

## SECTION 3 POWER TRAIN SYSTEM

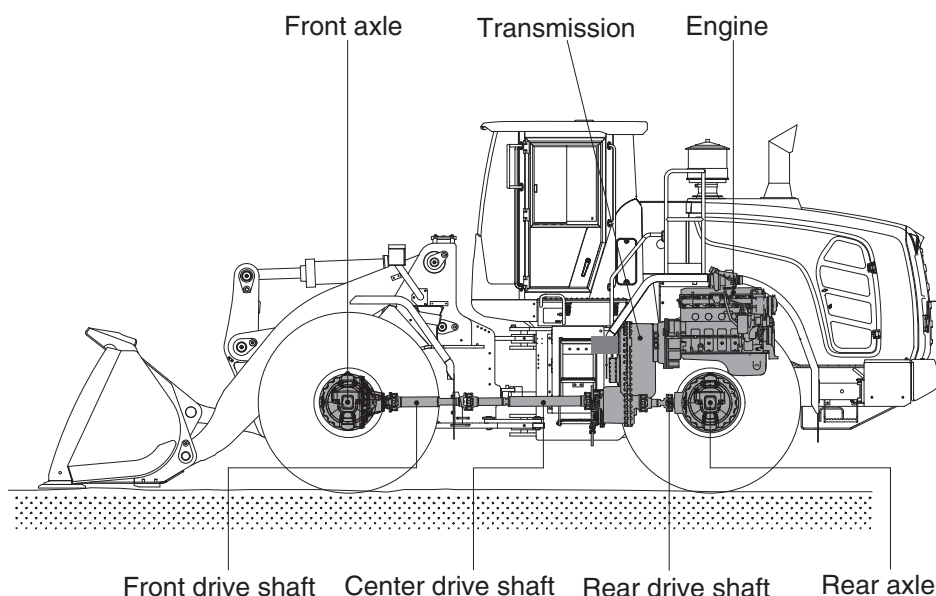
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## SECTION 3 POWER TRAIN SYSTEM

### GROUP 1 STRUCTURE AND FUNCTION

#### 1. POWER TRAIN COMPONENT OVERVIEW



770F3PT01

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, Hyd lock differential).

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

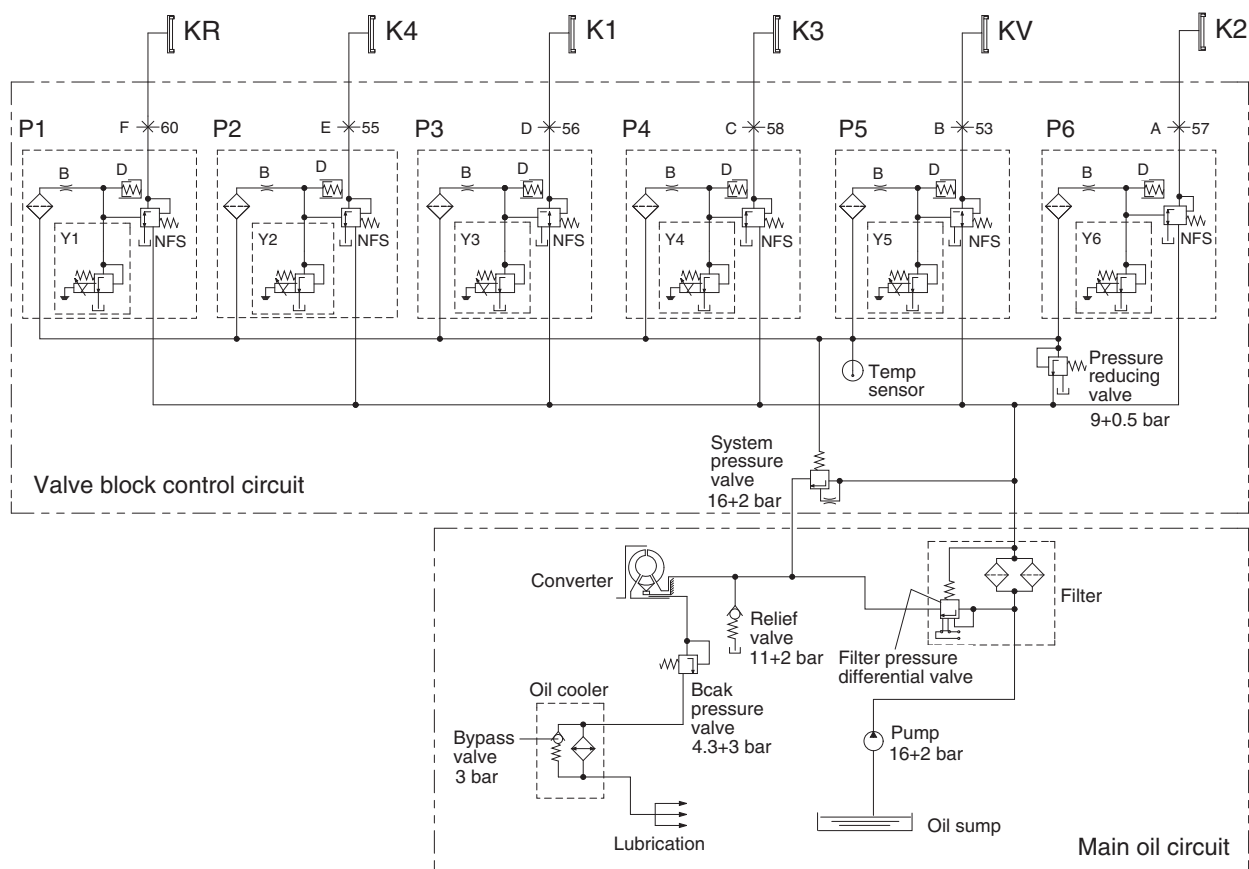
The rear axle is mounted on an oscillating pivot.

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

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



## HYDRAULIC CIRCUIT (4-speed transmission)



7707APT09

NFS Follow-on slide

D Oscillation damper

B Orifice

P1 Proportional valve clutch KR

P2 Proportional valve clutch K4

P3 Proportional valve clutch K1

P4 Proportional valve clutch K3

P5 Proportional valve clutch KV

P6 Proportional valve clutch K2

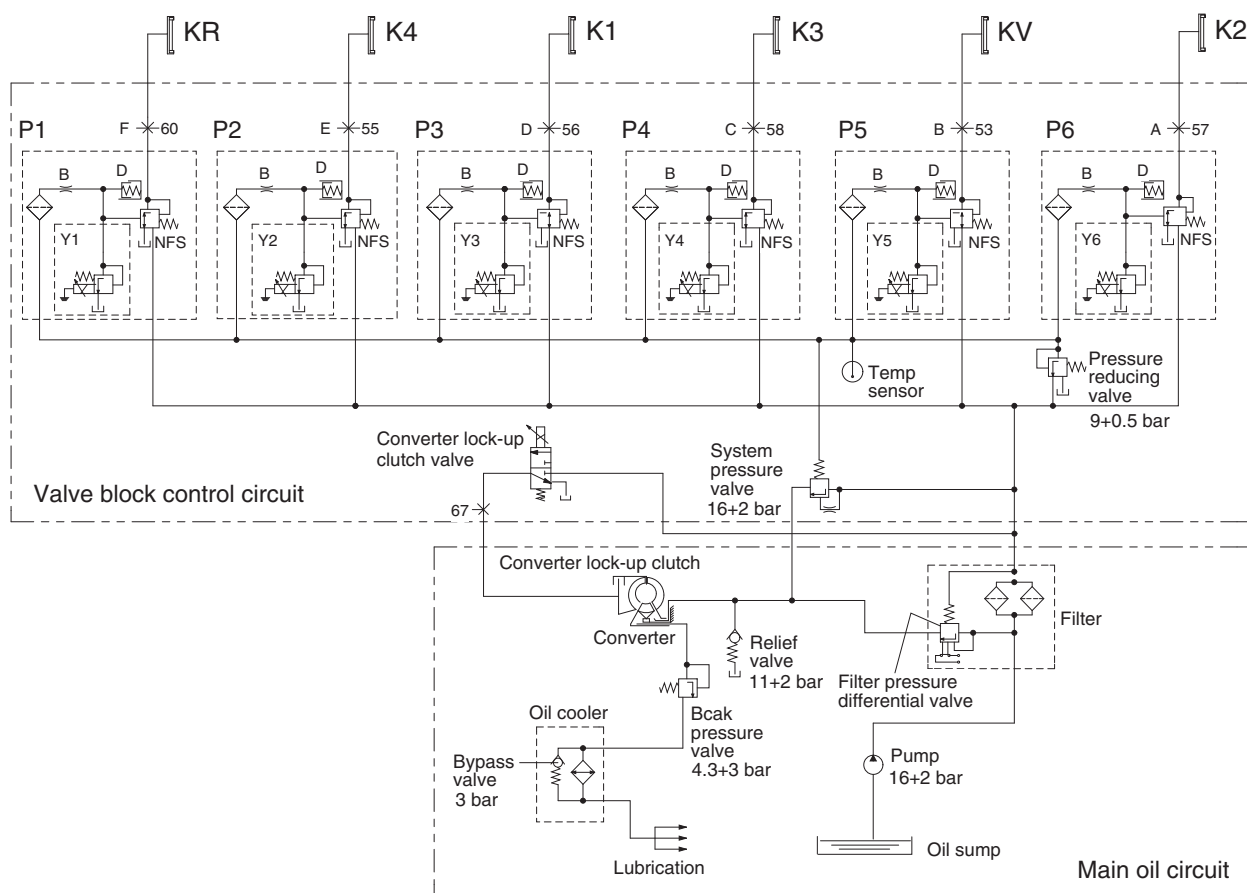
Y1~Y6 Pressure regulator valve with filter

| Speed          | Forward |       |       |       | Reverse |       |        | Neutral | Engaged clutch | Positions on the valve block | Current No. of the measuring points |
|----------------|---------|-------|-------|-------|---------|-------|--------|---------|----------------|------------------------------|-------------------------------------|
|                | 1       | 2     | 3     | 4     | 1       | 2     | 3      |         |                |                              |                                     |
| Y1             |         |       |       |       | X       | X     | X      |         | KR             | F                            | 55                                  |
| Y2             |         |       |       | X     |         |       |        |         | K4             | E                            | 60                                  |
| Y3             | X       |       |       |       | X       |       |        |         | K1             | D                            | 56                                  |
| Y4             |         |       | X     | X     |         |       | X      |         | K3             | C                            | 58                                  |
| Y5             | X       | X     | X     |       |         |       |        |         | KV             | B                            | 53                                  |
| Y6             |         | X     |       |       |         | X     |        |         | K2             | A                            | 57                                  |
| Engaged clutch | K1,KV   | KV,K2 | KV,K3 | K4,K3 | KR,K1   | KR,K2 | KR, K3 |         | -              | -                            | -                                   |

X : Pressure regulator under voltage



## HYDRAULIC CIRCUIT (5-speed transmission)



7709A3PT09

NFS Follow-on slide

D Oscillation damper

B Orifice

P1 Proportional valve clutch KR

P2 Proportional valve clutch K4

P3 Proportional valve clutch K1

P4 Proportional valve clutch K3

P5 Proportional valve clutch KV

P6 Proportional valve clutch K2

Y1~Y6 Pressure regulator with filter

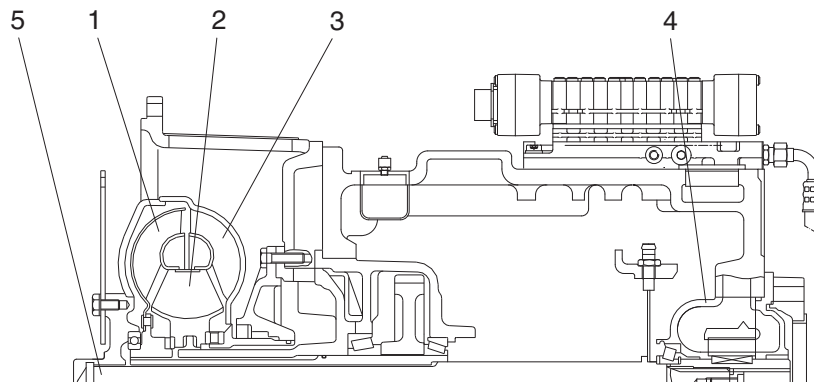
| Speed          | Forward |       |       |       |       | Reverse |       |       | Neutral | Engaged clutch | Positions on the valve block | Current No. of the measuring points |
|----------------|---------|-------|-------|-------|-------|---------|-------|-------|---------|----------------|------------------------------|-------------------------------------|
|                | 1       | 2     | 3     | 4     | 5     | 1       | 2     | 3     |         |                |                              |                                     |
| Y1             |         |       |       |       |       | X       | X     | X     |         | KR             | F                            | 55                                  |
| Y2             |         |       | X     |       | X     |         |       |       |         | K4             | E                            | 60                                  |
| Y3             | X       |       |       |       |       | X       |       |       |         | K1             | D                            | 56                                  |
| Y4             |         |       |       | X     | X     |         |       | X     |         | K3             | C                            | 58                                  |
| Y5             | X       | X     |       | X     |       |         |       |       |         | KV             | B                            | 53                                  |
| Y6             |         | X     | X     |       |       |         | X     |       |         | K2             | A                            | 57                                  |
| Engaged clutch | K1,KV   | KV,K2 | K2,K4 | KV,K3 | K3,K4 | KR,K1   | KR,K2 | KR,K3 |         | -              | -                            | -                                   |

X : Pressure regulator under voltage



## 2. TORQUE CONVERTER

### 1) FUNCTION



7704PT03

- |   |         |   |                   |   |             |
|---|---------|---|-------------------|---|-------------|
| 1 | Turbine | 3 | Pump              | 5 | Input shaft |
| 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 will be defined according to the engine power so that the most favorable operating conditions for each installation case are given.

**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 is constantly streaming out of the transmission pump 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 through the escaping oil.

The oil, escaping out of the pump wheel, enters the turbine wheel and is there inversed in the direction of flow.

According to the rate of inversion, the turbine wheel and with it also the output shaft, receive a more or less high reaction moment. The stator (reaction member), following the turbine, has the task to inverse again the oil which is escaping out of the turbine and to delivery it under the suitable discharge direction to the pump wheel.

Due to the inversion, the stator receives a reaction moment.

The relation turbine moment/pump moment is called torque conversion. This is the higher the greater the speed difference of pump wheel and turbine wheel will be.

Therefore, the maximum conversion is created at standing turbine wheel.

With increasing output speed, the torque conversion is decreasing. The adoption of the output speed to a certain required output moment is infinitely variable and automatically achieved by the torque converter.



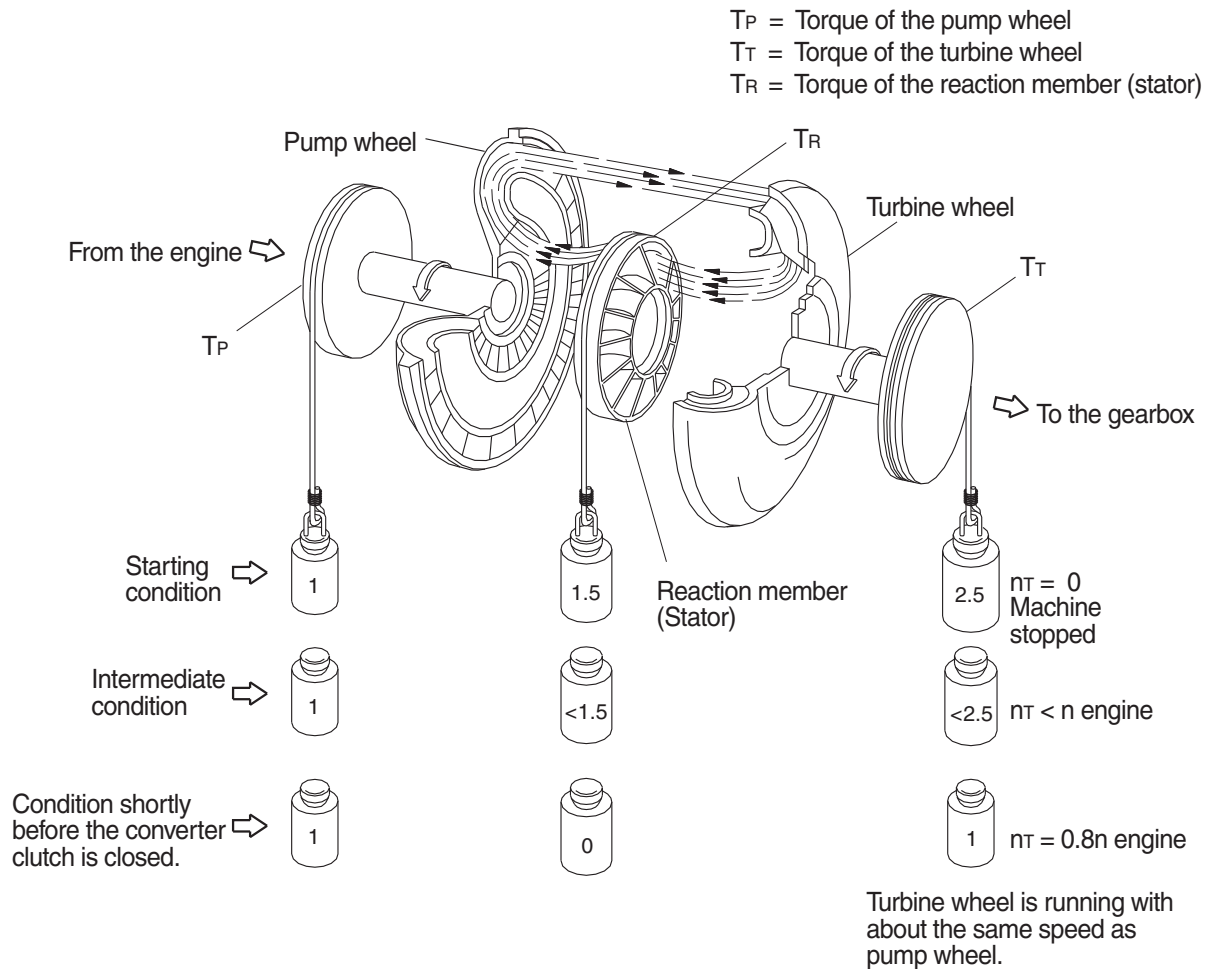
If the turbine speed is reaching about 80% of the pump speed, the conversion becomes 1.0 i.e. the turbine moment becomes equal to that of the pump moment.

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, it is backing up in the conversion range the moment upon the housing, and is released in the coupling range.

In this way, the stator can rotate freely.

### Function of a hydrodynamic torque converter (schematic view)



3-4(770-3)



## 2) CONVERTER LOCK-UP CLUTCH (5-speed transmission)

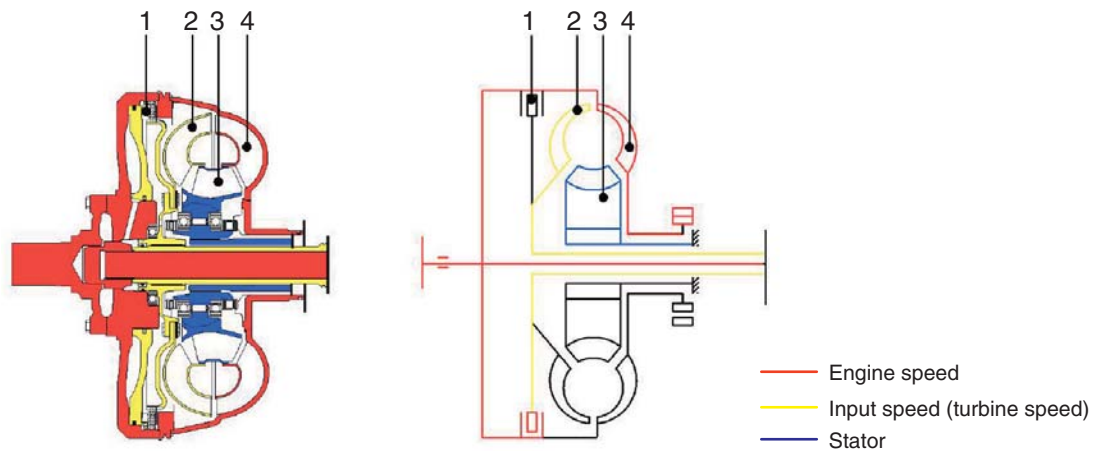


Figure A

7609A3PT22

- 1 Converter lock-up clutch
- 2 Turbine wheel
- 3 Stator
- 4 Circuit cover/pump wheel
- 5 Proportional valve
- 6 Measuring point "Lock-up clutch"
- 7 Cover
- 8 System pressure to lock-up clutch valve
- 9 System pressure from lock-up clutch valve to lock-up clutch

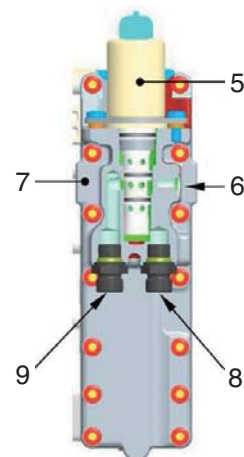


Figure B

7609A3PT23

With closed converter lock-up clutch the slip between pump and turbine wheel and consequently the hydraulic loss in the converter is equal to "zero" (see figure A).

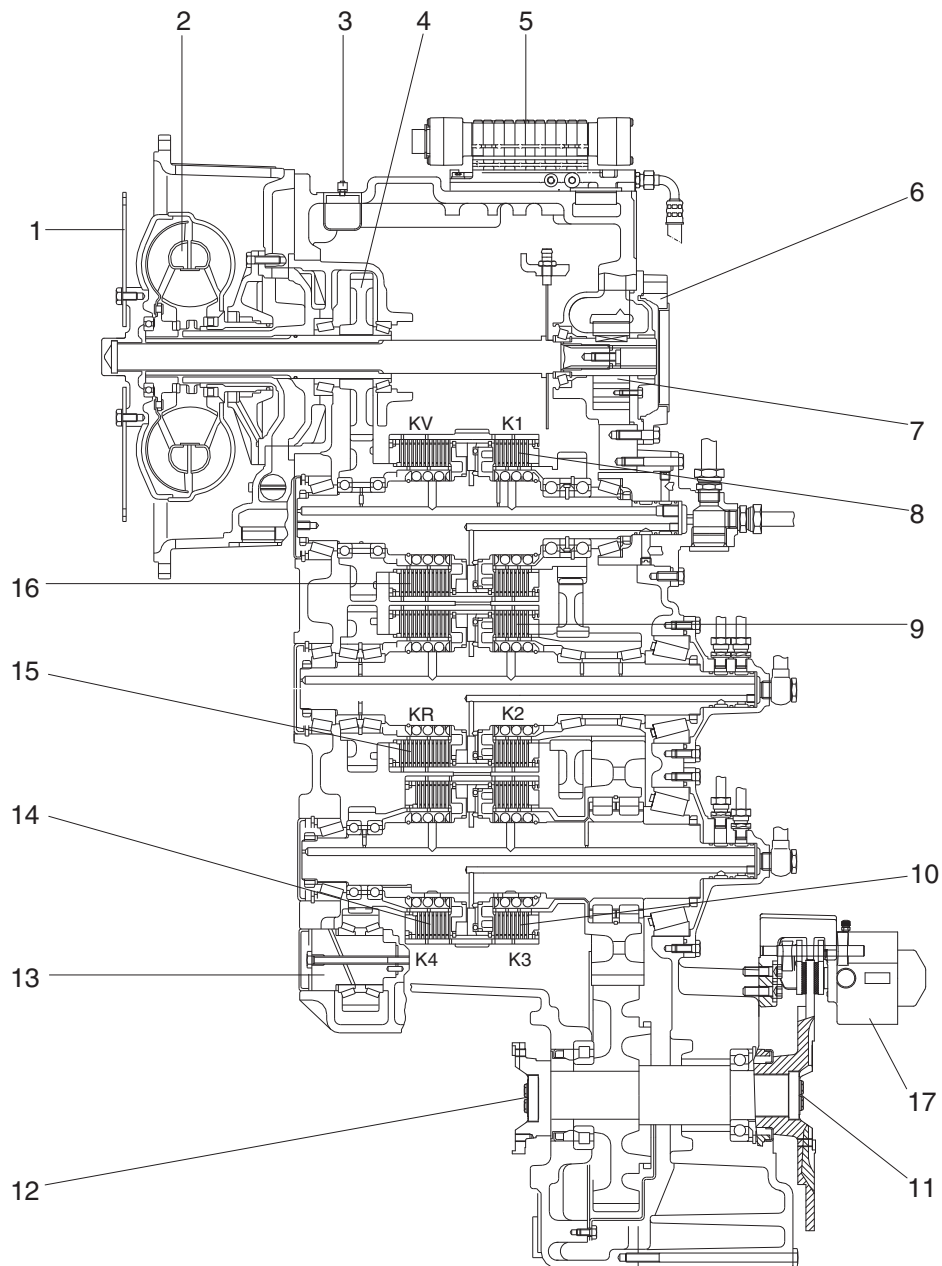
According to the turbine speed the converter lock-up clutch is shifted automatically.

Via a proportional valve the pilot pressure is applied to the actuating piston, which compresses the disc set (see figure B, lock-up clutch valve).



### 3. TRANSMISSION

#### 1) LAYOUT

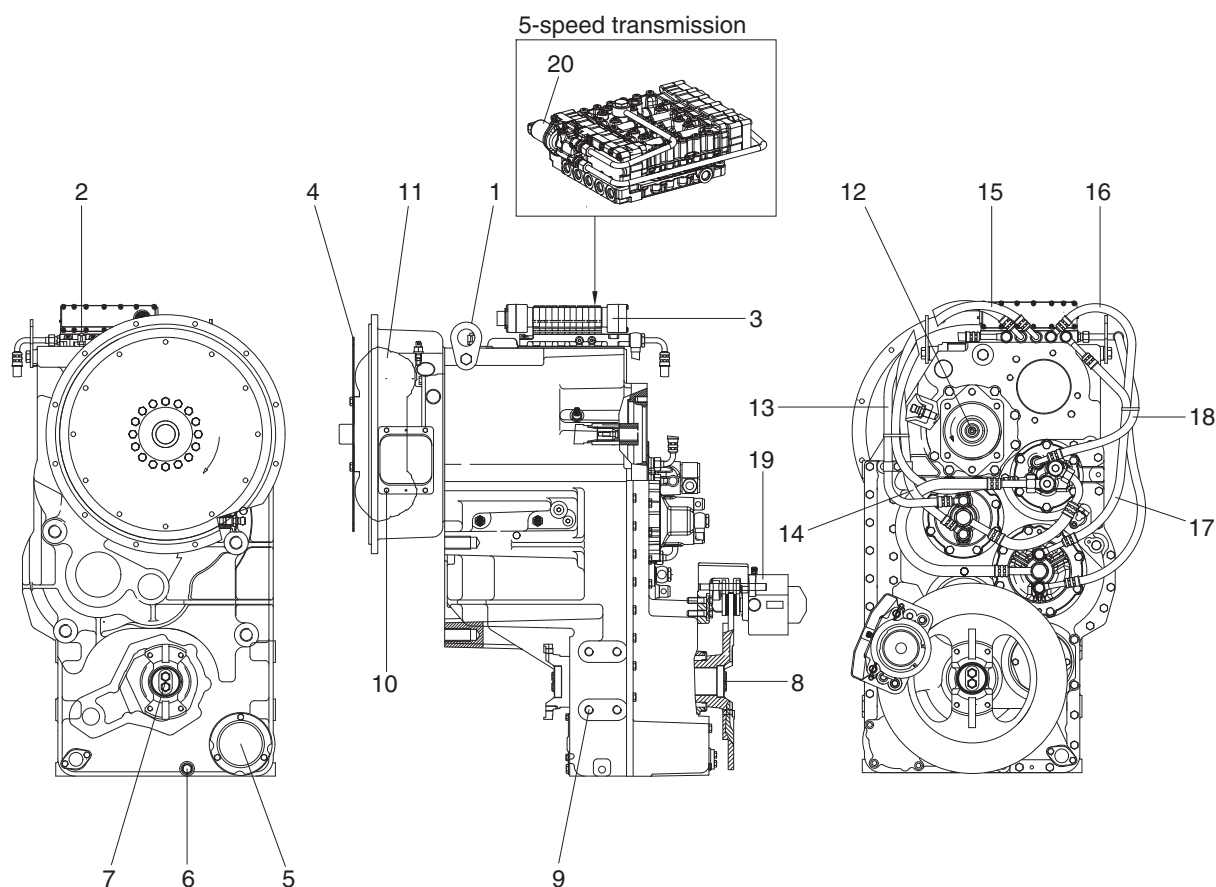


77093PT03

- |   |                                 |    |  |    |                     |
|---|---------------------------------|----|--|----|---------------------|
| 1 | Engine connection               | 7  | Converter change and control pressure pump | 12 | Output shaft        |
| 2 | Torque converter                | 8  | 1st clutch (K1)                            | 13 | Lay shaft           |
| 3 | Breather                        | 9  | 2nd clutch (K2)                            | 14 | 4th clutch (K4)     |
| 4 | Drive                           | 10 | 3rd clutch (K3)                            | 15 | Reverse clutch (KR) |
| 5 | Electro-hydraulic shift control | 11 | Output shaft                               | 16 | Forward clutch (KV) |
| 6 | 1st power take off              |    |  | 17 | Parking brake       |



## 2) INSTALLATION VIEW



7709A3PT02

- |    |                                   |    |  |
|----|-----------------------------------|----|--|
| 1  | Lifting lugs                      | 11 | Converter  |
| 2  | Breather                          | 12 | Engine driver  |
| 3  | Electro-hydraulic shift control   | 13 | Pressure line clutch K2  |
| 4  | Engine connection                 | 14 | Pressure line clutch KR  |
| 5  | Coarse filter                     | 15 | Pressure line clutch KV  |
| 6  | Oil drain plug M22×1.5            | 16 | Pressure line clutch K4  |
| 7  | Output-rear axle                  | 17 | Pressure line clutch K3  |
| 8  | Output-front axle                 | 18 | Pressure line clutch K1  |
| 9  | Transmission suspension holes M20 | 19 | Parking brake  |
| 10 | Mounting holes                    | 20 | Solenoid valve for converter lock-up clutch<br>(5-speed transmission only) |



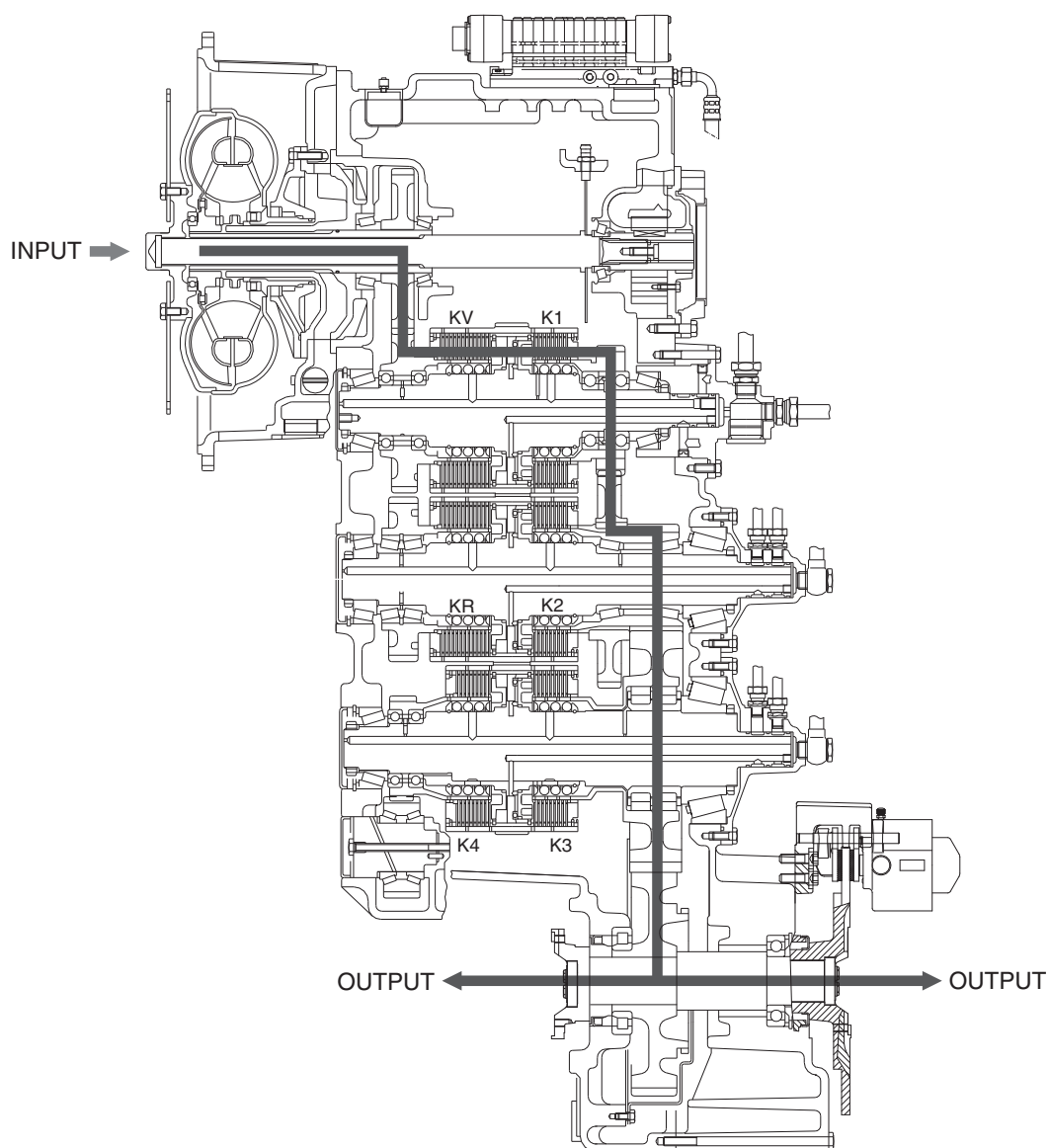
### 3) OPERATION OF TRANSMISSION (4-speed transmission)

#### (1) Forward

##### ① Forward 1st

In 1st forward, forward clutch (KV) and 1st clutch (K1) are engaged.

Forward clutch and 1st clutch are actuated by the hydraulic pressure applied to the clutch piston.



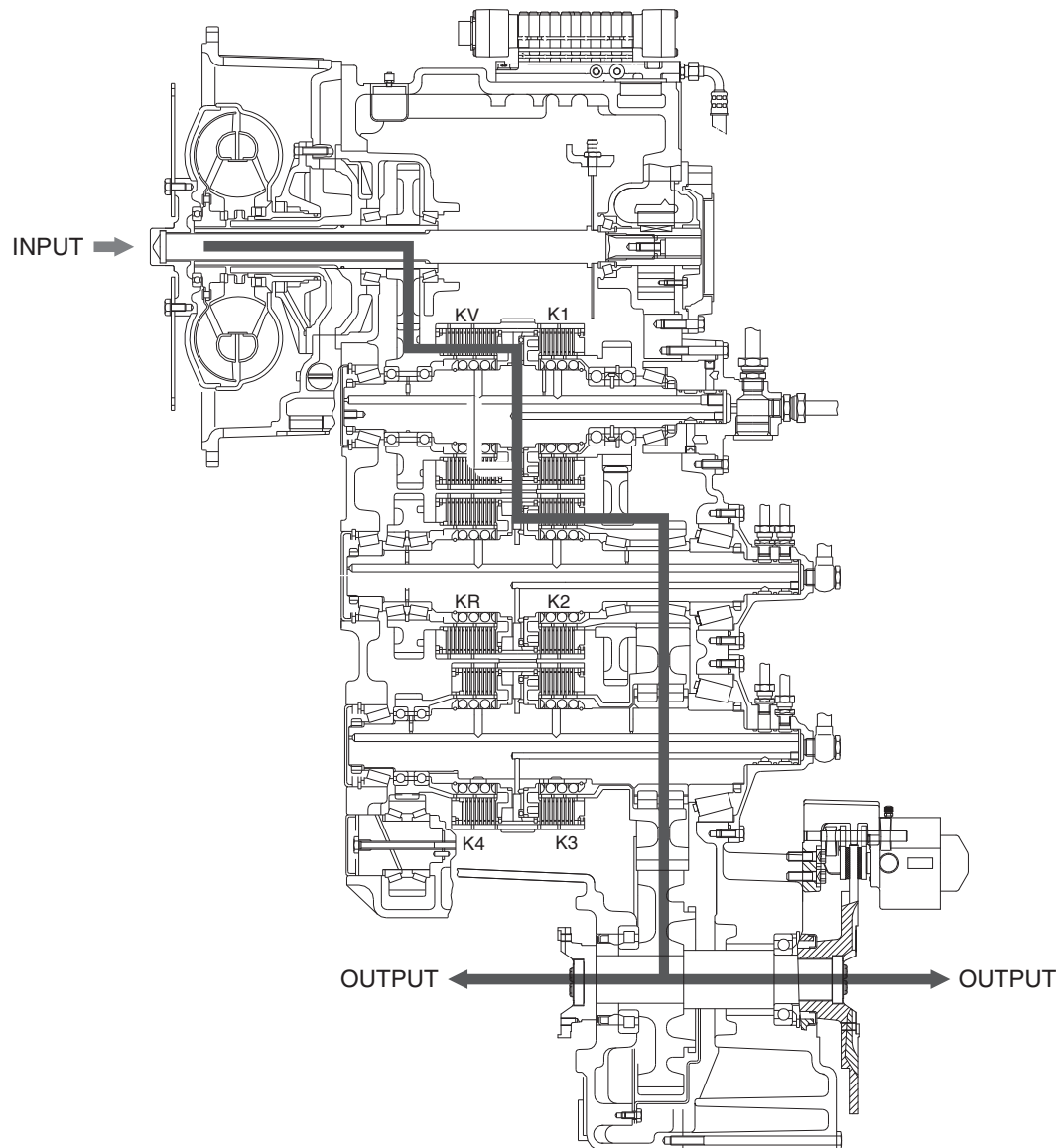
77093PT07



## ② Forward 2nd

In 2nd forward, forward clutch (KV) and 2nd clutch (K2) are engaged.

Forward clutch and 2nd clutch are actuated by the hydraulic pressure applied to the clutch piston.



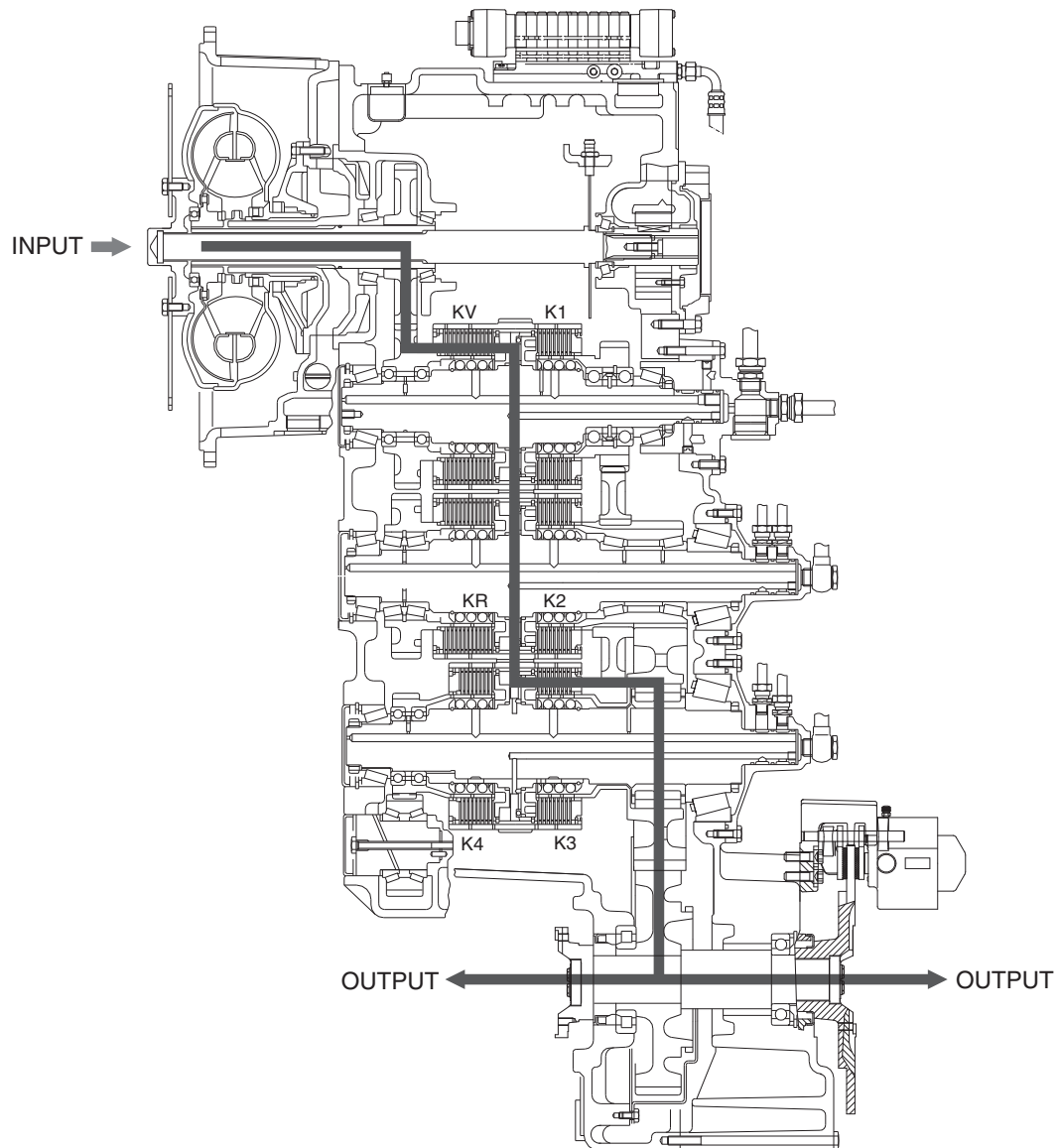
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### ③ Forward 3rd

In 3rd forward, forward clutch (KV) and 3rd clutch (K3) are engage.

Forward clutch and 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.



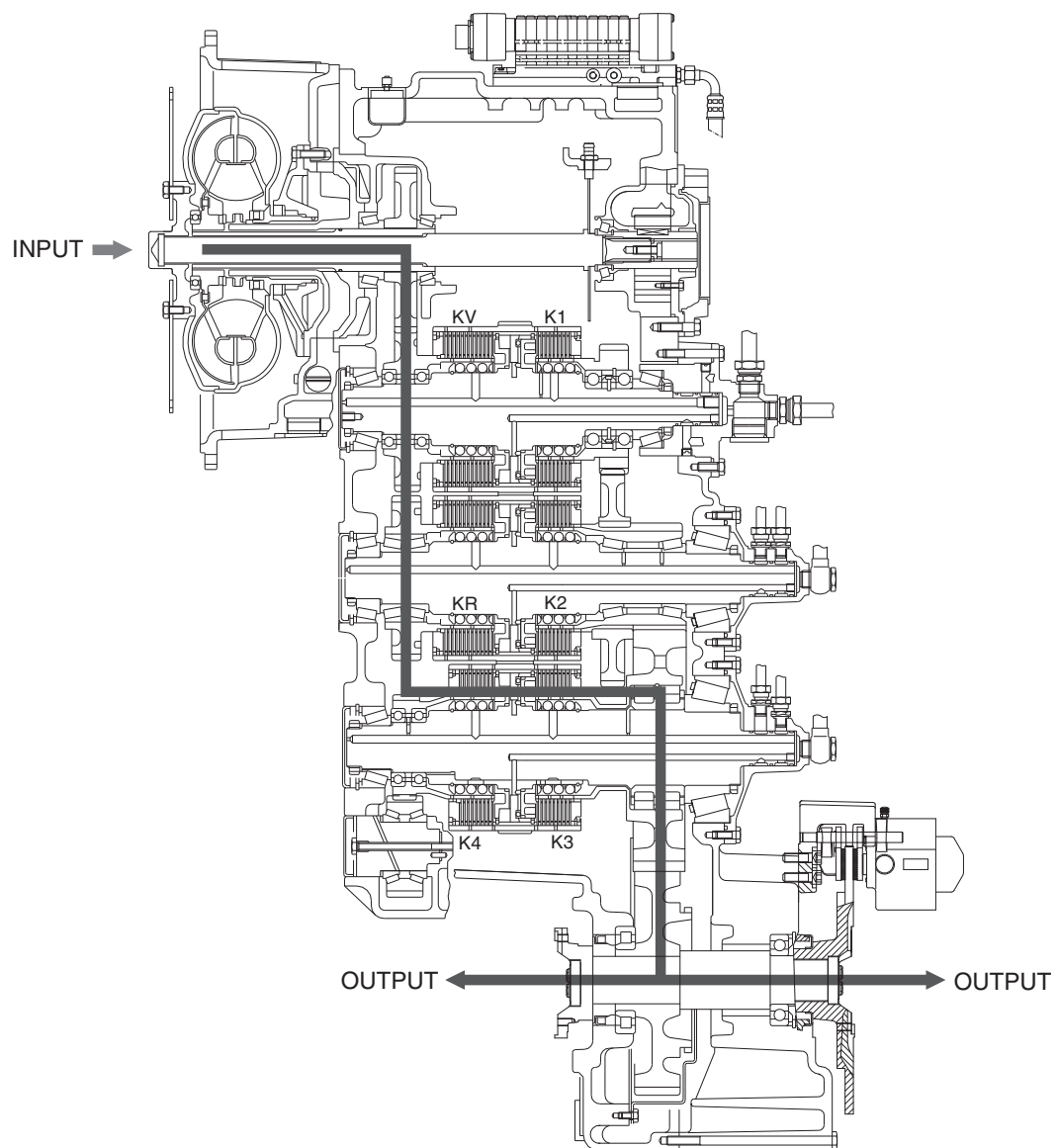
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#### ④ Forward 4th

In 4th forward, 4th clutch (K4) and 3rd clutch (K3) are engaged.

4th clutch and 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.



77093PT10

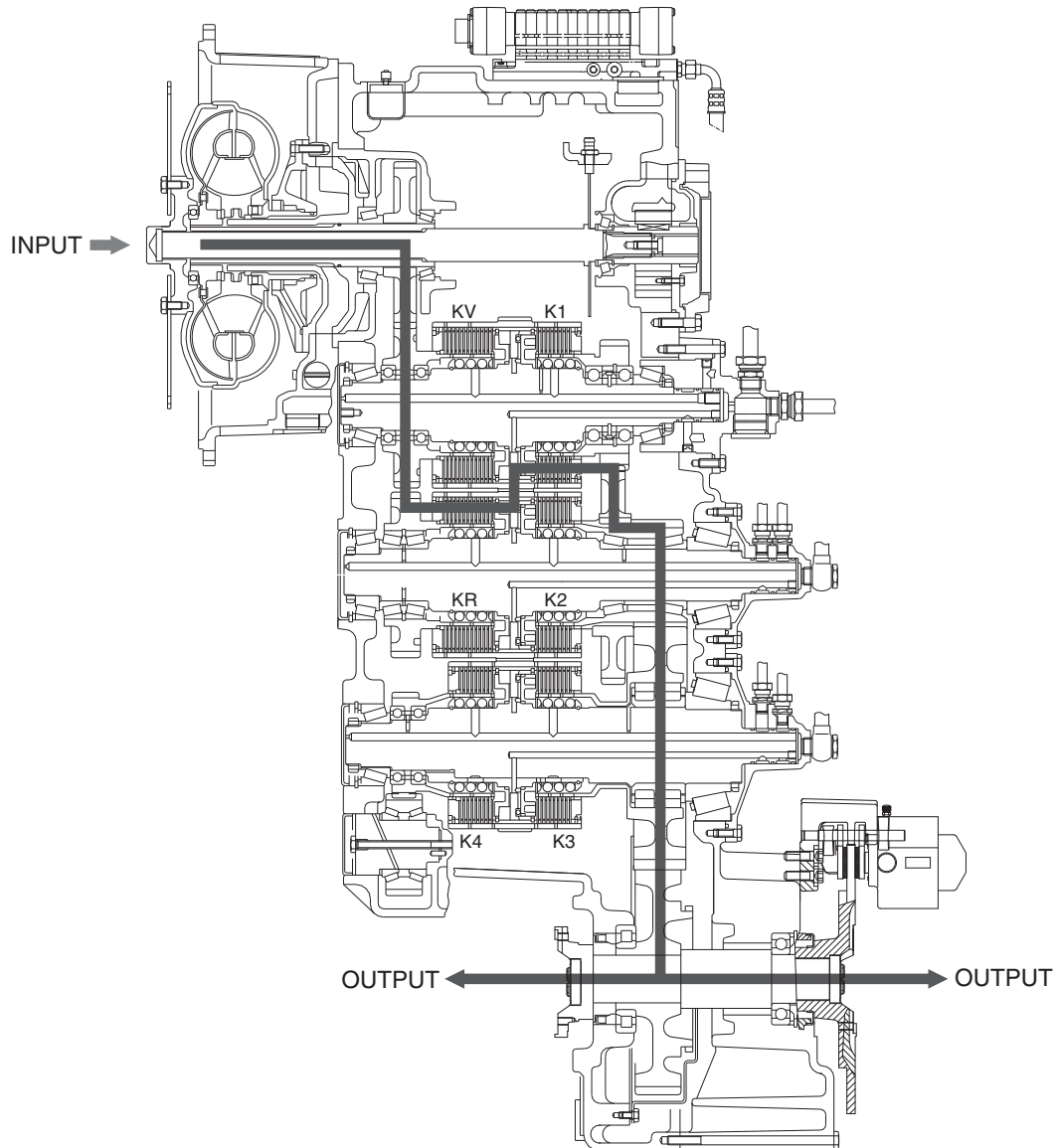


## (2) Reverse

### ① Reverse 1st

In 1st reverse, reverse clutch (KR) and 1st clutch (K1) are engaged.

Reverse clutch and 1st clutch are actuated by the hydraulic pressure applied to the clutch piston.



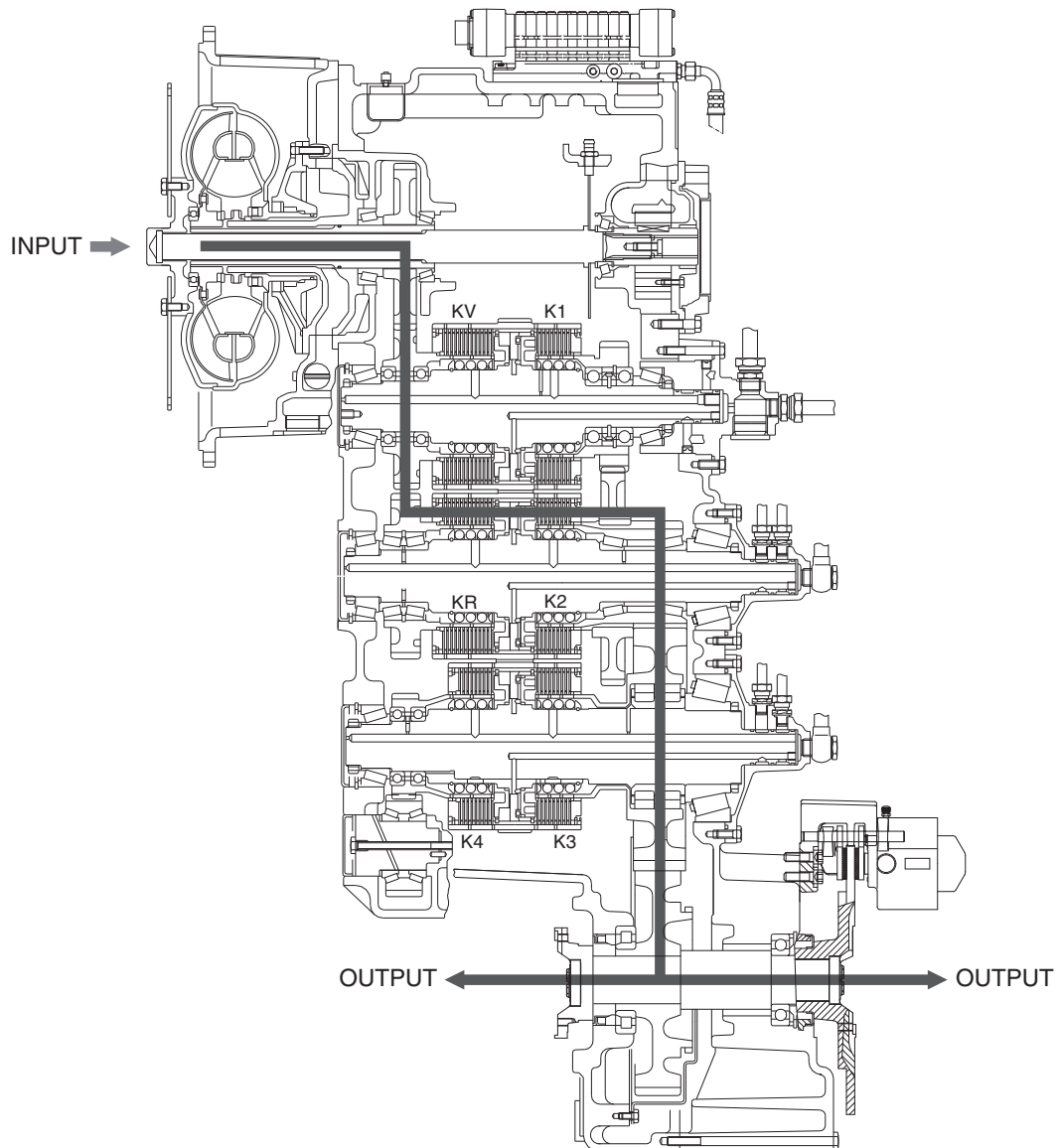
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## ② Reverse 2nd

In 2nd reverse, reverse clutch (KR) and 2nd clutch (K2) are engaged.

Reverse clutch and 2nd clutch are actuated by the hydraulic pressure applied to the clutch piston.



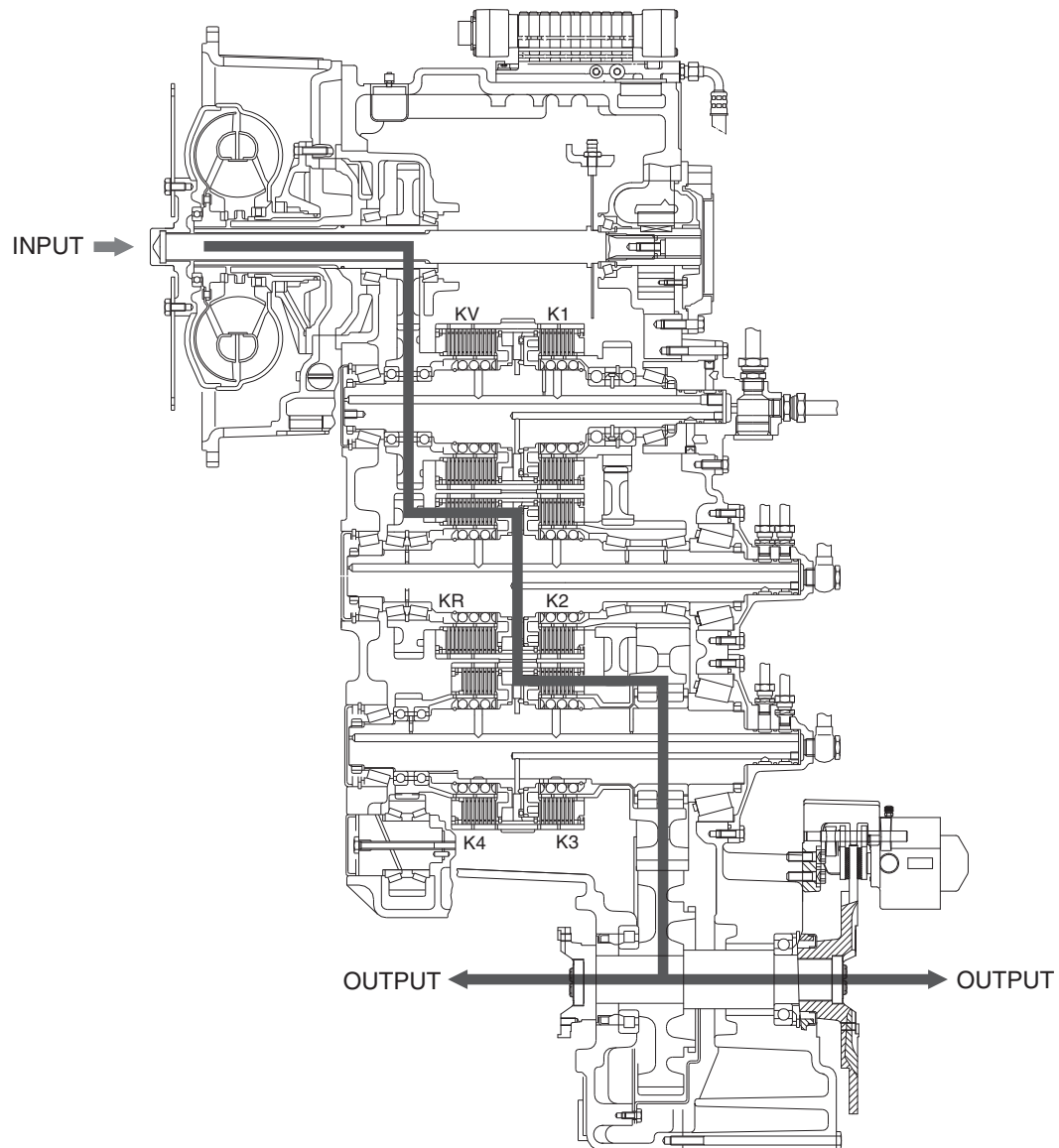
77093PT12



### ③ Reverse 3rd

In 3rd reverse, reverse clutch (KR) and 3rd clutch (K3) are engaged.

Reverse clutch and 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.

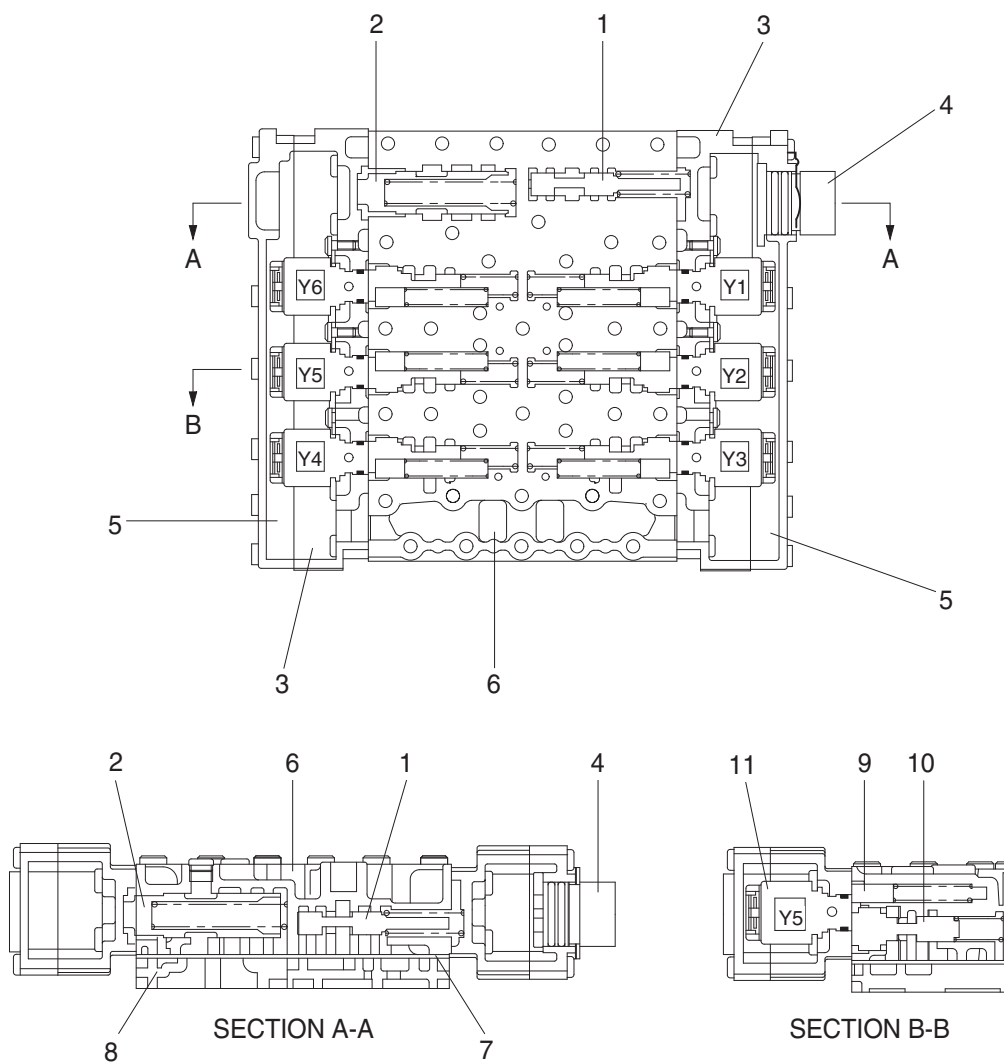


77093PT13



#### 4) ELECTRO-HYDRAULIC SHIFT CONTROL WITH PROPORTIONAL VALVE

##### (1) 4-speed transmission

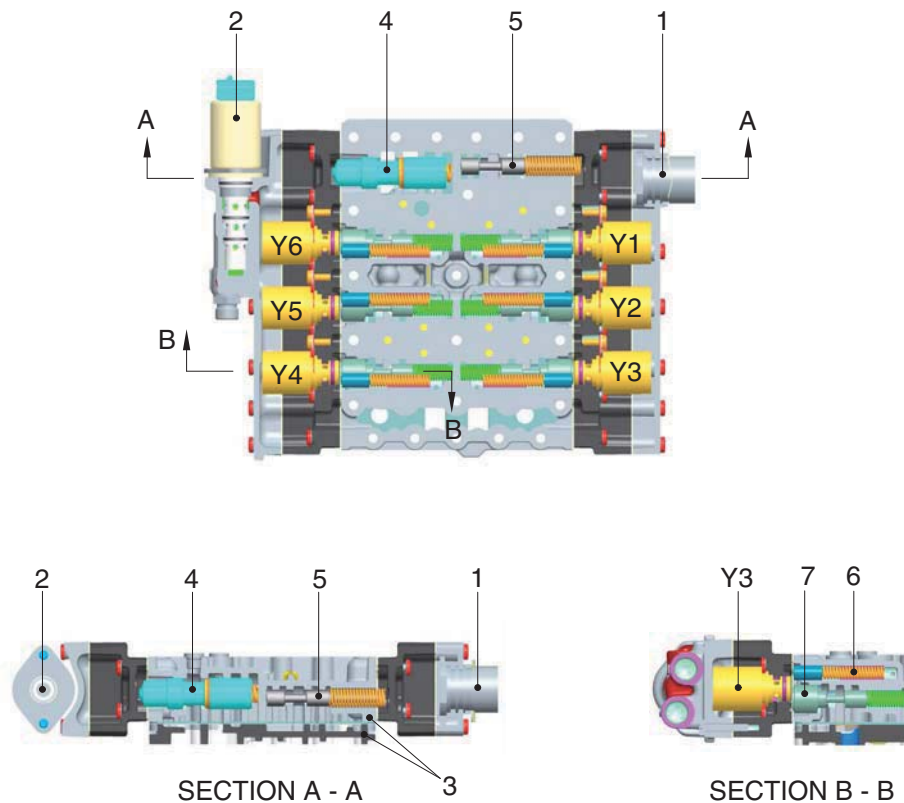


73033CV01

- |   |                                     |    |                    |
|---|-------------------------------------|----|--------------------|
| 1 | Pressure reducing valve (9+0.5 bar) | 7  | Intermediate sheet |
| 2 | System pressure valve (16+2 bar)    | 8  | Duct plate         |
| 3 | Housing                             | 9  | Oscillation damper |
| 4 | Cable harness                       | 10 | Follow-on slide    |
| 5 | Cover                               | 11 | Pressure regulator |
| 6 | Valve block                         |    |                    |



## (2) 5-speed transmission



7609AW3PT30

- |                                    |                                       |
|------------------------------------|---------------------------------------|
| 1 Cable harness                    | 5 Pressure reducing valve (9+0.5 bar) |
| 2 Proportional valve               | 6 Vibration damper                    |
| 3 Intermediate plate/duct plate    | 7 Follow-on slide                     |
| 4 System pressure valve (16+2 bar) | Y1~Y6 Proportional valve              |

Transmission control, see schedule of hydraulic circuit, electro-hydraulic control unit and measuring points at page 3-2, 3-16, 3-17 and 3-95.

The six clutches of the transmission are selected via the 6 proportional valves P1 to P6. The proportional valve (pressure regulator unit) is composed of pressure regulator (e.g. Y1), follow-on slide and vibration damper.

The control pressure of 9 bar for the actuation of the follow-on slides is created by the pressure reducing valve. The pressure oil (16+2 bar) is directed via the follow-on slide to the respective clutch.



Due to the direct proportional selection with separated pressure modulation for each clutch, the pressures to the clutches, which are engaged in the gear change, will be controlled. In this way, a hydraulic intersection of the clutches to be engaged and disengaged becomes possible.

This is creating spontaneous shiftings without traction force interruption.

At the shifting, the following criteria are considered:

- Speed of engine, turbine, central gear train and output.
- Transmission temperature.
- Shifting mode (Up-, down-, reverse shifting and speed engagement out of neutral).
- Load condition (full and part load, traction, overrun inclusive consideration of load cycles during the shifting).

The main pressure valve is limiting the maximum control pressure to 16+2 bar and releases the main stream to the converter and lubricating circuit.

In the inlet to the converter, a converter safety valve is installed which protects the converter from high internal pressures (opening pressure 11+2 bar).

Within the converter, the oil serves to transmit the power according to the well-known hydrodynamic principle (see torque converter, page 3-3).

To avoid cavitation, the converter must be always completely filled with oil.

This is achieved by a converter back pressure back-up valve, rear-mounted to the converter, with an opening pressure of at least 4.3bar.

The oil, escaping out of the converter, is directed to a oil cooler.

The oil is directed from the oil cooler to the transmission and from there to the lubricating oil circuit, so that all lubricating points are supplied with cooled oil.

In the electro-hydraulic control unit are 6 pressure regulators installed.

## 5) GEAR SELECTOR (DW-3)

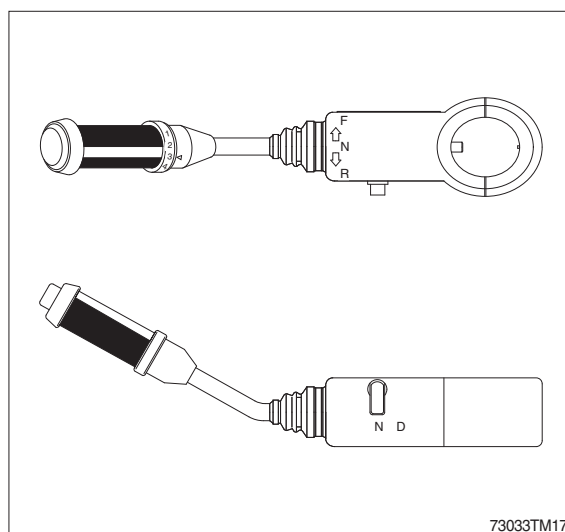
The gear selector is designed for the mounting on the left side of the steering column. The positions (speeds) 1 to 4 are selected by a rotary motion, the driving direction Forward (F)-Neutral (N)-Reverse (R) by tilting the gear selector lever.

The gear selector is also available with integrated kickdown push button.

For the protection from unintended start off, a neutral interlock is installed.

Position N - Gear selector lever blocked in this position.

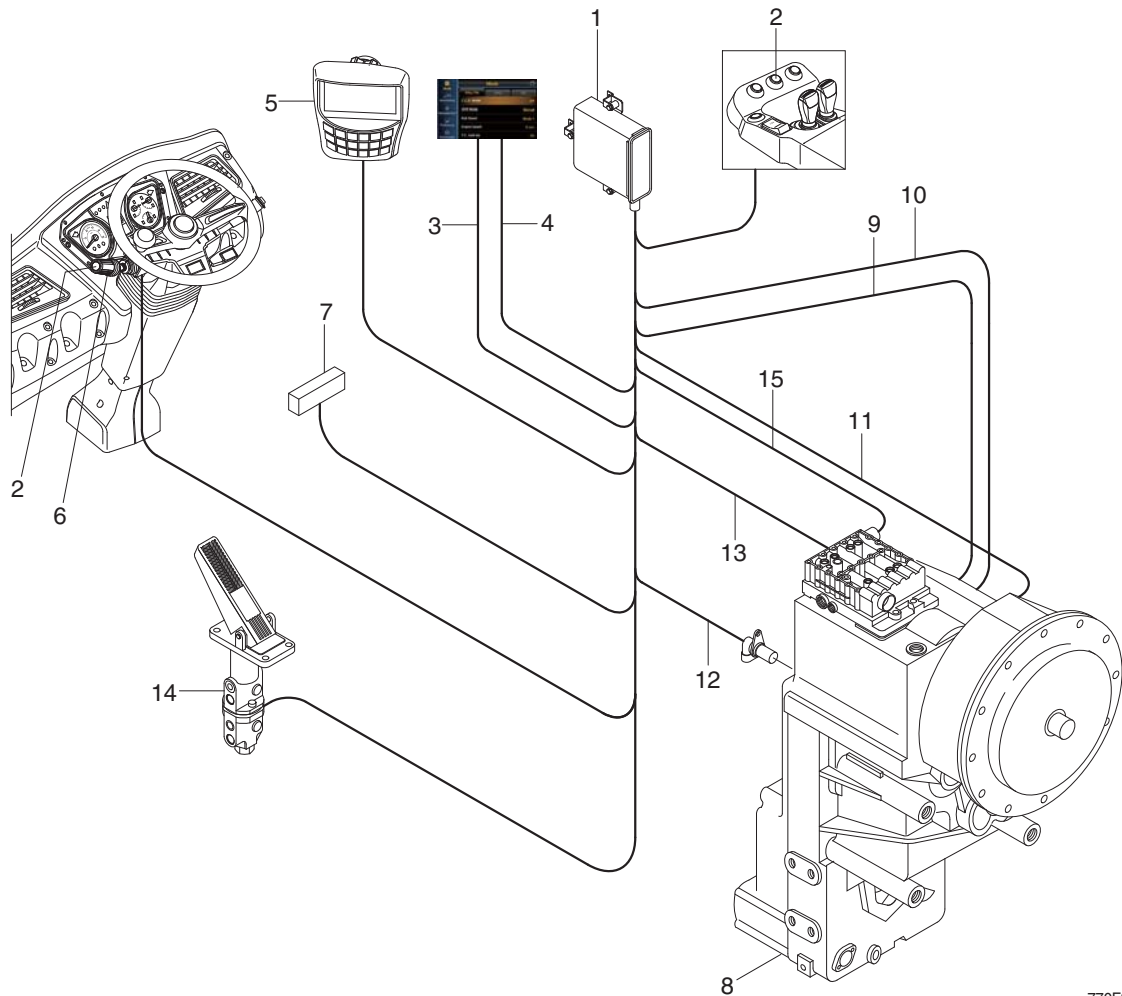
Position D - Driving.





## 6) ELECTRIC CONTROL UNIT

### (1) Complete system



770F3PT37

- 1 Control unit (EST-37A)
- 2 Kickdown switch
- 3 Clutch cut off mode
- 4 Transmission shift mode
- 5 Monitor
- 6 Gear selector (DW-3) with integrated kickdown switch
- 7 Supply-system connection
- 8 Transmission
- 9 Cable to inductive transmitter - speed central gear train
- 10 Cable to inductive transmitter - speed turbine
- 11 Cable to inductive transmitter - speed engine
- 12 Cable to speed sensor output and speedometer
- 13 Cable to plug connection on the electro - hydraulic control unit
- 14 Brake pressure sensor/load sensor
- 15 Cable to lock-up clutch valve (5-speed transmission)

### (2) Description of the basic functions

The powershift-reversing transmissions will be equipped with the electronic transmission control unit (EST-37A), developed for them.

The system is processing the wishes of the driver according to the following criteria.

- Speed definition as a function of gear selector position, driving speed and load level.



- Protection against operating errors, as far as possible and practical.
- Protection against overspeeds (on the basis of engine and turbine speed).
- Reversing-automatic system (driving speed-dependent).
- Pressure cut off (disconnecting of the drive train for maximum power on the power take-off).
- Switch for manual or automatic operation.
- Reversing function button, respectively kickdown function.

### **(3) Gearshifts**

The control unit (EST-37A) shifts the required speeds fully-automatically under consideration of the following criteria.

- Gear selector position
- Driving speed
- Load level

At the same time, the following speeds are picked up by the control unit (EST-37A).

- n Engine
- n Turbine
- n Central gear train
- n Output

#### **- Neutral position**

Neutral position is selected through the gear selector.

After the ignition is turned on, the electronics remains in the waiting state; By the position neutral of the gear selector, respectively by pressing on the key neutral, the control unit (EST-37A) becomes ready for operation.

Now, a speed can be engaged.

#### **- Speed engagement**

In principle, the speed, adapted to the driving speed (at standing, or rolling machine), will be engaged. The engagement is realized in dependence on load and rotational speed.

#### **- Upshifting under load**

Upshifting under load will be then realized if the machine can still accelerate by it.

#### **- Downshifting under load**

Downshifting under load will be realized if more traction force is needed.

#### **- Upshifting in coasting condition**

In the coasting condition, the upshifting will be suppressed if the speed of the machine on a slope shall not be further increased.

#### **- Downshifting in coasting condition**

Downshifts in the coasting condition will be realized if the machine shall be retarded.

#### **- Reversing**

At speeds below the reversing limit, direct reversing can be carried out at any time in the speeds 1F 1R and 2F 2R (as a rule, this is the maximum driving speed of the 2nd speed).



Reversings in the speeds 3 and 4 are realized dependent on the driving speed.

- Above the programmed reversing limit, the machine is braked down by downshifts of the electronic control unit (EST-37A) to the permitted driving speed, and only then, the reversing into the correspondingly preselected speed will be carried out.
- Below the permitted driving speed, the reversing is carried out immediately.

#### **(4) Specific kickdown function**

By means of the kickdown-button, integrated in the gear selector, it is at any time possible to select in the speeds 2F and 2R (i.e. position 2 of the gear selector, at automatic mode also in the 2nd speed of the automatic range) the 1st speed by a short touch. This kickdown state can be cancelled by :

1. Pressing the kickdown-button again
2. Realization of a reversal operation
3. Change of the gear selector position by the following modification  
Gear selector (DW-3) - (rotation) of the driving position 1...4.

The kickdown function will be always terminated by shifting to neutral.

#### **(5) Clutch cut off**

Especially at wheel loaders, the clutch cut off can be activated through a switch signal. It is interrupting the power flow in the transmission as long as this signal is active. Besides, this function can be used for the transmission-neutral shifting at applied hand brake or as emergency-stop (in this case, a restarting is only possible through the gear selector-neutral position).



#### 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,<br>Boom cylinder 'rod' pressure Measurement Voltage > 5.3V   | ●           |   |   |
|        | 4   | 10 seconds continuous,<br>Boom cylinder 'rod' pressure Measurement Voltage < 0.3V   | ●           |   |   |
|        |     | (Results / Symptoms)<br>1. Monitor – Boom cylinder 'rod' press. display failure<br>2. Control Function – No Boom pressure calibration function operation, workload measurement sys. operation failure<br><br>(Checking list)<br>1. CN-58B(#36) – CD-81(B) Checking Open/Short<br>2. CN-58A(#11) – CD-81(A) Checking Open/Short<br>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)<br>1. Monitor – Fuel level display failure<br>2. Control Function – Fuel level low warning operation failure<br><br>(Checking list)<br>1. CN-58B (#22) – CD-02 (#2) Checking Open/Short<br>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)<br>1. Monitor – Cooling Fan revolutions display failure<br><br>(Checking list)<br>1. CN-58A (#15) – CD-73 (#1) Checking Open/Short<br>2. CN-58A (#18) – CD-73 (#2) Checking Open/Short   |             |   |   |
|        |     |   |             |   |   |
|        |     |   |             |   |   |
| 339    | 3   | 10 seconds continuous,<br>Accel pedal position 1 voltage Measurement Voltage > 5.0 V  |             |   | ● |
|        | 4   | 10 seconds continuous,<br>Accel pedal position 1 voltage Measurement Voltage < 0.2 V  |             |   | ● |
|        |     | (Results / Symptoms)<br>1. Monitor – Accel pedal position 1 voltage display failure<br>2. Control Function – Engine rpm control failure<br><br>(Checking list)<br>1. CN-58B(#39) – CN-162(#2) Checking Open/Short<br>2. CN-58A(#6) – CN-162(#3) Checking Open/Short<br>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,<br>Accel pedal position 2 voltage Measurement Voltage > 5.0 V      |             |   | ● |
|        | 4   | 10 seconds continuous,<br>Accel pedal position 2 voltage Measurement Voltage < 0.2 V      |             |   | ● |
|        | (Results / Symptoms)<br>1. Monitor – Accel pedal position 2 voltage display failure<br>2. Control Function – Engine rpm control failure<br>(Checking list)<br>1. CN-58B (#40) – CN-162 (#5) Checking Open/Short<br>2. CN-58A (#7) – CN-162 (#6) Checking Open/Short<br>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)<br>1. Monitor – Brake oil press. display failure<br>2. Control Function – Brake oil pressure low warning display failure<br>(Checking list)<br>1. CN-58B (#27) – CD-03 (B) Checking Open/Short<br>2. CN-58A (#11) – CD-03 (A) Checking Open/Short<br>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)<br>1. Monitor – Parking oil Press. display failure<br>2. Control Function – No judgment Parking status<br>(Checking list)<br>1. CN-58B (#34) – CD-26 (B) Checking Open/Short<br>2. CN-58A (#11) – CD-26 (A) Checking Open/Short<br>3. CN-58B (#25) – CD-26 (C) Checking Open/Short   |   |             |   |   |
| 557    | 0   | 10 seconds continuous,<br>Brake oil charging priority pressure Measurement Voltage > 5.3V | ●           |   |   |
|        | 4   | 10 seconds continuous,<br>Brake oil charging priority pressure Measurement Voltage < 0.3V | ●           |   |   |
|        | (Results / Symptoms)<br>1. Monitor – Brake oil charging priority press. display failure<br>2. Control Function – Cooling fan revolutions control failure, Brake oil(Accumulator) charging failure<br>(Checking list)<br>1. CN-58B (#38) – CD-31 (B) Checking Open/Short<br>2. CN-58A (#11) – CD-31 (A) Checking Open/Short<br>3. CN-58B (#25) – CD-31 (C) Checking Open/Short |   |             |   |   |

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| 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)<br>1. Control Function – Disabled startup<br>(Checking list)<br>1. Checking battery voltage<br>2. CN-58A (#1) – CN-36 (07 fuse) Checking Open/Short<br>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)<br>1. Control Function – Battery charging circuit failure<br>(Checking list)<br>1. CN-58B (#33) – CN-04 (#18) Checking Open/Short<br>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)<br>1. Monitor – Boom position sensor signal voltage display failure<br>2. Control Function – No calibration angle sensor, No calibration boom pressure , Boom Detent operation failure,<br>Soft end stop(Boom) operation failure, Lock-up clutch operation failure<br>(Checking list)<br>1. CN-58B (#37) – CN-100 (B) Checking Open/Short<br>2. CN-58A (#5) – CN-100 (C) Checking Open/Short<br>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)<br>1. Monitor – Bucket position sensor signal voltage display failure<br>2. Control Function – No calibration angle sensor, Bucket Detent operation failure, Soft end stop(Bucket) operation failure<br>(Checking list)<br>1. CN-58B(#30) – CN-101(B) Checking Open/Short<br>2. CN-58A(#5) – CN-101(C) Checking Open/Short<br>3. CN-58B(#25) – CN-101(A) Checking Open/Short  |             |   |   |

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

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## 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   | EHCUSensor power voltage high  |
| 2328   | 1   | EHCUSensor power voltage low   |
| 2328   | 3   | EHCUSensor power voltage above normal or shorted to high source            |



| HCESPN | FMI | Description  |
|--------|-----|--|
| 2328   | 4   | EHCUC sensor power voltage below normal or shorted to low source |
| 2329   | 0   | EHCUC power voltage high   |
| 2329   | 1   | EHCUC power voltage low  |
| 2329   | 11  | EHCUC 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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)                                     |
|--------------------------------------|---|---|
| 111<br>629<br>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<br>612<br>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<br>102<br>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<br>102<br>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<br>102<br>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<br>102<br>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<br>91<br>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<br>91<br>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<br>974<br>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<br>974<br>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<br>100<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)  |
|--------------------------------------|--|--|
| 144<br>110<br>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<br>110<br>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<br>110<br>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<br>110<br>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<br>105<br>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<br>105<br>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<br>105<br>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<br>3464<br>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<br>3464<br>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<br>3464<br>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<br>3510<br>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<br>111<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)   |
|--------------------------------------|---|---|
| 196<br>111<br>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<br>111<br>18                     | Coolant level - Data valid but below normal operational range - Moderately severe level. Low coolant level has been detected.   | Engine power derate.  |
| 221<br>108<br>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<br>108<br>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<br>3510<br>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<br>190<br>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<br>3511<br>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<br>3511<br>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<br>84<br>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<br>647<br>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<br>171<br>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<br>171<br>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<br>1347<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)  |
|--------------------------------------|---|--|
| 272<br>1347<br>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<br>639<br>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<br>639<br>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<br>974<br>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<br>108<br>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<br>651<br>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<br>655<br>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.<br>Engine power derate.                     |
| 324<br>653<br>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.<br>Engine power derate.                     |
| 325<br>656<br>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.<br>Engine power derate.                     |
| 331<br>652<br>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.<br>Engine power derate.                     |
| 332<br>654<br>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.<br>Engine power derate.                     |
| 334<br>110<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)  |
|--------------------------------------|---|--|
| 338<br>1267<br>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<br>1267<br>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<br>629<br>12                     | Engine control module warning internal hardware failure - Bad intelligent device or component. ECM power supply errors have been detected.  | Engine power derate.   |
| 346<br>630<br>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<br>627<br>12                     | Injector power supply - Bad intelligent device or component. The ECM measured injector boost voltage is low.  | Engine power derate.   |
| 352<br>3509<br>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<br>729<br>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<br>3509<br>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<br>100<br>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<br>97<br>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<br>639<br>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<br>97<br>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<br>100<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)  |
|--------------------------------------|--|--|
| 436<br>105<br>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<br>168<br>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<br>168<br>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<br>157<br>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<br>157<br>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<br>1349<br>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<br>1349<br>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<br>3514<br>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<br>3514<br>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<br>157<br>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<br>101<br>16                     | Crankcase pressure - Data valid but above normal operational range - Moderately severe level. The crankcase breather filter requires maintenance.  | None on performance.   |
| 556<br>101<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)  |
|--------------------------------------|---|--|
| 559<br>157<br>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 <b>not</b> start.             |
| 584<br>677<br>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<br>677<br>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<br>103<br>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<br>167<br>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<br>167<br>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<br>1378<br>31                    | Engine oil change interval - Condition exists. Change engine oil and filter.  | None on performance.   |
| 687<br>103<br>18                     | Turbocharger 1 speed - Data valid but below normal operational range - Moderately severe level. Low turbocharger speed detected by the ECM.   | Engine power derate.<br>The ECM uses an estimated turbocharger speed.                    |
| 689<br>190<br>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<br>1172<br>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<br>1172<br>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<br>1172<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)  |
|--------------------------------------|--|--|
| 731<br>723<br>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<br>157<br>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<br>723<br>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<br>1590<br>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<br>627<br>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<br>651<br>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<br>652<br>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<br>653<br>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<br>654<br>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<br>655<br>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<br>656<br>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<br>27<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)    |
|--------------------------------------|--|--|
| 1239<br>2623<br>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<br>2623<br>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<br>91<br>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<br>91<br>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<br>1323<br>31                   | Engine misfire cylinder 1- Condition exists. Engine misfire has been detected in cylinder number 1.  | Possible reduced engine performance.       |
| 1655<br>1324<br>31                   | Engine misfire cylinder 2 - Condition exists. Engine misfire has been detected in cylinder number 2.   | Possible reduced engine performance.       |
| 1656<br>1325<br>31                   | Engine misfire cylinder 3 - Condition exists. Engine misfire has been detected in cylinder number 3.   | Possible reduced engine performance.       |
| 1657<br>1326<br>31                   | Engine misfire cylinder 4 - Condition exists. Engine misfire has been detected in cylinder number 4.   | Possible reduced engine performance.       |
| 1658<br>1327<br>31                   | Engine misfire cylinder 5 - Condition exists. Engine misfire has been detected in cylinder number 5.   | Possible reduced engine performance.       |
| 1659<br>1328<br>31                   | Engine misfire cylinder 6 - Condition exists. Engine misfire has been detected in cylinder number 6.   | Possible reduced engine performance.       |
| 1668<br>1761<br>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<br>1761<br>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<br>1761<br>1                    | Aftertreatment diesel exhaust fluid tank level - Data valid but below normal operating range - Most severe level.<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)                 |
|--------------------------------------|--|---|
| 1677<br>3031<br>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<br>3031<br>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<br>3031<br>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<br>3362<br>31                   | Aftertreatment diesel exhaust fluid dosing unit input lines - Condition exists.<br>The aftertreatment diesel exhaust fluid dosing unit is unable to prime.   | Possible reduced engine performance.                    |
| 1683<br>3363<br>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<br>3363<br>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<br>100<br>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<br>3513<br>3                    | Sensor supply 5 - Voltage above normal or shorted to high source.<br>High voltage detected at sensor supply 5 circuit in the oem harness.  | the engine will operate in limp home mode.              |
| 1696<br>3513<br>4                    | Sensor supply 5 - Voltage below normal or shorted to low source.<br>Low voltage detected at sensor supply number 5 circuit in the oem harness.   | the engine will operate in limp home mode.              |
| 1712<br>3363<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 1713<br>3363<br>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<br>1322<br>31                   | Engine misfire for multiple cylinders - Condition exists. Engine misfire has been detected in multiple cylinder numbers.  | Possible reduced engine performance.    |
| 1776<br>2634<br>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<br>2634<br>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<br>101<br>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<br>101<br>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<br>411<br>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<br>412<br>2                     | Engine gas recirculation temperature - Data erratic, intermittent, or incorrect. Engine misfire has been detected in multiple cylinder numbers.   | Possible reduced engine performance.    |
| 1879<br>3251<br>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<br>3251<br>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<br>3251<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 1885<br>3216<br>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<br>3226<br>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<br>2791<br>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<br>3251<br>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<br>3251<br>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<br>3597<br>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<br>101<br>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<br>2791<br>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<br>641<br>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<br>101<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)  |
|--------------------------------------|---|--|
| 1993<br>4795<br>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<br>3512<br>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<br>3512<br>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<br>641<br>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<br>27<br>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<br>411<br>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<br>411<br>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<br>103<br>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<br>633<br>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<br>723<br>2                     | Engine camshaft speed / position sensor - Data erratic, intermittent, or incorrect. Camshaft engine speed sensor intermittent synchronization.  | None on performance.   |
| 2349<br>2791<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)                    |
|--------------------------------------|--|--|
| 2353<br>2791<br>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<br>95<br>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<br>1209<br>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<br>1209<br>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<br>412<br>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<br>412<br>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<br>647<br>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 <b>not</b> run at all. |
| 2387<br>641<br>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<br>171<br>2                     | Ambient air temperature - Data erratic, intermittent, or incorrect. The ambient air temperature sensor is reading an erratic value.  | Possible reduced engine performance.                       |
| 2448<br>111<br>17                    | Coolant level - Data valid but below normal operational range - Least severe level. Low engine coolant level detected.   | none on performance.                                       |
| 2449<br>641<br>13                    | Vgt actuator controller - Out of calibration. The VGT actuator has been installed incorrectly.   | Possible reduced engine performance.                       |
| 2468<br>102<br>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<br>1209<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)                 |
|--------------------------------------|---|---|
| 2555<br>729<br>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<br>729<br>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<br>641<br>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<br>641<br>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<br>5298<br>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<br>3251<br>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<br>110<br>32                    | Engine coolant temperature - Condition exists. The EGR valve was closed to reduce engine coolant temperature.   | Possible reduced engine performance.                    |
| 2718<br>520325<br>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<br>3226<br>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<br>3703<br>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<br>412<br>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<br>412<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)   |
|--------------------------------------|---|---|
| 2963<br>110<br>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<br>105<br>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<br>102<br>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<br>3361<br>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<br>3610<br>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<br>3610<br>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<br>3610<br>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<br>4363<br>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<br>4363<br>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<br>4363<br>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<br>4794<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active) |
|--------------------------------------|---|---|
| 3165<br>4363<br>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<br>3936<br>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<br>1623<br>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<br>1623<br>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<br>3216<br>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<br>3216<br>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<br>4363<br>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<br>4340<br>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<br>4340<br>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<br>4342<br>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<br>4342<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)   |
|--------------------------------------|---|---|
| 3242<br>3363<br>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<br>3060<br>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<br>4765<br>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<br>3242<br>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<br>3242<br>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<br>3246<br>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<br>3246<br>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<br>4340<br>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<br>4342<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)   |
|--------------------------------------|--|---|
| 3311<br>3242<br>0                    | Aftertreatment diesel particulate filter intake temperature - Data valid but above normal operating range - Most severe level.<br>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<br>3246<br>0                    | Aftertreatment diesel particulate filter outlet temperature - Data valid but above normal operating range - Most severe level.<br>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<br>4765<br>4                    | Aftertreatment diesel oxidation catalyst intake temperature sensor circuit - Voltage below normal or shorted to low source.<br>Low signal voltage detected at the catalyst intake sensor circuit.  | Possible reduced engine performance.  |
| 3314<br>4765<br>3                    | Aftertreatment diesel oxidation catalyst intake temperature sensor circuit - Voltage above normal or shorted to high source.<br>High signal voltage detected at the catalyst intake temperature sensor circuit.  | Possible reduced engine performance.  |
| 3315<br>4765<br>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<br>3242<br>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<br>3242<br>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<br>3242<br>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<br>3246<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)                 |
|--------------------------------------|--|---|
| 3321<br>3246<br>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<br>3246<br>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<br>91<br>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<br>191<br>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<br>4752<br>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<br>5285<br>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<br>102<br>10                    | Intake manifold 1 pressure - Abnormal rate of change. The VGT position reading is stuck.   | Possible reduced engine performance.                    |
| 3366<br>111<br>18                    | Coolant level - Data valid but below normal operating range - Moderately severe level. Very low engine coolant level detected.   | None on performance.                                    |
| 3374<br>1818<br>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<br>5397<br>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<br>5319<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)                 |
|--------------------------------------|--|---|
| 3382<br>3058<br>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<br>3058<br>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<br>4766<br>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<br>3750<br>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<br>191<br>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<br>4344<br>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<br>4344<br>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<br>4344<br>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<br>563<br>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<br>251<br>10                    | Real time clock - Abnormal rate of change. The real time clock indicates a stuck engine off timer.   | None on performance.                                    |
| 3494<br>1081<br>7                    | Engine wait to start lamp - Mechanical system not responding or out of adjustment. Wait to Start lamp has malfunction.   | None on performance.                                    |
| 3497<br>1761<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)  |
|--------------------------------------|---|--|
| 3498<br>1761<br>18                   | Aftertreatment diesel exhaust fluid tank level -<br>Data valid but below normal operating range -<br>Moderately severe level.<br>The aftertreatment diesel exhaust fluid tank level is very low.  | None on performance.   |
| 3525<br>84<br>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<br>84<br>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<br>558<br>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<br>558<br>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<br>171<br>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<br>171<br>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<br>51<br>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<br>51<br>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<br>51<br>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<br>3226<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active) |
|--------------------------------------|--|---|
| 3547<br>4096<br>31                   | Aftertreatment diesel exhaust fluid tank empty - Condition exists. The diesel exhaust fluid tank is empty.   | Possible reduced engine performance.    |
| 3555<br>1081<br>9                    | Engine wait to start lamp - Abnormal update rate. A loss of communication has been detected.   | None on performance.                    |
| 3556<br>1081<br>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<br>3361<br>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<br>3361<br>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<br>5491<br>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<br>5491<br>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<br>5394<br>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<br>5394<br>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<br>4334<br>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<br>4334<br>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<br>4334<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)                   |
|--------------------------------------|--|---|
| 3575<br>4334<br>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<br>4376<br>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<br>4376<br>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<br>4364<br>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<br>5031<br>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<br>4334<br>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<br>5024<br>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<br>3228<br>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<br>3218<br>2                    | Aftertreatment Intake NOx sensor power supply - Data erratic, intermittent or incorrect. The aftertreatment intake NOx sensor indicates that the power supply to the sensor is incorrect.  | None on performance.                                      |
| 3697<br>630<br>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<br>5246<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)  |
|--------------------------------------|--|--|
| 3714<br>1569<br>31                   | Engine protection torque derate - Condition exists. Critical fault codes related to engine operation are active.   | Possible reduced engine performance.   |
| 3715<br>188<br>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<br>188<br>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<br>3226<br>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<br>3216<br>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<br>168<br>17                    | Battery 1 voltage - Data valid but below normal operating range - Least severe level.<br>Low voltage to the EGR valve device driver has been detected.   | Possible reduced engine performance.   |
| 3725<br>3216<br>10                   | Aftertreatment Intake NOx sensor - Abnormal rate of change. The aftertreatment intake NOx sensor reading is not valid.   | None on performance.   |
| 3727<br>5571<br>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<br>1675<br>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<br>5571<br>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<br>3226<br>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<br>2978<br>9                    | Estimated engine parasitic losses - Percent torque - Abnormal update rate. A loss of communication has been detected.  | None on performance.   |
| 3843<br>5603<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)    |
|--------------------------------------|--|--|
| 3844<br>5605<br>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<br>5603<br>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<br>5848<br>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<br>5848<br>9                    | Aftertreatment SCR Intermediate NH3 sensor - Abnormal update rate. Loss of communication with the aftertreatment SCR intermediate NH3 sensor.  | Possible reduced engine performance.       |
| 3912<br>5853<br>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<br>5851<br>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<br>5851<br>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<br>5851<br>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<br>5848<br>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<br>5848<br>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<br>5848<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)    |
|--------------------------------------|---|--|
| 4149<br>2623<br>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<br>5742<br>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<br>5743<br>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<br>5746<br>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<br>5746<br>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<br>4376<br>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<br>5742<br>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<br>5743<br>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<br>5742<br>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<br>5742<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)  |
|--------------------------------------|--|--|
| 4163<br>5742<br>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<br>5743<br>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<br>5743<br>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<br>5743<br>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<br>5745<br>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<br>5745<br>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<br>5745<br>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<br>3695<br>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<br>563<br>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<br>4337<br>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<br>J1939 SPN<br>J1939 FMI | Reason   | Effect (only when fault code is active)            |
|--------------------------------------|--|--|
| 4245<br>5798<br>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<br>4337<br>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<br>5798<br>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<br>1081<br>31                   | Engine wait to start lamp - Condition exists. The received signal does not match the commanded signal.   | None on performance.                               |
| 4259<br>5742<br>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<br>5743<br>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<br>5848<br>21                   | Aftertreatment 1 SCR Intermediate NH3 - Data not rational - Drifted low. An in range low failure has been detected.  | Possible reduced engine performance.               |
| 4281<br>5848<br>2                    | Aftertreatment SCR Intermediate NH3 - Data erratic, intermittent or incorrect. The aftertreatment SCR intermediate NH3 sensor reading is stuck.  | None on performance.                               |
| 4284<br>5793<br>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<br>91<br>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<br>520668<br>31                 | Aftertreatment outlet NOx sensor closed loop operation - Condition exists. The maximum dosing adjustment has been reached.   | Possible reduced engine performance.               |
| 4453<br>520669<br>31                 | Aftertreatment intermediate NH3 sensor closed loop operation - Condition exists. The maximum dosing adjustment has been reached.   | None on performance.                               |
| 4517<br>237<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)   |
|--------------------------------------|---|---|
| 4518<br>5862<br>3                    | Aftertreatment SCR Intermediate gas temperature sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the aftertreatment SCR intermediate temperature sensor circuit.         | Possible reduced engine performance.  |
| 4519<br>5862<br>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<br>5862<br>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<br>5862<br>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<br>5862<br>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<br>521<br>2                     | Brake pedal position - Data erratic, intermittent or incorrect. The values of the 2 brake switch signals do not match.  | None on performance.  |
| 4572<br>3031<br>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<br>3936<br>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<br>4792<br>14                   | Aftertreatment 1 SCR catalyst system - Special instructions. The incorrect SCR system has been Installed.   | Engine will be shut down.   |
| 4612<br>520701<br>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<br>4331<br>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<br>J1939 SPN<br>J1939 FMI | Reason  | Effect (only when fault code is active)  |
|--------------------------------------|---|--|
| 4691<br>5585<br>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<br>5357<br>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<br>1239<br>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<br>157<br>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<br>3031<br>13                   | Aftertreatment diesel exhaust fluid tank temperature sensor - Out of calibration. The received datalink message was not valid.  | Possible reduced engine performance.   |
| 4732<br>1761<br>13                   | Aftertreatment diesel exhaust fluid tank level sensor - Out of calibration. The received datalink message was not valid.  | None on performance.   |
| 4739<br>1761<br>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<br>1761<br>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<br>6303<br>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<br>6303<br>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<br>520750<br>13                 | Engine variable geometry turbo (VGT) software - Out of calibration. VGT software does not match application.  | Possible reduced engine performance.   |
| 4957<br>520750<br>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

| Fault code (Hex) | Meaning of the fault code possible reason for fault detection   | Reaction of the TCU   | Possible steps to repair  |
|------------------|---|---|---|
| 10               | Logical error at direction select signal 3rd shift lever<br>TCU detected a wrong signal combination for the direction <ul style="list-style-type: none"> <li>· Cable from shift lever 3 to TCU is broken</li> <li>· Cable is defective and is contacted to battery voltage or vehicle ground</li> <li>· Shift lever is defective</li> </ul>   | TCU shifts transmission to neutral if selector active<br>OP mode : Transmission shutdown if selector active | <ul style="list-style-type: none"> <li>· Check the cables from TCU to shift lever 3</li> <li>· Check signal combinations of shift lever positions F-N-R</li> <li>· If shift lever is a CAN shift lever check CAN cable/shifter/device</li> </ul> <p>※ Fault is cleared if TCU detects a valid neutral signal for the direction at the shift lever</p> |
| 11               | Logical error at gear range signal<br>TCU detected a wrong signal combination for the gear range <ul style="list-style-type: none"> <li>· Cable from shift lever to TCU is broken</li> <li>· Cable is defective and is contacted to battery voltage or vehicle ground</li> <li>· Shift lever is defective</li> </ul>  | TCU shifts transmission to neutral<br>OP mode : Transmission shutdown                                       | <ul style="list-style-type: none"> <li>· Check the cables from TCU to shift lever</li> <li>· Check signal combinations of shift lever positions for gear range</li> </ul> <p>※ Failure cannot be detected in systems with DW2/DW3 shift lever. Fault is taken back if TCU detects a valid signal for the position</p>                                 |
| 12               | Logical error at direction select signal<br>TCU detected a wrong signal combination for the direction <ul style="list-style-type: none"> <li>· Cable from shift lever to TCU is broken</li> <li>· Cable is defective and is contacted to battery voltage or vehicle ground</li> <li>· Shift lever is defective</li> </ul>   | TCU shifts transmission to neutral<br>OP mode : Transmission shutdown                                       | <ul style="list-style-type: none"> <li>· Check the cables from TCU to shift lever</li> <li>· Check signal combinations of shift lever positions F-N-R</li> </ul> <p>※ Fault is taken back if TCU detects a valid signal for the direction at the shift lever</p>  |
| 13               | Logical error at engine derating device<br>TCU detected no reaction of engine while derating device active  | After selecting neutral, TCU change to OP mode limp home  | <ul style="list-style-type: none"> <li>· Check engine derating device</li> </ul> <p>※ This fault is reset after power up of TCU</p>   |
| 15               | Logical error at direction select signal 2 shift lever<br>TCU detected a wrong signal combination for the direction <ul style="list-style-type: none"> <li>· Cable from shift lever 2 to TCU is broken</li> <li>· Cable is defective and is contacted to battery voltage or vehicle ground</li> <li>· Shift lever is defective</li> </ul>   | TCU shifts transmission to neutral if selector active<br>OP mode : Transmission shutdown if selector active | <ul style="list-style-type: none"> <li>· Check the cables from TCU to shift lever 2</li> <li>· Check signal combinations of shift lever positions F-N-R</li> </ul> <p>※ Fault is taken back if TCU detects a valid neutral signal for the direction at the shift lever</p>  |
| 17               | S.C. to ground at customer specific function No. 1 (ride control)<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to vehicle ground</li> <li>· Customer specific function No. 1 device has an internal defect</li> <li>· Connector pin is contacted to vehicle ground</li> </ul> | Customer specific   | <ul style="list-style-type: none"> <li>· Check the cable from TCU to customer specific function No. 1 device</li> <li>· Check the connectors from customer specific function No. 1 to TCU</li> <li>· Check the resistance of customer specific function No. 1 device</li> </ul>   |

※ Some fault codes are not applied to this machine.



| Fault code<br>(Hex) | Meaning of the fault code<br>possible reason for fault detection  | Reaction of the TCU  | Possible steps to repair   |
|---------------------|---|--|--|
| 18                  | S.C. to battery voltage at customer specific function No. 1 (ride control)<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to battery voltage</li> <li>· Customer specific function No. 1 device has an internal defect</li> <li>· Connector pin is contacted to battery voltage</li> </ul> | Customer specific  | <ul style="list-style-type: none"> <li>· Check the cable from TCU to customer specific function No. 1 device</li> <li>· Check the connectors from customer specific function No. 1 to TCU</li> <li>· Check the resistance of customer specific function No. 1 device</li> </ul>        |
| 19                  | O.C. at customer specific function No. 1 (ride control)<br>TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin <ul style="list-style-type: none"> <li>· Cable is defective and has no connection to TCU</li> <li>· Customer specific function No. 1 device has an internal defect</li> <li>· Connector has no connection to TCU</li> </ul>                                     | Customer specific  | <ul style="list-style-type: none"> <li>· Check the cable from TCU to customer specific function No. 1 device</li> <li>· Check the connectors from customer specific function No. 1 device to TCU</li> <li>· Check the resistance of customer specific function No. 1 device</li> </ul> |
| 21                  | S.C. to battery voltage at clutch cut off input<br>The measured voltage is too high: <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to battery voltage</li> <li>· Clutch cut off sensor has an internal defect</li> <li>· Connector pin is contacted to battery voltage</li> </ul>  | Clutch cut off function is disabled<br>OP mode : Normal      | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the clutch cut off sensor</li> </ul>  |
| 22                  | S.C. to ground or O.C. at clutch cut off input<br>The measured voltage is too low: <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to vehicle ground</li> <li>· Cable has no connection to TCU</li> <li>· Clutch cut off sensor has an internal defect</li> <li>· Connector pin is contacted to vehicle ground or is broken</li> </ul>   | Clutch cut off function is disabled<br>OP mode : Normal      | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the clutch cut off sensor</li> </ul>  |
| 25                  | S.C. to battery voltage or O.C. at transmission sump temperature sensor input<br>The measured voltage is too high: <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to battery voltage</li> <li>· Cable has no connection to TCU</li> <li>· Temperature sensor has an internal defect</li> <li>· Connector pin is contacted to battery voltage or is broken</li> </ul>                    | No reaction, TCU use default temperature<br>OP mode : Normal | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the temperature sensor</li> </ul>   |

※ Some fault codes are not applied to this machine.



| Fault code<br>(Hex) | Meaning of the fault code<br>possible reason for fault detection   | Reaction of the TCU   | Possible steps to repair  |
|---------------------|--|---|---|
| 26                  | S.C. to battery voltage or O.C. at transmission sump temperature sensor input<br>The measured voltage is too low:<br><ul style="list-style-type: none"> <li>· Cable is defective and is contacted to vehicle ground</li> <li>· Temperature sensor has an internal defect</li> <li>· Connector pin is contacted to vehicle ground</li> </ul>  | No reaction, TCU uses default temperature<br>OP mode : Normal | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the temperature sensor</li> </ul>  |
| 27                  | S.C. to battery voltage or O.C. at retarder temperature sensor input<br>The measured voltage is too high:<br><ul style="list-style-type: none"> <li>· Cable is defective and is contacted to battery voltage</li> <li>· Cable has no connection to TCU</li> <li>· Temperature sensor has an internal defect</li> <li>· Connector pin is contacted to battery voltage or is broken</li> </ul>           | No reaction, TCU uses default temperature<br>OP mode : Normal | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the temperature sensor</li> </ul>  |
| 28                  | S.C. to ground at retarder temperature sensor input<br>The measured voltage is too low:<br><ul style="list-style-type: none"> <li>· Cable is defective and is contacted to vehicle ground</li> <li>· Temperature sensor has an internal defect</li> <li>· Connector pin is contacted to vehicle ground</li> </ul>  | No reaction, TCU uses default temperature<br>OP mode : Normal | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the temperature sensor</li> </ul>  |
| 31                  | S.C. to battery voltage or O.C. at engine speed input<br>TCU measures a voltage higher than 7.00V at speed input pin<br><ul style="list-style-type: none"> <li>· Cable is defective and is contacted to battery voltage</li> <li>· Cable has no connection to TCU</li> <li>· Speed sensor has an internal defect</li> <li>· Connector pin is contacted to battery voltage or has no contact</li> </ul> | OP mode : Substitute clutch control                           | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the speed sensor</li> </ul>  |
| 32                  | S.C. to ground at engine speed input<br>TCU measures a voltage less than 0.45V at speed input pin<br><ul style="list-style-type: none"> <li>· Cable/connector is defective and is contacted to vehicle ground</li> <li>· Speed sensor has an internal defect</li> </ul>  | OP mode : Substitute clutch control                           | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the speed sensor</li> </ul>  |
| 33                  | Logical error at engine speed input<br>TCU measures a engine speed over a threshold and the next moment the measured speed is zero<br><ul style="list-style-type: none"> <li>· Cable/connector is defective and has bad contact</li> <li>· Speed sensor has an internal defect</li> <li>· Sensor gap has the wrong size</li> </ul>   | OP mode : Substitute clutch control                           | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the speed sensor</li> <li>· Check the sensor gap</li> </ul> <p>※ This fault is reset after power up of TCU</p> |

※ Some fault codes are not applied to this machine.



| Fault code (Hex) | Meaning of the fault code possible reason for fault detection  | Reaction of the TCU   | Possible steps to repair  |
|------------------|--|---|---|
| 34               | S.C. to battery voltage or O.C. at turbine speed input<br>TCU measures a voltage higher than 7.00V at speed input pin<br>· Cable is defective and is contacted to vehicle battery voltage<br>· Cable has no connection to TCU<br>· Speed sensor has an internal defect<br>· Connector pin is contacted to battery voltage or has no contact  | OP mode : Substitute clutch control<br>If a failure is existing at output speed, TCU shifts to neutral<br>OP mode : Limp home                                     | · Check the cable from TCU to the sensor<br>· Check the connectors<br>· Check the speed sensor  |
| 35               | S.C. to ground at turbine speed input<br>TCU measures a voltage less than 0.45V at speed input pin<br>· Cable/connector is defective and is contacted to vehicle ground<br>· Speed sensor has an internal defect   | OP mode : Substitute clutch control<br>If a failure is existing at output speed, TCU shifts to neutral<br>OP mode : Limp home                                     | · Check the cable from TCU to the sensor<br>· Check the connectors<br>· Check the speed sensor<br>※ This fault is reset after power up of TCU                           |
| 36               | Logical error at turbine speed input<br>TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero<br>· Cable/connector is defective and has bad contact<br>· Speed sensor has an internal defect<br>· Sensor gap has the wrong size  | OP mode : Substitute clutch control<br>If a failure is existing at output speed, TCU shifts to neutral<br>OP mode : Limp home                                     | · Check the cable from TCU to the sensor<br>· Check the connectors<br>· Check the speed sensor<br>· Check the sensor gap  |
| 37               | S.C. to battery voltage or O.C. at internal speed input<br>TCU measures a voltage higher than 7.00V at speed input pin<br>· Cable is defective and is contacted to vehicle battery voltage<br>· Cable has no connection to TCU<br>· Speed sensor has an internal defect<br>· Connector pin is contacted to battery voltage or has no contact | OP mode : Substitute clutch control   | · Check the cable from TCU to the sensor<br>· Check the connectors<br>· Check the speed sensor  |
| 38               | S.C. to ground at turbine speed input<br>TCU measures a voltage less than 0.45V at speed input pin<br>· Cable/connector is defective and is contacted to vehicle ground<br>· Speed sensor has an internal defect   | OP mode : Substitute clutch control   | · Check the cable from TCU to the sensor<br>· Check the connectors<br>· Check the speed sensor  |
| 39               | Logical error at internal speed input<br>TCU measures a internal speed over a threshold and at the next moment the measured speed is zero<br>· Cable/connector is defective and has bad contact<br>· Speed sensor has an internal defect<br>· Sensor gap has the wrong size  | OP mode : Substitute clutch control   | · Check the cable from TCU to the sensor<br>· Check the connectors<br>· Check the speed sensor<br>· Check the sensor gap<br>※ This fault is reset after power up of TCU |
| 3A               | S.C. to battery voltage or O.C. at output speed input<br>TCU measures a voltage higher than 12.5V at speed input pin<br>· Cable is defective and is contacted to battery voltage<br>· Cable has no connection to TCU<br>· Speed sensor has an internal defect<br>· Connector pin is contacted to battery voltage or has no contact           | Special mode for gear selection<br>OP mode : Substitute clutch control<br>If a failure is existing at turbine speed, TCU shifts to neutral<br>OP mode : Limp home | · Check the cable from TCU to the sensor<br>· Check the connectors<br>· Check the speed sensor  |

※ Some fault codes are not applied to this machine.



| Fault code (Hex) | Meaning of the fault code possible reason for fault detection   | Reaction of the TCU   | Possible steps to repair   |
|------------------|---|---|--|
| 3B               | S.C. to ground at output speed input<br>TCU measures a voltage less than 1.00V at speed input pin<br><ul style="list-style-type: none"> <li>· Cable/connector is defective and is contacted to vehicle ground</li> <li>· Speed sensor has an internal defect</li> </ul>   | Special mode for gear selection<br>OP mode : Substitute clutch control<br>If a failure is existing at turbine speed, TCU shifts to neutral<br>OP mode : Limp home | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the speed sensor</li> </ul>   |
| 3C               | Logical error at output speed input<br>TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero<br><ul style="list-style-type: none"> <li>· Cable/connector is defective and has bad contact</li> <li>· Speed sensor has an internal defect</li> <li>· Sensor gap has the wrong size</li> </ul>          | Special mode for gear selection<br>OP mode : Substitute clutch control<br>If a failure is existing at turbine speed, TCU shifts to neutral<br>OP mode : Limp home | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the sensor</li> <li>· Check the connectors</li> <li>· Check the speed sensor</li> <li>· Check the sensor gap</li> </ul> <p>※ This fault is reset after power up of TCU</p>                |
| 3D               | Turbine speed zero doesn't fit to other speed signals   | -   | <ul style="list-style-type: none"> <li>· Not used</li> </ul>   |
| 3E               | Output speed zero doesn't fit to other speed signals<br>If transmission is not neutral and the shifting has finished, TCU measures output speed zero and turbine speed or internal speed not equal to zero.<br><ul style="list-style-type: none"> <li>· Speed sensor has an internal defect</li> <li>· Sensor gap has the wrong size</li> </ul> | Special mode for gear selection<br>OP mode : Substitute clutch control<br>If a failure is existing at turbine speed, TCU shifts to neutral<br>OP mode : Limp home | <ul style="list-style-type: none"> <li>· Check the sensor signal of output speed sensor</li> <li>· Check the sensor gap of output speed sensor</li> <li>· Check the cable from TCU to the sensor</li> </ul> <p>※ This fault is reset after power up of TCU</p> |
| 54               | DCT1 timeout<br>Timeout of CAN-message DCT1 from display computer<br><ul style="list-style-type: none"> <li>· Interference on CAN-Bus</li> <li>· CAN wire/connector is broken</li> <li>· CAN wire/connector is defective and has contact to vehicle ground or battery voltage</li> </ul>  | OP mode : Normal  | <ul style="list-style-type: none"> <li>· Check display computer</li> <li>· Check wire of CAN-Bus</li> <li>· Check cable to display computer</li> </ul>   |
| 55               | JSS timeout<br>Timeout of CAN-message JSS from joystick steering controller<br><ul style="list-style-type: none"> <li>· Interference on CAN-Bus</li> <li>· CAN wire/connector is broken</li> <li>· CAN wire/connector is defective and has contact to vehicle ground or battery voltage</li> </ul>  | TCU shifts to neutral while joystick steering is active<br>OP mode : Normal   | <ul style="list-style-type: none"> <li>· Check joystick steering controller</li> <li>· Check wire of CAN-Bus</li> <li>· Check cable to joystick steering controller</li> </ul>   |
| 56               | Engine CONF timeout<br>Timeout of CAN-message engine CONF from engine controller<br><ul style="list-style-type: none"> <li>· Interference on CAN-Bus</li> <li>· CAN wire/connector is broken</li> <li>· CAN wire/connector is defective and has contact to vehicle ground or battery voltage</li> </ul>   | OP mode : Substitute clutch control   | <ul style="list-style-type: none"> <li>· Check engine controller</li> <li>· Check wire of CAN-Bus</li> <li>· Check cable to engine controller</li> </ul>   |

※ Some fault codes are not applied to this machine.



| Fault code<br>(Hex) | Meaning of the fault code<br>possible reason for fault detection   | Reaction of the TCU  | Possible steps to repair   |
|---------------------|--|--|--|
| 57                  | EEC1 timeout<br>Timeout of CAN-message EEC1 from EEC controller<br><ul style="list-style-type: none"> <li>Interference on CAN-Bus</li> <li>CAN wire/connector is broken</li> <li>CAN wire/connector is defective and has contact to vehicle ground or battery voltage</li> </ul> | OP mode : Substitute clutch control                                | <ul style="list-style-type: none"> <li>Check EEC controller</li> <li>Check wire of CAN-Bus</li> <li>Check cable to EEC controller</li> </ul>                             |
| 58                  | EEC3 timeout<br>Timeout of CAN-message EEC3 from EEC controller<br><ul style="list-style-type: none"> <li>Interference on CAN-Bus</li> <li>CAN wire/connector is broken</li> <li>CAN wire/connector is defective an has contact to vehicle ground or battery voltage</li> </ul>  | OP mode : Substitute clutch control                                | <ul style="list-style-type: none"> <li>Check EEC controller</li> <li>Check wire of CAN-Bus</li> <li>Check cable to EEC controller</li> </ul>                             |
| 5C                  | Auto downshift signal<br>CAN signal for automatic downshift is defective<br><ul style="list-style-type: none"> <li>Cluster controller is defective</li> <li>Interference on CAN-Bus</li> </ul>   | No reaction  | <ul style="list-style-type: none"> <li>Check cluster controller</li> <li>Check wire of CAN-Bus</li> <li>Check cable to cluster controller</li> </ul>                     |
| 5D                  | Manual downshift signal<br>CAN signal for manual downshift is defective<br><ul style="list-style-type: none"> <li>Cluster controller is defective</li> <li>Interference on CAN-Bus</li> </ul>  | No reaction  | <ul style="list-style-type: none"> <li>Check cluster controller</li> <li>Check wire of CAN-Bus</li> <li>Check cable to controller</li> </ul>                             |
| 5E                  | CCO request signal<br>CAN signal for CCO request is defective<br><ul style="list-style-type: none"> <li>Cluster controller is defective</li> <li>Interference on CAN-Bus</li> </ul>  | No reaction  | <ul style="list-style-type: none"> <li>Check cluster controller</li> <li>Check wire of CAN-Bus</li> <li>Check cable to controller</li> </ul>                             |
| 61                  | AEB request signal<br>CAN signal for AEB request is defective<br><ul style="list-style-type: none"> <li>I/O controller is defective</li> <li>Interference on CAN-Bus</li> </ul>  | No reaction<br>OP mode : Normal                                    | <ul style="list-style-type: none"> <li>Check I/O controller, Omron master</li> <li>Check wire of CAN-Bus</li> <li>Check cable to I/O controller, Omron master</li> </ul> |
| 64                  | Sarting gear signal<br>CAN signal for starting gear is defective<br><ul style="list-style-type: none"> <li>I/O controller is defective (illegal starting gear)</li> <li>Interference on CAN-Bus</li> </ul>   | No reaction.<br>TCU uses default starting gear<br>OP mode : Normal | <ul style="list-style-type: none"> <li>Check I/O controller</li> <li>Check wire of CAN-Bus</li> <li>Check cable to I/O controller</li> </ul>                             |
| 65                  | Engine torque signal<br>CAN signal for engine torque is defective<br><ul style="list-style-type: none"> <li>Engine controller is defective</li> <li>Interference on CAN-Bus</li> </ul>   | OP mode : Substitute clutch control                                | <ul style="list-style-type: none"> <li>Check engine controller</li> <li>Check wire of CAN-Bus</li> <li>Check cable to engine controller</li> </ul>                       |
| 69                  | Reference engine torque signal<br>CAN signal for reference of engine torque is defective<br><ul style="list-style-type: none"> <li>Engine controller is defective</li> <li>Interference on CAN-Bus</li> </ul>  | OP mode : Substitute clutch control                                | <ul style="list-style-type: none"> <li>Check engine controller</li> <li>Check wire of CAN-Bus</li> <li>Check cable to engine controller</li> </ul>                       |
| 6A                  | Actual engine torque signal<br>CAN signal for actual engine torque is defective<br><ul style="list-style-type: none"> <li>Engine controller is defective</li> <li>Interference on CAN-Bus</li> </ul>   | OP mode : Substitute clutch control                                | <ul style="list-style-type: none"> <li>Check engine controller</li> <li>Check wire of CAN-Bus</li> <li>Check cable to engine controller</li> </ul>                       |

※ Some fault codes are not applied to this machine.



| Fault code (Hex) | Meaning of the fault code<br>possible reason for fault detection   | Reaction of the TCU  | Possible steps to repair  |
|------------------|--|--|---|
| 6E               | EEC2 timeout<br>Timeout of CAN-message EEC2 from EEC controller <ul style="list-style-type: none"> <li>Interference on CAN-Bus</li> <li>CAN wire/connector is broken</li> <li>CAN wire/connector is defective and has contact to vehicle ground or battery voltage</li> </ul>  | No reaction, TCU uses default signal accelerator pedal in idle position<br>OP mode : Normal  | <ul style="list-style-type: none"> <li>Check EEC controller</li> <li>Check wire of CAN-Bus</li> <li>Check cable to EEC controller</li> </ul>  |
| 71               | S.C. to battery voltage at clutch K1<br>The measured resistance value of the valve is out of limit, the voltage at K1 valve is too high <ul style="list-style-type: none"> <li>Cable/connector is defective and has contact to battery voltage</li> <li>Cable/connector is defective and has contact to another regulator output of the TCU</li> <li>Regulator has an internal defect</li> </ul> | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | <ul style="list-style-type: none"> <li>Check the cable from TCU to the gearbox</li> <li>Check the connectors from TCU to the gearbox</li> <li>Check the regulator resistance*</li> <li>Check internal wire harness of the gearbox</li> </ul> <p>* See page 3-79</p> |
| 72               | S.C. to ground at clutch K1<br>The measured resistance value of the valve is out of limit, the voltage at K1 valve is too low <ul style="list-style-type: none"> <li>Cable/connector is defective and has contact to vehicle ground</li> <li>Regulator has an internal defect</li> </ul>   | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | <ul style="list-style-type: none"> <li>Check the cable from TCU to the gearbox</li> <li>Check the connectors from gearbox to TCU</li> <li>Check the regulator resistance*</li> <li>Check internal wire harness of the gearbox</li> </ul> <p>* See page 3-79</p>     |
| 73               | O.C. at clutch K1<br>The measured resistance value of the valve is out of limit <ul style="list-style-type: none"> <li>Cable/connector is defective and has no contact to TCU</li> <li>Regulator has an internal defect</li> </ul>   | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | <ul style="list-style-type: none"> <li>Check the cable from TCU to the gearbox</li> <li>Check the connectors from gearbox to TCU</li> <li>Check the regulator resistance*</li> <li>Check internal wire harness of the gearbox</li> </ul> <p>* See page 3-79</p>     |
| 74               | S.C. to battery voltage at clutch K2<br>The measured resistance value of the valve is out of limit, the voltage at K2 valve is too high <ul style="list-style-type: none"> <li>Cable/connector is defective and has contact to battery voltage</li> <li>Cable/connector is defective and has contact to another regulator output of the TCU</li> <li>Regulator has an internal defect</li> </ul> | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | <ul style="list-style-type: none"> <li>Check the cable from TCU to the gearbox</li> <li>Check the connectors from gearbox to TCU</li> <li>Check the regulator resistance*</li> <li>Check internal wire harness of the gearbox</li> </ul> <p>* See page 3-79</p>     |
| 75               | S.C. to ground at clutch K2<br>The measured resistance value of the valve is out of limit, the voltage at K2 valve is too low <ul style="list-style-type: none"> <li>Cable/connector is defective and has contact to vehicle ground</li> <li>Regulator has an internal defect</li> </ul>   | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | <ul style="list-style-type: none"> <li>Check the cable from TCU to the gearbox</li> <li>Check the connectors from gearbox to TCU</li> <li>Check the regulator resistance*</li> <li>Check internal wire harness of the gearbox</li> </ul> <p>* See page 3-79</p>     |

※ Some fault codes are not applied to this machine.



| Fault code (Hex) | Meaning of the fault code<br>possible reason for fault detection  | Reaction of the TCU  | Possible steps to repair  |
|------------------|---|--|---|
| 76               | O.C. at clutch K2<br>The measured resistance value of the valve is out of limit<br>· Cable/connector is defective and has no contact to TCU<br>· Regulator has an internal defect   | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the gearbox<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79             |
| 77               | S.C. to battery voltage at clutch K3<br>The measured resistance value of the valve is out of limit, the voltage at K3 valve is too high<br>· Cable/connector is defective and has contact to battery voltage<br>· Cable/connector is defective and has contact to another regulator output of the TCU<br>· Regulator has an internal defect | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the gearbox<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79             |
| 78               | S.C. to ground at clutch K3<br>The measured resistance value of the valve is out of limit, the voltage at K3 valve is too low<br>· Cable/connector is defective and has contact to vehicle ground<br>· Regulator has an internal defect   | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the gearbox<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79             |
| 79               | O.C. at clutch K3<br>The measured resistance value of the valve is out of limit<br>· Cable/connector is defective and has no contact to TCU<br>· Regulator has an internal defect   | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the gearbox<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79             |
| 7D               | S.C. ground at engine derating device<br>· Cable is defective and is contacted to vehicle ground<br>· Engine derating device has an internal defect<br>· Connector pin is contacted to vehicle ground   | Engine derating will be on until<br>TCU power down even if fault vanishes (Loose connection)<br>OP mode : Normal                           | · Check the cable from TCU to the engine derating device<br>· Check the connectors from engine derating device to TCU<br>· Check the resistance* of engine derating device<br>※ Not used<br>* See page 3-79 |
| 7E               | S.C. battery voltage at engine derating device<br>· Cable/connector is defective and is contacted to battery voltage<br>· Engine derating device has an internal defect   | No reaction<br>OP mode : Normal  | · Check the cable from TCU to the engine derating device<br>· Check the connectors from backup alarm device to TCU<br>· Check the resistance* of backup alarm device<br>* See page 3-79                     |

※ Some fault codes are not applied to this machine.



| Fault code<br>(Hex) | Meaning of the fault code<br>possible reason for fault detection  | Reaction of the TCU  | Possible steps to repair   |
|---------------------|---|--|--|
| 7F                  | O.C. at engine derating device<br>TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin<br>· Cable is defective and has no connection to TCU<br>· Engine derating device has an internal defect<br>· Connector has no connection to TCU  | No reaction<br>OP mode : Normal  | · Check the cable from TCU to the engine derating device<br>· Check the connectors from engine derating device to TCU<br>· Check the resistance* of engine derating device<br>* See page 3-79                  |
| 81                  | S.C. to battery voltage at clutch K4<br>The measured resistance value of the valve is out of limit, the voltage at K4 valve is too high<br>· Cable/connector is defective and has contact to battery voltage<br>· Cable/connector is defective and has contact to another regulator output of the TCU<br>· Regulator has an internal defect | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the gearbox<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79                |
| 82                  | S.C. to ground at clutch K4<br>The measured resistance value of the valve is out of limit, the voltage at K4 valve is too low<br>· Cable/connector is defective and has contact to vehicle ground<br>· Regulator has an internal defect   | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the engine derating device<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79 |
| 83                  | O.C. at clutch K4<br>The measured resistance value of the valve is out of limit<br>· Cable/connector is defective and has contact to TCU<br>· Regulator has an internal defect  | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the gearbox<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79                |
| 84                  | S.C. to battery voltage at clutch KV<br>The measured resistance value of the valve is out of limit, the voltage at KV valve is too high<br>· Cable/connector is defective and has contact to battery voltage<br>· Cable/connector is defective and has contact to another regulator output of the TCU<br>· Regulator has an internal defect | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the gearbox<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79                |
| 85                  | S.C. to ground at clutch KV<br>The measured resistance value of the valve is out of limit, the voltage at KV valve is too low<br>· Cable/connector is defective and has contact to vehicle ground<br>· Regulator has an internal defect   | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the gearbox<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79                |

※ Some fault codes are not applied to this machine.



| Fault code (Hex) | Meaning of the fault code possible reason for fault detection   | Reaction of the TCU  | Possible steps to repair  |
|------------------|---|--|---|
| 86               | O.C. at clutch KV<br>The measured resistance value of the valve is out of limit<br>· Cable/connector is defective and has contact to TCU<br>· Regulator has an internal defect  | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the gearbox<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79 |
| 87               | S.C. to battery voltage at clutch KR<br>The measured resistance value of the valve is out of limit, the voltage at KR valve is too high<br>· Cable/connector is defective and has contact to battery voltage<br>· Cable/connector is defective and has contact to another regulator output of the TCU<br>· Regulator has an internal defect | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the gearbox<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79 |
| 88               | S.C. to ground at clutch KR<br>The measured resistance value of the valve is out of limit, the voltage at KR valve is too low<br>· Cable/connector is defective and has contact to vehicle ground<br>· Regulator has an internal defect   | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the gearbox<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79 |
| 89               | O.C. at clutch KR<br>The measured resistance value of the valve is out of limit<br>· Cable/connector is defective and has no contact to TCU<br>· Regulator has an internal defect   | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | · Check the cable from TCU to the gearbox<br>· Check the connectors from gearbox to TCU<br>· Check the regulator resistance*<br>· Check internal wire harness of the gearbox<br>* See page 3-79 |
| 91               | S.C. to ground at relay reverse warning alarm<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground<br>· Cable is defective and is contact to vehicle ground<br>· Backup alarm device has an internal defect<br>· Connector pin is contacted to vehicle ground  | Backup alarm will be on until<br>TCU power down even if fault vanishes (Loose connection)<br>OP mode : Normal                              | · Check the cable from TCU to the backup alarm device<br>· Check the connectors from backup alarm device to TCU<br>· Check the resistance* of backup alarm device<br>* See page 3-79            |
| 92               | S.C. to battery voltage at relay reverse warning alarm<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage<br>· Cable is defective and is contacted to battery voltage<br>· Backup alarm device has an internal defect<br>· Connector pin is contacted to battery voltage                          | No reaction<br>OP mode : Normal  | · Check the cable from TCU to the backup alarm device<br>· Check the connectors from backup alarm device to TCU<br>· Check the resistance* of backup alarm device<br>* See page 3-79            |

※ Some fault codes are not applied to this machine.



| Fault code (Hex) | Meaning of the fault code possible reason for fault detection   | Reaction of the TCU             | Possible steps to repair   |
|------------------|---|---------------------------------|--|
| 93               | O.C. at relay reverse warning alarm<br>TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin<br>· Cable is defective and has no connection to TCU<br>· Backup alarm device has an internal defect<br>· Connector has no connection to TCU  | No reaction<br>OP mode : Normal | · Check the cable from TCU to the backup alarm device<br>· Check the connectors from backup alarm device to TCU<br>· Check the resistance* of backup alarm device<br>* See page 3-79                   |
| 94               | S.C. to ground at relay starter interlock<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground<br>· Cable is defective and is connection to vehicle ground<br>· Starter interlock relay has an internal defect<br>· Connector pin is contacted to vehicle ground                 | No reaction<br>OP mode : Normal | · Check the cable from TCU to the stater interlock relay<br>· Check the connectors from starter interlock relay to TCU<br>· Check the resistance* of starter interlock relay<br>* See page 3-79        |
| 95               | S.C. to battery voltage at relay starter interlock<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage<br>· Cable is defective and has no connection to battery voltage<br>· Starter interlock relay has an internal defect<br>· Connector pin is contacted to battery voltage | No reaction<br>OP mode : Normal | · Check the cable from TCU to the starter interlock relay<br>· Check the connectors from starter interlock relay to TCU<br>· Check the resistance* of starter interlock relay<br>* See page 3-79       |
| 96               | O.C. at relay starter interlock<br>TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin<br>· Cable is defective and has no connection to TCU<br>· Starter interlock relay has an internal defect<br>· Connector has no connection to TCU  | No reaction<br>OP mode : Normal | · Check the cable from TCU to the starter interlock relay<br>· Check the connectors from starter interlock relay to TCU<br>· Check the resistance* of starter interlock relay<br>* See page 3-79       |
| 9A               | S.C. to ground at converter lock up clutch solenoid<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground<br>· Cable is defective and is contacted to vehicle ground<br>· Converter clutch solenoid has an internal defect<br>· Connector pin is contacted to vehicle ground      | No reaction<br>OP mode : Normal | · Check the cable from TCU to the converter clutch solenoid<br>· Check the connectors from converter clutch solenoid to TCU<br>· Check the resistance* of converter clutch solenoid<br>* See page 3-79 |

※ Some fault codes are not applied to this machine.



| Fault code<br>(Hex) | Meaning of the fault code<br>possible reason for fault detection   | Reaction of the TCU  | Possible steps to repair   |
|---------------------|--|--|--|
| 9B                  | O.C. at converter lock up clutch solenoid<br>TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin<br>· Cable is defective and has no connection to TCU<br>· Converter clutch solenoid has an internal defect<br>· Connector has no connection to TCU   | Converter clutch always open, retarder not available<br>OP mode : Normal | · Check the cable from TCU to the converter clutch solenoid<br>· Check the connectors from converter clutch solenoid to TCU<br>· Check the resistance* of converter clutch solenoid<br>* See page 3-79 |
| 9C                  | S.C. to battery voltage at converter lock up clutch solenoid<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage<br>· Cable is defective and has no contacted to battery voltage<br>· Converter clutch solenoid has an internal defect<br>· Connector pin is contacted to battery voltage | No reaction<br>OP mode : Normal  | · Check the cable from TCU to the converter clutch solenoid<br>· Check the connectors from converter clutch solenoid to TCU<br>· Check the resistance* of converter clutch solenoid<br>* See page 3-79 |
| A1                  | S.C. to ground at difflock or axle connection solenoid<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground<br>· Cable is defective and is contacted to vehicle ground<br>· Difflock solenoid has an internal defect<br>· Connector pin is contacted to vehicle ground                      | No reaction<br>OP mode : Normal  | · Check the cable from TCU to the difflock solenoid<br>· Check the connectors from difflock solenoid to TCU<br>· Check the resistance* of difflock solenoid<br>* See page 3-79                         |
| A2                  | S.C. to battery voltage at difflock or axle connection solenoid<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage<br>· Cable is defective and has no connection to battery voltage<br>· Difflock solenoid has an internal defect<br>· Connector pin is contacted to battery voltage     | No reaction<br>OP mode : Normal  | · Check the cable from TCU to the difflock solenoid<br>· Check the connectors from difflock solenoid to TCU<br>· Check the resistance* of difflock solenoid<br>* See page 3-79                         |
| A3                  | O.C. at difflock or axle connection solenoid<br>TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin<br>· Cable is defective and has no connection to TCU<br>· Difflock solenoid has an internal defect<br>· Connector has no connection to TCU  | No reaction<br>OP mode : Normal  | · Check the cable from TCU to the difflock solenoid<br>· Check the connectors from difflock solenoid to TCU<br>· Check the resistance* of difflock solenoid<br>* See page 3-79                         |

※ Some fault codes are not applied to this machine.



| Fault code (Hex) | Meaning of the fault code possible reason for fault detection   | Reaction of the TCU  | Possible steps to repair   |
|------------------|---|--|--|
| A4               | S.C. to ground at warning signal output<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground<br><ul style="list-style-type: none"> <li>· Cable is defective and is contacted to vehicle ground</li> <li>· Warning device has an internal defect</li> <li>· Connector pin is contacted to vehicle ground</li> </ul>   | No reaction<br>OP mode : Normal  | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the warning device</li> <li>· Check the connectors from warning device to TCU</li> <li>· Check the resistance* of warning device</li> </ul> <p>* See page 3-79</p>  |
| A5               | O.C. voltage at warning signal output<br>TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin<br><ul style="list-style-type: none"> <li>· Cable is defective and has no connection to TCU</li> <li>· Warning device has an internal defect</li> <li>· Connector has no connection to TCU</li> </ul>   | No reaction<br>OP mode : Normal  | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the warning device</li> <li>· Check the connectors from warning device to TCU</li> <li>· Check the resistance* of warning device</li> </ul> <p>* See page 3-79</p>  |
| A6               | S.C. to battery voltage at warning signal output<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage<br><ul style="list-style-type: none"> <li>· Cable is defective and has is contacted to battery voltage</li> <li>· Warning device has an internal defect</li> <li>· Connector pin is contacted to battery voltage</li> </ul>   | No reaction<br>OP mode : Normal  | <ul style="list-style-type: none"> <li>· Check the cable from TCU to the warning device</li> <li>· Check the connectors from warning device to TCU</li> <li>· Check the resistance* of warning device</li> </ul> <p>* See page 3-79</p>  |
| B1               | Slippage at clutch K1<br>TCU calculates a differential speed at closed clutch K1. If this calculated value is out of range, TCU interprets this as slipping clutch<br><ul style="list-style-type: none"> <li>· Low pressure at clutch K1</li> <li>· Low main pressure</li> <li>· Wrong signal at internal speed sensor</li> <li>· Wrong signal at output speed sensor</li> <li>· Wrong size of the sensor gap</li> <li>· Clutch is defective</li> </ul> | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | <ul style="list-style-type: none"> <li>· Check pressure at clutch K1</li> <li>· Check main pressure in the system</li> <li>· Check sensor gap at internal speed sensor</li> <li>· Check sensor gap at output speed sensor</li> <li>· Check signal at internal speed sensor</li> <li>· Check signal at output speed sensor</li> <li>· Replace clutch</li> </ul> |
| B2               | Slippage at clutch K2<br>TCU calculates a differential speed at closed clutch K2. If this calculated value is out of range, TCU interprets this as slipping clutch<br><ul style="list-style-type: none"> <li>· Low pressure at clutch K2</li> <li>· Low main pressure</li> <li>· Wrong signal at internal speed sensor</li> <li>· Wrong signal at output speed sensor</li> <li>· Wrong size of the sensor gap</li> <li>· Clutch is defective</li> </ul> | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | <ul style="list-style-type: none"> <li>· Check pressure at clutch K2</li> <li>· Check main pressure in the system</li> <li>· Check sensor gap at internal speed sensor</li> <li>· Check sensor gap at output speed sensor</li> <li>· Check signal at internal speed sensor</li> <li>· Check signal at output speed sensor</li> <li>· Replace clutch</li> </ul> |

※ Some fault codes are not applied to this machine.



| Fault code (Hex) | Meaning of the fault code possible reason for fault detection  | Reaction of the TCU  | Possible steps to repair  |
|------------------|--|--|---|
| B3               | Slippage at clutch K3<br>TCU calculates a differential speed at closed clutch K3. If this calculated value is out of range, TCU interprets this as slipping clutch<br><ul style="list-style-type: none"> <li>Low pressure at clutch K3</li> <li>Low main pressure</li> <li>Wrong signal at internal speed sensor</li> <li>Wrong signal at output speed sensor</li> <li>Wrong size of the sensor gap</li> <li>Clutch is defective</li> </ul>  | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | <ul style="list-style-type: none"> <li>Check pressure at clutch K3</li> <li>Check main pressure in the system</li> <li>Check sensor gap at internal speed sensor</li> <li>Check sensor gap at output speed sensor</li> <li>Check signal at internal speed sensor</li> <li>Check signal at output speed sensor</li> </ul> Replace clutch   |
| B4               | Slippage at clutch K4<br>TCU calculates a differential speed at closed clutch K4. If this calculated value is out of range, TCU interprets this as slipping clutch<br><ul style="list-style-type: none"> <li>Low pressure at clutch K4</li> <li>Low main pressure</li> <li>Wrong signal at internal speed sensor</li> <li>Wrong signal at turbine speed sensor</li> <li>Wrong size of the sensor gap</li> <li>Clutch is defective</li> </ul> | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | <ul style="list-style-type: none"> <li>Check pressure at clutch K4</li> <li>Check main pressure in the system</li> <li>Check sensor gap at internal speed sensor</li> <li>Check sensor gap at turbine speed sensor</li> <li>Check signal at internal speed sensor</li> <li>Check signal at turbine speed sensor</li> </ul> Replace clutch |
| B5               | Slippage at clutch KV<br>TCU calculates a differential speed at closed clutch KV. If this calculated value is out of range, TCU interprets this as slipping clutch<br><ul style="list-style-type: none"> <li>Low pressure at clutch KV</li> <li>Low main pressure</li> <li>Wrong signal at internal speed sensor</li> <li>Wrong signal at turbine speed sensor</li> <li>Wrong size of the sensor gap</li> <li>Clutch is defective</li> </ul> | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | <ul style="list-style-type: none"> <li>Check pressure at clutch KV</li> <li>Check main pressure in the system</li> <li>Check sensor gap at internal speed sensor</li> <li>Check sensor gap at turbine speed sensor</li> <li>Check signal at internal speed sensor</li> <li>Check signal at turbine speed sensor</li> </ul> Replace clutch |
| B6               | Slippage at clutch KR<br>TCU calculates a differential speed at closed clutch KR. If this calculated value is out of range, TCU interprets this as slipping clutch<br><ul style="list-style-type: none"> <li>Low pressure at clutch KR</li> <li>Low main pressure</li> <li>Wrong signal at internal speed sensor</li> <li>Wrong signal at turbine speed sensor</li> <li>Wrong size of the sensor gap</li> <li>Clutch is defective</li> </ul> | TCU shifts to neutral<br>OP mode : Limp home<br>If failure at another clutch is pending<br>TCU shifts to neutral<br>OP mode : TCU shutdown | <ul style="list-style-type: none"> <li>Check pressure at clutch KR</li> <li>Check main pressure in the system</li> <li>Check sensor gap at internal speed sensor</li> <li>Check sensor gap at turbine speed sensor</li> <li>Check signal at internal speed sensor</li> <li>Check signal at turbine speed sensor</li> </ul> Replace clutch |
| B7               | Overtemp sump<br>TCU measured a temperature in the oil sump that is over the allowed threshold.  | No reaction<br>OP mode : Normal  | <ul style="list-style-type: none"> <li>Cool down machine</li> <li>Check oil level</li> <li>Check temperature sensor</li> </ul>  |
| B9               | Overspend engine   | Retarder applies<br>OP mode : Normal   | -   |
| BA               | Differential pressure oil filter<br>TCU measured a voltage at differential pressure switch out of the allowed range<br><ul style="list-style-type: none"> <li>Oil filter is polluted</li> <li>Cable/connector is broken or cable/connector is contacted to battery voltage or vehicle ground</li> <li>Differential pressure switch is defective</li> </ul>   | No reaction<br>OP mode : Normal  | <ul style="list-style-type: none"> <li>Check oil filter</li> <li>Check wiring from TCU to differential pressure switch</li> <li>Check differential pressure switch(Measure resistance)</li> </ul>   |

※ Some fault codes are not applied to this machine.



| Fault code (Hex) | Meaning of the fault code<br>possible reason for fault detection  | Reaction of the TCU   | Possible steps to repair   |
|------------------|---|---|--|
| BB               | Slippage at converter lockup clutch<br>TCU calculates a differential speed at closed converter lockup clutch. If this calculated value is out of range, TCU interprets this as slipping clutch <ul style="list-style-type: none"> <li>· Low pressure at converter lockup clutch</li> <li>· Low main pressure</li> <li>· Wrong signal at engine speed sensor</li> <li>· Wrong signal at turbine speed sensor</li> <li>· Wrong size of the sensor gap</li> <li>· Clutch is defective</li> </ul> | No reaction<br>OP mode : Normal                                       | <ul style="list-style-type: none"> <li>· Check pressure at converter lockup clutch</li> <li>· Check main pressure in the system</li> <li>· Check sensor gap at engine speed sensor</li> <li>· Check sensor gap at turbine speed sensor</li> <li>· Check signal at engine speed sensor</li> <li>· Check signal at turbine speed sensor</li> <li>· Replace clutch</li> </ul> |
| C0               | Engine torque or engine power overload<br>TCU calculates an engine torque or engine power above the defined thresholds  | OP mode : Normal  |  |
| C1               | Transmission output torque overload<br>TCU calculates an transmission output torque above the defined threshold   | OP mode : Normal  |  |
| C2               | Transmission input torque overload<br>TCU calculates an transmission input torque above the defined threshold   | programmable :<br>No reaction or shift to neutral<br>OP mode : Normal |  |
| C3               | Overtemp converter output<br>TCU measured a oil temperature at the converter output that is the allowed threshold   | No reaction<br>OP mode : Normal                                       | <ul style="list-style-type: none"> <li>· Cool down machine</li> <li>· Check oil level</li> <li>· Check temperature sensor</li> </ul>   |
| C4               | S.C. to ground at joystick status indicator<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to vehicle ground</li> <li>· Joystick status indicator has an internal defect</li> <li>· Connector pin is contacted to vehicle ground</li> </ul>   | No reaction<br>OP mode : Normal                                       | <ul style="list-style-type: none"> <li>· Check the cable from TCU to joystick status indicator</li> <li>· Check the connectors from joystick status indicator to TCU</li> <li>· Check the resistance* of joystick status indicator</li> </ul> <p>* See page 3-79</p>   |
| C5               | S.C. to battery voltage at joystick status indicator<br>TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage <ul style="list-style-type: none"> <li>· Cable is defective and is contacted to battery voltage</li> <li>· Joystick status indicator has an internal defect</li> <li>· Connector pin is contacted to battery voltage</li> </ul>   | No reaction<br>OP mode : Normal                                       | <ul style="list-style-type: none"> <li>· Check the cable from TCU to joystick status indicator</li> <li>· Check the connectors from joystick status indicator to TCU</li> <li>· Check the resistance* of joystick status indicator</li> </ul> <p>* See page 3-79</p>   |

※ Some fault codes are not applied to this machine.



| Fault code<br>(Hex) | Meaning of the fault code<br>possible reason for fault detection   | Reaction of the TCU                        | Possible steps to repair   |
|---------------------|--|--|--|
| C6                  | O.C. at joystick status indicator<br>TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin<br>· Cable is defective and has no connection to TCU<br>· Joystick status indicator has an internal defect<br>· Connector pin has no connection to TCU   | No reaction<br>OP mode : Normal            | · Check the cable from TCU to joystick status indicator<br>· Check the connectors from joystick status indicator to TCU<br>· Check the resistance* of joystick status indicator<br>* See page 3-79 |
| D1                  | S.C. to battery voltage at power supply for sensors<br>TCU measures more than 6V at the pin AU1 (5V sensor supply)   | See fault codes No.21 to 2C                | · Check cables and connectors to sensors, which are supplied from AU1<br>· Check the power supply at the pin AU1(Should be appx. 5V)<br>· Fault codes No.21 to No.2C may be reaction of this fault |
| D2                  | S.C. to ground at power supply for sensors<br>TCU measures less than 4V at the pin AU1 (5V sensor supply)  | See fault codes No.21 to 2C                | · Check cables and connectors to sensors, which are supplied from AU1<br>· Check the power supply at the pin AU1(Should be appx. 5V)<br>· Fault codes No.21 to No.2C may be reaction of this fault |
| D3                  | Low voltage at battery<br>Measured voltage at power supply is lower than 18V(24V device)   | Shift to neutral<br>OP mode : TCU shutdown | · Check power supply battery<br>· Check cables from batteries to TCU<br>· Check connectors from batteries to TCU   |
| D4                  | High voltage at battery<br>Measured voltage at power supply is higher than 32.5V(24V device)   | Shift to neutral<br>OP mode : TCU shutdown | · Check power supply battery<br>· Check cables from batteries to TCU<br>· Check connectors from batteries to TCU   |
| D5                  | Error at valve power supply VPS1<br>TCU switched on VPS1 and measured VPS1 is off or TCU switched off VPS1 and measured VPS1 is still on<br>· Cable or connectors are defect and are contacted to battery voltage<br>· Cable or connectors are defect and are contacted to vehicle ground<br>· Permanent power supply KL30 missing<br>· TCU has an internal defect | Shift to neutral<br>OP mode : TCU shutdown | · Check fuse<br>· Check cables from gearbox to TCU<br>· Check connectors from gearbox to TCU<br>· Replace TCU  |
| D6                  | Error at valve power supply VPS2<br>TCU switched on VPS2 and measured VPS2 is off or TCU switched off VPS2 and measured VPS2 is still on<br>· Cable or connectors are defect and are contacted to battery voltage<br>· Cable or connectors are defect and are contacted to vehicle ground<br>· Permanent power supply KL30 missing<br>· TCU has an internal defect | Shift to neutral<br>OP mode : TCU shutdown | · Check fuse<br>· Check cables from gearbox to TCU<br>· Check connectors from gearbox to TCU<br>· Replace TCU  |

※ Some fault codes are not applied to this machine.



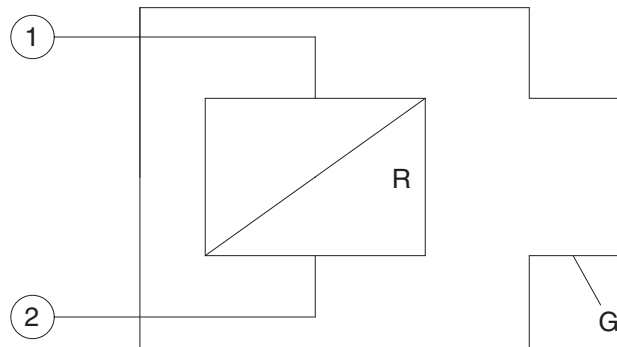
| Fault code (Hex) | Meaning of the fault code<br>possible reason for fault detection   | Reaction of the TCU  | Possible steps to repair  |
|------------------|--|--|---|
| E3               | S.C. to battery voltage at display output<br>TCU sends data to the display and measures always a high voltage level on the connector<br>· Cable or connectors are defective and are contacted to battery voltage<br>· Display has an internal defect | No reaction<br>OP mode : Normal  | · Check the cable from TCU to the display<br>· Check the connectors at the display<br>· Change display              |
| E4               | S.C. to ground at display output<br>TCU sends data to the display and measures always a high voltage level on the connector<br>· Cable or connectors are defective and are contacted to battery voltage<br>· Display has an internal defect          | No reaction<br>OP mode : Normal  | · Check the cable from TCU to the display<br>· Check the connectors at the display<br>· Change display              |
| E5               | Communication failure on DeviceNet   | Shift to neutral<br>OP mode : TCU shutdown                                     | · Check Omron master<br>· Check wire of DeviceNet-Bus<br>· Check cable to Omron master                              |
| F1               | General EEPROM fault<br>TCU can't read non volatile memory<br>· TCU is defective   | No reaction<br>OP mode : Normal  | · Replace TCU<br>※ Often shown together with fault code F2  |
| F2               | Configuration lost<br>TCU has lost the correct configuration and can't control the transmission<br>· Interference during saving data on non volatile memory<br>· TCU is brand new or from another vehicle  | Transmission stay neutral<br>OP mode : TCU shutdown                            | · Reprogram the correct configuration for the vehicle (e.g. with cluster controller,...)                            |
| F3               | Application error<br>Something of this application is wrong  | Transmission stay neutral<br>OP mode : TCU shutdown                            | · Replace TCU<br>※ This fault occurs only if an test engineer did something wrong in the application of the vehicle |
| F5               | Clutch failure<br>AEB was not able to adjust clutch filling parameters<br>· One of the AEB-Values is out of limit  | Transmission stay neutral<br>OP mode : TCU shutdown                            | · Check clutch<br>※ TCU shows also the affected clutch on the display   |
| F6               | Clutch adjustment data lost<br>TCU was not able to read correct clutch adjustment parameters<br>· Interference during saving data on non volatile memory<br>· TCU is brand new   | No reaction,<br>Default values : 0 for AEB<br>Offsets used<br>OP mode : Normal | · Execute AEB and brake sensor calibration  |
| F7               | Substitute clutch control<br>· Transmission input torque wrong<br>· Engine retarder torque wrong<br>· Speed signal (s) defective   | OP mode : Substitute<br>clutch control   | · Check engine retarder torque<br>· Check speed sensors   |

※ Some fault codes are not applied to this machine.



## 5) MEASURING OF RESISTANCE AT ACTUATOR/SENSOR AND CABLE

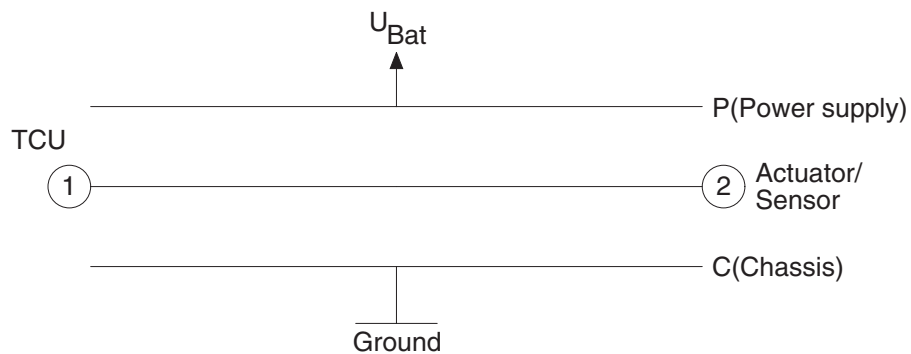
### (1) Actuator



76043PT19

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

### (2) Cable



76043PT20

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

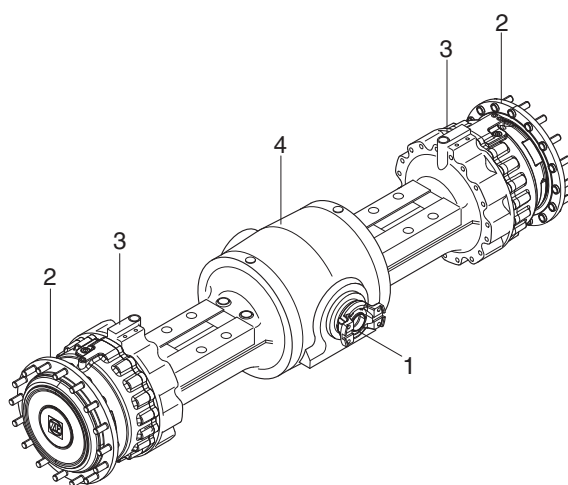


## 5. AXLE

### 1) OPERATION

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

#### (1) Front axle



7709A3PT10

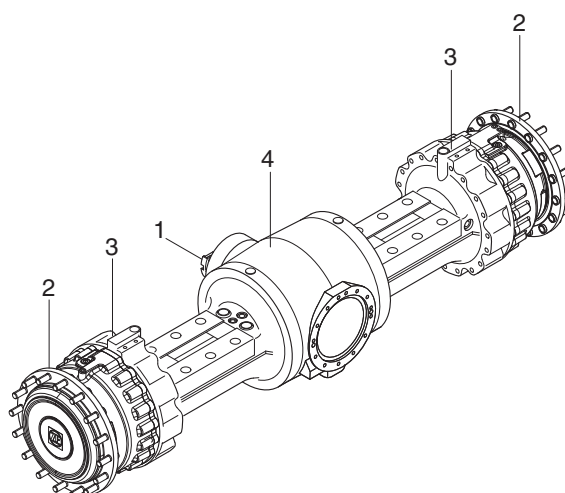
1 Input

2 Output

3 Brake

4 Axle housing

#### (2) Rear axle



7709A3PT11

1 Input

2 Output

3 Brake

4 Axle housing



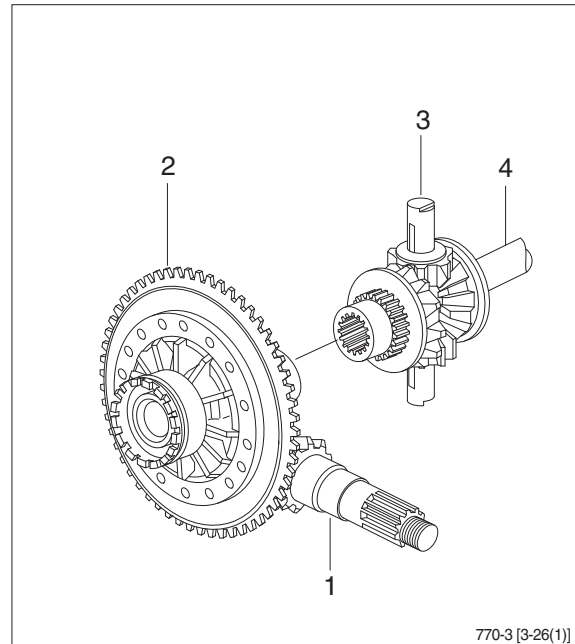
## 2) DIFFERENTIAL

### (1) Description

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

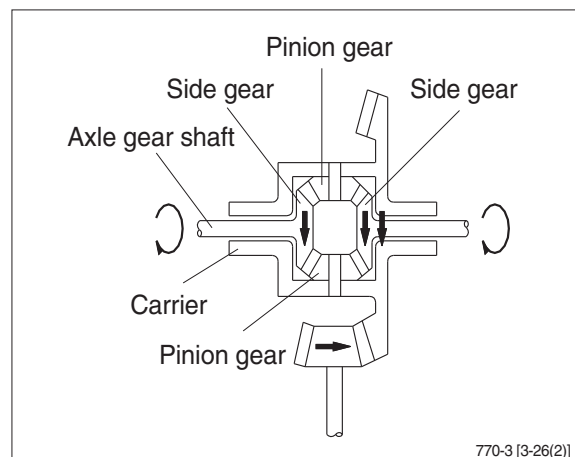
The power from the drive shaft passes through bevel pinion (1) and is transmitted to the bevel gear (2). The bevel gear changes the direction of the motive force by 90 degree, and at the same time reduces the speed.

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



### (2) When driving straight forward

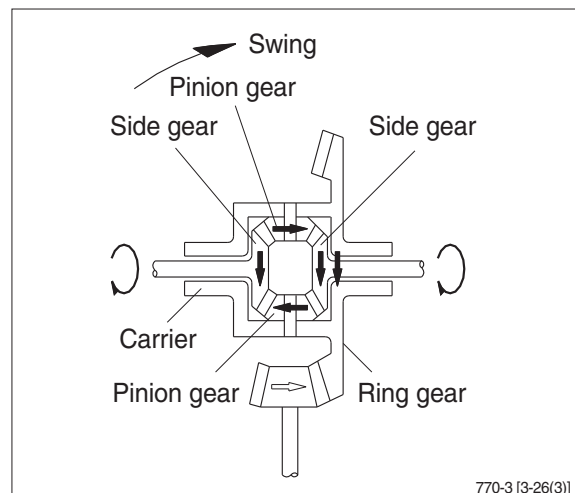
When the machine is being driven straight forward and the right and left wheels are rotating at the same speed, so the pinion gear inside the differential assembly do not rotate. The motive force of the carrier is sent through the pinion gear and the side gear, therefore the power is equally transmitted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



### (3) When turning

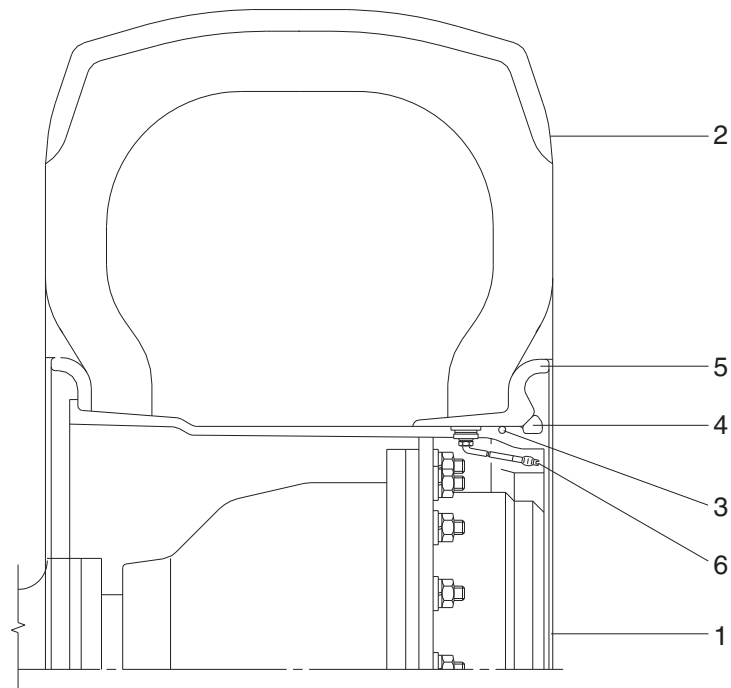
When turning, the rotating speed of the left and right wheels is different, so the pinion gear and side gear inside the differential assembly rotate in accordance with the difference between the rotating speed of the left and right wheels.

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





## 6. TIRE AND WHEEL



7407APT10

1 Wheel rim

2 Tire

3 O-ring

4 Lock ring

5 Side ring

6 Valve assembly

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



## GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

### 1. POWER TRAIN OPERATIONAL CHECKS

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

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

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

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

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


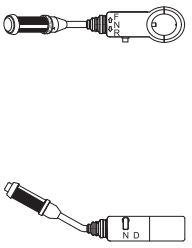

If verification is needed, you will be given next best source of information :

Chapter 2 : Troubleshooting

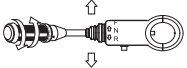
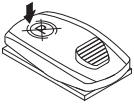



Group 3 : Tests and adjustments





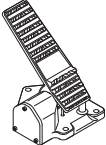
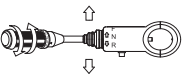
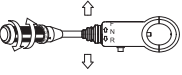
※ Transmission oil must be at operating temperature for these checks.

| Item   | Description   | Service action  |
|--|---|---|
| Transmission oil warm-up procedure                               |  <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>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><b>OK</b><br/>Check completed.</p>   |
| Gear selector lever and neutral lock latch checks<br>Engine OFF. |  <p>Move gear selector lever to each position.</p> <p><b>NOTE</b> : Gear selector lever position changes slightly as steering column is tilted.</p> <p><b>FEEL</b> : 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><b>LOOK</b> : Neutral lock must stay engaged.</p>  | <p><b>OK</b><br/>Check completed.</p> <p><b>NOT OK</b><br/>Repair lock or replace switch.</p>   |
| Automatic shifting check   |  <p>Start engine.</p> <p>Move gear selector lever to 4th speed.</p> <p>Select T/M shift mode to AL (auto light) mode.</p> <p><b>LOOK</b> : Automatic sign on cluster.</p> <p>Move gear selector lever to forward or reverse position.</p> <p>Increase engine rpm.</p> <p><b>LOOK</b> : Speed on cluster must vary with machine speed.</p>  | <p><b>OK</b><br/>Check completed.</p> <p><b>NOT OK</b><br/>Go to transmission fault code group at page 3-62~3-78.<br/>Repair or replace the monitor or harness.</p> |



| Item   | Description   | Service action   |
|--|---|--|
| <b>Transmission noise check</b><br>Engine running.         |  <p>Run engine at approximately 1600 rpm.</p> <p>Drive unit with transmission in each forward and reverse speed.</p> <p><b>LISTEN</b> : 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><b>OK</b><br/>Check completed.</p> <p><b>NOT OK</b><br/>Go to transmission makes excessive noise, chapter 2 in this group.</p>  |
| <b>Transmission "quick shift" check</b><br>Engine running. | <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><b>LOOK/FEEL</b> : Transmission must shift to and remain in 1st gear.</p> <p>Press gear selector lever kick down switch once.</p> <p><b>LOOK/FEEL</b> : 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><b>LOOK/FEEL</b> : 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><b>LOOK/FEEL</b> :</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><b>OK</b><br/>Check completed.</p> <p><b>NOT OK</b><br/>Check connector at base of control valve.</p> <p><b>IF OK</b><br/>Go to transmission controller circuit in group 1.</p> |



| Item  | Description   | Service action   |
|---|---|--|
| <b>Forward, reverse and 4th speed clutch pack drag check</b><br>※ Transmission must be warmed up for this check.<br>Engine running. | <br><br> <p>Park unit on level surface.</p> <p>Apply service brakes.</p> <p>Move gear selector lever to neutral.</p> <p>Move gear selector lever to 1st.</p> <p>Release parking brake and service brakes.</p> <p>Run engine at low idle.</p> <p><b>LOOK</b> : Unit must not move in either direction.</p> <p><b>NOTE</b> : If unit moves forward, either the forward pack or the 4th speed pack is dragging.</p> | <p><b>OK</b><br/>Check completed.</p> <p><b>NOT OK</b><br/>If unit moves, repair transmission.</p>   |
| <b>Transmission shift modulation check</b><br>Engine running.   |  <p>Run engine at approximately 1300 rpm.</p> <p>Put transmission in 1st forward, shift several times from forward to reverse and reverse to forward. Repeat check in 2nd gear.</p> <p><b>LOOK</b> : Unit must slow down and change direction smoothly.</p>  | <p><b>OK</b><br/>Check completed.</p> <p><b>NOT OK</b><br/>Go to unit shifts too fast, chapter 2 in this group.</p>  |
| <b>Torque converter check</b>   |  <p>Start engine. Apply service brakes and release parking brake.</p> <p>Move gear selector lever to 3rd speed.</p> <p>Move gear selector control lever to forward "F" position.</p> <p>Increase engine speed to high idle.</p> <p><b>LOOK</b> : Torque converter stall rpm must be within the following range.<br/>Stall rpm : <math>1820 \pm 70</math> rpm</p> <p>Move gear selector control lever to neutral "N" position and run for 15 seconds.</p>   | <p><b>OK</b><br/>Check completed.</p> <p><b>NOT OK</b><br/>If stall rpm are too low or too high, problem may be engine power or torque converter.</p> <p><b>IF OK</b><br/>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 | Low oil level.                                   | Add oil.   |
|                       | Wrong oil grade.                                 | Change oil.  |
|                       | Restricted transmission pump suction screen.     | Remove and clean screen.                               |
|                       | Leak in transmission control valve or gasket.    | Remove valve and inspect gaskets.                      |
|                       | Low transmission pump flow due to worn pump.     | Do transmission pump flow test.                        |
|                       | Weak or broken pressure regulating valve spring. | Do transmission system pressure test.                  |
| Error code on display | Something wrong in transmission.                 | Go to transmission fault code group at page 3-62~3-78. |



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



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



| Problem                                 | Cause  | Remedy   |
|---|--|--|
| Transmission shifts too fast            | <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.<br>Worn parts or damaged in transmission.<br>Warped drive line between engine and torque converter.<br>Low or no lube.  | Check engine low idle speed.<br>Remove transmission suction screen. Inspect for metal particles.<br>Repair as necessary.<br>Inspect drive line.<br>Do converter-out and lube pressure test. Do transmission pump flow test.                         |
| Foaming oil  | Incorrect type of oil.<br>High oil level.<br>Low oil level.<br>Air leak on suction side of pump.   | Change oil.<br>Transmission overfilled or hydraulic pump seal leaking.<br>Add oil.<br>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.<br>Low engine speed.<br>Failed universal joints on transmission drive shaft or differential drive shafts.   | Add oil.<br>Check engine speed.<br>Check universal joints.  |
| Machine lacks power and acceleration                 | Engine high idle speed set too low.<br>Incorrect transmission oil.<br>Aerated oil.<br>Low transmission pressure.<br>Warped transmission clutch.<br>Torn transmission control valve gasket.<br>Brake drag.<br>Failed torque converter.<br>Low engine power. | Check high idle adjustment.<br>Change oil.<br>Add oil.<br>Do transmission system pressure test.<br>Do transmission clutch drag checks.<br>Inspect gasket.<br>Do brake drag check.<br>Do torque converter stall speed test.<br>Do engine power test. |
| Torque converter stall RPM too high                  | Aerated oil.<br>Stuck open converter relief valve.<br>Leakage in torque converter seal.<br>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.<br>Do converter-out pressure test.<br>Do converter-out pressure test.<br>Replace torque converter.   |



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



## 2) DIFFERENTIAL / AXLE

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



### 3) DRIVE LINE

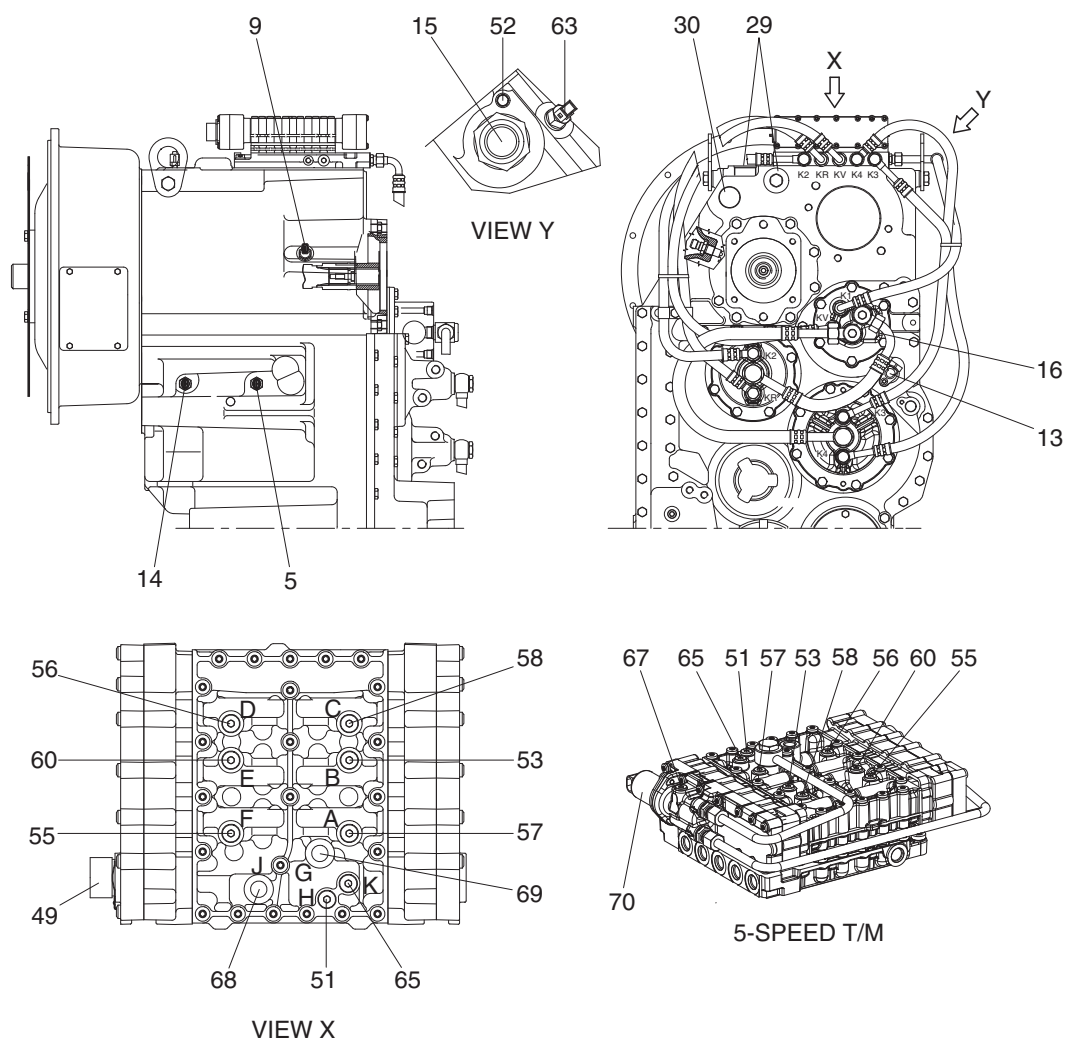
| Problem                                 | Cause  | Remedy                                 |
|---|--|--|
| Excessive drive line vibration or noise | Yokes not in line on drive shafts.                             | Inspect. Align drive shaft yokes.      |
|   | Worn front drive line support bearing.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



## GROUP 3 TESTS AND ADJUSTMENTS

### 1. TRANSMISSION MEASURING POINTS AND CONNECTIONS

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



7709A3PT17

#### 1) OIL PRESSURE AND TEMPERATURE

| Port | Description  | Size    |
|------|--|---------|
| 51   | In front of the converter-opening pressure (11bar) H     | M10×1.0 |
| 52   | Behind the converter-opening pressure (5bar)             | M14×1.5 |
| 53   | Forward clutch (16+2bar) KV B                            | M10×1.0 |
| 55   | Reverse clutch (16+2bar) KR F                            | M10×1.0 |
| 56   | 1st clutch (16+2bar) K1 D                                | M10×1.0 |
| 57   | 2nd clutch (16+2bar) K2 A                                | M10×1.0 |
| 58   | 3rd clutch (16+2bar) K3 C                                | M10×1.0 |
| 60   | 4th clutch (16+2bar) K4 E                                | M10×1.0 |
| 63   | Behind the converter temperature 100°C, short-time 120°C | M14×1.5 |
| 65   | System pressure (16+2bar) K                              | M10×1.0 |
| *67  | Lock-up clutch pressure (12+2bar)                        | M10×1.0 |

\* : 5-speed transmission



## 2) CONNECTIONS

| Port | Description                                   | Size      |
|------|---|-----------|
| 15   | Connection to the oil cooler                  | M42 × 2.0 |
| 16   | Connection from the oil cooler                | M42 × 2.0 |
| 29   | Connection from filter                        | M42 × 2.0 |
| 30   | Connection to filter                          | M42 × 2.0 |
| 49   | Plug connection on the hydraulic control unit | -         |
| 68   | Pilot pressure (option) J                     | M16 × 1.5 |
| 69   | System pressure (option) G                    | M16 × 1.5 |

## 3) INDUCTIVE TRANSMITTER AND SPEED SENSOR

| Port | Description                                | Size      |
|------|--|-----------|
| 5    | Inductive transmitter n Central gear chain | M18 × 1.5 |
| 9    | Inductive transmitter n Engine             | M18 × 1.5 |
| 13   | Speed sensor n Output and speedometer      | -         |
| 14   | Inductive transmitter n Turbine            | M18 × 1.5 |

## 4) SOLENOID VALVE (5-speed transmission)

| Item | Description              | Size           |
|------|--------------------------|----------------|
| 70   | Converter lock-up clutch | AMP 282080 - I |



## MEMORANDUM



## MEMORANDUM



## GROUP 4 DISASSEMBLY AND ASSEMBLY

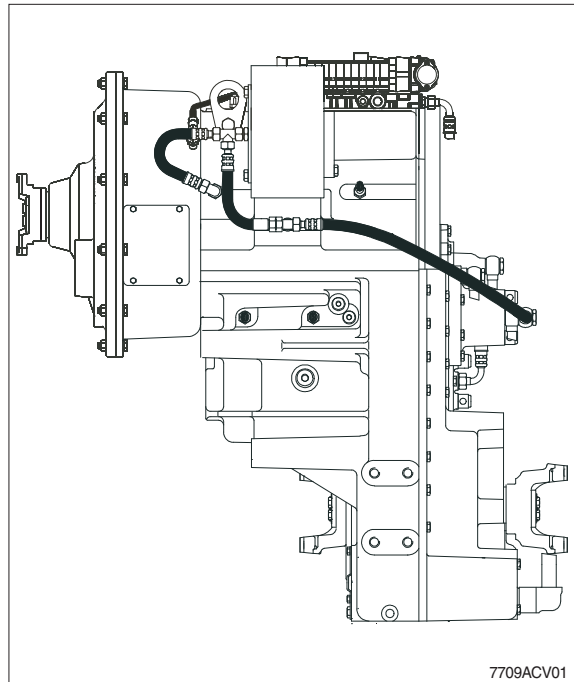
### 1. CONTROL VALVE

#### 1) DISASSEMBLY

- (1) Attach transmission to assembly truck.

|                 |              |
|-----------------|--------------|
| Assembly truck  | 5870 350 000 |
| Holding fixture | 5870 350 071 |

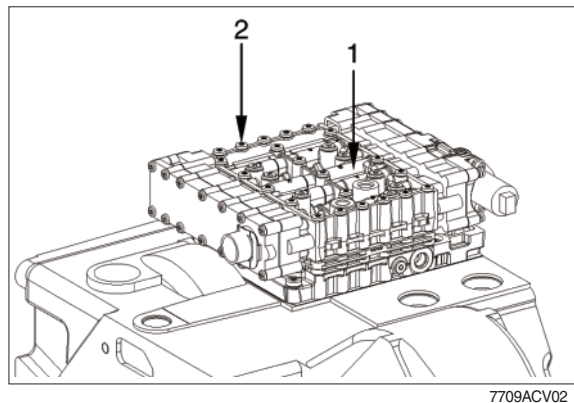
- ※ Drain oil prior to starting disassembly.
- ※ Disposal of oil according to legal requirements.



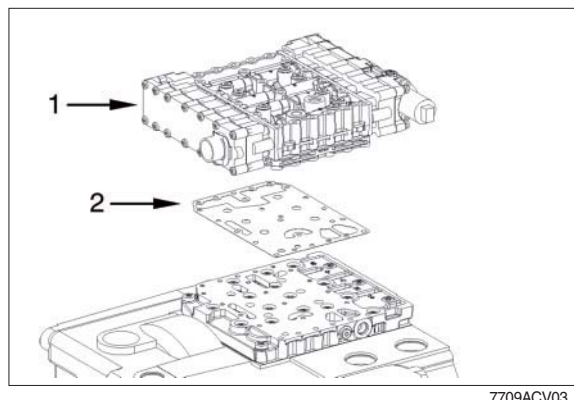
#### Removal of electric gear-shift control

- (2) Remove all oil pipes.  
Remove gear-shift control (1).  
Loosen torx screws (2).

|                     |              |
|---------------------|--------------|
| Socket wrench TX-27 | 5873 042 002 |
| Adjusting screws M6 | 5870 204 063 |

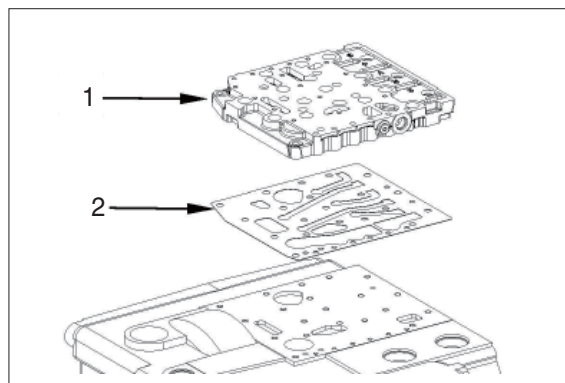


- (3) Remove gear-shift control assy (1) and gasket (2).



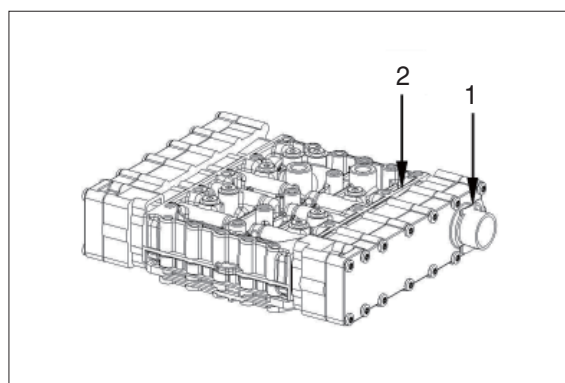


- (4) Loosen torx screws and separate duct plate (1) and gasket (2) from gearbox housing.



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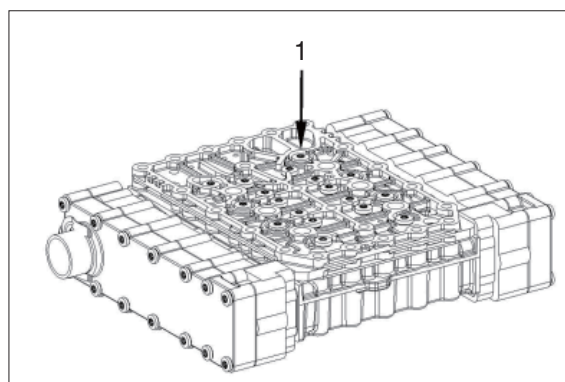
- (5) Mark installation position of wiring harness (1) towards valve block (2).



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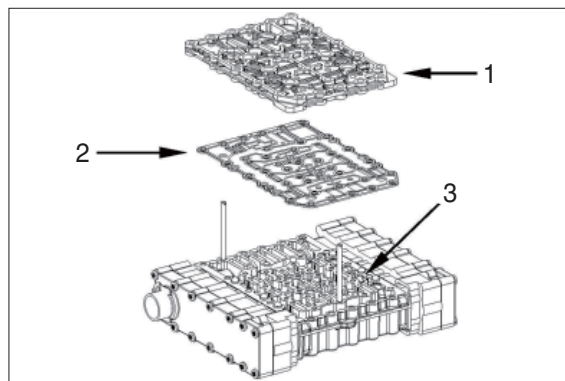
- (6) Loosen torx screws (1).

Socket wrench TX-27      5873 042 002



7709ACV06

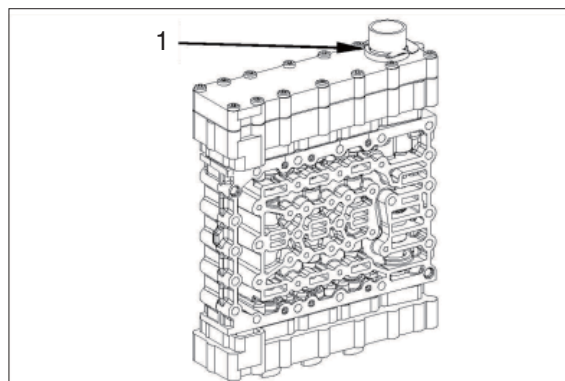
- (7) Separate duct plate (1) and sealing plate (2) from valve block (3).



7709ACV07



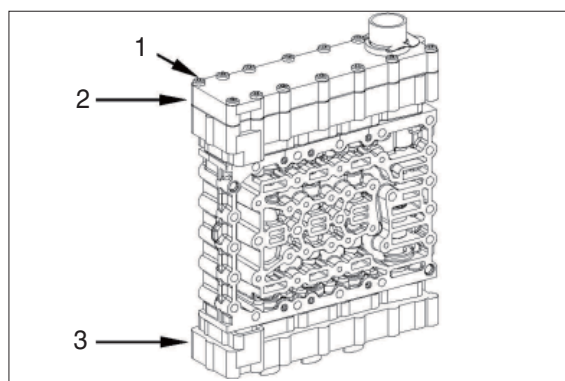
(8) Remove retaining clamp (1).



7709ACV08

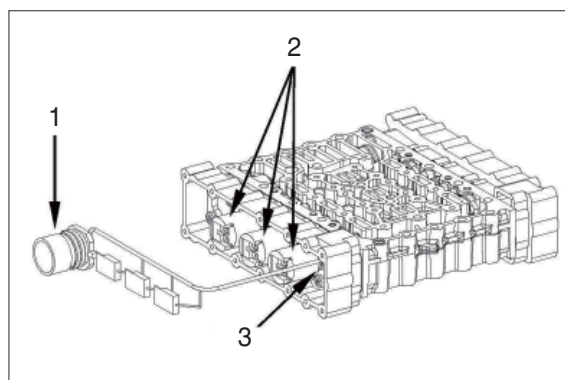
(9) Loosen torx screws (2) and remove cover (2). Remove opposite cover (3) in the same way.

Socket wrench TX-27      5873 042 002



7709ACV09

(10) Remove wiring harness (1).  
Loosen cylindrical screws (3), remove fixing plates and remove pressure controllers (2).



7709ACV10

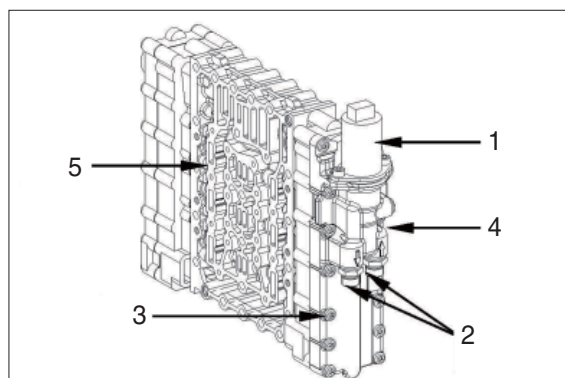
(11) **Lock-up clutch solenoid valve (5-speed transmission)**

Mark installation position of connecting housing (4) towards valve block (5).

Loosen cylindrical screws (1) and remove lock-up clutch valve.

Loosen screws neck (2) and remove O-rings.

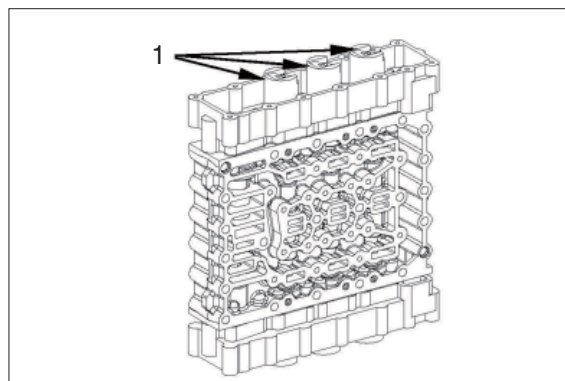
Loosen torx screws (3) and remove connecting housing.



7709ACV11



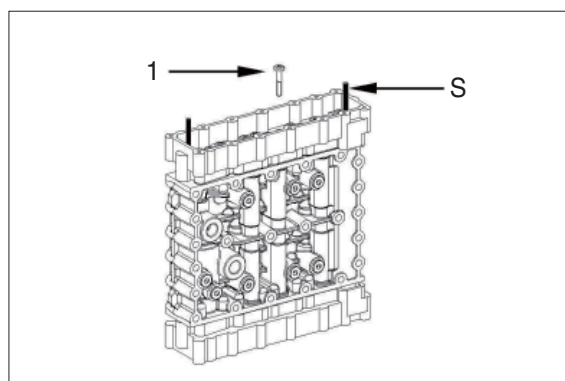
- (12) Loosen cylindrical screws, remove fixing plates and remove pressure controllers (1) on opposite side.



7709ACV12

- (13) Loosen torx screws (1) and preliminarily fix housing by means adjusting screws (S). (Housing is spring-loaded.) Then loosen remaining torx screws.

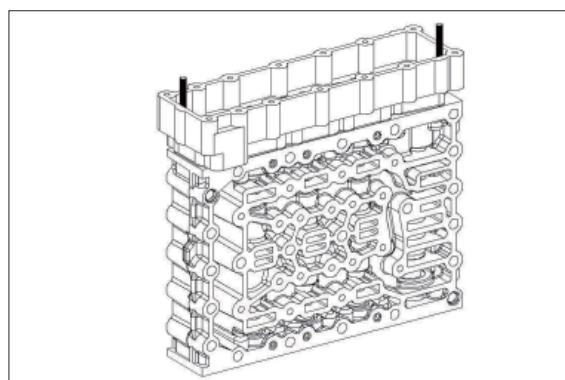
Adjusting screws                      5870 204 036



7709ACV13

- (14) Separate housing from valve housing by loosening the adjusting screws equally.

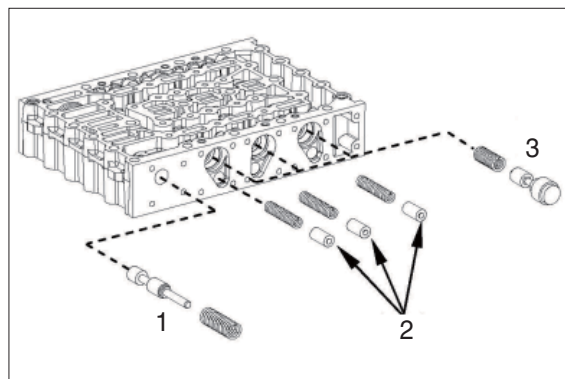
Adjusting screws                      5870 204 036



7709ACV14

- (15) Remove individual parts :

- 1 Pressure reducing valve
- 2 Vibration dampers
- 3 Follow-on silde

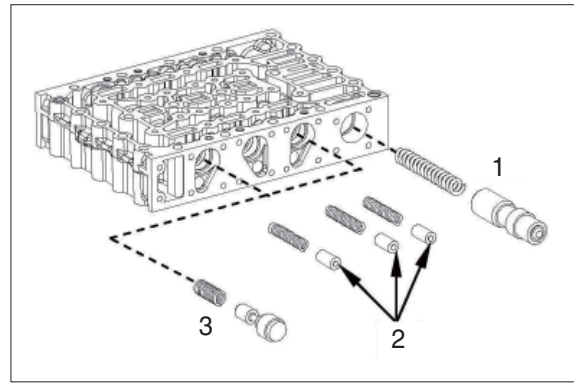


7709ACV15



(16) Remove individual parts of opposite side analogously :

- 1 Main pressure valve
- 2 Vibration dampers
- 3 Follow-on silde



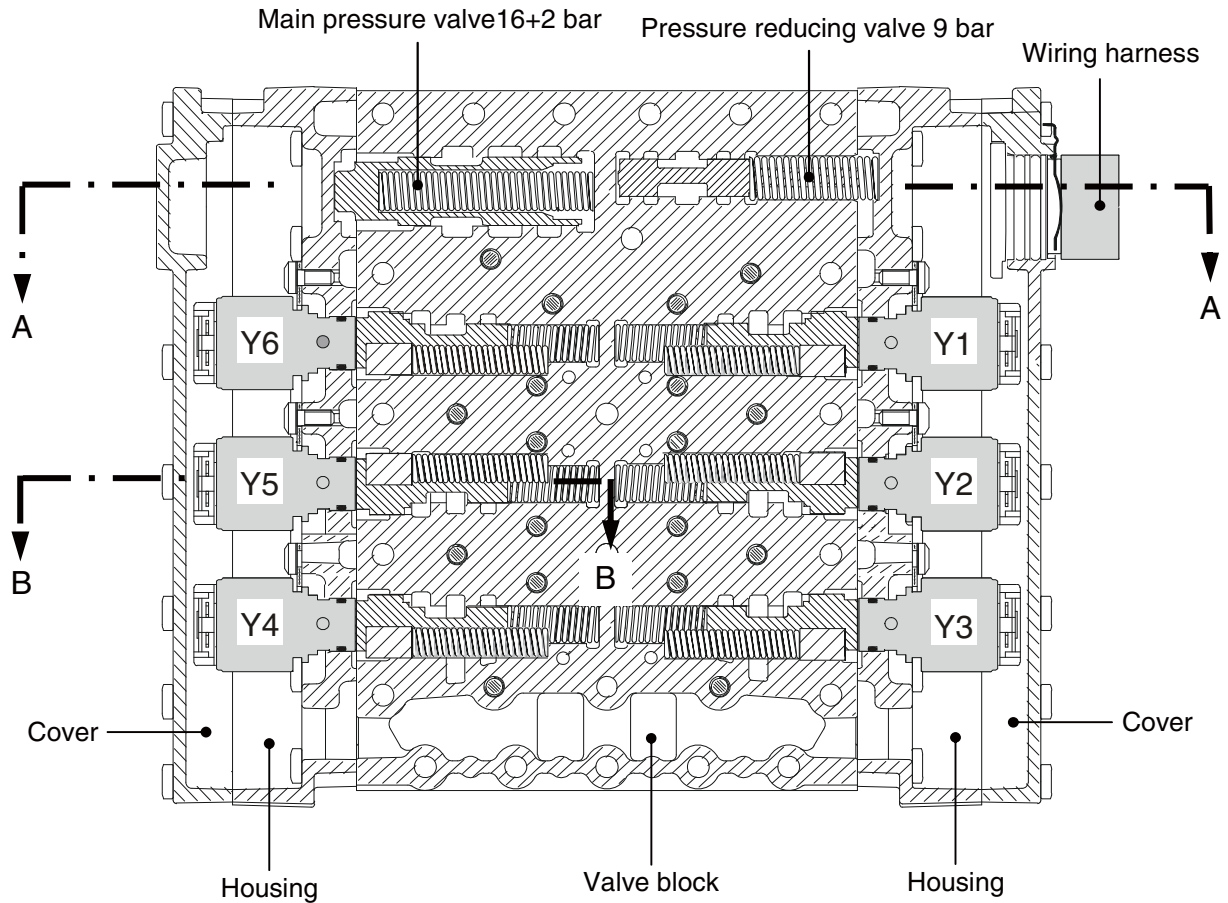
7709ACV16



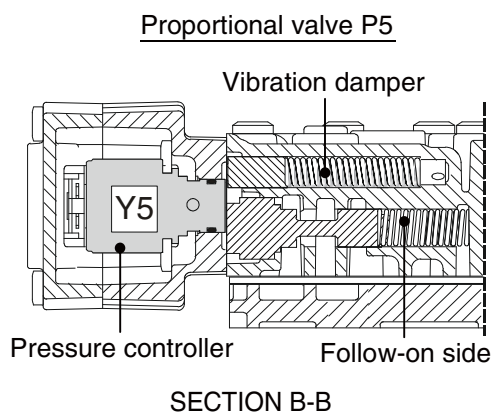
## 2) REASSEMBLY

### Electro-hydraulic control with proportional valves :

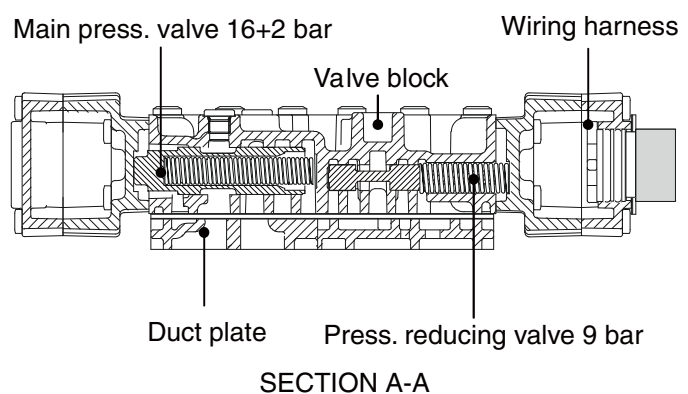
※ The following sketches show the sectional views of the electro-hydraulic control.



7709ACV17



7709ACV18



7709ACV19



### (1) Fitting of electric control

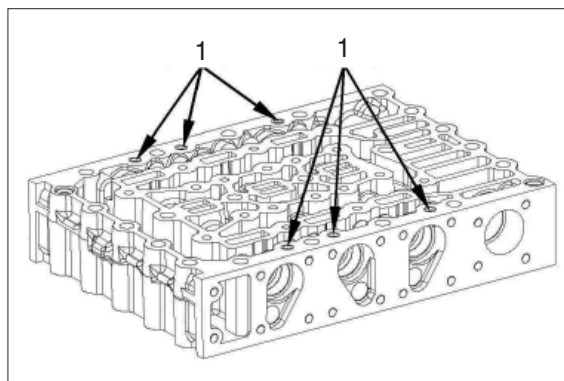
※ All single parts are to be checked for damage and replaced, if required.

Ensure free travel of the moving parts in the valve block prior to installation. Pistons can be exchanged individually.

Prior to the installation, oil single part.

- ① With the concave side showing upwards, insert orifice (1) until contact is obtained.

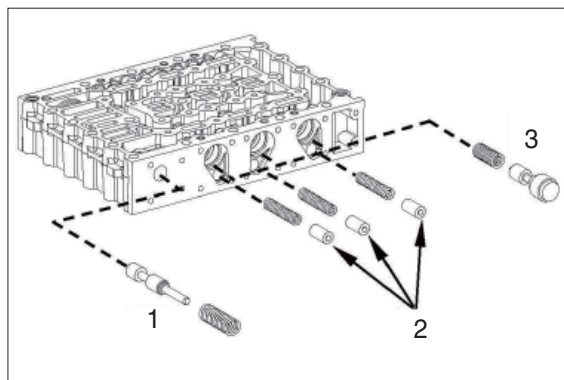
※ See arrows for installation position.



7709ACV20

- ② The opposite figure shows the following single parts :

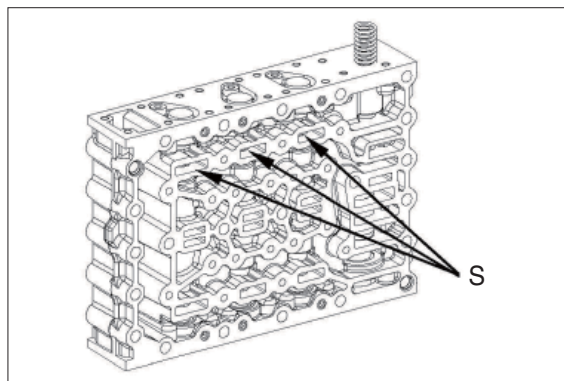
- 1 Pressure reducing valve  
(1EA, piston and compression spring)
- 2 Vibration damper  
(3EA, piston and compression spring)
- 3 Follow-on slide  
(3EA, piston and compression spring)



7709ACV21

- ③ Install the single parts according to figure CV21.

※ Preload compression springs of the follow-on slides and preliminarily fix pistons by means of cylindrical pins  $\varnothing 5.0$  mm (assembly aid), see arrows (S).



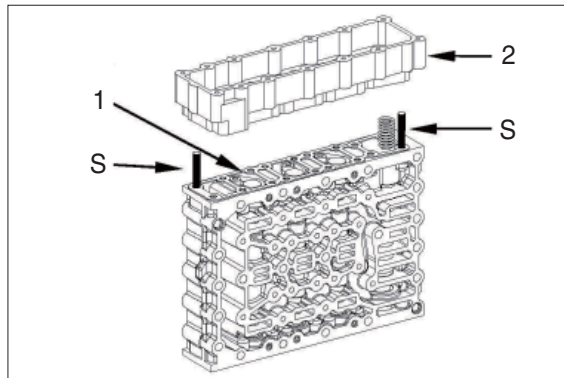
7709ACV22

- ④ Fit two adjusting screws.

Mount seal (1) and housing (2).

Then position housing equally by means of adjusting screws until contact is obtained.

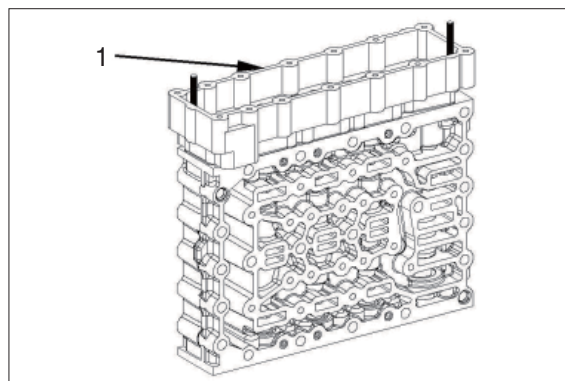
Adjusting screws (S) 5870 204 036



7709ACV23



- ⑤ Bring housing (1) into contact position by means of the torx screws. This will preload the pistons, and you can remove the cylindrical pins (assembly aid).

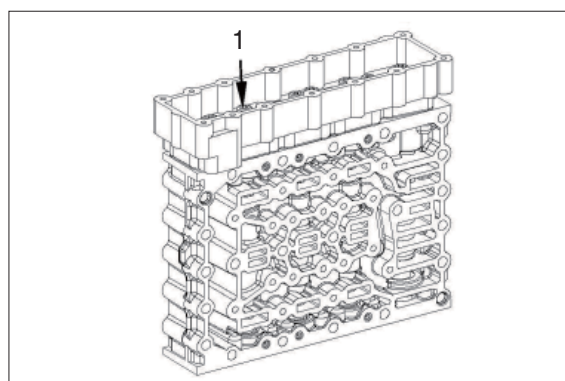


7709ACV24

- ⑥ Fix housing by means of the torx screws (1).

· Tightening torque (M5/10.9×30) :  
0.56 kgf · m (4.06 lbf · ft)

Reducing adapter                    5870 656 056  
Socket wrench TX-27                5873 042 002



7709ACV25

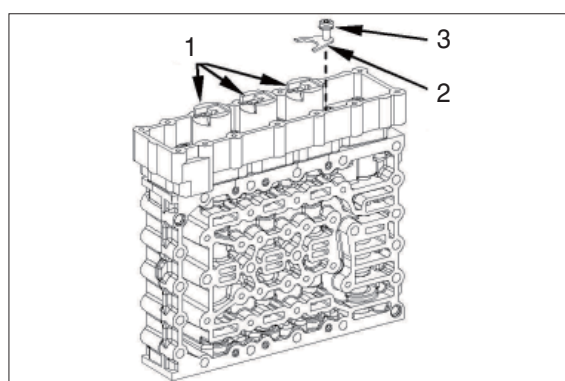
- ⑦ Monut pressure controllers with O-ring 13.5×2 (1) and fasten them by means of fixing plates (2) and torx screws (3).

※ Install the fixing plate, with the claw showing downwards.

Pay attention to the radial installation position of pressure controllers, see figure.

· Tightening torque (M5/8.8×12) :  
0.56 kgf · m (4.06 lbf · ft)

Reducing adapter                    5870 656 056  
Socket wrench TX-27                5873 042 002

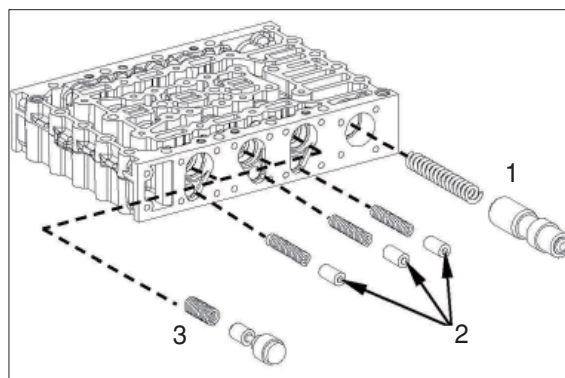


7709ACV26

### Preassemble the opposite side

- ⑧ The figure on the right shows the following single parts :

- 1 Main pressure valve  
(1EA, piston and compression spring)
- 2 Vibration damper  
(3EA, piston and compression spring)
- 3 Follow-on slide  
(3EA, piston and compression spring)



7709ACV27



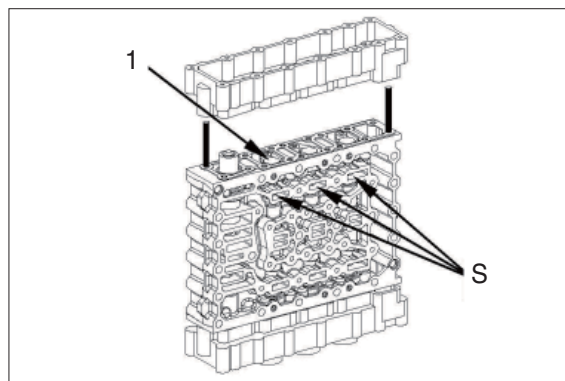
- ⑨ Install the single parts according to figure CV27.

- ※ Preload the compression springs of the follow-on slides and fasten the pistons preliminarily by means of cylindrical pins (S)  $\varnothing 5.0$  mm (assembly aid), see arrows (S).

Install two adjusting screws.

Adjusting screws M5      5870 204 036

Assemble flat gasket (1) and housing cover. Then place the housing cover by means of adjusting screws equally until contact.



7709ACV28

- ⑩ Preload the position with torx screws and remove the cylindrical pins (assembly aid) again.

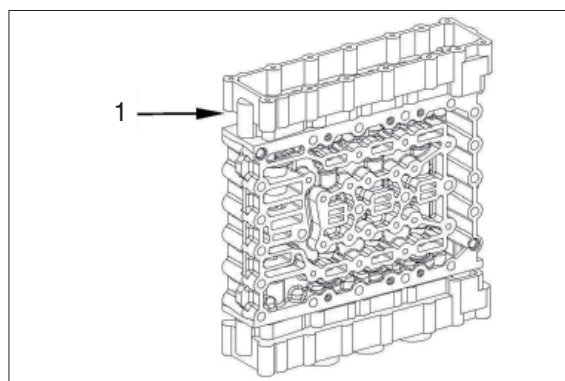
Then fasten the housing cover by means of torx screws (1).

- Tightening torque (M5/10.9 $\times$ 30) :  
0.56 kgf · m (4.06 lbf · ft)

Adjusting screws      5870 204 036

Reducer      5870 656 056

Socket spanner TX-27      5873 042 002



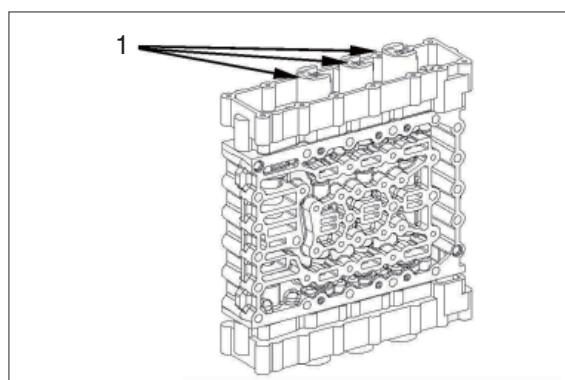
7709ACV29

- ⑪ Mount the pressure regulators with O-ring 13.5 $\times$ 2 (1) and fasten them by means of fixing plates and cap screws.

- ※ Install the fixing plate with the neck showing downwards.

Observe radial installation position of the pressure regulators, see figure.

- Tightening torque (M5/8.8 $\times$ 12) :  
0.56 kgf · m (4.06 lbf · ft)

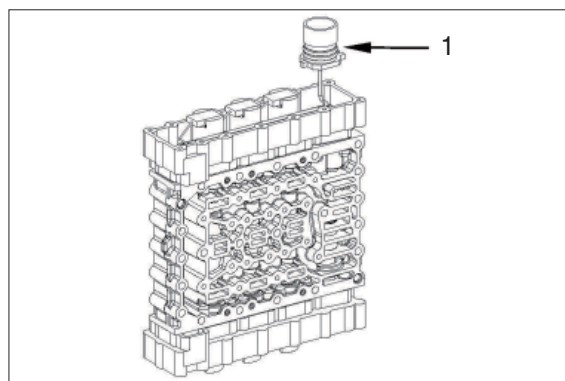


7709ACV30

- ⑫ Assemble the wiring harness (1) and connect the pressure regulators (6EA).

- ※ See figure CV01 for installation position of pressure regulators.

- ※ Pay attention to the installation position of the wiring harness, also see markings (figure CV05).



7709ACV31



⑬ Put on the flat gasket (1).

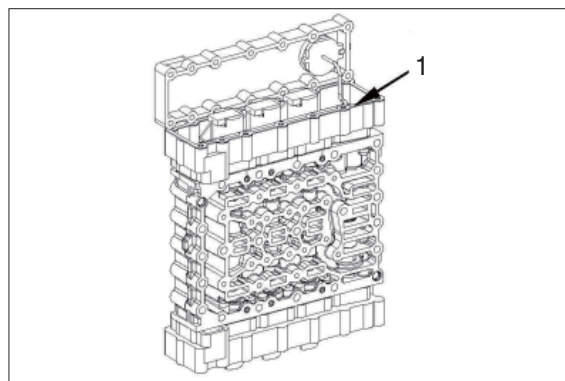
Assemble the plug socket with the slot showing to the lug of the cover until contact.

Fasten the cover by means of cap screws.

- Tightening torque (M5/10.9×30) :  
0.56 kgf · m (4.06 lbf · ft)

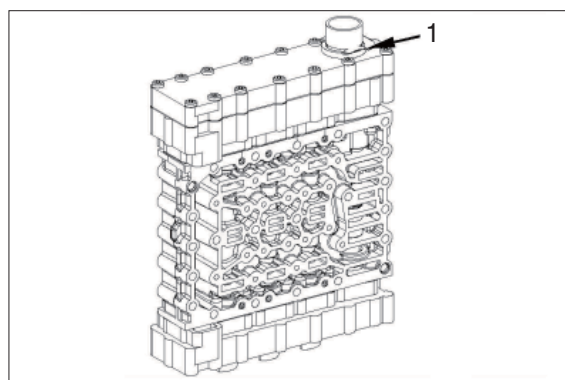
Reducer 5870 656 056

Socket spanner TX-27 5873 042 002



7709ACV32

⑭ Fix the wiring harness by means of retaining clamp (1).



7709ACV33

⑮ Lock-up clutch solenoid valve (5-speed transmission)

a. Place gasket (1).

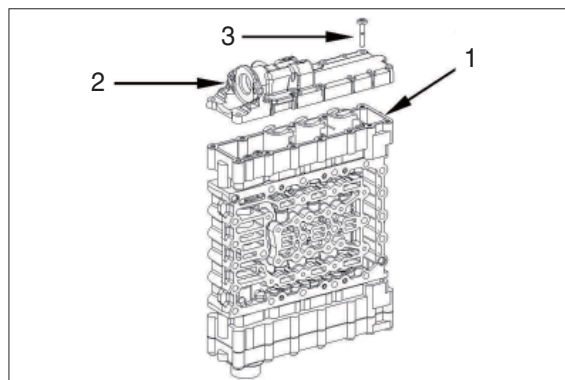
Fix connecting housing (2) by means of torx screws (3).

- Tightening torque (M5/10.9×30) :  
0.56 kgf · m (4.06 lbf · ft)

Torque wrench 5870 203 031

Socket wrench TX-27 5873 042 002

Reducing adapter 5870 656 056



7709ACV34

※ Pay attention to installation position of connection housing, see the markings applied during disassembly.



- b. Fix pressure controller (1) by means of cylindrical screws (2).

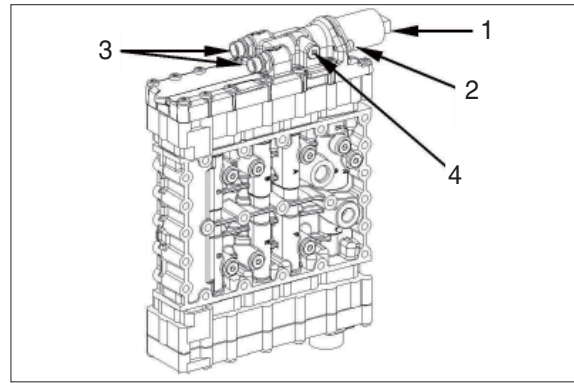
· Tightening torque (M6/8.8 × 12) :  
1.02 kgf · m (7.38 lbf · ft)

Fit screw necks with O-ring 11.3 × 2.4 (3).

· Tightening torque :  
2.55 kgf · m (18.4 lbf · ft)

Fit screw plug with O-ring 8 × 1.5 (4).

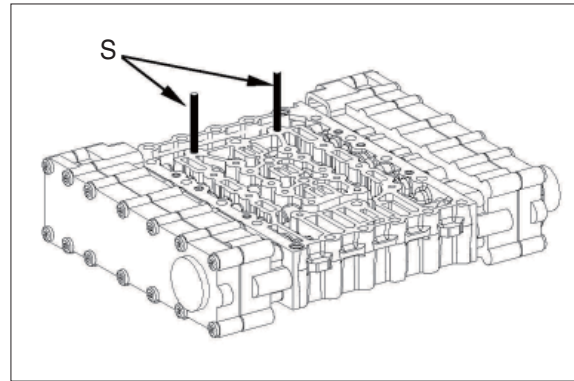
· Tightening torque (M10 × 1) :  
1.02 kgf · m (7.38 lbf · ft)



7709ACV35

- ⑩ Install two adjusting screws (S).

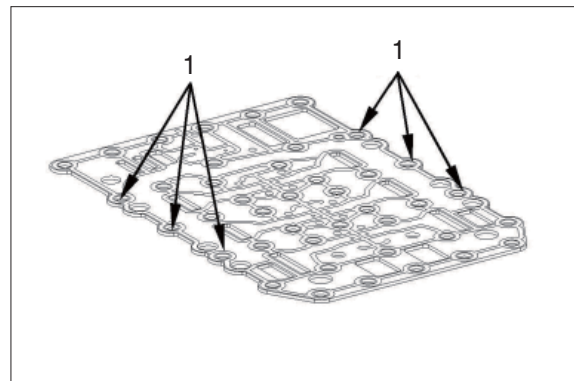
Adjusting screws 5870 204 063



7709ACV36

- ⑪ Flush-mount screens (1) into the holes of the sealing plate, see arrows.

※ Pay attention to the installation position  
- screens to show upwards (towards the duct plate).



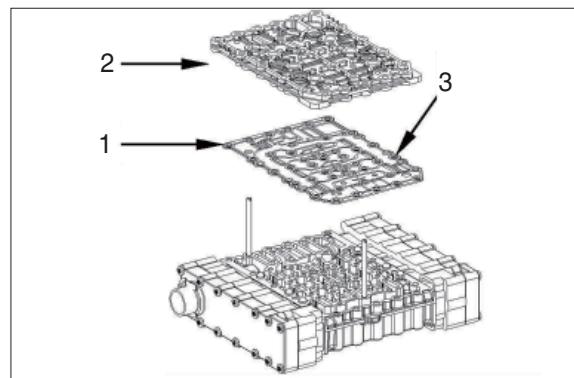
7709ACV37

- ⑫ Put on sealing plate (1) and duct plate (2).

※ Screens (3) to show upwards.

※ It is not permitted to reassemble the seal plate after opening the threaded joint shift unit/duct plate.

In case of repair it is always necessary to mount a new seal plate.



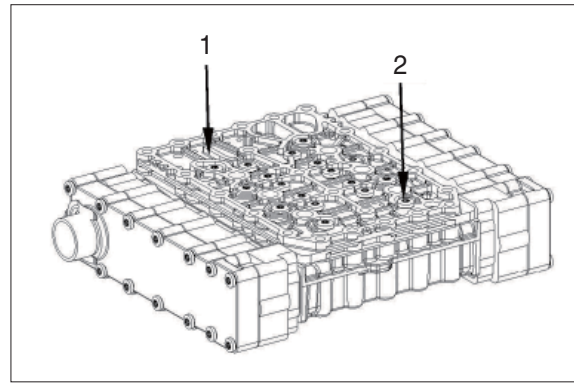
7709ACV38



- ⑲ Place duct plate (1) and fix it equally by means of torx screws (2).

· Tightening torque (M6/10.9×23) :  
1.07 kgf · m (7.74 lbf · ft)

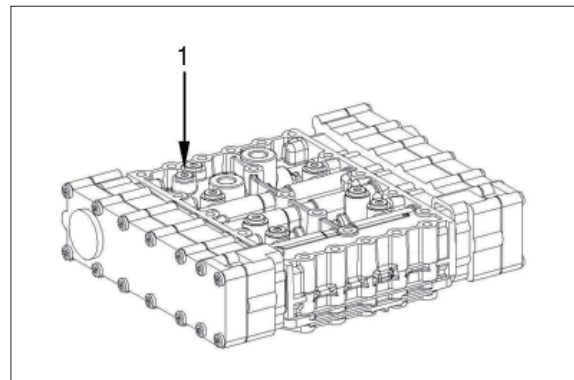
Socket wrench TX-27      5873 042 002



7709ACV39

- ⑳ Provide the screw plugs M10×1 with O-rings 8×1.5 (1) and install them.

· Tightening torque :  
0.61 kgf · m (4.43 lbf · ft)

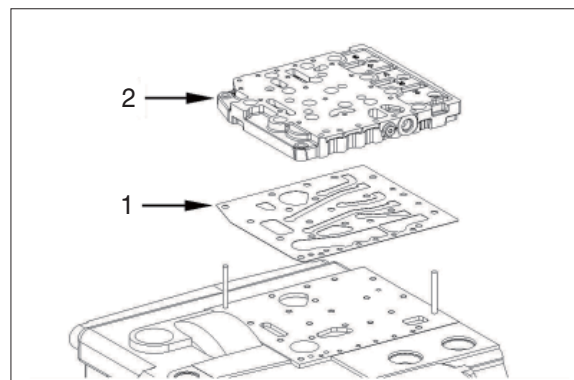


7709ACV40

- ㉑ Fit two adjusting screws.

Adjusting screws      5870 204 011

Place gasket (1) and duct plate (2) at the gearbox housing part until contact is obtained.



7709ACV41

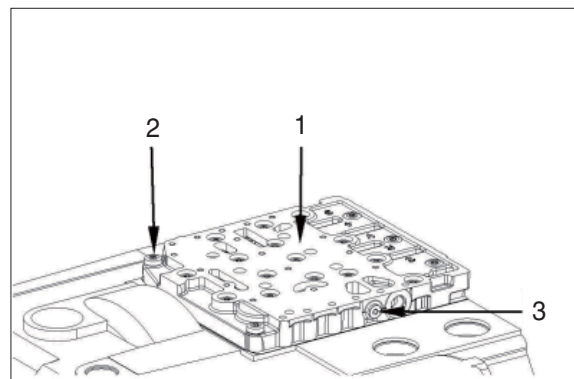
- ㉒ Fix duct plate (1) by means of torx screws (2).

· Tightening torque (M8/10.9×35) :  
2.35 kgf · m (17.0 lbf · ft)

Mount screw plug with O-ring 8×1.5 (3).

· Tightening torque (M10×1) :  
0.61 kgf · m (4.43 lbf · ft)

Socket wrench TX-40      5873 042 004



7709ACV42

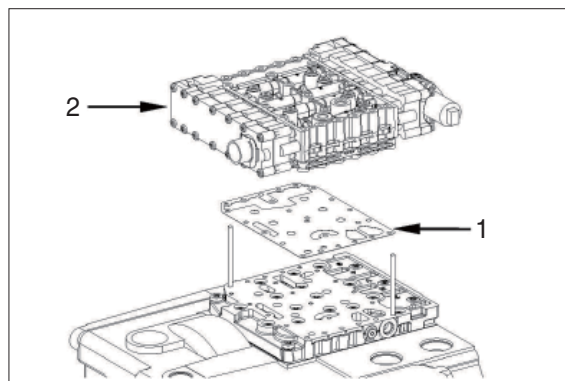


②③ Fit two adjusting screws.

Adjusting screws 5870 204 063

Mount sealing plate (1) and electro-hydraulic control unit (2).

- ※ It is not permitted to reassemble the seal plate after opening the threaded joint shift unit/gearbox housing.  
In case of repair it is always necessary to mount a new seal plate.



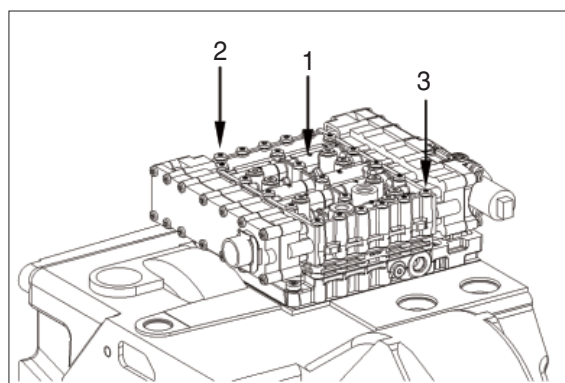
7709ACV43

②④ Fix electro-hydraulic control unit (1) equally by means of torx screws (2 and 3)

- Tightening torque (M6/10.9×76) :  
0.97 kgf · m (7.01 lbf · ft)
- Tightening torque (M6/10.9×100) :  
0.97 kgf · m (7.01 lbf · ft)

Socket wrench TX-27 5873 042 002

Reducing adapter 5870 656 056



7709ACV44

**Pipe - System pressure to lock-up clutch valve (5-speed transmission)**

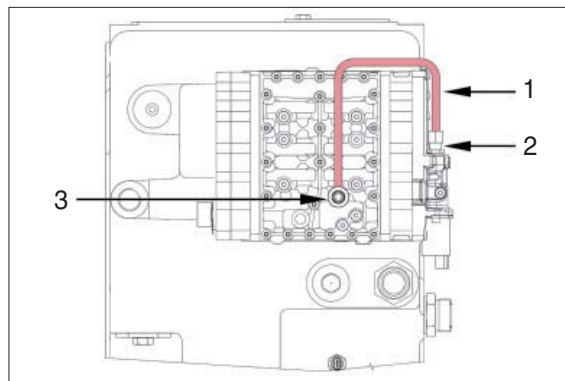
②⑤ Fix pipes (1) with hollow screws (3) and O-rings and screw nut (2).

Fit O-ring 13×2 on hollow screw (3), insert into eye of pipes, mount O-ring 18×2.5.

- Tightening torque :  
4.59 kgf · m (33.2 lbf · ft)

Fixing of screw nut (2).

- Tightening torque :  
3.57 kgf · m (25.8 lbf · ft)



7709ACV45



**Pipes - System pressure from lock-up clutch valve to lock-up clutch (5-speed transmission)**

②⑥ Fix pipe union (1).

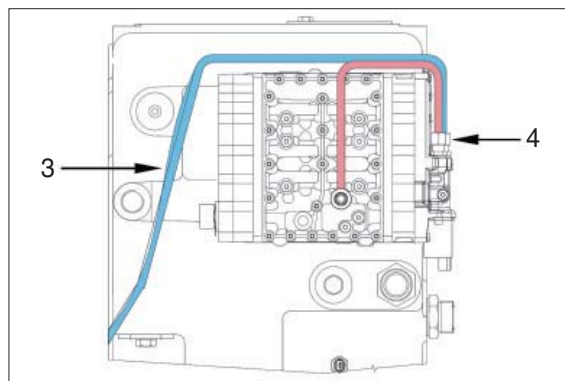
- Tightening torque :  
4.08 kgf · m (29.5 lbf · ft)

Fix connection socket (2).

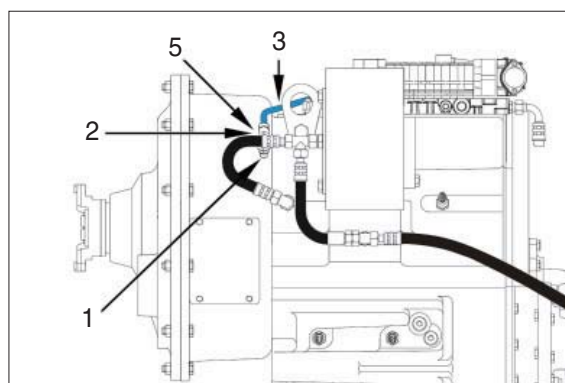
- Tightening torque :  
3.57 kgf · m (25.8 lbf · ft)

Fix pipes (3) with screw nut (4 and 5).

- Tightening torque :  
3.57 kgf · m (25.8 lbf · ft)

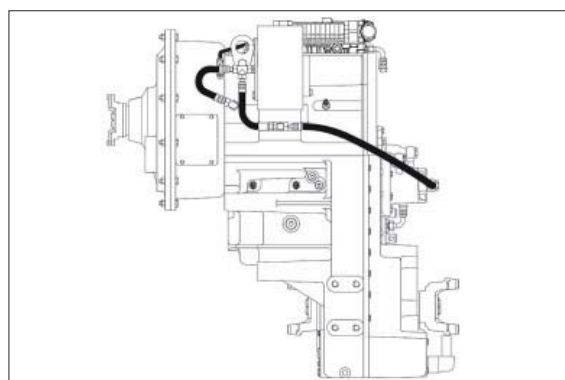


7709ACV46



7709ACV47

※ Before putting the transmission into operation, fill it with oil according to operation manual.



7709ACV48



## 2. TRANSMISSION

### 1) DISASSEMBLY

- (1) Fasten the complete transmission to the assembly truck.

※ Special tool

Assembly truck 5870 350 000

Holding fixture 5870 350 071



Figure 1

- (2) Remove the plug (arrow) and drain the oil. Then remove the oil cylinder.

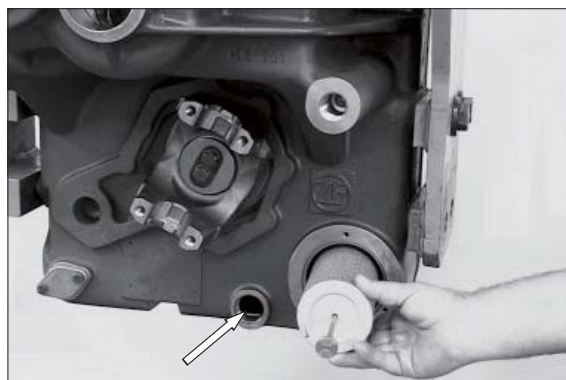


Figure 2

- (3) Remove all oil pipes, the complete gear shift system and the duct plate.

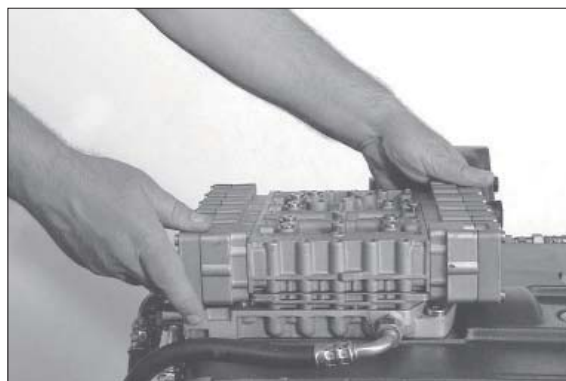


Figure 3

### Converter/drive

- (1) By means of the lifting tackle separate the torque converter from the transmission.

※ Special tool

Eybolts assortment 5870 204 002

Lifting chain 5870 281 047



Figure 4



- (2) Loosen the bolt connection and by means of the forcing screws (3EA) separate the cover from the converter bell.

※ Special tool

Forcing screws 5870 204 005



Figure 5

- (3) By means of the extractor pull the oil supply flange out of the converter bell.

※ Special tool

Extractor 5870 000 089



Figure 6

- (4) Remove the converter safety valve (arrow 1), if required.

※ Converter safety valve is fixed by means of slotted pin (arrow 2).



Figure 7

- (5) Loosen the bolt connection (M8 and M12) and by means of lifting tackle and pry bar set separate the coverter bell from the transmission housing.

※ Special tool

Eyebolts assortment 5870 204 002

Pry bar set 5870 345 036

Lifting chain 5870 281 047



Figure 8



(6) Remove the rectangular ring (arrow).



Figure 9

(7) Press the input shaft out of the spur gear bearing. Remove the released bearing inner ring and the spur gear.

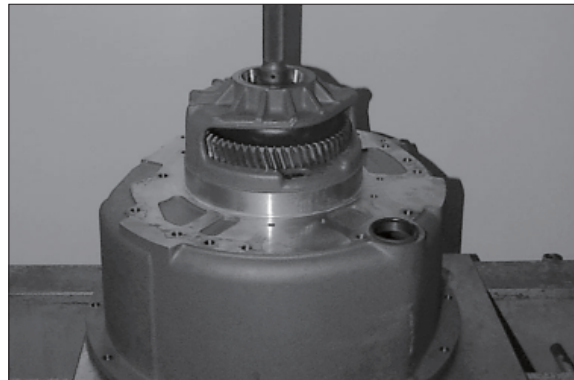


Figure10

(8) Press off the bearing inner ring from the spur gear.

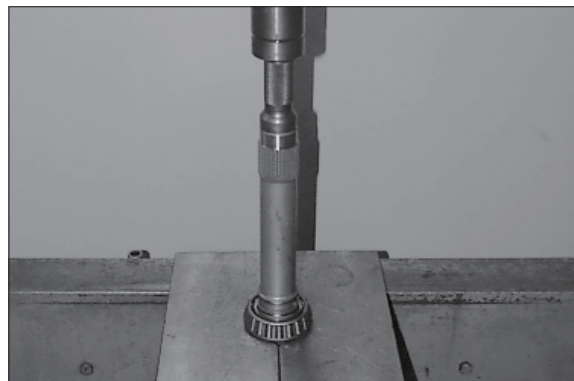


Figure11

(9) Remove the converter pressure back-up valve.



Figure 12



- (10) Remove the inductive transmitter.  
9 = n - Engine

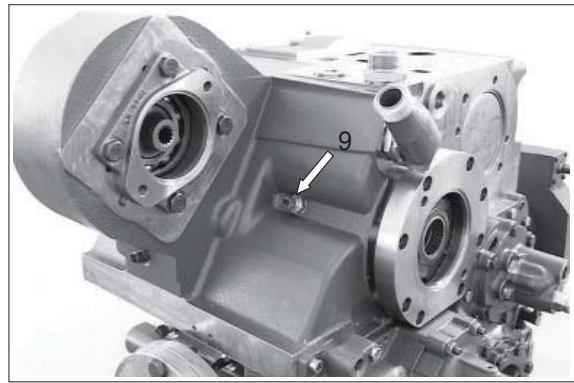


Figure 13

### Input shaft - pump/power take-off

- (1) Loosen the cap screw.

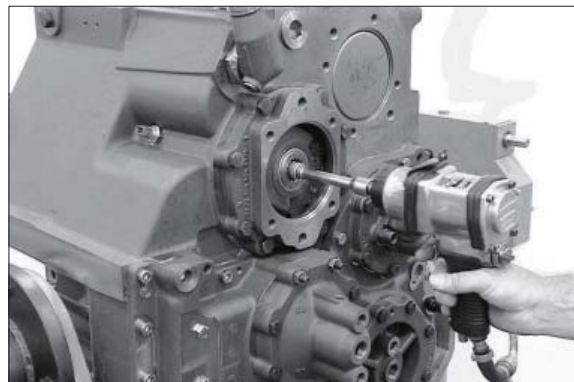


Figure 21

- (2) Remove the cap screw and clamping plate.

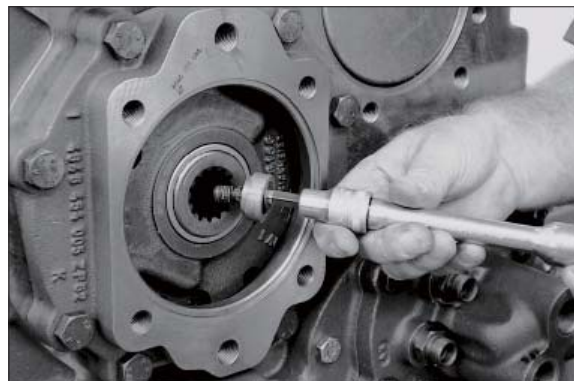


Figure 22

- (3) Press the input shaft out of the bearing.

※ Pay attention to released input shaft as well as shims.

※ Special tool

Extractor

5870 000 065



Figure 23



- (4) Snap out the rectangular ring (arrow 1) and remove both shims (arrow 2).

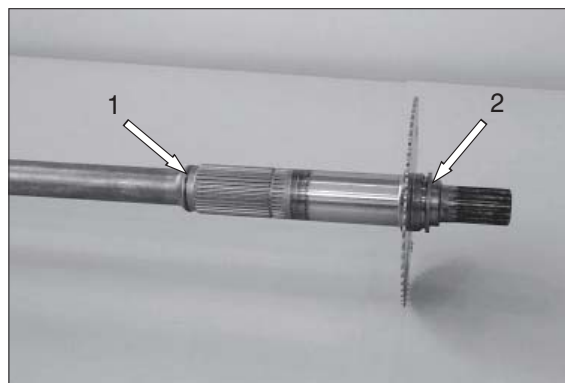


Figure 24

### Transmission pump

- (1) Loosen the cap and hexagon screws (depending on the version) respectively and separate the pump flange from the housing.



Figure 25

- (2) Loosen the cap screws (4EA / M8).  
Position the extractor on the transmission pump and fasten it by means of screws (M8 × 65) to the transmission pump. Then pull out the pump from the housing bore.

※ Extracting is supported by slightly tapping onto the transmission housing.

※ Special tool

Extractor

5870 000 089

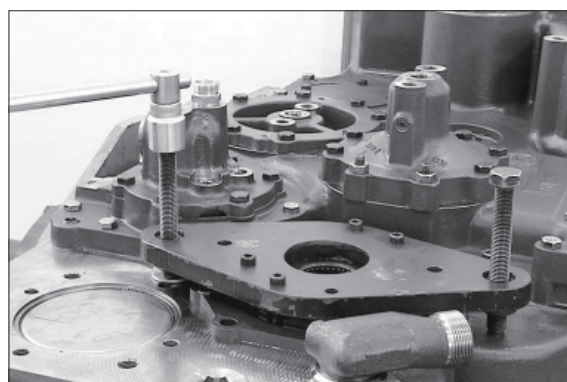


Figure 26

### Remove the ball bearing and the driver (figure 28~29)

- (3) Snap out the retaining ring.



Figure 28



- (4) Press out the driver with ball bearing from the bearing bore.  
Then separate the ball bearing from the driver.

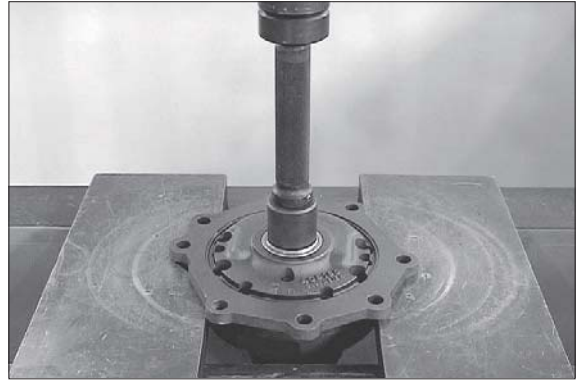


Figure 29

- (5) Loosen the cap screws, take off the pump cover and remove the rotor set.

**⚠ If marks due to running-in are found on the pump housing or housing cover, the complete pump is to be replaced.**

Then assemble the rotor set with the chamfer on the tooth tip showing downwards and install the housing cover again.

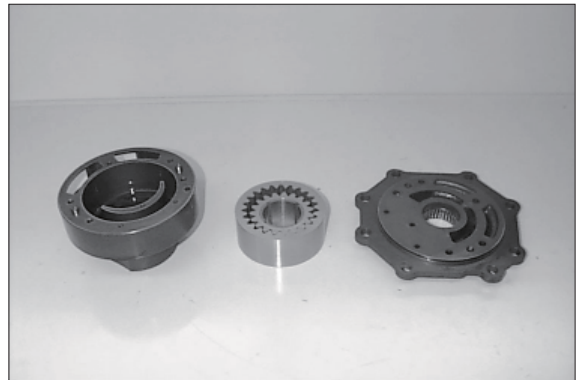


Figure 30

- Torque limit (M8/8.8) :  
2.35 kgf · m (17.0 lbf · ft)
- Torque limit (M6/8.8) :  
0.97 kgf · m (7.01 lbf · ft)



### Layshaft

- (1) Remove the sealing cover and loosen the hexagon screw.

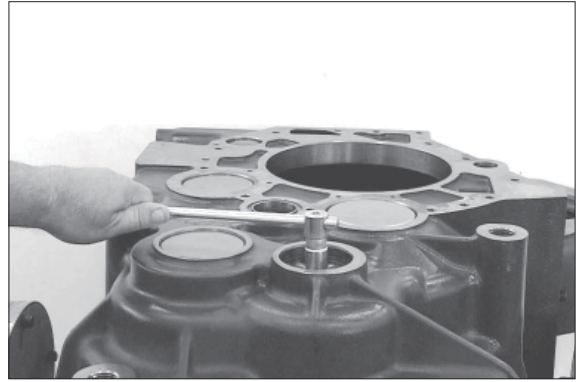


Figure 38

- (2) Expel the idler shaft by means of the striker from the housing bore and layshaft bearing respectively.

※ Special tool

Striker

5870 650 014

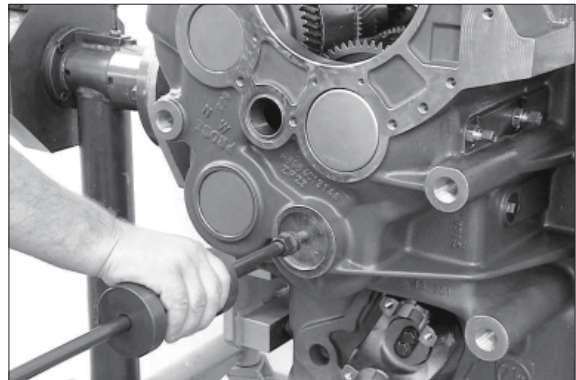


Figure 39

### Removal of inductive and speed transmitter (figure 40~41)

14 = n - Turbine

5 = n - Internal speed input

13 = n - Output (speed transmitter)

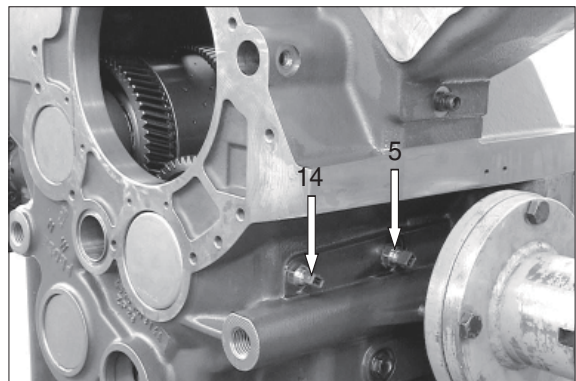


Figure 40

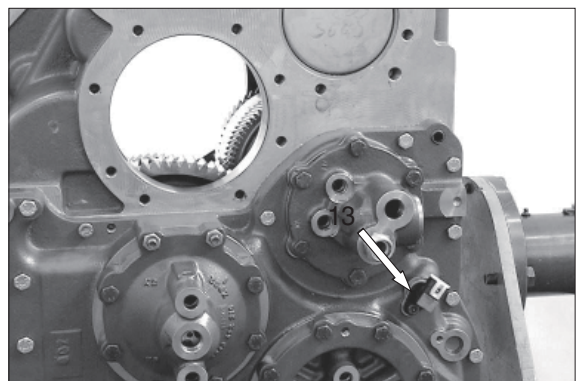


Figure 41



## Output

### Converter side :

Remove the lock plate. Loosen hexagon screws and take off the output flange. Rotate the housing by 180° and remove the output flange on the housing rear side.

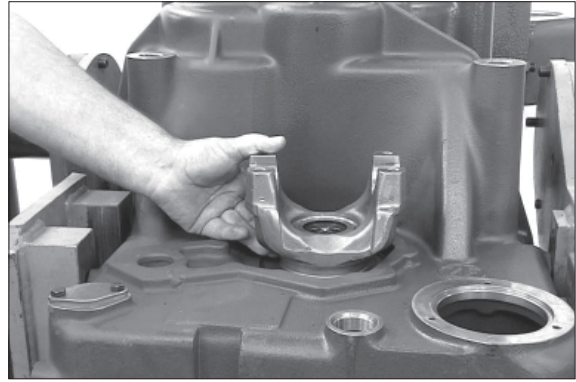


Figure 42

## Removal of the clutches and layshaft

- (1) Loosen the hexagon screws and expel the bearing cover KV/K1 by means of the striker from the housing bore. Remove the bearing cover KR/K2 (arrow) analogously.

※ Mark the installation location of the bearing cover.

※ Special tool

Threaded insert 5870 204 069

Striker 5870 650 014

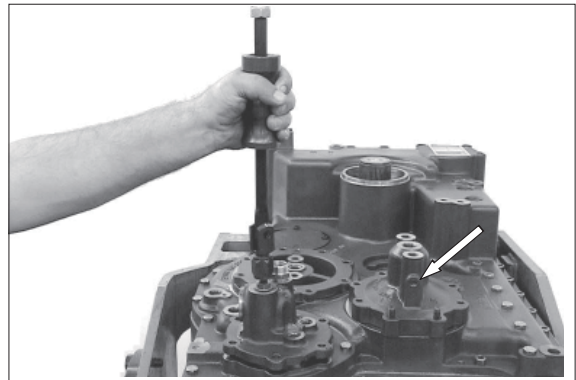


Figure 46

- (2) Pull out the bearing cover K4/K3 by means of the forcing screws from the housing bore.

※ Special tool

Forcing screws 5870 204 005

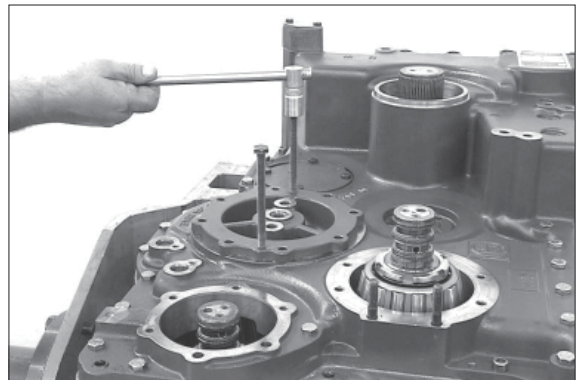


Figure 47

- (3) Separate the bearing inner ring from bearing cover K4/K3.

※ Special tool

Three-armed puller 5870 971 003



Figure 48



- (4) Loosen the bolt connection.

Separate the housing cover from the housing by equally tightening both forcing screws (arrow 1 and 2) as well as the threaded spindle (arrow 3).

※ Special tool

Internal hex spanner, size 8 5870 290 003

Forcing screws 5870 204 005

Lifting tackle 5870 281 061

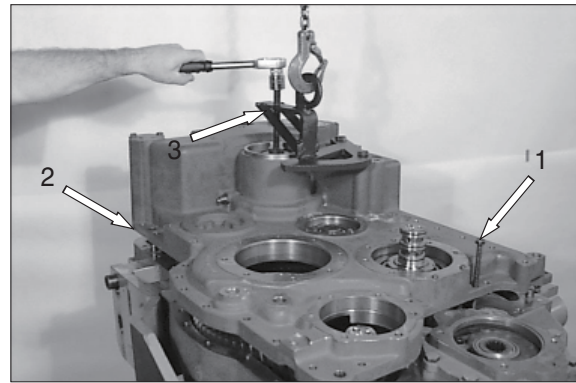


Figure 49

- (5) Expel the output shaft from the output gear.

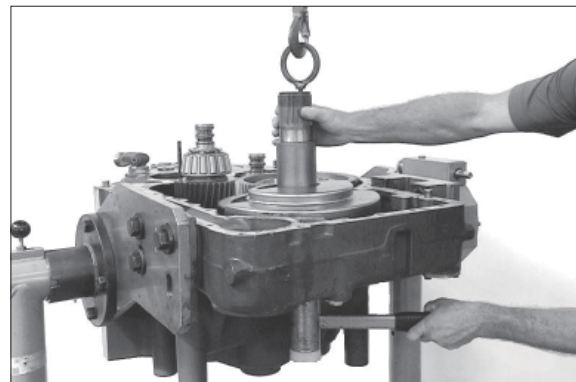


Figure 50

- (6) Loosen the hexagon screws and remove the oil baffle.

Lift the output gear out of the transmission housing (figure).

※ Special tool

Stop washer 5870 100 054

Eyebolts assortment 5870 204 002



Figure 51

- (7) Remove the bearing inner ring from the output gear.

※ Special tool

Three-armed puller 5870 971 003



Figure 52



- (8) Take the roller bearing out of the housing bore and remove the oil baffle (arrow).



Figure 53

### Remove the multi-disc clutches

- ※ For removal of the single clutches observe the following sequence :

K4/K3 → KR/K2 → KV/K1.

For removal of clutch K4/K3, lift the clutch KR/K2 slightly and move it in direction of the arrow, see figure.

- ※ Special tool

Eyebolts assortment      5870 204 002

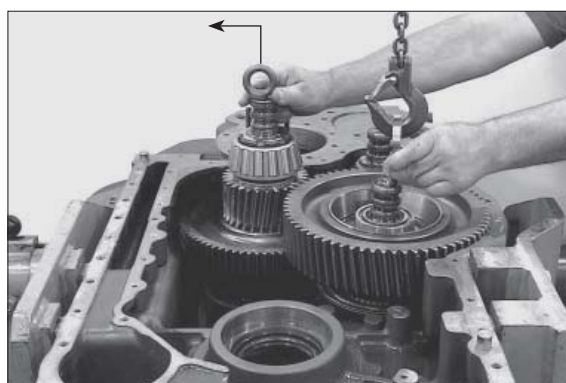


Figure 54

- (9) Opposite figure shows the clutches when removed.

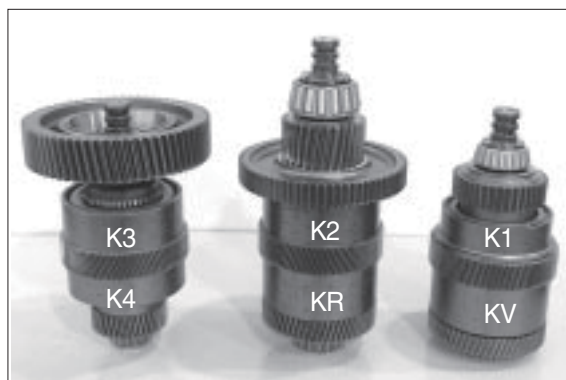


Figure 55

- (10) Remove the layshaft gear.



Figure 56



### Dismantling of the Multi-Disc Clutch K3/K4

- (1) By means of clamping ring fasten the clutch to the assembly truck.

※ Special tool  
Clamping ring 5870 654 033



Figure 62

- (2) Pull off the roller bearing from the disc carrier.

※ Special tool  
Three-armed puller 5870 971 002



Figure 63

- (3) Separate spur gear K3 from the disc carrier.



Figure 64

- (4) Pull off the bearing inner ring from the disc carrier.

※ Special tool  
Rapid grip 5873 012 012  
Basic tool 5873 002 001



Figure 65



- (5) Squeeze out the snap ring.  
Remove the end shim and disc set K3.



Figure 66

- (6) Rotate disc carrier by 90°.  
Loosen the slotted nut.

- ※ Special tool  
Slotted nut wrench                    5870 401 118  
Slotted nut wrench                    5870 401 115



Figure 67

- (7) Rotate disc carrier by 90°.  
Pull off the taper roller bearing.

- ※ Special tool  
Gripping insert                    5873 011 012  
Basic tool                    5873 001 000



Figure 68

- (8) Pull off the spur gear K4 from the disc carrier.

- ※ Special tool  
Three-armed puller                    5870 971 003



Figure 69



(9) Remove the ring.



Figure 70

(10) Pull off the taper roller bearing.

※ Special tool  
Three-armed puller 5870 971 002

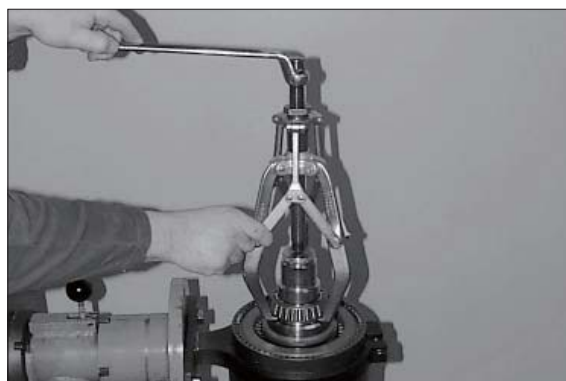


Figure 71

(11) Squeeze out the snap ring.  
Remove the end shim and the disc set K4.



Figure 72

(12) Preload the compression spring by means of fixture.  
Squeeze out the snap ring and the released single components.  
Remove the opposite single components (K3 side) analogously.

※ Special tool  
Pressure piece 5870 345 072



Figure 73



- (13) Separate both pistons by means of compressed air from the disc carrier.

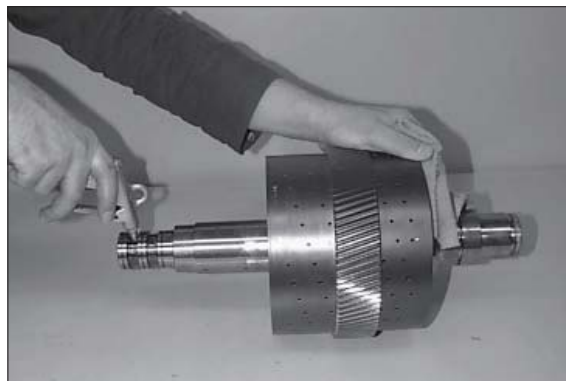


Figure 74

### Dismantling of the multi-disc clutch KR/K2

- (1) Fasten the clutch by means of clamping ring (arrow) on the assembly truck.

※ Special tool  
Clamping ring 5870 654 033



Figure 75

- (2) Rotate disc carrier by 90°.  
Loosen the slotted nut.

※ Special tool  
Slotted nut wrench 5870 401 099



Figure 76

- (3) Pull off the taper roller bearing from the disc carrier.

※ Special tool  
Gripping insert 5873 012 018  
Basic tool 5873 002 001



Figure 77



- (4) Press off the spur gear K2 from the disc carrier.

⚠ Pay attention to released disc carrier.

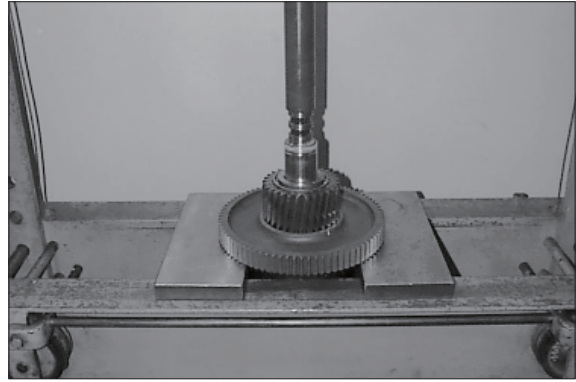


Figure 78

- (5) Fasten the disc carrier by means of clamping ring.  
Pull off the taper roller bearing from the disc carrier.

※ Special tool  
Clamping ring                    5870 654 033  
Gripping insert                5873 012 019  
Basic tool                        5873 002 001

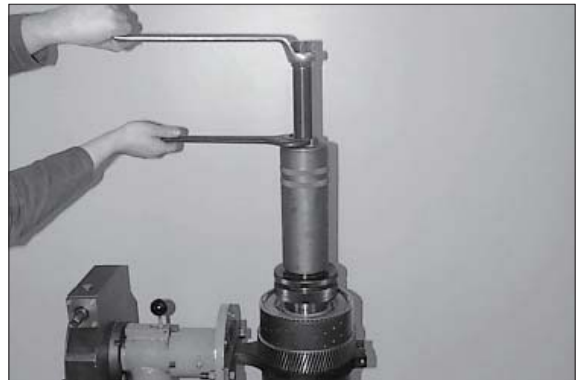


Figure 79

- (6) Squeeze out the snap ring.  
Remove the end shim and disc set K2.



Figure 80

- (7) Rotate disc carrier by 90°.  
Loosen the slotted nut.

※ Special tool  
Slotted nut wrench            5870 401 099

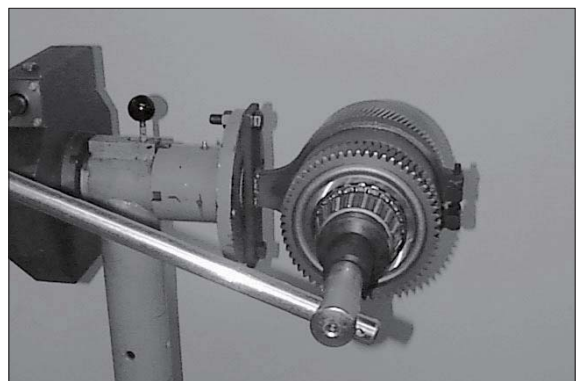


Figure 81



(8) Pull off the taper roller bearing from the disc carrier.

※ Special tool

Gripping insert 5873 002 044

Basic tool 5873 002 001



Figure 82

(9) Fasten spur gear KR by means of clamping ring (arrow) and pull it from the disc carrier.

※ Collar of the clamping ring must show upwards (to the spur gear).

※ Special tool

Three-armed puller 5870 971 003

Clamping ring 5870 654 045

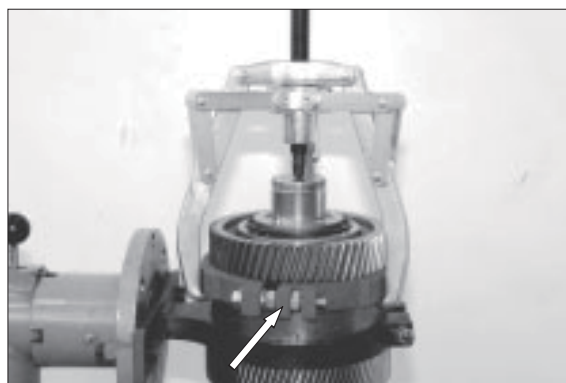


Figure 83

(10) Remove the ring.



Figure 84

(11) Squeeze out the snap ring.  
Remove end shim and disc set KR.



Figure 85



(12) Pull off the taper roller bearing from the disc carrier.

※ Special tool

Gripping insert 5873 012 013

Basic tool 5873 002 001

Remove both piston (like described in figure 73 and 74)



Figure 86

### Dismantling of the multi-disc clutch KV/K1

(1) Fasten clutch by means of clamping ring to the assembly truck.

Loosen the slotted nut (figure 87).

※ Special tool

Clamping ring 5870 654 033

Slotted nut wrench 5870 401 118

Slotted nut wrench 5870 401 099



Figure 87

(2) Pull off the taper roller bearing from the disc carrier.

※ Special tool

Gripping insert 5873 001 023

Basic tool 5873 001 000



Figure 88

(3) Remove the shim.



Figure 89



(4) Pull off spur gear K1 from the disc carrier.

※ Special tool

Three-armed puller 5870 971 003



Figure 90

(5) Opposite figure shows the spur gear bearing K1.

Bearing (1) can only be obtained as complete part.

▲ If it is necessary to remove the clutch-pack-sided ball bearing (arrow or Figure 93 and 94), the complete bearing (1) has to be removed.

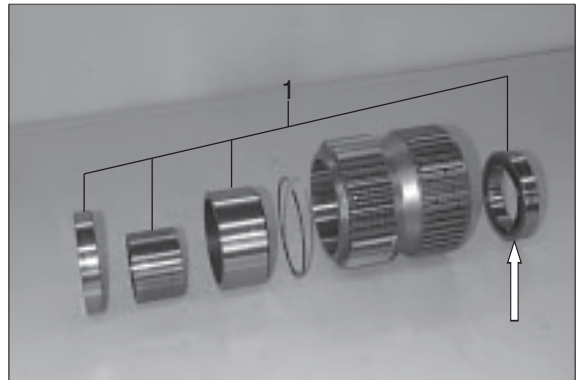


Figure 91

(6) Take off the bush.



Figure 92

(7) Pull off the ball bearing from the disc carrier (figure 93 and 94).

※ Pay attention to released balls.



Figure 93





Figure 94

- (8) Squeeze out the snap ring.  
Remove end shim and disc set K1.



Figure 95

- (9) Rotate disc carrier by 90°.  
Loosen the slotted nut.

- ※ Special tool  
Slotted nut wrench                    5870 401 118  
Slotted nut wrench                    5870 401 115

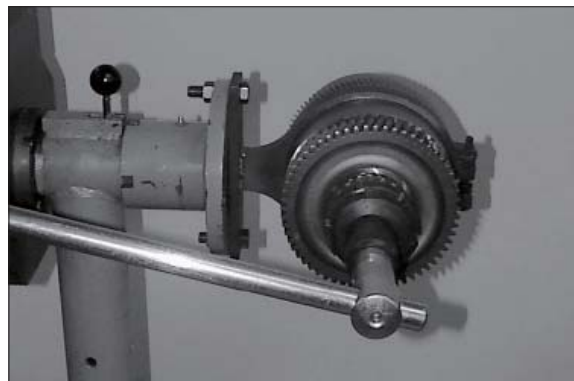


Figure 96

- (10) Pull off the taper roller bearing from the  
disc carrier.

- ※ Special tool  
Gripping insert                    5873 001 034  
Basic tool                    5873 001 000



Figure 97



(11) Pull off spur gear KV from the disc carrier.

※ Special tool

Three-armed puller                      5870 971 003



Figure 98

(12) Remove the ring.



Figure 99

(13) Pull off the taper roller bearing from the disc carrier (figure 100).

Squeeze out the snap ring.

Remove end shim and disc set KV.

Remove both pistons (like described in Figure 73 and 74).

※ Special tool

Gripping insert                      5873 001 034

Basic tool                              5873 001 000



Figure 100



## 2) ASSEMBLY

Assembly of the multi-disc clutch K4/K3

The following sketch shows the clutch sectioning

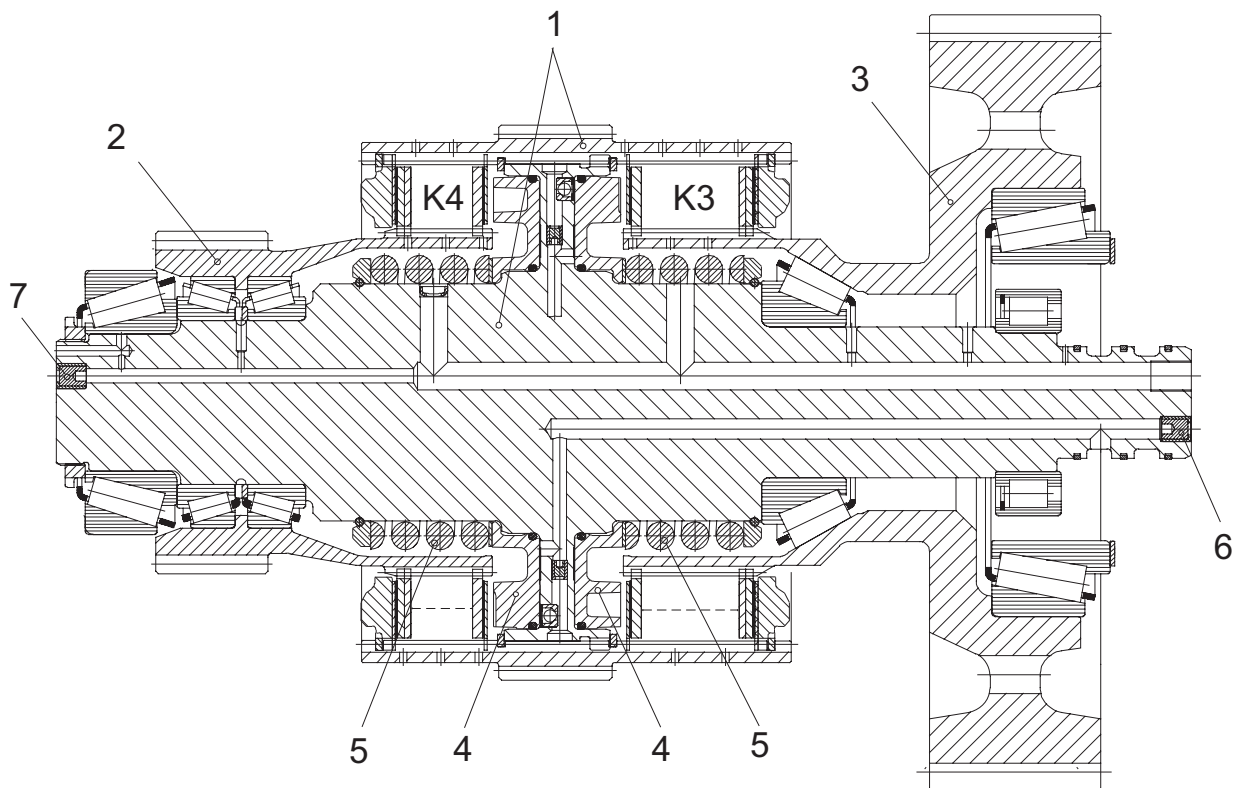


Figure 127

- |   |                    |    |                      |   |                    |
|---|--------------------|----|----------------------|---|--------------------|
| 1 | Disc carrier(assy) | K4 | Multi-disc clutch K4 | 5 | Compression spring |
| 2 | Spur gear K4       | K3 | Multi-disc clutch K3 | 6 | Plug 2EA           |
| 3 | Spur gear K3       | 4  | Piston               | 7 | Plug 1EA           |

※ Observe the installation position of the single components for the following assembly.



- (1) Lift the disc carrier with the K4-side showing downwards into the clamping ring (S) and fasten it.  
Rotate disc carrier by 180°.

※ Special tool  
Clamping ring 5870 654 033

▲ To install new disc carriers the finished bores have to be sealed with plugs.  
Installation position, see arrow, figure 128 and 129.

※ Special tool  
Hand inserting tool 5870 320 014  
Ratchet spanner 5870 320 018



Figure 128



Figure 129

- (2) Flush-mount the drain valve (arrow) with the chamfer showing downwards.

※ Special tool  
Inserting tool 5870 320 019

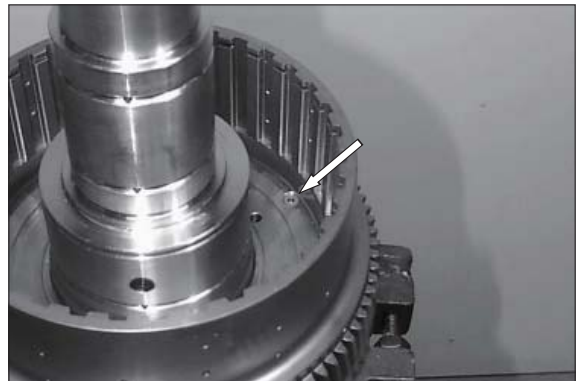


Figure 130

- (3) Put both O-rings scroll-free into the annular grooves of the piston, see arrows.

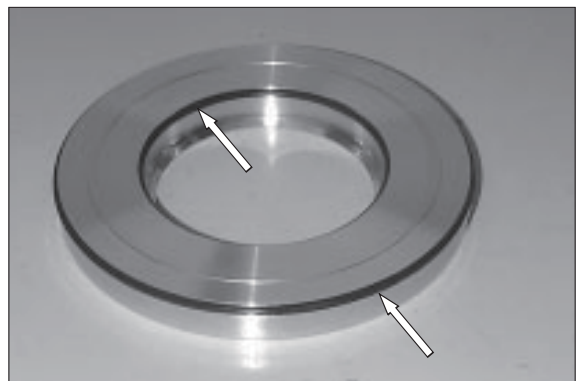


Figure 131



- (4) Oil the O-rings and the piston contact surface.

Install K3 piston equally until contact.

- ※ Observe the installation position of the piston, see figure.



Figure 132

- (5) Install spacer and compression spring.



Figure 133

- (6) Place guide ring, with the chamfer (arrow) showing upwards, over the compression spring and install the snap ring.

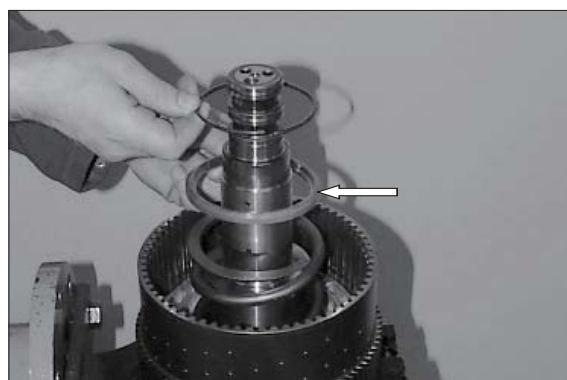


Figure 134

- (7) Lift the disc carrier out of the clamping ring. Preload the compression spring by means of fixture and engage the snap ring into the annular groove of the disc carrier (arrow), see figure 135.

- ※ Special tool

Fixture 5870 345 072

Clamping fixture 5870 654 036

Install the drain valve, piston and compression spring on the opposite side (clutch K4) analogously (figure 130~135).

Then lift the disc carrier with the K4-side showing downwards into the clamping ring and fasten it. Rotate disc carrier by 180°.



Figure 135



## Disc Components K4

※ Below sketch or table shows the standard version as to the installation position of the single components. Obligatory is the respective spare parts list.

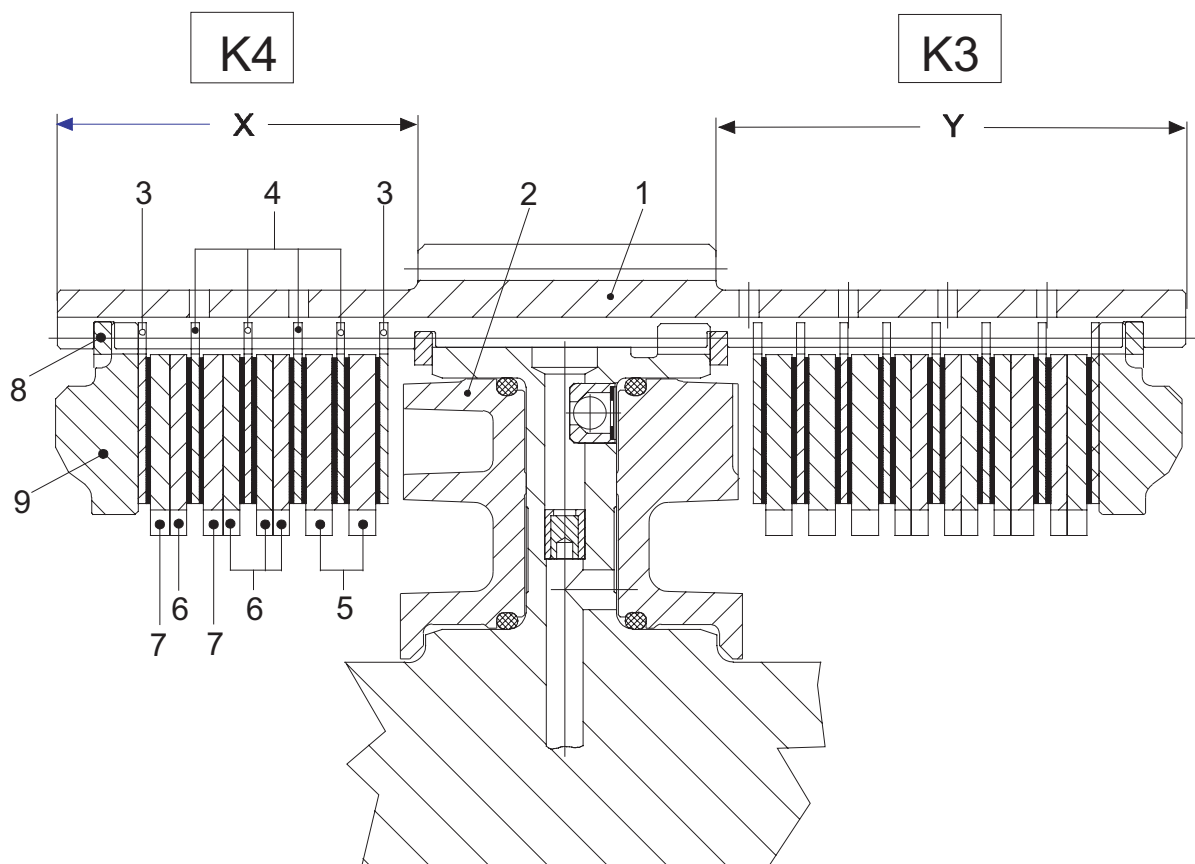


Figure 136

| Position                         | Description       | Quantity | s (mm)    | Remarks              |
|----------------------------------|-------------------|----------|-----------|----------------------|
| 1                                | Disc carrier      | 1        |           |                      |
| 2                                | Piston            | 1        |           |                      |
| 3                                | Outer clutch disc | 2        | 1.85      | Coated on one side   |
| 4                                | Outer clutch disc | 4        | 2.5       | Coated on both sides |
| 5                                | Inner clutch disc | 2        | 4.0       |                      |
| 6                                | Inner clutch disc | 4        | 2.5       |                      |
| 7                                | Inner clutch disc | 2        | 2.5~4.0   | Optional             |
| 8                                | Snap ring         | 1        | 2.10~3.10 | Optional             |
| 9                                | End shim          | 1        |           |                      |
| Number of friction surfaces : 10 |                   |          |           |                      |
| Disc clearance : 2.2 ~ 2.4 mm    |                   |          |           |                      |

※ Install the outer clutch discs position 3 with uncoated side showing to the piston and end shim respectively. The respective clutch side can be seen on the length of the disc carrier, see sketch.

K4 Dimension X (short disc carrier side)

K3 Dimension Y (long disc carrier side)



**Check disc clearance  $K_4=2.2\sim 2.4$  mm**  
(figure 137~139)

※ In order to ensure a perfect measuring result, the disc set is first of all to be installed without oil.

(1) Install disc set according to sketch or table (page 3-118).



Figure137

(2) Install the end shim and fasten it by means of the snap ring.

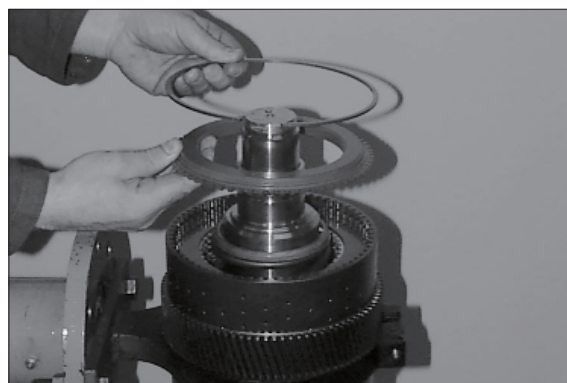


Figure138

(3) Press on end shim with approximately 100N (10 kg) and set dial indicator to "Zero".

Then press end shim against snap ring (upwards) and read disc clearance on the dial indicator.

※ If the required disc clearance differs, it has to be corrected with the adequate inner clutch disc or/and snap ring, see table/ position 7 and position 8.

Upon setting of disc clearance, remove the disc set, oil the clutch discs and reinstall them.

※ Special tool

Magnetic stand 5870 200 055

Dial indicator 5870 200 057

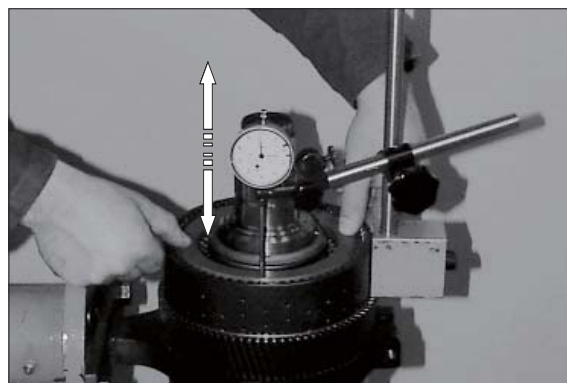


Figure139



**Preamble and install spur gear K4**  
(figure 140~144) :

(1) Opposite figure shows the single components of spur gear K4.

- 1 Bearing inner ring
- 2 Bearing outer ring
- 3 Ring
- 4 Spur gear

Locate both bearing outer rings (2) until contact.

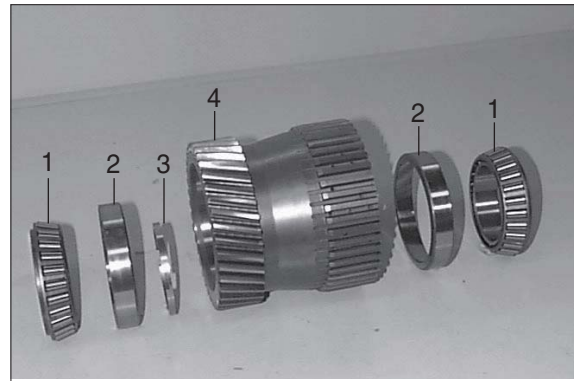


Figure140

(2) Heat the bearing inner ring and install it until contact.



Figure141

(3) Install the ring (3).



Figure142

(4) Assemble the spur gear until all inner clutch discs are located.



Figure143



(5) Heat the bearing inner ring (spur gear bearing) and locate it until contact.

**⚠ Use safety gloves.**



Figure144

(6) Heat the bearing inner ring (clutch bearing) and install it until contact.

**⚠ Use safety gloves.**



Figure145



Clutch Components K3

※ Below sketch or table shows the standard version as to the installation position of the single components. Obligatory is the respective spare parts list.

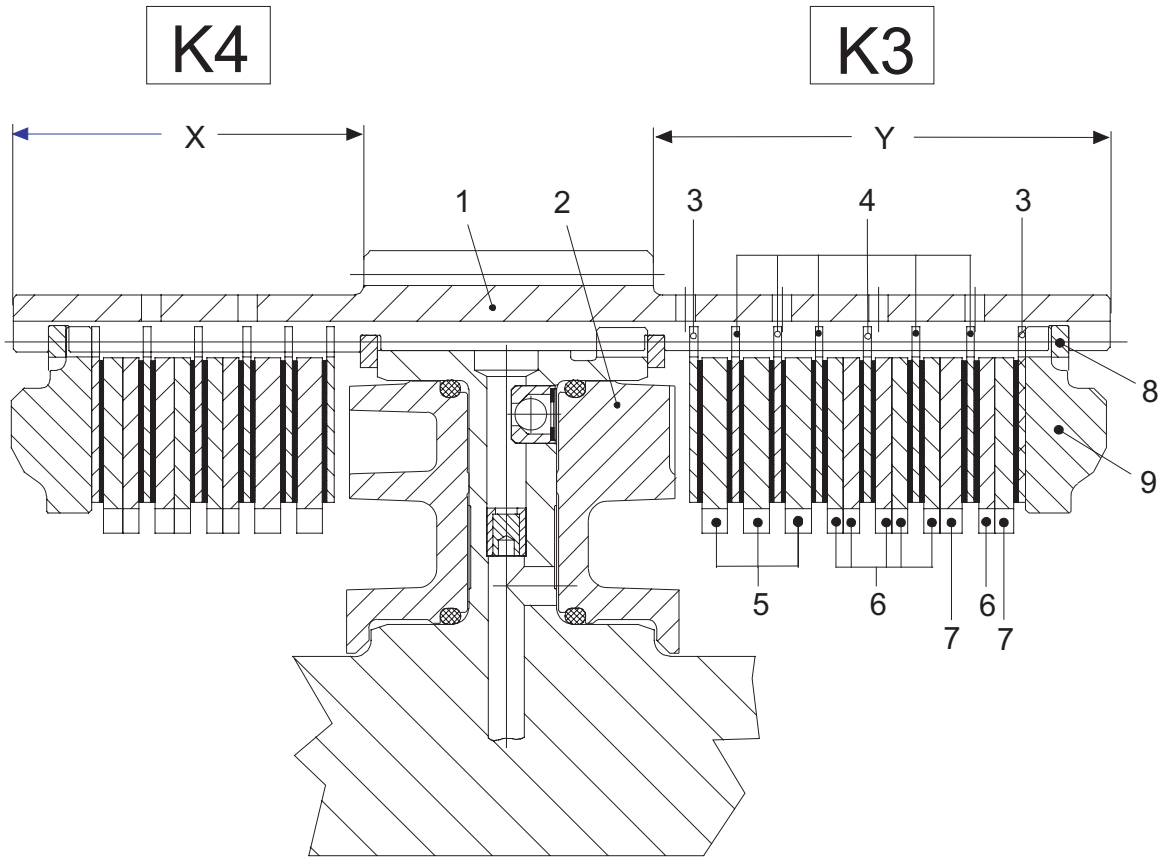


Figure146

| Position                         | Description       | Quantity | s(mm)     | Remarks              |
|----------------------------------|-------------------|----------|-----------|----------------------|
| 1                                | Disc carrier      | 1        |           |                      |
| 2                                | Piston            | 1        |           |                      |
| 3                                | Outer clutch disc | 2        | 1.85      | Coated on one side   |
| 4                                | Outer clutch disc | 6        | 2.5       | Coated on both sides |
| 5                                | Inner clutch disc | 3        | 4.0       |                      |
| 6                                | Inner clutch disc | 6        | 2.5       |                      |
| 7                                | Inner clutch disc | 2        | 2.5~4.0   | Optional             |
| 8                                | Snap ring         | 1        | 2.10~3.10 | Optional             |
| 9                                | End shim          | 1        |           |                      |
| Number of friction surfaces : 14 |                   |          |           |                      |
| Disc clearance : 2.2 ~ 2.4mm     |                   |          |           |                      |

※ Install the outer clutch discs position 3 with uncoated side showing to the piston and end shim respectively. The respective clutch side can be seen on the length of the disc carrier, see sketch.

K3    Dimension Y (long disc carrier side)

K4    Dimension X (short disc carrier side)



**Check disc clearance  $K3=2.2\sim 2.4$  mm**  
(figure 147~149)

※ In order to ensure a perfect measuring result, the disc set is first of all to be installed without oil.

(1) Install disc set according to sketch or table (page 3-140).



Figure 147

(2) Install the end shim and fasten it by means of the snap ring.



Figure 148

(3) Press on end shim with approximately 100N (10 kg) and set dial indicator to "Zero".

Then press end shim against snap ring (upwards) and read disc clearance on the dial indicator.

※ If the required disc clearance differs, it has to be corrected with the adequate inner clutch disc or/and snap ring, see table/ position 7 and position 8.

Upon setting of disc clearance, remove the disc set, oil the clutch discs and reinstall them.

※ Special tool

※ Magnetic stand 5870 200 055

Dial indicator 5870 200 057

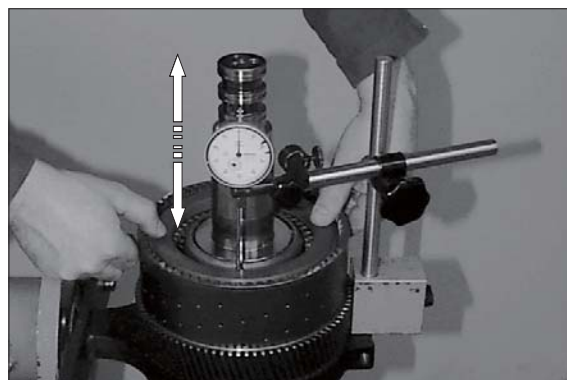


Figure 149



- (4) Heat the bearing inner ring and install it until contact.

⚠ Use safety gloves.



Figure 150

- (5) Lift the disc carrier out of the clamping ring.

To ensure the exact locating of the single components, preload the bearing with 100KN (10 t) (figure 151)

⚠ Support on the lower as well as upper bearing inner ring.  
Use pressure pieces.

※ Special tool

Pressure piece 5870 506 096



Figure 151

- (6) Lift the disc carrier with the K4-side showing downwards into the clamping ring (S) and fasten it.  
Rotate disc carrier by 90°.  
Install the slotted nut.

※ Observe installation position of the slotted nut. Collar (ø 60 mm) must show to the bearing inner ring, also see sketch/page 3-133. Oil the thread.

· Tightening torque : 56.1 kgf · m (406 lbf · ft)

※ Special tool

Clamping ring 5870 654 033

Slotted nut wrench 5870 401 118

Slotted nut wrench 5870 401 115



Figure 152



- (7) Install the bearing outer ring into spur gear K3 until contact.



Figure 153

- (8) Assemble the spur gear until all inner clutch discs are located.

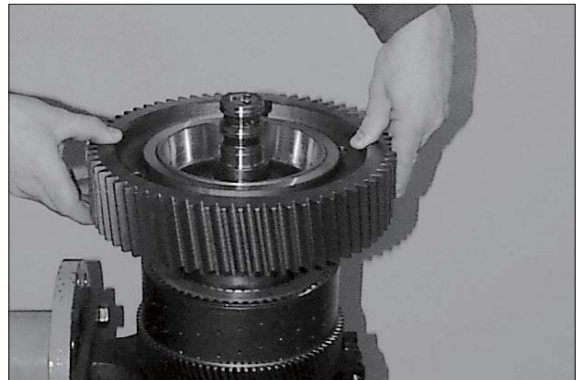


Figure 154

- (9) Heat the roller bearing and locate it until contact.

**▲ Use safety gloves.**



Figure 155

- (10) Install the bearing inner ring.



Figure 156



(11) Check function of the clutches K3 and K4 by means of compressed air.

※ Closing or opening of the clutches is clearly audible when the single parts have been installed adequately.

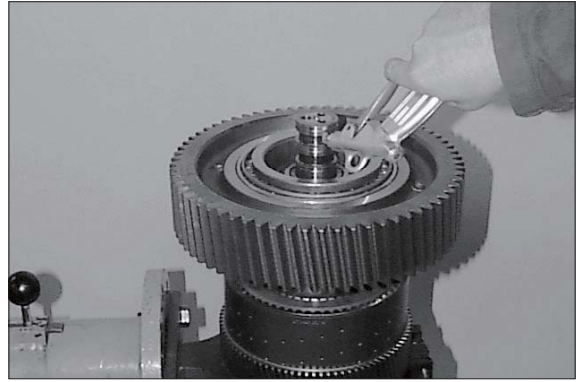


Figure 157

(12) Snap-in and lock the rectangular rings (3EA, see arrows).



Figure 158



## Assembly of the multi-disc clutch KR/K2

The following sketch shows the clutch sectioning.

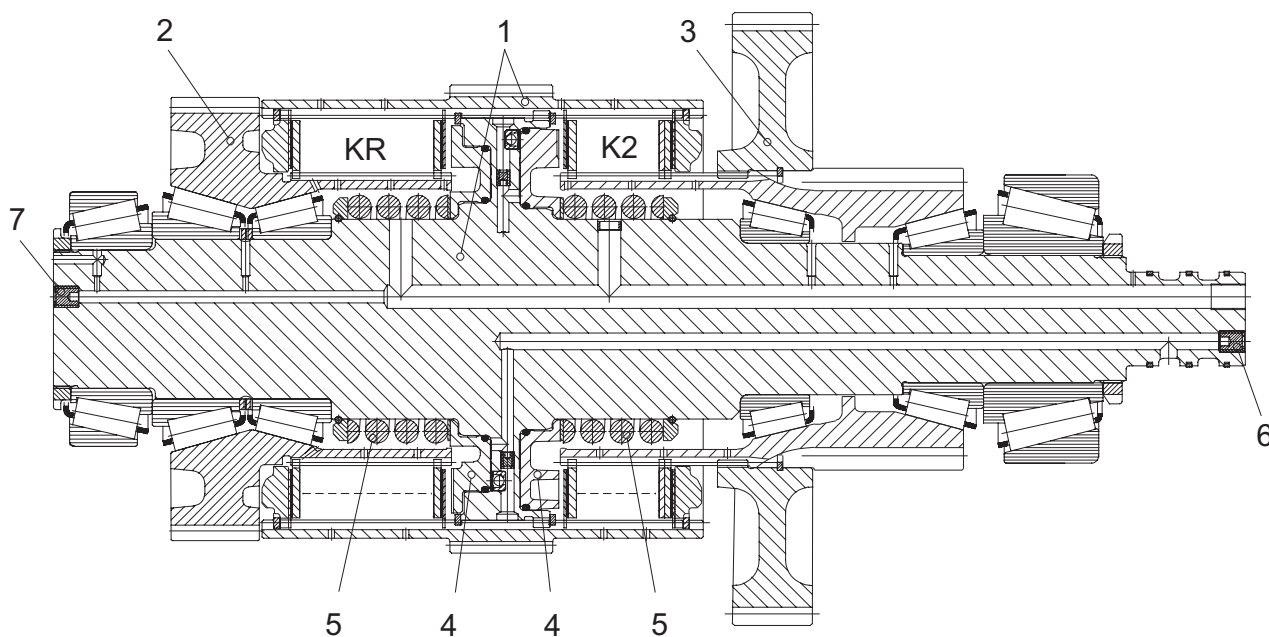


Figure159

- |   |              |    |                      |   |                    |
|---|--------------|----|----------------------|---|--------------------|
| 1 | Disc carrier | K4 | Multi-disc clutch KR | 5 | Compression spring |
| 2 | Spur gear KR | K3 | Multi-disc clutch K2 | 6 | Plug 2EA           |
| 3 | Spur gear K2 | 4  | Piston               | 7 | Plug 1EA           |

※ Observe the installation position of the single components for the following assembly.



- (1) Lift the disc carrier with the KR-side showing downwards into the clamping ring and fasten it.  
Then rotate disc carrier by 180°.

**▲ To install new disc carriers the finished bores have to be sealed with plugs.  
Installation position, see arrow, figure 160~161.**

※ Special tool

Clamping ring                      5870 654 033

Hand mounting tool              5870 320 014

Ratchet                              5870 320 018



Figure 160

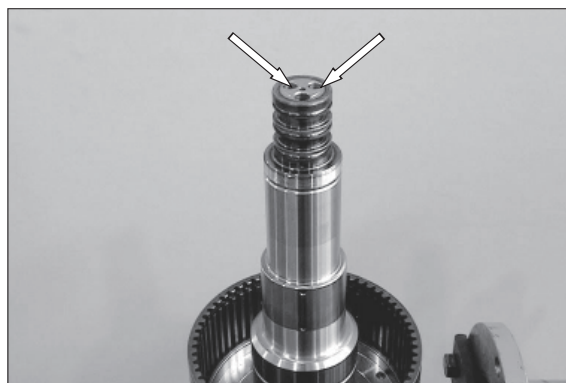


Figure 161

- (2) Flush-mount the drain valve (arrow) with the chamfer showing downwards.

※ Special tool

Inserting tool                      5870 320 019



Figure 162

- (3) Put both O-rings scroll-free into the annular grooves of the piston, see arrows.

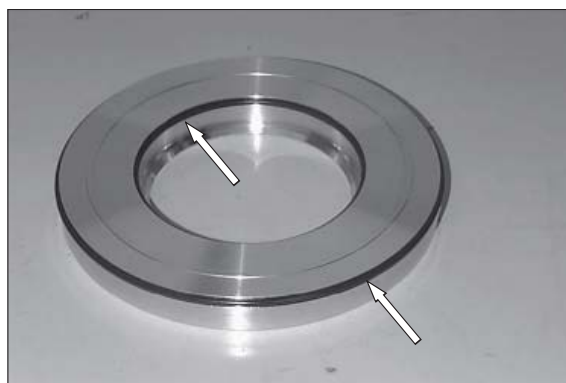


Figure 163



- (4) Oil the O-rings and the piston contact surface.

Install K2 piston equally until contact.

- ※ Observe the installation position of the piston, see figure.



Figure 164

- (5) Install spacer and compression spring.



Figure 165

- (6) Place guide ring, with the chamfer (arrow) showing upwards, over the compression spring and install the snap ring.



Figure 166

- (7) Lift the disc carrier out of the clamping ring. Preload the compression spring by means of fixture and engage the snap ring into the annular groove of the disc carrier (arrow), see figure 167.

Install the drain valve, piston and compression spring on the opposite side(clutch K4) analogously (like figure 162~167).

Then lift the disc carrier with the KR-side showing downwards into the clamping ring and fasten it. Rotate disc carrier by 180°.



Figure 167

- ※ Special tool

Pressure piece 5870 345 072

Clamping fixture 5870 654 036



## Disc Components KR

※ Below sketch or table shows the standard version as to the installation position of the single components. Obligatory is the respective spare parts list.

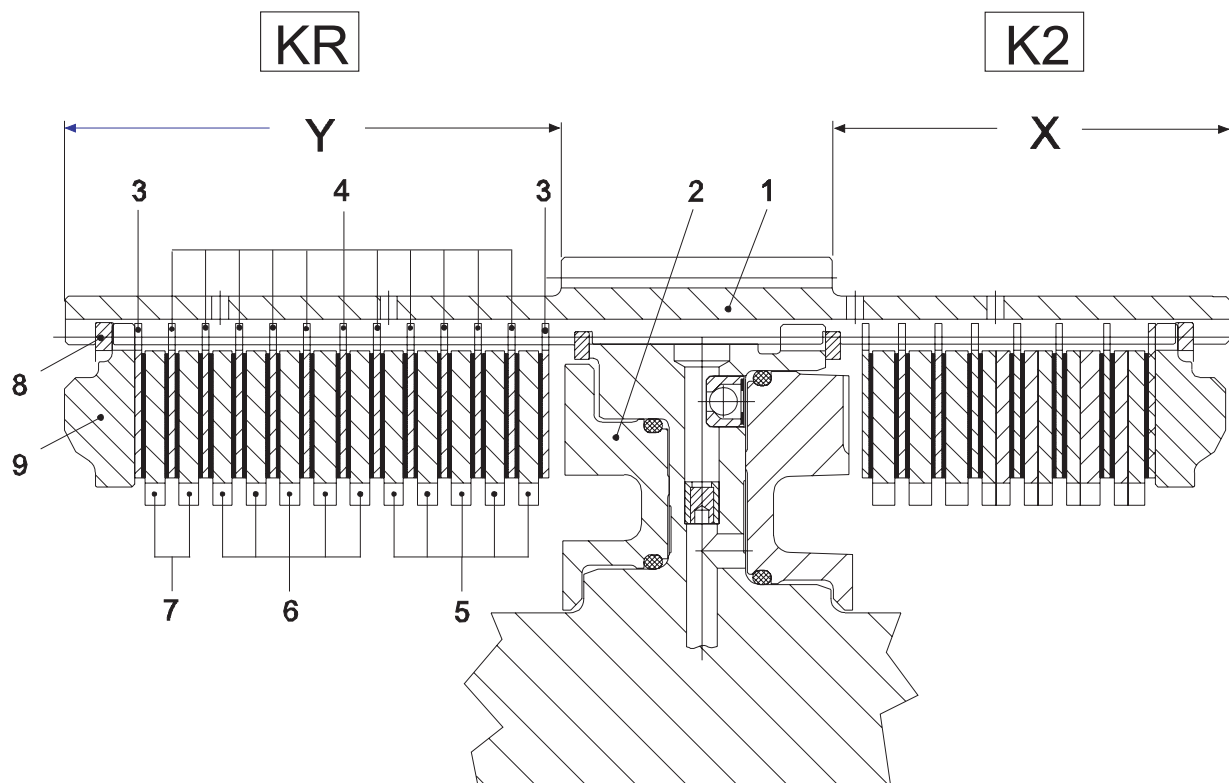


Figure 168

| Position                         | Description       | Quantity | s (mm)    | Remarks              |
|----------------------------------|-------------------|----------|-----------|----------------------|
| 1                                | Disc carrier      | 1        |           |                      |
| 2                                | Piston            | 1        |           |                      |
| 3                                | Outer clutch disc | 2        | 1.85      | Coated on one side   |
| 4                                | Outer clutch disc | 11       | 3.35      | Coated on both sides |
| 5                                | Inner clutch disc | 5        | 2.5       |                      |
| 6                                | Inner clutch disc | 5        | 3.0       |                      |
| 7                                | Inner clutch disc | 2        | 2.5~4.0   | Optional             |
| 8                                | Snap ring         | 1        | 2.10~3.10 | Optional             |
| 9                                | End shim          | 1        |           |                      |
| Number of friction surfaces : 24 |                   |          |           |                      |
| Disc clearance : 2.8 ~ 3.0 mm    |                   |          |           |                      |

※ Install the outer clutch discs position 3 with uncoated side showing to the piston and end shim respectively. The respective clutch side can be seen on the length of the disc carrier, see sketch.

KR Dimension X (long disc carrier side)

K2 Dimension Y (short disc carrier side)



**Check disc clearance  $KR=2.8\sim3.0$  mm**  
(figure 169~171)

※ In order to ensure a perfect measuring result, the disc set is first of all to be installed without oil.

(1) Install disc set according to sketch or table (page 3-148).



Figure 169

(2) Install the end shim and fasten it by means of the snap ring.

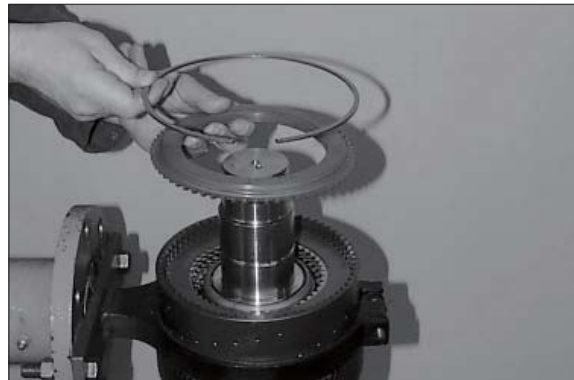


Figure 170

(3) Press on end shim with approximately 100N (10 kg) and set dial indicator to "Zero".

Then press end shim against snap ring (upwards) and read disc clearance on the dial indicator.

※ If the required disc clearance differs, it has to be corrected with the adequate inner clutch disc or/and snap ring, see table/ position 7 and Position 8.

Upon setting of disc clearance, remove the disc set, oil the clutch discs and reinstall them.

※ Special tool

Magnetic stand 5870 200 055

Dial indicator 5870 200 057

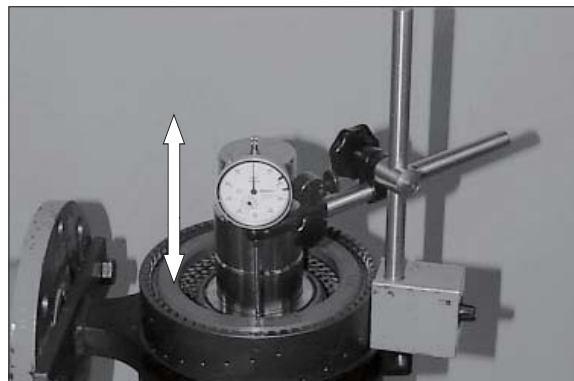


Figure 171



Preassemble and install spur gear KR  
(figure 172~176) :

(1) Opposite figure shows the single components of spur gear KR.

- 1 Bearing inner ring (75×37 mm)
- 2 Ring
- 3 Spur gear
- 4 Bearing inner ring (75×41 mm)

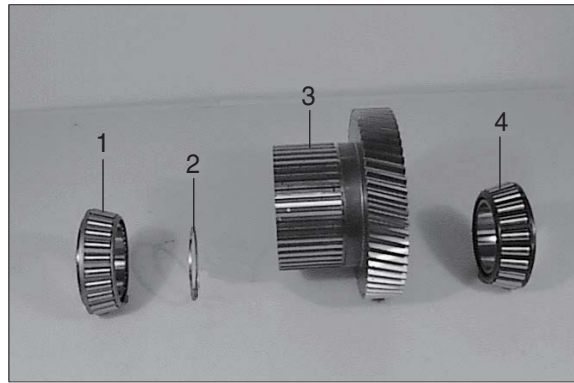


Figure 172

(2) Heat the bearing inner ring (75×37 mm)  
and install it until contact.

**▲ Use safety gloves.**



Figure 173

(3) Assemble the spur gear until all inner  
clutch discs are located.



Figure 174

(4) Install the ring.



Figure 175



(5) Heat the bearing inner ring (75×41 mm) and locate it until contact.

**⚠ Use safety gloves.**



Figure 176

(6) Heat the bearing inner ring (clutch bearing) and locate it until contact.

**⚠ Use safety gloves.**



Figure 177



## Disc Components K2

※ Below sketch or table shows the standard version as to the installation position of the single components. Obligatory is the respective spare parts list.

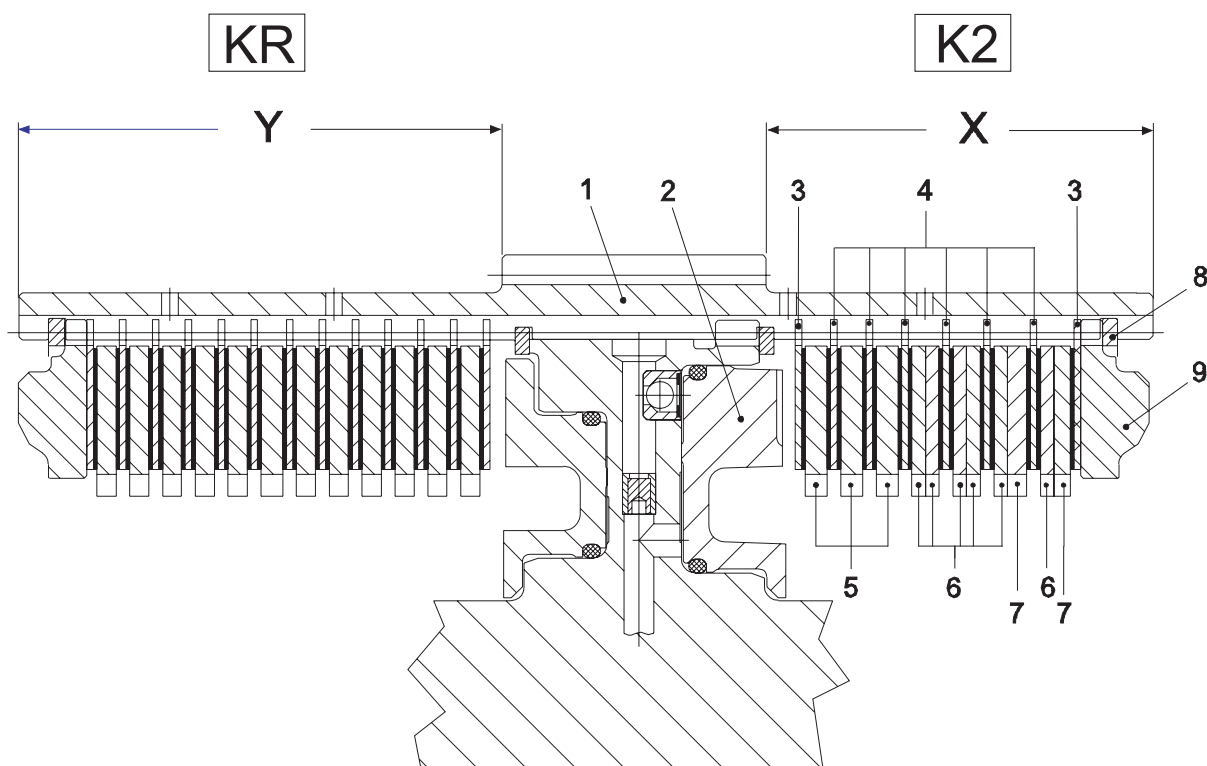


Figure 178

| Position                         | Description       | Quantity | s (mm)    | Remarks              |
|----------------------------------|-------------------|----------|-----------|----------------------|
| 1                                | Disc carrier      | 1        |           |                      |
| 2                                | Piston            | 1        |           |                      |
| 3                                | Outer clutch disc | 2        | 1.85      | Coated on one side   |
| 4                                | Outer clutch disc | 6        | 2.5       | Coated on both sides |
| 5                                | Inner clutch disc | 3        | 4.0       |                      |
| 6                                | Inner clutch disc | 6        | 2.5       |                      |
| 7                                | Inner clutch disc | 2        | 2.5~4.0   | Optional             |
| 8                                | Snap ring         | 1        | 2.10~3.10 | Optional             |
| 9                                | End shim          | 1        |           |                      |
| Number of friction surfaces : 14 |                   |          |           |                      |
| Disc clearance : 2.2 ~ 2.4 mm    |                   |          |           |                      |

※ Install the outer clutch discs position 3 with uncoated side showing to the piston and end shim respectively. The respective clutch side can be seen on the length of the disc carrier, see sketch.

K2 Dimension X (short disc carrier side)

KR Dimension Y (long disc carrier side)



**Check disc clearance  $K_2=2.2\sim 2.4$  mm**  
(figure 179~181)

※ In order to ensure a perfect measuring result, the disc set is first of all to be installed without oil.

(1) Install disc set according to sketch or table (page 3-152).



Figure 179

(2) Install the end shim and fasten it by means of the snap ring.



Figure 180

(3) Press on end shim with approximately 100N (10 kg) and set dial indicator to "Zero".

Then press end shim against snap ring (upwards) and read disc clearance on the dial indicator.

※ If the required disc clearance differs, it has to be corrected with the adequate inner clutch disc or/and snap ring, see table/ position 7 and position 8.

Upon setting of disc clearance, remove the disc set, oil the clutch discs and reinstall them.

※ Special tool

Magnetic stand 5870 200 055

Dial indicator 5870 200 057

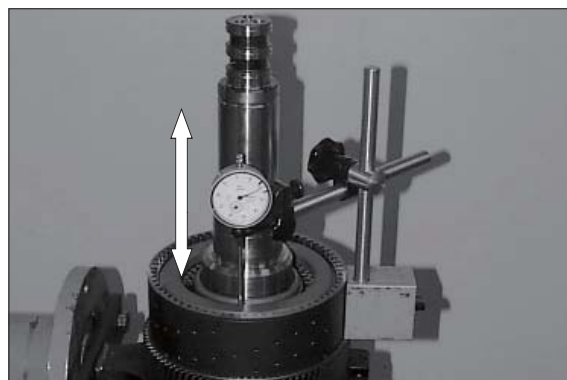


Figure 181



**Preamble and install spur gear K2**  
(figure182~186) :

- (1) Undercool gear 1 (approx -80°C) and heat gear 2 (approx 120°C).

Engage the snap ring (arrow), preload it and join both components by means of hydraulic press until the snap ring engages into the annular groove of gear 2.

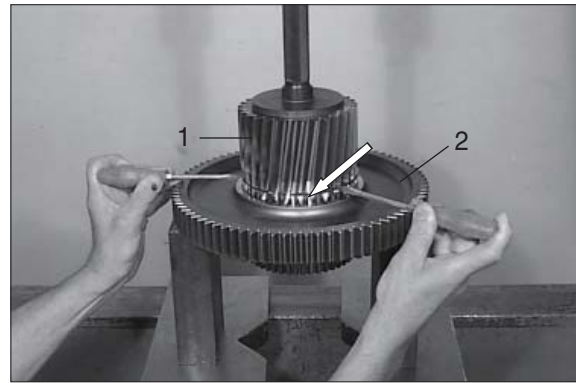


Figure 182

- (2) Opposite figure shows the single components of the spur gear bearing.

- 1 Bearing inner ring
- 2 Spur gear assy
- 3 Bearing inner ring

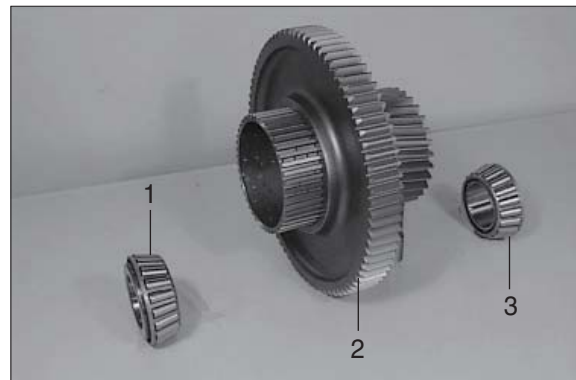


Figure 183

- (3) Heat the bearing inner ring and install it until contact.

**▲ Use safety gloves.**



Figure 184

- (4) Assemble the spur gear until all inner clutch discs are located.



Figure 185



- (5) Heat the bearing inner ring (spur gear bearing) and install it until contact.

**⚠ Use safety gloves.**



Figure 186

- (6) Heat the bearing inner ring (clutch bearing) and locate it until contact.

**⚠ Use safety gloves.**



Figure 187

- (7) Lift the disc carrier out of the clamping ring.

To ensure the exact locating of the single components, preload the bearing with 100 KN (10t) (figure 188)

**⚠ Support on the lower as well as upper bearing inner ring.  
Use pressure pieces.**

※ Special tool

Pressure piece

5870 506 096



Figure 188



- (8) Lift the disc carrier into the clamping ring and fasten it.

Rotate disc carrier by 90°.

**K2-side :**

Install the slotted nut.

- ※ Observe installation position of the slotted nut. Chamfer must show to the bearing inner ring, also see sketch/page 3-123. Oil the thread.

• Torque limit : 81.6 kgf · m (590 lbf · ft)

- ※ Special tool

Clamping ring                      5870 654 033

Slotted nut wrench              5870 401 099

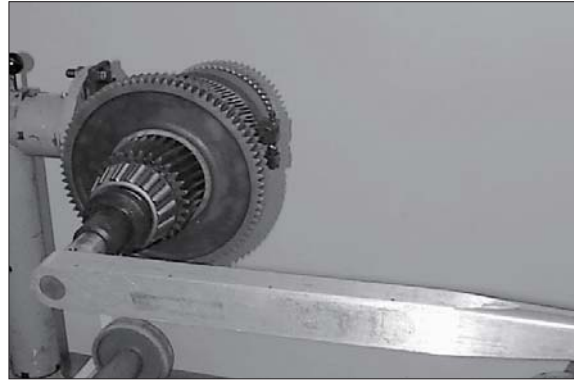


Figure 189

**KR-side :**

Install the slotted nut.

- ※ Observe installation position of the slotted nut. Collar (ø 76 mm) must show to the bearing inner ring, also see sketch/page 3-123. Oil the thread.

• Torque limit : 81.6 kgf · m (590 lbf · ft)

- ※ Special tool

Slotted nut wrench              5870 401 099



Figure 190

- (9) Check function of the clutches K3 and K4 by means of compressed air (figure 191).

- ※ Closing or opening of the clutches is clearly audible when the single parts have been installed adequately.

Snap-in and lock the rectangular rings (3EA, see arrows).

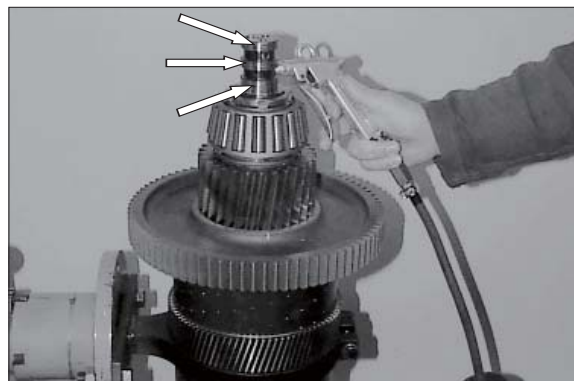


Figure 191



## Assembly of the multi-disc clutch KV/K1

The following sketch shows the clutch sectioning

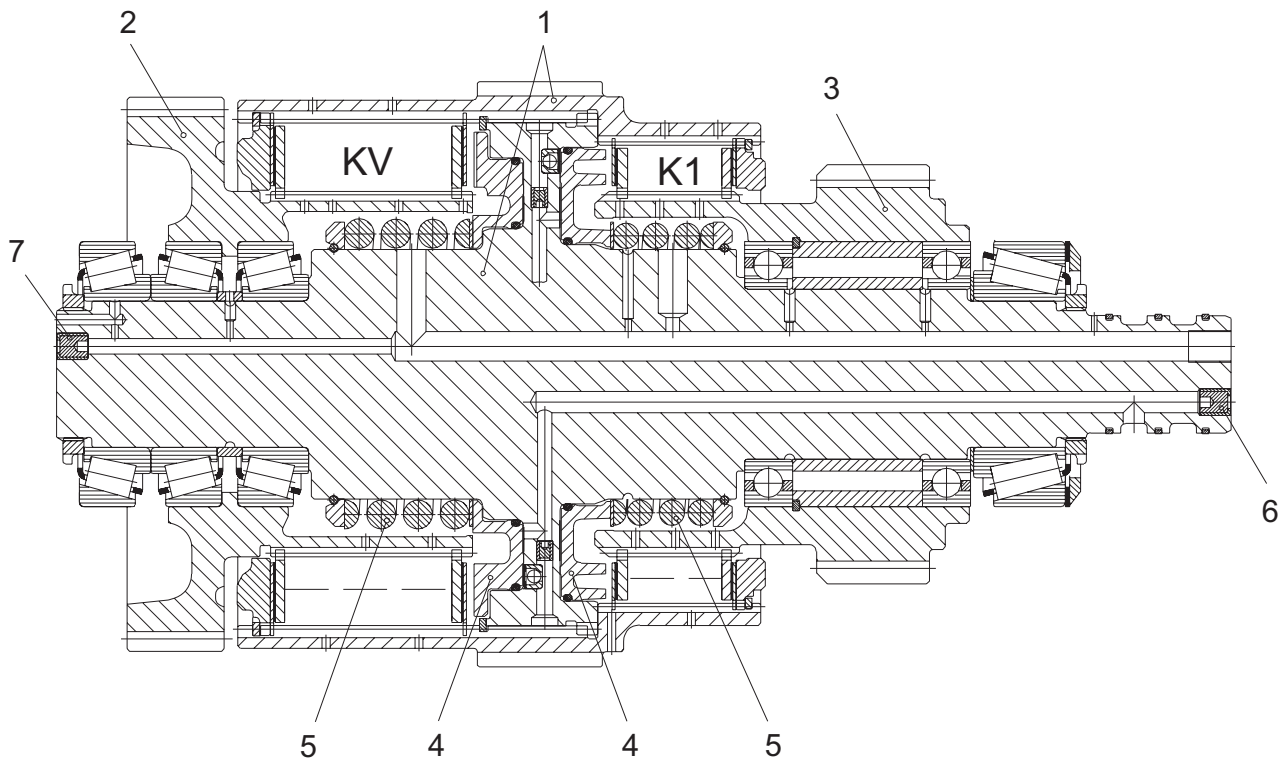


Figure 192

|   |              |    |                      |   |                    |
|---|--------------|----|----------------------|---|--------------------|
| 1 | Disc carrier | KV | Multi-disc clutch KV | 5 | Compression spring |
| 2 | Spur gear KV | K1 | Multi-disc clutch K1 | 6 | Plug 2EA           |
| 3 | Spur gear K1 | 4  | Piston               | 7 | Plug 1EA           |

※ Observe the installation position of the single components for the following assembly.



- (1) Lift the disc carrier with the KV-side showing downwards into the clamping ring(S) and fasten it.  
Then rotate disc carrier by 180°.

**▲ To install new disc carriers the finished bores have to be sealed with plugs.  
Installation position, see arrow, figure193~194.**

※ Special tool

Hand mounting tool 5870 320 014

Ratchet spanner 5870 320 018



Figure 193



Figure 194

- (2) Flush-mount the drain valve (arrow) with the chamfer showing downwards.

※ Special tool

Inserting tool 5870 320 019

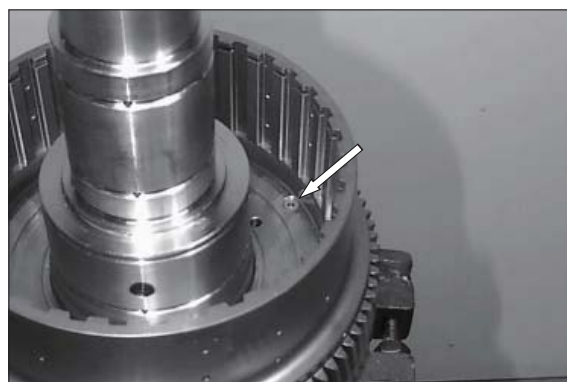


Figure 195

- (3) Put both O-rings scroll-free into the annular grooves of the piston, see arrows.

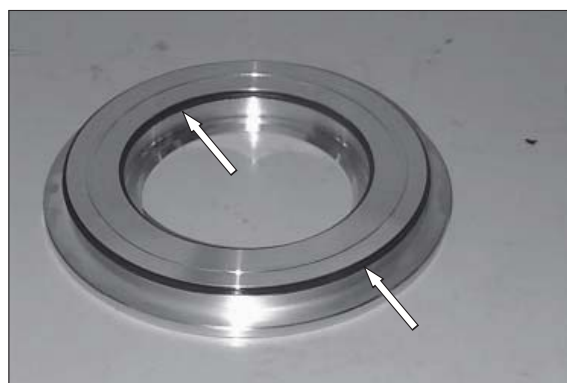


Figure 196



- (4) Oil the O-rings and the piston contact surface.

Install K1 piston **equally** until contact.

- ※ Observe the installation position of the piston, see figure.



Figure 197

- (5) Install spacer and compression spring.



Figure 198

- (6) Place guide ring, with the chamfer (arrow) showing upwards, over the compression spring and install the snap ring.

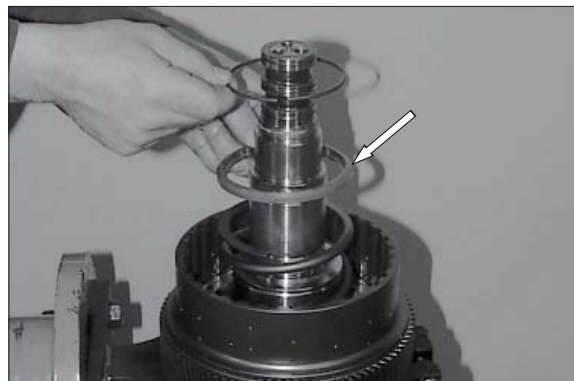


Figure 199

- (7) Lift the disc carrier out of the clamping ring. Preload the compression spring by means of fixture and engage the snap ring into the annular groove of the disc carrier (arrow), see figure 200.

Install the drain valve, piston and compression spring on the opposite side (clutch KV) analogously.

Then lift the disc carrier with the KV-side showing downwards into the clamping ring and fasten it.

Rotate disc carrier by 180°.



Figure 200

- ※ Special tool

Pressure piece 5870 345 072

Clamping fixture 5870 654 036



## Disc Components KV

※ Below sketch or table shows the standard version as to the installation position of the single components. Obligatory is the respective spare parts list.

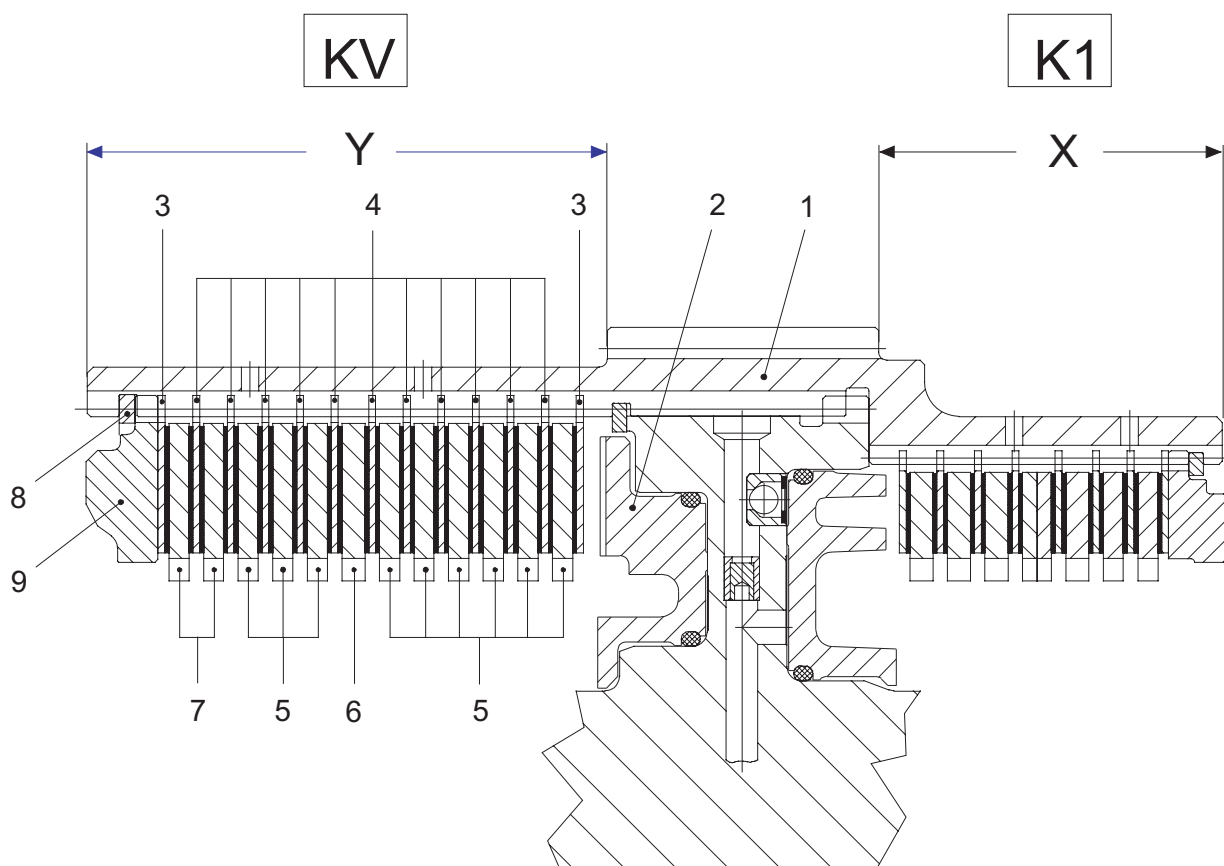


Figure 201

| Position                         | Description       | Quantity | s (mm)    | Remarks              |
|----------------------------------|-------------------|----------|-----------|----------------------|
| 1                                | Disc carrier      | 1        |           |                      |
| 2                                | Piston            | 1        |           |                      |
| 3                                | Outer clutch disc | 2        | 1.85      | Coated on one side   |
| 4                                | Outer clutch disc | 11       | 2.5       | Coated on both sides |
| 5                                | Inner clutch disc | 9        | 3.5       |                      |
| 6                                | Inner clutch disc | 1        | 4.0       |                      |
| 7                                | Inner clutch disc | 2        | 2.5~4.0   | Optional             |
| 8                                | Snap ring         | 1        | 2.10~3.10 | Optional             |
| 9                                | End shim          | 1        |           |                      |
| Number of friction surfaces : 24 |                   |          |           |                      |
| Disc clearance : 2.8 ~ 3.0 mm    |                   |          |           |                      |

※ Install the outer clutch discs position 3 with uncoated side showing to the piston and end shim respectively. The respective clutch side can be seen on the length and  $\varnothing$  of the disc carrier respectively, see sketch.

KV Dimension Y (long disc carrier side and large  $\varnothing$  respectively)

K1 Dimension X (short disc carrier side and small  $\varnothing$  respectively)



**Check disc clearance KV=2.8~3.0 mm**  
(figure 202~204)

※ In order to ensure a perfect measuring result, the disc set is first of all to be installed without oil.

- (1) Install disc set according to sketch or table (page 3-160).

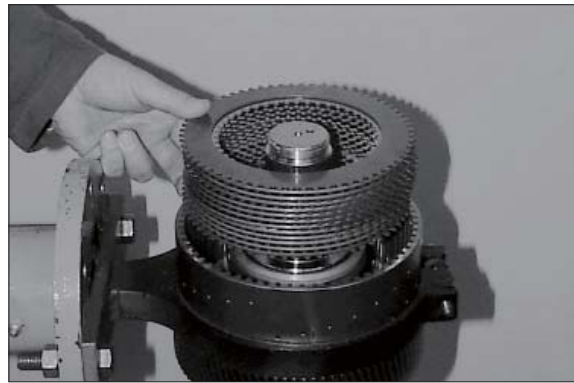


Figure 202

- (2) Install the end shim and fasten it by means of the snap ring.

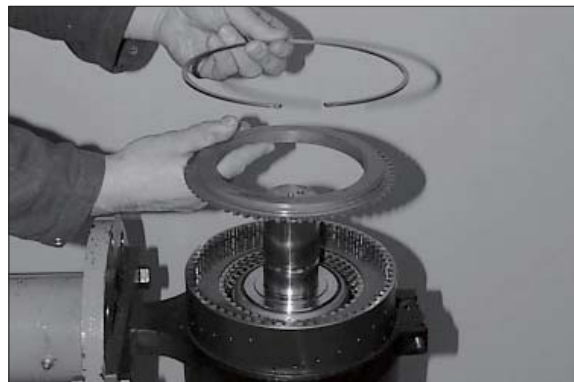


Figure 203

- (3) Press on end shim with approximately 100N (10 kg) and set dial indicator to "Zero".

Then press end shim against snap ring (upwards) and read disc clearance on the dial indicator.

※ If the required disc clearance differs, it has to be corrected with the adequate inner clutch disc or/and snap ring, see table/ position 7 and position 8.

Upon setting of disc clearance, remove the disc set, oil the clutch discs and reinstall them.

※ Special tool

Magnetic stand 5870 200 055

Dial indicator 5870 200 057

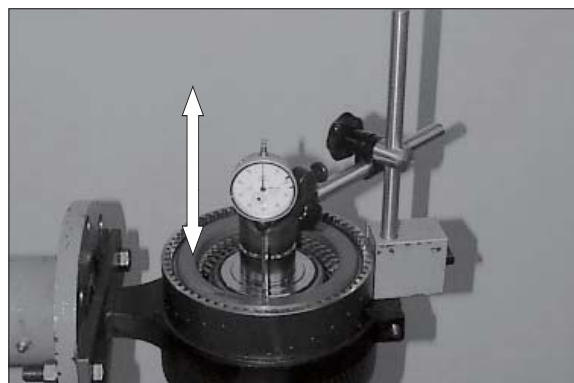


Figure 204



**Preamble and install spur gear KV**  
(figure 205~209) :

(1) Opposite figure shows the single components of spur gear KV.

- 1 Bearing inner ring
- 2 Bearing outer ring
- 3 Ring
- 4 Spur gear

Install both bearing outer rings (2) until contact.

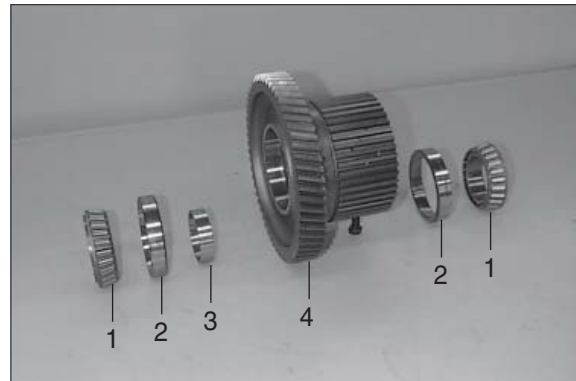


Figure 205

(2) Heat the bearing inner ring and install it until contact.

**▲ Use safety gloves.**



Figure 206

(3) Install the ring.

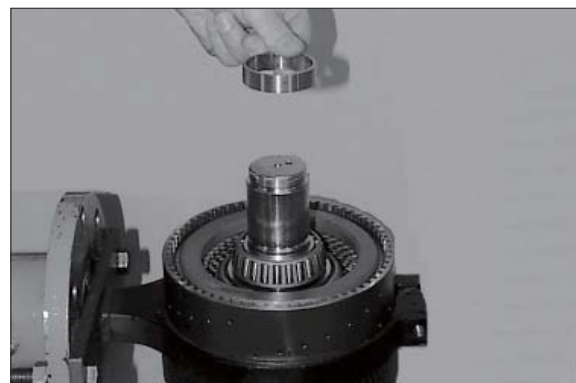


Figure 207

(4) Assemble the spur gear until all inner clutch discs are located.

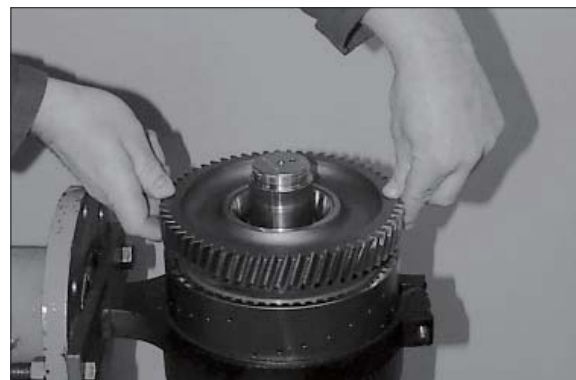


Figure 208



- (5) Heat the bearing inner ring (spur gear bearing) and locate it until contact.

**⚠ Use safety gloves.**



Figure 209

- (6) Heat the bearing inner ring (clutch bearing) and locate it until contact.

**⚠ Use safety gloves.**

Rotate disc carrier by 180°.



Figure 210



## Disc Components K1

※ Below sketch or table shows the standard version as to the installation position of the single components. Obligatory is the respective spare parts list.

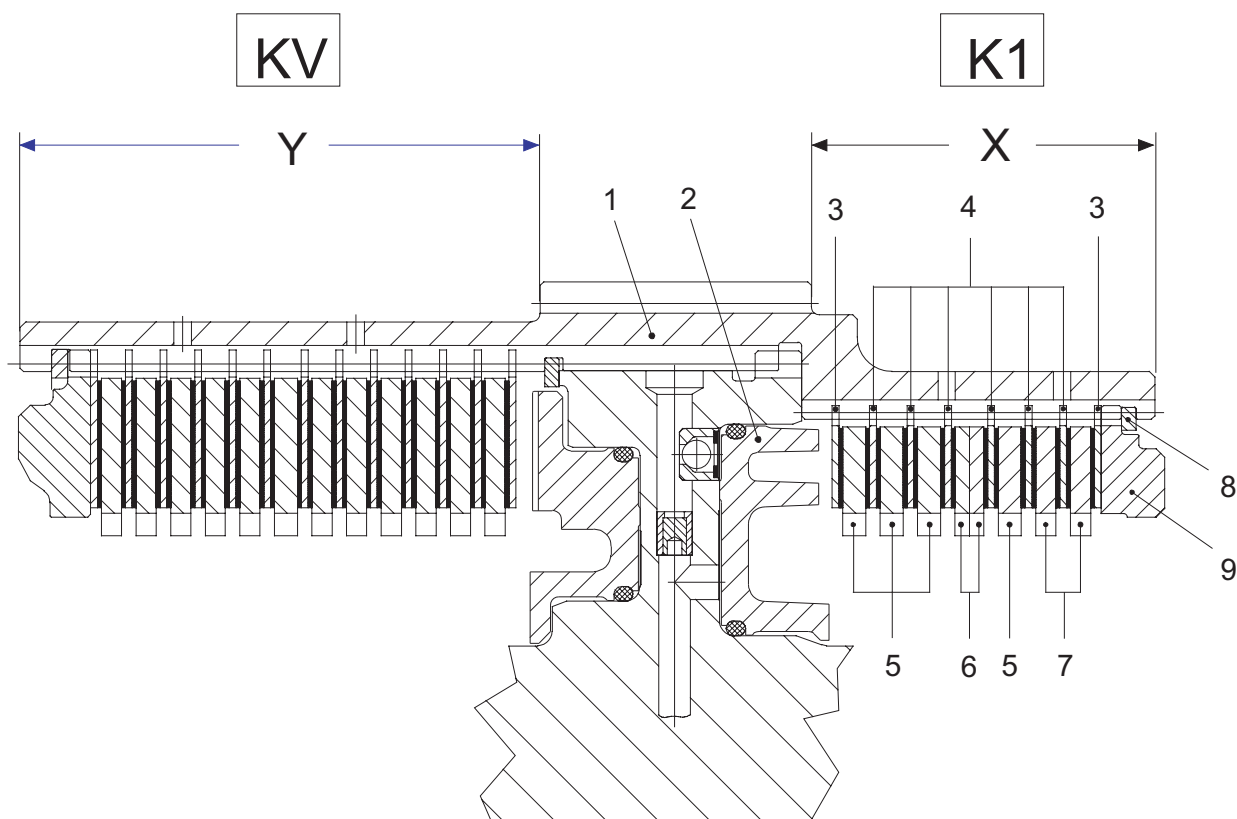


Figure 211

| Position                         | Description       | Quantity | s (mm)  | Remarks              |
|----------------------------------|-------------------|----------|---------|----------------------|
| 1                                | Disc carrier      | 1        |         |                      |
| 2                                | Piston            | 1        |         |                      |
| 3                                | Outer clutch disc | 2        | 1.85    | Coated on one side   |
| 4                                | Outer clutch disc | 6        | 2.5     | Coated on both sides |
| 5                                | Inner clutch disc | 4        | 4.0     |                      |
| 6                                | Inner clutch disc | 2        | 2.5     |                      |
| 7                                | Inner clutch disc | 2        | 2.5~4.0 | Optional             |
| 8                                | Snap ring         | 1        | 2.1~2.5 | Optional             |
| 9                                | End shim          | 1        |         |                      |
| Number of friction surfaces : 14 |                   |          |         |                      |
| Disc clearance : 2.2 ~ 2.4 mm    |                   |          |         |                      |

※ Install the outer clutch discs position 3 with uncoated side showing to the piston and end shim respectively. The respective clutch side can be seen on the length and  $\varnothing$  of the disc carrier respectively, see sketch.

K1 Dimension X (short disc carrier side and small  $\varnothing$  respectively)

KV Dimension Y (long disc carrier side and large  $\varnothing$  respectively)



**Check disc clearance  $K1=2.2\sim2.4$  mm**  
(figure 212~214)

※ In order to ensure a perfect measuring result, the disc set is first of all to be installed without oil.

(1) Install disc set according to sketch or table (page 3-164).



Figure 212

(2) Install the end shim and fasten it by means of the snap ring.

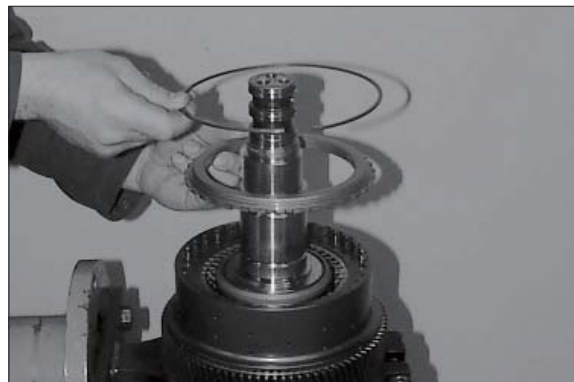


Figure 213

(3) Press on end shim with approximately 100N (10 kg) and set dial indicator to "Zero".

Then press end shim against snap ring (upwards) and read disc clearance on the dial indicator.

※ If the required disc clearance differs, it has to be corrected with the adequate inner clutch disc or/and snap ring, see table/ position 7 and position 8.

Upon setting of disc clearance, remove the disc set, oil the clutch discs and reinstall them.

※ Special tool

Magnetic stand 5870 200 055

Dial indicator 5870 200 057

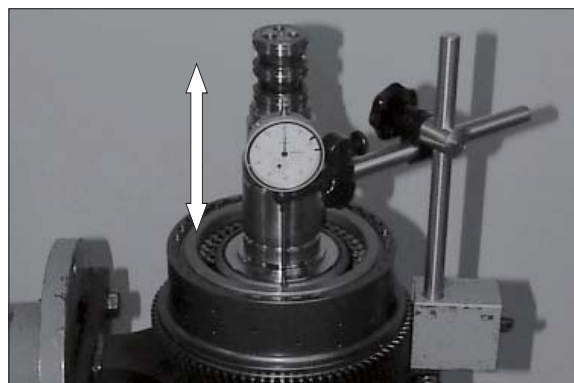


Figure 214



**Preamble and install spur gear K1**  
(figure 215~222) :

(1) Opposite figure shows the single components of spur gear K1.

- 1 Ball bearing (assy)
- 2 Snap ring
- 3 Spur gear

※ Prior to installation of the single components, align the disc set by means of the spur gear radially and center it, see figure 216.

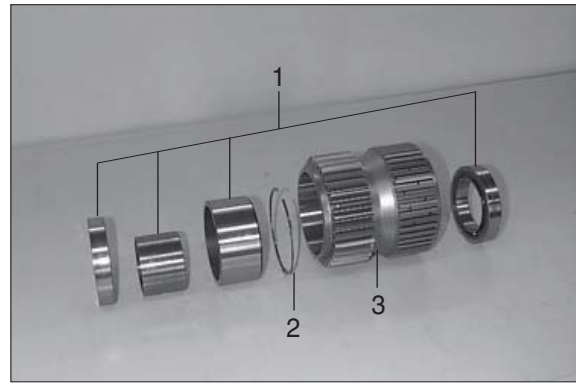


Figure 215



Figure 216

(2) Install the ring.



Figure 217

(3) Install the bush with collar (arrow) on face end showing to the snap ring.



Figure 218



(4) Press in the ball bearing until contact.

- ※ Install the ball bearing with the lubricating groove (arrow) showing downwards. Put the press-in tool only to the bearing outer ring.



Figure 219

(5) Heat the second ball bearing and install it until contact.

- ※ Lubricating groove (arrow), must show upwards.

**▲ Use safety gloves.**



Figure 220

(6) Assemble the bush.



Figure 221

(7) Heat the spur gear to approximately 120°C and assemble it until all inner clutch discs are located.

**▲ Use safety gloves.**



Figure 222



(8) Install shim  $s = 1.20 \text{ mm}$



Figure 223

(9) Heat the bearing inner ring and install it until contact.

**▲ Use safety gloves.**



Figure 224

(10) Lift the disc carrier out of the clamping ring (S). To ensure the exact locating of the single components, preload the bearing with 100kN (10 t) (figure 225).

**▲ Support on the lower as well as upper bearing inner ring.  
Use pressure pieces (S).**

※ Special tool

Pressure pieces

5870 506 096



Figure 225



(11) Lift the disc carrier into the clamping ring.  
Rotate disc carrier by 90°.  
Install the slotted nut.

- ※ Observe installation position of the slotted nut. Collar (ø 60 mm) must show to the taper roller bearing also see sketch/page 3-146. Oil the thread.

- Torque limit : 56.1 kgf · m (406 lbf · ft)

- ※ Special tool

Slotted nut wrench                      5870 401 118

Slotted nut wrench                      5870 401 099

Install the opposite slotted nut (KV-side) analogously.

- ※ Special tool

Slotted nut wrench                      5870 401 118

Slotted nut wrench                      5870 401 115

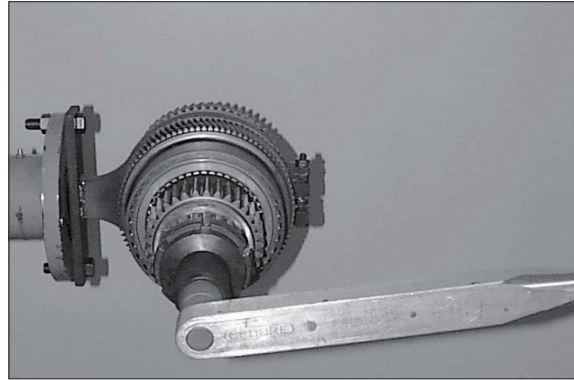


Figure 226

(12) Check function of the clutches KV and K1 by means of compressed air.

- ※ Closing or opening of the clutches is clearly audible when the single parts have been installed adequately.



Figure 227

(13) Snap-in and lock the rectangular rings (3EA, see arrows).

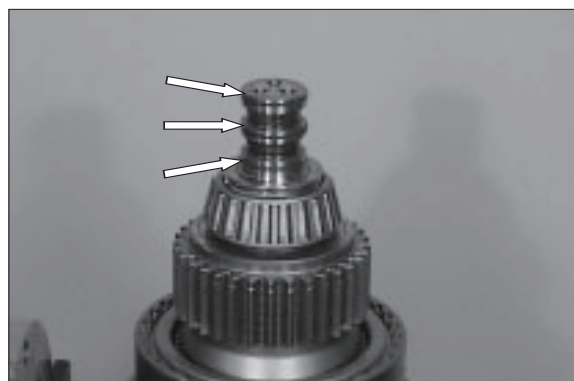


Figure 228



## Installation of layshaft gear, multi-disc clutches and output gear

(1) Opposite figure shows the single components of the layshaft gear bearing.

- 1 Bearing inner ring (2EA)
- 2 Ring
- 3 Layshaft gear

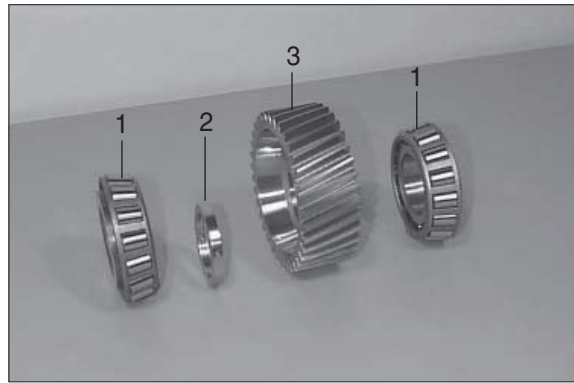


Figure 229

(2) Position layshaft gear (assy) in the housing.

※ Only when the clutches are installed, the idler shaft can be mounted.



Figure 230

(3) Insert the bearing outer rings KV/K1, KR/K2 and K3/K4 into the housing bores until contact, see arrows.

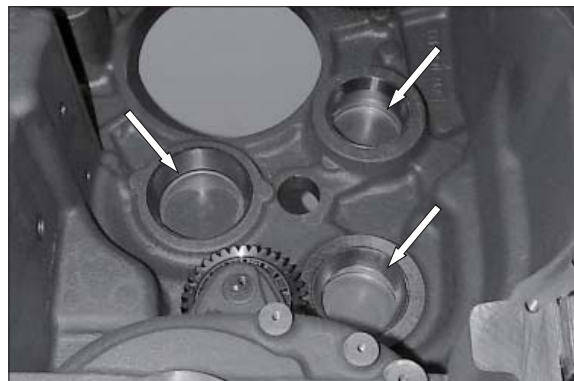


Figure 231

(4) Position clutch KV/K1 by means of lifting tackle.

※ Special tool  
Eyebolts assortment 5870 204 002



Figure 232



(5) Position clutch KR/K2.

※ Special tool

Eyebolts assortment 5870 204 002



Figure 233

(6) Check the installation position of the layshaft gear (arrow) once again and correct it, if required.



Figure 234

(7) Fasten the spur gear K3 by means of fixture and eyebolt (arrow) axially.

※ Spur gear fixing prevents the clutch discs from dislocating when the clutch is lifted in.

※ Special tool

Assembly fixture 5870 345 033

Eyebolt 5870 204 066



Figure 235

(8) Lift the clutch KR/K2 slightly, move it in direction of the arrow and position clutch K3/K4.

Then remove the fixture (figure 235) again.



Figure 236



- (9) Insert the bearing outer ring into the housing bore until contact.

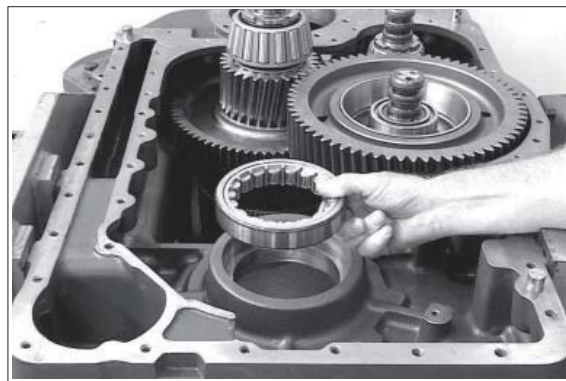


Figure 237

- (10) Heat the bearing inner ring and install it until contact.

**▲ Use safety gloves.**

- ※ Observe installation position-collar (arrow) shows to the spur gear. Install the bearing inner ring after cooling down subsequently (press).



Figure 238

- (11) Position the oil baffle.



Figure 239

- (12) Install the output gear by means of lifting tackle.

- ※ Special tool  
Stop washer 5870 100 054  
Eyebolts assortment 5870 204 002



Figure 240



- (13) Position upper oil baffle and fasten both plates by means of hexagon screws (4EA).

※ Install washers.

Secure hexagon screws with loctite (type No.243).

• Torque limit : 2.35 kgf · m (16.7 lbf · ft)



Figure 241

### Preassembly and mounting of the housing cover

Note to figure 242 and 243 :

Depending on the transmission version, differences as regards the single components and their installation position are possible.

Obligatory is the respective parts list.

- (1) Install the sealing cover (arrow).

※ Wet the sealing surface with loctite (type No.262).

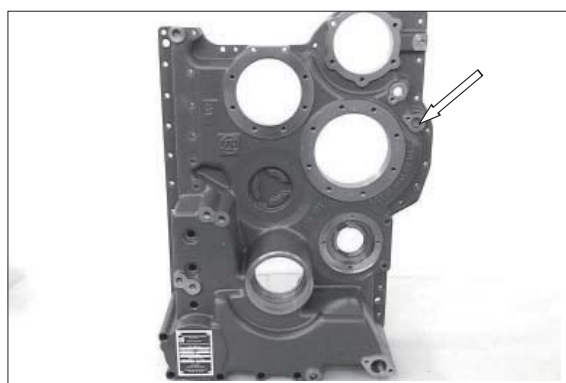


Figure 242

- (2) Insert the O-ring into the annular groove of the cover and fasten the cover by means of hexagon screws.

※ Wet the thread of the hexagon screws with loctite (type No.574). Observe the installation position of the cover, see figure.

• Torque limit : 2.35 kgf · m (16.7 lbf · ft)



Figure 243

- (3) Wet the mounting face with sealing compound (loctite, type No.574).  
By means of the lifting tackle place the housing cover on the transmission housing until contact.

※ Special tool

Lifting tackle

5870 281 055



Figure 244



- (4) Install both cylindrical pins (arrow 1 and 2) and the slotted pin (arrow 3).

Then fasten the housing cover by means of hexagon and cap screws.

- Torque limit M10/8.8 :

4.69 kgf · m (33.9 lbf · ft)

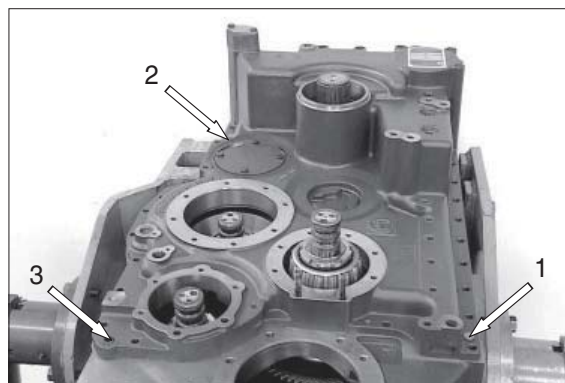


Figure 245

### Adjust the bearing preload of clutch K4/K3 = 0.0~0.05 mm (figure 248~250)

- ※ For installation of a new bearing cover, both finished bores have to be sealed by means of a plug.

Finished bores are located opposite (180°) to each other, also see arrow/figure 246 and 247.

1 Bearing cover-K4/K3

2 Plug (konig)

(S) Special tool

- ※ Special tool

Hand mounting tool 5870 320 014

Ratchet spanner 5870 320 018

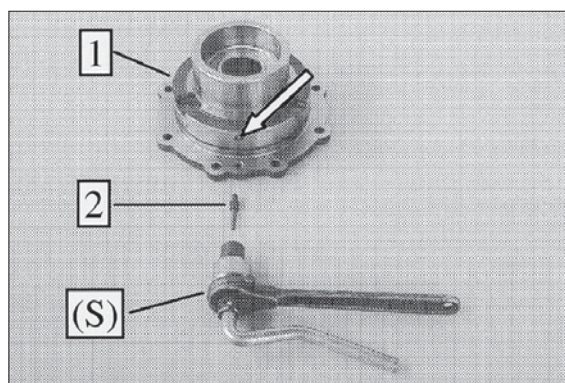


Figure 246

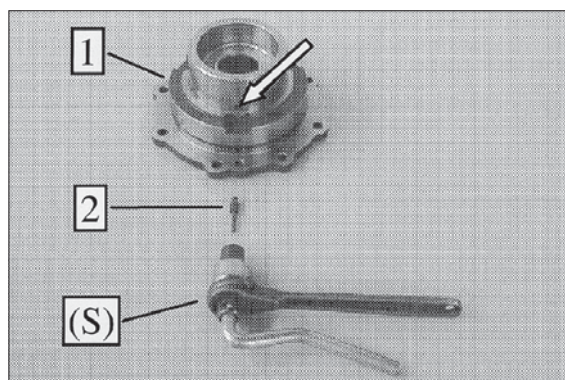


Figure 247



### Housing dimension :

- (1) Press on equally the bearing inner ring and determine Dimension I, from the mounting face to the bearing inner ring.

Dimension I e.g ..... 43.65 mm

- ※ Take several measuring points and determine the mean value.

Then remove the bearing inner ring again.

- ※ Special tool

Measuring shaft ..... 5870 200 022

Digital depth gauge ..... 5870 200 072

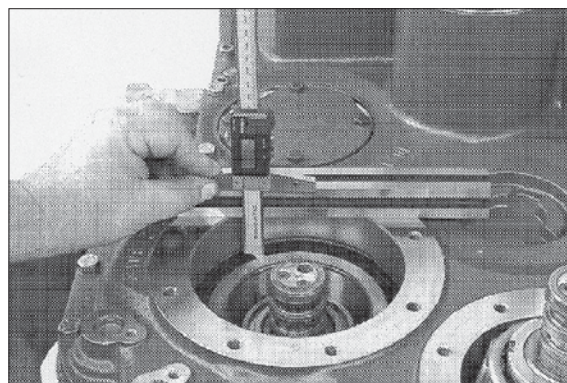


Figure 248

### Cover dimension :

- (2) Determine Dimension II, from the mounting face until contact/bearing inner ring.

Dimension II e.g ..... 42.12 mm

- ※ Special tool

Straightedge ..... 5870 200 022

Gauge blocks ..... 5870 200 067

Digital depth gauge ..... 5870 200 072

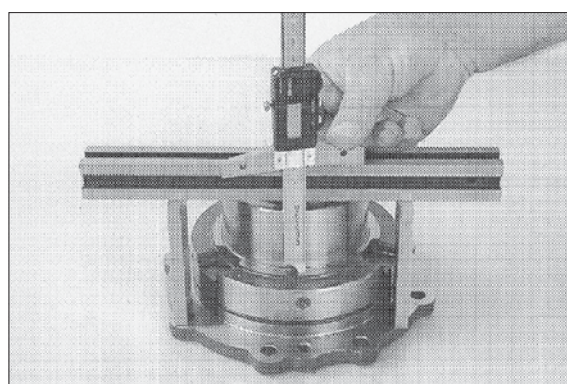


Figure 249

### Example :

Dimension I ..... 43.65 mm

Dimension II ..... - 42.12 mm

Difference ..... = 1.53 mm

Bearing preload ..... e.g. + 0.02 mm

Resulting shim(s) ..... s = 1.55 mm

- (3) Put on the shim.



Figure 250

- (4) Heat the bearing inner ring and place it until contact.

### ▲ Use safety gloves.

- ※ Install the bearing inner ring after cooling down subsequently (press).



Figure 251



- (5) Grease the rectangular rings (3EA, arrows) and centrally align them.



Figure 252

- (6) Install the O-ring (arrow) and grease it.  
Heat the inner diameter of the bearing cover (bearing seat).

※ Special tool

Hot-air blower 230V 5870 221 500

Hot-air blower 115V 5870 221 501



Figure 253

- (7) Install two adjusting screws.  
Assemble the bearing cover and tighten it equally until contact by means of hexagon screws.

• Torque limit (M10/8.8) :

4.69 kgf · m (33.9 lbf · ft)

※ Observe the radial installation position.

※ Special tool

Adjusting screws 5870 204 007



Figure 254

- (8) Check the function of **both** clutches by means of compressed air.

※ In case of a decisive pressure loss, the possible cause might be the breakage of one or several rectangular rings (see arrow , figure 252).

Replace the rectangular rings, if required.



Figure 255



**Adjust the bearing preload of clutch KR/K2  
= 0.0~0.05 mm (figure 258~262)**

- ※ For installation of a new bearing cover, both finished bores have to be sealed by means of a plug.

Finished bores are located opposite (18°) to each other, also see arrow/Figure 256 and 257.

1 Bearing cover-KR/K2

2 Plug

(S) Special tool

- ※ Special tool

Hand mounting tool 5870 320 014

Ratchet spanner 5870 320 018

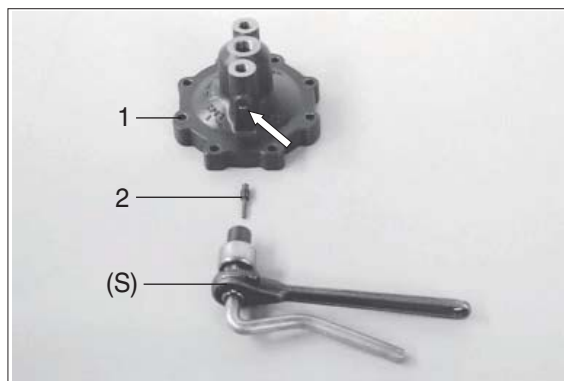


Figure 256

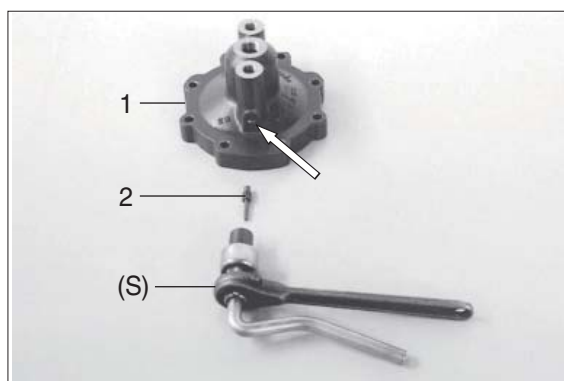


Figure 257

(1) Install both studs (arrows).

- ※ Wet the thread with loctite (type No. 243).

• Torque limit (M10) :  
1.33 kgf · m (9.59 lbf · ft)



Figure 258

(2) Install the bearing outer ring until contact.

- ※ Pay attention to exact contact.



Figure 259



### Housing dimension :

- (3) Determine Dimension I, from the bearing outer ring to the mounting face.

Dimension I e.g ..... 16.13 mm



Figure 260

### Cover dimension :

- (4) Determine Dimension II, from the contact/ bearing outer ring to the mounting face.

Dimension II e.g ..... 17.75 mm

※ Special tool

Digital depth gauge 5870 200 072



Figure 261

### Example :

Dimension II ..... 17.75 mm

Dimension I ..... - 16.13 mm

Difference ..... = 1.62 mm

Bearing preload ..... e.g. + 0.03 mm

Resulting shim (s) ..... s = 1.65 mm

- (5) Fix the shim with assembly grease into the cover. Install the O-ring (arrow).



Figure 262

- (6) Grease the rectangular rings (arrows) and centrally align them.



Figure 263



(7) Pull the bearing cover equally until contact.

• Torque limit (M10/8.8) :

4.69 kgf · m (33.9 lbf · ft)

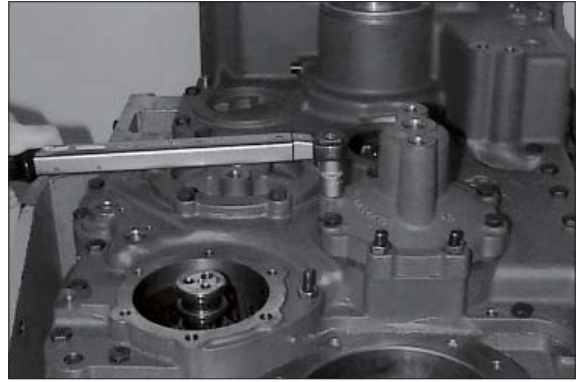


Figure 264

(8) Check the function of both clutches by means of compressed air.

※ In case of a decisive pressure loss, the possible cause might be the breakage of one or several rectangular rings (see figure 263).

Replace the rectangular rings, if required.



Figure 265



**Adjust the bearing preload of clutch KV/K1  
= 0.0~0.05 mm (figure 267~270)**

※ For installation of a new bearing cover, both finished bores have to be sealed by means of a plug.

Installation position, see arrows/Figure 266.

1 Bearing cover-KV/K1

2 Plug

(S) Special tool

※ Special tool

Hand mounting tool 5870 320 014

Ratchet spanner 5870 320 018

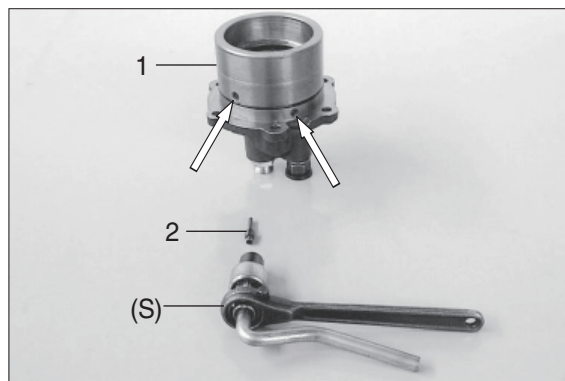


Figure 266

- (1) Put the bearing outer ring over the bearing inner ring.

Housing dimension :

Press on equally the bearing outer ring and determine Dimension I, from the mounting face to the bearing outer ring.

Dimension I e.g ..... 52.67 mm

※ Take several measuring points and determine the mean value.

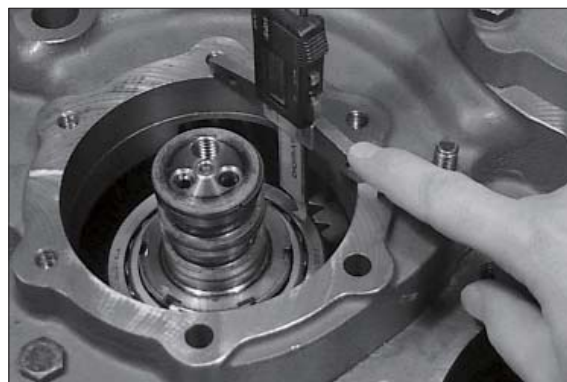


Figure 267

- (2) Put the ring with the chamfer showing downwards into the bearing cover.



Figure 268



Cover dimension :

- (3) Determine Dimension II, from the mounting face to the ring.

Dimension II e.g ..... 50.75 mm

※ Special tool

Digital depth gauge ..... 5870 200 072

Gauge blocks ..... 5870 200 067



Figure 269

Example :

Dimension I ..... 52.67 mm

Dimension II ..... - 50.75 mm

Difference ..... e.g. 1.92 mm

Bearing preload ..... + 0.03 mm

Resulting shim (s) ..... s = 1.95 mm

- (4) Put in the shim.



Figure 270

- (5) Install the bearing outer ring until contact.  
Assemble the O-ring (arrow).



Figure 271

- (6) Grease the rectangular rings (arrows) and centrally align them.



Figure 272



(7) Heat the bearing bore.

※ Special tool

Hot-air blower 230V                    5870 221 500

Hot-air blower 115V                  5870 221 501



Figure 273

(8) Install two adjusting screws.

Place the bearing cover until contact and  
fasten it by means of hexagon screws.

※ Observe the radial installation position,  
see figure.

※ Special tool

Adjusting screws                    5870 204 007



Figure 274

(9) Check the function of **both** clutches by  
means of compressed air.

※ In case of a decisive pressure loss, the  
possible cause might be the breakage of  
one or several rectangular rings (see  
arrow, figure 272).  
Replace the rectangular ring (s), if  
required.

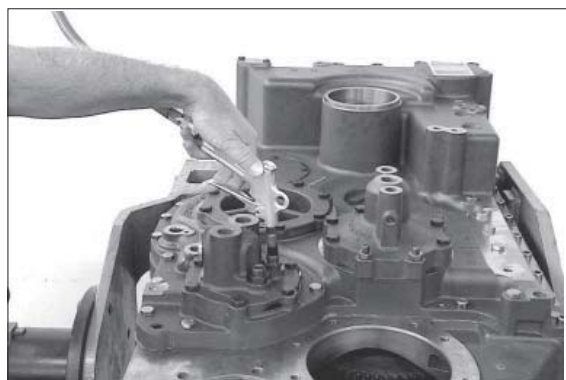


Figure 275



## Output

### Installation of the output shaft

(1) Heat the inner diameter of the output gear.

※ Special tool

Hot-air blower 230V                      5870 221 500

Hot-air blower 115V                    5870 221 501

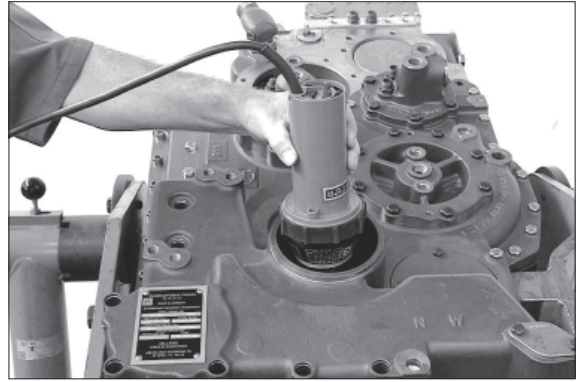


Figure 276

(2) Assemble the output shaft with the long gearing showing downwards until contact.



Figure 277

(3) Rotate the transmission housing into the vertical position (90°).

By means of the mounting tool the output shaft has preliminarily to be fixed axially (figure 278 and 279) at the convert-er side.

※ Special tool

Mounting tool                              5870 048 265

Then rotate the transmission housing back again (90°).



Figure 278

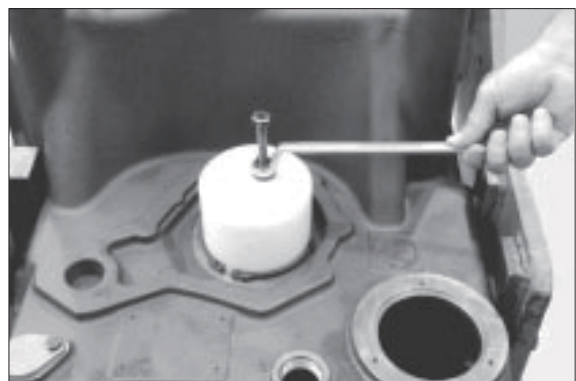


Figure 279



**Adjust the axial play of the output bearing  
= 0.3~0.5 mm (figure 280~282)**

- (4) Determine Dimension I, from plane face/  
housing to end face/output shaft.

Dimension I e.g ..... 66.90 mm

※ Special tool

Digital depth gauge 5870 200 072



Figure 280

- (5) Measure Dimension II, from plane face/  
housing to contact face/ball bearing.

Dimension II e.g ..... 64.20 mm

Example :

Dimension I ..... 66.90 mm

Dimension II ..... - 64.20 mm

Difference ..... = 2.70mm

Required axial play ..... e.g. - 0.40 mm  
(0.3~0.5 mm)

Resulting shim ..... s = 2.30 mm



Figure 281

- (6) Install the shim.

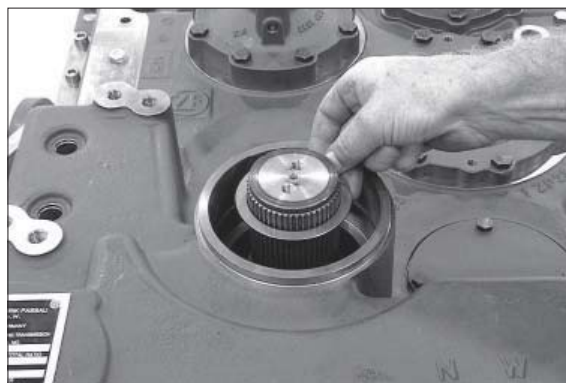


Figure 282

- (7) Install the ball bearing (figure 283) and  
pull it until contact by means of the output  
flange (figure 284).

Then remove the output flange again.



Figure 283





Figure 284

(8) Fasten the ball bearing by means of retaining ring.

※ Clamping pliers 5870 900 021



Figure 285

(9) Remove the converter-side mounting tool again.

Install the shaft seal, (arrow) with the sealing lip showing to the oil sump.

※ Using of the specified mounting tool, results in the exact installation position (without retaining ring = 20 mm). Grease the sealing lip.

※ Special tool  
Mounting tool 5870 048 265

※ Depending on the version different shaft seals can be used :  
Outer diameter rubber-coated-wet it with spirit. Outer diameter metallic-wet it with sealing compound (loctite, type No. 574).

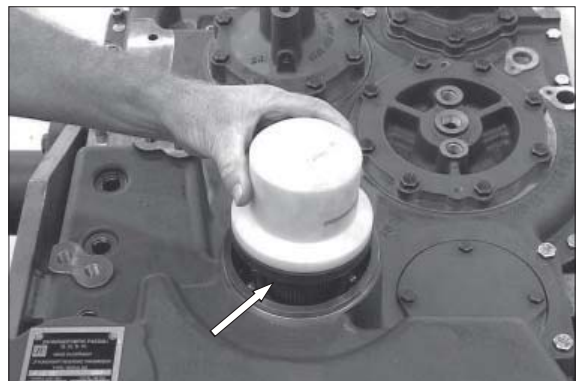


Figure 286



## Output Flange

(1) Press on the screen sheet (arrow) until contact.

※ Observe the installation position, see figure 288.

※ Special tool

Pressing bush

5870 506 138

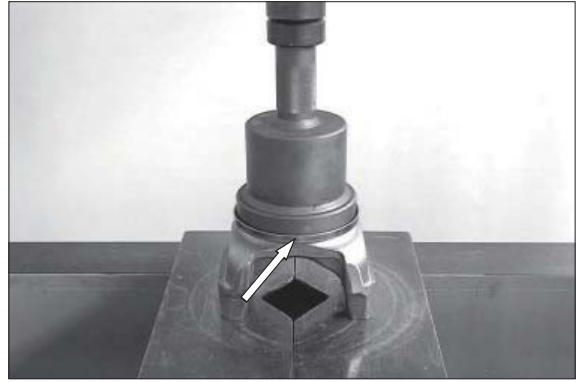


Figure 287

- 1 Screen sheet
- 2 Output flange

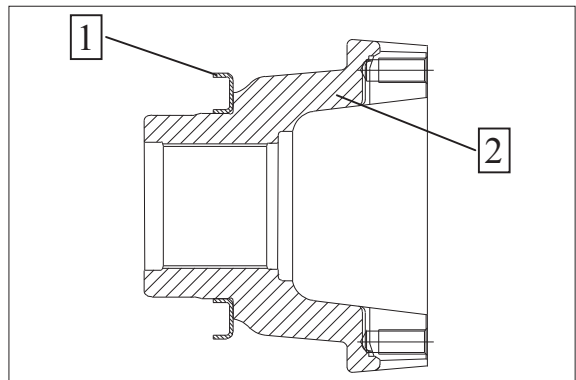


Figure 288



Adjust gap size  $X = 0.3 \sim 0.8$  mm  
(figure 289~292) :

- X     Gap size
- 1     Shim
- 2     O-ring.

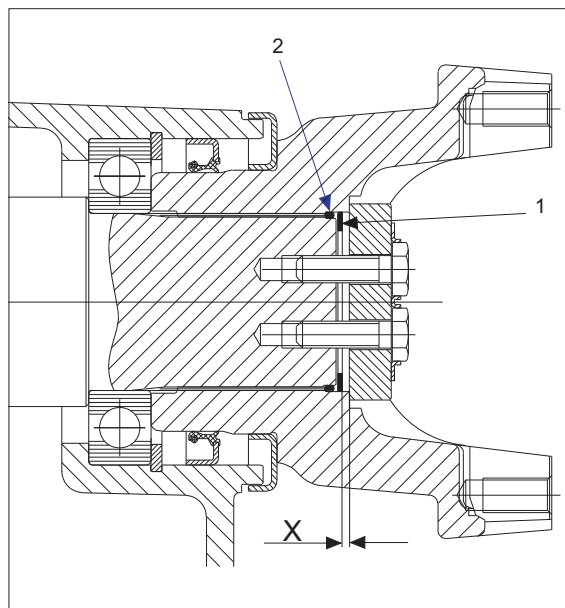


Figure 289

- (1) Install the output flange until contact.

Measure Dimension I, from the plane face of the output flange to the end face of the output shaft.

Dimension I e.g. ....37.00 mm

※ Special tool

Digital depth gauge                      5870 200 072

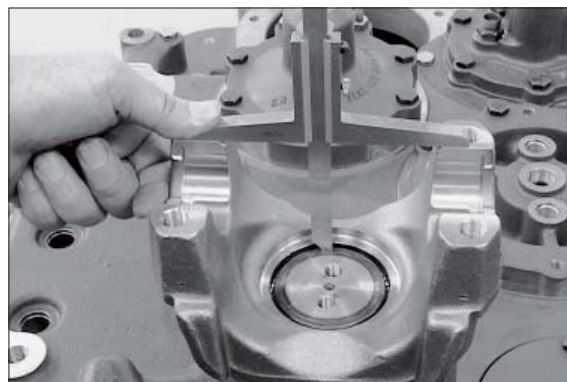


Figure 290

- (2) Measure Dimension II, from the plane face to the collar of the output flange.

Dimension II e.g. .... 36.00 mm

Example :

Dimension I ..... 37.00 mm

Dimension II ..... - 36.00 mm

Difference ..... = 1.00 mm

Gap size X ..... e.g. - 0.50 mm  
(0.3~0.8 mm)

Resulting shim ..... s = 0.50 mm

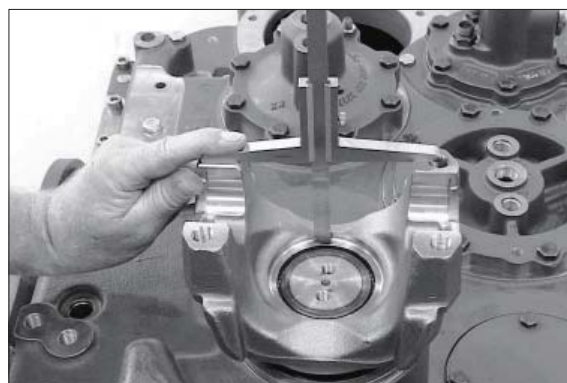


Figure 291



- (3) Place the O-ring (arrow) into the space between output flange and shaft (see also figure 289) and put on the shim.

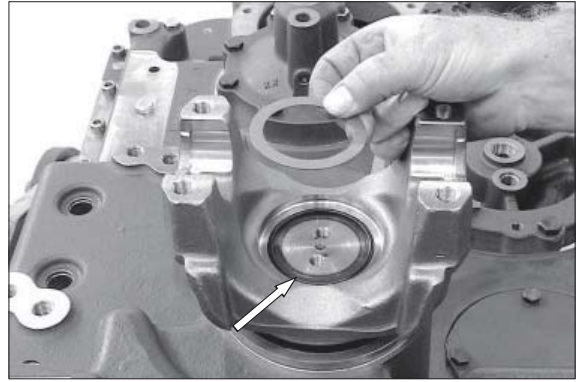


Figure 292

- (4) Put on the washer and fasten the output flange by means of hexagon screws.

- Torque limit (M10/8.8) :  
4.69 kgf · m (33.9 lbf · ft)



Figure 293

- (5) Fasten the hexagon screws by means of the lock plate.

- ※ Specail tool
- |               |              |
|---------------|--------------|
| Mounting tool | 5870 057 009 |
| Handle        | 5870 260 002 |



Figure 294



### Output Flange (converter side)

(1) Install the shaft seal (arrow) with the sealing lip showing to the oil sump.

- ※ Using of the specified mounting tool, results in the exact installation position (with retaining ring = 7.0 mm). Grease the sealing lip.

※ Special tool

Mounting tool 5870 048 265

- ※ Depending on the version different shaft seals can be used :

Outer diameter rubber-coated-wet it with spirit. Outer diameter metallic-wet it with sealing compound (loctite, Type No. 574).

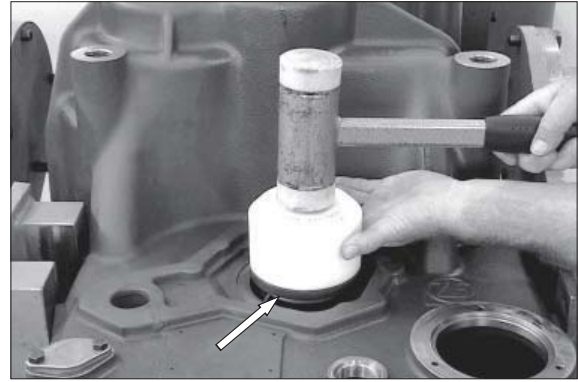


Figure 302

(1) Press the screen sheet (arrow) over the collar of the output flange until contact.

- ※ Observe the installation position, see figure 304.

※ Special tool

Pressing bush 5870 506 138

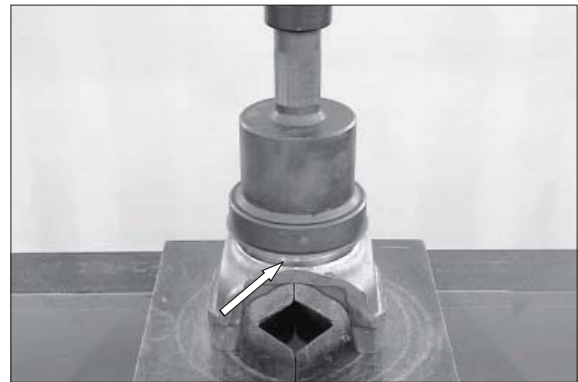


Figure 303

1 Screen sheet

2 Output flange

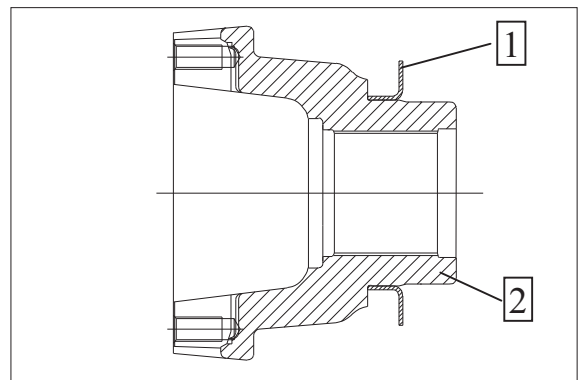


Figure 304



(2) Install the output flange until contact.

- ※ Setting of the gap size as well as fixing of the output flange is identical with the installation of the output flange at the transmission rearside, see page 3-187 and 3-188.



Figure 305

### Installation of the idler shaft

(1) Align the layshaft gear and the single components centrally.  
Heat the layshaft gearing (figure 306).

- ※ Special tool  
Hot-air blower 230V                      5870 221 500  
Hot-air blower 115V                    5870 221 501



Figure 306

(2) Install the adjusting screw.

- ※ Special tool  
Adjusting screws                      5870 204 007



Figure 307

(3) Install the idler shaft until contact.



Figure 308



(4) Remove the adjusting screw and fasten the axle by means of hexagon screw.

※ Wet the thread of the hexagon screw with Loctite (type No. 243).

- Torque limit (M10/8.8) :  
4.69 kgf · m (33.9 lbf · ft)



Figure 309

(5) Insert the sealing covers (arrow), with the concave side showing downwards, flush to the housing surface.

※ Wet contact face with Loctite (type No. 262).

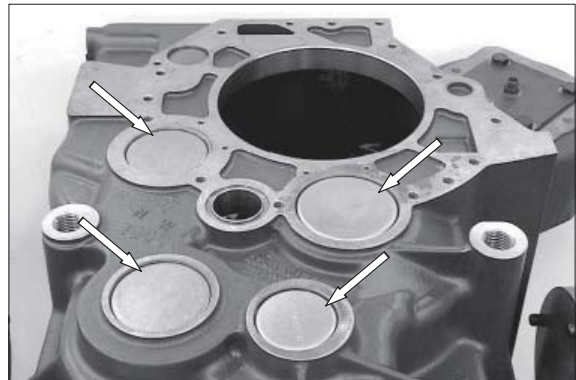


Figure 310



## Transmission pump

- (1) Press the needle sleeve (arrow), with the reinforced coating towards the press-in tool until contact.

※ Special tool

Mounting tool 5870 058 041

Handle 5870 260 002



Figure 329

- (2) Snap the V-Rings (3EA) into the recess of the driver (internal gearing). Install the key (arrow).



Figure 330

- (3) Press the ball bearing over the collar of the driver until contact.



Figure 331

- (4) Install the ball bearing and driver respectively and press it until contact.

※ Pay attention to align the key to the keyway.



Figure 332



(5) Fasten the ball bearing by means of retaining ring.

※ Special tool

Set of internal pliers 5870 900 013



Figure 333

(6) Install the O-ring (arrow) and grease it.



Figure 334

(7) Heat the housing bore.

※ Special tool

Preheating bush 5870 801 006

Hot-air blower 230V 5870 221 500

Hot-air blower 115V 5870 221 501



Figure 335

(8) Install two adjusting screws and assemble the pump until contact.

※ Observe the radial installation position.

※ Special tool

Adjusting screws 5870 204 021



Figure 336



(9) Put the O-ring (arrow) into the annular groove of the pump flange.

- ※ Depending on the transmission version, differences as regards the version and fastening of the pump flange are possible. Obligatory is the respective parts list.



Figure 337

(10) Fasten the pump flange and the pump respectively by means of hexagon screws.

- ※ Wet thread of both hexagon screws (position, see arrows) with loctite, Type No. 574 (through holes).

- Torque limit (M12/8.8) :

8.06 kgf · m (58.3 lbf · ft)

Then rotate the transmission housing by 90°.

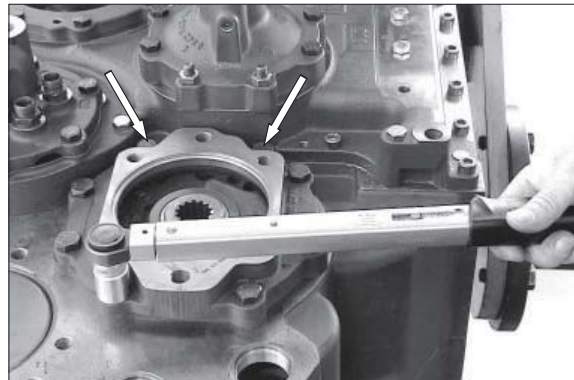


Figure 338

(11) Snap-in and lock the rectangular ring (arrow).

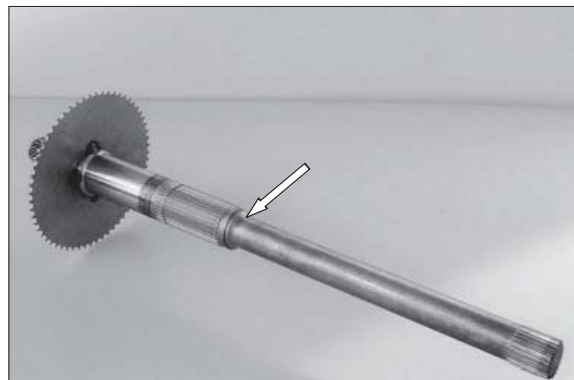


Figure 339

(12) Install both shims (each 2.0 mm thick)

- ※ Use assembly grease.



Figure 340



(13) Heat the bevel bearing inner ring.

※ Special tool

Hot-air blower 230V                    5870 221 500

Hot-air blower 115V                  5870 221 501



Figure 341

(14) Install the input shaft until contact.

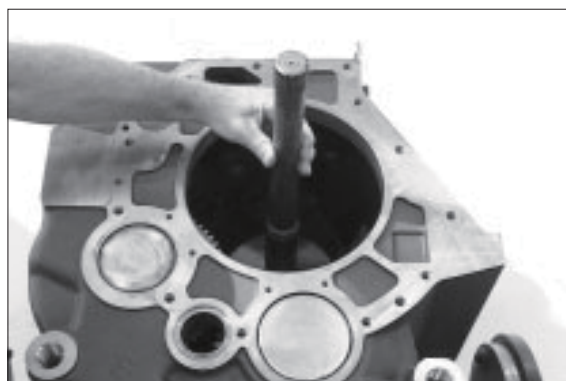


Figure 342

(15) Fasten the input shaft by means of clamping plate and cap screw (arrow).

· Torque limit (M10/8.8) :

3.26 kgf · m (23.6 lbf · ft)

※ Wet thread of the cap screw with loctite (type No. 243).



Figure 343



### Input-Converter Bell

※ To install a new converter bell the finished bores (3EA) have to be sealed with plugs. Installation position, see arrow, figure 344.

※ Special tool

Lever riveting tongs                      5870 320 016



Figure 344

(1) Locate the bearing outer ring into the housing bore until contact and install the bearing inner ring, see arrow.



Figure 345

(2) Install the spur gear (arrow) with the long collar showing upwards and position it.



Figure 346

(3) Heat the spur gear bore (arrow).

※ Special tool

Hot-air blower 230V                      5870 221 500

Hot-air blower 115V                      5870 221 501



Figure 347



- (4) Install the input shaft until contact.



Figure 348

- (5) Heat the bearing inner ring and install it until contact.

⚠ Use safety gloves.



Figure 349

- (6) Install the bearing outer ring until contact.



Figure 350

- (7) Snap in the rectangular ring (arrow) into the annular groove of the input shaft and lock it.  
Then grease the rectangular ring and centrally align it.



Figure 351



- (8) Install the converter safety valve (arrow 1) and fasten it by means of slotted pin (arrow 2).

※ Flush-mount slotted pin to recess.

Put the O-ring (arrow 3) into the annular groove.



Figure 352

- (9) Press the needle bearing (arrow), with the reinforced coating towards the press-in tool into the bore of the bearing cover until contact.

※ Special tool

Mounting tool 5870 058 051

Handle 5870 260 002



Figure 353

- (10) Flush-mount the shaft seal (arrow) with the sealing lip showing (downwards) to the oil sump.

※ Wet the outer diameter with spirit.  
Grease the sealing lip.

※ Special tool

Mounting tool 5870 048 030



Figure 354

※ Make the following steps (figure 355~358) in direct time sequence to secure the precise contact of the oil supply flange.

- (11) Heat the housing bore.

※ Special tool

Preheating bush 5870 801 006

Hot-air blower 5870 221 500

Hot-air blower 5870 221 501



Figure 355



(12) Install two adjusting screws and put in the oil supply flange until contact.

※ Observe the radial installation position.

※ Special tool

Adjusting screws 5870 204 007



Figure 356

(13) Place the O-ring (arrow) with assembly grease into the annular groove of the bearing cover.



Figure 357

(14) Put on the bearing cover and fasten it by means of hexagon screws.

• Torque limit (M10/8.8) :

4.69 kgf · m (33.9 lbf · ft)



Figure 358

(15) Install the single components according to the opposite figure.

1 Screw plug : 15.3 kgf · m (110 lbf · ft)

2 Screw plug : 2.55 kgf · m (18.4 lbf · ft)

3 Temperature sensor :

2.55 kgf · m (18.4 lbf · ft)

and screw plug respectively (depending on the version) : 3.57 kgf · m (25.8 lbf · ft)

※ Always install new O-ring.



Figure 359



**Converter pressure back-up valve**  
(figure 360~361)

- (1) Install the slotted pin (6×50 mm) until contact.



Figure 360

- (2) Assemble piston and compression spring. Provide screw plug with a new O-ring and install it.

- Torque limit (M36×1.5) :  
13.3 kgf · m (95.9 lbf · ft)



Figure 361

- (3) Fasten the gasket and cover plate by means of hexagon screws (install the washers).

- Torque limit (M6/8.8) :  
0.97 kgf · m (7.0 lbf · ft)



Figure 362

- (4) Install two adjusting screws and put on the gasket (arrow 1). Put the O-ring (arrow 2) into the annular groove.

- ※ Special tool  
Adjusting screws 5870 204 021

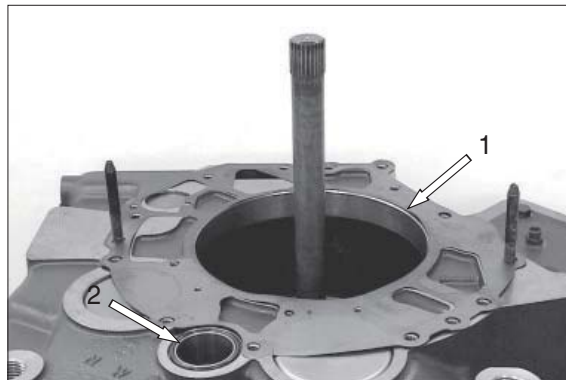


Figure 363



(5) Install the converter bell by means of lifting tackle until contact.

※ Slight rotary motions of the input shaft facilitate the installation (protect teeth from damage). Observe the radial installation position.

※ Special tool

Lifting tackle 5870 281 047

Eyebolts assortment 5870 204 002



Figure 364

(6) Fasten the converter bell by means of hexagon screws.

• Torque limit (M8/10.9) :

3.47 kgf · m (25.1 lbf · ft)

• Torque limit (M12/10.9) :

11.7 kgf · m (84.8 lbf · ft)



Figure 365

(7) Fasten flexible plate (3EA) by means of hexagon screws (install the washers).

※ Wet thread of the hexagon screws with Loctite (type No. 243).

• Torque limit (M10/8.8) :

4.69 kgf · m (33.9 lbf · ft)

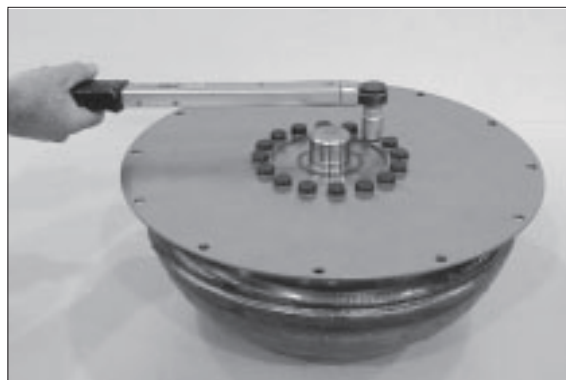


Figure 366

(8) Install the rectangular ring (arrow) into the annular groove and lock it.

Then grease the rectangular ring and centrally align it.



Figure 367



(9) Assemble converter by means of lifting tackle until contact (figure 368).

※ At a control dimension < 43 mm, the exact installation position of the converter is ensured, see Figure 369.

※ Special tool

Eyebolts assortment 5870 204 002

Lifting chain 5870 281 047



Figure 368



Figure 369

⚠ Until installation of the transmission, fix the converter axially, see figure 370.



Figure 370



## Coarse Filter

(1) Install filter (assy) into the housing bore.

※ Oil the sealing (arrow).



Figure 371

(2) Fasten the cover by means of hexagon screws (install the washers).

※ Install the new O-ring (arrow).

• Torque limit (M8/8.8) :

2.35 kgf · m (17.0 lbf · ft)



Figure 372

## Inductive and speed transmitters

(1) Following sketches show the installation position of the single inductive and speed transmitters.

|    |                       |                        |
|----|-----------------------|------------------------|
| 14 | Inductive transmitter | n-Turbine              |
| 9  | Inductive transmitter | n-Engine               |
| 5  | Inductive transmitter | n-Internal speed input |
| 13 | Speed transmitter     | n-Output               |

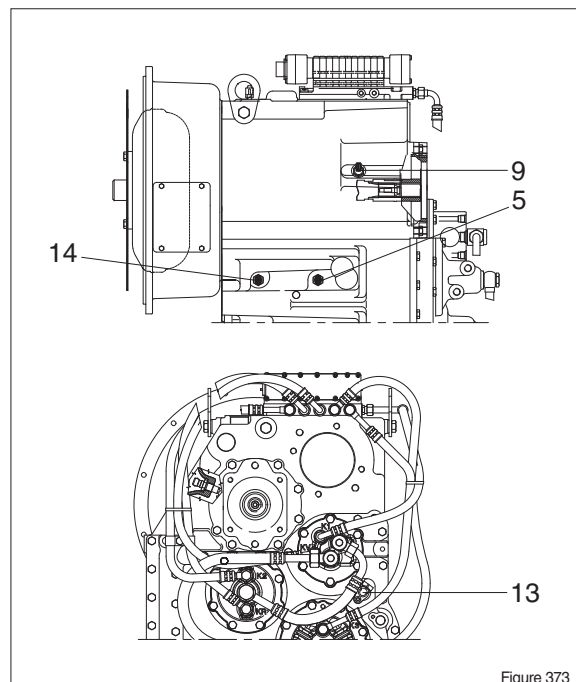


Figure 373



※ The following figures describe the installation and setting respectively of the inductive transmitter n-Engine (9).

Installation of the inductive transmitter n-Turbine (14) and n-internal speed input (5) is to be made analogously.

Observe the different setting dimensions "X" :

▲ **Inductive transmitter n-Engine (9)**

**X =  $0.5^{+0.3}_{-0}$  mm**

**Inductive transmitter n-Turbine (14)**

**X =  $0.5^{+0.3}_{-0}$  mm**

**Induct. transmitter n-int. speed input (5)**

**X =  $0.3 \pm 0.1$  mm**

Adjust Dimension "X" by means of shim ring (s) (figure 376~381)

(1) Measure Dimension I on the inductive transmitter, from contact face to screw-in face.

※ Dimension I e.g. .... 30.00 mm

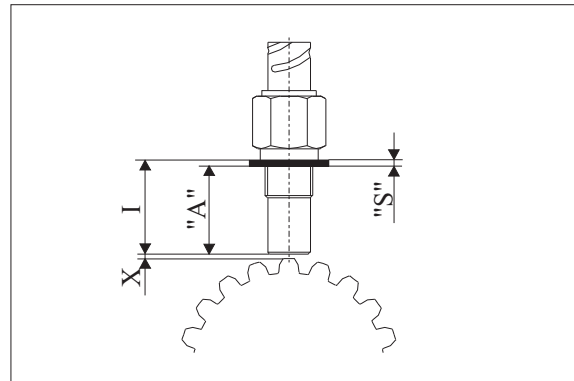


Figure 375



Figure 376

(2) Turn in the counting disc radially until one tooth tip is centrally to the inductive transmitter bore.

Turn the plug gauge until contact.

Locate anvil at the tooth tip and lock it by means of threaded pin (figure 377 and 378).

※ Special tool

Plug gauge 5870 200 104



Figure 377

※ Special tool

Plug gauge 5870 200 104

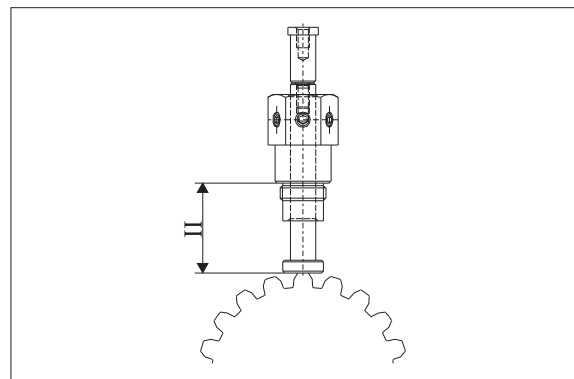


Figure 378



- (3) Turn out the plug gauge and determine Dimension II (also see figure 378).

Dimension II e.g ..... 30.10 mm



Figure 379

Example "A<sub>1</sub>" :

|                                      |                  |
|--------------------------------------|------------------|
| Dimension II                         | <u>30.10 mm</u>  |
| Dimension X (0.5 <sup>+0.3</sup> mm) | - <u>0.60 mm</u> |
| Results in installation dimension A  | = 29.50 mm       |

Example "A<sub>2</sub>" :

|                          |                   |
|--------------------------|-------------------|
| Dimension I              | <u>30.00 mm</u>   |
| Installation dimension A | - <u>29.50 mm</u> |
| Results in shim ring (s) | s = 0.50 mm       |

- (4) Install the adequate shim ring (s) and wet the thread (arrow) with loctite (type No. 574).



Figure 380

- (5) Install the inductive transmitter n-Engine (9), see arrow.

• Torque limit : 3.06 kgf · m (22.1 lbf · ft)

Set and install the inductive transmitter n-Turbine (14) and n-internal speed input (5) analogously.

- ※ Observe the different setting dimensions. Installation position of the single inductive transmitters, also see page 3-203.



Figure 381



Install speed transmitter n-Output/Speedo  
(13) (figure 382~387)

- 1 Housing
- 2 Spur gear K3
- 3 Disc carrier
- 13 Speed transmitter (hall sensor)
- X** Setting dimension "X" =  $1.0 \pm 0.5$  mm

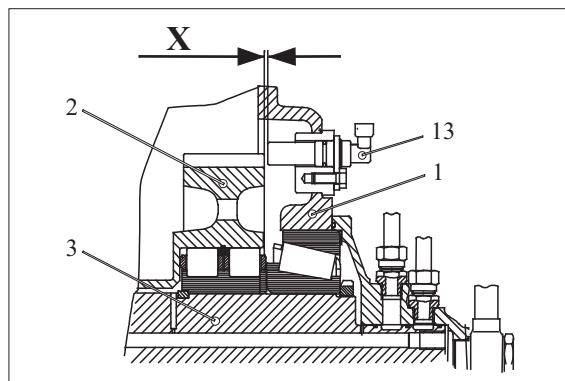


Figure 382

(1) Opposite figure shows the speed transmitter (hall sensor).



Figure 383

(2) Determine Dimension I, from the housing face to spur gear K3.

Dimension I e.g ..... 39.70 mm

※ Special tool

Digital depth gauge 5870 200 072

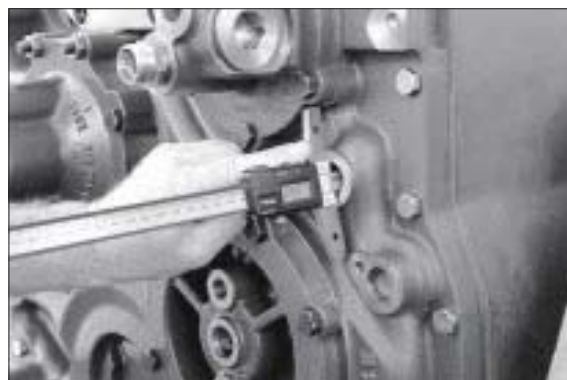


Figure 384

(3) Measure Dimension II, from the contact face to the mounting face.

Dimension II e.g ..... 40.00 mm

※ Special tool

Digital depth gauge 5870 200 072



Figure 385



Example "B<sub>1</sub>" :

|                                     |                   |
|-------------------------------------|-------------------|
| Dimension I                         | <u>39.70 mm</u>   |
| Dimension X(1.0 <sup>+0.5</sup> mm) | - <u>1.20 mm</u>  |
| Results in installation dimension   | <u>= 38.50 mm</u> |

Example "B<sub>2</sub>" :

|                          |                    |
|--------------------------|--------------------|
| Dimension II             | <u>40.00 mm</u>    |
| Installation dimension A | - <u>38.50 mm</u>  |
| Results in shim(s)       | s = <u>1.50 mm</u> |

- (4) Install shims (3EA, s = 0.50 mm) and grease the O-ring (arrow).

- (5) Fasten the speed transmitter by means of cap screw.

- Torque limit (M8/8.8) :  
2.35 kgf · m (17.0 lbf · ft)

※ Installation position of the speed transmitter, also see page 3-203.

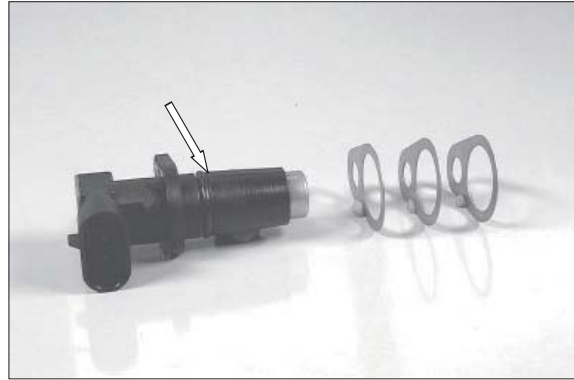


Figure 386



Figure 387



### 3. FRONT AXLE

#### 1) DISASSEMBLY

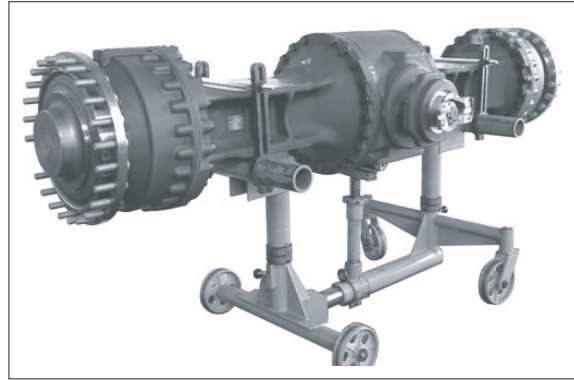
##### (1) Disassembly output and brake

- ① Fix axle to assembly truck.

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

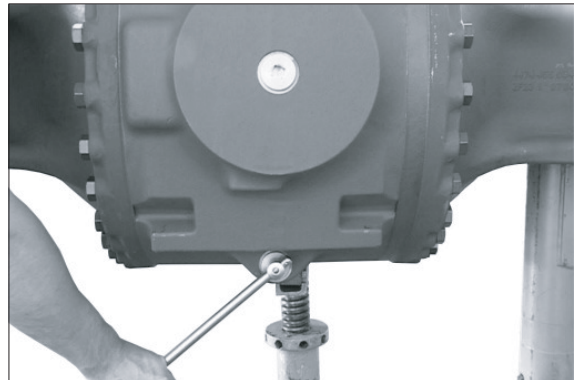
- ※ Before clamping the axle fully turn in the support.

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

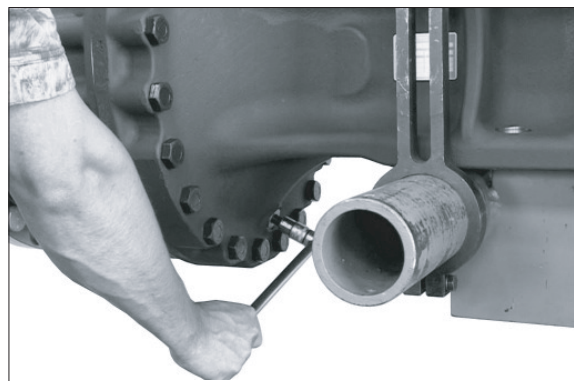


7809AX01

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



7809AX02

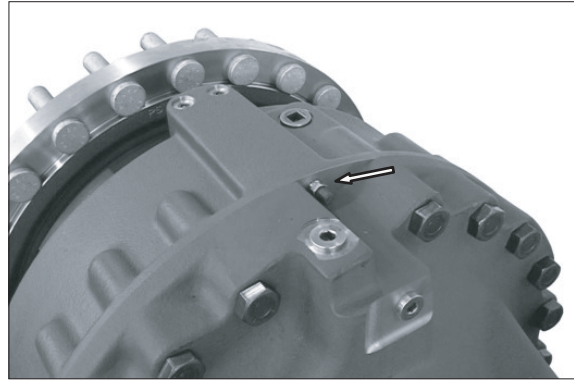


7809AX03



③ Remove the breather valve (see arrow).

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

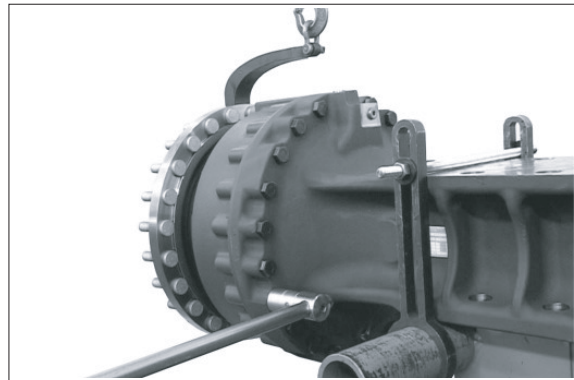


7809AX04

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

Load carrying device      AA00 685 875

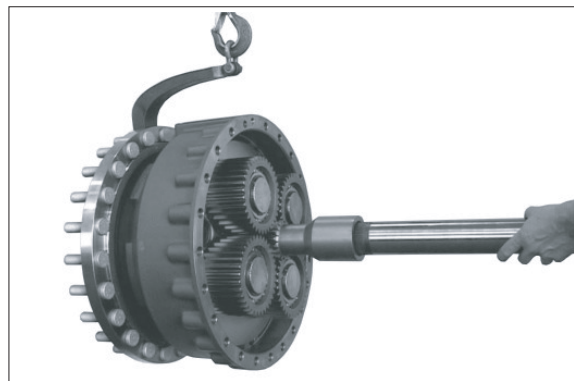
※ Fix the load carrying device with wheel nuts.



7809AX05

⑤ Pull stub shaft and sun gear shaft.

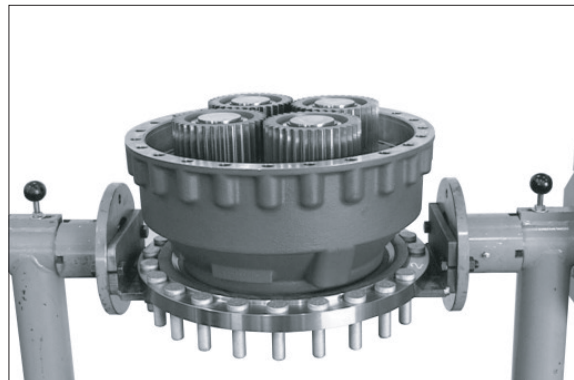
※ Pay attention to potentially releasing shim(s).



7809AX06

⑥ Fix output to assembly truck.

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



7809AX07

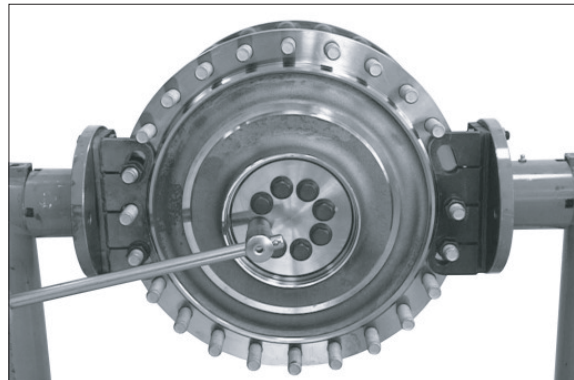


- ⑦ Use a lever to remove the cover from the output shaft.



7809AX08

- ⑧ Loosen locking screws and remove the releasing cover.



7809AX09

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

- Planetary carrier with 3 planetary gears

Internal extractor 5870 300 019

Eye bolt 5870 204 073



7809AX10

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

Rapid grip AA00 693 459

Basic tool 5873 004 001

Clamping cylinder 5873 003 016

Pump 5870 287 010



7809AX70



⑪ Disengage retaining ring.



7809AX71

⑫ Pull off planetary gear.

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



7809AX72

⑬ Lift the end plate out of the brake housing.



7809AX73

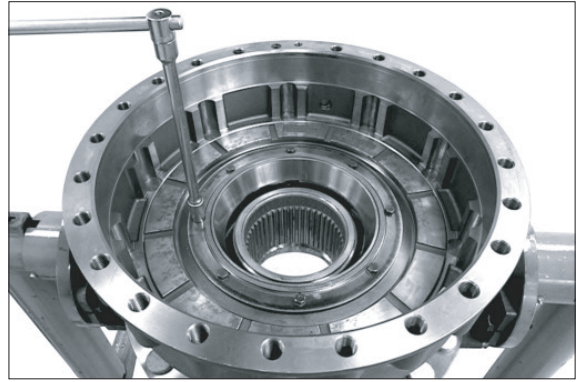
⑭ Lift the disk package out of the brake housing.



7809AX12

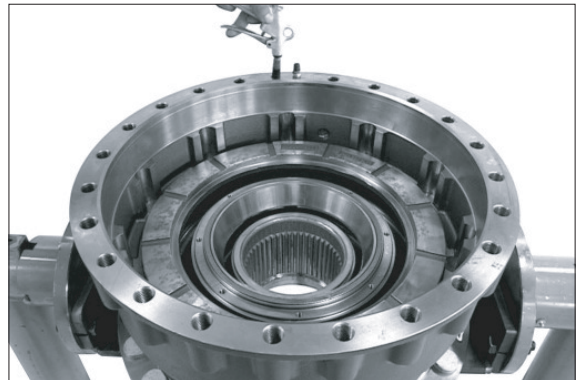


- ⑮ Loosen hexagon screws, remove releasing disk and cup spring.



7809AX13

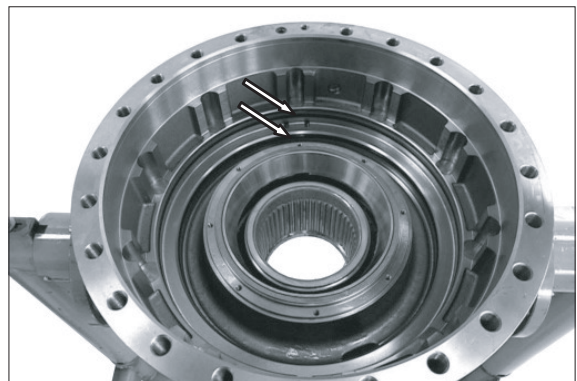
- ⑯ Mount breather valve and press piston out of the brake housing by means of compressed air.



7809AX14

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

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

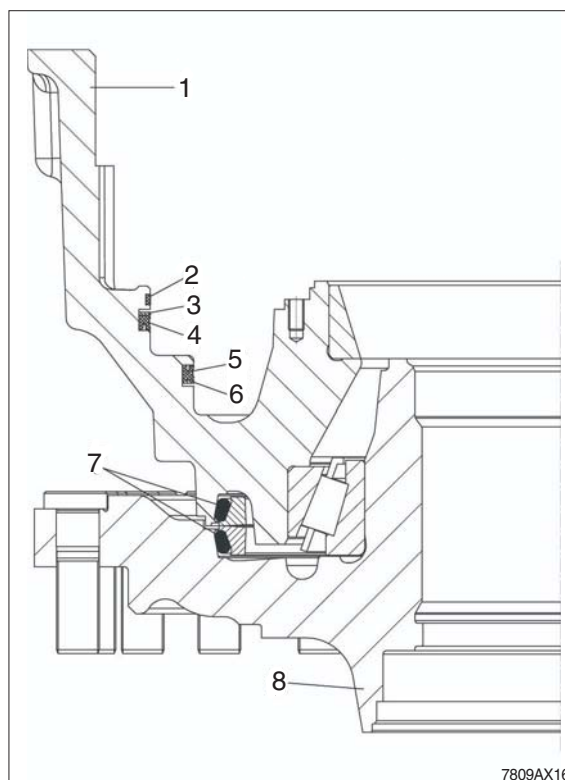


7809AX15



**Legend to sketch :**

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



7809AX16

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



7809AX17

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

If necessary, force out both bearing outer rings.

Resetting device                      5870 400 001



7809AX18



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

Resetting device                      5870 400 001



7809AX74

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

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

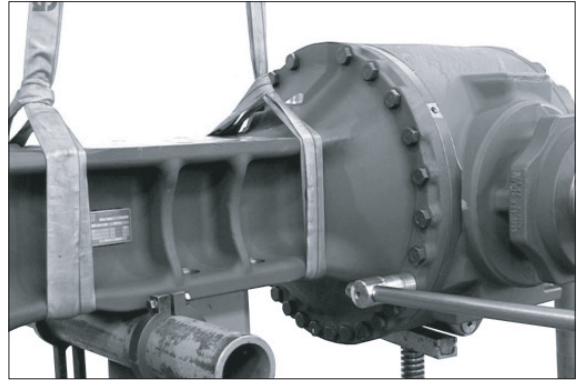


7809AX75



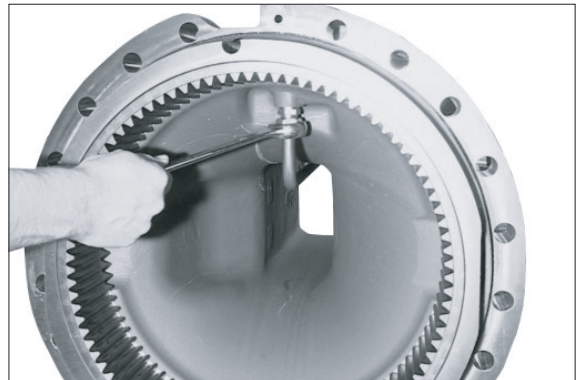
## (2) Disassembly axle housing

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



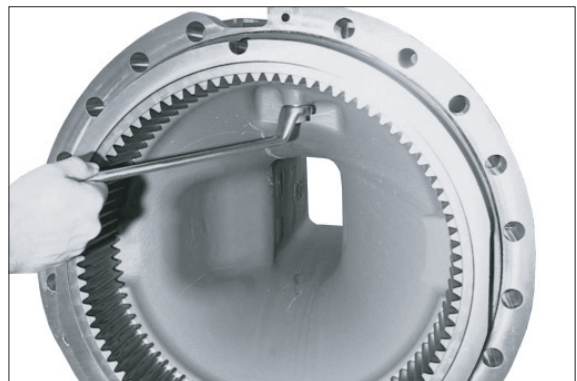
7809AX19

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



7809AX20

- ③ Loosen both screw necks.



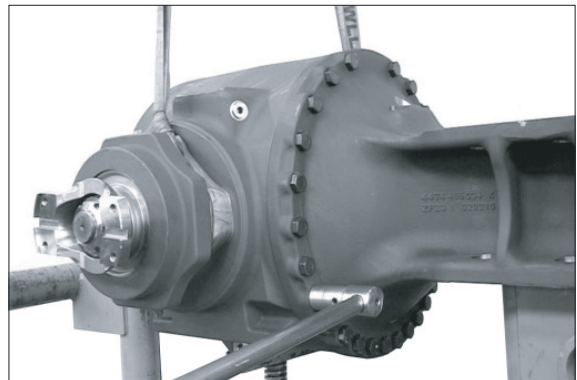
7809AX21

## (3) Disassembly axle drive housing

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

Eyebolt (M20)  
Thread insert

5870 204 086  
AA00 677 715



7809AX22



- ② Fix axle drive housing to the assembly truck.

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



7809AX76

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

|                 |              |
|-----------------|--------------|
| Inner extractor | 5870 300 008 |
| Eye bolt        | AA00 680 376 |



7809AX77

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



7809AX78

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



7809AX79



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

Inner extractor                      5870 300 008  
Eye nut                                AA00 680 376

※ Disassembly of the various differentials is described as of page 3-234.



7809AX80

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



7809AX81

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

※ Slotted nut is secured with Loctite # 262.



7809AX82

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

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



7809AX83



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



7809AX84

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



7809AX85

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

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



7809AX86

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



7809AX87



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

|                 |              |
|-----------------|--------------|
| Assembly device | AA00 696 770 |
| Counter support | 5870 300 020 |



7809AX88

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

|                 |              |
|-----------------|--------------|
| Assembly device | AA00 696 770 |
| Counter support | 5870 300 020 |



7809AX89



#### (4) Disassembly differentials

##### Disassembly multi-disk differential lock

- ① Remove axial roller cage (arrow).



7809AX90

- ② Pull both tapered roller bearings from the differential.

##### Crown wheel side

Rapid grip AA00 303 274

Basic tool 5873 004 001

Pressure piece AA00 694 360

##### Opposite side

Grab sleeve 5873 004 026

Basic tool 5873 004 001

Clamping cylinder 5873 003 016

Pump 5870 287 010



7809AX91

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

Pressure piece AA00 694 360



7809AX92

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

Inner extractor 5870 300 008

Eye nut AA00 680 376

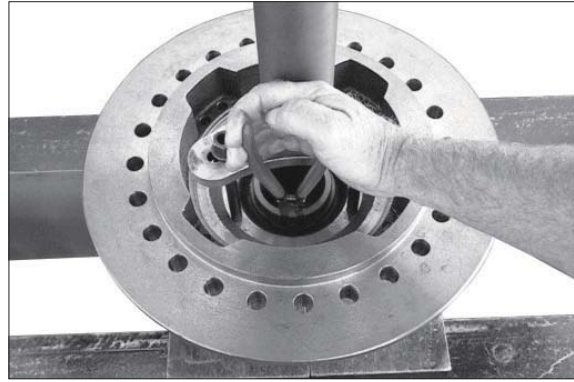


7809AX93



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

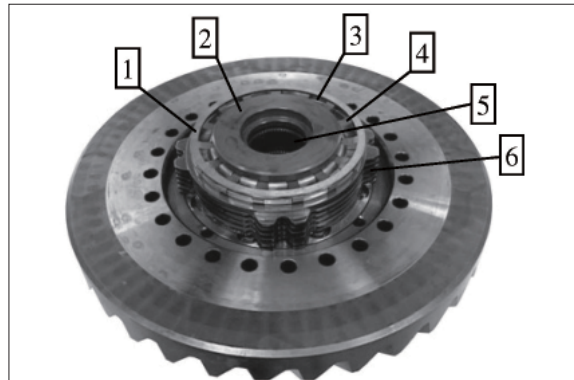
Then pull the sliding sleeve out of the differential cover and remove the releasing compression springs.



7809AX94

- ⑥ Remove single parts.

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



7809AX95

- ⑦ Loosen hexagon screws and remove the releasing disk.



7809AX96

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



7809AX97



- ⑨ Force out slotted pins (4EA).



7809AX98

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



7809AX99

- ⑪ Remove the axle bevel gears and the shims behind.



7809AX100

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



7809AX101



## 2) ASSEMBLY

### (1) Assembly differentials

#### Assembly multi-disk differential lock

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

Adjusting screws                      5871 204 040



7809AX102

- ② Insert disk and thrust washer into the differential housing



7809AX103

- ③ Insert axle bevel gear.

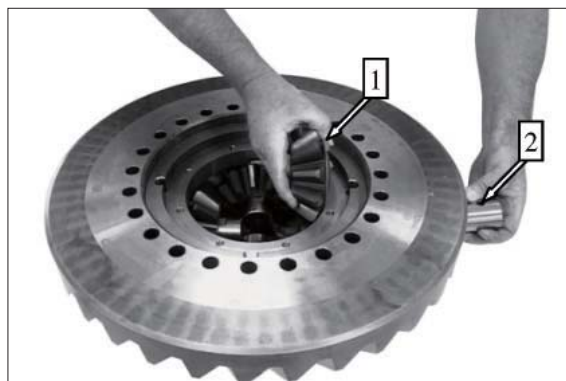


7809AX104

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

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

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



7809AX105



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



7809AX106

- ⑥ Mount second axle bevel gear and thrust washer.



7809AX107

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



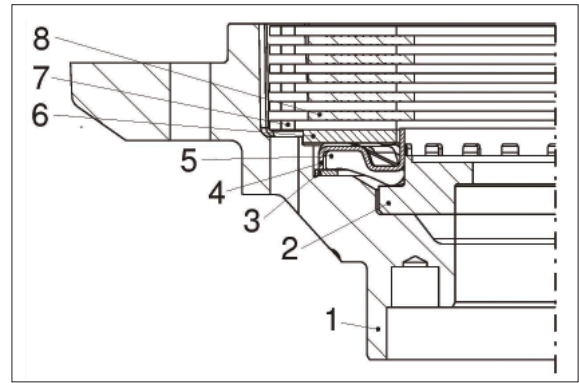
7809AX108



### Setting of disk package

- ⑧ Premount single parts according to the adjacent sketch.

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



7809AX109

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

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

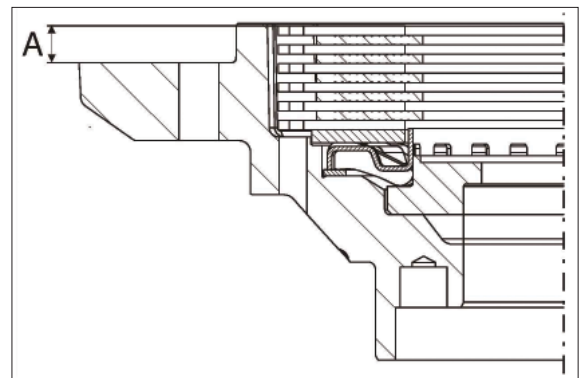
- ※ Any deviation from the specified setting dimension must be corrected with a corresponding outer disk.



7809AX110

### Legend to sketch:

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



7809AX111

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



7809AX112



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



7809AX113

- ⑫ Mount outer and inner disks.

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



7809AX114

- ⑬ Insert end plate.



7809AX115

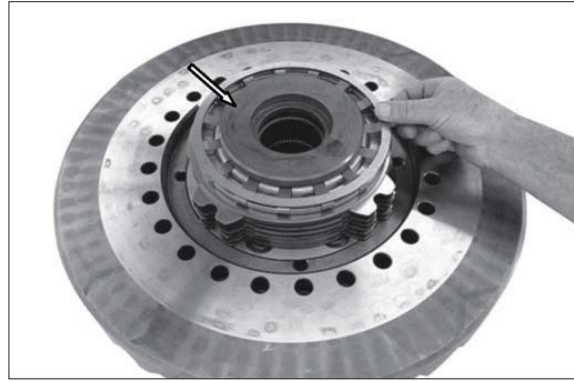
- ⑭ Mount cage and lever (15EA).



7809AX116



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



7809AX117

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



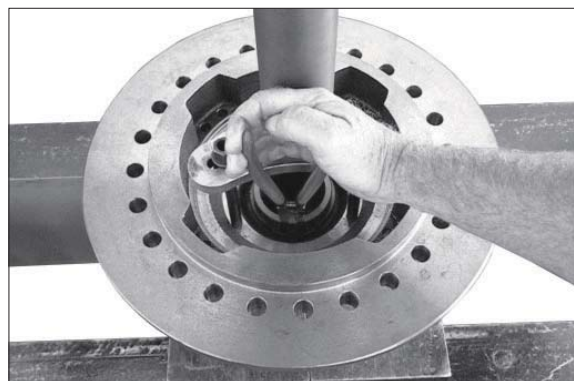
7809AX118

- ⑰ Insert sliding sleeve.



7809AX119

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



7809AX120



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

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



7809AX121

- ②⑩ Preload the differential by means of the press and bolt with **new** locking screws.

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

Pressure piece AA00 694 360



7809AX122

- ②⑪ Heat both tapered roller bearings and insert until contact is obtained.

※ Adjust tapered roller bearing after cooling down.



7809AX123

- ②⑫ Insert axial roller cage (see arrow).



7809AX124



## (2) Assembly axle drive housing

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

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

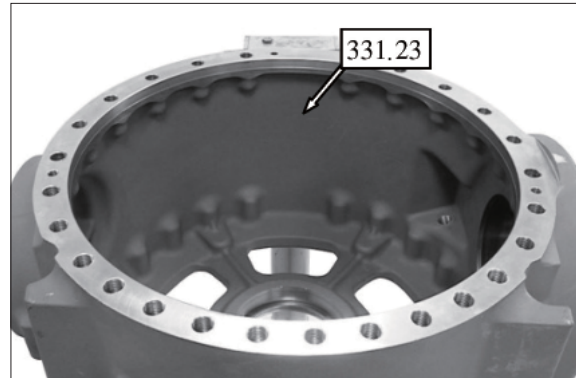
### Determination of shim thickness to obtain a correct contact pattern

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

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

- ① Read dimension I from the axle drive housing.

Dimension I e.g ..... 331.25 mm



7809AX125

- ② Read dimension II (pinion dimension).

Dimension II e.g ..... 265.00 mm



7809AX126



- ③ Determine dimension III (bearing width).

Dimension III e.g. .... 63.60 mm

Calculation example A :

Dimension I ..... 331.25 mm

Dimension II ..... - 265.00 mm

Dimension III ..... - 63.60 mm

Difference = shim                      s = 2.60 mm



7809AX127

### Reassembly of input pinion

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

Driver tool                      5870 050 007

Handle                          5870 260 004



7809AX128

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



7809AX129

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

Assembly fixture              AA00 623 955



7809AX130



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



7809AX131

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

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



7809AX132

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



7809AX133

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



7809AX134



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

• Tightening torque :

122 kgf · m (885 lbf · ft)

Wrench 5870 401 093

Fixing device AA00 695 905

Clamping device 870 240 002

- ※ Preliminarily mount slotted nut without Loctite.

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



7809AX135

- ⑨ Check rolling torque (0.15~0.51 kgf·m without shaft seal ring).

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

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

Excessive rolling torque - install thicker spacer ring.



7809AX136

- ⑩ Mount threaded connection.

• Tightening torque :

10.2 kgf · m (73.8 lbf · ft)



7809AX137



⑪ Mount oil tube.

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



7809AX138

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



7809AX139

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



7809AX140



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

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

① Deviation see crown wheel rear side.

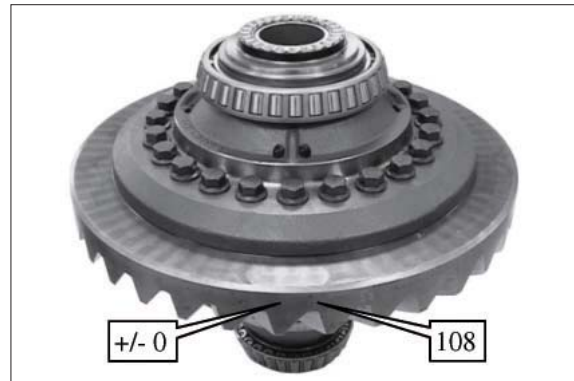
The test dimension 108 is stamped into the crown wheel rear side. If no + or – deviation is indicated, this value corresponds to the actual value 0 in the table below. According to this value, the required shims are allocated in the table below.

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

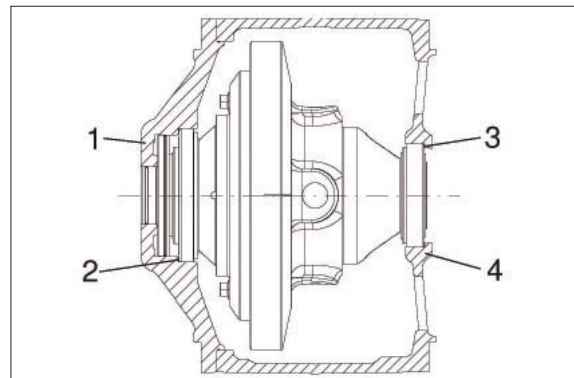
In accordance with this deviation, the required shims are allocated in the table below.

Legend to sketch:

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



7809AX141



7809AX142

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



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



7809AX143

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

|                 |              |
|-----------------|--------------|
| Inner extractor | 5870 300 008 |
| Eye nut         | AA00 680 376 |



7809AX144

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



7809AX145

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

|                 |              |
|-----------------|--------------|
| Inner extractor | 5870 300 008 |
| Eye nut         | AA00 680 376 |

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



7809AX146



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

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



7809AX147

### Leakage test of lock

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

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



7809AX148

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

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

Compare the obtained contact pattern with contact pattern.

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



7809AX149

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



7809AX150



## Reassembly of shaft seal ring (figure AX151~153)

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

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



7809AX151

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

|             |              |
|-------------|--------------|
| Driver tool | AA00 623 986 |
|-------------|--------------|

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



7809AX152

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

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

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

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



7809AX153

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



7809AX154



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

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



7809AX155

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



7809AX156

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

Then fix the axle drive housing with hexagon screws.

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

Adjusting screws (M20) 5870 204 024

Eye bolt (M20) 5870 204 086

Thread insert AA00 677 715



7809AX157

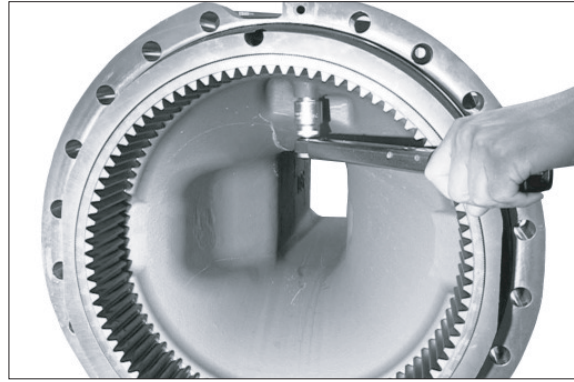
- ※ After mounting the axle drive housing unbolt the support until contact is obtained.



### (3) Assembly axle housing

① Mount both fittings.

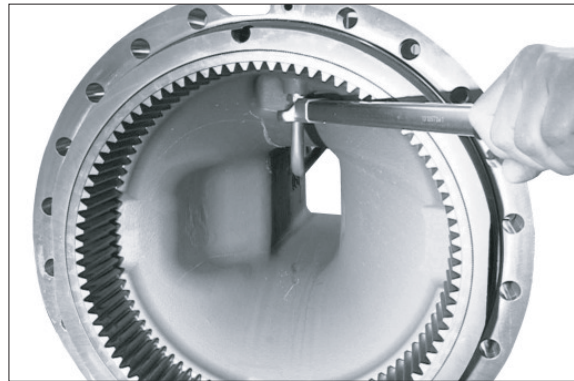
- Tightening torque : 3.67 kgf · m  
(26.6 lbf · ft)



7809AX158

② Mount brake tube.

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



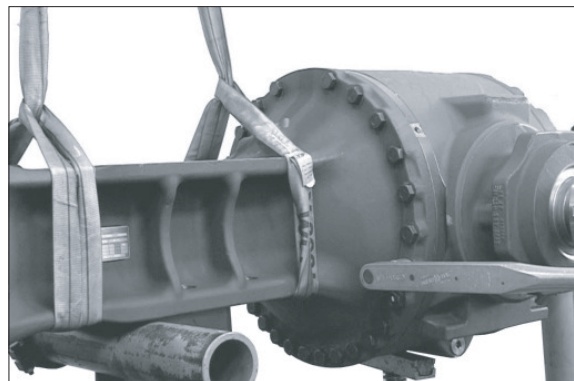
7809AX159

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

Then fix the axle housing by means of hexagon screws.

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

Adjusting screws (M20) 5870 204 024



7809AX160

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



#### (4) Assembly output and brake

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

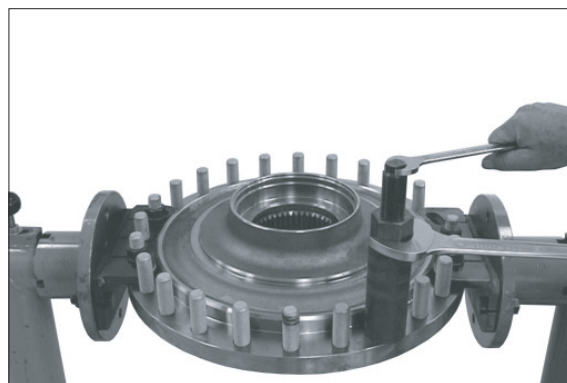
Wheel stud puller - basic tool

5870 610 001

Insert (M22x1.5)

5870 610 002

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



7809AX28

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



7809AX29

- ② Wet O-ring of the slide ring seal and locating hole with spirit.

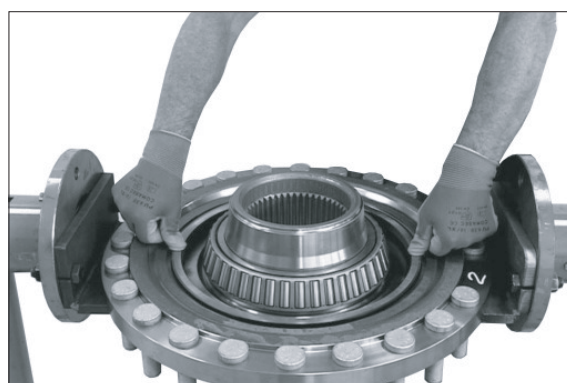
Snap **new** slide ring seal (1) into the output shaft.

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

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

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

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



7809AX30

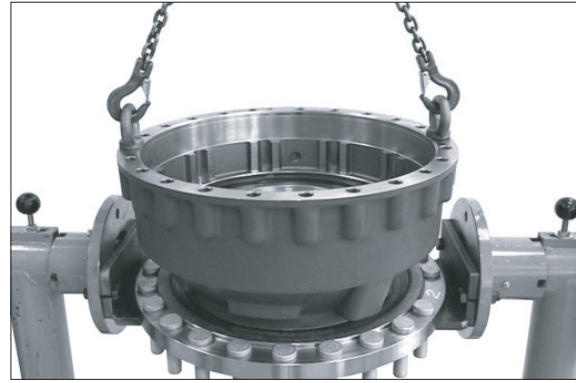


7809AX31



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

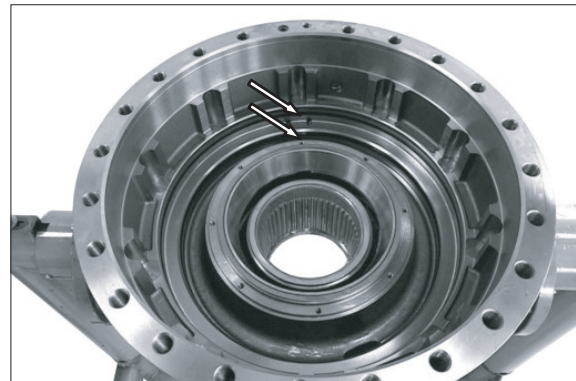
※ Before clamping the seal rings to installation dimension, clean the sliding surfaces and apply an oil film. We recommend to use a leather cloth soaked with oil.



7809AX31

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

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



7809AX32

- ⑤ Clean the annular groove of the brake housing with spirit. Then insert the guide ring into the annular groove (see also the following sketch) and fix it with loctite #415 at its extremities (see arrows).

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

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

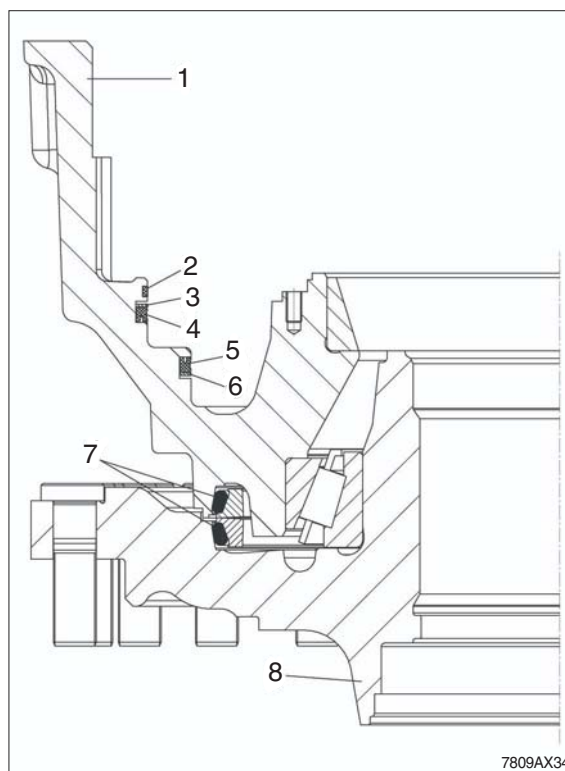


7809AX33



**Legend to sketch:**

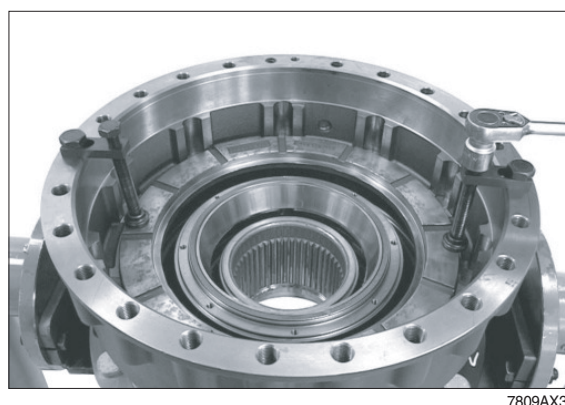
- 1 = Brake housing
- 2 = Guide ring
- 3 = Back-up ring
- 4 = Grooved ring
- 5 = Grooved ring
- 6 = Back-up ring
- 7 = Slide ring seal
- 8 = Output shaft



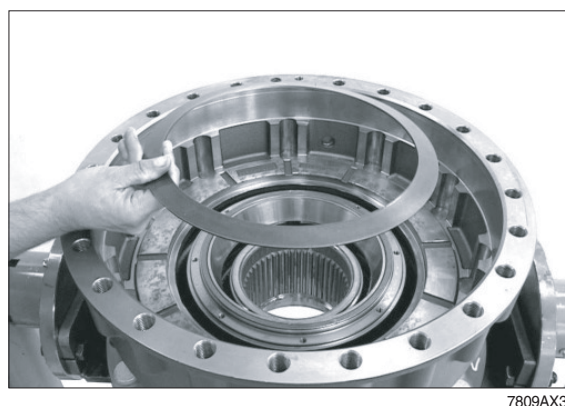
- ⑥ Insert the piston into the brake housing and carefully install with the fixing device until contact is obtained.

Fixing device                      AA00 680 530

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



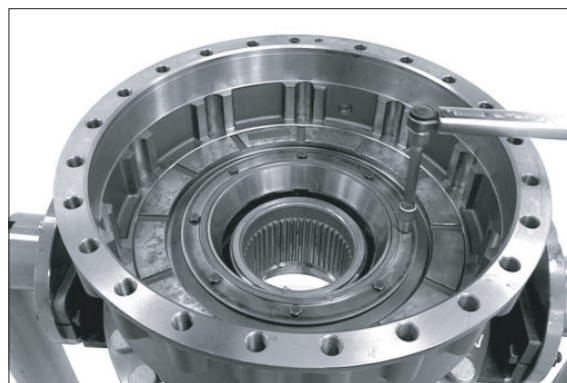
- ⑦ Insert cup spring into the piston with the convex side showing upwards.





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

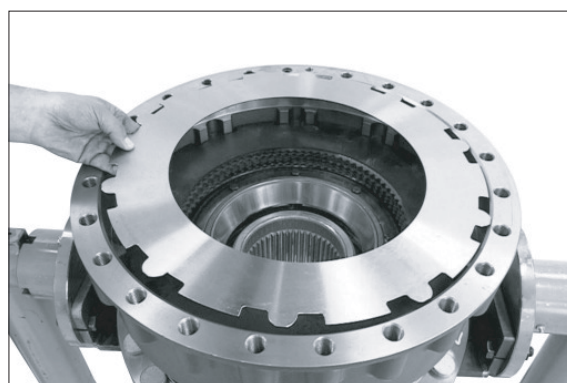
· Tightening torque (M8/10.9) :  
3.47 kgf · m (25.1 lbf · ft)



7809AX37

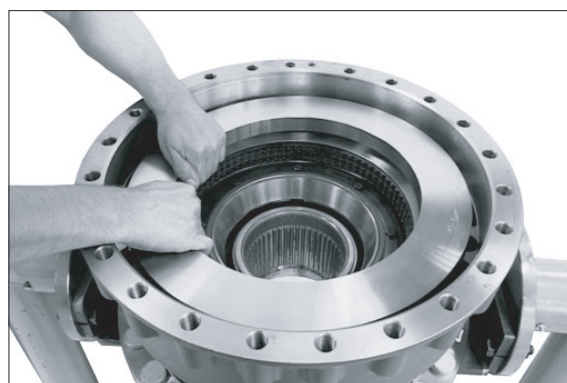
- ⑨ Mount outer and inner disks.

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



7809AX38

- ⑩ Insert end plate.



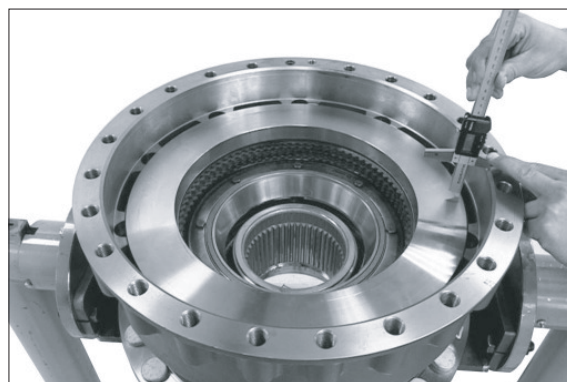
7809AX39

**Setting of installation dimension 57.25~57.79 mm**

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

Installation dimension e.g . . . . . 57.50 mm

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



7809AX40

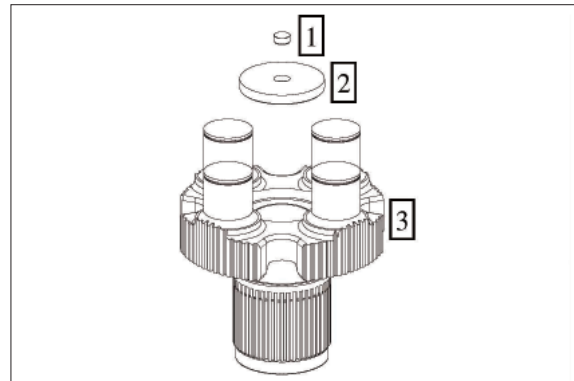


- ⑫ Press stop bolt into the cover until contact is obtained.

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

**Legend to sketch:**

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

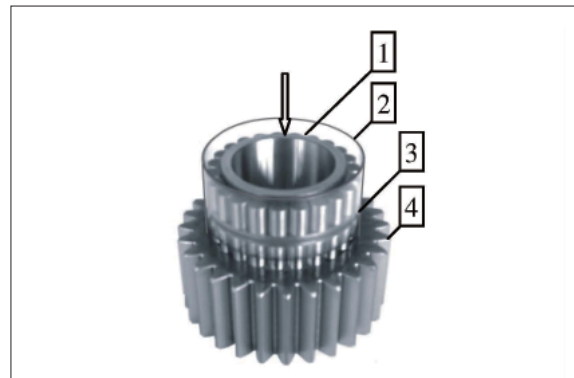


7809AX161

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

※ Use packaging sleeve to facilitate assembly.

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



7809AX162

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

※ Adjust bearing inner rings after cooling down.

Then fix planetary gears by means of retaining rings.



7809AX163

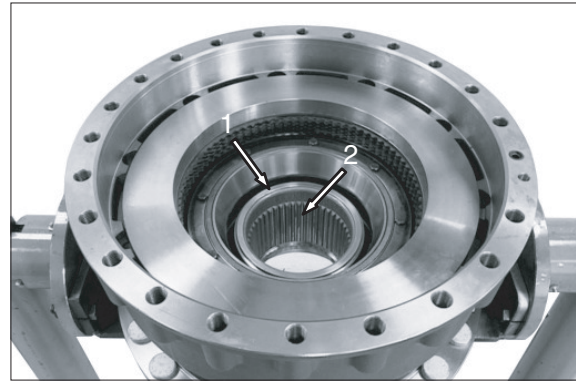
- ⑮ Heat tapered roller bearing and install it to the planetary carrier until contact is obtained.



7809AX164



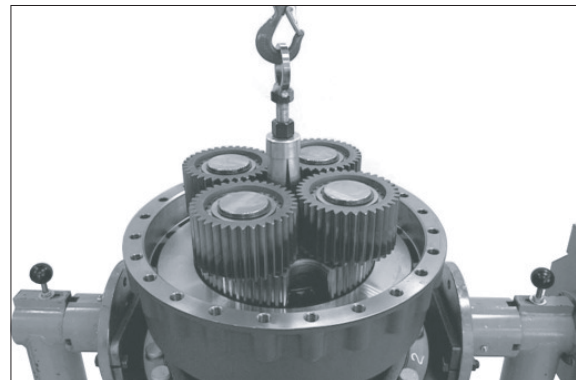
- ⑩ Wet front face (contact face bearing inner ring, arrow 1) and profile (teeth, arrow 2) in the output shaft with anti-corrosive agent.



7809AX41

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

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

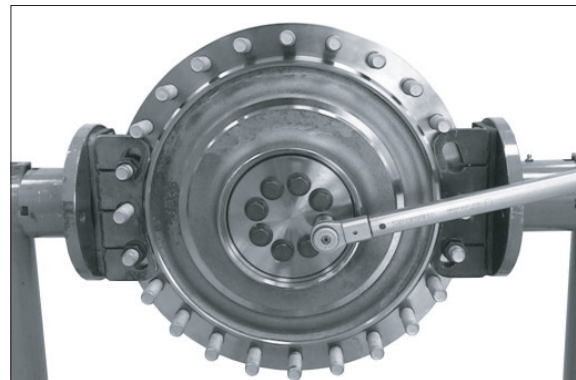


7809AX42

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

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

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



7809AX43

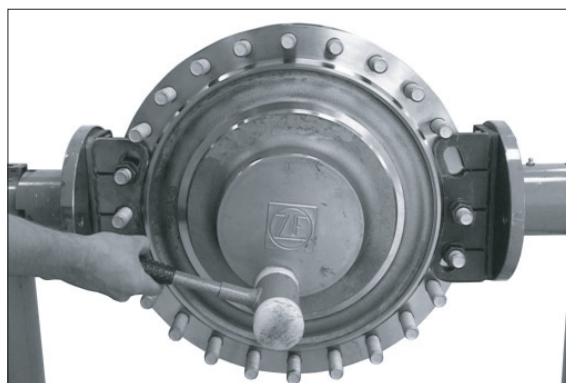


- ①⑨ Install O-ring (see arrow) to the cover.



7809AX44

- ②⑩ Insert the cover into the output shaft until contact is obtained.



7809AX45

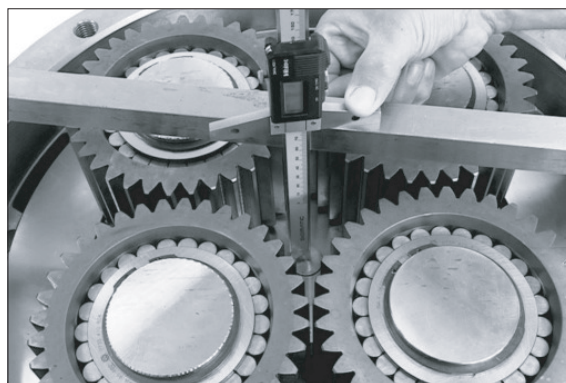
**Set the axial play of the sun gear shaft  
0.5~2.0 mm**

- ②⑪ Determine dimension I, from the mounting face of the brake housing to the front face of the stop bolt.

Dimension I e.g. .... 58.60 mm

Gauge blocks 5870 200 066

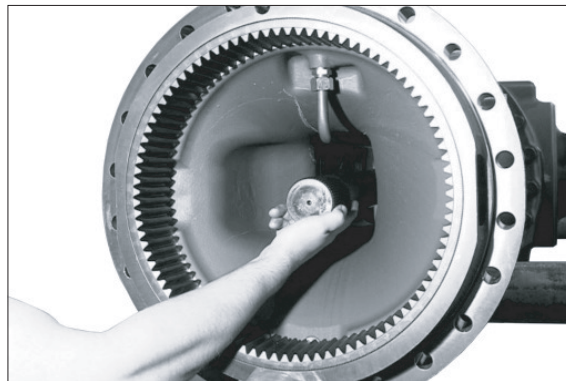
Straightedge 5870 200 022



7809AX46

- ②⑫ Insert stub shaft into the teeth of the axle bevel gear until contact is obtained.

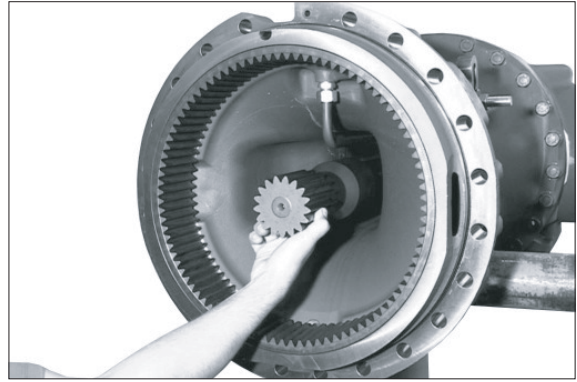
- ※ Pay attention to the installation position;  
mount the stub shaft with the long teeth  
showing to the differential.



7809AX47



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



7809AX48

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

Dimension II e.g. .... 56.60 mm

Straightedge 5870 200 022

**Calculation example :**

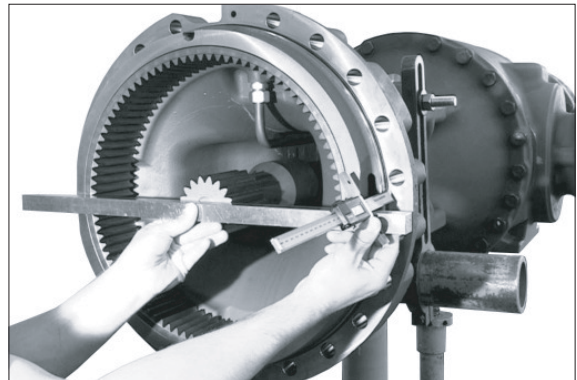
Dimension I ..... 58.60 mm

Dimension II ..... - 56.60 mm

Difference ..... 2.00 mm

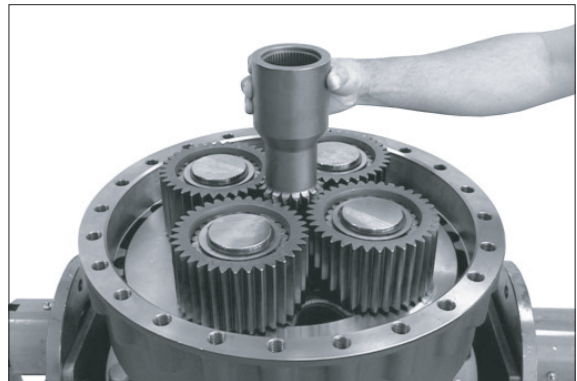
Required axial play e.g. .... - 1.00 mm

**Difference = shim e.g. s = 1.00 mm**



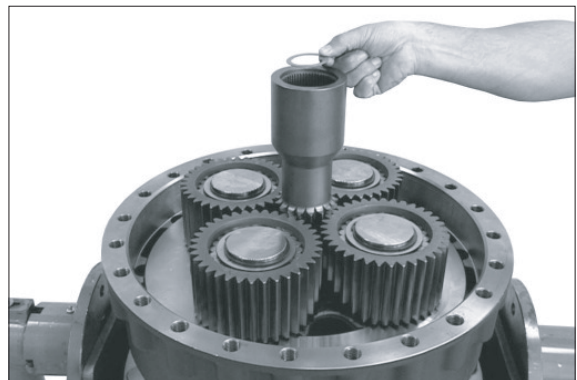
7809AX49

- ④ Insert sun gear shaft into the planetary carrier.



7809AX50

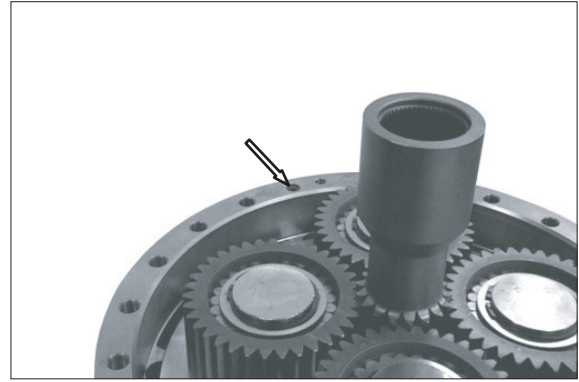
- ⑤ Fix determined shim e.g.  $s = 1.00$  mm with grease into the sun gear shaft.



7809AX51

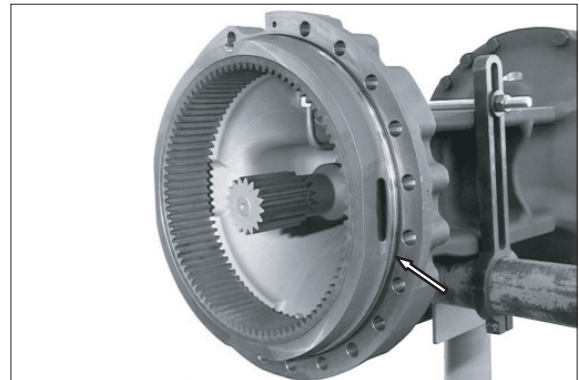


- ②⑥ Fix O-ring (see arrow) with grease into the countersink of the brake housing.



7809AX52

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



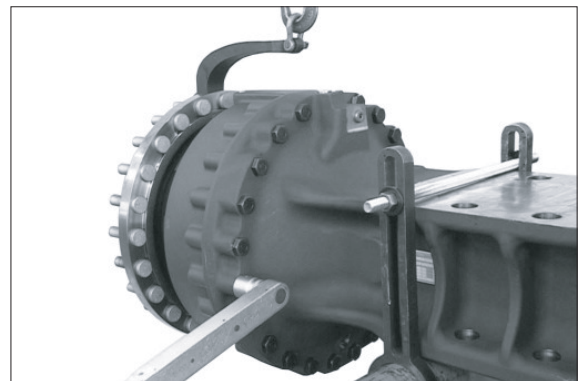
7809AX53

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

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

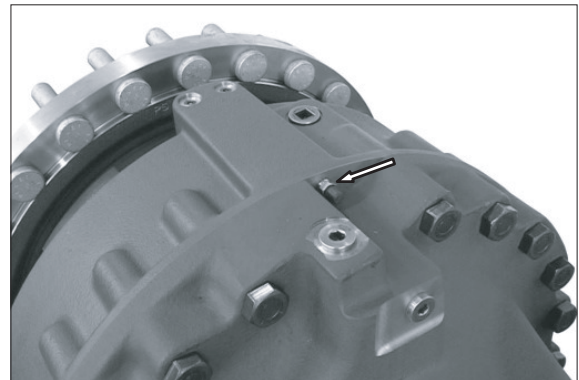
Adjusting screws (M20) 5870 204 024  
Load-carrying device AA00 685 875

- ※ Fix load carrying device with wheel stud.



7809AX54

- ②⑨ Mount breather (see arrow).



7809AX55



③⑩ Check brake hydraulics for leakages.

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

**High-pressure test :**

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

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

**Low-pressure test :**

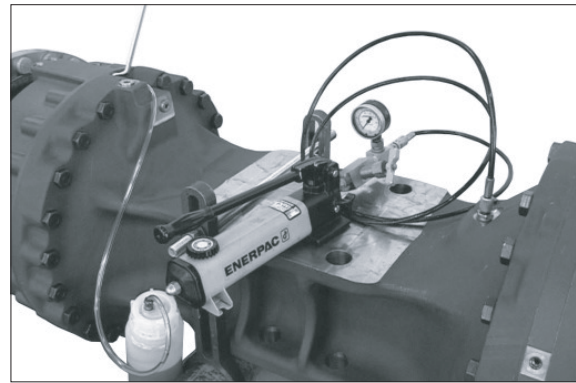
Reduce test pressure  $p = 5$  bar and close shut-off valve.

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

**Test media :**

Engine oils SAE 10-W

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



7809AX56

③⑪ Check operability of differential hydraulic lock

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

**Lock on:**

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

**Lock off:**

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

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



7809AX165



## 4. REAR AXLE

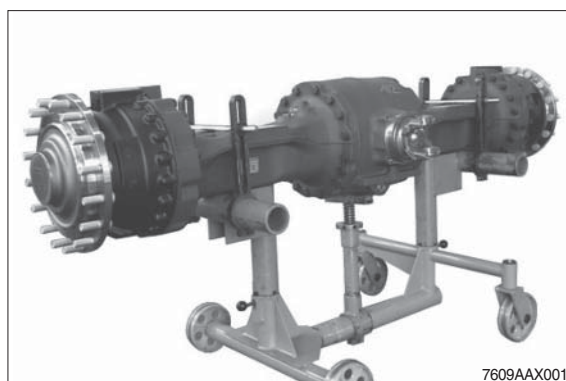
### 1) DISASSEMBLY

#### (1) Disassembly output and brake

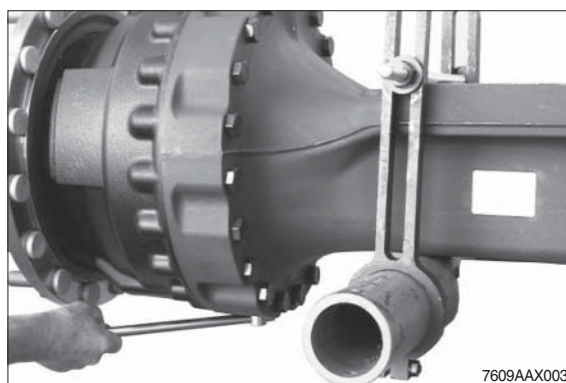
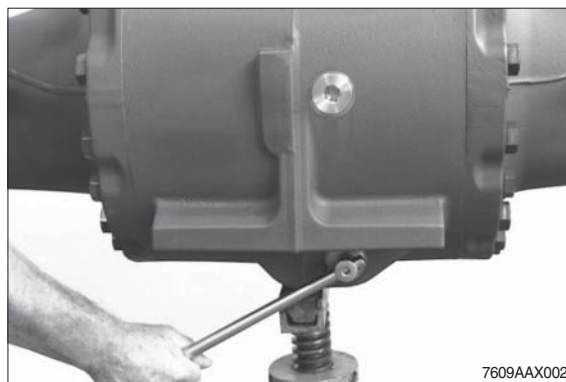
- ① Fix axle to assembly truck.

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

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



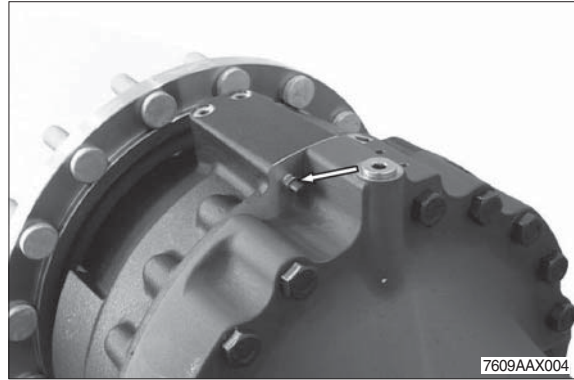
- ② Loosen screw plugs (3EA, see AX002 and AX003) and drain oil from the axle.





③ Remove the breather valve (see arrow).

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

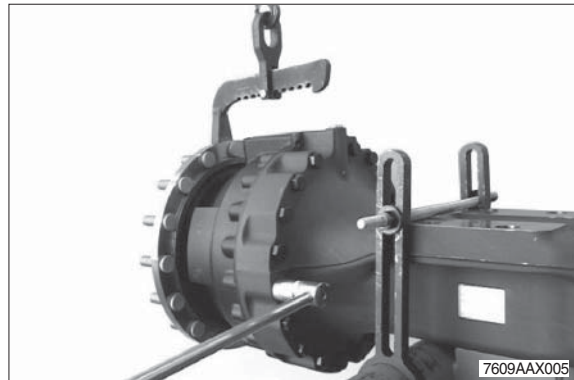


④ Secure the output with the lifting device and loosen hexagon screws.

Then separate the output assy from the axle housing.

Load carrying device      5870 281 043

※ Fix the load carrying device with a wheel nut.



⑤ Pull stub shaft and sun gear shaft.

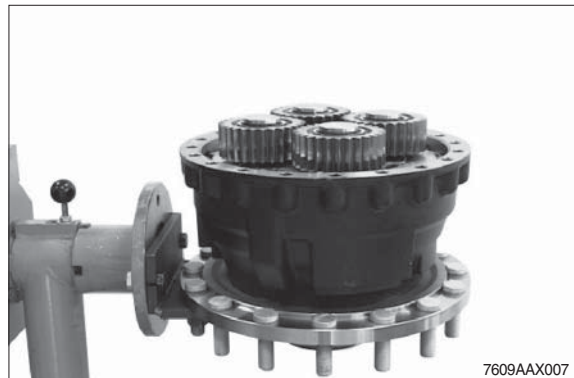
※ Pay attention to potentially releasing shim.



⑥ Fix output to assembly truck.

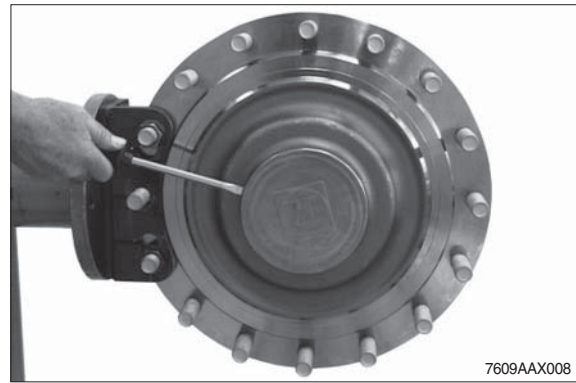
Assembly truck      5870 350 000

Fixture      5870 350 113

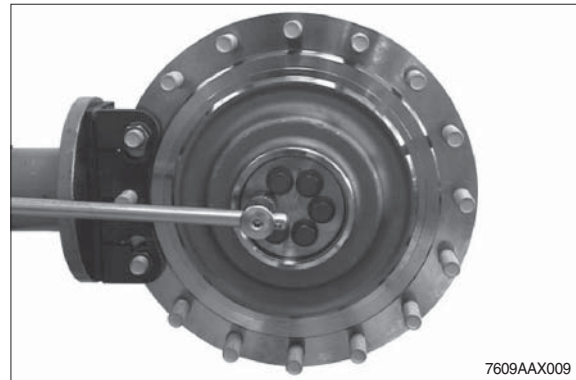




- ⑦ Use a lever to remove the cover from the output shaft.



- ⑧ Loosen locking screws and remove the releasing cover.

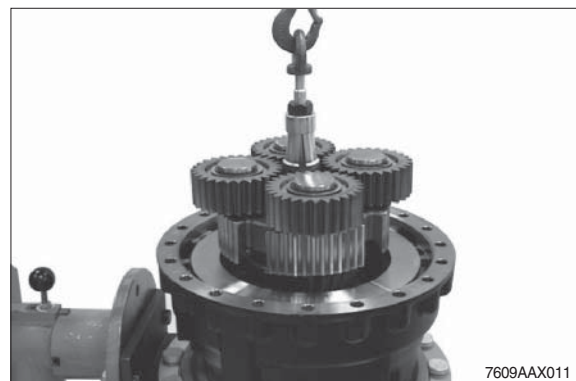


- ⑨ Press planetary carrier with a two-armed puller out of the profile of the output shaft.



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

Inner extractor                      5870 300 017  
Eye nut                                5870 204 076





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

|            |              |
|------------|--------------|
| Rapid grip | 5873 014 016 |
| Basic tool | 5873 004 001 |



- ⑫ Disengage retaining ring.



- ⑬ Pull off planetary gear.

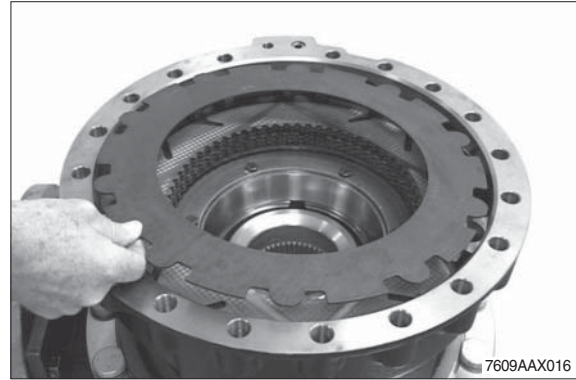


- ⑭ Lift the end plate out of the brake housing.

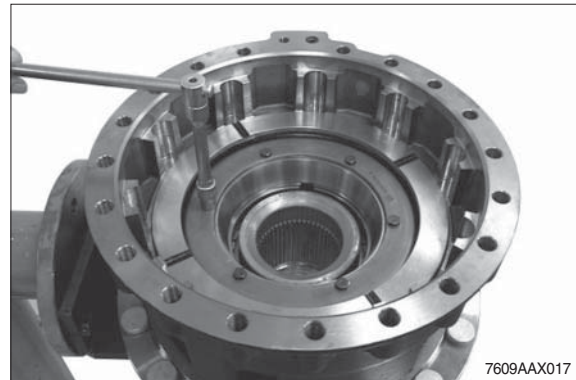




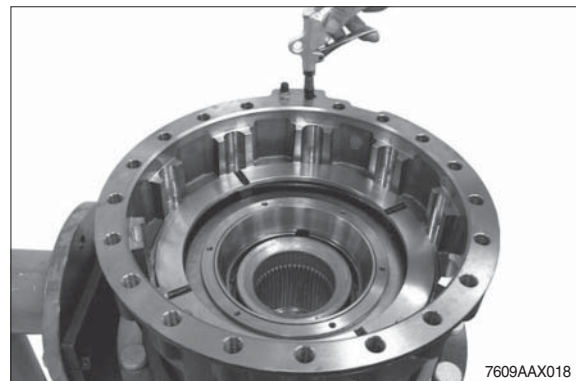
- ⑮ Lift the disk package out of the brake housing.



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

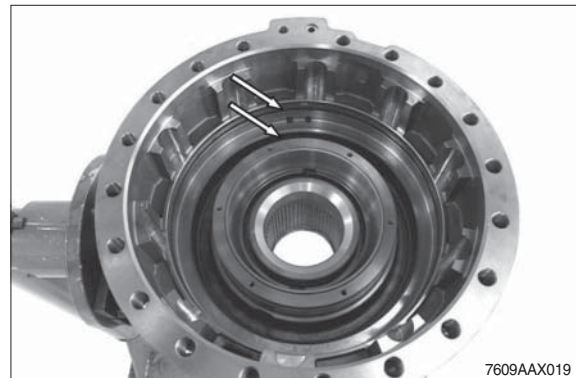


- ⑰ Mount breather valve and press piston out of the brake housing by means of compressed air.



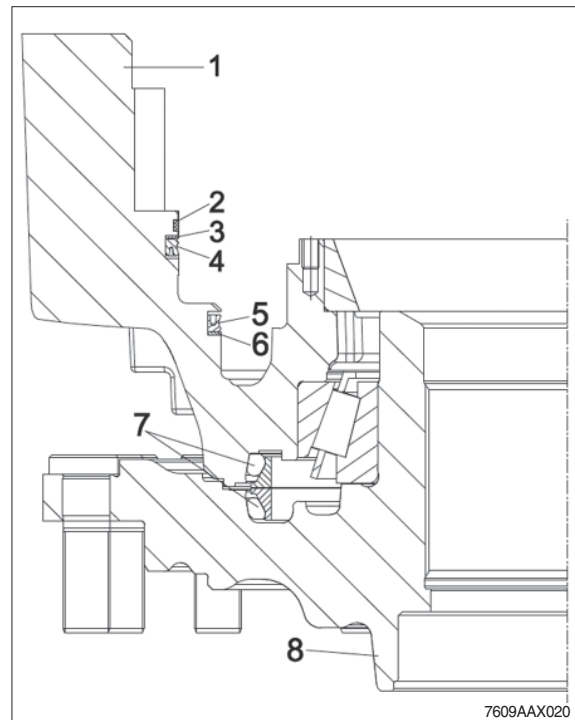
- ⑱ If necessary, remove guide ring, back-up rings and grooved rings out of the annular grooves of the brake housing (see arrows).

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





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



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



- ①⑩ Use a lever to remove the slide ring seal from the brake housing.

If necessary, force out both bearing outer rings.

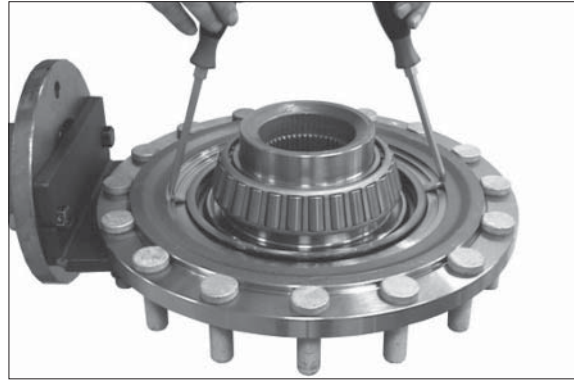
Resetting device                      5870 400 001





- ②① Use a lever to remove the slide ring seal from the output shaft.

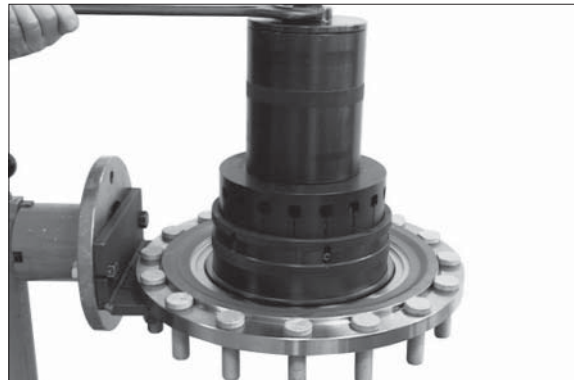
Resetting device                      5870 400 001



7609AAX023

- ②② Pull the tapered roller bearing from the output shaft.

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



7609AAX024

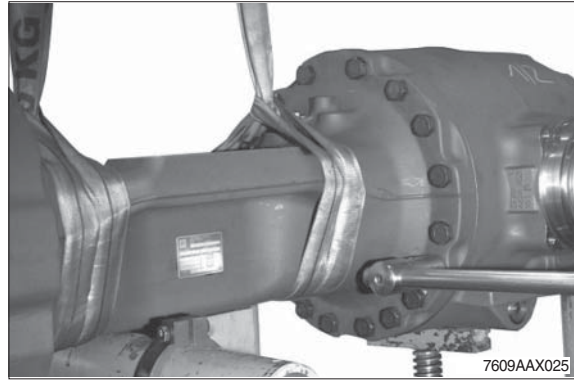


## (2) Disassembly axle housing

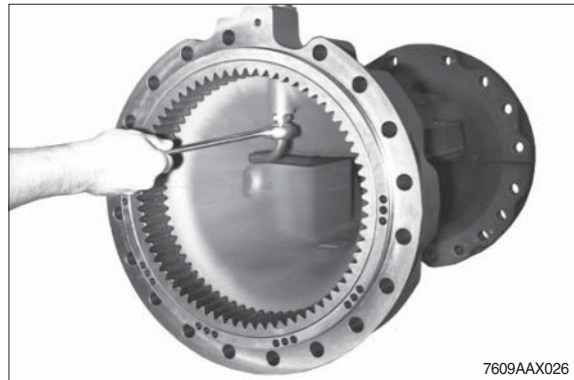
- ① Secure axle housing with the lifting device and loosen the hexagon screws.

Then separate the axle housing from the axle drive housing.

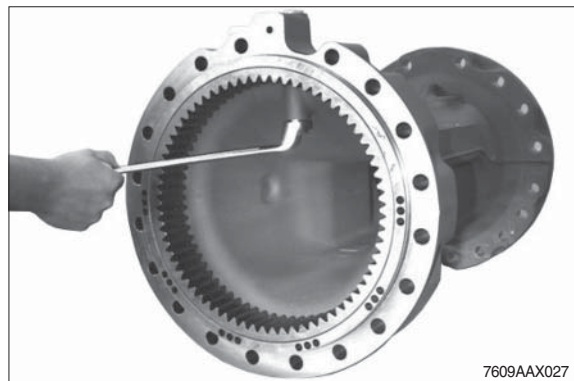
※ Pay attention to releasing differential.



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

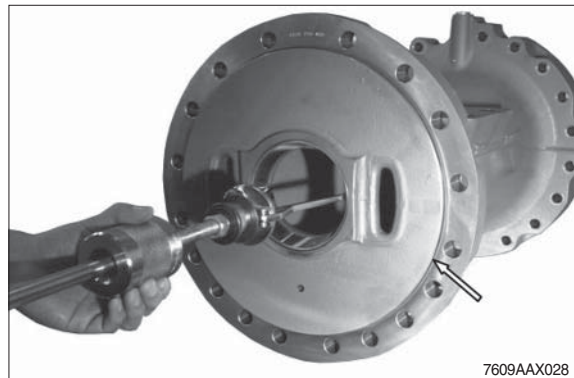


- ③ Loosen screw neck.



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

Then remove the O-ring (see arrow).



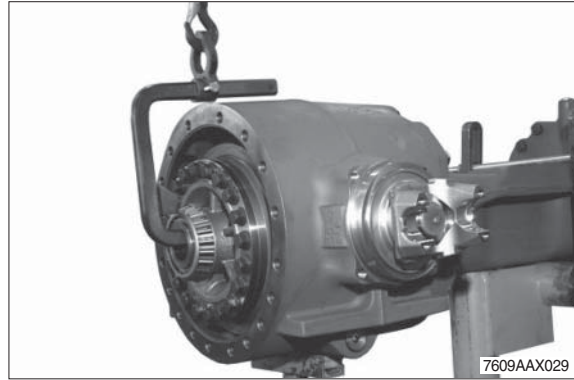


### (3) Disassembly input

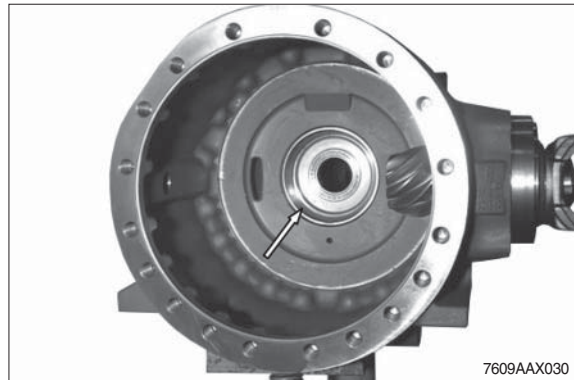
- ① Use the lifting device to lift the differential out of the axle drive housing.

Load carrying fixture      5870 281 083

- ※ Disassembly of the differential is described as of page 3-261.

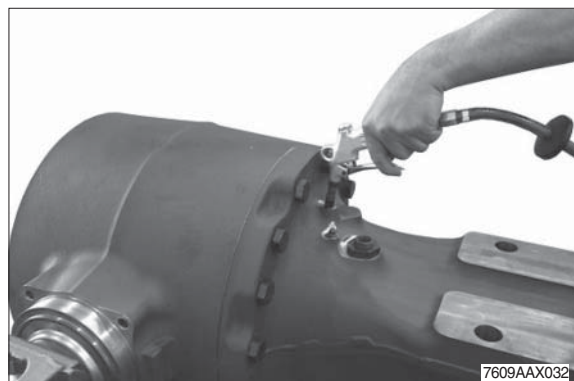
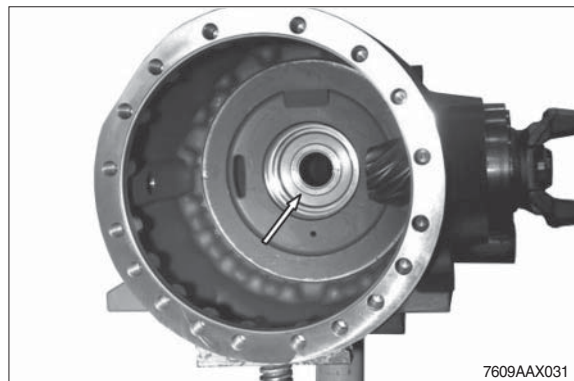


- ② Pull the bearing outer ring (see arrow) out of the housing hole and remove the shim behind.



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

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





- ④ Heat slotted nut by means of hot air blower.

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

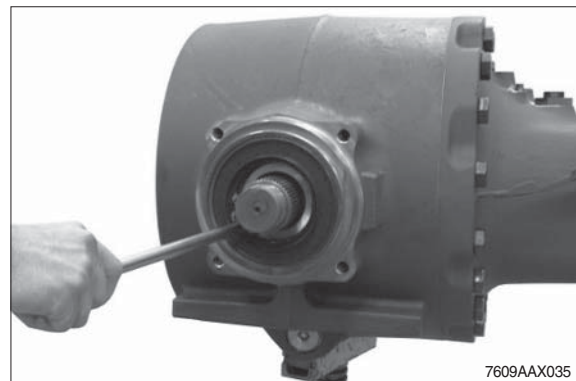


- ⑤ Loosen slotted nut and remove the shim behind.

|                    |              |
|--------------------|--------------|
| Slotted nut wrench | 5870 401 139 |
| Clamping device    | 5870 240 002 |



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



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

|             |              |
|-------------|--------------|
| Clamp (2EA) | AA00 338 279 |
|-------------|--------------|



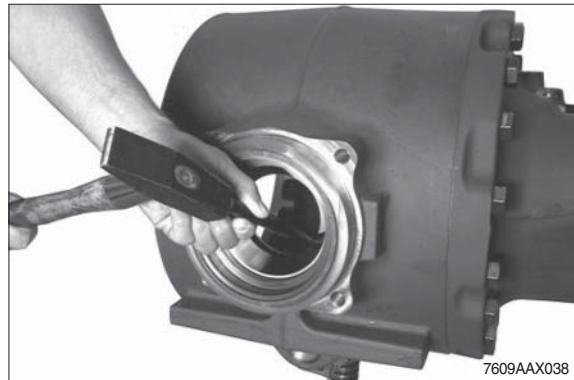


- ⑧ Remove spacer ring and pull the tapered roller bearing from the input pinion.

|                 |              |
|-----------------|--------------|
| Gripping device | 5873 002 030 |
| Basic tool      | 5873 002 000 |



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





#### (4) Disassembly differentials

##### Disassembly hydraulic lock differential (option)

- ① Remove axial roller cage (arrow).



- ② Pull both tapered roller bearings from the differential.

##### **Crown wheel side**

Grab sleeve 5873 012 016

Basic tool 5873 002 001

##### **Opposite side**

Grab sleeve 5873 003 029

Basic tool 5873 002 001

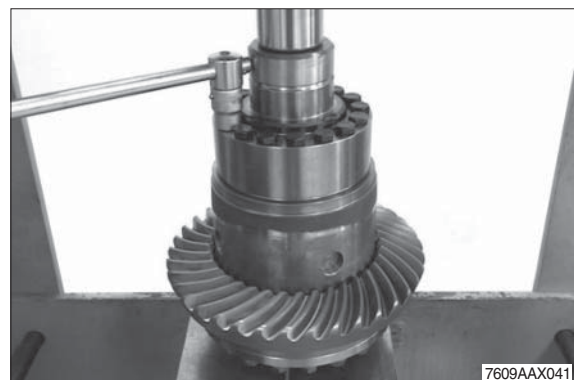
Reduction 5873 003 011

Pressure piece 5870 100 075



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

Pressure piece 5870 100 075



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

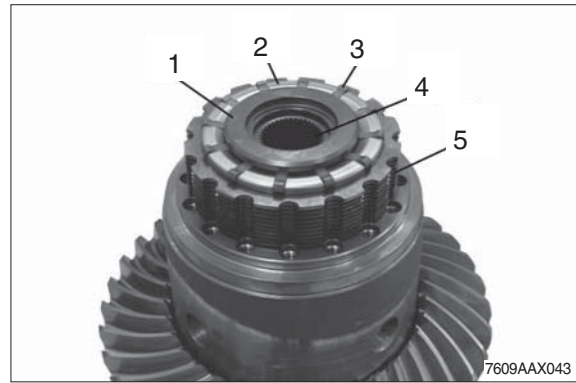
Then remove sliding sleeve and compression spring from the housing cover.



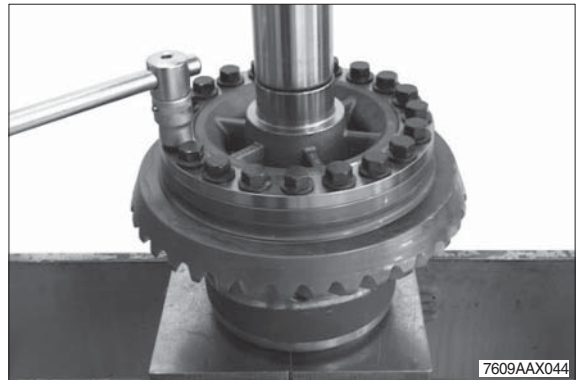


⑤ Remove single parts.

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



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



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

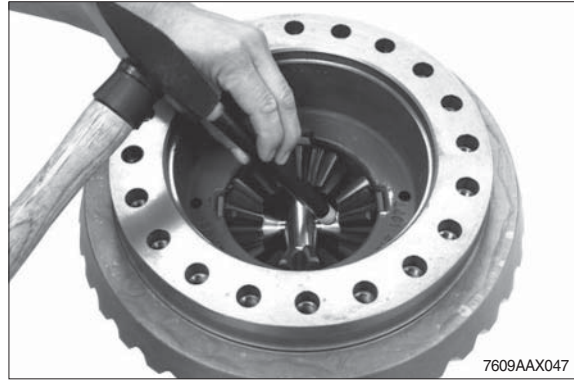


⑧ Force out both slotted pins.





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



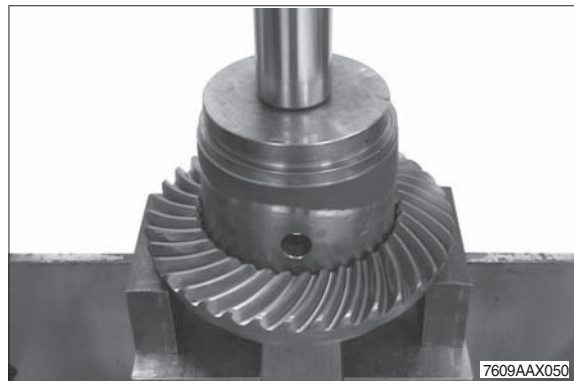
- ⑩ Pull the differential axle (long) and remove the releasing spider gears with thrust washers from the differential housing.



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



- ⑫ Press crown wheel from the differential carrier.





## Disassembly conventional differential (standard)

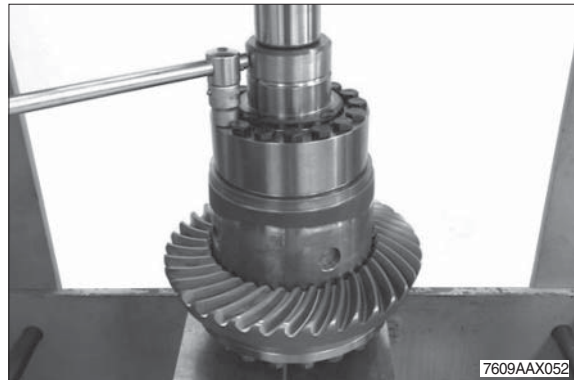
- ① Pull both tapered roller bearings from the differential.

Grab sleeve 5873 012 016

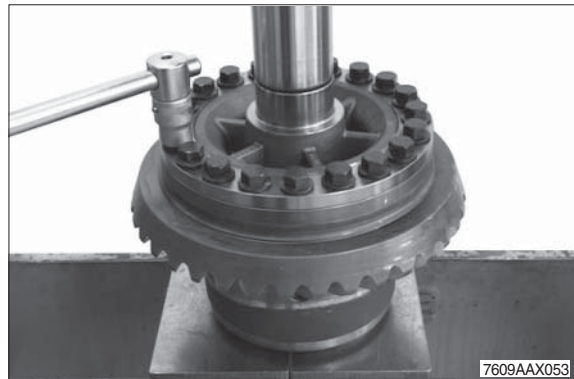
Basic tool 5873 002 001



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



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

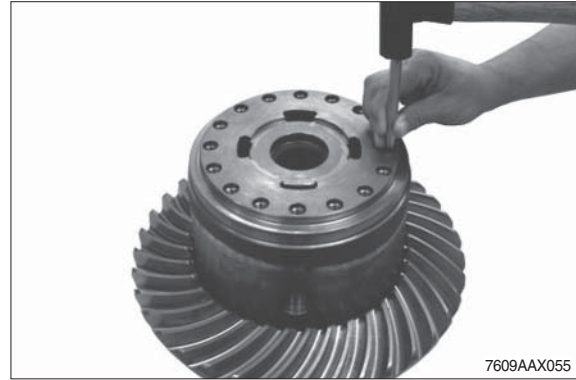


- ④ Remove axle bevel gear with thrust washers from the differential housing.

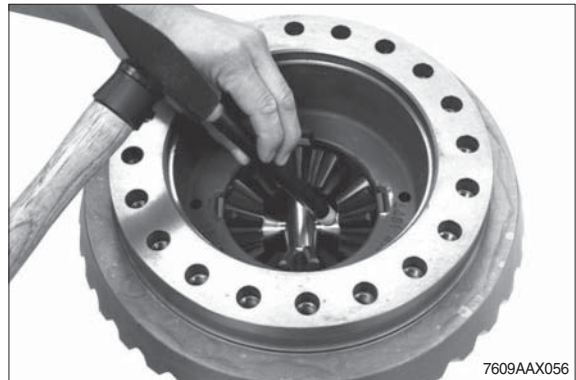




- ⑤ Force out both slotted pins.



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



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

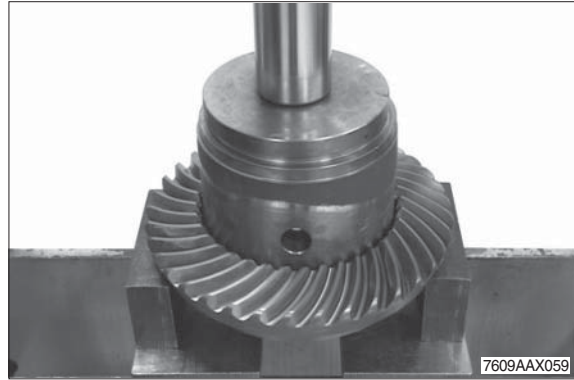


- ⑧ Remove the axle bevel gear and the shim behind.





- ⑨ Press crown wheel from the differential carrier.



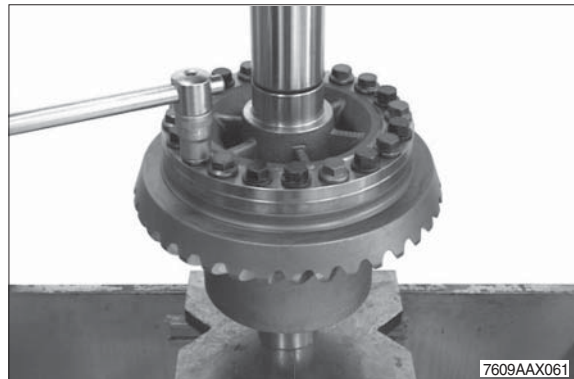
### Disassembly limited slip differential (option)

- ① Pull both tapered roller bearings from the differential.

|             |              |
|-------------|--------------|
| Grab sleeve | 5873 012 016 |
| Basic tool  | 5873 002 001 |



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



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





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



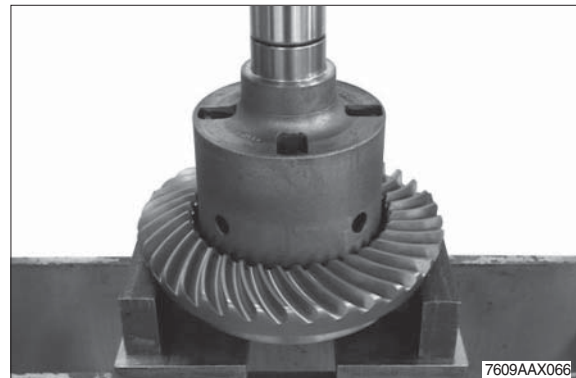
- ⑤ Remove the second axle bevel gear.



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



- ⑦ Press crown wheel from the differential carrier.



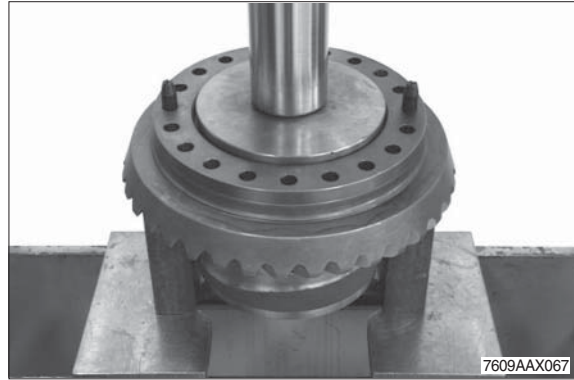


## (5) Reassembly differentials

### Reassembly hydraulic lock differential (option)

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

Locating pins                      5870 204 040



- ② Insert thrust washer into the differential housing.



- ③ Insert axle bevel gear.



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

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

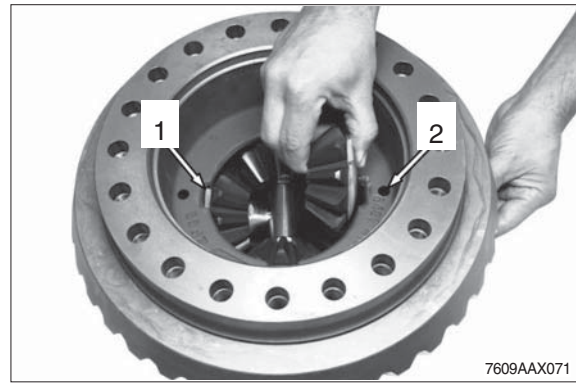




⑤ Insert spider gears with thrust washers into the differential housing and fix them with the two spider shafts (short).

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

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

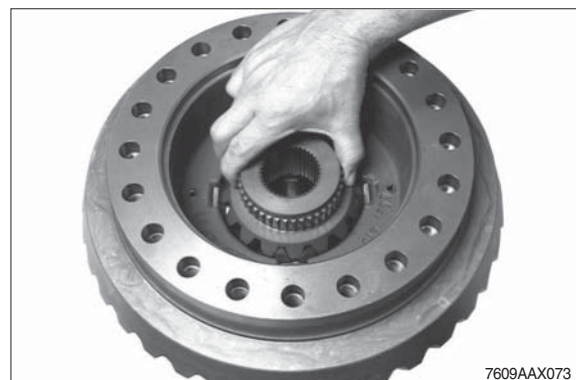


⑥ Fix spider shafts (short) with slotted pins.

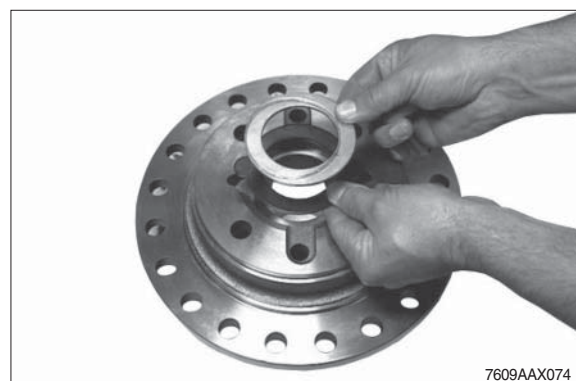
※ Flush mount slotted pins.



⑦ Mount second axle bevel gear.



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



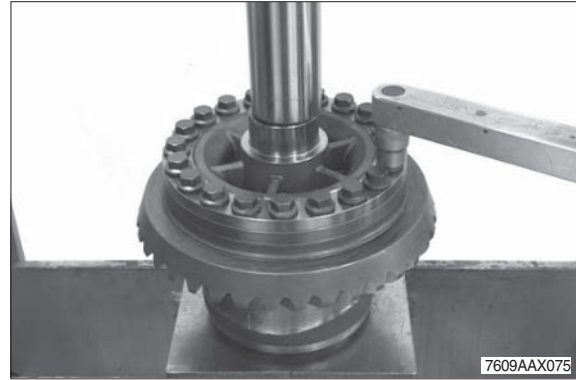


- ⑨ Mount two adjusting screws and insert the housing cover until contact with the differential housing is obtained.

Locating pins 5870 204 040

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

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



- ⑩ Install compression spring onto the sliding sleeve.



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

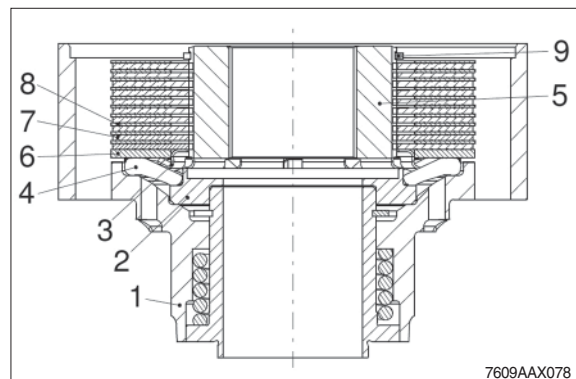
Preload the compression spring by means of the press and engage the retaining ring into the annular groove of the sliding sleeve.



### Setting of disk package

- ⑫ Premount single parts according to the adjacent sketch.

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



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

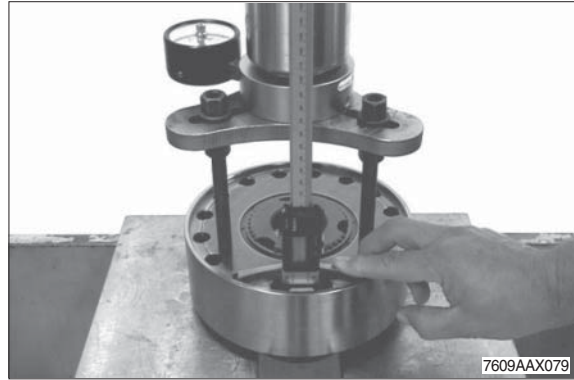


- ⑬ Preload disk package with an axial force of  $F = 50^{+30}$  kN.

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

Pressure piece                      5870 100 069  
Load cell                              5870 700 004

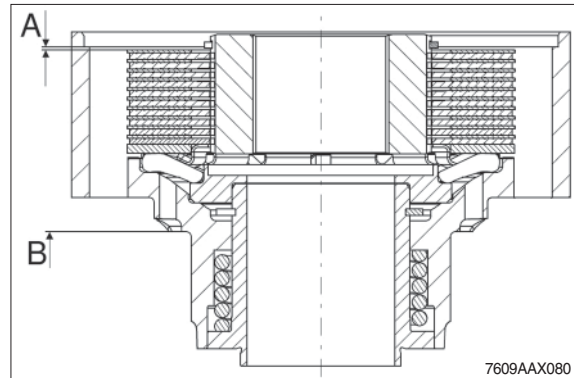
- ※ Any deviation from the specified setting dimension must be corrected with a corresponding outer disk.



A = Setting dimension =  $1.05 \pm 0.1$  mm

B = Contact face

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



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

Pressure piece                      5870 100 075



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

Lifting device                      AA00 331 446



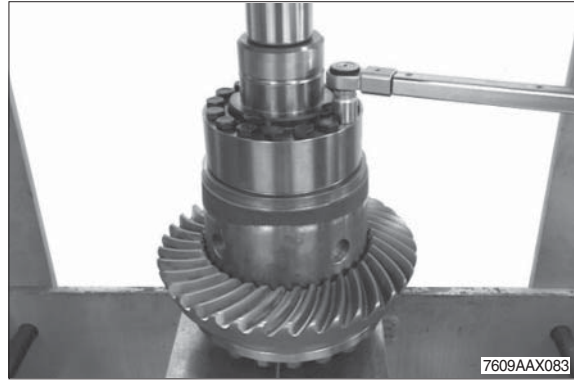


- ⑰ Preload the differential by means of the press and the pressure piece.

Then finally tighten the housing cover with hexagon screws.

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

Pressure piece 5870 100 075



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

※ Adjust tapered roller bearing after cooling down.



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

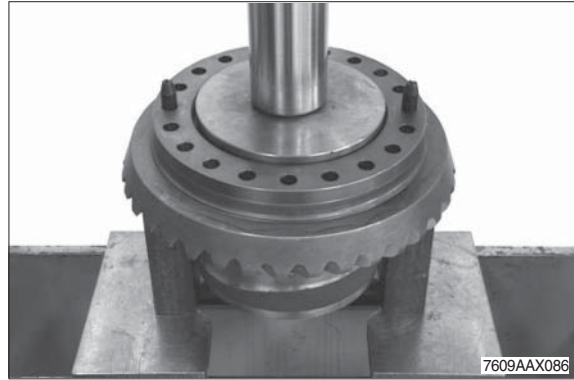




## Reassembly conventional differential (standard)

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

Locating pins                      5870 204 040



- ② Insert thrust washer into the differential housing.



- ③ Insert axle bevel gear.



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

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

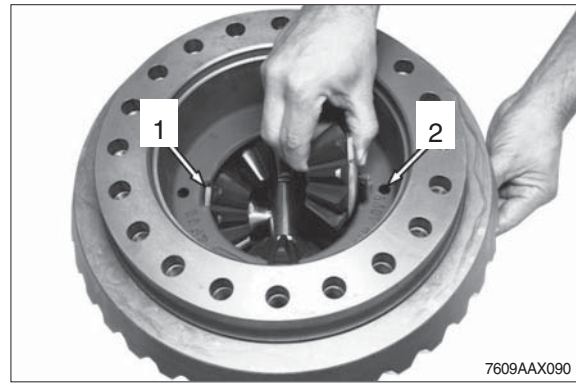




⑤ Insert spider gears with thrust washers into the differential housing and fix them with the two spider shafts (short).

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

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



⑥ Fix spider shafts (short) with slotted pins.

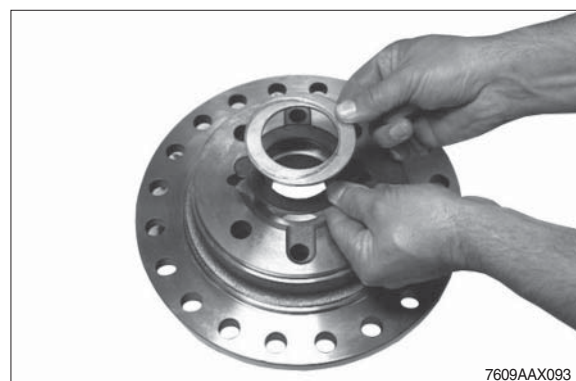
※ Flush mount slotted pins.



⑦ Mount second axle bevel gear.



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



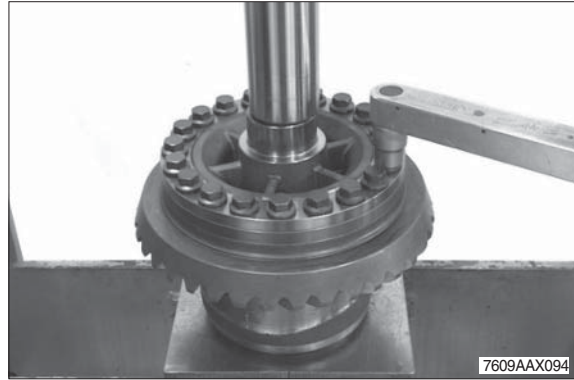


- ⑨ Mount two adjusting screws and insert the housing cover until contact with the differential housing is obtained.

Locating pins 5870 204 040

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

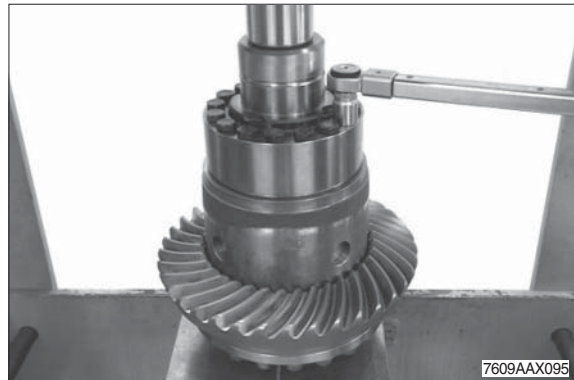
- Tightening torque (M16/12.9) :  
40.8 kgf · m (295 lbf · ft)



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

Then fix the housing cover with hexagon screws.

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



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

- ※ Adjust tapered roller bearing after cooling down.

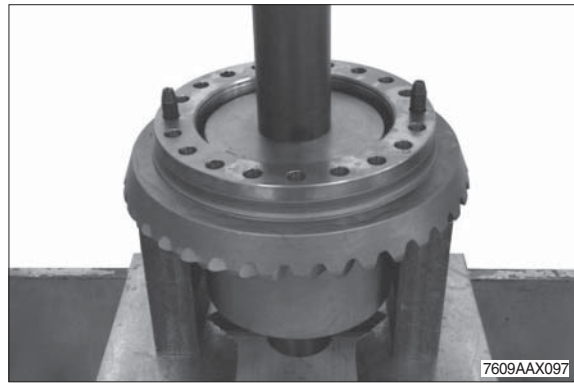




### Reassembly limited slip differential (option)

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

Locating pins                      5870 204 040



- ② Insert thrust washer into the differential housing.



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

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

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



- ④ Place the pressure ring.





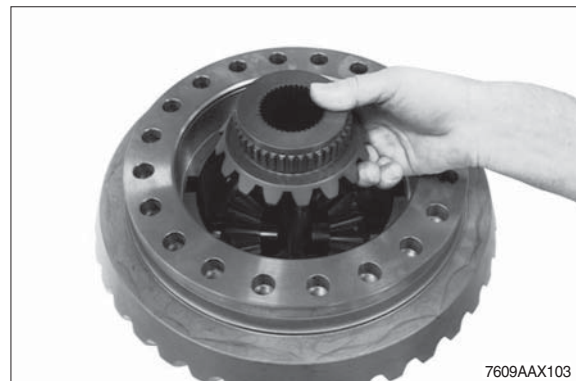
- ⑤ Insert the axle bevel gear until contact is obtained and install the inner disks with the teeth.



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



- ⑦ Mount second axle bevel gear.



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





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

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

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



### Determine the installation clearance 0.2~0.7 mm

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

Dimension I e.g. .... 44.30 mm



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

Dimension II e.g. .... 43.95 mm

### CALCULATION EXAMPLE :

Dimension I ..... 44.30 mm

Dimension II ..... - 43.95 mm

**Difference = disk clearance = 0.35 mm**



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



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

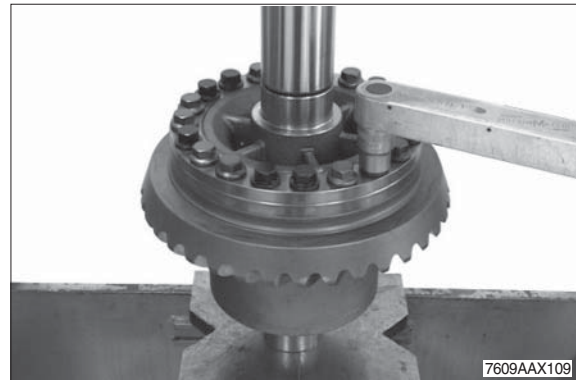


- ⑬ Mount two adjusting screws and insert the housing cover until contact with the differential housing is obtained.

Locating pins 5870 204 040

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

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



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

- ※ Adjust tapered roller bearing after cooling down.





## (6) Reassembly input

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

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

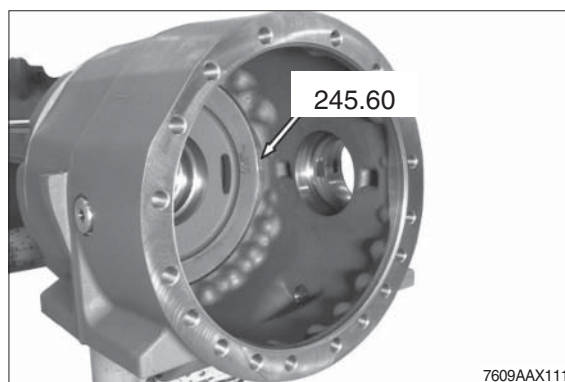
### Determination of shim thickness to obtain a correct contact pattern

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

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

- ① Read dimension I from the axle drive housing.

Dimension I e.g. .... 245.60 mm



- ② Read dimension II (pinion dimension).

Dimension II e.g. .... 202.00 mm





- ③ Determine dimension III (bearing width).

Dimension III e.g. .... 42.50 mm

#### CALCULATION EXAMPLE "A<sub>1</sub>":

Front axle

Dimension I ..... 245.60 mm

Dimension II ..... - 202.00 mm

Dimension III ..... - 42.60 mm

**Difference = shim**      **s = 1.00 mm**

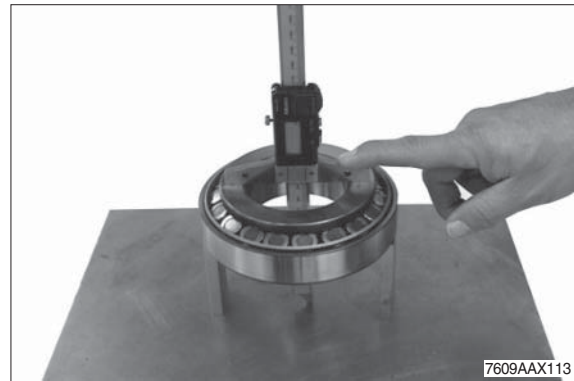
Rear axle

Dimension I ..... 221.10 mm

Dimension II ..... - 181.00 mm

Dimension III ..... - 39.10 mm

**Difference = shim**      **s = 1.00 mm**

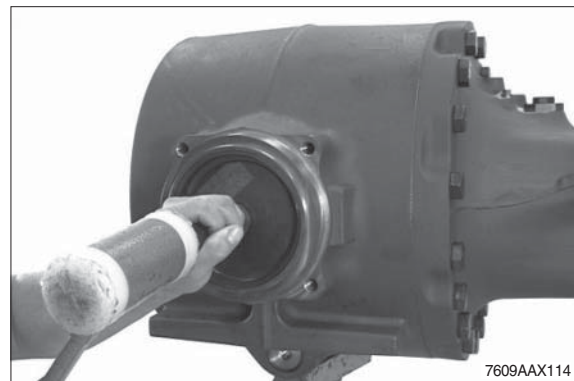


#### Reassembly of input pinion

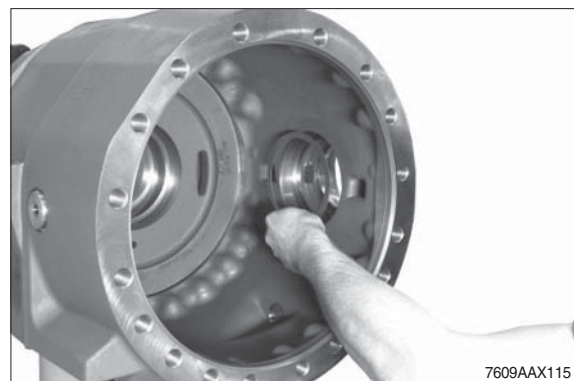
- ④ Undercool the external bearing outer ring and insert it into the axle drive housing until contact is obtained.

Driver tool                      5870 058 079

Handle                          5870 260 004



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



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

Assembly fixture              AA00 338 352





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

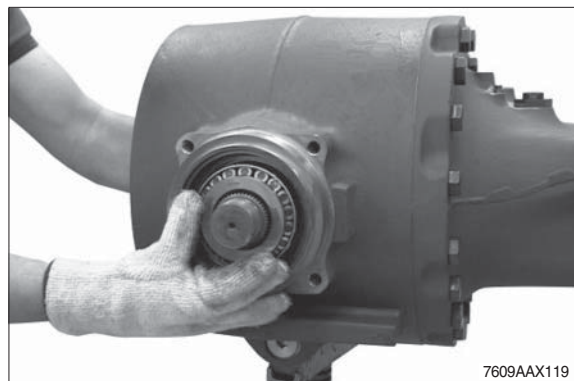


**Setting of rolling torque of input pinion bearing 0.15~0.41 kgf · m (1.11~2.95 lbf · ft) (without shaft seal)**

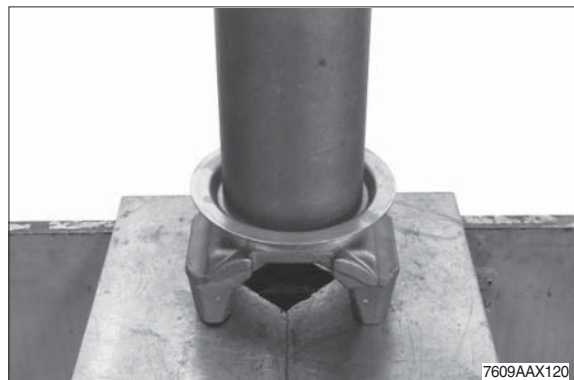
- ⑧ Insert spacer (e.g.  $s = 8.18 \text{ mm}$ ).
- ※ According to our experience the necessary rolling torque is obtained when reusing the spacer which has been removed during disassembly (e.g.  $s = 8.18 \text{ mm}$ ).
- A later check of the rolling torque, however, is absolutely necessary.



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



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





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

· Tightening torque :

122 kgf · m (885 lbf · ft)

Slotted nut wrench            5870 401 139

Clamping device                5870 240 002

- ※ Preliminarily mount slotted nut without loctite.

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

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

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

**▲ In case of deviations from the necessary rolling torque correct with a corresponding spacer (AX118) as specified below.**

Insufficient rolling torque

install thinner spacer ring

Excessive rolling torque

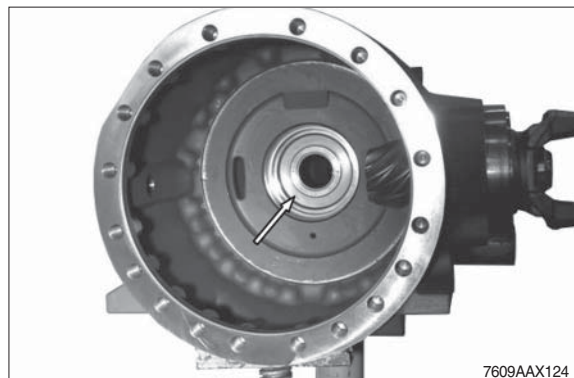
install thicker spacer ring

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

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



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





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

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

(KRS – SET – RIGHT)

(KRS = bevel gear set)



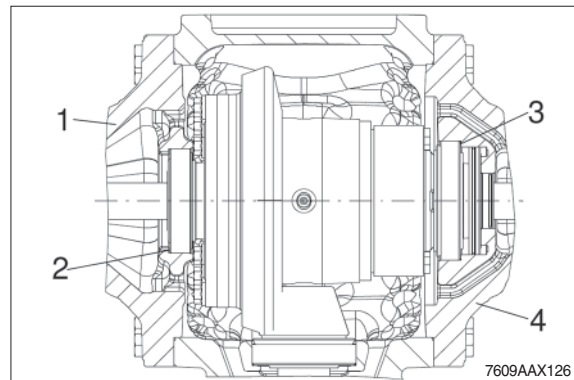
### ⑮ Deviation see crown wheel rear side.

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

According to this value, the required shims are allocated in the table below.

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

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

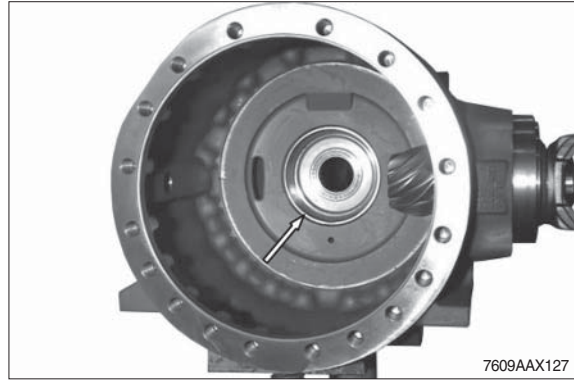


- 1 Axle housing
- 2 Shim (crown wheel side)
- 3 Shim (differential carrier side)
- 4 Axle housing

| Shims for differential                           |            |            |            |            |            |
|--|------------|------------|------------|------------|------------|
| Crown wheel marking                              |            | - 20       | - 10       | -          | 10         |
| Deviation  |            | - 0.2      | - 0.1      | 0          | 0.1        |
| Shim<br>Differential cage side<br>Shim thickness | Front axle | <b>0.8</b> | <b>0.9</b> | <b>1.0</b> | <b>1.1</b> |
|  | Rear axle  | <b>0.7</b> | <b>0.8</b> | <b>0.9</b> | <b>1.0</b> |
| Shim   | Front axle | ZGAQ-04167 | ZGAQ-04168 | ZGAQ-04169 | ZGAQ-04170 |
| Shim<br>Hydraulic lock differential              | Rear axle  | ZGAQ-04367 | ZGAQ-04167 | ZGAQ-04168 | ZGAQ-04169 |
| Shim<br>Conventional, L/slip differential        | Rear axle  | ZGAQ-04368 | ZGAQ-03896 | ZGAQ-03897 | ZGAQ-03898 |
| Shim<br>Crown wheel side<br>Shim thickness       | Front axle | <b>1.2</b> | <b>1.1</b> | <b>1.0</b> | <b>0.9</b> |
|  | Rear axle  | <b>1.3</b> | <b>1.2</b> | <b>1.1</b> | <b>1.0</b> |
| Shim   | Front axle | ZGAQ-04171 | ZGAQ-04170 | ZGAQ-04169 | ZGAQ-04168 |
|  | Rear axle  | ZGAQ-04368 | ZGAQ-03900 | ZGAQ-03899 | ZGAQ-03898 |

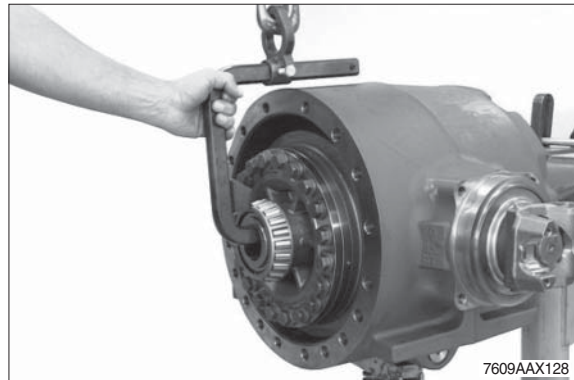


- ⑩ Insert the determined shim (e.g.  $s = 0.9 \text{ mm}$ ) into the hole of the axle housing and adjust the bearing outer ring (see arrow) until contact is obtained.

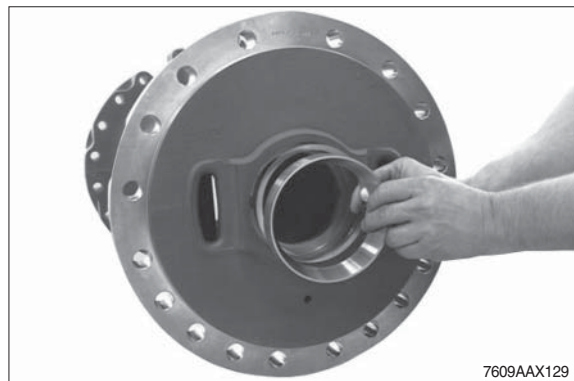


- ⑪ Cover some drive and coast flanks of the crown wheel with marking ink.
- Then insert the premounted differential into the axle drive housing.

Load carrying device      5870 281 083



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



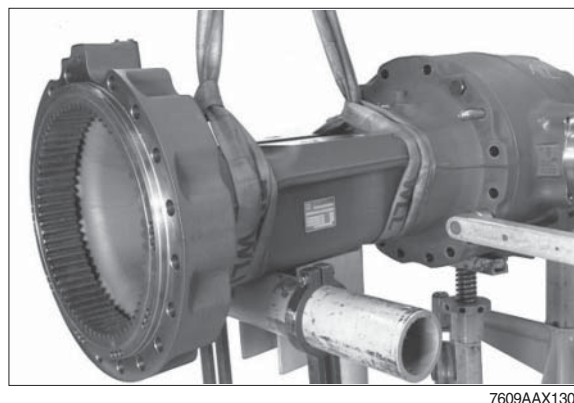
- ⑬ Mount two locating pins and bring the axle housing into contact position with the axle drive housing by means of the lifting device.

Locating pins      5870 204 024

Then preliminarily fix the axle housing with 4 hexagon screws.

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

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



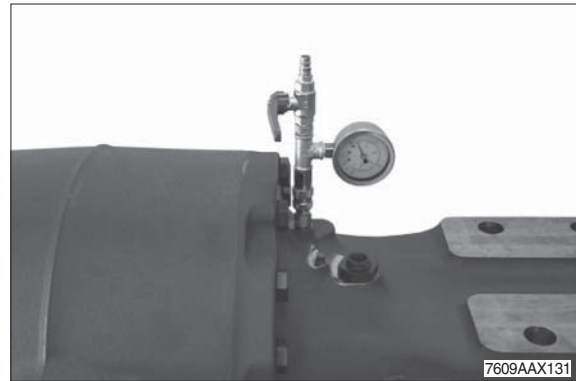


### Leakage test of lock

- ②⑩ Pressurize the lock ( $p = 1 \text{ bar}$ ), close shut-off valve and remove air line.

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

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

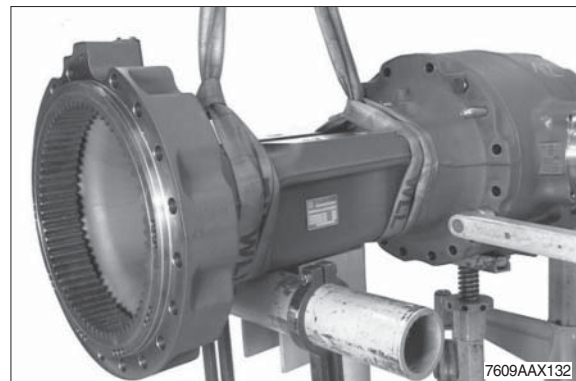


- ②⑪ By rotating the input flange, roll crown wheel over the input pinion in both directions several times.

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

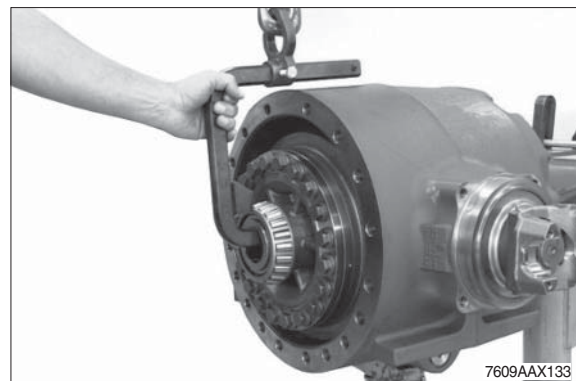
Compare the obtained contact pattern.

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



- ②⑫ After the contact pattern check insert the differential again into the axle drive housing.

Load carrying device      5870 281 083



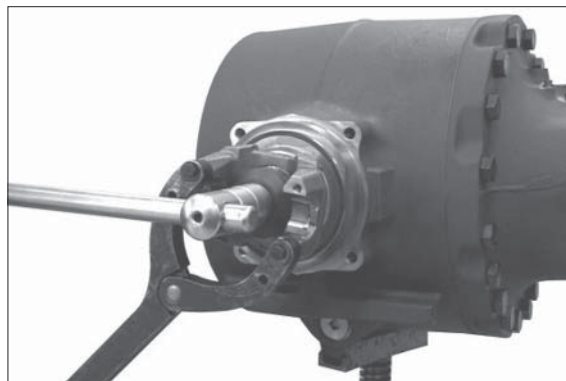


## Reassembly of shaft seal (figure AX134~136)

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

Slotted nut wrench                      5870 401 139

Clamping device                        5870 240 002

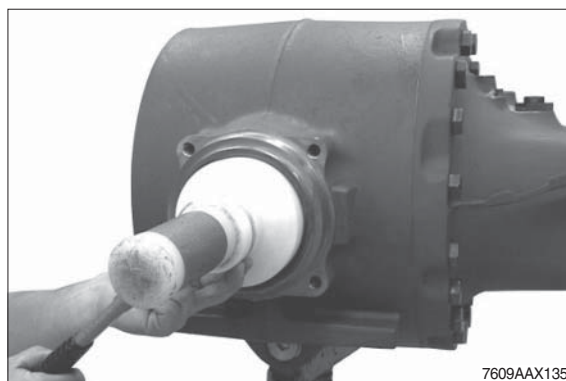


7609AAX134

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

Driver tool                                5870 048 233

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



7609AAX135

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

· Tightening torque :

122 kgf · m (885 lbf · ft)

Slotted nut wrench                      5870 401 139

Clamping device                        5870 240 002

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



7609AAX136



## (7) Reassembly axle housing

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

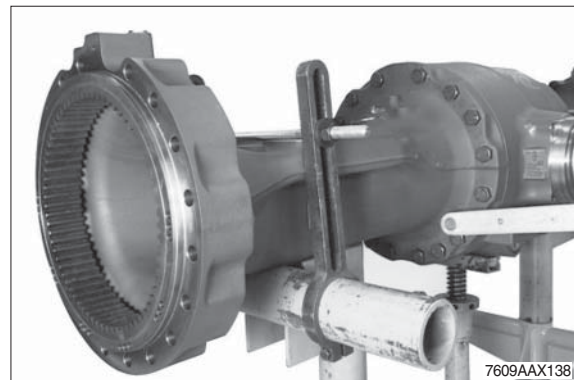


- ② Mount two locating pins and bring the axle housing into contact position with the axle drive housing by using the lifting device.

Then fix the axle housing by means of hexagon screws.

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

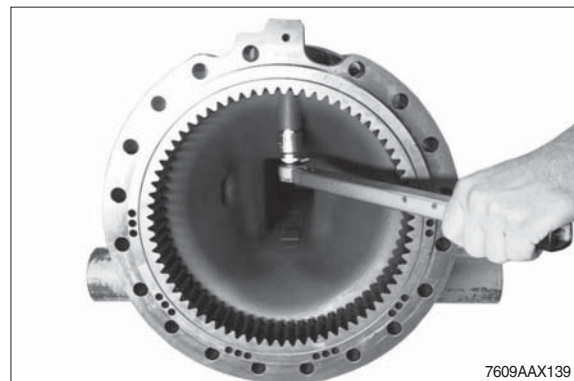
Locating pins 5870 204 024



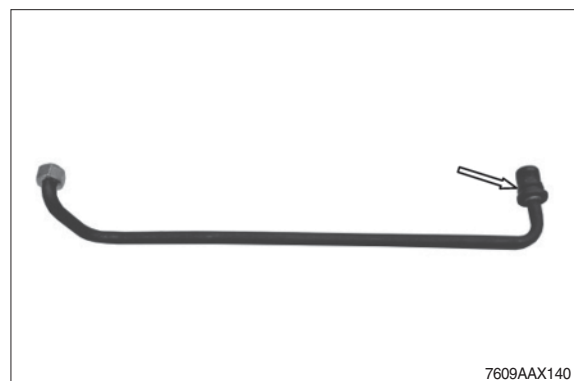
- ※ After assembling the axle housing secure the axle with clamping brackets.

- ③ Mount fitting.

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



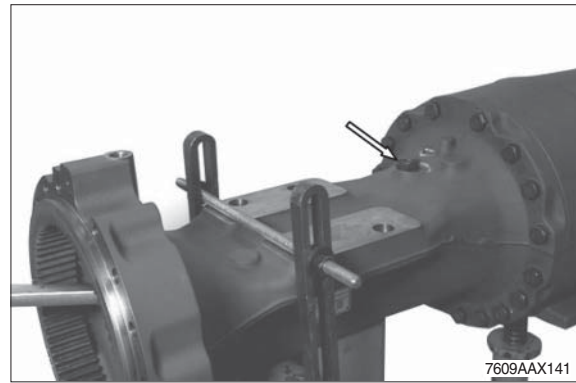
- ④ Grease O-ring and insert it into the annular groove of the brake tube (see arrow).





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

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



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

Flush mount slotted pins.

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





## (8) Reassembly output and brake

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

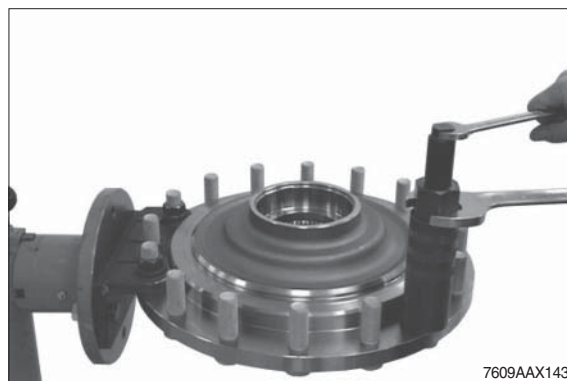
Wheel stud puller-basic tool

5870 610 001

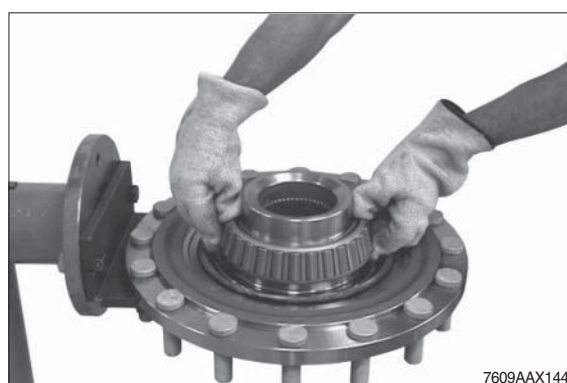
Insert (M22 × 1.5)

5870 610 002

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



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

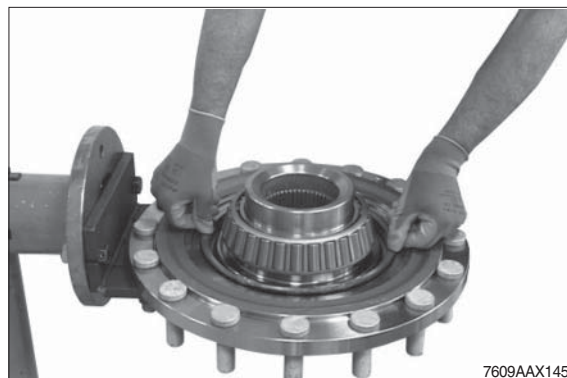


- ③ Wet O-ring of slide ring seal and locating hole with spirit.

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

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

- ※ For the installation position of the seal please also refer to sketch, page 3-292.



- ※ The surface of the slide ring seal may not have any grooves, scratches or other types of damage. Take care that the sealing surface is parallel to the housing face. The O-rings must be mounted evenly into the locating hole and must not bulge out of the hole.

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





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



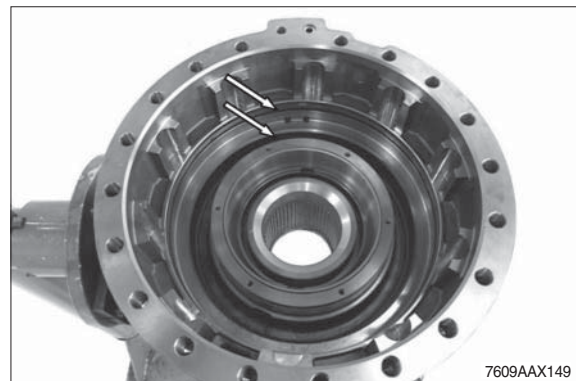
- ⑤ Insert the premounted brake housing by means of the lifting device over the output shaft until contact is obtained.

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



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

- ※ Pay attention to the installation position.



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

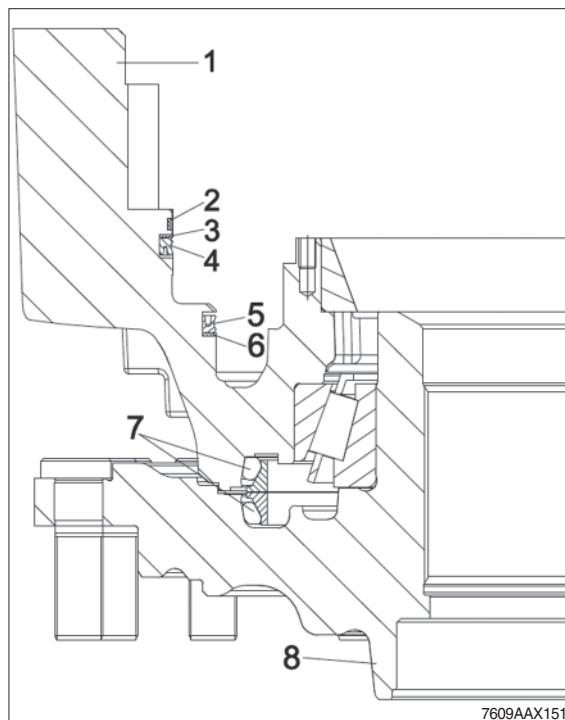
Then insert the guide ring into the annular groove (see also the following sketch) and fix it with loctite (type No. : 415) at its extremities (see arrows).

- ※ The full circumference of the guide ring must be in an exact contact position.
- ※ Upon installation the orifice of the guide ring must show upwards (12 o'clock).





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



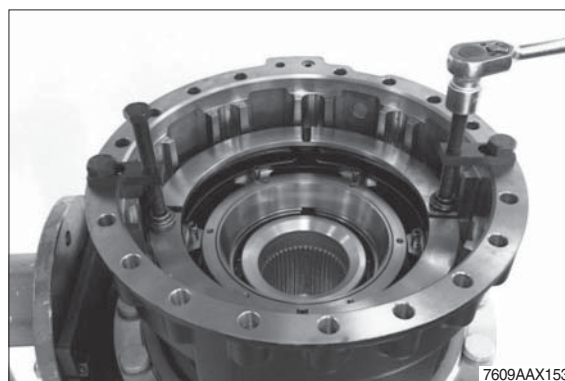
- ⑧ Flush-mount the slotted pins (6EA) into the holes of the piston.



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

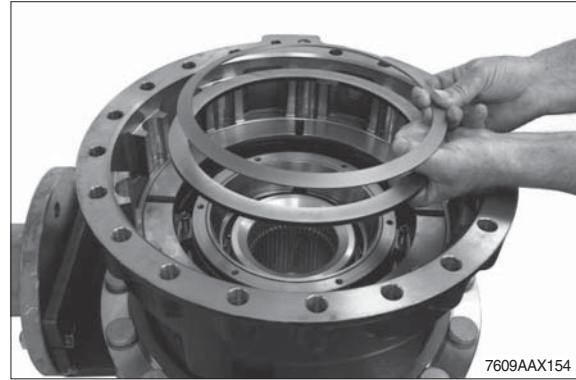
Fixing device                      AA00 680 530

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



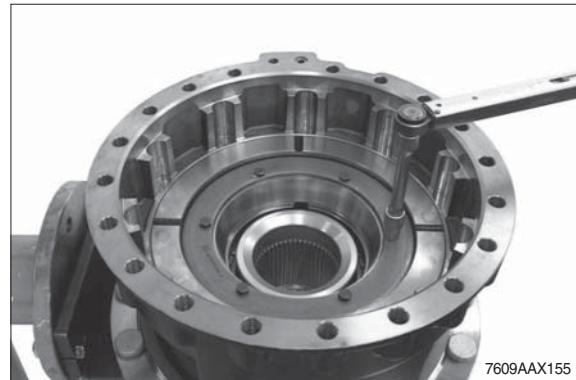


- ⑩ Insert disk and cup spring with the convex side showing upwards into the piston.



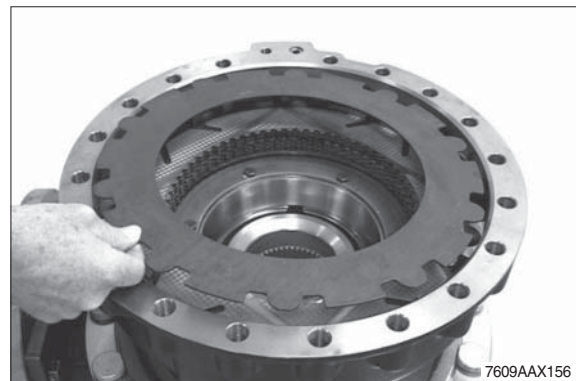
- ⑪ Insert cover and fix it by means of hexagon screws.

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

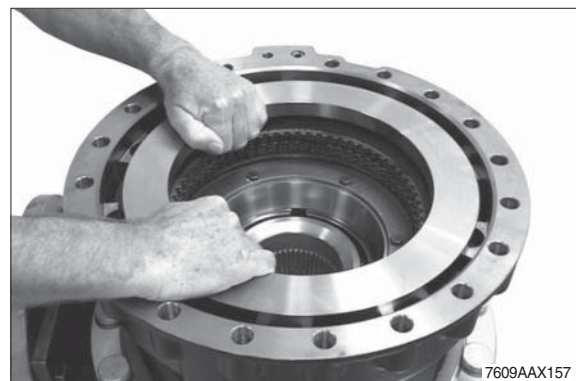


- ⑫ Mount outer and inner disks.

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



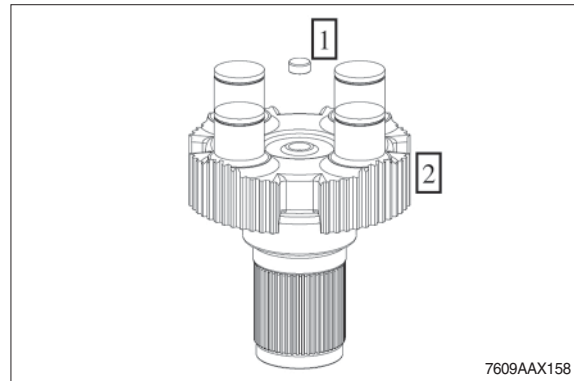
- ⑬ Insert end plate.





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

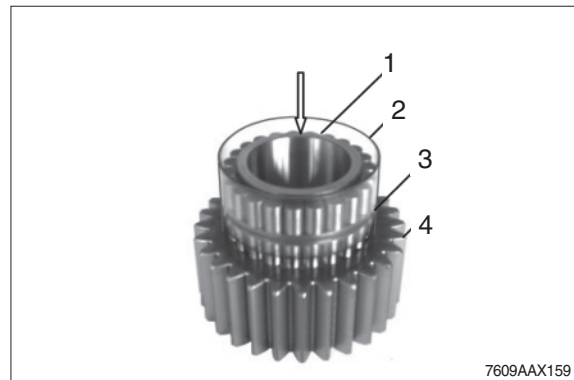
- 1 Stop bolt
- 2 Planetary carrier



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

※ Use packaging sleeve to facilitate assembly.

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



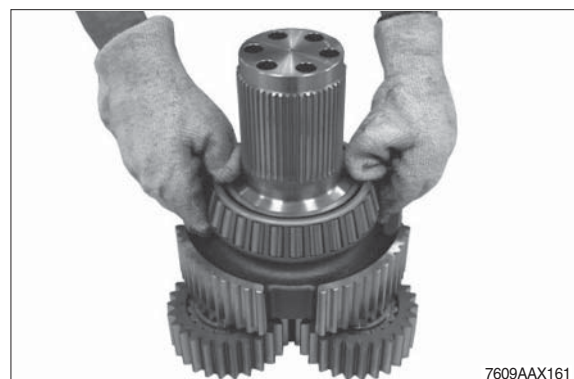
- ⑯ Heat bearing inner rings and insert the premounted planetary gears with large radius facing the planetary carrier (downwards) until contact is obtained.

※ Adjust bearing inner rings after cooling down.

Then fix planetary gears by means of retaining rings.

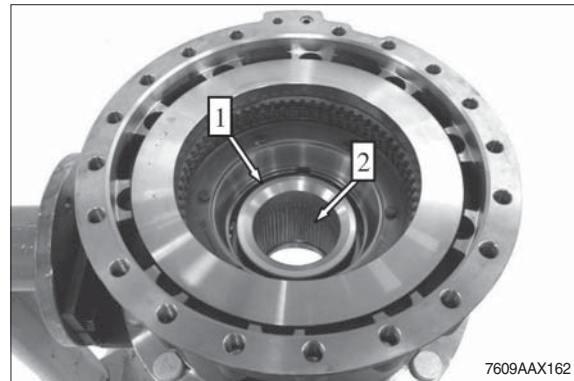


- ⑰ Heat tapered roller bearing and install it to the planetary carrier until contact is obtained.



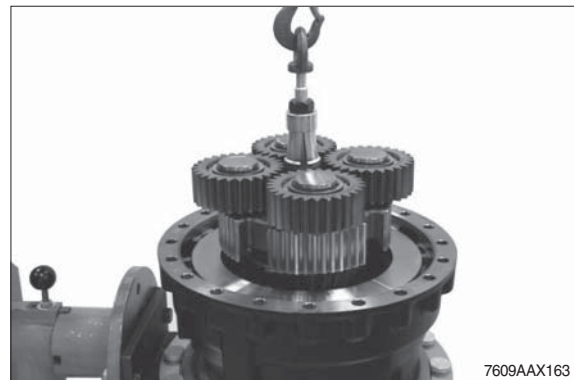


- ⑱ Wet front face (contact face bearing inner ring, arrow 1) and profile (teeth, arrow 2) in the output shaft with anti-corrosive agent.



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

Inner extractor                      5870 300 017  
Eye nut                                5870 204 076

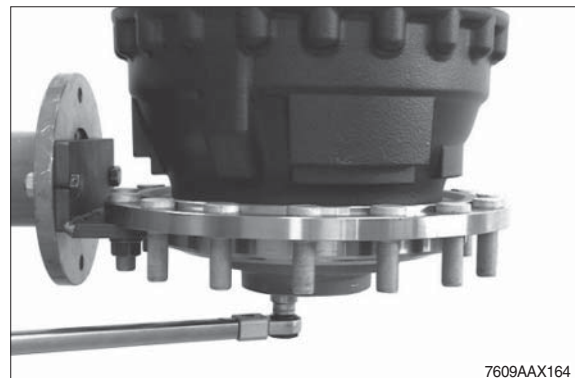


### Setting of gap width output shaft / planetary carrier

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

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

Measuring disk                      AA00 360 730



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

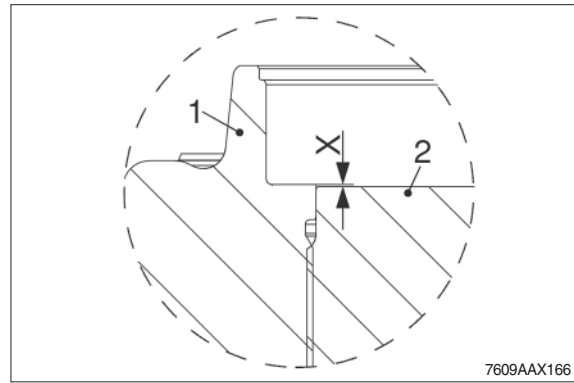
Gap width e.g. .... 0.21 mm

Then remove the locking screws and the measuring disk again.





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

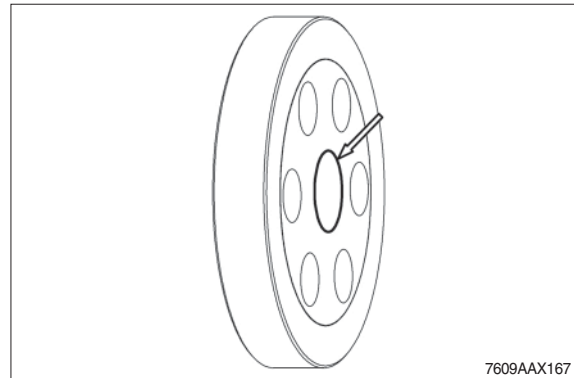


② Select the cover (optional) on the basis of the following table.

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

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

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

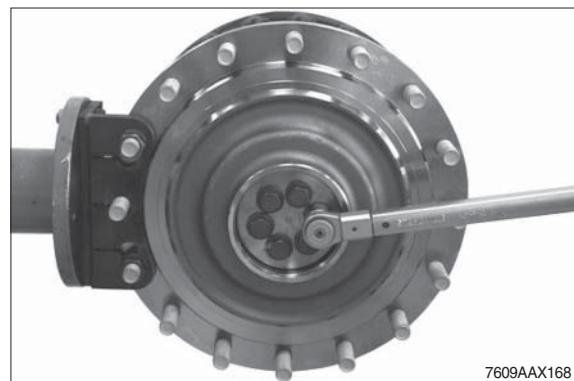


③ Insert the cover with the offset e.g. 0.07 mm showing to the planetary carrier and tighten with **new** locking screws.

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

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

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



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

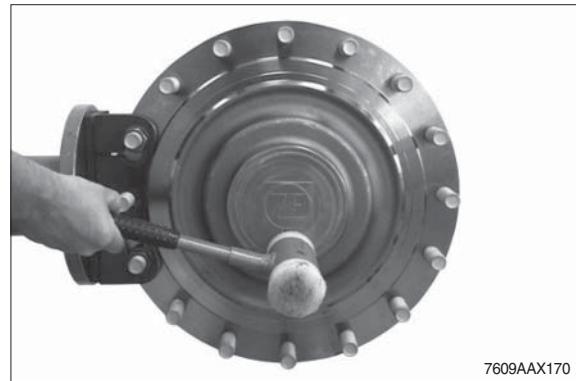
Then wet contact face (arrow 2).

※ Use new cover and O-ring.





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



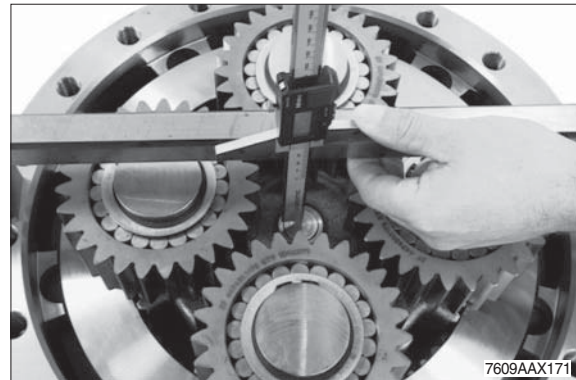
**Set the axial play of the sun gear shaft  
0.5~2.0 mm**

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

Dimension I e.g. .... 40.80 mm

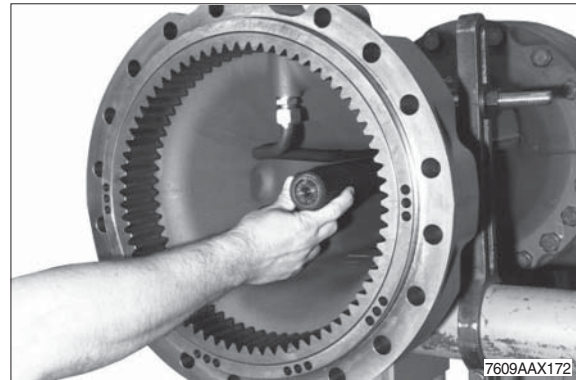
Gauge blocks 5870 200 066

Straightedge 5870 200 022

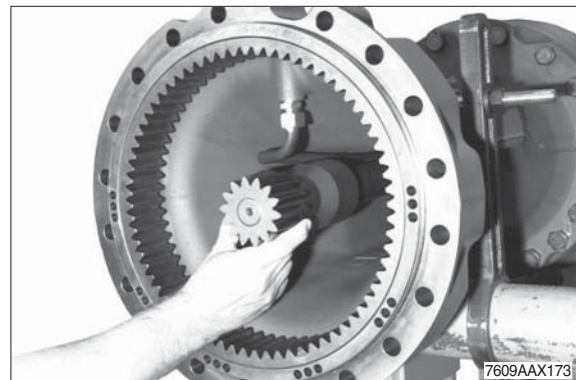


- ②⑦ Insert stub shaft into the teeth of the axle bevel gear until contact is obtained.

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



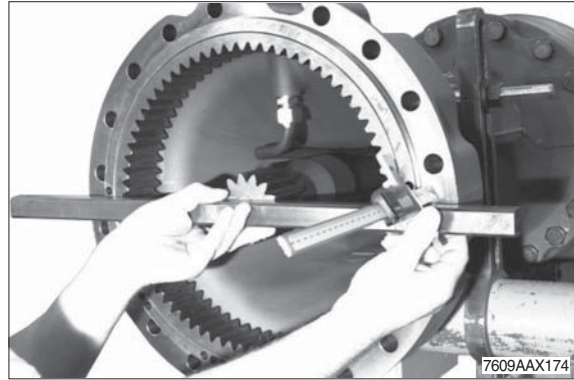
- ②⑧ Insert the sun gear shaft until contact is obtained.





- ②⑨ Measure dimension II, from the front face of the sun gear shaft to the mounting surface of the axle housing.

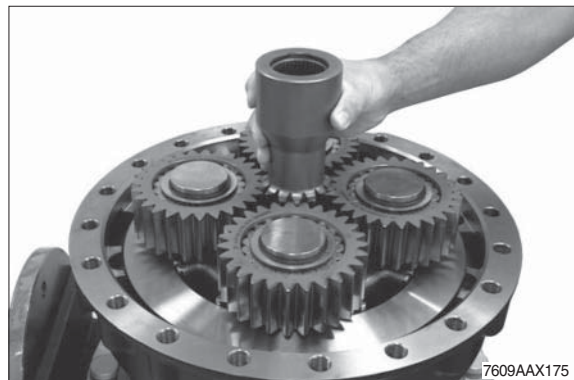
Dimension II e.g. . . . . 38.20  
 Straightedge 5870 200 022



#### CALCULATION EXAMPLE :

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

- ③⑩ Insert sun gear shaft into the planetary carrier.

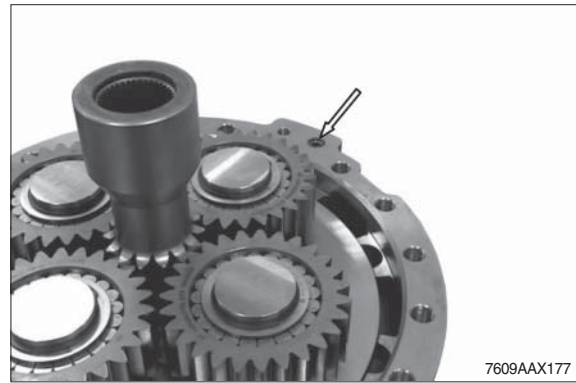


- ③⑪ Fix determined shim (s) e.g. s = 1.60 mm with grease into the sun gear shaft.

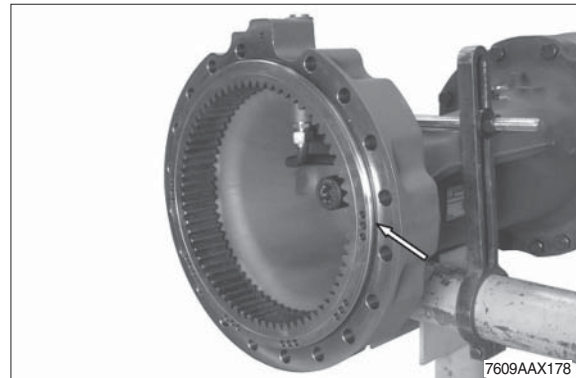




- ③② Fix O-ring (see arrow) with grease into the countersink of the brake housing.



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

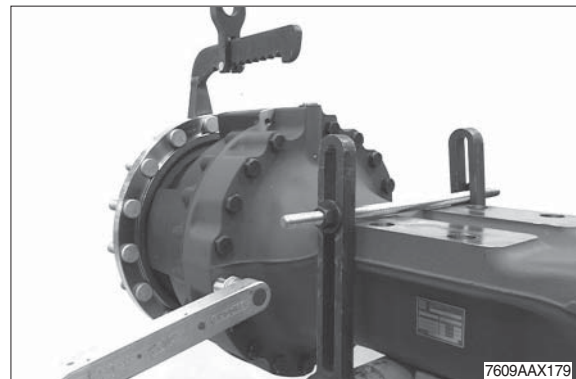


- ③④ Mount two adjusting screws and use the lifting device to bring the output into contact position with the axle housing.

Then fix the output by means of hexagon screws.

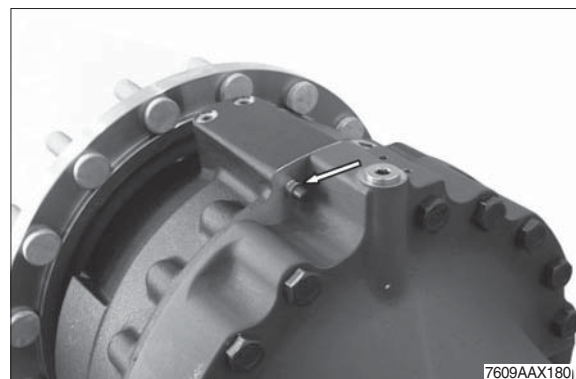
· Tightening torque :  
(M20/10.9) 57.1 kgf · m (413 lbf · ft)

Adjusting screws  
(M20) 5870 204 024  
Load carrying device 5870 281 043



- ※ Fix load carrying device with wheel stud.

- ③⑤ Mount breather (see arrow).





### Check brake hydraulics for leakages

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

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

#### High-pressure test :

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

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

#### Low-pressure test :

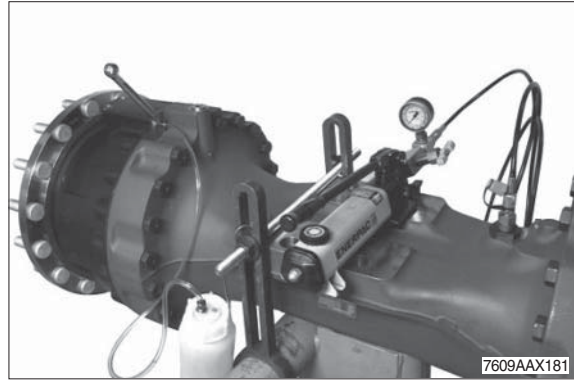
Reduce test pressure  $p = 5$  bar and close shut-off valve.

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

#### Test media :

Engine oil SAE 10W

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



### Check operability of hydraulic lock differential (opt)

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

#### Lock on :

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

#### Lock off :

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

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

