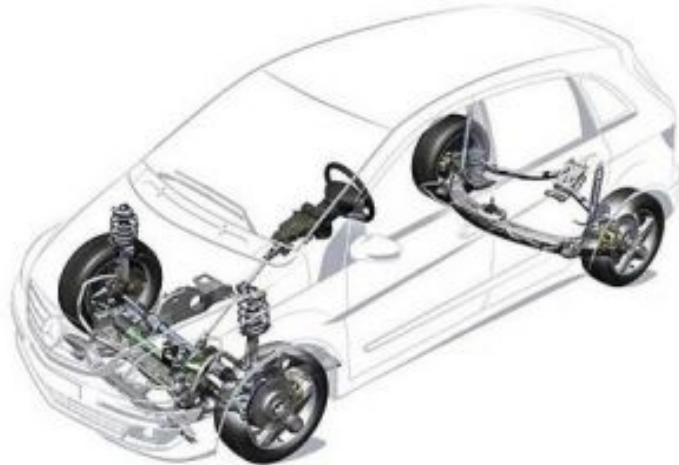




THE GARAGE EQUIPMENT ASSOCIATION

THE FUNDAMENTALS OF WHEEL ALIGNMENT

Getting things straight



There's money to be made by offering a good wheel alignment service, but what workshop area and equipment do you need and how much training is involved?

Hear the GEA will try to answer these questions and hopefully provide the technical knowledge required to provide a first class "full" 4-wheel alignment service. So let's start by looking at what working area is required within your workshop.

Wheel alignment should be carried out on a level area. If there's no intention to measure and adjust camber, castor and KPI angles and providing that the floor does not slope too much, most alignment equipment can check toe angles on a floor which is flat, but not necessarily level.

However, if it's intended to offer a camber, caster and KPI angle check together with any adjustment, the service must be provided on a level working area. The main reason for this is the fact that changing the ride-height of the vehicle also changes its geometry. A sure way of knowing that the readings taken from the vehicle are not being affected by an unlevel floor or an incorrect ride-height is to load the vehicle's suspension down onto blocks, thus fixing the ride-height to the manufacturer's preferred measurement height. However, this is not always practical, so it's sensible to use an area that is as level as possible.

Acceptable working areas include:

- A wheel supporting lift with the platforms correctly levelled.
- Over a vehicle inspection pit with a level floor surface area.
- On a level piece of concrete floor area.

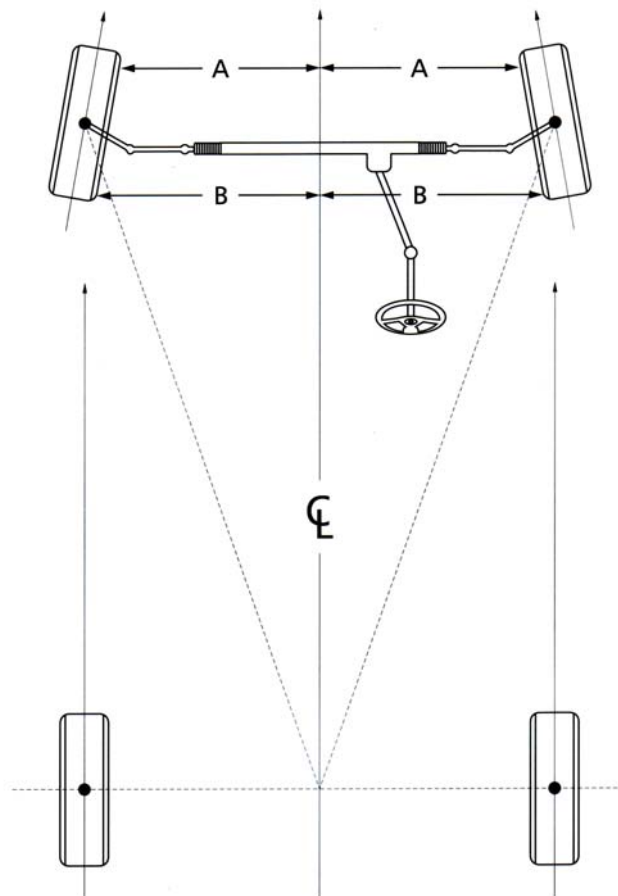
All areas must be checked across the width and length of the vehicle area, an accuracy of 6mm over a 2 metre distance is the normal recommendation. It's also worth remembering that when using ball bearing turntables, which because of their profile raise the front wheels, the readings taken for the caster angle will be higher than they actually are. Therefore, using rear run up ramps is also advisable as this keeps the vehicle nice and level.

So the question that should be answered before you prepare your workshop is: what service do you intend to provide to your customer. If you operate a Tyre Centre then checking and adjusting just the vehicle's toe angles is often the only service you will be asked to provide. However, more cars today are becoming fully adjustable and with customers becoming more demanding, many tyre centres are beginning to offer a full 4-wheel alignment service, but how do you define this? – Most agree that a full 4-wheel alignment service is one that offers to check and adjust both front and rear toe, set-back, caster, camber and KPI. If a vehicle is suffering with what most call "crabbing" then thrust angle checks and solutions should also be provided. Before we look at different kinds of equipment, starting with toe, let's run through the basics of a vehicles geometry angles.

Toe Angle:

Toe angle, also referred to as 'tracking', relates to the way in which the actual width of the wheel track varies between the front edges when compared to the rear edges of an axle's wheels. (See diagram – in this case B is greater than A).

Please note, in this simple front-only situation, the steering wheel position is shown set at right angles to the centre line, and each front wheel equally set toed in to the centre line, with the rear wheels parallel.



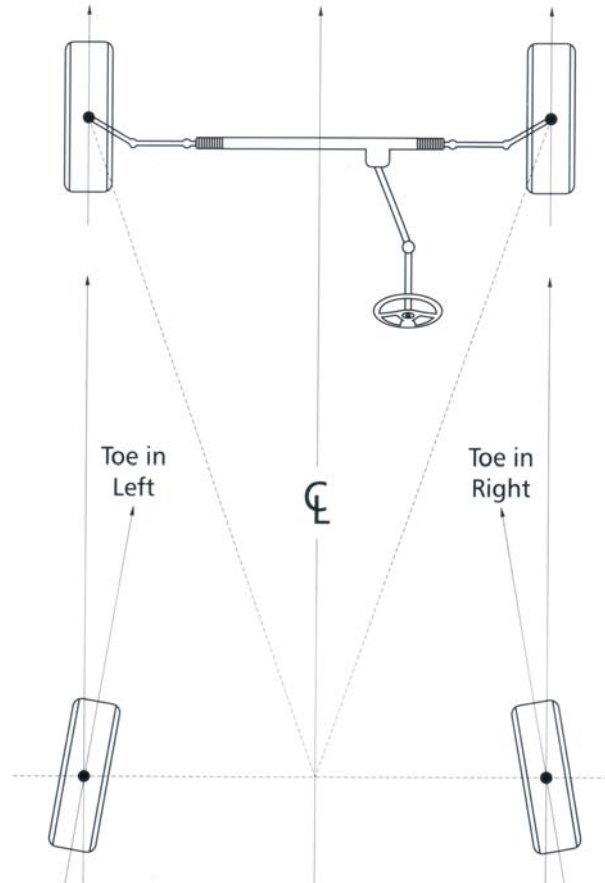
As viewed from above, the front road wheels, will either be pointing towards the centre line or away from it. If the wheels point away from the centre line, they are said to be toed-out (also called negative toe); in specification books this will be represented by a number preceded by a minus sign. Wheels pointing towards the centre line, (as shown in the diagram) are toed-in (positive toe).

Toe angle is built into vehicle geometry to reduce the tyre wear to a minimum and to counteract any tension built in by the other angles. Ideally once the vehicle is moving, the two wheels of a said axle should become perfectly straight (parallel) to each other, In order to achieve this, when static the axle is set with a small amount of toe-in or toe-out. Once the vehicle starts moving forward, forces in the suspension and drive should pull the wheels almost parallel. However, most vehicles today will be set to have a slight toe-in or toe-out, this is a result of vehicle designers compromising; for example, setting the wheels to toe-in provides better straight-line stability whereas setting to toe-out offers a quicker steering response.

Rear toe angle:

Rear wheel toe, either in or out, is always an individual measurement. Front wheel toe can be measured as a total, using a toe gauge, because the steering system will allow unequal adjustments on either side, to self centre. With rear wheel toe however, each wheel can affect the steering as there is no compensating steering wheel for the rear axle. It is the rear wheel axle alignment that controls the steering wheel position.

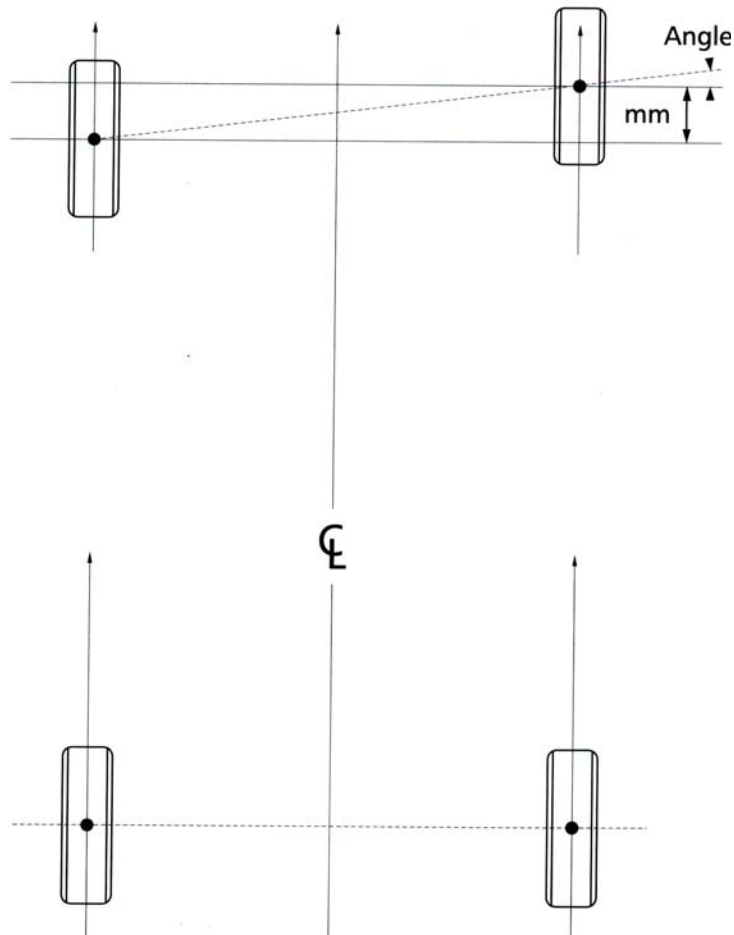
When adjusting rear wheels for toe in or toe out, each angle must be exactly equal on both sides, if not, the vehicle will be steered away from its centre line by the inaccurate wheel. The rule of thumb, when making rear wheel adjustments, is to firstly adjust both wheels to equal toe with respect of the centre line, then equally increase or decrease them to the manufacturer's settings. The vast majority of modern vehicles have a toe-in or toe-out of no more than 1mm per wheel. Over that tyre wear occurs to unacceptable levels. With the onset of the front wheel drive vehicle, rear wheel toe adjustments have become more common place. It is easier to build an average tolerance body shell and trim the rear wheel alignment to suit, as opposed to tying yourself down to a close tolerance body, which would give acceptable tyre wear and steering capability.



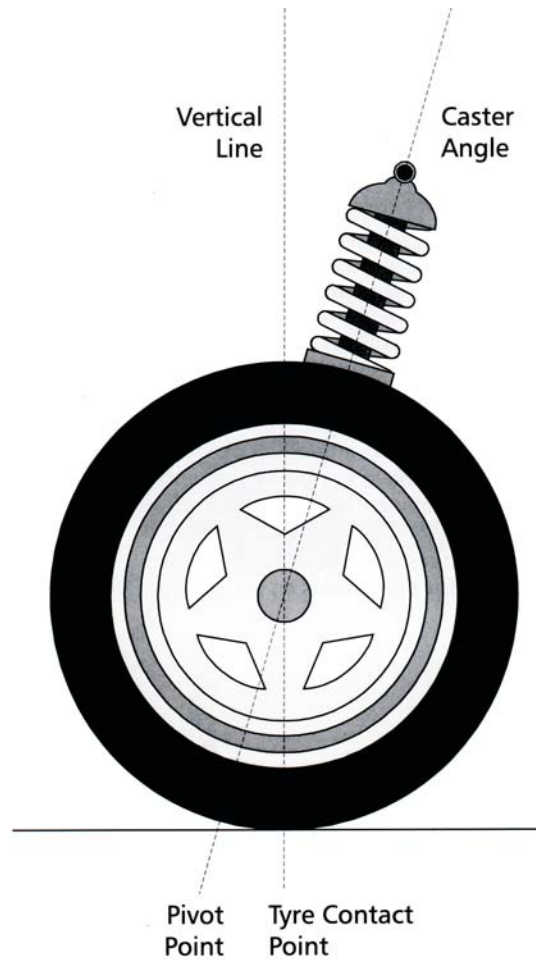
Front wheel set-back:

Front wheel set-back is a check used to determine the position of the front wheels with reference to a line placed perpendicular to the vehicle's centre line. Ideally the left hand wheel should be located directly opposite the right hand wheel. However, a tolerance of 5mm is allowed on all new cars, it's acceptable on older cars to have a set back of 10mm.

Whilst conducting a routine toe check on vehicles, noting any excessive set back provides a good indicator, which suggests closer inspection is required as collision damage or suspension problems may be present. Please note: Most alignment equipment does not tell you which wheel is at fault, just that there is a difference across the centre line. However, positive set-back indicates that the right hand wheel is set-back further than the left. Negative set-back indicates that the left hand wheel is set-back further than the right.

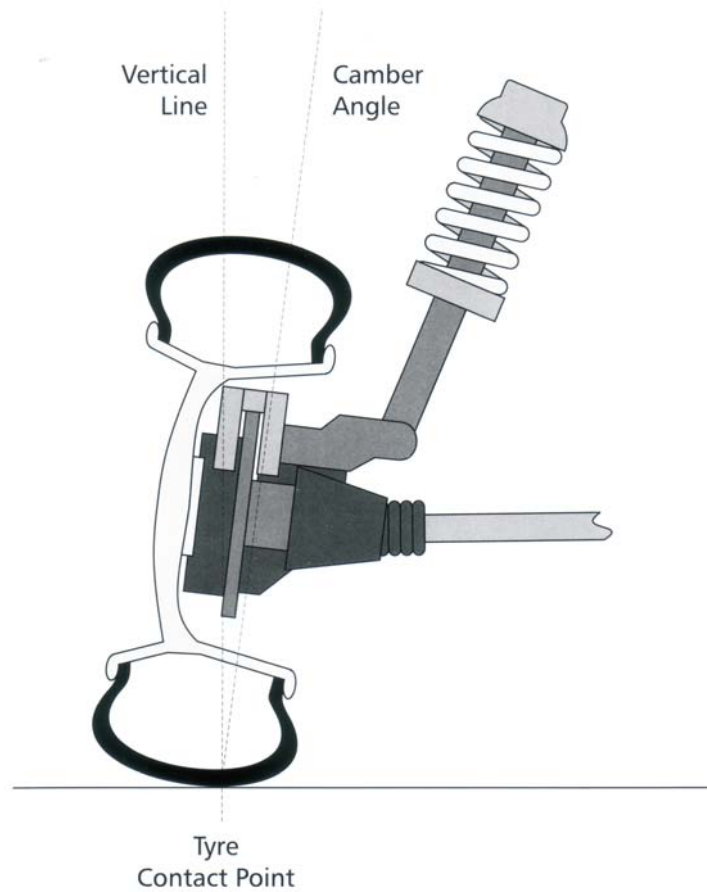


Caster:



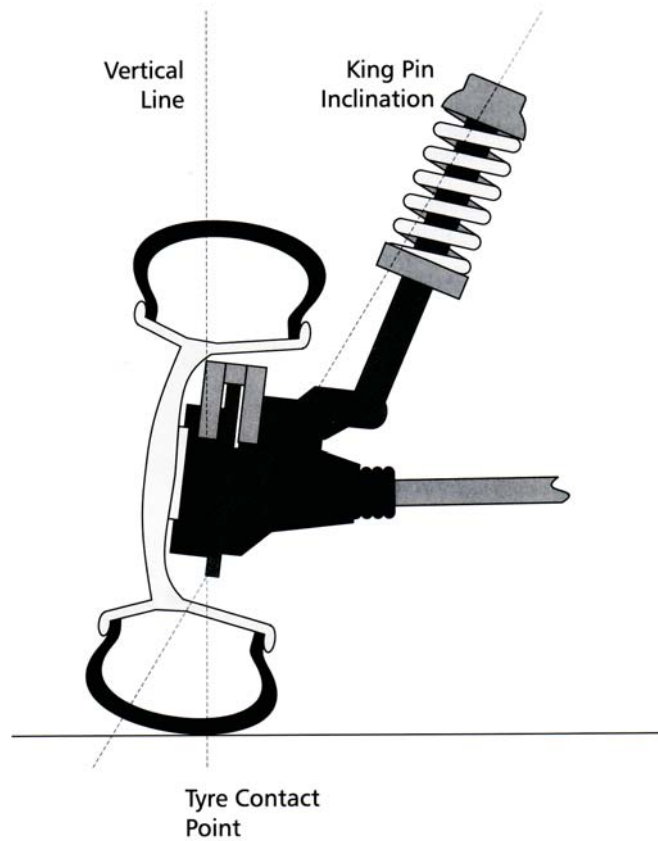
Looking at a front wheel from the side of the vehicle, caster is the measurement between the plane of the king-pin or strut compared to a vertical line, basically the amount of tilt in the swivel - Bike forks for example tilt backward thus providing a positive caster reading. Most of us have suffered by attempting to push a supermarket trolley around the store when one of the wheels has no caster angle, it's the one that keeps chattering from side to side!

Camber:



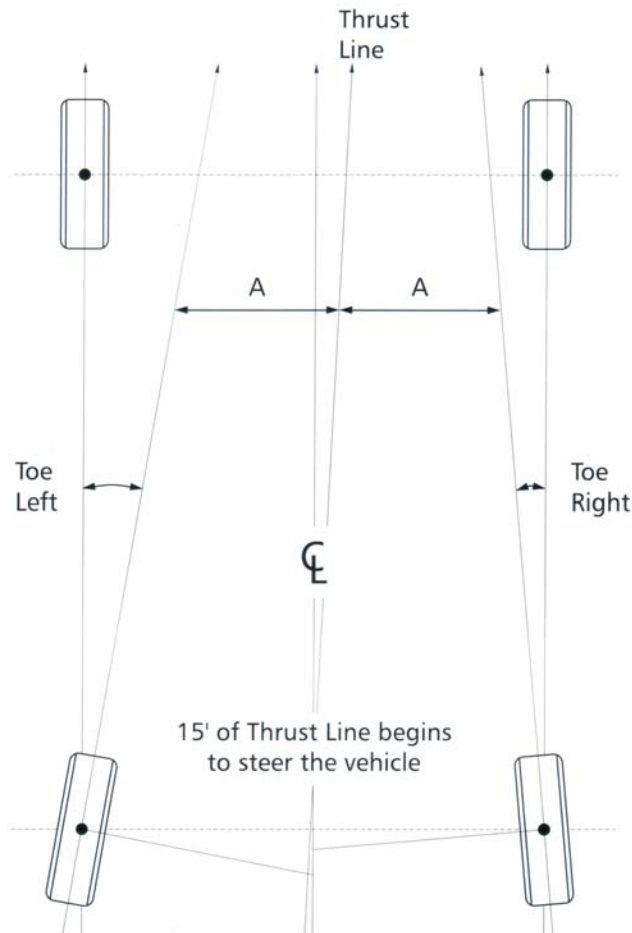
Looking at a front or rear wheel from the front or rear of the vehicle, camber is the measurement between the plain of the wheel compared to a vertical line, basically the amount the wheel tilts in or out at the top. Incorrect camber often causes excessive tyre wear and is one of the angles that are often adjustable both front and back on modern cars.

King pin inclination KPI:



Looking at a front wheel from the front of the vehicle, KPI is the measurement between the plane of the king pin or strut compared to the vertical, basically the amount of tilt in the wheel as it swivels. Changes to this will change the turning arc of the front wheels.

Thrust axis deviation or thrust angle:



Thrust angle is the amount that the rear axle is out of align to the front axle. If the rear is not aligned, it may be steering the vehicle from the rear, which will result in what's known as Crabbing. When a problem similar to the one shown in the drawing occurs, the vehicle will steer to the left, resulting in the steering wheel having to be turned to the right to counteract the rear steering force.

At the same time the front wheel position adopts a set back situation with respect of the vehicle's centre line. Should the front axle now be measured from the front only, this set back situation will not be noticed. So to offer a full alignment service a vehicle's trust angle must be checked.

So basically, rear wheel toe must be kept equal to the centre line and correctly toed in or out in order for the vehicle to handle correctly.



Equipment types:

Wheel alignment Equipment comes in all shapes and sizes. If you are only checking and adjusting toe angles then a basic manual toe gauge will suffice. Toe gauges vary in design, some are simple sight gages others use elastic strings or light sources. However, if you want to provide a full service and offer caster, camber, KPI and trust axis checks, then the equipment can become more complicated.

The next question will be: how much knowledge and understanding have my technicians or I, what will my customer volume be and is customer presentation important?

There are good, non computer based, full alignment systems available, which work as precisely as most of the computerised systems, so if you already have a good knowledge of geometry it's worth checking these out. But nevertheless if you want the system to guide you through any adjustments then a computerised system may be your best bet; computerised systems also provide a print-out for your customer, which helps to present a more professional image.

Another thing to consider is speed of test, today there are systems available that do not actually come into contact with the vehicle whilst it's being checked, although these are expensive they can save time and money.

For more information on Wheel Alignment visit the GEA website:
www.gea.co.uk