Pull or Push— Drift, Drag or Wobble

Sometimes your best (and sometimes your only) clues are the strange way a car feels or steers. Here are a few such oddities and some possible diagnoses.

Part of a continuing series of articles on undercar systems

Sponsored by Federal-Mogul Corporation.

What's the first thing to do in an alignment? After listening to the customer's description, confirm the complaint by driving the car. Usually this can point you in the direction of a solution and correction, even if it does not eliminate every other possibility at the same time.

Pulls can come from many different problems, beginning with the tire pressures. Obviously a vehicle will tend to pull toward the tire with lower inflation pressure simply from the greater drag. This does not argue for overinflation, of course, but to identical inflation pressure on each, as specified in the manufacturer's information. When tires of the same size have the same inflation pressure, the axle wants to steer straight....

...Except when something else induces a pull or drift. While few modern vehicles use longitudinal leaf springs to secure a tubular axle in place, many use a subframe to which the engine and suspension/steering elements are connected through rubber bushings, the better to isolate the passenger compartment from the vibration and noise generated by the road and the drivetrain. It is not uncommon to find these subframes shifted when the bushings deteriorate either from heat, oil or stress. Once the subframe shifts, the results can be just the same as with those old solid axles.

Here are some typical problems you might find in customers' cars and some things that might cause those problems.

Constant Pull To One Side

Let's be clear. A pull is not the same thing as a steering wheel not properly centered. Many, perhaps most, cars eventually have an off-center steering wheel after 50,000 miles or so, when the bushings have taken a set and the frame or unibody has sustained a certain amount of bending. This can be corrected, of course, but it is not the same thing as an active pull.

You have to use some force to overcome a pull. Probably the most common cause of it in modern cars is incorrect camber on one side, often the right. Sometimes you can see this at the wheels, noticing which one leans more to the outside as the car stands still with the wheels pointed straight. Before radial tires became common, this was also visible in tire wear, with the outside tread worn down more on the wrong-cambered wheel. On a radial tire, though, such wear is more indicative of the wrong toe setting.

Pull Only During Braking

We immediately suppose there must be a grabbing brake if we discover pull only during braking, and that is one of the possibilities. But far from the only one. Most cars now are front-wheel-drive, with the brakes plumbed in a dual-diagonal way, so the right front and the left rear apply together and the others on the other hydraulic circuit. If there is anything holding off one of the diagonal pairs of brakes — even a self-adjuster that has failed or gone crazy — that can translate into a steering pull during braking.

In such cases, be suspicious if you find a brake pedal that travels more than seems normal, and check to see that there is fluid in both master cylinder chambers. With many cars, especially European models, there is one reservoir feeding both, and it is not always easy to see whether both are full. If a car runs out of master cylinder travel, one of the hydraulic circuits will lose it first.

A less frequent but not rare cause of brake pulling can occur with brakes that drag slightly. If one of the front brakes is slightly on during normal driving, this may not cause enough drag to feel from behind the wheel. But it will still be enough to heat the disk. When you apply the brakes, of course, you're changing the kinetic energy of the car's motion for heat at the disk. If the disks start at different temperatures, this will throw off the balance of decelerative force they can apply to the car. A good test for this is to drive the car for a time at highway speeds, then slowing to a stop either by downshifting and coasting or by using only the hand brake. Then check the temperatures of each front disk: they should both be as cool as the ambient air. If one of them is not, one gets you five somebody just hung pads the last time brake work was done, and neglected the calipers entirely.

One more brake-related but not brake-caused source of steering pull occurs when a tie-rod end is worn on a front-wheel-drive vehicle. As the engine provides torque to move the car, the wheels want to toe in from the drivetrain force. And when acceleration/deceleration forces go neutral when coasting, the alignment geometry can hold the wheel about where it should be. But when you apply the brakes, the wheel with the worn tie-rod goes to the extreme toe-out position, forced there by the brake drag. Obviously, nothing you do to the brakes will change this; it's a steering/alignment problem.

Brakes are intended to pull—the car to a stop when the driver intends that to happen. But if they apply differently from one side to the other, they still pull, but at the steering as well. Major reasons for brake pull include: seized pistons in calipers or seized calipers on knuckles, differences in rotor surface quality or brake pad condition from side to side, air in the hydraulic circuits of one side, and shifting or bending brake parts.

Drift Or Vague Steering

Caster is the alignment angle that is supposed to provide self-centering for the steering, and it is often thought to be non-adjustable on some cars. Just as with camber, as a car ages and racks up the miles, the gradual hammering on the chassis can have the effect of slowly changing the geometry so that a car that had the proper small positive camber ends up with none or even with some negative caster. Sometimes the shop manuals will say that a given car does not have adjustable caster, and some manuals don't even give a specific caster measurement at all. The angle works in the normal way in any case, whether the manufacturer chooses to mask manufacturing tolerance variations or not, however. For vehicles without a specified caster, it is worthwhile keeping a record of 'known-goods' to compare later problem cars against. There are, of course, aftermarket devices to adjust even the 'un-adjustable.'

Another factor can simulate bad caster: someone may have recently replaced any of the bushings and retightened them either with the steering wheel turned or with the wheels hanging from the car, that is, without the weight on the suspension. When bushings are tightened in either of these conditions, they are then misaligned when the vehicle is at its normal position, and the elasticity of the bushing rubber wants to push the link back to the position it was in when tightened. This, of course, is exactly why you only want to tighten those you install yourself in a loaded, centered steering wheel position.

Bump steer occurs if at normal driving height the tie rod angles up or down compared to the steering rack. This angle pivots the wheel in and out as the suspension goes through jounce and rebound, causing the car to steer first one way and then the other. Causes can be mispositioned racks, sagging springs or even a bent steering arm on the knuckle.

Sometimes it's the steering gear that allows the pull. If a tie rod end is worn, that can let the alignment toe change depending on whether the car is accelerating, cruising, coasting or stopping. If the front toe is adjusted too much in or out, the car can change steering feedback as soon as a turn begins. If the rear toe is wrong, this will throw off the thrust line, requiring a constant steering correction from the driver.

Steering Wheel Twitch Or Wobble At Low Speeds

If you see the steering wheel move on its own when driving very slowly - in a way that might be called "notching" or "wobbling" - this is almost always a problem with the tires or wheels. Routine tests for out of round and out of true should identify a wheel that has kissed a curb too forcibly, though sometimes the damage is not to the wheel but to a spindle or spindle mount (on the rear). Tires, of course, can cause practically any kind of steering problem, depending on just what has gone wrong with them. Even if turning the wheel by hand and inspecting it does not show a problem with the rubber, it is almost always worth the time with any non-obvious steering problem to rotate the wheels front to back to see whether the problem follows the tires or goes away.

Wheel Vibrations

Most wheel vibrations are simply due to out-of-round, out-of-true or out-of-balance conditions, and are easily diagnosed and corrected. But there are some apparent wheel vibrations caused by other problems, and they may not yield quite so easily.

Constant velocity joints have a variety of ways of failing, usually with split boots and a grinding, cracking noise until the shaft falls out of the socket. But not always; those are the ones that fail because the boot splits, the grease goes away and road grit excavates the metal. Sometimes the boot lasts longer than anything else, even though there is internal wear. When that happens, the joint itself can get out of balance because the shaft is allowed to bounce around somewhat in the cup.

One clue that you have this sort of problem rather than a more traditional wheel imbalance is that such a problem will not necessarily vibrate at wheel speed; it may be intermittent or may follow a different resonance. Bent and out of balance wheels, while they may be more evident at one speed than another, are never intermittent.

If you find a vibrating front wheel on a car where the condition has persisted for some time, you can be almost certain the strut cartridge has failed, too. Like shock absorbers of old, the working element is the oil, and it is worn out once air and moisture get into solution, allowing cavitation of the fluid and an end to vibration damping. Many otherwise insoluble wheel vibration problems go away with the old Mac strut cartridges.

No Or Intermittent Power Steering Boost

This problem can become very dangerous, particularly for a motorist with limited upper-body strength. Any problem with a car's steering can result in an accident more quickly than most people can make corrections. This is something to remind ourselves of from time to time, because professional mechanics are quite untypical in being able to handle this sort of problem without great alarm. Most people can't and won't. There are, in plain words, no unimportant steering problems.

No doubt the most frequent cause of intermittent steering boost is a slipping hydraulic pump drive belt, glazed, improperly tensioned or whatever. Fortunately, if this is the cause the effect will occur most frequently during parking when safety is not as much an issue. One part of the correction people sometimes miss is to clean the glazed rubber off the

The reason a wheel pulls or drifts could be and frequently is the wheel itself or the tire mounted on it. Wheels and tires are surprisingly strong in resisting normal shocks and blows, but when a driver smacks sideways against a curb, for instance, the wheel can take a permanent bend. A pothole may not puncture a tire right away, but the blow can sometimes tear the cords inside the tire carcass, allowing the tire itself to warp out of round.

pump pulley. A glazed pulley can have a much reduced grip on the new belt.

"Morning sickness" is how people have described power steering that doesn't work until the car has warmed up for a while. What actually occurs is that the hydraulic oil simply bypasses the seals in the rack until the increased temperature of the oil warms the seals enough that they can spread that extra thousandth of an inch and dam up the fluid. Unfortunately for the customer, there's not much you can do about this but to replace the rack with a good quality rebuilt unit. Specifically you should avoid using or recommending any kind of pour-in fix. There just is no magic potion that will seal the cold rack piston rings without having adverse effects during other operating conditions.

And what is going on if you have boost in one direction but not in the other? That's internal to the hydraulic valve in the rack, possibly caused by debris or by wear. Unless you are experienced in rack rebuilding, this is another one that calls for rack replacement.

The most dangerous form of intermittent steering boost comes because the level of fluid is too low, so the boost stops when the pump starts to suck air. Obviously, the only way the fluid went low was through a leak, either internal or external. If you don't find the place from an ordinary inspection of the hydraulic circuits, make sure to check inside the bellows-boots at either end of the rack, enclosing the inner tie-rod ends. In any case where you find there has been noticeable metal abrasion either at the pump or at the rack, it is a good practice to install a particle filter in the low-pressure return hose.

Bump Steer And Change Of Steer In A Turn

Two steering surprises (and there are, as I said, no good steering surprises) can occur unexpectedly. Bump steer occurs when the movement of a wheel through its normal suspension travel also causes the geometry of the tie-rods and rack to abruptly change the toe back and forth. The most common cause of this is sagging springs, which allow the car to ride lower, changing the angle between the rack and the steering knuckles (which, of course, don't ride lower). The only other causes of bump steer are a mis-positioned steering rack or rack mounting bushings that move depending on the steering load.

Steering that changes angle suddenly once you enter a turn comes from wrong toe or worn components that let the toe change. Once the car shifts its weight to the outside wheel in a turn, the toe of that wheel becomes the dominant toe determining the angle the car will follow. If that angle is significantly different from the average toe — what the car was following before the turn — the driver will perceive this as an abrupt change, either sharpening or widening the turn.

Binding Steering

Now this one's really dangerous. It's one thing to have the car want to turn the wrong way, or drift to the side or not return to straight after a turn. But if the steering locks in one position — in ANY position — that is a safety problem like none other. There is, unfortunately, no regular and simple cause of bound steering. One thing for sure: don't drive the car until the problem is identified and solved.

Anything that can cause friction or mechanical lockup can bind the steering. Sometimes it's something as simple as a seized tower bearing in a MacPherson strut. This doesn't really lock the steering, but it holds the spring and makes the driver work against it. When the bearing does pop loose, the feedback through the steering wheel changes dramatically and all at once, so you can go from a strong left pull to a strong right pull with one clang of the spring!

To identify the cause of the binding, you have to disconnect separate parts from the system. I have seen steering binding because the little U-joints on the steering column became loose and twisted to a position never planned. I've seen steering that seized because a ball joint had collected so much road salt and sand that it finally just decided not to turn any more. In some cases, it may be necessary to put the weight of the car on the wheels to get the faulty component to react in the way causing the binding.

Throughout the work, keep in mind that while you always want to save your customer money and get him or her the best deal for the exchange, steering is the last place on the car to economize. This is one place where it really does make sense to say "If this were an airplane, I wouldn't fly in it." Steering **IS** that important.

—by Joe Woods