

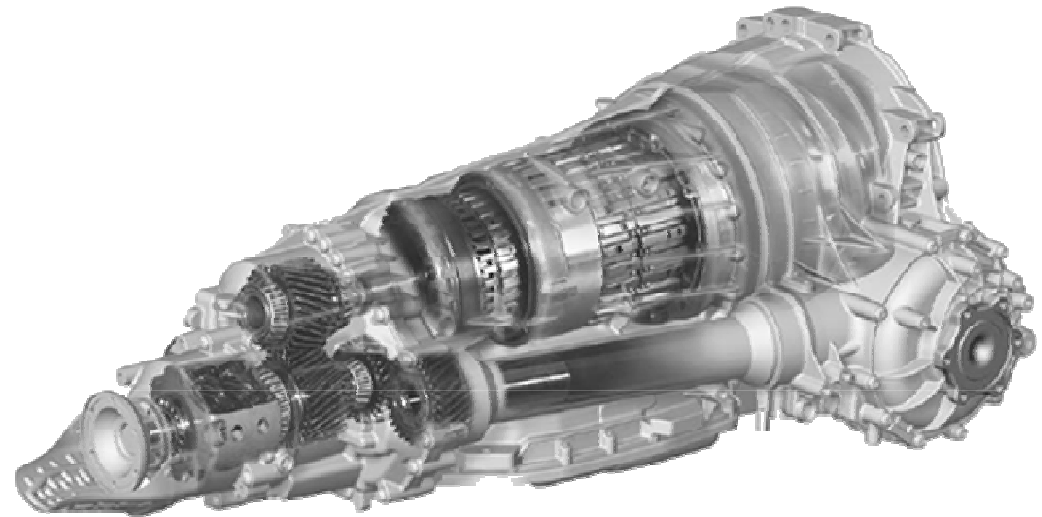
# ZF6HP26



**BENTLEY**



ASTON MARTIN



Presented by

Dr. William (Bill) Henney PhD F.I.M.I

# ZF 6HP26



ASTON MARTIN



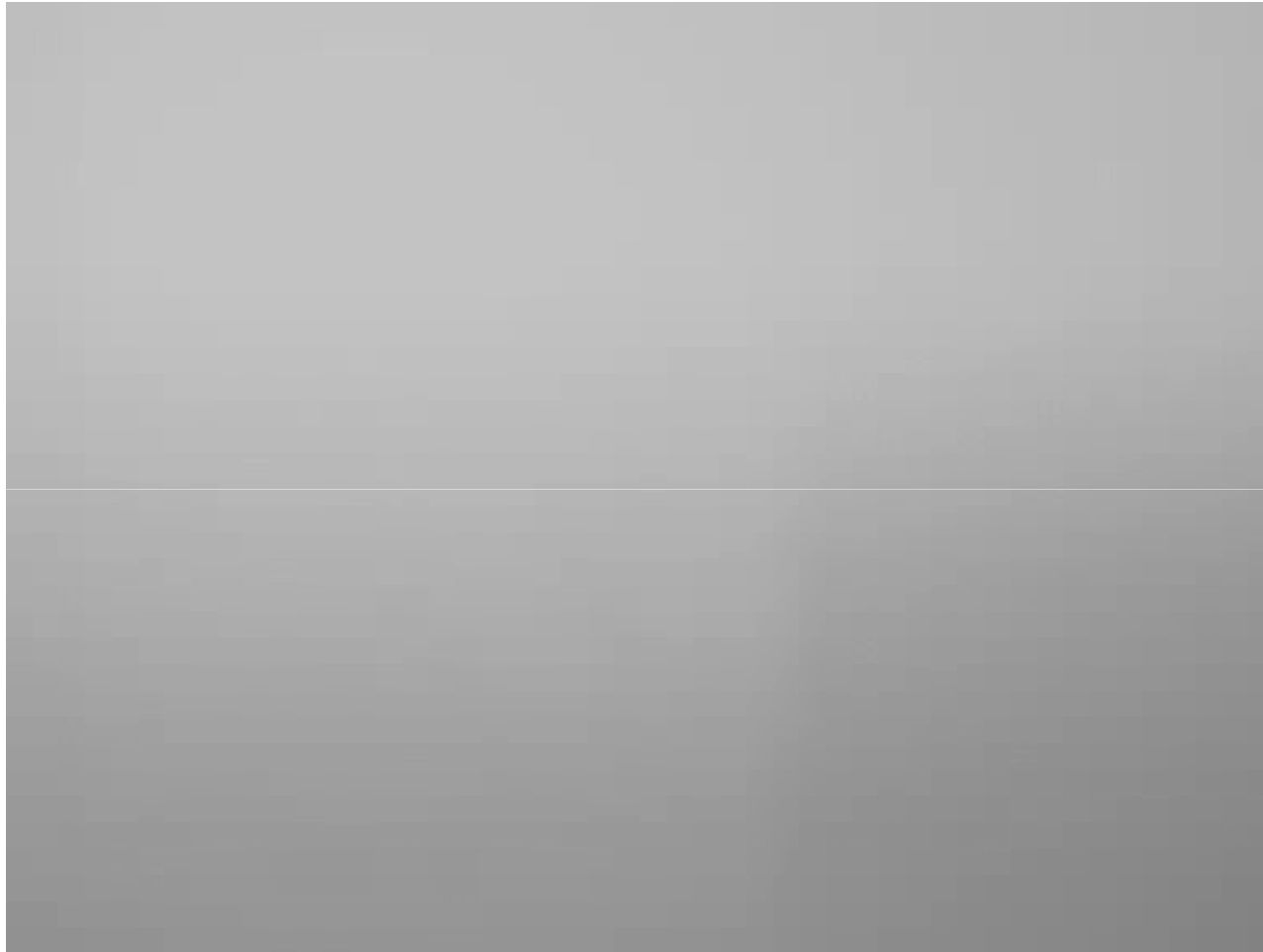
BENTLEY

# ZF Saarbrücken

ZF 6HP26



# The ZF6HP26



# ZF6HP26 (09E)

Model Variations:

6HP19 6HP19A 6HP19FL 6HP19FLA

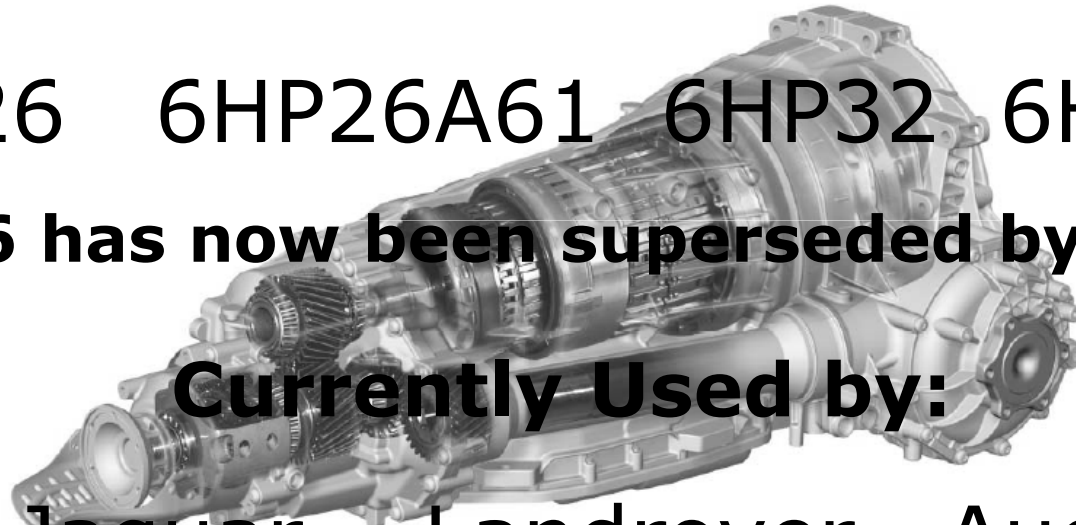
6HP26 6HP26A61 6HP32 6HP32A

**ZF6HP26 has now been superseded by ZF6HP28**

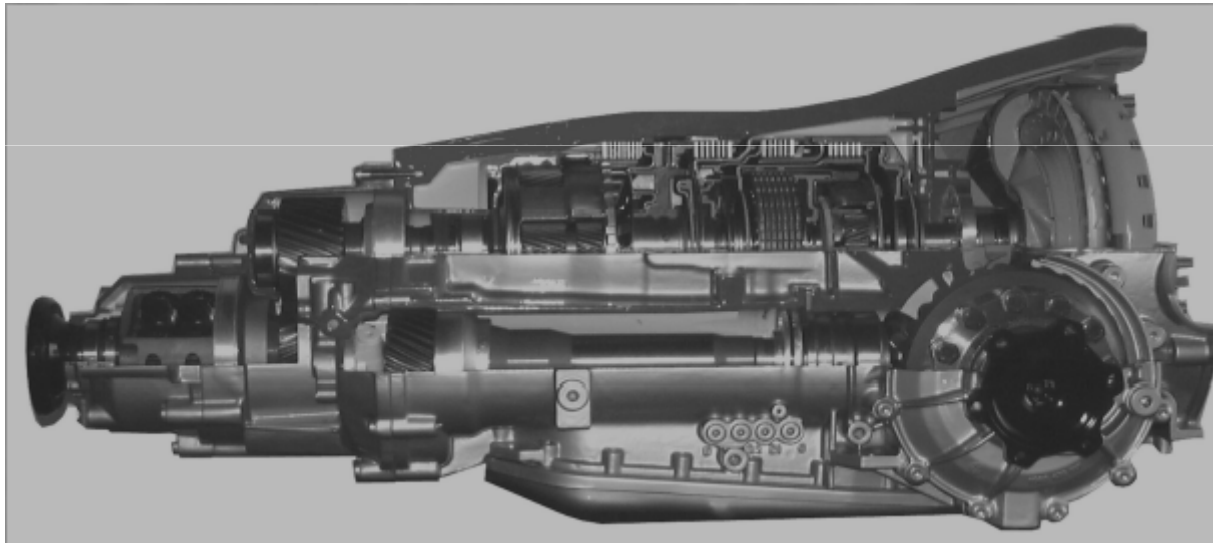
**Currently Used by:**

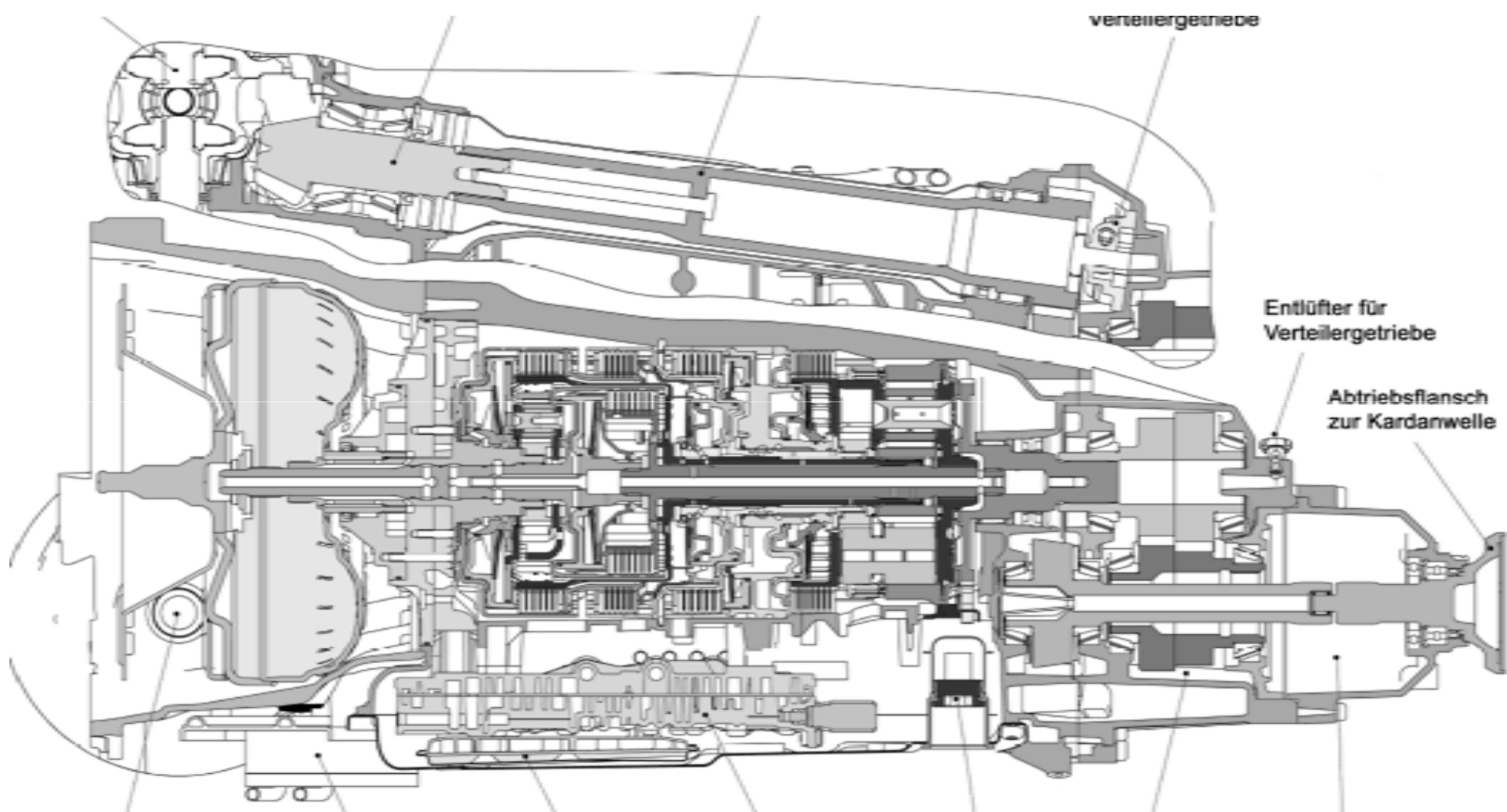
BMW Jaguar Landrover Audi Ford

Bentley Rolls Royce Aston Martin

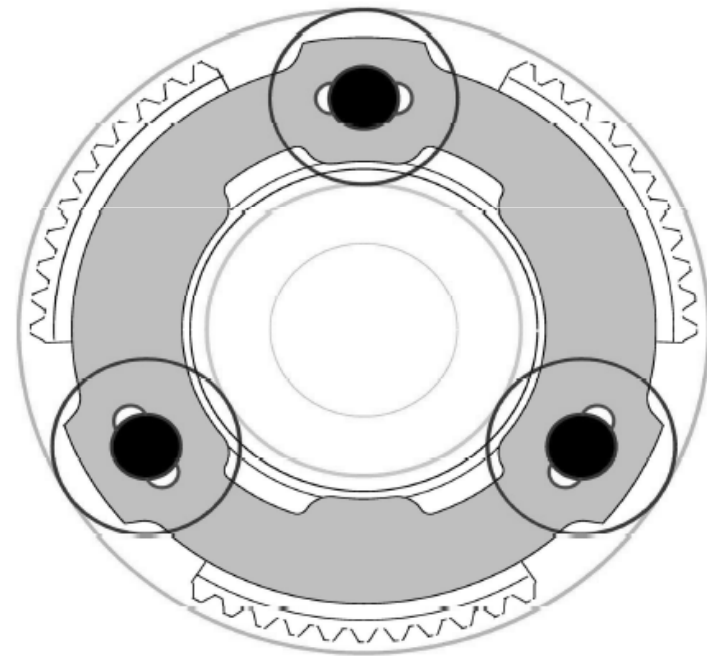
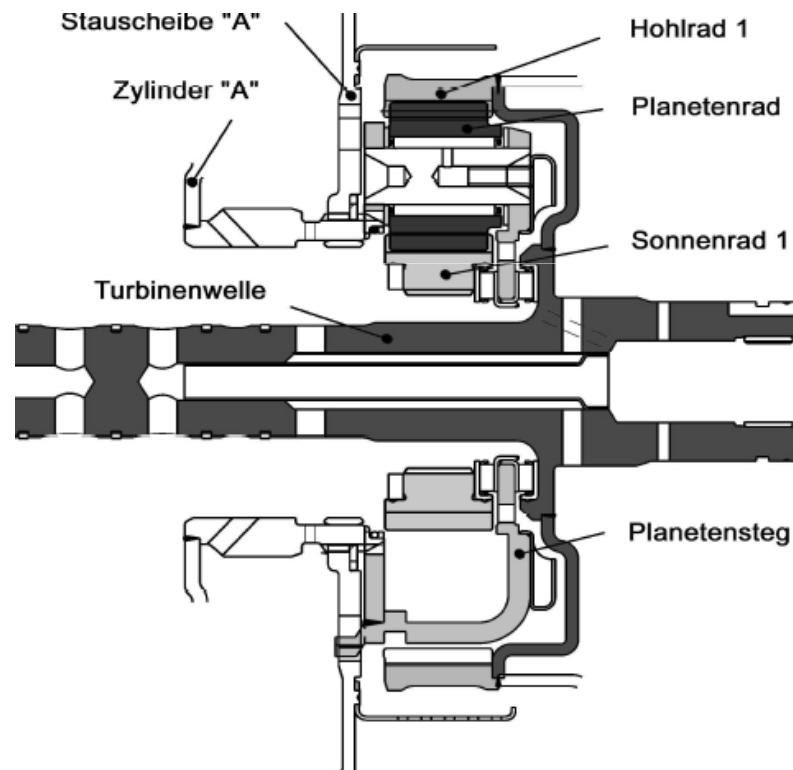


# 6HP26 A61/32A



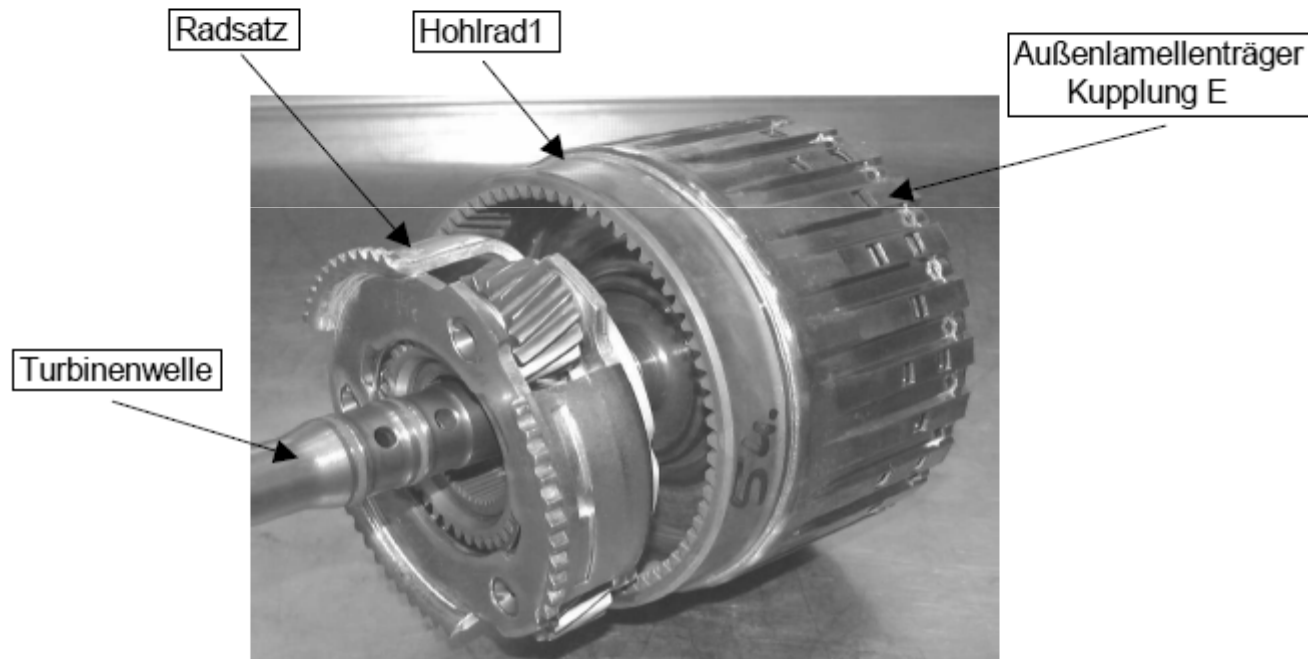


# Simple Planetary (3 Planets)

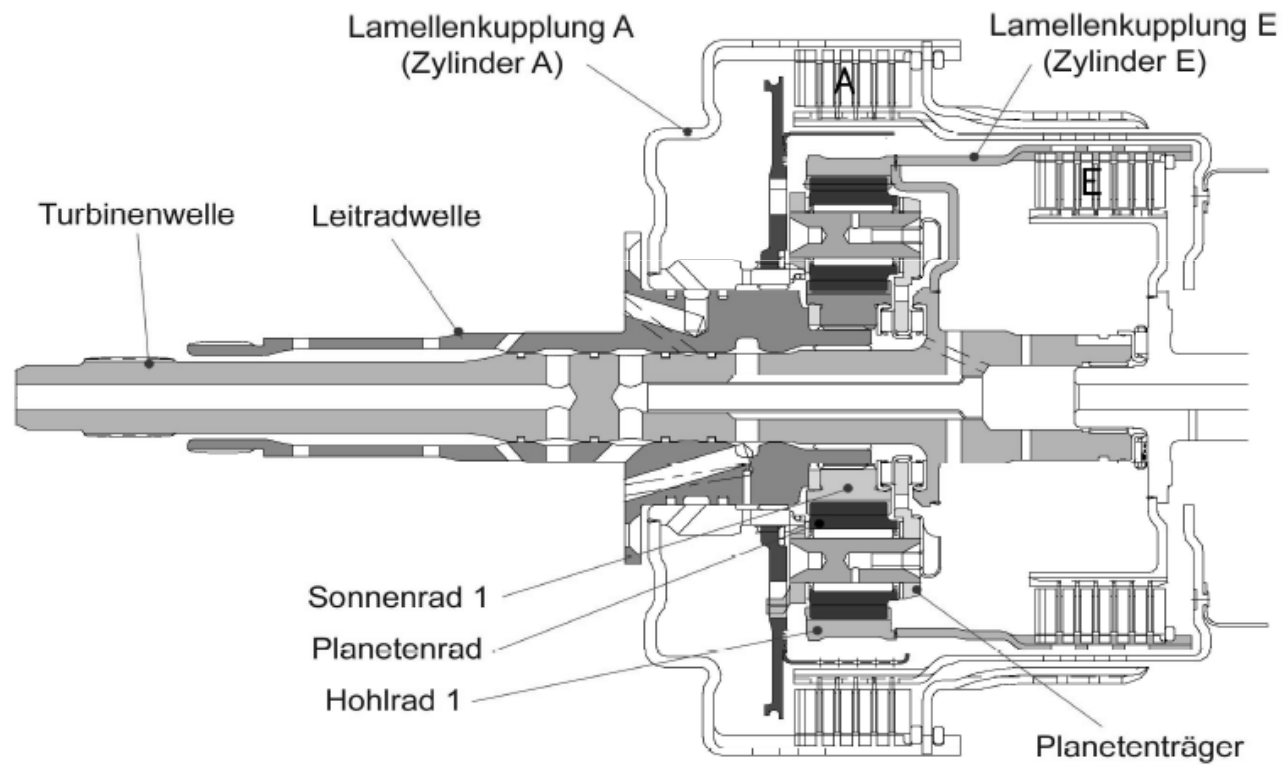




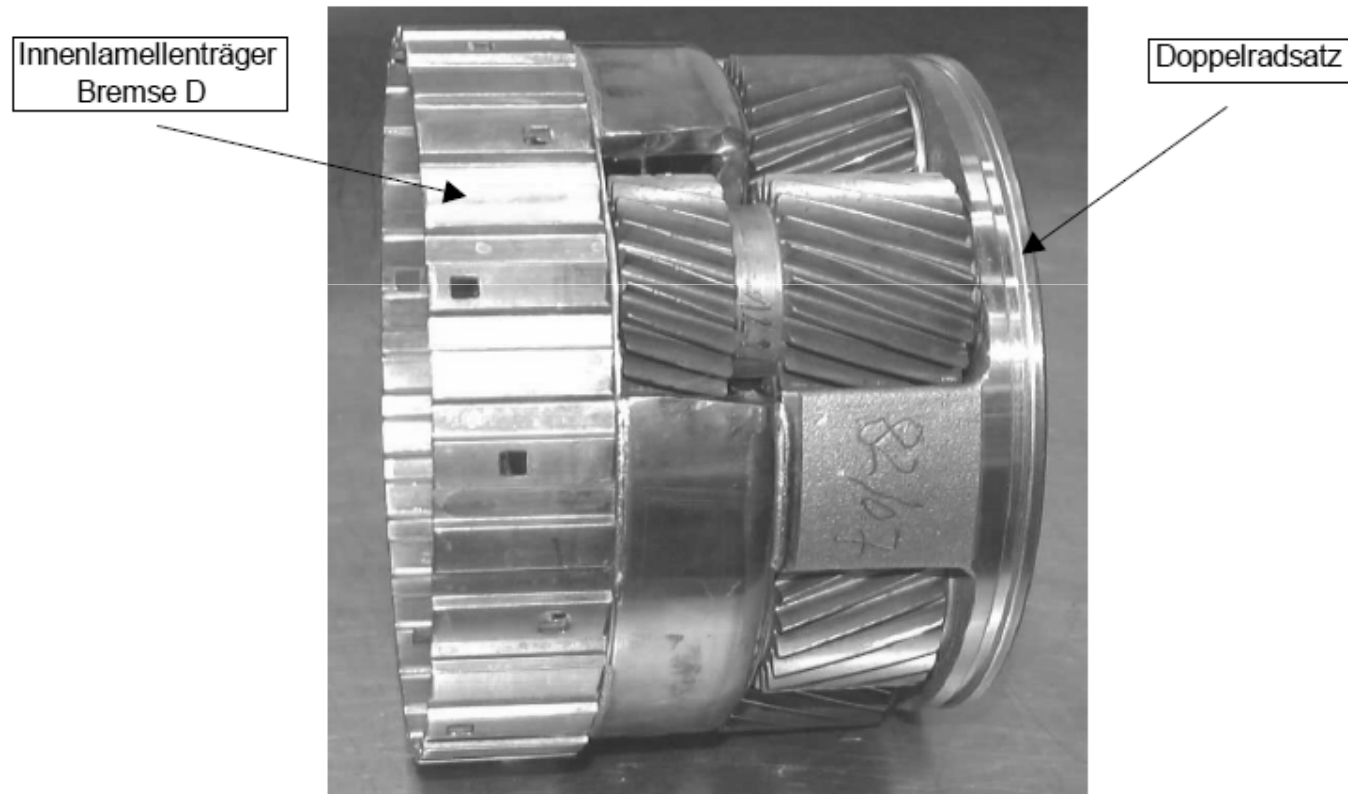
# 3 Planetary



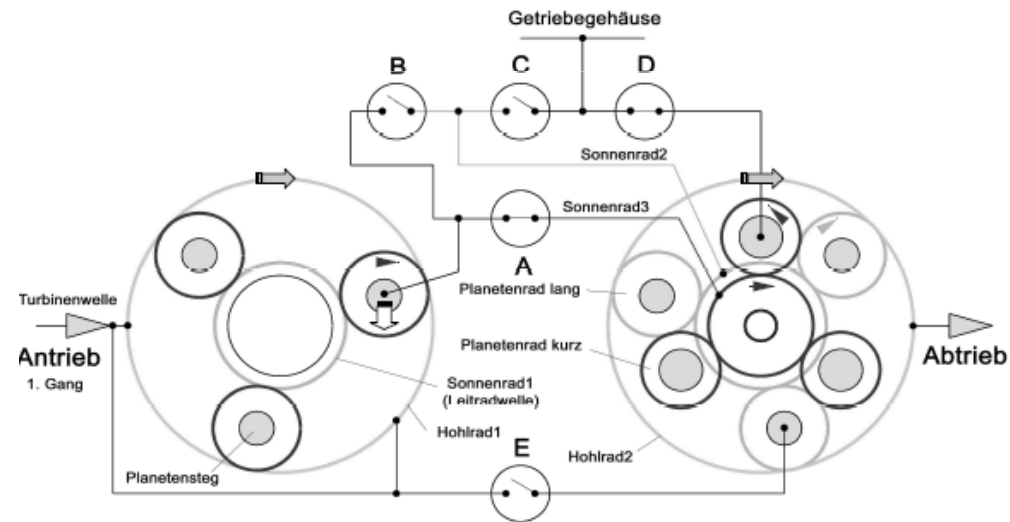
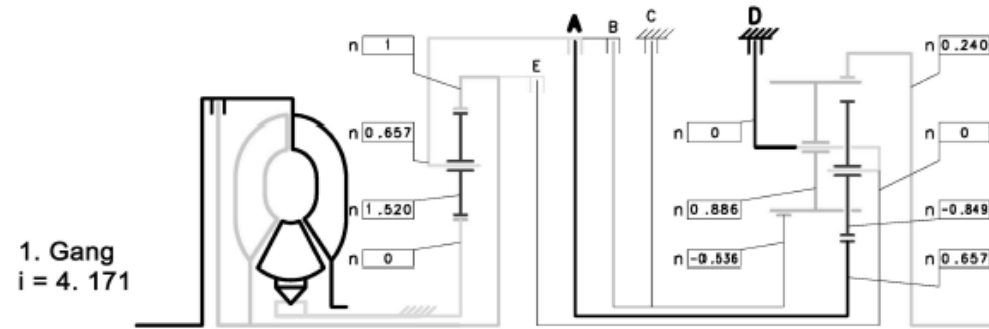
# Ravenaux (Planets)



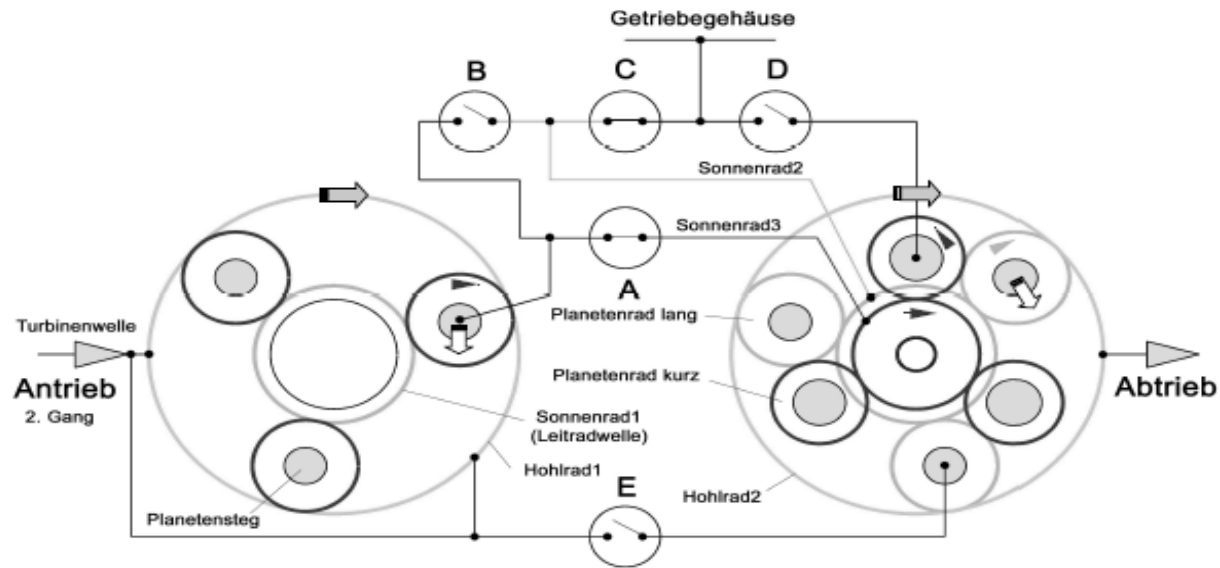
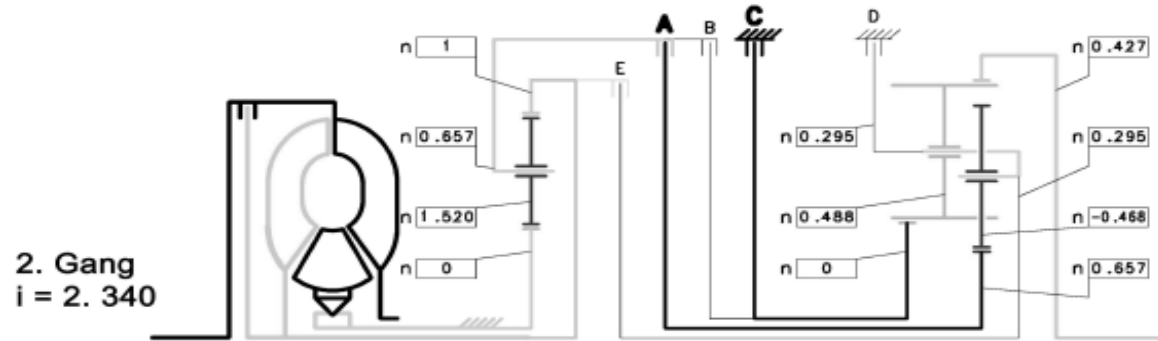
# 4 Planetary



# 1<sup>st</sup> Gear Power Flow



# 2nd Gear Power Flow



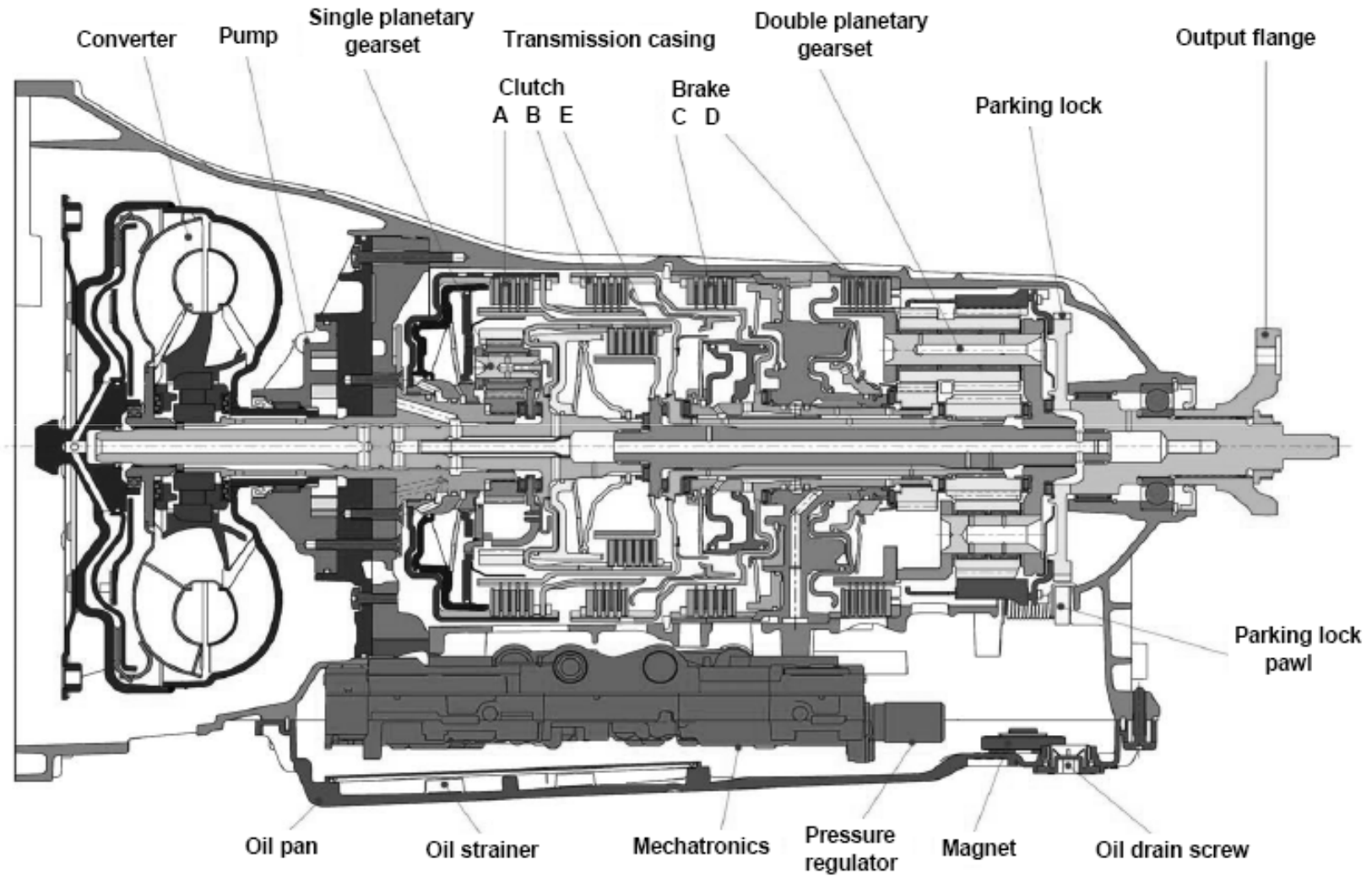
# Designators

- 4X4 For Audi AL 600 6W
- ZF 6HP26 A61
- GNT - V8 3.7L
- GNU - V8 4.2L
- GKY - 4.0L TDI
- Max Torque 650 Nm (320Kw/5800 rpm)

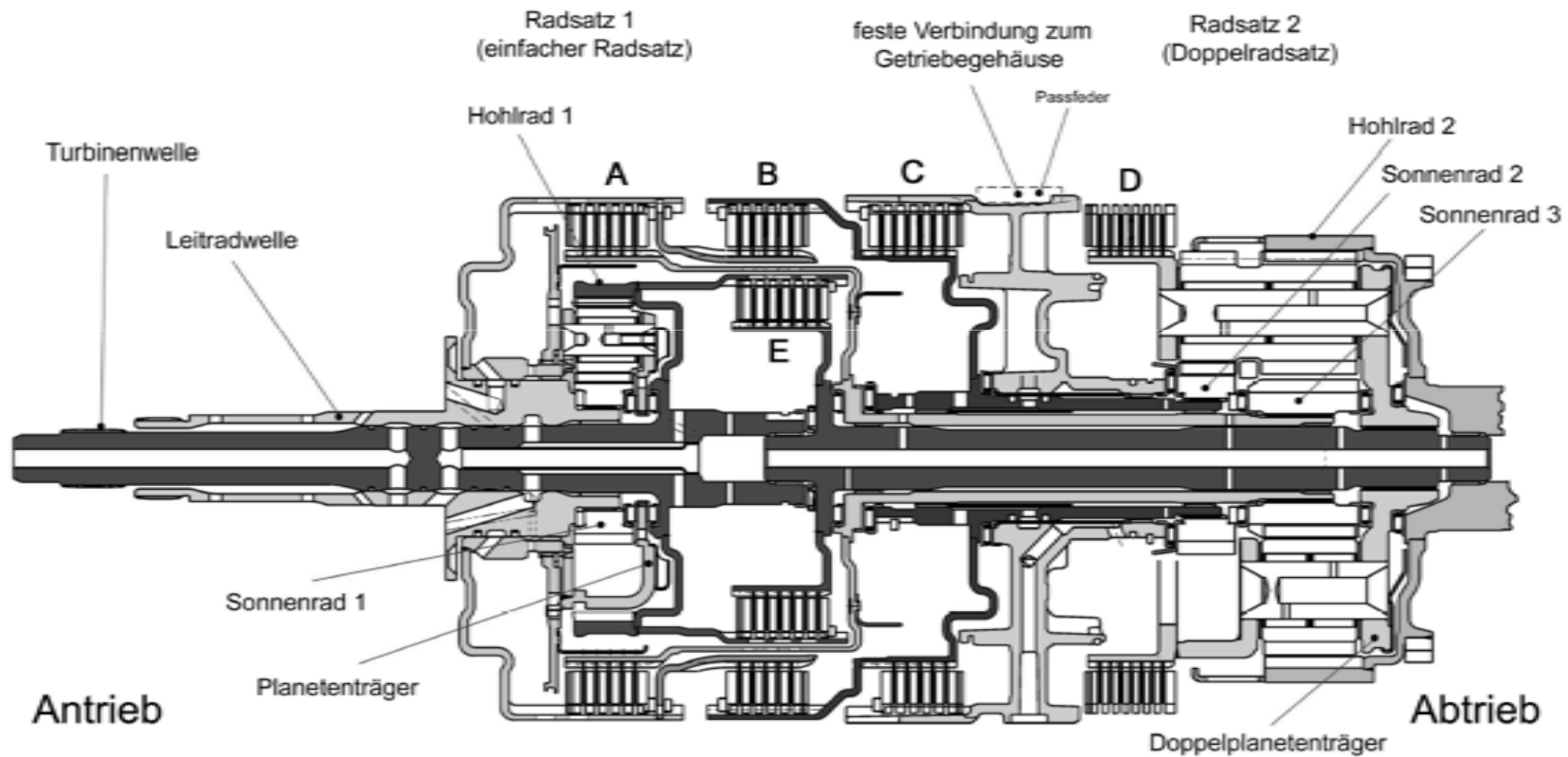
## Torque Converter Specifications

- 2WK Means 2 Lining clutch
- W 280S 2WK 650 Nm
- W 260S 2WK 440 Nm
- W 260S Fitted to V8-V5 4.2/3.7L
- W 280S Fitted to TDI 4.0L and W12 6.0L

# ZF6HP26

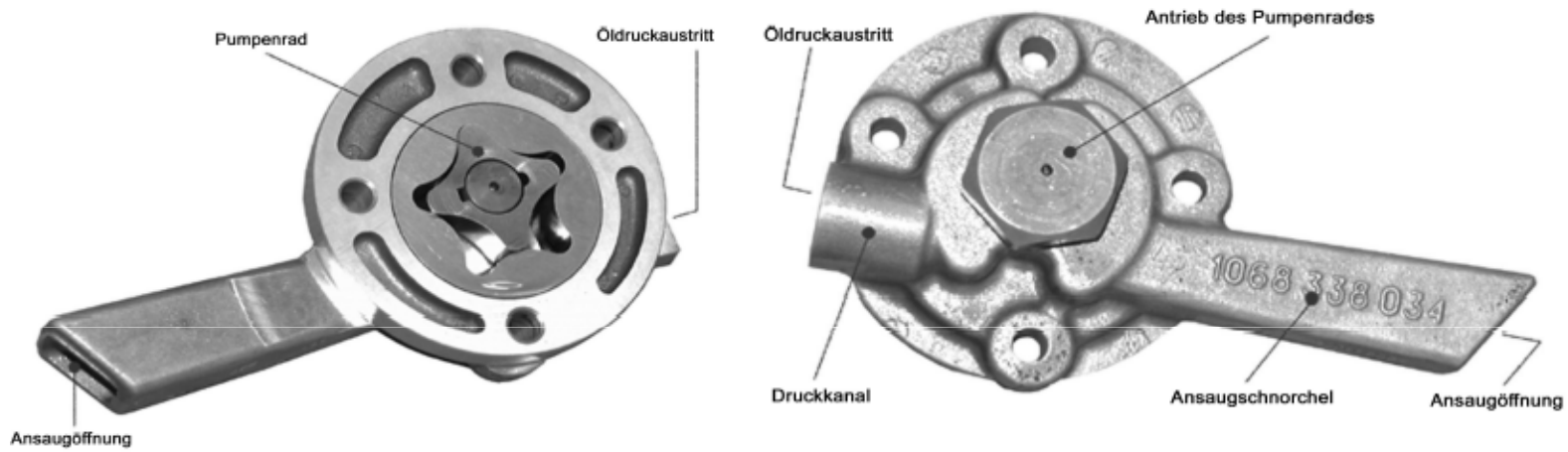


# Component Location

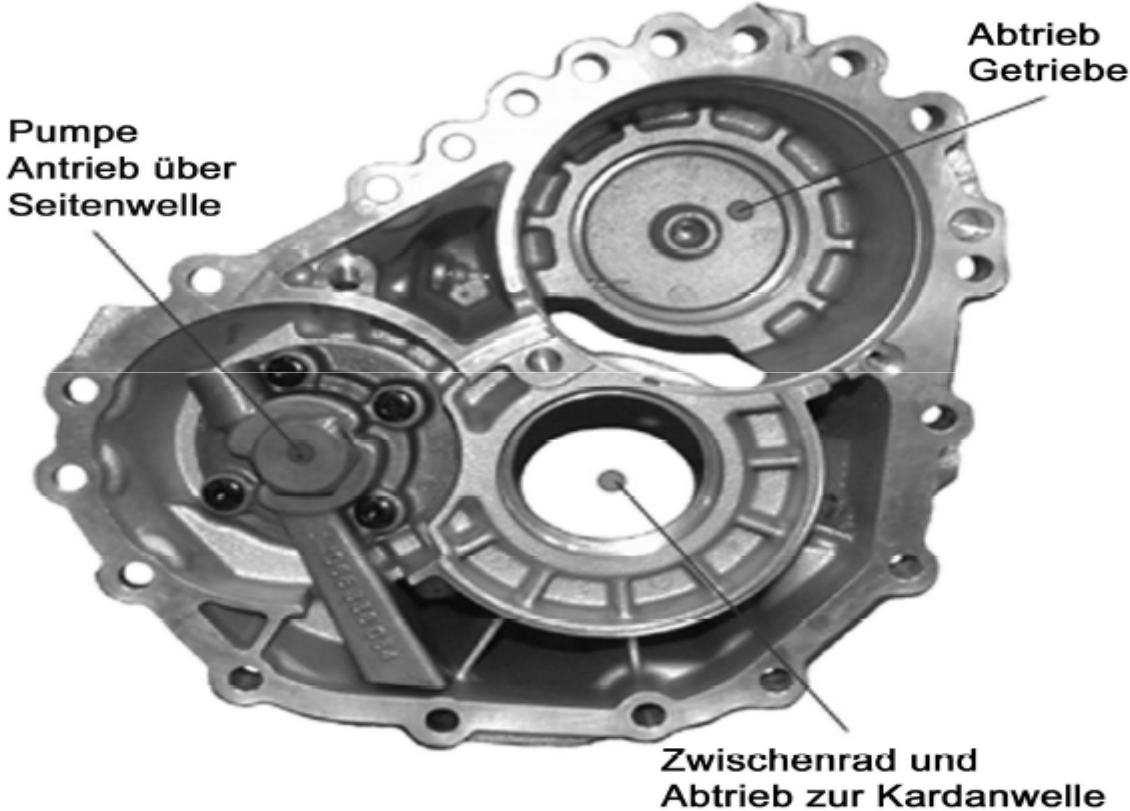




# Cooling oil pump for transfer cases built in the transfer case



# Location of Cooling oil pump for transfer cases built in the transfer case

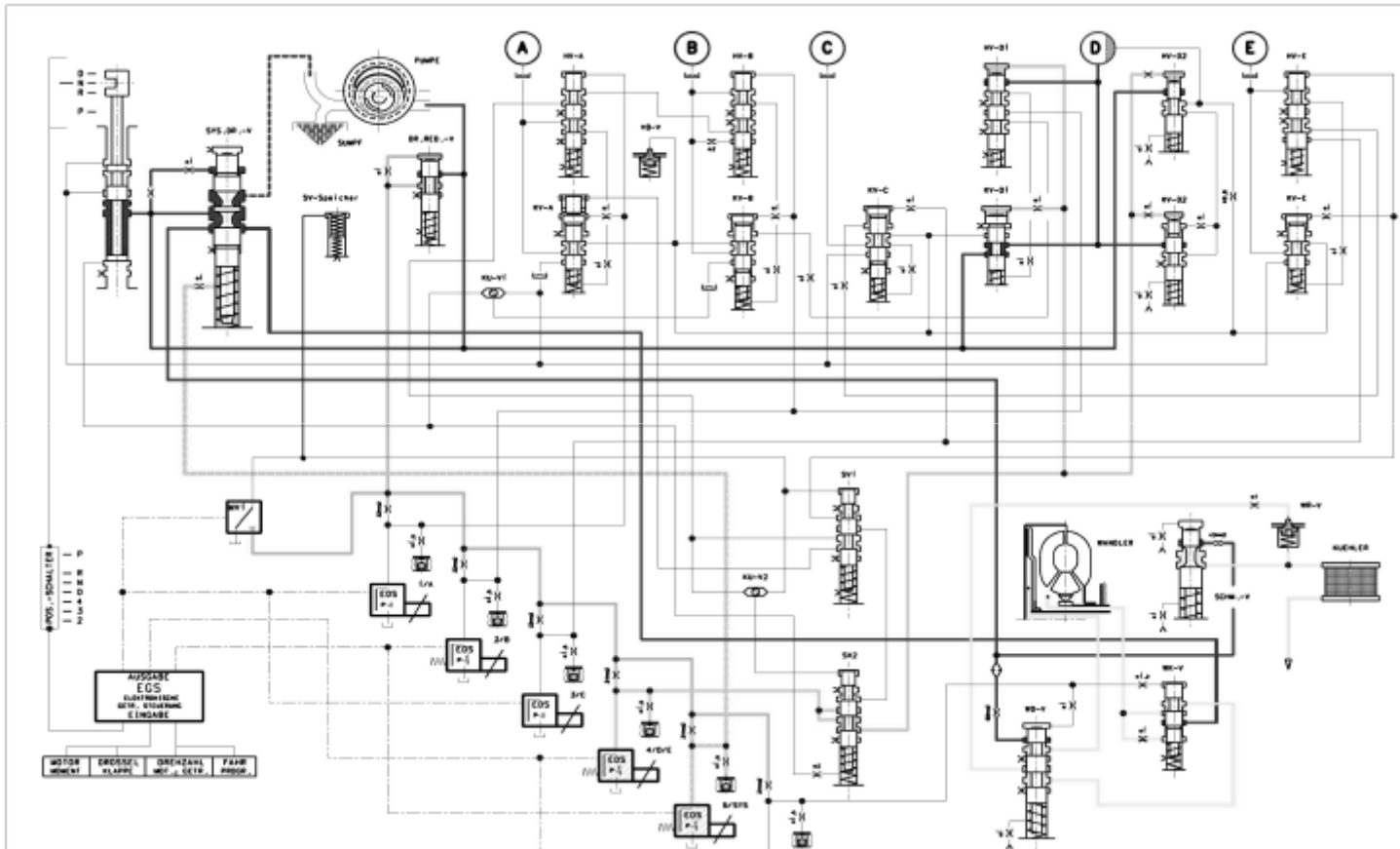


# Technical Data Sheet

ZF 6HP26

Transmission Type	6HP26															
Type of drive	Standard drive															
Input torque	Max 440Nm	Max 600Nm														
Torque Converter	W260S-2GWK	W280S-2GWK														
Standard ratios	<table> <tr> <td><b>GEAR 1</b></td> <td><b>4.17</b></td> </tr> <tr> <td><b>2</b></td> <td><b>2.34</b></td> </tr> <tr> <td><b>3</b></td> <td><b>1.52</b></td> </tr> <tr> <td><b>4</b></td> <td><b>1.14</b></td> </tr> <tr> <td><b>5</b></td> <td><b>0.87</b></td> </tr> <tr> <td><b>6</b></td> <td><b>0.69</b></td> </tr> <tr> <td><b>R</b></td> <td><b>3.40</b></td> </tr> </table>		<b>GEAR 1</b>	<b>4.17</b>	<b>2</b>	<b>2.34</b>	<b>3</b>	<b>1.52</b>	<b>4</b>	<b>1.14</b>	<b>5</b>	<b>0.87</b>	<b>6</b>	<b>0.69</b>	<b>R</b>	<b>3.40</b>
<b>GEAR 1</b>	<b>4.17</b>															
<b>2</b>	<b>2.34</b>															
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<b>4</b>	<b>1.14</b>															
<b>5</b>	<b>0.87</b>															
<b>6</b>	<b>0.69</b>															
<b>R</b>	<b>3.40</b>															
Transmission spreading	6.04															
Weight (inc. oil)	84Kg	89Kg														
Oil capacity	9.6 Litres	10.3 Litres														
Transmission Oil	Lifetime oil fill															
Operation	"Shift by wire"															

# Hydraulic Diagram



## Comparisons to the ZF5HP..

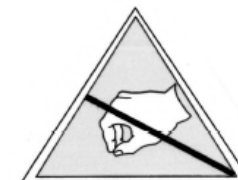
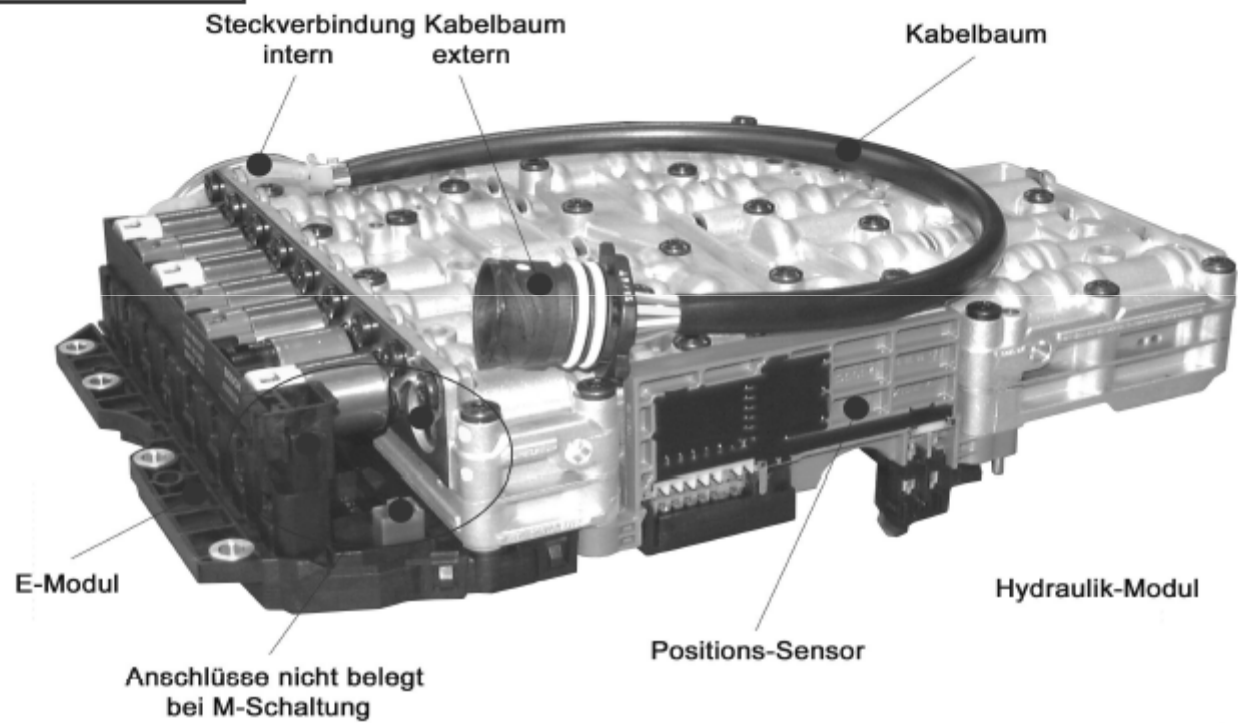
- The 6HP26 is around 13% lighter in weight
- The acceleration is 5% faster and uses 7% less fuel
- The 5 Speed unit has in the region of 660 parts whilst the 6 Speed has only 470
- The 6 Speed transmission is 5 centimetres shorter
- The torque limits are as follows :

6HP19	max. torque	400Nm
6HP26	max. torque	600Nm
6HP32	max. torque	750Nm

**Attention**  
ESD sensitive device.  
Do not touch the pins  
of the electrical connector.



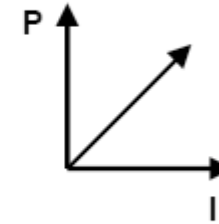
### Mechatronik 6HP26 A61 (M-Schaltung)



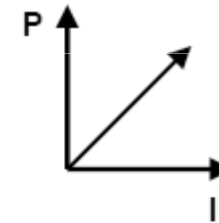
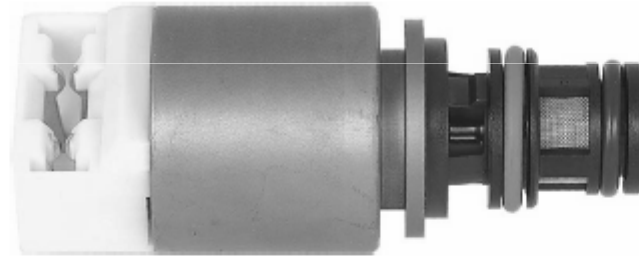


## Mechatronic Solenoids

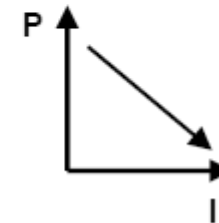
Pressure range 0 to 4.7 bar  
Operating voltage 12V  
Resistance 5.05 Ohms at 20°C  
Characteristic rising



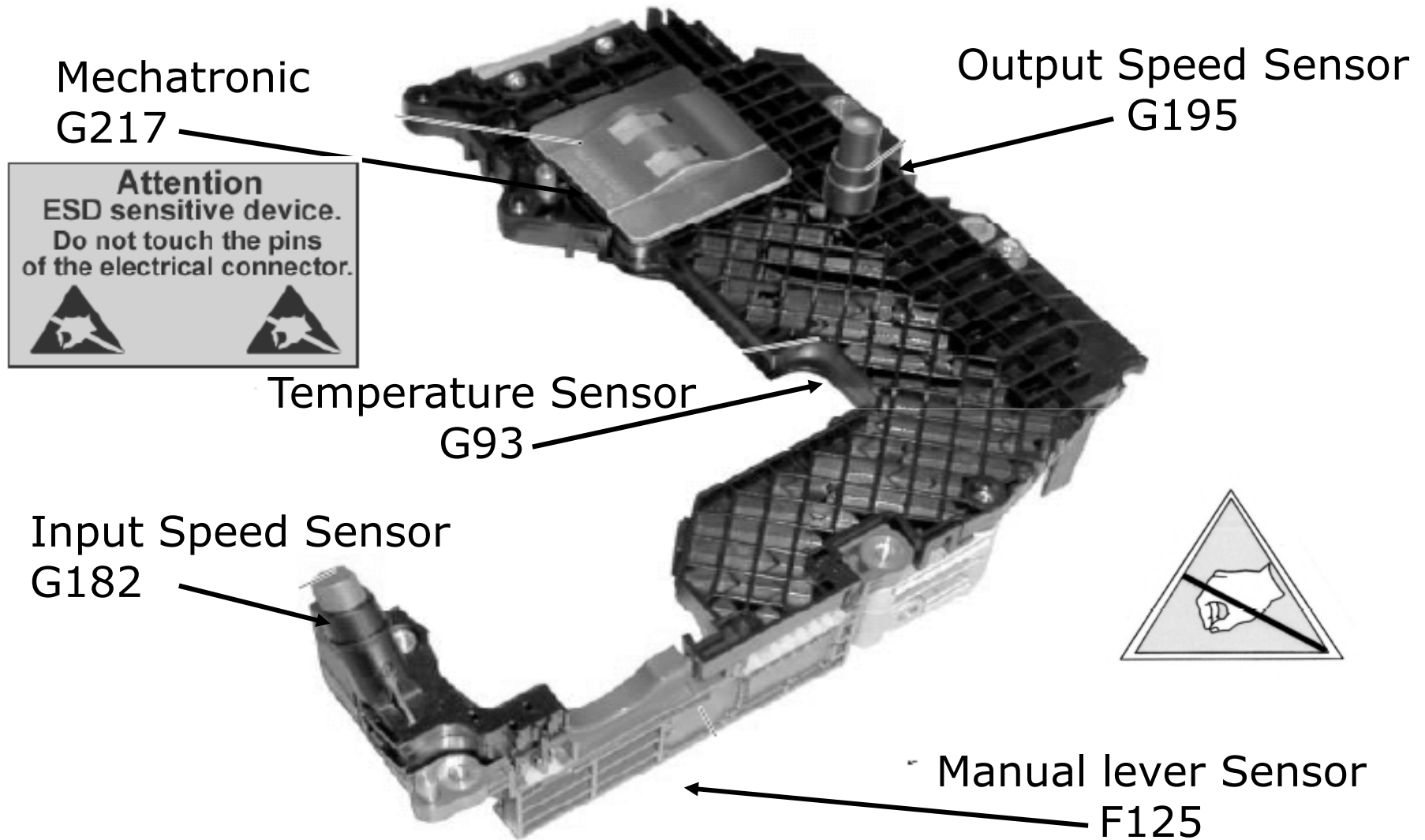
Pressure range 0 to 4.6 bar  
Operating voltage 12V  
Resistance 5.05 Ohms at 20°C  
Characteristic rising



Pressure range 4.6 to 0 bar  
Operating voltage 12V  
Resistance 5.05 Ohms at 20°C  
Characteristic falling

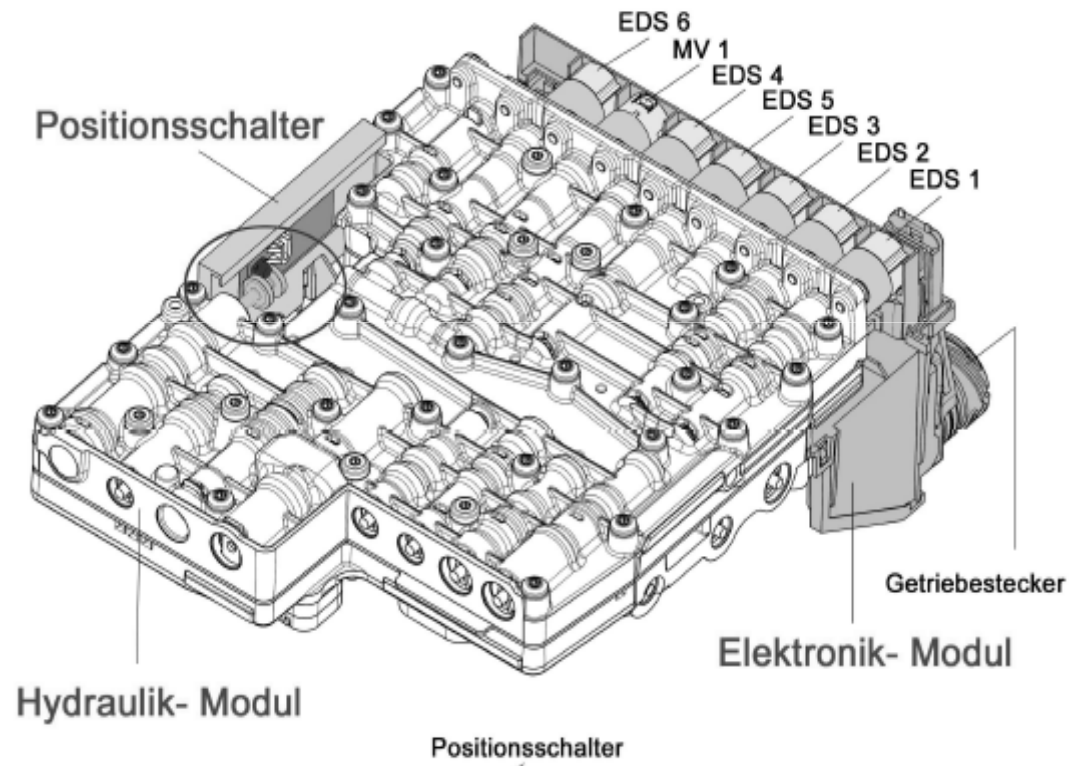


# Electronic Control Module

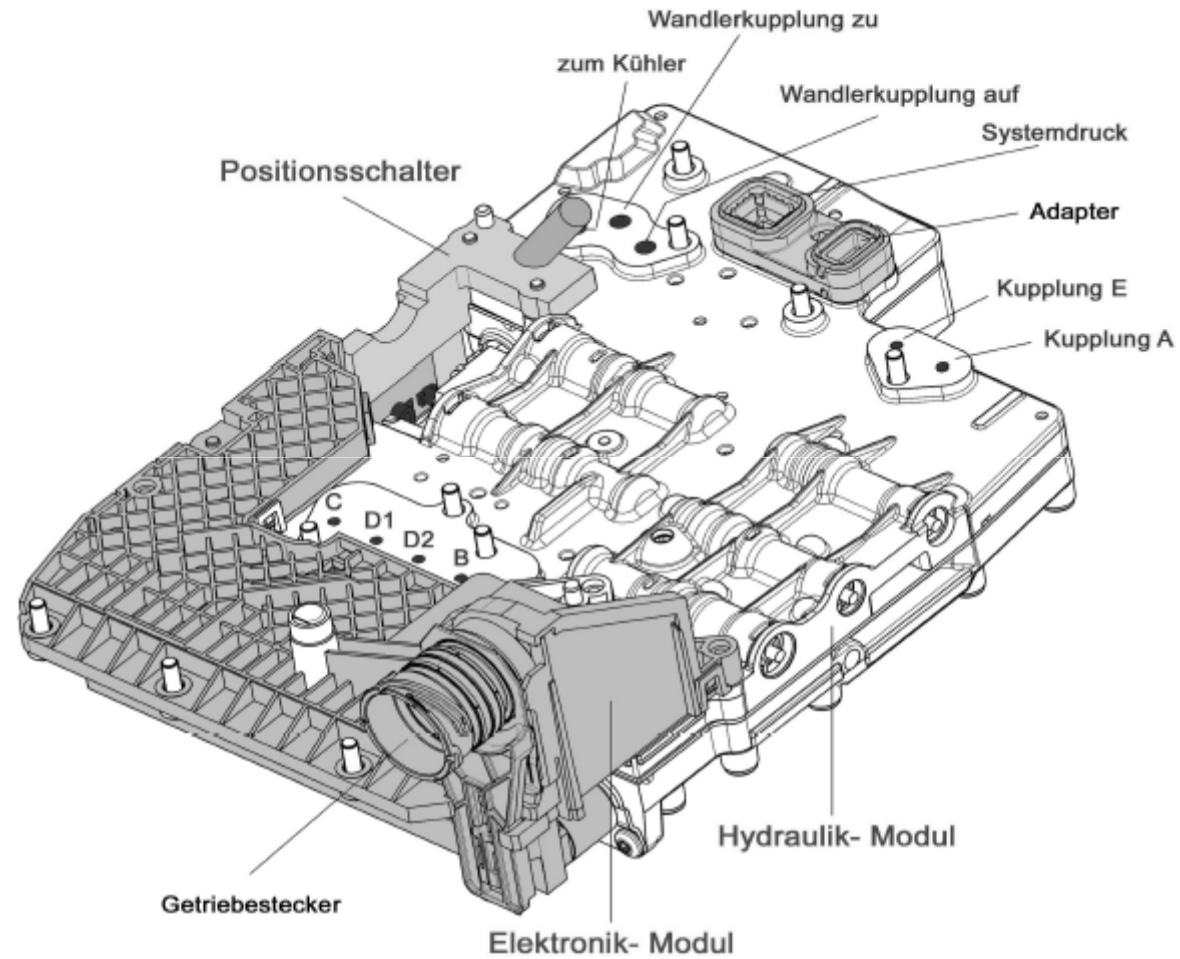




# Selector – V- CAN

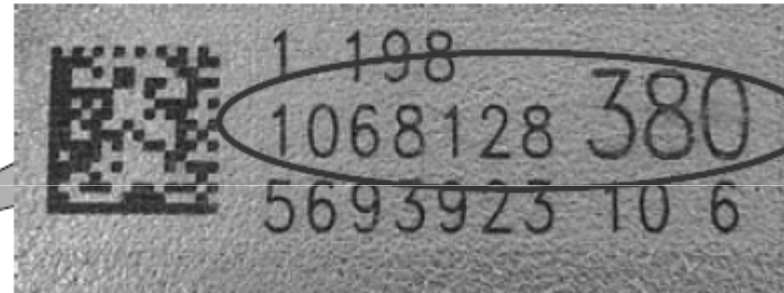


# VB to Clutch Ports







# Mechatronic Identification



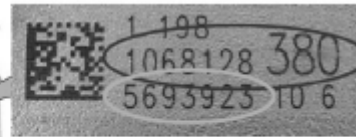
**Attention**  
ESD sensitive device.  
Do not touch the pins  
of the electrical connector.



 = Main parts list



## Mechatronic identification

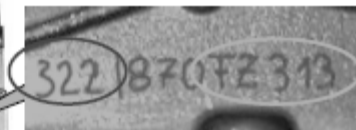


- = Main parts list
- = Cumulative quantity

### New mechatronic:

- Hardware-parts list
- Cumulative quantity

**Attention**  
ESD sensitive device.  
Do not touch the pins  
of the electrical connector.



- = Main parts list
- = Cumulative quantity

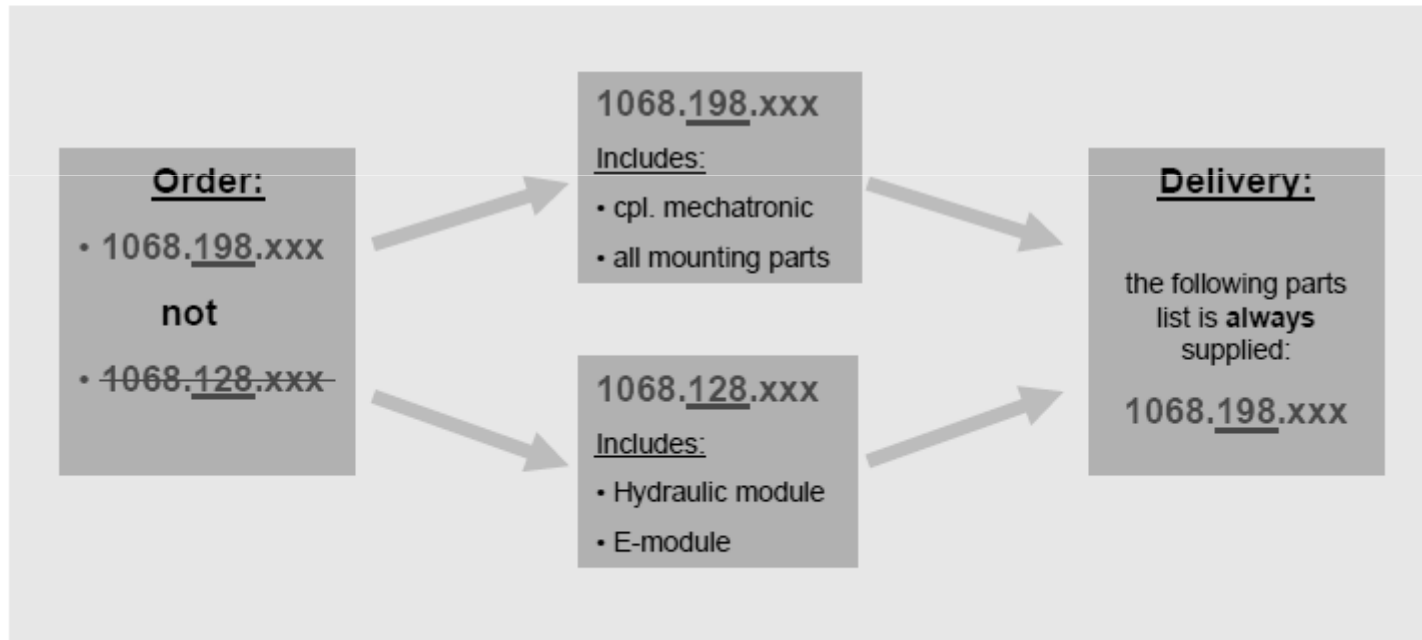
### Exchange-mechatronic:

- End number of the hardware-parts list
- Cumulative quantity
- Blue dot ● = exchange module
- White dot ○ = programmed without transmission



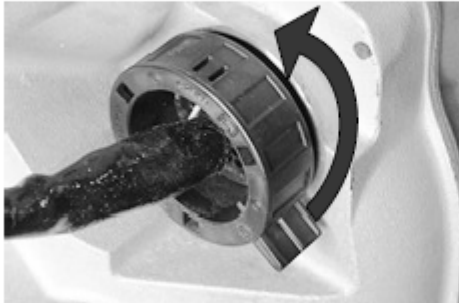
## To order a mechatronic

What can be ordered and what is delivered?

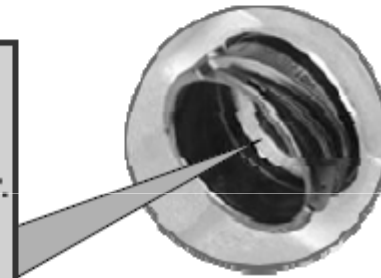




## Mechatronic Replacement



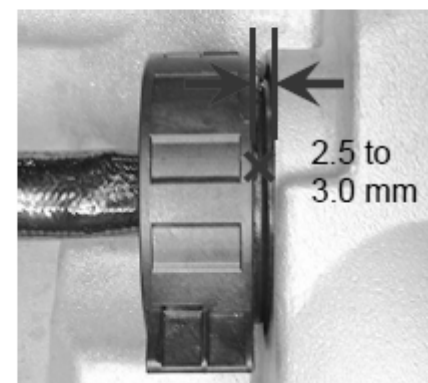
1. Secure vehicle against rolling, secure wheels with wheel chocks.  
**Important:** On some vehicles (E-shift) it is necessary to shift vehicle out of Park to replace the mechatronic.
2. Drain transmission fluid and remove the transmission oil pan.
3. Unlock and disconnect the vehicle connector from the transmission.



4. Pull the sealing sleeve locking mechanism to the unlocked position. The locking tab is located on the bottom of the mechatronic below the sealing sleeve.
5. Remove the sealing sleeve.



## Mechatronic Replacement



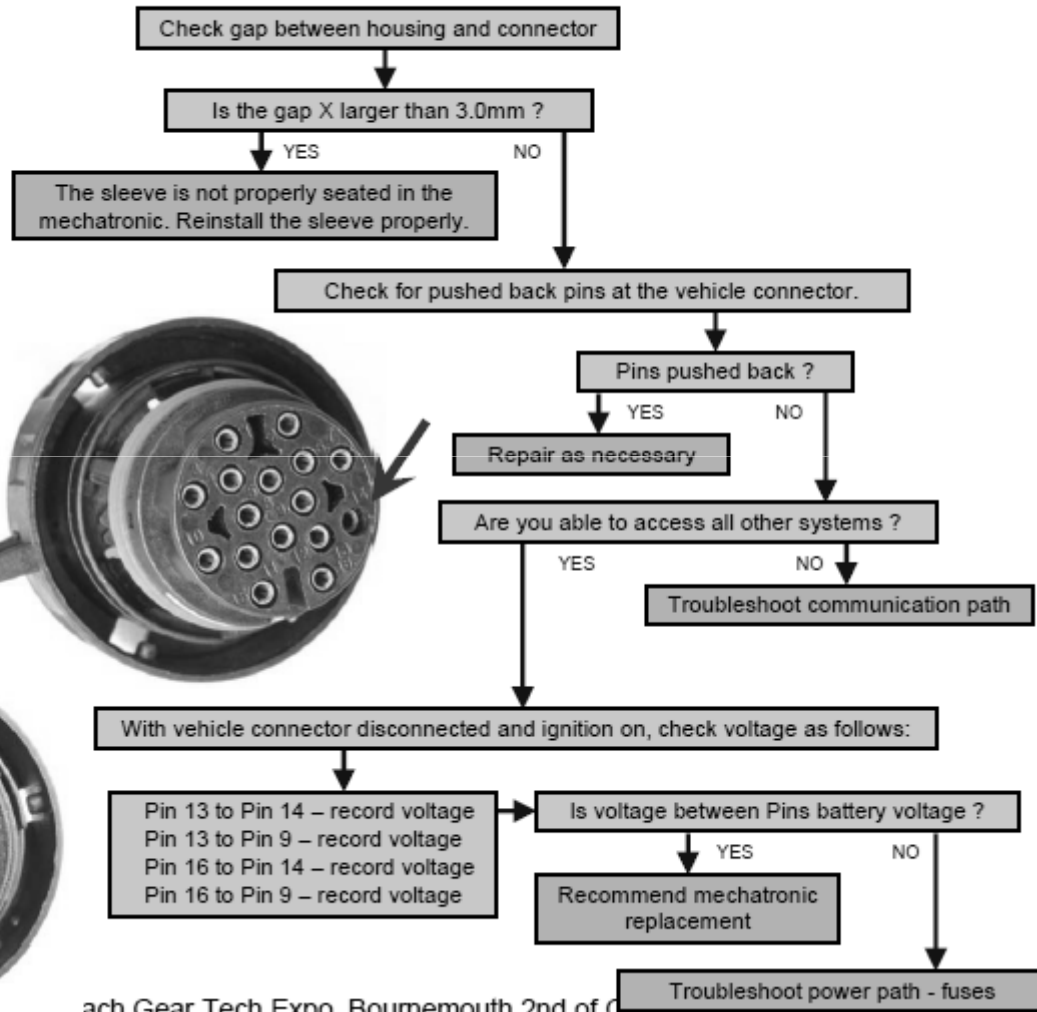
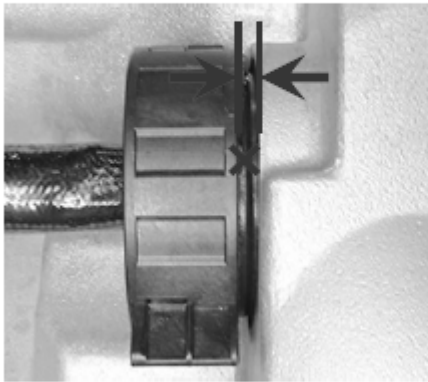
11. Unlock the sealing sleeve locking mechanism and install the sealing sleeve with the locating tab properly aligned with the mechatronic. Use transmission fluid to lubricate the seals for installation. After the sleeve is properly seated, push the locking mechanism to the locked position. Install the vehicle connector plug and check that the sleeve is properly seated. The gap  $x$  should be between 2.5 to 3.0 mm.

Check  
Measurement





# Communication issues/failsafe after Mechatronic work

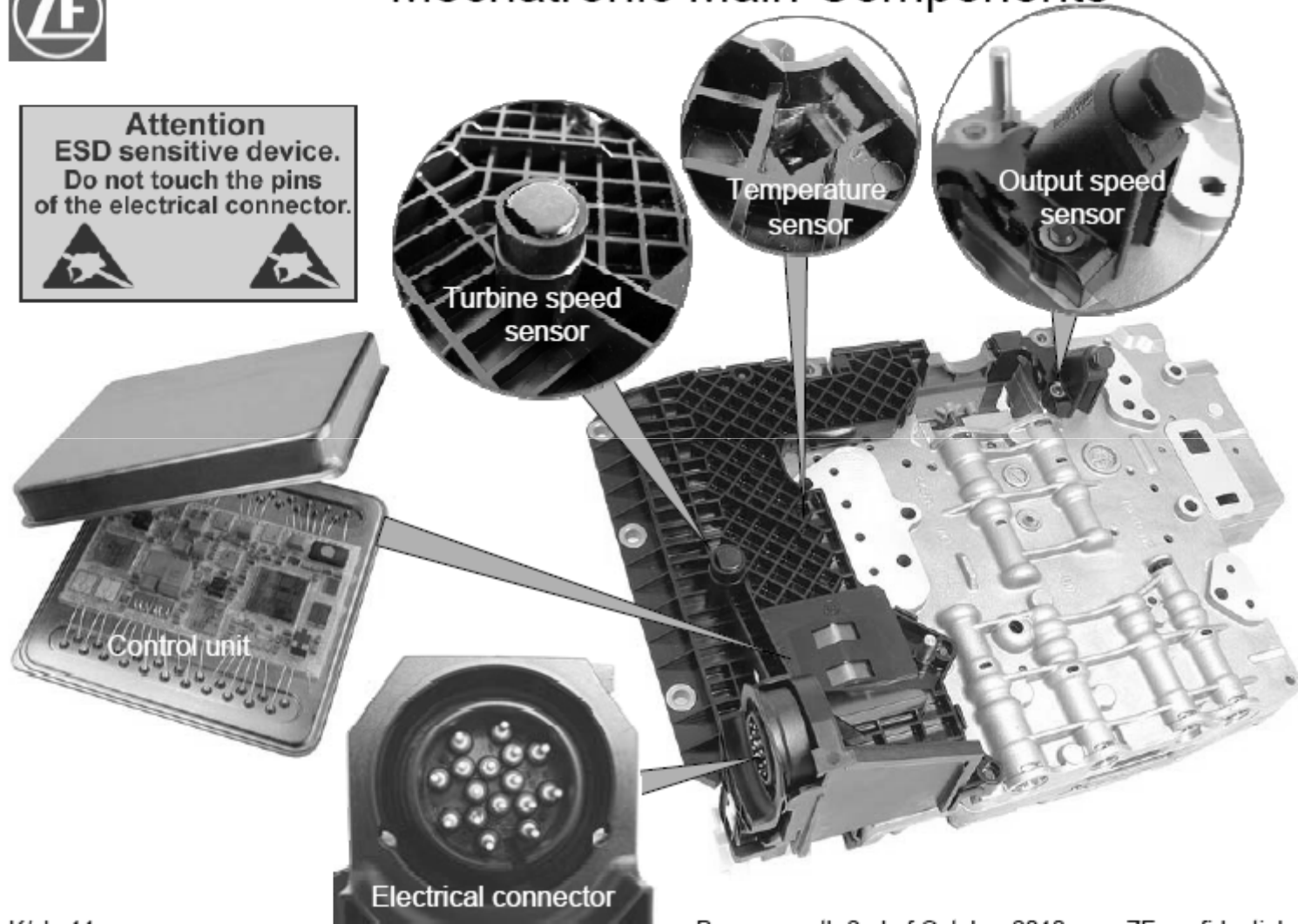






# Mechatronic Main Components

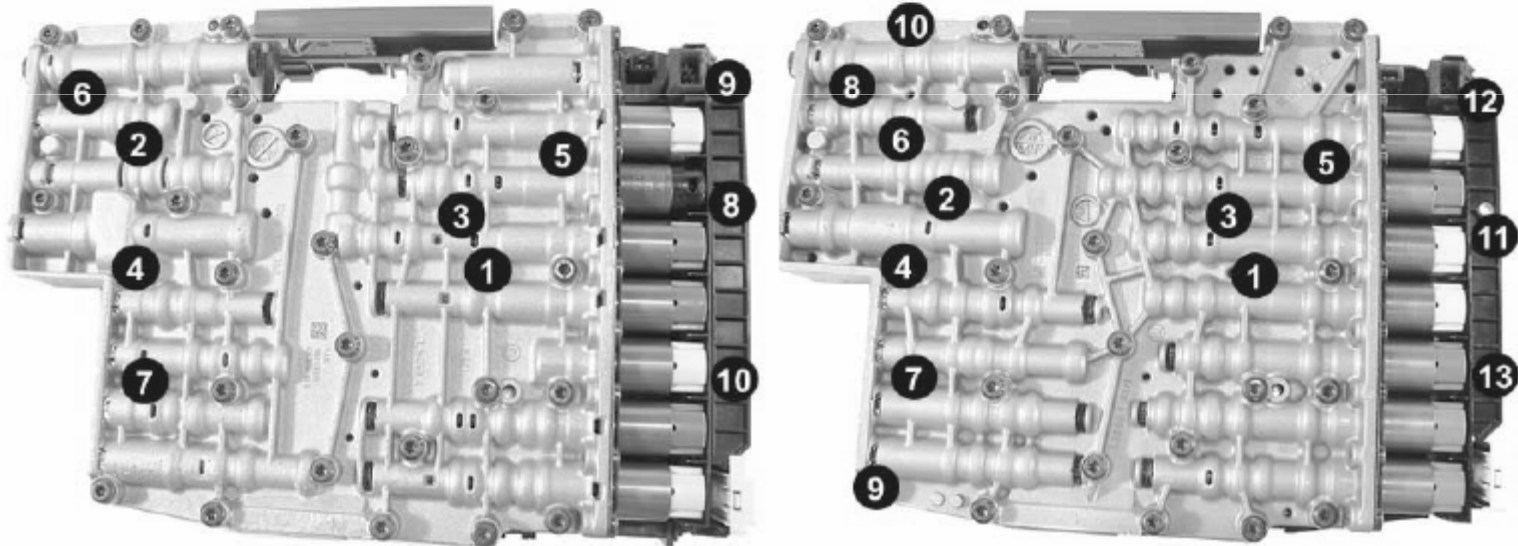
**Attention**  
ESD sensitive device.  
Do not touch the pins  
of the electrical connector.



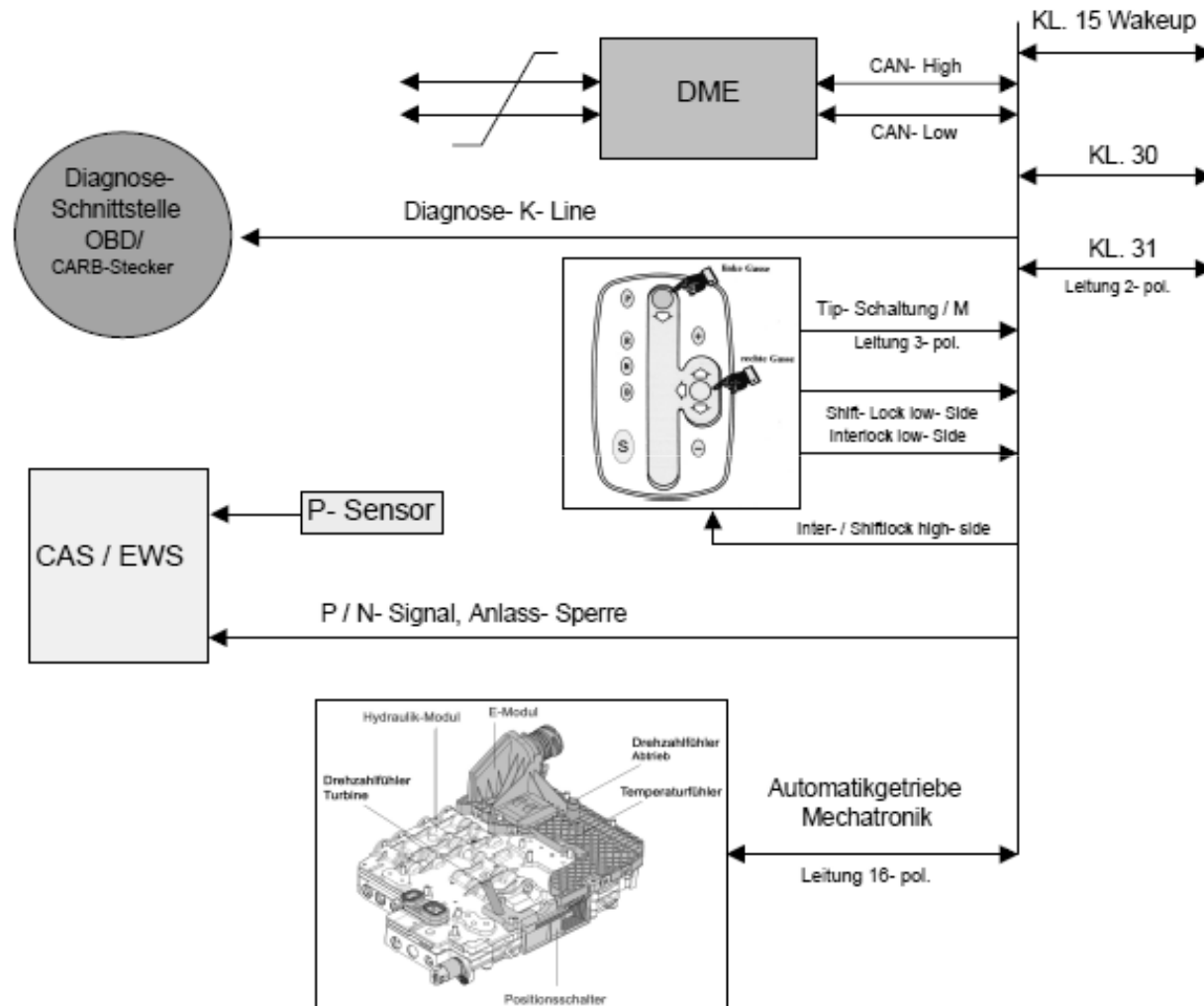


## Mechatronic Replacement

7. To remove the mechatronic, remove the screws indicated in blue.
- Note:** There are mechatronic versions with 10 or 13 mounting screws.  
Handle mechatronic with care to prevent external damage.



# Communication over CAN



# Electronic Control Module

**The Mechatronic is constructed from Substrate Base on Ceramic.**

**Temperatures above 120 deg C will have a detrimental effect on performance.**

**At 150 deg C component damage will occur.**

**\*\*\*\*\***

## **3 Stage function of temperature control.**

**Stage 1:** At 126 deg C, Shift points are higher and Lock-up range is extended.

**Stage 2:** At 141 deg C, Engine torque is reduced by up to 40%

**Stage 3:** At 147 deg C, Solenoid power is de-activated

# Mechatronic Modules

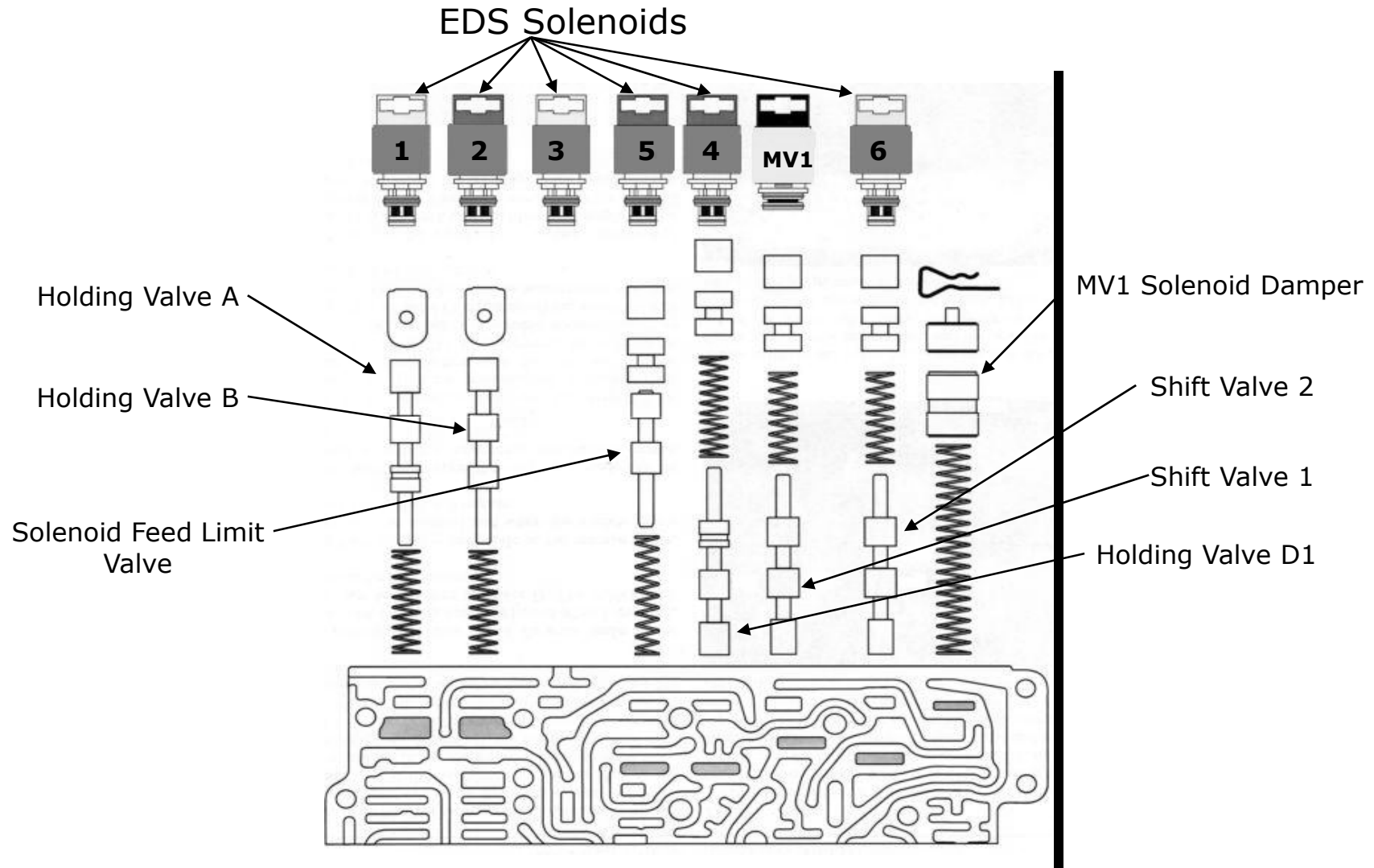
ZF uses what is known as a Mechatronic module to control this transmission. There are two versions of this known as "M" and "E"

The difference between the two is that "M" uses a conventional gearshift comprising of a Manual valve. The version "E" uses a shift by wire strategy with no manual valve.

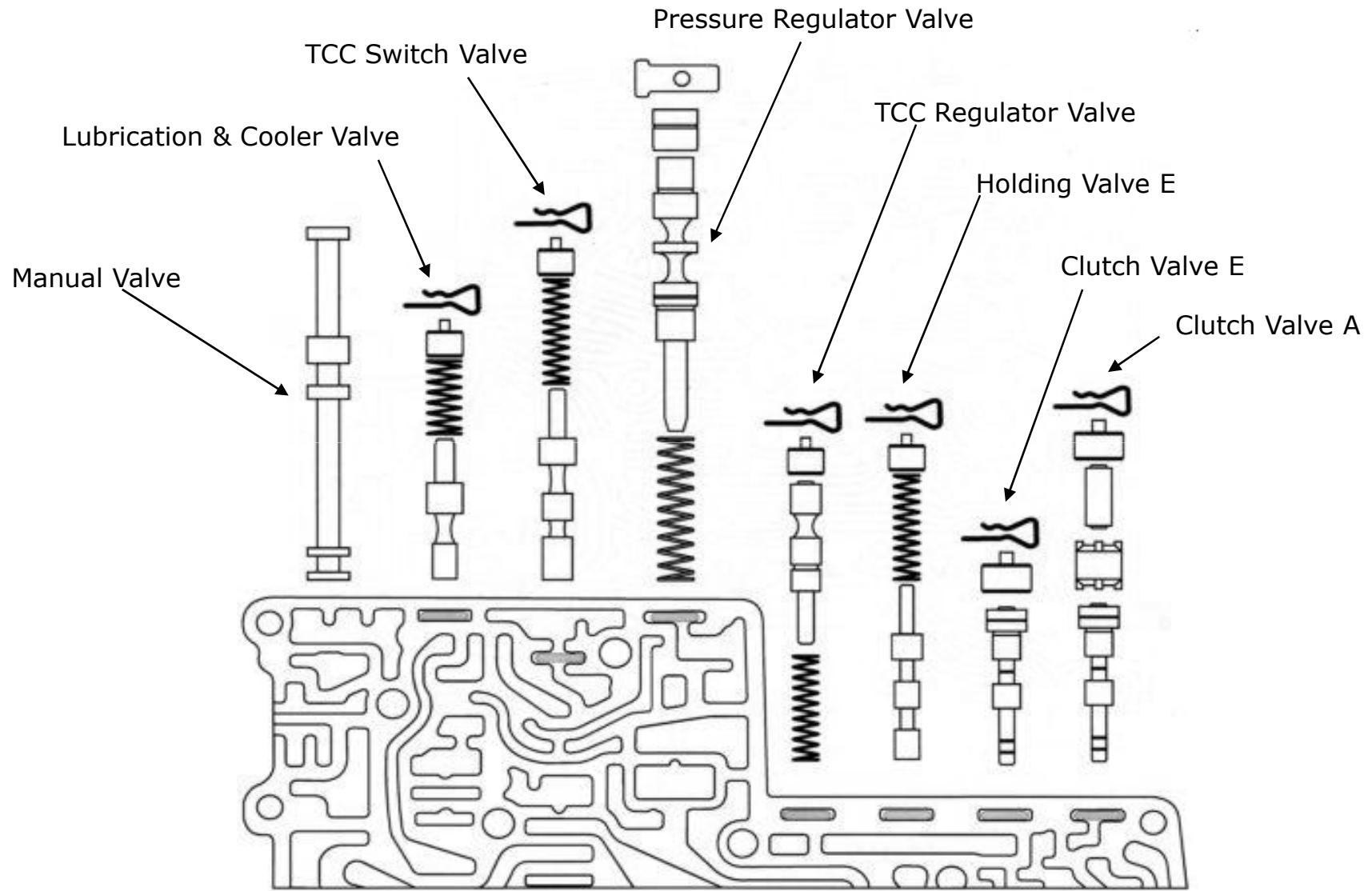
The Mechatronic controls the shift in and out of Park using the MV2 and MV3 Solenoids.

Park is engaged when the ignition key is removed.

# Jaguar "M" Lower Valve Body

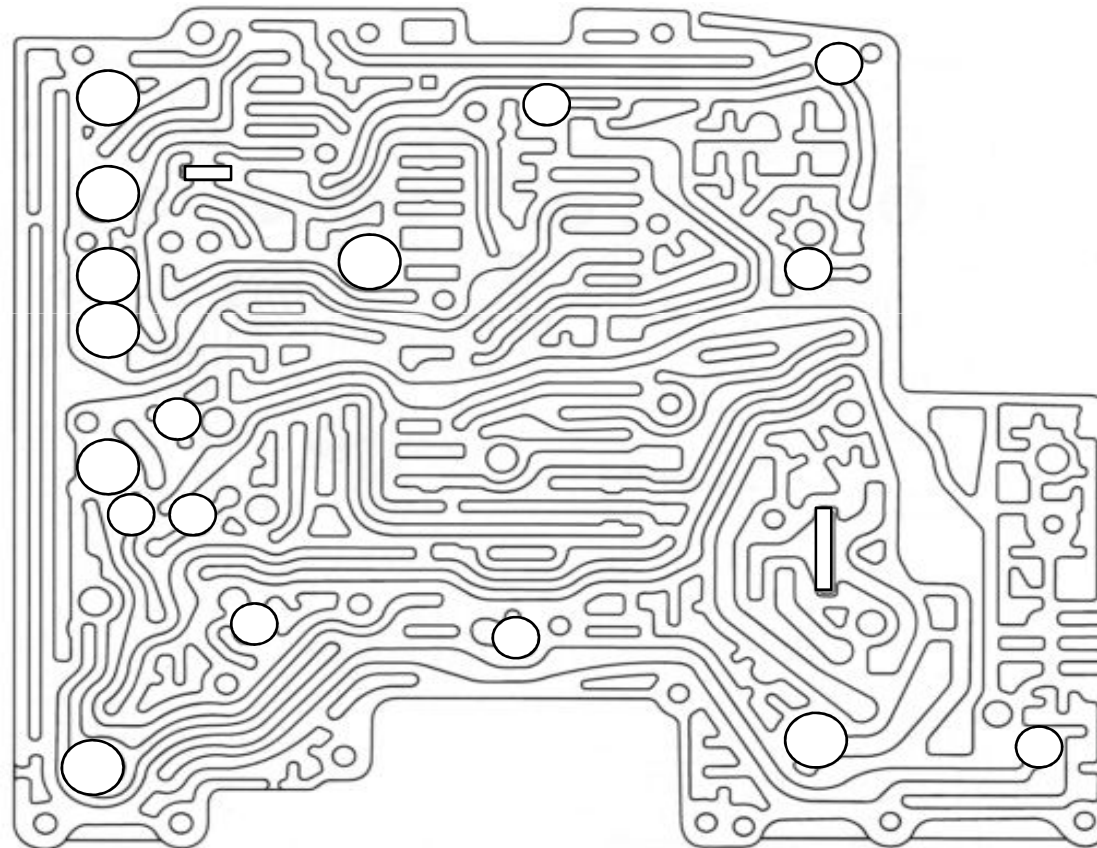


# Jaguar "M" Lower Valve Body



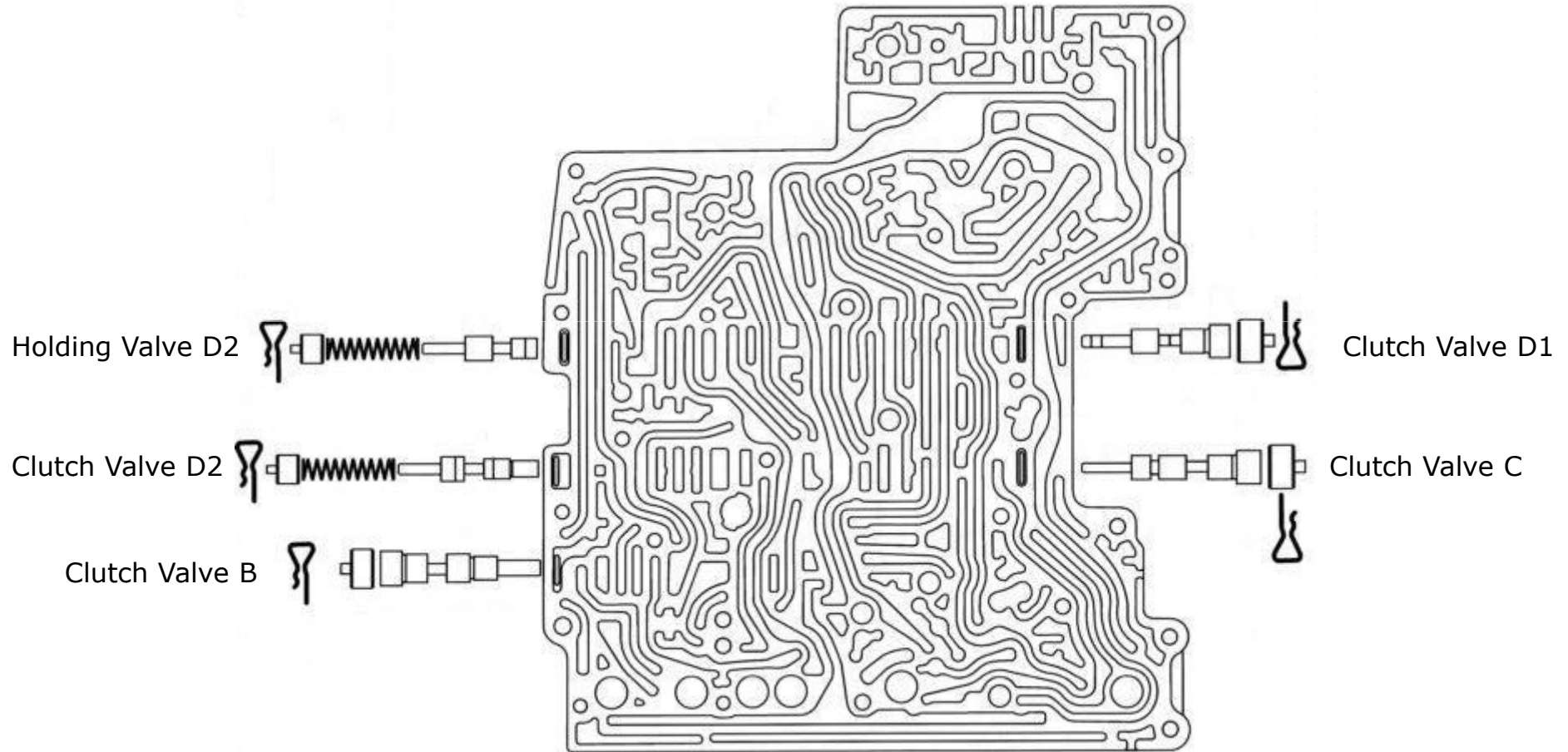
# Jaguar "M" Valve Body Parts Locations

○ EDS Dampers    ○ Limit Valves    ○ 6mm Balls    | Large Screen    ▭ Small Screen





# Jaguar "M" Upper Valve Body



# Solenoid Identification

The **MV** Solenoids have Black plastic covers. When energised the inlet is open to the outlet port and the exhaust is closed. When de-energised the inlet is closed and the outlet is open to exhaust.

**EDS 1, 3 & 6** have Green or Yellow plastic covers. At 0mA output pressure is 0 bar. At 700mA output pressure rises to 4.6 bar

**EDS 2, 4, & 5** have Black or Blue plastic covers. At 0mA output pressure is 4.6 bar. At 700mA output pressure falls to 0 bar.

**EDS Solenoids measure 5 Ohms approx at 20 C**

# Clutch and Solenoid Logic (Electronic)

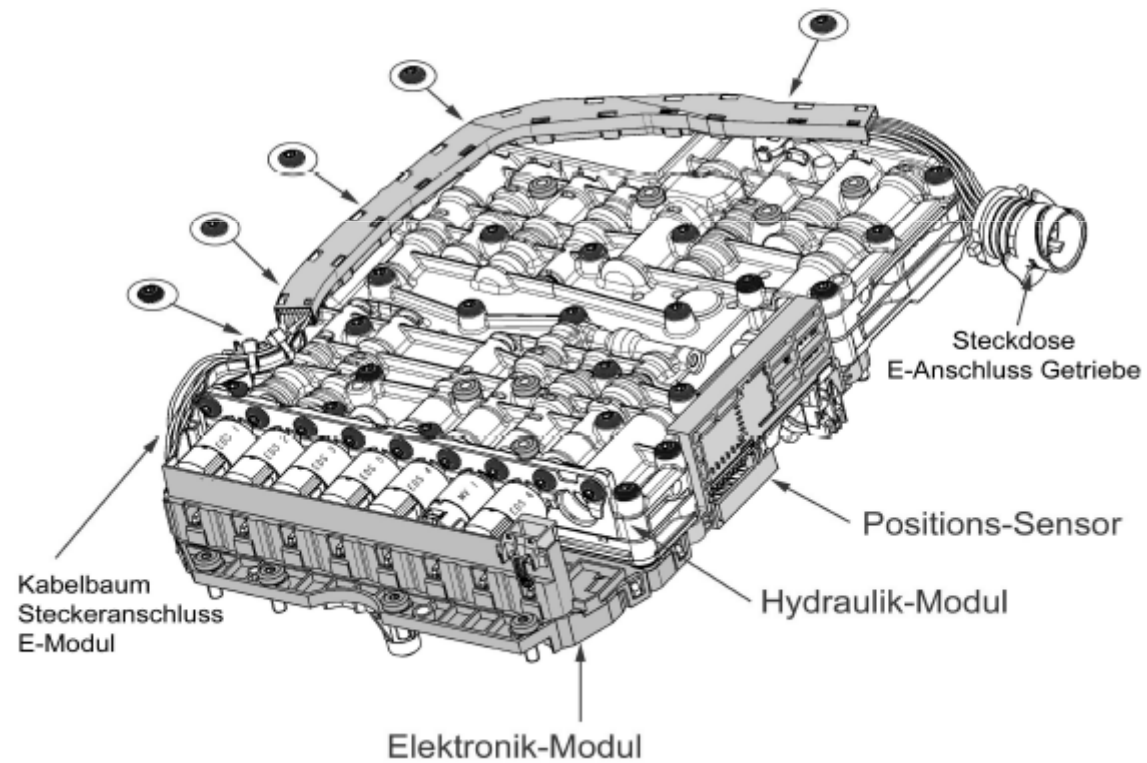
POS / Gear	Solenoid valve logic									Clutch logic					
	Solenoid valve			Pressure - electronic pressure valve						Clutch				Brake	
	1	2	3	1	2	3	4	5	6	A	B	E	WK	C	D
P = Parking							X	-X-							●
R = R-Gear	X	X	X		X		X	-X-			●				●
N = Neutral	X	X	X				X	-X-							●
D, 1. Gear	X	X	X	X			X	-X-	-X-	●			●		●
D, 2. Gear	X	X	X	X		X		-X-	-X-	●			●	●	
D, 3. Gear			X	X	X			-X-	-X-	●	●		●		
D, 4. Gear	X		X	X			X	-X-	-X-	●		●	●		
D, 5. Gear	X		X		X		X	-X-	-X-		●	●	●		
D, 6. Gear	X		X			X	X	-X-	-X-			●	●	●	
	Shift valve 1	Parking lock valve	Parking lock cylinder	Clutch A	Clutch B	Brake C	Brake D / Clutch E	Main pressure	Clutch control about the gear logic	Planet carrier single planet gear set	Sun gear 1 double planet gear set	Planet spider double planet gear set	Clutch control about the torque converter lock up clutch	Sun gear 1 double planet gear set	Planet spider double planet gear set

# Clutch and Solenoid Logic (Manual)

POS / Gear	Solenoid valve logic									Clutch logic					
	SV			Pressure - electronic pressure control valve						Clutch				Brake	
	1			1	2	3	4	5	6	A	B	E	WK	C	D
P = Parking							X	-X-							●
R = R- Gear					X		X	-X-			●				●
N = Neutral							X	-X-							●
D, 1. Gear				X			X	-X-	-X-	●			●		●
D, 2. Gear				X		X		-X-	-X-	●			●	●	
D, 3. Gear				X	X			-X-	-X-	●	●		●		
D, 4. Gear	X			X			X	-X-	-X-	●		●	●		
D, 5. Gear	X				X		X	-X-	-X-		●	●	●		
D, 6. Gear	X					X	X	-X-	-X-			●	●	●	
	Shift valve 1			Clutch A	Clutch B	Brake C	Brake D / Clutch E	Main pressure	Clutch control about the gear logic	Planet carrier single planet gear set	Sun gear 1 double planet gear set	Planet spider double planet gear set	Clutch control about the torque converter lock-up clutch	Sun gear 1 double planet gear set	Planet spider double planet gear set

# Fixing Bolt Locations

- Schrauben M5 (Elektronik-Modul an Hydraulik-Modul) 6x
- Schrauben M5 (Hydraulik-Modul)
- Schrauben M6 (Mechatronik kpl. an Getriebegehäuse) 11x
- Schrauben M5 (zur Kabelbaumbefestigung)



# Tightening Sequence and Torque

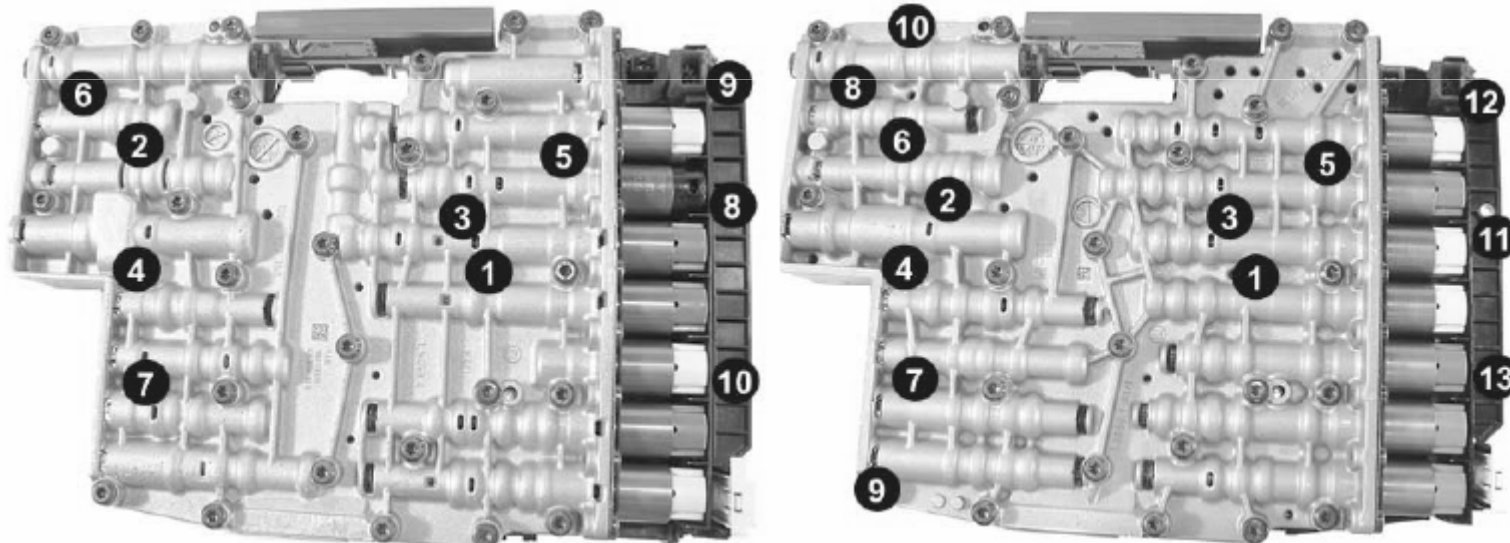


## Mechatronic Replacement

10. Use hand tools – Do not use power tools for screw installation.

First install and turn screw 1 and 4 alternately until seated then install all other screws until they make contact with the mechatronic. After all screws are installed, tighten screws in order 1 to 10 or 13 as shown in the schematic below.

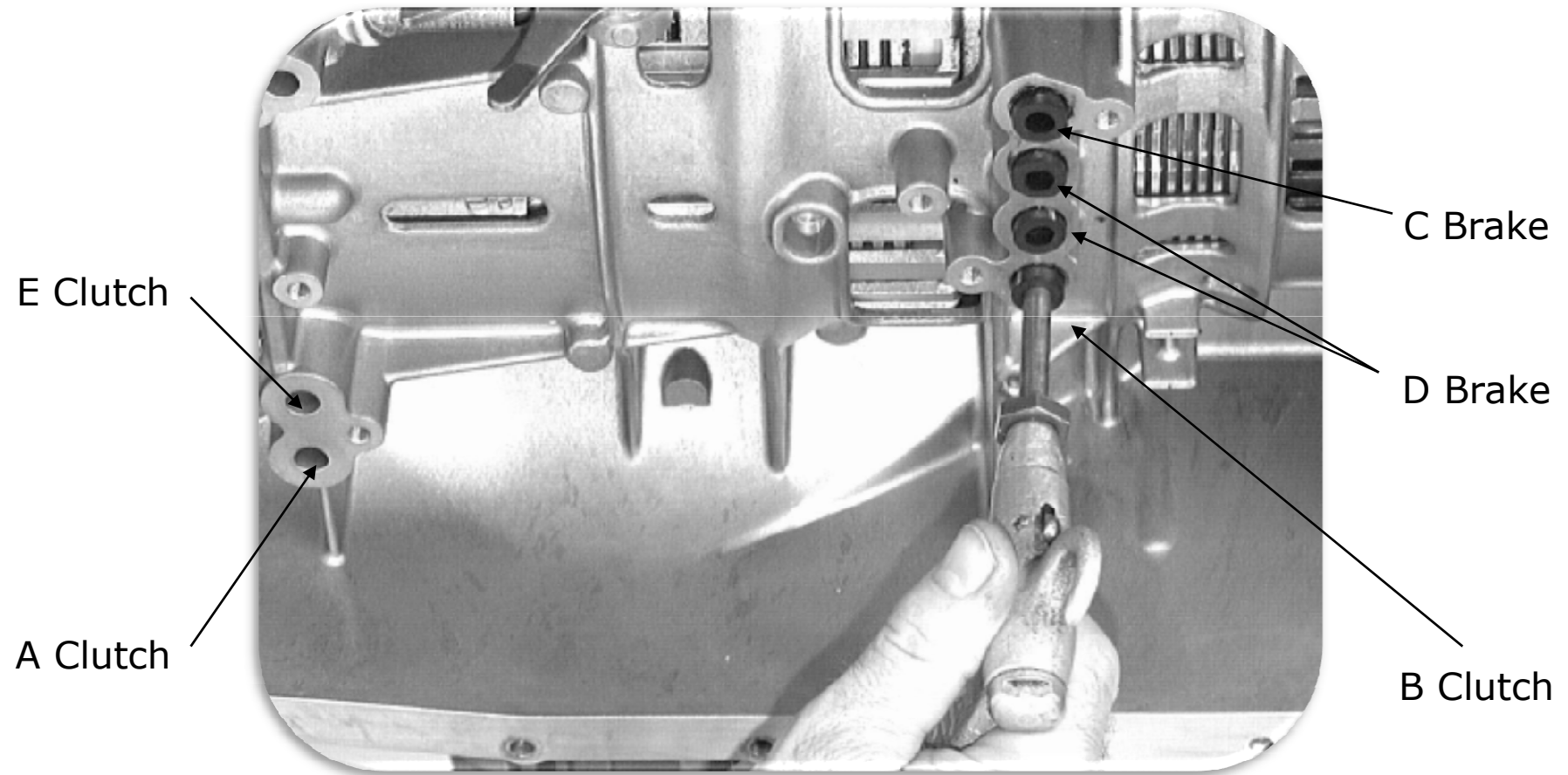
Torque for screws is  $8 \text{ Nm} \pm 0.8 \text{ Nm}$ .



# Clutch & Brake Application

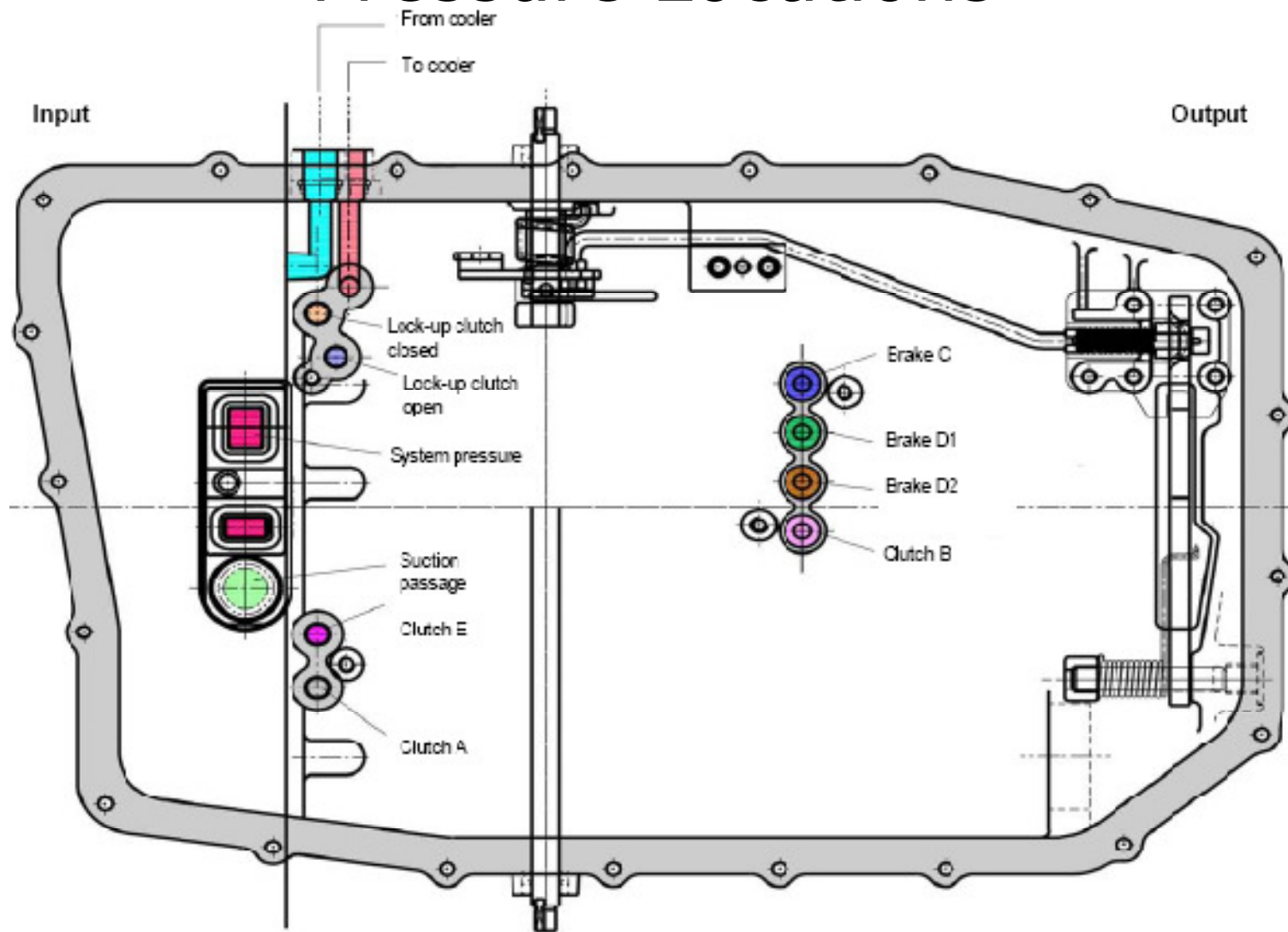
Range	A Clutch	B Clutch	E Clutch	C Brake	D Brake
Park					X
Reverse		X			X
Neutral					X
D - 1 <sup>st</sup>	X				X
D - 2 <sup>nd</sup>	X			X	
D - 3 <sup>rd</sup>	X	X			
D - 4 <sup>th</sup>	X		X		
D - 5 <sup>th</sup>		X	X		
D - 6 <sup>th</sup>			X	X	

# Clutch & Brake Air Test Locations



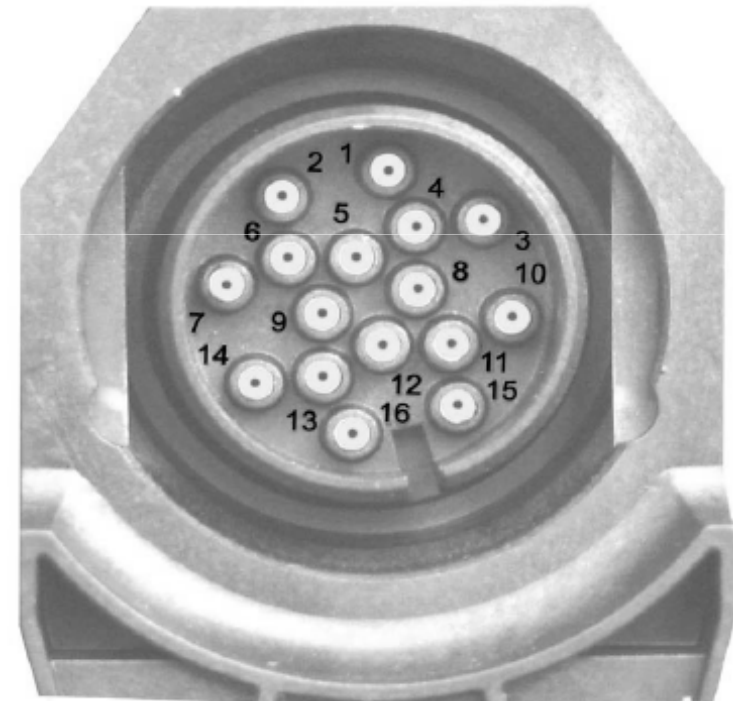


# Pressure Locations



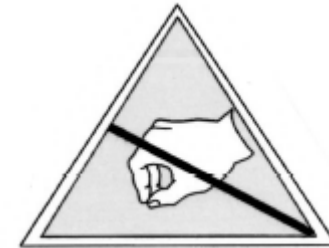
# Jaguar 6HP26 Pin Assignment

Pin	Assigned to:	Notes:
1	M shift	Manual shift program
2	CAN L	CAN low
3	ISO K	K line (for example application)
4	Touch -	Manual downshift
5	Touch +	Manual upshift
6	CAN H	CAN high
7	not in use	
8	not in use	
9	Terminal 15	Wake-up signal, terminal 15
10	P/N signal	P line for starter inhibit
11	not in use	
12	not in use	
13	Terminal 31-1	Earth (ground)
14	Terminal 30	Permanent positive (EGS supply voltage)
15	not in use	
16	Terminal 31-2	Earth (ground) 2

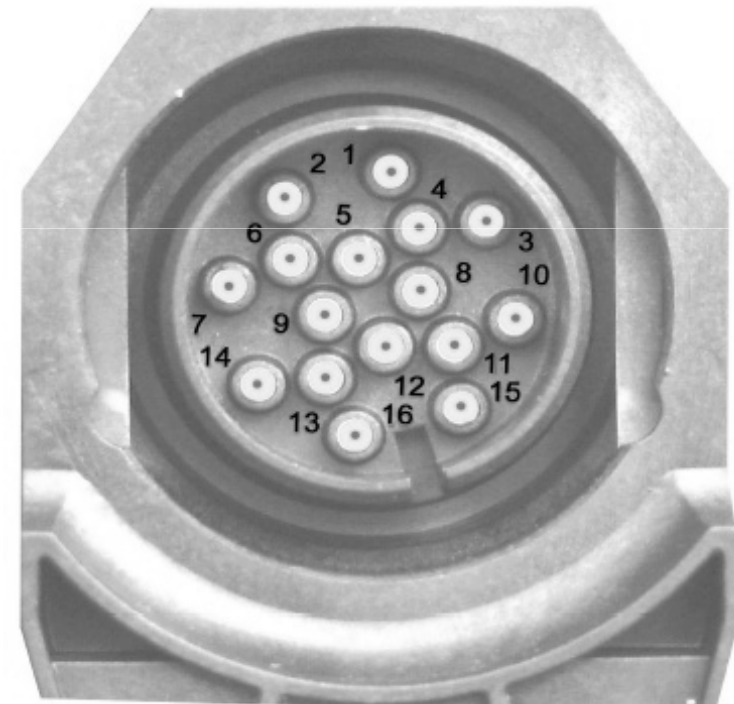


# Jaguar 6HP26/28 Pin Assignment

With "Shift by Wire"

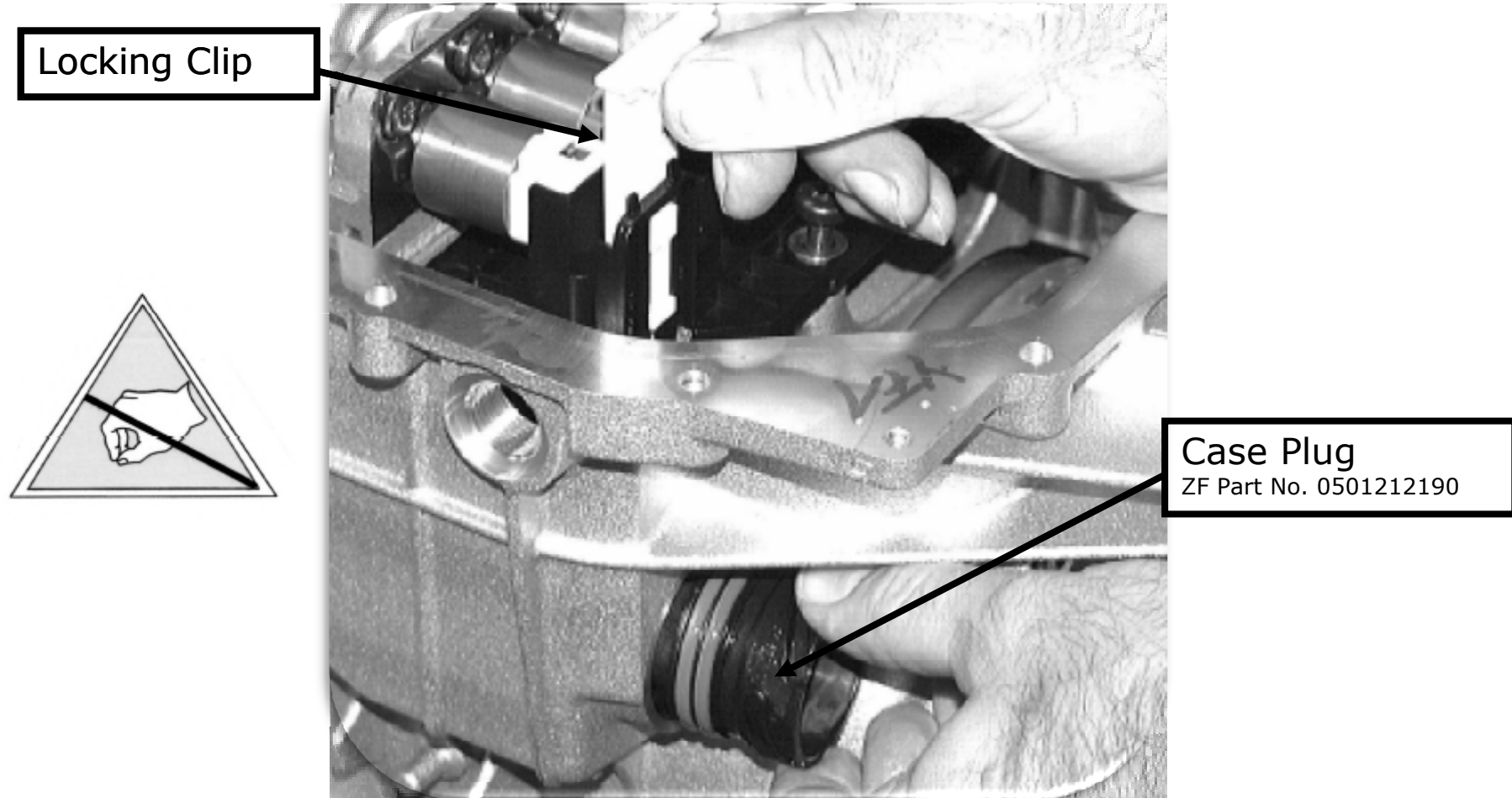


Pin	Assigned to:	Notes:
1	not in use	
2	CAN L	CAN low
3	ISO K	K line (for example application)
4	not in use	
5	not in use	
6	CAN H	CAN high
7	not in use	
8	LIN	Position Information by LIN
9	Terminal 15	Wake-up signal, terminal 15
10	P/N signal	Park / No Park
11	not in use	
12	not in use	
13	Terminal 31-1	Earth (ground)
14	Terminal 30	Permanent positive (EGS supply voltage)
15	not in use	
16	Terminal 31-2	Earth (ground) 2



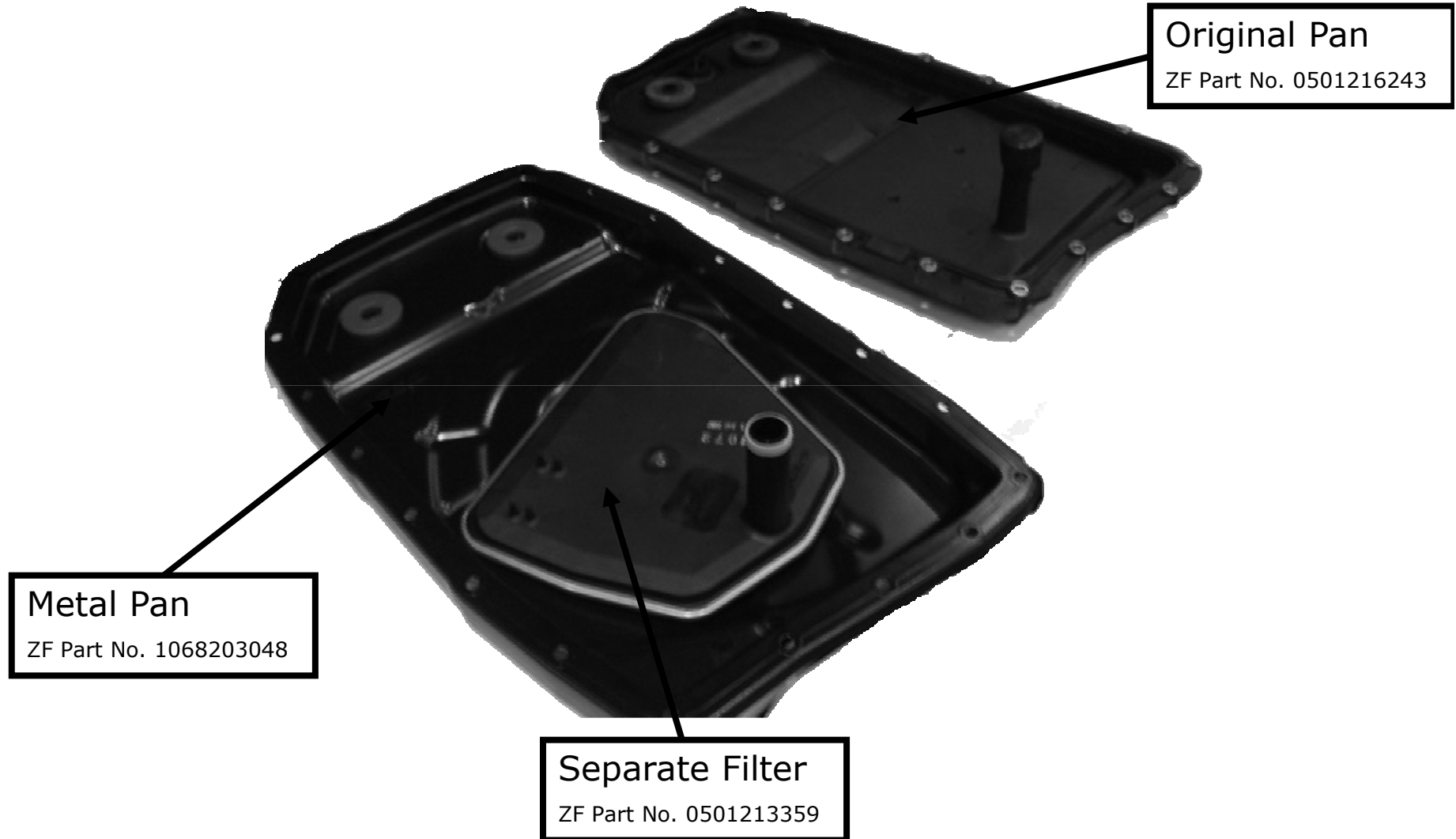
# Case Connector Removal

Release the locking clip to remove the case connector plug.



ZF 6HP26

# Oil Pan



# Transmission Problems

- Harsh shifting. (Programming)
- Roll out bump. (Programming)
- Squawk under load. (Additive)
- Cooler. (Check for glycol)
  
- Valve Body to Case Bridge Seal



# Wrong Size Adapter !!!



## Mechatronic Replacement



8. Remove the mechatronic adapter and replace it with the one that comes with the mechatronic.

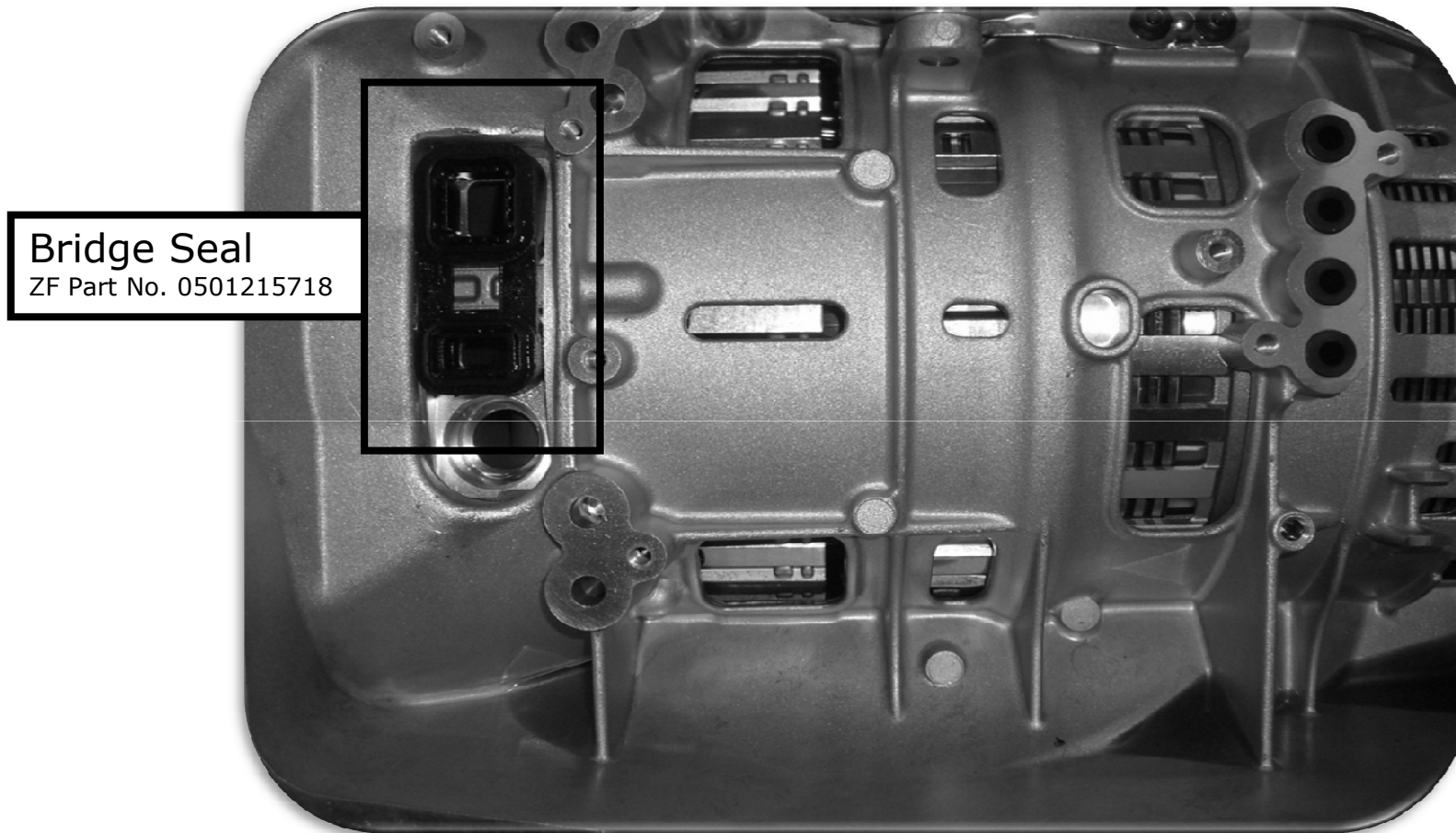


**Note:**

Seal adapter height X on 6HP19 & 21 = 15.4 mm  $\pm$  0.1 mm

Seal adapter height X on 6HP26 & 28 & 32 = 14.4 mm  $\pm$  0.1 mm

# Valve Body to Case Bridge Seal



Bridge Seal  
ZF Part No. 0501215718



# Changes to the ZF6HP26

The following changes have been made to the C & D Brakes to improve shift quality :

## Brake C

Cylinder C-D

Piston C

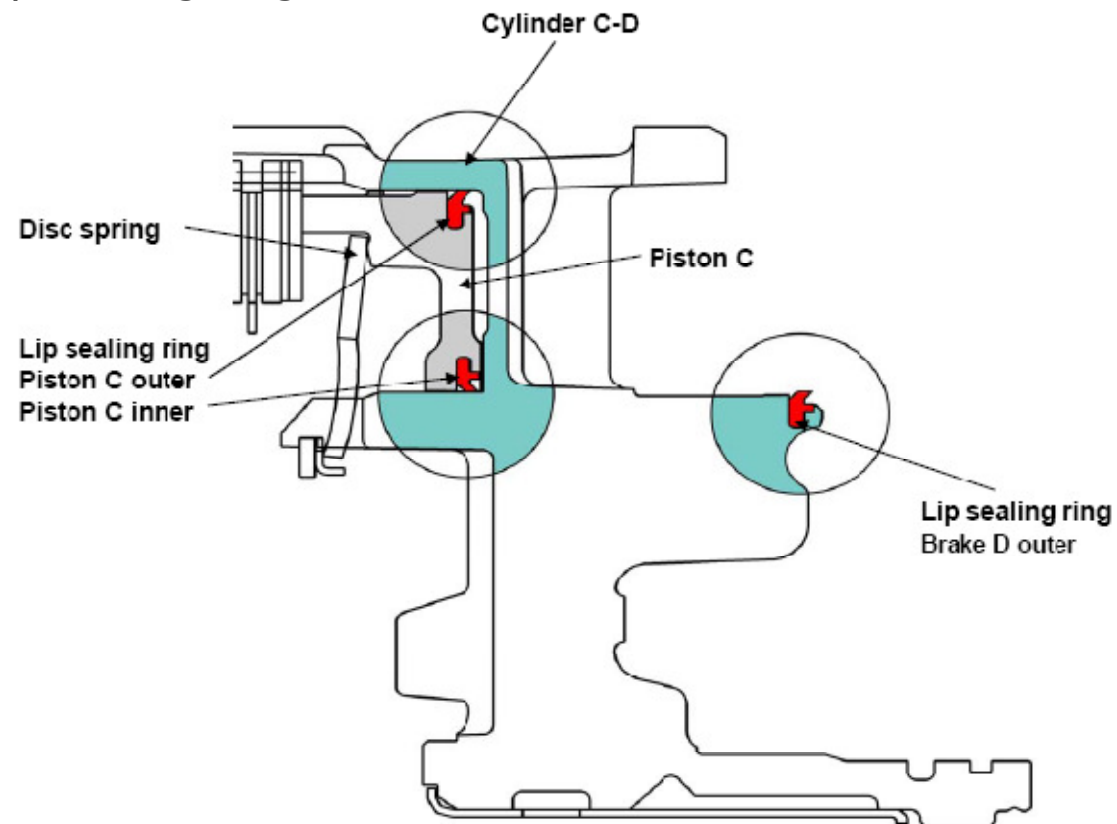
Disc spring C

Lip sealing ring C inner

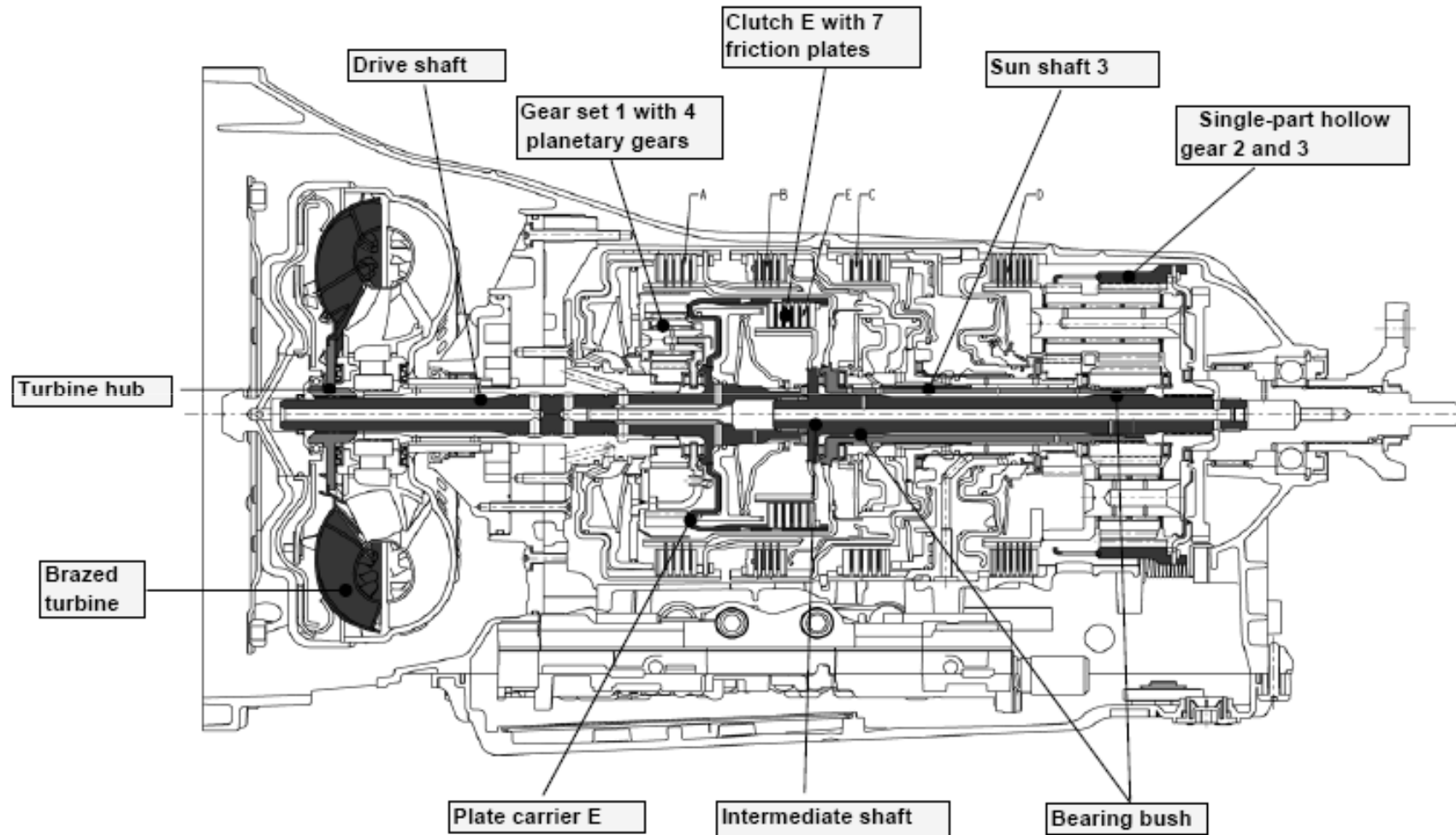
Lip sealing ring C outer

## Brake D

Lip sealing ring D outer



# Upgrade Pack 6HP28 to 700Nm



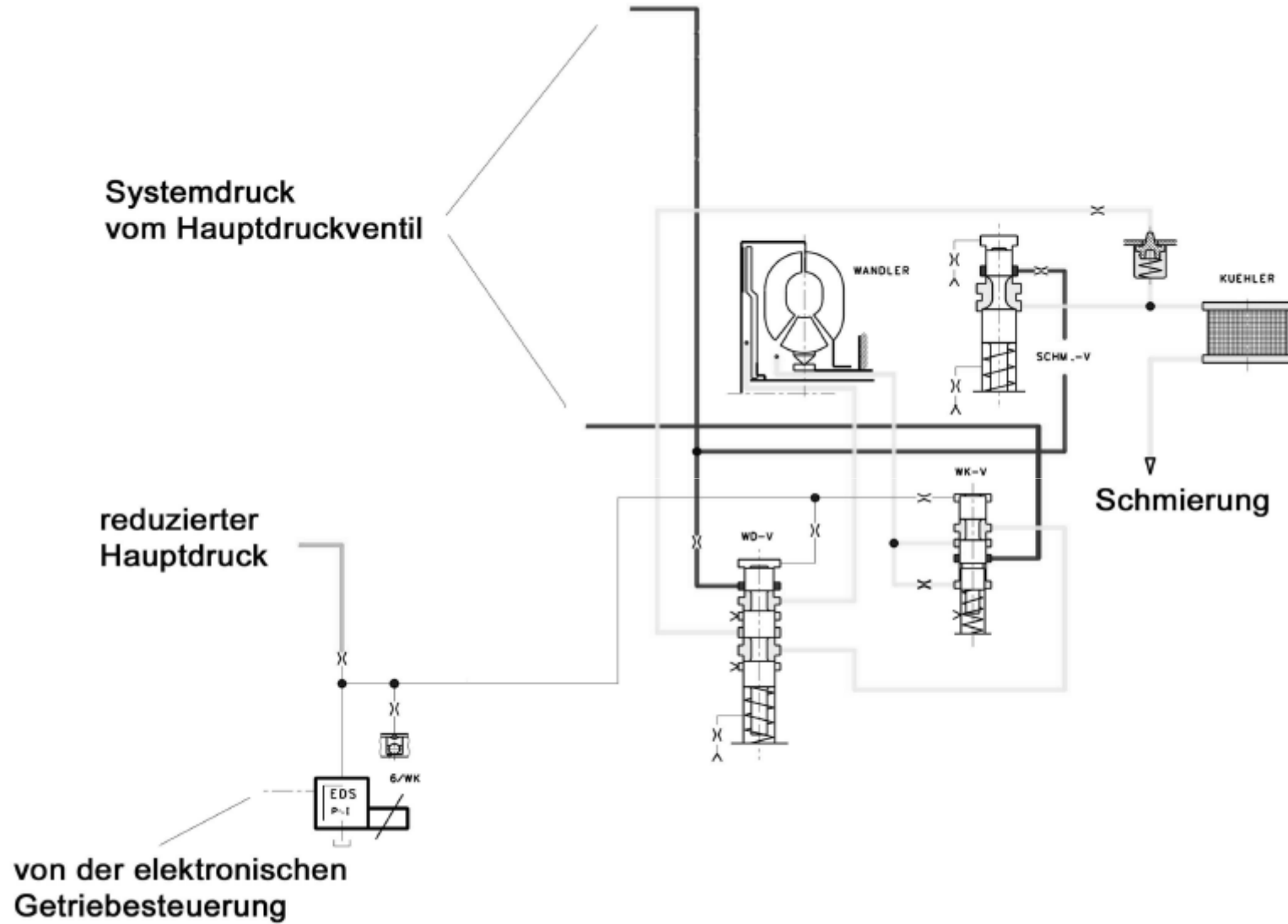
# BMW Strategies

- Warm-up program
- Reverse Interlock
- Adaptive Control
- Curve Recognition
- Brake Evaluation
- Constant Driving Evaluation
- Winter Program
- Hill Recognition Function
- Shift Adapt Control

# Torque Converter Problems

- P0741 Torque Converter Stuck Open
- Premature Clutch Failure
- Harmonic Vibrations – Noise on warm-up in 4<sup>th</sup> gear Requires TCM Re-flash
- Loosening of Converter bolts

# TCC Hydraulic Circuit



# Premature Clutch Failure



# Torque Converter Specifications

The 6HP Torque converter is similar to the 5HP as it also has a captive clutch design.

- Pilot Diameter 1.375"
- Overall Stack Height 5.510"
- Internal Clearance 0.015"

# Lock-up Lining Removal

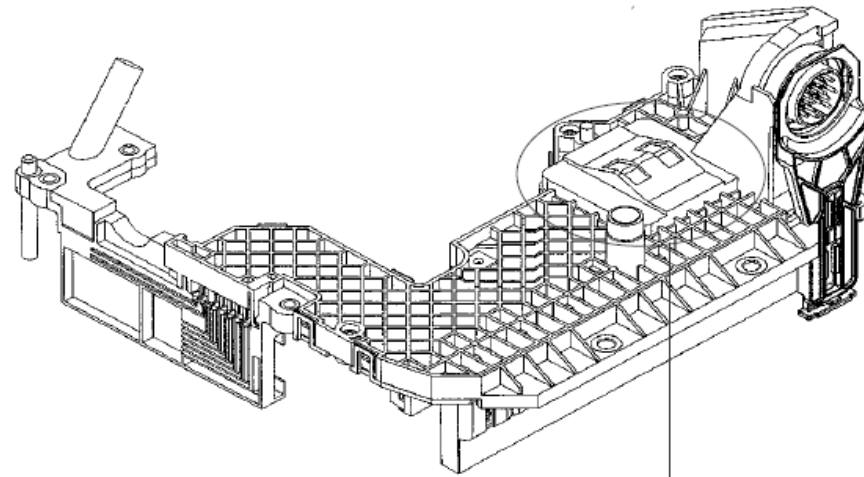
Use a 0.050" Parting tool to cut a groove with a 2.930" OD. Do not machine into the 3 holes. Various techniques can be used when re-welding depending on the individuals preference.



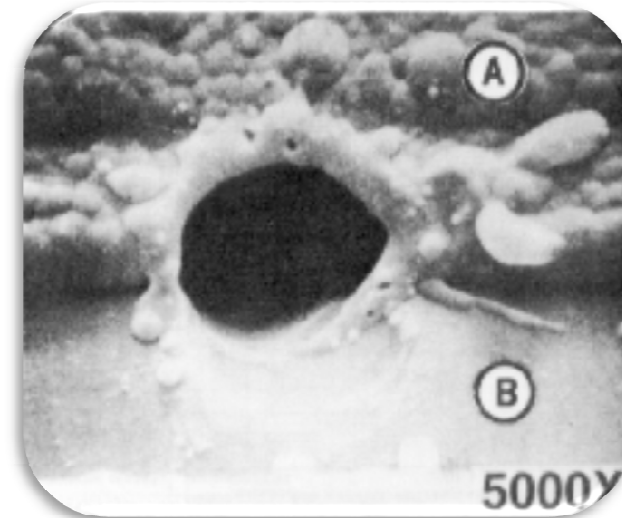
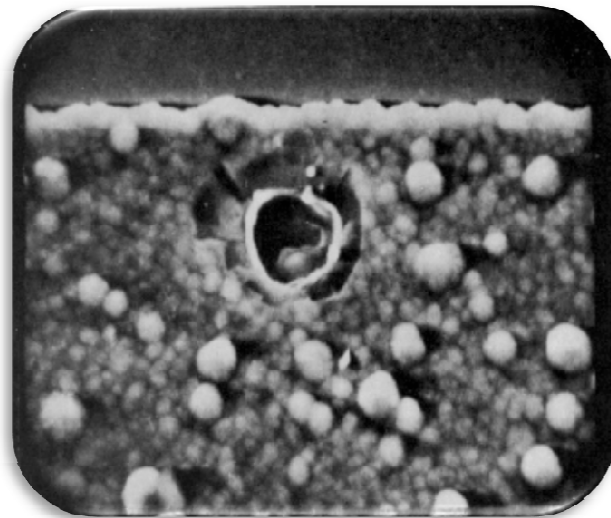
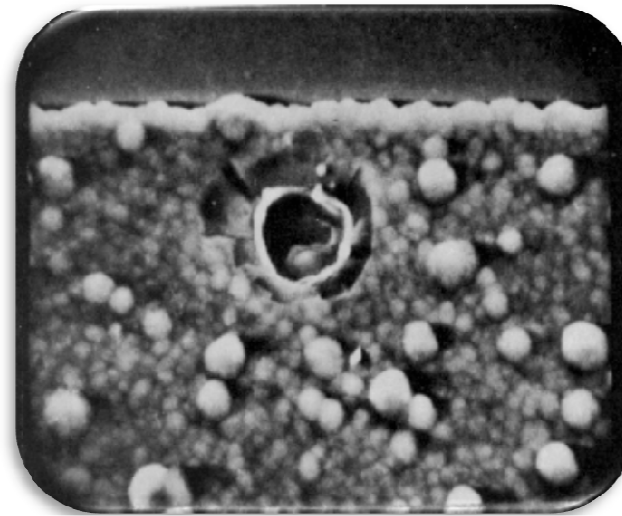
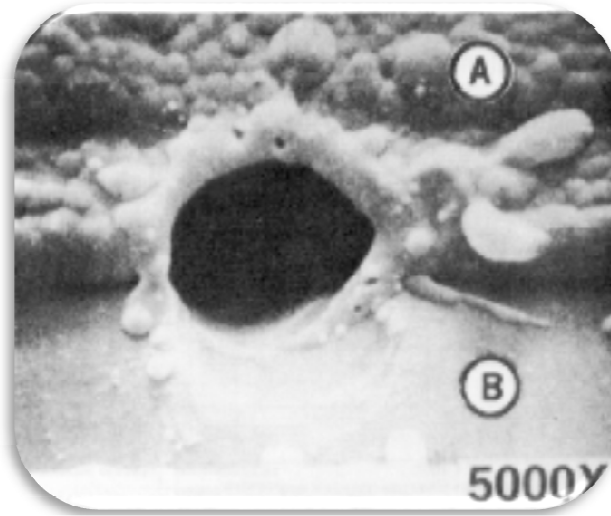


# Mechatronic and E-Module

ZF 6HP26



# Typical Mechatronic Failure

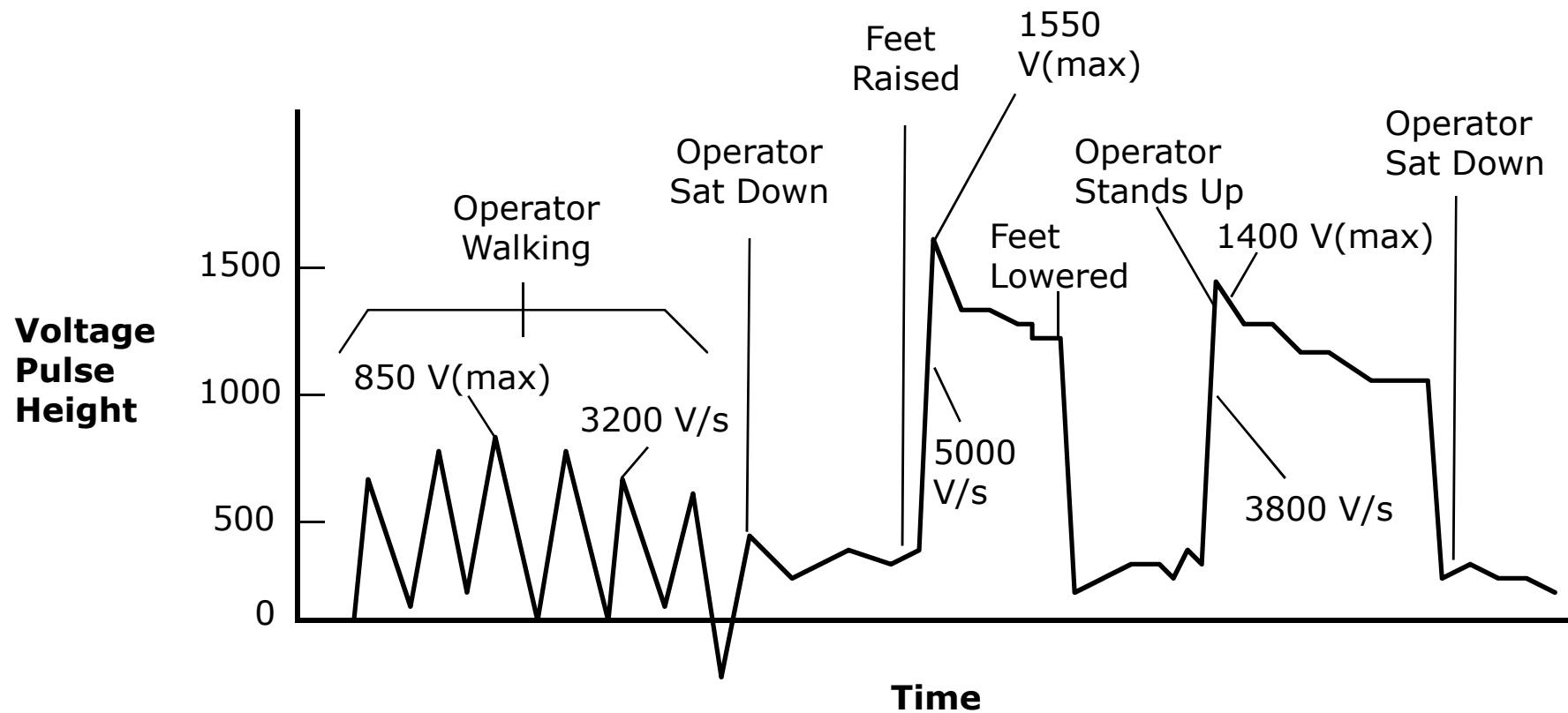


# SOLUTIONS

- Work surface Materials
- Flooring Materials
- Wrist Straps
- Shoe Grounding
- Ionization



# Typical Voltage Variations Monitored on a Person with No Wrist Strap



# End of Presentation

