FIGURE 19.1 The owner of this Honda thought that all it needed was an alignment. Obviously, something more serious than an alignment caused this left rear wheel to angle inward at the top.

FIGURE 19.2 Magnetic bubble-type camber/caster gauge. To help it keep its strong magnetism, it is best to keep it stored stuck to a metal plate or metal tool box.
FIGURE 19.3 Typical tire wear chart as found in a service manual. Abnormal tire wear usually indicates a fault in a steering or suspension component that should be corrected or replaced before an alignment is performed.

FIGURE 19.4 Measuring points for ride (trim) height vary by manufacturer.

FIGURE 19.5 Measuring to be sure the left and right sides of the vehicle are of equal height. If this measurement is not equal side to side by as little as 1/8 inch (3 mm), it can affect the handling of the vehicle.
FIGURE 19.6 The bulge in this tire was not noticed until it was removed from the vehicle as part of a routine brake inspection. After replacing this tire, the vehicle stopped pulling and vibrating.

FIGURE 19.7 Equal outer CV joint angles produce equal steer torque (toe-in). If one side receives more engine torque, that side creates more toe-in and the result is a pull toward one side, especially during acceleration.

FIGURE 19.8 Broken or defective engine or transaxle mounts can cause the powertrain to sag, causing unequal drive axle shaft CV joint angles.
FIGURE 19.9 This alignment chart indicates the preferred setting with a plus or minus tolerance.

<table>
<thead>
<tr>
<th>WHEEL ALIGNMENT SPECIFICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRESCENT</td>
</tr>
<tr>
<td>REAR</td>
</tr>
</tbody>
</table>

FIGURE 19.10 Using the alignment rack hydraulic jacks, raise the tires off the rack so that they can be rotated as part of the compensating process.

FIGURE 19.11 An optical-type wheel sensor. Compensation is achieved by simply rolling the vehicle backward and forward.
FIGURE 19.12 If toe for an oversize tire is set by distance, the toe angle will be too small. Toe angle is the same regardless of tire size.

FIGURE 19.13 The protractor scale on the front turn plates allows the technician to test the turning radius by turning one wheel to an angle specified by the manufacturer and observing the angle of the other front wheel.

FIGURE 19.14 By checking the SAI, camber, and included angle, a damaged suspension component can be determined by using this chart.
FIGURE 19.15 In this example, both SAI and camber are far from being equal side to side. However, both sides have the same included angle, indicating that the frame may be out of alignment.

FIGURE 19.16 This is the same vehicle as shown in Figure 19.15, except now the frame (cradle) has been shifted over and correctly positioned.

FIGURE 19.17 Geometric-centerline-type alignment sets the front toe readings based on the geometric centreline of the vehicle and does not consider the thrust line of the rear wheel toe angles.
FIGURE 19.18 Thrust line alignment sets the front toe parallel with the rear-wheel toe.

FIGURE 19.19 Four-wheel alignment corrects for any rear-wheel toe to make the thrust line and the geometric central line of the vehicle both the same.

FIGURE 19.20 The rear camber is adjustable on this vehicle by rotating the eccentric cam and watching the alignment machine display.
FIGURE 19.21 Some vehicles use a threaded fastener similar to a tie rod to adjust camber on the rear suspension.

FIGURE 19.22 Aftermarket alignment parts or kits are available to change the rear camber.

FIGURE 19.23 Full-contact plastic or metal shims can be placed between the axle housing and the brake backing plate to change rear camber, toe, or both.
FIGURE 19.24 The rear toe was easily set on this vehicle. The adjusting nuts were easy to get to and turn. Adjusting rear toe is not this easy on every vehicle.

FIGURE 19.25 By moving various rear suspension members, the rear toe can be changed.

FIGURE 19.26 The use of these plastic or metal shims requires that the rear wheel as well as the hub assembly and/or backing plate be removed. Proper torque during reassembly is critical to avoid damage to the shims.
FIGURE 19.27 Many struts allow camber adjustment at the strut-to-knuckle fasteners.

FIGURE 19.28 Some struts require modification of the upper mount for caster adjustment.

FIGURE 19.29 An example of the many methods that are commonly used to adjust front caster and camber.
FIGURE 19.30 If there is a nut on both sides of the strut rod bushing, then the length of the rod can be adjusted to change caster.

FIGURE 19.31 Placing shims between the frame and the upper control arm pivot shaft is a popular method of alignment for many SLA suspensions.

FIGURE 19.32 The general rule of thumb is that a 1/8 inch shim added or removed from both shim locations changes the camber angle about 1/2 degree.
FIGURE 19.33 Some SLA-type suspensions use slotted holes for alignment angle adjustments.

FIGURE 19.34 When the nut is loosened and the bolt on the eccentric cam is rotated, the upper control arm moves in and out.

FIGURE 19.35 Many procedures for setting toe specify that the steering wheel be held in the straight-ahead position using a steering wheel lock, as shown.
FIGURE 19.36 Adjusting toe by rotating the tie rod on a vehicle equipped with rack-and-pinion steering.

FIGURE 19.37 Toe is adjusted on a parallelogram-type steering linkage by turning adjustable tie rod sleeves.

FIGURE 19.38 Special tie rod adjusting tools should be used to rotate the tie rod adjusting sleeves.
FIGURE 19.39 Most vehicles have alignment marks made at the factory on the steering shaft and steering wheel to help the service technician keep the steering wheel in the center position.

FIGURE 19.40 A puller being used to remove a steering wheel after the steering wheel retaining nut has been removed.

FIGURE 19.41 The toe-in on the right wheel creates a turning force toward the right.
**FIGURE 19.42** An aftermarket camber shim can be added to change the front camber on this Honda.

**FIGURE 19.43** An aftermarket kit for this Ford is installed at the top of the strut tower and allows more camber and caster adjustment than is possible with the factory adjustment.

**FIGURE 19.44** A typical tire temperature pyrometer. The probe used is a needle that penetrates about 1/4 inch (7 mm) into the tread of the tire for most accurate readings.
FIGURE 19.45 Jig holes used at the assembly plant to locate suspension and drivetrain components.

FIGURE 19.46 A typical analog-type steering angle sensor that uses a variable voltage as the steering wheel is rotated.

FIGURE 19.47 The output of a typical digital steering angle sensor.
Begin the alignment procedure by first driving the vehicle onto the alignment rack as straight as possible.

Position the front tires in the center of the turn plates. These turn plates can be moved inward and outward to match a vehicle of any width.

Raise the vehicle and position the alignment rack following the rack manufacturer's instructions.
Check and adjust tire pressures and perform the pre-alignment checks necessary to be assured of proper alignment.

Select the exact vehicle on the alignment machine.

Securely mount the alignment heads or target wheels.
If mounting a transmitter-type alignment head, be sure to attach the retaining wire to the tire valve.

After installation of the heads, follow the specified procedure for compensation, which allows accurate alignment readings.

Rolling compensation is used on machines that use lasers and wheel targets.
An alignment reading is displayed even though caster has not yet been measured. The readings marked in red indicate that they are not within specifications.

Before performing a caster sweep, install a brake pedal depressor to keep the front wheels from rotating when the steering wheel is turned.

Perform the caster sweep by turning the front wheels inward, and then outward following the instructions on the screen.
Most alignment machines will display where to make the alignment correction and will often include drawings and live action videos that show the procedure.

The rear toe is being adjusted by rotating the eccentric cam on the lower control arm while watching the display.

The alignment machine display indicates that front caster is not a factory-adjustable angle.
Adjusting the front toe on this vehicle involves loosening the jam nut (left wrench) and rotating the tie rod using the right wrench.

One last adjustment of the left front toe is needed to achieve a perfect alignment. The final alignment reading can be printed and attached to the work order.

After disconnecting all of the attachments, reinstalling the valve caps, and removing the steering wheel holder, the vehicle should be test-driven to check for proper alignment before returning it to the customer.