

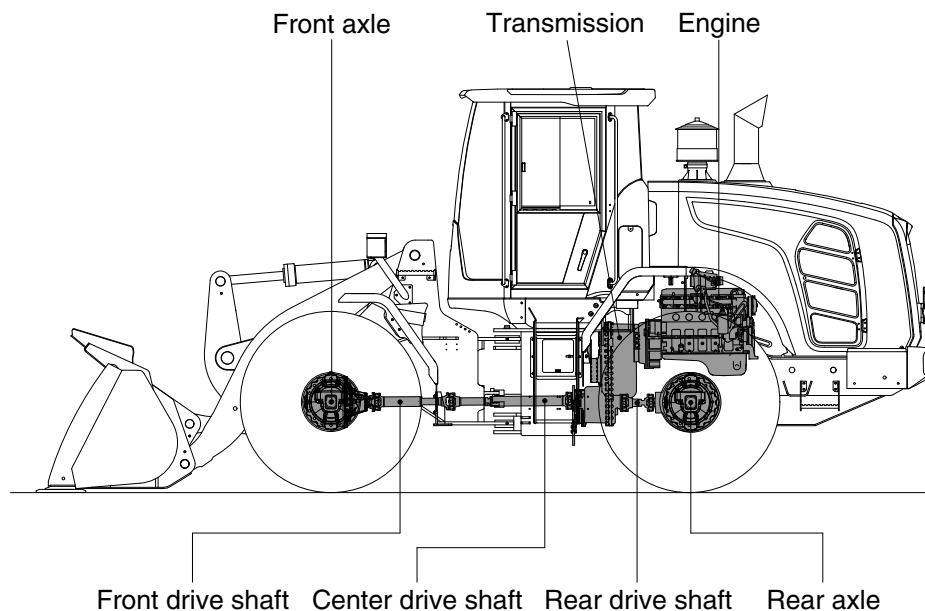
SECTION 3 POWER TRAIN SYSTEM

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SECTION 3 POWER TRAIN SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. POWER TRAIN COMPONENT OVERVIEW



940F3PT01

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.

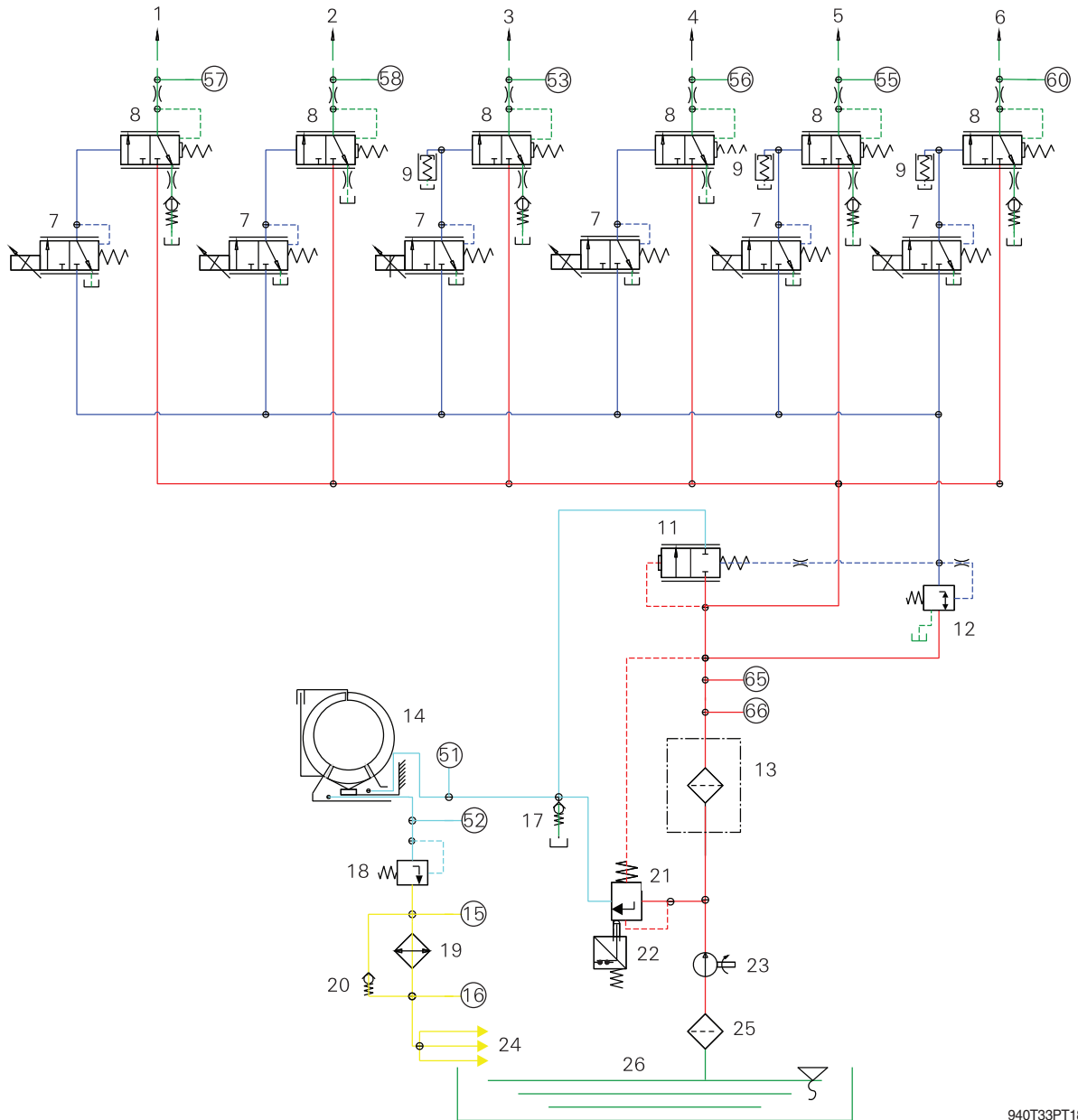
The transmission is a hydraulically engaged four speed forward, three speed reverse countershaft type power shift transmission. A calliper-disc type parking brake is located on the transmission.

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 conventional differential as standard (option : Limited slip differential). The rear axle is equipped with conventional differential as standard (option : Limited slip differential). The rear axle is mounted on an oscillating pivot.






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

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

HYDRAULIC CIRCUIT



940T33PT18

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

Positions 15, 16, 51, 52, 53, 55, 56, 57, 58, 60, 65, 66 correspond to the numbers on the installation drawing.

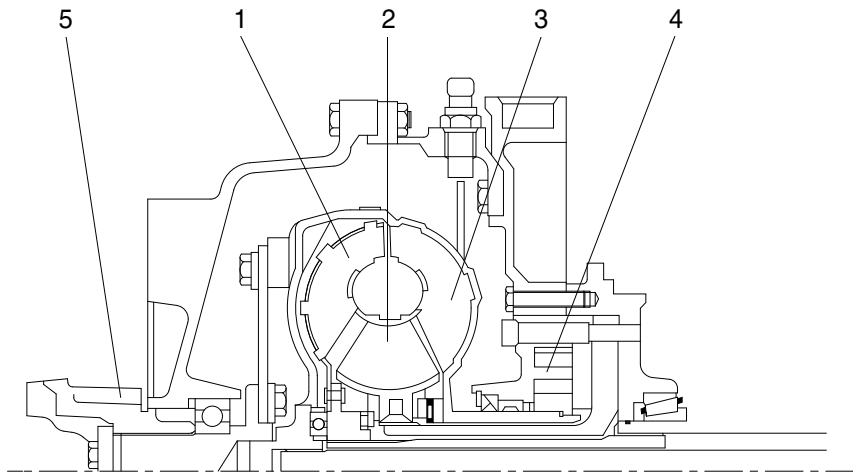
- | | |
|---|---|
| 1 Clutch K2 | 2 Clutch K3 |
| 3 Clutch KV (clutch forward) | 4 Clutch K1 |
| 5 Clutch KR (clutch reverse) | 6 Clutch K4 |
| 7 Pilot valve | 8 Downstream valve |
| 9 Damper piston | |
| 11 Main pressure valve | 12 Pressure reduction valve |
| 13 Transmission pressure filter | 14 Converter |
| 15 Connection of pressure oil to oil cooler | 16 Connection of pressure oil from oil cooler |
| 17 Converter safety valve | 18 Converter counter-pressure valve |
| 19 Oil cooler | 20 Oil cooler bypass valve |
| 21 Filter bypass valve | 22 Filter bypass switch |
| 23 Transmission pump | 24 Lubrication |
| 25 Suction filter | 26 Tank |
| 51 Measuring point of oil pressure before converter | 52 Temperature sensor for oil temperature after the converter |
| 53 Measuring point of clutch pressure KV | 55 Measuring point of clutch pressure KR |
| 56 Measuring point of clutch pressure K1 | 57 Measuring point of clutch pressure K2 |
| 58 Measuring point of clutch pressure K3 | 60 Measuring point of clutch pressure K4 |
| 65 Measuring point of system pressure | |
| 66 Temperature sensor for sump temperature | |

Assignment of clutch and solenoid valve

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

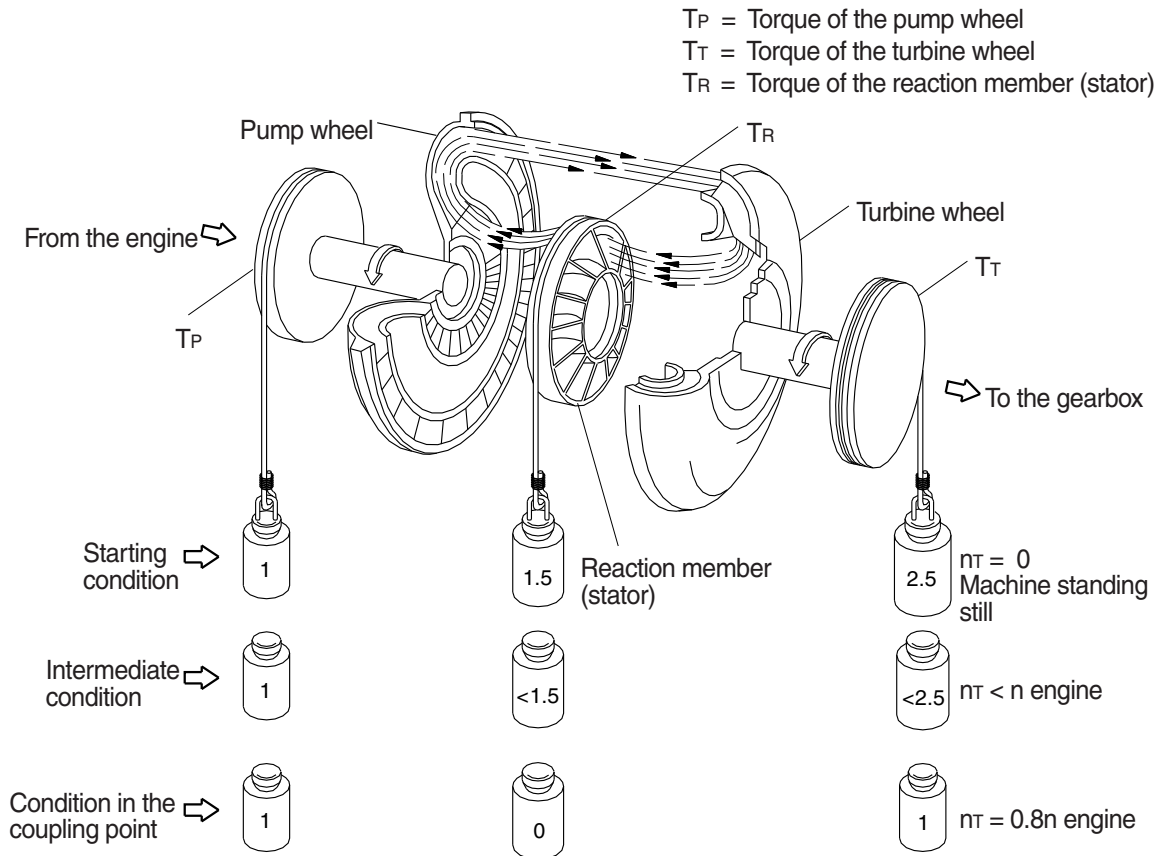
Therefore, the maximum torque multiplication is created at stationary turbine wheel.

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.

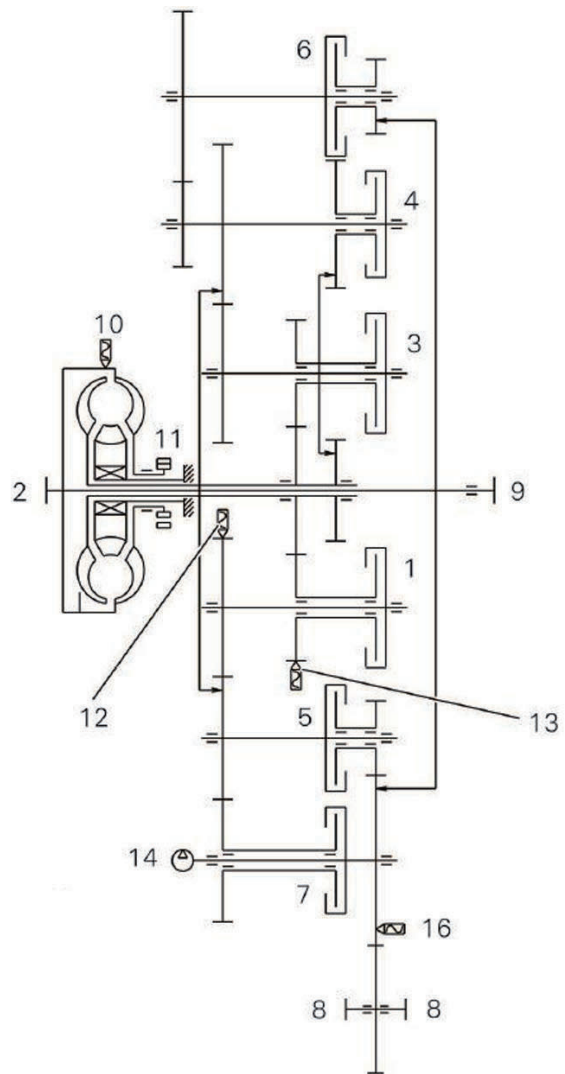
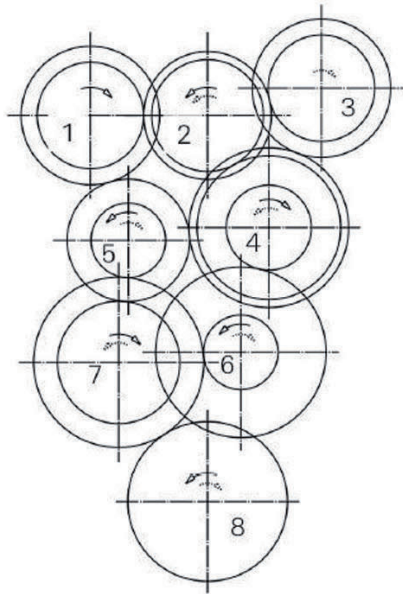
Function of a hydrodynamic torque converter (schematic view)



7577APT100

3. TRANSMISSION

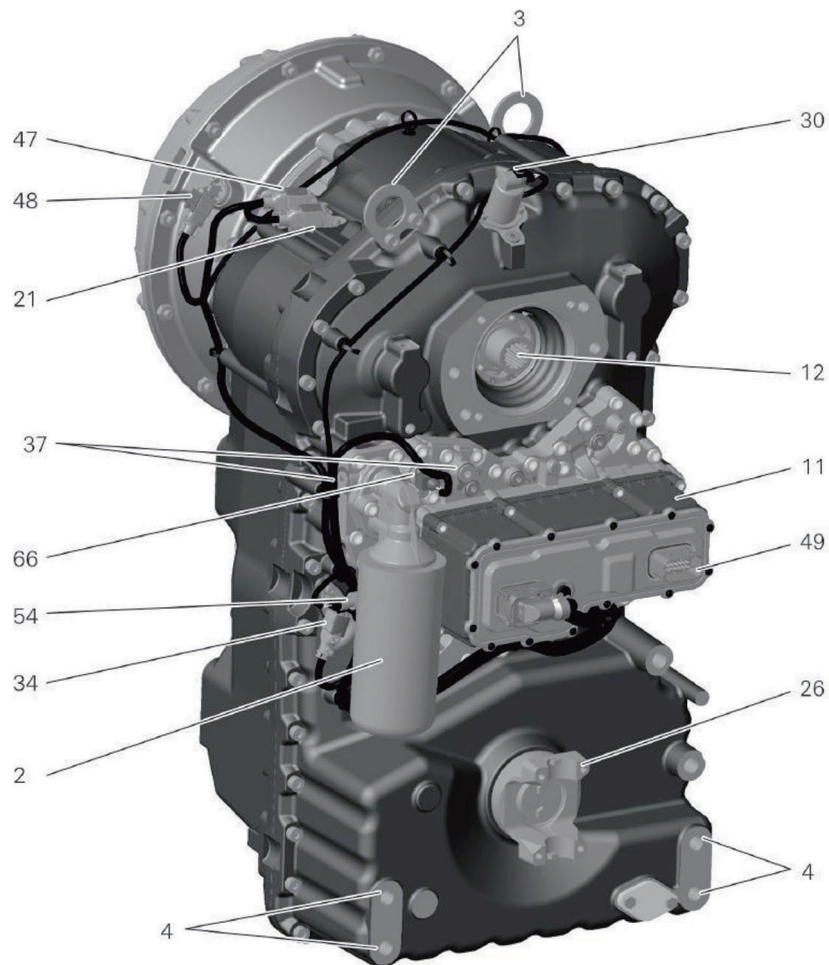
1) DIAGRAM



940T33PT10

- | | | | |
|----|------------------------------------|----|--|
| 1 | Clutch KV (clutch forward) | 2 | Input |
| 3 | Clutch KR (clutch reverse) | 4 | Clutch K4 |
| 5 | Clutch K2 | 6 | Clutch K1 |
| 7 | Clutch K3 | 8 | Output |
| 9 | Engine-dependent PTO | 10 | Inductive sensor for engine speed |
| 11 | Pump | 12 | Inductive sensor for speed of central gear chain |
| 13 | Inductive sensor for turbine speed | 16 | Speed sensor for output speed |
| 14 | Emergency steering pump (optional) | | |

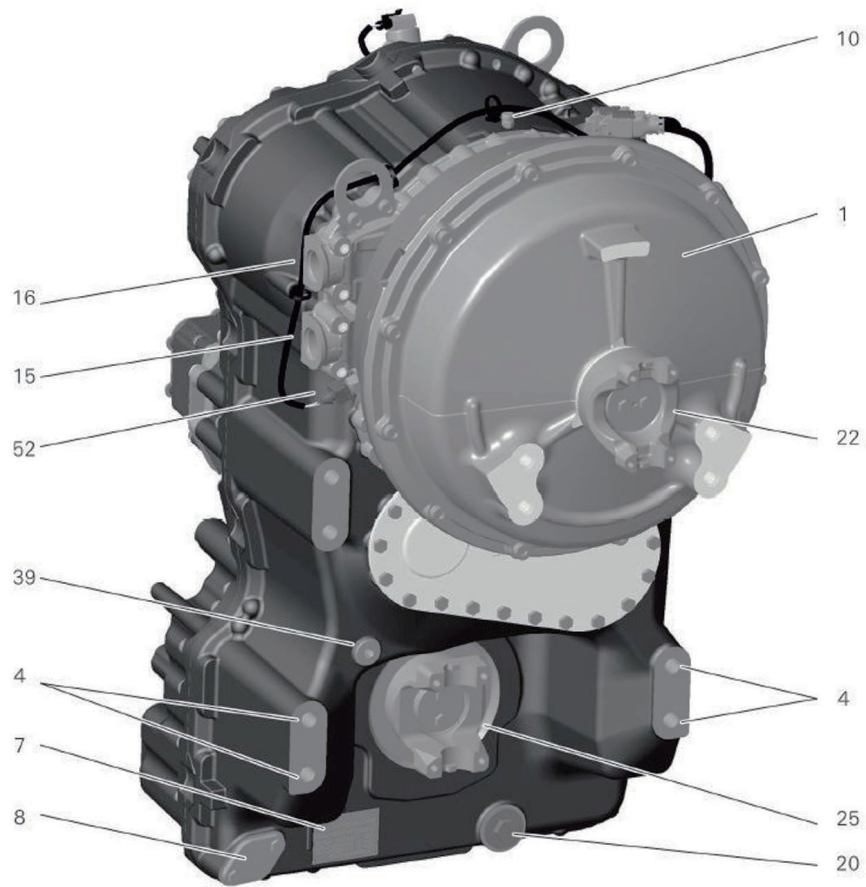
2) INSTALLATION VIEW



940T33PT11

- | | | | |
|----|---|----|--|
| 2 | Full flow filter | 37 | System pressure connection M16 x 1.511 |
| 3 | Lifting eye | 47 | Speed sensor for speed/central gear hain |
| 4 | Transmission suspension holes | 48 | Speed sensor for engine speed |
| 11 | Electrohydraulic transmission control unit | 49 | Plug connection for machine connector |
| 12 | PTO coaxial, engine-dependent | 54 | Differential pressure switch for pressure filter |
| 21 | Speed sensor for turbine speed | 66 | Temperature sensor for sump temperature |
| 26 | Output flange | | |
| 30 | Solenoid valve for torque converter lock-up clutch (not used) | | |

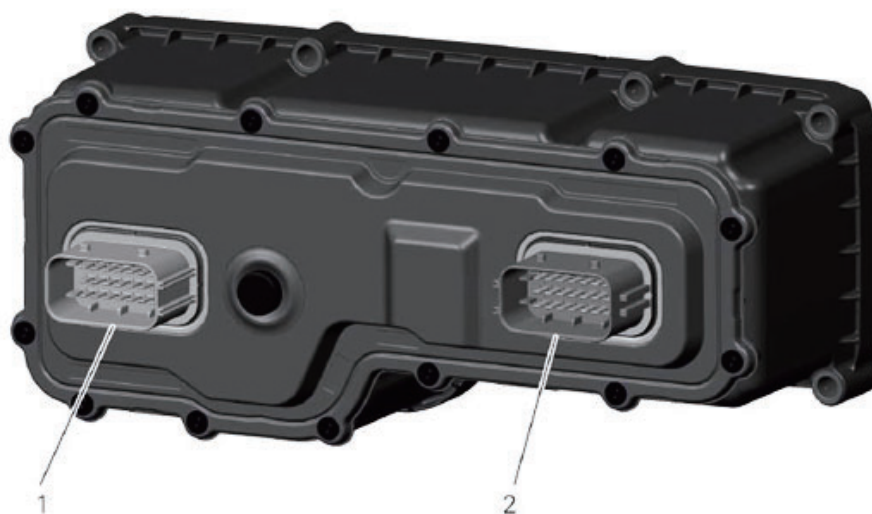
INSTALLATION VIEW



940T33PT12

- | | | | |
|----|--------------------------------------|----|---|
| 1 | Converter | 16 | Connection from oil cooler |
| 4 | Transmission suspension holes | 20 | Oil drain plug M38 x 1.5 (tightening torque : 80 Nm) |
| 7 | Name plate | 22 | Input flange |
| 8 | Connection for oil level measurement | 25 | Output flange |
| 10 | Breather | 39 | Connection of return flow to sump |
| 15 | Connection to oil cooler | | |

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 wiring 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 a screwdriver or similar tool. Do not damage the detents on the plug.

4. FAULT CODE

1-1) MACHINE FAULT CODE

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

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

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

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 - forward switch error |
| 2322 | 2 | Steering joystick - neutral switch error |
| 2323 | 2 | Steering joystick - reverse switch error |
| 2324 | 2 | Steering joystick - kick down switch error |
| 2325 | 2 | Steering joystick - steering on switch error |
| 2326 | 5 | PVE coil power current below normal or open circuit |
| 2326 | 6 | PVE coil power current above normal or grounded circuit |
| 2327 | 0 | PVE coil PWM duty cycle input value above normal operation range |
| 2327 | 1 | PVE coil PWM duty cycle input value below normal operation range |
| 2327 | 5 | PVE coil PWM duty cycle current below normal or open circuit |
| 2327 | 6 | PVE coil PWM duty cycle current above normal or grounded circuit |
| 2327 | 14 | PVE coil PWM duty cycle control block parameter invalid |
| 2311 | 2 | Boom joystick position signal error |
| 2311 | 0 | Boom joystick position input value above normal operation range |
| 2311 | 1 | Boom joystick position input value below normal operation range |
| 2311 | 3 | Boom joystick position input voltage above normal or shorted to high source |
| 2311 | 4 | Boom joystick position input voltage below normal or shorted to low source |
| 2311 | 13 | Boom joystick position control block out of calibration |
| 2311 | 14 | Boom joystick position control block parameter invalid |
| 2311 | 31 | Boom joystick position signal redundancy lost |
| 2313 | 2 | Bucket joystick position signal error |
| 2313 | 0 | Bucket joystick position input value above normal operation range |
| 2313 | 1 | Bucket joystick position input value below normal operation range |
| 2313 | 3 | Bucket joystick position input voltage above normal or shorted to high source |
| 2313 | 4 | Bucket joystick position input voltage below normal or shorted to low source |
| 2313 | 13 | Bucket joystick position control block out of calibration |
| 2313 | 14 | Bucket joystick position control block parameter invalid |
| 2313 | 31 | Bucket joystick position signal redundancy lost |
| 2315 | 2 | Aux joystick position signal error |
| 2315 | 0 | Aux joystick position input value above normal operation range |
| 2315 | 1 | Aux joystick position input value below normal operation range |

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

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

1-3) AAVM FAULT CODE

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

2) ENGINE FAULT CODE

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

| Fault code J1939 SPN J1939 FMI | Reason | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 2555 729 3 | Intake air heater 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at the intake air heater signal circuit. | The intake air heaters may be ON or OFF all the time. |
| 2556 729 4 | Intake air heater 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at the intake air heater signal circuit. | The intake air heaters may be ON or OFF all the time. |
| 2634 641 12 | VGT Actuator controller - Bad intelligent device or component. An internal error has been detected by the smart VGT controller. | Possible reduced engine performance. |
| 2636 641 9 | VGT Actuator driver circuit - abnormal update rate. No communications on the J1939 data link between the engine ECM and the smart VGT controller. | Possible reduced engine performance. |
| 2638 5298 17 | Aftertreatment diesel oxidation catalyst conversion efficiency - Data valid but below normal operating range - Least severe level. The temperature increase across the aftertreatment diesel oxidation catalyst is lower than expected. | Possible frequent need for aftertreatment regeneration. |
| 2639 3251 15 | Aftertreatment diesel particulate filter differential pressure - Data valid but above normal operating range - Least severe level. The soot load of the aftertreatment diesel particulate filter has exceeded the recommended limits. | Possible reduced engine performance. |
| 2646 110 32 | Engine coolant temperature - Condition exists. The EGR valve was closed to reduce engine coolant temperature. | Possible reduced engine performance. |
| 2718 520325 31 | Brake switch and accelerator pedal position incompatible - Condition exists. The ECM has detected the brake pedal and accelerator pedal were depressed simultaneously. | The engine will operate in limp home mode. |
| 2771 3226 9 | Aftertreatment outlet NOx sensor - Abnormal update rate. No communications or an invalid data transfer rate detected on the J1939 data link between the ECM and the aftertreatment outlet NOx sensor. | Possible reduced engine performance. |
| 2777 3703 31 | Particulate trap active regeneration inhibited due to inhibit switch - Condition exists. Regeneration of the diesel particulate filter has been prevented due to the permit switch being disabled. | Possible frequent need for aftertreatment regeneration. |
| 2961 412 15 | Exhaust gas recirculation temperature - Data valid but above normal operational range - Least severe level. EGR temperature has exceeded the engine protection limit. | Possible reduced engine performance. |
| 2962 412 16 | Exhaust gas recirculation temperature - Data valid but above normal operational range - Moderately severe level. EGR temperature has exceeded the engine protection limit. | Possible reduced engine performance. |

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

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

※ Some fault codes are not applied to this machine.

3) DEFINITION OF OPERATING MODES

(1) Normal

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

(2) Substitute clutch control

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

(3) Limp-home

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

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

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

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

If output speed is greater than the threshold, TCU will shift the transmission into neutral.

The operator has to slow down the vehicle and must shift the gear selector into neutral position.

(4) Transmission-shutdown

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

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

Transmission shifts to neutral.

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

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

(5) TCU-shutdown

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

TCU will shut off all solenoid valves and also both common power supplies (VPS1, VPS2).

The park brake will engage, also functions are disabled which use ADM 1 to ADM 8.

The transmission will stay in neutral.

※ Abbreviations

OC : Open circuit

SC : Short circuit

OP mode : Operating mode

TCU : Transmission control unit

EEC : Electronic engine controller

PTO : Power take off

4) TRANSMISSION FAULT CODES

| SPN | FMI | FaultDescription | OpMode | Cause | PossibleSteptoRepair |
|--------|-----|--------------------------|--------------|--|--|
| 523000 | 1 | Battery low undervoltage | Trm Shutdown | <p>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.</p> <ol style="list-style-type: none"> 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. | <p>The cause of the missing or insufficient voltage on terminal 30 must be located.</p> <ol style="list-style-type: none"> 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 | <p>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.</p> <ol style="list-style-type: none"> 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. | <p>The cause of the excessive voltage on terminal 30 must be located.</p> <ol style="list-style-type: none"> 1. Make sure that the control unit has a stable voltage supply. Check the voltage on the terminal tester with a voltmeter. <ul style="list-style-type: none"> · 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 | PossibleStepsToRepair |
|--------|-----|---|--------------|--|--|
| | | | | | 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 | PossibleStepsToRepair |
|--------|-----|--|--------------|---|--|
| | | sensors (AU3) undervoltage | | <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Sensor has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | <p>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.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect. <p>Note: If this error occurs, calculations are partially being made with replacement values. The transmission functions are limited and the shifting quality is reduced.</p> | <ol style="list-style-type: none"> 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 | <p>The measured voltage is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Sensor has an internal defect. 3. Control unit has an internal defect. | <p>The cause of the incorrect voltage must be located.</p> <ol style="list-style-type: none"> 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 | <p>The measured voltage is too low.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. | <p>The cause of the incorrect voltage must be located.</p> <ol style="list-style-type: none"> 1. Check the wiring, in particular with regard to |

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

| 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 behaviour 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 | PossibleStepsToRepair |
|--------|-----|---|-----------|--|--|
| | | controller hardware detected | | application. | |
| 523100 | 3 | Speed sensor input 1 (EF1) overvoltage: Turbine speed | Limp Home | <p>The measured voltage at the input is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <p>The cause of the incorrect voltage must be located.</p> <ol style="list-style-type: none"> 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 | <p>The measured line resistance between the connected component and the control unit is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | <p>The control unit does not recognize the rotational direction at the input.</p> <ol style="list-style-type: none"> 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. | <p>The cause of the unknown rotational direction must be located.</p> <ol style="list-style-type: none"> 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 | PossibleStepsToRepair |
|--------|-----|--|-----------|---|--|
| 523100 | 9 | Speed sensor input 1 (EF1) speed unknown: Turbine speed | Limp Home | <p>The control unit does not recognize the speed at the input.</p> <ol style="list-style-type: none"> 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. | <p>The cause of the unknown speed must be located.</p> <ol style="list-style-type: none"> 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 | <p>The measured voltage at the input is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <p>The cause of the incorrect voltage must be located.</p> <ol style="list-style-type: none"> 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 | <p>The measured line resistance between the connected component and the control unit is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | <p>The control unit does not recognize the rotational direction at the input.</p> | <p>The cause of the unknown rotational direction must be located.</p> |

| SPN | FMI | FaultDescription | OpMode | Cause | PossibleStepsToRepair |
|--------|-----|---|-----------|---|--|
| | | rotation unknown: Internal speed | | <ol style="list-style-type: none"> 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. | <ol style="list-style-type: none"> 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 | <p>The control unit does not recognize the speed at the input.</p> <ol style="list-style-type: none"> 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. | <p>The cause of the unknown speed must be located.</p> <ol style="list-style-type: none"> 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 | <p>The measured voltage at the input is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <p>The cause of the incorrect voltage must be located.</p> <ol style="list-style-type: none"> 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 | <p>The measured line resistance between the connected component and the control unit is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | PossibleStepsToRepair |
|--------|-----|---|-----------|--|--|
| | | | | | 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 | PossibleStepsToRepair |
|--------|-----|--|-----------|--|--|
| | | | | <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | <p>The control unit does not recognize the rotational direction at the input.</p> <ol style="list-style-type: none"> 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. | <p>The cause of the unknown rotational direction must be located.</p> <ol style="list-style-type: none"> 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 | <p>The control unit does not recognize the speed at the input.</p> <ol style="list-style-type: none"> 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. | <p>The cause of the unknown speed must be located.</p> <ol style="list-style-type: none"> 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 | <p>The measured line resistance between the connected component and the control unit is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | PossibleStepsToRepair |
|--------|-----|---|--------|---|--|
| | | | | | 4. Replace the control unit if the error continues to occur. |
| 523140 | 6 | Resistance sensor input 1 (ER1) short to ground: Sump temperature | Normal | <p>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.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | <p>The measured voltage at the input is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <p>The cause of the incorrect voltage must be located.</p> <ol style="list-style-type: none"> 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 sensor input 2 (EI2) open circuit or short to ground: Oil Filter Restriction Switch | Normal | <p>The measured line resistance between the connected component and the control unit is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | PossibleStepsToRepair |
|--------|-----|--|--------------|---|--|
| | | | | | 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. | <ol style="list-style-type: none"> Using the circuit diagram, check if a component is assigned to the output. Check the wiring, in particular that it is wired correctly. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts Replace the control unit if the error continues to occur. |
| 523200 | 3 | Current output driver 1 (AIM01) short to battery | Limp Home | <p>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.</p> <ol style="list-style-type: none"> Wiring or plug connection contacts battery voltage. Proportional valve has an internal defect. Control unit has an internal defect. | <ol style="list-style-type: none"> Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 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. Check the function of the connected component and replace it if needed. Replace the control unit if the error continues to occur. |
| 523200 | 5 | Current output driver 1 (AIM01) open circuit | Limp Home | <p>The measured line resistance between the connected component and the control unit is too high.</p> <ol style="list-style-type: none"> Wiring or plug connection is defective. Component has an internal defect. Control unit has an internal defect. | <ol style="list-style-type: none"> Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester. 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 | PossibleStepsToRepair |
|--------|-----|--|--------------|--|--|
| | | | | | <p>or damaged plug contacts.</p> <p>4. Check the function of the connected component and replace it if needed.</p> <p>5. Replace the control unit if the error continues to occur.</p> |
| 523200 | 6 | Current output driver 1 (AIM01) short to ground | TCU Shutdown | <p>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.</p> <p>1. Wiring or plug connection contacts vehicle ground.</p> <p>2. Component has an internal defect.</p> <p>3. Control unit has an internal defect.</p> | <p>1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active.</p> <p>2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester.</p> <p>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.</p> <p>4. Check the function of the connected component and replace it if needed.</p> <p>5. Replace the control unit if the error continues to occur.</p> |
| 523200 | 8 | Current output driver 1 (AIM01) short to another valve | Trm Shutdown | <p>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.</p> <p>1. Wiring or plug connection contacts another proportional valve.</p> <p>2. Proportional valve has an internal defect.</p> <p>3. Control unit has an internal defect.</p> | <p>1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active.</p> <p>2. Check if the error occurs with an additional proportional valve or with which valve the error is bypassed.</p> <p>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.</p> <p>4. Switch the ignition off, unplug the control unit, and measure the resistance of the proportional valve using a terminal tester.</p> <p>5. Check the function of the proportional valve and</p> |

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

| 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 | PossibleStepsToRepair |
|--------|-----|--|--------------|---|--|
| | | | | 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 damaged plug contacts. |

| SPN | FMI | FaultDescription | OpMode | Cause | PossibleStepsToRepair |
|--------|-----|--|--------------|--|---|
| | | | | | <p>4. Switch the ignition off, unplug the control unit, and measure the resistance of the proportional valve using a terminal tester.</p> <p>5. Check the function of the proportional valve and replace it if needed.</p> <p>6. Replace the control unit if the error continues to occur.</p> |
| 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. | <p>1. Using the circuit diagram, check if a component is assigned to the output.</p> <p>2. Check the wiring, in particular that it is wired correctly.</p> <p>3. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts</p> <p>4. Replace the control unit if the error continues to occur.</p> |
| 523215 | 3 | Current output driver 4 (AIM04) short to battery | Limp Home | <p>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.</p> <p>1. Wiring or plug connection contacts battery voltage.</p> <p>2. Component has an internal defect.</p> <p>3. Control unit has an internal defect.</p> | <p>1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active.</p> <p>2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester.</p> <p>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.</p> <p>4. Check the function of the connected component and replace it if needed.</p> <p>5. Replace the control unit if the error continues to occur.</p> |
| 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 | <p>1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active.</p> |

| 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. | <p>defective plug connections such as corroded or damaged plug contacts.</p> <p>4. Switch the ignition off, unplug the control unit, and measure the resistance of the proportional valve using a terminal tester.</p> <p>5. Check the function of the proportional valve and replace it if needed.</p> <p>6. Replace the control unit if the error continues to occur.</p> |
| 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. | <p>1. Using the circuit diagram, check if a component is assigned to the output.</p> <p>2. Check the wiring, in particular that it is wired correctly.</p> <p>3. Check the wiring, in particular with regard to defective plug connections such as corroded or damaged plug contacts</p> <p>4. Replace the control unit if the error continues to occur.</p> |
| 523220 | 3 | Current output driver 5 (AIM05) short to battery | Limp Home | <p>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.</p> <p>1. Wiring or plug connection contacts battery voltage.</p> <p>2. Component has an internal defect.</p> <p>3. Control unit has an internal defect.</p> | <p>1. Switch the ignition off, wait 10 seconds and switch the ignition back on. Check if the error is still active.</p> <p>2. Switch the ignition off, unplug the control unit and measure the resistance of the connected component using a terminal tester.</p> <p>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.</p> <p>4. Check the function of the connected component and replace it if needed.</p> <p>5. Replace the control unit if the error continues to occur.</p> |

| SPN | FMI | FaultDescription | OpMode | Cause | PossibleSteptoRepair |
|--------|-----|--|--------------|---|--|
| 523220 | 5 | Current output driver 5 (AIM05) open circuit | Limp Home | <p>The measured line resistance between the connected component and the control unit is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | <p>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.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | <p>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.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection contacts another | <ol style="list-style-type: none"> 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 | PossibleStepsToRepair |
|--------|-----|--|--------------|---|--|
| | | | | 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 | <p>The measured line resistance between the connected component and the control unit is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | <p>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.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | <p>The measured line resistance between the proportional valve and the control unit is too high or the voltage on the control unit output is</p> | <ol style="list-style-type: none"> 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 | PossibleStepsToRepair |
|--------|-----|--|--------------|---|---|
| | | | | <p>too low.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection contacts another proportional valve. 2. Proportional valve has an internal defect. 3. Control unit has an internal defect. | <p>proportional valve or with which valve the error is bypassed.</p> <ol style="list-style-type: none"> 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 | <p>If this error occurs, then an electrical component has been connected at the output although the input should not be used.</p> | <ol style="list-style-type: none"> 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 | <p>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.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection contacts battery voltage. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | <p>The measured line resistance between the connected component and the control unit is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | <p>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.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect. 3. Control unit has an internal defect. | <ol style="list-style-type: none"> 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 | <p>The measured line resistance between the proportional valve and the control unit is too high or the voltage on the control unit output is</p> | <ol style="list-style-type: none"> 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 |
|--------|-----|---|--------------|---|---|
| | | | | <p>too low.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection contacts another proportional valve. 2. Proportional valve has an internal defect. 3. Control unit has an internal defect. | <p>proportional valve or with which valve the error is bypassed.</p> <ol style="list-style-type: none"> 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 | PossibleStepsToRepair |
|--------|-----|--|-----------|--|--|
| | | | | <ol style="list-style-type: none"> 1. Wiring or plug connection contacts vehicle ground. 2. Component has an internal defect 3. Control unit has an internal defect. | <p>component and the control unit, in particular with regard to defective plug connections such as corroded or damaged plug contacts.</p> <ol style="list-style-type: none"> 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 | <p>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</p> | <p>check the cable from TCU to the sensor check the connectors check the sensor</p> |
| 523125 | 6 | Voltage sensor input 1 (EU1) open or short to ground | Limp Home | <p>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</p> | <p>check the cable from TCU to the sensor check the connectors check the sensor</p> |
| 523125 | 12 | Voltage sensor input 1 (EU1) defect | Limp Home | <p>The measured voltage from sensor output signal 1 and output signal 2 don't match or are out of range.</p> <ol style="list-style-type: none"> 1. Cable is defective 2. Sensor has an internal defect | <p>check the cable from TCU to the sensor check the connectors check the sensor</p> |
| 523023 | 3 | Supply for temperature sensors (AU_ER) overvoltage | Limp Home | <p>The measured voltage is too high.</p> <ol style="list-style-type: none"> 1. Wiring or plug connection is defective. 2. Sensor has an internal defect. | <p>The cause of the incorrect voltage must be located.</p> <ol style="list-style-type: none"> 1. Check the wiring, in particular with regard to defective plug connections such as corroded or |

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

| SPN | FMI | FaultDescription | OpMode | Cause | PossibleStepsToRepair |
|--------|-----|---|--------------|---|--|
| 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 | <p>1. Filter clogged.</p> <p>2. Sensor has an internal defect.</p> | <p>If this error occurs while driving, then remain at a standstill, switch the ignition off, then on again and wait another 40 seconds.</p> <p>1. Replace the filter.</p> <p>2. Check the wiring of the switch, in particular with regard to defective plug connections such as corroded or damaged plug contacts.</p> |
| 523310 | 0 | Transmission input torque too high | Normal | <p>The control unit receives a transmission input torque via the CAN bus that exceeds the permissible maximum.</p> <p>1. Engine torque too high.</p> <p>2. CAN bus signal is faulty.</p> | <p>1. Reduce the applied engine torque.</p> <p>2. If this error continues to occur, please contact your vehicle manufacturer.</p> |
| 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. | <p>Reduce the engine speed.</p> <p>In order to prevent long-term damage, stay within the permissible speed range.</p> |
| 523340 | 0 | Transmission output torque too high | Trm Shutdown | <p>The control unit calculates a torque at the transmission output that exceeds the permissible maximum.</p> <p>1. Engine torque too high.</p> | 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 | PossibleStepsToRepair |
|--------|-----|----------------------------------|--------------|---|---|
| 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 | PossibleStepsToRepair |
|--------|-----|---------------------------------|-----------|---|---|
| | | | | 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 | PossibleStepsToRepair |
|--------|-----|---|-----------|---|---|
| 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 occur, 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 | PossibleStepsToRepair |
|--------|-----|--|--------------|---|--|
| | | 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 | Unallowed 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 | Unallowed 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 | Unallowed 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 | PossibleStepsToRepair |
|--------|-----|--|--------------|---|--|
| | | | | 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 | PossibleStepsToRepair |
|--------|-----|--|--------------|---|--|
| | | | | | replace it. |
| 523110 | 11 | EF3 direction of rotation does not match with other directions of rotation | Trm Shutdown | <p>The control unit recognizes a rotational direction at the input, which does not agree with the other rotational directions.</p> <ol style="list-style-type: none"> 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. | <p>The cause of the different rotational directions must be located.</p> <ol style="list-style-type: none"> 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 | <p>The control unit measures a speed at the input which does not agree with the other speeds.</p> <ol style="list-style-type: none"> 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. | <p>The cause of the different speeds must be located.</p> <ol style="list-style-type: none"> 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 | <p>The control unit recognizes a rotational direction at the input, which does not agree with the other rotational directions.</p> <ol style="list-style-type: none"> 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. | <p>The cause of the different rotational directions must be located.</p> <ol style="list-style-type: none"> 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 | <p>The measured oil temperature at the converter is too high.</p> <ol style="list-style-type: none"> 1. The oil level is incorrect. 2. The cooling system is faulty. 3. Load is permanently too high. | <p>The cause of the increased temperature at the converter must be located.</p> <ol style="list-style-type: none"> 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 | PossibleStepsToRepair |
|--------|-----|---|-----------|--|---|
| | | | | | 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 | <p>The measured oil temperature at the converter is too high.</p> <ol style="list-style-type: none"> 1. The oil level is incorrect. 2. The cooling system is faulty. 3. Load is permanently too high. | <p>The cause of the increased temperature at the converter must be located.</p> <ol style="list-style-type: none"> 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 | <p>Signal 'Engine Reference Torque from engine controller contains faulty data.</p> <ol style="list-style-type: none"> 1. Incorrect software on the transmission control unit. 2. Incorrect software on the engine controller. | <ol style="list-style-type: none"> 1. Check the software version of the transmission control unit and program the current software version if required. 2. If this error continues to occur, please contact HCE. |
| 523451 | 19 | Actual engine torque signal invalid | Limp Home | <p>Signal 'Actual Engine Torque' from engine controller contains faulty data.</p> <ol style="list-style-type: none"> 1. Incorrect software on the transmission control unit. 2. Incorrect software on the engine controller. | <ol style="list-style-type: none"> 1. Check the software version of the transmission control unit and program the current software version if required. 2. If this error continues to occur, please contact HCE. |
| 523452 | 19 | Engine nominal friction torque signal invalid | Normal | <p>Signal 'Engine Nominal Friction Torque' from engine controller contains faulty data.</p> <ol style="list-style-type: none"> 1. Incorrect software on the transmission control unit. | <ol style="list-style-type: none"> 1. Check the software version of the transmission control unit and program the current software version if required. 2. If this error continues to occur, please contact your |

| SPN | FMI | FaultDescription | OpMode | Cause | PossibleStepsToRepair |
|--------|-----|---|--------------|---|---|
| | | | | 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 occur, 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 | PossibleStepsToRepair |
|--------|-----|---------------------------------|-----------|---|---|
| | | | | <ul style="list-style-type: none"> 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. | <ul style="list-style-type: none"> 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 | <p>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.</p> <ul style="list-style-type: none"> 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. | <p>The cause of the occurring speed difference must be located.</p> <ul style="list-style-type: none"> 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 | <p>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.</p> <ul style="list-style-type: none"> 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. | <p>The cause of the occurring speed difference must be located.</p> <ul style="list-style-type: none"> 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 |

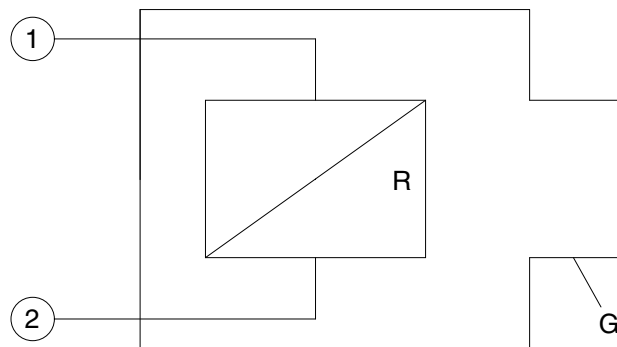
| SPN | FMI | FaultDescription | OpMode | Cause | PossibleStepsToRepair |
|--------|-----|---------------------------------|-----------|---|---|
| | | unintendedly | | <p>the clutch is closed. If this value is too high, it is interpreted as slip on the clutch.</p> <ol style="list-style-type: none"> 1. 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. | <p>located.</p> <ol style="list-style-type: none"> 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 | <p>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.</p> <ol style="list-style-type: none"> 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. | <p>The cause of the occurring speed difference must be located.</p> <ol style="list-style-type: none"> 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 | <p>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.</p> <ol style="list-style-type: none"> 1. Insufficient pressure on the clutch. 2. Insufficient system pressure. 3. Filter clogged. 4. Clutch faulty. 5. Transmission input speed signal faulty. | <p>The cause of the occurring speed difference must be located.</p> <ol style="list-style-type: none"> 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 | PossibleStepsToRepair |
|--------|-----|---|--------------|---|--|
| | | | | 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 mismatch | 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. | <ol style="list-style-type: none"> 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. | <ol style="list-style-type: none"> 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. | <ol style="list-style-type: none"> 1. Check cable from TCU or the sensor 2. Check connectors 3. Check sensor |

5) MEASURING OF RESISTANCE AT ACTUATOR/SENSOR AND CABLE

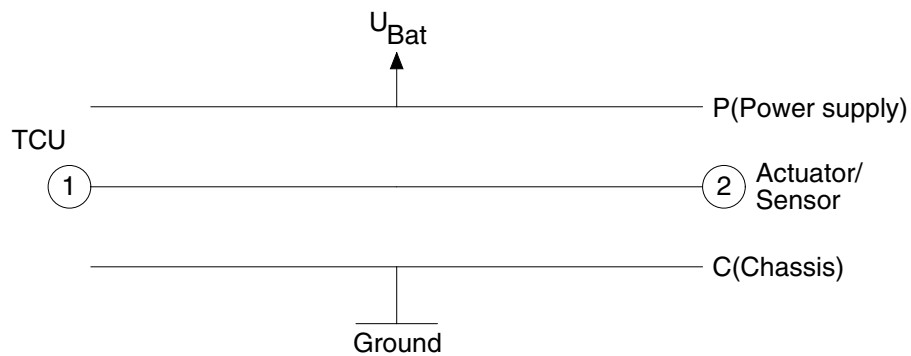
(1) Actuator



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

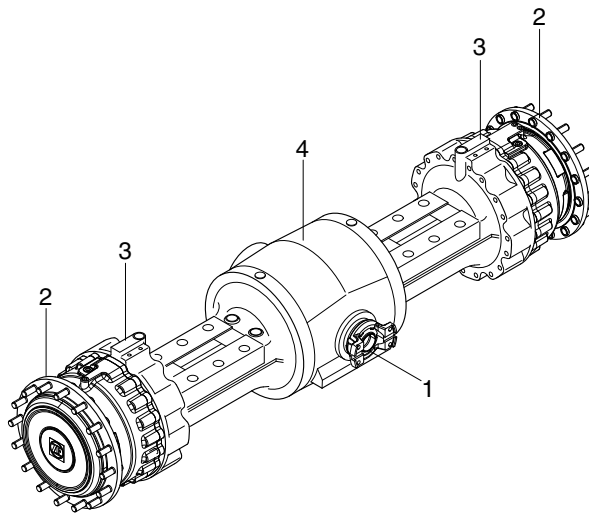
- Open circuit $R_{12} = R_{1P} = R_{1C} = R_{2P} = R_{2C} = \infty$
 Short cut to ground $R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = \infty$
 Short cut to battery $R_{12} = 0$; $R_{1C} = R_{2C} = 0$, $R_{1P} = R_{2P} = 0$

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



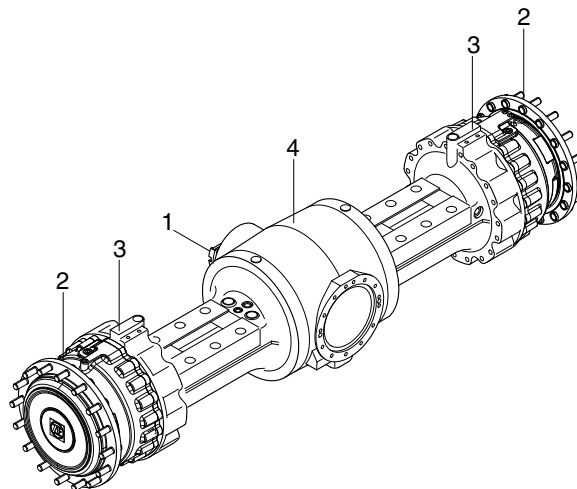
- 1 Input
4 Axle housing

2 Output

3 Brake

7609A3PT15

(2) Rear axle



- 1 Input
4 Axle housing

2 Output

3 Brake

7609A3PT16

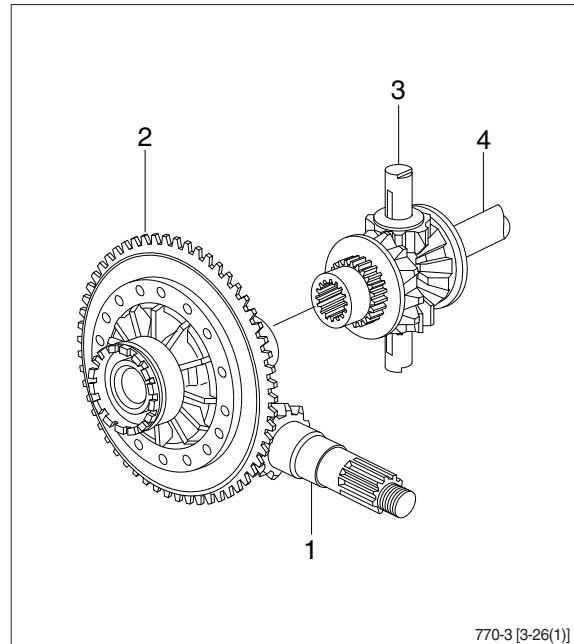
2) DIFFERENTIAL

(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.

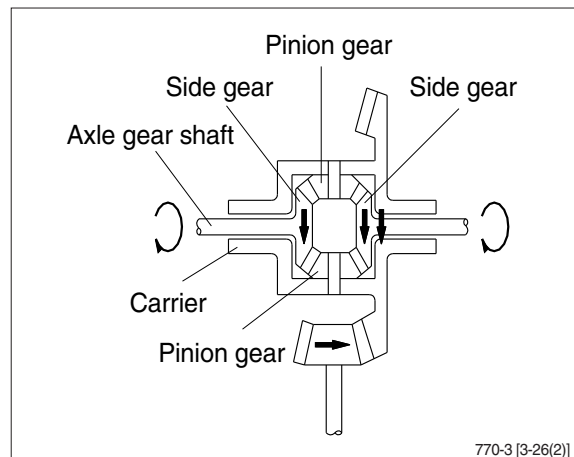
The power from the drive shaft passes through bevel pinion (1) and is transmitted to the bevel gear (2). The bevel gear changes the direction of the motive force by 90 degree, and at the same time reduces the speed.

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



(2) When driving straight forward

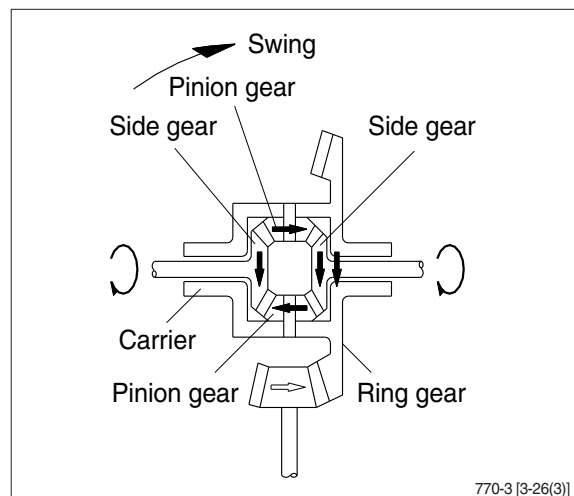
When the machine is being driven straight forward and the right and left wheels are rotating at the same speed, so the pinion gear inside the differential assembly do not rotate. The motive force of the carrier is send through the pinion gear and the side gear, therefore the power is equally transmitted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



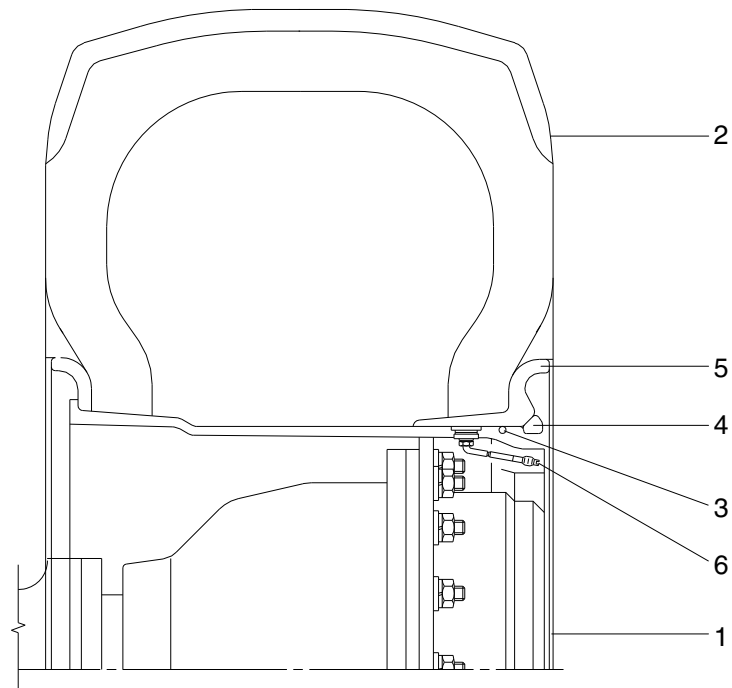
(3) When turning

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

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



6. TIRE AND WHEEL



7407APT10

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

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

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. POWER TRAIN OPERATIONAL CHECKS

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

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

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

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

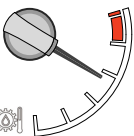



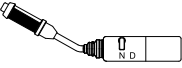



At the end of each check, if no problem is found(OK), that check is complete or an additional check is needed. If problem is indicated(NOT OK), you will be given repair required and group location.

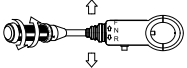
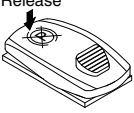



If verification is needed, you will be given next best source of information :

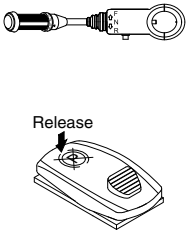
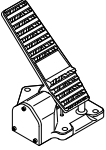
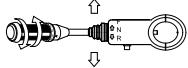
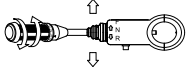
Chapter 2 : Troubleshooting

Group 3 : Tests and adjustments

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

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

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

| Item | Description | Service action |
|---|---|---|
| <p>Forward, reverse and 4th speed clutch pack drag check ※ Transmission must be warmed up for this check. Engine running.</p> |   <p>Park unit on level surface. Apply service brakes. Move gear selector lever to neutral. Move gear selector lever to 1st. Release parking brake and service brakes. Run engine at low idle. LOOK : Unit must not move in either direction. NOTE : If unit moves forward, either the forward pack or the 4th speed pack is dragging.</p> | <p>OK Check completed. NOT OK If unit moves, repair transmission.</p> |
| <p>Transmission shift modulation check Engine running.</p> |  <p>Run engine at approximately 1300 rpm. Put transmission in 1st forward, shift several times from forward to reverse and reverse to forward. Repeat check in 2nd gear. LOOK : Unit must slow down and change direction smoothly.</p> | <p>OK Check completed. NOT OK Go to unit shifts too fast, chapter 2 in this group.</p> |
| <p>Torque converter check</p> |  <p>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 : 2050 ± 70 rpm Move gear selector control lever to neutral "N" position and run for 15 seconds.</p> | <p>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.</p> |

2. TROUBLESHOOTING

1) TRANSMISSION

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

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

Step 2. Operational checks (In this group.)

Step 3. Troubleshooting

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

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

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

| Problem | Cause | Remedy |
|--|---|--|
| Transmission pressure is low (all gears) | <p>Low oil level.</p> <p>Failed transmission pressure switch.</p> <p>Plugged suction strainer.</p> <p>Stuck transmission pressure regulating valve or broken spring.</p> <p>Failed control valve gasket.</p> <p>Stuck PPC valve.</p> | <p>Check transmission oil level and refill if necessary.</p> <p>Verify transmission system pressure. Do transmission system pressure test.</p> <p>Transmission pump may be noisy if transmission suction screen is clogged. Drain transmission. Remove and clean suction screen. Also, check condition of transmission filter.</p> <p>Remove transmission pressure regulating valve. Inspect for damage (See transmission control valve).</p> <p>Inspect transmission control valve for external leakage. Remove control valve. Inspect or replace gasket.</p> <p>Remove end cover to inspect modulation spool and check torque on cap screws retaining control valve to transmission.</p> |
| Transmission system pressure is low (one or two gears) | <p>Failed transmission pump.</p> <p>Failed transmission control valve gasket.</p> <p>Leakage in clutch piston or seal ring.</p> | <p>Do pump flow test.</p> <p>Inspect transmission control valve for external leakage. Remove control valve. Inspect or replace gasket.</p> <p>Disassemble and repair.</p> |
| Transmission shifts too low | <p>Low oil level (aeration of oil).</p> <p>Low transmission pressure.</p> <p>Restricted transmission pump suction screen.</p> <p>Low transmission pump flow.</p> <p>Excessive transmission element leakage.</p> <p>Stuck PPC valve.</p> <p>Restricted PPC valve orifice.</p> <p>Restricted oil passages between control valve and transmission elements.</p> <p>Incorrect transmission oil.</p> | <p>Add oil.</p> <p>Do transmission system pressure test.</p> <p>Remove and clean screen.</p> <p>Do transmission pump flow test.</p> <p>Do transmission element leakage test using system pressure.</p> <p>Remove end cover to inspect modulation spool. Replace if necessary.</p> <p>Remove orifice and inspect for contamination and /or plugging.</p> <p>Remove control valve and inspect oil passage.</p> <p>Change oil (SAE 10W-30/15W-40)</p> |

| Problem | Cause | Remedy |
|---|--|--|
| Transmission shifts too fast | <p>Wrong transmission controller.</p> <p>System pressure too high.</p> <p>Stuck PPC valve.</p> <p>Stuck or missing check valves.</p> <p>Missing O-ring from end of modulation orifice.</p> <p>Broken piston return spring.</p> <p>Incorrect transmission oil.</p> | <p>Check if transmission controller has been changed</p> <p>Do transmission system pressure test.</p> <p>Remove and inspect PPC valve. Replace if necessary. Also remove end cover to inspect PPC valve and control valve housing. Replace if necessary.</p> <p>Inspect transmission control valve.</p> <p>Remove orifice and inspect port for O-ring.</p> <p>Disassemble and inspect clutch.</p> <p>Change oil (SAE 10W-30/15W-40).</p> |
| Machine "creeps" in neutral | Warped disks and plates in transmission. | Check transmission. |
| Transmission hydraulic system overheats | <p>High oil level.</p> <p>Low oil level.</p> <p>Wrong oil grade.</p> <p>Park brake dragging.</p> <p>Pinched, restricted or leaking lube lines.</p> <p>Machine operated in too high gear range.</p> <p>Malfunction in temperature gauge or sensor.</p> <p>Restricted air flow through oil cooler or radiator.</p> <p>Failed oil cooler bypass valve (In thermal bypass valve).</p> <p>Failed thermal bypass valve.</p> <p>Internally restricted oil cooler.</p> <p>Leakage in transmission hydraulic system.</p> <p>Malfunction in converter relief valve.</p> <p>Low transmission pump output.</p> | <p>Transmission overfilled or hydraulic pump seal leaking.</p> <p>Add oil.</p> <p>Change oil.</p> <p>Check for heat in park brake area.</p> <p>Check cooler lines.</p> <p>Operate machine in correct gear range.</p> <p>Install temperature sensor the verify temperature. Do tachometer/temperature reader installation procedure.</p> <p>Do radiator air flow test.</p> <p>Disassemble and inspect.</p> <p>Remove thermal bypass valve and check to see if machine still overheats. Do transmission oil cooler thermal bypass valve test.</p> <p>Do oil cooler restriction test.</p> <p>Do transmission system pressure, element leakage test.</p> <p>Do converter out pressure test.</p> <p>Do transmission pump flow test.</p> |

| Problem | Cause | Remedy |
|--|--|---|
| Excessive transmission noise (Under load or no load) | Too low engine low idle. Worn parts or damaged in transmission. Warped drive line between engine and torque converter. Low or no lube. | Check engine low idle speed. Remove transmission suction screen. Inspect for metal particles. Repair as necessary. Inspect drive line. Do converter-out and lube pressure test. Do transmission pump flow test. |
| Foaming oil | Incorrect type of oil. High oil level. Low oil level. Air leak on suction side of pump. | Change oil. Transmission overfilled or hydraulic pump seal leaking. Add oil. Check oil pickup tube on side of transmission. |
| Oil ejected from dipstick | Plugged breather. | Inspect breather on top of transmission. Replace. |
| Machine vibrates | Aerated oil. Low engine speed. Failed universal joints on transmission drive shaft or differential drive shafts. | Add oil. Check engine speed. Check universal joints. |
| Machine lacks power and acceleration | Engine high idle speed set too low. Incorrect transmission oil. Aerated oil. Low transmission pressure. Warped transmission clutch. Torn transmission control valve gasket. Brake drag. Failed torque converter. Low engine power. | Check high idle adjustment. Change oil. Add oil. Do transmission system pressure test. Do transmission clutch drag checks. Inspect gasket. Do brake drag check. Do torque converter stall speed test. Do engine power test. |
| Torque converter stall RPM too high | Aerated oil. Stuck open converter relief valve. Leakage in torque converter seal. Torque converter not transferring power (Bent fins, broken starter). | Put clear hose on thermal bypass outlet port. Run machine to check for bubbles in oil. Do converter-out pressure test. Do converter-out pressure test. 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. Incorrect type of oil. Dragging brakes. Failed pinion bearing. Incorrect gear mesh pattern between ring and pinion gear. Failed differential pinion gears and/or cross shafts. Failed axle bearing. Mechanical failure in axle planetary. | Check oil. Remove drain plug and inspect for metal particles in differential case. Disassemble and determine cause. Change oil Do brake check. Remove and inspect pinion. Check to ensure pinion housing was indexed. Remove pinion gear housing and inspect ring and pinion gear. Remove differential housing drain plug and inspect for metal particles. Disassemble and inspect. Do axle bearing adjustment check. Remove differential. Inspect, repair. |
| Oil seeping from outer axle seal | Excessive end play in axle. Worn outer bearing and/or cup. Overfilled differential. | Do axle bearing adjustment check. Disassemble and inspect outer axle bearing, cup, spacer, and seal. Replace, if necessary. Check differential oil return system for excessive internal restriction. |
| Axle overheats | Low differential oil. Overfilled differential. Brake drag. | Add oil. See differential overfills with oil in this group. See brakes drag in this group. |

3) DRIVE LINE

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

GROUP 3 TESTS AND ADJUSTMENTS

1. TRANSMISSION MEASURING POINTS AND CONNECTIONS

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



| Measuring point | Measurement variable pressure/ temperature |
|-----------------|--|
| 51 | 11 + 2 bar |
| 52 (not shown) | 4.3 + 3 bar |
| 53 | 16 + 3 bar |
| 55 | 16 + 3 bar |
| 56 | 16 + 3 bar |
| 57 | 16 + 3 bar |
| 58 | 16 + 3 bar |
| 60 | 16 + 3 bar |
| 65 | 16 + 3 bar |
| 67 | 15 + 1 bar |

940T33PT14

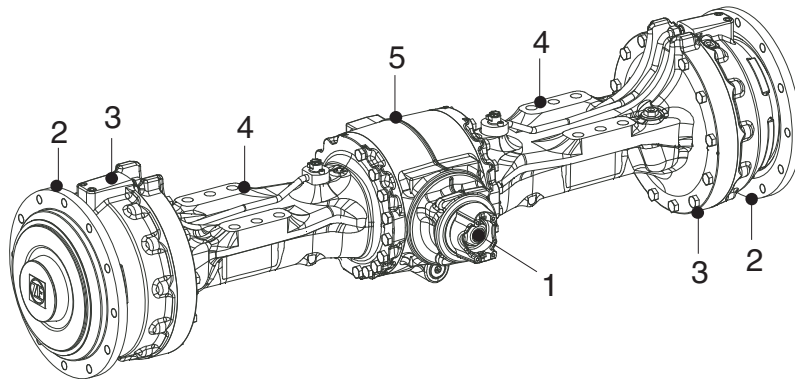
- 51 Measuring point for pressure before converter, M12 x 1.5
- 53 Measuring point for clutch KV, M12 x 1.5
- 55 Measuring point for pressure oil of clutch KR, M12 x 1.5
- 56 Measuring point for pressure oil of clutch K1, M12 x 1.5
- 57 Measuring point for pressure oil of clutch K2, M12 x 1.5
- 58 Measuring point for pressure oil of clutch K3, M12 x 1.5
- 60 Measuring point for pressure oil of clutch K4, M12 x 1.5
- 65 Measuring point for system pressure, M12 x 1.5
- 67 Measuring point for pressure in torque converter lock-upclutch, M12 x 1.5 (not used)

GROUP 4 DISASSEMBLY AND ASSEMBLY

1. AXLE

1) DISASSEMBLY

(1) Output and brake disassembly

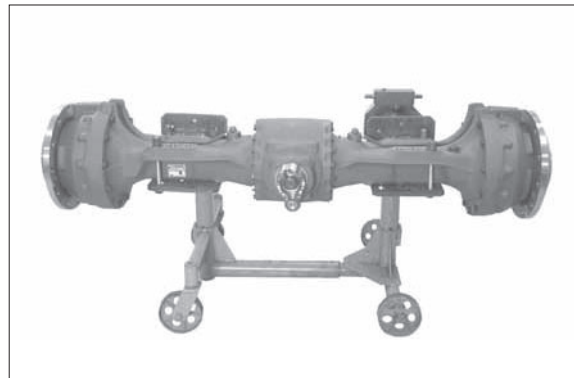


7409AAX001

- | | | |
|----------|----------------|----------------------|
| 1 Input | 3 Brake | 5 Axle drive housing |
| 2 Output | 4 Axle housing | |

① Mount axle on assembly truck.

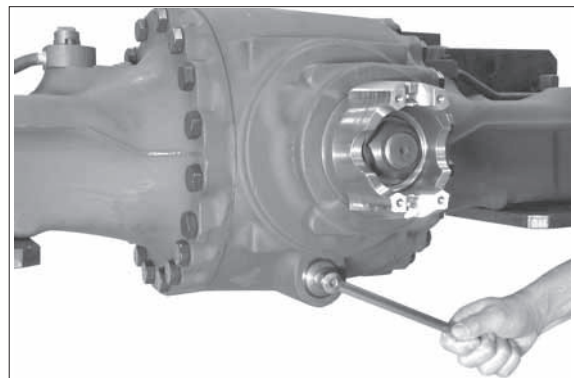
Assembly truck 5870 350 000
Supporting bracket (2EA) 5870 350 106



7409AAX002

② Drain oil from axle.

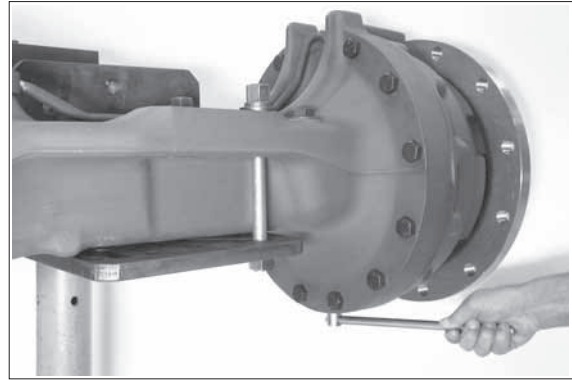
※ Use suitable reservoir-environmental protection.



7409AAX003

③ Drain oil from both outputs.

※ Use suitable reservoir-environmental protection.



7409AAX004

Disassembly output assy /brake

For any replacement of components you can remove the output assy (with brake) as one unit.

In this context refer to work steps on figure AX007~AX009 and assembly steps page 3-128~130.

※ Please consider, however, that multi discs of the brake must be replaced on both outputs each.



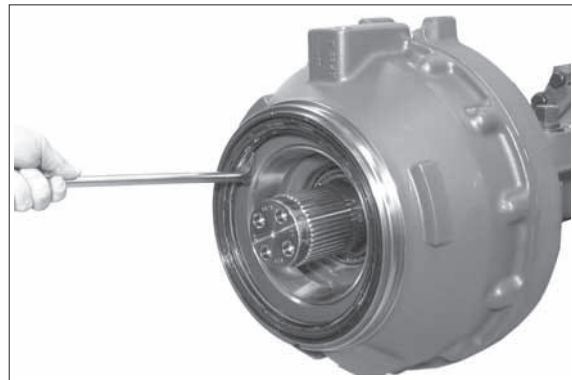
7409AAX005

Replacement combi seal ring (output)

※ The combi seal ring (output) can also be replaced on the installed axle for this purpose remove output shaft.

For the installation of the combi seal ring, refer to work steps on figure AX303~AX305.

Pry bar 5870 345 071



7409AAX006

Output /brake

① Disassemble brake tube.



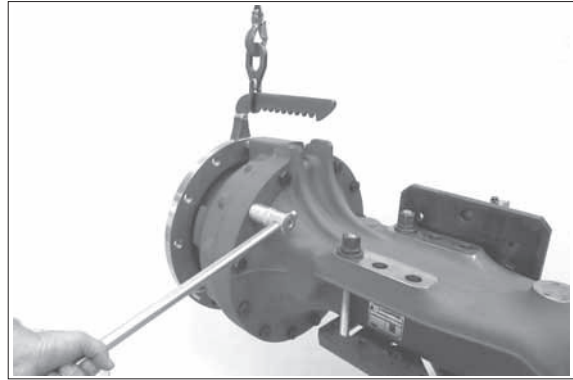
7409AAX007

- ② Take up output by means of a lifting bracket.

Loosen bolted connection (output /axle housing) and separate output from axle housing.

Pay attention to releasing end plate and multi discs.

Lifting bracket 5870 281 043

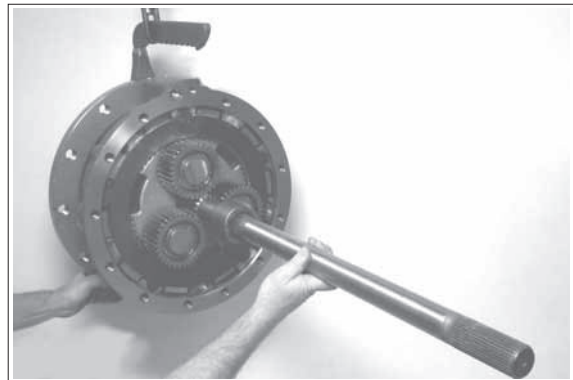


7409AAX008

- ③ Remove stub shaft and sun gear shaft.

※ Pay attention to shim (placed in sun gear shaft) and mark allocation of shim to sun gear shaft and output side assembly aid.

In certain cases the stub shaft /sun gear shaft could get stuck in the axle housing (gearing of axle bevel gear /differential).



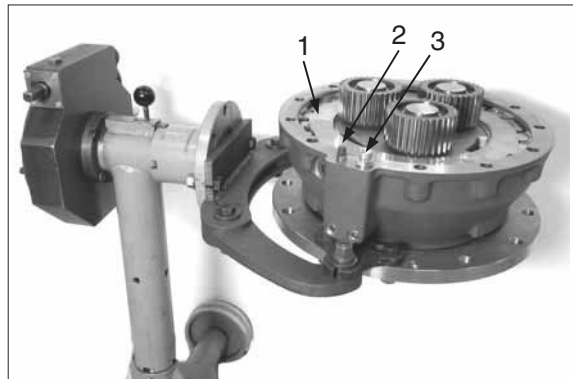
7409AAX009

- ④ Mount output assy on assembly truck.

Remove end plate (1), brake breather valve (2) and screw neck (3).

Assembly truck 5870 350 000

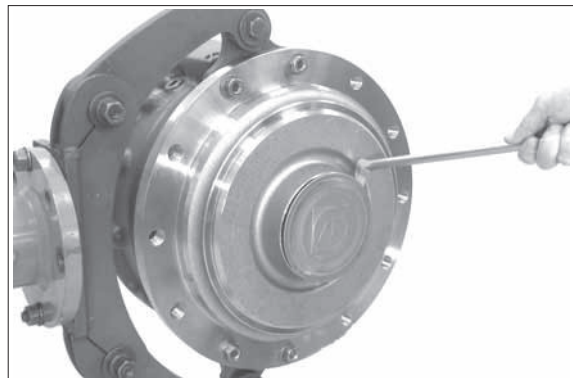
Fixture 5870 350 112



7409AAX010

- ⑤ Remove lid (with O-ring).

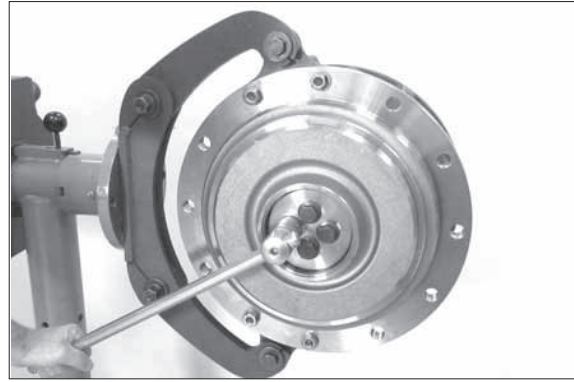
Pry bar 5870 345 071



7409AAX011

⑥ Loosen locking screws and remove lid.

※ Pay attention to releasing planetary carrier, risk of accident.

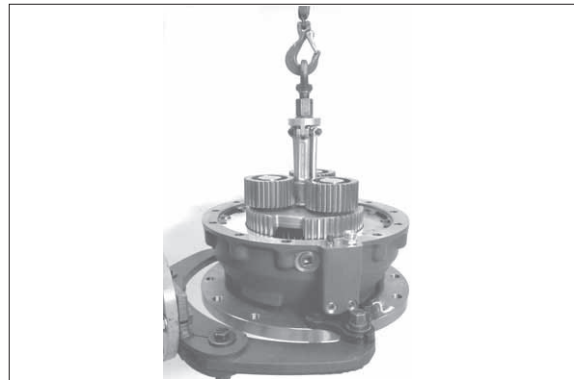


7409AAX012

⑦ Lift compl. planetary carrier out of brake housing.

Inner extractor 5870 300 019

Eye nut 5870 204 073



7409AAX013

⑧ Snap out retaining ring.

Set of external pliers 5870 900 015



7409AAX014

⑨ Pull off planetary gear.

Disassemble the remaining planetary gears in the same way.

Three armed puller 5870 971 002



7409AAX015

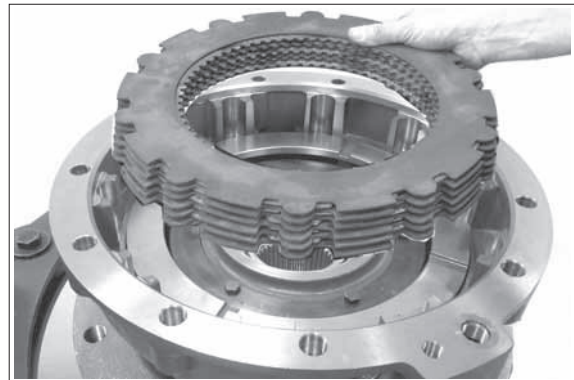
- ⑩ Pull bearing inner ring off the planetary carrier.

Grab sleeve 5873 003 033
Basic tool 5873 003 001



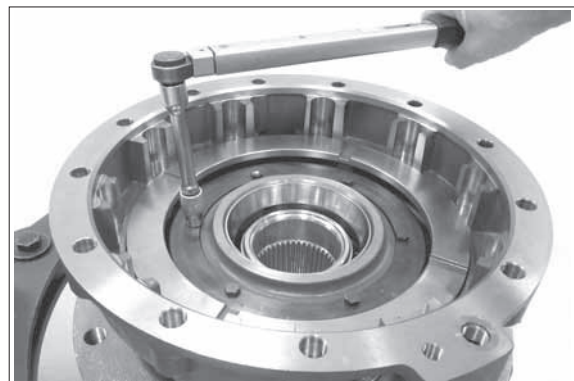
7409AAX016

- ⑪ Take disc package out of brake housing.



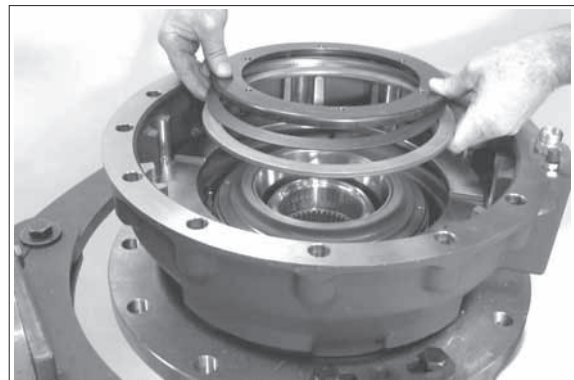
7409AAX017

- ⑫ Loosen threaded joint.



7409AAX018

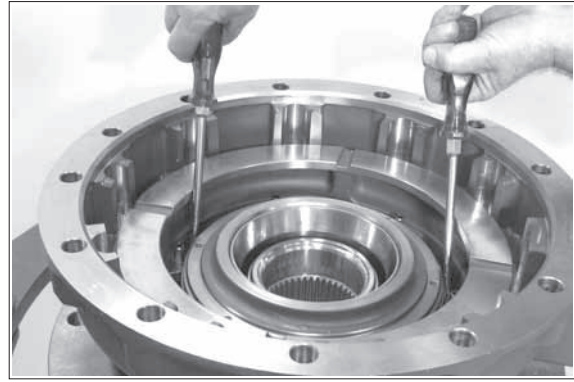
- ⑬ Remove lid, cup spring and disk.



7409AAX019

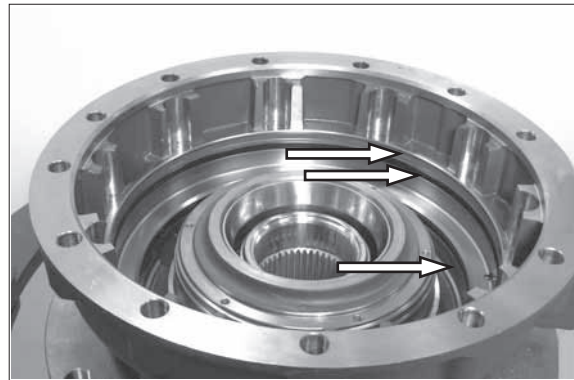
⑭ Lift piston off with lever.

Adjusting device 5870 400 001



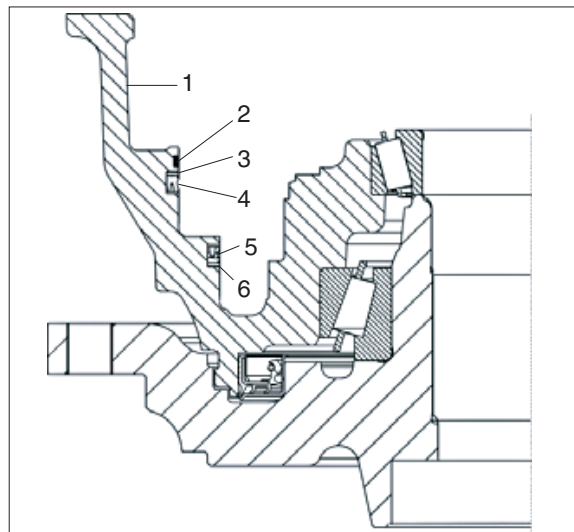
7409AAX020

⑮ Remove sealing elements (arrows also refer to AX022) from annular grooves of brake housing.



7409AAX021

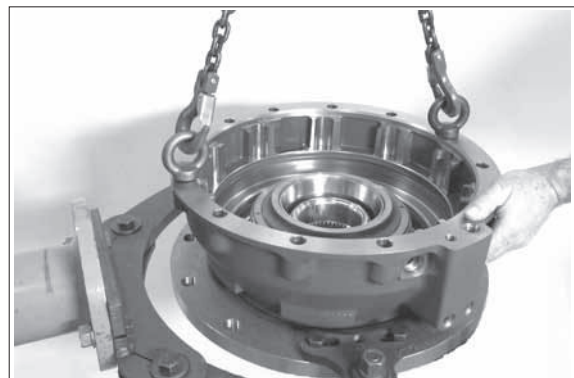
- 1 Brake housing
- 2 Guide ring
- 3 Support ring
- 4 Grooved ring
- 5 Grooved ring
- 6 Support ring



7409AAX022

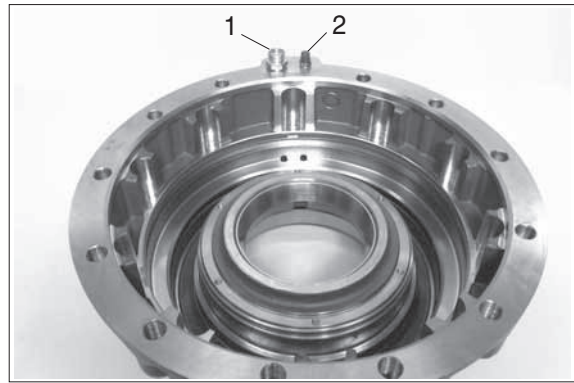
⑯ Lift brake housing off the output shaft by means of lifting device.

Lifting chain 5870 281 047
Eyebolts 5870 204 071



7409AAX023

- ⑰ Remove screw neck (1) and breather valve (2).



7409AAX024

- ⑱ Lift off shaft seal by lever and remove both bearing outer rings from brake housing, if required.

Pry bar 5870 345 071



7409AAX025

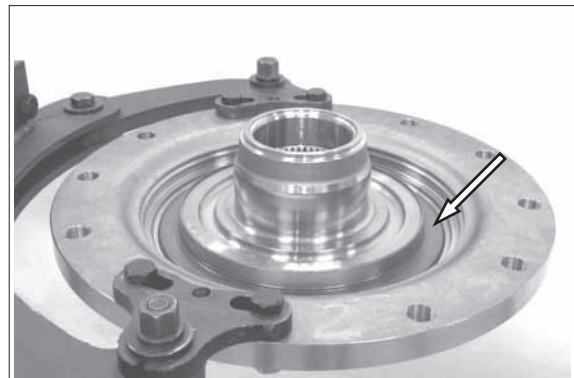
- ⑲ Pull bearing inner ring from output shaft.

Rapid grip 5873 014 016
Basic tool 5873 004 001



7409AAX026

- ⑳ If required, disassemble wear sleeve (arrow) of combi seal ring.



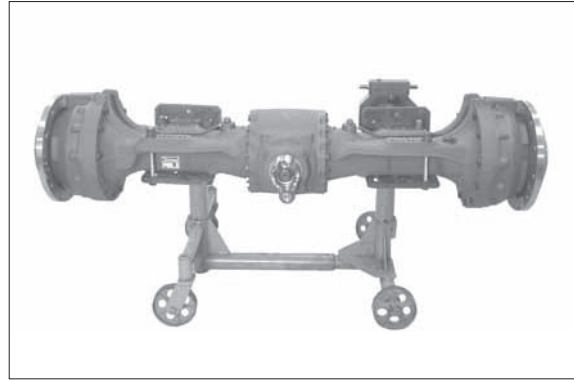
7409AAX027

(2) Differential and input disassembly

■ Differential

- ① Mount axle on assembly truck.

Assembly truck 5870 350 000
Supporting bracket (2EA) 5870 350 106



7409AAX101

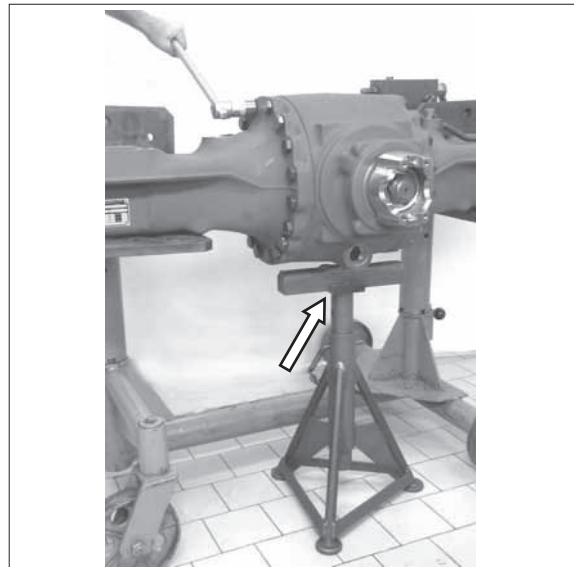
- ※ The following illustration shows the removal of the differential in the course of a complete disassembly of the axle.

To remove the differential, however, it is possible to separate the axle half assy (axle housing with output) from the axle drive housing.

- ※ Secure axle by means of a support (arrow), risk of accident.

- ② Take up axle housing half on crown wheel side with lifting chain (see AX103) and loosen bolted connection (axle housing /axle drive housing).

Lifting chain 5870 281 047
Eyebolts 5870 204 071



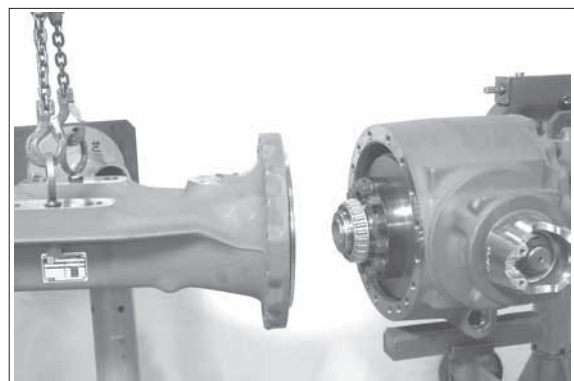
7409AAX102

- ③ Separate axle housing from axle drive housing.

- ※ Pay attention to releasing axial roller ring and differential.

- ※ Pay attention to releasing stub shaft and sun gear shaft with inserted shim (sun gear shaft clearance).

Mark allocation of shim versus sun gear shaft /stub shaft and output side, assembly aid.



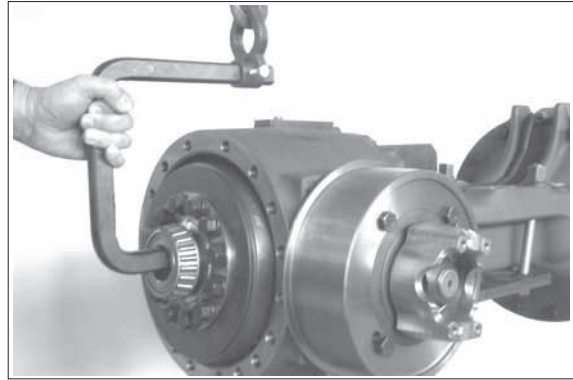
7409AAX103

Conventional differential (STD)

※ Description of disassembly and reassembly of the limited slip differential from page 3-94.

- ① Lift differential assy out of axle drive housing.

Lifting bracket 5870 281 033



7409AAX104

- ② Pull both taper roller bearings off the differential carrier.

Grab sleeve 5873 002 035

Basic tool 5873 002 001

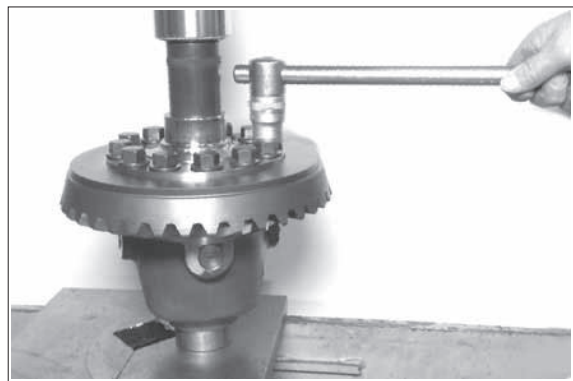
Pressure piece 5873 100 047



7409AAX105

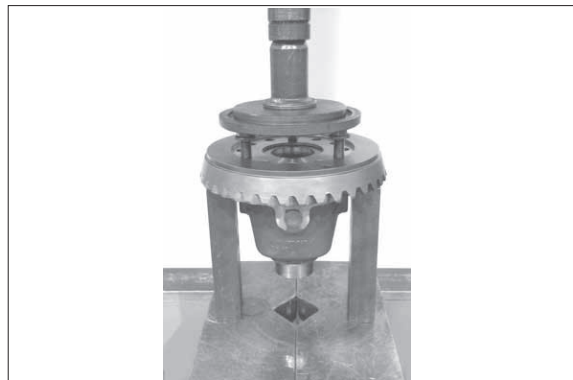
- ③ Hold differential by means of a press. Loosen locking screws and remove lid.

※ Locking screws permitted for one time use only.



7409AAX106

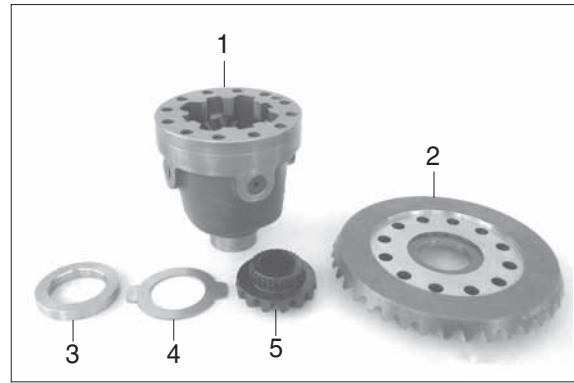
- ④ Insert some locking screws, position pressure plate and press differential carrier off the crown wheel.



7409AAX107

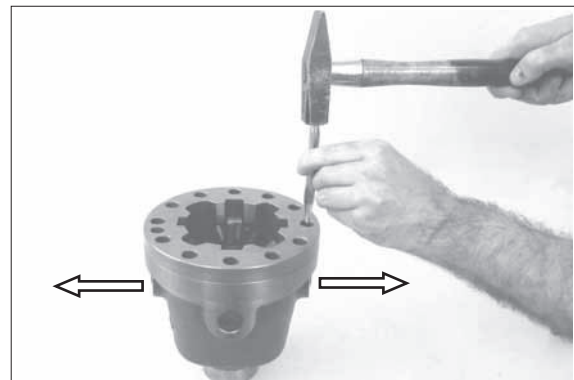
⑤ Remove axle bevel gear, thrust washer and constant spacer.

- 1 Differential carrier
- 2 Crown wheel
- 3 Constant spacer
- 4 Thrust washer
- 5 Axle bevel gear



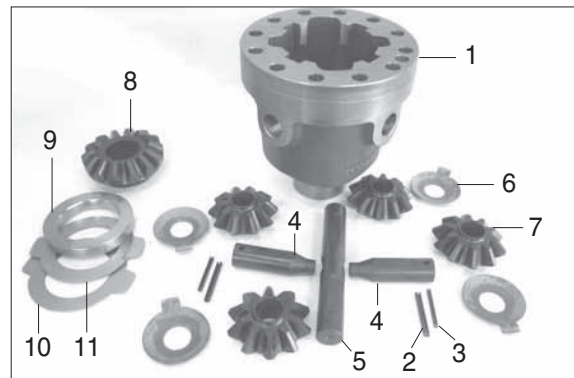
7409AAX108

⑥ Force slotted pin (fixing) out of both spider shaft halves (split version), then remove both spider shaft halves in arrow direction and take components (see AX110) out of differential carrier.



7409AAX109

- 1 Differential carrier
- 2 Slotted pin (2EA)
- 3 Slotted pin (2EA)
- 4 Spider shaft (split version)
- 5 Spider shaft (one piece)
- 6 Spider gear (4EA)
- 7 Thrust washer (4EA)
- 8 Axle bevel gear
- 9 Constant spacer
- 10 Outer disc
- 11 Thrust washer

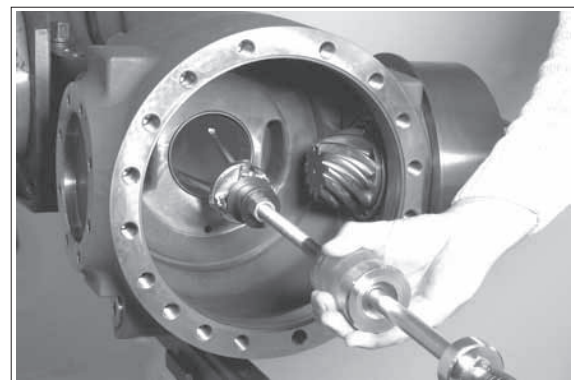


7409AAX110

⑦ Pull bearing outer ring out of hole by means of the striker and remove shim behind (backlash).

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

Striker 5870 650 004

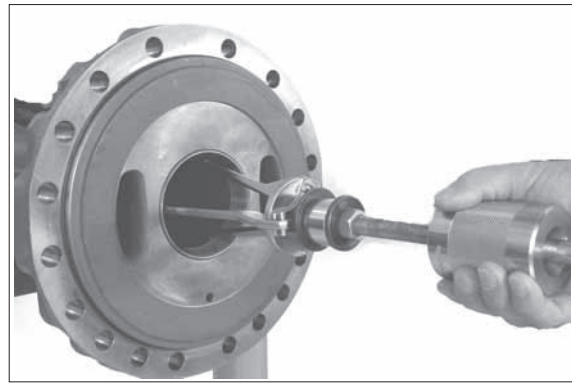


7409AAX111

- ⑧ Remove O-ring (arrow).
Remove bearing outer ring and shim behind (rolling torque differential bearing) from axle housing.

- ※ Mark shim (position/bearing allocation), assembly aid.

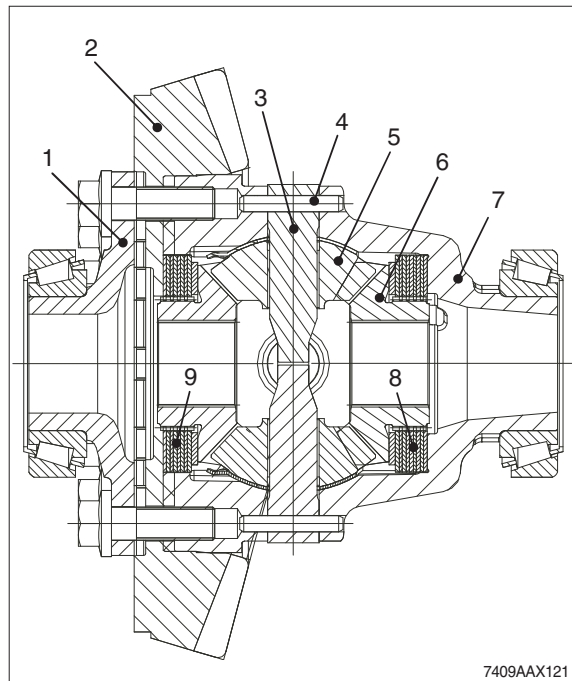
Striker 5870 650 004



7409AAX112

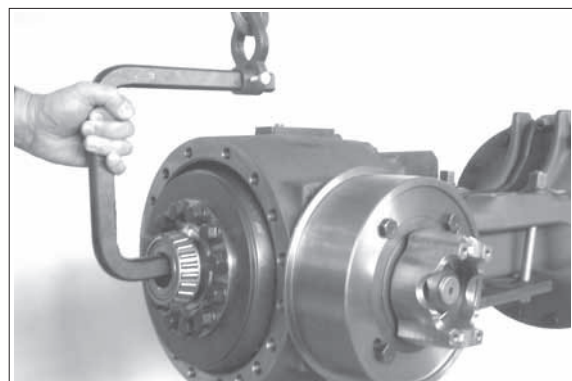
Limited slip differential (option)

- 1 Housing cover
- 2 Crown wheel
- 3 Spider shaft (split version) (2EA)
- 4 Double slotted pins (5 × 50 and 8 × 50 mm)
- 5 Spider gear
- 6 Axle bevel gear
- 7 Differential carrier
- 8 Disk package "A"
- 9 Disk package "B"



7409AAX121

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



7409AAX122

- ② Pull the tapered roller bearing from the housing cover /differential carrier.

Grab sleeve 5873 002 035

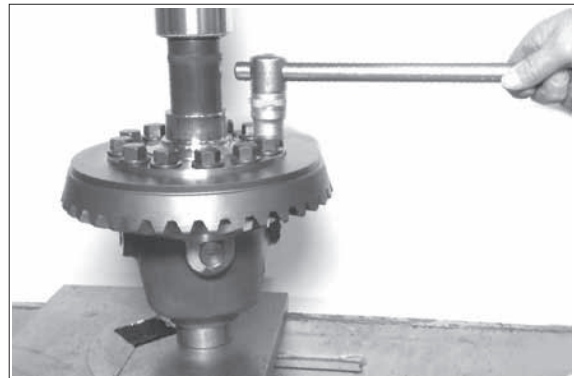
Basic tool 5873 002 001

Pressure piece 5873 100 047



7409AAX123

- ③ Use the press to fix the differential ; loosen the locking screws and remove the cover.



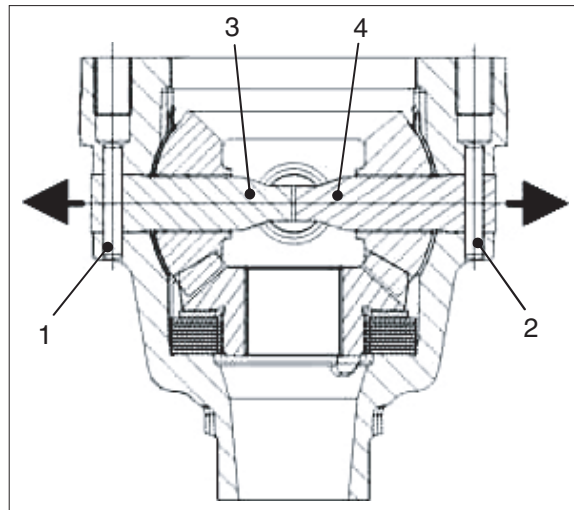
7409AAX124

- ④ Mount some locking screws, position the pressure plate and press the differential carrier from the crown wheel. Remove the releasing disk package, thrust washer and axle bevel gear.



7409AAX125

- ⑤ Force the double slotted pins out (position 1 and 2) and pull the spider shafts (position 3 and 4) in direction of arrow out of the holes. Then remove the remaining single parts.

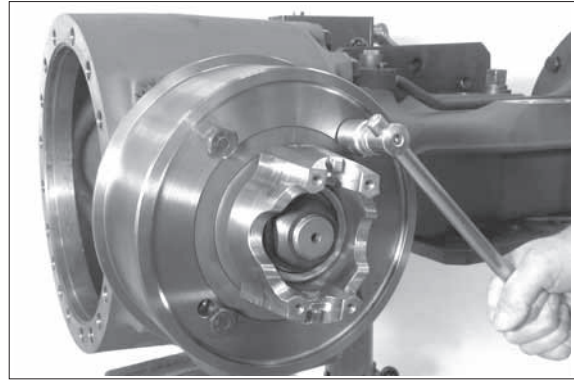


7409AAX126

■ Input

For axle version with pivot bearing only
(see AX128)

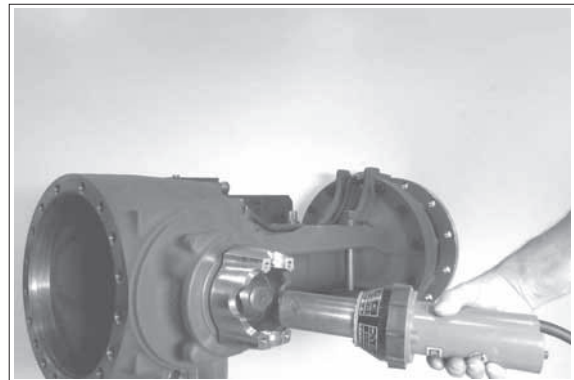
- ① Loosen bolted connection and pull off bearing flange.



7409AAX128

- ② Heat up hex nut (loctite locking compound) by means of hot air blower disassembly aid.

| | |
|----------------------|-------------|
| Hot air blower 230 V | 5870 221500 |
| Hot air blower 115 V | 5870 221501 |

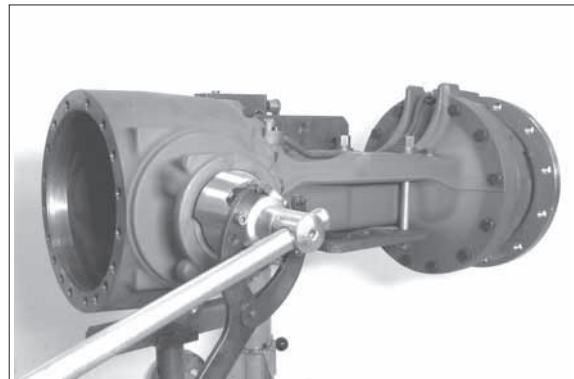


7409AAX129

- ③ Fix input flange by means of a clamping fork, loosen hex nut.

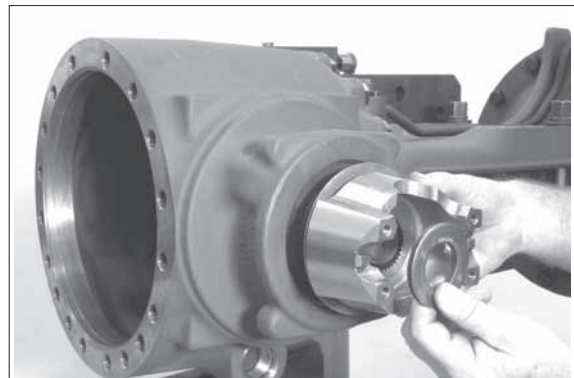
▲ Secure axle by means of a support, risk of accident.

| | |
|---------------|--------------|
| Clamping fork | 5870 240 025 |
|---------------|--------------|



7409AAX130

- ④ Remove disc and pull off flange.
Remove screen sheet from output flange, if required.

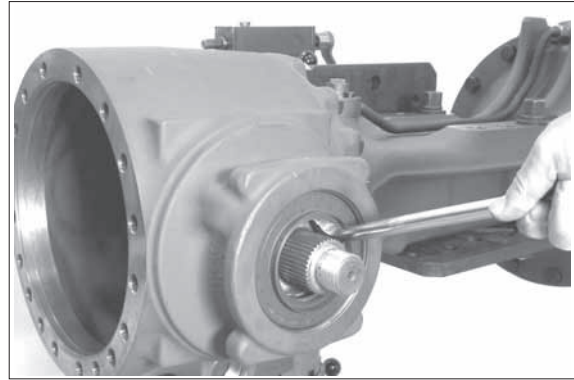


7409AAX131

⑤ Lift shaft seal off.

Pry bar

5870 345 071

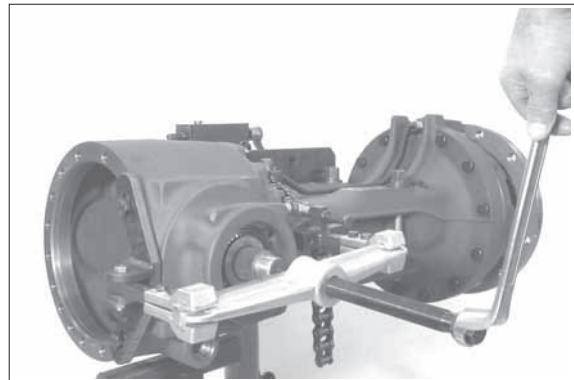


7409AAX132

⑥ Press input pinion out by means of press off tool and remove releasing bearing inner ring.

Press-off tool

5870 280 044



7409AAX133

⑦ Remove spacer ring from pinion.



7409AAX134

⑧ Pull bearing inner ring off the pinion.

Grab sleeve

5873 012 013

Basic tool

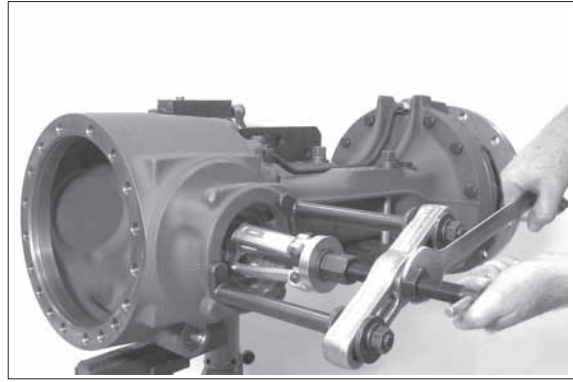
5873 002 001



7409AAX135

⑨ Pull-off outside bearing outer ring.

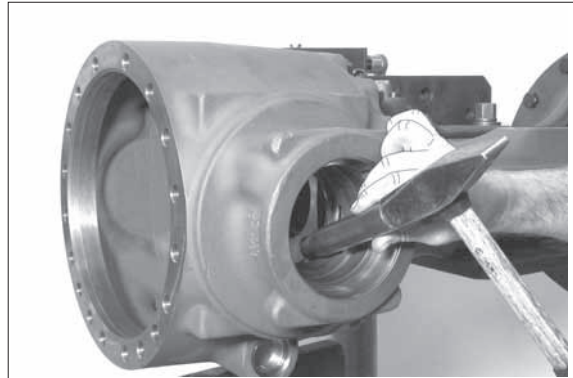
| | |
|--------------------|--------------|
| Internal extractor | 5870 300 019 |
| Counter support | 5870 300 020 |



7409AAX136

⑩ Force bearing outer ring out of inner bearing hole, pay attention to shim behind (contact pattern/bevel gear set).

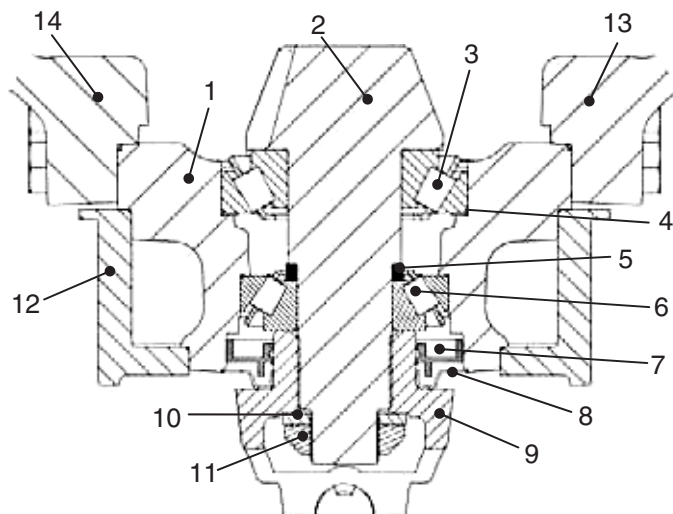
※ Mark shim (thickness/position and bearing allocation), assembly aid.



7409AAX137

2) ASSEMBLY

(1) Input assembly



7409AA201

- | | | | |
|---|--|----|--|
| 1 | Axle drive housing | 8 | Protection plate |
| 2 | Input pinion | 9 | Input flange |
| 3 | Tapered roller bearing | 10 | Disc |
| 4 | Shim for contact pattern (bevel gear set) | 11 | Hexagon nut |
| 5 | Spacer ring (bearing roller torque/ pinion bearing) | 12 | Bearing flange (only for axle version with pivot bearing) |
| 6 | Tapered roller bearing | 13 | Axle housing/ part I |
| 7 | Shaft seal | 14 | Axle housing/ part II (crown-wheel side) |

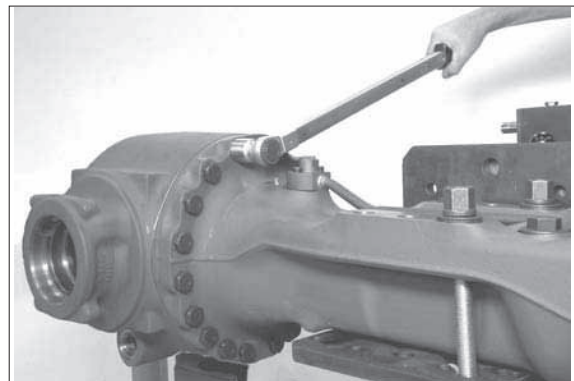
※ Depending on the version, crown wheel and bevel pinion may be mounted as a bevel gear set (for production reasons, crown wheel and pinion are paired and show an identical pairing number see AX204) or as single parts, the respective version has to be taken from the specification of the corresponding spare parts list.

If a bevel gear set is specified, the crown wheel must only be replaced together with the pinion.

Only for assembly of new parts or if disassembled :

Mount O-ring on axle housing /part I and install axle drive housing, pay attention to radial installation position.

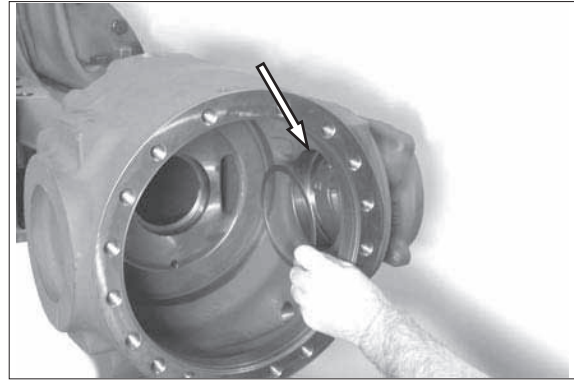
- Tightening torque (M18×1.5/10.9) :
39.8 kgf · m (288 lbf · ft)



7409AAX202

Determine shim for pinion position required to obtain an optimum contact pattern on the bevel gear set (crown wheel /pinion):

- ※ We recommend to reinstall the shim found during disassembly (e.g. "S" = 1.20 mm, see disassembly instructions, AX137) into the inner bearing hole / pinion bearing.
- ※ The contact pattern required on the bevel gear set, however, is decisive. If this is not achieved, see contact pattern check on figure AX237, correct the pinion position with a corresponding shim.
- ※ As an alternative, a basic setting of the required pinion position can be made, e.g. when assembling a new part, as shown below (see AX204~AX206).

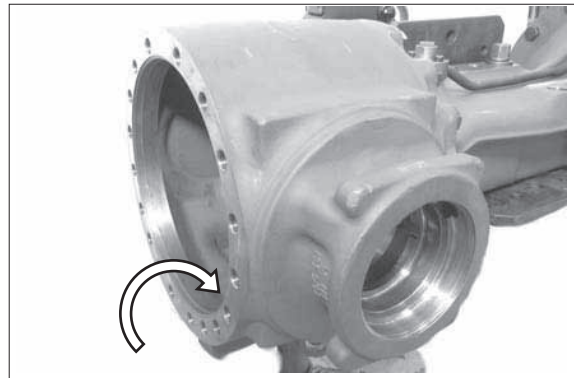


7409AAX203

Basic setting of pinion position :

- ① Read dimension "I" = production dimension /axle drive housing (from axle center to bearing contact /inner bearing hole) from the axle drive housing (position, see arrow).

Dimension I e.g. 182.81 mm



7409AAX204

- ② Read pinion dimension "X" (pinion basic dimension e.g. = 148) from pinion, or determine it in case of a + or - deviation from pinion dimension due to production (value concerned is marked by hand on the pinion, e.g.+ 0.1).

Pinion dimension "X" (without + or - deviation value) = 148.0 mm

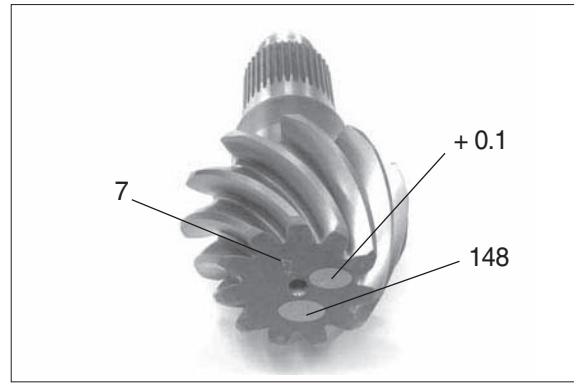
Pinion dimension "X" with indication of + 0.1 deviation = 148.1 mm

Pinion dimension "X" with indication of - 0.1 deviation = 147.9 mm

Dimension II (pinion dimension X)

e.g. 148.00 mm

- ※ Pairing number e.g. 7 - only for version with bevel gear set, see note AX201.



- ③ Determine dimension "III" bearing width, ensure here that the rollers are located without any play (rotate bearing inner ring in both directions several times, roller setting).

Since the installed roller bearing is subject to a pre-load in installation position, deduct an experience value of -0.05 mm.

Dimension III = e.g.
33.67 mm - 0.05 mm → 33.62 mm

CALCULATION EXAMPLE :

Dimension I 182.81 mm

Dimension II + III (148.00 + 33.62)

-181.62 mm

Result = 1.19 mm

Required shim "S" → 1.20 mm

Insert determined shim into the hole of the axle drive housing, see AX203.

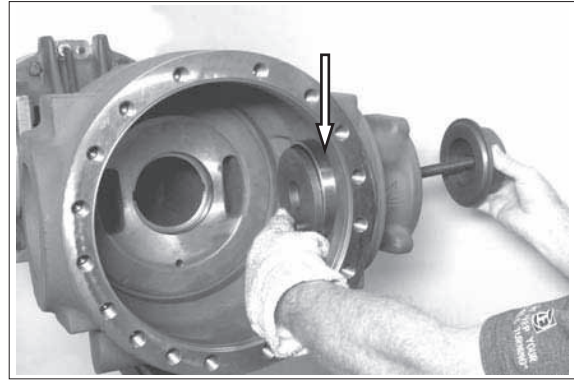
Digital depth gauge 5870 200 072

Gauge blocks 5870 200 066



- ④ Undercool bearing outer ring (see arrow) and bring it into contact position in the inner bearing hole /pinion bearing by means of the fixture.

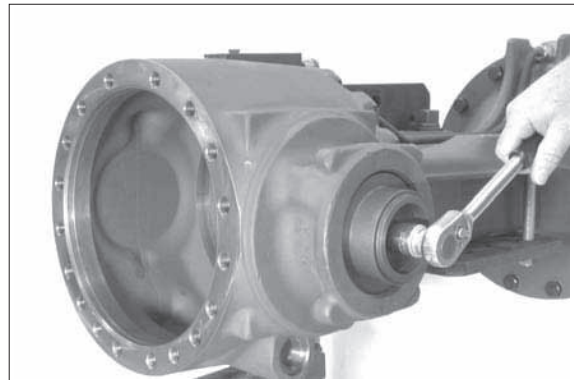
Assembly fixture 5870 345 049



7409AAX207

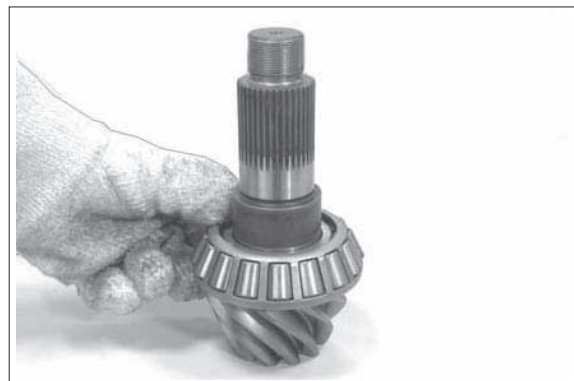
- ⑤ Install outside bearing outer ring /pinion bearing.

Assembly fixture 5870 345 049



7409AAX208

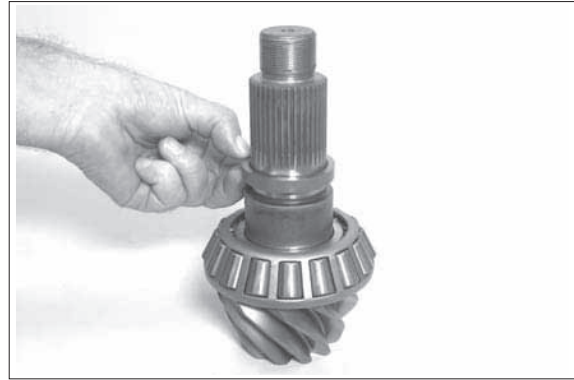
- ⑥ Mount heated bearing inner ring until contact position and adjust after cooling down.



7409AAX209

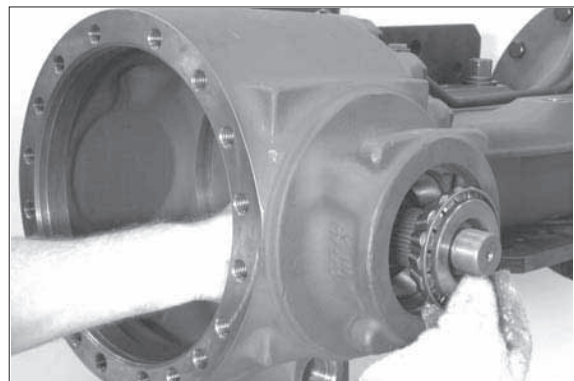
Set rolling torque of input pinion bearing 0.11~0.23 kgf · m (0.81~1.70 lbf · ft) (without shaft seal) :

- ⑦ Mount spacer ring (s = optional).
- ※ We recommend to reinstall the spacer ring found during disassembly (e.g. s = 8.7 mm).
If the originally installed shim was replaced (contact pattern /bevel gear set), see figure AX203, also install a spacer ring adjusted by the same correction value.
- ※ The required bearing rolling torque of 0.11~0.23 kgf · m (0.81~1.70 lbf · ft) (without shaft seal), however, is decisive, in case it is not achieved, see bearing rolling torque check (see AX213), correct the bearing rolling torque with a corresponding shim.



7409AAX210

- ⑧ Insert preassembled input pinion, mount heated bearing inner ring until contact is obtained.

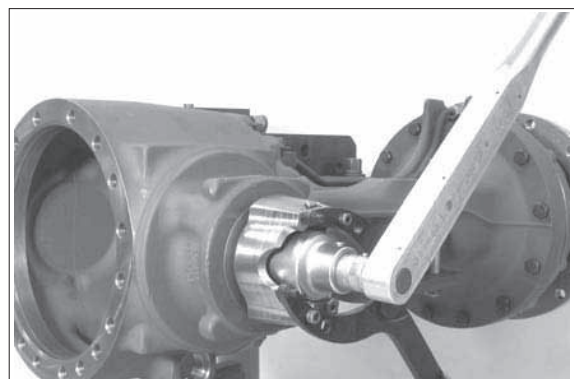


7409AAX211

- ⑨ Mount flange, fix with disc and hex. nut.
- ※ While tightening, rotate pinion in both directions several times (roller setting).

· Tightening torque (M36 × 1.5) :
71.4 kgf · m (516 lbf · ft)

Clamping fork 5870 240 025



7409AAX212

- ⑩ Check rolling torque of the pinion bearing.

Bearing rolling torque (without shaft seal)
: 0.11~0.23 kgf · m (0.81~1.70 lbf · ft).

Try to achieve upper value.

- ※ In case of a deviation from the required rolling torque correct it with a corresponding spacer ring (see AX210)

Torque wrench 5870 203 031

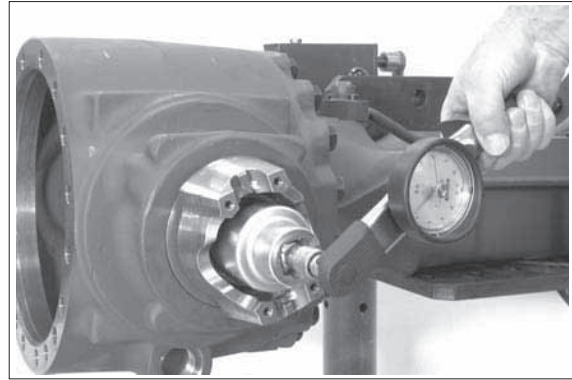
Reducing adapter ¼" to ½"

5870 656 056

Reducing adapter ½" to ¾"

5870 656 057

For assembly of shaft seal stick to description in page 3-115 (after completed differential assembly and positive contact pattern check).



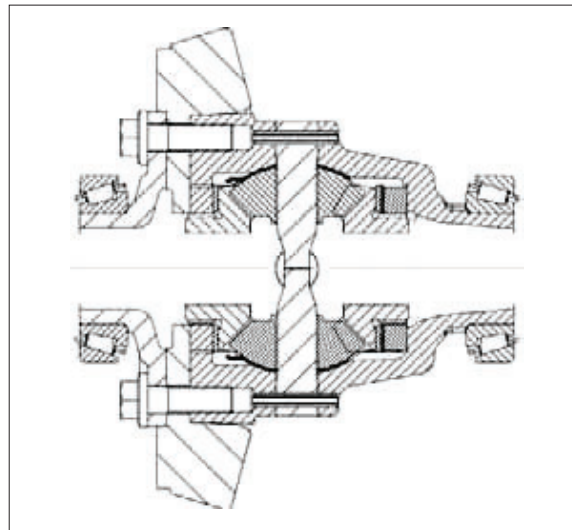
7409AAX213

(2) Differential assembly

Conventional differential (STD)

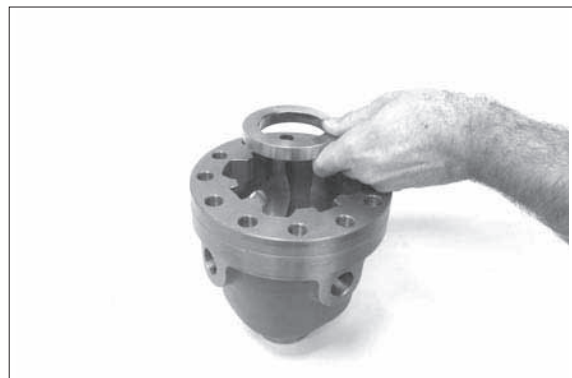
- ① Illustration in figure AX214 shows conventional differential.

- ※ Description of the reassembly of the limited slip differential from page 3-112.



7409AAX214

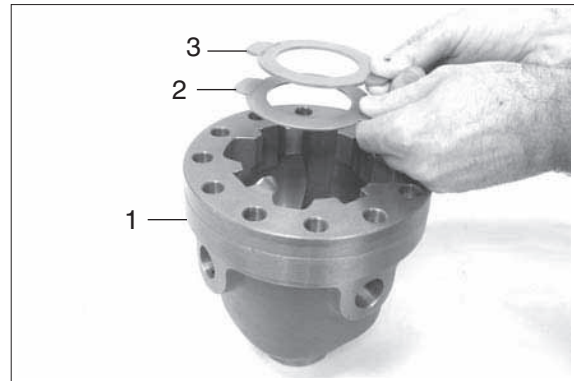
- ② Insert constant spacer into differential carrier.



7409AAX215

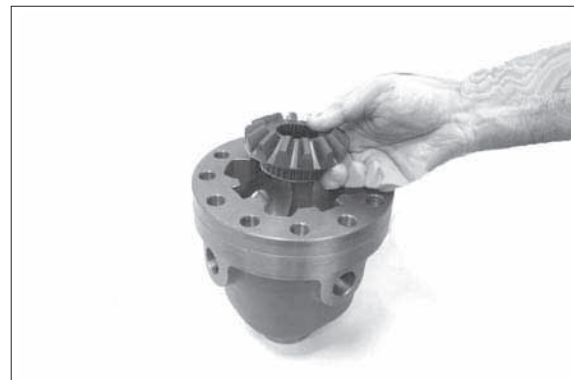
③ Insert steel outer disc (2) and thrust washer (3) into the differential carrier (1)

※ Pay attention to installation position of outer disc and thrust washer see position/figure.



7409AAX216

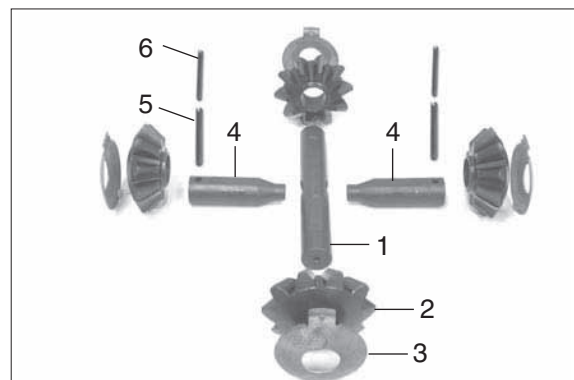
④ Insert axle bevel gear.



7409AAX217

⑤ Differential spider single parts :

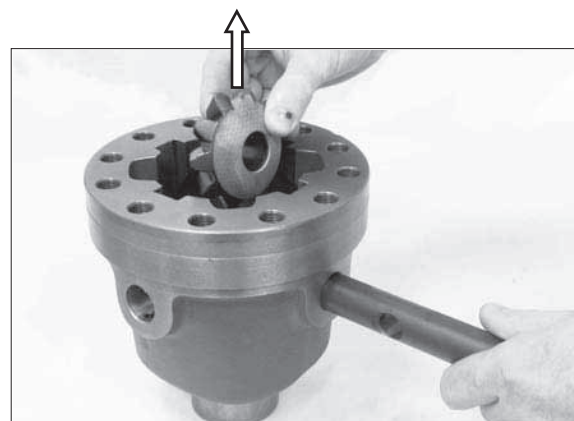
- 1 Spider shaft (one part)
- 2 Spider gear (4EA)
- 3 Thrust washer (4EA)
- 4 Spider shaft (split version)
- 5 Slotted pin (2EA)
- 6 Slotted pin (2EA)



7409AAX218

⑥ Insert one part spider shaft (1) into hole / differential (without slotted pin location hole) thereby mounting two spider gears (2) with thrust washers (3).

※ Insert thrust washers with tabs showing upwards (see arrow) and being located in recess.

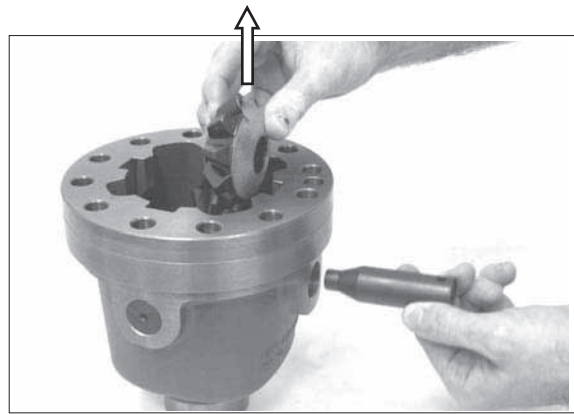


7409AAX219

⑦ Install split spider shaft (4) with spider gears (2) and thrust washers (3).

※ Insert thrust washers with tabs showing upwards (see arrow) and being located in recess.

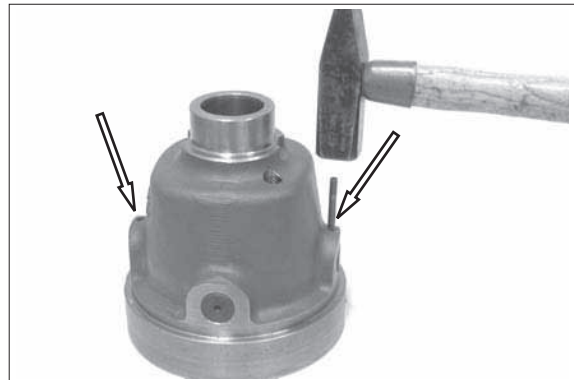
※ Pay attention to installation position of spider shaft/ halves-slotted pin/location holes of spider shaft towards differential carrier.



7409AAX220

⑧ Fix spider shaft half (arrows) with double slotted pins.

※ Install double slotted pins, always with slots in a 180° offset position to each other.



7409AAX221

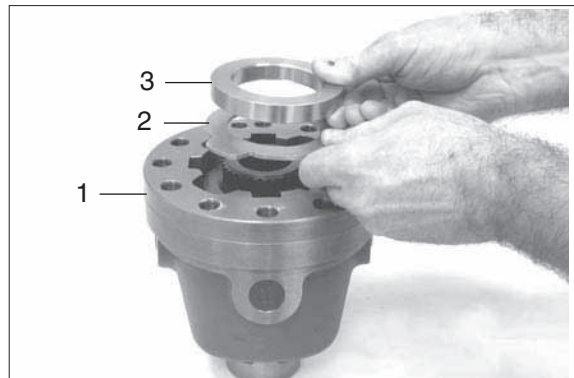
⑨ Insert second axle bevel gear into differential carrier.



7409AAX222

⑩ Insert thrust washer (2) and constant spacer (3) into differential carrier (1).

※ Pay attention to installation position of thrust washer and constant spacer, see position /figure.



7409AAX223

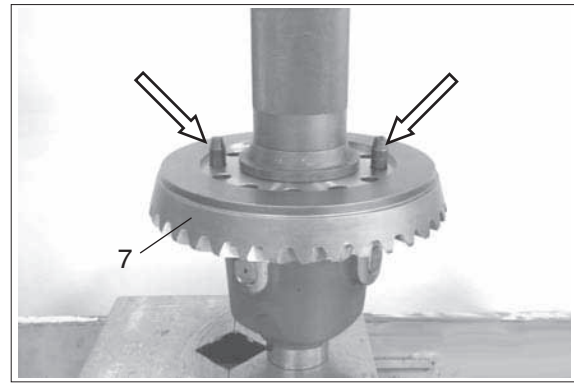
- ⑪ Install two adjusting screws (M16) (see arrows) and press crown wheel to contact position.

For input version with bevel gear set only, see specification in the corresponding spare parts list :

If a bevel gear set is specified, the pairing number/crown wheel (e.g. "7") must be identical with pairing number/ input pinion (also refer to note on page 3-101, AX205).

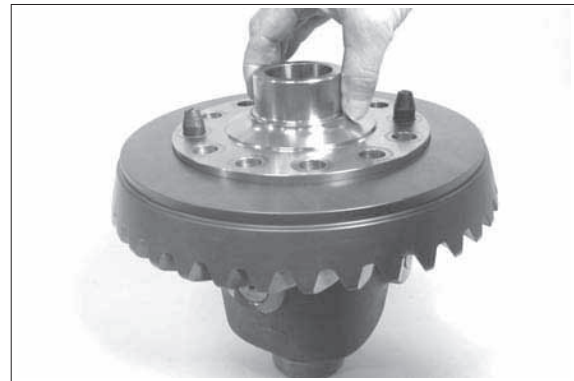
Adjusting screws (M16×1.5)

5870 204 040



7409AAX224

- ⑫ Mount housing lid.

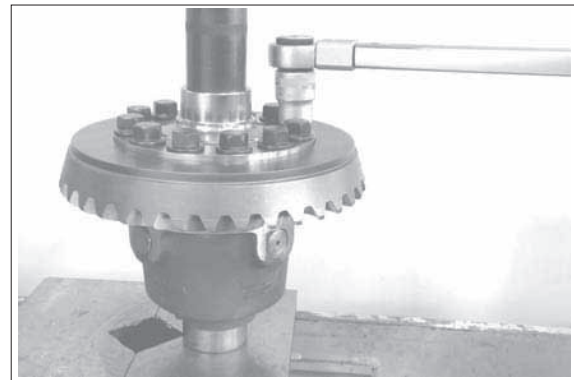


7409AAX225

- ⑬ Fix differential by means of a press and fix lid with new locking screws.

※ Locking screws permitted for one time use only.

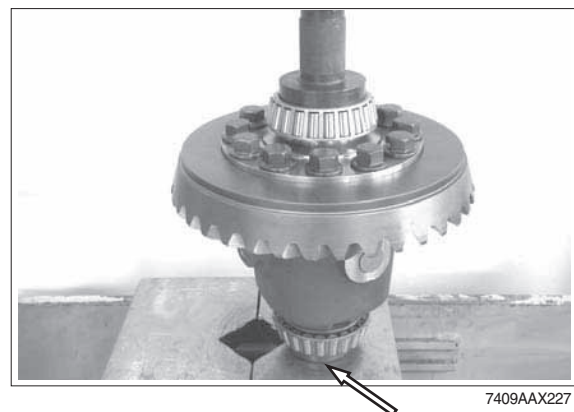
· Tightening torque (M16×1.5/12.9) :
42.8 kgf · m (302 lbf · ft)



7409AAX226

- ⑭ Press both bearing inner rings to contact position.

※ Use suitable support (arrow) for provisionally mounted bearing ring, roller bearing cage, risk of damage.



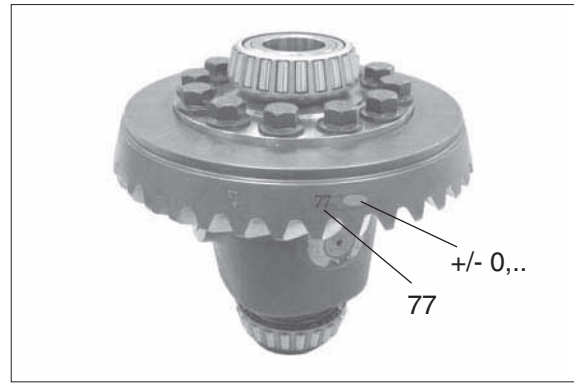
7409AAX227

Determine shims for bearing rolling torque /differential bearing and backlash /bevel gear set

- ⑮ Read crown wheel labeling (test dimension) from crown wheel rear side.

Determine required shims by means of the read value (crown wheel) and the relating specifications of the following table :

Test dimension, e.g. "77" mm is stamped on the crownwheel rear side, without + or - deviation, which corresponds to the real value/test dimension "77" in the following table. The required shims according to this real value /test dimension are allocated in the following table.



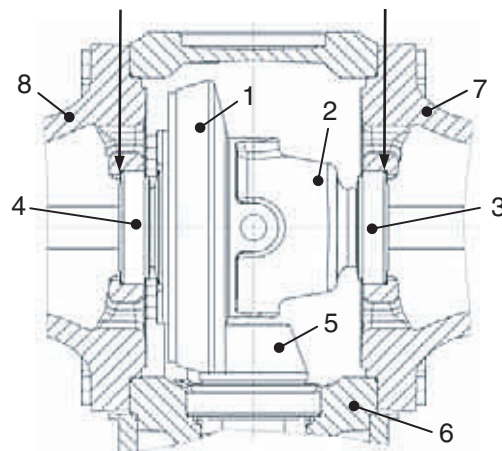
7409AAX228

- ⑯ Any + or - deviation from the test dimension due to production is manually applied on the crown wheel rear side (e.g. - 20 or - 10 or 10).

The required shims according to this real value /test dimension are allocated in the following table.

- 1 Crown wheel
- 2 Differential carrier
- 3 Tapered roller bearing (crown wheel side)
- 4 Tapered roller bearing (differential carrier side)
- 5 Input pinion
- 6 Axle drive housing
- 7 Axle housing
- 8 Axle housing

Shim crown wheel side **Shim diff carrier side**
 Bearing roll torque Backlash bevel gear
 differential bearing set



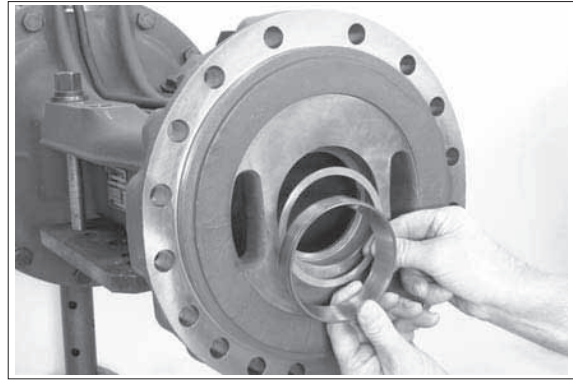
7409AAX229

| Shims for differential | | | | |
|--|------------|------------|------------|------------|
| Crown wheel marking | - 20 | - 10 | - | 10 |
| Deviation | - 0.2 | - 0.1 | 0 | 0.1 |
| Shim / Differential cage side Shim thickness | 0.8 | 0.9 | 1.0 | 1.1 |
| Shim | ZGAQ-02566 | ZGAQ-02567 | ZGAQ-02568 | ZGAQ-02569 |
| Shim / Crown wheel side Shim thickness | 1.2 | 1.1 | 1.0 | 0.9 |
| Shim Conventional, Limited slip | ZGAQ-02570 | ZGAQ-02569 | ZGAQ-02568 | ZGAQ-02567 |

- ⑰ Insert determined shim (e.g. $s = 1.00$ mm) and bearing outer ring into hole of axle housing on crown wheel side.

※ Observe allocation of shim regarding installation position.

Driver tool 5870 058 021
Handle 5870 260 002

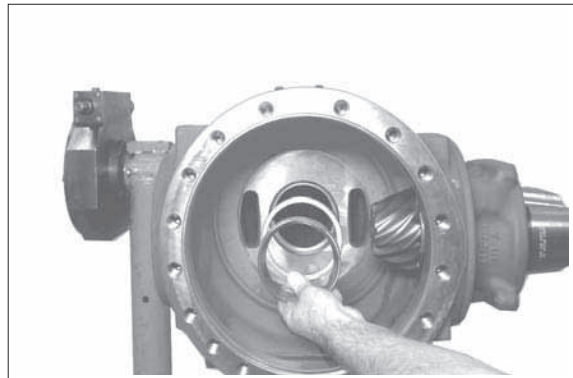


7409AAX230

- ⑱ Insert determined shim (e.g. $s = 1.00$ mm) and bearing outer ring into hole of axle housing on differential carrier side.

※ Observe allocation of shim regarding installation position.

Driver tool 5870 058 021
Handle 5870 260 002



7409AAX231

Contact pattern check of bevel gear set :

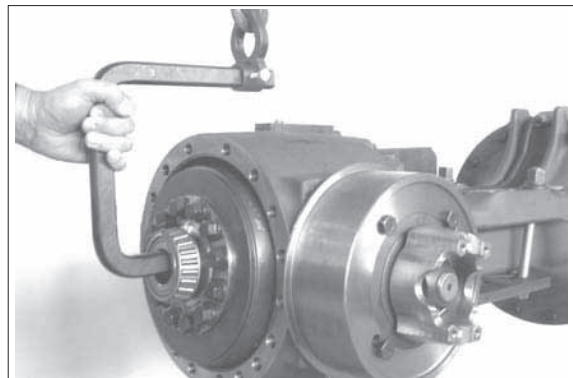
- ⑲ Cover some tooth flanks of crown wheel with marking ink (contact pattern check).



7409AAX232

- ⑳ Insert preassembled differential.

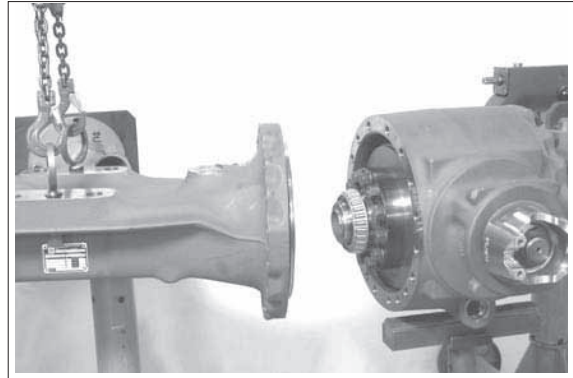
Lifting bracket 5870 281 033



7409AAX233

- ②① Position axle housing of crown wheel side (without O-ring) on axle drive housing, pay attention to radial installation position.

Lifting chain 5870 281 047
Eyebolts 5870 204 071



7409AAX234

- ②② Bring axle housing to contact position with hexagon screw and fix temporarily. Rotate differential several times in both directions, roller setting (also see AX236).

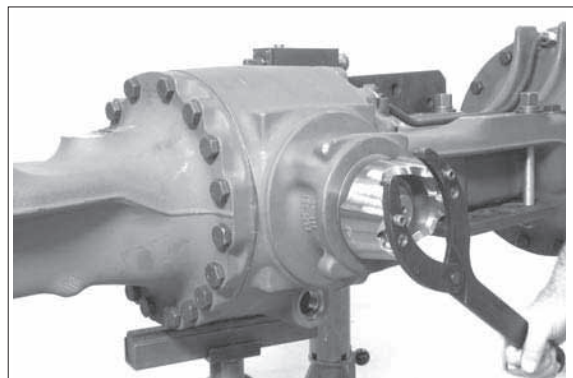
· Tightening torque (M18/10.9) :
39.8 kgf · m (288 lbf · ft)



7409AAX235

- ②③ Roll input pinion over crown wheel in both directions (coast-drive flank meshing-contact pattern).

Clamping fork 5870 240 025



7409AAX236

- ②④ Disassemble differential.
Compare contact pattern.

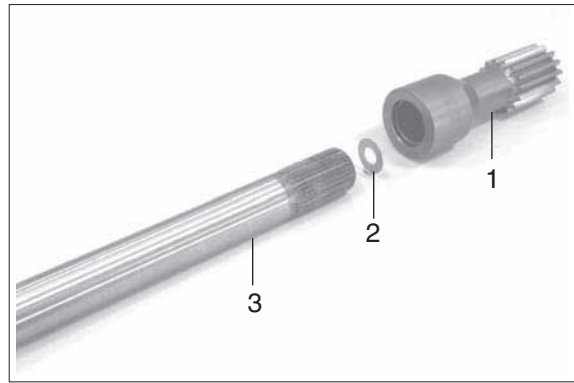
※ If contact pattern differs considerably, use a suitable shim for correction (see AX203, page 3-224).



7409AAX237

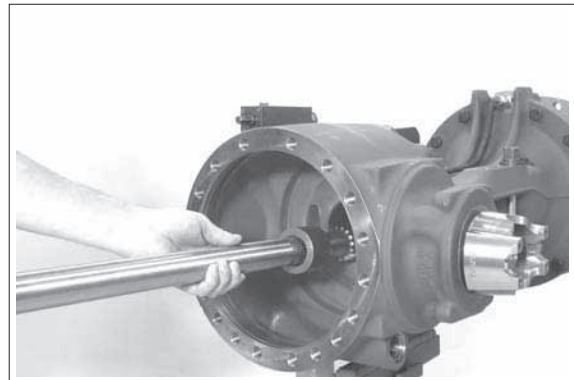
- ②⑤ If disassembled :
Insert shim(s) (2) into sun gear shaft (1)
and mount stub shaft (3).

- ※ If position was not allocated, as specified
in disassembly instructions on AX103,
sun gear shaft clearance (see
AX330~AX334) must be set on both
output sides.



7409AAX238

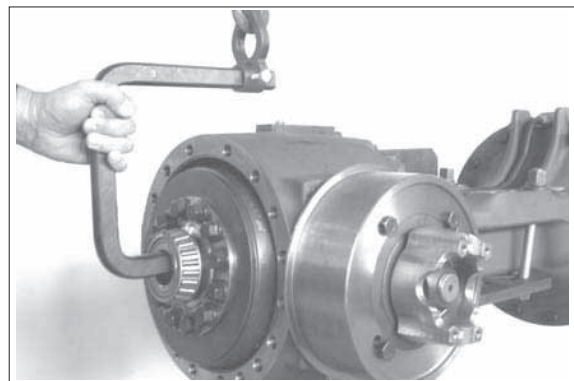
- ②⑥ Insert preassembled stub shafts into
both outputs (considering allocation to
the correct output side).



7409AAX239

- ②⑦ Remount differential by mounting stub
shaft into gearing of axle bevel gear
(differential).

Lifting bracket 5870 281 033

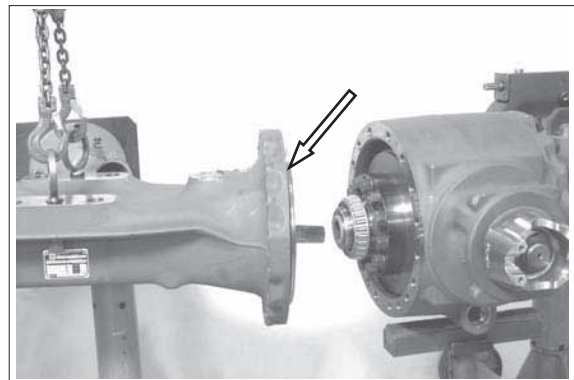


7409AAX240

- ②⑧ Oil O-ring (arrow) and mount it.
Position complete axle half on the axle
drive housing by mounting the stub shaft
into the gearing of the axle bevel gear
(differential).

- ※ Pay attention to radial installation position
of output towards axle drive housing.

Lifting chain 5870 281 047
Eyebolts 5870 204 071



7409AAX241

- ② Fix axle housing finally by means of hexagon screws.
 Rotate differential several times in both directions roller setting.

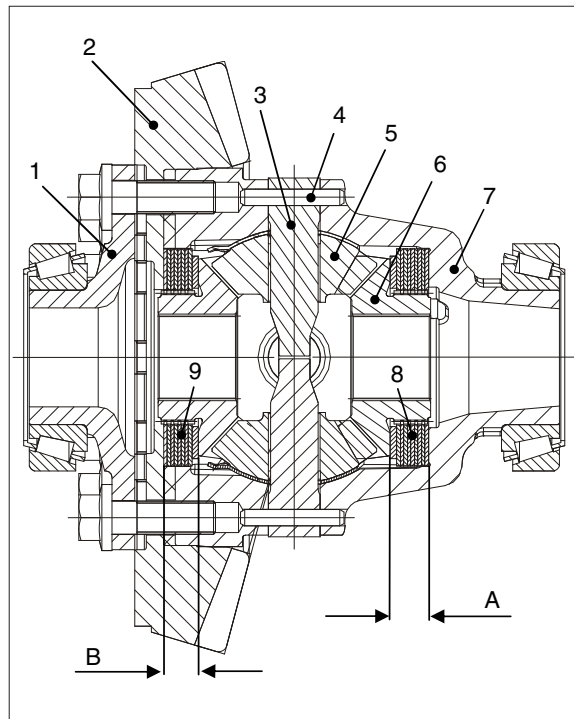
· Tightening torque (M18/10.9) :
 39.8 kgf · m (288 lbf · ft)



7409AAX242

(3) Limited slip differential (OPT) assembly

- 1 Housing cover
 - 2 Crown wheel
 - 3 Spider shaft (split version) (2EA)
 - 4 Double slotted pins
(5 × 50 and 8 × 50 mm)
 - 5 Spider gear
 - 6 Axle bevel gear
 - 7 Differential carrier
 - 8 Disk package "A"
 - 9 Disk package "B"
- A Installation dimension = 18.6 - 0.2 mm
 B Installation dimension = 16.7 - 0.2mm



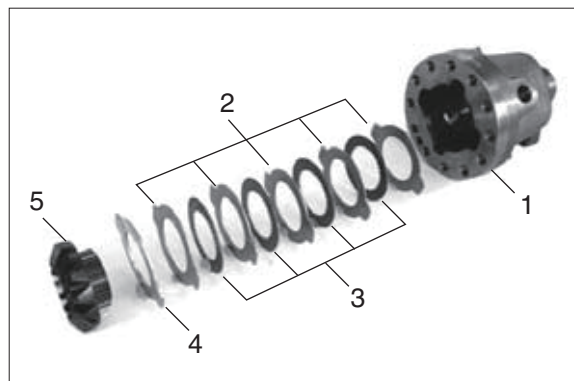
7409AAX247

- ① Mount the single parts as indicated on the figure right.

- 1 Differential carrier
- 2 5 outer disks (optional)
- 3 4 inner disks
- 4 Thrust washer (brass)
- 5 Axle bevel gear

- ※ Determine the installation dimension "A" = 18.6 - 0.2mm with the different outer disks (s = 1.8~2.0 mm), see also AX247. Pay attention to the disk arrangement, AX248.

Oil the single parts.

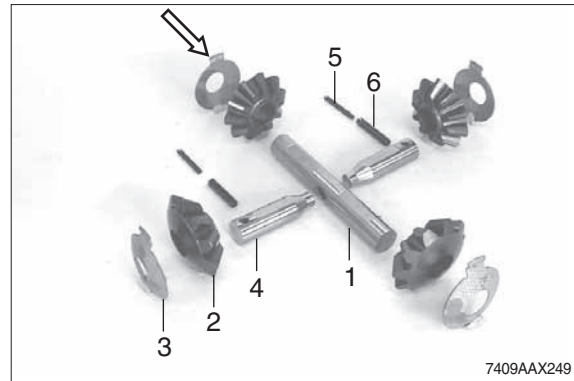


7409AAX248

- ② Mount the single parts, see AX249 and AX250.

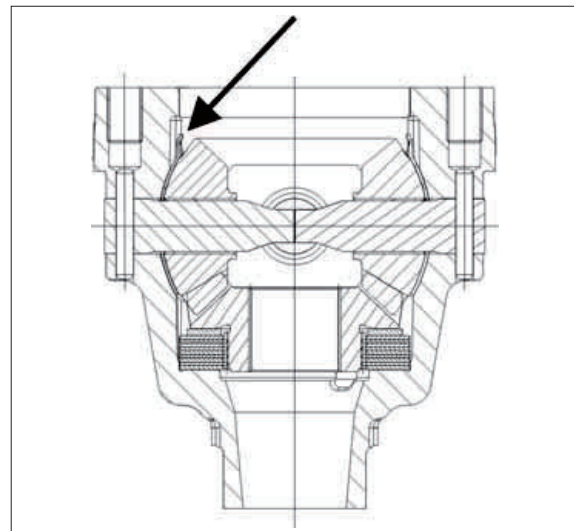
Single parts differential spider :

- 1 Spider shaft (one piece)
- 2 Spider gear (4EA)
- 3 Thrust washer (4EA)
- 4 Spider shaft (two pieces)
- 5 Slotted pins (2 pieces, 5 × 50 mm)
- 6 Slotted pins (2 pieces, 8 × 50 mm)



- ③ Pay attention to the radial installation position of the thrust washers (3). The torsional stop must show upwards, see arrow /AX250.

The two spider shafts (4) are fixed by means of double slotted pins (5 and 6). Thereby mount the slots of the slotted pins 180° offset to each other.



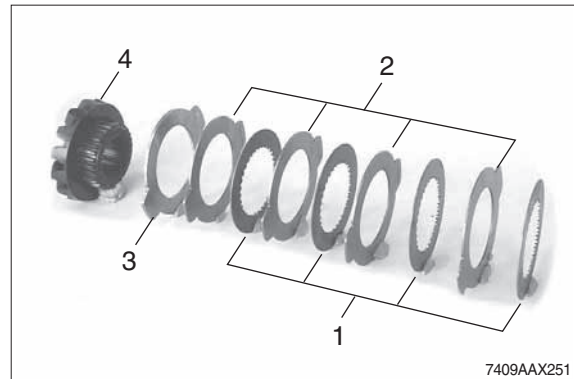
- ④ Mount the single parts as indicated on the figure right.

- 1 4 inner disks
- 2 4 outer disks (optional)
- 3 Thrust washer (brass)
- 4 Axle bevel gear

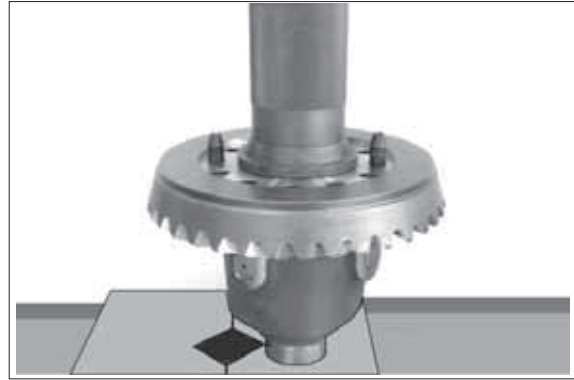
- ※ Determine the installation dimension ("B" = 16.7 - 0.2 mm) with the different outer disks = 1.8~2.0 mm), see also AX247.

Pay attention to the disk arrangement, see AX251.

Oil the single parts.



- ⑤ Mount two adjusting screws and press the crown wheel until contact is obtained.



7409AAX252

- ⑥ Mount the housing cover.

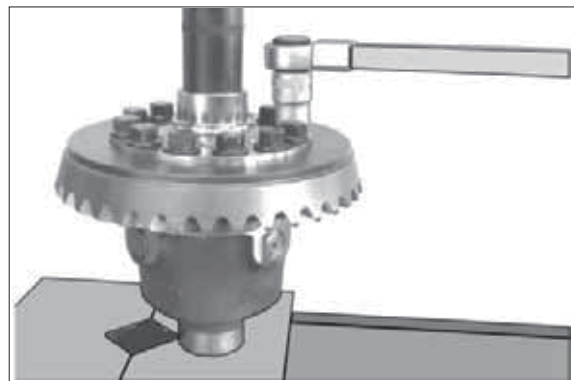


7409AAX253

- ⑦ Bolt housing cover, crown wheel and differential housing.

· Tightening torque (M16×1.5/12.9) :
42.8 kgf · m (302 lbf · ft)

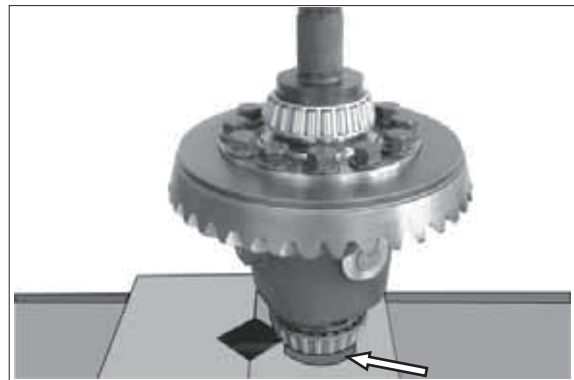
- ※ It is only permitted to use new locking screws.



7409AAX254

- ⑧ Press both bearing inner rings until contact position is obtained.

- ※ Support the lower tapered roller bearing appropriately (arrow), pay attention that the roller cage is not damaged.

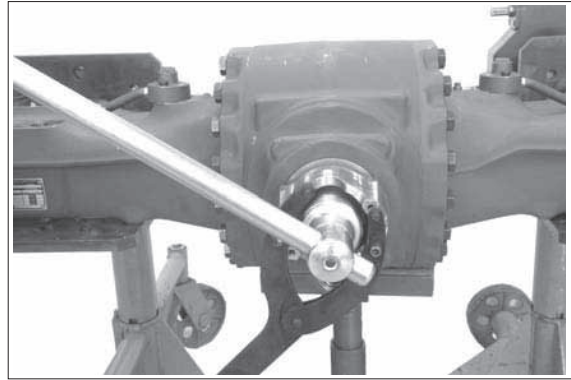


7409AAX255

(4) Shaft seal /input flange assembly

- ① Remove flange.

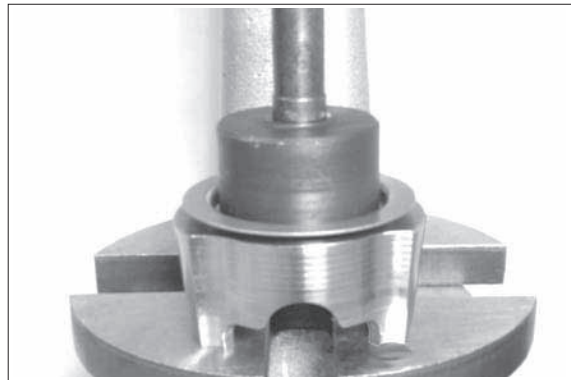
Clamping fork 5870 240 025



7409AAX289

- ② For new parts assembly only :
Mount protection plate on screen sheet
on input flange and bring to contact
position.

※ Pay attention to installation position of
screen sheet also see AX292.



7409AAX290

- ③ Insert shaft seal (1), considering the
required installation position (dimension
"X") see detailed AX292.

Contact face (outer diameter) of shaft
seal :

- if rubber - coated :

 wet with spirit (assembly aid)

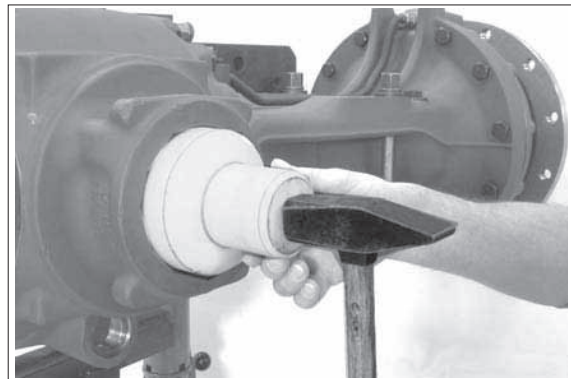
- if made of metal :

 apply sealing agent (loctite no. 574)

Grease the shaft seal around the sealing
and dust lip.

※ Ensure plane installation position of shaft
seal use the specified driver tool to
obtain an exact installation position of the
shaft seal.

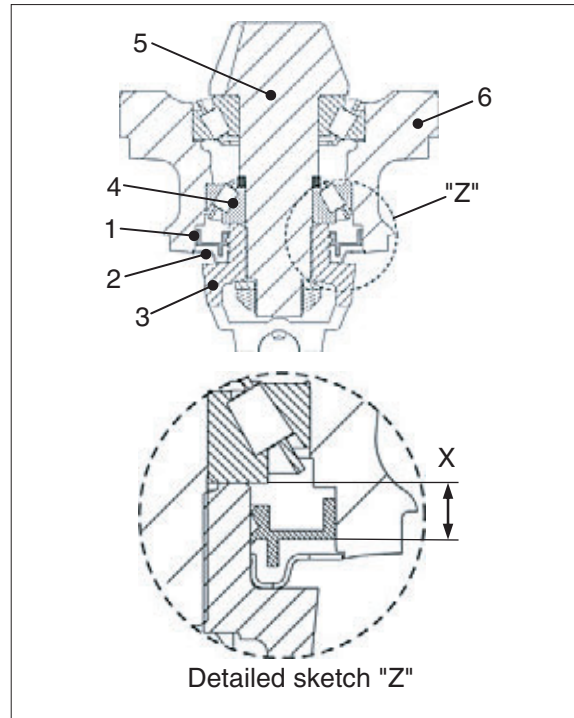
Driver tool 5870 048 225



7409AAX291

- 1 Shaft seal
- 2 Protection plate
- 3 Input flange
- 4 Tapered roller bearing
- 5 Input pinion
- 6 Axle drive housing

X = Install. dimension 16.6 ± 0.2 mm



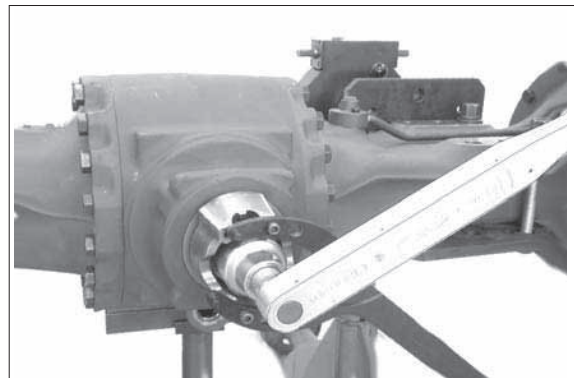
7409AAX292

- ④ Mount flange, fix with washer and hexagon nut.
During tightening, rotate pinion several times in both directions (roller setting).

※ Install hexagon nut with locking compound (loctite #262).

- Tightening torque (M36×1.5) :
71.4 kgf · m (516 lbf · ft)

Clamping fork 5870 240 025



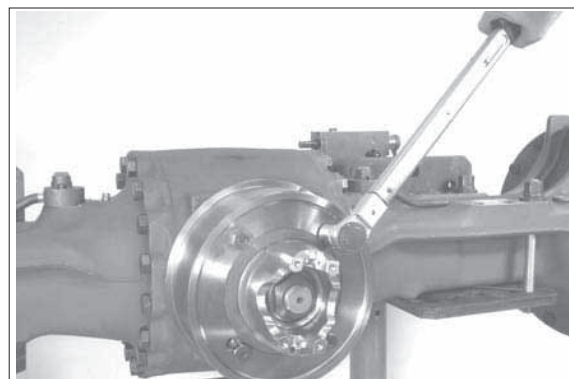
7409AAX293

(5) Pivot bearing assembly

For version with pivot bearing only (AX294) :

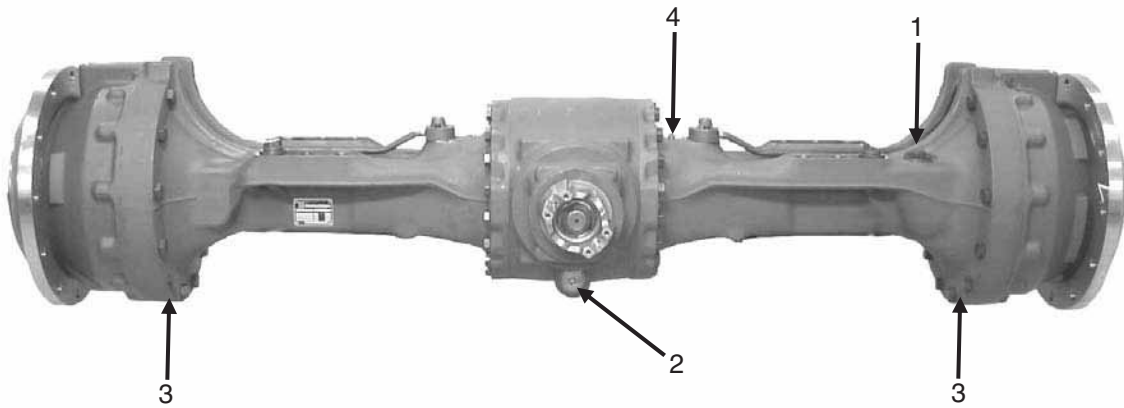
Mount bearing flange and fix with hexagon screws.

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



7409AAX294

(6) Oil dipstick, drain plugs and breather valve assembly



7409AAX295

- 1 Oil dipstick
- 2 Drain plug /axle drive housing
(Axle version with pivot bearing is fitted with another drain plug)
- 3 Drain plug/output
- 4 Depending on version
Breather valve or screw plug

Provide oil dipstick and drain plugs with new O-ring and install them.
Mount breather valve or screw plug, depending on version.

· Tightening torque

Oil dipstick (M36 × 1.5) : 5.1 kgf · m (36.9 lbf · ft)

Drain plug (M36 × 1.5) : 5.1 kgf · m (36.9 lbf · ft)

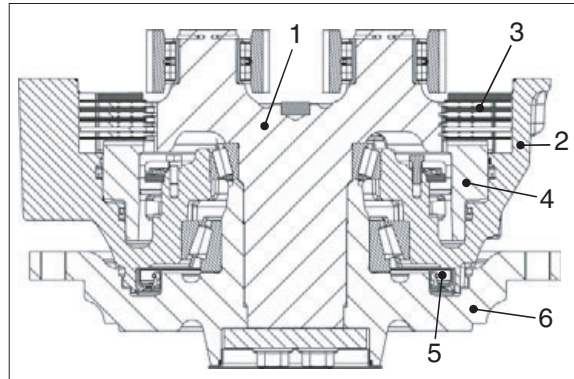
Drain plug (M24 × 1.5) : 5.1 kgf · m (36.9 lbf · ft)

Breather valve /screw plug (M10 × 1) : 0.6 kgf · m (4.4 lbf · ft)

(7) Output and brake assembly

- 1 Planetary carrier
- 2 Brake housing
- 3 Disc package
- 4 Piston
- 5 Combi seal ring
- 6 Output shaft

Assembly truck 5870 350 000
Fixture 5870 350 112



7409AAX301

Close apertures of oil supply holes with plugs.

Hand tool 5870 320 014
Ratchet wrench 5870 320 018



7409AAX302

Installation combi seal ring

- ① Mount shaft seal (part I /combi seal ring) considering installation dimension "X", see detailed sketch AX304.
- ※ Wet contact faces of shaft seal /brake housing with spirit right before assembly, assembly aid.
- ※ Grease shaft seal around the dust and sealing lips.
- ※ Observe plane installation position of shaft seal, use the specified driver to ensure an exact shaft seal installation position.

Driver tool 5870 051 065

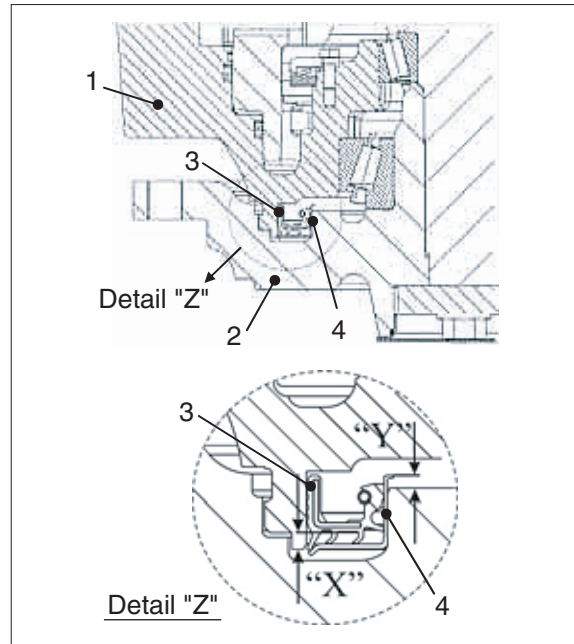


7409AAX303

- 1 Brake housing
- 2 Output shaft
- 3 Shaft seal (part I)
- 4 Wear sleeve (part II)] combi seal ring

"X" = installation dimension /shaft seal
 $4.1 + 0.2 \text{ mm}$

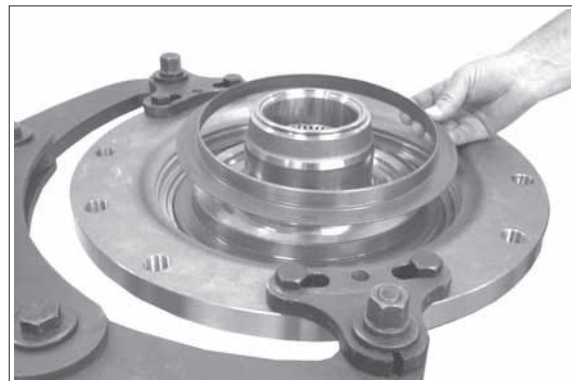
"Y" = installation dimension /wear sleeve
 $2.6 + 0.2 \text{ mm}$



7409AAX304

- ② Apply sealing agent (loctite #574) on contact faces of wear sleeve /output shaft and mount wear sleeve (part I / combi seal ring) considering installation dimension "Y" see detailed AX304.

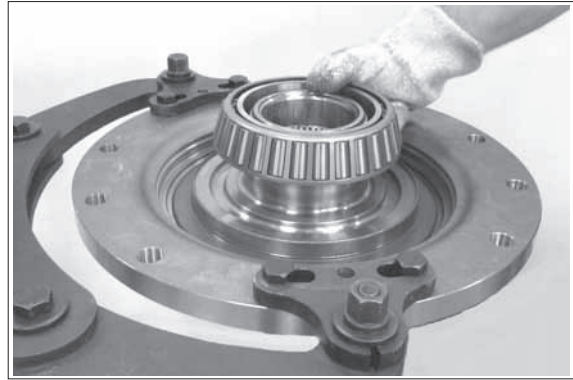
Pressing device 5870 506 172



7409AAX305

Output shaft /brake housing

- ① Mount heated bearing inner ring until contact.
- ※ Adjust bearing inner ring after cooling down.



7409AAX306

- ② Press outside bearing outer ring into brake housing until contact.

Driver tool 5870 050 010



7409AAX307

- ③ Press inside bearing outer ring into brake housing until contact.

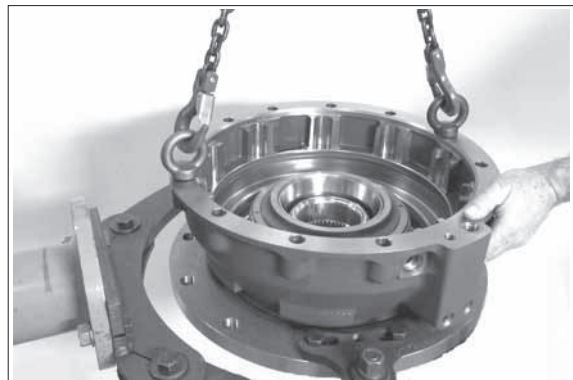
Driver tool 5870 050 003



7409AAX308

- ④ Position preassembled brake housing on the output shaft.

Lifting chain 5870 281 047
Eyebolts 5870 204 071



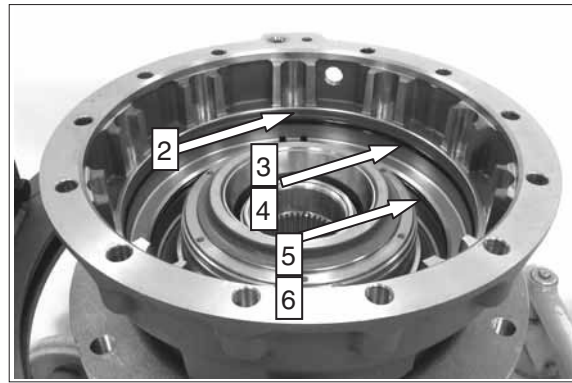
7409AAX309

⑤ Insert sealing elements (arrows) into annular grooves of brake housing paying attention to installation position and arrangement, in this context refer to AX311.

※ Guide ring installation :

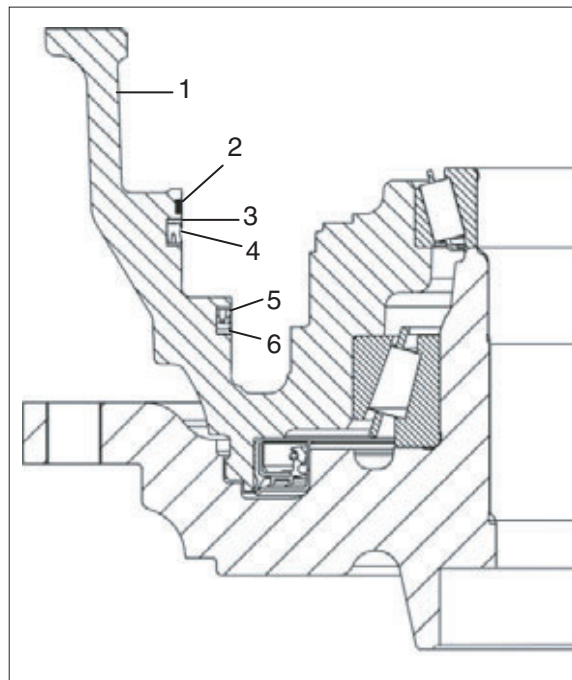
Clean annular groove of brake housing with spirit. Then insert guide ring into annular groove - Ensure an exact contact position of the whole guide ring circumference - afterwards stick guide ring with glue (loctite #415) on its endpoints.

※ Ensure a correct installation position of the guide ring - Endpoints of guide ring to be in 12 o'clock position in the axle installed in the vehicle (radial position in brake housing - area of brake oil supply and vent hole).



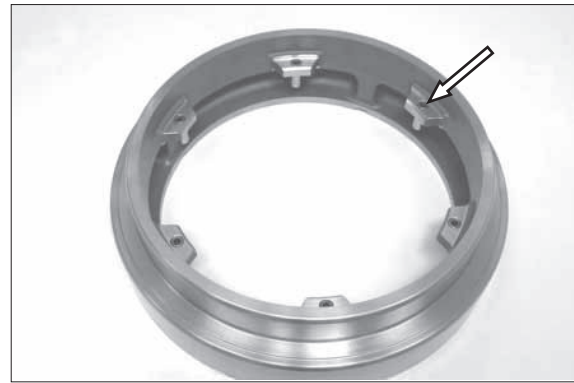
7409AAX310

- 1 Brake housing
- 2 Guide ring
- 3 Support ring
- 4 Grooved ring
- 5 Grooved ring
- 6 Support ring



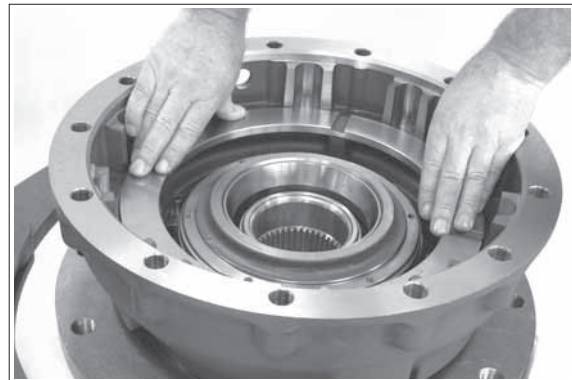
7409AAX311

- ⑥ Flush-mount slotted pins (for installation position refer to arrow) into the piston, if not disassembled, adjust adequately (flushfitting).



7409AAX312

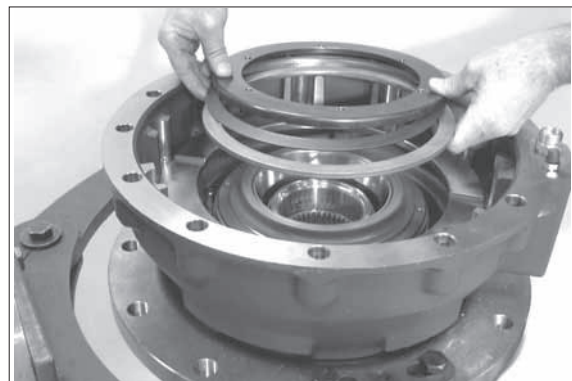
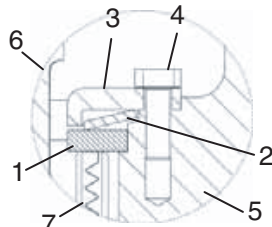
- ⑦ Oil sealing/sliding surface of piston and sealing elements.
Carefully bring piston in contact position.



7409AAX313

- ⑧ Insert disc, cup spring and lid considering the installation position, see detail sketch.

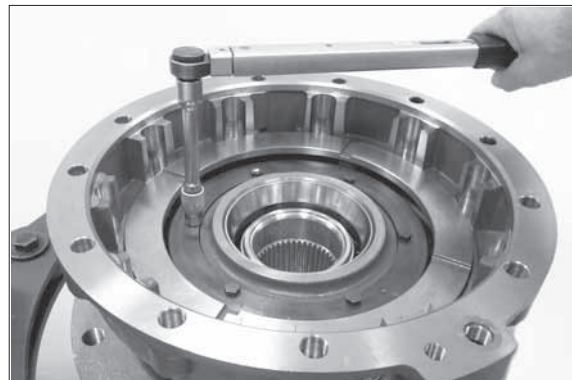
- 1 Disc
- 2 Cup spring
- 3 Lid
- 4 Hexagon screw
- 5 Brake housing
- 6 Piston
- 7 Slotted pin



7409AAX314

- ⑨ Fix lid with hexagon screws evenly until contact is obtained (cup spring pre load).
Finally tighten hexagon screws.

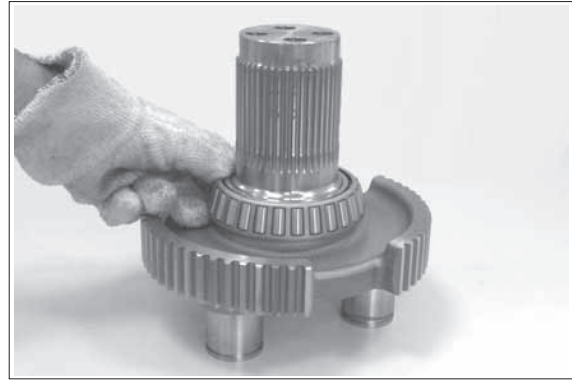
- Tightening torque (M8/10.9) :
3.47 kgf · m (25 lbf · ft)



7409AAX315

⑩ Mount heated bearing inner ring until contact.

※ Adjust bearing inner ring after cooling down.

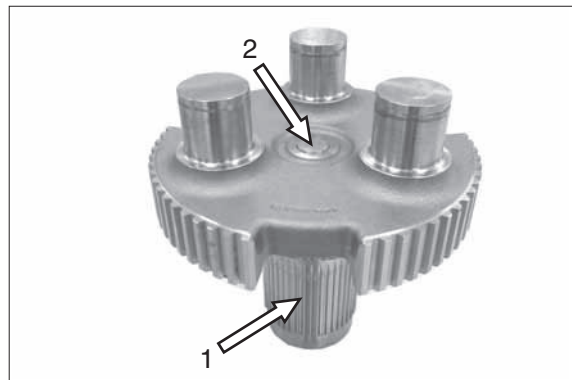


7409AAX316

⑪ Apply anti-corrosive agent on spline (arrow 1).

Only for assembly of a new planetary carrier or if disassembled :

Insert shim (arrow 2) into planetary carrier until contact.



7409AAX317

⑫ Insert pre assembled planetary carrier.

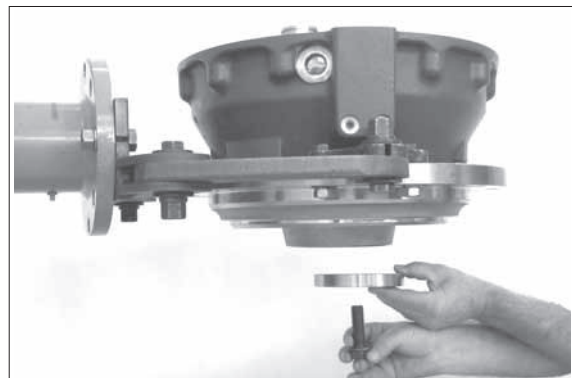
| | |
|----------------|--------------|
| Lifting chain | 5870 281 047 |
| Lifting device | 5870 281 082 |



7409AAX318

⑬ Fix planetary carrier with disc and new locking screws.

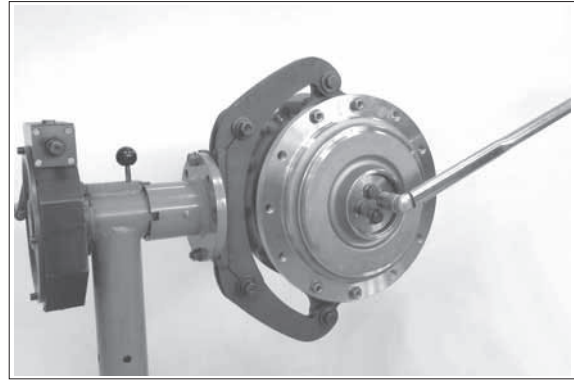
※ Do not reuse locking screws, just one time installation is permitted.



7409AAX319

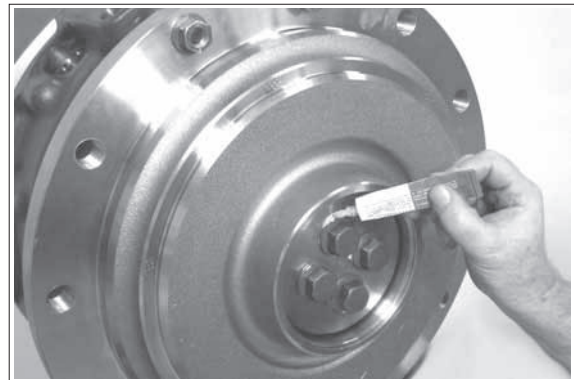
- ⑭ Evenly tighten locking screws crosswise while rotating the brake housing in both directions several times (roller setting).

· Tightening torque (M8/12.9) :
51.0 kgf · m (369 lbf · ft)



7409AAX320

- ⑮ Apply a screw safety marking paint on correctly installed locking screws.



7409AAX321

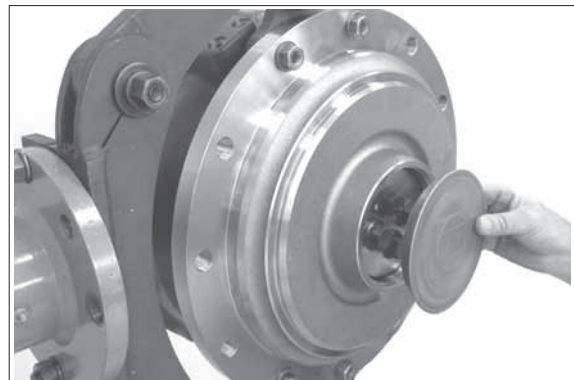
- ⑯ Mount O-ring (arrow) on lid.



7409AAX322

- ⑰ Insert pre-assembled lid into output shaft.

Plastic hammer 5870 280 004

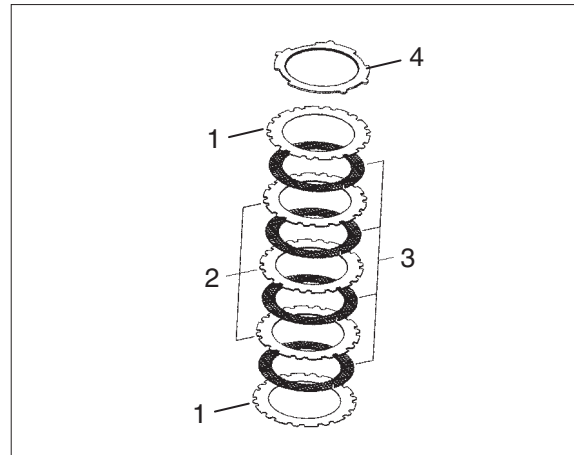


7409AAX323

Brake

※ Possible other versions could have a deviating equipment (number and arrangement of single discs), the illustration in the relating spare parts list forms the basis for the required equipment.

- 1 Outer disc s = 2.0 mm
- 2 Outer disc s = 4.0 mm
- 3 Inner disc (lined disc)
- 4 End plate



7409AAX324

① Insert disc package, considering disc arrangement and installation position of outer discs, see AX324.



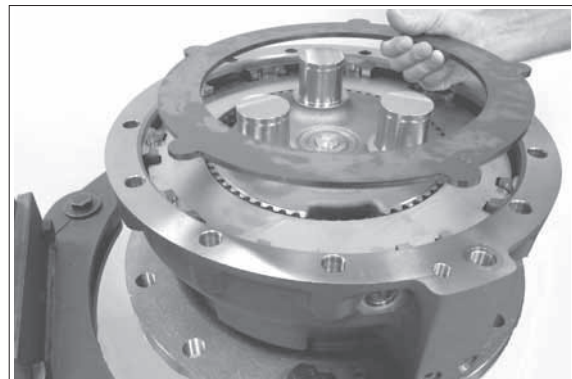
7409AAX325

② Insert end plate (item 4, see AX324) fix by means of grease assembly aid.

※ Ensure radial installation position driving tabs of end plate must be positioned in recessed grooves of the brake housing.

Locating screw 5870 204 078

※ Make leakage test on brake hydraulics see page 3-130.

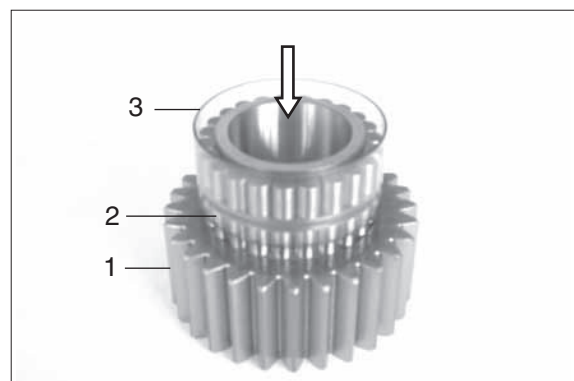


7409AAX326

③ Only for assembly of new parts :

Install cylindrical roller bearing into planetary gear by pressing roller bearing into planetary gear by means of assembly sleeve (arrow) until snap ring engages into annular groove of planetary gear.

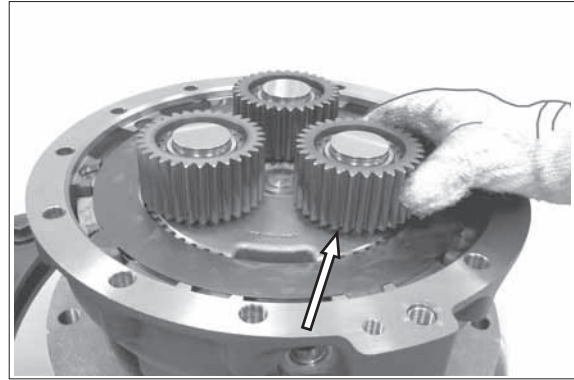
- 1 Planetary gear
- 2 Roller bearing
(with bearing inner ring /cylindrical rollers /axial discs and snap ring)
- 3 Assembly sleeve



7409AAX327

- ④ Heat up planetary gears and mount to the pin of the planetary carrier until contact is obtained, with the large radius /bearing inner ring showing downwards (arrow).

※ Adjust bearing after cooling down.

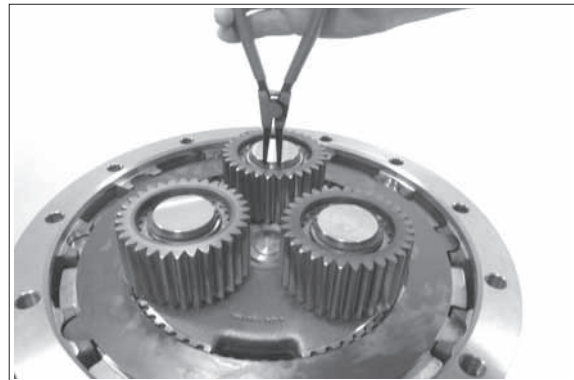


7409AAX328

- ⑤ Fix planetary gears with retaining ring.

※ Check contact position of retaining ring on groove base and readjust, if required.

Set of external pliers 5870 900 015

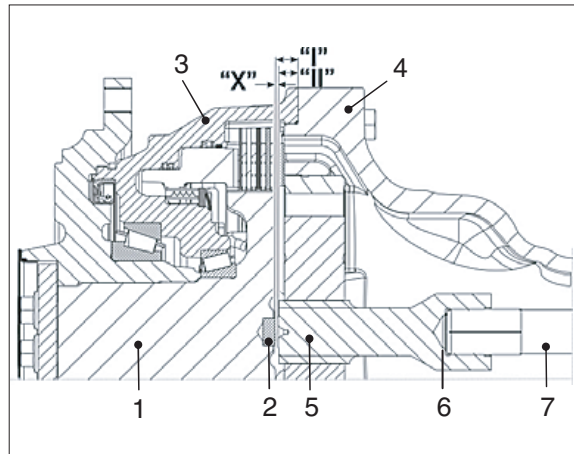


7409AAX329

Axial play setting of sun gear shaft :

- 1 Planetary carrier
- 2 Stop pin
- 3 Brake housing
- 4 Axle housing
- 5 Sun gear shaft
- 6 Shim (s = optional)
- 7 Stub shaft

"X" = axial play - sun gear shaft 0.5~2.0 mm

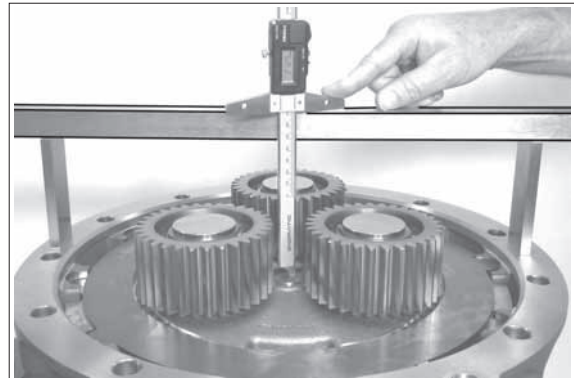


7409AAX330

- ① Determine dimension "I" from mounting face (brake housing/axle housing) to stop pin.

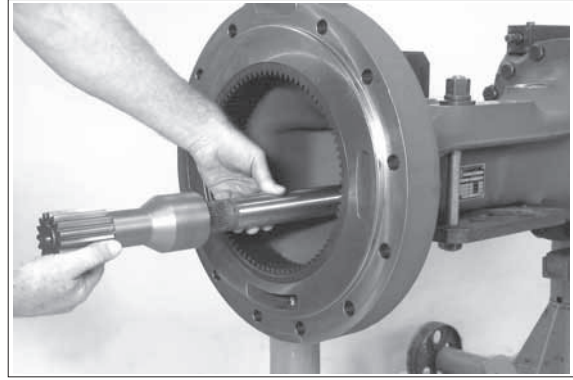
Dimension I e. g. 21.25 mm

Digital-depth gauge 5870 200 072
 Gauge blocks 5870 200 066
 Straightedge 5870 200 022



7409AAX331

- ② Mount stub shaft with fitted sun gear shaft (without shim) into differential /axle bevel gear until contact.



7409AAX332

- ③ Determine dimension "II" from mounting face (brake housing /axle housing) to front face /sun gear shaft.

Dimension II e. g. 19.00 mm

CALCULATION EXAMPLE:

Dimension I 21.25 mm

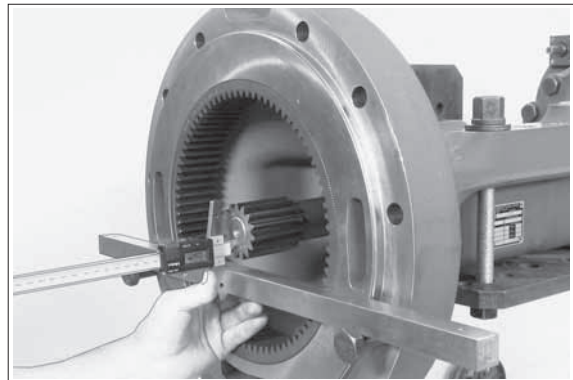
Dimension II - 19.00 mm

Difference 2.25 mm

Required axial play e.g. (average)

- 1.25 mm

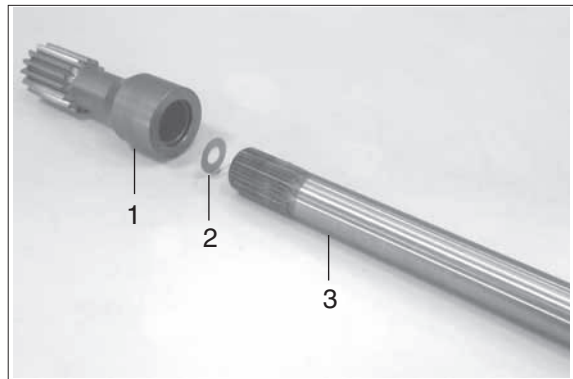
Result = shim required e.g. $s = 1.00$ mm



7409AAX333

- ④ Pull stub shaft with sun gear shaft out of axle housing.

Insert determined shim(s) (2) into sun gear shaft (1) and mount stub shaft (3).

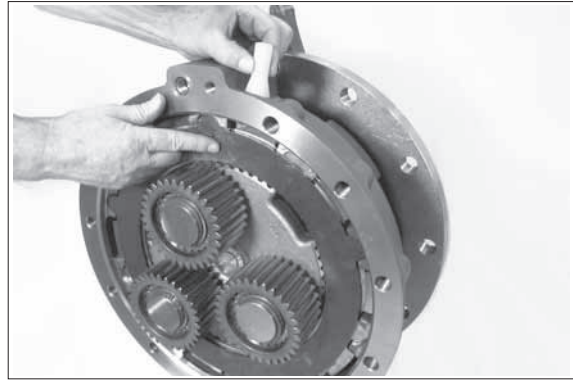


7409AAX334

Assemble output assy

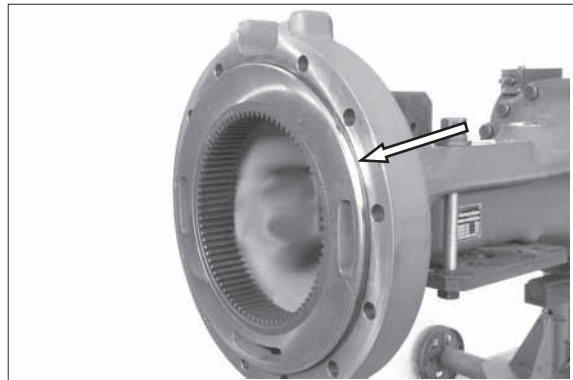
- ① Fix disc package by means of locating screw, assembly aid.

Locating screw 5870 204 078



7409AAX335

- ② Oil O-ring and mount on collar of axle housing.

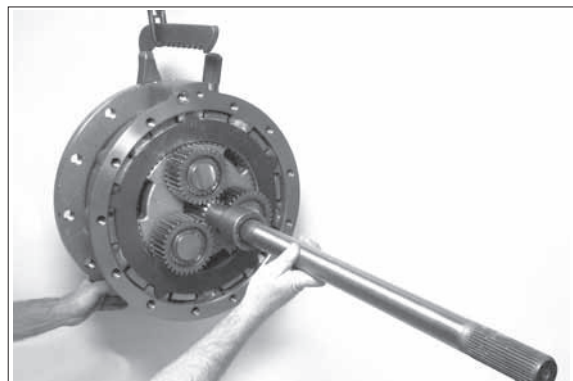


7409AAX336

- ③ Take up output by means of lifting bracket.

Mount pre-assembled sun gear /stub shaft into teeth of planetary gears.

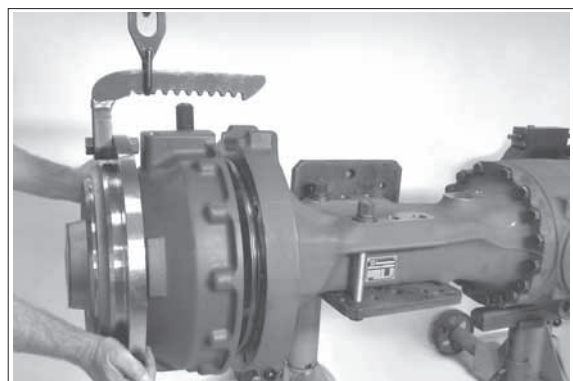
Lifting bracket 5870 281 043



7409AAX337

- ④ Bring output assy into contact position with axle housing by mounting the stub shaft into the gearing of the axle bevel gear /differential.

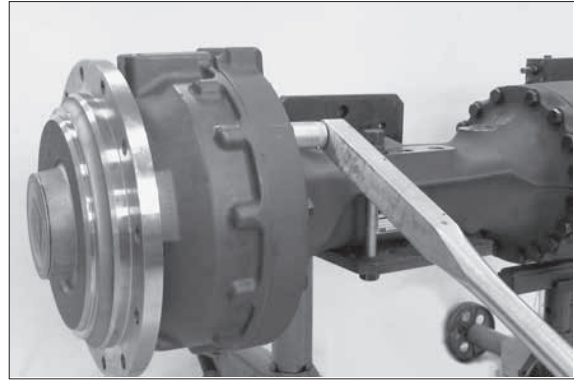
※ Pay attention to end plate see AX326, page 3-125.



7409AAX338

- ⑤ Connect output with axle housing evenly by means of hex. screws.

- Tightening torque (M18×1.5/10.9) :
39.8 kgf · m (288 lbf · ft)



7409AAX339

- ⑥ Install screw plug (1) with new O-ring.

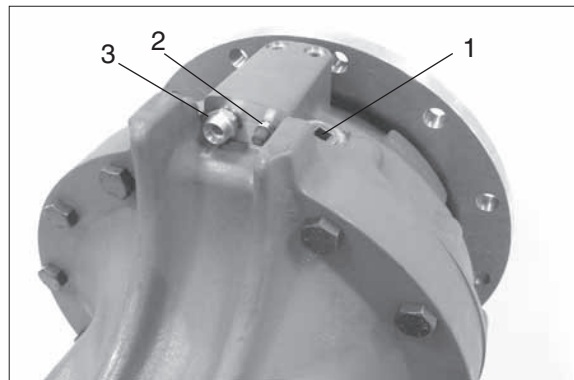
- Tightening torque (M24×1.5) :
5.1 kgf · m (36.9 lbf · ft)

Mount breather valve (2).

- Tightening torque :
0.6 kgf · m (4.4 lbf · ft)

Install screw neck (3) with new O-ring.

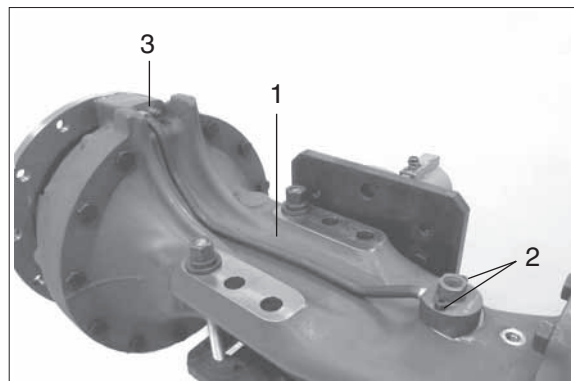
- Tightening torque :
3.7 kgf · m (26.6 lbf · ft)



7409AAX340

- ⑦ Install brake tube (1).

- Tightening torque:
Screw nut (2)
10.2 kgf · m (73.8 lbf · ft)
Cylindrical screw (3) (M8 /8.8)
2.35 kgf · m (17.0 lbf · ft)



7409AAX341

Make leakage test on brake hydraulics

- ※ Prior to starting the test, completely breathe brake hydraulics.

High pressure test :

Build up testing pressure $p = 100 - 10$ bar maximum and close connection to HP pump by means of a shutoff valve. A pressure drop by maximum 3% (3 bar) is permissible during a 5 minute test duration.

Low pressure test :

Reduce testing pressure to $p = 5$ bar and close shut off valve again.

No pressure drop is permitted during a 5-minute test duration.

Test medium : SAE 15W-40

HP-pump 5870 287 007

Straight screw-in connection
0637 842 518

Measuring fitting (M18 × 1.5)
5870 950 139

Oil collector bottle 5870 286 072

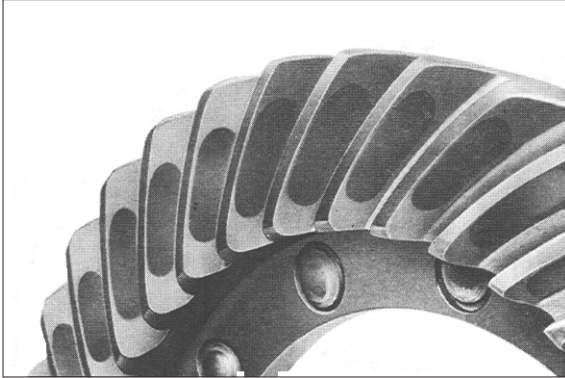


7409AAX342

※ **BACKLASH CHECK**

- Applied the paint (or red lead) on the surface of several bevel gear teeth.
- Turn the pinioin gear and check the contact pattern.

Correct pattern



WTHAX16

Concave side

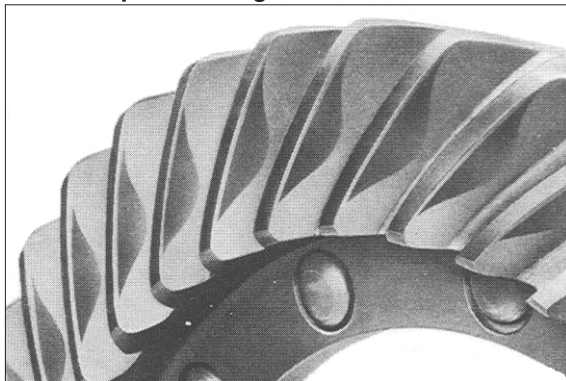


WTHAX17

Convex side

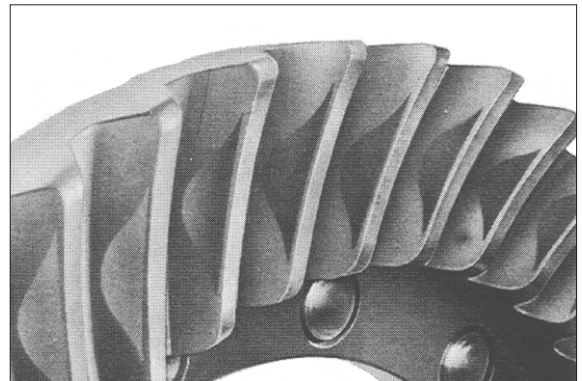
※ **ADJUSTMENT**

Incorrect pattern : high contact



WTHAX18

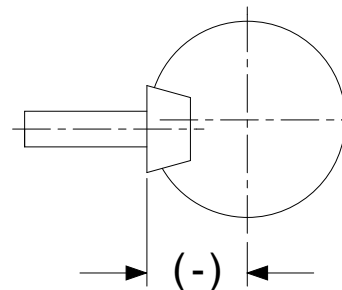
Concave side



WTHAX19

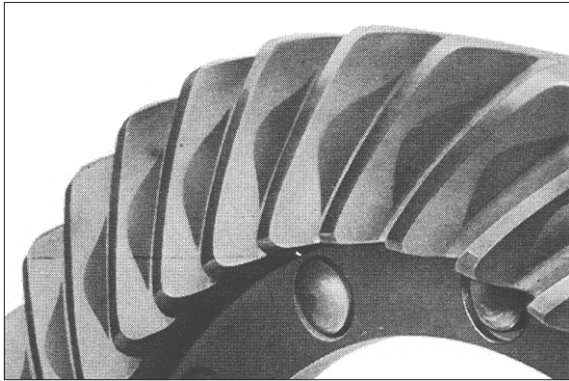
Convex side

- Reduce the distance (-)



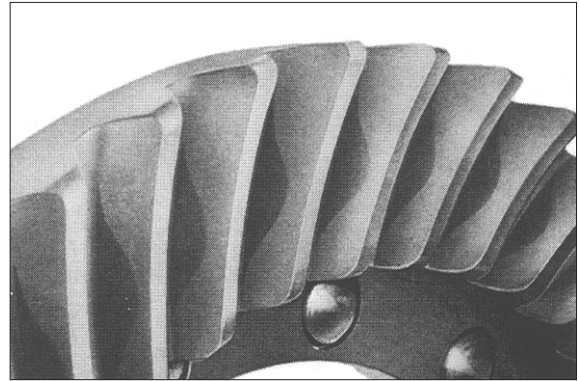
WTHAX20

Incorrect pattern, low contact



WTHAX21

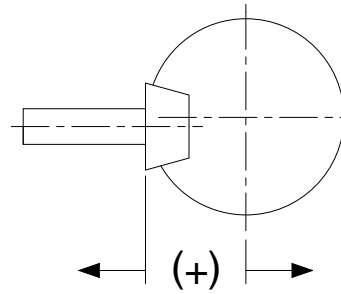
Concave side



WTHAX22

Convex side

- Add the distance (+)



WTHAX23

2. TRANSMISSION

Preparatory Activities

Mounting transmission on assembly truck

Special tools:

- 5870.350.090 Connection plate
- 5870.350.063 Clamping plate
- 5870.350.000 Assembly truck

CAUTION

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.

Use 5870.350.090 [Connection plate] and 5870.350.063 [Clamping plate] to fix transmission to 5870.350.000 [Assembly truck].

Draining oil



Observe the environmental regulations (*see General safety instructions*).

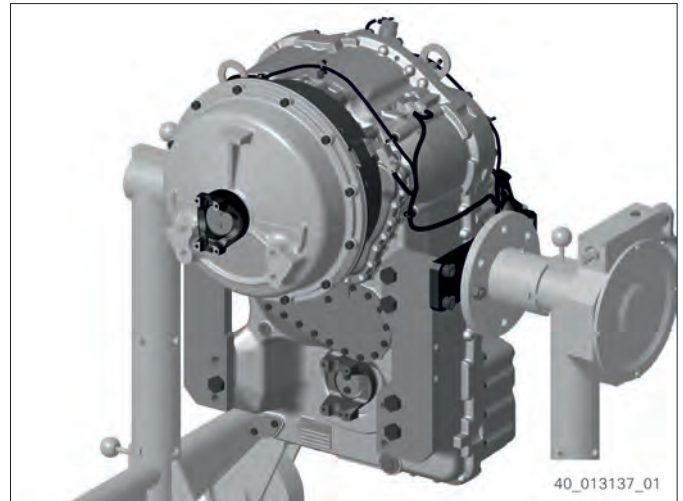


Fig. 21

1. Loosen screw plug (1) and drain oil from the transmission.

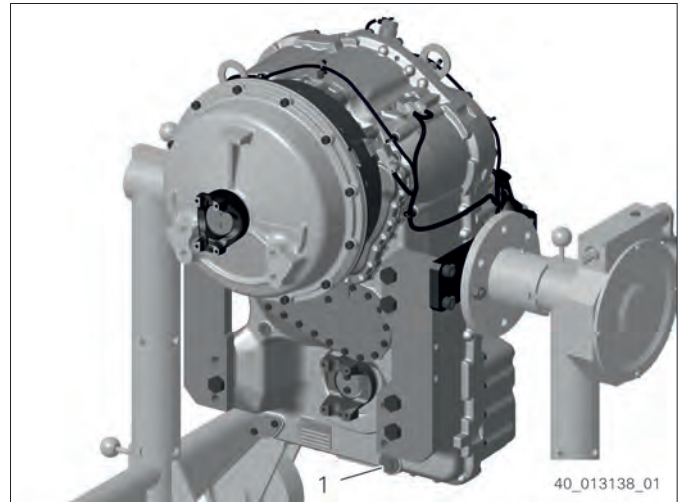


Fig. 22

Dismantling

Dismantling

Removing the pressure filter

1. Loosen the pressure filter (1).

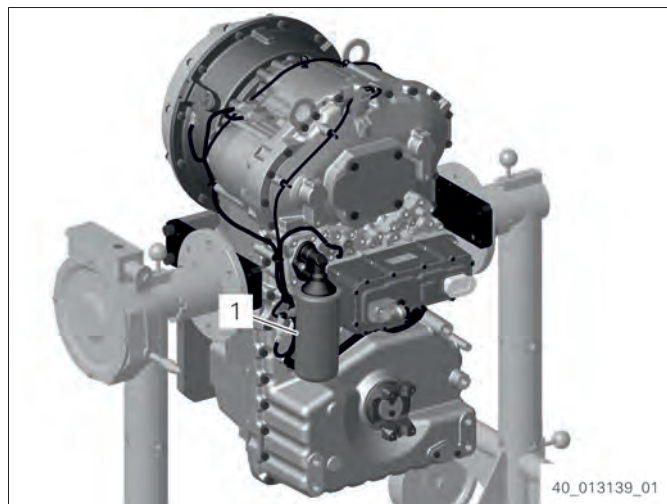


Fig. 23

2. Loosen internal hexalobular bolts and remove filter head (1).

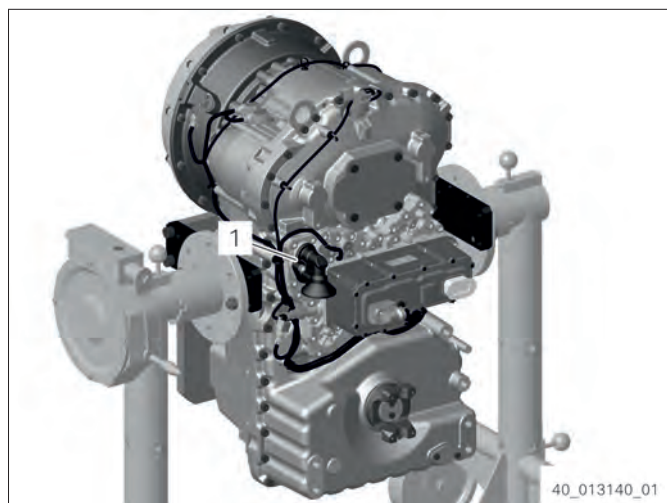


Fig. 24

Removing cover plate (filler neck)

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

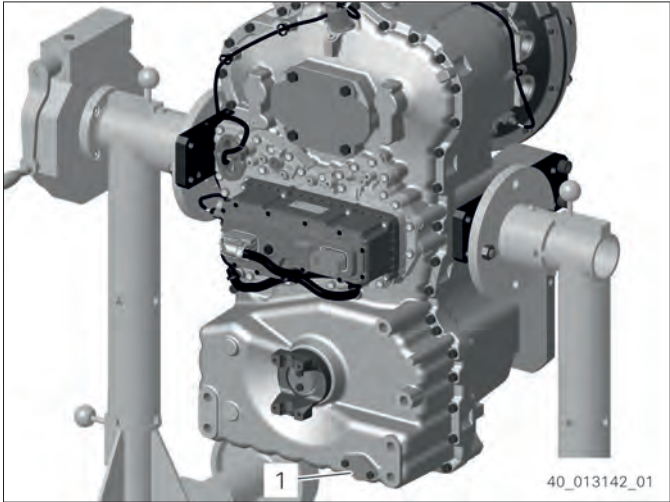


Fig. 25

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

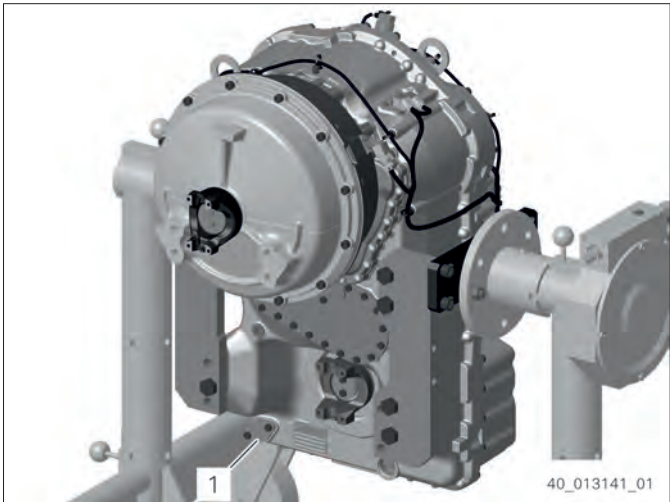


Fig. 26

Dismantling

Removing pressure controller and speed sensors

1. Remove the cable ties.
2. Disconnect plug connections and remove cable (1).

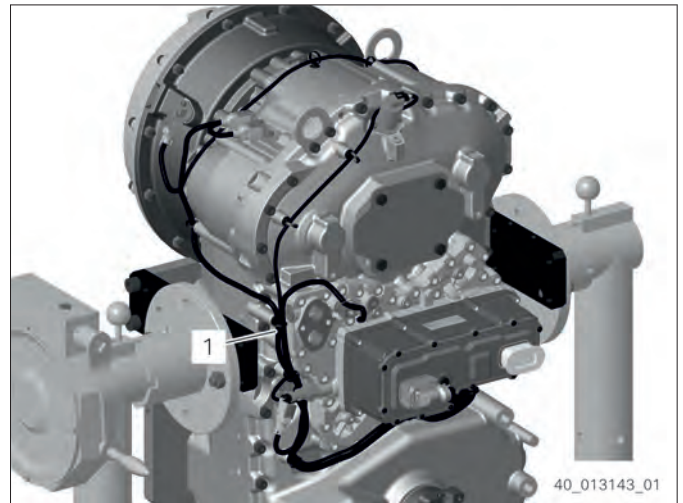


Fig. 27

3. Loosen cap screws.
4. Pull the pressure controller (1) out of the housing hole.

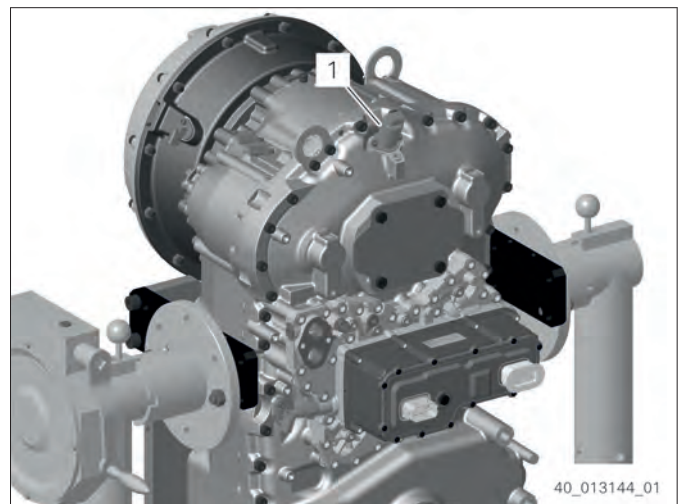


Fig. 28

5. Loosen cap screws.
6. Pull the speed sensors (1) out of the housing holes.

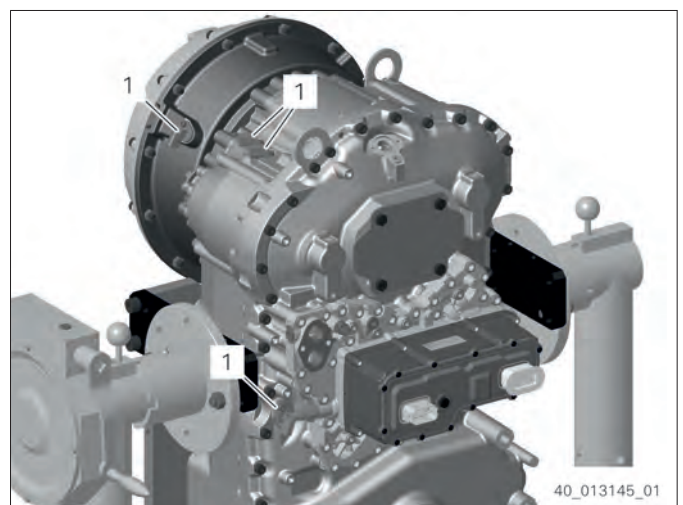


Fig. 29

Removing the temperature sensors and the breather

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

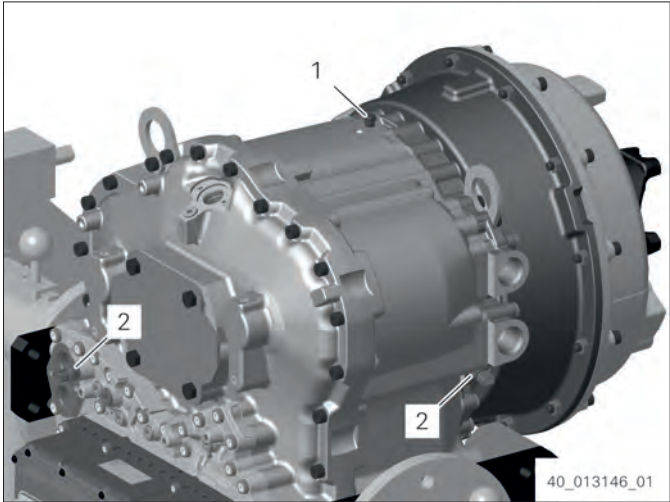


Fig. 30

Removing output flanges

Removing output flange on input side

- 1. Loosen hexagon screws (1).
- 2. Remove washer (2).

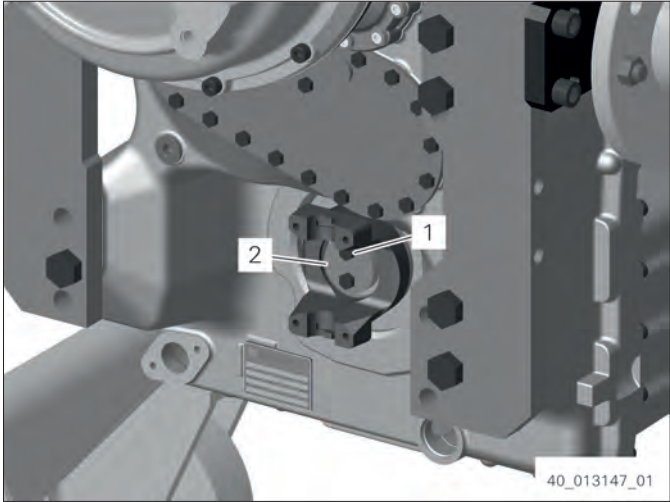


Fig. 31

Dismantling

3. Remove O-ring (1).

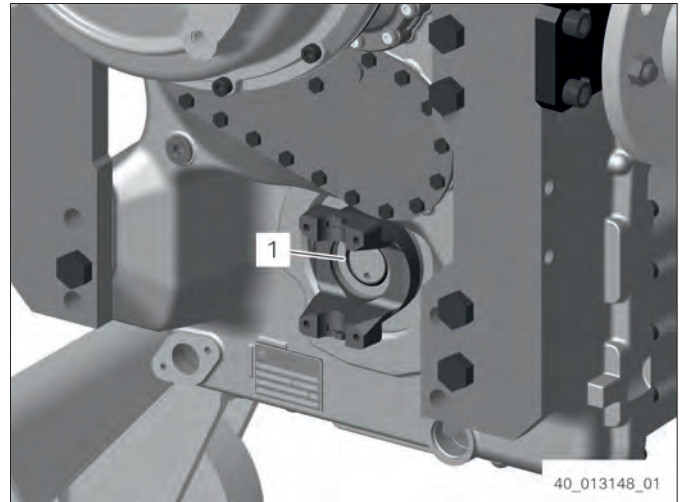


Fig. 32

4. Pull off output flange (1).

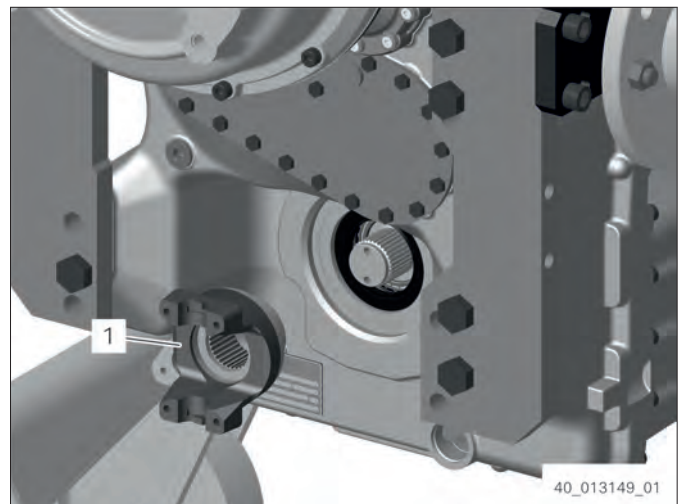


Fig. 33

5. Remove shaft seal (1) from the housing hole.

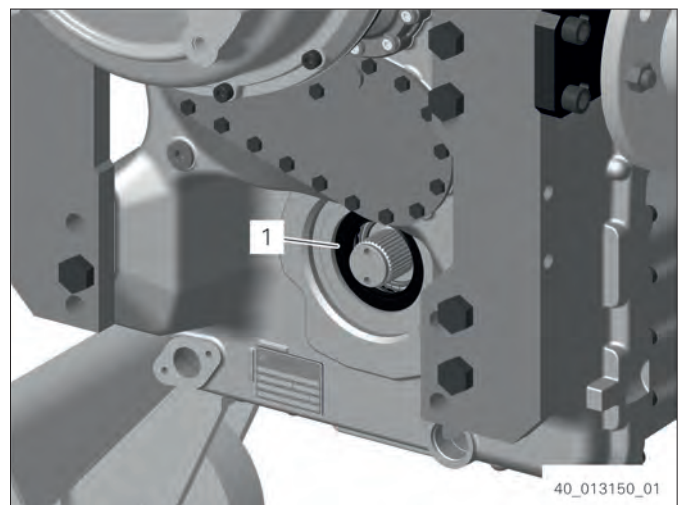


Fig. 34

Removing output flange on gearshift side

- 6. Loosen hexagon screws (1).
- 7. Remove washer (2).

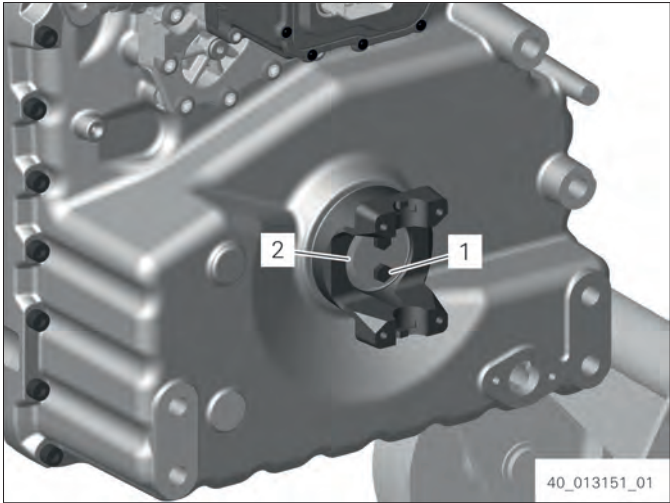


Fig. 35

- 8. Remove O-ring (1).

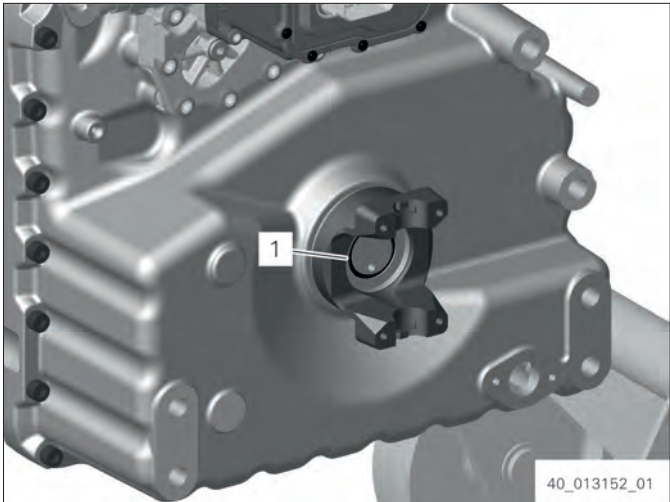


Fig. 36

- 9. Pull off output flange (1).

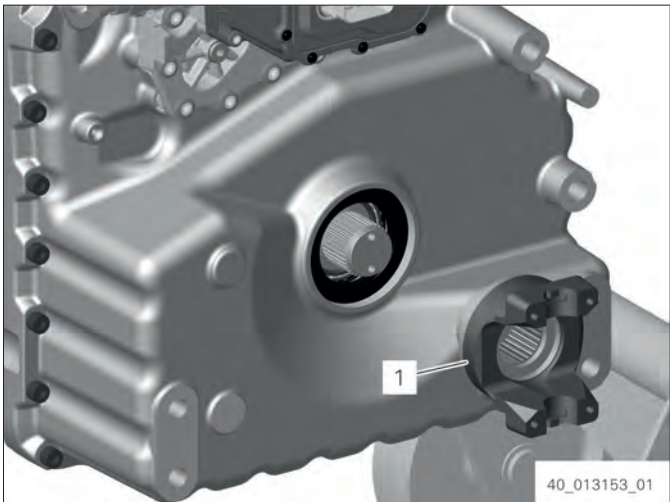


Fig. 37

Dismantling

10. Remove shaft seal (1) from the housing hole.

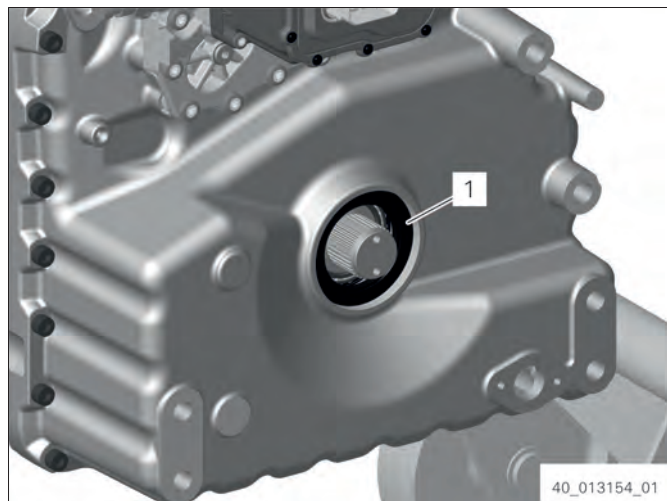


Fig. 38

Removing and dismantling shift system

Removing filter bypass valve

1. Loosen the tappet switch (1).

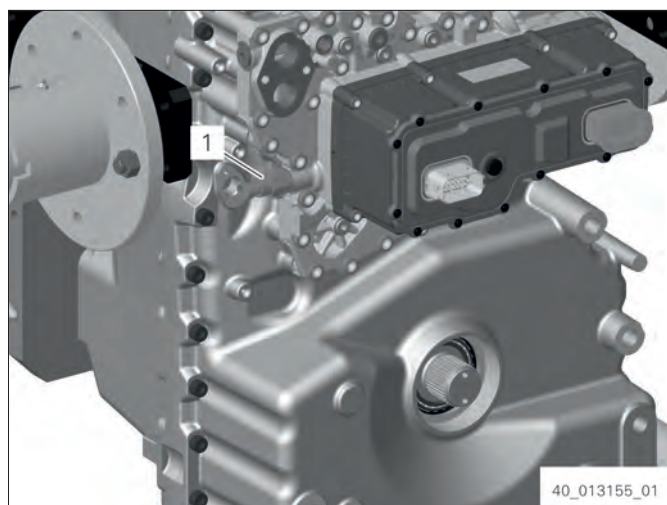


Fig. 39

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

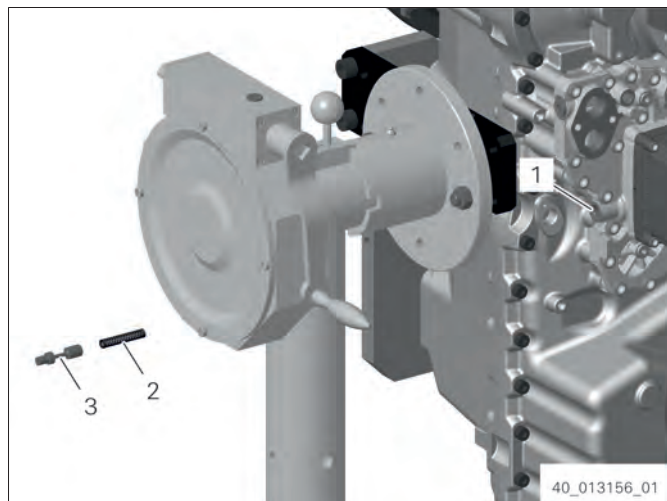


Fig. 40

Removing control unit (ECA4)

1. Loosen internal hexalobular bolts.
2. Remove control unit (1).

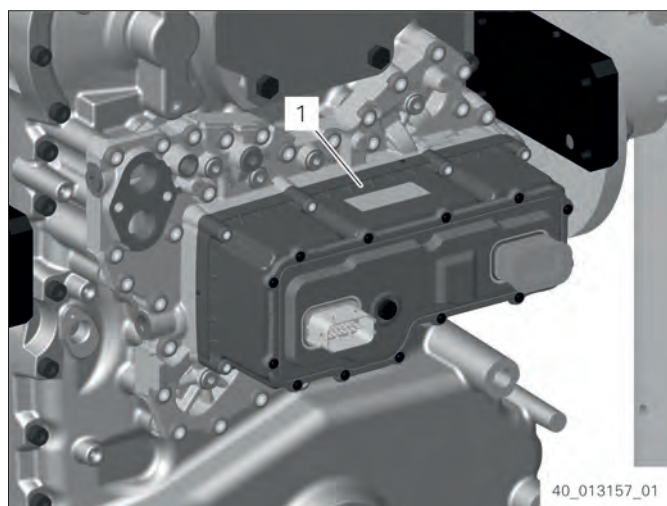


Fig. 41

Dismantling

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).

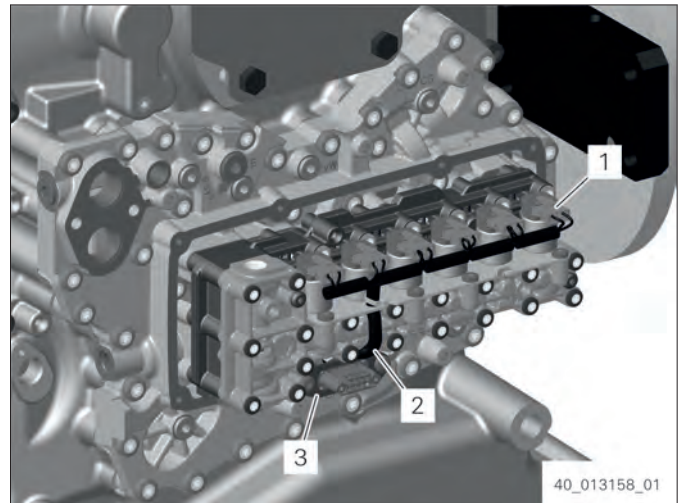


Fig. 42

4. Loosen internal hexalobular bolts and remove clamping plate (1).
5. Pull out the pressure controllers (2).

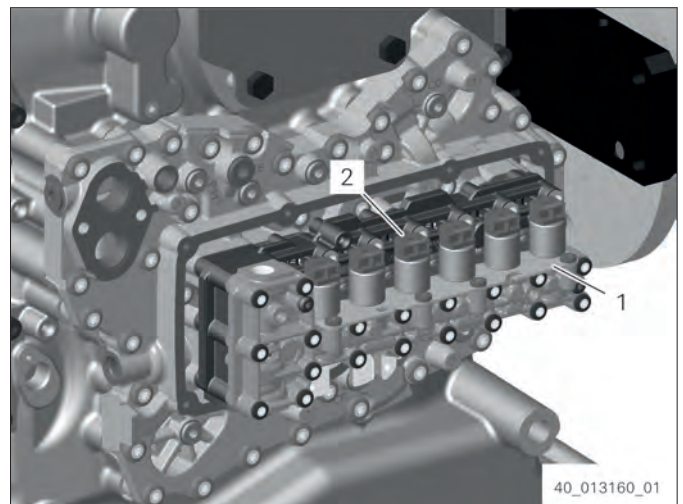


Fig. 43

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.

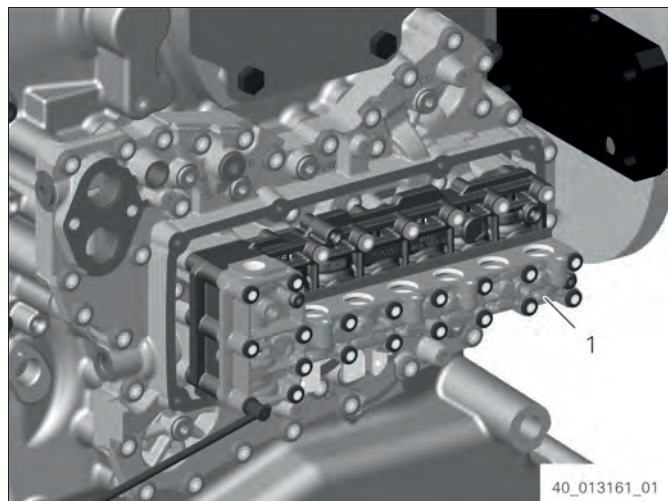


Fig. 44

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

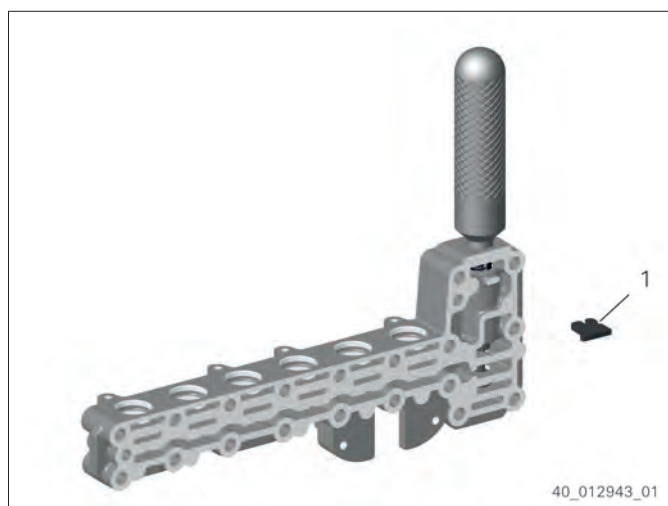


Fig. 45

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

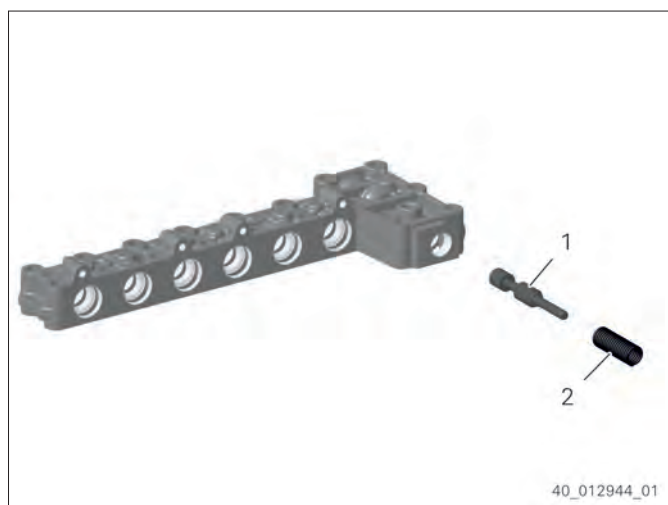


Fig. 46

Dismantling

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

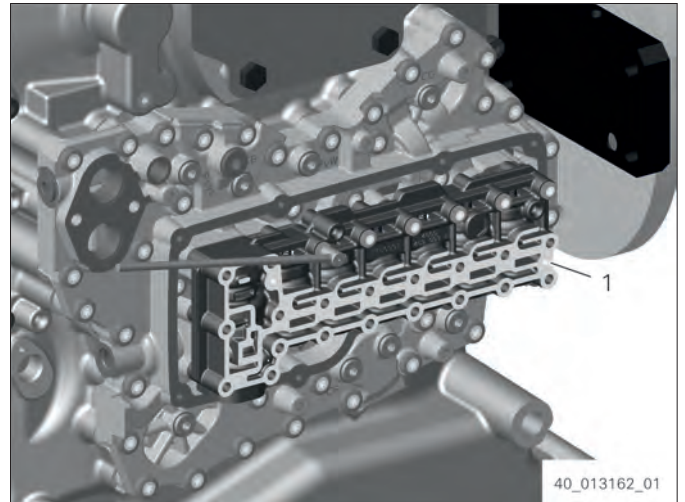


Fig. 47

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

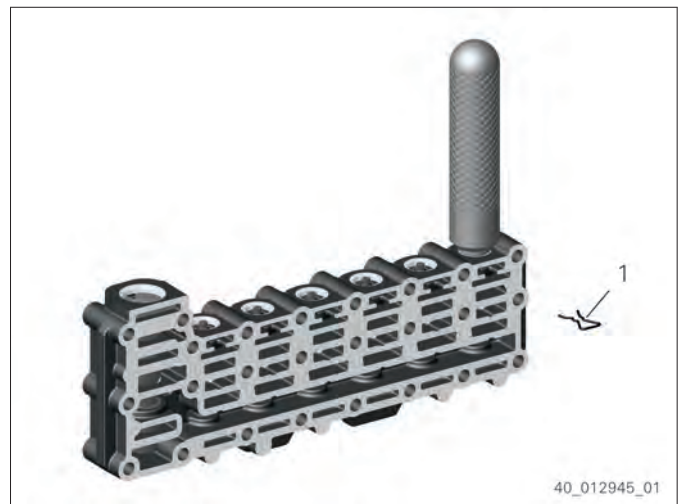


Fig. 48

6. Pull the plug (3) out of the hole.
7. Remove control piston (2) and compression spring (1) from the hole.

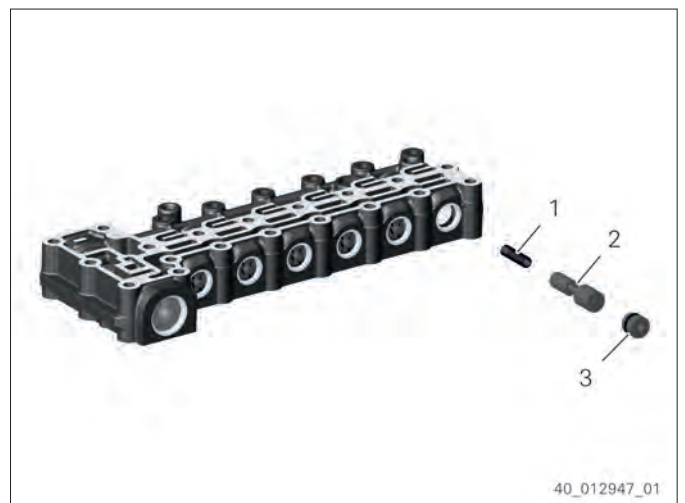


Fig. 49

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

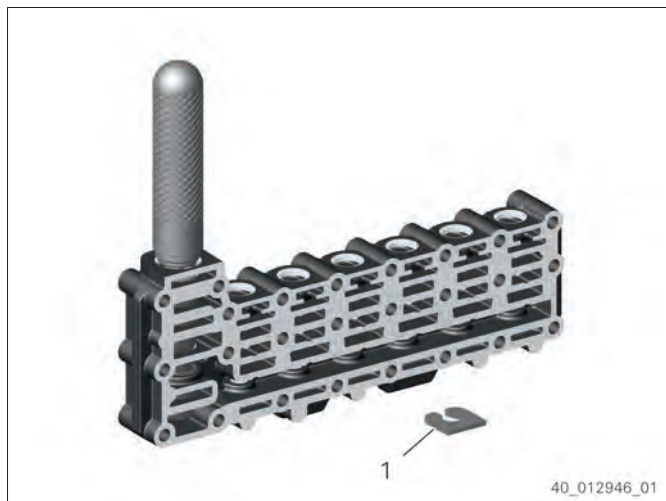


Fig. 50

9. Pull the plug (3) out of the hole.
10. Remove compression spring (2) and control piston (1) from the hole.

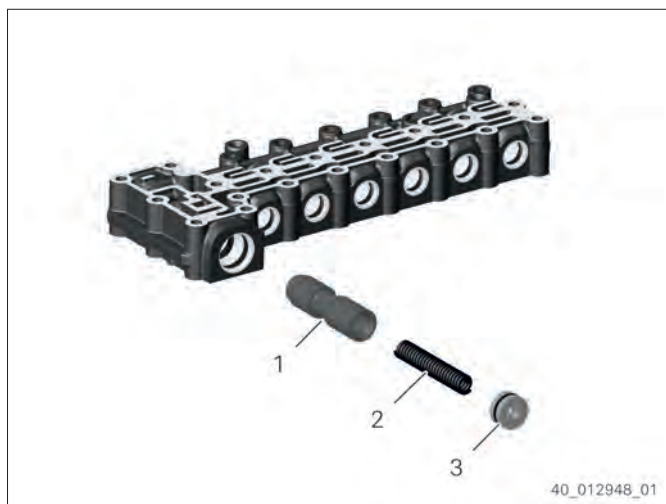


Fig. 51

Removing duct plate

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

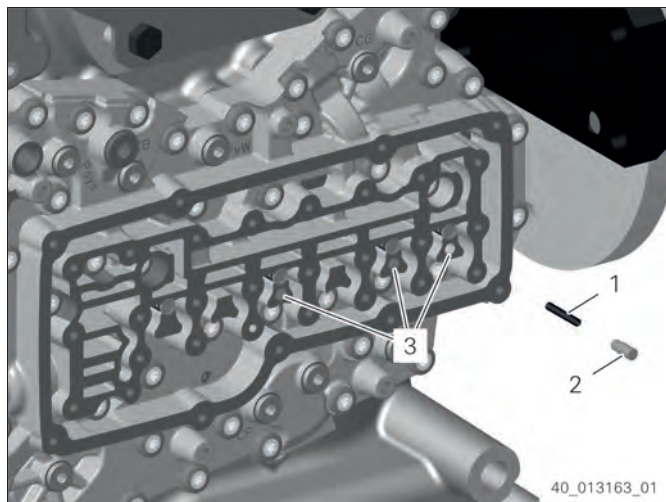


Fig. 52

Dismantling

2. Remove valves (1) from duct plate.

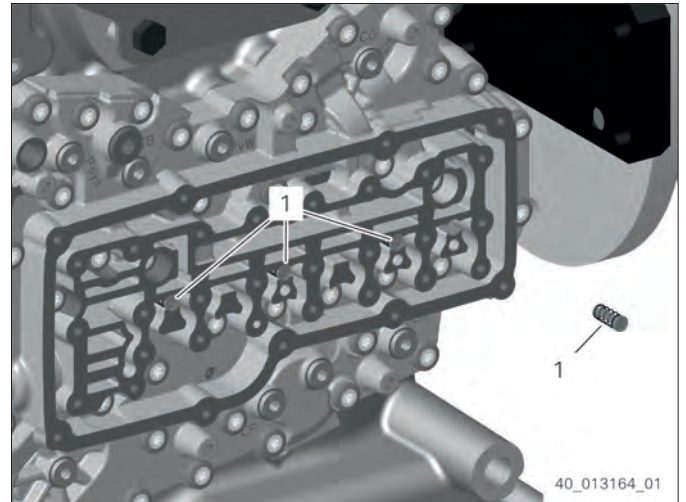


Fig. 53

3. Loosen internal hexalobular bolts.
Remove duct plate and seal.

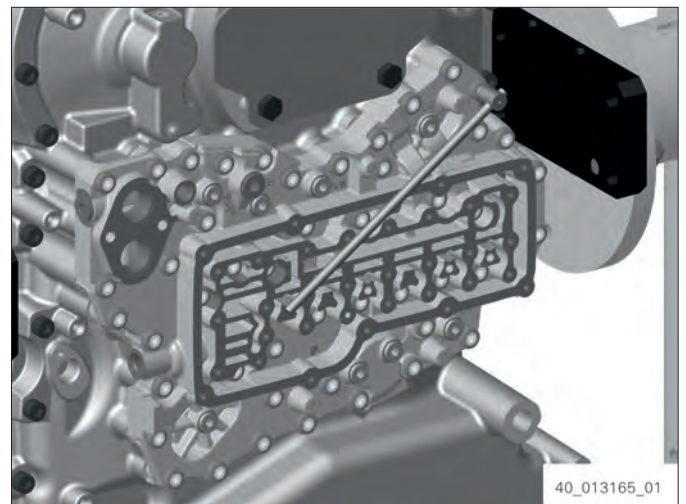


Fig. 54

4. Remove screw plugs from duct plate.

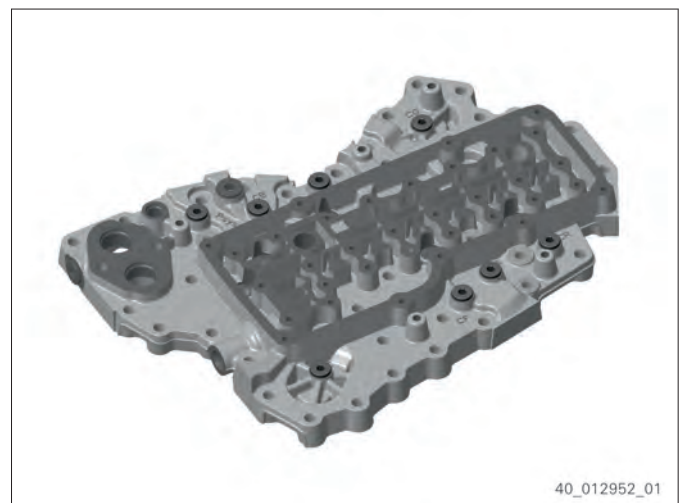


Fig. 55

Removing cover plate (PTO)

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

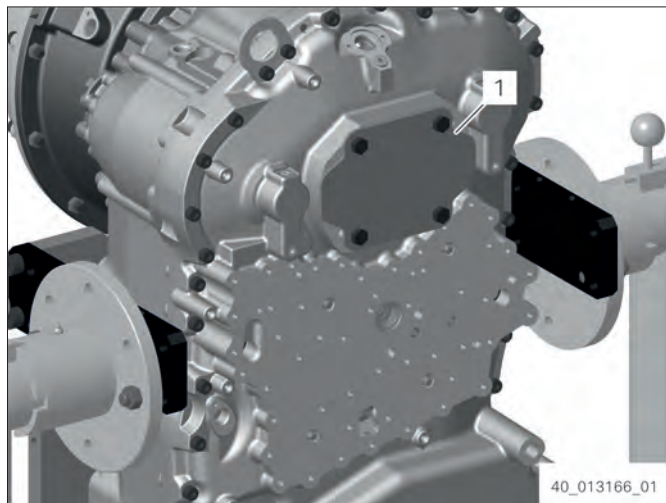


Fig. 56

2. Remove O-ring (1).

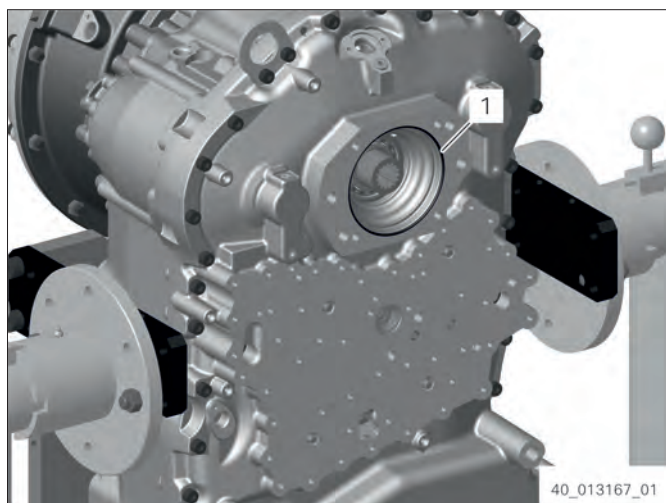


Fig. 57

Removing and dismantling engine connection

Removing the converter

Special tools:

- AA02.676.915 Load ring

Dismantling

1. Mark installation position of the cover towards the torque converter bell housing.
2. Loosen hexagon nuts (2).
3. Remove cap screws (1).

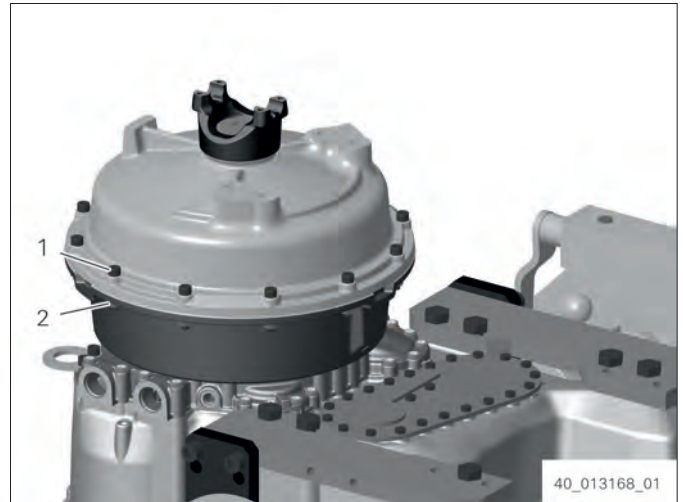


Fig. 58

4. **⚠ 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. 59

5. Loosen hexagon screws.
6. Remove washer.
7. Use two-armed extractor to pull yoke off the input shaft.



Fig. 60

8. **⚠ CAUTION**

Risk of crushing due to hydraulic tool.
Slight to moderate injury possible.

⇒ Do not reach into danger area.

Force input shaft and the converter out of the cover.



Fig. 61

9. Remove V-ring (1).

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



Fig. 62

11. Loosen hexagon screws (1).

12. Remove input shaft with flexplates (2).

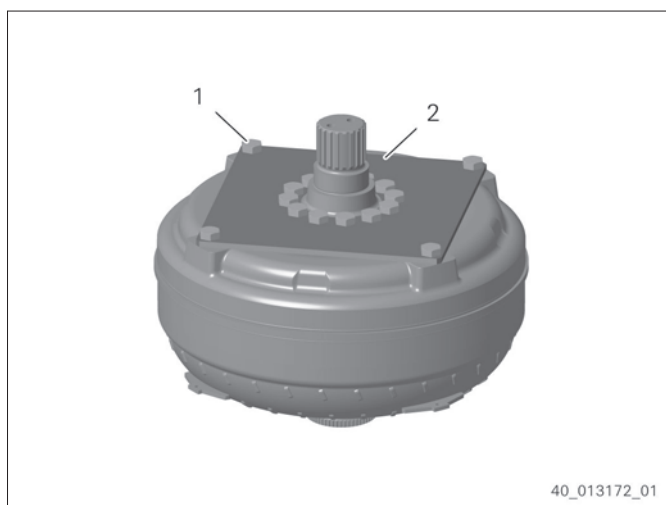


Fig. 63

Dismantling

13. Loosen hexagon screws.

14. Remove flexplates (1).

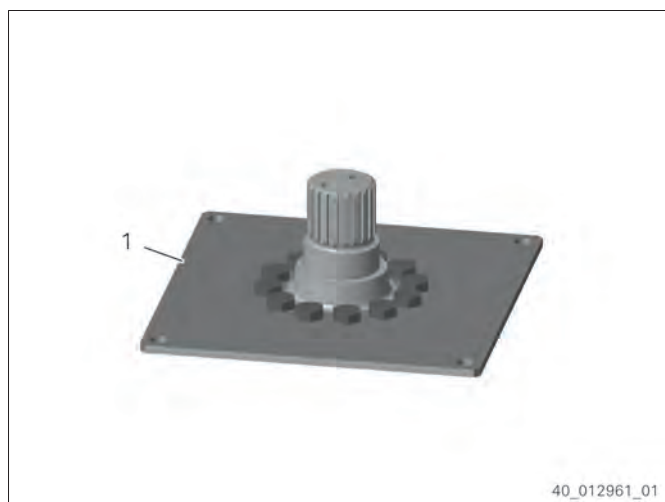


Fig. 64

Removing torque converter bell housing

Special tools:

- AA02.247.426 Eyebolt

1. Loosen hexagon screws (1).

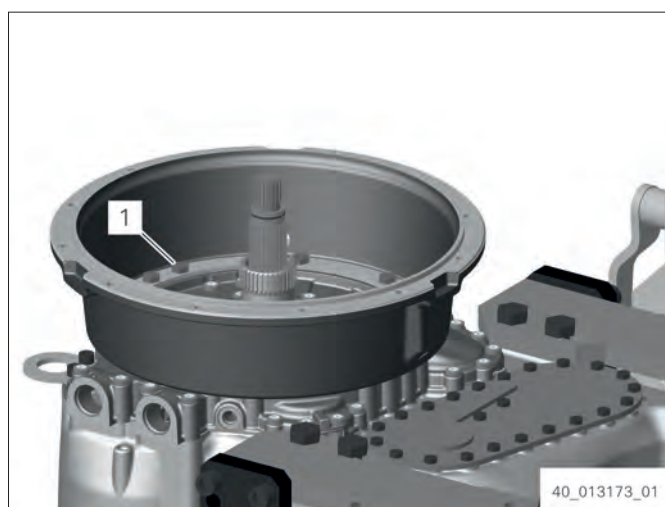


Fig. 65

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

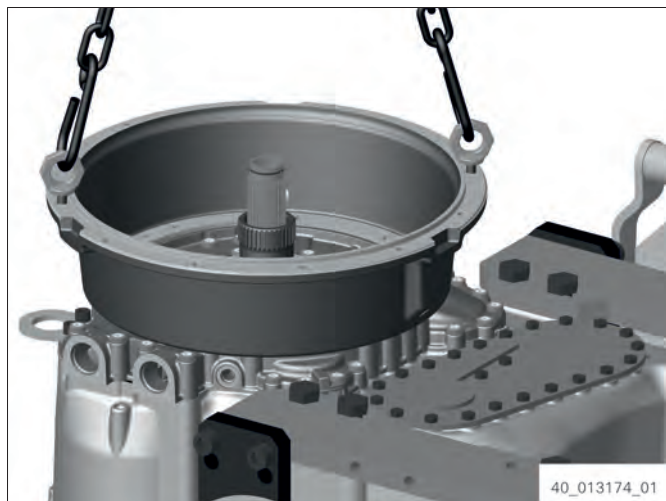


Fig. 66

Removing the oil feed housing and pressure oil pump

Special tools:

- 5870.345.036 Pry bar
- 5870.450.003 Magnetic holder

1. Loosen internal hexalobular bolts.
2. Loosen cap screws and remove fixing plate (1).
3. Loosen cap screws (2).

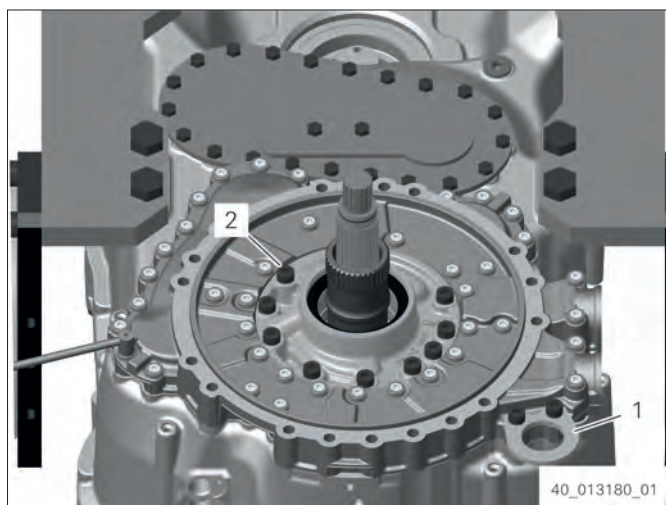


Fig. 67

Dismantling

4. Pull off the oil feed housing and gear pump evenly with 5870.345.036 [Pry bar].

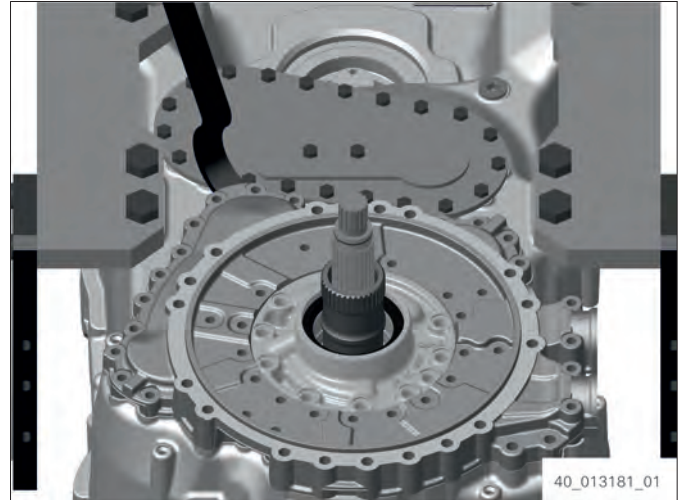


Fig. 68

5. Place the oil feed housing on 5870.450.003 [Magnetic holder].
6. Force out the gear pump.

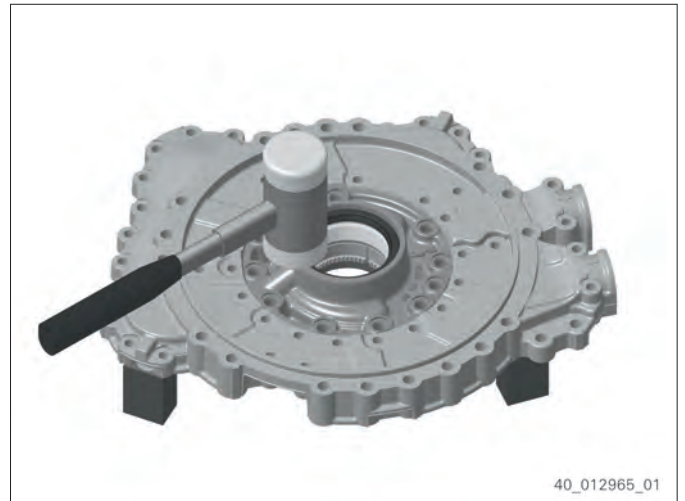


Fig. 69

7. Push pressure plate inwards with a mandrel and remove fixing plate (1).

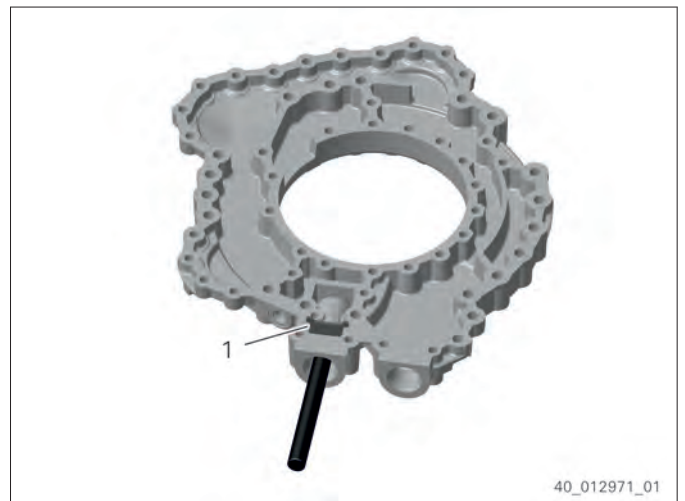


Fig. 70

8. Remove pressure plate (3).
9. Remove compression spring (2) and piston (1) from housing hole.

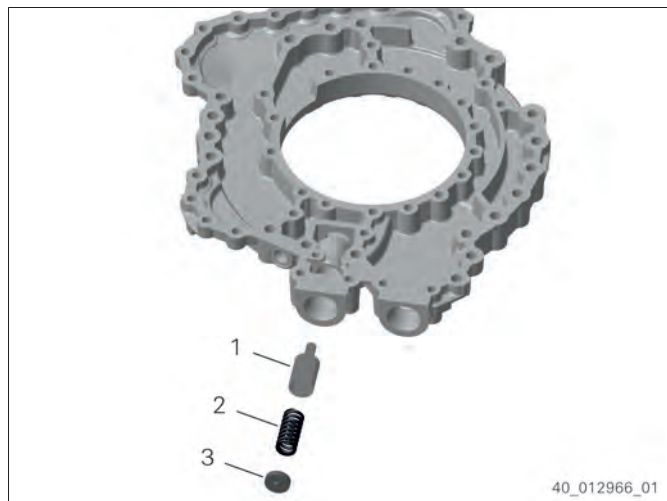


Fig. 71

Checking gear pump

10. Remove shaft sealing ring (1).
11. Remove O-ring (2).



Fig. 72

12. ※ 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 (1).

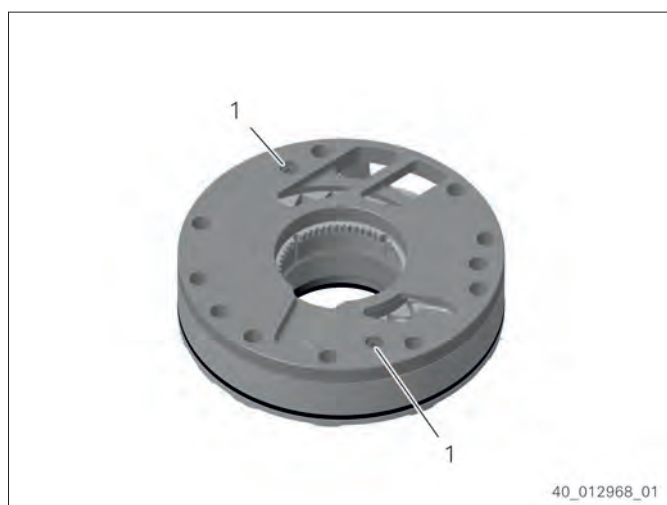


Fig. 73

Dismantling

13. Lift off cover (1).
14. Check the cover (1), outer rotor (2), inner rotor (3) and the housing (4) for wear marks. In case of any damage, install **new** gear pump.
15. Insert the outer rotor (2) and inner rotor (3) with the chamfered tooth side facing the housing (4).
16. Place the cover (1).
17. Screw in cap screws by hand until contact is obtained and loosen again by 180°.
18. Remove seal (1).
19. Remove stator shaft (2).

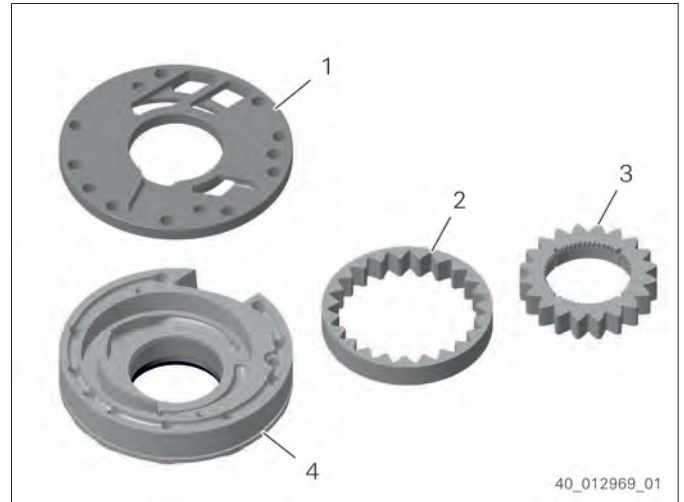


Fig. 74

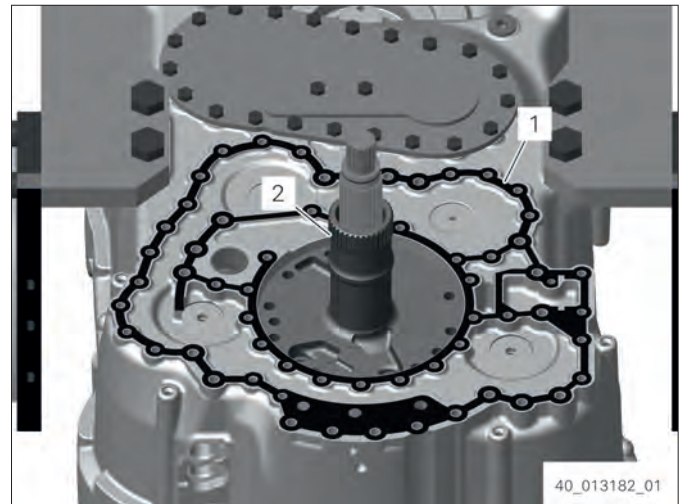


Fig. 75

Removing pump shaft

1. Remove securing ring.



Fig. 76

- 2. Pull pump shaft (1) out of the transmission.

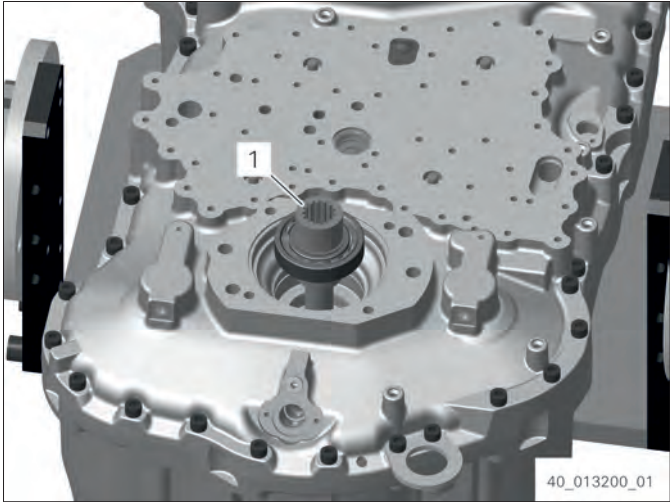


Fig. 77

- 3. Remove R-ring (1) from radial groove of the pump shaft.

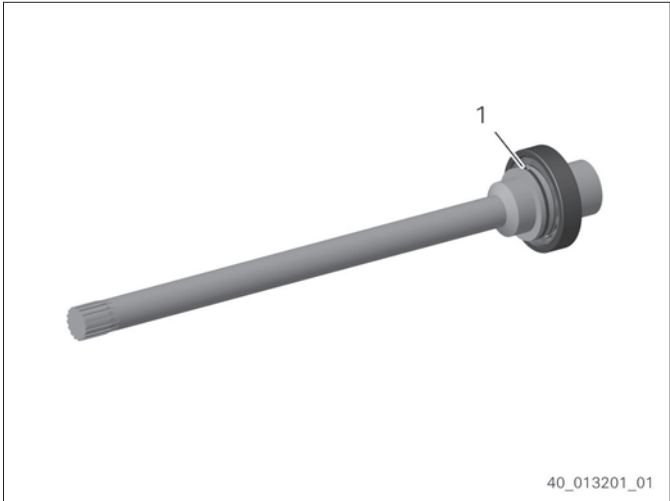


Fig. 78

- 4. Remove securing ring (1).
- 5. Press off the ball bearing (2).

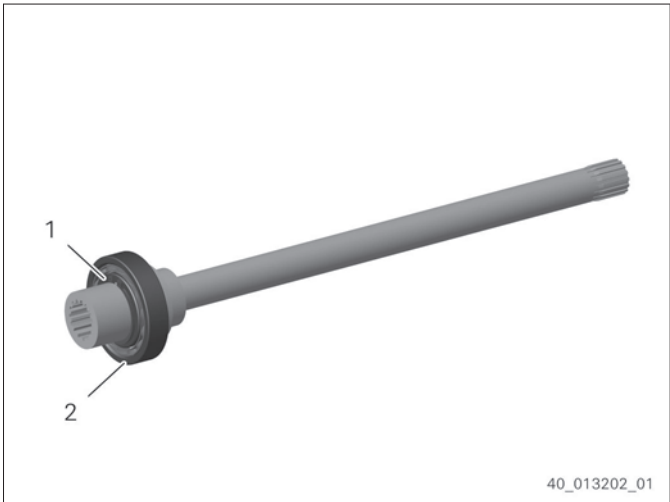


Fig. 79

Dismantling

Removing the cover (emergency steering pump)

1. Loosen hexagon screws.
2. Remove cover (1).
3. Remove seal.

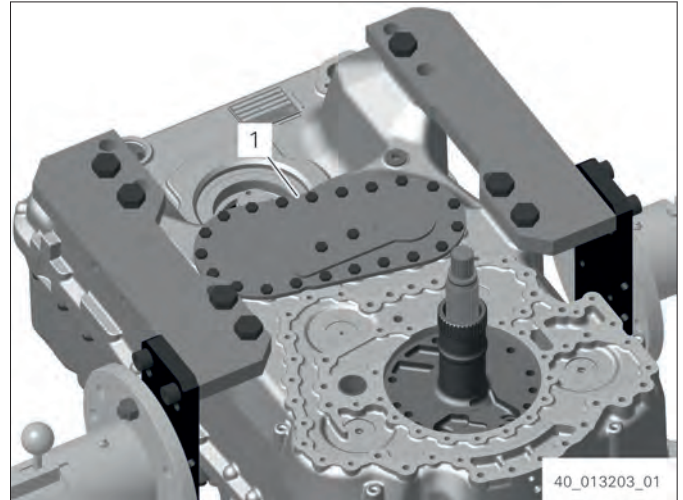



Fig. 80

Separating the housings

Special tools:

- AA02.691.822 Handle
- 5870.204.083 Eyebolt
- 5870.204.086 Eyebolt

1.  **CAUTION**
Risk of injury due to parts flying away.
Slight or moderate injury possible.
⇒ Wear protective goggles.

Force out both cylindrical pins.

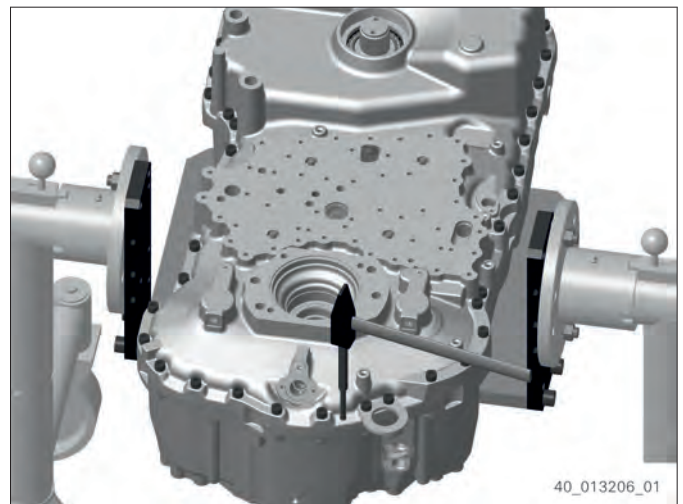


Fig. 81

2. Loosen cap screws (1).
3. Remove fixing plate (2).

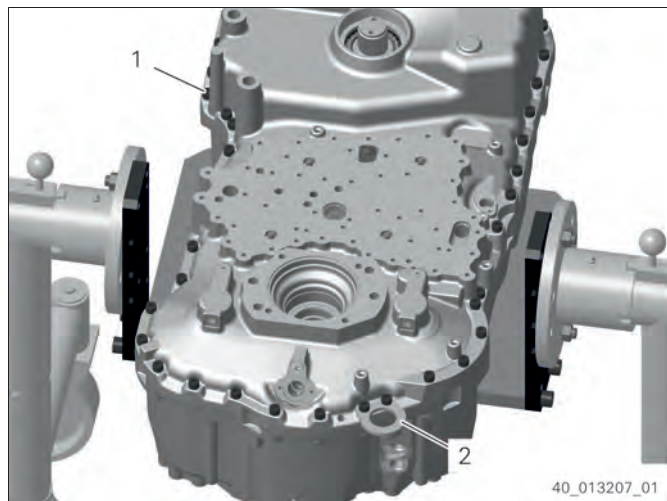


Fig. 82

4. Fasten clutches K1, K2, K3 and K4 in the housing rear section with AA02.691.822 [Handle].

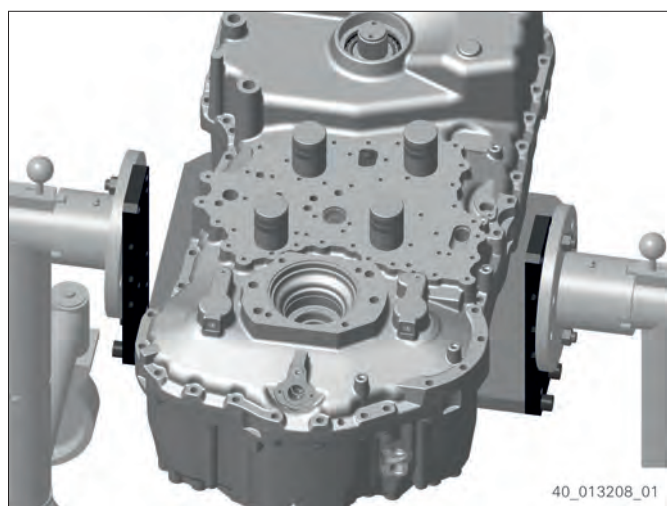


Fig. 83

5. Screw two 5870.204.083 [Eyebolt] into the housing rear section.
6. Screw in two 5870.204.086 [Eyebolt].

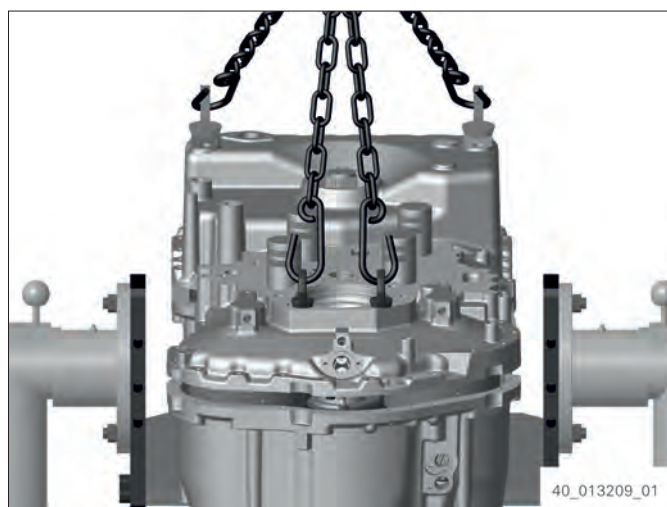


Fig. 84

Dismantling

7.

CAUTION

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.

Lift off housing rear section and clutches using a crane.

Removing and dismantling output shaft

Special tools:

- AA01.100.718 Eyebolt
- 5873.001.058 Gripping device
- 5873.001.001 Basic tool

1. Loosen cap screws.

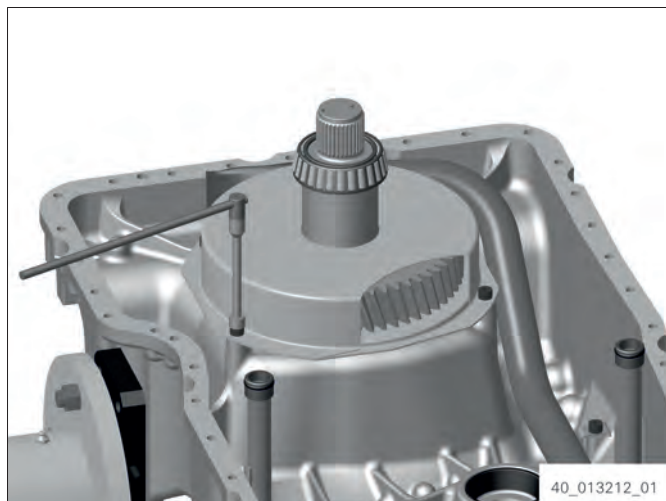


Fig. 85

2. Remove output shaft from the front part of the housing using AA01.100.718 [Eyebolt] and crane.

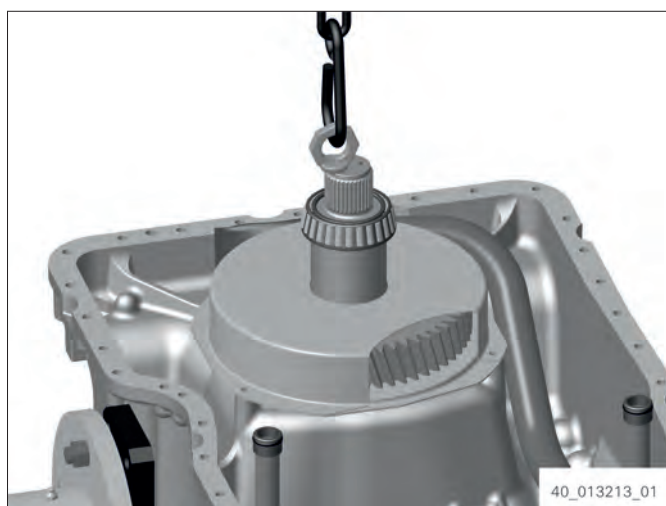


Fig. 86

3. Use 5873.001.058 [Gripping device] and 5873.001.001 [Basic tool] to pull off both bearing inner rings from the output shaft.

4. Remove screen sheet (1).

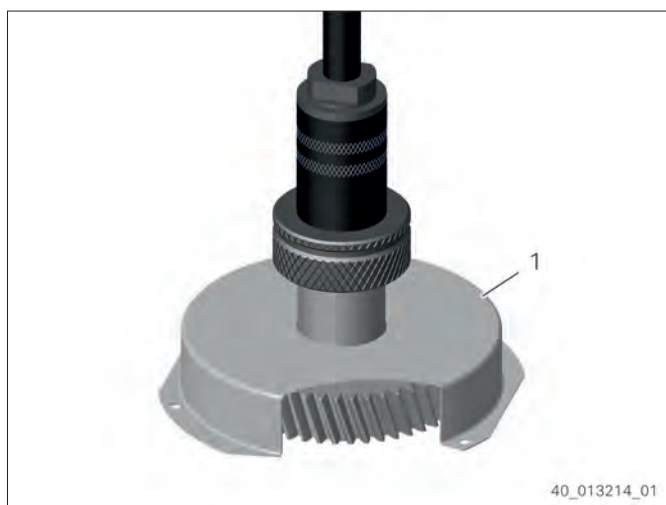


Fig. 87

Dismantling

Dismantling housing front part

1. Remove screen sheet (1).



Fig. 88

2. Loosen cap screws.
3. Remove oil tubes (1).
 - ※ No further dismantling possible.

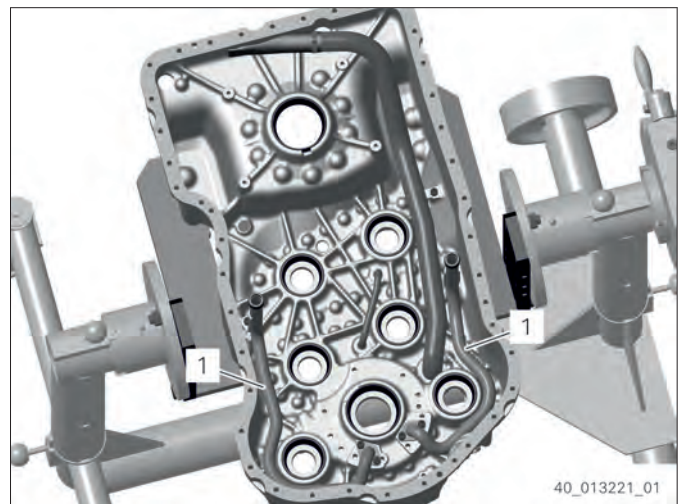


Fig. 89

4. Pull bearing outer rings out of housing holes.
The Figure shows the positions of the bearing outer rings.
 - 1 = Output shaft
 - 2 = Clutch K3
 - 3 = Clutch K2
 - 4 = Clutch KV
 - 5 = Input shaft
 - 6 = Clutch KR
 - 7 = Clutch K4
 - 8 = Clutch K1

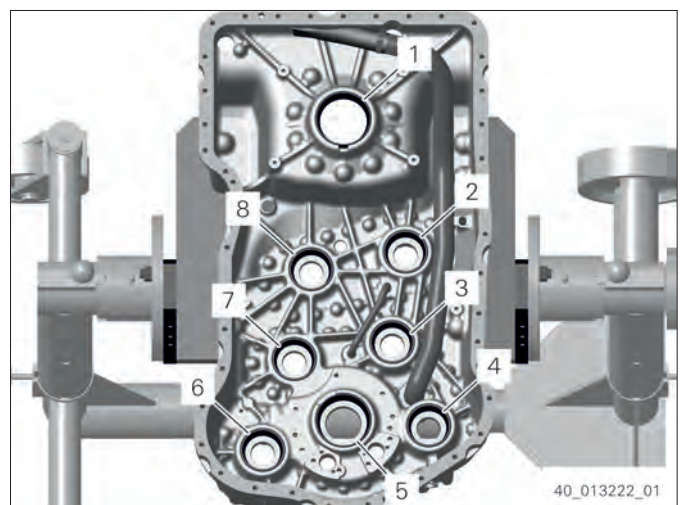


Fig. 90

Removing and dismantling clutches and input shaft

Removing clutches

Special tools:

- 5870.350.000 Assembly truck
- AA02.415.533 Assembly fixture
- AA02.691.822 Handle

1.

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.

Secure the housing rear section to the 5870.350.000 [Assembly truck] with AA02.415.533 [Assembly fixture].

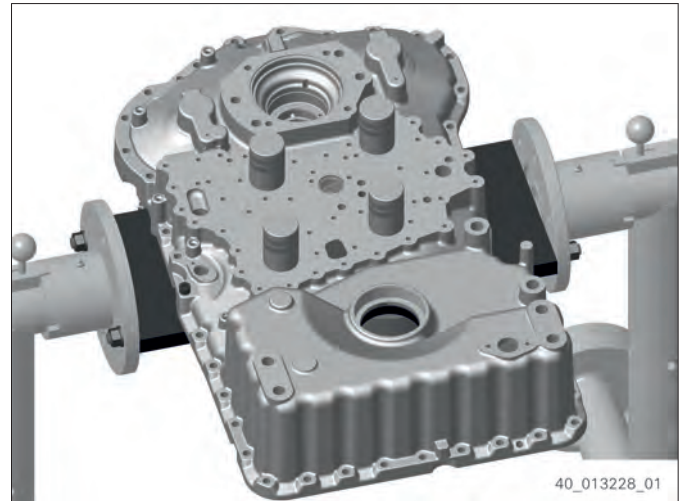


Fig. 91

Dismantling

2. Rotate the housing rear section 180°.
3. Remove four AA02.691.822 [Handle].
4. Remove clutches from the housing rear section in the sequence specified.
 - 1 = Clutch K1
 - 2 = Clutch K2
 - 3 = Clutch K3
 - 4 = Clutch K4
 - 5 = Clutch KR
 - 6 = Clutch KV
 - 7 = Input shaft

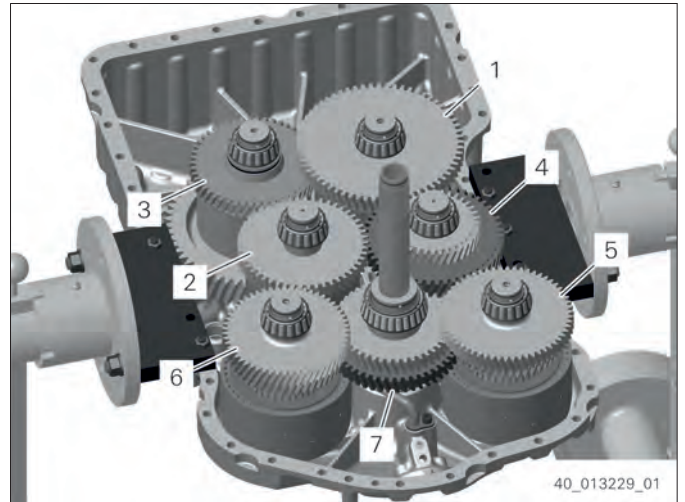


Fig. 92

Dismantling clutch KV

Special tools:

- 5873.001.057 Gripping device
- 5873.001.001 Basic tool
- 5870.345.088 Assembly fixture
- 5870.300.024 Disassembly device
- 5870.300.033 Extractor

1. Remove stud bolt (1).
2. Remove piston ring (2).

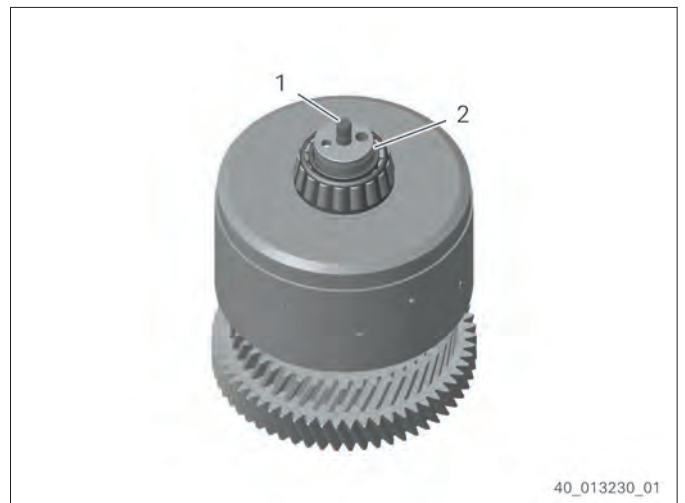


Fig. 93

- 3. Pull off bearing inner ring with 5873.001.057 [Gripping device] and 5873.001.001 [Basic tool].



Fig. 94

- 4. Pull off clutch from shaft.



Fig. 95

- 5. Remove snap ring (1).
- 6. Remove end shim from the disk carrier.
- 7. Remove disk pack.

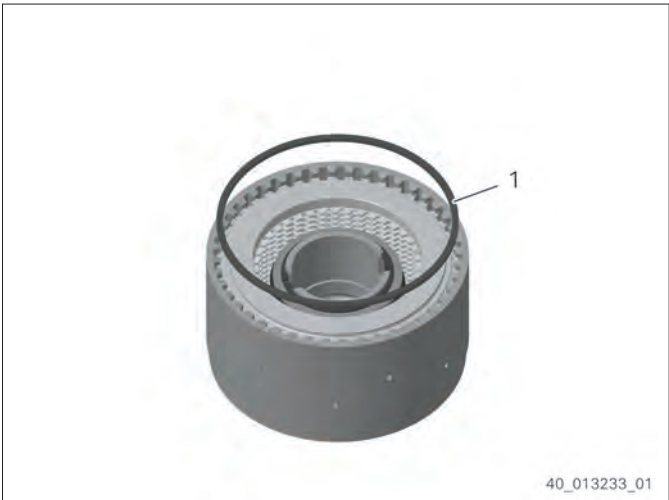


Fig. 96

Dismantling

8. Preload compression spring with 5870.345.088 [Assembly fixture] and press.
9. Remove L-ring (1).

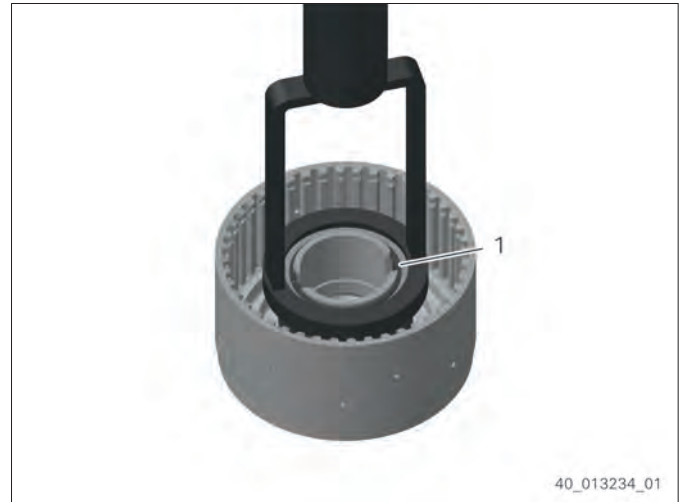


Fig. 97

10. Remove supporting ring, compression spring and shim.



Fig. 98

11. Press the piston (1) out of the disk carrier using compressed air.



Fig. 99

12. Remove securing ring.



Fig. 100

13. Pull off idler gear from shaft with 5870.300.024 [Disassembly device] and 5870.300.033 [Extractor].

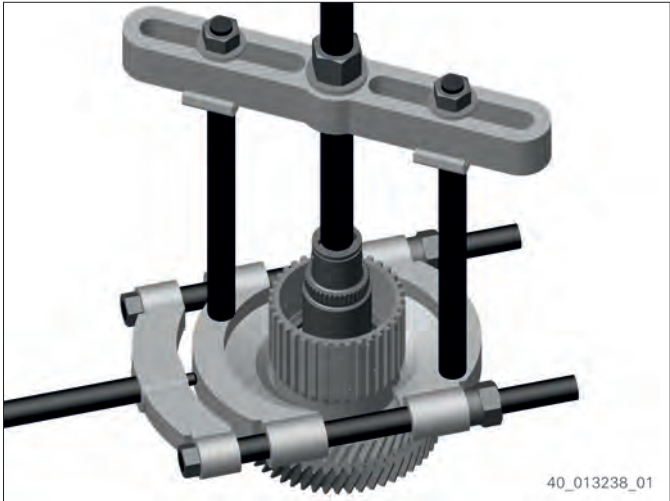


Fig. 101

14. Remove securing ring.

15. Pull out the ball bearing (1).

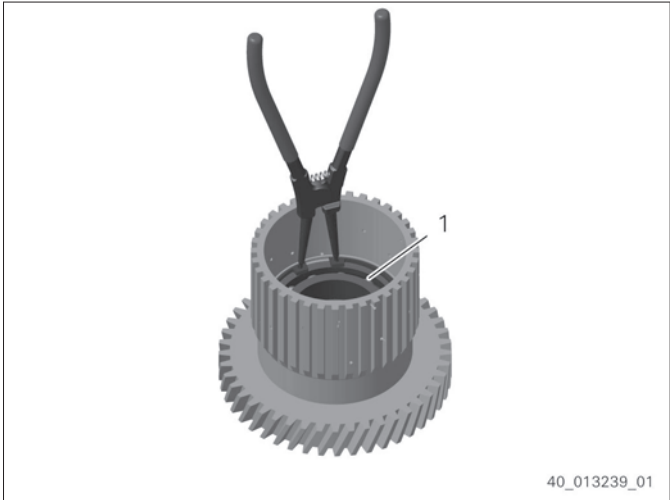


Fig. 102

Dismantling

16. Remove needle cage (1).

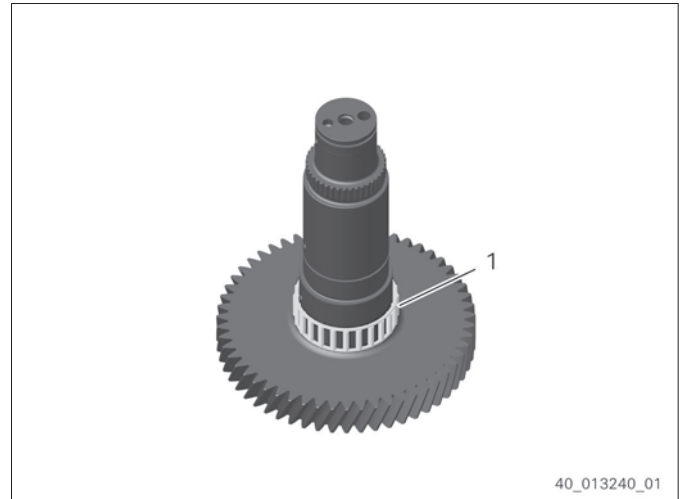


Fig. 103

17. Remove piston ring (1).

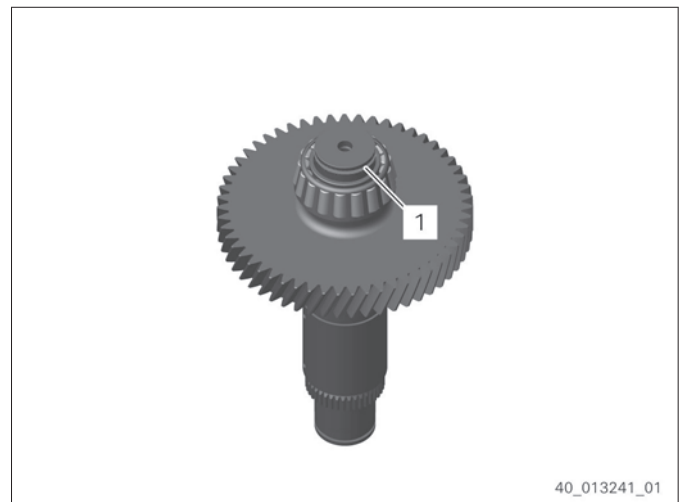


Fig. 104

18. Pull off bearing inner ring with 5873.001.057 [Gripping device] and 5873.001.001 [Basic tool].



Fig. 105

Dismantling KR clutch

Special tools:

- 5873.001.057 Gripping device
- 5873.001.001 Basic tool
- 5870.345.088 Assembly fixture
- 5870.300.024 Disassembly device
- 5870.300.033 Extractor

1. Remove stud bolt (1).
2. Remove piston ring (2).

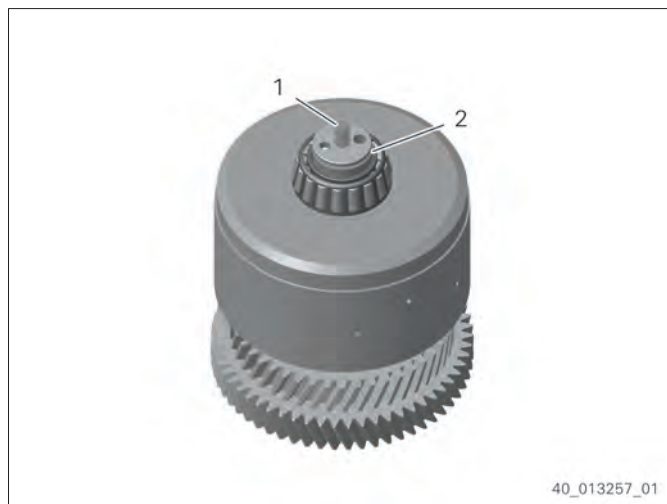


Fig. 106

3. Pull off bearing inner ring with 5873.001.057 [Gripping device] and 5873.001.001 [Basic tool].



Fig. 107

Dismantling

4. Pull off clutch from shaft.



Fig. 108

5. Remove snap ring (1).
6. Remove end shim from the disk carrier.
7. Remove disk pack.

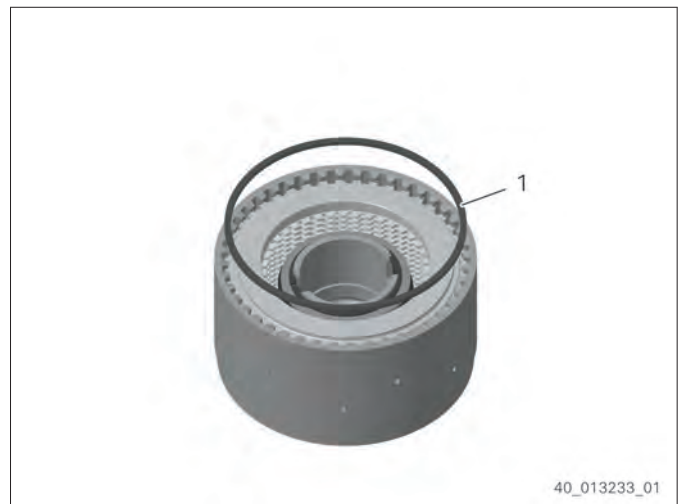


Fig. 109

8. Preload compression spring with 5870.345.088 [Assembly fixture] and press.
9. Remove L-ring (1).

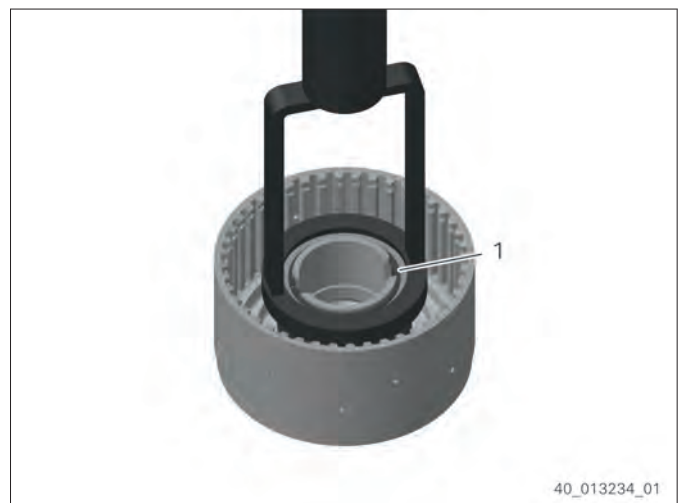


Fig. 110

- 10. Remove supporting ring, compression spring and shim.



Fig. 111

- 11. Press the piston (1) out of the disk carrier using compressed air.



Fig. 112

- 12. Remove securing ring.



Fig. 113

Dismantling

13. Pull off idler gear from shaft with 5870.300.024 [Disassembly device] and 5870.300.033 [Extractor].

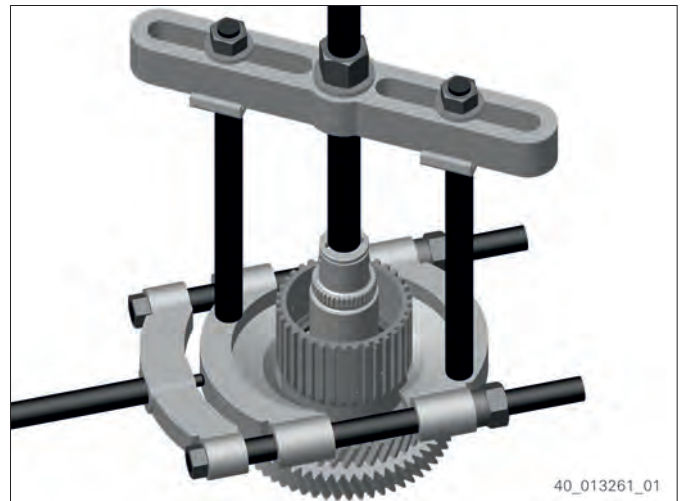


Fig. 114

14. Remove securing ring.
15. Pull out the ball bearing (1).

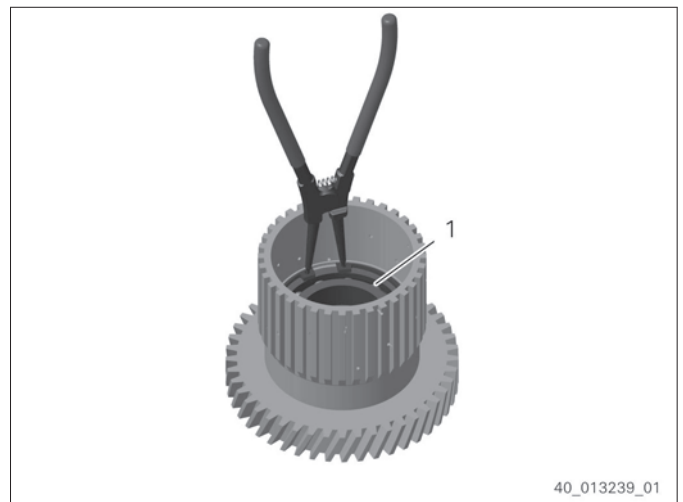


Fig. 115

16. Remove needle cage (1).

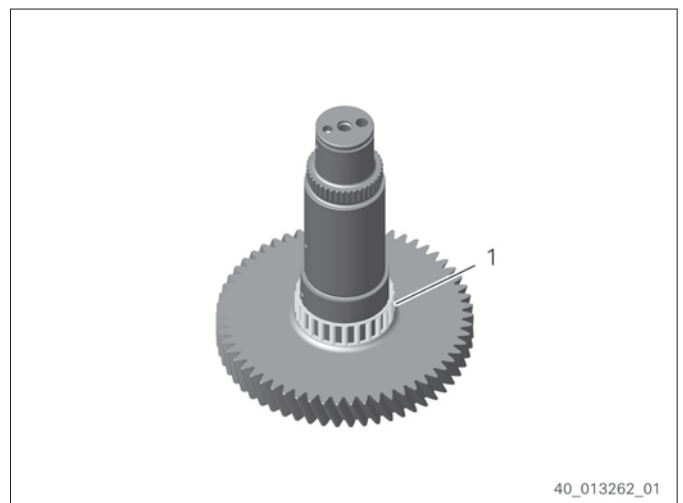


Fig. 116

17. Remove piston ring (1).



Fig. 117

18. Pull off bearing inner ring with 5873.001.057 [Gripping device] and 5873.001.001 [Basic tool].



Fig. 118

9.15.4 Dismantling clutch K1

Special tools:

- 5873.001.057 Gripping device
- 5873.001.001 Basic tool
- 5870.345.088 Assembly fixture

Dismantling

1. Remove stud bolt (1).
2. Remove piston ring (2).

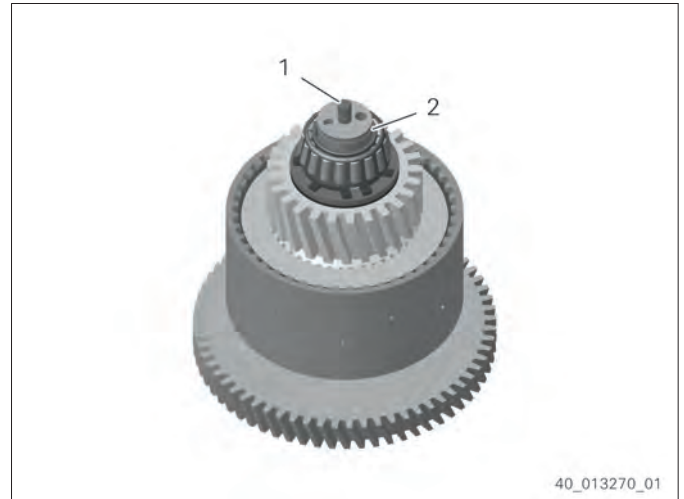


Fig. 119

3. Pull off bearing inner ring with 5873.001.057 [Gripping device] and 5873.001.001 [Basic tool].

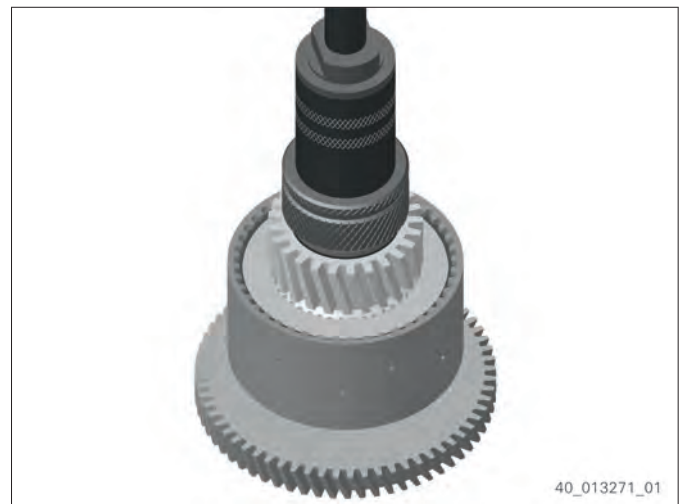


Fig. 120

4. Remove securing ring.

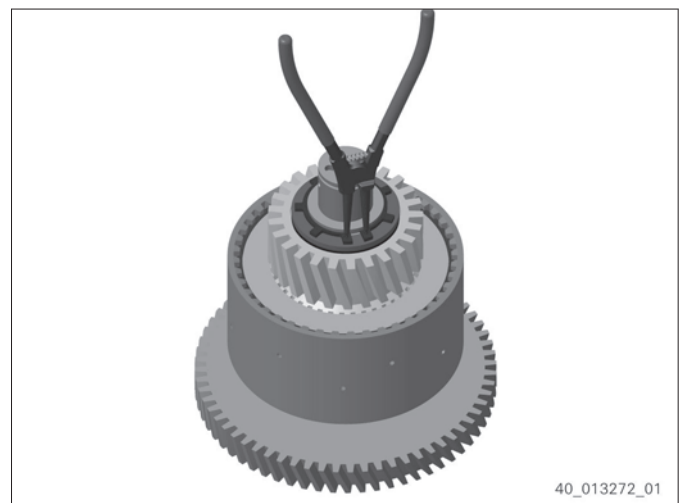


Fig. 121

- 5. Remove thrust washer (1), axial needle cage (2) and axial washer (3).

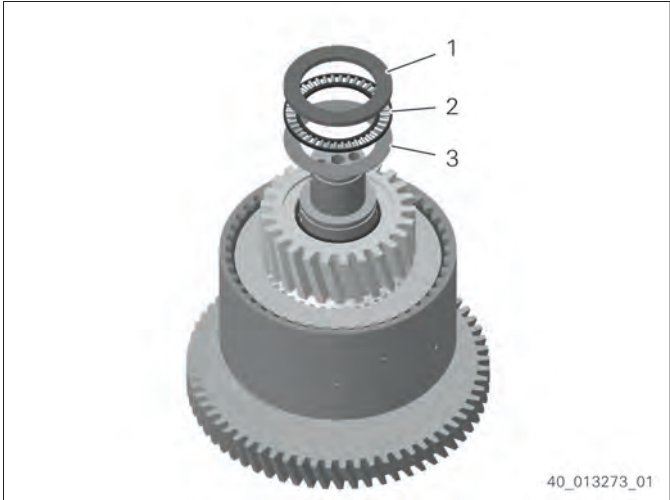


Fig. 122

- 6. Remove idler gear (1).

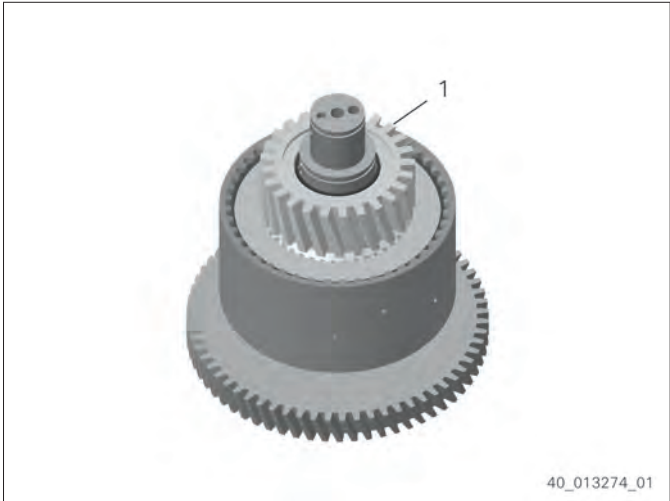


Fig. 123

- 7. Remove needle cage (1).

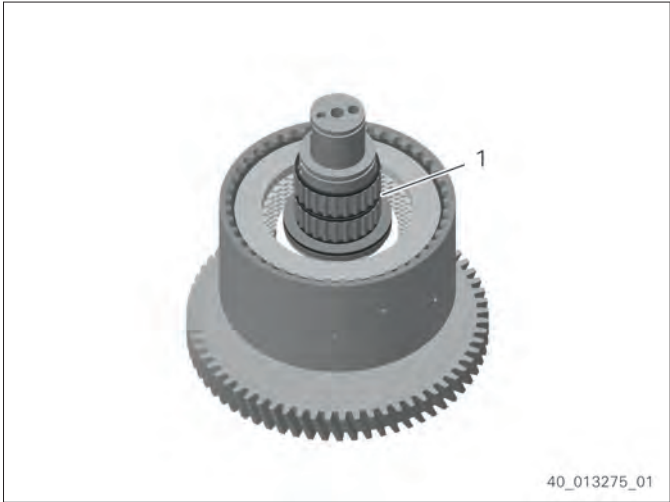


Fig. 124

Dismantling

8. Remove axial washer (1), axle needle cage (2) and thrust washer (3).

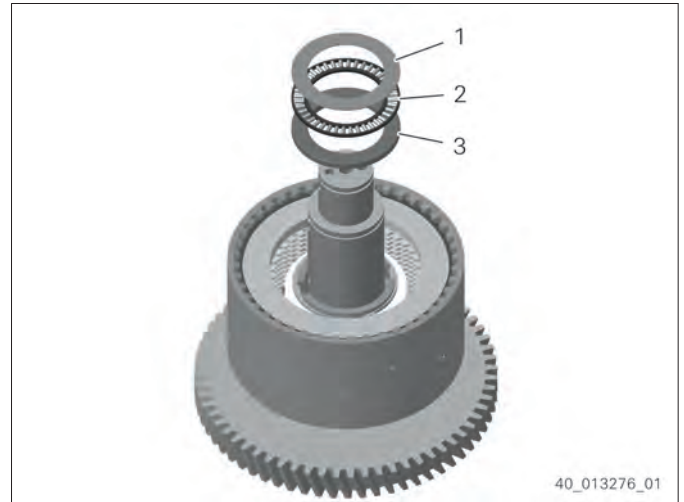


Fig. 125

9. Pull off clutch from shaft.



Fig. 126

10. Remove snap ring (1).
11. Remove end shim from the disk carrier.
12. Remove disk pack.



Fig. 127

- 13. Preload compression spring with 5870.345.088 [Assembly fixture] and press.
- 14. Remove securing ring (1).

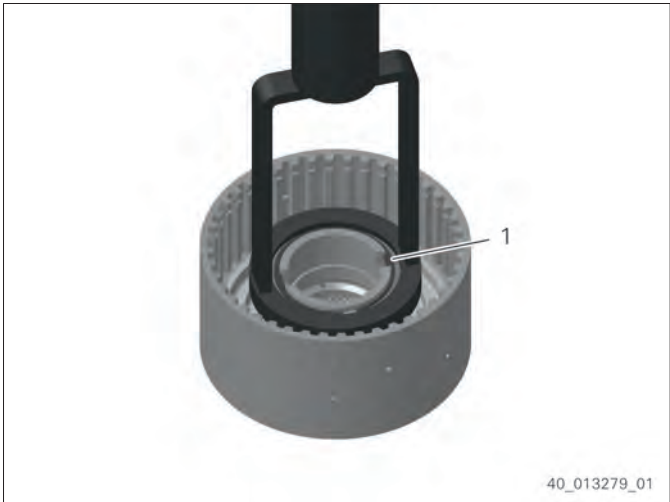


Fig. 128

- 15. Remove guide rings and compression spring.



Fig. 129

- 16. Press the piston (1) out of the disk carrier using compressed air.



Fig. 130

Dismantling

17. Remove piston ring (1).



Fig. 131

18. Pull off bearing inner ring with 5873.001.057 [Gripping device] and 5873.001.001 [Basic tool].

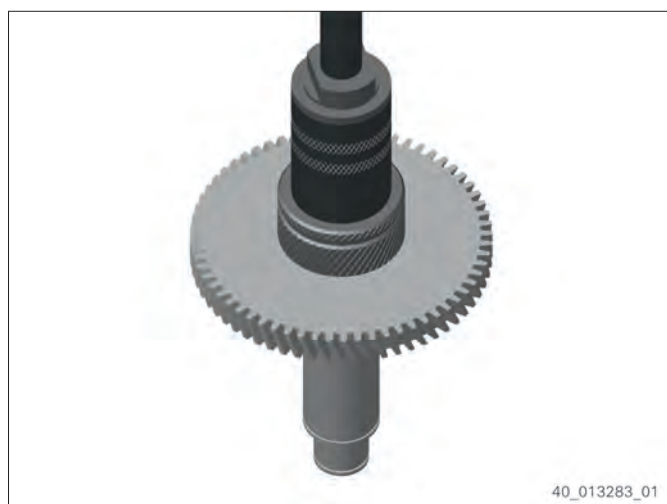


Fig. 132

Dismantling clutch K2

Special tools:

- 5873.001.057 Gripping device
- 5873.001.001 Basic tool
- 5870.345.085 Assembly aid

1. Remove stud bolt (1).
2. Remove piston ring (2).

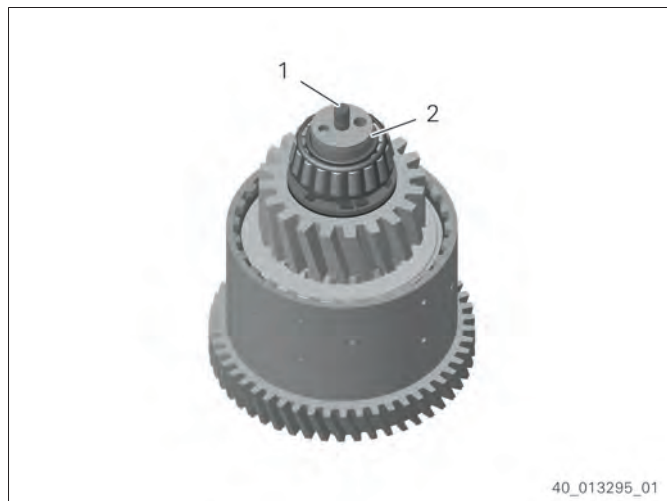


Fig. 133

3. Pull off bearing inner ring with 5873.001.057 [Gripping device] and 5873.001.001 [Basic tool].

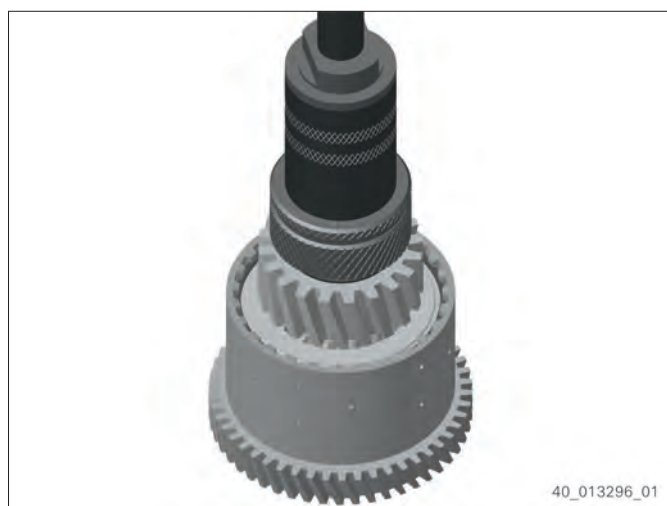


Fig. 134

4. Remove securing ring.



Fig. 135

Dismantling

5. Remove thrust washer (1), axial needle bearing (2) and axial washer (3).

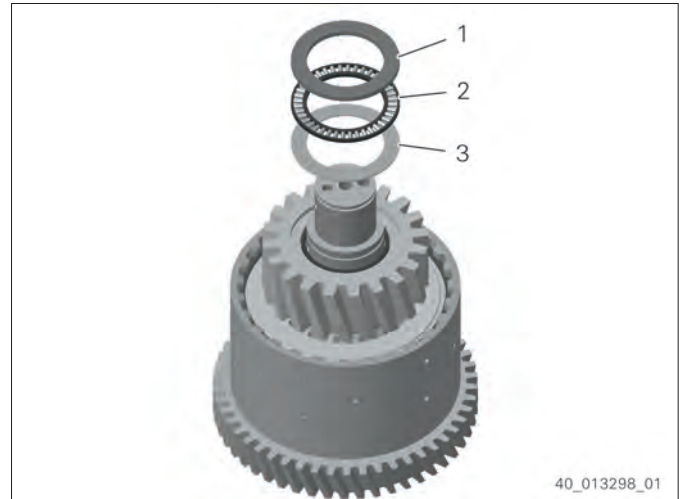


Fig. 136

6. Remove idler gear (1).

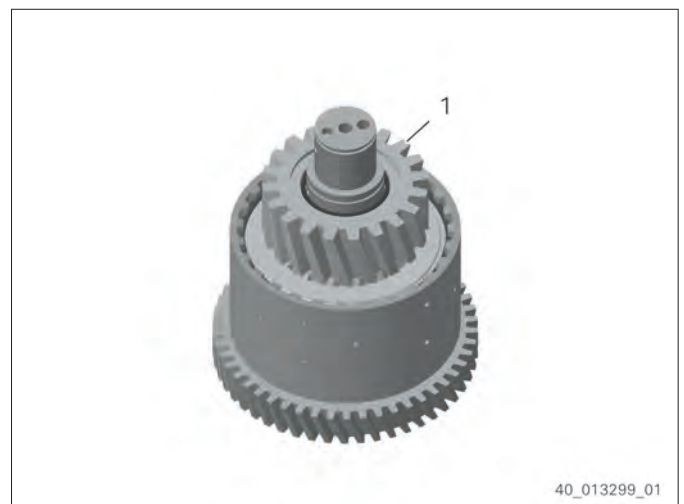


Fig. 137

7. Remove needle cages (1).



Fig. 138

- 8. Remove axial washer (1), axial needle bearing (2) and thrust washer (3).

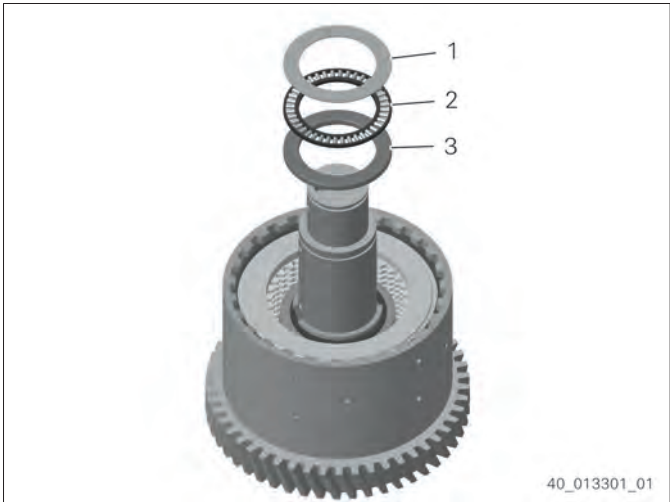


Fig. 139

- 9. Pull off clutch from shaft.



Fig. 140

- 10. Remove snap ring (1).
- 11. Remove end shim from the disk carrier.
- 12. Remove disk pack.



Fig. 141

Dismantling

13. Preload compression spring with 5870.345.085 [Assembly aid] and press.
14. Remove securing ring (1).

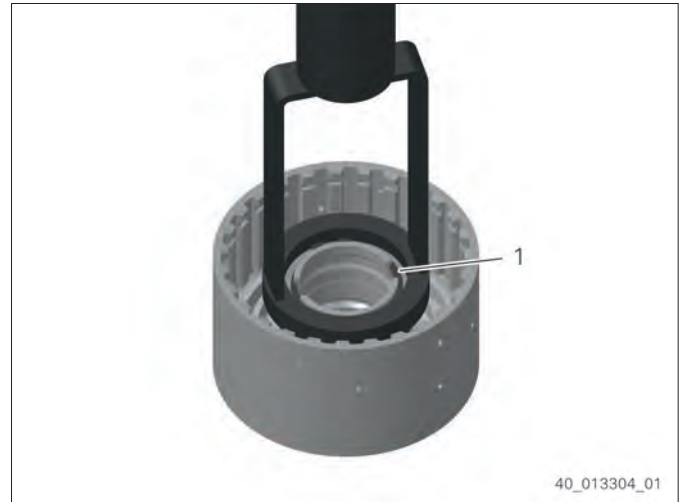


Fig. 142

15. Remove guide rings and compression spring.



Fig. 143

16. Press the piston (1) out of the disk carrier using compressed air.



Fig. 144

17. Remove piston ring (1).

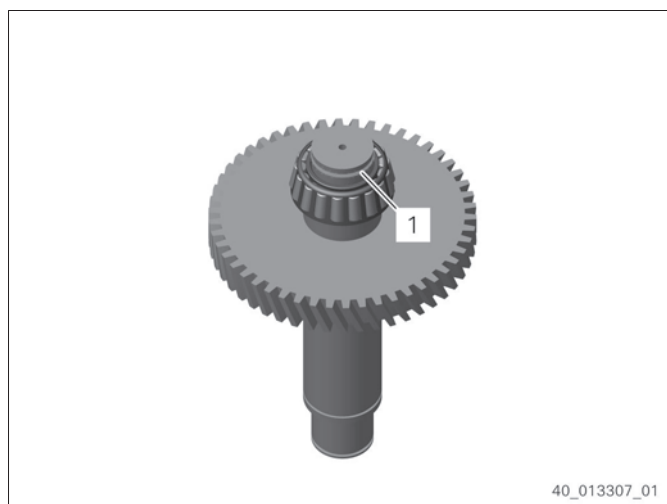


Fig. 145

18. Pull off bearing inner ring with 5873.001.057 [Gripping device] and 5873.001.001 [Basic tool].



Fig. 146

Dismantling clutch K3

Special tools:

- 5873.001.058 Gripping device
- 5873.001.001 Basic tool
- 5873.001.057 Gripping device
- 5870.345.085 Assembly aid

Dismantling

1. Remove stud bolt (1).
2. Remove piston ring (2).

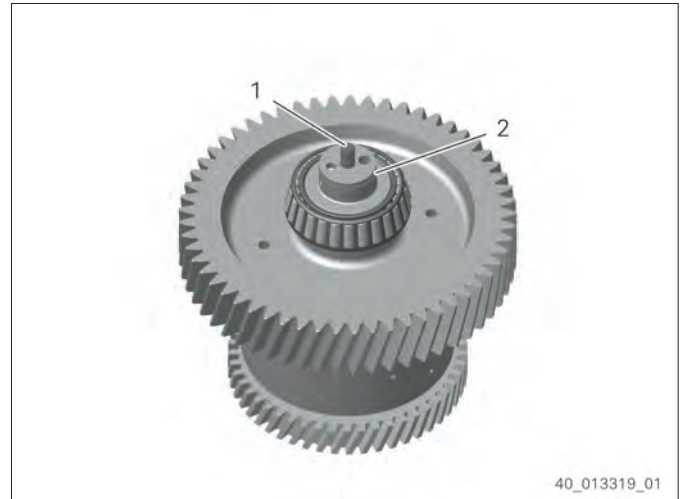


Fig. 147

3. Pull off bearing inner ring with 5873.001.058 [Gripping device] and 5873.001.001 [Basic tool].

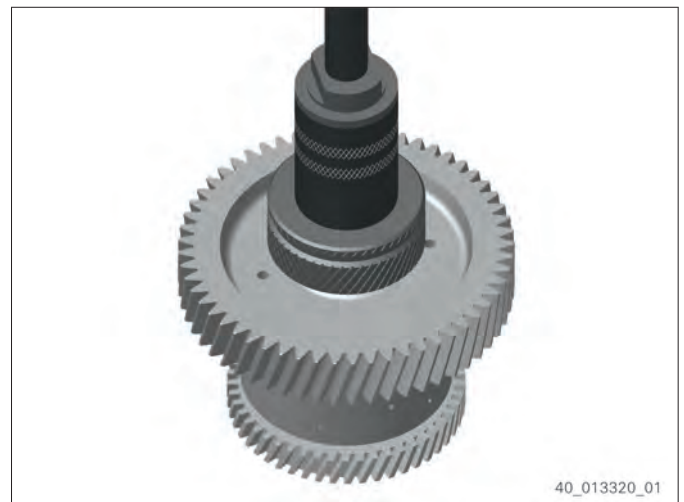


Fig. 148

4. Remove piston ring (1).

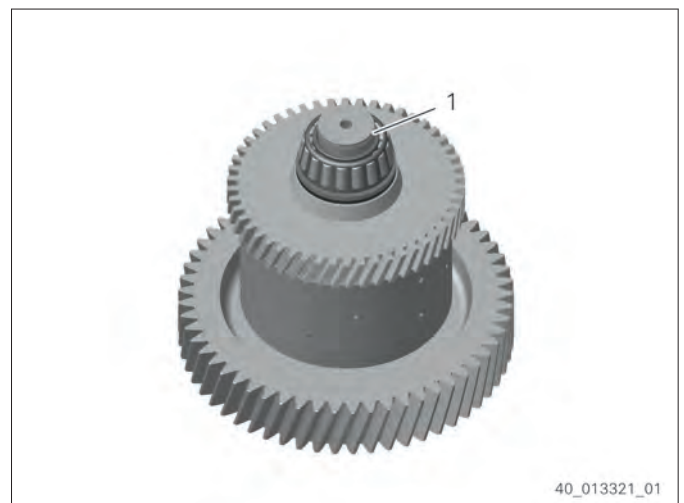


Fig. 149

- 5. Pull off bearing inner ring with 5873.001.057 [Gripping device] and 5873.001.001 [Basic tool].

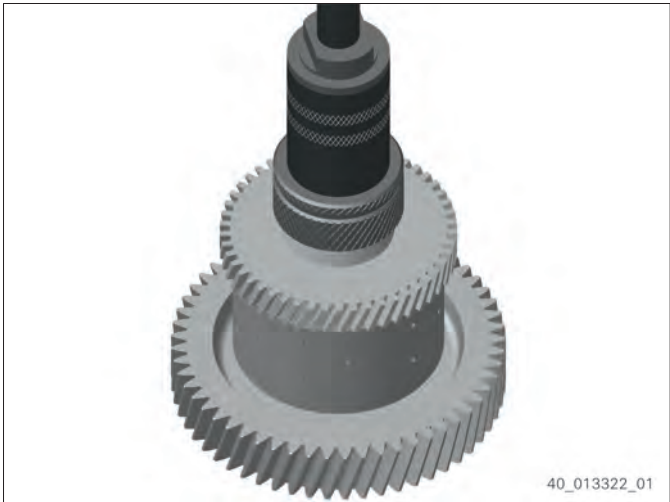


Fig. 150

- 6. Remove thrust washer (1), axial needle bearing (2) and axial washer (3).

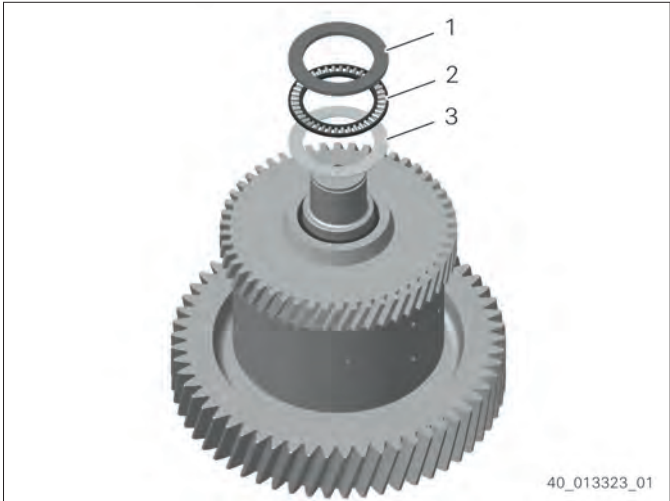


Fig. 151

- 7. Remove idler gear (1).

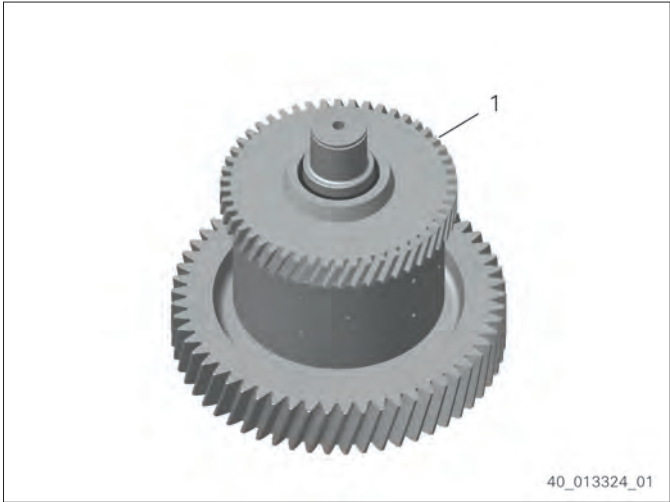


Fig. 152

Dismantling

8. Remove needle cages (1).

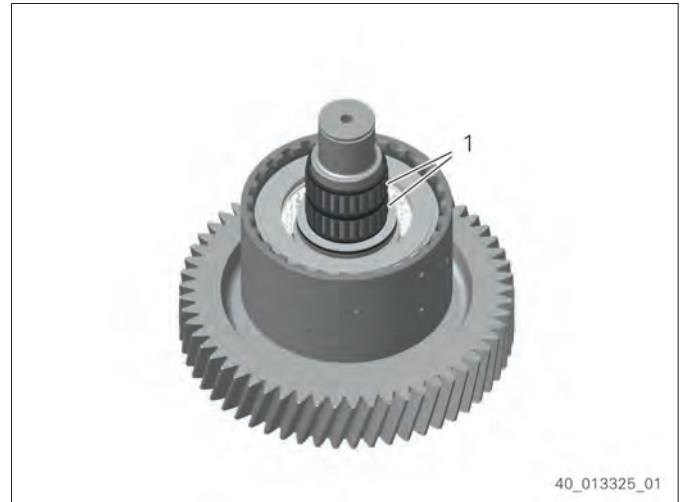


Fig. 153

9. Remove axial washer (1), axial needle bearing (2) and thrust washer (3).

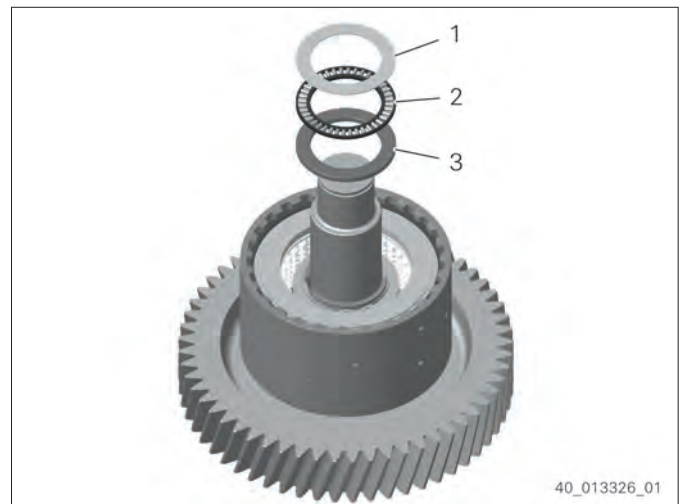


Fig. 154

10. Pull off clutch from shaft.



Fig. 155

11. Remove snap ring (1).
12. Remove end shim from the disk carrier.
13. Remove disk pack.



Fig. 156

14. Preload compression spring with 5870.345.085 [Assembly aid] and press.
15. Remove securing ring (1).

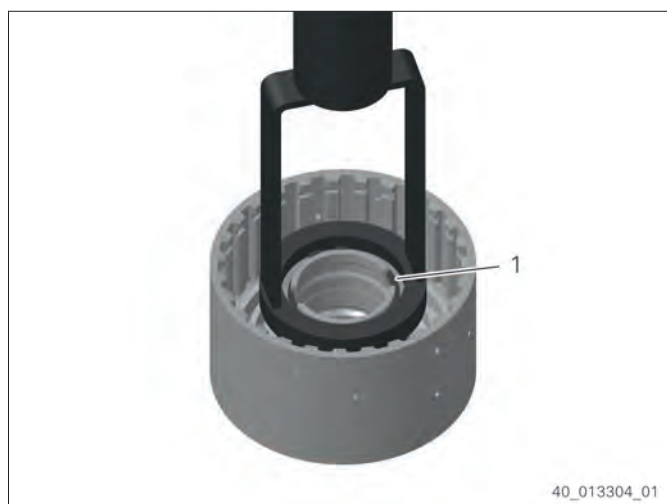


Fig. 157

16. Remove guide rings and compression spring.



Fig. 158

Dismantling

17. Press the piston (1) out of the disk carrier using compressed air.



Fig. 159

Dismantling clutch K4

Special tools:

- 5873.001.057 Gripping device
- 5873.001.001 Basic tool
- 5870.345.085 Assembly aid

1. Remove stud bolt (1).
2. Remove piston ring (2).

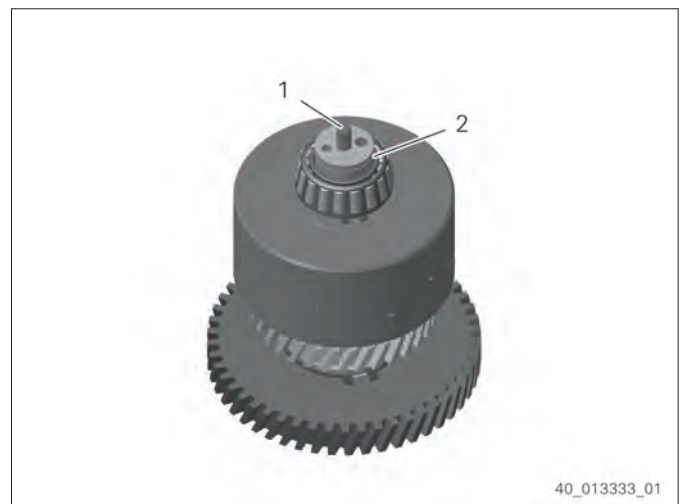


Fig. 160

3. Pull off bearing inner ring with 5873.001.057 [Gripping device] and 5873.001.001 [Basic tool].

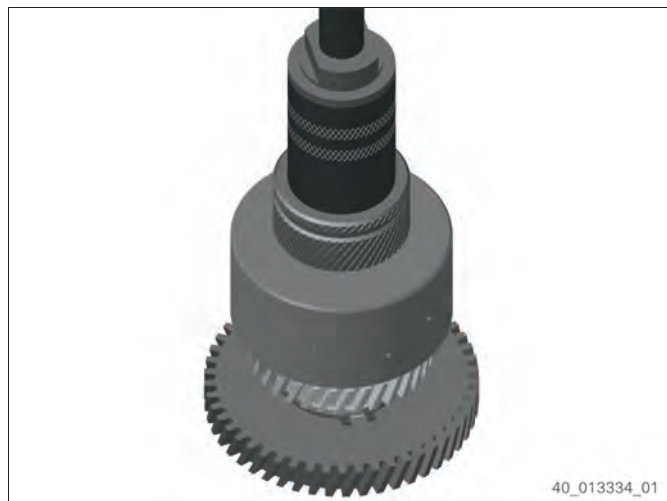


Fig. 161

4. Remove securing ring.



Fig. 162

5. Pull off clutch from shaft.



Fig. 163

Dismantling

6. Remove snap ring (1).
7. Remove end shim from the disk carrier.
8. Remove disk pack.



Fig. 164

9. Preload compression spring with 5870.345.085 [Assembly aid] and press.
10. Remove securing ring (1).



Fig. 165

11. Remove guide rings and compression spring.



Fig. 166

- 12. Press the piston (1) out of the disk carrier using compressed air.



Fig. 167

- 13. Remove thrust washer (1), axial needle bearing (2) and axial washer (3).

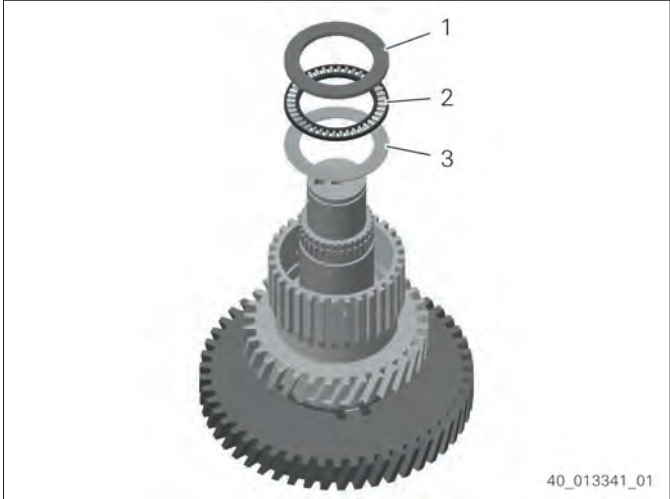


Fig. 168

- 14. Remove idler gear (1).

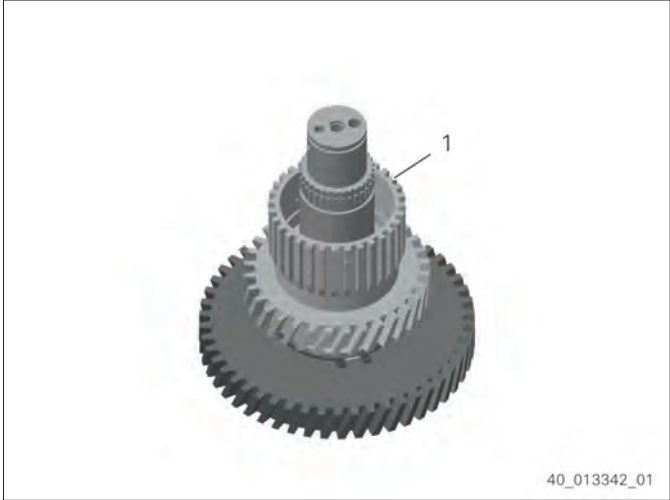


Fig. 169

Dismantling

15. Remove needle cages (1).

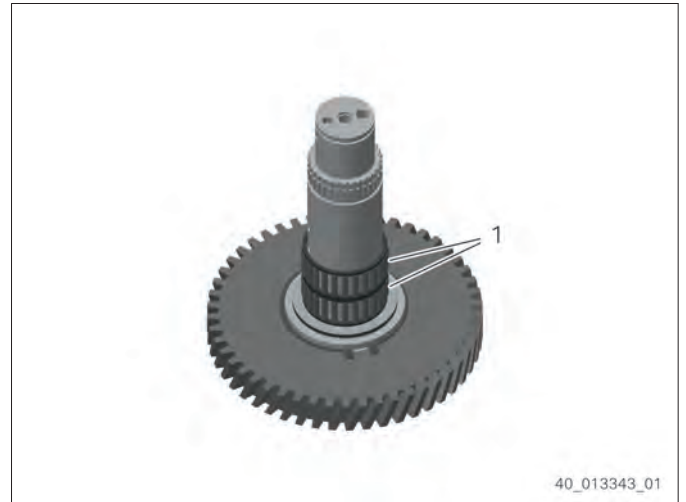


Fig. 170

16. Remove axial washers (1) and axial needle bearing (2).

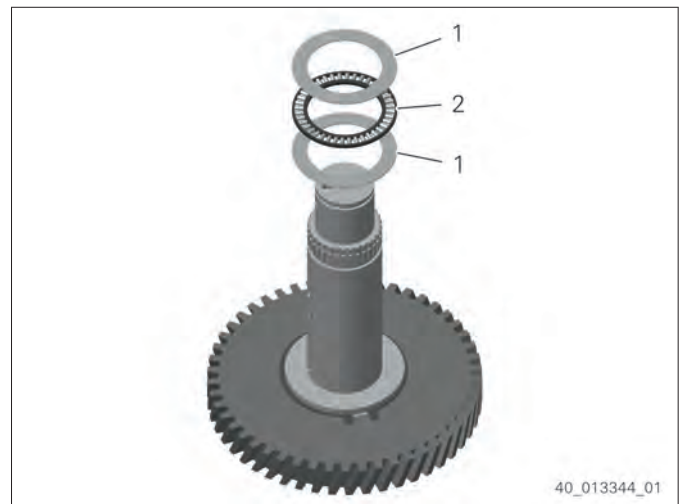


Fig. 171

17. Remove piston ring (1).



Fig. 172

18. Pull off bearing inner ring with 5873.001.057 [Gripping device] and 5873.001.001 [Basic tool].
 - ※ No further dismantling possible.

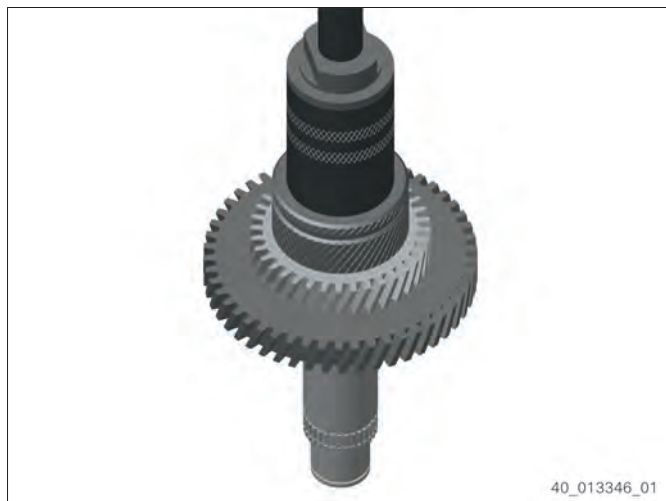


Fig. 173

Dismantling input shaft

Special tools:

- 5873.001.058 Gripping device
- 5873.001.001 Basic tool

1. Remove R-rings (1).
2. Pull off bearing inner rings (2) with 5873.001.058 [Gripping device] and 5873.001.001 [Basic tool].
 - ※ No further dismantling possible.

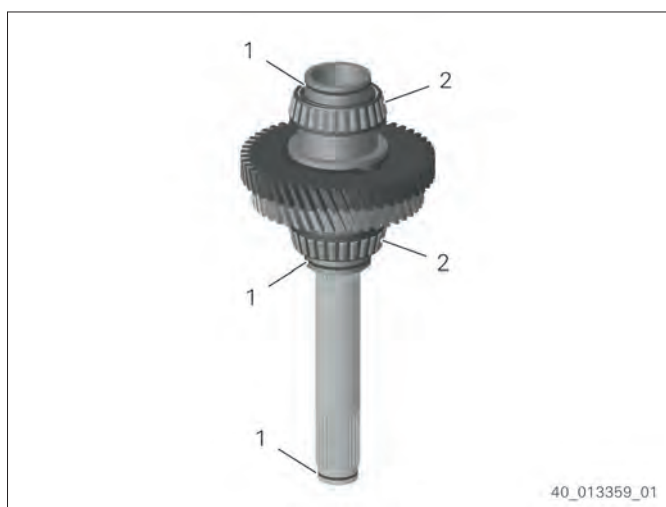


Fig. 174

Dismantling

9.16 Dismantling housing rear section

1. Force the converter safety valve out of the housing hole.

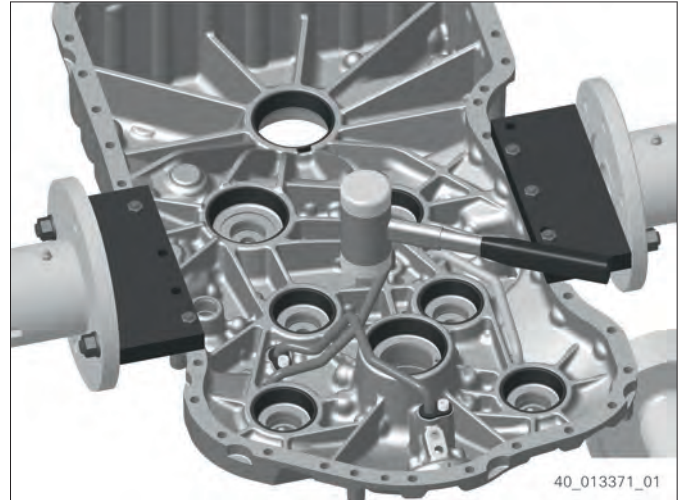


Fig. 175

2. Pull bearing outer rings out of housing holes. The Figure shows the positions of the bearing outer rings.

- 1 = Output shaft
- 2 = Clutch K1
- 3 = Clutch K4
- 4 = Clutch KR
- 5 = Input shaft
- 6 = Clutch KV
- 7 = Clutch K2
- 8 = Clutch K3

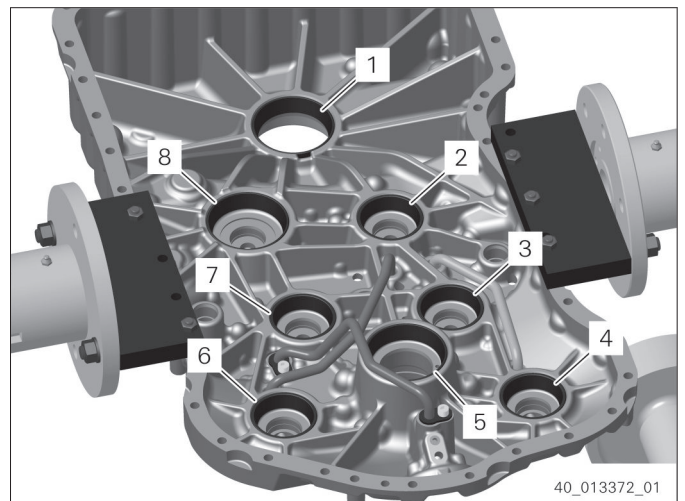


Fig. 176

3. Loosen cap screws.
4. Remove oil tube (1)
 - ※ No further dismantling possible.

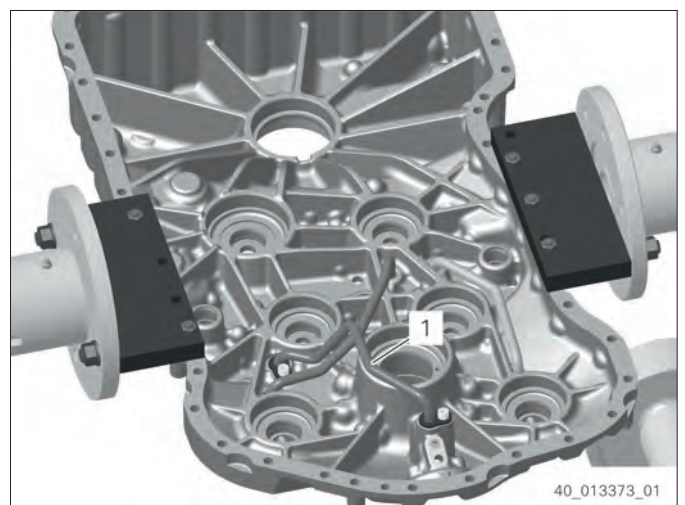


Fig. 177

10 Assembly

10.1 Assembling housing rear section

1. Grease O-rings.
2. Slide O-rings (1) onto the oil tube



Fig. 178

3. Insert oil tube (1) in housing holes.
4. Fix oil tube with cap screws.
Tightening torque: **23 Nm**

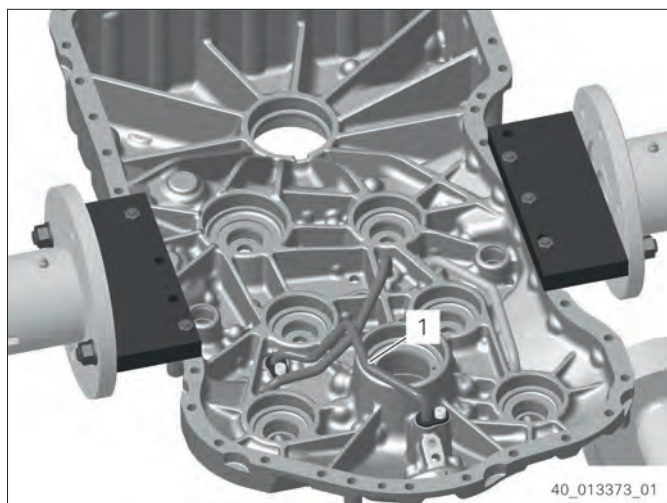


Fig. 179

5. Insert bearing outer rings in housing holes until contact is obtained.
The Figure shows the positions of the bearing outer rings.

- 1 = Output shaft
- 2 = Clutch K1
- 3 = Clutch K4
- 4 = Clutch KR
- 5 = Input shaft
- 6 = Clutch KV
- 7 = Clutch K2
- 8 = Clutch K3

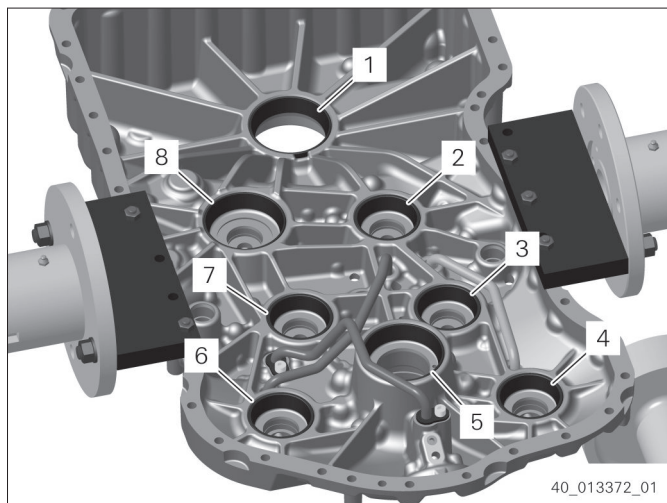


Fig. 180

Assembly

Assembling and installing clutches and input shaft

Assembling clutch KV

Special tools:

- 5870.345.124 Assembly fixture
- 5870.345.088 Assembly fixture

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 the bearing inner ring.

2. Slide bearing inner ring (1) onto shaft until contact is obtained.
3. Let bearing inner ring cool down.
4. Adjust bearing inner ring.
5. Insert piston ring (1).



Fig. 181

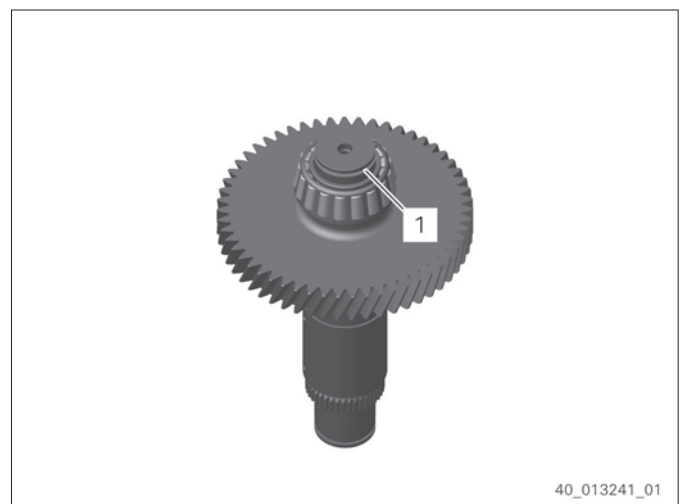


Fig. 182

- 6. Slide on needle cage (1).

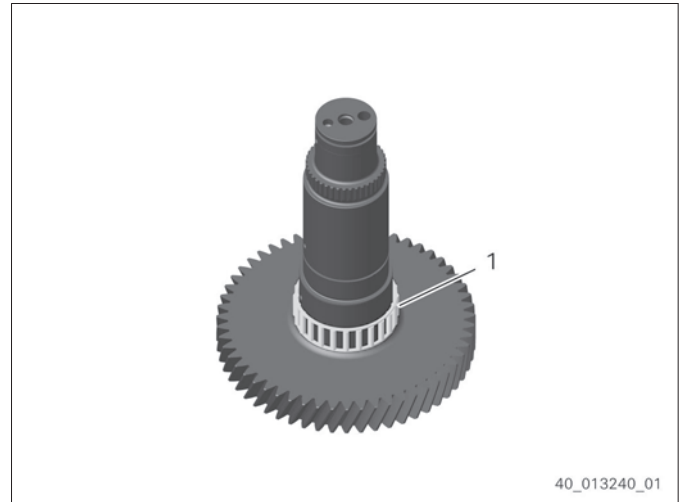


Fig. 183

- 7. Insert ball bearing (1) into idler gear until contact is obtained.
- 8. Insert securing ring.

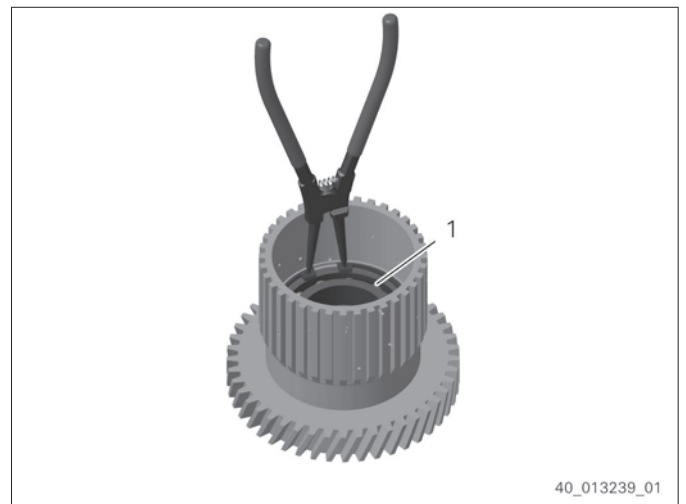


Fig. 184

- 9. Press idler gear onto the shaft until contact is obtained.

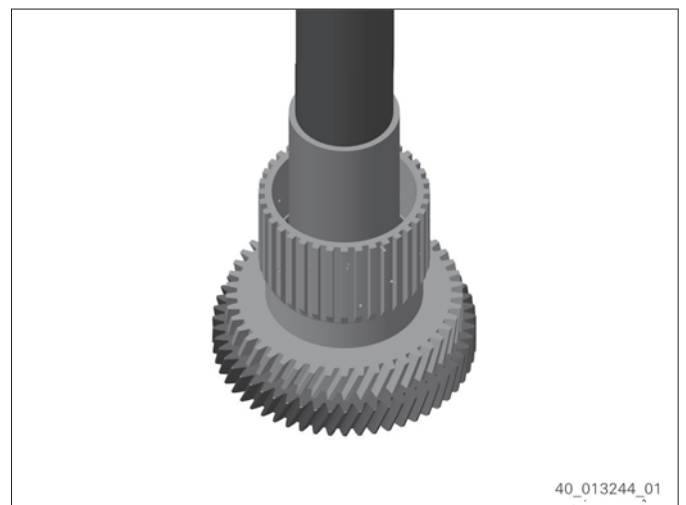


Fig. 185

Assembly

10. Insert securing ring in the shaft.



Fig. 186

11. Check clearance of the ball in the drain valve (1).
12. Oil O-rings (2) and insert them twist-free in the radial grooves.



Fig. 187

13. Oil O-rings and piston bearing surfaces.
14. Insert piston (1) into the disk carrier until contact is obtained.



Fig. 188

15. Insert shim (2) and compression spring (1).



Fig. 189

16. Insert 5870.345.124 [Assembly fixture] (1) in the disk carrier.
17. Slide on supporting ring (2).
18. Slide on **new** L-ring (3) with the offset front face facing downwards.

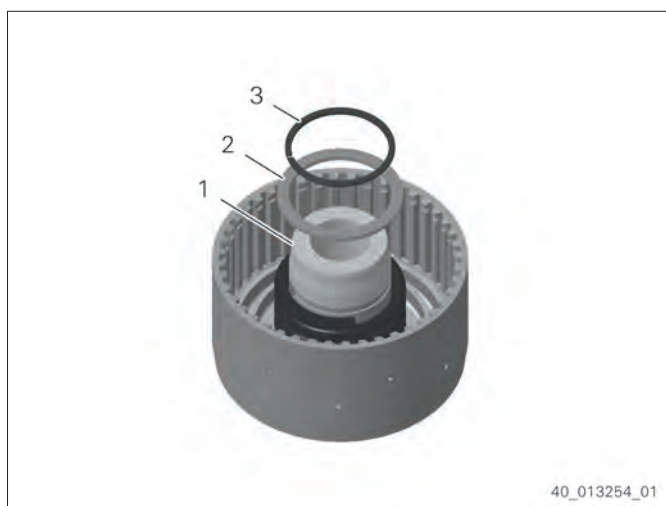


Fig. 190

19. Push L-ring downwards with 5870.345.124 [Assembly fixture] and 5870.345.088 [Assembly fixture] until it engages in the radial groove of the disk carrier.



Fig. 191

Assembly

Setting disk clearance

20. Insert outer disk (1) with the uncoated side facing the piston.

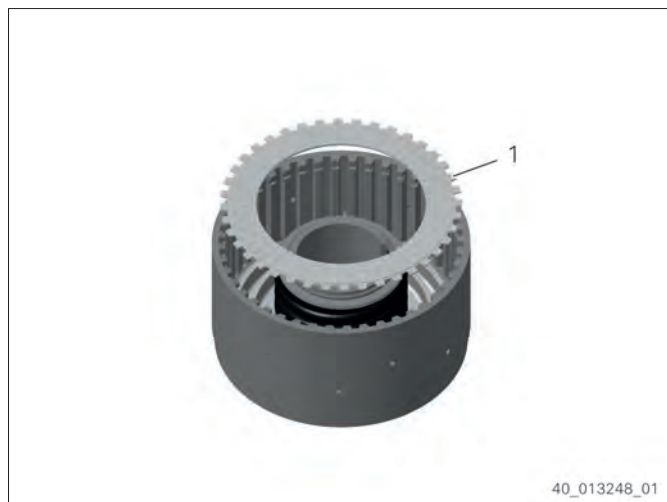


Fig. 192

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

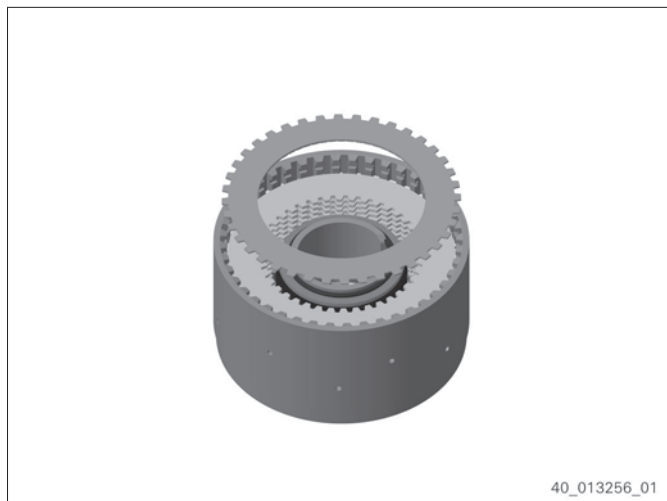


Fig. 193

22. Insert end shim (1).
23. Insert snap ring e. g. 2.70 mm.



Fig. 194

24. Position dial gauge on the end shim.
25. Push end shim downwards with 100 N and set dial gauge to zero.
26. Lift end shim on the snap ring until contact is obtained and check the necessary Disk clearance 2.45 mm until 2.75 mm.
If the disk clearance is too small, install a thinner snap ring.
If the disk clearance is too big, install a thicker snap ring.

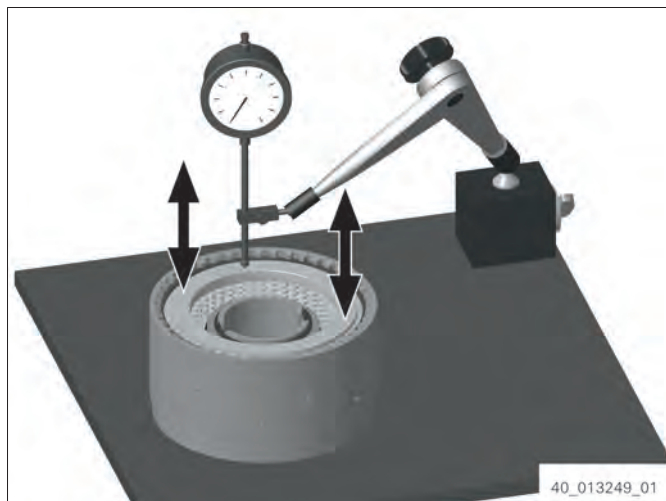


Fig. 195

27. ※ 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 internal spline of the disk carrier.



Fig. 196

28. Slide clutch onto shaft until contact is obtained. Insert idler gear into the disk pack by short mutual rotary motions.



Fig. 197

Assembly

29. ※ 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 bearing inner ring.

30. Slide on bearing inner ring (1) until contact is obtained.
31. Let bearing inner ring cool down.
32. Adjust bearing inner ring.
33. Screw in stud bolt (1) and tighten.
Tightening torque: **17 Nm**
34. Insert piston ring (2).

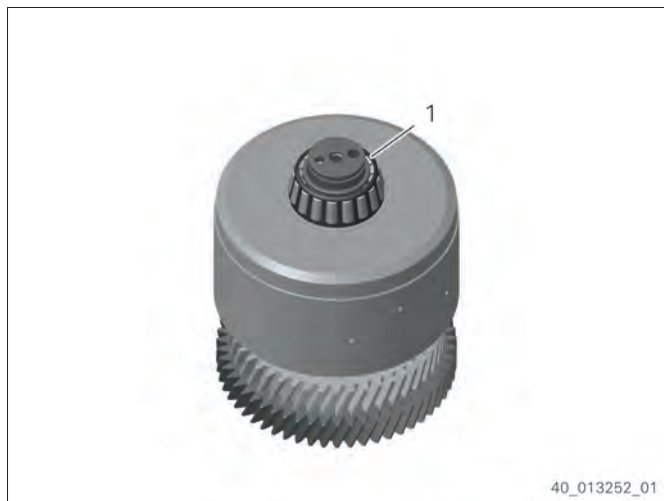


Fig. 198

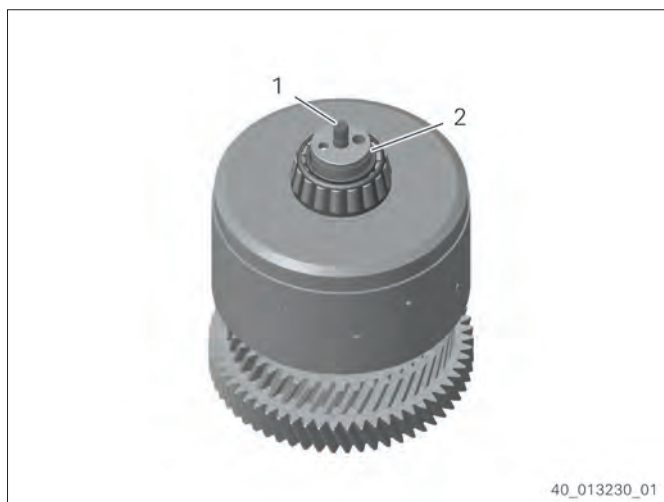


Fig. 199

35. Check function of the clutch with compressed air.
- Closing and opening of the clutch is clearly audible.
- If closing and opening is not audible, remove and check clutch.



Fig. 200

Assembling clutch KR

Special tools:

- 5870.345.124 Assembly fixture
- 5870.345.088 Assembly fixture

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 the bearing inner ring.

2. Slide bearing inner ring (1) onto shaft until contact is obtained.
3. Let bearing inner ring cool down.
4. Adjust bearing inner ring.



Fig. 201

Assembly

5. Insert piston ring (1).



Fig. 202

6. Slide on needle cage (1).

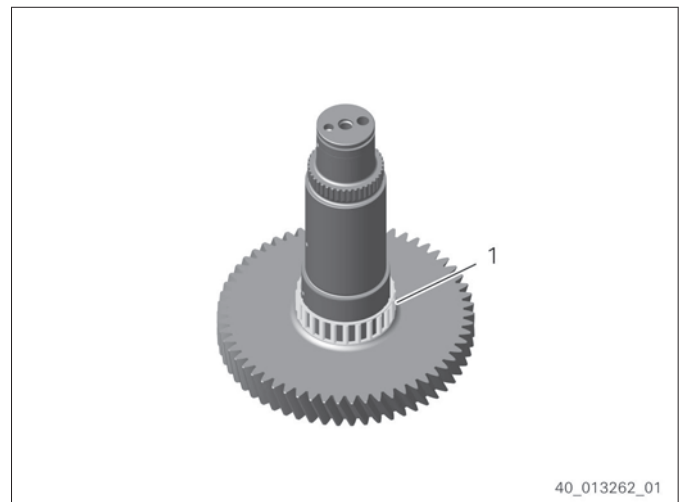


Fig. 203

7. Insert ball bearing (1) into idler gear until contact is obtained.
8. Insert securing ring.

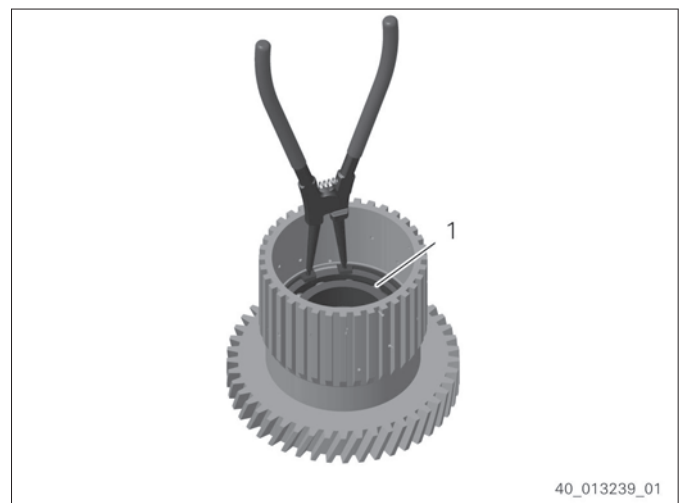


Fig. 204

- 9. Press idler gear onto the shaft until contact is obtained.



Fig. 205

- 10. Insert securing ring in the shaft.



Fig. 206

- 11. Check clearance of the ball in the drain valve (1).
- 12. Oil O-rings (2) and insert them twist-free in the radial grooves.



Fig. 207

Assembly

13. Oil O-rings and piston bearing surfaces.
14. Insert piston (1) into the disk carrier until contact is obtained.



Fig. 208

15. Insert shim (2) and compression spring (1).



Fig. 209

16. Insert 5870.345.124 [Assembly fixture] (1) in the disk carrier.
17. Slide on supporting ring (2).
18. Slide on **new** L-ring (3) with the offset front face facing downwards.

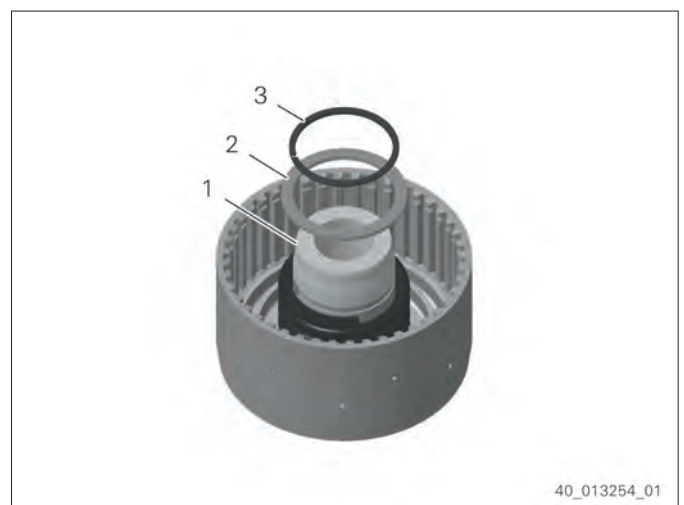


Fig. 210

19. Push L-ring downwards with 5870.345.124 [Assembly fixture] and 5870.345.088 [Assembly fixture] until it engages in the radial groove of the disk carrier.



Fig. 211

Setting disk clearance

20. Insert outer disk (1) with the uncoated side facing the piston.

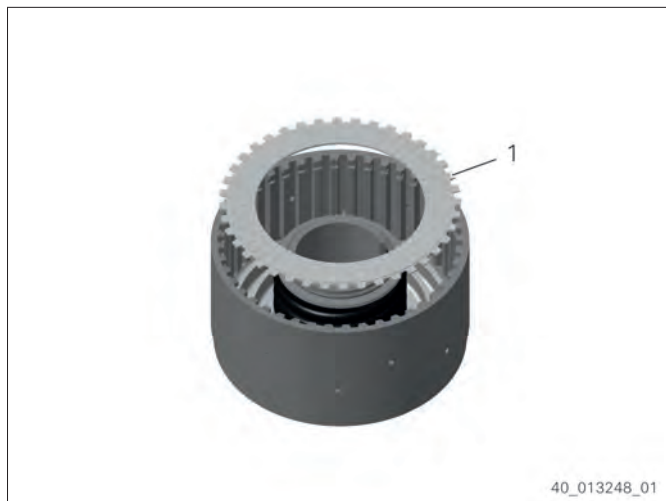


Fig. 212

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

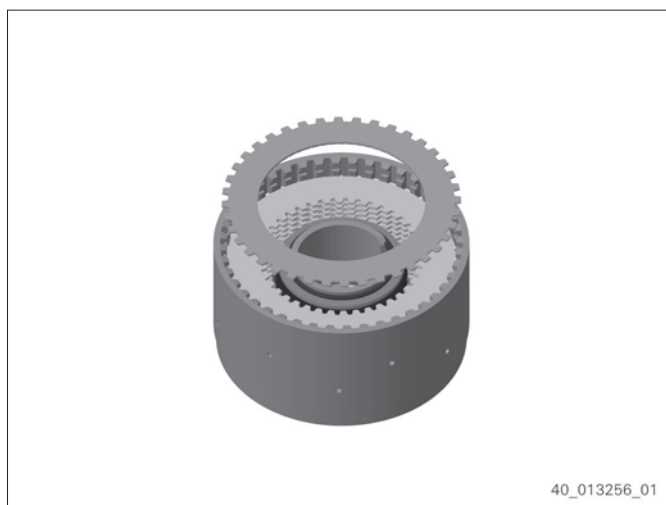


Fig. 213

Assembly

22. Insert end shim (1).
23. Insert snap ring e. g. 2.70 mm.

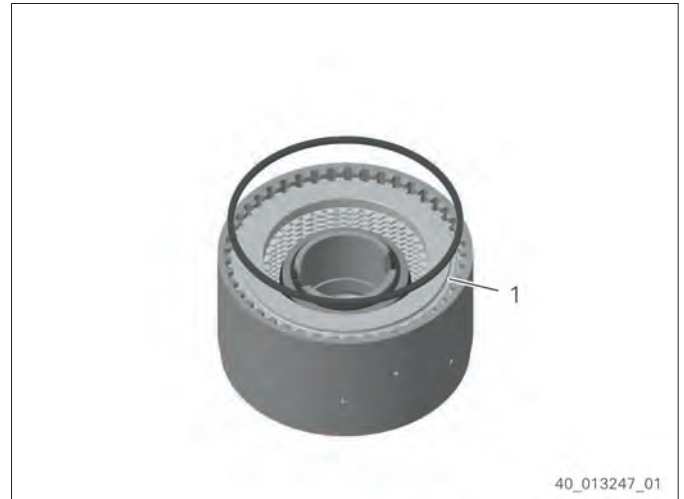


Fig. 214

24. Position dial gauge on the end shim.
25. Push end shim downwards with 100 N and set dial gauge to zero.
26. Lift end shim on the snap ring until contact is obtained and check the necessary Disk clearance 2.45 mm until 2.75 mm. If the disk clearance is too small, install a thinner snap ring. If the disk clearance is too big, install a thicker snap ring.

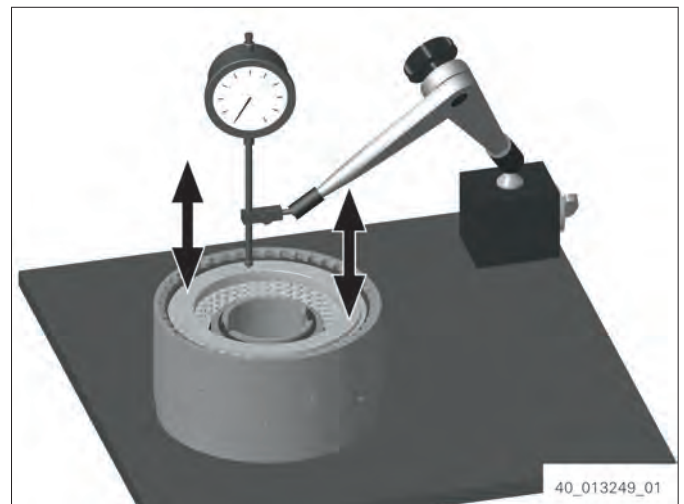


Fig. 215

27. * 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 internal spline of the disk carrier.



Fig. 216

28. Slide clutch onto shaft until contact is obtained. Insert idler gear into the disk pack by short mutual rotary motions.

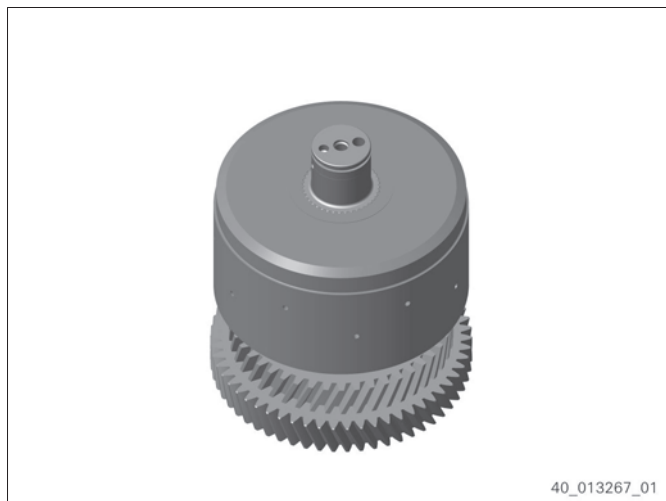


Fig. 217

29. ※ 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 bearing inner ring.

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

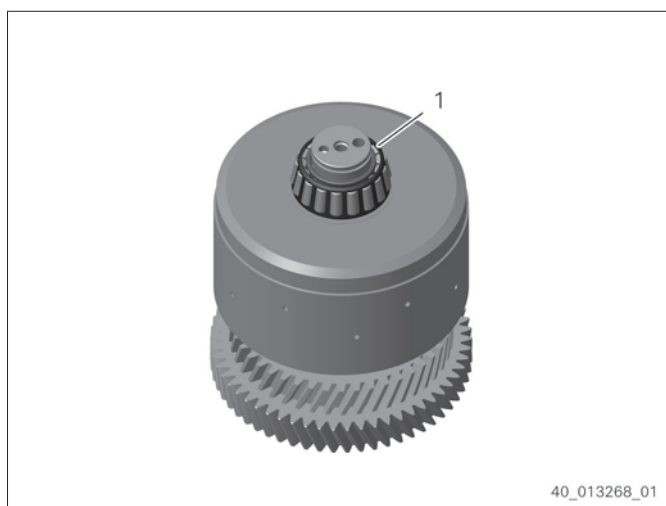


Fig. 218

31. Let bearing inner ring cool down.

32. Adjust bearing inner ring.

Assembly

33. Screw in stud bolt (1) and tighten.
Tightening torque: **17 Nm**
34. Insert piston ring (2).

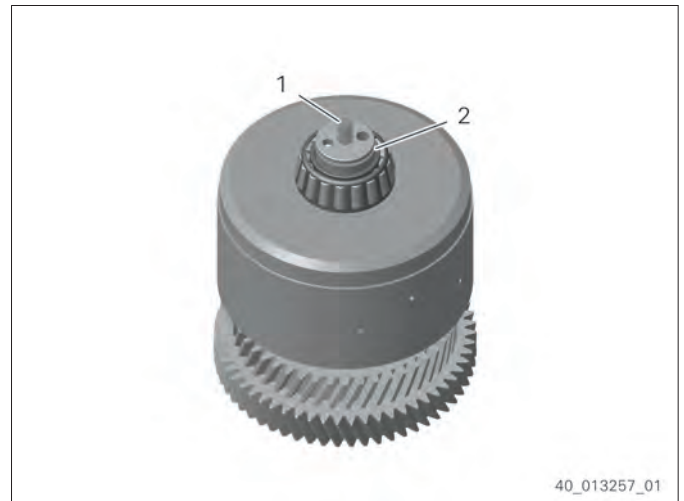


Fig. 219

35. Check function of the clutch with compressed air.
→ Closing and opening of the clutch is clearly audible.

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



Fig. 220

Assembling clutch K1

Special tools:

- 5870.345.088 Assembly fixture

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 the bearing inner ring.

2. Slide bearing inner ring (1) onto shaft until contact is obtained.
3. Let bearing inner ring cool down.
4. Adjust bearing inner ring.
5. Insert piston ring (1).



Fig. 221



Fig. 222

Assembly

6. Check clearance of the ball in the drain valve (1).
7. Oil O-rings (2) and insert them twist-free in the radial grooves.

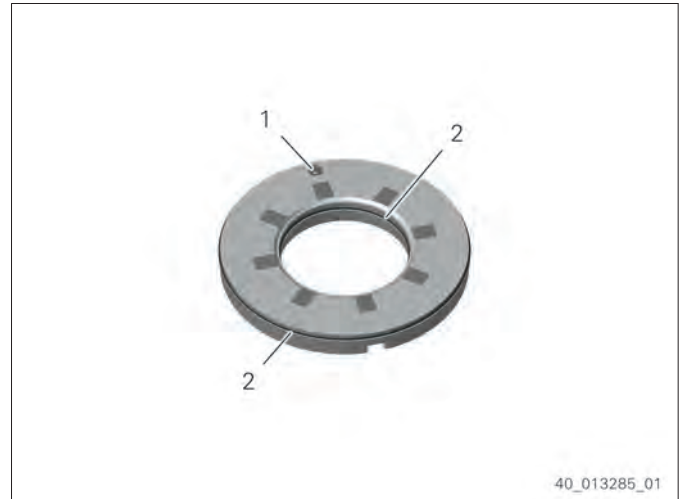


Fig. 223

8. Oil O-rings and piston bearing surfaces.
9. Insert piston (1) into the disk carrier until contact is obtained.



Fig. 224

10. Slide on guide ring (3) with the offset front face facing upwards.
11. Slide on compression spring (2).
12. Slide on guide ring (1) with the offset front face facing downwards.



Fig. 225

13. Preload compression spring with 5870.345.088 [Assembly fixture] and press.
14. Insert securing ring (1).

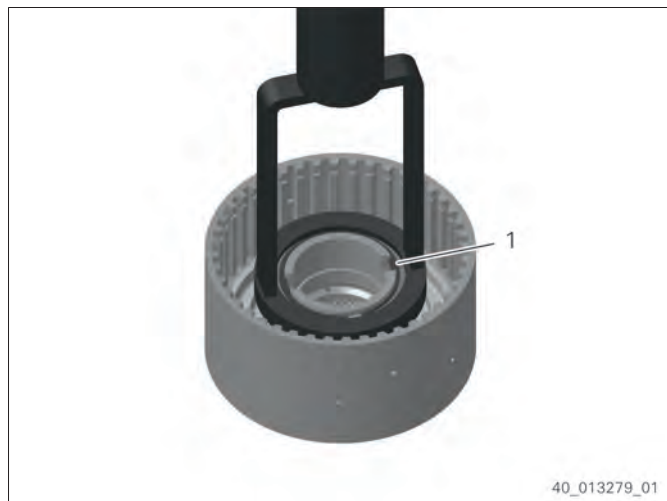


Fig. 226

Setting disk clearance

15. Insert outer disk (1) with the uncoated side facing the piston.

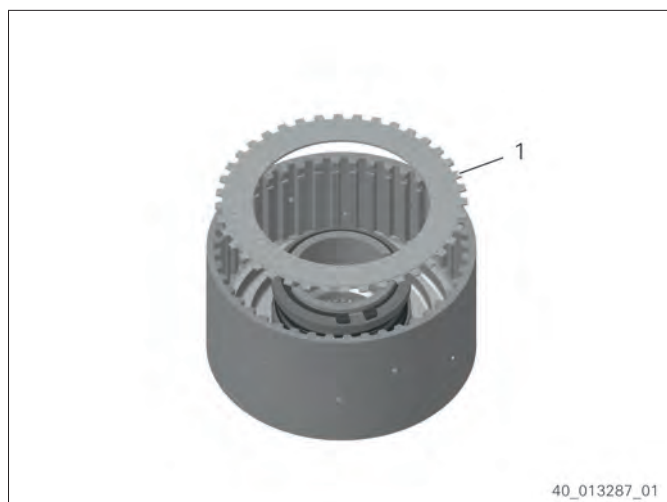


Fig. 227

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



Fig. 228

Assembly

17. Insert end shim (1).
18. Insert snap ring e. g. 2.85 mm.

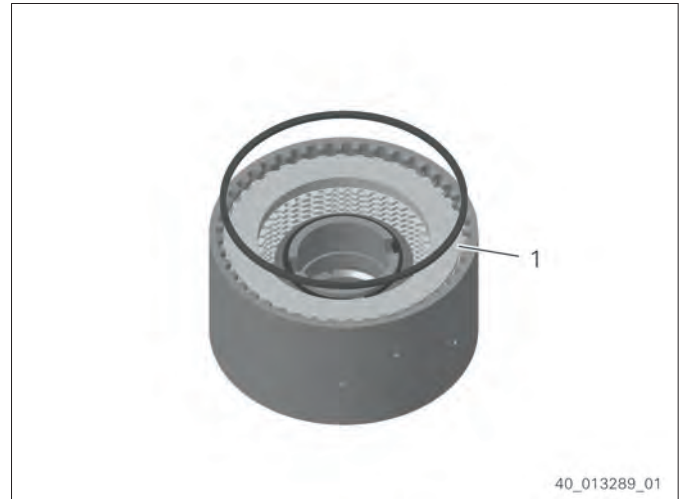


Fig. 229

19. Position dial gauge on the end shim.
20. Push end shim downwards with 100 N and set dial gauge to zero.
21. Lift end shim on the snap ring until contact is obtained and check the necessary Disk clearance 2.05 mm until 2.35 mm.
If the disk clearance is too small, install a thinner snap ring.
If the disk clearance is too big, install a thicker snap ring.

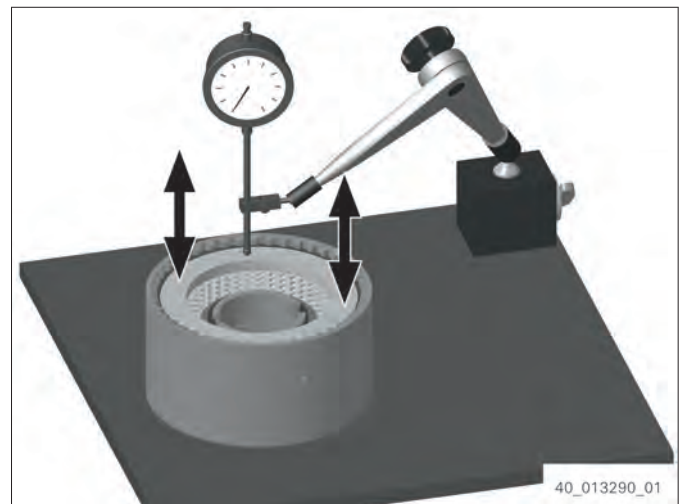


Fig. 230

22. ※ 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 internal spline of the disk carrier.



Fig. 231

- 23. Slide clutch onto shaft until contact is obtained.



Fig. 232

- 24. Slide on thrust washer (3) with the chamfer facing the axle needle cage.
- 25. Slide on axial needle cage (2).
- 26. Slide on the axial washer (1).

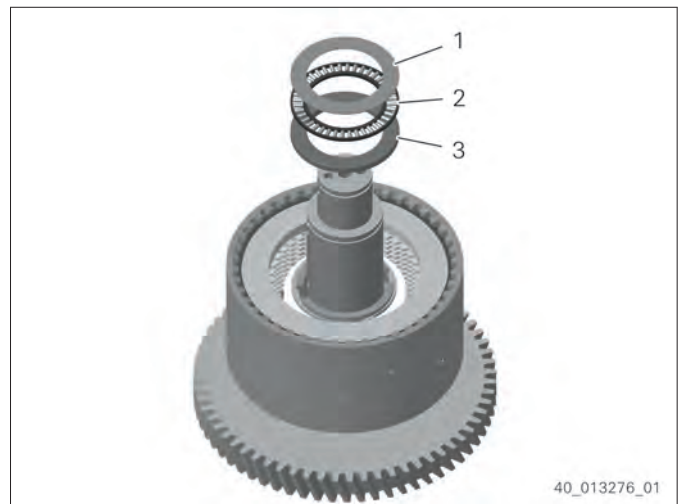


Fig. 233

- 27. Slide on needle cage (1).

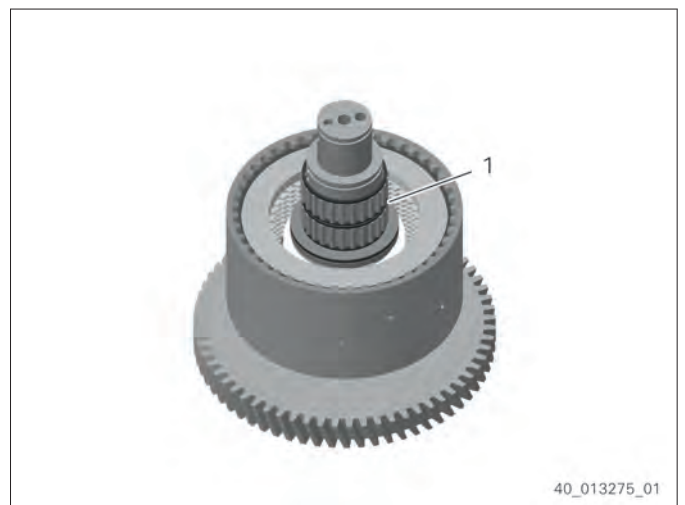


Fig. 234

Assembly

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

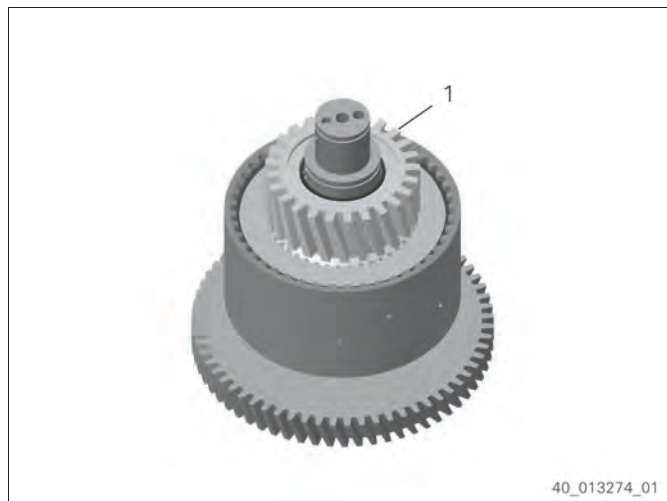


Fig. 235

29. Slide on the axial washer (3).
30. Slide on axial needle cage (2).
31. Slide on thrust washer (1) with the chamfer facing the axle needle cage.

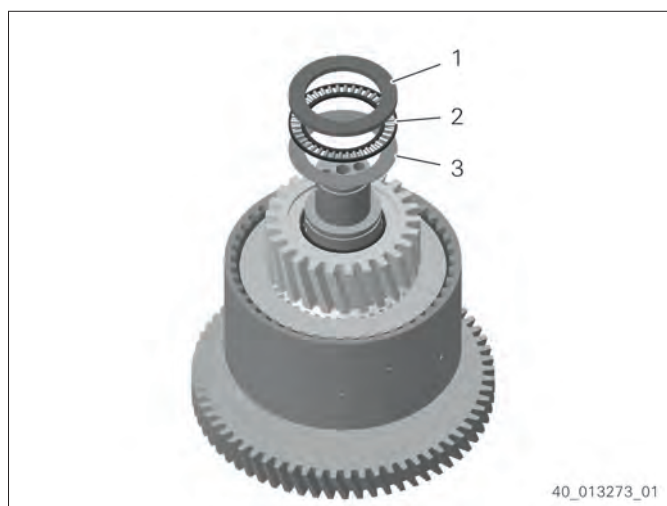


Fig. 236

32. Insert securing ring in the shaft.

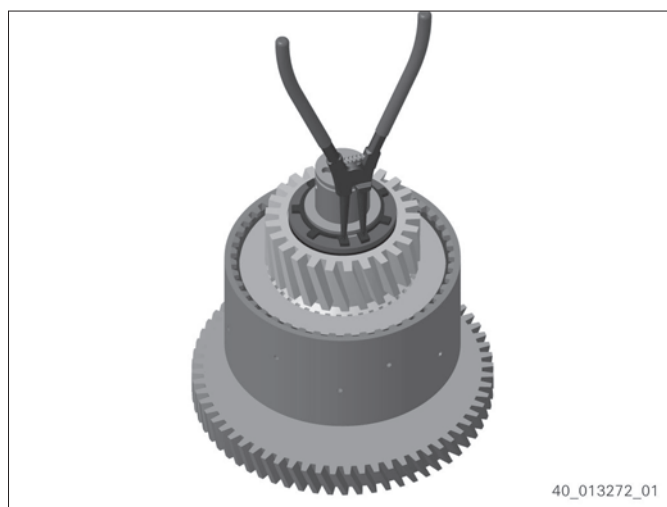


Fig. 237

33. ※ 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 bearing inner ring.

34. Slide bearing inner ring (1) onto shaft until contact is obtained.
35. Let bearing inner ring cool down.
36. Adjust bearing inner ring.
37. Screw in stud bolt (1) and tighten.
Tightening torque: **17 Nm**
38. Insert piston ring (2).

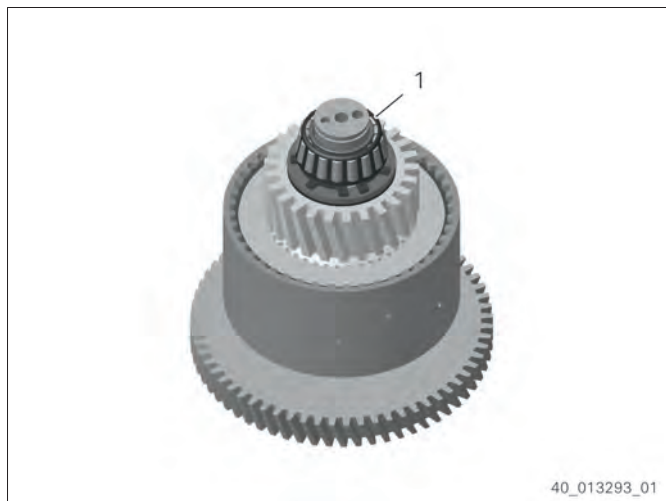


Fig. 238

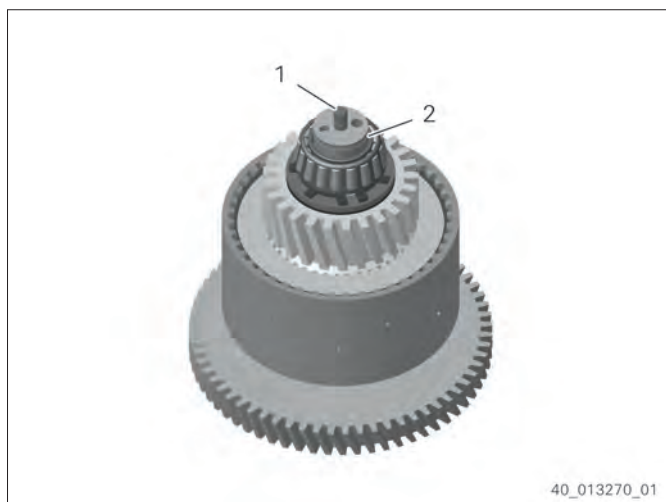


Fig. 239

Assembly

39. Check function of the clutch with compressed air.
- Closing and opening of the clutch is clearly audible.
- If closing and opening is not audible, remove and check clutch.



Fig. 240

Assembling clutch K2

Special tools:

- 5870.345.085 Assembly aid
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 the bearing inner ring.

2. Slide bearing inner ring (1) onto shaft until contact is obtained.
3. Let bearing inner ring cool down.
4. Adjust bearing inner ring.



Fig. 241

- 5. Insert piston ring (1).



Fig. 242

- 6. Check clearance of the ball in the drain valve (1).
- 7. Oil O-rings (2) and insert them twist-free in the radial grooves.

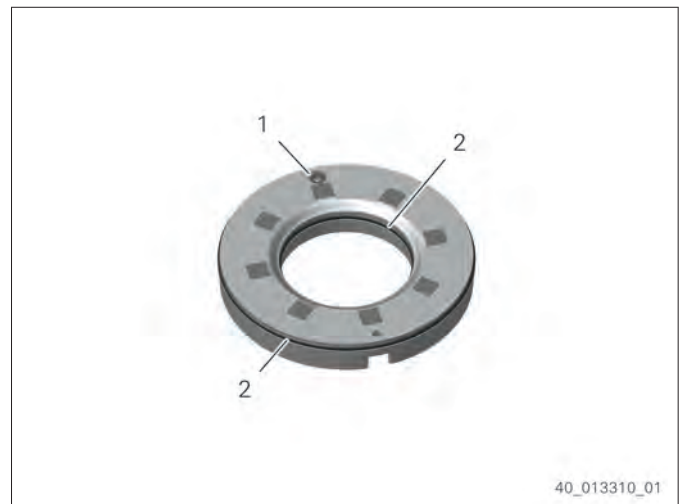


Fig. 243

- 8. Oil O-rings and piston bearing surfaces.
- 9. Insert piston (1) into the disk carrier until contact is obtained.



Fig. 244

Assembly

10. Slide on guide ring (3) with the offset front face facing upwards.
11. Slide on compression spring (2).
12. Slide on guide ring (1) with the offset front face facing downwards.

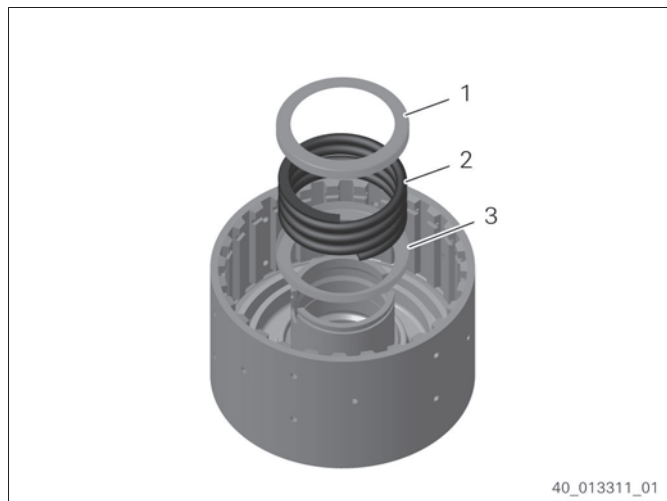


Fig. 245

13. Preload compression spring with 5870.345.085 [Assembly aid] and press.
14. Insert securing ring (1).

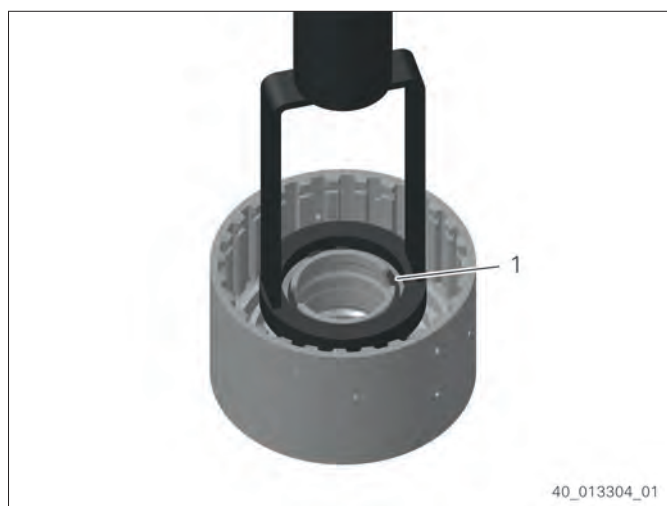


Fig. 246

Setting disk clearance

15. Insert friction disk (1) with the uncoated side facing the piston.

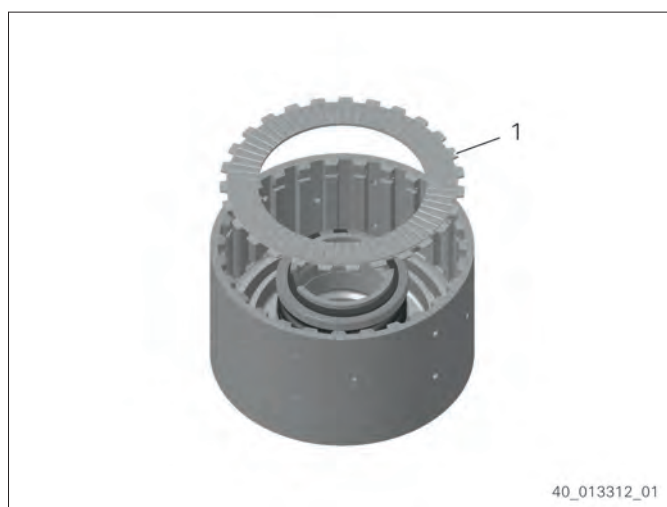


Fig. 247

16. Insert inner disks and outer disks.
 ※ For the arrangement refer to the current spare parts list.
17. Insert friction disk (1) with the uncoated side facing the end shim.

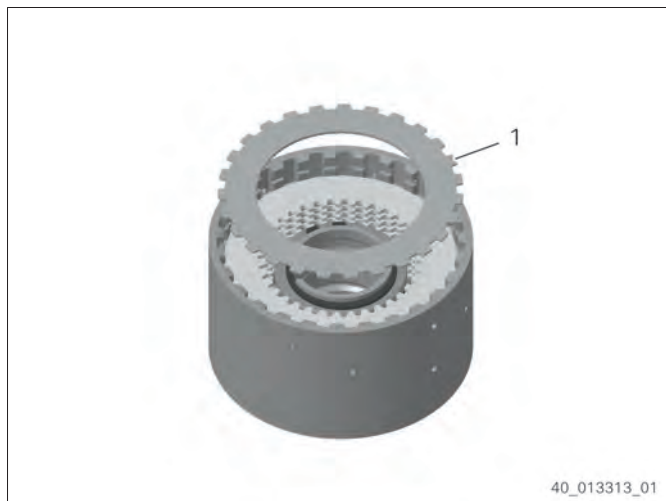


Fig. 248

18. Insert end shim (1).
19. Insert snap ring e. g. 3.15 mm.



Fig. 249

20. Position dial gauge on the end shim.
21. Push end shim downwards with 100 N and set dial gauge to zero.
22. Lift end shim on the snap ring until contact is obtained and check the necessary Disk clearance 2.00 mm until 2.30 mm.
 If the disk clearance is too small, install a thinner snap ring.
 If the disk clearance is too big, install a thicker snap ring.

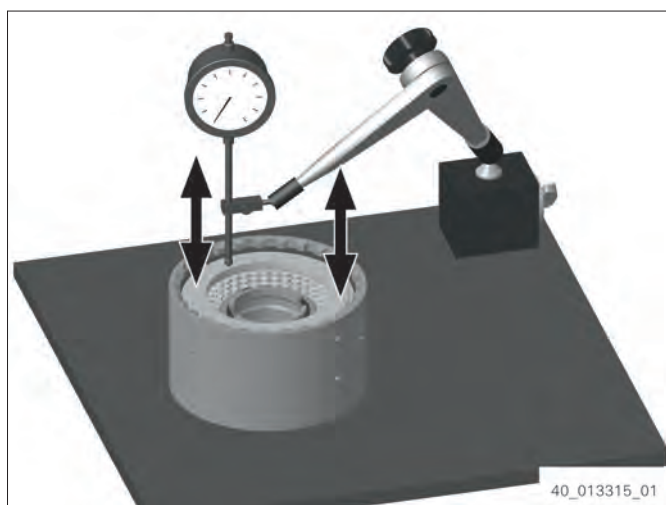


Fig. 250

Assembly

23. ※ 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 internal spline of the disk carrier.



Fig. 251

24. Slide clutch onto shaft until contact is obtained.



Fig. 252

25. Slide on thrust washer (3) with the chamfer facing the axial needle bearing.
26. Slide on the axial needle bearing (2).
27. Slide on the axial washer (1).

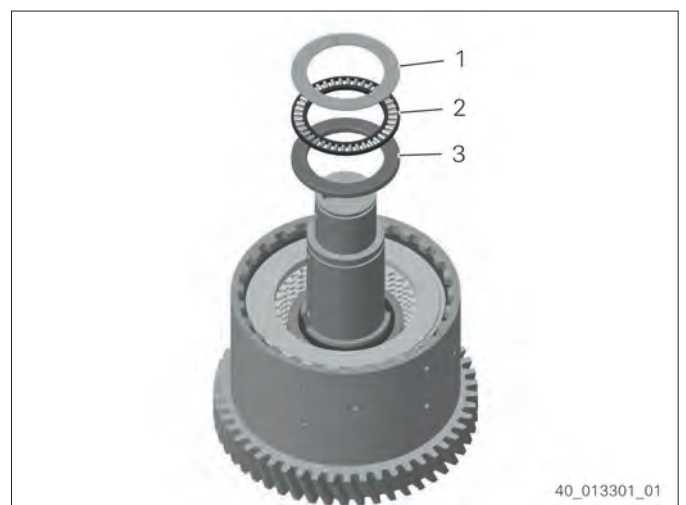


Fig. 253

28. Slide on needle cages (1).

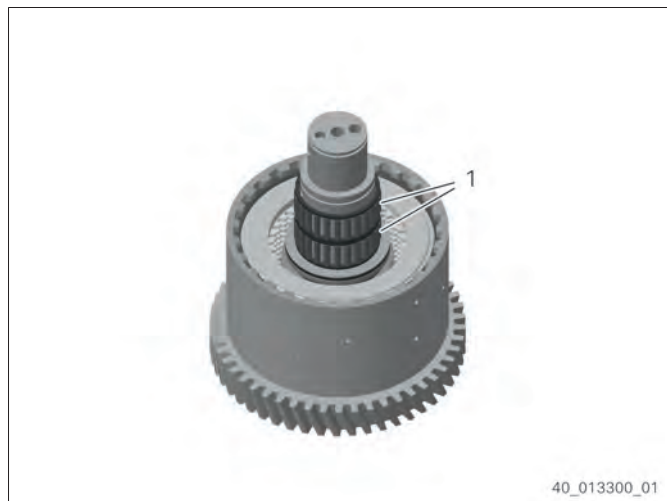


Fig. 254

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

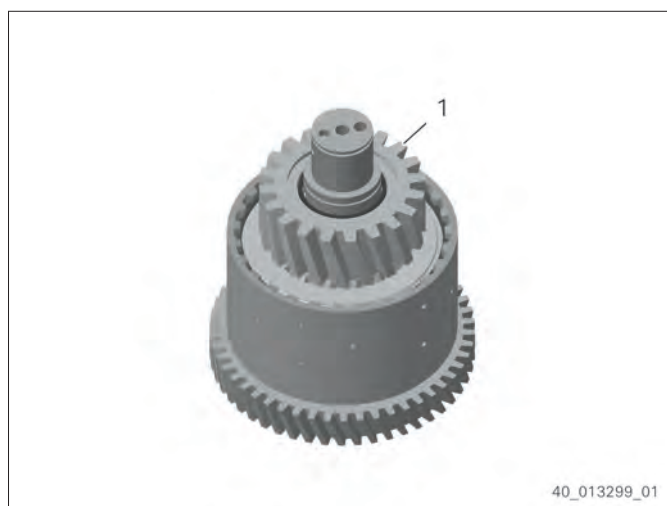


Fig. 255

30. Slide on the axial washer (3).
31. Slide on the axial needle bearing (2).
32. Slide on thrust washer (1) with the chamfer facing the axial needle bearing.

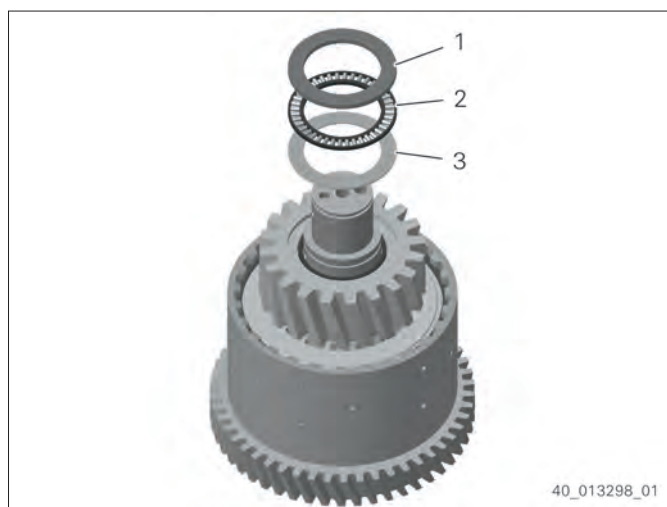


Fig. 256

Assembly

33. Insert securing ring in the shaft.



Fig. 257

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 the bearing inner ring.

35. Slide bearing inner ring (1) onto shaft until contact is obtained.

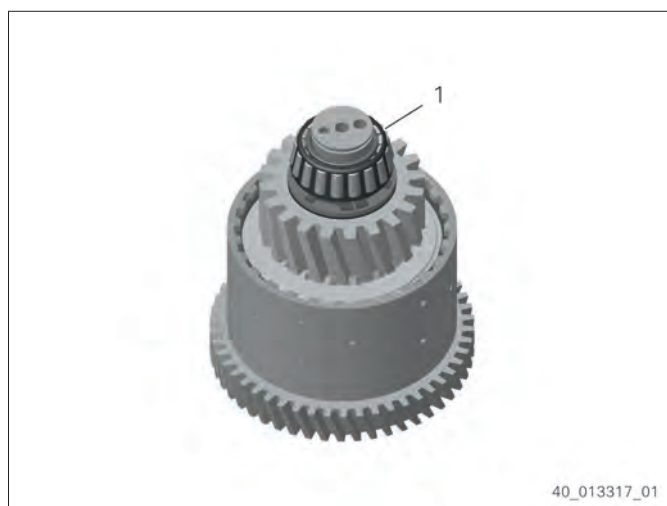


Fig. 258

36. Let bearing inner ring cool down.
37. Adjust bearing inner ring.

38. Screw in stud bolt (1) and tighten.
Tightening torque: **17 Nm**
39. Insert piston ring (2).

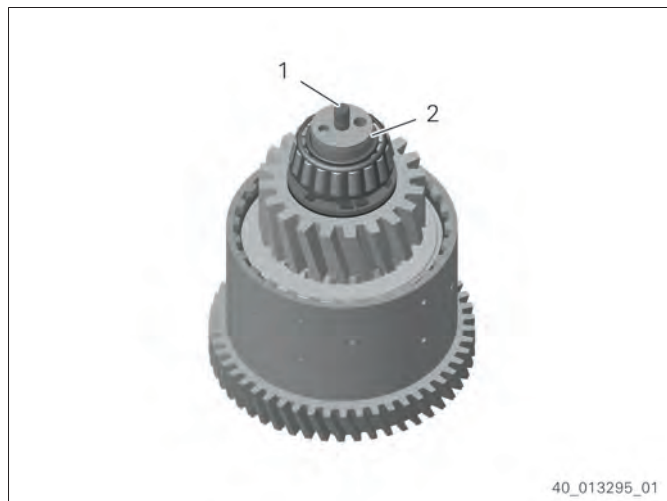


Fig. 259

40. Check function of the clutch with compressed air.
 → Closing and opening of the clutch is clearly audible.
 If closing and opening is not audible, remove and check clutch.



Fig. 260

Assembling clutch K3

Special tools:

- 5870.345.085 Assembly aid

Assembly

1. Check clearance of the ball in the drain valve (1).
2. Oil O-rings (2) and insert them twist-free in the radial grooves.

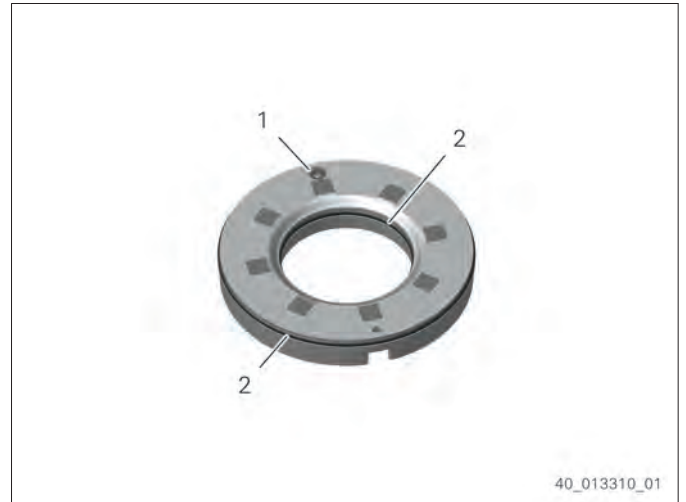


Fig. 261

3. Oil O-rings and piston bearing surfaces.
4. Insert piston (1) into the disk carrier until contact is obtained.



Fig. 262

5. Slide on guide ring (3) with the offset front face facing upwards.
6. Slide on compression spring (2).
7. Slide on guide ring (1) with the offset front face facing downwards.

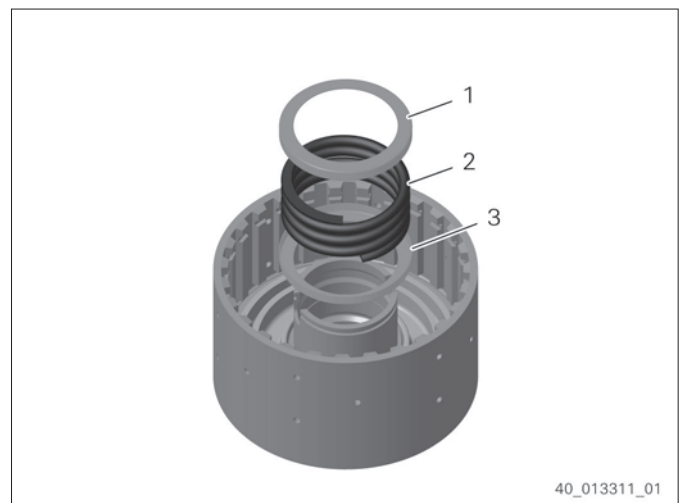


Fig. 263

8. Preload compression spring with 5870.345.085 [Assembly aid] and press.
9. Insert securing ring (1).

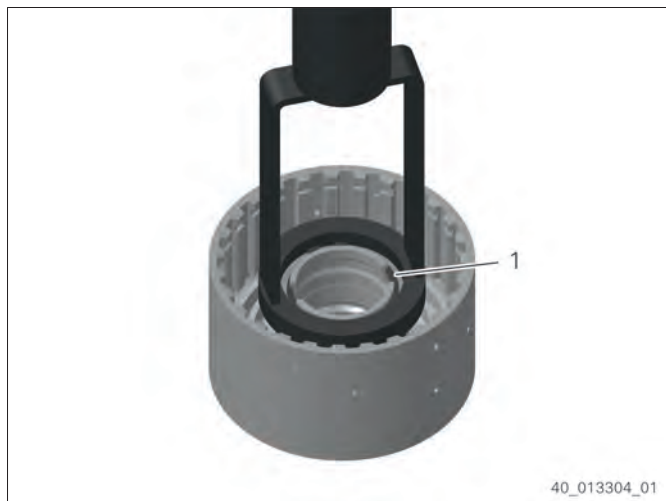


Fig. 264

Setting disk clearance

10. Insert friction disk (1) with the uncoated side facing the piston.

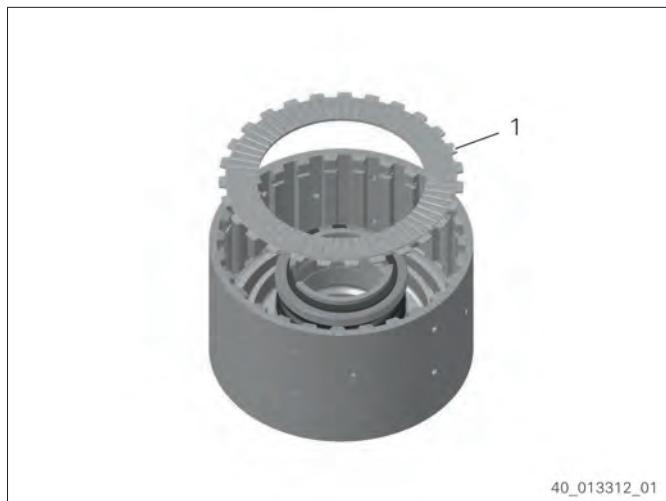


Fig. 265

11. Insert inner disks and outer disks.
 ※ For the arrangement refer to the current spare parts list.
12. Insert friction disk (1) with the uncoated side facing the end shim.

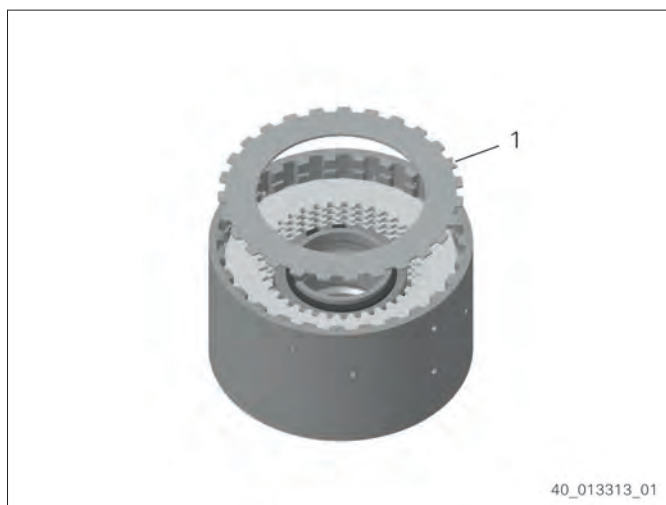


Fig. 266

Assembly

13. Insert end shim (1).
14. Insert snap ring e. g. 3.15 mm.



Fig. 267

15. Position dial gauge on the end shim.
16. Push end shim downwards with 100 N and set dial gauge to zero.
17. Lift end shim on the snap ring until contact is obtained and check the necessary Disk clearance 2.00 mm until 2.30 mm.
If the disk clearance is too small, install a thinner snap ring.
If the disk clearance is too big, install a thicker snap ring.

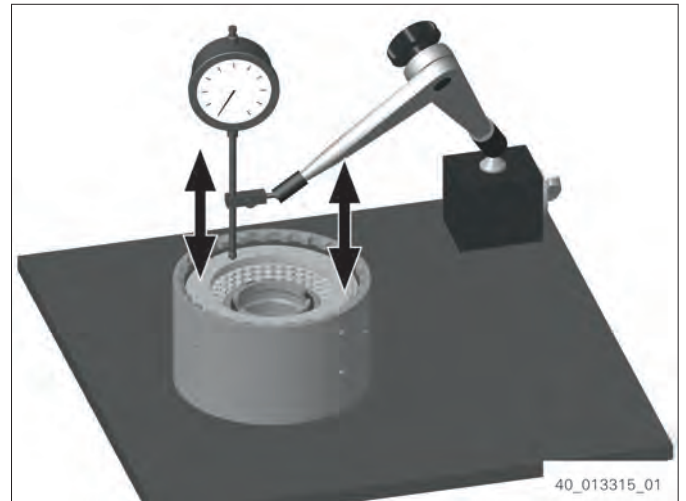


Fig. 268

18. ※ 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 internal spline of the disk carrier.



Fig. 269

- 19. Slide clutch onto shaft until contact is obtained.



Fig. 270

- 20. Slide on thrust washer (3) with the chamfer facing the axial needle bearing.
- 21. Slide on the axial needle bearing (2).
- 22. Slide on the axial washer (1).

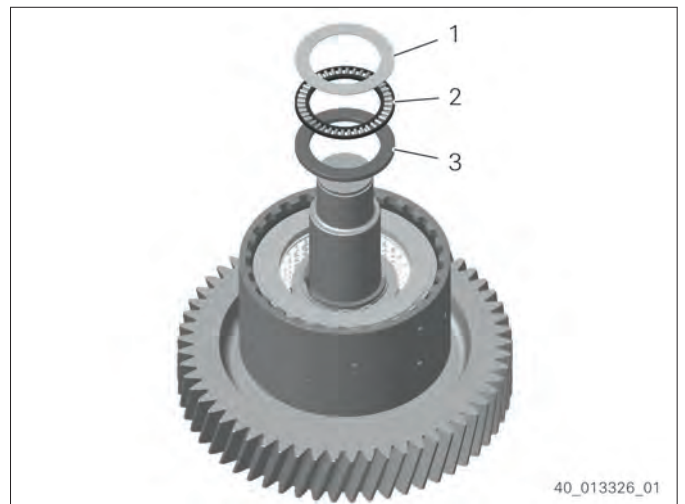


Fig. 271

- 23. Slide on needle cages (1).

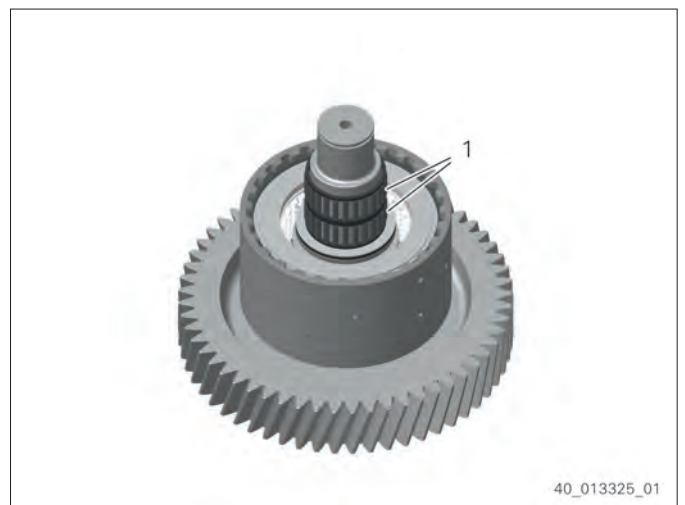


Fig. 272

Assembly

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

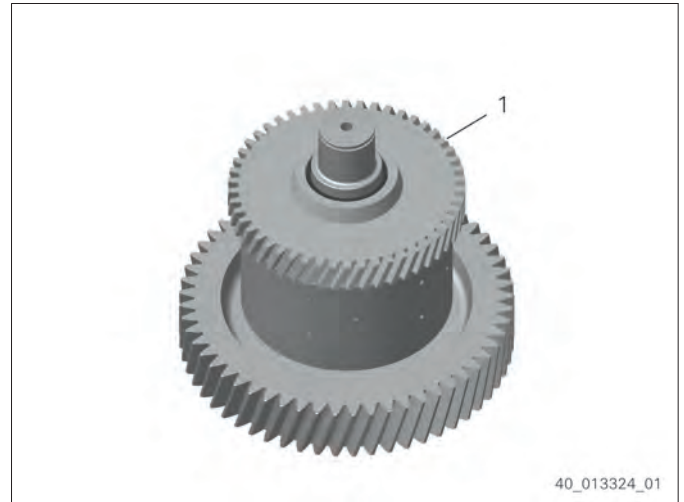


Fig. 273

25. Slide on the axial washer (3).
26. Slide on the axial needle bearing (2).
27. Slide on thrust washer (1) with the chamfer facing the axial needle bearing.

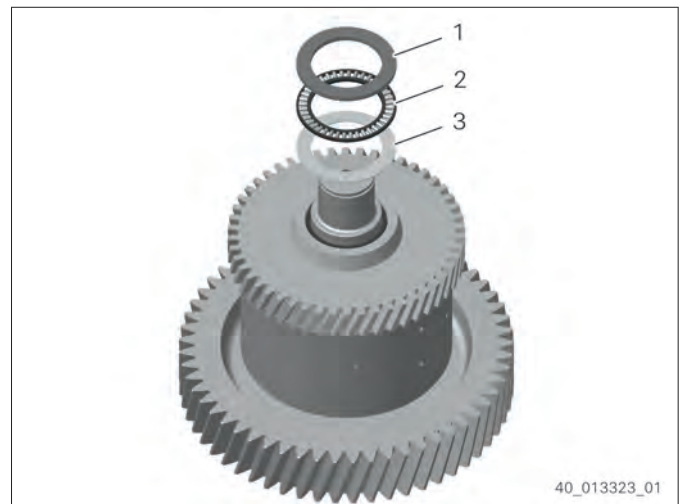


Fig. 274

28. ※ 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 bearing inner ring.

29. Slide bearing inner ring (1) onto shaft until contact is obtained.

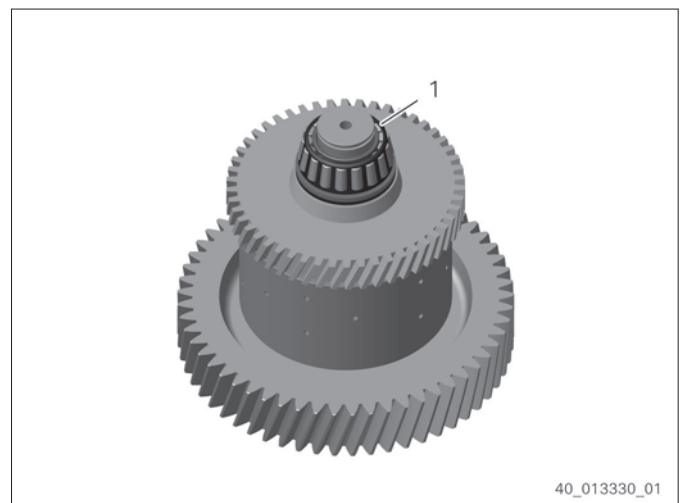


Fig. 275

30. Let bearing inner ring cool down.

31. Adjust bearing inner ring.

32. Insert piston ring (1).

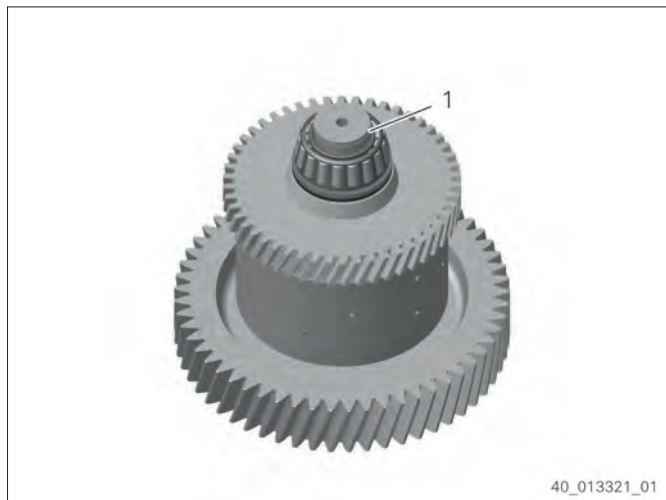


Fig. 276

33. ※ 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 bearing inner ring.

34. Slide bearing inner ring (1) onto shaft until contact is obtained.

35. Let bearing inner ring cool down.

36. Adjust bearing inner ring.

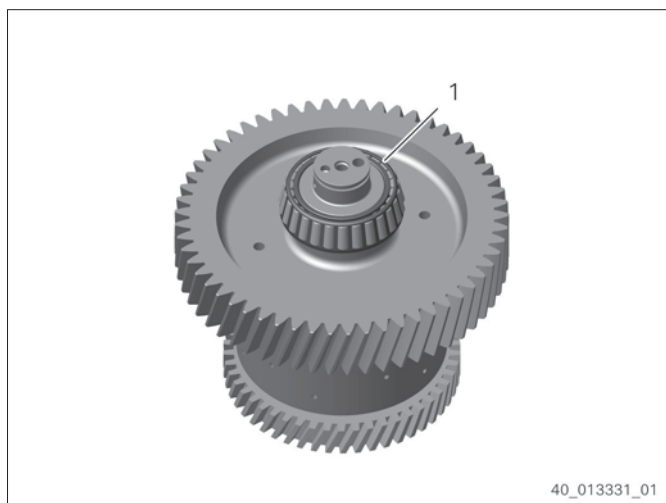


Fig. 277

Assembly

37. Screw in stud bolt (1) and tighten.
Tightening torque: **17 Nm**
38. Insert piston ring (2).

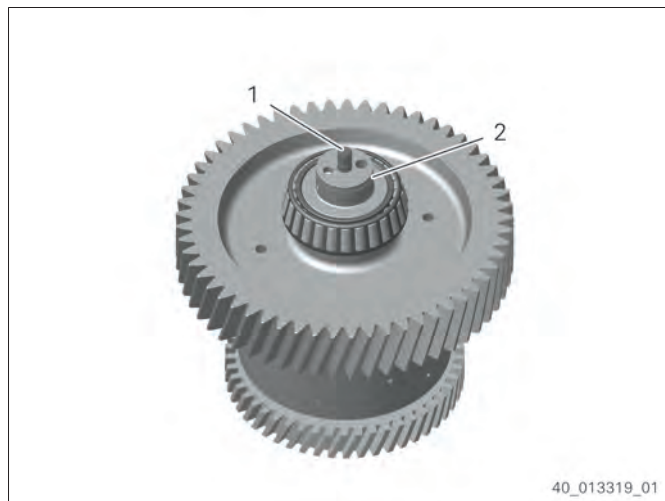


Fig. 278

39. Check function of the clutch with compressed air.
→ Closing and opening of the clutch is clearly audible.

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



Fig. 279

Assembling clutch K4

Special tools:

- 5870.345.085 Assembly aid

1. ※ Carry out the following three 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.

Cool down shaft.

2. **⚠ CAUTION**

Risk of burn injuries due to contact with hot surfaces.

Slight or moderate injury possible.

⇒ Wear protective gloves.

Heat up gear.

3. Slide gear (1) onto shaft until contact is obtained.

4. Insert securing ring in the shaft.

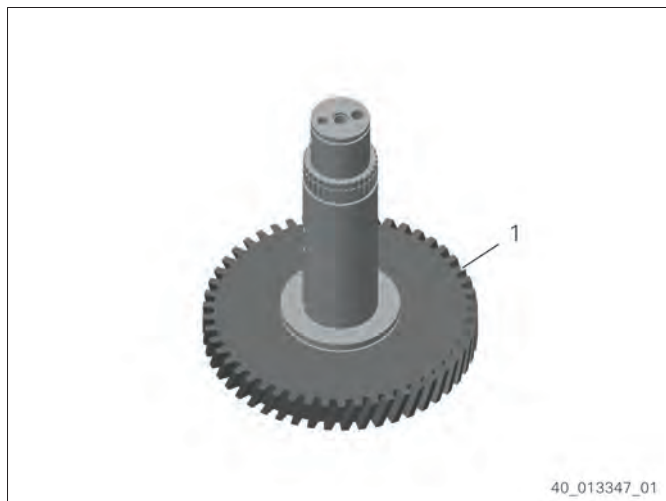


Fig. 280



Fig. 281

Assembly

5. ✖ 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 bearing inner ring.

6. Slide bearing inner ring (1) onto shaft until contact is obtained.
7. Let bearing inner ring cool down.
8. Adjust bearing inner ring.
9. Insert piston ring (1).

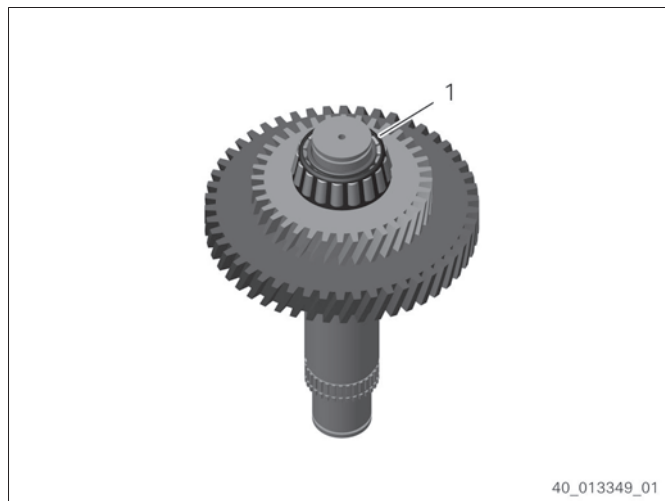


Fig. 282

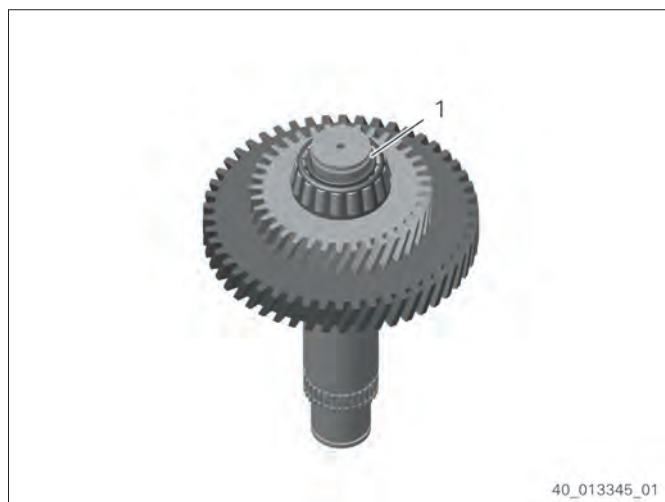


Fig. 283

- 10. Slide on the axial washer (1).
- 11. Slide on the axial needle bearing (2).
- 12. Slide on the axial washer (1).

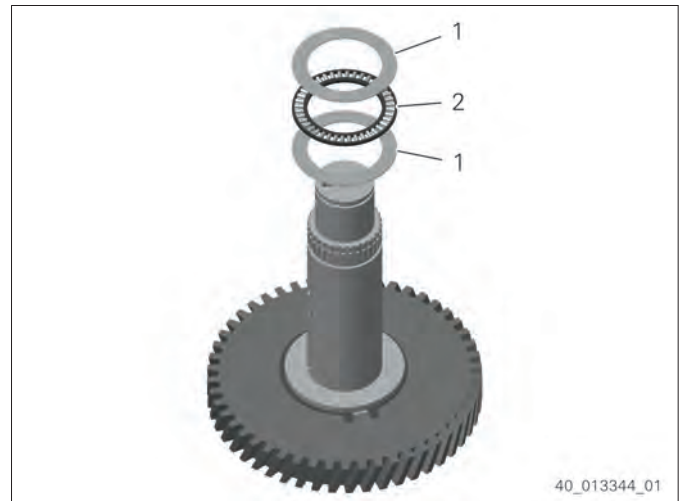


Fig. 284

- 13. Slide on needle cages (1).

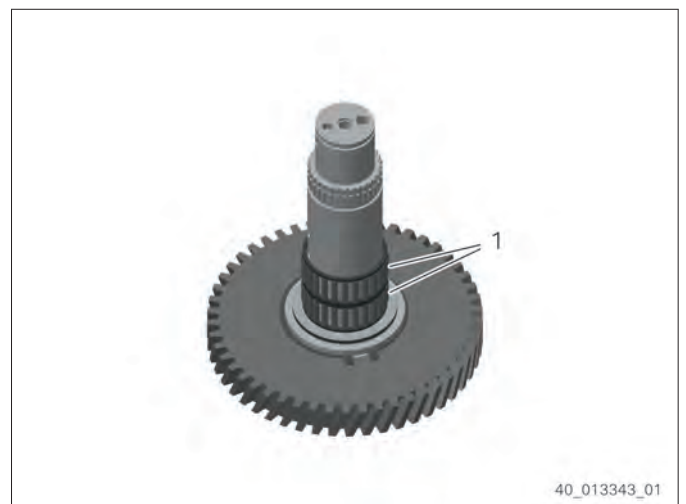


Fig. 285

- 14. Slide on idler gear (1).

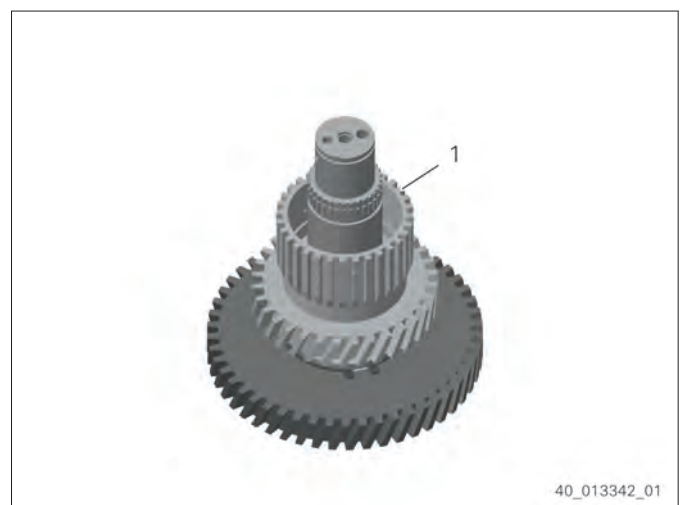


Fig. 286

Assembly

15. Slide on the axial washer (3).
16. Slide on the axial needle bearing (2).
17. Slide on thrust washer (1) with the chamfer facing the axial needle bearing.

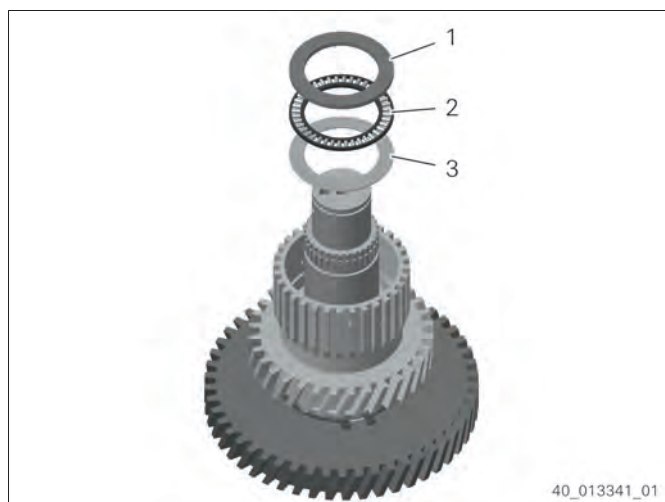


Fig. 287

18. Check clearance of the ball in the drain valve (1).
19. Oil O-rings (2) and insert them twist-free in the radial grooves.

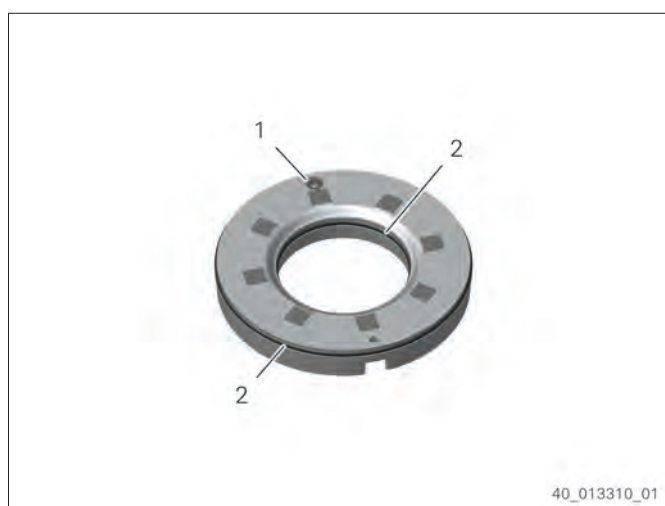


Fig. 288

20. Oil O-rings and piston bearing surfaces.
21. Insert piston (1) into the disk carrier until contact is obtained.



Fig. 289

22. Slide on guide ring (3) with the offset front face facing upwards.
23. Slide on compression spring (2).
24. Slide on guide ring (1) with the offset front face facing downwards.



Fig. 290

25. Preload compression spring with 5870.345.085 [Assembly aid] and press.
26. Insert securing ring (1).



Fig. 291

Setting disk clearance

27. Insert friction disk (1) with the uncoated side facing the piston.



Fig. 292

Assembly

28. Insert inner disks and outer disks.
 - ※ For the arrangement refer to the current spare parts list.
29. Insert friction disk (1) with the uncoated side facing the end shim.



Fig. 293

30. Insert end shim (1).
31. Insert snap ring e. g. 3.15 mm.



Fig. 294

32. Position dial gauge on the end shim.
33. Push end shim downwards with 100 N and set dial gauge to zero.
34. Lift end shim on the snap ring until contact is obtained and check the necessary Disk clearance 1.35 mm until 1.65 mm.
If the disk clearance is too small, install a thinner snap ring.
If the disk clearance is too big, install a thicker snap ring.

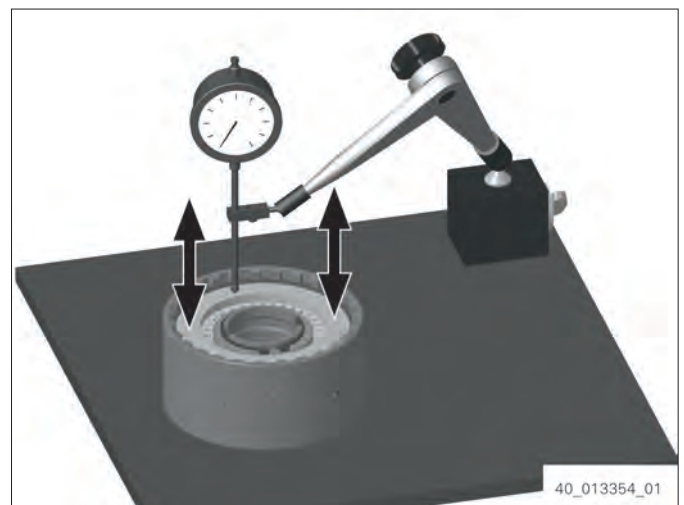


Fig. 295

35. ※ 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 internal spline of the disk carrier.



Fig. 296

36. Slide clutch onto shaft until contact is obtained. Insert idler gear into the disk pack by short mutual rotary motions.



Fig. 297

37. Insert securing ring in the shaft.



Fig. 298

Assembly

38. ※ 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 bearing inner ring.

39. Slide bearing inner ring (1) onto shaft until contact is obtained.
40. Let bearing inner ring cool down.
41. Adjust bearing inner ring.
42. Screw in stud bolt (1) and tighten.
Tightening torque: **17 Nm**
43. Insert piston ring (2).

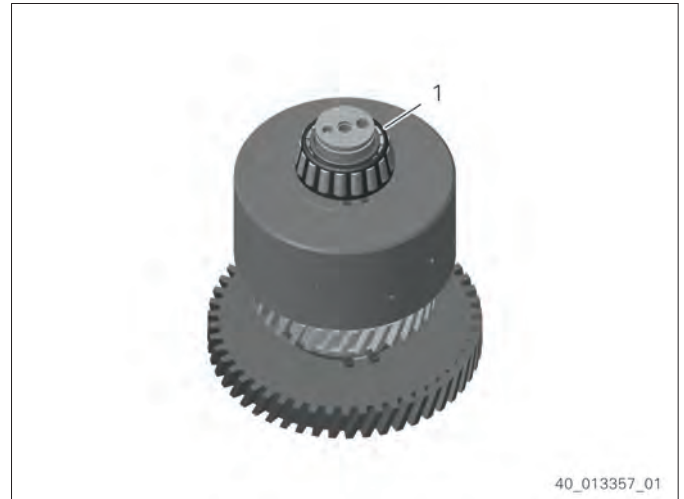


Fig. 299

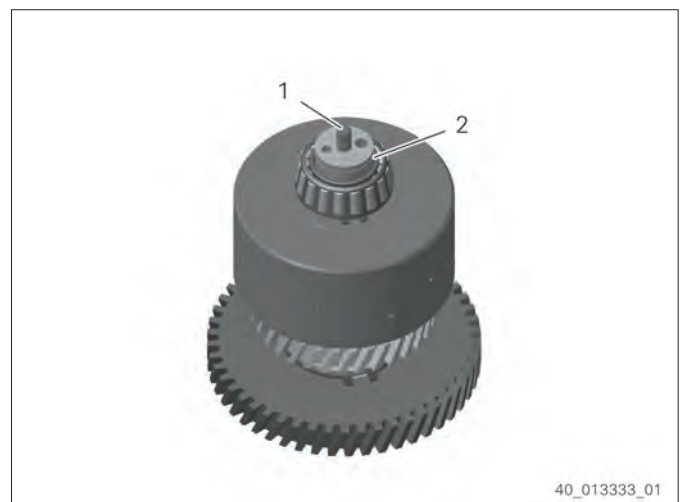


Fig. 300

44. Check function of the clutch with compressed air.
- Closing and opening of the clutch is clearly audible.
- If closing and opening is not audible, remove and check clutch.



Fig. 301

Assembling input shaft

1. ※ Carry out the following three 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 input shaft.

2. **⚠ CAUTION**

Risk of burn injuries due to contact with hot surfaces.

Slight or moderate injury possible.

⇒ Wear protective gloves.

Heat up input gear.

3. Slide input gear onto input shaft until contact is obtained.



Fig. 302

Assembly

4. Insert securing ring (1) in the input shaft.

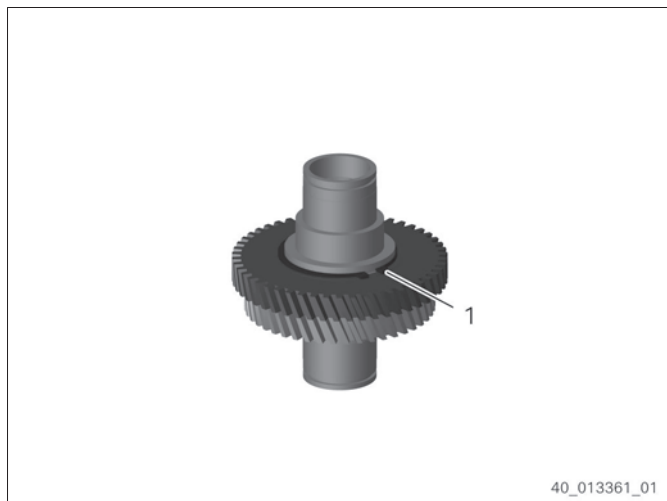


Fig. 303

5. Grease O-ring.
6. Insert O-ring (1) in the radial groove of the input shaft.

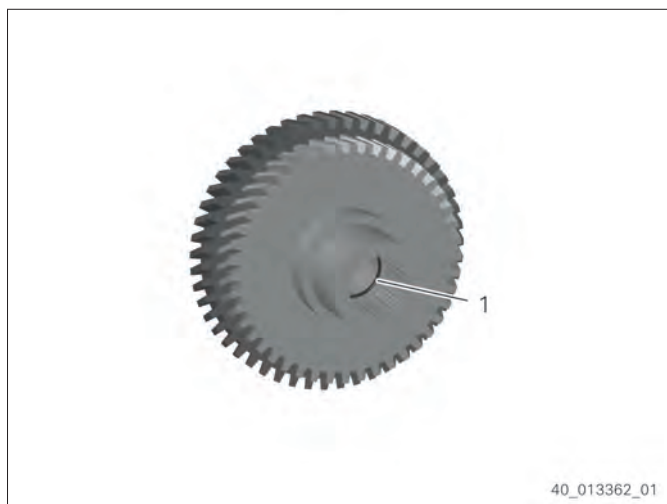


Fig. 304

7. Insert snap ring in the radial groove on the turbine shaft.



Fig. 305

8. Insert turbine shaft in the input shaft until the snap ring audibly engages.



Fig. 306

9. **⚠ CAUTION**

Risk of burn injuries due to contact with hot surfaces.

Slight or moderate injury possible.

⇒ Wear protective gloves.

Slide the heated bearing inner rings (2) on until contact is obtained.

※ Adjust bearing inner rings after cooling-down.

10. Insert R-rings (1).

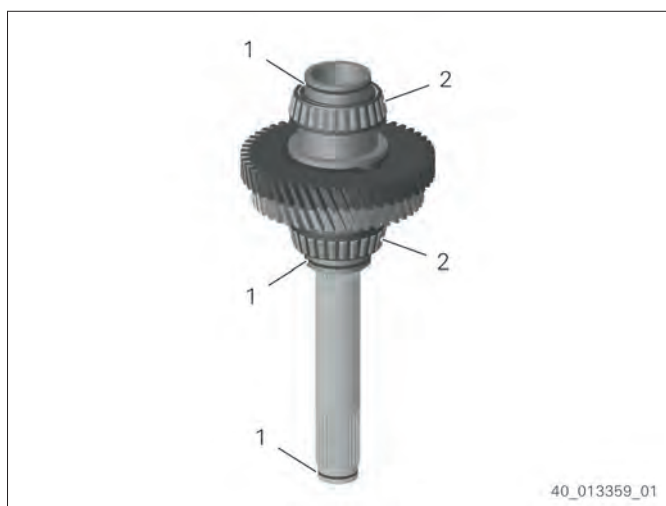


Fig. 307

Installing clutches

Special tools:

- AA02.691.822 Handle

Assembly

1. Insert clutch KV (1), input shaft (2) and clutch KR (3) together in the housing rear section.

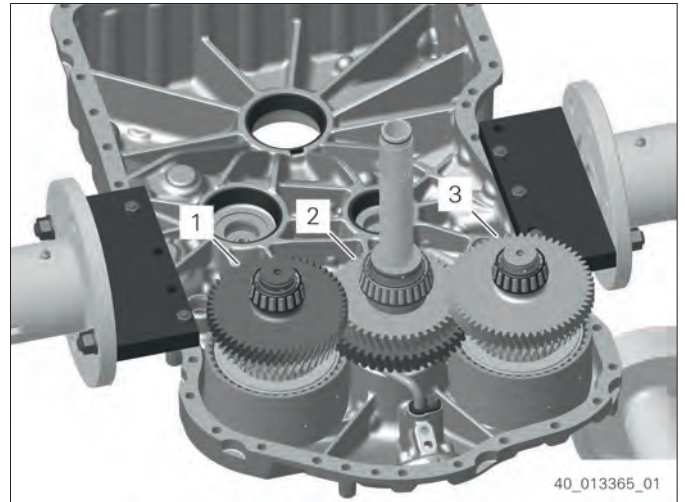


Fig. 308

2. Insert clutch K4 (1).

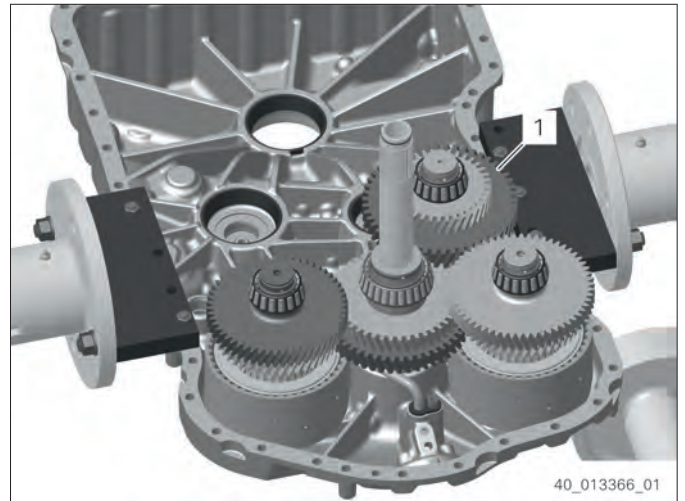


Fig. 309

3. Insert clutch K3 (1).

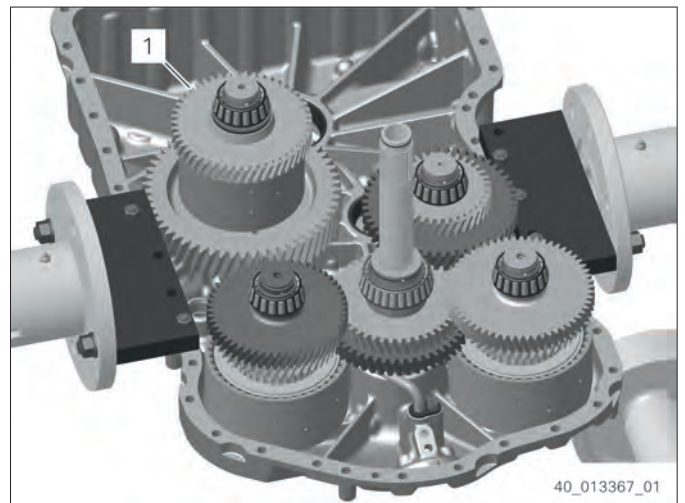


Fig. 310

4. Insert clutch K2 (1).

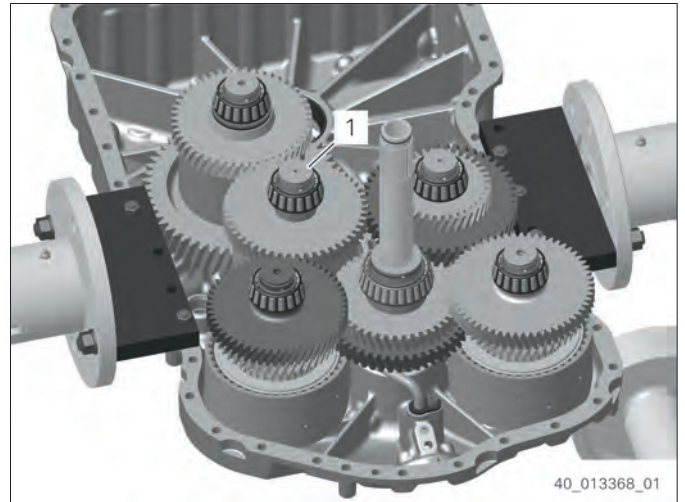


Fig. 311

5. Lift up clutch K4 (2) slightly and insert clutch K1 (1).

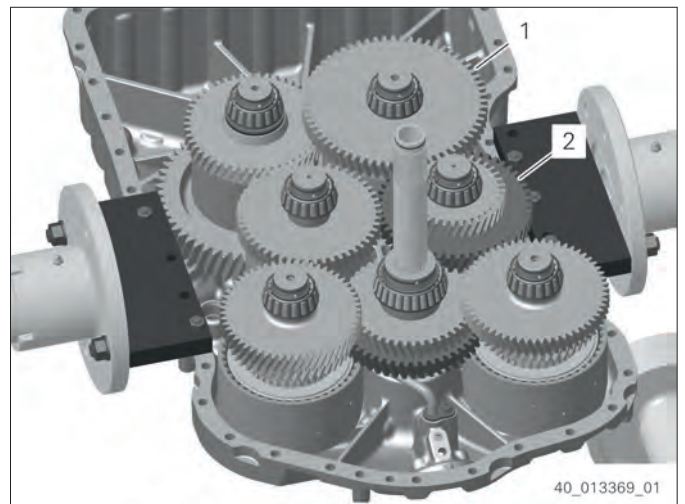


Fig. 312

6. Fasten clutches K1, K2, K3 and K4 in the housing rear section with AA02.691.822 [Handle].

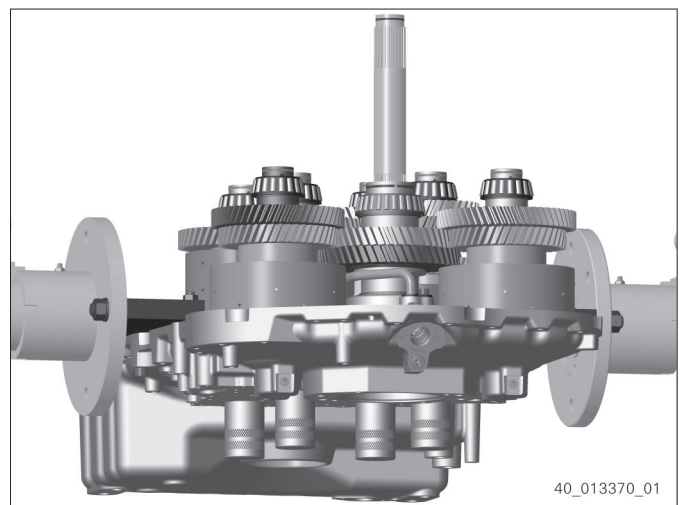


Fig. 313

Assembly

Assembling housing front part

Special tools:

- AA02.068.532 Pipe roller

1. Insert suction tube (1) in housing front part.
2. Fasten suction tube with cap screw.
Tightening torque: **23 Nm**

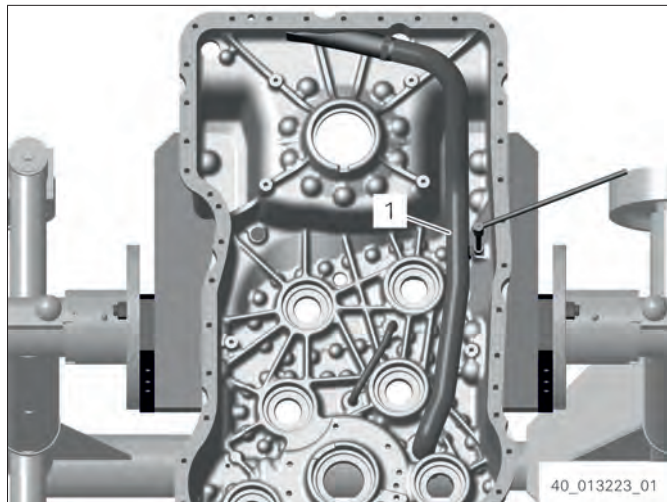


Fig. 314

3. Apply oil to inner diameter of the suction tube and to rollers of AA02.068.532 [Pipe roller].
4. Insert AA02.068.532 [Pipe roller] in suction tube.
5. Fasten suction tube with AA02.068.532 [Pipe roller] in the front part of the housing.
Tightening torque: **40 Nm**

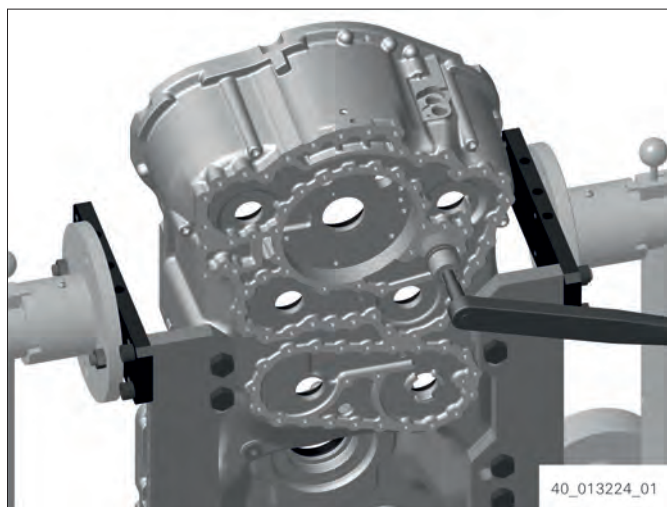


Fig. 315

6. Grease O-rings.
7. Insert O-rings (1) in radial grooves of the oil tube.



Fig. 316

8. Grease O-rings.
9. Insert O-rings (1) in radial grooves of the oil tube.

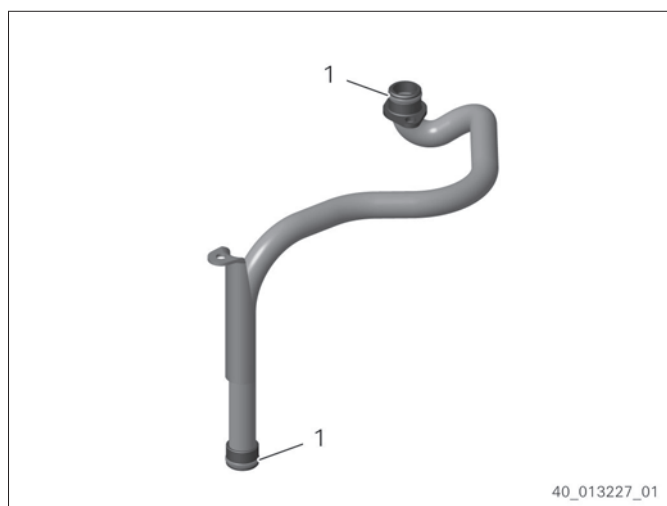


Fig. 317

10. Insert oil tubes (1).
11. Fix oil tubes with cap screws. Tightening torque: **23 Nm**

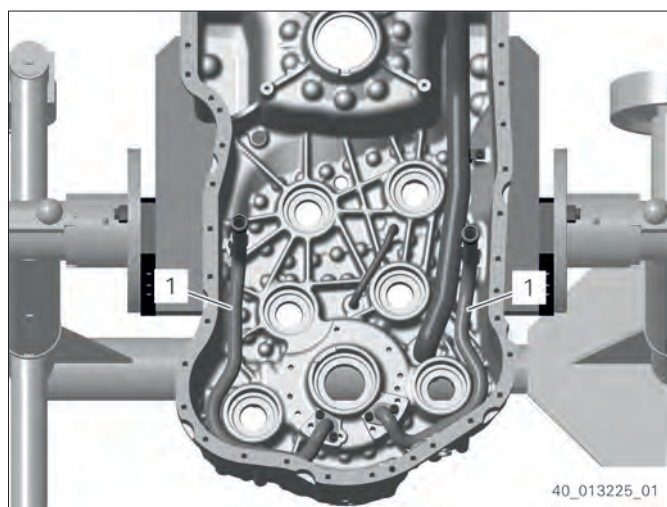


Fig. 318

Assembly

12. Insert bearing outer rings in housing holes until contact is obtained.

The Figure shows the positions of the bearing outer rings.

- 1 = Output shaft
- 2 = Clutch K3
- 3 = Clutch K2
- 4 = Clutch KV
- 5 = Input shaft
- 6 = Clutch KR
- 7 = Clutch K4
- 8 = Clutch K1

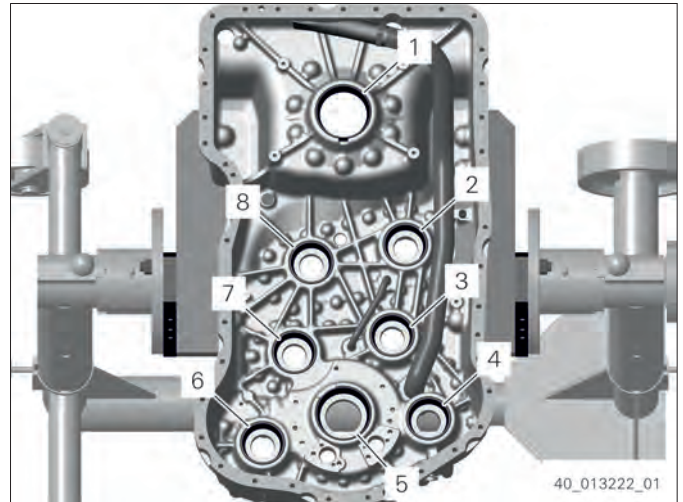


Fig. 319

Assembling and installing output shaft

Special tools:

- AA01.100.718 Eyebolt

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 the bearing inner ring.

2. Slide bearing inner ring (1) onto the output shaft until contact is obtained.
3. Let bearing inner ring cool down.
4. Adjust bearing inner ring.



Fig. 320

5. Slide on screen sheet (1).

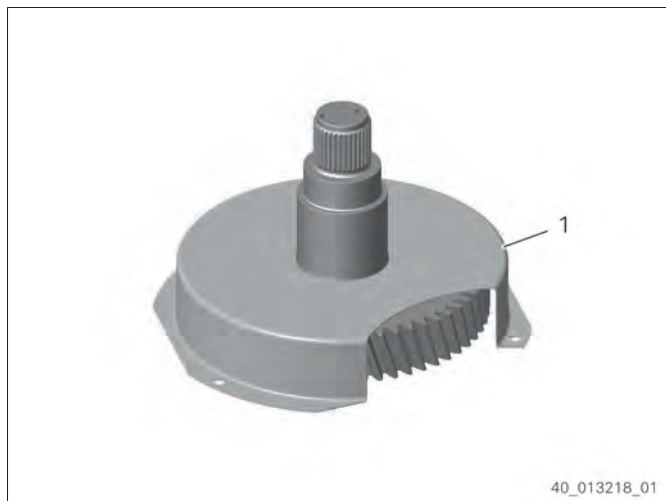


Fig. 321

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 the bearing inner ring.

7. Slide on bearing inner ring (1) until contact is obtained.
8. Let bearing inner ring cool down.
9. Adjust bearing inner ring.

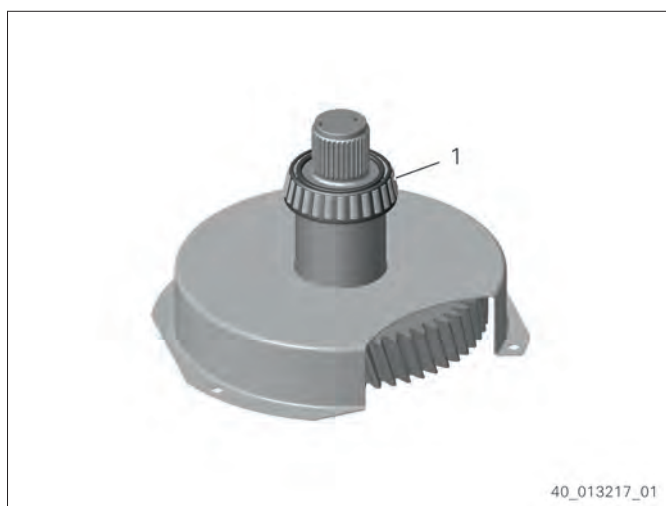


Fig. 322

Assembly

10. Place on screen sheet (1).

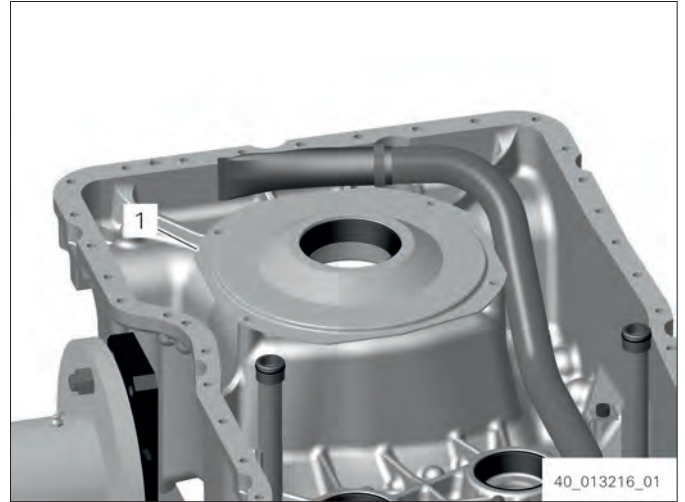


Fig. 323

11. Insert output shaft with AA01.100.718 [Eyebolt] and crane.

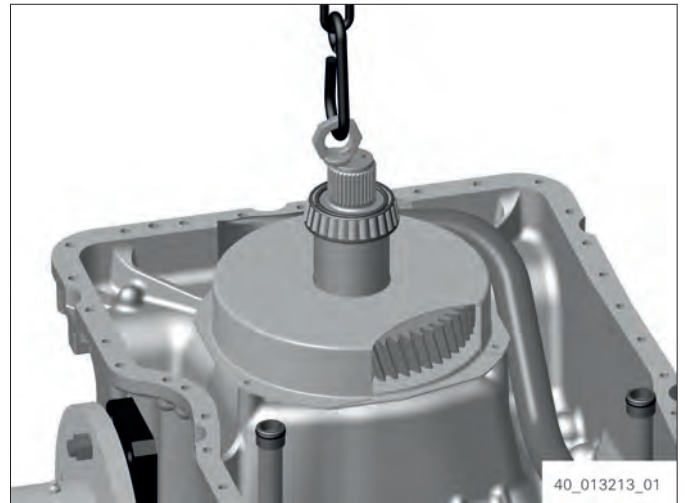


Fig. 324

12. Fasten screen sheets with cap screws (1).
Tightening torque: **23 Nm**

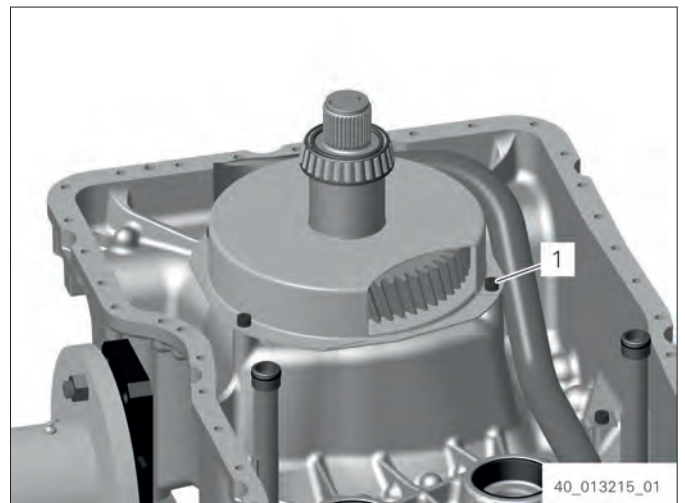


Fig. 325

Assembling the housings

Special tools:

- 5870.204.083 Eyebolt
- 5870.204.086 Eyebolt
- AA02.691.822 Handle

Operating supplies and auxiliary materials:

- 0666.790.033 LOCTITE 574

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

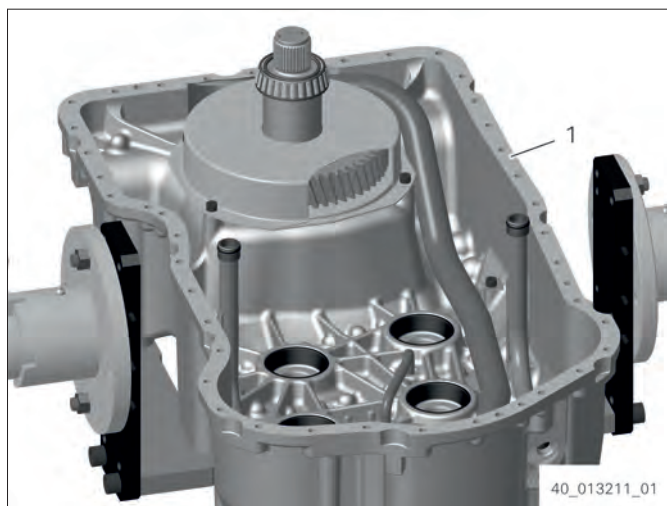


Fig. 326

2. Screw two 5870.204.083 [Eyebolt] into the housing rear section.

3. Screw in two 5870.204.086 [Eyebolt].

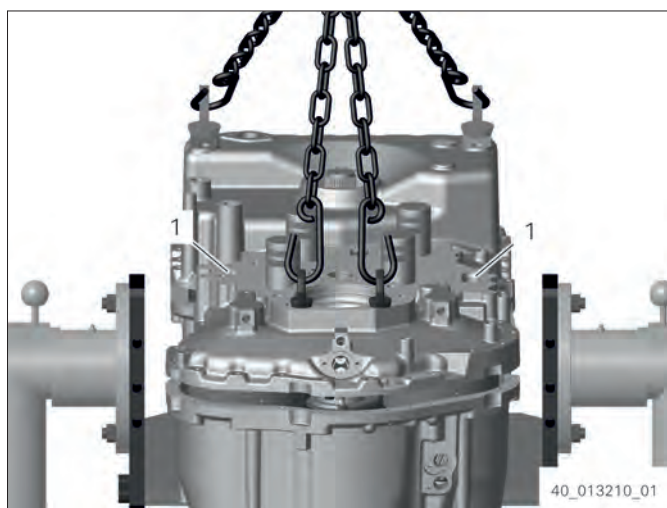


Fig. 327

Assembly

4.

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.
-

Install housing rear section and clutches with a crane.

Insert oil tubes in housing holes (1).

5. Remove four AA02.691.822 [Handle].

6. **⚠ CAUTION**

**Risk of injury due to parts flying away.
Slight or moderate injury possible.**

- ⇒ Wear protective goggles.

Insert both cylindrical pins centrally.

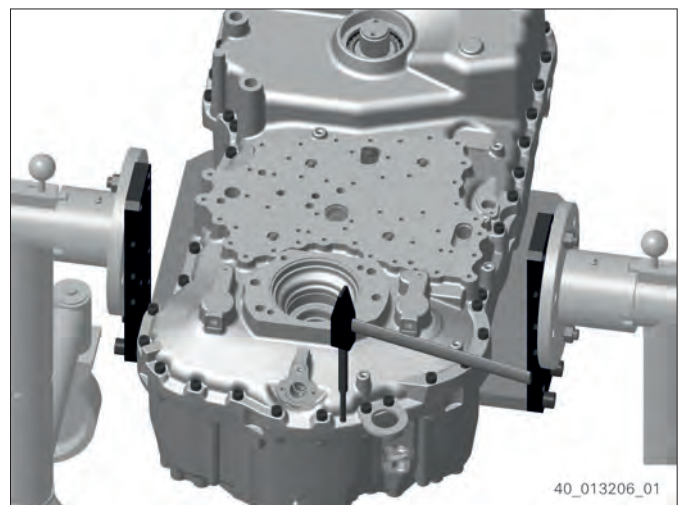


Fig. 328

7. Bolt in and tighten cap screws (1).
Tightening torque: **46 Nm**
8. Fasten fixing plate (2) with cap screws.
Tightening torque: **46 Nm**

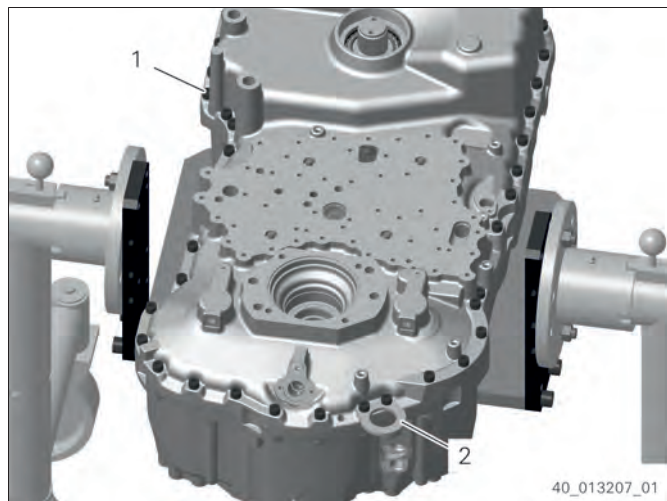


Fig. 329

Mounting cover (emergency steering pump)

Special tools:

- 5870.204.011 Fixing pin

1. Screw two 5870.204.011 [Fixing pin] into the housing.
2. Put on seal (1).

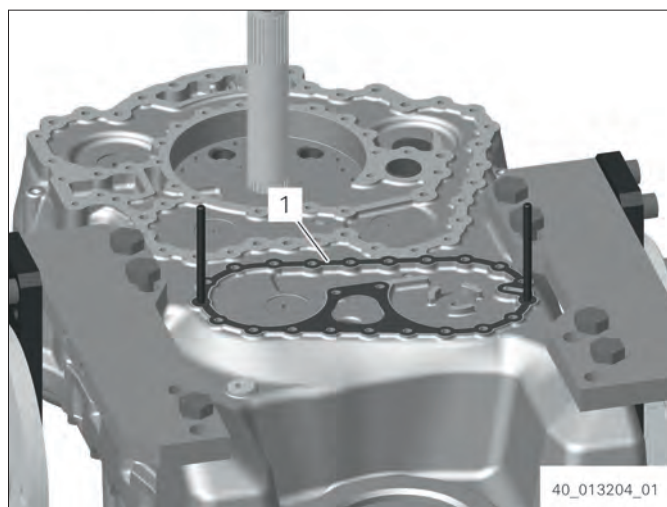


Fig. 330

Assembly

3. Place the cover (1).
4. Fasten cover with hexagon screws.
Tightening torque: **23 Nm**

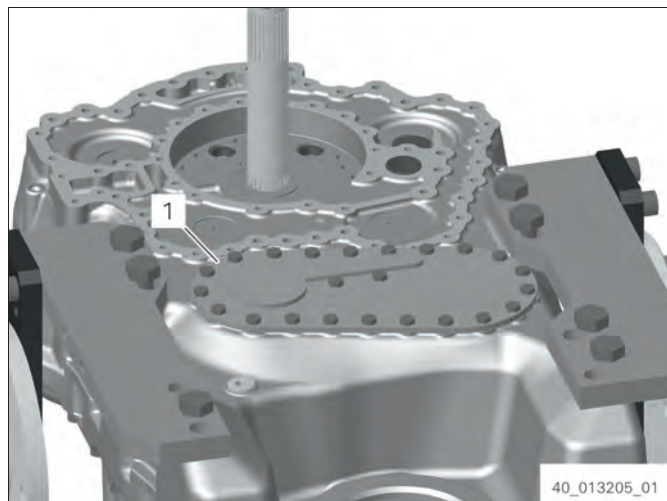


Fig. 331

Mounting the oil feed housing and oil pressure pump

Special tools:

- 5870.204.007 Locating pin
- 5870.204.011 Locating pin
- 5870.055.070 Driver tool
- 5870.260.002 Handle
- 5870.345.126 Assembly fixture

Operating supplies and auxiliary materials:

- 0666.690.191 PHÖNIX SPIRITUS

1. Screw two 5870.204.007 [Locating pin] into the housing.
2. Insert the stator shaft (1).
※ Observe radial installation position.

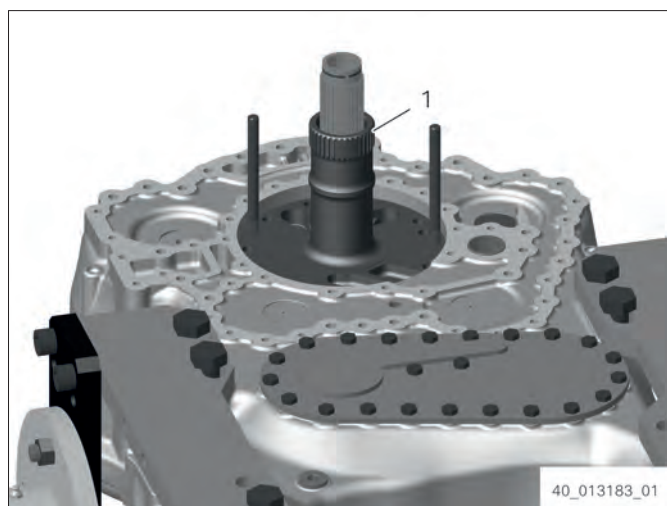


Fig. 332

3. Bolt in four 5870.204.011 [Locating pin].
4. Put on seal (1).

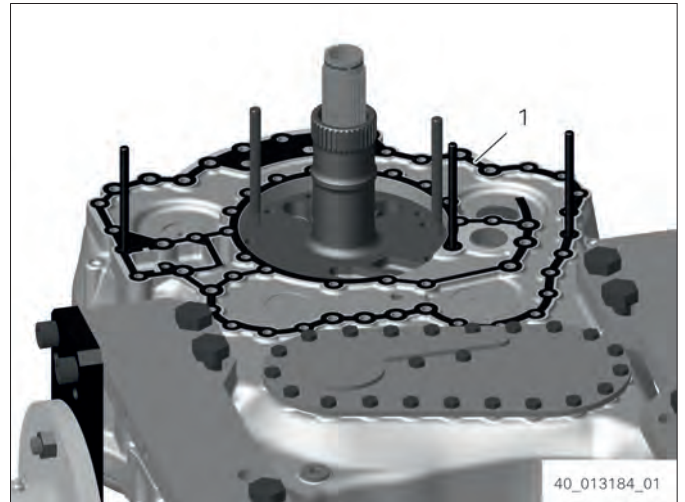


Fig. 333

5. Insert the piston (1) in the oil feed housing.
6. Insert compression spring (2).
7. Insert pressure plate (3).

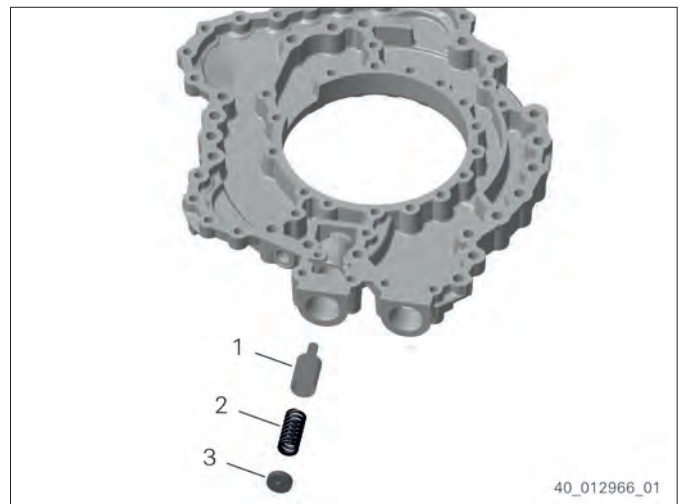


Fig. 334

8. Push pressure plate inwards with a mandrel and insert fixing plate (1).

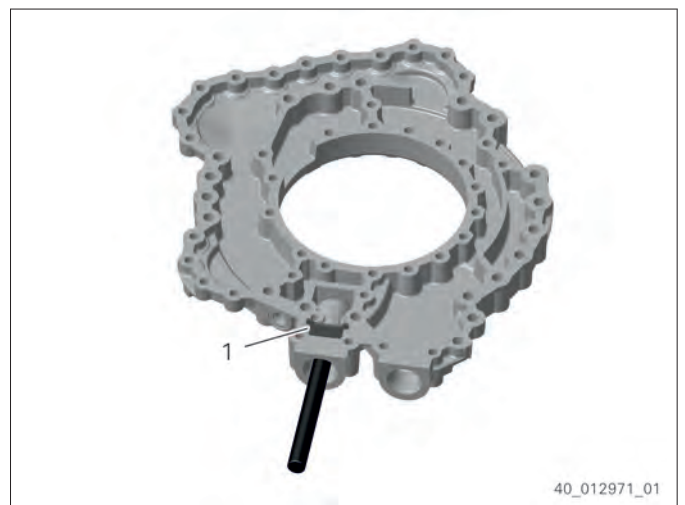


Fig. 335

Assembly

9. Slide on the oil feed housing (1).

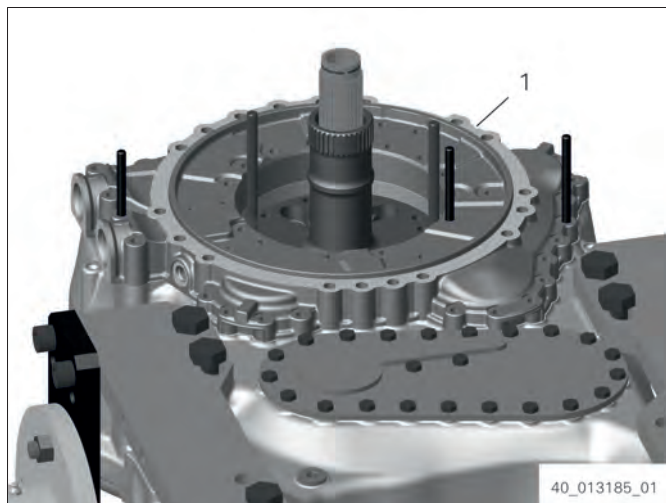


Fig. 336

Checking gear pump

10. Remove shaft sealing ring (1).
11. Remove O-ring (2).



Fig. 337

12. ※ 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 (1).

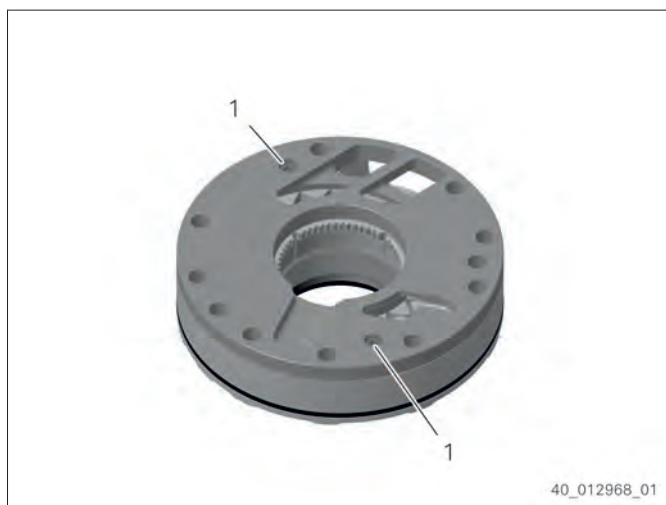


Fig. 338

13. Lift off cover (1).
14. Check the cover (1), outer rotor (2), inner rotor (3) and the housing (4) for wear marks. In case of any damage, install **new** gear pump.
15. Insert the outer rotor (2) and inner rotor (3) with the chamfered tooth side facing the housing (4).
16. Place the cover (1).
17. Screw in cap screws by hand until contact is obtained and loosen again by 180°.

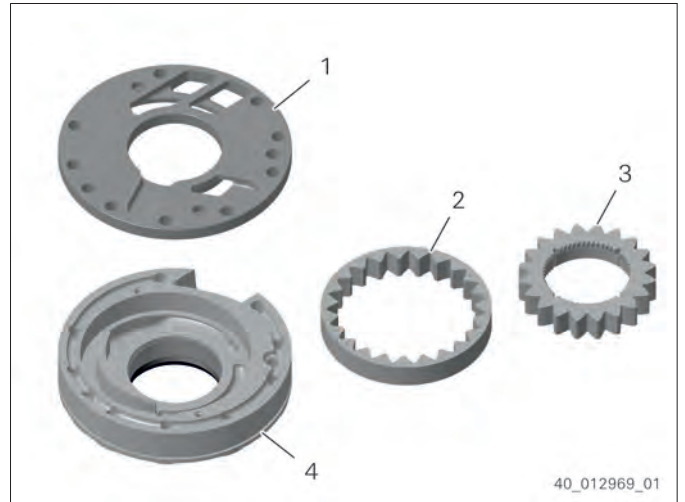


Fig. 339

18. ✖ 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.

19. Use 5870.055.070 [Driver tool] and 5870.260.002 [Handle] to insert shaft seal (1) with the seal lip facing the oil chamber.
20. Apply oil to O-ring.
21. Insert O-ring (2) into radial groove.



Fig. 340

22. Insert gear pump with 5870.345.126 [Assembly fixture] into oil feed housing until contact is obtained.
 - ✖ Observe radial installation position.

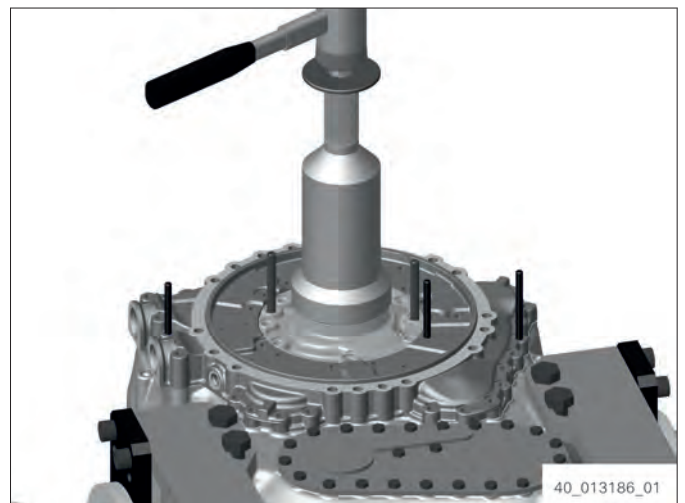


Fig. 341

Assembly

23. Slide O-rings onto cap screws.
24. Fasten gear pump (1) with cap screws.
Tightening torque: **46 Nm**

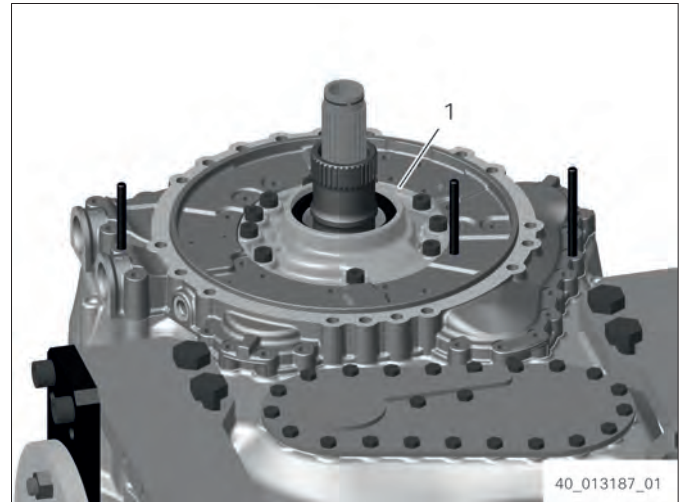


Fig. 342

25. Fasten the oil feed housing (1) with internal hexalobular bolts.
Tightening torque: **23 Nm**
26. Fasten fixing plate (2) with cap screws.
Tightening torque: **46 Nm**

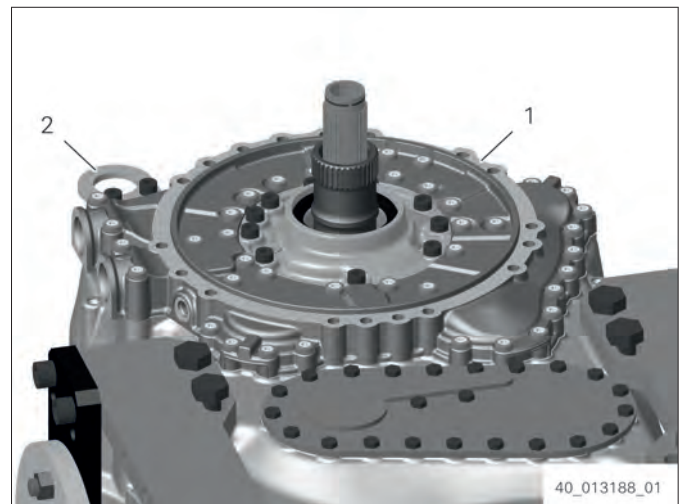


Fig. 343

Assembling and mounting motor connection

Installing torque converter bell housing

Special tools:

- 5870.204.007 Locating pin
- AA02.247.426 Eyebolt

1. Screw in two 5870.204.007 [Locating pin].
2. Mount torque converter bell housing with two AA02.247.426 [Eyebolt] and a crane.

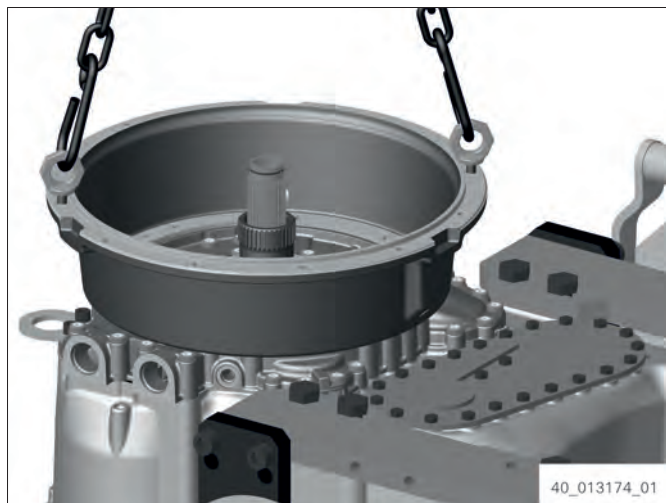


Fig. 344

3. Screw in and tighten hexagon screws (1).
Tightening torque: **65 Nm**

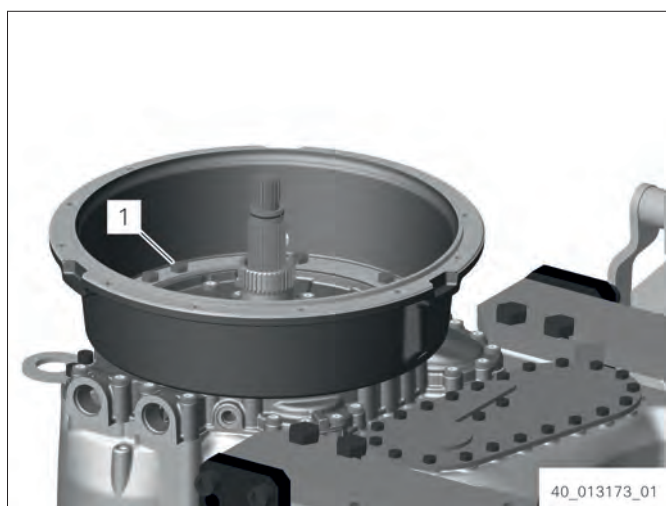


Fig. 345

Installing the converter

Special tools:

- AA02.676.915 Load ring

Operating supplies and auxiliary materials:

- 0666.690.022 LOCTITE 262

Assembly

1. Position flexplate (1) on the input shaft.
2. Apply 0666.690.022 [LOCTITE 262] to threads of the hexagon screws.
3. Screw in and tighten hexagon screws. Tightening torque: **115 Nm**

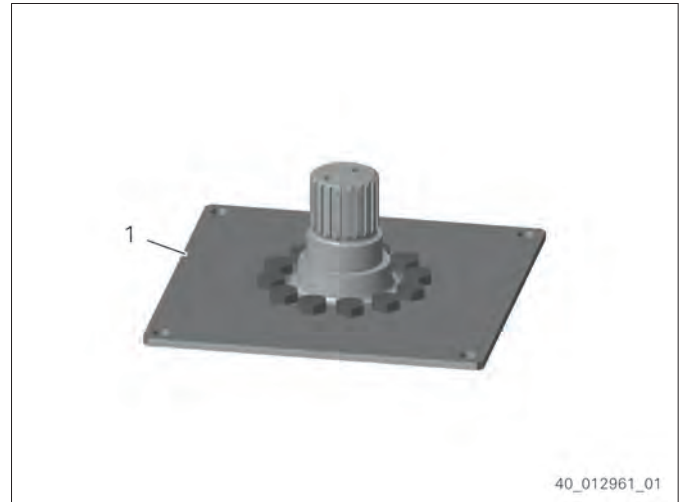


Fig. 346

4. Place the input shaft with flexplate (2) on the converter.
5. Apply 0666.690.022 [LOCTITE 262] to threads of the hexagon screws.
6. Screw in and tighten hexagon screws (1). Tightening torque: **115 Nm**

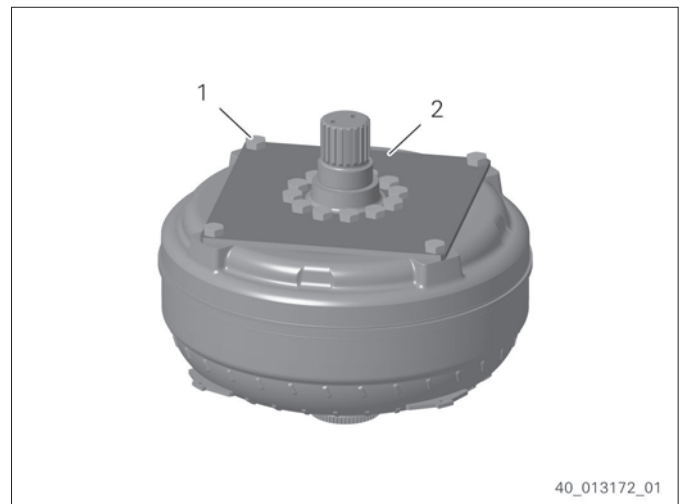


Fig. 347

7. Insert the ball bearing (2) in the cover until contact is obtained.
8. Insert V-ring (1).



Fig. 348

9. **⚠ CAUTION**

Risk of crushing due to hydraulic tool.
Slight to moderate injury possible.

⇒ Do not reach into danger area.

Use suitable tool to force the cover onto input shaft until contact is obtained.



Fig. 349

10. Force screen sheet (1) onto yoke until contact is obtained.



Fig. 350

11. ※ 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.

Slight or moderate injury possible.

⇒ Wear protective gloves.

Heat internal spline of the yoke.

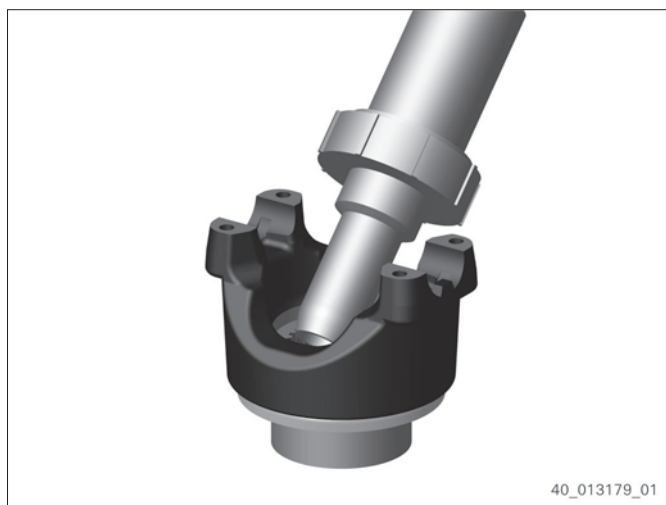


Fig. 351

Assembly

- Slide yoke (1) onto input shaft until contact is obtained.

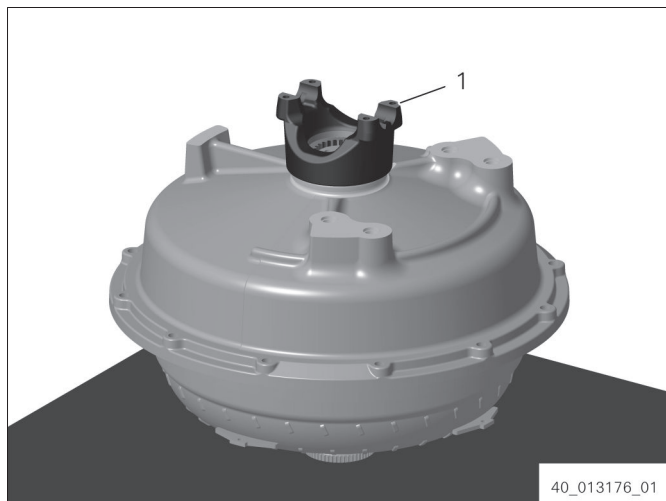


Fig. 352

- Position washer (1).
- Screw in and tighten hexagon screws (2).
Tightening torque: **40 Nm**

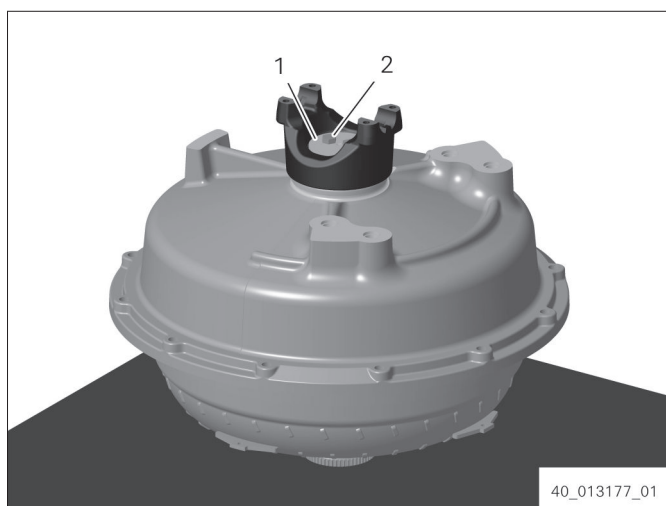


Fig. 353

- ⚠ 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 a crane to slide on the converter until contact is obtained. Mount the cover according to the marking.



Fig. 354

16. Insert cap screws (1) into the holes and tighten nuts.

Tightening torque: **46 Nm**

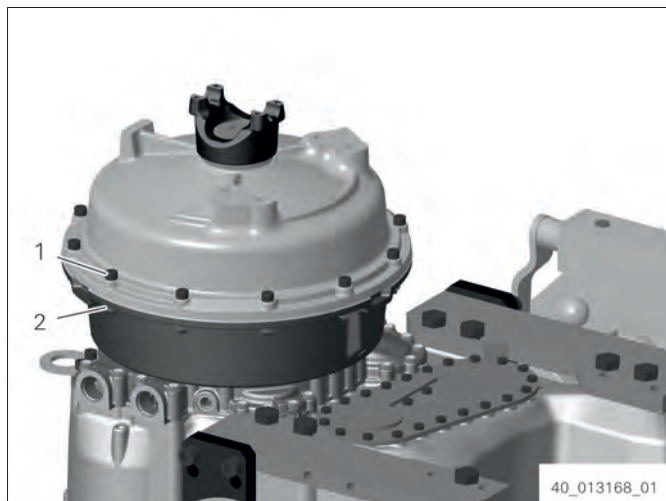


Fig. 355

Installing pump shaft

1. Press ball bearing (2) onto pump shaft until contact is obtained.
2. Set Axial clearance of the ball bearing 0.00 mm to 0.05 mm.
Insert securing ring e. g. 2.35 mm (1) into radial groove of the pump shaft.
3. Check play-free seating of the securing ring.
If securing ring has play, install thicker securing ring.
If securing ring cannot be inserted into radial groove, use thinner securing ring.

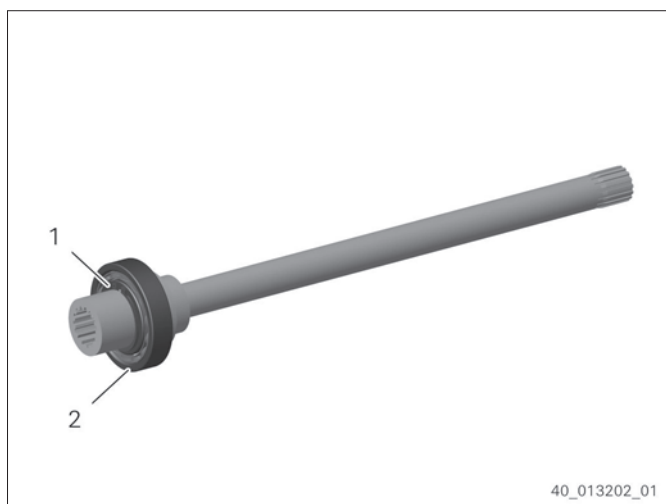


Fig. 356

4. Insert R-ring (1) in radial groove.

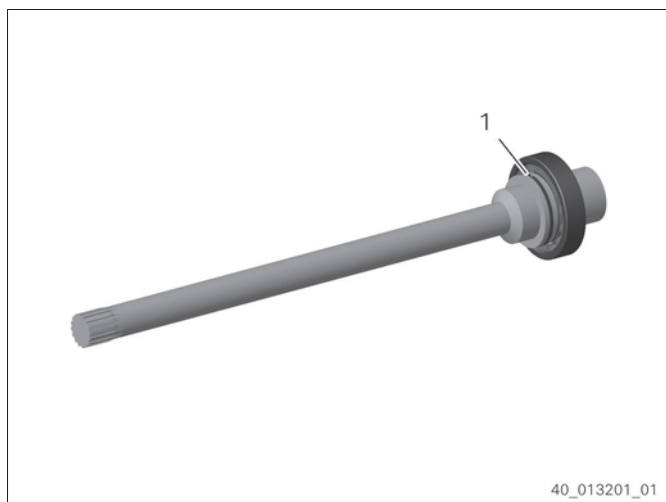


Fig. 357

Assembly

5. Insert pump shaft (1) into the transmission until contact is obtained. Insert the pump shaft in the gearing of the converter.

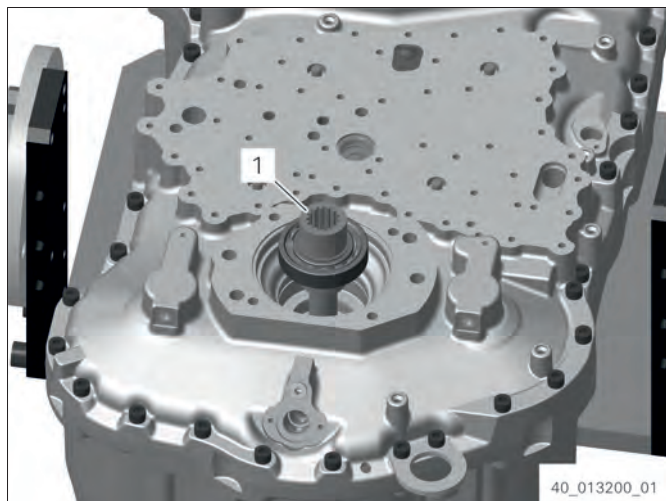


Fig. 358

6. Insert securing ring.

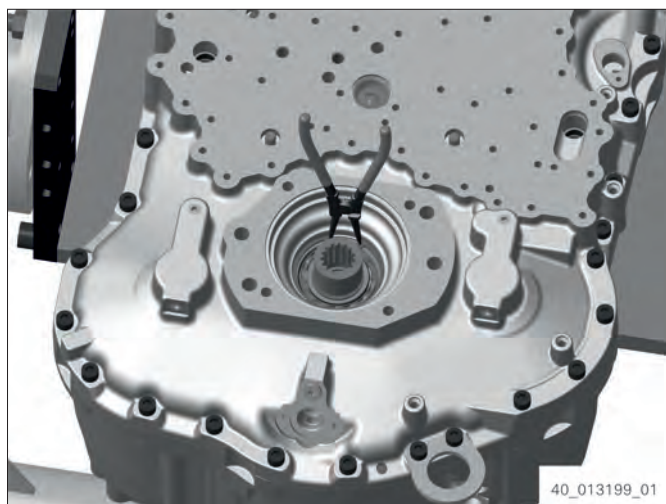


Fig. 359

Mounting cover plate (PTO)

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

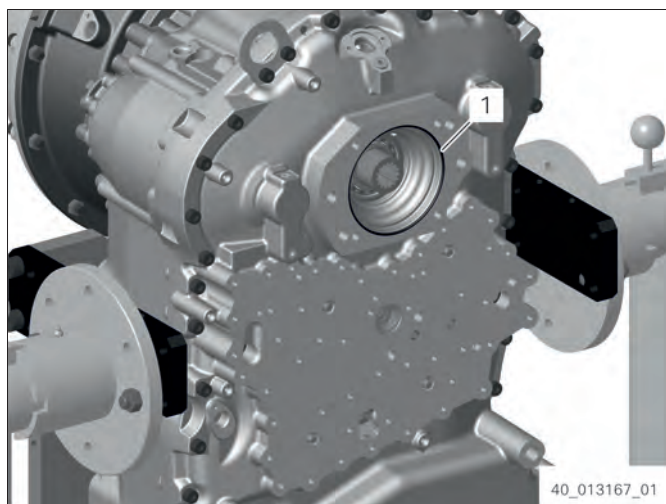


Fig. 360

3. Fix cover plate (1) with hexagon screws.
Tightening torque: **46 Nm**

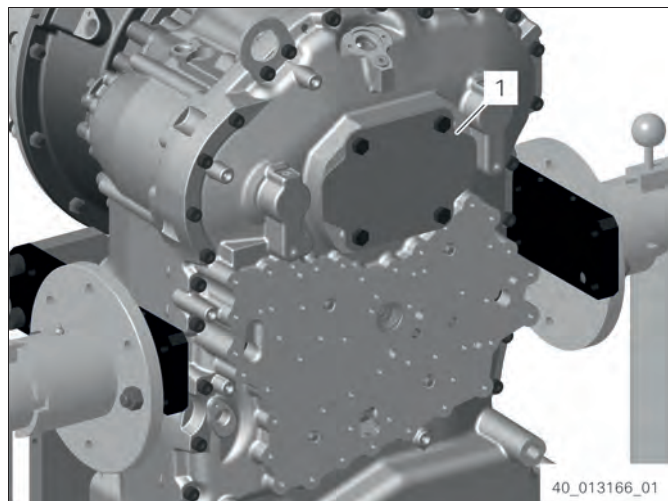


Fig. 361

Assembling and installing shift system

Installing duct plate

Special tools:

- 5870.204.037 Fixing pin

1. Insert converter safety valve (1) into the housing hole until contact is obtained.

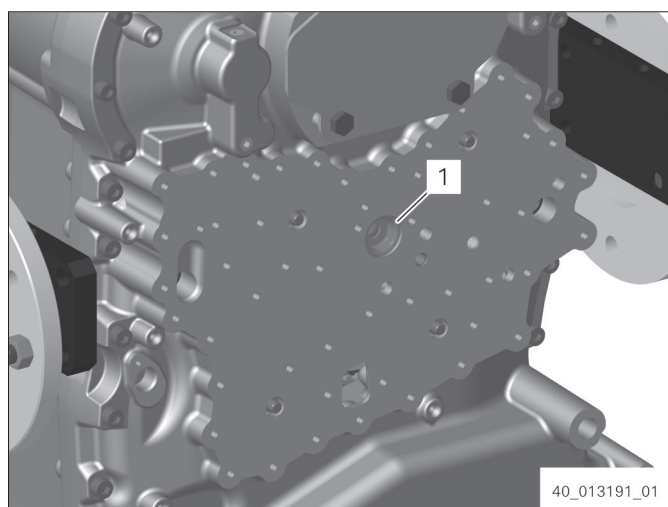


Fig. 362

Assembly

2. Bolt in screw plugs into the duct plate and tighten.
Tightening torque: **25 Nm**
Tightening torque: **30 Nm**

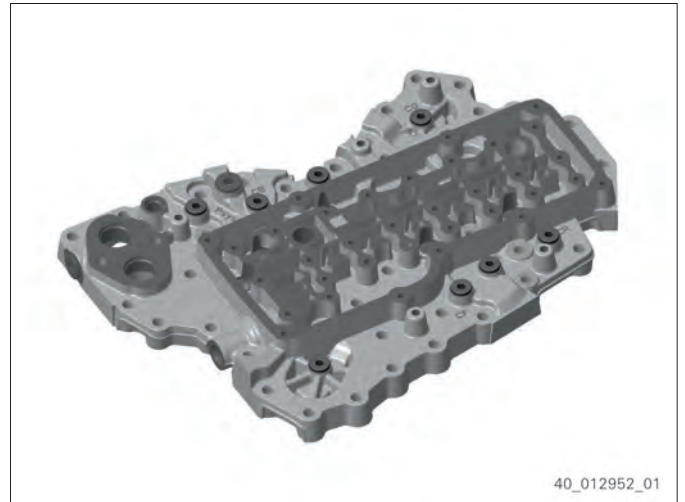


Fig. 363

3. Screw in two 5870.204.037 [Fixing pin].
4. Slide on seal (1).

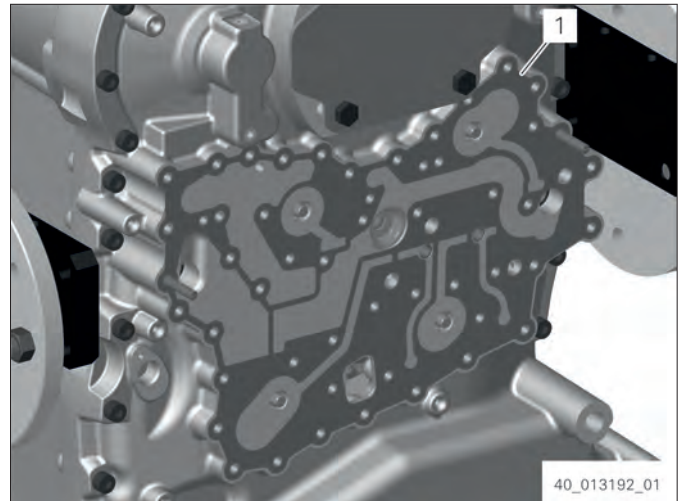


Fig. 364

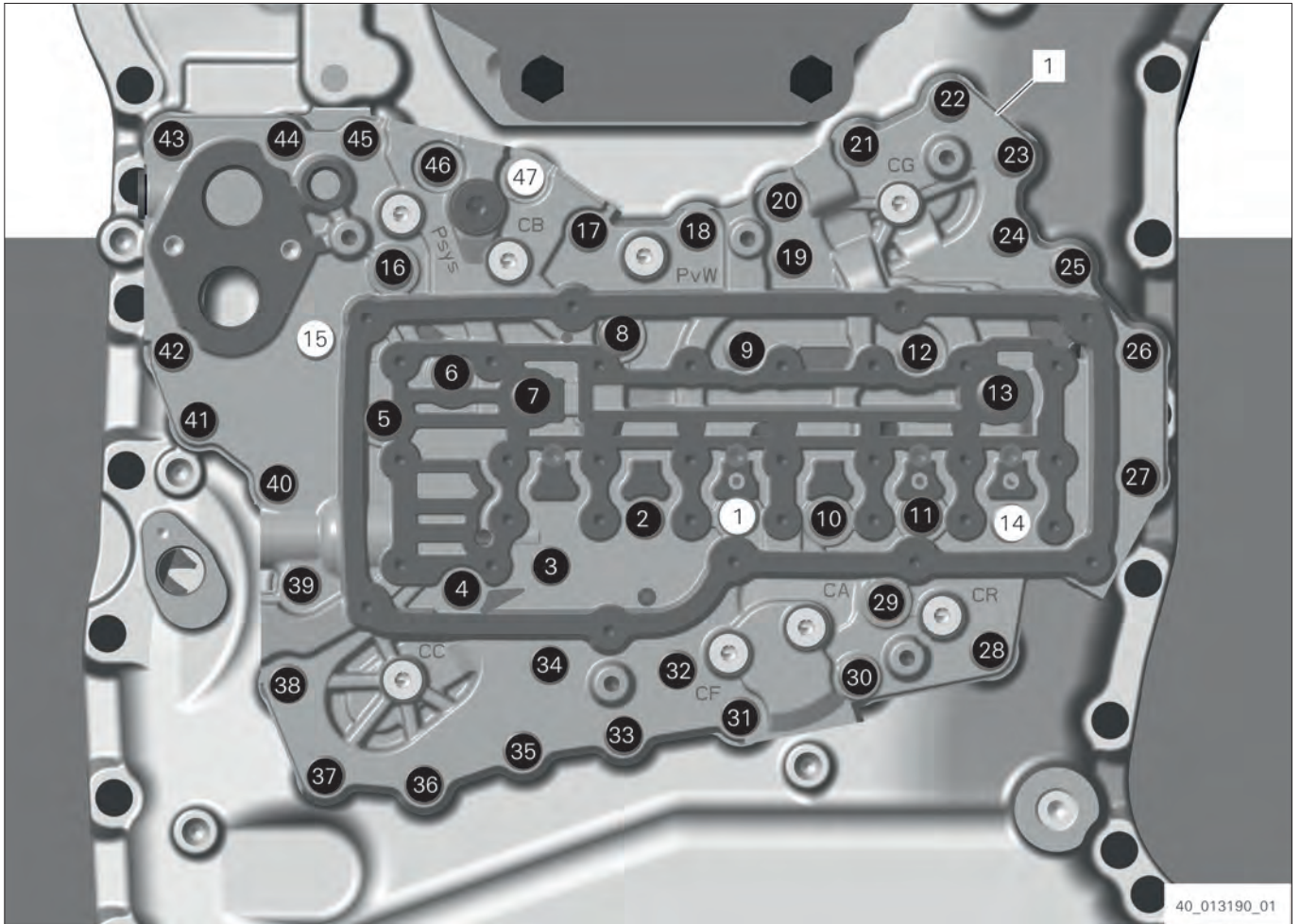


Fig. 365

5. Slide on duct plate (1).
6. Fix duct plate with internal hexalobular bolts in the specified order.
Tightening torque: **23 Nm**
7. Insert valves (1) in duct plate.

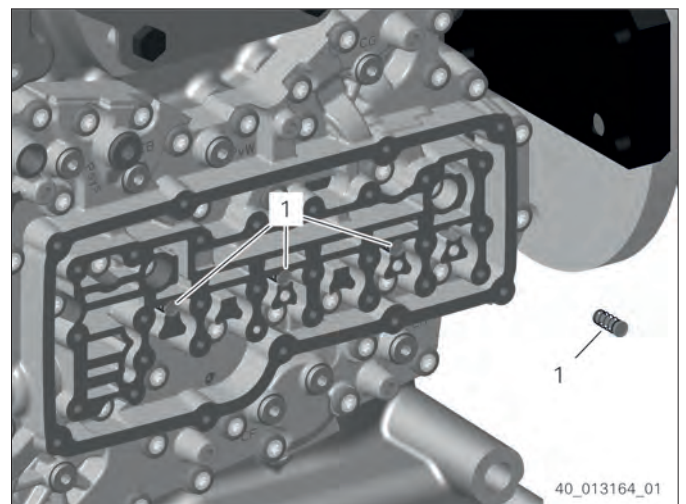


Fig. 366

Assembly

8. Insert compression springs (1) in holes (3).
9. Insert pistons (2) in holes (3).

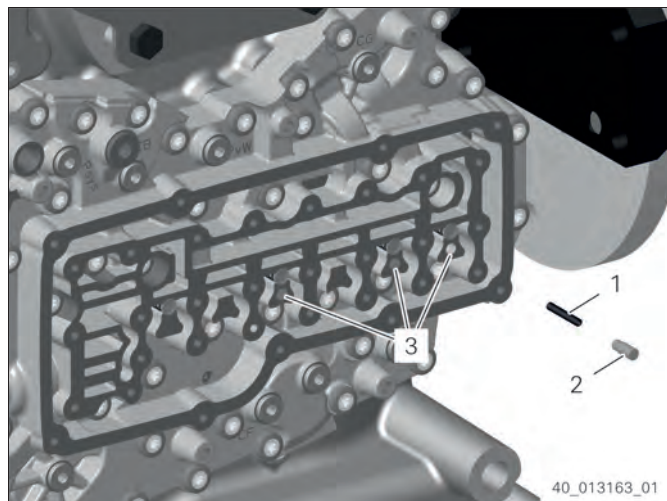


Fig. 367

Assembling and mounting valve blocks

Special tools:

- 5870.204.063 Fixing pin
 - AA02.416.230 Driver tool
 - AA02.416.754 Driver tool
 - AA02.414.200 Driver tool
 - AA02.318.019 Torque wrench
1. Bolt two 5870.204.063 [Fixing pin] into the duct plate.
 2. Push on intermediate plate (1).

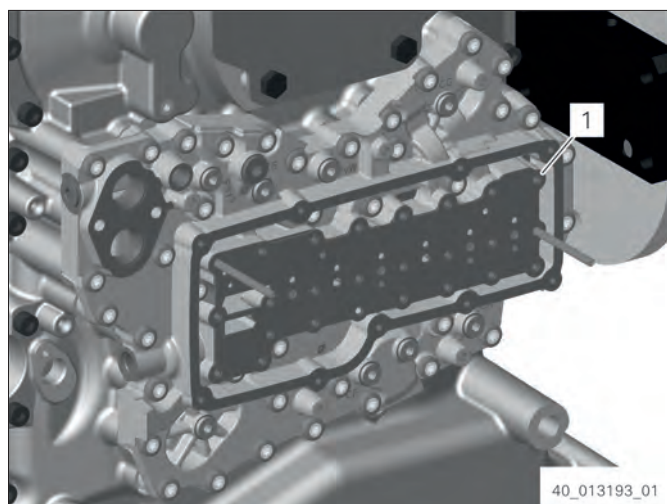


Fig. 368

3. Insert the control piston (1) in the hole.
4. Insert compression spring (2).
5. Apply oil to O-ring
6. Insert O-ring in the radial groove of the plug (3).
7. Insert the plug (3) in the hole.

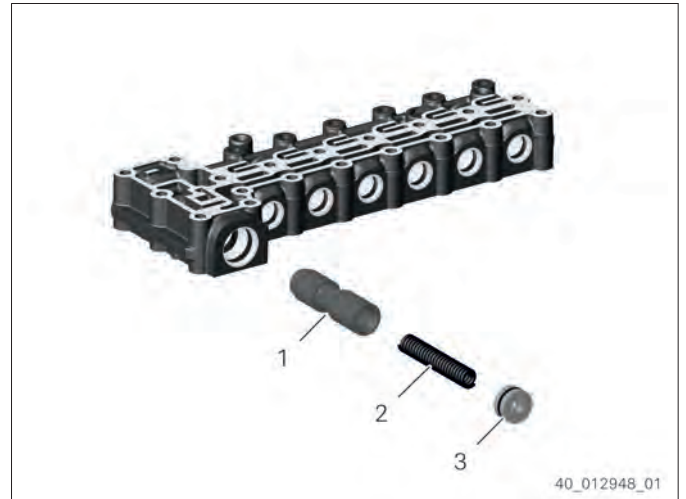


Fig. 369

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

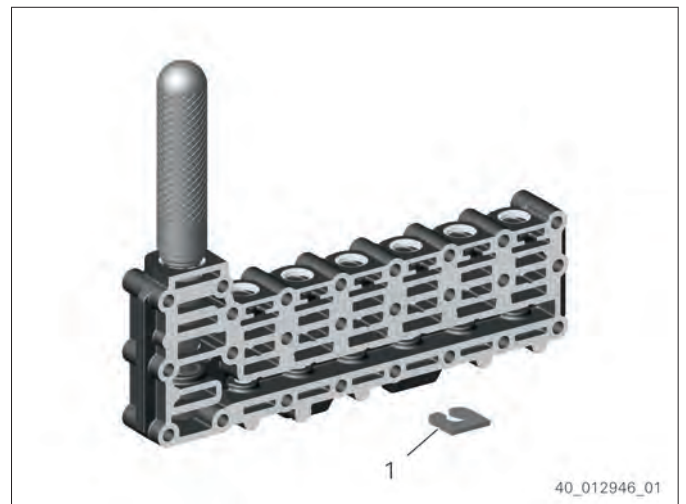


Fig. 370

9. Insert the compression spring (1) into the bore.
10. Insert the control piston (2).
11. Apply oil to O-ring
12. Insert O-ring in the radial groove of the plug (3).
13. Insert the plug (3) in the hole.

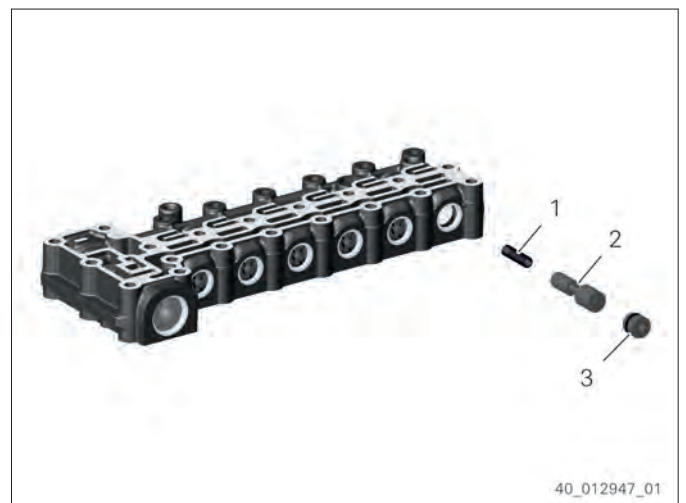


Fig. 371

Assembly

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

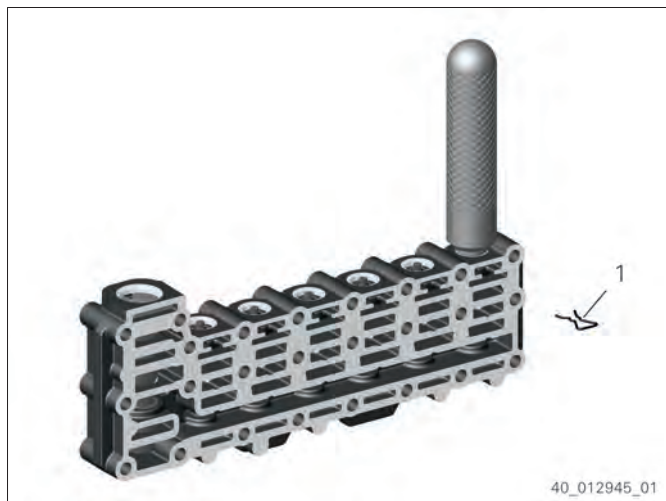


Fig. 372

15. Push on valve block (1).

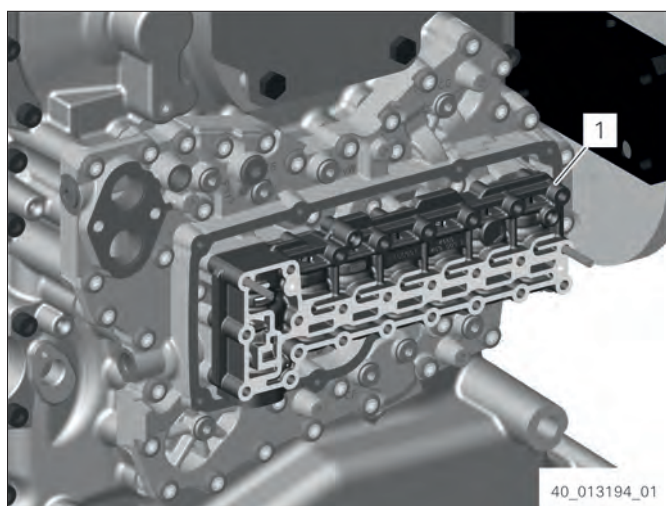


Fig. 373

16. Push on intermediate plate (1).

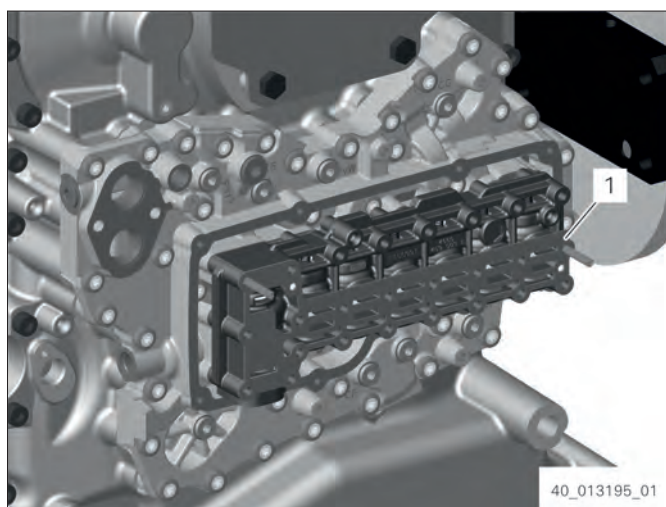


Fig. 374

17. Insert piston (1) in the hole.
18. Insert compression spring (2).

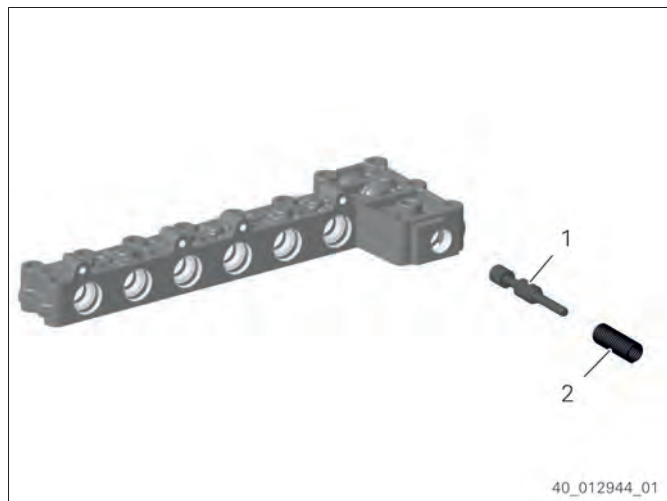


Fig. 375

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

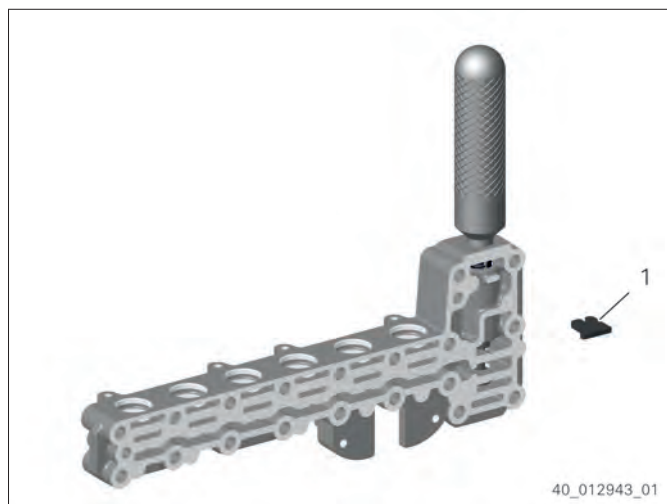


Fig. 376

20. Push on valve block (1).

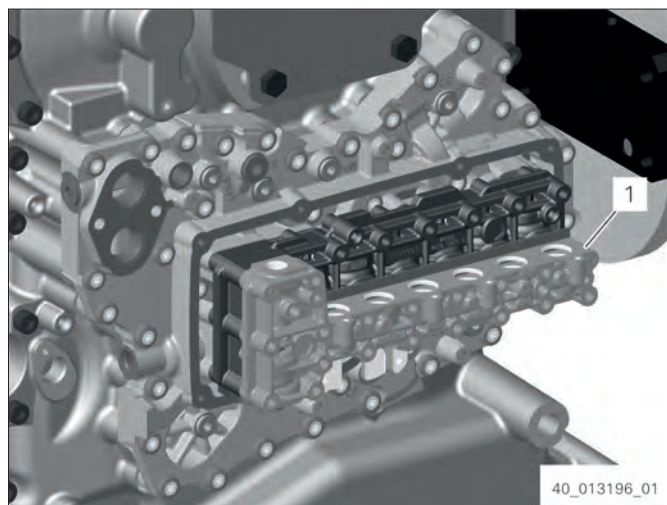


Fig. 377

Assembly

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

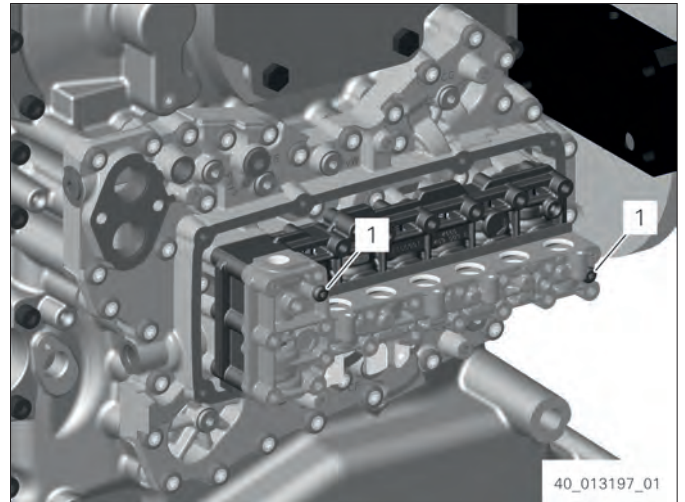


Fig. 378

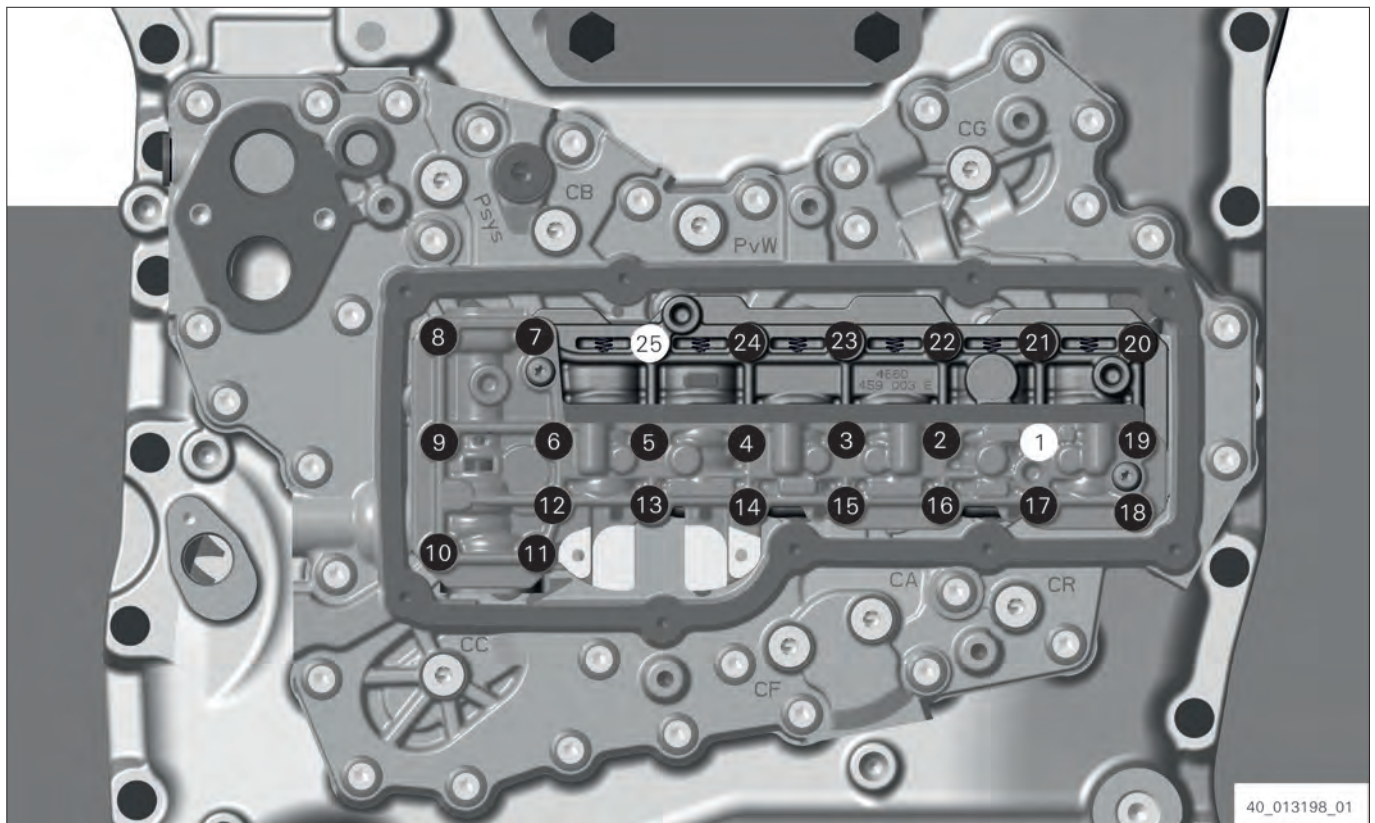


Fig. 379

22. Bolt in internal hexalobular bolts (1) to (19) and tighten with AA02.318.019 [Torque wrench] in the specified order.
Tightening torque: **3 Nm** and **60°** additional angle (tightening torque must be between 7 Nm and 13 Nm)
 - ※ If the tightening torque is not within the range specified, fit a new screw.
23. Bolt in internal hexalobular bolts (20) to (25) and tighten with AA02.318.019 [Torque wrench] in the specified order.

Tightening torque: **3 Nm** and **45°** additional angle (tightening torque must to be between 7 Nm and 13 Nm)

※ If the tightening torque is not within the range specified, fit a new screw.

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

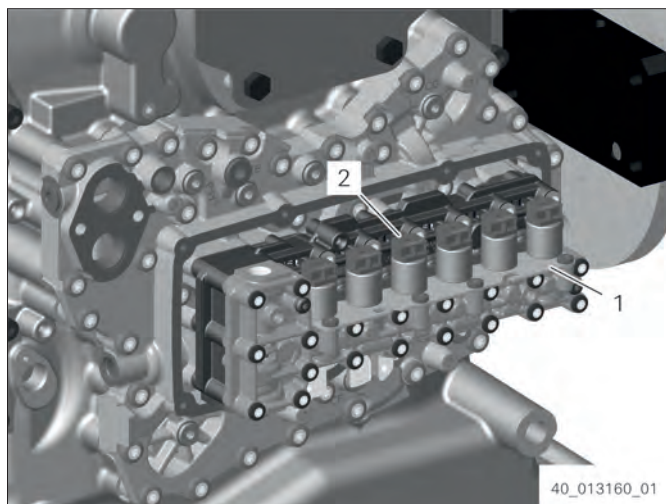


Fig. 380

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.

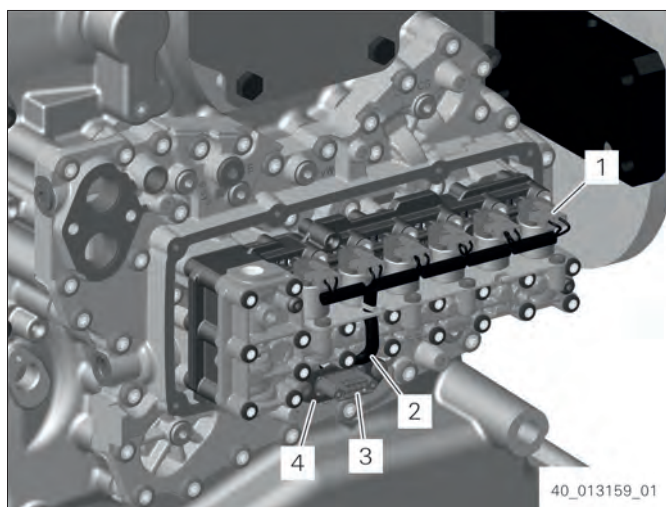


Fig. 381

Installing control unit (EC4A)

Special tools:

- 5870.204.063 Fixing pin

Assembly

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

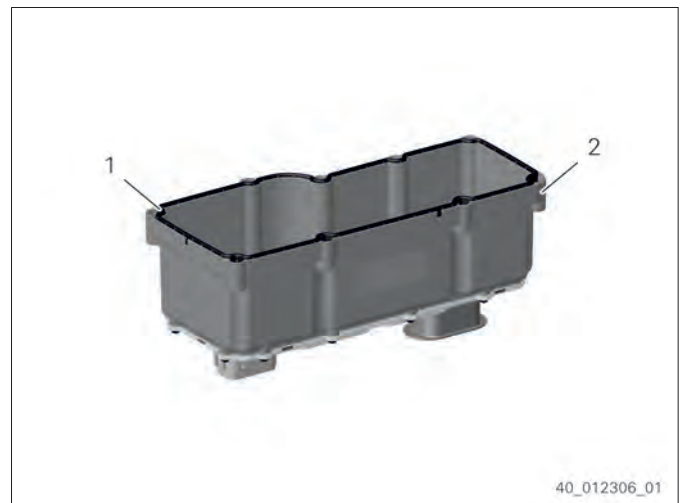


Fig. 382

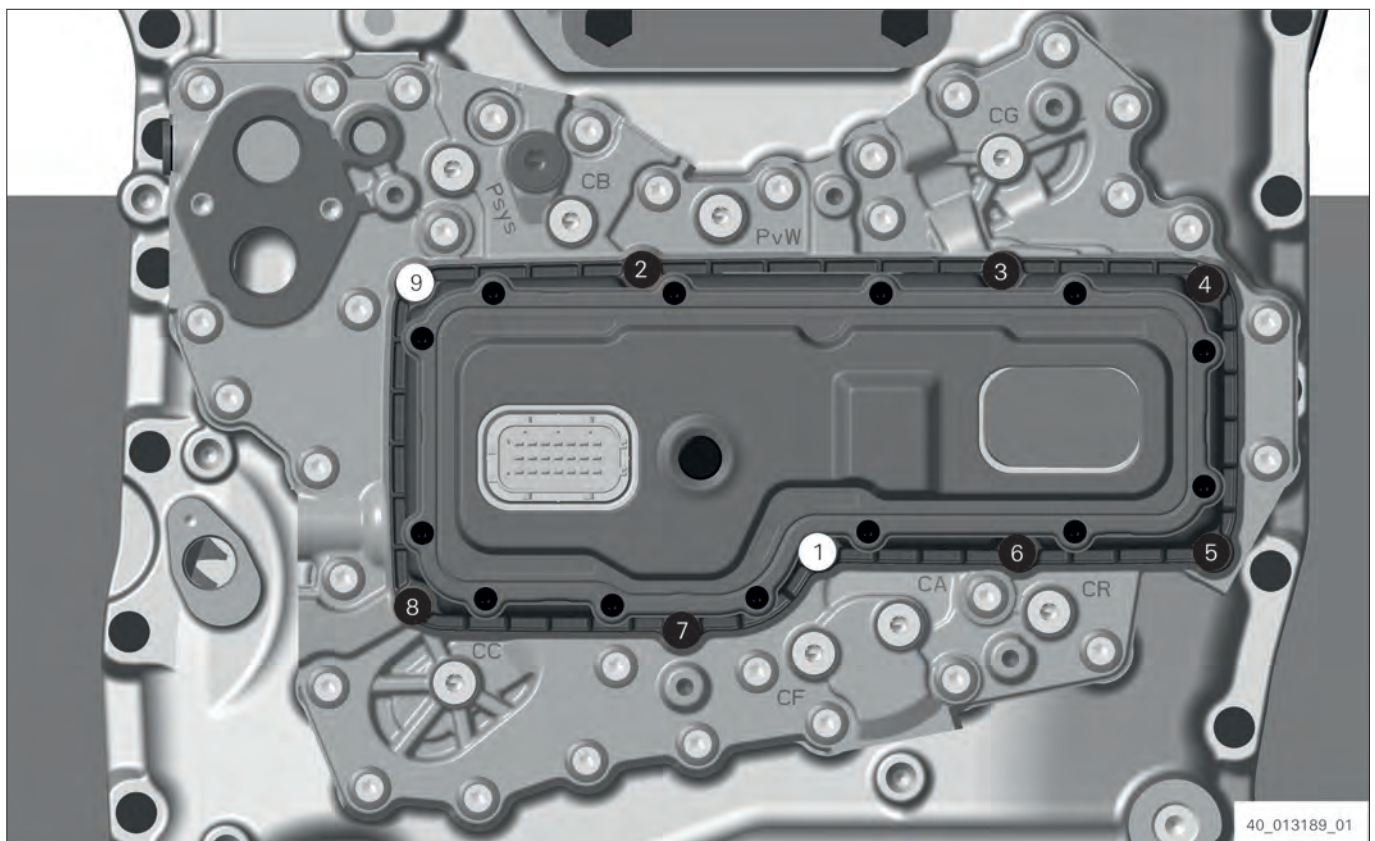


Fig. 383

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**

Installing filter bypass valve

1. Insert compression spring (2) and piston (3) in hole (1).

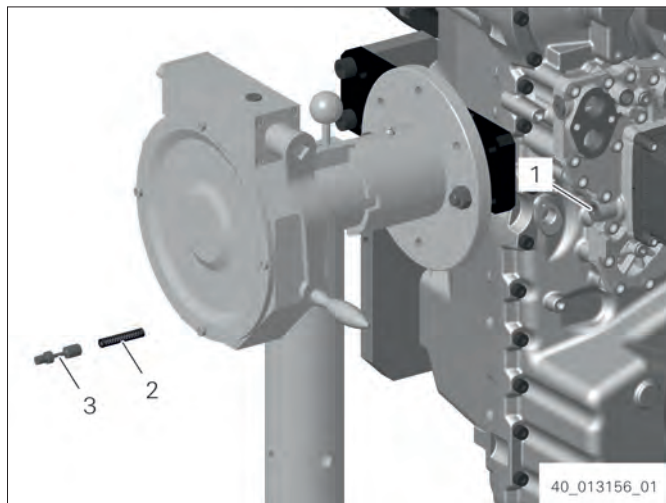


Fig. 384

2. Screw in tappet switch with O-ring (1) and tighten.
Tightening torque: **30 Nm**

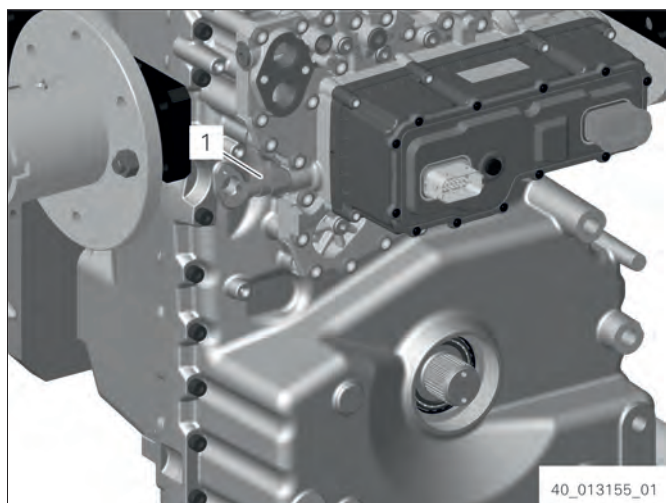


Fig. 385

Installing output flanges

Special tools:

- 5870.048.057 Driver tool

Operating supplies and auxiliary materials:

- 0666.690.191 PHÖNIX SPIRITUS

Assembly

Installing output flange on gearshift 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 5870.048.057 [Driver tool] to insert shaft seal (1) with seal lip facing the oil chamber.

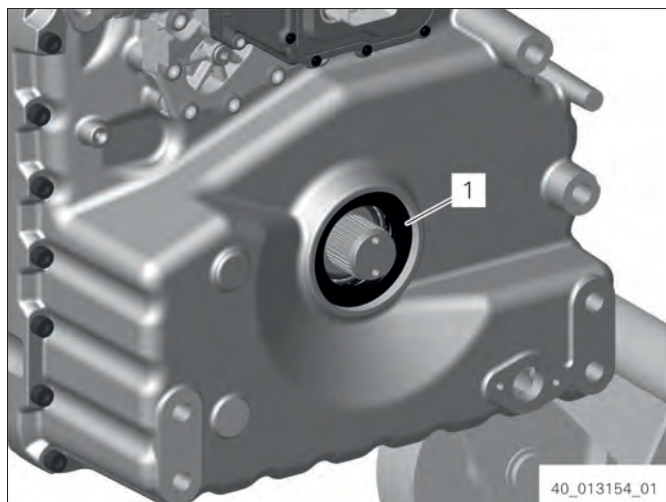


Fig. 386

3. Push the output flange (1) onto the output shaft until contact is obtained.

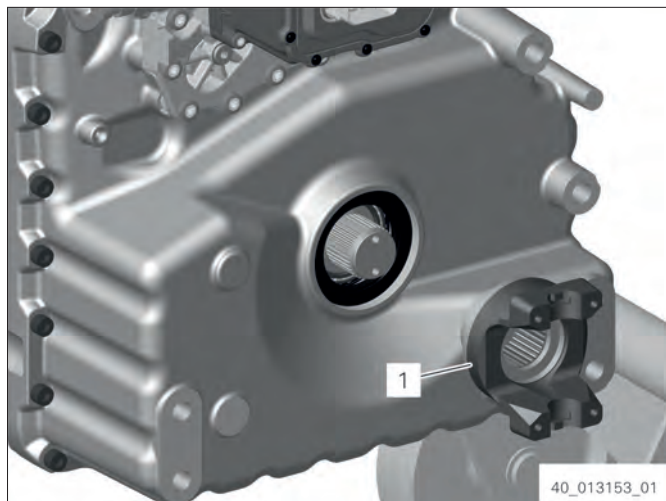


Fig. 387

4. Insert O-ring (1) in the space between output shaft and output flange.

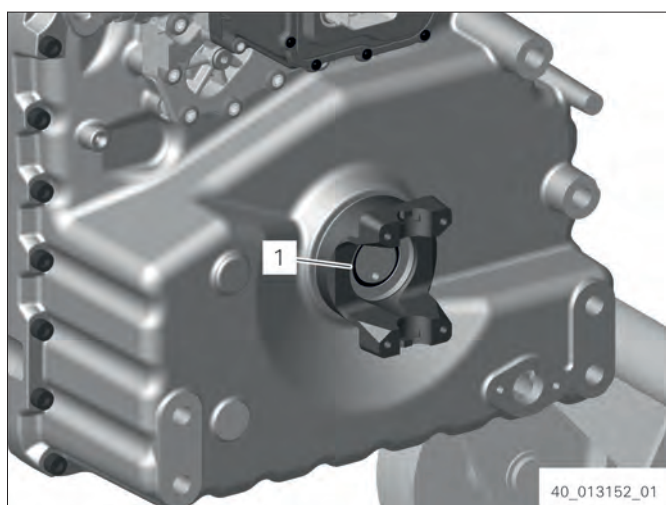


Fig. 388

5. Fix output flange with washer (2) and hexagon screws (1).
Tightening torque: **40 Nm**

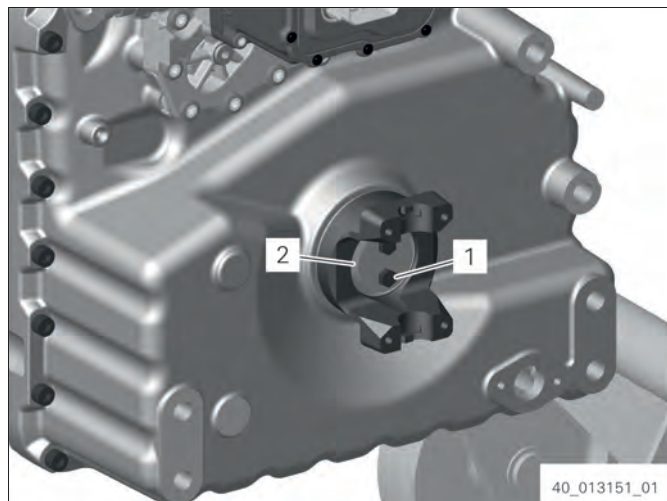


Fig. 389

Installing output flange on input side

6. ※ 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.

7. Use 5870.048.057 [Driver tool] to insert shaft seal (1) with seal lip facing the oil chamber.

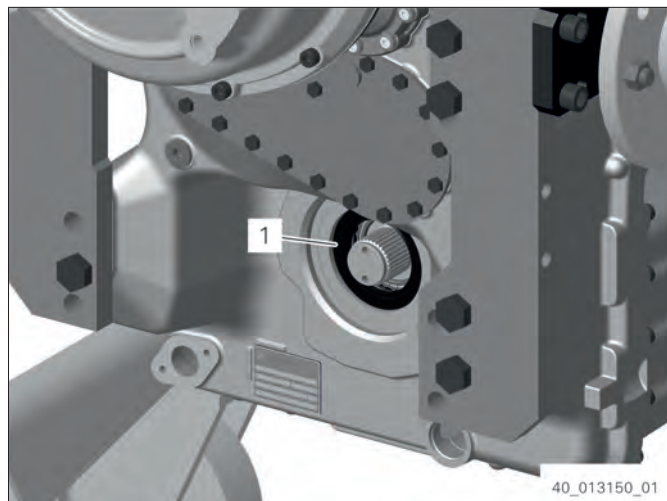


Fig. 390

8. Push the output flange (1) onto the output shaft until contact is obtained.

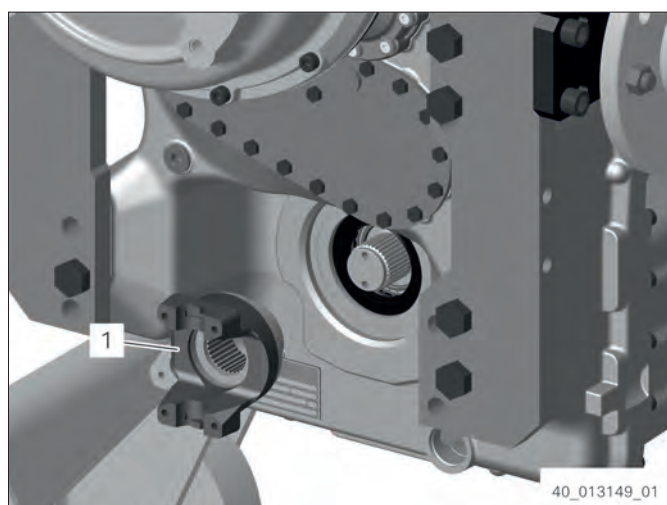


Fig. 391

Assembly

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

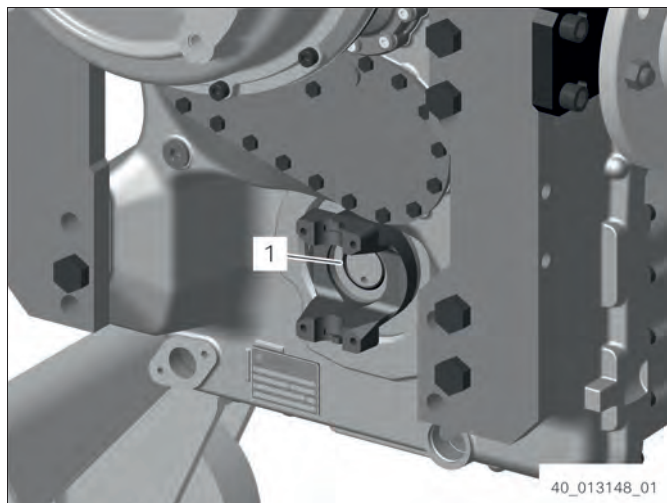


Fig. 392

10. Fix output flange with washer (2) and hexagon screws (1).
Tightening torque: **40 Nm**

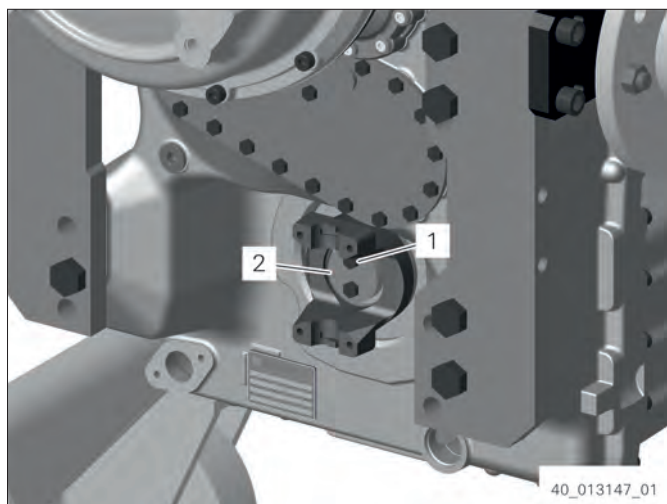


Fig. 393

Installing the temperature sensors and the breather

1. Screw in breather (1) and tighten.
Tightening torque: **12 Nm**
2. Screw in and tighten temperature sensors with O-ring (2).
Tightening torque: **25 Nm**

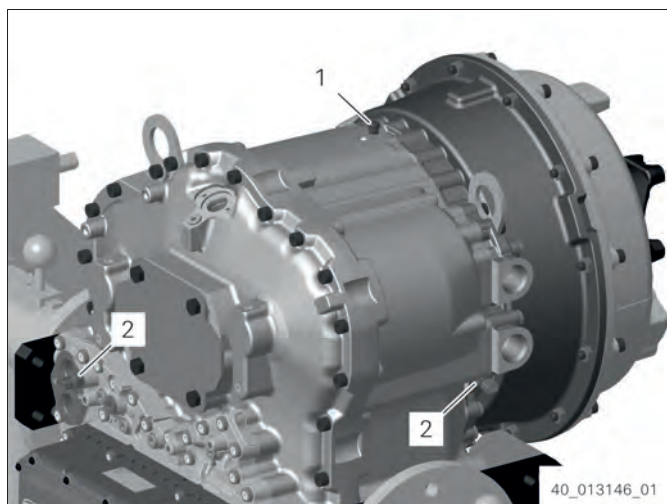


Fig. 394

Installing the speed sensors and pressure controller

1. Insert speed sensors with sealing element (1) in housing holes.
2. Fix speed sensors with cap screws. Tightening torque: **9.5 Nm**

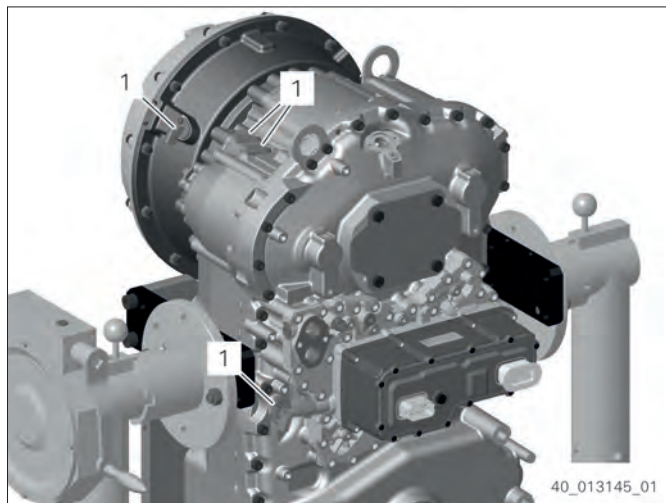


Fig. 395

3. Insert the pressure controller with O-rings (1) in the 3 o'clock position in the housing hole.
4. Fix pressure controller with cap screws. Tightening torque: **9.5 Nm**

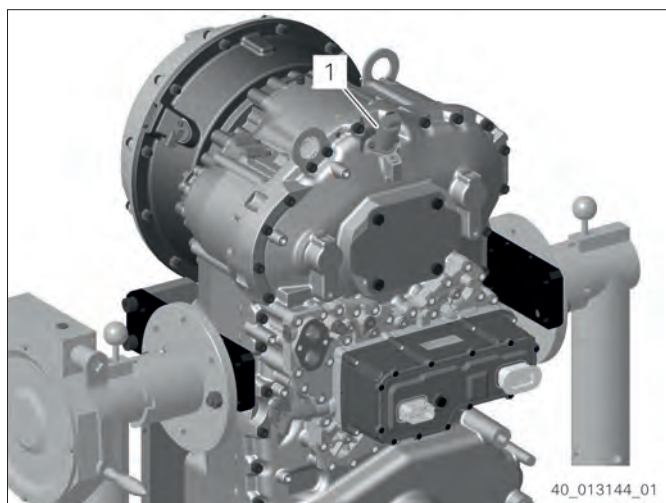


Fig. 396

5. Route cable (1) and insert plugs.
6. Fasten cable to the transmission with cable ties.

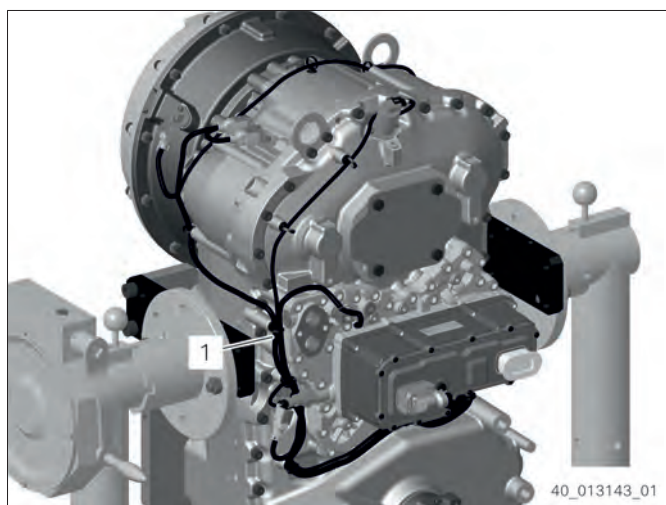


Fig. 397

Assembly

Installing cover plate (filler neck)

1. Put on seal and cover plate (1).
2. Screw in and tighten hexagon screws.
Tightening torque: **23 Nm**

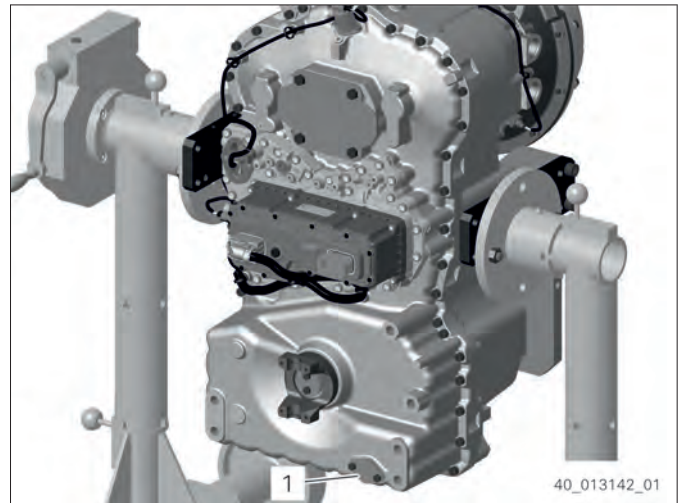


Fig. 398

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

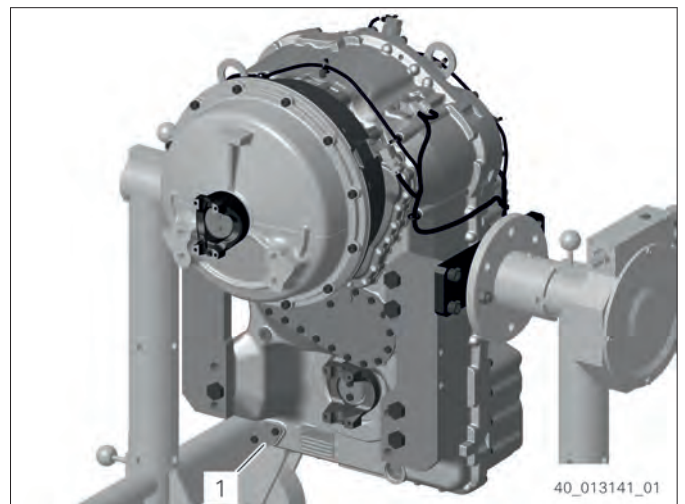


Fig. 399

Installing the pressure filter

1. Oil O-rings (1) and insert them in the radial grooves on the filter head.



Fig. 400

2. Fix filter head (1) with internal hexalobular bolts.
Tightening torque: **34 Nm**

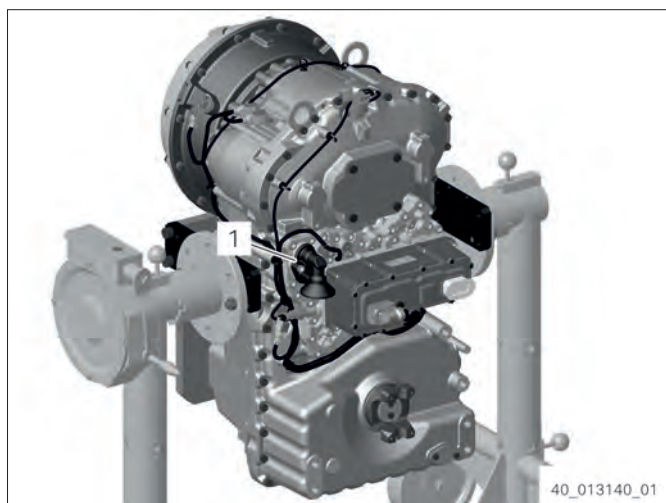


Fig. 401

3. Lightly oil the seal of the pressure filter.
4. Screw in pressure filter (1) until contact is obtained with the sealing surface on the filter head.
5. Tighten the pressure filter.
Tightening torque: Contact sealing surface +90° to 180°
As an alternative use a tool with torque indicator to tighten.
Tightening torque: **40 Nm**

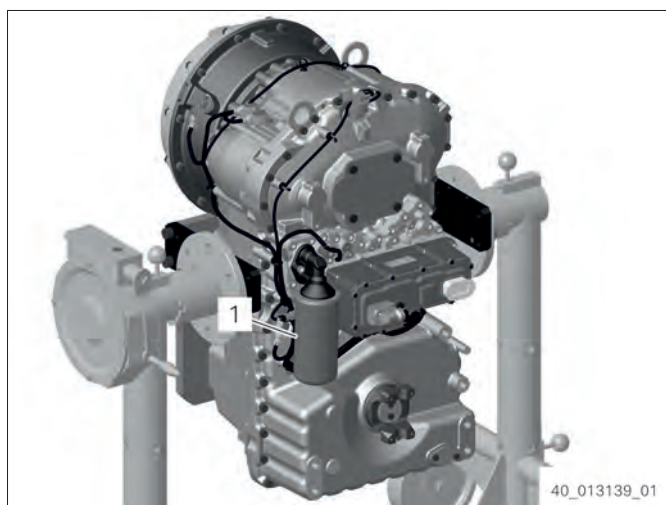


Fig. 402

Assembly

Adding oil

1. Bolt in screw plug with O-ring (1) and tighten.
Tightening torque: **80 Nm**
2. Prior to initial operation, fill transmission with oil according to Operating Instructions.

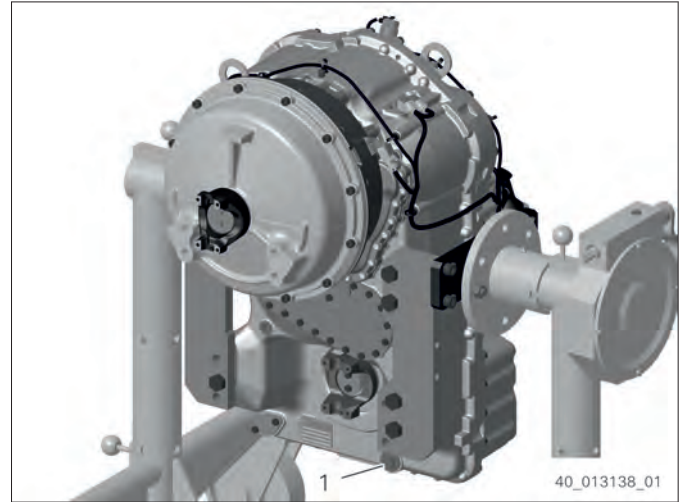


Fig. 403