PORSCHE

Chassis

Technology Workshop Cayenne

Driving dynamic properties of all Porsche models

Optimum **driving dynamics** and **steering precision** from high-performance chassis, steering and all-wheel drive systems

Performance **brakes** and efficient **high-performance tyres**

Highest level of functional **spread** between performance and fuel consumption, as well as driving dynamics and comfort

Optimal efficiency with the specific target parameters and framework conditions

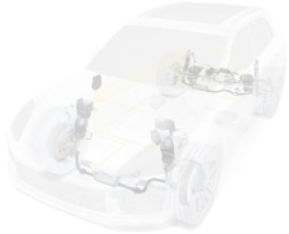
Three-stage Porsche chassis development for superior performance

Total vehicle concept

- Systematic attention to driving dynamic requirements in total vehicle concept
- Driver-oriented operating concept (seat position, steering wheel, pedals)

Chassis mechanics

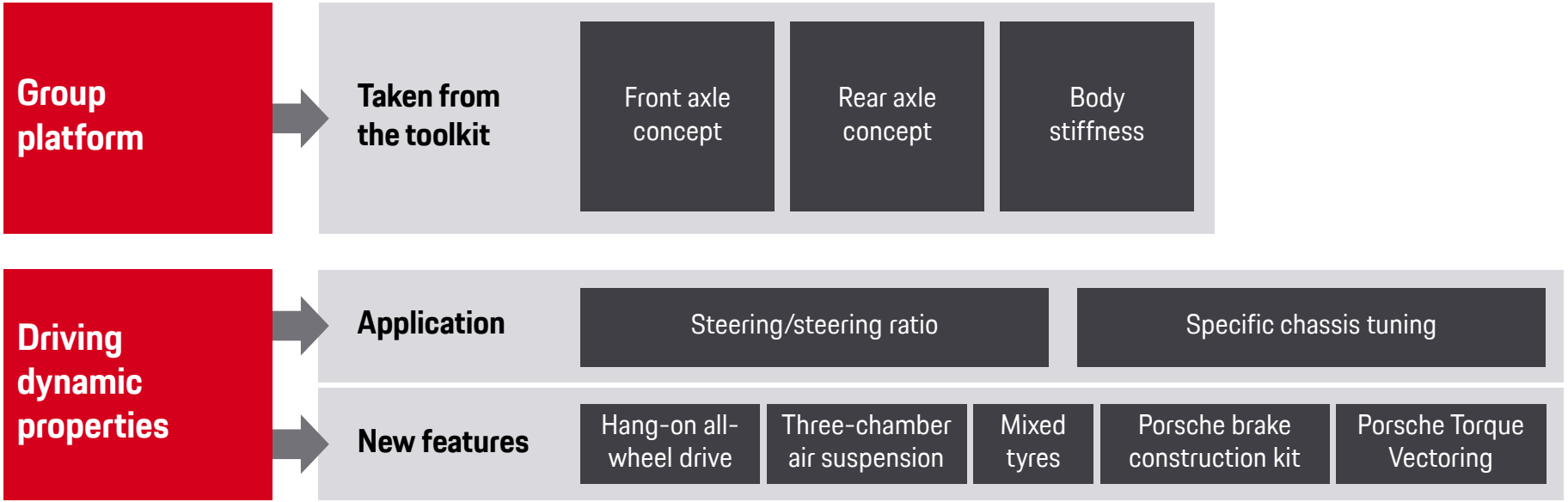
- Precision suspensions
- High-performance fixed-calliper brakes
- High-performance tyres
- Lightweight design



Mechatronic chassis systems

- Further boost to performance potential
- Increased spread between driving dynamics and comfort

Use of intelligent modular technologies within the Group



Total vehicle concept

	Cayenne S (previous model)	**Cayenne S**
Wheelbase (mm)	2,895	2,895
Track width front/rear (mm)	1,655/1,669	1,680/1,673
Axle load distribution front/rear (%)	54.2/45.8	56.4/43.6
Power (kW/hp)	309/420	324/440
Drive system (-)	Hang-on all wheel drive	Hang-on all wheel drive
Tyre size front	255/55 R 18	255/55 R 19
Tyre size rear	255/55 R 18	275/50 R 19

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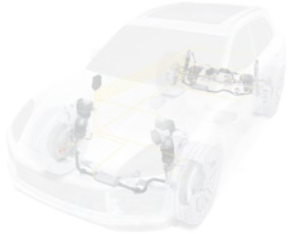

Mechatronic chassis systems

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Chassis mechanics – Axles

- Newly developed front axle
- Multi-link suspension instead of double wishbone at the front
- Responsiveness, precision and straight-line steering further optimized

Chassis mechanics – Brakes

	Cayenne	Cayenne S	Cayenne Turbo PSCB	PCCB
Front axle	Ø **350** mm x **34** mm 18-inch	Ø **390** mm x **38** mm 19-inch	Ø **415** mm x **40** mm 20-inch	Ø **440** mm x **40** mm 21-inch
Delta previous model	0 mm/0 mm	+30 mm/+2 mm	+25 mm/+2 mm	+20 mm/0 mm
Rear axle	Ø **330** mm x **26** mm	Ø **330** mm x **28** mm	Ø **365** mm x **28** mm	Ø **410** mm x **32** mm
Delta previous model	0 mm/-2 mm	0 mm/0 mm	+7 mm/0 mm	+40 mm/+2 mm

- New Porsche Surface Coated Brake (PSCB) standard in the Cayenne Turbo
- New PCCB with bigger brake discs
- New lightweight brake with aluminium pan (so-called pin disc) in Cayenne S
- Optimised pedal feel

Chassis mechanics – The world first Porsche Surface Coated Brake PSCB

Brake disc with tungsten carbide coating

Performance

Improved responsiveness
and higher fading stability

Resolution of conflict between performance and brake dust

Reduced brake dust without compromising performance, no comfort pads required

Reduction in wear

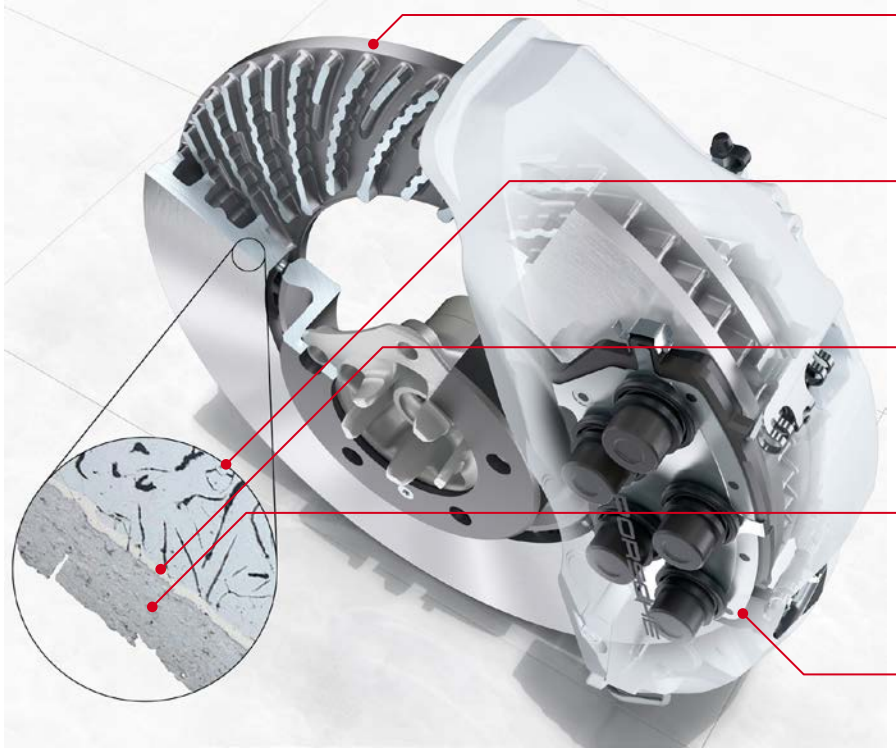
Increased durability by 30 per cent and reduced fine dust

Look/corrosion

Lasting optimal appearance due to corrosion-free friction surfaces, robust friction behaviour

Chassis mechanics – Porsche Surface Coated Brake PSCB

Structure of the PSCB



Brake disc and calliper

Grey cast brake disk in lightweight construction with ten piston fixed calliper and large surface area

Thermally treated surface:

Procedure:
Roughen and clean laser-structured surface

Ductile intermediate layer:

Galvanically applied intermediate layer to optimize layer adhesion

Hard metal layer (Hardness > 1000 HV):

Tungsten carbide (W_2C);
Coated with high velocity oxygen fuel (HVOF)

PSCB brake pads

Special material composition

Chassis mechanics – Porsche Surface Coated Brake PSCB

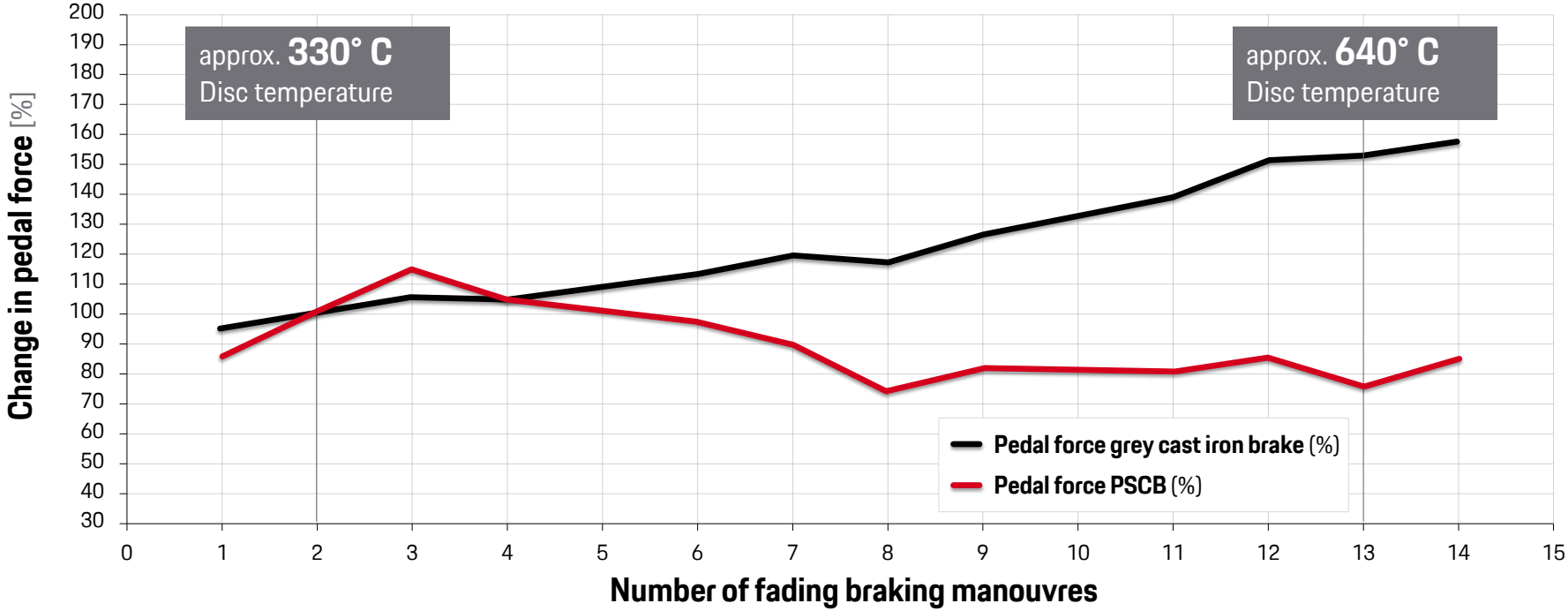
Structure of the PSCB

Hard metal layer (Hardness > 1000 HV):

- Tungsten carbide (W_2C);
- Coated with high velocity oxygen fuel (HVOF)

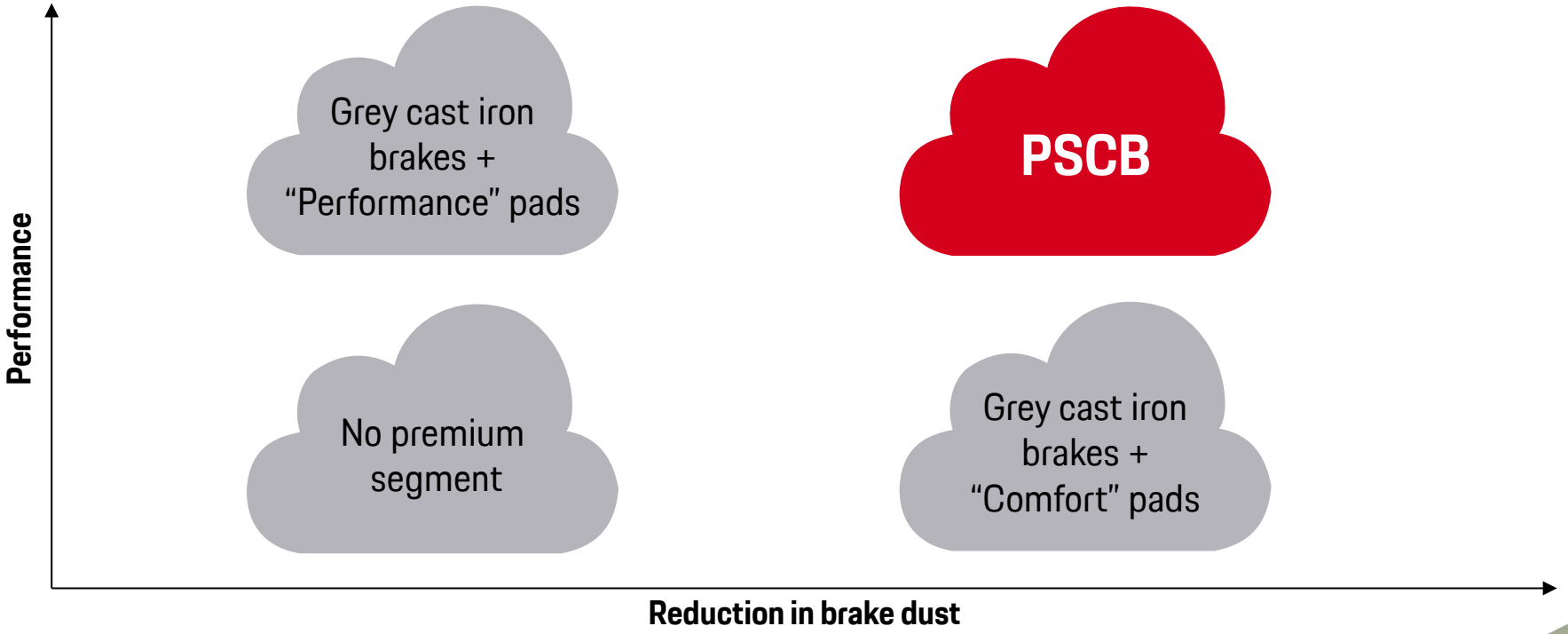
Chassis mechanics – Performance of the PSCB

Fading stability of PSCB brake at 0.8 g braking

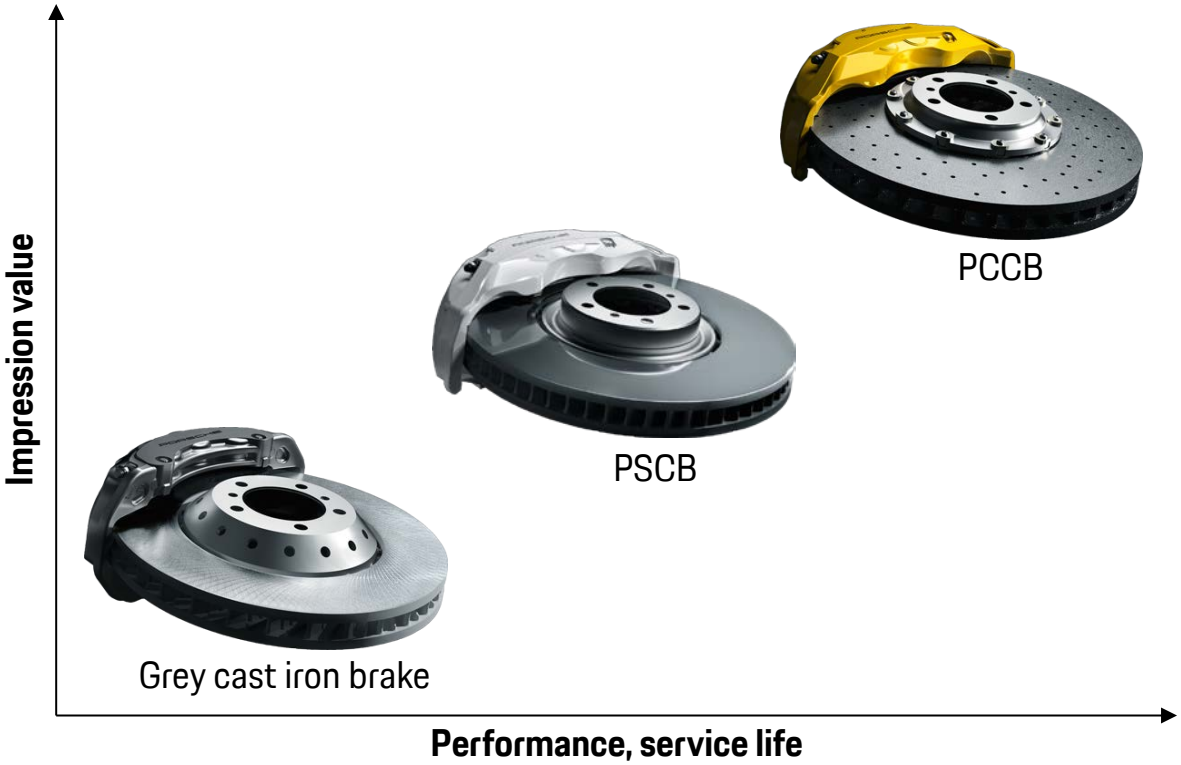


Chassis mechanics– PSCB brake features

Conflict of objectives between performance and brake dust



Chassis mechanics – Porsche brake philosophy



The PSCB closes the gap between the high-performance grey cast iron brakes and the PCCB ceramic brakes suitable for racing

PSCB is available as an option for Cayenne and Cayenne S

Chassis mechanics – Extensive range of wheels

	19 inch	20 inch	21 inch
Front axle tyre size	255/55 ZR19 (8.5J)	275/45 ZR20 (9.0J)	285/40 ZR21 (9.5J)
Rear axle tyre size	275/50 ZR19 (9.5J)	305/40 ZR20 (10.5J)	315/35 ZR21 (11.0J)

For the first time mixed tyres with different sizes at the front and rear wheels for the Cayenne

19" basic and S-wheel designed as a forged wheel

Chassis mechanics – High-performance tyres

Wide-ranging requirements for high-performance tyres

- Steering precision and agility
- High level of driving stability and driving pleasure
- Maximum driving performance
- Best possible ride comfort
- Best-in-class braking distances
- Low rolling resistance coefficients

Implemented in the new Cayenne through

- Typical Porsche mixed tyres
- Larger wheel diameter
- Systematic tyre development with respect to driving dynamics and driving quality
- Confirmation of the typical Porsche tyre properties with the N-marking

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Mechatronic chassis systems

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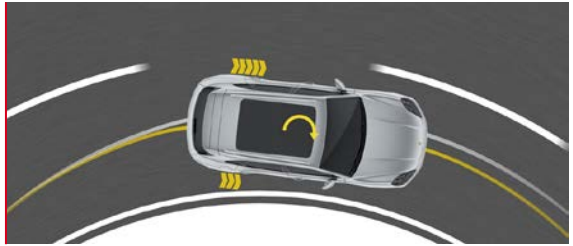
Mechatronic chassis systems

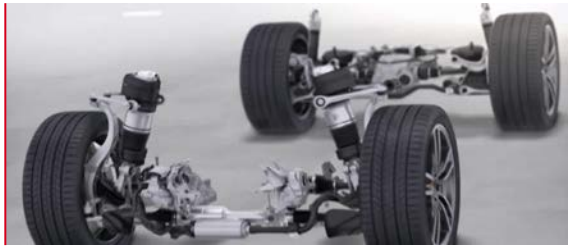
Adaptive three-chamber air suspension with PASM

Rear-axle steering

Controlled differential lock/PTV+



Electromechanical roll stabilisation



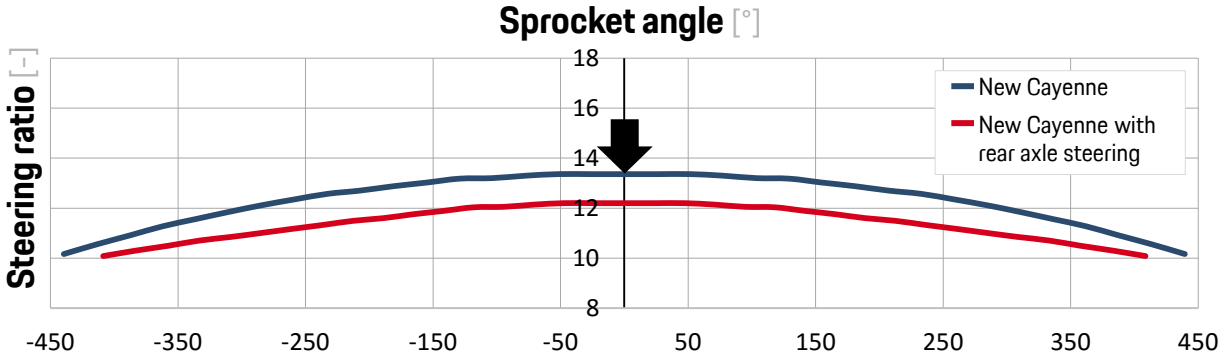
Hang-on all-wheel drive

Electromechanical steering

Chassis systems – Electromechanical steering with a special controller

- More direct steering ratio for a sporty driving style
- Stiff system design for optimum steering precision
- Porsche specific controller with force-feedback for a Porsche-typical steering feel with optimised steering response

Chassis systems – Electromechanical steering with a special controller



Model	Platform	Platform with rear axle steering	New Cayenne	New Cayenne with rear axle steering
Steering ratio	15.8:1	13.3:1	13.3:1	12.2:1

- More direct steering behaviour and increased agility
- Optimum steering precision and typical Porsche feedback

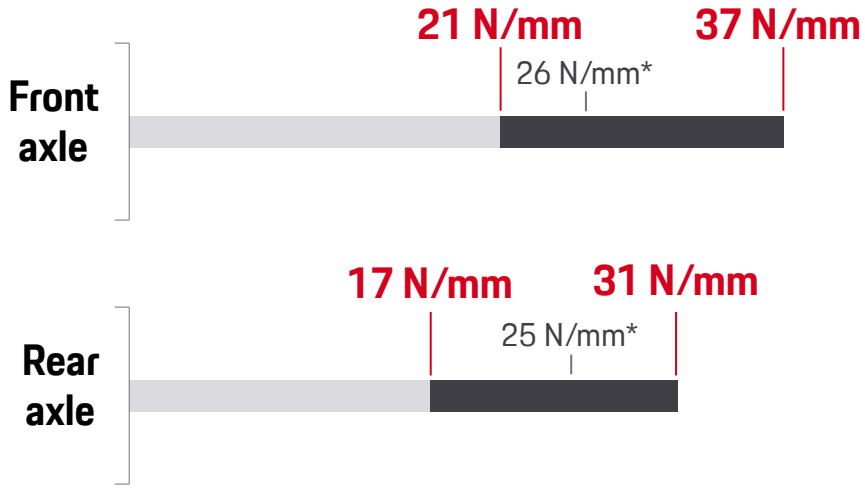
Steering ratio is 10 to 15 per cent more direct compared with the platform and previous model

Performance-oriented system layout with increased stiffness including aluminium tie

increased rotary vane stiffness in the Cayenne with rear axle steering (3.3 Nm/° instead of 2.0 Nm/°)

Further optimised system weight of 15.0 kg at maximum boost force of 16.0 kN

Chassis systems – Adaptive air suspension with PASM



*One-chamber air suspension of the previous model E2 II

Three-chamber air suspension in conjunction with regulated twin-tube damper

Spring rate switching according to the driving situation and the selected driving mode

Maximum spread between **driving dynamics** and **ride comfort**

Reduces rolling and **pitching movements**

Effects of **driving dynamic properties**

Chassis systems – Rear axle steering

At low driving speeds

Reduces the steering angle required
→ **Makes steering more manageable**

Virtual shortening of wheelbase
→ **Increased manoeuvrability**

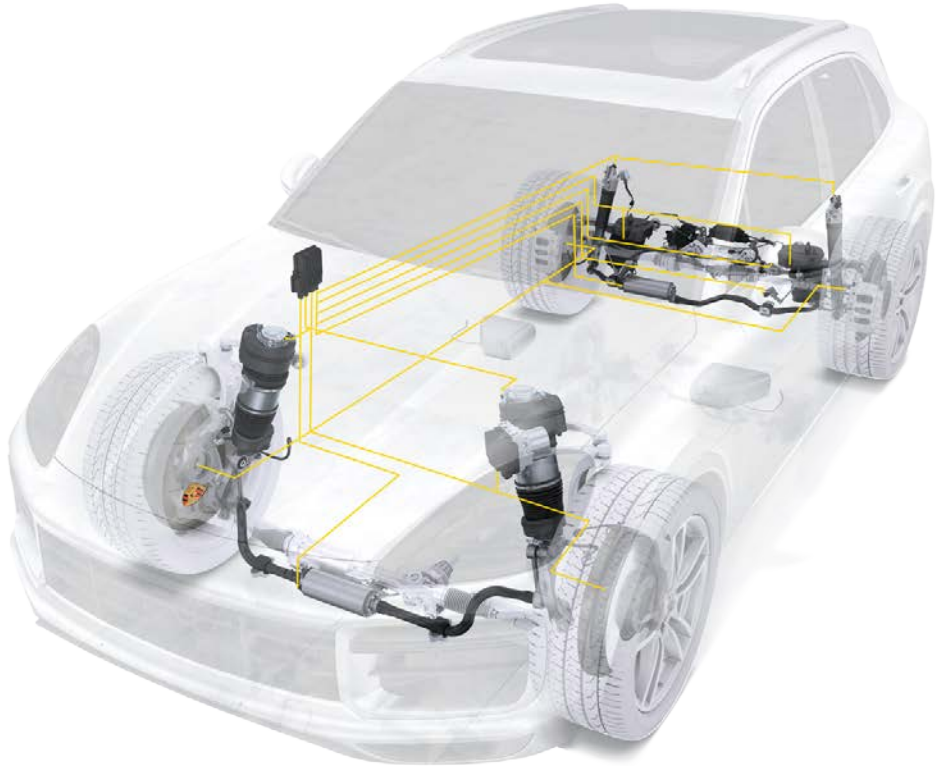
At higher driving speeds

Improved damping of yaw movements
→ **Increased vehicle stability**

Faster build-up of lateral acceleration for more spontaneous vehicle response
→ **Enhanced agility**

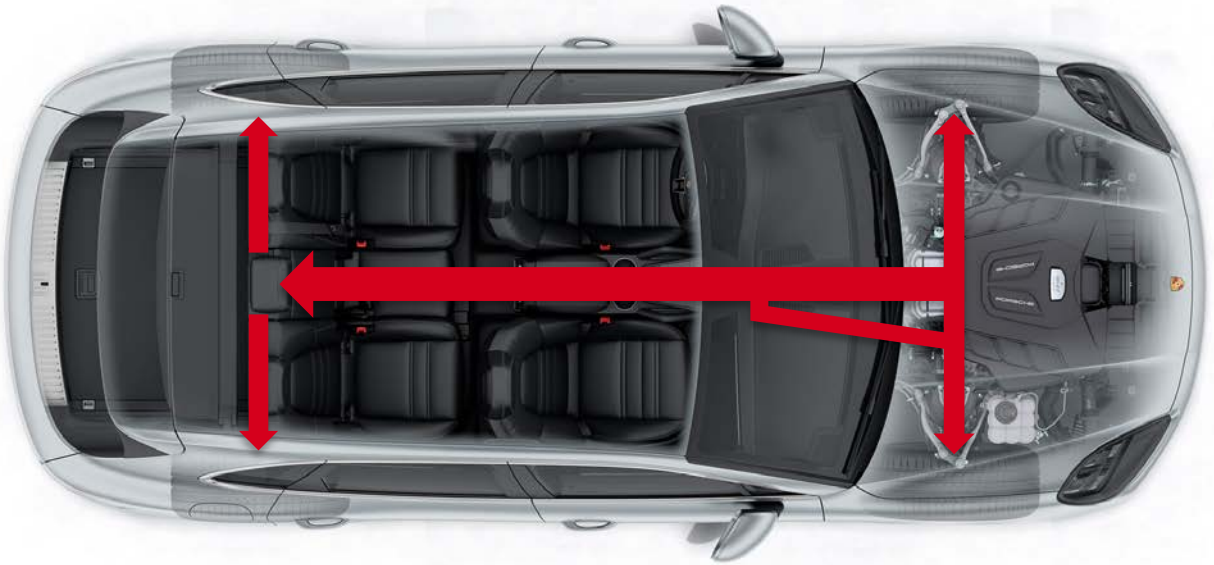
Virtual elongation of wheelbase
→ **Improved stability at high driving speeds**

Chassis systems – Electromechanical roll stabilisation



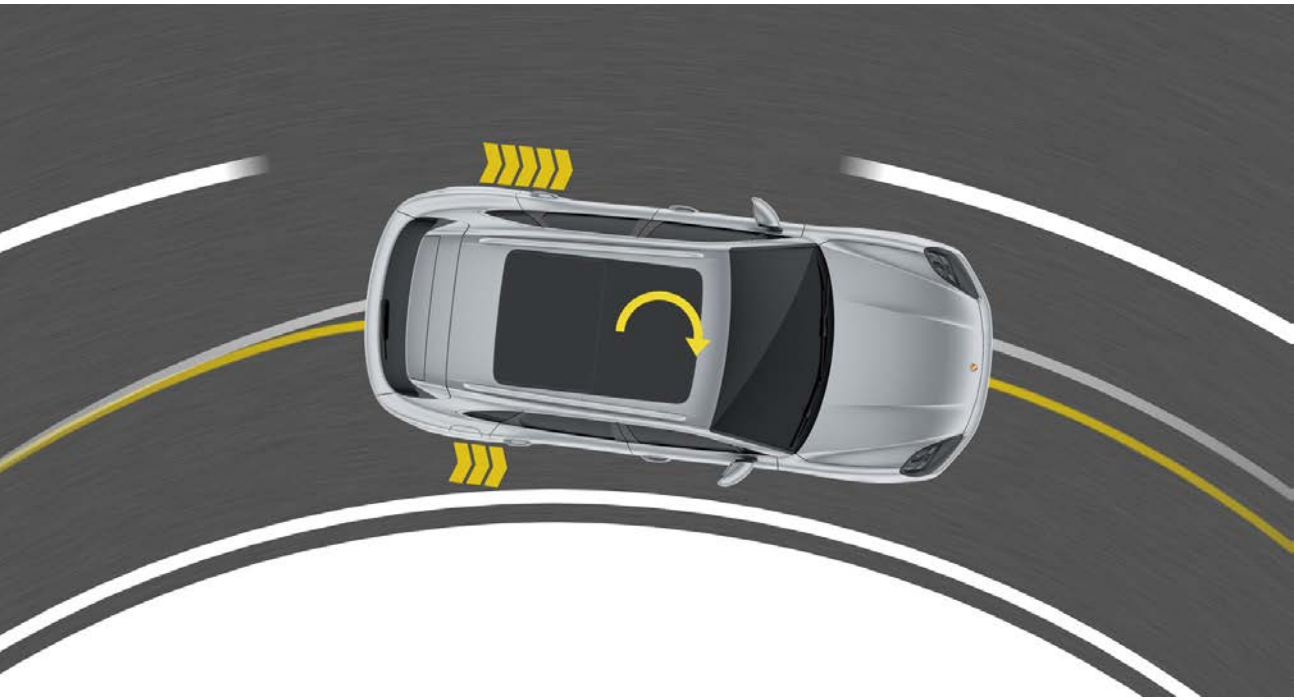
- Active roll stabilisation based on a 48 V energy supply
- 1,200 Nm actuator torque to compensate for the rolling motion
- High adjustment dynamics to optimise the steering behaviour
- Offroad stabiliser activation
- Variable roll torque distribution between front axle/rear axle to provide vehicle agility
- High efficiency to prevent loss of performance

Chassis systems – Porsche Traction Management



- Electronically controlled hang-on all-wheel drive
- Torque distribution to front axle as required
- Optimum steering behaviour and lateral support to the front axle
- Maximum traction
- Clear and predictable handling
- Optimum agility
- Optimised all-wheel drive distribution for offroad scenarios

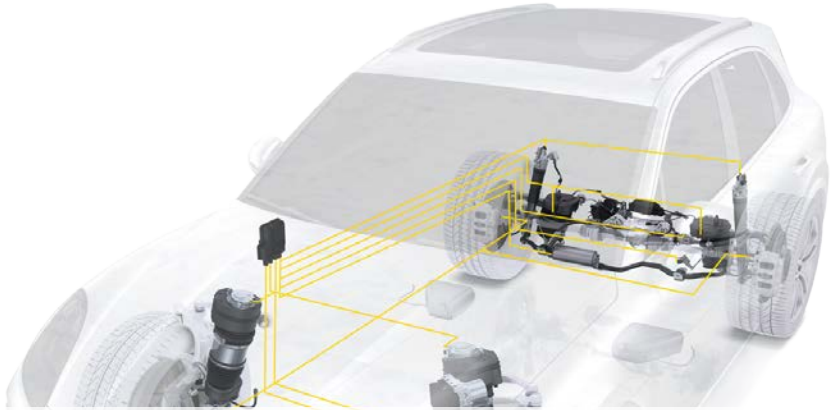
Chassis systems – Porsche Torque Vectoring Plus



- Controlled rear differential lock depending on driving situation
- Dynamic brake intervention on the rear axle
- Increased traction
- Increase in lateral dynamics
- Increase in driving stability
- Improved steering precision
- Improved steering behaviour
- Optimised for offroad scenarios

4D Chassis Control – Electronic chassis platform

Foundation for the intelligent chassis



Functions included

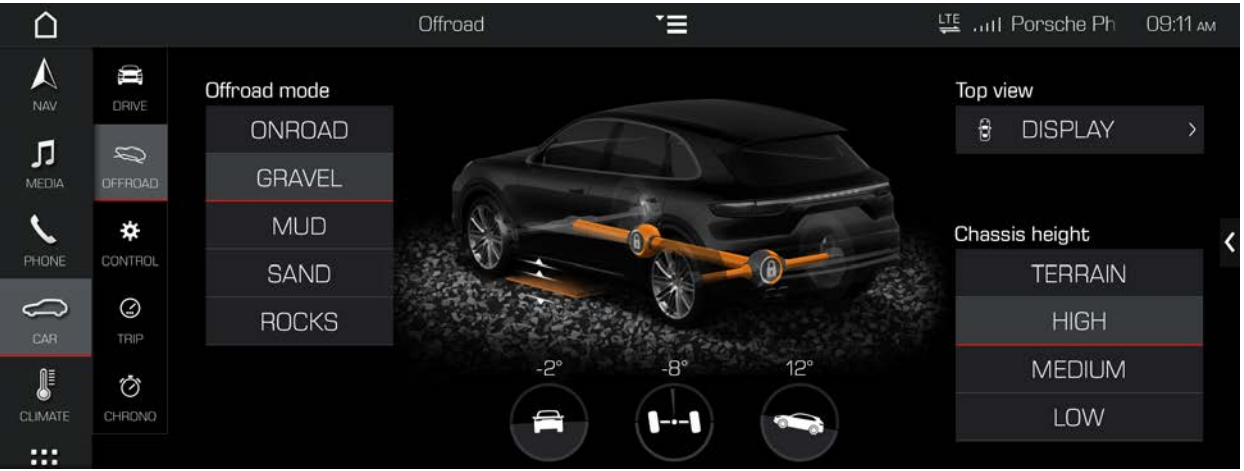
- Adaptive damper control
- Vehicle state observer
- Offroad scenes/modes
- Roll stabilisation
- Controlled all-wheel drive and differential lock
- Offroad displays
- Adaptive three-chamber air suspension

Benefits

- Intelligent networking of all software controllers on a computer platform in real time
- Central driving status coordination for all chassis controllers
- Maximum utilisation of system performance
- Ensuring and optimising typical Porsche handling characteristics
- Differentiation from competition

4D Chassis Control – Electronic chassis platform

New offroad modes for the ideal chassis setup



4D-Chassis Control enables central control of all chassis systems

Automatic adjustment, among other things, of diff locks, ride height, spring rates and dampers, PDCC, RWS and powertrain

Four offroad modes
1. GRAVEL (mild offroad)
2. MUD (muddy dirt roads)
3. SAND (deep sand, dunes)
4. ROCKS (hard surfaces)

Option to individually select special levels suitable for the selected terrain

Chassis of the new Cayenne

Hang-on all-wheel drive

Rear-axle steering

Porsche high-performance brakes incl. PSCB und PCCB

Porsche 4D Chassis Control

Adaptive three-chamber air suspension with PASM

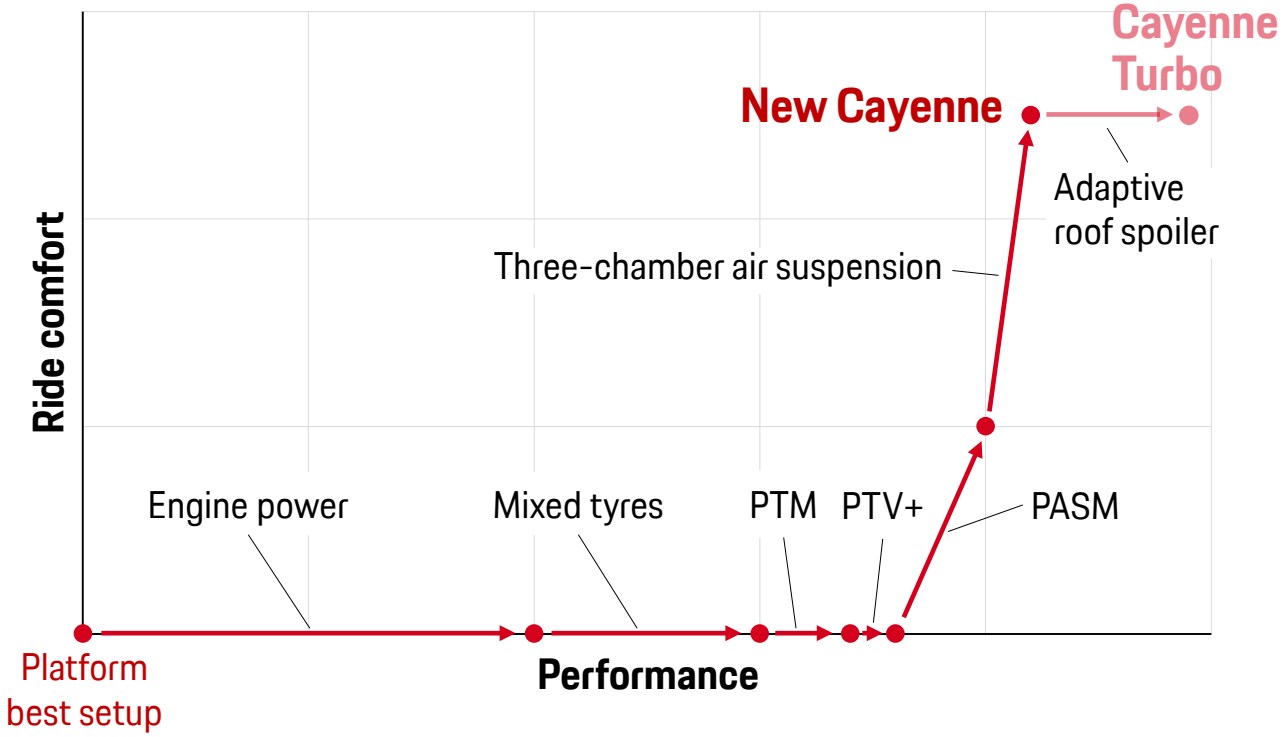
Use of intelligent modular technologies in the Group

Electromechanical roll stabilization PDCC

New generation of tyres mixed tyres, new wheels

Porsche Torque Vectoring Plus

Development of Cayenne from the platform with respect to performance and ride comfort



Three-chamber air suspension: Spring rate switching according to the driving situation

PASM: Porsche sensor and control concept for maximum spread between ride comfort and driving dynamics

PTM and PTV+: Controlled longitudinal and transverse torque distribution according to the driving situation
→ Agility and traction

Mixed tyres: Increased performance, driving stability and agility