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# **GROUP 1 STRUCTURE AND OPERATION**

## 1. POWER TRAIN COMPONENT OVERVIEW



250D9VPT01

The power train consists of the following components :

- · Torque converter
- · Transmission
- · Propeller shaft
- $\cdot$  Drive axle

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

The transmission is a hydraulically engaged three speed forward, three speed reverse power shift type transmission.

The transmission outputs through universal joints to drive axle assembly.

The power transmitted to front axle drives front wheels.

## · Hydraulic circuit



D507PT31

Speed	Forward		Reverse		Noutral	Positions	No. of		
Speed	F1	F2	F3	R1	R2	R3	neutrai	valve block	points
Y1							-	F	60
Y2							-	E	55
Y3							-	D	56
Y4							-	С	58
Y5							-	В	53
Y6							-	А	57
Clutch engaged	KV, K1	KV, K2	KV, K3	KR, K1	KR, K2	KR, K3	-	-	-

#### NFS Follow-on slide

- D Vibration damper
- B Orifice
- P1 Not used
- P2 Proportional valve KR

- P3 Proportional valve K1
- P4 Proportional valve K3
- P5 Proportional valve KV
- P6 Proportional valve K2
- Y1~Y6 Pressure regulators

### 2. TORQUE CONVERTER



D503TM01

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)



D503TM02

## 3. TRANSMISSION

1) LAYOUT





180D7ETM03

- 1 Clutch shaft (lay shaft, K4)
- 2 Clutch shaft (KV)
- 3 Input shaft / Power take-off (AN/PTO)
- 4 Clutch shaft (KR)

- 5 Clutch shaft (KZ)
- 6 Clutch shaft / Output (K3/AB)
- 7 Clutch shaft (K1)
- 8 Electro-hydraulic control

#### 2) INSTALLATION VIEW





180D7EPT26

- 1 Electro hydraulic control
- 2 Converter bell
- 3 Lifting lugs
- 4 Gearbox housing front and rear section
- 5 Oil level tube with oil dipstick (rear side)
- 6 Transmission suspension holes M20
- 7 Plate
- 8 Converter with diaphragm direct mounting
- 9 Power take off; coaxial, engine dependent
- 10 Gearbox housing front and rear section

- 11 Lifting lugs
- 12 Converter bell
- 13 Converter with diaphragm direct mounting
- 14 Converter with diaphragm
- 15 Exchange filter with filter head
- 16 Transmission suspension holes M20
- 17 Oil drain plug M38×1.5
- 18 Type plate
- 19 Output flange
- 20 Oil level tube with oil dipstick (rear side)

#### 3) OPERATION OF TRANSMISSION

#### (1) Gearbox diagram

The multi-speed reversing transmission in counter shaft design is power shiftable by hydraulically actuated multi-disk clutches.

All gears are constantly meshing and carried on anti-friction bearings.

The gear wheels, bearings and clutches are cooled and lubricated with oil.

The 3-speed reversing transmission is equipped with 5 multi-disk clutches.

At the shifting, the actual plate pack is compressed by a piston, movable in axial direction, which is pressurized by pressure oil.

A compression spring takes over the pushing bask of the piston, thus the release of the plate pack. As to the layout of the transmission as well as the specifications of the closed clutches in the single speeds.





Legend

KV	= Clutch forward
KR	= Clutch reverse
K1	= Clutch 1st speed
K2	= Clutch 2nd speed
K3/AB	= Clutch 3rd speed / output
K4	= Clutch 4th speed(layshaft)
AN/PTO	= INPUT / Power take-off

#### Diagram Clutches

<b>D</b> · · · · · ·	<u> </u>	<u></u>
Driving direction	Speed	Clutch
	1	KV/K1
Forward	2	KV/K2
	3	KV/K3
	1	KR/K1
Reverse	2	KR/K2
	3	KR/K3

### (2) Forward

In forward, forward clutch and 1st, 2nd, 3rd clutch are engaged.

Forward clutch and 1st, 2nd, 3rd clutch are actuated by the hydraulic pressure applied to the clutch piston.



#### (3) Reverse

In reserve, reserve clutch and 1st, 2nd, 3rd clutch are engaged.

Reverse clutch and 1st, 2nd, 3rd are actuated by the hydraulic pressure applied to the clutch piston.



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





D507PT03

- 1 Pressure reducing valve (9bar)
- 2 Main pressure valve (16 + 2bar)
- 3 Housing
- 4 Plug (cable harness)
- 5 Cover
- 6 Valve block

- 7 Intermediate plate
- 8 Duct plate
- 9 Vibration damper
- 10 Follow on slide
- 11 Pressure regulator

Transmission control, see schedule of measuring points, Oil circuit diagram and Electro-hydraulic control unit see page 3-2, 3-10.

The transmission pump, necessary for the oil supply of the converter, and for the transmission control, is sitting in the transmission on the engine-dependent input shaft.

The feed rate of the pump is

Q = 105  $\ell$  /min, at n<sub>Engine</sub> = 2000 min <sup>-1</sup>

This pump is sucking the oil via the coarse filter out of the oil sump and delivers it via the fine filter - the filter can also be fitted externally from the transmission - to the main pressure valve.

If because of contamination, respective damage, the through-flow through the fine filter is not ensured, the oil will be directly conducted via a filter differential pressure valve (bypass valve  $\triangle p = 5.5+3$  bar) to the lubrication.

In this case, an error indication is shown on the display.

The five clutches of the transmission are selected via the 5 proportional valves P2 to P6. The proportional valve (pressure regulator unit) is composed of pressure regulator (e.g. Y6), followon slide and vibration damper.

The control pressure of 9+0.5 bar for the actuation of the follow-on slides is created by 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 pressure 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 will be 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 max. control pressure to 16+2.5 bar and releases the main stream to the converter and lubrication 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 Chapter torque converter page 3-3).

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

This is achieved by converter pressure back-up valve, rear-mounted to the converter, with an opening pressure of at least 4.3+3 bar.

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

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

In the electrohydraulic control unit are 5 pressure regulators installed.

### 5) GEAR SELECTOR (ES1C)

The gear selector is designed for the mounting on the steering column left side. By a rotative motion, the positions (speeds) 1 to 3 are selected by tilting the lever, the driving direction (Forward (F) - Neutral (N) - Reverse (R)).

The lever is operated by using the HALL IC with non-contact magnetic field switch method and the output signal sends with CAN bus.



## **GEAR SELECTOR (ES1C)**

#### (3) Connector

All connections terminate in the 18-way Deutsch integrated connector. Mating connector is DT16-18SA-K004.



### (4) PINNING

Output connector			
Terminal	Designation		
1	-		
2	CAN_H		
3	CAN_H*		
4	CAN_T		
5	KL15		
6	-		
7	-		
8	CAN_L*		
9	CAN_L		
10	GND		
11	KL30		
12	-		
13	-		
14	-		
15	-		
16	-		
17	-		
18	-		



160D9VGS05

#### 6) TRANSMISSION ERROR DISPLAY

#### (1) Function

The display can be used with the gear selector. It indicates speed and driving direction as well as the activated inching.

When driving in the automatic mode, a bar indicator gives additionally also information about the selected driving range; The automatic range is symbolized by arrows above and below the bar indicator. In case of possible errors in the system, a wrench appears on the display, combined with indication of the error number. Also sporadically occurring errors can be indicated.



180D93ACD33

\* If it happens error codes, consult with Hyundai service center to repair the fault.

### 2) DISPLAY DURING AEB-MODE

Symbol	Meaning	Remarks
K1K3 KV, KR	Calibrating clutch K1K3, KV or KR resp.	
_and Kx	Wait for start, initialization of clutch $Kx$ , $x$ : 1, 2, 3, V, R	
≡and Kx	Fast fill time determination of clutch Kx	
=and Kx	Compensating pressure determination of clutch Kx	
ОК	Calibration for all clutches finished	Transmission stays in neutral, you have to restart the TCU (ignition off/on) after removing AEB-Starter
STOP	AEB canceled(activation stopped)	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
STOP and Kx	AEB stopped, clutch Kx can't be calibrated	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
Spanner and Kx	Kx couldn't be calibrated, AEB finished	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
∆E	Engine speed too low $\rightarrow$ raise enging speed	
∇E	Engine speed too high $\rightarrow$ lower enging speed	
∆T	Transmission oil temperature too low $\rightarrow$ heat up transmission	
$\nabla T$	Transmission oil temperature too high $\rightarrow$ cool down transmission	
FT	Transmission temperature not in defined range during calibration	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FB	Operating mode not NORMAL or transmission temperature sensor defective or storing of Calibrated values to EEPROM-has failed.	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FO	Output speed_not_zero	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FN	Shift lever not in Neutral position	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FP	Park brake_not_applied	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
STOP	AEB-Starter was used incorrect or is defective. Wrong device or wrong cable used.	Transmission stays in neutral, you have to restart the TCU (ignition off/on)

#### 3) INITIALIZING THE INCHING SENSOR

- (1) Start engine after parking the machine on flat floor and blocking wheels.
- (2) Release parking brake and keep neutral gear shift.
- (3) Adjust the inching setting bolt so that the regular voltage is supplied to inching sensor when operating the pedal.
- \* Regular voltage ; Before pedal operation (1 $\pm$ 0.1V), After pedal operation (3.5 $\pm$ 0.1V).
- (4) Stop the engine and then just KEY ON. (Release parking brake, keep neutral gear)
- (5) Connect the AEB STARTER to the T/M controller.
- (6) Push AEB STARTER over 3 seconds.
- (7) If display shows "▼IP", Step on the pedal fully.
- (8) If display shows "▲IP", release "OK"
- (9) After the successful completion, it displays "OK".
- (10) In case of abnormal running, it may display "STOP" with the appropriate error code.
- (11)After troubleshooting, start the machine again to repeat above.
- \* Above works are to be done with the parking brake released, so machine's wheels must be blocked for safety.

Symbol	Meaning	Remarks	
▼IP	Push down the pedal slowly until endposition is reached and hold this position		
▲IP	Release the pedal slowly until endposition is reached		
IP blinkt	A problem occurred, release the pedal slowly until endposition is reached	If the expected endposition could not be reached, release the pedal and try again	
OK	Finished inchpedal calibration successful		
FN and Stop	Shift lever not in Neutral position	Calibrations is aborted	
FS and Stop	Sensor supply voltage AU1 is out of the specified range	Calibrations is aborted	
FO and Stop	Outputspeed_not_zero	Calibrations is aborted	
SL and Stop	Sensor voltage below specified range	Calibrations is aborted	
SU and Stop	Sensor voltage below specified range	Calibrations is aborted	
IL and Stop	Sensor position for released pedal out of specified range	Calibrations is aborted	
IU and Stop	Sensor position for released pedal out of specified range	Calibrations is aborted	
TO and Stop	Time-out calibration, pedal not moved after calibration start	Calibrations is aborted	
DL and Stop	Angle between pedal positions released and pressed to small	Calibrations is aborted	
DU and Stop	Angle between pedal positions released and pressed to small	Calibrations is aborted	
FI and Stop	Sensor signal 1 and 2 don't match together	Calibrations is aborted	

### 4) DISPLAY DURING INCHPEDAL CALIBRATION

# (4) Transmission error codes

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
11	Logical error at gear range signal TCU detected a wrong signal combination for the gear range · Cable from shift lever to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective	TCU shifts transmission to neutral OP-mode : Transmission shutdown	<ul> <li>Check the cables from TCU to shift lever</li> <li>Check signal combinations of shift lever positions for gear range</li> <li>Failure cannot be detected in systems with DW2/DW3 shift lever.</li> <li>Fault is taken back if TCU detects a valid signal for the position</li> </ul>
12	Logical error at direction select signal TCU detected a wrong signal combination for the direction · Cable from shift lever to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective	TCU shifts transmission to neutral OP-Mode : Transmission shutdown	<ul> <li>Check the cables from TCU to shift lever</li> <li>Check signal combinations of shift lever positions F-N-R</li> <li>Fault is taken back if TCU detects a valid signal for the direction at the shift lever</li> </ul>
13	Logical error at engine derating device TCU detected no reaction of engine while derating device active	After selecting neutral, TCU change to OP mode limp home	<ul> <li>Check engine derating device</li> <li>This fault is reset after power up of TCU</li> </ul>
15	Logical error at direction select signal 2 shift lever TCU detected a wrong signal combination for the direction · Cable from shift lever 2 to TCU is broken · Cable is defective and is contacted to battery voltage or vehicle ground · Shift lever is defective	TCU shifts transmission to neutral if selector active OP mode : Transmission shutdown if elector active	<ul> <li>Check the cables from TCU to shift lever 2</li> <li>Check signal combinations of shift lever positions F-N-R</li> <li>Fault is taken back if TCU detects a valid neutral signal for the direction at the shift lever</li> </ul>
16	Logical error at axle connection Feedback axle connection measured by TCU and output signal axle connection don't fit · Axle can't be connected or disconnected due to mechanical problem · One of the cables from feedback axle connection switch to TCU is broken	OP mode : Normal	<ul> <li>Check the cables from TCU to feedback axle connection switch</li> <li>Check signals of the feedback axle connection switch</li> </ul>
21	<ul> <li>S.C. to battery voltage at clutch cut off input</li> <li>The measured voltage is too high: <ul> <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> </li> </ul>	Clutch cut off function is disabled OP mode : Normal	<ul> <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	<ul> <li>S.C. to ground or O.C. at clutch cut off input</li> <li>The measured voltage is too low: <ul> <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> </li> </ul>	Clutch cut off function is disabled OP mode : Normal	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the clutch cut off sensor</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
23	<ul> <li>S.C. to battery voltage at load sensor input</li> <li>The measured voltage is too high: <ul> <li>Cable is defective and is contacted to battery voltage</li> <li>Load sensor has an internal defect</li> <li>Connector pin is contacted to battery voltage</li> </ul> </li> </ul>	Retarder function is affected TCU uses default load OP mode : Normal	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the load sensor</li> <li>Check the assembly tolerances of load sensor</li> <li>Xvailability of retarder depends on default load</li> </ul>
24	<ul> <li>S.C. to ground or O.C. at load sensor input</li> <li>The measured voltage is too low: <ul> <li>Cable is defective and is contacted to vehicle ground</li> <li>Cable has no connection to TCU</li> <li>Load sensor has as internal defect</li> <li>Connector pin is contacted to vehicle ground or is broken</li> </ul> </li> </ul>	Retarder function is affected TCU use default load OP mode : Normal	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the load sensor</li> <li>Check the assembly tolerances of load sensor</li> <li>Availability of retarder depends on default load</li> </ul>
25	<ul> <li>S.C. to battery voltage or O.C. at transmi-ssion sump temperature sensor input</li> <li>The measured voltage is too high: <ul> <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> </li> </ul>	No reaction, TCU use default temperature OP mode : Normal	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the temperature sensor</li> </ul>
26	S.C. to battery voltage or O.C. at transmi-ssion sump temperature sensor input The measured voltage is too low: · Cable is defective and is contacted to vehicle ground · Temperature sensor has an internal defect · Connector pin is contacted to vehicle ground	No reaction, TCU uses default temperature OP mode : Normal	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the temperature sensor</li> </ul>
27	<ul> <li>S.C. to battery voltage or O.C. at retarder temperature sensor input</li> <li>The measured voltage is too high: <ul> <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> </li> </ul>	No reaction, TCU uses default temperature OP mode : Normal	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the temperature sensor</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
28	<ul> <li>S.C. to ground at retarder temperature sensor input</li> <li>The measured voltage is too low: <ul> <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> </li> </ul>	No reaction, TCU uses default temperature OP mode : Normal	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the temperature sensor</li> </ul>
29	<ul> <li>S.C. to battery voltage or O.C. at converter output temperature sensor input</li> <li>The measured voltage is too high: <ul> <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> </li> </ul>	No reaction, TCU uses default temperature OP mode : Normal	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the temperature sensor</li> </ul>
30	<ul> <li>S.C. to ground at converter output temperature sensor input</li> <li>The measured voltage is too low: <ul> <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> </li> </ul>	No reaction, TCU uses default temperature OP mode : Normal	<ul> <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 TCU measures a voltage higher than 7.00V at speed input pin · Cable is defective and is contacted to battery voltage · Cable has no connection to TCU · Speed sensor has an internal defect · Connector pin is contacted to battery voltage or has no contact	OP mode : Substitute clutch control	<ul> <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 TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	OP mode : Substitute clutch control	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the speed sensor</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
33	Logical error at engine speed input TCU measures a engine speed over a threshold and the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	OP mode : Substitute clutch control	<ul> <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> <li>This fault is reset after power up of TCU</li> </ul>
34	<ul> <li>S.C. to battery voltage or O.C. at turbine speed input</li> <li>TCU measures a voltage higher than 7.00V at speed input pin</li> <li>Cable is defective and is contacted to vehicle 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 If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the speed sensor</li> </ul>
35	<ul> <li>S.C. to ground at turbine speed input</li> <li>TCU measures a voltage less than 0.45V at speed input pin <ul> <li>Cable/connector is defective and is contacted to vehicle ground</li> <li>Speed sensor has an internal defect</li> </ul> </li> </ul>	OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the speed sensor</li> <li>This fault is reset after power up of TCU</li> </ul>
36	Logical error at turbine speed input TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	OP mode : Substitute clutch control If a failure is existing at output speed, TCU shifts to neutral OP mode : Limp home	<ul> <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>
37	<ul> <li>S.C. to battery voltage or O.C. at internal speed input</li> <li>TCU measures a voltage higher than 7.00V at speed input pin</li> <li>Cable is defective and is contacted to vehicle 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> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the speed sensor</li> </ul>
38	S.C. to ground at turbine speed input TCU measures a voltage less than 0.45V at speed input pin · Cable/connector is defective and is contacted to vehicle ground · Speed sensor has an internal defect	OP mode : Substitute clutch control	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the speed sensor</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
39	Logical error at internal speed input TCU measures a internal speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	OP mode : Substitute clutch control	<ul> <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> <li>This fault is reset after power up of TCU</li> </ul>
ЗА	<ul> <li>S.C. to battery voltage or O.C. at output speed input</li> <li>TCU measures a voltage higher than 12.5V at speed input pin</li> <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>	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : lamp home	<ul> <li>Check the cable from TCU to the sensor</li> <li>Check the connectors</li> <li>Check the speed sensor</li> </ul>
3В	<ul> <li>S.C. to ground at output speed input</li> <li>TCU measures a voltage less than 1.00V at speed input pin <ul> <li>Cable/connector is defective and is contacted to vehicle ground</li> <li>Speed sensor has an internal defect</li> </ul> </li> </ul>	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : lamp home	<ul> <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 TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero · Cable/connector is defective and has bad contact · Speed sensor has an internal defect · Sensor gap has the wrong size	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : lamp home	<ul> <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> <li>This fault is reset after power up of TCU</li> </ul>
3D	Turbine speed zero doesn't fit to other speed signals	-	* Not used
3E	Output speed zero doesn't fit to other speed signals 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. • Speed sensor has an internal defect • Sensor gap has the wrong size	Special mode for gear selection OP mode : Substitute clutch control If a failure is existing at turbine speed, TCU shifts to neutral OP mode : lamp home	<ul> <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> <li>This fault is reset after power up of TCU</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
71	<ul> <li>S.C. to battery voltage at clutch K1</li> <li>The measured resistance value of the valve is out of limit, the voltage at K1 valve is too high <ul> <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> </li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>
72	<ul> <li>S.C. to ground at clutch K1</li> <li>The measured resistance value of the valve is out of limit, the voltage at K1 valve is too low <ul> <li>Cable/connector is defective and has contact to vehicle ground</li> <li>Regulator has an internal defect</li> </ul> </li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>
73	<ul> <li>O.C. at clutch K1</li> <li>The measured resistance value of the valve is out of limit <ul> <li>Cable/connector is defective and has no contact to TCU</li> <li>Regulator has an internal defect</li> </ul> </li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>
74	<ul> <li>S.C. to battery voltage at clutch K2</li> <li>The measured resistance value of the valve is out of limit, the voltage at K2 valve is too high <ul> <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> </li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>
75	<ul> <li>S.C. to ground at clutch K2</li> <li>The measured resistance value of the valve is out of limit, the voltage at K2 valve is too low <ul> <li>Cable/connector is defective and has contact to vehicle ground</li> <li>Regulator has an internal defect</li> </ul> </li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>
76	O.C. at clutch K2 The measured resistance value of the valve is out of limit · Cable/connector is defective and has no contact to TCU · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
77	<ul> <li>S.C. to battery voltage at clutch K3</li> <li>The measured resistance value of the valve is out of limit, the voltage at K3 valve is too high <ul> <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> </li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>
78	<ul> <li>S.C. to ground at clutch K3</li> <li>The measured resistance value of the valve is out of limit, the voltage at K3 valve is too low <ul> <li>Cable/connector is defective and has contact to vehicle ground</li> <li>Regulator has an internal defect</li> </ul> </li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>
79	O.C. at clutch K2 The measured resistance value of the valve is out of limit □Cable/connector is defective and has no contact to TCU □Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>
7A	S.C. to battery voltage at converter clutch	-	-
7B	S.C. to ground at converter clutch	-	-
7C	O.C. at converter clutch	-	* Not used
7D	<ul> <li>S.C. ground at engine derating device</li> <li>Cable is defective and is contacted to vehicle ground</li> <li>Engine derating device has an internal defect</li> <li>Connector pin is contacted to vehicle ground</li> </ul>	Engine derating will be on until TCU power down even if fault vanishes(Loose connection) OP mode : Normal	<ul> <li>Check the cable from TCU to the engine derating device</li> <li>Check the connectors from engine derating device to TCU</li> <li>Check the resistance* of engine derating device</li> <li>Xot used</li> <li>* See page 3-36</li> </ul>
7E	<ul> <li>S.C. battery voltage at engine derating device</li> <li>Cable/connector is defective and is contacted to battery voltage</li> <li>Engine derating device has an internal defect</li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the engine derating device</li> <li>Check the connectors from backup alarm device to TCU</li> <li>Check the resistance* of backup alarm device</li> <li>* See page 3-36</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
7F	<ul> <li>O.C. at engine derating device</li> <li>TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin</li> <li>Cable is defective and has no connection to TCU</li> <li>Engine derating device has an internal defect</li> <li>Connector has no connection to TCU</li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the engine derating device</li> <li>Check the connectors from engine derating device to TCU</li> <li>Check the resistance* of engine derating device</li> <li>* See page 3-36</li> </ul>
85	<ul> <li>S.C. to ground at clutch KV</li> <li>The measured resistance value of the valve is out of limit, the voltage at K4 valve is too low <ul> <li>Cable/connector is defective and has contact to vehicle ground</li> <li>Regulator has an internal defect</li> </ul> </li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>
86	<ul> <li>O.C. at clutch KV</li> <li>The measured resistance value of the valve is out of limit <ul> <li>Cable/connector is defective and has contact to TCU</li> <li>Regulator has an internal defect</li> </ul> </li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>
87	<ul> <li>S.C. to battery voltage at clutch KR</li> <li>The measured resistance value of the valve is out of limit, the voltage at KR valve is too high <ul> <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> </li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
88	S.C. to ground at clutch KR The measured resistance value of the valve is out of limit, the voltage at KR valve is too low · Cable/connector is defective and has contact to vehicle ground · Regulator has an internal defect	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>
89	<ul> <li>O.C. at clutch KR</li> <li>The measured resistance value of the valve is out of limit</li> <li>Cable/connector is defective and has no contact to TCU</li> <li>Regulator has an internal defect</li> </ul>	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>* See page 3-36</li> </ul>
91	<ul> <li>S.C. to ground at relay reverse warning alarm</li> <li>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground <ul> <li>Cable is defective and is contact to vehicle ground</li> <li>Backup alarm device has an internal defect</li> <li>Connector pin is contacted to vehicle ground</li> </ul> </li> </ul>	Backup alarm will be on until TCU power down even if fault vanishes(Loose connection) OP mode : Normal	<ul> <li>Check the cable from TCU to the backup alarm device</li> <li>Check the connectors from backup alarm device to TCU</li> <li>Check the resistance* of backup alarm device</li> <li>* See page 3-36</li> </ul>
92	<ul> <li>S.C. to battery voltage at relay reverse warning alarm</li> <li>TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage <ul> <li>Cable is defective and is contacted to battery voltage</li> <li>Backup alarm device has an internal defect</li> <li>Connector pin is contacted to battery voltage</li> </ul> </li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the backup alarm device</li> <li>Check the connectors from backup alarm device to TCU</li> <li>Check the resistance* of backup alarm device * See page 3-36</li> </ul>

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 TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Backup alarm device has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the backup alarm device</li> <li>Check the connectors from backup alarm device to TCU</li> <li>Check the resistance* of backup alarm device</li> <li>* See page 3-36</li> </ul>
94	<ul> <li>S.C. to ground at relay starter interlock</li> <li>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground</li> <li>Cable is defective and is connection to vehicle ground</li> <li>Starter interlock relay has an internal defect</li> <li>Connector pin is contacted to vehicle ground</li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the stater interlock relay</li> <li>Check the connectors from starter interlock relay to TCU</li> <li>Check the resistance* of starter interlock relay</li> <li>* See page 3-36</li> </ul>
95	S.C. to battery voltage at relay starter interlock TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no connection to battery voltage · Starter interlock relay has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the starter interlock relay</li> <li>Check the connectors from starter interlock relay to TCU</li> <li>Check the resistance* of starter interlock relay</li> <li>* See page 3-36</li> </ul>
96	O.C. at relay starter interlock TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Starter interlock relay has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the starter interlock relay</li> <li>Check the connectors from starter interlock relay to TCU</li> <li>Check the resistance* of starter interlock relay</li> <li>* See page 3-36</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
97	<ul> <li>S.C. to ground at park brake solenoid</li> <li>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground</li> <li>Cable is defective and is connection to vehicle ground</li> <li>Park brake solenoid has an internal defect</li> <li>Connector pin is contacted to vehicle ground</li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the park brake solenoid</li> <li>Check the connectors from park brake solenoid to TCU</li> <li>Check the resistance* of park brake solenoid</li> <li>* See page 3-36</li> </ul>
98	<ul> <li>S.C. to battery voltage at park brake solenoid</li> <li>TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage <ul> <li>Cable is defective and is connection to battery voltage</li> <li>Park brake solenoid has an internal defect</li> <li>Connector pin is contacted to battery voltage</li> </ul> </li> </ul>	No reaction Optional : (Some customers) TCU shifts to neutral caused by park brake feed back OP mode : Normal	<ul> <li>Check the cable from TCU to the park brake solenoid</li> <li>Check the connectors from park brake solenoid to TCU</li> <li>Check the resistance* of park brake solenoid</li> <li>* See page 3-36</li> </ul>
99	<ul> <li>O.C. at park brake solenoid</li> <li>TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin</li> <li>Cable is defective and has no connection to TCU</li> <li>Park brake solenoid has an internal defect</li> <li>Connector has no connection to TCU</li> </ul>	No reaction Optional : Some customers TCU shifts to neutral caused by park brake feed back OP mode : Normal	<ul> <li>Check the cable from TCU to the park brake solenoid</li> <li>Check the connectors from park brake solenoid to TCU</li> <li>Check the resistance* of park brake solenoid</li> <li>* See page 3-36</li> </ul>
9A	S.C. to ground at converter lock up clutch solenoid TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Converter clutch solenoid has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the converter clutch solenoid</li> <li>Check the connectors from converter clutch solenoid to TCU</li> <li>Check the resistance* of park brake solenoid</li> <li>* See page 3-36</li> </ul>
9B	O.C. at converter lock up clutch solenoid TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Converter clutch solenoid has an internal defect · Connector has no connection to TCU	Converter clutch always open, retarder not available OP mode : Normal	<ul> <li>Check the cable from TCU to the converter clutch solenoid</li> <li>Check the connectors from converter clutch solenoid to TCU</li> <li>Check the resistance* of park brake solenoid</li> <li>* See page 3-36</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
9C	S.C. to battery voltage at converter lock up clutch solenoid TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no contacted to battery voltage · Converter clutch solenoid has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the converter clutch solenoid</li> <li>Check the connectors from converter clutch solenoid to TCU</li> <li>Check the resistance* of converter clutch solenoid</li> <li>* See page 3-36</li> </ul>
9D	<ul> <li>S.C. to ground at retarder solenoid</li> <li>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground</li> <li>Cable is defective and is contacted to vehicle ground</li> <li>Retarder solenoid has an internal defect</li> <li>Connector pin is contacted to vehicle ground</li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the retarder solenoid</li> <li>Check the connectors from retarder solenoid to TCU</li> <li>Check the resistance* of retarder solenoid</li> <li>* See page 3-36</li> </ul>
9E	<ul> <li>O.C. at retarder solenoid</li> <li>TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin</li> <li>Cable is defective and has no connection to TCU</li> <li>Retarder solenoid has an internal defect</li> <li>Connector has no connection to TCU</li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the retarder solenoid</li> <li>Check the connectors from retarder solenoid to TCU</li> <li>Check the resistance* of retarder solenoid</li> <li>* See page 3-36</li> </ul>
9F	S.C. to battery voltage at retarder solenoid TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has no connection to battery voltage · Retarder solenoid has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the retarder solenoid</li> <li>Check the connectors from retarder solenoid to TCU</li> <li>Check the resistance* of retarder solenoid</li> <li>* See page 3-36</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
A1	S.C. to ground at difflock or axle connection solenoid TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground · Cable is defective and is contacted to vehicle ground · Difflock solenoid has an internal defect · Connector pin is contacted to vehicle ground	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the difflock solenoid</li> <li>Check the connectors from difflock solenoid to TCU</li> <li>Check the resistance* of difflock solenoid</li> <li>* See page 3-36</li> </ul>
A2	<ul> <li>S.C. to battery voltage at difflock or axle connection solenoid</li> <li>TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage <ul> <li>Cable is defective and has no connection to battery voltage</li> <li>Difflock solenoid has an internal defect</li> <li>Connector pin is contacted to battery voltage</li> </ul> </li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the difflock solenoid</li> <li>Check the connectors from difflock solenoid to TCU</li> <li>Check the resistance* of difflock solenoid</li> <li>* See page 3-36</li> </ul>
A3	O.C. at difflock or axle connection solenoid TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Difflock solenoid has an internal defect · Connector has no connection to TCU	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the difflock solenoid</li> <li>Check the connectors from difflock solenoid to TCU</li> <li>Check the resistance* of difflock solenoid</li> <li>* See page 3-36</li> </ul>
A4	<ul> <li>S.C. to ground at warning signal output TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground</li> <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 OP mode : Normal	<ul> <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> <li>* See page 3-36</li> </ul>
A5	<ul> <li>O.C. voltage at warning signal output TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin</li> <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 OP mode : Normal	<ul> <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> <li>* See page 3-36</li> </ul>
A6	S.C. to battery voltage at warning signal output TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage · Cable is defective and has is contacted to battery voltage · Warning device has an internal defect · Connector pin is contacted to battery voltage	No reaction OP mode : Normal	<ul> <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> <li>* See page 3-36</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
B1	Slippage at clutch K1 TCU calculates a differential speed at closed clutch K1. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch K1 · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <li>Check pressure at clutch K1</li> <li>Check main pressure in the</li> <li>system</li> <li>Check sensor gap at internal</li> <li>speed sensor</li> <li>Check sensor gap at output speed</li> <li>sensor</li> <li>Check signal at internal speed</li> <li>sensor</li> <li>Check signal at output speed</li> <li>sensor</li> <li>Check signal at output speed</li> <li>sensor</li> <li>Replace clutch</li> </ul>
B2	Slippage at clutch K2 TCU calculates a differential speed at closed clutch K2. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch K2 · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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>Check signal at output speed sensor</li> <li>Replace clutch</li> </ul>
B3	Slippage at clutch K3 TCU calculates a differential speed at closed clutch K3. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch K3 · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at output speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>Check signal at output speed sensor</li> <li>Check clutch</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
B5	Slippage at clutch KV TCU calculates a differential speed at closed clutch KV. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch KV · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>Check signal at turbine speed sensor</li> <li>Replace clutch</li> </ul>
B6	Slippage at clutch KR TCU calculates a differential speed at closed clutch KR. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at clutch KR · Low main pressure · Wrong signal at internal speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective	TCU shifts to neutral OP mode : Limp home If failure at another clutch is pending TCU shifts to neutral OP mode : TCU shutdown	<ul> <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> <li>Check signal at turbine speed sensor</li> <li>Replace clutch</li> </ul>
B7	<b>Overtemp sump</b> TCU measured a temperature in the oil sump that is over the allowed threshold.	No reaction OP mode : Normal	<ul> <li>Cool down machine</li> <li>Check oil level</li> <li>Check temperature sensor</li> </ul>
B8	Overtemp retarder TCU measured a temperature in the retarder oil that is over the allowed threshold	TCU disables retarder OP mode : Normal	<ul> <li>Cool down machine</li> <li>Check oil level</li> <li>Check temperature sensor</li> </ul>
B9	Overspend engine	Retarder applies OP mode : Normal	-
BA	<ul> <li>Differential pressure oil filter</li> <li>TCU measured a voltage at differential pressure switch out of the allowed range</li> <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 OP mode : Normal	<ul> <li>Check oil filter</li> <li>Check wiring from TCU to differential pressure switch</li> <li>Check differential pressure switch(Measure resistance)</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
BB	Slippage at converter lockup clutch TCU calculates a differential speed at closed converter lockup clutch. If this calculated value is out of range, TCU interprets this as slipping clutch · Low pressure at converter lockup clutch · Low main pressure · Wrong signal at engine speed sensor · Wrong signal at turbine speed sensor · Wrong size of the sensor gap · Clutch is defective	-	<ul> <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>
BD	<ul> <li>S.C. to ground at engine brake solenoid</li> <li>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground</li> <li>Cable is defective and is contacted to vehicle ground</li> <li>Engine brake solenoid has an internal defect</li> <li>Connector pin is contacted to vehicle ground</li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to engine brake solenoid</li> <li>Check the connectors from engine brake solenoid to TCU</li> <li>Check the resistance* of engine brake solenoid</li> <li>* See page 3-36</li> </ul>
BE	<ul> <li>S.C. to battery voltage at engine brake</li> <li>TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage</li> <li>Cable is defective and is contacted to battery voltage</li> <li>Engine brake solenoid has an internal defect</li> <li>Connector pin is contacted to battery voltage</li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the engine brake solenoid</li> <li>Check the connectors from engine brake solenoid to TCU</li> <li>Check the resistance* of engine brake solenoid</li> <li>* See page 3-36</li> </ul>
BF	<ul> <li>O.C. at engine brake</li> <li>TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin</li> <li>Cable is defective and has no connection to TCU</li> <li>Engine brake solenoid has an internal defect</li> <li>Connector has no connection to TCU</li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the engine brake solenoid</li> <li>Check the connectors from engine brake solenoid to TCU</li> <li>Check the resistance* of engine brake solenoid</li> <li>* See page 3-36</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
C3	Overtemp converter output TCU measured a oil temperature at the converter output that is the allowed threshold	No reaction OP mode : Normal	<ul> <li>Cool down machine</li> <li>Check oil level</li> <li>Check temperature sensor</li> </ul>
C4	<ul> <li>S.C. to ground at joystick status indicator</li> <li>TCU detected a wrong voltage at the output pin, that looks like a S.C. to vehicle ground</li> <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 OP mode : Normal	<ul> <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 * See page 3-36</li> </ul>
C5	<ul> <li>S.C. to battery voltage at joystick status indicator</li> <li>TCU detected a wrong voltage at the output pin, that looks like a S.C. to battery voltage <ul> <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> </li> </ul>	No reaction OP mode : Normal	<ul> <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> <li>* See page 3-36</li> </ul>
C6	O.C. at joystick status indicator TCU detected a wrong voltage at the output pin, that looks like a O.C. for this output pin · Cable is defective and has no connection to TCU · Joystick status indicator has an internal defect · Connector pin has no connection to TCU	No reaction OP mode : Normal	<ul> <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 * See page 3-36</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
D1	S.C. to battery voltage at power supply for sensors TCU measures more than 6V at the pin AU1 (5V sensor supply)	See fault codes No.21 to 2C	<ul> <li>Check cables and connectors to sensors, which are supplied from AU1</li> <li>Check the power supply at the pin AU1 (Should be appx. 5V)</li> <li>Fault codes No.21 to No.2C may be reaction of this fault</li> </ul>
D2	S.C. to ground at power supply for sensors TCU measures less than 4V at the pin AU1 (5V sensor supply)	See fault codes No.21 to 2C	<ul> <li>Check cables and connectors to sensors, which are supplied from AU1</li> <li>Check the power supply at the pin AU1 (Should be appx. 5V)</li> <li>Fault codes No.21 to No.2C may be reaction of this fault</li> </ul>
D3	Low voltage at battery Measured voltage at power supply is lower than 18V(24V device)	Shift to neutral OP mode : TCU shutdown	<ul> <li>Check power supply battery</li> <li>Check cables from batteries to TCU</li> <li>Check connectors from batteries to TCU</li> </ul>
D4	<b>High voltage at battery</b> Measured voltage at power supply is higher than 32.5V(24V device)	Shift to neutral OP mode : TCU shutdown	<ul> <li>Check power supply battery</li> <li>Check cables from batteries to TCU</li> <li>Check connectors from batteries to TCU</li> </ul>
D5	Error at valve power supply VPS1 TCU switched on VPS1 and measured VPS1 is off or TCU switched off VPS1 and measured VPS1 is still on · Cable or connectors are defect and are contacted to battery voltage · Cable or connectors are defect and are contacted to vehicle ground · Permanent power supply KL30 missing · TCU has an internal defect	Shift to neutral OP mode : TCU shutdown	<ul> <li>Check fuse</li> <li>Check cables from gearbox to TCU</li> <li>Check connectors from gearbox to TCU</li> <li>Replace TCU</li> </ul>
D6	Error at valve power supply VPS2 TCU switched on VPS2 and measured VPS2 is off or TCU switched off VPS2 and measured VPS2 is still on · Cable or connectors are defect and are contacted to battery voltage · Cable or connectors are defect and are contacted to vehicle ground · Permanent power supply KL30 missing · TCU has an internal defect	Shift to neutral OP mode : TCU shutdown	<ul> <li>Check fuse</li> <li>Check cables from gearbox to TCU</li> <li>Check connectors from gearbox to TCU</li> <li>Replace TCU</li> </ul>

Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
E1	S.C. battery voltage at speedometer output	-	* Not used
E2	S.C. to ground or O.C at speedometer output	-	* Not used
E3	<ul> <li>S.C. to battery voltage at display output TCU sends data to the display and measures always a high voltage level on the connector</li> <li>Cable or connectors are defective and are contacted to battery voltage</li> <li>Display has an internal defect</li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the display</li> <li>Check the connectors at the display</li> <li>Change display</li> </ul>
E4	<ul> <li>S.C. to ground at display output</li> <li>TCU sends data to the display and measures always a high voltage level on the connector <ul> <li>Cable or connectors are defective and are contacted to battery voltage</li> <li>Display has an internal defect</li> </ul> </li> </ul>	No reaction OP mode : Normal	<ul> <li>Check the cable from TCU to the display</li> <li>Check the connectors at the display</li> <li>Change display</li> </ul>
E5	Communication failure on DeviceNet	Shift to neutral OP mode : TCU shutdown	<ul> <li>Check Omron master</li> <li>Check wire of DeviceNet-Bus</li> <li>Check cable to Omron master</li> </ul>
E5	DISPID1 timeout Timeout of CAN-massage DISPID1 from display controller · Interference on CAN-Bus · CAN wire/connector is defective · Can wire/connector is defective and has contact to vehicle ground or battery voltage	TCU select parameter set with ID0 OP mode : Limp home	<ul> <li>Check display controller</li> <li>Check wire of CAN-Bus</li> <li>Check cable display controller</li> </ul>
Fault code (Hex)	Meaning of the fault code possible reason for fault detection	Reaction of the TCU	Possible steps to repair
---------------------	--	--	---
F1	General EEPROM fault TCU can't read non volatile memory · TCU is defective	No reaction OP mode : Normal	<ul> <li>Replace TCU</li> <li>Øften shown together with fault code F2</li> </ul>
F2	Configuration lost TCU has lost the correct configuration and can't control the transmission · Interference during saving data on non volatile memory · TCU is brand new or from another vehicle	Transmission stay neutral OP mode : TCU shutdown	<ul> <li>Reprogram the correct configurat- ion for the vehicle (e.g. with cluster controller,)</li> </ul>
F3	Application error Something of this application is wrong	Transmission stay neutral OP mode : TCU shutdown	<ul> <li>Replace TCU</li> <li>This fault occurs only if an test engineer did something wrong in the application of the vehicle</li> </ul>
F5	<b>Clutch failure</b> AEB was not able to adjust clutch filling parameters · One of the AEB-Values is out of limit	Transmission stay neutral OP mode : TCU shutdown	<ul> <li>Check clutch</li> <li>TCU shows also the affected clutch on the display</li> </ul>
F6	Clutch adjustment data lost TCU was not able to read correct clutch adjustment parameters · Interference during saving data on non volatile memory · TCU is brand new	No reaction, Default values : 0 for AEB Offsets used OP mode : Normal	· Execute AEB

- (5) Measuring of resistance at actuator/sensor and cable
- 1 Actuator



76043PT19

76043PT20

2 Cable



 Short cut to ground
  $R_{12} = 0$ ;
  $R_{1c} = R_{2c} = 0$ ,
  $R_{1P} = R_{2P} = \infty$  

 Short cut to battery
  $R_{12} = 0$ ;
  $R_{1c} = R_{2c} = 0$ ,
  $R_{1P} = R_{2P} = 0$ 

## 7) ELECTRONIC CONTROL FOR POWER TRANSMISSION

#### (1) Description of the basic functions

The powershift transmission is equipped with TCU.

- $\cdot$  The system is processing the desire of the driver according to the following criteria :
- · Gear determination depending on gear selector position, driving speed and load condition.
- Protection from operating error as far as necessary, is possible via electronic protection (programming).
- $\cdot$  Protection from over-speeds (on the base of engine and turbine speed).
- · Electronic inching.

#### (2) Automatic calibration of the shifting elements (AEB)

The AEB serves to compensate tolerances (plate clearance and pressure level), which are in fluencing the filling procedure of the clutches. For each clutch, the correct filling parameters for

- \* Period of the rapid filling time
- \* Level of the filling equalizing pressure are defined in a test cycle.

The filling parameters are stored, together with the ABE-program and the driving program in the transmission electronics. Because the electronics will be separately supplied, the AEB-cycle must be started only after the installation of both components in the vehicle, thus ensuring the correct mating (transmission and electronics).

\* At any rate, the AEB - cycle must be carried out at the vehicle manufacturer prior to the commissioning of the vehicles.

It is imperative, to respect the following test conditions :

- Shifting position neutral
- Engine in idling speed
- Praking brake applied
- Transmission in operating temperature
- ※ After a replacement of the transmission the electrohydraulic control or the TCU in the vehicle the AEB-cycle must be as well carried out again.

The AEB-cycle continues for about 3 to 4 minutes. The determined filling parameters are stored in the EEPROM of the electronics. In this way, the error message F6 shown on the display will be cancelled also at non - performed AEB.

\* For the start of the AEB-cycle there are principally two possibilities :

- ① Start of the AEB by separate tools which are connected on the diagnostic port of the wiring. Following tools for the AEB start will be offered by the ZF service ;
  - Testmann (see Diagnostic systems)
  - AEB Starter

Order - No. : ZGAQ-03870

The Special tool developped by the ZF can be used only for the starting of the AEB.



- ② Start AEB by operating elements on the vehicle.
   For it a CAN-communication between transmission and vehicle electronics is necessary.
- Due to the operation of the transmission the paper friction linings installed in the ergopower transmissions are settling, i.e. the plate clearance becomes greater. Because these settling appearances can interfere the shifting quality, ZF recommends to repeat the AEB-cycle at the Maintenance intervals.
- \* The ZF recommends likewise at a reduced shifting quality as first measure to repeat the AEBcycle.

#### (3) Inching device

This function is especially suitable for lift trucks. It allows to reduce the driving speed infinitely variable without modification of the engine speed in such a way that driving with a very low speed will be possible. In his way, the driver can move the vehicle very exactly to a determined position.

At the same time and important part of the engine power for the output of the hydraulic system is at disposal by the high engine speed.

Operation is carried out by a separate inching pedal, where an angle of rotation sensor is mounted.

By means of the proportional valve technology the TCU regulates the pressure in the driving direction clutch in such a way that the driving speed is adjusted in accordance with the inch rotating angle sensor position. Clutch overloading is avoided thanks to the electronic protection.

# 4. TRANSMISSION MEASURING POINTS AND CONNECTIONS

The measurement have to be carried out with hot transmission (about 80~95°C)



180D7ETM04

		· Pressure regulator under voltage				Engaged eluteb		
Driving direction	Speed	Y2	Y3	Y4	Y5	Y6	Engage	CIULCH
	1						K1	KV
Forward	2						KV	K2
Torward	3						K3	KV
	1						KR	K1
Poverse	2						KR	K2
neverse	3						KR	K3
Neutral								
Engaged clutch		KR	K1	K3	KV	K2		
Position on valve block		Е	D	С	В	Α		
Consec. No. Of measuring points		55	56	58	53	57		

# 1) OIL PRESSURE AND TEMPERATURE

Port		Description		Size
51	In front of converter	r - Opening pressure 11	+2 bar	M10×1
53	Clutch Forward	16 + 2 bar	KV	M10×1
55	Clutch reverse	16 + 2 bar	KR	M10×1
56	Clutch	16 + 2 bar	K1	M10×1
57	Clutch	16 + 2 bar	K2	M10×1
58	Clutch	16 + 2 bar	K3	M10×1
63	Temperature sensor behind the converter			M14×1.5
65	System pressure	16 + 2.5 bar		M10×1

## 2) MEASURING POINTS FOR DELIVERY RATES

Port	Description	Size
15	Connection to the oil cooler	M33×2
16	Connection from the oil cooler	M33×2

# 3) INDUCTIVE TRANSMITTER - IMPURSE - SPEED SENSOR AND SWITCH

Port	Description	Size
21	Inductive transmitter n Turbine	M18×1.5
34	Speed sensor n Output an speedometer	-
47	Inductive transmitter n Central gear train	M18×1.5
48	Inductive transmitter n Engine	M18×1.5
54	Filter contamination switch	M14×1.5

# 4) CONNECTIONS

Port	Description	Size
10	Breather	-
49	Plug connection on electro-hydraulic control unit	-

# 5. DRIVE AXLE

1) STRUCTURE (1/6)



250D7EDR02

- 400 Differential carrier assy
- 401 Drive pinion
- 402 Ring gear
- 403 Differential housing
- 404 Differential housing
- 405 Differential spider
- 406 Differential side gear
- 408 Differential pinion
- 409 Clutch disc
- 411 Thrust washer
- 412 Bearing bushing
- 413 Hexagon socket screw

- 414 Hexagon screw
- 415 Tapered roller bearing
- 417 Differential carrier housing
- 418 Hexagon screw
- 419 Setting ring
- 420 Setting ring
- 421 Lock plate
- 422 Hexagon screw
- 423 Hexagon screw
- 427 Screw plug
- 428 Sealing ring
- 432 Tapered roller bearing

- 433 Thrust washer
- 434 Breather
- 436 Tapered roller bearing
- 439 Cover
- 440 Radial seal ring
- 442 Hexagon socket screw
- 444 Drive flange
- 445 Adjusting nut
- 572 O-ring
- 579 Lock pin

#### 2) STRUCTURE (2/6)



- 250 Friction disk
- 251 Steel disk
- 252 Piston
- 253 Bushing
- 254 Hex socket screw
- 255 Disk carrier
- 256 Hex socket screw
- 258 Gasket
- 259 Gasket

- 260 Brake carrier
- 261 Brake housing
- 262 O-ring
- 264 O-ring
- 265 O-ring
- 266 Hex socket screw
- 267 Hex socket screw
- 269 Hex screw
- 271 Face seal

- 272 Screw plug
- 273 Sealing ring
  - 274 Screw plug
- 275 Sealing ring
- 278 Bleeding socket
- 280 Bleeder valve
- 281 Pipe
- 282 Hexagon screw with flange
- 283 Compression spring

# 3) STRUCTURE (3/6)



- 300 Planetary housing
- 304 O-ring
- 305 Screw plug
- 306 Sealing ring
- 309 Thrust washer
- 312 Hexagon socket screw
- 314 Sun gear

- 318 Sleeve
- 319 Hexagon socket screw
- 320 Thrust ring
- 322 Planetary gear
- 324 Thrust washer
- 329 Needle bearing
- 331 Planetary pin

- 333 Locking pin
- 335 Ring gear
- 336 Ring gear carrier
- 337 Retainer
- 338 Hexagon screw
- 340 O-ring

# 4) STRUCTURE (4/6)



- 1 Axle housing
- 2 Breather
- 5 Screw plug
- 6 Seal
- 40 Drive shaft
- 42 Wheel hub

- 43 Stud
- 44 Wheel nut
- 45 Clamp
- 50 Radial seal
- 51 Radial seal
- 53 Tapered roller bearing
- 55 Ring spacer
- 59 Nut
- 60 Hex socket screw
- 121 Ring





- 605 Brake lining kit
- 606 Bleeder valve
- 608 Circlip
- 609 Dish spring610 Hex nut
- 611 Set screw

- 612 Cap
- 615 Pressure bolt
- 617 Castle nut
- 618 Split pin
- 623 Magnet
- 624 Tolerance ring
- 625 O-ring
- 626 O-ring
- 629 Socket screw
  - 630 Seal

#### 6) STRUCTURE (6/6)



250D9VDR07

601 Brake carrier 602 O-ring 603 Disc plate604 Hex screw

628 Hex screw

#### 7) OPERATION

Both sides of the housing are supported by the frame and the center is mounted on the transmission case through propeller shaft.

The mast is installed on the front of the frame. The final deceleration and differential device built in the housing guarantee accurate rotation and smooth operation.

The power from the transmission in transferred through the pinion, ring gear, differential case, the pinion of the differential device and the side gear to the drive axle shaft by the side gear spline and to the hub and wheel mounted on the shaft by high tension bolts.

# 6. TIRE AND WHEEL



250D7EAX68

Harden washer

7

- Wheel rim 1
- Side ring 4

- 2 Tire
- 5 Extension valve
- 3 Lock ring 6 Wheel nut
- 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.

# **GROUP 2 OPERATION AND MAINTENANCE**

# 1. OPERATION

## 1) Driving preparation and maintenance

Prior to the commissioning of the transmission, take care that the prescribed oil grade will be filled in with the correct quantity. At the initial filling of the transmission has to be considered that the oil cooler, the pressure filters as well as the pipes must get filled with oil.

According to these cavities, the quantity of oil to be filled in, is greater than at the later oil fillings in the course of the usual maintenance service.

\* Because the converter and the oil cooler, installed in the vehicle, as well as the pipes can empty at standstill into the transmission, the **oil level check must be carried out at engine idling speed and operation temperature of the transmission.** 

# At the oil level check, the vehicle has to be secured against rolling by blocks, articulated vehicles additionally against unintended turning-in.

#### 2) DRIVING AND SHIFTING

#### (1) Neutral position

Neutral position will be selected via the gear selector.

After the ignition is switched on, the electronics remains in the waiting state. By the position NEUTRAL of the gear selector, the TCU becomes ready for operation.

A gear can be engaged.

#### (2) Starting

The starting of the engine has always to be carried out in the NEUTRAL POSITION of the gear selector.

For safety reasons it is to recommend to brake the vehicle securely in position with the parking brake prior to start the engine.

After the starting of the engine and the preselection of the driving direction and the gear, the vehicle can be set in motion by acceleration.

At the start off, the converter takes over the function of a master clutch.

On a level road it is possible to start off also in higher gears.

#### - Upshifting under load.

Upshifting under load will be then realized if the vehicle can continue to accelerate by it.

- Downshifting under load.

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

#### - Upshifting in overrunning condition.

In the overrunning mode, the upshifting will be suppressed by accelerator pedal idling position,

if the speed of the vehicle on a downgrade should not be further increased.

#### - Downshifting in overrunning condition.

Downshifting in overrunning mode will be then carried out if the vehicle should be related.

If the vehicle will be stopped and is standing with running engine and engaged transmission, the engine cannot be stalled. On a level and horizontal roadway it is possible that the vehicle begins to crawl, because the engine is creating at idling speed a slight drag torque via the converter. It is convenient to brake the vehicle at very stop securely in position with the parking brake. At

longer stops, the controller has to be shifted to the NEUTRAL POSITION.

At the start off, the parking brake has to be released. We know from experience that at a converter transmission it might not immediately be noted to have forgotten this quite normal operating step because a converter, due to its high ratio, can easily overcome the braking torque of the parking brake.

Temperature increases in the converter oil as well as overheated brakes will be the consequences to be find out later.

Neutral position of the selector switch at higher vehicle speed (above stepping speed) is not admissible.

Either a suitable gear is to be shifted immediately, or vehicle must be stopped at once.

#### 3) COLD START

At an oil temperature in the shifting circuit <-12°C, the transmission must be warmed-up for some minutes.

This must be carried out in neutral with an increased engine speed(about 1500 min<sup>-1</sup>).

Until this oil temperature is reached, the electronics remains in neutral, and the symbol of the cold start phase will be indicated on the display.

Indication on the display:

After the indication on the display is extinguished, the full driving program can be utilized out of "NEUTRAL".

#### 4) OIL TEMPERATURE

The oil temperature in the transmission sump is in the electrohydraulic control unit.

The service temperature in the sump of  $60^{\circ}$ ~90°C must not be exceeded.

By overstepping results by 105°C notice "WS" on the display.

At a trouble-free unit and an adequate driving mode, a higher temperature will not occur.

The notice "WS" results at the display, the vehicle has to be stopped and controlled for external oil loss and the engine must run with a speed of 1200-1500 min<sup>-1</sup> at NEUTRAL POSITION of the transmission.

Now, the temperature must drop quickly (in about 2-3 minutes) to normal values. If this is not the case, there is a trouble pending, which must be eliminated prior to continue working.

The monitoring of the oil temperature (behind the converter) is additionally on the temperature gauge which is located on the dashboard.

Operating temperature behind the converter at least 65°C and 100°C in continuous operation, a short-time increase up to max. 120°C is permitted.

The temperature is measured on the measuring point  $_{"}63"$  (see schedule of measuring points-3-40)

# 2. MAINTENANCE

#### 1) TRANSMISSION

#### (1) Oil level check

#### A At the oil level check, the vehicle has to be secured against rolling with blocks.

The oil level check must be carried out as follows :

- Oil level check (weekly)
- At horizontally standing vehicle
- Transmission in neutral position  $\ensuremath{"\!N"}$
- In the cold start phase, the engine must be running about 2~3 minutes at idling speed, and the marking on the oil dipstick must then be lying above the cold start mark "COLD"
- At operating temperature of the transmission(about 80°~90°C)
- At engine idling speed
- Loosen oil dipstick by counter-clock rotation, remove and clean it
- Insert oil dipstick slowly into the oil level tube until contact is obtained, and pull it out again.
- On the oil dipstick, the oil level must be lying in the zone "HOT"
- Insert the oil dipstick again, and tighten it by clockwise rotation

If the oil level has dropped in operating temperature condition below the "HOT" zone, it is absolutely necessary to replenish oil.

An oil level above the "HOT" marking, is leading to a too high oil temperature.

#### (2) Oil change and filter replacement intervals

First oil change after 100 operating hours in service.
 Every further oil change after 1000 operating hours in service, however at least once a year.
 At every oil change, the fine filter has to be replaced.

#### ① Oil change and oil filling capacity

The oil change has to be carried out as follows. At operating temperature of the transmission, horizontally standing vehicle open the oil drain plug and drain the used oil.

- Clean oil drain plug with magnetic insert and surface on the housing and install again along with O-ring.
- Fill in oil (about 20 liters).

(Sump capacity, external oil capacities e. g. in the heat exchanger, in the lines etc. are depended on the vehicle).

The indicated value is a guide value.

\* It is imperative to pay attention to absolute cleanliness of oil and filter.

Binding is in any case the making on the oil dipstick.

- Start the engine-idling speed
- Transmission in neutral position "N"
- Top up oil up to the marking "COLD"
- Brake the vehicle securely in position and warm up the transmission
- Shift all controller positions through
- Check the oil level once more and top up oil once more if necessary
- On the oil dipstick, the oil level must be lying in the zone "HOT"
- Insert the oil dipstick again and tighten it by clockwise rotation
- \* At the initial filling of the transmission has to be considered that the heat exchanger, the pressure filter as well as the pipes must get filled with oil.

According to these cavities, the oil capacity to be filled in is greater than at the later oil fillings in the course of the usual maintenance service.

#### 2 Filter replacement

At the replacement of the filter in the main oil steam, pay attention that no dirt or oil sludge can penetrate into the circuit.

At the mounting of the filter, any exertion of force has to be avoided.

※ Treat the filter carefully at the installation, the transport and the storage.

Damaged filters must no more be installed.

The mounting of the filter must be carried out as follows:

- Cover the gasket with a small amount of oil.
- Screw the filter in until contact with the sealing surface is obtained and tighten it now by hand about 1/3 to 1/2 turn.



180D7EPT19

# Legend:

- 1 = Oil filter tube with oil dipstick
- 2 = Oil drain plug M38  $\times$  1.5
- 3 = Fine filter

Oil dipstick



180D7EPT20

# 2) DRIVE AXLE

#### (1) Important remarks

- ① For safety reasons, the operator should verify and service at regular intervals all of the bolted assemblies and all of the important safety locks such as :
  - Wheel nuts
  - Nuts of axle mounting bolts
  - Bolts on the steering components and the brake system parts : if the screws are tightable, the loctite contact breaks loose and remounting is necessary.
  - Corrosion on the carrier elements (such as the axle spindle) is not acceptable for operational safety reasons.
  - Verify seals, oil levels and lubrication at regular intervals.

#### 2 Brakes

- Inspect brake disk regularly as well as wear of brake system parts.
- In case of signs of excessive heating, consult a brake specialist or the manufacturer.

#### (2) General lubrication instructions

- ① Lubrication points
  - See page 3-56 installation drawing.
- 2 Fill levels

Checked at the level control plugs.

③ Oil change

Place the vehicle in a horizontal position. Draining of the oil is to be accomplished only in warm condition. Clean all lubrication points before opening them. On the hub assemblies, the drain plug should be turned downward.

Replacement of the oil draining plugs.

#### Oil draining

Remove the oil filler plug as well as the oil level control plug on the carrier assembly, and on the planetary assembly. Drain the oil.

#### Oil filling

Supply oil into oil filler hole until it overflows.

Check the oil level at the oil level plug hole (Overflow control). Wait a few minutes. If the oil level falls, add oil until the level remains constant.

Clean the grease nipples before lubrication.

# (3) Lubrication points

- \* Legend
  - 1 : Oil fill plug
  - 2 : Oil level control plug
  - 3 : Oil drain plug



# 3. TROUBLESHOOTING

# 1) BRAKE LEAKS ACTUATION FLUID

Condition	Possible cause	Correction
Internal leak : Fluid bypasses seals into axle and fills axle with fluid and blows out breather or empties brake fluid reservoir.	<ol> <li>Worn or damaged piston seal.</li> <li>Melted or extruded piston seals.</li> <li>Corrosion, pitting, wear or other damage, marks, scratches to piston and/or brake housing bore in area of seal/sealing lips.</li> </ol>	<ol> <li>Replace piston seals.</li> <li>Correct cause of overheating and replace seals.</li> <li>Clean, smooth, rework or replace affected parts.</li> </ol>
External leak	<ol> <li>Loose bleeder screw.</li> <li>Loose inlet fitting or plugs.</li> <li>Damaged inlet fitting or plugs or damaged seats.</li> </ol>	<ol> <li>Tighten bleeder screw to 2.0~2.7 kgf · m (15~20 lb-ft)</li> <li>Tighten inlet fitting to 3.4~4.8 kgf · m (25~35 lb-ft)</li> <li>Replace inlet fitting or plug and O-ring if used.</li> </ol>

# 2) BRAKE NOISE AND VIBRATION

Condition	Possible cause	Correction
Brakes product noise, chatter, vibration.	Incorrect axle fluid and/or friction material used.	1. Use only meritor specified or approved materials.
		2. Drain and flush fluid from axle. Replace with approved fluid.
		3. Replace all friction discs. Thoroughly clean or replace stationary discs.

# 3) BRAKE OVERHEATS

Condition	Possible cause	Correction
Overheating due to excessive duty cycle.	Inadequate coolant flow or heat exchange.	1. Install brake cooling system if not already installed on vehicle.
		2. Re-analyze and re-size brake cooling system if necessary.
Inadequate coolant flow	Low pump output, blocked filter or coolant lines.	Check pump output at different operating modes. Replace filter and check lines.
Low or no coolant.	1. Improper fill or leaks.	1. Check for proper fill level.
	2. Leaking face seal.	2. Replace or reinstall face seal assembly.
	3. Loose or damaged plugs.	<ol> <li>Tighten drain, fill or forced cooling plug. Replace if damaged.</li> </ol>
	4. Deteriorated or inadequate sealant used at joint.	4. Dissemble, clean, re-seal and re-assemble brake housing joint.
Brake drags.	1. More than 1.4bar(20psi) pressure applies when brakes released.	1. Repair hydraulic system so pressure is less than 1.4bar(20psi) when brakes released and while machine is operating in any mode.
	<ol> <li>Damaged piston return spring assembly.</li> </ol>	<ol> <li>Repair or replace piston return spring assembly.</li> </ol>
	3. Piston not returning.	3. Check piston seals and seal separator.
	<ol> <li>Wrong cooling and/or actuation fluid used.</li> </ol>	<ul><li>4. Check piston seals and seal separator for swelling or damaged. Replace as necessary.</li><li>Purge system and use correct fluid.</li></ul>
	5. Tight or damaged splines (eg. friction disc-to-hub driver).	5. Repair or replace parts.

# 4) BRAKE DOES NOT APPLY

Condition	Possible cause	Correction
Low or no pressure to brake	1. Empty fluid reservoir.	1. Fill reservoir to correct level with specified fluid.
	2. Damaged hydraulic system.	2. Repair hydraulic system.
	3. Leaked of brake actuation fluid.	3. Refer to "Brake leaks actuation fluid" in this section.
	<ol> <li>Parking brake not adjusted properly.</li> </ol>	4. Adjust parking brake lever as described in assembly of this manual.

# 5) BRAKE DOES NOT RELEASE

Condition	Possible cause	Correction
Vehicle does not move	Damaged hydraulic system.	Repair hydraulic system.
Brakes dragging	1. More than 1.4bar(20psi) pressure applied when brakes released.	1. Repair hydraulic system so pressure is less than 1.4bar(20psi) when brakes released and while machine is operating in any mode.
	<ol> <li>Damaged piston return spring assembly.</li> </ol>	<ol> <li>Repair or replace piston return spring assembly.</li> </ol>
	3. Piston not returning.	3. Check piston seals for swelling or damage. Replace as necessary.
	<ol> <li>Wrong cooling and/or actuation fluid used.</li> </ol>	<ol> <li>Check piston seals for swelling or damage.</li> <li>Purge system and use specified fluid.</li> </ol>
	5. Parking brake not adjusted properly.	<ol><li>Adjust parking brake lever as described in assembly of this manual.</li></ol>

# 6) BRAKING PERFORMANCE

Condition	Possible cause	Correction
Noticeable change or decrease in stopping	1. Inadequate actuation fluid supply to brakes.	1. Replenish fluid in brake system. Check for leakage and correct cause.
performance.	<ol> <li>Inadequate pressure to apply brakes.</li> </ol>	2. Check brakes apply system. Check for leakage in brake system or brakes, and correct cause.
	3. Worn or damaged discs.	<ol> <li>Inspect and replace discs if necessary.</li> <li>* As disc wear occurs, make sure brake system can supply adequate fluid to fully apply brakes.</li> </ol>
	4. Overheated seals and/or discs.	<ol> <li>Inspect and replace discs and seals if necessary.</li> </ol>
	5. Dirty or contaminated cooling fluid.	5. Drain and flush cooling fluid from brakes and entire brake system. Replace with approved fluid. In some cases, it may necessary to replace discs. Clean or replace filter.
Brake does not fully apply.	1. Empty fluid reservoir.	1. Fill reservoir to correct level with specified fluid.
	2. Damaged hydraulic system.	2. Repair hydraulic system.
	3. Leakage of brake actuation fluid.	3. Refer to "Brake leaks actuation fluid" in this section.
Brakes fell spongy/soft.	Brakes or brake system not properly bled.	Bleed brakes and brake system.

# **GROUP 3 DISASSEMBLY AND ASSEMBLY**

# 1. TRANSMISSION DISASSEMBLY 1) ELECTRO-HYDRAULIC CONTROL UNIT AND FINE FILTER

① Fix transmission on assembly truck.

5870 350 000

- (S) Holding fixtures (1) 5870 350 063
- (S) Clamping Angle (2) 5870 350 124



180DTM011

• (6) 180DTM012

# (1) Remove oil drain plug and oil filler tube

#### Drain oil before starting disassembly

① Loosen screw plug (1) and remove seal ring (2).

② Loosen hex screw (1) from tab and hex screws (2) from oil level tube and remove oil level tube (3) with sealing (4).



2

#### (2) Dismounting of filter

- ① Separate fine filter (1) from filter head by belt wrench.
  - (S) Belt wrench 5870 105 005



180DTM014

- ② Loosen torx screws (1), separate filter head (2) from transmission housing and remove O-rings (3).
  - (S) Socket wrench TX 40 5873 042 004



180DTM015

#### (3) Dismounting of electric control unit

① Dismantle control unit (1).

Loosen torx screws (2).

- (S) Socket wrench TX-27 5873 042 002
- (S) Adjusting screws M6 5870 204 063



- ② Remove cpl control unit (1) and sealing plate (2).
  - (S) Adjusting screws M6 5870 204 063



180DTM017

<sup>(3)</sup> Remove differential pressure switch for fine filter from the duct plate.

④ Loosen torx screws and separate duct

plate (1) and seals (2 and 3) from

- 1 = Switch with O-ring
- 2 = Piston
- 3 = Compression spring

housing front part.



180DTM018

180DTM019

- <sup>⑤</sup> Pull converter safety valve out of housing hole.
  - 1 = Piston
  - 2 = Compression spring



<sup>(6)</sup> Mark installation position of wiring harness (1) towards valve block (2).



180DTM021

- $\ensuremath{\overline{\mathcal{O}}}$  Loosen torx screws (1).
  - (S) Socket wrench TX-27 5873 042 002



180DTM022

<sup>(8)</sup> Separate duct plate (1) and sealing plate plate (2) from valve block (3).



9 Remove retaining clamp (1).





<sup>(1)</sup> Loosen torx screws (1) and remove lid (2).

Remove opposite cover (3) in the same way.

(S) Socket wrench TX-27 5873 042 002



(1) Remove wiring harness (1).

Loosen cyl screws (3), remove fixing plates and dismount pressure controllers (2).



180DTM026

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

180DTM027

Loosen two torx screws (1) and temporarily fix housing by means of adjusting screws (S).

Then loosen remaining torx screws (Housing is spring-loaded).

(S) Adjusting screws 5870 204 036



180DTM028

- Geparate housing from valve housing by evenly loosening the adjusting screws.
  - (S) Adjusting screws 5870 204 036



180DTM029

3-64

- 15 Remove single components :
  - 1 = Pressure reducing valve
  - 2 = Vibration damper
  - 3 = Follow-on slide



180DTM030

- <sup>(1)</sup> Remove single components of the opposite side analogously :
  - 1 = Main pressure valve
  - 2 = Vibration damper
  - 3 = Follow-on slide



180DTM031

# 2) INDUCTIVE SENSOR, HALL SENSOR, BREATHER AND TEMPERATURE SENSOR

- 1 Dismantle positioned parts.
  - 1 = Breather
  - 2 = Inductive sensor-n central gear chain
  - 3 = Inductive sensor-n turbine
- ② Dismantle inductive sensor n engine (1) and temperature sensor (3)

Loosen cyl screw and remove speed sensor (2).

Remove O-ring.

1 =Inductive sensor - n engine (1)

- 2 = Speed sensor n output (Hall sensor)
- 3 =Temperature sensor measuring point
- "63" after converter



180DTM032



# 3) ENGINE CONNECTION AND OIL PRESSURE PUMP

#### (1) Engine connection

Loosen two hex screws (2), fit eye bolts (1) and pull off converter by means of lifting device.

① Separate flexplate (3) from converter.

(S) Eye bolts assortment	5870 204 002
(S) Lifting chain	5870 281 047

<sup>2</sup> Loosen threaded connection converter bell-housing/transmission housing and remove converter bell-housing (1).



180DTM034



180DTM035

③ Remove O-ring (1).

Loosen threaded connection plate/ transmission housing and oil pressure pump/transmission housing, then remove plate (2).



# (2) Oil pressure pump

- ① Pull off stator hollow shaft/oil pressure pump by means of puller and lifting device.
  - (S) Puller 5870 000 107



180DTM037

2 Remove O-ring (1).

Loosen cylindrical screws (2).



\* Check oil gear pump :

In case of wear marks in the pump housing, cover or on the inner and outer rotor, the complete oil pressure pump is to be replaced.

- 1 = Cover
- 2 = Inner rotor
- 3 = Outer rotor
- 4 = Pump housing
- ④ Remove shaft seal (1) from the pump housing (2).





# 4) DISASSEMBLY PTO

① Loosen hex screws (1) and remove lid (2).



180DTM041

<sup>(2)</sup> Take O-ring (1) out of lid, unsnap and remove retaining ring (2).

Pull pump shaft (3) out of housing hole.

Unsnap rectangular ring (4).

180DTM042

③ Snap out retaining ring (1) and press ball bearing (2) off the pump shaft.



180DTM043

## 5) REMOVAL OF INPUT SHAFT AND CLUTCHES

① Loosen hex Screws (1), remove disc and O-ring.



180DTM044

<sup>(2)</sup> Pull-off output flange (1) and remove shaft seal (2).

Force out both cylindrical pins (3).

Loosen threaded connection (4) housing front and rear part.



180DTM045

- ③ Separate housing rear part by means of lifting device.
  - (S) Lifting chain 5870 281 047
  - (S) Eye-bolt assortment 5870 204 002



180DTM046

④ Dismantle pipes (system pressure from the electro-hydraulic control unit to the corresponding clutch).

Keep the following order to dismantle the pipes :

- 1 = Pipe K1
- 2 = Pipe KV
- 3 = Pipe K3
- 4 = Pipe K2
- 5 = Pipe KR



180DTM047
- <sup>(5)</sup> Dismantle bearing outer rings from housing front part.
- \* Legend: see figure TM050.
- If, contrary to the ZF recommendation, the tapered roller bearings of clutches and input are not replaced, it is imperative to ensure the previous pairing (bearing outer ring/bearing inner ring).
- Bearing outer ring and bearing inner ring must be marked.
- <sup>(6)</sup> Loosen cylinder screws (1), remove upper screen sheet (2) and sleeves.

Remove all rectangular rings (3) from clutches KV, KR, K1, K2, K3, K4 and input shaft.

Remove tubes (4) with O-rings.



180DTM048



- ⑦ Lift clutches out of the housing following the numeric order, as described in the legend.
  - 1 = Clutch K3 / Output
  - 2 = Clutch K2
  - 3 = Clutch K1
  - 4 = Clutch K4 (Intermediate shaft)
  - 5 = Clutch KR
  - 6 = Clutch KV
  - 7 = Input shaft
- <sup>(8)</sup> Loosen and remove cyl screws of suction tube (1) in the housing front part.



180DTM050



- Dismantle bearing outer rings from housing rear part.
- \* Legend : see figure TM050.
- If, contrary to the recommendation, the tapered roller bearings of clutches and input are not replaced, it is imperative to ensure the previous pairing (bearing outer ring/bearing inner ring).

Bearing outer ring and bearing inner ring must be marked.



#### 6) CLUTCHES KV/KR/K1/K2/K3/K4 INPUT SHAFT

- 1 = Clutch K3 / Output
- 2 = Clutch K2
- 3 = Clutch K1
- 4 = Clutch K4 (Intermediate shaft)
- 5 = Clutch KR
- 6 = Clutch KV
- 7 = Input shaft

(1) Clutch KV

1 Unsnap piston ring (1).

# 

180DTM050



180DTM053

② Pull tapered roller bearing (internal ring) off the shaft.

(S) Forcing device	5870 026 100
(S) Grab sleeve	5873 001 057
or	
(S) Rapid grip	5873 011 011



- 3 Unsnap retaining ring (1).
  - (S) Set of external pliers 5870 900 015



- 4 Pull clutch (1) off the shaft.
  - (S) Two-armed puller 5870 970 004



180DTM056

5 Remove snap ring (1).



⑥ Remove end plate (1) and disc package (2) from disc carrier (3).



- ⑦ Preload compression spring and remove L-ring (1).
  - (S) Assembly aid

5870 345 088



8 Remove guide ring (1), compression spring (2) and disc (3).



180DTM060

④ Lift piston (1) off the disc package by compressed air out of hole, and remove it.



10 Remove both O-rings (1 and 2).



1 Pull spur gear off the shaft.

(S) Cut-off device	5870 300 024
(S) Puller	5870 300 033



- 12 Unsnap retaining ring (2) out of idler gear (1) and remove ball bearing (3).
  - (S) Set of internal pliers 5870 900 013



180DTM064

<sup>13</sup> Pull needle cage (1) off the shaft (2).



4 Pull tapered roller bearing (internal ring) off the shaft.

(S) Forcing device	5870 026 100
(S) Grab sleeve	5873 001 057
or	
(S) Rapid grip	5873 011 011



<sup>(15)</sup> Unsnap piston ring (1).



## (2) Clutch KR

1 Unsnap piston ring (1).



180DTM068

<sup>(2)</sup> Pull tapered roller bearing (internal ring) off the shaft.

(S) Forcing device	5870 026 100
(S) Grab sleeve	5873 001 059



180DTM069

- 3 Unsnap retaining ring (1).
  - (S) Set of external pliers 5870 900 015



180DTM070

- ④ Pull clutch (1) together with spur gear off the shaft.
  - (S) Two-armed puller 5870 970 004



- $\bigcirc$  Pull clutch (1) off the spur gear (2).
- \* No further disassembly of spur gear (2) is possible.



180DTM072

0 Remove snap ring (1).



⑦ Remove end plate (1) and disc package(2) from disc carrier.



- 8 Preload compression spring and remove L-ring (1).
  - (S) Assembly aid

5870 345 088



(9) Remove guide ring (1), compression spring (2) and disc (3).



180DTM060

It is the first on (1) off the disc carrier by compressed air out of hole, and remove it.



1 Remove both O-rings (1 and 2).



- 12 Pull off needle cage (1) off the shaft (2).

- <sup>(3)</sup> Unsnap retaining ring (2) from idler gear(1) and dismount ball bearing (3).
  - (S) Set of internal pliers 5870 900 013



180DTM074

<sup>(i)</sup> Pull tapered roller bearing (internal ring) off the shaft.

(S) Forcing device	5870 026 100
(S) Grab sleeve	5873 001 057
or	
(S) Rapid grip	5873 011 011



180DTM066

15 Unsnap piston ring (1).



# (3) Clutch K1

1 Unsnap piston ring (1).



180DTM075

<sup>(2)</sup> Pull tapered roller bearing (internal ring) off the shaft.

(S) Forcing device	5870 026 100
(S) Grab sleeve	5873 001 059



180DTM076

- 3 Unsnap retaining ring (1).
  - (S) Set of external pliers 5870 900 015



④ Remove cpl axial bearing (1) and idler gear (2).



<sup>(5)</sup> Remove needle cage (1) and cpl axial bearing (2).



180DTM079

- <sup>6</sup> Pull clutch (1) off the shaft.
  - (S) Two-armed puller 5870 970 004



180DTM080

0 Remove snap ring (1).



8 Remove end plate (1) and disc package (2) from disc carrier.



- 9 Preload cup springs and remove L-ring (1).
  - (S) Assembly aid 5870 345 088



180DTM059

<sup>(1)</sup> Remove guide ring (1) and cup spring package (2).



 Ift piston (1) off the disc carrier by compressed air out of hole, and remove it.





12 Unsnap piston ring (1).



180DTM083

- <sup>(3)</sup> Pull tapered roller bearing (internal ring) off the shaft.
  - (S) Basic tool(S) Grab sleeve
- 5873 002 001 5873 002 038



# (4) Clutch K2

1 Unsnap piston ring (1).



180DTM085

<sup>(2)</sup> Pull tapered roller bearing (internal ring) off the shaft.

(S) Forcing device	5870 026 100
(S) Grab sleeve	5873 001 059



180DTM086

- 3 Unsnap retaining ring (1).
  - (S) Set of external pliers 5870 900 015



180DTM087

④ Remove cpl axial bearing (1) and idler gear (2).



<sup>(5)</sup> Remove needle cage (1) and cpl axial bearing (2).



- <sup>6</sup> Pull clutch (1) off the shaft.
  - (S) Two-armed puller 5870 970 004



0 Remove snap ring (1).



8 Remove end plate (1) and disc package (2) from disc carrier.



- 9 Preload cup springs and remove L-ring (1).
  - (S) Assembly aid 5870 345 088



180DTM059

<sup>(1)</sup> Remove guide ring (1) and cup spring package (2).



 Ift piston (1) off the disc carrier by compressed air out of hole, and remove it.



<sup>(1)</sup> Remove both O-rings (1 and 2).



13 Unsnap piston ring (1).



<sup>(i)</sup> Pull tapered roller bearing (internal ring) off the shaft.

(S) Forcing device	5870 026 100
(S) Grab sleeve	5873 001 059



# (5) Clutch K3

1 Unsnap piston ring (1).



180DTM094

<sup>(2)</sup> Pull tapered roller bearing (internal ring) off the shaft.

(S) Forcing device	5870 026 100
(S) Grab sleeve	5873 001 059



③ Remove cpl axial bearing (1) and idler gear (2).



④ Remove needle cage (1) and cpl axial bearing (2).



5 Pull clutch (1) off the shaft.

(S) Two-armed puller 5870 970 004



0 Remove snap ring (1).



Remove end plate (1) and disc package(2) from disc carrier.



- 8 Preload cup springs and remove L-ring (1).
  - (S) Assembly aid 5870





Image: Image:



180DTM082

It is to a compressed air out of hole, and remove it.



1 Remove both O-rings (1 and 2).



12 Unsnap piston rings (1).



<sup>(3)</sup> Pull tapered roller bearing (internal ring) off the shaft.

5873 002 001

(S) Grab sleeve

5873 002 038



#### (6) Clutch K4 (Intermediate shaft)

1 Unsnap piston ring (1).



180DTM100

2 Pull tapered roller bearing (internal ring) off the shaft.

(S) Forcing device	5870 026 100
(S) Grab sleeve	5873 001 057
or	
(S) Rapid grip	5873 011 011



180DTM101

\* The gear (3) cannot be removed (shrink fit).



180DTM102

③ Unsnap piston rings (1).



④ Pull tapered roller bearing (internal ring) off the shaft.

(S) Forcing device	5870 026 100
(S) Grab sleeve	5873 001 059



#### (7) Input shaft

1 Unsnap piston rings (1).

Turbine wheel shaft (2) and drive gear (3) are fixed by means of a snap ring.

When separated, the components will be destroyed.



180DTM105

<sup>(2)</sup> Pull tapered roller bearing (internal ring) off the drive gear.

(S) Basic tool	5873 001 000
(S) Rapid grip	5873 011 014
or	
(S) Grab sleeve	5873 001 058



180DTM106

- ③ Pull tapered roller bearing (internal ring) off the drive gear.
  - (S) Forcing device
     5870 026 100

     (S) Rapid grip
     5873 011 014



# 7) REASSEMBLY OF CLUTCHES

# (1) Clutch KV

1 Shaft - clutch shaft KV- (1).



180DTM108

- <sup>(2)</sup> Heat up bearing inner ring (app. 120°C).
  - (S) Hot air blower 230 V 5870 221 500
  - (S) Hot air blower 115 V 5870 221 501



3 Mount bearing inner ring (1) until contact.

Mount piston ring (2).

## A Wear protective gloves.

Readjust bearing inner ring after cooling down.



180DTM110

4 Mount needle cage  $60 \times 68 \times 20$  (1) on shaft and oil it.



5 Mount stud bolt (1).

Tightening torque (M10/8.8×16)  $M_A = 1.7 \text{ Nm}$ 



180DTM112

- $\bigcirc$  Insert ball bearing 55×90×18 (2) into idler gear (1) until contact is obtained and fix it by means of retaining ring (3) 90×3.
  - (S) Set of internal pliers 5870 900 013



180DTM113

- $\bigcirc$  Heat up ball bearing (app. 120°C).
  - (S) Hot air blower 230 V 5870 221 500
  - (S) Hot air blower 115 V 5870 221 501



180DTM114

- 8 Mount pre-assembled idler gear (1) until contact.
- **A** Wear protective gloves.



Insert both O-rings (1 and 2) into piston grooves and oil them.

 $1 = 75 \times 3$  $2 = 142 \times 3$ 

\* Check function of the drain valve (see arrow) - there must be no jamming of the ball.



180DTM116

- 10 Insert piston (1) into disc carrier.
- \* Observe installation position, see figure.



180DTM117

- Use a hand-operated press to place piston into the disc carrier by means of the assembly aid.
  - (S) Assembly aid 5870 345 088



180DTM118

<sup>(12)</sup> Mount inner installer (S) onto the disk carrier.

Install disk (1), compression spring (2), support shim (3) and L-ring (4).

- Installation position support shim and L-ring see figure TM121.
  - (S) Inner installer  $\rightarrow$  see figure TM120.



<sup>(3)</sup> Preload compression spring by means of assembly aid (S1) and pressure piece (S2), until L-ring has engaged into the annular groove.

(S) Assembly aid 5870 345 088
(S) Assembly fixture 5870 345 124
(Inner installer and pressure piece)

- It is always necessary to mount a new L-ring.
- 4 Disk carrier with piston retraction :

Legend :

- 1 = Washer
- 2 = Compression spring
- 3 = Support shim
- 4 = L-ring
- 5 = Disk carrier
- 6 = Drain valve (piston)
- 7 = Piston with O-rings
- Install outer and inner disks alternately into the disk carrier (4) as personated in figure TM122.

Legend :

- 1 = Friction disk-coated on one side
- (1 pcs)

2 = Outer disks	(10 pcs)
3 = Inner disks	(10 pcs)

\* Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston.

Number of friction surfaces : 20.

 If Mount end plate (1) and fix disk package by means of snap ring (2) (e.g. thickness = 2.65 mm / recommended value).



180DTM120







O Press on end plate with F (approx. 100 N = 10 kg) and set dial indicator to "zero".



180DTM124

- <sup>(1)</sup> Then press end plate against the snap ring (upwards) and read disk clearance.
- \* Disk clearance : 2.65 ~ 2.95 mm
- \* In case of deviations, the disk clearance must be corrected with an appropriate snap ring (optional thicknesses = 2.1~4.2 mm).





180DTM125



2 Install clutch until contact is obtained.

Mount inner disks onto the inner disk carrier by means of short left/right rotations.

**A** Wear protective gloves.



 Fix clutch (1) by means of retaining ring 55×2 (2).



180DTM128

Heat up bearing inner ring (approx. 120°C)



Output bearing inner ring (1) until contact is obtained.

#### A Wear protective gloves.

\* Adjust bearing inner ring after coolingdown.

Check closing and opening of the clutch by means of compressed air at the hole (see arrow).

Closing and opening of the clutch must be clearly audible.



# (2) Clutch KR

1 Shaft - clutch shaft KR- (1).



180DTM108

- <sup>(2)</sup> Heat up bearing inner ring (app. 120°C).
  - (S) Hot air blower 230 V 5870 221 500
  - (S) Hot air blower 115 V 5870 221 501



3 Mount bearing inner ring (1) until contact.

Mount piston ring (2).

## A Wear protective gloves.

Readjust bearing inner ring after cooling down.



180DTM110

4 Mount needle cage  $60 \times 68 \times 20$  (1) on shaft and oil it.



<sup>(5)</sup> Mount stud bolt (1).

Tightening torque (M10/8.8 $\times$ 16)

 $M_A = 17 \text{ Nm}$ 



180DTM112

- $\bigcirc$  Insert ball bearing 55×90×18 (2) into idler gear (1) until contact is obtained and fix it by means of retaining ring (3) 90×3.
  - (S) Set of internal pliers 5870 900 013
- \* The idler gear (1) is only available as a complete assy in spare parts service. Consisting of :
  - 1A = Idler gear
  - 1B = Spur gear
  - 1C = Retaining ring 110x4
- ⑦ Heat up ball bearing (app. 120°C).
  - (S) Hot air blower 230 V 5870 221 500
  - (S) Hot air blower 115 V 5870 221 501







180DTM132

- 8 Mount pre-assembled idler gear (1) until contact.
- A Wear protective gloves.



Insert both O-rings (1 and 2) into piston grooves and oil them.

 $1 = 75 \times 3$  $2 = 142 \times 3$ 

\* Check function of the drain valve (see arrow) - there must be no jamming of the ball.



180DTM116

- 10 Insert piston (1) into disc carrier.
- \* Observe installation position, see figure.



(S) Assembly aid 5870 345 088





180DTM118

12 Mount inner installer (S) onto the disk carrier.

Install disk (1), compression spring (2), support shim (3) and L-ring (4).

- Installation position support shim and L-ring see figure TM121.
  - (S) Inner installer  $\rightarrow$  see figure TM120.



<sup>(3)</sup> Preload compression spring by means of assembly aid (S1) and pressure piece (S2), until L-ring has engaged into the annular groove.

(S) Assembly aid5870 345 088(S) Assembly fixture5870 345 124(Inner installer and pressure piece)

- It is always necessary to mount a new L-ring.
- 4 Disk carrier with piston retraction :

Legend :

- 1 = Washer
- 2 = Compression spring
- 3 =Support shim
- 4 = L-ring
- 5 = Disk carrier
- 6 = Drain valve (piston)
- 7 = Piston with O-rings
- Install outer and inner disks alternately into the disk carrier (4) as personated in figure TM122.

Legend :

1 = Friction disk-coated on one side

	(Tpcs)
2 = Outer disks	(10 pcs)
3 = Inner disks	(10 pcs)

(A )

Take care that the uncoated (blank) side of the friction disk (1) is showing towards the piston.

Number of friction surfaces : 20.

 If Mount end plate (1) and fix disk package by means of snap ring (2) (e.g. thickness = 2.65 mm / recommended value).



180DTM120





O Press on end plate with F (approx. 100 N = 10 kg) and set dial indicator to "zero".



180DTM124

- <sup>(B)</sup> Then press end plate against the snap ring (upwards) and read disk clearance.
- \* Disk clearance : 2.65 ~ 2.95 mm
- \* In case of deviations, the disk clearance must be corrected with an appropriate snap ring (optional thicknesses = 2.1~4.2 mm).





180DTM125



180DTM126

<sup>(2)</sup> Install clutch until contact is obtained.

Mount inner disks onto the inner disk carrier by means of short left/right rotations.

**A** Wear protective gloves.


<sup>(2)</sup> Fix clutch (1) by means of retaining ring  $55 \times 2$  (2).



180DTM134

② Heat up bearing inner ring (approx. 120°C).



Output bearing inner ring (1) until contact is obtained.

## A Wear protective gloves.

\* Adjust bearing inner ring after coolingdown.

Check closing and opening of the clutch by means of compressed air at the hole (see arrow).

Closing and opening of the clutch must be clearly audible.



# (3) Clutch K1

1 Shaft - clutch shaft K1- (1).



180DTM137

- <sup>(2)</sup> Heat up bearing inner ring (app. 120°C).
  - (S) Hot air blower 230 V 5870 221 500
  - (S) Hot air blower 115 V 5870 221 501



3 Mount bearing inner ring (1) until contact.

Mount piston ring (2).

# A Wear protective gloves.

Readjust bearing inner ring after cooling down.



180DTM110

④ Insert both O-rings (1 and 2) into piston grooves and oil them.

 $1 = 75 \times 3$  $2 = 158 \times 3$ 

\* Check function of the drain valve (see arrow) - there must be no jamming of the ball.



- <sup>5</sup> Insert piston (1) into disc carrier.
- \* Observe installation position, see figure.



180DTM117

- <sup>(6)</sup> Use a hand-operated press to place piston into the disc carrier by means of the assembly aid.
  - (S) Assembly aid 5870 345 088



180DTM118

⑦ Mount inner installer (S) onto the disk carrier.

Install cup spring package (1) and L-ring (2).

- Installation position cup spring package and L-ring see figure TM139.
  - (S) Inner installer  $\rightarrow$  see figure TM120.



(S) Assembly aid5870 345 088(S) Assembly fixture5870 345 124(Inner installer and pressure piece)

It is always necessary to mount a new L-ring.



180DTM138



<sup>(9)</sup> Disk carrier with piston retraction :

Legend :

- 1 = Cup spring package
- 2 = L-ring
- 3 = Disk carrier
- 4 = Piston with O-rings



180DTM139

 Install outer and inner clutch discs alternately into disc carrier (4) as described in figure.

Legend :

1 = Friction disc - coated on one side

	(1pc)
2 = Outer discs	(9 pcs)
3 = Inner discs	(9 pcs)

- When mounting the friction disc (1) ensure that its uncoated (bare) side shows towards the piston. Number of friction surfaces : 18.
- Mount end plate (1) and fix disc package by means of snap ring (2) (e.g. s = 2.65 mm / experience value).



180DTM140



- Press on end plate with F (app. 100 N = 10 kg) and set dial indicator to "zero".
  - (S) Magnetic stand 5870 200 055
  - (S) Dial indicator 5870 200 057



- <sup>(3)</sup> Then press end plate against snap ring (upwards) and read disc clearance.
- \* Disc clearance : 2.35 ~ 2.65 mm
- \* Any deviation demands a correction of the disc clearance by a suitable snap ring (optional s = 2.1~4.2 mm).



180DTM125

- Heat up internal diameter of clutch (app. 120°C).
  - (S) Hot air blower 230 V 5870 221 500
  - (S) Hot air blower 115 V 5870 221 501



180DTM126

(5) Mount clutch (1) until contact is obtained.

## A Wear protective gloves.



- I Mount and oil running disc  $55 \times 78 \times 5$ (1), axial cage (2) and axial washer  $55 \times 78 \times 1$  (3).
- Install running disc (1) with chamfer (see arrow) showing towards the axial cage.



0 Mount needle cage 55 $\times$ 63 $\times$ 64 (1) on shaft and oil it.



180DTM143

R

<sup>®</sup> Install idler gear.

Install inner discs on inner disc carrier (idler gear) by shortly rotating them cw/ ccw.

1800ТМ144

L

- Mount and oil axial washer 55×78×1
  (1), axial cage (2) and running disc
  55×78×5 (3).
- Install running disc (3) with chamfer (see arrow) showing towards the axial cage.



180DTM145

- 0 Fix clutch (1) with retaining ring (2) 50  $\times$  3.
  - (S) Set of external pliers 5870 900 015



<sup>(2)</sup> Heat up bearing inner ring (app. 120 °C).

(S) Hot air blower 230 V	5870 221 500
(S) Hot air blower 115 V	5870 221 501



180DTM135

 $\ensuremath{\oslash}$  Mount bearing inner ring (1) until contact.

Mount stud bolt (1).

Tightening torque (M10/8.8  $\times$  16)

 $M_A = 17 \text{ Nm}$ 

# A Wear protective gloves.

- Readjust bearing inner ring after cooling down.
- \* Check closing and opening of the clutch by means of compressed air at the hole (see arrow).

Closing and opening of the clutch must be clearly audible.





# (4) Clutch K2

- ① Heat up bearing inner ring (app. 120° C).
  - (S) Hot air blower 230 V  $\,$  5870 221 500  $\,$
  - (S) Hot air blower 115 V 5870 221 501



180DTM135

2 Mount bearing inner ring (1) until contact.

Mount piston ring (2).

#### **A** Wear protective gloves.

Readjust bearing inner ring after cooling down.



180DTM149

<sup>③</sup> Insert both O-rings (1 and 2) into piston grooves and oil them.

$$1 = 75 \times 3$$
$$2 = 142 \times 3$$

\* Check function of the drain valve (see arrow) - there must be no jamming of the ball.



- ④ Insert piston (1) into disc carrier.
- \* Observe installation position, see figure.



- <sup>(5)</sup> Use a hand-operated press to place piston into the disc carrier by means of the assembly aid.
  - (S) Assembly aid

5870 345 088



180DTM118

<sup>(6)</sup> Mount inner installer (S) onto the disk carrier.

Install cup spring package (1) and L-ring (2).

- Installation position cup spring package and L-ring see figure TM139.
  - (S) Inner installer  $\rightarrow$  see figure TM120.
- Preload cup spring package by means of assembly aid (S1) and pressure piece (S2), until L-ring has engaged into the annular groove.
  - (S) Assembly aid 5870 345 088
  - (S) Assembly fixture 5870 345 124 (Inner installer and pressure piece)
- It is always necessary to mount a new L-ring.
- 8 Disk carrier with piston retraction :

#### Legend :

- 1 = Cup spring package
- 2 = L-ring
- 3 = Disk carrier
- 4 = Piston with O-rings



180DTM138





Install outer and inner clutch discs alternately into disc carrier (4) as described in figure TM150.

Legend :

1 = Friction disc- coated on one side

	(1 pc)
2 = Outer discs	(7 pcs)
3 = Inner discs	(7 pcs)

- When mounting the friction disc (1) ensure that its uncoated (bare) side shows towards the piston.
   Number of friction surfaces : 14
- Mount end plate (1) and fix disc package by means of snap ring (2) (e.g. s = 2.65 mm / experience value).





- Press on end plate with F (app. 100 N = 10 kg) and set dial indicator to "zero".
  - (S) Magnetic stand 5870 200 055
  - (S) Dial indicator 5870 200 057



180DTM124

- <sup>(12)</sup> Then press end plate against snap ring (upwards) and read disc clearance.
- \* Disc clearance : 1.75 ~ 2.05 mm
- \* Any deviation demands a correction of the disc clearance by a suitable snap ring (optional s = 2.1 ~ 4.2 mm).



- <sup>(3)</sup> Heat up internal diameter of clutch (app. 120 °C).
  - (S) Hot air blower 230 V 5870 221 500
  - (S) Hot air blower 115 V 5870 221 501



180DTM126

- 4 Mount clutch until contact is obtained.
- A Wear protective gloves.



- I Mount and oil running disc  $55 \times 78 \times 5$ (1), axial cage (2) and axial washer  $55 \times 78 \times 1$  (3).
- Install running disc (see arrow) with chamfer (see arrow) showing towards the axial cage.



180DTM152

If Mount needle cage  $55 \times 63 \times 50$  (1) on shaft and oil it.



 $\ensuremath{\mathbb{O}}$  Install idler gear.

Install inner discs on inner disc carrier (idler gear) by shortly rotating them cw/ ccw.



180DTM154

Image: Book State Sta

Install running disc (arrow) with chamfer (see arrow) showing towards the axial cage.



9 Fix clutch (1) with retaining ring (2) 50×3.

\* (S) Set of external pliers 5870 900 015



180DTM156

<sup>(2)</sup> Heat up bearing inner ring (app. 120°C).

(S) Hot air blower 230 V 5870 221 500 (S) Hot air blower 115 V 5870 221 501



② Mount bearing inner ring (1) until contact.

Mount stud bolt (1).

Tightening torque (M10/8.8×16)

 $M_{A} = 17 \text{ Nm}$ 

# A Wear protective gloves.

- \* Readjust bearing inner ring after cooling down.
- \* Check closing and opening of the clutch by means of compressed air at the hole (see arrow).

Closing and opening of the clutch must be clearly audible.



180DTM157



# (5) Clutch K3

- ① Close machining aperture of the oil supply hole by means of plug (1).
  - (S) Lever riveting pliers 5870 320 016



180DTM159

- 2 Heat up bearing inner ring (app. 120  $^{\circ}$  C).
  - (S) Hot air blower 230 V 5870 221 500
  - (S) Hot air blower 115 V 5870 221 501



180DTM135

③ Mount bearing inner ring (1) until contact.

Install rectangular rings  $65 \times 2$  (2).

### ▲ Wear protective gloves.

Readjust bearing inner ring after cooling down.



180DTM160

④ Insert both O-rings (1 and 2) into piston grooves and oil them.

 $1 = 75 \times 3$  $2 = 142 \times 3$ 

\* Check function of the drain valve (see arrow) - there must be no jamming of the ball.



- <sup>5</sup> Insert piston (1) into disc carrier.
- \* Observe installation position, see figure.



180DTM117

- <sup>6</sup> Use a hand-operated press to place piston into the disc carrier by means of the assembly aid.
  - (S) Assembly aid 5870 345 088



180DTM118

⑦ Mount inner installer (S) onto the disk carrier.

Install cup spring package (1) and L-ring (2).

Installation position cup spring package and L-ring see figure TM139.

% (S) Inner installer → see figure TM120.



(S2), until L-ring has engaged into the annular groove.(S) Assembly aid 5870 345 088

(S) Assembly fixture 5870 345 124 (Inner installer and pressure piece)

It is always necessary to mount a new L-ring.



180DTM138



<sup>(9)</sup> Disk carrier with piston retraction :

Legend :

- 1 = Cup spring package
- 2 = L-ring
- 3 = Disk carrier
- 4 = Piston with O-rings



180DTM139

 Install outer and inner clutch discs alternately into disc carrier (4) as described in figure TM150.

Legend :

1 = Friction disc-coated on one side (1 pc)

2 = Outer discs	(7 pcs)
3 = Inner discs	(7 pcs)

- When mounting the friction disc (1) ensure that its uncoated (bare) side shows towards the piston. Number of friction surfaces : 14.
- ① Mount end plate (1) and fix disc package by means of snap ring (2) (e.g. s = 2.65 mm / experience value).



- Press on end plate with F (app. 100 N = 10 kg) and set dial indicator to "zero".
  - (S) Magnetic stand 5870 200 055
  - (S) Dial indicator 5870 200 057



<sup>(3)</sup> Then press end plate against snap ring (upwards) and read disc clearance.

Disc clearance : 1.75 ~ 2.05 mm

Any deviation demands a correction of the disc clearance by a suitable snap ring (optional s =  $2.1 \sim 4.2$  mm).



180DTM125

- 1 Heat up internal diameter of clutch (app. 120° C).
  - (S) Hot air blower 230 V 5870 221 500
  - (S) Hot air blower 115 V  $\,$  5870 221 501  $\,$



180DTM126

(15) Mount clutch (1) until contact is obtained.

## ▲ Wear protective gloves.



- I Mount and oil running disc  $55 \times 78 \times 5$ (1), axial cage (2) and axial washer  $55 \times 78 \times 1$  (3).
- \* Install running disc (1) with chamfer (see arrow) showing towards the axial cage.



0 Mount needle cage 55 $\times$ 63 $\times$ 50 (1) on shaft and oil it.



180DTM164

<sup>(B)</sup> Install idler gear.

Install inner discs on inner disc carrier (idler gear) by shortly rotating them cw/ ccw.

- (1), axial cage (2) and running disc  $55 \times 78 \times 5$  (3).
- Install running disc (3) with chamfer (see arrow) showing towards the axial cage.

\* Pay attention that the running disc (see arrow) is flush with the shaft collar to ensure that all inner discs are mounted on the idler gear teeth.





180DTM166



② Heat up bearing inner ring (app. 120 °C).

(S) Hot air blower 230 V	5870 221 500
(S) Hot air blower 115 V	5870 221 501



180DTM135

<sup>(2)</sup> Mount bearing inner ring (1) until contact.

# A Wear protective gloves.

Readjust bearing inner ring after cooling down.



180DTM168

\* Check closing and opening of the clutch by means of compressed air at the hole (seer arrow).

Closing and opening of the clutch must be clearly audible.



# (6) Clutch K4

- ① Heat up bearing inner ring (app. 120°C).
  - (S) Hot air blower 230 V  $\,$  5870 221 500  $\,$
  - (S) Hot air blower 115 V 5870 221 501



180DTM135

2 Mount bearing inner ring (1) until contact.

Mount piston ring (2).

### **A** Wear protective gloves.

Readjust bearing inner ring after cooling down.



180DTM170

- ③ Undercool shaft (1) (app. -80°C), heat up gear (2) (app. +120°C) and mount until contact is obtained.
- A Wear protective gloves.



- (4) Secure gear by means of retaining ring  $80 \times 2.5$  (1).
- \* (S) Set of external pliers 5870 900 015



# (7) Input shaft

① Install snap ring SB-38 (1) into annular groove of turbine shaft (2).



180DTM173

- O Press turbine shaft (1) into the input shaft (2) under a handoperated press until snap ring engages into the groove.
- \* Axial fixture of turbine shaft.



- ③ Heat up both bearing inner rings (app. 120°C).
  - (S) Hot air blower 230 V 5870 221 500
  - (S) Hot air blower 115 V 5870 221 501



180DTM135

④ Mount bearing inner rings (1) until contact.

Install rectangular ring (2)  $60 \times 3$ .

- **A** Wear protective gloves.
- \* Readjust bearing inner ring after cooling down.



5 Heat up bearing inner ring (app. 120°C).

(S)	Hot air blower 230 V	5870 221 500
(S)	Hot air blower 115 V	5870 221 501



180DTM135

<sup>(6)</sup> Mount bearing inner ring (1) until contact is obtained.

Fit rectangular ring  $40 \times 2.5$  (2).

# A Wear protective gloves.

\* Adjust bearing inner ring after coolingdown.

Mount stud bolt (3).

Tightening torque (M10/8.8 $\times$ 16)

$$M_A = 17 \text{ Nm}$$



# 8) INSTALLATION OF INPUT SHAFT AND CLUTCHES

## (1) Preassembly of front and rear transmission housing

① Stop for converter outlet pressure valve.

Fit threaded pin M10  $\times$  16 (1) with pin.

Tightening torque  $M_A = 10 \text{ Nm}$ 

Fit threaded pin M10  $\times$  12 (2).

Tightening torque  $M_A = 23 \text{ Nm}$ 

② Fix screen sheet (1) by means of cyl screws (2) in the transmission housing.

Oil cylinder screws before the assembly.

Tightening torque M8/8.8×12

 $M_{A} = 23 \text{ Nm}$ 

- It is always necessary to use new cylinder screws.
- ③ Insert all bearing outer rings into bearing holes of both housing parts.

## Housing front part :

- 1 = "K3" Clutch 3rd gear
- 2 = "K2" Clutch 2nd gear
- 3 = "K1" Clutch 1st gear
- 4 = "K4" Clutch Intermediate shaft
- 5 = "KR" Clutch reverse
- 6 = "KV" Clutch forward
- 7 = "An" Input
- K4/K2/K3 and "An" have got the same outer diameter, but merely K4/K2/K3 are fitted with the same bearings. Risk of confusing.









#### Housing rear part :

Legend see figure TM179.

- Insert bearing outer rings into bearing holes with assembly grease.
- If, contrary to the recommendation, the tapered roller bearings of clutches and the input are not replaced, it is imperative to ensure the previous pairing (bearing inner ring/bearing outer ring) - see chapter 5) figure TM048 and TM052.
- K1/K2/KR and "An" have got the same outer diameter, but merely K1/K2/KR are fitted with the same bearings. Risk of confusing.
- ④ Install pipes (system pressure from electro-hydraulic control unit to the corresponding clutch).

Keep the following order to install the pipes with hollow screws and seal rings A14 $\times$ 18:

1 = Pipe	KR
2 = Pipe	K2
3 = Pipe	K3
4 = Pipe	K4 - Intermediate shaft -
5 = Pipe	K1
Tightening torqu	$M_{A} = 40 \text{ Nm}$

(5) Install various screw plugs and place closing covers until contact is obtained.

with O-ring
(1×)
vith O-ring
(14×)
(3×)

Tightening torque (item. 1)  $M_A = 40 \text{ Nm}$ Tightening torque (Item. 2)  $M_A = 25 \text{ Nm}$ 

Wet contact face of closing covers (3) with Loctite (type no. 262).







<sup>(6)</sup> Place closing covers (1) until contact and fasten fixing plate (2) with cyl screws on the transmission housing rear part.

1 = Closing cover

2 = Fixing plate with cyl screw

Tightening torque (item. 2) M10/8.8  $\times$  20  $M_{\text{A}} = 46 \text{ Nm}$ 

Wet contact face of closing covers (1) with Loctite (type no. 262).

# (2) Installation of converter outlet pressure valve

 Insert valve (1) into transmission housing front part by means of drift (S) until contact is obtained.

(S) Drift 5870 705 012



180DTM183



② Place indented ring (1) into transmission housing front part by means of press-fit mandrel (S).

(S) Press-fit mandrel 5870 705 015

Fasten fixing plate (2) on transmission housing front part by means of cyl screws.

Tightening torque M10/8.8×20

 $M_{A} = 46 \text{ Nm}$ 

Install screw plug M22 $\times1.5$  (3) with O-ring 19 $\times2$ 

Tightening torque M10/8.8×20

 $M_A = 60 \text{ Nm}$ 





# (3) Insert clutches into transmission housing front part

<sup>(1)</sup> Install piston rings in clutches KV and KR, as well as rectangular ring  $60 \times 3$  into input shaft, align and grease them.

Insert clutch KR (2), clutch KV (3) and input shaft (1) jointly into bearing outer rings.

<sup>(2)</sup> Install piston ring into clutch K4 -Intermediate shaft-, align and grease it.

Bring clutch K4 - Intermediate shaft - (1) into proper position.

③ Install piston ring in clutch K1 (1), align

Bring clutch K1 (1) into proper position.

and grease it.



180DTM186



180DTM187



180DTM188

④ Mount O-ring 35×3 on suction tube (1), grease it and then fix it in the transmission housing front part with cyl screws M8×12.

Oil cylinder screws before the assembly.

Tightening torque M8/8.8  $\times$  12

 $M_{A} = 23 \text{ Nm}$ 

It is always necessary to use new cylinder screws.



<sup>(5)</sup> Mount piston ring into clutch K2, align and grease it.

Bring clutch K2 (1) into proper position.



180DTM190

<sup>(6)</sup> Mount piston ring into clutch K3, align and grease it.

Place screen sheet (1) and bring clutch K3 (2) into proper position.



180DTM191

Place screen sheet (1) and fix it with cyl screws (2) with sleeves and with cyl screws (3).

Oil cylinder screws before the assembly.

Tightening torque M6/8.8×10

 $M_A = 9.5 \text{ Nm}$ Tightening torque M8/8.8×65

 $M_{A} = 23 \text{ Nm}$ 

Insert tubes . guide tubes - (4 and 5) into connecting holes of transmission housing front part with O-rings. O-ring  $24 \times 3$  (2×) O-ring  $12 \times 2.5$  (7×)

- \* It is always necessary to use new cylinder screws.
- Wet tubes (4 and 5) on outer diameter with Loctite (type no. 262) and insert into hole.



- <sup>(8)</sup> Install piston rings on clutches KV, KR, K1, K2, K4, and rectangular ring  $65 \times 3$ on clutch K3 and rectangular ring  $60 \times 3$ on input shaft, align and grease them.
  - 1 = Clutch K2
  - 2 = Clutch K1
  - 3 = Clutch K3
  - 4 = Clutch K4 Intermediate shaft -
  - 5 = Input shaft
  - 6 = Clutch KR
  - 7 = Clutch KV
- ④ Carefully bring transmission housing rear part into contact position by means of lifting device.
- \* Ensure an exact alignment of the tubes.
- Wet mounting face with Loctite (type no. 574).







180DTM194

ID Fix transmission housings with 2 cyl screws (1) crosswise by hand.

Fit both cylindrical pins (2)  $10 \times 26$  centrically to the mounting face.

Fix transmission housing front and rear part by means of cylinder screws (1).

Tightening torque M10/8.8×65

 $M_{A} = 46 \text{ Nm}$ 



## (4) Install output flange

- (1) Mount shaft seal  $90 \times 120 \times 13$  (1) by means of driver tool, with the sealing lip showing to the oil sump.
  - (S) Driver tool 5870 048 237
- \* Use the specified driver tool (S), to obtain the exact installation position.
- Fill space between sealing lip and dust lip with grease.

Wet outer diameter (rubber-coated) with spirit.

- ② Install hex screws (1) M12×1.5×45 into holes of output flange (2) and press screen sheet (3) into flush position.
  - (S) Pressure sleeve 5870 506 142



180DTM196



180DTM197

③ Mount pre-assembled output flange (1) on output shaft.



3-135

④ Insert O-ring 48×4 into the space between output flange and shaft.

Fix output flange with washer (1) and hex screws (2).

Oil hexagon screws before the assembly.

Tightening torque M10/8.8×30

 $M_{A} = 46 \text{ Nm}$ 

It is always necessary to use new hexagon screws.

<sup>(5)</sup> Check clearance of gear drive train and output gears by rotating the output flange (1) and turbine shaft (2).



180DTM199



# 9) REASSEMBLY ENGINE CONNECTION AND OIL PRESSURE PUMP

### (1) Oil pressure pump :

- \* In case of wear marks in the pump housing or on the control disk, the pump assy must be replaced.
- 1 Install outer rotor.
- Chamfer (see arrow) to show downwards.



180DTM201

- $\ensuremath{\textcircled{}}$  Install inner rotor.
- \* Teeth (see arrow) to show upwards.



- ③ Place control disk and fix it radially by means of two cylindrical screws M6×12 (1).
  - Do not tighten the cylindrical screws-just turn them in until contact is obtained and then turn them back by approx 1/2 rotation.

Pay attention to the installation position of the control disk, see figure.

Place O-ring 182  $\times3$  (2) into the annular groove and oil it.

- With the sealing lip showing downwards, carefully insert the shaft seal 75×905×10 (1) into the pump housing (2) until contact is obtained.
- Wet outer diameter of shaft seal with spirit.

(S) Driver	5870 055 070
(S) Handle	5870 260 002





- <sup>5</sup> Install two adjusting screws and mount stator shaft (1).
- \* Pay attention to hole pattern.
  - (S) Adjusting screws (M10)

5870 204 007



180DTM205

- 1
  - 180DTM206
- 1 3
  - 180DTM207



- \* Oil sliding bearing (see arrow) before the assembly.
- 6 Mount pre-assembled pump (1).
- \* Pay attention to hole pattern.

- ⑦ Provide cylinder screws with O-rings 9.5×1.6.
- \* Grease O-rings.

Fix transmission pump (2) by means of cyl screws (1).

Tightening torque (M10/8.8×75)

 $M_A = 46 \text{ Nm}$ 

- \* Wet mounting faces duct ribs (3) with Loctite (type no. 574).
- 8 Mount two adjusting screws and place plate (1), and fix with cylinder screws (2).
  - (S) Adjusting screws (M10)

5870 204 007

Tightening torque (M10/8.8×20)

 $M_A = 46 \text{ Nm}$ 

#### (2) Converter connection :

- Install two adjusting screws and place converter bell-housing (1), and bring into contact position evenly with 3 cylinder screws (3×180 offset).
- \* Make sure that O-ring will not be damaged (sheared off).

Fix converter bell-housing with cylinder screws (2).

Tightening torque (M10/8.8×30)

 $M_A = 46 \text{ Nm}$ 

Mount, align and grease rectangular ring  $36 \times 2.5$  (3) .

- Wet mounting face with Loctite (type no 574).
- <sup>(2)</sup> Always position 1 disk  $4 \times (1)$  onto the flexplate mounting web  $(4 \times)$ .

Install flexplate set (2)

Flexplate set consisting of : 3 = flexplates (3 pieces) 4 = clamps (4 pieces)





<sup>(3)</sup> Mount disk (1) onto the hexagon screw M10x16 (2) and fix flexplates.

Mount eyebolts

Tightening torque (M12/10.9  $\times$  18)

 $M_{A} = 115 \text{ Nm}$ 

Wet the thread with Loctite (Type no. 262).



④ Insert the converter by using the lifting device until contact is obtained.

Remove the eyebolts and fix the flexplates with hexagon screws (see figure TM211).



#### 10) REASSEMBLY PTO

(1) Press ball bearing (1) on pump shaft (2) until contact is obtained.

Mount, align and grease rectangular ring (4)  $60 \times 3$ .



1

2

3

180DTM213

(2) Mount pump shaft (1) into turbine wheel of converter until contact is obtained and fix with retaining ring (2)  $85 \times 3$ .

Grease O-ring (3)  $180 \times 3$  and insert it into hole.

When mounting the pump shaft make sure that the converter will not be forced out of the converter bellhousing. Fix converter axially.

Risk of injury.



(3) Fix cover plate (1) with hex screws (2).

Tightening torque (M12/10.9  $\times$  18)  $M_{\text{A}} = 115 \text{ Nm}$ 



# 11) REASSEMBLY INDUCTIVE SENSOR, HALL SENSOR, BREATHER AND TEMPERATURE SENSOR

(1) Mount positioned parts.

1 = Breather

Tightening torque  $M_A = 12 \text{ Nm}$ 

- 2 = Inductive sensor with O-ring  $15.5 \times 2.6$ (n central gear chain)
- Tightening torque  $M_A = 30 \text{ Nm}$ 3 = Inductive sensor with O-ring  $15.5 \times 2.6$ (n turbine)

Tightening torque  $M_A = 30 \text{ Nm}$ 

- (2) Mount inductive sensor (1), temperature sensor (2) and speed sensor (3).
  - 1 = Inductive sensor with O-ring  $15.5 \times 2.6$ (n engine)

Tightening torque  $M_A = 30 \text{ Nm}$ 

- $\label{eq:2} \begin{array}{l} \text{2 = temperature sensor with O-ring $11 \times 3$} \\ \text{(Measuring point "63" after converter)} \\ \text{Tightening torque} \\ \end{array} \\ \begin{array}{l} M_{\text{A}} = 25 \text{ Nm} \end{array}$
- 3 = Speed sensor with O-ring  $15.5 \times 2.6$ (n output Hall sensor) Fix with cyl screws

Tightening torque (M8/8.8  $\times$  16)  $M_{\text{A}} = 23 \text{ Nm}$ 



180DTM216



180DTM217
# 12) REASSEMBLY

Electro-hydraulic control with proportional valves :

\* Different versions regarding the wiring harness position are possible.

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







## (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 parts.
- ① With the concave side showing upwards, insert orifice (1 and 2) until contact is obtained.
- See arrows for installation position. Orifice - cover plate - (2) without throughhole.

The opposite figure shows the following single parts :

1 = pressure reducing valve

 $(1 \times$ , piston and compr spring)

2 = vibration damper

 $(3\times$ , piston and compr spring)

3 = follow-on slide

(3 $\times$ , piston and compr spring)



180DTM221



180DTM222

- <sup>(2)</sup> Install the single parts acc to figure TM222.
- Preload compression springs of the follow-on slides and preliminarily fix pistons by means of cylindrical pins Ø 5.0 mm (assembly aid), see arrows (S).



180DTM223

 $\bigcirc$  Fit two adjusting screws.

Mount seal (1) and housing (2). Then position housing equally by means of adjusting screws until contact is obtained.

(S) Adjusting screws 5870 204 036



④ 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).



180DTM225

(5) Fix housing by means of Torx screws (1).

Tightening torque (M5/10.9×30)

 $M_{A} = 5.5 \text{ Nm}$ 

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



180DTM226

#### <sup>6</sup> Preassemble the opposite side

The figure on the right shows the following single parts :

1 = Main pressure valve

 $(1 \times$ , Piston a. compr spring) 2 = Vibration damper

(3×, Piston a. compr spring)

3 = Follow-on slide

 $(3 \times$ , Piston a. compr spring)

- $\ensuremath{\overline{\mathcal{D}}}$  Install the single parts acc. to figure TM228.
- Preload the compression springs of the follow-on slides and fasten the pistons preliminarily by means of cylindrical pins
   (S) Ø 5.0 mm (assembly aid), see arrows
   (S).

Install two adjusting screws.

(S) 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.



180DTM227



180DTM228

<sup>(8)</sup> Preload the pistons with Torx screws and remove the cyl pins (assembly aid) again.

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

Tightening torque (M5/10.9×30)

 $M_{A} = 5.5 \text{ Nm}$ 

- (S) Adjusting screws 5870 204 036
- (S) Reducer 5870 656 056
- (S) Socket spanner TX-27 5873 042 002
- 9 Mount pressure controllers with O-ring 13.5×2 (1) and fasten them by means of fixing plates (2) and Torx screws (3).
- Install 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)

 $M_{A} = 5.5 \text{ Nm}$ 

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

- 10 Mount the pressure regulators (1) and fasten them by means of fixing plates and Torx 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)

 $M_{A} = 5.5 \text{ Nm}$ 

(S) Reducing adapter	5870 656 056

(S) Socket wrench TX-27 5873 042 002





180DTM230



- <sup>(II)</sup> Assemble the wiring harness (1) and connect the pressure regulators  $(5 \times)$ .
- \* See figure TM218, page 3-143 for installation position of pressure regulators.
- \* Pay attention to the installation position of the wiring harness, also see markings (Chapter 1) figure TM019).
- 12 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 Torx screws.

Tightening torque (M5/10.9×30)

 $M_{A} = 5.5 \text{ Nm}$ 

- (S) Socket spanner TX-27 5873 042 002
- <sup>(3)</sup> Fix the wiring harness by means of retaining clamp (1).
- \* Install the opposite cover.



180DTM232



180DTM233



180DTM234

(4) Install two adjusting screws.

(S) Adjusting screws 5870 204 063



- (5) 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).



180DTM236

180DTM237

3

- <sup>(1)</sup> Put on sealing plate (1) and duct plate (2).
- \* Screens (3) to show upwards.

means of Torx screws (2).

Tightening torque (M6/10.9×23)

(S) Socket wrench TX-27 5873 042 002

\* It is not permitted to re-assemble 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.

O Place duct plate (1) and fix it equally by

2

1 2

180DTM238

<sup>(1)</sup> Provide the screw plugs M10x1 with O-rings  $8 \times 1.5$  (1) and install them.

Tightening torque

 $M_A = 6 Nm$ 

 $M_A = 10.5 \text{ Nm}$ 



Insert converter outlet pressure valve (1) into housing hole.



180DTM240

② Fit 4 adjusting screws.

Mount sealing (1 and 2) and duct plate (3).

(S) Adjusting screws 5870 204 063



180DTM241

<sup>(2)</sup> Fix duct plate with torx screws (1). Tightening torque (M6/10.9  $\times$  25)  $M_A = 9.5 \text{ Nm}$ Tightening torque (M6/10.9  $\times$  60)  $M_A = 9.5 \text{ Nm}$ 



Mount filter differential pressure valve (1).

Filter differential pressure valve consists of :

- 2 = Switch with O-ring  $13 \times 2$
- 3 = Piston

4 = Compression spring

Tightening torque  $M_A = 30 \text{ Nm}$ 



180DTM243

<sup>23</sup> Fit two adjusting screws.

(S) Adjusting screws 5870 204 063

Mount sealing plate (1) and electrohydraulic control unit (2).

It is not permitted to re-assemble 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.

Evenly fix electro-hydraulic control unit(1) by means of torx screws.

Tightening torque (M6/10.9  $\times$  80)  $M_A = 9.5 \text{ Nm}$ Tightening torque (M6/10.9  $\times$  100)

 $M_{A} = 9.5 \text{ Nm}$ 

- (S) Torque wrench 5870 203 031
- (S) Reducing adapter 5870 656 056
- (S) Socket wrench TX-27 5873 042 002



180DTM244



180DTM245

# 13) REASSEMBLY FINE FILTER (PRE-SSURE FILTER), OIL FILLER TUBE AND OIL DRAIN PLUG

## (1) Installation of fine filter (pressure filter)

 Fix filter head (1) with O-rings 34.2x3 (2) by means of torx screws (3) on housing rear part.

Tightening torque (M8/10.9 $\times$ 35)

 $M_{A} = 23 \text{ Nm}$ 

- (S) Torque wrench 5870 203 034
- (S) Socket wrench TX-40 5870 042 004
- Stick to the following instructions for the installation of the filter (1):
  - Slightly oil sealing
  - Turn in the filter until contact with the sealing surface is obtained, and then tighten it by hand with approx. 1/3 to 1/2 rotation.
- ② Bring oil level tube (1) with seal (2) into contact position with the housing rear part and fix it by means of hexagon screws (3).

Tightening torque (M8/10.9×50)

 $M_{A} = 34 \text{ Nm}$ 

Fix tab of oil level tube with hexagon screw (4) on housing rear part.

Tightening torque (M10/8.8 $\times$ 65) M<sub>A</sub> = 46 Nm

Turn oil dipstick (5) into oil level tube.









180DTM248

3 Install oil drain plug (1) with O-ring (2)  $35{\times}2$ 

Tightening torque (M38  $\times$  1.5)

 $M_{A} = 80 \text{ Nm}$ 

Fix identification plate (3) to the housing front part.

- \* Use Loctite (type no. 5069).
- (4) Fit screw plug M16×1.5 (1) with O-ring  $13\times2$ .

Tightening torque  $M_A = 23 \text{ Nm}$ 

Before putting the transmission into operation, fill it with oil according to the operator's manual.



180DTM249



# 3. DRIVE AXLE DISASSEMBLY

## 1) GENERAL INSTRUCTIONS FOR CORRECT ASSEMBLY AND DISASSEMBLY

- (1) Disassembly and assembly are to be accomplished only by trained personnel.
- (2) The assembly can be made reverse to the respective disassembly instruction.
- (3) Drain oil before removing, check for presence of metal particles.
- (4) Mark the parts to each other before dismantle.
- (5) Never use a hard object to separate tightly fitted assemblies. To remove bearings, drive flanges and similar parts, use the proper pullers.
- (6) It is recommended that the special tools according page 3-158 used for disassembly.
- (7) Do not place parts on a dirty surface.
- (8) Systematically replace used seals, O-rings and, if necessary, bearings on disassembly.
- (9) Clean parts before reassembly.
- (10)Replace or clean corroded parts.
- (11)The cages of bearings rotating in oil are to be coated with oil at reassembly.
- (12)Seal ring treads on flanges, shafts etc. must be preserved with SAE80W-90/API GL-5 before mounting.
- (13)Oil seal rings and particularly the anti-dust lip seals must be filled with grease.
- (14) The universal joint shafts and the axle shafts must not be force mounted (They must slide).
- (15)At mounting of radial seal rings pay attention that there is suffice overlap to the housing bores. Pay attention for a plain alignment of the radial seal ring. The seal lips always must not be contacted with Loctite.
- (16)The bolted or keyed assemblies safeties are to be checked according to instructions ; in case of doubt, consult Hyundai dealer.
- (17)Refill the oil after assembly.
- (18) Repair weldment is only allowed after consultation with Hyundai.

# 2) USING OF LOCTITE AND OPERATING SUPPLIES

Kind	Туре	Color	Application
Loctite	243	Blue	Lightly locked screws
	262	Red	Middle locked screws
	270	Green	Highly locked screws
	270	Green	Increased coefficient of friction in contact surfaces
	510	Orange	Surface gasket
	572	White	Special gasket
	638	Light-green	Glueing with big width of slit
Epple	33	Grey	Surface gasket
Dirko	-	Grey	Elastic gasket

# 3) REMARKS FOR WORKING UP LOCTITE AND OPERATING SUPPLIES

- (1) Threads and surfaces have to be cleaned and free from color, oil and grease before applying loctite.
- (2) Loctite will harden under following conditions :
- 1 Exclusion of air
- 0 Metal contact
- 3 Increased temperature
- (3) Pre-assembly and control tightening has to be made in a short time(5 to 10min).
- (4) The time between glueing and mounting of the parts should be shorter than 1 hour. Exception : Parts made from nonferrous metal have to be glued within one minute.
- (5) Assembled parts must remain unloaded for at least 24 hours.
- (6) Loctite quantity :
  - At screws :



100D7XL80

- At contact surfaces : Pay attention for a sufficient loctite application.

# 4) UTILIZATION OF LOCTITE AND OPERATING SUPPLIES

# (1) Hub assembly

Safety blocked parts	Joint	Loctite	Operating supplies		
Spacer ring	Contact surface	572	-		
Axle spindle	Screws	562	-		
Axle spindle	Contact surface	270	-		
Grommet	In planetary housing	270	-		
Disk	In axle spindle	270	-		
Adjusting screw with nut	In planetary housing	270	-		
Support	Screw	262	-		
Ring gear retainer	Screws	270	-		
Pol wheel	Contact surface	638	-		
Steering lever	Sorowo	262	-		
Track rod lever	Sciews	202	-		
Steering lever	Contact ourface	270	-		
Track rod lever	Contact Surface	270	-		
Wheel hub cover	Thread	572	-		
Radial seal rings	Contact surface	572	-		
Rubber casing	Contact Surface		-		
Radial seal rings	Contact surface	270	-		
Steel casing		210	-		
Wheel safety nut $\rightarrow$ See page 3-170 $\rightarrow$ Adjustment of wheel bearings					

# (2) Drive assembly

Safety blocked parts	Joint	Loctite	Operating supplies
Drive flange	Nut surface	-	Epple 33
Diff-housing	Screws	262	-
Shifter cylinder (Diff-lock)	Contact surface	572	-
Diff. carrier (Through drive)	Contact surface	510	-
Drop gear housing	Contact surface	510	-
Diff. carrier	Contact surface	-	Epple 33
Through drive cover	Contact surface	510	-
Differential stap	Screws	262	-
Adjustment nut screw	Screw	270	-
Ring gear	Screw	262	-
Ring gear	Contact surface	270	-
Ring gear support	Сар	270	-
Ring gear support	Thread	-	Epple 33

# 5) TIGHTENING TORQUES

Unit : N · m

Metric standard thread							
Thread	Screw	Nut	Screw	Nut	Screw	Nut	
Inread	8.8	8	10.9	10	12.9	12	
M4	3.	0	4.4		5.1		
M5	5.	9	8	7	1	10	
M6	1	0	1	5	1	18	
M8	2	5	3	6	43		
M10	4	9	7	72		84	
M12	85		125		145		
M14	135		200		23	35	
M16	210		31	0	365		
M8	300		430		500		
M20	425		610		710		
M22	580		830		970		
M24	730		1050		1220		
M27	1100		1550		1800		
M30	1450		2100		2450		

Unit : N · m

Metric fine thread						
Throad	Screw	Nut	Screw	Nut	Screw	Nut
mieau	8.8	8	10.9	10	12.9	12
M 8×1	2	7	39		46	
M10×1	5	5	81		9	5
M10×1.25	5	2	76		90	
M12×1.25	9	3	135		160	
M12×1.5	89		130		155	
M14×1.5	145		215		255	
M16×1.5	225		33	30	39	90
M18×1.5	340		485		570	
M20×1.5	475		680		790	
M22×1.5	650		920		1050	
Brake caliper dowel screws(Greased)						
M20×1.5	400 + 100					
M27×2	900 + 100					

Wheel nut (M22×1.5) : 650 Nm

# (1) Tightening torque of the adjusting nut respective slotted nut at flanges respective gear wheels ect.

Thread	Torque
d1 (mm)	(Nm)
M45×1.5	850



# 6) SERVICE TOOLS

When ordering service tools please provide order number (Installation drawing no), respective fabrication number→see identification plate. (The illustrations are not binding for the design)

(1) Spanner for wheel safety nut







(2) Spanner for splined nut (hub assembly)

(3) Seal ring sleeve driver.



(4) Spanner for thread rings. (Differential bearing)



(5) Spanner for counter nut. (Planetary gear drive)



(6) Assembly cone for O-ring. (Differential lock)



(7) Centering tool for discs.



(8) Installation tool for face seal.



# 7) ASSEMBLY DRIVE ASSEMBLY

#### (1) Adjustment of gear meshing of gleason gears

#### ① Perfect marking

To become a perfect gear meshing is only possible, if the fabrication number of the drive pinion (marked on the end face) and the ring gear (marked on the circumference) are corresponding.



#### \* Improper gear meshing marks

The following figures are showing improper gear meshing marks of the ring gear. The text alongside gives the corrections to obtain correct gear meshing. The dark colored arrows in the sketch of the drive pinion and ring gear are indicating the direction towards which the drive pinion has to be moved. The clear arrows are indicating the direction towards which the ring gear has to be moved, to get further more a correct backlash.

#### 2 Gear meshing to deep

Increase the drive pinion distance by correction of the adjustment disk thickness. Regulate the backlash by inwards moving of the ring gear.



#### ③ Gear meshing to high

Decrease the drive pinion distance by correction of the adjustment disk thickness. Regulate the backlash by outwards moving of the ring gear.



## (2) Securing of the striking nut

The brim of the striking nut has to be sheared only along the slot flank and the corner has to be bent on the slot ground.



100D7XL26

100D7XL25

#### ① Using of Loctite and other operating supplies

#### a. Striking nut at drive flange

- In thread : Assembly paste with MoS<sub>2</sub> (exception through drive pinion see point Z).
- Front side contact surface : Sealing compound (Epple 33 or equivalent).

#### b. Striking nut at through drive pinion

- In thread : Loctite 262.

#### Striking nut at gear wheels, bearings etc.

- In thread : Assembly paste with MoS<sub>2</sub>.

#### <sup>(2)</sup> Removing of the striking nut

Bend away the nose and screw off the nut.



250DEXL27

#### (3) Adjustment drive pinion distance

To obtain the proper tooth flank contact, adjust the axial position of the drive pinion with the thickness of the adjustment disk.

The necessary thickness of the adjustment disk for first time assembly can be obtained by measurement (see calculation example).

The final thickness of the adjustment disk can be fixed during the checking of gear meshing at the assembled drive assembly (see page 3-192 "Adjustment of gear meshing of gleason gears")



- A = Set value for correct pinion support. This dimension is written on the end face of the pinion in millimeter. It indicates the deviation from the theoretic distance (setpoint dimension).
- $^{\circ}$  B = Measured width of the taper roller bearing. (B theorem = 40 mm)
- \* Calculation example to ascertain the thickness S from the adjustment disk :
  - A = + 0.10 ; B = 39.95
  - S = 3.20 mm (theorem)
  - <u>+0.05 mm</u>  $\rightarrow$  B = 0.05mm smaller than B theorem.
  - = 3.25 mm
  - -0.10 mm  $\rightarrow$  Drive pinion value A
  - = 3.15 mm  $\rightarrow$  Necessary thickness of the adjustment disk

Fit corresponding disk and outer rings of the taper roller bearings.

- If value A is positive (e.g +0.1) the adjustment disk has to be 0.1 mm thinner than theorem.
   S. If value A is negative (e.g -0.1) the adjustment disk has to be 0.1 mm thicker than theorem S.
- If measure B is positive (e.g 40.05) the adjustment disk has to be 0.05 mm thinner than theorem S. If measure B is negative (e.g 39.95) the adjustment disk has to be 0.05 mm thicker than theorem S.

#### (4) Assembly of drive pinion bearing

- Insert the two outer rings of the taper roller bearings into the differential carrier.
- ② Calculate the thickness C of the spacer ring.
  - a. Place the two inner rings of the taper roller bearings in their outer rings. Measure A.
- b. Measure the dimension B of the drive pinion.
- c. Thickness of the spacer ring C = A-B.
- ③ Heat the drive pinion side taper roller bearing to about 100 °C and install it on the drive pinion shaft.(Drive on completely after it cools)
- 4 Install the spacer ring on the pinion shaft.
- ⑤ Install the drive pinion into the differential carrier. Heat the taper roller bearing inner ring at undersize to about 100 °C and install it with a tube onto the drive pinion shaft.
- ⑥ Install the drive flange onto the drive pinion shaft. Tighten the safety nut according page 3-170. For tightening fix the differential carrier and block the drive flange.





- ⑦ Measure the resistance of the bearings by using a torque wrench. If the measured value is not the prescribed 0.8 to 1.2Nm, adjust the resistance by modification of the thickness of the spacer ring. After arriving at the adjustment of the bearing, back-off the safety nut and draw off the drive flange.
- Install the radial seal ring with Loctite 572 applied. Fill the radial seal ring with bearing grease. Fit the carrier of the parking brake (if present) on the differential carrier and tighten the screws. Slip on the drive flange, screw on the safety nut with sealing compound between the contact surfaces. Tighten the safety nut according page 3-170. Lock the nut by striking the nut brim into the slot of the pinon.

## 8) ASSEMBLY OF THE DIFFERENTIAL

Before assembly all of the bevel gears and the thrust rings should be well oiled.

- (1) Place one differential side gear with the side gear thrust washer in the differential case.
- (2) Install the spider with differential gears and differential pinion thrust washers in the differential case.



- (3) Install the other differential side gear and side gear thrust washer. (At variants with nospin differential install the nospin diff. instead of the differential gears)
- (4) Install the other half of the differential case over the assembly and observe the alignment marks, tighten the differential case bolts. Secure with Loctite 262.



- (6) Coat the contact surface of the ring gear with Loctite 270 and install the ring gear on the differential case by tapping lightly on the circumference. Tighten the ring gear bolts. Secure with Loctite 262.
- (7) Heat the two taper roller bearings to about 100°C and install them by using a sleeve.





### 9) ASSEMBLY OF DRIVE ASSEMBLY

- (1) Place the differential with the outer rings of the taper roller bearings on the differential carrier which is in a vertical position, with mounted drive pinion.
- (2) Mount the differential straps and align them with the thread rings.
- (3) During this operation be careful of the alignment marks on the differential straps with respect to the differential carrier. (Do not interchange the differential straps)
- (4) Hand tighten the differential strap bolts. By a counter rotation of the two thread rings, move the differential until the backlash is correct. (The smallest admissible value at the closest place is marked on the ring gear)
- (5) Therefore hold the drive pinion at the drive flange. Check the backlash by careful forwards and rearwards rotating the ring gear. Use a dial indicator.
- (6) Measure the backlash during a few times turns of the ring gear and if need correct the backlash, because of the smallest admissible value at the closest place must not be fall short of.
- (7) Adjust gear meshing according to page 3-192 "Adjustment of gear meshing of gleason gears".
- (8) Tighten screws of the differential straps and lock them with Loctite 262.
- (9) Adjust the bearing roll resistance through tightening of the thread rings. Set value : 2.0 to 3.0 Nm. Check the value with a torque wrench. If measuring at the drive pinion/drive flange, take the ratio of the bevel wheel set into account.
- (10) Screw the lock plates for the thread rings and secure with Loctite 270, if need bend the lock plates.







# 10) ASSEMBLY OF HUB ASSEMBLY

#### (1) Assembly of the spacer ring

Coat the seat of the spacer ring on the steering knuckle respective axle spindle with Loctite 572. Heat the spacer ring to about 100°C and push it by gently striking onto the steering knuckle respective axle spindle. (The steering knuckle respective axle spindle must be free of corrosion) Oil the seal ring tread onto the spacer ring.



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#### (2) Hub assembly drive axle



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# 11) ASSEMBLY OF THE DRIVE ASSEMBLY ONTO THE AXLE HOUSING



- (1) Coat the contact surface of the axle housing with Epple 33 and mount the complete drive assembly. The axle housing being placed in a horizontal position, secure the screws with Loctite 262.
- (2) Engage the axle shaft into the axle housing.
- (3) The axle shaft should be able to be moved easily (by hand) in the toothing of the differential side gear.

#### (5) Assembly hub assembly

- ① Assembly of the spacer ring (if present) see page 3-168.
- ② Install the brake onto the axle spindle, be careful of the brake control position and bolt it. At version with disk brake install the brake carrier then mount the wheel hub with the brake disk, and after this operation install the brake.
- ③ Prepare and mount the wheel hub see page 3-170.
  Attention : Hold the wheel hub with a hoist till the outer bearing with ring gear carrier is mounted.
- ④ Assembly of the planetary gear drive see page 3-176.

#### (6) Prepare wheel hub

- ① Install the wheel studs (1), attach the shim (2), screw on the nuts (3) with 800 Nm.
- 2 Press in outer rings of taper roller bearings (4+5), do not hammer them.
- ③ Install inner ring of taper roller bearing (5).
- ④ Install the distance ring (6).
- (5) Press the radial seal rings (7) with Loctite 572 (rubber cage) respective Loctite 270 (steel cage) applied into the wheel hub (9). Fill the radial seal rings with bearing grease.
- 6 Install the face seal (8) into the wheel hub (9) (see page 3-173).

# (7) Mount wheel hub

- ① Push the pre-assembled wheel hub (9) parallel onto the axle spindle respective steering knuckle.
- \* Be carefully do not damage the seal rings.



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#### (8) Adjustment of wheel bearings

① Tightening torque of the wheel safety nut.

Series	Nm
91	500

#### 2 Adjustment of wheel bearings

The temperature of the axle parts should be between 0 and +20°C at the bearing adjustment. Screw on the wheel safety nut (Loctite-respective Molykote-using see below) and adjust and secure as following described :

Screw on the wheel safety nut and tighten it with a 1.5 to 2 times higher tightening torque than the finish tightening torque. During the tightening, turn the wheel hub a few times and knock it with a plastic hammer. Untighten the wheel safety nut (about 180° back rotation), then tighten the wheel safety nut to the tightening torque according to the table. At this tightening turn the wheel hub also a few times, if there is no possibility for securing, the wheel safety nut has to be turned back to next securing possibility.

#### ③ Wheel safety nut

Designation	Version	Security / Remarks
Shaft nut with cheese head screw	Loctite #270 Molykote	Cheese head screw & Loctite 270

#### (9) Assembly of the face seal

- 1 Seal ring
- 2 Rubber toric ring
- 3 Housing retaining lip
- 4 Housing ramp
- 5 Seal ring housing



- ① Seal rings, torics, and housings must be clean and free of any oil film, dust, or other foreign matter. Use a solvent that evaporates quickly, leaves no residue, and is compatible with the rubber toric rings. The recommended solvent is lsopropanol. Ring and housings should be wiped with a solvent-soaked lint free cloth or paper towel.
- ② After all components have been wiped clean, the torics should be installed on the metal seal rings so that they rest in the radius on the tail of the metal ring. Insure that the torics are not twisted by inspecting the mold flash line on the outside diameter of the toric for true circumferential tracking around the seal. Twisted torics will case nonuniform face load that can result in leakage of lubricant and pumping of debris past the toric. If a twist is apparent, it can be eliminated by gently pulling a section of the toric radially away from the metal seal ring and letting it "snap" back. Repeating this in several places around the ring will eliminate any twist in the toric ring.



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- ③ Put the toric ring (2) on seal ring (1), at the bottom of the seal ring ramp (7) and against the retaining lip (8).
- ④ The toric ring (2) can twist if it is not wet all around during installation or if there are burrs or fins on the retaining lip (3) of the housing (5).
- ⑤ Eliminate toric twist by gently pulling a section of the toric (2) rapidly away from the seal ring (1) and letting it "snap" back.
- (6) Place the installation tool around the seal ring and dip the seal ring into a pan of Isopropanol solvent to lubricate the toric ring. It is essential to lubricate the toric with Isopropanol so that the toric will slip past the housing retaining lip and seal uniformly in the housing nose radius. Insufficient lubrication can cause poor seal performance due to nonuniform loading (twisted torics or cocked seals). Use of solvents other than Isopropanol can leave a residue on the toric or ramps and allow the toric to slide rather than roll in seat. This can also result in poor seal performance due to nonuniform loading.

⑦ Put the installation tool (9) onto the seal ring (1) with toric ring (2).

Lower the rings into a container with lsopropanol until all surfaces of the toric (2) are wet.



8 Toric sliding on retainer ramp.



(9) Toric caught on housing retainer lip.





10 Toric sliding on seal ramp.

- ① After dipping the seal assembly in the solvent, shake the excess solvent from the seal assembly and immediately "pop" the seal into the housing with a firm push of the installation tool. Remove the installation tool and check the seal standout height at several places around the circumference of the ring to verify an accurate installation. If the seal does not meet the height specification, inspect the toric for twists or obvious bulges.
- With all surfaces of the toric ring (2) wet with Isopropanol, use the installation tool (9) to position the seal ring (1) and the toric ring (2) squarely against the housing (5) as shown. Use sudden and even pressure to pop (push) the toric ring (2) under the retaining lip (3) of the housing (5).
- I The seal can be adjusted by gently pushing the toric into position by hand or by using a fabricated adjustment hook.
- If small adjustments are necessary, do not push directly on the seal ring (1) ; use the installation tool (9) to push down or the adjustment tool (11) to pull up.





Is A thin film of light oil should be applied to the seal faces prior to assembly. Use an applicator, a disposable tissue or a clean finger to distribute the oil evenly. Be careful not to get any oil on the rubber toric rings.



Ib Be sure there is no visible debris on either of the seal faces even a small piece of lint can hold the seal faces apart and cause leakage.



- After successful installation, wait one minute for the lsopropanol to dry before assembling the two seal halves in the final loaded position. This delay is to allow any excess solvent to dry so that the torics roll, rather than slide, in the housing as the faceload is increased. If the torics slide, this can produce a nonuniform load that can result in poor seal performance.
- Results of incorrect assembly : Point "A" and point "B" remain stationary. Points "X" and "Y" rotate 180°.
  This causes high pressure at "A" and "Y" and possible galling.
  When rotated, points "B" and "X" have low pressure and possible leakage.





- (B) After the unit to be sealed is assembled, a post-assembly leakage test can be performed to insure the seal is properly installed. A vacuum check is recommended rather than a pressure check as vacuum checks are more sensitive. Many users find this an easy check to combine with a vacuum fill technique for the lubricant. It is recommended the compartment be filled to the correct level with lubricant and then rotated slowly several revolutions to seat the seals. A vacuum test will catch big seal damage such as broken seal rings or cut torics that may be caused in the last phases of assembly. The Duo-Cone seal is not designed to seal air, so some leakage can be expect using such a procedure.
- IP Following these guidelines and recommendations should insure optimum performance from the Duo-Cone-Seals.

#### 10) ASSEMBLY OF PLANETARY GEAR DRIVE

# (1) Prepare the ring gear and the ring gear carrier

Heat the taper roller bearing inner ring with cage (1) to about 100°C and install it onto the ring gear carrier (2). Place the ring gear (3) onto the ring gear carrier. Bolt the retainer (5) with the screws (4), secure the screws with Loctite 270.



#### (2) Assembly of the ring gear carrier

Install the ring gear carrier (2) with ring gear (3) into the wheel hub respective onto the steering knuckle respective axle spindle.

The oil compensating hole in the ring gear carrier must be on the bottom.

Subsequent adjust wheel bearings (see page 3-170).

#### (3) Assembly of the thrust ring

Press the thrust ring (6) into the steering knuckle respective axle spindle. Secure with Loctite 270.



# (4) Assembly of the sun gear

Push the sleeve (34) onto the universal joint respective axle shaft. Introduce the sun gear (8) into the sleeve and bolt it with the screw (35) onto the universal joint respective axle shaft, secure the screw with Locitite 262.

Push the universal joint respective axle shaft towards the inside until the sun gear contacts to the sleeve and the sleeve contacts to the thrust ring.



The binding lubrication points have to be taken from the according installation drawing of the axle.

Single drive assembly

\* The position is dependent from the respective axle version.

I=Oil fill plug II=Oil level control plug III=Oil drain plug



Hub assembly with planetary gear drive



Hub assembly with wet disc brake



- (5) Assembly of planetary gear
- Prepare planetary gear : Install the needle bearing (10) into the planetary gear (12).

Insert the preassembled planetary gears (12) with needle bearings (10) and thrust disks (14, 15) into the planetary housing (22) (planetary housing in horizontal position).

③ Place O-ring (19) into the slot of the planetary housing (22). Because of the difference of diameter of 0.1mm press the planetary pin (17) in direction of arrow. Be sure, that the bore hole of the locking pin in the planetary pin and planetary housing are aligned. After inserting, secure the planetary pin with the locking pin (20).






## (6) Disassembly of planetary gear

- ① Knock the locking pin (20, 21) completely to the inner side of the planetary pin.
- ② Press the planetary pin in direction of arrow out of the planetary housing.
- Because of the difference of diameter of 0.1 mm do not press the planetary pin against the direction of arrow out of the planetary housing, to prevent damaging the bore.



③ Remove the planetary gears with the thrust disks and needle bearings.



#### 11) Adjustment of the axial clearance

The axial clearance between sun gear and thrust disc (27) in the planetary housing must be  $0.3 \sim 0.7$  mm.

Measure distances : Dimension A =Dimension B =

Calculate required thickness, take the axial clearance (0.3~0.7 mm) into consideration. Mount the correctly dimensioned thrust disc (if necessary, make final correction on a lathe) into the planetary housing. Secure with Loctite 270.

#### 12) Assembly of the planetary housing

Place o-ring (30) into the slot of the planetary housing. Install the preassembled planetary housing and bolt it, secure with Loctite 262.



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# 14) Assembly of service brake



1 Brake carrier

2 Brake housing

- 3 Piston
- 4 Inner disk
- 5 Outer disk
- 6 O-ring
- 7 Screw
- 8 Screw plug

- 9 Seal ring
- 10 Seal ring
- 11 Connection piece
- 12 Breather
- 13 Sealing ring
- 14 Sealing ring
- 15 Spring
- 16 Screw

17 Seal ring

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- 18 Screw plug
- 19 O-ring
- 20 Face seal
- 21 Screw
- 22 Tube
- 23 Bushing
- 24 Screw

## (2) Assembly of the piston seals

Place piston with the larger diameter downwards. Note succession of the sealing parts at fitting. Install O-rings free of torsion and loops.

# (3) Assembly of O-ring and supporting ring

Install the supporting rings to the averting side of pressure.





100D7XL73/84

- 1 Large supporting ring
- 2 Large O-ring

- 3 Small O-ring
- 4 Small supporting ring

# (4) Assembly of the Omegat seal kit

Install the PTFE-profile rings with small diameter to pressure side. For assembly there can be used mounting tapes from Merkel company.



Pressure ⇒

100D7XL74/85

- 1 Large O-ring
- 2 Small O-ring

- 3 Large supporting ring
- 4 Small supporting ring

# (5) Assembly of the piston



100D7XL86

Lubricate cylinder bore, apply the thread holes at wet disk brakes with Loctite 243. Place the piston onto the brake carrier(do not cant it).

Press the piston equal by hand into the brake carrier.

# 1 Prepare housing and check the air gap





100D7XL87

Lay discs into the housing.

# 2 Check the air gap

Air gap = measure A-measure B (measured without pressure) Rated size about 0.5 mm smaller than the air gap pressurized (see table).

Install O-ring (brake housing / brake carrier) free of torsion and loops.

#### 3 Air gap and wear dimension

Brake type	Air gap sL new (Pressurized) (mm)	Wear dimension (mm)
4460	2.5 [+0.7 / -0.1]	1.6

# (6) Finish assembly

Place the brake carrier onto the brake housing and bolt it. Mount breather with connection piece and seal ring, screw plugs with seal rings.

Check brake hydraulic system for leaks (see tightness checking instruction).

Install O-ring (Brake carrier / axle spindle respective steering knuckle) free of torsion and loops.

# ① Check the air gap (pressurized)

Measure through the check hole the distance from brake carrier to the piston end face, while non actuated brake, actuate the brake and repeat the measure operation-the difference of the measured distances gives the air gap sL (pressurized), rated size sL see table.

Measure through the check hole the distance from brake carrier to the piston end face, while actuating the brake and knock the measured value with marking punches into the brake carrier. Install the complete brake on the axle (coat the contact surface with Loctite 270). Mount face seal see page 3-171.

# 2 Alignment of the discs

The alignment of the discs has to be made at mounting of the wheel hub by itself.

# (7) Tightness checking instruction for brake hydraulic system and cooling oil room

# ① Check brake hydraulic system for leaks

Before conducting the test, bleed the brake hydraulic system.

The pressure drop after applying 120 bar for a period of 15 minutes must not exceed 2% (leaving 117.5 bar).

Test medium : Motor oil SAE 10W corresponding to MIL-L2104.

## 2 Check cooling oil room for leaks

After assembly of the wheel hub with the face seal and adjusting of the wheel bearings check the tightness of the cooling oil room. Install a air pressure gauge with shutoff valve.

Beload the hub assembly with 1.5 bar pressure air. Turn the hub assembly several times.

The pressure drop after a period of 10 minutes must not exceed 0.1 bar.



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- (8) Permissible oil for brake with external cooling
- 1 Actuation fluid

Do not use brake fluid any time. Use a mineral oil base hydraulic oil.

2 Cooling fluid

· Hydraulic oil with an additive (LZ 9990A).

# ③ Check measure

It is measured through the check hole, while actuating the brake. The check measure, new, is marked in the housing below the hole. Is the measured dimension bigger than the marked dimension and max. wear dimension, unconditional consult Hyundai dealer.



After working at the brake, bleed the brake hydraulic system and check for tightness.

#### (9) Brake disk



100D7XL78

- A Network like formation of cracks
- B Radially shaped crack
- C Uneven brake surface characteristics below 1.0 mm
- D Continuous cracks

admissible not admissible admissible not admissible

#### (10) Spring - loaded sliding caliper brakes

#### Safety notes :

#### · Warning

Before commencing work on the parking brake, ensure that no unintended machine movement can happen when the braking effect is removed.

#### · Danger

The parking brake is under spring tension. Parts could become loose and fly out suddenly if improper brake opening. Therefore release the lock nut (2) and turn the adjusting screw (3) counter - clockwise until the spring set is released before disassembly of the circlip (1).



# **GROUP 4 ADJUSTMENT**

# 1. CHECKING THE RING GEAR BACKFACE RUNOUT

Runout specification : 0.20 mm (0.008-inch)

maximum

- 1) Attach a dial indicator on the mounting flange of the carrier.
- Adjust the dial indicator so that the plunger or pointer is against the back surface of the ring gear.
- 3) Set the dial indicator to zero (0).
- 4) Rotate the ring gear and read the dial indicator. The runout must not exceed 0.20 mm (0.008 inch).

If runout exceeds specification, remove the differential and ring gear assembly from the carrier. Refer to "Assembly of the differential".

- 5) Check the differential parts, including the carrier, for problems that may cause the ring gear runout to exceed specifications. Repair or replace parts.
- Re-install the differential and ring gear into the carrier. Refer to "Assembling the differential case".
- 7) Repeat the preload adjustment of the differential bearings.



# 2. ADJUSTING THE GEARSET BACKLASH

Backlash specification : 0.13~0.18 mm (0.005-0.007 inch)

If the old gearset is installed, adjust the backlash to the setting that was measured before the carrier was disassembled.

If a new gearset is installed, adjust the backlash to the correct specification for new gearsets.

- 1) Attach a dial indicator on the mounting flange of the carrier.
- Adjust the dial indicator so that the plunger or pointer is against the tooth surface, near the heel end of the gear tooth. Set the indicator dial to zero (0).
- 3) Hold the drive pinion in position.
- 4) Read the dial indicator, while rotating the ring gear a small amount in both directions, against the drive pinion teeth.
- When you adjust backlash, move the ring gear ONLY. DO NOT move the drive pinion.
- 5) If the backlash reading is within specification, continue checking tooth contact patterns.

Otherwise, adjust backlash. Refer to step 6), and check, following steps 1)-4).

- Backlash is increased by moving the ring gear away from the drive pinion. Backlash is decreased by moving the ring gear toward the drive pinion.
- 6) Loosen one bearing adjusting ring one notch, then tighten the opposite ring the same amount.







# 3. ADJUSTING TOOTH CONTACT PATTERN OF THE GEARSET

Always check tooth contact pattern on the drive side of the gear teeth.

 Apply marking compound to approximately 12 teeth of the ring gear.





- 2) Rotate ring gear forward and backward so that the 12 marked teeth go past the drive pinion six times to get a good contact pattern.
- 3) Compare the contact patterns.

In new gearsets, a good contact pattern is toward the toe of the tooth, and centered between the top and bottom of the tooth.

In used gearsets, a good contact pattern fills approximately the full length of the tooth. The top of the pattern is near the top of the tooth. The location should match the wear pattern on the tooth.

If the contact patterns require adjustment along the width of tooth (top/bottom), follow steps 4)-5).

If the contact patterns requires adjustment along the length of tooth (toe/heel), follow step 6)-7).









4) High pattern : A high contact pattern indicates that the pinion was installed too shallow into the carrier.

To correct, move the pinion toward the ring gear by decreasing the shim pack between pinion spigot and inner bearing cone. Refer to "Assembling the pinion bearing cage".

- Decrease shim pack
- 5) Low pattern : A low contact pattern indicates that the pinion was installed too deep into the carrier.

To correct, move the pinion away from the ring gear by increasing the shim pack between pinion spigot and inner bearing cone. Refer to "Assembling the pinion bearing cage".



# 4. ADJUSTMENT OF GEAR MESHING OF GLEASON GEARS

To become a perfect gear meshing is only possible, if the fabrication number of the drive pinion (marked on the end face) and the ring gear (marked on the circumference) are corresponding.

## Perfect marking

The following figures are showing improper gear meshing marks of the ring gear.

The text alongside gives the corrections to obtain correct gear meshing. The dark colored arrows in the sketch of the drive pinion and ring gear are indicating the direction towards which the drive pinion has to be moved. The clear arrows are indicat-ing the direction towards which the ring gear has to be moved, to get further more a correct backlash.

## Gear meshing to deep

Increase the drive pinion distance by correction of the adjustment disk thickness. Regulate the backlash by inwards moving of the ring gear.





Gear meshing to high

Decrease the drive pinion distance by correction of the adjustment disk thickness. Regulate the backlash by outwards moving of the ring gear.



# 5. SECURING OF THE STRIKING NUT

The brim of the striking nut has to be sheared only along the slot flank and the corner has to be bent on the slot ground.



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# Using of Loctite and other operating supplies

- 1) Striking nut at drive flange
  - In thread : Assembly paste with MoS<sub>2</sub> (Exception through drive pinion see point Z)
  - Front side contact surface : Sealing compound (Epple 33 or equivalent).
- 2) Striking nut at through drive pinion
  - In thread : Loctite 262.
- 3) Striking nut at gear wheels, bearings etc.
  - In thread : assembly paste with MoS<sub>2</sub>.

## Removing of the striking nut

Bend away the nose and screw off the nut.