PEDDERS TECHSTOP

16/06

BASIC WHEEL ALIGNMENT

SHOCK ABSORBER, SUSPENSION, BRAKES, TOWBARS
AND WHEEL ALIGNMENT SPECIALISTS

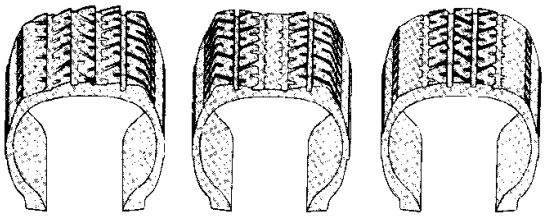
There are many reasons why a wheel alignment is to be considered an important repair/service operation on any car. It is therefore necessary to understand the basic principles involved within the steering geometry of the vehicle. This tech stop is designed to give you an insight into the technical aspects of wheel alignments and the reasons why it is important to take this operation very seriously.

There are 6 good reasons why you should take wheel alignments seriously:

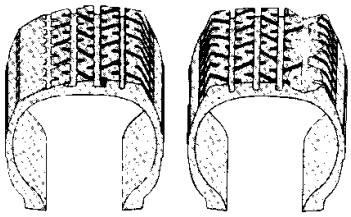
- Vehicle control.
- Directional stability.
- Maximum effect from the foot print of the tyre.
- Long tyre life.
- Fuel economy.
- Braking effect.

Pre – Alignment Inspection:

Before any wheel alignment is to be performed on a car, the steering and suspension is to be checked for worn or damaged components.



Toe | Over Inflated | Under Inflated



Camber/ Caster | Scalloped Shock Absorbers

It is a total waste of your customer's money and your time if a wheel alignment takes place and there are ball joints, tie rod ends and/or bushes that are not within permitted acceptable serviceable allowances.

For example, 2mm of wheel bearing movement will affect the toe reading by 4mm, this is tyre wearing territory.

If a wheel alignment is performed on a car and it has worn components, then there is a high probability that the car will still wear tyres, pull to one side and the steering wheel will not be straight.

What will happen now, is that the customer will come back to your store and complain, this is not a good situation, as the customer came to you in the first place because you are the steering and suspension expert and "No Bull".

Wheels and Tyres:

A worn tyre is a history story on what happened within the suspension, it can tell you a lot.

Issue	Alignment Status	Tyre Condition
Angles Out	Incorrect Toe	Feather or sawtooth wear
	Incorrect Camber	One edge worn (Smooth Edge)
Components Worn	Worn Shock/ Component	Cupper or scalloped wear
Balance problems	Out of round & out of balance	Random bald spots
Inflation levels	Under inflated	Both edges
	Over Inflated	Worn tread centre
The Driver	Corners quickly, brakes hard, accelerates fast, drives on rocky surfaces, overloads vehicle	Worn sidewalls, radial feathering, torn tread, both edges

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Always check the tyre pressure and make sure that all the rims are the same size and have the same “Off – Set”

Any wheel alignment on a car with unmatched or severely worn tyres will create a problem. Tyres on the same axle should be:

- The same size
- The same construction
- The same tread design
- The same tread depth
- On the same sized rim
- If directional, all rotating in the correct direction

Ride Heights and Load Distribution:

Prior to conducting a wheel alignment on a vehicle, it is very important that the vehicle to have an even ride height from side to side. It is reasonable to expect a vehicle to have rake to the front, so front to rear height is not a critical measurement, unless it is excessive. If in doubt always check, and remember when doing so, the vehicle is to be on a firm level surface.

In order to maximise the tyre life and handling of vehicles designed for load carrying or towing purposes, it is essential to perform the wheel alignment operation whilst the vehicle is in it’s usual operating situation, i.e. carrying it’s normal load.

Camber

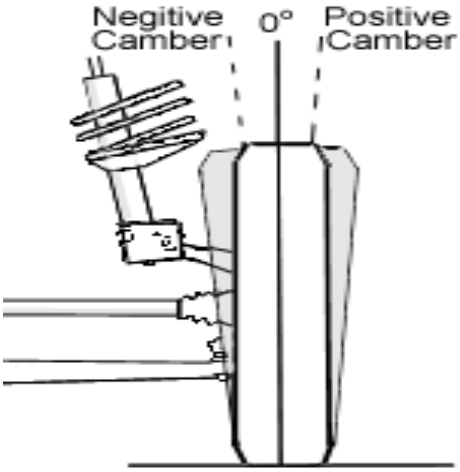
Camber is the angle of the wheel, measured in degrees, when viewed from the front of the vehicle. If the top of the wheel is leaning out from the centre of the car, then the camber is positive ,if it’s leaning in, then the camber is negative. If the camber is out of adjustment, it will cause tire wear on one side of the tire’s tread. If the camber is too far negative, for instance, then the tire will wear on the inside of the tread.

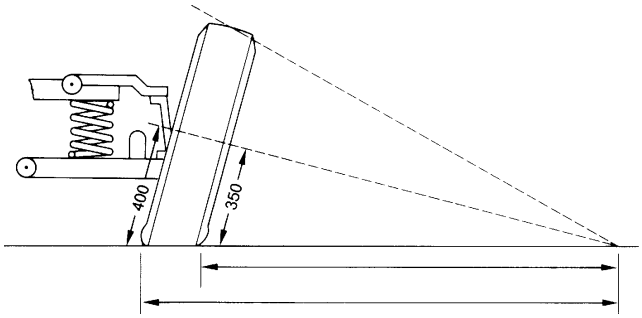
Positive or negative camber causes the tyre to become tapered across its tread, effectively creating a cone. When a cone is rolled it rolls in a circle around its tip.

A vehicle with equal camber left and right will not have a camber induced pull as one side counteracts the other.

When one cone is greater than the other a pull will be induced in to the car.

The main purpose of camber these days is to maintain even tyre contact across the entire tread surface. This helps reduce tyre wear on the tyre’s edges and improves the cornering ability of the vehicle.





Camber: Positive or negative camber causes the tyre to become tapered across its tread, effectively creating a cone.

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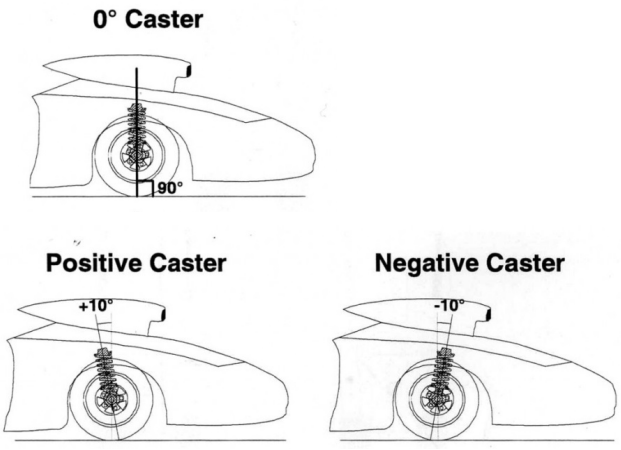
Caster

Caster is the angle of this steering pivot, measured in degrees, when viewed from the side of the vehicle. If the top of the pivot is leaning toward the rear of the car, then the caster is positive, if it is leaning toward the front, it is negative. If the caster is out of adjustment, it can cause problems in straight line tracking. If the caster is different from side to side, the vehicle will pull to the side with the least amount of positive caster. If the caster is equal but too negative, the steering will be light and the vehicle will wander and be difficult to keep in a straight line. If the caster is equal but has too much positive, the steering will be heavier (especially with non-power steering assistance) and the steering wheel may kick when you hit a bump. Caster has little affect on tire wear, except where unequal caster causes the driver to have input into the steering to counteract the "pull". In this case there maybe noticeable edge wear on the tyres.



Types of Castor

Purpose

Caster is the angle that most affects directional stability primarily on rear wheel drive vehicles. Positive Caster provides 3 important characteristics.

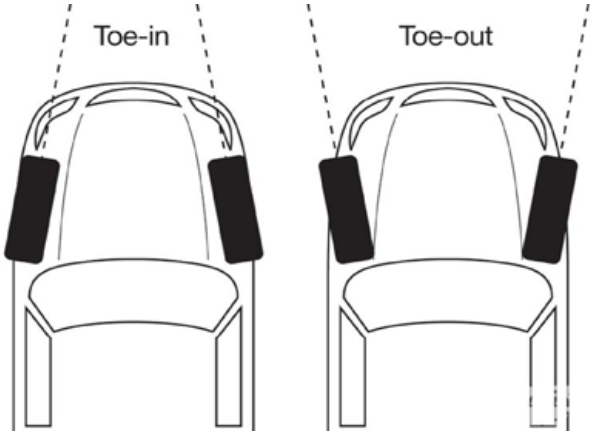
1. Steering feel or feed back
2. Directional stability
3. Steering self-centring

Toe In and Toe Out

Toe is a measurement of how much the front and/or rear wheels are turned in or out from a straight-ahead position. When the wheels are turned in, toe is positive (+). When the wheels are turned out, toe is negative (-). The actual amount of toe is normally only a fraction of a degree. The purpose of toe is to ensure that the wheels roll parallel. Toe also serves to offset the small deflections of the wheel support system that occur when the vehicle is rolling forward. In other words, with the vehicle standing still and the wheels set with toe-in, the wheels tend to roll parallel on the road when the vehicle is moving. Improper toe adjustment will cause premature tire wear and cause steering instability.

Purpose

Toe angle is the wheel alignment angle that can have the greatest effect on tyre wear because it controls the direction of the tyres on the road in relation to one another. Toe angles were first examined and adjusted when it first became known that a vehicle's motion had the effect of forcing the wheels away from parallel.



Toe In & Toe Out

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Toe Out on turns

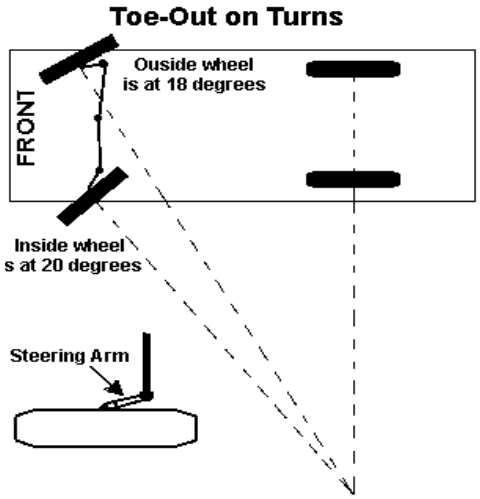
When you steer a car through a turn, the outside front wheel has to navigate a wider arc then the inside wheel. For this reason, the inside front wheel must steer at a sharper angle than the outside wheel.Two degrees of toe change can equate to 12mm of toe – out

Purpose

When the car is turning a corner, the front wheels rotate on different axes, if the geometry does not allow for this, then tyre scrubbing will occur. The intention of Ackermann geometry is to avoid the need for tyres to slip sideways when following the path around a curve.

Measuring

Toe-out on turns is measured by the turning angle gauges (turn plates) that are a part of every wheel alignment machine. The readings are either directly on the turn plate or they are measured electronically and displayed on the screen. Wheel alignment specifications will usually provide the measurements for toe-out on turns. They will give an angle for the inside wheel and the outside wheel such as 20: for the inside wheel and 18: for the outside wheel. Make sure that the readings are at zero on each side when the wheels are straight ahead, then turn the steering wheel so that the inside wheel is at the inside spec. then check the outside wheel.



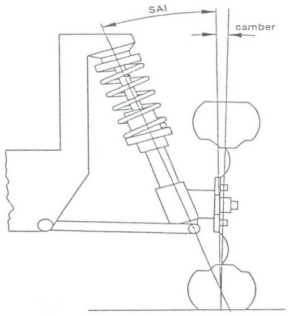
Steering Axis Inclination (S.A.I.)

SAI is the measurement in degrees of the steering pivot line when viewed from the front of the vehicle. This angle, when added to the camber to form the included angle (see below) causes the vehicle to lift slightly when you turn the wheel away from a straight ahead position. This action uses the weight of the vehicle to cause the steering wheel to return to the center when you let go of it after making a turn. Because of this, if the SAI is different from side to side, it will cause a pull at very slow speeds. Most alignment machines have a way to measure SAI; however it is not separately adjustable. The most likely cause for SAI being out of specification is bent parts which must be replaced to correct the condition. SAI is also referred to as KPI (King Pin Inclination) on trucks and old cars with kingpins instead of ball joints.

Purpose

In today's cars S.A.I. is also used as the primary directional stability angle and reduces the need for caster. It provides excellent straight line steering and self-centring steering.

Another thing to keep in mind, all the Wheel Alignment geometry settings are measured and adjusted whilst the car is stationary (Static), but they are calculated for when the car is in motion (Dynamic).



Steering Axis Inclination (S.A.I.)

One Final Note: When the head of the wheel alignment machine has been fitted to the wheel, a "run-out" is to be performed. This procedure neutralises any imperfection of the head to the rim and will give accurate readings. A lot of modern machines have this built in to their process, but the older machines do not and it is to be performed manually on EVERY wheel alignment.