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E70 Powertrain Workbook

Initial Print Date: 12/06 Revision Date:

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Powertrain

Model: E70

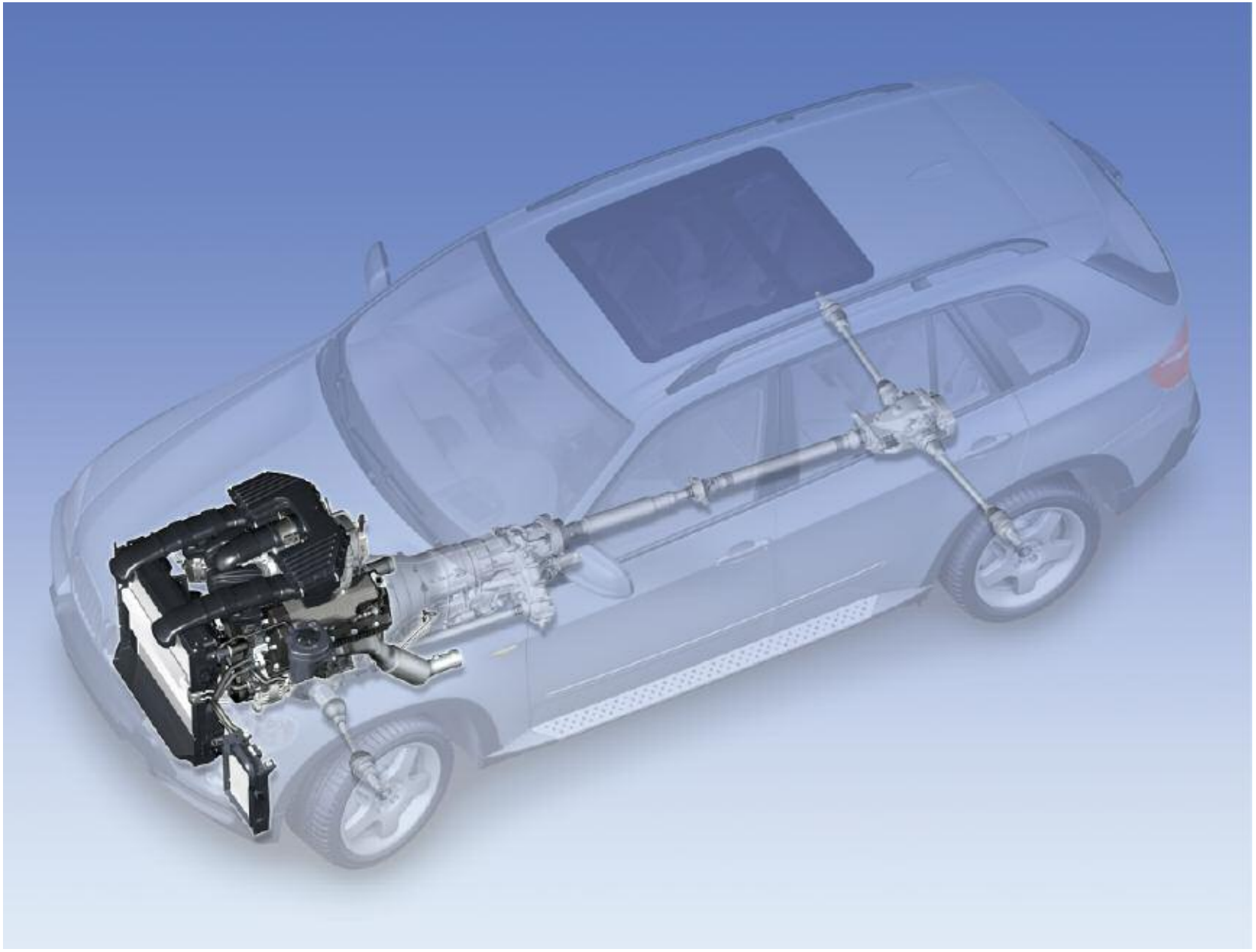
Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Describe the new engines used in the E70
- Understand the changes to the powertrain on the E70
- Understand GWS shifter operation on the E70

E70 Powertrain



E70 Engines

N62B48O1

From the start of production, the X5 4.8is will receive the N62TU engine as introduced on the E65 in 2005. This engine will be referred to as the N62B48O1 engine to be consistent with the new engine code designations.

The N62B48O1 features the following:

- New air cleaner and air intake system
- Modified belt drive
- Oil pan (for installation into E70)

The engine management for the new engine is the ME9.2.3 system which is a further variant of the ME9.2.2 . The processor speed has been increased to 66 Mhz to cope with the enhanced capabilities of the engine and chassis systems in the E70.

Most of the engine systems and mechanical components are the same as on the previous N62TU from 2005. With the exception of the items outlined above, the engine is mechanically the same as it's predecessor.

As compared to the N62B44 in the E53, the horsepower and torque have been increased. However, the N62B48O1 complies with the ULEV II requirements.

The exhaust system has been modified to meet ULEV standards. The catalyst design allows the elimination of the secondary air system.

On of the most notable changes to the physical appearance of the engine is the air intake system and air cleaner assembly. This design allows the new N62 to meet acoustic goals as well as the necessary requirements for pedestrian protection.

Specification	N62B44 (E53)	N62B48O1 (E70)
Engine type	V-8 90 degrees	V-8 90 degrees
Displacement (cm^3)	4398	4799
Stroke/bore (mm)	82.7/92	88.3/93
Power output (kW/bhp) at engine speed (rpm)	235/320 6100	261/350 6300
Torque (Nm) at engine speed (rpm)	440 3600	475 3500
Compression ratio	10.0	10.5
Valves/cylinder	4	4
Fuel type (RON)	98	98
Firing order	1-5-4-8-6-3-7-2	1-5-4-8-6-3-7-2
Engine management	ME9.2 with VVT	ME9.2.3 with VVT
Emission standard	LEV	ULEV II

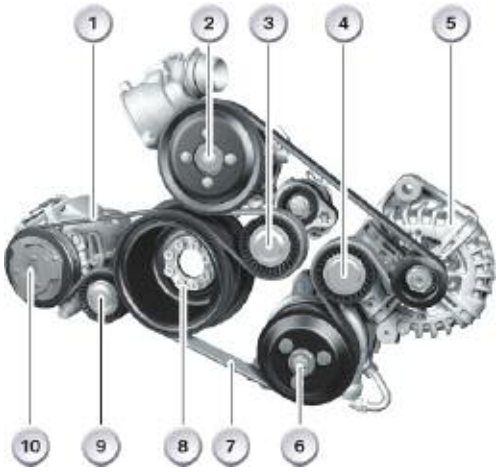
New Belt Drive

The belt drive on the 4.8 engine has been modified for use on the E70. The alternator and A/C compressor have been relocated for space reasons.

The belt drive is a double system as standard. The main belt drive is a ribbed seven groove belt which includes the power steering pump, alternator and coolant pump.

The A/C compressor is driven by an ELAST drive belt. However, a new feature is a linear tensioner which eliminates the need for a special tool for removal or installation.

Be aware that the A/C compressor and alternator have a new mounting technique which has a threaded insert to align the belt drive properly. It is imperative to follow the removal instructions.



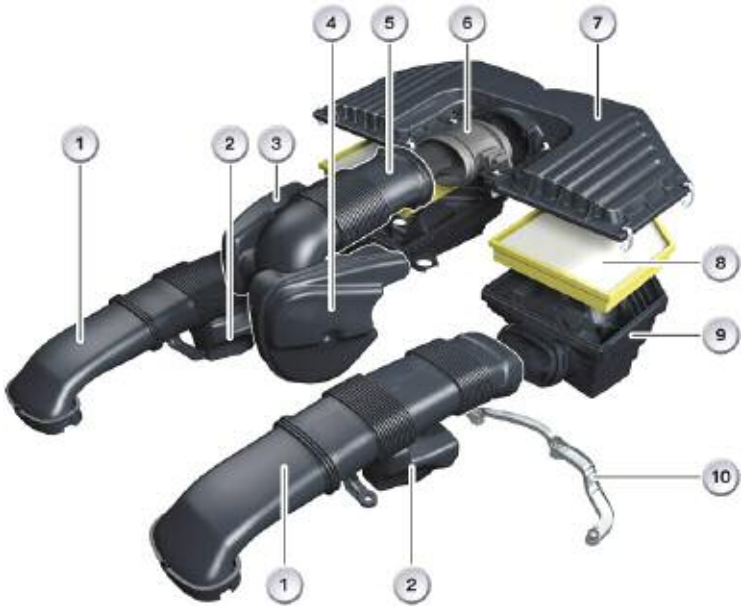
Index	Explanation	Index	Explanation
1	ELAST drive belt for AC comp	6	Power steering pump
2	Coolant pump	7	Ribbed V-belt
3	Tensioning pulley	8	Torsional vibration damper
4	Deflection pulley	9	Linear tensioner
5	Alternator	10	AC compressor

Air Intake and Filter

The new air filter and intake system has been designed to allow increased airflow and improve engine acoustics. It is mounted on the engine rather than on the inner fender or front support as on past designs.

The intake system features a series of filtered and un-filtered air resonators to accomplish these goals.

The new design also allows compatibility with the pedestrian protection features on the E70.



Index	Explanation	Index	Explanation
1	Unfiltered air pipe	6	HFM
2	Unfiltered air resonator	7	Intake silencer cover
3	Filtered air resonator	8	Air cleaner
4	Double-chamber filtered resonator	9	Intake silencer
5	Unfiltered air pipe	10	Bracket

N52B30O1

For the 6-cylinder version of the E70, the new N52KP engine will be used. This new N52KP is the upper output version as introduced on the E83LCI with some minor changes.

Many of the mechanical changes are the same as on the N52KP engines in order models (E83/E9X etc).

The N52B30O1 features:

- Plastic cylinder head cover
- Modified oil pan for installation into E70
- Crankshaft has higher degree of balance (to reduce load on drivetrain)
- New Torsional vibration damper
- Modified belt drive
- 6 mm exhaust valves
- Lightweight “hydroformed” camshafts

The engine management system is the MSV80 system which includes improvements over the MSV70 system. These items include:

- Digital HFM
- New throttle valve with magneto resistive feedback
- 180 amp alternator (Bosch or Valeo)
- Oil level/quality sensor (QLT)

The MSV80 engine management complies with the ULEV II requirements for 2007.

The catalyst system allows for the elimination of the secondary air pump.

Note: For more detail, see the ST616 training course.

Specification	M54B30 (E53)	N52B30O1 (E70)
Engine type	inline 6	inline 6
Displacement (cm^3)	2979	2996
Stroke/bore (mm)	89.6/84	88.0/85
Power output (kW/bhp) at engine speed (rpm)	170/231 5900	163/260 6600
Torque (Nm) at engine speed (rpm)	300 3500	305 2500
Compression ratio	10.2	10.7
Valves/cylinder	4	4
Fuel type (RON)	98	98
Firing order	1-5-3-6-2-4	1-5-3-6-2-4
Engine management (DME)	MS43	MSV80
Emission standard	LEV	ULEV II

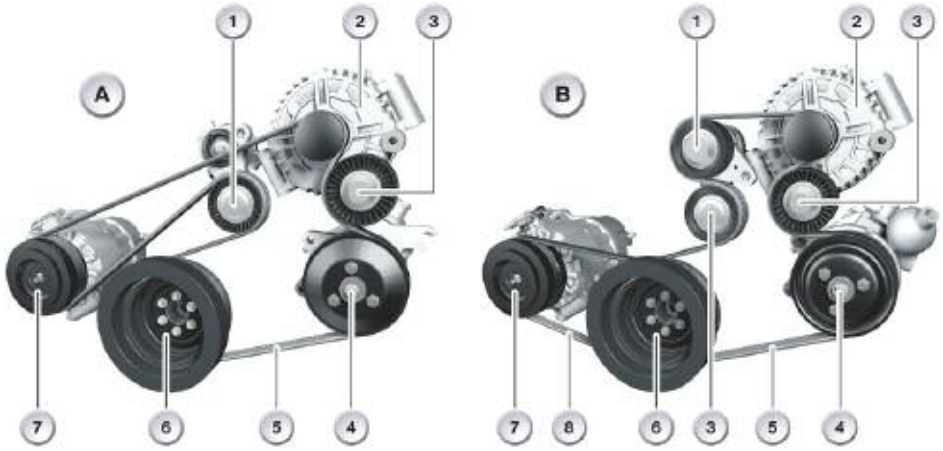
New Belt Drive (N52B30O1)

With regard to the 6-cylinder, there are two possible belt drive arrangements on the E70.

The single belt drive uses a 6 rib v-belt with a conventional “spring loaded” belt tensioner.

If the E70 is equipped one of the following options; Active steering, Adaptive Drive or the 220 Amp Alternator, there is a double belt drive.

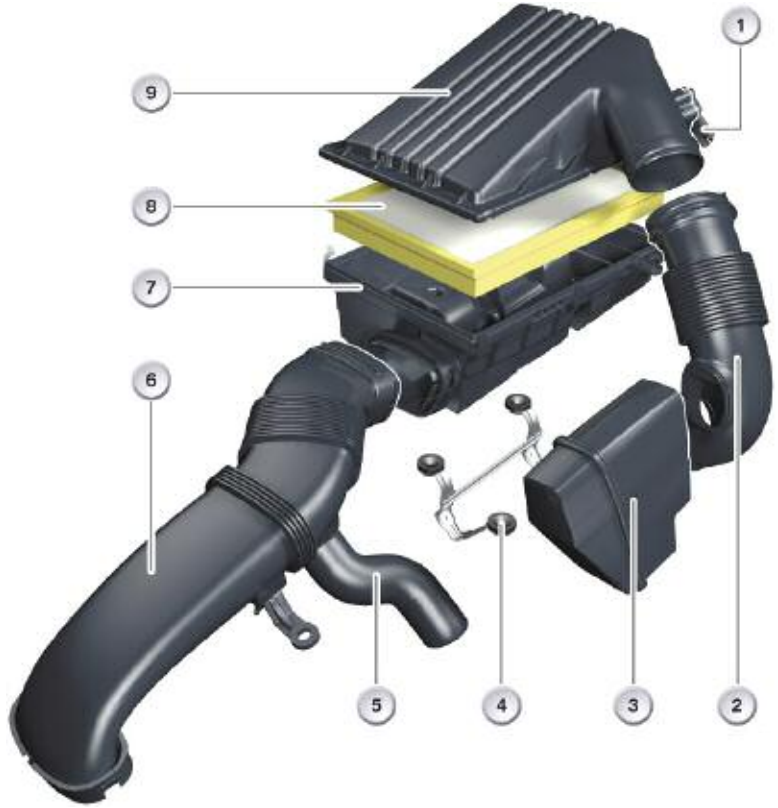
In this case, the A/C compressor is driven separately by a four rib ELAST drive belt. As opposed to the V-8 engine, this ELAST belt does not have a linear tensioner and must be installed with the special tool as one previous applications.



Index	Explanation	Index	Explanation
A	Basic belt drive	4	Power steering pump
B	Double belt drive	5	Ribbed V-belt
1	Tensioning pulley	6	Torsional vibration damper
2	Alternator	7	A/C compressor
3	Deflection pulley	8	ELAST drive belt for A/C comp

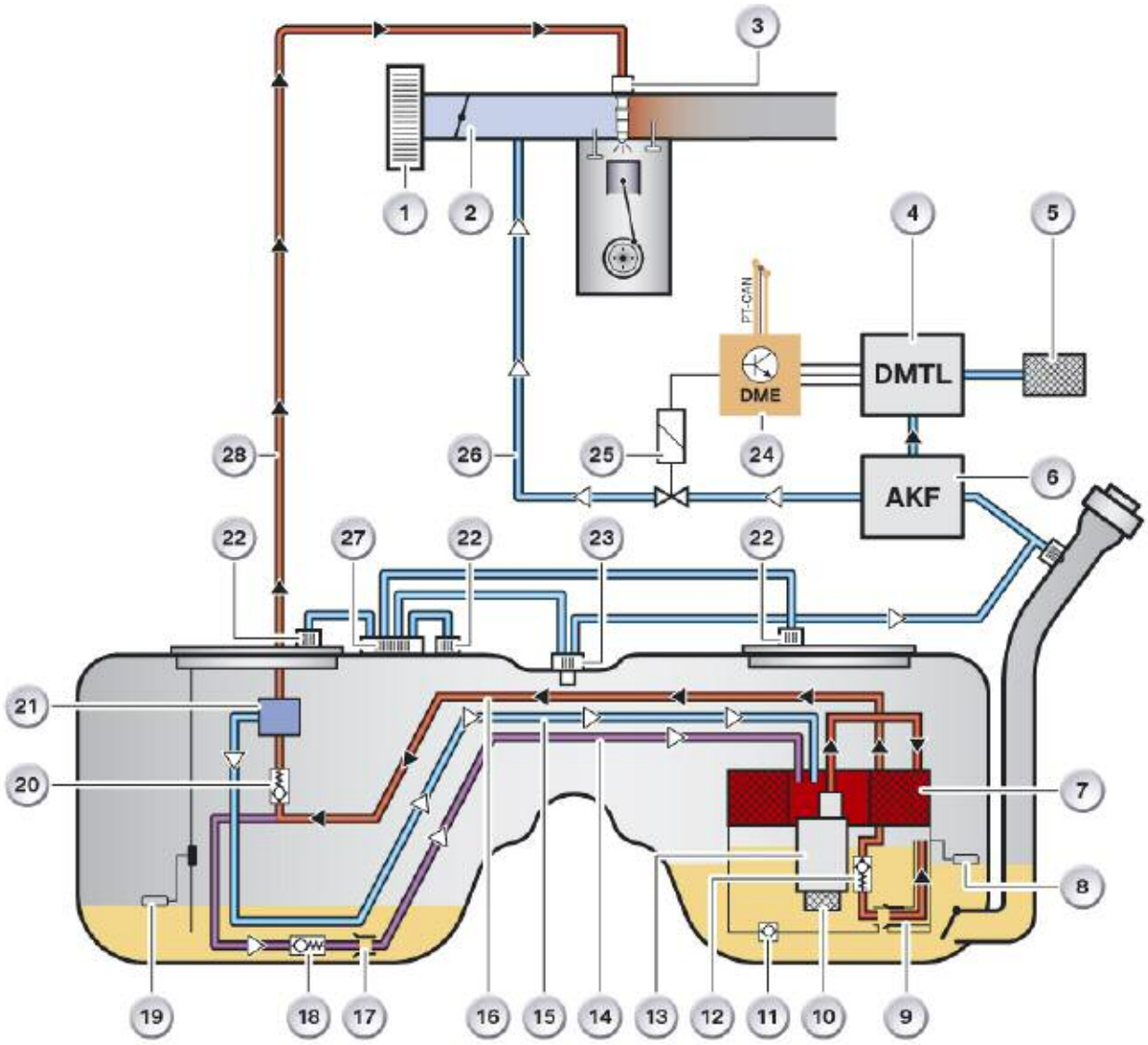
Intake Air Control

As with the V-8 engine option, the 6-cylinder uses an engine mounted air filter and duct system. This arrangement also achieves the desired sound quality goals and also meets the necessary crash optimization requirements for pedestrian protection.



Index	Explanation	Index	Explanation
1	Hot-film air mass meter	6	Unfiltered air pipe
2	Filtered air pipe	7	Intake silencer
3	Double chambered filtered air resonator	8	Air cleaner
4	Bracket	9	Intake silencer cover
5	Unfiltered air resonator		

E70 Fuel Tank



Index	Explanation
1	Engine air cleaner
2	intake manifold
3	Fuel injectors
4	DM-TL
5	Dust filter
6	Purge canister
7	Fuel filter
8	Fuel level sensor
9	Suction jet pump
10	Intake mesh filter
11	Initial filling valve
12	Non-return valve
13	Electric fuel pump
14	Compensating line
15	Return line
16	Feed line
17	Suction jet pump
18	Non-return valve
19	Fuel level sensor
20	Non-return valve
21	Pressure regulator
22	Breather valve
23	Refuelling vent valve
24	ECM (DME)
25	Fuel tank vent valve (purge valve)
26	Purge air line
27	Central constant pressure valve (Z-DHV)
28	Feed line to engine

Workshop Exercise - Fuel Tank

Using the fuel tank training aid, remove the service openings from both sides. Remove the fuel pump and both sending units.

What's new about the seals and clamps on the service openings on the fuel tank?

Why are the seals and clamps a new design?

When installing a new clamp (or clamps) how is proper tightening torque achieved?

Using the illustration on the page above, compare actual components to the illustrated ones to gain better understanding of actual system operation.

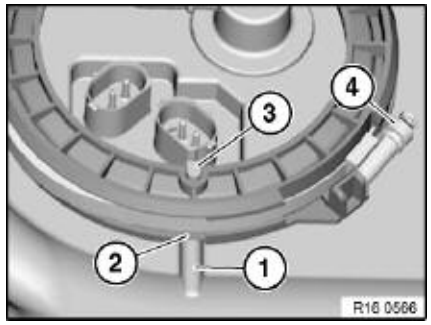
Re-install fuel system components into fuel tank and observe the following:

Installation:

Make sure that service cover is installed in correct position.

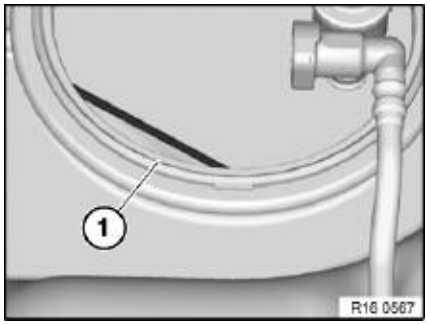
Indentation (2) on clamping ring must line up with raised section (1) of tank.

Pin on service cover (3) must line up with indentation on clamping ring.



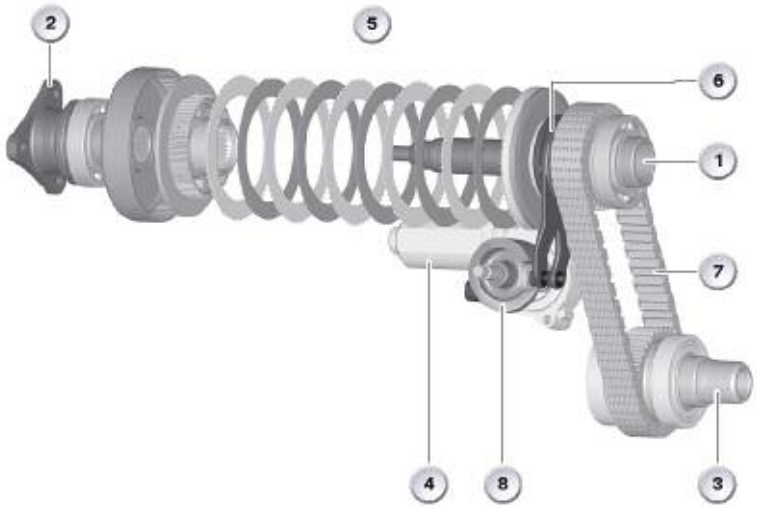
Ensure correct positioning of seal.

Always replace seal and clamp in field service situations.



Transfer Case ATC 700

The ATC 700 transfer case is a further development of the ATC500 transfer case known from the E53. The power transfer takes place via a chain drive and multi-disc clutch.



Index	Explanation	Index	Explanation
1	Input from automatic gearbox	5	Multi-disc clutch
2	Output to rear axle	6	Actuator lever with ball ramp
3	Output to front axle	7	Chain drive
4	Actuator motor	8	Control wheel

As compared to the ATC 500, there are only minor changes:

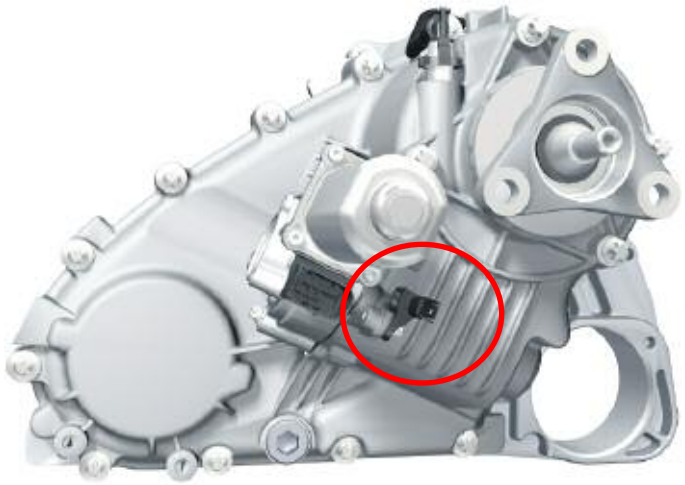
- Installation position of coding resistor
- Optimized lifetime gear oil
- New ventilation system
- Transfer case control unit (VGSG)

Coding Resistor

The locking power characteristic of the multi-disc clutch can vary slightly due to the mechanical tolerances in the production process. After measuring the actual locking power on the clutch test rig, a resistor is fitted to the actuator motor with its value representing a reference regarding the progression of the locking power.

Every time the engine is started, the transfer box control unit measures the resistance and correspondingly selects the optimum characteristic map for the installed transfer box.

To facilitate accessibility, the coding resistor is no longer fitted on the casing of the worm drive but rather on the casing of the transfer box.



Transfer Box Control Unit

The transfer box control unit is known from the E60 and E90 all-wheel drive models. It has a new housing that is not water-tight. It is arranged under the luggage compartment floor on the left next to the battery.

NOTES PAGE

Front and Rear Differential

Front Axle Gearbox VAG180A

The front axle gearbox is a new design with an aluminum casing. As before, it is centered and mounted as part of the oil pan. In terms of function, the front axle gearbox remains the same as that in the E53 predecessor.

Two different drive flange variants are used for 6-cylinder and 8-cylinder engines.

- In connection with the N52B30O1 engine, the propeller shaft is connected by means of a flexible coupling to the front axle gearbox.
- In connection with the N62B48O1 engine, the propeller shaft is pivoted further downward due to the catalytic converters.

The front axle gearbox is adapted accordingly. For this reason, a universal joint is used as the drive flange in this case. The oil filler and drain plug is located in the same position as on the E53.

Final Drive Unit HAG188K/188L

The final drive unit (rear axle differential) HAG188K is already known from the previous model series. The HAG188L represents a further development that is fitted on the E70 with N62B48O1 engine.

The output shafts are now also fitted in a plug-on arrangement to the final drive unit as known from the front axle gearbox of the E53. Since there is now no flange for the output shafts, the final drive unit is supplied without an oil fill for replacement purposes.

The propeller shaft is also fitted in a plug-on arrangement to the final drive unit and therefore also has no drive flange. Instead, the SAE gearing of the drive pinion extend out of the casing of the final drive unit. The propeller shaft is fitted onto the spline.

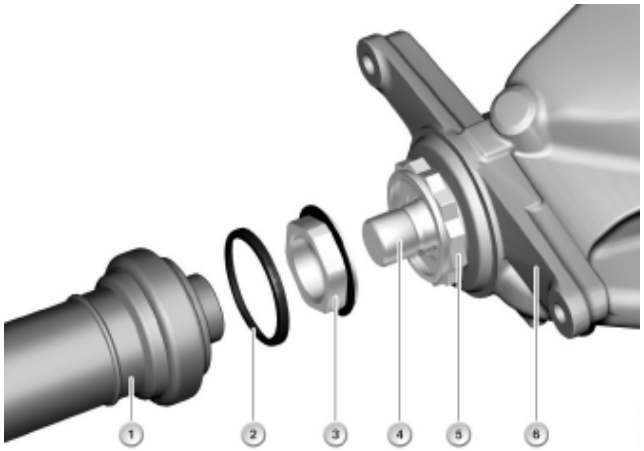
HAG188L

Angular contact ball bearings are used in the HAG188L instead of the taper roller bearings in the HAG188K. The ball bearings greatly reduce friction losses. In addition to contributing to lowering fuel consumption, this measure also reduces power loss in the thermal balance of the axle drive.

`Propeller Shaft and Output Shafts

Propeller Shafts

A new connection arrangement of the rear propeller shaft to the final drive unit (rear axle differential) is used on the E70.
The constant velocity joint of the propeller shaft is now bolted to the flange of the final drive unit but rather it is fitted onto the unit.



Index	Explanation	Index	Explanation
1	Propeller shaft	4	Drive pinion
2	Retaining clip	5	Flange nut
3	Nut	6	Casing of final drive unit

This arrangement offers various advantages:

- Reduced overall size
- Improved balance characteristics
- Shorter assembly time
- Quieter running
- Higher torsional rigidity

The rear propeller shaft in the E70 is fitted onto the final drive unit. This arrangement provides many advantages regarding function and assembly.

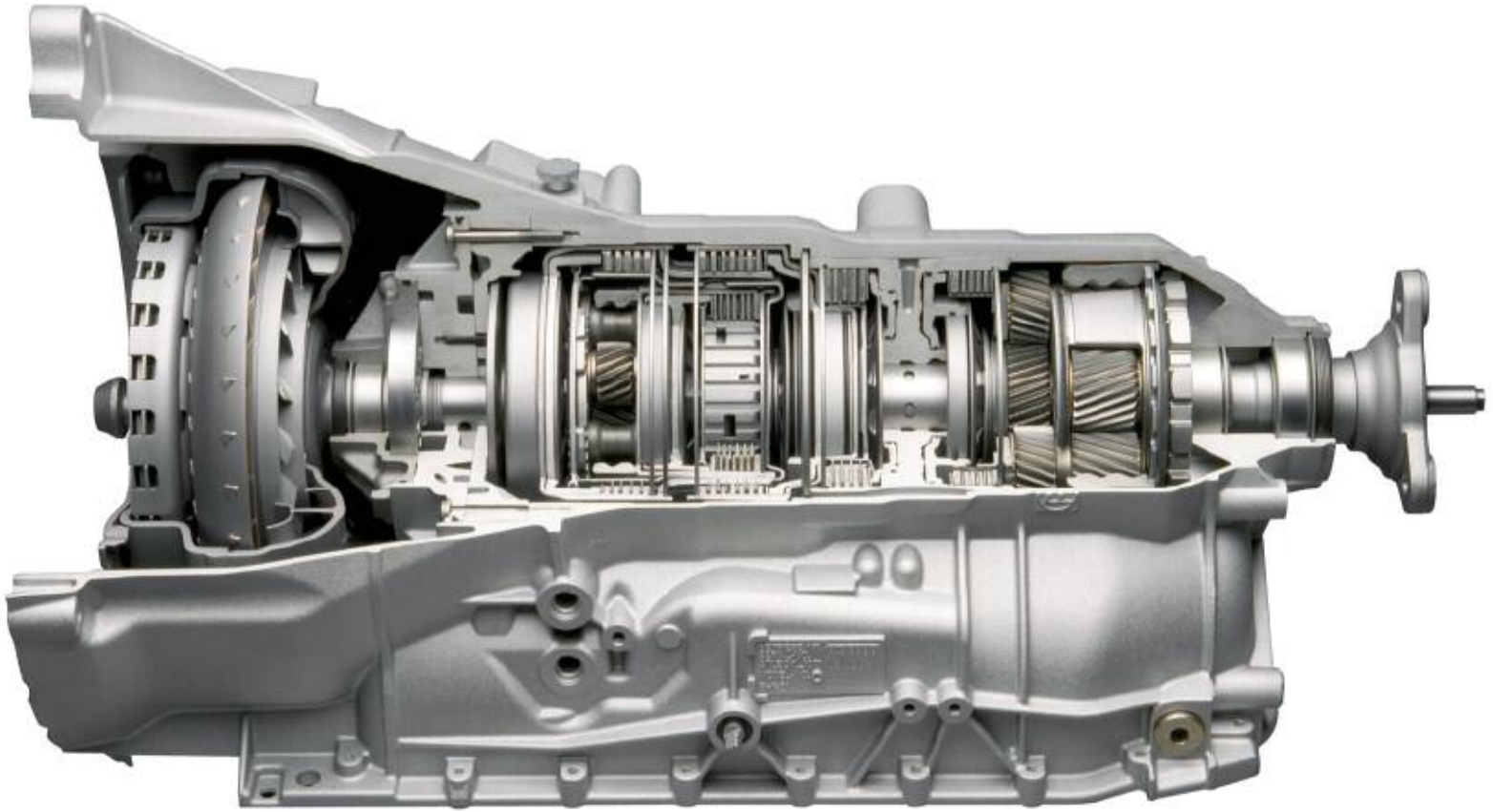
Output Shafts

The output shafts are also fitted in a plug-on arrangement to the final drive unit as already known from the front axle gearbox.

The rear output shafts are now fitted in a plug-on arrangement to the final drive unit as already known from the front output shafts. Currently, the two CV boots (gaiters) on the constant velocity joints cannot be replaced.

The housings of the constant velocity joints for the front and rear output shafts are no longer powder-coated but now have a bright finish.

Automatic Transmission (GA6HPTU)



There are 2 new transmission variants for the X5. The new “TU” version of the already proven 6HP19/26Z has been improved for use in new vehicles including the X5.

The 6HP19 is used in the E70 X5 3.0, while the 6HP26 can be found in the 4.8 version.

Vehicle	Engine	Transmission	Torque Cap.
E70 X5 3.0	N52B30O1	GA6HP19TU	400 Nm
E70 X5 4.8	N62B48O1	GA6HP26TU	650 Nm

The automatic gearbox GA6HPTU for the E70 has been re-engineered in terms of the following points:

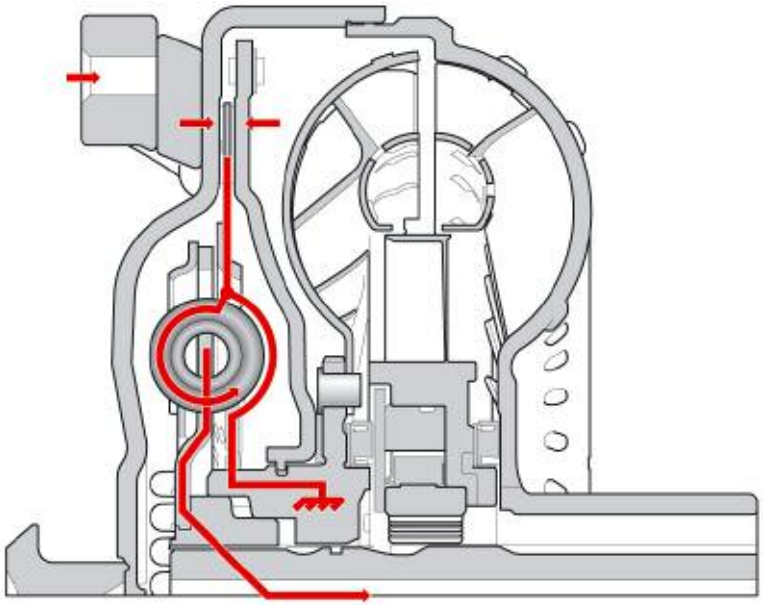
- Torque converter with turbine-torsion damper
- Clutch E
- Adapted electronic transmission control (EGS)
- Faster hydraulics through new pressure regulator
- Electric gearshift

Torque Converter

A new torque converter is used in the GA6HPTU gearbox. This torque converter contains an effective torsion damper system known as the turbine-torsion damper (TTD).

This is a classic torsion damper, in which the primary side (engine side) is fixed to the turbine wheel of the torque converter.

This arrangement brings about an increase in the flywheel mass on the primary side thus distinctly improving the damping properties.



With the converter lockup clutch disengaged, i.e. in converter mode, the power flow from the turbine wheel does not take place in the usual manner to the transmission input shaft.

The turbine wheel transmits the power to the primary side of the torsion damper.

The secondary side of the turbine-torsion damper is connected to the input shaft of the gearbox. Since the converter transmits no vibrations, the torsion damper need not perform any damping work. In this case it functions virtually as a rigid transmission element.

When the converter lockup clutch is engaged, the power is transmitted directly from the clutch to the primary side of the turbine torsion damper. Due to the rigid connection to the turbine wheel of the torque converter, the flywheel mass is increased on the primary side.

The power is transmitted via the turbine-torsion damper to the input shaft of the gearbox. Torsional vibration is filtered out very effectively.

With this system, it is possible to engage (close) the converter lockup clutch much earlier without having to take any deterioration in comfort into account. This arrangement directly connects the gearbox to the engine, resulting in a boost in dynamics as well as a reduction in fuel consumption and exhaust emissions.

Converter Lockup Clutch Connection Stages

The ability of the new torque converter to dampen torsional vibration with the turbine torsion damper is used to keep the converter lockup clutch closed as often as possible.

A general statement as to under what conditions the converter lockup clutch is disengaged (open) or engaged (closed) can still not be made as this depends on very many factors.

- Load choice signal (accelerator pedal position)
- Engine load status
- Vehicle speed
- Transmission fluid temperature
- Selected gearshift program

Casing and Intermediate Plate

The casing and the intermediate plate of the GA6HPTU gearbox have been adapted to the new hydraulic unit and the resulting channel arrangement.

The GA6HPTU gearbox is a reengineered version of the 6-speed automatic gearbox that was introduced in the E65 and since then used in all model series.

The modifications are specifically targeted at achieving higher dynamics, lower fuel consumption and reduced pollutant emissions.

Clutches

The clutch E has been reworked. The clutch E is a drive clutch that connects the ring gear of the single planetary gear train with the long planet gear of the double planetary gear train.

It is closed in fourth, fifth and sixth gear. The lining of clutch E is made from a new material that offers greater stability in terms of vibration and squeaking.

Electronic-hydraulic Control

The electronic-hydraulic control installed in the GA6HP19/26TU has been optimized in the following areas with regard to faster gearshift operations and higher efficiency.

- Torque converter control
- Cooling oil flow
- System pressure in "R"
- Clutch valves
- Electronic pressure control valves

The electronic-hydraulic control now has only two solenoid valves but seven electronic pressure control valves.

Torque Converter Control

The torque converter control including the converter lockup clutch has undergone distinct improvements with regard to the control capabilities under all conditions.

It is equipped with a new pressure regulator. Raised converter pressure (increased from approx. 0.5 bar to 1 bar at the low end) ensures faster control of the converter lockup clutch particularly at low temperatures.

The oil feed comes from the primary connection of the main pressure control valve, thus improving control at low speeds. The converter lockup clutch is now engaged with a backpressure in order to proportionate more effectively.

Variable Cooling Oil Flow

The flow of cooling oil is variable in order to reduce power losses. No cooling is required for the clutch faces when the converter lockup clutch is engaged (closed). The flow of cooling oil can be reduced in this state thus also reducing the pump power. The flow of cooling oil is controlled by the main pressure and can vary between 10 l/min and 15 l/min.

System Pressure in Reverse Gear

The system pressure that is applied in reverse gear has been increased from 15 bar to 16 bar. This change caters for the higher torque and the higher possible total weight. It ensures that clutch slip is prevented even in extreme situations (e.g. uphill gradient with trailer).

Clutch Valves

The clutch valves now exhibit a smaller control space. This facilitates a more spontaneous response as the time required until the clutch valve reacts to the control pressure applied by the EDS is shorter. This results in distinctly shorter gearshift times.

Solenoid Valves (MV)

Two solenoid valves are mounted on the hydraulic selector unit. These valves are designed as 3/2-way valves, i.e. valves with three connections and two switch positions.

The solenoid valves are controlled by the electronic transmission control (EGS) and assume the "opened" or "closed" positions making it possible to switch over the hydraulic valves.

The two solenoid valves are used for the electronically switched parking lock. One solenoid valve controls the valve for the parking lock and the other solenoid valve locks the cylinder for the parking lock.

Electronic Pressure Control Valves (EDS)

The electronic pressure control valves convert electrical current into a proportional hydraulic pressure. They are driven by the EGS and operate the hydraulic valves belonging to the shift elements.

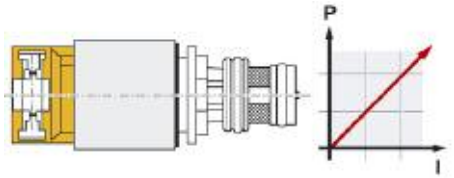
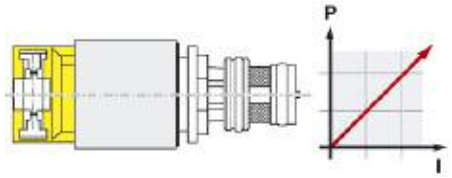
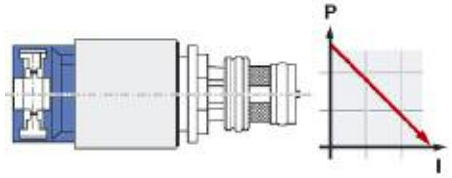
The tasks of the electronic pressure control valves are listed in the following:

EDS Valve	Corresponding Shift Element
1	Drive Clutch A
2	Converter lock-up clutch
3	Drive Clutch B
4	Drive Clutch E
5	Brake Clutch C
6	Brake Clutch D
7	System pressure

The solenoid valve that the EDS (4) in the predecessor model assigned to the clutches (D and E) depending on the gear to be shifted is no longer required.

Instead another electronic pressure control valve is used so that each clutch is now controlled by its own electronic pressure control valve. The pressure control valve 7 maintains a constant system pressure during the gearshift operations, thus making shorter shift times possible.

Three different electronic pressure control valves (EDS) are now installed which are all resistant to low temperatures. They enable stable presentation of the gearshift requirements even at low temperatures and when the transmission fluid is cold:

EDS with rising characteristic	
	Electronic pressure control valves 1, 2: Orange cap, rising characteristic Technical data: • Pressure range 0 to 4.7 bar (0 mA = 0 bar, 700 mA = 4.7 bar) • Supply voltage 12 V • Resistance 5.05 Ohm (at 20 °C)
	Electronic pressure control valves 4, 5, 6: Yellow cap, rising characteristic Technical data: • Pressure range 0 to 4.6 bar (0 mA = 0 bar, 700 mA = 4.6 bar) • Supply voltage 12 V • Resistance 5.05 Ohm (at 20 °C)
EDS with falling characteristic	
	Electronic pressure control valves 3, 7: Blue cap, rising characteristic Technical data: • Pressure range 0 to 4.6 bar (700 mA = 0 bar, 0 mA = 4.6 bar) • Supply voltage 12 V • Resistance 5.05 Ohm (at 20 °C)

Target gear allocation dependent on accelerator pedal gradient

Target gear allocation dependent on the accelerator pedal gradient replaces the previous target gear allocation system dependent on the accelerator pedal for the purpose of shifting down while accelerating.

In the case of accelerator-dependent target gear allocation, based on the respective downshift characteristic curves, the EGS determines whether a downshift is necessary while accelerating.

The gearbox shifts down by one gear if the accelerator pedal is pressed and the first downshift characteristic is reached within a certain time. If the accelerator pedal is pressed further, the gearbox shifts down again to the second downshift characteristic and again to response to the third downshift characteristic.

In the case of accelerator pedal gradient dependent target gear allocation, the EGS determines the target gear already at the first downshift characteristic. The accelerator pedal gradient is used for this purpose. This is the angle the movement of the accelerator pedal currently described or expressed more simply, the speed at which the accelerator pedal is depressed.

The target gear which is now determined in connection with the first downshift characteristic is engaged by a multiple downshift function. This serves as a boost to overall dynamics as the corresponding gear is engaged earlier and the interruption in tractive power is minimized.

Shift Speed Characteristics

The transmission control now has three different shift speed levels known as quickshift 1, 2 and 3. The higher the level, the faster the gearshift. The respective shift speed level is selected as a function of the selected drive program ("D", "S" or "M") and the accelerator pedal gradient, i.e. as a function of the speed at which the pedal is depressed.

Torque Intervention

When shifting gear at low load or when coasting, the EGS sends a so-called torque pulse to the engine management in order to achieve a torque intervention.

This is negative when upshifting so that the engine speed is reduced. When downshifting while coasting, the torque intervention is positive in order to boost the engine speed. This torque intervention facilitates smooth gearshifts without the torque converter having to intervene in this task.

LIN-bus Module

The EGS now contains a LIN-bus module for communication with the gear selector lever (GWS).

Gear Selector Lever (GWS)

The automatic gearbox in the E70 is operated by means of an electric gearshift system. This shifter arrangement is similar to the E65, however unlike the E65 the E70 is not on the steering column but rather in the usual position on the center console.

The gear selector lever consists of the selector lever itself with indicator and the housing with the control unit.

Operation and Functions

The shift pattern is modeled on the conventional BMW automatic gearbox. It features an automatic gate and a manual gate. Only the parking lock is not engaged by pushing the selector lever forward but rather by pressing a button at the top of the selector lever.

The selector lever is monostable in both gates (manual and automatic). This means, after being moved, the selector lever always returns to its initial position. In the manual gate this is the same as automatic gearboxes with Steptronic.

In addition to the one-touch function, the selector lever can also be pushed in the automatic gate. This is comparable to the function of the direction indicator stalk in the E90.

The drive range is changed by tapping the selector lever. A direct change from "D" to "R" or vice versa can be achieved by tapping the selector lever twice or by pushing the lever.

The Unlock button is located on the left-hand side of the selector lever.

Haptic Locks

Electrically controlled, mechanically actuated locks ensure that the selector lever can only be pushed in the logically possible direction, e.g. only forward from "D".

These locks are also used for the shift lock function, i.e. when a drive range can be engaged only by pressing the unlock button. The selector lever is not locked if it is necessary to depress the service brake in order to engage a drive range for example.

Instead, the function is not executed and a message appears in the on-board monitor indicating: "Press brake to engage gear". The lock for moving the lever forward differs from the lock for moving the lever back.

The forward lock is a double lock and can therefore prevent over-pressing the lever when a flick is possible. In contrast to this, the backward lock can only completely prevent the movement.

Whenever the selector lever can be pulled back, it can also be pulled back beyond the stop even if it no longer has a function.

The following graphics illustrate the operating options. The arrows indicate:

- Yellow arrow - Movement possible only with unlock button pressed.
- Grey arrow - Movement not possible.
- Green arrow - Movement possible.

Manual Gate, Sport Program (M/S)

As before, the sport program is engaged by shifting the selector lever to the left. The selector lever locks in this position. The sport program can only be engaged from "D".

Parking Lock "P"

The parking lock "P" is engaged by pressing the button at the top of the selector lever when the vehicle speed is < 2 km/h. The gearbox also automatically selects "P" as soon as the engine is turned off and "N" is not engaged.

Automatic Downshift from "M/S"

The automatic downshift function returns the selector lever from the "M/S" gate to the automatic gate. This occurs, for example, when the EGS signals gearbox position "P" as is the case when the engine is shut down or the "P" button is pressed.

The selector lever remains locked in the "M/S" gate only if "S" or "M" mode is actually active while driving in forward direction or the automatic downshift is defective or receives no power supply.

5 downshift attempts are executed at intervals of approx. 5 seconds if the selector lever is blocked from the outside, e.g. by an object.

If the downshift cannot be executed, the check control message: "Move selector lever back into automatic gate" appears after two attempts. A fault code memory entry is generated.

Interface to the EGS

With the aim of increasing availability, the gear selector lever position is sent via the PT-CAN and LIN-bus. This means, a signal is still sent to the EGS should the PT-CAN fail. This is not necessary for safety reasons.

Safety is guaranteed by neutrally complementary signals or alive counters. The gear selector switch (GWS) is woken by a high-level on the PT-CAN wakeup line. The GSW itself has no active wake-up capabilities.

Definition of Messages

Interface	From	To	Message
PT-CAN	GWS	EGS	Gear selector lever operation
PT-CAN	EGS	GWS	Show gearbox data
LIN-bus	GWS	EGS	Gear selector lever operation
LIN-bus	EGS	GWS	Show gearbox data

Communication

The data blocks are sent both event controlled as well as cyclically on the PT-CAN. They are sent only cyclically on the LIN-bus. Complementary signals are sent for the purpose of securing the transmission link.

These signals are compared with the actual signals in the respective receive control unit. Alive counters serve the purpose of detecting defects in the transmit control unit. The alive counter in the respective receive control unit is monitored to establish whether it remains at a constant value.

A plausibility check between the signals of the PT-CAN transmission and of the LIN-bus does not take place in the receive control unit.

Safe Status for Sending

If a GWS-internal plausibility check determines that the position of the selector lever can be transmitted incorrectly, the system assumes the safe status for sending the message "Operation of gear selector lever".

Consequently, all signals of this message are sent invalid on the PT-CAN and the LIN-bus. If it is not possible to ensure that the signals can be sent invalid, the sending of these messages is completely deactivated.

Indicator in the Gear Selector Lever

The task of the indicator in the gear selector lever (GWS) is to reliably indicate the drive range currently engaged. The indicator consists of the locator light that represents the shift pattern and the function lighting. This comprises the various position LEDs that indicate the drive range currently engaged.

The function lights in the gear selector lever are controlled by the "Indicate gearbox data" message sent from the EGS. It is necessary to monitor the function lighting. For this purpose, the indication is read back and compared with the required indication.

The indicator is active as soon as bus communication is active on the PT-CAN or the LIN-bus.

Flashing of a Position LED

A position LED flashing draws the driver's attention to incorrect operation. The locator lighting remains constant and does not flash. The flashing action is triggered by an EGS signal. The frequency is 0.5 Hz.

Indicator Flashing Through Diagnosis

The entire function lighting can be made to flash at a frequency of 1 Hz for approx. 10 seconds by means of a diagnosis job for testing the indicator.

Secure Indicator Status

The indicator is a safety-relevant function so that incorrect indication must be prevented. The system assumes the secure indicator status if the possibility of an incorrect indication cannot be ruled out.

The function lighting is switched off for this purpose. The locator lighting remains switched on.

Transfer to the secure status can be triggered by two events:

- Defective communication on the bus or
- An internal defect in the gear selector lever

The main transmission path to the EGS is the PT-CAN. If the "Display gearbox data" message is not received correctly on the PT-CAN, the gear selector lever will change over to the LIN-bus.

If, after changing over to the LIN-bus, a fault is also detected on this communication path, the system will assume the secure status. The plausibility check of the LIN-bus is constantly executed in the background. If it is necessary to change over to the LIN-bus in the event of a defect, it is possible to switch directly to the secure indicator state if the system detects beforehand that there are problems with the communication on the LIN-bus.

A fault code entry is generated in response to changing over to the secure status due to communication problems. This fault situation is irreversible. If the "Display gearbox data" message is received correctly again, the indicator will be activated normally once again after 2 seconds.

The gear selector lever immediately changes over to the secure indicator status if the diagnostic function in the gear selector lever detects an implausibility regarding the indicator.

In this case, a corresponding fault code entry is generated. This fault case is not reversible until the next time the gear selector lever assumes sleep mode.

Park and Unlock Button

Evaluating the P-button

The P-button sends the driver's choice to apply the parking lock to the EGS.

- The P-button is read by means of two contacts in inverse logic.
- The two contacts are evaluated in separate logic and represented by the two signals P1 and P2 independent of each other.
- Before being sent, the P2 signal is inverted in the gear selector lever.
- The two contacts in the gear selector lever are compared for diagnostic purposes. A fault code entry is stored if different contacts are applied for longer than 2 seconds.
- An internal diagnostic function in the gear selector lever detects a defective contact and enters a corresponding fault code in the fault code memory.
- The button sticking is detected when at least one contact is applied for longer than 2 minutes.
- The P1 and P2 signals are sent independent of each other on the PT-CAN and redundantly on the LIN-bus to the EGS.
- Due to the confirmation tolerances, one signal can be sent as confirmed before the other.

If the required conditions are met (speed, ...), the EGS will engage the parking lock when at least one signal (P1 and/or P2) was sent as confirmed.

Evaluating the Unlock Button

The lock to shift to "R" or out of "P" is released by pressing the unlock button.

- The unlock button is read by means of two contacts in inverse logic.
- The two contacts in the gear selector lever are compared for diagnostic purposes. A fault code entry is stored if different contacts are applied for longer than 2 seconds.
- An internal diagnostic function in the gear selector lever detects a defective contact and enters a corresponding fault code in the fault code memory.
- Before being sent, the P2 signal is inverted in the gear selector lever.
- The button sticking is detected when at least one contact is applied for longer than 2 minutes.
- Both signals are sent on the PT-CAN and redundantly on the LIN-bus to the EGS as soon as a contact is detected as confirmed.

Components

Sensors

The selector lever position is detected without contact with the aid of seven Hall sensors for detecting the selector lever position in the longitudinal direction of the vehicle as well as four Hall sensors for detecting the selector lever position in the transverse direction of the vehicle.

In the event of one individual sensor failing, the software in the gear selector lever is still capable of calculating the correct position of the selector lever.

Actuators

Three actuators are used. A motor with subsequently connected gear mechanism is used for shifting out of the "M/S" gate and for the lock (inhibit) to "M/S".

A bi-directional spring-centered double magnet is used for the inhibit in "R" direction. A single magnet with spring reset is used for the inhibit in "D" direction.

The actuators do not inhibit the shift to "R" and "D" in the case of fault or if no power is applied.

Workshop Exercise - GWS

Demonstrate the emergency release procedure for the E70 transmission as shown below:

When the transmission park lock is released manually, are there any indications to the driver/technician?

Apply parking brake for safety. Operate shifter through all modes (P,R,N,D etc.). Note shifter operation and indicator lights.

With the vehicle is Drive (sport mode), turn off ignition.

What happens to the shifter when the ignition is turned off?

Remove GWS assembly from center console.

Observe proper removal steps with regard to bolts.

What 2 bus systems connect GWS with EGS and Why?

ls there any mechanical connection between GWS and EGS?

Re-install GWS assembly using proper procedures.

Go to diagnostics and look for any status requests or component activations. List below: