## Performance concept: Chassis

### 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

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*Image of a car structure with mechanical components marked.*
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Total Vehicle Concept

- Longer wheelbase
- Boosted engine power
- Defined aerodynamic balance
- Mixed tyres tuned to axle load distribution

Unladen weight under 2,000 kg despite much greater system complexity and added product substance
# Total Vehicle Concept

<table>
<thead>
<tr>
<th>Concept characteristic</th>
<th>Unit</th>
<th>Panamera Turbo (predecessor)</th>
<th>Panamera Turbo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wheelbase</td>
<td>mm</td>
<td>2,920</td>
<td>2,950</td>
</tr>
<tr>
<td>Track width, front/rear</td>
<td>mm</td>
<td>1,646/1,637</td>
<td>1,657/1,639</td>
</tr>
<tr>
<td>Axle load distribution, front/rear</td>
<td>%</td>
<td>54.3/45.7</td>
<td>54.4/45.6</td>
</tr>
<tr>
<td>Centre of gravity height</td>
<td>mm</td>
<td>530</td>
<td>532</td>
</tr>
<tr>
<td>Engine power output</td>
<td>kW (hp)</td>
<td>382 (520)</td>
<td>404 (550)</td>
</tr>
<tr>
<td>Drive concept</td>
<td>-</td>
<td>All-wheel</td>
<td>All-wheel</td>
</tr>
<tr>
<td>Aerodynamic lift coeff. front/rear</td>
<td>-</td>
<td>0.13/-0.01</td>
<td>0.13/-0.01</td>
</tr>
<tr>
<td>Tyre width</td>
<td>mm</td>
<td>255/295</td>
<td>275/315</td>
</tr>
</tbody>
</table>
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*PORSCHE*
## Chassis mechanics – front suspension

| Lightweight double-wishbone suspension with steering at back and rigidly screwed subframe |
| Stabiliser interface at pivot bearing enables installation of mono-tube dampers |
| Optimised suspension kinematics for higher steering precision and good directional stability |
| Pivot bearing produced in hollow, low-pressure casting process |
| Lightweight wheel suspension with forged aluminium links |

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*Image of chassis mechanics.*
Chassis mechanics – rear suspension

Further developed, compact four-link rear suspension

Optimised ride comfort by use of hydro-bearings on subframe and transverse links

Integration of rear axle steering in front of the wheel centres

High lightweight design rating by use of hollow, low-pressure casting technology for the subframe and lower transverse links

Lightweight wheel suspension with forged aluminium links
Chassis mechanics – brakes with best-in-class performance

Panamera Turbo
New six-piston aluminium monoblock fixed-calliper front brakes 410 mm x 38 mm
New four-piston aluminium monoblock fixed-calliper rear brakes 380 mm x 30 mm

New ten-piston PCCB brake system, optional

Improved fading stability

Cu-free brake linings (ECE market)

Optimised pedal feel

<table>
<thead>
<tr>
<th>Brakes</th>
<th>Front axle</th>
<th>Delta previous model</th>
<th>Rear axle</th>
<th>Delta previous model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Panamera 4S Panamera 4S Diesel</td>
<td>ø 360 mm x 36 mm</td>
<td>0 mm / 0 mm</td>
<td>ø 330 mm x 28 mm</td>
<td>0 mm / 0 mm</td>
</tr>
<tr>
<td>Panamera Turbo</td>
<td>ø 410 mm x 38 mm</td>
<td>+20 mm / 0 mm</td>
<td>ø 380 mm x 30 mm</td>
<td>+30 mm / +2 mm</td>
</tr>
<tr>
<td>PCCB – Panamera 4S</td>
<td>ø 420 mm x 40 mm</td>
<td>+30 mm / +2 mm</td>
<td>ø 390 mm x 32 mm</td>
<td>+40 mm / +4 mm</td>
</tr>
<tr>
<td>PCCB – Panamera Turbo</td>
<td>ø 420 mm x 40 mm</td>
<td>+10 mm / +2 mm</td>
<td>ø 390 mm x 32 mm</td>
<td>+40 mm / +4 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actuation</th>
<th>New Panamera</th>
<th>Previous model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brake servo</td>
<td>9/10&quot; Tandem BKV</td>
<td>9/9&quot; Tandem BKV</td>
</tr>
<tr>
<td>Master brake cylinder</td>
<td>28.57 mm</td>
<td>26.99 mm</td>
</tr>
</tbody>
</table>
## Extensive range of wheels

<table>
<thead>
<tr>
<th>19-inch</th>
<th>20-inch</th>
<th>21-inch</th>
<th>21-Inch Exclusive</th>
</tr>
</thead>
</table>
| Front axle: 9J x 19  
Rear axle: 10.5J x 19 | Front axle: 9.5J x 20  
Rear axle: 11.5J x 20 | Front axle: 9.5J x 21  
Rear axle: 11.5J x 21 | Front axle: 9.5J x 21  
Rear axle: 11.5J x 21 |
| Panamera S wheel | Panamera Turbo | Panamera Sport Design | Exclusive Design wheel |
| Panamera Design | 911 Turbo Design | | High-gloss black |
Wide-ranging requirements for high-performance tyres

- Use of a brand-defining **mixed tyre set**
- **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**
Wide-ranging requirements for high-performance tyres

<table>
<thead>
<tr>
<th>Tyre dimensions</th>
<th>Wheel size</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>19-inch</strong></td>
<td></td>
</tr>
<tr>
<td>Front 265/45</td>
<td>9.0 x 19</td>
</tr>
<tr>
<td>Rear 295/40</td>
<td>10.5 x 19</td>
</tr>
<tr>
<td><strong>20-inch</strong></td>
<td></td>
</tr>
<tr>
<td>Front 275/40</td>
<td>9.5 x 20</td>
</tr>
<tr>
<td>Rear 315/35</td>
<td>11.5 x 20 (winter: 10.5)</td>
</tr>
<tr>
<td><strong>21-inch</strong></td>
<td></td>
</tr>
<tr>
<td>Front 275/35</td>
<td>9.5 x 21</td>
</tr>
<tr>
<td>Rear 315/30</td>
<td>11.5 x 21 (winter: 10.5)</td>
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- High-performance tyres
- Lightweight design

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

Systematic attention to driving dynamic requirements in total vehicle concept.

Driver-oriented operating concept (seat position, steering wheel, pedals).

Precision suspensions, high-performance fixed-calliper brakes, high-performance tyres, lightweight design.

Further boost to performance potential.

Increased spread between driving dynamics and comfort.
<table>
<thead>
<tr>
<th>Chassis systems – overview</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adaptive air suspension with PASM</td>
</tr>
<tr>
<td>Electromechanical roll stabilisation</td>
</tr>
</tbody>
</table>
Chassis systems – adaptive air suspension with PASM

- Three-chamber air spring in conjunction with regulated mono-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 – adaptive air suspension with PASM

Technology of three-chamber air spring
- Comfort advantage due to higher volume air spring
- Performance benefits due to three-stage, adaptive switching

Implementation
- Each driving mode is assigned its own spring rate
- The system switches to the optimal spring rate based on the driving situation (braking, accelerating, lateral acceleration, sudden changes in steering angle input)

Spread: comfort <-> driving dynamics

<table>
<thead>
<tr>
<th>Comfort</th>
<th>Sport</th>
<th>Sport Plus</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dynamic switching</td>
<td>Dynamic switching</td>
<td>Dynamic switching</td>
</tr>
</tbody>
</table>

14 N/mm | 23 N/mm | 36 N/mm
Chassis systems – adaptive air suspension with PASM

**PASM technology**
- Controlled mono-tube damper, high-performance and lightweight
- Comfort advantage due to very low, minimal damping forces
- Significantly larger spread of damper characteristics (hydraulic) for optimal interface to car body and wheel control
- Performance advantages due to high maximum forces

**Implementation**
- Extended sensor system for more precise control
- Controller developed in-house at Porsche
- Integrated reaction to spring rate switching for optimal degree of damping
Chassis systems – Porsche Dynamic Chassis Control Sport

Conceptually, electromechanical system lends itself to use in PHEV and BEV vehicles.

- **Precise control** of roll movements
- **Active compensation** for rolling moments
- **Roll torque is distributed variably according to driving situation** and therefore affects self-steering behaviour
Chassis systems – electromechanical steering

Direct steering response

Ideal steering precision and typical Porsche steering feedback

Enhanced steering comfort

Active steering wheel return

Steering pulse during split-µ braking (DSR)

Lane keep assist (LKS)

Reduced fuel consumption (approx. 0.1 l/100 km)
Chassis systems – electromechanical steering

Feedback optimised **hand torque control**

**Performance-oriented** system layout with 8 Nm boosting motor

**Optimised system weight** (16.0 kg) at maximum boost force of 15.6 kN

![Steering ratio vs. Pinion angle graph](image)

- New Panamera
- New Panamera with rear axle steering

**Steering ratio [°]**

Pinion angle [°]
Chassis systems – electromechanical rear axle steering

<table>
<thead>
<tr>
<th>At low driving speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduces the steering angle required</td>
</tr>
<tr>
<td>➔ Makes steering more manageable</td>
</tr>
<tr>
<td>Virtual shortening of wheelbase</td>
</tr>
<tr>
<td>➔ Increased manoeuvrability</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>At higher driving speeds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved damping of yaw movements</td>
</tr>
<tr>
<td>➔ Increased vehicle stability</td>
</tr>
<tr>
<td>Faster build-up of lateral acceleration for more spontaneous vehicle response</td>
</tr>
<tr>
<td>➔ Enhanced agility</td>
</tr>
<tr>
<td>Virtual elongation of wheelbase</td>
</tr>
<tr>
<td>➔ Improved stability at high driving speeds</td>
</tr>
</tbody>
</table>
Three-chamber air suspension (+ 60 % air volume)
Porsche Active Suspension Management (PASM)
Porsche Dynamic Chassis Control Sport (PDCC Sport)
Rear axle steering
4D Chassis Control – electronic chassis platform

- Internal know-how to assure typical Porsche handling characteristics
- Maximum utilisation of system performance
- Intelligent networking of systems
- Differentiation from competition
- Adaptive air suspension
- Adaptive damper control
- Roll stabilisation
- Controlled all-wheel drive and torque vectoring
- Vehicle state observer

Ideal conditions for advancing along the path towards the intelligent chassis
Chassis of the new Panamera – overview

Adaptive air suspension with Porsche Active Suspension Management

Optimised concept parameters

Porsche 4D Chassis Control

Newly developed suspensions

Rear axle steering

Porsche Dynamic Chassis Control Sport with Porsche Torque Vectoring Plus

New generation of tyres, new wheels

Optimised brakes
The new Panamera chassis – maximum spread between performance and ride comfort

- Adaptive air suspension with PASM
- Electromechanical rear axle steering
- PDCC Sport
- Electromechanical steering
- Concept parameters and chassis mechanics
- Panamera predecessor
- New Panamera