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LEVYRACING

PRO Bump Steer Kit
Installation Manual

Thank you for your purchase of this Levy Racing quality product. Like all Levy Racing products, this kit is a fully engineered system. It is not a conglomeration of parts that fit a variety of applications. It is a system that is specific in both design and application. For this reason, please read the manual entirely before attempting installation. Check the parts in the box against the parts list and make sure everything is there. Above all, work safely. Use the proper tools and wear the appropriate clothing and safety attire. Always use jack stands and ***NEVER*** work on heavy equipment alone.

Parts list

Part	**# Pieces**
POLY RACK BUSHING	4
TIE ROD END	2
5/8 ID TIE ROD END SPACER	2
RACK MOUNT SPACER	2
STEERING SHAFT	1
UPPER BALL JOINT	2
LOWER BALL JOINT	2
RACK BRACKET (RIGHT)	1
RACK BRACKET (LEFT)	1
BOLT 5/8 X 6” NF G8	2
BOLT ½ X 4 ½” NC G8	2
BOLT ½ X 4” NC G8	2
BOLT ½ X 1 ½” NC G8	2
WASHER 5/8 HARDEND	2
WASHER ½ G8	12
NUT 5/8 NF NYLOCK	2
NUT ½ NC NYLOCK	6

Tools

A good set of hand tools
A half drive drill
A pickle fork
A welder (can be farmed out)
½ “drill bit
1/8” drill bit
5/8” drill bit
Ball joint removal tool (optional)

Installation

Note #1: While following these steps it will become necessary to either remove the front brake lines and set the spindle on the floor, or hang the spindle from the chassis without breaking into the brake lines. The choice is up to the installer. If you choose hang the spindles, make sure you support them <u>BEFORE</u> you remove the ball joints.

Note #2: If you are running a front sway bar you may have to moon or re-locate the frame mounts to clear the rack in its new location. Since you ordered this kit it is assumed this was discussed with Levy Racing at the time of purchase. If it has not, please call 480-446-8442.

Note #3: the 2 re-locating rack brackets are coated with ArmerShield prior to leaving the factory. It may be necessary to ream the holes back to ½” before installation.

1) Raise the car off the ground and support with jack stands. Remove the front wheels, radiator (if needed), steering rack and lower steering shaft. Remove the front spindles from the ball joints. This is best done with a large hammer or air hammer and a pickle fork.

2) The upper ball joints are screwed into the control arms. Grind the weld tacks off (if any) and remove the upper ball joints by unscrewing.

3) The lower ball joints are pressed into the control arms. Grind the weld tacks off (if any) and press the lower ball joints out using the ball joint removal tool. An alternative to this is to remove the lower control arms, take them to a suspension shop and have them press the ball joints out for you.

4) Install the new upper ball joints in the upper arms by screwing them in. Get them as tight as you can by hand, but there is no need to over do it. Place two or three weld tacks on the edge of the ball joint to hold it in place. This can be farmed out to a weld shop. **WARNING: DO NOT SKIP THIS STEP.** Place ¾" worth of spacers' on the ball joint shaft and slide it into the ball joint. The spacers should be on the bottom side of the control arm. Torque it to 100 lb.ft.

5) Install the new lower ball joints by pressing them in. Secure them with a couple of weld tacks. **WARNING: DO NOT SKIP THIS STEP.**

6) The spindles can now be re-installed onto the upper and lower ball joints. The uppers are straight forward. Install the castle nut and tighten. Then install a cotter pin to retain the nut. The lowers need to be drilled for cotter pins. Install the ball joint nut. Torque it to 80 lb.ft. With a hand drill, drill a 1/8 hole all the way through the nut and ball joint. Install the cotter pin.

7) Using the new hardware and rack bushings, mount the right and left rack brackets (view right and left from sitting in the driver's seat) to the rack first. Leave the nuts and bolts snug, but not tight, so the brackets can be rotated. See figures 1 and 2.

8) Install the rack to the original mounting points using the new brackets. This means you will install the rack with the new brackets on the front of the existing mounting ears that are welded onto the frame. Install the new brackets using the top hole on the bracket and the existing rack mounting hole in the frame. Place the supplied anti-crush bushing on the mounting bolt in between the original mounting ears. Tighten the bolts until snug and position the rack so it is centered between the ears. This will place rack approximately ½" to the right and 3 ¼" forward of where it was originally mounted. Once the rack is positioned, tighten the mounting bolts tight. See figure 2.

9) The remaining two holes in the new brackets now need to be marked and drilled. This can be done with either a ½" locating punch or by placing the ½" drill in the hole and spinning it enough with the drill motor to make a mark. Once this is done, remove the rack and use the 1/8" drill to drill a

pilot hole. Then use the ½" drill to finish the hole. Re-mount the rack using all of the supplied hardware. Torque all fasteners to 40 lb. ft. See figure 2.

10) Using a sharp 5/8" drill bit, ream the tapered tie rod mounting holes in the spindle to 5/8" strait holes. This will take some time and patience. Be careful to get the holes as strait as possible. Place the supplied 5/8" bolts into the holes from the top and leave them hanging.

11) Center the rack by turning the steering input sline all the way to lock in either direction. Then turn the input spline all the way to lock in the other direction counting the turns. Divide the counted number by two and again turn the input spline back that many turns. The rack is now centered. Once the rack is centered the new lower steering shaft can be installed. Center the steering wheel and insert the new lower steering shaft. The new lower shaft is sent from the factory to fit the longest length needed for this kit. For this reason, it may have to be cut to length for your application. This may be done with a chop saw or hack saw. Be careful to get it only far enough into the universal joints to have enough room to lock it with the Allen lock nuts. This will keep the universal joints from binding through rotation. Lock the shaft in place using the Allen head lock screws and nuts.

12) Screw the tie rod ends into the tie rod sleeves. These are left hand threads. Screw the 5/8 rod end in as far as it will go. Make sure to install the 5/8 left hand thread nut onto the rod end before screwing the rod end into the tie rod sleeve. Now screw the tie rod sleeve onto the tie rod until it stops. Place the 3 ¼" long 5/8" I.D. bushing on the 5/8" bolt in the spindle from the bottom. Holding the bushing in place, slide tie rod end on the 5/8" bolt below the bushing. Then slide on the ¼" spacer and secure everything with the 5/8" Nylock nut. Torque to 100 lb.ft. do this step for both sides.

13) Set the toe as close as you can get it by eye looking down the side of the car. The toe will look slightly out when it is acceptable for this step. With the new tie rod sleeves, the adjustment is as simple as turning the sleeve. Make sure to have someone hold the steering wheel straight wile making the adjustments. Just get it close. It will be set correctly when an alignment is performed. There are several different length tie rod sleeves available with this kit. If it looks like you have to turn the tie rod sleeve more than 4-5 threads out to get the toe set, contact us about longer

sleeves. This is a very important safety issue. Examine this step carefully.

14) Re-install the wheels and radiator (if needed). Set the car on the ground and set your ride height.

15) You are now ready for the alignment. This is best handled by a professional shop with an alignment computer, but you also need a shop that will set to YOUR specs. Not the specs THEY think are correct. For this reason we are listing our initial set-up specs as well as some handling diagnostics here. You will need to read this carefully to actually understand what is going on with the car. The fact that you bought this kit in the first place tells us that you are interested in the material so read on.

Set-Up

Extensive testing with the FFR has taught us that the initial alignment specs for this set-up are as follows.

TOE	**0**
CASTER	**3 TO 4 DEGREES POSITIVE**
CAMBER	**1 TO 1.5 DEGREES NEGATIVE**

These are the initial settings and will give good results if everything else (control arm bushings, tires, tire pressures, shocks, ect.) are working correctly. The part of handling that is not constant is the driver. Since you installed the bump steer kit, your front suspension is now far more adjustable. To set the car to your preference you need to do some things that let you know what you need, or don't need for that matter.

Roll Center

To start with, your roll center is adjustable. By lowering the roll center, you will increase the swing arm length of the suspension geometry. What will this do for you as a driver? It will add independence to the front suspension. This means that the front wheels will move more independently of each other when traveling over bumps. Is this good? Only you can tell. As a general rule

the answer is yes. Independence of the front tires means that while cornering the tires actually spend more time on the track wile hitting bumps. That means traction and traction translates to cornering speed. The trade off is higher required spring rates, higher tire temperatures, and more potential for set-up errors. To adjust the roll center, take spacers out of the bottom of the upper ball joint and move them to the top. To lower the roll center to stock height, remove all the spacers. The stock roll center height is 4.8”. By adding spacers the roll center can be raised to as much as 9.3”. This will shorten the swing arm length. This means a reduction in required spring rate, less independence of the front suspension, an increase in high speed stability and in some cases no need for a front sway bar. It will also result in less king pin angle which will intern reduce the scrub radius to zero. This will greatly increase both tire life and cornering stability.

Toe

Next we need to discuss toe. Toe is the one front suspension setting that enjoys complete freedom of adjustment. This means that you can set it were ever you want and it will not affect any other part of the suspension. If you set toe at zero, the car “should” exhibit moderately high stability on high speed straits, and relatively sharp turn-in going into corners. If you adjust the toe out in small increments the car will steer into corners quicker with less steering input. The trade off is high speed stability. The more static toe out, the more the car will feel twitchy and wander on high speed straits. The reverse is true if the car is toed in. The obvious issue here is what the driver likes and what type of track conditions exist. The rule of thumb for race set-up is as follows. If the track is tight and utilizes decreasing radius turns, set the toe out and sacrifice the straits. If the track is a big track and has a long strait, set the toe in and sacrifice the corners. These are general rules. There are many track conditions that will over ride the most obvious obstacles. The idea is to set the lowest possible lap time. Street driving is not left out with this kit. In fact, the street is one venue were this kit shines the brightest. The fact that you have virtually zero toe change over varying conditions means you have the freedom to set the car up for a very comfortable ride (high degree of suspension travel) without sacrificing good handling characteristics. Even when you set the toe for good turn in you won’t have to fight the wheel on bumpy roads.

Camber

Camber is an issue that is best set with a tire temperature gage. The camber curve in an SLA suspension always works to your advantage. This is because the SLA has a negative camber gain by design. The question is how much.

The stock FFR set-up has -.62 degrees of camber gain for one inch of travel. The new suspension geometry obtained with the bump steer kit yields -1.54 degrees of camber gain for one inch of travel. This is a great advantage for both tire wear and handling. This also means the need for a great deal of static camber for an initial setting at the alignment stage is greatly reduced. With the stock set-up we have run as much as -3.5 degrees on some of our race cars depending on track conditions. With the new set-up we have never run more than -1.5 degree. The tire temperatures are consistent all the way across the contact surface even with a static setting this low. This is what you are really shooting for when setting the desired camber spec. The tire carcass needs to be heated thoroughly and evenly all the way across. The temperatures should range from 175 to 195 degrees. Notice that the CARCASS temperature is what needs to be measured. Measuring carcass temperature rules out the use of an infrared tire temp gage as they read surface temperature only. What is needed is a tire temperature probe. It needs to be pushed into the tread far enough to read the temperature of the carcass. If the tire temperatures are higher than 195-200 degrees, the tires are too small for the car or the car is being overdriven by the driver (he is sliding the car). If the tire temperatures are consistently lower than 175 degrees, the tires are too big (a **very** common mistake with armature racers) or the car is not being driven to its potential. The fact that a static camber setting this low is still conducive to handling means that tire wear on the street will be very high and the car will still stick at high speed.

Caster

Since the bump steer with this kit is reduced to essentially zero, caster can now be used as a suspension tuning tool rather than to control the stability of the steering. The factory set-up for the FFR works well with +5 to +6 degrees of caster. This is because with the high degree of caster the spindles are laid way back in side view and the king pin trails behind the front axel line. One of the best analogies is that front caster works just like a shopping cart. As long as the wheel axel trails the castor pivot (king pin) the wheel is stable. If you pull the cart backwards, the castor's axel rotates about the king pin turning the castor wheel around backwards and it now follows as a function of axel/king pin placement. This is the same way castor in a front suspension works. If you set the castor at 0, the king pin is directly in line with the axel line. This would make the car jump towards the direction of steering input because the wheel is now trying to turn around backwards. To avoid this, positive castor is added to the static set-up. This will insure the king pin always leads the axel line and just like a shopping cart, the wheels will always try to get back to center no matter how much steering input is induced. Take this a step farther by adding more castor and extra stability can be induced to mask some suspension design flaws such as bump steer, McPherson Strut idiosyncrasies, or in the case of a salt flats car the stability needed to run at speeds over 300 mph. The trade off for this is the fact that the steering wheel

tends to feel “dead”, has trouble returning to center when let go, and is very hard to turn. With this kit, the reduction in bump steer frees up about 2 degrees of castor adjustment. This means you can run +3 to +4 degrees static castor and still have more handling stability than the stock set-up with castor set at +5 to +6 degrees. The car is easier to turn, more responsive to steering input, exhibits more handling stability and is more fun to drive. On the race track the car can be driven at higher speeds. On the street the car can be driven with much less effort. The sense of driver confidence and comfort is much greater as well.

Conclusion

All of the set-up and handling issues discussed in this installation manual are subject to trade offs and driver preference. That is the most gratifying thing about building and setting up you own race car. The most important thing to remember here is to follow your instincts, take your time and don’t get frustrated if what you try for set-up doesn’t work the first time. You have already displayed the need to improve the way suspension works by purchasing this bump steer kit in the first place. This kit gives you the improvement in geometry and the adjustability you need to make the improvements yourself. So, go for it!

If you need more help or have any concerns on installation please call Levy Racing at 480-446-8442.

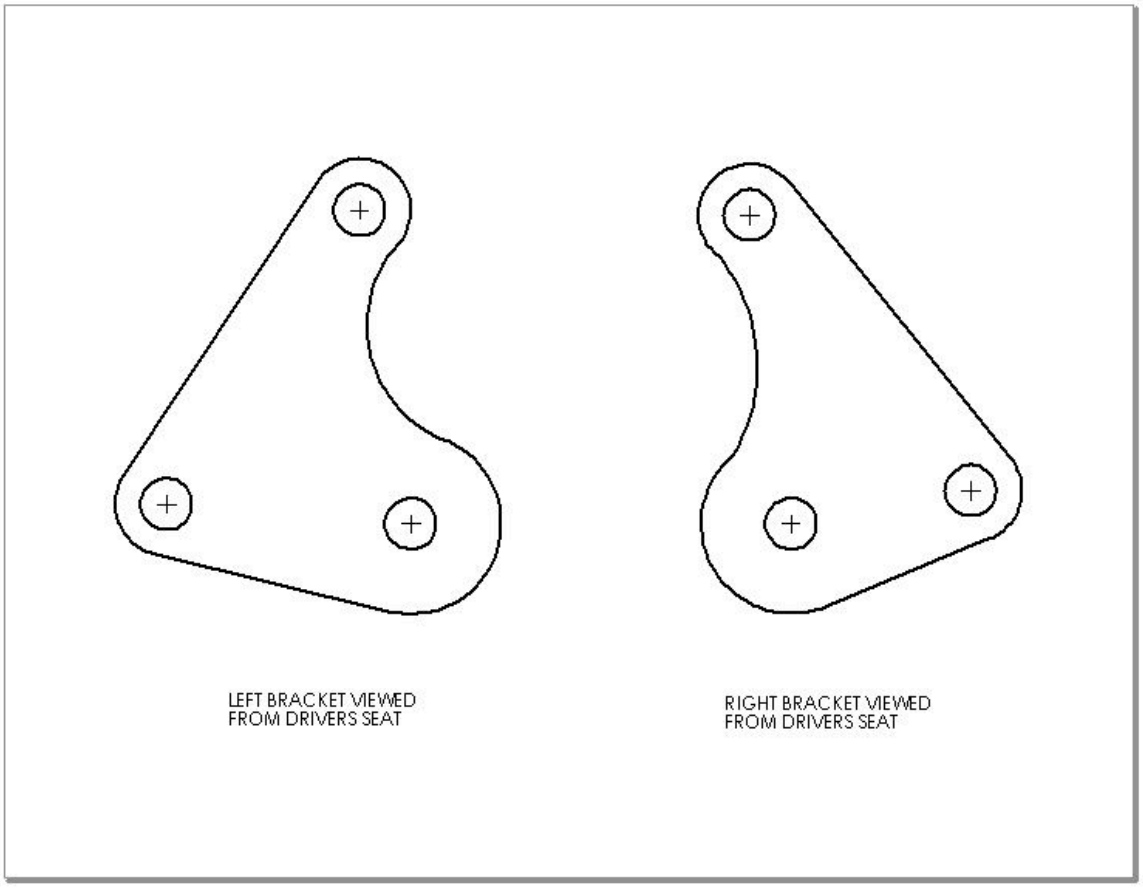

Figure 1. Bracket layout.

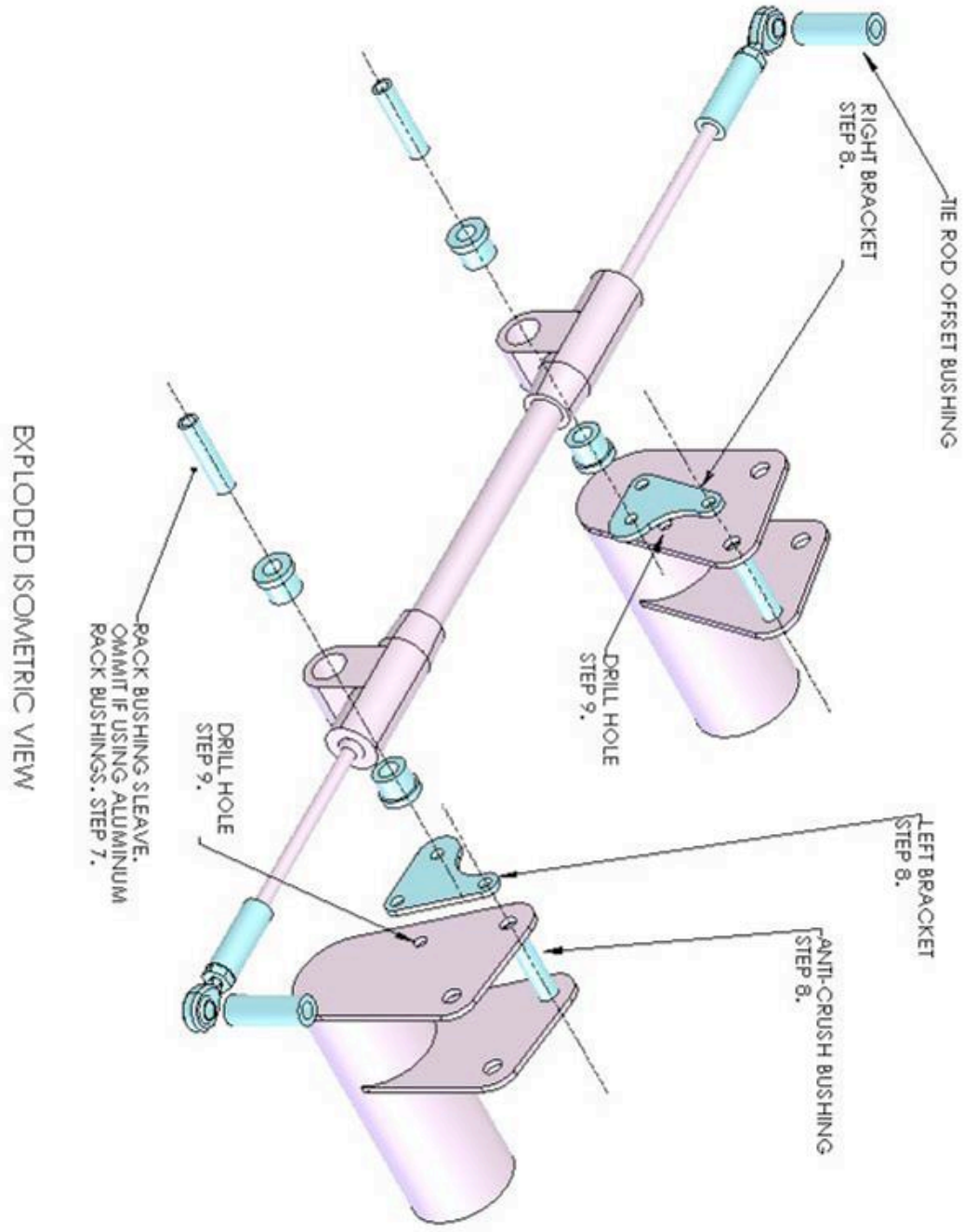
TIE ROD OFFSET BUSHING
RIGHT BRACKET
STEP 8.
DRILL HOLE
STEP 9.
LEFT BRACKET
STEP 8.
ANTI-CRUSH BUSHING
STEP 8.
DRILL HOLE
STEP 9.
RACK BUSHING SLEAVE.
OMMIT IF USING ALUMINUM
RACK BUSHINGS. STEP 7.
EXPLODED ISOMETRIC VIEW

Figure 2.