’85 Toyota 4Runner Square Driveshaft Project
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Problem:

The ’85 4Runner OEM front driveshaft will work during normal 2x4 operating conditions, but does not have the necessary length of spline engagement during 4x4 driving with a lift installed, especially during +Class 3 rock crawling. See Figure 1 for an example of my front driveshaft separating while four wheeling at Windrock, TN.

Figure 1. Front driveshaft separated but not damaged. Photo by Doc Elliott.

Upgrade Options:

Here are the front drivshaft upgrade options, as I researched the problem:

- Leave stock
- Replace with new aftermarket long length driveshaft
- Replace with tractor PTO driveshaft
- Fabricate square driveshaft

Leaving the OEM driveshaft as-is doesn't work unless I were to restrict my four wheeling to essentially dirt and gravel roads; therefore this was not an option for me.

There are a number of aftermarket driveshaft vendors, both local here in North Alabama plus over the internet. The biggest downside: cost. The usual price I've heard quoted for a long length front driveshaft is around +$200 plus shipping and/or tax. No thanks.

There are people on Pirate4x4.com that have made their front drivshaft out of PTO tractor shafts from Tractor Supply. However, I've seen no detailed write-ups with pictures and parts numbers. Plus, I don't live within convenient distance to a Tractor Supply where I could buy and design it myself, so I didn't pursue this option.

Making my own square driveshaft, however, has a lot of benefits:

- Requires welding, always a good thing.
- Cheap components, mainly your existing OEM CV joints and yokes plus some square tubing available almost anywhere (more about this later)
- Strong driveshaft with long engagement surfaces for aggressive four wheeling under tough conditions

Downsides:
- Possible vibration problems due to out of "roundness" or balancing.
- Costs go up if you don't have good OEM CV joints or yokes to start with.

Materials, Design and Fabrication:

My intent when writing this square driveshaft paper was to have detailed photos to show each step of the design and fabrication. However, I fried my 256MB Compact Flash memory containing all my buildup photos; all that are left are photos of the driveshaft after it was fabricated, assembled and painted. Therefore, you'll have to muddle through a verbal description of the design and fabrication steps. The good news is that making a front square driveshaft, especially for a Toyota 4Runner, is pretty easy.

Materials:

From the discussion at Pirate4x4.com and other places, the most common size tubing for use in a square front driveshaft is 2 ½” x ¼” thick for the outer tube and 2” x ¼” thick for the inner tube. People using this size tubing usually use hitch tubing since it does not have any seams. Others say this size is pretty big and recommend 2” x ¼” for the outer and 1 ½” x ¼” thick for the inner. This is the size I decided to use since I already had the 2” tubing in stock.

One problem I had was finding 1/4” thick 1 ½” tubing; basically I couldn’t find it at the one steel supplier and one welding shop that get my steel from. One poster on Pirate4x4.com had the same problem and he ended up using 3/16” thick material; therefore I decided to use it since I could find this size readily.

Design:

The first thing I did was measure the distance of the OEM driveshaft in its current configuration[1] from the CV body to the yoke body; this measurement turned out to be about 17 3/8”. I also measured the maximum compression I experienced on my last 4x4 drive, a club ride at Windrock, TN, where the driveshaft originally separated. This distance turned out to about 1 1/2"”. An easy way to measure max driveshaft compression is to fill the driveshaft with grease and then drive a trail where you’ll compress the front axle; the grease path will provide a good indicator of max compression. Alternatively, you could use a ramp or any other structure that compresses your front axle on the same side as the driveshaft.

From these measurements, I decided to make the 2” outer tube 13 ½” and the 1 1/2” inner tube 13 ¼” long.

Fabrication:

I cut the 2” outer and 1 ½” inner tubing at 13 ½” and 13 ¼” long respectively, using my chop saw. I then cut the OEM driveshaft about ½” – ¾”” from the CV and yoke body, keeping the cut as square as possible. In my case, my china-made chop saw didn’t make a good square cut and I had to grind some material away to square the cuts as much as possible. I agonized a couple of days about getting a friend to turn both the CV and yoke ends on a lathe to square them up; but eventually decided against it due to: a) the need to disassemble the CV and yoke in order to get it on the lathe and b) I ran out of time for our Memorial Day club ride to Estill Fork, AL. As it turned out, not having perfectly square ends didn’t appear to make much difference on how well the driveshaft worked.

I welded the 2” tubing to the CV end, indexing the sides of the tube with the CV ears (see Figure 2). I tried different ways to measure and setup the ends to try to make the ears and tubing side line up and the tubing concentric, but I just ended up eyeballing it. If someone knows of a better way, please e-mail me.

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[1] ’85 Toyota 4Runner with 22RE engine and automatic transmission and 4” spring lift and 1” body lift.

Figure 2. CV joint with 2” square outer tubing welded on the end. Note that the sides of the tube are parallel with the CV ears.

Next, I welded the 1 ½” tubing to the yoke end, again lining the sides of the tube with the yoke ears (Figure 3). The purpose of lining the sides of the tubing with the CV or yoke ears is so you can “index” the driveshafts when you assemble them; that is, ensure that the CV and yoke ears are in the same plane.

Figure 3. 1 ½" inner tubing welded to the yoke end. Note that the sides of the tubing are parallel with the yoke ears. The white hole in the center of the pic is the OEM grease fitting hole with some of the sand I added to the small tubing to help with balancing. After this pic was taken, I cleaned the hole up and welded it shut to prevent the sand from getting out.

To help with balancing the driveshaft, I added about 8-10 oz. of dry sand to the inner square tube, then welded a cap to the end of the tube and welded shut the OEM grease fitting hole to contain the sand.

The next step was to ensure that the 2 tubes would slide within each other without binding. This task consisted of mainly filing down the seam inside the 2" outer tube as far as possible, then grinding down any still interfering areas on the inner tube. What you want is a snug but not loose or too tight fit. Ensure there is no binding in the tubes for the full engagement of both tubes.

Finally, I drilled a hole for the OEM grease fitting at the CV end of the outer tube and tapped it for the 12-24 threads, then installed the grease fitting. I put a pretty good amount of grease into the outer tube, assembled the two tubes together and installed the driveshaft on the vehicle.   See figure 4 for the assembled driveshaft at its longest length and figure 5 at its normal driving length and figure 6 with the driveshaft installed and the vehicle sitting in the driveway.

Figure 4. Final driveshaft in fully extended mode. Total extension distance is about 10”-11”, compared to 2-3” (or less) for the OEM driveshaft. Note that the CV and yoke ears are in the same plane.

Figure 5. Driveshaft in normal driving configuration. Note the almost 3” of compression available.

Figure 6. Driveshaft installed, vehicle sitting level in the driveway. Note the grease fitting near the CV end of the outer tube; this is to fill the outer tube with grease ensuring the two tubes can slide into one another without binding while on the trail.

Final Product and Results:

Test drives consisted of driving around my neighborhood in three different modes: 4hi with hubs unlocked, 2 hi with hubs locked, and 2hi with hubs unlocked (i.e. normal road driving mode). The first two modes will turn the front driveshaft, but not drive the wheels, which could do bad things to the axle and birfields while on dry pavement, the third mode does not turn the driveshaft and was run as a baseline.

In none of the driving tests did I notice any vibration or abnormal noises from the front driveshaft area. Top speed in my residential neighborhood was about 20-25 mph.   See Figure 7 for the maximum compression noted during on-road testing.

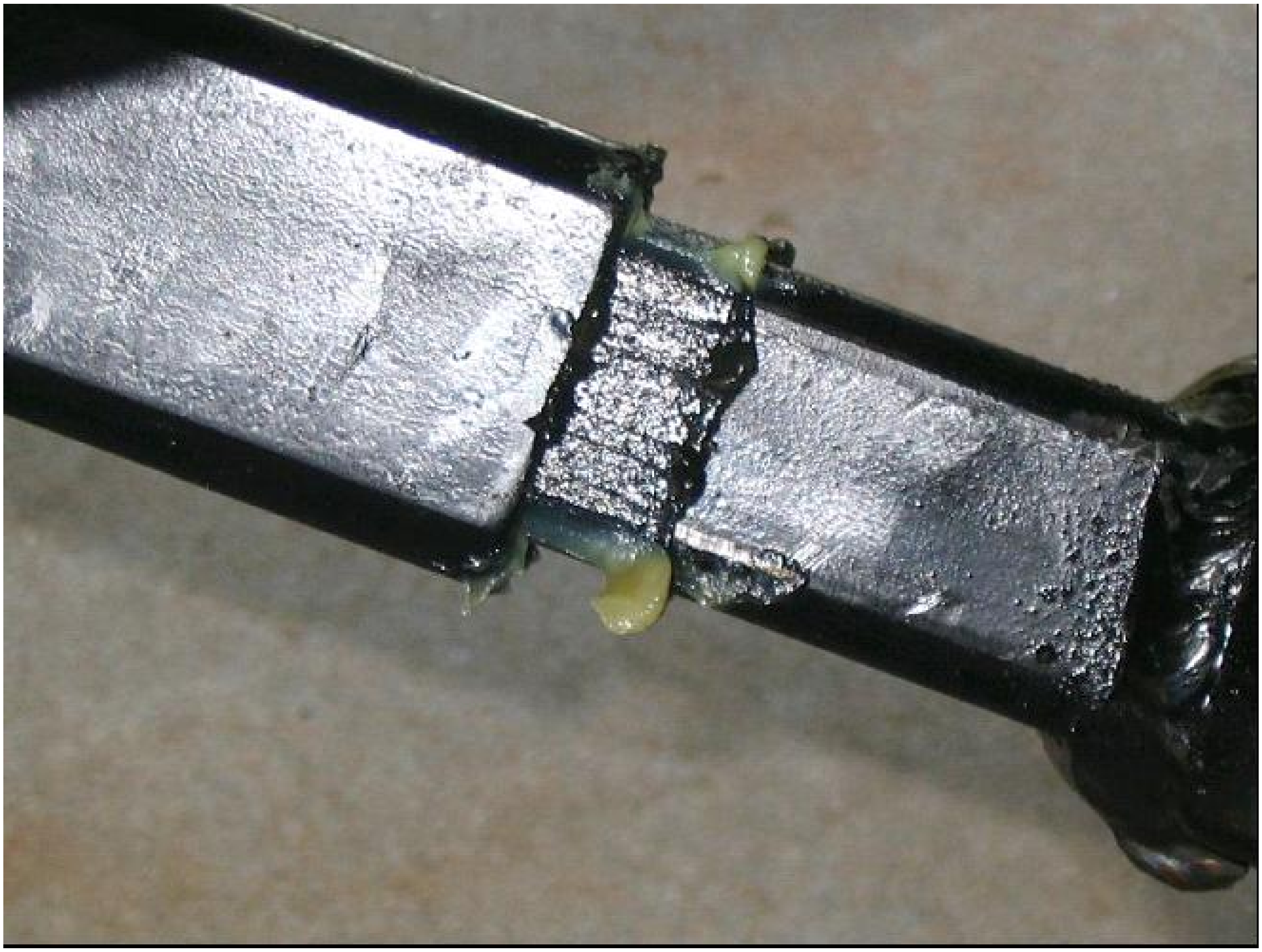

Figure 7. Grease path after a couple of test drives around my neighborhood. The grease path shows maximum compression experienced during my test drives around my neighborhood, max speed was 20-30 mph with 3 speed bumps.

I went four wheeling north of Estill Fork, AL on a Memorial Day weekend club ride. This trip consisted of normal road travel to and from the site (probably 100 miles or so), gravel roads and steep rocky 4x4 trails plus some mud holes. I never had any problems or noted any noises from the front driveshaft during the ride. Figure 8 shows a typical section of trail in this area.

Figure 8. Typical 4x4 trail near Estill Fork, AL. Plenty of opportunities to test out a square driveshaft. Photo by Rachel using Doc's camera.

Figure 9 shows the maximum compression experienced during this trip; the grease path shows I still have ½" to ¾" compression left in the driveshaft although the front suspension was probably fully compressed at least once on the trip.

Figure 9. Driveshaft after extensive fourwheeling near Estill Fork, AL. Note that the grease path provides a good measure of the maximum compression of the driveshaft and that I still have ½" – ¾" compression left although the front suspension was probably fully compressed at least once on this trip.

Epilogue:

The Toyota 4Runner OEM front driveshaft leaves a lot to be desired in terms of engagement length during 4x4 driving, especially with a suspension lift. A square driveshaft solves this engagement problem at low cost, easy design and fabrication and good performance. All that is needed are good OEM CV joints and yokes, steel tubing, and basic fabrication and welding skills.