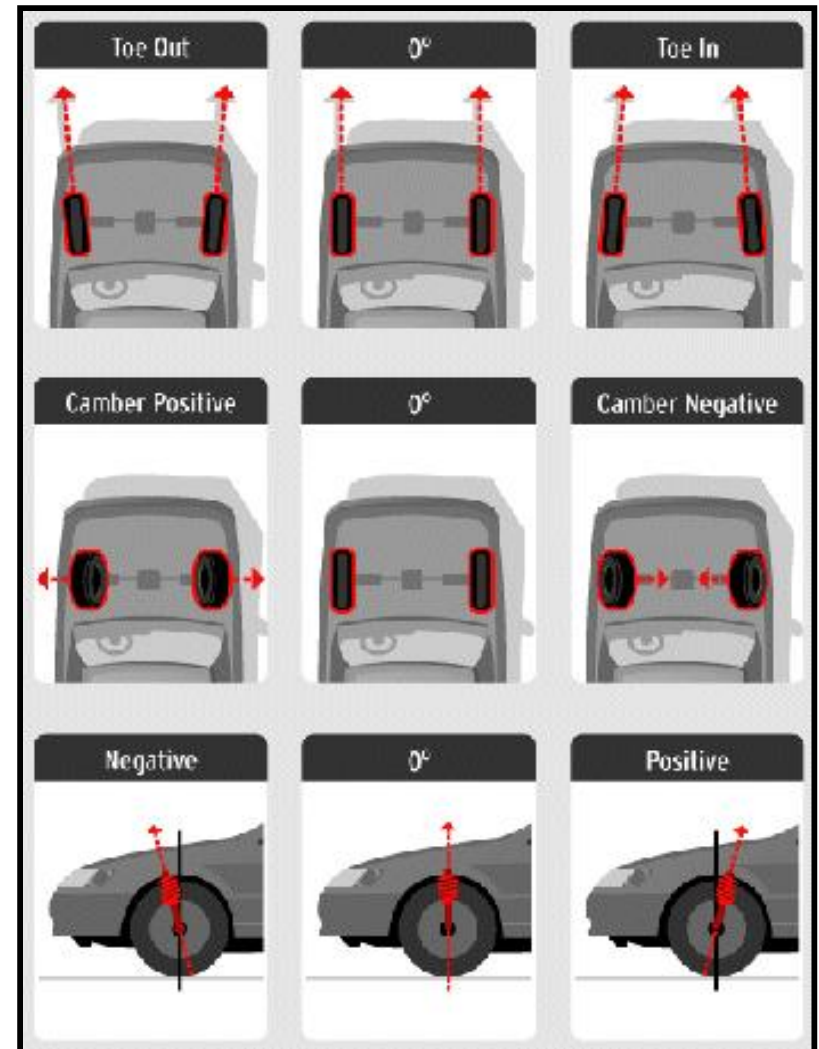


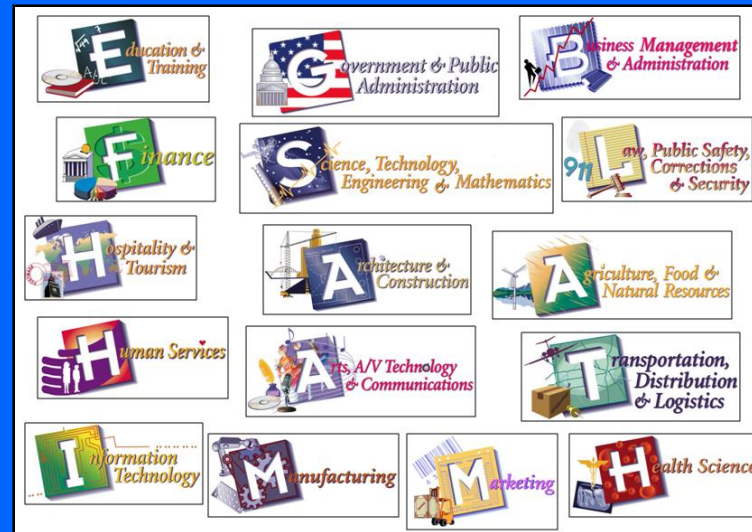
ATASA 5th Wheel Alignment

ATASA 5TH Study Guide
Chapter 47 Pages: 1403 - 1423
Wheel Alignment
64 Points

Please Read The Summary



Before We Begin...



Keeping in mind the **Career Cluster** of Transportation, Distribution & Logistics

Ask yourself:

What careers might be present in this slide series?

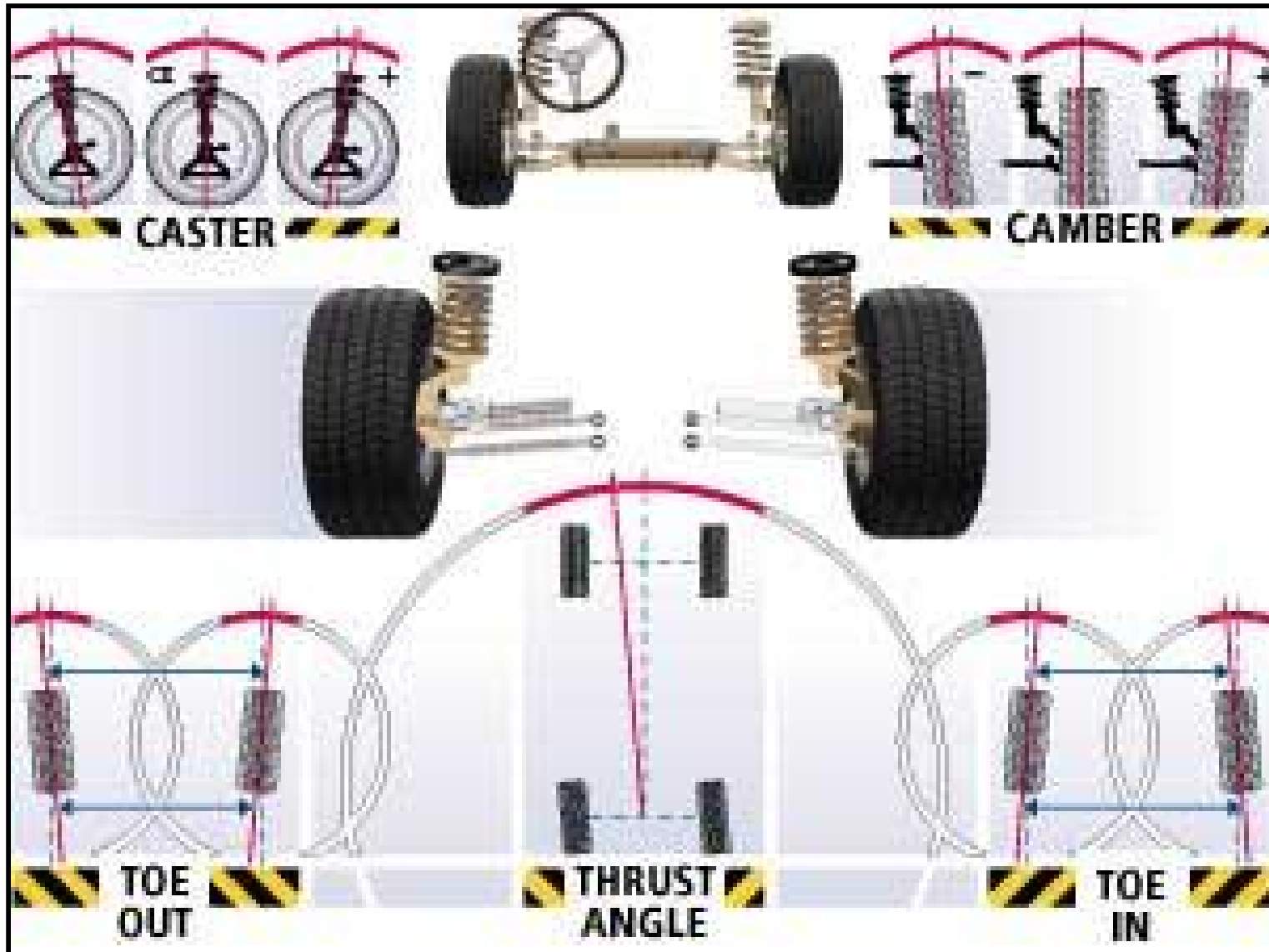
What careers might interest me?

How do these careers relate to my other high school classes?

What career cluster is my 4-year plan preparing me for?

ATASA 5th Wheel Alignment

1. Wheel _____ allows the wheels to roll without scuffing, dragging or slipping.



Alignment
Balancing
Rotation

ATASA 5th Wheel Alignment

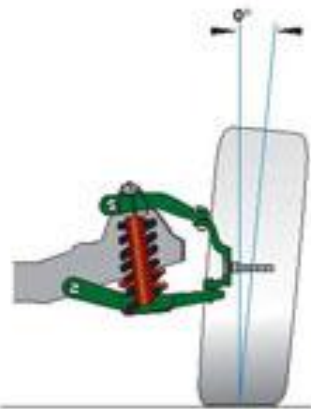
2. Proper alignment of both the front & rear wheels ensures _____, easier _____, longer _____ life, reduced _____ consumption, and less strain on steering & suspension parts.



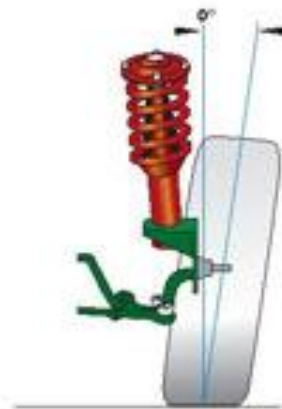
Toe In



Toe Out



Camber-
Conventional
Suspension
Alignment Angles

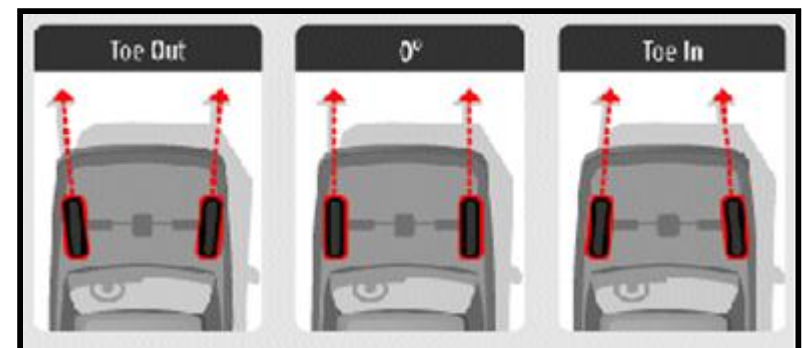
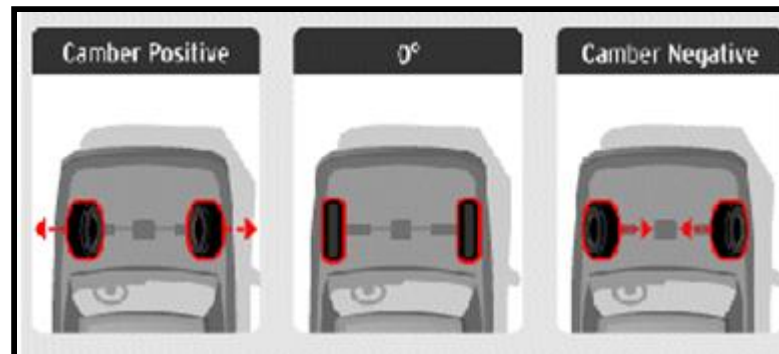
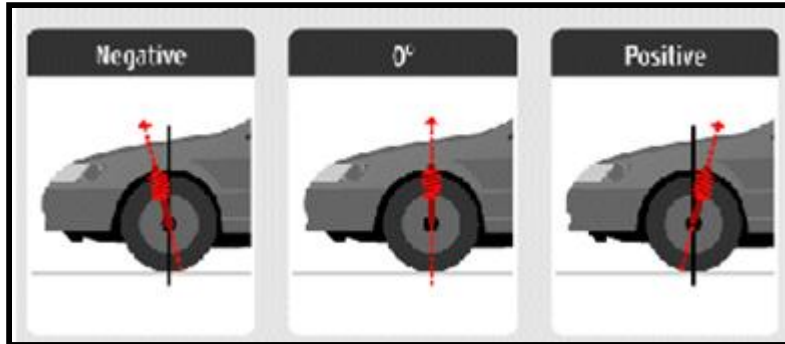


Camber-
Strut Suspension
Alignment Angles

Safety, Steering, Tire, Fuel
Safety, Braking, Parts, Oil
Safety, Traction, Tire, Fuel

ATASA 5th Wheel Alignment

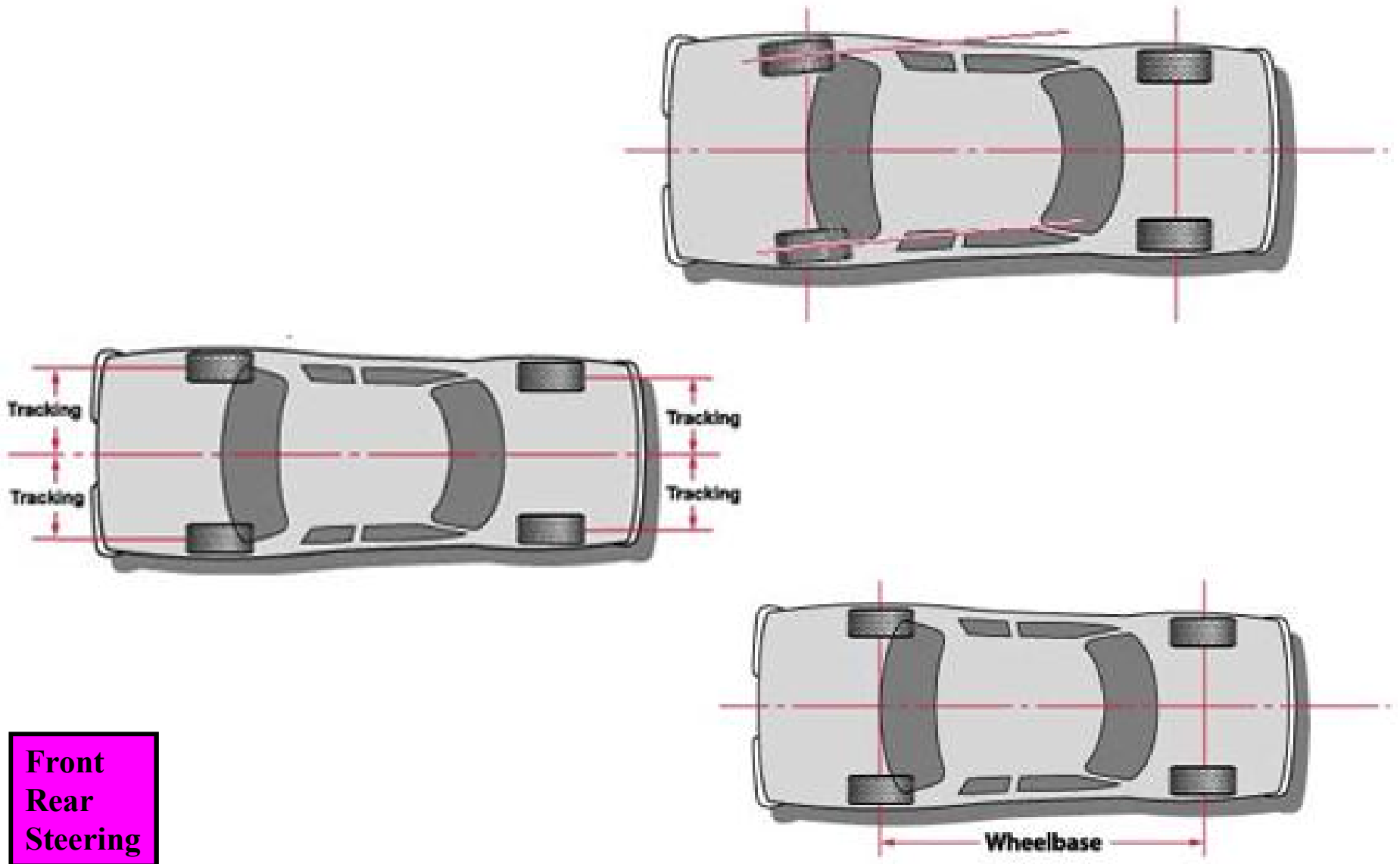
3. A wheel alignment restores the _____ of the steering & suspension angles of the vehicle to properly locate the vehicle's weight on the tires and other moving parts and to facilitate steering.



Geometry
Dimensions
Tolerances

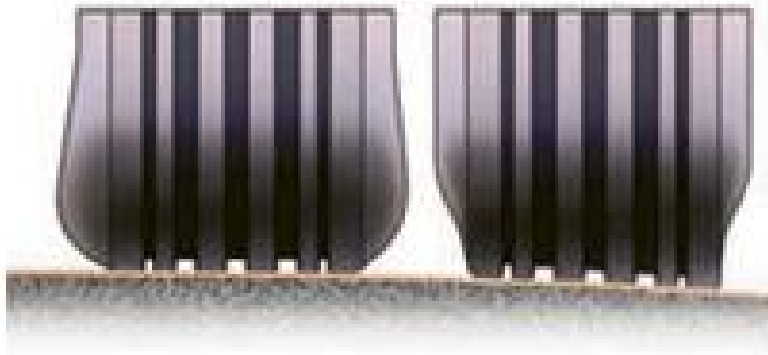
ATASA 5th Wheel Alignment

4. When performing a 4 wheel alignment, _____ wheels are adjusted first and then the front wheels are aligned to the vehicle's *geometric centerline*.

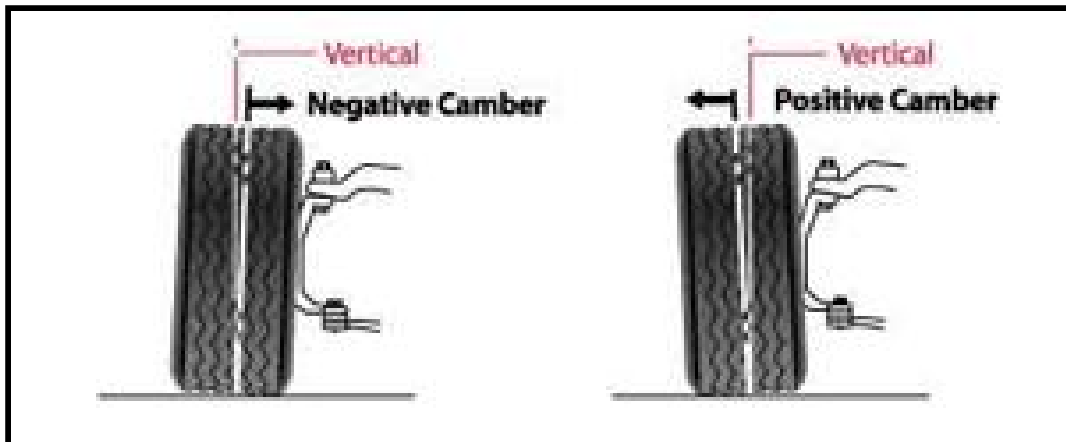
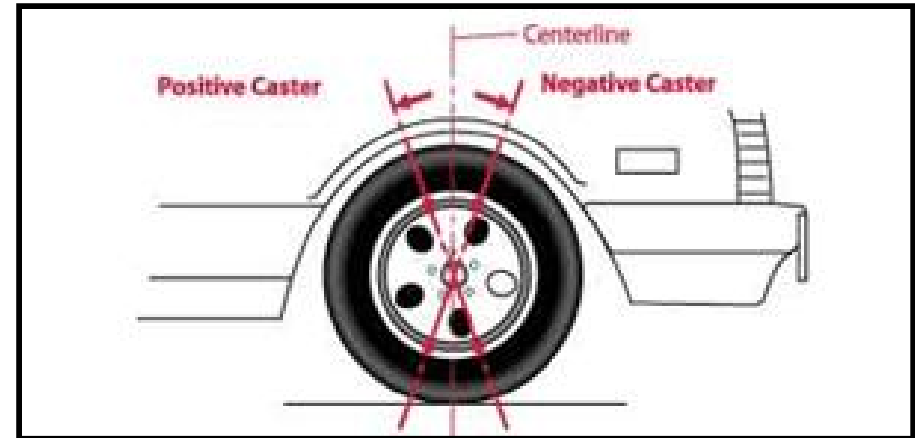


ATASA 5th Wheel Alignment

5. Alignment angles may be different on each side of a vehicle to compensate for _____.



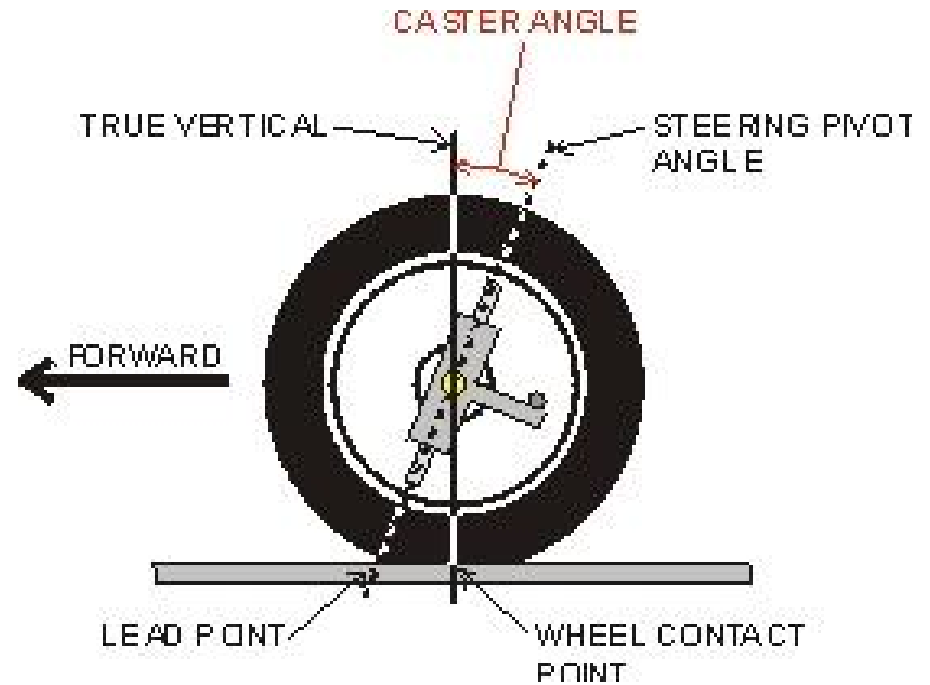
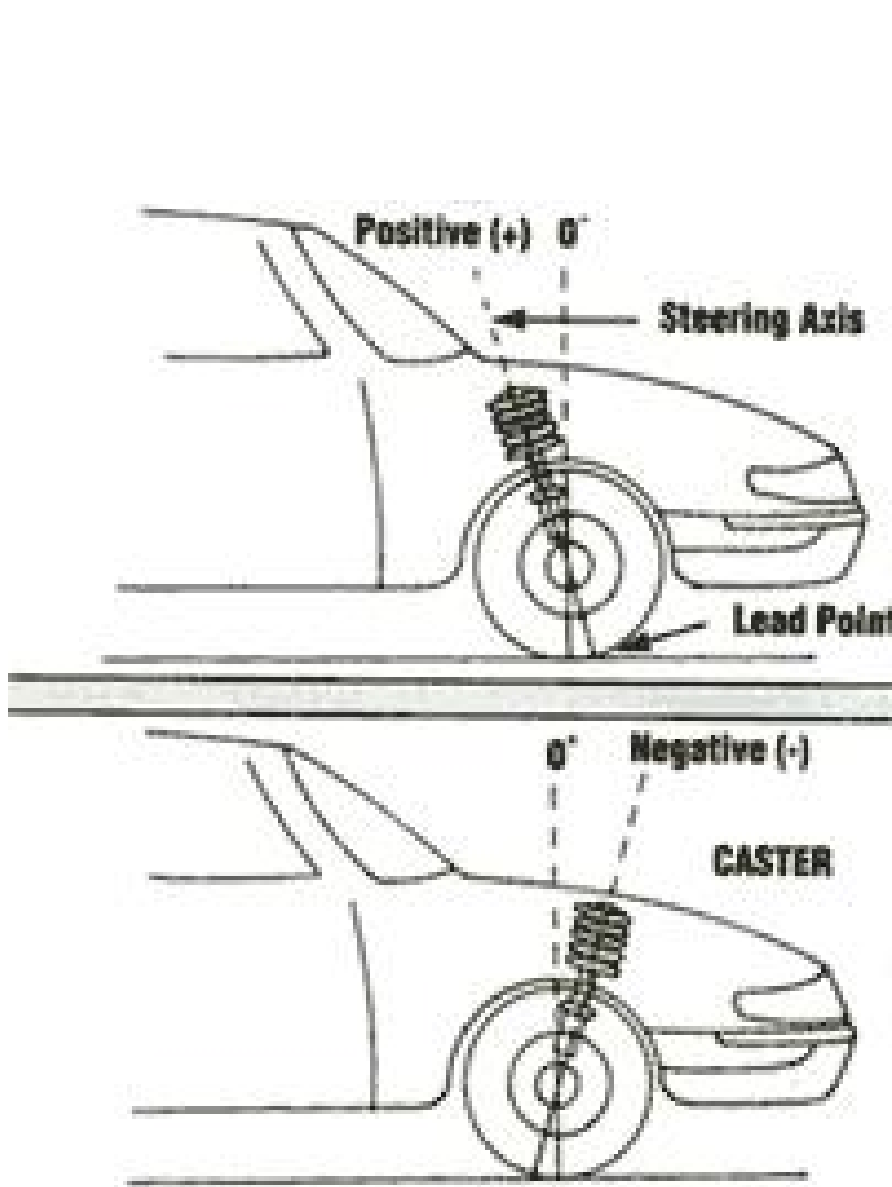
road crown



Road Crown
Road Grade
Road Surface

ATASA 5th Wheel Alignment

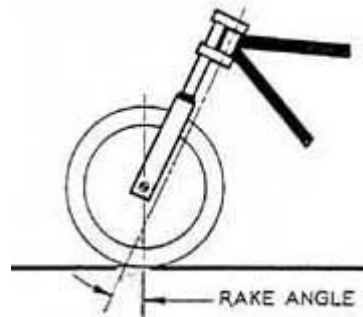
6. _____ is forward or rearward tilt of the steering axis as viewed from the side of the vehicle.



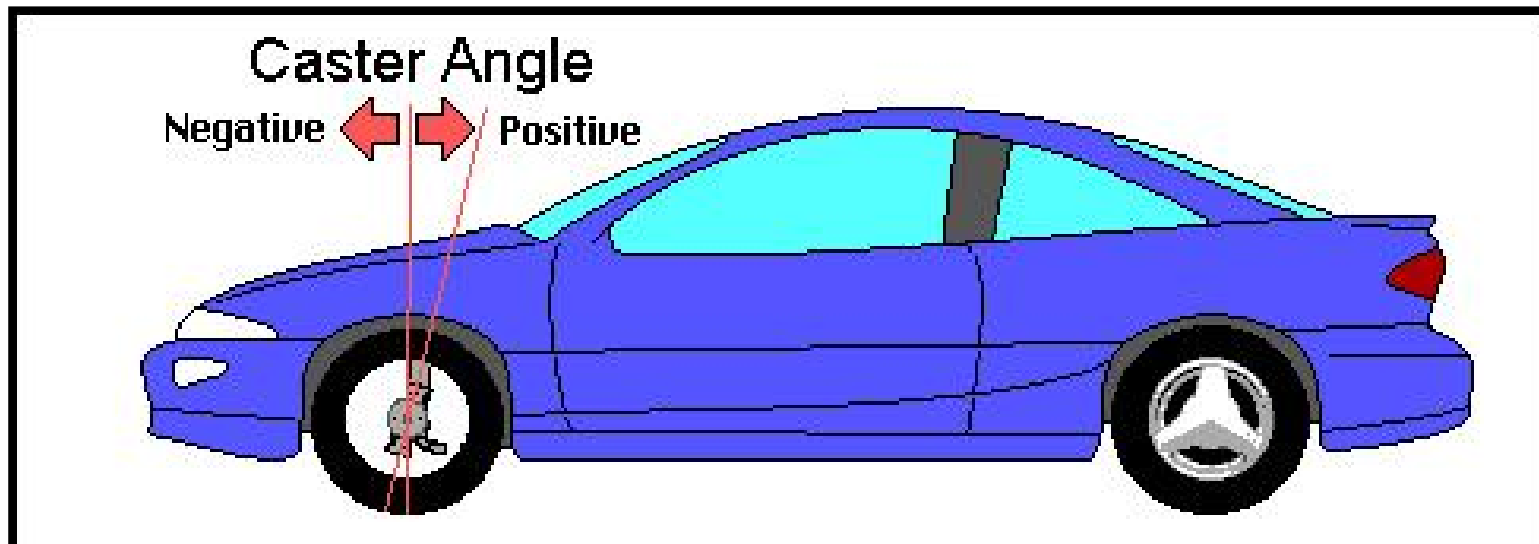
Caster
Camber
Toe

ATASA 5th Wheel Alignment

7. Caster provides steering _____.
Caster is not considered a tire wear angle & is adjusted first.



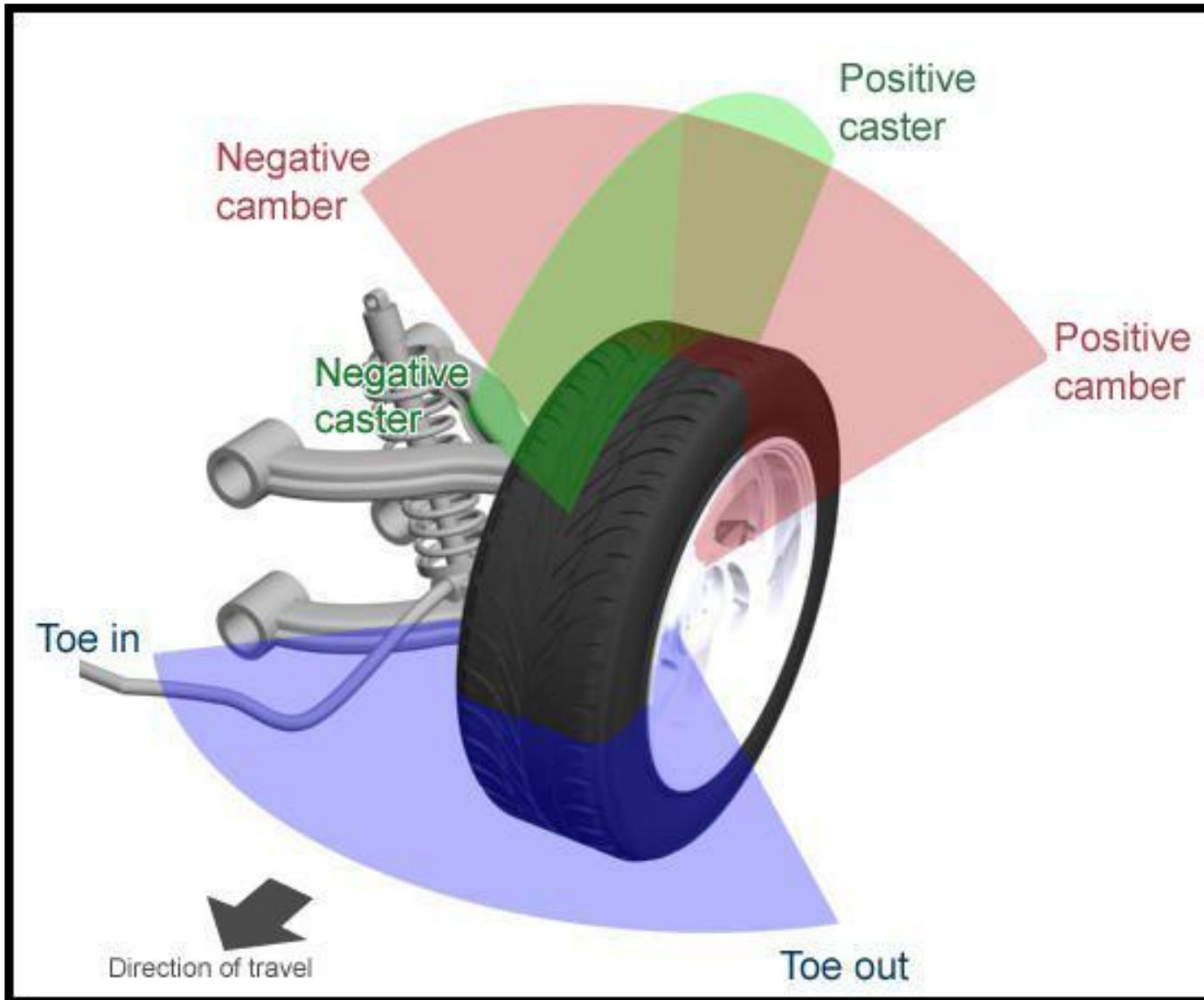
www.advantagewheelalignment.com/



Accuracy
Stability
Balance

ATASA 5th Wheel Alignment

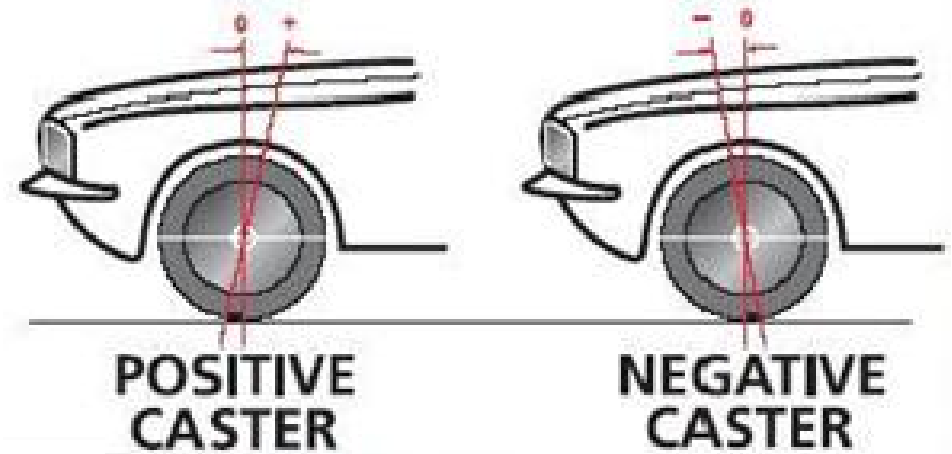
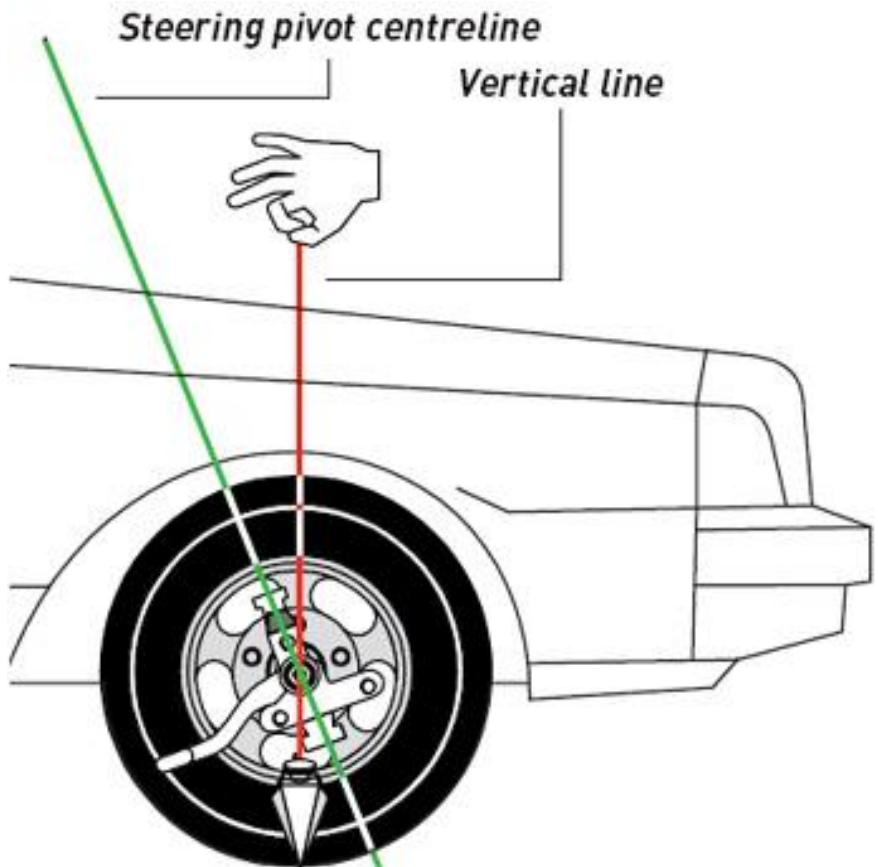
8. A vehicle will pull or drift to the side with the _____ caster.
(also called *most negative*)



**Most
Least
Neutral**

ATASA 5th Wheel Alignment

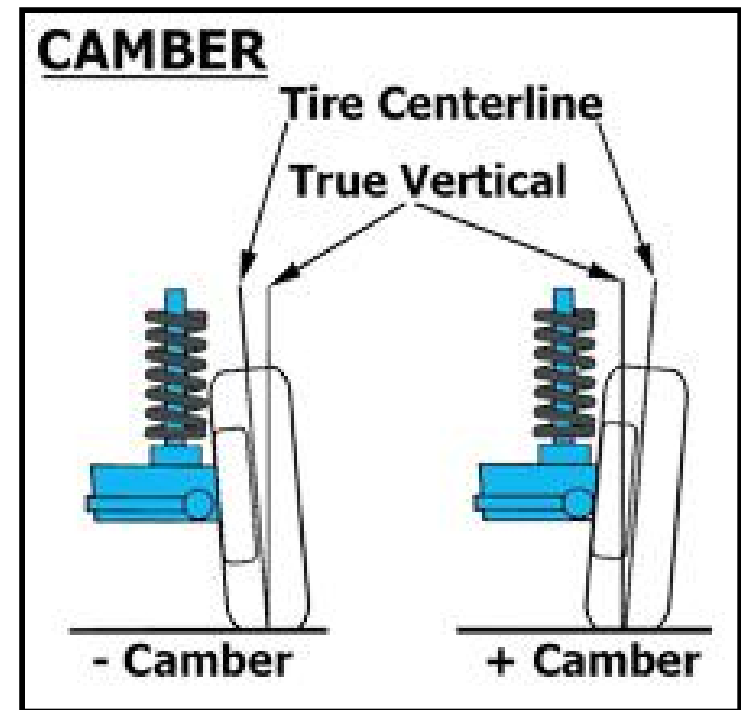
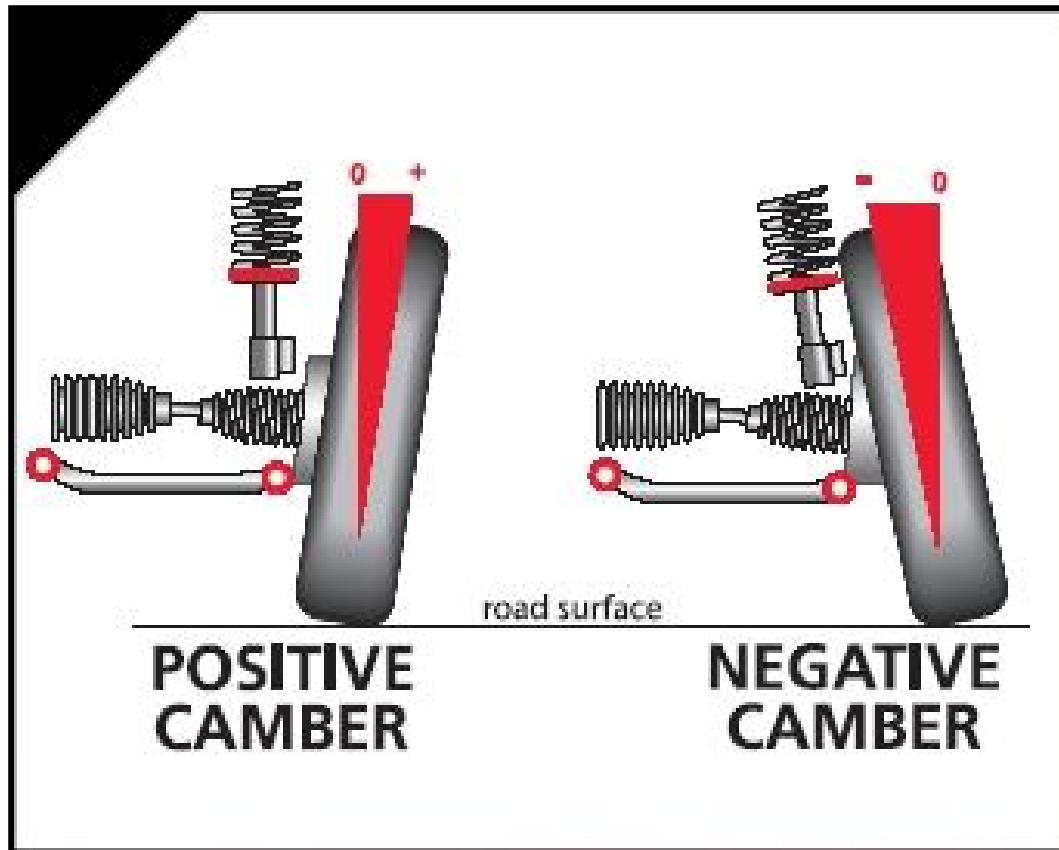
9. Equal, but too much negative caster will cause a vehicle to _____ on straight roads.



Pull
Drift
Wander

ATASA 5th Wheel Alignment

10. _____ is *inward or outward tilt of the tires at the top as viewed from the front of the vehicle.*

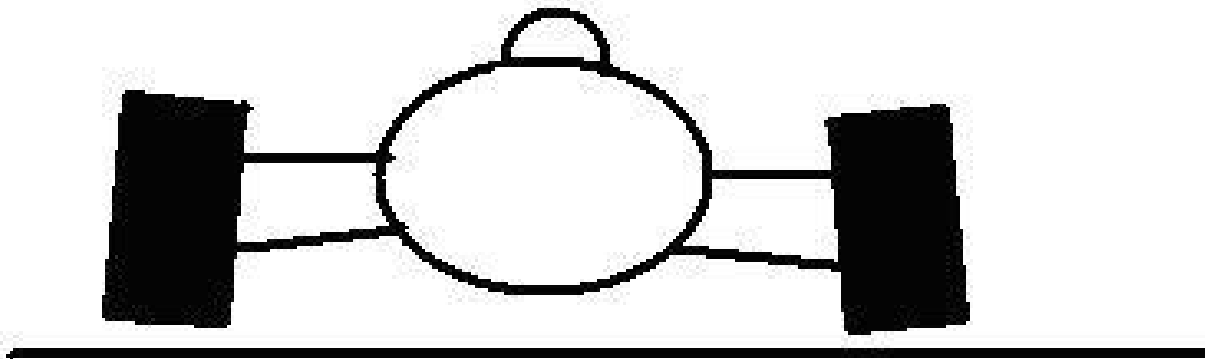


Caster
Camber
Toe

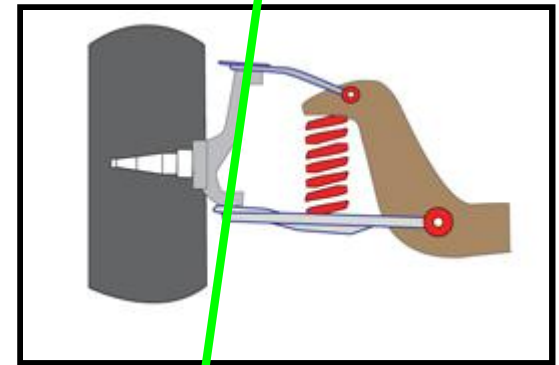
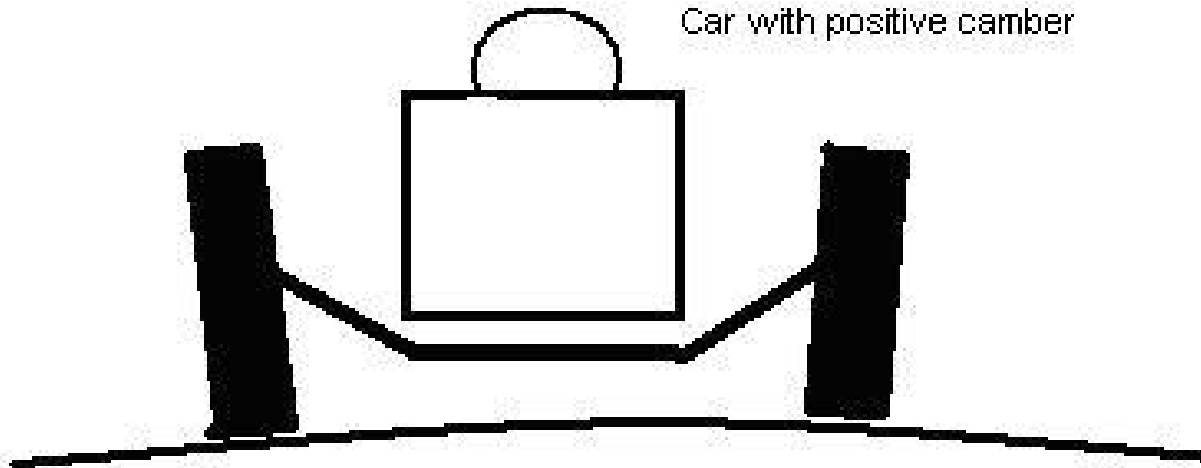
ATASA 5th Wheel Alignment

11. Camber compensates for _____, passenger & vehicle weight.
Camber is a tire wear angle.

Car with negative camber



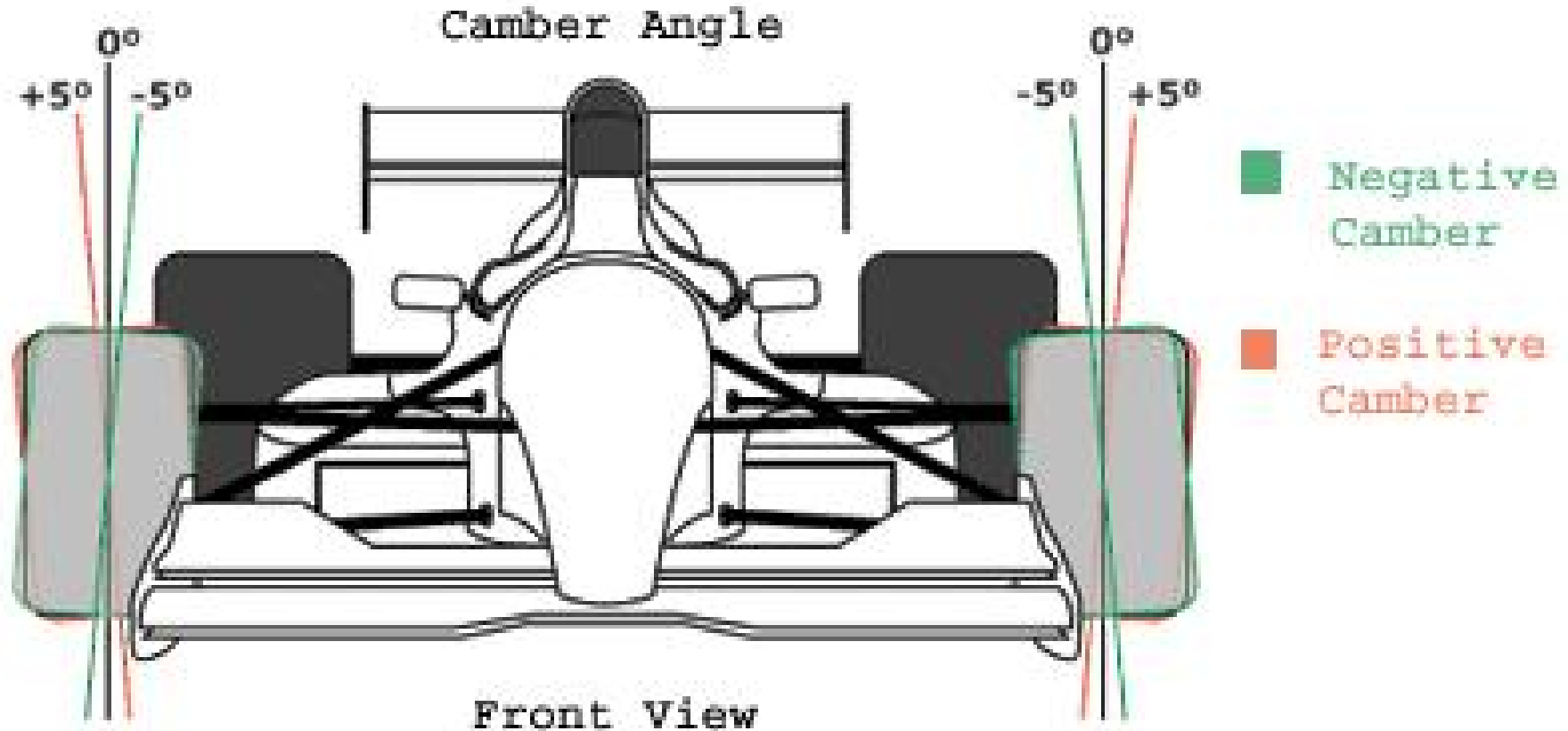
Car with positive camber



Road Harshness
Road Hogs
Road Crown

ATASA 5th Wheel Alignment

12. A vehicle will pull or drift to the side with the _____ camber.
(also called most positive)

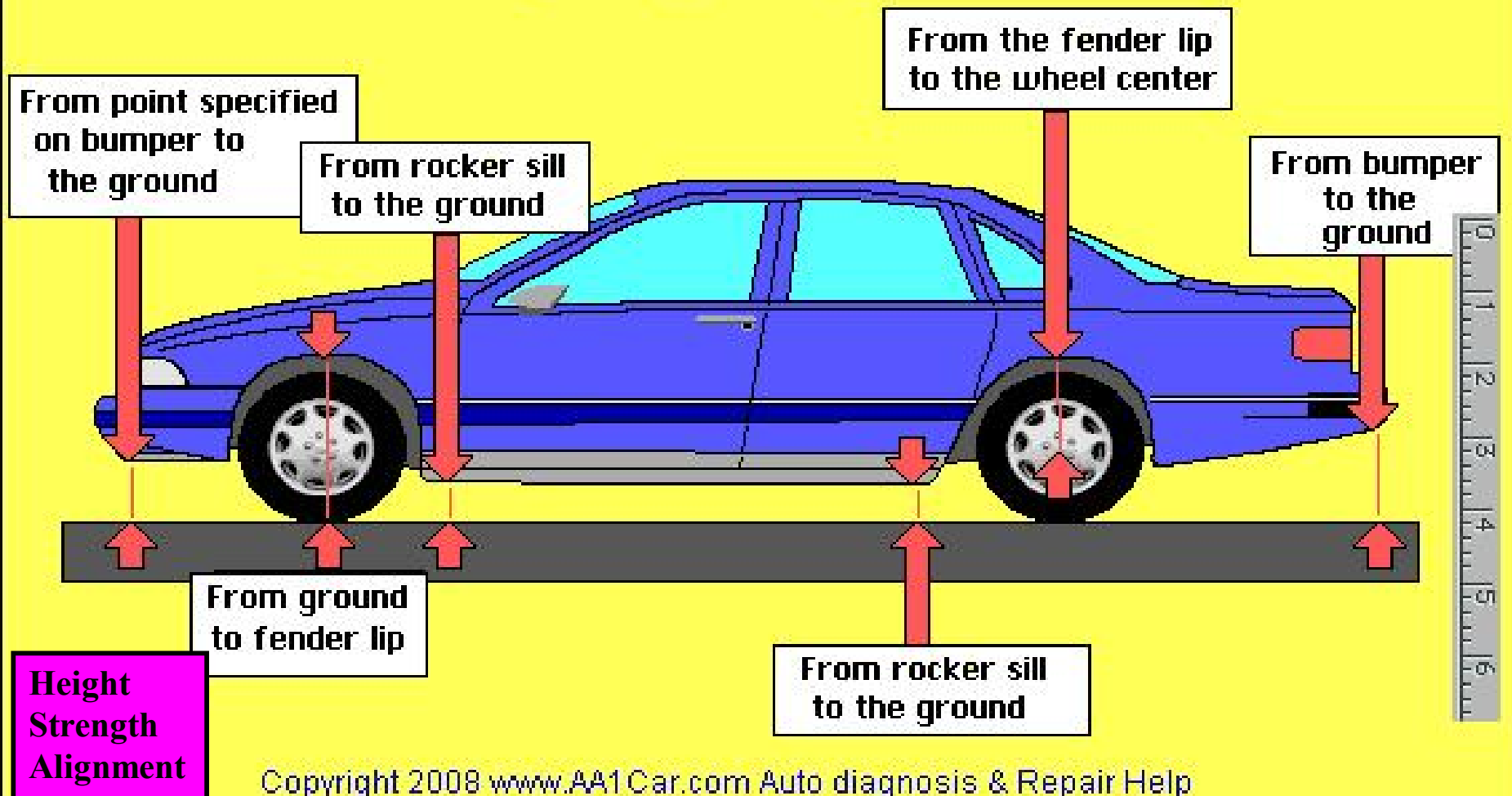


**Most
Least
Neutral**

ATASA 5th Wheel Alignment

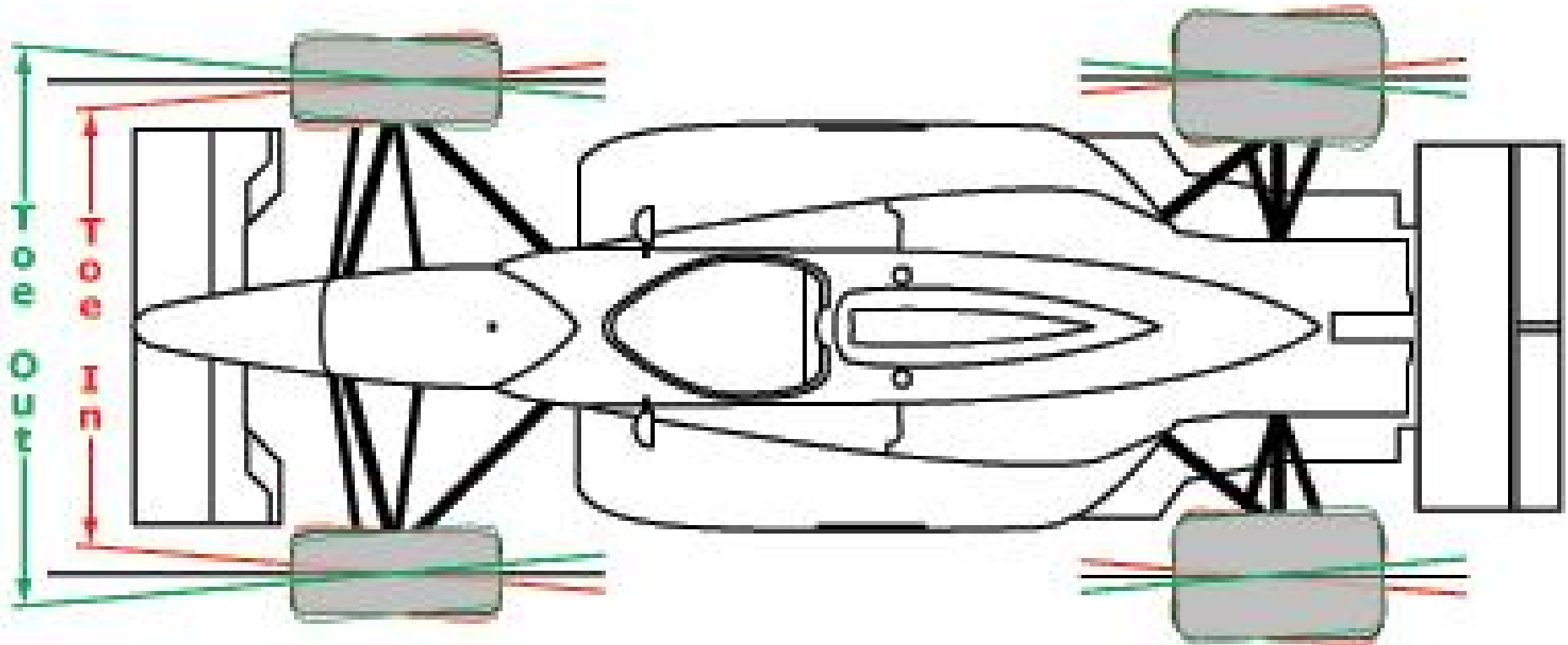
13. Anything that changes chassis or ride _____ also changes camber.
(adjusts on control arms)

Where Ride Height May Be Specified & Measured



ATASA 5th Wheel Alignment

14. _____ is the *inward or outward pointing or aim of the tires* as viewed from the top of the vehicle.



Caster
Camber
Toe

ATASA 5th Wheel Alignment

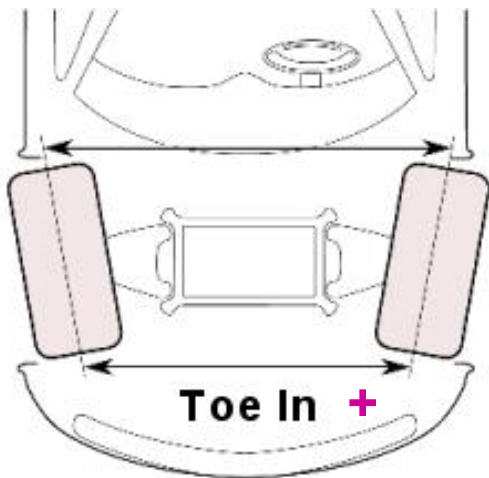
15. _____ - _____ is known as *positive toe*.
_____ - _____ is known as *negative toe*.



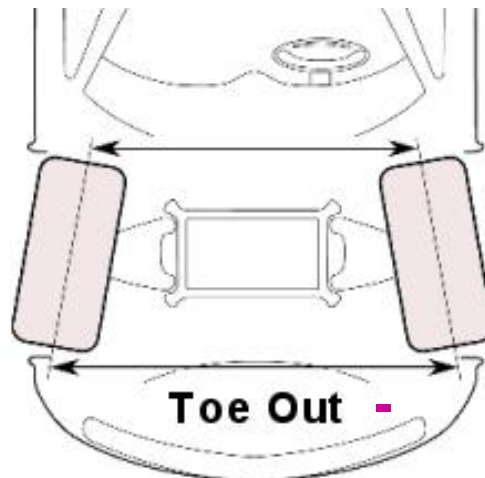
Toe In +



Toe Out -



Toe In +

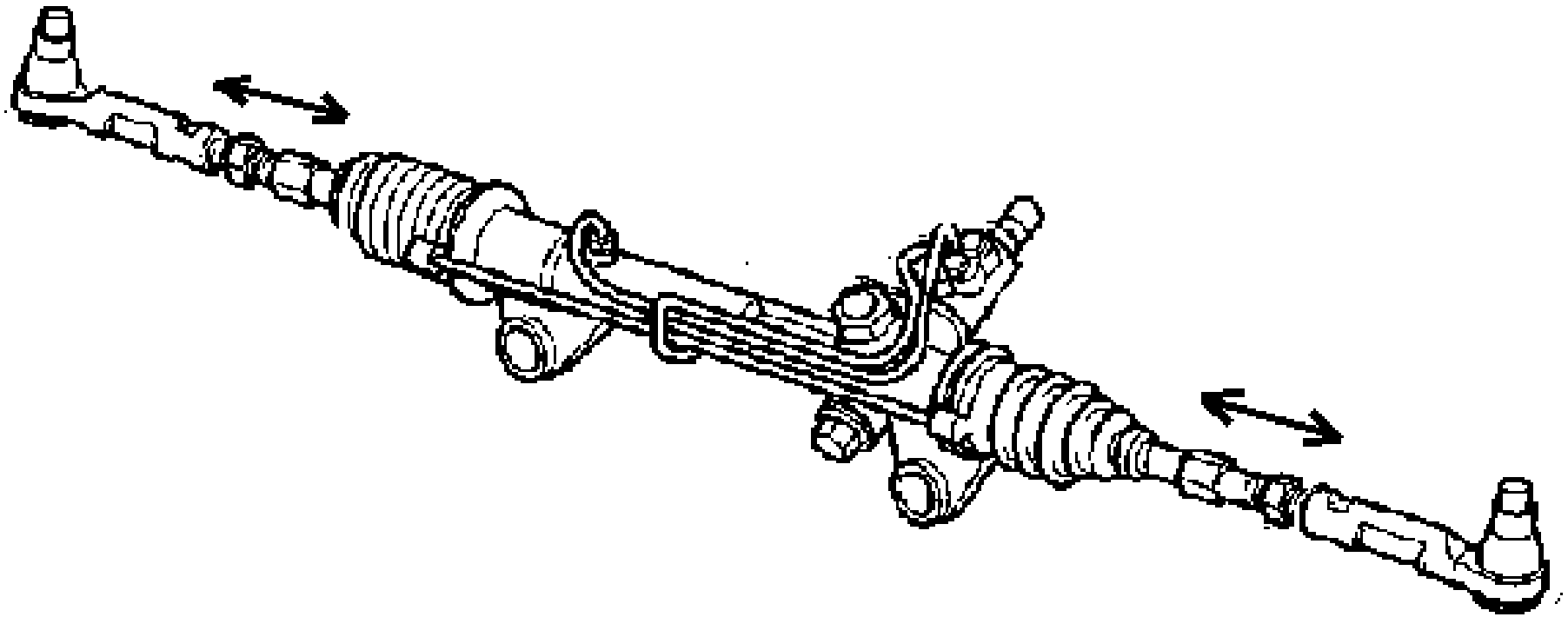


Toe Out -

Toe-in, Toe-out
Toe-out, Toe-in
Zero Toe, Neutral Toe

ATASA 5th Wheel Alignment

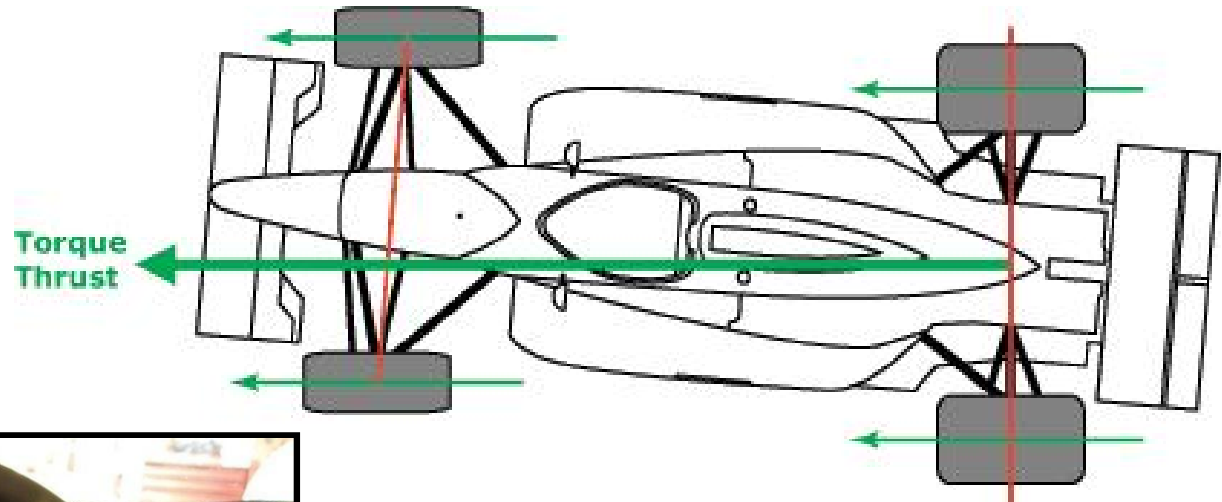
16. Front toe adjustment is made at the _____ and is the _____ adjustment to be made.



Stabilizer Links, First
Control Arms, First
Tie Rods, Last

ATASA 5th Wheel Alignment

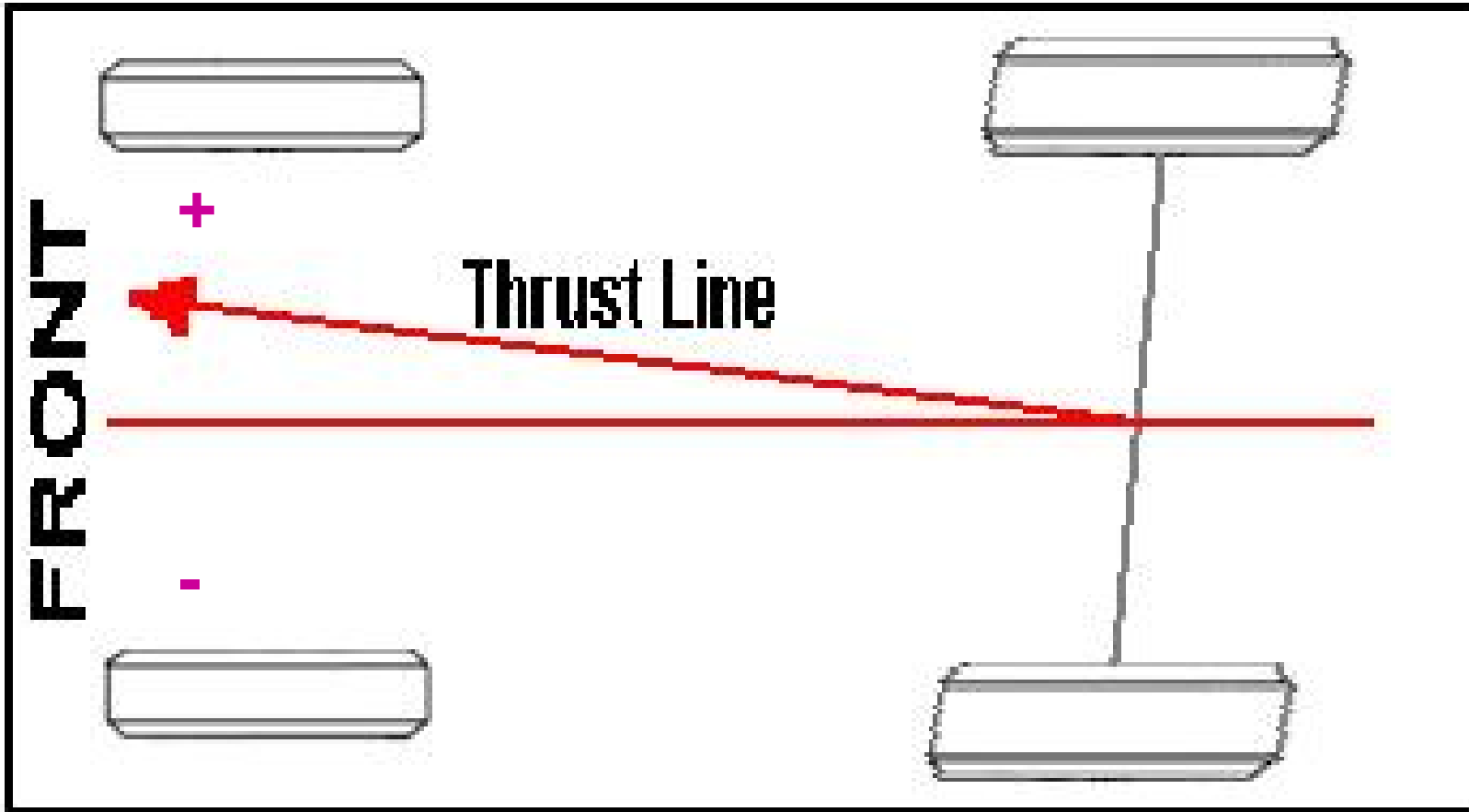
17. Improperly adjusted toe causes the steering wheel to be off-center.
It will cause dog-tracking & is the most severe tire wear angle leading to feather edge or saw-tooth wear patterns.



Off-Center
Out-of-Round
Sloppy

ATASA 5th Wheel Alignment

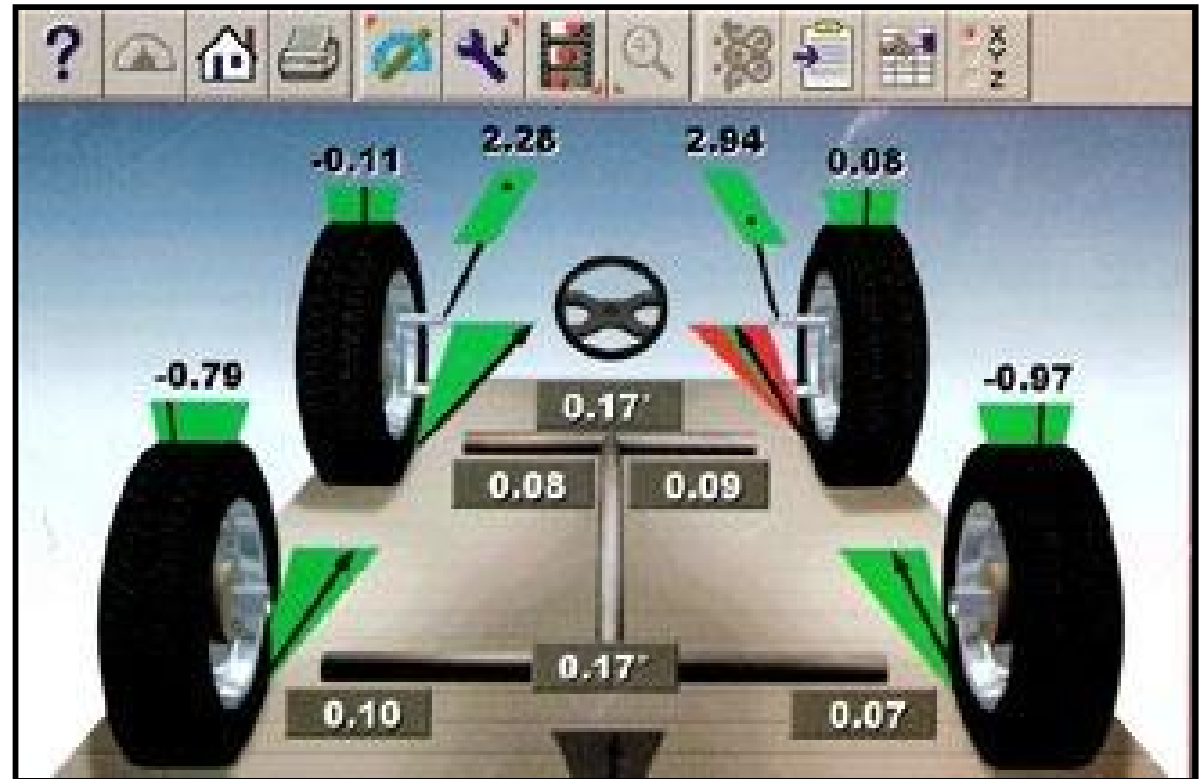
18. The *difference of rear toe from the geometric centerline* is known as _____.



Thrust Line or Thrust Angle
Trust Back
Thrust Radius

ATASA 5th Wheel Alignment

19. Four wheel alignment begins with adjusting the _____ wheels to be correctly cambered and to match the geometric centerline of the vehicle to avoid an off-center steering wheel & dog tracking.

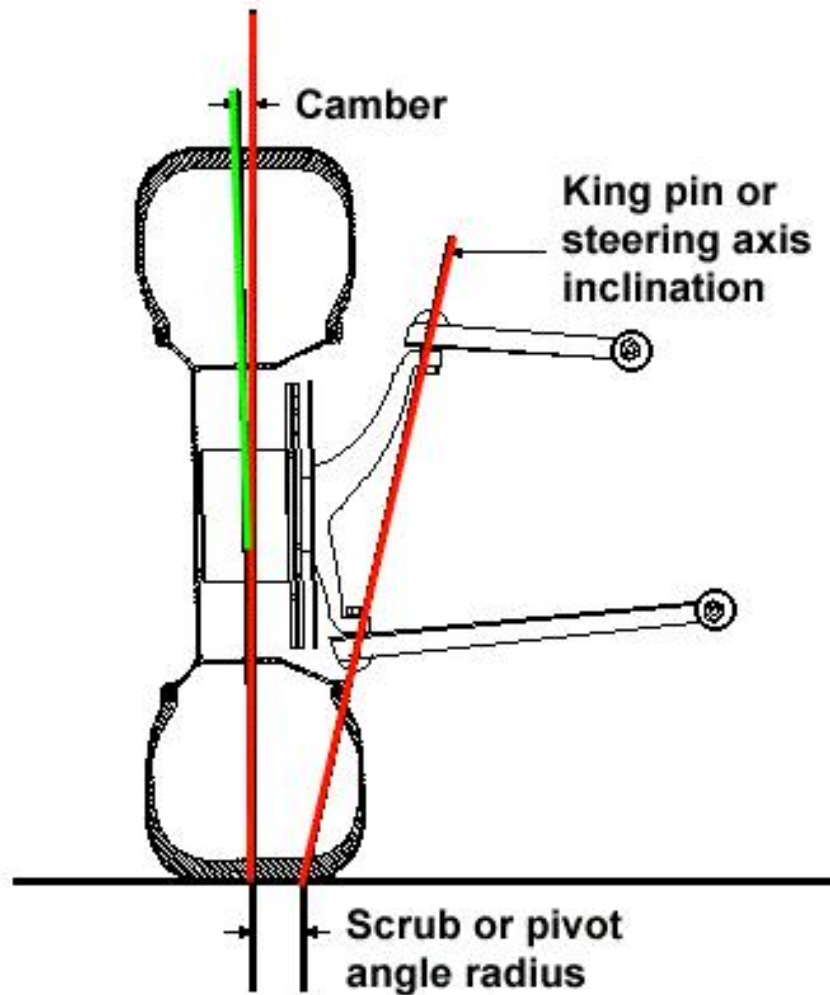


Explain what's going on in this picture

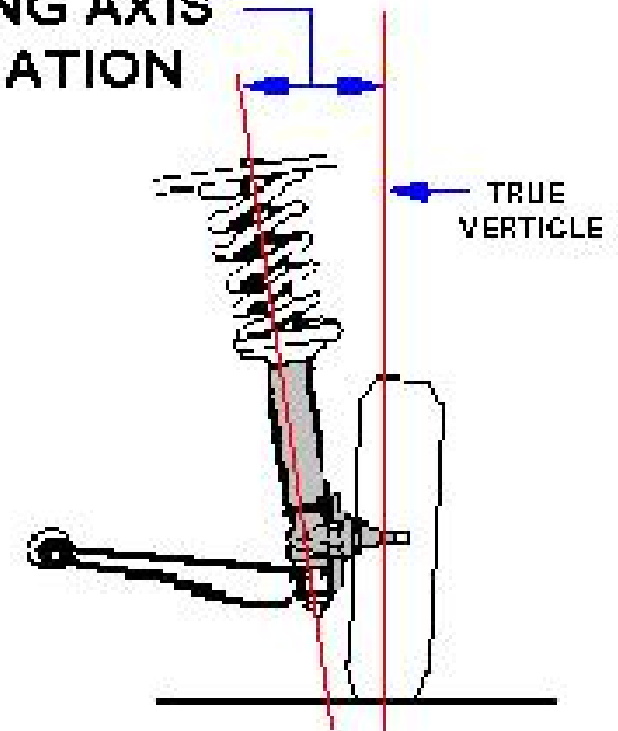
Front
Rear
Training

ATASA 5th Wheel Alignment

20. _____ (SAI) is the *angle between true vertical and a line between the steering pivots or ball joints as viewed from the front of the vehicle.*



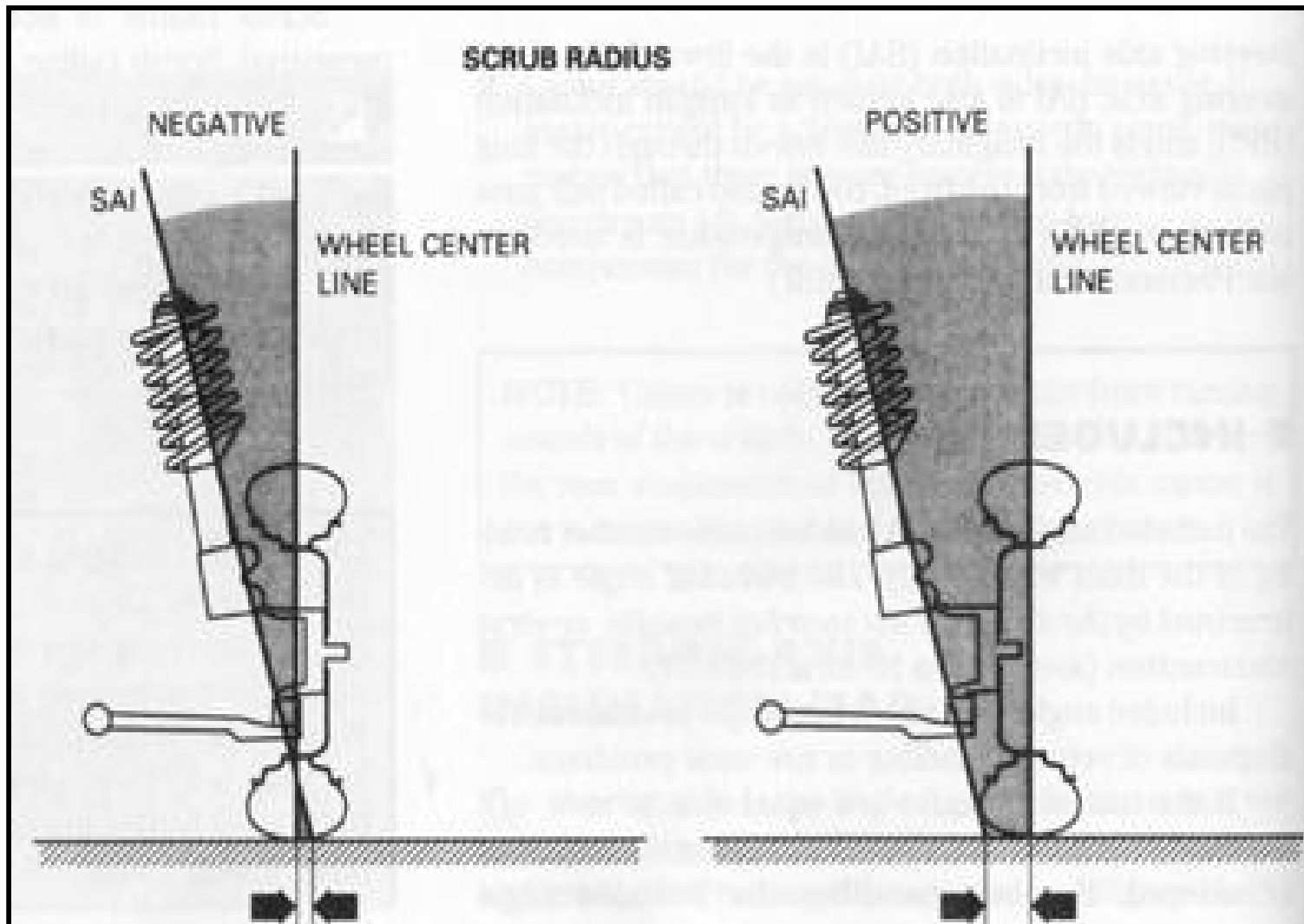
STEERING AXIS INCLINATION



Steering Axis Inclination
Shortened Axial Inclination
Sweet Child of Mine

ATASA 5th Wheel Alignment

21. SAI is an *engineering angle* that properly locates vehicle weight and provides _____ to a straight ahead position with the steering wheel after a turn. *SAI is not adjustable.*



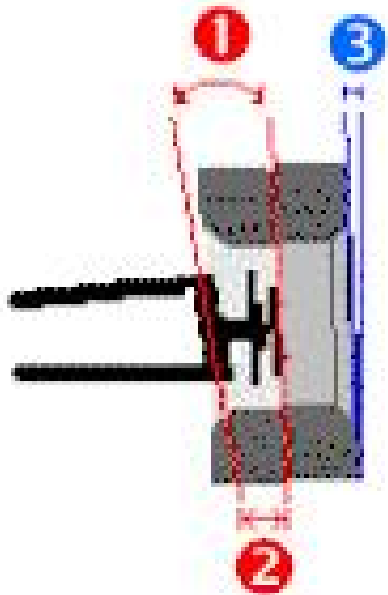
Deviation
Return
Bump Steer

ATASA 5th Wheel Alignment

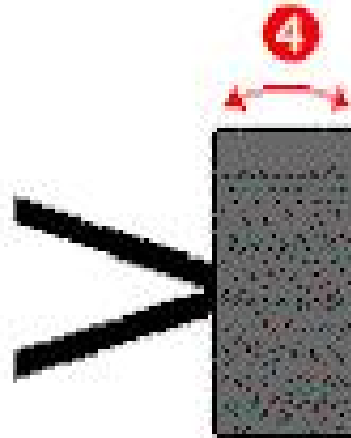
22. ____ is a “diagnostic angle”. If incorrect, parts are dislocated or damaged & need replacement. Unequal SAI side-to-side can cause torque steer, brake pull, and bump steer.

Suspension Geometry Factors

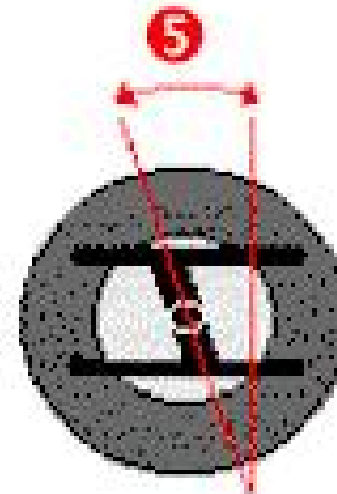
Front View



Top View



Side View



1 Kingpin Inclination

2 Scrub Radius

3 Camber

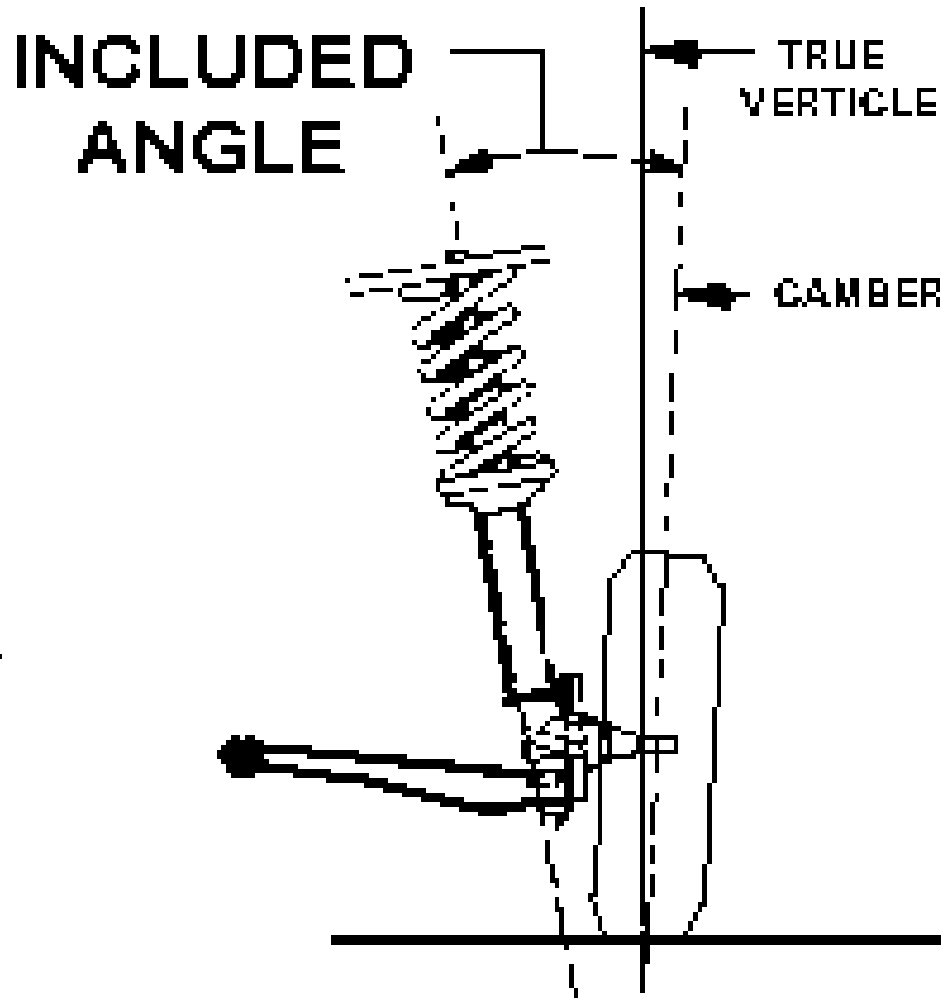
4 Toe In/Out

5 Caster

SLA
Toe
SAI

ATASA 5th Wheel Alignment

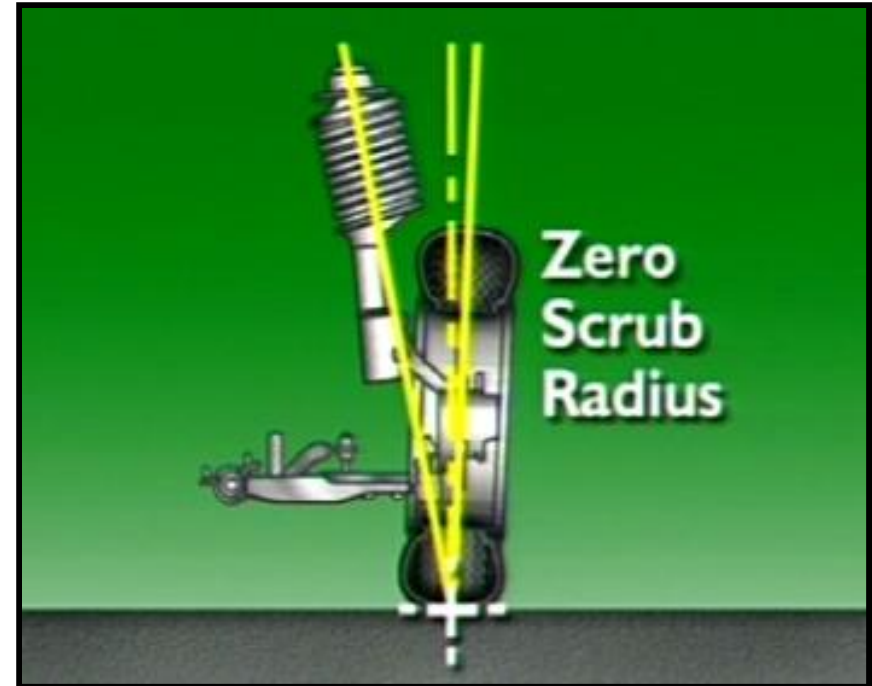
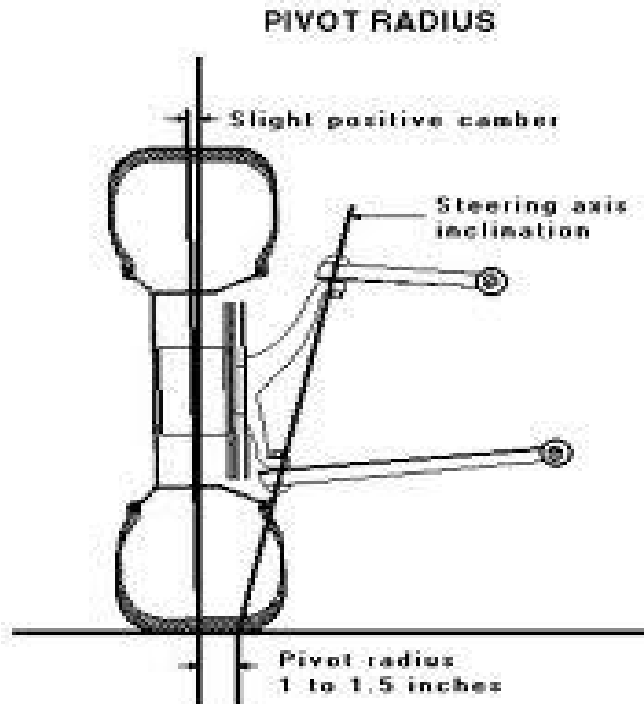
23. The sum of the camber angle added to *steering axis inclination* is called _____ . This is also a diagnostic angle, that indicates bent or dislocated parts if not within specs.



Induced Angle
Included Angle
Insane Angle

ATASA 5th Wheel Alignment

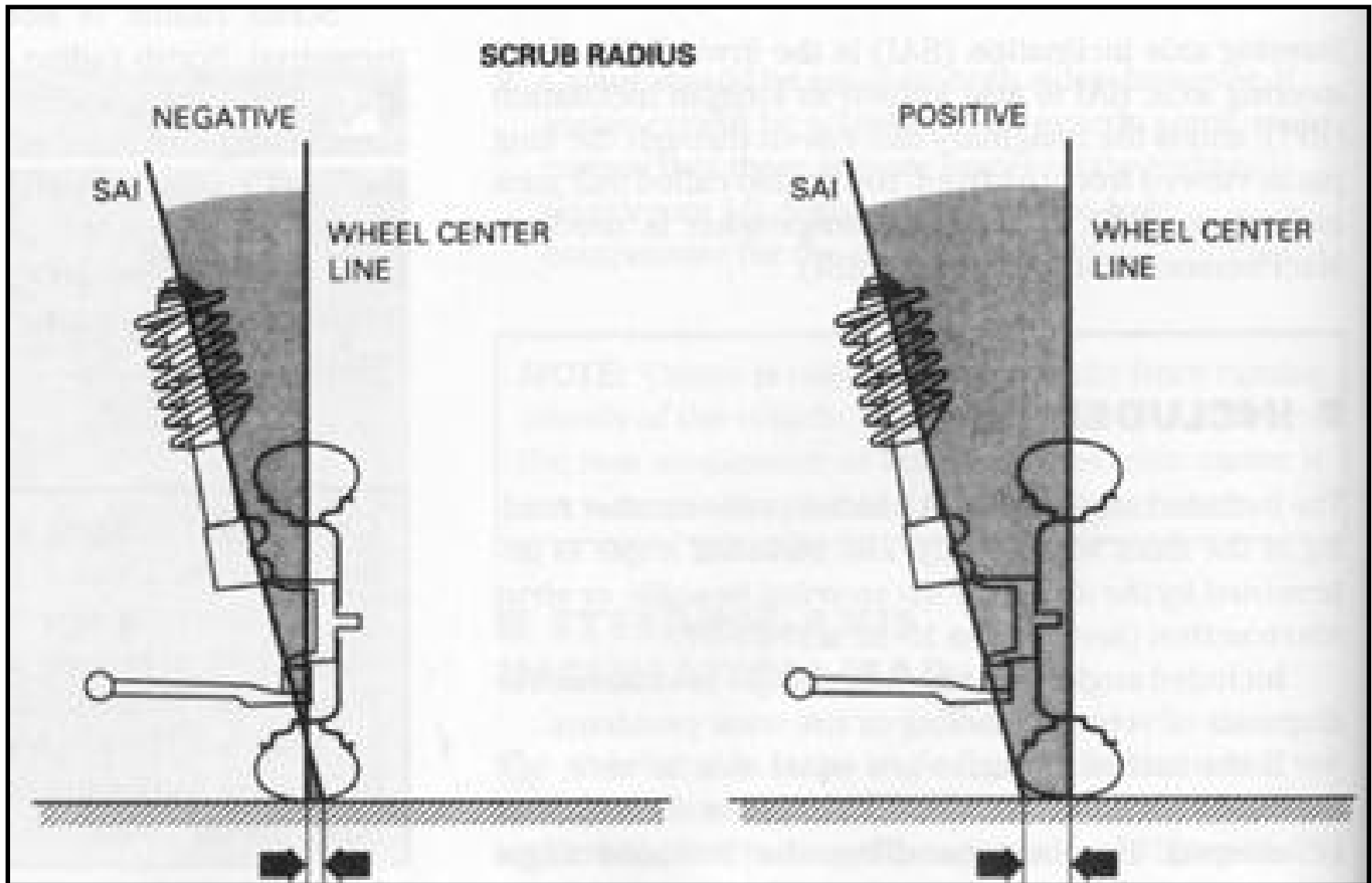
24. is the distance between the center of the tire and where SAI intersects the road surface. Scrub radius is not adjustable, but can cause a pull if it is unequal side-to-side.



Vehicles with a diagonal-split brake system have negative scrub radius built into the steering geometry. If one half of the brake system fails, then the vehicle will tend to pull up in a straight line.

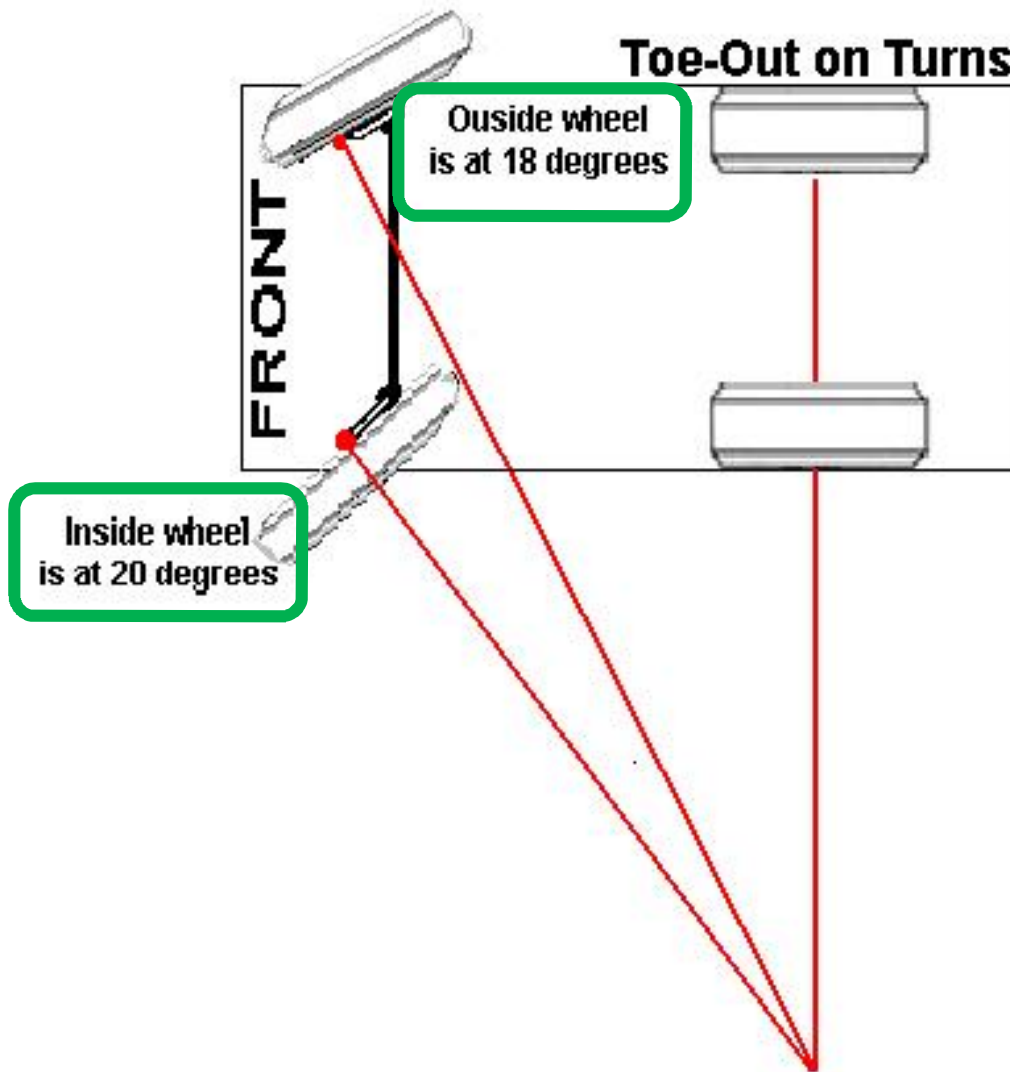
Included Angle
Scrub Mop
Scrub Radius

ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment

25. Turning radius is the amount of _____ - _____ on turns, often called turning angle. *It is a diagnostic angle and if incorrect, a bent steering arm or steering knuckle may be suspected.*

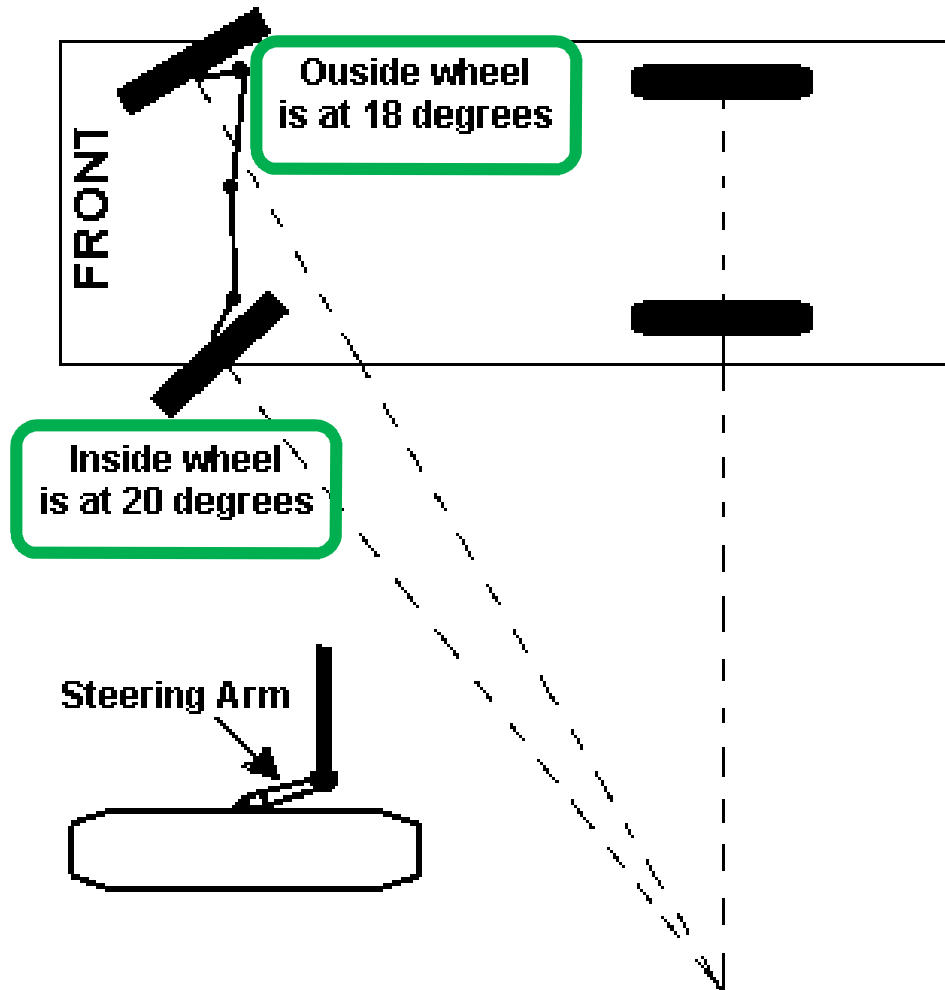


Toe-In
Toe-Out
Toe-Around

ATASA 5th Wheel Alignment

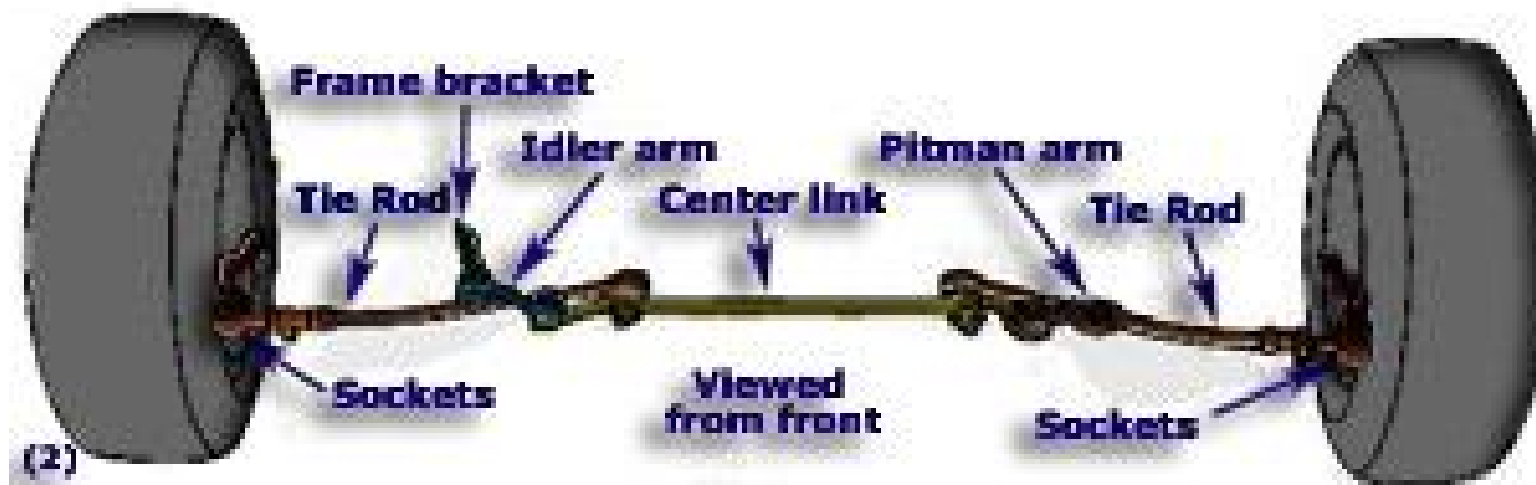
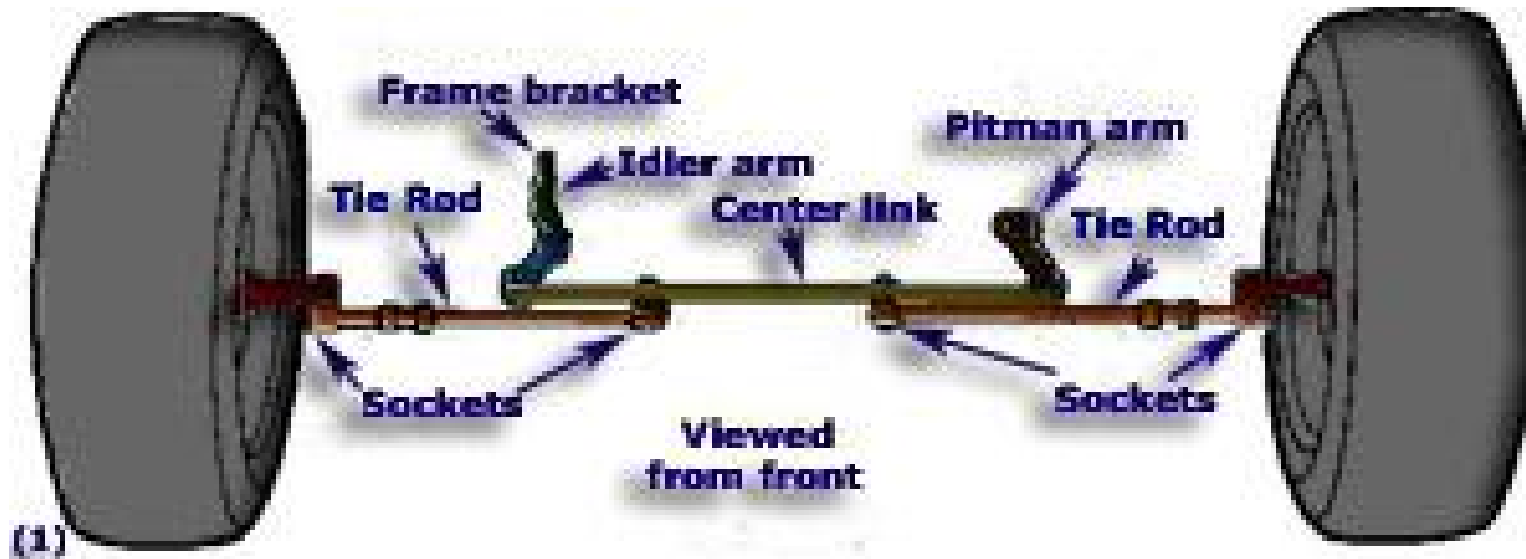
26. During turns, the outer wheel moves through a lesser numerical angle.
True or False

Toe-Out on Turns



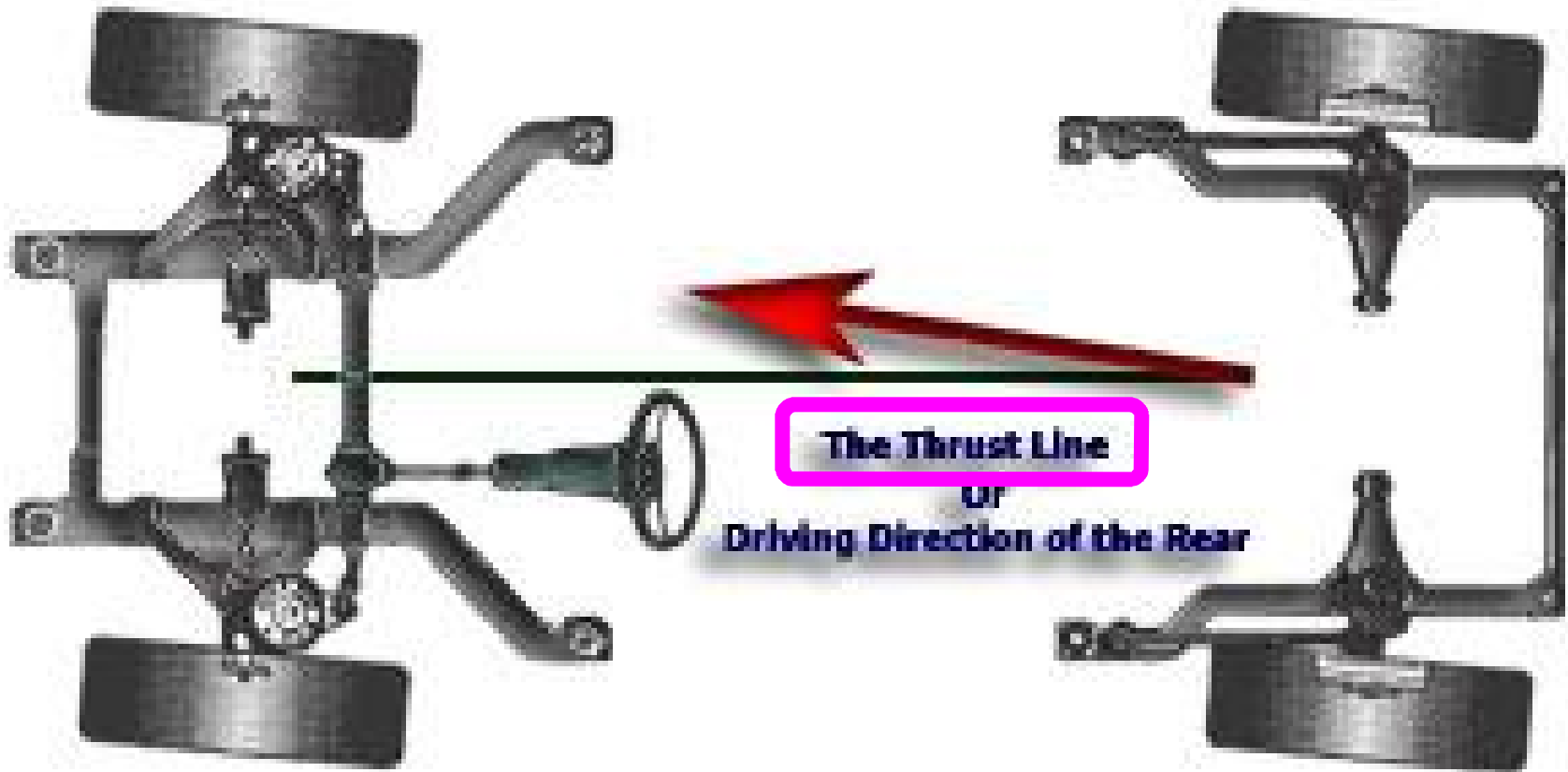
ATASA 5th Wheel Alignment

27. Turning radius is not adjustable. If incorrect, _____, steering arms, or knuckles are bent.



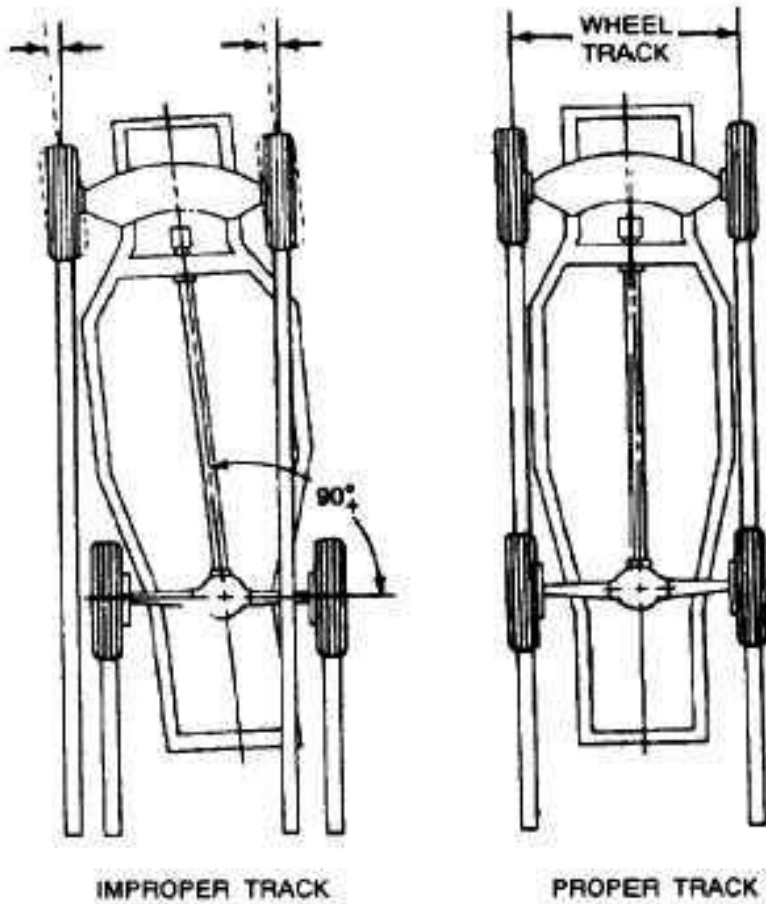
ATASA 5th Wheel Alignment

28. _____ is the direction the rear axle would travel if unaffected by the front wheels.

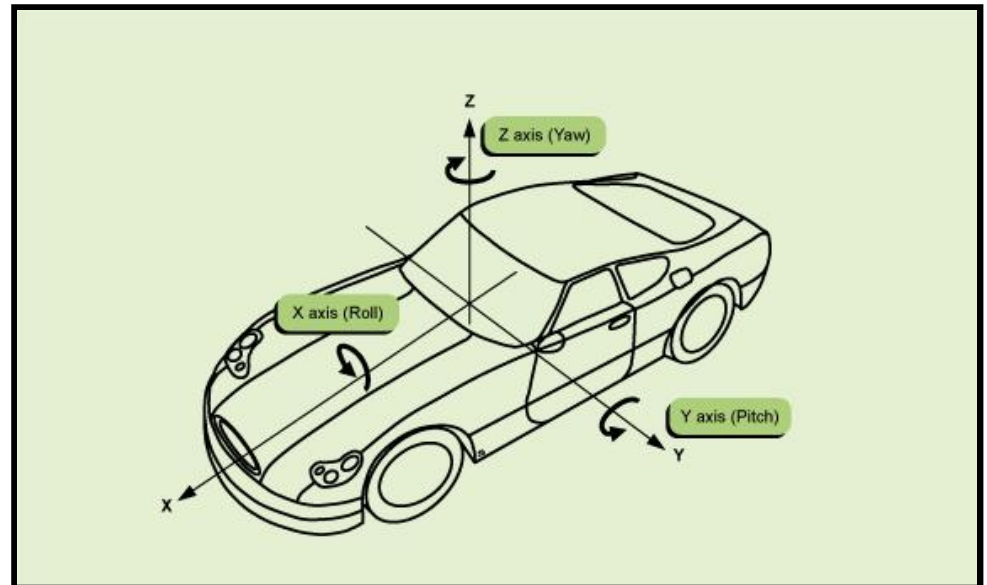


ATASA 5th Wheel Alignment

29. Correct _____ refers to a situation with all suspension and wheels in their correct location and condition and aligned to that the rear wheels follow directly behind the front wheels while driving in a straight line. *All 4 wheels form a perfect rectangle & are parallel to geometric centerline.*



REAR WHEELS MUST TRACK CORRECTLY

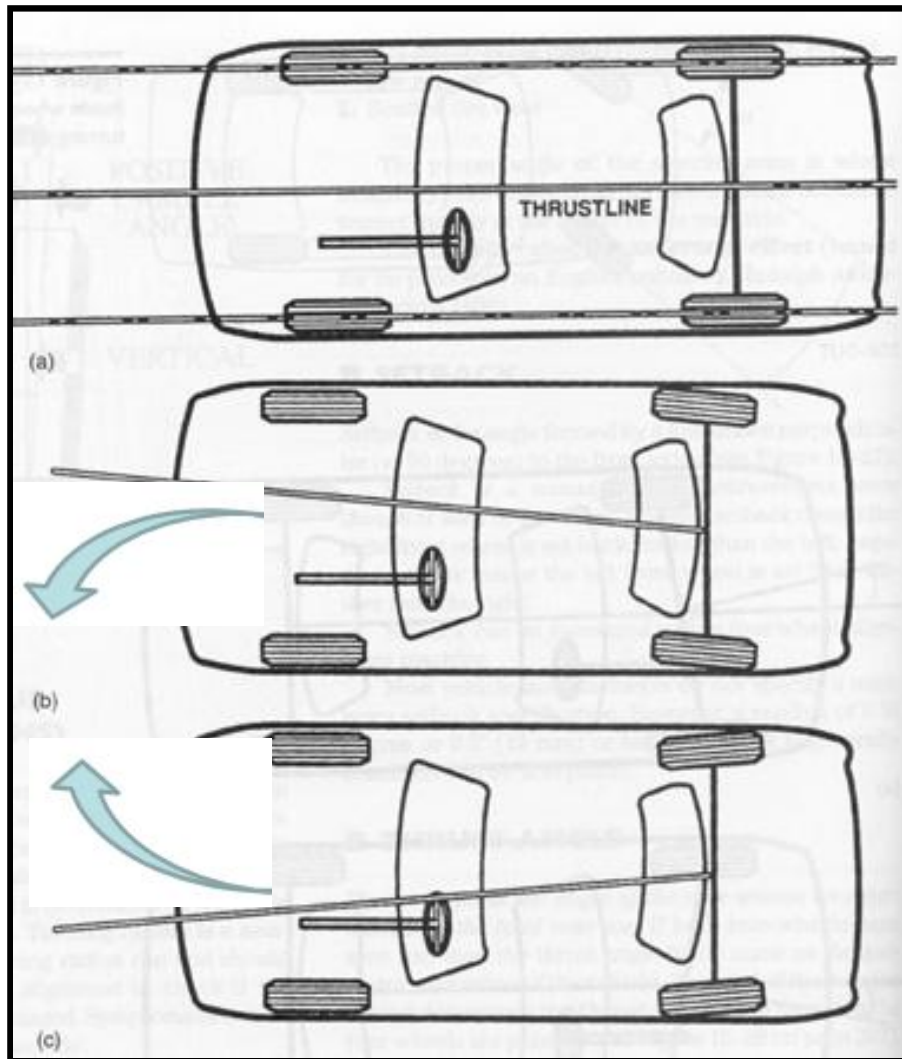


Positioning
Punctuation
Tracking

ATASA 5th Wheel Alignment

30. An offset thrust angle affects handling by pulling _____ from the thrust line.

A positive thrust angle points the rear tires to the right.
A negative thrust angle points the rear tires to the left.



Away
Toward
Left of

ATASA 5th Wheel Alignment

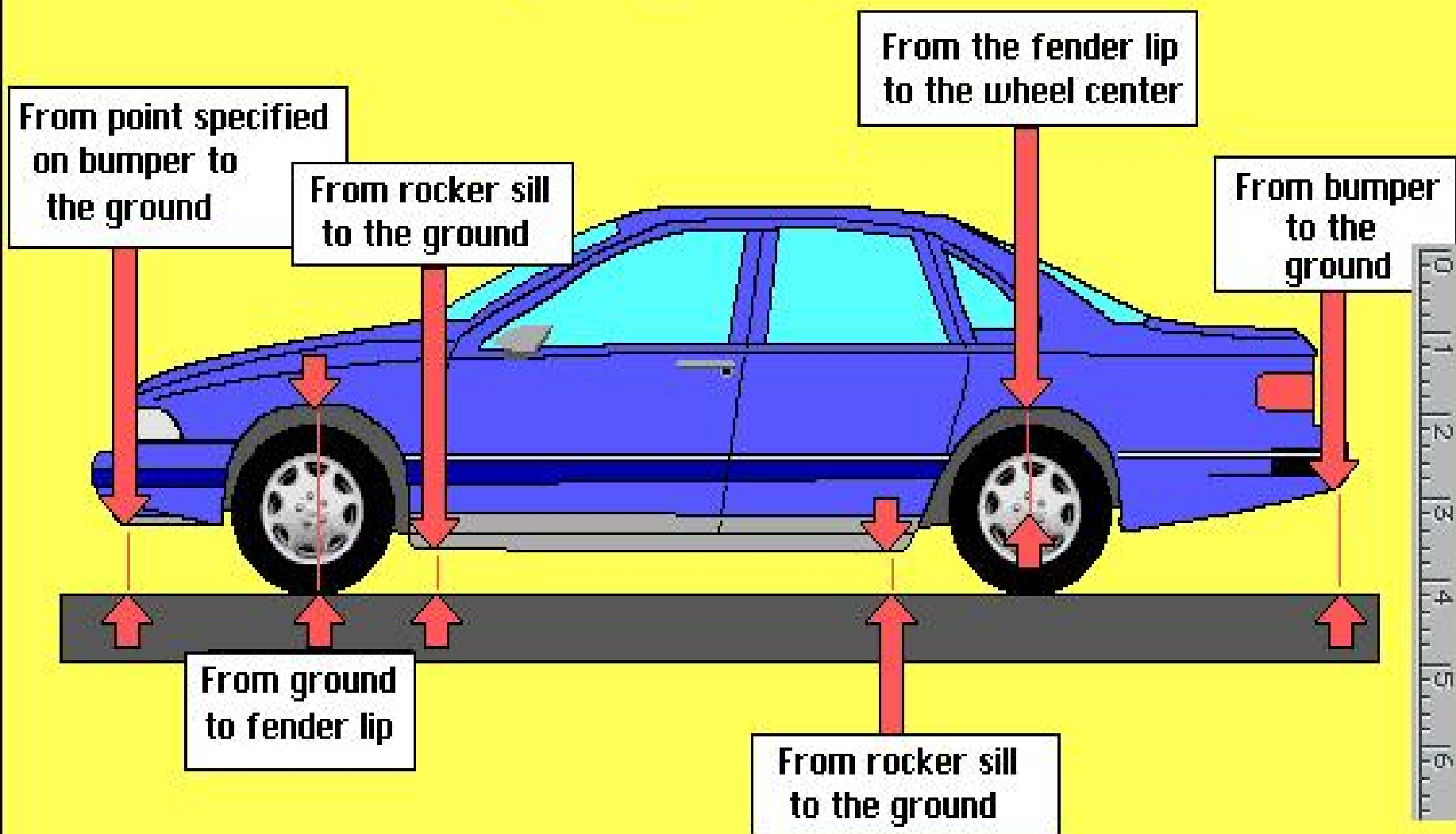
31. Every vehicle is built to operate a designed _____ height.
Also called trim, chassis or ride height.



Curb
Rim
Roof

ATASA 5th Wheel Alignment

Where Ride Height May Be Specified & Measured



ATASA 5th Wheel Alignment

32. Always begin alignment with a _____ test to *verify customer complaint* & note any problems.

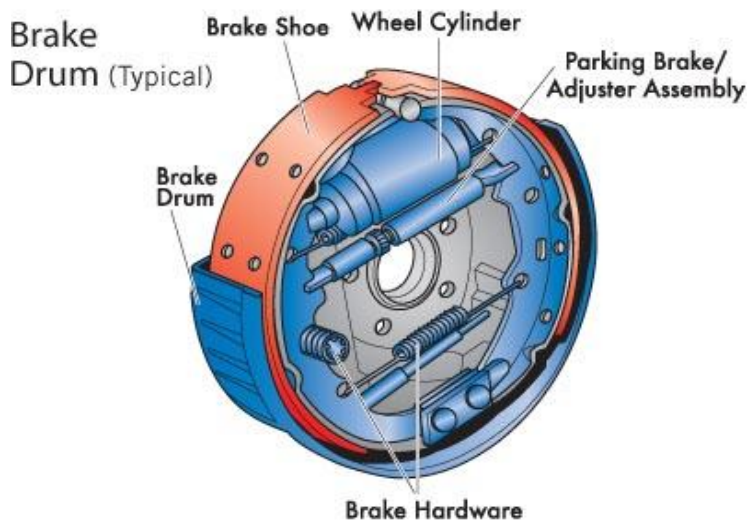
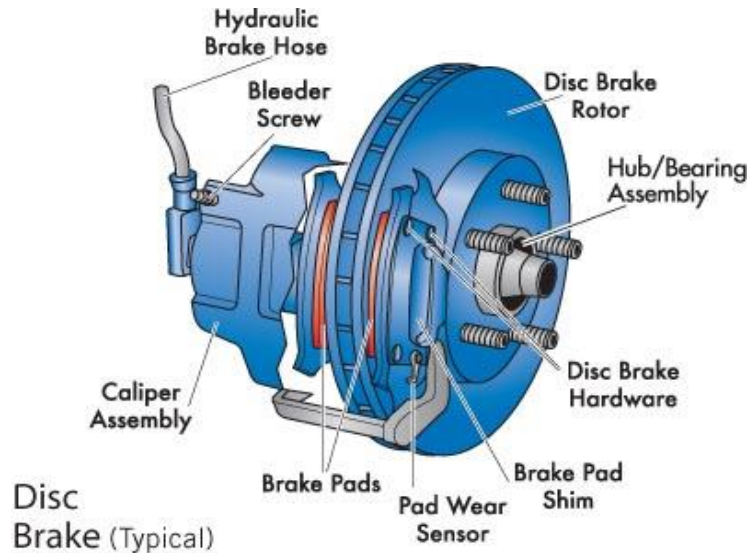


Note: Your road test should simulate customer driving and be used to verify the complaint or concern

Scope
Road
Litmus

ATASA 5th Wheel Alignment

33. Pre alignment inspection of the _____, steering, suspension, tire inflation & wear, *wheel bearing adjustment*, abnormal vehicle loads, *ride height*, and *steering wheel play* are important.



Roof
Brakes
PCM

ATASA 5th Wheel Alignment

34. An alignment _____ with front turn plates and rear slip plates allow for 4-wheel adjustment.

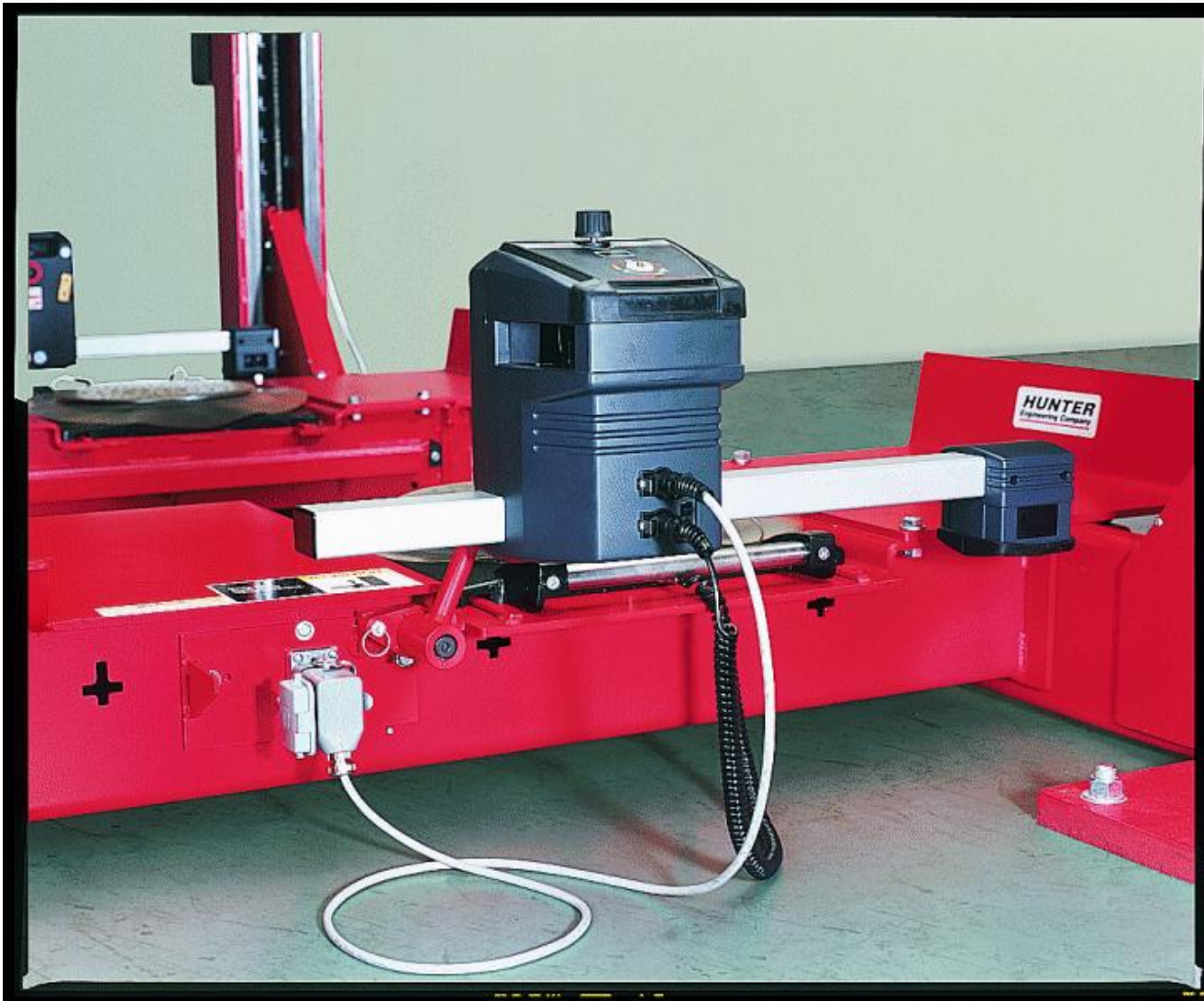


Rack
Bay
Stall

Note: Turn Plate Marked in Degrees used to Diagnose Toe-out on Turns

ATASA 5th Wheel Alignment

35. Alignment heads (*targets*) are attached to the four wheels and are then _____ for runout. (*Rolling Compensation vs. Raised & Rotated*)



Compensated
Complicated
Communicated

ATASA 5th Wheel Alignment

Rapid Rolling Compensation Helps Your Shop Complete More Alignments Per Day

Obtain Measurement Data Faster Than Conventional Sensors

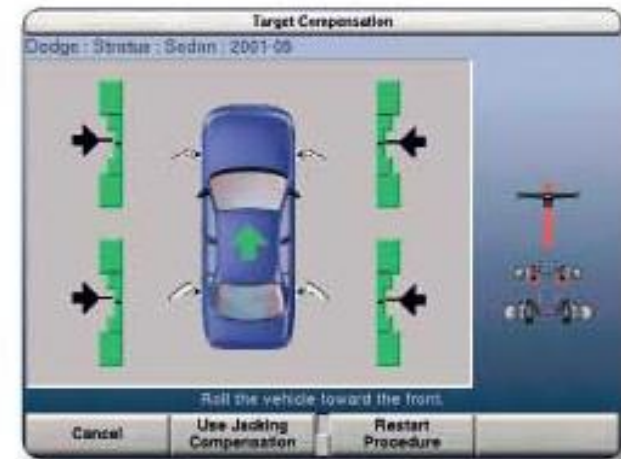
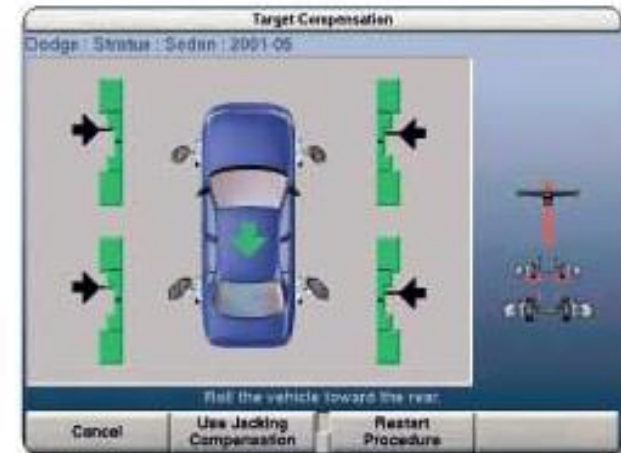


Step 1
Mount alignment targets

Step 2
Roll vehicle back until on-screen indicators turn green

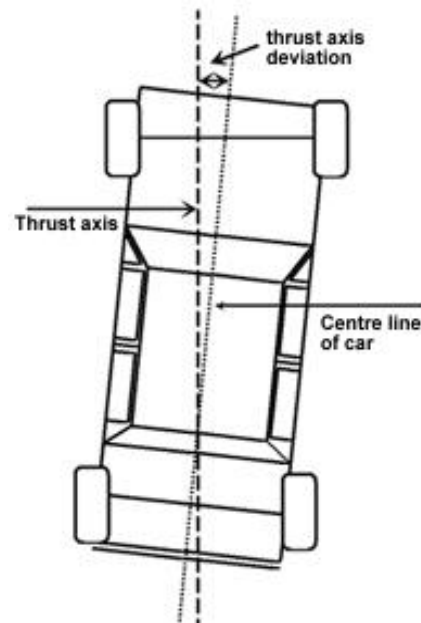
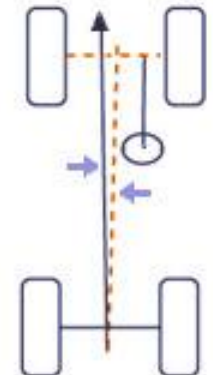
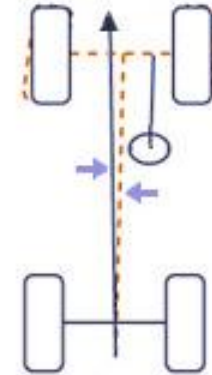
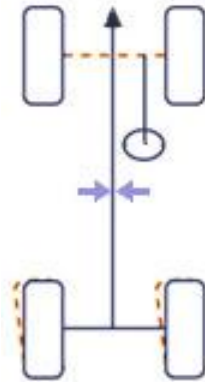
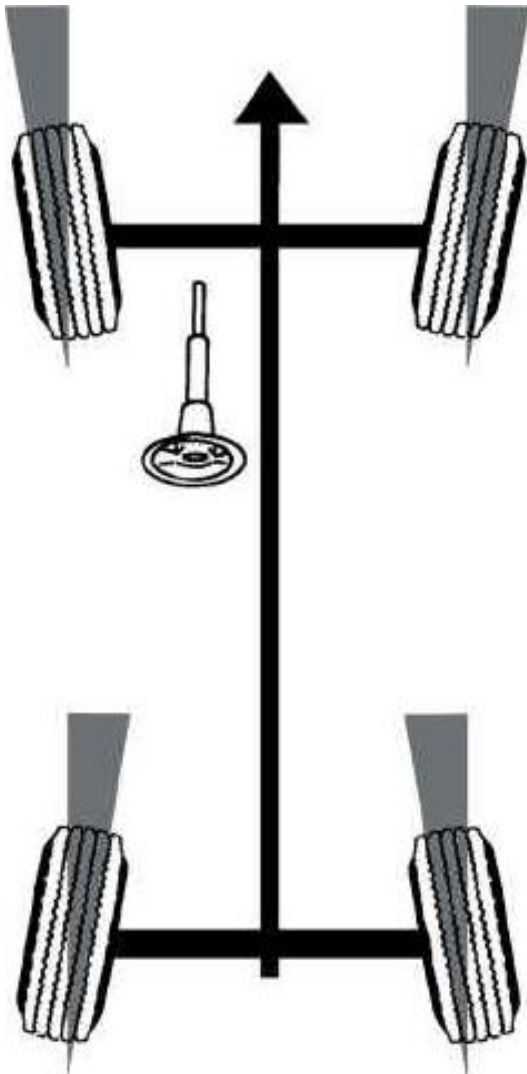
Step 3
Roll vehicle forward and stop on center of turnplate

Step 4
All front and rear camber and toe measurements are immediately displayed



ATASA 5th Wheel Alignment

36. Rear _____ is adjusted first followed by rear _____.
This establishes a zero thrust angle.



Camber, Toe
Caster, Camber
Caster, SAI

ATASA 5th Wheel Alignment

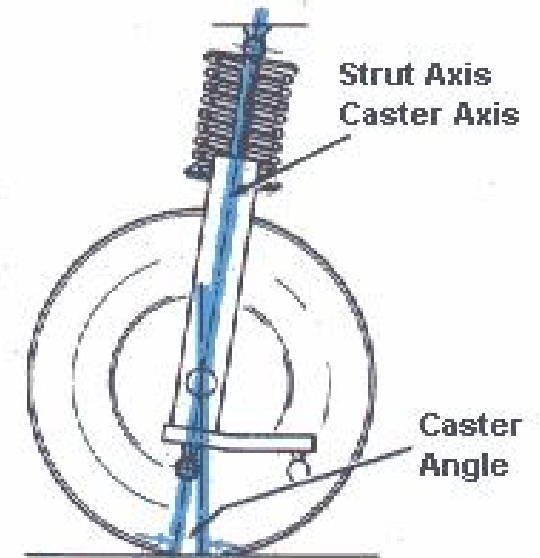
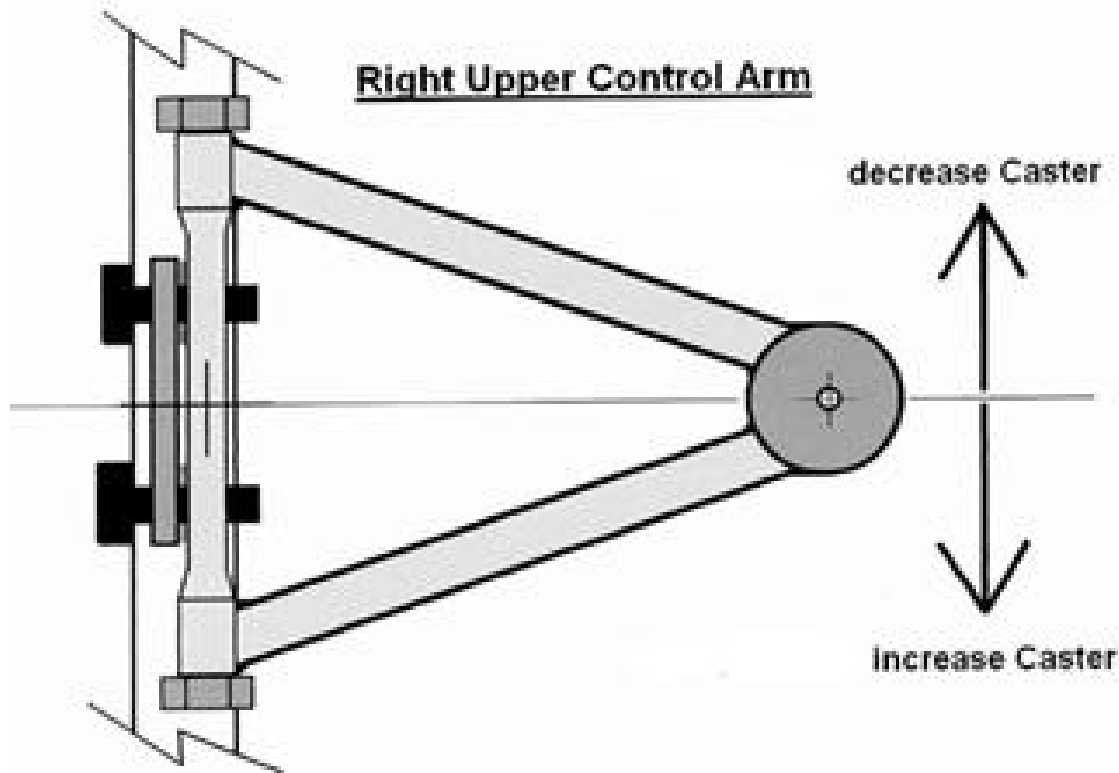
37. After adjusting the rear of the vehicle, front **caster**, **camber**, & lastly front wheel _____ are adjusted in that order, although the *caster & camber adjustment may take place simultaneously.*

Camber
Toe
SAI



ATASA 5th Wheel Alignment

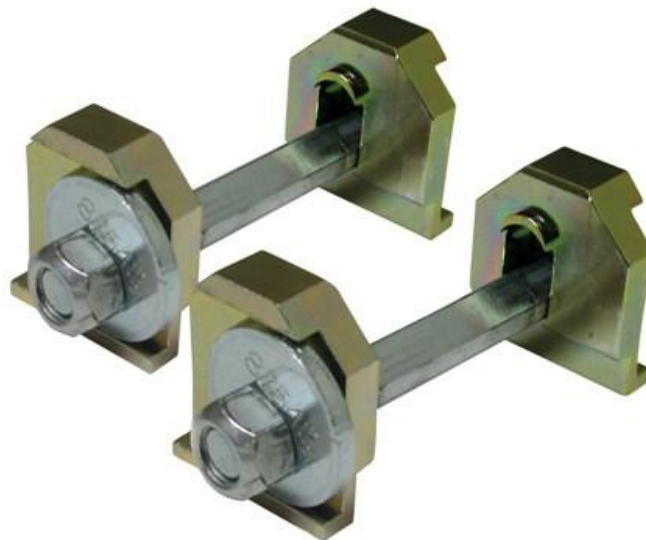
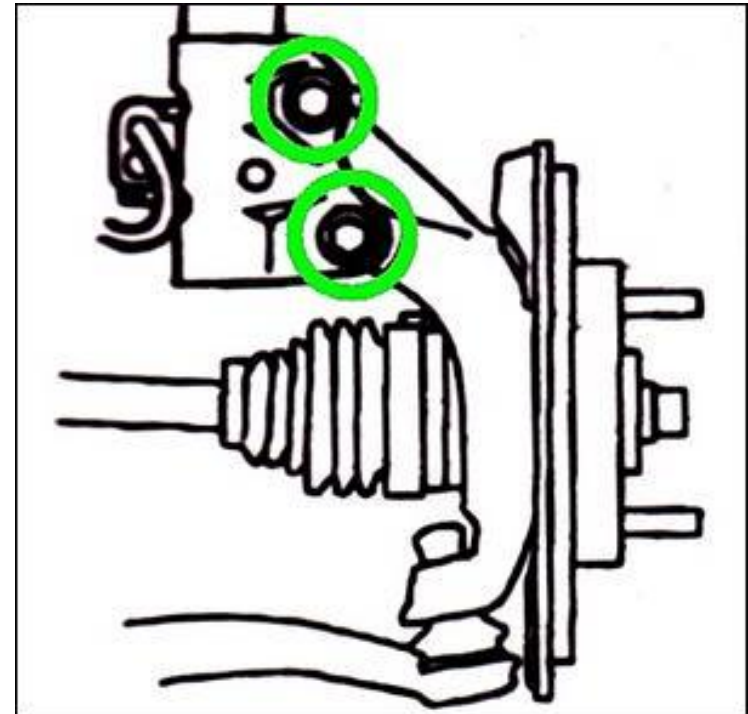
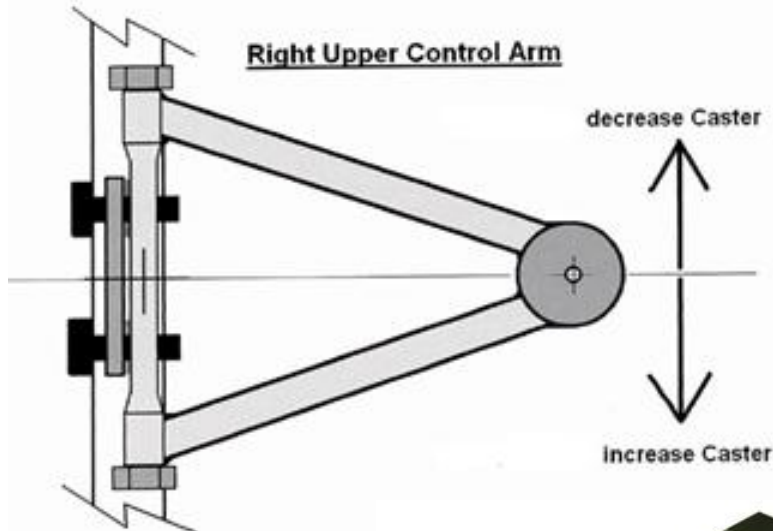
38. Most vehicles are set with a _____ caster angle & near-zero or a slightly positive camber.



Positive
Zero
Negative

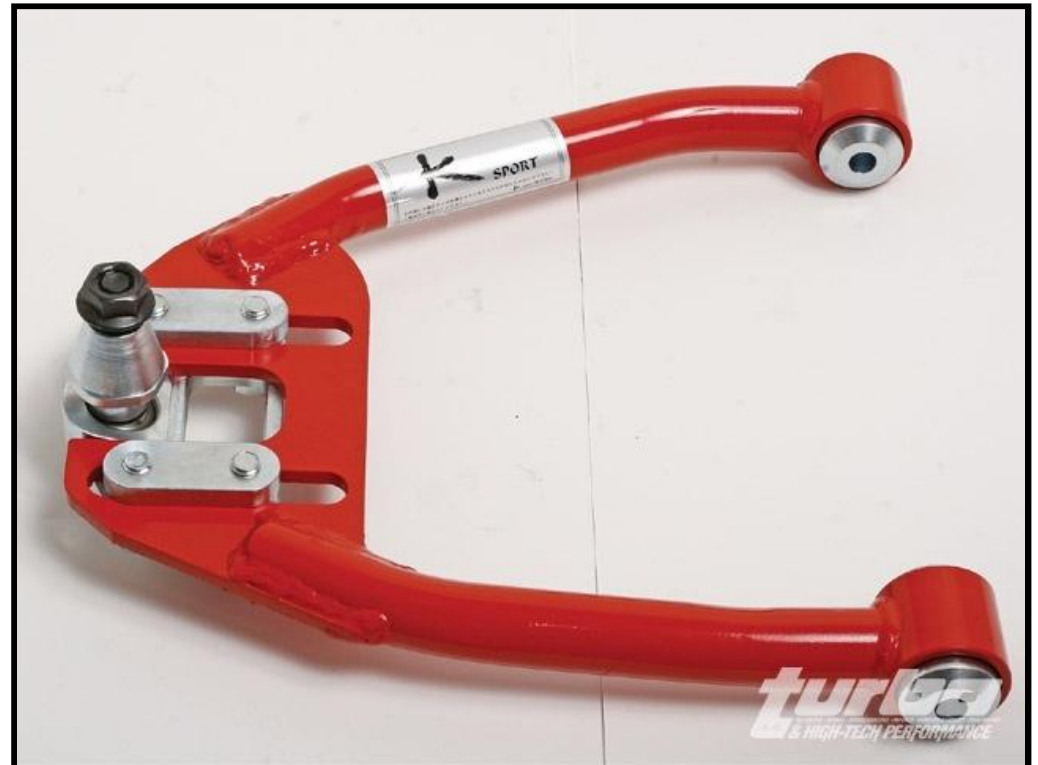
ATASA 5th Wheel Alignment

39. Caster & camber may be adjusted with _____, _____ bolts & cams, _____ holes in the frame under the control arm, a rotating _____, shortening or lengthening a strut rod that holds the lower control arm, or by repositioning the MacPherson strut top or bottom.



Shims, Eccentric, Slotted, Ball Joint
Shims, Washers, Jagged, Tie Rod Joints
Shims, Strut Rods, Slotted, Strut Joints

ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment

40. If **OEM** makes no allowance for caster or camber adjustment, **aftermarket** ___ are often readily available from parts stores to make the angles adjustable.



Kits
Zits
Kites

ATASA 5th Wheel Alignment

41. Sagging springs or overloading of the rear suspension causes _____ camber on the rear.



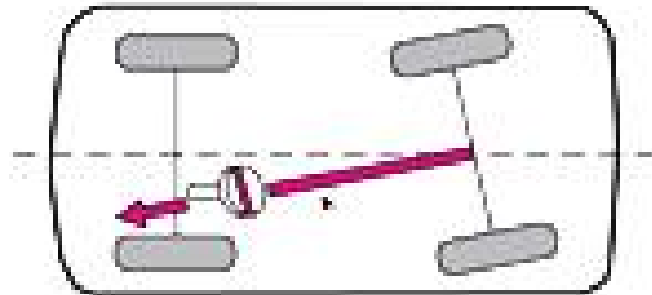
Positive
Negative
Neutral

ATASA 5th Wheel Alignment

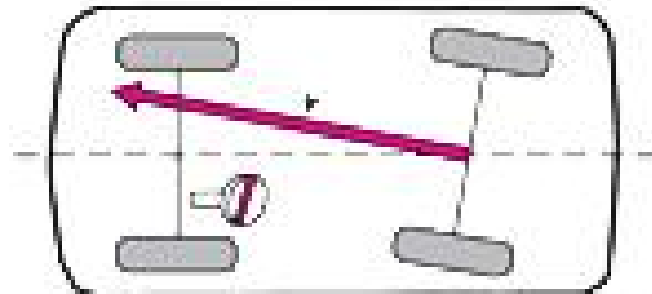
42. If the rear axle pulls to the right, the vehicle will drift to the _____.
(*thrust angle concept*)

Thrust Angle

NEGATIVE
THRUST
ANGLE



POSITIVE
THRUST
ANGLE



Right
Left
Center

ATASA 5th Wheel Alignment

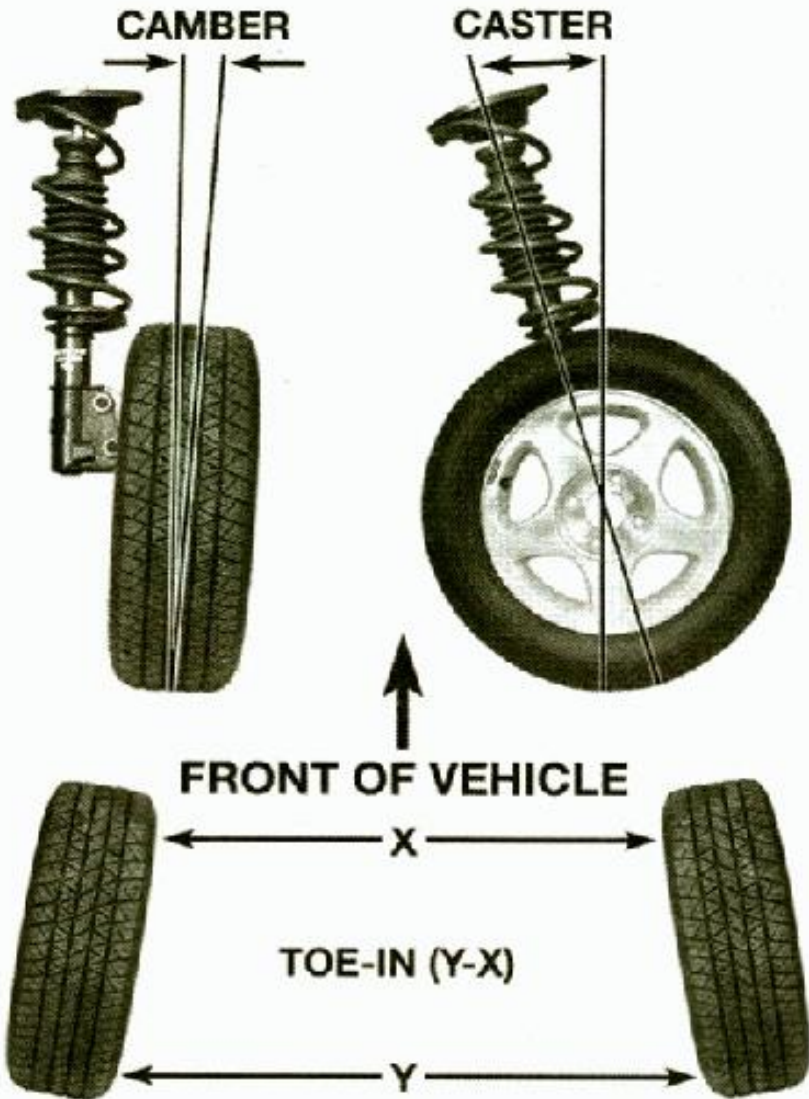
43. A _____ shim between the rear spindle & spindle mounting can adjust/correct both rear camber and rear toe.



**Inclined Plane
Full - Contact
Special NAPA**

ATASA 5th Wheel Alignment

44. Front _____ is the last angle to be adjusted. This is done with the steering wheel _____.



Caster
Camber
Toe



Off-Center
Removed
Centered

ATASA 5th Wheel Alignment

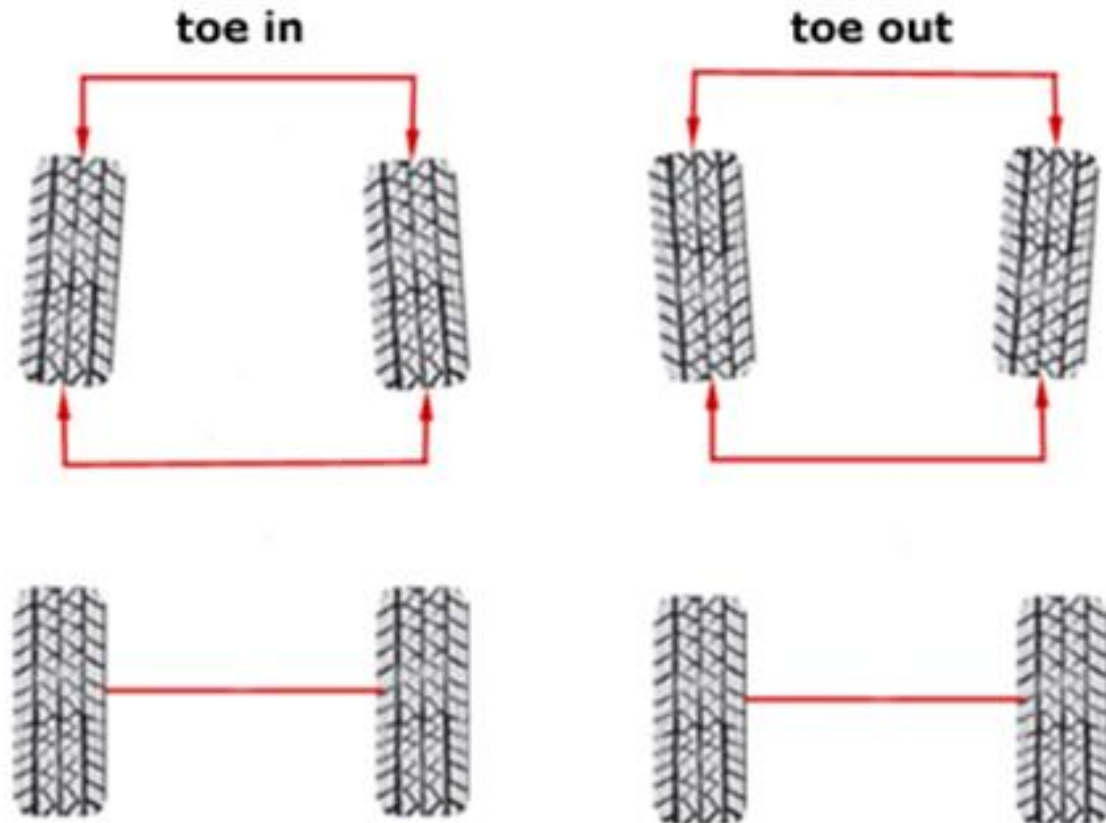
45. Some manufacturers recommend a steering wheel _____ gauge to ensure the wheel is centered.



Angle
Dangle
Rangle

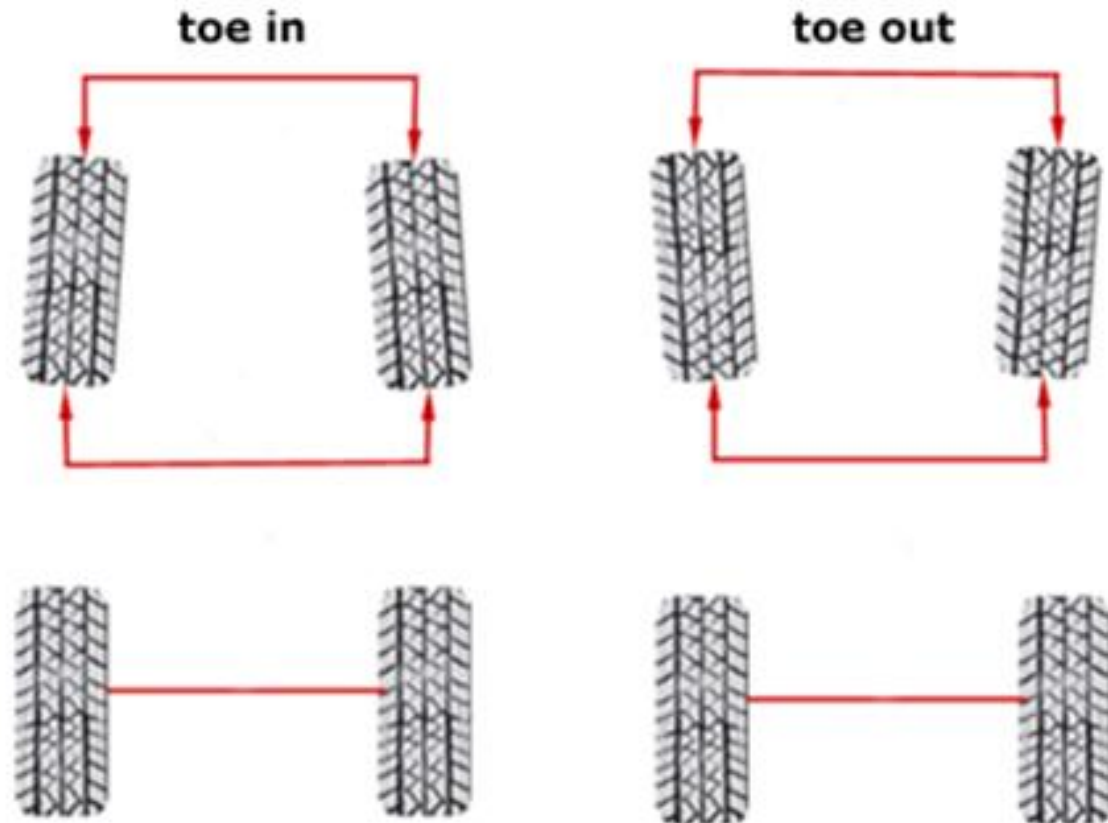
ATASA 5th Wheel Alignment

46. On FWD vehicles the front wheels tend to toe-___ under power & the rears toe-_____ in response to rolling resistance & suspension compliance.
Zero running toe is the goal.



ATASA 5th Wheel Alignment

47. On RWD vehicles, the front wheels tend to toe-_____ while the rear wheels on an independent suspension tend to toe-in as they push the vehicle ahead. *Zero running toe is the goal.*



ATASA 5th Wheel Alignment

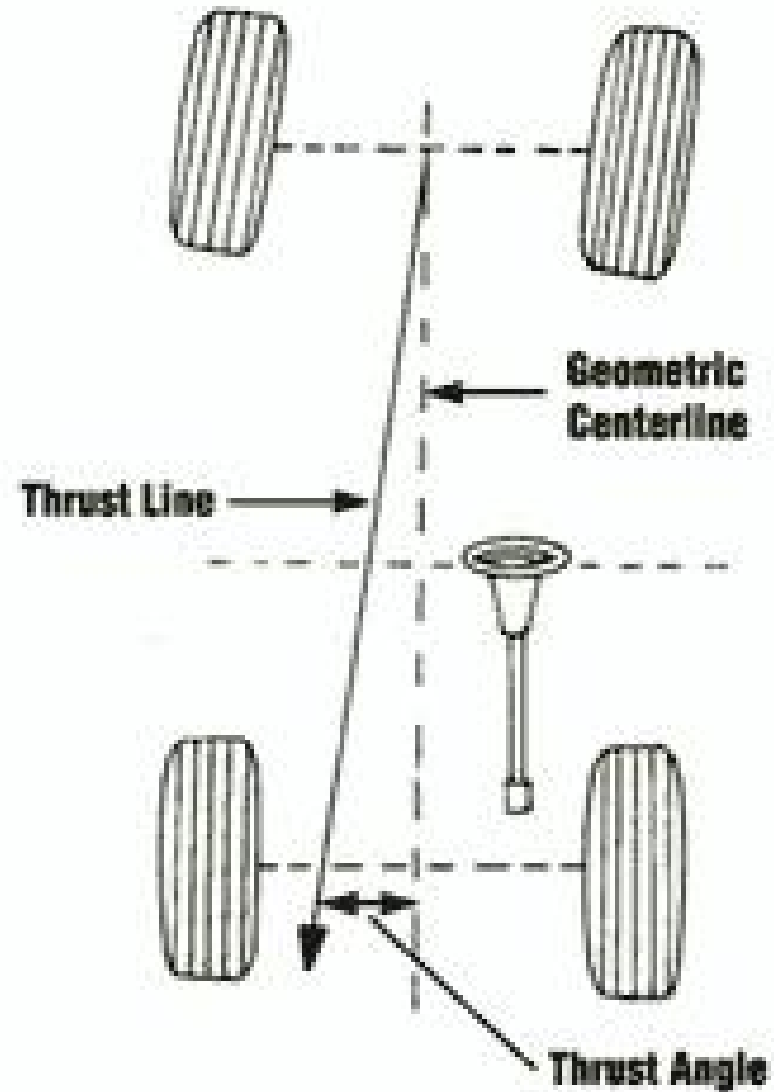
48. Improperly cambered or toed rear wheels can affect steering as well as ABS. *True or False*



ATASA 5th Wheel Alignment

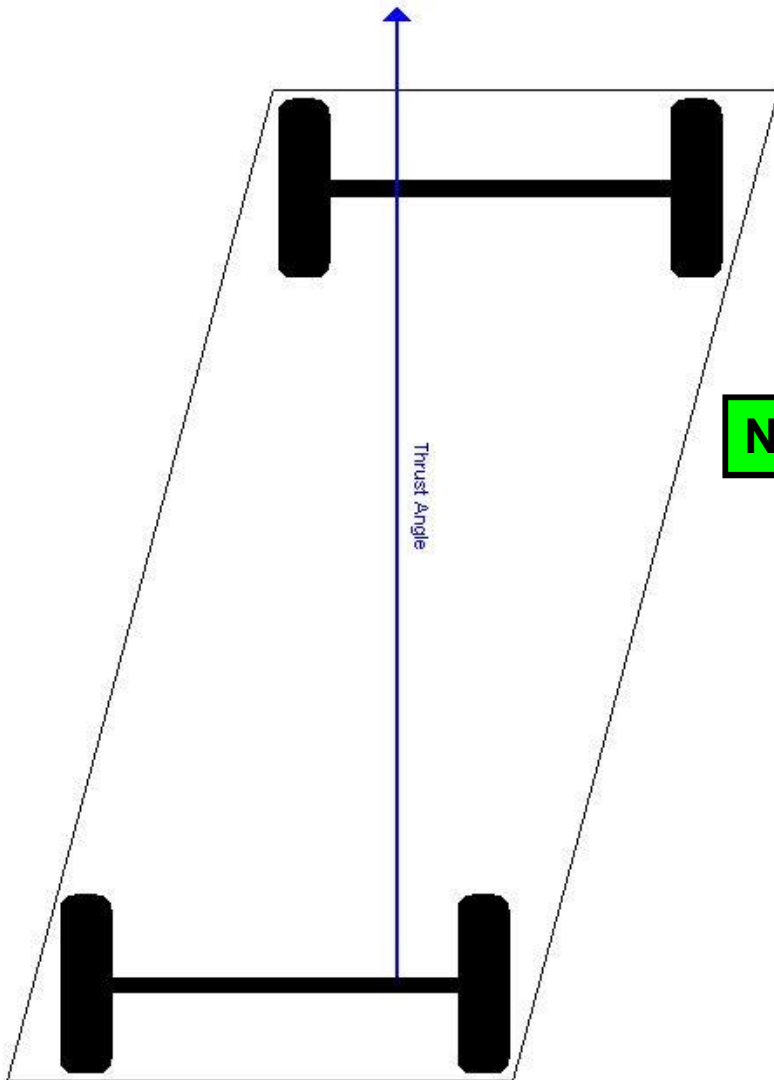
49. A thrust line or thrust angle that is off-center to the right will cause a pull to the _____.

Right
Left
Rear



ATASA 5th Wheel Alignment

50. Front wheels aligned to a rear thrust line, centers the steering wheel but results in _____ tracking.



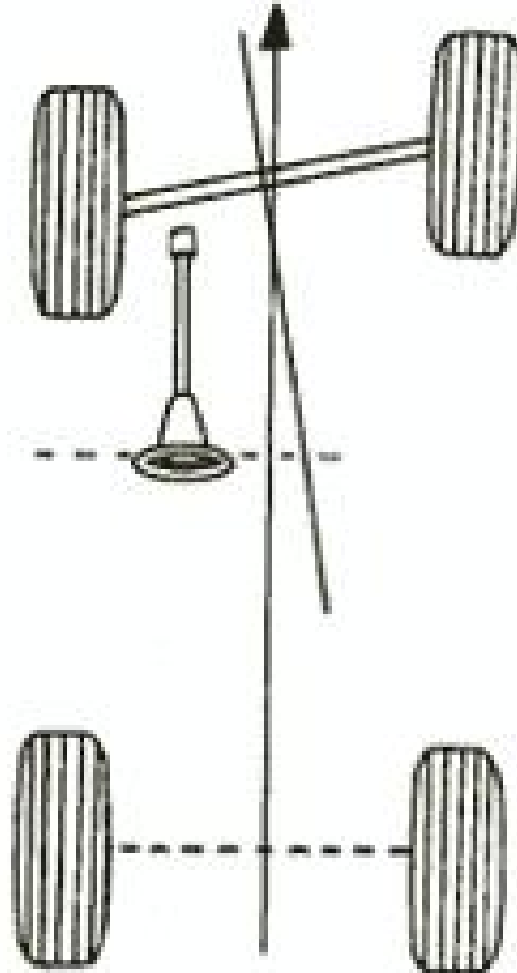
Note: Rear paws not directly behind front paws.



Elephant
Dog
Deer

ATASA 5th Wheel Alignment

51. _____, is a condition when one wheel on an axle is set behind the other. It will cause an off-center steering wheel, just like unequal toe. *It can be caused by a misaligned front cradle.*



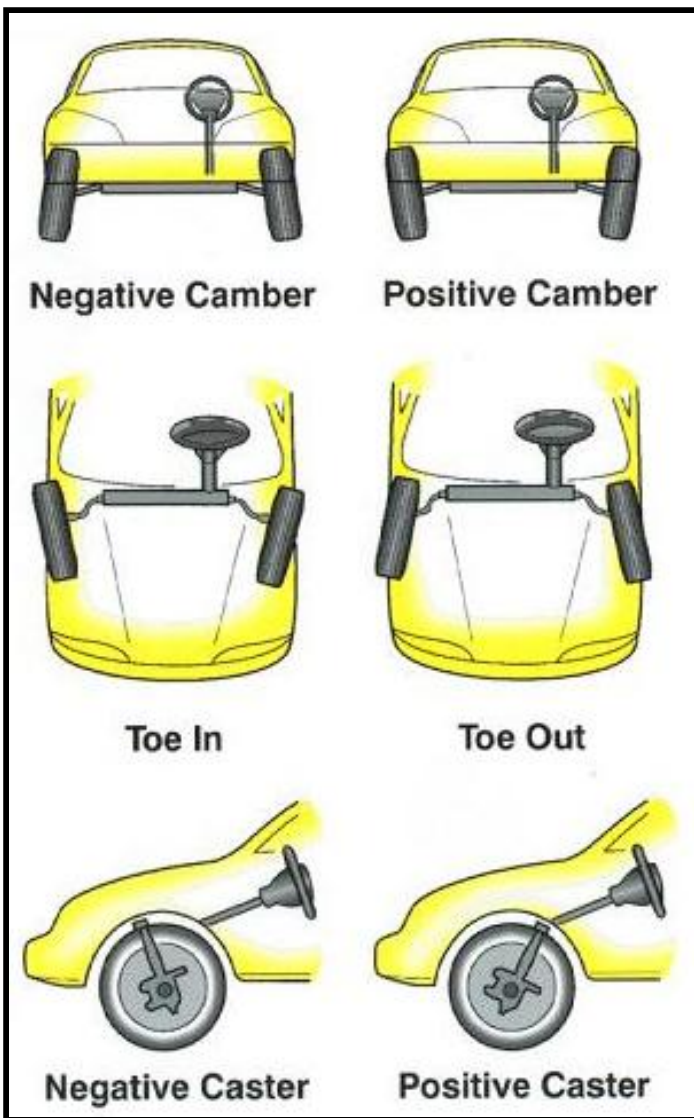
Set back
Give back
Take back

ATASA 5th Wheel Alignment

52. Toe misalignment of only 1/8" (.125", 3mm, 1/4 degree) can scrub _____ feet sideways every mile!



That's why toe is considered to be the most severe tire wearing angle!



200'
12'
5280'

ATASA 5th Wheel Alignment

53. The direction of feather edge or saw-tooth tire wear indicates the toe problem. *True or False*

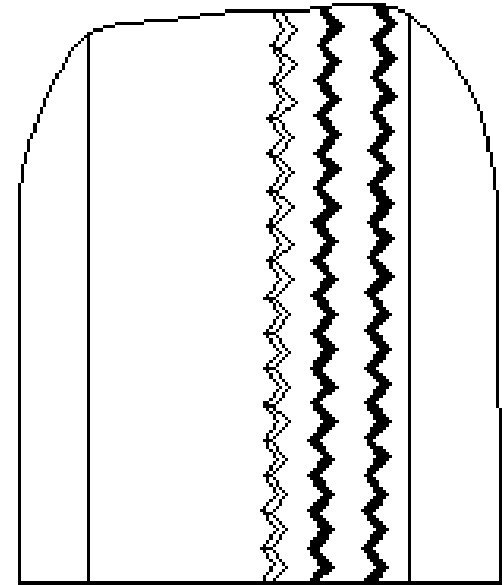
Toe Wear



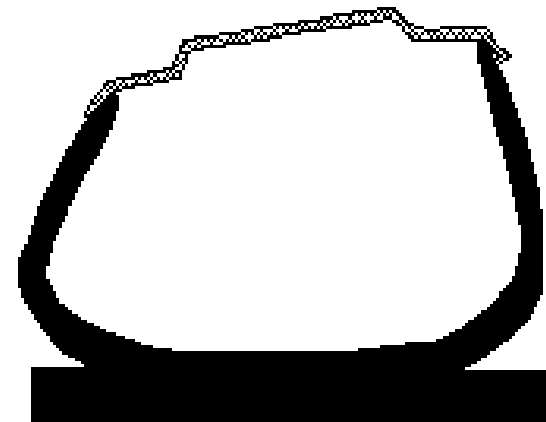
Camber Wear



ATASA 5th Wheel Alignment



WEAR ON ONE SIDE

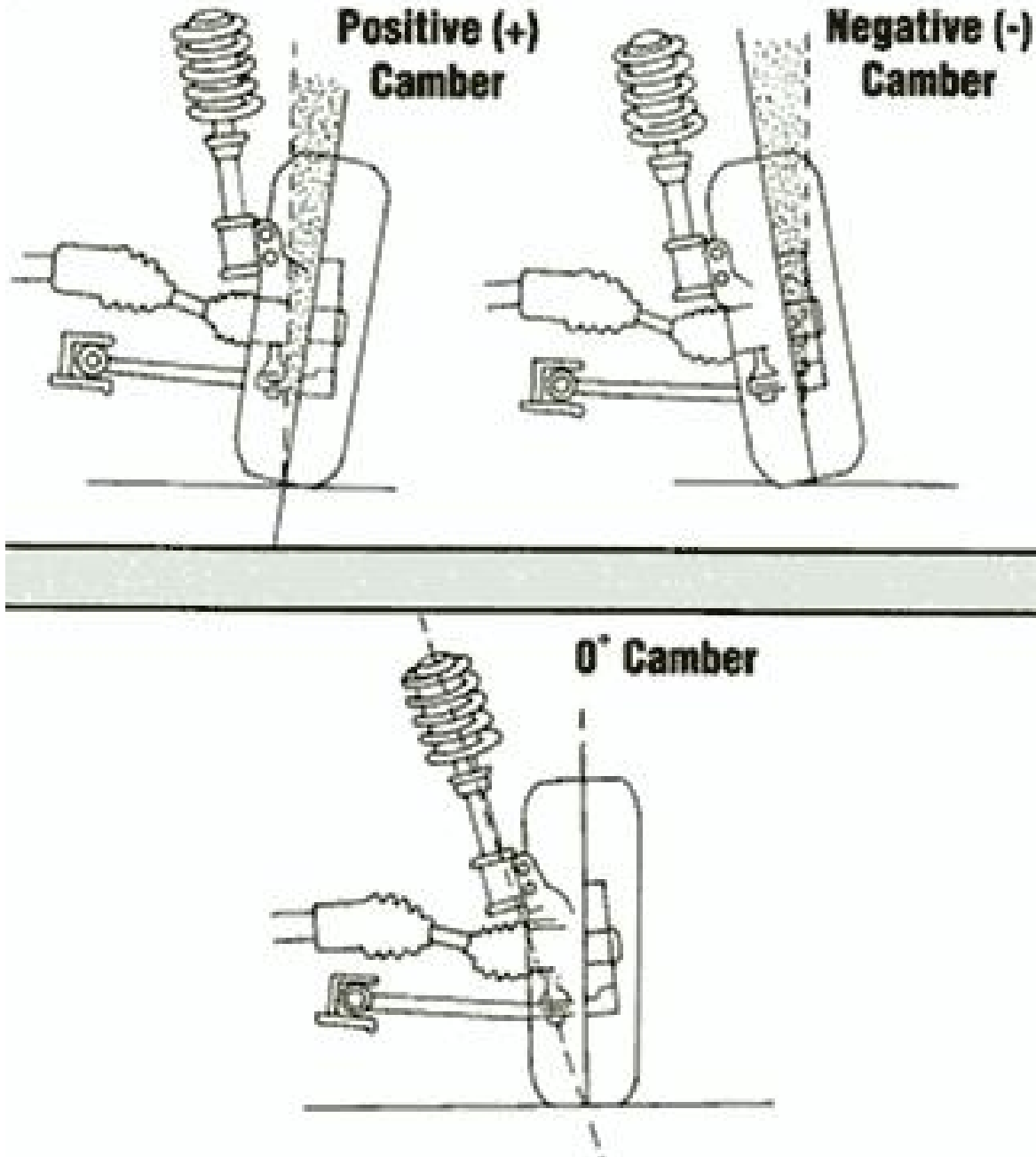


EXCESSIVE CAMBER

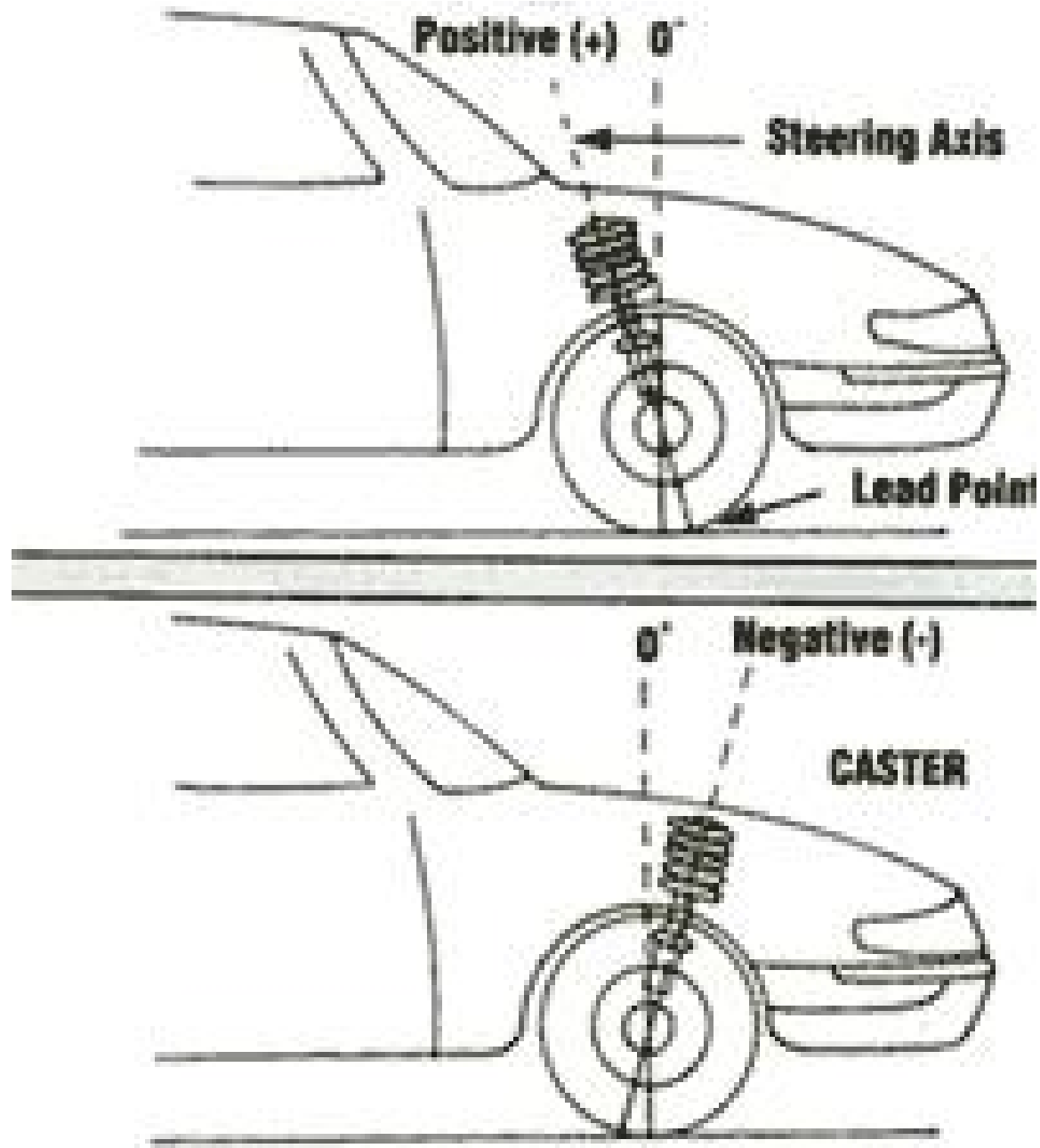
ATASA 5th Wheel Alignment



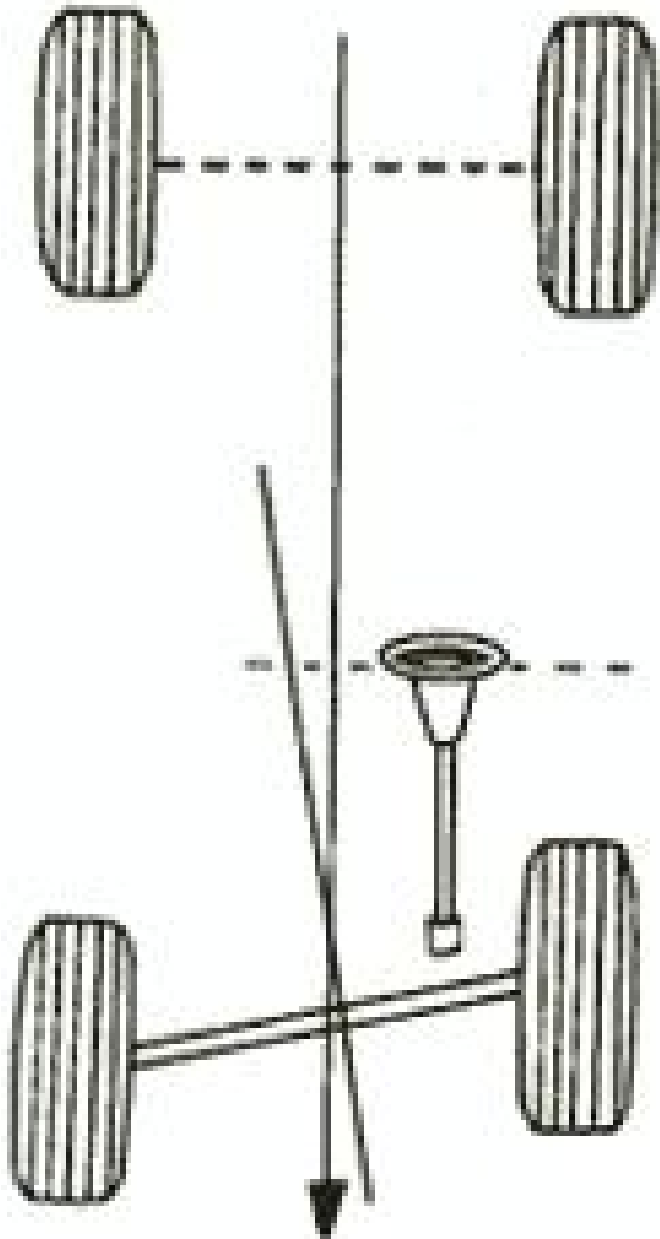
ATASA 5th Wheel Alignment



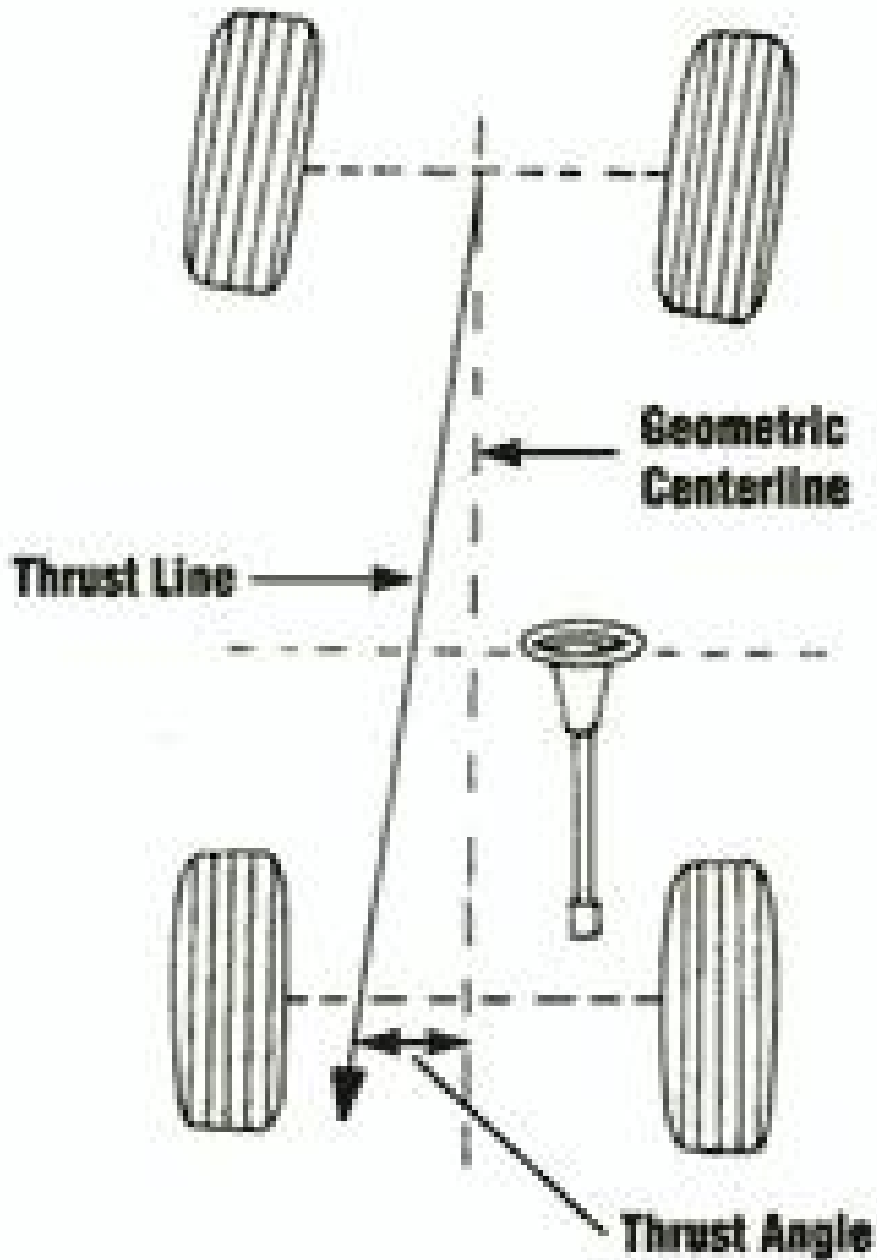
ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment

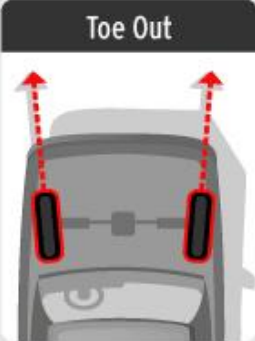
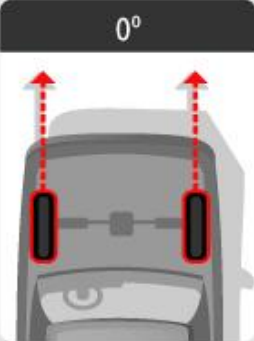
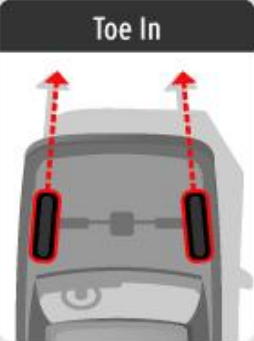
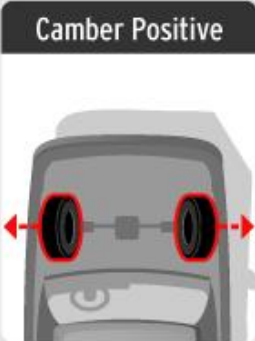

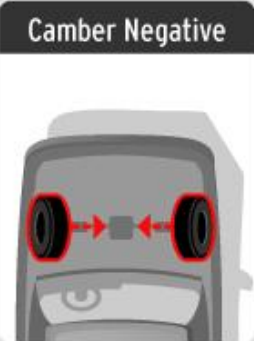

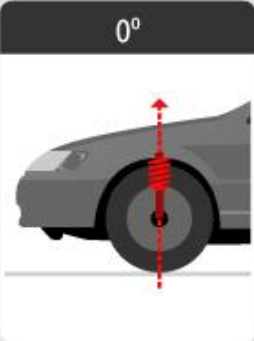



ATASA 5th Wheel Alignment









ATASA 5th Wheel Alignment

Wheel Alignment

<p>TOE Direction tires point, relative to each other</p>	<p>Toe Out</p> 	<p>0°</p> 	<p>Toe In</p> 
<p>CAMBER Tire angle, pivoting toward or away from the axle.</p>	<p>Camber Positive</p> 	<p>0°</p> 	<p>Camber Negative</p> 
<p>CASTER The degree that the steering axis is tilted as viewed from the side of the car.</p>	<p>Negative</p> 	<p>0°</p> 	<p>Positive</p> 

ATASA 5th Wheel Alignment

Checking Your Fluids						
	 OIL	 TRANSMISSION FLUID	 BRAKE FLUID	 COOLANT (ANTIFREEZE)	 WIPER FLUID	 POWER STEERING FLUID
GOOD COLOR	Honey	Red or Light Pink	Clear	Green, Red, Yellow, Orange	Blue	Bright Red
BAD COLOR	Dark Brown, Black	Brown, Black	Dark Color	Dark Brown, Rusty	Clear May Freeze	Dark Brown
CHECK	<ul style="list-style-type: none"> • Every fill up • Engine should be off 	<ul style="list-style-type: none"> • Engine warm • Engine running • Once/month 	<ul style="list-style-type: none"> • Check level • Once/month 	<ul style="list-style-type: none"> • Engine should be cold • Once/month 	<ul style="list-style-type: none"> • Check weekly and seasonally • Before trips 	<ul style="list-style-type: none"> • Engine cold • Once/month
CHANGE	<ul style="list-style-type: none"> • 3,000 miles 	<ul style="list-style-type: none"> • 30,000 miles 	<ul style="list-style-type: none"> • 30,000 miles 	<ul style="list-style-type: none"> • Every 2 years 	<ul style="list-style-type: none"> • Just top off 	<ul style="list-style-type: none"> • 30,000 miles
OTHER NOTES	<ul style="list-style-type: none"> • Check before and often during long trips • Top off as needed until change. 	<ul style="list-style-type: none"> • Do not overfill! • Check while idling • Top off as needed until change. 	<ul style="list-style-type: none"> • Do not overfill! • Top off as needed until change. 	<ul style="list-style-type: none"> • Fill to between min and max lines on reservoir • Top off as needed until change. 		<ul style="list-style-type: none"> • Top off as needed until change.

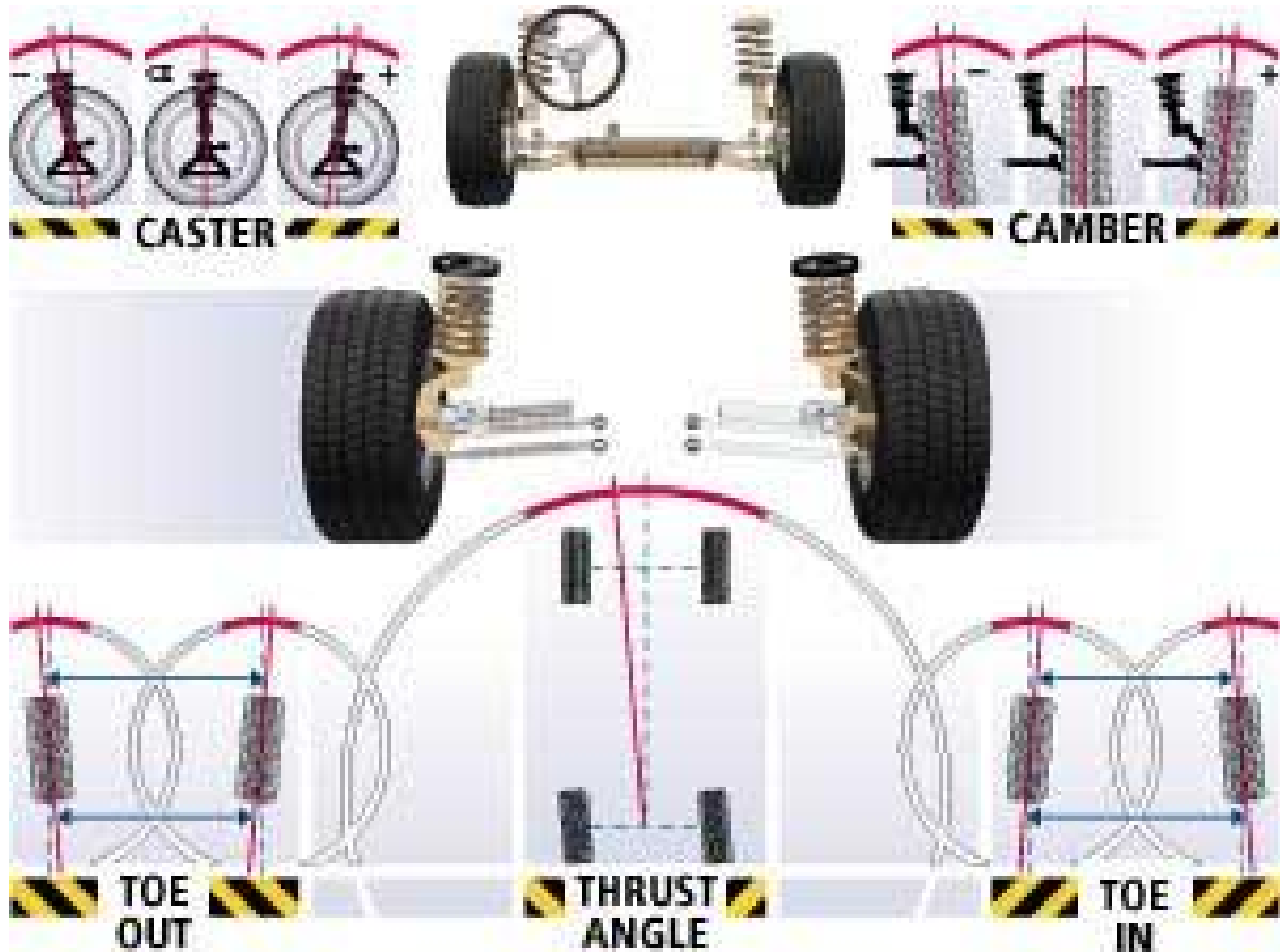
ATASA 5th Wheel Alignment



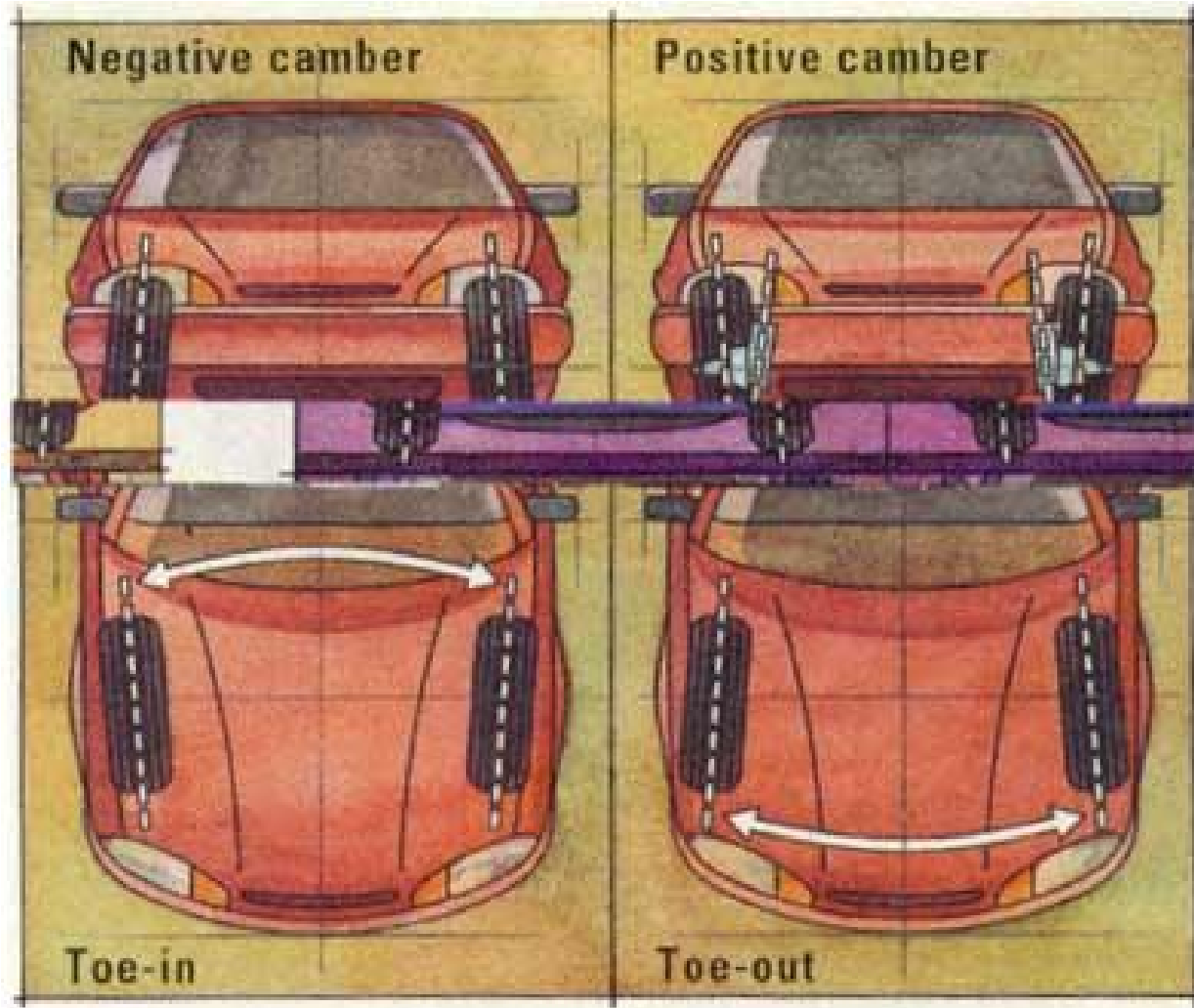
ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment

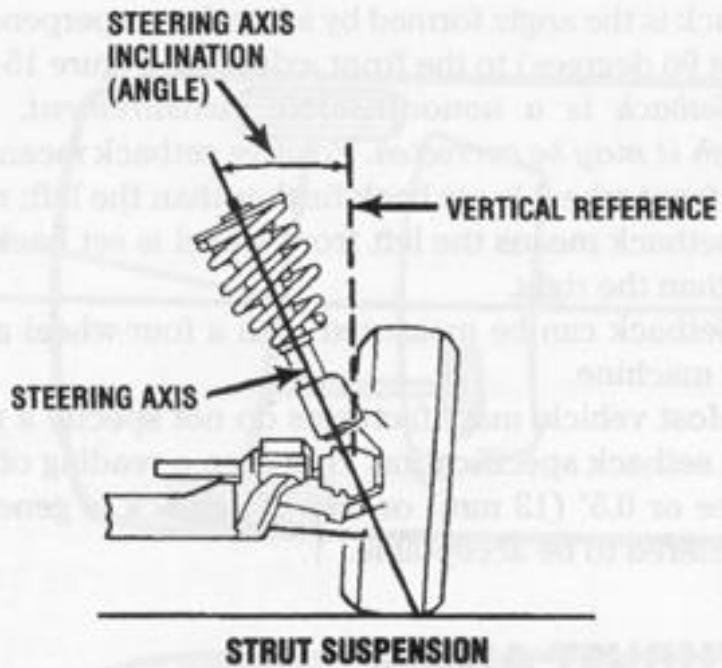
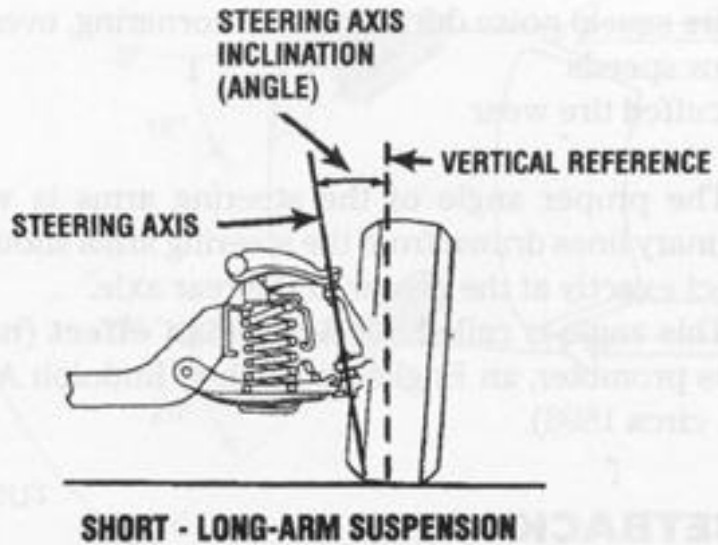


ATASA 5th Wheel Alignment

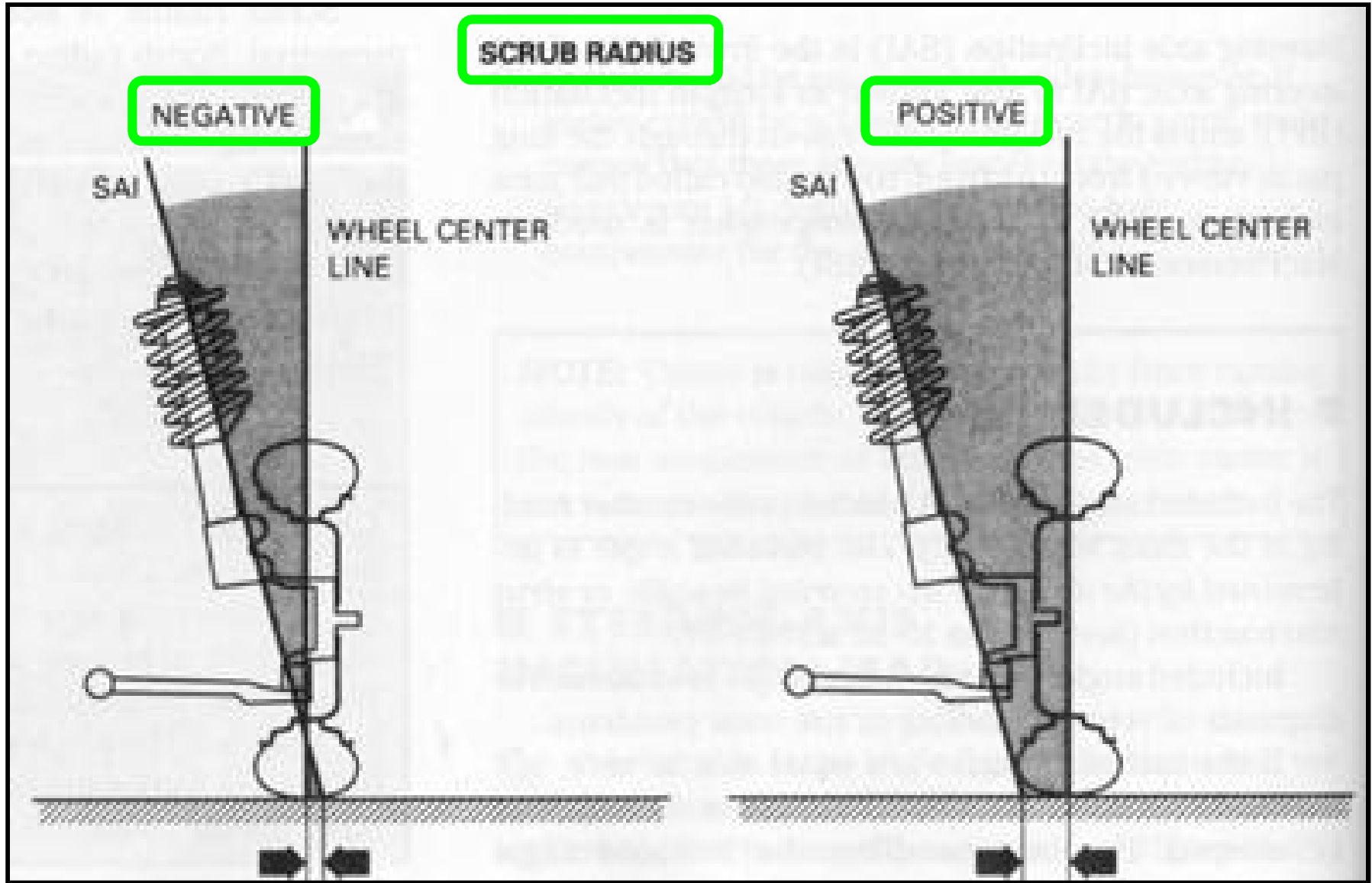


Zero camber means wheels are perpendicular to road, minimizing tire wear. Negative (inward tilt) or positive camber (outward tilt) cause irregular tire wear. Wheels that toe-in or toe-out at highway speeds scuff and wear unevenly.

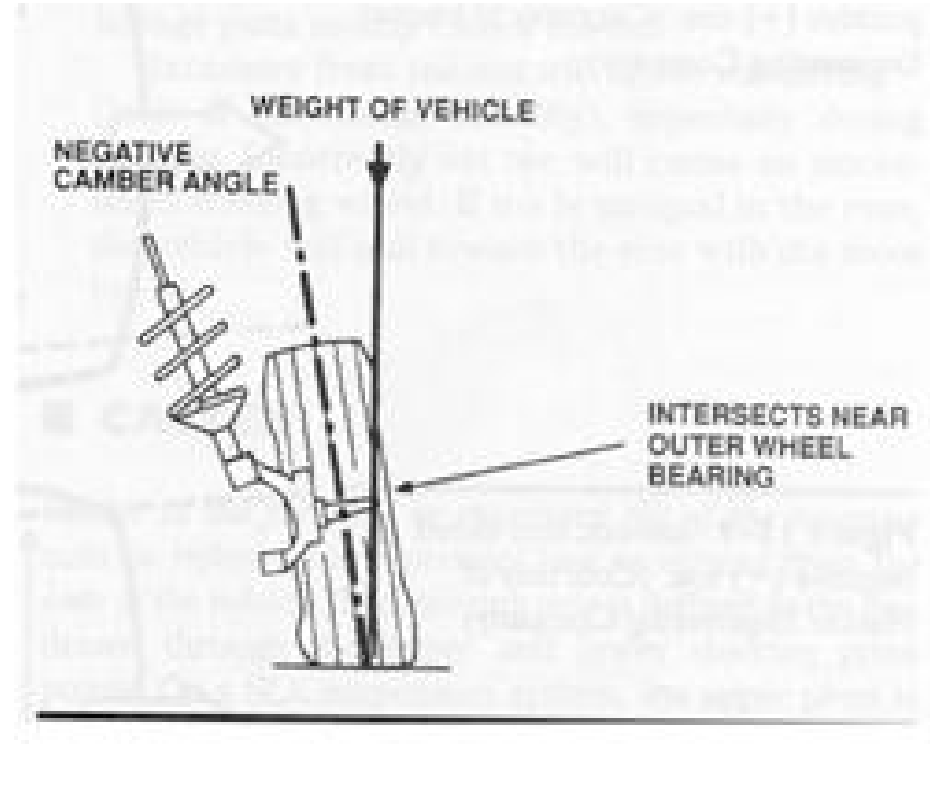
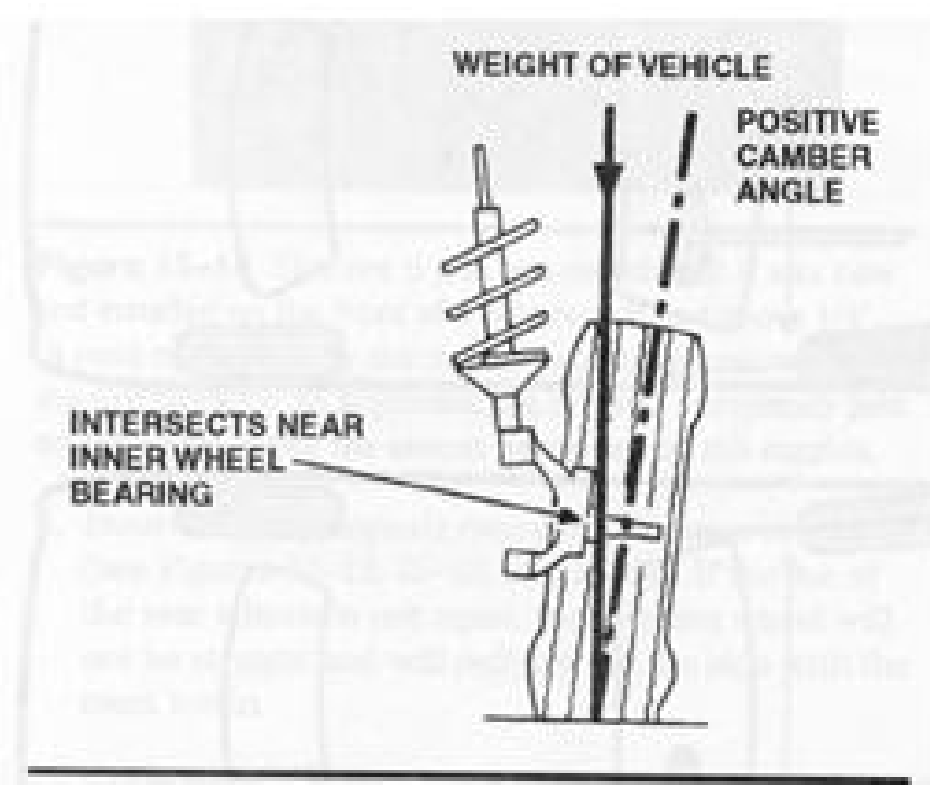
ATASA 5th Wheel Alignment



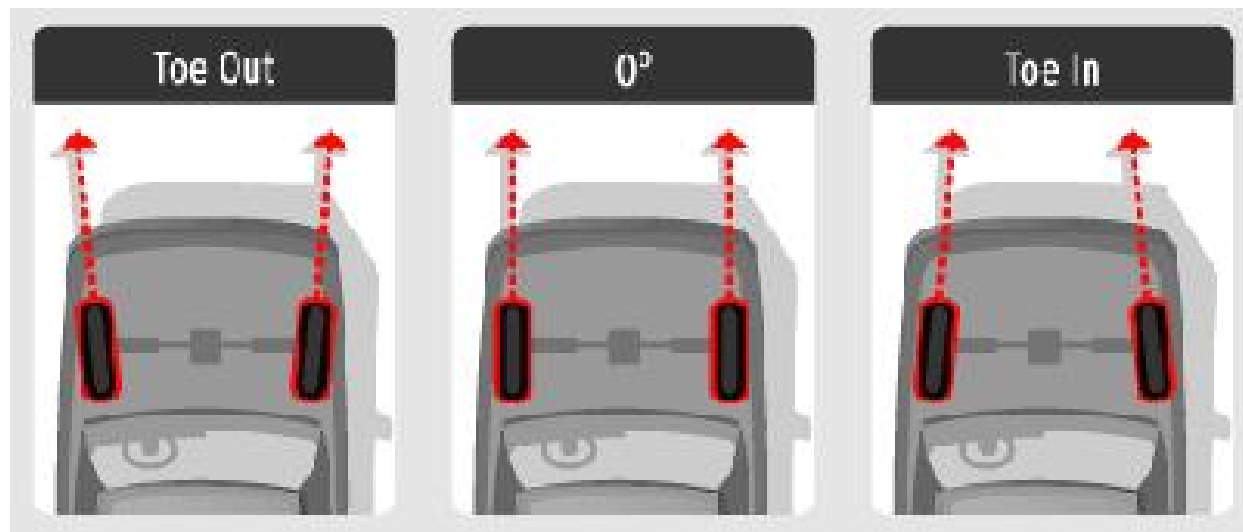
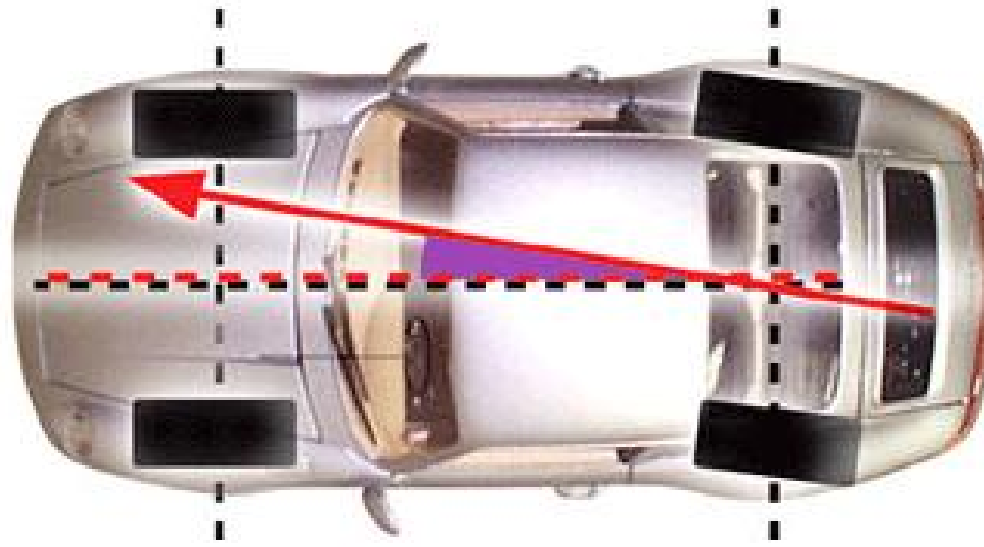
ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment

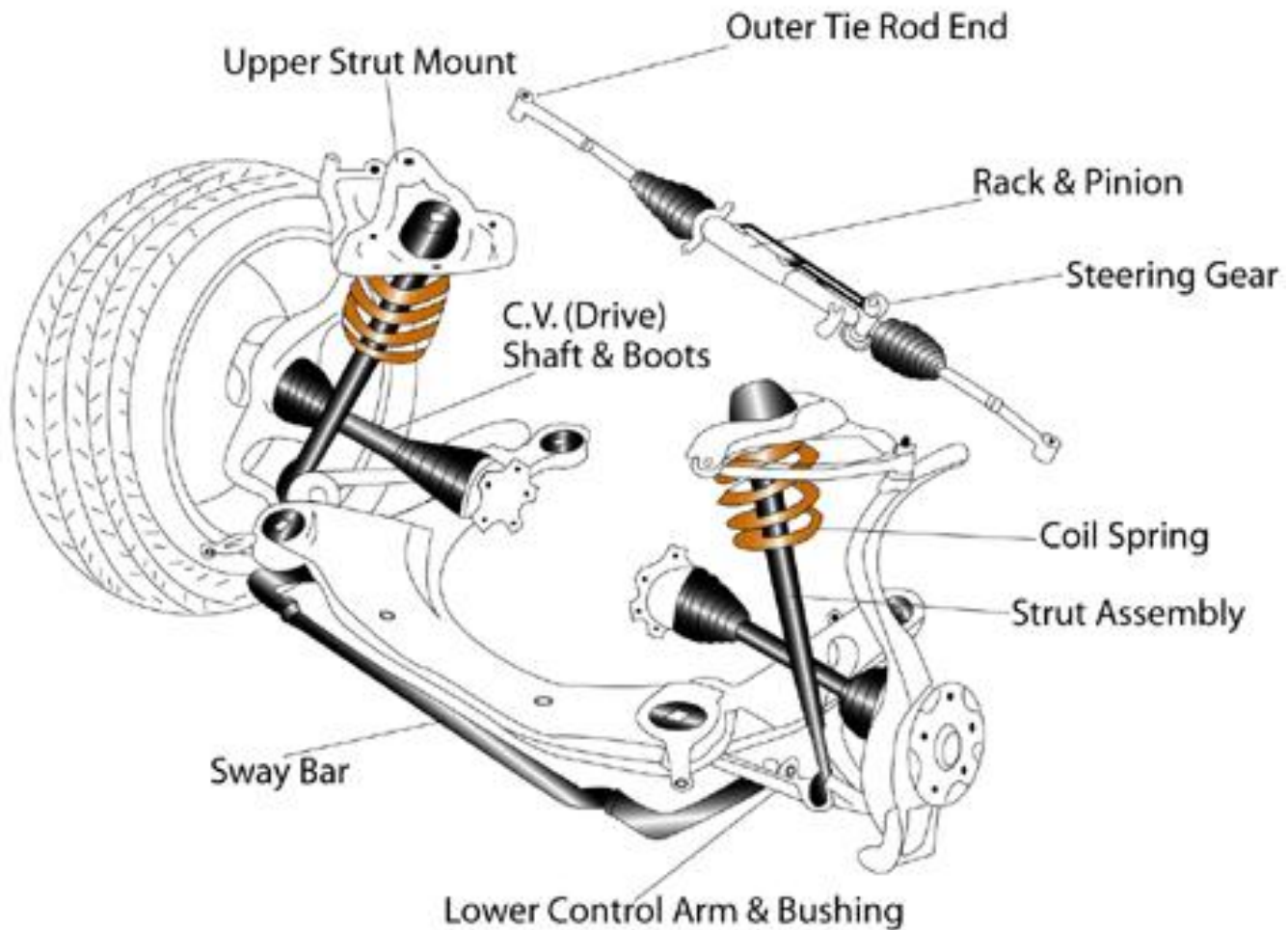


ATASA 5th Wheel Alignment



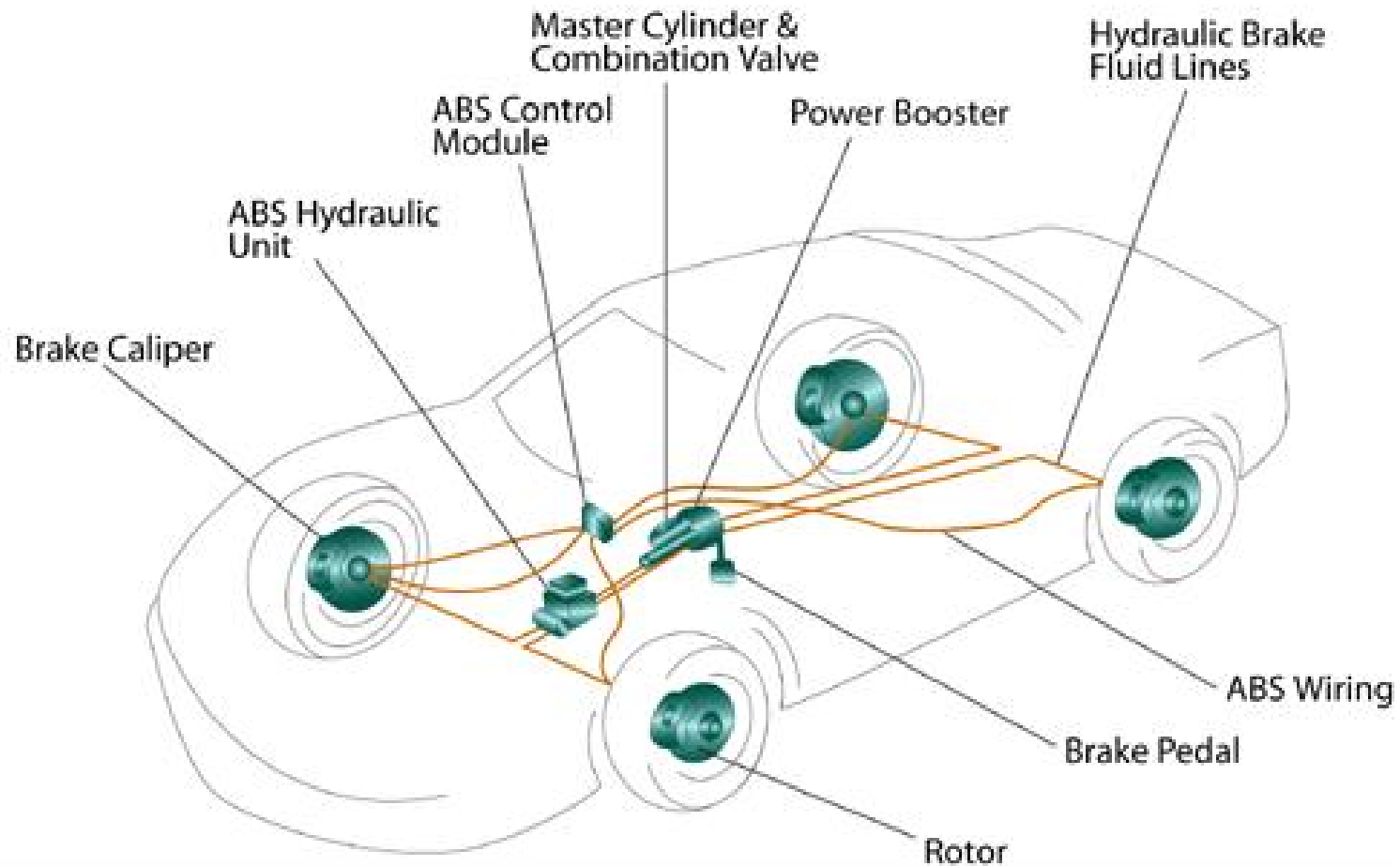
ATASA 5th Wheel Alignment

Front Suspension (Front Wheel Drive-Typical)



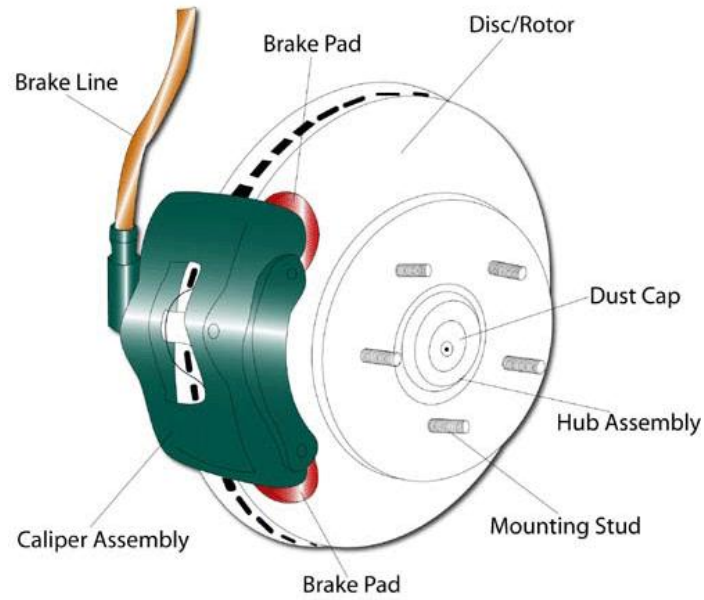
ATASA 5th Wheel Alignment

Brake System: Overview

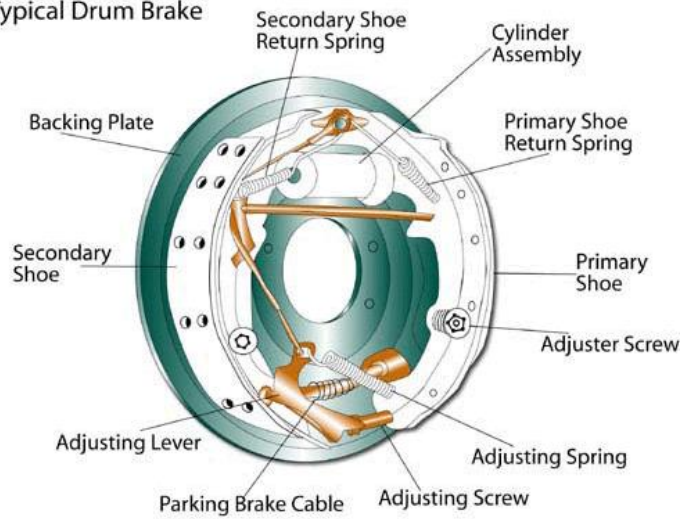


ATASA 5th Wheel Alignment

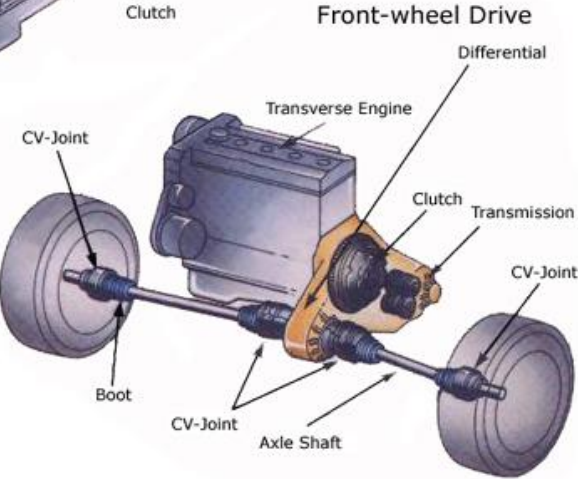
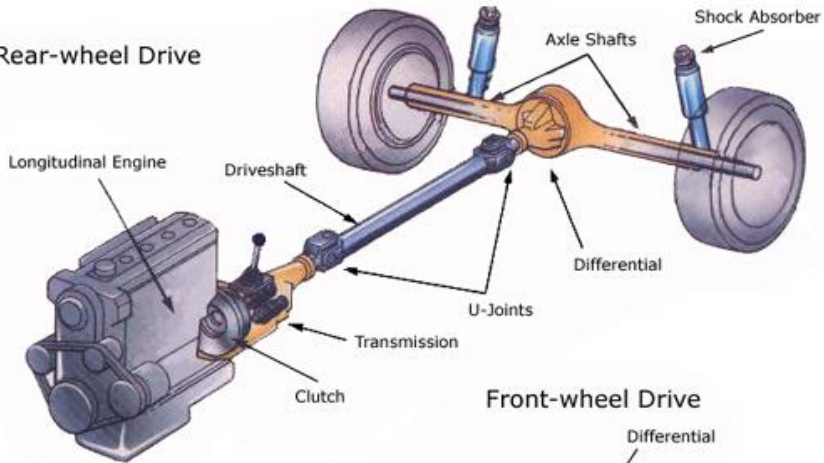
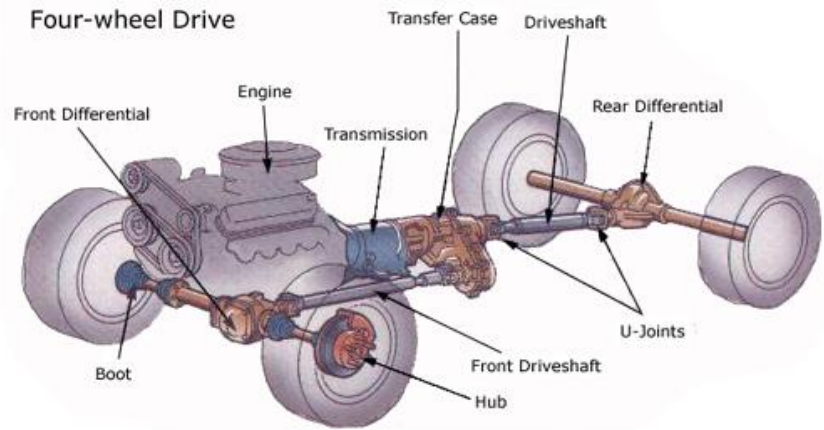
Typical Disc Brake



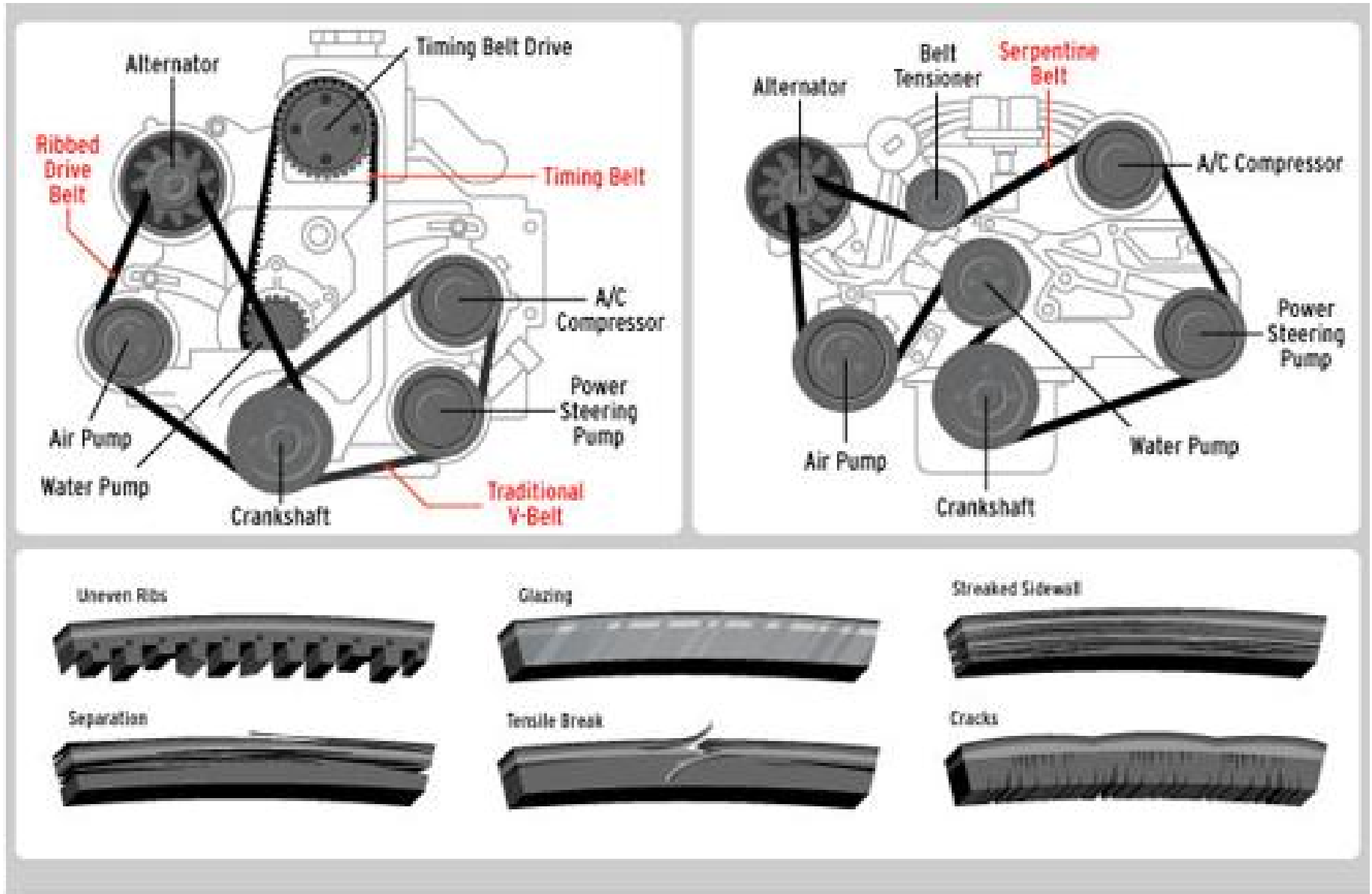
Typical Drum Brake



ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment

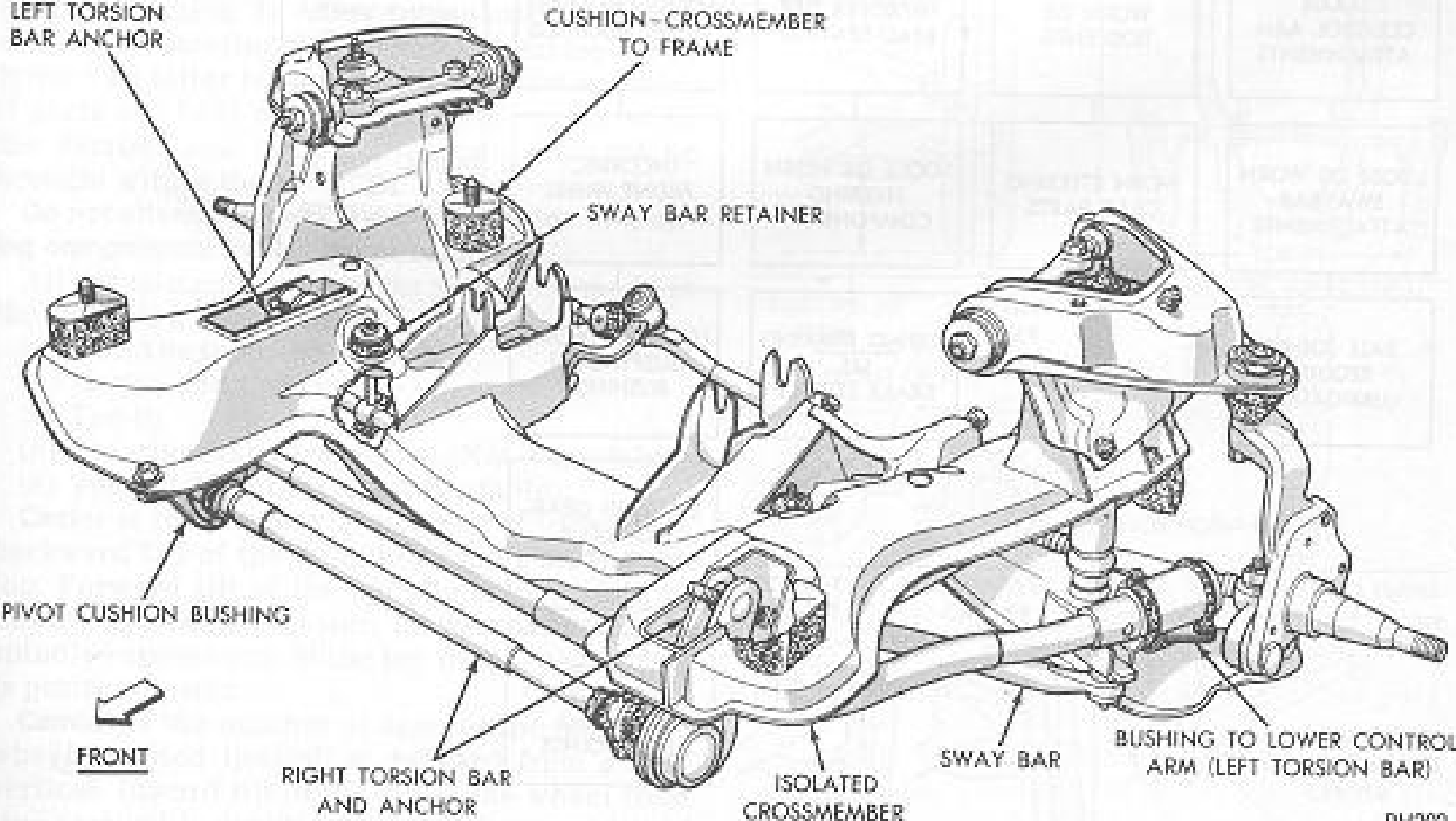
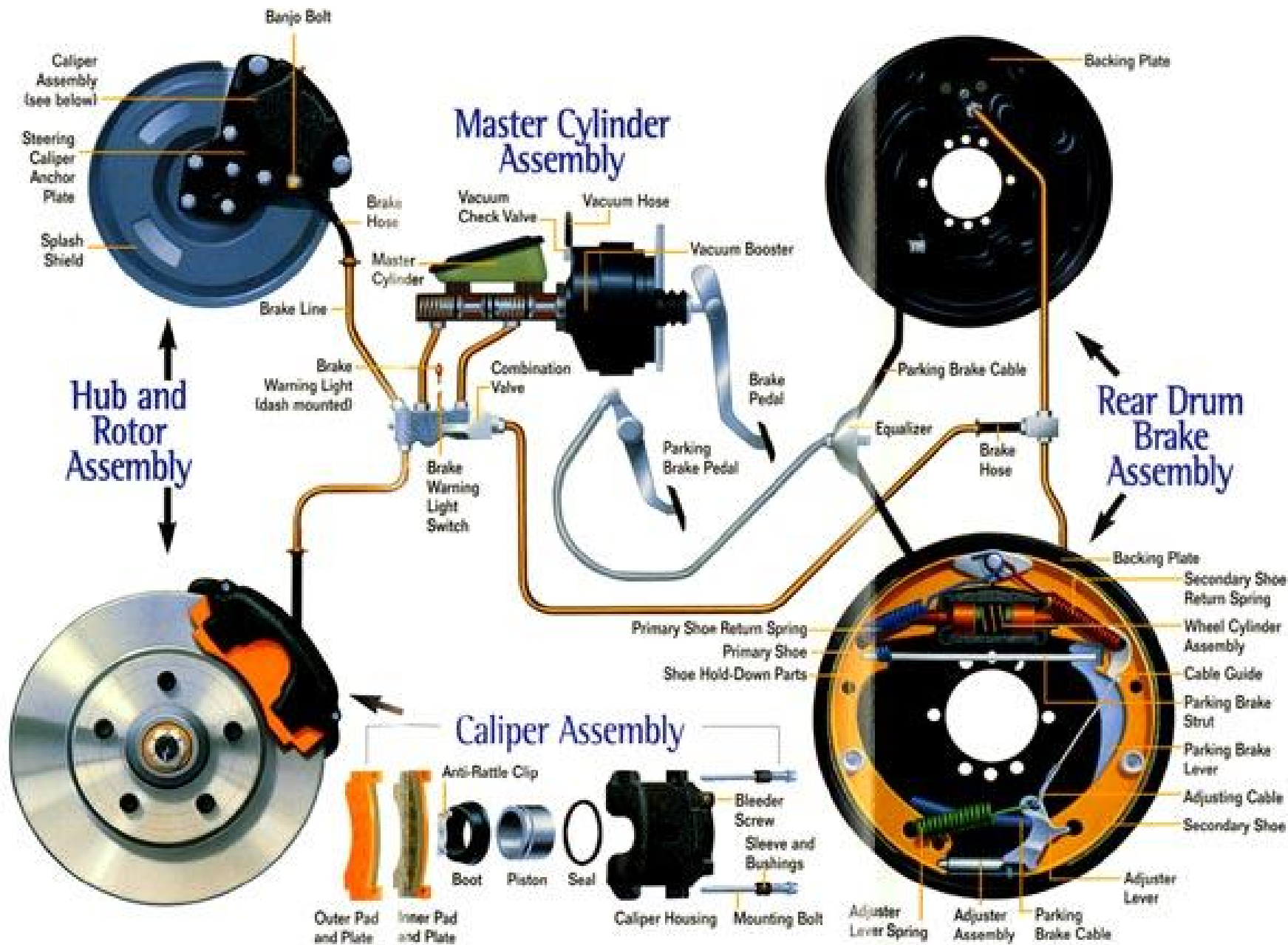
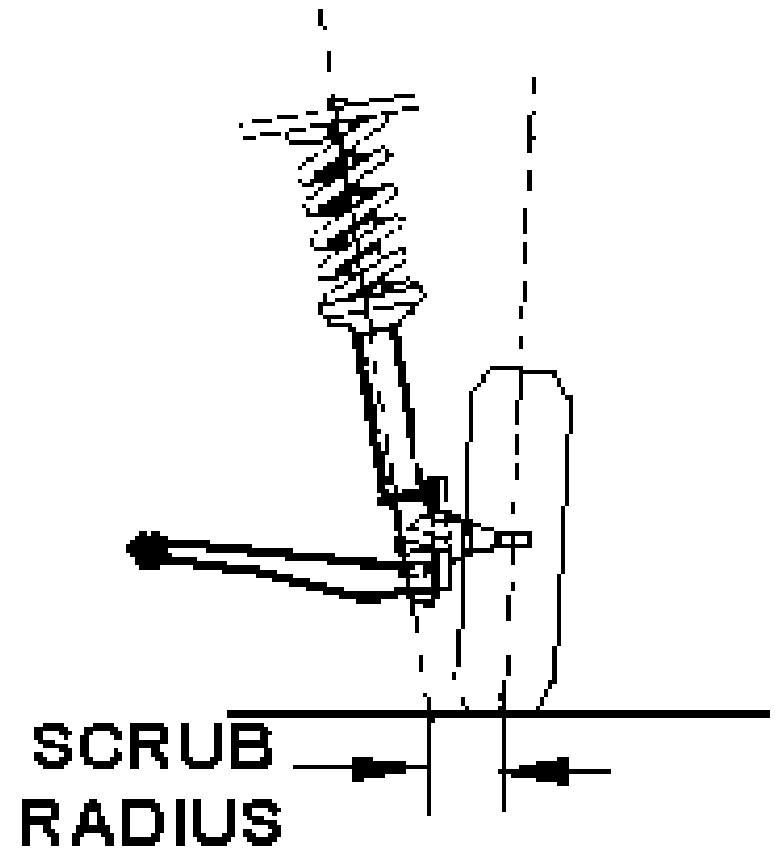
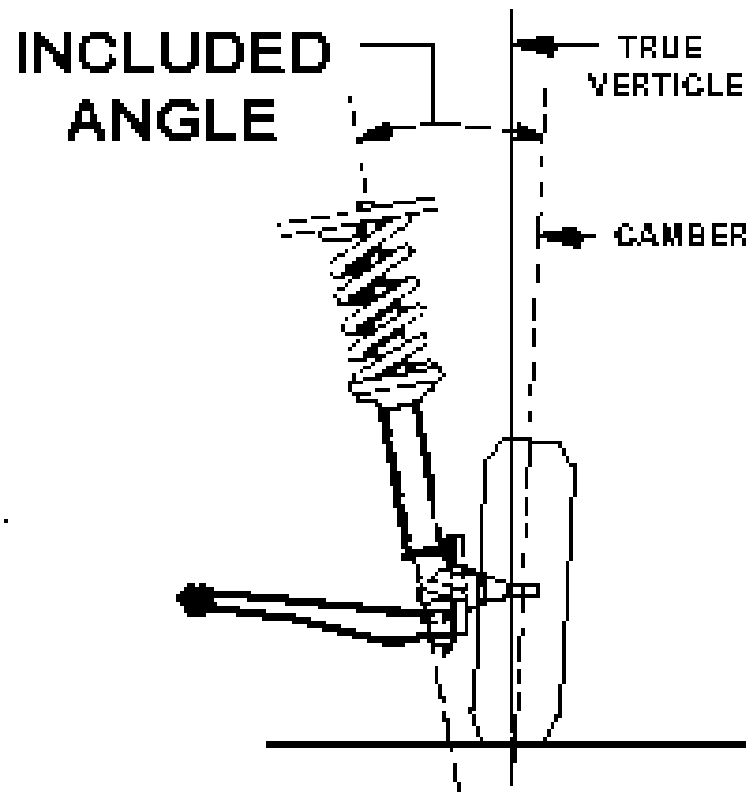


Fig. 1—Front Suspension

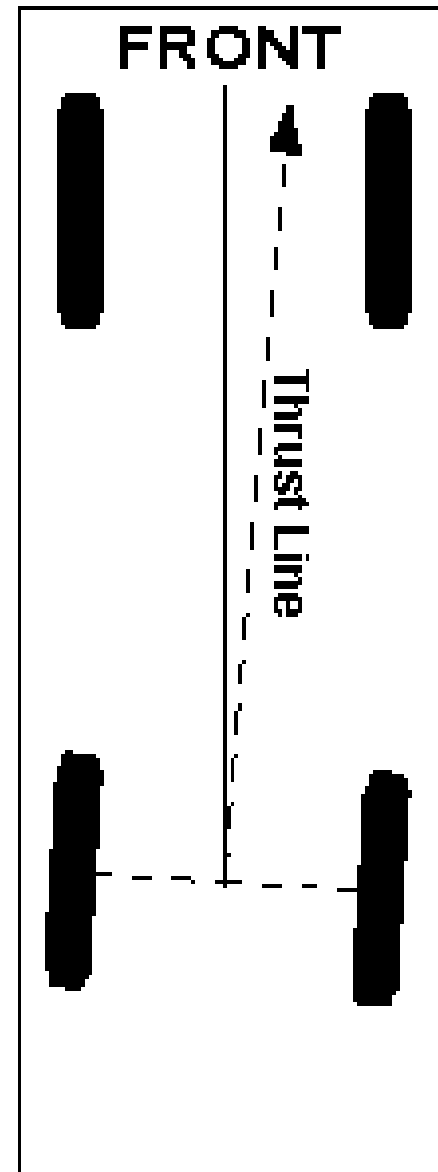
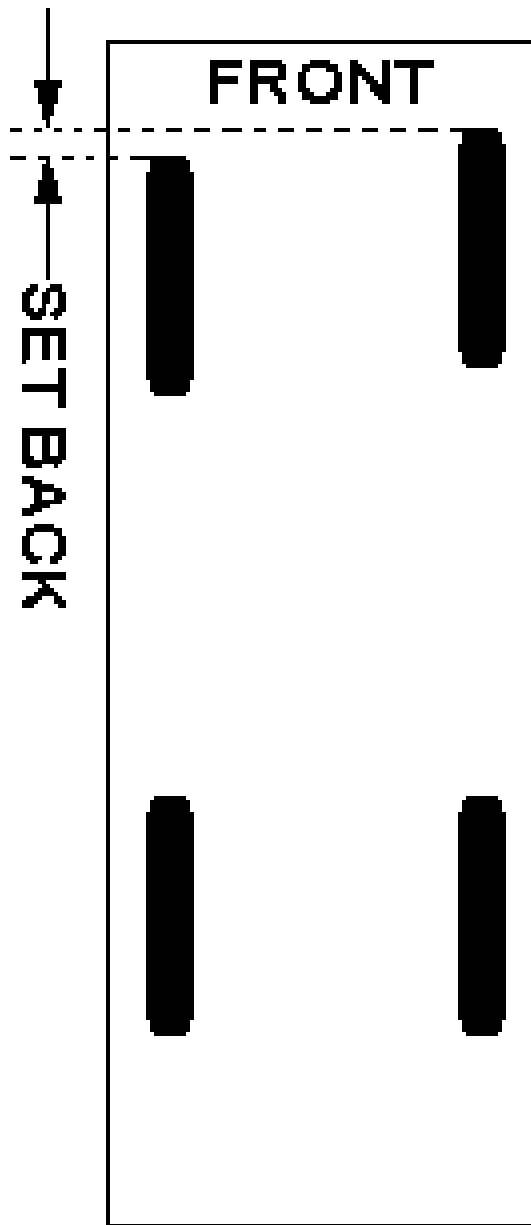
ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment



Under-inflation

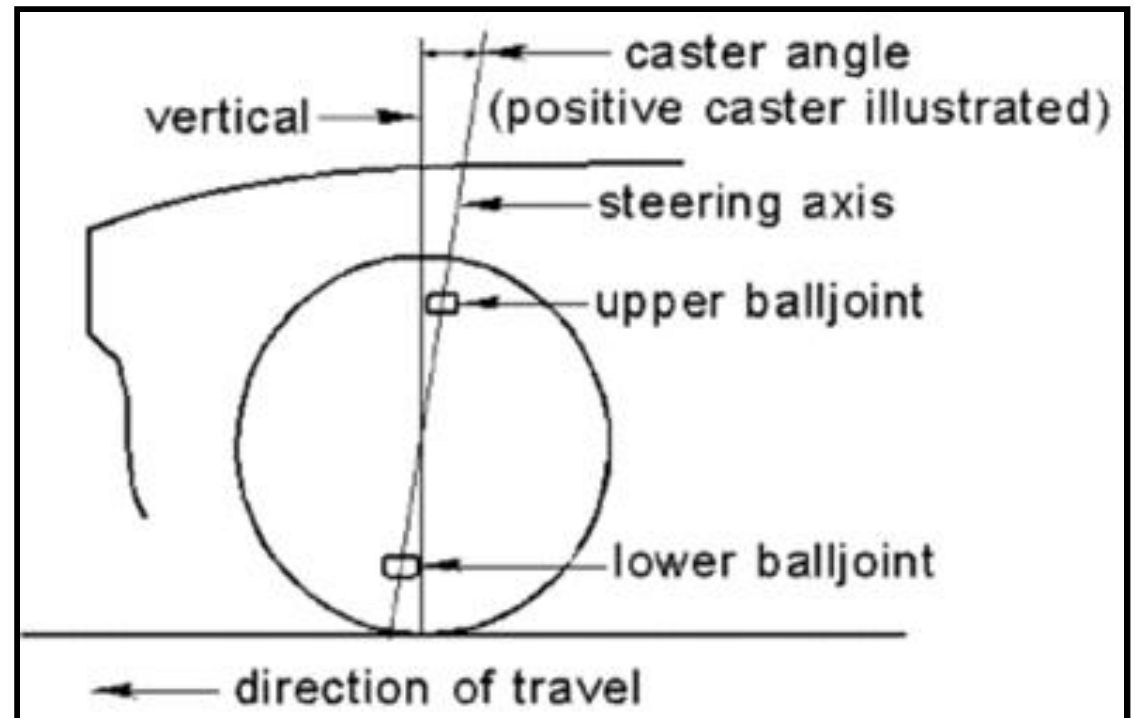
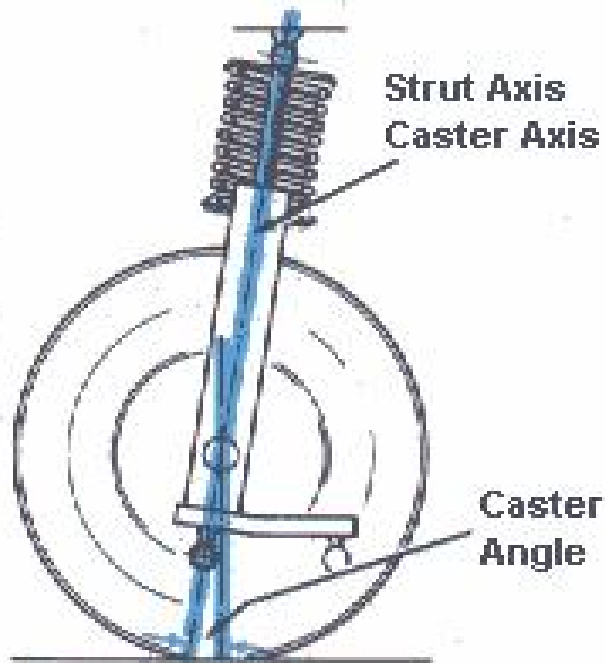


Correct

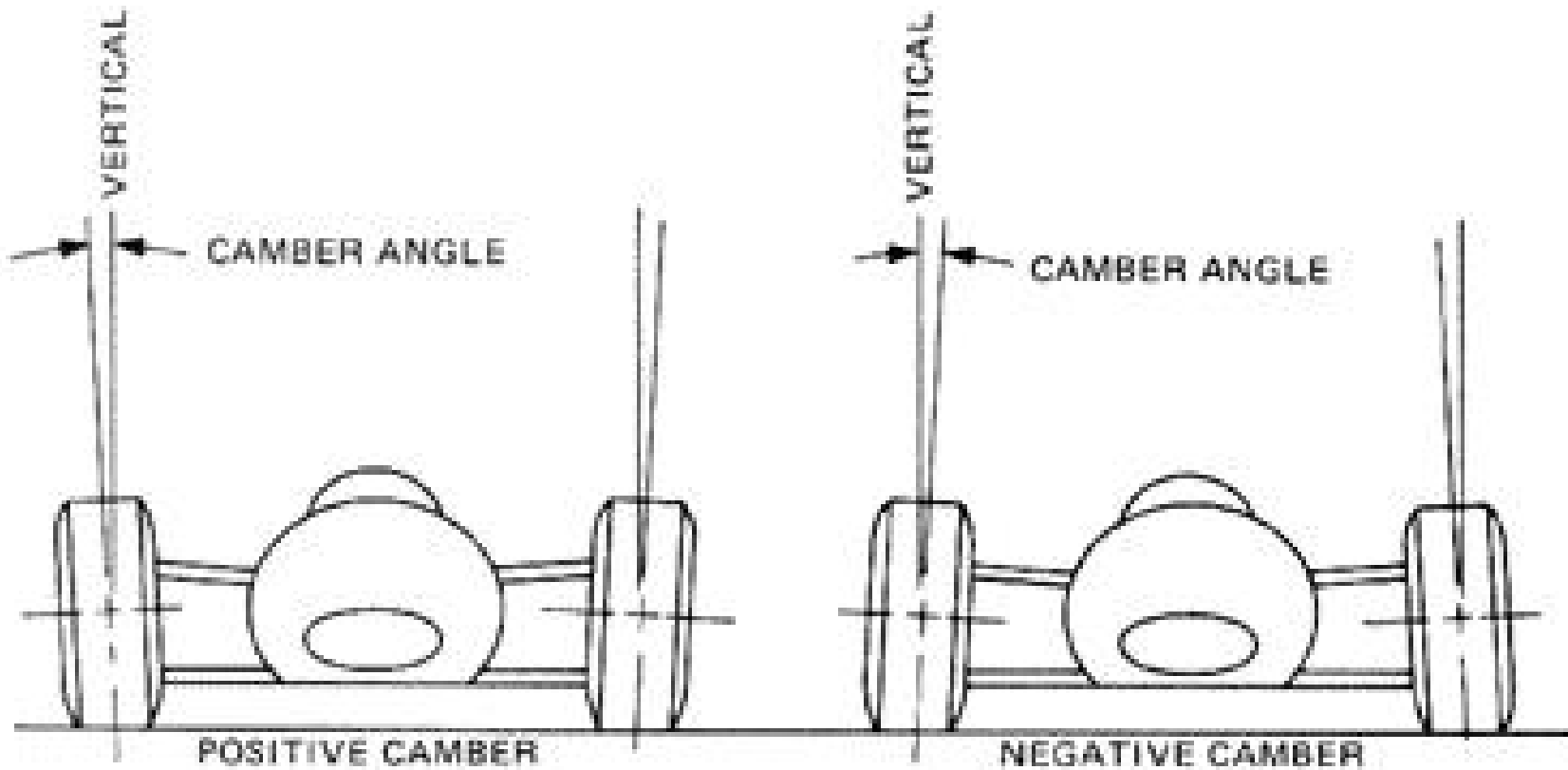


Over-inflation

ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment



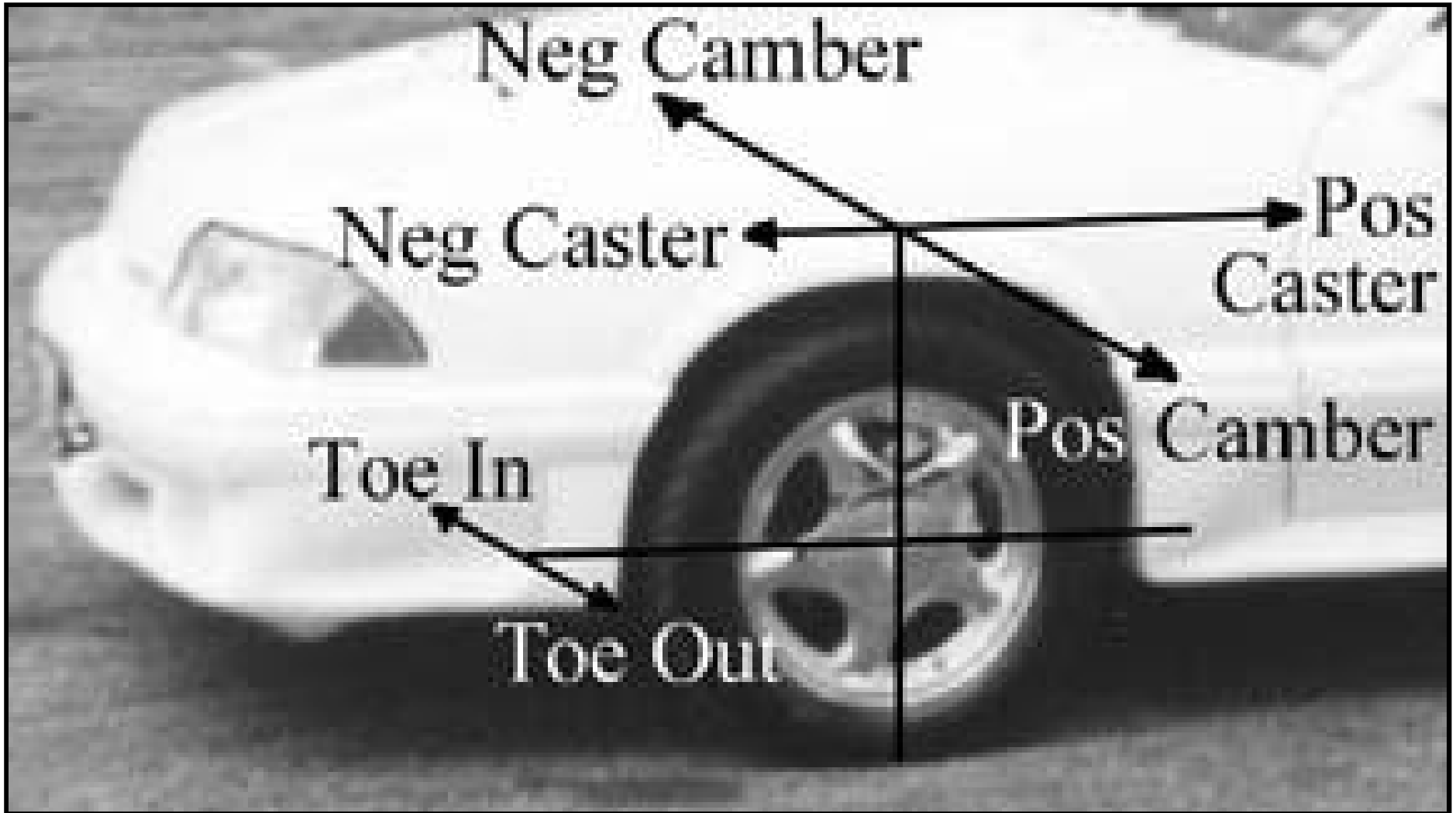
ATASA 5th Wheel Alignment



Magnetic Caster-Camber Gauges

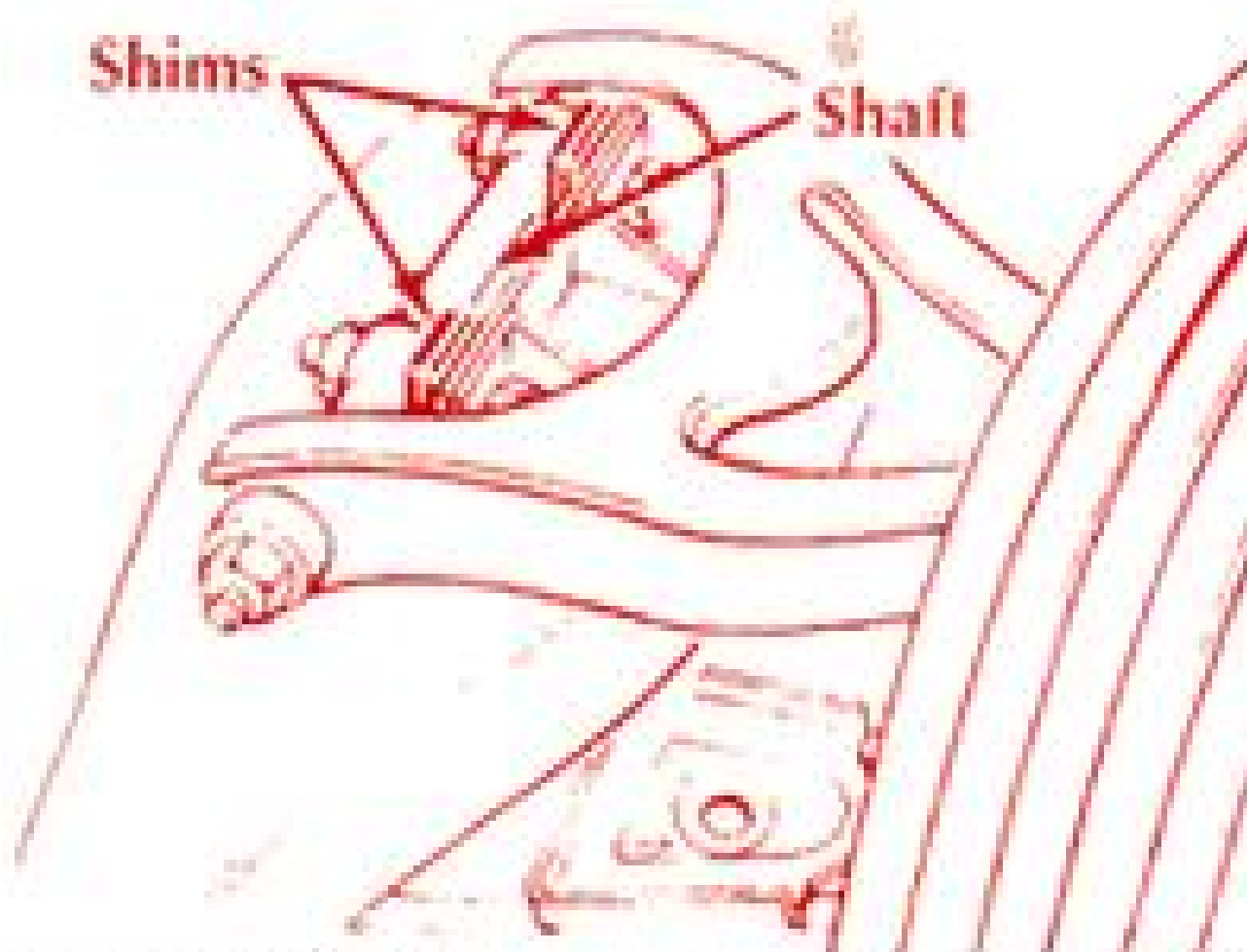


ATASA 5th Wheel Alignment



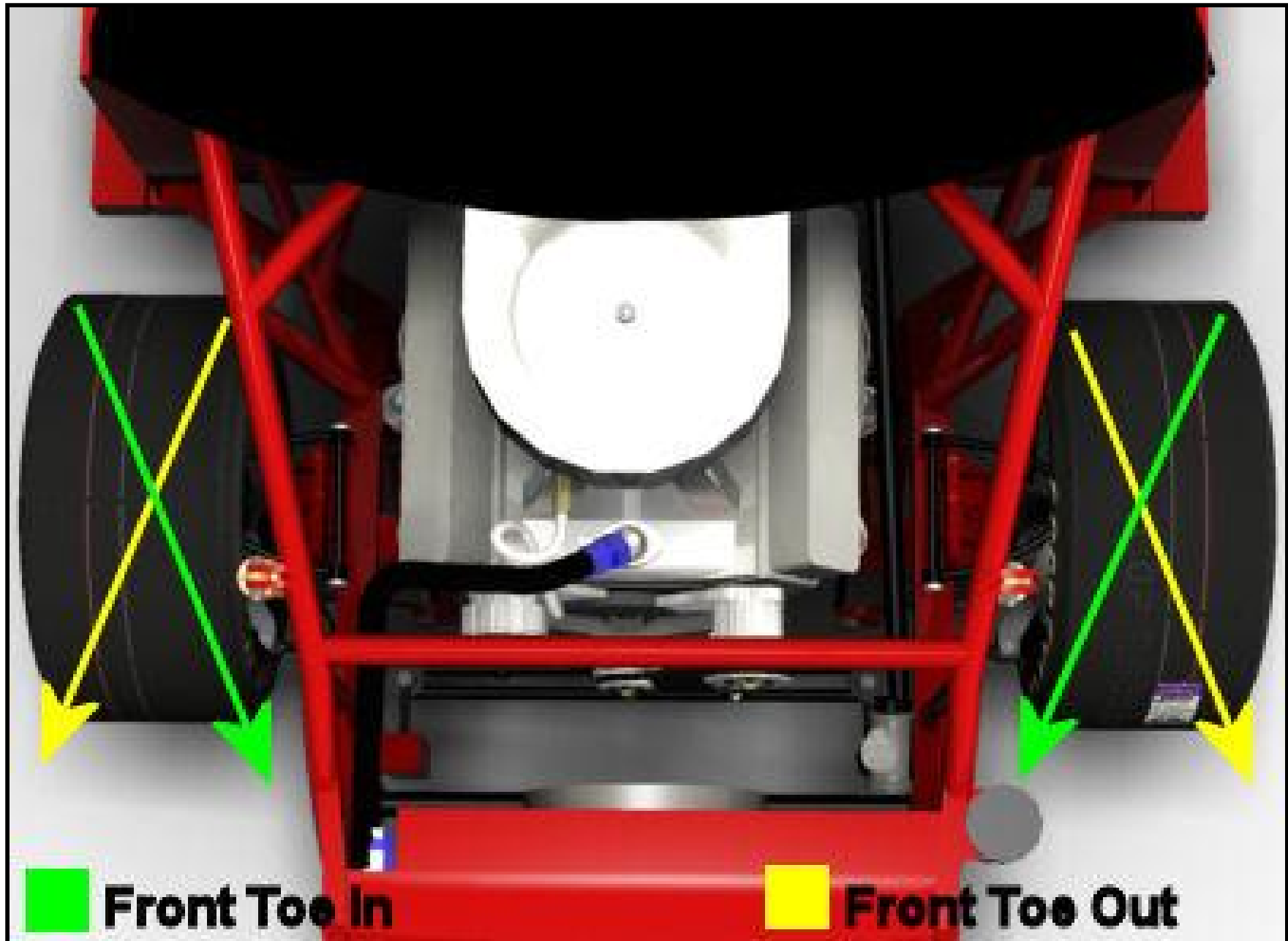
ATASA 5th Wheel Alignment

Caster & Camber Adjustment



Front SLA Shims

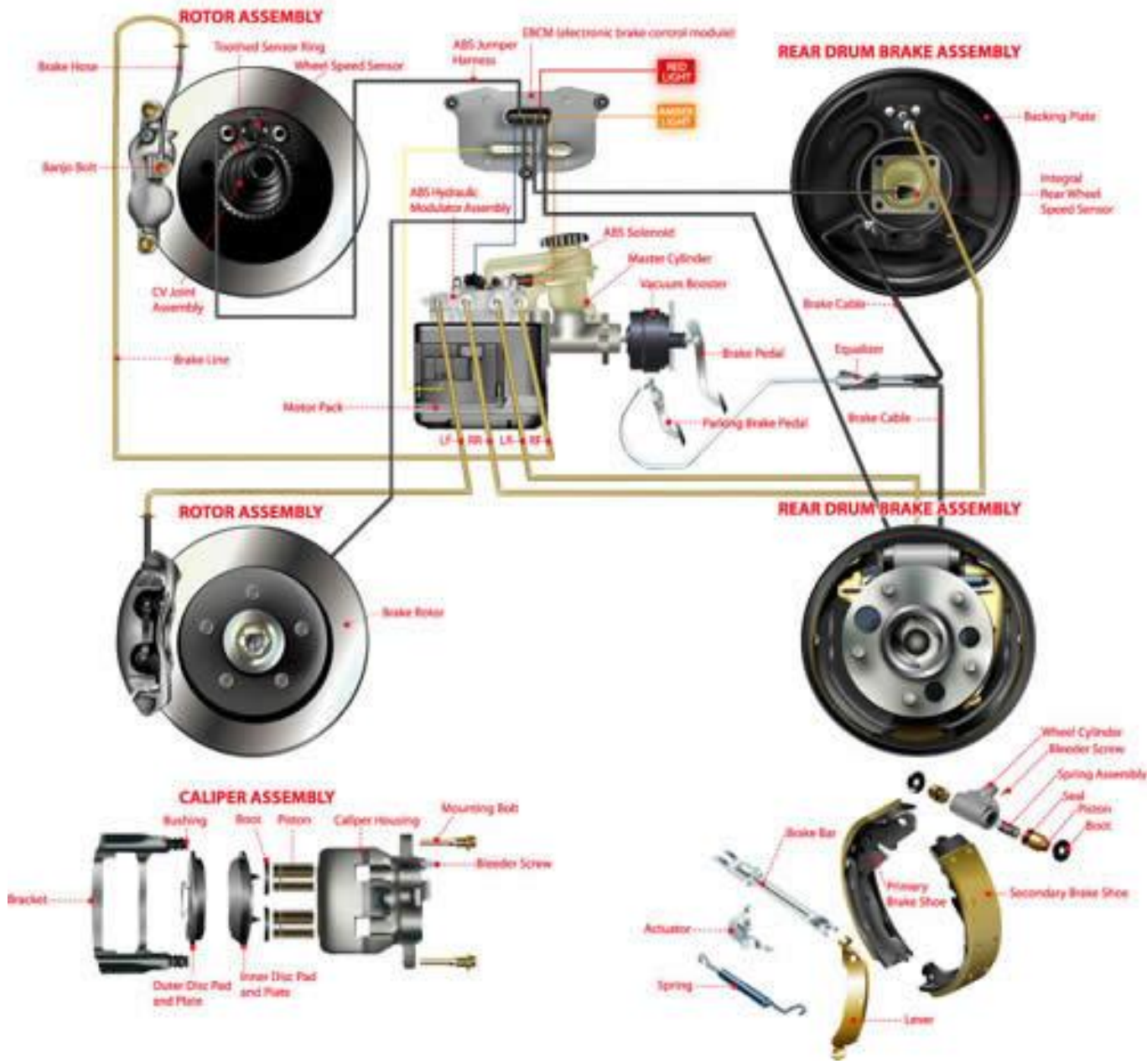
ATASA 5th Wheel Alignment



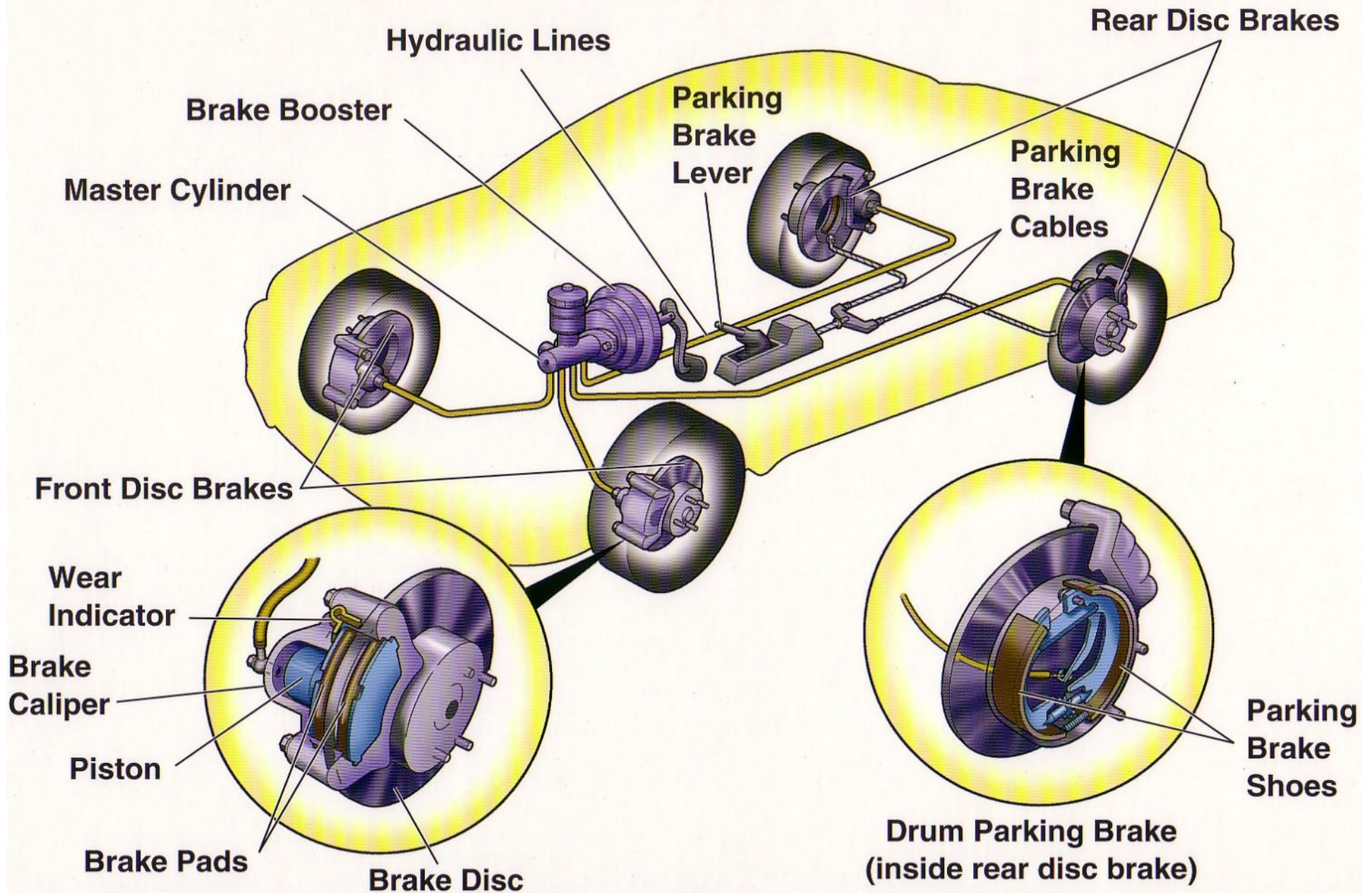
ATASA 5th Wheel Alignment



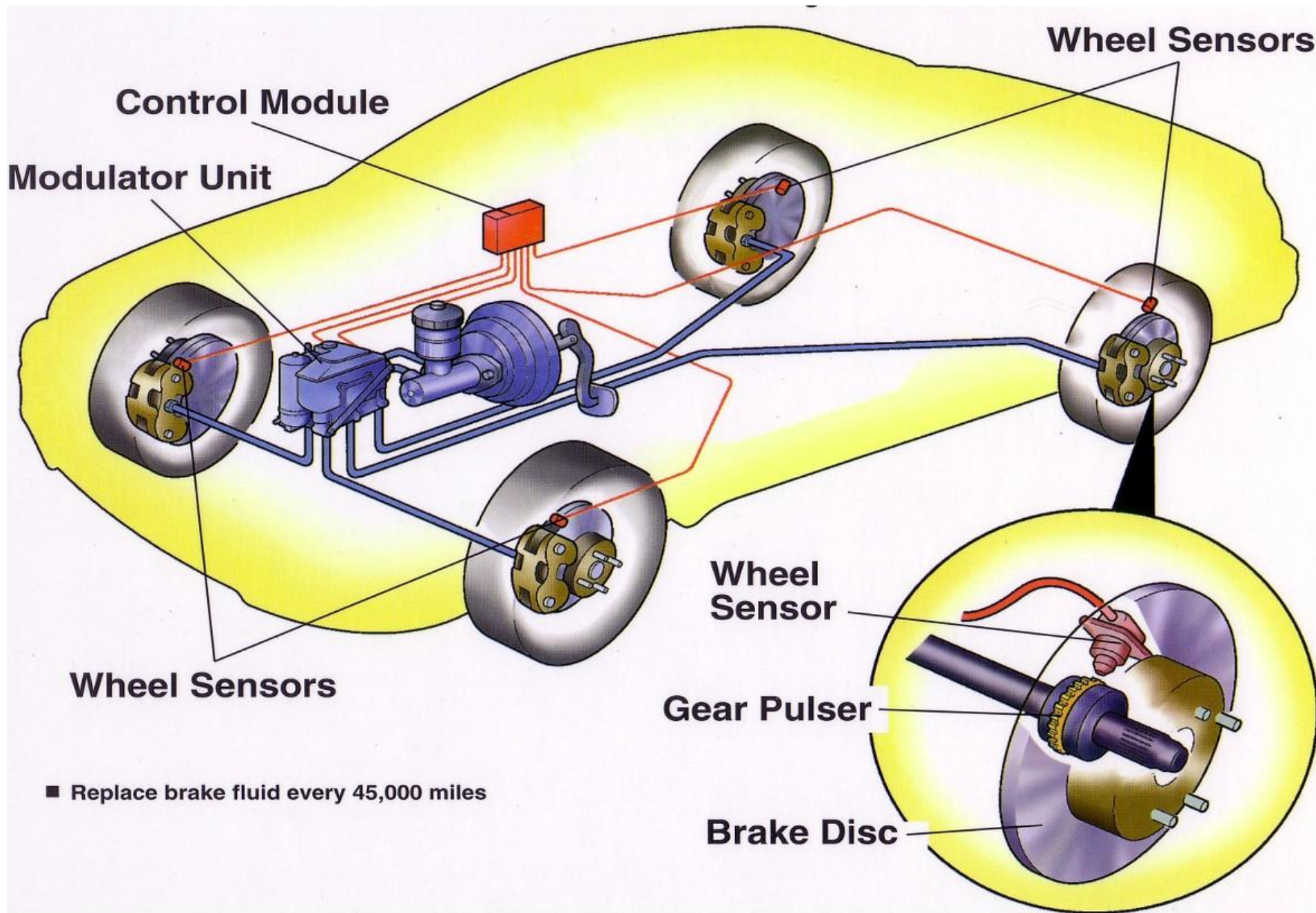
ATASA 5th Wheel Alignment



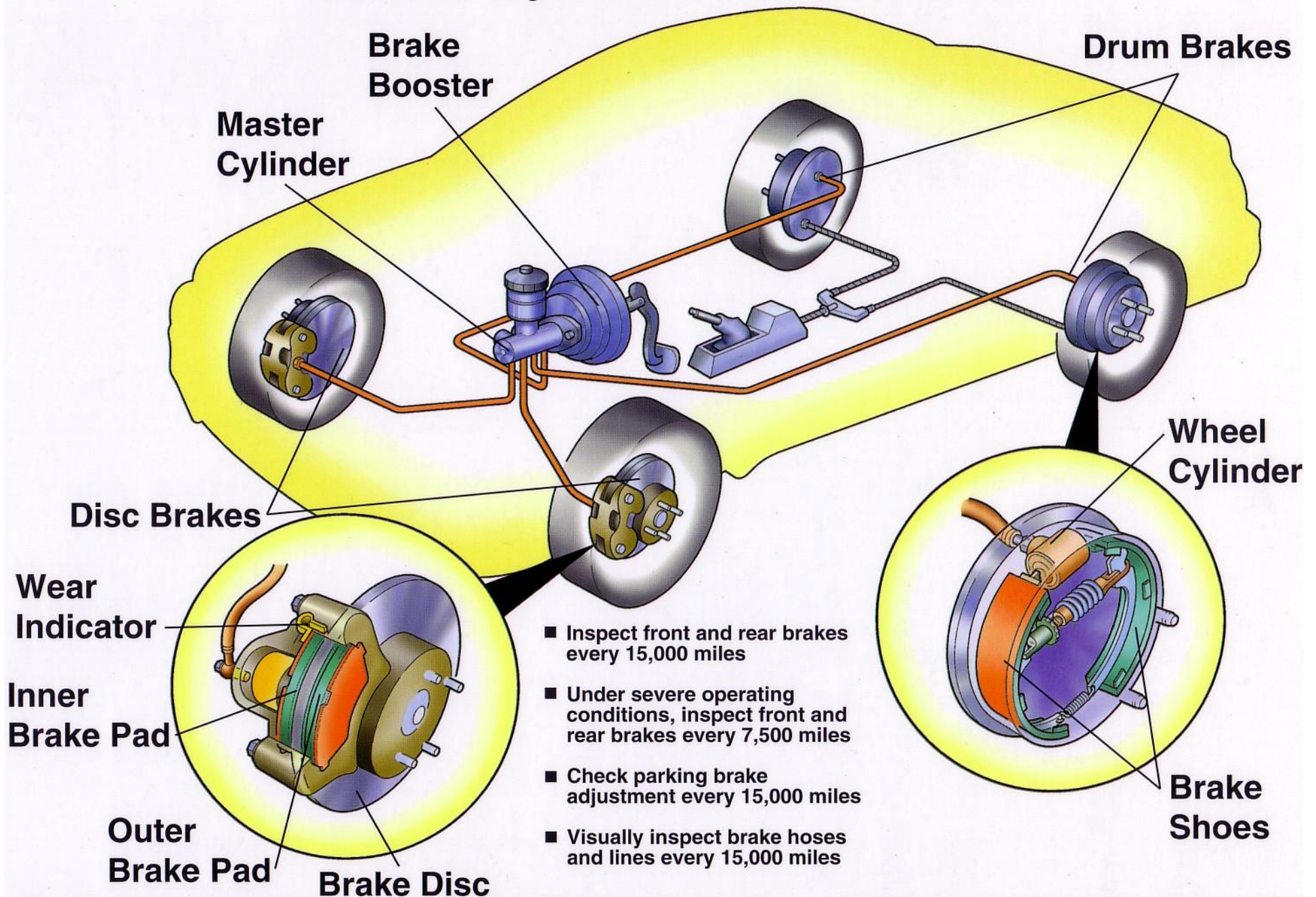
ATASA 5th Wheel Alignment



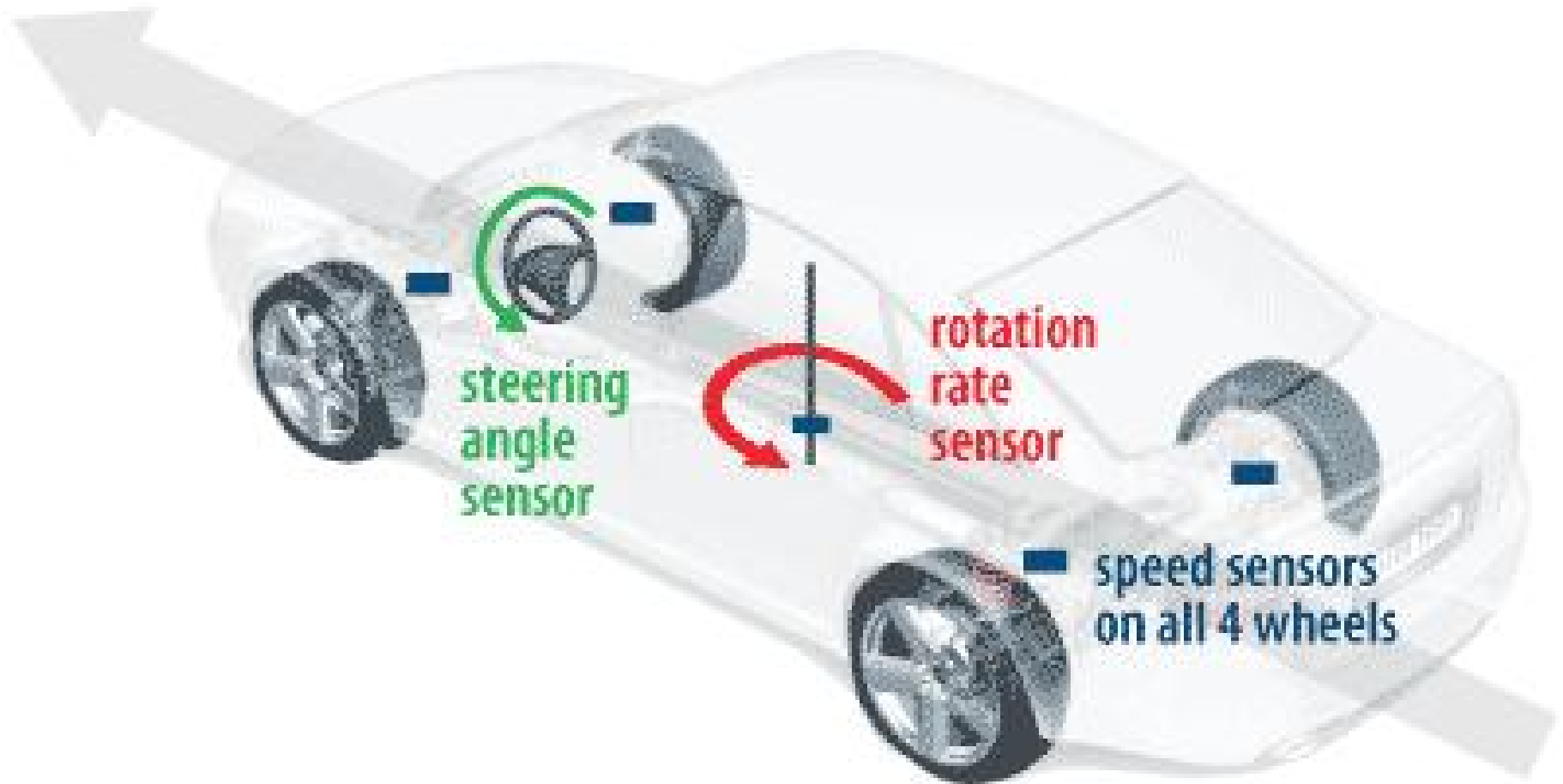
ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment

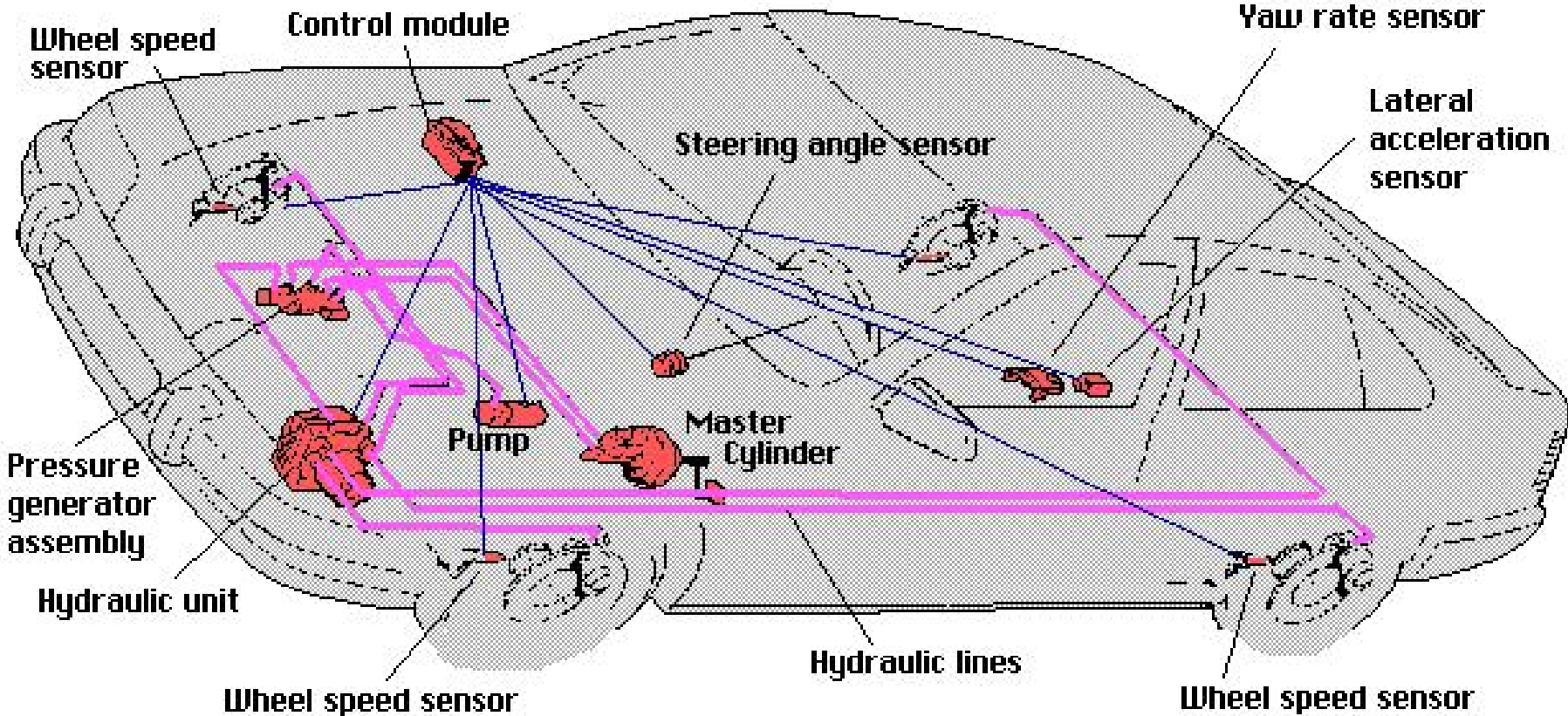


ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment

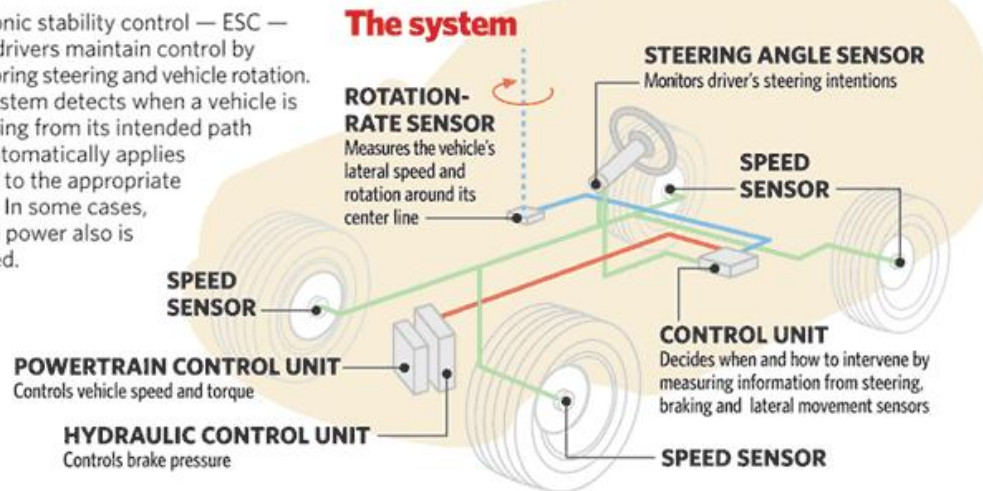
Bosch UDC / Mercedes ESP Stability Control



ATASA 5th Wheel Alignment

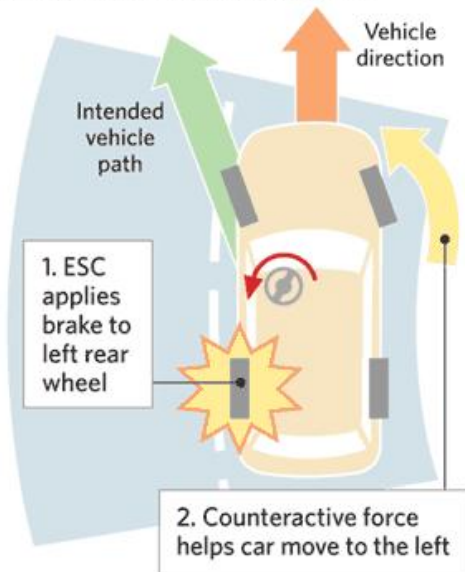
HOW ELECTRONIC STABILITY CONTROL WORKS

Electronic stability control — ESC — helps drivers maintain control by monitoring steering and vehicle rotation. The system detects when a vehicle is departing from its intended path and automatically applies brakes to the appropriate wheel. In some cases, engine power also is reduced.



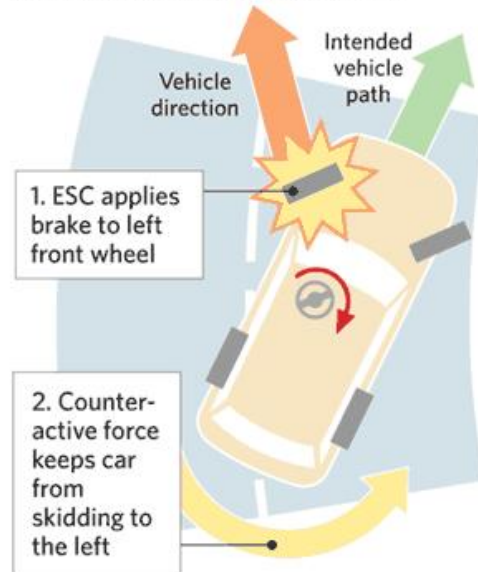
When a driver understeers

A driver tries to avoid an obstacle but doesn't steer sharply enough. ESC senses this and applies brakes to the left rear wheel. The counteractive force helps get the vehicle to its intended path.

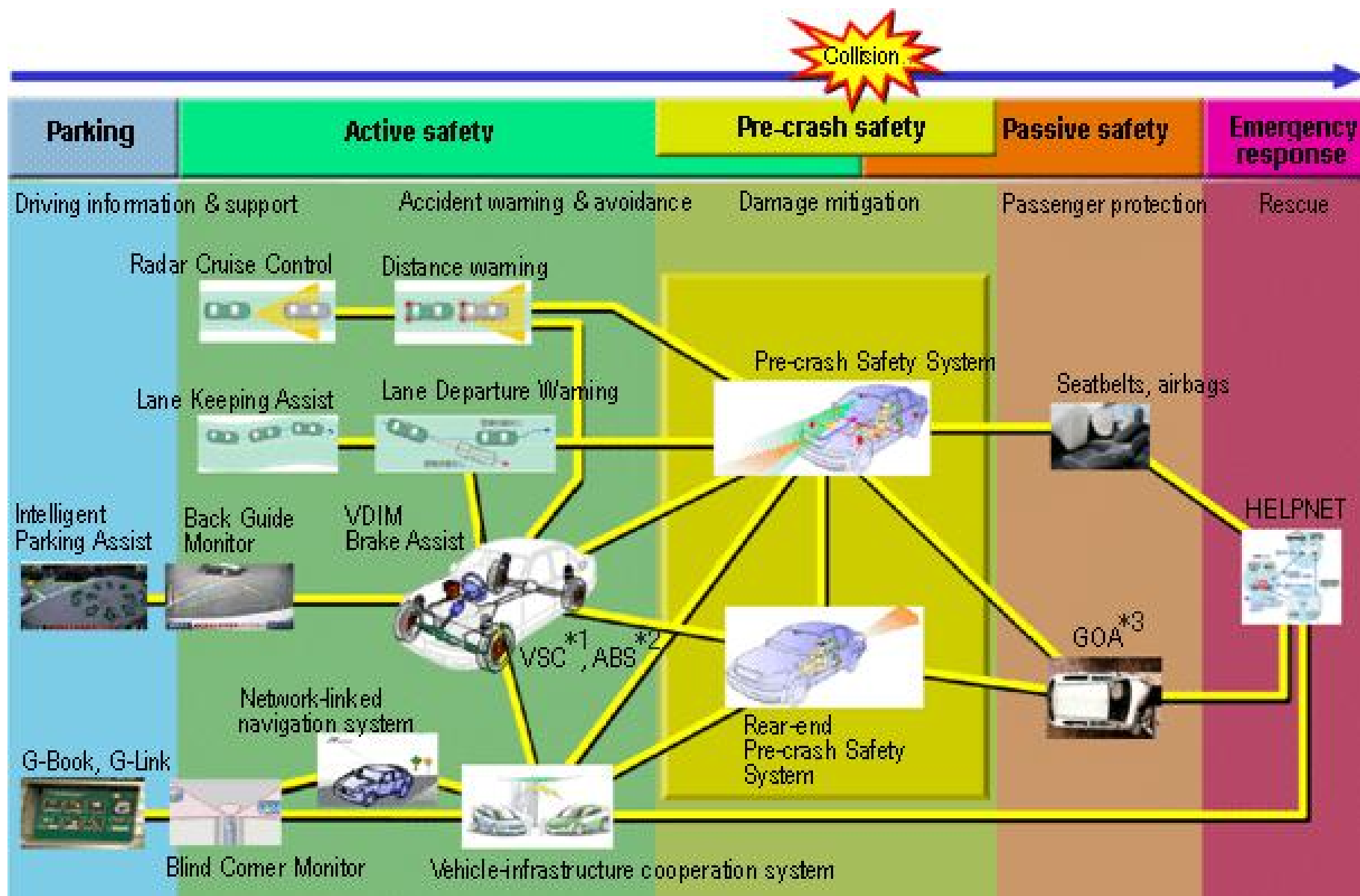


When a driver oversteers

The driver steers too sharply trying to get back to the lane. ESC applies brake to the left front wheel. The counteractive force keeps the vehicle from skidding to the left, and gets it back to its intended path.



ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment

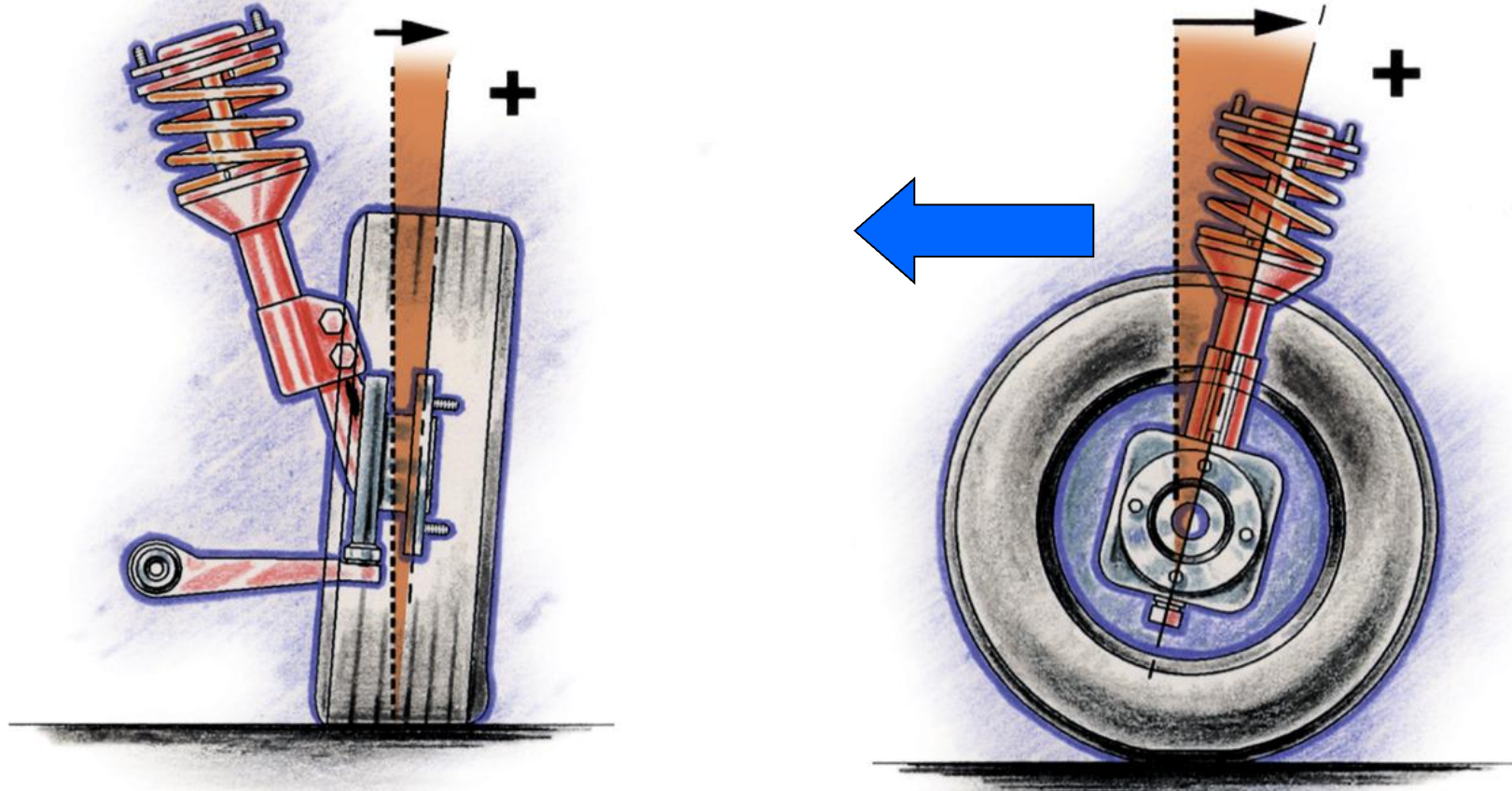


ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment

Camber Caster

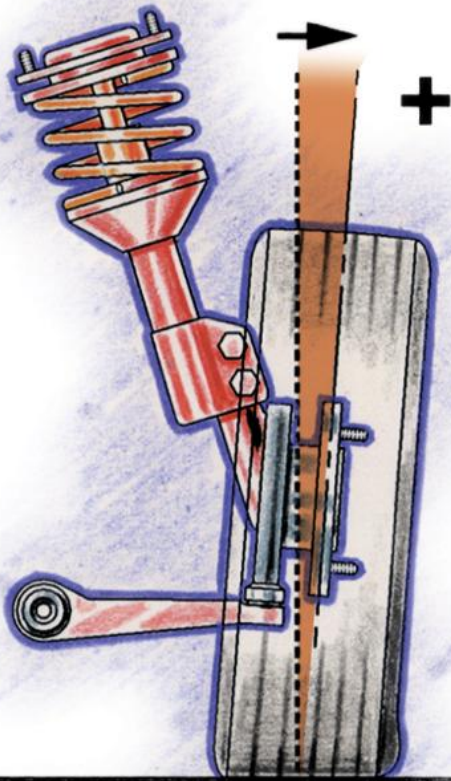


**Inward – Outward Tilt of the Tire
As Viewed from the Front of the Vehicle**

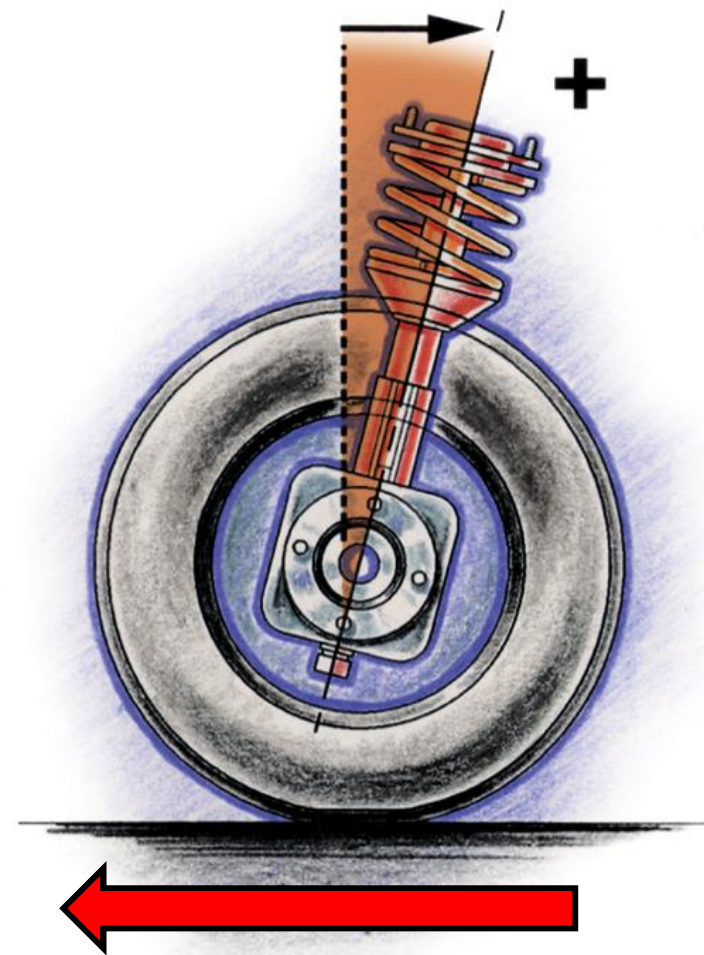
**Forward - Rearward Tilt of the Steering Axis
As Viewed from the Side of the Vehicle**

ATASA 5th Wheel Alignment

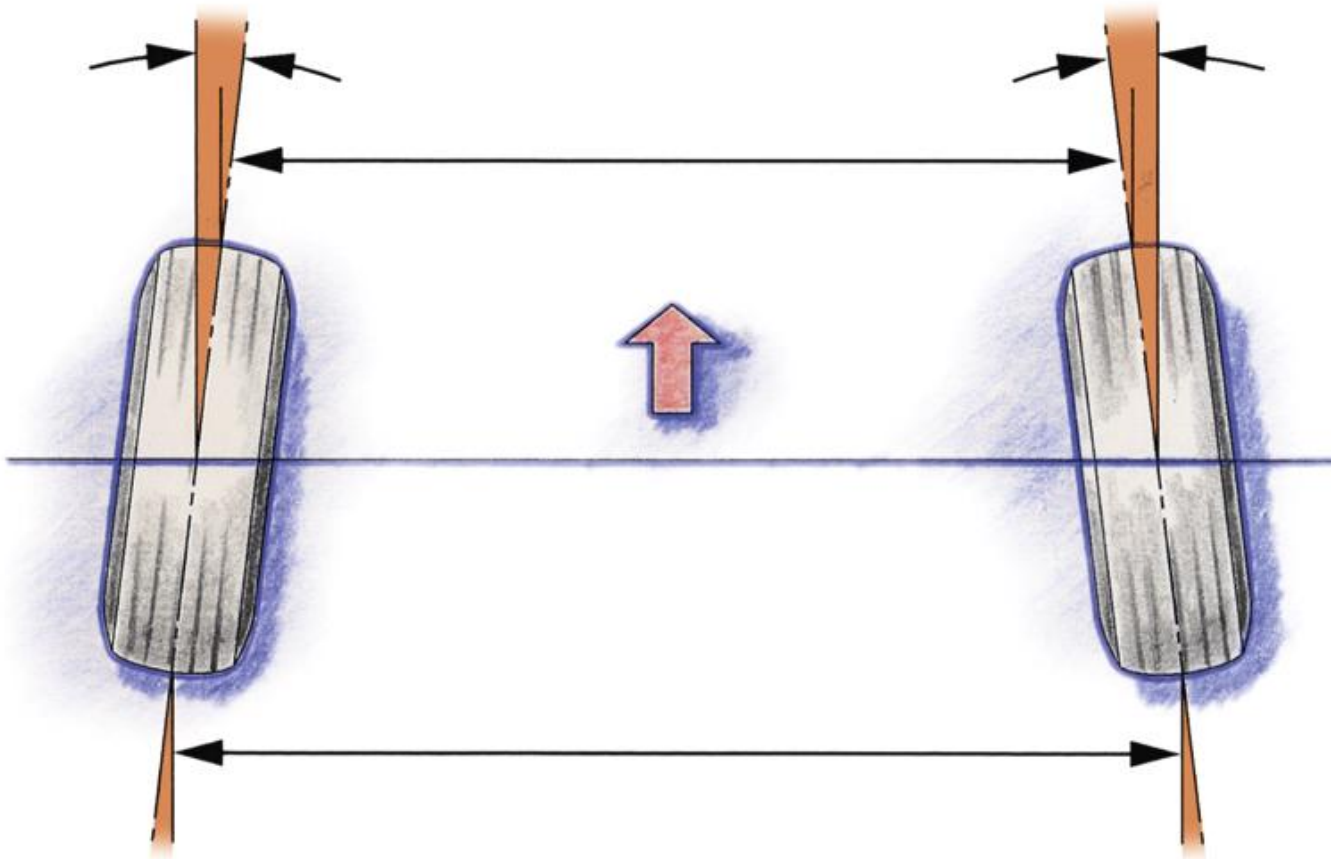
Camber



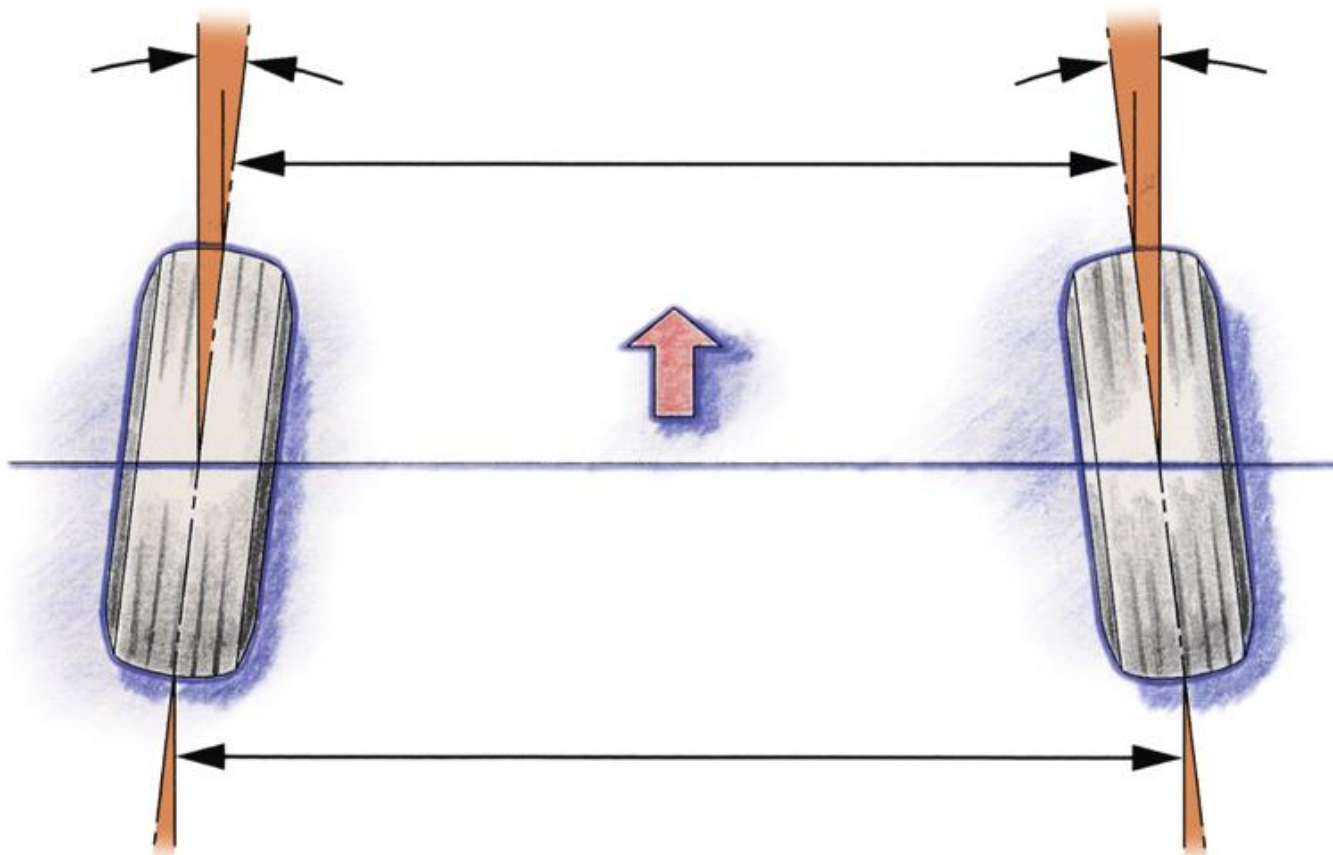
Caster



Toe Angle

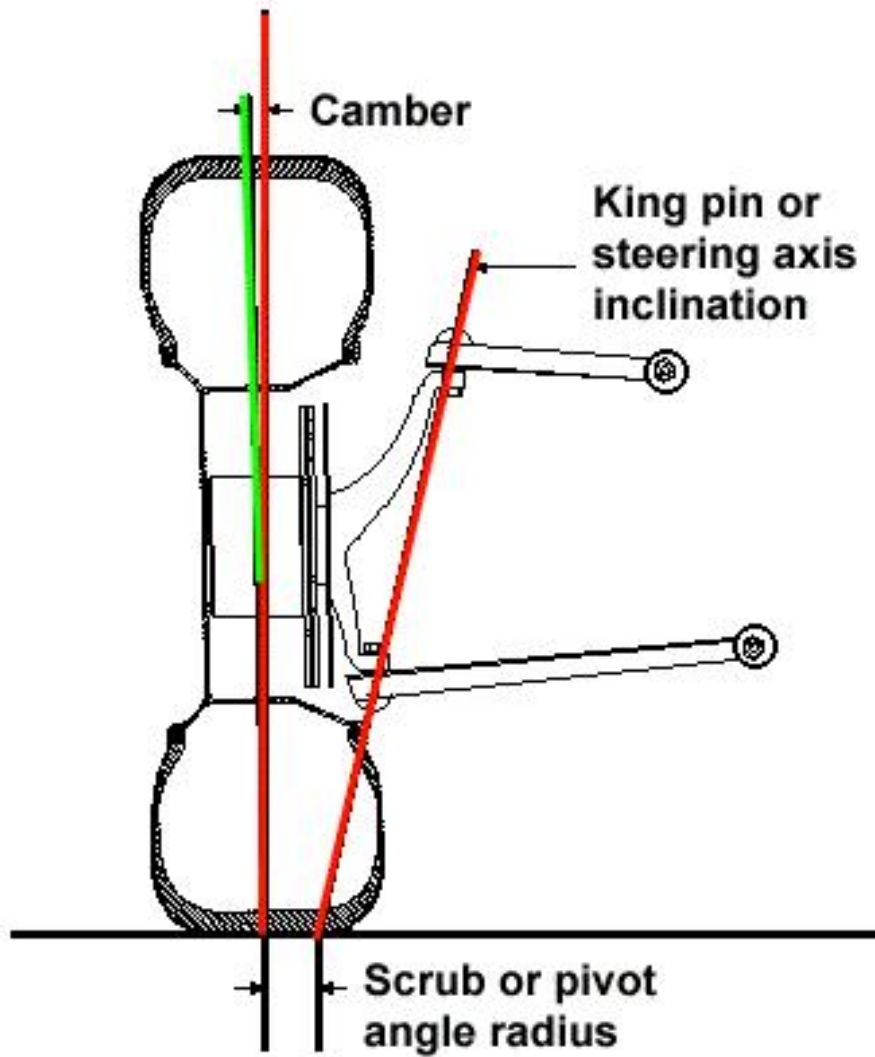


Toe Angle

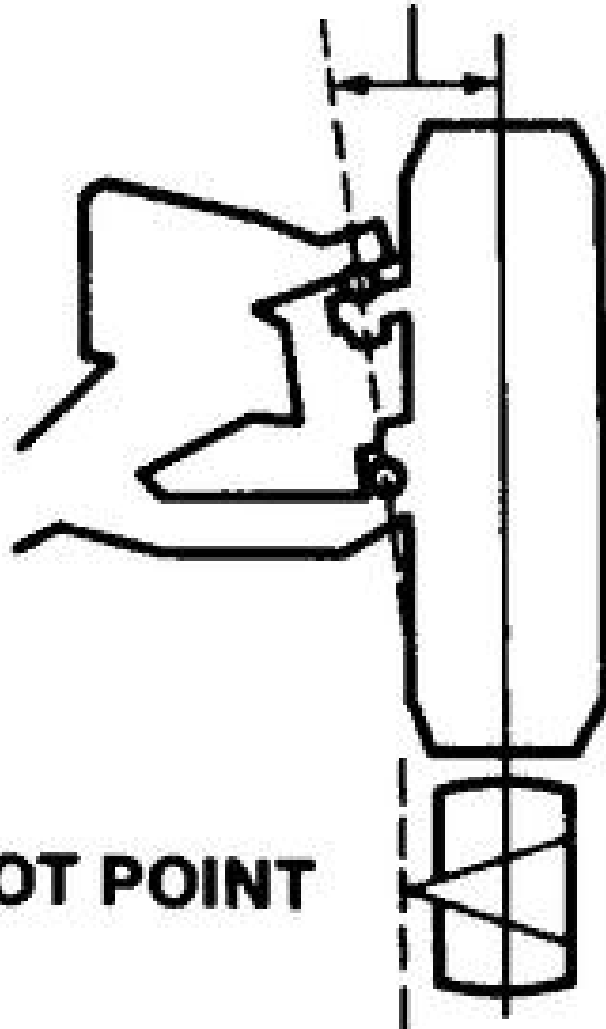


**Inward – Outward Pointing of the Tires
As viewed from the Top of the Vehicle**

ATASA 5th Wheel Alignment

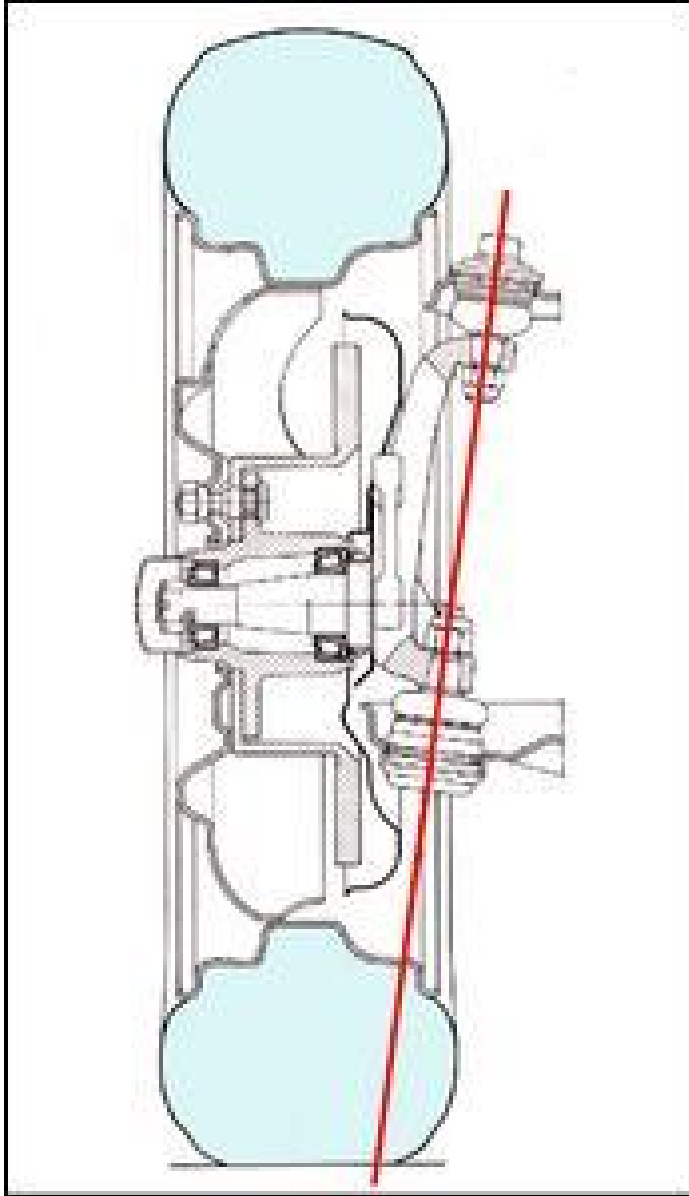


STEERING AXIS INCLINATION



PIVOT POINT

ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment

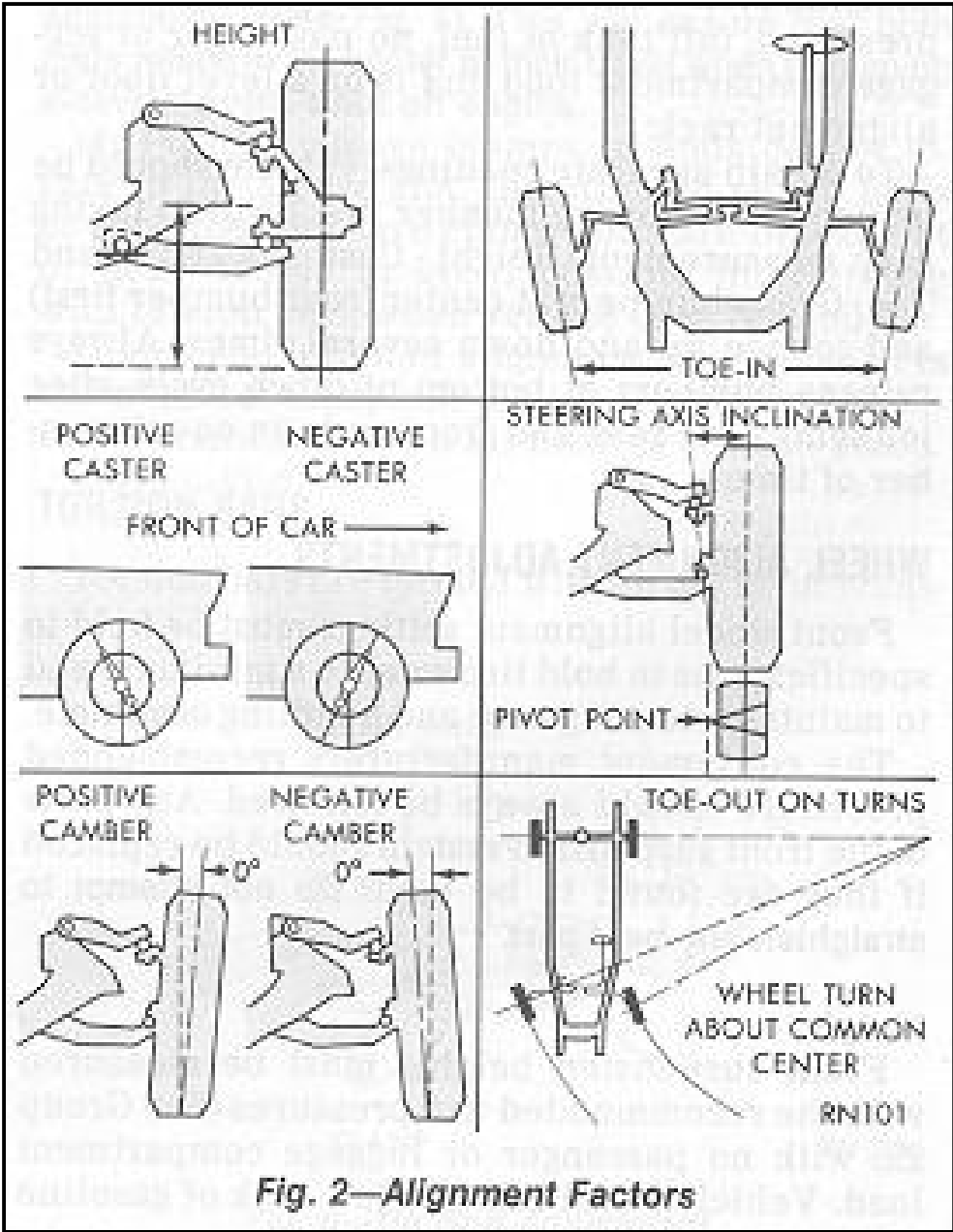
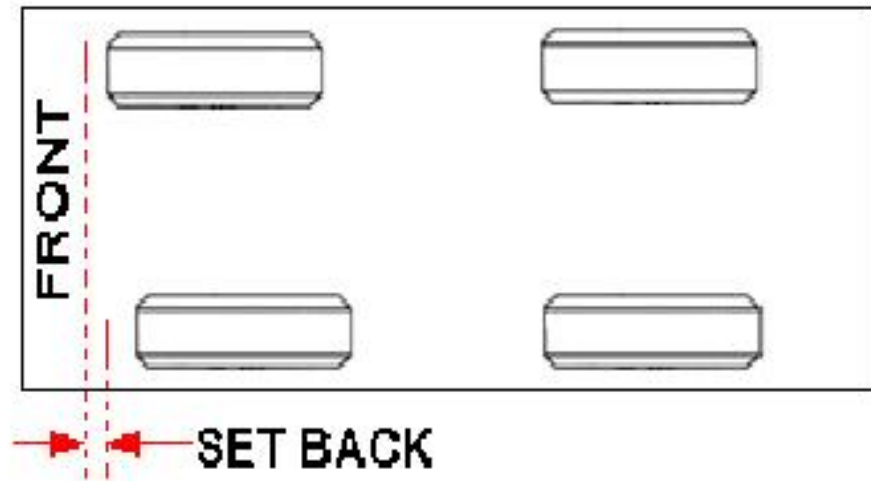
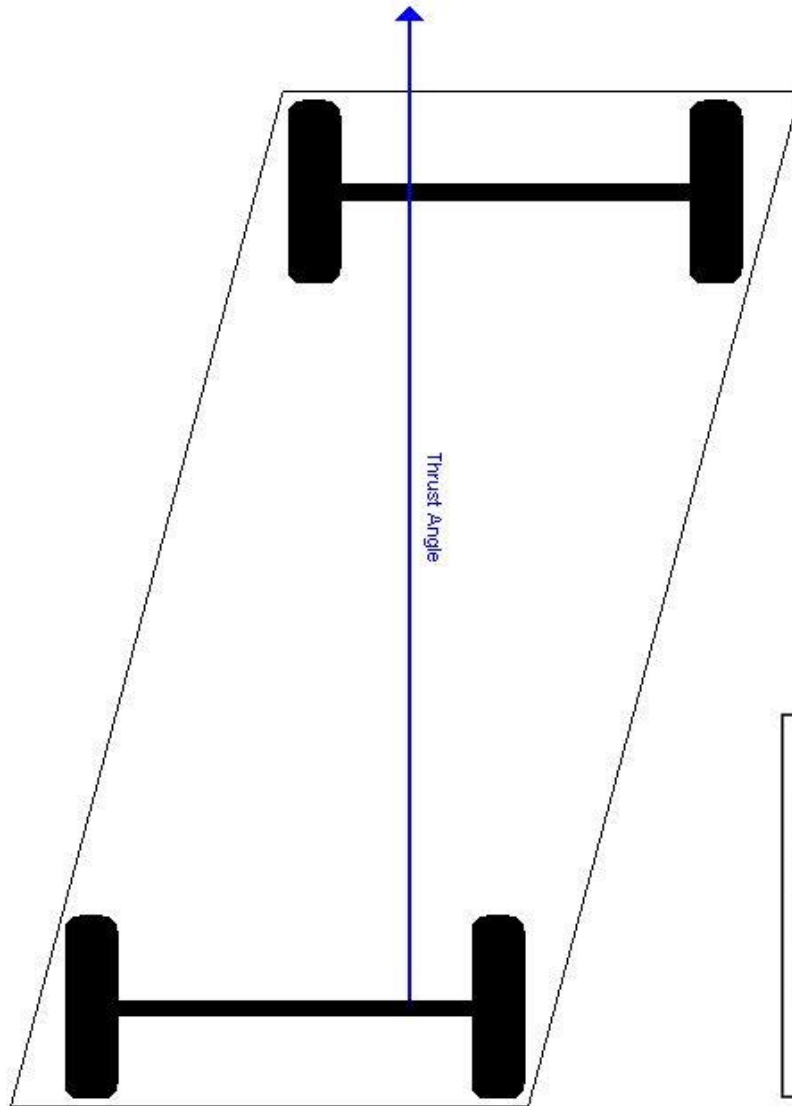
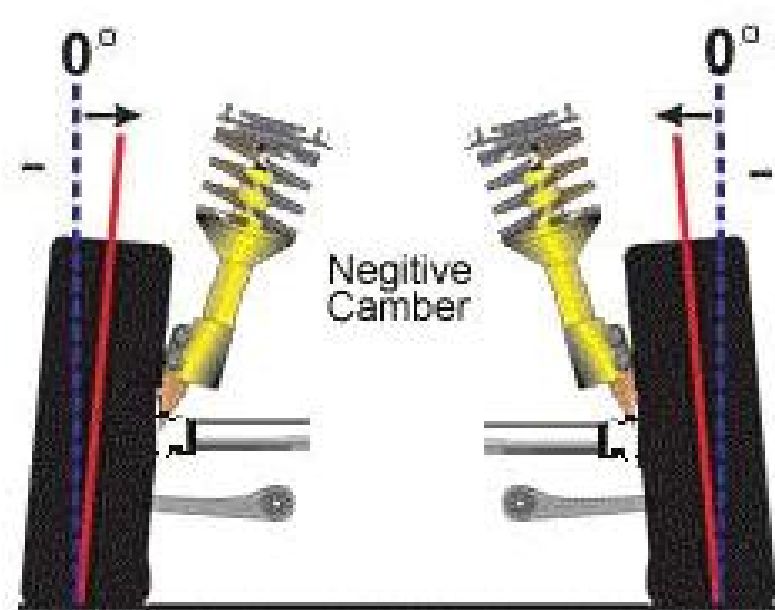
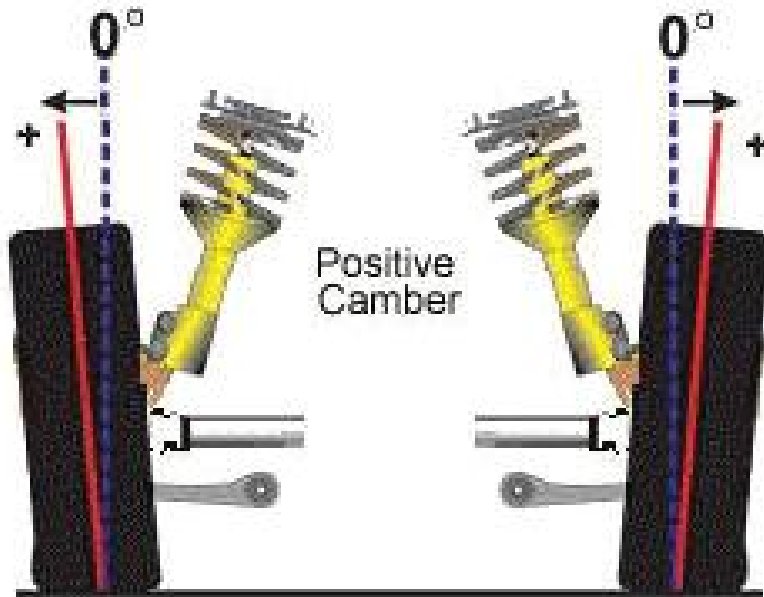
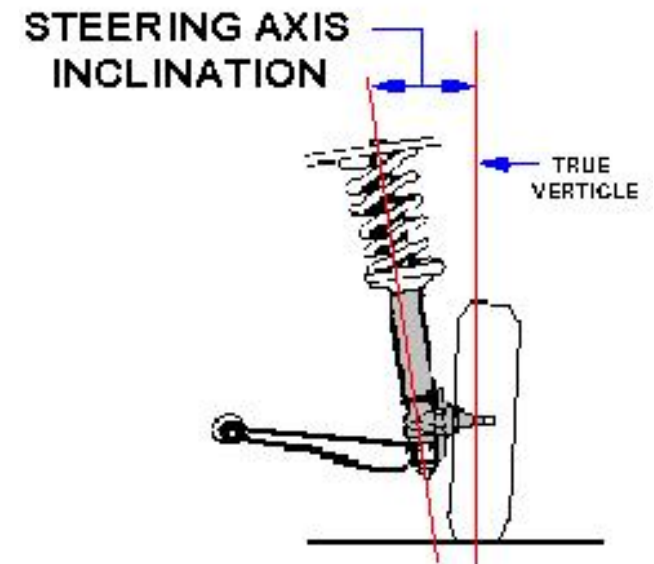
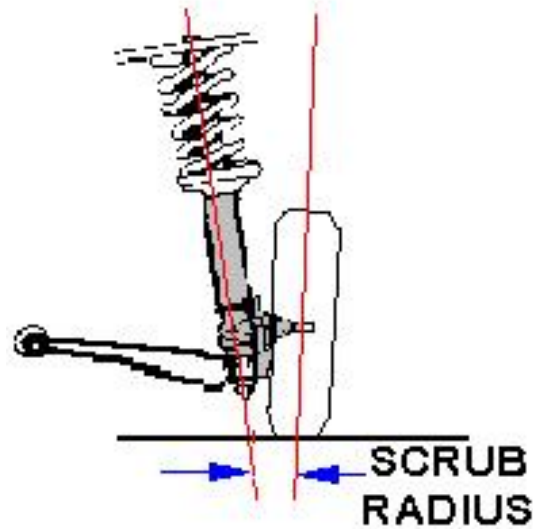
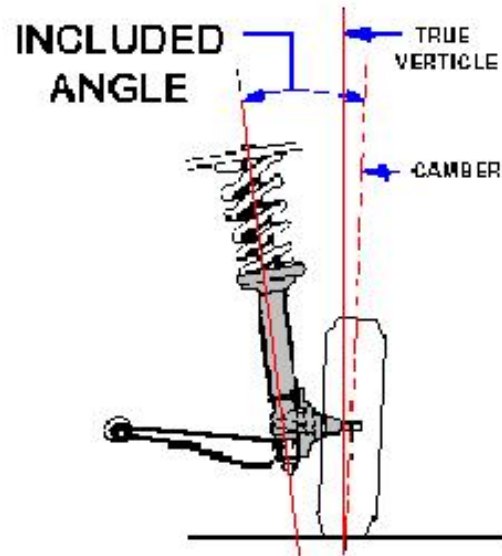


Fig. 2—Alignment Factors

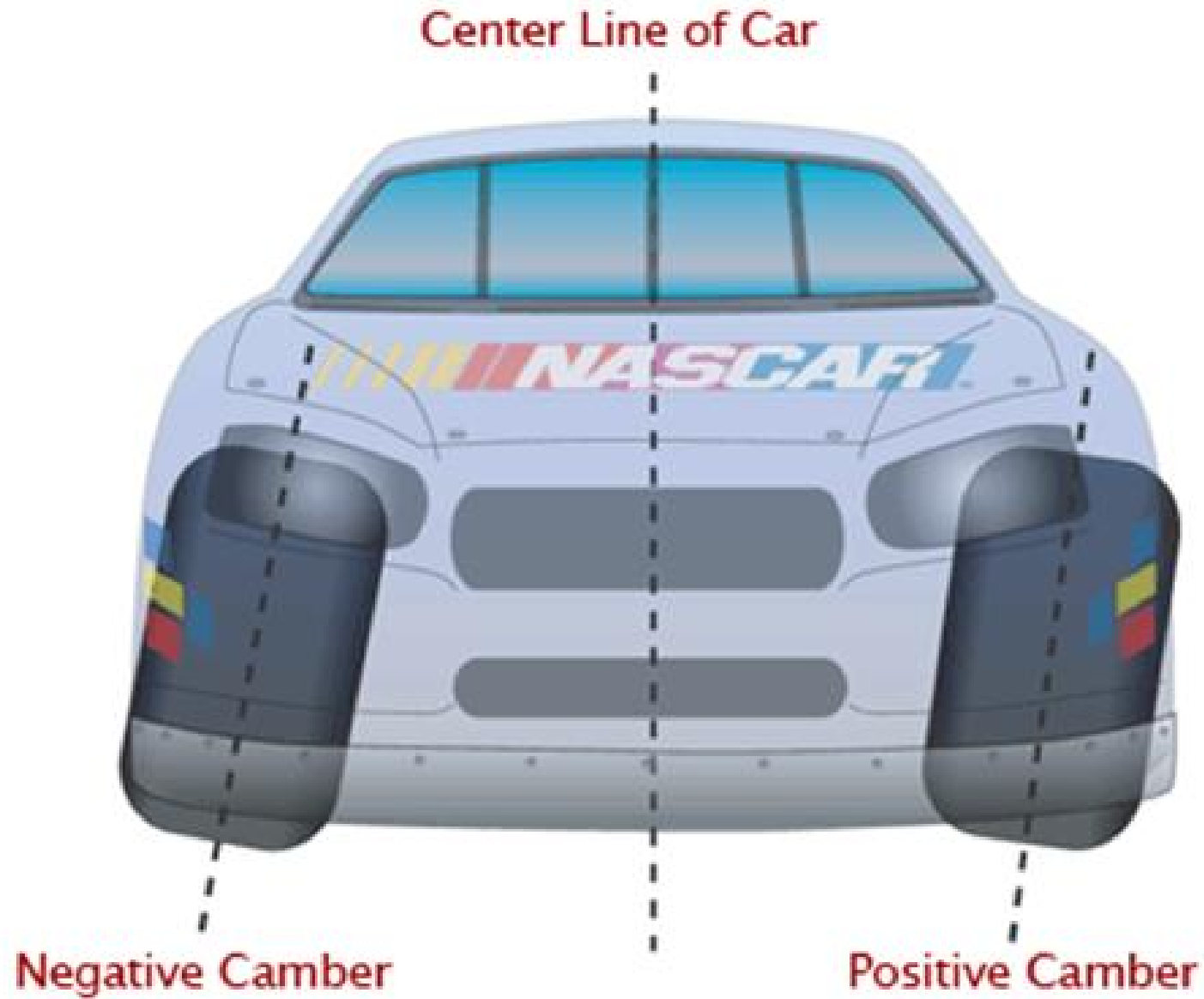
ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment



ATASA 5th Wheel Alignment



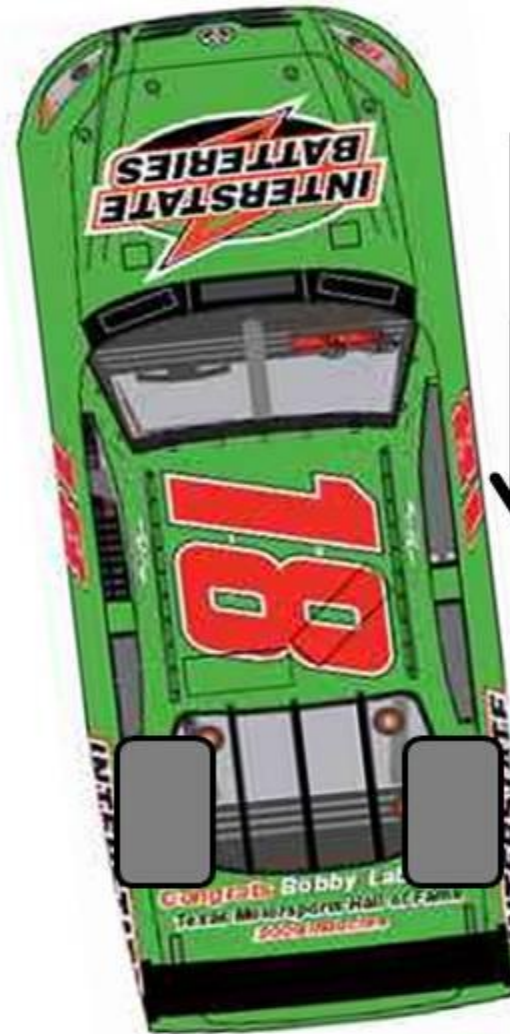
ATASA 5th Wheel Alignment



Air Stays Smooth



Zero Toe



Air Hits Body And Creates Side Force



Axle Creates Rear Steer Like Monster Truck

1/2" Toe In, 1/2" Toe Out