MacPherson Strut Diagnosis

Discussing strut diagnosis can be a little like discussing religion. No two people agree on every issue, but they're all sure they have access to absolute truth in the matter.

And while the road to steering salvation may be straight and narrow, there are some off-ramps. Some really questionable theories have been thrown around as gospel in the past. I know that for sure after reading a number of strut articles that actually contradict one another.

As usual, the burden of solving knotty strut problems will fall squarely on your shoulders. Your experience and common sense will usually go a lot farther than you think. Good observation and attention to detail will usually do more good than fancy engineering concepts.

Killer B's

Now that MacPherson strut front ends are more the rule than the exception, you're going to be diagnosing specific problems different from those you saw on the old two-control arm cars.

Most problems will be caused by what I call the Killer B's, namely bent, broken, binding, or just plain beat components.

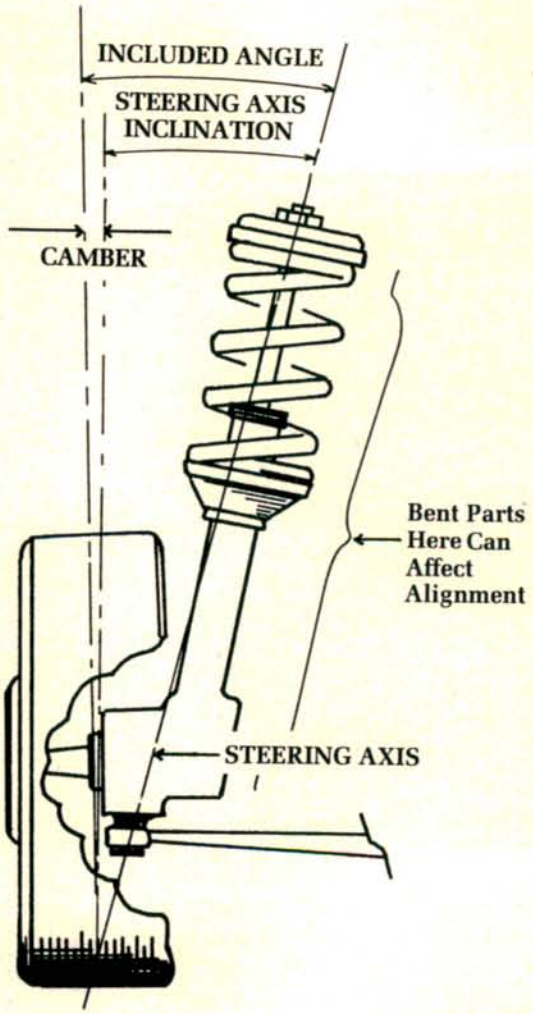
If we can at least agree that OEM design is adequate for passenger car applications, we have a starting point. If we also agree that restoring a vehicle to original specs is essential to good suspension and alignment repair, we're on our way.

As we go on, keep the Killer B's in mind, because if you have a real problem with a strut front end, then something is basically busted.

Drive, Look and Listen

The two best tools you have for diagnosing strut problems are your eyes and ears.

• Take the time to drive the problem car before you start tearing things apart. Most good technicians test drive *after* a repair. Too few start that way. If you observe a handling problem before making a repair and it still exists after the repair, at least you know you didn't create a problem.



As you drive, listen for any abnormal noises and note when they occur. When turning? When stopping? Does the car pull when braking? When accelerating? Does the car wander? Does it bottom, shake, or bang over bumps?

• Take a moment to talk with the customer. I know it's time consuming, but there's always time to talk about problems after it's too late.

Let's face it, the customer lives with the car. He's driven the car under a wider variety of road condi-

tions than you're likely to encounter on one test drive. If he's been paying attention at all, he may be some help. Listen to the car *and* its owner.

• Before you raise the car on a lift, take a moment to look it over. Check to see that it sits level. Bounce the front end to see if the suspension rebounds, and rebounds evenly. Are the tires the right size for the car, the same size all around, and properly inflated?

If the car refuses to stop bouncing, rebounds unevenly or not at all, or makes noise during suspension compression and rebound, you're getting closer to the Killer B's.

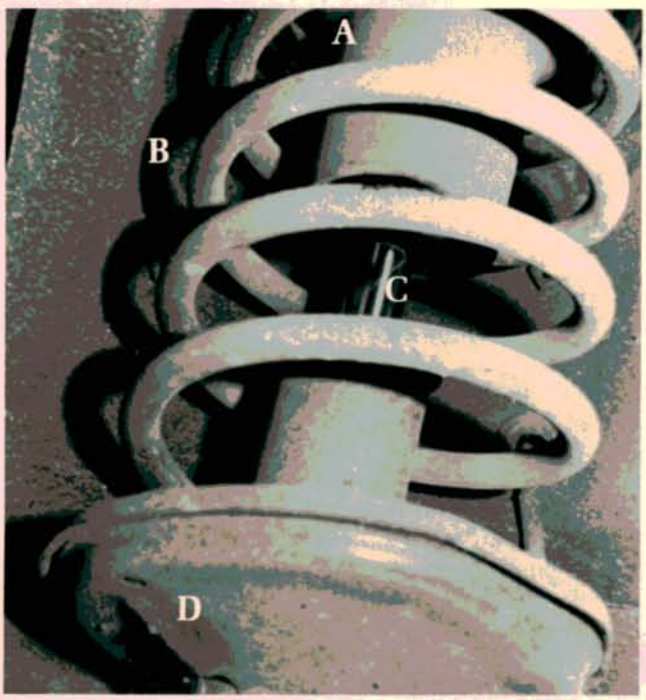
• Lift the hood and inspect the inner fender area where the strut bushing mounts to the strut tower. If the outer fender is freshly painted, you want to pay special attention to the inner support metal. Improper collision repair—or even worse—damaged but unrepaired support metal will throw everything out of whack.

Unit body cars are easier to damage at critical points than full-framed vehicles. They can also be a lot less forgiving.

• While an assistant turns the steering wheel back and forth, look under the hood to see that the strut shaft rotates in the strut bearing. The shaft should not move from side to side or fore and aft. This is a pivot point. Along with the ball joint, this pivot determines steering axis inclination or SAI. If it's moving side to side, the upper mount is bad. As a result, it's constantly changing the car's alignment.

Up On The Lift

Even if a car is in for something as simple as a tire rotation, it pays to look at the points we've marked in the following photos.



• Point A—Check to see that the protective boots are properly attached and not torn.

• Point B—Check to see that the spring is not broken or otherwise damaged.

• Point C—Inspect this area for signs of an oil leak. Also check the strut shaft for rust, pitting, or galling. A rough surface can cause binding and will eventually ruin the shaft seal.

• Point D—Check here for any signs of tire rub. A bent strut tube could allow the spring perch to contact the inner edge of the tire. In areas where salt and corrosion are problems, you should also look for signs of rust perforation. Even though most spring perches have drain holes, they can get clogged. This causes the cup to fill with salt and corrode.

Inspect the marked areas for signs of damage.

• Point A—Look for a kink or bend in this area. Any severe bend here will usually be accompanied by some kind of sticking or binding.

• Point B—Check for a bent control arm. These arms have gotten a lot lighter on the new front drive compacts. They also ride down low, right near the road hazards. Also check the inner control arm mount bushings for damage or wear. Has the body been damaged in the area where the bushings mount?

Memory Steer

Memory steer is a fancy word for steering that sticks or binds in a turn. It wants to stay in a turn instead of centering itself again.

To isolate the cause of memory steer, you may want to disconnect the tie rods. This will allow you to turn each strut individually. A hard-to-turn strut

may be caused by a dry or sticking ball joint or a binding upper strut bearing. Occasionally that rubber snubber on the strut shaft will stick to the strut shaft and bind on the strut bearing.

If neither strut is binding, but memory steer remains, you'll have to check the steering shaft and rack assembly for binding.

Help From the Alignment Rack

The measurement of SAI or Steering Axis Inclination collected dust in the attic of alignment theory for years. Now it's been pulled out of storage as a method for checking strut front ends for bent parts.

One of the major differences between the old SLA (short/long arm) front suspension and the strut is the distance between the pivot points determining SAI. On cars with upper and lower control arms, the ball joints, or pivot points, were fairly close together. On struts, the upper pivot bearing and ball joint are much farther apart. Now any change in pivot point position spreads alignment change over a longer distance.

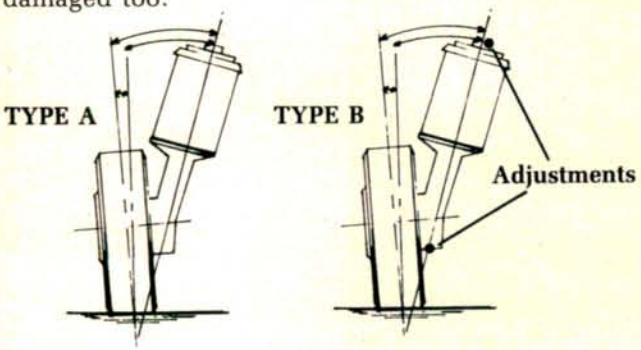
This was great for the manufacturer. It allowed him to start making some cars with no provision for alignment correction except for toe. This was not necessarily good for the owner or technician. Fine tuning the steering for minor changes of alignment caused by non-critical wear was not possible. (Sure—anything's possible, but it certainly wasn't practical on many of these cars.)

Now when a car showed up with drastic alignment problems, the technician had to assume that something, somewhere was bent. But how to find it? Checking SAI can help.

A Helpful Little Chart

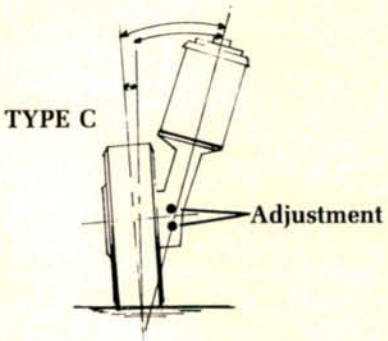
In the following chart, we've listed three basic types of strut, depending on whether or not the manufacturer allows for camber and/or caster adjustments.

Whenever we refer to a "spindle," we also refer to those front drive cars that have drive hubs carried by bearings in the knuckle. These bearings can be damaged too.



Type A
- This type has no adjustment except for toe.
- The upper strut bearing is not movable.
- The lower ball joint is not movable.
- The spindle is not adjustable for camber.
- If caster, camber, or SAI are out of specs, something is bent or broken.
- If both camber and SAI are out, suspect bent body parts where the control arm mounts inboard, or look for a damaged strut tower.
- If camber is out but SAI is correct, check for a bent part in the area of the spindle. Other possibilities are bad wheel bearings, a bent wheel or drive hub, or a bent spindle. Remember the Killer B's.

Type B
- This type allows for some adjustment of camber and/or caster. There are limits to the amount of adjustment.
- The adjustment requires movement of a strut pivot point. Either the strut tower is slotted to allow for movement of the upper strut bearing, or the ball joint is mounted in a slide in the control arm.
- Since you're moving the whole strut, any change in camber changes SAI.
- If you can't correct the camber within the limits of the factory adjustment, look for more bent parts or out-of-location mounting points.



Type C
- This type allows for adjustment of camber without a change in SAI.
- Since the spindle can be corrected for camber without changing the strut pivot points, camber can be altered without a change in SAI.
- If you adjust camber and a driveability problem persists, check SAI.

Checking SAI

We're going to include a specific example of checking for SAI. We happened to do it on a Hunter alignment machine using their suggested method.

Of course, your equipment may require a slightly different approach. Be sure to use the recommendations and procedures listed by the manufacturer of your particular equipment.

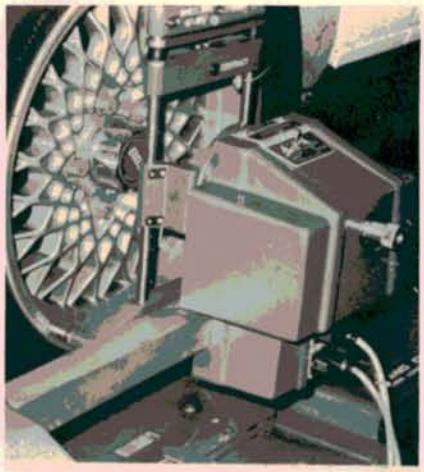
If you haven't been doing SAI checks as a part of strut diagnosis, you may be relieved to see that it isn't extremely complicated or difficult. It's certainly worth the effort if it pinpoints problems for you and helps you look smart to the customer.

If the area by the arrow is rubbed shiny by the inside of the tire, something is drastically out of whack. (We're assuming that no one has changed the rim width or tire size.) Possible causes include: a bent strut, bent spindle, bent rim, completely wasted wheel bearing, severe body damage, or a *combination* of these problems.

The ball joint (A) provides the lower pivot for the strut and connects the lower strut to the chassis by the control arm (B). Wear in the ball joint or a bent arm affects SAI (Steering Axis Inclination) and camber.

The arrows point to the engine cradle, which in this case also functions as the inner mount for the control arm. Look closely in this area for any signs of damage. Make sure the cradle mount bolts are tight. Also check the bushings in the arm for excessive play.

Checking SAI will look similar to checking caster. This should be done after an alignment or if a problem is encountered. Hunter suggests you raise the vehicle and let the wheels hang free.



If you haven't already done an alignment and are only checking for SAI, be sure to compensate for runout. Small imperfections in the wheel, or uneven mounting of the heads can result in faulty readings if you don't.

You'll have to lock the brakes to keep the front wheels from turning. Position a rod between the seat and the brake pedal to apply the brakes firmly enough that you can't spin the wheels.

Now level and lock the heads with the wheels set in the straight ahead position. This equipment will tell you the position of the wheels so the traditional turntable scales are not needed. Again, be sure to follow directions for your particular equipment.

Now turn the wheels to the left and right using the steering wheel. The machine tells us how far to go in each direction, computes SAI, and gives us a printout. You'll usually find more SAI specs available for imports than for domestics. ■