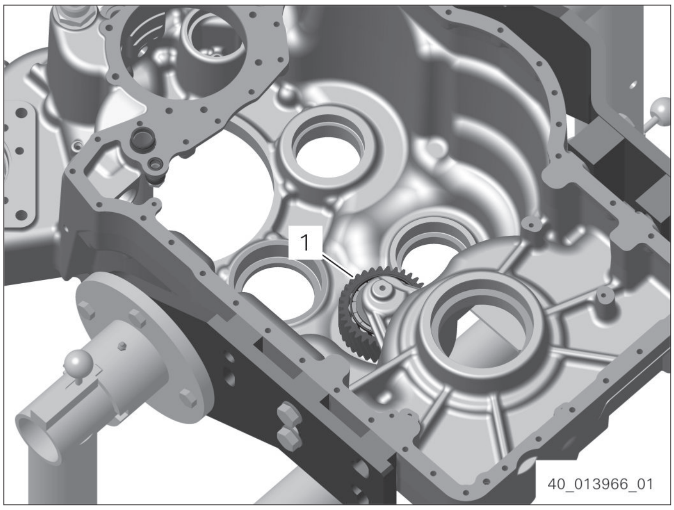


Fig. 161

3. Loosen the adapter (1).

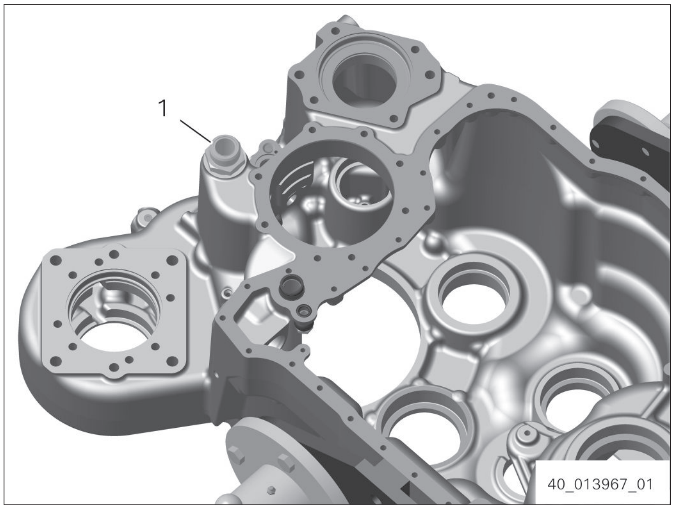


Fig. 162

4. Remove tube (1).

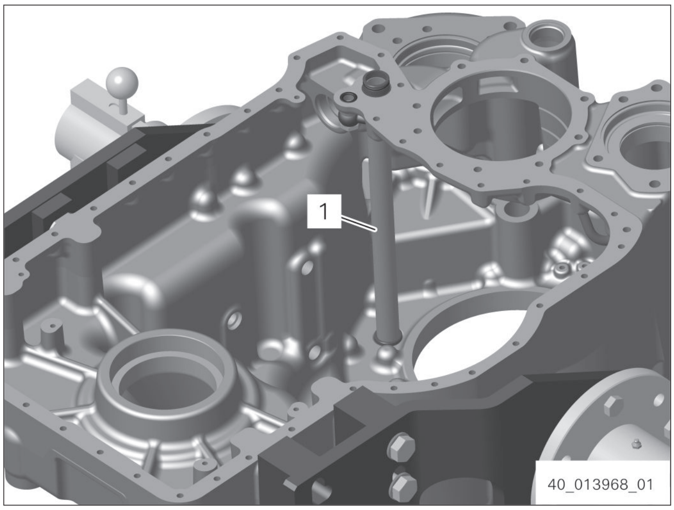


Fig. 163

5. Loosen hollow screws and tube.

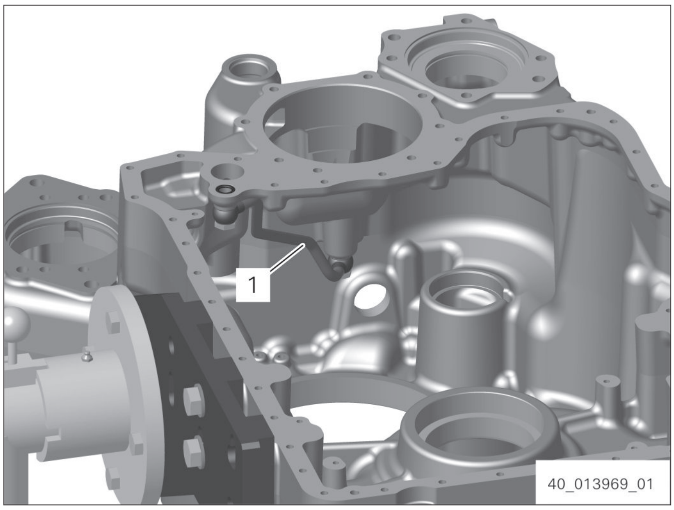


Fig. 164

Assembly

Assembling housing

1. Insert sealing rings between tube (2) and housing.
2. Push sealing rings onto the hollow screws.
3. Screw in the hollow screws with sealing ring (1) and tighten them.
   Tightening torque: 45 Nm

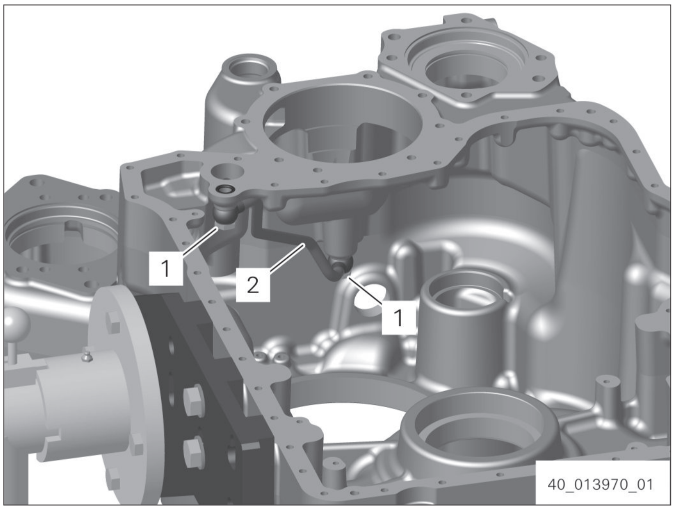


Fig. 165

4. Grease O-rings.
5. Insert O-rings (1) into annular grooves of the tube.

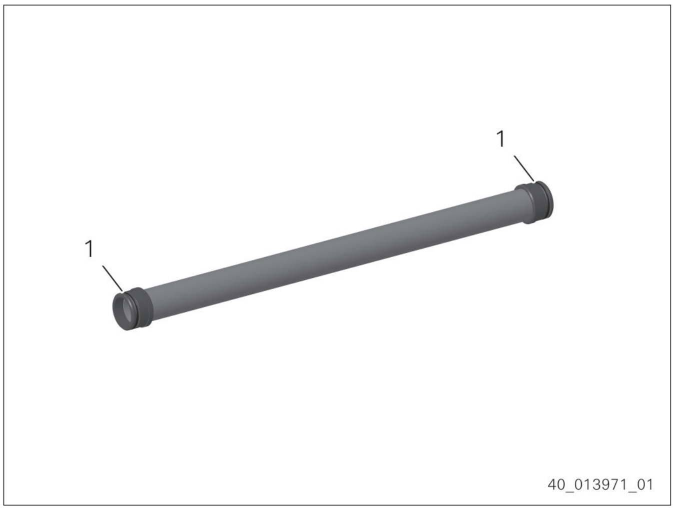


Fig. 166

6. Insert tube (1) into the housing.

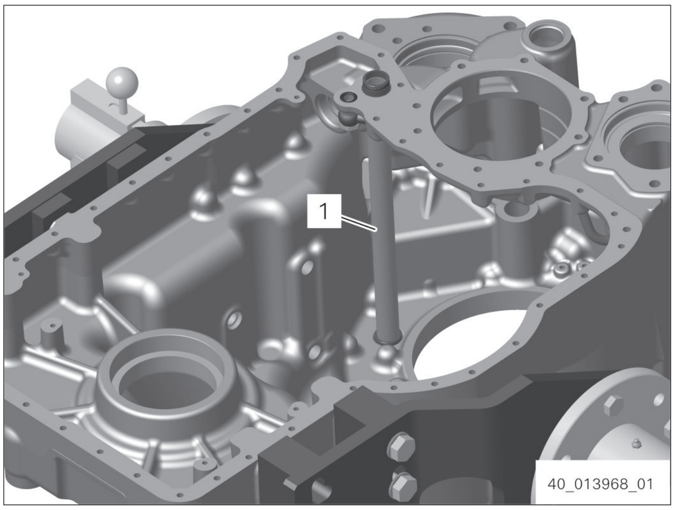


Fig. 167

7. Screw in the adapter with O-ring (1) and tighten.
   Tightening torque: 117 Nm

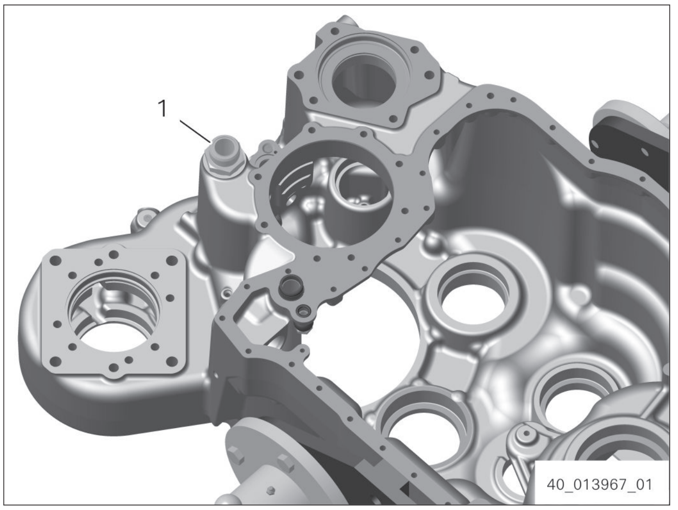


Fig. 168

8. Insert ring and both tapered roller bearings into gear (layshaft gear).

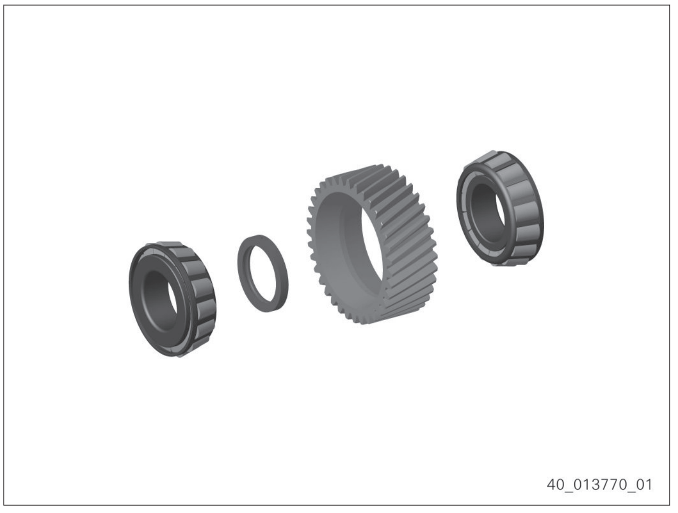


Fig. 169

9. Insert gear (1) into the housing.
   Countershaft cannot be inserted before installation of the clutches.

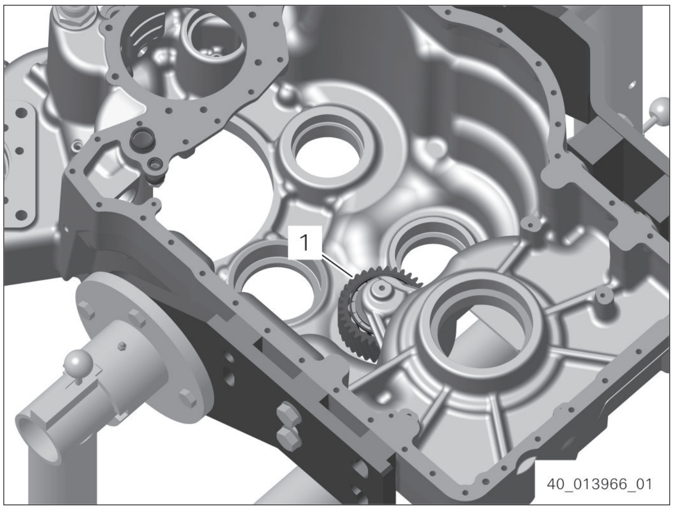


Fig. 170

10. Insert bearing outer rings in housing holes until contact is obtained.
    Figure shows the positions of the bearing outer rings.
    - 1 = clutch KV/K1
    - 2 = clutch K3/K4
    - 3 = clutch KR/K2

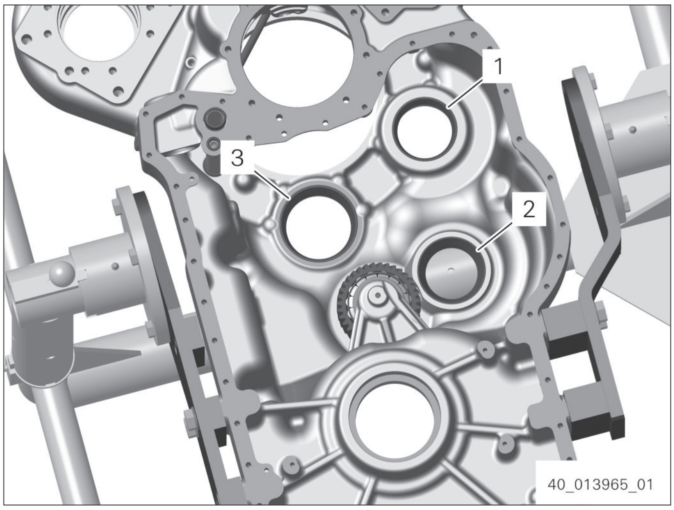


Fig. 171

Assembling and installing clutches and output

Assembling clutch KV/K1

Special tools:

- 5870.350.000 Assembly truck
- 5870.654.033 Assembly fixture
- 5870.320.014 Assembly fixture
- 5870.320.018 Inserting tool
- 5870.320.019 Press-in mandrel
- 5870.345.072 Assembly fixture
- 5870.401.118 Groove nut wrench
- 5870.401.115 Groove nut wrench

1. Fasten disk carrier to 5870.350.000 [Assembly truck] using 5870.654.033 [Assembly fixture].

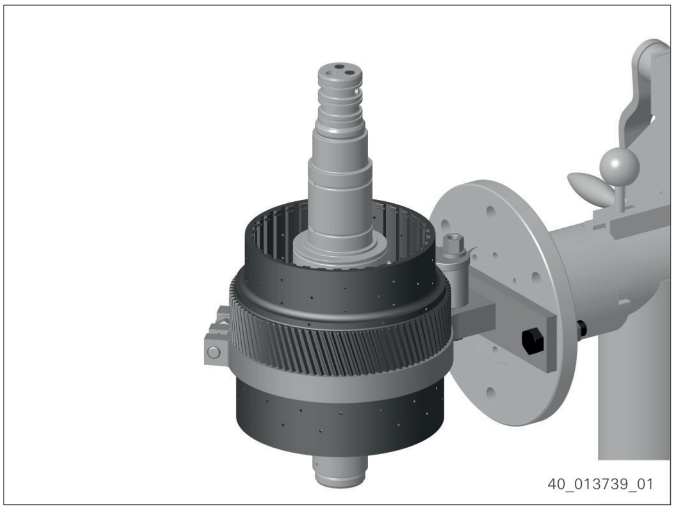


Fig. 172

Assembling disk carrier

2. Turn disk carrier by 180.

3. Insert sealing plug (1) into hole with 5870.320.014 [Assembly fixture] and 5870.320.018 [Inserting tool].

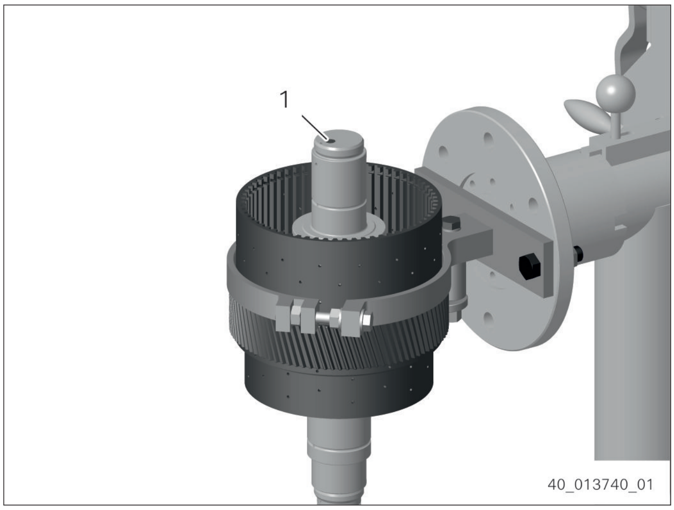


Fig. 173

4. Flush-mount valve (1) using 5870.320.019 [Press-in mandrel]. Insert valve with the chamfered side facing downwards.

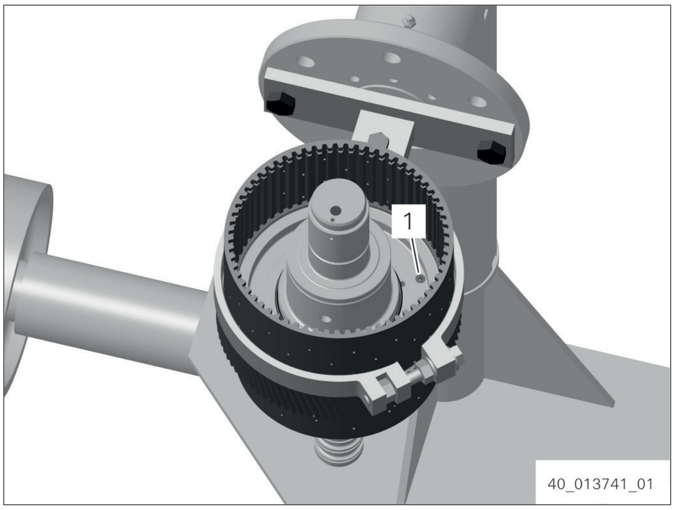


Fig. 174

5. Turn disk carrier by 180.

6. Insert sealing plugs (1) into holes using 5870.320.014 [Assembly fixture] and 5870.320.018 [Inserting tool].

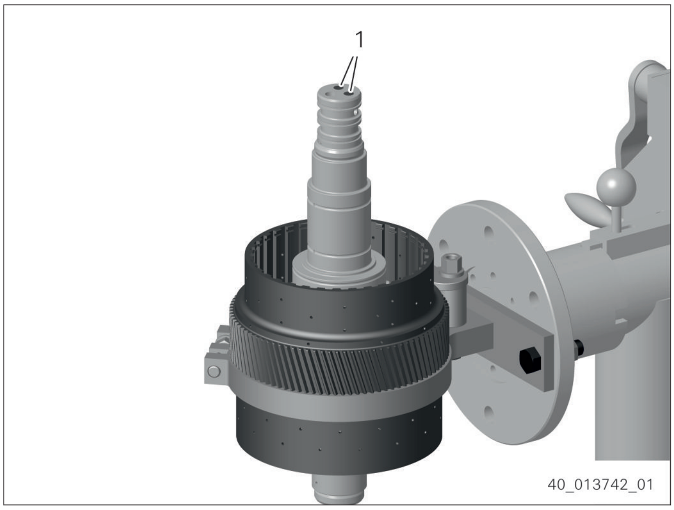


Fig. 175

7. Flush-mount valve (1) using 5870.320.019 [Press-in mandrel]. Insert valve with the chamfered side facing downwards.

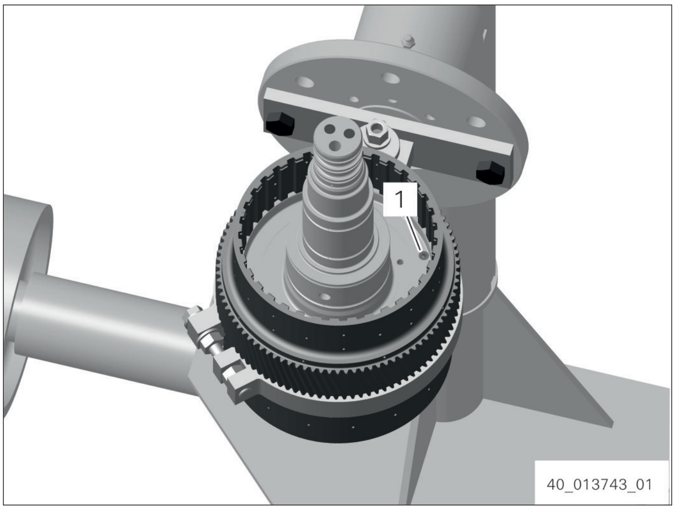


Fig. 176

8. Apply oil to O-rings (1) and insert them twist-free into annular grooves of the piston.

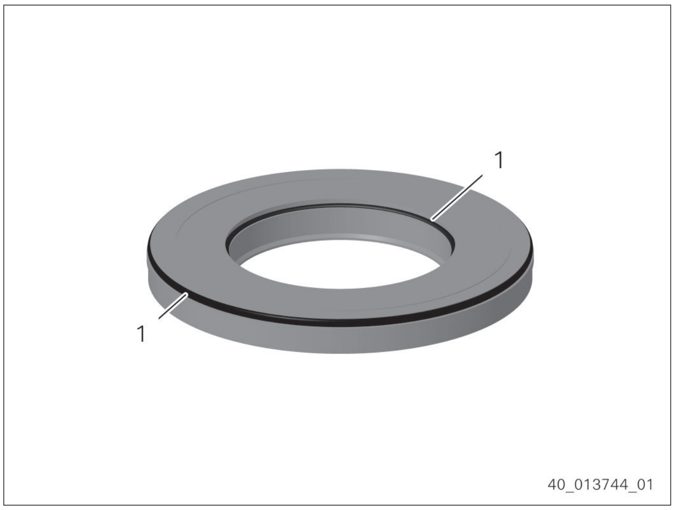


Fig. 177

9. Oil O-rings and piston bearing surfaces.

10. Insert piston (1) into the disk carrier until contact is obtained.

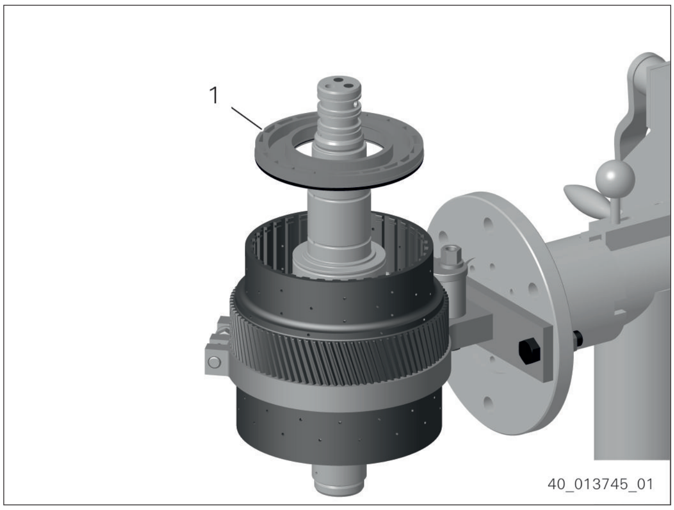


Fig. 178

11. Slide on intermediate washer (2) and compression spring (1).

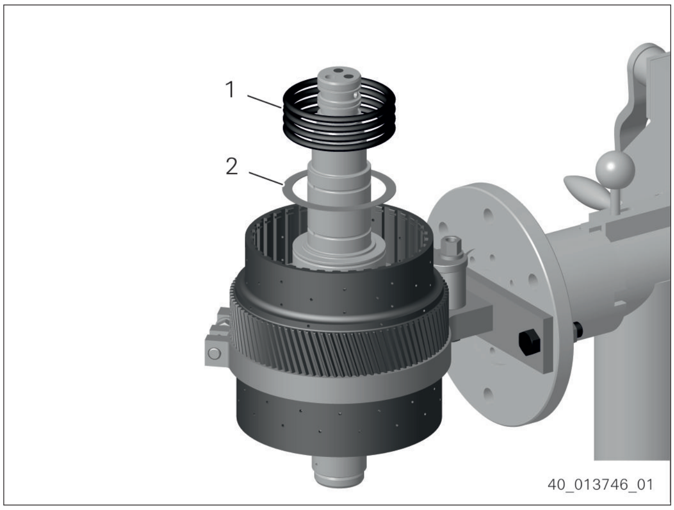


Fig. 179

12. Place guide ring (2) onto compression spring with chamfer facing upwards.

13. Slide on snap ring (1).

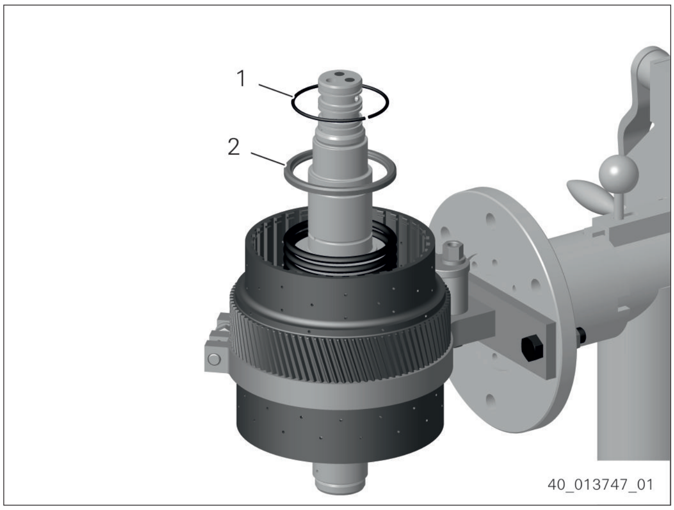


Fig. 180

14. Press guide ring downwards with 5870.345.072 [Assembly fixture] and hand-operated press and hold it there.

15. Insert snap ring into annular groove of disk carrier.

16. Release hand-operated press.

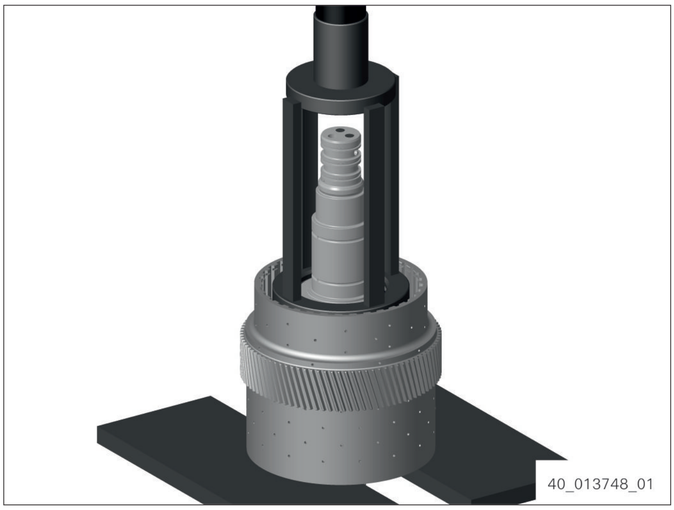


Fig. 181

17. Turn disk carrier by 180.

18. Apply oil to O-rings and insert them twist-free into annular grooves of the piston.

19. Oil O-rings and piston bearing surfaces.

20. Insert piston into the disk carrier until contact is obtained.

21. Slide on intermediate washer and compression spring.

22. Place guide ring onto compression spring with chamfer facing upwards.

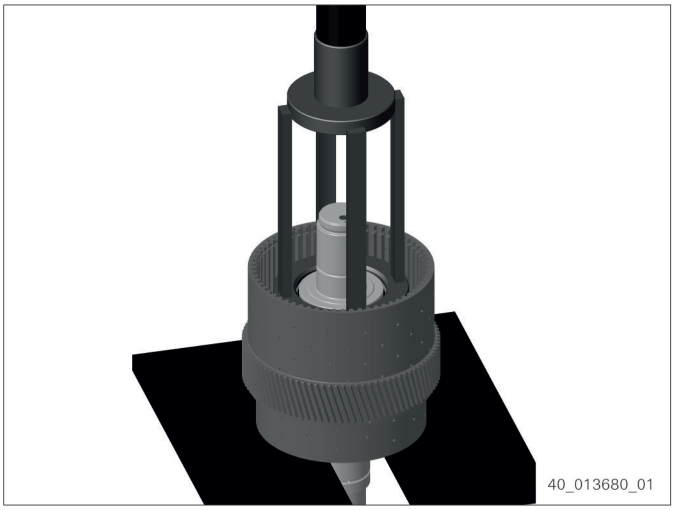


Fig. 182

23. Slide on snap ring.

24. Press guide ring downwards with 5870.345.072 [Assembly fixture] and hand-operated press and hold it there.

25. Insert snap ring into annular groove of disk carrier.

26. Release hand-operated press.

27. Fasten disk carrier to 5870.350.000 [Assembly truck] using 5870.654.033 [Assembly fixture].

Assembling clutch KV

28. To ensure a correct measuring result, install single parts without oil for the time being.

    Insert outer disks and inner disks.
    Insert first outer disk with the uncoated side facing the piston.
    Insert last outer disk with the uncoated side facing the end shim.

    For the arrangement refer to the current spare parts list.

    Thickness of the two optional inner disks must not differ by more than 0.7 mm.

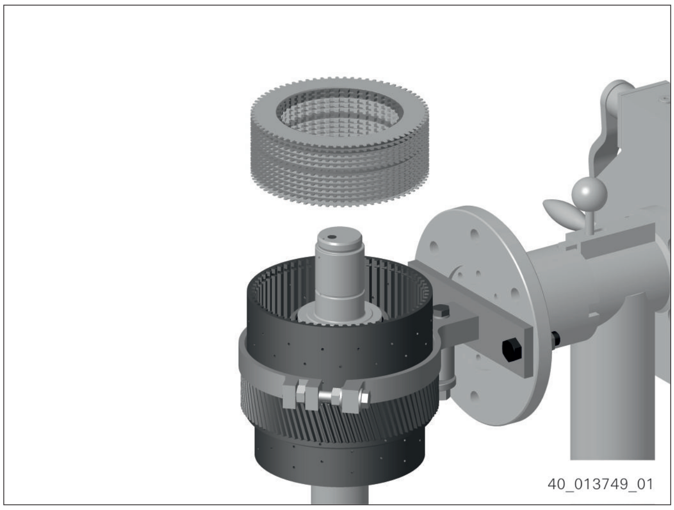


Fig. 183

29. Insert end shim (2).

30. Insert snap ring e. g. 2.60 mm (1).

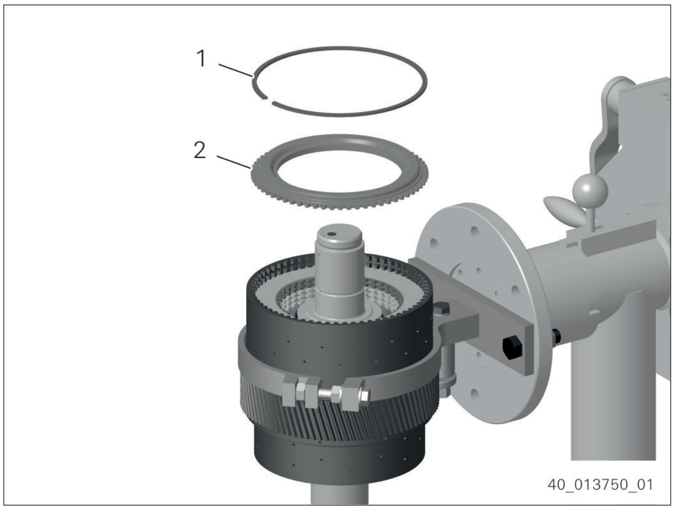


Fig. 184

31. Position dial gauge on the end shim.

32. Push end shim downwards with 100 N and set dial gauge to zero.

33. Lift end shim until contact with snap ring is obtained and check the necessary Disk clearance 2.8 mm to 3.0 mm.
If the disk clearance is too small, insert thinner inner disks or (and) a thinner snap ring.
If disk clearance is too big, install thicker inner disks or (and) and a thicker snap ring.

Thickness of the two optional inner disks must not differ by more than 0.7 mm.

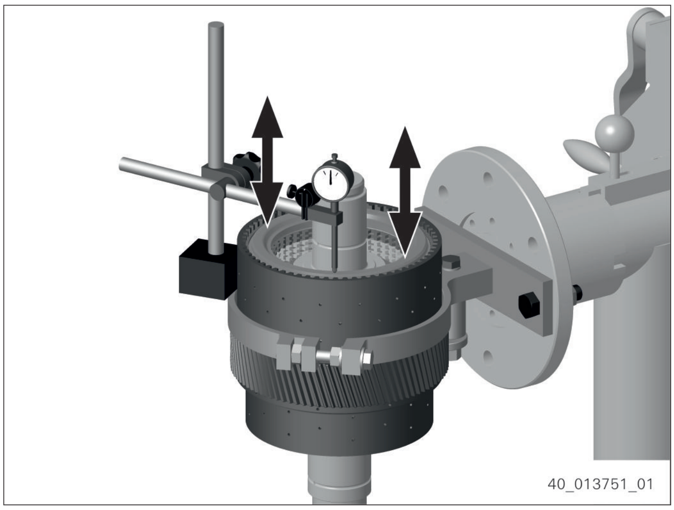


Fig. 185

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

35. Slide on bearing inner ring until contact is obtained.

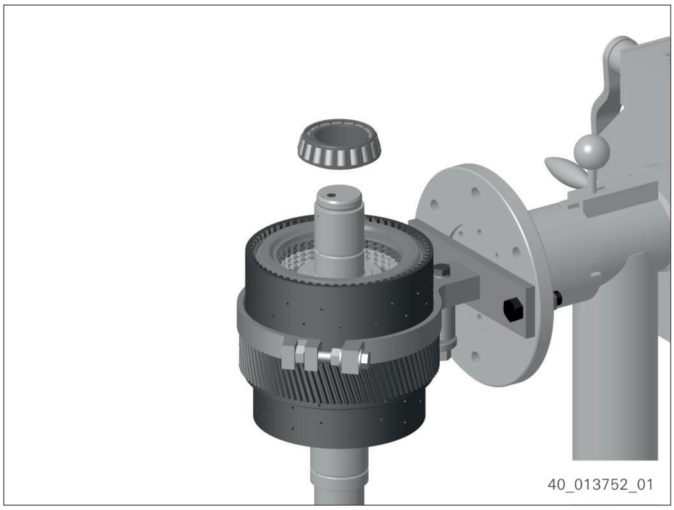


Fig. 186

36. Let bearing inner ring cool down.

37. Adjust bearing inner ring.

38. Slide on ring.

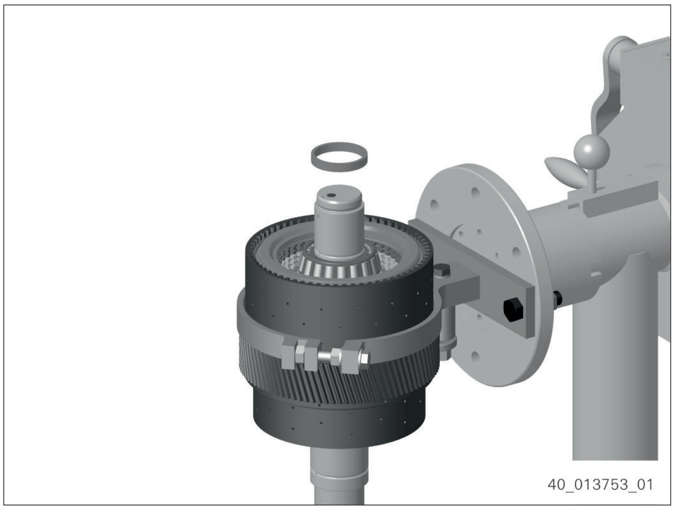


Fig. 187

39. Insert bearing outer rings into spur gear until contact is obtained.

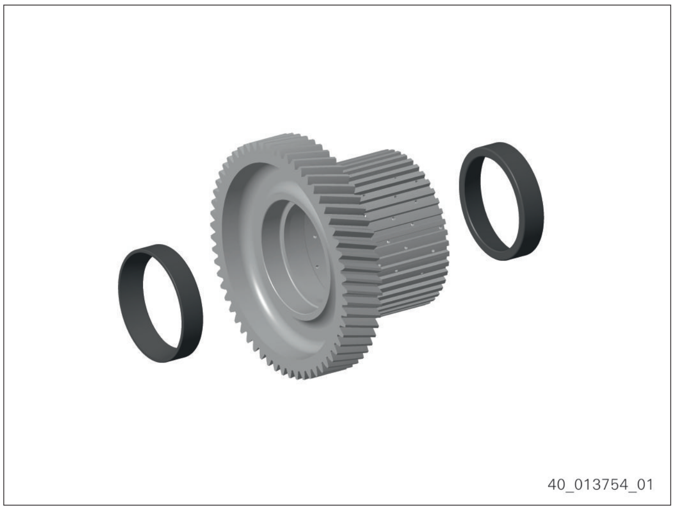


Fig. 188

40. Slide spur gear (1) onto shaft until contact is obtained. Insert spur gear into disk package by short mutual rotary motions.

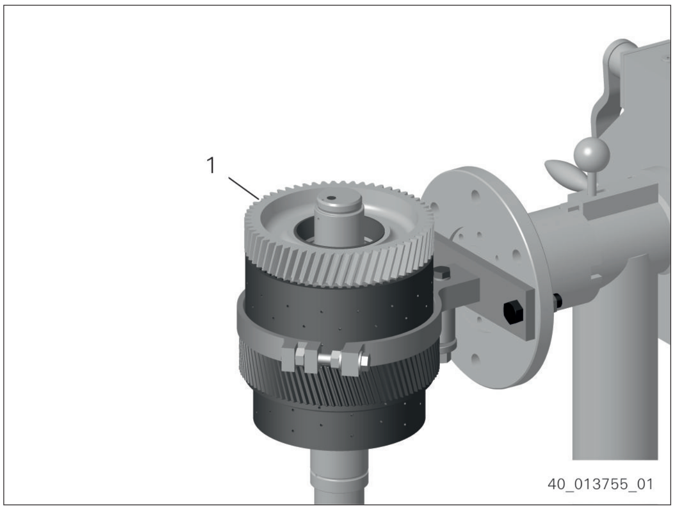


Fig. 189

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

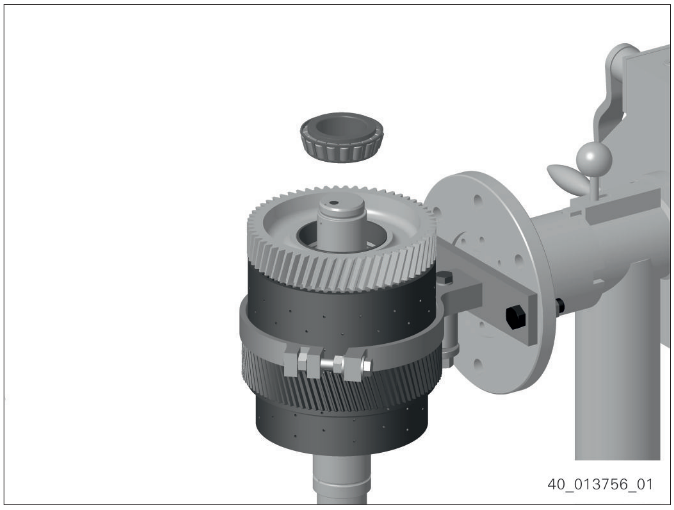


Fig. 190

42. Slide on bearing inner ring until contact is obtained.

43. Let bearing inner ring cool down.

44. Adjust bearing inner ring.

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

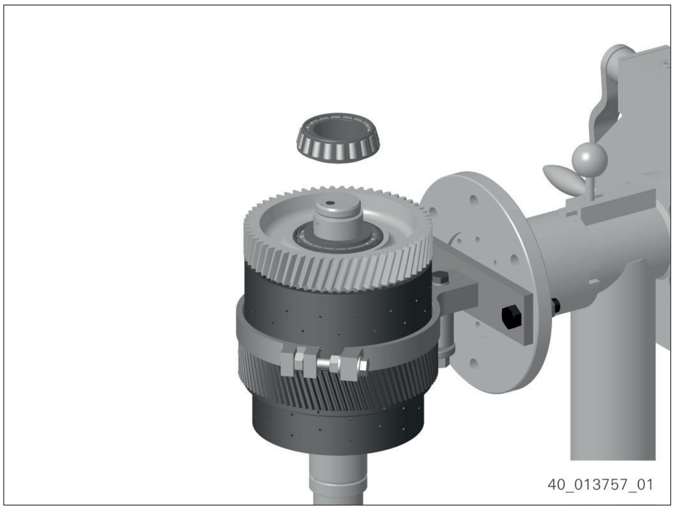


Fig. 191

46. Slide on bearing inner ring until contact is obtained.

47. Let bearing inner ring cool down.

48. Adjust bearing inner ring.

49. Turn disk carrier by 90.

50. Use 5870.401.118 [Groove nut wrench] and 5870.401.115 [Groove nut wrench] to tighten the slotted nut.
Tightening torque: 550 Nm

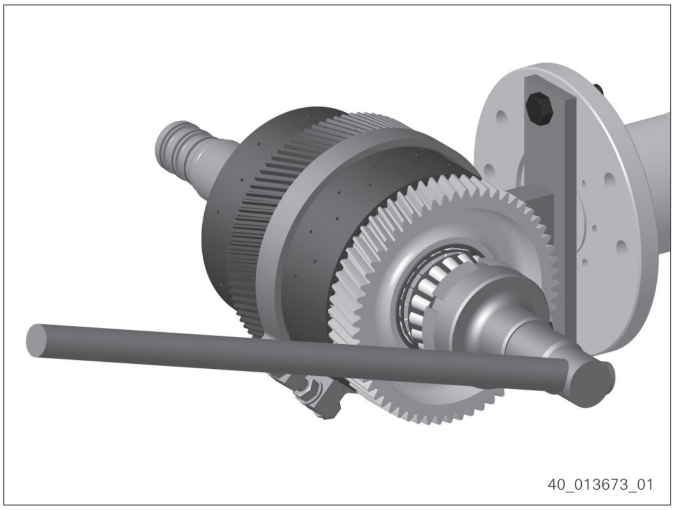


Fig. 192

Assembling clutch K1

51. Turn disk carrier by 90.

52. To ensure a correct measuring result, install single parts without oil for the time being.

Insert outer disks and inner disks.
Insert first outer disk with the uncoated side facing the piston.
Insert last outer disk with the uncoated side facing the end shim.

For the arrangement refer to the current spare parts list.

Thickness of the two optional inner disks must not differ by more than 0.7 mm.

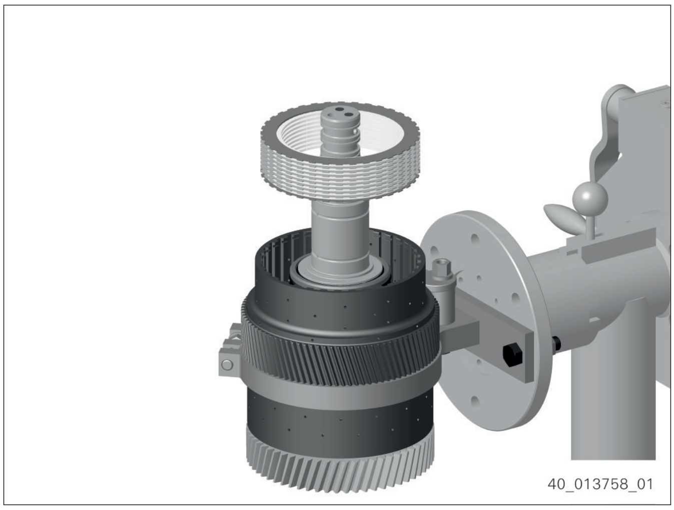


Fig. 193

53. Insert end shim (2).

54. Insert snap ring e. g. 2.30 mm (1).

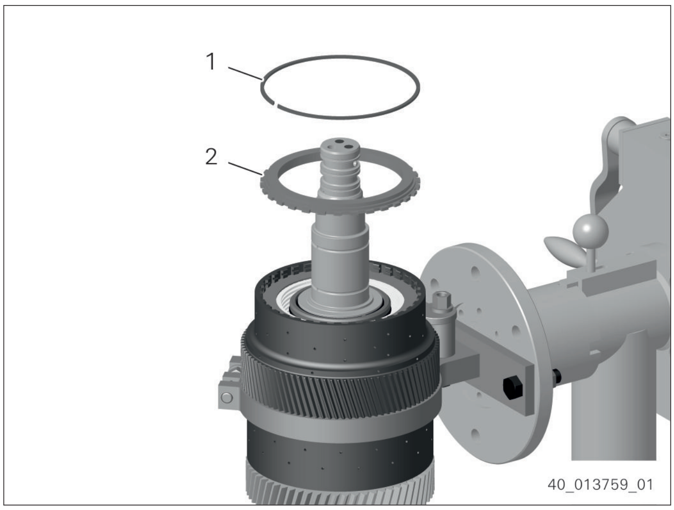


Fig. 194

55. Position dial gauge on the end shim.

56. Push end shim downwards with 100 N and set dial gauge to zero.

57. Lift end shim until contact with snap ring is obtained and check the necessary Disk clearance 2.2 mm to 2.4 mm.
If the disk clearance is too small, insert thinner inner disks or (and) a thinner snap ring.
If disk clearance is too big, install thicker inner disks or (and) and a thicker snap ring.

Thickness of the two optional inner disks must not differ by more than 0.7 mm.

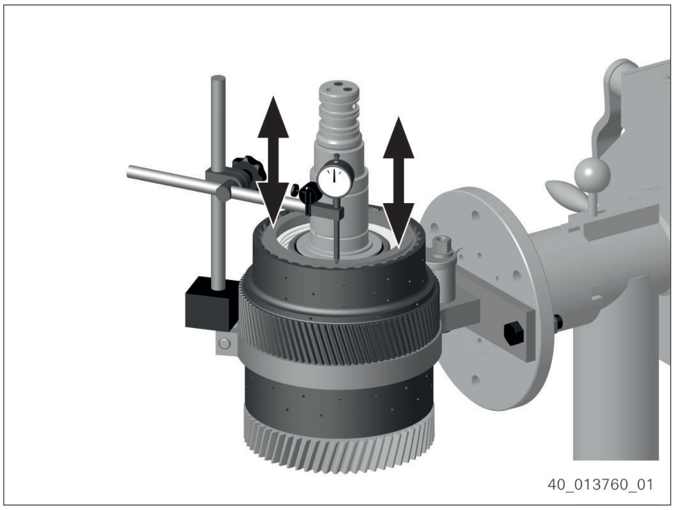


Fig. 195

58. The angular ball bearing has not yet been installed in the gear.

Align disk package with the gear (1). Insert gear into the disk package by short mutual rotary motions.

59. Remove gear.

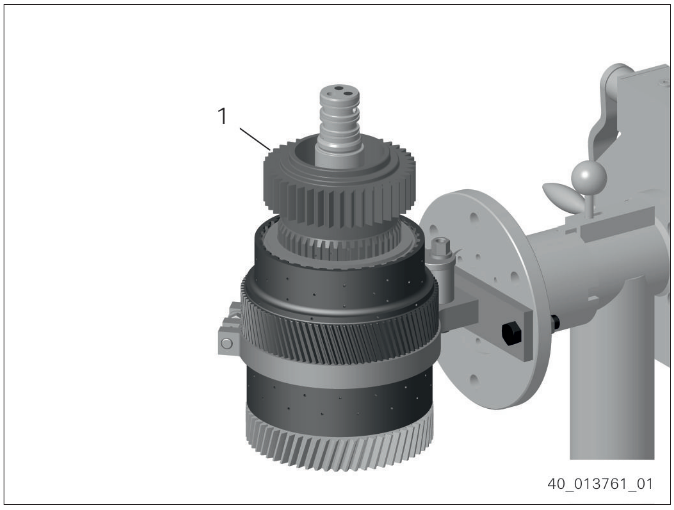


Fig. 196

60. Figure shows single parts of gear bearing.
    - 1 = Angular ball bearing
    - 2 = Snap ring
    - 3 = Gear

    The angular ball bearing is only available as complete unit.

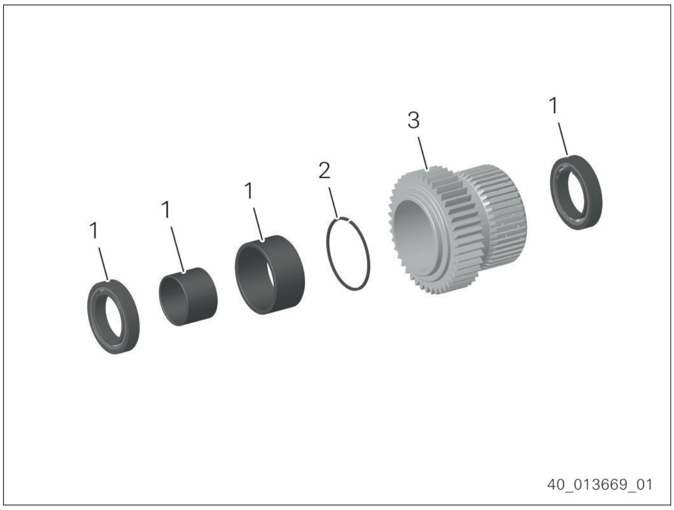


Fig. 197

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat the ball bearing inner ring.

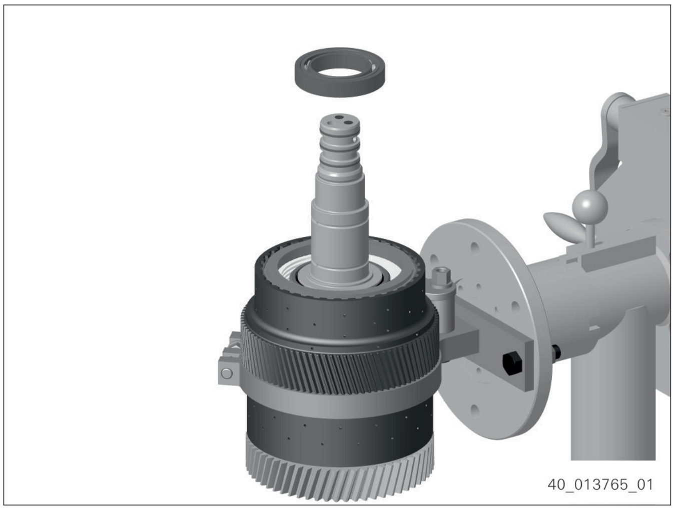


Fig. 198

62. Slide on the ball bearing with the lubricating groove facing upwards until contact is obtained.

63. Allow the ball bearing to cool down.

64. Adjust bearing inner ring.

65. Slide on intermediate ring.

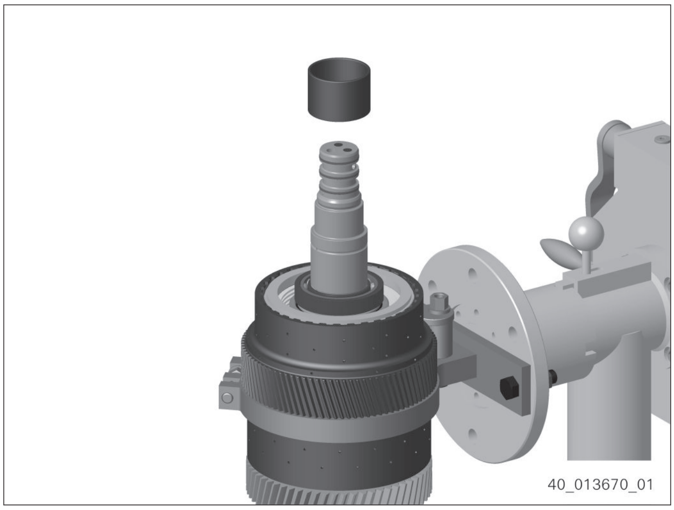


Fig. 199

66. Insert snap ring into annular groove of the gear.

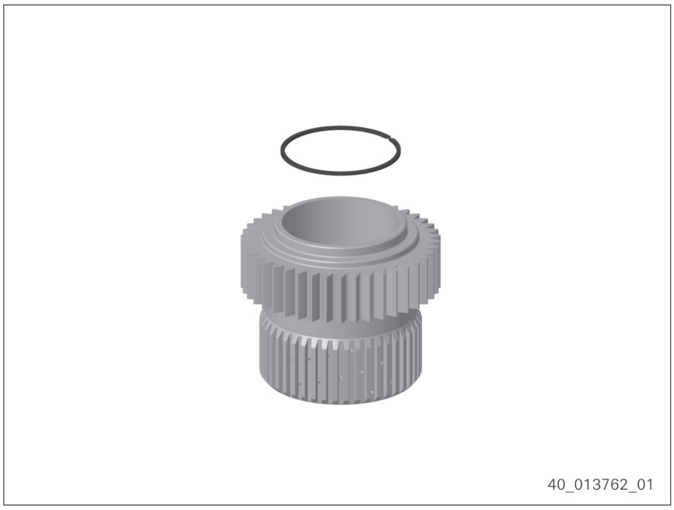


Fig. 200

67. Insert intermediate ring with the offset front face facing the snap ring.

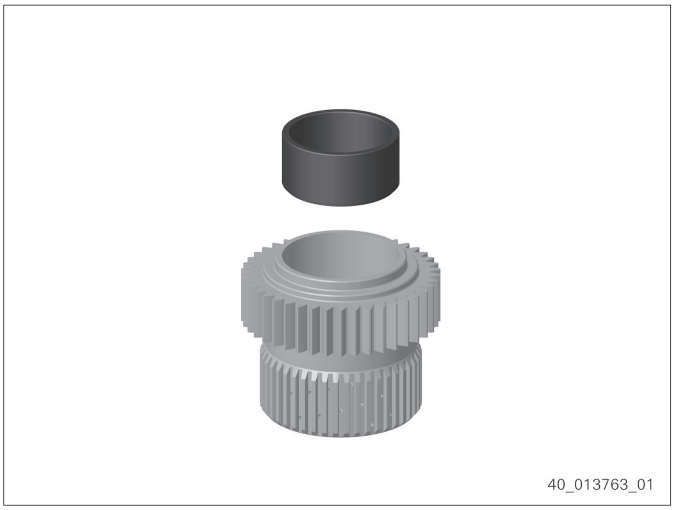


Fig. 201

68. Insert ball bearing with the lubricating groove facing downwards until contact is obtained.

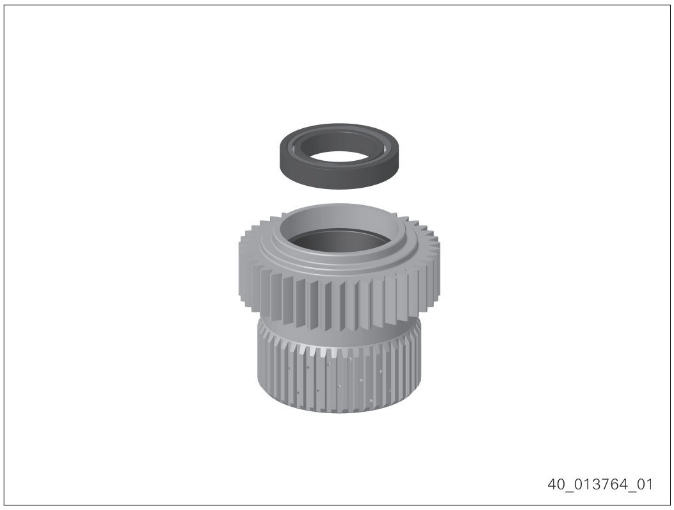


Fig. 202

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat gear and ball bearing.

70. Slide gear (1) onto shaft until contact is obtained. Insert gear into disk package.

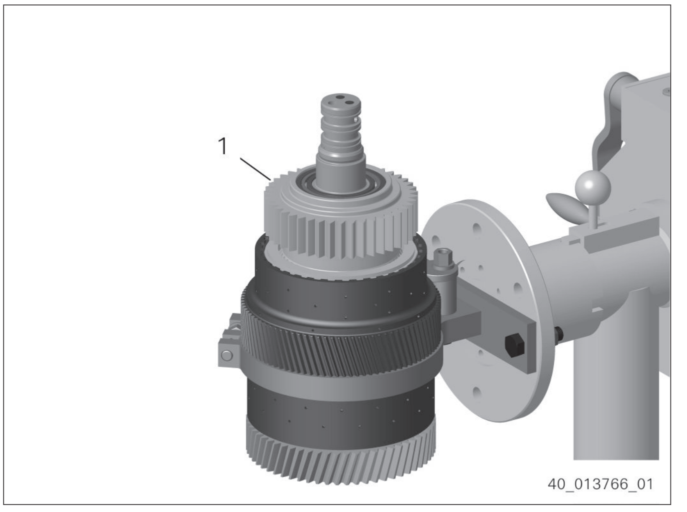


Fig. 203

71. Allow the ball bearing to cool down.

72. Adjust bearing inner ring.

73. Slide on shim.

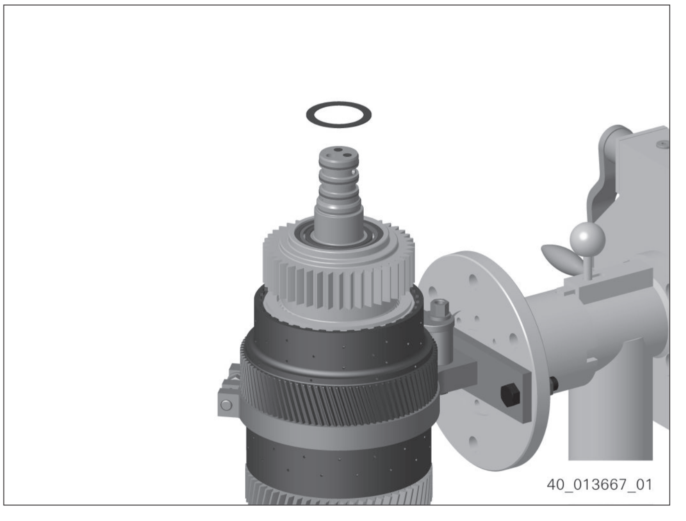


Fig. 204

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

CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

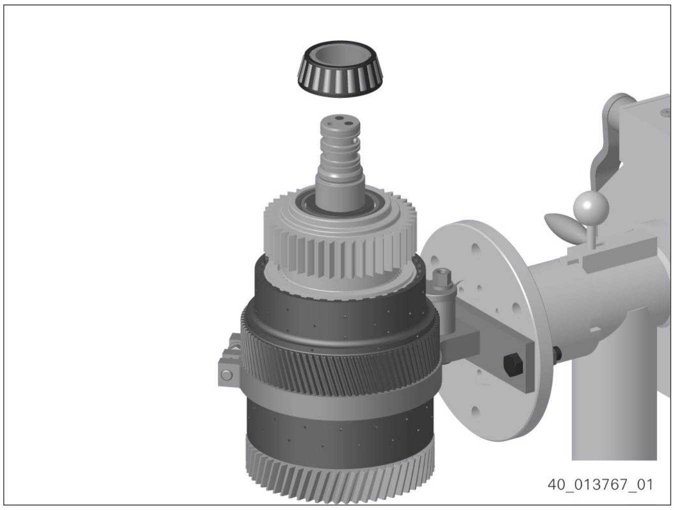


Fig. 205

75. Slide on bearing inner ring until contact is obtained.

76. Let bearing inner ring cool down.

77. Adjust bearing inner ring.

78. Turn disk carrier by 90.

79. Use 5870.401.118 [Groove nut wrench] and 5870.401.115 [Groove nut wrench] to tighten the slotted nut.
Tightening torque: 550 Nm

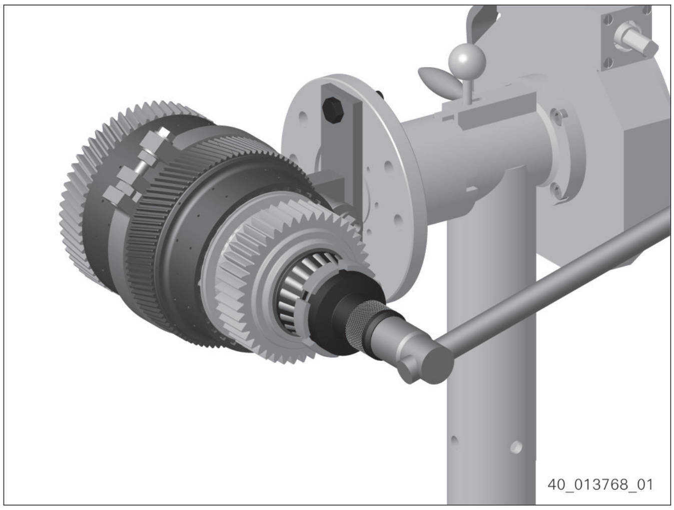


Fig. 206

80. Check function of the clutches by applying compressed air.

→ Closing and opening of the clutch is clearly audible.

If closing and opening is not audible, disassemble and check clutch.

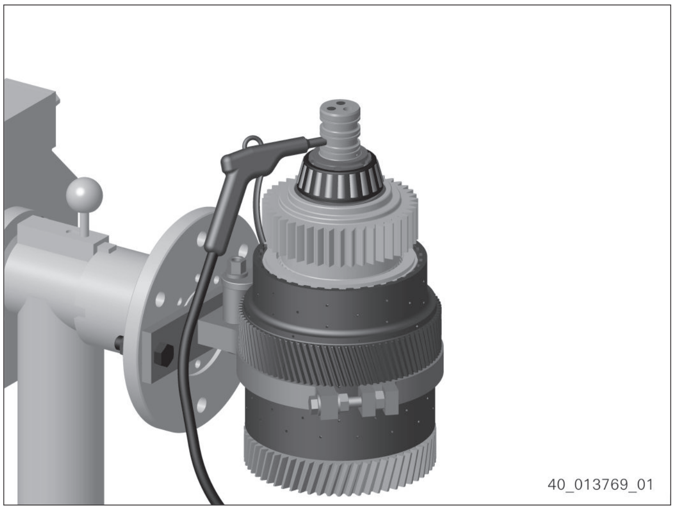


Fig. 207

81. Grease annular grooves of shaft.

82. Insert R-rings (1).

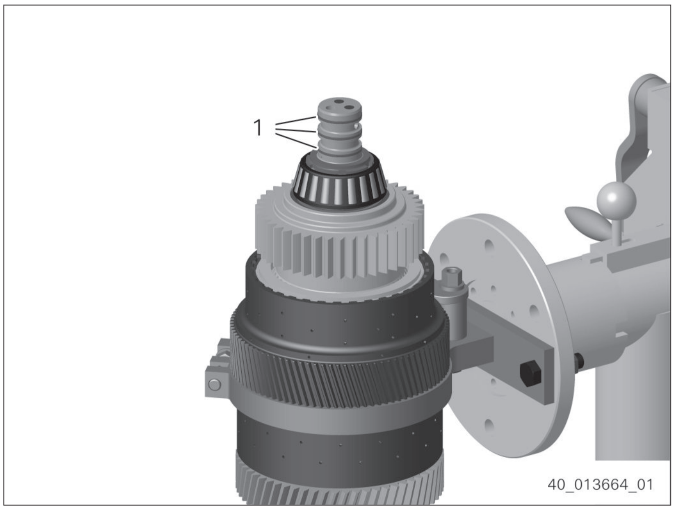


Fig. 208

Assembling clutch KR/K2

Special tools:

- 5870.350.000 Assembly truck
- 5870.654.033 Assembly fixture
- 5870.320.014 Assembly fixture
- 5870.320.018 Inserting tool
- 5870.320.019 Press-in mandrel
- 5870.345.072 Assembly fixture
- 5870.401.099 Groove nut wrench
- AA02.769.745 Slotted nut wrench

Assembly

1. Fasten disk carrier to 5870.350.000 [Assembly truck] using 5870.654.033 [Assembly fixture].

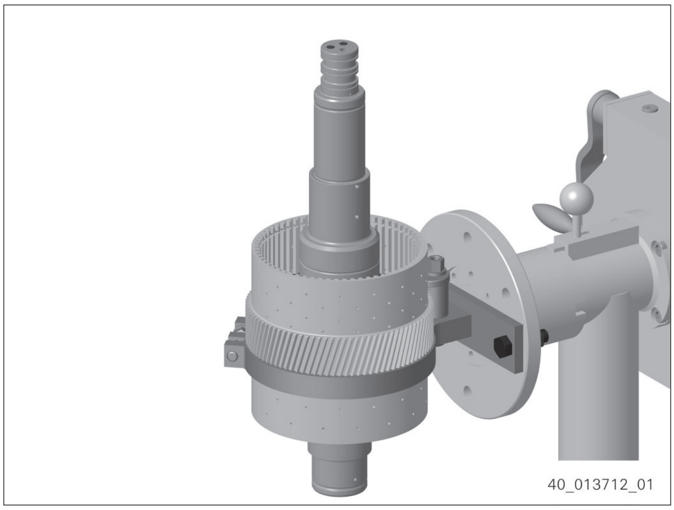


Fig. 209

Assembling disk carrier

2. Turn disk carrier by 180.

3. Insert sealing plug (1) into hole with 5870.320.014 [Assembly fixture] and 5870.320.018 [Inserting tool].

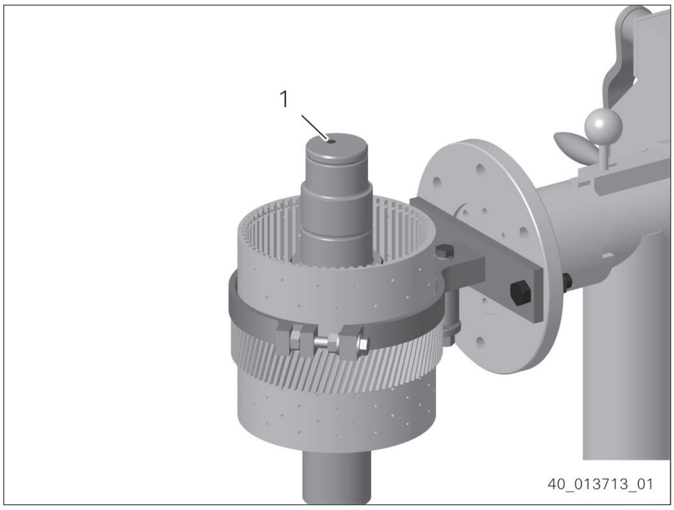


Fig. 210

4. Flush-mount valve (1) using 5870.320.019 [Press-in mandrel]. Insert valve with the chamfered side facing downwards.

Fig. 211

5. Turn disk carrier by 180.

6. Insert sealing plugs (1) into holes using 5870.320.014 [Assembly fixture] and 5870.320.018 [Inserting tool].

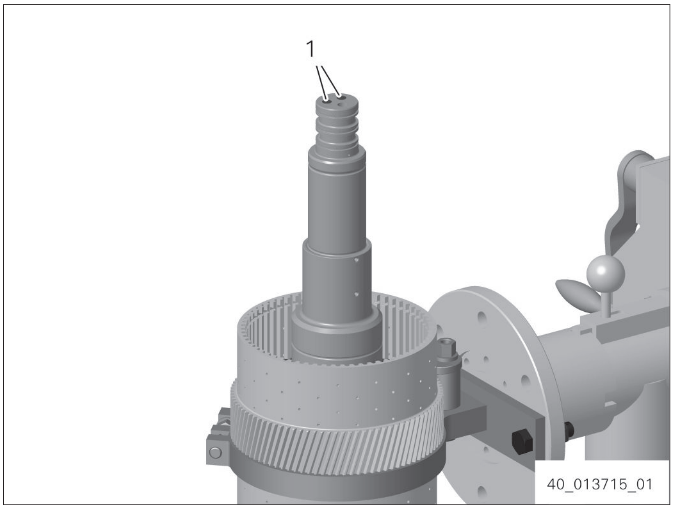


Fig. 212

7. Flush-mount valve (1) using 5870.320.019 [Press-in mandrel]. Insert valve with the chamfered side facing downwards.

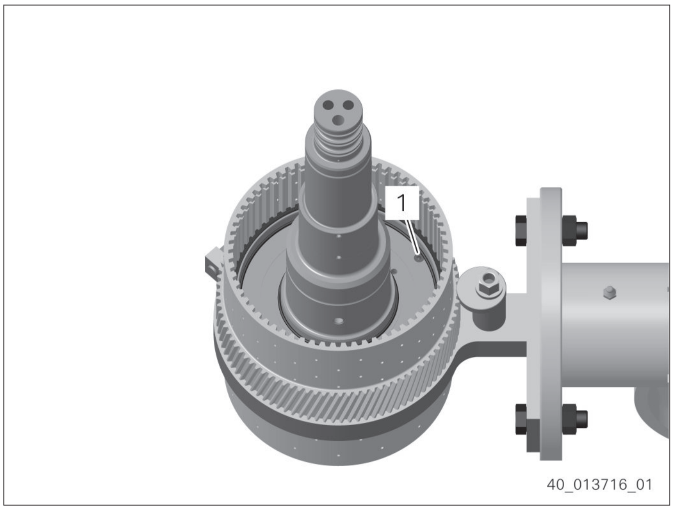


Fig. 213

8. Apply oil to O-rings (1) and insert them twist-free into annular grooves of the piston.

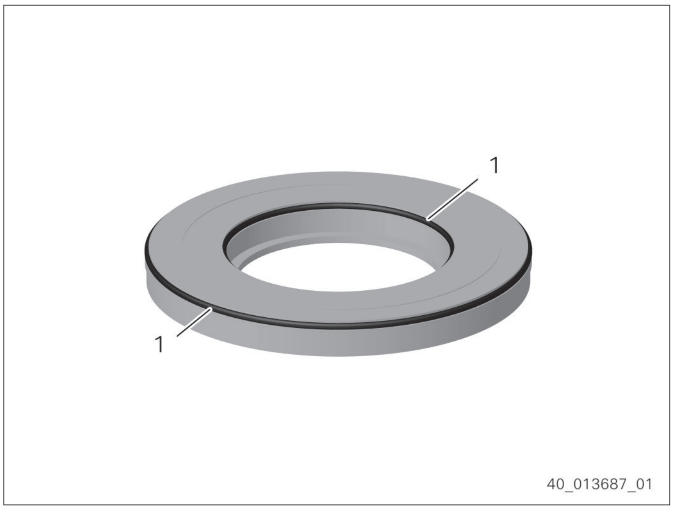


Fig. 214

9. Oil O-rings and piston bearing surfaces.

10. Insert piston (1) into the disk carrier until contact is obtained.

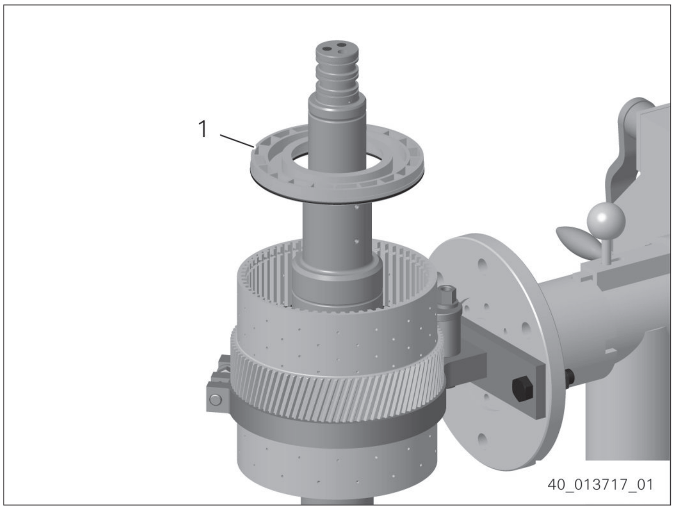


Fig. 215

11. Slide on intermediate washer (2) and compression spring (1).

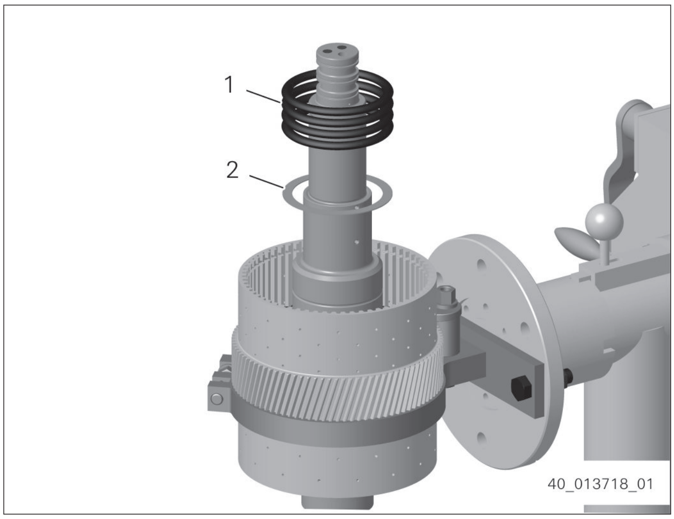


Fig. 216

12. Place guide ring (2) onto compression spring with chamfer facing upwards.

13. Slide on snap ring (1).

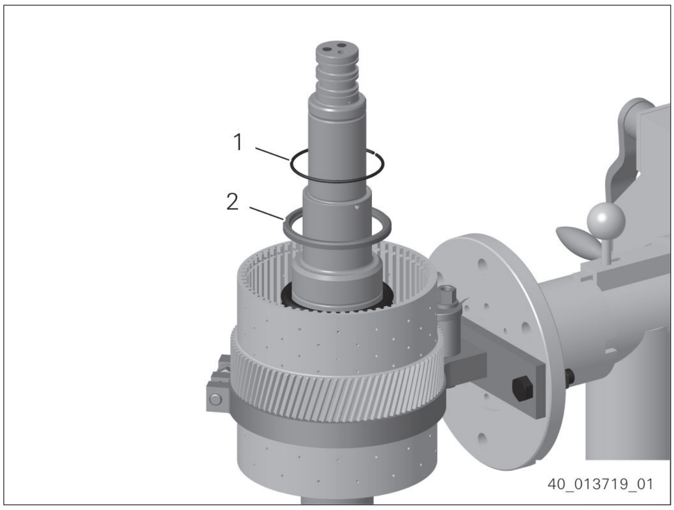


Fig. 217

14. Press guide ring downwards with 5870.345.072 [Assembly fixture] and hand-operated press and hold it there.

15. Insert snap ring into annular groove of disk carrier.

16. Release hand-operated press.

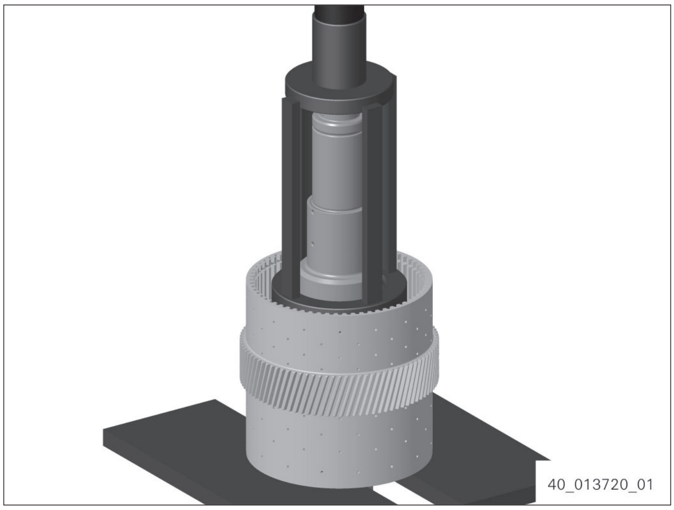


Fig. 218

17. Turn disk carrier by 180.

18. Apply oil to O-rings and insert them twist-free into annular grooves of the piston.

19. Oil O-rings and piston bearing surfaces.

20. Insert piston into the disk carrier until contact is obtained.

21. Slide on intermediate washer and compression spring.

22. Place guide ring onto compression spring with chamfer facing upwards.

23. Slide on snap ring.

24. Press guide ring downwards with 5870.345.072 [Assembly fixture] and hand-operated press and hold it there.

25. Insert snap ring into annular groove of disk carrier.

26. Release hand-operated press.

27. Fasten disk carrier to 5870.350.000 [Assembly truck] using 5870.654.033 [Assembly fixture].

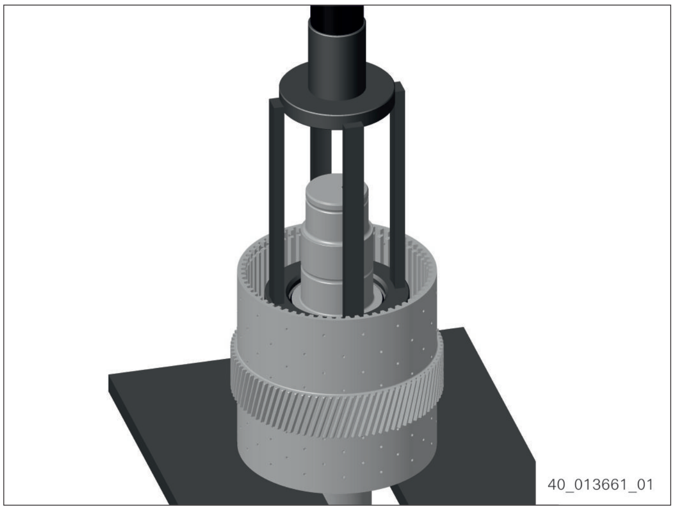


Fig. 219

Assembling clutch KR

28. To ensure a correct measuring result, install single parts without oil for the time being.

Insert outer disks and inner disks.
Insert first outer disk with the uncoated side facing the piston.
Insert last outer disk with the uncoated side facing the end shim.
For the arrangement refer to the current spare parts list.

Thickness of the two optional inner disks must not differ by more than 0.7 mm.

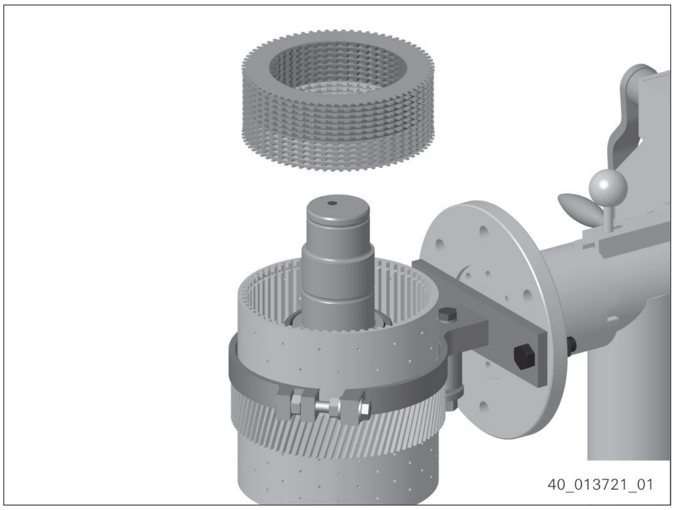


Fig. 220

29. Insert end shim (2).

30. Insert snap ring e. g. 2.60 mm (1).

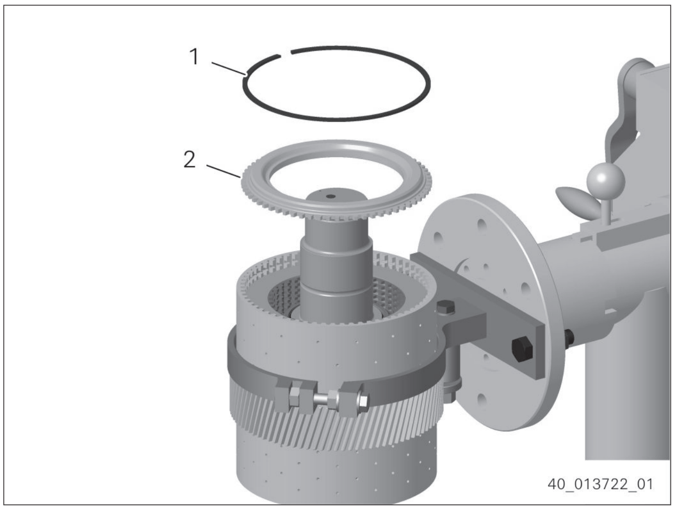


Fig. 221

31. Position dial gauge on the end shim.

32. Push end shim downwards with 100 N and set dial gauge to zero.

33. Lift end shim until contact with snap ring is obtained and check the necessary Disk clearance 2.8 mm to 3.0 mm.
If the disk clearance is too small, insert thinner inner disks or (and) a thinner snap ring.
If disk clearance is too big, install thicker inner disks or (and) and a thicker snap ring.

Thickness of the two optional inner disks must not differ by more than 0.7 mm.

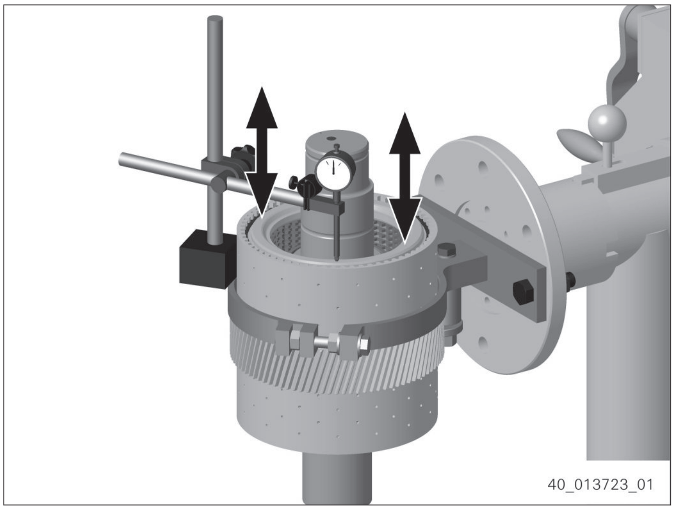


Fig. 222

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

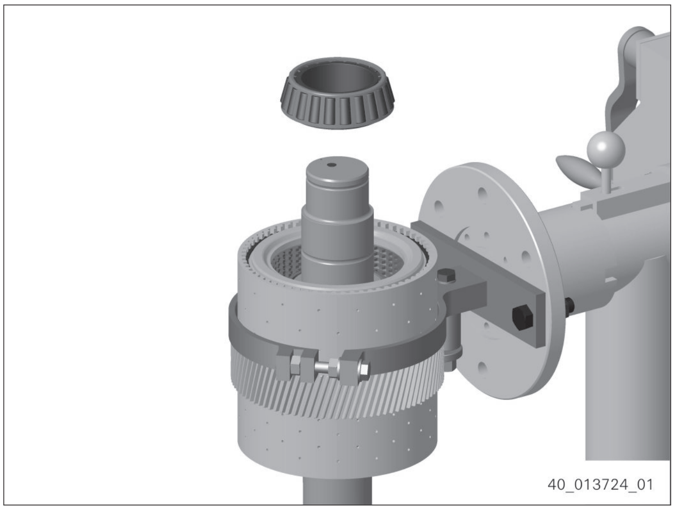


Fig. 223

35. Slide on bearing inner ring until contact is obtained.

36. Let bearing inner ring cool down.

37. Adjust bearing inner ring.

38. Slide spur gear (1) onto shaft until contact is obtained. Insert spur gear into disk package by short mutual rotary motions.

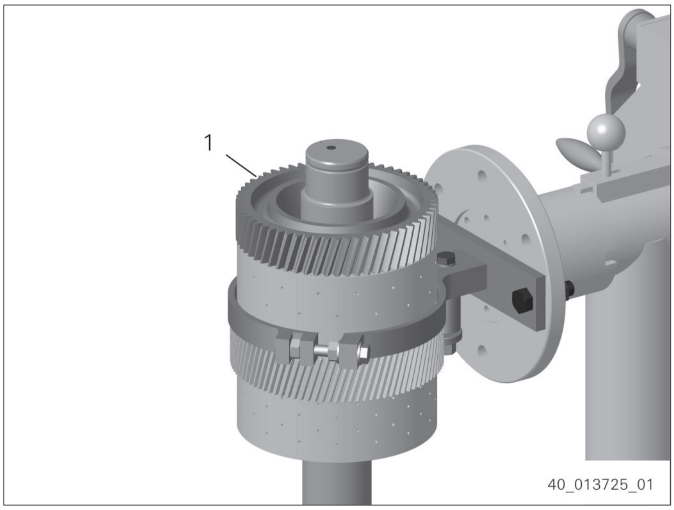


Fig. 224

39. Slide on ring with the recesses facing downwards.

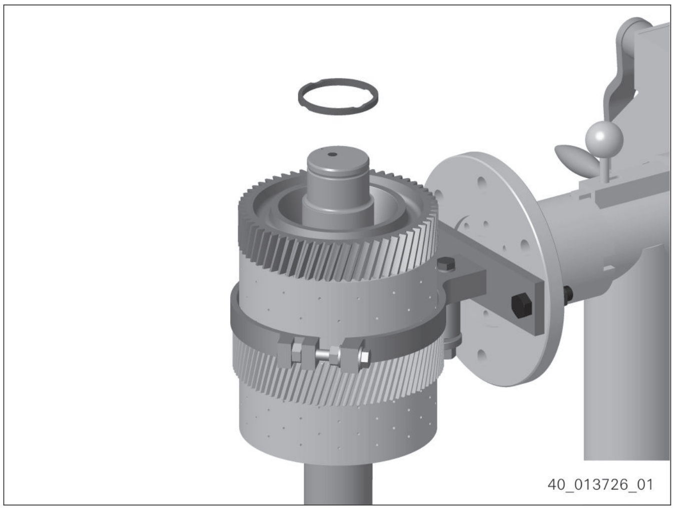


Fig. 225

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

CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

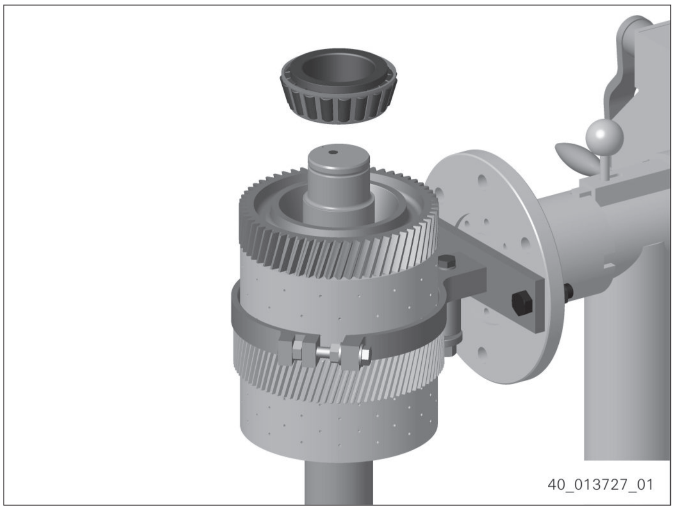


Fig. 226

41. Slide on bearing inner ring until contact is obtained.

42. Let bearing inner ring cool down.

43. Adjust bearing inner ring.

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

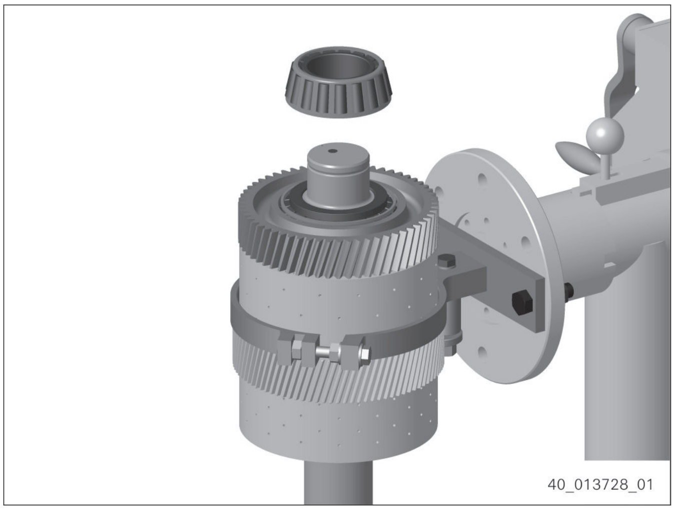


Fig. 227

45. Slide on bearing inner ring until contact is obtained.

46. Let bearing inner ring cool down.

47. Adjust bearing inner ring.

48. Turn disk carrier by 90.

49. Tighten slotted nut with 5870.401.099 [Groove nut wrench]. Tightening torque: 800 Nm

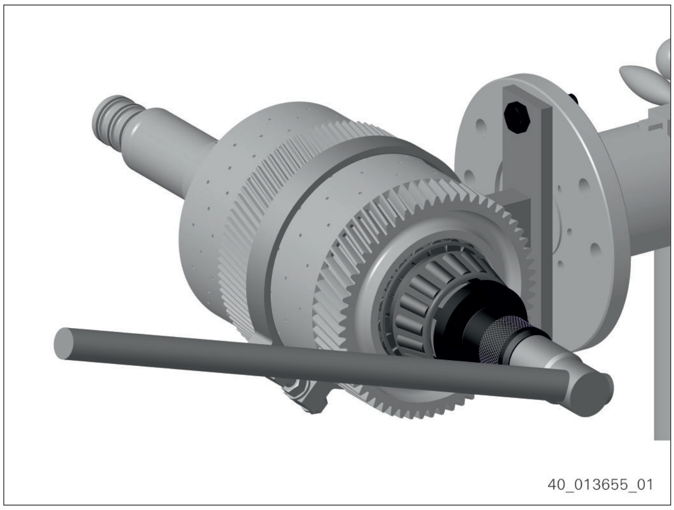


Fig. 228

Assembling clutch K2

50. Turn disk carrier by 90.

51. To ensure a correct measuring result, install single parts without oil for the time being.

Insert outer disks and inner disks.
Insert first outer disk with the uncoated side facing the piston.
Insert last outer disk with the uncoated side facing the end shim.

For the arrangement refer to the current spare parts list.

Thickness of the two optional inner disks must not differ by more than 0.7 mm.

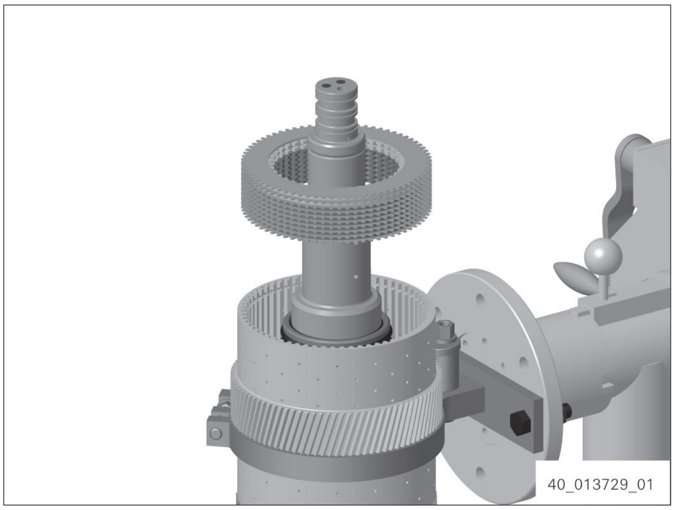


Fig. 229

52. Insert end shim (2).

53. Insert snap ring e. g. 2.60 mm (1).

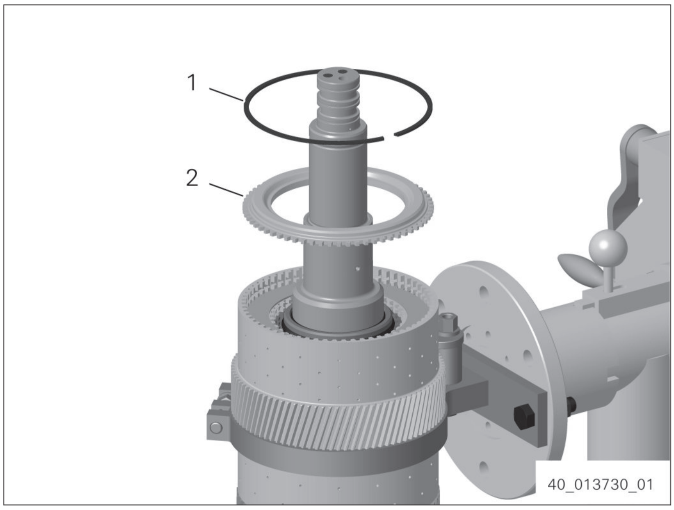


Fig. 230

54. Position dial gauge on the end shim.

55. Push end shim downwards with 100 N and set dial gauge to zero.

56. Lift end shim until contact with snap ring is obtained and check the necessary Disk clearance 2.2 mm to 2.4 mm.
If the disk clearance is too small, insert thinner inner disks or (and) a thinner snap ring.
If disk clearance is too big, install thicker inner disks or (and) and a thicker snap ring.

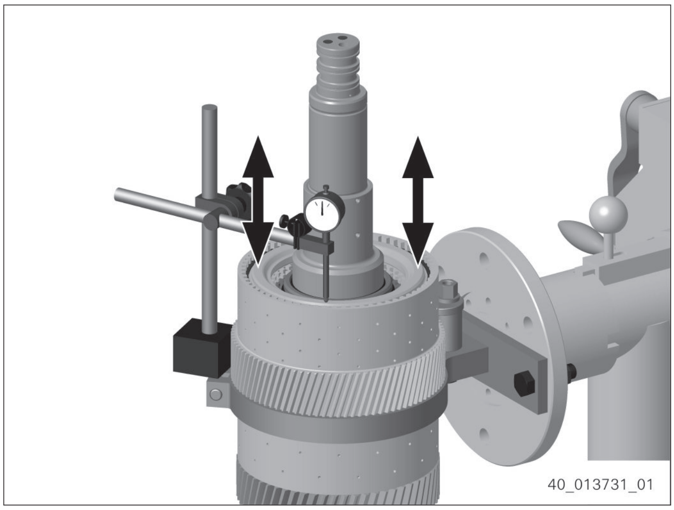


Fig. 231

Thickness of the two optional inner disks must not differ by more than 0.7 mm.

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

⚠ **CAUTION**

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

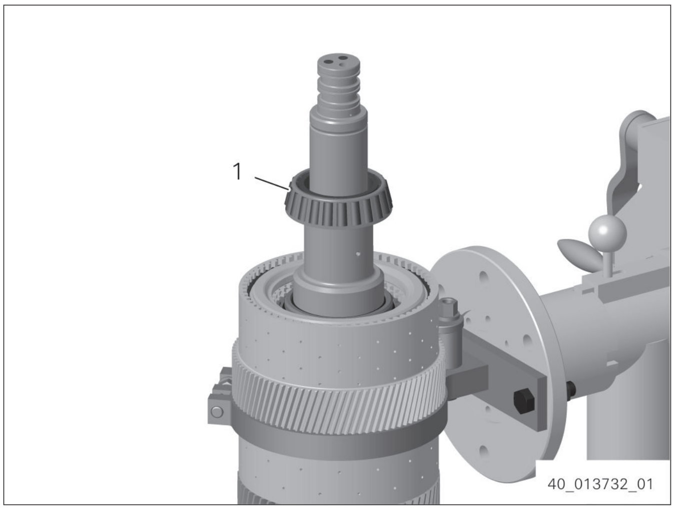


Fig. 232

58. Slide on bearing inner ring (1) until contact is obtained.

59. Let bearing inner ring cool down.

60. Adjust bearing inner ring.

61. ⚠ **CAUTION**

Risk of burn injuries due to contact with cold surface.
Slight to moderate injury possible.
⇨ Wear protective gloves.

Undercool gear (1).

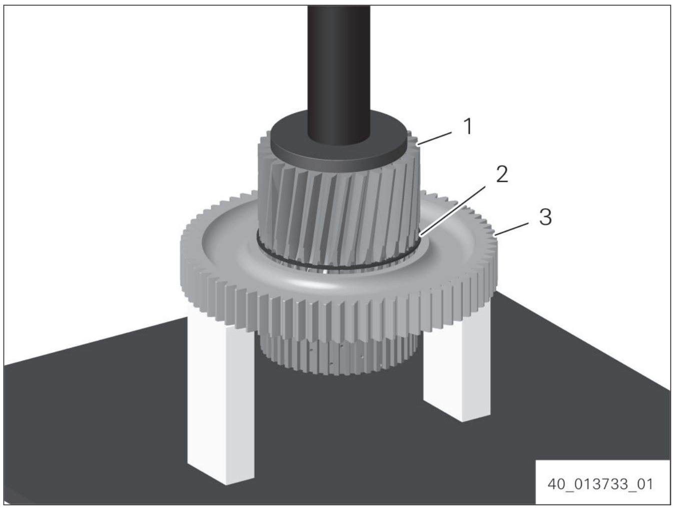


Fig. 233

62. ⚠ **CAUTION**

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat up the gear (3).

63. Carry out the following three work steps immediately one after the other.

Insert snap ring (2) into annular groove of the gear (1).

64. Insert gear (1) into gear (3).

65. **CAUTION**

Risk of crushing due to hydraulic tool.
Slight to moderate injury possible.
⇨ Do not reach into danger area.

Push snap ring (2) into annular groove and force gear (1) into gear (3), until snap ring engages audibly.

66. Slide gear (1) onto shaft until contact is obtained. Insert gear into the disk package by short mutual rotary motions.

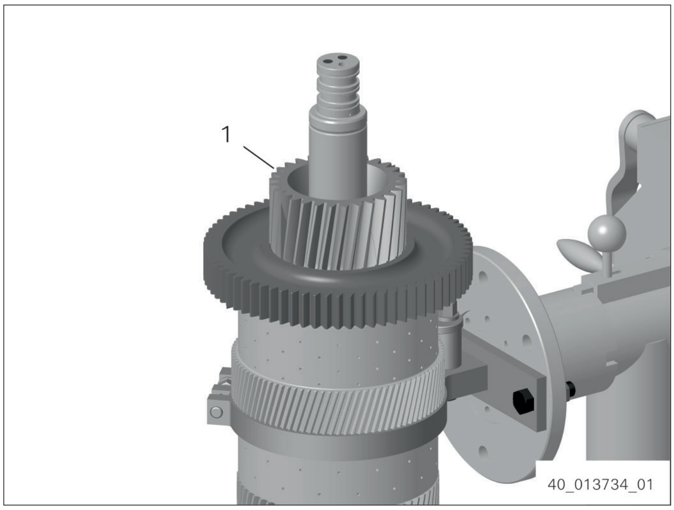


Fig. 234

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

CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

68. Slide on bearing inner ring until contact is obtained.

69. Let bearing inner ring cool down.

70. Adjust bearing inner ring.

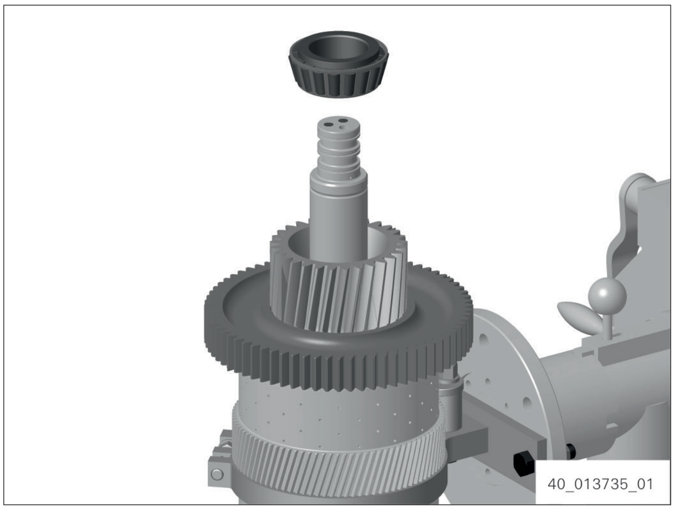


Fig. 235

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

72. Slide on bearing inner ring until contact is obtained.

73. Let bearing inner ring cool down.

74. Adjust bearing inner ring.

75. Turn disk carrier by 90.

76. Tighten slotted nut with AA02.769.745 [Slotted nut wrench].
Tightening torque: 800 Nm

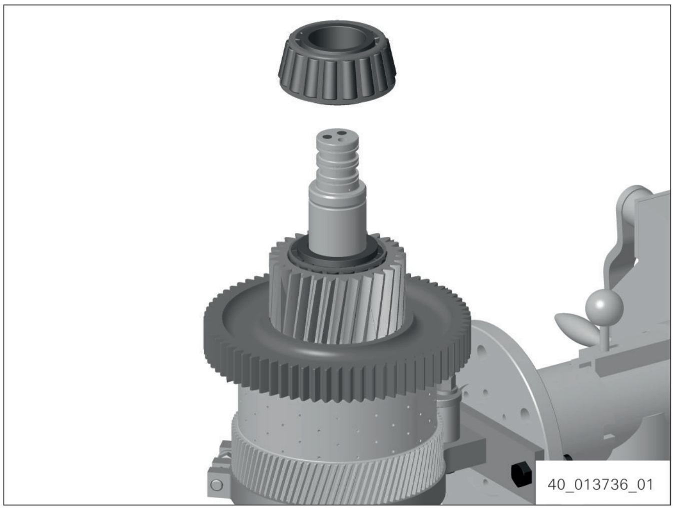


Fig. 236

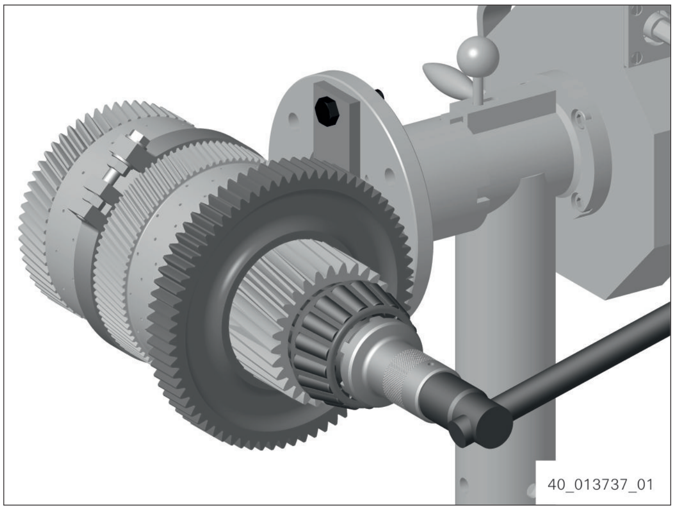


Fig. 237

77. Check function of the clutches by applying compressed air.

    → Closing and opening of the clutch is clearly audible.

    If closing and opening is not audible, disassemble and check clutch.

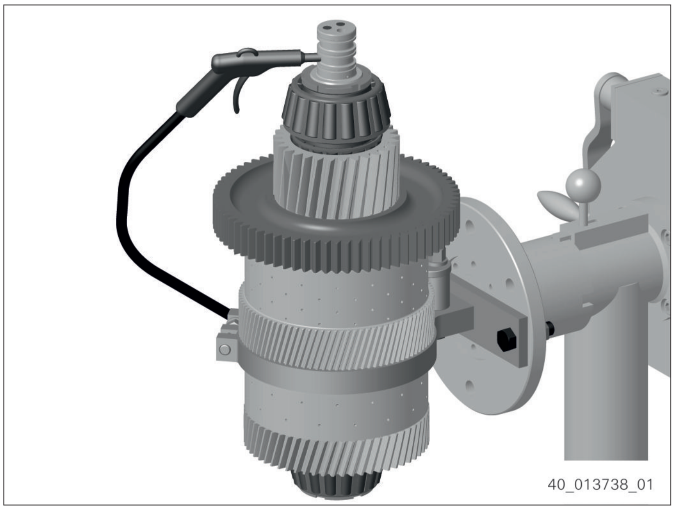


Fig. 238

78. Grease annular grooves of shaft.

79. Insert R-rings (1).

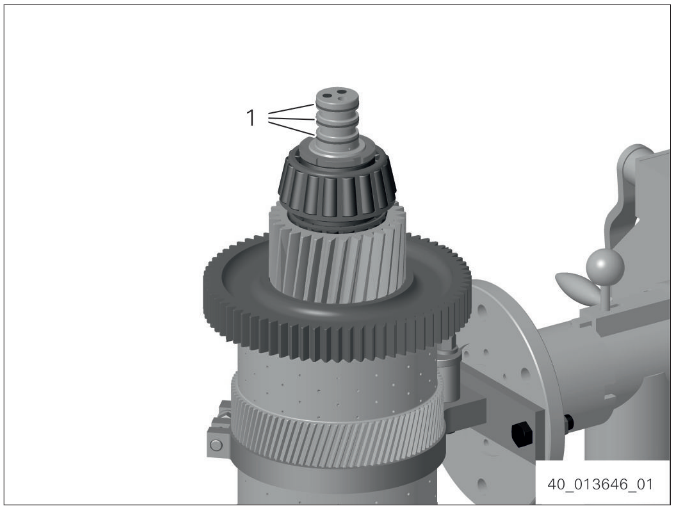


Fig. 239

Assembling clutch K3/K4

Special tools:

- 5870.350.000 Assembly truck
- 5870.654.033 Assembly fixture
- 5870.320.014 Assembly fixture
- 5870.320.018 Inserting tool
- 5870.320.019 Press-in mandrel
- 5870.345.072 Assembly fixture
- 5870.401.118 Groove nut wrench
- 5870.401.115 Groove nut wrench
- 5870.345.033 Assembly fixture
- AA00.317.255 Load ring

1. Fasten disk carrier to 5870.350.000 [Assembly truck] using 5870.654.033 [Assembly fixture].

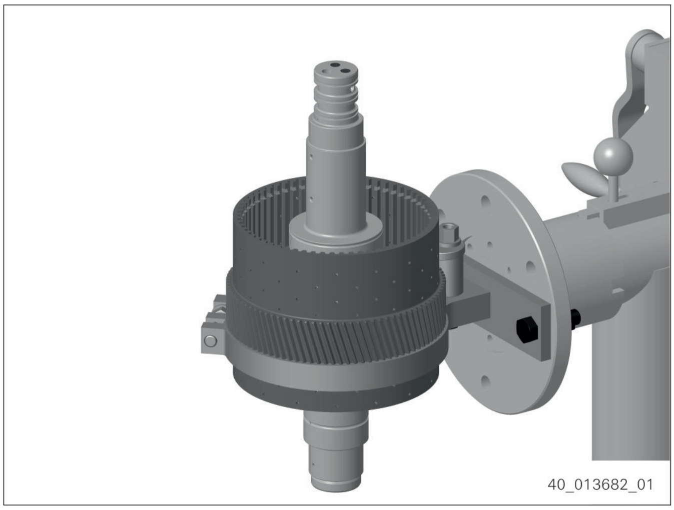


Fig. 240

Assembling disk carrier

2. Turn disk carrier by 180.

3. Insert sealing plug (1) into hole with 5870.320.014 [Assembly fixture] and 5870.320.018 [Inserting tool].

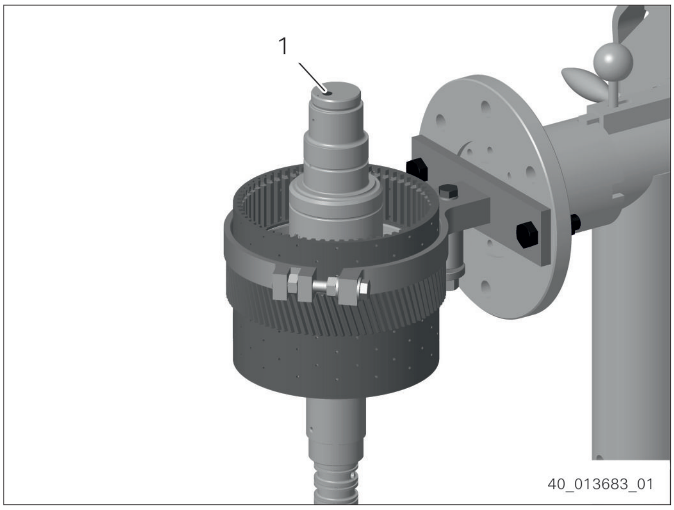


Fig. 241

4. Flush-mount valve (1) using 5870.320.019 [Press-in mandrel]. Insert valve with the chamfered side facing downwards.

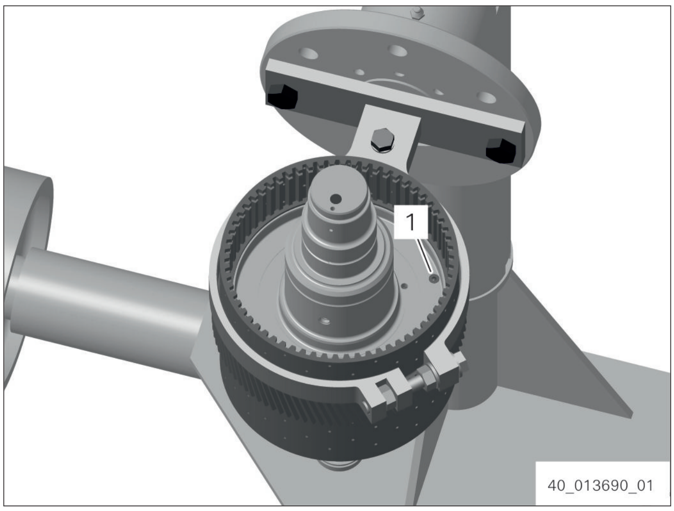


Fig. 242

5. Turn disk carrier by 180.

6. Insert sealing plugs (1) into holes using 5870.320.014 [Assembly fixture] and 5870.320.018 [Inserting tool].

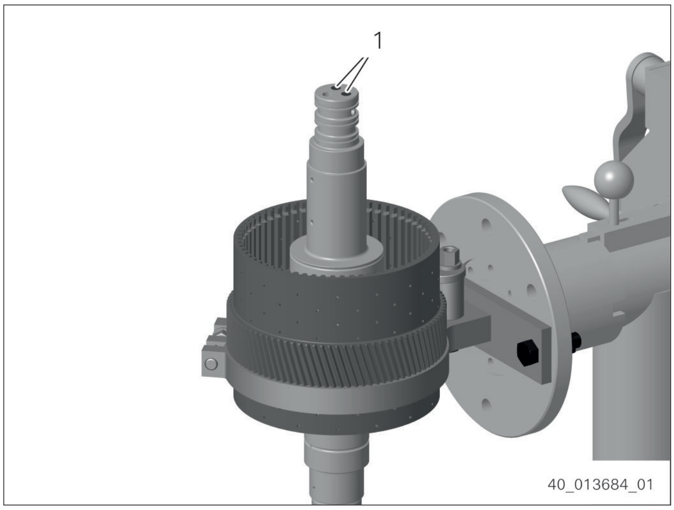


Fig. 243

7. Flush-mount valve (1) using 5870.320.019 [Press-in mandrel]. Insert valve with the chamfered side facing downwards.

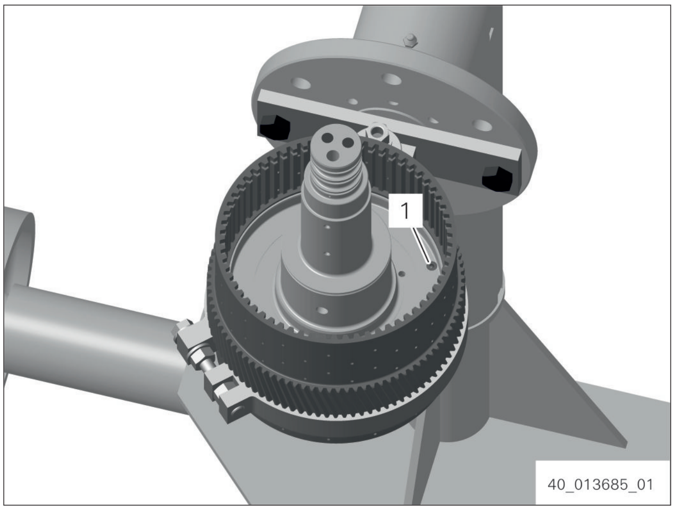


Fig. 244

8. Apply oil to O-rings (1) and insert them twist-free into annular grooves of the piston.

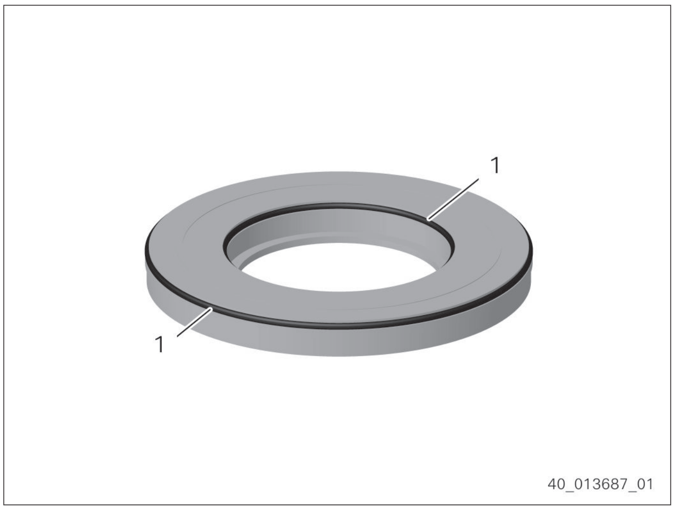


Fig. 245

9. Oil O-rings and piston bearing surfaces.

10. Insert piston (1) into the disk carrier until contact is obtained.

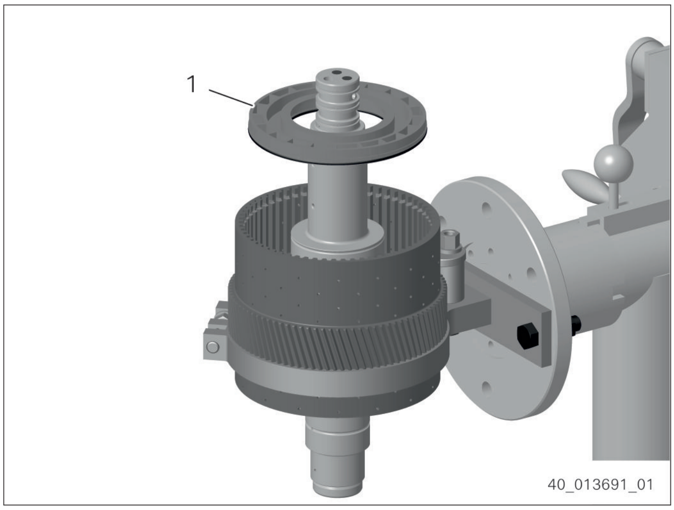


Fig. 246

11. Slide on intermediate washer (2) and compression spring (1).

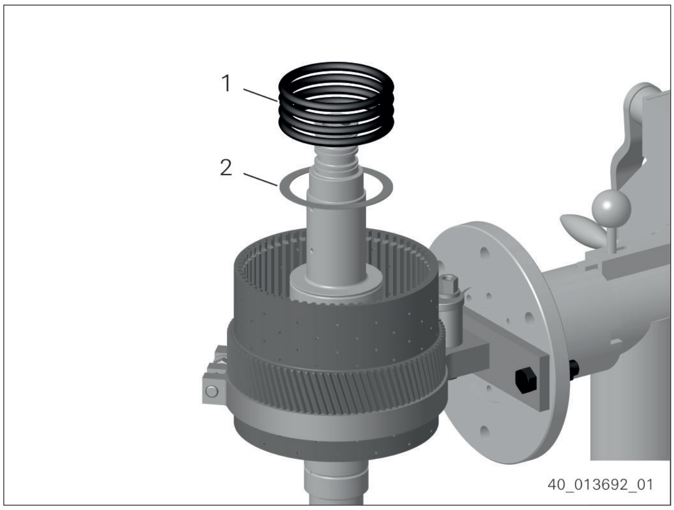


Fig. 247

12. Place guide ring (2) onto compression spring with chamfer facing upwards.

13. Slide on snap ring (1).

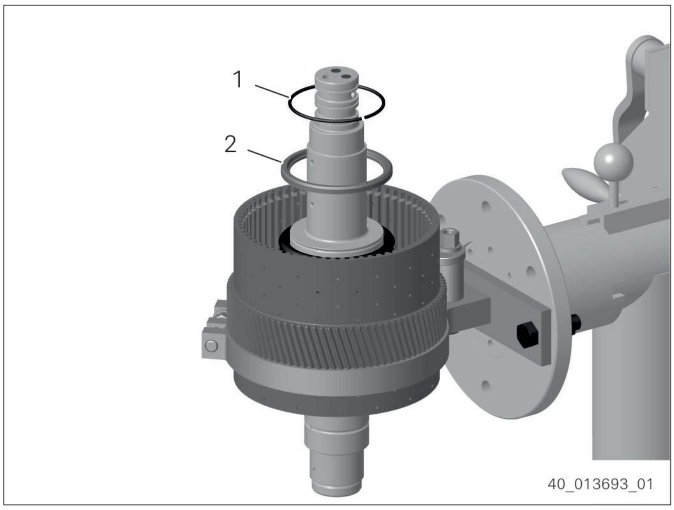


Fig. 248

14. Press guide ring downwards with 5870.345.072 [Assembly fixture] and hand-operated press and hold it there.

15. Insert snap ring into annular groove of disk carrier.

16. Release hand-operated press.

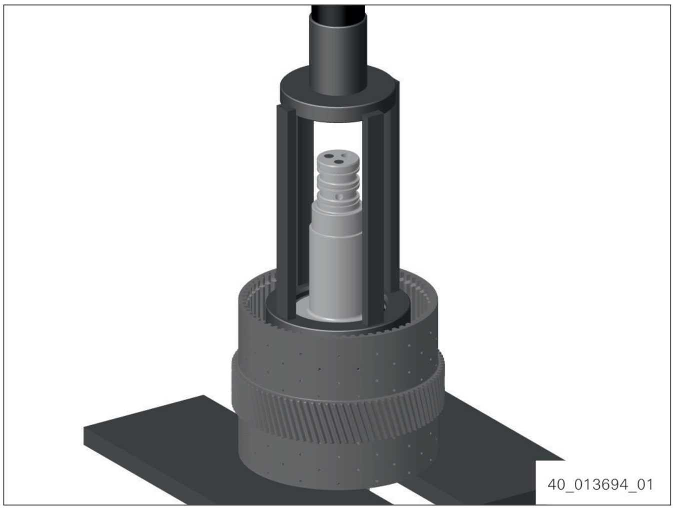


Fig. 249

17. Turn disk carrier by 180.

18. Apply oil to O-rings and insert them twist-free into annular grooves of the piston.

19. Oil O-rings and piston bearing surfaces.

20. Insert piston into the disk carrier until contact is obtained.

21. Slide on intermediate washer and compression spring.

22. Place guide ring onto compression spring with chamfer facing upwards.

23. Slide on snap ring.

24. Press guide ring downwards with 5870.345.072 [Assembly fixture] and hand-operated press and hold it there.

25. Insert snap ring into annular groove of disk carrier.

26. Release hand-operated press.

27. Fasten disk carrier to 5870.350.000 [Assembly truck] using 5870.654.033 [Assembly fixture].

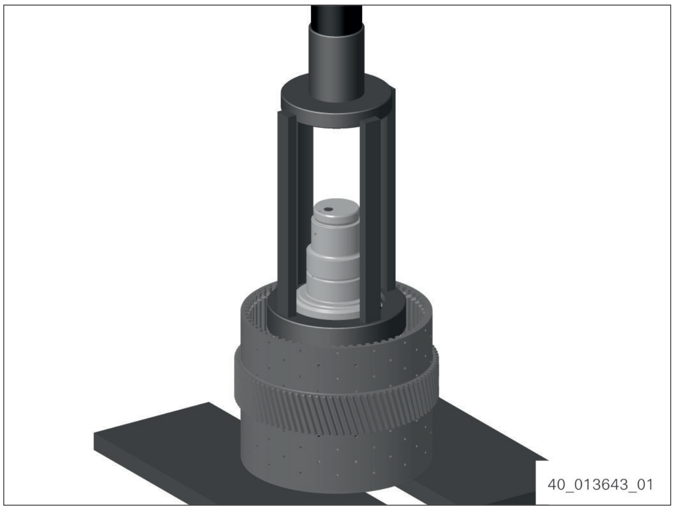


Fig. 250

Assembling clutch K4

28. To ensure a correct measuring result, install single parts without oil for the time being.

    Insert outer disks and inner disks.
    Insert first outer disk with the uncoated side facing the piston.
    Insert last outer disk with the uncoated side facing the end shim.

    For the arrangement refer to the current spare parts list.

    Thickness of the two optional inner disks must not differ by more than 0.7 mm.

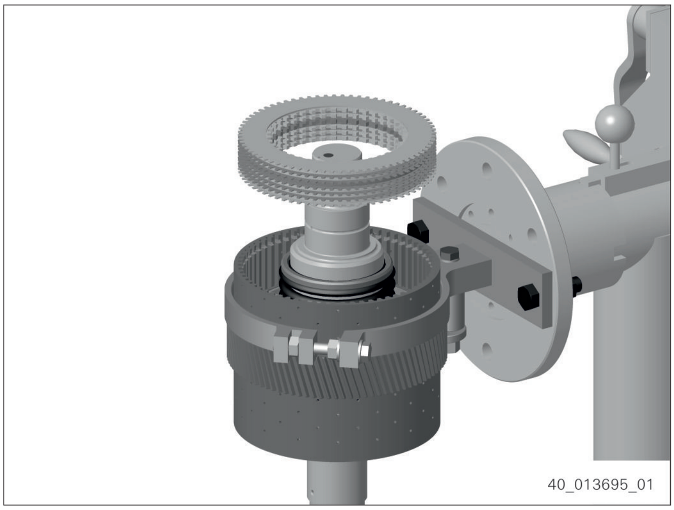


Fig. 251

29. Insert end shim (2).

30. Insert snap ring e. g. 2.60 mm (1).

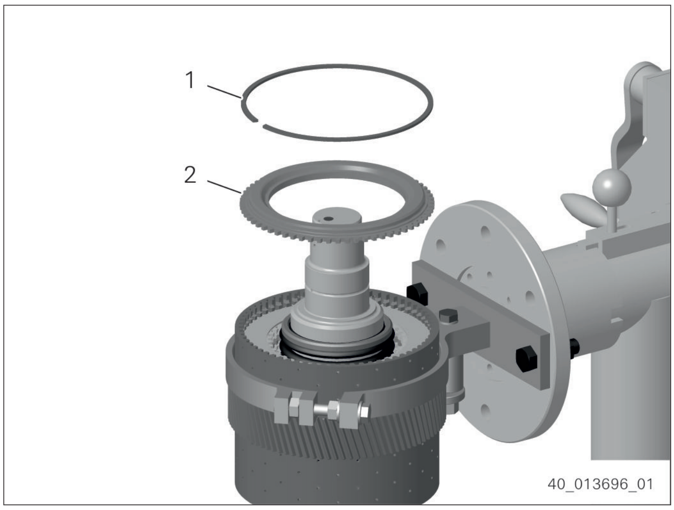


Fig. 252

31. Position dial gauge on the end shim.

32. Push end shim downwards with 100 N and set dial gauge to zero.

33. Lift end shim until contact with snap ring is obtained and check the necessary Disk clearance 2.2 mm to 2.4 mm.
    If the disk clearance is too small, insert thinner inner disks or (and) a thinner snap ring.
    If disk clearance is too big, install thicker inner disks or (and) and a thicker snap ring.

    Thickness of the two optional inner disks must not differ by more than 0.7 mm.

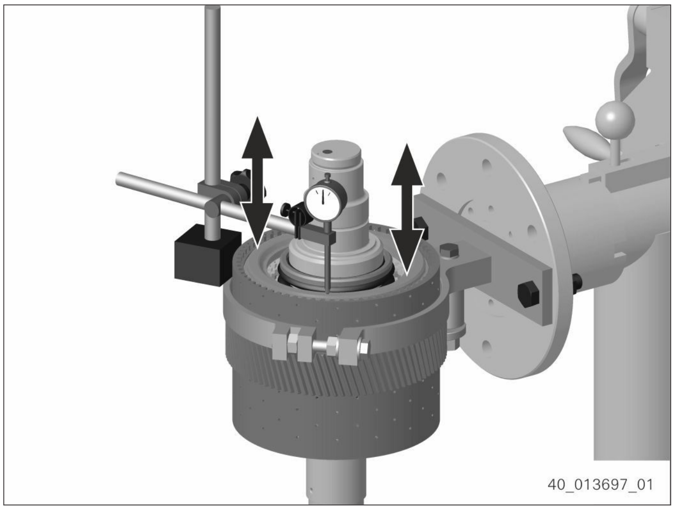


Fig. 253

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

⚠ **CAUTION**

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

35. Slide on bearing inner ring until contact is obtained.

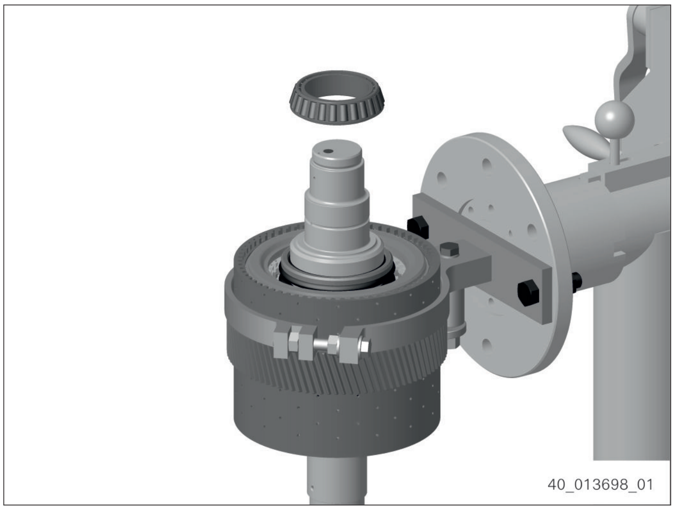


Fig. 254

36. Let bearing inner ring cool down.

37. Adjust bearing inner ring.

38. Slide on washer with recesses facing downwards.

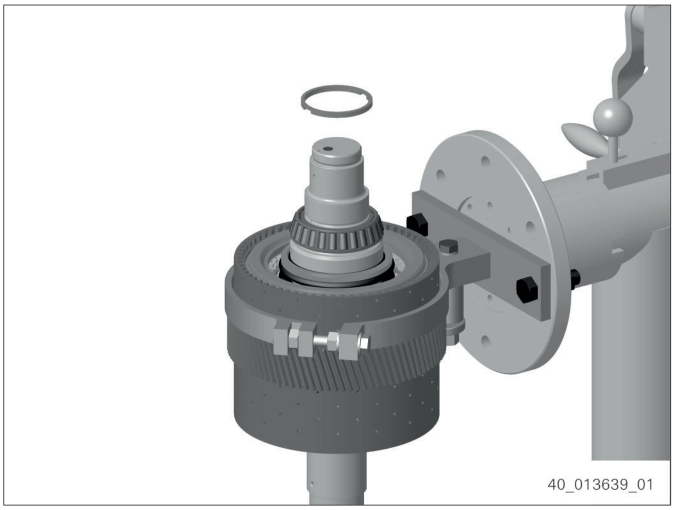


Fig. 255

39. Insert bearing outer rings into helical gear until contact is obtained.

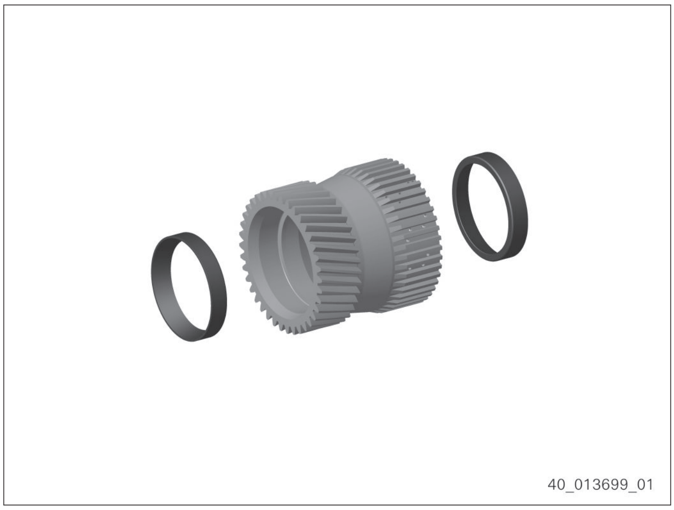


Fig. 256

40. Slide helical gear (1) onto shaft until contact is obtained. Insert helical gear into the disk package by short mutual rotary motions.

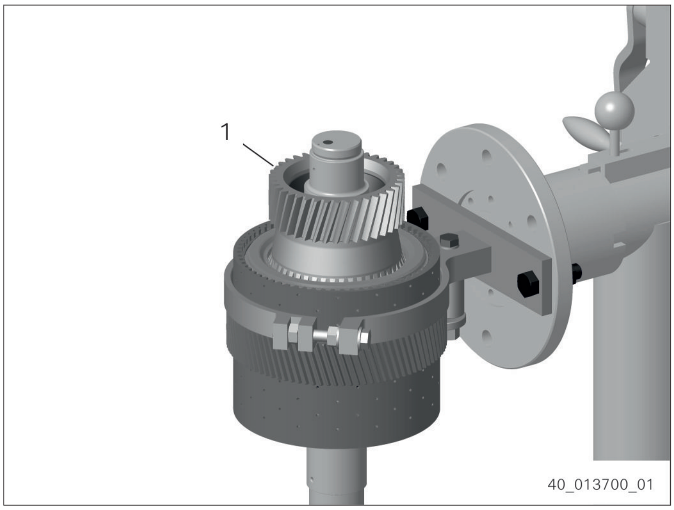


Fig. 257

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

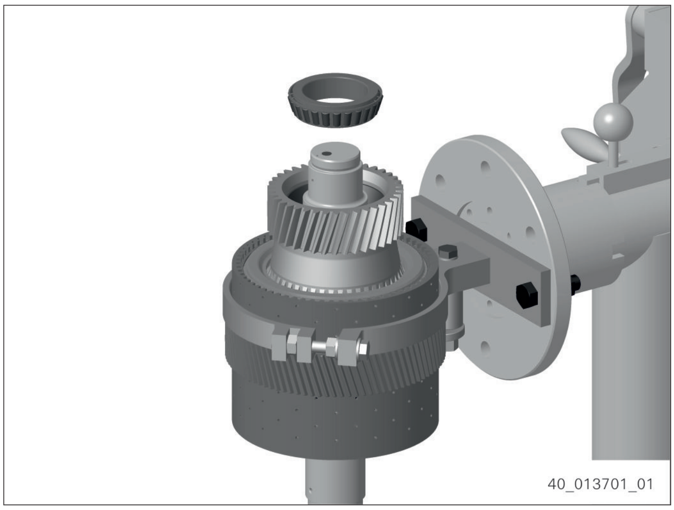


Fig. 258

42. Slide on bearing inner ring until contact is obtained.

43. Let bearing inner ring cool down.

44. Adjust bearing inner ring.

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

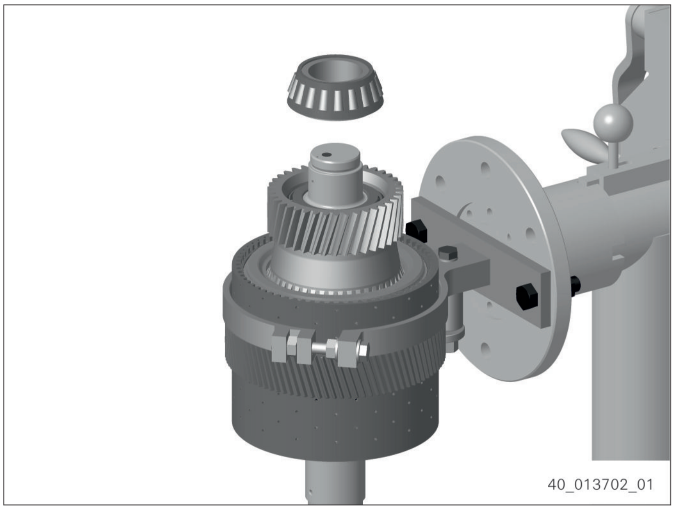


Fig. 259

46. Slide on bearing inner ring until contact is obtained.

47. Let bearing inner ring cool down.

48. Adjust bearing inner ring.

49. Turn disk carrier by 90.

50. Use 5870.401.118 [Groove nut wrench] and 5870.401.115 [Groove nut wrench] to tighten the slotted nut.
Tightening torque: 550 Nm

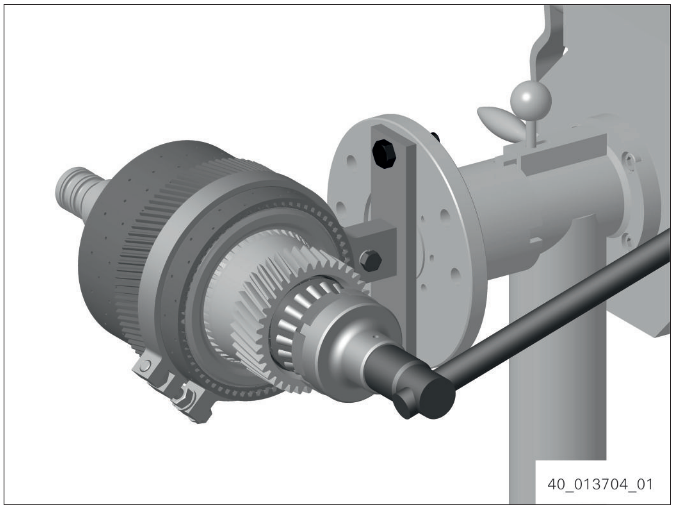


Fig. 260

Assembling clutch K3

51. Turn disk carrier by 90.

52. To ensure a correct measuring result, install single parts without oil for the time being.

Insert outer disks and inner disks.
Insert first outer disk with the uncoated side facing the piston.
Insert last outer disk with the uncoated side facing the end shim.

For the arrangement refer to the current spare parts list.

Thickness of the two optional inner disks must not differ by more than 0.7 mm.

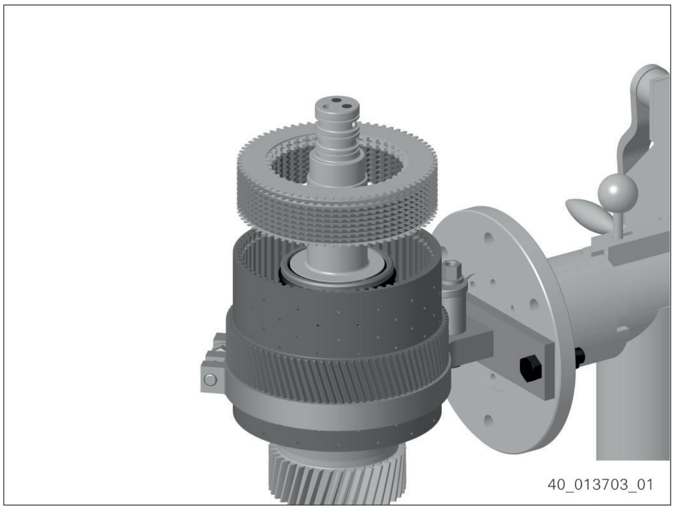


Fig. 261

53. Insert end shim (2).

54. Insert snap ring e. g. 2.60 mm (1).

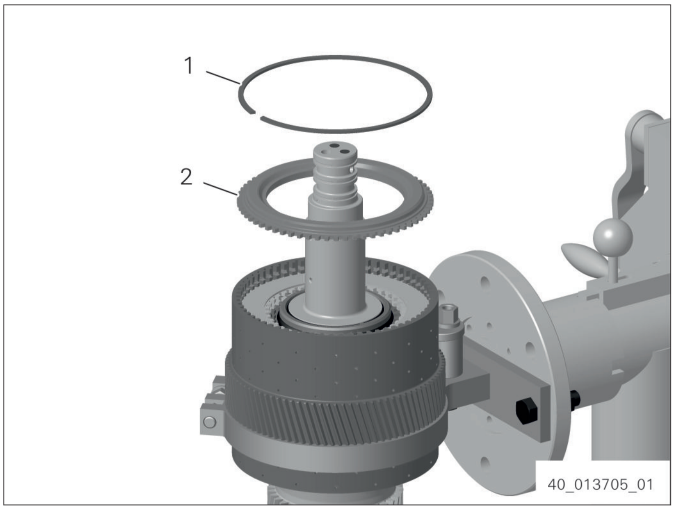


Fig. 262

55. Position dial gauge on the end shim.

56. Push end shim downwards with 100 N and set dial gauge to zero.

57. Lift end shim until contact with snap ring is obtained and check the necessary Disk clearance 2.2 mm to 2.4 mm.
If the disk clearance is too small, insert thinner inner disks or (and) a thinner snap ring.
If disk clearance is too big, install thicker inner disks or (and) and a thicker snap ring.

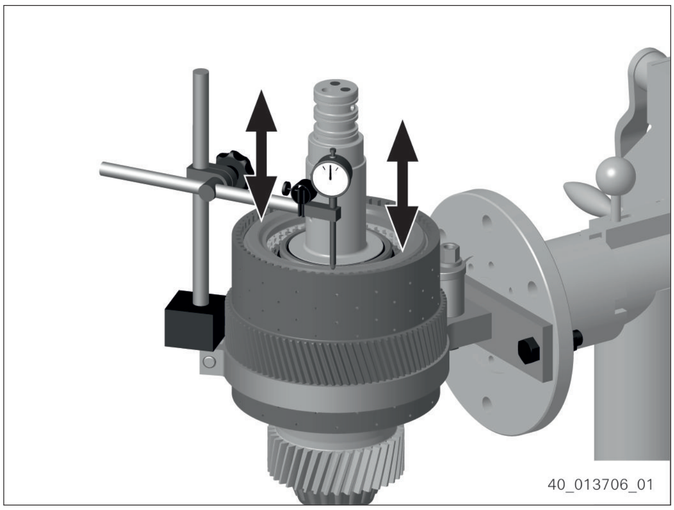


Fig. 263

Thickness of the two optional inner disks must not differ by more than 0.7 mm.

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

⚠ **CAUTION**

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

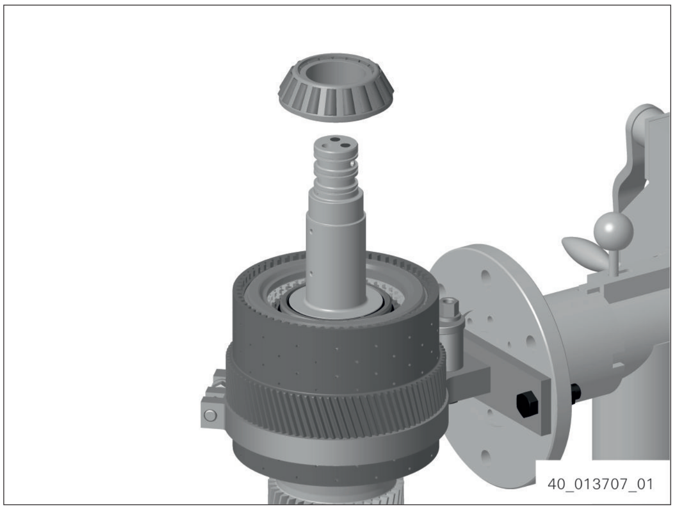


Fig. 264

59. Slide on bearing inner ring until contact is obtained.

60. Let bearing inner ring cool down.

61. Adjust bearing inner ring.

62. Insert bearing outer ring into spur gear until contact is obtained.

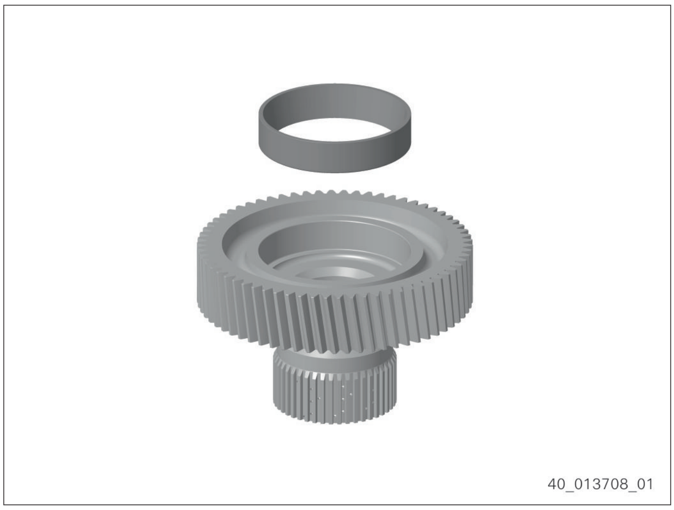


Fig. 265

63. Slide spur gear (1) onto shaft until contact is obtained. Insert spur gear into disk package by short mutual rotary motions.

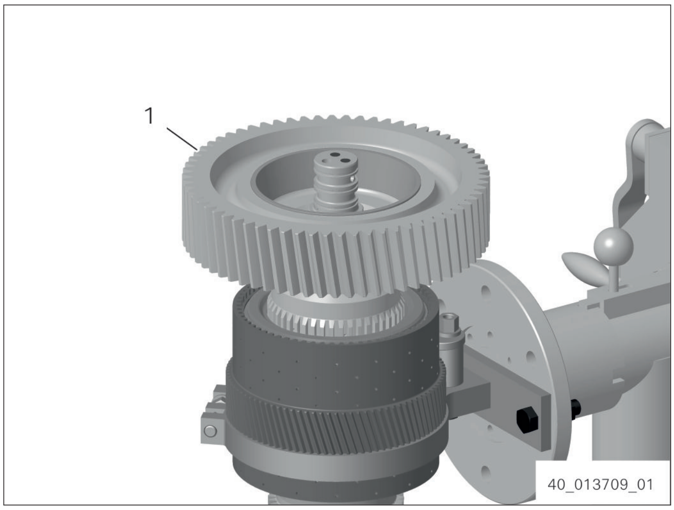


Fig. 266

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat up roller bearing.

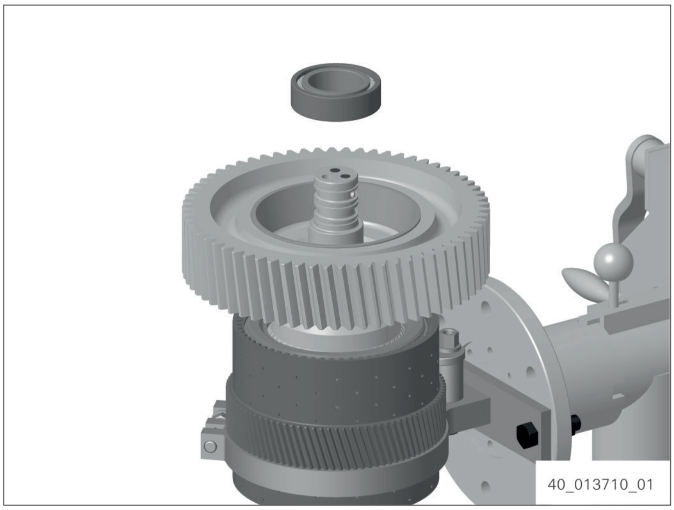


Fig. 267

65. Slide on roller bearing until contact is obtained.

66. Let the roller bearing cool down.

67. Adjust bearing inner ring.

68. Check function of the clutches by applying compressed air.

    → Closing and opening of the clutch is clearly audible.

    If closing and opening is not audible, disassemble and check clutch.

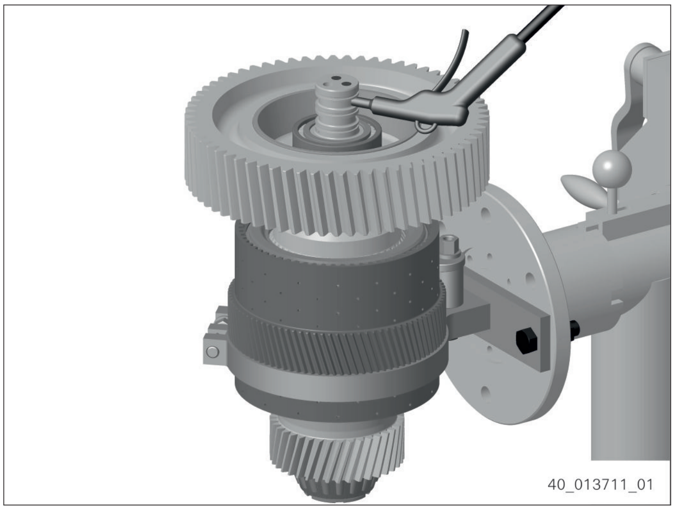


Fig. 268

69. Grease annular grooves of shaft.

70. Insert R-rings (1).

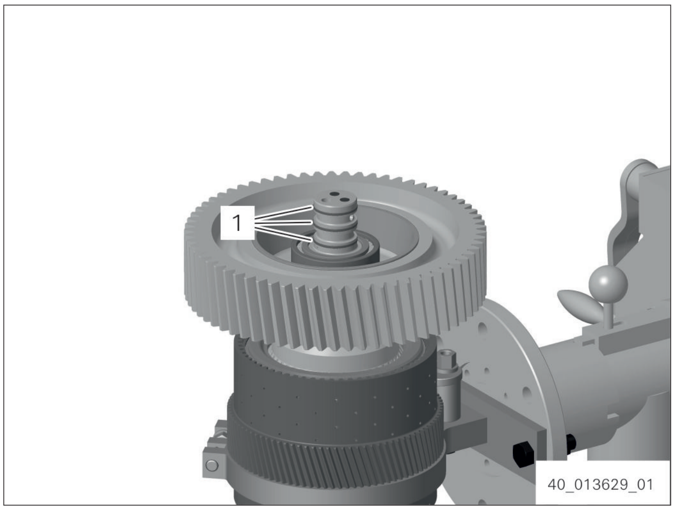


Fig. 269

71. Fix spur gear axially by means of 5870.345.033 [Assembly fixture] and AA00.317.255 [Load ring].

    → Spur gear has been fixed and cannot be pulled out of the disk package.

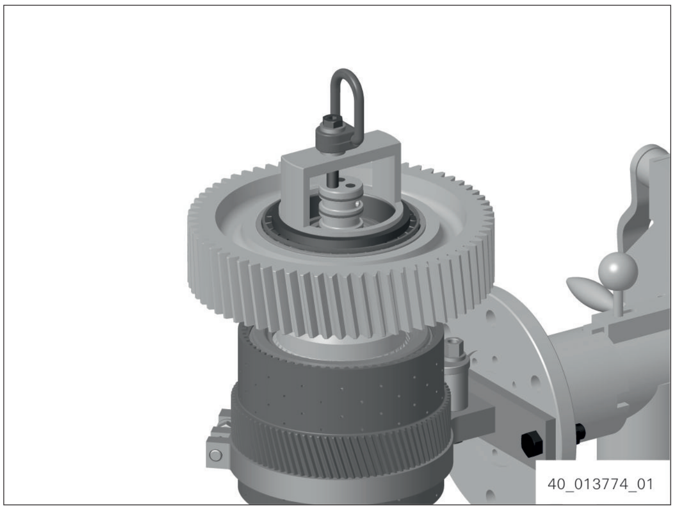


Fig. 270

Installing clutches

Special tools:

- 5870.204.002 Eyebolt
- 5870.345.033 Assembly fixture
- AA00.317.255 Load ring

1. **⚠ CAUTION**

   Risk of crushing due to moving load.
   Slight to moderate injury possible.
   ⇨ Move load slowly and carefully.
   ⇨ Do not reach into danger area.

   Insert clutch KV/K1 into housing by means of 5870.204.002 [Eyebolt] and crane.

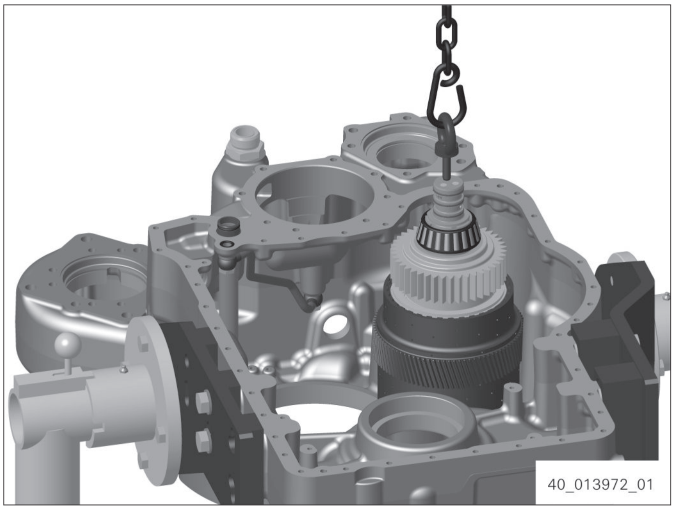


Fig. 271

2. **⚠ CAUTION**

   Risk of crushing due to moving load.
   Slight to moderate injury possible.
   ⇨ Move load slowly and carefully.
   ⇨ Do not reach into danger area.

   Insert clutch KR/K2 by means of 5870.204.002 [Eyebolt] and crane.

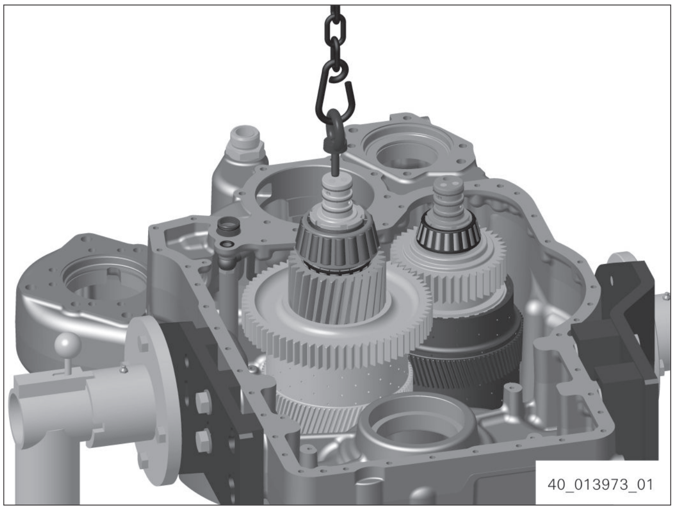


Fig. 272

3. Check position of gear (1). Flush-align tapered roller bearings and housing hole.

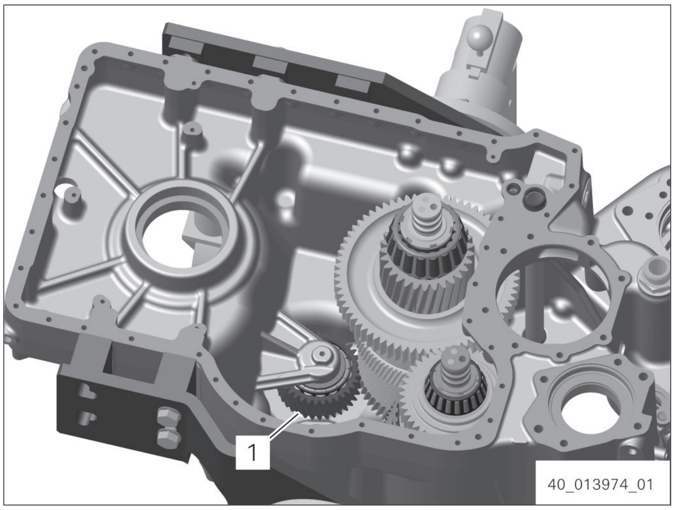


Fig. 273

4. **CAUTION**

   Risk of crushing due to moving load.
   Slight to moderate injury possible.
   ⇨ Move load slowly and carefully.
   ⇨ Do not reach into danger area.

   Slightly lift clutch KR/K2 (1) and move in direction of arrow.

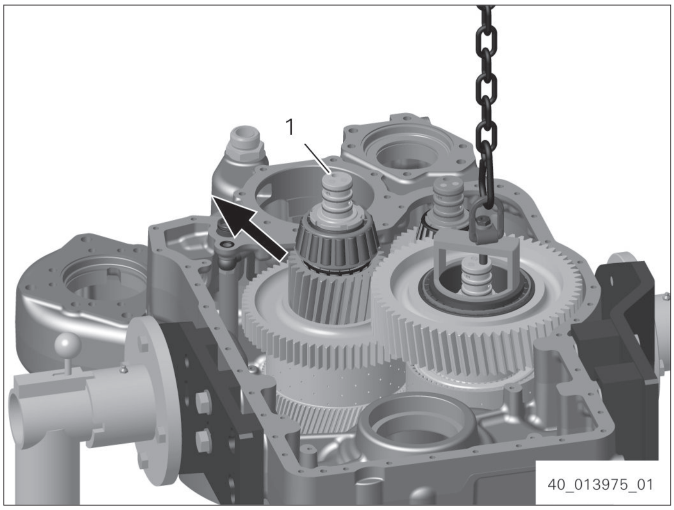


Fig. 274

5. Insert clutch K3/K4 into housing by means of 5870.345.033 [Assembly fixture], AA00.317.255 [Load ring] and crane.

6. Remove AA00.317.255 [Load ring] and 5870.345.033 [Assembly fixture].

Installing output gear

Special tools:

- 5870.100.054 Stop washer
- 5870.204.002 Eyebolt

1. Insert cylindrical roller bearing (1) into housing hole until contact is obtained.

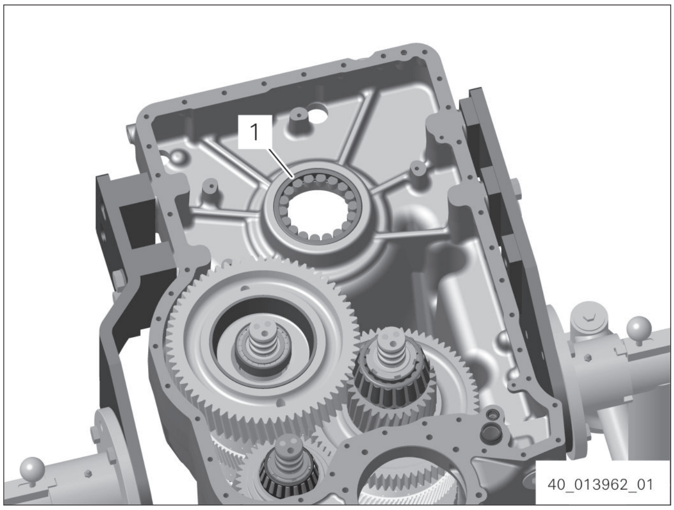


Fig. 275

2. Place cover sheet (1) into position.

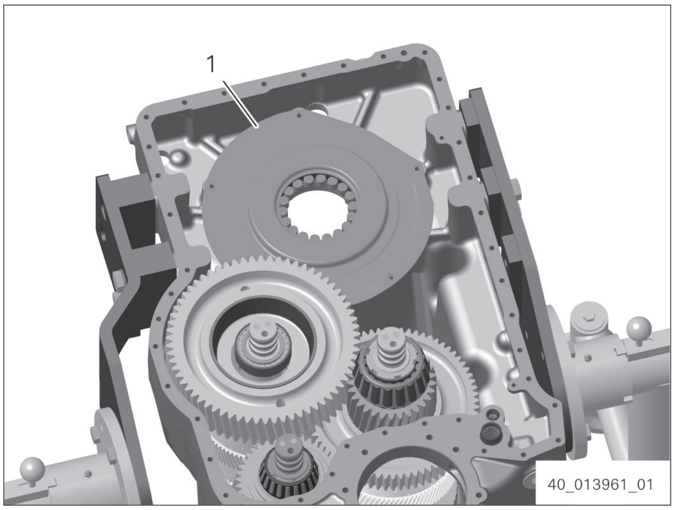


Fig. 276

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

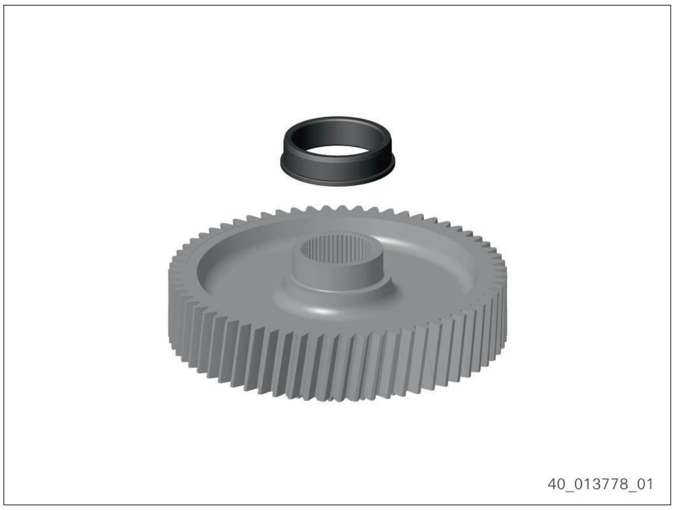


Fig. 277

4. Slide bearing inner ring onto gear until contact is obtained.

5. Let bearing inner ring cool down.

6. Adjust bearing inner ring.

7. ⚠ **CAUTION**

Risk of crushing due to moving load.
Slight to moderate injury possible.
⇨ Move load slowly and carefully.
⇨ Do not reach into danger area.

Use 5870.100.054 [Stop washer], 5870.204.002 [Eyebolt] and crane to insert gear into the housing. Insert gear into the cylindrical roller bearing until contact is obtained.

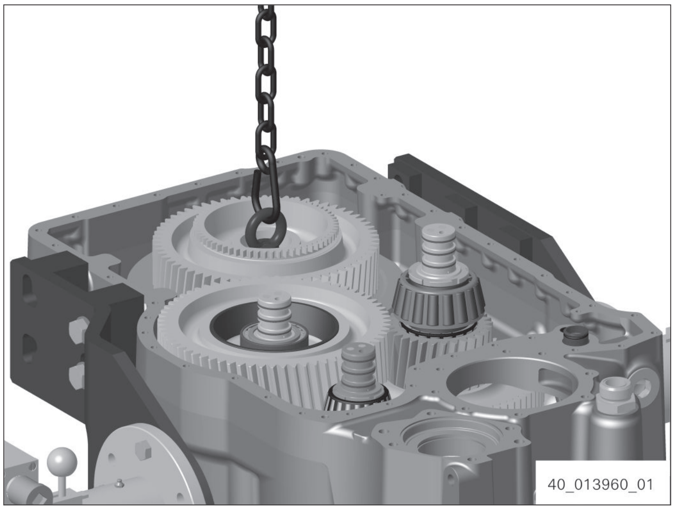


Fig. 278

8. Place cover sheet (1) into position.

9. Bolt in and tighten cap screws.
Tightening torque: 23 Nm

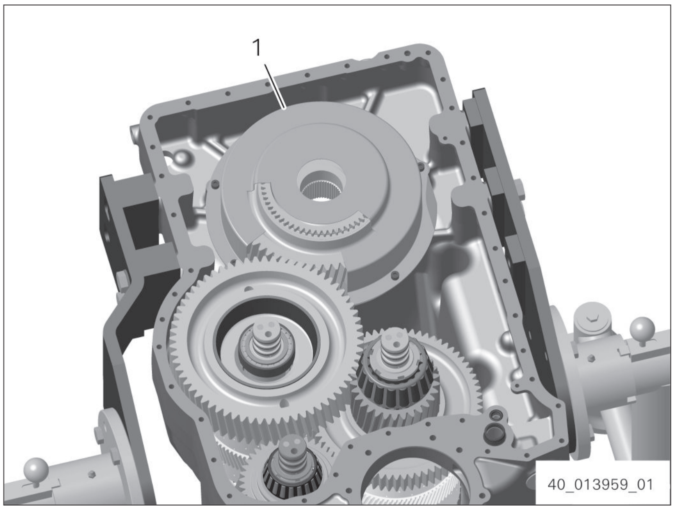


Fig. 279

Installing suction tube

1. Insert suction tube (1).

2. Bolt in and tighten cap screws (2).
   Tightening torque: 23 Nm

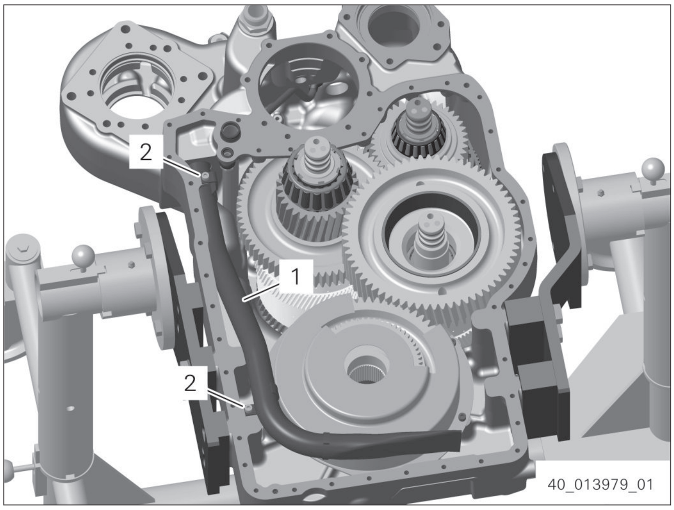


Fig. 280

Fitting the cover to the housing

Special tools:
- 5870.281.061 Load-lifting equipment

Operating supplies and auxiliary materials:
- 0666.790.033 LOCTITE 574

1. Screw in the adapter with O-ring (1) and tighten.
   Tightening torque: 117 Nm

2. Bolt in screw plugs with O-ring (2) and tighten.
   Tightening torque: 35 Nm

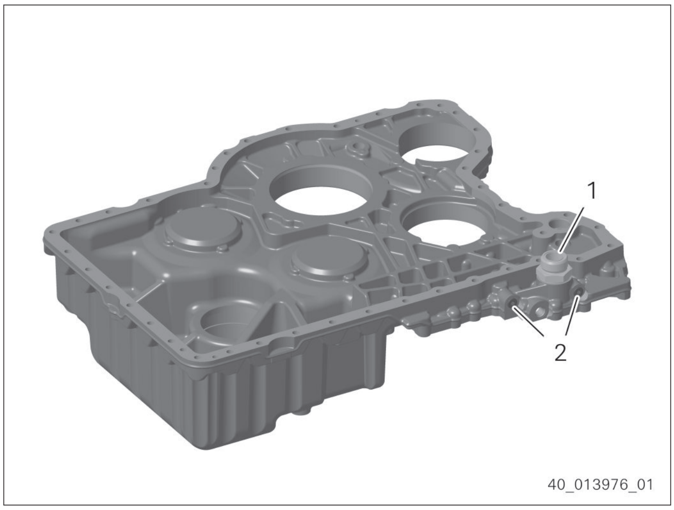


Fig. 281

3. Apply 0666.790.033 [LOCTITE 574] onto the mounting face (1).

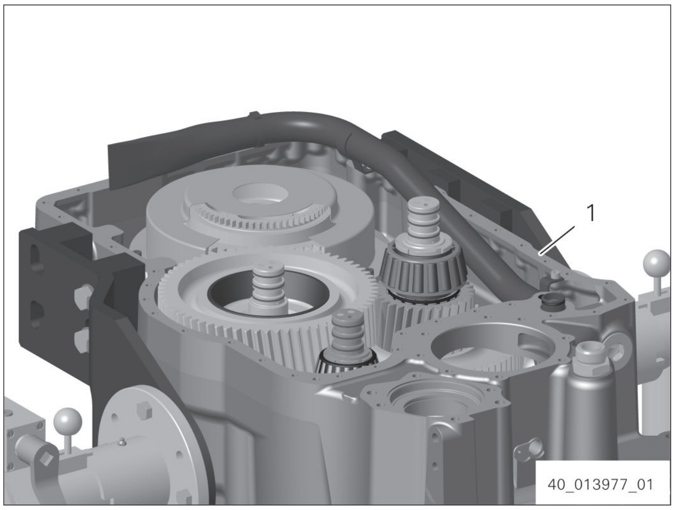


Fig. 282

4. Fit 5870.281.061 [Load-lifting equipment] to the cover.

5. ⚠ **CAUTION**

   Risk of crushing due to moving load.
   Slight to moderate injury possible.
   ⇨ Move load slowly and carefully.
   ⇨ Do not reach into danger area.

   Mount cover using a crane.

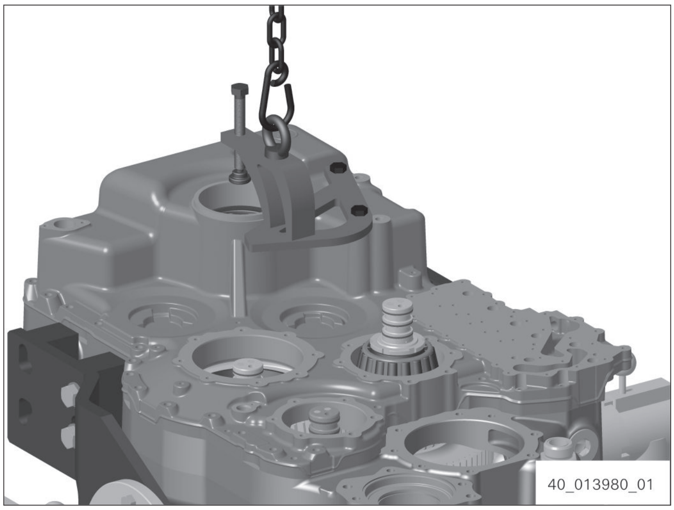


Fig. 283

6. ⚠ **CAUTION**

   Risk of injury due to parts flying away.
   Slight or moderate injury possible.
   ⇨ Wear protective goggles.

   Flush-mount both pins (1).

7. Bolt in and tighten cap screws.
   Tightening torque: 46 Nm

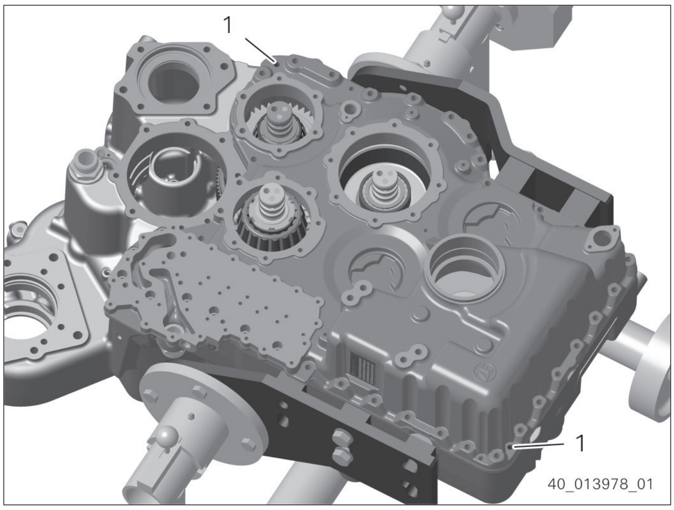


Fig. 284

Setting bearing preload of clutches

Special tools:
- 5870.320.014 Assembly fixture
- 5870.320.018 Inserting tool
- 5870.200.022 Straightedge
- 5870.204.007 Locating pin

Setting bearing preload of clutches K3/K4

1. Insert sealing plug (1) into hole of cover by means of 5870.320.014 [Assembly fixture] and 5870.320.018 [Inserting tool].

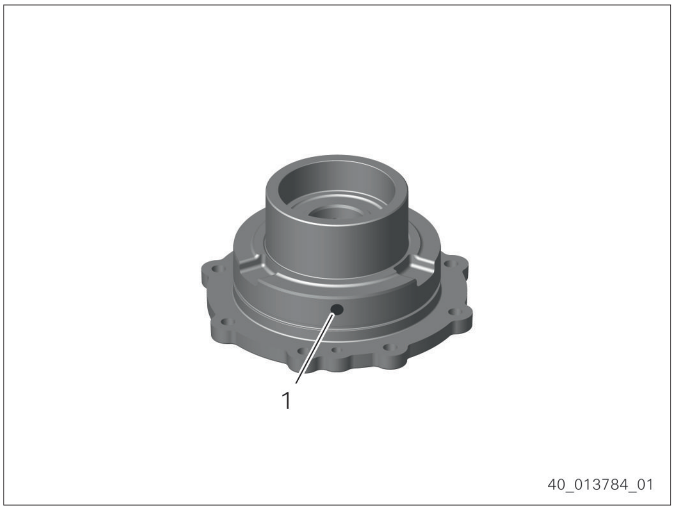


Fig. 285

2. Insert sealing plug (1) into hole with 5870.320.014 [Assembly fixture] and 5870.320.018 [Inserting tool].

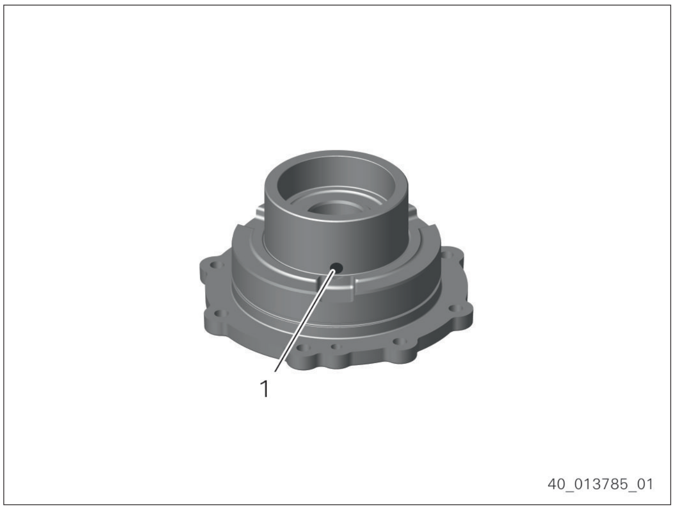


Fig. 286

3. Insert bearing inner ring (1) into bearing outer ring.

4. Rotate bearing inner ring in both directions several times.

5. Use depth gauge and 5870.200.022 [Straightedge] to measure the distance from mounting face to front face of the bearing inner ring.
   Distance A = e. g. 43.70 mm

   Measure at several points and calculate the average.

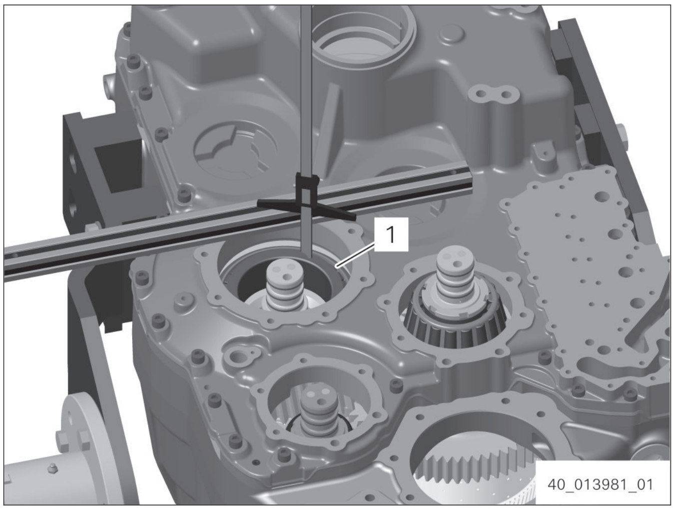


Fig. 287

6. Use depth gage, parallel gage blocks and 5870.200.022 [Straightedge] to measure distance from mounting face to contact face of bearing inner ring.
   Distance B = e.g. 42.20 mm

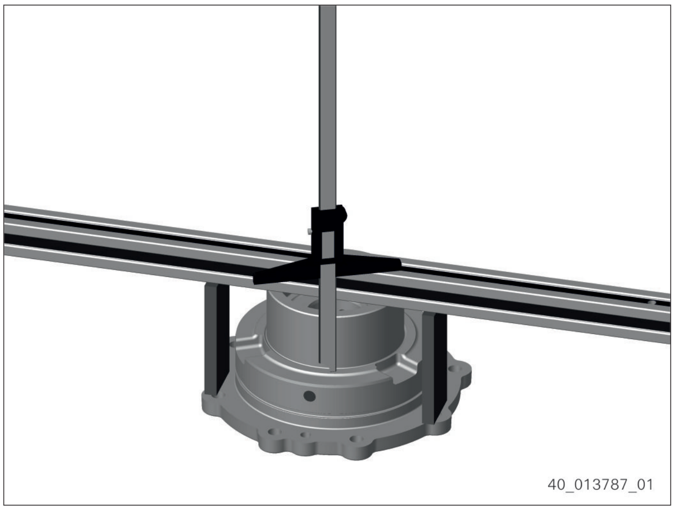


Fig. 288

7. Calculate thickness of spacer washer for Bearing preload 0.12 mm to 0.18 mm.

   Calculation example:
   s = distance A – distance B + mean value of required bearing preload
   s = 43.70 mm – 42.20 mm + 0.15 mm
   s = 1.65 mm

8. Slide spacer washer with the calculated thickness, e. g. s = 1.65 mm onto the cover.

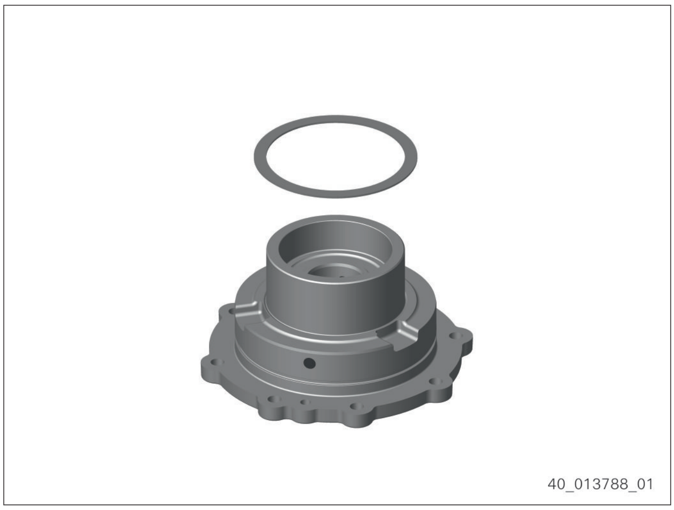


Fig. 289

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

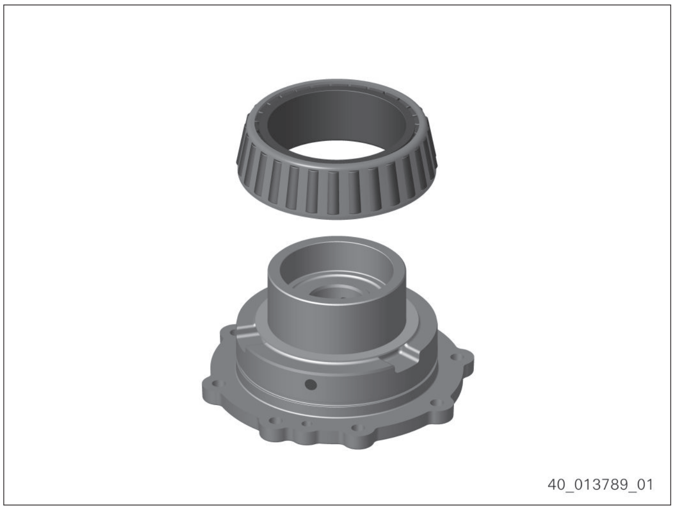


Fig. 290

10. Slide on bearing inner ring until contact is obtained.

11. Let bearing inner ring cool down.

12. Adjust bearing inner ring.

13. Turn two 5870.204.007 [Locating pin] into cover.

14. Center R-rings (1).

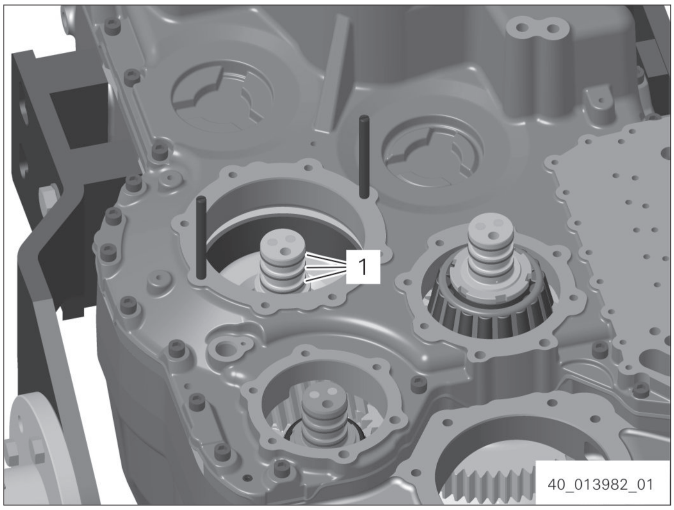


Fig. 291

15. Grease O-ring.

16. Insert O-ring (1) into annular groove.

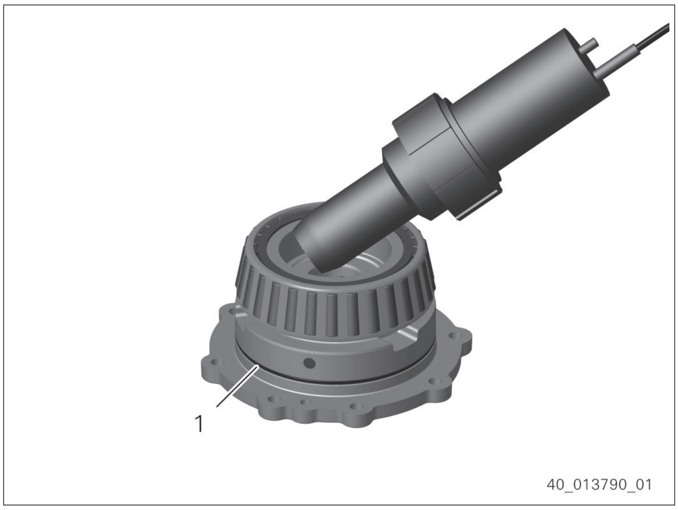


Fig. 292

17. Carry out the following three work steps immediately one after the other.

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing hole.

18. Slide on cover (1).

19. Turn in and tighten hexagon screws evenly.
Tightening torque: 46 Nm

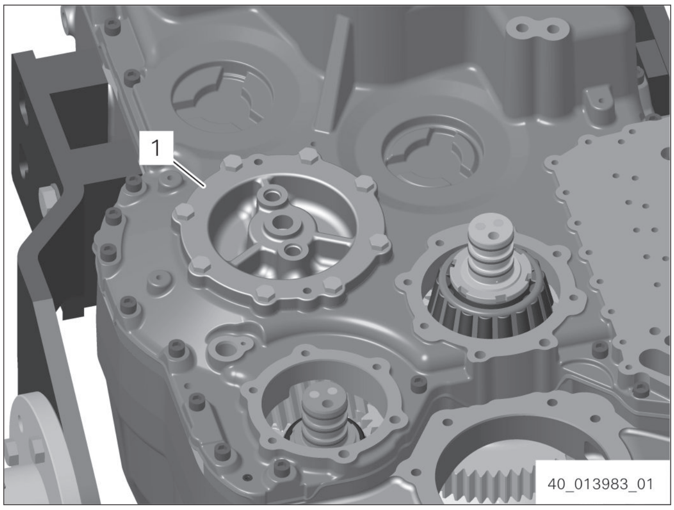


Fig. 293

20. Check function of the clutches by applying compressed air.

→ Closing and opening of the clutch is clearly audible.

If closing and opening is not audible, remove cover and check R-rings.

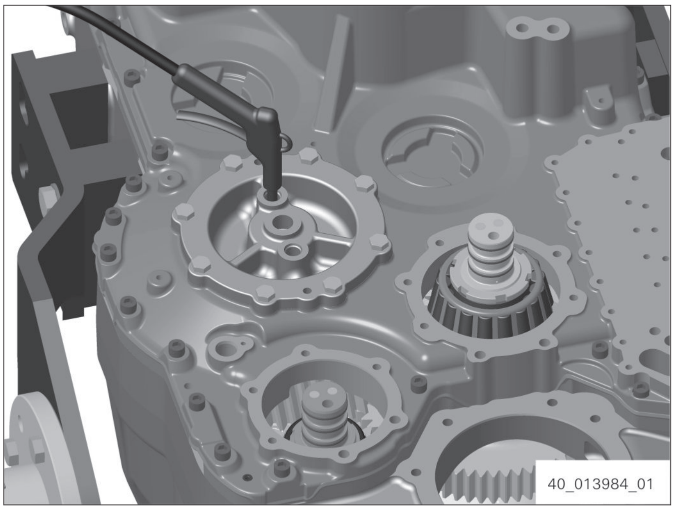


Fig. 294

Setting bearing preload of clutch KR/K2

21. Insert sealing plug (1) into hole of cover by means of 5870.320.014 [Assembly fixture] and 5870.320.018 [Inserting tool].

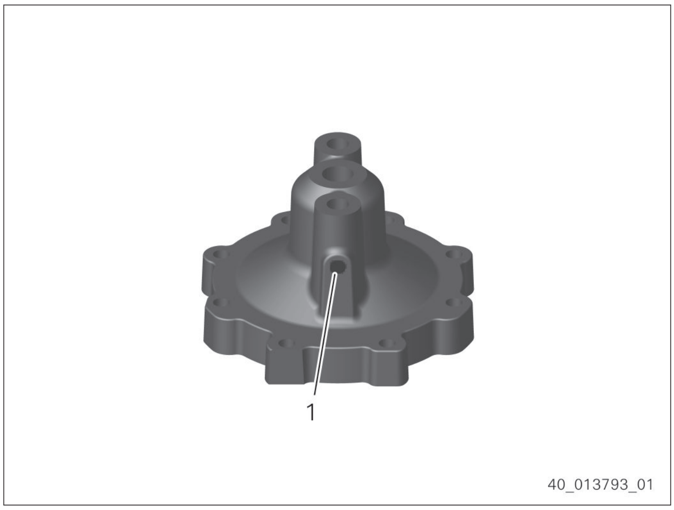


Fig. 295

22. Insert sealing plug (1) into hole with 5870.320.014 [Assembly fixture] and 5870.320.018 [Inserting tool].

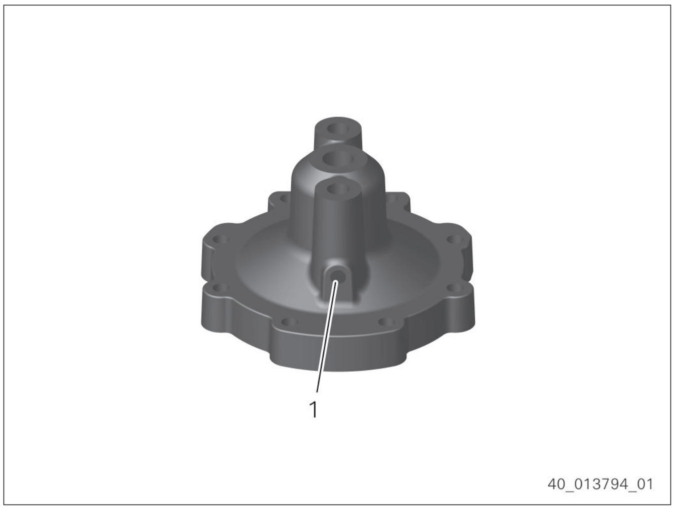


Fig. 296

23. Insert bearing outer ring (1) until contact is obtained.

24. Use depth gage to measure distance from front face of bearing outer ring to mounting face.
    Distance A = e. g. 16.20 mm

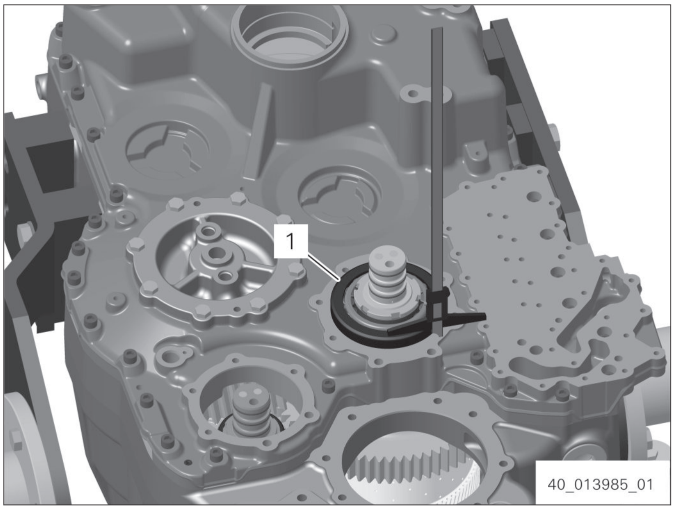


Fig. 297

25. Use depth gage to measure distance from mounting face to contact face of bearing inner ring.
Distance B = e.g. 17.75 mm

26. Calculate thickness of shim for Bearing preload 0.12 mm to 0.18 mm.

Calculation example:
s = distance B – distance A + mean value of the required bearing preload
s = 17.75 mm – 16.20 mm + 0.15 mm
s = 1.70 mm

Fig. 298

27. Use grease to insert shim (1) with the calculated thickness, e. g. s = 1.70 mm into the cover.

28. Grease O-ring.

29. Insert O-ring (2) into annular groove.

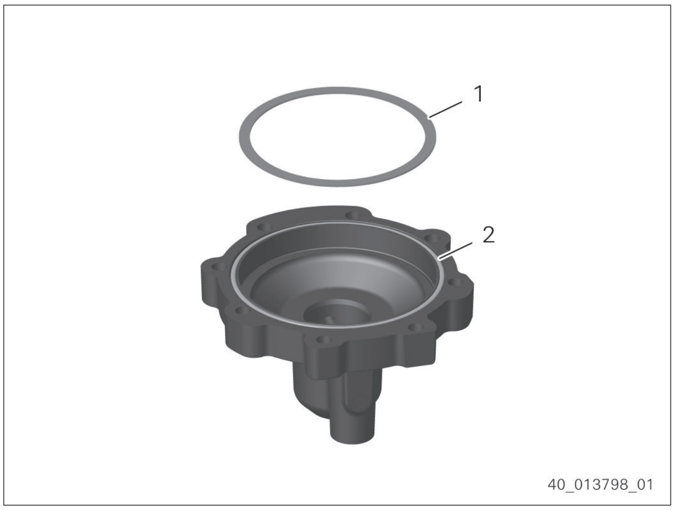


Fig. 299

30. Turn two 5870.204.007 [Locating pin] into cover.

31. Center R-rings (1).

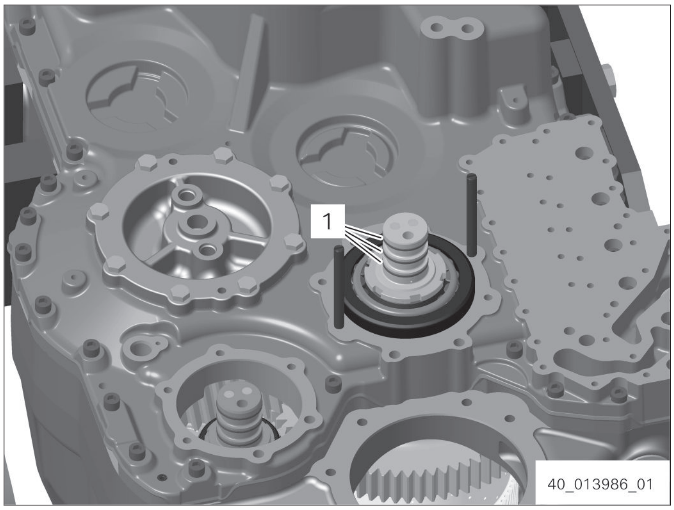


Fig. 300

32. Slide on cover (1).

33. Turn in and tighten hexagon screws evenly.
Tightening torque: 46 Nm

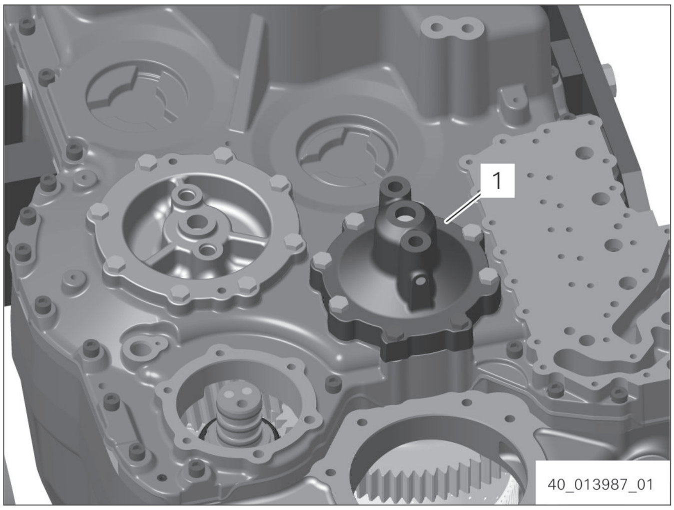


Fig. 301

34. Check function of the clutches by applying compressed air.

→ Closing and opening of the clutch is clearly audible.

If closing and opening is not audible, remove cover and check R-rings.

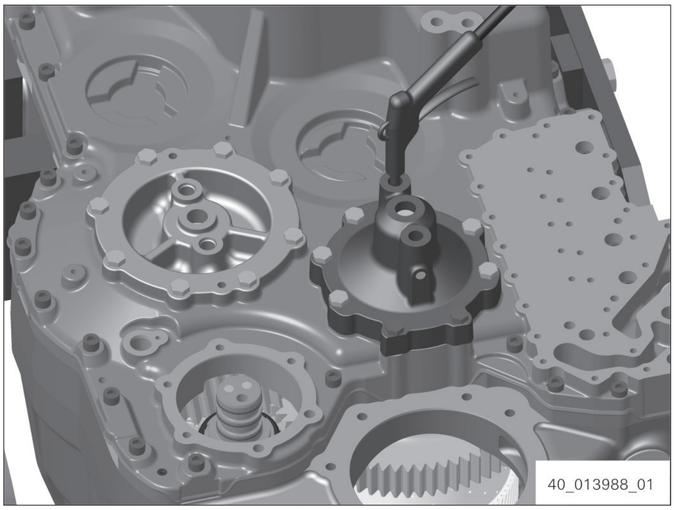


Fig. 302

Setting bearing preload of clutch KV/K1

35. Insert sealing plugs (1) into holes of the bearing cover using 5870.320.014 [Assembly fixture] and 5870.320.018 [Inserting tool].

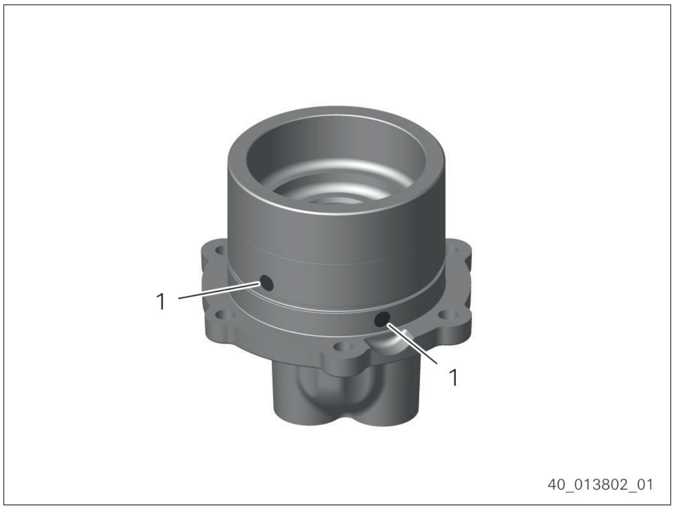


Fig. 303

36. Put on bearing outer ring (1).

37. Rotate bearing outer ring in both directions several times.

38. Use depth gage to measure distance from mounting face to front face of bearing outer ring.
    Distance A = e. g. 52.60 mm
    Measure at several points and calculate the average.

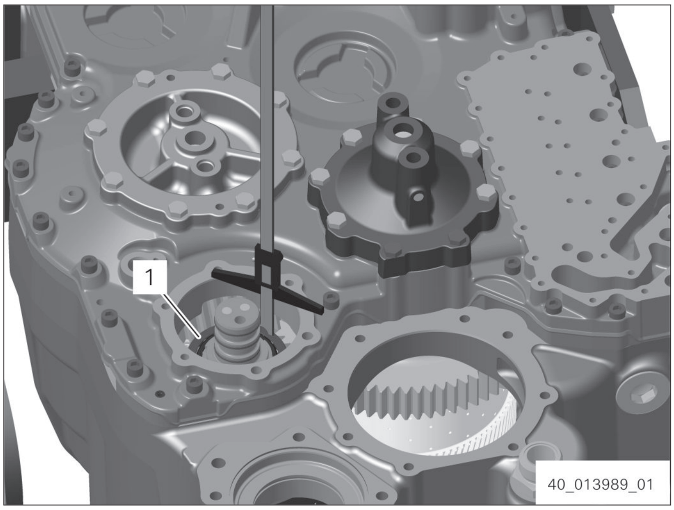


Fig. 304

39. Insert ring with chamfered side facing downwards into the bearing cover.

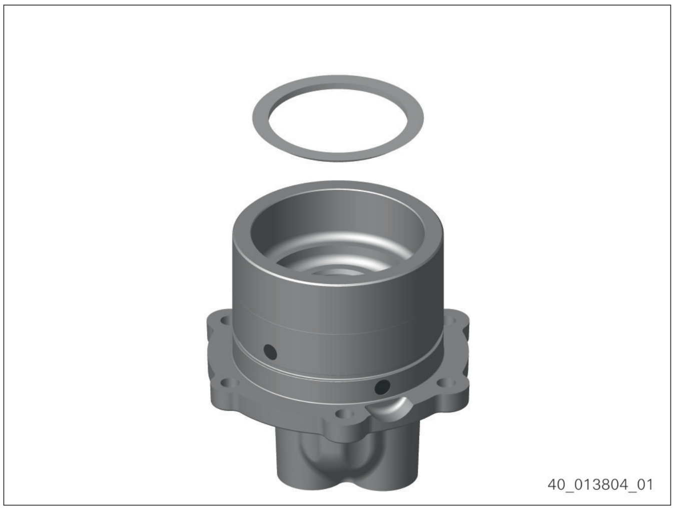


Fig. 305

40. Use depth gage to measure distance from mounting face to plane face of the ring.
    Distance B = e.g. 50.75 mm

41. Calculate thickness of shim for Bearing preload 0.12 mm to 0.18 mm.

    Calculation example:
    s = distance A – distance B + mean value of required bearing preload
    s = 52.60 mm – 50.75 mm + 0.15 mm
    s = 2.00 mm

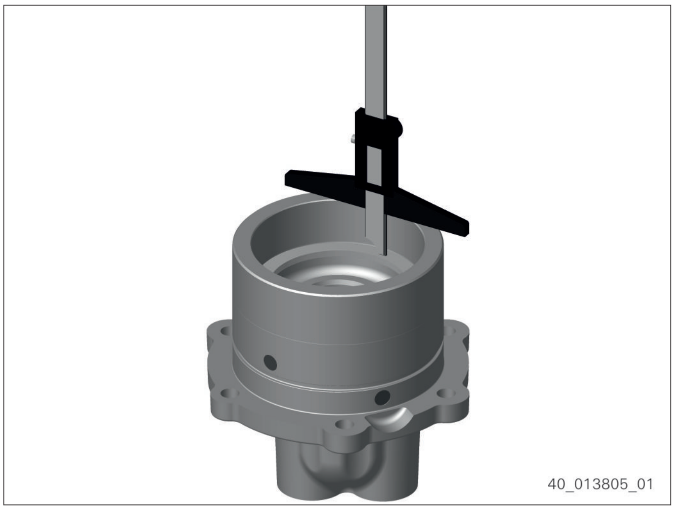


Fig. 306

42. Insert shim with the calculated thickness, e. g. s = 2.00 mm into the bearing cover.

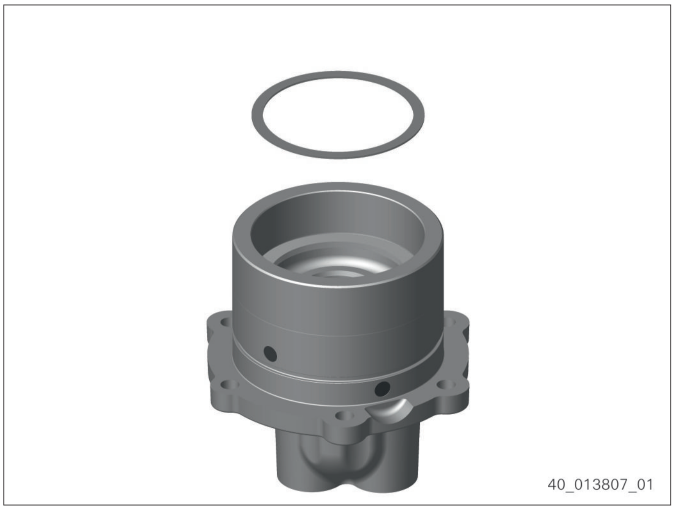


Fig. 307

43. Insert bearing outer ring (1) until contact is obtained.

44. Grease O-ring.

45. Insert O-ring (2) into annular groove.

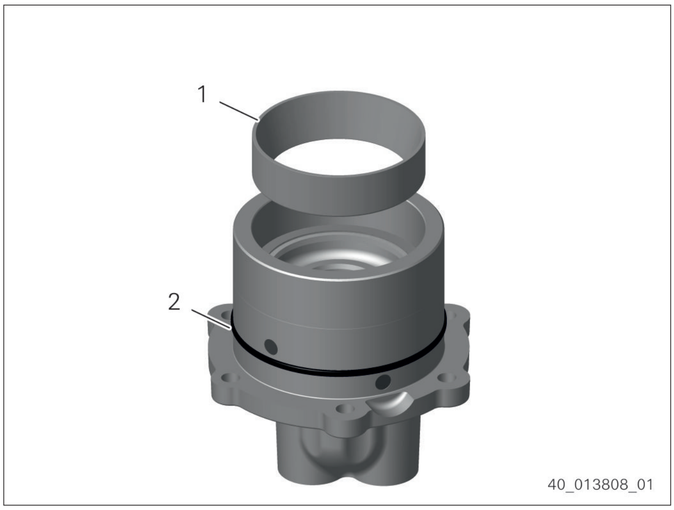


Fig. 308

46. Center R-rings (1).

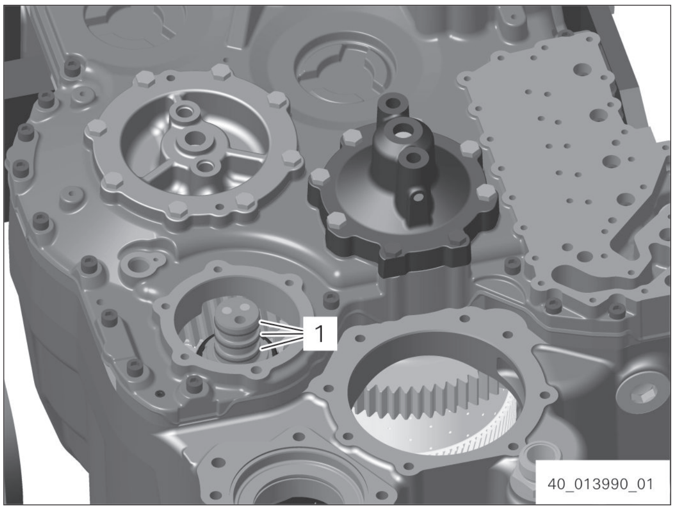


Fig. 309

47. Turn two 5870.204.007 [Locating pin] into cover.

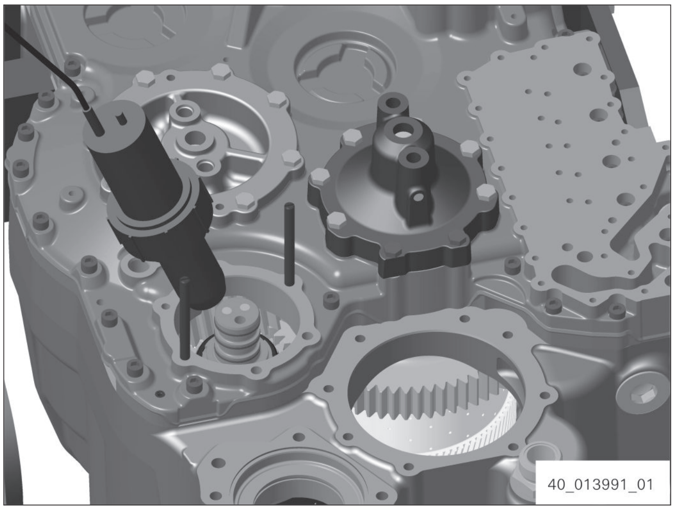


Fig. 310

48. Carry out the following three work steps immediately one after the other.

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat up hole.

49. Insert bearing cover (1).

50. Turn in and tighten hexagon screws evenly. Tightening torque: 46 Nm

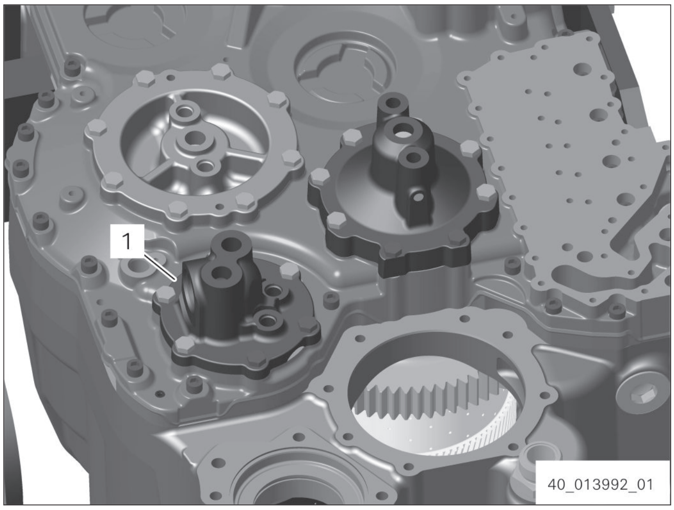


Fig. 311

51. Check function of the clutches by applying compressed air.

→ Closing and opening of the clutch is clearly audible.

If closing and opening is not audible, remove bearing cover and check R-rings.

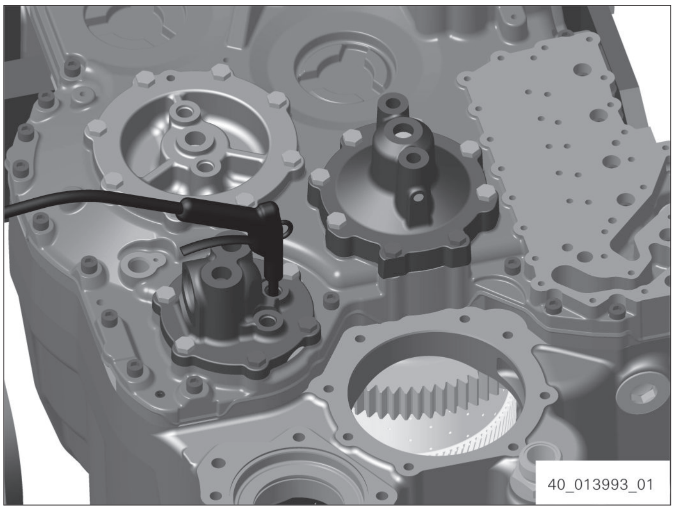


Fig. 312

10.3 Installing the output shaft

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

   ⚠ CAUTION

   Risk of burn injuries due to contact with hot surfaces.
   Slight or moderate injury possible.
   ⇨ Wear protective gloves.

   Heat up hole in gear.

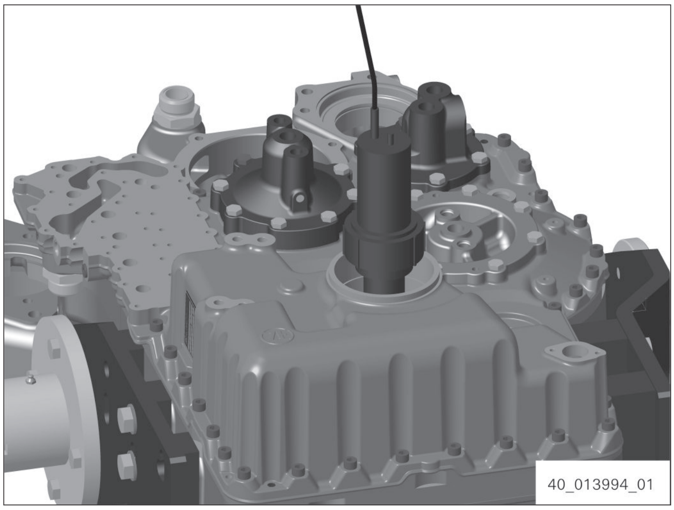


Fig. 313

2. Insert output shaft (1) with long toothing into gear until contact is obtained.
3. Let gear cool down.
4. Adjust output shaft.

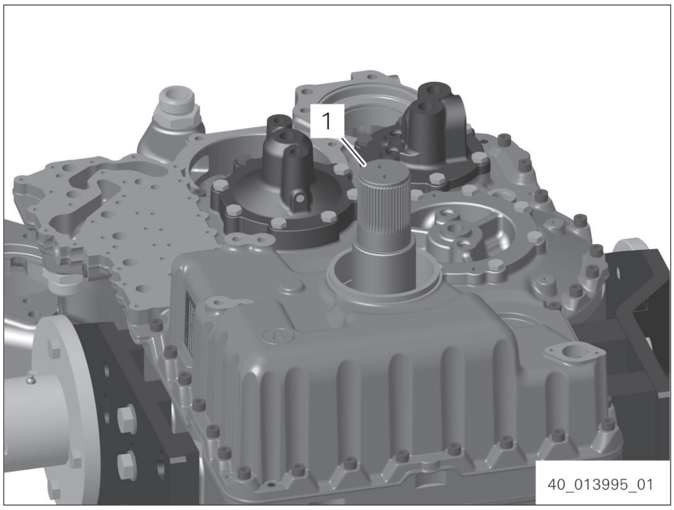


Fig. 314

Setting axial clearance of output shaft

5. Use depth gage to measure distance from front face of the cover to contact face of the shim.
   Distance A = e. g. 66.90 mm

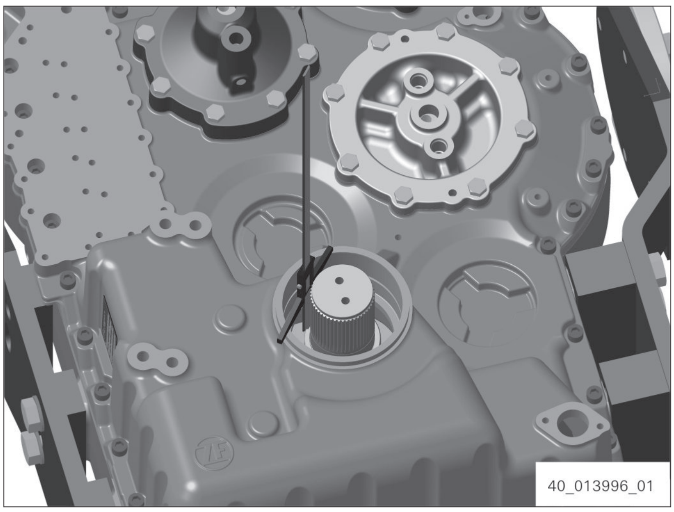


Fig. 315

6. Use depth gage to measure distance from front face of cover to contact face of ball bearing.
   Distance B = e.g. 64.20 mm

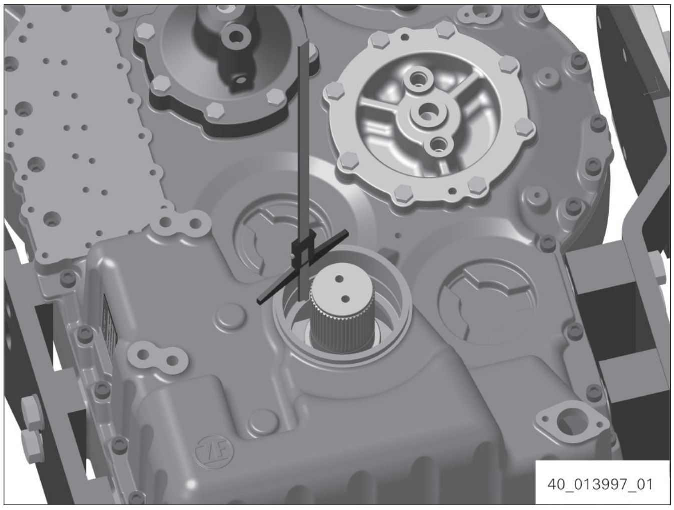


Fig. 316

7. Calculate thickness of shim for Axial clearance of output shaft 0.30 mm to 0.50 mm.

   Calculation example:
   s = distance A – distance B – mean value of axial clearance
   s = 66.90 mm – 64.20 mm – 0.40 mm
   s = 2.30 mm

8. Slide on shim (1) with the calculated thickness, e. g. s = 2.30 mm.

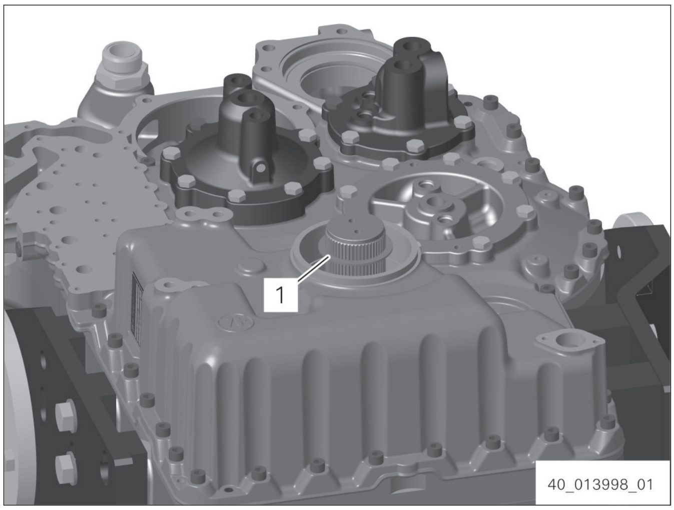


Fig. 317

9. Insert ball bearing (1) until contact is obtained.

10. Insert retaining ring (2) into annular groove.

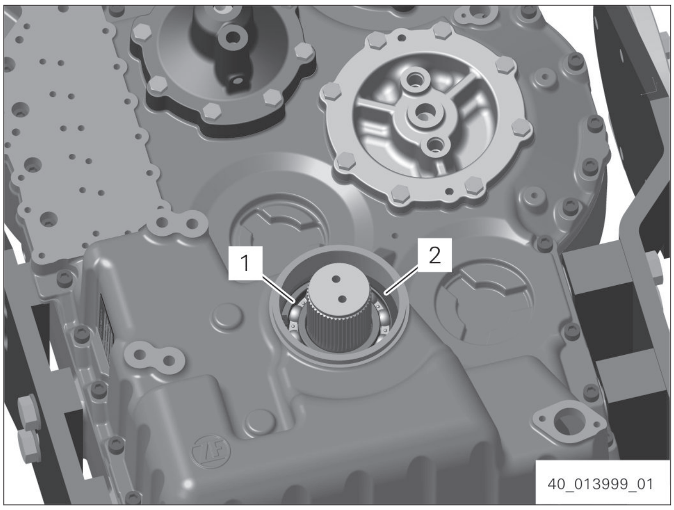


Fig. 318

Installing yokes

Special tools:

- 5870.048.290 Driver tool
- AA01.368.722 Press-in bush
- 5870.057.009 Driver tool
- 5870.260.002 Handle
- 5870.048.265 Driver tool

Operating supplies and auxiliary materials:

- 0666.690.191 PHÖNIX SPIRITUS

Installing yoke on output side

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

   Apply 0666.690.191 [PHÖNIX SPIRITUS] to outer diameter of the shaft sealing ring.

2. Use 5870.048.290 [Driver tool] to insert shaft sealing ring (1) with seal lip facing the oil chamber.

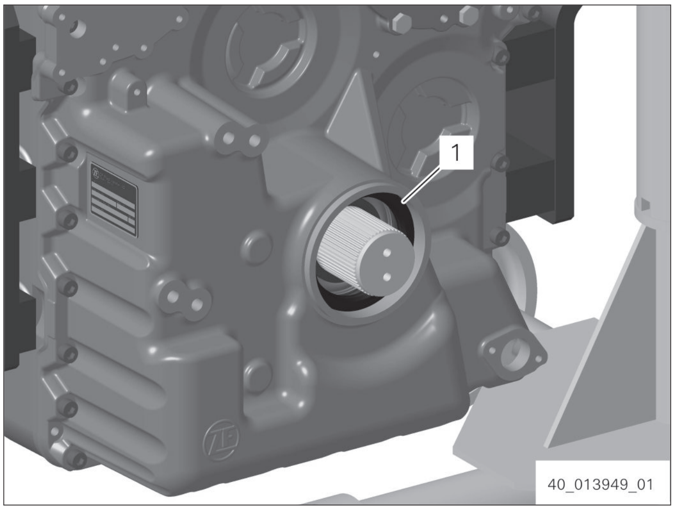


Fig. 319

3. Use AA01.368.722 [Press-in bush] to force screen sheet onto yoke until contact is obtained.

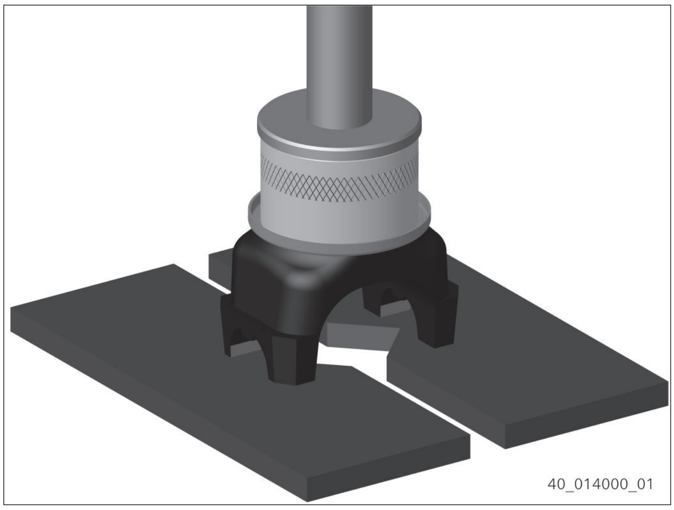


Fig. 320

4. Slide yoke (1) onto output shaft until contact is obtained.

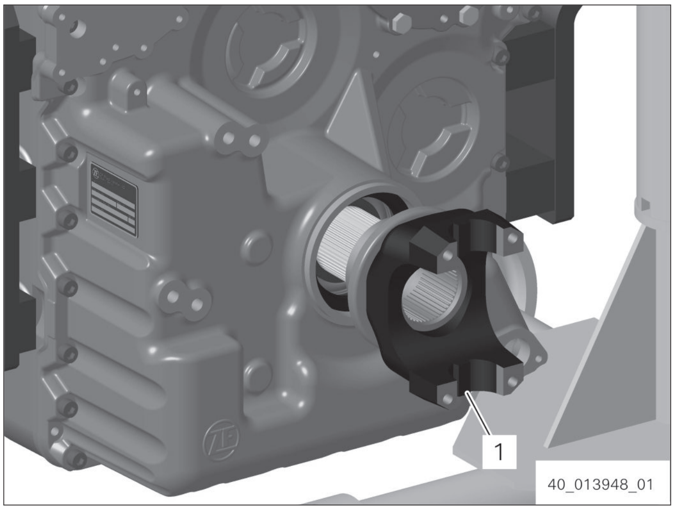


Fig. 321

5. Adjust the gap width (distance X).
   - 1 = Yoke
   - 2 = Washer
   - 3 = Output shaft
   - 4 = Washer
   - 5 = O-ring

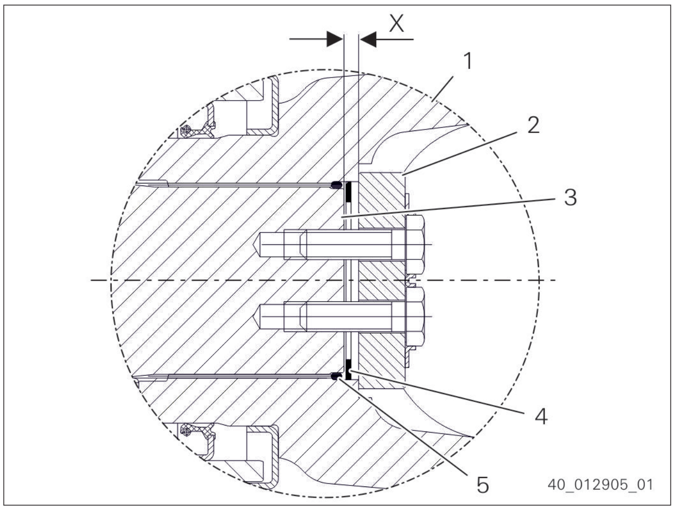


Fig. 322

6. Use depth gage to measure distance from front face of the yoke to front face of the output shaft.
   Distance A = e. g. 79.50 mm

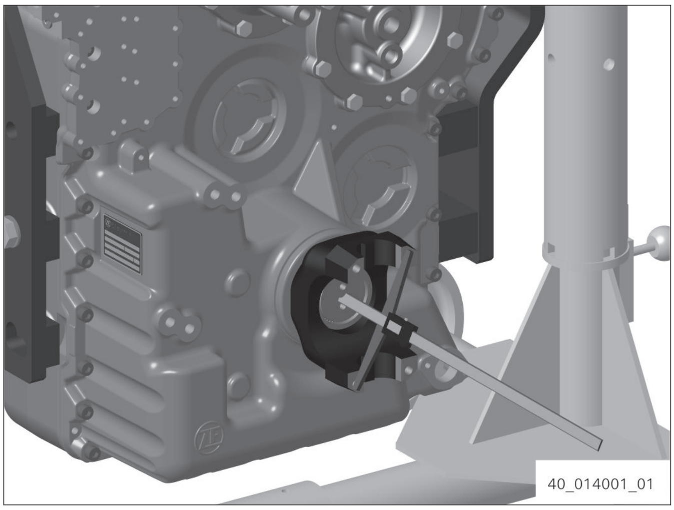


Fig. 323

7. Use depth gage to measure distance from front face to contact face of the washer on the yoke.
   Distance B = e.g. 78.00 mm

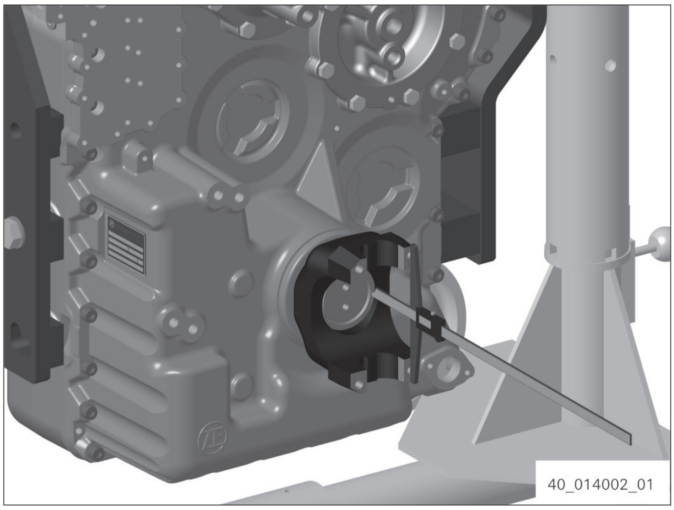


Fig. 324

8. Calculate thickness s of shim for setting Gap width of the output flange 0.30 mm to 0.80 mm to the output shaft.

   Calculation example:
   s = distance A – distance B – mean value of the required distance
   s = 79.50 mm – 78.00 mm – 0.50 mm
   s = 1.00 mm

9. Insert O-ring (1) in the space between output shaft and yoke.

10. Insert washer (2) with the calculated thickness, e. g. s = 1.00 mm.

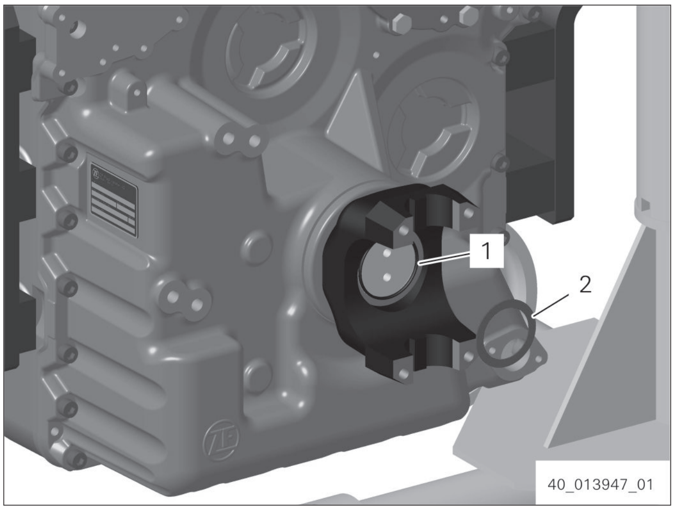


Fig. 325

11. Fix yoke with washer (3) and hexagon screws (2).
    Tightening torque: 46 Nm

12. **⚠ CAUTION**

    Risk of injury due to parts flying away.
    Slight or moderate injury possible.
    ⇨ Wear protective goggles.

    Mount locking plate (1) using the 5870.057.009 [Driver tool] and 5870.260.002 [Handle] until contact is obtained.

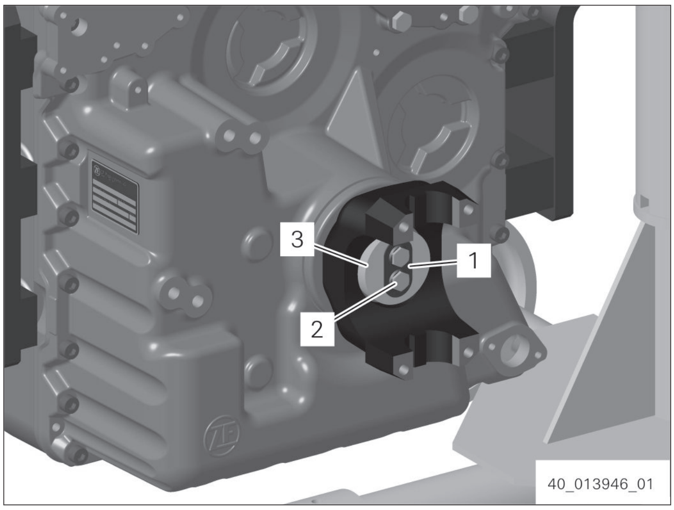


Fig. 326

Installing yoke on converter side

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

    Apply 0666.690.191 [PHÖNIX SPIRITUS] to outer diameter of the shaft sealing ring.

14. Use 5870.048.265 [Driver tool] to insert shaft sealing ring (1) with seal lip facing the oil chamber.

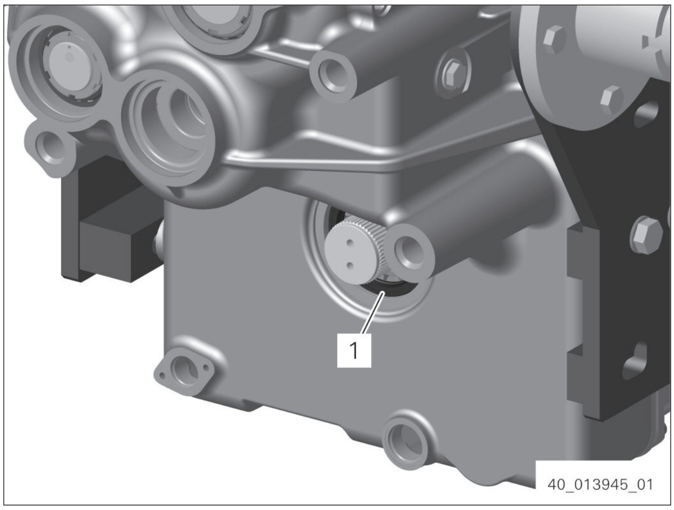


Fig. 327

15. Use AA01.368.722 [Press-in bush] to press protecting plate onto the yoke until contact is obtained.

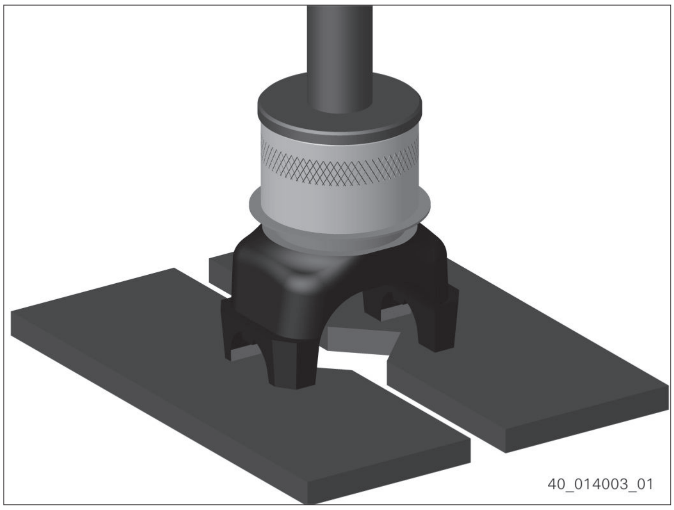


Fig. 328

16. Slide yoke (1) onto output shaft until contact is obtained.

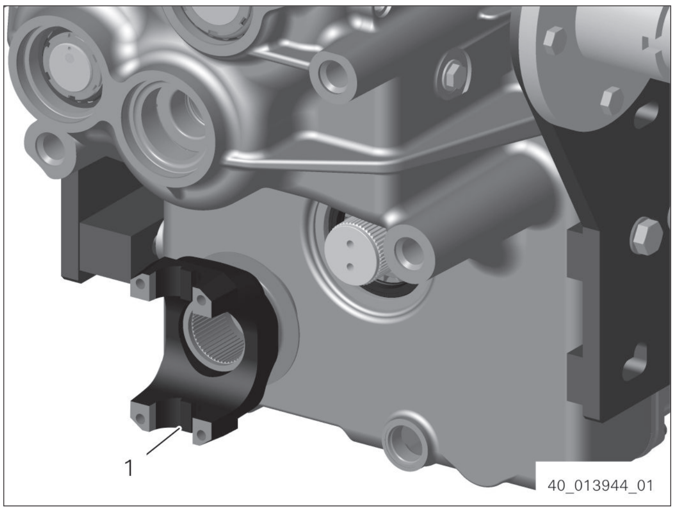


Fig. 329

17. Adjust the gap width (distance X).
    - 1 = Yoke
    - 2 = Washer
    - 3 = Output shaft
    - 4 = Washer
    - 5 = O-ring

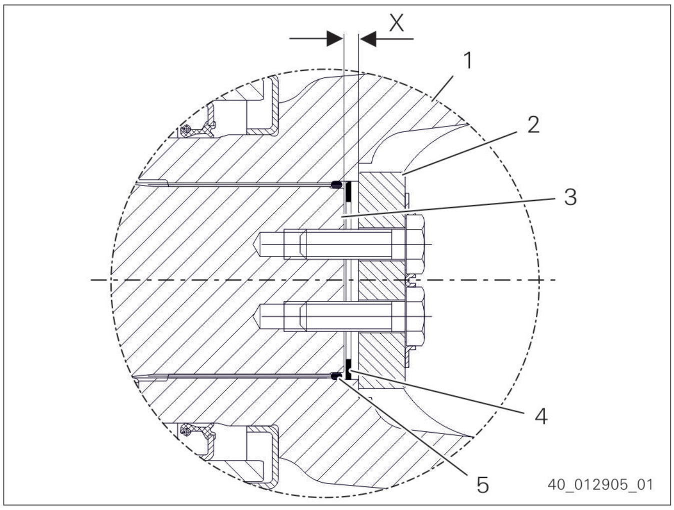


Fig. 330

18. Use depth gage to measure distance from front face of the yoke to front face of the output shaft.
    Distance A = e. g. 79.50 mm

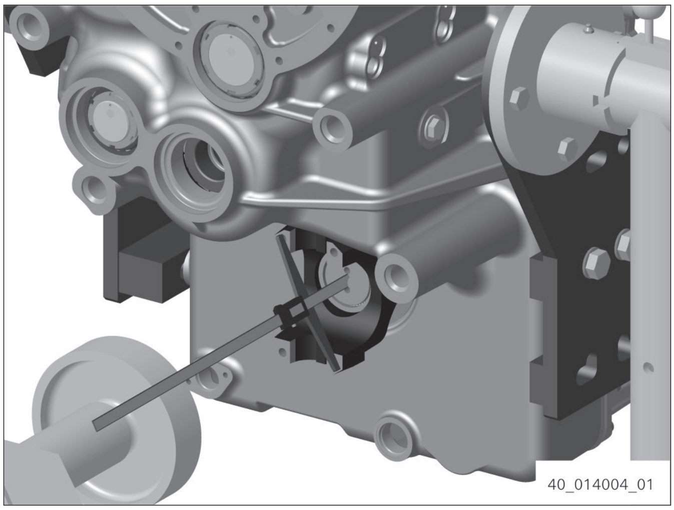


Fig. 331

19. Use depth gage to measure distance from front face to contact face of the washer on the yoke.
    Distance B = e.g. 78.00 mm

20. Calculate thickness s of shim for setting Gap width of the output flange 0.30 mm to 0.80 mm to the output shaft.

    Calculation example:
    s = distance A – distance B – mean value of the required distance
    s = 79.50 mm – 78.00 mm – 0.50 mm
    s = 1.00 mm

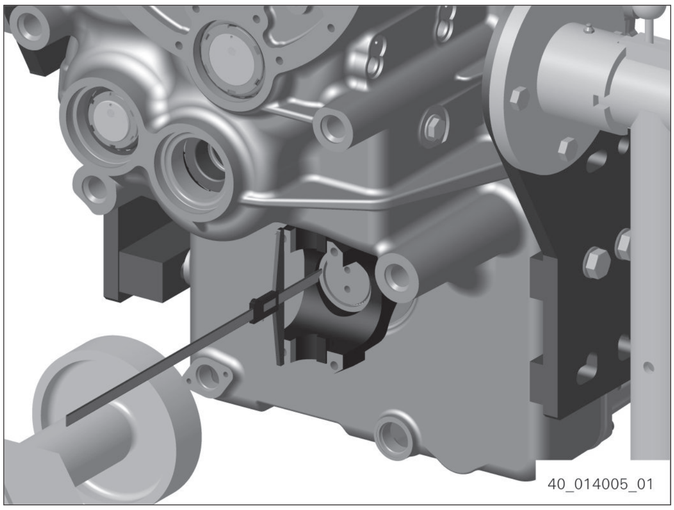


Fig. 332

21. Insert O-ring (2) in the space between output shaft and yoke.

22. Insert washer (1) with the calculated thickness, e. g. s = 1.00 mm.

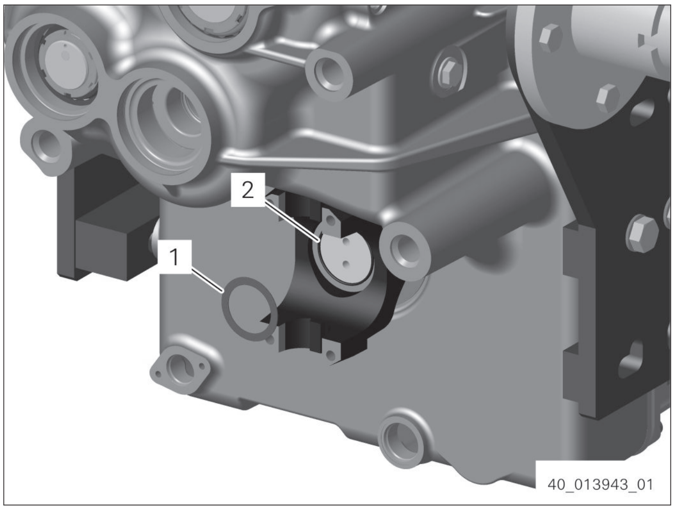


Fig. 333

23. Fix yoke with washer (3) and hexagon screws (2).
Tightening torque: 46 Nm

24. ⚠ **CAUTION**

Risk of injury due to parts flying away.
Slight or moderate injury possible.
⇨ Wear protective goggles.

Mount locking plate (1) using the 5870.057.009 [Driver tool] and 5870.260.002 [Handle] until contact is obtained.

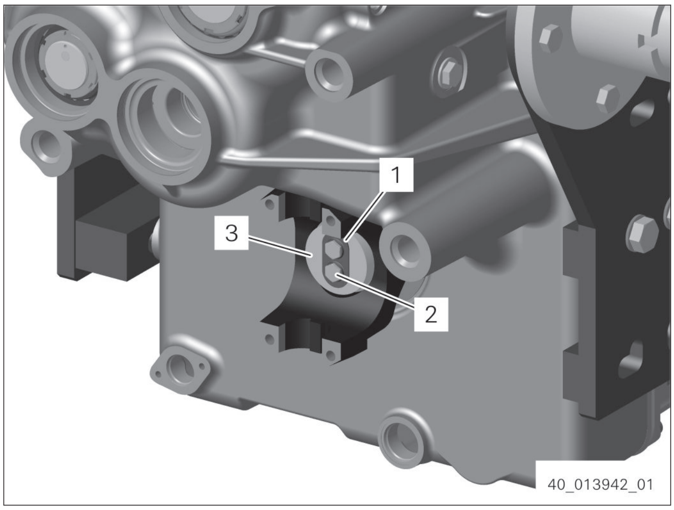


Fig. 334

Installing countershaft

Special tools:
- 5870.204.007 Locating pin

Operating supplies and auxiliary materials:
- 0666.690.248 LOCTITE 243
- 0666.690.191 PHÖNIX SPIRITUS

1. Center gear, bearing inner rings and ring.

2. Carry out the following three work steps immediately one after the other.

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat up bearing inner rings.

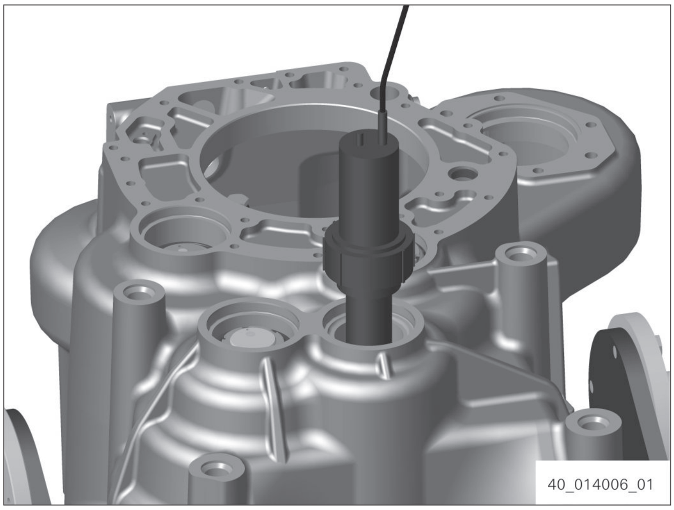


Fig. 335

3. Bolt one 5870.204.007 [Locating pin] (1) into housing.

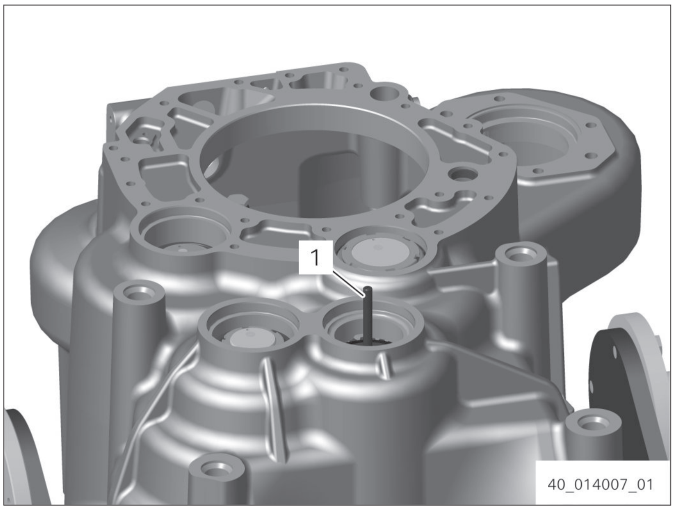


Fig. 336

4. Insert axle (1) until contact is obtained.

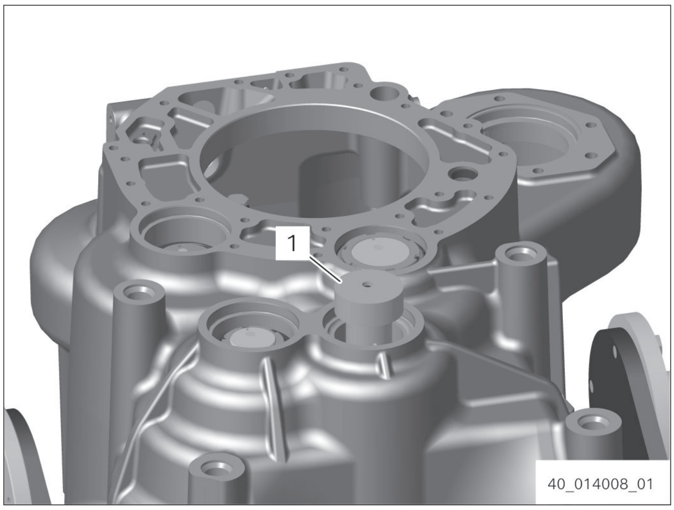


Fig. 337

5. Remove 5870.204.007 [Locating pin].

6. Apply 0666.690.248 [LOCTITE 243] to the thread of the hexagon screw.

7. Turn in and tighten hexagon screw (1).
   Tightening torque: 46 Nm

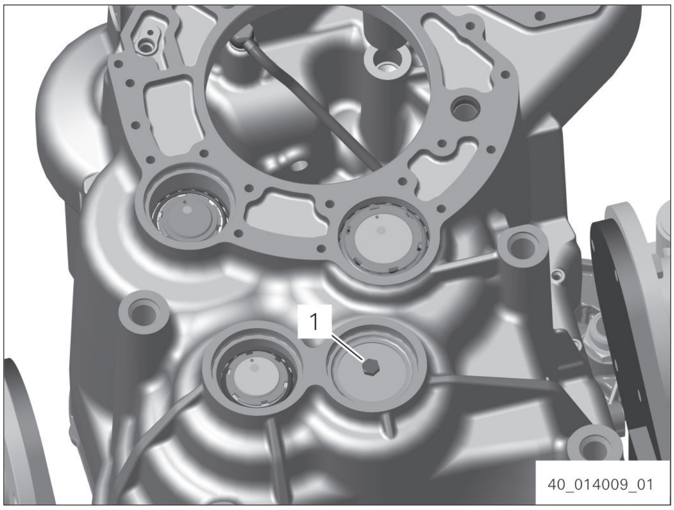


Fig. 338

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

   Apply 0666.690.191 [PHÖNIX SPIRITUS] to the outer diameter of the protection cap.

9. Flush-mount protection cap (1) with the open side facing inwards into the housing hole.

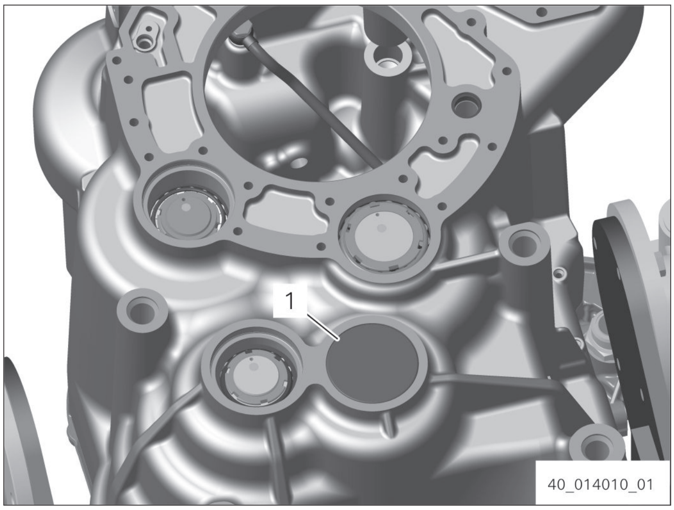


Fig. 339

Assembling and installing the power take-offs (variant with PTO) 1, 3 and 4)

Installing PTOs 3 and 4

Special tools:
- 5870.200.113 Feeler gauge

Operating supplies and auxiliary materials:
- 0666.690.191 PHÖNIX SPIRITUS

1. Insert plug with O-ring (1) into housing hole.

2. Fasten plug with cap screw.
   Tightening torque: 23 Nm

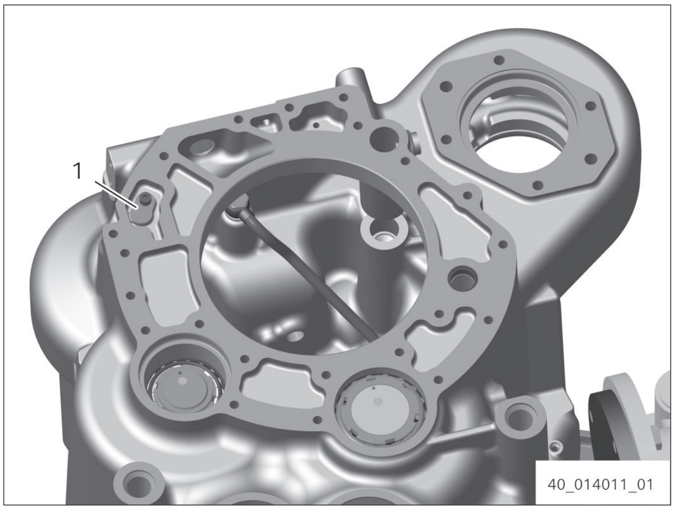


Fig. 340

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

   Apply 0666.690.191 [PHÖNIX SPIRITUS] to the outer diameter of the protection cap.

4. Flush-mount protection cap (2) with the open side facing inwards into the housing hole.

5. Insert the ball bearing (1) into the housing hole until contact is obtained.

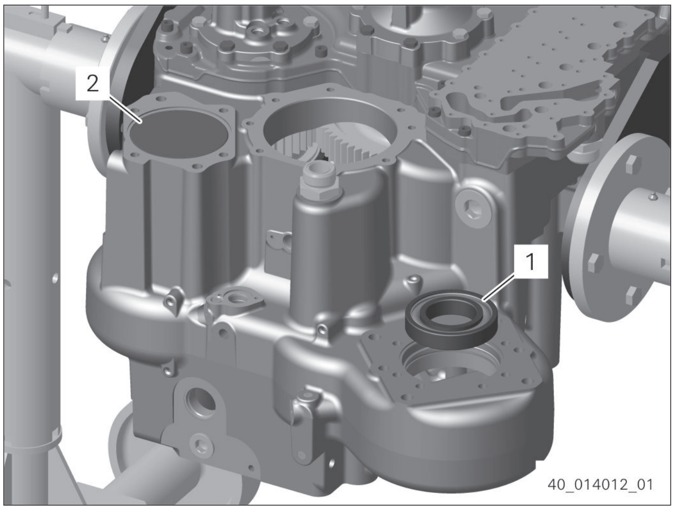


Fig. 341

6. Insert gear (1) with the short collar facing downwards into the housing.

7. Center gear.

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

   ⚠ **CAUTION**

   Risk of burn injuries due to contact with hot surfaces.
   Slight or moderate injury possible.
   ⇨ Wear protective gloves.

   Heat hole in the gear and bearing inner ring of the ball bearing.

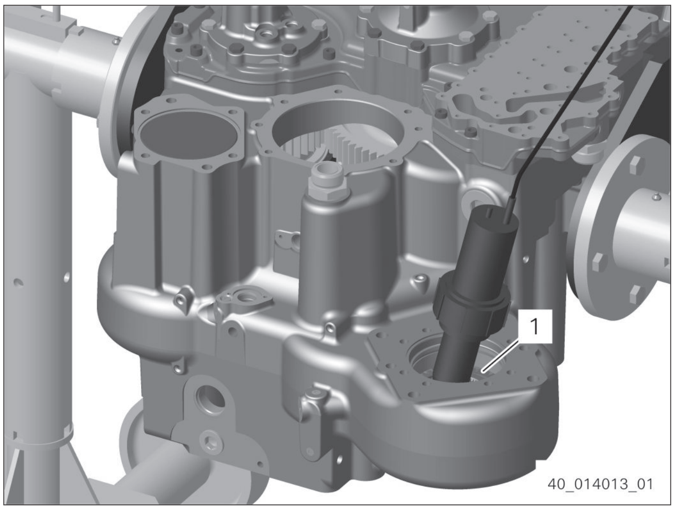


Fig. 342

9. Insert driver (1) with the short collar facing downwards until contact is obtained.

10. Let gear cool down.

11. Adjust the driver.

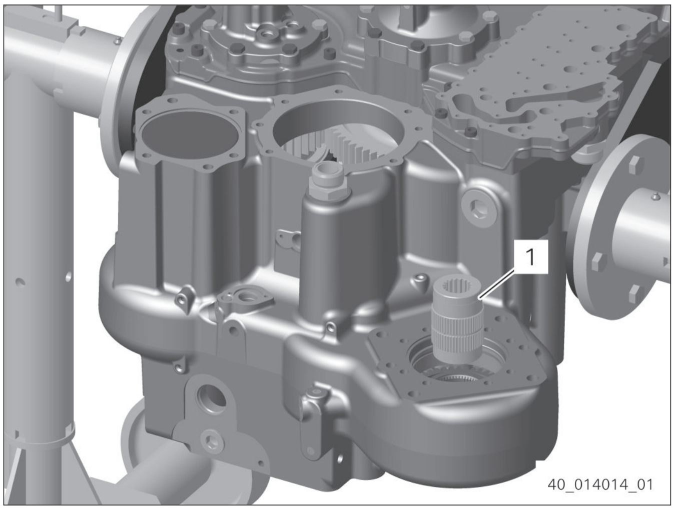


Fig. 343

Setting axial play of the gear bearing

12. Insert the ball bearing (3) into the housing hole until contact is obtained.

13. Insert shim (2) e. g. s = 1.40 mm.

14. Insert retaining ring (1) into annular groove.

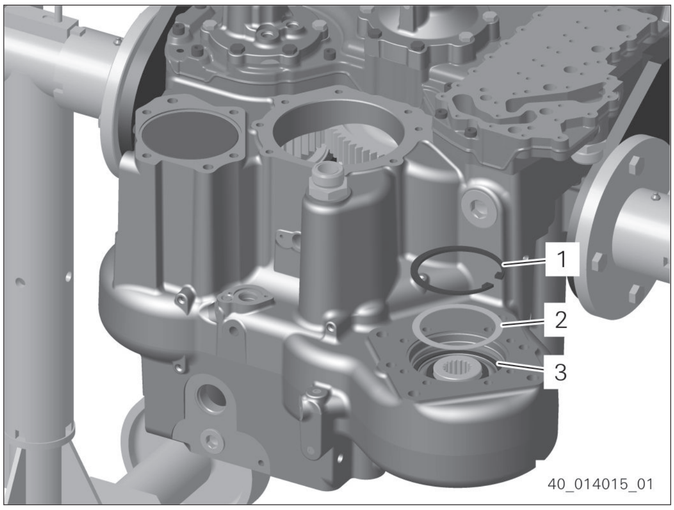


Fig. 344

15. Check Axial play gear bearing 0.20 mm to 0.30 mm with 5870.200.113 [Feeler gauge].
If the axial clearance is too small, install a thinner shim.
If the axial clearance is too large, install a thicker shim.

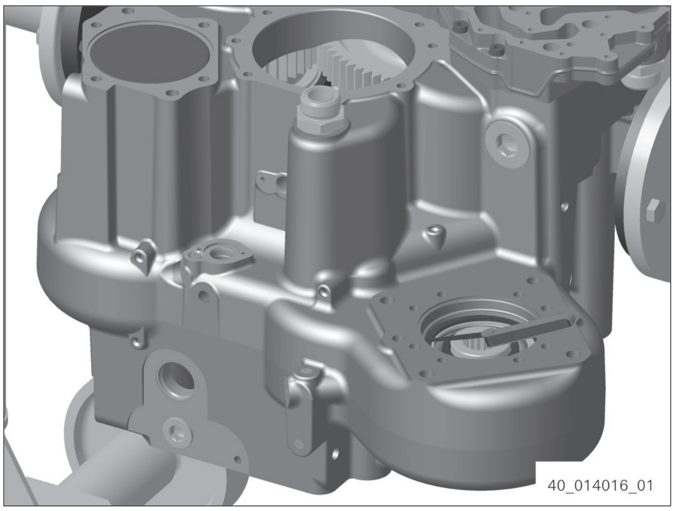


Fig. 345

16. Grease O-ring.

17. Insert the O-ring (1) into the countersink of the housing.

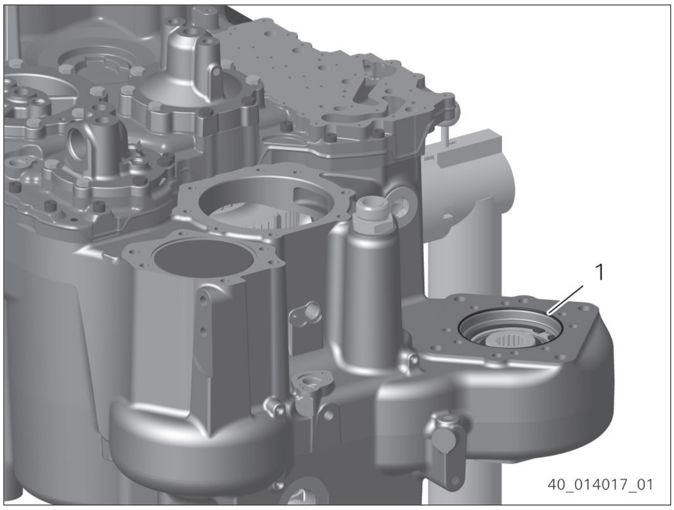


Fig. 346

18. Fix cover (1) with hexagon screws.
Tightening torque: 46 Nm

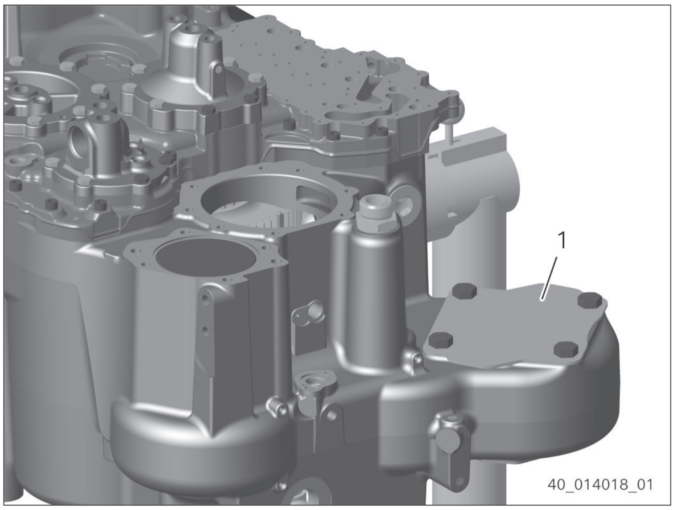


Fig. 347

19. Rotate transmission by 180.

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

Apply 0666.690.191 [PHÖNIX SPIRITUS] to the outer diameter of the protection cap.

21. Flush-mount protection cap (1) with the open side facing inwards into the housing hole.

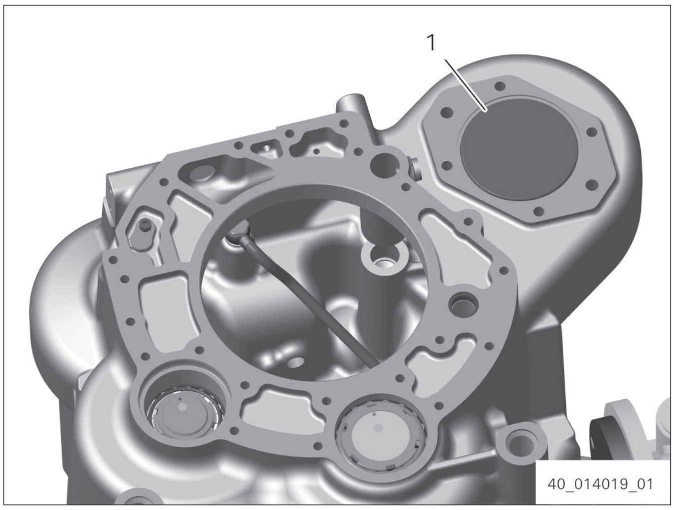


Fig. 348

22. Insert bearing outer rings into the gear until contact it obtained.

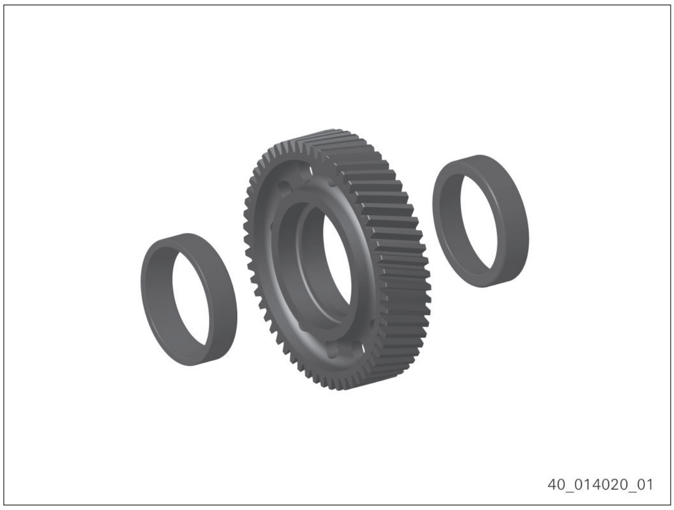


Fig. 349

23. Insert bearing inner rings into bearing outer rings.

24. Insert gear (1) into the housing.

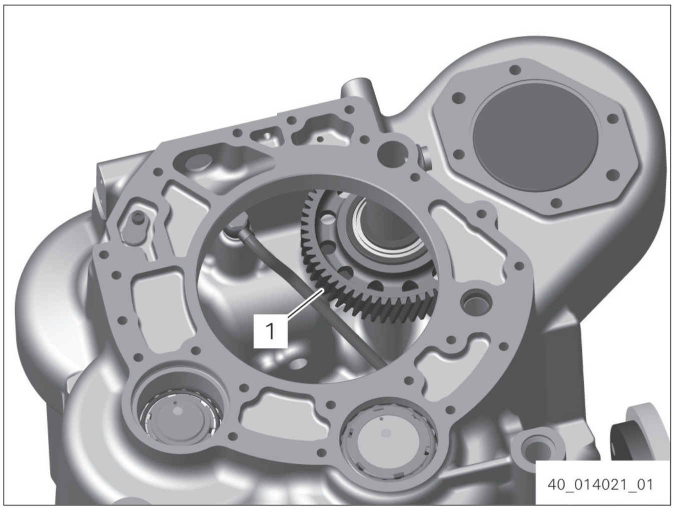


Fig. 350

Adjusting axial clearance of the gear bearing (intermediate gear)

25. Measure distance between housing and front side bearing inner ring with 5870.200.113 [Feeler gauge].
Distance = e. g. 1.45 mm

26. Calculate thickness of the shim for Axial clearance gear bearing (intermediate gear) 0.01 mm to 0.10 mm.

Calculation example:
s = distance – mean value of axial clearance
s = 1.45 mm – 0.05 mm
s = 1.40 mm

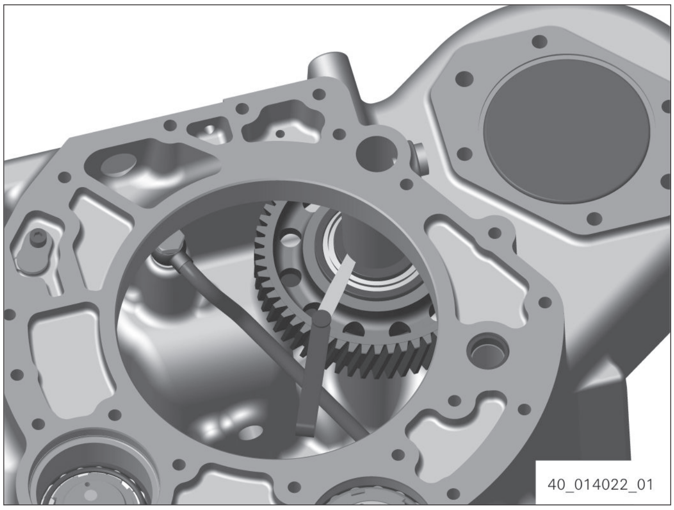


Fig. 351

27. Insert shim (1) with the calculated thickness e. g. s = 1.40 mm.

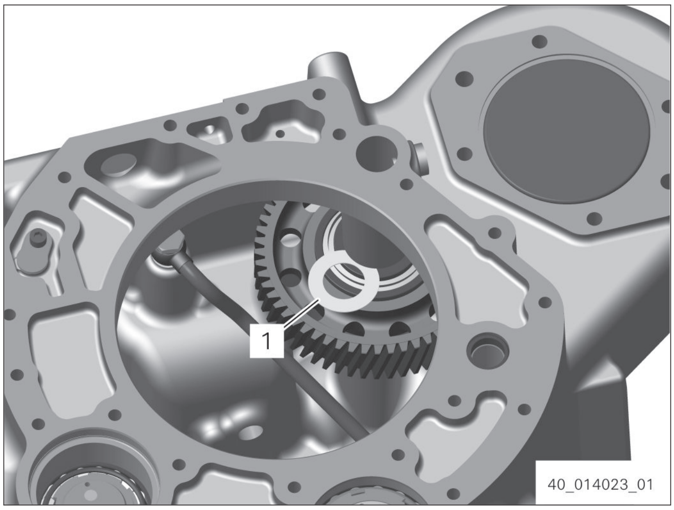


Fig. 352

28. Center gear and shim.

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

⚠ CAUTION

Risk of burn injuries due to contact with cold surface.
Slight to moderate injury possible.
⇨ Wear protective gloves.

Undercool pin.

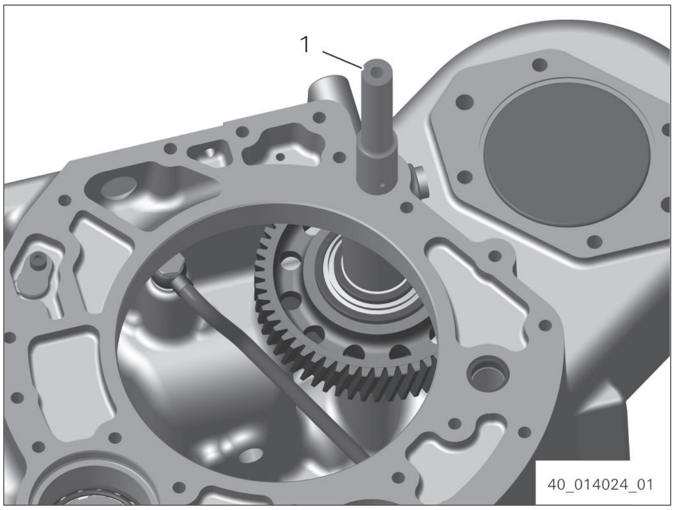


Fig. 353

30. Insert pin (1) into housing hole until contact is obtained.

Installing pressure oil pump

Special tools:

- 5870.801.006 Hot air pot
- 5870.204.021 Fixing pin

Checking gear pump

1. Check individual parts of the gear pump for wear marks before assembling the transmission.

   The gear pump is only available as a complete unit.

Loosen cap screws.

2. Remove cover (1).

3. Check the cover, outer rotor, inner rotor and the pump housing for wear marks.
   In case of any damage, install new gear pump.

4. Insert outer rotor and inner rotor, with the chamfered tooth side facing the pump housing.

5. Insert cylindrical pins until contact is obtained.

6. Place the cover.

7. Bolt in and tighten cap screws.
   Tightening torque: 23 Nm
   Tightening torque: 9.5 Nm

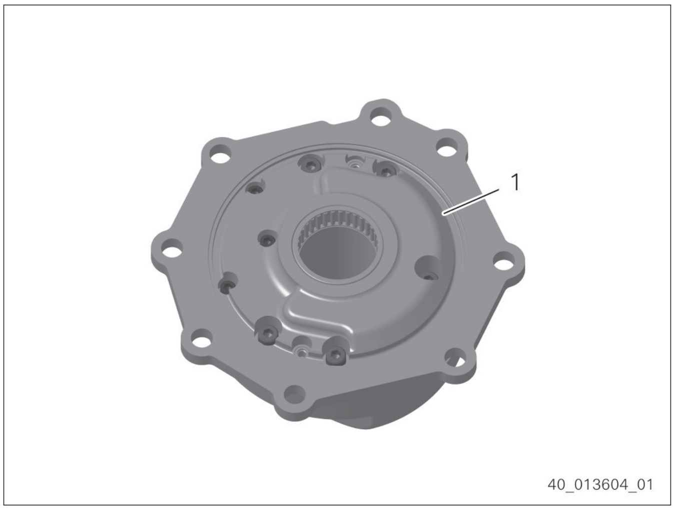


Fig. 354

8. Insert bearing outer ring (1) until contact is obtained.

9. Grease O-ring.

10. Insert O-ring (2) into annular groove.

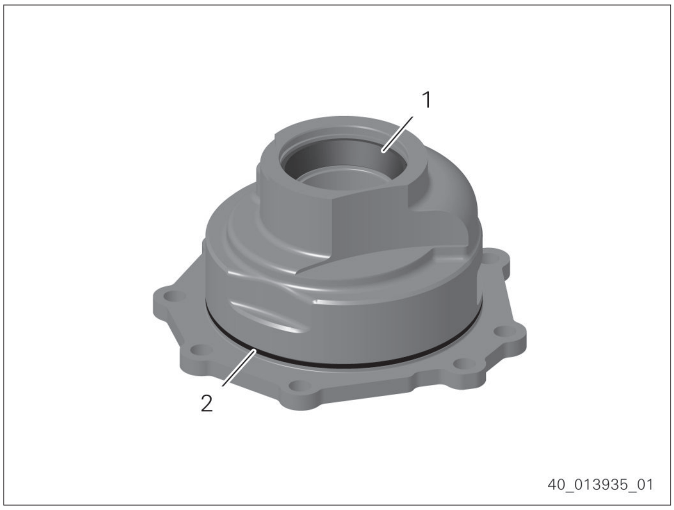


Fig. 355

11. Carry out the following three work steps immediately one after the other.

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat up housing hole by means of hot air blower and 5870.801.006 [Hot air pot].

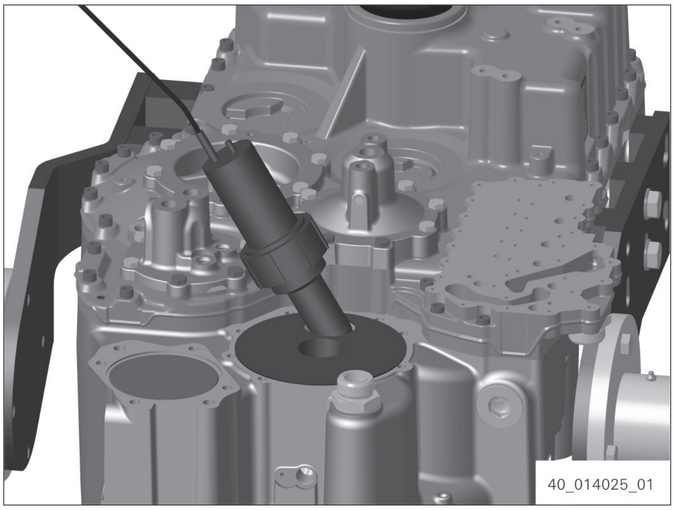


Fig. 356

12. Screw two 5870.204.021 [Fixing pin] into the housing.

13. Insert gear pump (1) into housing hole until contact is obtained.

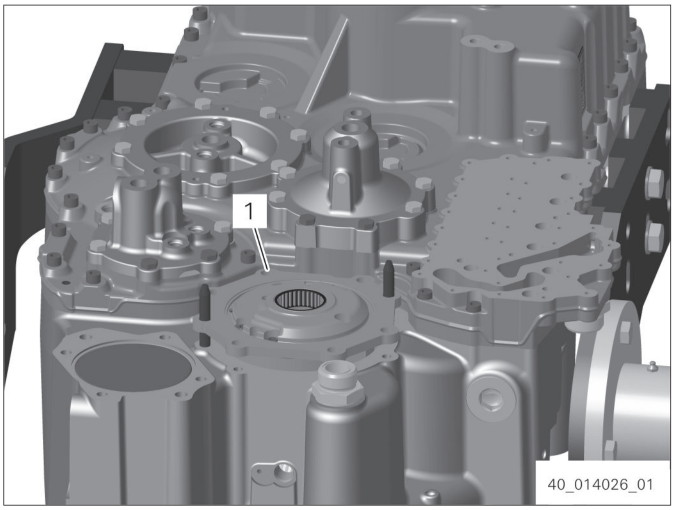


Fig. 357

14. Grease O-ring.

15. Slide O-ring (1) onto pump flange.

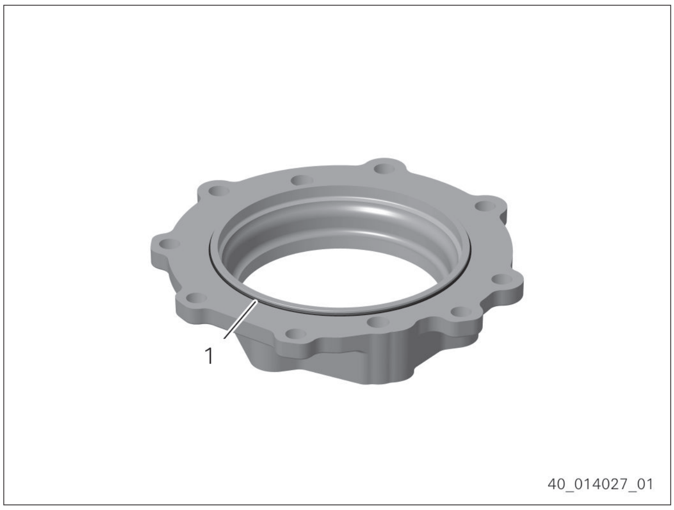


Fig. 358

16. Fit pump flange (1).

17. Fix pump flange and gear pump with hexagon screws.
Tightening torque: 79 Nm

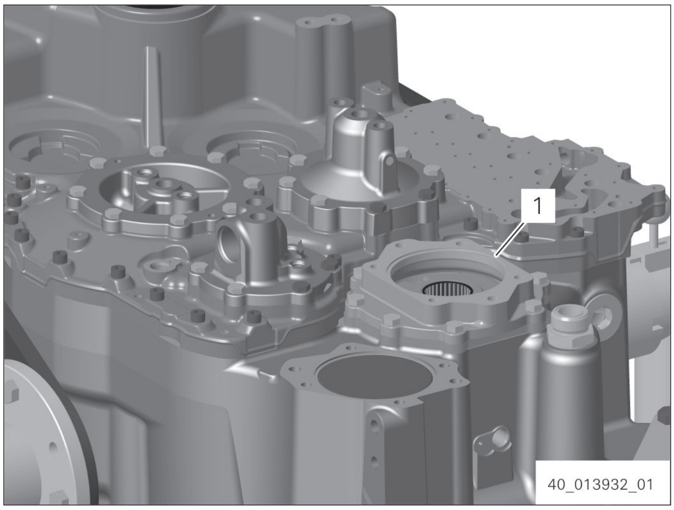


Fig. 359

Installing shaft

Operating supplies and auxiliary materials:

- 0666.690.248 LOCTITE 243

1. Slide shim (2) onto driver.

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

CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

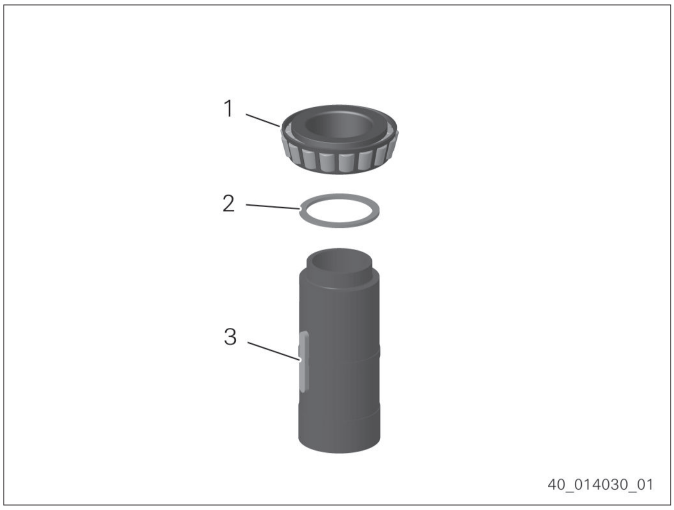


Fig. 360

3. Slide on bearing inner ring (1) until contact is obtained.

4. Let bearing inner ring cool down.

5. Adjust bearing inner ring.

6. Insert fitting key (3).

7. Slide washer onto shaft.

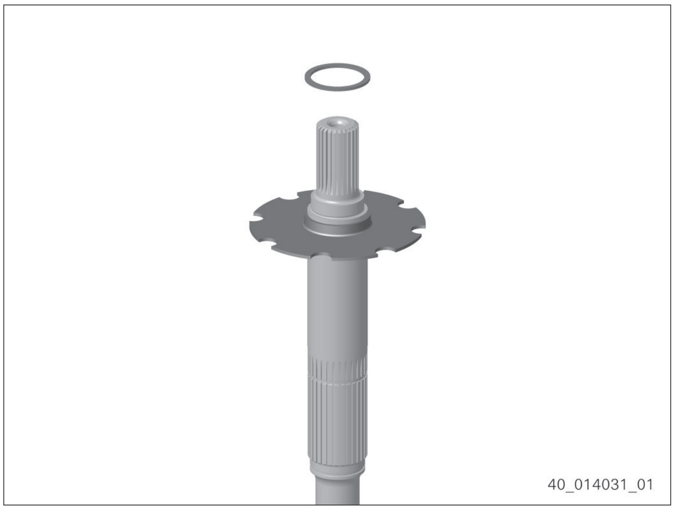


Fig. 361

8. Slide the driver (3) onto the shaft.

9. Insert spring washer (2) with the larger inner diameter facing upwards.

10. Apply 0666.690.248 [LOCTITE 243] to thread of cap screw.

11. Bolt in cap screw (1) and tighten.
Tightening torque: **46 Nm**

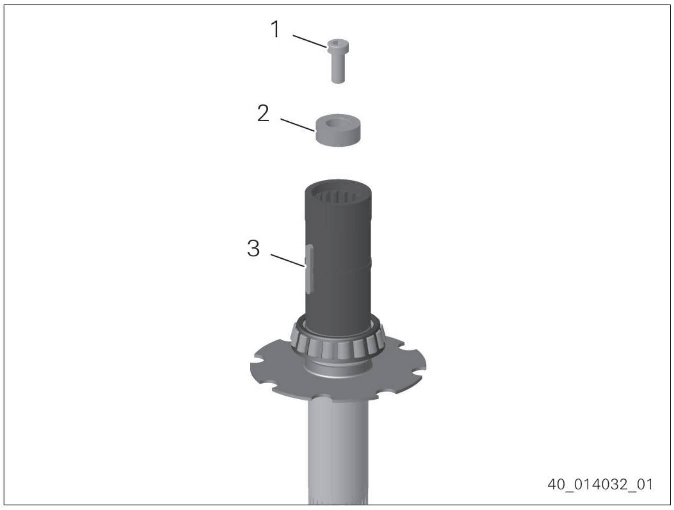


Fig. 362

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

13. Slide on bearing inner ring (1) onto the gear until contact is obtained.

14. Let bearing inner ring cool down.

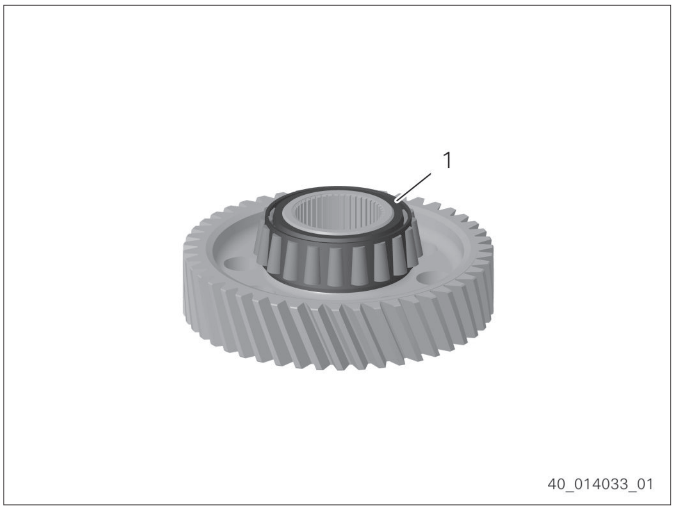


Fig. 363

15. Adjust bearing inner ring.

16. Insert retaining ring (2).

17. Slide on gear (1) until contact is obtained.

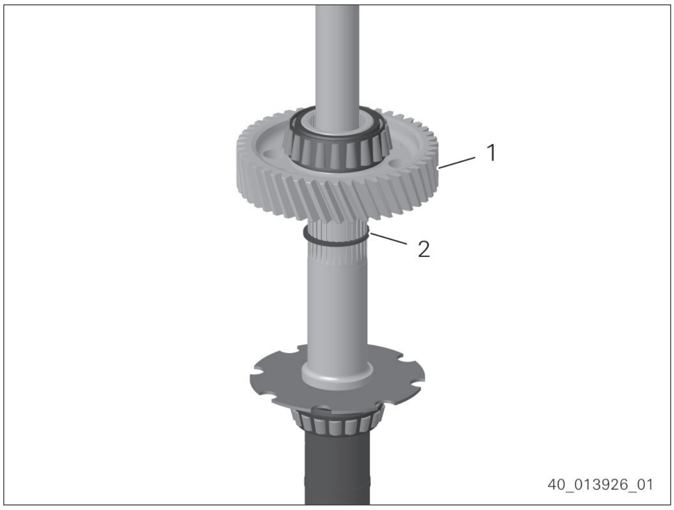


Fig. 364

18. Grease the annular groove on the shaft.

19. Insert and center R-ring (1).

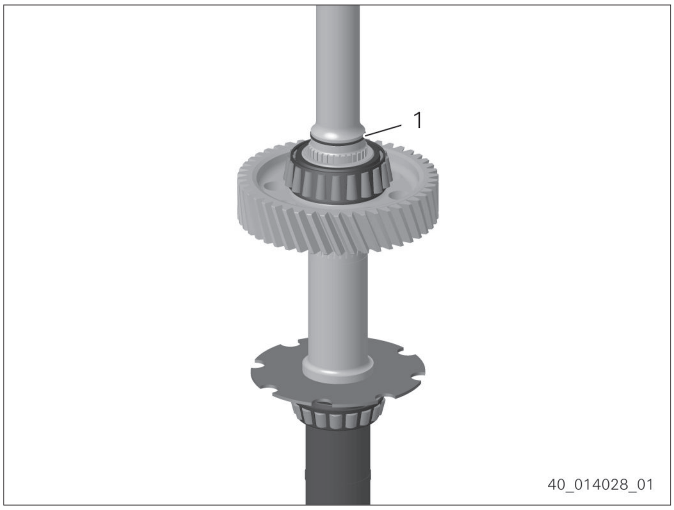


Fig. 365

20. Flush-align fitting key and fitting key groove.

21. Insert shaft (1) into the gear pump until contact is obtained.

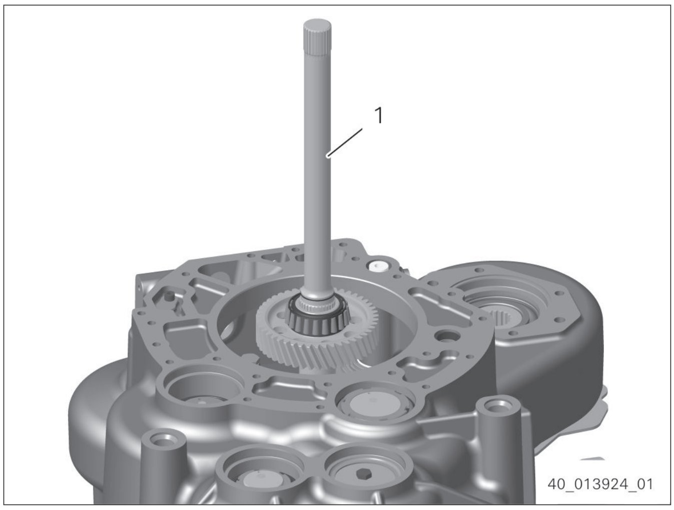


Fig. 366

22. Grease O-ring.

23. Insert the O-ring (1) into the countersink of the pump flange.

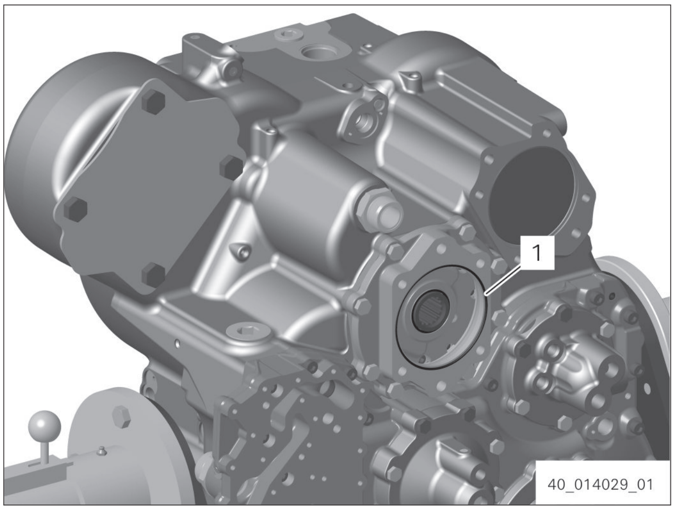


Fig. 367

24. Secure the cover (1) with hexagon screws. Tightening torque: 46 Nm

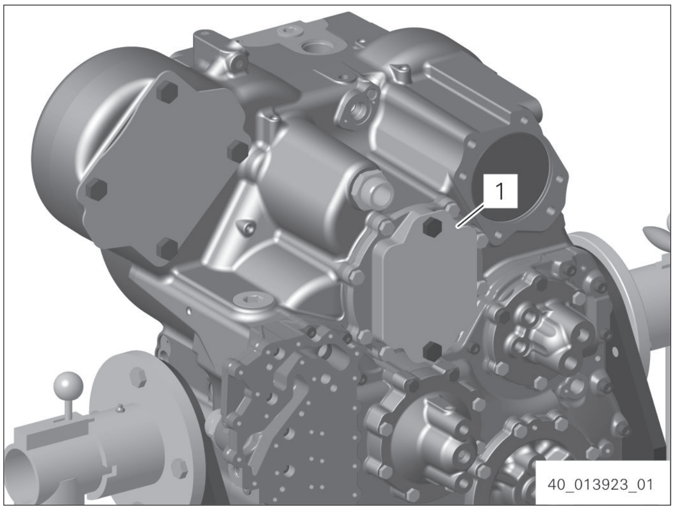


Fig. 368

Assembling drive

Special tools:

- 5870.320.016 Lever riveter
- 5870.801.006 Hot air pot
- 5870.204.007 Locating pin
- 5870.058.051 Driver tool
- 5870.260.002 Handle
- 5870.048.030 Driver tool
- 5870.204.021 Fixing pin
- AA02.247.426 Eyebolt

Operating supplies and auxiliary materials:

- 0666.690.191 PHÖNIX SPIRITUS

Assembly

1. Insert sealing plugs (1) into holes using 5870.320.016 [Lever riveter].

2. Screw in and tighten screw plug with O-ring (2).
   Tightening torque: 35 Nm

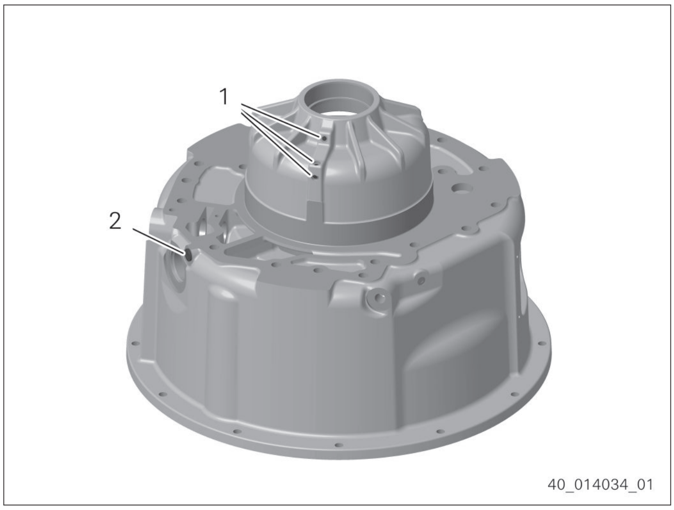


Fig. 369

3. Insert bearing outer ring (1) into bearing hole until contact is obtained.

4. Insert bearing inner ring (2).

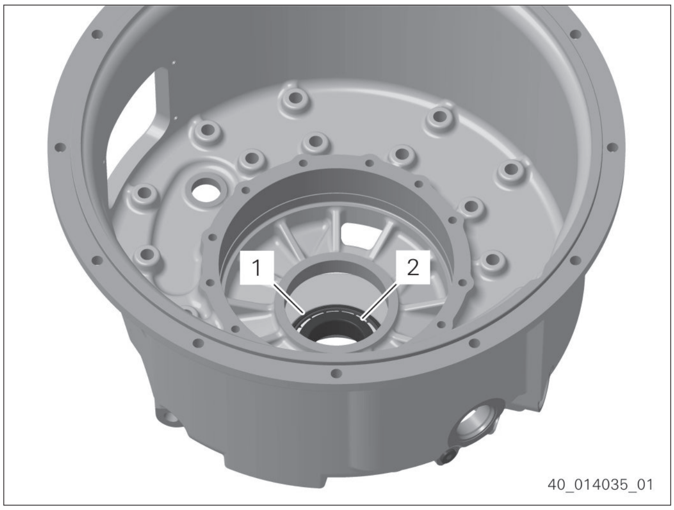


Fig. 370

5. Insert helical gear (1) with long collar facing upwards into torque converter bell housing.

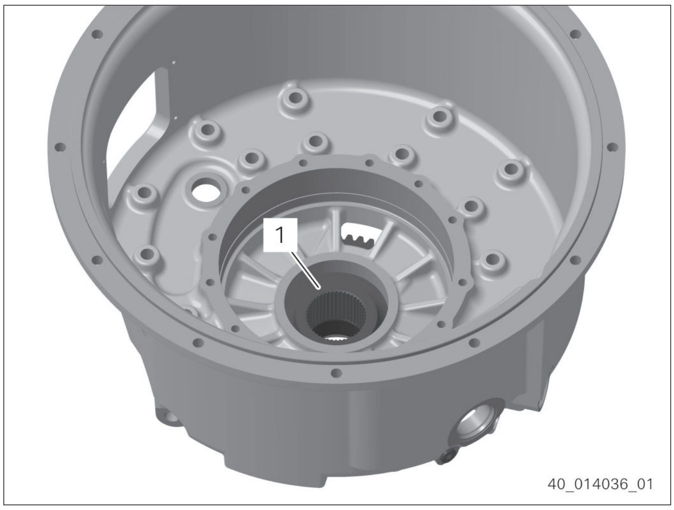


Fig. 371

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat up hole in helical gear and bearing inner ring.

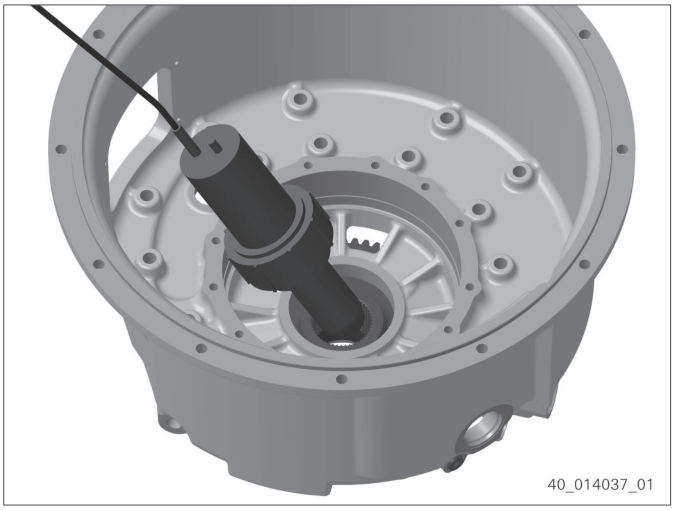


Fig. 372

7. Insert input shaft (1) until contact is obtained.

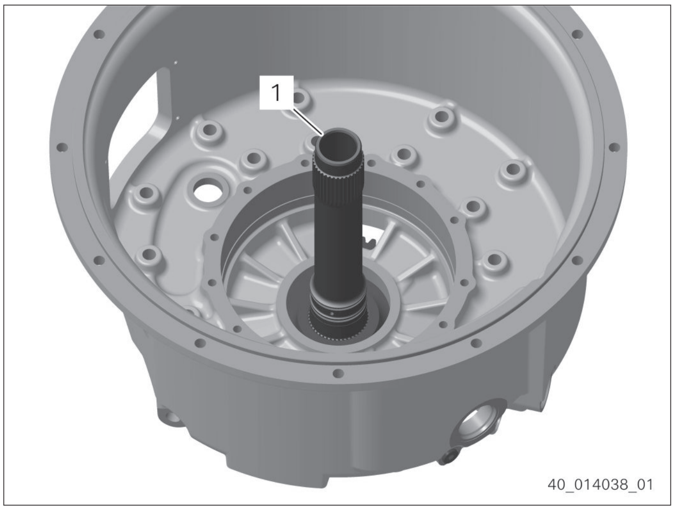


Fig. 373

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

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat bearing inner ring.

9. Slide on bearing inner ring (2) until contact is obtained.

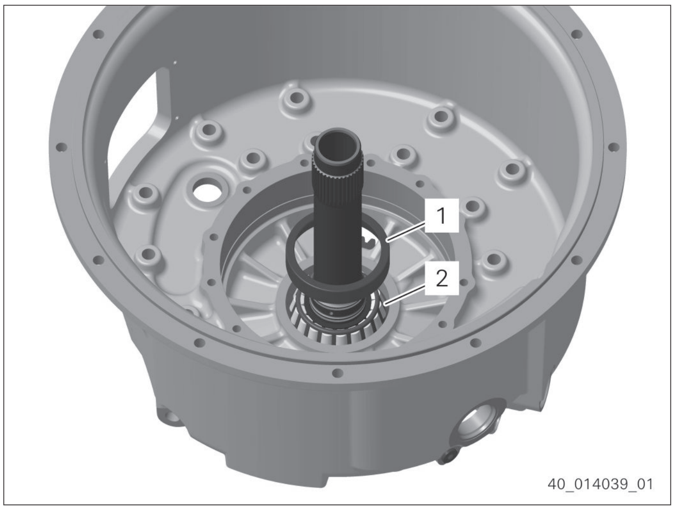


Fig. 374

10. Let bearing inner ring cool down.

11. Adjust bearing inner ring.

12. Insert bearing outer ring (1) until contact is obtained.

13. Grease annular grooves of input shaft.

14. Insert and center R-rings (1).

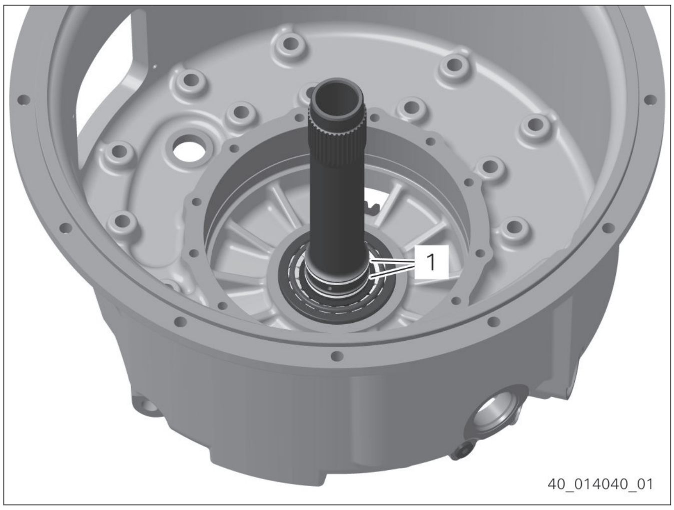


Fig. 375

15. Insert converter safety valve (2) into oil feed flange until contact is obtained.

16. ⚠ **CAUTION**

    Risk of injury due to parts flying away.
    Slight or moderate injury possible.
    ⇨ Wear protective goggles.

    Flush-mount slotted pin (1).

17. Grease O-ring.

18. Slide on O-ring (3).

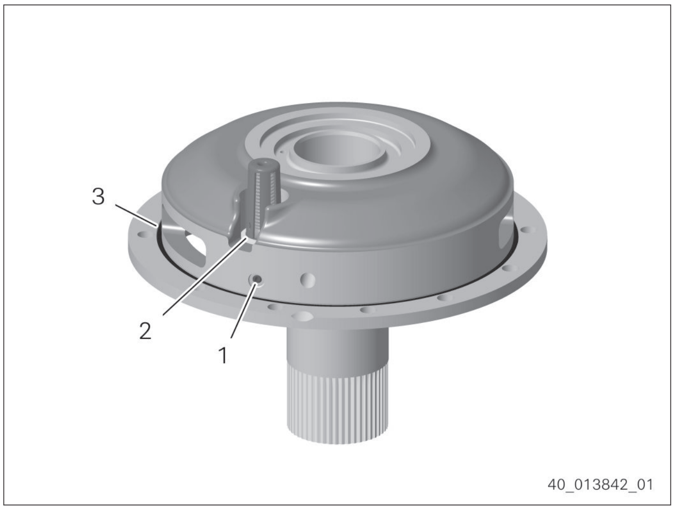


Fig. 376

19. Carry out the following three work steps immediately one after the other.

⚠ CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat up hole with hot air blower and 5870.801.006 [Hot air pot].

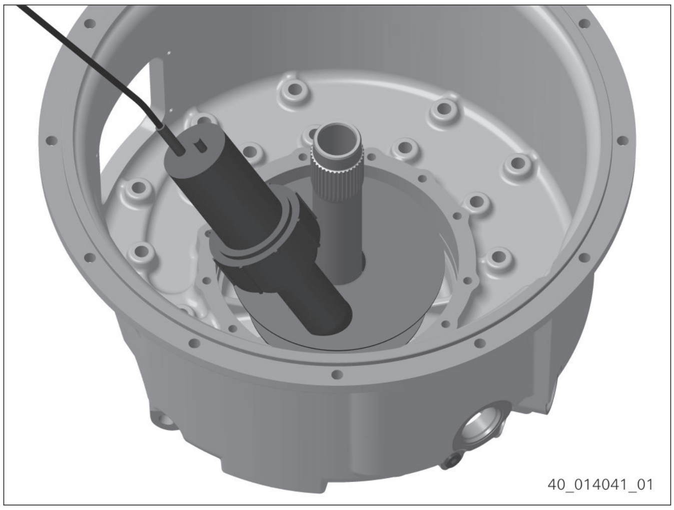


Fig. 377

20. Turn two 5870.204.007 [Locating pin] into torque converter bell housing.

21. Insert oil feed flange (1) into hole until contact is obtained.

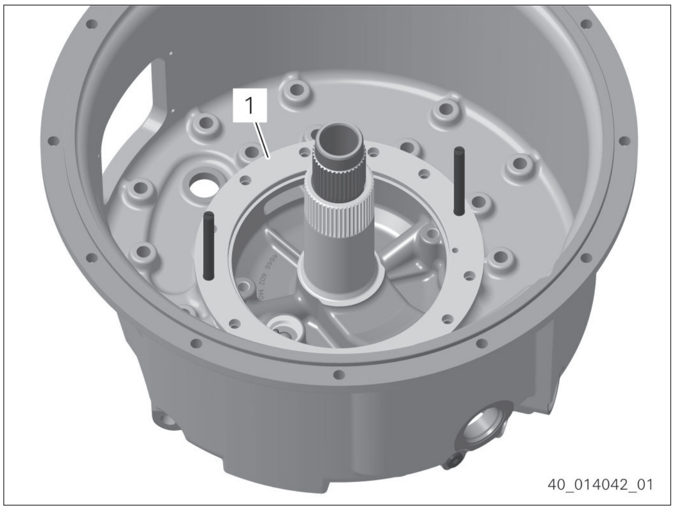


Fig. 378

22. Insert needle sleeve (1) into bearing cover using 5870.058.051 [Driver tool] and 5870.260.002 [Handle] until contact is obtained. Insert needle sleeve with marked front face showing upwards.

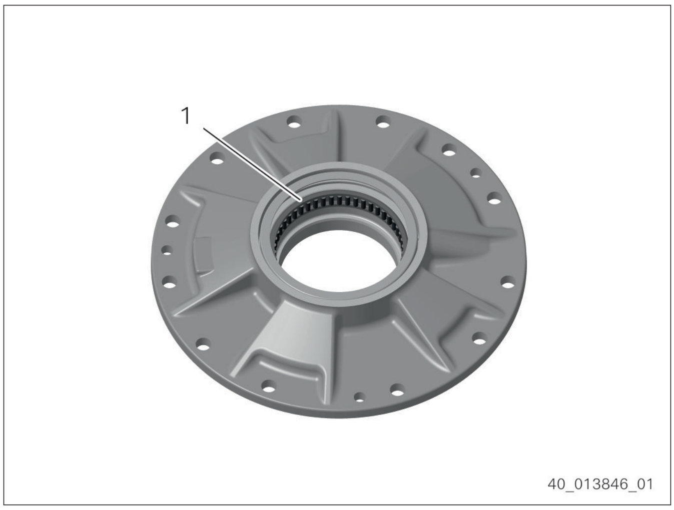


Fig. 379

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

Apply 0666.690.191 [PHÖNIX SPIRITUS] to outer diameter of shaft sealing ring.

24. Insert shaft sealing ring (1) with 5870.048.030 [Driver tool].

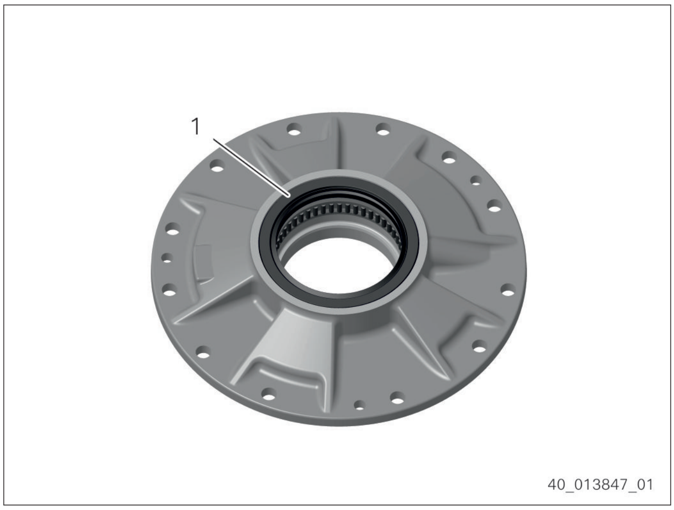


Fig. 380

25. Grease O-ring.

26. Fit O-ring (1).

Fig. 381

27. Fit bearing cover (1).

28. Turn in and tighten hexagon screws.
Tightening torque: 46 Nm

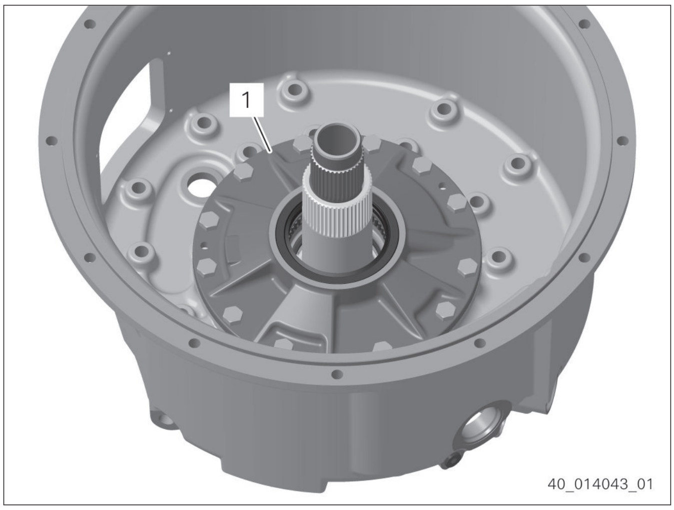


Fig. 382

29. Push washers onto hexagon screws.

30. Fix cover plate (1) and cover sheet (2) with hexagon screws.
Tightening torque: 2 Nm (±1 Nm)

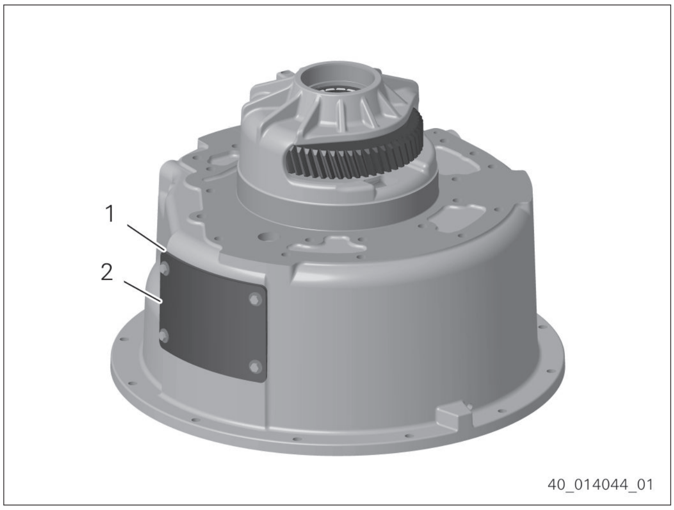


Fig. 383

31. **⚠ CAUTION**

Risk of injury due to parts flying away.
Slight or moderate injury possible.
⇨ Wear protective goggles.

Force in slotted pin until contact is obtained.

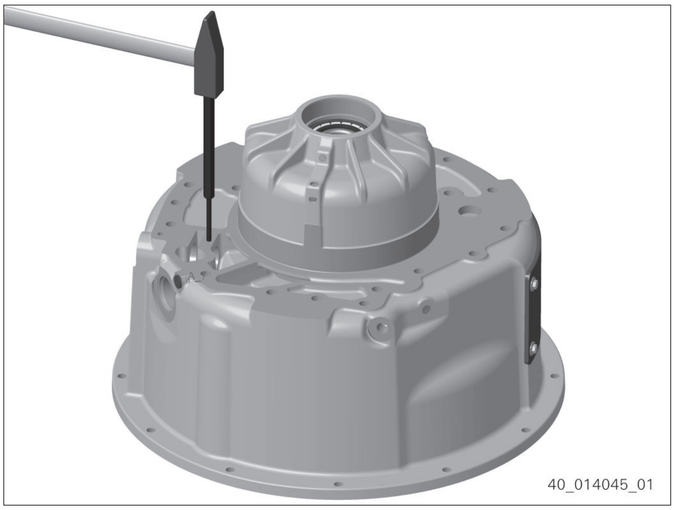


Fig. 384

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

Apply 0666.690.191 [PHÖNIX SPIRITUS] to the outer diameter of the protection caps.

33. Flush-mount protection caps (1) with the open side facing inwards into housing holes.

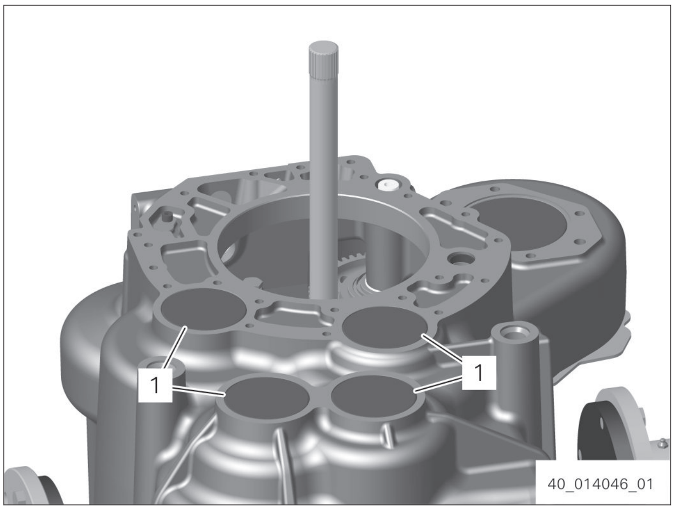


Fig. 385

34. Screw two 5870.204.021 [Fixing pin] into the housing.

35. Put on seal (1).

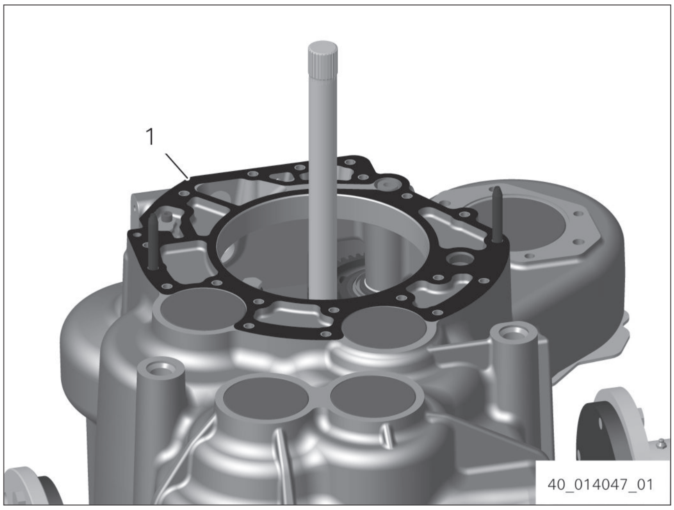


Fig. 386

36. **CAUTION**

Risk of crushing due to moving load.
Slight to moderate injury possible.
⇨ Move load slowly and carefully.
⇨ Do not reach into danger area.

Mount torque converter bell housing with two AA02.247.426 [Eyebolt] and a crane.

Fig. 387

37. Turn in and tighten hexagon screws.
Tightening torque: 115 Nm

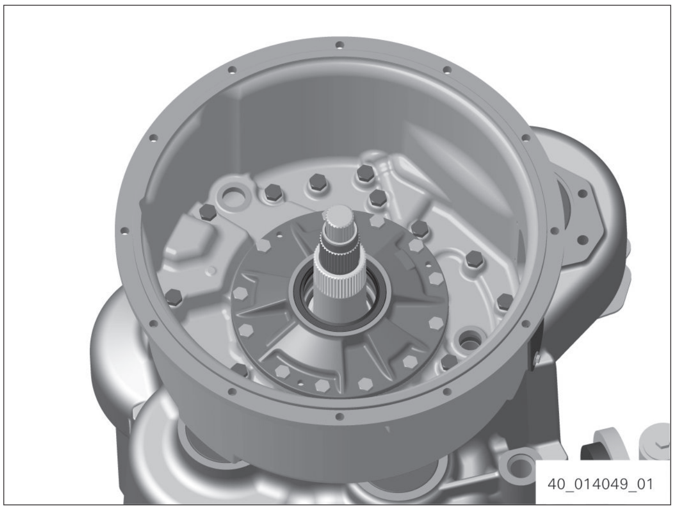


Fig. 388

38. Insert sealing rings between oil tube (1) and torque converter bell housing.

39. Slide sealing ring onto hollow screws (2).

40. Screw in the hollow screws with sealing ring (2) and tighten them.
Tightening torque: 130 Nm

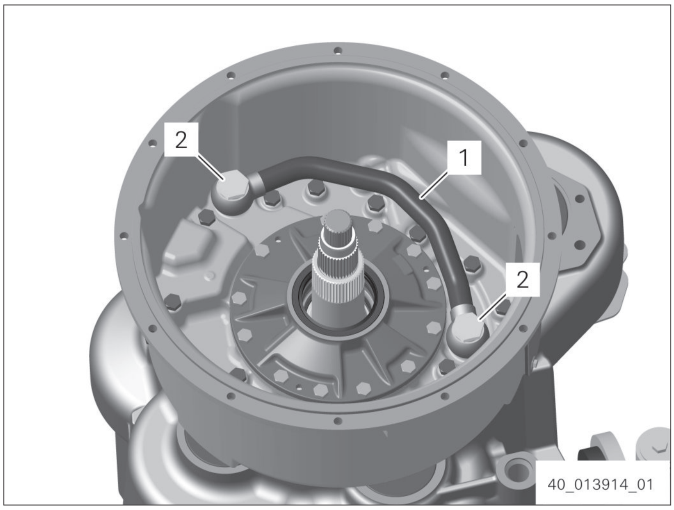


Fig. 389

Mounting engine connection and converter

Special tools:

- 5870.057.009 Driver tool
- 5870.260.002 Handle
- AA02.676.915 Load ring

Operating supplies and auxiliary materials:

- 0666.690.248 LOCTITE 243

1. Position flange shaft (2) onto converter.

2. Apply 0666.690.248 [LOCTITE 243] to thread of hexagon screws.

3. Screw in and tighten hexagon screws (1).
Tightening torque: 68 Nm

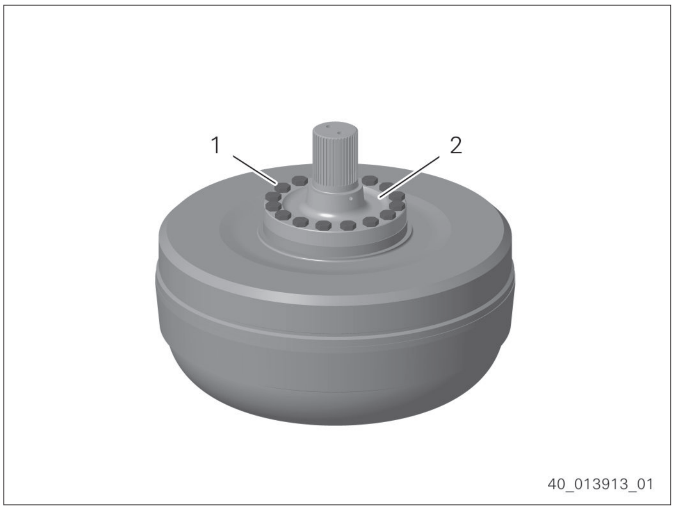


Fig. 390

4. Grease annular groove.

5. Insert and center R-ring (1).

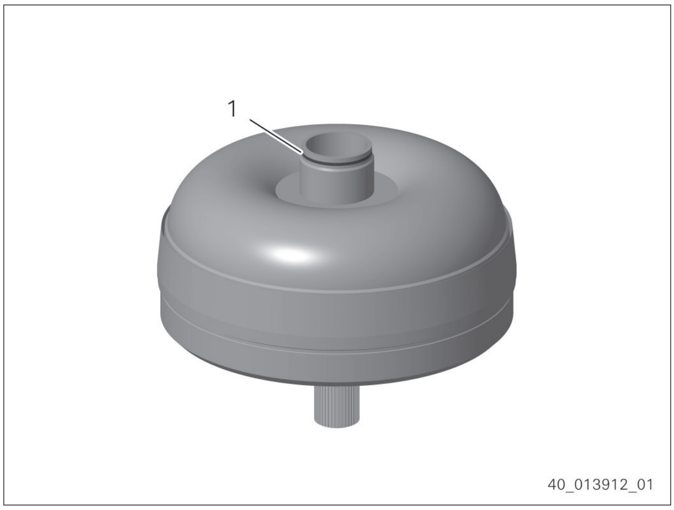


Fig. 391

6. Insert the ball bearing (2) in the cover until contact is obtained.

7. Insert V-ring (1).

Fig. 392

8. ⚠ **CAUTION**

   Risk of crushing due to hydraulic tool.
   Slight to moderate injury possible.
   ⇨ Do not reach into danger area.

   Use suitable tools to press cover onto flange shaft until contact is obtained.

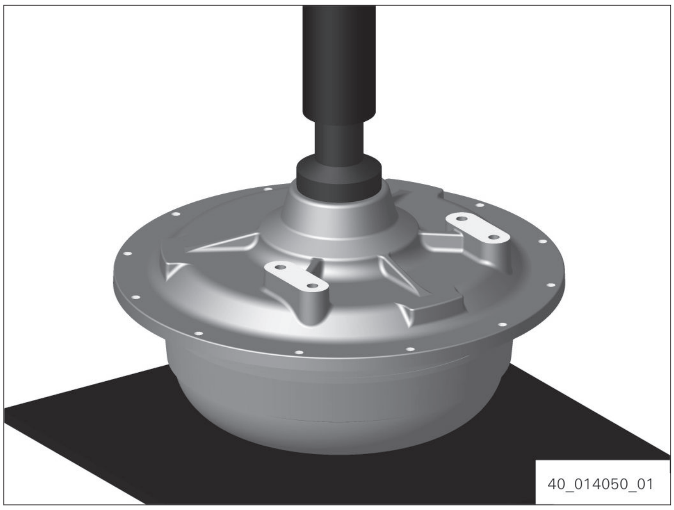


Fig. 393

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

CAUTION

Risk of burn injuries due to contact with hot surfaces.
Slight or moderate injury possible.
⇨ Wear protective gloves.

Heat up internal spline.

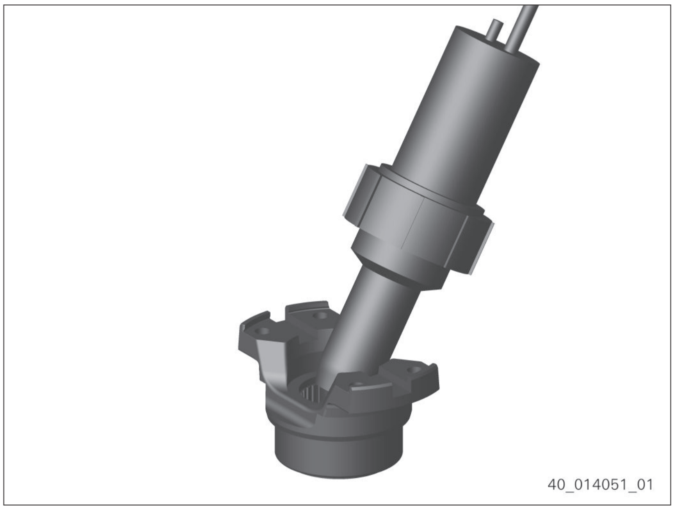


Fig. 394

10. Slide output flange (1) onto flange shaft until contact is obtained.

Fig. 395

11. Fix output flange with washer (3) and hexagon screws (2).
Tightening torque: 46 Nm

12. **CAUTION**

Risk of injury due to parts flying away.
Slight or moderate injury possible.
⇨ Wear protective goggles.

Mount locking plate (1) using the 5870.057.009 [Driver tool] and 5870.260.002 [Handle] until contact is obtained.

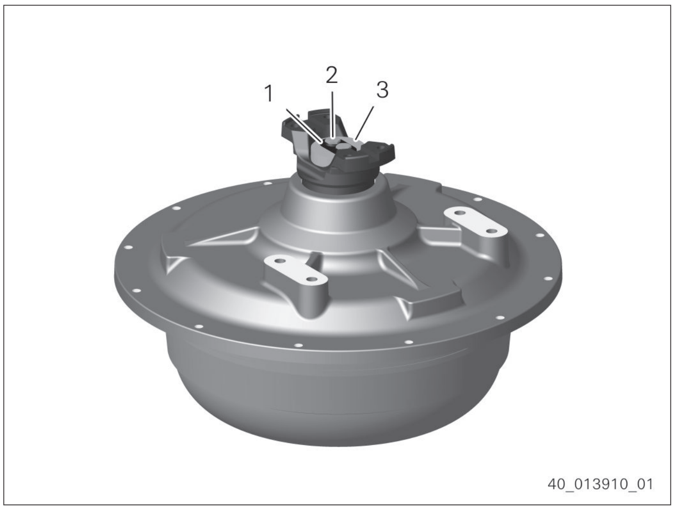


Fig. 396

13. ⚠ **CAUTION**

Risk of crushing due to moving parts.
Slight or moderate injury possible.
⇨ Do not reach into danger area!

Use two AA02.676.915 [Load ring] and crane to slide on cover and converter until contact is obtained. Mount the cover according to the marking.

Fig. 397

14. Insert hexagon screws (2) into holes and tighten nuts (1).
Tightening torque: 46 Nm

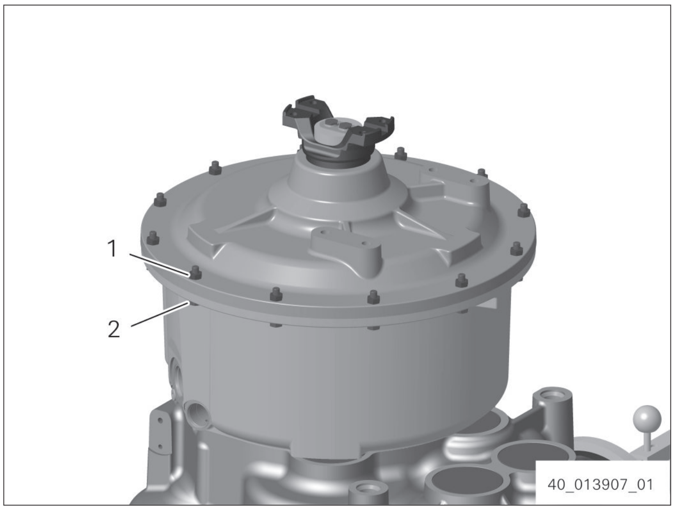


Fig. 398

Mounting the fixing plates

1. Fix the fixing plates (1) with hexagon screws.
Tightening torque: 195 Nm

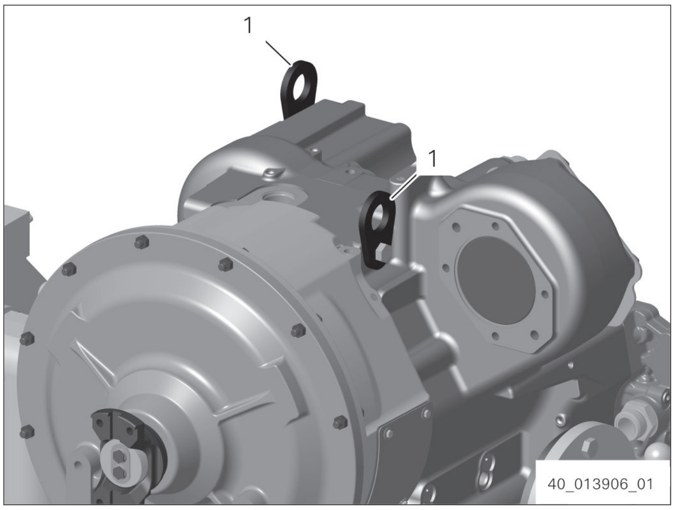


Fig. 399

Installing the torque converter pressure retaining valve

1. Insert the piston (2) into the torque converter bell housing.

2. Insert compression spring (1).

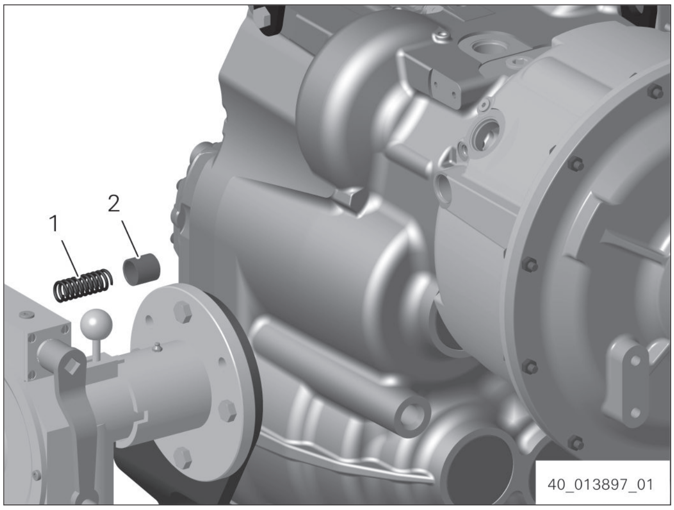


Fig. 400

3. Insert screw plug with O-ring (1) and tighten. Tightening torque: 130 Nm

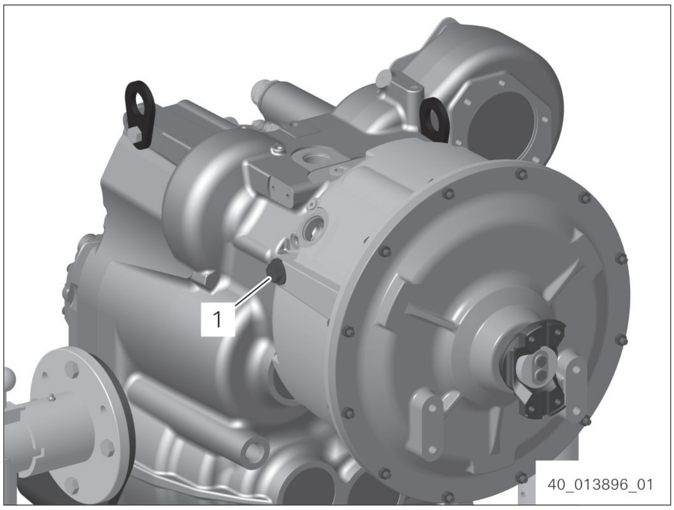


Fig. 401

Assembling and installing shift system

Installing duct plate

Special tools:

- 5870.204.037 Fixing pin

Assembly

1. Turn two 5870.204.037 [Fixing pin] into cover.

2. Slide on seal (1).

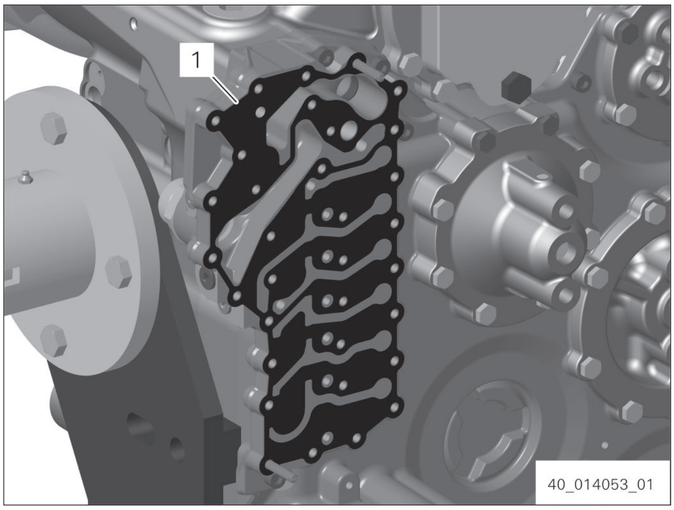


Fig. 402

3. Bolt in screw plugs (1) into duct plate and tighten.
   Tightening torque: 9.5 Nm

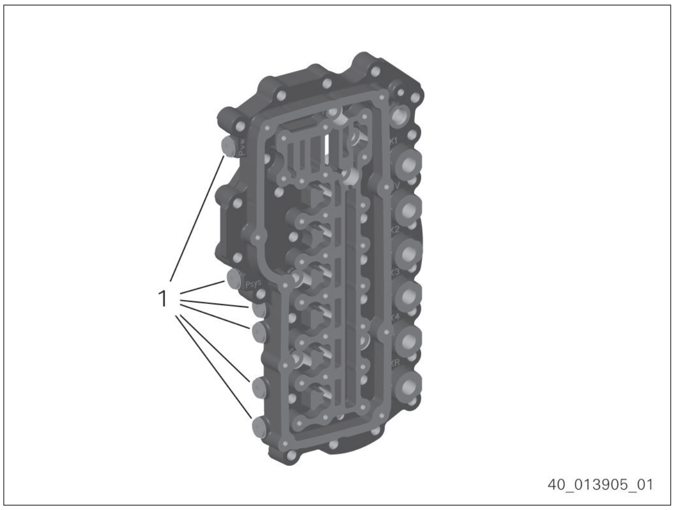


Fig. 403

4. Slide on duct plate (1).

5. Fix duct plate with internal hexalobular bolts in the specified order.
   Tightening torque: 23 Nm

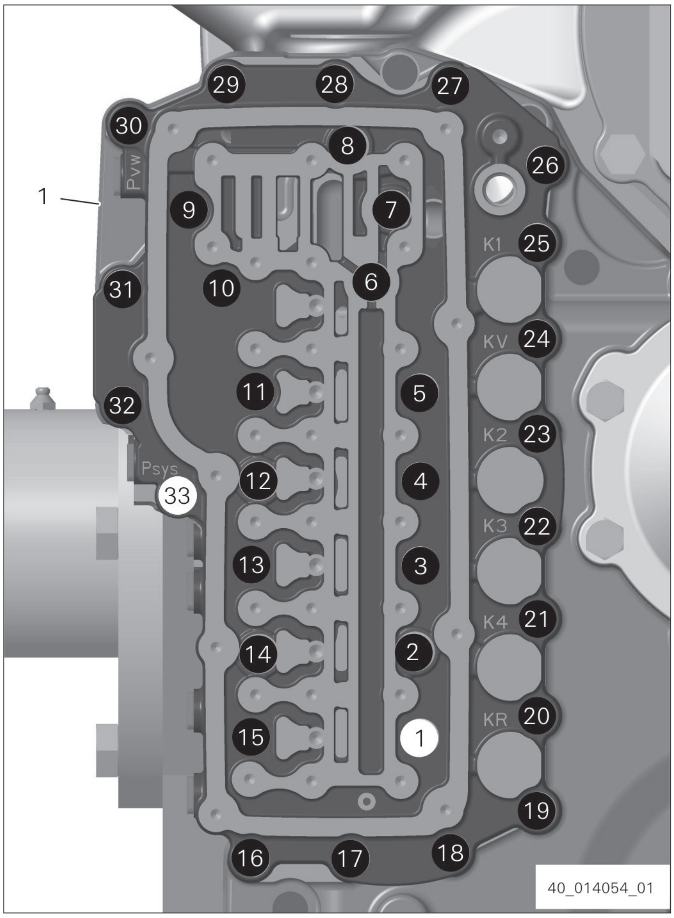


Fig. 404

6. Insert valves (1) in duct plate.

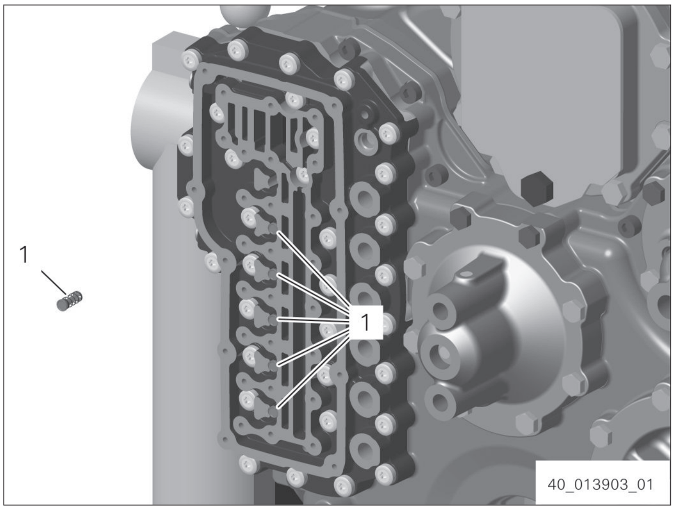


Fig. 405

Assembling and mounting valve blocks

Special tools:

- 5870.204.063 Fixing pin
- AA02.416.230 Driver tool
- AA02.416.754 Driver tool

Assembly

- AA02.414.200 Driver tool
- AA02.788.633 Torque wrench

1. Bolt two 5870.204.063 [Fixing pin] into the duct plate.

2. Slide on new intermediate plate (1).

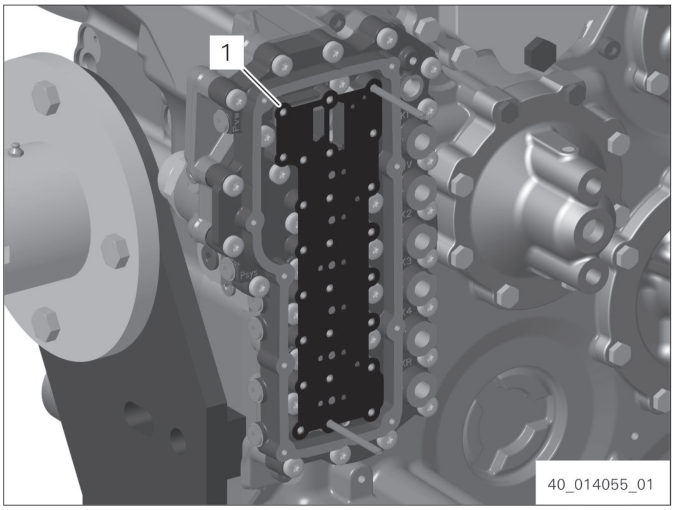


Fig. 406

3. Insert the control piston (1) in the hole.

4. Insert compression spring (2).

5. Oil O-ring.

6. Insert O-ring in the annular groove of the plug (3).

7. Insert the plug (3) in the hole.

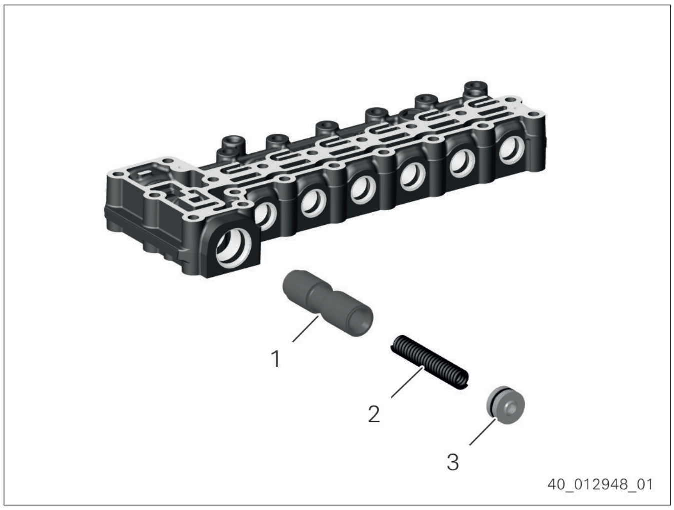


Fig. 407

8. Press the plug inwards with AA02.416.230 [Driver tool] until contact is obtained and insert fixing plate (1).

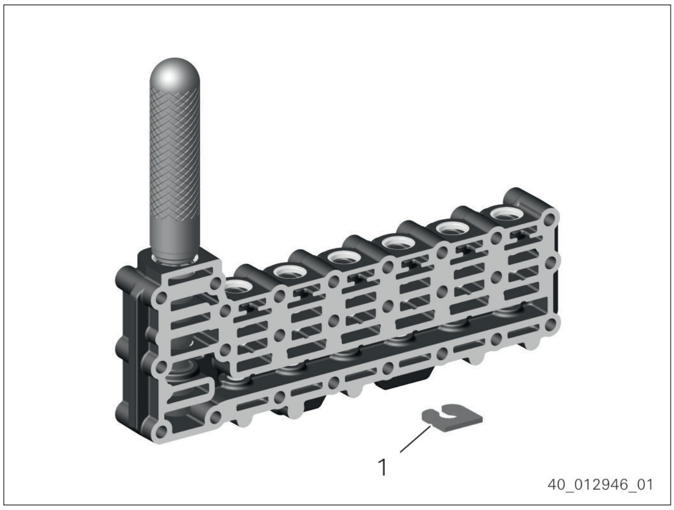


Fig. 408

9. Insert the compression spring (1) into the bore.

10. Insert the control piston (2).

11. Oil O-ring.

12. Insert O-ring in the annular groove of the plug (3).

13. Insert the plug (3) in the hole.

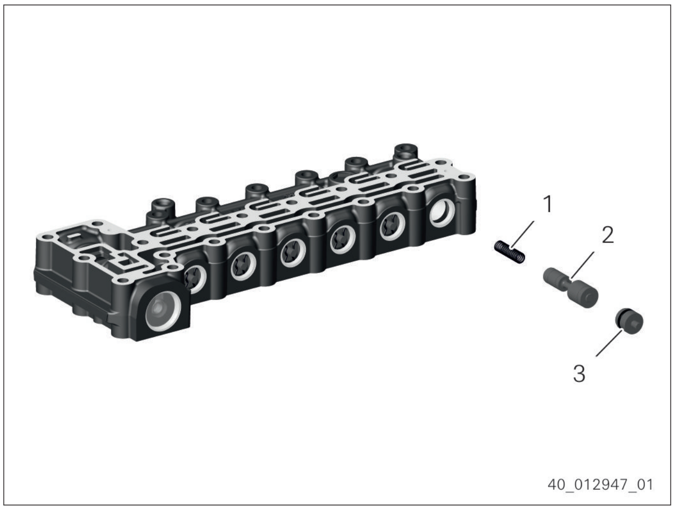


Fig. 409

14. Push the plug inwards with the AA02.416.754 [Driver tool] until contact is obtained and insert the spring clip (1).

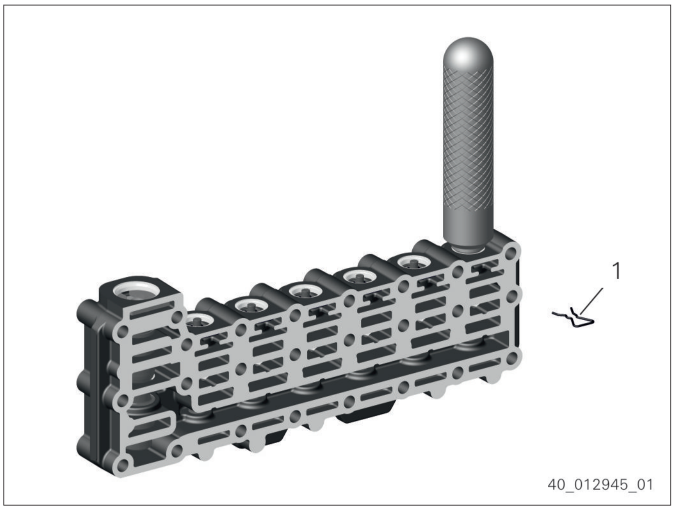


Fig. 410

15. Push on valve block (1).

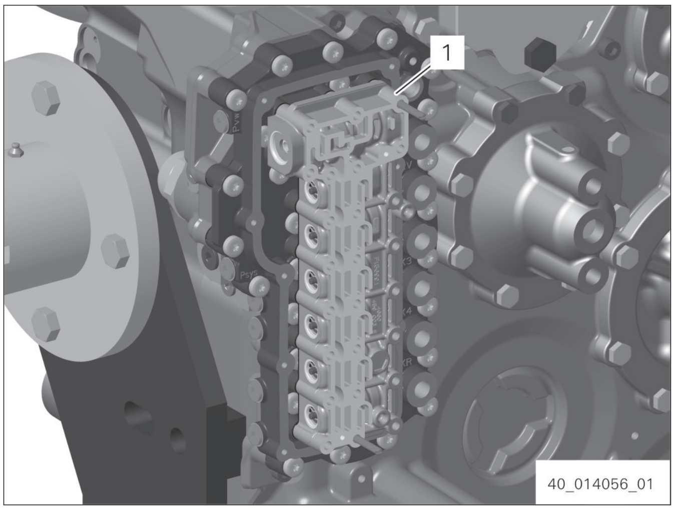


Fig. 411

16. Push on intermediate plate (1).

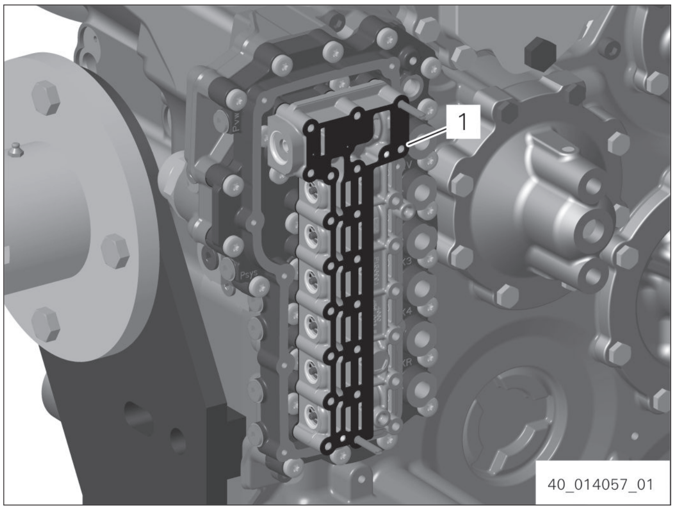


Fig. 412

17. Insert piston (1) in the hole.

18. Insert compression spring (2).

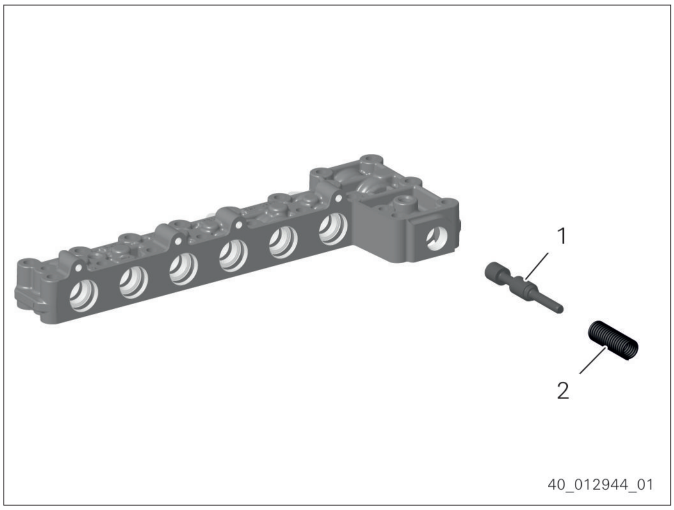


Fig. 413

19. Push the compression spring inwards with AA02.414.200 [Driver tool] until contact is obtained and insert the fixing plate (1).

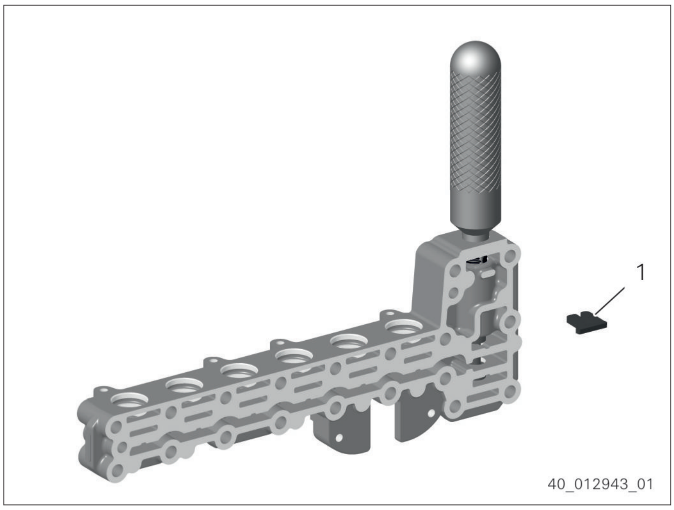


Fig. 414

20. Push on valve block (1).

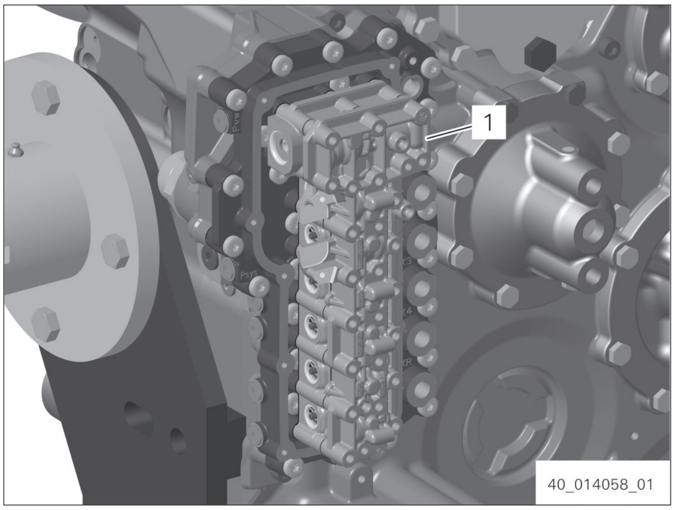


Fig. 415

21. Screw in and tighten the hexalobular driving screws (1).
Tightening torque: 3 Nm

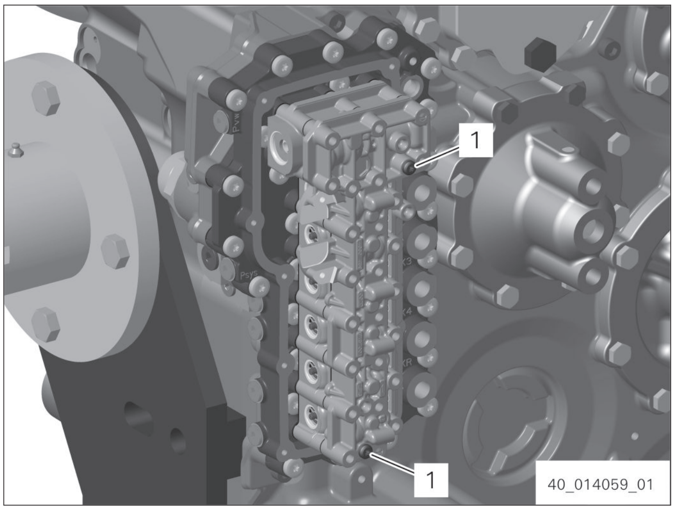


Fig. 416

Fixing valve blocks (Variant using the duct plate removed during disassembly)

22. Apply oil to the threads of the internal hexalobular bolts M 6x 85.

23. Bolt in internal hexalobular bolts M6 x 85 (1 bis 19) and tighten with AA02.788.633 [Torque wrench] in the specified order.
    Tightening torque: 2 Nm and 35° Additional tightening angle

24. Apply oil to the threads of the internal hexalobular bolts M 6x 50.

25. Bolt in internal hexalobular bolts M6 x 50 (20 bis 25) and tighten with AA02.788.633 [Torque wrench] in the specified order.
    Tightening torque: 2 Nm and 17° Additional tightening angle

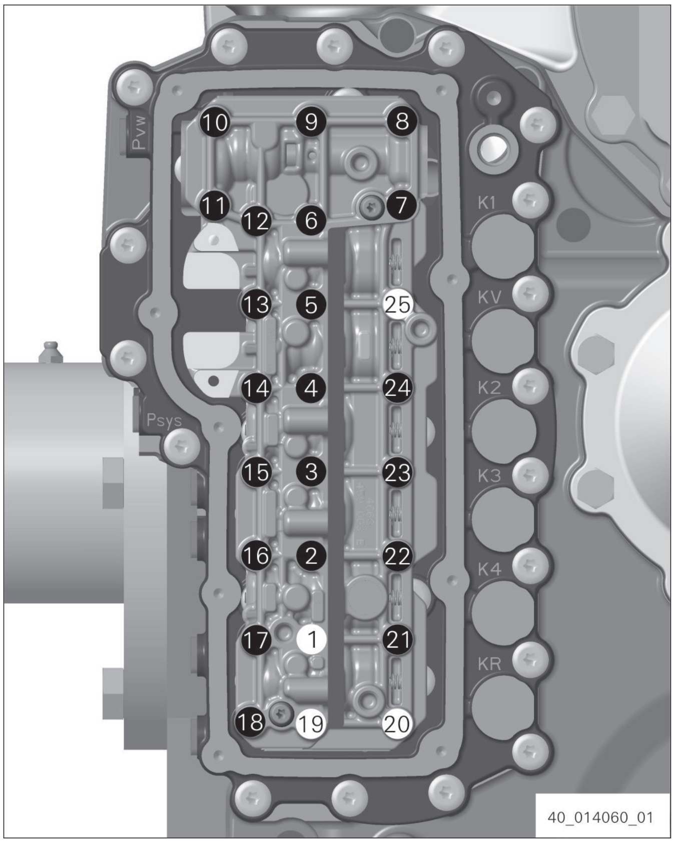


Fig. 417

Fixing valve blocks (Variant with new oil-free duct plate)

26. Bolt in **new** non-lubricated internal hexalobular bolts M6 x 85 (1 bis 19) and tighten with AA02.788.633 [Torque wrench] in the specified order.
    Tightening torque: **3 Nm** and **60°** Additional tightening angle

27. Bolt in **new** non-lubricated internal hexalobular bolts M6 x 50 (20 bis 25) and tighten with AA02.788.633 [Torque wrench] in the specified order.
    Tightening torque: **3 Nm** and **45°** Additional tightening angle

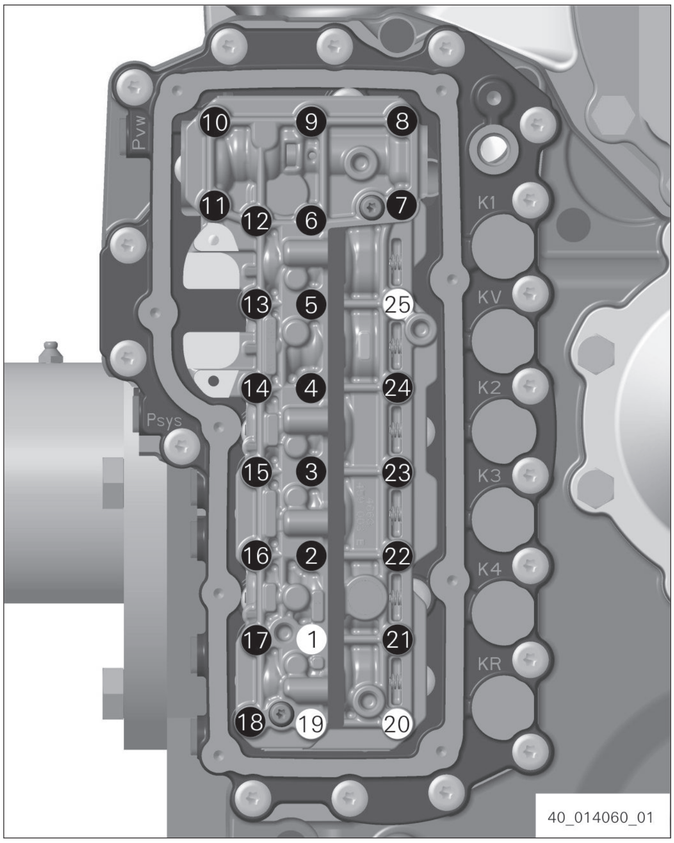


Fig. 418

Installing the pressure controllers

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

   Insert pressure controllers with O-rings (2) in valve block.

2. Fix pressure controllers with clamping plate (1) and internal hexalobular bolts.
   Tightening torque: **9.5 Nm**

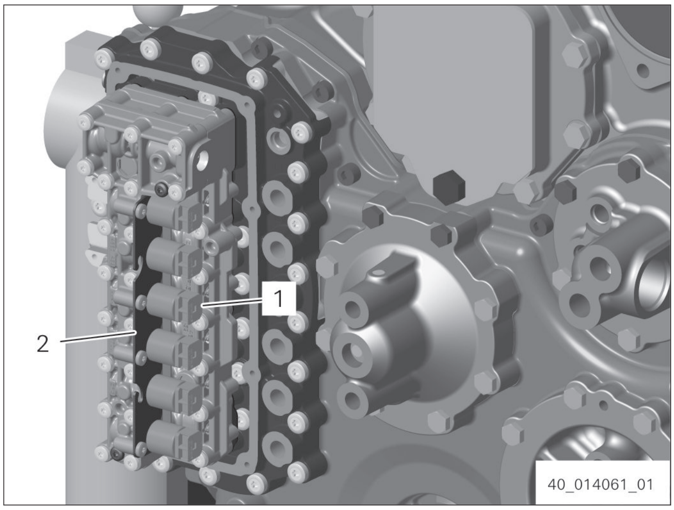


Fig. 419

3. Insert plugs (1) on the pressure controllers.

4. Fix plug (3) with fixing plate (4) and internal hexalobular bolts.
   Tightening torque: 9.5 Nm

5. Insert cable (2) in cable routing on the clamping plate.

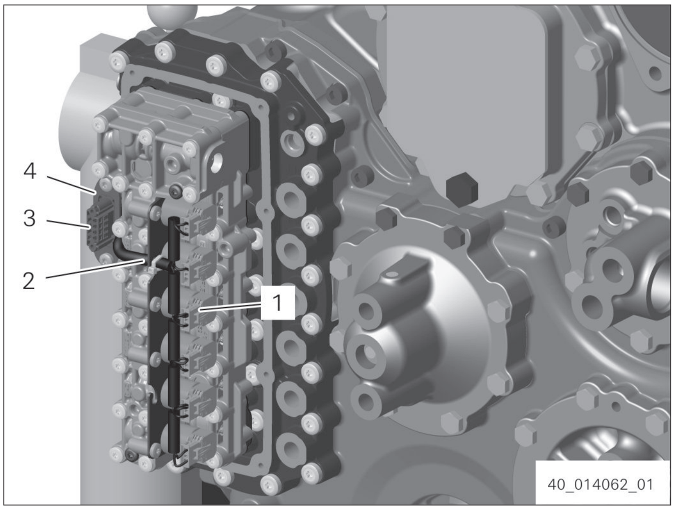


Fig. 420

Installing control unit (EC4A)

Special tools:
- 5870.204.063 Fixing pin

1. Insert seal (1) in control unit (2).

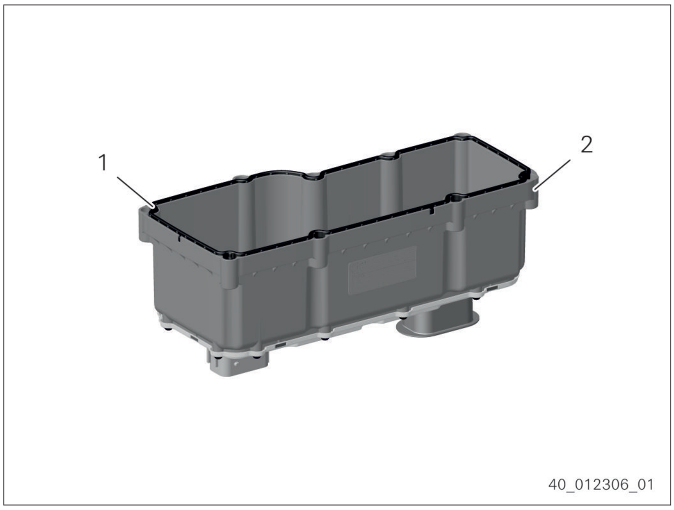


Fig. 421

2. Bolt two 5870.204.063 [Fixing pin] into the duct plate.

3. Slide on control unit.

4. Bolt in internal hexalobular bolts and tighten in the specified order.
Tightening torque: 9.5 Nm

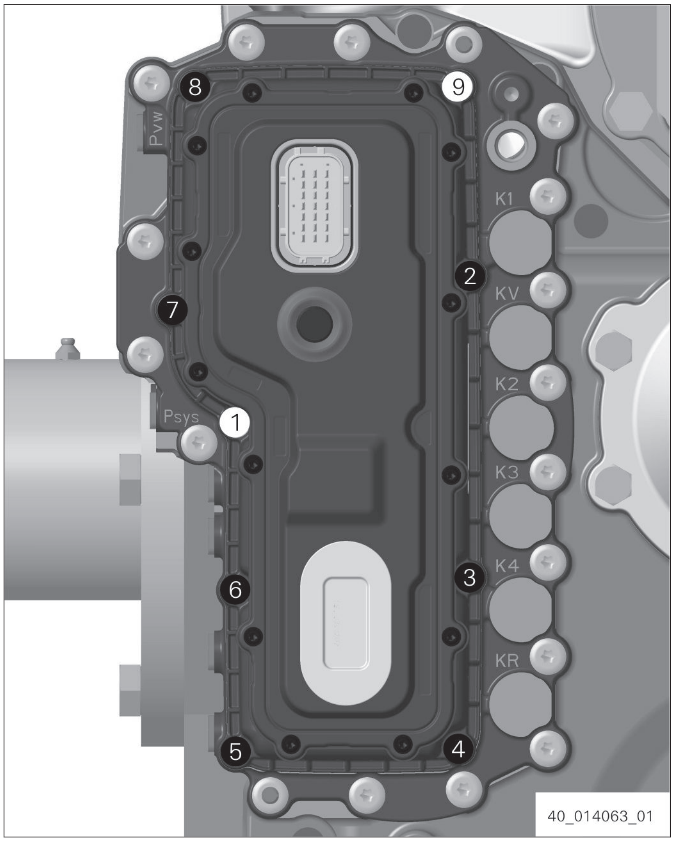


Fig. 422

Installing the temperature sensors and the breather

1. Bolt in breather (1) and tighten.
Tightening torque: 12 Nm

2. Screw in and tighten temperature sensors with O-ring (2).
Tightening torque: 25 Nm

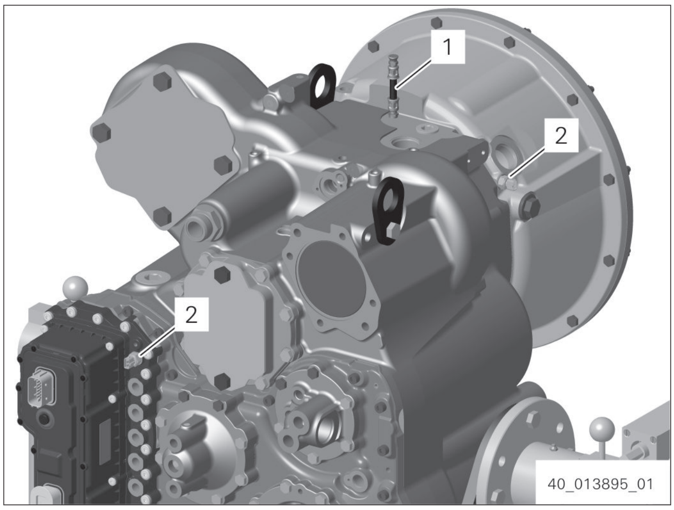


Fig. 423

Installing the speed sensors

1. Insert speed sensors with O-ring (1) in housing holes.

2. Fix speed sensors with cap screws.
   Tightening torque: 9.5 Nm

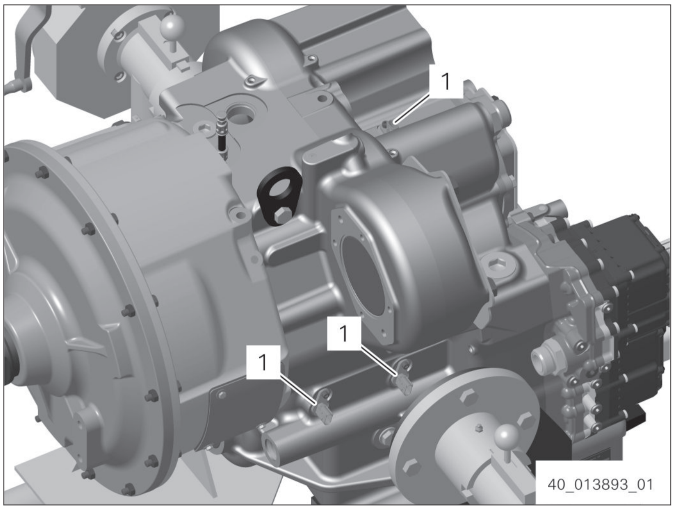


Fig. 424

3. Insert speed sensor with sealing element (1) into the housing hole.

4. Fasten speed sensor with cap screw.
   Tightening torque: 9.5 Nm

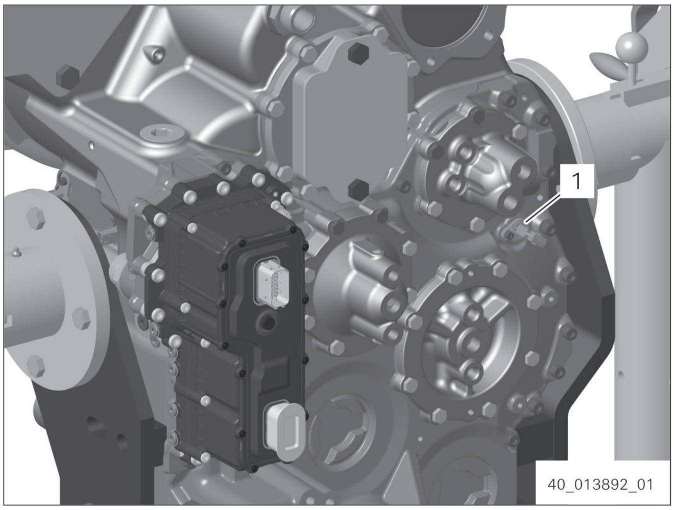


Fig. 425

Attaching the hose assemblies

Attaching the hose assembly K1

1. Insert the O-ring between the hose assembly (3) and the bearing cover (2).
2. Turn in hollow screw with O-ring (1) and tighten.
   Tightening torque: 45 Nm
3. Insert O-ring between hose assembly (3) and duct plate (5).
4. Turn in hollow screw with O-ring (4) and tighten.
   Tightening torque: 45 Nm

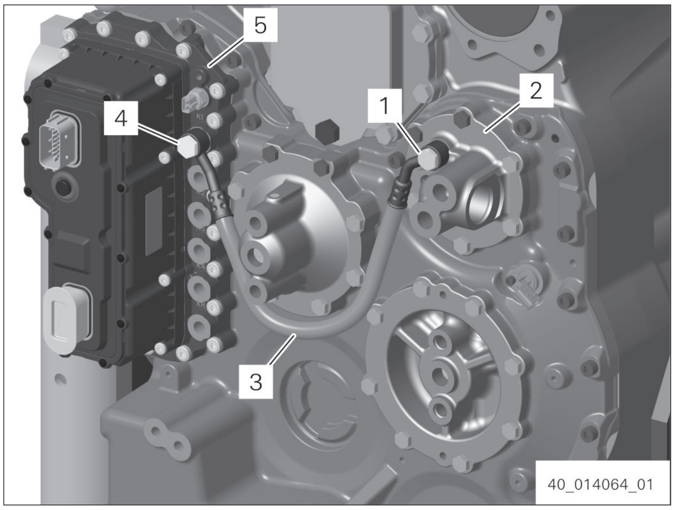


Fig. 426

Attaching the hose assembly KV

5. Insert the O-ring between the hose assembly (3) and the bearing cover (2).
6. Turn in hollow screw with O-ring (1) and tighten.
   Tightening torque: 45 Nm
7. Insert O-ring between hose assembly (3) and duct plate (5).
8. Turn in hollow screw with O-ring (4) and tighten.
   Tightening torque: 45 Nm

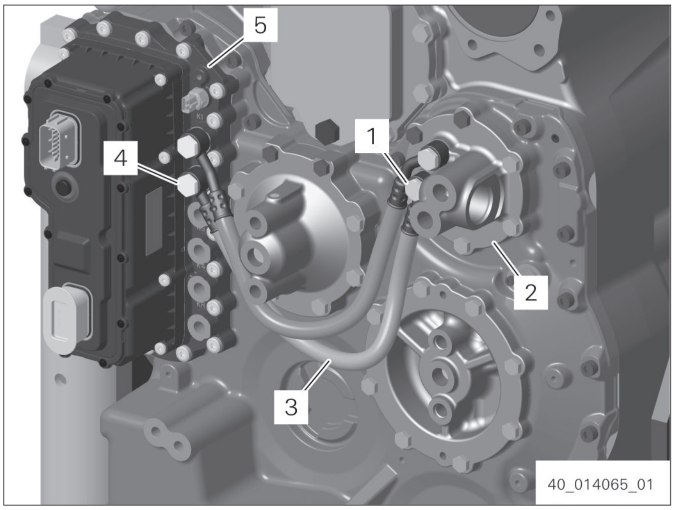


Fig. 427

Attaching the hose assembly K2

9. Insert O-ring between hose assembly (3) and the cover (2).

10. Turn in hollow screw with O-ring (1) and tighten.
    Tightening torque: 45 Nm

11. Insert O-ring between hose assembly (3) and duct plate (5).

12. Turn in hollow screw with O-ring (4) and tighten.
    Tightening torque: 45 Nm

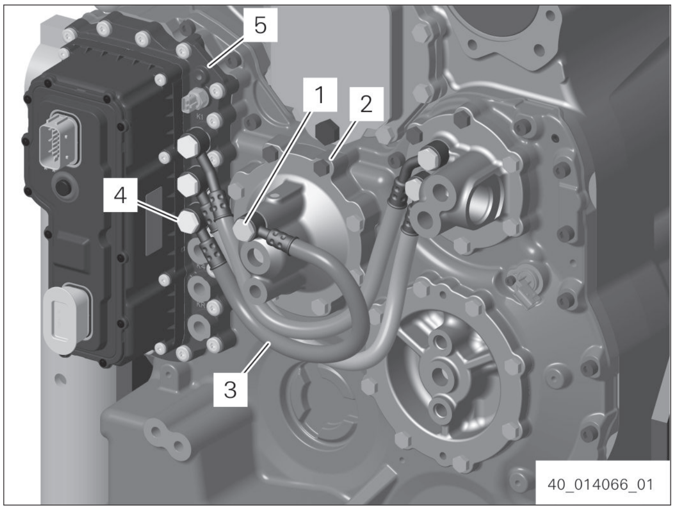


Fig. 428

Attaching the hose assembly K3

13. Insert O-ring between hose assembly (3) and the cover (2).

14. Turn in hollow screw with O-ring (1) and tighten.
    Tightening torque: 45 Nm

15. Insert O-ring between hose assembly (3) and duct plate (5).

16. Turn in hollow screw with O-ring (4) and tighten.
    Tightening torque: 45 Nm

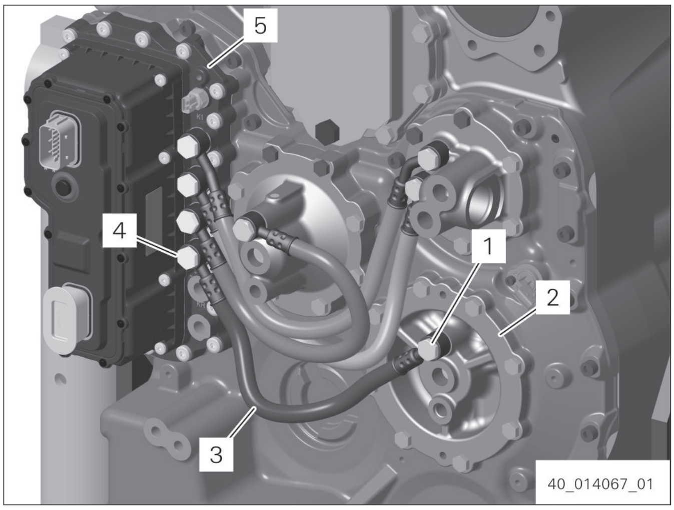


Fig. 429

Attaching the hose assembly K4

17. Insert O-ring between hose assembly (3) and the cover (2).

18. Turn in hollow screw with O-ring (1) and tighten.
    Tightening torque: 45 Nm

19. Insert O-ring between hose assembly (3) and duct plate (5).

20. Turn in hollow screw with O-ring (4) and tighten.
    Tightening torque: 45 Nm

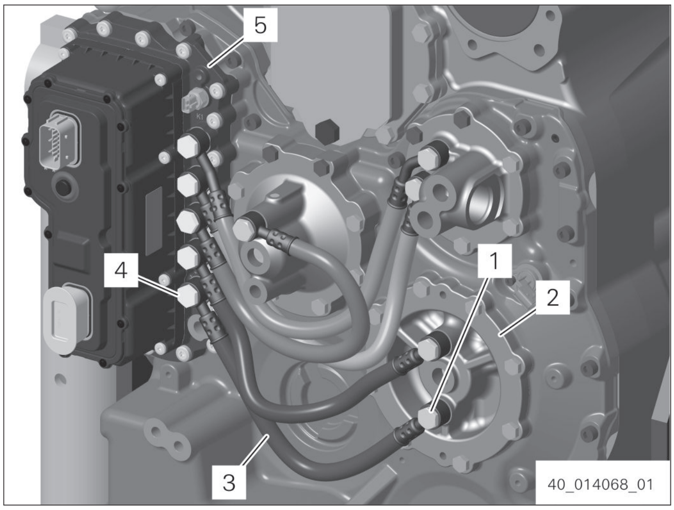


Fig. 430

Attaching the hose assembly KR

21. Insert O-ring between hose assembly (3) and the cover (2).

22. Turn in hollow screw with O-ring (1) and tighten.
    Tightening torque: 45 Nm

23. Insert O-ring between hose assembly (3) and duct plate (5).

24. Turn in hollow screw with O-ring (4) and tighten.
    Tightening torque: 45 Nm

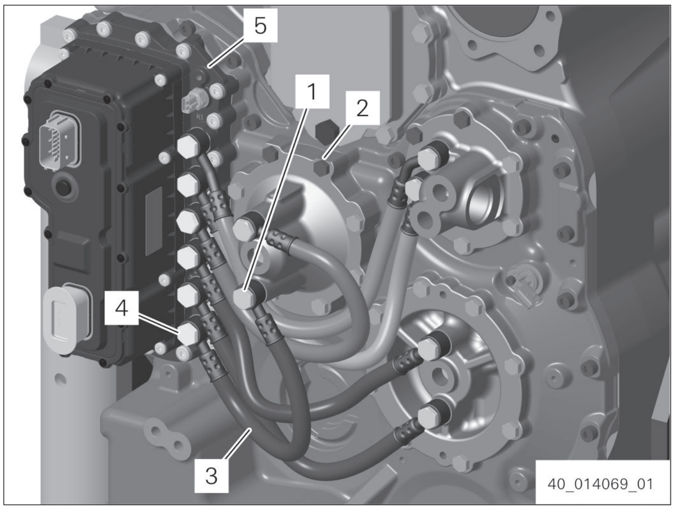


Fig. 431

Attaching the hose assembly S2

25. Insert the O-ring between the hose assembly (3) and the bearing cover (2).

26. Turn in hollow screw with O-ring (1) and tighten.
    Tightening torque: 60 Nm

27. Insert O-ring between hose assembly (3) and the cover (5).

28. Turn in hollow screw with O-ring (4) and tighten.
    Tightening torque: 60 Nm

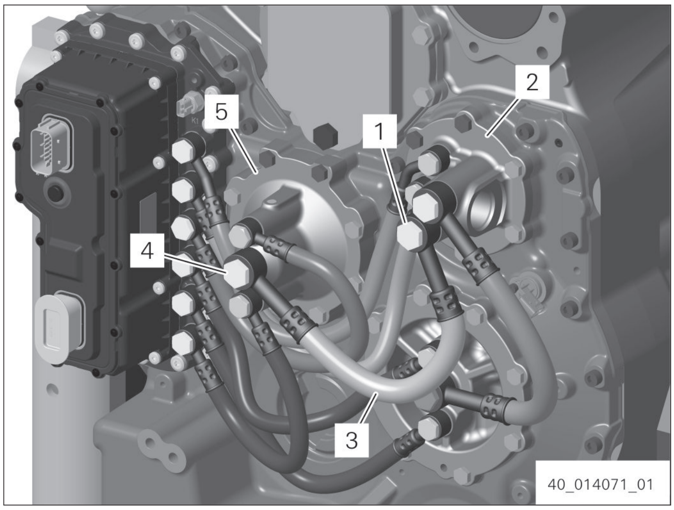


Fig. 432

Installing the tube

1. Insert sealing ring between tube (3) and housing.

2. Insert sealing ring between tube (3) and torque converter bell housing.

3. Bolt in hollow screws with O-ring (1) and tighten.
   Tightening torque: 45 Nm

4. Bolt in screw plugs with O-ring (2) and tighten.
   Tightening torque: 20 Nm

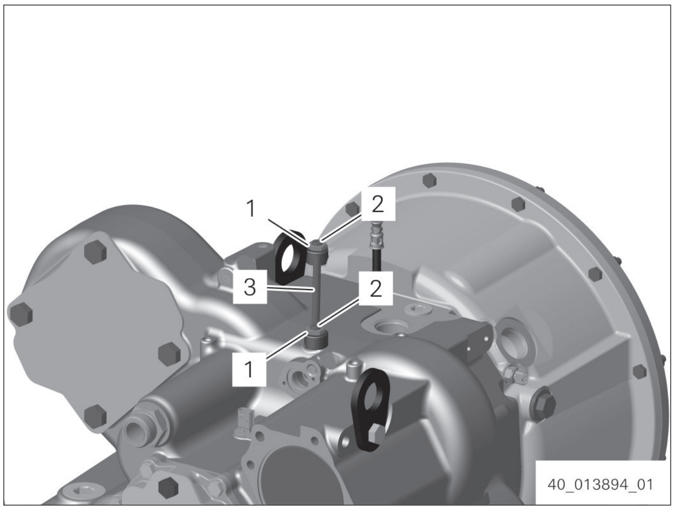


Fig. 433

Installing pressure controller (converter clutch valve)

1. Insert pressure controller with O-rings (1) into the housing hole.
2. Fix pressure controller with two cap screws. Tightening torque: 9.5 Nm

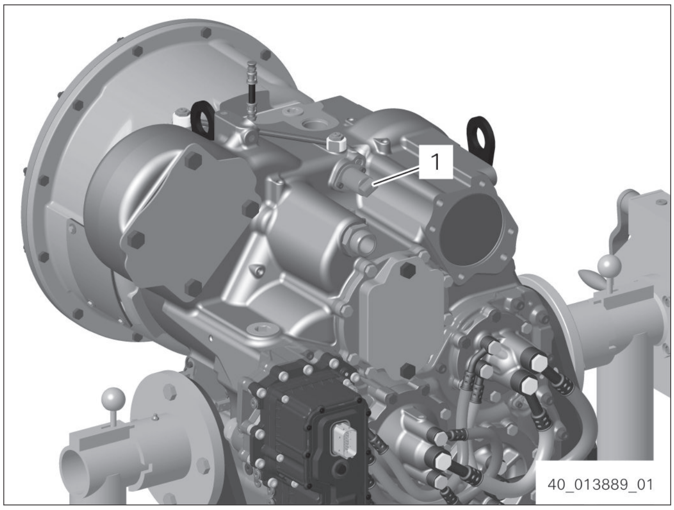


Fig. 434

3. Route cable (1) and insert plugs.
4. Fasten cable to the transmission with cable ties.

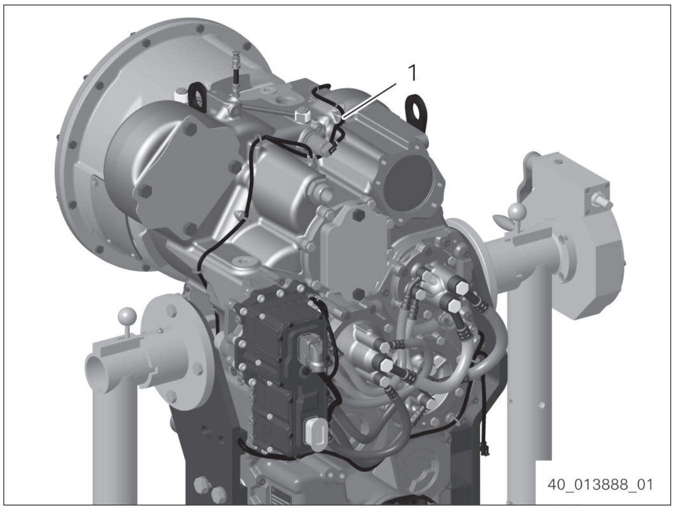


Fig. 435

Installing cover sheets (filler neck)

1. Put on seal and cover sheet (1).
2. Turn in and tighten hexagon screws.
   Tightening torque: 23 Nm

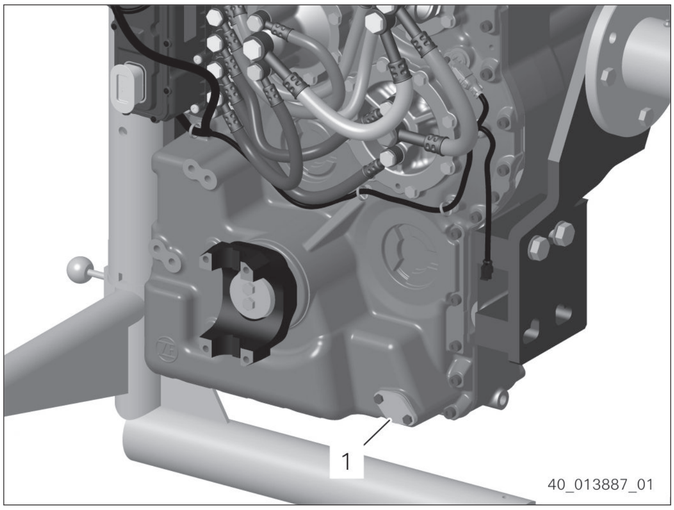


Fig. 436

3. Put on seal and cover sheet (1).
4. Turn in and tighten hexagon screws.
   Tightening torque: 23 Nm

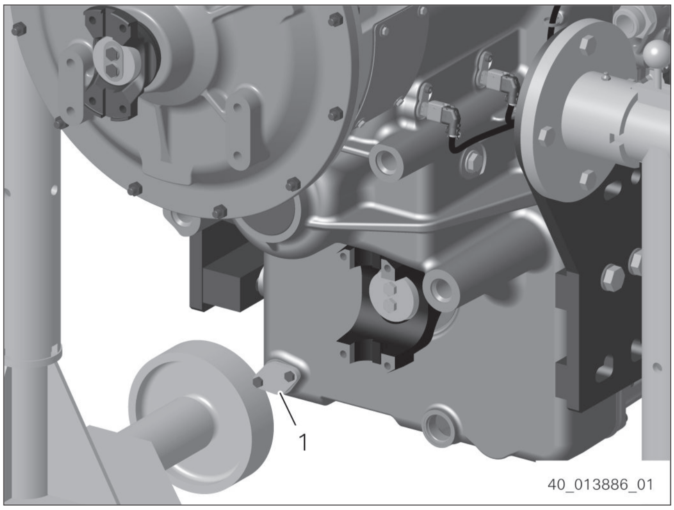


Fig. 437

Installing pressure filters

1. Apply a thin film of oil to the seal of the pressure filters.

2. Bolt in the pressure filters (1) until contact between the sealing face to the filter head is obtained.

3. Tighten the pressure filters (1).
   Tightening torque: Contact sealing surface +90°to 180°
   As an alternative, use a tool with torque display to tighten the pressure filters.
   Tightening torque: 40 Nm

4. Screw in the plunger switch including the O-ring (2) and tighten it.
   Tightening torque: 25 Nm (±5 Nm).
   The filter head is located near the transmission.

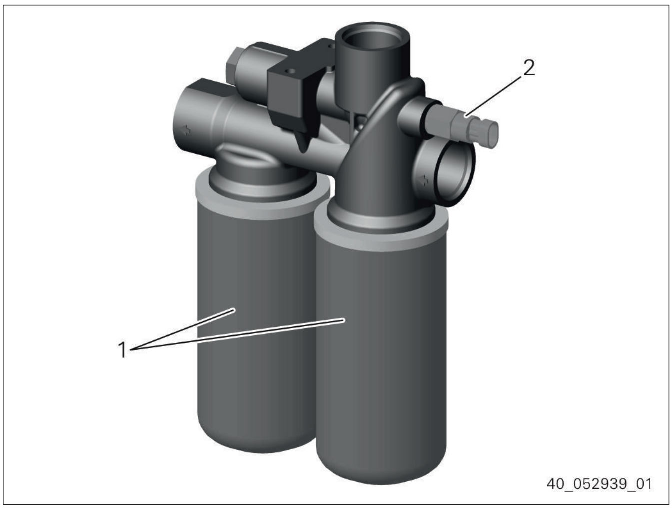


Fig. 438

Adding oil

1. Turn in screw plug with O-ring (2) and tighten.
   Tightening torque: 80 Nm

2. Before starting the transmission, fill up with oil according to the Operating Instructions *(refer to Section Document overview, page 6)*.

3. Screw in and tighten screw plug with O-ring (1).
   Tightening torque: 145 Nm

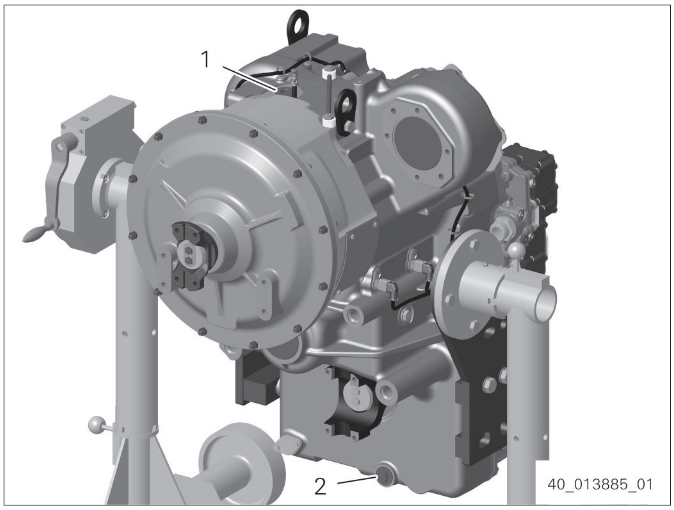


Fig. 439

2 AXLE

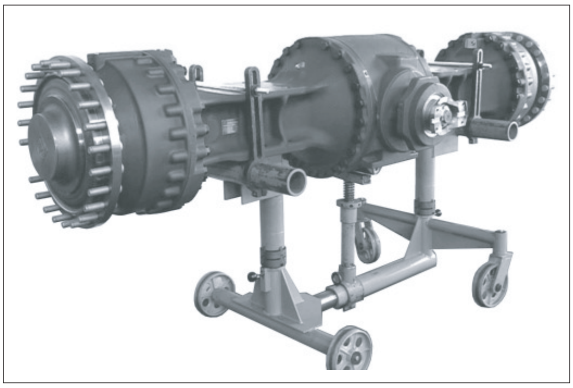
1) DISASSEMBLY

(1) Disassembly output and brake

① Fix axle to assembly truck.

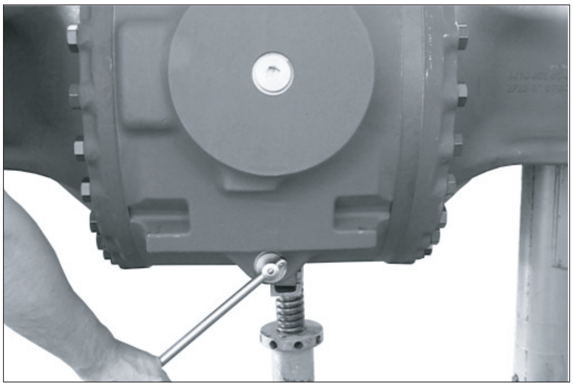
Assembly truck	5870 350 000
Fixtures	5870 350 077
Clamping brackets	5870 350 075
Support	5870 350 125

※ 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.

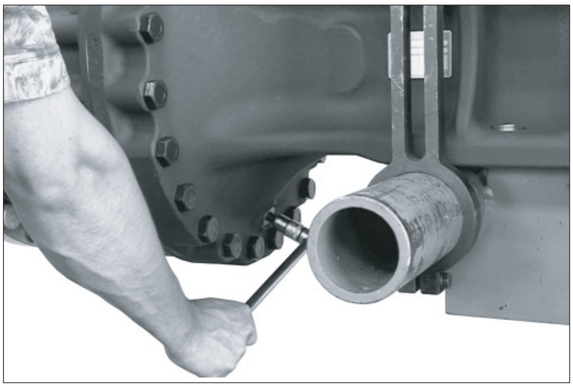


7809AX01

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



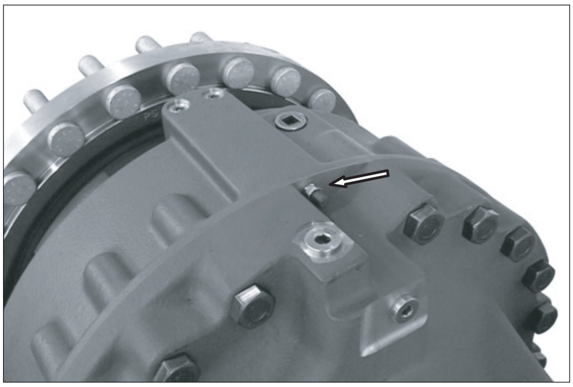
7809AX02



7809AX03

③ Remove the breather valve (see arrow).

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

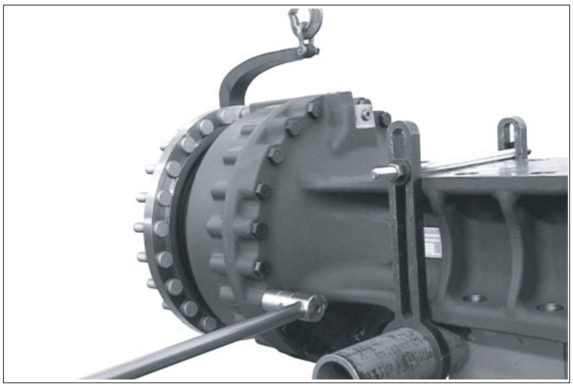


7809AX04

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

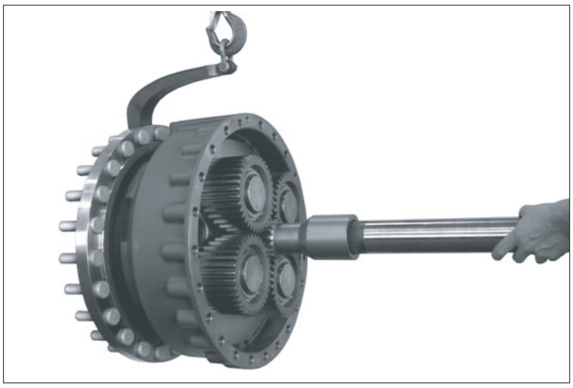
※ Fix the load carrying device with wheel nuts.



7809AX05

⑤ Pull stub shaft and sun gear shaft.

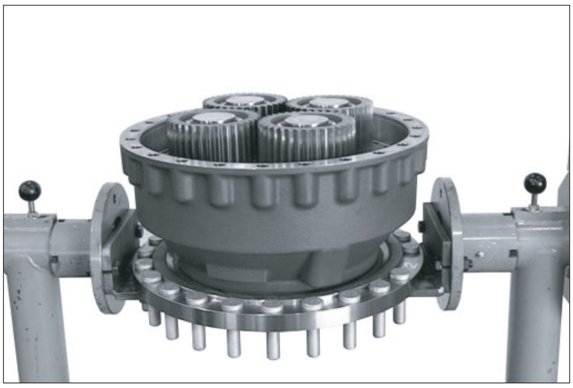
※ Pay attention to potentially releasing shim(s).



7809AX06

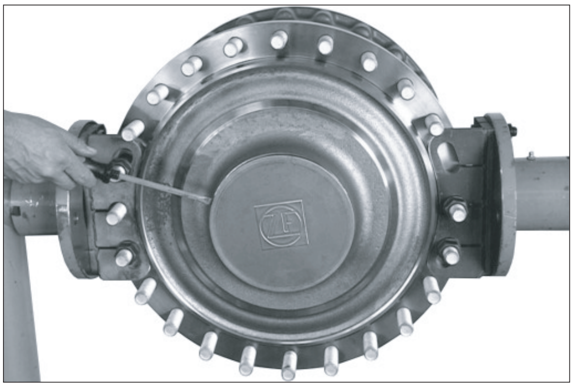
⑥ Fix output to assembly truck.

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



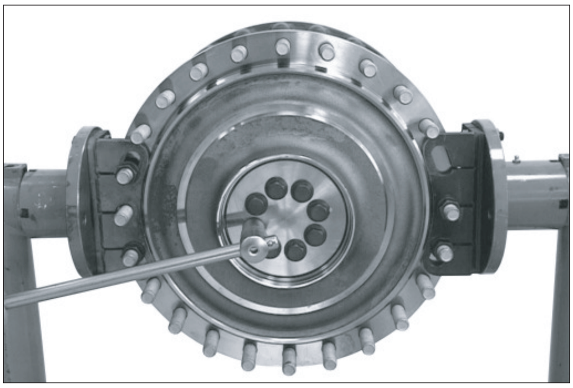
7809AX07

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



7809AX08

⑧ Loosen locking screws and remove the releasing cover.



7809AX09

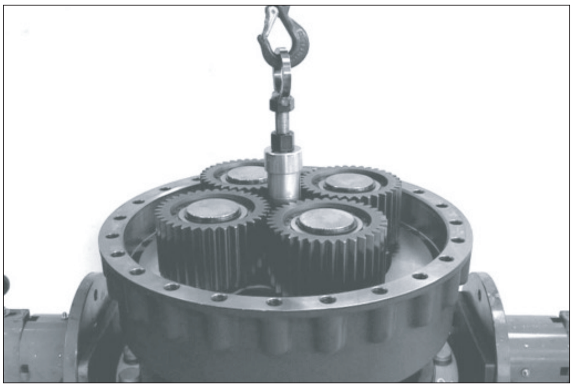
⑨ Lift the planetary carrier out of the brake housing by means of the lifting device.

· Rear axle (planetary carrier with 3 planetary gears)

Internal extractor	5870 300 019
Eye bolt	5870 204 073

· Front axle (planetary carrier with 4 planetary gears)

Internal extractor	5870 300 008
Eye nut	AA00 680 376



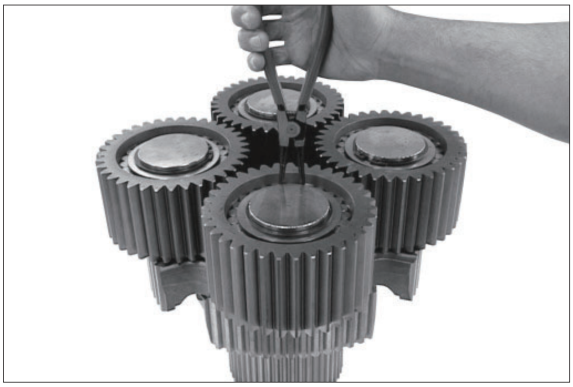
7809AX10

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.

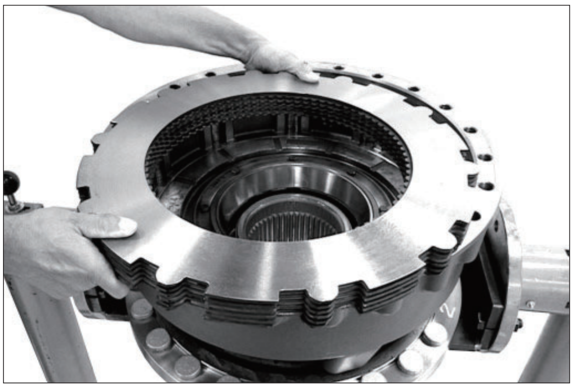
Extractor	AA00 696 012
Clamping cylinder	5873 003 016
Pump	5870 287 010

7809AX72

⑬ Lift the end plate out of the brake housing.

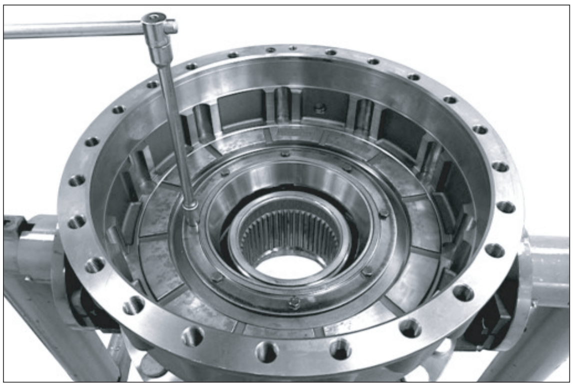
7809AX73

⑭ Lift the disk package out of the brake housing.



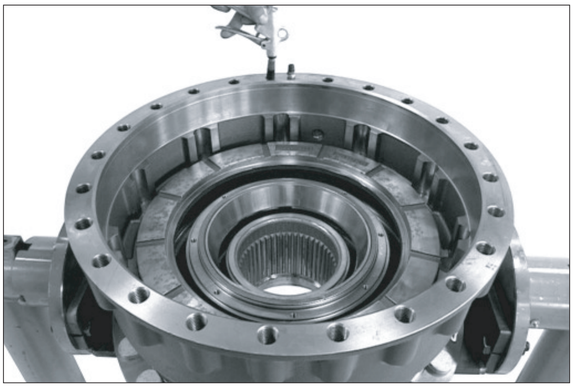
7809AX12

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



7809AX13

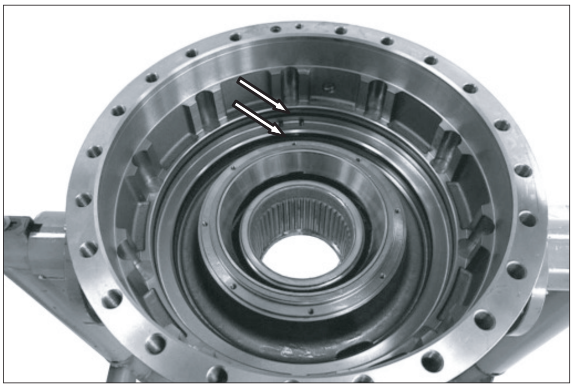
⑯ Mount breather valve and press piston out of the brake housing by means of compressed air.



7809AX14

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

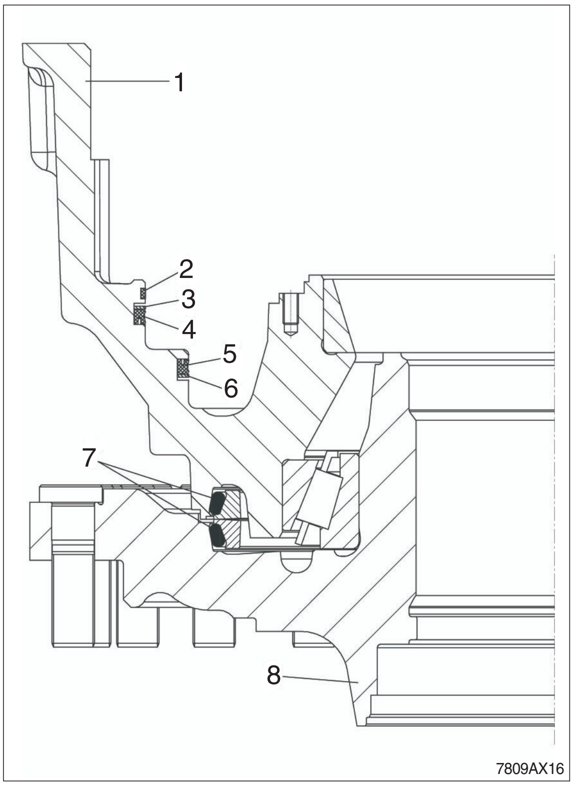
※ For the installation position of the single parts please also refer to the following sketch.



7809AX15

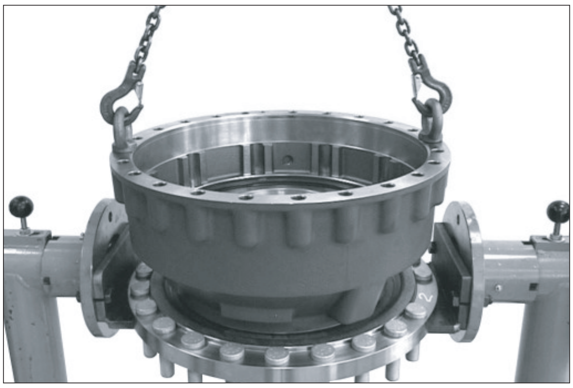
Legend to sketch :

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



7809AX16

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


7809AX17

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

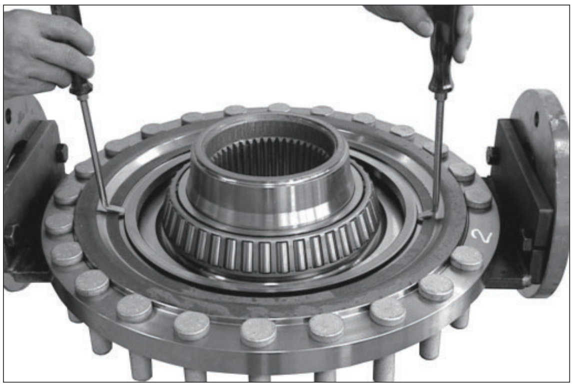
If necessary, force out both bearing outer rings.

Resetting device 5870 400 001


7809AX18

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

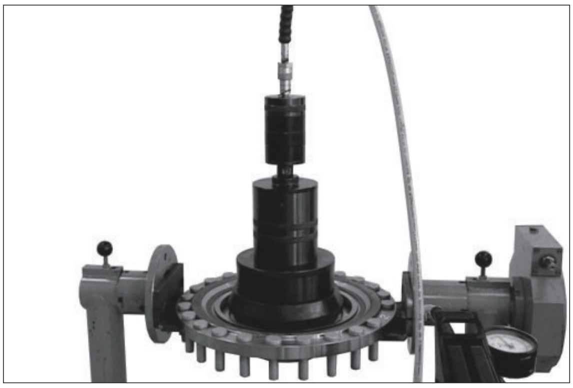
Resetting device	5870 400 001



7809AX74

㉑ Pull the tapered roller bearing from the output shaft.

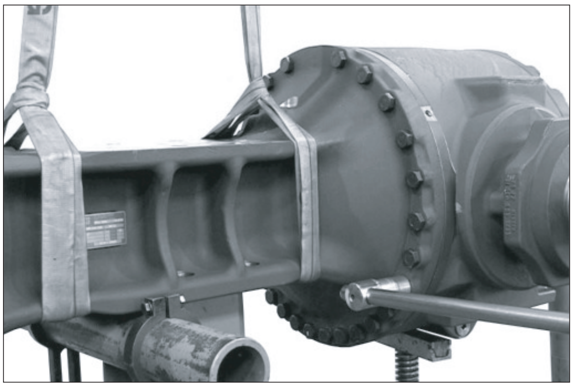
Gripping device	AA00 633 495
Adapter ring	AA00 633 500
Basic tool	5873 004 001
Pressure piece	AA00 696 181
Clamping cylinder	5873 003 016
Pump	5870 287 010



7809AX75

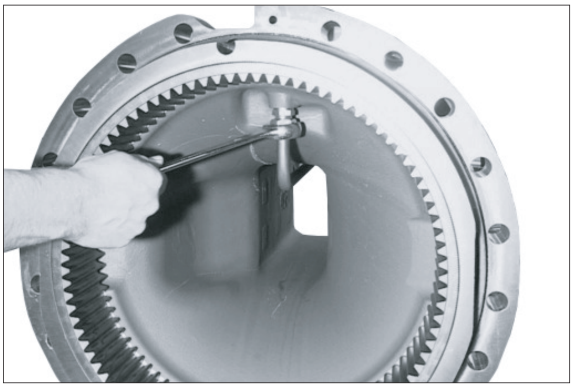
(2) Disassembly axle housing

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



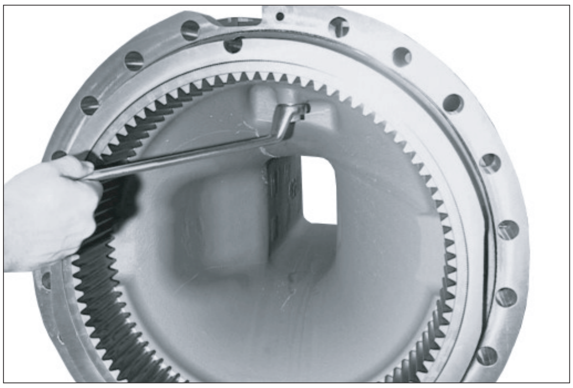
7809AX19

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



7809AX20

③ Loosen both screw necks.

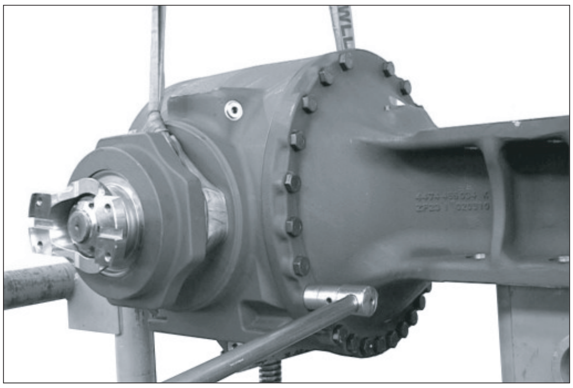


7809AX21

(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)	5870 204 086
Thread insert	AA00 677 715



7809AX22

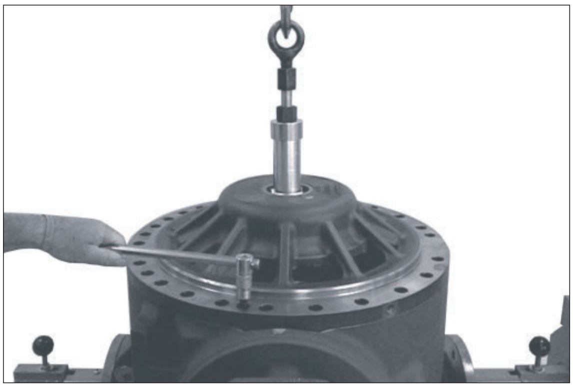
② Fix axle drive housing to the assembly truck.

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

7809AX76

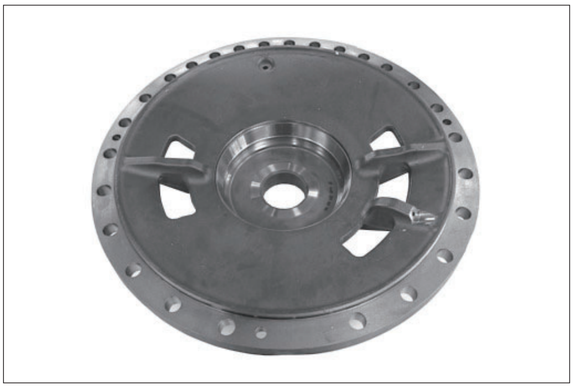
③ Loosen cylindrical screws and lift the releasing bearing housing with the lifting device.

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 3-262.

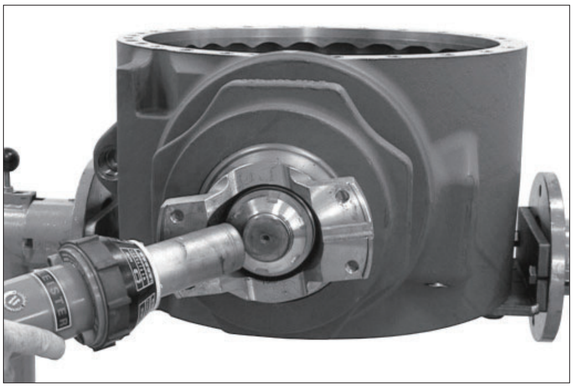
7809AX80

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.

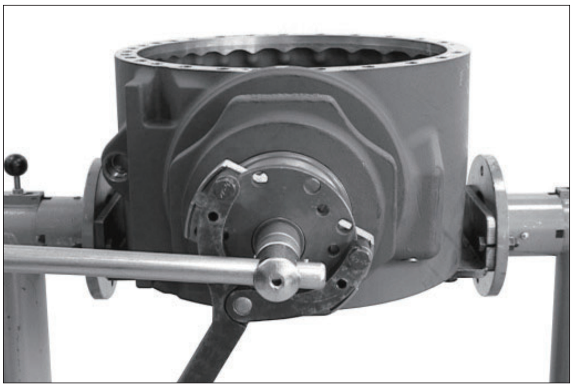
※ Slotted nut is secured with Loctite # 262.



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

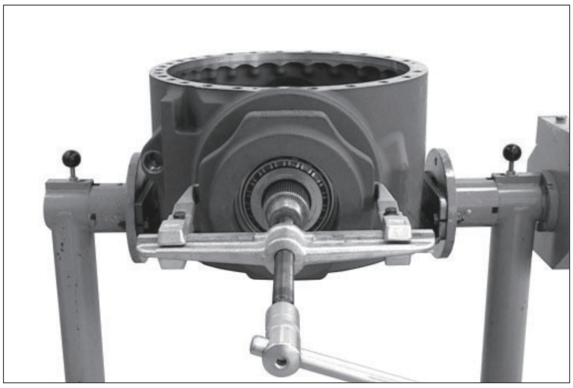


7809AX83

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

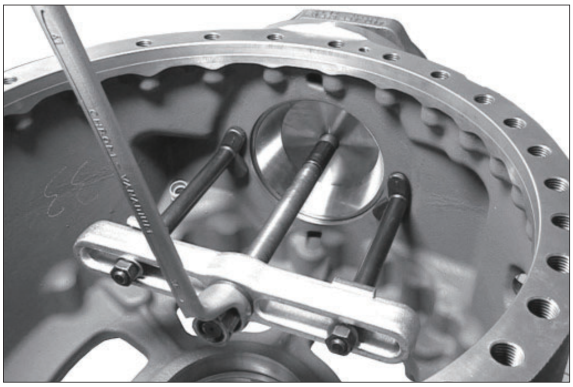

7809AX86

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.

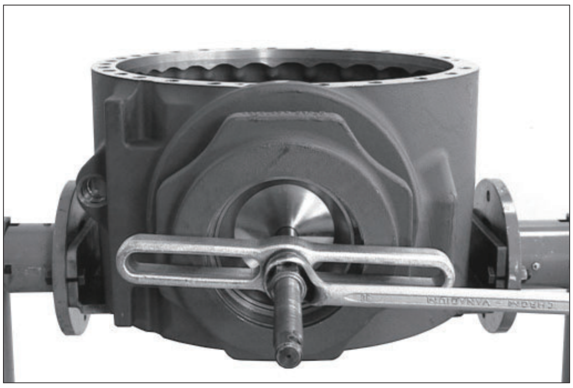
Assembly device	AA00 696 770
Counter support	5870 300 020



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

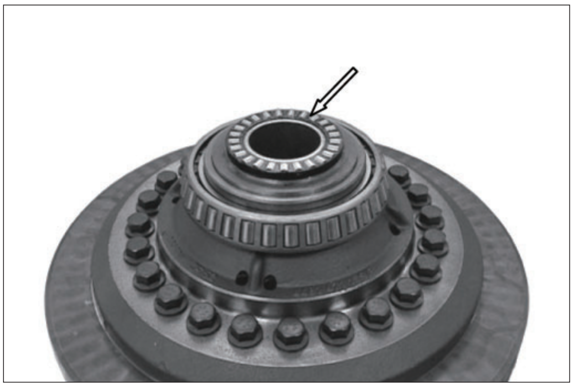


7809AX89

(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

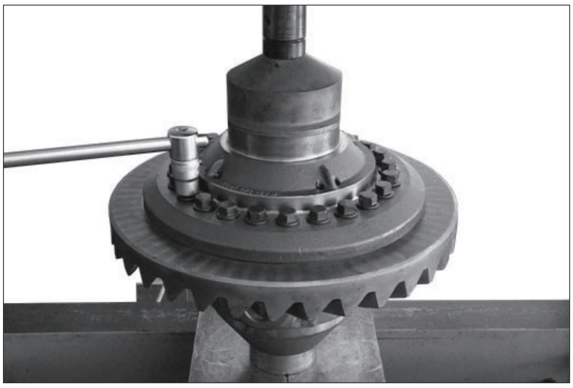
Opposite side

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

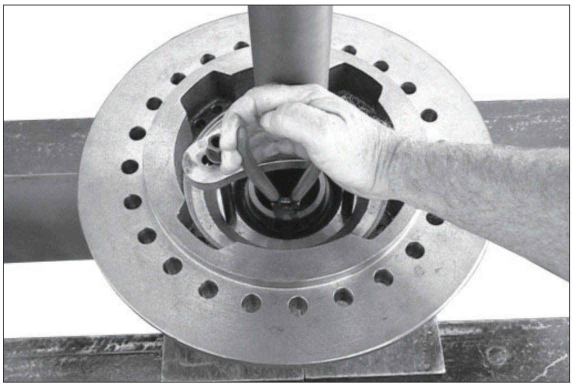
④ Lift the differential cover from the differential housing by means of the lifting device.

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.

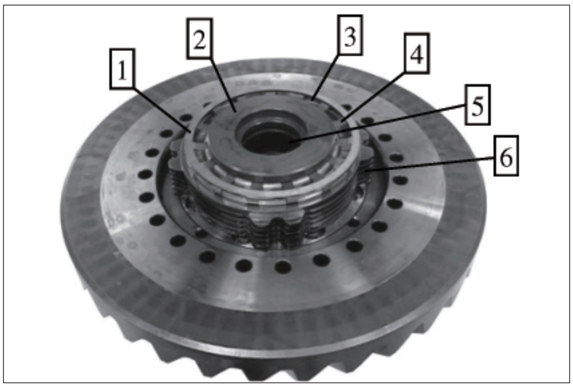
Then pull the sliding sleeve out of the differential cover and remove the releasing compression springs.



7809AX94

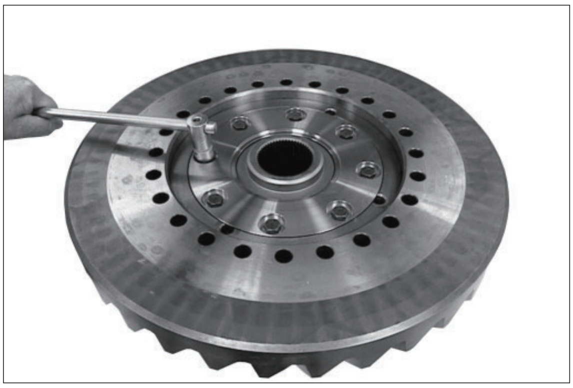
⑥ Remove single parts.

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



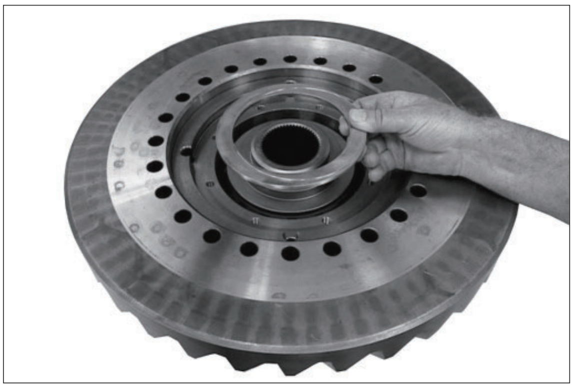
7809AX95

⑦ Loosen hexagon screws and remove the releasing disk.



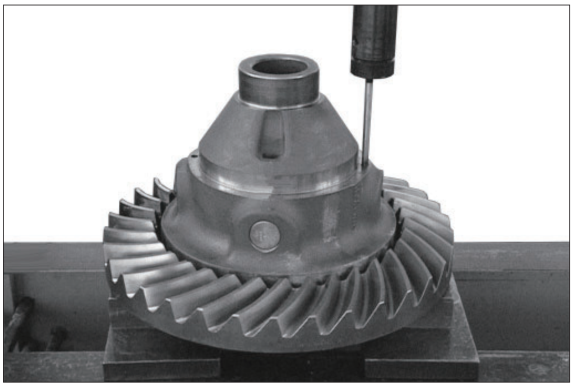
7809AX96

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



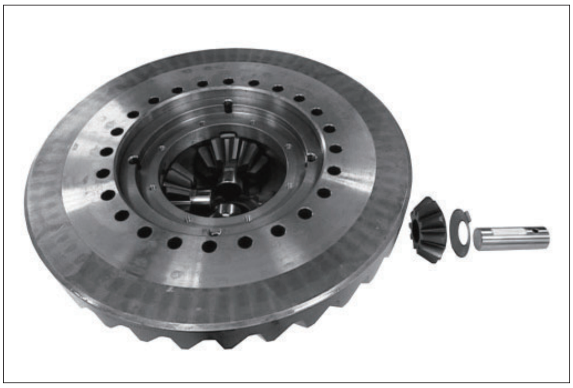
7809AX97

⑨ Force out slotted pins (4EA).



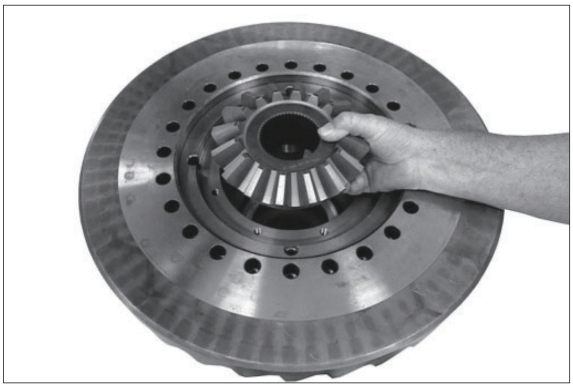
7809AX98

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



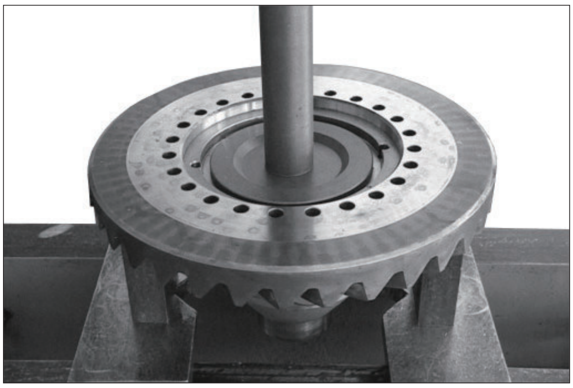
7809AX99

⑪ Remove the axle bevel gears and the shims behind.



7809AX100

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



7809AX101

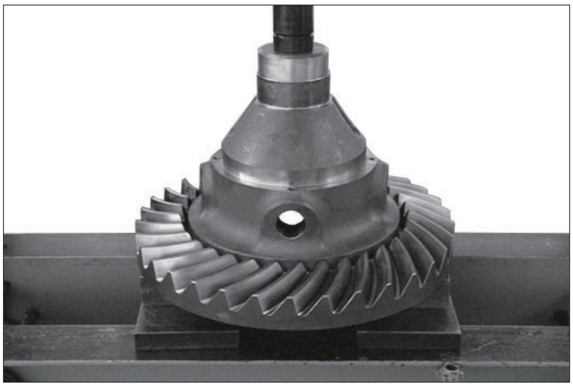
2) ASSEHBY

(1) Assembly differentials

Assembly multi-disk differential lock

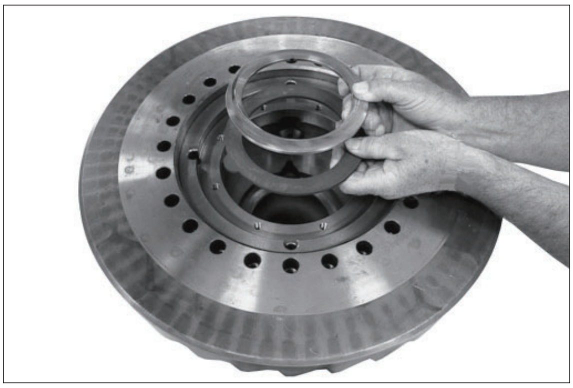
① Mount two adjusting screws and press the heated crown wheel onto the differential housing until contact is obtained.

Adjusting screws 5871 204 040



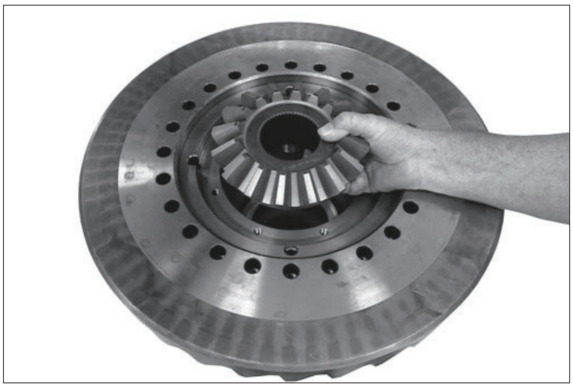
7809AX102

② Insert disk and thrust washer into the differential housing



7809AX103

③ Insert axle bevel gear.

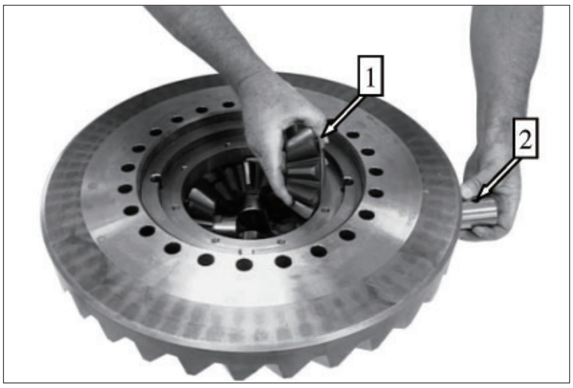


7809AX104

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.

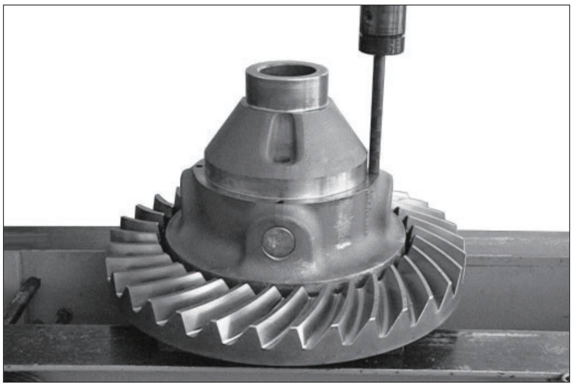
Pay attention to radial installation position of the spider shafts (fixing holes, arrow 2).



7809AX105

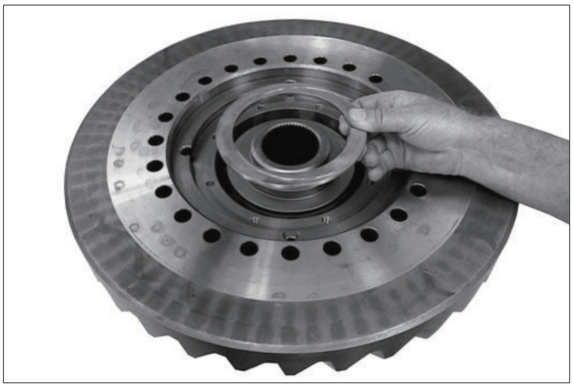
⑤ Fix spider shafts with slotted pins (2 pieces / hole).

※ Press the slotted pins with 180° offset openings into flush position.



7809AX106

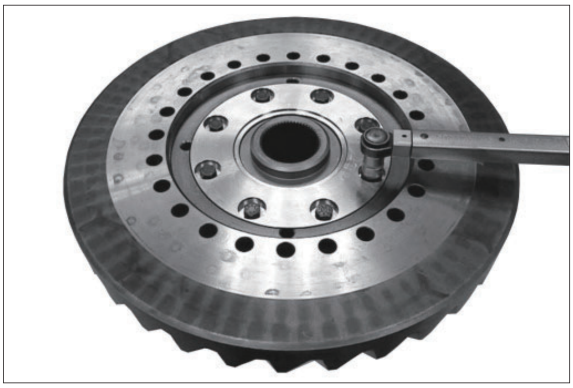
⑥ Mount second axle bevel gear and thrust washer.



7809AX107

⑦ Mount disk and fix it with hexagon screws.

· Tightening torque (M10/10.9) :
5.1 kgf · m (36.9 lbf · ft)

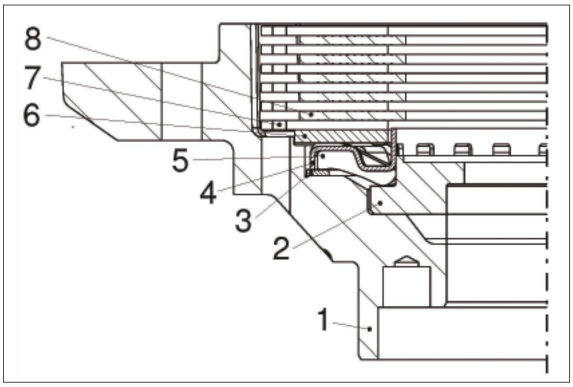


7809AX108

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

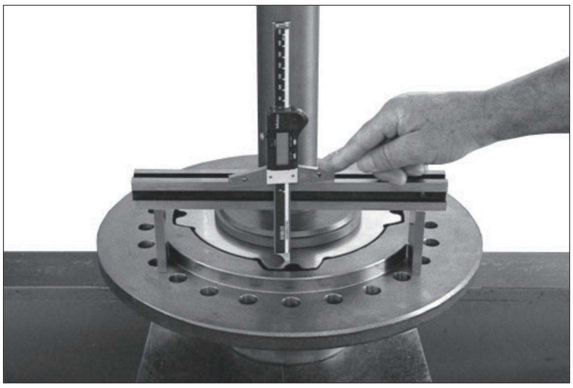


7809AX109

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

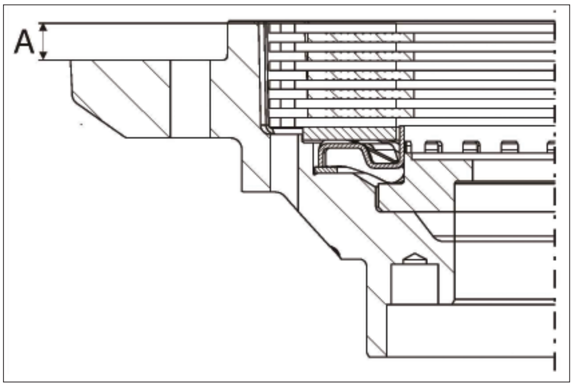
Then check the **setting dimension A = 15.5 $_{-0.2}$ mm** from the mounting face of the differential cover to the plane face of the outer disk (see also below sketch).

※ 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

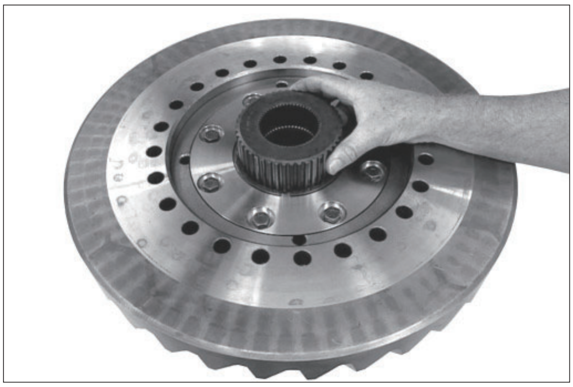


7809AX111

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.

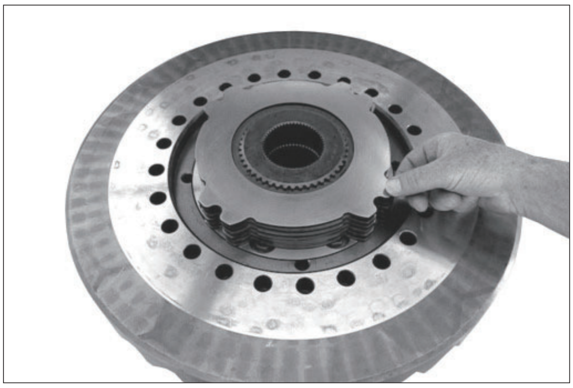


7809AX113

⑫ Mount outer and inner disks.

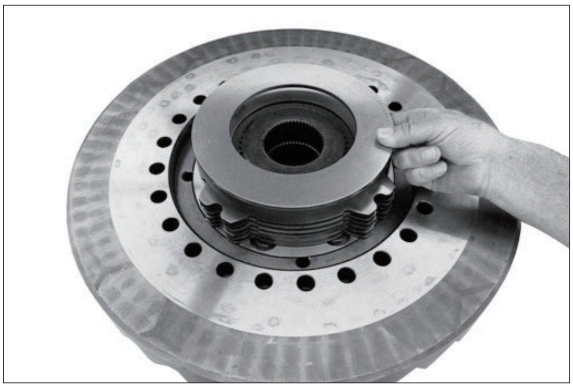
※ For the number of disks and disk arrangement please refer to the parts manual.

※ Pay attention to the radial installation position of the disk package, as shown on the adjacent figure.



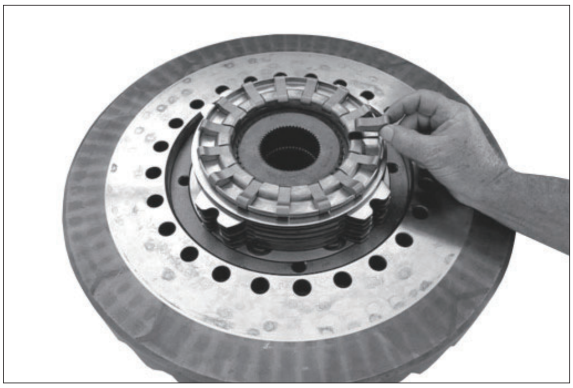
7809AX114

⑬ Insert end plate.



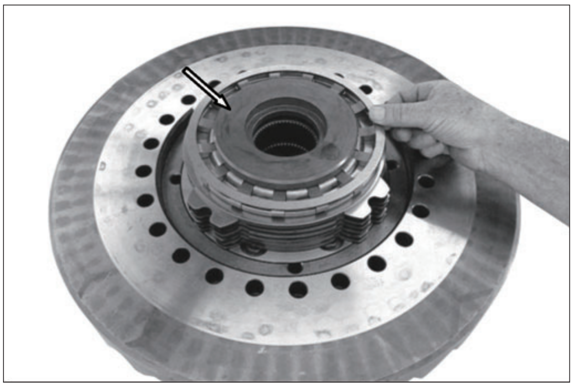
7809AX115

⑭ Mount cage and lever (15EA).



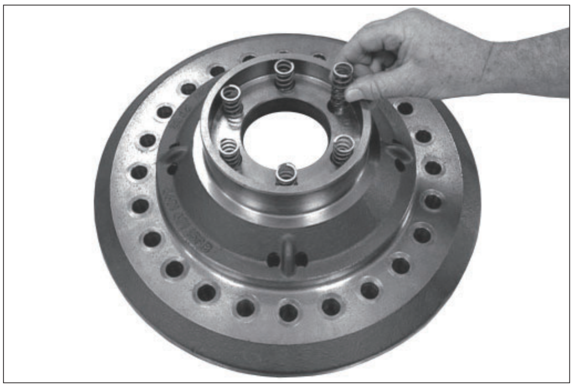
7809AX116

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



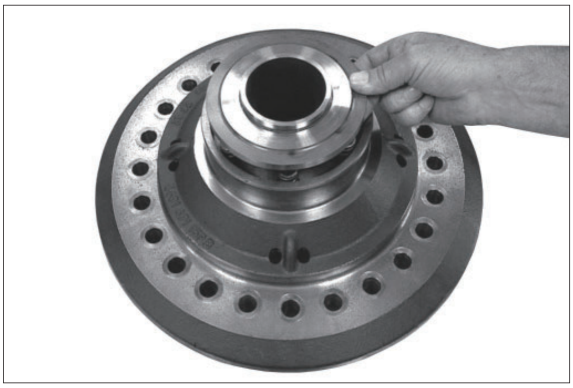
7809AX117

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



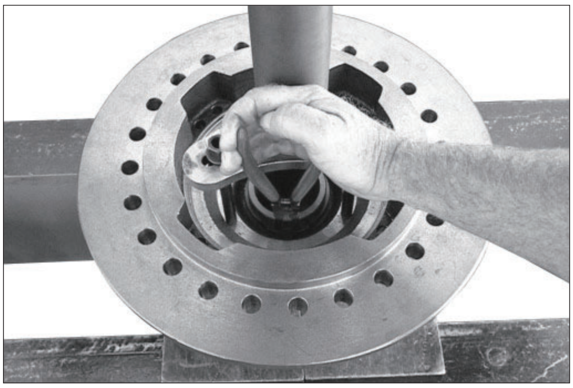
7809AX118

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

⑲ Mount two adjusting screws and insert the differential cover by means of the lifting device.

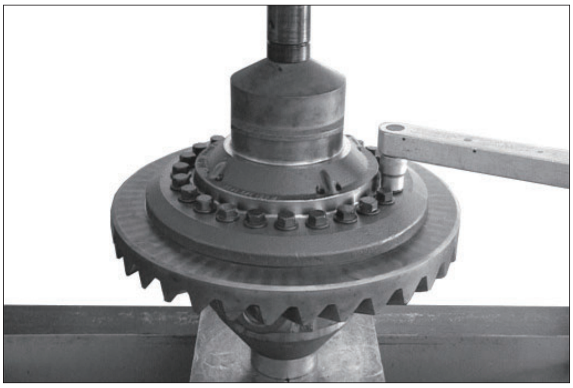
Adjusting screws	5870 204 040
Inner extractor	5870 300 008
Eye nut	AA00 680 376

7809AX121

⑳ 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)

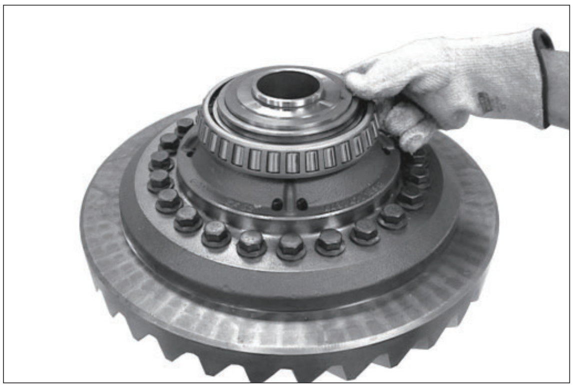
Pressure piece	AA00 694 360



7809AX122

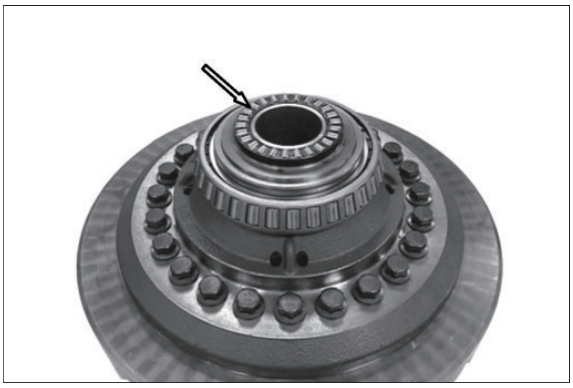
㉑ Heat both tapered roller bearings and insert until contact is obtained.

※ Adjust tapered roller bearing after cooling down.



7809AX123

㉒ Insert axial roller cage (see arrow).



7809AX124

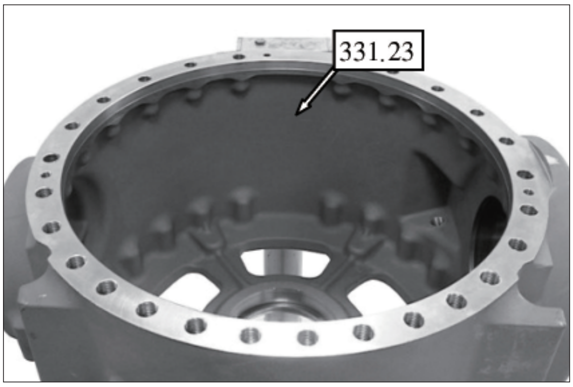
(2) Assembly axle drive housing

※ 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

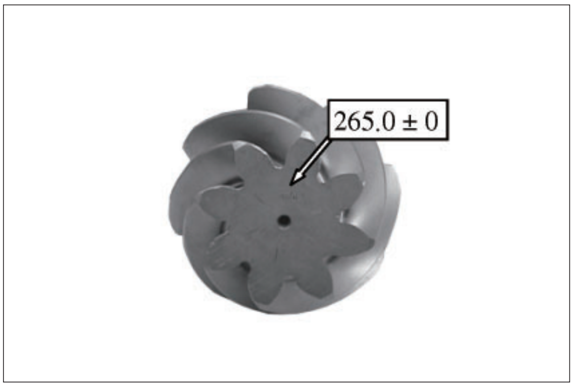
※ The following measuring procedures must be carried out with utmost accuracy.
Inaccurate measurements lead to an incorrect contact pattern requiring an additional disassembly and reassembly of input pinion and differential.

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 :

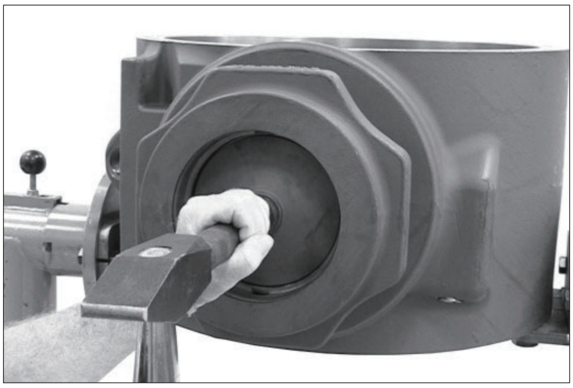
Dimension I	331.25 mm
Dimension II	- 265.00 mm
Dimension III	- 63.60 mm
Difference = shim	s = 2.60 mm

7809AX127

Reassembly of input pinion

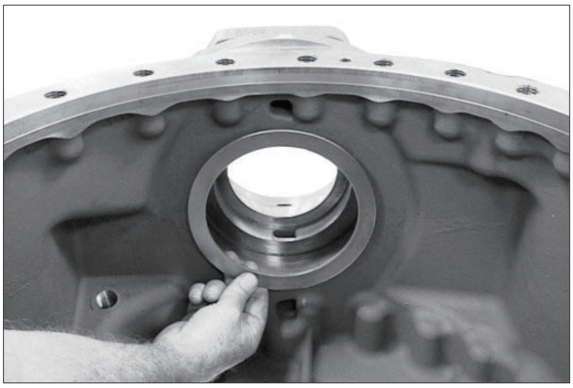
① Undercool the external bearing outer ring and insert it into the axle drive housing until contact is obtained.

Driver tool	5870 050 007
Handle	5870 260 004



7809AX128

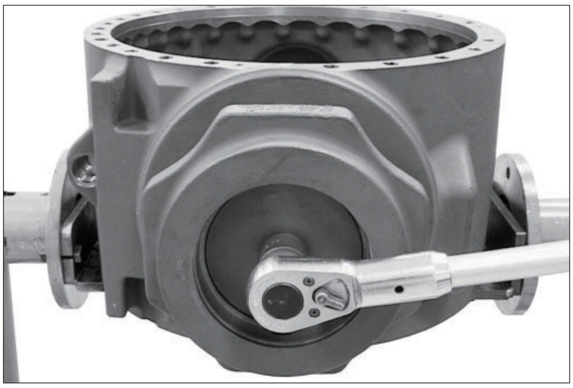
② Insert the determined shim e.g. s = 2.60 mm into the housing hole.



7809AX129

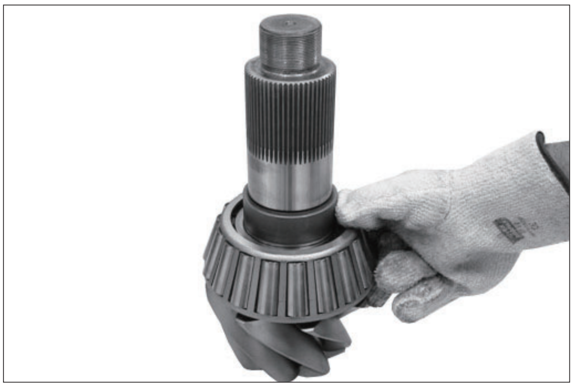
③ Undercool the internal bearing outer ring and bring it into contact position in the housing hole by using the assembly fixture.

Assembly fixture	AA00 623 955



7809AX130

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

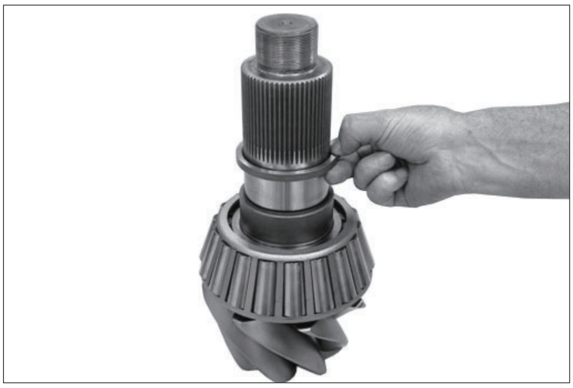


7809AX131

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

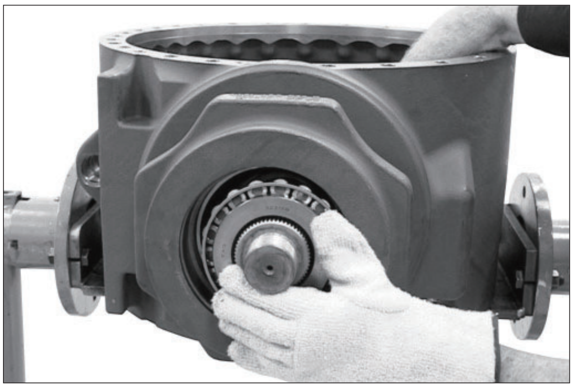
⑤ Insert spacer (e.g. s = 7.13 mm).

※ 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

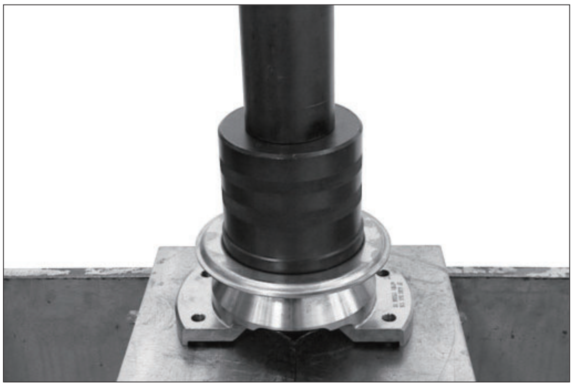
⑥ Insert the preassembled input pinion into the axle drive housing and insert the heated tapered roller bearing until contact is obtained.



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

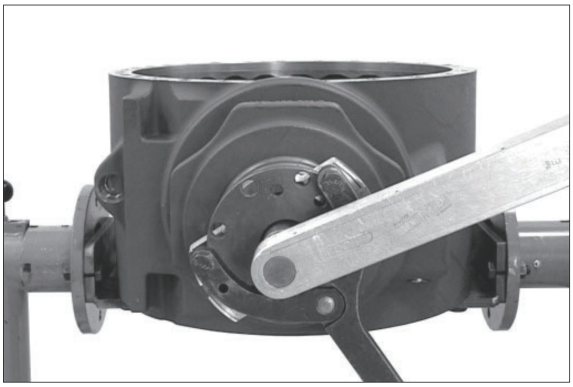
⑧ Insert input flange and fix it by means of disk and slotted nut.

· 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.

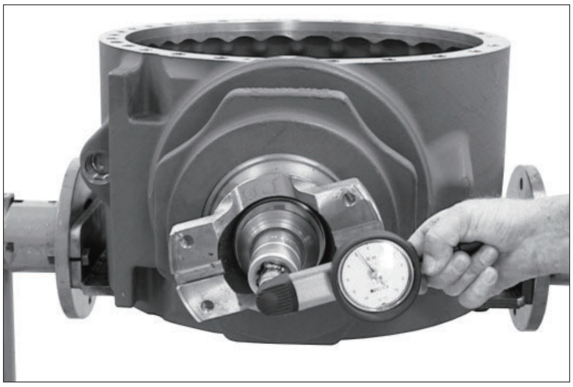


7809AX135

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.

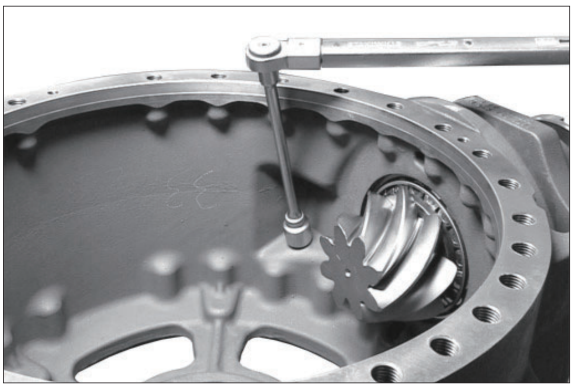
※ In case of deviations from the necessary rolling torque correct with a corresponding spacer (figure AX132) as specified below.
Insufficient rolling torque - install thinner spacer ring.
Excessive rolling torque - install thicker spacer ring.



7809AX136

⑩ Mount threaded connection.

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



7809AX137

⑪ Mount oil tube.

· Tightening torque :

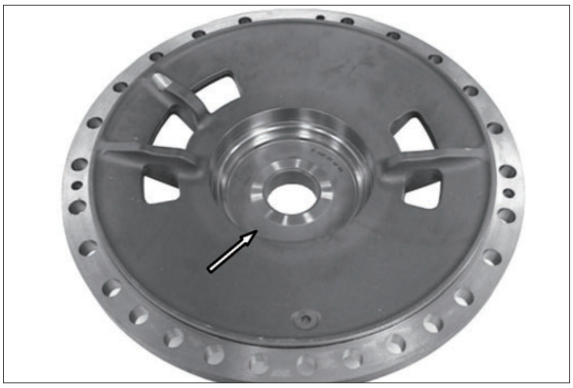
10.2 kgf · m (73.8 lbf · ft)

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)

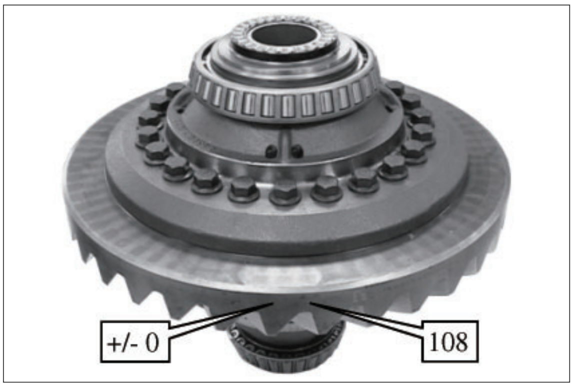
※ Determine the required shims on the basis of the read value (deviation/test dimension) and the corresponding specifications of the table below: (KRS – SET – RIGHT) (KRS = bevel gear set):

① Deviation see crown wheel rear side.

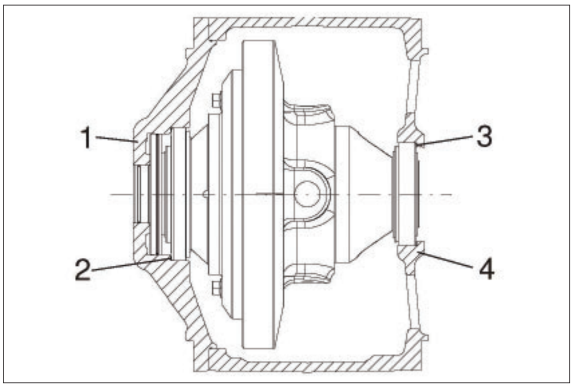
The test dimension 108 is stamped into the crown wheel rear side. If no + or – deviation is indicated, this value corresponds to the actual value 0 in the table below. According to this value, the required shims are allocated in the table below.

※ 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.

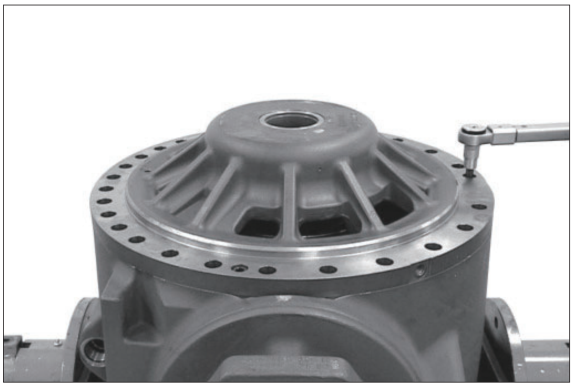
Inner extractor	5870 300 008
Eye nut	AA00 680 376

※ 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)

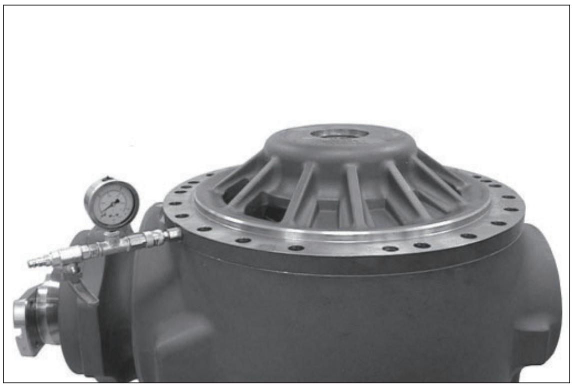


7809AX147

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

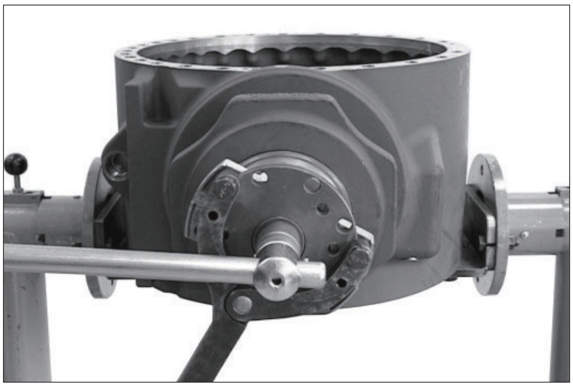
⑨ After the contact pattern check insert the differential again into the axle drive housing.

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



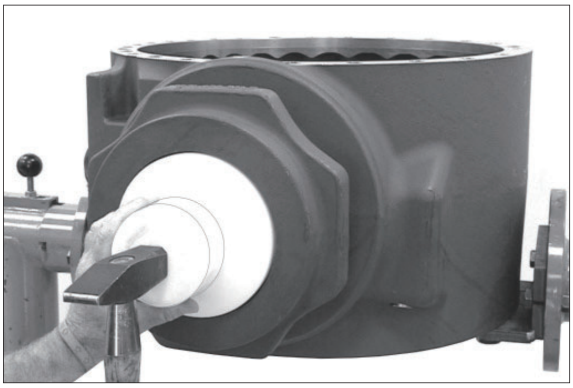
7809AX151

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

Driver tool	AA00 623 986

※ 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.



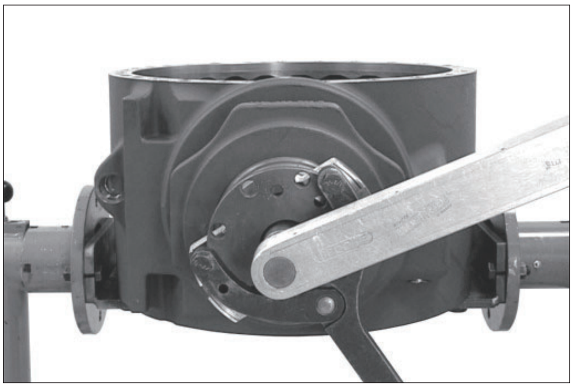
7809AX152

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.



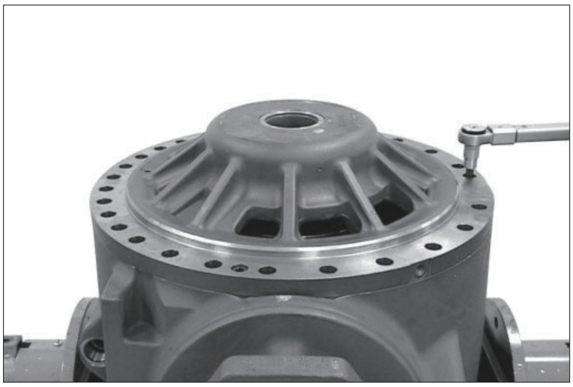
7809AX153

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

7809AX154

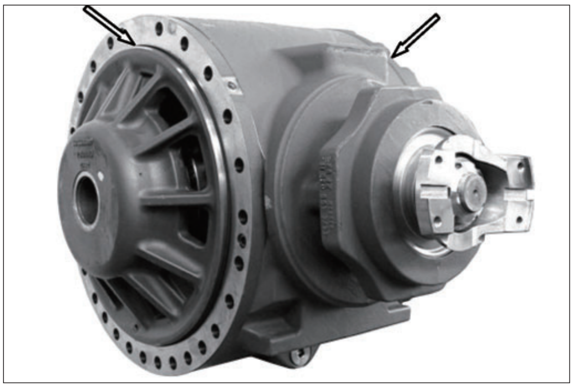
⑭ Insert the bearing housing by means of the lifting device and finally tighten it with cylindrical screws.

· 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.

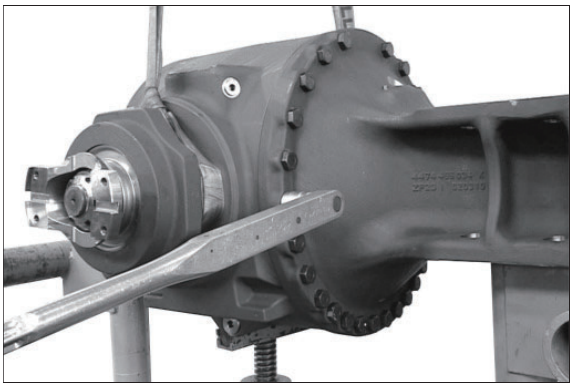


7809AX156

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



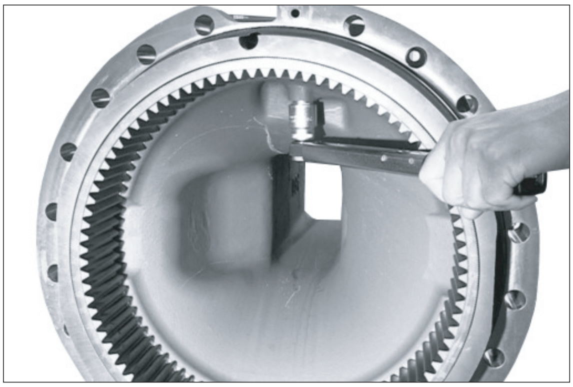
7809AX157

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

(3) Assembly axle housing

① Mount both fittings.

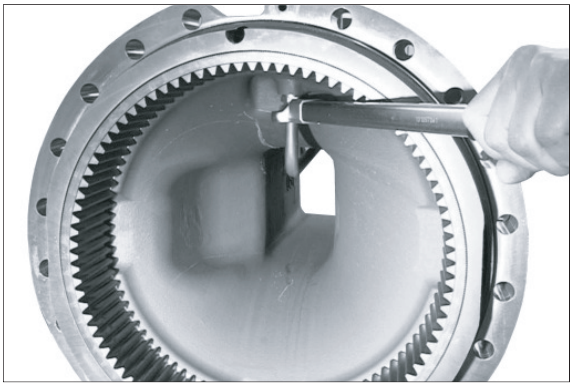
· Tightening torque : 3.67 kgf · m (26.6 lbf · ft)



7809AX158

② Mount brake tube.

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



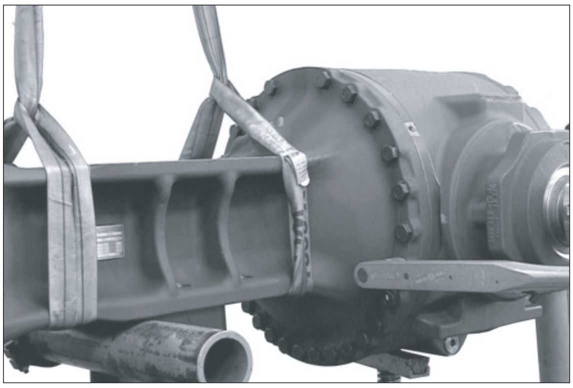
7809AX159

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.



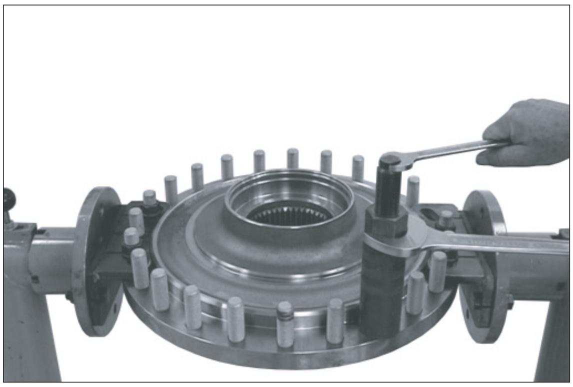
7809AX160

(4) Aeassembly output and brake

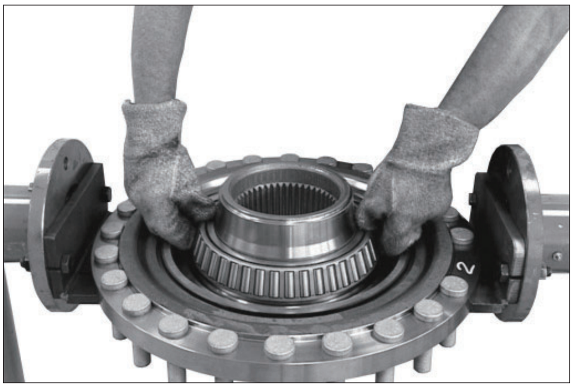
① Pull in wheel stud into the output shaft until contact is obtained.

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

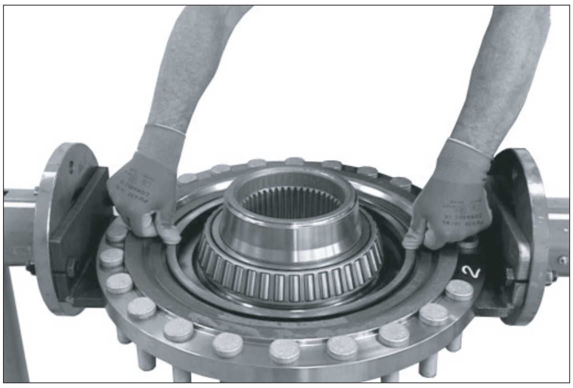
② Heat tapered roller bearing and insert it into the output shaft until contact is obtained.


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.

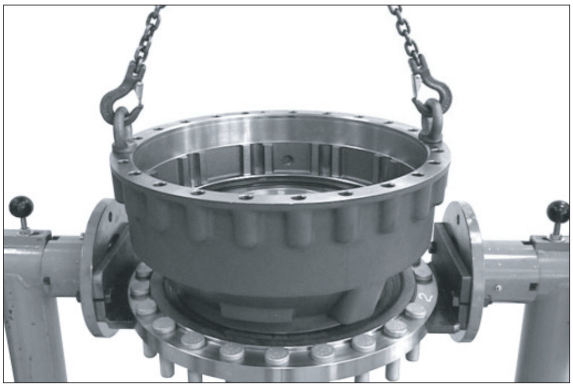
※ The surface of the slide ring seal may not have any grooves, scratches or other types of damage. Take care that the sealing surface is parallel to the housing face.
The O-rings must be mounted evenly into the locating hole and must not bulge out of the hole. Risk of injury - Metal rings have extremely 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.

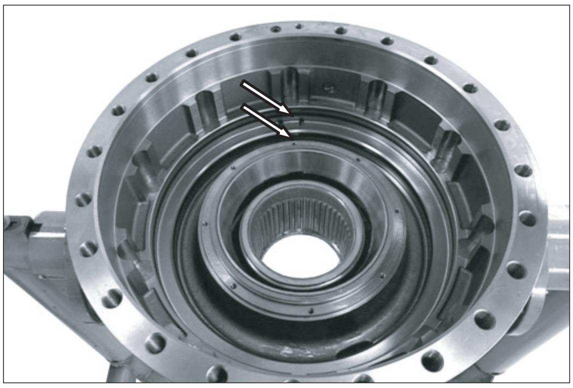
※ Before clamping the seal rings to installation dimension, clean the sliding surfaces and apply an oil film. We recommend to use a leather cloth soaked with oil.



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.

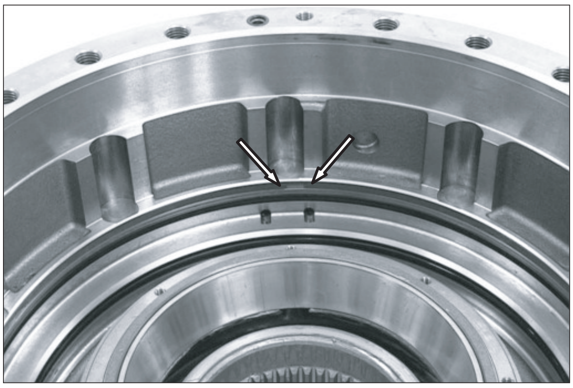


7809AX32

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.

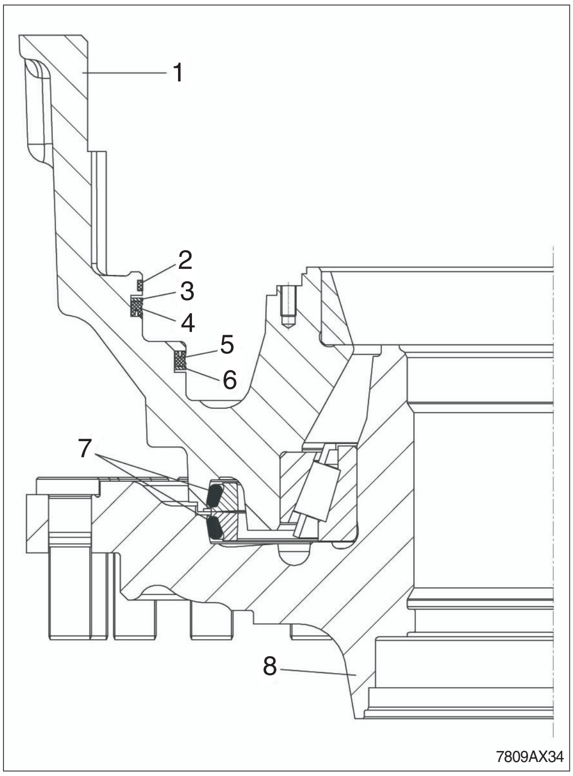
※ Upon installation the orifice of the guide ring must show upwards (12 o'clock).



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

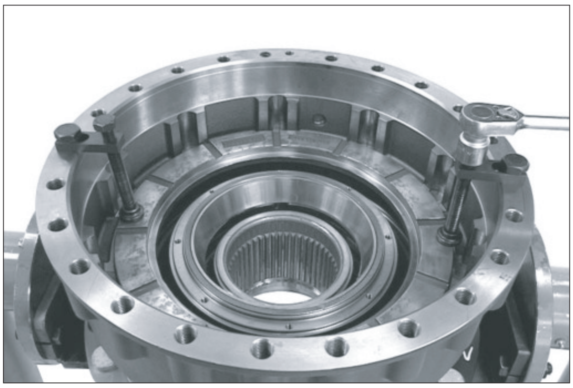


7809AX34

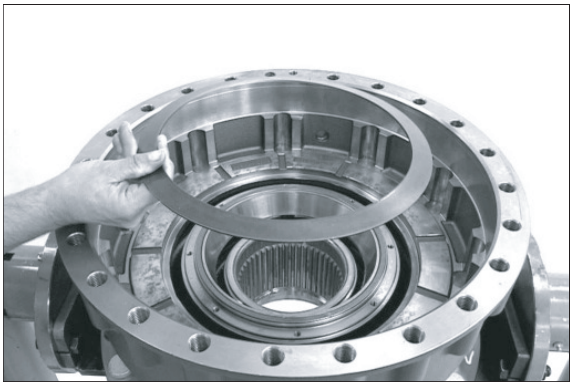
⑥ Insert the piston into the brake housing and carefully install with the fixing device until contact is obtained.

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).

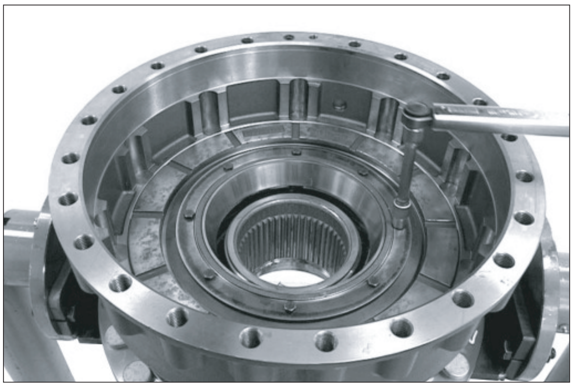

7809AX35

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


7809AX36

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

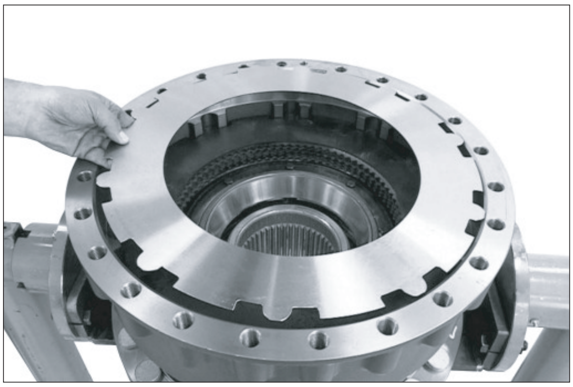
· Tightening torque (M8/10.9) :
3.47 kgf · m (25.1 lbf · ft)



7809AX37

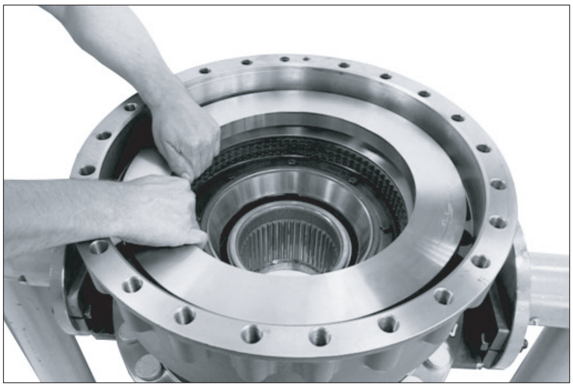
⑨ Mount outer and inner disks.

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



7809AX38

⑩ Insert end plate.



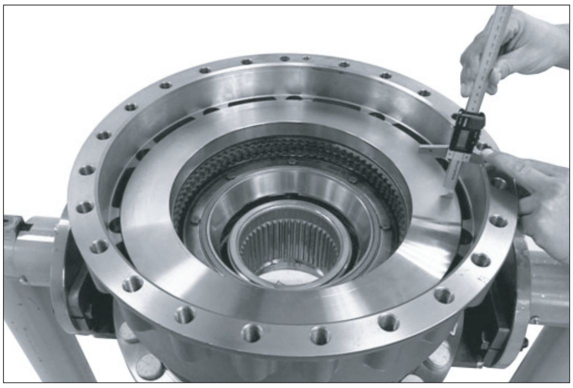
7809AX39

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).

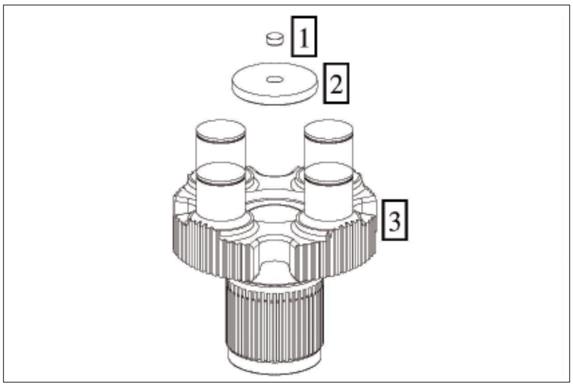


7809AX40

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

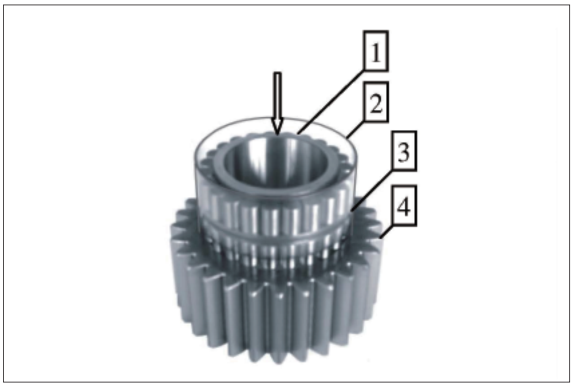


7809AX161

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

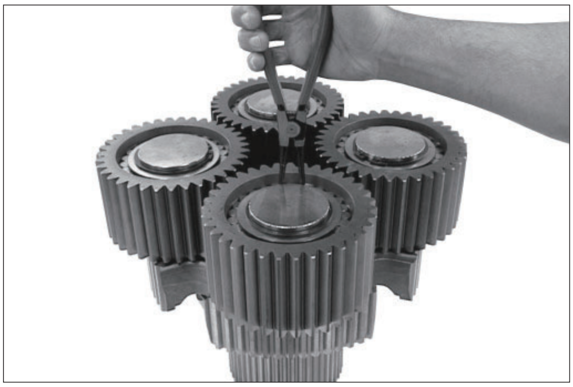


7809AX162

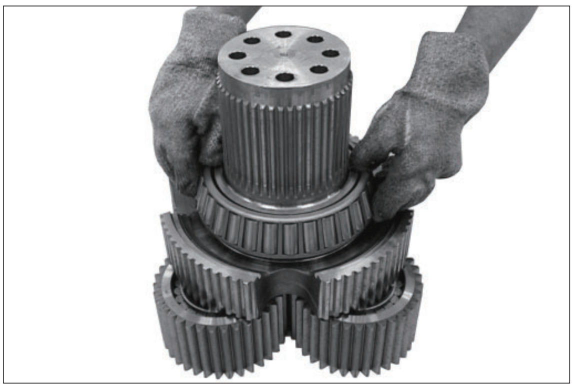
⑭ Heat bearing inner rings and insert the premounted planetary gears with large radius facing the planetary carrier (downwards) until contact is obtained.

※ Adjust bearing inner rings after cooling down.

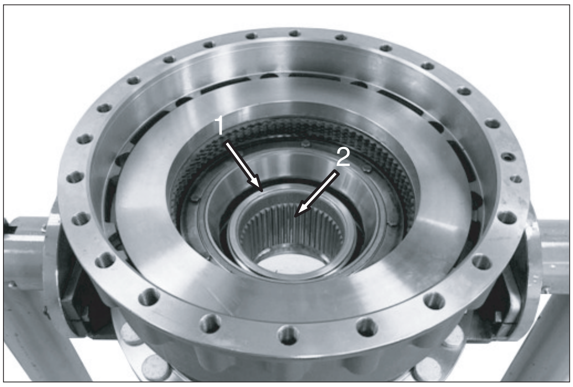
Then fix planetary gears by means of retaining rings.


7809AX163

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


7809AX164

⑯ Wet front face (contact face bearing inner ring, arrow 1) and profile (teeth, arrow 1) in the output shaft with anti-corrosive agent.



7809AX41

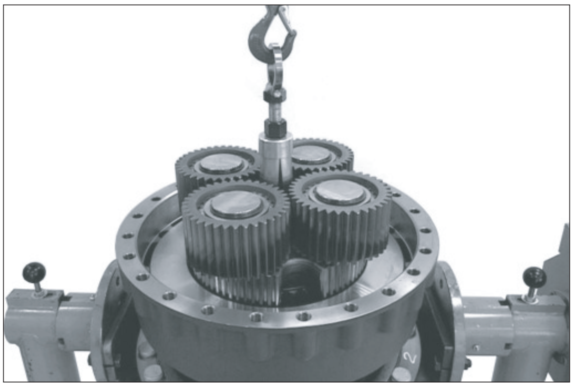
⑰ Align disk package centrally and radially. Then insert the planetary carrier by means of the lifting device into the teeth of the output shaft until contact is obtained.

· Rear axle (planetary carrier with 3 planetary gears)

Inner extractor	5870 300 019
Eye bolt	5870 204 073

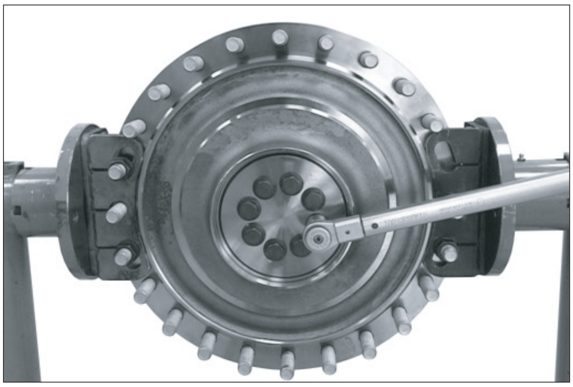
· Front axle (planetary carrier with 4 planetary gears)

Inner extractor	5870 300 008
Eye nut	AA00 680 376


7809AX42

⑱ Pivot output 90°.
Insert disk and fix planetary carrier with new locking screws.

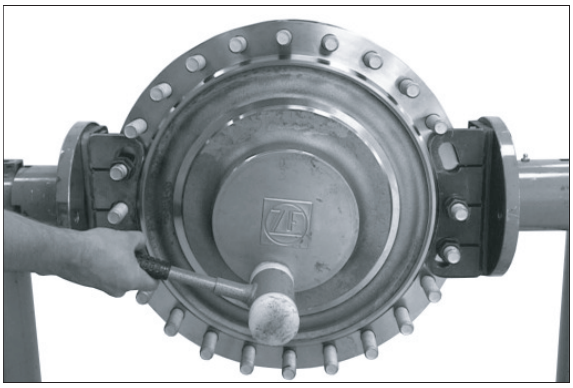
※ Tighten locking screws successively with a tightening torque of 20.4 kgf · m (147.5 lbf · ft).
Then retighten the locking screws successively with a tightening torque of 51 kgf · m (369 lbf · ft).


7809AX43

⑲ Install O-ring (see arrow) to the cover.

7809AX44

⑳ Insert the cover into the output shaft until contact is obtained.



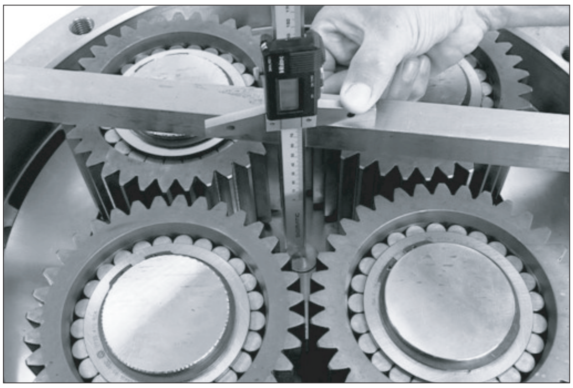
7809AX45

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

⑳ 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

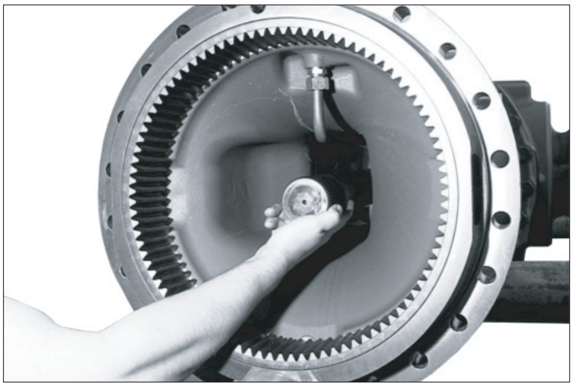
Gauge blocks	5870 200 066
Straightedge	5870 200 022



7809AX46

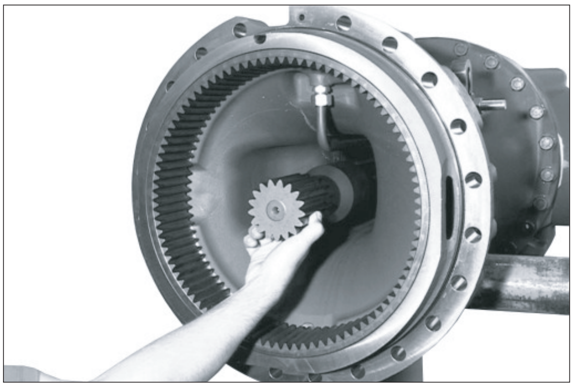
㉑ Insert stub shaft into the teeth of the axle bevel gear until contact is obtained.

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



7809AX47

㉒ Insert the sun gear shaft until contact is obtained.



7809AX48

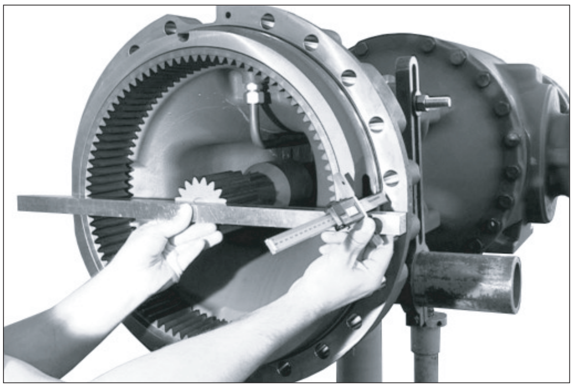
㉓ Measure dimension II, from the front face of the sun gear shaft to the mounting surface of the axle housing.

Dimension II e.g. . . . . 56.60 mm

Straightedge 5870 200 022

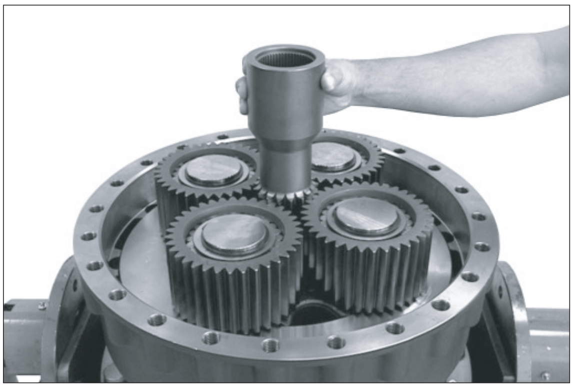
Calculation example :

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



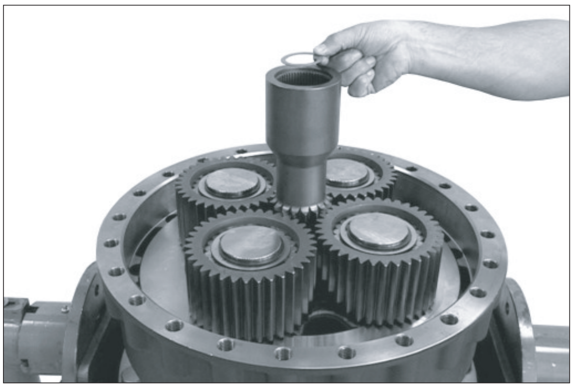
7809AX49

㉔ Insert sun gear shaft into the planetary carrier.



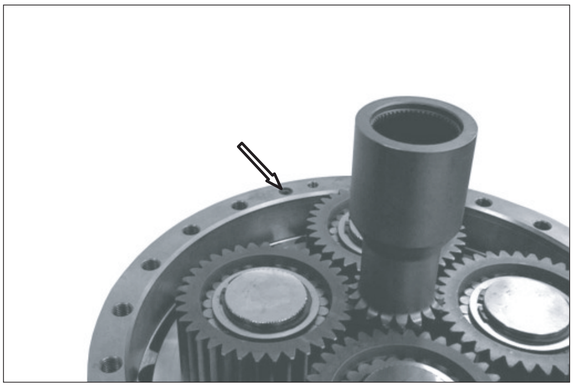
7809AX50

㉕ Fix determined shim e.g. s = 1.00 mm with grease into the sun gear shaft.



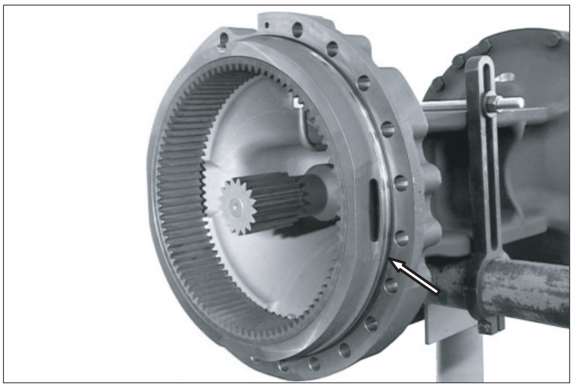
7809AX51

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.



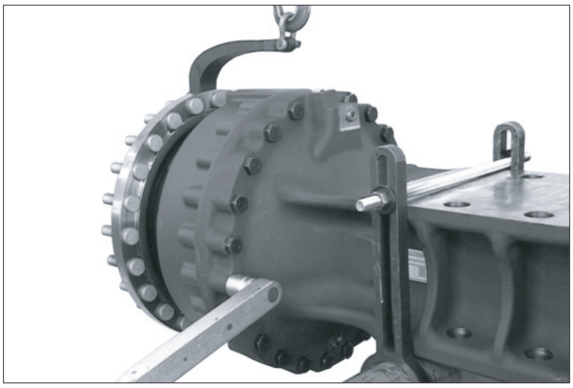
7809AX53

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)

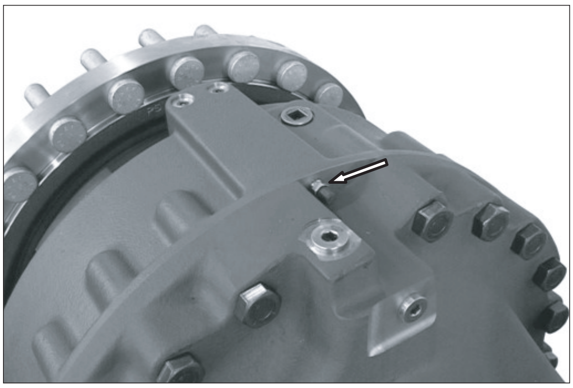
Adjusting screws (M20)	5870 204 024
Load-carrying device	AA00 685 875

※ Fix load carrying device with wheel stud.



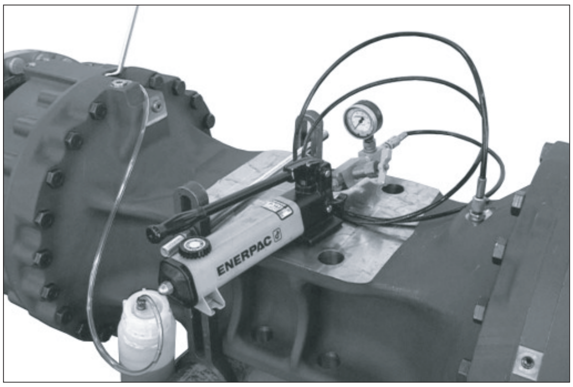
7809AX54

㉙ Mount breather (see arrow).



7809AX55

⑶ Check brake hydraulics for leakages.



7809AX56

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

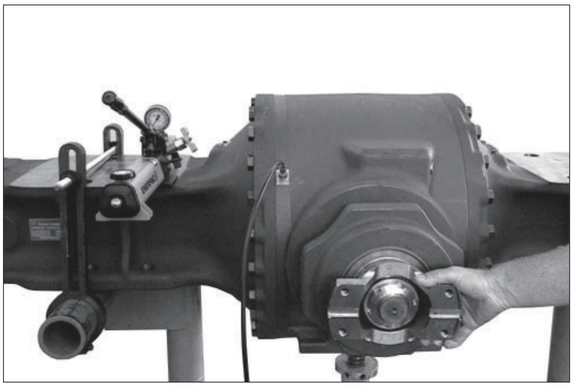
High-pressure test :
Build up test pressure p = 100_{-10} bar max. and close connection to HP pump via shut-off valve.
A pressure drop of max. 2 % (2 bar) is permissible during a 5 minute testing time.

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

⑶ Check operability of differential hydraulic lock


7809AX165

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.