# Technical Torque #28

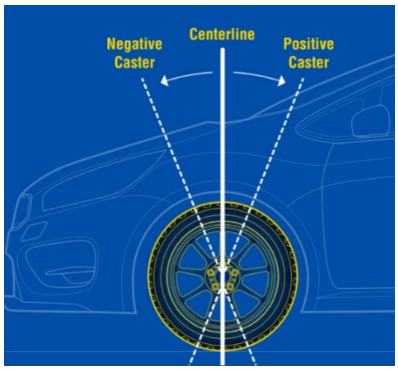
## Staying in line - Russell Walsh

The importance of wheel alignment is well understood but in today's environment the use of string, a sprit level, tape measure and a protractor are no longer acceptable for checking and adjusting alignment.

Wheel alignment setting today is largely done using laser technology to achieve the accuracy required, so we often forget just what it is that is been checked and why.

### Contributing angles

Wheel alignment seems a simple task but is made up by balancing a number of independent and what could be considered competing, measurements; caster, camber, kingpin inclination, toe, Ackerman angle.

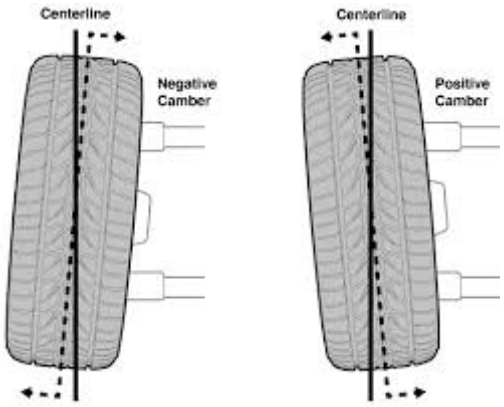



### Caster

Caster is the backward, or forward tilt, usually backward, of the steering axis (pivot point) of a steering road wheel, for most trucks this would be a king pin. The effect of this is to move the contact point between the tyre and road surface back providing a degree of self-centring of the wheel with the road surface.

A common example of caster are the wheels on a shopping trolley, no matter which way you push the trolley the wheels will bring the trolley back into a straight line.

**Camber**

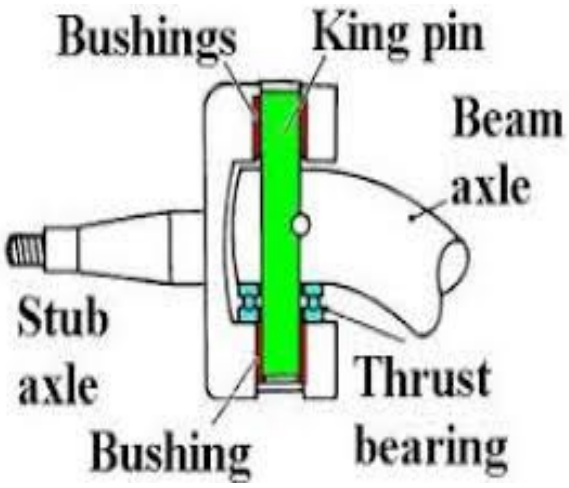



Camber angle is the angle between the centre line of a tyre and the vertical line. Camber may be either positive or negative. Positive camber is when the wheel leans outward with the centre line of the wheel at the top being to the outside of a vertical line from the ground through the centre line of the wheel while negative camber is when the wheel leans inward and the centreline of the wheel is towards the inside of that vertical centreline.

The purpose of camber is to bring the centre of a tyre's contact with the road surface to as near as possible under the centre line if the king pin or, for a front axle with independent suspension with top and bottom wishbone arms the centre of the ball joints. Negative camber is used to ensure maximum tyre contact on the outer, more heavily loaded, tyre when cornering

Camber angle also assists to ensure the majority of the vehicle's weight, transferred from the road surface through the wheel and tyre to the suspension, is carried on the large, inner, wheel bearing.

**Stub axles (Sometimes referred to as steering knuckles or spindles.)**




A stub axle is a short axle fitted to each end of each steering axles by a pivot point, (king pin or upper and lower ball joints), and are capable of movement that allows the vehicle to be steered.

Stub axles are the foundation on which the brake assemblies are mounted and also the wheel hub that supports the road wheels.

Stub axles are connected to each other via a track rod and during normal day to day operation are subjected to many, varied external forces.

**Kin pin inclination (KPI)**

King pin inclination is the number of degrees the top of the king pin is offset towards the centre of the vehicle compared to the vertical. The centre line of the king pin, not the vertical line, is the line around which the king pin rotates when it is turned.

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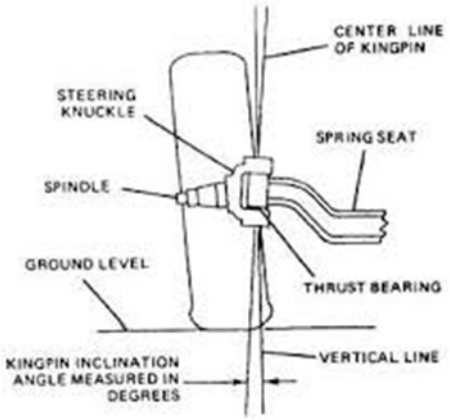
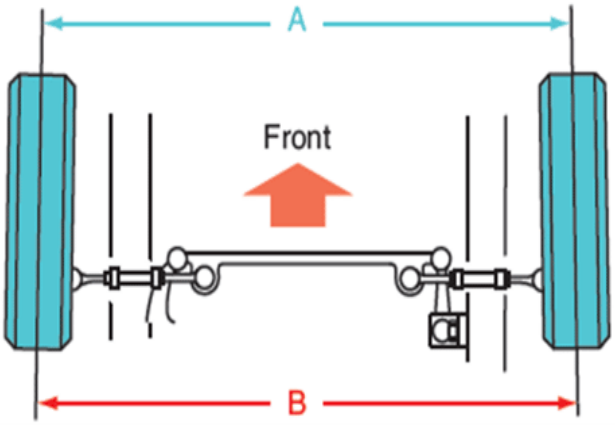



KPI assists steering by reducing binding in the top and bottom king pin bushes when the vehicle is steered. This reduction results in lighter steering and reduced wear on the bushes and king pin. In a vehicle with independent suspension, when the king pin is replaced by upper and lower ball joints, the same principle applies.

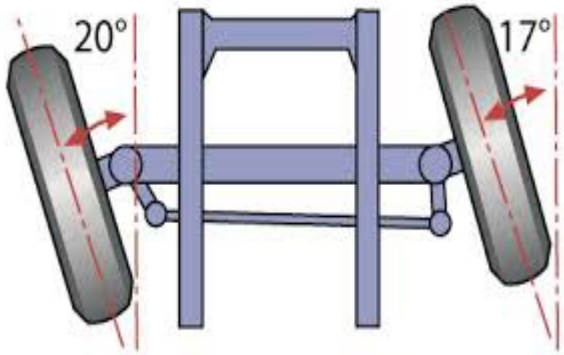
When a wheel is turned during cornering KPI results in the extreme outboard end of the stub axles moving through an arc not the horizontal plane reducing the required steering effort.




**Toe in**

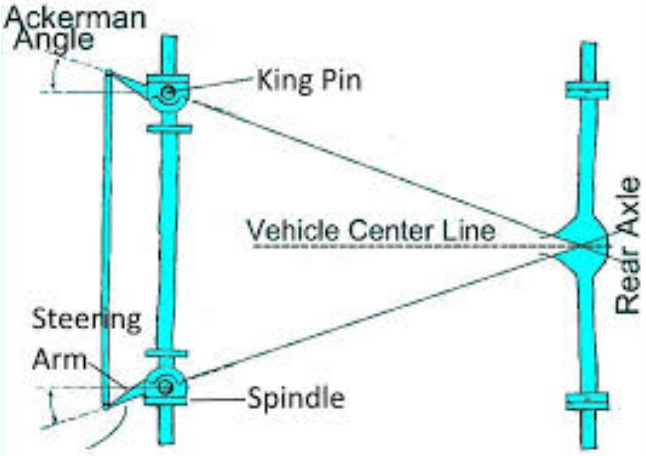
When a wheel is subjected to camber it will tend to roll outwards when moving forward, slight toe in is used to correct this.

In this diagram illustrating how toe in looks in plan view, dimension “A” is less than dimension “B”




**Toe out on turns**.

When a set of steering wheels are turned to negotiate a corner, the inner wheel turns through a sharper angle than the outer one. This arrangement helps to ensure that the tyres are not exposed to excessive scrubbing thus prolonging their life.




Toe out on turns is achieved by using the Ackerman principle which is the arrangement of the steering arms mounted on the stub axles and their connection to the steering track rod.

**Working together**

Individually the angles involved in the way a vehicle's wheels and tyres interact with both the chassis and the road are small however, when wheel alignment has been correctly achieved, each one works in harmony with the others and the compound effect on the vehicle of incorrect wheel alignment can by large be eliminated.

The effects of incorrect wheel alignment can result in:

- Excessive tyre scrubbing.
- Excessive tyre wear.
- Vehicle wandering from side to side on the road.
- Heavy or non-reactive steering.
- Premature failure of steering components.
- Driver tiredness.

***Source***

*The diagrams in the above were retrieved from various publicly accessible websites*

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