

SUSPENSION

Wheel Alignment - Canyon, Colorado

SPECIFICATIONS

WHEEL ALIGNMENT SPECIFICATIONS

Alignment Condition: Full tank of fuel, no passengers and placed on flat level surface.

Front Suspension Wheel Alignment Service at Curb										
Model	RPO Restriction	Caster $\hat{A} \pm 1.0 \hat{A}^\circ$		Cross Caster $\hat{A} \pm 1.0 \hat{A}^\circ$	Camber $\hat{A} \pm 0.8 \hat{A}^\circ$		Cross Camber $\hat{A} \pm 0.8 \hat{A}^\circ$	Total Toe $\hat{A} \pm 0.2 \hat{A}^\circ$	Steering Wheel Angle $\hat{A} \pm 3.0 \hat{A}^\circ$	Thrust Angle $\hat{A} \pm 0.4 \hat{A}^\circ$
		Left	Right	(Left - Right)	Left	Right	(Left - Right)	(Left + Right)		(Left - Right)/2
All	All	$2.8 \hat{A}^\circ$	$2.8 \hat{A}^\circ$	$0.00 \hat{A}^\circ$	$-0.10 \hat{A}^\circ$	$-0.10 \hat{A}^\circ$	$0.0 \hat{A}^\circ$	$0.10 \hat{A}^\circ$	$-1.0 \hat{A}^\circ$	$0.0 \hat{A}^\circ$

FASTENER SPECIFICATIONS

Application	Specification	
	Metric	English
Steering Linkage Inner Tie Rod Nut	75 N.m	55 lb ft
Lower Control Arm Cam Bolt Nut	260 N.m	192 lb ft

REPAIR INSTRUCTIONS

WHEEL ALIGNMENT MEASUREMENT

Steering and vibration complaints are not always the result of improper alignment. One possible cause is wheel and tire imbalance. Another possibility is tire lead due to worn or improperly manufactured tires. Lead/pull is defined as follows: At a constant highway speed on a typical straight road, lead/pull is the amount of effort required at the steering wheel to maintain the vehicle's straight path. Lead is the vehicle deviation from a straight path on a level road without pressure on the steering wheel. [Radial Tire Lead/Pull Correction](#) in order to determine if the vehicle has a tire lead problem.

Before performing any adjustment affecting wheel alignment, perform the following inspections in order to ensure correct alignment readings:

- Inspect for visible damage to the suspension components and replace as necessary.
- Inspect the tires for the proper inflation and irregular tire wear. [Vehicle Certification, Tire Placard, Anti-Theft, and Service Parts ID Label](#) , and [Tire Diagnosis - Irregular or Premature Wear](#)
- Inspect the runout of the wheels and the tires. [Tire and Wheel Runout Specifications](#)
- Inspect the wheel bearings for backlash and excessive play. [Wheel Bearings Diagnosis](#)
- Inspect the ball joints for looseness or wear.
- Inspect the tie rod ends for looseness or wear.
- Inspect the control arms and stabilizer shaft for looseness or wear.
- Inspect the steering gear for looseness at the frame. [Fastener Specifications](#)

the struts/shock absorbers for wear, leaks, and any noticeable noises. [Suspension Strut and Shock Absorber Testing - On Vehicle](#)

- Inspect the vehicle trim height. [Trim Height Inspection](#)
- Inspect the steering wheel for excessive drag or poor return due to stiff or rusted linkage or suspension components.
- Inspect the fuel level. The fuel tank should be full or the vehicle should have a compensating load added.

Give consideration to excess loads, such as tool boxes, sample cases, etc. If normally carried in the vehicle, these items should remain in the vehicle during alignment adjustments. Give consideration also to the condition of the equipment being used for the alignment. Follow the equipment manufacturer's instructions.

Satisfactory vehicle operation may occur over a wide range of alignment settings. However, if the setting exceeds the service allowable specifications, correct the alignment to the service preferred specifications. [Wheel Alignment Specifications](#)

Perform the following steps in order to measure the front and rear alignment angles:

1. Install the alignment equipment according to the manufacturer's instructions.
2. Jounce the front and the rear bumpers 3 times prior to checking the wheel alignment.
3. Measure the alignment angles and record the readings.

NOTE:

- Record the "Before" and "After" alignment measurements.
- When performing adjustments to vehicles requiring a 4-wheel alignment, set the rear toe adjustment first in order to obtain proper front alignment angles.

4. Adjust alignment angles to vehicle specification, if necessary. [Wheel Alignment Specifications](#)
5. Check and center steering angle sensor. [Steering Angle Sensor Centering](#)

FRONT CASTER AND CAMBER ADJUSTMENT

NOTE:

Caster measurements are now relative to ground.

1. The caster and camber adjustments are made by rotating the offset cam bolt and the cam in the slotted frame bracket in order to reposition the control arm.

NOTE:

Before adjusting the caster and camber angles, jounce the front bumper 3 times to allow the vehicle to return to normal height. Measure and adjust the caster and the camber with the vehicle at curb height. The front suspension Z dimension is indicated in Trim Heights. [Trim Height Inspection](#)

2. For an accurate reading, do not push or pull on the tires during the alignment process.

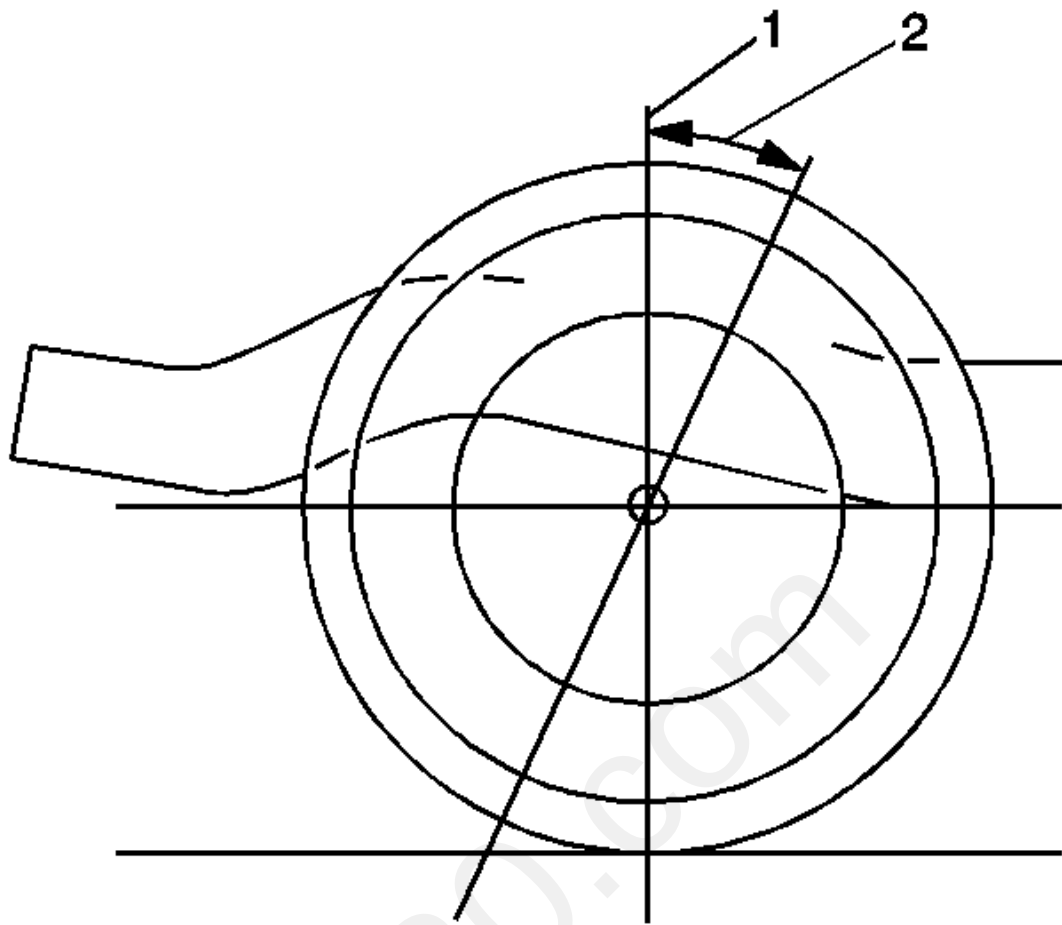


Fig. 1: Caster Angle

Courtesy of GENERAL MOTORS COMPANY

3. Determine the caster angle (2).

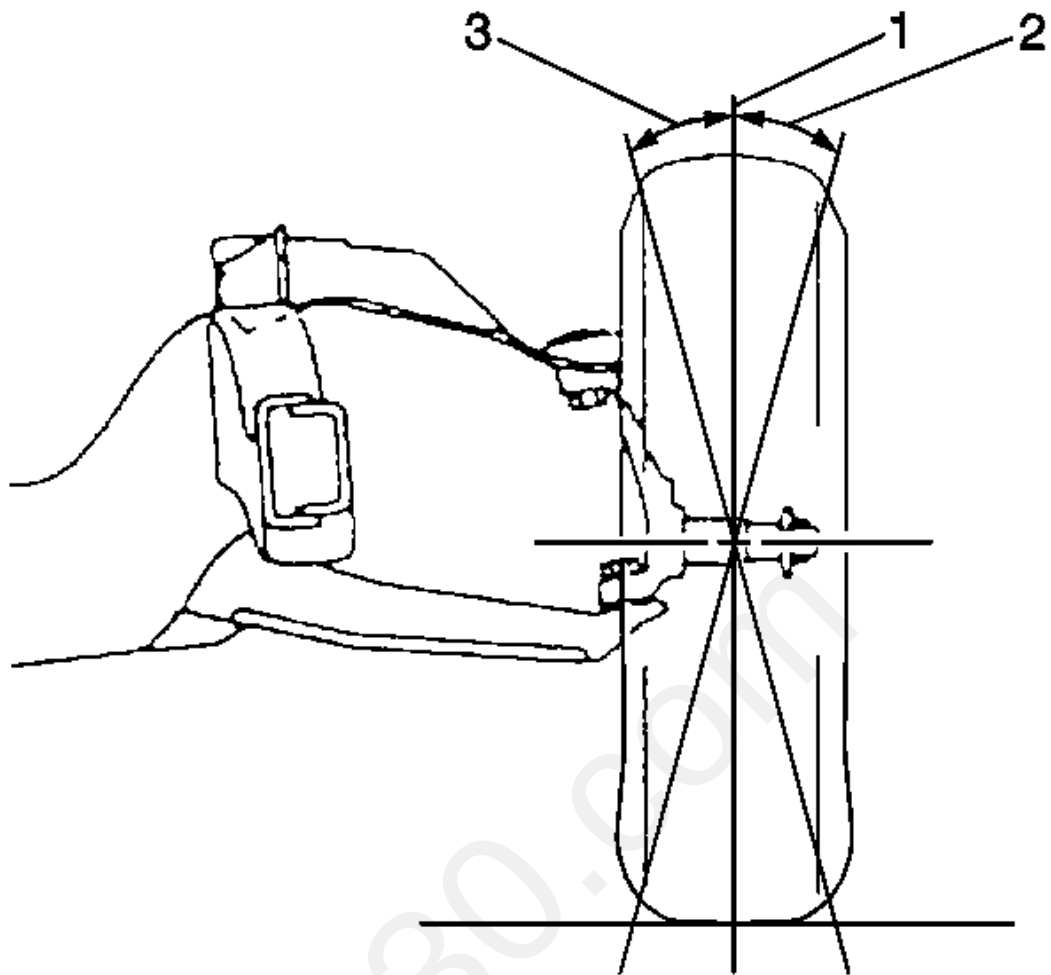


Fig. 2: Determining Positive Camber Or Negative Camber
Courtesy of GENERAL MOTORS COMPANY

4. Determine the positive camber (2) or negative camber (3) angle.

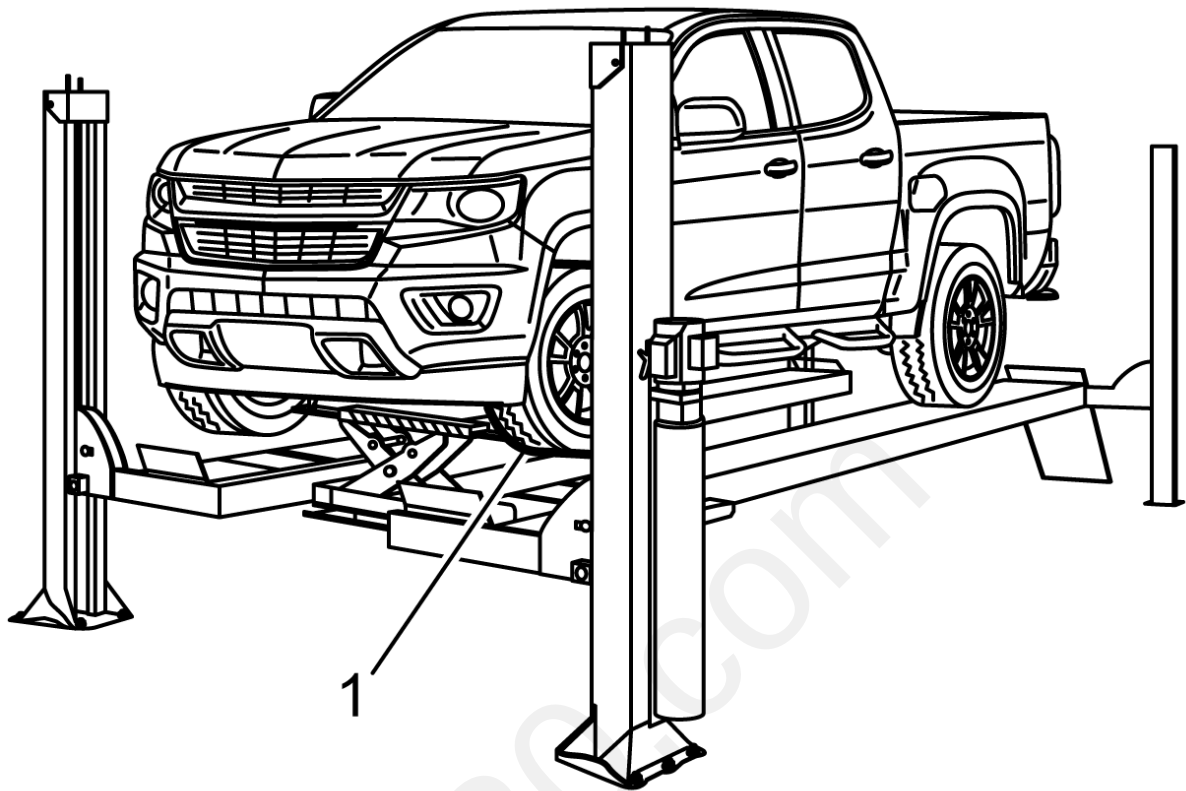


Fig. 3: Lift Front Wheels On Alignment Rack Prior To Camber Adjustment

Courtesy of GENERAL MOTORS COMPANY

CAUTION: Lift the front wheels of the vehicle prior to adjusting camber. Lifting the front wheels minimizes force on the cam adjustment pin during camber adjustment. Failure to lift the front wheels prior to camber adjustment can result in damage to the cam adjustment pin.

5. Lift the front wheels on the alignment rack prior to camber adjustment.
6. Remove the pinned adjusting cam insert. Do not reinstall the cam insert.
7. Loosen the lower control arm cam adjustment bolts.

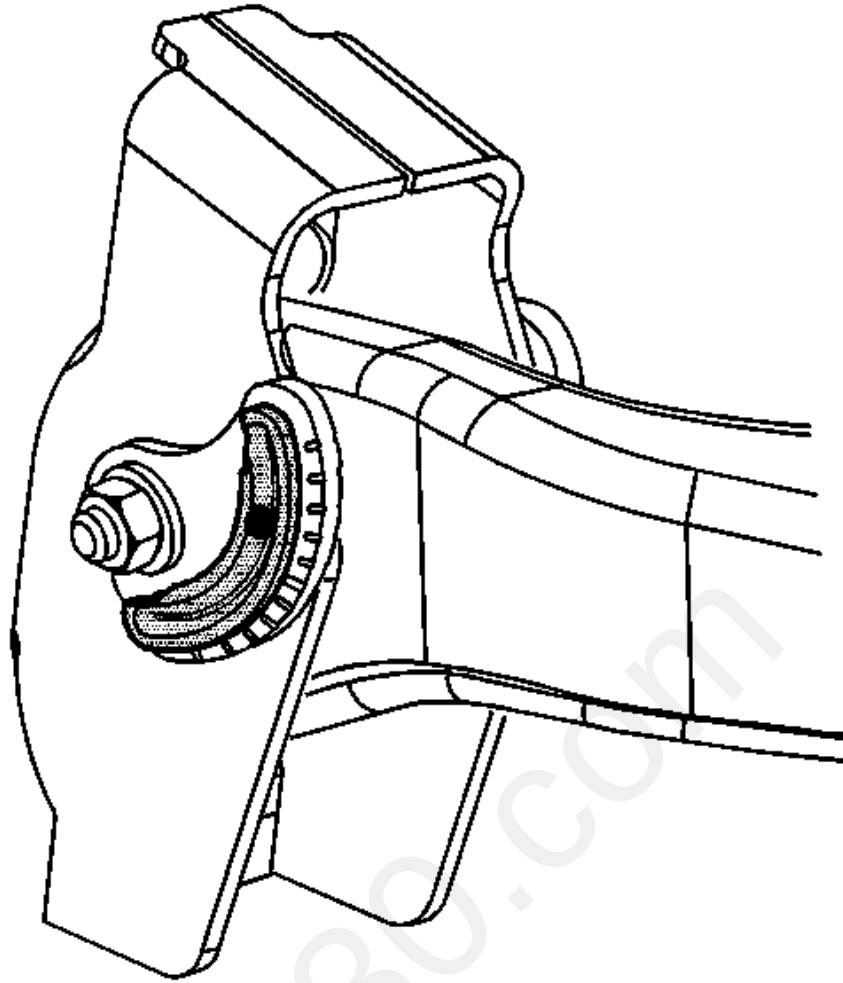


Fig. 4: Adjusting Caster & Camber Angle
Courtesy of GENERAL MOTORS COMPANY

CAUTION: Refer to [Fastener Caution](#) .

NOTE: If the pin is missing, a 1/4 inch dowel rod or a punch can be utilized as a temporary alignment aid to properly center the cam to the bracket, while making adjustments and torquing the control arm nuts.

8. Adjust the caster and the camber angle by turning the cam bolts until the specifications have been met. [Wheel Alignment Specifications](#)
9. When the adjustments are complete, hold the cam bolt head in order to ensure the cam bolt position does not change while tightening the nut. [Lower Control Arm Replacement \(2WD\)](#) [Lower Control Arm Replacement \(4WD\)](#)
10. Verify that the caster and the camber are still within specifications. [Wheel Alignment Specifications](#)
11. When the caster and camber are within specifications, adjust the toe. [Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment](#)

WHEEL ALIGNMENT - STEERING WHEEL ANGLE AND/OR FRONT TOE ADJUSTMENT

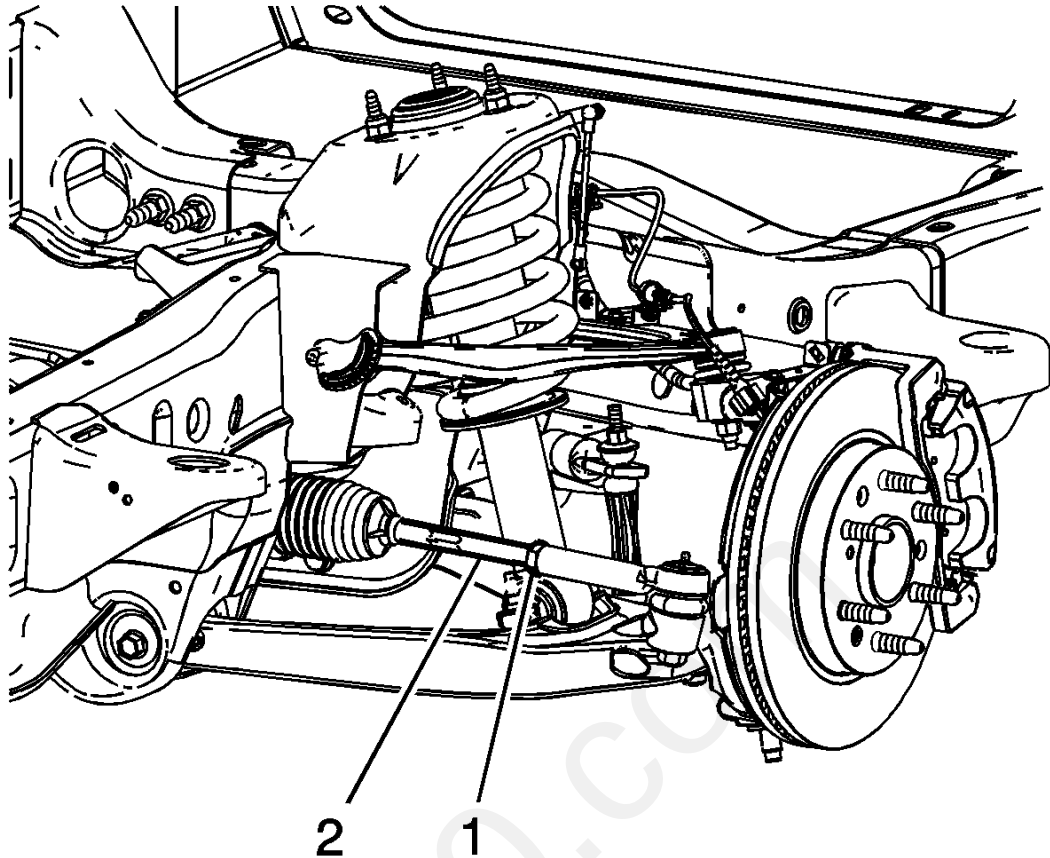


Fig. 5: View Of Inner Tie Rod & Jam Nut
Courtesy of GENERAL MOTORS COMPANY

1. Loosen the jam nut on the inner tie rod (1).
2. Rotate the inner tie rod (2) to the required toe specification setting. [Wheel Alignment Specifications](#)

CAUTION: [Fastener Caution](#) .

3. Tighten the jam nut (1) on the tie rod to 75 N.m (55 lb ft).
4. Check the toe setting after tightening.
5. Re-adjust the toe setting if necessary.
6. Check and center steering angle sensor. [Steering Angle Sensor Centering](#)

DESCRIPTION AND OPERATION

CAMBER DESCRIPTION

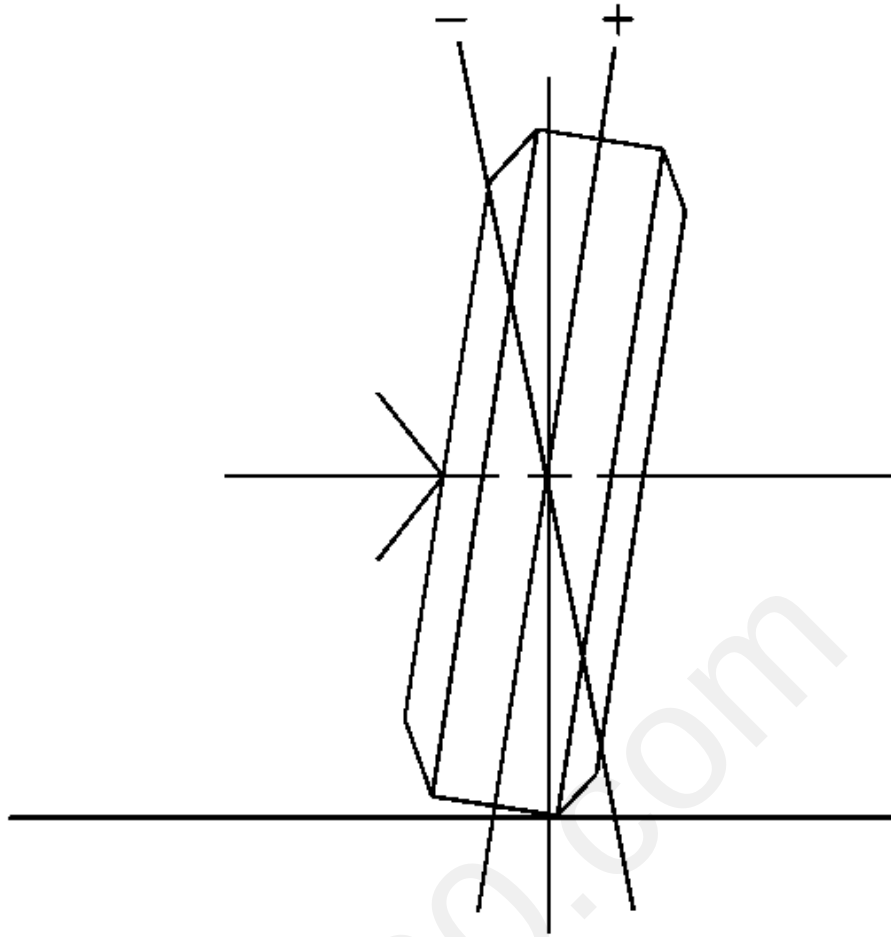


Fig. 6: Illustrating Camber Angle

Courtesy of GENERAL MOTORS COMPANY

Camber is the tilting of the wheels from the vertical when viewed from the front of the vehicle. When the wheels tilt outward at the top, the camber is positive (+). When the wheel tilts inward at the top, the camber is negative (-). The amount of tilt is measured in degrees from the vertical. Camber settings influence the directional control and the tire wear.

Too much positive camber will result in premature wear on the outside of the tire and cause excessive wear on the suspension parts.

Too much negative camber will result in premature wear on the inside of the tire and cause excessive wear on the suspension parts.

Unequal side-to-side camber of 1 degree or more will cause the vehicle to pull or lead to the side with the most positive camber.

Cross Camber is the difference between the left camber value and the right camber value.

Cross Camber = L camber - R camber

CASTER DESCRIPTION

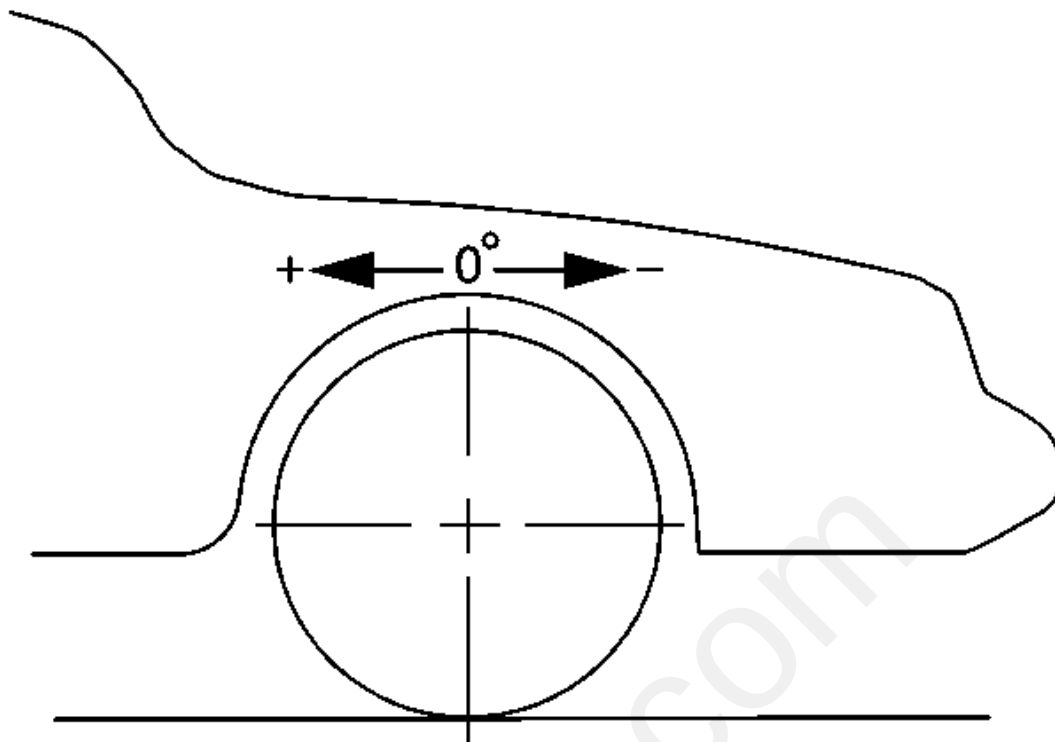


Fig. 7: Illustrating Caster Angle

Courtesy of GENERAL MOTORS COMPANY

Caster is the tilting of the uppermost point of the steering axis either forward or backward, when viewed from the side of the vehicle. A backward tilt is positive (+) and a forward tilt is negative (-). Caster influences directional control of the steering but does not affect the tire wear. Caster is affected by the vehicle height, therefore it is important to keep the body at its designed height. Overloading the vehicle or a weak or sagging rear spring will affect caster. When the rear of the vehicle is lower than its designated trim height, the front suspension moves to a more positive caster. If the rear of the vehicle is higher than its designated trim height, the front suspension moves to a less positive caster.

With too little positive caster, steering may be touchy at high speed and wheel returnability may be diminished when coming out of a turn. If one wheel has more positive caster than the other, that wheel will pull toward the center of the vehicle. This condition will cause the vehicle to pull or lead to the side with the least amount of positive caster.

Cross Caster is the difference between the left caster value and the right caster value.

Cross caster = L caster - R caster

LEAD/PULL DESCRIPTION

highway speed on a typical straight road, lead/pull is the amount of effort required at the steering wheel to maintain the vehicle's straight path.

IMPORTANT: Vehicles will tend to lead/pull in the direction of the road slope as part of normal operation.

Lead/pull is usually caused by the following factors:

- Road slope
- Variability in tire construction
- Wheel alignment (front cross caster and camber)
- Unbalanced steering gear
- Electronic Power Steering (EPS) steering position and torque sensors not calibrated correctly, if equipped.

SCRUB RADIUS DESCRIPTION

Ideally, the scrub radius is as small as possible. Normally, the SAI angle and the centerline of the tire and the wheel intersect below the road surface, causing a positive scrub radius. With struts, the SAI angle is much larger than the long arm/short arm type of suspension. This allows the SAI angle to intersect the camber angle above the road surface, forming a negative scrub radius. The smaller the scrub radius, the better the directional stability. Installing aftermarket wheels that have additional offset will dramatically increase the scrub radius. The newly installed wheels may cause the centerline of the tires to move further away from the spindle. This will increase the scrub radius.

A large amount of scrub radius can cause severe shimmy after hitting a bump. Four-wheel drive vehicles with large tires use a steering damper to compensate for an increased scrub radius. Scrub radius is not directly measurable by the conventional methods. Scrub radius is projected geometrically by engineers during the design phase of the suspension.

SETBACK DESCRIPTION

Setback applies to both the front and the rear wheels. Setback is the amount that one wheel may be aligned behind the other wheel. Setback may be the result of a road hazard or a collision. The first clue is a caster difference from side-to-side of more than 1 degree.

THRUST ANGLES DESCRIPTION

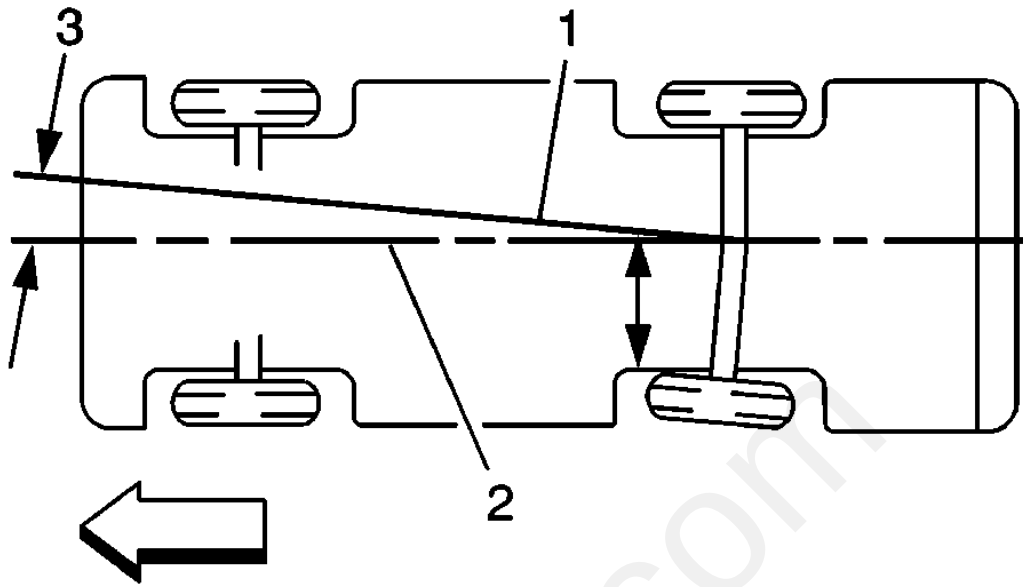


Fig. 8: Illustrating Thrust Angles

Courtesy of GENERAL MOTORS COMPANY

The front wheels aim or steer the vehicle. The rear wheels control tracking. This tracking action relates to the thrust angle (3). The thrust angle is the path that the rear wheels take. Ideally, the thrust angle is geometrically aligned with the body centerline (2).

In the illustration, toe-in is shown on the left rear wheel, moving the thrust line (1) off center. The resulting deviation from the centerline is the thrust angle.

If the thrust angle is not set properly the vehicle may "dog track", the steering wheel may not be centered or it could be perceived as a bent axle. Thrust angle can be checked during a wheel alignment.

Positive thrust angle means the thrust line is pointing to the right hand side (RHS) of the vehicle.

Negative thrust angle means the thrust line is pointing to the left hand side (LHS) of the vehicle.

If the thrust angle is out of specification, moving the axle to body relationship will change the thrust angle reading.

If the vehicle is out in the Positive (+) direction-moving the RHS forward and/or LHS rearward will move the thrust angle towards zero degrees.

s out in the Negative (-) direction-moving the RHS rearward and/or LHS forward will move the thrust angle towards zero degrees.

TOE DESCRIPTION

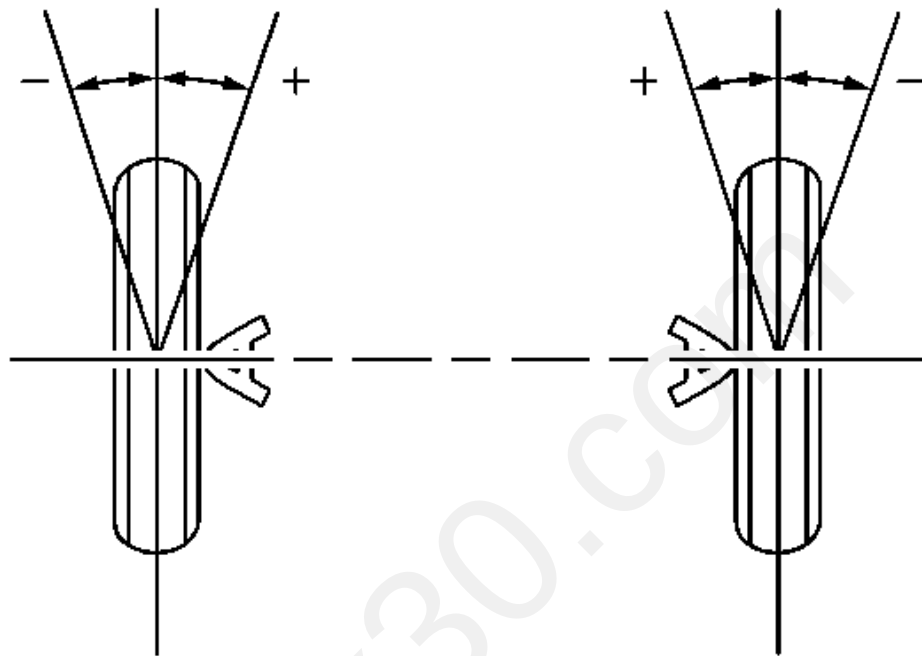


Fig. 9: Illustrating Toe Angle

Courtesy of GENERAL MOTORS COMPANY

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 offsets 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.

WANDER DESCRIPTION

Wander is the undesired drifting or deviation of a vehicle to either side from a straight path with hand pressure on the steering wheel. Wander is a symptom of the vehicle's sensitivity to external disturbances, such as road crown

, and accentuated by poor on-center steering feel.

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