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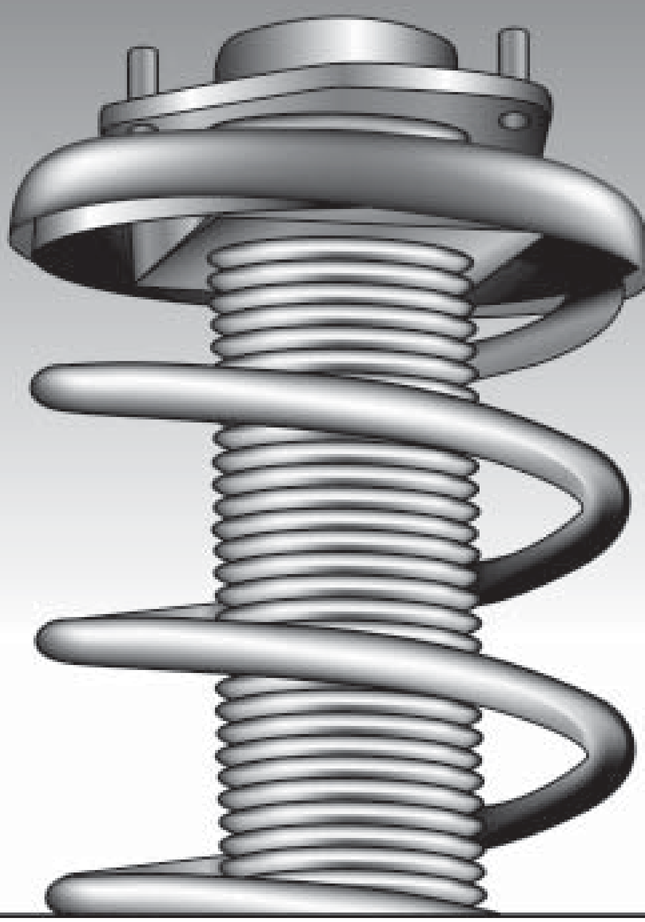
CHASSIS SYSTEMS DIAGNOSIS AND REPAIR



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CHASSIS SYSTEMS DIAGNOSIS AND REPAIR
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CHASSIS SYSTEMS DIAGNOSIS AND REPAIR OBJECTIVES

Upon completion of this training program, you will be able to:

- Accurately define and measure wheel and tire runout.
- Inspect vehicles and measure alignment angles and adjust front and rear toe.
- Verify, determine and perform ride height diagnosis and perform repair.
- Inspect vehicles and measure alignment angles and adjust front caster and camber.
- Verify steering gear movement and adjust steering rack.
- Demonstrate the Steering Angle Sensor reset procedures used after Steering Angle Sensor failure or power failure.
- Identify Anti Lock Brake System (ABS) operation using information presented in the Anti-Lock Brake System video and appropriate Service Manual.
- Diagnose ABS malfunctions.
- Access ABS Self-Diagnosis without using CONSULT or CONSULT-II using appropriate service manual.
- Inspect power brake system to determine if service and repair are required, using appropriate service manual.
- Perform ABS diagnostics, including the G-sensor, using CONSULT-II.
- Measure disc brake rotor lateral runout, brake rotor hub runout and set up on-car brake lathe.
- Identify Traction Control System (TCS) functions on an Electronic Throttle Control (ETC) equipped vehicle, and identify how “active” wheel speed sensors provide signal information to the ABS/TCS control unit.

TEXT

SUSPENSION SYSTEMS

Introduction

The vehicle suspension system has several primary functions:

- Provide a support system for the weight of the vehicle.
- Absorb shock from the road surface to smooth out vehicle motion.
- Remain rugged enough to withstand severe pounding, yet provide a supple and smooth ride on uneven road surfaces.
- Provide the necessary travel to keep all four tires on the ground over rough surfaces, and also instill confident handling on winding, paved roads.
- Protect the body, chassis, cargo, and passengers from road surface-induced vibration.
- Provide a smooth, comfortable, safe, and stable ride.

Every road surface is different. They range from washboard-rutted gravel roads to pothole-laden urban freeways to fresh asphalt thoroughfares. The suspension system design must negotiate all road surfaces to safely provide vehicle control during acceleration, turning and braking.

Design Objectives

Nissan/Infiniti engineers design suspension systems with the following objectives:

- Provide an accurate steering feel.
- Maintain tire traction and wheel control.
- Deliver directional stability at any speed.
- Provide a supple and communicative drive.
- Provide exceptional cabin isolation from noise, vibration and harshness (NVH).
- Maximize driver control during braking.

Vehicle Body Movement

The design of a suspension system must control the movement of the vehicle body in three distinct and separate motions.

- **Pitch:** Vertical up-and-down body motion. When viewing a vehicle from the side, forward pitch describes a vehicle body that moves down in the front as the rear moves up. Typically, pitch occurs during braking. Rearward pitch occurs during acceleration as the front of the body moves up and the rear moves down.
- **Roll:** Side-to-side body leaning motion. When viewing a vehicle from the rear, roll is described as the leaning of the vehicle body. Roll typically occurs during turns. In a turn, centrifugal force shifts the vehicle center of gravity toward the outside of the turn. For example, in a left turn, the body will tend to lean to the right.
- **Yaw:** Horizontal side-to-side body motion. When viewed from above, yaw describes a body movement, for example, in which the front moves to the left as the rear moves to the right.

Suspension System Purpose

Suspension systems have two interrelated purposes. The first is to maintain dynamic control of the vehicle. The second is to isolate the body structure from the road surface. Engineers have designed numerous suspension systems to accomplish these two goals.

- During vehicle acceleration, the suspension plays an important role in delivering engine power to the drive wheels while maintaining vehicle balance.
- During braking, the suspension acts to keep the vehicle level.
- During cornering, the suspension system acts to counter against the effects of centrifugal force, keeping the vehicle body as flat and level as possible throughout the turn.

Under all conditions, the suspension provides the stabilizing counter force for the up-and-down and side-to-side motion of the vehicle.

However, some suspension designs perform these tasks differently than others do. Nissan and Infiniti engineers design suspension systems that provide the riding and handling characteristics that are specific to each model. For example:

- The 2002 Nissan Altima has a sport-tuned suspension to provide crisp, responsive handling. It also gives the driver a greater feel for the road.
- The 2002 Infiniti Q45 has a luxury-tuned suspension with softer control arm bushings and more compliant spring rates to create the luxurious ride one expects in an Infiniti vehicle.

- The 2002 Nissan Pathfinder has a heavy-duty suspension system. This system provides enhanced on- or off-road control on smooth or rugged terrain. It also is specifically designed for carrying heavy payloads or trailer towing.

When combined with sophisticated steering components, certain suspension system designs can give the driver and passengers a comfortable ride on most road surfaces. The ride has been described as “refined” and “flat”; free of undesired pitch or yaw.

Suspension Components

Springs

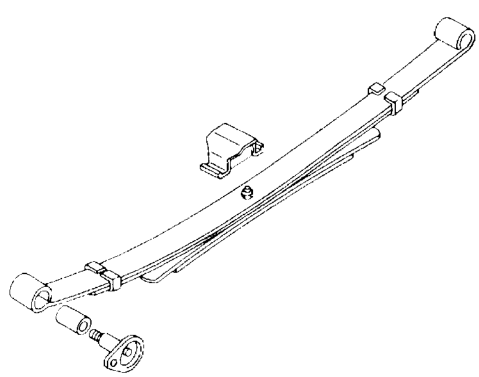
Every suspension system uses springs to support the weight of the vehicle to respond to road irregularities. Spring performance is a direct result of the correlation between sprung weight and unsprung weight.

Sprung weight refers to what the springs actually need to support. For example, springs hold the weight of the vehicle body, the driveline, occupants and cargo. The greater the sprung weight, the stiffer the springs need to be to support that weight.

Unsprung weight refers to the various components that are not supported by the springs. For example, the wheels, tires, brakes suspension components and the springs. Engineers strive to reduce unsprung weight whenever possible. Reducing unsprung weight allows for more responsive handling.

Leaf Springs

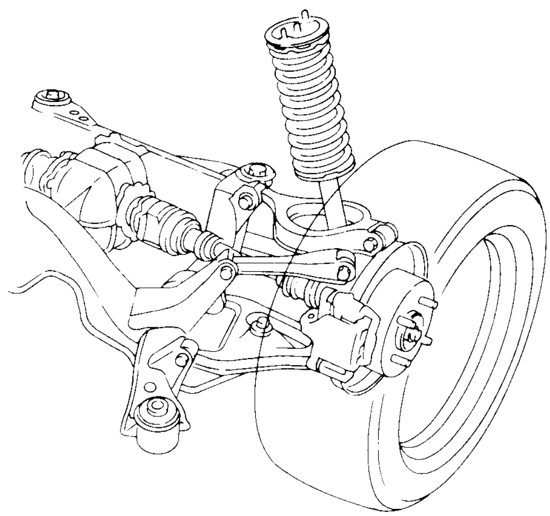
Leaf springs are long curved bands of tempered steel. Each end of the spring mounts to the frame of the vehicle. The axle mounts in the center of each leaf spring. The springs flex to hold the vehicle weight. A leaf spring suspension controls axle movement.



Rear leaf springs can be arranged in two or more layers to provide heavy-duty strength. Leaf springs are used in the rear suspension systems of the Frontier, Xterra and Quest (single leaf).

Coil Springs

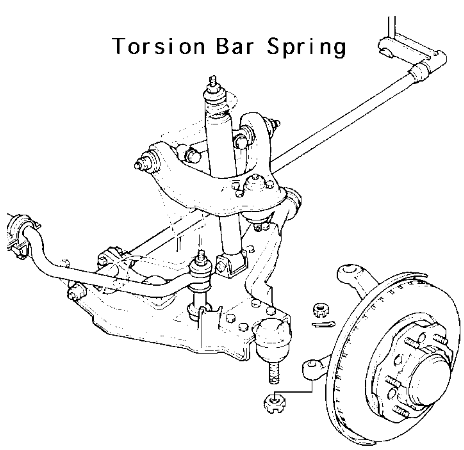
Coil springs are constructed of round tempered steel rod that is wound to a coil shape. The coil spring can compressed or allowed to expand based on sprung weight and suspension movement. Coil springs are the most popular style of spring due to their space efficiency.



Coil springs are used on the front and rear suspensions of all Nissan sedans and Pathfinder, as well as the Quest front suspension. All 2002 Infiniti vehicles use coil springs in the front and rear suspension systems.

Torsion Bars

Torsion bars are long, straight bars, made similar to a coil spring. This type of spring is anchored to the frame at one end and to a suspension component at the other. When the suspension moves, the bar is twisted and produces a spring action. The main advantage of the torsion bar is that is allows optimum packaging of the heavy-duty suspension and drive train components used in Frontier and Xterra vehicles.



Stabilizer Bars

The stabilizer bar helps keep the vehicle level in corners and sudden lane changes. The stabilizer bar middle section is mounted to the vehicle chassis in rubber mounts. Each end of the stabilizer bar is connected to the left and right side lower control arm. Like a torsion bar, a stabilizer bar operates by twisting.

In a turn, the body rolls to one side. As the body rolls, the stabilizer bar stores energy. The stored energy in the stabilizer bar pushes against the control arm mount and the connection to the vehicle body. The only effect the bar has is to push the vehicle body upward, helping to reduce vehicle body roll.

All Nissan vehicles have front and rear stabilizer bars with the exception of Sentra XE and 4-cylinder and 4x4 Frontiers. They have a stabilizer bar only in the front.

Shock Absorbers

A shock absorber is a sealed chamber filled with fluid or gas. A piston moves up and down inside this chamber. The shock absorber is attached to the suspension and to the vehicle body. As the suspension moves up and down in response to varying road conditions, the shock absorber slows and controls these movements and provides a smoother, more comfortable ride. All modern vehicles have shock absorbers.

Suspension System Action

In action, all suspension systems share these common operational characteristics:

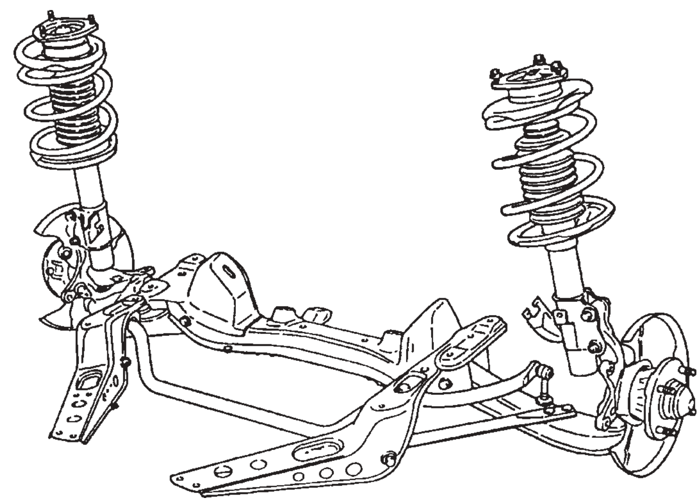
- The suspension system links and shock absorbers are mounted to the to the vehicle body.
- When a tire and wheel assembly strikes a bump in the road, the bump forces the wheel/tire assembly and suspension link rapidly upward.
- The spring for that wheel compresses to absorb the upward-directed energy of the wheel/tire assembly and suspension link. Energy is stored in the compressed spring.
- As the spring expands, it releases the stored energy, pushing against the suspension link and vehicle body.
- The spring action must be controlled, or the vehicle body will repeatedly pitch fore and aft.
- The shock absorber controls the natural oscillation of the spring to smooth out the ride.

Suspension System Types

There are a variety of different suspension systems, some for the front, some for the rear, and some for both. For each vehicle, the front and rear suspensions are uniquely designed to support the uses of that vehicle, whether it be cargo hauling, recreational trips, everyday riding comfort, or high performance driving.

Independent Strut Front Suspension

All Nissan sedans, Pathfinder and Quest have an independent strut front suspension. This configuration is used because it provides the most comfortable ride on a variety of road surfaces. "Independent" means that a disturbance affecting one wheel has little or no effect on the opposite wheel.



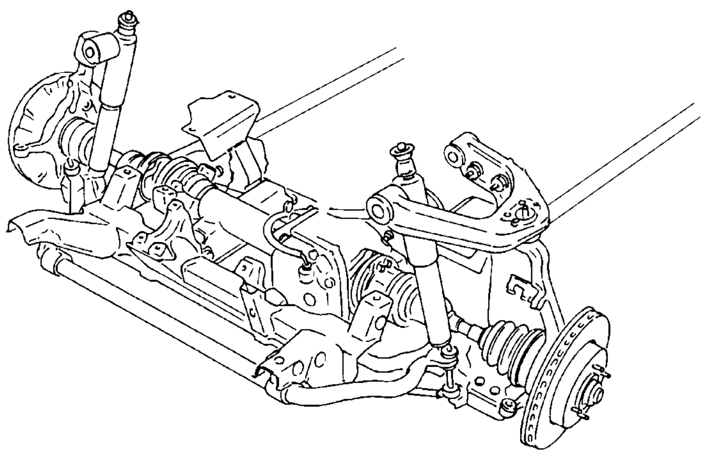
The independent strut front suspension uses a coil spring and a shock strut combined into one unit. The strut is an integral part of the system and provides the suspension upper mounting to the body. A lower control arm supports the suspension at the bottom. Compared to many other suspension designs, strut systems use fewer parts and generally weigh less.

Pathfinder's independent strut front suspension incorporates a heavy-duty design that makes it appropriate for rugged off-road use. It features thicker walled struts and offset springs to absorb and deflect off-road driving loads. It also has a long-stroke design that increases suspension travel to help the wheels maintain contact with the ground over uneven terrain.

Independent Double-Wishbone Torsion Bar Front Suspension

Nissan Frontier and Xterra use an independent double-wishbone torsion bar front suspension. The double-wishbone design gets its name from the shape of the horizontal "arm" linking the spindle to the vehicle body. There are two wishbones: an upper and a lower. The lower wishbone is often longer than the upper one to help keep the front wheels in a "straight up" position over bumps and rough surfaces, maintaining traction and increasing steering control.

The torsion bar is anchored at one end to the frame and at the other end to the lower wishbone. The front suspension of Frontier V6 and Xterra have a heavy-duty lower wishbone to increase durability and to enhance control of the suspension on rugged terrain.



Solid Axle Rear Suspensions

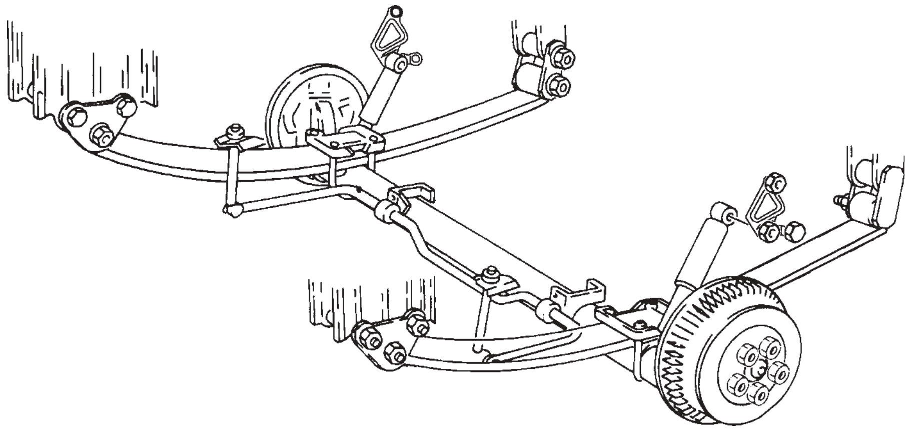
Two types of rear suspensions are available: live and beam. The live axle design is used on rear wheel drive vehicles and the beam axle design used on front wheel drive vehicles.

The live axle is the cornerstone of the suspension system. By separating the attachment points of the rear drive axle, it prevents undesired movement of the rear wheels.

The beam solid axle is used on certain front wheel drive vehicles because of its inherent strength, cargo load and towing capacity. It also takes up less space, allowing for a flatter floor.

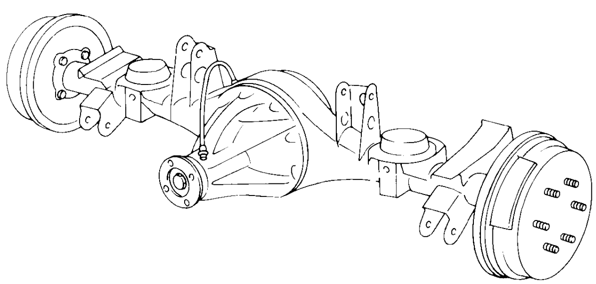
Frontier and Xterra have a live solid rear axle with a variable-rate leaf spring rear suspension.

Quest has a beam solid rear axle with single leaf, variable-rate leaf springs (shown below).



In both suspension designs, the leaf springs are mounted to the frame rails, providing added strength and durability. Wide-design long leaf springs minimize movement during lateral maneuvers, improving handling performance. The leaf spring design also provides superior management of cargo loads and towing.

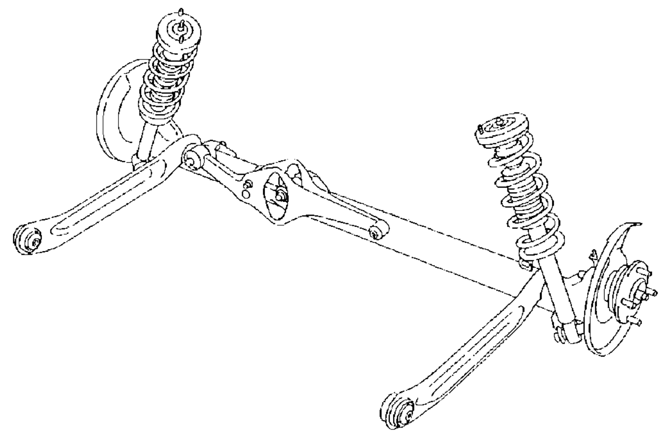
Pathfinder uses a 5-link coil-spring solid rear axle suspension. It is a more sophisticated version that more precisely controls wheel movement, especially in off-road driving situations. It provides rugged off-road capability and a smooth on-road ride. Its “multi-link” design eliminates unwanted wheel movement for greater ride comfort, while the solid axle provides strength over rough terrain, an important durability benefit.



Multi-Link Beam Rear Suspension

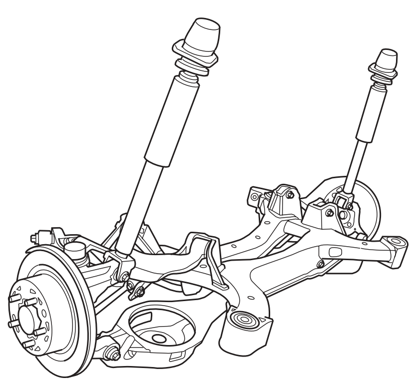
Maxima and Sentra have Nissan’s unique Multi-Link Beam rear suspension. This configuration is specific to front-wheel drive vehicles. It combines the unique benefits of a multi-link design with a rugged “beam” axle. The suspension combines a compact lightweight axle beam and a unique lateral link to create a suspension that helps keep the rear wheels perpendicular to the road while allowing them to move up in response to changes in the road surface. The result is excellent stability and handling. The beam suspension designs of other manufacturers do not have the sophistication and ride qualities of Nissan’s Multi-Link design.

Links and shock absorbers are soft-mounted and require fewer attached points, which minimizes road noise and vibration. At the same time, this rear suspension system allows the use of softer suspension settings to provide a smoother, more comfortable ride. Finally, its compact design allows for a larger passenger space and trunk space, providing improved passenger comfort with larger storage area.



Independent Rear Suspension

The 2002 Altima has an independent strut rear suspension that incorporates Nissan's Super Toe Control. The position of the rear suspension parallel links and the stiffness of the bushings cause the front bushings to deform (compress) more than the rear bushings. In other words, when the front bushings compress, they in effect "steer" the outside rear wheel. Super Toe Control corrects the natural tendency of the rear wheels to "toe out" during cornering.



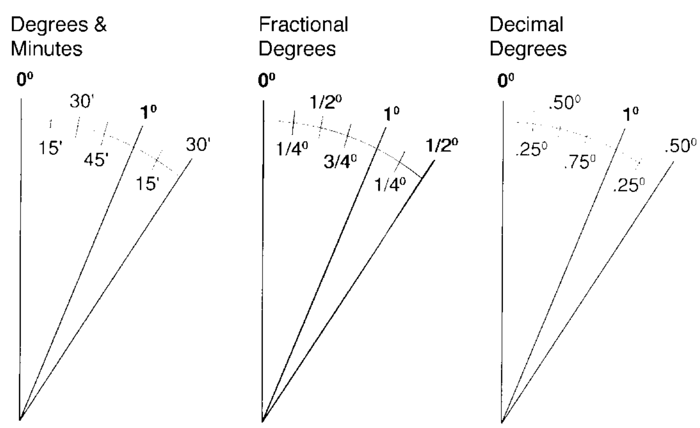
Wheel Alignment

Wheel alignment is described in terms of three primary angles: caster, camber and toe.

Understanding how these angles affect handling, and how they relate to each other, is very important to properly performing a four wheel alignment. A thorough understanding of how alignment angles are measured is important before discussing the specific angles.

Measuring Alignment Angles

Alignment angles are measured in degrees. Since specification angles are not always given in whole degrees, it is necessary to divide angles into smaller units. Service Manual specifications are given in degrees and minutes. The specification can also be expressed as fractional degrees and as decimal degrees.



Fractional degrees are a common, non-technical way of describing angles. Many alignment machines display specifications and measurements in decimal.

Alignment specifications can be published one way and displayed by an alignment rack in another form. Therefore, it is essential to identify which measurement style is being used when comparing specifications to measured values.

Nissan service manual wheel alignment specifications are published in degrees and minutes.

- The symbol (°) means “degrees”
- 8° is read “eight degrees”

Degrees are divided into smaller units, called minutes. There are 60 minutes in one degree.

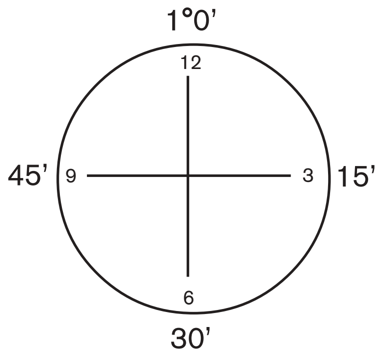
- The symbol (′) means minutes
- 30′ is read "thirty minutes"

A clock is a quick and easy point of reference:

- On a clock, 30 minutes is equal to one half hour
- Similarly, 30′ is equal to 1/2°

Adding minutes of a degree is the same as adding minutes to an hour.

- On a clock, 30 minutes plus 15 minutes equals 45 minutes. On an alignment rack, 30′ plus 15′ equals 45′
- On a clock, 30 minutes plus 45 minutes equals 1 hour, 15 minutes. On an alignment rack, 30′ plus 45′ equals 1° 15′
- On a clock, 25 minutes plus 35 minutes equals one hour. On an alignment rack, 25′ plus 35′ equals 1°



Measurements are sometimes described in decimal degrees. When you need to interpret decimal degrees, dollars and cents are a quick and easy point of reference.

- 50 cents ($0.50) is equal to 1/2 of a dollar. On an alignment equipment, 0.50° equals 1/2°.