the Quick 'n Dirty on FIT

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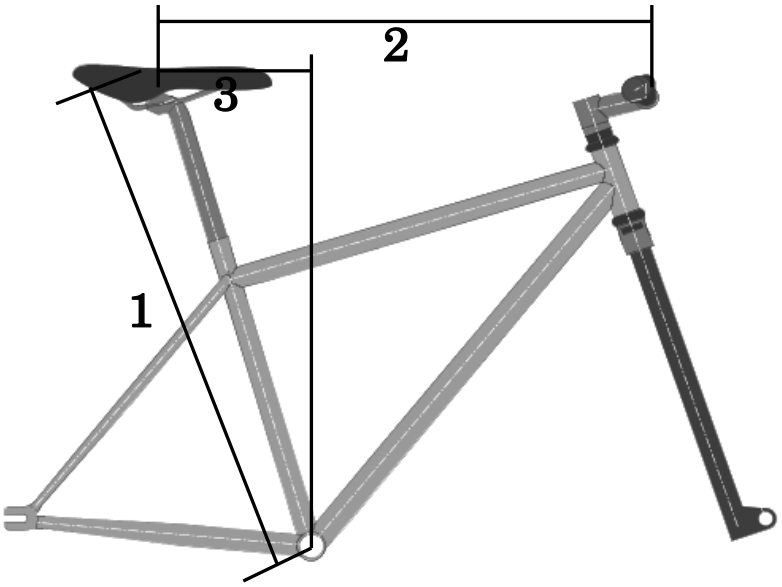
This is one of the most difficult concepts in bicycle mechanics to convey. Why? There is very little science on the biomechanics of cycling and there are so many individual preferences on bicycle fit.

THE BASICS

There are several key measurements that set the basic framework for bicycle fit. In reference to road bikes (and with a particular focus on racing) Keith Bontrager suggests the three important measurements are the 1) **saddle height**, 2) **saddle to bar distance**, and 3) **fore-aft saddle position**. There are additional measures (bar height compared to saddle height, bottom bracket height, stand over height, wheelbase, head tube angle, chainstay length, and front center) which determine how a bike will handle under certain conditions. We can't cover all the details – preference on these additional parameters is largely gained from experience riding many different bikes.



1) Saddle height

2) Saddle to bar distance

3) Fore-Aft saddle position

Saddle height is solely determined by leg length, set at a distance that allows a slight bend in the knee during the furthest extension of the cranks. It is affected by the seat tube length and seat post extension. The **saddle to bar distance** should account for torso and arm length as well as the desired riding posture (more aero or more upright). It is affected by top tube length, stem length, seat post offset, and saddle rail positioning. **Fore-aft saddle position** is the most debated measure of the three – some bike fitters swear by certain measures related to femur length or K.O.P.S. (to be discussed later). Fore-aft saddle position is affected by the seat tube angle, seat post offset, and saddle rail positioning.

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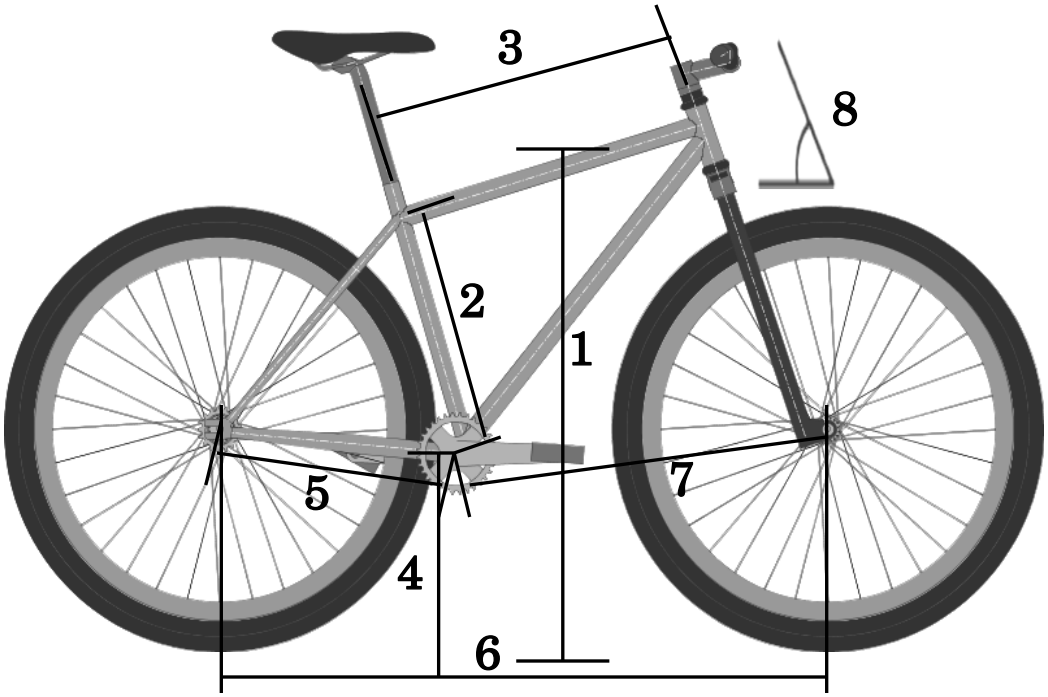
Notice that the basics were missing a few common fit measures – like stand over height, so what's actually important?

THE NECESSITIES

Bontrager's three basics relate primarily to pedaling efficiency and the fore-aft distribution of gravity on the bike, which affects comfort, aerodynamics, and cornering. While the three basics control how a bike rides, he assumes we can cover the necessities.



1) **Stand over height**
2) **Seat tube length**
3) **Top tube length**
4) **Bottom bracket height**
5) **Chainstay length**
6) **Wheelbase**
7) **Front center**
8) **Head tube angle**

Stand over height is probably the single most important measure for urban and mountain biking. You don't want to endanger the family jewels during unexpected dismounts! **Seat tube length** is the frame property that controls stand over, and along with seat post extension, affects saddle height. The **top tube length** similarly is the frame component of the saddle-to-bar dimension, further refined with seat post offset and stem length. The **bottom bracket height, chainstay length, wheelbase, front center, and headtube angle** affect how a bike "feels." Longer chainstays and longer wheelbases feel more stable compared to shorter ones. Shorter chainstays are stiffer than longer ones. Steeper head tube angles are twitchier than slacker ones, but extremely slack angles can feel floppy. The front center is a second order measurement related to frame size, head tube angle, and fork length. It is a good one-figure-measure of how a mountain bike feels.

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So, you're helping someone pick out a bike at the co-op. You aren't custom making a frame and you don't have the selection to shop around for perfect fit. What can you do?

ADJUSTMENTS AND COMPONENT SWAPS

1) **Raise or lower the seat post**
   Raising or lowering the seat post is the most basic adjustment to fit someone to a bicycle. Aim for a height that allows near, but not full extension of the knee while at the longest reach of the pedal stroke. Make sure not to exceed the minimum insertion line!
2) **Raise or lower the stem**
   Most quill stems have room for 1-3" of vertical adjustment. Loosen the retaining bolt on the top of the stem, unseat the wedge, and adjust the vertical position of the stem. Watch for the minimum insertion line! Clamping stems (threadless) have room for vertical adjustment if there are headset spacers present on the steerer tube. Unfortunately, the request is usually to raise the stem, in which case the spacers would have to be above the stem, which is rare (there is an adapter).
3) **Move the saddle fore-aft**
   There are a few reasons to adjust the fore-aft positioning of the saddle. One is to reduce or increase the saddle-to-handlebar distance to accommodate a person's reach. Another reason is to adjust the saddle-to-bottom bracket relationship in order to better balance the rider's center of gravity over the bike. Moving the saddle fore-and-aft can also accommodate different pedaling positions.
4) **Swap the stem**
   The first component change is often the stem. If the user complains of back or neck pain, straining to reach, wrist or hand pain, or leaning too far forward, then a shorter stem or a stem with more rise may be the proper solution. Less often, a rider will complain that they feel cramped while riding. A longer stem, or a stem with less rise (or even some drop to it) may be the correct solution. For clamping stems (threadless) with rise you can always flip the stem upside down to turn that rise into drop!
5) **Swap the seatpost**
   Seatposts come with varying offsets (the position of the clamp compared to the axis of the seat tube). If someone complains of a long reach, switch to a zero offset post. If someone feels cramped, pick a post with more offset, which will place the saddle further back.
6) **Swap the handlebars**
   Handlebars can vary from flat, to drop, to riser, to mustache, to apehangers. Switching handlebars can do a lot to change the effective reach and rider posture. Be aware of brake and shifter requirements when considering a handlebar swap – there are some constraints.

FIT

This is a commonly accepted practice, so I feel that I must teach it, but many suggest this is an over simplistic method that is coincidental, in it's fit at best.

K.O.P.S.

Knee over pedal spindle or K.O.P.S. is a method of bike fitting aimed at optimizing pedaling efficiency. The positioning of the rider is adjusted so that the tibial tuberosity (the bump below the knee) lines up with the pedal spindle when the cranks are in the three o'clock position.

The rider position is adjusted by selecting a bike frame with an appropriate seat tube angle and a seatpost with the correct offset. The riders position can then be fine-tuned with fore-aft saddle positioning. K.O.P.S. claims to optimize biomechanics, but what it really does is place the rider's center of gravity (CG) over the pedals, which is important, because applying force to the pedals is how a rider should provide input to the bicycle. If the rider is too far back, pedaling forces will drive the rider back off the saddle, requiring constant input from the rider to pull himself back over the saddle. To far forward and the opposite would happen. In the middle the rider's gravity balances the pedaling forces with little input.

K.O.P.S. is probably **most relevant** for competitive road and cross-country mountain biking, where pedaling efficiency matters. For recreational riding, comfort, posture, and bike handling may trump K.O.P.S. In gravity-oriented mountain biking, some bikes are designed with blatant disregard to K.O.P.S., placing the riders CG further back so that the bike is balanced when descending a steep slope.

When will K.O.P.S. affect you? Most bicycles are designed with a seat tube angle and equipped with a seatpost that should accommodate a wide range of rider sizes. The most common K.O.P.S. issue arises when using a much longer (or much shorter) fork on a mountain bike than what the frame was designed for. Adding length to the fork "jacks up" the front end, slackening both the head tube angle and the seat tube angle, and moving the rider's CG further behind the bottom bracket. This position may work well for descending, but riders typically complain that it feels sluggish and low power in the flats and while climbing. This may be remedied by moving the saddle fore, but this also changes the saddle-to-handlebar dimension which may make the rider feel cramped.

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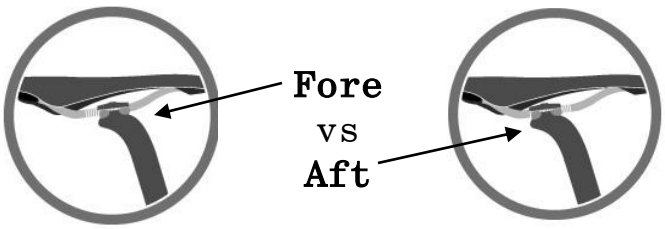
Stems and seatposts are the first parts to change to make a bike fit a rider better.

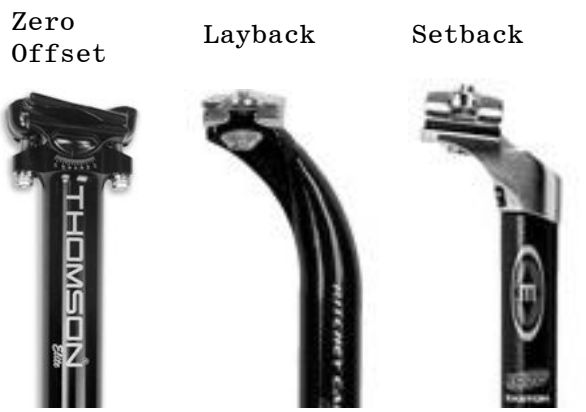
STEMS

Quill stems can be raised or lowered by loosening the quill bolt. There are many quill stem styles meant for different bike fits and styles of riding.

Clamping stems have limited adjustment. Generally, if the reach isn't right go for a new stem. There are adjustable styles and vertical adapters to get more rise.

Seatpost style and fore-aft saddle positioning can move the rider closer to or further from the bars. Select a zero offset post for less reach or a setback seatpost for more reach.





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Handlebars. There are so many options, but don't get too excited about something new until you make sure your controls (shifters and brake levers) are compatible.

HANDLEBARS

Flat handlebars are most common on mountain bikes and commuters. Compatible with cantilever and V-brake levers, thumb shifters, trigger shifters, stem shifters, and down tube shifters.

Riser bars are just a variation on the flat handlebar. Same compatibility.

Drop bars are most common on road and cyclocross bikes. Compatible ONLY with drop-style brake levers, bar end shifters, integrated road shifters, stem shifters, and down tube shifters.

Mustache bars are most common on older 3-speed cruisers. Compatible with some, but not all mountain and road components depending on placement relative to bends. Must wear tweed.

Alt bars are the it thing for retrogrouch mountain bikers and hipsters. Extra hand positions, ramming spikes, gadget attachments, etc.

Aero bars and bar ends are never cool. Just kidding. Aero bars may be warranted for road time trials or triathlons. Bar ends aid in climbing and add hand positions. Also utilized for the classic "I know this is probably a bad idea but this hook will hold my groceries."