# ARE YOU WANDERING?

## Fixing Requires Comprehensive Diagnosis

By: William C. "Bill" Anderson, P.E.

Reformatted for this website and published with the permission of *Old Cars Weekly.*

*Wander*, the difficulty in keeping the car moving straight ahead, was a common problem for cars more than 40 years ago. Most shop manuals of the time included it and potential causes in their sections on steering problem diagnoses. Wander is often cited by enthusiasts who own 1950s and earlier vintage collector cars. Many of these owners blame bias-ply tires and install a set of radial tires. Radial tires are less sensitive to wander but they also mask problems which contribute to wander.

## Background

A key problem in assessing driving performance of collector cars is the inherent tendency to compare their performance with regularly-driven modern car(s). In the last 40 years, there have been significant improvements in design, materials, and manufacturing of automotive suspension and steering systems and their components. *Therefore, even at optimum conditions, cars 30 and more years old riding on bias-ply tires will not handle like a modern car riding on radial tires.*

Bias-ply tires, the only tire design readily before the mid-1960s, have the ability to carry a larger load than a similar sized radial tire. They were also less costly to manufacture. Radial-ply tires came to be the standard because, compared to the bias ply tires, they offered greater directional stability over varying surfaces, less rolling resistance, and longer wear. However, radials have a harder riding capability. Although radial-ply tires offer advantages, hundred of thousands of miles were safely driven on bias-ply tires in the years before radials were introduced.

Coincident with the availability of radial tires, suspension engineers began designing suspension and steering systems with tires considered as an integral component. Before 1967 when Ford pioneered this new approach, car engineers designed the suspension and steering systems and then tested tires available from tire manufacturers to identify those tires which worked best with the car; these tires became the recommended tires supplied with the car when delivered from the factory. The following admonition regularly appeared in GM shop manuals in the 1940s and 1950s:

> *"All tires and tubes used as original factory equipment have been worked out with the tire manufacturer for stability. Tires other than those used as standard equipment may cause* ***wander****."*

The tires supplied as original equipment when your collector was manufactured are no longer available and the extent to which those available today conform to what your car's en desired is unknown. It is also important to consider that the method of manufacturing tires introduces the potential for and the existence of variability in the final

product. Even tires of the same brand and size can and do vary in their performance characteristics. Because of construction characteristics, manufacturing tolerances are larger for bias-ply tires than for radials.

## Causes of Wander

Wander can occur during many driving situations. However, it is commonly experienced on roadways with variations in the pavement surface. While some variations in pavement can be so severe as to affect the steering of most all cars, there are several deficiencies in an auto's steering and suspension that can induce wander. These include looseness or binding in the steering gear or tie rods, incorrect alignment, looseness in the king pins or ball joints, and tire condition and inflation.

After decades of driving, it is reasonable to expect that some or all parts of a collector car's suspension and steering components are sufficiently worn as to exceed design tolerances. If one or more of the components are worn out, adjusting the steering or balancing the tires cannot be expected to correct a wandering car.

It is my experience that a collector car's suspension and steering systems are among the last items to be fixed. Also, there is a common tendency to assume that a problem has a singular cause which may or may not be the source when there are multiple causes. A recent project illustrates the kinds of problems that can contribute to a wandering car which were identified by a comprehensive diagnosis.

## Case History

The owner of a low-mileage, 1941 Buick riding on bias-ply tires complained of wander. He had others attempt repair of the problem with no success. Because so many factors can contribute, a comprehensive analysis was the first step. Table 1, Steering and Suspension Analysis, accompanying this article provides the findings of this analysis.

A driving test revealed that there was no apparent binding or looseness in the steering gear or linkage. The proper adjustment of the steering gear and adequacy of the steering linkage was confirmed by examination in the shop.

The wheels were tested for lateral runout and the wheel/tire assembly was tested for radial runout. The runout checks found no problems.

The air pressure in the tires and balance of the wheel/tire assembly were also checked. The tire pressures were substantially equal. However, if the front tire pressure is less than the rear, as recommended by Buick for this car, directional stability is enhanced. This result occurs because with greater tire deflection in the front, because of less pressure, the slip angle is increased which creates understeer which enhances directional stability.

1941 Buicks employ knee-action type shock absorbers. These can leak fluid and if the correct fluid level is not maintained, they will not function as intended. In this case, the shock absorbers were dry and, therefore, providing no damping of wheel movement to keep the tire firmly planted on the road.

Before any check of alignment can made, it is necessary check for (1) looseness in the front wheel bearings and (2) looseness in the king pins. In this case, the king pins were satisfactory, but one wheel bearing was loose. The wheel bearing was properly adjusted and then the alignment checked. The alignment check revealed:

- incorrect and unequal caster setting – the caster should be equal and within the specified tolerance for the prescribed setting
- toe-out setting – toe-out or excessive toe-in will affect directional stablity
- tie rods not equally adjusted resulting in the front wheels not centered on the vehicle centerline and, in turn, adversely affecting the steering geometry

After correcting all the problems discovered to factory specifications, the car drove straight and true under all conditions, except when traversing roads with severe longitudinal ruts caused by heavy truck traffic.

## Conclusions

Steering and suspension systems are complex designs involving many components which included at the time of manufacture many compromises among conflicting requirements. These compromises were carefully worked out during design and testing and appropriate specifications established governing each component.

Collector cars will not handle like modern cars. However, by ensuring that *all* components are as specified at the time the car was manufactured by the design engineers, reliable, stable handling and steering will result under most conditions encountered when driving collector cars.

TABLE 1
STEERING & SUSPENSION ANALYSIS
1941 Buick Century 4-Door Sedan

STEERING

| | Measured | Specification | Result |
|---|---|---|---|
| **Left Front** | | | |
| Camber | 0.2 degrees | -0.125 to 1.125 degrees | Satisfactory |
| Caster | -0.2 degrees | 0.375 +/- 0.375 degrees (0 to 0.75 degrees) | UNSATISFACTORY |
| King Pin Angle | 3.5 degress | 3.5 degrees | SATISFACTORY |
| **Right Front** | | | |
| Camber | 0.25 degrees | -0.125 to 1.125 degrees | Satisfactory |
| Caster | 1 degree | 0.375 +/- 0.375 degrees (0 to 0.75 degrees) | UNSATISFACTORY |

| | | | |
|---|---|---|---|
| King Pin Angle | 3.5 degrees | 3.5 degrees | Satisfactory |

**Turning Radius – Right Turn**

| | | | |
|---|---|---|---|
| Left Front | 29.5 degrees | 30.75 degrees | UNSATISFACTORY |
| Right Front | 39 degrees | 36.5 degrees | UNSATISFACTORY |

**Turning Radius – Left Turn**

| | | | |
|---|---|---|---|
| Left Front | 36.5 degrees | 36.5 degrees | Satisfactory |
| Right Front | 27 degrees | 29.75 degrees | UNSATISFACTORY |

| | | | |
|---|---|---|---|
| **Toe** | 1/16 inch OUT | 0 to 1/16 inch IN | UNSATISFACTORY |

*NOTE: Wheels are not centered Left = 18 ¼ inch; Right = 18 1/8 inch*

**Steering Geometry on Turns (Also referred to as Toe-Out)**
*When the outside wheel is turned to an angle of 20 degrees*

***Right Turn***

| | | | |
|---|---|---|---|
| Left Front | 20 degrees | 20 degrees | UNSATISFACTORY |
| Right Front | 25.5 degrees | 22 +/- 0.75 degrees | UNSATISFACTORY |

***Left Turn***

| | | | |
|---|---|---|---|
| Left Front | 24.5 degrees | 22 +/- 0.75 degrees | UNSATISFACTORY |
| Right Front | 20 degrees | 20 degrees | UNSATISFACTORY |

SUSPENSION

| | Measured | Specification | Result |
|---|---|---|---|
| **Rear** | | | |
| Left Camber | -0.25 degrees | -0.125 to 0.125 degrees | UNSATISFACTORY |
| Right Camber | -0.50 degrees | -0.125 to 0.125 degrees | UNSATISFACTORY |
| Toe | 0 degrees | -0.125 to 0.125 degrees | Satisfactory |
| **Front** | | | |
| Left Spring | 4.0 inch | 3.62 +/-0.25 inch | Satisfactory |
| Right Spring | 4.0 inch | 3.62 +/-0.25 inch | Satisfactory |

## WHEELS & TIRES

| | | | |
|---|---|---|---|
| **Left Front** | | | |
| Lateral Runout | 0.041 in. | +/- 0.125 inch | Satisfactory |
| Radial Runout | 0.062 in. | | |
| Balance | Unbalanced | | UNSATISFACTORY |
| Pressure | 30.0 psi | 25 psi | UNSATISFACTORY |
| **Right Front** | | | |
| Lateral Runout | 0.041 in. | +/- 0.125 inch | Satisfactory |
| Radial Runout | 0.055 in. | | |
| Balance | Unbalanced | | UNSATISFACTORY |
| Pressure | 30.5 psi | 25 psi | UNSATISFACTORY |
| **Left Rear** | | | |
| Lateral Runout | 0.034 in. | +/- 0.125 inch | Satisfactory |
| Radial Runout | 0.070 in. | | |
| Balance | Unbalanced | | UNSATISFACTORY |
| Pressure | 29.7 psi | 30 psi | Satisfactory |
| **Right Rear** | | | |
| Lateral Runout | 0.035 in. | +/- 0.125 inch | Satisfactory |
| Radial Runout | 0.060 in | | |
| Balance | Balanced | | Satisfactory |
| Pressure | 29.8 psi | 30 psi | Satisfactory |