Road Bike Fitting Guidelines:
The Essentials for Proper Fit

Eric Bowen, Fit Technician

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San Marcos, CA 92078

www.bikfit.com • 858.414.7093 • bikfit@yahoo.com

Road Bike Fitting Guidelines

If you have received this document because you are already a client, then I sincerely thank you for your trust in my expertise. I feel it is important that you understand some of my basic fitting philosophies, and the reasons behind some of the changes I may have made or suggested.

Now, for those of you who might be using this as a reference to possibly fit yourself, and haven't seen me for help with your positioning, please keep in mind that there can be many exceptions to every one of these general rules of thumb. Even if I were to fit two cyclists with identical measurements, chances are they would still have different final positions. There are just too many variables that measurements, no matter how precise and numerous, aren't going to identify, especially when it comes to the foot/pedal interface. That is why I don't use, or recommend, any type of fitting system that relies on taking measurements, plugging them into software, and then using the suggestions for final bike set up. The only way to conduct a proper fit is to observe a cyclist while actually riding – what is called a dynamic fit.

Please use caution when making any changes. A position change should never result in pain. Sure, it may feel a little strange at first, but if you let common sense serve as your guiding light, then you should be able to avoid most problems. Please email or phone me if you have any questions.

A. Frame sizing

The right size frame – seat tube and top tube lengths

Step 1. Measure your inseam.

Do not use your pant inseam, as it can sometimes be way off the mark. First, you will need an assistant; it's too difficult to do this on your own. Make sure you are in socks and cycling shorts. Next, set your feet about 9-10" (23-25 cm) apart and straddle a 2-3 foot long (61-91 cm) carpenter's level that has about a 2-3" (50-76 mm) thickness. Pull the device firmly into your crotch while facing a wall. Leave enough space between you and the wall so you can hold both the front and back of the level, and your helper also has room to mark the wall. Make sure your level is perpendicular to the wall. Have your helper mark the spot on the wall at the top of the level. Measure from floor to this mark and you now have a fairly accurate measurement of your inseam.

Step 2. Determine your seat tube length and top tube length.

Multiply your inseam (as measured in centimeters) by .655. If you don't have a metric tape measure, 1" = 2.54 cm. The result will give you your correct center-to-center seat tube measurement for a bike with traditional level top tube geometry (a dying breed among today's mass produced bikes). This measurement will also serve to give you your correct center-to-center top tube length. Short and tall cyclists may have special requirements (see below). Sloping top tube geometry, or compact frames, can be particularly tricky to size correctly, as the actual seat tube length won't even come close to the results of the above formula. Also, sizing conventions such as XS, S, M, L and XL are of little help in knowing what size frame is correct for you. Always make sure you know the length of the virtual (or

“effective”) top tube on sloping/compact geometry, and that this is the correct size for your body (see Step 3).

Step 3. Determine if your upper body and lower body are proportionate.

If your upper body is in proportion to your lower body, then the top tube should be the same length as the seat tube, as determined in Step 2. First, you will need know your height. If you haven't had your height measured in a while, I'd check to see if it has changed. People are often amazed by how much they shrink as they age. I also think that many people originally had their height measured while wearing shoes, as most folks are routinely an inch shorter than they thought. Once you do know how tall you are, divide your height (cm) by your inseam (cm), record the answer, and use the following as a guideline:

- If the answer is between 2.0 and 2.2, then your lower body is in proportion to your upper body, and your top tube and seat tube should be about the same length.
- If the answer falls outside of that range, or is close to either extreme, your torso is either proportionately longer or shorter than your inseam.
- If the result is close to 2.0, you have fairly long legs and you will probably want a top tube that is about 1-2cm *shorter than* the seat tube.
- If the result is closer to 2.2, then you have a fairly long torso and will want a top tube about 1-2cm *longer than* your seat tube.
- Those far outside of the extremes are good candidates for a custom built frame.

If you have relatively long arms, you might also want to lengthen the top tube, increase your saddle-to-handlebar drop, or the decrease the number of stem spacers used. Conversely, if you have short arms, you might want to do just the opposite. How do you know if you have long or short arms? Measure the distance between the tips of your middle fingers with your arms outstretched (arm span). If the measurement exceeds your total height by more than 3 cm (1.25"), you have long arms. If the measurement is less than your height by 3 cm or more, then you have relatively short arms.

Adjustments to Top Tube Length

Sometimes static measurements alone aren't the best way to ultimately determine your correct top tube length. Measurements and formulas are a good starting point, but your level of fitness, type of riding, flexibility, age, and injury history should also be taken into consideration. I use the following "5 Fs" to help determine if the top tube length should be further shortened:

Fit - How often does the cyclist ride?

No Deduction - Cycles at least 3x per week.
.5 cm deduction - Cycles 2x per week (preferably with one mid week ride).
1 cm deduction - Cycles only once per week.

Fast - What consistent speed can the cyclist maintain on relatively flat ground, while by themselves, for at least an hour (group rides don't count)?

No deduction - approximately 18+ mph (27+ kph)
.5 deduction - 15-18 mph (23-27 kph)
1 cm deduction - less than 15 mph (23 kph)

Fairly young - How old is the cyclist?

No deduction - Less than 40 years old
.5 cm deduction - 40-60 years old
1 cm deduction - 60+ years old

Flexibility - Can the cyclist touch the ground when bending over at the waist, feet together, and knees locked?

No deduction - cyclist can easily touch the ground
.5cm deduction - cyclist can get to about ankle height
1 cm deduction - cyclist can only reach to shins

Free of pre-existing conditions - Has the cyclist had injuries/pain/accidents/medical conditions (includes obesity) that would affect fit?

no deductions - none/never
.5 deduction - in the past, but not currently an issue
1 cm deduction - current/present (within the past year)

Overall, I find that most "roadies" tend to need about a 1 cm reduction from their starting top tube length, thus the vast majority of them are on bikes with top tubes that are a bit too long.

<u>Seat Tube Angles</u>

The seat tube angle not only plays a role in determing the location of your knees relative to the bottom bracket, but can also have a major impact on your reach to the handlebars. If you are comparing two bikes with the same top tube length, but they have different seat tube angles, the one with the *steeper* seat tube angle is going to have a *longer* effective reach to the bars. This concept can be a little difficult to grasp at first, but it's true. Let's imagine you are trying to keep your knees in the same position relative to the bottom bracket on two different bikes, one is your current bike with a 73° seat tube angle, and the other is a new bike with a 74° seat tube angle. Both bikes have the same top tube length, and you are happy with the fore/aft position of your current bike. If you buy the new bike, you will have to move the saddle *further back* to compensate for the steeper seat tube (for most people a full degree change in seat tube angle results in about a 1.3 cm [1/2"] change in fore-aft position). Since you will need to move the saddle to the rear of the bike, more of the top tube will now be in front of the nose of the saddle, thus the effective reach to the bars was lengthened by over a centimeter, which is fairly significant.

So, even though you may be comparing bikes with the same exact top tube measurements, just remember that if one has a steeper seat tube angle, it will also have the longer effective reach. The reverse is also true. If you are looking at a bike with a shallower seat tube than the one you are currently riding, then your effective reach to the bars will actually be shorter (you will have to move your saddle forward to maintain the same knee/bottom bracket position). The moral of the story is that switching seat tube angles, combined with a change in the top tube length, can have some pretty serious implications to your reach to the handlebars.

Unless someone has unusually long or shorts femurs (thigh bones), I don't advocate steep or shallow seat tubes (greater than 75° or less than 72°) for traditional road riding. Most people

tend to do just fine on a frame with a 73°- 73.5° seat tube angle. Generally, those with a fairly high cadence (100+ rpm) prefer to be positioned a bit more forward, and lean toward slightly steeper seat tube angles, while the more recreational type of rider with a lower cadence (90 rpms or less) prefers a more rearward position, which favors a slightly shallower seat tube angle.

Short and Tall Cyclists

Ladies (and men, usually less than 5'6"/167.6 cm) really need to be careful when purchasing a frame. Stay away from bikes with long top tubes; it's pretty easy to get a bike that is going to stretch you out. Just because a bike is labeled a 50 cm, don't expect the top tube to be the same length. It's very common for smaller bikes to have disproportionately long top tubes. Also, look out for steep seat tube angles, which is also very common with smaller bikes; it is sometimes impossible to move your saddle far enough back on the rails if the angle is 75°, or more. It's also quite common for shorter riders to have a problem with toe overlap with the front wheel, and if that's a real issue for you, it can sometimes make more sense to go with a bike designed for 650, rather than 700c wheels, especially on frames less than 50 cm. Adequate standover height can also be a problem for shorter cyclists trying to stay on a bike that has both 700c wheels and traditional level top tube geometry, so a compact frame may be another option worth considering.

Taller men (and ladies, usually more than 6'1"/185.4 cm) need to be wary of top tube/seat tube combinations that are going to bunch them up. Slack seat tube angles (around 72°) are common on large frames, and as mentioned earlier, this can lead to moving the saddle far forward to get the correct fore/aft position, which effectively shortens the reach to the bars. Taller cyclists will find it difficult to find a frame that is both long enough and tall enough. Those 6'5"+ (195.6 cm) really would be better served by a custom built frame, as trying to fix an incorrectly sized top tube with an unusually long stem is a poor workaround, and bike handling will suffer. Downhill "shimmy," and poor control when cornering are the two most common problems. Crank length (see below) is another problem spot for both short and tall cyclists.

Head Tube Length

Most cyclists simply don't give this part of the frame the attention it deserves. A large part of the problem is that body measurements aren't going to be very helpful in determining an appropriate head tube length. If the head tube is too short for you, there is a good chance the steerer tube will be cut too short, and your saddle to handlebar drop will be too severe. Once cut, there is no going back, and about the only option you have at that point is to use a stem with a pretty steep positive rise, or buy a new uncut fork. This is one of the things I really miss about the old quill stems, because you could simply raise the stem if it needed to come up.

So what is the right head tube length? Look at your current bike. If you are happy with the saddle to handlebar drop (see Stem Height, below in Section "C"), the number of spacers between the stem and headset, and the rise of your stem, then make sure your next frame has a head tube at least as long as your current bike. Most cyclists in their 40s, and older, would probably be better served by a longer head tube than the one on their current bike. Many of the manufacturers now offer models specifically designed to address the need for this more upright position.

B. Foot/Pedal Interface

Cleat placement – Fore/Aft

I like to place the cleat so that the pedal spindle is right around the ball of the foot. If you have longer feet (men size 10+, women size 11+), I'll position the first metatarsal head (the boney bump on the side of your foot, just below the big toe) in front of the spindle by about 5mm (that means the pedal spindle will be slightly behind the ball), and up to 1cm or more for really long feet. With shorter feet (men, size 8 and below; women, size 9 and below), I'll place the ball of the foot so that it's just over the very front of the spindle, and for all others, just over the rear of the pedal spindle. Also, make sure both cleats are in the same fore/aft position on both shoes, or you're actually creating a functional leg length difference.

I am not a proponent of mid-foot cleat placement (arch cleats). If you were to throw on a pair of flip-flops, grab a beach cruiser and go for a spin, I'm pretty sure you aren't going to pedal that bike with the arches of your feet. I know there are some well-respected proponents of mid-foot cleat placement, but for general road riding/racing, the cleat should be around the ball of the foot. Arch cleats would also necessitate drilling new holes in the sole, and I certainly don't want to be the one doing this to a pair of five hundred dollar carbon fiber Italian wonder shoes.

Cleat Placement – Side to side and stance width (Q factor)

Your feet should be in line with your hips. It's absolutely amazing how much more efficiently you'll pedal once this is done, and in many cases I've found it's the single most important change that can be made. Simply put, getting your stance width dialed in can make you a better cyclist; it will often also cure the dreaded shoe "hot spot." I use a vertical laser to help with the alignment, and often times a simple 1 mm spacer or two (placed between the pedal and crank) will work wonders. Many pedal systems simply do not have enough side-to-side adjustment built into either the pedal or cleat. Stance width is such a critical part of the fitting process that I may even recommend a switch to a different pedal system – one that has a different spindle length. I have also found that it's almost always the folks who need their stance widened, rather than narrowed, who tend to have most of the problems.

Cleat Placement – Rotation

I like to match the cleat rotation (toes in/ toes out, or heels in/heels out) to the way you walk when you're up on the balls of your feet, what could best be described as "tippy-toes." This method closely mimics the way you would apply pressure to the pedals. Setting the rotation based on the way your toes point when walking doesn't make sense, as cycling does not involve a heel to toe transition as in running and walking. Often times someone will walk duck toed or pigeon toed, but they won't when on the balls of their feet.

Wedges and shims

Most cyclists should not be trying to use wedges and shims without some professional guidance. There are far too many examples of "wedging and shimming gone bad."

Wedges are typically used to correct for a tilt in the forefoot, known as either varus or vulgus. I use a forefoot-measuring device to determine the degree of tilt, and the possible number of wedges that may be needed. After the wedges have been installed (either in the shoe, or between the cleat and shoe), a vertical laser is then used to confirm the effectiveness of the devices. There can be a bit of trial and error involved before I get it just right. Rarely do I find that I need to use the exact number of wedges that were originally indicated. Rarely do I find that same numbers of wedges are needed on the right and left sides. Bikes are symmetrical, but people rarely are. Like stance width, if wedging is done correctly, it can have a significant impact on efficiency, power, and the prevention or elimination of injuries. The full benefits are usually not realized until muscle adaptation occurs over the course of several months.

Shims are used to correct for a leg length discrepancy, and are added material placed between the cleat and shoe that effectively increases shoe sole thickness on side of the short leg. I usually won't use shims unless the difference in legs is .5 cm or more, and I never correct for the full discrepancy. Lower leg (tibial) discrepancies are usually shimmed for half the leg length difference, and upper leg (femur) discrepancies are usually shimmed for a third the length of the difference.

C. Position

Saddle Height

Unfortunately, there isn't a good formula for setting your saddle height. Your knees should have a bend of anywhere from 25-35° toward the bottom of the pedal stroke, when the crank is lined up with the seat tube. Competitive cyclists usually like to be at the very low end of the range. Those with less flexibility, or a previous history of injuries, should be at the other end of the extreme. I measure knee flexion with an angle finder known as a goniometer. The anatomic markers used to determine knee flexion are the bony bumps on the outside of the hips (greater trochanter), the pivot point at the center of the knee, and the ankle (lateral malleolus).

The Lemond/Guimard method of establishing saddle height is very popular, and has you multiply your inseam by .883 to find the measurement from the center of the bottom bracket to the top of the saddle (in line with the seat tube). This method can sometimes be way off the mark. Equally as hit and miss is setting your saddle height by placing your heal on the pedal and raising or lowering your saddle until your leg is straight when lined up with the seat tube. Neither method takes into account cleat stack height, arch length, cleat placement, or heel up/ heel down pedaling preferences.

If you must use a formula, multiply your inseam by 1.11. Use the result to set the saddle height by measuring from the bottom of the pedal spindle, with the crank lined up with the seat tube, to the top of the saddle.

Crank length

Crank length should be proportionate to your inseam length. There are numerous formulas floating around, and the topic has been endlessly debated, but I multiply the inseam length (in millimeters) by .21, which will yield the following results:

Inseam 28 – 30”/71 – 76 cm (711 mm – 760 mm) = crank length of 149 – 160 mm
Inseam 31- 33”/79 - 84 cm (790 mm – 840 mm) = crank length of 166 – 176 mm
Inseam 34 – 36”/86 - 91 cm (860 mm – 910 mm) = crank length of 181 – 191 mm

As you can see, if you have an average male inseam length, you'll fall into one of the traditional sizes – 170-175 mm. If you are much shorter or taller than average, then you might want to contact me for a quote on custom cranks. If you need really long cranks, you are also a candidate for a custom frame, as the bottom bracket will need to be higher than on most stock frames. Pedaling style can also factor into going with longer or shorter cranks – spinners may like to go shorter, and mashers a little longer. Taller criterium racers may also like to go with shorter cranks, so they can avoid clipping their pedals on the ground when blasting through tight corners.

Saddle Position Fore-Aft

A good starting point is for the front of your knee and the front of the crank arm to fall in a vertical line when the pedals are in the 9 o'clock and 3 o'clock position, a slight variation to the method known as KOPs (knees-over-pedals). You can use a plumb line to measure this, but unless your bike is perfectly level on a trainer, and your cranks are also level, this method can be pretty off the mark.

There is no simple way to finalize your fore-aft position without also determining your pedaling style and center of gravity, which can be largely effected by your upper body mass, seat tube angle, and reach to the bars.

Saddle Angle

Your saddle should be level. Period. If it's not, then something else is not right, probably your reach.

Stem length

If your top tube length and seat tube angle are in the right ballpark, then your stem length should fall in the 70 mm – 130 mm range. Obviously shorter riders would be at one end of the extreme, and taller riders at the other. If you need something longer or shorter, you're probably on frame that doesn't fit. Most cyclists will be in the 90-110 range.

Saddle to handlebar differential/drop to the bars (vertical distance between the top of the saddle and top of the handlebars)

This should normally be in the range of 2-10 cm. If the difference is any greater, then you might be on a frame that is too small, or your saddle height could be too high. If your bike is set up to look like the ones in the magazines, and like the pros, then your saddle to handlebar drop is probably going to put you in an uncomfortable position. If you can't raise your stem, and your saddle height is correct, you may need to get a stem with a fairly steep positive rise (10-12 degrees, or more). Some find these upturned stems hard on the eyes, but aesthetics aside, this setup certainly beats a chronic sore back. When you're in your 20s, you can get

away with large saddle to handlebar differentials, but as you age you tend lose flexibility; it's best not to let your ego get in the way of a more comfortable position. Again, a bike with longer head tube, or a new uncut fork (which would allow for additional spacers), could be the best solution.

Handlebar width

The bars when measured center-center should be about the same width as your shoulders. Not the outside of your shoulders, but the width between the two boney bumps on the top of your shoulders (the acromion process) as measured from the behind. For whatever reason, it seems like most of the people I see are on bars that are a couple cm too wide.

Brake lever hoods

Most mechanics install the brake levers so that the bottom tip of the brake lever is in line with the drops of the bars. This will usually allow you to rotate the bars so that that there is an almost level transition from the tops of the handlebars to flat part of the hoods. The newer Campy, SRAM, and Shimano gruppos have nice long hoods, almost like a shelf, on which to rest your hands. You don't want this "shelf" cocked up or down. It's a bit more difficult with the older hoods, but you still want to make sure that the majority of the hood is fairly level. The hoods should also be angled in toward the stem a bit. Imagine if you were to reach out and shake a person's hand; that is about the same angle you'd want position the hoods inward.

Handlebar Shape

You want to make sure that your hands fit comfortably in the bends of the bars, and they should fit in there without the web between your first finger and thumb getting squeezed. At the same time, you don't want too much extra space, as you'll find the reach to be a bit much, and then you'll rarely want to ride in the drops. I'm not a fan of some of the newer anatomic designs, as they make it difficult to position the hoods as recommended in the previous section. Again, you want a nice level transition from bar tops to the hoods.

Shoulder Angle

Your shoulder should form a 90° angle with your torso when you are on the brake hoods, with elbows slightly bent at 15°. If your shoulder angle is greater than 90°, you are probably too stretched out.

Torso Angle

Again, this is another one of those measurements that will be a little difficult without an angle finder or goniometer. What I'm talking about here is the angle formed by your shoulder, hip (greater trochanter) and a hypothetical horizontal line extending out from your hip. Top tube length, stem height, stem length, stem rise, and the fore-aft position of your saddle all effect torso angle. Basically, torso angle and the shoulder angle combine to form your total reach.

There are three basic handlebar positions affecting reach: tops, hoods, and drops. There aren't any set in stone guidelines to determine proper reach in the hoods and drops, as all the following can come into play: core, back, and shoulder strength; flexibility; arm and torso length; injuries; type of handlebars; type of brake hoods; and type of riding (ie. touring, racing, etc.). Of course, most important are your personal preferences. A bike fitter can't tell you what is comfortable, only you can be the judge of that. As a very rough rule, especially for recreational riders, I'd suggest keeping your torso angle at no less than 30° with hands on the hoods and elbows slightly bent. In turn, this should place your torso angle while in the drops somewhere between 15-25°. A perfectly flat back while in the drops is only going to be obtained by years of training and extreme flexibility, and is not a position most should be trying emulate.

While climbing, your torso angle on the tops of the bars should really be no less than 42-45°. When cycling at fairly low speeds uphill, overcoming aerodynamic drag is simply not that important. It becomes far more critical to open up the angle between the thigh and hip (hip angle). This is one of the reasons why people will move their hands in close to the stem when they climb; this position allows for a more a more upright torso, which leads to a more efficient transfer of power to the pedals.

This is certainly not an exhaustive overview of everything related to road bike fit, but I hope it serves as a good primer to get you steered in the right direction. Again, for those who are already clients, this paper should help shed a little more light on some of the information contained in my written analysis of our fitting session. If you have a particular issue, question, or concern please feel free to contact me.

Eric Bowen, Fitting Technician
BīkFit
858-414-7093
bikfit@yahoo.com

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