

Reparaturanleitung
Repair Manual
Manuel de Réparation
Manual de Reparaciones
Manuale di Riparazione



6 AP 1000 B / 6 AP 1200 B / 6 AP 1400 B /
6 AP 1700 B / 6 AP 2000 B
and the corresponding angle drive variants
Stages 1-2

4181 751 102



Subject to technical changes

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Index	Date of issue	Chapter	Initiator	Comment

This documentation is intended for skilled personnel trained by ZF Friedrichshafen AG to carry out maintenance and repair work on ZF products.

This manual deals with the standard ZF products in accordance with the state of development on the date of issue.

However, due to continuing technical development of the product, repair work might require work practices and test or adjustment data not contained in this manual.

We recommend that work done on your ZF product is carried out only by skilled mechanics who have had their practical and theoretical knowledge updated on a regular basis at our Customer Service / After Sales training center.

Service Centers equipped by ZF Friedrichshafen AG all over the world offer you:

1. Continually trained personnel,
2. Specified equipment, e.g. special tools,
3. Genuine ZF spares, according to our latest specifications.

All work performed at these Service Centers is carried out conscientiously and with utmost care.

Warranty:

Repair work carried out at ZF Service Centers is subject to the contractual conditions prevailing in the individual case.

Damage resulting from work performed by non-ZF personnel in an improper and unprofessional manner and any consequential costs are excluded from the contractual liability agreement. Exclusion of liability also applies if genuine ZF spares are not used.

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Safety Instructions

In principal, companies repairing ZF units are responsible for their own work safety.

To avoid injury to personnel and damage to products, all safety regulations and legal requirements which apply to repair and maintenance work must be adhered to.

Before starting work, mechanics must familiarize themselves with these regulations.

Personnel required to carry out repairs on ZF products must receive appropriate training in advance. It is the responsibility of each company to ensure that their repair staff is properly trained.

The following safety instructions appear in this manual:

NOTE

Refers to special working procedures, methods, information, use of auxiliary equipment, etc.

CAUTION

This is used when incorrect, unprofessional working practices could damage the product.



DANGER

This is used when lack of care could lead to personal injury or death.

General Information

Read this manual carefully before starting any tests or repair work.

CAUTION

Pictures, drawings, and components shown do not always represent the original object, but are used to illustrate working procedures.

Pictures, drawings, and components are not to scale. Conclusions about size and weight should not be drawn (even within a complete illustration).

Always follow the working steps as described in the text.

After completion of repair work and testing, skilled staff must check whether the product is functioning correctly.



THREATS TO THE ENVIRONMENT !

Lubricants, consumables, and cleaning agents must not be allowed to enter the soil, ground water, or sewage system.

- **Ask your local environment agency for safety information on the relevant products and adhere to their requirements.**
 - **Collect used oil in a suitably large container.**
 - **Dispose of used oil, dirty filters, lubricants, and cleaning agents in accordance with environmental protection guidelines.**
 - **When working with lubricants and cleaning agents always refer to the manufacturer's instructions.**
-

CAUTION

The transmission must NOT be suspended by the input shaft NOR by the output flange.

ZF Service Information must be observed. This information is available at all ZF Service Centers or via the ZF-ServiceLine.

In case of doubt always turn to the relevant department within ZF Customer Service / After Sales Service for advice.

All work on transmissions is to be performed by experts only and under clean conditions. Use specified tools to dismantle and assemble transmissions.

After removing the transmission from the vehicle, clean it thoroughly with a suitable cleaning agent before opening.

Pay particular attention to the projections and recesses of housings and covers when cleaning.

Parts joined with Loctite are easier to separate if warmed with a fan heater.

Cleaning Parts

Remove remains of old gaskets on all sealing surfaces. Carefully remove burrs or similar patches of roughness using an oilstone.

Lube bores and grooves must be free of anti-corrosion agents and foreign matter; check for perfect passage.

Carefully cover opened transmissions to prevent foreign matter from entering.

Reusing Parts

Parts such as roller bearings, disks, thrust washers etc., must be inspected by a competent person who should decide whether or not they can be re-used. Replace parts which are damaged or have suffered from excessive wear.

Gaskets, Locking Plates

Parts which cannot be removed without being damaged must always be replaced with new parts (e.g. gaskets and locking plates).

Shaft Seals

Always change shaft seals with rough, ripped, or hardened sealing lips. Seal contact surfaces must be totally clean and in perfect condition.

Reworking

Rework may be carried out on seal contact surfaces using plunge-cut grinding only, never use an emery cloth. Ensure that there are no traces of grinding or scroll.

If rework is needed on spacer disks, shims etc. because of clearance adjustment, ensure that the reworked areas contain no face runout and have the same surface quality.

Transmission Assembly

Find a clean work area to assemble the transmission. Gaskets are installed without sealing compound or grease. When measuring silicon-coated gaskets, do **not include the silicon layer**. During assembly, comply with all adjustment data and tightening torques in the Repair Manual.

Bearings

If bearings are mounted in heated condition, they are to be heated evenly (e.g. heating cabinet). Temperature should be at approx. 85 °C and must not exceed 120 °C. Each mounted bearing must be lubricated with operating oil.

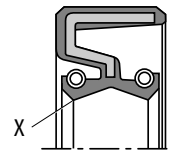
Sealing

If a specific sealing agent* is to be used for sealing, comply with the manufacturer's directions for use. Apply a thin layer of sealing agent to the surfaces and spread evenly. Do not allow sealing to enter oil ducts and bores. On oil-carrying ducts and bores, wipe off the sealing agent on the surfaces to be sealed near apertures to ensure that no sealing agent enters the oil feeds when the parts are pressed together.

Shaft Seals

- a) Apply a light coat of sealing agent* on circumference of shaft seals with "steel jacket".
- b) **Never apply sealing agent** to shaft seals with "rubber jacket", but apply a thin coat of Vaseline 8420 to the outer circumference or wet with a lubricant, e.g. a water-soluble, concentrated washing-up liquid (e.g. Pril, Coin, Palmolive).
- c) Shaft seals with steel and rubber jackets should be treated on the outer circumference of the rubber jacket as described for shaft seal b).

- d) Dual shaft seals have two sealing lips. The dust-proof sealing lip (X) must face outwards.



- e) Fill the gap between the sealing lips so it is 60 % filled with grease (e.g. produced by Aral, such as Aralub HL2 or by DEA, such as Spectron FO 20).
- f) If possible, heat shaft seal bores to between 40 and 50 °C (makes fitting easier). Press in shaft sealing ring with mounting or face plate until firmly home at relevant installation depth.

Retaining Agents

Retaining agents* may only be used where specified by the parts list.

Always comply with manufacturer's directions for use when using retaining agents (e.g. Loctite).

During assembly, comply with all adjustment data, checking data, and tightening torques.

Transmission Oil

After completing repairs, fill transmissions with transmission oil. For the procedure and approved oil grades, refer to the transmission Operating Instructions and TE-ML List of Lubricants (refer to identification plate) which can be obtained from all ZF Customer Service / After Sales Centers and on the Internet under www.zf.com.

After filling the transmission with oil, tighten the screw plugs at the oil filling point and the oil overflow using the specified torques.

* refer to expendable material

Tightening Torques for Bolts/Screws and Nuts

Extract from ZFN 148

This standard applies to screws/bolts acc. to DIN 912, DIN 931, DIN 933, DIN 960, DIN 961, as well as ISO 4762, ISO 4014, ISO 4017, ISO 8765, ISO 8676, and to nuts acc. to DIN 934 as well as ISO 4032, ISO 8673.

This Standard contains data on tightening torques for screws/bolts and nuts in strength categories 8.8, 10.9, and 12.9, and nuts in strength categories 8, 10, and 12.

Surface condition of bolts/screws and nuts: Thermally blackened and oiled or galvanized and oiled or galvanized, chromated, and oiled.

Tighten screws/bolts with a calibrated ratchet dial torque or ratchet wrench.

NOTE

Deviating tightening torques are listed separately in the Repair Manual.

Regular screw thread			
Size Screw/Bolt Nut	Tightening torque (Nm) for		
	8.8	10.9	12.9
	8	10	12
M4	2.8	4.1	4.8
M5	5.5	8.1	9.5
M6	9.5	14	16.5
M7	15	23	28
M8	23	34	40
M10	46	68	79
M12	79	115	135
M14	125	185	215
M16	195	280	330
M18	280	390	460
M20	390	560	650
M22	530	750	880
M24	670	960	1100
M27	1000	1400	1650
M30	1350	1900	2250

Fine screw thread			
Size Screw/Bolt Nut	Tightening torque (Nm) for		
	8.8	10.9	12.9
	8	10	12
M8x1	24	36	43
M9x1	36	53	62
M10x1	52	76	89
M10x1.25	49	72	84
M12x1.25	87	125	150
M12x1.5	83	120	145
M14x1.5	135	200	235
M16x1.5	205	300	360
M18x1.5	310	440	520
M18x2	290	420	490
M20x1.5	430	620	720
M22x1.5	580	820	960
M24x1.5	760	1100	1250
M24x2	730	1050	1200
M27x1.5	1100	1600	1850
M27x2	1050	1500	1800
M30x1.5	1550	2200	2550
M30x2	1500	2100	2500

Screw Plugs DIN 908, 910, and 7604

The screw plug tightening torques were determined according to DIN 7604 for screwing into steel, gray cast, and aluminum alloys.

The values are based on experience and are intended as reference values for the fitter.

The values for the tightening torque apply analogously to screw plugs according to DIN 908 and DIN 910, as the thread geometries are almost identical.

General rule:

Screw/Bolt class 5, ZFN 148-1

Screw/Bolt material: Steel acc. to DIN 7604.

Surface condition: As manufactured (without surface protection) and lightly oiled or galvanized, chromated, and lightly oiled.

Union Screws DIN 7643

The tightening torques were determined for screwing into steel, gray cast, and aluminum alloys.

The values are based on experience and are intended as reference values for the fitter.

General rule:

Screw/Bolt class 5, ZFN 148-1

Material: 9SMnPb28K acc. to DIN 1651

Surface condition: As manufactured (without surface protection) and lightly oiled or galvanized, chromated, and lightly oiled.

Screw plugs (DIN 908, 910, 7604)		
Dimensions	Tightening torque in Nm screwed into	
	steel/gray cast	Al alloy
M8x1	20*	10*
M10x 1	25 / 30*	15 / 20*
M12x1.5	35	25
M14x1.5	35	25
M16x1.5	40	30
M18x1.5	50	35
M20x1.5	55	45
M22x1.5	60 / 80*	50 / 65*
M24x1.5	70	60
M26x1.5	80 / 105*	70 / 90*
M27x2	80	70
M30x1.5	100 / 130*	90 / 130*
M30x2	95	85
M33x2	120	110
M36x1.5	130	115
M38x1.5	140	120
M42x1.5	150	130
M42x2	145	125
M45x1.5	160	140
M45x2	150	130
M48x1.5	170	145
M48x2	160	135
M52x1.5	180	150
M60x2	195	165
M64x2	205	175

Union screws (DIN 7643)		
Pipe outer diameter	Thread	Tightening torque in Nm
4 - 5	M8x1	20 - 25
6	M10x1	25 - 35
8	M12x1.5	30 - 40
10	M14x1.5	35 - 40
12	M16x1.5	45
15	M18x1.5	50
18	M22x1.5	60
22	M26x1.5	90
28	M30x1.5	130
35	M38x1.5	140

* DIN 7604 Form C

Designation ZF item number	Name	Quantity approx.	Application	Comments
Grease 0750 199 001	For example Spectron FO 20		Assembly aids in general	
Grease 0671 190 016	Technical Vaseline 8420		Assembly aids in general	
Transmission oil	Refer to TE-ML14 List of Lubricants		Assembly aid in general	

NOTE: Inquire size of containers before placing any orders!

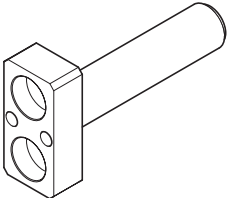
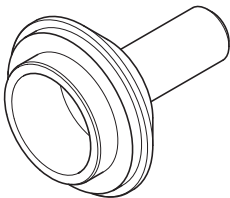
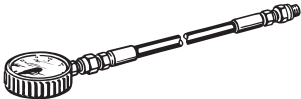
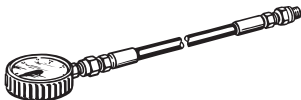
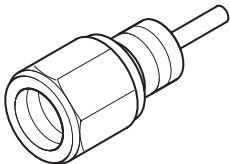
Fig. no.	Figure	Order no.	Application	Qty.	Remarks
1		1X56 137 452 Mounting adapter for safety plate on output flange		1	
2		1X56 138 625 Press-in mandrel for the shaft sealing ring - output		1	
3		1P01 136 670 Test gage 0 – 25 bar with connection socket M10x1		1	
4		1P01 137 856 Test gage 0 – 10 bar with connection socket M10x1		1	
5		1P82 139 839 Adapter for EcoLife test gage		2	

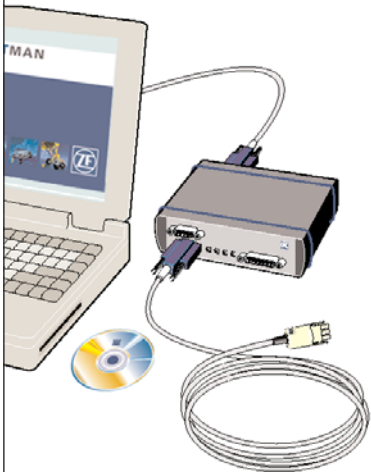
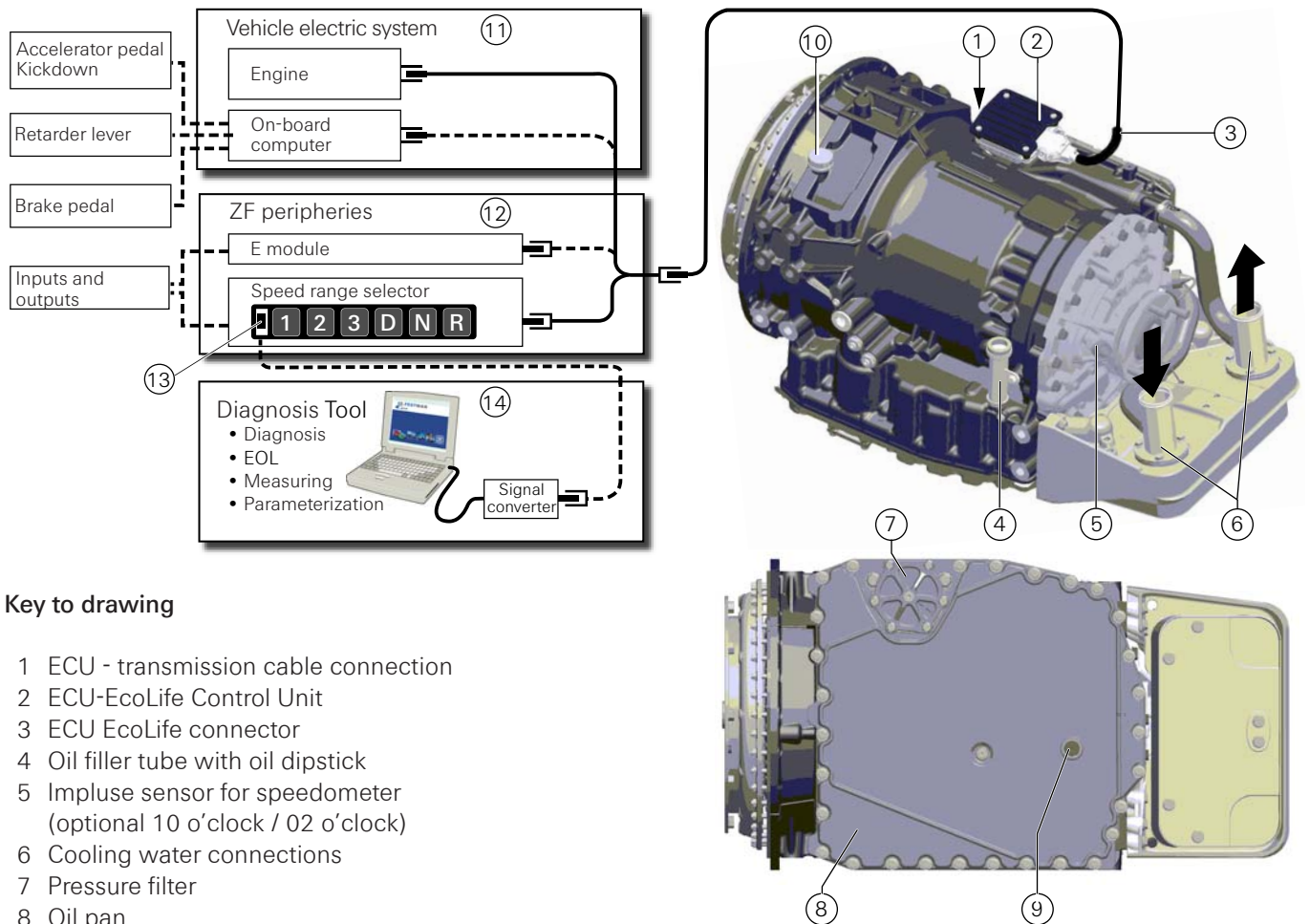
Fig. no.	Figure	Order no.	Application	Qty.	Remarks
6		6008 006 002 68-pin terminal tester for troubleshooting in the electrical sector		1	
7		6008 208 838 Application software ZF-Testman for EcoLife on CD ROM		1	
8		6008 208 100 + 6008 208 920 Diagnosis system ZF-TESTMAN Windows 2000 / XP Complete system without PC This includes: ZF-Testman Software on CD ROM DPA 05 ZF-Diagnostic adapter with adapter cable		1	Complete system without PC WIN2000 min. SP3 WIN XP min. SP2
9		6008 206 038 Adapter cable between transmission control unit and terminal tester		1	

Fig. no.	Figure	Order no.	Application	Qty.	Remarks
10		6008 206 039 Adapter cable between transmission connector and terminal tester		1	
11		6008 206 040 Adapter kit contains 6008 206 038 and 6008 206 039		1	
12		6008 206 042 T-adapter between transmission control unit and vehicle connector with CAN2 interface and power supply		1	
13		6008 207 038 TMA Table Mode Adapter Table mode-based programming of electronics		1	

Arrangement of Peripheral Parts

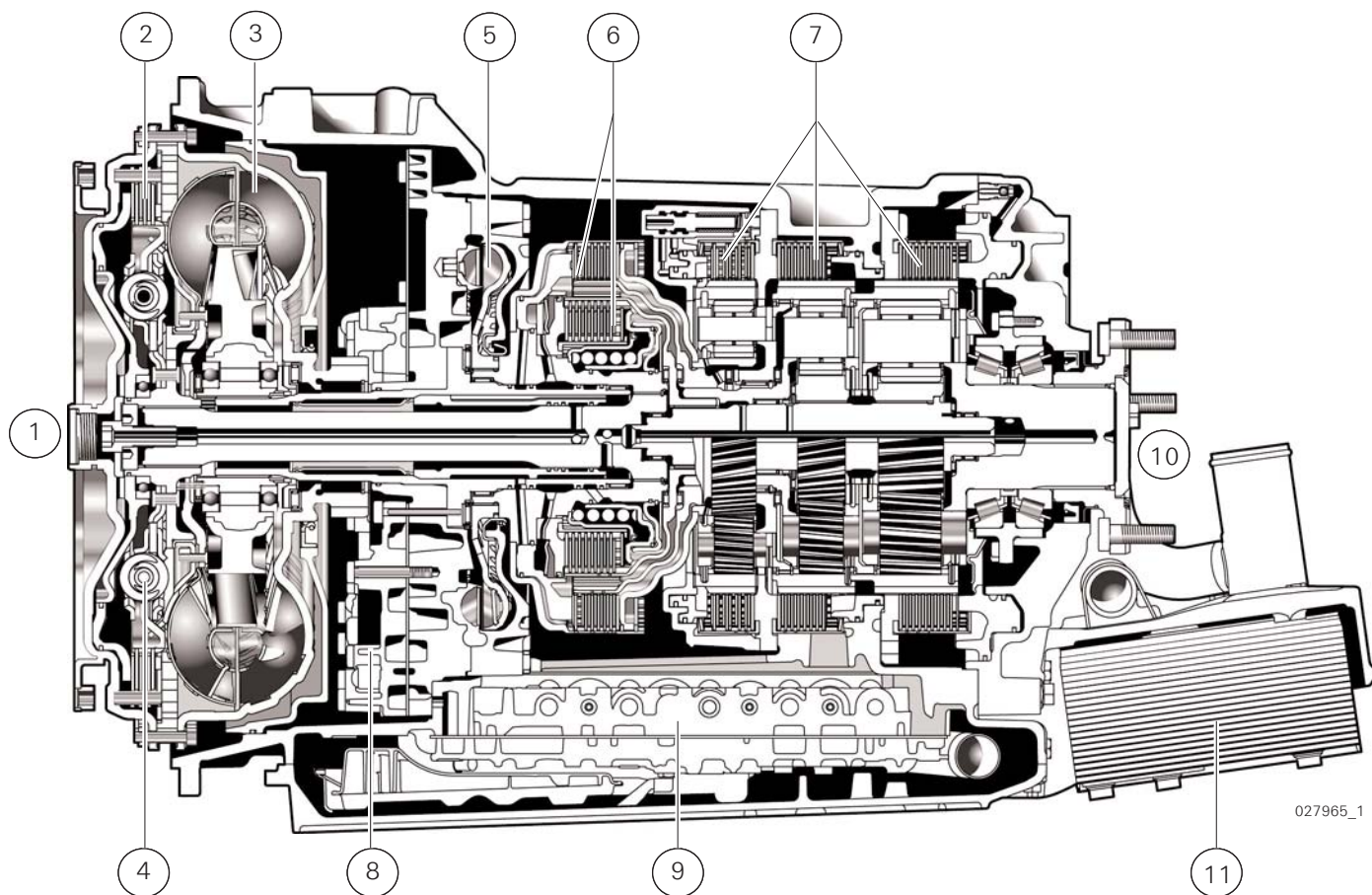


Key to drawing

- 1 ECU - transmission cable connection
- 2 ECU-EcoLife Control Unit
- 3 ECU EcoLife connector
- 4 Oil filler tube with oil dipstick
- 5 Impluse sensor for speedometer (optional 10 o'clock / 02 o'clock)
- 6 Cooling water connections
- 7 Pressure filter
- 8 Oil pan
- 9 Oil drain plug
- 10 Vent

- 11 Main power system "Vehicle CAN"
 - Engine
 - On-board computer
 - Accelerator pedal, kick-down
 - Retarder lever
 - Foot pedal
- 12 ZF peripherals "ZF CAN"
 - Speed range selector (pushbutton switch)
 - Inputs and outputs
 - E module (optional)
 - Inputs and outputs
- 13 - Diagnosis "Universal Serial Bus" (USB) interface
- 14 Diagnose tool, ZF-Testman
 - Diagnosis
 - EOL
 - Measurements
 - Parameterization

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6 AP 1000 B, 6 AP 1200 B, 6 AP 1400 B, 6 AP 1700 B und 6 AP 2000 B

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Key to drawing

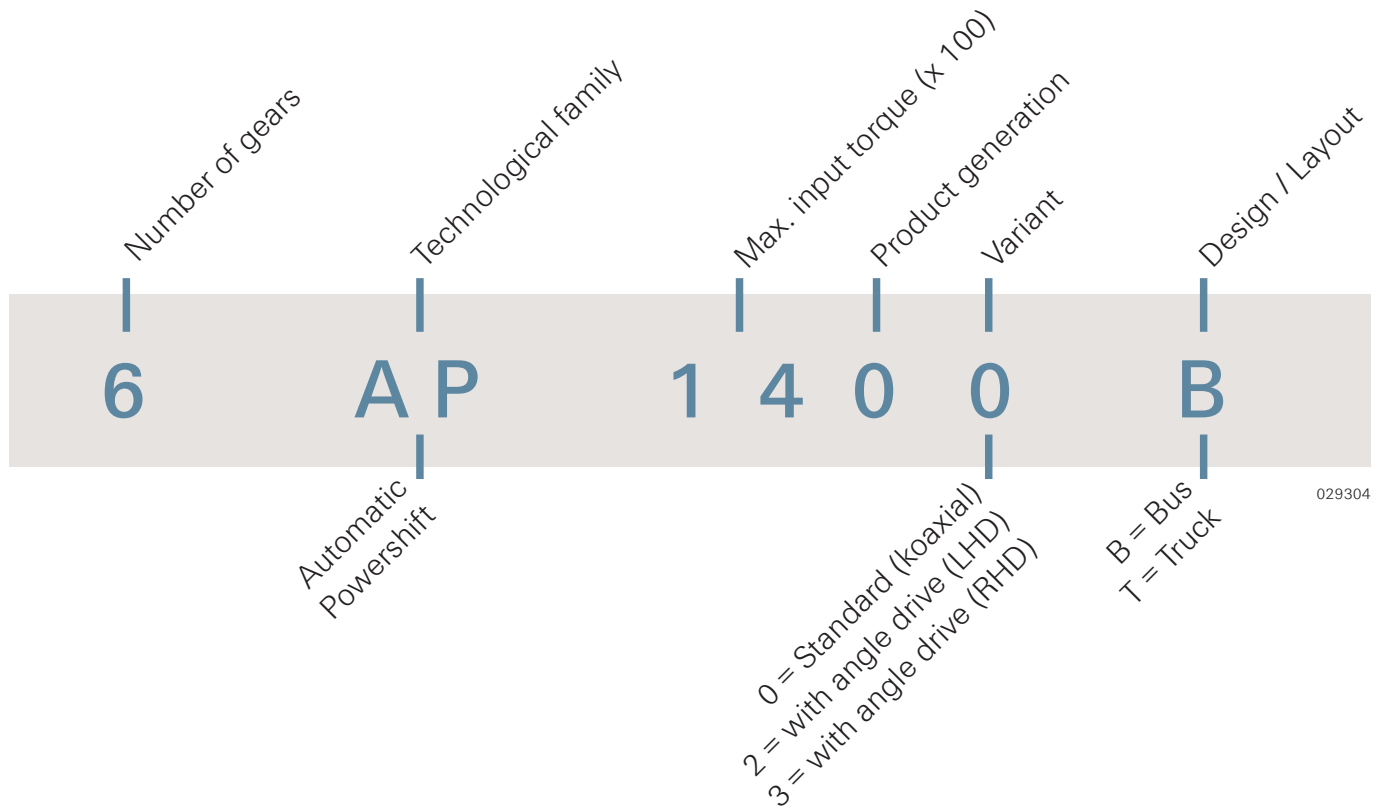
- | | | | |
|---|--------------------------------------|----|-------------------------|
| 1 | Input | 6 | Clutches A, B |
| 2 | Torque converter lock-up clutch (WK) | 7 | Brakes D, E, F |
| 3 | Torque converter | 8 | Oil pump |
| 4 | Torsional vibration damper | 9 | Hydraulic shift control |
| 5 | Retarder | 10 | Output |
| | | 11 | Retarder heat exchange |

ZF-EcoLife - Product Designation

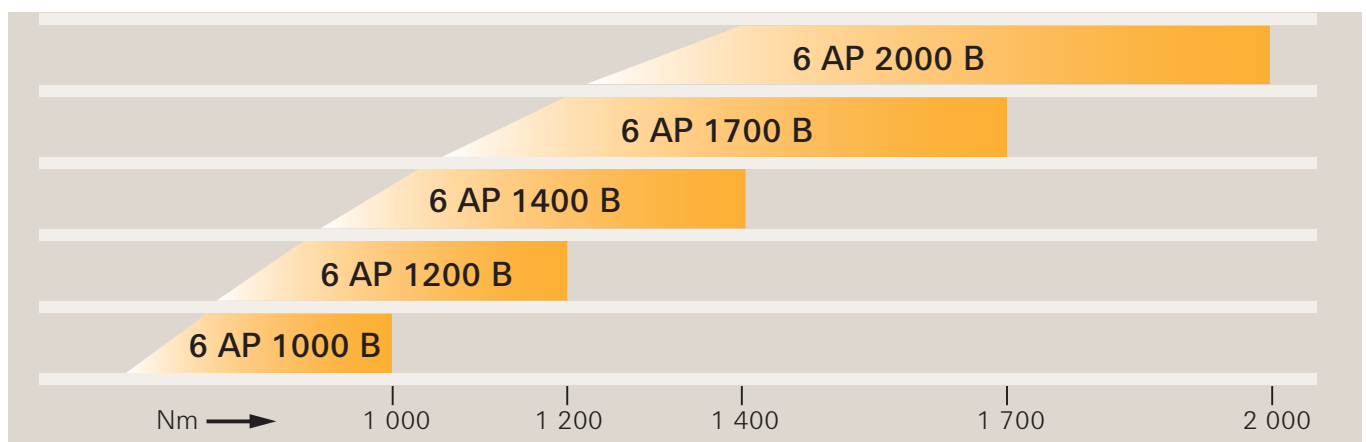
The entire ZF-EcoLife transmission family at a glance.

The new nomenclature:

- transparent and standardized, in relation to other ZF model ranges



Transmission-typ



Installation conditions and interfaces of all transmission types are identical.

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Shift Elements - Combinations

The table depicts the combination options for the shift elements in relation to the gears engaged and the ratios to be activated.

Ratios: 6-speed coaxial i = 3.364 - 0.615

Clutch - Brake Combinations / Ratios								
Gear	A	B	D	E	F	i Gear	ϕ	ϕ total
1.	●				●	3.364		5.469
							1.762	
2.	●			●		1.909		
							1.343	
3.	●		●			1.421		
							1.421	
4.	●	●				1.000		
							1.389	
5.		●	●			0.720		
							1.171	
6.		●		●		0.615		
AIS 1.					●			
AIS 2.				●				
AIS R					●			
R			●		●	4.235		

Admissible Transmission Input Speeds

Transmission type			6 AP 1000 B 6 AP 1200 B 6 AP 1400 B	6 AP xxxx B Angle drive 80° RHD/LHD	6 AP 1700 B 6 AP 2000 B
Speeds					
Minimum idle speed	$n_{\min}$	[rpm]	400	400	400
Maximum input speed	$n_{\max}$	[rpm]	2800 (1 st - 5 th gear)	2400 (1 st - 5 th gear)	2600 (1 st - 5 th gear)
			2100 (6 th gear)	2100 (6 th gear)	2100 (6 th gear)

1. Maintenance

1.1 Oil Change Intervals

NOTE

The pressure filter must be replaced at each oil change.
You may only use ZF oil filters.

Transmission oil change	Mileage
List of Lubricants TE-ML 20	
- Vehicle classification TE-ML 20,105, Lubricant classes 20E/20F	180 000 km
- Vehicle classification TE-ML 20,110, Lubricant classes 20F	120 000 km
- but at least 1x every 3 years.	

1.2 Oil Volume

- When changing oil (drain time approx. 10 mins) approx. 24 liters
- When first filling the dry transmission approx. 42 liters

NOTE

These values are reference values!
The definitive oil volume is the one obtained after
oil level check at operating temperature (90 °C).

1.3 Oil Grade

- The specifications of the ZF List of Lubricants TE-ML 20 are binding.

**In order to fill EcoLife transmissions, only oil according
to lubricant class 20E/20F must be used.**

The latest List of Lubricants can be obtained from all
ZF Sales & Service Centers or viewed on the
Internet under www.zf.com (Service / Technical
Information / ZF List of Lubricants).

1.4 Checking the Oil Level

CAUTION

It is mandatory to maintain the correct oil level:

- Insufficient oil leads to transmission malfunctions and damage.
- Too much oil causes the transmission to overheat.



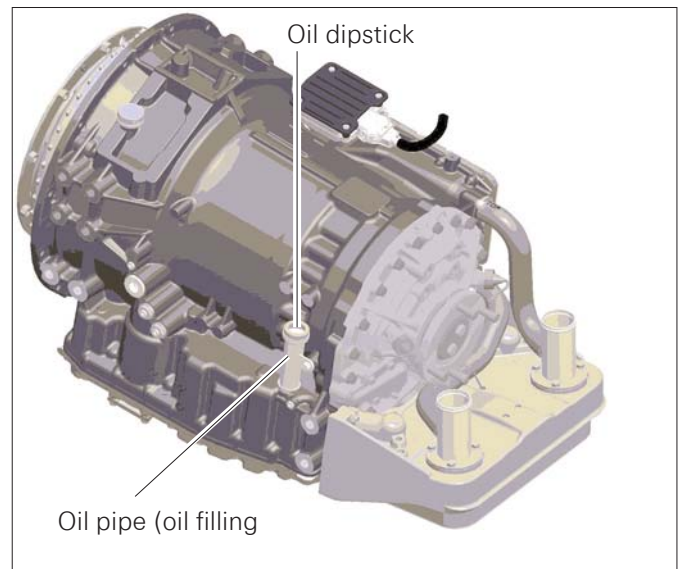
DANGER

Insufficient oil level leads to partial or continuous failure of the retarder, i.e. braking action is impaired or non-existent.

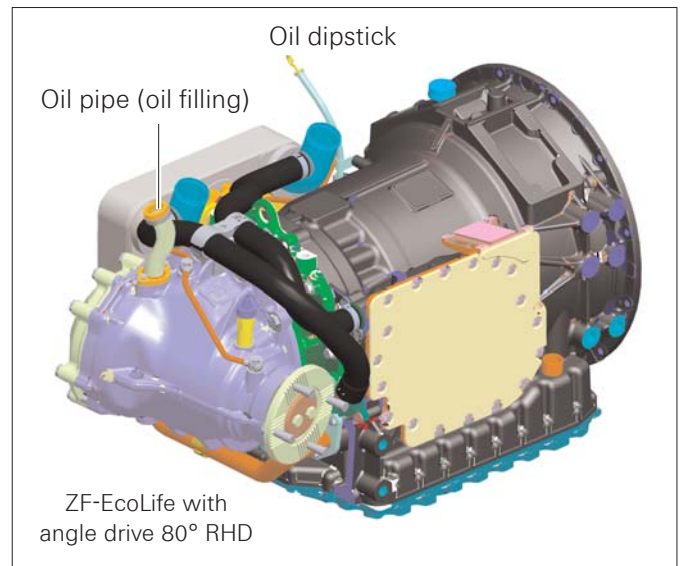
The following applies in general:

- Check the oil level at operating temperature (90 °C) to obtain a definitive figure.
- The vehicle must be parked on level ground when checking the oil level.
- Shift speed range selector (pushbutton) to “Neutral”.
- Let engine run at idle speed.
- Carry out oil level check at least quarterly.
- Conduct regular visual inspections of the transmission for signs of leakage.
- In exceptional cases the oil level may need to be checked while the transmission oil is cold - refer to Chapter 1.4.1. Then always check the oil level again at operating temperature.

Options for heating up transmission oil, see Chapter 1.4.3.



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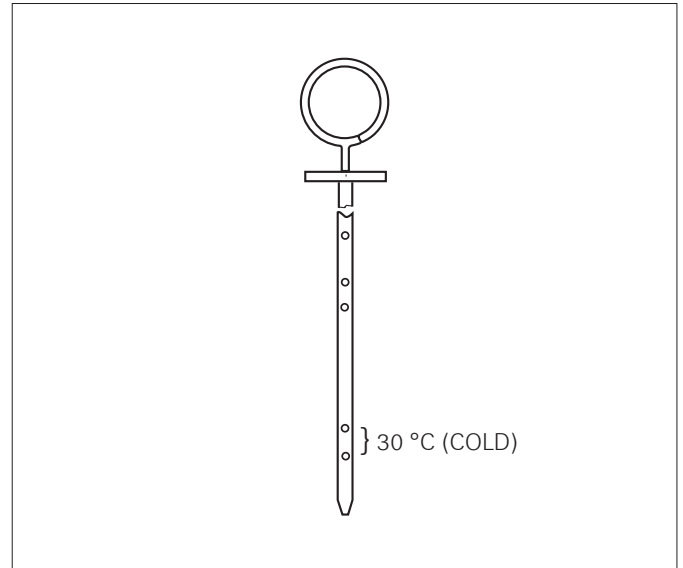


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1.4.1 Check After Engine Start-Up

Oil level check with cold transmission oil (30 °C):

- Vehicle stationary and on horizontal ground.
- Shift speed range selector (pushbutton) to “Neutral”.
- Let run for 15 - 20 seconds at 1200 - 1500 rpm.
- Let engine run at idle speed.
- Oil level must be in the “30 °C (COLD)” range.



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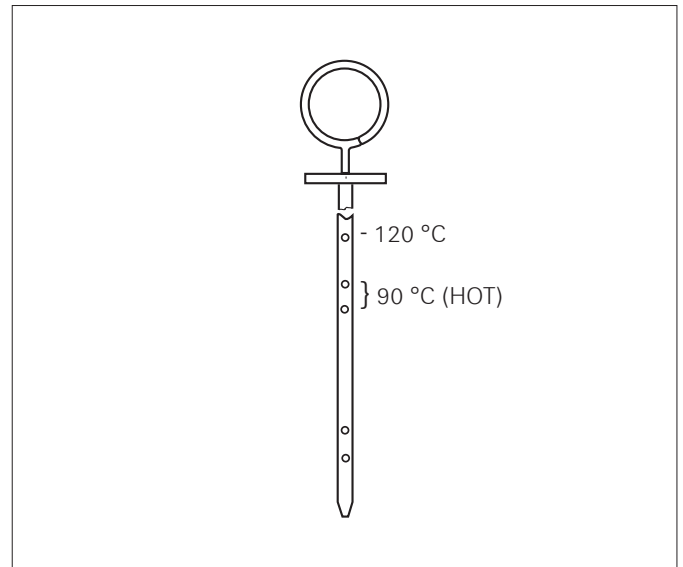
1.4.2 Checking at Operating Temperature

Oil level check when transmission oil is hot (90 °C):

- Vehicle stationary and on horizontal ground.
- Shift speed range selector (pushbutton) to “Neutral”.
- Let run for 15 - 20 seconds at 1200 - 1500 rpm.
- Let engine run at idle speed.

CAUTION

The engine idle speed should be set to between 500 and 700 rpm. It must never drop below 400 rpm.



027726

- Oil level must be in the “90 °C (HOT)” range.

NOTE

The oil level can rise and reach the “120 °C mark” when the oil sump temperature is 120 °C.

1.4.3 Option for Heating up the Transmission Oil

The transmission oil can be heated up to its specified operating temperature for oil check purposes by running the vehicle with retarder cycles until the oil sump temperature reaches 90 °C.

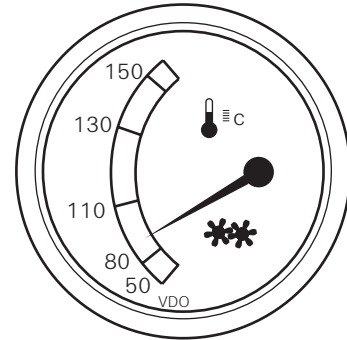
If ordinary operation is not possible, the transmission must be heated up as described in the following:

- Apply parking brake.
- Select speed range “D”.
- Apply service brake.
- **Run engine** at part throttle for 15 to 20 seconds at 1200 to 1500 rpm.
- After every heating-up phase and with the transmission in Neutral, run engine at 1500 to 2000 rpm for 15 to 30 seconds.
- Repeat several times with speed range selector “D” and “N”.

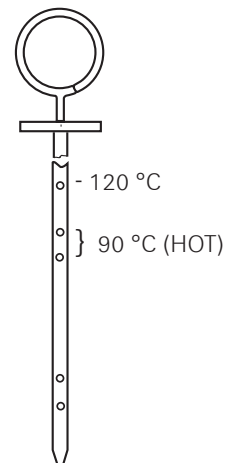
CAUTION

The max. permissible oil temperature in the oil sump is 120 °C (continuous).

Once the operating temperature has been reached carry out **“Check at Operating Temperature”** (Chapter 1.4.2).



001683



027726

1.5 Oil Drain



DANGER

Transmission oil is hot!

Danger of burns!

Wear protective gloves when loosening the oil drain plug.

Do not put your hand into the draining oil stream.



DANGER

When draining oil, used oil can get into the environment.

Threats to the environment !

Collect used oil in a sufficiently large container and dispose of it in accordance with the regulations of the environmental protection laws.

NOTE

Only drain oil at operating temperature and for at least 10 minutes:

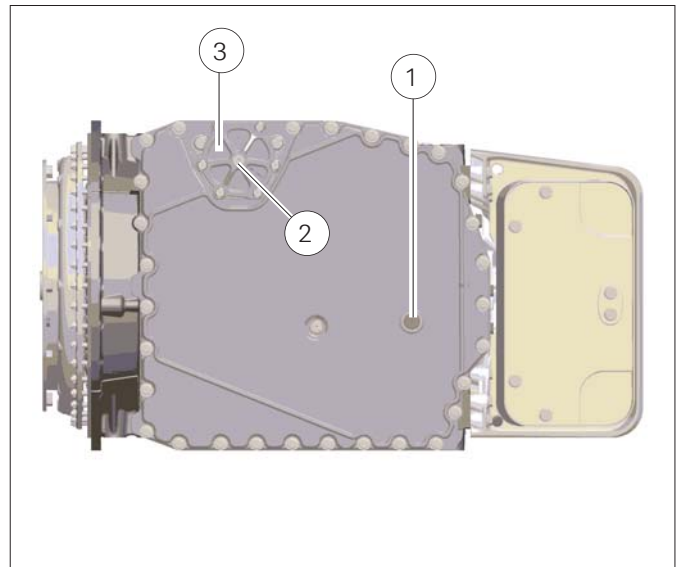
- Engine must be stationary
- Unscrew oil drain plug **(1)** and drain oil.
- Remove screw plug **(2)** and filter cover **(3)**.
- Replace filter cartridge (pressure filter) and O-ring at filter cover and at oil drain plug.

NOTE

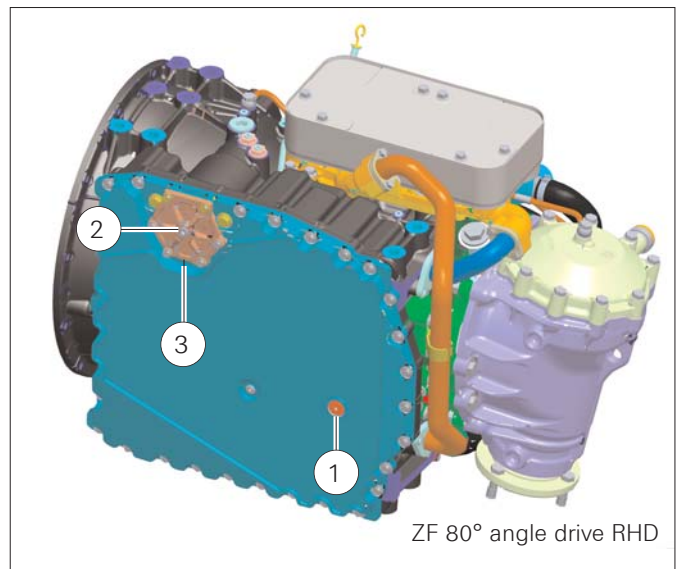
Pressure filter must be replaced at oil changes.

ZF 80° angle drive RHD / LHD

The angle drive does not have its own oil drain plug. Drain oil according to Chapter 1.5 via the main transmission oil drain plug.

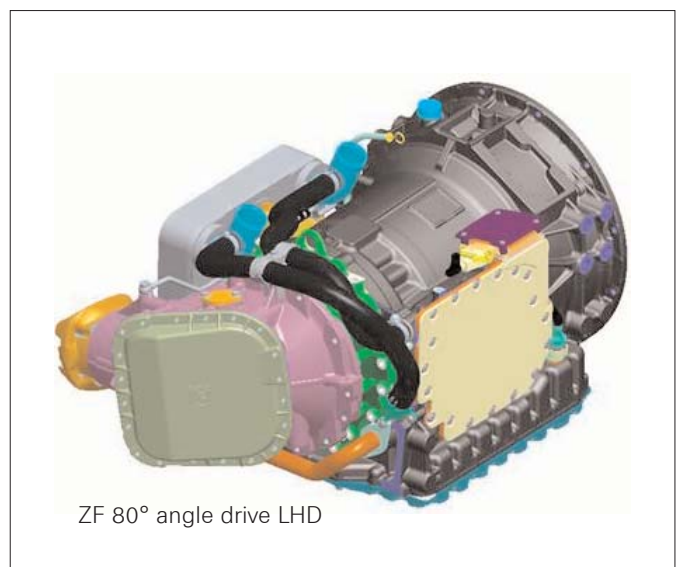


021113



ZF 80° angle drive RHD

027588



ZF 80° angle drive LHD

027589

1.6 Oil Fill

- Screw down filter cover **(3)**,
Tightening torque: **23 Nm**

NOTE

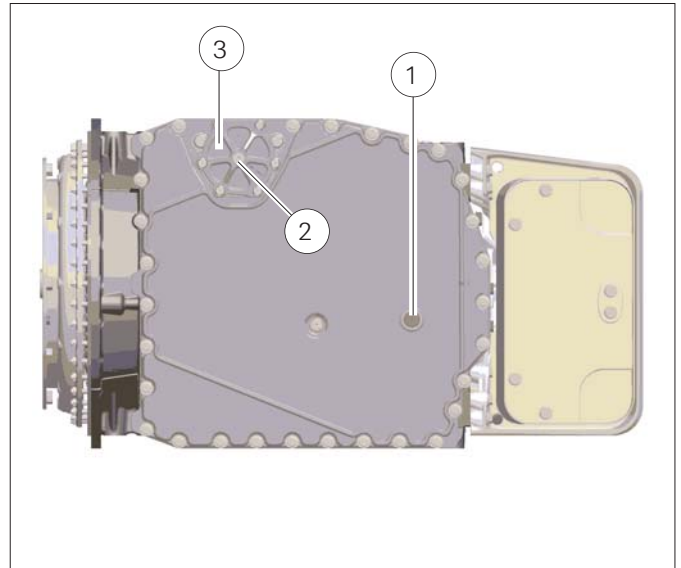
Be aware of different screw lengths.

- Insert screw plug **(2)** in filter cover **(3)** and tighten.
Tightening torque: 25 Nm.
- Screw in oil drain plug **(1)**:
Tightening torque: **35 Nm**

CAUTION

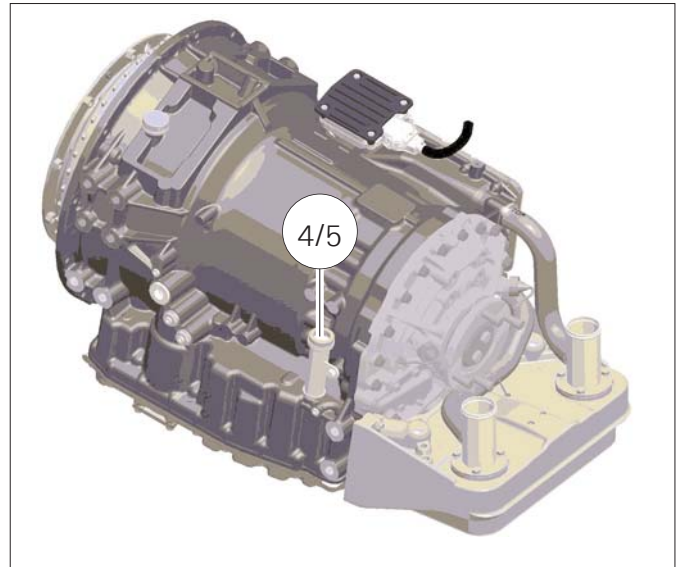
Always use genuine ZF oil drain plugs.

The converter drain valve is activated via the ZF oil drain plug.



021113

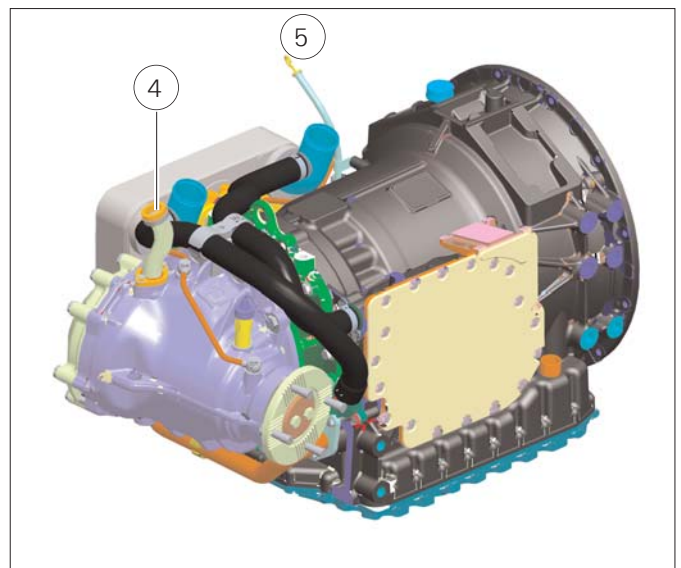
- Fill in oil according to Chapter 1.2 at the oil filler tube **(4)**.
- Check oil level at oil dipstick **(4)**, refer to Chapter 1.4.
- For oil grade refer to Chapter 1.3



027489

NOTE

The oil dipstick **(5)** can also be attached separately from the oil filler tube **(4)**.



027590

2 Repair

2.1 Replacing Filter

DANGER

When draining oil, used oil can leak out and get into the environment!

Threats to the environment! Collect used oil in a sufficiently large container and dispose of it in accordance with the regulations of the environmental protection laws.

Dispose of contaminated filters in accordance with the regulations of the environmental protection laws.

- 1 Switch the engine off.

DANGER

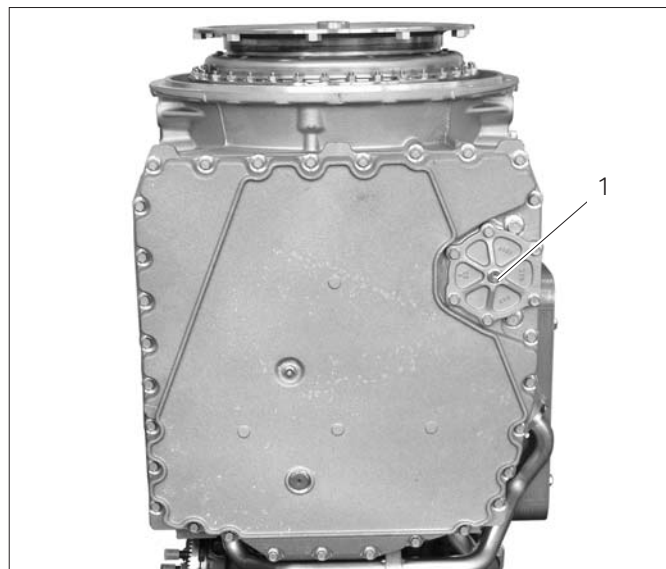
Transmission oil is hot!

Danger of burns!

Wear protective gloves when loosening the oil drain plug.

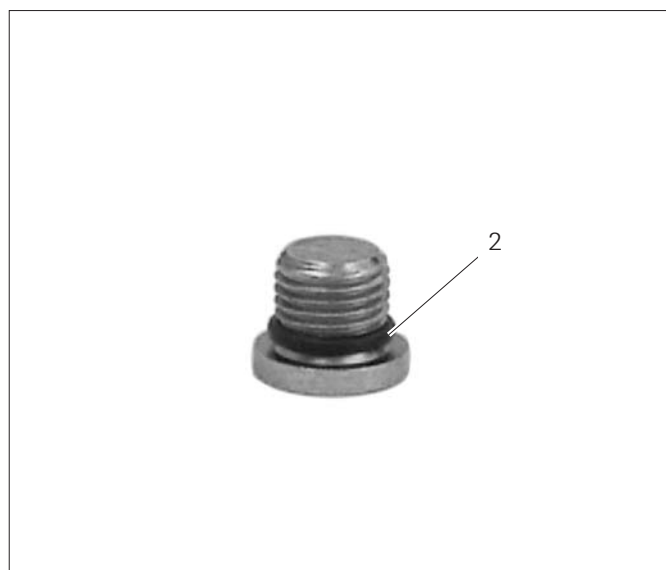
Do not put your hand into the draining oil stream.

- 2 Screw out the plug (1) and drain oil from filter chamber.



025015

- 3 Remove O-ring (2).



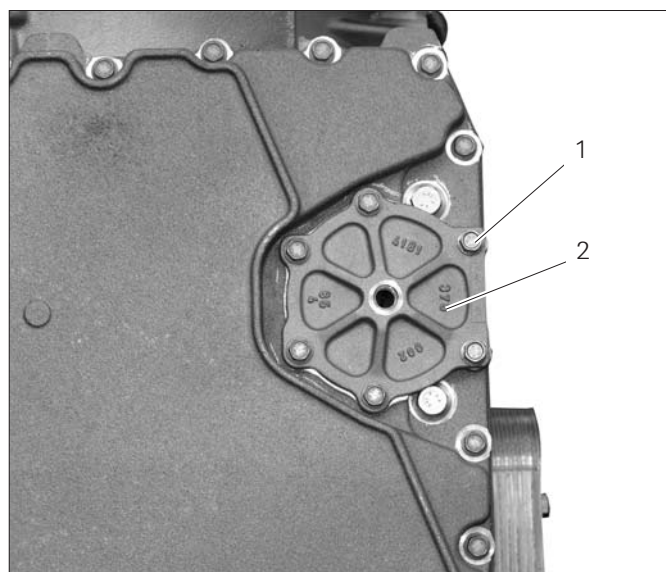
024194

- 4 Unscrew six hex-head screws **(1)** from filter cover **(2)**.

- 5 Remove filter cover **(2)**.

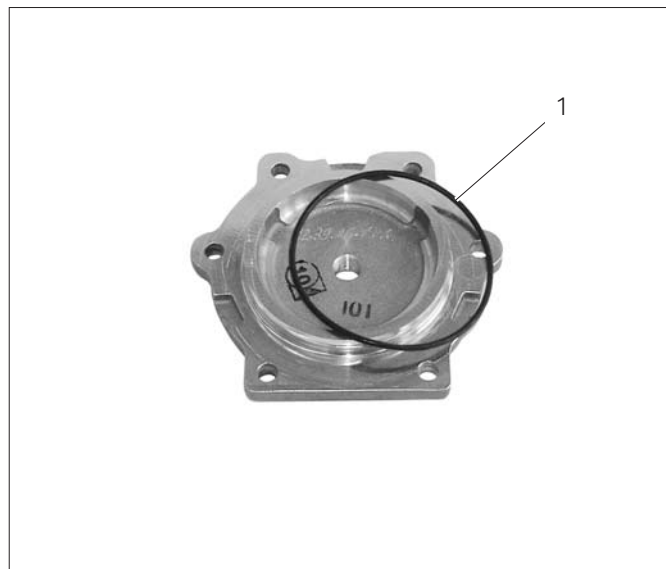
NOTE

When removing the filter cover residual oil may run out.



025016

- 6 Remove O-ring **(1)** from filter cover.



025021

- 7 Take out filter **(1)**.

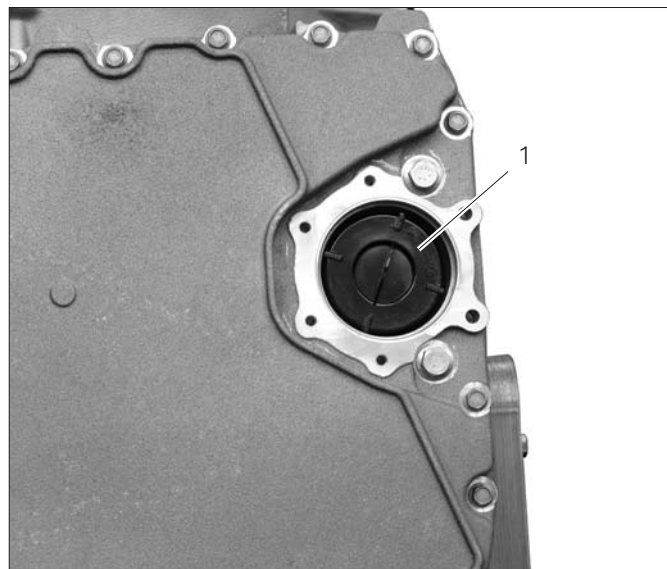
NOTE

Check filter for contamination.



025016

- 8 Insert new filter (1).



025017

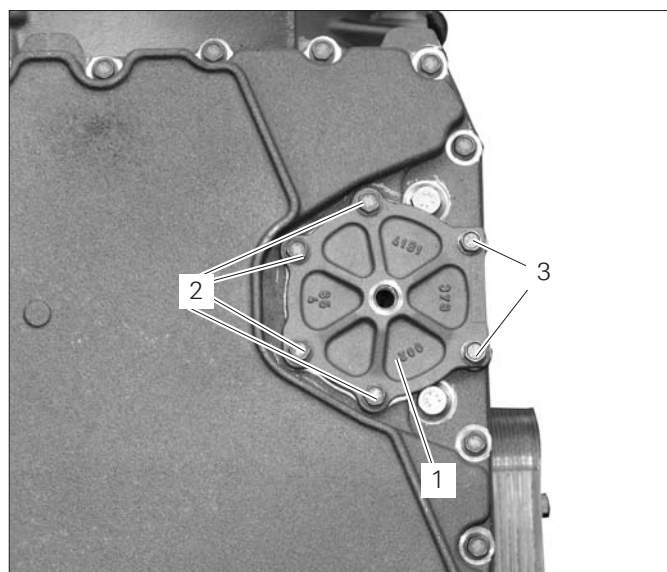
- 9 Coat new O-ring (2) with technical Vaseline.

- 10 Insert O-ring (2) in filter cover (1).



025020

- 11 Position filter cover (1).
- 12 Screw in four M8x30 hex-head screws (2) and tighten.
Tightening torque: **23 Nm**
- 13 Screw in two M8x55 hex-head screws (3) and tighten.
Tightening torque: **23 Nm**



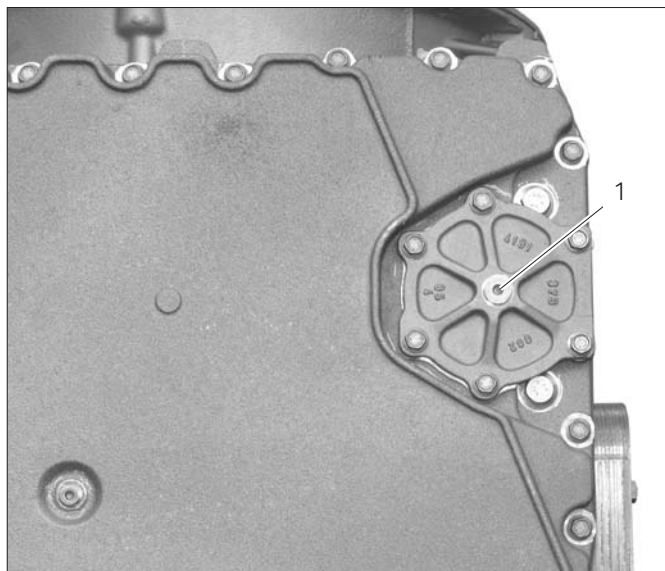
025016

- 14 Coat new O-ring **(1)** with technical Vaseline.
- 15 Fit new O-ring **(1)** to screw plug.



024194

- 16 Insert screw plug M14x1.5 **(1)** in filter cover and tighten.
Tightening torque: **25 Nm**

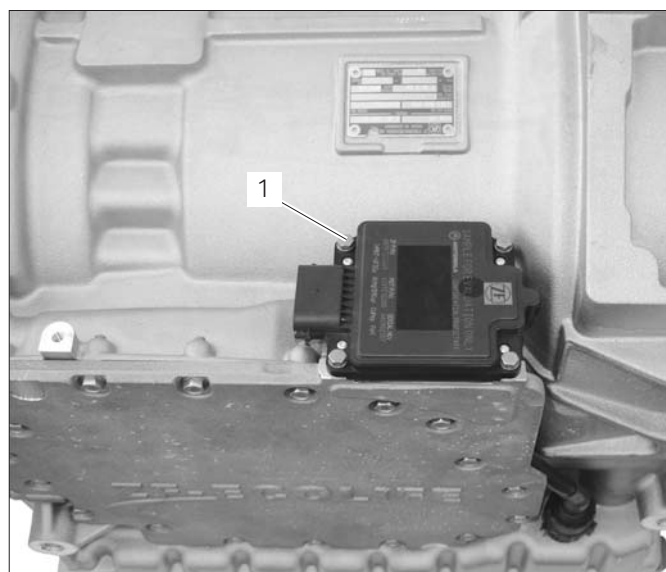


025022

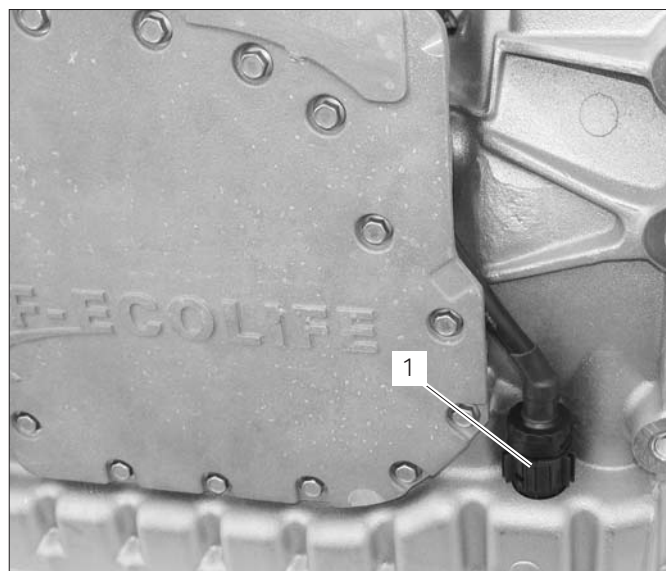
2.2 Replacing the ECU EcoLife, the Electronic Control Unit

2.2.1 Remove the ECU

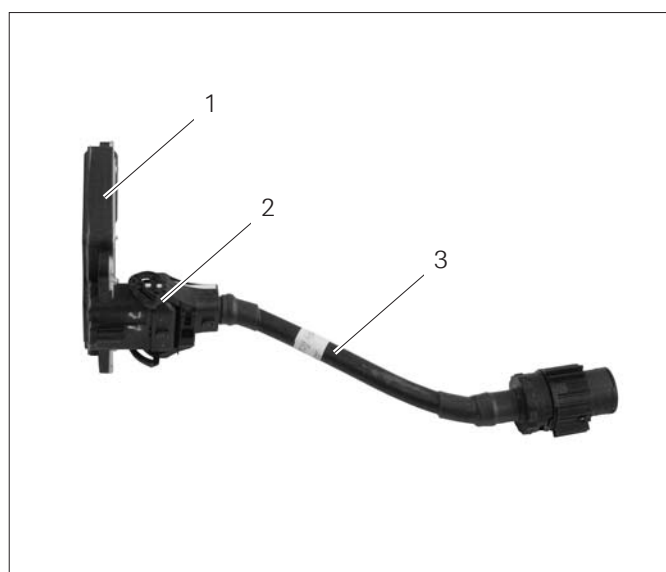
- 1 Unscrew four hex-head screws **(1)** from the ECU.
- 2 Loosen securing device **(1)** and disconnect the plug.
- 3 Take off ECU **(1)** together with cable harness **(3)**.
- 4 Open plug securing device **(2)** and disconnect plug **(2)** from ECU.



025045



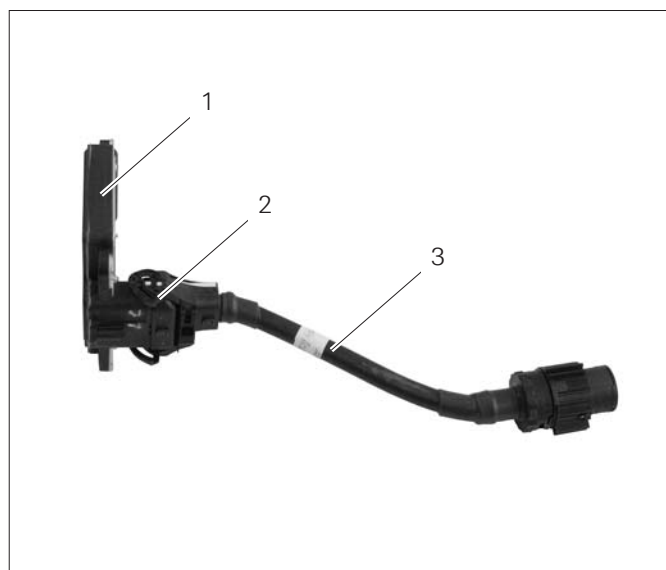
025046



025000

2.2.2 Mount the ECU

- 1 Insert cable harness (3) with connector (2) in new ECU (1) and close plug securing device (2).



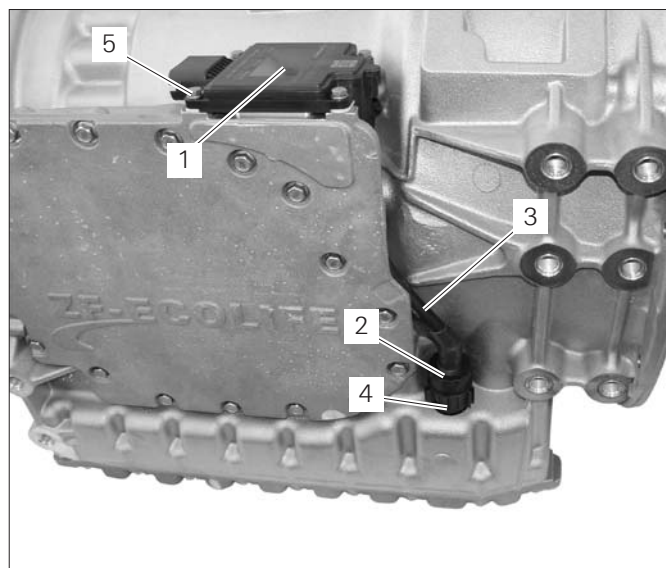
025000

- 2 Position ECU (1) together with cable harness (3) on the transmission.

CAUTION

The contact faces of the ECU and the transmission must be even and clean; otherwise, the ECU might be damaged.

- 3 Insert connector (2).
- 4 Snap in the securing device (4).
- 5 Screw in four M6x26 hex-head screws (5) and tighten.
Tightening torque: **9.5 Nm**

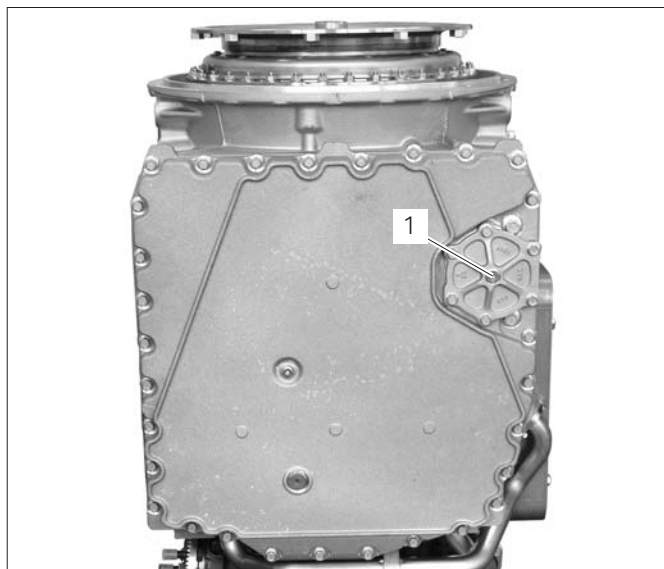


025047

2.3 Replacing Complete Hydraulic Transmission Control Unit

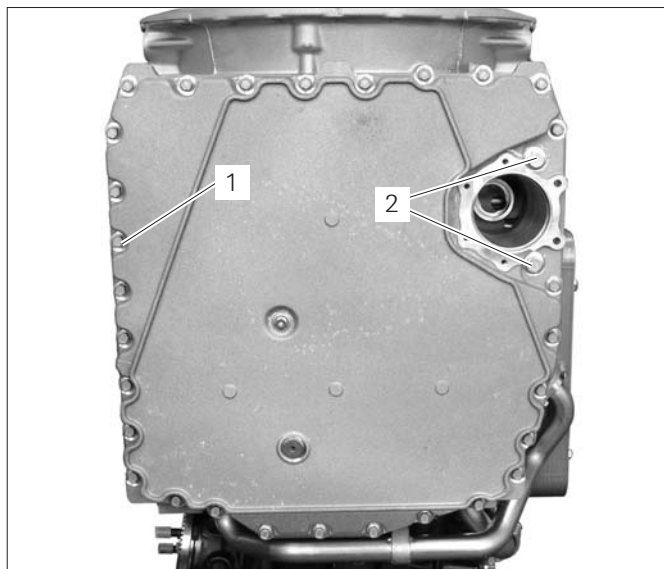
2.3.1 Remove Oil Pan

- 1 Remove cover **(1)** and filter as described in Chapter 2.1 “Replacing Filter”.



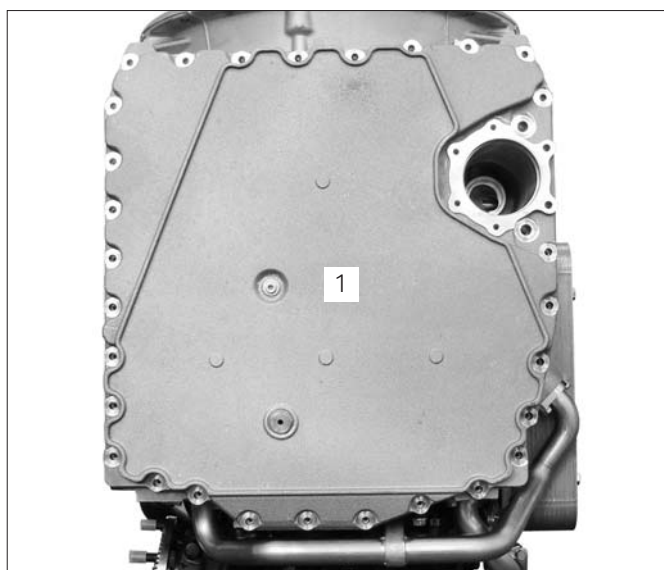
025015

- 2 Unscrew two hex-head screws **(2)**.
- 3 Unscrew 29 hex-head screws **(1)** from circumference of oil pan.



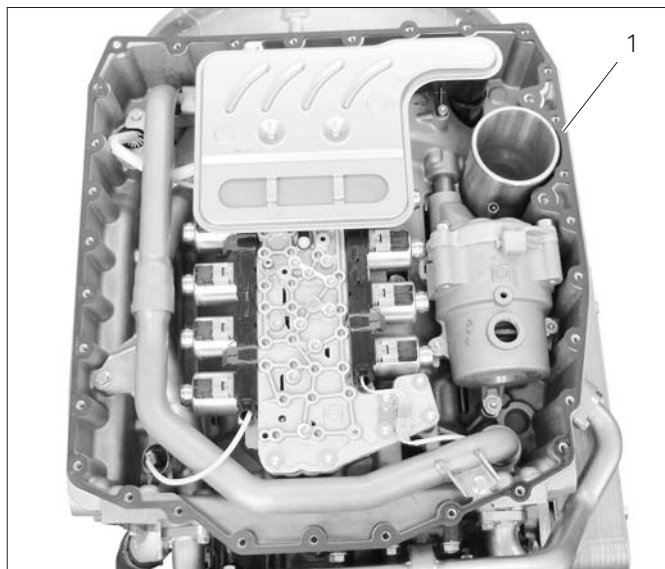
025019

- 4 Remove oil pan **(1)**.



025023

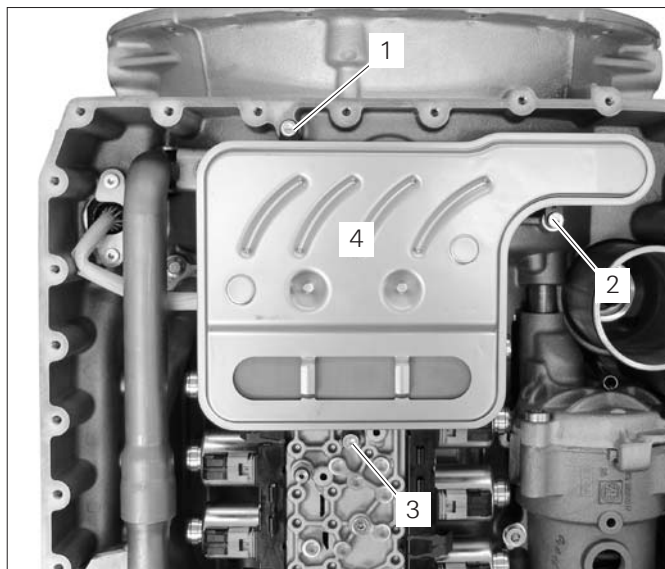
- 5 Remove gasket **(1)** from oil pan.



025024

2.3.2 Remove the Suction Filter

- 1 Unscrew three TORX screws **(1, 2, 3)** from the suction filter **(4)**.



025025

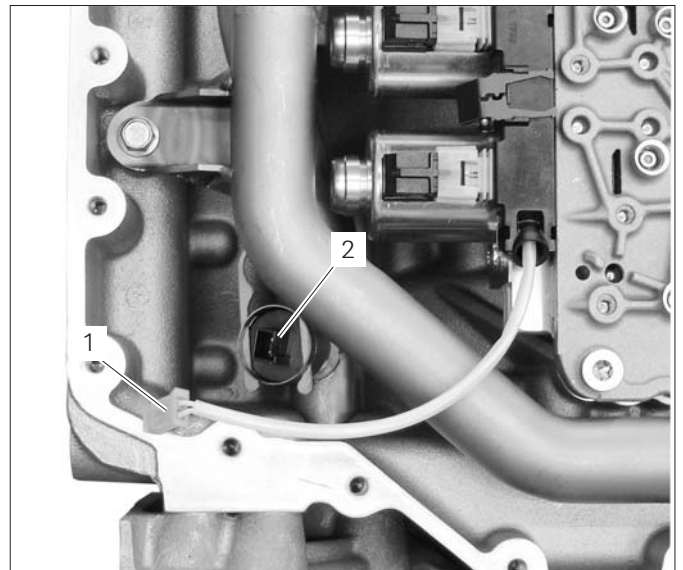
- 2 Remove suction filter **(1)**.



025026

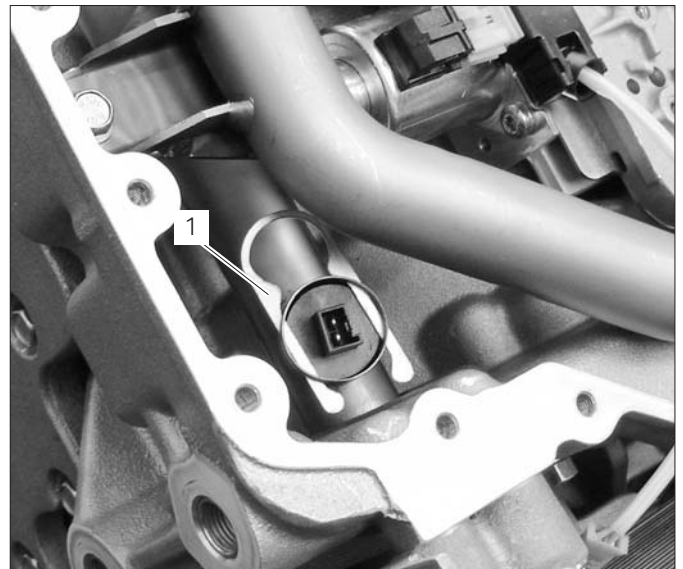
2.3.3 Remove the Temperature Sensor

- 1 Pull off connector (1) of temperature sensor (2).



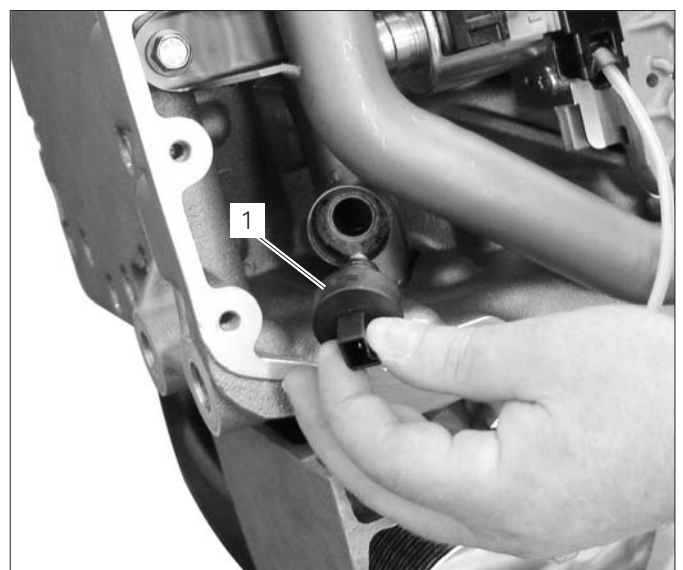
024195

- 2 Remove retaining clamp (1).



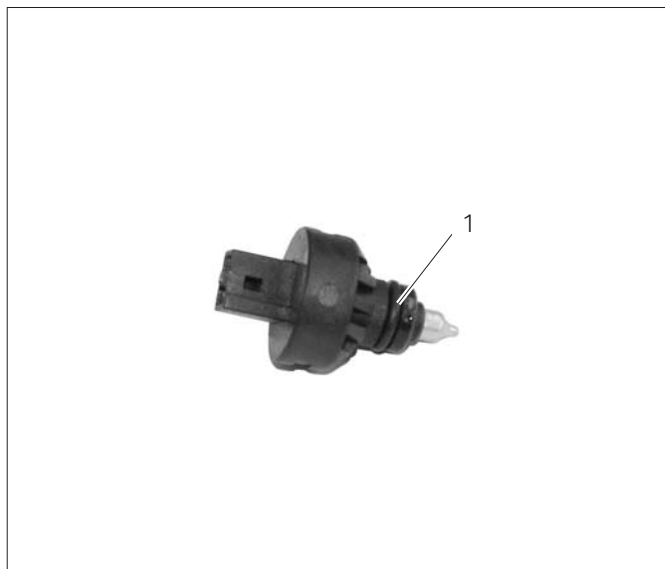
024196

- 3 Take out temperature sensor (1).



024197

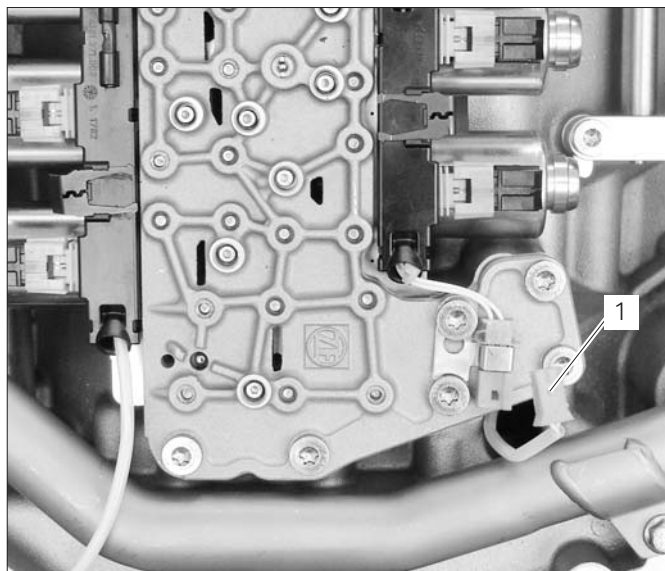
- 4 Remove O-ring **(1)** of temperature sensor.



02419

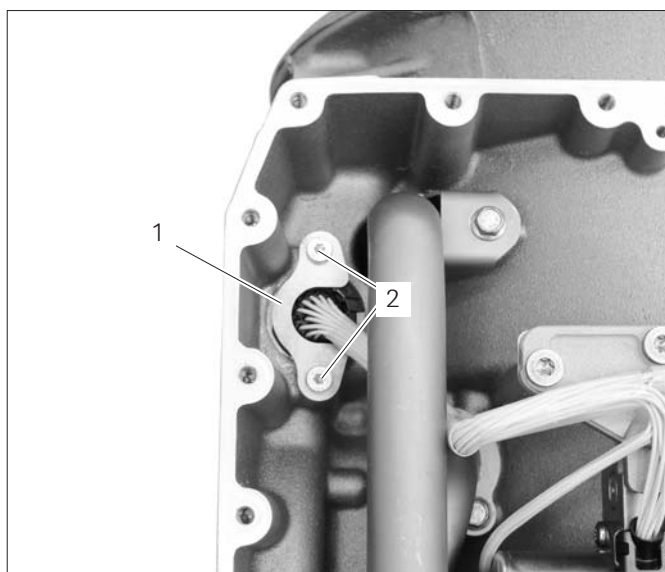
2.3.4 Remove the Hydraulic Transmission Control Unit

- 1 Pull out inductive sensor output connector **(1)**.



024199

- 2 Unscrew two TORX screws **(2)** of transmission connector retaining plate **(1)**.
- 3 Remove fixing plate **(1)**.



024200

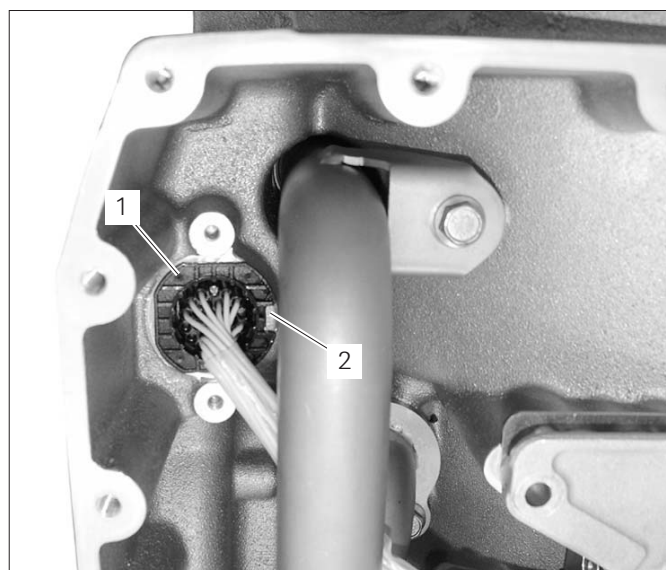
- 4 Push out transmission connector (1) from below.

NOTE

Pay attention to anti-rotation device (2).

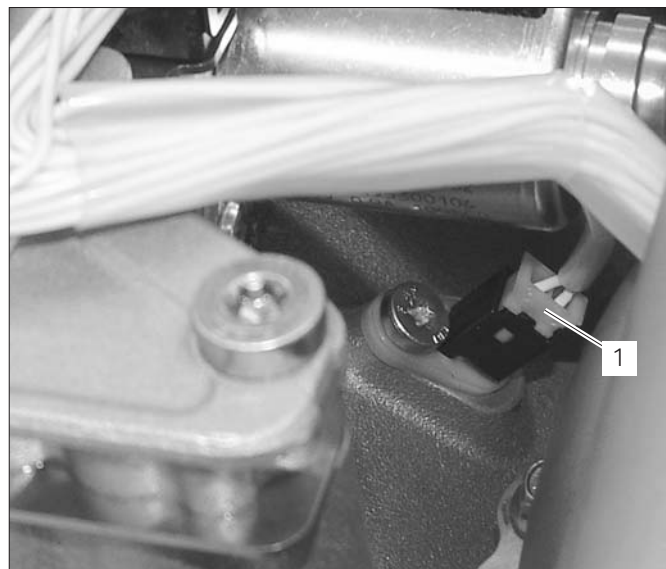
CAUTION

Do not pull on the cable. This could lead to damage of the connector.



024191

- 5 Pull out inductive sensor turbine connector (1).

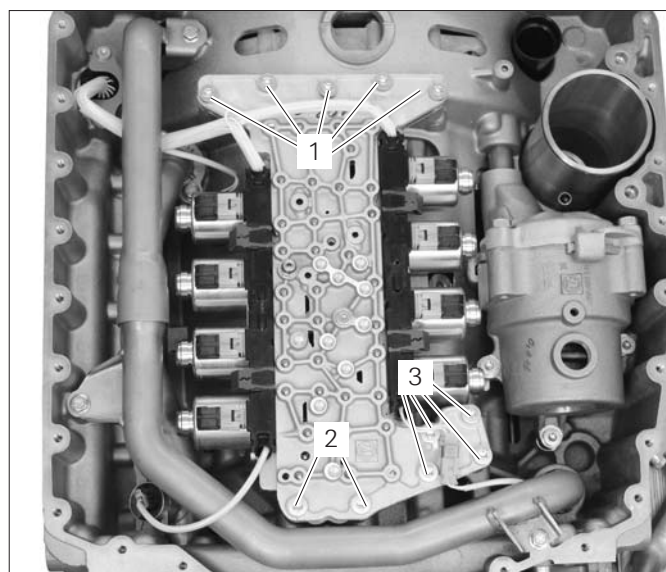


024192

- 6 Screw out eleven TORX screws (1, 2, 3) from hydraulic control unit.

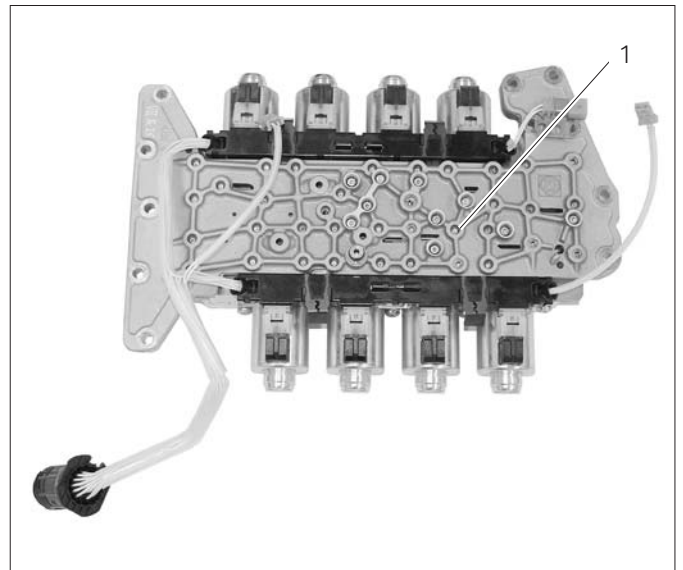
CAUTION

The shift control unit must be secured against falling down.



025027

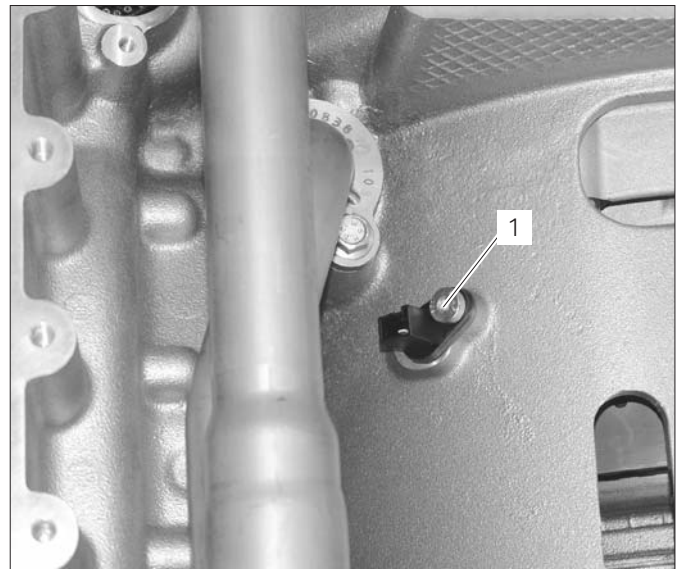
- 7 Remove hydraulic control unit **(1)**.



024193

2.3.5 Remove the Inductive Sensor Turbine

- 1 Unscrew the TORX screw **(1)**.



025028

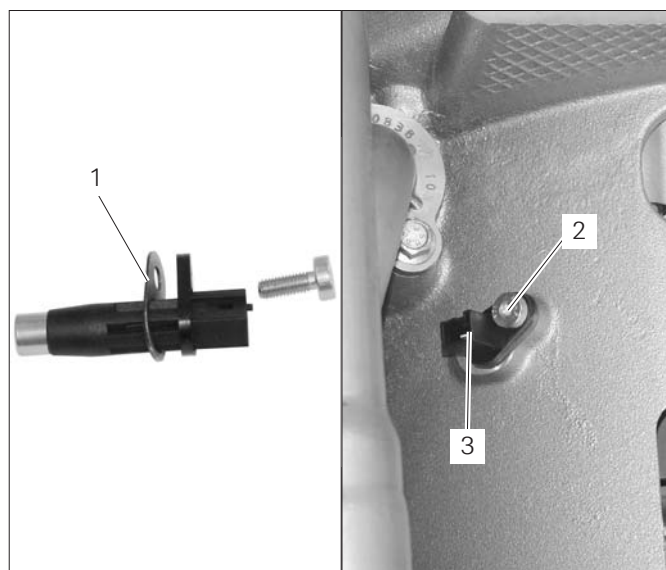
- 2 Take out inductive sensor turbine **(1)**.



025029

2.3.6 Install the Inductive Sensor Turbine

- 1 Slide spacer plate (1) onto inductive sensor.
- 2 Insert inductive sensor (3) into the transmission housing.
- 3 Screw in a TORX screw M6x17 (2) and tighten. Tightening torque: **8.5 Nm**



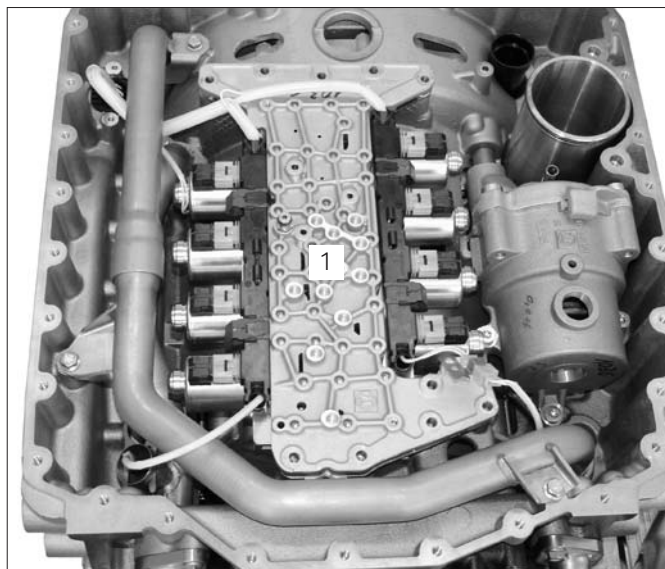
025029/025028

2.3.7 Install the Hydraulic Transmission Control Unit

- 1 Insert hydraulic control unit (1) into transmission housing.

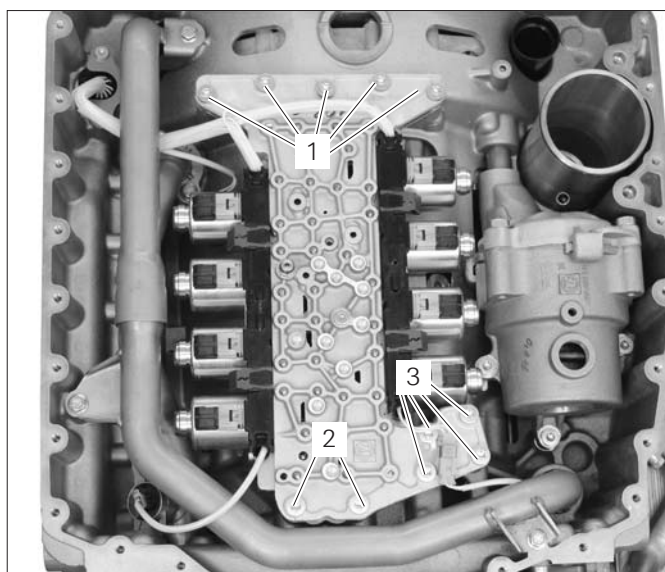
CAUTION

The shift control unit must be secured against falling down.



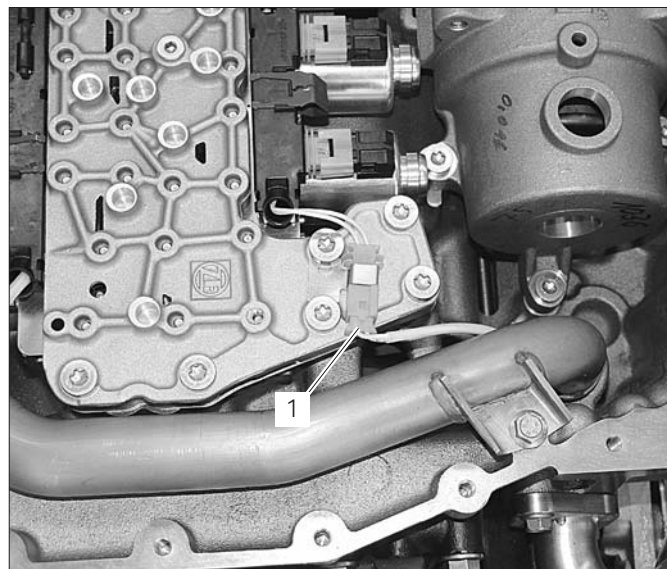
025030

- 2 Screw eleven TORX screws (1, 2, 3) into hydraulic control unit and tighten. Tightening torque: **20 Nm**



025027

- 3 Plug in the inductive sensor output connector **(1)**.



025031

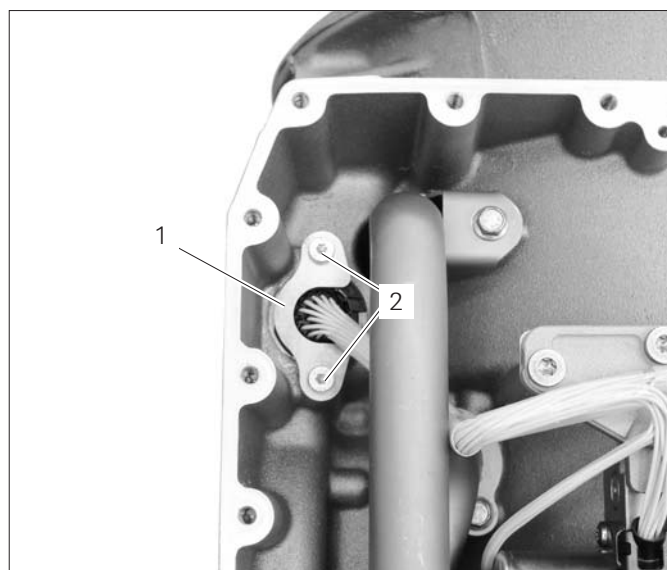
- 4 Insert transmission connector **(1)**.



024191

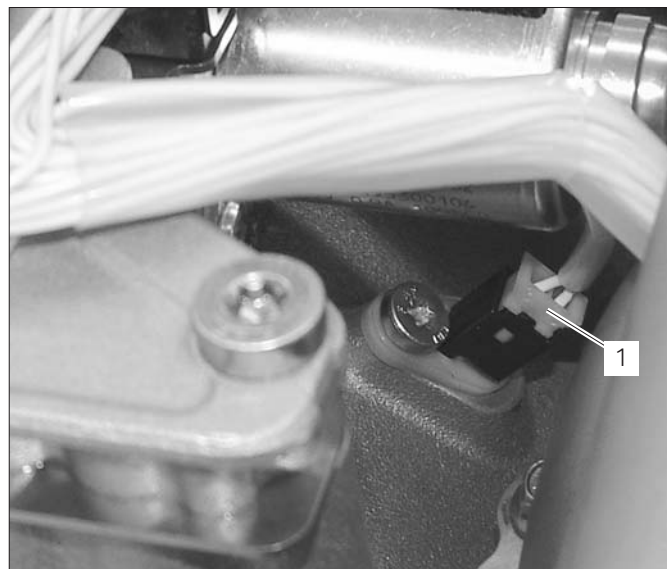
- 5 Fit fixing plate **(1)**.

- 6 Screw in two TORX screws M6x17 **(2)** and tighten.
Tightening torque: **8.5 Nm**



024200

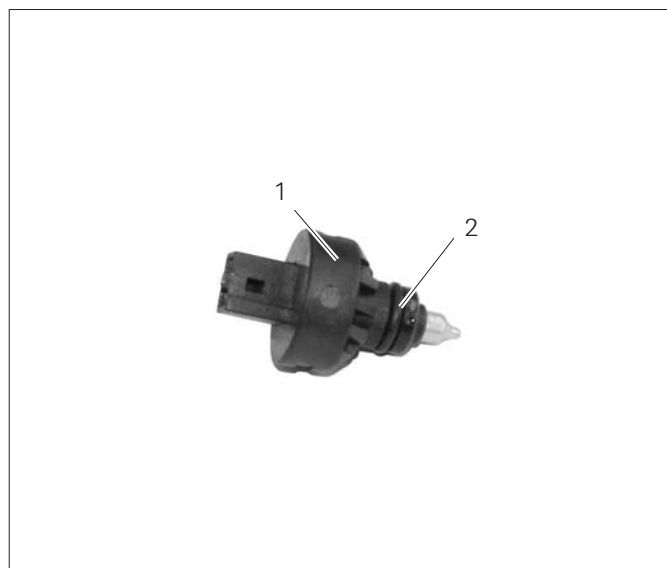
- 7 Plug in the inductive sensor turbine connector **(1)**.



024192

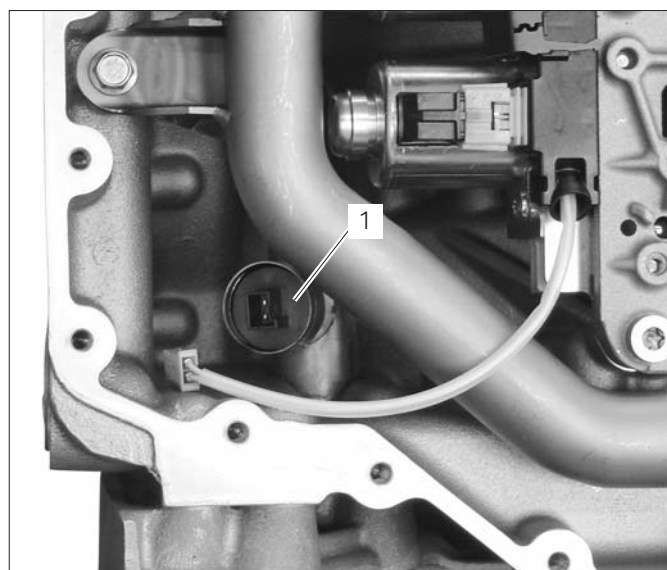
2.3.8 Install the Temperature Sensor

- 1 Coat new O-ring **(2)** of temperature sensor **(1)** with technical Vaseline.
- 2 Fit O-ring **(2)** to temperature sensor **(1)**.



024198

- 3 Insert temperature sensor **(1)**.



025001

- 4 Fit the securing clamp **(1)**.



024196

- 5 Plug in the temperature sensor connector **(1)**.



025002

2.3.9 Install the Suction Filter

- 1 Coat new O-ring **(1)** with technical Vaseline.
- 2 Fit O-ring **(1)** to suction filter **(2)**.



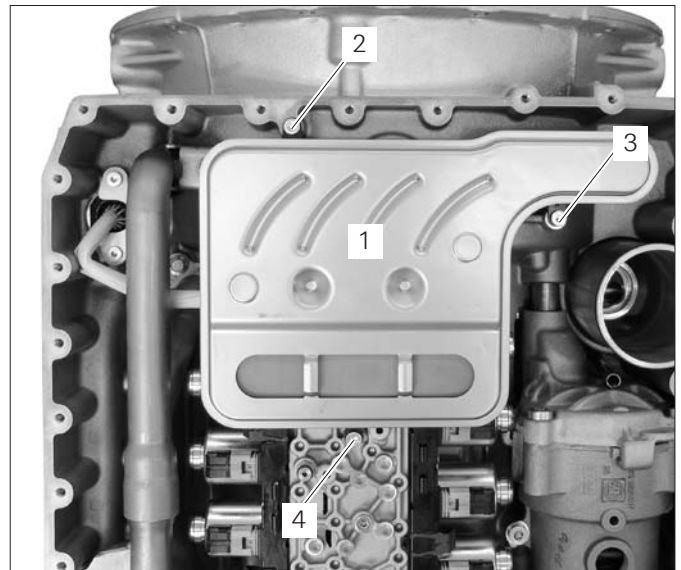
025026

- 3 Insert suction filter (1).

CAUTION

When inserting the suction filter, the cable harness must not be squashed.

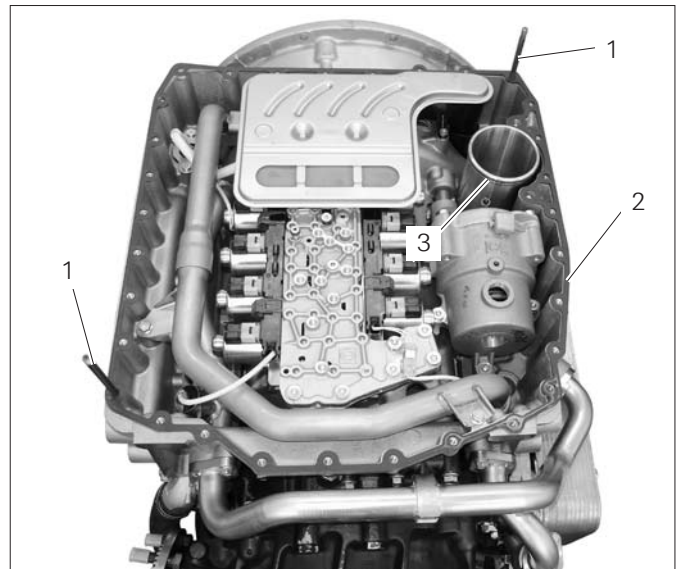
- 4 Screw in three TORX screws M8x25 (2, 3, 4) and tighten.
Tightening torque: **9.5 Nm**



025025

2.3.10 Mount the Oil Pan

- 1 Position gasket (2) for oil pan.
- 2 Screw in two guide screws M8 (1).
- 3 Check two O-rings on oil tube (3); if required, replace.



025036

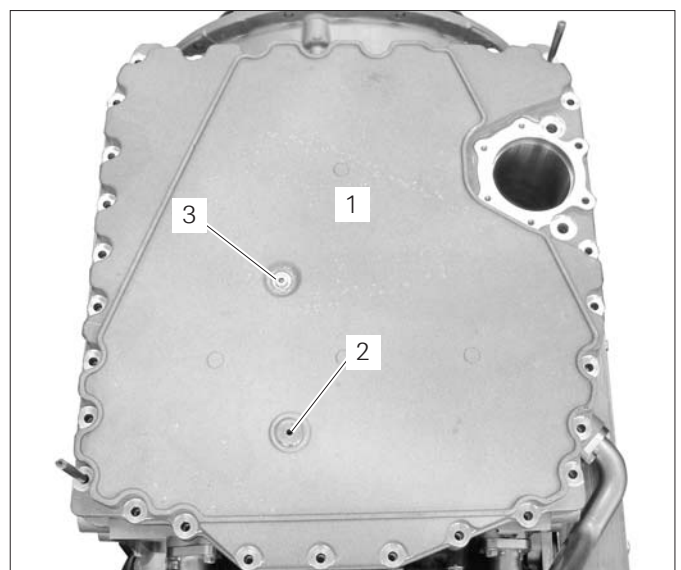
- 4 Carefully position oil pan (1).

CAUTION

When positioning the oil pan, ensure that the O-ring of the oil tube is in proper position and is not damaged.

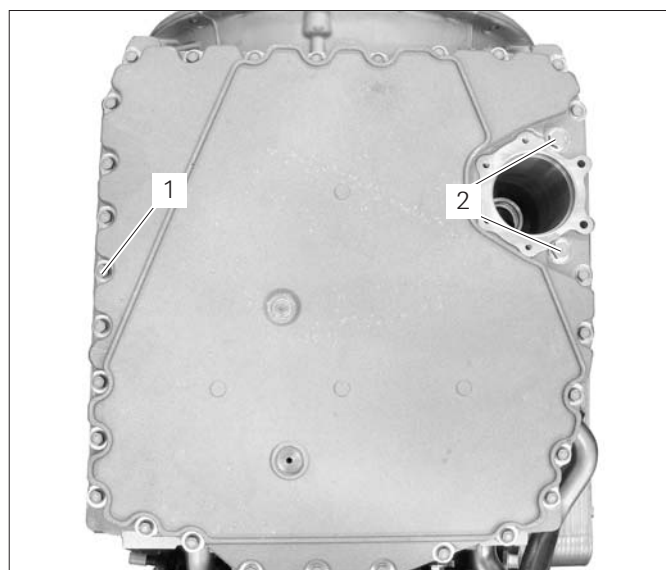
NOTE

The converter drain valve (2) and the nozzle of the pressure check point (3) must be in proper position.



025037

- 5 Screw in 29 hex-head screws M8 **(1)** at circumference of oil pan by hand - do not tighten yet. Replace guide screws with M8 hex-head screws.
- 6 Screw in two M10x53 hex-head screws **(2)** and tighten.
Tightening torque: **46 Nm**
- 7 Tighten 29 hex-head screws M8x30 **(1)** at circumference of oil pan.
Tightening torque: **23 Nm**



025038

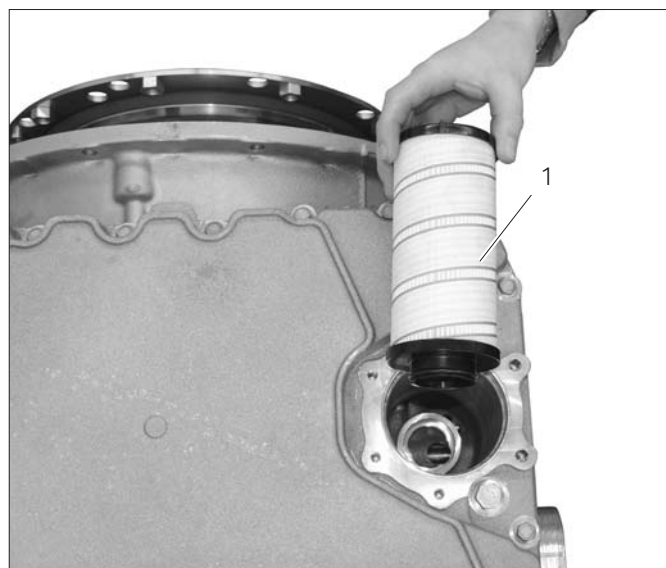
- 8 Insert new filter **(1)**.

CAUTION

Ensure correct fit of O-rings at filter **(1)**.

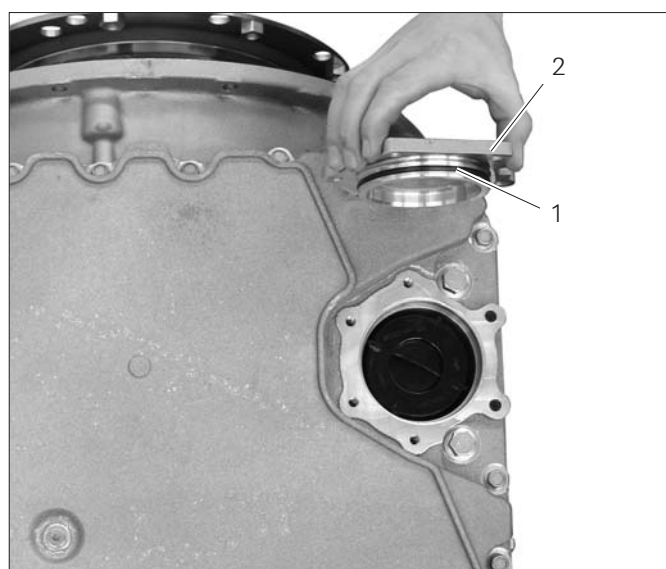
NOTE

Refer to Chapter 2.1 "Replacing Filter" when inserting the new filter.



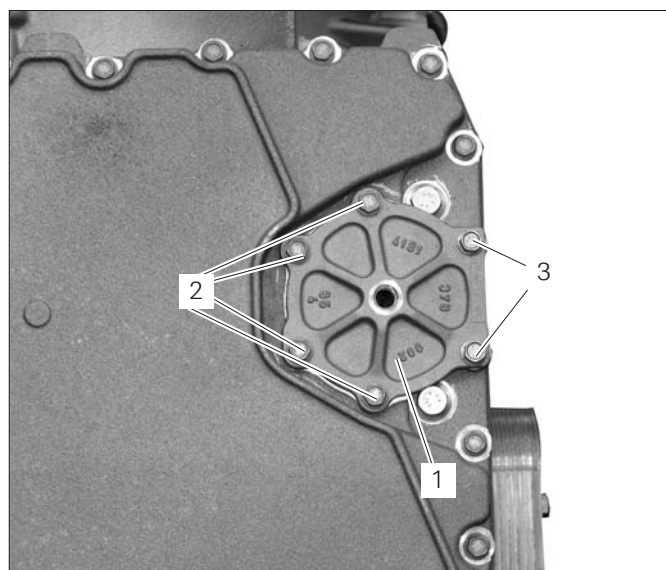
025039

- 9 Coat O-ring **(1)** with technical Vaseline.
- 10 Insert new O-ring **(1)** in the filter cover **(2)**.



025040

- 11 Position filter cover **(1)**.
- 12 Screw in four M8x30 hex-head screws **(2)** and tighten.
Tightening torque: **23 Nm**
- 13 Screw in two M8x55 hex-head screws **(3)** and tighten.
Tightening torque: **23 Nm**



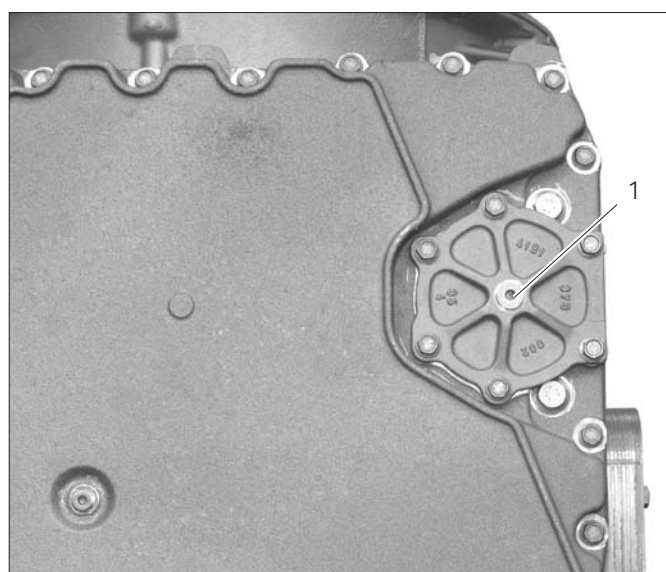
025016

- 14 Coat O-ring **(1)** with technical Vaseline.
- 15 Fit new O-ring **(1)** to screw plug.



024194

- 16 Screw in screw plug M14x1.5 **(1)** and tighten.
Tightening torque: **25 Nm**

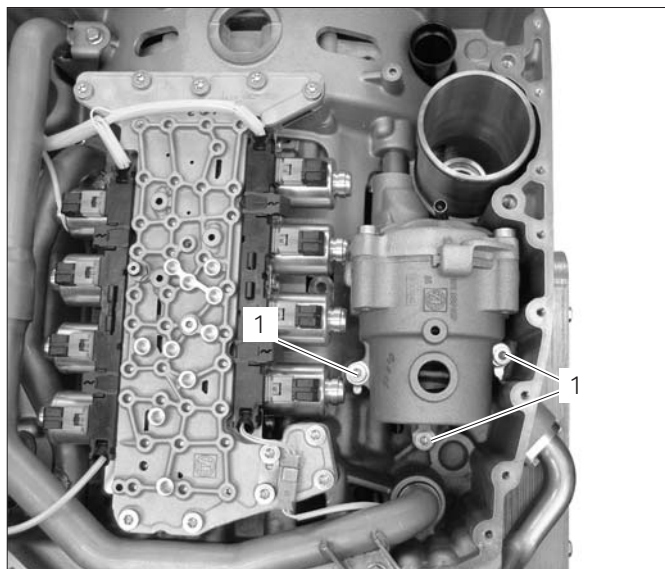


025022

2.4 Replace the Retarder Accumulator

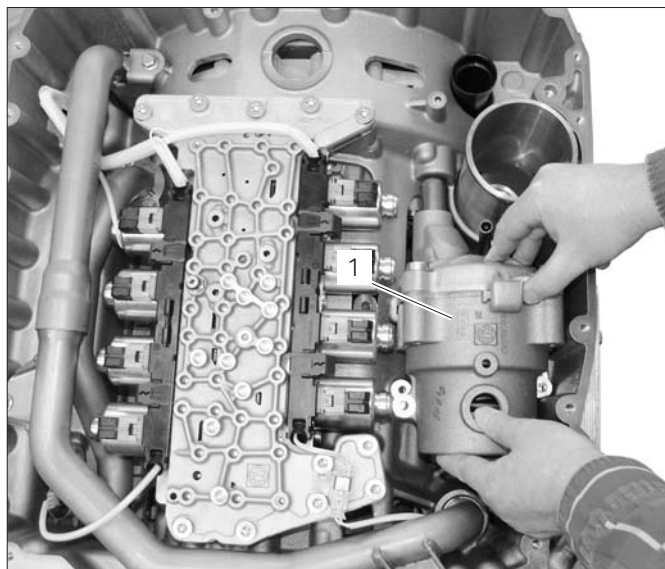
2.4.1 Remove the Retarder Accumulator

- 1 Unscrew three TORX screws (1).



025032

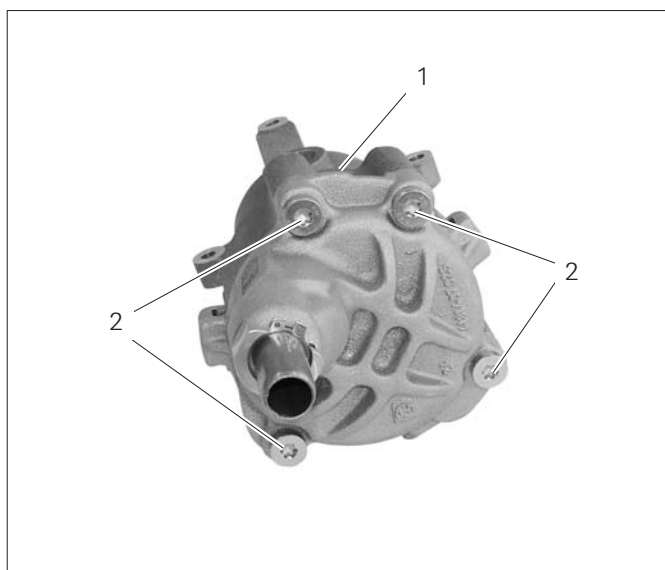
- 2 Pull retarder accumulator (1) in direction of output and remove.



025033

**DANGER**

The four TORX screws (2) must only be opened with the corresponding counter support. Failure to do so leads to a considerable risk of injury.

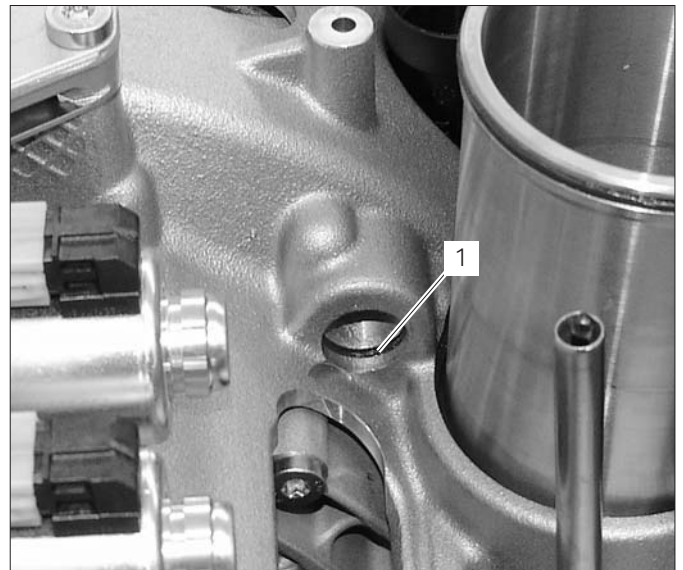


025034

2.4.2 Installing the Retarder Accumulator

1 Coat new O-ring **(1)** with technical Vaseline.

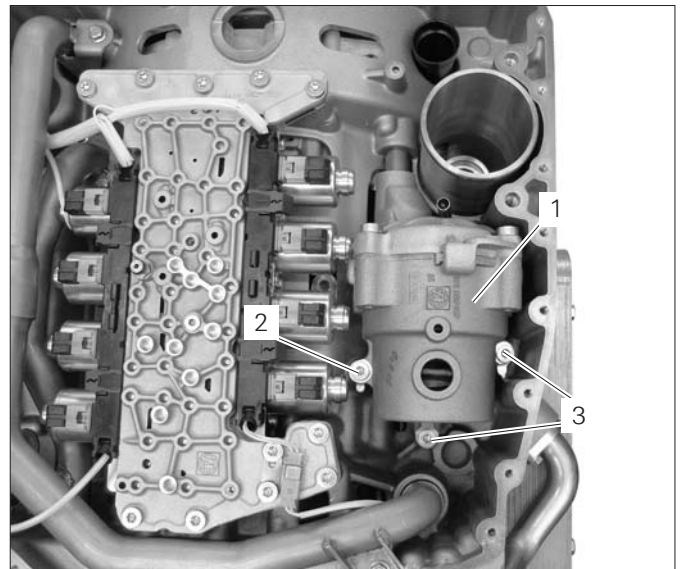
2 Insert O-ring **(1)**.



025035

3 Insert retarder accumulator **(1)**.

4 Screw in three TORX screws **(2, 3)** M8x35.
Tightening torque: **20 Nm**



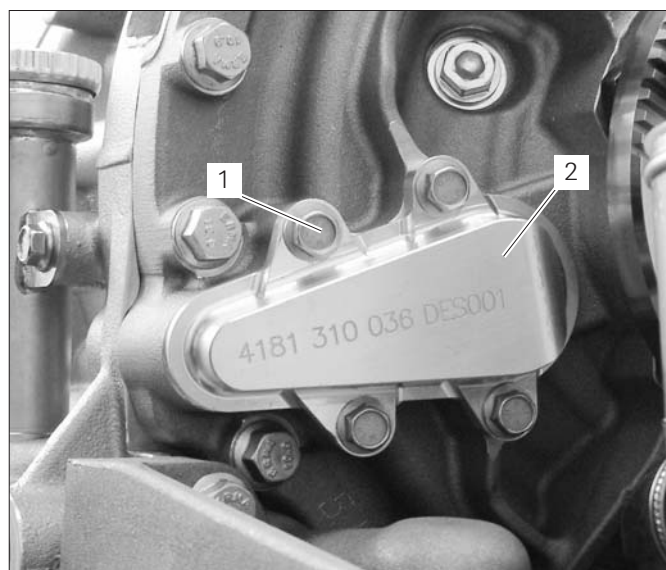
025032

2.5 Replace the Inductive Sensor Output

2.5.1 Remove the Inductive Sensor Output (Coaxial Transmission)

1 Remove four hex-head screws M8 (1).

2 Remove cover (2).



025005

3 Take out seal (2) from inductive sensor cover (1).



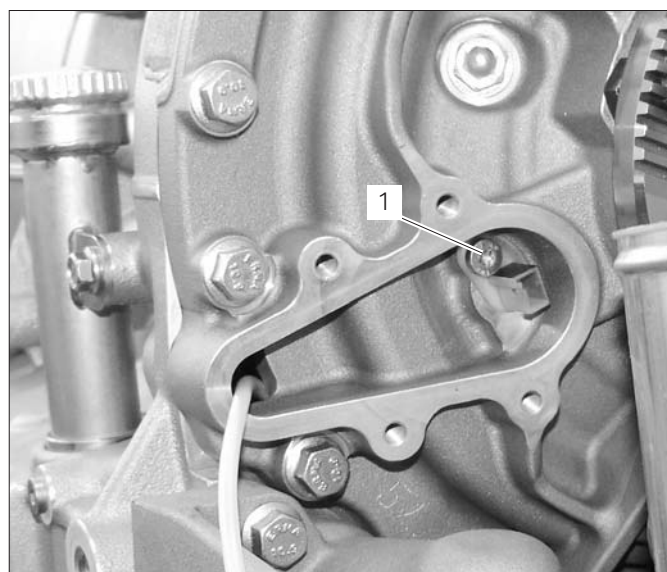
024189

4 Pull off connector (1).



025004

- 5 Unscrew one TORX screw M6 (1).



025003

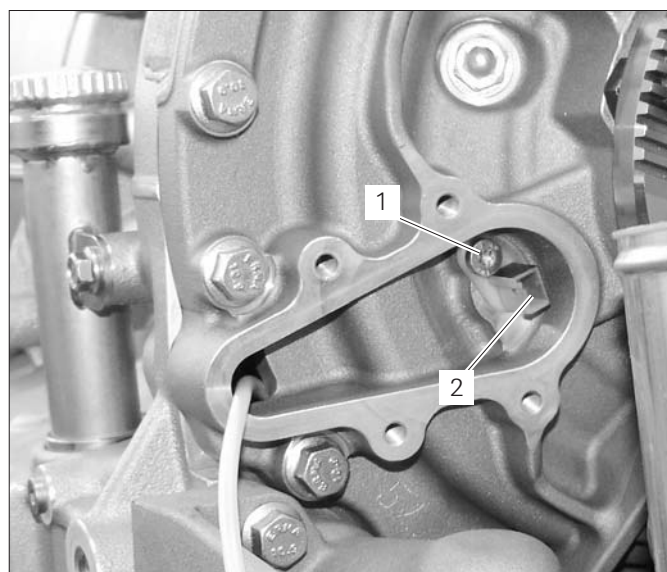
- 6 Take out inductive sensor output (1).



025043

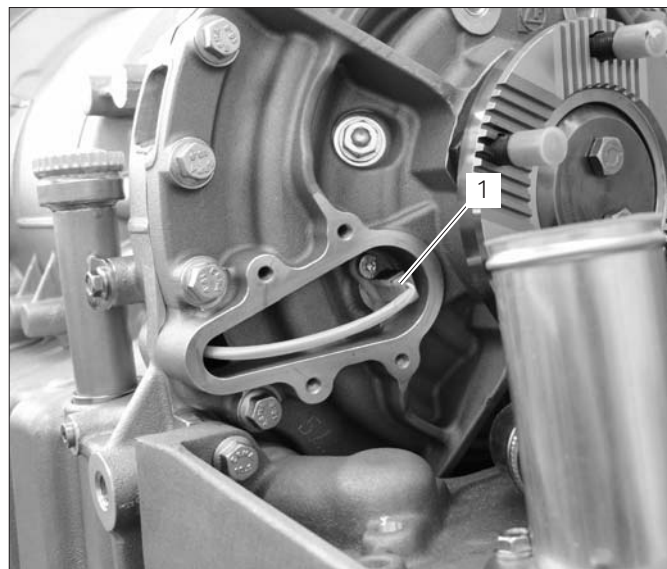
2.5.2 Install the Inductive Sensor Output (Coaxial Transmission)

- 1 Insert new inductive sensor output **(2)**.
- 2 Screw in TORX screw M6x17 **(1)** and tighten. Tightening torque: **9.5 Nm**



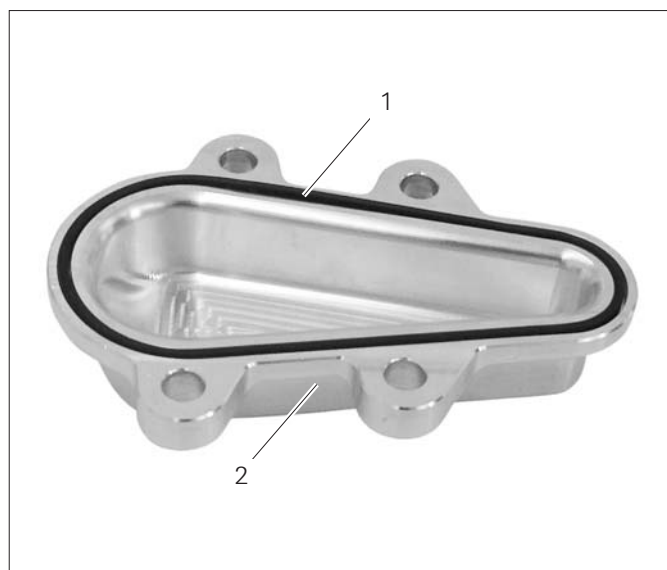
025003

- 3 Insert connector **(1)**.



025004

- 4 Coat new seal **(1)** with technical Vaseline.
- 5 Insert seal **(1)** in inductive sensor cover **(2)**.



024190

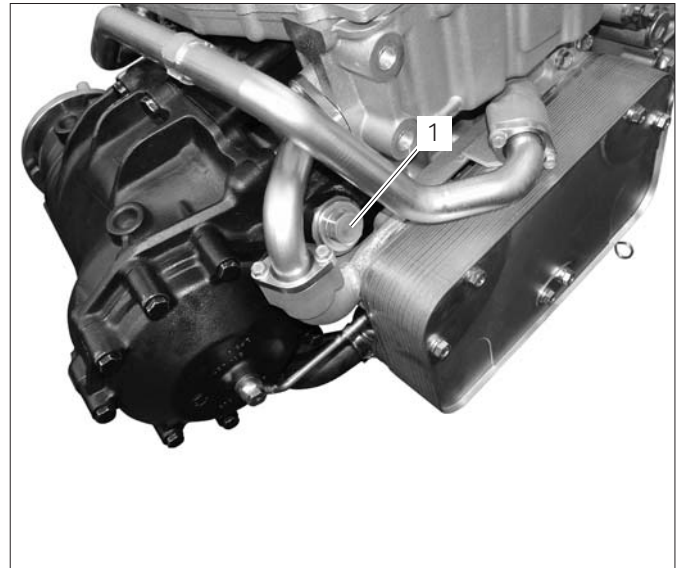
- 6 Position cover **(2)**.
- 7 Screw in four M8x30 hex-head screws **(1)** and tighten.
Tightening torque: **23 Nm**



025005

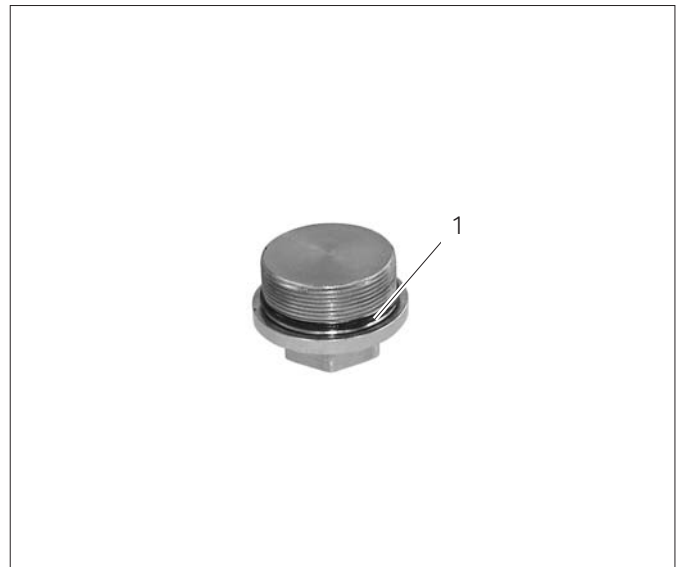
2.5.3 Remove the Inductive Sensor Output (Angle Drive)

1 Unscrew screw plug (1).



025041

2 Remove O-ring (1).



025042

3 Pull off connector (1).

4 Unscrew one TORX screw M6 (2).



025044

- 5 Take out inductive sensor output **(1)**.



025043

2.5.4 Install the Inductive Sensor Output (Angle Drive)

- 1 Insert inductive sensor output **(1)** into the transmission housing.



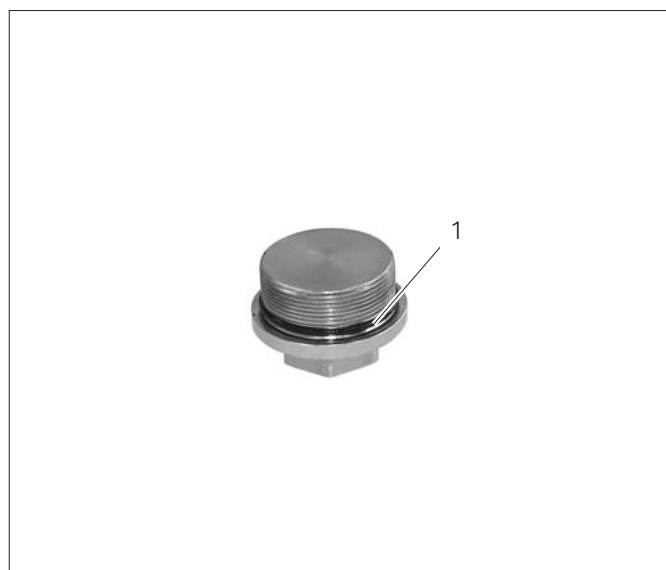
025043

- 2 Screw in TORX screw M6x17 **(2)** and tighten. Tightening torque: **9.5 Nm**
- 3 Insert connector **(1)**.



025044

- 4 Coat O-ring **(1)** with technical Vaseline.
- 5 Fit O-ring **(1)** to screw plug.



025042

- 6 Screw in screw plug M42x1.5 (1).
Tightening torque: **120 Nm**



025041

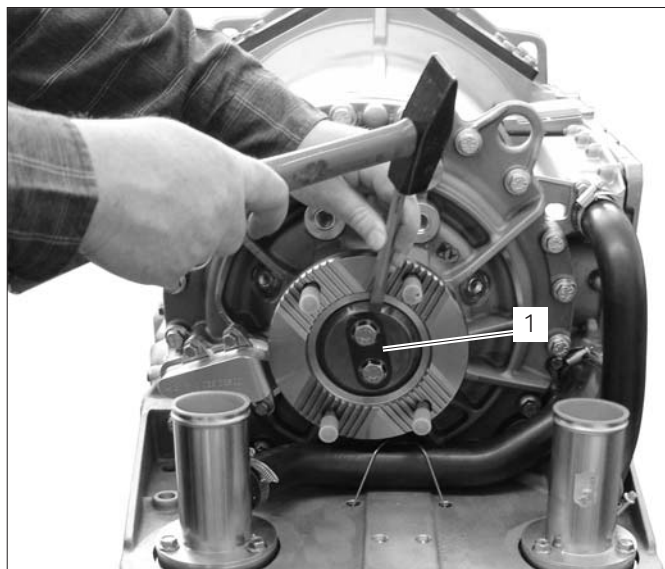
2.6 Replace the Shaft Sealing Ring Output

2.6.1 Remove the Shaft Sealing Ring

NOTE

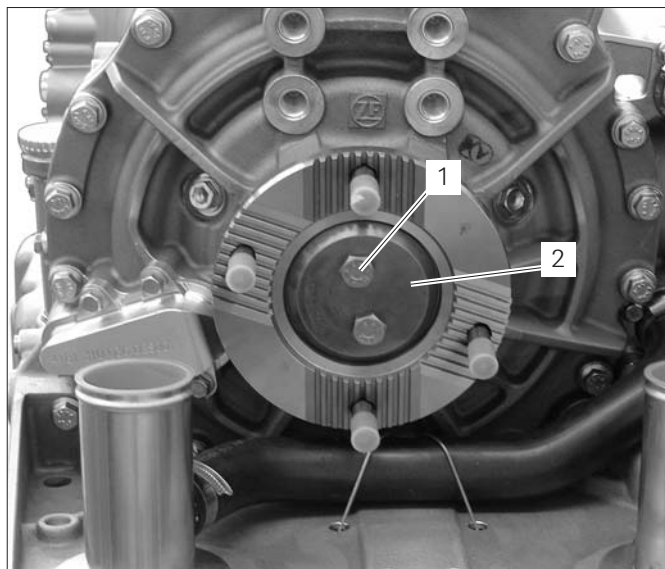
The procedure for a transmission equipped with angle drive is identical.

- 1 If necessary, remove locking plate **(1)** using a suitable tool.



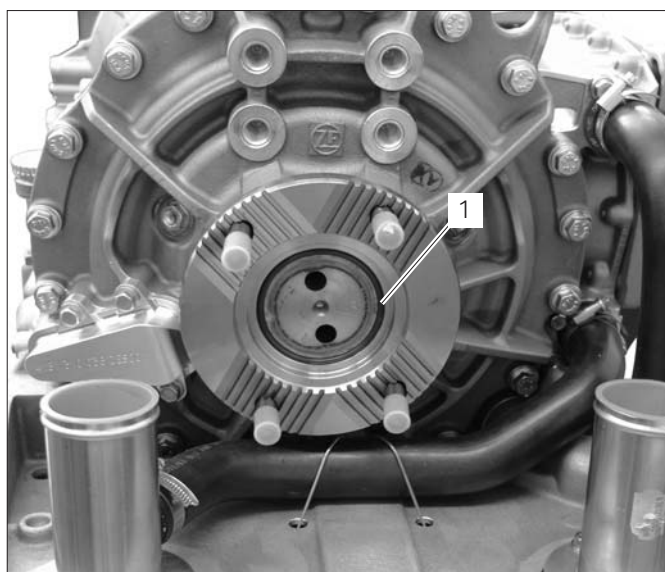
025014

- 2 Unscrew two hex-head screws **(1)** from flange.
- 3 Take off fixing plate **(2)**.



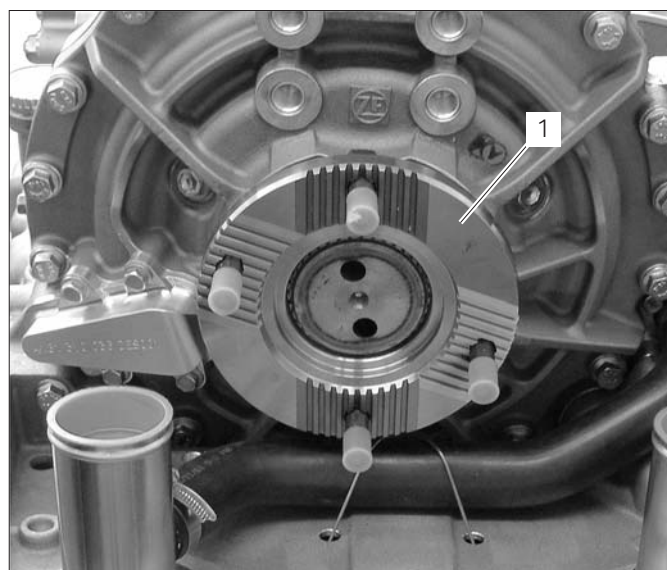
025006

- 4 Remove O-ring **(1)**.



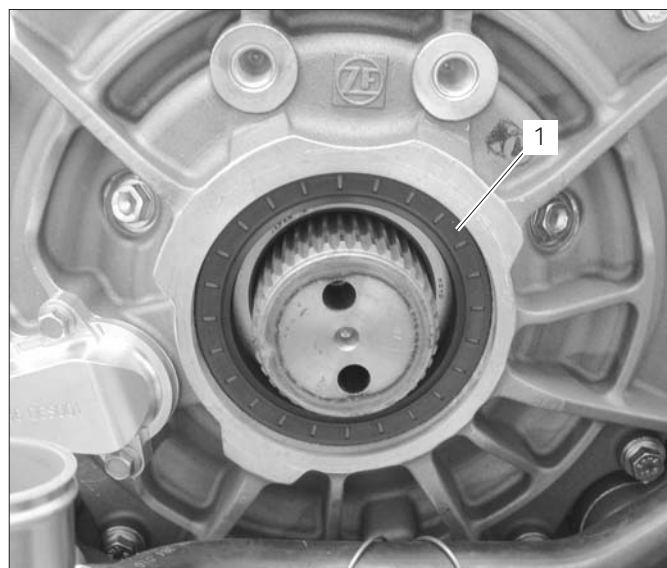
025011

- 5 Pull off output flange (1).



025007

- 6 Remove shaft sealing ring (1) using a suitable tool.



025008

2.6.2 Install the Shaft Sealing Ring

NOTE

The procedure for a transmission equipped with angle drive is identical.

- 1 Position new shaft sealing ring on tool 1X56 138 625.
- 2 Drive shaft sealing ring in until firmly home using tool 1X56 138 625.



025009



025010

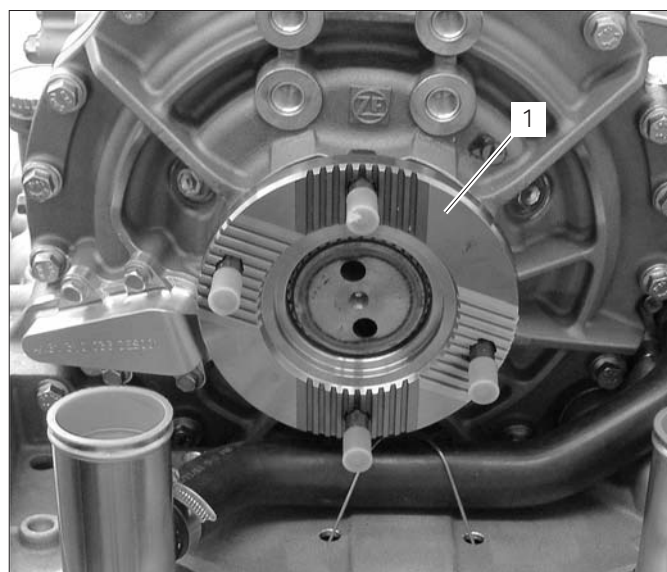
NOTE

The installation position of the shaft sealing ring (1) is determined by the tool.



025008

- 3 Slide on output flange (1).

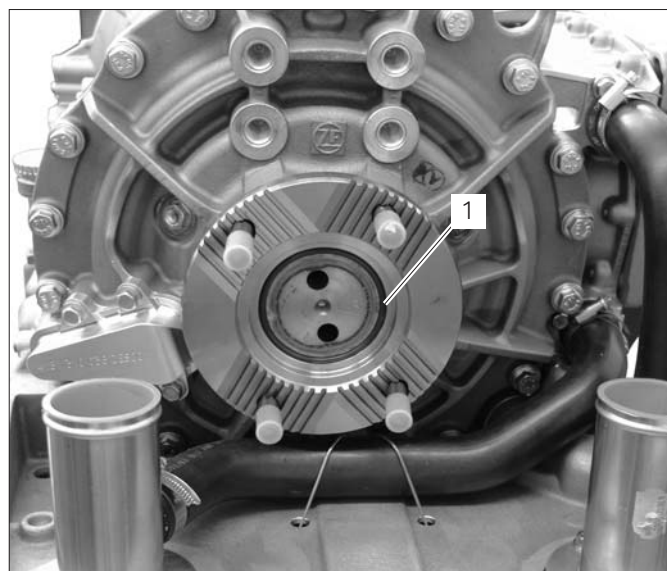


025007

- 4 Insert new O-ring (1).

NOTE

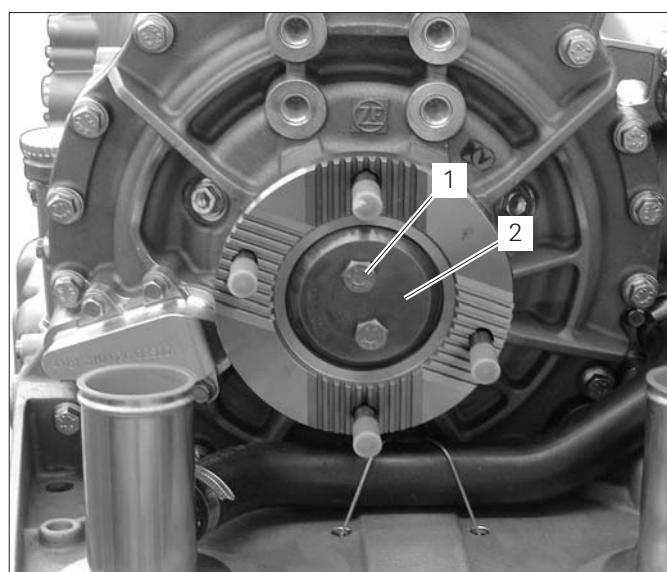
O-ring (1) must be dry.



025011

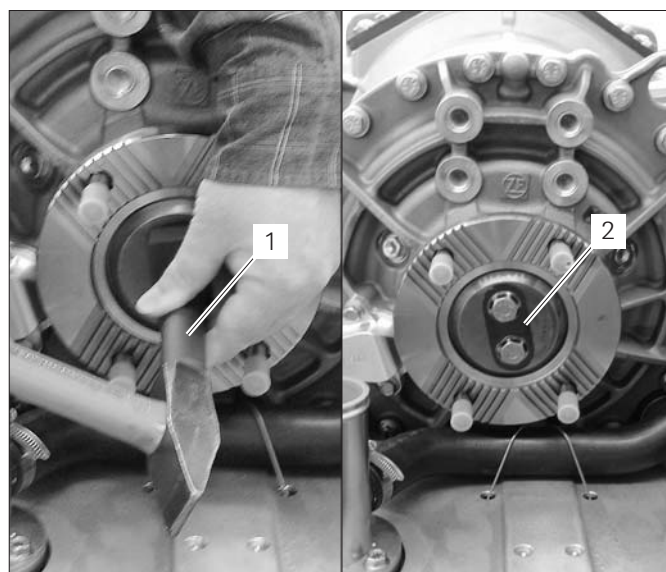
- 5 Position fixing plate (2).

- 6 Screw in two M12x60 hex-head screws (1) and tighten.
Tightening torque: **80 Nm**



025006

- 7 Drive locking plate **(2)** part no. 4132 304 015
using tool 1X56 137 452 **(1)**.

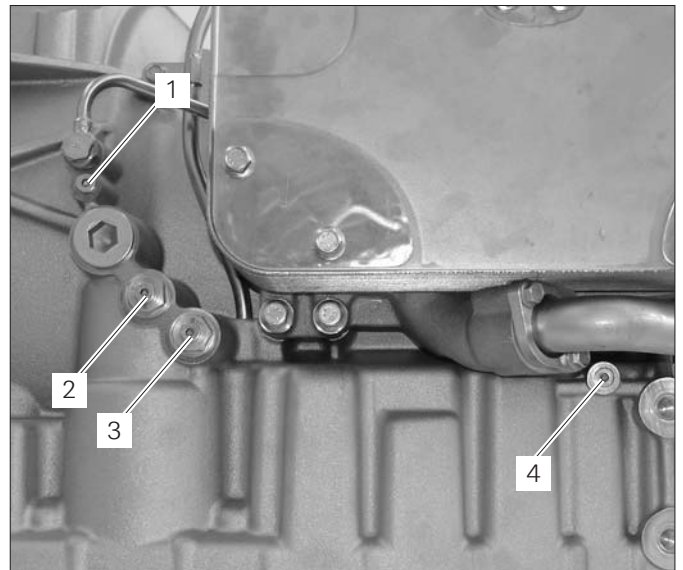


025012/025013

2.7 Pressure Test

Pressure test with the transmission fitted in the vehicle:

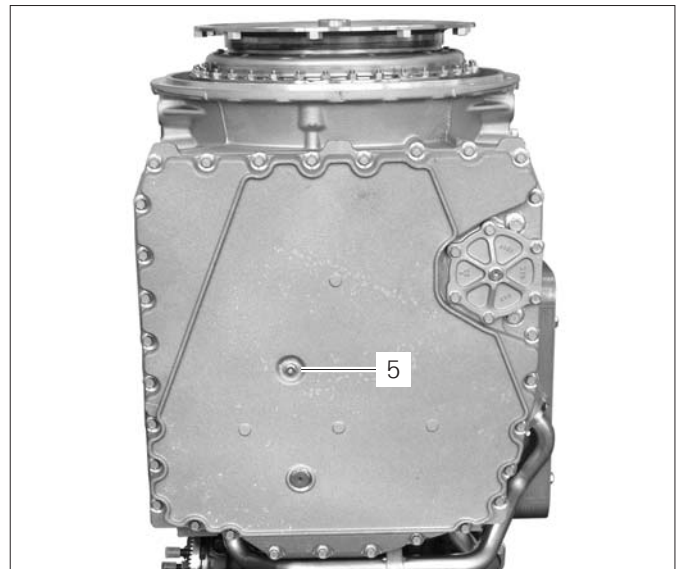
- 1 Establish the pressure measuring connections required for the testing. Unscrew the screw plug and screw in the test manometer (gage).
- 2 Test manometer **1P01 136 670** (up to 25 bar)
- 3 Test manometer **1P01 137 856** (up to 10 bar)



025048

Pressure measuring connections

- 1 = Lubricating pressure **PD8**
0,2 - 1,5 bar
 - 2 = Main pressure **PHD**
20 - 25 bar
 - 3 = Pressure before filter **PVF**
20,2 - 25 bar
 - 4 = Pressure after retarder oil cooler **PD6**
0,5 - 4,0 bar
 - 5 = Converter counterpressure **A8**
4 - 6 bar
- 4 Carry out pressure test.
 - 5 After pressure measurement remove test manometer.
 - 6 Screw in five screw plugs M10x1 with new copper sealing rings.
Tightening torque: **12 Nm**



025015

NOTE

Find an excerpt from the inspection protocol in the following section Customer Service functional check shown.

The **latest** inspection protocol on the Customer Service functional check.

The EcoLife can be ordered with the print no.: 4181 754 103 or via the ZF-ServiceLine under the following address:

<https://serviceline.zf.com/serviceline/>

Bus / City- and line service bus / EcoLife / Documentation / Test Rig / Customer Service Functional Check

 N - FN	Customer Service Functional Check 	Inspector: _____ Date: _____														
Transmission: Parts list: Transmission no.:																
ECU: Parts list: ECU no.:																
Customer:																
Preparation of transmission for test run: The test run to be performed without load on output The test run must be carried out either with Ecofluid A Plus (TE-ML 14 E) or with Ecofluid Life (TE-ML 20) . Before the test run starts, the original pressure filter of the transmission is to be replaced with a separate test bench filter. This test bench filter corresponds to the original pressure filter of the transmission and, depending on the degree of contamination, it can be used for several test runs. <u>The condition of the test filter can be determined by measuring main pressure (PHD) and pressure before filter (PVF). The allowed pressure difference is max. 0,8 bar. The test has to be performed with a sump temperature between 50 °C - 70 °C</u> The following steps are required if the transmission software status is lower than version AP 44: 1. Read out and note down the values for torque converter multiplication ratio (mue) _____ and retarder calibration torque (Nm) _____ via Testman 2. Completely program transmission ECU with the test bench program.																
Note: For transmission software above or equal to AP 44, the test program is already part of the programming; thus, items 1 and 2 are not relevant. ☐																
Phase 1 <u>System check 1 when idling</u> (turbine speed = 620 rpm) * LL = lower limit ** UL = upper limit 1. Shift through all gears 2 or 3 times R / 1 / 2 / 3 / 4 / 5 / 6 /WK (converter lock-up clutch) / Ret. 2. Shift transmission into Neutral and insert measured values <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 16.6%;">PHD (bar) LL* - UL** 9.0 - 11.0 ACTUAL</th> <th style="width: 16.6%;">PA 8 (bar) LL - UL 4.5 - 6.0 ACTUAL</th> <th style="width: 16.6%;">PD 6 (bar) LL - UL 0.5 - 4.0 ACTUAL</th> <th style="width: 16.6%;">PD 8 (bar) LL - UL 0.2 - 1.5 ACTUAL</th> <th style="width: 16.6%;">QOL (L/min) LL - UL 20 - 40 ACTUAL</th> <th style="width: 16.6%;">TSUE (°C) LL - UL 20 - 60 ACTUAL</th> </tr> </thead> <tbody> <tr> <td style="height: 30px;"></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table>			PHD (bar) LL* - UL** 9.0 - 11.0 ACTUAL	PA 8 (bar) LL - UL 4.5 - 6.0 ACTUAL	PD 6 (bar) LL - UL 0.5 - 4.0 ACTUAL	PD 8 (bar) LL - UL 0.2 - 1.5 ACTUAL	QOL (L/min) LL - UL 20 - 40 ACTUAL	TSUE (°C) LL - UL 20 - 60 ACTUAL								
PHD (bar) LL* - UL** 9.0 - 11.0 ACTUAL	PA 8 (bar) LL - UL 4.5 - 6.0 ACTUAL	PD 6 (bar) LL - UL 0.5 - 4.0 ACTUAL	PD 8 (bar) LL - UL 0.2 - 1.5 ACTUAL	QOL (L/min) LL - UL 20 - 40 ACTUAL	TSUE (°C) LL - UL 20 - 60 ACTUAL											
Note: After system check, bring transmission to sump temperature of 50 °C – 60 °C, e.g. actuate retarder. Sump temperature in Testman occurs delayed ☐																
Phase 2 <u>Main pressure parameterization</u> (main pressure line) Specified: Transmission in Neutral and Turbine speed approx. 1000 rpm (Testman) Note: The 6 values are first entered in Testman. After that, insert the values received from Testman in the table <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="width: 16.6%;">Current target values (mA)</th> <th style="width: 16.6%;">900</th> <th style="width: 16.6%;">700</th> <th style="width: 16.6%;">500</th> <th style="width: 16.6%;">300</th> <th style="width: 16.6%;">100</th> <th style="width: 16.6%;">0</th> </tr> </thead> <tbody> <tr> <td style="height: 30px;">PHD – actual value (bar)</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </tbody> </table> ☐			Current target values (mA)	900	700	500	300	100	0	PHD – actual value (bar)						
Current target values (mA)	900	700	500	300	100	0										
PHD – actual value (bar)																

Phase 3 System check 2 when in idle speed (turbine speed 620 rpm)

* LL = lower limit

** UL = upper limit, **WTR**= angle drive

Engine current consumption (optional) (Nm /Amp)	Gear	QOL (L/min) LL - UL 20 - 40 ACTUAL	PHD (bar) LL - UL 9.0 - 12.0 ACTUAL	PA 8 (bar) LL - UL 5.0 - 6.5 ACTUAL	PD 6 (bar) LL - UL 1.0 - 2.0 ACTUAL	PD 8 (bar) LL - UL 0.4 - 1.5 ACTUAL	Psch. WTR (bar) LL - UL 0.1 - 1.0 ACTUAL	TSUE (°C) LL - UL 50 - 60 ACTUAL
	R. WK open							
	N. WK open							
	N. WK closed							
	1. WK closed							
	2. WK closed							
	3. WK closed							
	4. WK closed							
	5. WK closed							
	6. WK closed							

☐**Phase 4** System check 3 at high speed (turbine speed 2200 rpm)

* LL = lower limit

** UL = upper limit, **WTR**= angle drive**Note:** * in 6-speed version, 1800 rpm at max.

Engine current consumption (optional) (Nm /Amp)	Gear	QOL (L/min) LL - UL 60 - 90 ACTUAL	PHD (bar) LL - UL 10.0 - 12.0 ACTUAL	PA 8 (bar) LL - UL 5.0 - 6.5 ACTUAL	PD 6 (bar) LL - UL 3.0 - 5.0 ACTUAL	PD 8 (bar) LL - UL 1.8 - 3.0 ACTUAL	Psch. WTR (bar) LL - UL 0.6 - 3.0 ACTUAL	TSUE (°C) LL - UL 50 - 60 ACTUAL
	R. WK open							
	N. WK open							
	N. WK closed							
	1. WK closed							
	2. WK closed							
	3. WK closed							
	4. WK closed							
	5. WK closed							
	6. WK closed *							

☐**Phase 5** WK - Check (converter lock-up clutch)

- Shift transmission to neutral
- Turbine speed 620 rpm
- Activate retarder via test program (Testman)
- Close converter lock-up clutch via the button in the test program (Testman)
- Converter lock-up clutch is activated correctly when n_Input (engine) is synchronous with n_turbine (converter)

Note:

Test function is automatically deactivated after an activation period (ret. and converter lock-up clutch) of approx. 20 secs.

Converter lock-up clutch function confirmed

yes

☐

no

☐

Phase 6 Retarder check (depending on the test bench's engine power)**Specified: Transmission in Neutral and turbine speed approx. 1400 rpm**

Current specification (mA)	PD 6 (bar) ACTUAL	N turb. (rpm) ACTUAL
360		
550		
450		

Retarder function confirmed yes ☐ no ☐**Phase 7 Main pressure HD****Specified: Trans. in Neutral, characteristic curve with current specification (mA) and turbine speed 1000 rpm**

Current specification (mA)	PHD (bar)				Hysteresis (bar) (Actual 1 -2)	
	Actual 1	Actual 2	LL	UL	Actual	UL
Actual 1 0			21.0	25.0		2.5
100			20.0	24.0		2.0
300			16.0	21.0		2.0
500			11.0	17.0		2.0
700			7.0	14.0		2.0
900 Actual 2			6.0	9.0		2.0

☐**Phase 8 Temperatures** (plausibility check)

TSUE (°C) (oil sump temperature)	TRTE (°C) (retarder temperature)	TECU (°C) (ECU temperature)

☐**Phase 9 Leakage check and oil fill**

- Drain test oil
- Replace test filter with new, original pressure filter
- Mount oil pipe from retarder heat exchanger (Caution! Grease O-rings slightly)
- Fill transmission with Ecofluid Life acc. to TE-ML 20 (see operating instructions)
- Ensure correct oil level
- Leakage test

Note:

Check all disconnection areas and sealing points for leakage

☐**Phase 10 Only valid for transmissions with software status below AP 44**

1. Entirely program the transmission ECU with the originally supplied software status
2. Insert the values noted down for torque converter multiplication ratio and retarder calibration torque in the corresponding EEPROM area via Testman
3. Insert the values noted down for main pressure calibration (see Phase 2) in the corresponding EEPROM area via Testman

Note:

For transmission software above or equal to AP 44, the values for main pressure calibration are written to the respective EEPROM area in an automated way during the test run.

The values for converter characteristics and retarder calibration torque are maintained
Thus, items 1 to 3 are not relevant for transmission software above or equal to AP 44.☐

3 Troubleshooting

3.1 Inspection with terminal tester 6008 006 002

Use of the terminal tester 6008 006 002 with the adapter kit 6008 206 040.

For troubleshooting purposes, the terminal tester 6008 006 002 together with the adapter kit 6008 206 040 can be connected between the transmission cable and the electronic control unit as well as between the electronic control unit and the vehicle connector.



DANGER

Driving with terminal tester and adapter cable is only permitted for test purposes and is not allowed on public roads!

CAUTION

Do not apply any voltage to the emergency switch (yellow sockets), the inductive sensor (green sockets) and the proportional valves (gear clutches, main pressure and retarder), or there will be a short circuit and failure of the concerning components. The proportional valve can handle max. 900 mA.

Carry out resistance measurements according to the table "Pin assignment with measured values at EcoLife transmission".

NOTE

Resistance values can depending on temperature. On the solenoid valves the resistance value decreases with rising temperature.

Pin assignment with measured values at EcoLife transmission

Pin at transmission connector	EcoLife	Comment	EcoLife measured value (setpoint)
1	n_Tu	Turbine speed resistance value cannot be measured, signal test with TestmanLife	-
2	n_Ab	Output speed resistance value cannot be measured, signal test with TestmanLife	-
3	VPS1	Positive supply pin control valves	-
4	TG_Sumpf	Sump temperature sensor	approx. 62 kOhm between pin 4 and 15 at (°C see page 3-3)
5	VPS2	Positive supply pin control valves	-
6	-	-	-
7	-	-	-
8	RR3	Retarder regulator valve	10-15 Ohm between pin 8 and 5 at 20 °C
9	WK(lockupclutch)	Lockup clutch control valve	10-15 Ohm between pin 9 and 5 at 20 °C
10	RHD	Main pressure control valve	10-15 Ohm between pin 10 and 5 at 20 °C
11	-	-	-
12	B	Clutch B control valve	10-15 Ohm between pin 12 and 5 at 20 °C
13	A	Clutch A control valve	10-15 Ohm between pin 13 and 5 at 20 °C
14	-	-	-
15	GM1	Ground sump temperature sensor	-
16	-	-	-
17	GM2	Ground retarder temperature sensor	-
18	TG_Ret	Retarder temperature sensor	approx. 124 kOhm between pin 18 and 17 at (°C see page 3-3)
19	F	Brake F control valve	10-15 Ohm between pin 19 and 5 at 20 °C
20	-	-	-
21	AU +5V	Positive supply pin for output speed sensor	-
22	D	Brake D control valve	10-15 Ohm between pin 22 and 5 at 20 °C
23	AU +5V	Positive supply pin for turbine speed sensor	-
24	E	Brake E control valve	10-15 Ohm between pin 24 and 5 at 20 °C

Notes: Do not supply a voltage of 24V to the control valves!!

Sump temperature tolerance table**NTC temperature sensor**

Thermometrics DKS 4261

Tolerance table – 40 °C to 150 °C

Temperature °C	R/R25	R setpoint ohm	R minimum ohm	R maximum ohm
-40	33.0042179	1650061.2	1524759.4	1784945.9
-35	23.8370981	1191746.8	1104837.5	1284978.4
-30	17.4083136	870336.7	809406.5	935479.3
-25	12.8483939	642361.4	599208.4	688346.7
-20	9.5788331	478898.2	448040.3	511676.7
-15	7.2101341	360474.0	338206.1	384054.3
-10	5.4770683	273828.6	257620.4	290940.1
-5	4.1970599	209834.0	197939.9	222353.8
0	3.2431186	162141.2	153345.4	171373.0
5	2.5260344	126290.3	119738.1	133147.7
10	1.9825385	99117.9	94203.5	104247.0
15	1.5673486	78360.3	74650.3	82221.8
20	1.2477705	62382.9	59565.0	65307.9
25	1.0000000	49995.5	47842.9	52224.0
30	0.8065651	40324.6	38671.5	42031.6
35	0.6545420	32724.1	31448.2	34038.2
40	0.5342997	26712.6	25723.2	27728.9
45	0.4386094	21928.5	21158.0	22717.9
50	0.3620081	18098.8	17496.4	18714.4
55	0.3003397	15015.6	14543.0	15497.4
60	0.2504222	12520.0	12148.0	12898.2
65	0.2098044	10489.3	10195.6	10787.0
70	0.1765668	8828.5	8596.2	9063.5
75	0.1492890	7463.8	7279.6	7649.6
80	0.1267509	6337.0	6190.7	6484.1
85	0.1080586	5402.4	5286.2	5519.1
90	0.0924884	4624.0	4531.5	4716.5
95	0.0794644	3972.9	3887.5	4058.5
100	0.0685260	3426.0	3347.4	3505.0
105	0.0593035	2964.9	2892.7	3037.7
110	0.0514982	2574.7	2508.5	2641.6
115	0.0448682	2243.2	2182.5	2304.7
120	0.0392169	1960.7	1905.0	2017.1
125	0.0343832	1719.0	1668.0	1770.8
130	0.0302352	1511.6	1464.9	1559.2
135	0.0266644	1333.1	1290.3	1376.8
140	0.0235809	1178.9	1139.7	1219.1
145	0.0209103	1045.4	1009.4	1082.3
150	0.0185906	929.4	896.4	963.4

Retarder temperature sensor

Resistance value in kOhm

Measured current: <1.2 mA

°C	Min	Setpoint	Max
-40	-	-	-
-20	830.7	1000.2	1203.7
0	281.3	329.4	385.6
20	108.3	123.8	141.4
40	46.39	51.88	57.98
60	21.73	23.83	26.12
80	10.98	11.84	12.75
100	5.9231	6.283	6.661
120	3.3786	3.533	3.692
140	2.0234	2.088	2.154
160	1.2498	1.289	1.329
180	0.7932	0.8275	0.8627

Adjusted at 150 °C 1.633 kOhm

Tau 63: < 3 s
 Operating current: < 2.5 mA
 U_B: 5 V
 Temperature range: – 40 °C to +160 °C
 (short-term +180 °C)

Measuring range: –20 °C to +180 °C
 Housing material: Ultramid TKR 4355 G7
 Color: black

3.2 Brief Description ZF-Testman

3.2.1 General Information on the User Interface

The TESTMAN diagnosis tool can be operated with the keyboard as well as the computer mouse. Thus, in relation to the application, a comfortable working environment is always ensured, be it in the workshop or also in the vehicle.

The following documentation provides you with a brief description of the user interface as well as operating instructions for mouse and keyboard.

As usually under Windows, you are enabled to jump from section to section by means of the cursor keys and to confirm entries with the Enter key. Please see Page 8 for an overview on key commands.

General Information:

Starting the diagnosis tool may take up to 30 seconds.

System requirements:

Hardware:

Prozessor: 800 MHz or higher

RAM: 256 MB or higher

Free harddisk capacity: min. 1 GB

Software:

Windows 2000 SP4

Windows XP SP2

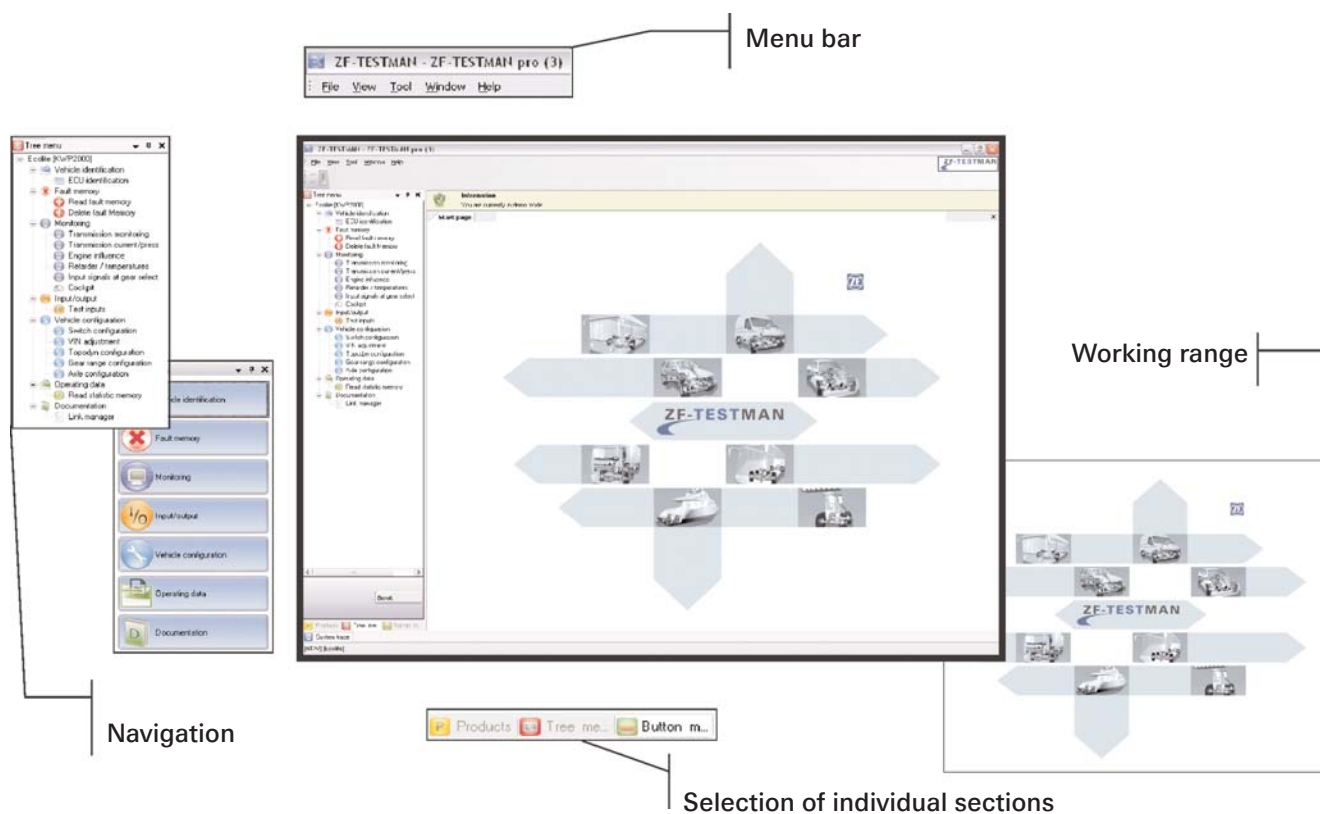
Windows Vista

Internet Explorer 5.01 or

new Windows Installer 3.0 or

new MDAC 2.8 SP1

3.2.2 Sections of the User Interface



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3.2.3 Detailed Description

1. Menu Bar

- File

- Communication control and closing the application

- View

- Setting options for different views of the entire interface

- Tool

- Change over to the demo version

- Window

- Control for all TESTMAN windows

- Help

- All about TESTMAN

2. Navigation Section

- ZF-TESTMAN offers two different navigation options; jumping back and fro is possible at any point in time
 - a. Tree structure analog to the Windows data explorer
 - b. Menu structure with big buttons as before under the previously used ZF-TESTMAN pro

3. Selection of Individual Sections

- Selection of the menu windows of the navigation area or quitting the current application

4. Working Range

- TESTMAN working range and display section.

3.2.4 Hotkeys

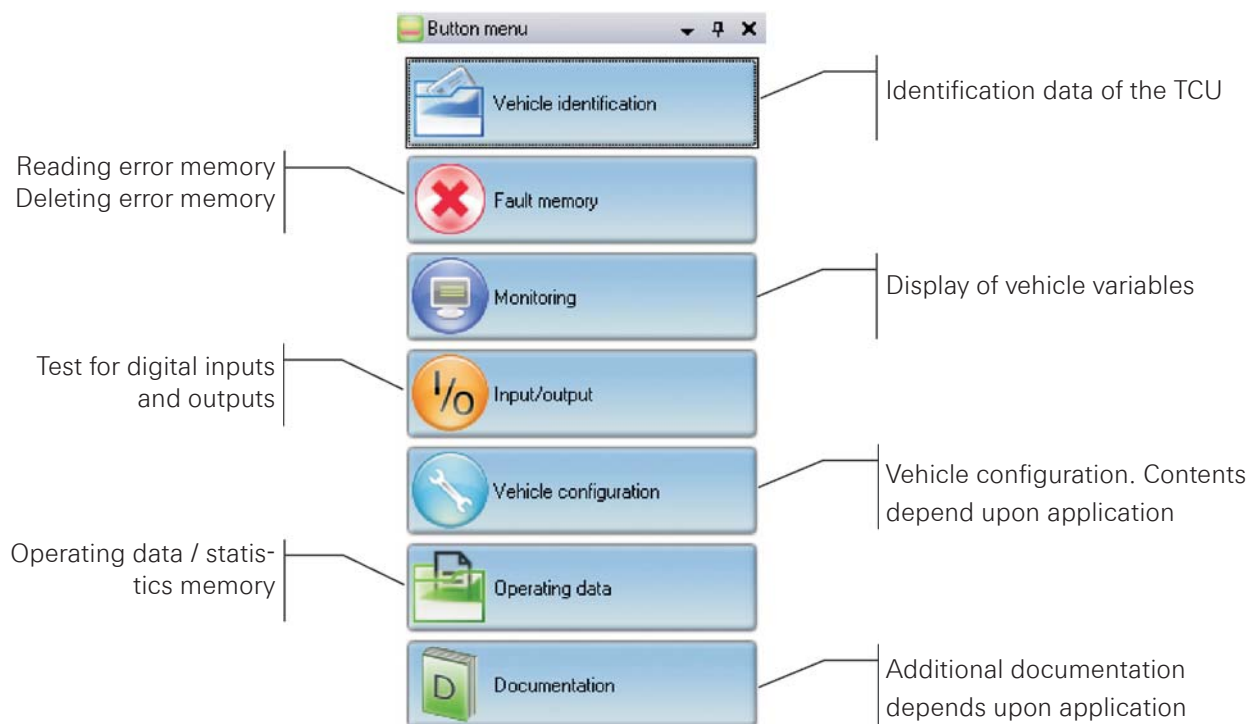
Operation Control Keys

F5	Update
F2	Setup or cancel communication
F11	Full Screen

Tastenkombinationen

Ctrl D	Project selection
Ctrl F	Tree menu
Ctrl G	Button menu
Ctrl E	System tracing

3.2.5 Functions' Overview



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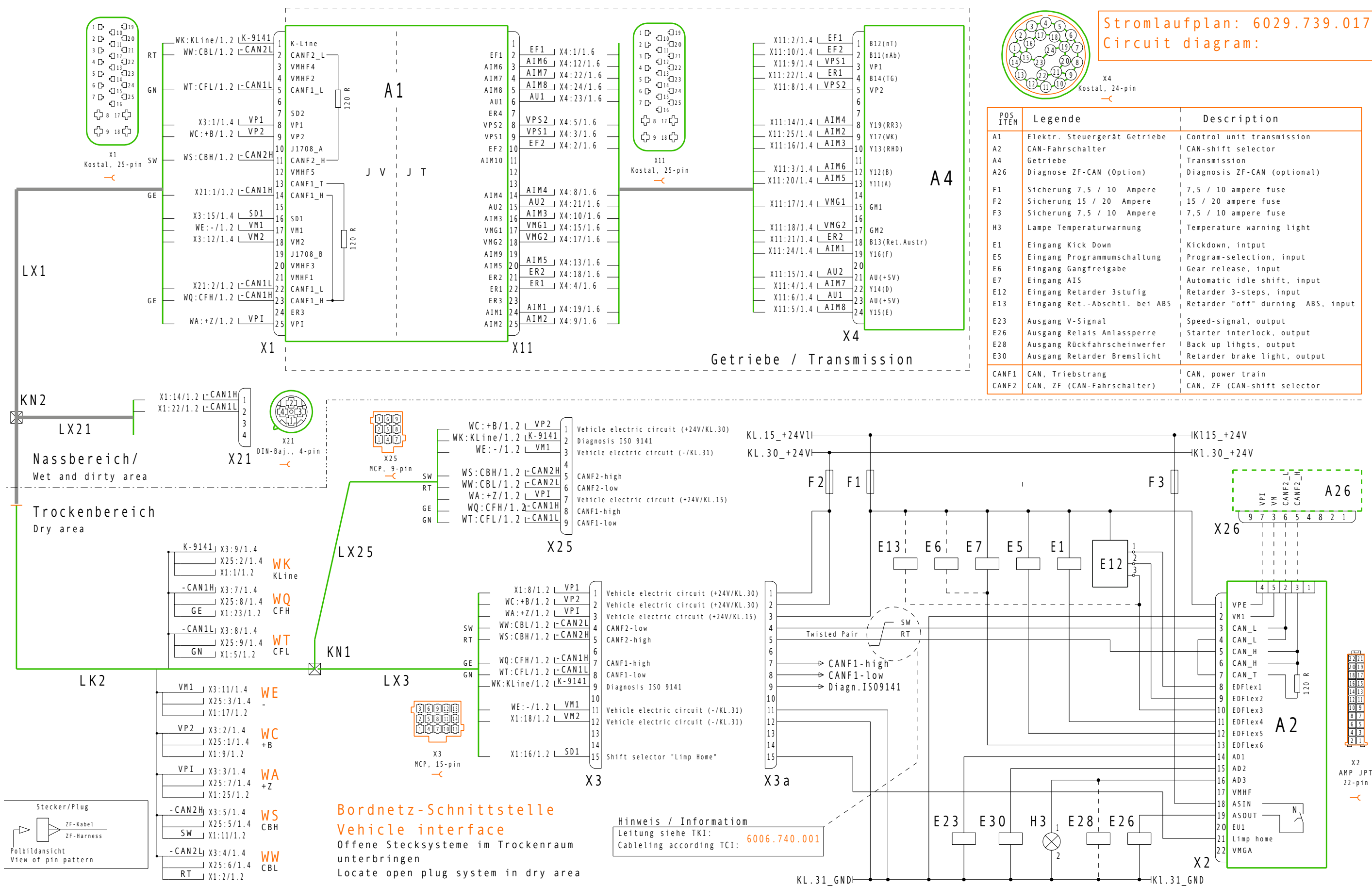


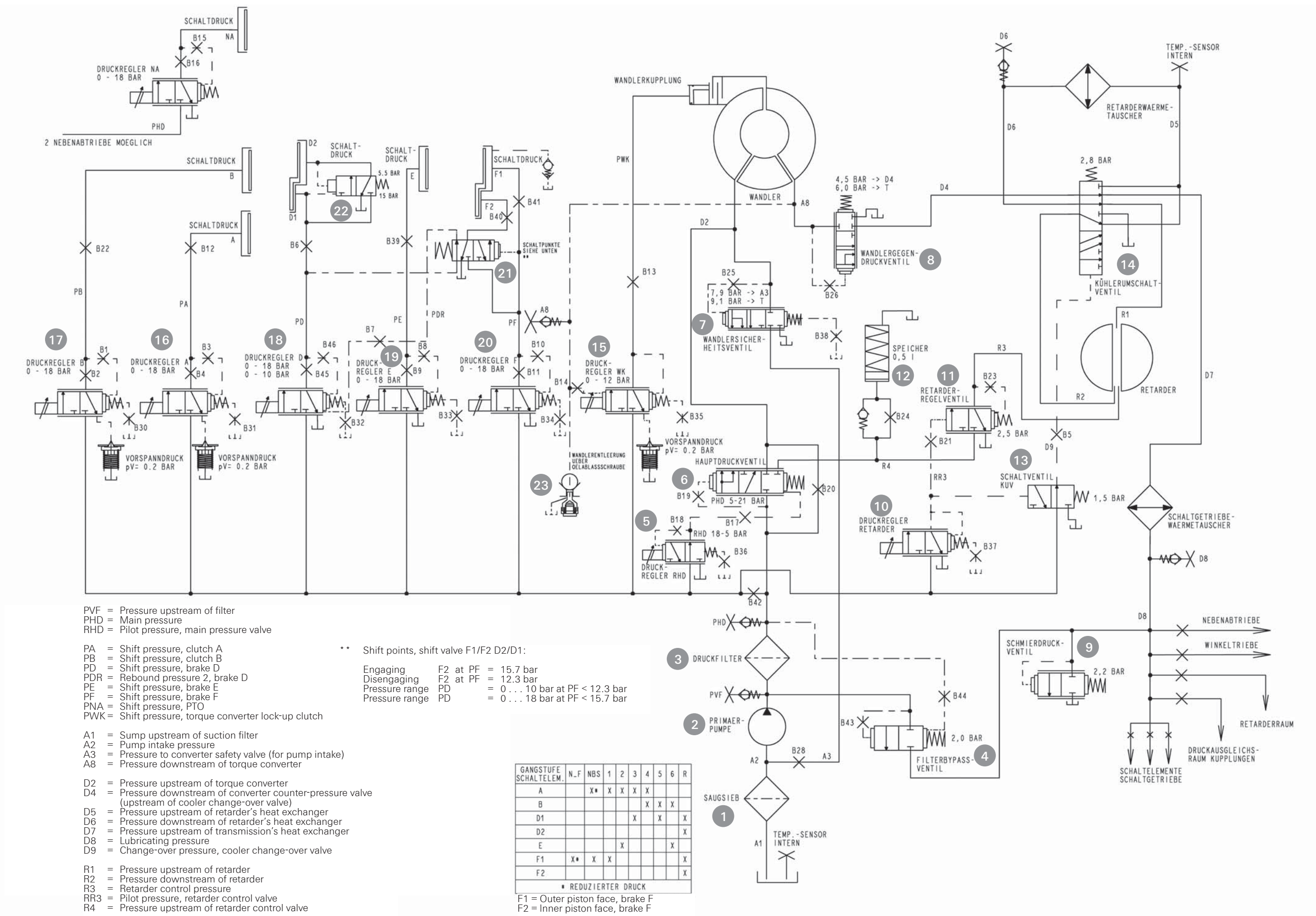
Verkabelung-Anforderungen	Harness-requirements	
Stecker, ECU, fahrzeugseitig Typ: 25pol, Kostal, Buchse (SLK/MLK) ZF-Best-Nr.: 6029 199 156 Hersteller: Fa. Kostal Hersteller Best-Nr.: siehe TKI 0000 702 303 ZF-Verarbeitungsspezifikation: 0501 700 453 Kostal-Verarbeitungsspez: DOK 000 860 29 (verbindlich) <u>Achtung:</u> Der Kabelabgang am ECU-Stecker muss nach ca. 100mm befestigt werden ! Hierzu ist eine Gewindebohrung (M8) am Getriebe-Wärmetauscher vorgesehen	Plug, ECU, vehicle-part Type: 25pin, Kostal, female (SLK/MLK) ZF-Order-no.: 6029 199 156 Manufacturer: Co. Kostal Manufacturer order-no: See TCI 0000 702 303 ZF-processing-specification: 0501 700 453 Kostal-processing-specific: DOK 000 860 29 (binding) <u>Attention:</u> The cable must be fixed ca. 100mm after cable-out from the ECU-plug ! For this is designed a threaded hole (M8) at the transmission heat-exchanger	11019 21020 311 41222 51323 61424 71525 816 917 1018 Kostal 25-pin, ECU Stecker/Plug ZF-Kabel ZF-Harness Polbildansicht View of pin pattern
Stecker, CAN-Fahrschalter Typ: 22pol, Tyco, Buchse, Jun.P.T., 2reihig ZF-Best-Nr.: 6029 199 132 Hersteller: Fa. Tyco Hesteller Best-Nr.: 929504-7 (Stecker-Gehäuse) Herteller Best-Nr.: 927771-3 (Kontaktbuchse)	Plug, CAN shift-seletor Type: 22pin, Tyco, female, jun.p.t., 2-array ZF-Order-no.: 6029 199 132 Manufacturer: Co. Tyco Manufacturer order-no: 929504-7 (plug-housing) Manufacturer order-no: 927771-3 (female terminal)	221 2015 1817 1618 1413 1214 1011 89 67 45 21 AMP JPT 22-pin, FS
Stecker, Diagnose Typ: 9pol, Tyco, Buchse, MCP, 3reihig ZF-Best-Nr.: 6029 199 157 Hersteller: Fa. Tyco Hesteller Best-Nr.: 8-968971-1 (Stecker-Gehäuse) Herteller Best-Nr.: 1-968849-1 (Kontaktbuchse)	Plug, diagnoses Type: 9pin, Tyco, female, MCP, 3-array ZF-Order-no.: 6029 199 157 Manufacturer: Co. Tyco Manufacturer order-no: 8-968971-1 (plug-housing) Manufacturer order-no: 1-968849-1 (female terminal)	369 298 147 X25 MCP 3-reihig 9-pin, Diagnose
Stecker, Bordnetz (Vorschlag-ZF) Typ: 15pol, Tyco, Buchse, MCP, 3reihig ZF-Best-Nr.: 6029 199 161 Hersteller: Fa. Tyco Hesteller Best-Nr.: 8-968973-1 (Stecker-Gehäuse) Herteller Best-Nr.: 1-968849-1 (Kontaktbuchse, 1,0qmm) Herteller Best-Nr.: 1-968851-1 (Kontaktbuchse, 2,5qmm)	Plug, vehicle interface (ZF proposal) Type: 15pin, Tyco, female, MCP, 3-array ZF-Order-no.: 6029 199 161 Manufacturer: Co. Tyco Manufacturer order-no: 8-968973-1 (plug-housing) Manufacturer order-no: 1-968849-1 (female terminal, 1,0qmm) Manufacturer order-no: 1-968851-1 (female terminal, 2,5qmm)	369118 290119 147120 MCP, 3-reihig 15-pin, Bordnetz
Leitungen, CAN-Schnittstellen Schnittstellen nach: SAE J1939 / SAE J 1708 Verdrilltes Leitungspaar: Schläge 32mm (32 S/m) Empfohlener Leiterquerschnitt: 1,0qmm	Wires, CAN-interface Interfaces according: SAE J1939 / SAE J 1708 Twisted pair wires: Twisted 32mm (32 S/m) Recommended wire cross-section: 1,0qmm	
Leitungen, BN(+)Kl.30, BN(-)Kl.31 Empfohlener Leiterquerschnitt: 2,50qmm Kl.30 (VPE1/VPE2), Pin 8 / 9 Kl.31 (VM1/VM2), Pin 17 / 18	Wires, power supply, Kl.30, Kl.31 Recommended wire cross-section: 2,5qmm Kl.30 (VPE1/VPE2), pin 8 / 9 Kl.31 (VM1/VM2), pin 17 / 18	
Leitungen, BN(+)Kl.15 und sonstige Empfohlener Leiterquerschnitt: 1,00qmm Kl.15 (VPI), Pin 25 und alle sonstigen Leitungen	Wires, power(+)Kl.15 and miscellaneous Recommended wire cross-section: 1,0qmm Kl.15 (VPI), pin 25 and all other wires	
<u>Hinweis:</u> Der Fahrzeughersteller (OEM) ist verantwortlich für die Auslegung der Verkabelung.	<u>Notice</u> The Vehicle manufacturer (OEM) is responsible for the construction of the harness.	

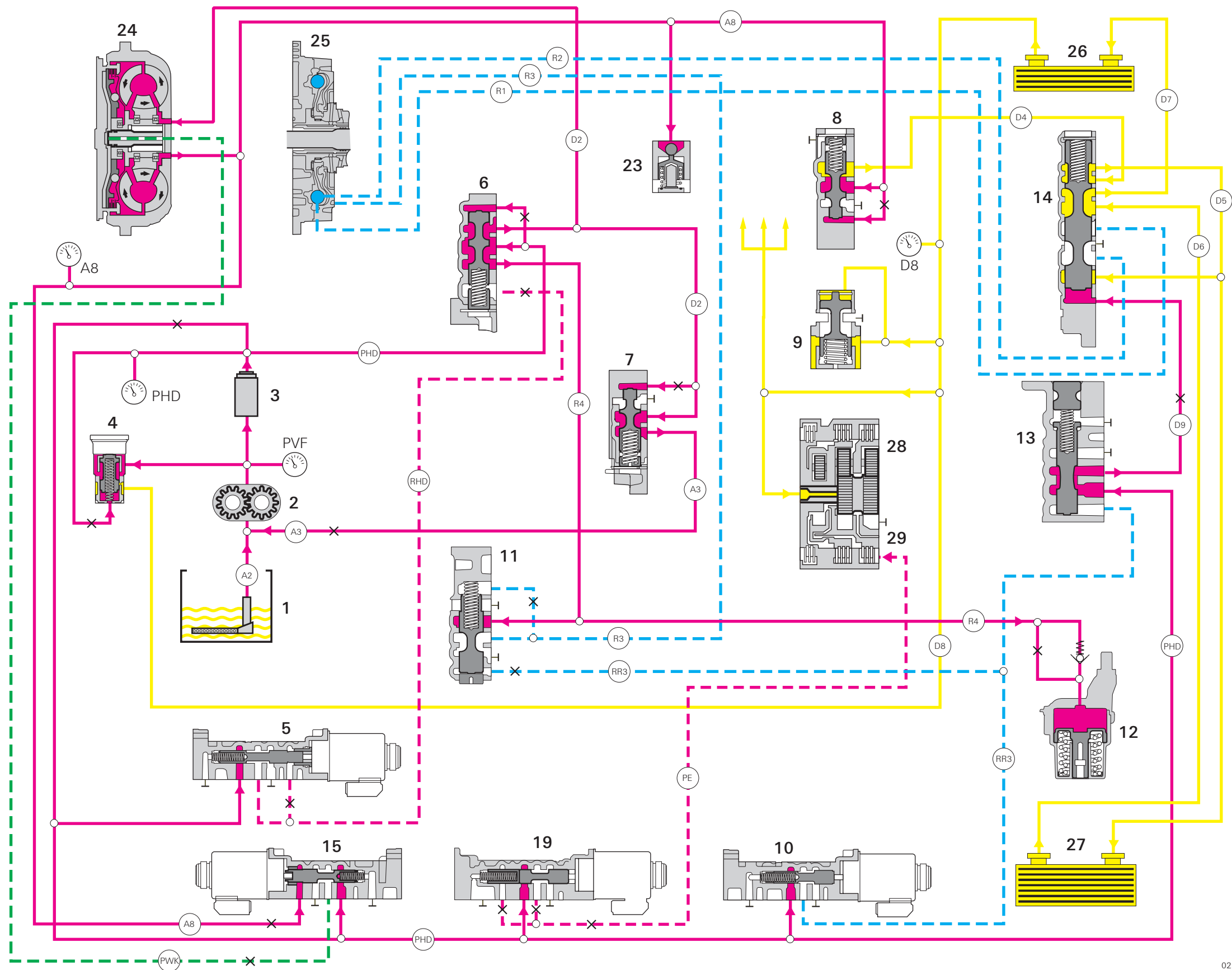








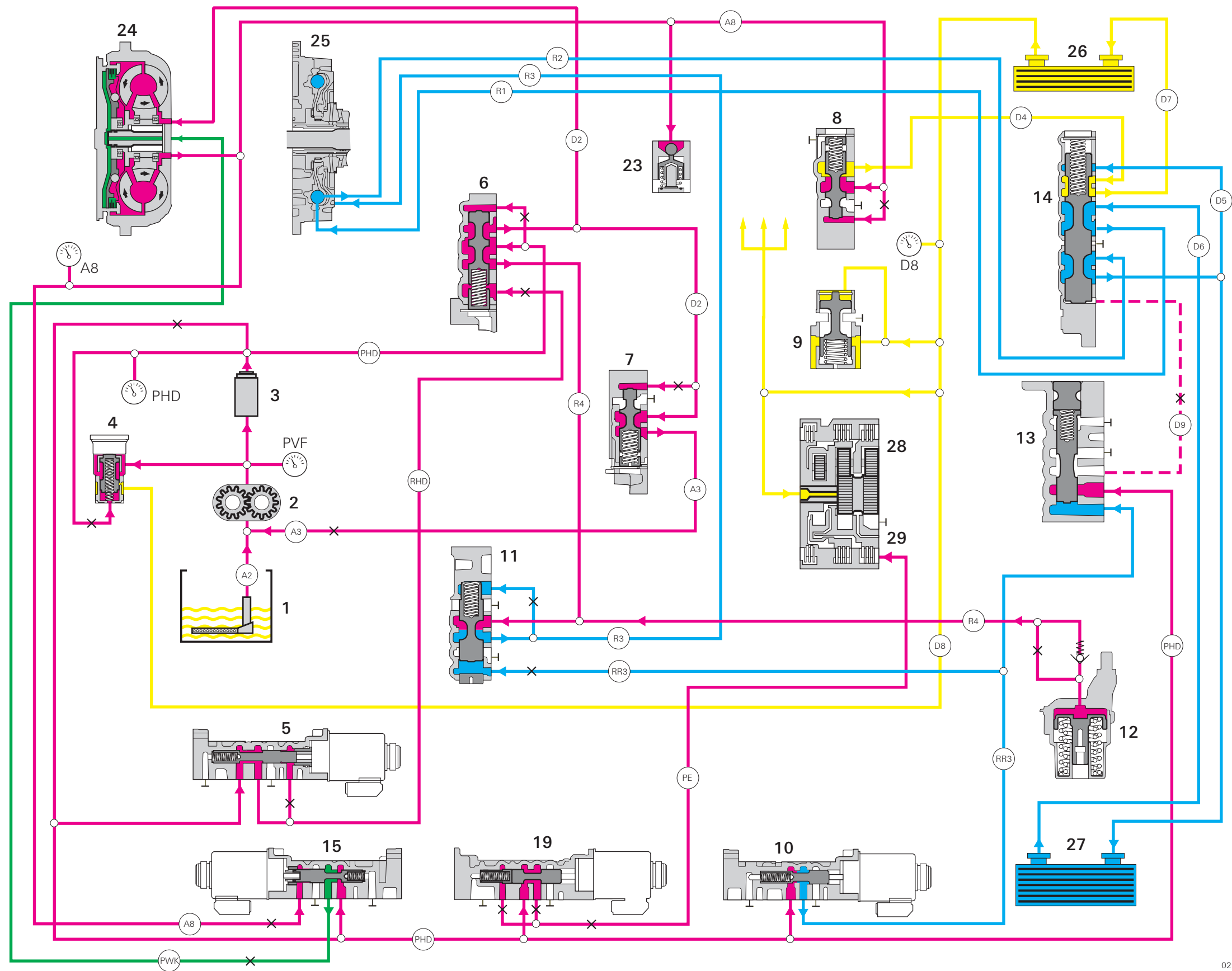




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- 1 Suction strainer insert
- 2 Pump
- 3 Pressure filter
- 4 Filter bypass valve
- 5 Pressure regulator (RHD)
- 6 Main pressure valve (PHD)
- 7 Converter safety valve
- 8 Converter counter-pressure valve
- 9 Lubrication pressure
- 10 Pressure regulator retarder
- 11 Retarder control valve
- 12 Accumulator
- 13 Shift valve (KUV)
- 14 Cooler change-over valve (KUV)
- 15 Pressure regulator (WK)
- 16-20 Pressure regulator A, B, D, E, F
- 23 Torque converter drain valve
- 24 Torque converter
- 25 Retarder
- 26 Heat exchanger (TOC)
- 27 Heat exchanger (ROC)
- 28 Planet gear train
- 29 Clutches/Brakes A, B, D, E, F

Subject to technical change without notice



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