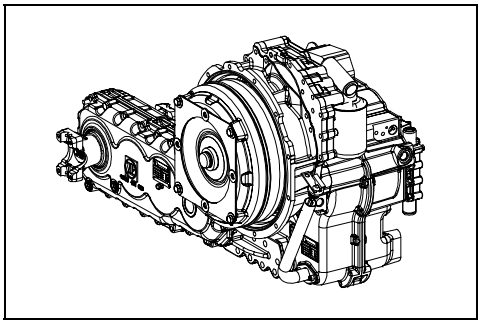


Order-No. 5872 135 002

ZF - POWERSHIFT TRANSMISSION 4 WG-92/98 TSC
(TELESCOPIC HANDLER TRANSMISSION)

and

TRANSFER BOX TB 92-I4

TECHNICAL DATA
DESCRIPTION
INSTALATION INSTRUCTIONS
MAINTENANCE

ZAHNRADFABRIK PASSAU GmbH
Donaustr. 25 - 71
D - 94034 Passau

Edition: 2002/09
Subject to Modifications !

1. Edition

Preface

The present Documentation has been developed for skilled personnel which has been trained by the ZF for the maintenance and repair operations on ZF-units.
However, because of technical development of the product, the maintenance and repair of the unit in your hands may require differing steps as well as also different setting and test data.

This Manual is based on the technical state at the printing.
At the preparation, every possible care has been taken to avoid errors.
However, we are not liable for possible mistakes concerning the representation and the description.

We are reserving ourselves the right of modifications without previous information.

The responsibility lies with the owner and the user, to pay attention to the safety indications, and to carry out the maintenance operations according to the prescribed specifications.

The ZF is not liable for faulty installation, incorrect treatment, insufficient maintenance, improperly and unskilled performed works, and for the subsequential damages resulting from it.

It is ***absolutely*** necessary to pay attention to the corresponding Specifications and Manuals of the Vehicle Manufacturer.

Important Informations concerning the technical reliability and reliability in service are accentuated by the following Symbols:

☞ **Valid for Instructions which must be observed at the maintenance, the performance or the operation of the vehicle !**

⚠ **Is inserted at working and operating procedures which have to be exactly respected to avoid a damage or destruction of the unit or to exclude a danger to persons !**

TECHNICAL DATA:

Maximum engine power	kW	90*
Maximum engine speed	min^{-1}	2600*
Maximum engine torque	Nm	480*
Starting torque multiplication		up to 3,0*
Maximum vehicle weight	to.	12*
Weight (transmission without oil)	about kg	290

* = dependent on vehicle type and application

Description:
The ZF-Powershift Transmission 4 WG-92/98 TSC is composed of a hydrodynamic torque converter and a rear-mounted multi-speed powershift reversing transmission with integrated transfer case (see Table-1).
The torque converter is a wear-free starting device which is adapting itself infinitely variable to the required conditions (road resistance).

Input by direct mounting via diaphragm on the engine.

Torque converter:
Unit size W-280 with torque conversion μ to 3,0 according to the Version.

Powershift reversing transmission:
4 Forward speeds and 3 Reverse speeds

Power take-off:
1 engine-dependent output, i = 1 : 1 for hydraulic pump.
Option 1 Connection SAE - B, 2 hole screw connection, driver profile SAE – BB,
Option 2 Connection SAE - C, 4 hole screw connection, driver profile SAE – C.

Final drive:
Through transfer case TB92-I4 with output flanges to the front and rear axle for different universal shafts Converter side.

The powershift reversing transmission has between input and output shaft a centre distance of 226,5 mm

Shift control:
Electro-hydraulic.

Gearbox ratio (mechanical)

SPEED	DRIVING DIRECTION	RATIO
1	Forward	5,241
2	Forward	3,141
3	Forward	1,270
4	Forward	0,838
1	Reverse	4,699
2	Reverse	2,816
3	Reverse	1,138

* = According to the Transmission version, other ratios are also possible.

IMPORTANT INFORMATIONS

Oil level check (see 4.2):
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.
The oil level check in the transmission must be carried out at engine idling speed and operating temperature of the transmission (80° to 90° C).

Keep the oil change intervals!

At every oil change, the ZF-Fine filter must be replaced.

Prior to start the engine, put the Controller always to the Neutral position.

Loosen the parking brake always before the drive off.

At the reversing, reduce the engine speed, and reverse only at low driving speeds.

During the drive, the vehicle must not be shifted to Neutral.

Do not skip speeds at up- and downshiftings.

At stationary engine, the engaged speed has no effect.

Prior to leave the vehicle, secure the vehicle additionally by brake blocks.

The towing speed must in no case be higher than 10 km/h; the towing distance not longer than 10 km.

Operating temperature 80° - 100° C, short-time increase up to max. 120° C admissible.
(Measuring point behind the converter - see Schedule of measuring points Table –6, Measuring point No. 63)

In case of irregularities on the transmission, put the vehicle out of service and ask for specialists.

Protective measures for the ZF-Electronics at electrical operations on the vehicle :

At the following operations, the ignition must be turned off and the control unit plug must be pulled off from the ZF-Electronic unit :

* **At any kind of electrical repairs on the vehicle.**

* **“At welding operations on the vehicle, the transmission electronics has to be generally separated, through the central electronic plug, from the supply system and all connections to the electronic components”.**

* **At insulation tests on the electric system**

I. DESCRIPTION

1.1 Function of the converter:

The torque converter is composed of 3 Main components:

- **Impeller**
- **Turbine wheel**
- **Stator (Reaction member)**

Function of a hydrodynamic Torque converter
(Schematic view)

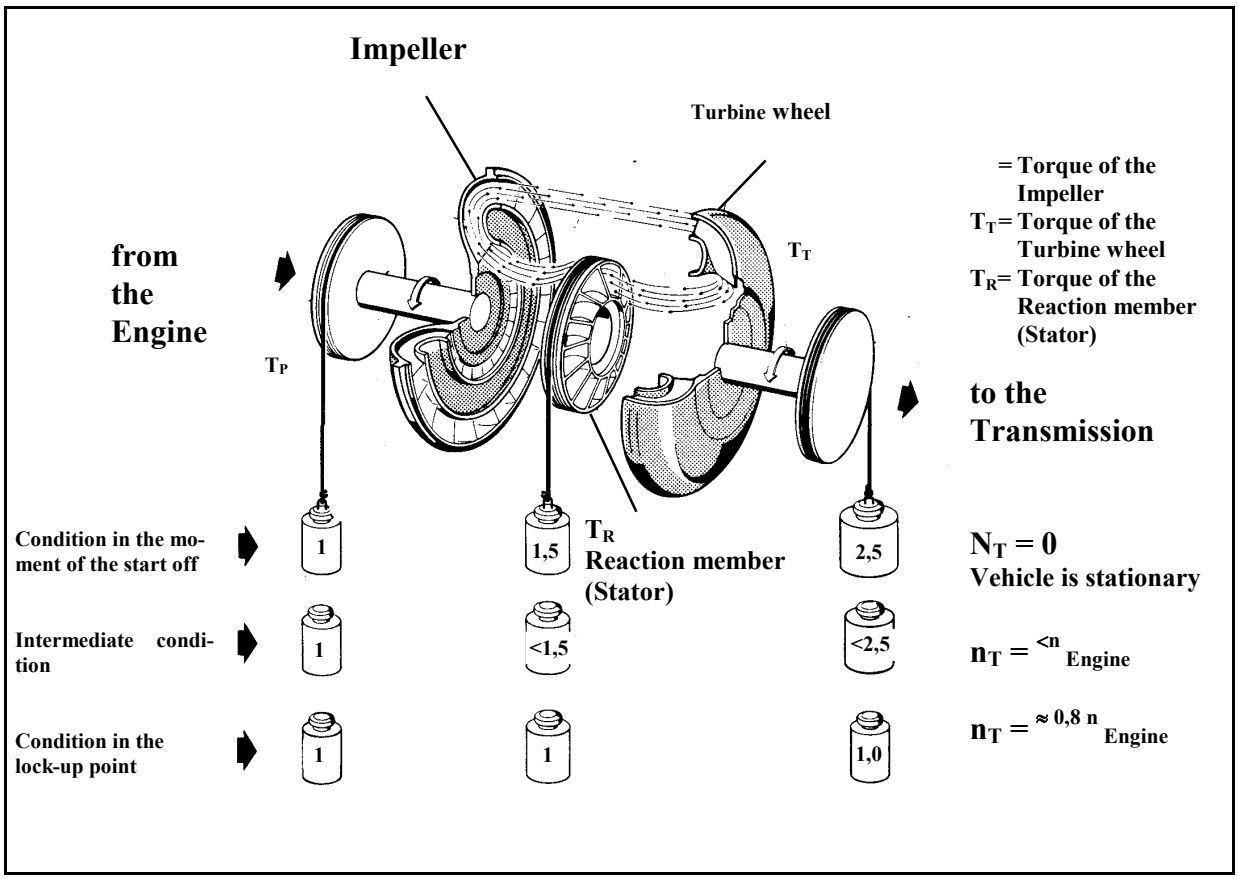


Fig.-No.: 1.1

These three impellers are passed through from the transmission oil as operating fluid.
For this purpose, the converter is integrated in the transmission oil circuit, i.e. it is supplied with the transmission pump. A converter safety valve, arranged in front of the converter, makes sure that the permitted internal converter pressure will not be exceeded.

The direction of flow of the oil, which is streaming out of the impeller, is reversed within the turbine wheel. According to the rate of reversion, the turbine wheel and with it the transmission drive shaft is receiving a variable high input torque. In the following stator, the flow is reversed again to the impeller. The reaction torque, resulting from it, must be stationary supported through the stator.

The relation turbine torque to pump torque is called torque conversion. The torque conversion becomes more and more higher with increasing differential speed between impeller and turbine wheel, i.e. the maximum torque conversion is achieved at turbine speed 0, therefore at stationary output.
This point is called stall speed.
Dependent on the driving resistance, i.e. on the required output torque, the optimal working condition (turbine speed ▷ torque conversion ▷ input torque) becomes effective on the converter!

The hydrodynamic converter is working according to the Trilok-System, i.e. at lower differential speeds between pump and turbine, therefore in the zone of the low torque conversion, the converter is working similar to a hydrodynamic fluid clutch. For it, the stator is supported in one direction through a freewheel.
From the lock-up point on, the stator is then no more supporting torques, and the converter is working as fluid clutch.

1.2 Powershift transmission:

The multi-speed reversing transmission in countershaft design is shifting under load by hydraulically controlled multi-disk clutches.
All gears are constantly meshing and supported by anti-friction bearings.

The gears, bearings and clutches are cooled and lubricated with oil.
The 4-speed reversing transmission is equipped with 6 multi-disk clutches.
At the gear change, the corresponding multi-disk clutch will be hydraulically actuated.
A piston is at the same time transmitting the shifting force upon the plate pack, which is then transmitting a torque analog to the pressure build-up.
The clutch is released when the actuation pressure for the multi-disk clutch is dropping.
A cup-spring pack is then pushing back the piston into the start position.

1.3 Power take-off:

For the drive of the externally fitted hydraulic pump, an engine-dependent power take-off is attached. The mounting face is located on the output side of the transmission.
Option-1 Connection SAE - B, 2-hole screw connection, driver profile SAE – BB,
Option-2 Connection SAE - C, 4-hole screw connection, driver profile SAE - C.

1.4 Transmission control:

Transmission control with electro-hydraulic shift control (Oil circulation diagram and electric shift control, see Table-7, 8 and 9).
In the electro-hydraulic control unit are 2 solenoids installed - see Table-9.
The allocation of the pressure regulators to the single speeds can be seen on the Tables - 6, 7 and 8.

The transmission pump, which is necessary for the oil supply of the converter and the transmission control, is rear-side mounted on the gearbox housing. The input is realized by the engine-dependent drive shaft.

The feed rate of the pump is Q = 54 l/min, at n_{Engine} = 2000 min^{-1}.

This pump is sucking the oil out of the oil sump and delivers it through the ZF-Fine filter to the main pressure valve (HDV = 16+3 bar).

ZF-Fine filter:

Filter grade:	$ß_{30} \geq 20\ \mu m$ $ß_{10} \geq 1{,}5\ \mu m$
Filter area:	2450 cm^2
Bypass opens at	$\Delta p = 2{,}5^{\pm 0{,}3}$ bar

The oil pressurized by the main pressure valve is directed through the modulation valve (MOD) to the shift valve (S-VR) and to the solenoid switch valve Neutral Y6.

Through the solenoid switch valves Y1 or Y2 the shift valve (SV-R) is switched with the system pressure in accordance with the selected driving direction. Resetting is carried out by spring force.

From the shift valve the modulated shift pressure is directed to the direction clutches KV, KR or K4 being required for the specific driving direction. In connection with the direction clutches KV and K4 the modulated shift pressure is also directed by the solenoid valve Y3.

Through the solenoid switch valve Y6 the modulated shift pressure is directed by the solenoid switch valves Y5 and Y5 to the relevant gear clutch.

During the gear change operation the modulation valve (pressure control valve) is modulating the pressure build-up in the direction and gear clutches between 3 and 12 bar, and is then rising again to 16+3 bar.

At the change-over, the pressure is dropping for a short time and is increasing again after the termination of the gear change operation to 16+3 bar. Due to this procedure, the gear changes are softened.

The main pressure valve is limiting the max. control pressure to 16+3 bar, and releases the main flow to the converter circuit and lubricating circuit.
In the converter inlet, a converter safety valve is installed, which is protecting the converter against high internal pressures (opening pressure 8,0 + 2 bar).
Within the converter, the oil serves to the power transmission according to the well-known hydrodynamic principle (see Chapter Torque converter 1.1).

The oil which is streaming out of the converter is directed to a heat exchanger (oil-water, resp. oil-air).

The selection and determination of the heat exchanger must be carried out by the costumer on his own responsibility, in accordance with our Installation Instructions for the hydrodynamic powershift transmissions 4644 700 711.

The heat exchanger is not scope of supply of the **Zahnradfabrik Passau GmbH.**

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

1.5 Final drive:

see Table-2

Through transfer case TB92-I4 with output flanges to the front and rear axle for different universal shafts Converter side.
The powershift reversing transmission has between input and output shaft a centre distance of 226,5 mm

1.6 Controller DW-3

see Table-10

The Controller is designed for the mounting on the left side of the steering column. The positions (Speeds) 1 to 4 are selected by a rotary motion, the driving direction (Forward (V) - Neutral (N) - Reverse (R) by tilting the controller stick

A Neutral lock is installed as protection against inadvertent drive off.
Position “N” - Controller stick blocked in this position.
Position “D” - Driving.

DW-3 Controller

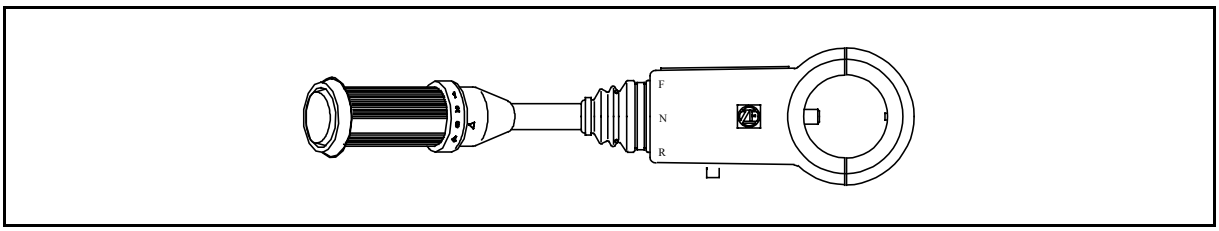


Fig.-No.: 1.6

II. INSTALLATION INSTRUCTIONS

The installation of hydrodynamic powershift transmissions of the WG-Series in construction machinery, industrial trucks and other mobile implements must be carried out in accordance with our Installation Instructions 4644 700 709 German, resp. 4644 700 711 English.

These Instructions for the installation of hydrodynamic powershift transmission of the WG-Series are the basis for the technically perfect installation of theses transmissions in the vehicle. These Installation Instructions are part of the transmission documentation and are imperative.

An incorrect installation of the transmission into the vehicle will:
- affect the operating quality,
- cause malfunctions, and
- lead to transmission damages, resp. transmission failures !

The Vehicle Manufacturer is responsible for the correct installation of the transmission. ZF does not admit any guarantee or warranty claims for damages, if the installation has not been carried out in accordance with these Instructions.

In order to assist the customer in case of new or initial applications, ZF-Passau (Dept. KBE) carries out transmission installation checks. On this occasion, all transmission-specific installation features are examined and the Vehicle-, resp. Equipment Manufacturer will be informed about the encountered defects.

These Installation Instructions:

4644 700 709 GERMAN
4644 700 711 ENGLISH

can be requested under the following address:

ZAHNRADFABRIK PASSAU GmbH
Abt. KVD
Donaustr. 25 - 71
94034 Passau

III. OPERATION

3.1 Driving preparation and Maintenance:

Prior to the commissioning of the transmission, take care that the correct quantity of the prescribed oil grade will be filled in. At the initial filling of the transmission has to be considered that the oil cooler, the pressure filter 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 also the heat exchanger, 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 operating Temperature of the transmission (see Chapter Oil level check 4.2).

⚠ **At the oil level check, the prescribed safety directions according to § 6 of the regulations for the prevention of accidents for power plants in Germany, and in all other countries, the respective national regulations have to be absolutely observed.**
For example, the vehicle has to be secured against rolling by blocks, articulated vehicles additionally against unintended turning-in.

3.2 Start the engine:

☞ Which control lamps in the INFOCENTER (dashboard) are illuminated for the functional control, can be different from Vehicle Manufacturer to Vehicle Manufacturer.
Control elements and displays can be from the ZF, however can be also customer-specific products; the precise specifications must therefore be taken from the Operating Instructions of the respective Vehicle Manufacturer.

The starting of the engine has always to be carried out in the NEUTRAL POSITION of the Controller.
For safety reasons it is recommended to brake the vehicle always securely in position with the parking brake, prior to start the engine.

After the engine start and the preselection of the driving direction and the gear, the vehicle can be set in motion by applying the accelerator.
At the drive off, the converter takes over the function of a master clutch.
On a level road, it is possible to drive off also in higher gears.
The acceleration will be only slower.

3.3 Start and driving:

At the drive off, the parking brake has to be released. We know from experience that in case of a converter transmission, it may not have been noted at the moment 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 are the consequences which are found out only later.

We want to point out that the engine speed, also at a converter transmission, will be increased at the downshifting of speeds, especially if one gear has been skipped, and can reach in this condition speeds which endanger the engine.
The gear change should be carried out only then if the maximum driving speed of the lower gear is reached.

In case of necessity, the vehicle has to be slowed down to this driving speed by means of the foot brake.

☞ During the drive, the vehicle must not be shifted to Neutral.

At the reversing, reduce the engine speed and reverse only at low driving speeds.

3.4 Stopping:

If the vehicle will be stopped and is standing with running engine at engaged speed and shifted directional clutch, the engine cannot be stalled. On a level roadway, resp. on a slight gradient it is possible that the vehicle begins to crawl, because the engine is creating at idling speed throughout the converter a slight drag torque.
It is convenient to brake the vehicle securely in position with the parking brake at ecery stop.
At longer stop times, the controller has to be shifted to NEUTRAL-POSITION and the vehicle has to be braked securely in position with the parking brake.

3.5 Stopping and Parking:

Since due to the converter there is no rigid connection existing between engine and axle, it is recommended to secure the vehicle on upgrades, resp. downgrades against unintended rolling away not only by application of the parking brake, but additionally by means of a brake block on the wheel, if the driver has the intention to leave the vehicle.

3.6 Towing:

The towing speed must be maximally 10 km/h, and the towing distance must not be longer than 10 km.

☞ **This Specification has to be absolutely observed since otherwise the transmission will be damaged because of insufficient lubrication.**

At a longer distance, the defective vehicle has to be shipped or towed with disassembled universal shaft.

3.7 Oil temperature:

The oil temperature of the transmission must be monitored by a temperature sensor.
A maximum temperature of 120° C on the converter exit must not be exceeded.
At a trouble-free unit and a correct driving mode, a higher temperature will not set in. If the temperature is exceeding 120° C, the vehicle has to be stopped, checked for external oil loss, whilst the engine should be running with a speed of 1200 - 1500 min $^{-1}$ 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, a trouble is existing which must be eliminated before the working can be continued.
See Measuring point “63” – Table-6.

IV. MAINTENANCE

4.1. Oil grade:

☞ Permitted for the Powershift transmissions 4 WG-92/98 TSC & TB92-I4 are oils according to ZF-List of lubricants TE-ML 03.

☞ This List of lubricants will be updated every two years and can be requested, resp. inspected as follows:

- At all ZF-Plants
- At all ZF-Service Stations
- Internet http://www.zf.com **Information/Technical Information**

4.2 Oil level check:

⚠ **At the oil level check, the prescribed safety directions according to § 6 of the rules for accident prevention for power plants in Germany, and in all other countries the respective national regulations have to be absolutely respected.**
For example, the vehicle has to be secured against rolling with blocks, articulated vehicles additionally against unintended turning-in.

Powershift transmission 4 WG-92/98 TSC:

The oil level check must be carried out as follows:

- Oil level check (weekly)
- At horizontally standing vehicle
- Transmission in Neutral position „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 MIN“ (see Figure-No. 4.2 B2)
- At operating temperature of the transmission (about 80° - 90° C)
- At engine idling speed
- Loosen oil dipstick by counterclock 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“ (see Figure-No.: 4.2 B2)
- 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 according to the ZF-List of lubricants TE-ML-03.
An oil level above the „HOT“ marking, is leading to a too high oil temperature.

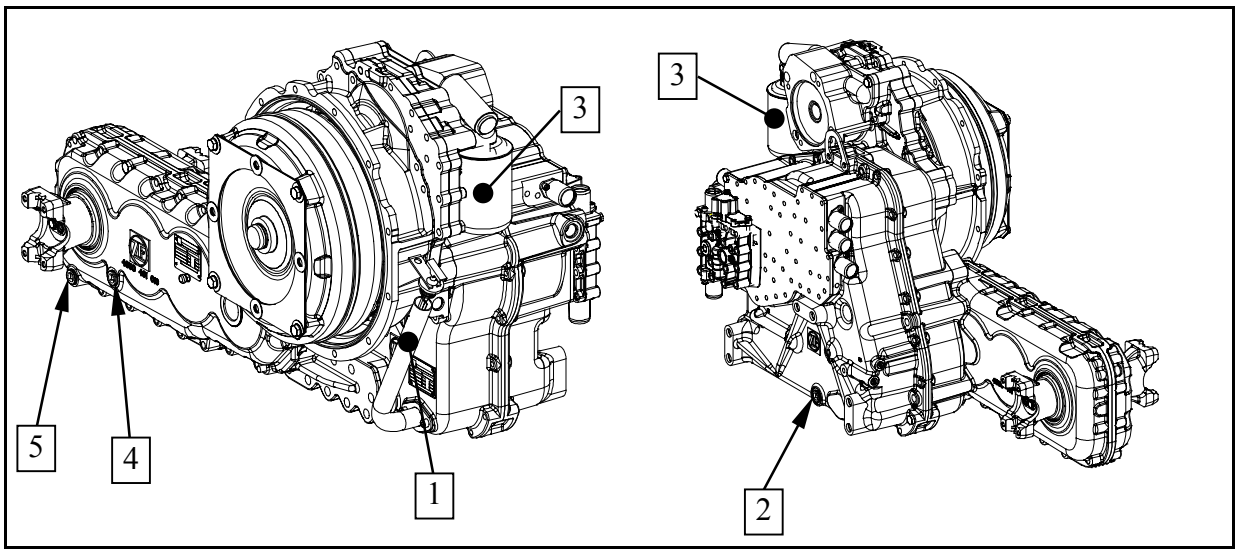


Fig.-No.: 4.2 B1

Legend:

Powershift transmission 4 WG-92/98 TSC	**Thread**	**Tightening torque**
1 = Oil filler tube with oil dipstick		
2 = Oil drain plug	7/8" - 14 UNF	35 Nm
3 = ZF-fine filter		
Transfer caseTB92-I4		
4 = Oil filler plug	7/8" - 14 UNF	35 Nm
5 = Oil drain plug	7/8" - 14 UNF	35 Nm

Oil dipstick

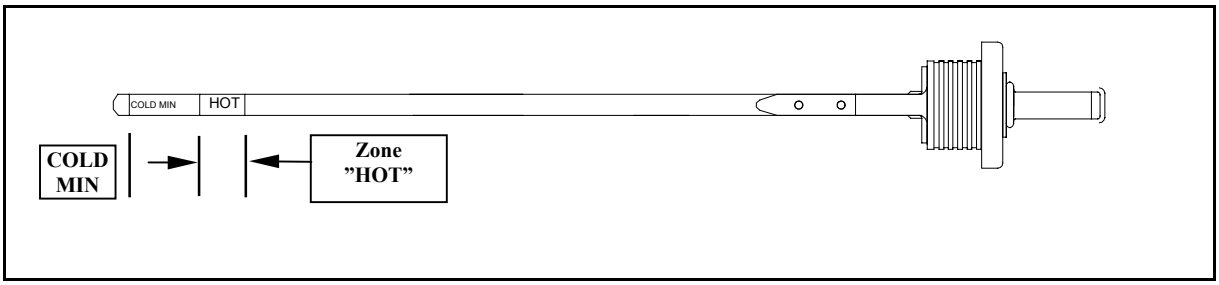


Fig.-No.: 4.2 B2

Transfer case TB92-I4:

The oil level check must be carried out as follows:

- Oil level check (weekly)
- At horizontally standing vehicle
- Fill up oil to the overflow on the level plug (see Fig-No.: 4.2 B1)

4.3 Oil change and Filter replacement intervals:

Powershift transmission 4 WG-92/98 TSC:

☞ **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 !

The oil change has to be carried out as follows:

- At operating temperature of the transmission, horizontally standing vehicle open the oil drain plug (see Fig.-No.: 4.2 B1) and drain the used oil.

☞ Only the oil capacities in the transmission and in the upper part of the converter can be drained.

- Clean oil drain plug insert and surface on the housing and install again.
- Fill in oil (about 15 liter) according to ZF-List of lubricants TE-ML 03.
  (Sump capacity, external oil capacities e.g. in the heat exchanger, in the lines etc. are dependent on the vehicle).

☞ **It is imperative to pay attention to absolute cleanliness of oil and filter !**
Binding is in any case the marking on the oil dipstick !

- Start the engine – idling speed
- Transmission in Neutral position „N“
- Top up oil up to the marking „COLD-MIN“
- 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“ (see Figure-No.: 4.2 B2)
- 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 according to the ZF-List of lubricants TE-ML-03.
An oil level above the „HOT“ marking, is leading to a too high oil temperature.

☞ 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.

Transfer caseTB92-I4:

☞ **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 !

The oil change has to be carried out as follows:
- At operating temperature of the transmission, horizontally standing vehicle open the oil drain plug (see Fig.-No.: 4.2 B1) and drain the used oil.
- Clean oil drain plug insert and surface on the housing and install again.
- Fill in oil (ca. 1,6 liter) up to the overflow at the filling or control bore.
- After some minutes, check oil and refill, if necessary, until the specified level is reached and remains constant.
- Provide filling or control screw and mount it.

4.4 Filter replacement:

☞ **At every oil change, the ZF-Fine filter (pressure filter) has to be replaced.**

At the replacement of the ZF-Filter in the main oil stream, 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.

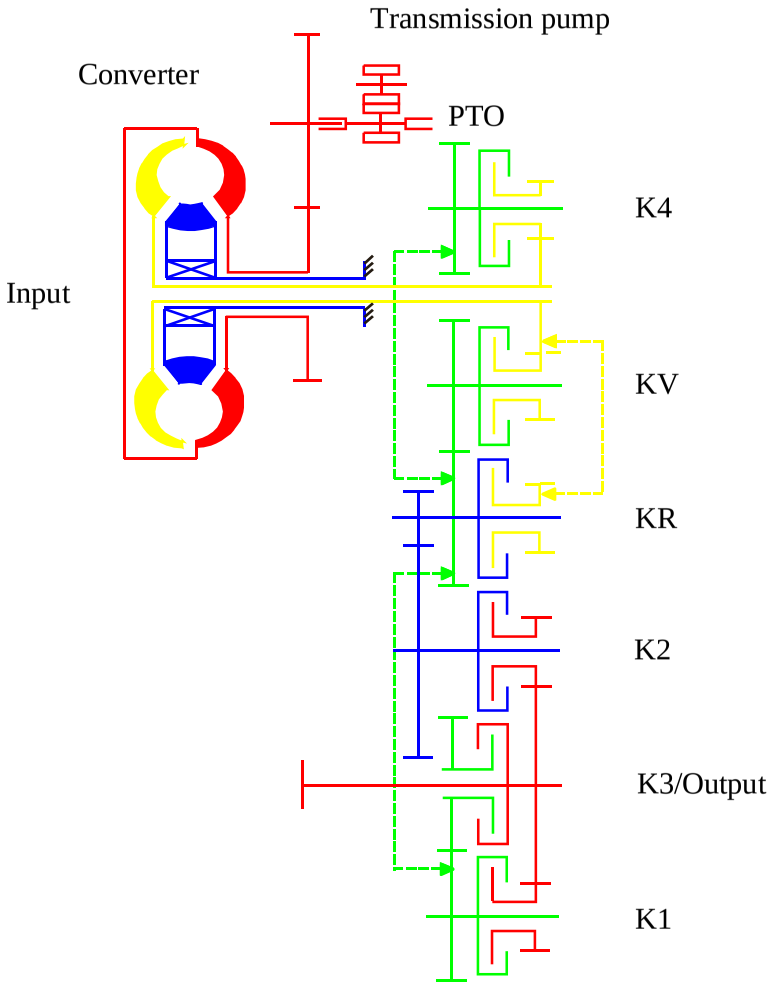
☞ Treat the filter carefully at the installation, the transport and the storage !
Damaged filters must no more be installed !

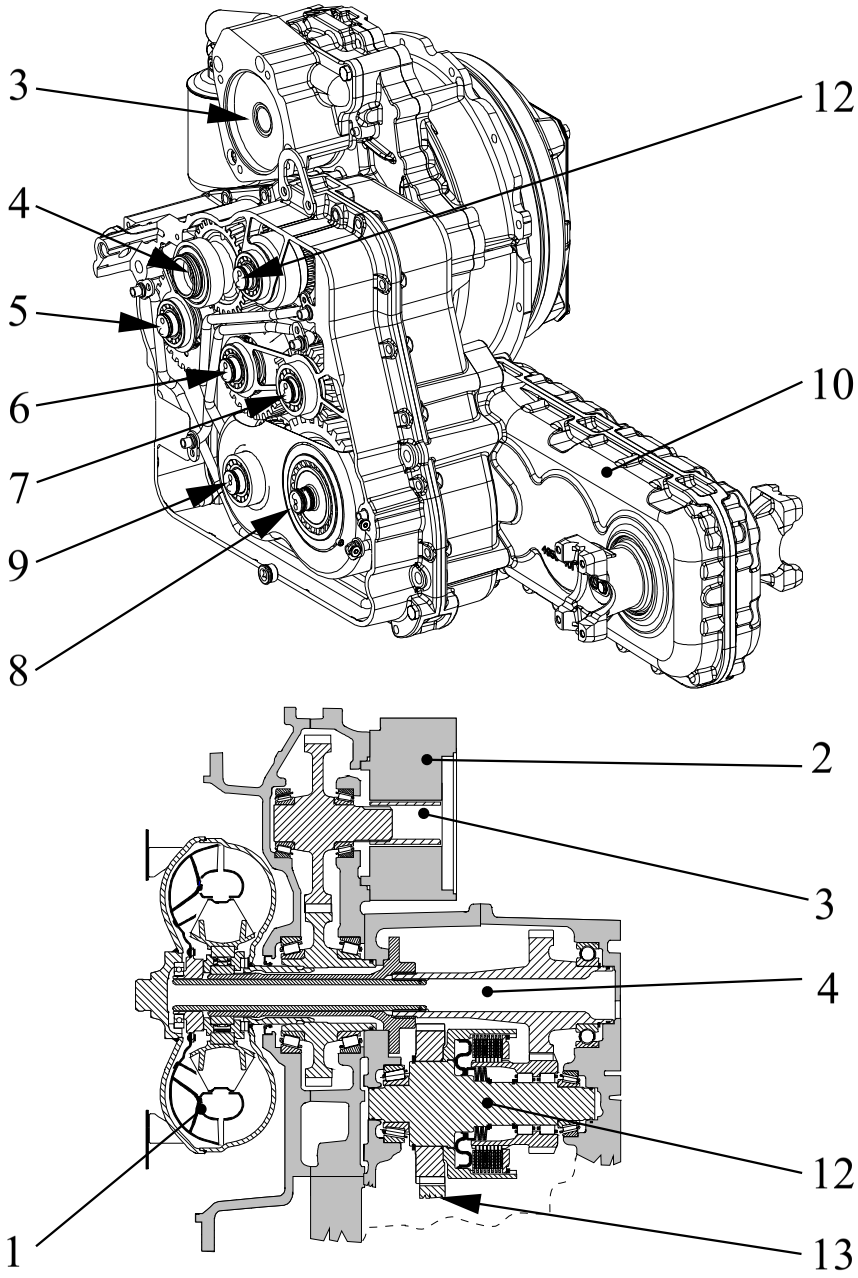
The mounting of the filter must be carried out as follows:
- Cover the gasket with a small amount of oil.
- Screw the filter in until contact with the sealing surface is obtained and tighten it now by hand about 1/3 to 1/2 turn.

LAYOUT POWERSHIFT TRANSMISSION 4 WG-92/98 TSC TABLE-1

1	=	Converter	
2	=	Transmission pump	
3	=	Power take-off; coaxial engine-dependent	"PTO"
4	=	Input	
5	=	Clutch shaft	"KV"
6	=	Clutch shaft	"KR"
7	=	Clutch shaft	"K2"
8	=	Clutch shaft / Output	"K3"
9	=	Clutch shaft	"K1"
10	=	Transfer box TB92-I4	
11	=	Output gear	
12	=	Clutch shaft	"K4"
13	=	KR-Spur gear	

Gearbox diagram




3
12
4
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1
13
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2
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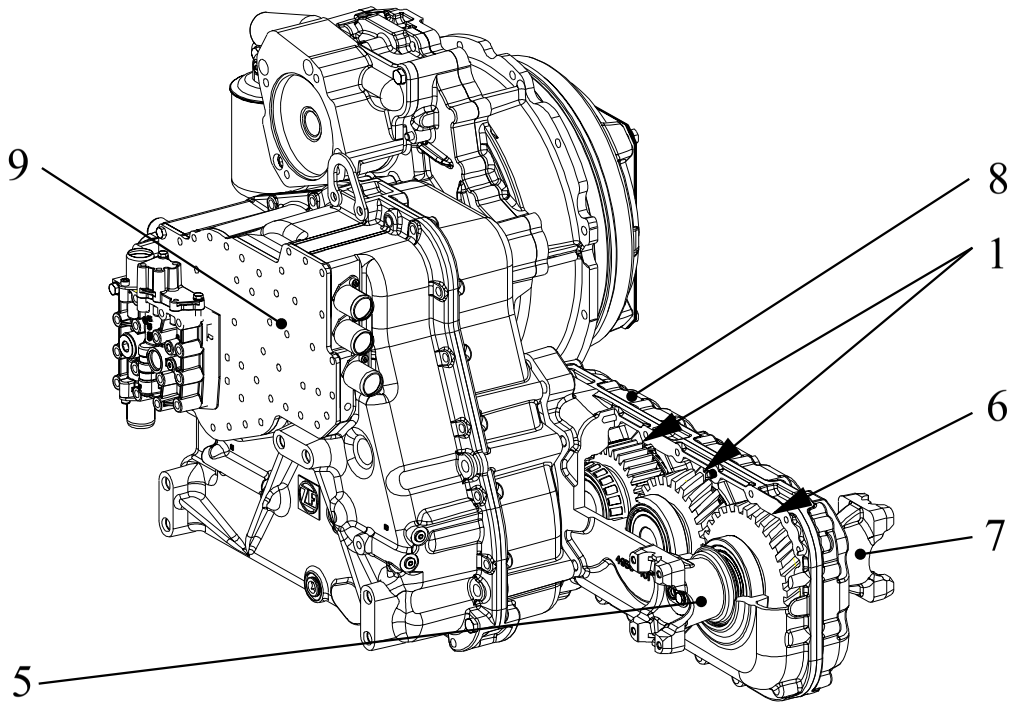
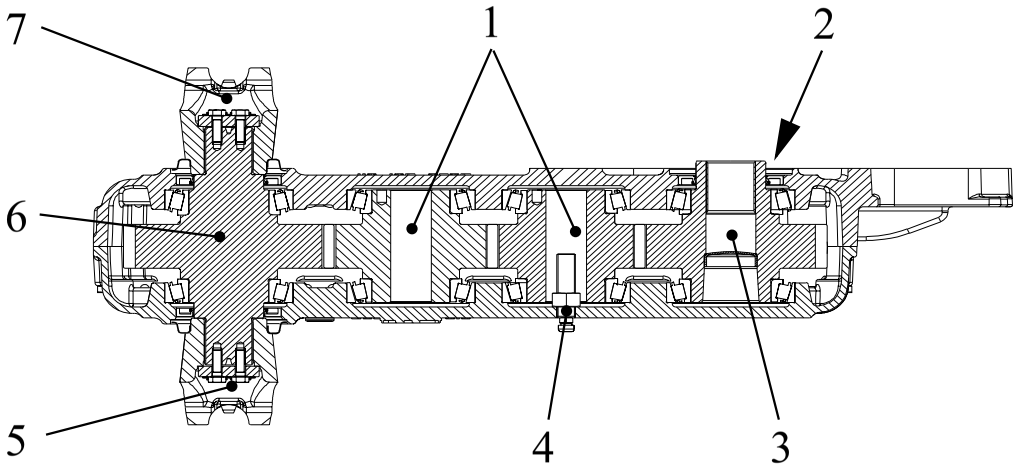
6
7
11
8
10
9

LAYOUT TRANSFER BOX TB92-I4
TABLE-2

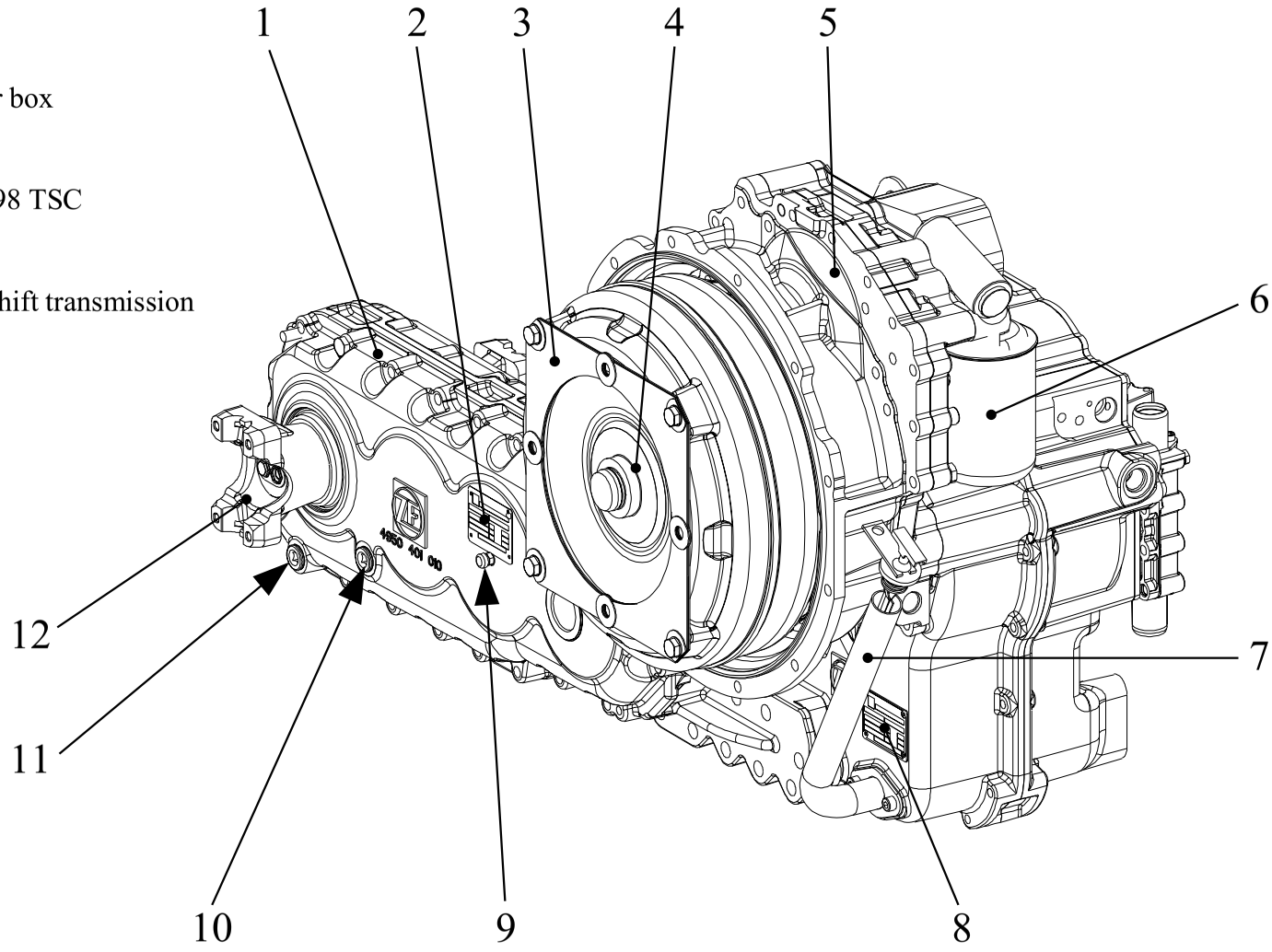
1 = Intermediate shaft
2 = Mounting face 4 WG-92/98 TSC
3 = Input shaft
4 = Breather transfer box TB92-I4
5 = Output flange(Front axle)
6 = Output shaft
7 = Output flange(Rear axle)
8 = Transfer box TB92-I 94
9 = Powersiift transmission 4 WG-92/98 TSC





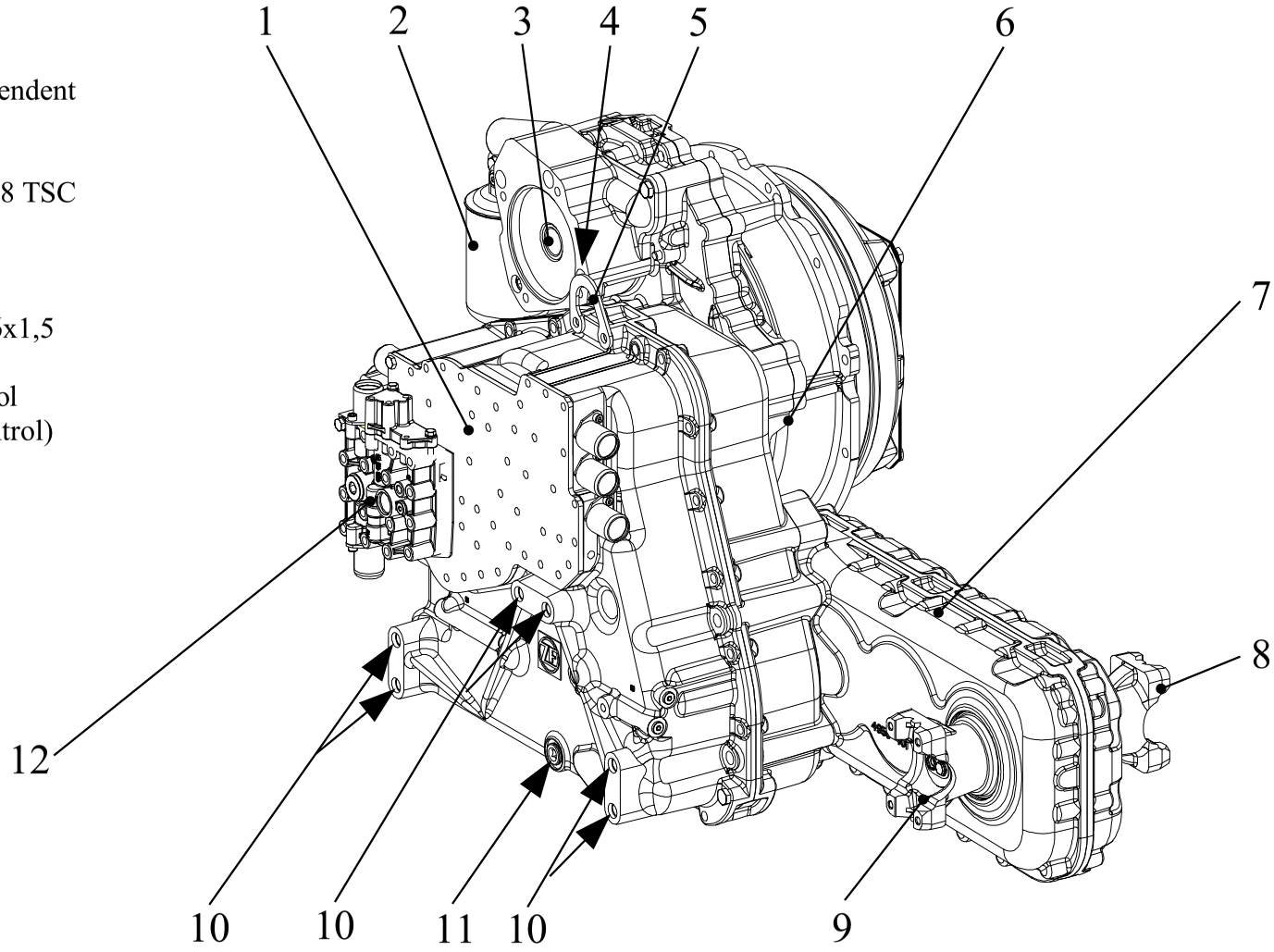
INSTALLATION VIEW 4 WG-92/98 TSC & TB92-I4
FRONT VIEW
TABLE-3

1 = Transfer box TB92-I4
2 = Model identification plate - transfer box
3 = Diaphragm – direct mounting
4 = Converter
5 = Powershift transmission 4 WG-92/98 TSC
6 = ZF-Fine filter
7 = Oil filler tube with oil dipstick
8 = Model identification plate - powershift transmission
9 = Breather - transfer box
10 = Oil filler plug 7/8" - 14 UN-2A
11 = Oil drain plug 7/8" - 14 UN-2A
12 = Output flange - rear axle

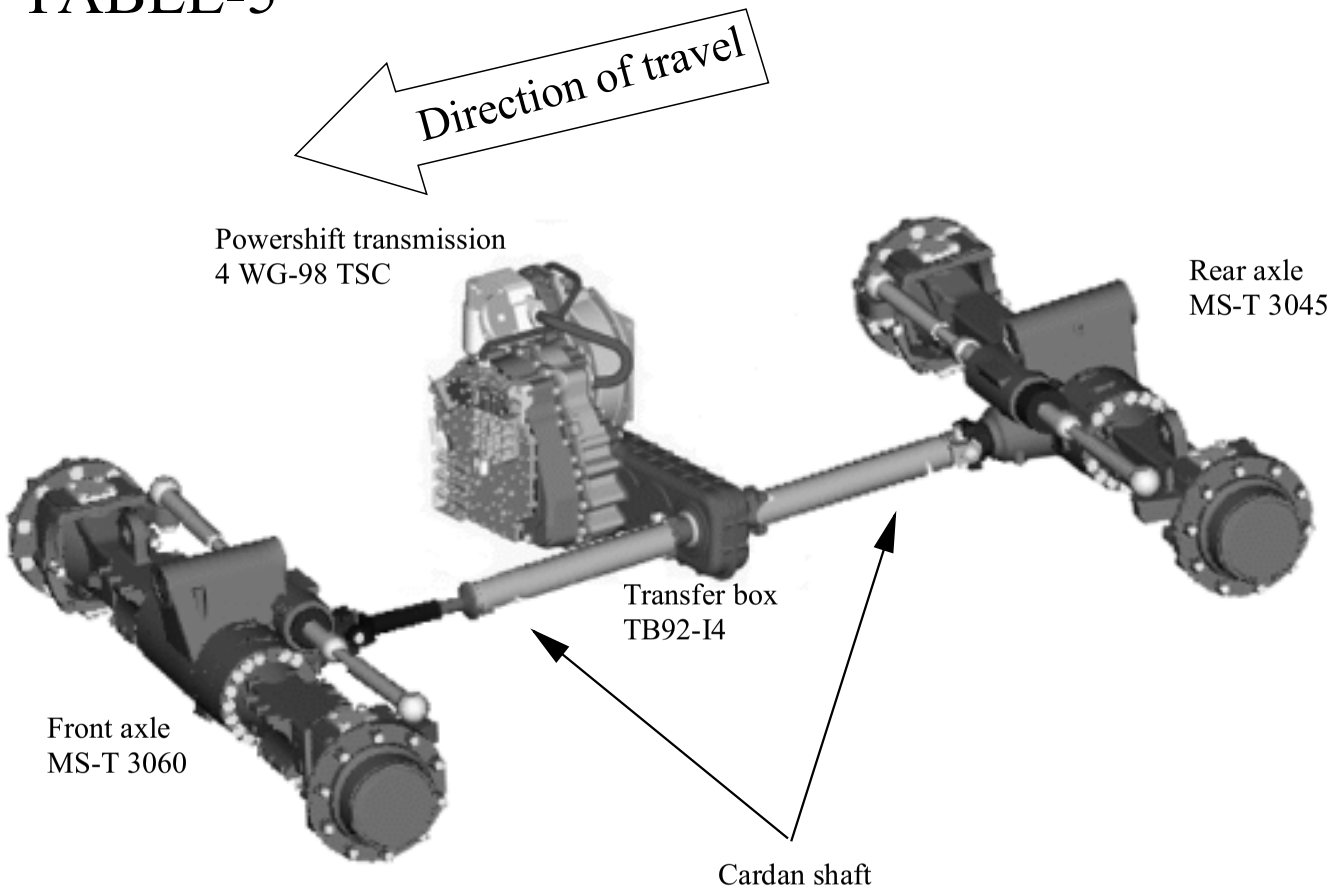


INSTALLATION VIEW 4 WG-92/98 TSC & TB92-I4
REAR VIEW
TABLE-4

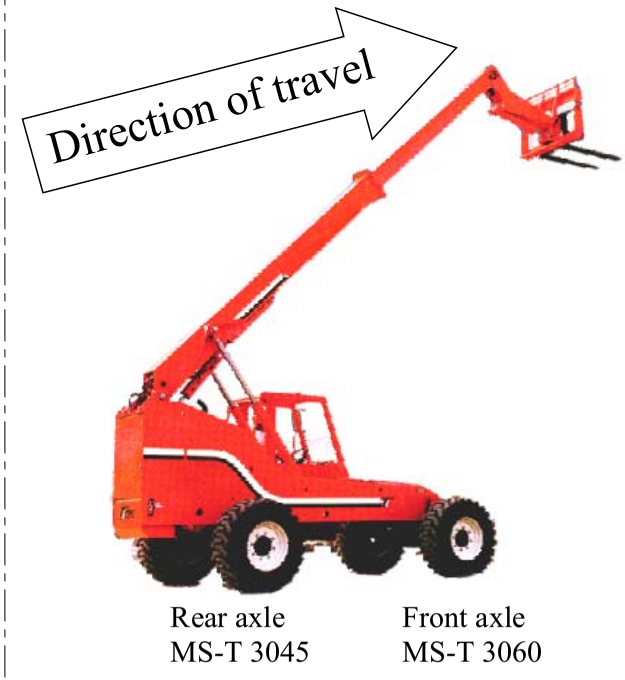
1 = Cover plate
2 = ZF-Fine filter
3 = Power take-off; coaxial, engine-dependent
4 = Breather - Powershift transmission
5 = Lifting lug
6 = Powershift transmission 4 WG-92/98 TSC
7 = Transfer box TB92-I4
8 = Output flange - rear axle
9 = Output flange - front axle
10 = Transmission suspension holes M16x1,5
11 = Oil drain plug 7/8" - 14 UNF
12 = Valve block electro-hydraulic control
(Directional clutch and pressure control)



INSTALLATION VIEW 4 WG-92/98 TSC & TB92-I4 IN VEHICLE TABLE-5



TELESCOPIC-HANDLER



SCHEDULE OF MEASURING POINTS AND CONNECTIONS 4 WG-92/98 TSC TABLE-6

The marked positions (e.g. 53) correspond with the positions on the table-7!
The measurements have to be carried out at hot transmission (about 80° - 95° C) !

Legend:

p	=	Pressure in bar	
P_1	=	Modulation pressure - start	max. 3,5 bar
P_2	=	Modulation pressure - end	11,5+1,5 bar
P_{PM}	=	Modulation pressure	4±0,5 bar
P_N	=	Modulation pressure - neutral	2,7-3 bar
P_S	=	System pressure - modulate	16+3 bar
P_R	=	Clutch pressure at reversal	≥ 11 bar
t	=	Time in seconds	
Δt_F	=	Clutch filling time	≤ 0,6
Δt_{PM}	=	Modulation time - start	≤ 0,4
Δt_1	=	Modulation time	
α	=	Grandient (p_2* - p_{PM}) / Δ_{t1}	16±2 bar/s
N_an	=	Input speed at test	1500 min^{-1}

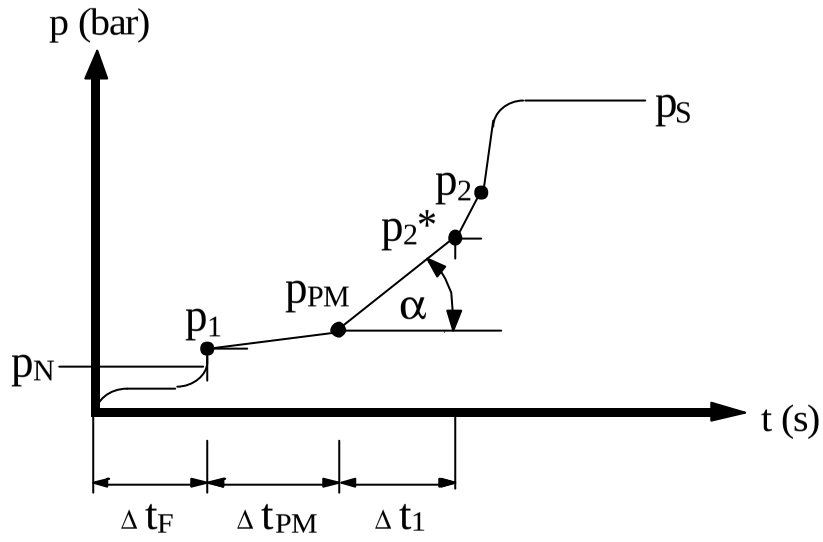
Measuring points modulation pressure:

P_1	=	65
P_2	=	53 bzw. 55
P_{PM}	=	53 bzw. 55
P_N	=	65
P_S	=	65

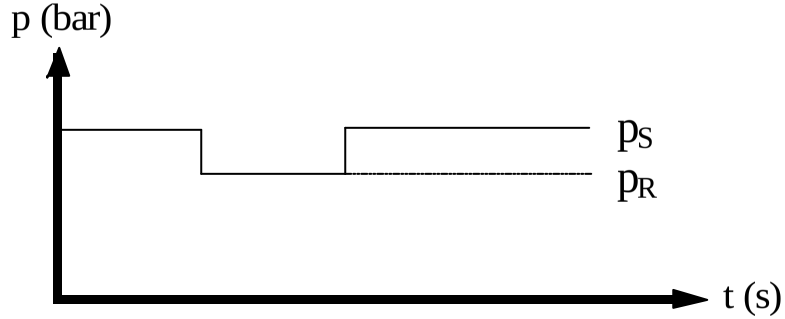
Measuring points at reversal:

1-1	=	56
2-2	=	57
3-3	=	58
4-3	=	58
3-4	=	58

Pressure control curve

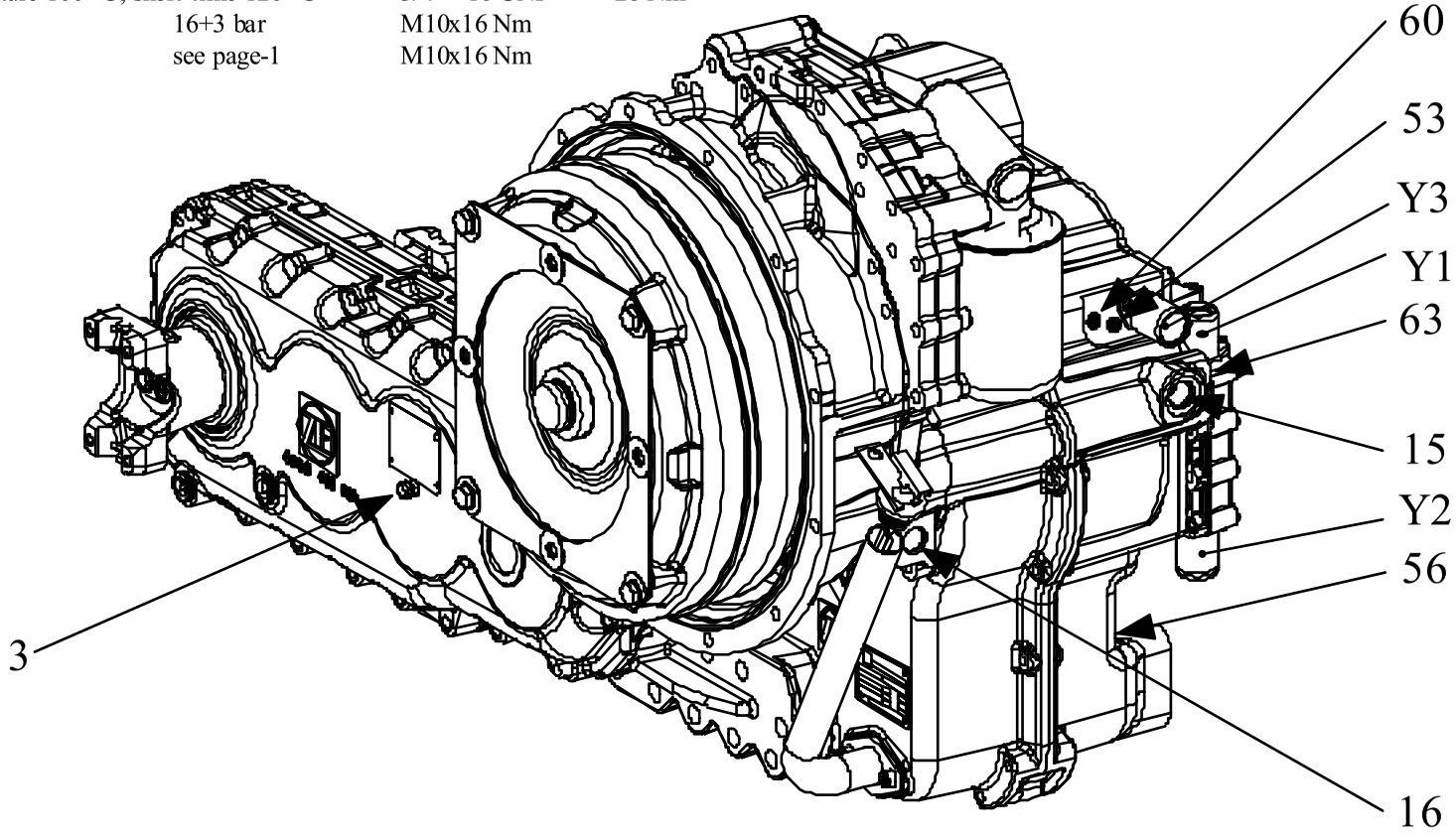


Clutch pressure at reversal



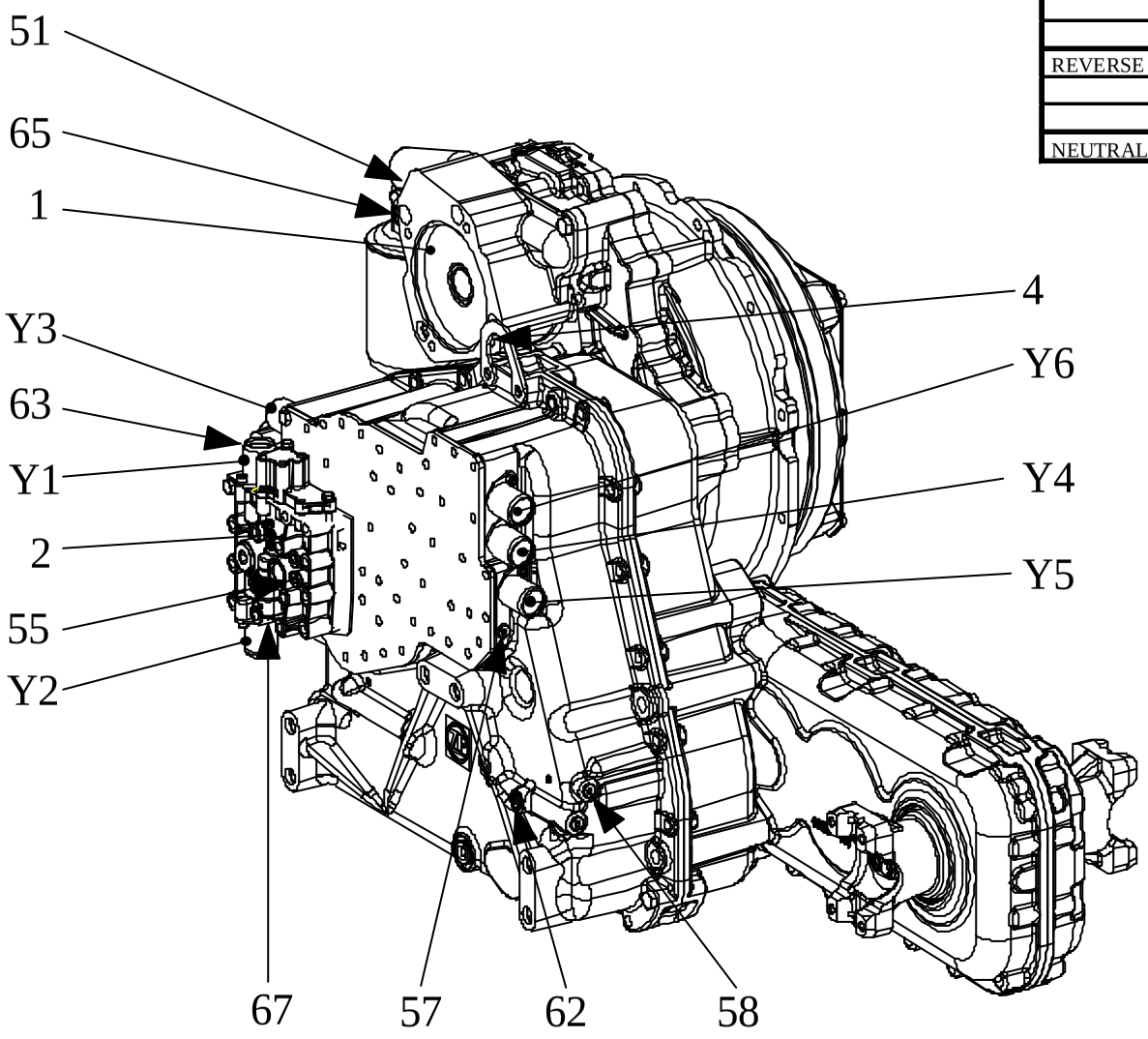
		CONNECTIONS	TORQUE LIMITS	
15	=	Connection to heat exchanger	7/8“ - 14 UNF	35 Nm
16	=	Connection from heat exchanger	7/8“ - 14 UNF	35 Nm

		CONNECTIONS			TORQUE LIMITS	
51	=	In front of the converter – opening pressure	8+2 bar		M10x16 Nm	
53	=	Clutch- Forward	16+3 bar	KV	M10x1	6 Nm
55	=	Clutch- Reverse	16+3 bar	KV	M10x16 Nm	
56	=	Clutch	16+3 bar	K1	M10x16 Nm	
57	=	Clutch	16+3 bar	K2	M10x16 Nm	
58	=	Clutch	16+3 bar	K3	M10x16 Nm	
60	=	Clutch	16+3 bar	K4	M10x16 Nm	
62	=	Lubrication pressure K3	0,2 - 1,2 bar		M10x16 Nm	
63	=	Behind the converter Temperature 100° C; short-time 120° C			3/4“ - 16 UNF	28 Nm
65	=	System pressure	16+3 bar		M10x16 Nm	
67	=	Modulation pressure	see page-1		M10x16 Nm	



Coding

		· SOLENOID VALVES UNDER VOLTAGE						ENGAGED CLUTCHES	
DRIVING DIRECTION	**SPEED**	Y1	Y2	Y3	Y4	Y5	Y6		
FORWARD	1	•		•	•		•	K1	KV
	2	•		•		•	•	KV	K2
	3	•		•			•	K3	KV
	4	•					•	K4	K3
REVERSE	1		•		•		•	KR	K1
	2		•			•	•	KR	K2
	3		•				•	KR	K3
NEUTRAL									



1 = Transmission pump
2 = Valve block electro-hydraulic control (Directional clutch and pressure control)
3 = Breather - transfer box TB92-I4
4 = Breather - Powershift transmission 4 WG-92/98 TSC

Solenoid:

Y1 = Clutch forward
Y2 = Clutch reverse
Y3 = Clutch KV/K4
Y4 = Clutch K3/K2
Y5 = Clutch K1
Y6 = Neutral

OIL CIRCULATION DIAGRAM 4 WG-92/98 TSC
- NEUTRAL -
TABLE-7

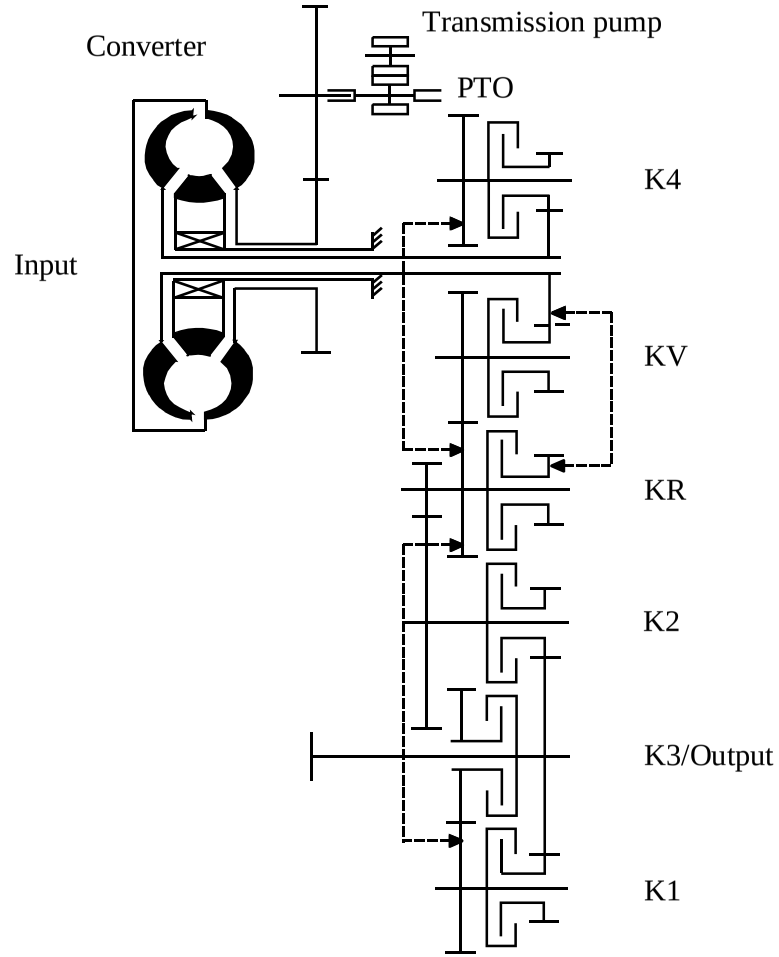
The marked positions (e.g. 53) correspond with the positions on the table-6!

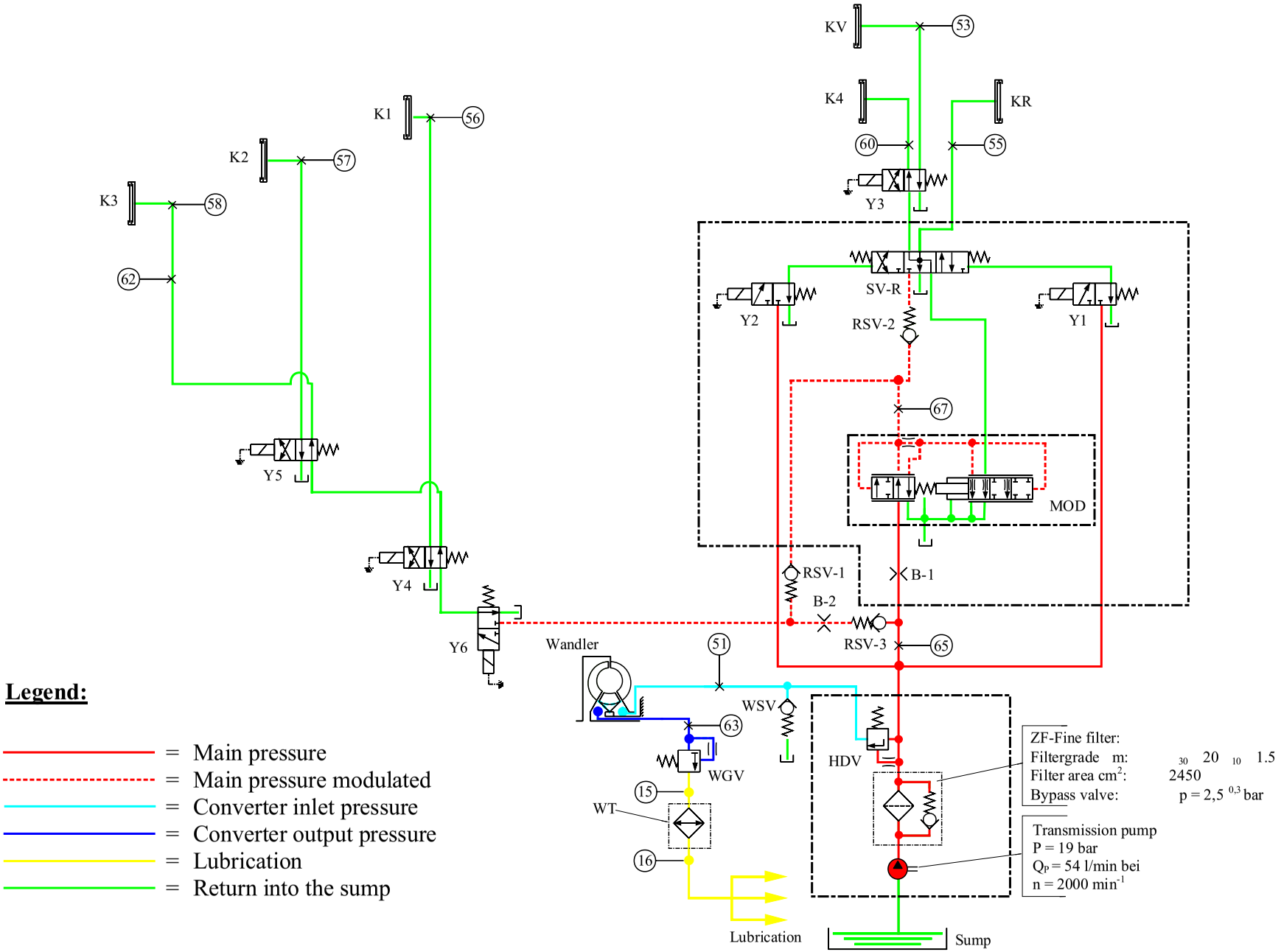
WT = Cooler
WGV = Back pressure valve
WSV = Converter safety valve
HDV = Main pressure valve
MOD = Modulations valve
B1 = Feed pressure orifice
B2 = Replenishing orifice
RSV-1 = Check valve 1
RSV-2 = Check valve 2
RSV-3 = Check valve 3
SV-R = Reversing valve
Y1 = Solenoid Clutch - Forward
Y2 = Solenoid Clutch - Reverse
Y3 = Solenoid Clutch KV/K4
Y4 = Solenoid Clutch K3/K2
Y5 = Solenoid Clutch K1
Y6 = Solenoid Neutral

Coding

		· SOLENOID VALVES UNDER VOLTAGE						ENGAGED CLUTCHES	
DRIVING DIRECTION	**SPEED**	Y1	Y2	Y3	Y4	Y5	Y6		
FORWARD	1	•		•	•		•	KV	K1
	2	•		•		•	•	KV	K2
	3	•		•			•	KV	K3
	4	•					•	K4	K3
REVERSE	1		•		•		•	KR	K1
	2		•			•	•	KR	K2
	3		•				•	KR	K3
NEUTRAL									

Gearbox diagram





Legend:

= Main pressure

= Main pressure modulated

= Converter inlet pressure

= Converter output pressure

= Lubrication

= Return into the sump

OIL CIRCULATION DIAGRAM 4 WG-92/98 TSC - 1st SPEED FORWARD - TABLE-8

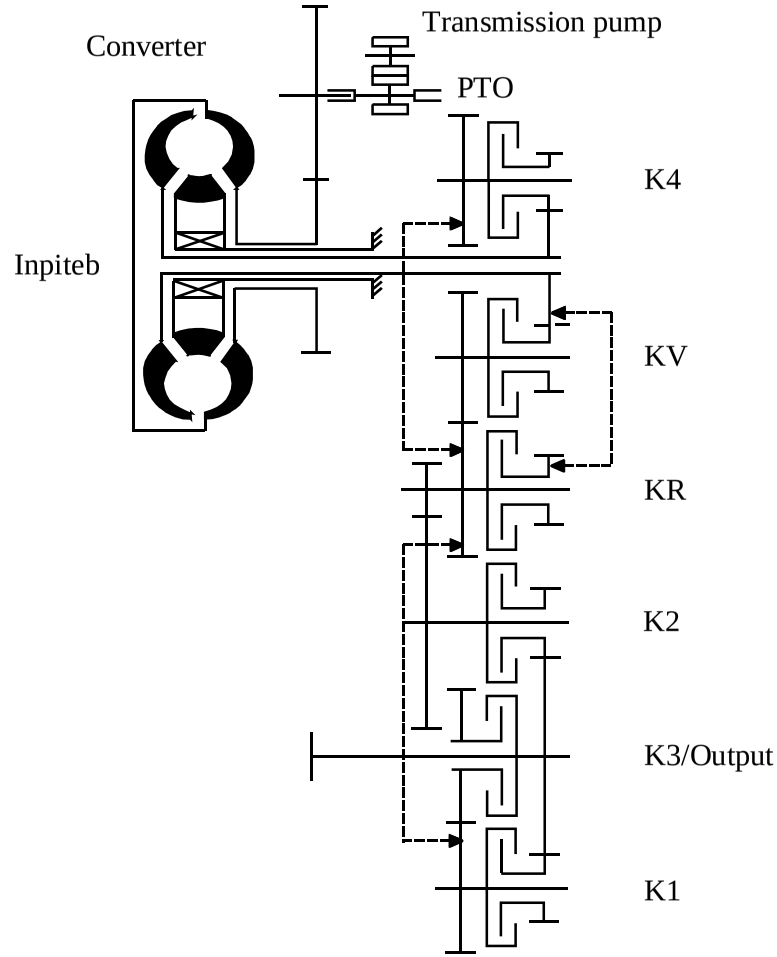
The marked positions (e.g. 53) correspond with the positions on the table-6!

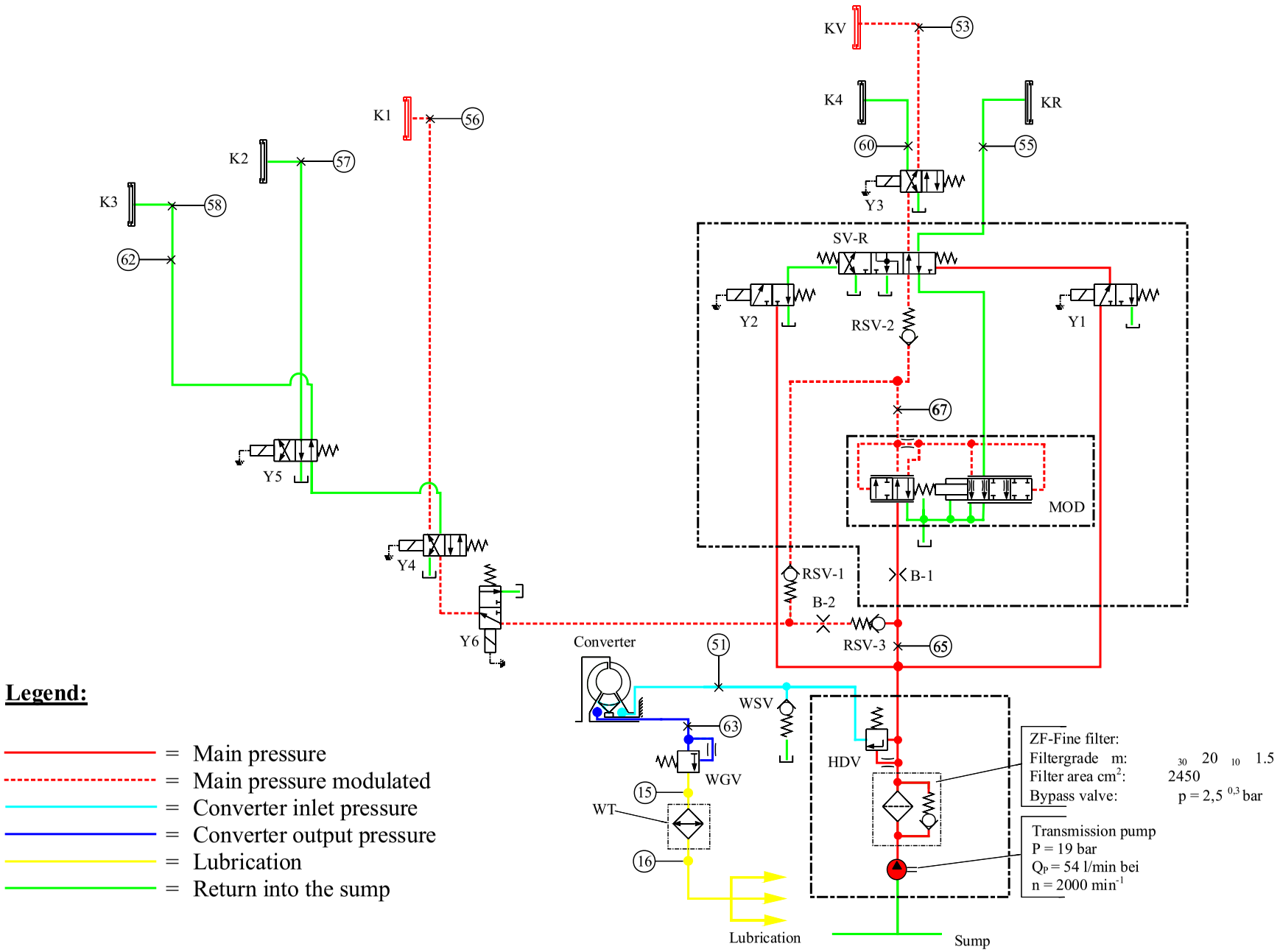
WT = Cooler
WGV = Back pressure valve
WSV = Converter safety valve
HDV = Main pressure valve
MOD = Modulations valve
B1 = Feed pressure orifice
B2 = Replenishing orifice
RSV-1 = Check valve 1
RSV-2 = Check valve 2
RSV-3 = Check valve 3
SV-R = Reversing valve
Y1 = Solenoid Clutch - Forward
Y2 = Solenoid Clutch - Reverse
Y3 = Solenoid Clutch KV/K4
Y4 = Solenoid Clutch K3/K2
Y5 = Solenoid Clutch K1
Y6 = Solenoid Neutral

Coding

		· SOLENOID VALVES UNDER VOLTAGE						ENGAGED CLUTCHES	
DRIVING DIRECTION	**SPEED**	Y1	Y2	Y3	Y4	Y5	Y6		
FORWARD	1	•		•	•		•	KV	K1
	2	•		•		•	•	KV	K2
	3	•		•			•	KV	K3
	4	•					•	K4	K3
REVERSE	1		•		•		•	KR	K1
	2		•			•	•	KR	K2
	3		•				•	KR	K3
NEUTRAL									

Gearbox diagram





Legend:

= Main pressure

= Main pressure modulated

= Converter inlet pressure

= Converter output pressure

= Lubrication

= Return into the sump

OIL CIRCULATION DIAGRAM 4 WG-92/98 TSC - 1st SPEED FORWARD - TABLE-8

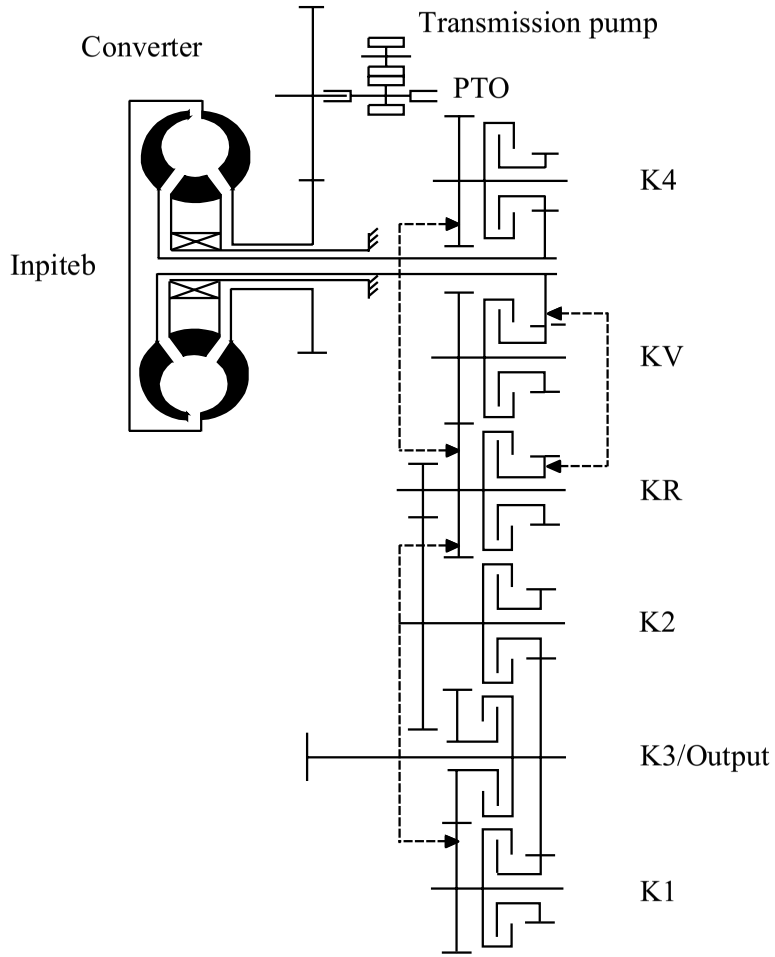
The marked positions (e.g. 53) correspond with the positions on the table-6!

WT = Cooler
WGV = Back pressure valve
WSV = Converter safety valve
HDV = Main pressure valve
MOD = Modulations valve
B1 = Feed pressure orifice
B2 = Replenishing orifice
RSV-1 = Check valve 1
RSV-2 = Check valve 2
RSV-3 = Check valve 3
SV-R = Reversing valve
Y1 = Solenoid Clutch - Forward
Y2 = Solenoid Clutch - Reverse
Y3 = Solenoid Clutch KV/K4
Y4 = Solenoid Clutch K3/K2
Y5 = Solenoid Clutch K1
Y6 = Solenoid Neutral

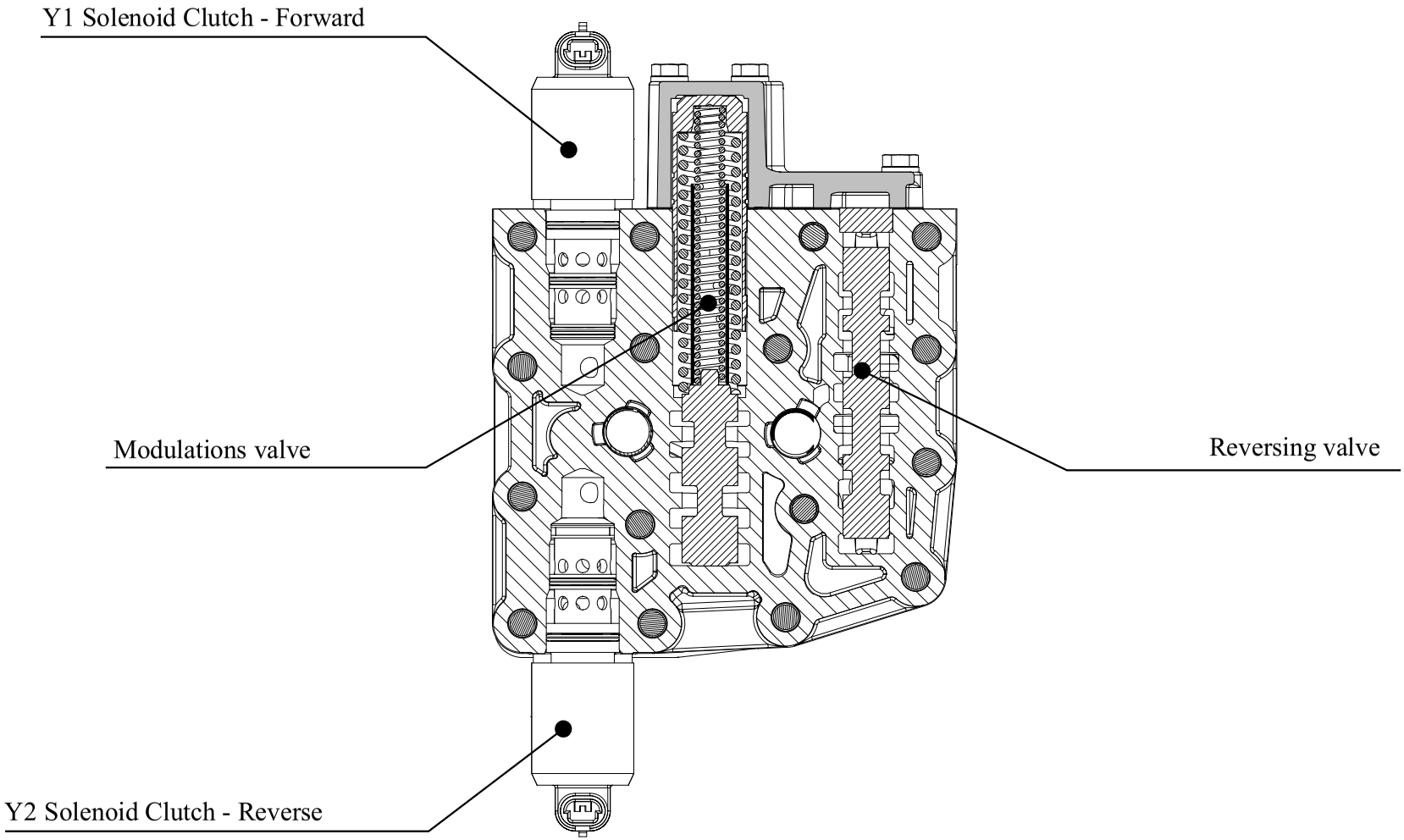
Coding

		SOLENOID VALVES UNDER VOLTAGE						ENGAGED CLUTCHES	
DRIVING DIRECTION	**SPEED**	Y1	Y2	Y3	Y4	Y5	Y6		
FORWARD	1							KV	K1
	2							KV	K2
	3							KV	K3
	4							K4	K3
REVERSE	1							KR	K1
	2							KR	K2
	3							KR	K3
NEUTRAL									

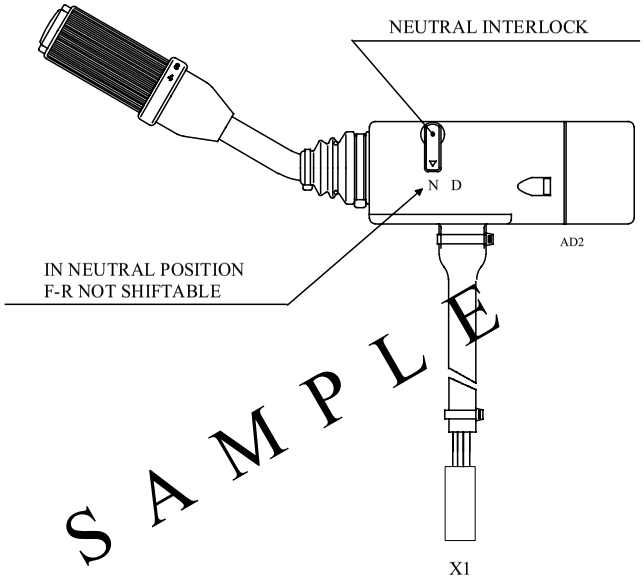
Gearbox diagram

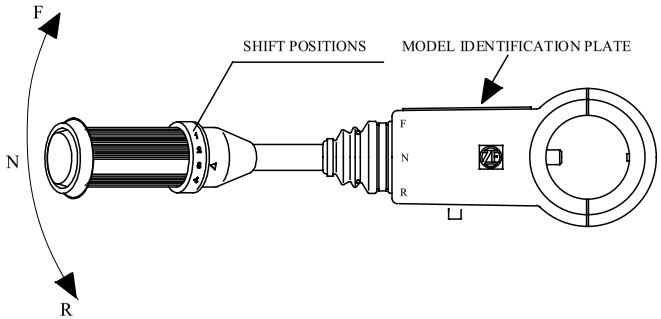


ELECTRO-HYDAULIC SHIFT CONTROL 4 WG-92/98 TSC TABLE-9

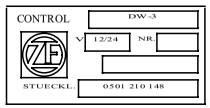


CONTROLLER DW-3
TABLE-10





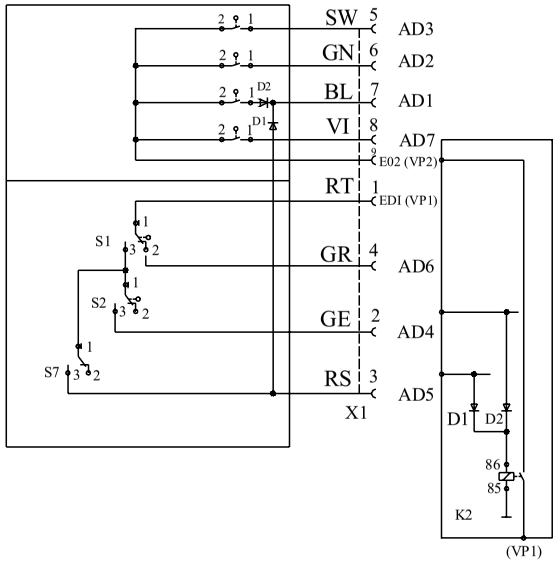
MODEL IDENTIFICATION



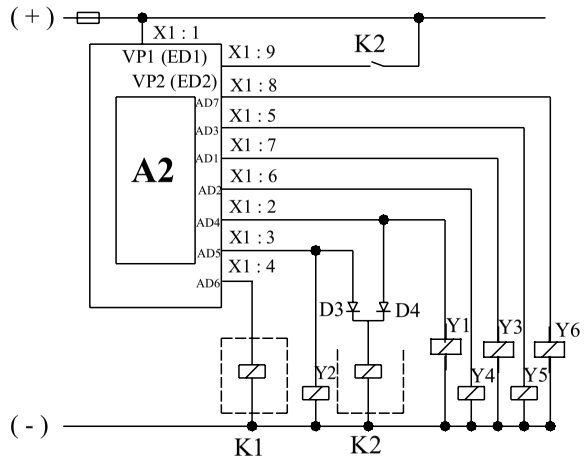
CODING CONTROLLER

OUTPUT															
SPEED			FORWARD				REVERSE				NEUTRAL				
			1	2	3	4	1	2	3	4	1	2	3	4
AD1	B1	Y3												
AD2	B2	Y4												
AD3	B3	Y5												
AD4	V	Y1												
AD5	R	Y2												
AD6	AS													
AD7	B4	Y6												

CIRCUIT DIAGRAM CONTROLLER



CONNECTION CIRCUIT CONTROLLER



K1 = RELAY STARTER INTERLOCK

K2 = RELAY REVERSING LIGHT

A1 = ELECTRONIC UNIT EST-37

A2 = CONTROLLER