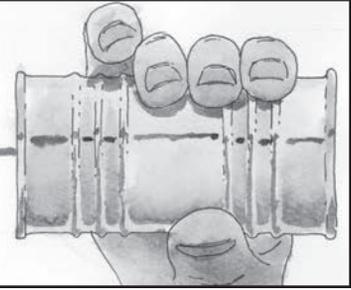


MEMBER 2 MEMBER



*Members' Solutions to Members' Questions
This Issue features suspension upgrades by TDR Writer Doug Leno.*

THIRD GENERATION SUSPENSION UPGRADES: PART THREE

by Doug Leno

In August of 2012, TDR Issue 77 (pages 42-50), I described the first part of a major suspension upgrade for my 2004 Turbo Diesel. At the heart of this upgrade was Carli Suspension's "Backcountry 2.0" system, which included multi-rate coil springs in the front and a progressive five-leaf "add-a-pack" in the rear. Also in the kit: Carli's adjustable track bar and 2-inch diameter 5160-series Bilstein reservoir shocks. To these impressive components, I added Carli Suspension control arms as well as their torsion sway bar.

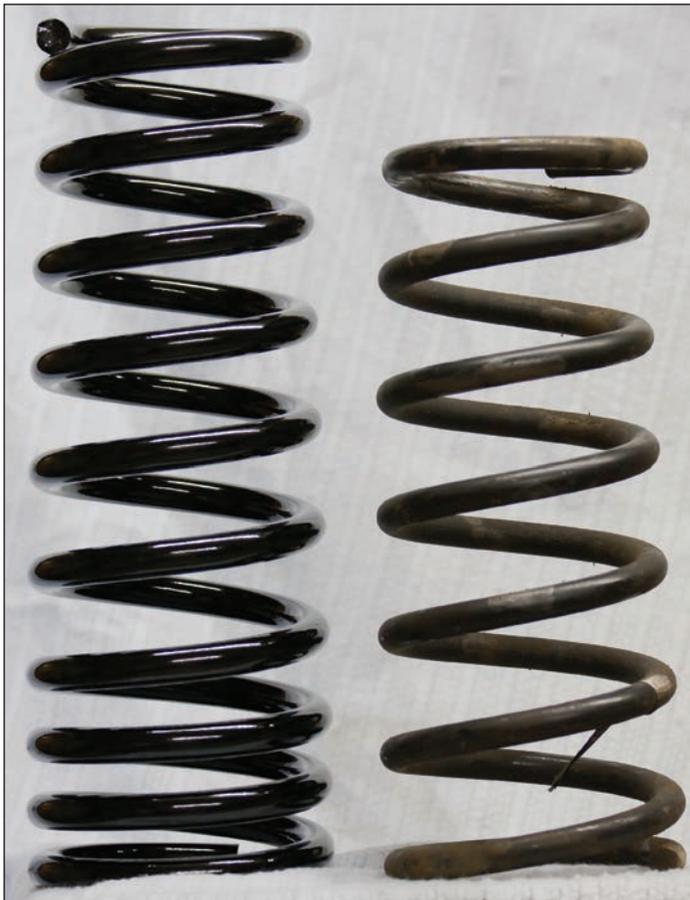


Figure 1: Carli Suspension multi-rate coil spring (left) installed in 2012, provided approximately three inches of lift compared to the factory spring (right)



Figure 2: Carli suspension lower control arm, installed in 2012. The serviceable bearing eliminated the friction caused by the rubber bushings in the factory control arm.

Part Two of the project was covered in February 2015, TDR Issue 87 (pages 13-17). In this article I described the Carli Suspension "dual-opposing steering stabilizer" solution. This upgrade greatly reduced the risk of stabilizer damage in off-road situations by locating both stabilizer bodies above the bottom of the axle tube (see figure 3).



Figure 3: My (Issue 87) Installation of the Carli Suspension "Dual opposing steering stabilizers." Without using the factory mount point, the lower stabilizer is located above the bottom of the axle tube, reducing the risk of damage in off-road situations.

LET'S GET STARTED: PART THREE

In this article I will describe my repair of the factory steering linkage system and discuss my choice to upgrade to the newest factory design.

Steering Systems: "Y" and "T" Styles From the Factory

After 10 years and 150,000 miles, my factory steering system tie rod ends were showing the expected signs of deterioration and the wear produced some sloppy steering performance. To determine the repair, I first looked to see if there were any steering system recalls. I discovered "Safety Recall H46" which affected a small number of vehicles requiring a new drag link inner joint and/or pitman arm, but it turned out that this recall did not affect my vehicle. I was on my own for parts replacement.

Turbo Diesels from 2003 through the mid-2008 model year were manufactured with what is known as a "Y-type" steering system, illustrated in figure 4. In the illustration, note that the tie rod from the left front tire connects to the steering drag link, forming a "Y" configuration. Why is this important? Imagine, for example, that the steering box in Figure 4 moved upward. This action would pull the left and right steering knuckles closer together, causing the tires to "toe in" (pigeon-toed). Conversely, moving the steering box downward would push the steering knuckles farther apart, causing the tires to "toe out." The main point of interest for this geometry is that *suspension toe changes dynamically during normal vehicle operation.*

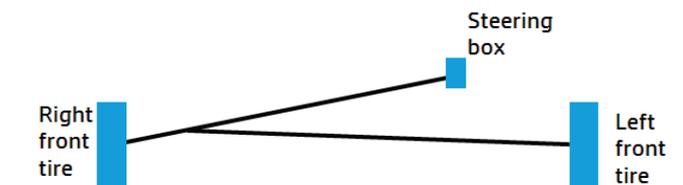


Figure 4: "Y-type" steering system supplied on 2003-2008 model year trucks. In this configuration, suspension toe changes dynamically during normal vehicle operation.

During the 2008 model year, Chrysler began to ship model 2500 and 3500 model Turbo Diesels with a different steering linkage geometry known as the "T-type", illustrated in figure 5. Note that for this geometry, the distance between the left and right steering knuckles is fixed, due to the rigid tie rod connecting the two together. *This means toe is not affected by suspension flex.*

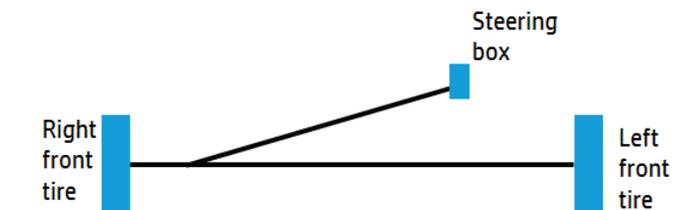


Figure 5: During the 2008 model year, Chrysler introduced the "T-type" steering system, so named because the steering drag link "tees" into the steering tie rod. For this geometry, the distance between left and right steering knuckles remains fixed, keeping toe constant during suspension flex.

Instead of repairing my 2004 steering system, why not upgrade my truck to the latest steering system?

The "T-type" steering system, first introduced in 2008, presented an interesting option to me: Instead of repairing my 2004 steering system, why not upgrade my truck to the latest steering system?

Beyond the geometry differences themselves, the new T-type steering system provides additional stiffness and stability via larger diameter tubes, 1.5" versus 1.25", compared to the older Y-type system (see figures 6 and 7). This made the decision to upgrade easy. Because the job would be a simple one, I decided to perform the upgrade myself.



Figure 6: My tape measure shows the 1.25" diameter steering linkage tubes used on the 2003-2008 "Y-type" steering system that I replaced. The newer "T-type" system uses larger 1.5" diameter tubes.



Figure 7: T-type steering system is made with 1.5" diameter tubing, and is considerably more robust than the older, Y-type steering system. The new system is over five pounds heavier.

Oops, A Recall of the T-Type System

It turns out that Chrysler has made a number of updates to the T-type steering system since its introduction in 2008, the most important of which coincided with Safety Recall N49 / NHTSA 13V-529. This recall, issued in January 2014, impacted some 260,000 vehicles built between February 14, 2008 and December 22, 2012. The subject of this recall was to address the following condition:

The left tie rod ball stud on about 264,000 of the above vehicles may fracture under certain driving conditions. This could cause loss of directional control and/or crash without warning.

N49 is a comprehensive recall: All 2008-2012 vehicles equipped with T-type steering systems are updated with a newer T-type steering linkage at factory expense. What was wrong with the parts that are replaced under the N49 Recall? I contacted my dealer, who was (understandably) unable to give me any information beyond N49 itself (stated above).

Unsatisfied with this lack of detail, I requested permission to inspect a few steering linkages which my dealer had already replaced under the recall. I started by inspecting the left tie rod ball stud of both "new" and "recalled" systems, as shown in Figure 10. Do you see any difference? I didn't either!



Figure 10: I found no difference between "good" and "recalled" tie rod ball studs, the subject of N49. On the left is a verified "good" part which I installed on my truck. On the right is a recalled part from my dealer's boneyard.

It addresses the probability that a careless alignment technician might pre-stress the left-side ball stud during toe adjustment!

After further investigation I found what I believe to be the real reason for the recall: The recall does not appear to address the ball stud itself; it addresses the probability that a careless alignment technician might pre-stress the left-side ball stud during toe adjustment! If you carefully inspect figure 11, you will see the update: The newest tie rod has an internal mechanism to prevent the right-hand tube from rotating along with the toe adjustment collar. The older (recalled) tie rod has no such mechanism, as you can see in figure 12.



Figure 11: The adjustment collar on the newest T-style steering system. Note the inner mechanism in between the two threaded halves. This prevents the right hand tube from rotating along with the adjustment collar.



Figure 12: The older (recalled) system allowed the right hand tube to rotate along with the adjustment collar, allowing a careless technician to pre-stress the ball stud inside the steering knuckle.

A WORD OF CAUTION

A caution about installing the newer steering linkage system onto an older truck: *Even if the upgrade is performed by a dealer, Chrysler has no way of tracking or associating the new steering system to your VIN.* In fact, 2003-2008 trucks that were upgraded to the new steering system during or prior to calendar year 2014 may have received the components that N49 was designed to catch. I am aware of one Turbo Diesel owner, for example, who upgraded his 2003 truck, only to find out later that the parts he installed were recalled by N49. The good part of the story is that his dealer performed the recall procedure on his 2003 truck, even though N49 itself did not apply to that model year. So, if your 2003-2008 truck has been upgraded to the new T-type steering system, you will need to pay close attention to factory communications, TSBs, and recalls. When in doubt, take your truck to your dealer for inspection.

One additional concern I had was the possibility that T-type steering systems might be aligned differently than Y-type systems. For example, witness the recommendation from Carli Suspension to align T-type systems with 1/8" of positive toe-in, and Y-type systems with zero toe. Would a shop be able to recognize, for example, a 2004 truck with the steering system from model year 2012?

After discussing this concern with three local alignment shops who were gracious enough to look up the alignment specs published by Chrysler, I came to the conclusion that there is really nothing to worry about. The factory spec is the same for both systems: 0.20 degrees +/- 0.10 degree. ***(Editor's note: it is frustrating to see alignment specifications in "degrees" versus the layman's understanding of "1/8" toe-in or 1/16" toe out." How do degrees translate to an "inch" measurement? Check out the website www.ingallseng.com and the conversion chart tells me 1/16" is .12°, 1/8" is .24°, and 1/4" is .50°)*** Turbo Diesel owners who are particular about the actual toe-in set point should discuss this subject with the shops they trust.

Installation

Installation of the new T-type steering system is easily accomplished in a home garage with the front axle on jack stands. For removal of the old system, a pitman arm puller and a little patience are all that is required beyond standard garage tools. Table 1 shows my shopping list:

Mopar Part Number	Description
52122362AF	T-type steering linkage (1)
68039930AA	Pitman Arm (1)
6505623AA	Nuts (3)
52122370AB	Steering Damper (1)

Table 1: part numbers required for upgrading 2003-2008 trucks to T-type steering.

From my "Part Two" (Issue 87) article you know that the Carli Suspension steering stabilizers are already installed on my truck. Therefore, I did not purchase a new factory damper, but I did have to update my Carli Suspension stabilizers with different mounting hardware, which I will describe later.

After removing the Pitman arm from the steering box, the entire system can be removed by loosening the nuts on the left and right ball studs (see Figure 8).



Figure 8: Dropping the old Y-type tie rod from the driver-side steering knuckle. The nut in this photograph (circled) is only partially removed.

Setting the initial Toe

Although most of us rely on alignment shops to check or perform the adjustment, our Turbo Diesels are easy to align, even in a home garage. "Total Toe" is the only adjustable alignment parameter, determined by the length of the tie rod set via the adjustment collar. This meant I had to set "Total Toe" myself, at least initially. Rather than measure the parameter directly on the vehicle, I decided to pre-adjust the length of the new tie rod to match the length of the old one (see figure 9), and then go to an alignment shop for final adjustment. It turned out my pre-adjustment was only 1/32" off!



Figure 9: pre-adjusting the length of the new tie rod before installation.

Adapting the Carli Suspension Stabilizers

Carli Suspension's dual stabilizer system is compatible with either "Y-type" or "T-type" steering systems. As is the focus of this article, the newer steering system is manufactured with larger diameter tubes, which means that a different Carli suspension clamp is required for the upper stabilizer (see figure 12). Carli's low-mount stabilizer utilizes the factory supplied clamp, shown in figure 13. Note that for these photographs, I decided to break with tradition and show the installation after several hundred miles of road use. You won't see shiny new parts in these photos, but you will see how road grime accumulates, and how the axle tube itself protects the lower stabilizer (figure 13).



Figure 12: Installation of the Carli Suspension "High mount stabilizer" required a new clamp to accommodate the new tube diameter.



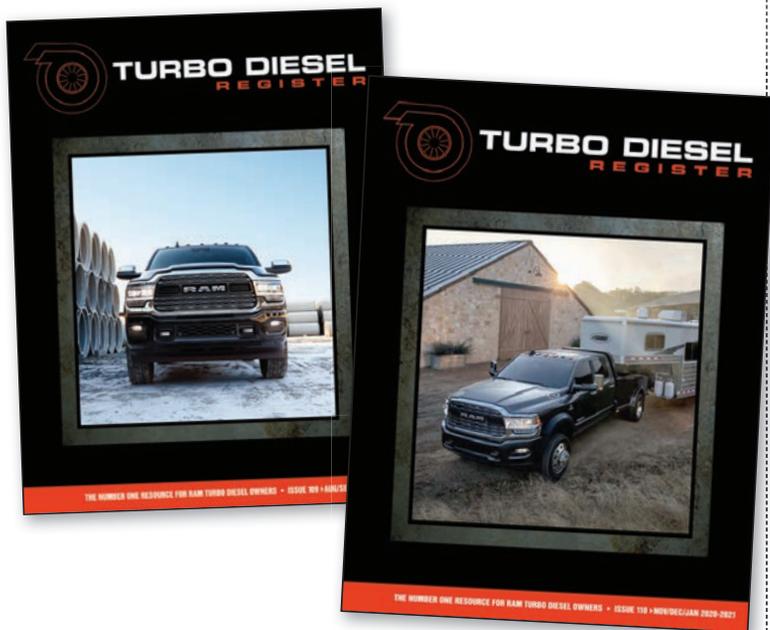
Figure 13: The Carli Suspension Low-mount stabilizer utilizes the factory supplied clamp, repositioned to the correct location per instructions from Carli Suspension.

Conclusion/Notes

Overall I am very pleased with my truck's steering performance after upgrading to the T-type drag link. Stiffer tubes and new tie rod ends are good! Here are some additional summary points:

- Chrysler has demonstrated a commitment to the T-type steering system, first introduced during the 2008 model year, and this system is an attractive upgrade to the older Y-type systems found on 2003-2008 trucks. With the N49 recall behind us, the currently available replacement steering systems are a good choice. The upgrade is frequently installed by dealers.
- Turbo Diesel owners who upgrade their 2003-2008 model year trucks to the new steering system will not be automatically notified of Chrysler-initiated updates or recalls that are model-year or VIN specific. Care should be taken to ensure that such installations remain current with the latest information intended for 2008-present model year trucks.
- Aside from the above, there are no serviceability issues or risks associated with installing the newer T-type steering system onto 2003-2008 trucks. The upgrade is a drop-in replacement for Y-type steering systems, and subject to the same factory alignment specs. Turbo Diesel owners who are particular about the actual toe set point should discuss the upgrade with the alignment shops they trust.

Doug Leno
TDR Writer



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BALL JOINT REPLACEMENT

by Doug Leno

After installing the steering system upgrade I just described, I visited a local alignment shop to check the toe-in specifications. Unfortunately, the shop refused to align my truck on account of a loose ball joint. I have known high volume tire stores to do this sort of thing to boost sales, but this diagnosis was no surprise, and it came from a shop that I trusted: After 150,000 miles, I knew it was ball joint replacement time.

*After 150,000 miles,
I knew it was ball joint
replacement time.*

My analytical nature kicked in, and I decided to do some research before choosing my parts. I rounded up four different sets of ball joints for comparison against the factory parts available from my local dealer: NAPA Chassis, Moog Problem Solver (obtained from O'Reilly auto parts), Duralast (obtained from AutoZone), and Carli Suspension. The assortment is shown in figure 1.



Figure 1: from left to right: Upper ball joints from Carli Suspension, Moog, Napa, Duralast, and Mopar. Some are smooth, some are knurled, some have a grease zerk, and some are sealed. The Zerk on the NAPA part in this photograph has not yet been installed.

Two characteristics were immediately apparent. First, note that the ball joints from Carli Suspension, Moog, and NAPA are outfitted with a grease zerk, while those from Duralast and Mopar are not. Secondly note that some parts are knurled, while others are smooth. In a surprising twist, I found that the two Moog parts supplied by my local O'Reilly Auto Parts store had different body textures: The upper ball joint (shown in figure 1) was smooth while the lower ball joint (see figure 2) was knurled. Both were supplied in identical boxes labeled "Moog Problem Solver."



Figure 2: Lower ball joints from Moog (left) and Mopar (right). The Moog "problem solver" part supplied by my local O'Reilly Auto Parts store has a knurled body.

Using a micrometer, I was able to compare the body diameters of the aftermarket parts to the factory parts, with some interesting results (see Table 1).

LOWER BALL JOINTS	Size compared to Mopar (thousandths of an inch)	Body Surface
Mopar		Smooth
Carli Suspension	+5	Smooth
NAPA Chassis	+5	Knurled
Moog Problem Solver	+3	Knurled
Duralast (Autozone)	+1	Smooth

LOWER BALL JOINTS	Size compared to Mopar (thousandths of an inch)	Body Surface
Mopar		Smooth
Carli Suspension	+5	Smooth
NAPA Chassis	+5.5	Knurled
Moog Problem solver	+3	Smooth
Duralast (Autozone)	+9	Smooth

Table 1: micrometer measurements of four aftermarket ball joints compared to the factory-supplied part.

As you can see, the Carli Suspension ball joints were the only ones in my test group matching factory specifications, in both body size and surface type. The locally available parts from O'Reilly, Autozone, and NAPA all measured a few thousandths of an inch larger than the factory parts. The NAPA and Moog parts combine an oversize body with a knurled surface.

Table 1 also shows very good dimensional constancy from part to part, in all cases except for Duralast. For this brand, I measured the lower ball joint at only one-thousandth of an inch larger than the factory part, while the upper ball joint was nine-thousandths of an inch larger. Wow!

Ball Joints are Boring: Why do we care?

I found it interesting that local retail stores sold only oversized parts. More than one local repair shop told me they do not use oversized parts unless it is necessary. One local distributor, who supplies ball joints to local repair shops, confirmed that he sells exclusively Moog Problem Solver parts, a favorite among local shops. So I consulted the Federal-Mogul website to confirm that I had selected the right part numbers for my Turbo Diesel. Sure enough, I found Moog Problem Solver part numbers K7460 and K7467, the very same as I had obtained locally.

Interestingly, here is a statement from the web site (emphasis is mine):

An enlarged ball joint receptacle in the control arm can cause a loose ball joint fit. MOOG Problem Solver design includes an **oversized housing** for a more secure fit.

I could not help but wonder: Did I have an enlarged ball joint receptacle that required an oversized housing? If not, wouldn't an oversized or knurled part permanently enlarge the factory knuckle bore? How would you ever get the Moog in? Out? More importantly, does it matter?

Editor's note: TDR members have grappled with this question many times over in web discussions and in pages of the magazine. Some swear by the Moog products; some swear at the Moog products; all of us swear as we beat, bang, press and break tools in our efforts to remove factory or aftermarket ball joints from the housing. Let's continue with Doug's story—the first one I've seen where the author actually measured the replacement parts.



Figure 3: The smooth lower ball joint knuckle bore on my Turbo Diesel. I decided not to install a knurled or oversized part, in order to preserve the factory bore as long as possible.

*Let's continue with Doug's story—
the first one I've seen where
the author actually measured
the replacement parts.*

I then turned to Carli Suspension, a highly respected expert in aftermarket suspension components that are well proven in off-road competition. Their decision to match factory specifications for ball joint body diameter and surface finish was an intriguing departure from the other parts I evaluated. It turns out that Carli Suspension regularly sees the consequences of oversized/knurled ball joints in their own shop, advising me that once you enlarge the knuckle bore with an oversized part, you are forever committed to using oversized ball joints or even machine shop heroics for the next replacement, should that ever be needed.

Dynatrac, another highly respected aftermarket supplier, actually had the following warning posted on their website:

Please note that installing knurled ball joint bodies permanently alters and creates unrecoverable wear in the end forging and knuckle bores. Knurled bodies should only be used as a last resort. We sell knurled versions to accommodate vehicles which previously had competitors' ball joints which may have enlarged or worn the mounting location, and now are switching to Dynatrac.

What does this mean for Turbo Diesel owners?

I have come to the conclusion that oversized and/or knurled ball joints have probably been installed on a great many Turbo Diesels, but in most cases the owner is unaware and unaffected because the truck will be sold before the aftermarket parts fail. If failure does occur, however, the choice of replacement parts will be limited: For example, replacing a NAPA chassis or Moog Problem Solver ball joint with a factory or Carli Suspension ball joint would not work.

There are two solutions to this: (1) make sure that the first ball joint replacement meets the factory spec for body diameter, or (2) make sure that your first replacement ball joint is your last!

Carli Suspension's ball joints address both of those concerns. While they are significantly more expensive than the mass marketed parts found in local auto parts stores, they will not enlarge the factory bore or introduce unrecoverable wear with a knurled body. Moreover, they will probably outlast both the truck and the driver, as they are supplied with a lifetime guarantee.

Installation and final checks

I made the choice to have Carli Suspension ball joints installed in my Turbo Diesel. For the installation work itself (see figure 4), I returned to Weaver's Diesel Performance in Dalton Gardens, Idaho—the same shop that installed my Carli Suspension "Backcountry 2.0" Kit, described in Issue 77. The photo in figure 5 shows the installed lower ball joint, with the accessible grease zerk.



Figure 4: Raymond Driggs at Weaver's Diesel Performance, installing my lower left ball joint.



Figure 5: The Carli Suspension Lower Ball Joint, installed at exactly the right position so that the grease zerk is accessible.

Changing the upper and lower ball joints can influence a number of important alignment parameters, such as camber, caster, and caster sweep; so I decided to have a four wheel alignment performed. I took my truck to Auto Works, a family owned automotive repair shop in Coeur d'Alene, ID (see figure 6).

Before heading to the alignment rack, Troy Hocking, the shop owner, first drove my truck to see how the new ball joints felt in the steering wheel. A Turbo Diesel enthusiast himself, Troy wanted to see if he could detect any "return steering" binding or other issues that could be caused by faulty or improperly installed ball joints. Once everything checked out, we headed to the alignment rack to adjust the toe. All the non-adjustable alignment parameters were well within factory specifications.

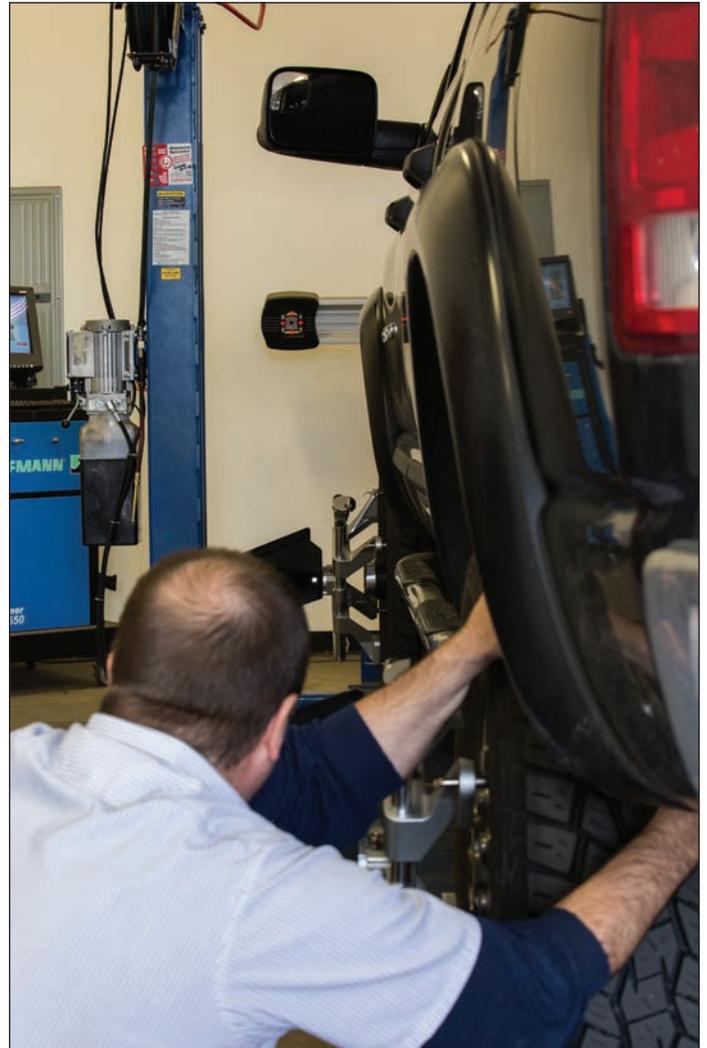


Figure 6: Four wheel alignment in progress at Auto Works automotive repair in Coeur d'Alene, ID. In this photograph, Troy Hocking is rolling my truck back and forth several inches at a time, to check wheel runout. All parameters including camber, caster and caster sweep, checked out.

Conclusions

I made the personal decision to install Carli Suspension ball joints, which are neither oversized nor knurled, but this is not to say that other aftermarket parts are bad choices. According to my research, a great many shops install Moog Problem Solver parts. I bet that shops as well as TDR members have installed the Moog products without even realizing that the parts are oversized. The shop is not likely to see the same truck again, and in many cases it won't matter to the owner, because the truck will be sold before the parts ever fail.

On the other hand, shops like Carli Suspension can give examples where the choice to install an oversized ball joint was not wise. As always, "your mileage may vary" and I will leave this boring subject with the following summary:

- If the factory knuckle bore is not damaged it is best to choose replacement ball joints that match the factory supplied parts as closely as possible in surface finish (smooth) and in diameter (not oversized).
- Oversized and/or knurled ball joints are a great way to accommodate an enlarged or damaged knuckle bore, but should be used only as a last resort.
- Some aftermarket parts, such as the Duralast brand from AutoZone, appeared to show a large dimensional variability from part to part in my tests. My advice is to avoid such parts.
- After 150,000 miles, my factory ball joints failed but the knuckle bores on my Turbo Diesel did not require an oversized part for a snug fit. Installing a ball joint with an oversized and/or knurled housing in this case just makes the next repair more difficult – if it occurs.
- Make your first ball joint replacement your last: Because the labor cost to replace ball joints is high, consider the purchase of a premium part with a lifetime guarantee, such as those from Carli Suspension.

Doug Leno
TDR Writer

Suppliers mentioned in this article.

Carli Suspension
www.thecarlisuspension.com

Auto Works
6050 Sunshine St., Unit B
Coeur d' Alene, ID 83815
208-762-2426

Weaver's Diesel Performance and Automotive Repair
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