Self Study Program 822223

2.0L EA888 EVO4 Engine

Tablet Format, Version 1.3

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Introduction

The 2.0L EA888 EVO4 Engine

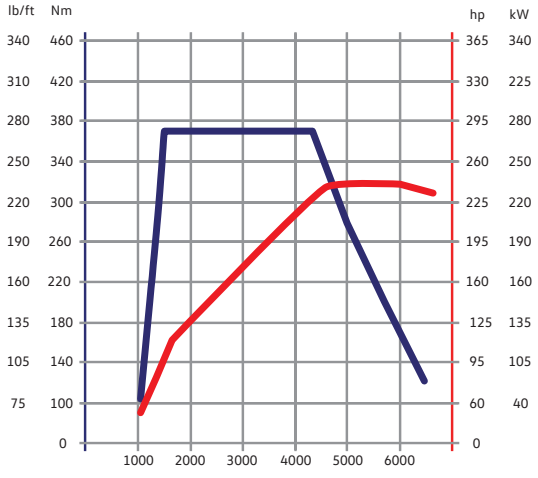
This next generation of the 2.0L EA888 engine is referred to as the "EA888 EVO4." The 2.0L turbocharged direct injection engine has been modified to reduce emissions further and provide even better performance.

The changes include:

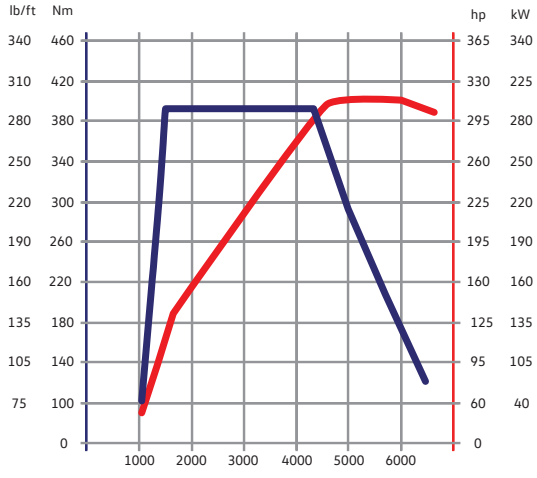
- New injectors
- An increase in maximum fuel injection pressure to 350 bar
- Internal friction improvements
- Improved acoustic properties

Model	GTI	Atlas	Arteon	Golf R
Displacement	1984 cm3			
Bore	82.5 mm			
Stroke	92.8 mm			
Valves Per Cylinder	4			
Compression Ratio	9.6:1	9.6:1	9.3:1	9.3:1
Horsepower	241 hp (180 kW) at 6500 rpm	270 hp (201 kW) at 5250 rpm	300 hp (224 kW) at 5350 rpm	315 hp (235 kW) at 5900 rpm
Torque	273 lb/ft (370 Nm) from 1,900 to 4,000 rpm	273 lb/ft (370 Nm) from 1550 to 4900 rpm	295 lb/ft (400 Nm) from 1,900 to 3,600 rpm	280 lb/ft (380 Nm) from 1,900 to 5,900 rpm
Engine Management	SIMOS 19.6			
Fuel	Regular	Regular	Premium	
Emission Treatment	Three-way catalytic converter, one upstream broadband lambda probe and one step-type lambda probe downstream of the catalytic converter			
Emission Standard	LEV3, Tier 3 (ULEV70)	LEV3, Tier 3 (ULEV70)	LEV3, Tier 3 (ULEV125)	LEV3, Tier 3 (ULEV70)

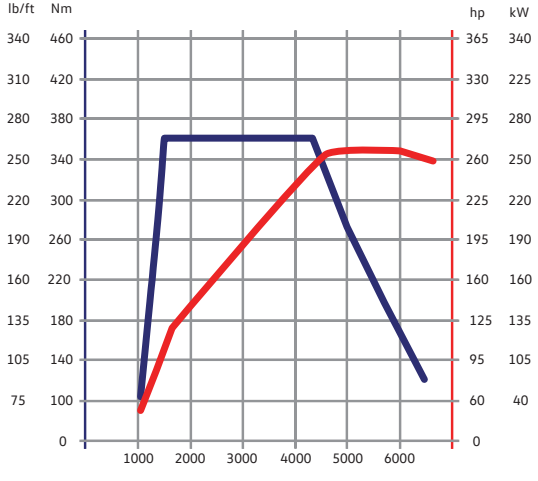
Technical Data



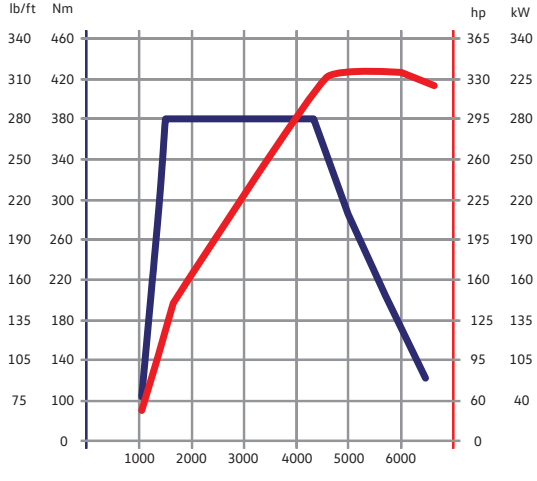
GTI



Arteon



Atlas



Golf R

Technical Features

Emission Changes

- High pressure of 350 bar
- Modified ventilation intake for activated charcoal filter with Venturi nozzle on turbocharger
- Modified location of oxygen sensor before catalytic converter; moved from turbocharger (third generation engine) to catalytic converter
- 5-layer fuel supply hose
- Improved activated charcoal filter solenoid valve (tolerances optimized)

Friction Changes

- Improved throttle valve with reduced air leakage
- Narrow oil pump drive chain
- New design of the one-way valve on the primary timing chain tensioner
- New bushing on the timing chain tensioner

Acoustic Changes

- Noise-reducing reinforcements on crankcase
- Noise-reducing reinforcements on upper part of sump
- Noise insulation on cold engine side (intake side)

View from Exhaust Side

Technical Features

Optimization/Robustness Changes

- Optimized filler cap on timing chain case cover
- Robust ignition coils
- Cylinder head manufactured using different casting method (bottom filling)
- 8Y spark plugs, product upgrade

Crash Requirement Changes

- Location of high-pressure pump optimized

Other Changes

- ULEV70: Tank Ventilation Pressure Sensor 1 G950 installed

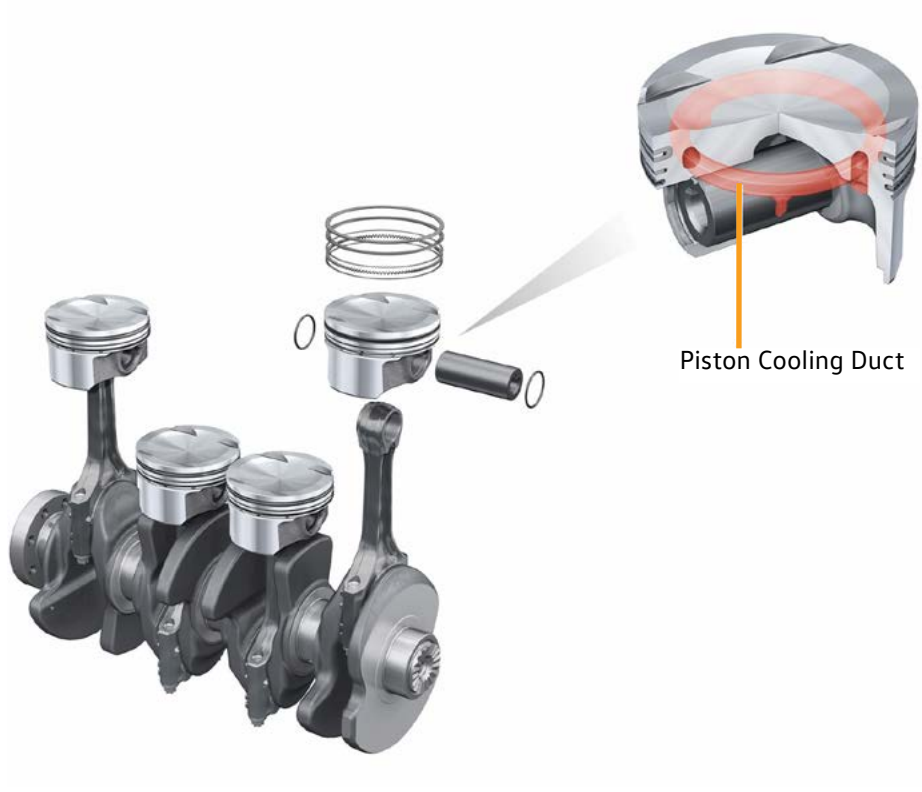
View from Intake Side

Mechanical

Pistons

EA888 Gen3

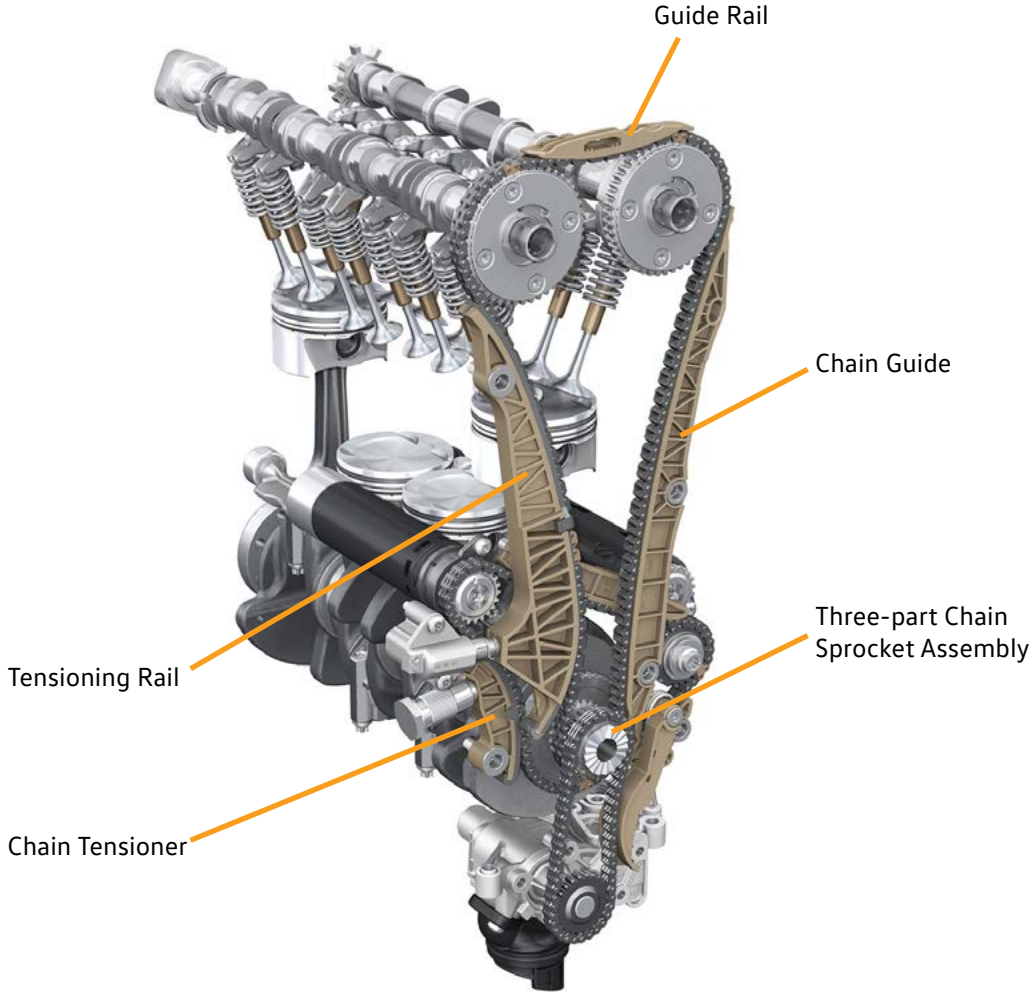
EA888 Evo4



Timing Chain

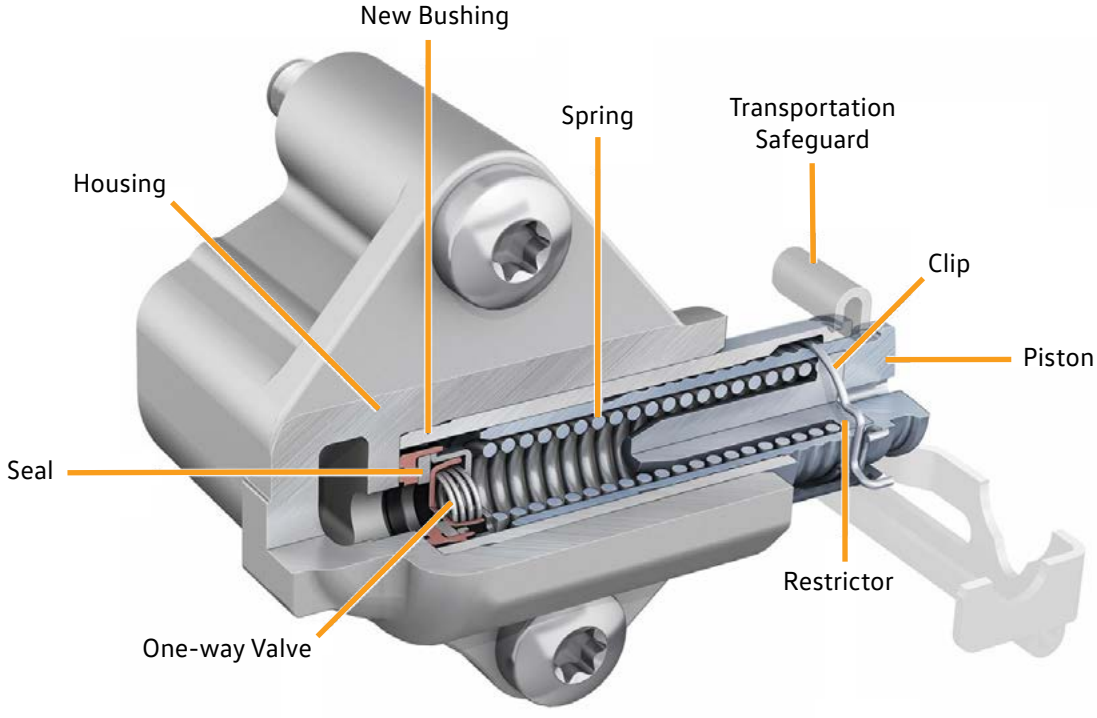
The timing chain has 170 links, the same amount as the previous Gen3 chain.

There are multiple colored links for use when setting the timing.

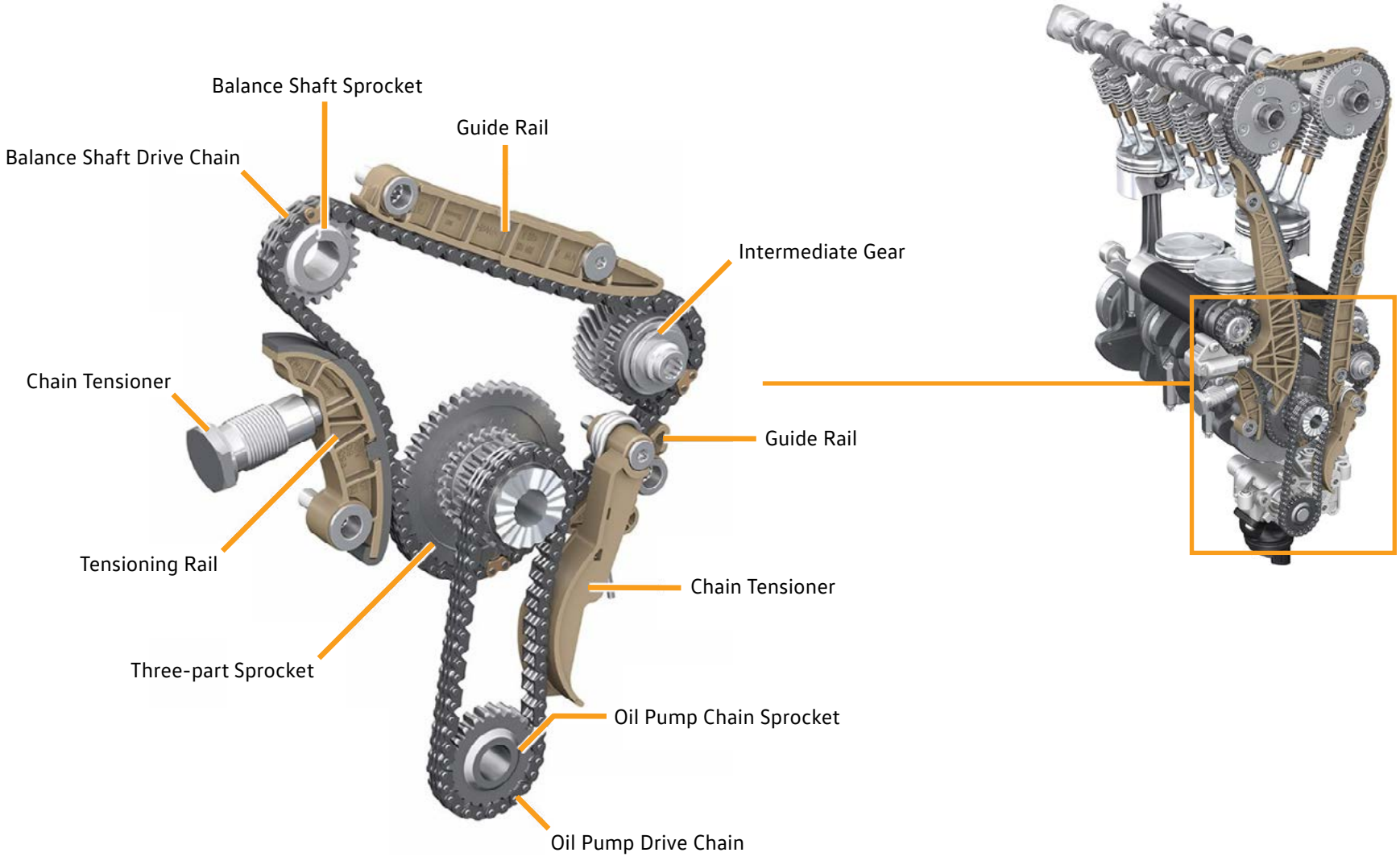


Timing Chain Tensioner

The timing chain tensioner does not use a pressure relief valve. Damping takes place using the high-flow one-way valve and the restrictor.

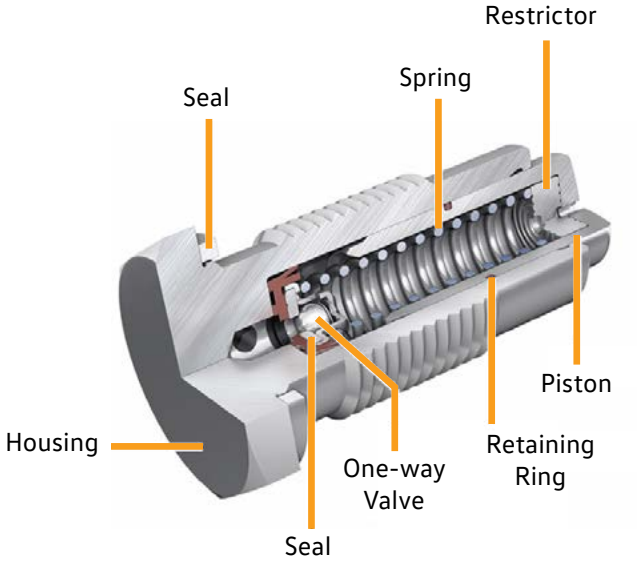


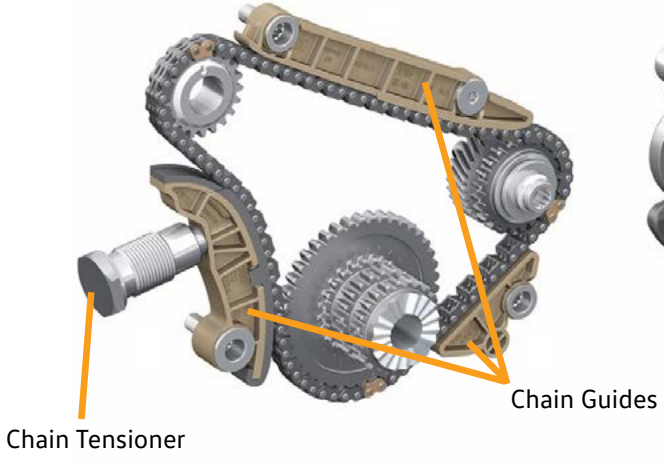
Balance Shaft and Oil Pump Drive

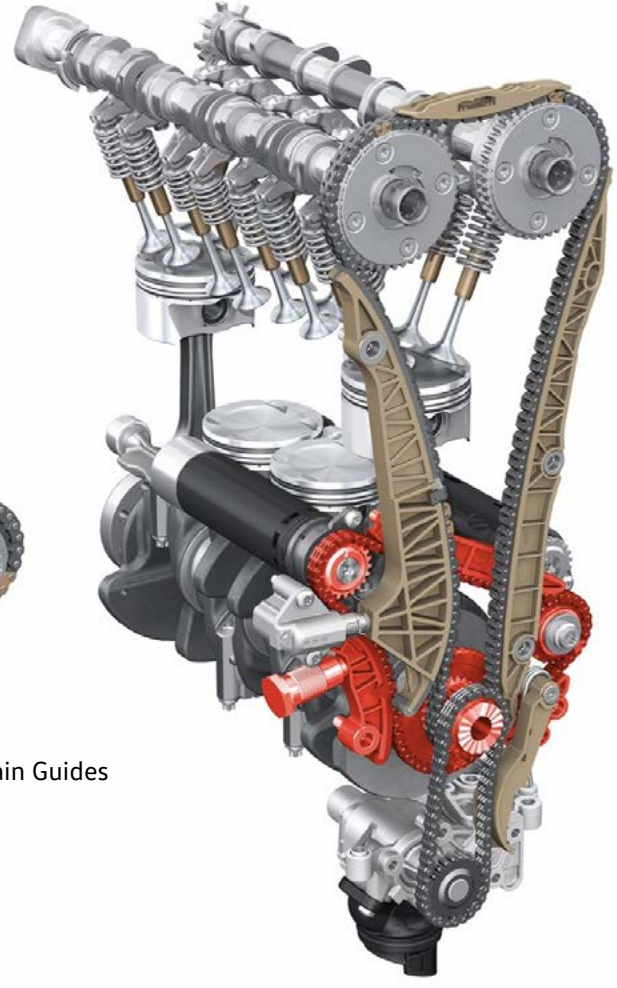


Balance Shaft Chain Tensioner

The balance shaft chain tensioner has a one-way valve that controls chain pressure.

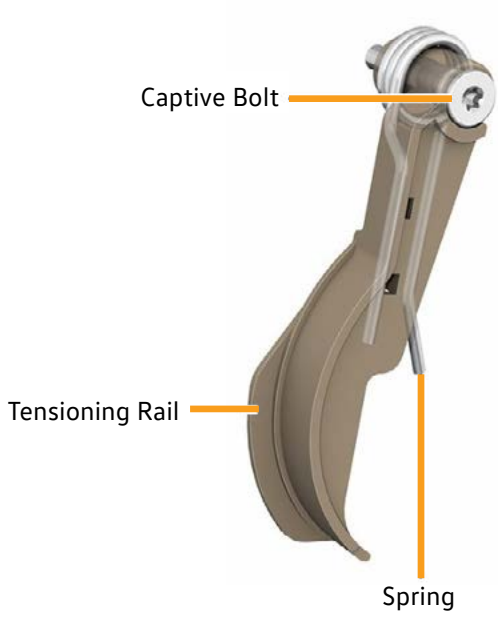


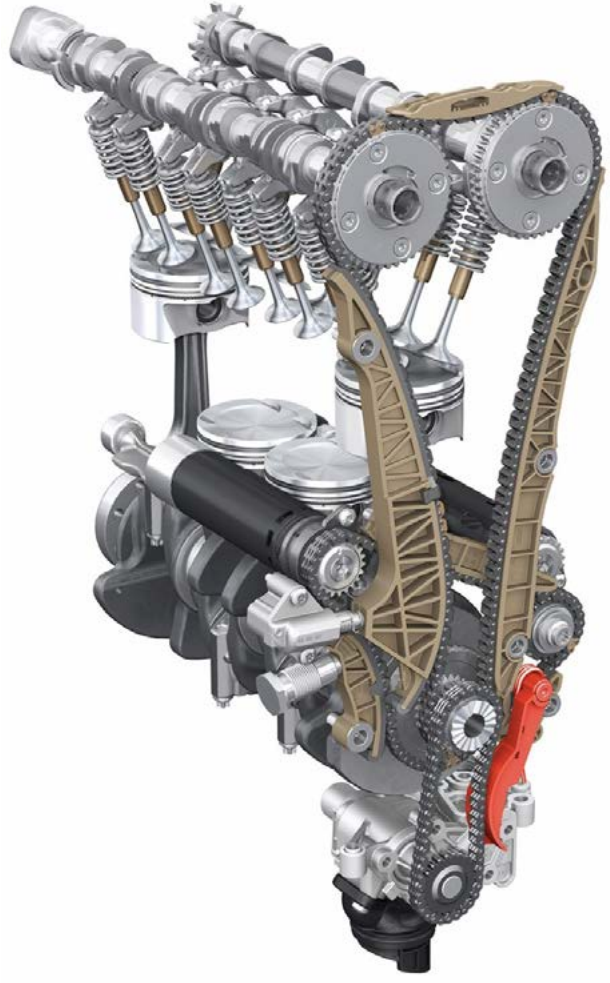




Oil Pump Drive

The chain tensioner has been optimized to reduce friction. The preload force of the spring is lower than in previous generations of the EA888 engine family.





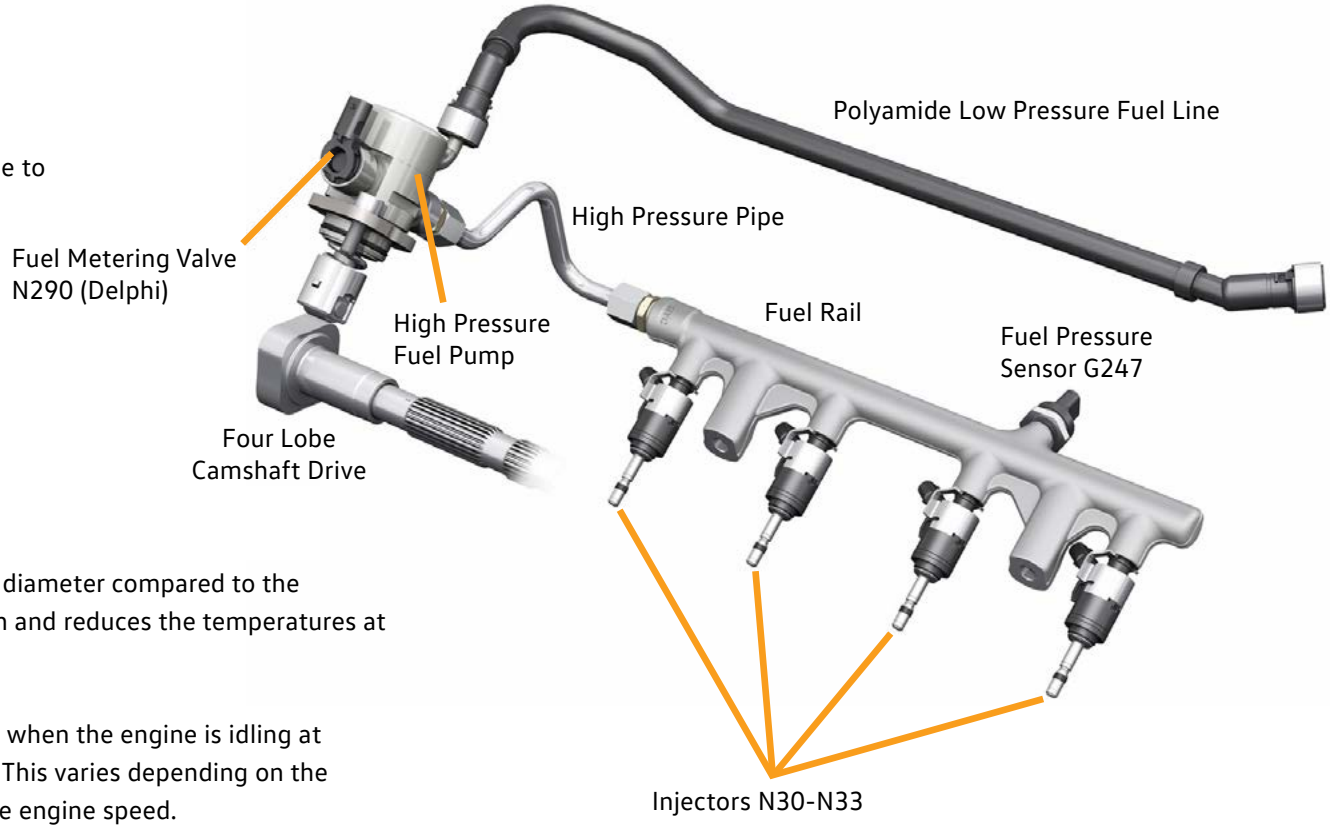
Fuel System

The most important goal was to improve raw particulate emissions. Improvements are:

- Increased fuel pressure
- Optimized direct injection solenoid valves
- Specially adapted injection control software for cold engine operating conditions

Features:

- Four-lobe camshaft drive
- Polyamide pipe instead of rubber fuel supply hose to high-pressure pump
- High fuel pressure up to 350 bar
- Forged high-pressure rail
- Modified injectors
  - Injector nozzle with 6 mm diameter
  - Reduced droplet size for improved mixture preparation



The new injector's nozzle and o-ring have a smaller diameter compared to the injector on the EA888 Gen3. This improves strength and reduces the temperatures at the splash plate.

The minimum pressure in the high-pressure system when the engine is idling at operating temperature is approx. 100 bar ± 20 bar. This varies depending on the amount of air required, the fuel temperature and the engine speed.

Crankcase Ventilation and Breather System + Fuel Tank Breather System

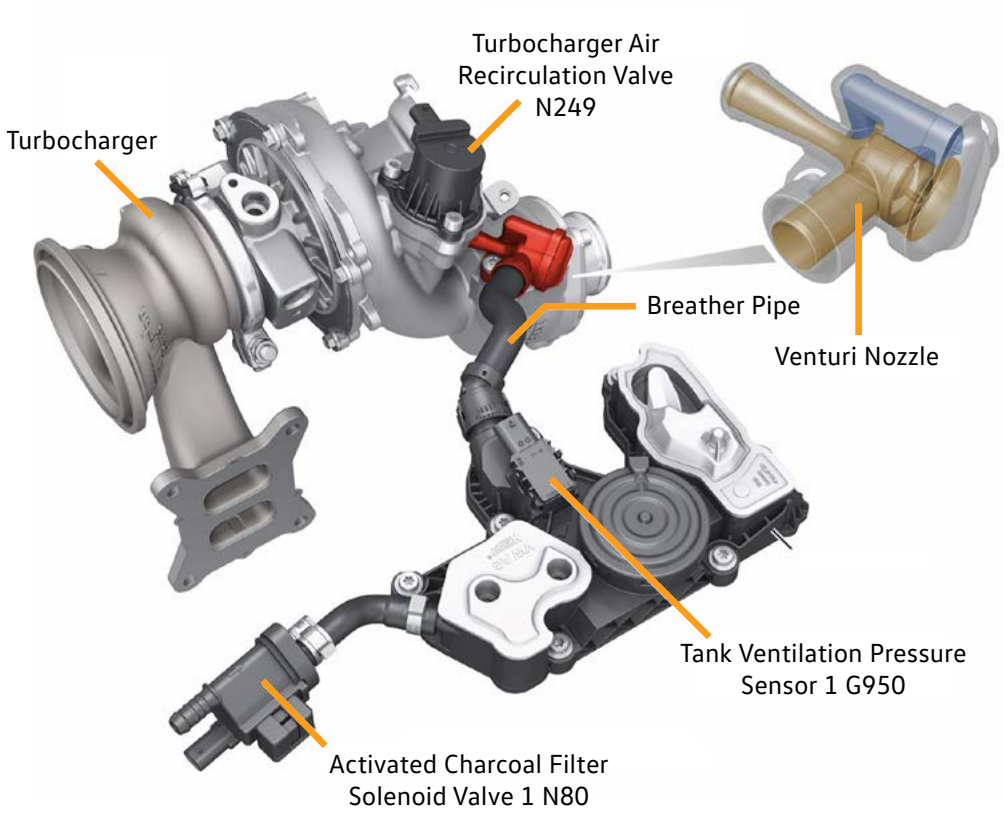
The crankcase ventilation and breather system is based on the EA888 Gen3. The goal was to ensure that the vacuum in the crankcase is maintained throughout the entire mapped range - i.e. at idling speed, under partial load and also when the engine is turbocharged. This was achieved by integrating a suction-jet pump at the inlet before the turbocharger.

A pressure sensor is located in the breather line leading to the turbocharger. This enables the system to be diagnosed at any time to check that it is working correctly. This ensures that the system has been reassembled correctly after repairs.

Pressure Sensor Roles:

- Measuring pressure in breather line (in turbocharged mode)
- In the event of a fault, such as a hole in the line that results in a leak, the vacuum that is normally in the crankcase is lost. The pressure sensor identifies this and reports it to the ECM

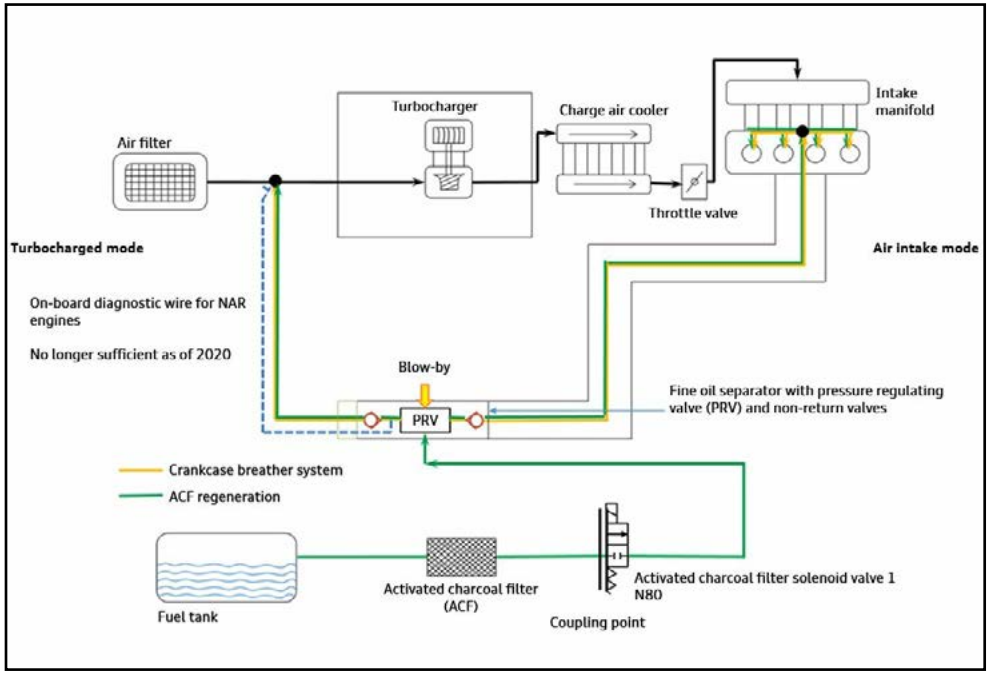
The tank breather system has also been altered. The tank breather system and the crankcase breather system are now separated from one another by two additional one-way valves in the oil separator module.



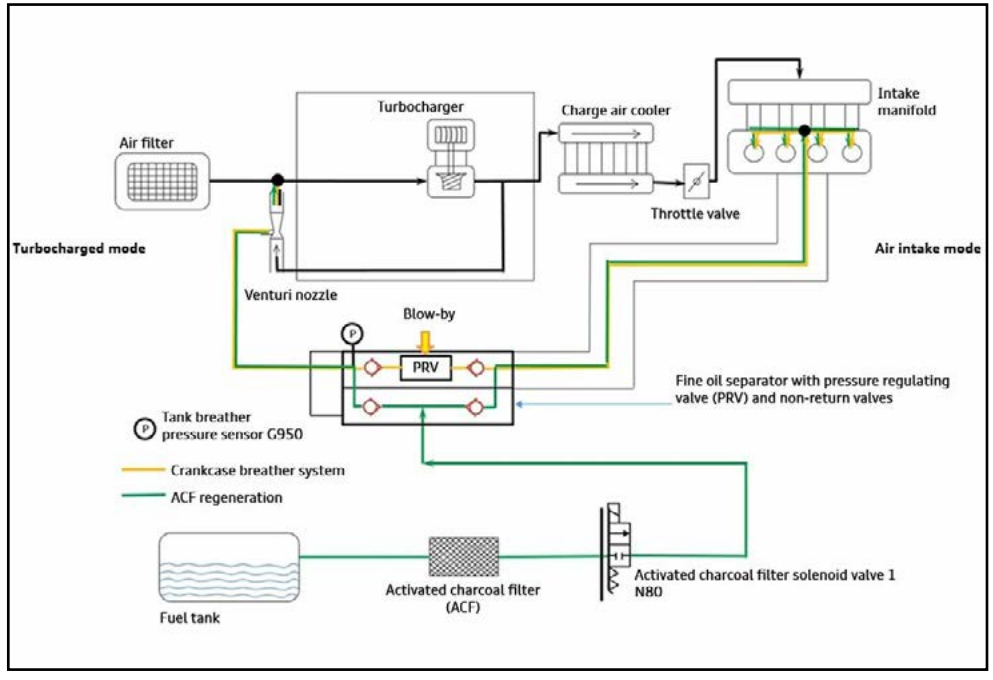
Crankcase Ventilation and Breather System

Crankcase and Fuel Tank Schematic Comparison

EA888 Gen3



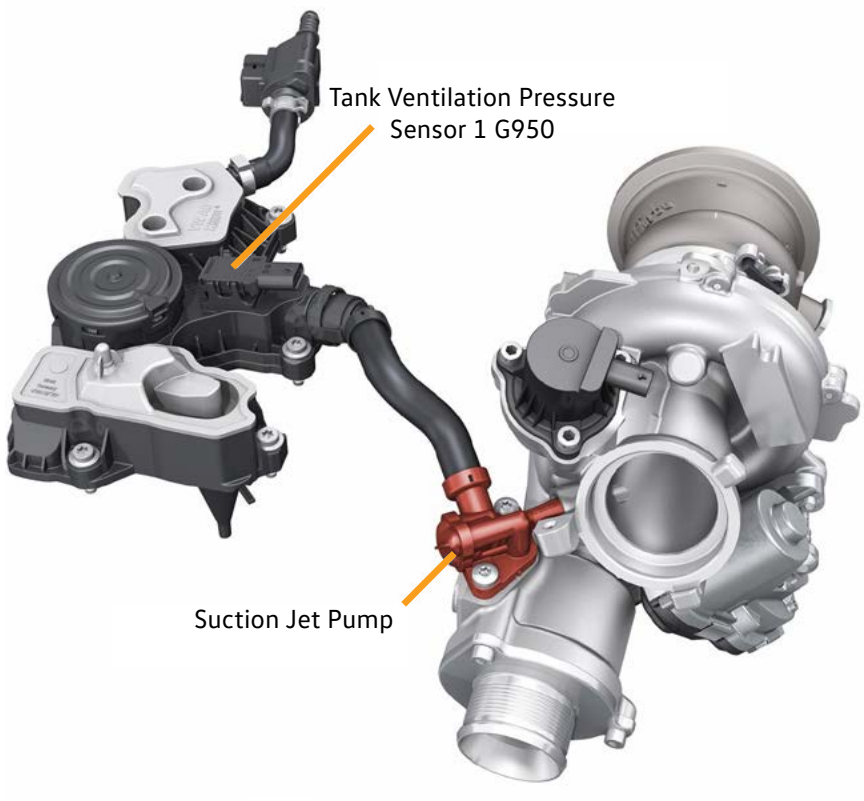
EA888 Evo4



Crankcase Breather System Components

Function of the suction-jet pump:

The suction-jet pump is located on the turbocharger and extracts blow-by and tank breather gases. It builds up pressure in the line that comes from the fine oil separator module. The gases enter before reaching the turbocharger's compressor. The pump uses the Venturi principle. It is driven by charge air which is routed into the suction-jet pump via a duct in the turbocharger housing.

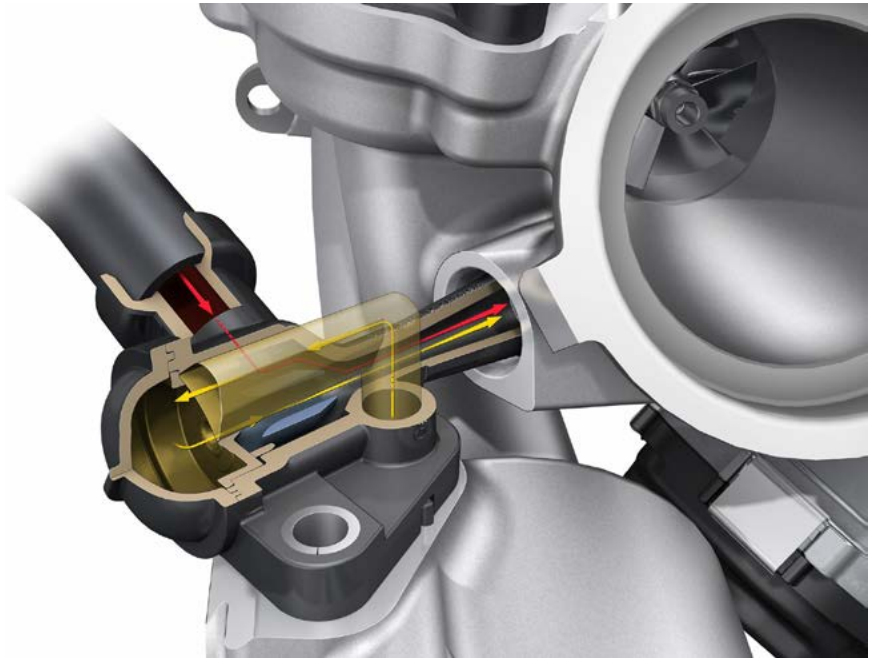


Crankcase Ventilation and Breather System

Crankcase Breather System Components

Role of suction-jet pump:

- Ensuring vacuum in crankcase is maintained throughout entire mapped range, especially in the turbocharged state
- The suction-jet pump is on the pressure side of the turbocharger. Passing air creates the venturi effect, and this increases the vacuum in the crankcase
- Breather gases cannot escape into the environment when a permanent vacuum is present



Blow-by and Tank Breather Gases

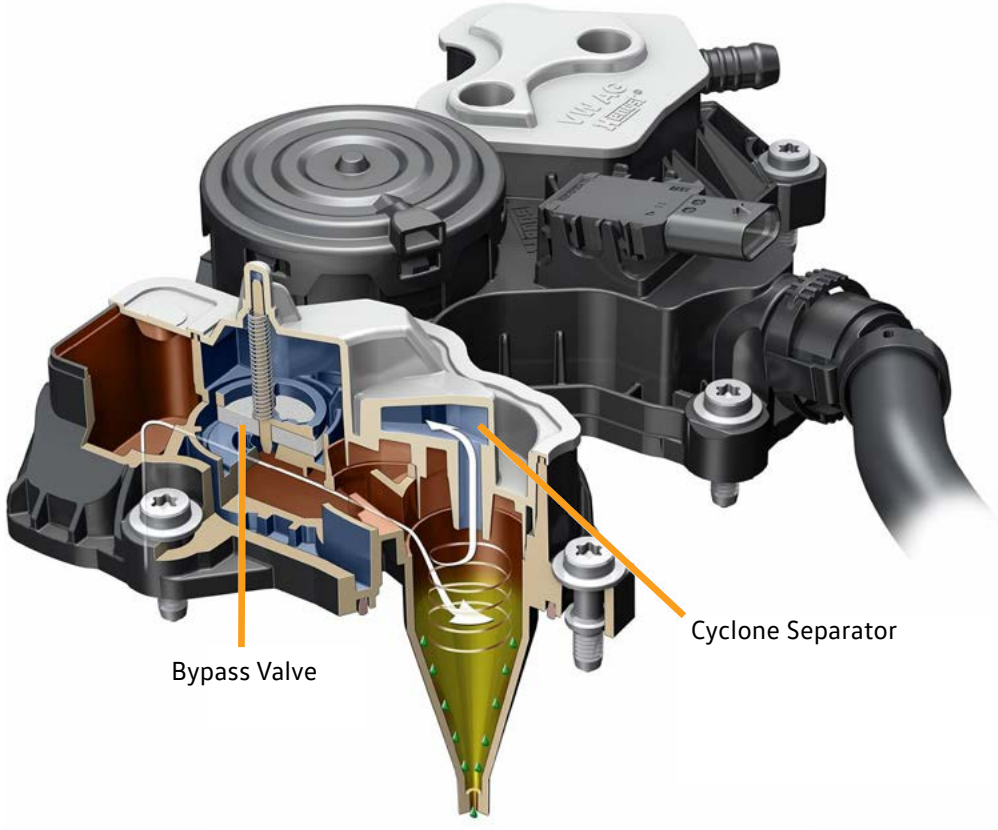
Charge Air

Crankcase Ventilation and Breather System

Crankcase Breather Bypass Valve

The fine oil separator modifications created significant oil discharge improvements in the mapped range. The changes are:

- A layer of non-woven material added as an additional separator
- The opening pressure has been adjusted to improve separation
- Air flows through the non-woven material and a vacuum is generated by the suction-jet pump, allowing for the correct pressure adjustments

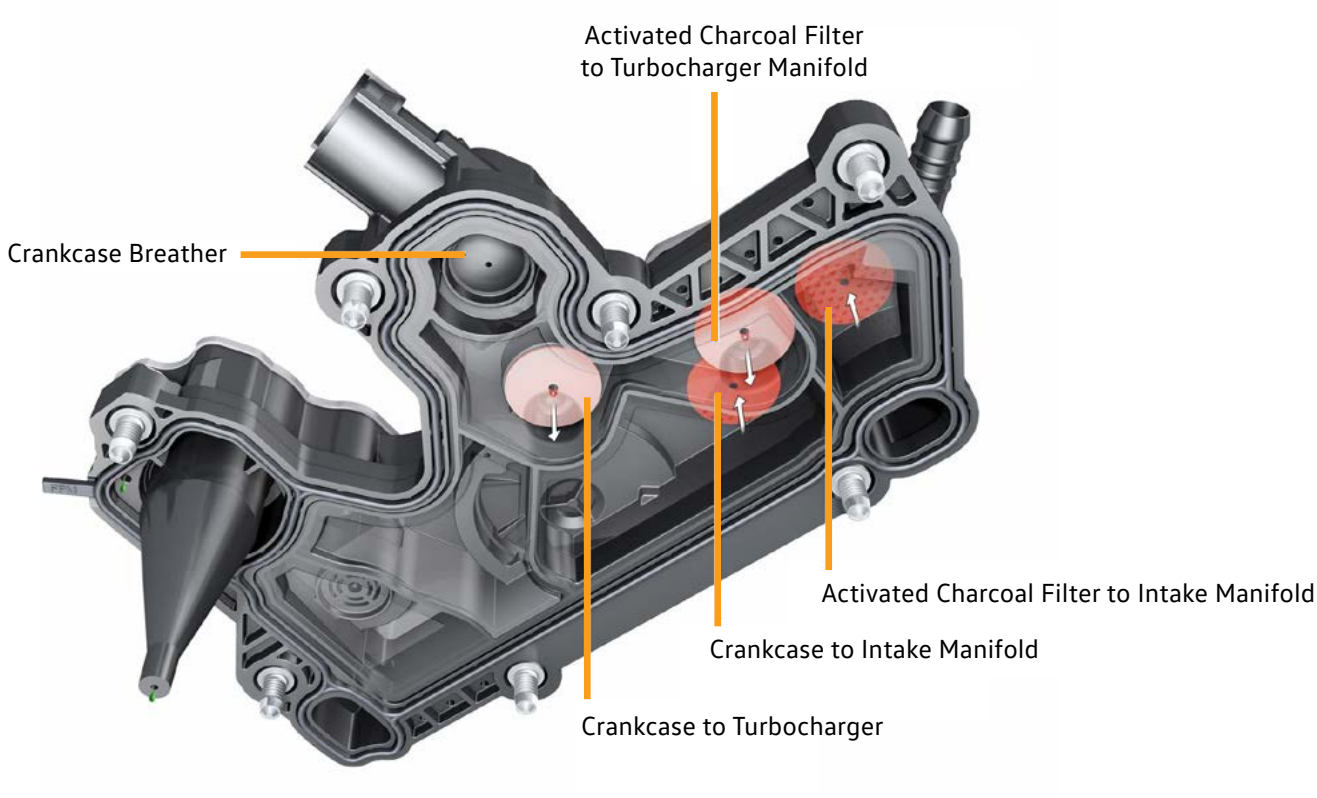


Crankcase Ventilation and Breather System

Crankcase Breather

The flow rate of the activated charcoal filter system has been improved by:

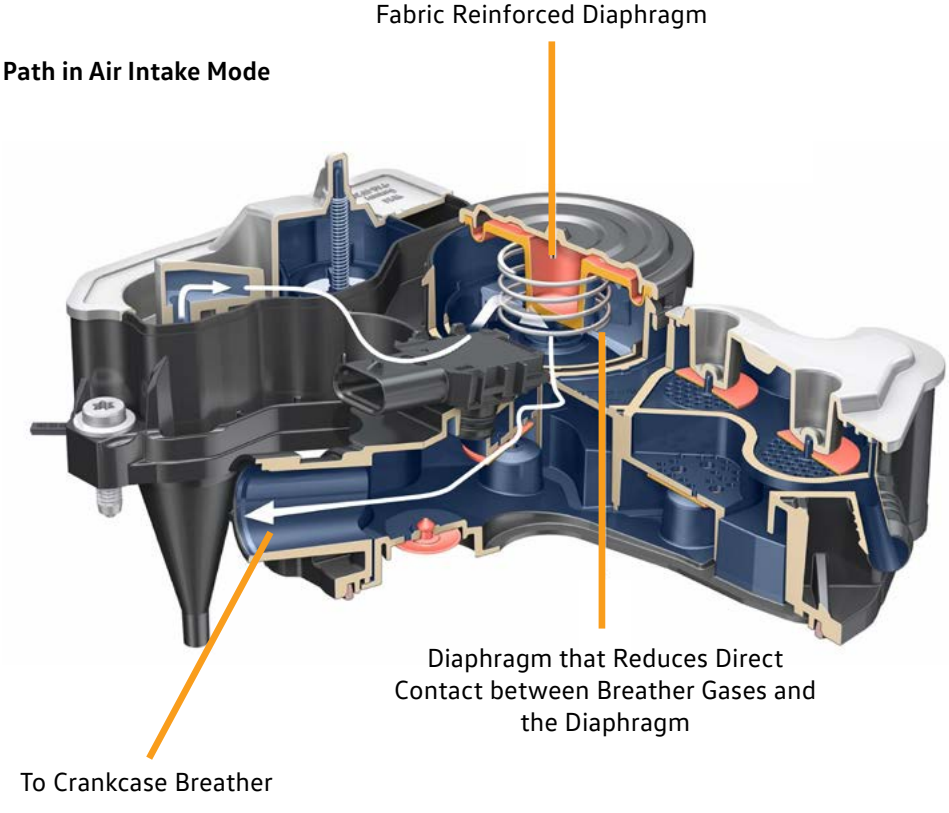
- Separate non-return valves for activated charcoal filter and crankcase breather system
- Improved regeneration under full load thanks to suction-jet pump (Venturi nozzle)



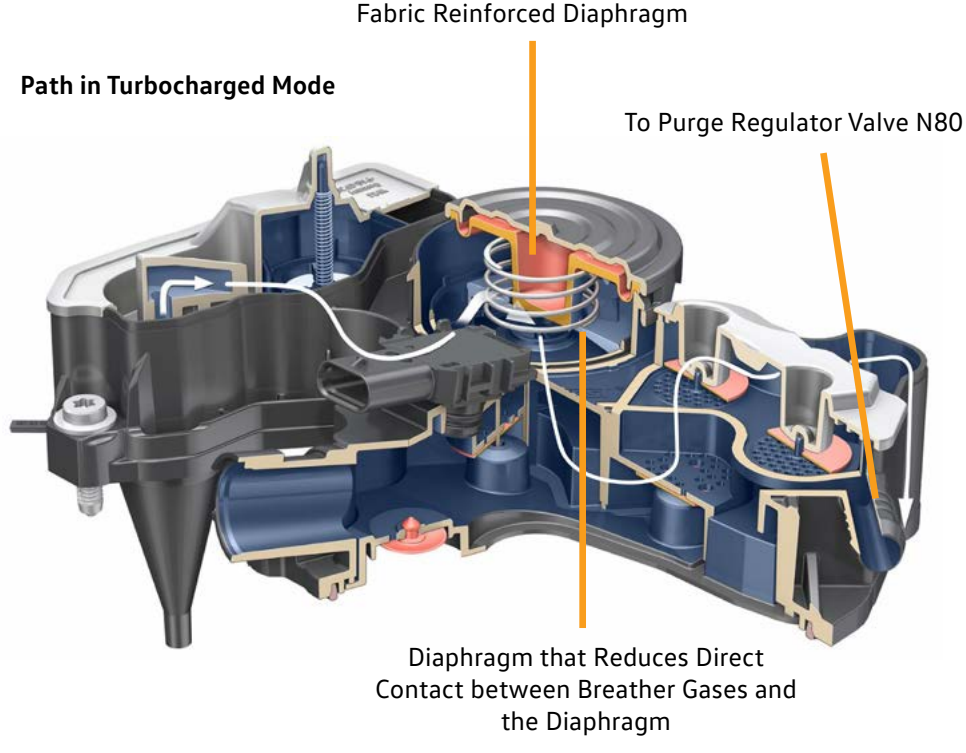
Crankcase Ventilation and Breather System

Crankcase Breather

Path in Air Intake Mode



Path in Turbocharged Mode

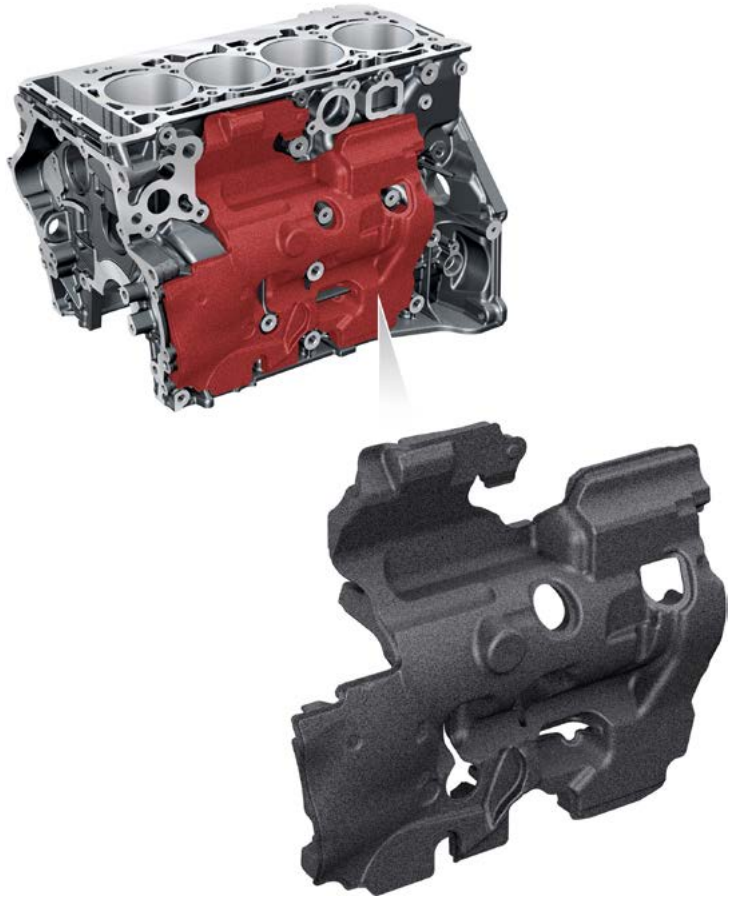


Acoustic Improvements

Noise Insulation

The following changes were made to improve the engine's acoustic properties:

- Insulating mat on intake side of crankcase
- Additional noise-reducing reinforcements cast into the crankcase

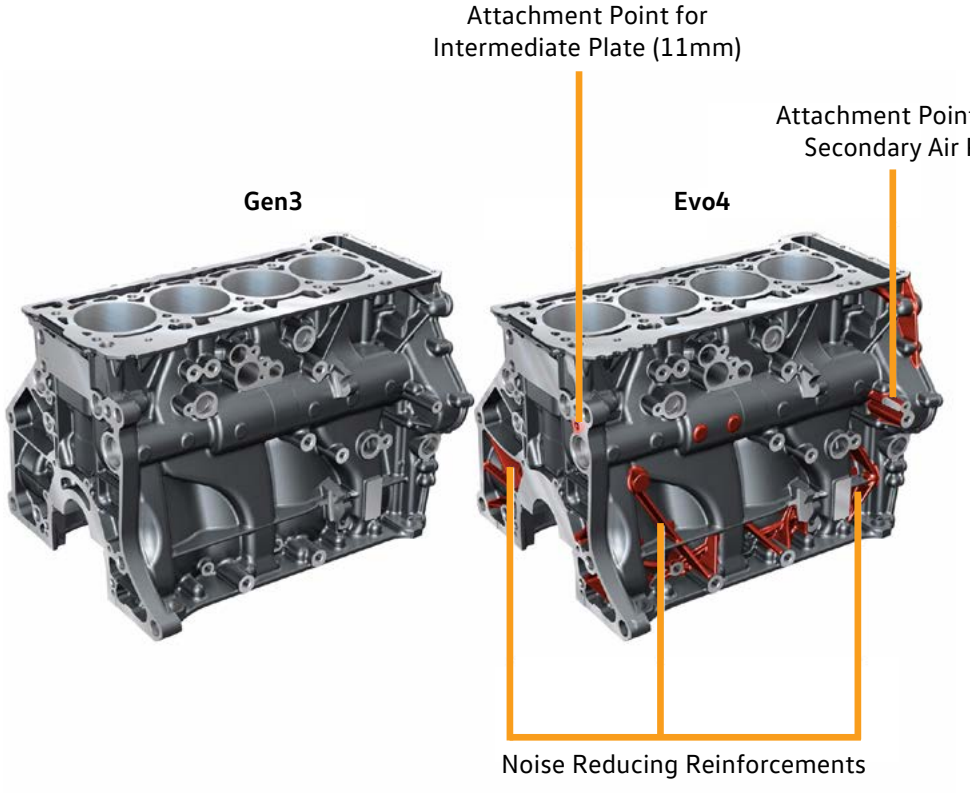


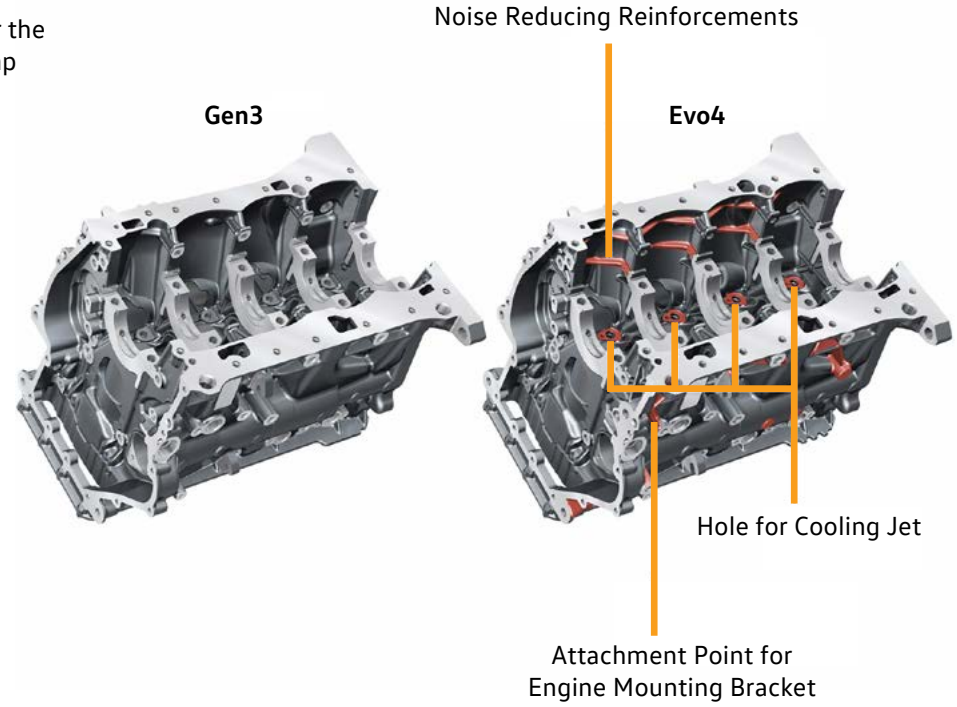
PUR Foam Insulating Mat

Acoustic Improvements

Noise Insulation

Crankcase modifications compared to the Gen3 engine:





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