

## Suspension

### Wheel Alignment - CTS Sedan

## SPECIFICATIONS

### WHEEL ALIGNMENT SPECIFICATIONS

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

#### Wheel Alignment Specifications

| RPO Restriction | Wheels | Caster      |             | Cross Caster   | Camber       |              | Cross Camber   | Total Toe      | Steering Wheel Angle | Thrust Angle     |
|-----------------|--------|-------------|-------------|----------------|--------------|--------------|----------------|----------------|----------------------|------------------|
|                 |        | Left        | Right       | (Left - Right) | Left         | Right        | (Left - Right) | (Left + Right) |                      | (Left - Right)/2 |
| FE2 - RWD       | Front  | 6.1° ± 0.8° | 6.1° ± 0.8° | 0.0° ± 0.8°    | -0.2° ± 0.8° | -0.2° ± 0.8° | 0.0° ± 0.8°    | 0.2° ± 0.2°    | 0.0° ± 3.5°          | -                |
|                 | Rear   | -           | -           | -              | -0.9° ± 0.8° | -0.9° ± 0.8° | -              | 0.3° ± 0.2°    | -                    | 0.0° ± 0.3°      |
| FE2 - AWD       | Front  | 6.6° ± 0.8° | 6.6° ± 0.8° | 0.0° ± 0.8     | -0.2° ± 0.8° | -0.2° ± 0.8° | 0.0° ± 0.8     | 0.2° ± 0.2°    | 0.0° ± 3.5°          | -                |
|                 | Rear   | -           | -           | -              | -0.9° ± 0.8° | -0.9° ± 0.8° | -              | 0.3° ± 0.2°    | -                    | 0.0° ± 0.3°      |
| FE3 - RWD       | Front  | 6.3° ± 0.8° | 6.3° ± 0.8° | 0.0° ± 0.8°    | -0.5° ± 0.8° | -0.5° ± 0.8° | 0.0° ± 0.8°    | 0.2° ± 0.2°    | 0.0° ± 3.5°          | -                |
|                 | Rear   | -           | -           | -              | -0.9° ± 0.8° | -0.9° ± 0.8° | -              | 0.3° ± 0.2°    | -                    | 0.0° ± 0.3°      |

### FASTENER TIGHTENING SPECIFICATIONS

#### Fastener Tightening Specifications

| Application                               | Specification   |          |
|-------------------------------------------|-----------------|----------|
|                                           | Metric          | English  |
| Rear Suspension Adjust Link Inner Nut (1) |                 |          |
| • First Pass                              | 70 Nm           | 52 lb ft |
| • Final Pass                              | plus 90 degrees |          |
| Inner Tie Rod Jam Nut                     | 80 Nm           | 59 lb ft |
| Rear Suspension Upper Control Arm (1)     |                 |          |
|                                           |                 |          |

|                                                          |                 |           |
|----------------------------------------------------------|-----------------|-----------|
| • First Pass                                             | 150 Nm          | 111 lb ft |
| • Final Pass                                             | plus 90 degrees |           |
| Front Upper and Lower Strut to knuckle Nuts              |                 |           |
| • First Pass                                             | 120 Nm          | 89 lb ft  |
| • Final Pass                                             | plus 90 degrees |           |
| 1. Torque to yield fasteners in use , requires new bolt. |                 |           |

## 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 straight path. Lead is the vehicle deviation from a straight path on a level road without pressure on the steering wheel.

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

- Inspect the tires for the proper inflation and irregular tire wear. Refer to **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.
- Inspect the wheel bearings for backlash and excessive play.
- Inspect the ball joints and 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. Refer to **Fastener Tightening Specifications** .
- Inspect the struts/shock absorbers for wear, leaks, and any noticeable noises. Refer to **Suspension Strut and Shock Absorber Testing - On Vehicle** .
- Inspect the vehicle trim height. Refer to **Trim Height Inspection** .
- Inspect the steering wheel for excessive drag or poor return due to stiff or rusted linkage or suspension components.

Give consideration to the condition of the equipment being used for the alignment. Follow the equipment manufacturer 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. Refer to **Wheel Alignment Specifications**.

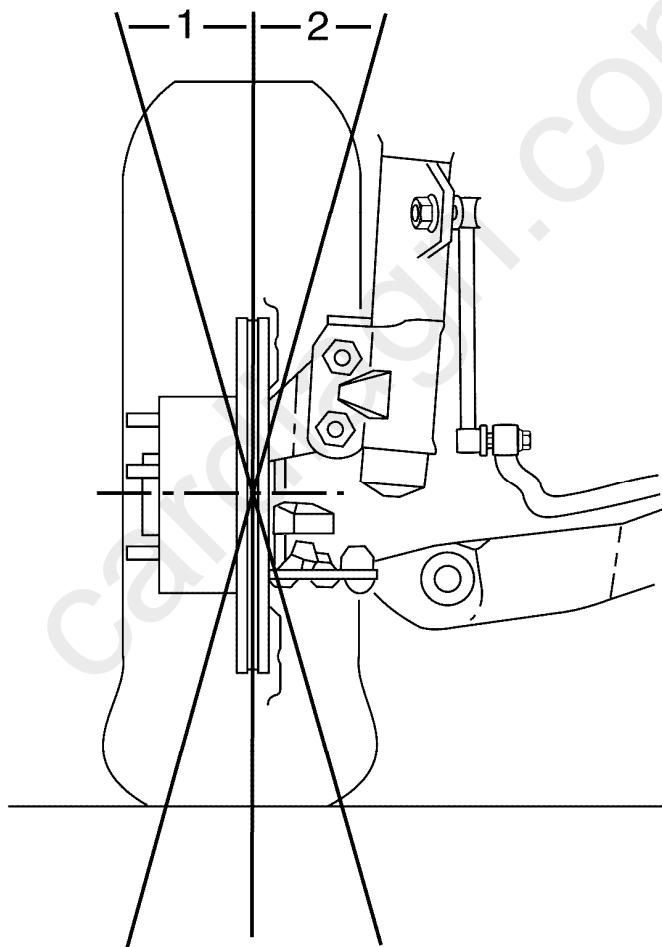
Perform the following steps in order to measure the front and rear alignment angles:

1. Install the alignment equipment according to the manufacturer 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.
4. Adjust alignment angles to vehicle specification, if necessary. Refer to **Wheel Alignment Specifications**.

## FRONT CAMBER ADJUSTMENT

### Adjustment Procedure

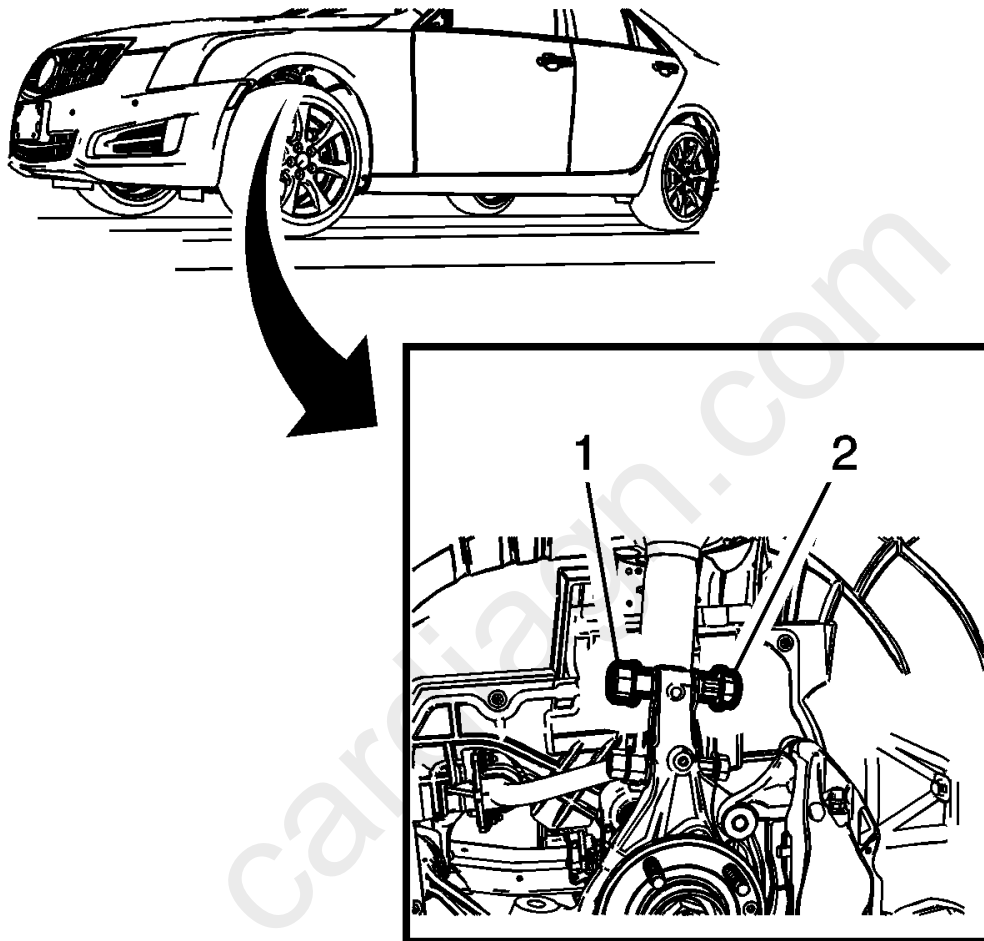
1. Before performing any adjustment affecting the wheel alignment, refer to **Wheel Alignment Measurement**.



**Fig. 1: View Of Positive Or Negative Camber**  
Courtesy of GENERAL MOTORS COMPANY

**CAUTION: Refer to Fastener Caution .**

2. Determine the actual camber, Positive (1) or Negative (2).
3. Raise the front of vehicle.
4. Remove the wheel.



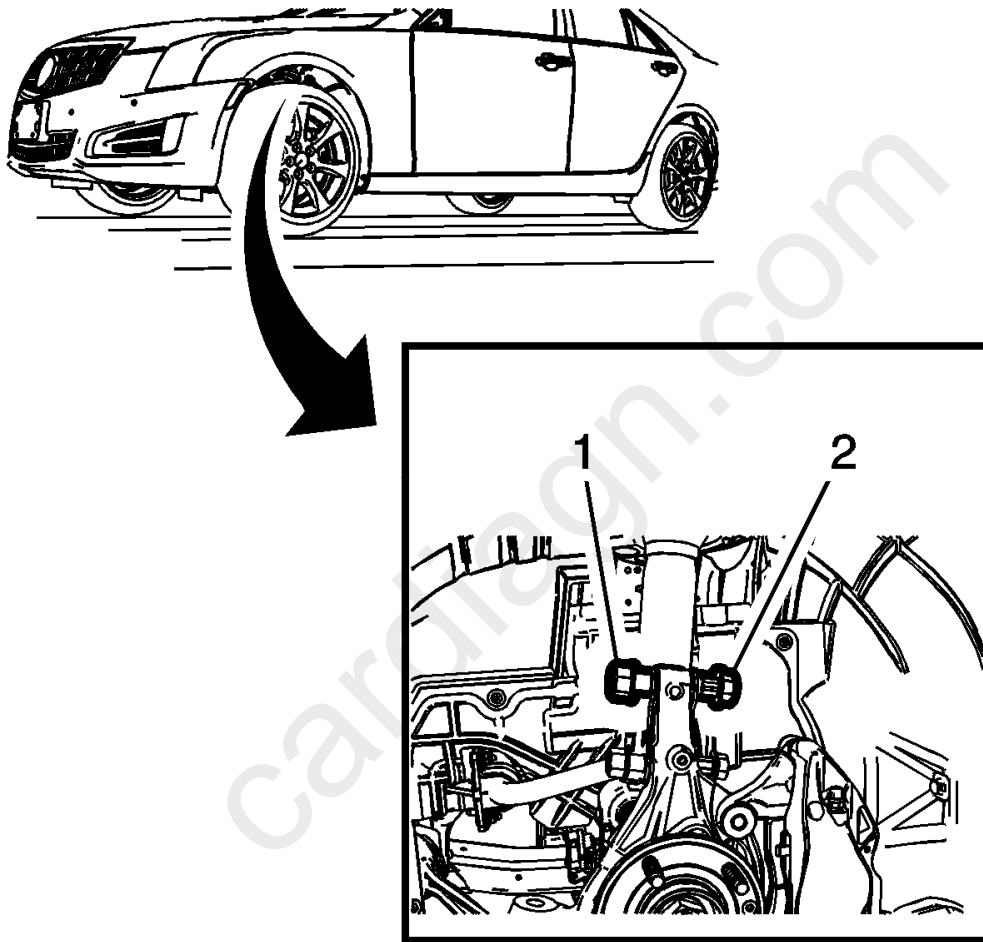
**Fig. 2: Strut To Knuckle Nuts & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

5. Loosen the strut to the knuckle nuts (1) enough to allow the splines of the bolts (2) to disengage from the knuckle. Refer to **Strut Assembly Removal and Installation (FE2 Base)** , **Strut Assembly Removal and Installation (FE2 or FE3 With F55 Magnetic Ride Suspension)** .
6. Reinstall the wheel.
7. Lower the vehicle.

**NOTE:** For accurate readings, do not push or pull on the tire and wheel assembly during the alignment.

**NOTE:** The next step may require assistance.

8. Adjust the front camber to specifications, refer to Wheel Alignment Measurement.
9. Hold the camber adjustment and tighten the bottom strut nut (1) while holding the bolt (2) to secure the adjustment. Do not fully torque at this time. Also make sure that the spline of the bolt is fully seated within the knuckle and strut.
10. Reinspect the camber settings.



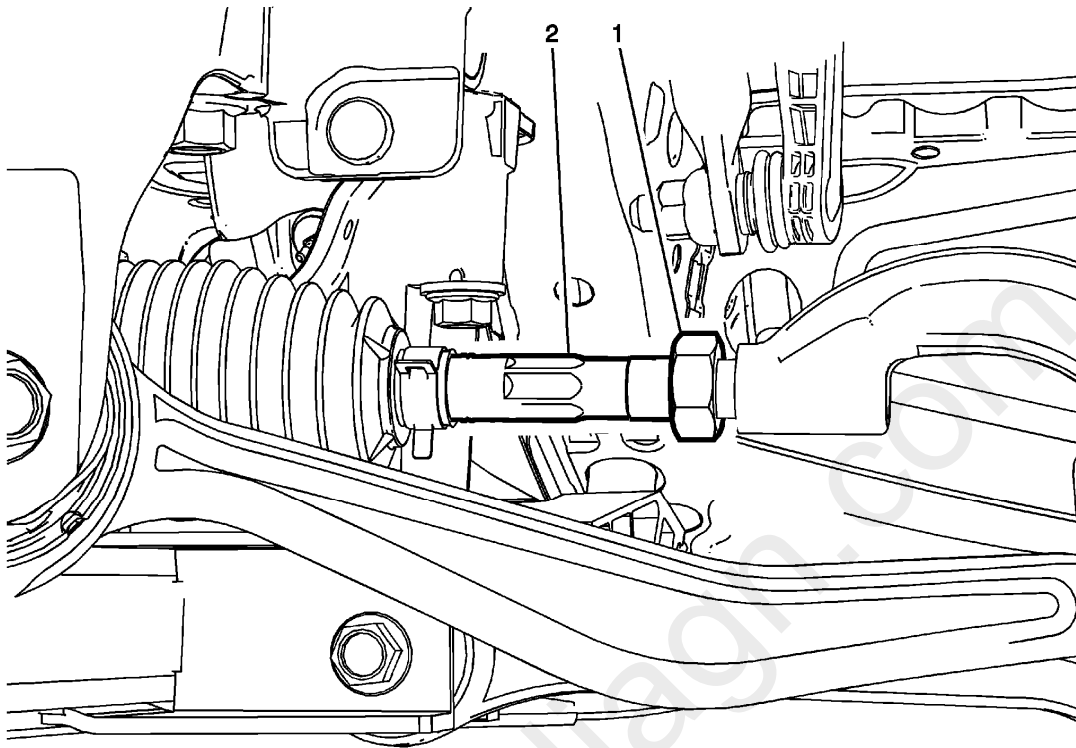
**Fig. 3: Strut To Knuckle Nuts & Bolts**  
Courtesy of GENERAL MOTORS COMPANY

11. Tighten the strut-to-knuckle nuts (1) to:
  - First Pass: 120 N.m (89 lb ft)
  - Final Pass: plus 90 degrees

**NOTE:** After adjusting the front camber, it is necessary to adjust the front toe.

12. Adjust the front toe. Refer to **Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment**.

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



**Fig. 4: Steering Linkage Inner Tie Rod & Nut**  
Courtesy of GENERAL MOTORS COMPANY

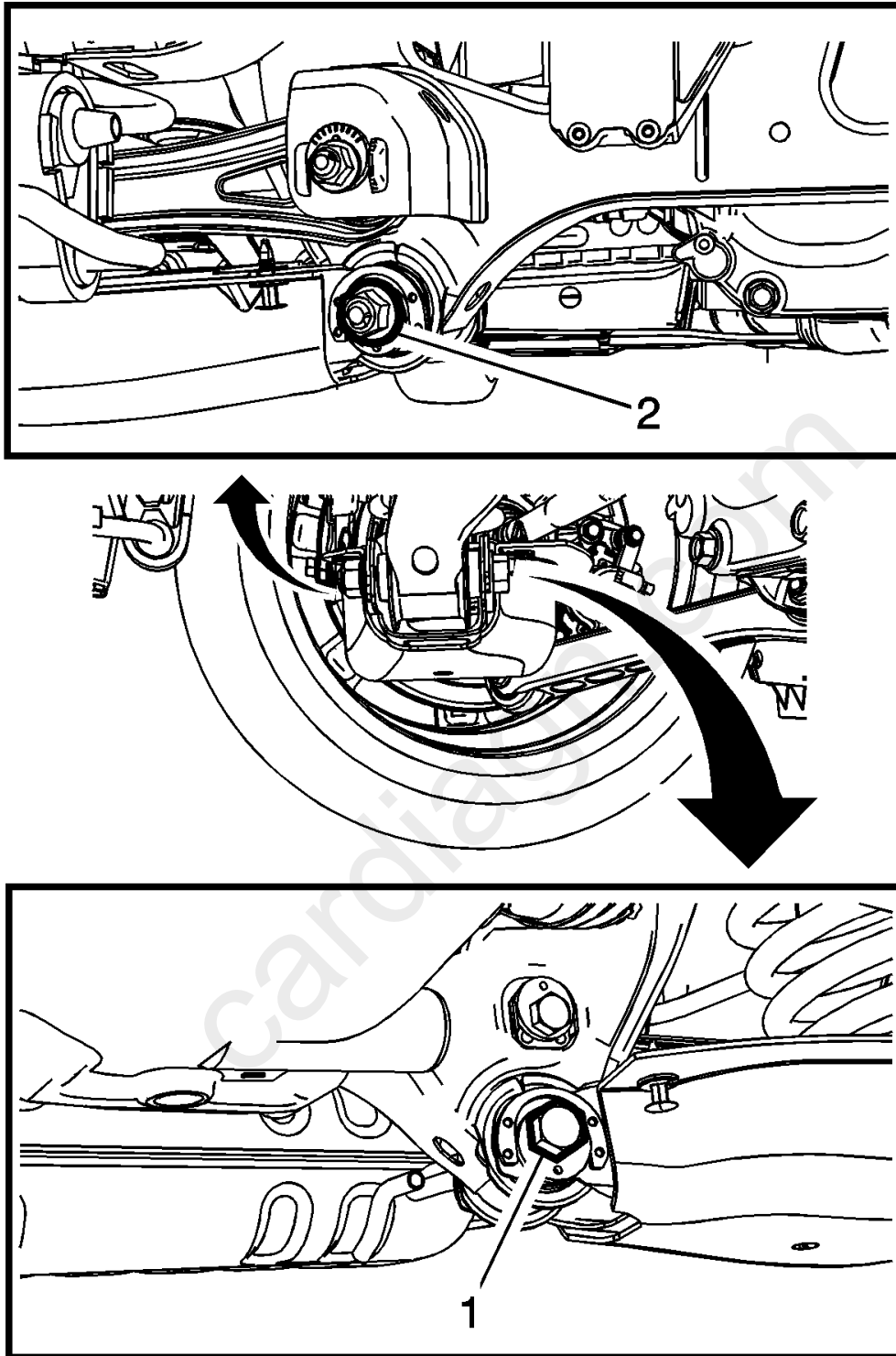
#### Wheel Alignment - Steering Wheel Angle and/or Front Toe Adjustment

| Callout                                                                                                                                                                           | Component Name                                                                                                                                                    |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Preliminary Procedure</b><br>With the vehicle on an alignment rack, perform any adjustment affecting the wheel alignment. Refer to <b><u>Wheel Alignment Measurement</u></b> . |                                                                                                                                                                   |
| 1                                                                                                                                                                                 | Steering Linkage Tie Rod Nut<br><b>Procedure</b><br>1. Loosen the tie rod nut.<br>2. Tighten the tie rod nut after the adjustment has been made to 80 (59 lb ft). |
| 2                                                                                                                                                                                 | Steering Linkage Inner Tie Rod<br><b>Procedure</b><br>Turn the inner tie rod to adjust the toe.                                                                   |

#### REAR CAMBER ADJUSTMENT

**CAUTION:** This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

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**Fig. 5: Rear Suspension Control Arm Nut & Bolt**  
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1. Remove the rear suspension control arm nut (2) and bolt (1). Replace the bolt with NEW only. Refer to

### **Lower Control Arm Replacement .**

2. Install the rear suspension control arm nut (2) and NEW bolt (1).
3. Rotate the rear suspension control arm bolt (1) until the correct the camber measurement is achieved.

**NOTE:**           **Tighten the nut and bolt enough to maintain the adjustment. Verify the camber reading prior to tightening the bolt to its final torque.**

**CAUTION:** Refer to **Fastener Caution .**

4. Hold the NEW rear suspension control arm bolt (1) and tighten the rear suspension upper control nut (2) to:

#### **Tighten**

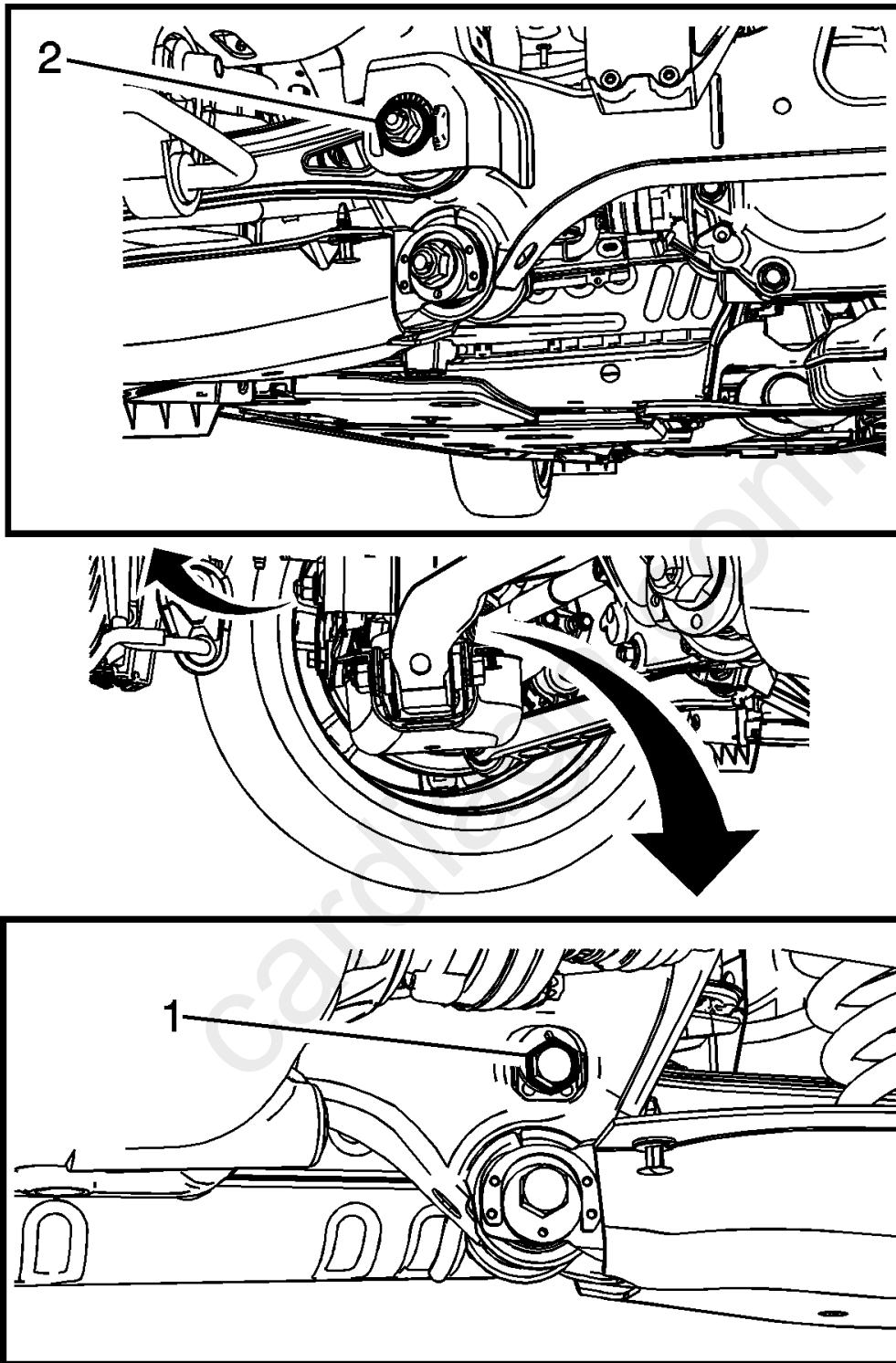
- First Pass: 115 N.m (85 lb ft)
- Final Pass: plus 105 degrees

**NOTE:**           **It will be necessary to replace the torque to yield fasteners if they are torqued to specification and loosened.**

5. Check the alignment specification and readjust if needed.

### **REAR TOE ADJUSTMENT**

1. Measure the alignment on an alignment rack. Refer to **Wheel Alignment Measurement.**



**Fig. 6: Rear Suspension Adjust Link Nut & Bolt**  
Courtesy of GENERAL MOTORS COMPANY

2. Remove the rear suspension adjust link nut (2).

**CAUTION:** This vehicle is equipped with torque-to-yield or single use fasteners. Install a NEW torque-to-yield or single use fastener when installing this component. Failure to replace the torque-to-yield or single use fastener could cause damage to the vehicle or component.

3. Remove and discard the rear suspension adjust link bolt (1). DO NOT reuse. Replace with NEW only.
4. Rotate the rear suspension adjust link bolt (1) until the proper toe measurement is achieved. Refer to **Wheel Alignment Specifications**.
5. Hold the adjust link bolt (1) and tighten the nut (2) enough to maintain the adjustment.
6. Check the alignment specification and readjust if needed.

**CAUTION:** Refer to **Fastener Caution** .

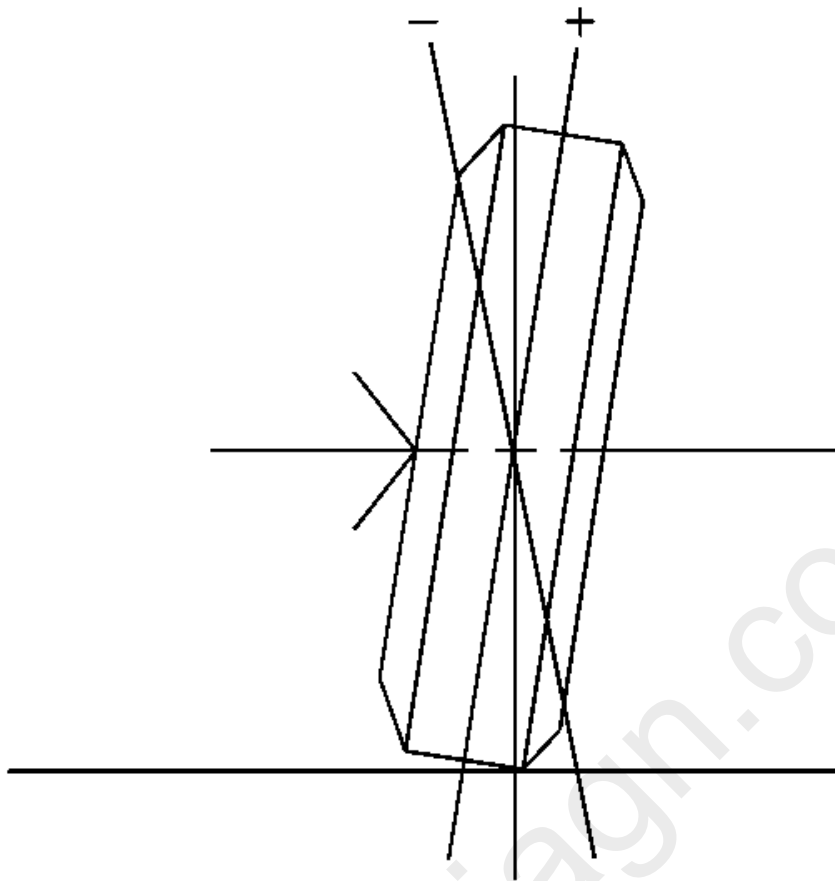
7. Hold the NEW rear suspension adjust link bolt (1) and tighten the rear suspension adjust link nut (2) to

**NOTE:** It will be necessary to replace the torque to yield bolt if they are torqued to specification and then loosened.

8.
  - First Pass: 70 (52 lb ft)
  - Final Pass: plus 90 degrees

## **DESCRIPTION AND OPERATION**

### **CAMBER DESCRIPTION**



**Fig. 7: 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.

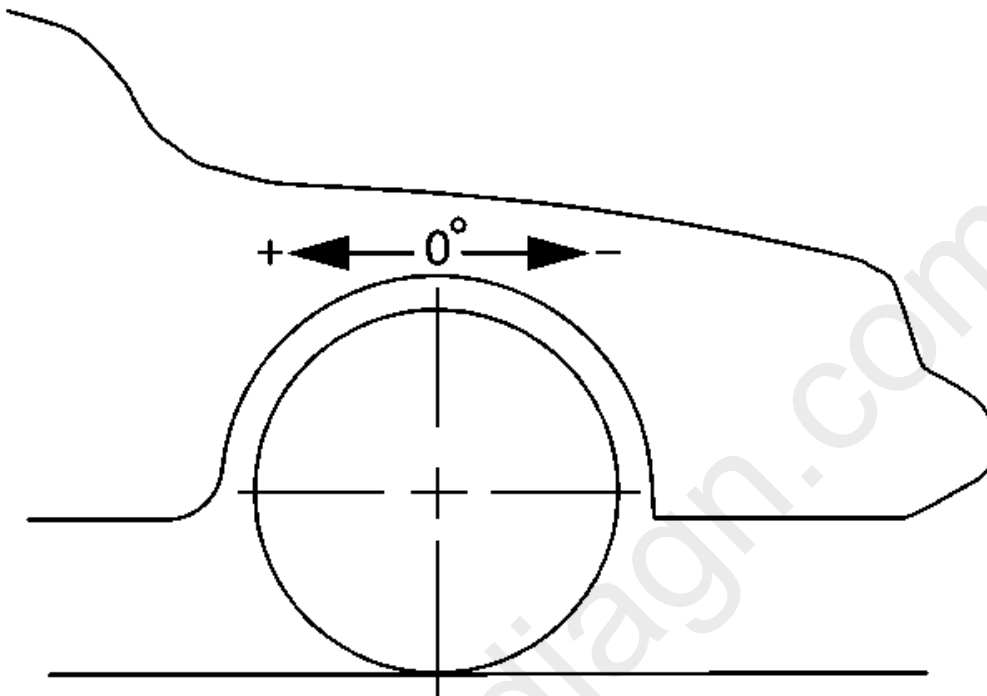
Too much negative camber will result in premature wear on the inside of the tire and cause excessive wear on the suspension parts.

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. 8: 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**

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.

**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.

## **MEMORY STEER DESCRIPTION**

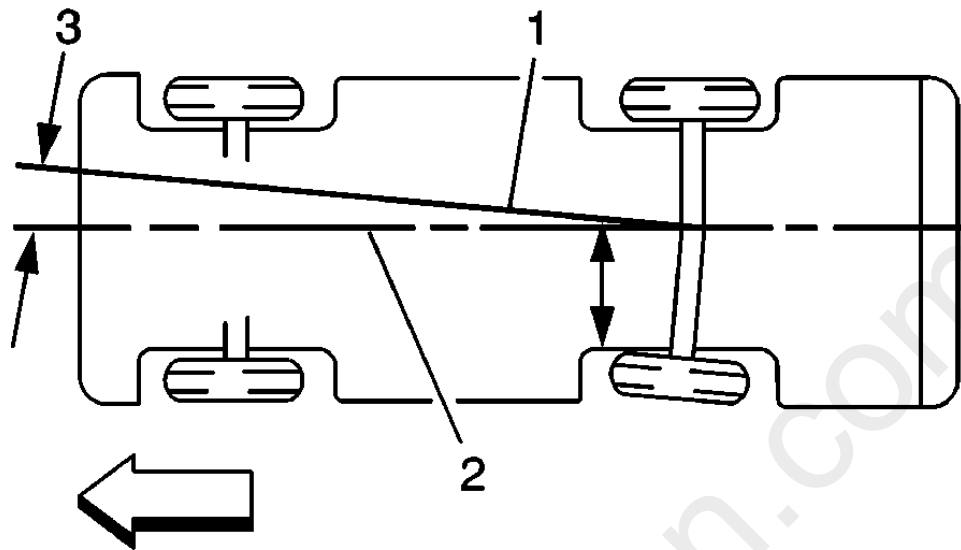
Memory steer is when the vehicle wants to lead or pull in the direction the driver previously turned the vehicle. Additionally, after turning in the opposite direction, the vehicle will want to lead or pull in that direction.

## **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.

## **THRUST ANGLES DESCRIPTION**



**Fig. 9: 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.

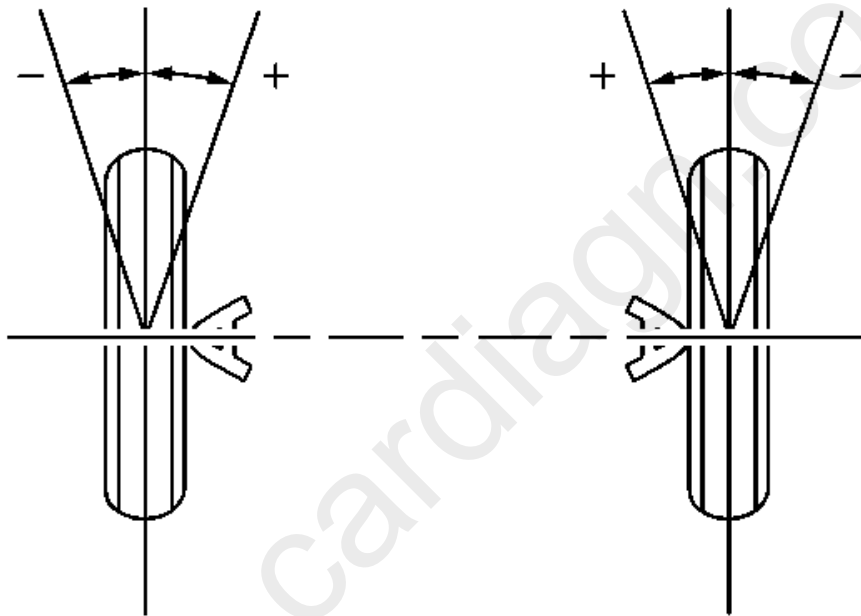
If the thrust angle is out of specification, moving the axle to body relationship will change the thrust angle

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.

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

## TOE DESCRIPTION



**Fig. 10: 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 crosswind, and accentuated by poor on-center steering feel.

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