Service Training

Self-study Programme 994448AG

Wheel Alignment – Basics



The material in this Self Study Program (SSP) may contain technical information or reference vehicle systems and configurations which are not available in the Canadian market.

Please ensure you reference ElsaPro for the most current technical information and repair procedures.

Today's modern vehicles have increasingly complex and advanced suspension systems that need to fulfil the requirements of comfort, sporty usage and especially road safety.

We now have very good means for measuring the suspension geometry and for correcting misaligned settings to ensure that the high requirements set for the suspension system can also be met over the entire vehicle life and after accidents.



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In this self-study programme, you will learn about the background of wheel alignment, for example:

- Suspension-related terms
- Preparation of the wheel alignment system
- Checking the wheel alignment system
- Why the alignment is carried out
- The tools used for wheel alignment
- How the alignment principle works

For current testing, adjustment and repair instructions, refer to the relevant service literature.

Important Note

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Introduction

The suspension system is the connecting link between the vehicle and the road. Wheel contact forces, drive forces and the lateral forces in corners are all transferred through the suspension onto the road via the wheels.

The suspension system is therefore subjected to a number of forces and moments.

Increasing vehicle performance figures and also greater expectations for vehicle comfort and vehicle safety have led to a constant increase in requirements for the suspension.

The structural design in the suspension kinematics has resulted in increasingly complex alignment processes and smaller tolerances in the adjustments.

To measure and, if necessary, re-align the suspension kinematics, the suspension needs to be checked and adjusted on a special wheel alignment stand.

It should be noted that the suspension should only be adjusted after repairs or problems with the suspension.

This self-study programme will provide you with an overview of wheel alignment – starting with the terms and going onto the actual alignment.

Suspension design

The suspension consists of

- Wheel mountings
- Wheels
- Springs
- Shock absorbers
- Front and rear axles
- Steering
- Brakes including controls
- Subframes

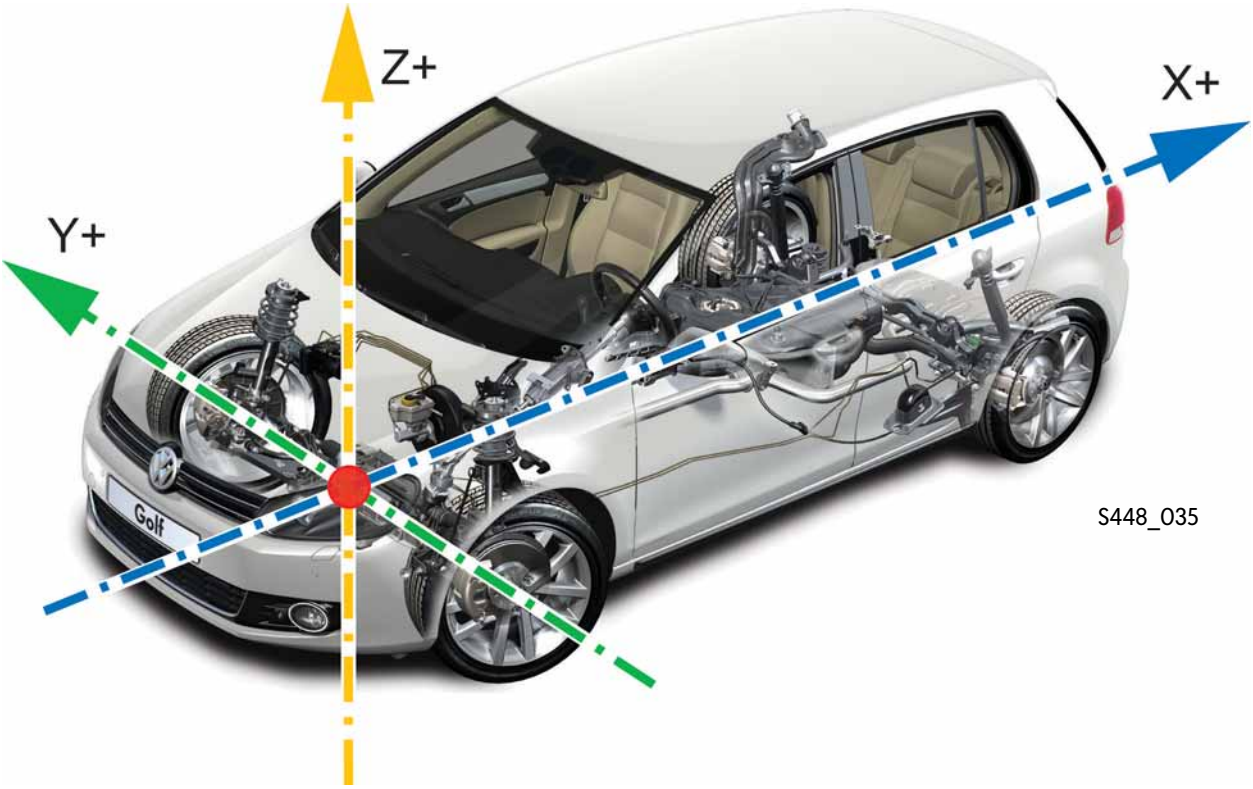
Design configuration – vehicle position in an X-Y-Z axis system

The design configuration is first defined during the development of a vehicle. It is described by an X-Y-Z axis system.

The Z- and the X-axes run through the centre of the front axle, and the Y-axis normally runs exactly through the centre of the front wheels. The design configuration corresponds with the vehicle position at the nominal ride height.

All nominal data specified by the vehicle manufacturer relate to the design configuration.

If data is collected and compared during the wheel alignment, the design configuration is always taken as a reference – this concerns the suspension terms described below.



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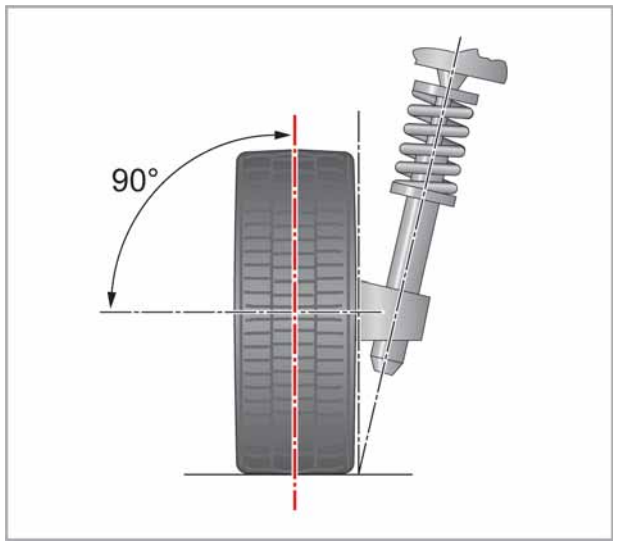
Ride height

The ride height has a decisive influence on the results of the wheel alignment. It is influenced by the load carried in the vehicle, by the contents of the fuel tank or other liquid containers and also by temperature differences that can cause the suspension measurements, for example, toe, camber and caster, to change.

Suspension-related terms

Wheel centre plane

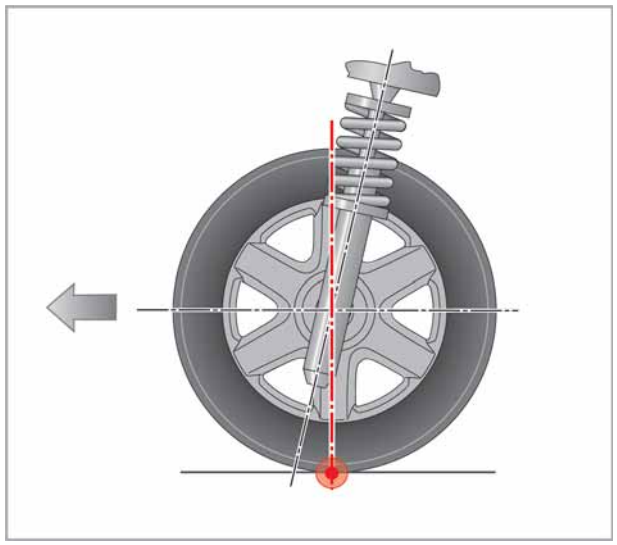
The wheel centre plane intersects the wheel rotational axis vertically in the centre of the tyre.



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Wheel contact point

The wheel contact point is the point where a vertical line passing through the wheel centre plane intersects the rotational axis and the road surface.

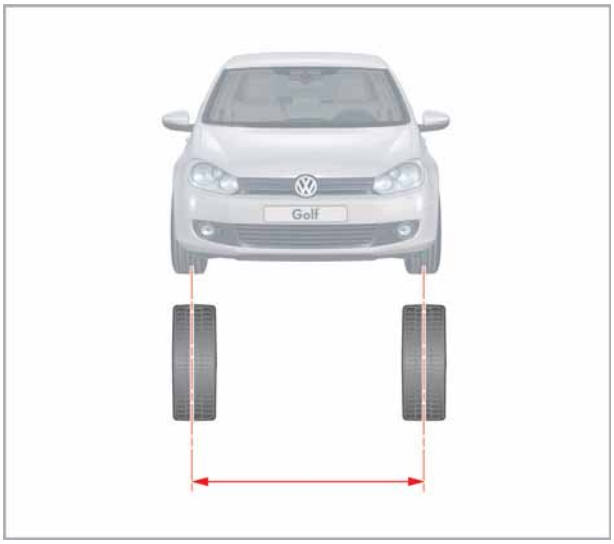


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Track width

The track width is the measurement from tyre centre to tyre centre on each axle.

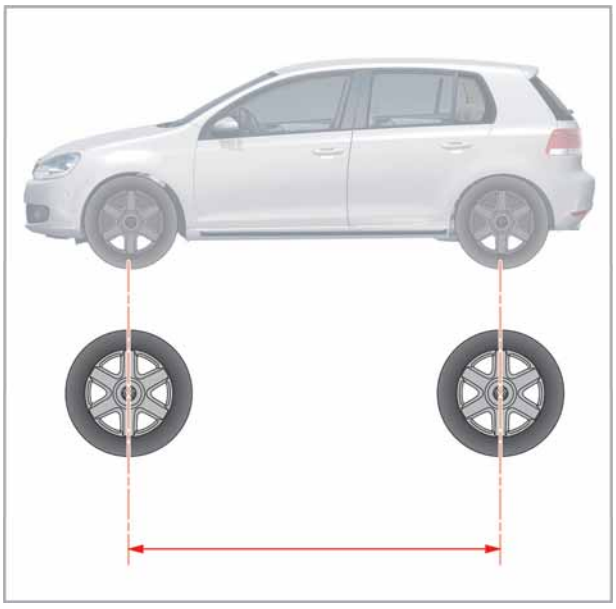
On vehicles with independent wheel suspension using traverse or semi-trailing links, the track width varies during compression and extension cycles.



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Wheelbase

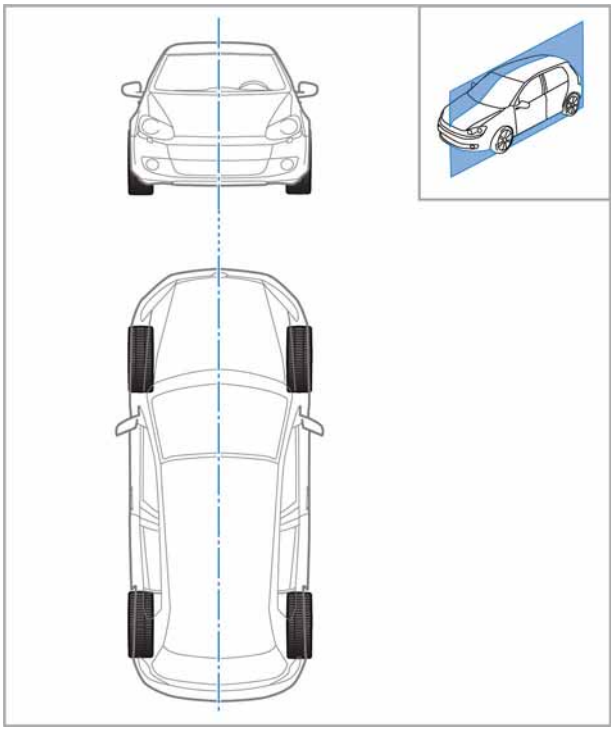
The wheelbase is the distance between the centres of the wheels on the front axle and the rear axle.



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Vehicle longitudinal median plane

The longitudinal median plane of the vehicle is a fixed vehicle-related plane that is vertical to the road and passes through the centre of the track width of the front and rear axle (X/Z plane).

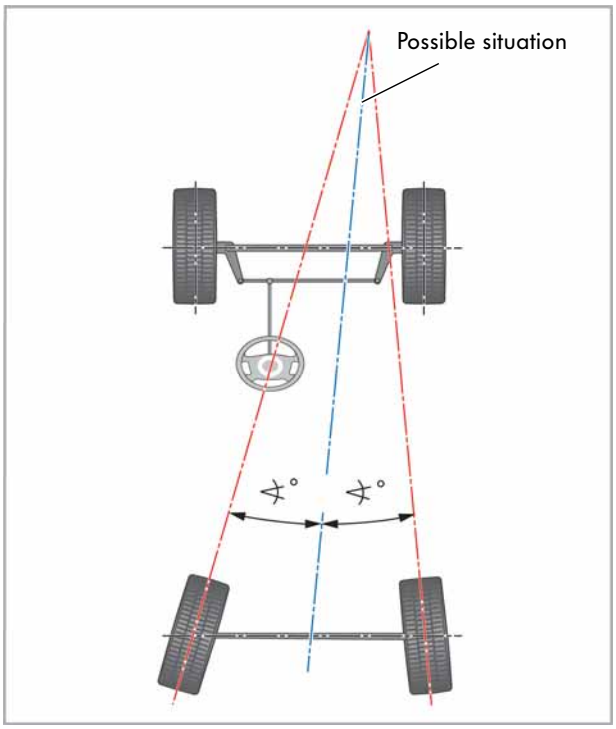


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Thrust axis

The thrust axis bisects the total toe angle of the rear axle.

The rear axle defines the tracking of the vehicle. For this reason, all measurements for the front wheels and for some assist systems are related to the thrust axis. Ideally, the thrust axis should be along the vehicle longitudinal median plane.



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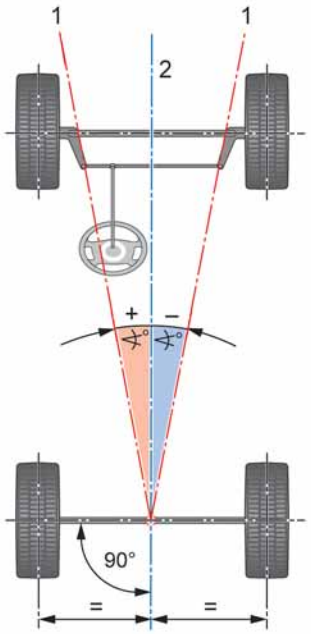
Thrust axis deviation

The thrust axis deviation is the angle between the vehicle longitudinal median plane (2) and the thrust axis (1).

It results from the thrust axis, the lateral offset and the angle of the rear axle.

If the thrust axis deviation is oriented to the front left, it is called positive. If it is oriented to the front right, it is called negative.

Optimum thrust axis deviation

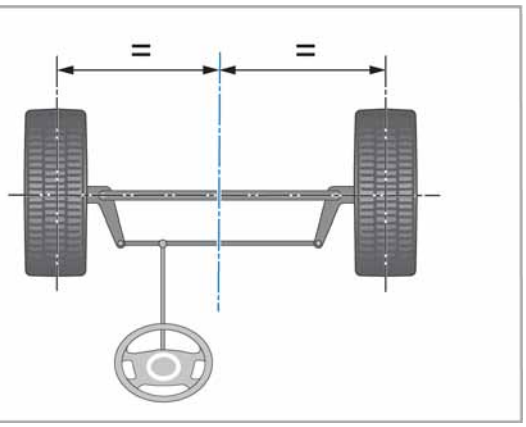


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Straight-ahead driving

This wheel position is a reference position in which the two front wheels have the same toe angles to the vehicle longitudinal median plane.

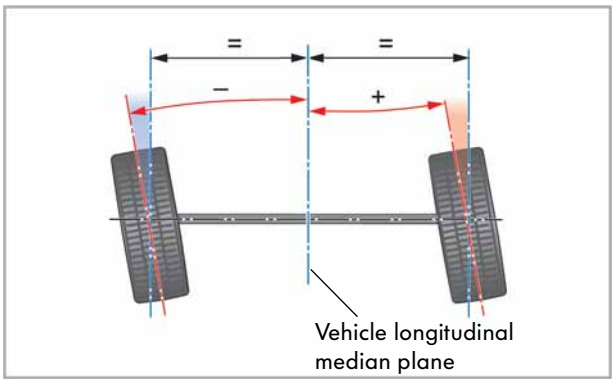
The rear axle is aligned in this position.



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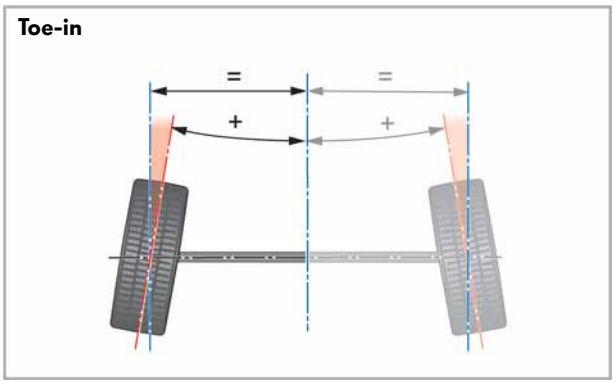
Toe angle of rear wheels

The toe angle of the rear wheels is the angle between the vehicle longitudinal median plane and a line intersecting the wheel centre plane.



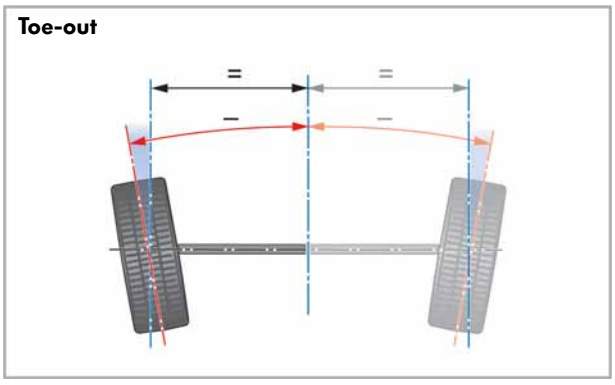
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It is positive (toe-in) when the front part of the wheel points towards the vehicle longitudinal median plane.



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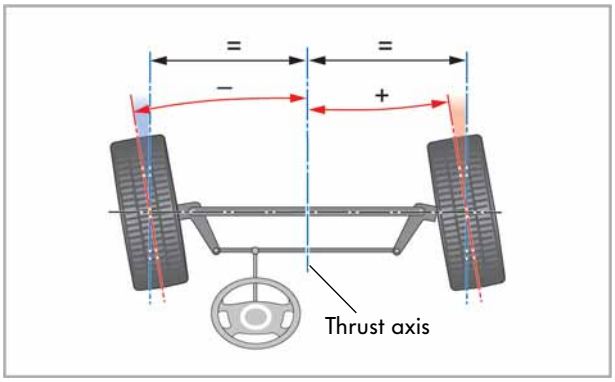
It is negative (toe-out) when the front part of the wheel points away from the vehicle longitudinal median plane.



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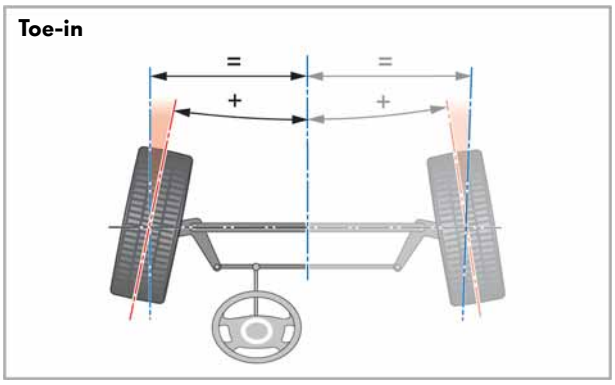
Individual toe angle of front wheels

The individual toe angle of the front wheels is the angle between the thrust axis and a line running along the wheel centre plane.



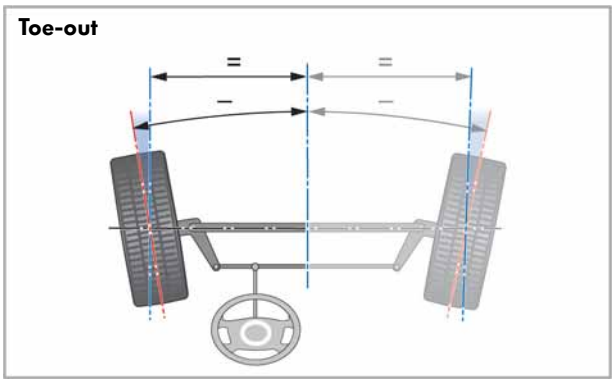
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It is positive (toe-in) when the front part of the wheel points towards the thrust axis.



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It is negative (toe-out) when the front part of the wheel points away from the thrust axis.



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Total toe

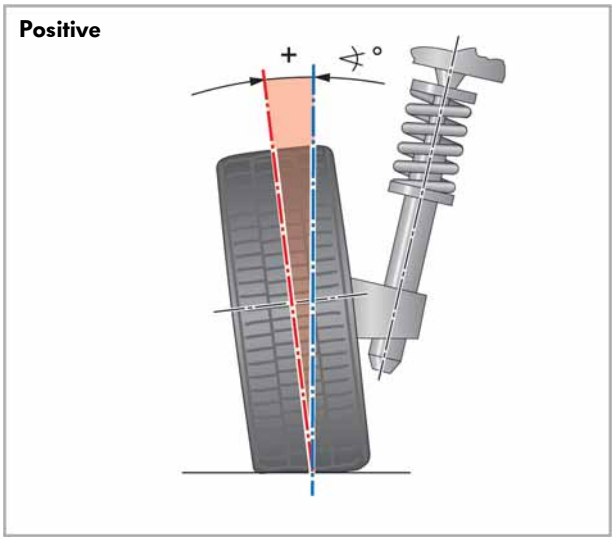
The total toe is the sum of the angles of the left and right wheels on an axle. The negative or positive sign in front of the individual toe angles is important.

Camber

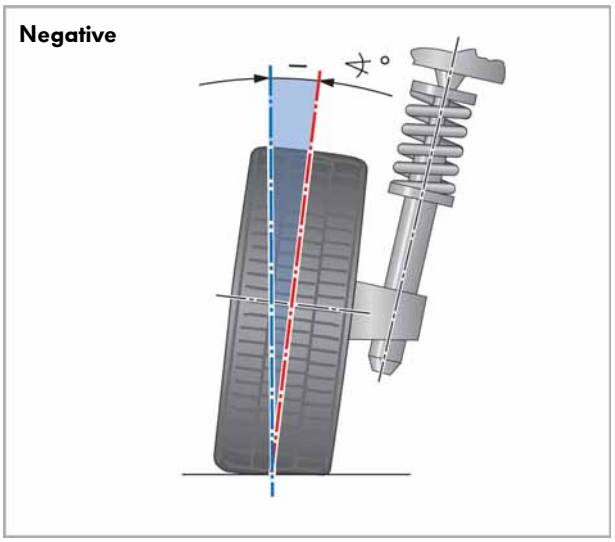
Camber is the angle between the wheel centre plane and a vertical line passing through the wheel contact point with the road surface.

Camber can be positive and negative.

- Positive (+) is when the upper part of the wheel is inclined away from the wheel centre plane to the outside.
- Negative (+) is when the upper part of the wheel is inclined away from the wheel centre plane to the inside.



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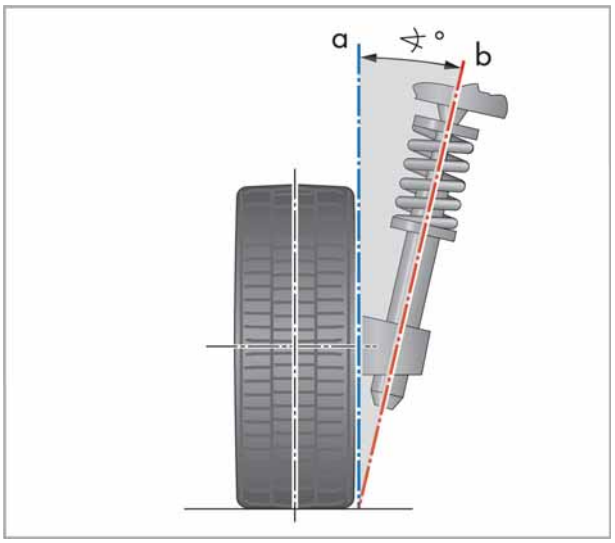


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Steering axis inclination (SAI)

The steering axis inclination (also called king pin inclination) is the angle of inclination of the steering axis (b) from the true vertical (a) (parallel to the vehicle longitudinal median plane).

The steering axis inclination causes the vehicle to lift when steered thus generating steering return forces.



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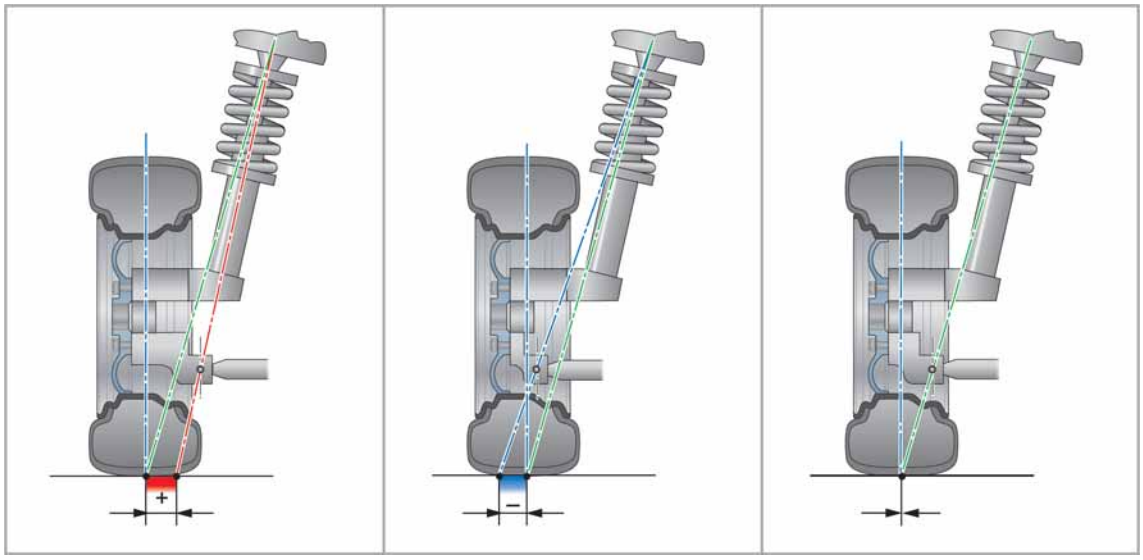
Scrub radius

The scrub radius is the distance from the wheel contact point to the point where the extended steering axis meets the road surface.

The scrub radius can be positive (+), negative (–) or zero.

The scrub radius results from the camber, steering axis inclination and wheel offset.

Positive scrub radius | **Negative scrub radius** | **Neutral scrub radius**

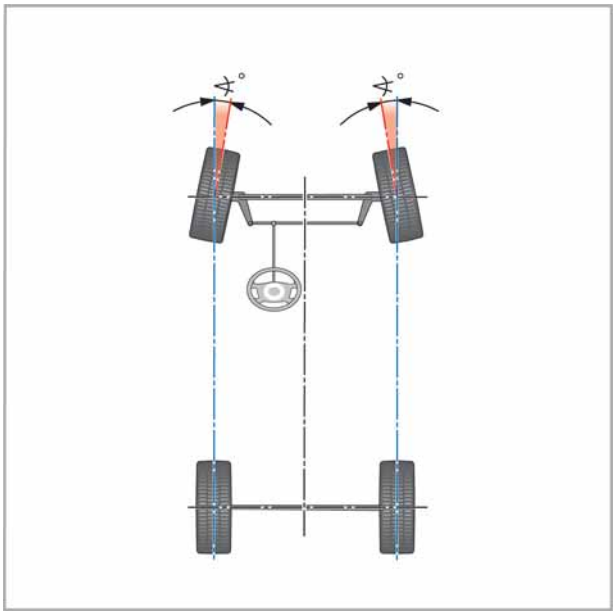


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Scrub radius – tracking stability

If the scrub radius is negative, the wheel with the greater frictional value is turned more to the inside – autonomous countersteer results – the driver just has to hold onto the steering wheel.

When the scrub radius is zero, the transfer of interfering forces to the steering will be prevented if the brakes pull to one side or there is a faulty tyre.



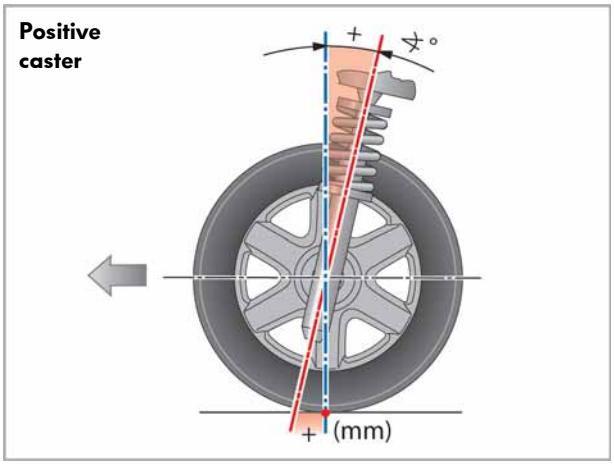
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Caster

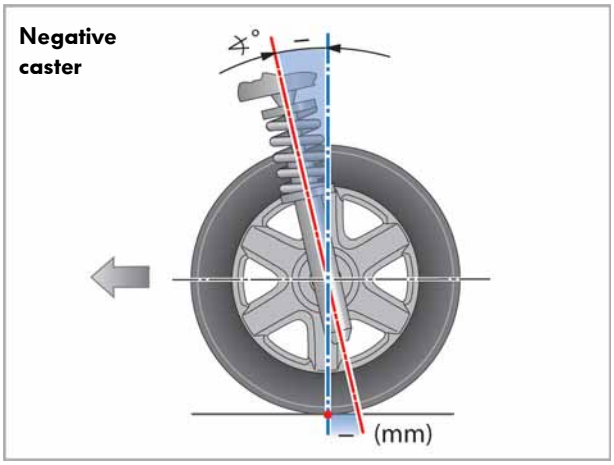
Caster is the inclination of the steering axis along the vehicle longitudinal axis from a vertical line to the road surface.

Caster can be positive and negative.

- Positive: The “wheel contact point is behind the point at which the steering axis intersects the road surface” – the wheels are pulled => tracking stability
- Negative: The “wheel contact point is in front of the point at which the steering axis intersects the road surface” – the wheels are pushed.



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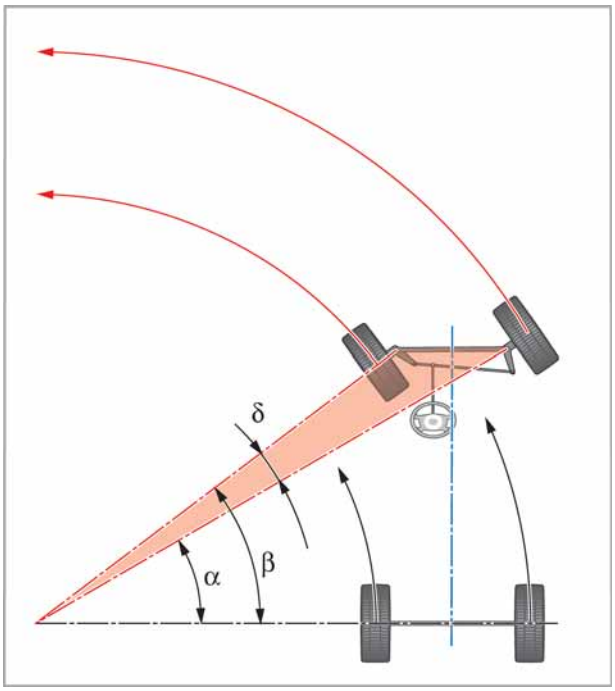


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Toe-out on turns

Toe-out on turns is the difference between the angles of the inside and outside wheels when the vehicle is cornering.

Toe-out on turns is determined by the Ackermann steering geometry. It thus provides information on the way the Ackermann steering geometry works for the respective steering angle – to the left of right.

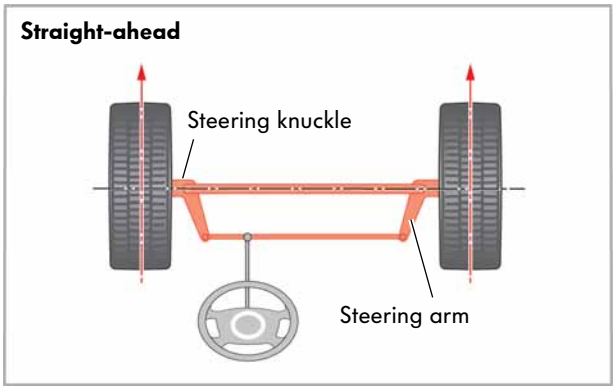


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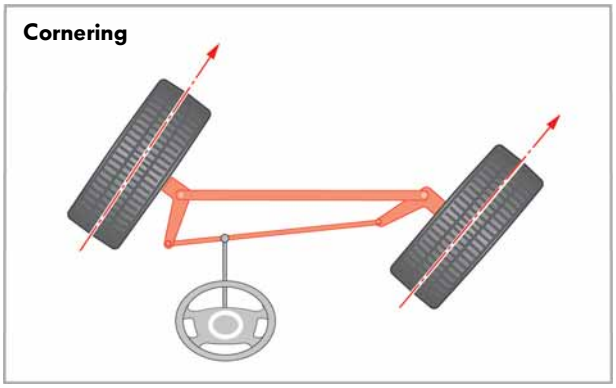
Ackermann steering geometry

The front axle, the steering arms and the steering rack with the track rods form the Ackermann steering geometry.
The Ackermann steering geometry creates the different steering angles that are required when the vehicle is cornering.

The steering knuckle and steering arms are not positioned at a 90° angle to each other. This results in unequal travel at the ends of the two steering arms when the steering wheel is turned. Consequently the wheels are turned at different angles.



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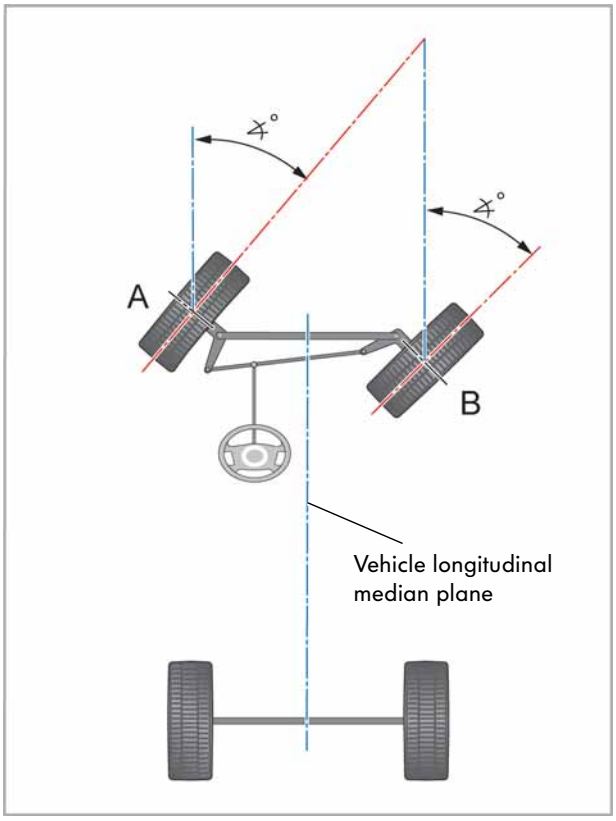


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Maximum steering angle

The maximum steering angle is the angle of the centre plane of the inside wheel (B) and of the outside wheel (A) relative to the vehicle longitudinal median plane when the steering wheel is at full left or right lock.

The maximum steering angle should be the same on both sides. The turning circles will then be the same.



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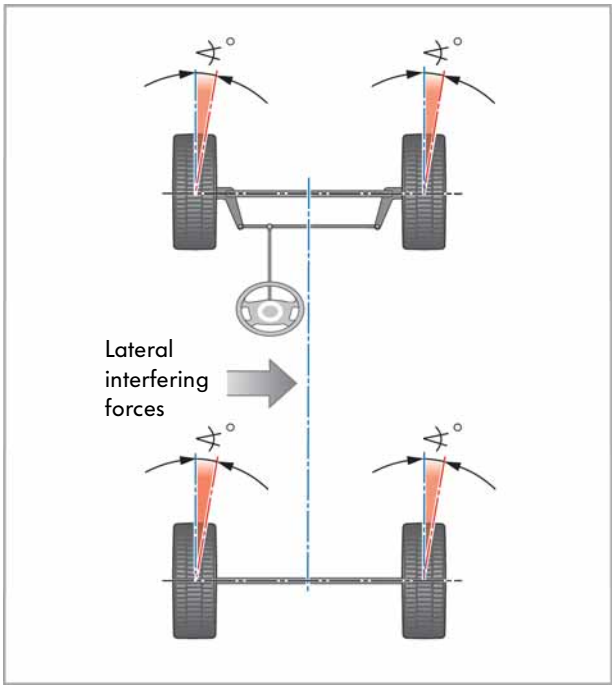
Slip angle

The slip angle is the angle between the wheel plane and the direction of travel (direction that the wheel moves).

A slip angle is formed when a rolling vehicle is subjected to interfering lateral forces, for example, wind and centrifugal forces. The wheels change their direction of travel and run at a specific angle diagonally to the original direction of travel.

If the slip angle is the same at the front and rear, the handling will be neutral. If the slip angle is greater at the front, the vehicle will understeer. If the slip angle is greater at the rear, the vehicle will oversteer.

The slip angle depends on the wheel load, interference force, tyre type, tyre tread, tyre inflation pressure and static friction.



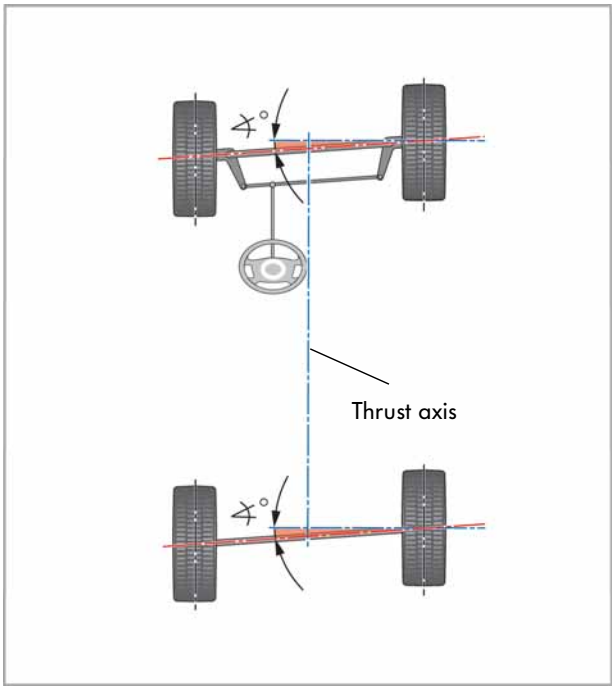
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Wheel set-back

The wheel set-back is the angle between a line connecting the wheel contact point and a line that runs at 90° to the thrust axis.

The wheel set-back can be positive and negative.

- Positive – right wheel is set to the front
- Negative – right wheel is set to the rear



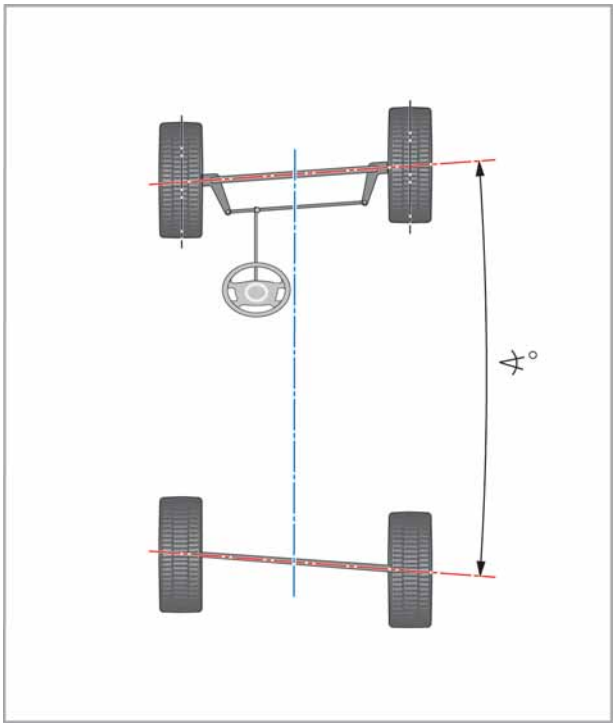
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Wheelbase difference

The wheelbase difference is the angle between a line connecting the front wheel contact points and a line connecting the rear wheel contact points.

The wheelbase difference can be positive and negative.

- Positive – the wheelbase is longer on the right-hand side than on the left-hand side
- Negative – the wheelbase is shorter on the right-hand side than on the left-hand side

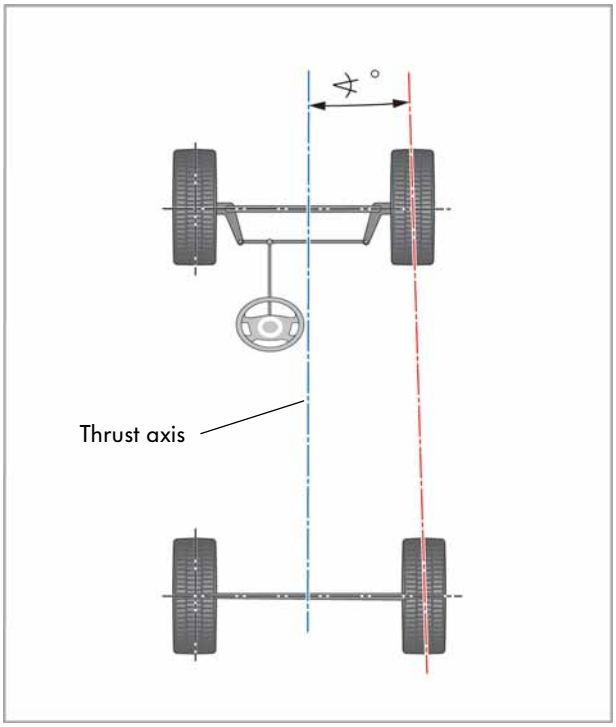


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Lateral offset

The lateral offset is the angle between a line connecting the wheel contact points of the right-hand or left-hand front and rear wheels and the thrust axis.

The lateral offset can be used to diagnose possible body damage.

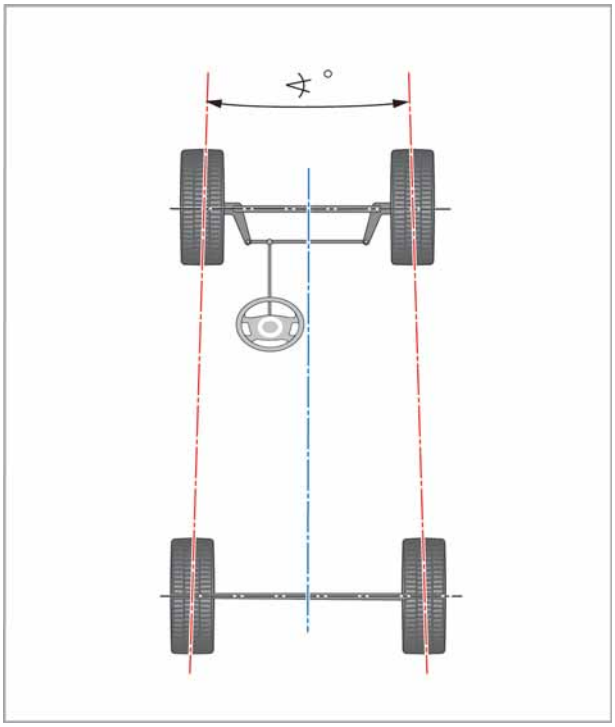


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Track width difference

The track width difference is the angle between a line connecting the wheel contact points of the left-hand front and rear wheels and a line connecting the wheel contact points of the right-hand front and rear wheels.

The track width is positive if the rear track width is larger than the front track width.

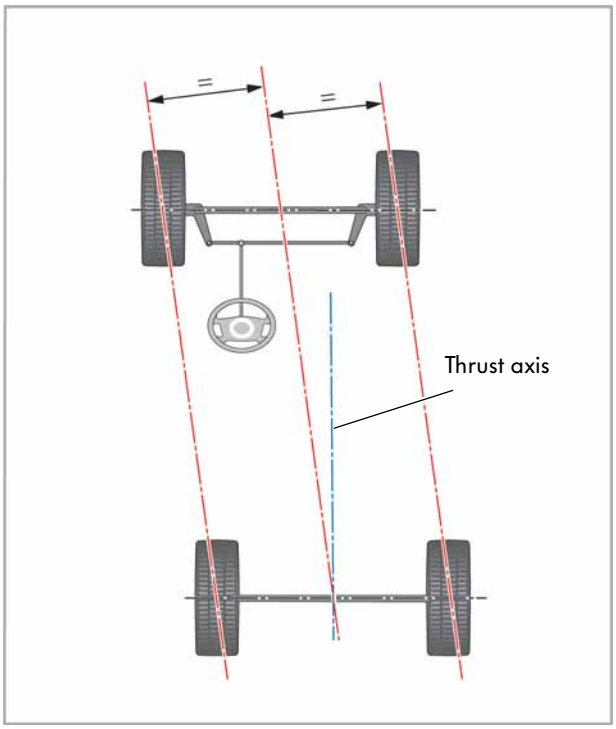


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Axle offset

The axle offset is considered to be positive if the rear axle is offset to the right of the front axle in relation to the thrust axis.

The axle offset can be used to diagnose possible body damage.

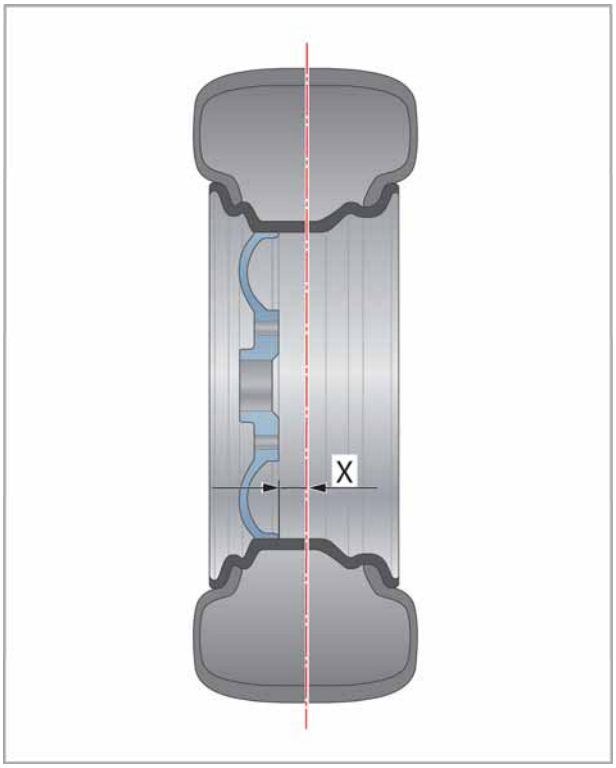


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Wheel offset

The wheel offset is the measurement from the centreline of the wheel to the hub mounting surface of the wheel (“x”).

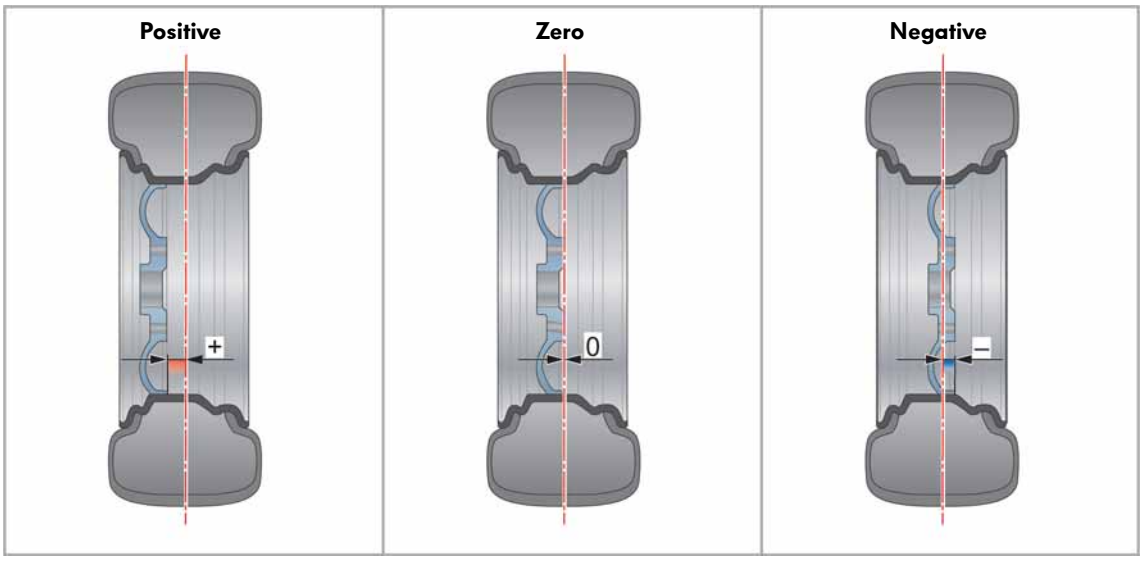
The wheel offset influences the track width and the scrub radius.



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One must distinguish between three variants of wheel offset

- Zero – If the hub mounting surface is precisely on the centreline of the wheel
- Positive – If the hub mounting surface, relative to the centreline of the wheel, is offset to the outside of the wheel – reduction in track width
- Negative – If the hub mounting surface, relative to the centreline of the wheel, is offset to the inside of the wheel – increase in track width



S448_034

Wheel Alignment

Why do the wheels need to be aligned?

Correct wheel alignment is necessary to run a vehicle with optimum handling and minimum tyre wear.

Incorrect adjustment, for example, of the toe or camber, caused by wear or accidents will affect the road safety of the vehicle.

Impermissible deviations in the wheel alignment can also occur following repairs, for example, when suspension parts are replaced.

Incorrect alignment can lead to incorrect wheel positions, which can consequently cause damage to the tyres.

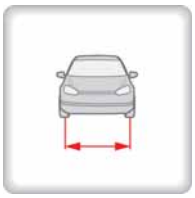
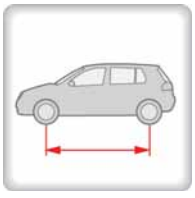
If handling problems or noticeable wear occur, wheel alignment can be used to diagnose the causes and determine what action needs to be taken to restore the correct suspension set-up.

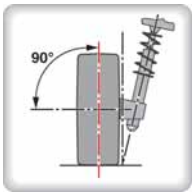
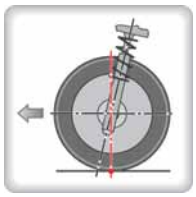
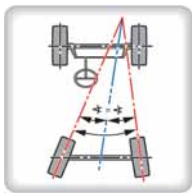
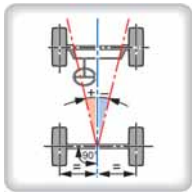
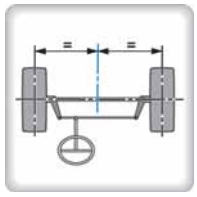
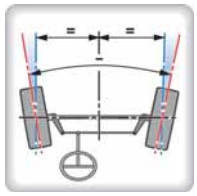


Wheel alignment should only be performed by properly trained personnel.

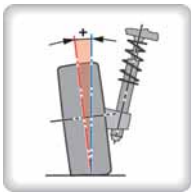
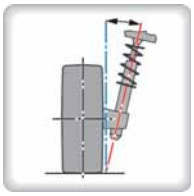
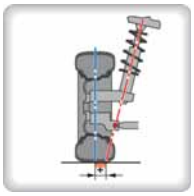
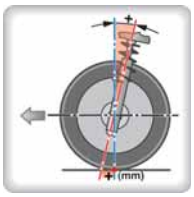
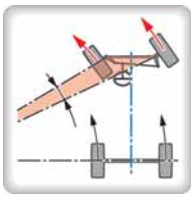
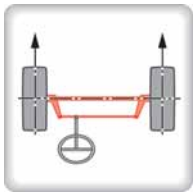
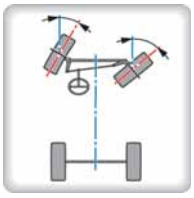
Suspension parameters – Effects of faults – Adjustment possibilities

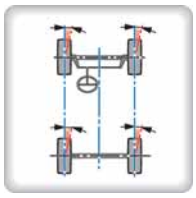
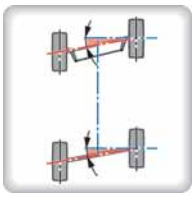
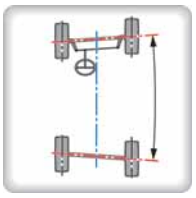
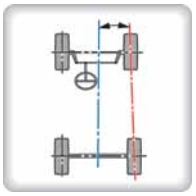
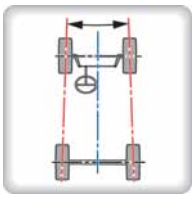
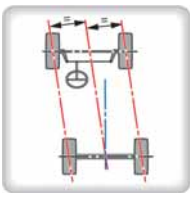
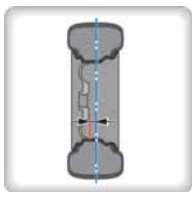
The suspension parameters are distinguished by non-adjustable original and reference design parameters and adjustable parameters. These will be explained separately in the following table.

Suspension parameter (basic terms)		**Effect of fault – Adjustment possibility**
Track width		Original and reference design parameter – therefore faults have no effect • Non-adjustable suspension parameter
Wheelbase		Original and reference design parameter – therefore faults have no effect • Non-adjustable suspension parameter

Suspension parameter (basic terms)		Effect of fault – Adjustment possibility
Wheel centre plane		Original and reference design parameter – therefore no fault effects • Non-adjustable suspension parameter
Wheel contact point		Original and reference design parameter – therefore no fault effects • Non-adjustable suspension parameter
Thrust axis		If this straight line deviates from the vehicle longitudinal median plane, a thrust axis deviation results and the vehicle will run to one side – this is known as “crabbing”. • Adjustable suspension parameter
Vehicle longitudinal median plane		Original and reference design parameter – therefore no fault effects • Non-adjustable suspension parameter
Thrust axis deviation		If the thrust axis deviation is an angle other than zero, the vehicle will run to one side – this is known as “crabbing”. • Adjustable suspension parameter
Straight ahead		In this wheel position, the front wheels are set at the same individual toe angle to the vehicle longitudinal median plane. The rear axle is aligned in this position.
Toe		Too much negative toe (toe-out): Wear on inside of tyre and poor straight running Too much positive toe (toe-in): Wear on outside of tyre and poor straight running • Adjustable suspension parameter

Wheel Alignment

Suspension parameter (basic terms)		Effect of fault – Adjustment possibility
Camber		Too much negative camber: Better directional stability in corners, but one-sided overloading and consequently greater wear on inside of tyre Too much positive camber: Poorer directional stability, increased wear on the outside of the tyre • Vehicle-dependent adjustable suspension parameter
Steering axis inclination (SAI)		Steering axis inclination too large: High steering and holding forces Steering axis inclination too small: Poor steering wheel return, sensitive to tyre faults, vehicle may pull to one side Right/left steering axis inclination different: Vehicle tends to pull to side • Non-adjustable suspension parameter
Scrub radius		The scrub radius is influenced by the camber, steering axis inclination and wheel offset and can therefore only be changed by adjusting these parameters. • Non-adjustable suspension parameter
Caster		Too much positive caster: High steering and holding forces Too much negative caster: Poor steering wheel return, sensitive to tyre faults Right/left caster different: Vehicle tends to pull to side The caster changes, for example, depending on the load in the luggage compartment. • Vehicle-dependent adjustable suspension parameter
Toe-out on turns		Original and reference design parameter – therefore no fault effects • Non-adjustable suspension parameter
Ackermann steering geometry		The front axle, the steering arms and the steering rack with the track rods form the Ackermann steering geometry. The Ackermann steering geometry creates the different steering angles that are required when the vehicle is cornering. • Non-adjustable suspension parameter
Max. steering angle		If the maximum steering angle differs for left/right full lock, the turning circle will be different on the left and right. This is a design specification. • Adjustable suspension parameter

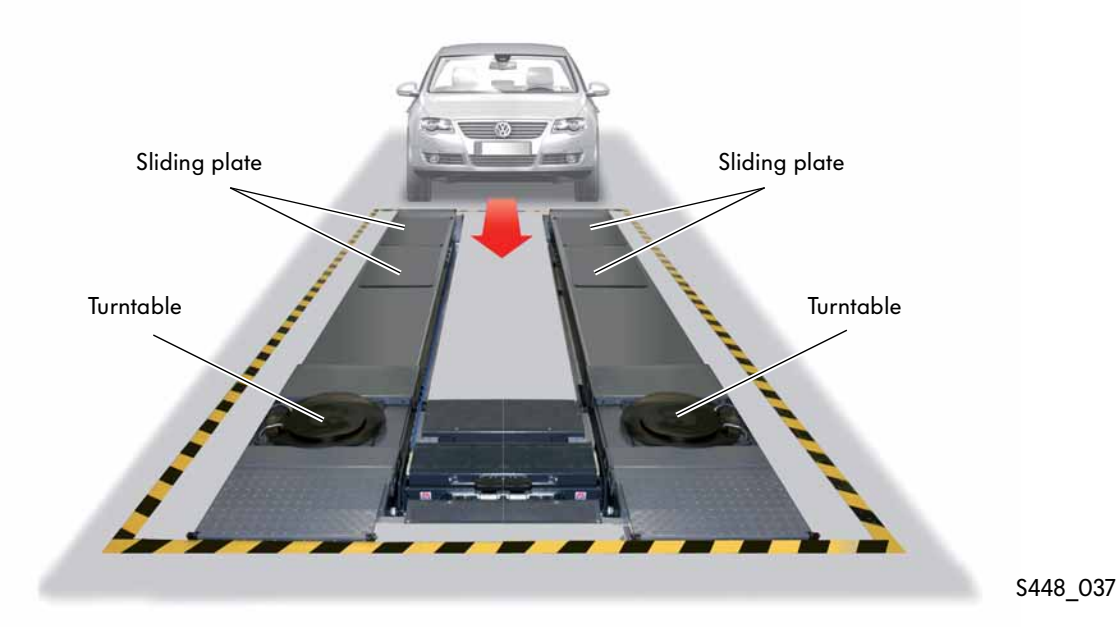
Suspension parameter (basic terms)		Effect of fault – Adjustment possibility
Slip angle		The slip angle results from the parameters wheel load, lateral force, tyre design, tyre tread, tyre inflation pressure and static friction coefficient. ● Non-adjustable suspension parameter
Wheel set-back		The wheel set-back is a measure of the angle of an axle. ● Non-adjustable suspension parameter
Wheelbase difference		The wheelbase difference is a measure of the angle of the axles. ● Non-adjustable suspension parameter
Lateral offset		Lateral offset can result from body damage. ● Non-adjustable suspension parameter
Track width difference		A track width difference can result from body damage. ● Non-adjustable suspension parameter
Axle offset		Axle offset can result from body damage. ● Non-adjustable suspension parameter
Wheel offset		Original and reference design parameter

Workshop equipment for wheel alignment

Special components are used for wheel alignment. They will be described over the following pages.

Wheel alignment platform

A special wheel alignment platform is used for wheel alignment.



In order to perform a precise wheel alignment and also to ensure reproducible measuring results, this alignment set-up must meet certain requirements.

- The wheel alignment platform must be clean and the turntables and sliding plates must move smoothly.
- The turntables and sliding plates should be locked in place with pins or similar locking devices so that they cannot move while the vehicle is driven onto or off the platform.
- All wheel contact points must be at the same height.
  The maximum permitted height differences should be maintained both in the lowered position for the initial and final measurements and in the raised position for the adjustment work.

Wheel alignment system

For precise wheel alignment, a corresponding alignment system that is approved by Volkswagen like, for example, the V.A.G 1813 F system from Beissbarth, should be used.

However, we cannot look at all systems approved by Volkswagen in this book. The following discussion therefore describes wheel alignment using only a computer-supported wheel alignment system as an example.



S448_044

The system comprises the following main components

- Computer with monitor and corresponding alignment software
- Input devices like keyboard and remote control
- Output unit, for example, printer
- Sensors
- Clamps for sensors

Sensors

The sensors work with rechargeable batteries or can be connected with power leads, if necessary. Each of the four sensors is equipped with two CCD cameras that allow infrared measurements.

The measurement is made with an infrared light beam that is projected through a lens to a light mark. All measurements on the horizontal plane are carried out with two transceiver CCD cameras that communicate with each other.

The measurement data is transferred to the measuring box wirelessly.



S448_050

The sensors form a closed measuring rectangle around the vehicle (see page 30).

Measuring unit bracket

The measuring unit bracket is universally suitable for wheels from 10 inches to 23 inches. The brackets on the clamp simply fit onto the tyre tread.

The corresponding accessories, for example, plastic sleeves, prevent damage to painted wheels or alloy wheels.



S448_048

Brake pedal actuator

The brake pedal actuator prevents wheels rolling on the turntables when the steering wheel is turned. This is absolutely necessary to obtain precise caster, steering axis inclination and track difference angle measurements.



S448_114

Bases for wheels

Turntable

The turntable can be ordered as an accessory for the wheel alignment computer.

It allows the steering to be turned.

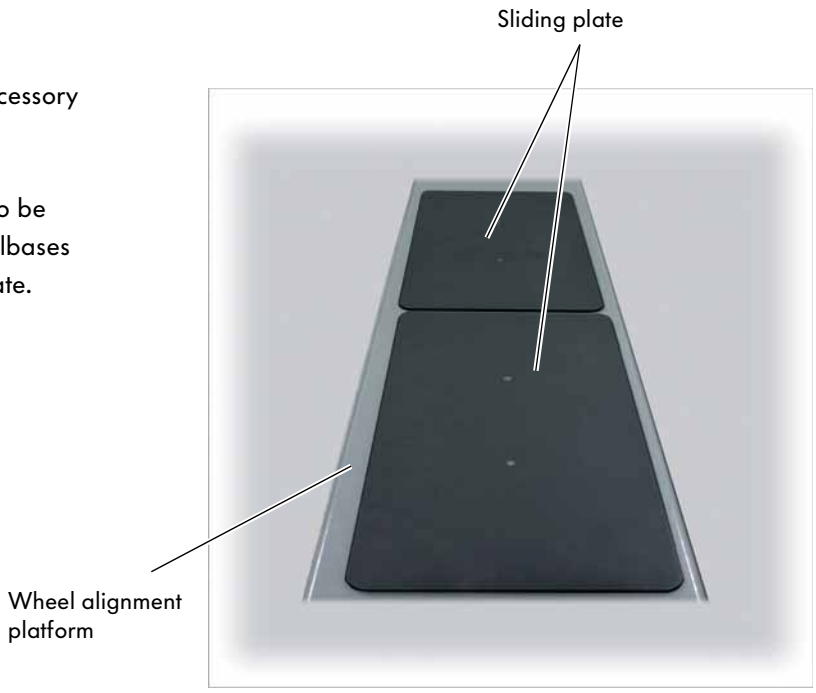


S448_038

Sliding plate

The sliding plate can be ordered as an accessory for the wheel alignment computer.

The sliding plate allows wheel alignment to be performed on vehicles with different wheelbases without having to reposition the sliding plate.



S448_039



The turntables and the sliding plates should be unlocked after wheel rim run-out compensation.

Wheel alignment software

Once the preparations have been completed and the alignment system has been set up, you can start the wheel alignment process.

The measurements are made in single steps with the aid of a dialog box on the computer screen.

The software has been specially developed for VW. It provides vehicle-specific measuring procedures and information. It provides information on the adjustment procedures and contains alignment data for vehicles throughout the Group.



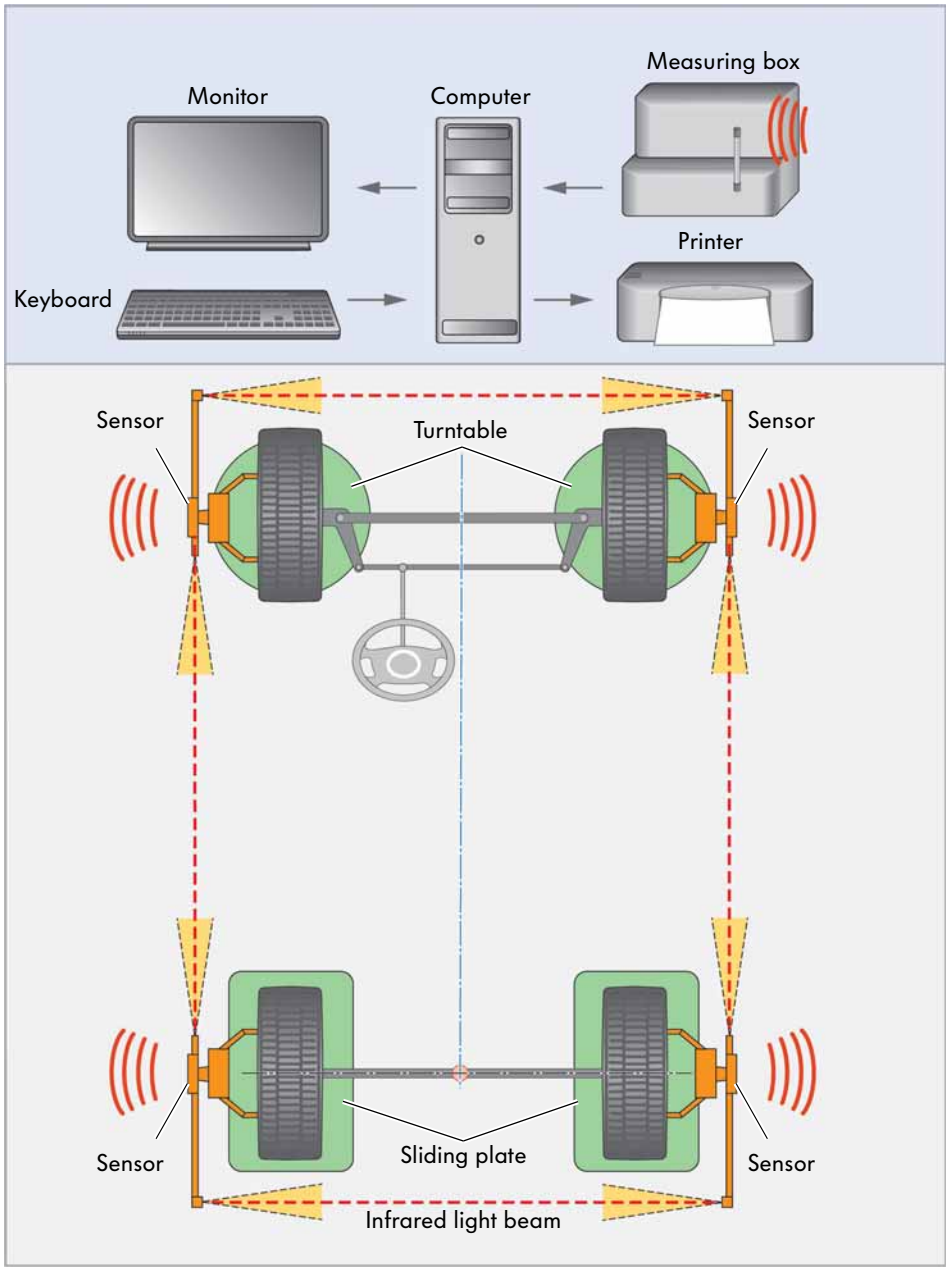
S448_054



The screenshot is only an example.

Wheel alignment system set-up

The illustration shows the communication paths of the wheel alignment system.



S448_047

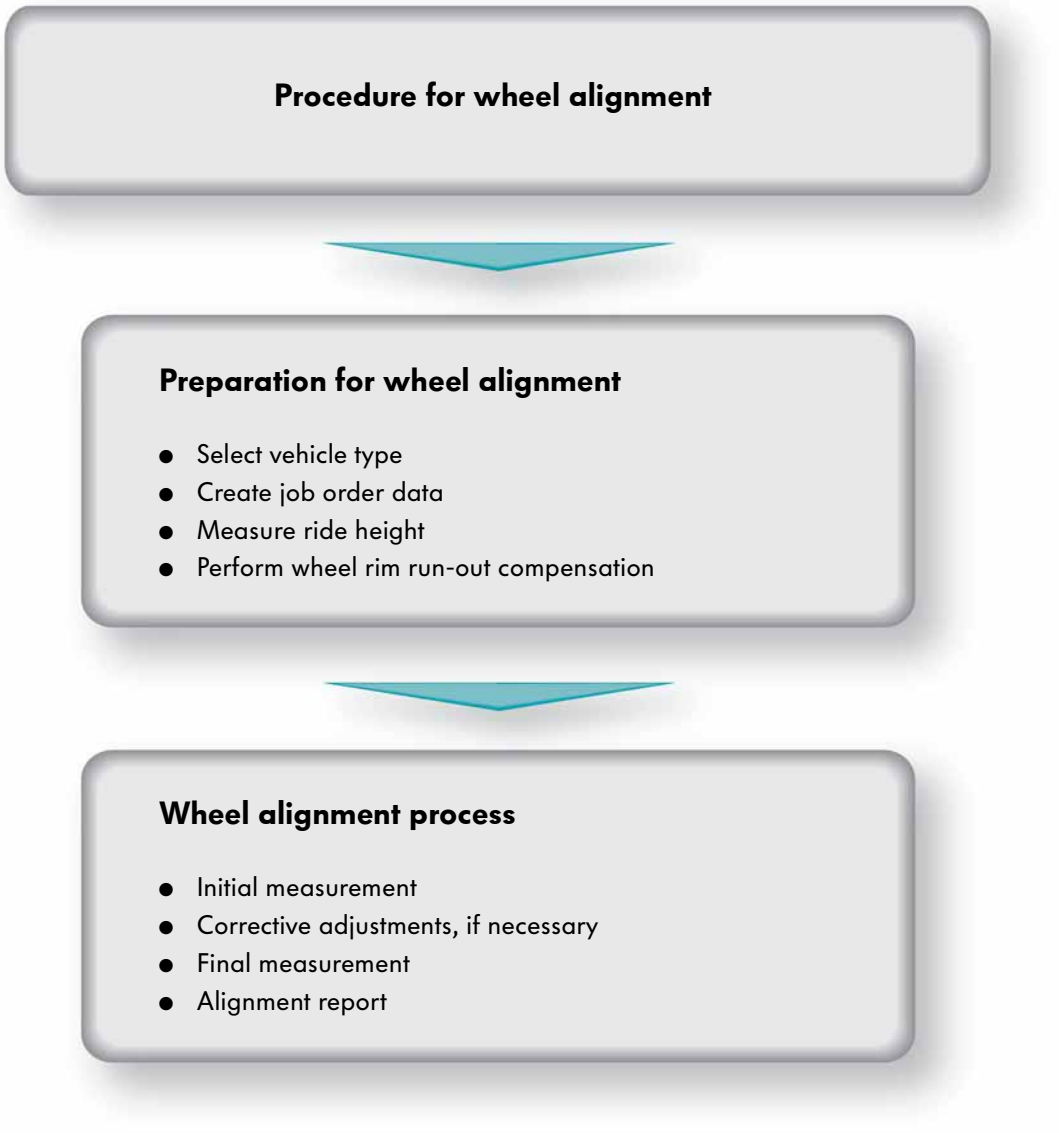


The infrared light beams emitted by the measuring system may not be broken during the measurement.

Carrying out the wheel alignment

The wheel alignment process allows the existing adjustment values (current state) to be compared with the parameters specified by the vehicle manufacturer for the suspension.

Corrective adjustments can be made if there are impermissible deviations.



S448_111



In the following descriptions, wheel alignment will be explained using electronic alignment with a wheel alignment computer.

Preparations for wheel alignment

The following table provides an overview of the basic work steps to prepare for the wheel alignment.



Preparations for wheel alignment
Line up the turntables and sliding plates and adjust the lifting platform width for the track width and wheelbase of the vehicle.
Drive the vehicle onto the turntables and sliding plates; the wheels must be in the centre of the turntables and plates.
Secure vehicle against rolling.
Test prerequisites: Please observe the vehicle-specific information in the wheel alignment software. ● Check the general condition of the suspension and shock absorbers. ● Check that the wheel rims and tyres are the same size. ● Check the suspension, wheel bearings, steering and steering linkage checked for impermissible play and damage. ● The tread depth of the tyres on one axle may differ by a maximum of 2 mm. ● The inflation pressure of the tyres must comply with the specifications. ● The kerb weight of the vehicle must be observed. ● The fuel tank must be full. Fill it up if necessary. ● The spare wheel and vehicle tool set must be in the prescribed location in the vehicle. ● The water reservoir for the windscreen and headlight washer system must be full. ● Make sure that none of the sliding plates or turntables are at their end position during the alignment process. ● Alternatively, compensating weights can be used for missing liquids. ● The vehicle should be cool (e.g. Touareg/Phaeton with air suspension).
Attach the measuring unit brackets to the wheels. The following criteria should be observed in particular: ● Sleeves should be used if necessary. ● Secure attachment of the measuring unit bracket ● Same attaching surface of measuring unit bracket ● Good form fit and positive engagement

Settings for wheel alignment

Ride height

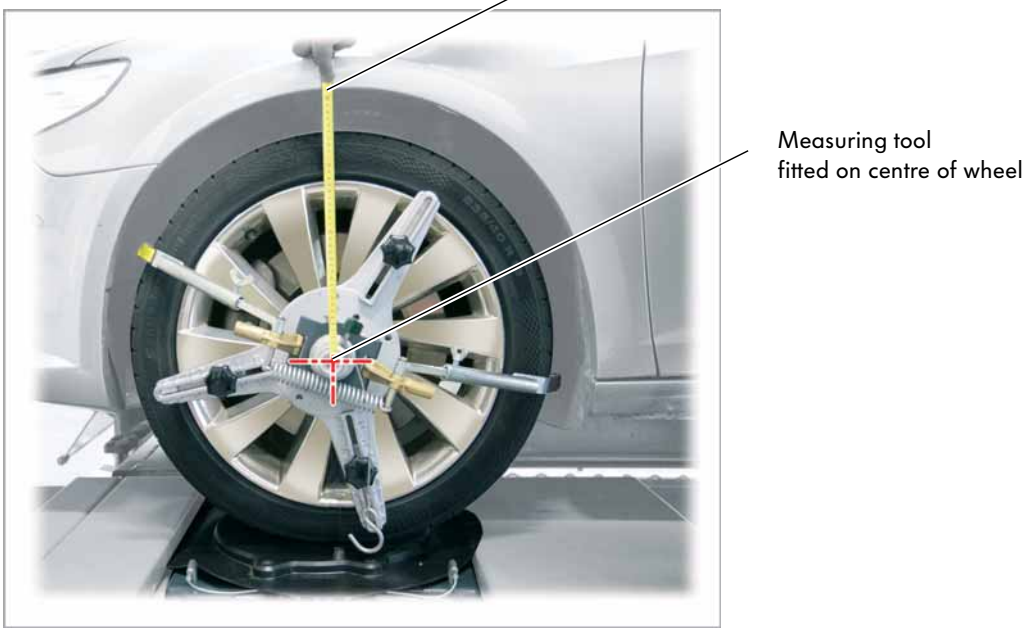
The ride height has a decisive influence on the results of the wheel alignment because the toe and camber readings will be different if the ride height differs due to the suspension geometry.

The ride height is determined by measuring vertically from the centre of the wheel to the lower edge of the wheel arch.

It is, however, also possible to measure the distance from the lower edge of the wheel arch to the rim flange and then add half of the wheel rim diameter (the wheel rim diameter must be measured).

This method is recommended as the centre of the wheel could be obscured by parts of the measuring equipment, for example, the quick clamp units.

The ride height can be varied by changing the load, which also changes the readings for the suspension. The vehicle should therefore have the correct kerb weight before the wheel alignment is started.



S448_051



You must make sure that the ride height is within the tolerance range specified by the manufacturer.
If the tank is not completely filled with fuel, changes to the toe, camber and caster readings will result.

Wheel Alignment

Wheel rim run-out compensation

Wheel rim run-out compensation must be carried out. This measures the lateral run-out of the wheel and the clamping errors of the measuring unit bracket in one revolution of the wheel and compensates the toe and camber readings.

The wheels must be lifted off the ground to perform the wheel rim run-out compensation. Loosen the securing screw on the sensor so that the rotational angle sender flanged onto the pin can measure the wheel position.



S448_052

After the wheel rim run-out compensation has been started, the wheel should be turned one quarter of a revolution three times in the direction of travel in accordance with the user guide on the screen.



S448_053

The following work is also necessary after the wheel rim run-out compensation and before the initial measurement

- Pull out the locking pins from the turntables under the wheels to prevent tension in the suspension
- Lower the vehicle
- Rock the vehicle at the front and rear axle so that the suspension settles in a stable central position
- Lock the brakes by fitting the brake pedal actuator



The vehicle should be lowered onto the centres of the turntables and sliding plates.



The screens shown over the following pages are purely examples.

Initial measurement

The initial measurement should basically be carried out with the following steps:

- Set wheels to straight-ahead
- Align spirit level on sensors
- Measure the rear axle values
- Perform steering routine by turning wheels to 20° on both sides in order to determine caster, steering axis inclination and toe-out on turns.
  Return steering wheel to straight ahead position.
- Measure toe and camber of front axle
- Perform steering routine for measuring maximum left/right steering angle
- Overview of readings with specified/current value comparison. If all readings are within the permitted tolerances, an alignment report can be printed out immediately and the wheel alignment can be ended on this vehicle.
- If the current readings are outside the tolerance range, adjustments are required. All values that can be adjusted on the vehicle are indicated by a tool icon during the adjustment work. Corresponding adjustment diagrams and information can be displayed on the screen for these readings at the touch of a button.



S448_073

Due to possible changes and updates, the instructions in ELSA (electronic service information system) should be observed during the preparation and performance of the wheel alignment.

Wheel Alignment

Adjustment work – camber and caster setting on front axle

The following can be set:

- Left camber
- Left caster
- Left toe
- Right camber
- Right caster
- Right toe
- Camber difference
- Caster difference



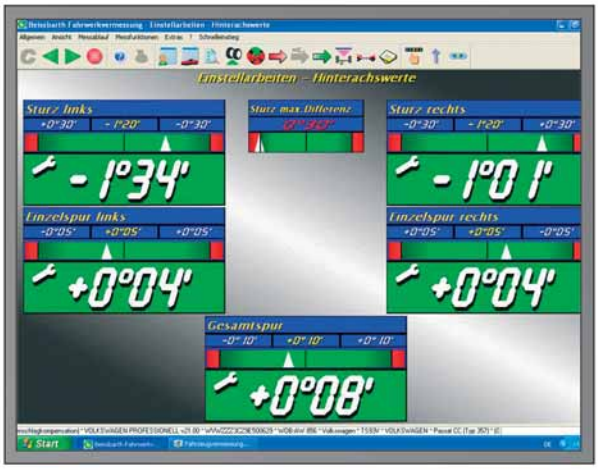
S448_056

Adjustment work – rear axle settings

The following can be set:

- Left camber
- Right camber
- Left toe
- Right toe
- Total toe
- Camber difference

On torsion beam axles like, for example, on the Polo, individual adjustments cannot be made. The readings can be averaged out by shifting the axle.

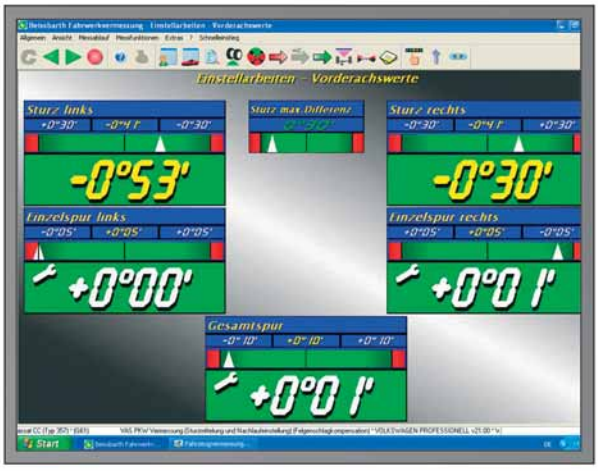


S448_057

Adjustment work – front axle settings

The following can be set:

- Left camber
- Right camber
- Left toe
- Right toe
- Total toe



S448_059

Final measurement

The final measurement should be carried out in the same way as the initial measurement.

The alignment report is displayed at the end of the final measurement.

If all readings from the final measurement are within the permitted tolerances, an alignment report can then be printed and the wheel alignment can be ended on this vehicle.



S448_061



Before the final measurement, all loosened screw connections on the axles should be tightened to the specified torques.

Alignment report

The customer and vehicle data is shown at the top of the alignment report.

In the lower section, you will see the specified data related to the readings from the initial and final measurement.



S448_072

Using Wheel Alignment Stands for Other Systems

Driver assistance systems

Driver assistance systems provide physical and psychological support for the driver.
As ever, the driver is solely responsible for his vehicle and its performance.

Lane departure warning system

If a vehicle is equipped with the lane departure warning system, the system's camera may need to be re-calibrated after wheel alignment.

This is absolutely necessary if the toe or camber of the rear axle has been adjusted.
Adjusting the settings on the rear axle also changes the thrust axis of the vehicle.

The setting device VAS 6430 is used to calibrate the warning system camera. It is positioned in front of the vehicle at a right angle to the thrust axis with the help of the wheel alignment system.
The setting device comprises different components and is also used to calibrate the ACC system, for example.

Calibration board for warning system – VAS 6430/4



S448_105

Setting device VAS 6430/1



The steps for the calibration process are listed in the wheel alignment computer software.



You will find detailed information on the warning system in self-study programme no. 418 "The Lane Departure Warning System".

Adaptive Cruise Control – ACC

If the vehicle is equipped with the adaptive cruise control system (ACC), the radar sensors used by the system may need to be re-calibrated after wheel alignment.

This is absolutely necessary if the rear axle toe has been adjusted during the wheel alignment. You will need the setting device VAS 6430 to calibrate the radar sensor.



S448_115

Setting device VAS 6430



You will find detailed information on the adaptive cruise control system in self-study programme no. 470 “The Touareg 2011 Electrical/Electronics System”.

Rear view camera – reversing camera system

If a vehicle is equipped with the rear view system, the system’s camera will need to be re-calibrated if the toe or camber settings of the rear axle have been adjusted during wheel alignment.

The calibration unit VAS 6350 is used to calibrate the rear view camera.

Adjusting the settings on the rear axle also changes the thrust axis of the vehicle. The optimum scanning area of the rear view camera depends on the thrust axis.



S448_116

Calibration unit VAS 6350



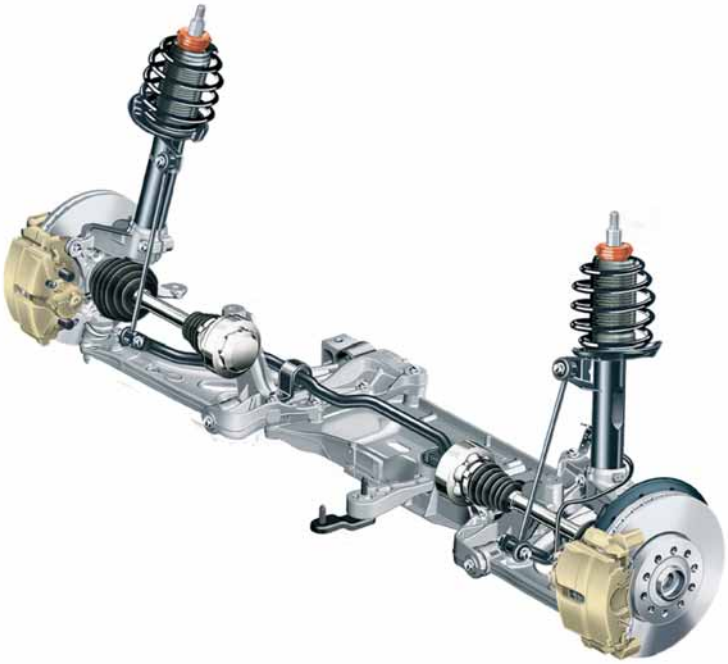
You will find detailed information on the reversing camera system in self-study programme. 407 “Reversing Camera System”.

Types of axle

The following are some examples of the types of axle used by Volkswagen.

McPherson strut front suspension on Golf 2004

- Toe adjustable
- Camber not adjustable, can be influenced by centring the axle



S448_006

Four-link rear axle on Golf 2004

- Toe and camber separately adjustable



S448_007

Torsion-beam rear axle on Polo 2010

- Cannot be adjusted
- Can only be centred



S448_070

Four-link 4motion rear axle on Passat and Tiguan

- Toe and camber separately adjustable



S448_069

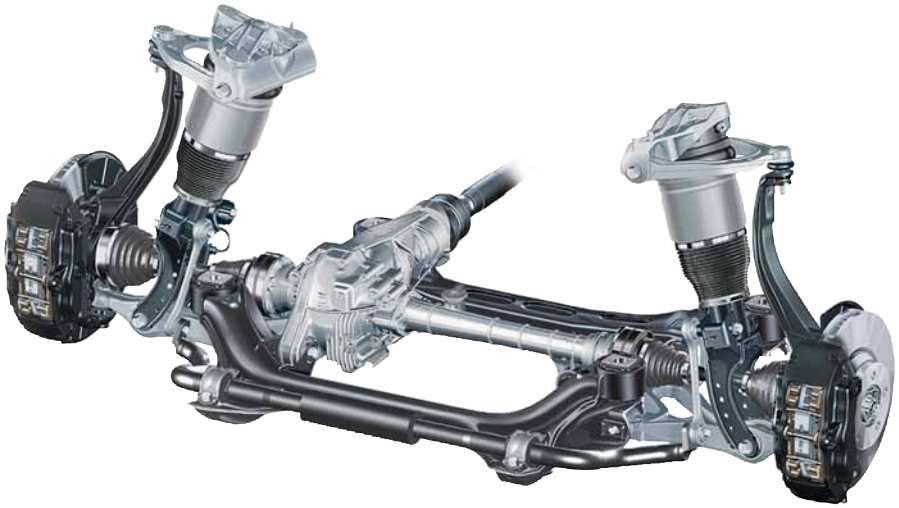
Axles

Steel-spring suspension or air suspension on Touareg

The Touareg can be equipped either with a steel-spring suspension system or an air suspension system. The illustrations show the version with air suspension.

Front axle

- Toe, camber and caster separately adjustable



S448_008

Rear axle

- Toe and camber separately adjustable



S448_106

Steel-spring suspension or air suspension on Phaeton

The Phaeton can be equipped either with a steel-spring suspension system or an air suspension system. The illustrations show the version with air suspension.

Front axle

- Toe, camber and caster separately adjustable



S448_009

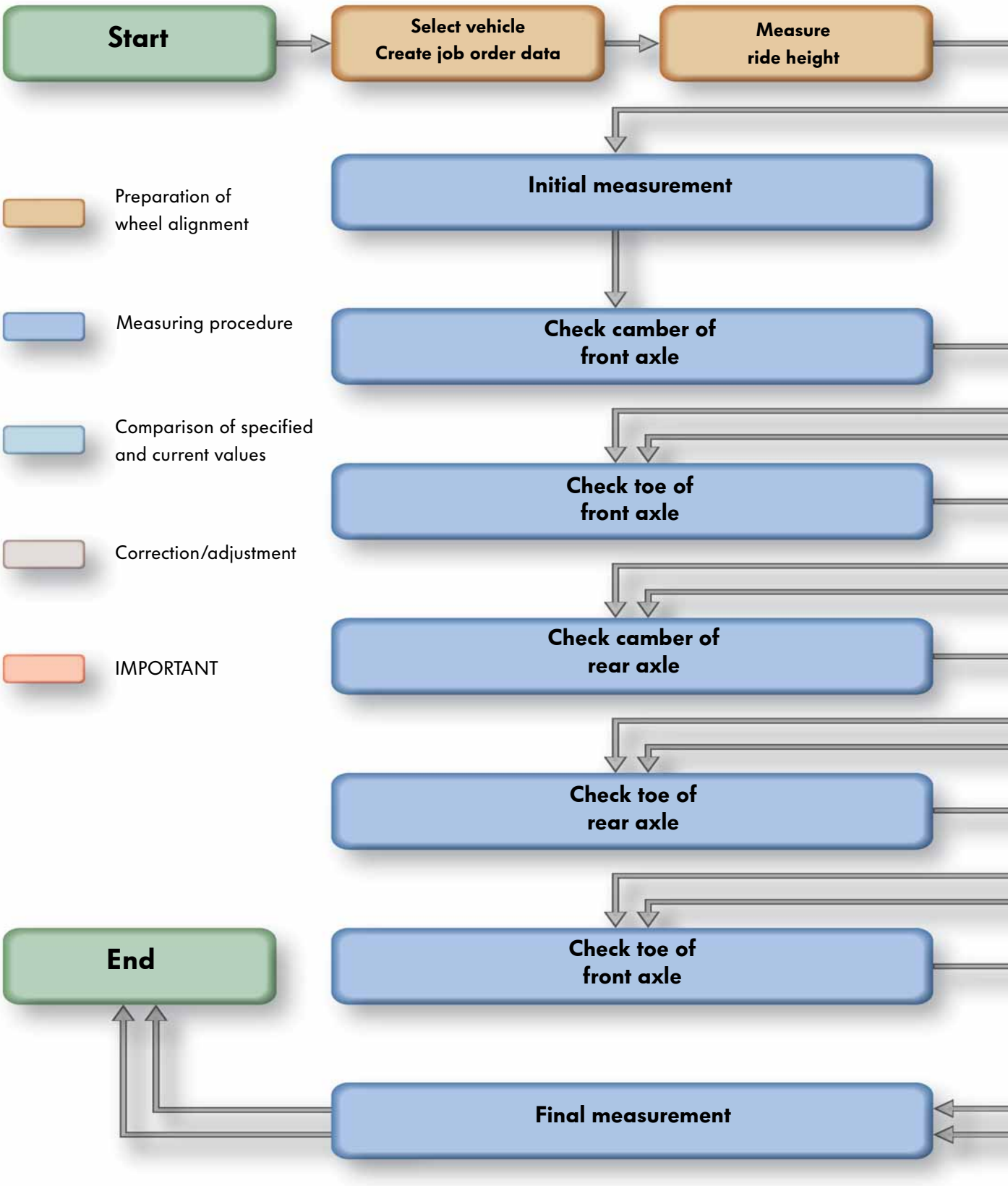
Rear axle

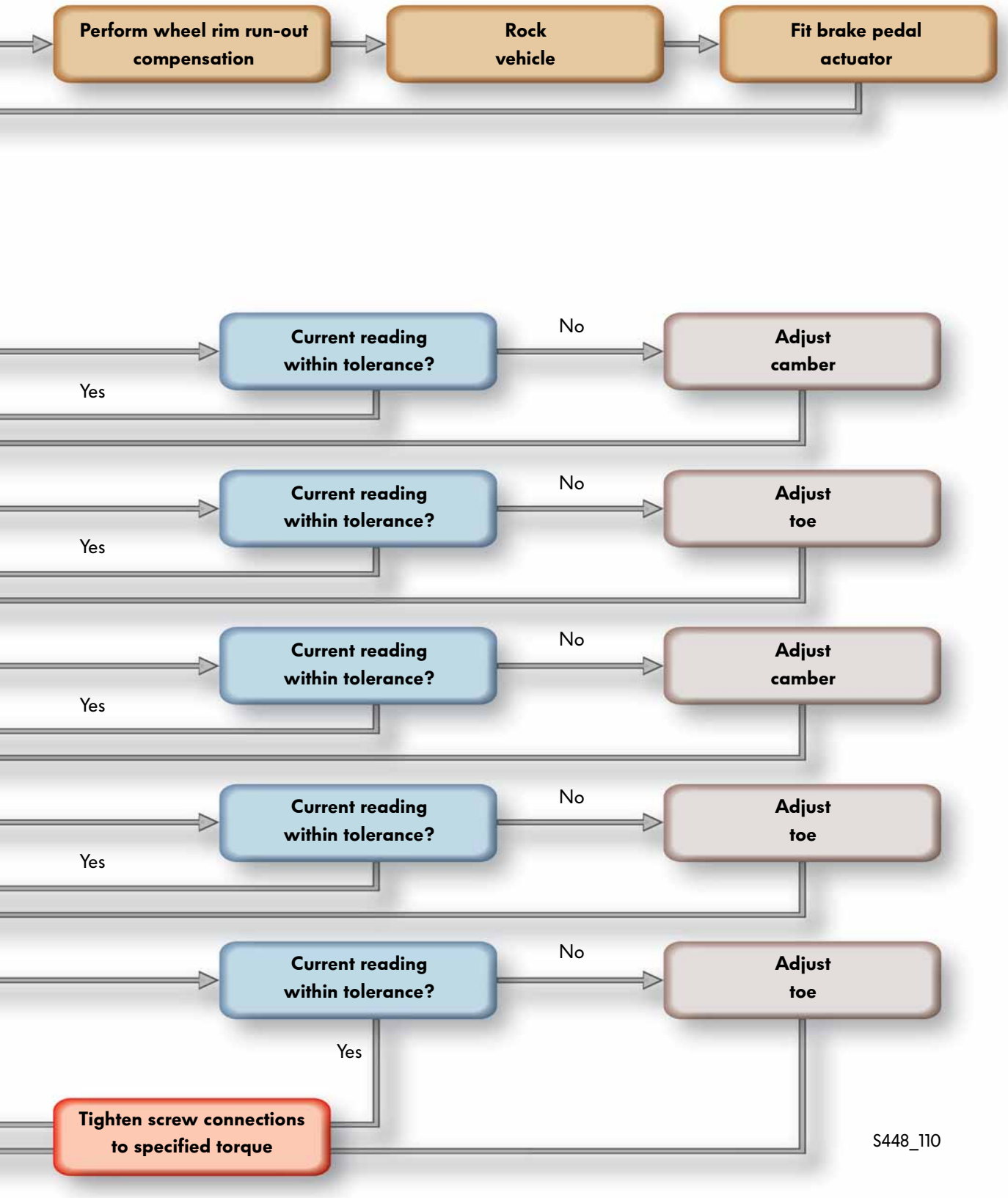
- Toe and camber separately adjustable



S448_107

Flowchart for wheel alignment
(using example of Golf 2009)




Perform wheel rim run-out compensation
Rock vehicle
Fit brake pedal actuator
Current reading within tolerance?
No
Adjust camber
Yes
Current reading within tolerance?
No
Adjust toe
Yes
Current reading within tolerance?
No
Adjust camber
Yes
Current reading within tolerance?
No
Adjust toe
Yes
Current reading within tolerance?
No
Adjust toe
Yes
Tighten screw connections to specified torque
S448_110

Notes



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000.2812.28.20 Technical status 02.2011

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❀ This paper was manufactured from pulp that was bleached without the use of chlorine.