

Vehicle Specific Diesel Changes

Diesel Vehicles for the US Market

Aside from the engine itself, there are several changes which have been made to the diesel versions of the 335d and X5. These changes are required to successfully adapt the diesel engine.

These changes are as follows:

- Transmission
- Rear differential
- Cooling system
- Climate control system (auxiliary PTC heater)
- Acoustic package

Transmission

In view of the high torque developed by the M57D30T2 engine, the GA6HP26TU gearbox is used, which is normally fitted behind 8-cylinder gasoline engines.

The transmission gear ratios have not been changed.



■ Twin Damper Torque Converter

The gearbox is identical to that used in the X5 4.8i; only the torque converter is different.

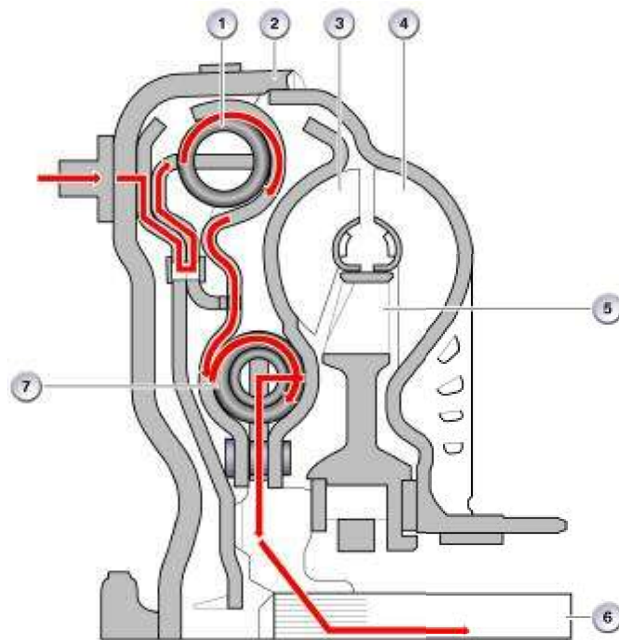
A so-called turbine torsional damper (TTD) is used while a twin damper torque converter is used for diesel engines.

In principle, the twin damper torque converter is a turbine torsional damper with a further damper connected upstream. The primary side of the first damper is connected to the converter lockup clutch while the secondary side is connected to the primary side of the second damper. As in the turbine torsional damper, the secondary side is fixed to the turbine wheel of the torque converter.

When the converter lockup clutch is open, the power flow is equal to that of the turbine torsional damper. The power is transferred from the turbine wheel via the second damper (but without damping) to the transmission input shaft.

When the converter lockup clutch is closed, the power is transmitted via the first damper that consists of an annular spring. From here the power is transmitted to the second damper which operationally corresponds to the turbine torsional damper and also consists of two annular springs.

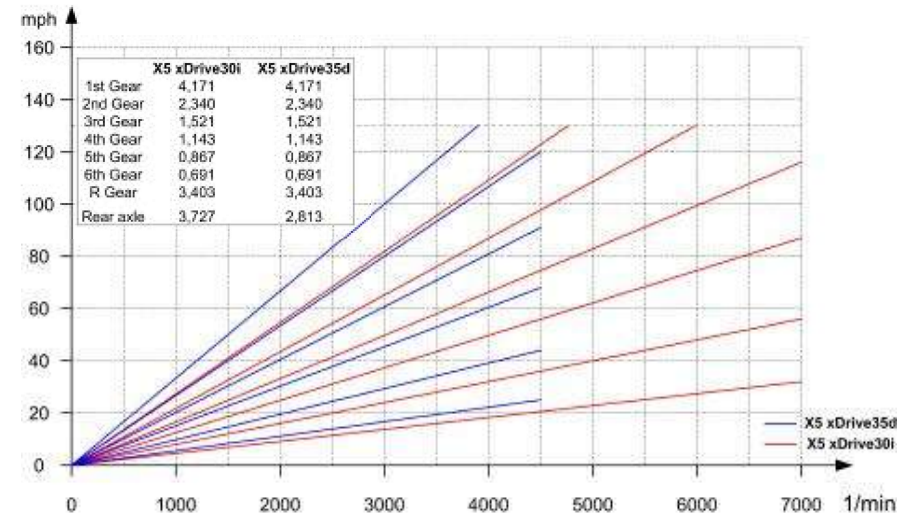
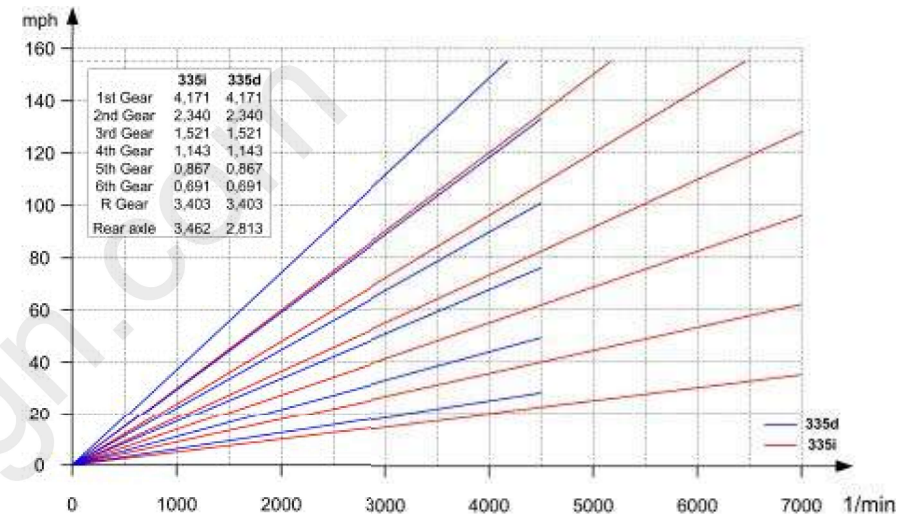
These further improved damping properties effectively adapt the transmission to the operational irregularities of the diesel engine.



Index	Explanation	Index	Explanation
1	Annular spring	5	Stator
2	Converter housing	6	Transmission input shaft
3	Turbine wheel	7	Annular spring assembly
4	Impeller		

Rear Differential

In order to optimize the torque curve of the diesel engine, the differential ratio has been changed in the final drive. The ratio is now numerically lower which keep the RPM to an optimum level. The following charts show the comparisons of the transmission and final drive ratios between the gasoline and diesel versions.



Cooling System

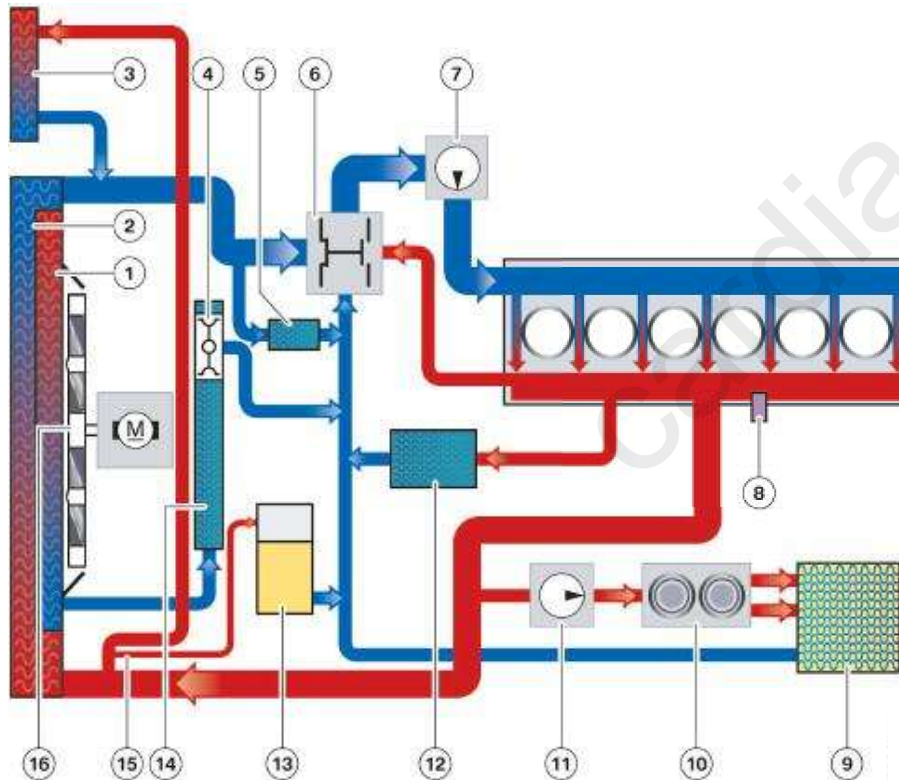
The cooling system, is in part, vehicle-specific. In principle, there are scarcely any differences between the cooling systems on petrol and diesel engines.

The two basic differences compared to a gasoline engine are:

- No characteristic map thermostat
- Addition of EGR cooler (LP and HP EGR).

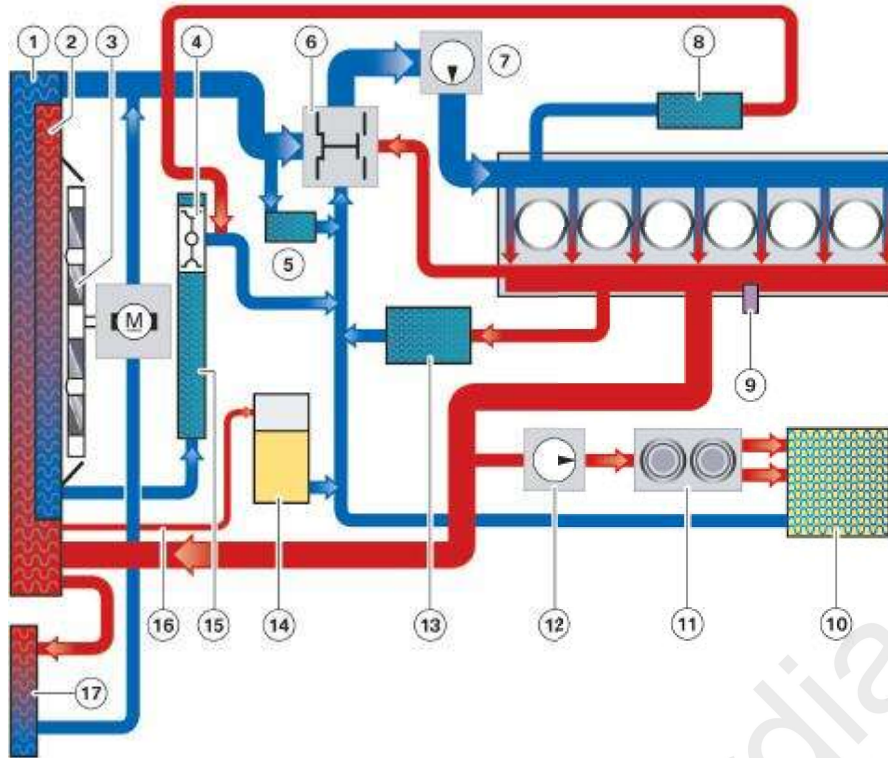
The E70 and E90 differ with regard to the EGR cooler. Since the E70 is equipped with a low pressure EGR system, it has a second EGR cooler, the low pressure EGR cooler.

Cooling System Overview - E90 Diesel



Index	Explanation	Index	Explanation
1	Transmission cooler (coolant to air)	9	Heater core (heat exchanger)
2	Radiator (coolant to air)	10	Water valve (dual)
3	Auxiliary radiator	11	Auxiliary coolant pump
4	Thermostat, transmission cooler	12	Engine oil cooler and engine oil to coolant heat exchanger
5	High pressure EGR cooler	13	Expansion tank
6	Thermostat	14	Transmission oil cooler and transmission oil to coolant heat exchanger
7	Coolant pump	15	Ventilation line
8	Coolant temperature sensor	16	Electric fan

Cooling System Overview - E70 Diesel



Index	Explanation	Index	Explanation
1	Radiator (coolant to air)	10	Heater core (heat exchanger)
2	Transmission cooler (coolant to air)	11	Water valve (dual)
3	Electric fan	12	Auxiliary coolant pump
4	Thermostat, transmission cooler	13	Engine oil cooler and engine oil to coolant heat exchanger
5	High pressure EGR cooler	14	Expansion tank
6	Thermostat	15	Transmission oil cooler and transmission oil to coolant heat exchanger
7	Coolant pump	16	Ventilation line
8	Low pressure EGR cooler	17	Auxiliary radiator
9	Coolant temperature sensor		

Cooling Method

The cylinder head varies according to the engineering used to implement the cooling concept.

There are 3 types of cooling concepts:

- Crossflow cooling
- Longitudinal flow cooling
- Combination of the two.

In BMW diesel engines only crossflow cooling is used. With cross-flow cooling, the coolant flows from the hot exhaust side of the cylinder head to the cooler inlet side.

This offers the advantage of even heat distribution throughout the cylinder head. By contrast, with longitudinal flow cooling, the coolant flows lengthways along the cylinder head, in other words from one end to the other.

As the coolant flows past each cylinder in succession, it becomes progressively hotter, resulting in very uneven heat distribution. This also causes pressure losses in the coolant circulation system.

A combination of both systems cannot outweigh the disadvantages of longitudinal flow cooling. Consequently, BMW diesel engines exclusively use crossflow cylinder head cooling.

Climate Control for Diesel Vehicles

The climate control system on the diesel vehicles is mostly identical to those on vehicles with gasoline engines. The major addition to the system is an electric auxiliary PTC heater. Both the E70 and E90 use an auxiliary PTC heater.

Since diesel engines are more thermally efficient than gasoline engines, the warmup time is increased. This can potentially cause a “comfort” related issue for the customer. So, this heater is needed to “boost” the output of the heater core until the coolant temperature is sufficient to provide the necessary heating.

The PTC heater does not heat the coolant, but rather the air passing through the heater core. The electric auxiliary heater is installed in the IHKA housing next to the heater core.

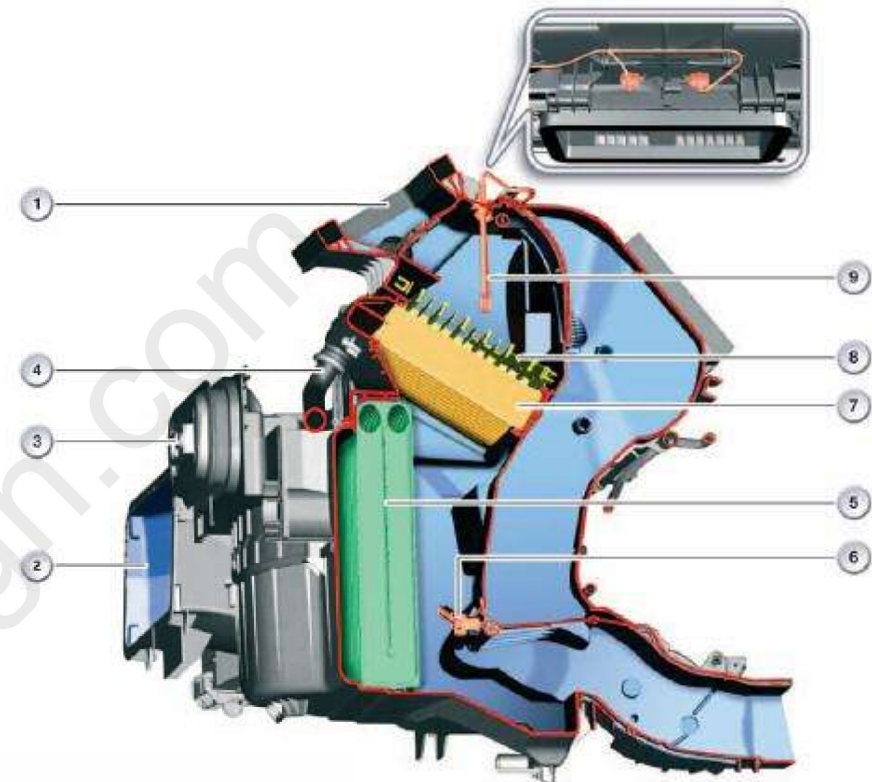
This is connected to the IHKA via the LIN bus and is controlled between 0 - 100% when heating is required (infinitely variable). The electric PTC auxiliary heater may only be operated using excess alternator power.

The power consumption can be limited via the DDE using power management. Notification of power availability is provided by the DDE via a CAN signal on the vehicle circuit and relayed to the electric PTC auxiliary heater by the IHKA via the LIN bus.

The output of the electric PTC auxiliary heater is 1250 W at a voltage of 13 V. The electric auxiliary heater consists of a heating grid and integrated actuation electronics.

The PTC heater has the following characteristics:

- Ceramic heating elements (PTC ceramic resistors)
- Access to air via metal grilles
- Actuation electronics.



Auxiliary PTC heater in A/C housing - E70

Index	Explanation	Index	Explanation
1	IHKA housing	6	Evaporator temperature sensor
2	Fresh air intake	7	Heat exchanger
3	Connection to expansion valve	8	PTC heater
4	Coolant connection to heat exchanger (heater core)	9	Temperature sensor for heat exchanger
5	Evaporator		

■ Front PTC Pin Assignments

The power connection and the signal connection are separate.

Power connection:

- Terminal 30
- Terminal 31.

Front PTC signal connection:

- Plug (3-pin)
- Terminal 15
- Generator load signal (PWM)
- LIN bus.

The electric PTC auxiliary heater has diagnostic capability for detecting faults such as:

- Missing contact
- Short circuit to ground and B+

The electronic system performs continuous self-diagnosis. This makes it possible to activate internal safety functions and make the diagnostic data available to the IHKA control unit via the LIN bus.

The following items have diagnostic capability:

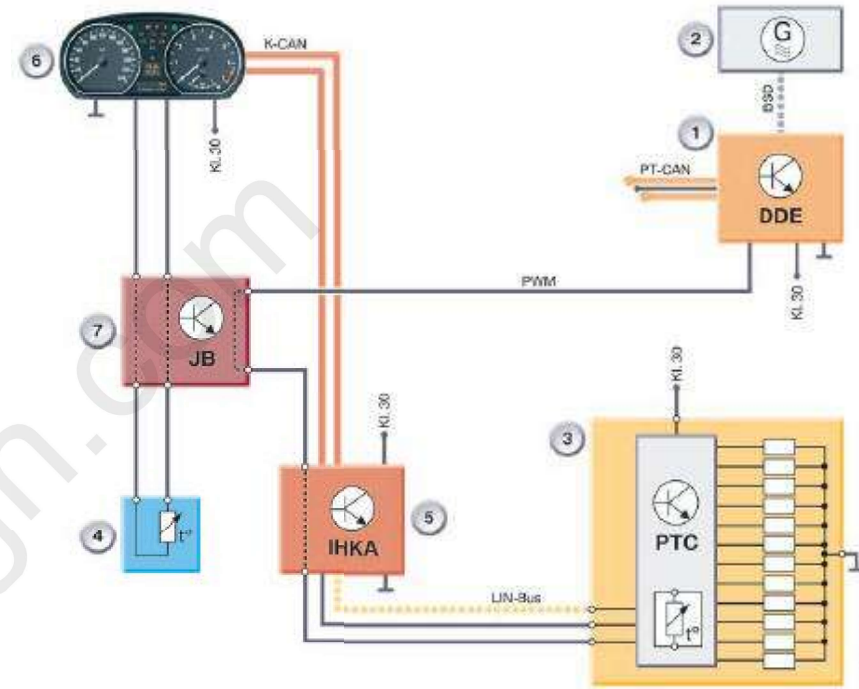
- Presence of power supply, terminal 15 and power supply voltage measurement
- Power output stage fault

The following safety functions are provided with the aid of self-diagnosis:

- PTC shut-off if the permitted operating voltage range is exceeded.

■ PTC Heater E90

PTC Heater s schematic - E90



Index	Explanation	Index	Explanation
1	DDE	5	IHKA control module
2	Alternator	6	Instrument cluster
3	PTC heater (with integrated electronics)	7	Junction box
4	Ambient temperature		

Acoustic Package

On the E90, there is additional paneling in the underbody below the engine. This paneling is used to further reduce any engine related noise which may emanate from the diesel engine.



NOTES

PAGE