

Self-Study Programme 331

Variable Anti-roll Bars on the Touareg

Design and Function



The running gear is a key component of the entire vehicle. It transmits all the forces acting between the road surface and the body. It therefore has a direct effect on driving comfort and driving safety.

The Touareg is a sporty SUV off-road but also a sporty, safe car on the road, with firm suspension, stiff dampers and rigid anti-roll bars.

The best tuning for optimum off-road mobility, however, requires soft suspension with low damping factor and less rigid anti-roll bars. To solve this conflict of requirements, ThyssenKrupp has developed a variable anti-roll bar.

It consists of split anti-roll bars which are an optimal compromise between dynamic handling characteristics, driving comfort and off-road mobility - it is a coupling that is also switchable under load.



This self-study programme describes the design and function of new developments. The contents will not be updated.

Please always refer to the relevant Service Literature for all inspection, adjustment and repair instructions.

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Introduction



Conventional anti-roll bar



Coupling rod

Anti-roll bars improve cornering behaviour by reducing body roll.

An anti-roll bar consists of a U-shaped tube. The middle part of the anti-roll bar is secured to the subframe by means of rubber-bush bearings that allow rotary movement. It is also directly attached to the spring dampers by means of a coupling rod. When the wheel on the outside of the corner bounces, the anti-roll bar reduces the rebound movement of the wheel on the other side of the axle on the inside of the corner.

Variable anti-roll bar

An off-road vehicle requires an extremely rigid anti-roll bar on the road. This prevents extreme body roll due to the high centre of gravity when cornering at high speeds. Off-road, anti-roll bars with low spring rates allow more torsional twist on the axle. This achieves continuous traction and high driving comfort.



Sporty, safe on-road handling



Optimum off-road mobility with high driving comfort



The variable anti-roll bar is a suspension system for optimising on-road and off-road driving characteristics. A hydraulically operated claw coupling couples and decouples the two anti-roll bar arms.

On-road driving

On-road, the anti-roll bar is coupled and extremely resistant to torsional twist (rigid). This allows sporty, safe on-road handling.



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Off-road driving

Off-road, the anti-roll bars are uncoupled. When the anti-roll bars are uncoupled, the wheels on one axle are free to bounce and rebound independently of each other. This increases off-road mobility, driving comfort and traction.



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Torsional twist

When the anti-roll bars are uncoupled, the torsional twist on an axle is increased by max. 60 mm.



In the examples below, normal torsional twist has already been reached.

When the anti-roll bars are uncoupled, the axle can achieve an additional torsional twist of max. 60 mm either on one side or as an aggregate on both sides.





Block diagram

Uncoupling an anti-roll bar



Coupling an anti-roll bar



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Variable anti-roll bar and its components

The overall system of the variable anti-roll bar consists of three main components:

- the hydraulic supply unit
- the anti-roll bar control unit
- the variable anti-roll bars

Rear axle anti-roll bar



Function of the variable anti-roll bar

When the ignition is switched on, the variable anti-roll bar is functional.

Uncoupling by pressing the button



Only when

- the vehicle road speed is less than 40 km/h,
- lateral acceleration is less than 0.5 g and
- the control unit is not in fault mode,

can the driver uncouple the anti-roll bars.



The opening pressure of the anti-roll bar is 110 bar. The coupling operation display in the dash panel insert flashes until the opening pressure has been reached.

The rear axle anti-roll bar is uncoupled first, then the front axle. When front axle uncoupling is completed, the coupling operation display appears continuously.

The pump motor continues to run throughout the entire operation and stops when a system pressure of 145 bar has been reached to charge the pressure accumulator.

If the driver presses the coupling button again or a system fault occurs, the uncoupling operation is cancelled.



Only when the gearbox is switched to "low" will the anti-roll bar uncoupling motor switch on automatically. The pressure accumulator will charge the system without the driver having to press the button. The system can thus react very quickly if the driver presses the button to uncouple the anti-roll bars.

Coupling by pressing the button

For driving dynamic reasons, the front axle anti-roll bar is coupled before the rear axle anti-roll bar.

The anti-roll bar coupling operation is indicated by the coupling operation display flashing in the dash panel insert.

When the coupling operation is completed, the associated display disappears from the dash panel insert.





When the front axle is uncoupled and the pressure in the pressure accumulator is below 70 bar, the coupling operation for the rear axle is delayed until the pressure reaches 70 bar again. This function protects the pressure accumulator from destruction.

The pump motor continues to run during the entire operation and stops when pressure in the system reaches 110 bar.

Automatic coupling

The system couples the front and rear anti-roll bars automatically when

- the vehicle exceeds a road speed of 50 km/h,
- lateral acceleration exceeds 0.9 g at a road speed below 35 km/h or
- lateral acceleration exceeds 0.7 g at a road speed above 35 km/h.



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System pressures

Pressure	Description	
70 bar	Minimum pressure	 To protect the pressure accumulator from destruction, pressure in the system must be over 70 bar during the coupling operation. When the front axle is coupled and pressure in the pressure accumulator is below 70 bar, the system delays coupling of the rear axle until pressure reaches a minimum level of 70 bar.
90 bar	Minimum pressure	• When the gearbox is switched to "low", the pressure accumulator is recharged if the pressure drops below the minimum level of 90 bar.
110 bar	System pressure	 The anti-roll bar opening pressure is 110 bar. If the system pressure drops below 90 bar during the uncoupling operation, the pump starts and builds up system pressure to 110 bar.
145 bar	Max. system pressure	 The pump motor runs during the entire uncoupling operation and stops when system pressure reaches 145 bar in order to charge the pressure accumulator. This is monitored by the hydraulic unit pressure sensor for anti-roll bar uncoupling. If pressure drops below 115 bar in uncoupled mode, the system is recharged to 145 bar.

Design and function

Hydraulic supply unit

The hydraulic supply unit on the Touareg is located behind the rear left side trim panel above the rear wheel housing.



The supply unit consists of a hydraulic pump driven by an electric motor, an expansion tank, a pressure accumulator, a pressure sensor and two anti-roll bar switch valves.

This supply unit allows the rear axle and front axle anti-roll bars to be switched separately.

Anti-roll bar uncoupling switch valves N399 and N400



When the driver presses the anti-roll bar uncoupling button, the switch valves N399 and N400 are electrically operated.

The switch element connects the duct from the pressure accumulator to the appropriate duct in pressure chamber 1 of the related anti-roll bar.

The switch valves are designed to prevent leaks almost completely. This is achieved by the gap between the switch element and the sleeve closing as a result of suspended particles in the hydraulic fluid.

System pressure can thus be maintained over a long period of time.





Design and function

Pressure accumulator



The pressure accumulator is a hydropneumatic diaphragm unit. It accumulates hydraulic pressure energy and supplies it on demand to the hydraulic supply unit.





The pressure accumulator is mounted directly on the pump housing. It is divided into two chambers by a diaphragm. The lower chamber receives the hydraulic fluid which is pumped by the anti-roll bar uncoupling motor. The upper chamber is filled with nitrogen gas. Incorporating compressible nitrogen gas into the hydraulic circuit allows energy to be stored. This means that gas and fluid must be physically separated.

