



Leader of the Three World®

# TECHNICAL HIGHLIGHTS

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TRIKE THEORY | DESIGN | MAINTENANCE | SAFETY | A COLLECTION OF USEFUL INFORMATION FROM LEHMAN TRIKES  
VERY OWN DESIGN AND PRODUCTION TEAM



# THE IMPORTANCE OF PROPER TIRE PRESSURE-TECHNICAL ARTICLE

## WHAT IS THE CORRECT TIRE PRESSURE FOR MY TRIKE?

There has been a lot of confusion and misinformation out there when it comes to tire pressures for trike riders. Most all trikes have a motorcycle tire up front and automotive tires in the rear. The motorcycle compliance label has a recommended pressure for both the front and the rear tires. Now that your motorcycle is a trike are these still the pressures to use? Since we are trying to clear up the confusion and misinformation... the answer is yes and no!

Let me explain more fully. We, Lehman Trikes, have always recommended that you maintain the same pressure the motorcycle manufacturer lists on the compliance label for the front wheel. There is no reason to change this pressure. That's the "yes".

The "no" is a bit more involved. First of all, the two automotive tires like those installed on the rear of your trike are a completely different design than the single motorcycle tire they replace. Now for some history. Lehman Trikes has been building and riding trikes for 25 years. Our founder, John Lehman, and many of the dedicated trike riders that work here have experimented for years trying to find what air pressure in the rear tires gives you the best ride, handling and tire life. What they found and recommended for years was an air pressure in the 20 to 22 psi range worked best.

So why, if you look at a current Lehman Trikes Owner's Manual or the Owner's Manual for a H-D Tri Glide, do you see a 26 psi recommendation for the rear tires? When I came to Lehman Trikes several years ago one of the things I was asked to do was to confirm with the manufacturer of our tires that they would support our recommendation of 20 to 22 psi air pressures for our application. What I learned is that no tire manufacturer will recommend anything less than 26 psi for standard automotive tires.

## THE IMPORTANCE OF PROPER TIRE PRESSURE (CONT.)

Where the 26 psi number came from is an interesting and somewhat involved story. There is a regulatory organization called the Tire and Rim Association (T&RA) which, of course, standardizes specifications for all different applications for tires and wheels (rims). One of the things that they provide is a load carrying capacity for each tire size at different air pressures. In their old reference books they listed load carrying capacities for tire pressures all the way down to 20 psi. I don't know what year they changed but in 1999 they still listed load carrying capacities down to 20 psi.

Do any of you remember the big public fight that went on between Firestone and Ford Motor Co a few years ago? As I recall, people were rolling over in their Ford Explorer's and Ford and Firestone were vigorously pointing the finger at each other. The final outcome was that it was determined that people were reducing the air pressure in their tires to improve ride quality. That would not have been a problem but they failed to increase the pressure when the vehicle was more heavily loaded. As a result, the T&RA elected to eliminate the lower pressure ratings from their reference books. In support of the T&RA, the tire manufacturers will not support running their tires at anything less than 26 psi.

So how much difference does it make? Why not just run them at a higher pressure? Running the rear tires on your trike at a higher tire pressure has a dramatic impact on how the trike rides and handles. For each additional psi of pressure you increase the rigidity of the sidewall. At maximum pressure the sidewalls of your tires are quite rigid. Rigid sidewalls will increase the occurrence of the low speed "head shake" inherent in all three wheeled vehicles. They will also transmit more of the bumps in the road to you and your passenger. As you reduce the tire pressure it allows the sidewall to provide additional "cushioning" when riding over irregularities in the road surface. Certainly you do not want to reduce the air pressure too far because that will adversely affect the handling of the trike.

## THE IMPORTANCE OF PROPER TIRE PRESSURE (CONT.)

The “cushioning” effect of the sidewalls is, of course, reduced if you are using a tire that has very little sidewall. For example, those 18 or 20 inch rims that look so cool on the back of your trike do all the wrong things for ride comfort and low speed head shake. A standard 15 or 16 inch rim with a properly sized, properly inflated tire will give you the best ride quality and the least amount of head shake.

The most commonly used tire on the rear axle of a Lehman Trike is the P205/70R15. As a point of interest, in the 1999 T&RA reference book it lists a load carrying capacity of 1146 lbs for a standard P205/70R15 tire with 20 psi of air pressure.

# WIRE WHEEL MOUNTING RECOMMENDATIONS-TECHNICAL ARTICLE

Occasionally we receive comments from dealers regarding mounting and dismounting wire wheels. The following recommendations from the wheel manufacturer may be helpful:

## **MOUNTING WHEEL TO TRIKE:**

- Under no circumstances should high powered impact wrenches be used to secure lug nuts as this can cause wheel damage and can also result in improper lug nut torque.
- Do not lubricate the lug nuts or stud threads.
- Run all lug nuts up fully before tightening.
- Tighten all lug nuts using a crisscross pattern to assure the even distribution of pressure while tightening the lug nuts.
- Tighten lug nuts to 75 ft. lbs.

## **MOUNTING TIRE TO WHEEL:**

Use of power operated tire mounting equipment should be avoided. In order not to mar or damage the wheel. Do not over-pressurize to seat the tire bead. Do not exceed 50 psi (40 psi in California).

# BELT DRIVE DIFFERENTIAL MAINTENANCE-TECHNICAL ARTICLE

The belt drive system on your Lehman Trike includes a carrier assembly located in the rear differential housing. Greasing the carrier at regular service intervals is recommended for prolonged service life. Lack of regular maintenance can affect the safe operation of your trike.

**NOTE: RAISING THE REAR PORTION OF THE TRIKE REQUIRES THE USE A FLOOR JACK AND TWO JACK STANDS.**

1. Center a floor jack under the differential carrier housing.
2. Place jack stands under the left and right rear axles.
3. Raise the trike to a safe working height.
4. Adjust jack stands to support left and right rear axles.

**NOTE: ON STORM AND RENEGADE MODELS (TOURING, SOFTAIL AND DYNA), THE GREASE FITTING IS LOCATED IN THE CENTER SECTION ON THE RH SIDE OF THE HOUSING. FOR RAIDER, CROSSBOW AND PITBOSS MODELS, THE FITTING IS LOCATED ON THE LH SIDE.**

5. Remove the red rubber plug (if applicable) from the RH or LH center section on the differential housing.
6. Place the transmission in neutral. Roll the rear wheels slowly and locate the grease fitting on the carrier.
7. Using a standard automotive style grease gun with a straight fitting and a high quality EP (extreme pressure) grease, add roughly one pump per 1000 miles of riding. Do not over grease the carrier.



## BELT DRIVE DIFFERENTIAL MAINTENANCE (CONT.)

**CAUTION: OVER-GREASING THE CARRIER ASSEMBLY MAY CAUSE EXCESS GREASE TO DRIP OUT ONTO THE BELT OR PULLEY. REMOVE ANY EXCESS GREASE TO PREVENT DAMAGE TO THE BELT.**

8. Reinstall rubber plug (if applicable).
9. Remove jack stands and slowly lower trike.
10. Record date and mileage in your owner's manual.

For further information regarding your differential or service procedures, please contact your local Lehman Trikes dealer.



# LEHMAN TRIKES NO-LEAN SUSPENSION-TECHNICAL ARTICLE

**AGILITY**  
Maximum roll resistance delivers responsive and immediate handling for emergency avoidance maneuvers.

**RELIABILITY**  
Built to last, requiring minimal maintenance for extended time on the road, not in the shop.

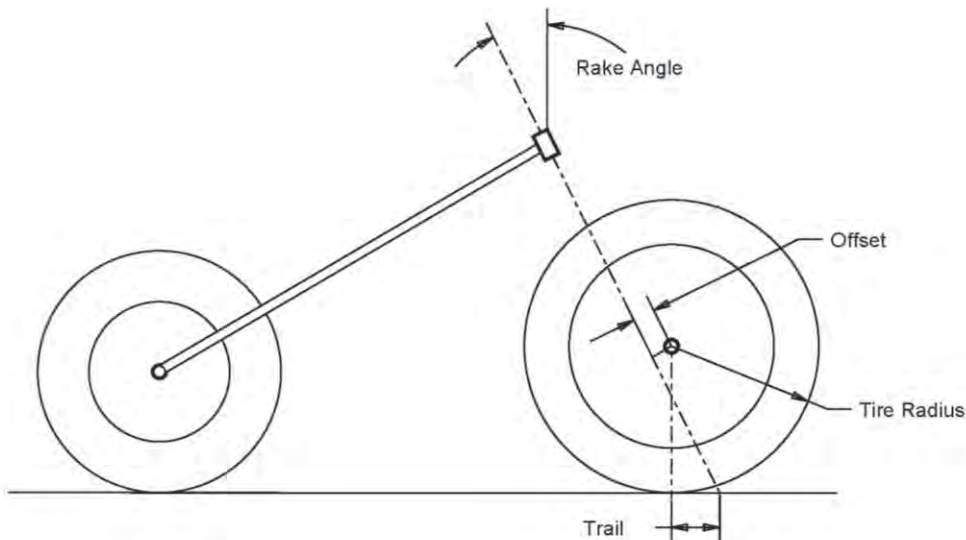
**TESTING**  
Refined and tested in cooperation with motorcycle OEMs enduring over 1.5 million miles of rigorous design testing.

**STABILITY**  
Superior cornering and high-speed control without the need for corrective anti-sway devices.

**MOTORCYCLE SUSPENSION**  
Utilizes motorcycle components and technology for optimal range of motion and smooth ride.

**LEHMAN TRIKES**  
Leader of the Three World®

# RAKE AND TRAIL AND TRIKES-TECHNICAL ARTICLE



There has been much confusion regarding rake and trail on motorcycles as well as trikes. So this article will attempt to clarify the facts and alleviate the fiction.

The most important aspect when it comes to trike steering geometry is trail. So what exactly is trail anyway? Well trail is a calculated number that results from the combination of three other numbers. Those other numbers are rake angle, front tire radius, and front axle offset. Here's the equation for all of you mathematical types:

$$\text{Trail} = [\text{Tire Radius} * \text{TANGENT}(\text{Rake Angle})] - [\text{Offset} / \text{COSINE}(\text{Rake Angle})]$$

Let's begin by establishing what determines "rake" angle. Steering rake angle is defined by an axis drawn between the centers of the two pivot bearings in the steering neck of the motorcycle frame. The amount of degrees that this axis is tilted back from vertical is the rake angle. There are a few basic ways to change the rake angle. These methods include

## RAKE AND TRAIL AND TRIKES (CONT.)

raising or lowering the front or rear of the trike, cutting the frame and welding the steering neck on at a different angle, or installing offset steering bearings. When a trike nose dives under braking, the frame rotates forward and reduces the rake angle. This in turn reduces the trail. Similarly, if the front end lifts under acceleration the rake angle increases and the trail increases. So during everyday operation the trail actually increases and decreases by some amount.

The second number used to calculate trail is the front axle offset. This is the distance measured from the front axle perpendicular to the steering axis. When installing a “raked” triple tree kit, the offset is the dimension that is actually changing. The raked triple trees push the front wheel farther ahead from the steering axis, which increases the offset. This increased offset effectively reduces the trail. As a side note, raked triple trees also change the angle of the front forks, so they are no longer parallel with the steering axis. This means that the offset changes continually depending on how far the front suspension is compressed. Therefore, raked triple trees not only reduce the trail, but can also have the added effect of decreasing the amount that trail varies during braking or accelerating.

Lastly is the front tire diameter. Installing a larger diameter front tire raises the front of the trike. This rotates the frame backward which increases the rake angle and results in increased trail. The same effect can be accomplished by adding fork extenders to the front suspension. In order to decrease the trail you can either install a smaller front tire or lower the front end.

As mentioned at the beginning of this article, trail is the most important aspect for trike steering. This is because trail is responsible for keeping the front tire pointed in the forward direction and for providing steering feedback to the rider. This feedback comes in three varieties: too little, too much, and somewhere in between.

With too little trail, the rider receives too little feedback and is unable to feel what’s happening. For example with a trail of zero inches it would be reasonably easy to turn the handlebars from lock to lock while traveling down the highway. In addition, the front tire doesn’t inherently stay pointed in the forward direction. As you can imagine, too little trail

## RAKE AND TRAIL AND TRIKES (CONT.)

leads to handle bar wobble at highway speeds. So please don't try this at home.

At the other, but safer extreme is too much trail. Too much trail creates excessive feedback for the rider, thus the trike steers rather hard around the corners. Too much trail also creates a tendency for the front wheel to over-correct itself while trying to point in the forward direction. This over-correction can result in handle bar wobble at speeds less than 45 mph. Typically this wobble is only noticeable if the rider takes both hands off the bars.

In between too much and too little trail is where most trikes reside. Unfortunately there isn't a one size fits all "perfect" trail dimension that works for every trike. This is because other factors such as weight on the front tire, front tire width, rake angle, and suspension travel all must be considered. Most trike riders prefer a trike with the trail in the 3-4 inch range. Trikes having more trail than 4 inches generally have better high speed steering stability, but at a cost of heavy steering and an increased tendency for handle bar oscillations at low speeds. Trikes having less than 3 inches of trail feature very light steering, but run the risk of suffering from handle bar oscillations at high speeds. This is especially true during situations when aerodynamic drag is high, such as strong head winds, carrying a passenger, and (dare I say) traveling above posted speed limits.

In summary, anyone wishing to modify the steering geometry of a trike should take precautions to avoid ending up with too little trail.

# HOW TO RIDE A TRIKE



ripped that box wide open.

An impending trip on a Harley Tri-Glide was to be preceded by a Riders Training Course at Lehman Trikes in Spearfish, South Dakota. Lehman is the leader in the development and conversion of two-wheel motorcycles into three-wheel trikes. All Lehman instructors are trained through The Evergreen Safety Council ([www.esc.org](http://www.esc.org)), who also train the instructors at participating Lehman Conversion dealers.

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by Wayne Peterson

Photos by John Kimpel

## TEACHING AN OLD DOG NEW TRICKS

Trikes are only for old people and children, and definitely for the unbalanced who can't keep a two-wheeler upright. Right? Wrong!

Faulty or preconceived notions often hold us back from trying new adventures. We form opinions based on what we've heard, or seen, but seldom from personal experience. For me, I had put trikes into that box of preconceived notions and never tried to think outside of it -- that is, until I rode a Lehman Conversion and

# HOW TO RIDE A TRIKE (CONT.)

## TRIKES 101

I am struck by the words of our instructor Kevin. “It’s easier for us to teach people who have never ridden motorcycles, to ride a trike, than to teach people who have ridden 30 or 40 years.” This goes against everything we ever learned. Experience, we’ve been told, is always the best teacher. But not with riding a trike; here the experienced must be un-trained from two-wheel thinking, to three-wheel riding.



Step one in this back-to-school program is a 10-minute instructional video, an excellent though brief overview of everything we can expect to encounter on a trike. Additionally, there’s a detailed 50-page safety manual, highlighting the science of trikes, along with some common sense two- and three-wheel safety approaches. Then, after a bit of Q&A with the instructors, we are ready to hit the road – or at least, the parking lot.

### FIRST RULE

Never, ever, put your feet down. There are three wheels, so you won’t tip over. But most certainly you can “mouse trap” your feet under the body or rear wheels – not an enjoyable experience.

# HOW TO RIDE A TRIKE (CONT.)

## SECOND RULE

All units have a hand brake, just like the one in your car, and you must release it before moving out. Without a kickstand, there's nothing but the hand brake to keep the trike from rolling into Grandma's Corvette.

## THIRD RULE

The wheelbase of a trike is the same as that of the two-wheeler, but because of its bodywork, it's slightly longer and a whole lot wider. To determine just how wide, once seated, stretch out your arms -- that's the width you must allow for when cornering.

## FOURTH RULE

A trike involves "direct steering." Point into the direction of travel, lock your outside elbow into the turn, and then roll on the throttle through the turn – this differs from a two-wheeler where you counter steer and lean through a corner. Using the Point, Lock, and Roll system, we went into, and out of, every type of corner quicker than when riding any comparable two-wheeler. And what's more, we did so with increased confidence from not having to brake or steer around light road debris, such as sand and gravel.



# HOW TO RIDE A TRIKE (CONT.)



## **FIFTH RULE**

Look into and ahead of your direction of travel. Good advice, whether on two, three, or four wheels.

## **SIXTH RULE**

Use both front and rear brakes. On a two-wheeler, your rear brakes are 30 percent of your stopping power. On a trike, though, two rear wheels mean twice the stopping power, so you don't want to override your front wheel. Even in panic stops, the trike stops quickly and keeps straight.

## **UNLEARNING OLD HABITS WITH HANDS ON EXPERIENCE**

Our initial road experience starts in an empty parking lot, where our instructor Kevin walks us through everything from getting into the saddle, to slow turns. It's here where the two-wheeler habits are likely to emerge and conflict: while it's clear visually that you have three well-planted wheels beneath you, the mind conveys "motorcycle." Begin slowly and lean. On a trike, you can lean until you're kissing the asphalt, as nothing is going to happen.

Another potential conflict can emerge from experiences with, and observations of, sidecars, as these too are three-wheelers. With a sidecar, the



## HOW TO RIDE A TRIKE (CONT.)



outside rear wheel will lift and put you over the high side. But on a trike, this won't happen. The big difference is that with a sidecar, there are two wheels on one side, with the third on the other, shaped like an L. With the trike, there are two wheels in back, with one centered in front, shaped like a V. Geometry alone suggests the trike is well-balanced, sturdier, and least likely to tip.

What's important to remember, regardless of the vehicle, is to keep your front wheel straight and pointed in the line of direction. Common sense on any machine. The trike maneuvers we practiced were figure-eights, panic stops, quick turns, and even cranking the handlebars in both a hard right and a hard left, while in motion. On a two-wheeler, this maneuver could only be accomplished by opening the throttle and doing donuts, or by going slower and falling over; but on a trike, no problem! The instructors cautioned us against one slow speed scenario, which is when "head wobble," or a shimmy in the handlebar occurs. But once you pick up speed to about 10 - 15 mph, it disappears, and after a few hours of riding, you won't even notice it.

### **IN THE REAL WORLD**

After marking our place in the parking lot a few times, we head out on the long and winding road with our other instructor, Clay. The first goal is to conquer our fears. Fear of tipping over on corners. Fear of losing con-

## HOW TO RIDE A TRIKE (CONT.)



trol while going too fast into corners. Fear of misjudging the brake system and smacking some poor four-wheeler. And mostly, fear of looking stupid. But we quickly learn that we need not have feared anything.

Within 30 minutes, I achieve a level of comfort and confidence like I've never felt on any other machine. Out in the real world, we have a chance to put all of our learning into practice. The corners flatten out like pancakes, the stopping is on-a-dime, high speed driving is stable and predictable, and encountering gravel is a breeze. Between Kevin's parking-lot training and Clay's road riding, we become very competent trikers.

### **YOU TOO CAN RIDE A TRIKE**

After watching the video, reading through the safety manual, and most importantly, getting true hands-on experience riding, I now understand why it's harder to instruct an experienced rider than a complete novice. As experienced riders, we bring a number of habits and expectations from riding two-wheelers, all of which must be unlearned. Additionally, there are preconceived notions that tend to be inaccurate and fostered by ignorance. But the bottom line is this: whether you're 75-years-old, or whether you were born in 1975, a trike is for anybody who wants performance, comfort, and a perpetual grin. Test drive a trike and you won't regret it.





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