CASE 325 & 330 ARTICULATED DUMP TRUCKS

Transmission

CNH America LLC
700 STATE STREET
RACINE, WI 53404 U.S.A.

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Objectives

The 25 TON TRUCK and the 30 TON TRUCK both use a ZF Ergo-Power Transmission. The objectives of this training program are:

1. To provide the technician an understanding of the mechanical functions of the ZF Transmission.

2. To provide the technician an understanding of the shift sequences of the ZF Transmission.

3. To provide the technician an understanding of the diagnostic procedures of the ZF Transmission.

The 25 TON TRUCK uses the model ZF 210 transmission and the 30 TON TRUCK uses the ZF 260 transmission. Although the two transmissions differ in many ways, their operating functions are quite similar. Both transmissions provide six speeds forward and three speeds in reverse. Forward directions can be shifted manually or automatically while the reverse direction only operates in the manual mode.

Other features include a “kick down/hold-in-range” switch, converter lock up and a diagnostics and fault code display. A Jake brake is a standard feature on the 30 TON TRUCK.

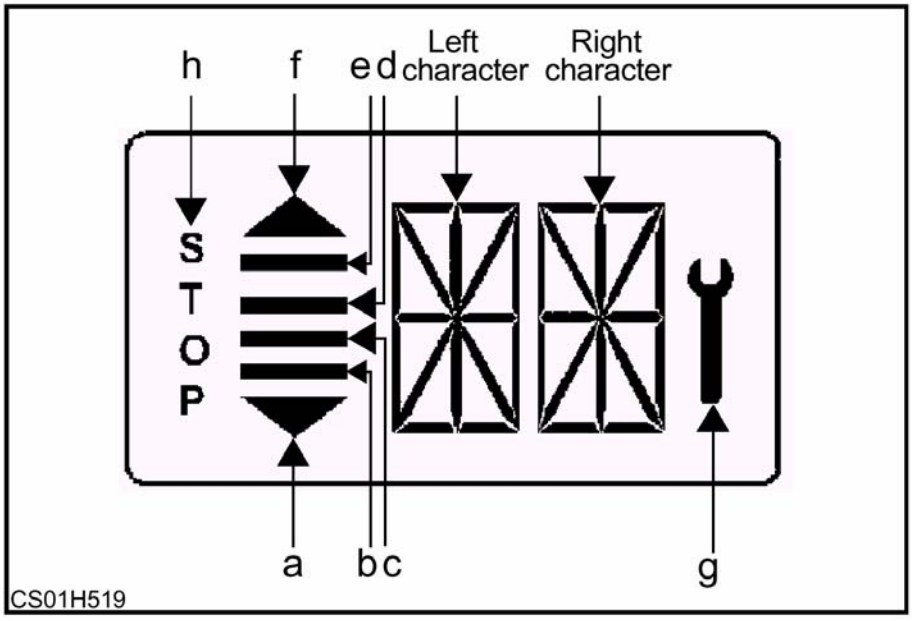
Major differences in the two transmissions include clutch size, clutch arrangements on the shafts, housing configuration, control valve location and function, input torque capacity and test port locations. The training material in this section pertains to both model transmissions, but may only reference and display one of the two models. Always refer to the specific Service Manual before performing maintenance or repair on the transmission.

Transmission Operation

The transmission is electronically controlled through the Transmission Control Unit (TCU). This allows for many automatic features and options for the operator. Included in these features and options are the digital transmission display, manual or automatic shift, kick down switch, converter lock-up and engine load sensing.

Additional information on these features and options are as follows:

Display



The transmission display provides information to the operator on the running transmission.

The left character indicates the engaged gear.

The right character indicates the engaged direction selected (F, N, or R).

Additional information available from the left and right characters include:

** = Cold start up, keep the transmission in neutral until warmed up.

EE = Interface error between the display and the control unit, complete stop, shift to neutral for error code display.

Two digit number = error in system corresponding to a fault code. Multiple errors will appear in succession. (This only appears when the gear shift is in Neutral).

a. arrow, along with f, indicates the transmission is in Automatic operation.

b. bar, indicates pre-selection is limited to first gear.

c. bar, indicates pre-selection is limited to second gear.

d. bar, indicates pre-selection is limited to third gear.

e. bar, indicating pre-selection is limited to fourth, fifth or sixth gear.

f. arrow, along with (a), indicates the transmission is in Automatic operation.

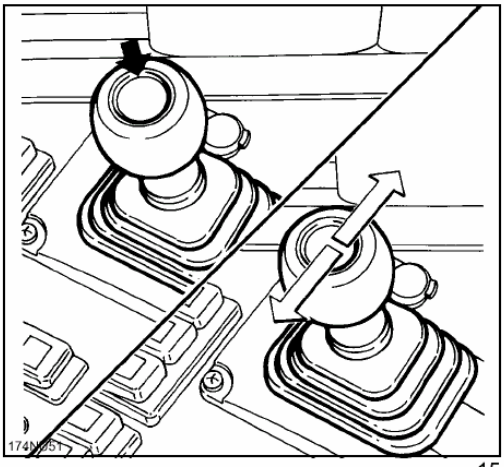
NOTE: The arrows and bars all stay on when automatic operation with-out pre-selection is working, (the normal way). Arrows (a) and (f) will flash when the kick-down switch under the throttle is pressed. All of the bars will flash if the lock-up clutch is disengaged (torque converter running).

g. wrench; indicates a system error. This symbol will flash to indicate that use is restricted.

h. stop, previously not used, now used for Heavy Failure.

Automatic/ Manual Operation

The transmission always starts in the automatic mode, second gear when first shifted into Forward. Each time the button on top of the shift lever is depressed, the mode changes from auto to manual or manual to automatic. When the transmission is in the Automatic mode and the shift lever is moved sideways it changes into the manual mode and an upshift or a downshift will occur. **NOTE: The button must be pressed while shifting from neutral into forward or reverse direction or the transmission remains in neutral.**



Select the Automatic or Manual mode as follows:

After selecting forward direction of travel, then either press the button on the top of the shift lever, to stay in the same gear, or move the lever to the left or right to change from automatic to manual mode, and up-shift or down-shift at the same time.

Use the Manual Mode

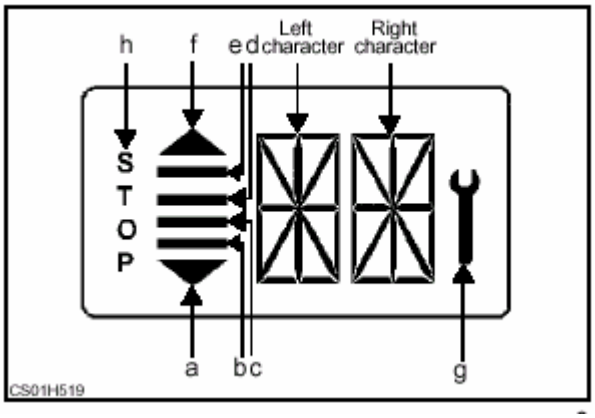
-when driving up a steep hill.

-when driving down a steep hill.

-in particularly difficult conditions such as steep grades or on slippery or rough surfaces.

Always use the automatic mode for normal vehicle conditions.

The automatic transmission control system ensures automatic torque converter lock-up clutch engagement that matches operational engine speed and load.

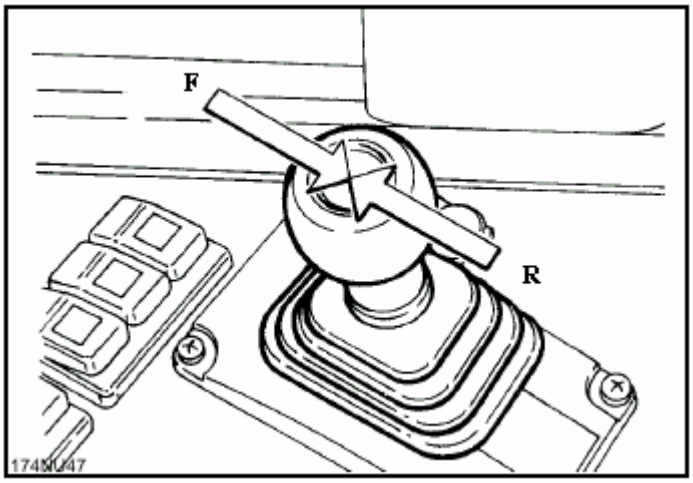


The torque converter condition is displayed by means of the bars. When the bars are flashing, the torque converter is operating. When the bars are on continuously, the lock-up clutch has locked the converter pump to the turbine and the converter functions as a mechanical device. The flashing bars are not an indicator of transmission system errors. Converter lock-up occurs at approximately 1200 to 1400 RPM and will not unlock, even when the transmission shifts, until the speed drops to approximately 700 RPM.

Forward/ Reverse Selection

The gearshift lever has three positions.

Position N (Neutral) is used for engine starting and for a stationary position with the engine running.



Position F (Forward) is used for forward movement of the vehicle.

Position R (Reverse) is used for reverse movement of the vehicle.

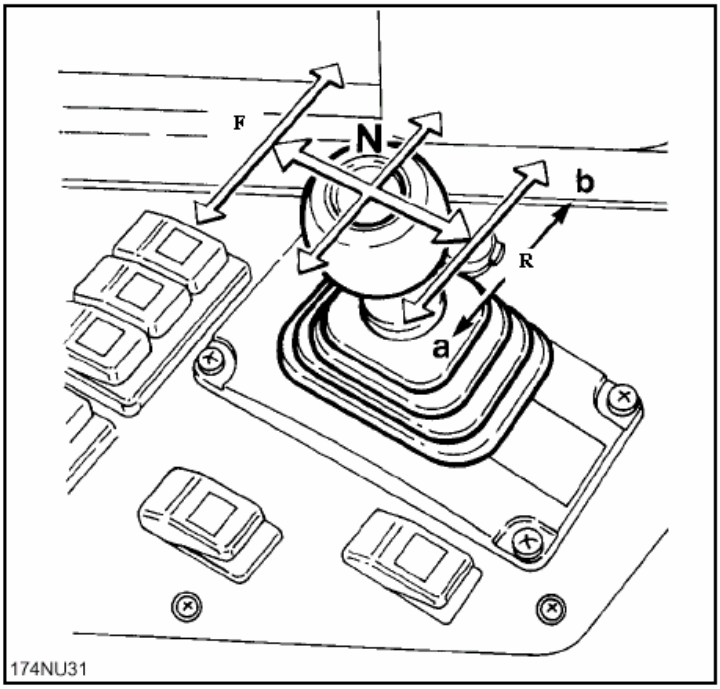
When shifting from Neutral into either Forward or Reverse, the button on top of the shift lever must be depressed at the same time. This keeps the transmission in automatic mode when in Forward. When Reverse is selected, the transmission will automatically switch to manual mode.

The transmission will not shift into Forward or Reverse if the parking brake is applied.

Warning! The vehicle must be completely stopped prior to changing direction from forward to reverse or from reverse to forward. If the lever is place in reverse while moving forward or placed in forward while moving in reverse, the truck will remain in neutral until the machine stops, then will shift to the direction selected.

Manual Gear Selection

To manually change gears, when the gearshift lever is in Forward or Reverse, move the lever to the side:



When the lever is pushed leftward, toward the driver, a lower gear is selected (down shifts one gear). When the lever is pushed rightward, away from the driver, a higher gear is selected (up shifts one gear). Each movement to the side will result in one gear shift.

When the shift lever is returned to Neutral, the transmission shifts to the pre-selected starting gear. The highest possible starting gear is second gear. However, if the vehicle is stopped in a higher gear, and the shift lever remains in forward, the transmission will remain in that gear when restarting.

The transmission control unit will prevent gearshifts which are not compatible with vehicle and engine speeds.

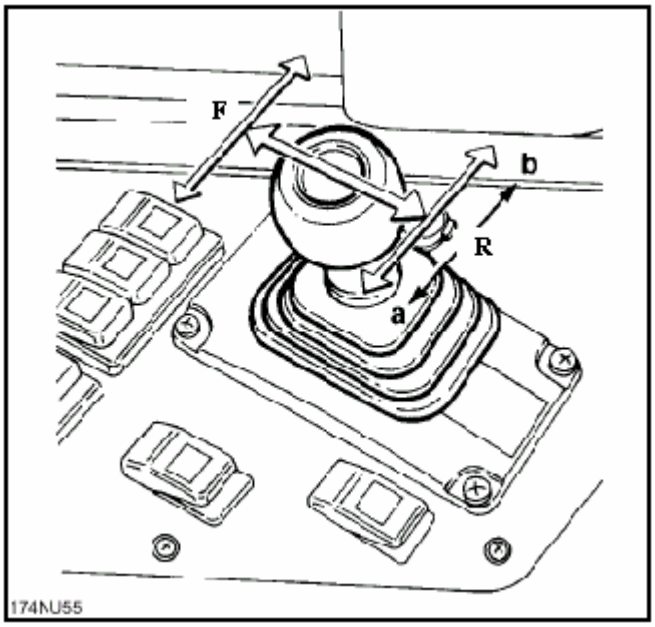
It is recommended to shift gears when the lock-up clutch indicator stops flashing. This avoids over loading the torque converter. The transmission oil temperature will increase with prolonged operation with the torque converter lock-up disengaged.

Shifting to a lower gear will allow the converter lock-up clutch to engage and lower the temperature.

Automatic Mode Gear Selection

The automatic transmission control system selects the most suitable gear according to engine speed and load. When starting from a standstill, the transmission will automatically start in second gear. **Always change to first gear manual mode when starting off uphill with a full load.**

Pre-selection of maximum speed: Push the gearshift lever laterally to select and limit the highest gear that can be engaged automatically to that gear and all lower gears. Push the lever toward the driver to shift down and away from the driver to shift up.

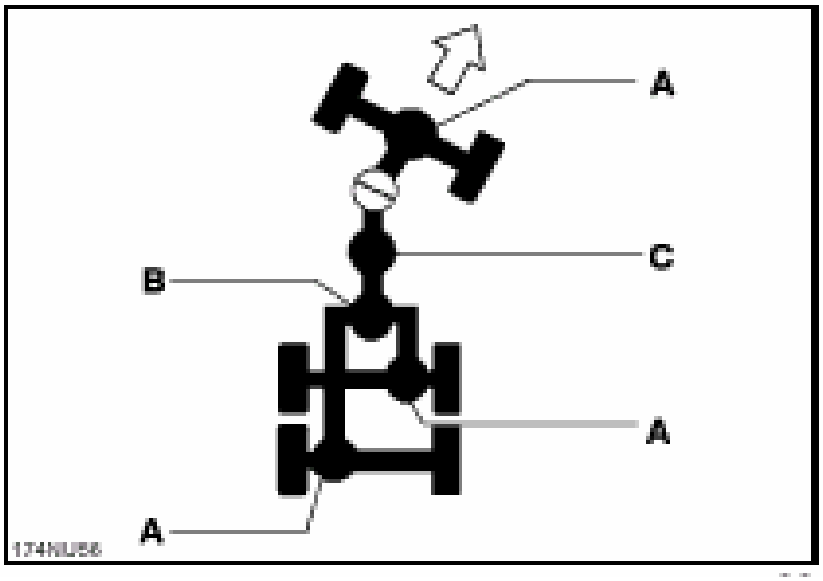


Kick-down / hold-in-range Function

The kick-down switch has two basic functions. One, the driver can force a down-shift from sixth gear to fifth gear by pressing the accelerator pedal to the floor, activating the kick-down switch beneath the pedal. This is functional when the machine has slowed down slightly due to an increase in load. The second function of the kick-down switch is when the driver does not want the transmission to automatically up-shift to the next gear. As an example, depressing the accelerator and activating the kick-down switch while in third gear, will lock the transmission in third gear until the driver releases the kick-down switch.

Differential Lock

The vehicle is equipped with a limited slip feature on all axles. These axles will transfer torque automatically, according to the lack of traction of each wheel.



The vehicle is also equipped with a rear differential lock (B) and a transmission differential lock (C).

Lock the rear differential to assure positive traction between the rear axles. Lock the transmission differential to assure positive traction to the front axle as well.
When neither differential lock is used, power is applied to all three axles in an unlocked condition. Engaging the rear differential lock assures positive drive to both front and rear tandem axles. Engaging the transmission differential lock assures drive to the front axle as well.
NOTE: Never engage the differential locks if additional traction is not required. Engaging the transmission differential lock when it is not needed creates undue tire wear and heavier transmission loads.
Do not engage a differential lock while a wheel is spinning. Stop the machine before engaging a differential lock.

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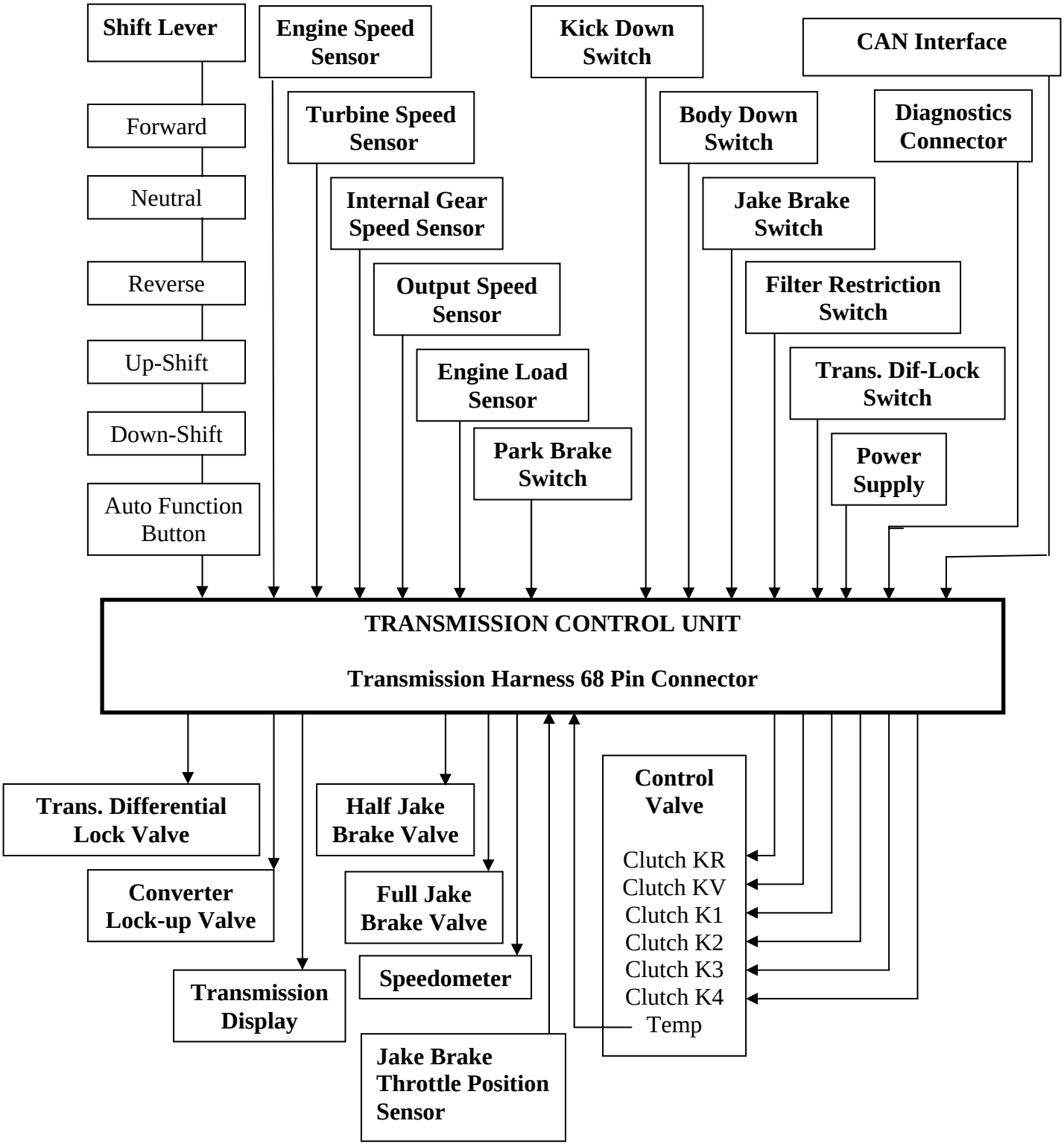
TRANSMISSION CONTROL UNIT

The transmission control unit (TCU) uses input information from a number of sensors to determine the proper gear, shift points, converter lock up and other operating requirements. A 68 pin wiring connector provides for all input and output information. The control valve, located on the back of the ZF 210 and on the top of the ZF 260, receives electrical information from the control unit and provides the proper shift requirements.

Inputs:

- The shift lever, located on the right panel, allows the operator to select Neutral, Forward or Reverse direction, choosing auto or manual up-shift or down-shift of the transmission.
- The engine speed sensor, located in the upper rear area of the transmission, measures the speed of the engine.
- The turbine speed sensor, located at the top of the transmission, measures the turbine speed.
- The internal gear speed sensor, located on the upper right side of the transmission, measures the speed of the central gear.
- The output speed sensor, located on the left side of the transmission, measures the speed of the transmission output shaft.
- The engine load sensor, located on the engine, provides information to the transmission.
- The kick down switch, located under the accelerator pedal, provides two functions while in the auto mode. One, it provides a downshift from sixth to fifth gear if the machine load has slowed the machine somewhat and two, it allows the operator to lock the transmission in a desired gear when the pedal is fully depressed.
- The body down switch, located on the machine chassis, prevents gear engagements above second gear, when the body is elevated toward the dump position.
- The two position Jake brake switches allow for the selection of half brake or full brake application, or for Jake brake or Retarder application. There is also a Throttle Position Sensor to engage the brake.
- The park brake switch, located on the right panel, stops transmission functions, if activated.
- The axle differential lock and the transmission differential lock switch, located on the right control panel, allows the operator to select each of these options.
- The oil temperature sensor, located in the transmission control valve, measures the oil temperature

ZF Transmission Control Valve



Inputs (Continued):

- The oil filter restriction switch, located on the left side of the transmission, monitors the condition of the filter.

- The power supply, diagnostic connection and the CAN interface (connection between transmission controller and other on board devices) complete the input information.

Outputs:

- The Transmission Differential Lock Valve, located in the lower area of the transmission, engages or disengages the lock between the front and rear drive shafts.

- The Converter Lock Up Valve, locks the converter when the pump and turbine approach a one to one ratio, to improve machine efficiency.

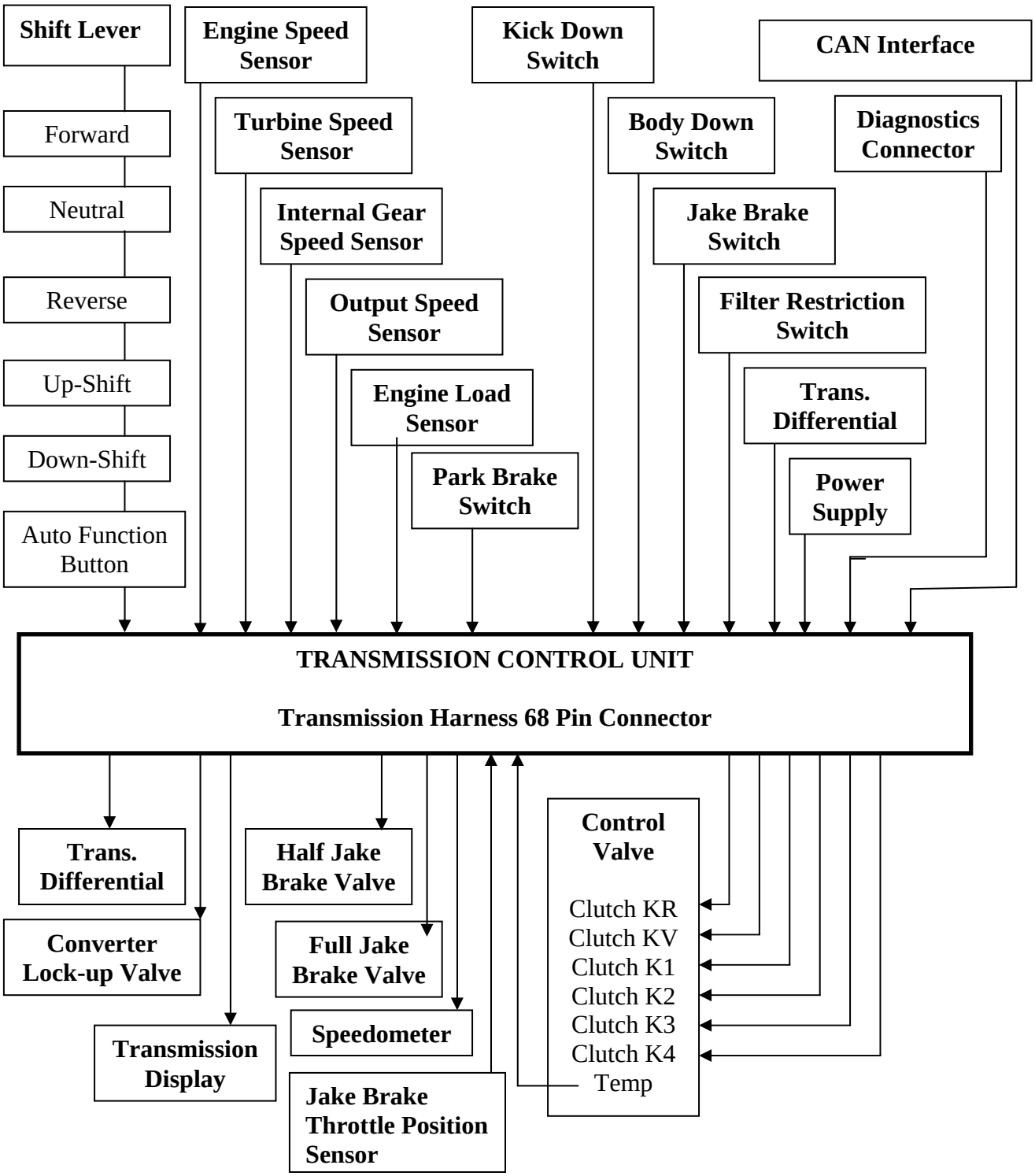
- The Jake Brake Valves (half brake and full brake) are activated if selected, when the accelerator pedal is released.

- The Speedometer displays the machines speed through a calculation of the transmission output speed.

- The Transmission Display provides the operator with information about, gear selection, direction, lock-up operation fault codes etc.

- The Clutch Solenoid Valves engage the clutches for machine direction and the six output speeds through various solenoid activation combinations.

ZF Transmission Control Valve



Electrical Component Testing

TO TEST THE ENGINE SPEED SENSOR, TURBINE SPEED SENSOR & INTERMEDIATE GEAR SENSORS:

1. Disconnect the sensor from the wiring harness.
2. Place the positive lead of the DVM on one sensor pin and the negative lead on the other pin.
3. Turn the DVM to the Ohms scale. 1050 Ohms, +/- 10% should be measured. If the specified reading is not obtained, replace the sensor.

TO TEST THE CONVERTER TEMPERATURE SENSOR:

1. Disconnect the connector at the sensor.
2. Place a lead of the DVM on each of the sensor terminals.
3. A resistance reading of 800 to 1500 Ohms should be read.

If the specified reading is not obtained, replace the sensor.

TO TEST THE TRANSMISSION OIL TEMPERATURE SENSOR:

1. Disconnect the connector at the sensor.
2. Place a lead of the DVM on each of the sensor terminals.
3. A resistance reading of 1000 to 1500 Ohms should be read.

If the specified reading is not obtained, replace the sensor.

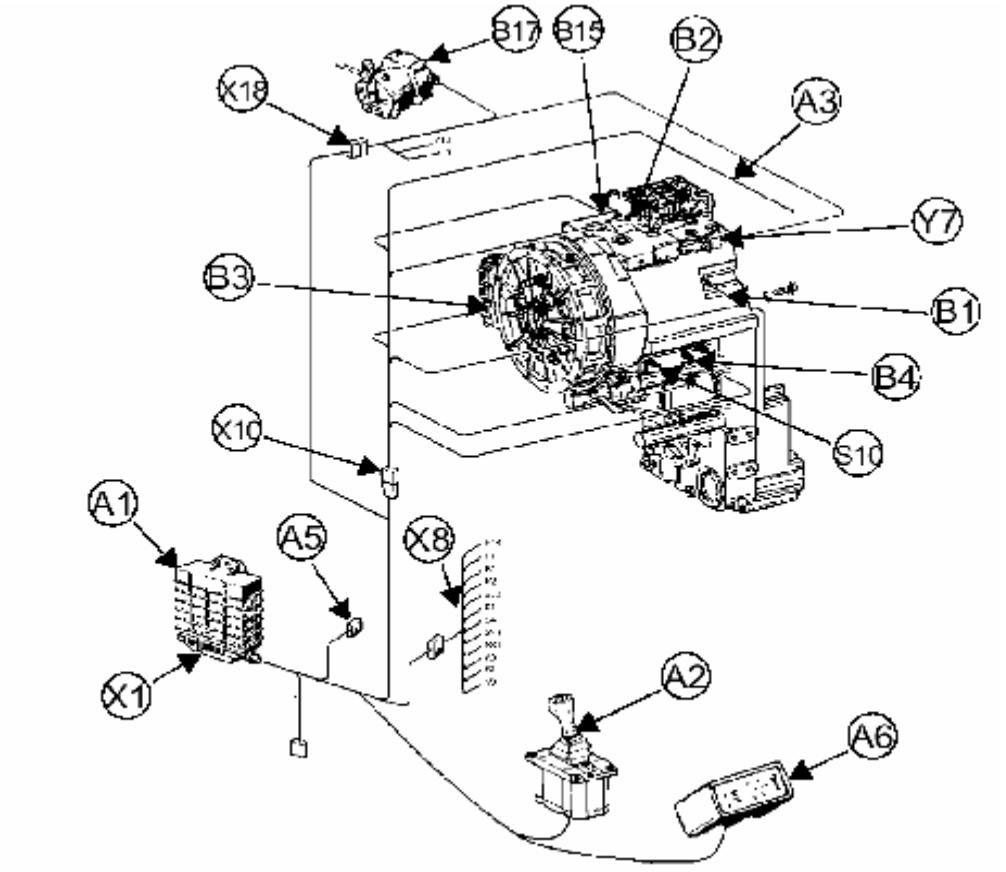
TO TEST THE TRANSMISSION SOLENOIDS:

NOTE: Due to the inaccessibility of the control valve on the 30 TON TRUCK, measure solenoid resistance at connector X10, located in front of the cab. See the Electrical Section for the pin locations.

1. Disconnect the connector at the sensor.
2. Place a lead of the DVM on each of the sensor terminals.
3. A resistance reading of 19 Ohms +/- 10% should be read.

If the specified reading is not obtained, replace the solenoid

Transmission System

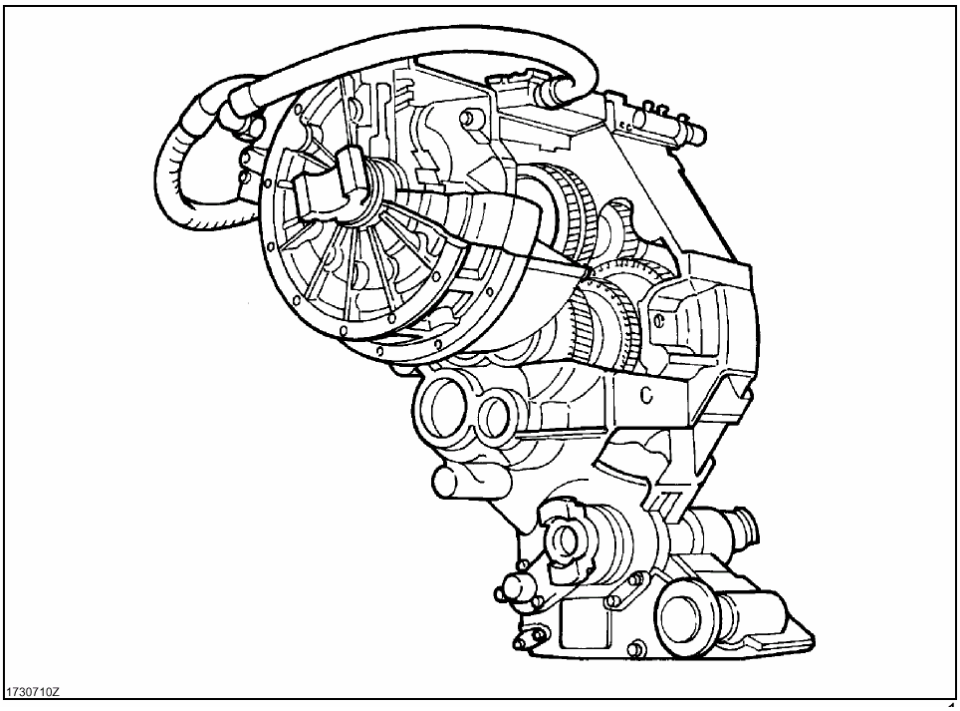


A1. Transmission Control Unit (TCU)
A2. Shift Controller.
A3. Electro-hydraulic Control Valve
A5. Diagnostic Interface Recorder
A6. Display
Y7. Converter Lock-up Valve
B1. Engine Speed Sensor.
B2. Turbine Speed Sensor.
B3. Intermediate Gear Speed
B4. Output Speed Sensor.
B15. Temperature Sensor (behind converter).
S10. Filter Restriction Switch.
B17. Engine Load Sensor.
X1. 68 Pin Connector.
X8. 22 Pin (machine connection).
X10. 22 Pin Connector
X18. 18 Pin Connector.

X8 Connection to:
Speedometer.
Fuse
Relay, Neutral Start
Relay for Back-up Alarm
Jake Brake Switch.
Kick Down Switch.
Pre-select Differential Lock Switch
Park Brake Switch
Dump Raised Switch
Idling Switch.
Jake Brake Relay

X18. Connection to:
B17. Load Sensor.
Y7. Converter Lock-up Valve.
Y9. Differential Lock Valve
Y10. Jake Brake Valve

Major Transmission Components



Model ZF 6WG260

Transmission TCU and wiring: The TCU receives the input signals and controls the outputs to assure correct operation of the transmission.

Hydraulic system: The system consists of a set of solenoid valves, controlled by the TCU, and pipes to carry the oil to the points required.

Torque converter: The torque converter transmits the input torque from the engine to the transmission. It consists of the pump, the turbine and the stator.

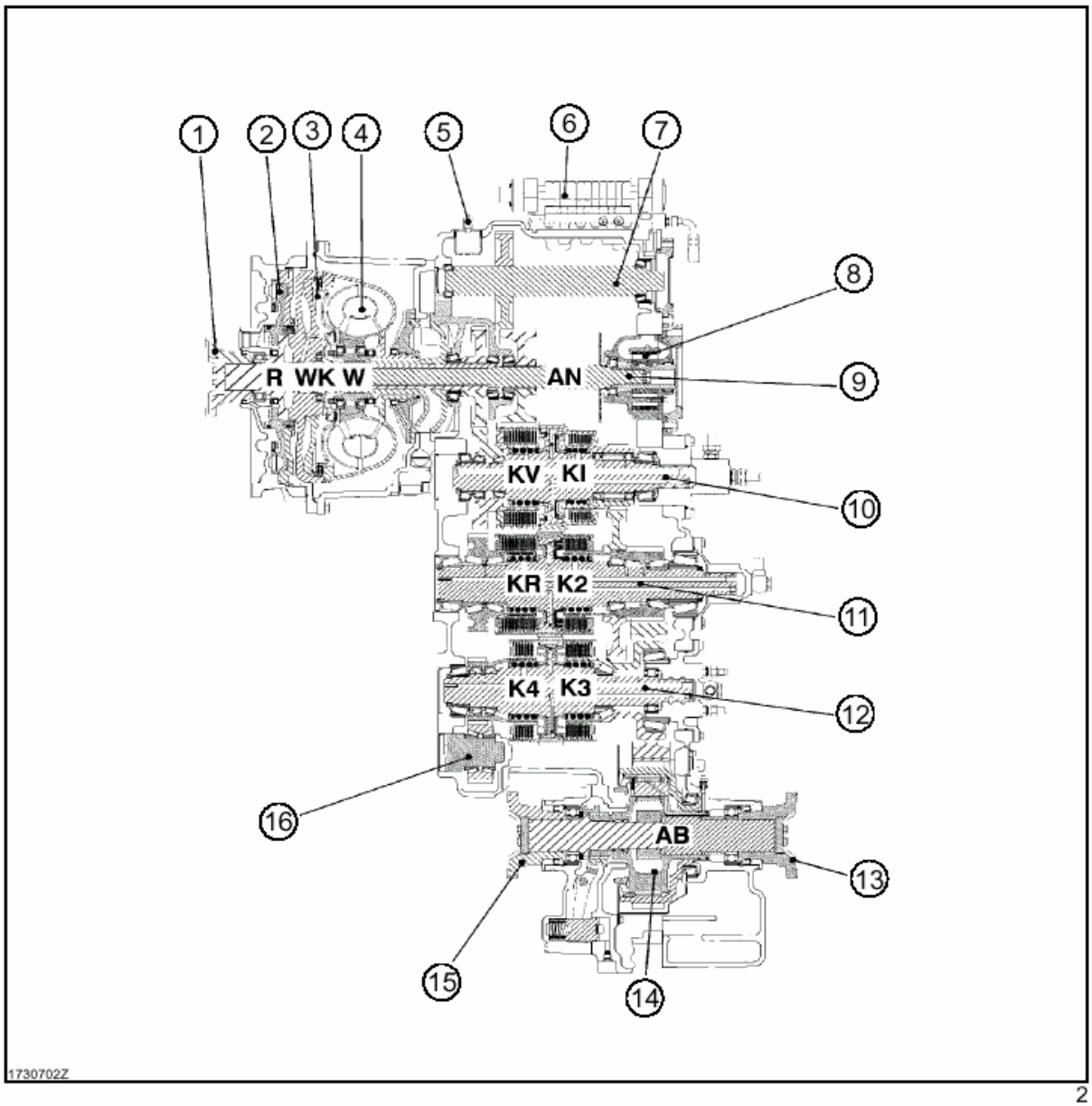
Lock-up clutch: The lock-up clutch locks the pump and turbine components together creating a 1:1 ratio.

Shafts and gears: The transmission consists of an input shaft, an output shaft with a transmission differential lock, and three main shafts.

Clutches: Each shaft has two multi-plate clutches.

Oil pump: The pump is fitted to the input shaft to supply oil for clutches and lubrication.

AUTOMATIC TRANSMISSION CROSS-SECTIONAL VIEW

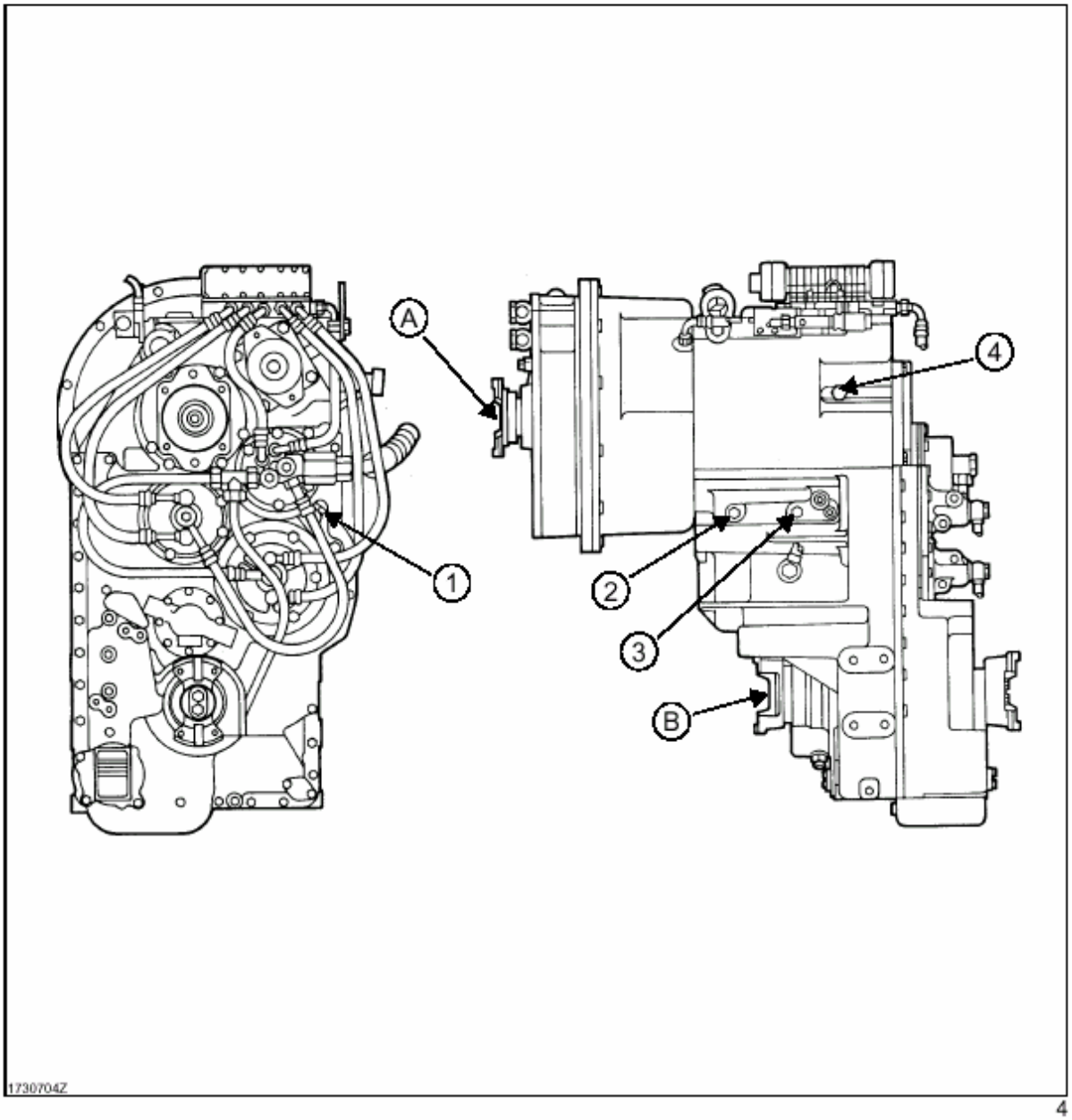


2

1. Drive torque input flange
2. R hydrodynamic brake (retarder)
3. WK lock-up clutch
4. W torque converter
5. Breather
6. Hydraulic control unit
7. PTO drive shaft
8. Transmission oil pressure pump
9. Drive torque input shaft AN
10. KV (forward gear) and K1 clutch shaft
11. KR (reverse) and K2 clutch shaft
12. K3 and K4 clutch shaft
13. Drive torque output flange, rear side
14. Differential lock
15. Drive torque output flange, front side
16. Intermediate shaft

Note: 30 TON TRUCK Transmission

AUTOMATIC TRANSMISSION SENSORS



4

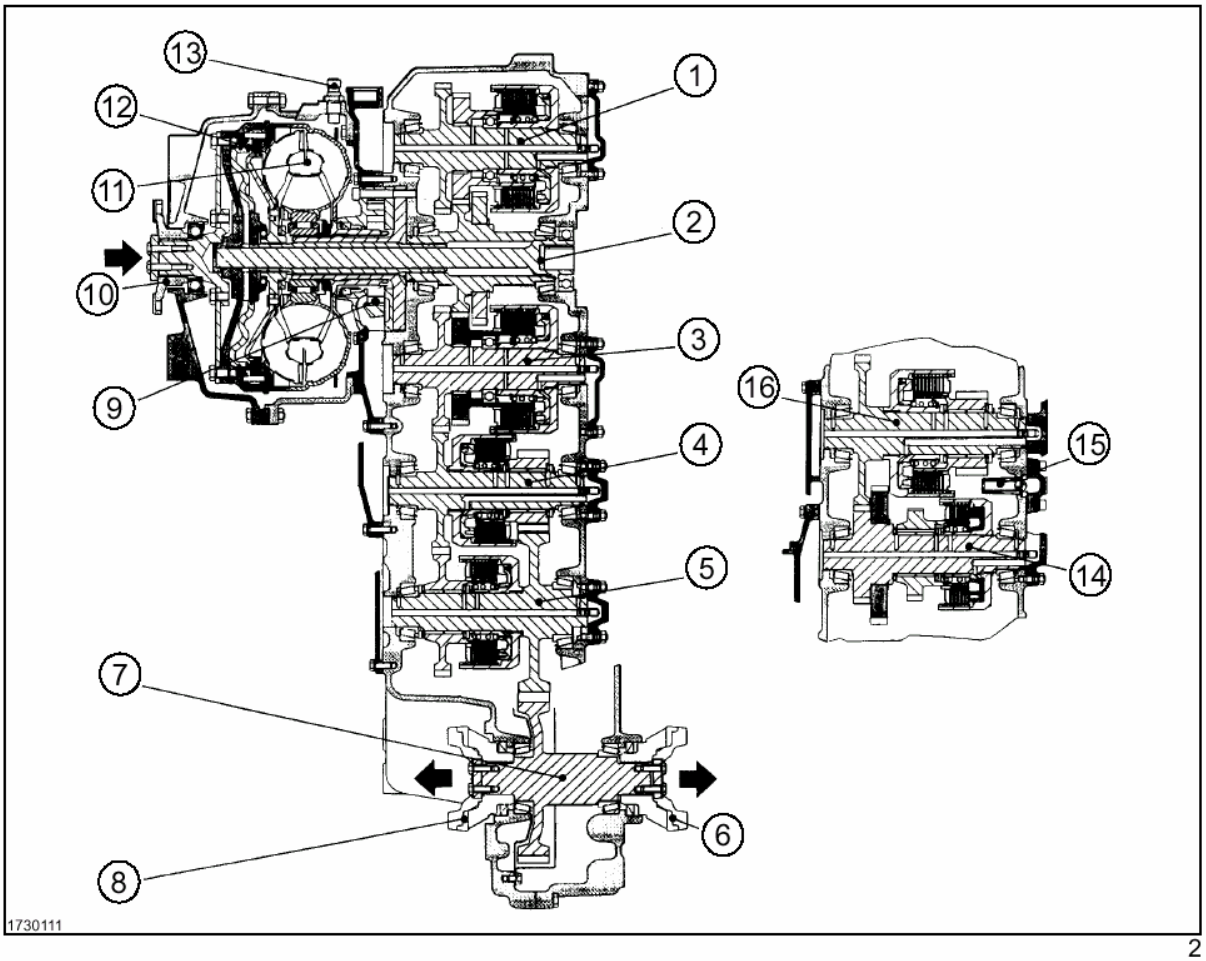
1. Output shaft rpm sensor
2. Turbine rpm sensor
3. Central shaft rpm sensor
4. Engine rpm sensor

A. Drive input flange
B. Front drive output flange
C. Rear drive output flange

Note: 30 TON TRUCK Transmission

AUTOMATIC TRANSMISSION CROSS SECTIONAL VIEW

25 TON TRUCK



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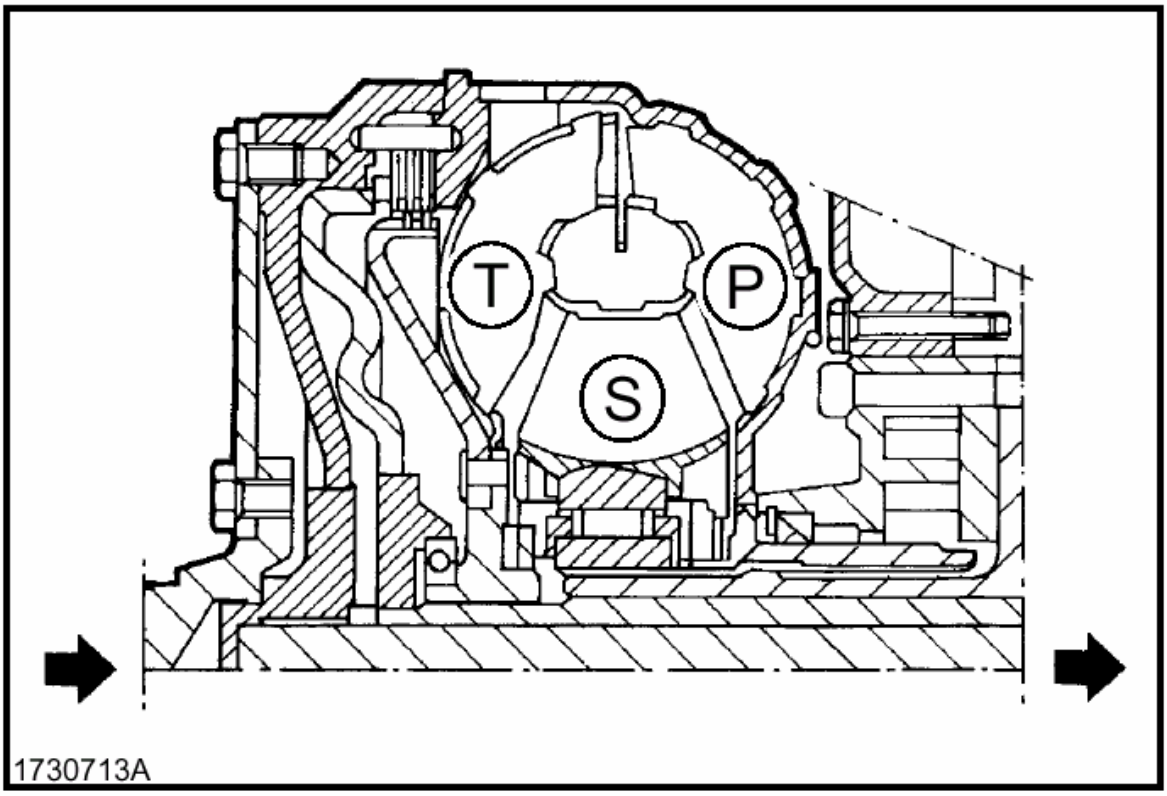
1. Reversing shaft KR
2. Drive torque input shaft AN
3. Forward gear shaft clutch KV
4. 2nd gear shaft K2
5. 3rd gear shaft K3
6. Drive torque output flange, rear
7. Drive torque output flange, front
8. Drive torque output shaft AB (without splitter)
9. Gearbox oil pressure pump
10. Drive torque input flange
11. Torque converter
12. Lock-up clutch WK
13. Input shaft speed sensor
14. 4th gear shaft K4
15. Converter safety valve
16. 1st gear shaft K1

Fundamental Transmission Components

TORQUE CONVERTER

The torque converter hydraulically transmits drive force from the engine to the transmission, at a multiplying ratio from a maximum of approximately 2.5:1 to a minimum of 1:1.



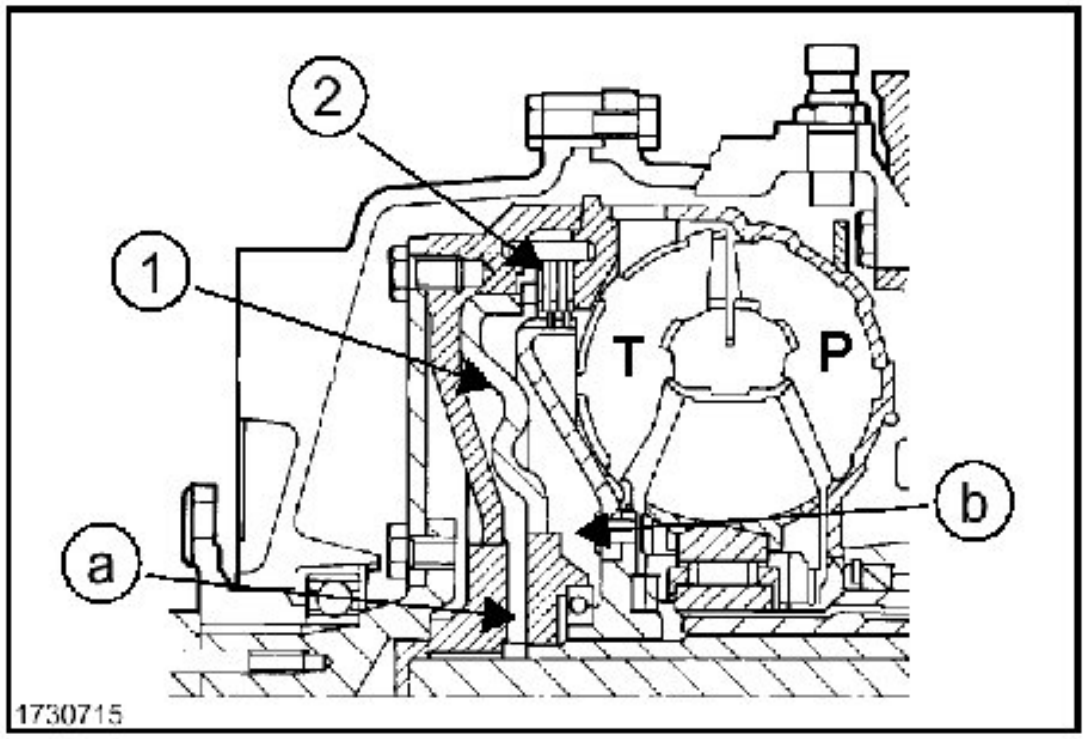
The torque converter consists of three parts: the pump P, the turbine T and the stator S. The pump is the input element and is rotated by the engine. The turbine is the output element and is hydraulically controlled by the pump. The stator is the reaction element (torque multiplier) which is mounted on a one-way bearing allowing rotation in one direction only. The assembly is enclosed in an oil filled housing which also includes a lock-up clutch for locking the turbine to the pump and also a hydrodynamic brake on the model ZF 260.

TORQUE CONVERTER OPERATION

The pump, which is driven by the engine, transmits energy to the oil through centrifugal force. The centrifugal force directs the oil to the outer edge of the pump where it leaves the vanes of the pump and enters the vanes of the turbine. The energy of the oil entering the turbine provides the rotary movement of the turbine. Oil driven to the center of the turbine is directed through the stator, changing the direction of flow for a favorable re-entry back into the pump. Whenever the turbine speed is slower than pump speed, the centrifugal force on the oil through the turbine becomes greater, thus allowing a greater amount of oil to flow. This increased flow creates the torque multiplying feature previously mentioned. When the pump and turbine speeds are near equal, oil flow through the three components is low, and lock-up occurs

LOCK-UP CLUTCH

The lock-up clutch WK (2), is a device which, when engaged by oil pressure on the piston (1), mechanically couples the pump to the turbine.



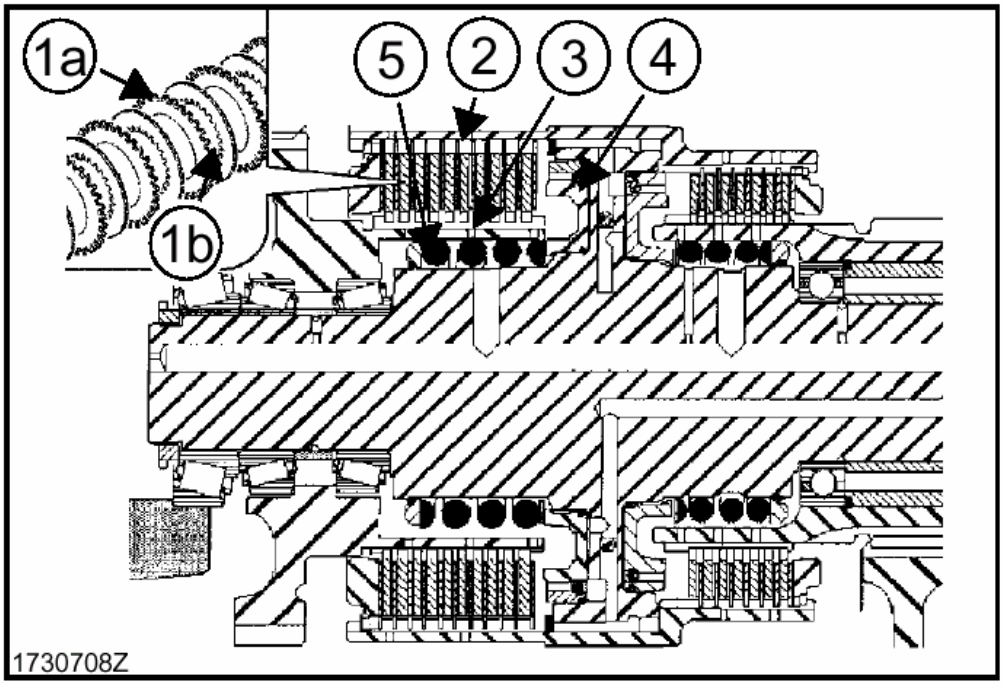
When the lock-up clutch is engaged, the slippage between the pump and turbine is eliminated. The transmission then operates as a mechanical transmission with no torque multiplying feature, no frictional losses and a reduction in fuel consumption.

When the clutch is disengaged, the oil circulating in the converter exerts equal pressure on the front and the rear of the clutch (2) engagement piston. In this condition, the turbine and pump are free to rotate independently.

The clutch engages when the Transmission Control Unit activates a solenoid valve which allows oil to flow into area (a). As pressure in area (a) builds, the piston (1) moves and applies the clutch, locking the turbine and pump together, eliminating relative slippage.

TRANSMISSION CLUTCHES

The multiple plate clutches lock the gear hub and the shaft bell when engaged. Each clutch consists of a set of plates with splines on the outside (1a) arranged alternately with a set of plates with splines on the inside (1b). The plates with the splines on the outside engage the bell (2) while the plates with the splines on the inside engage the hub (3).



Each clutch is hydraulically locked by sending pressurized oil from a solenoid valve to the back of the control piston (4), locking the plates from slipping thus locking the bell and hub together. Springs (5) on the reverse side of the clutch piston assure a release of the clutch plates when oil pressure is removed from the piston.

The ZF 260 transmission has two clutches on each shaft, the ZF 210 transmission is designed with one clutch per shaft.

TRANSMISSION HYDRAULIC PUMP

The transmission hydraulic pump is a gerotor type pump. It is mounted in the stator housing and rotates with the input shaft. The pump is rated to provide sufficient oil flow for machine operation even at low idle speed. Insufficient flow could result in rough shifts, poor modulation and failure of components. The pump draws oil from the sump and delivers oil to the oil filter.

TRANSMISSION CONTROL VALVE

The transmission control valve directs the flow of oil to the appropriate clutches at the appropriate time to drive the machine. The valve is located on the backside of the transmission on the 25 TON TRUCK with internal oil passages to the clutches. The control valve on the 30 TON TRUCK is located on top of the transmission with external hoses to the clutch assemblies.

The control valve houses six solenoids and 12 spools used to control the flow of oil to the required clutches. Six large spools control the flow of oil to the clutches while the six smaller spools are dampening spools used for modulation.

The control valve also houses a main pressure spool for regulating system pressure and a smaller spool which is a pressure reducing spool. This reduced pressure (130 to 160 psi) [9 to 11 bar] is used for shifting the spools in the control valve.

TRANSMISSION OIL FLOW

Oil from the reservoir passes through the oil pump and the filter(s) and enters the control valve where it is controlled by the system pressure valve.

The system pressure valve is normally closed and is designed to open at 232 to 253 psi (16 to 17 bar), providing regulated pressure to the control spools.

The pressure reducing valve is a normally open valve which provides oil for the pilot circuit at a pressure of 130 to 160 psi (9 to 11 bar).

The control solenoids, when de-energized, provide a passage of oil through the solenoid and on to the transmission sump. When energized, the return to sump passage in the solenoid is closed causing the pressure to build, and shift the control spool, allowing regulated pressure to fill the clutch assembly. The modulating spool also senses the pilot pressure and dampens the movement of the control spool.

Excess oil dumping over the system pressure valve is ported through the transmission to supply the torque converter with oil. A converter relief valve before the converter, controls the maximum pressure at 160 psi (11 bar), with excess oil returning to the sump. Return oil from the converter flows through the converter outlet valve. This valve is designed to maintain a back pressure in the converter of 61 psi (4 bar) maximum.

Oil from the relief valve passes through the oil cooler and from there to the lubrication system, then to the transmission sump.

TRANSMISSION DIFFERENTIAL LOCK

The front and rear output shafts of the transmission are driven through a double satellite sun and planetary gear differential which can be locked.

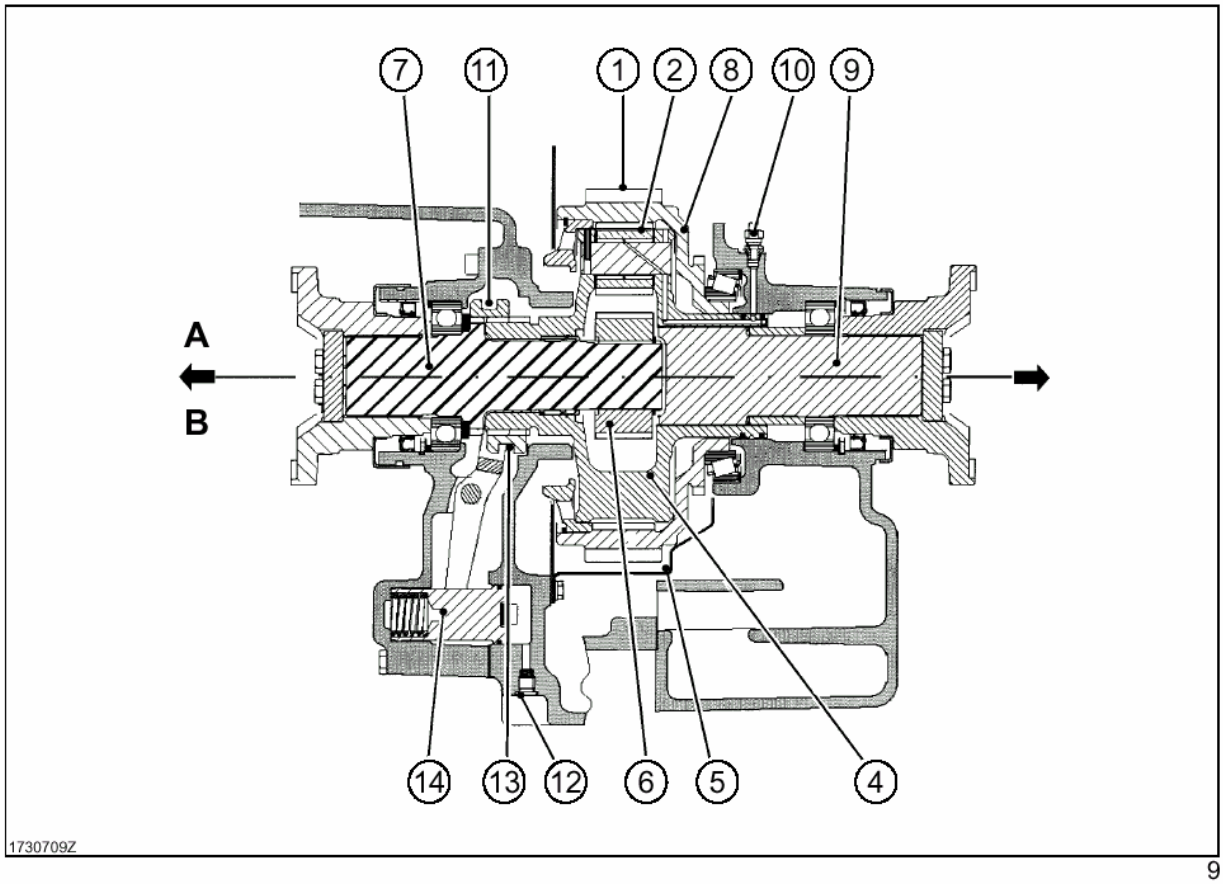
The differential is designed to spread the drive force while the two elements transmitting the output drive (sun gear and gear set holder) turn in the same direction. The transmission differential spreads the drive force between the front and rear axles providing 1/3 of the force to the front axle and 2/3 of the force to the rear axles.
The operator can lock the transmission differential by means of an electrical hydraulic control if either axle begins to slip.

The control works on a sliding sleeve which, when moved, locks the two elements transmitting the output drive (sun gear and gear set holder). In this way, the output shafts turn together at the same speed.

In normal conditions, the drive torque is applied to the external crown gear, with 2/3 of the force being sent through the gear set holder (4) to the rear output shaft while 1/3 of the force is sent through the sun gear to the front output shaft (7).

In the differential locked condition, the sliding sleeve (11) locks the gear set holder (4) which is solidly connected to the rear output shaft, to the front output shaft, which is solidly connected to the sun gear. The drive torque is consequently spread equally over both sides of the unit.

Transmission Differential Lock



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1. Crown wheel external gear
2. External satellite gear
3. Internal satellite gear (not shown)
4. Gear set holder
5. Protective guard
6. Sun gear
7. Output shaft front end
8. Crown gear
9. Output shaft rear end
10. Lubrication pipe fitting
11. Differential lock sliding sleeve
12. Hydraulic lock control fitting
13. Sliding sleeve control lever
14. Lever control piston

A: Engaged position (differential locked)
B: Disengaged position (differential released)

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Pressure testing the transmission

This test is normally performed if there is a complaint of low power in certain gears. Excessive leakage in a clutch could result in a loss of system pressure. To perform the test, proceed as follows:

1. For safety purposes, block the machine wheels, apply the parking brake and engage the steering lock at the articulation joint.
2. Install a pressure tap at the port for regulated pressure with a 400 psi (27 bar) gauge and sufficient hose to read the gauge from the cab. *(Because of the inaccessibility of the control valve on the 30 TON TRUCK, this test port is located at the rear of the cab).*
3. Heat the oil to 80° C (176° F).
4. Disengage the parking brake
5. With the service brake applied, and the engine running at rated speed, shift into each forward and reverse gear while the transmission is in the manual mode. A momentary drop in regulated pressure should be seen at each shift, immediately returning to the original pressure. Regulated pressure should be between 232 and 253 psi (16 to 17 bar).

Pressure testing of a specific clutch

This test is normally performed if there is a complaint of low power in one specific gear. Excessive leakage in a clutch could result in a loss of system pressure.

To perform this test, follow the same procedure as described above, but place the pressure tap at the appropriate test port on the control valve. (*The inaccessibility of the test ports on the 30 TON TRUCK, may require the pressure tap be placed in a tee fitting where the supply hose enters the clutch supply port on the rear of the transmission).*

PRESSURE TEST POINT DIAGRAM

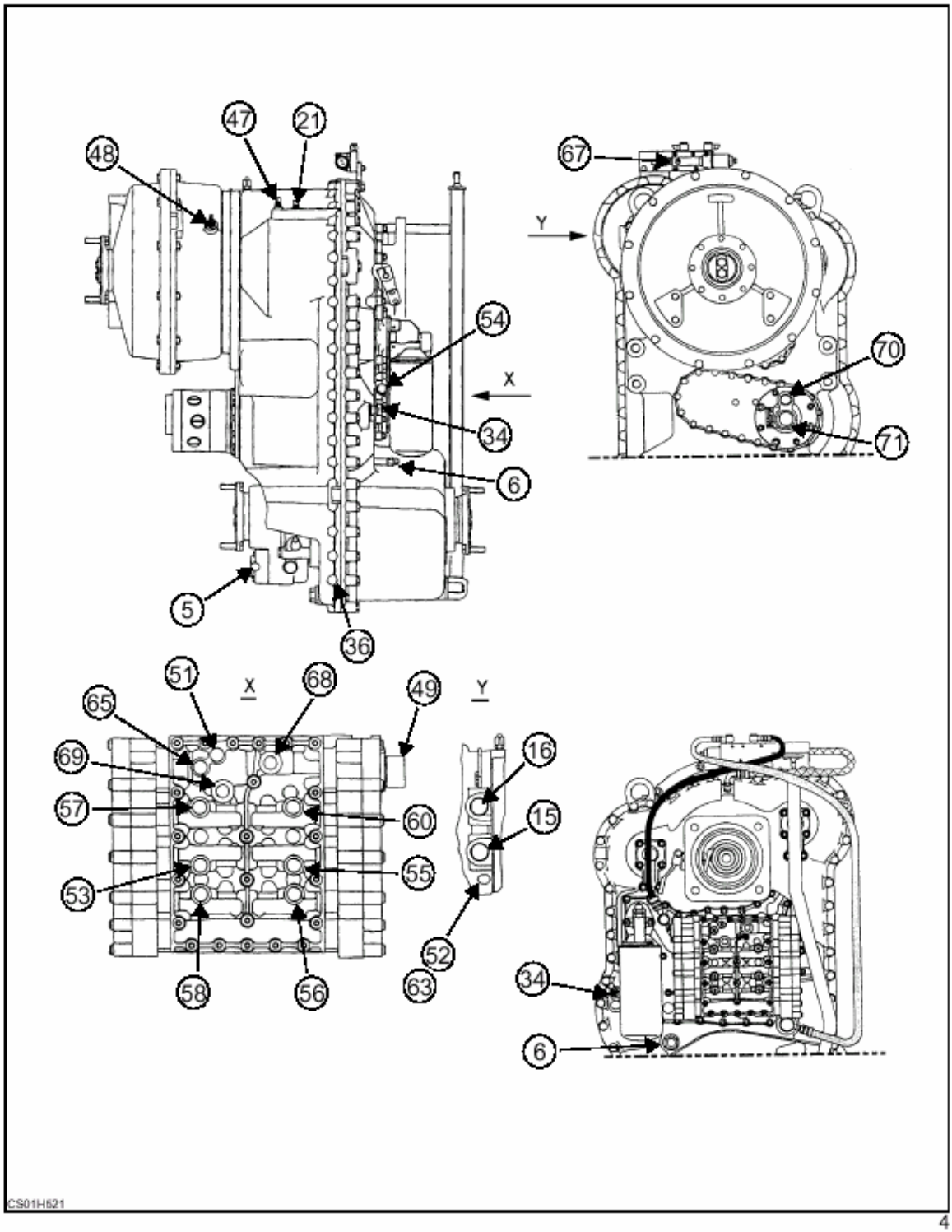
25 TON TRUCK ZF-ERGOPOWER TRANSMISION 6 WG-210

51	Before the converter - Opening pressure 11 bar (160 psi)		M10x1	H
52	Behind the converter - Opening pressure 4.3 bar (62 psi)		M14x1.5	
53	Clutch forward 16+2 bar (232+21 psi)	KV	M10x1	B
55	Clutch reverse 16+2 bar (232+21 psi)	KR	M10x1	E
56	Clutch 16+2 bar (232+21 psi)	K1	M10x1	D
57	Clutch 16+2 bar (232+21 psi)	K2	M10x1	A
58	Clutch 16+2 bar (232+21 psi)	K3	M10x1	C
60	Clutch 16+2 bar (232+21 psi)	K4	M10x1	F
63	Behind the Converter Temperature 100° C (212°F), Short Time 120°C		M14x1.5	
65	System Pressure 16+2 bar (232+21 psi)		M10x1	K
67	WK-Shift pressure 15+1 bar (217+21 psi)		M10x1	
	Measuring points for delivery rates			
15	Connection to the heat exchanger		1 5/16" - 12 UNF-2B	
16	Connection from the heat exchanger		1 5/16" - 12 UNF-2B	
	Inductive transmitter - Impulse-speed sensor and switch			
6	Inductive transmitter n speedometer		M18x1.5	
21	Inductive transmitter n turbine		M18x1.5	
34	Speed sensor n output and speedometer			
36	Axle disconnection-indicator		M27x1	
47	Inductive transmitter n central gear train		M18x1.5	
48	Inductive transmitter n engine		M18x1.5	
54	Filter contamination switch		M14x1.5	
	Connections			
5	Compressed air line for axle disconnection		M12x1.5	
49	Plug Connection on the Hydraulic Control Unit			
68	System Pressure (option)		M16x1.5	G
69	Control unit (option)		M16x1.5	J
70	Emergency steering pump - pressure line		M16x1	
71	Emergency steering pump - suction line		M28x1.5	

CODING

		PRESSURE REGULATOR UNDER VOLTAGE						ENGAGED CLUTCHES	
DRIVING DIRECTION	**SPEED**	Y1	Y2	Y3	Y4	Y5	Y6		
Forward	1			•		•		K1	KV
	2	•		•				K4	K1
	3					•	•	KV	K2
	4	•					•	K4	K2
	5				•	•		K3	KV
	6	•			•			K4	K3
Reverse	1		•	•				KR	K1
	2		•				•	KR	K2
	3		•		•			KR	K3
Neutral									
ENGAGED CLUTCH		K4	KR	K1	K3	KV	K2		
POSITIONS ON VALVE BLOCK		F	E	D	C	B	A		
CONSEC. N° OF MEAS. POINTS		60	55	56	58	53	57		

TRANSMISSION TEST PORT LOCATIONS
25 TON TRUCK



30 TON TRUCK ZF-ERGOPOWER TRANSMISSION 6 WG-260

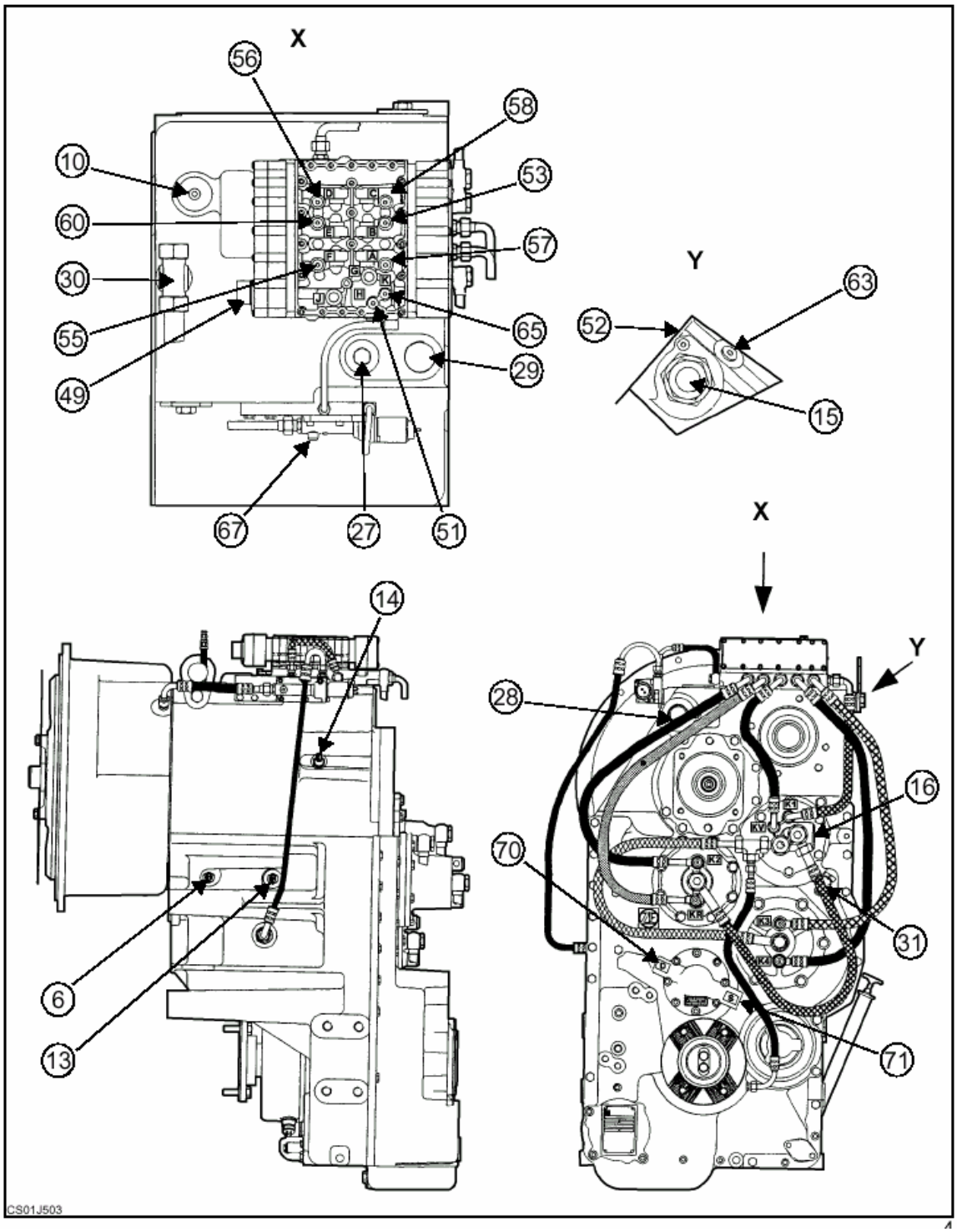
TRANSMISSION PRESSURE TEST POINTS DIAGRAM

No.	IDENTIFICATION/LOCATION		CONNECTION	DESIGNATION ON VALVE BLOCK
	Measuring points for pressure oil and temperature			
51	Before the converter - Opening pressure 8.5 bar (123 psi)		M10x1	H
52	Behind the converter - Opening pressure 5 bar (72.5 psi)		M10x1	
53	Clutch forward 16+2 bar (232+21 psi)	KV	M10x1	B
55	Clutch reverse 16+2 bar (232+21 psi)	KR	M10x1	F
56	Clutch 16+2 bar (232+21 psi)	K1	M10x1	D
57	Clutch 16+2 bar (232+21 psi)	K2	M10x1	A
58	Clutch 16+2 bar (232+21 psi)	K3	M10x1	C
60	Clutch 16+2 bar (232+21 psi)	K4	M10x1	E
63	Behind the Converter Temperature 100° C (212°F), Short Time 120°C (248°F) (max. 5 mn)		M10x1	
65	System pressure 16+2 bar (232+21 psi)		M10x1	K
67	WK-control pressure 12+2 bar (174+21 psi)		M10x1	
	Connections			
10	Breather		M10x1	
15	To the heat exchanger			
16	From the heat exchanger			
27	Oil filler plug		M42x2	
28	To the ZF-filter		M42x2	
29	From the ZF-filter		M42x2	
30	From the filter by-pass to the converter		M42x2	
49	Plug connection on the electrohydraulic control unit			
-	System pressure (option)		M16x1.5	G
-	Pilot pressure (option)		M16x1.5	J
70	Emergency steering pump - pressure line		M22x1.5	
71	Emergency steering pump - suction line		M26x1.5	
	Inductive transmitter - Impulse-speed sensor and switch			
6	Inductive transmitter n turbine		M18x1.5	
13	Inductive transmitter n central gear train		M18x1.5	
14	Inductive transmitter n engine		M18x1.5	
31	Speed sensor n output and speedometer			
35	Axle disconnection - indicator/acknowledgement		M18x1.5	

CODING

		PRESSURE REGULATOR UNDER VOLTAGE						ENGAGED CLUTCHES	
DRIVING DIRECTION	**SPEED**	Y1	Y2	Y3	Y4	Y5	Y6		
Forward	1			•		•		K1	KV
	2		•	•				K4	K1
	3					•	•	KV	K2
	4		•				•	K4	K2
	5				•	•		K3	KV
	6		•		•			K4	K3
Reverse	1	•		•				KR	K1
	2	•					•	KR	K2
	3	•			•			KR	K3
Neutral									
ENGAGED CLUTCH		KR	K4	K1	K3	KV	K2		
POSITIONS ON VALVE BLOCK		F	E	D	C	B	A		
CONSEC. N° OF MEAS. POINTS		55	60	56	58	53	57		

Transmission Test Port Locations



30 TON TRUCK Transmission

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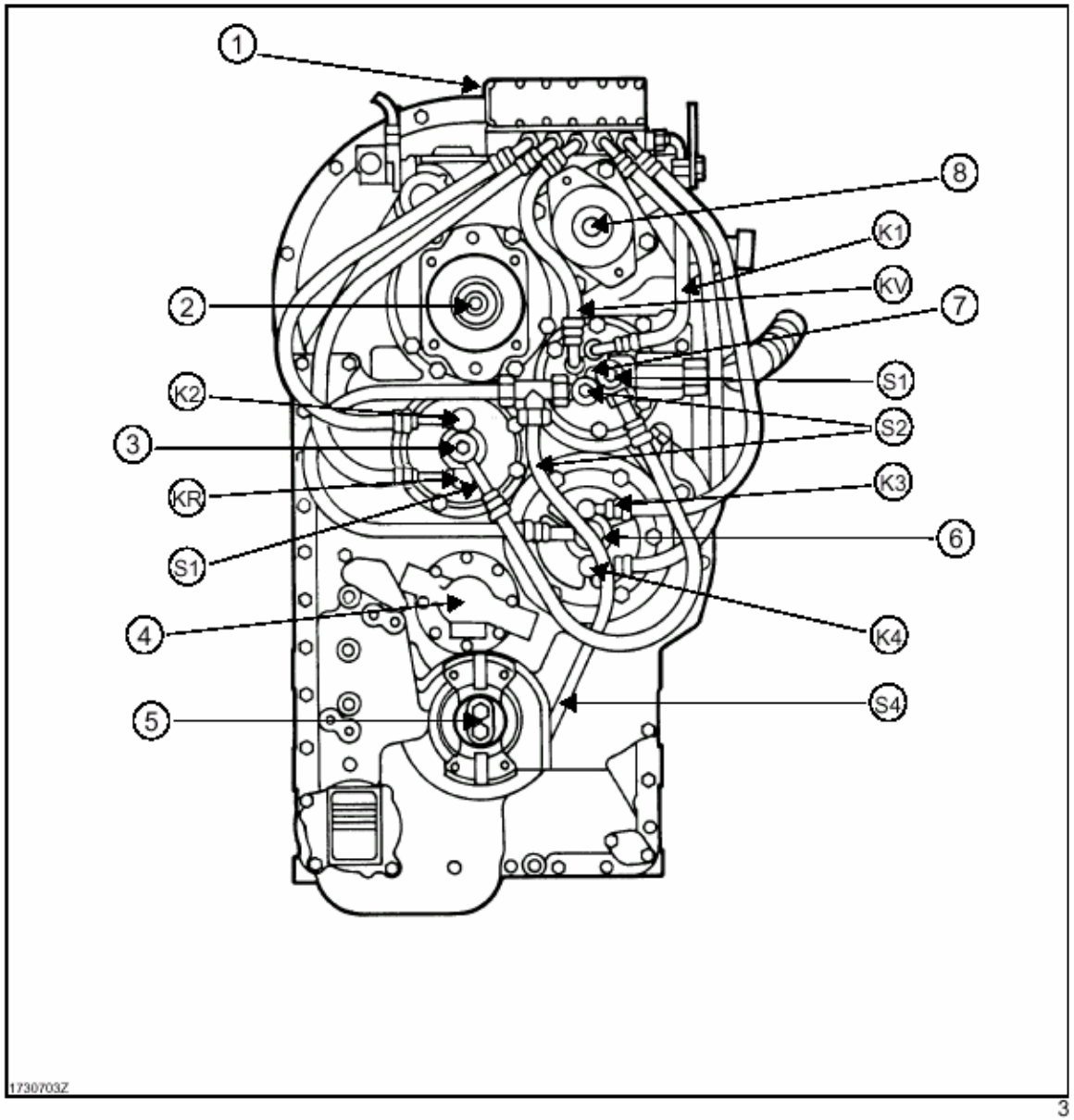
AUTOMATIC TRANSMISSION EXTERNAL PIPE LOCATION VIEW



3

1. Hydraulic control unit
2. AN drive torque input shaft
3. KR (reverse) and K2 clutch shaft
4. Intermediate shaft
5. AB drive torque output shaft
6. K3 and K4 clutch shaft
7. KV (forward gear) and K1 clutch shaft
8. PTO drive shaft

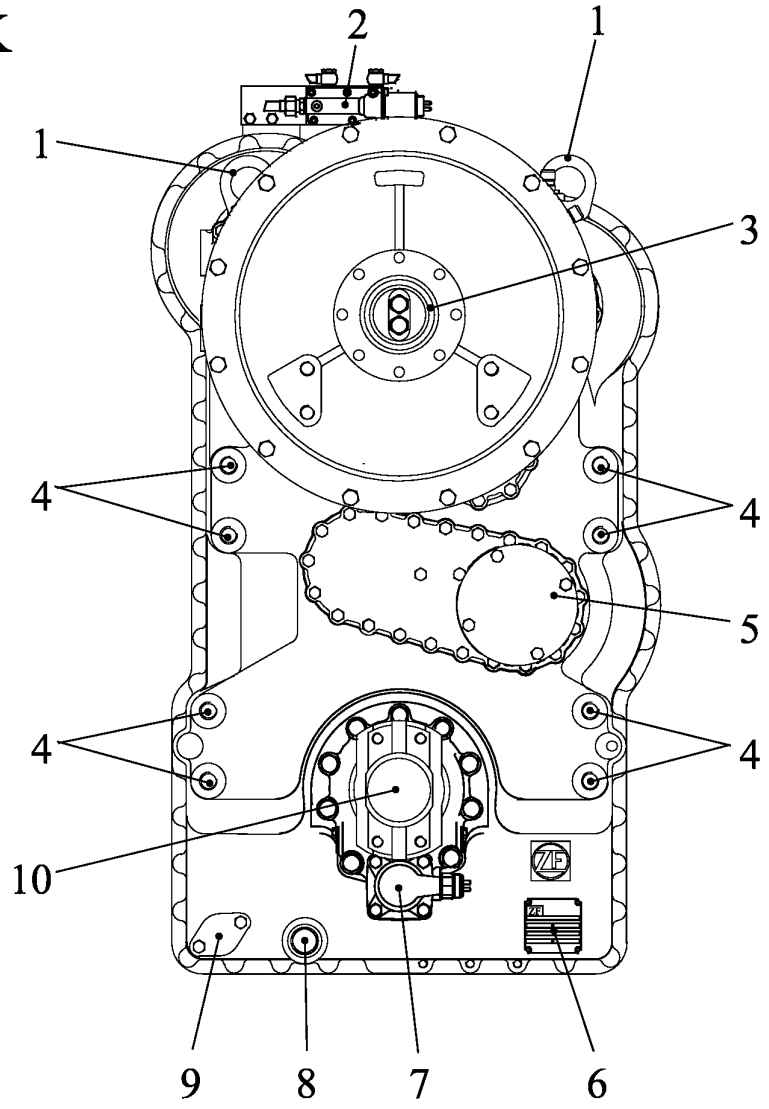
K1: K1 clutch control pipe
K2: K2 clutch control pipe
K3: K3 clutch control pipe
K4: K24 clutch control pipe
KV: KV clutch control pipe
KR: KR clutch control pipe

S1: KR-K2 shaft lubrication pipe
S2: K3-K4 shaft lubrication pipe
S4: AN output shaft lubrication pipe

Note: 30 TON TRUCK Transmission

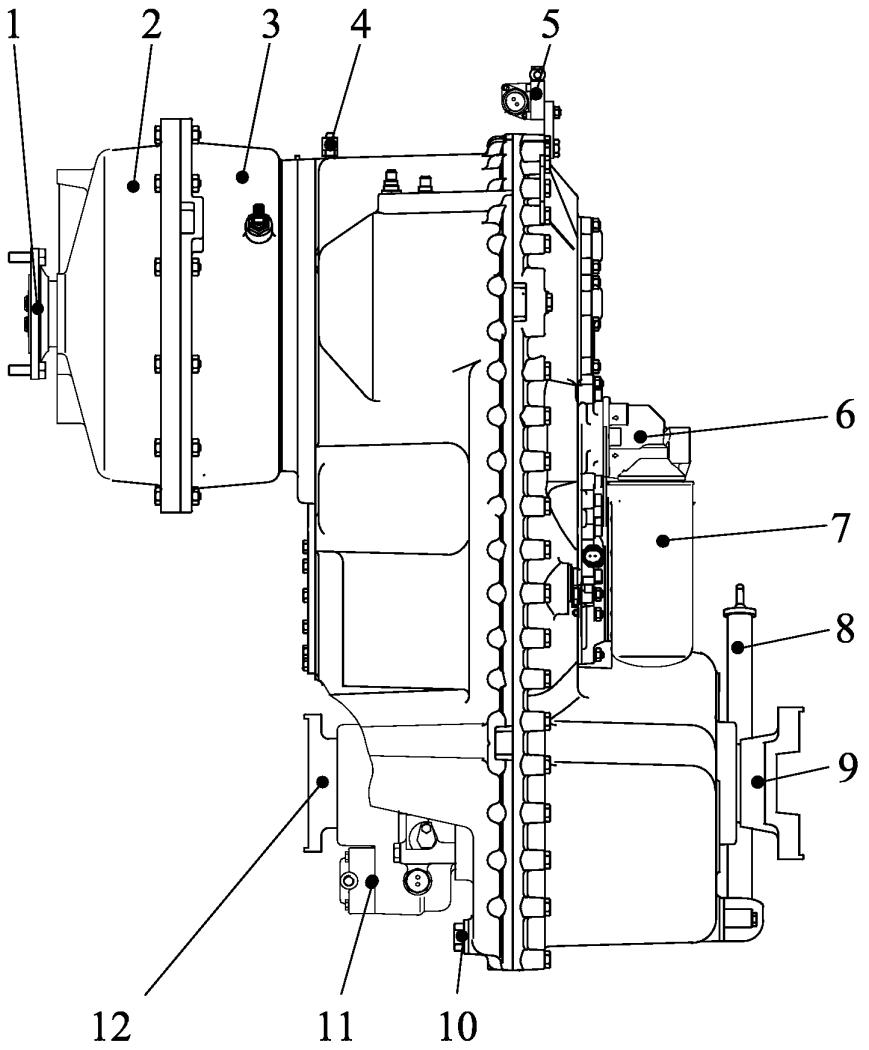
INSTALLATION VIEW 6 WG-210 SEPARATE INSTALLATION WITH INTERAXLE DIFFERENTIAL AND WK FRONT VIEW
TABLE - 6A

1 = LIFTING LUGS
2 = WK-VALVE
3 = INPUT FLANGE – DRIVE VIA UNIVERSAL SHAFT
4 = TRANSMISSION SUSPENSION HOLES M20
5 = ATTACHMENT POSSIBILITY FOR EMERGENCY STEERING PUMP
6 = MODEL IDENTIFICATION PLATE
7 = ENGAGEMENT AND DISCONNECTION INTERALXE DIFFERENTIAL PNEUMATIC OR HYDRAULIC
8 = OIL DRAIN PLUG WITH MAGNET M38x1,5
9 = ATTACHMENT POSSIBILITY FOR OIL FILLER TUBE WITH OIL DIPSTICK (CONVERTER-SIDE)
10 = OUTPUT FLANGE – FRONT AXLE (CONVERTER-SIDE)



INSTALLATION VIEW 6 WG-210 – SEPARATE INSTALLATION WITH INTERAXLE DIFFERENTIAL AND WK SIDE VIEW
TABLE – 6B

1 = INPUT FLANGE – DRIVE VIA UNIVERSAL SHAFT
2 = COVER
3 = CONVERTER BELL
4 = BREATHER
5 = WK-VALVE
6 = FILTER HEAD
7 = EXCHANGE FILTER (ZF-FINE FILTER)
8 = OIL FILLER TUBE WITH OIL DIPSTICK
9 = OUTPUT FLANGE – REAR AXLE (REAR-SIDE)
10 = OIL DRAIN PLUG WITH MAGNET M38x1,5
11 = ENGAGEMENT AND DISCONNECTION INTERAXLE DIFFERENTIAL PNEUMATIC OR HYDRAULIC
12 = OUTPUT FLANGE – FRONT AXLE (CONVERTER-SIDE)



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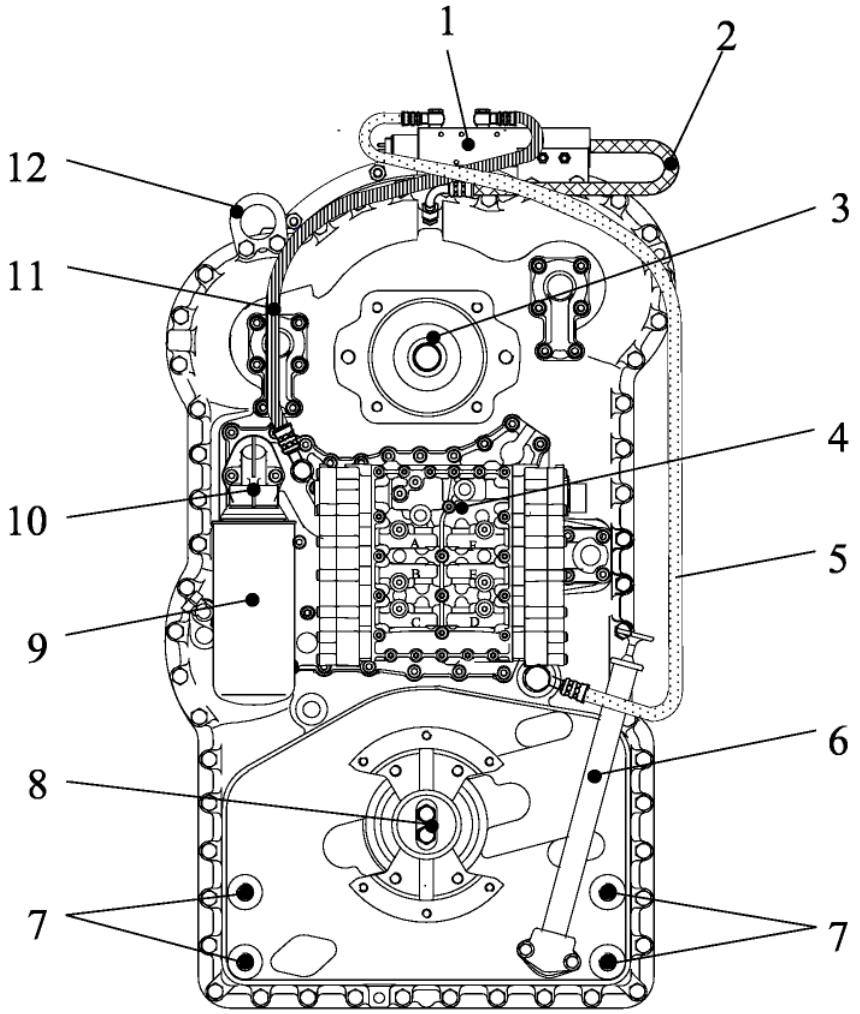
INSTALLATION VIEW 6 WG-210 SEPARATE INSTALLATION WITH INTERAXLE DIFFERENTIAL AND WK
REAR VIEW
TABLE 6C

1 = WK-VALVE
2 = OIL PRESSURE LINE FROM WK-VALVE TO THE WK
3 = POWER TAKE-OFF, COAXIAL, ENGINE-DEPENDENT
4 = ELECTROHYDRAULIC CONTROL
5 = BREATHER LINE WK
6 = OIL FILLER TUBE WITH OIL DIPSTICK
7 = TRANSMISSION SUSPENSION HOLES M20
8 = OUTPUT FLANGE – REAR AXLE (REAR-SIDE)
9 = EXCHANGE FILTER (ZF-FINE FILTER)
10 = FILTER HEAD
11 = OIL PRESSURE LINE FROM CONTROL UNIT TO WK-VALVE
10 = LIFTING LUGS

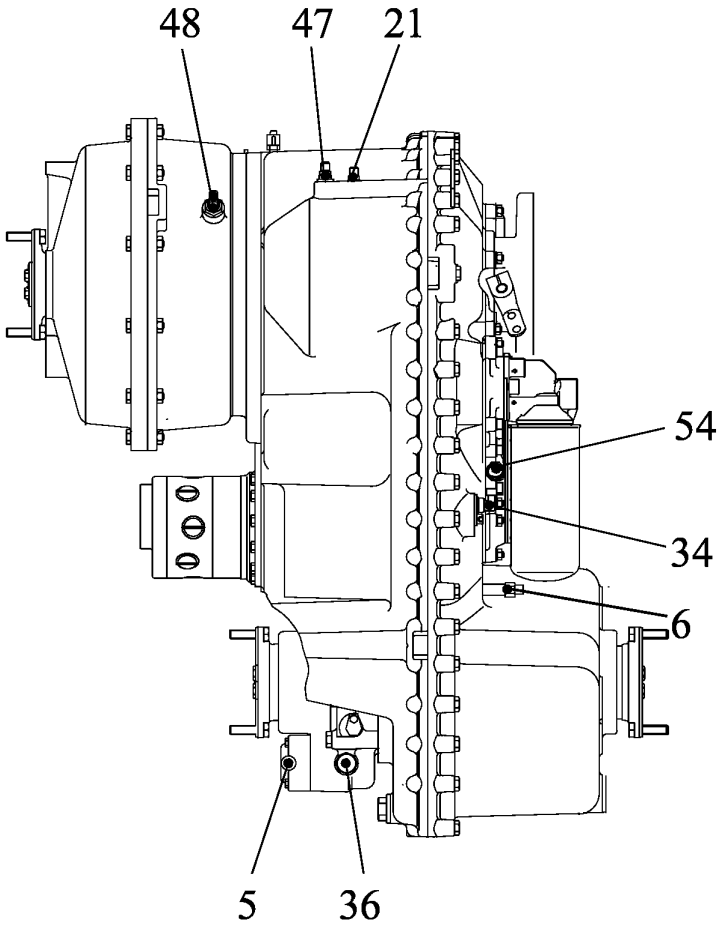


SCHEDULE OF MEASURING POINTS AND CONNECTIONS 6 WG-210 WITH WK

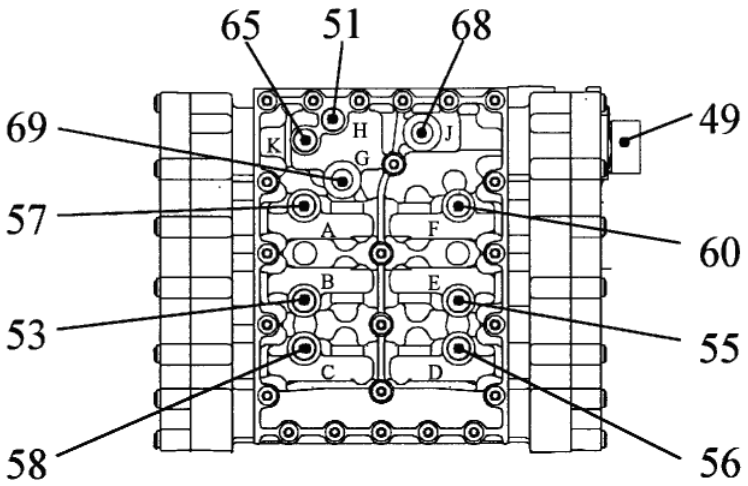
TABLE - 9

THE MARKED POSITIONS (e.g. 53) CORRESPOND WITH THE POSITIONS ON THE TABLE 12 !
THE MEASUREMENTS HAVE TO BE CARRIED OUT AT HOT TRANSMISSION (about 80° - 95° C) !

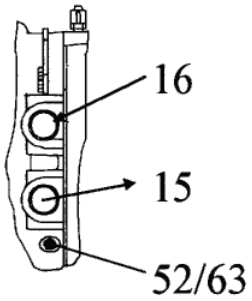
No.		*DENOMINATION OF THE POSITION*	*CONNECTION*	*MARKING ON THE VALVE BLOCK*
		MEASURING POINTS FOR HYDRAULIC OIL AND TEMPERATURE:		
51	=	IN FRONT OF THE CONVERTER – OPENING PRESSURE 11 bar	M10x1	H
52	=	BEHIND THE CONVERTER – OPENING PRESSURE 4,3 bar	M14x1,5	
53	=	CLUTCH FORWARD 16+2 bar KV	M10x1	B
55	=	CLUTCH REVERSE 16+2 bar KR	M10x1	E
56	=	CLUTCH 16+2 bar K1	M10x1	D
57	=	CLUTCH 16+2 bar K2	M10x1	A
58	=	CLUTCH 16+2 bar K3	M10x1	C
60	=	CLUTCH 16+2bar K4	M10x1	F
63	=	BEHIND THE CONVERTER TEMPERATURE 100° C, SHORT-TIME 120° C	M14x1,5	
65	=	SYSTEM PRESSURE 16+2 bar	M10x1	K
67	=	WK-SHIFT PRESSURE 15+1 bar	M10x1	
		MEASURING POINTS FOR DELIVERY RATES:		
15	=	CONNECTION TO THE HEAT EXCHANGER	$1\ ^{5}/_{16}$" – 12 UN-2B	
16	=	CONNECTION FROM THE HEAT EXCHANGER	$1\ ^{5}/_{16}$" – 12 UN-2B	
		INDUCTIVE TRANSMITTER – IMPULSE-SPEED SENSOR AND SWITCH:		
6	=	INDUCTIVE TRANSMITTER n SPEEDOMETER	M18x1,5	
21	=	INDUCTIVE TRANSMITTER n TURBINE	M18x1,5	
34	=	SPEED SENSOR n OUTPUT AND SPEEDOMETER	--------	
36	=	AXLE DISCONNECTION-INDICATOR	M27x1	
47	=	INDUCTIVE TRANSMITTER n CENTRAL GEAR TRAIN	M18x1,5	
48	=	INDUCTIVE TRANSMITTER n ENGINE	M18x1,5	
54	=	FILTER CONTAMINATION SWITCH	M14x1,5	
		CONNECTIONS:		
5	=	COMPRESSED AIR LINE FOR AXLE DISCONNECTION	M12x1,5	
49	=	PLUG CONNECTION ON THE ELECTROHYDRAULIC CONTROL UNIT		
68	=	SYSTEM PRESSURE (OPTION)	M16x1,5	G
69	=	CONTROL UNIT (OPTION)	M16x1,5	J
70	=	EMERGENCY STEERING PUMP - PRESSURE LINE	M16x1,	
71	=	EMERGENCY STEERING PUMP - SUCTION LINE	M28x1,5	

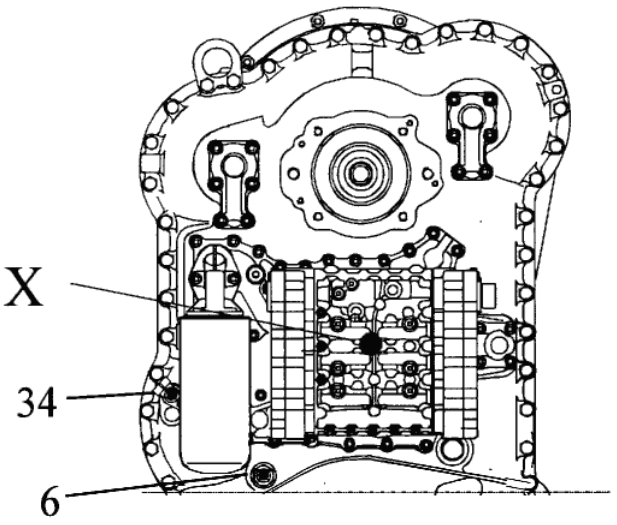


VIEW X



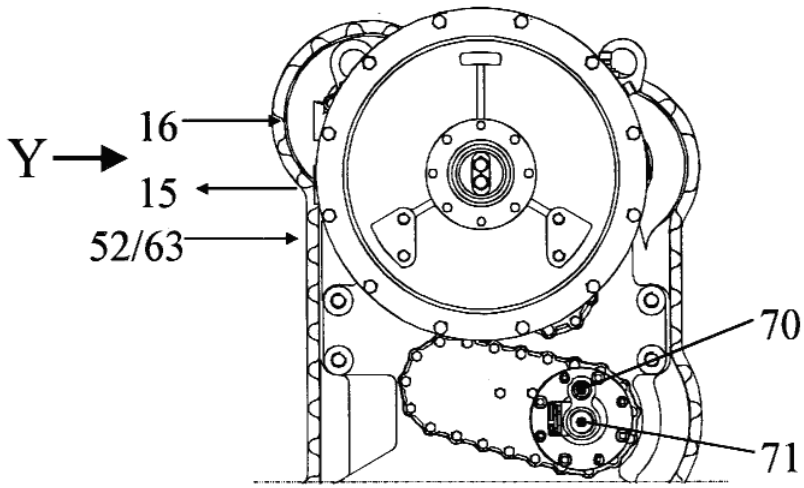
VIEW Y





CODING

		• PRESSURE REGULATOR UNDER VOLTAGE						ENGAGED CLUTCHES	
DRIVING DIRECTION	SPEED	Y1	Y2	Y3	Y4	Y5	Y6		
FORWARD	1			•		•		K1	KV
	2	•		•				K4	K1
	3					•	•	KV	K2
	4	•					•	K4	K2
	5				•	•		K3	KV
	6	•			•			K4	K3
REVERSE	1		•	•				KR	K1
	2		•				•	KR	K2
	3		•		•			KR	K3
NEUTRAL									
ENGAGED CLUTCH		K4	KR	K1	K3	KV	K2		
POSITIONS ON VALVE BLOCK		F	E	D	C	B	A		
CONSEC. No. OF MEAS. POINTS		60	55	56	58	53	57		



OIL CIRCUIT DIAGRAM 6 WG-210 WITH WK
- FORWARD 1st SPEED –
TABLE - 12

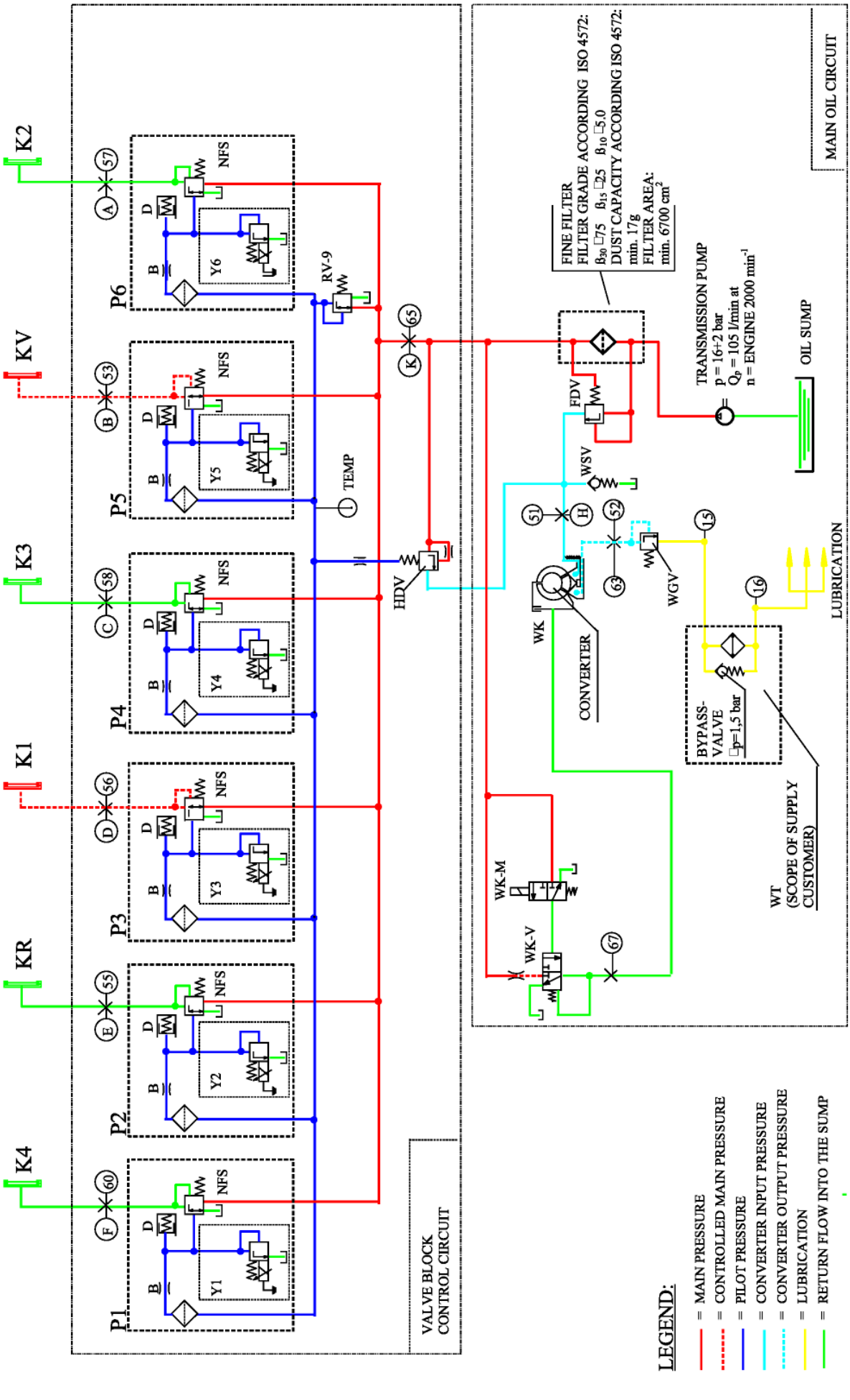
THE MARKED POSITIONS (e.g. 53) CORRESPOND WITH THE POSITIONS ON THE TABLE – 11 !

LEGEND:

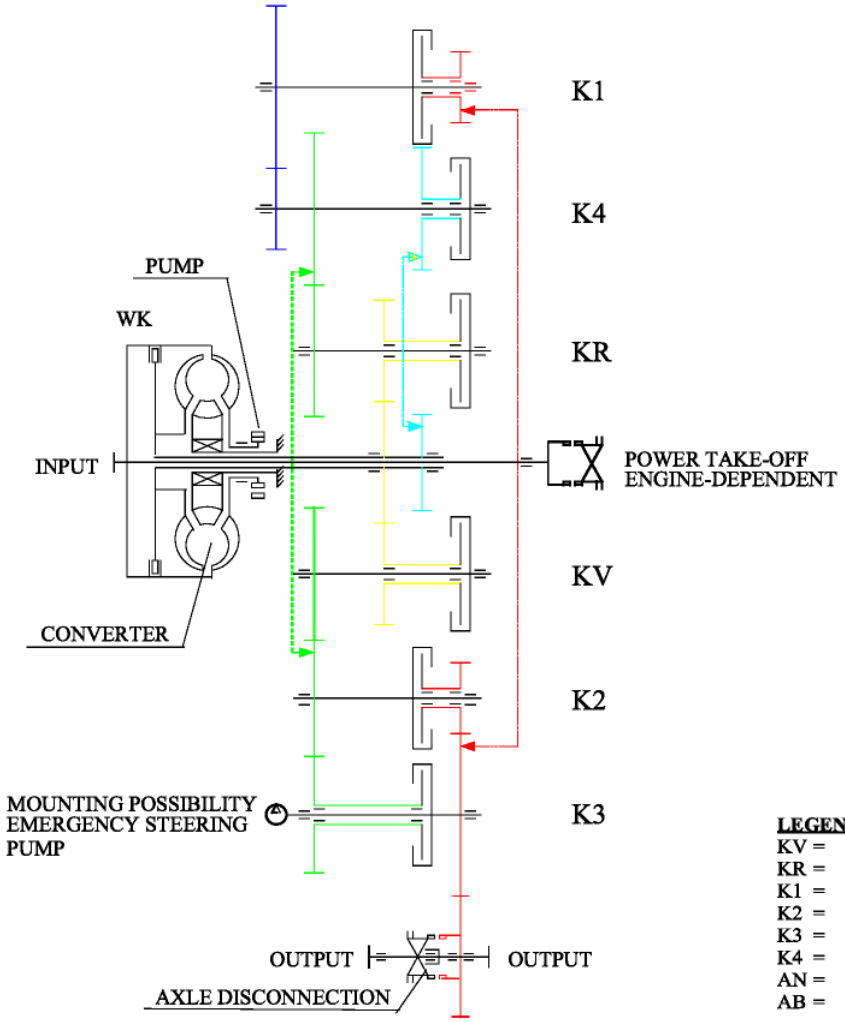
WT = HEAT EXCHANGER
WK-V = WK-SHIFT VALVE 15+1 bar
WK-M = WK-SOLENOID VALVE
WGV = CONVERTER BACK PRESSURE VALVE 4,3 bar
WSV = CONVERTER SAFETY VALVE 11 bar
HDV = MAIN PRESSURE VALVE 16+2 bar
RV-9 = PRESSURE REDUCING VALVE 9 bar
NFS = FOLLOW-ON SLIDE
D = VIBRATION DAMPER
B = ORIFICE
P1 = PROPORTIONAL VALVE – CLUTCH KR
P2 = PROPORTIONAL VALVE – CLUTCH K4
P3 = PROPORTIONAL VALVE – CLUTCH K1
P4 = PROPORTIONAL VALVE – CLUTCH K3
P5 = PROPORTIONAL VALVE – CLUTCH KV
P6 = PROPORTIONAL VALVE – CLUTCH K2
Y1 – Y6 = PRESSURE REGULATOR
TEMP = TEMPERATURE SENSOR
FDV = FILTER PRESSURE DIFFERENTIAL VALVE Δp=5,5 bar

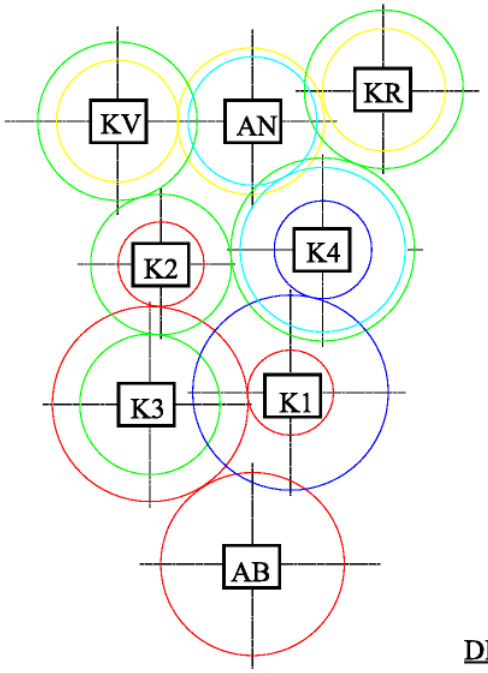
CODING

		• PRESSURE REGULATOR UNDER VOLTAGE							
DRIVING DIRECTION	SPEED	Y1	Y2	Y3	Y4	Y5	Y6		
FORWARD	1			•		•		K1	KV
	2	•		•				K4	K1
	3					•	•	KV	K2
	4	•					•	K4	K2
	5				•	•		K3	KV
	6	•			•			K4	K3
REVERSE	1		•	•				KR	K1
	2		•				•	KR	K2
	3		•		•			KR	K3
NEUTRAL									
ENGAGED CLUTCH		K4	KR	K1	K3	KV	K2		
POSITIONS ON VALVE BLOCK		F	E	D	C	B	A		
CONSEC. No. OF MEAS. POINTS		60	55	56	58	53	57		



GEARBOX DIAGRAM 6 WG-210
TABLE - 13





LEGEND:

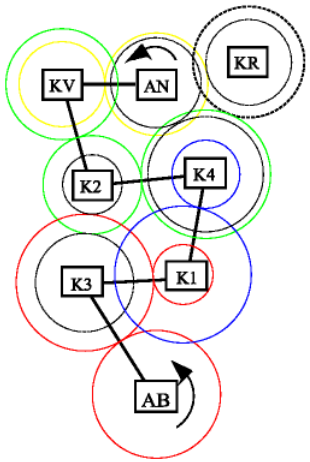
KV = CLUTCH FORWARD
KR = CLUTCH REVERSE
K1 = CLUTCH 1st SPEED
K2 = CLUTCH 2nd SPEED
K3 = CLUTCH 3rd SPEED
K4 = CLUTCH 4th SPEED
AN = INPUT
AB = OUTPUT

DIAGRAM - CLUTCHES

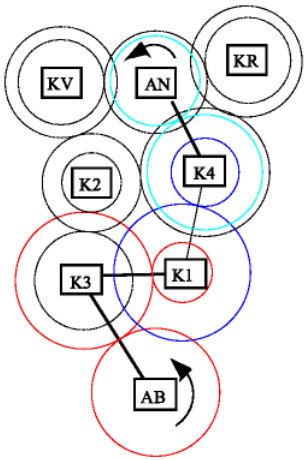
DRIVING SPEED	SPEED	CLUTCH
FORWARD	1	KV/K1
	2	K4/K1
	3	KV/K2
	4	K4/K2
	5	KV/K3
	6	K4/K3
REVERSE	1	KR/K1
	2	KR/K2
	3	KR/K3

POWER FLOW 6 WG-210 -FORWARD SPEEDS - TABLE - 14

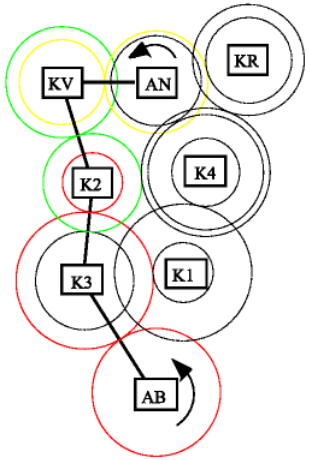
1st SPEED



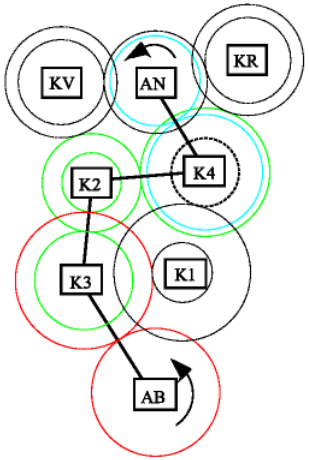
2nd SPEED



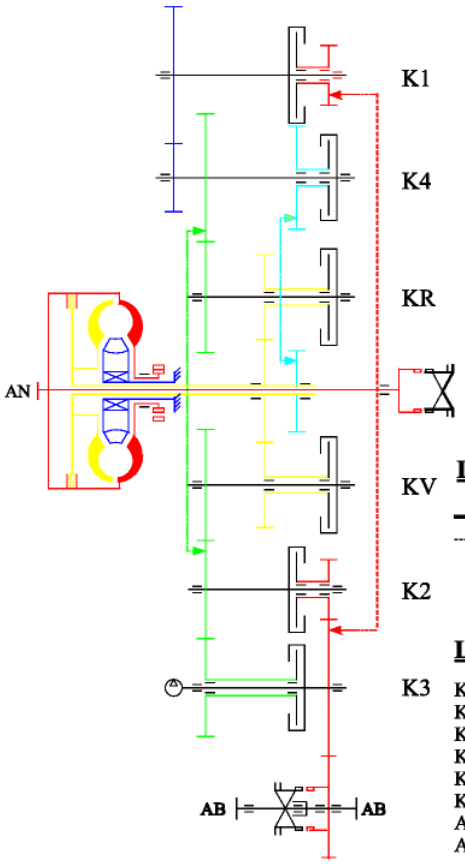
3rd SPEED



4th SPEED



GEARBOX DIAGRAM



VIEW - DIRECTION OF ROTATION

LEGEND:

_____ = POWER FLOW GEAR TRAIN

- - - - - - - - - - = GEARS NOT MESHING

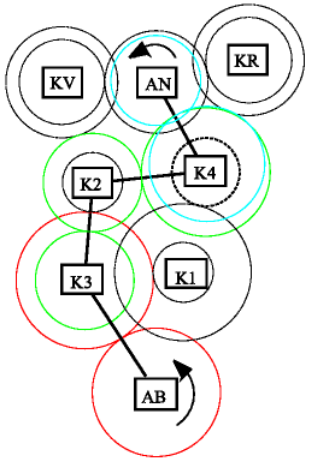
LEGEND:

KV = CLUTCH FORWARD
KR = CLUTCH REVERSE
K1 = CLUTCH 1st SPEED
K2 = CLUTCH 2nd SPEED
K3 = CLUTCH 3rd SPEED
K4 = CLUTCH 4th SPEED
AN = INPUT
AB = OUTPUT

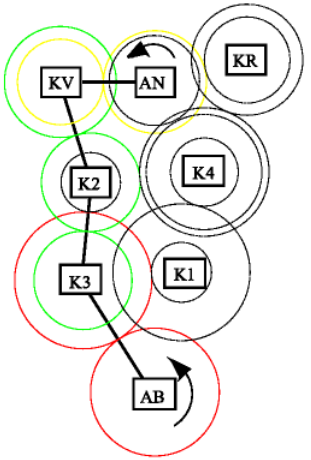
DIAGRAM - CLUTCHES

DRIVING DIRECTION	SPEED	CLUTCH
Forward	1	KV/K1
	2	K4/K1
	3	KV/K2
	4	K4/K2
	5	KV/K3
	6	K4/K3

6th SPEED



5th SPEED



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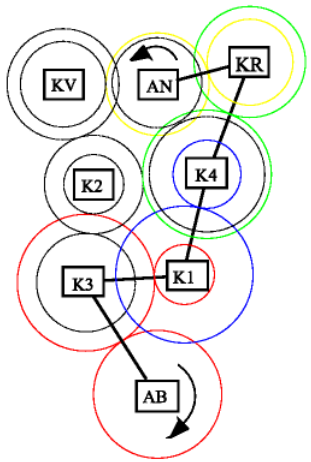
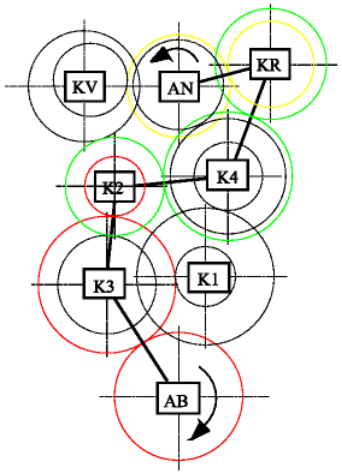
POWER FLOW 6 WG-210 - REVERSE SPEEDS - TABLE - 15

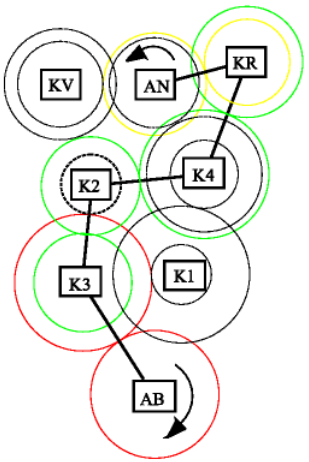
1st SPEED



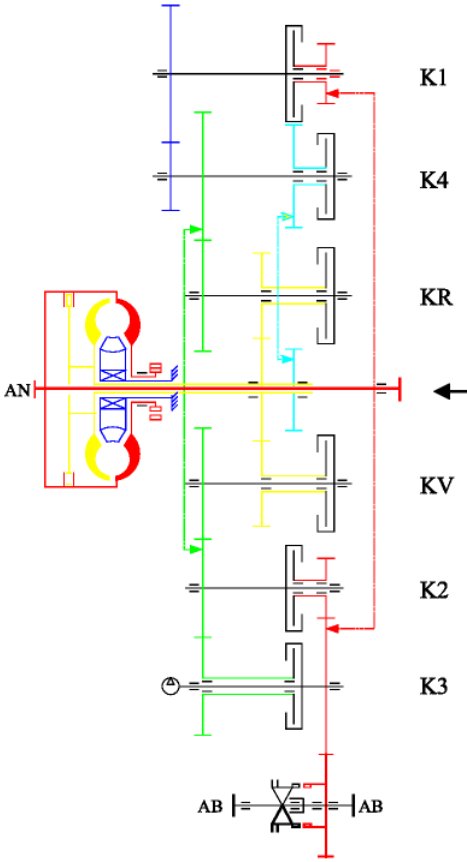
2nd SPEED



3rd SPEED



GEARBOX DIAGRAM



← VIEW - DIRECTION OF ROTATION

LEGEND:

KV = CLUTCH FORWARD
KR = CLUTCH REVERSE
K1 = CLUTCH 1st SPEED
K2 = CLUTCH 2nd SPEED
K3 = CLUTCH 3rd SPEED
K4 = CLUTCH 4th SPEED
AN = INPUT
AB = OUTPUT

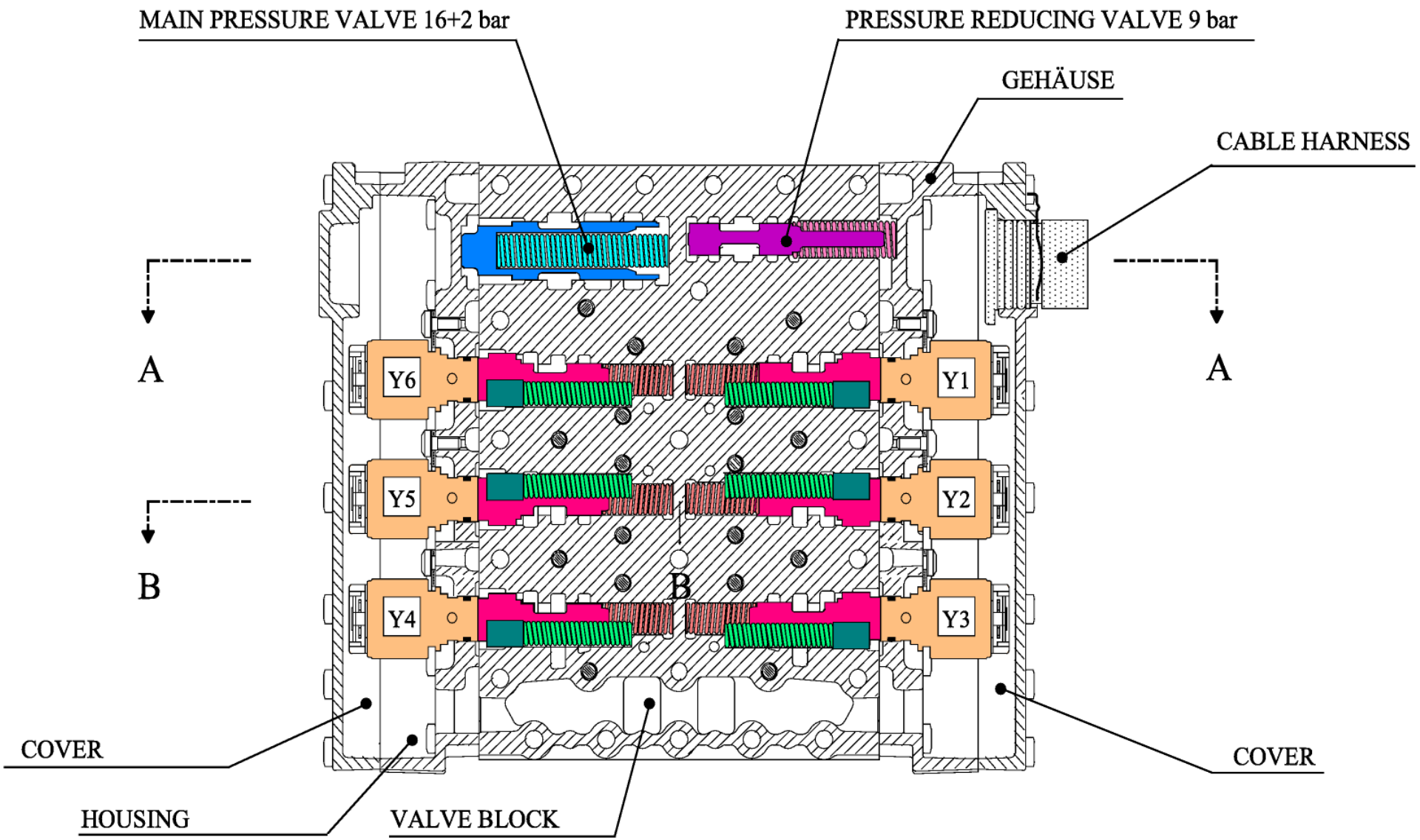
DIGRAM - CLUTCHES

DRIVING DIRECTION	SPEED	CLUTCH
REVERSE	1	KR/K1
	2	KR/K2
	3	KR/K3

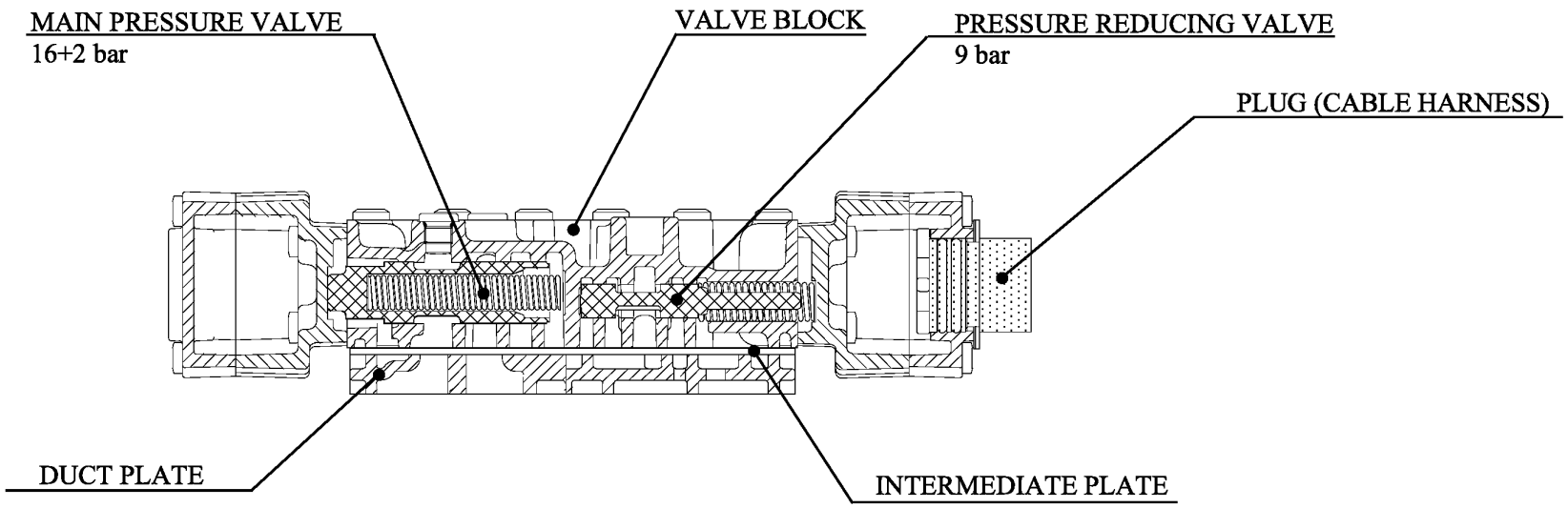
LEGEND:

——— = POWER FLOW GEAR TRAIN
- - - - - - = GEARS NOT MESHING

ELECTRO-HYDRAULIC SHIFT CONTROL WITH PROPORTIONAL VALVES

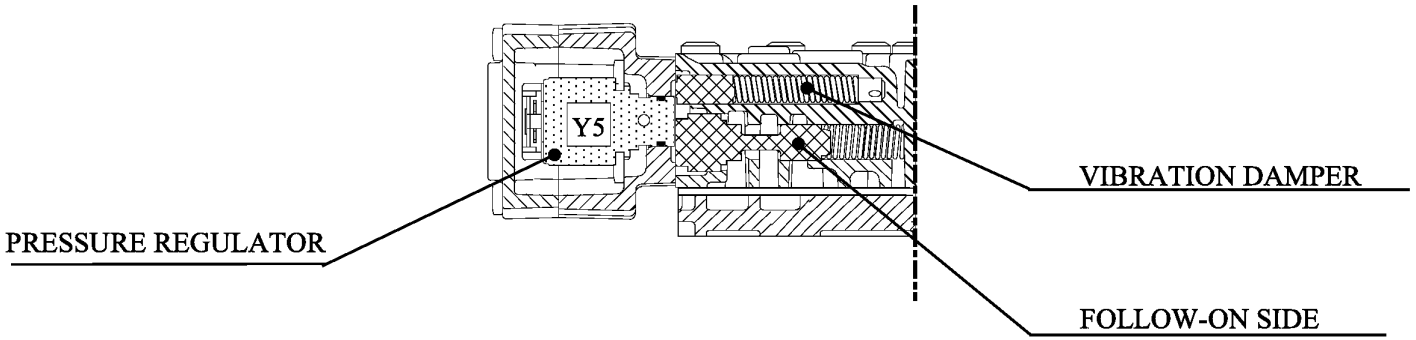


SECTION A - A



SECTION B - B

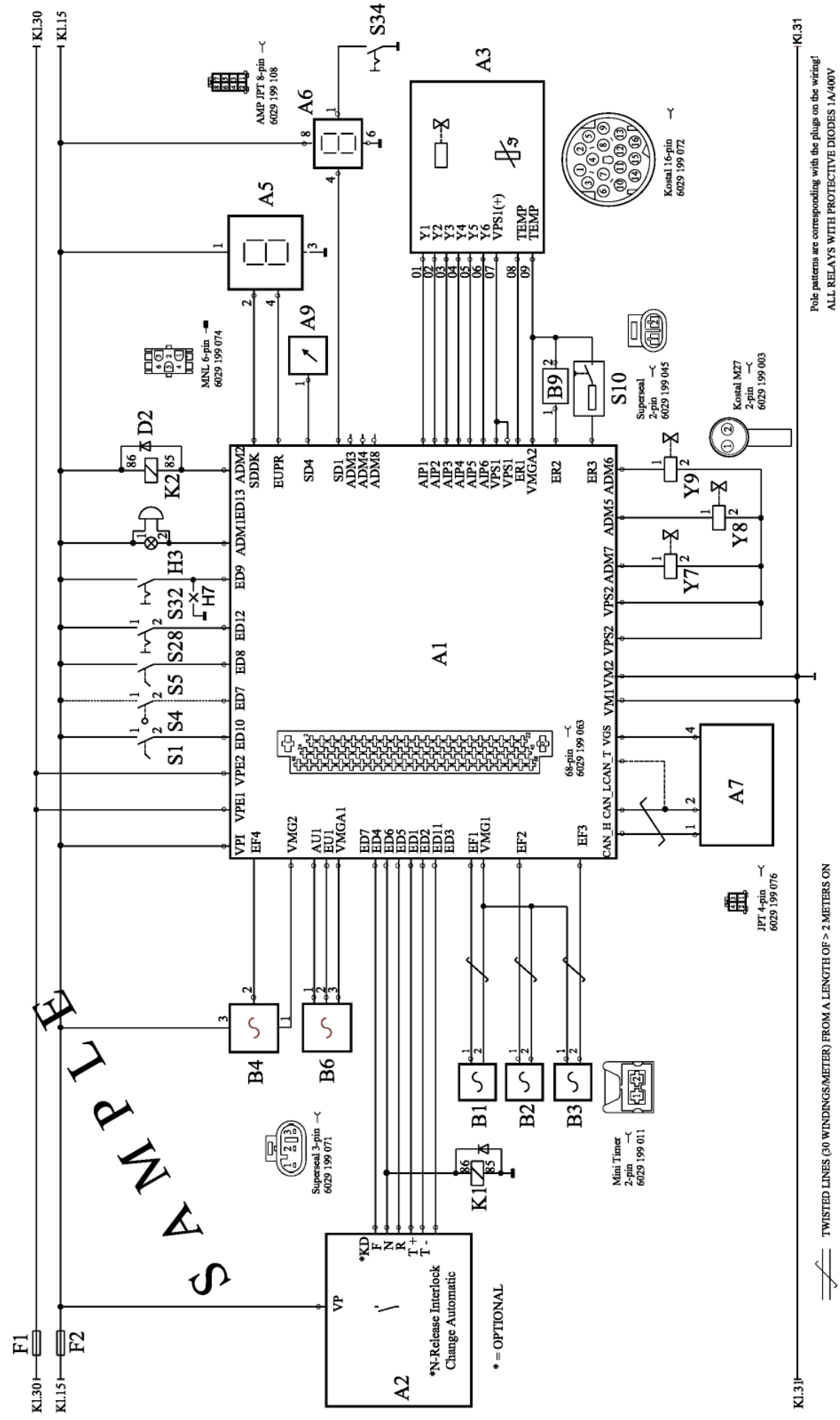
PROPORTIONAL VALVE P5



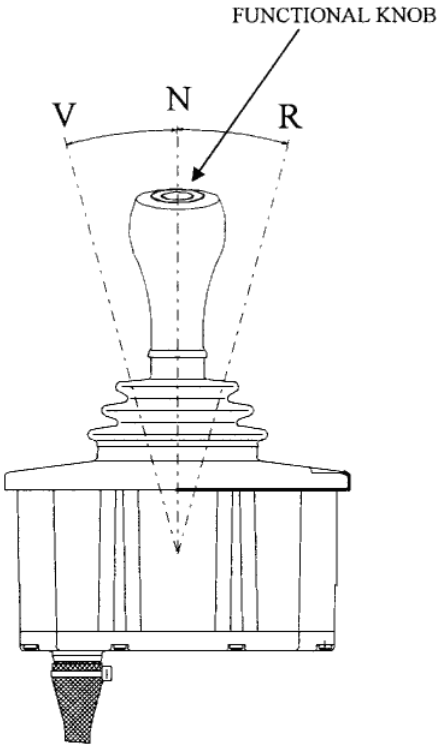
6 WG-210 FULLY-AUTOMATIC CONTROL UNIT EST-37
CIRCUIT DIAGRAM - STANDARD (6029 717 039)
TABLE - 17

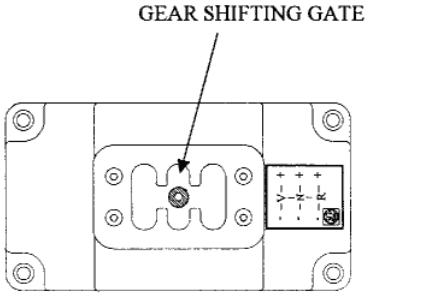
ITEM	LEGEND	ITEM	LEGEND
A1	ELECTRONIC CONTROL UNIT TCU	S1	SWITCH RETARDER
A2	CONTROLLER	S4	SWITCH KICK DOWN (OPTION)
A3	ELECTRO HYDRAULIC ONTROL UNIT 6 WG-210	S5	SWITCH REQUEST ENGINE BRAKE
A5	DIAGNOSTIC INTERFACE (PLUG)	S10	SWITCH FILTER CONTAMINATION
A6	DISPLAY	S28	SWITCH PRESELECTION DIFFERENTIAL LOCK
A7	CAN-INTERFACE (PLUG)	S32	SWITCH TROUGH ON TOP *
A9	SPEEDOMETER WITH FREQUENCY DIVIDER *	S34	SWITCH DISPLAY ILLUMINATION *
B1	SPEED SENSOR n ENGINE	Y7	SOLENOID VALVE WK
B2	SPEED SENSOR n TURBINE	Y8	SOLENOID VALVE RETARDER
B3	SPEED SENSOR n CENTRAL GEAR TRAIN	Y9	SOLENOID VALVE DIFFERENTIAL LOCK
B4	SPEED SENSOR n OUTPUT		
B6	LOAD SENSOR	K1	RELAY STARTER INTERLOCK *
B9	SENSOR – TEMPERATURE - RETARDER	K2	RELAY REVERSE DRIVE *
F1	FUSE 7,5 A*		
F2	FUSE 7,5 A*		
H3	ACOUSTIC / OPTIONAL WARNING *		
H7	PILOT LAMP RESTRICTED GEAR RANGE *		

NOTE: * = SCOPE OF SUPPLY CUSTOMER

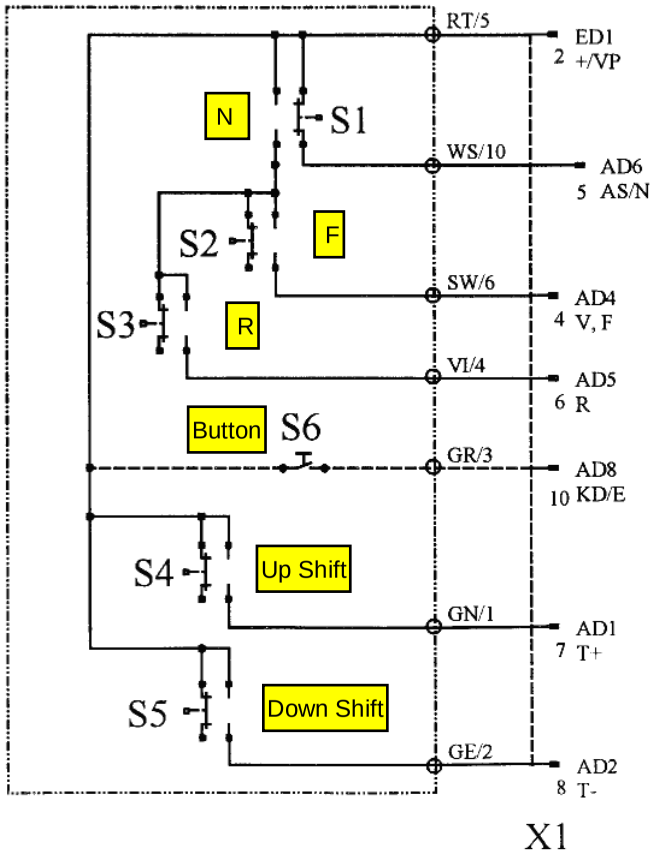


CONTROLLER VTS-3
TABLE - 19





CIRCUIT DIAGRAM CONTROLLER

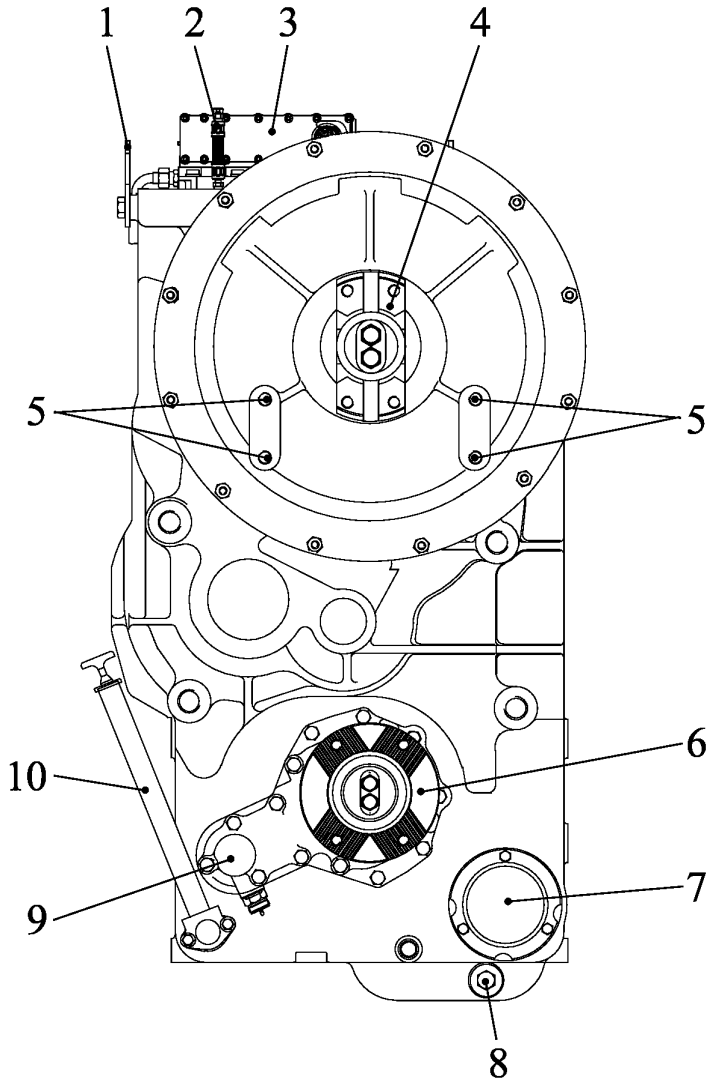


CODING CONTROLLER

			POSITION					
			V	R	N	T+	T-	KD/E
FUNKTION SWITCH	AD1	T+				•		
	AD2	T-					•	
	AD4	V	•					
	AD5	R		•				
	AD6	AS/N			•			
	AD8	KD/E						•

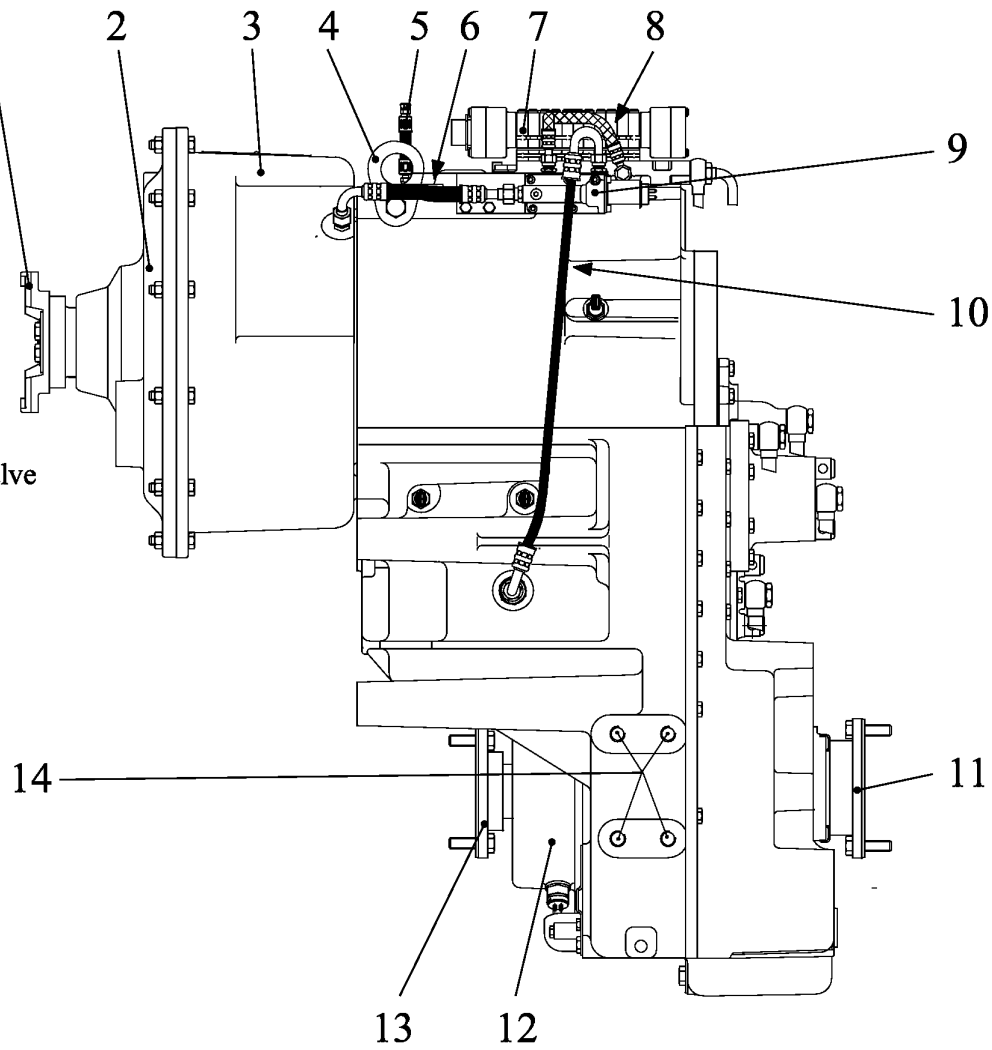
INSTALLATION VIEW 6 WG-260 SEPARATE INSTALLATION WITH INTERAXLE DIFFERENTIAL
FRONT VIEW
TABLE-7A

1 = Lifting lug
2 = Breather
3 = Electrohydraulic shift control
4 = Input flange – Drive via universal shaft
5 = Transmission suspension holes M16
6 = Output flange (converter-side)
7 = Coarse filter
8 = Oil drain plug
9 = Pneumatic or hydraulic engagement and disconnection
10 = Oil filler tube with oil dipstick (converter-side)



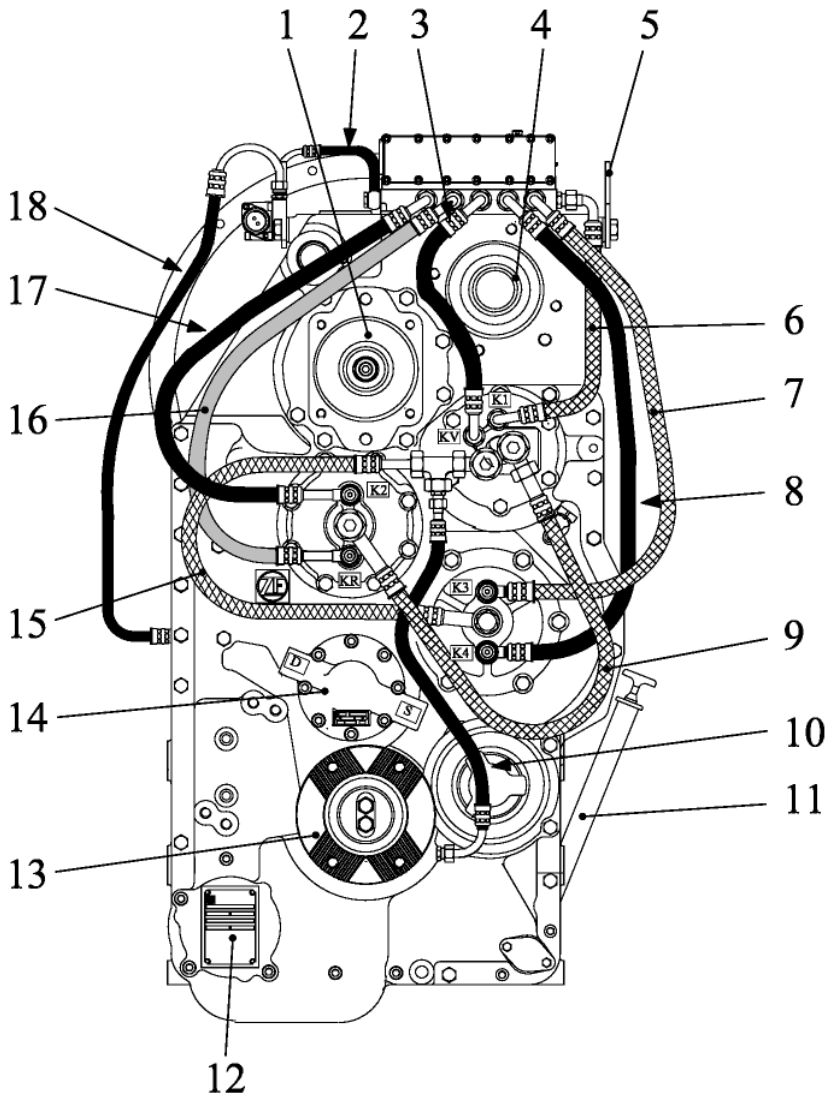
INSTALLATION VIEW 6 WG-260 SEPARATE INSTALLATION WITH INTERAXLE DIFFERENTIAL
SIDE VIEW
TABLE-7B

1 = Input flange – Drive via universal shaft
2 = Cover
3 = Converter bell
4 = Lifting lug
5 = Breather
6 = Pressure oil line from the WK-Valve to the WK
7 = Electrohydraulic shift control
8 = Pressure oil line from the electrohydraulic shift control to the WK-Valve
9 = WK-Valve
10 = Breather line WK
11 = Output flange (rear-side)
12 = Pneumatic or hydraulic engagement and disconnection
13 = Output flange (converter-side)
14 = Transmission suspension holes M20



INSTALLATION VIEW 6 WG-260 SEPARATE INSTALLATION WITH INTERAXLE DIFFERENTIAL
REAR VIEW
TABLE-7C

1 = 1 Power take-off
2 = Pressure oil line from the electrohydraulic shift control to the WK-Valve
3 = Pressure line Clutch KV
4 = 2nd Power take-off
5 = Lifting lug
6 = Pressure oil line Clutch K1
7 = Pressure oil line Clutch K3
8 = Pressure oil line Clutch K4
9 = Lubricating oil line „S1“ Clutch KR/K2
10 = Lubricating oil line interaxle differential
11 = Oil filler tube with oil dipstick
12 = Model identification plate
13 = Output flange (rear-side)
14 = Emergency steering pump
S = Suction port M26x1,5
D = Pressure port M22x1,5
15 = Lubricating oil line „S2“ Clutch K4/K3
16 = Pressure oil line Clutch KR
17 = Pressure oil line Clutch K2
18 = Breather line WK

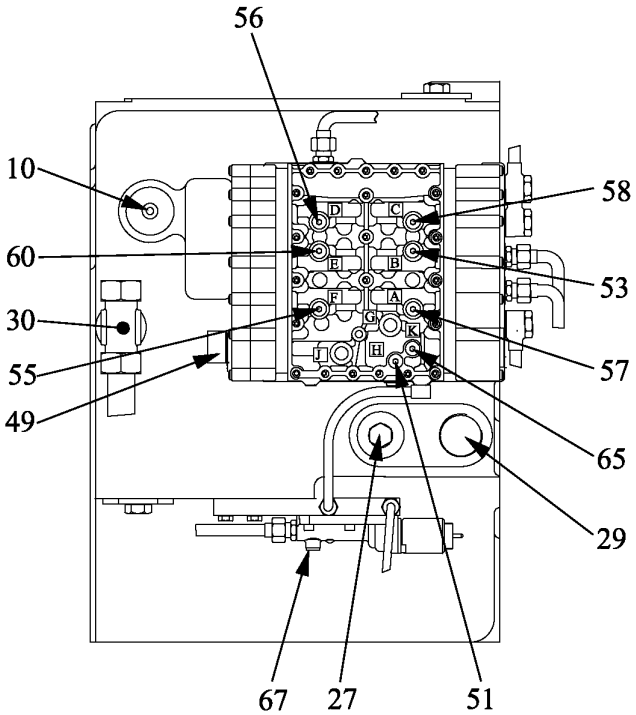


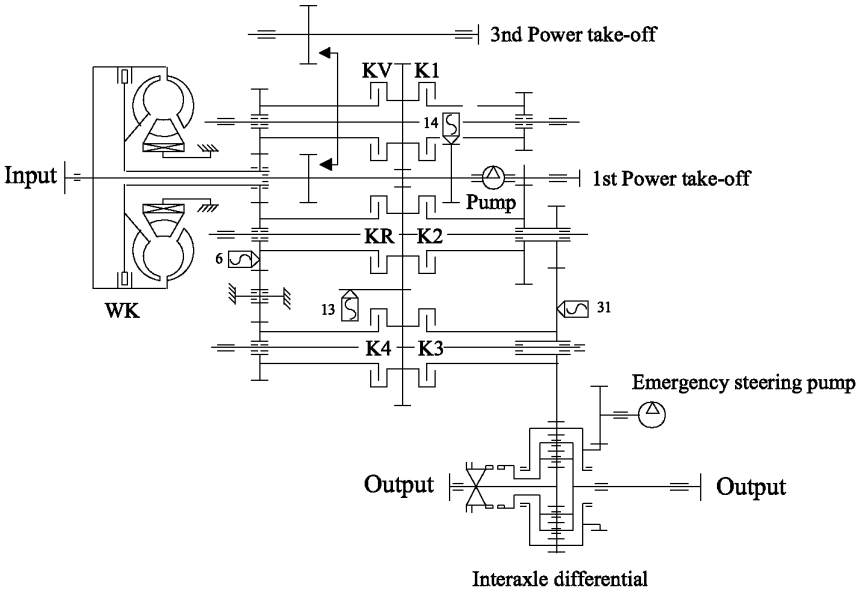
No.		*DENOMINATION OF THE POSITION*	*CONNECTION*	*MARKING ON THE VALVE BLOCK*
		MEASURING POINTS FOR PRESSURE OIL AND TEMPERATURE		
51	=	IN FRONT OF THE CONVERTER – OPENING PRESSURE 8,5 bar	M10x1	H
52	=	BEHIND THE CONVERTER – OPENING PRESSURE 5 bar	M10x1	
53	=	CLUTCH FORWARD 16+2 bar KV	M10x1	B
55	=	CLUTCH REVERSE 16+2 bar KR	M10x1	F
56	=	CLUTCH 16+2 bar K1	M10x1	D
57	=	CLUTCH 16+2 bar K2	M10x1	A
58	=	CLUTCH 16+2 bar K3	M10x1	C
60	=	CLUTCH 16+2 bar K4	M10x1	E
63	=	TEMPERATURE 100° C BEHIND THE CONVERTER, SHORT-TIME 120° C (MAX. 5 MINUTES)	M10x1	
65	=	SYSTEM PRESSURE 16+2 bar	M10x1	K
67	=	WK-CONTROL PRESSURE 12+2 bar	M10x1	
		CONNECTIONS		
10	=	BREATHER	M10x1	
15	=	TO THE HEAT EXCHANGER	---------	
16	=	FROM THE HEAT EXCHANGER	---------	
27	=	OIL FILLER PLUG	M42x2	
28	=	TO THE ZF-FILTER	M42x2	
29	=	FROM THE ZF-FILTER	M42x2	
30	=	FROM THE FILTER BYPASS TO THE CONVERTER	M42x2	
49	=	PLUG CONNECTION ON THE ELECTROHYDRAULIC CONTROL UNIT	---------	
--	=	SYTEM PRESSURE (OPTION)	M16x1,5	G
--	=	PILOT PRESSURE (OPTION)	M16x1,5	J
70	=	EMERGENCY STEERING PUMP - PRESSURE LINE	M22x1,5	
71	=	EMERGENCY STEERING PUMP - SUCTION LINE	M26x1,5	
		INDUCTIVE TRANSMITTER, SPEED SENSOR AND SWITCH		
6	=	INDUCTIVE TRANSMITTER n TURBINE	M18x1,5	
13	=	INDUCTIVE TRANSMITTER n CENTRAL GEAR TRAIN	M18x1,5	
14	=	INDUCTIVE TRANSMITTER n ENGINE	M18x1,5	
31	=	SPEED SENSOR n OUTPUT AND SPEEDOMETER	----------	
35	=	AXLE DISCONNECTION – INDICATOR/ACKNOWLEDGEMENT	M18x1,5	

SCHEDULE OF MEASURING POINTS AND CONNECTIONS 6 WG-260 WITH WK
TABLE 12

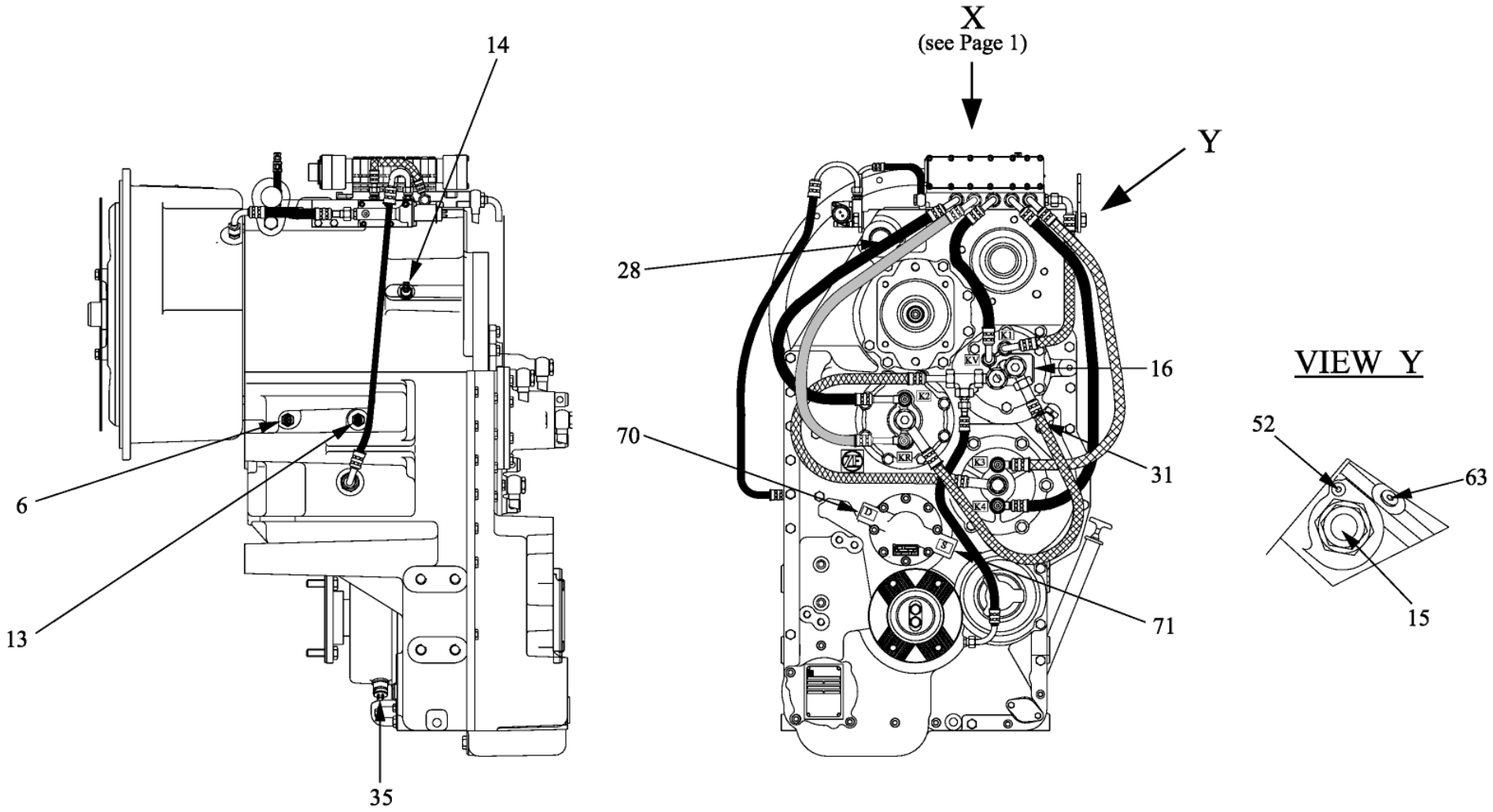
The marked positions (e.g. 53) are corresponding to the positions on the Table-13
The measurements have to be carried out at hot transmission (about 80° - 90° C)!

VIEW X
(see Page 3)





No.		*DENOMINATION OF THE POSITION*	*CONNECTION*	*MARKING ON THE VALVE BLOCK*
		MEASURING POINTS FOR PRESSURE OIL AND TEMPERATURE		
51	=	IN FRONT OF THE CONVERTER – OPENING PRESSURE 8,5 bar	M10x1	H
52	=	BEHIND THE CONVERTER – OPENING PRESSURE 5 bar	M10x1	
53	=	CLUTCH FORWARD 16+2 bar KV	M10x1	B
55	=	CLUTCH REVERSE 16+2 bar KR	M10x1	F
56	=	CLUTCH 16+2 bar K1	M10x1	D
57	=	CLUTCH 16+2 bar K2	M10x1	A
58	=	CLUTCH 16+2 bar K3	M10x1	C
60	=	CLUTCH 16+2 bar K4	M10x1	E
63	=	TEMPERATURE 100° C BEHIND THE CONVERTER, SHORT-TIME 120° C (MAX. 5 MINUTES)	M10x1	
65	=	SYSTEM PRESSURE 16+2 bar	M10x1	K
67	=	WK-CONTROL PRESSURE 12+2 bar	M10x1	
		CONNECTIONS		
10	=	BREATHER	M10x1	
15	=	TO THE HEAT EXCHANGER	---------	
16	=	FROM THE HEAT EXCHANGER	---------	
27	=	OIL FILLER PLUG	M42x2	
28	=	TO THE ZF-FILTER	M42x2	
29	=	FROM THE ZF-FILTER	M42x2	
30	=	FROM THE FILTER BYPASS TO THE CONVERTER	M42x2	
49	=	PLUG CONNECTION ON THE ELECTROHYDRAULIC CONTROL UNIT	---------	
--	=	SYTEM PRESSURE (OPTION)	M16x1,5	G
--	=	PILOT PRESSURE (OPTION)	M16x1,5	J
70	=	EMERGENCY STEERING PUMP - PRESSURE LINE	M22x1,5	
71	=	EMERGENCY STEERING PUMP - SUCTION LINE	M26x1,5	
		INDUCTIVE TRANSMITTER, SPEED SENSOR AND SWITCH		
6	=	INDUCTIVE TRANSMITTER n TURBINE	M18x1,5	
13	=	INDUCTIVE TRANSMITTER n CENTRAL GEAR TRAIN	M18x1,5	
14	=	INDUCTIVE TRANSMITTER n ENGINE	M18x1,5	
31	=	SPEED SENSOR n OUTPUT AND SPEEDOMETER	----------	
35	=	AXLE DISCONNECTION – INDICATOR/ACKNOWLEDGEMENT	M18x1,5	



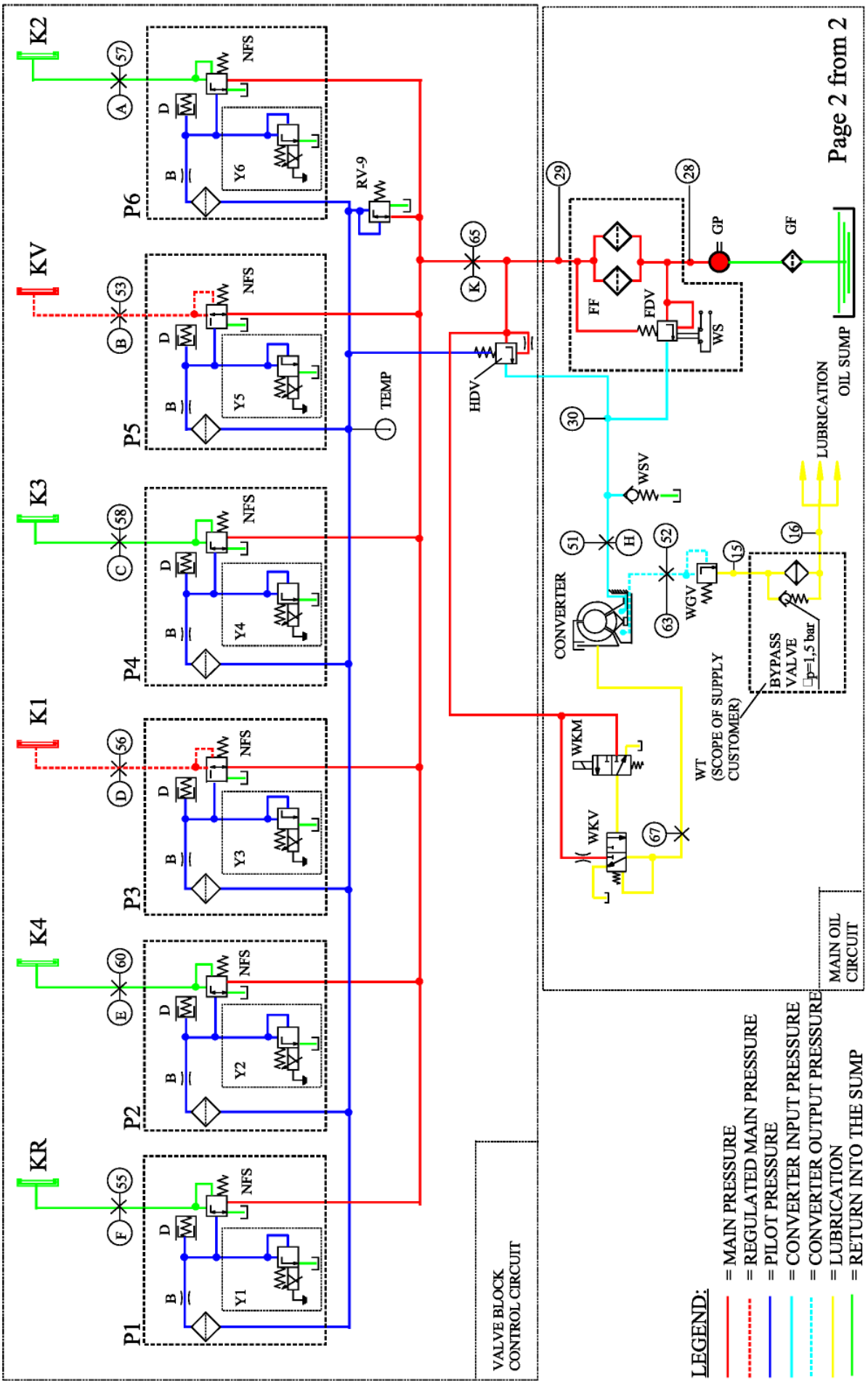
OIL CIRCUIT DIAGRAM 6 WG-260 WITH WK
- FORWARD 1st SPEED -
TABLE - 13

THE MARKED POSITIONS (e.g. 53) ARE CORRESPONDING TO THE POSITIONS ON THE TABLE – 12

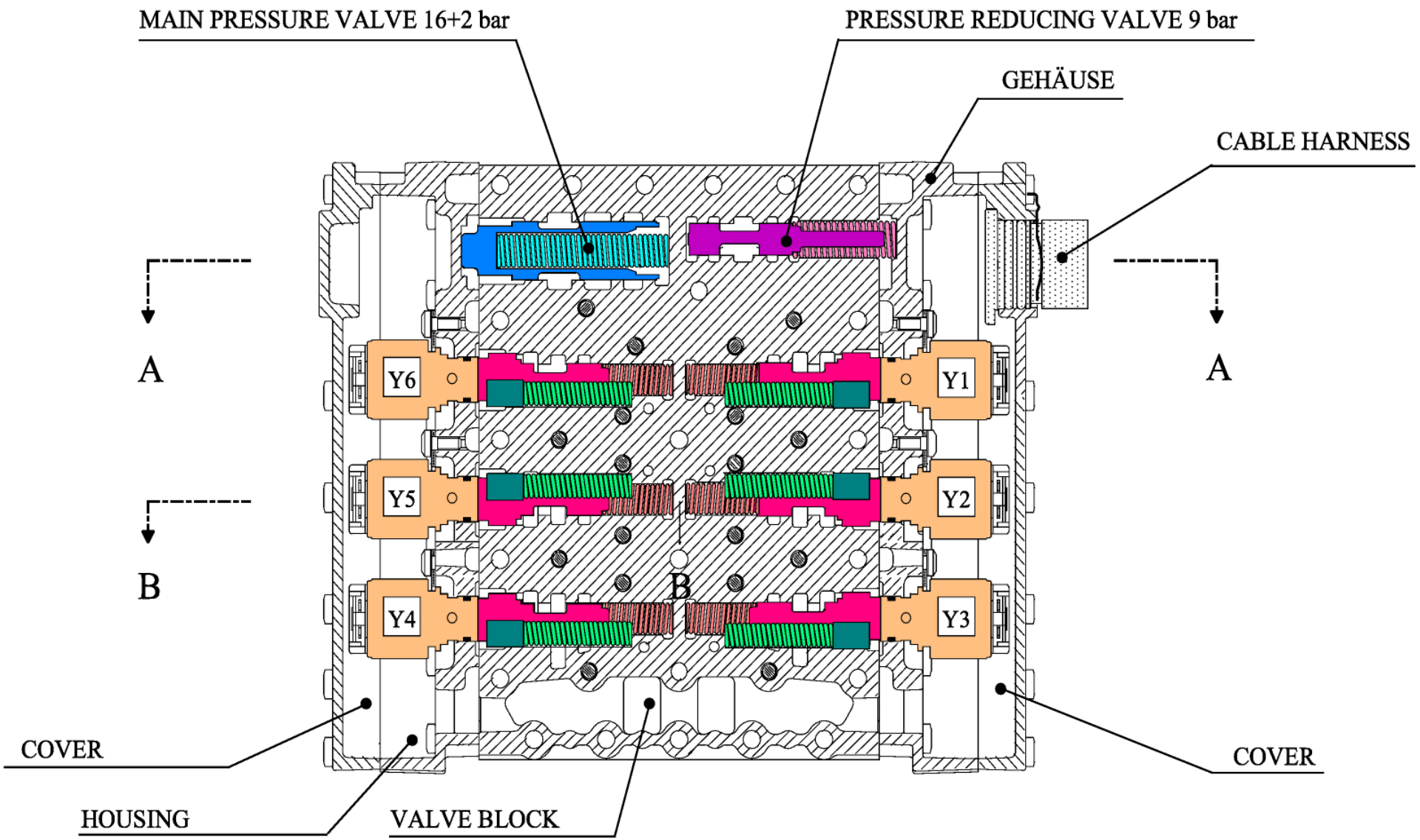
WT = HEAT EXCHANGER
WGV = CONVERTER BACK PRESSURE VALVE 5 bar
WSV = CONVERTER SAFETY VALVE 8,5 bar
WS = MAINTENANCE SWITCH ZF-FINE FILTER (OPENER)
HDV = MAIN PRESSURE VALVE 16+2 bar
RV-9 = PRESSURE REDUCING VALVE 9 bar
NFS = FOLLOW-ON SLIDE
D = VIBRATION DAMPER
B = ORIFICE
P1 = PROPORTIONAL VALVE – CLUTCH KR
P2 = PROPORTIONAL VALVE – CLUTCH K4
P3 = PROPORTIONAL VALVE – CLUTCH K1
P4 = PROPORTIONAL VALVE – CLUTCH K3
P5 = PROPORTIONAL VALVE – CLUTCH KV
P6 = PROPORTIONAL VALVE – CLUTCH K2
Y1 – Y6 = PRESSURE REGULATOR
TEMP = TEMPERATURE SENSOR
WKM = WK-SOLENOID VALVE
WKV = WK-SHIFT VALVE
GP = TRANSMISSION PUMP p=16+2 bar Q_p=115 l/min at n=Engine 2000 min^{-1}
GF = COARSE FILTER
MESH SIZE µm: 450
FILTER SURFACE cm^2 : 1000
FF = ZF-FINE FILTER ACCORDING ISO 4572:
$ß_{30} \geq 75$ $ß_{15} \geq 25$ $ß_{10} \geq 5.0$
DUST CAPACITY ACCORDING ISO 4572: min. 17g
FILTER SURFACE cm^2 : 2x6700 = 13 400
FDV = FILTER PRESSURE DIFFERENTIAL VALVE (BYPASS VALVE) $\Delta p = 5{,}7\ ^{+1,5}_{-0,5}$ bar

CODING

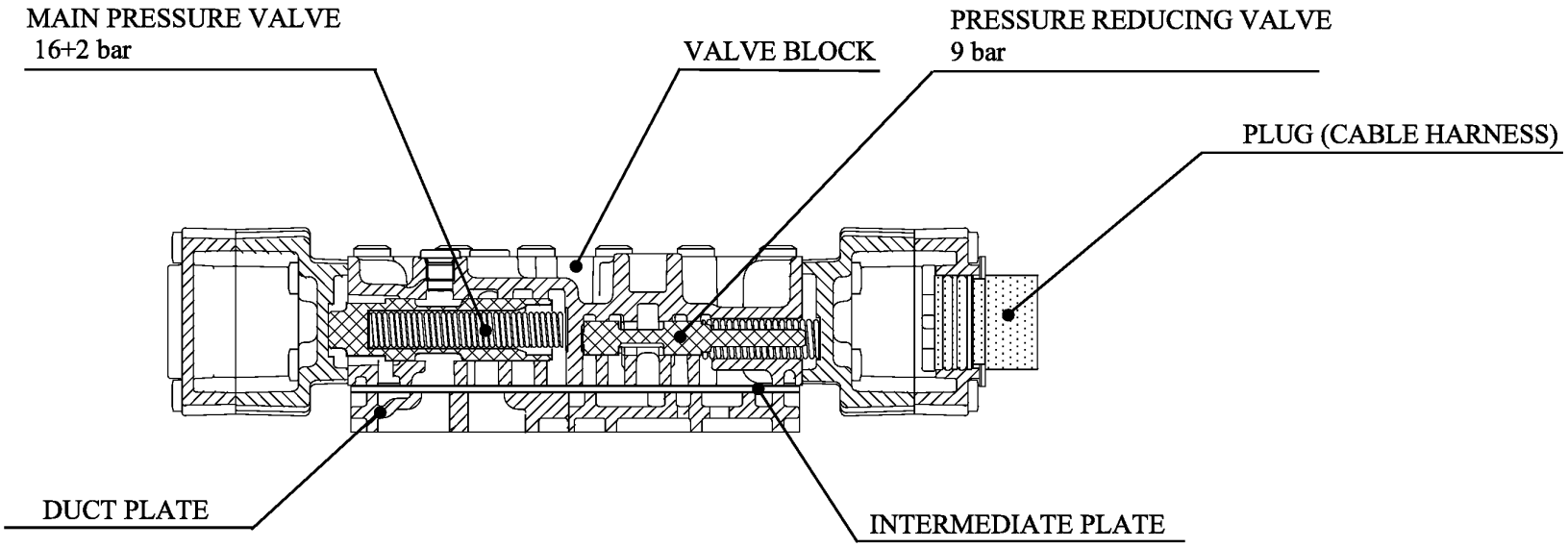
		• PRESSURE REGULATOR UNDER VOLTAGE						ENGAGED CLUTCHES	
DRIVING DIRECTION	SPEED	Y1	Y2	Y3	Y4	Y5	Y6		
FORWARD	1			•		•		K1	KV
	2		•	•				K4	K1
	3					•	•	KV	K2
	4		•				•	K4	K2
	5				•	•		K3	KV
	6		•		•			K4	K3
REVERSE	1	•		•				KR	K1
	2	•					•	KR	K2
	3	•			•			KR	K3
NEUTRAL									
ENGAGED CLUTCH		KR	K4	K1	K3	KV	K2		
POSTITIONS ON VALVE BLOCK		F	E	D	C	B	A		
CONSEC. NO. OF MEAS. POINTS		55	60	56	58	53	57		



ELECTRO-HYDRAULIC SHIFT CONTROL WITH PROPORTIONAL VALVES

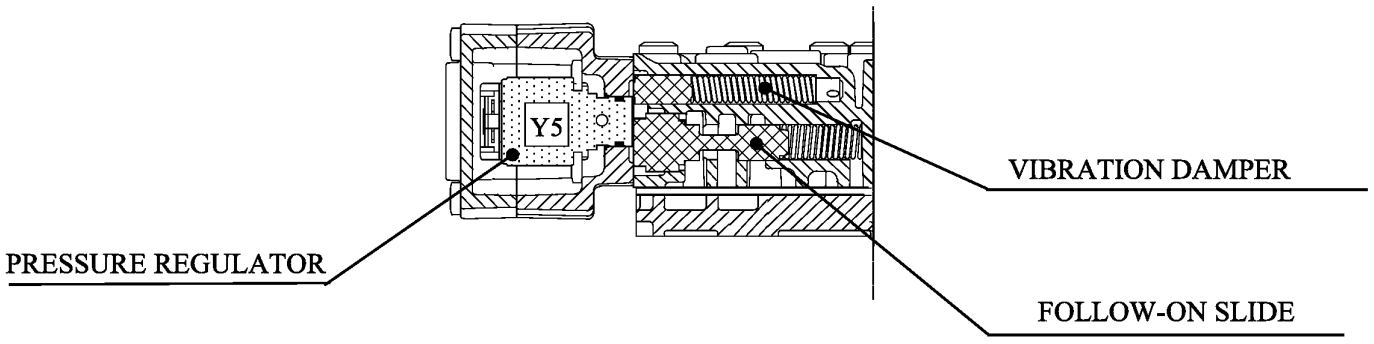


SECTION A - A



SECTION B - B

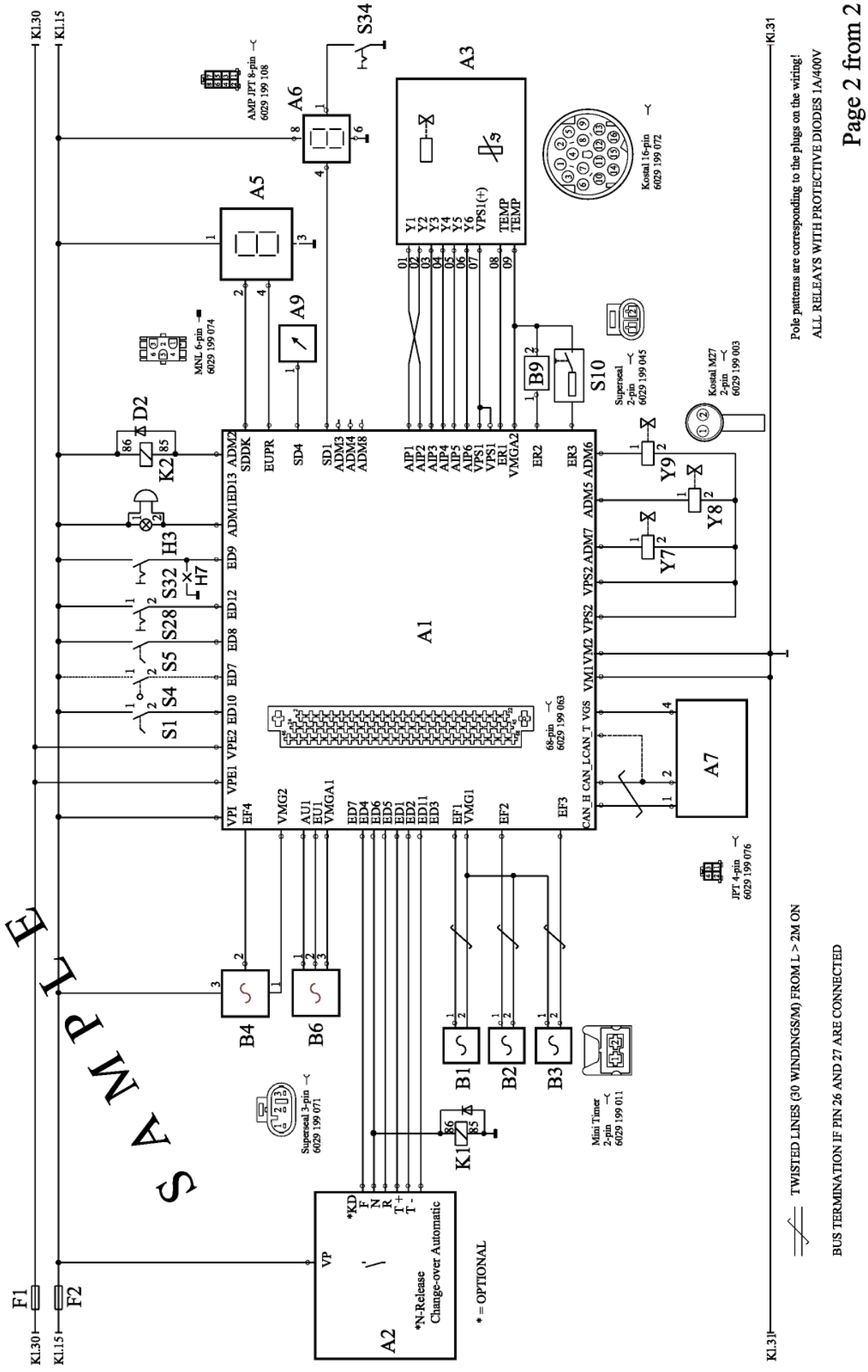
PROPORTIONAL VALVE P5



6 WG-260 FULLY-AUTOMATIC CONTROL EST-37
CIRCUIT DIAGRAM – STANDARD (6029 717 039)
TABLE-19

ITEM	LEGEND	ITEM	LEGEND
A1	ELECTRONIC CONTROL UNIT TCU	S1	SWITCH RETARDER
A2	CONTROLLER	S4	SWITCH KICKDOWN (OPTION)
A3	ELECTROHYDRAULIC CONTROL UNIT 6 WG-260	S5	SWITCH REQUEST ENGINE BRAKE
A5	DIAGNOSIS – INTERFACE (PLUG)	S10	SWITCH FILTER CONTAMINATION
A6	DISPLAY	S28	SWITCH PRESELECTION DIFFERENTIAL LOCK
A7	CAN-INTERFACE (PLUG)	S32	SWITCH TROUGH ON TOP *
A9	SPEEDOMETER WITH FREQUENCY DIVIDER *	S34	SWITCH DISPLAY ILLUMINATION *
B1	SPEED SENSOR n ENGINE	Y7	SOLENOID VALVE WK
B2	SPEED SENSOR n TURBINE	Y8	SOLENOID VALVE RETARDER
B3	SPEED SENSOR n CENTRAL GEAR TRAIN	Y9	SOLENOID VALVE DIFFERENTIAL LOCK
B4	SPEED SENSOR n OUTPUT		
B6	LOAD SENSOR	K1	RELAY STARTER INTERLOCK *
B9	SENSOR – TEMPERATURE RETARDER	K2	RELAY REVERSE DRIVE *
F1	FUSE 7,5 A*		
F2	FUSE 7,5 A*		
H3	ACOUSTIC - / OPTICAL WARNING*		
H7	PILOT LAMP RESTRICTED SPEED RANGE*		

NOTE: * = SCOPE OF SUPPLY CUSTOMER



INDUCTIVE TRANSMITTER AND SPEED SENSOR (HALL SENSOR) TABLE - 24

The speeds required for the Electronic control unit EST-37 are detected by the following transmitters:

6	=	Inductive transmitter	n-Central gear train
14	=	Inductive transmitter	n-Engine
39	=	Inductive transmitter	n-Turbine
31	=	Speed sensor (Hall sensor)	n-Output and speedometer

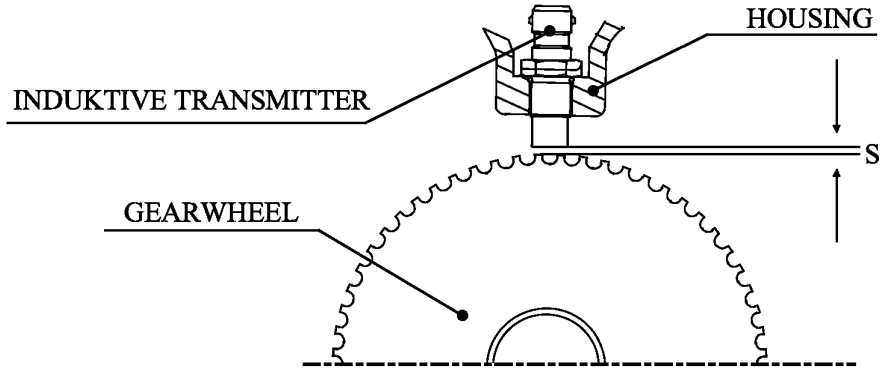
The installation positions of the transmitters are illustrated on the Schedules of Measuring points Table - 9, 10 and 11.

Attention:

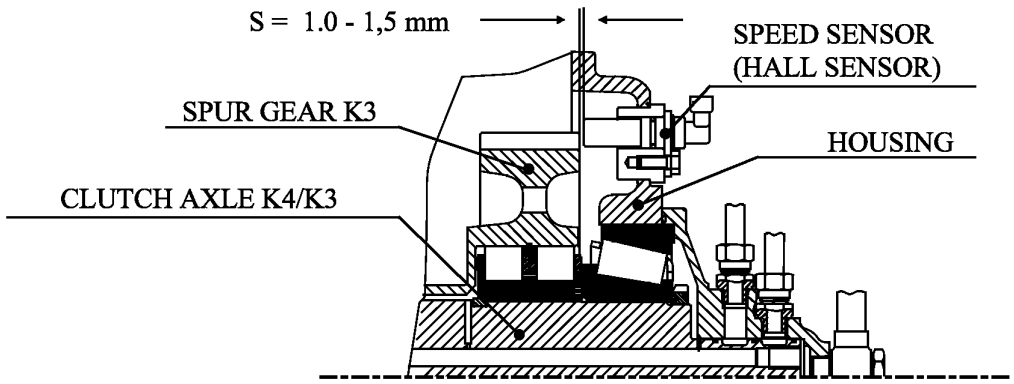
For the inductive transmitters, the following different setting dimensions between the contact area-inductive transmitter and the tooth tip have to be observed:

n-Engine (14)	A	=	$0{,}5\ ^{+0{,}3}$ mm
n-Turbine (39)	A	=	$0{,}5\ ^{+0{,}3}$ mm
n- Central gear train	A	=	$0{,}3\ ^{\pm 0{,}1}$ mm

INDUKTIVE TRANSMITTER



SPEED SENSOR (HALL SENSOR)



Hydraulic Component Testing

Several tests can be performed on the transmission to determine the condition of the major components. The following is a listing of suggested tests to be performed to aid in the diagnosis of the transmission.

Checking Converter Out Pressure

Equipment required:

Pressure gauge, 0 to 400 psi (0 to 28 bar), with a sufficient length of hose to take readings from the cab.

Test adapter CAS-2324.

NOTE: *Due to the inaccessibility of the control valve on the 30 TON TRUCK, a remote test port has been made available at the rear of the cab, It is the 5th port from the top.*

Test Procedure:

Block the machine tires, apply the parking brake and install the pressure gauge at test point 52. Heat the oil to operating temperature 176 to 212° F (80 to 100° C).

While in the cab, put the transmission in Neutral, run the engine at full throttle. Pressure must be 51 to 96 psi (3.5 to 6.5 bar).

Checking Lubrication Pressure

Equipment required:

Pressure gauge 0 to 100 psi (0 to 7 bar), with sufficient length hose to take readings from the cab.

Test Procedure:

Block the machine tires, apply the parking brake and install the pressure gauge in the cooler return line at the transmission. Heat the oil to operating temperature 176 to 212° F (80 to 100° C). While in the cab, run the engine at full throttle. Place the transmission in each gear and record the pressure. Pressure must be 3 to 18 psi (0.2 to 1.2 bar).

Flowmeter Testing

Equipment required:

Flowmeter kit and CAS2702 flowmeter adapter.

Test Procedure:

Block the machine tires, apply the parking brake and heat the oil to operating temperature 176 to 212° F (80 to 100° C). Remove the filter and install the CAS2702 adapter. Install the flowmeter between the adapter and the filter. While in the cab, run the engine at full throttle. With the transmission in Neutral, record the flow. Flow must be 28 gpm (105 l/ min).

Flow rating the transmission hydraulic pump

This test can be performed if a complaint exists of low power in all gears or poor modulation in all gears. Prior to performing this test, the AEB calibration should be conducted.

To flow rate the transmission, proceed as follows:

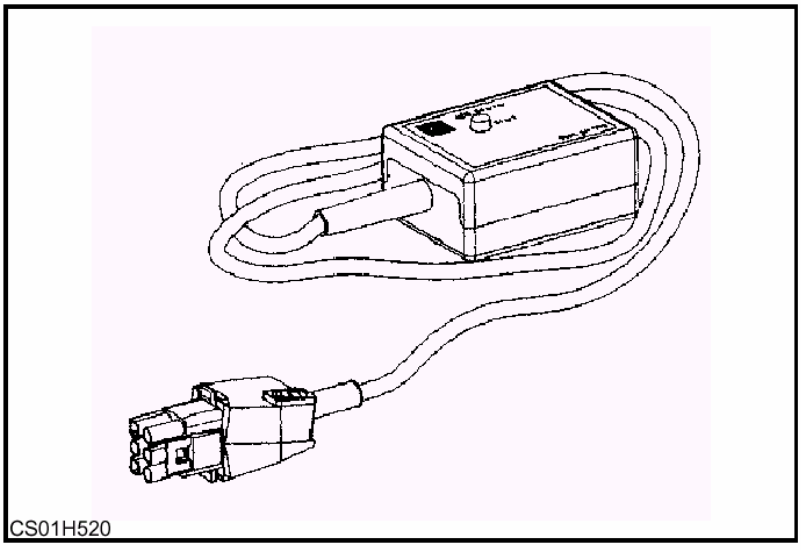
1. For safety purposes, block the machine wheels, apply the parking brake and engage the steering lock at the articulation joint.
2. Remove the transmission oil filter and install special tool CAS2011A to the filter head.
3. Connect the inlet of the flow meter to the inlet side of the special tool. Connect the outlet of the flow meter to the outlet side of the special tool.
4. Make certain the flow restriction valve on the flow meter is fully open!
5. Start the engine and run at rated engine speed. Heat the transmission oil to 176° F (80° C).
6. Read the flow rate with the engine running at 2000 RPM. The minimum flow should be 21 gal/min (80 L/min).
7. Remove the flow meter and the special tool. Reinstall the oil filter.

Automatic Calibration of the Shifting Elements (AEB)

The purpose of the AEB function is to compensate for tolerance changes in the clutch filling process due to component wear. AEB monitors the rapid filling time (the period of time when the flow of oil moves the clutch plates from the released position to the point where plate contact is made) and the equalizing time (the period of time in which the pressure increases to engage the clutch). These rates, controlled by proportioning valves, vary from clutch to clutch based on the volume of the clutch, clutch spring force, seal resistance and engine input torque. Clutch supply pressure is then controlled to provide the shift based on speed and load conditions.

As the clearances in the clutch assemblies change due to wear, shift quality also changes. It is recommended that the AEB-Cycle be performed at the maintenance intervals. The AEB-Cycle must also be performed if replacement of the transmission, the control valve or the Transmission Control Unit has occurred.

The AEB-Cycle requires about 3 to 4 minutes to perform. The determined filling parameters are stored in the of the Transmission Control Unit.


CS01H520

An AEB-Starter is required to perform the cycle. ZF part number 0501 211 778

The following information is available on the transmission display. Install the AEB-Starter by plugging into the connector #5 in the right side panel of the cab, then follow the symbols below and on the following page.

NOTE: The transmission must be at normal operating temperature and the engine speed must be held at 1000 RPM and the park brake must be applied.

DISPLAY DURING AEB-MODE

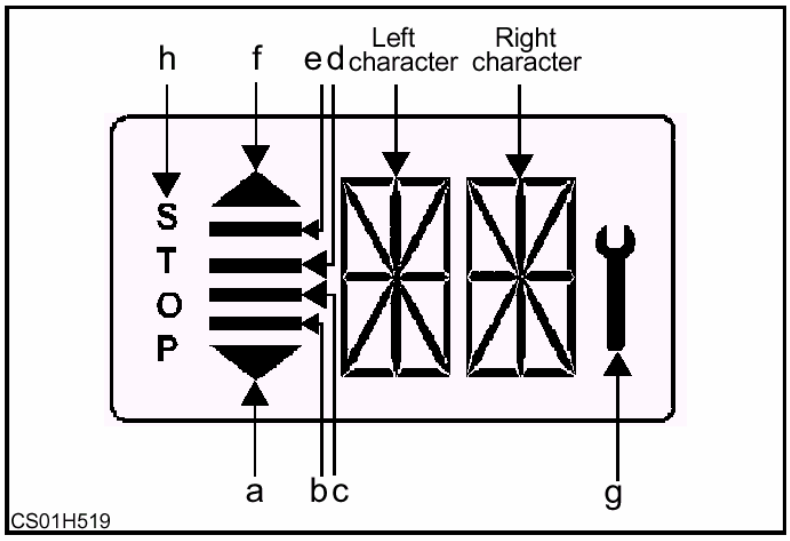
SYMBOL	MEANING	REMARKS
PL	AEB - Starter is plugged at the diagnostic plug	
ST	AEB - Starter-button is pressed	
K1..K4, KV, KR	Calibrating clutch K1..K4, KV, KR	
_ and Kx	Wait for start, initialisation of clutch Kx, X: 1, 2, 3, 4, V, R	
≡ and Kx	Fast fill time determination of clutch Kx	
= and Kx	Compensating pressure determination of clutch Kx	
OK	Calibration for all clutches finished	Transmissions trays in neutral, you have to restart the TCU (ignition off/on) after removing AEB-Starter
STOP	AEB canceled (activation speed)	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
STOP and Kx	AEB stopped, clutch Kx can't be calibrated	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
Spanner and Kx	Kx couldn't be calibrated, AEB finished	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
⇑ E	Engine speed too low,→ raise engine speed	
⇓ E	Engine speed too high,→ lower engine speed	
⇑ T	Transmission oil temperature too low,→ heat up transmission	
⇓ T	Transmission oil temperature too high → cool down transmission	
FT	Transmission temperature not in defined range during calibration	Transmission stays in neutral, you have to restart the TCU (ignition off/on)

SYMBOL	MEANING	REMARKS
FB	Operating mode not NORMAL or transmission temperature sensor defective or stopping of Calibrated values to EEPROM-has failed	Transmissions stays in neutral, you have to restart the TCU (ignition off/on)
FO	Output speed not zero	Transmissions trays in neutral, you have to restart the TCU (ignition off/on)
FN	Shift lever not in Neutral position	Transmissions trays in neutral, you have to restart the TCU (ignition off/on)
FP	Park brake not applied	Transmissions trays in neutral, you have to restart the TCU (ignition off/on)
STOP	AEB - Starter was used incorrect or is defective	Transmissions trays in neutral, you have to restart the TCU (ignition off/on)

Transmission Display Symbols

If the system recognizes an error, the wrench, also called a spanner (special symbol "g") flashes.

When the shift lever is in the Neutral position, a two digit error number appears in the two alphanumeric display positions. If more than one error is pending, the error numbers will be indicated one after the other, each appearing for about one second. It should be noted that error codes will only appear while the error condition exists and the machine is in neutral. If the error corrects itself, the error code signal is no longer shown.



The following codes may be seen during normal operation. They do not represent errors.

DISPLAY DURING OPERATION

SYMBOL	MEANING	REMARKS
1F, 1R 2F, 2R 3F, 3R 4F 5F 6F LF, LR	Actual gear and direction Left digit shows actual gear Right digit shows actual direction Limp home gear	
F or R, no gear	Clutch Cut-off	
F or R, no gear	Only 6WG: Direction F or R selected while turbine speed is too high, CAUTION gear will engage if turbine speed drops	
NN	Not neutral, waiting for neutral after power up or a severe fault	Go engage a gear, first move shift selector to neutral position and again to F or R position
**	Oil temperature too low, no gear available	Warm up engine/transmission
*N	Oil temperature low, only one gear available	Warm up engine/transmission
1 bar (special symbol)	Manual mode 1, gear	
2 bars	Manual mode 2, gear	
3 bars	Manual mode 3, gear	
4 bars	Manual mode 4, gear	
4 bars and 2 arrows	Automatic mode	
Bars flashing	6 WG: converter lockup clutch open 4WG: Downshift mode active	Difference of engine and turbine speed above a certain limit and lockup clutch not activated
Spanner	At least one fault active	Select neutral to get fault code displayed
Fault code	See fault code list	
WS	Warning sump temperature	Changes between actual gear/ direction while driving, in neutral only displayed if no fault is detected (wrench)
WR	Warning retarder temperature	Changes between actual gear/ direction while driving, in neutral only displayed if no fault is detected (wrench)
WT	Warning torque converter temperature	Changes between actual gear/ direction while driving, in neutral only displayed if no fault is detected (wrench)
WE	Warning high engine speed	Changes between actual gear/ direction while driving, in neutral only displayed if no fault is detected (wrench)

SYMBOL	MEANING	REMARKS
PN	Direction F or R selected while parking brake engaged	Transmission in neutral until parking brake is released CAUTION: vehicle starts to move after release of parking brake
F or R flashing	Direction F or R selected while turbine speed is to high, CAUTION gear will engage if turbine speed drops	
EE flashing	No communication with display	Checked wiring from TCU to display

Definition of Operating Modes

NORMAL: No faults are detected in the transmission system or the failure has no effect or only slight effects on the TCU.

SUBSTITUTE CLUTCH CONTROL: The TCU cannot change gears under the control of normal modulation. The TCU uses a substitute control of timed modulation only.

LIMP HOME: A failure limits the transmission to one speed (sometimes only one direction). The TCU will place the transmission in neutral, requiring the operator to place the shift selector into neutral, then into forward or reverse. The TCU will then select the limp home gear.

TRANSMISSION SHUTDOWN: The TCU detects a failure that disables the control of the transmission. The TCU shuts off the solenoids for the clutches and the power supply. The transmission will stay in neutral.

TCU SHUTDOWN: The TCU detects a severe failure that disables the control of the system. The TCU shuts off the solenoids for the clutches and the power supply and also engages the park brake.

Abbreviations used in the fault code table;

s. c. = short circuit

o. c. = open circuit

TCU = Transmission Control Unit

OP-MODE = operating mode

PTO = Power Take Off

B+ = Battery supply voltage

The following table lists the fault codes that may appear on the transmission display, the reason, reaction and the repair steps.

FAULT NO.	REASON FOR FAULT	REACTION TO FAULT	REPAIR STEPS
11	Gear range signal error	Transmission shifts to neutral.	Check signal from shift lever
12	Direction select signal error.	Transmission shifts to neutral.	Check signal from shift lever.
14	Park brake status error.	TCU shifts trans. to a DCO state	Check brake switch Check wiring
25	s. c. to B+ or o. c. at sump temp. sensor	No reaction, TCU uses a default temperature	Check the sensor Check the wiring and connections.
26	s. c. to ground at transmission sump temperature sensor	No reaction, TCU uses a default temperature	Check the sensor Check the wiring and connections.
27	s. c. to B+ or o. c. at converter output temp. sensor	No reaction, TCU uses a default temperature	Check the sensor Check the wiring and connections.
28	s. c. to ground at converter output temp sensor input.	No reaction, TCU uses a default temperature	Check the sensor Check the wiring and connections.
31	s. c. to B+ or o. c. at engine speed input sensor.	OP-Mode: substitute clutch control.	Check the sensor Check the wiring and connections.
32	s. c. to ground at engine speed input sensor.	OP-Mode: substitute clutch control.	Check the sensor Check the wiring and connections.
33	Logical error at engine speed input sensor	OP-Mode: substitute clutch control.	Check the sensor Check the wiring and connections. Check sensor air gap.
34	s. c. to B+ or o. c. at turbine speed input sensor.	OP-Mode: substitute clutch control. If a failure exists at output speed, transmission shifts to neutral.	Check the sensor Check the wiring and connections.

35	s. c. to ground at turbine speed input sensor	OP-Mode: substitute clutch control. If a failure exists at output speed, transmission shifts to neutral. OP-Mode limp home.	Check the sensor Check the wiring and connections.
36	Logical error at turbine speed input. *TCU measurement suddenly changes from normal to zero*	OP-MODE: Substitute clutch control . If a failure exists at output speed, transmission shifts to neutral OP-MODE: limp home	Check wiring from TCU to the sensor. Check connectors Check speed sensor Check sensor gap
37	s. c. to B+ or o. c. at internal speed input. TCU measures voltage higher than 7.00 volts at speed input pin.	OP-MODE: substitute clutch control	Check the wiring from TCU to the sensor. Check connectors. Check speed sensor.
38	s. c. to ground at internal speed input. TCU measures less than 0.45 volts at speed input pin.	OP-MODE: substitute clutch control	Check the wiring from TCU to the sensor. Check connectors. Check speed sensor.
39	Logical error at internal speed input. TCU measures internal an internal speed and suddenly it drops to zero.	OP-MODE: substitute clutch control	Check the wiring from TCU to the sensor. Check connectors. Check speed sensor.
3A	s. c. to B+ or o. c. at output speed sensor input. TCU measures a voltage higher than 12.5 volts.	Special mode for gear selection. OP_MODE: substitute clutch control. If a failure also exists at the turbine speed, TCU shifts to neutral. OP_MODE: limp home.	Check the wiring from the TCU to the sensor. Check the connectors. Check the speed sensor.
3B	s. c. to ground at output speed sensor input TCU measures less than 1.0 volts at the speed input pin.	Special mode for gear selection. OP_MODE: substitute clutch control. If a failure also exists at the turbine speed, TCU shifts to neutral. OP_MODE: limp home.	Check the wiring from the TCU to the sensor. Check the connectors. Check the speed sensor.

3C	Logical error at output speed sensor input TCU measures an output speed over the threshold and suddenly it drops to zero.	Special mode for gear selection. OP_MODE: substitute clutch control. If a failure also exists at the turbine speed, TCU shifts to neutral. OP_MODE: limp home.	Check the wiring from the TCU to the sensor. Check the connectors. Check the speed sensor. Check the sensor air gap.
3E	Output speed zero doesn't fit to other speed signals. If trans. Is not in neutral and shifting has finished, TCU measure an output speed of zero and turbine or intermediate gear not equal to zero.	Special mode for gear selection. OP_MODE: substitute clutch control. If a failure also exists at the turbine speed, TCU shifts to neutral. OP_MODE: limp home	Check the signal of the Output speed sensor. Check the air gap. Check wiring from TCU to sensor.
40	Gear range restriction signal. CAN signal for gear range restriction is defective.	No gear range restriction.	Check cluster controller. Check wire of CAN-bus. Check cable to cluster controller.
59	Test mode signal. CAN signal for test mode status is defective.	No reaction	Check cluster controller. Check wire of CAN-bus. Check cable to cluster controller.
5A	Park brake status signal. CAN signal for park brake status is defective.	No reaction.	Check cluster controller. Check wire of CAN-bus. Check cable to cluster controller.
5B	Shift quality SEL signal. CAN signal for shift quality selection is defective.	No reaction.	Check cluster controller. Check wire of CAN-bus. Check cable to cluster controller.

71	s. c. to B+ at clutch K1. Resistance value is out of limit. Voltage at K1 is too high.	TCU shifts to neutral. OP-MODE: limp home if failure of another clutch is pending. TCU shifts to neutral. OP-MODE: TCU shutdown	Check wiring and connectors from TCU to transmission. Check resistance. Check internal wiring in transmission.
72	s. c. to ground at clutch K1. Resistance value is out of limit. Voltage at K1 is too low.	TCU shifts to neutral. OP-MODE: limp home if failure of another clutch is pending. TCU shifts to neutral. OP-MODE: TCU shutdown	Check wiring and connectors from TCU to transmission. Check resistance. Check internal wiring in transmission.
73	o. c. at clutch K1. The measured resistance value of the valve is out of limit.	TCU shifts to neutral. OP-MODE: limp home if failure of another clutch is pending. TCU shifts to neutral. OP-MODE: TCU shutdown	Check wiring and connectors from TCU to transmission. Check resistance. Check internal wiring in transmission.
74	s. c. to B+ at clutch K2.	See fault 71	See fault 71
75	s. c. to ground at clutch K2	See fault 72	See fault 72
76	o. c. at clutch K2	See fault 73	See fault 73
77	s. c. to B+ at clutch K3	See fault 71	See fault 71
78	s. c. to ground at clutch K3	See fault 72	See fault 72
79	o. c. at clutch K3	See fault 73	See fault 73
81	s. c. to B+ at clutch K4	See fault 71	See fault 71
82	s. c. to ground at clutch K4	See fault 72	See fault 72
83	o. c. to clutch K4	See fault 73	See fault 73
84	s. c. to B+ at clutch KV	See fault 71	See fault 71
85	s. c. to ground at clutch KV	See fault 72	See fault 72
86	o. c. at clutch KV	See fault 73	See fault 73
87	s. c. to B+ at clutch KR	See fault 71	See fault 71
88	s. c. to ground at clutch KR	See fault 72	See fault 72
89	o. c. at clutch KR	See fault 73	See fault 73

91	s. c. to ground at relay back up alarm. TCU detecting a wrong voltage that seems like a s. c. to vehicle ground	Back up alarm will be on until TCU power down even if fault vanishes. OP-MODE: normal	Check wiring from TCU to back up alarm. Check connector from TCU to alarm. Check resistance of alarm.
92	s. c. to B+ at back up alarm. TCU detects a wrong voltage at output pin that looks like a s. c. to vehicle ground.	No reaction. OP-MODE: normal.	Check wiring from TCU to back up alarm. Check connector from TCU to alarm. Check resistance of alarm.
93	o. c. at relay for back up alarm. TCU detects a wrong voltage at output pin that looks like a s. c. to vehicle ground.	No reaction. OP-MODE: normal.	Check wiring from TCU to back up alarm. Check connector from TCU to alarm. Check resistance of alarm.
B1	Slippage at clutch K1. TCU calculates an out of range differential speed.	TCU shifts to neutral. OP-MODE: limp home if failure of another clutch is pending	Check clutch K1 pressure and main pressure. Check sensor gap at intermediate gear and output gear. Check signal at intermediate and output sensors. Replace clutch
B2	Slippage at clutch K2	See fault B1	See fault B1
B3	Slippage at clutch K3	See fault B1	See fault B1
B4	Slippage at clutch K4	See fault B1	See fault B1
B5	Slippage at clutch KV	See fault B1	See fault B1
B6	Slippage at clutch KR	See fault B1	See fault B1
B7	Over temp. of sump.	No reaction OP-MODE: Normal	Cool down machine Check oil level Check temp. sensor.
B8	Over temp. of converter out.	No reaction OP-MODE: Normal	Cool down machine Check oil level Check temp. sensor.
BA	Differential pressure at oil filter over allowable range.	No reaction OP-MODE: Normal	Check oil filter Check wiring from TCU to pressure switch. Measure resistance of switch.

D1	s. c. to B+ at power supply for sensors. TCU measures over 6 volts at AU1 5 volt supply		Check wires and connectors to sensors which are supplied by AU1
D2	s. c. to ground at power supply for sensors. TCU measures less than 4 volts at AU1 5 volt supply		Check wires and connectors to sensors which are supplied by AU1
D3	Low power at battery	Shift to neural OP-MODE: TCU shutdown	Check wires and connectors to sensors which are supplied by AU1
D4	High power at battery	Shift to neural OP-MODE: TCU shutdown	Check wires and connectors to sensors which are supplied by AU1
D5	Error at switch 1 for valve power supply VSP1 TCU switched on VSP1 and measured VSP1 as off, or switched VSP1 off and measured VSP1 as on.	Shift to neural OP-MODE: TCU shutdown	Check fuse. Check wiring and connectors from TCU to trans.,
D6	Error at switch 2 for valve power supply VSP2 TCU switched on VSP2 and measured VSP2 as off or switched VSP2 off and measured VSP2 as on.	Shift to neural OP-MODE: TCU shutdown	Check fuse. Check wiring and connectors from TCU to trans.,
E5	CL1 time out. Timeout of CAN-message CL1 from cluster controller	TCU keeps old information for status monitor, status plock, shift quality selection, gear range restriction OP-MODE: normal	Check cluster controller, wire on CAN-Bus and wire to cluster controller
E6	Illegal ID request via CAN	Transmission stay in neutral	
F1	General EEPROM fault	No reaction	Replace TCU
F2	Configuration lost. TCU can no longer control the trans.	Transmission stays in neutral	Reprogram the correct configuration
F3	Applications error	Transmission stays in neutral. OP-MODE: TCU shutdown	Replace TCU

F5	Clutch failure. AEB was unable to adjust clutch filling parameters.	Transmission stays in neutral. OP-MODE: TCU shutdown	Check clutch
F6	Clutch adjustment data loss. TCU unable to read correct clutch filling parameters	TCU shifts to neutral. OP-MODE: limp home	Perform AEB.

Abbreviations used in the fault code table;

s. c. = short circuit

o. c. = open circuit

TCU = trans. Control unit

OP-MODE = operating mode

PTO = power take off

B+ = Battery supply voltage