Gearing Briefing for C-SIG

by Jim Reaven, 2009, revised 2010

This is written mostly from the perspective of a road bike rather than a hybrid or mountain bike, but the principles are the same.

Introduction

High and Low: The purpose of the gears is to allow you to trade difficulty of pedaling, on the one hand, for distance travelled with each pedal stroke on the other. Shifting to a "lower" gear makes pedaling easier and is used for uphill. Shifting to a "higher" gear makes pedaling harder but the bike goes further with each stroke. The latter is appropriate for riding fast, or for control downhill.

Cadence

Spinning: Most people know that gears help with climbing hills, but another purpose of shifting, especially for people who ride for sport, is to allow the rider to maintain an even rate of pedaling, known as cadence, as riding conditions change. Conditions include grade, wind, and road surface. A good rider will try to maintain an optimum cadence, shifting as needed to maintain that cadence.

What Cadence to Use? Most beginners start with too low a cadence for either efficiency or personal conditioning…often about 60 turns per minute. Experience shows that 80 to 95 turns per minute is more efficient. But a fast cadence feels a little strange at first. A cycling computer with the cadence feature helps a rider learn faster cadence. Optimizing cadence for your body is a more advanced subject than can be covered in this briefing, but a rider who is new to bicycling as a sport needs to get accustomed to a spin rate of least 80 on flats and gentle rollers. That should keep you busy for a while.

Spin for Smoother Riding: Besides being more efficient, spinning at a correct cadence allows smoother acceleration. For example, if the speed of the group increases for whatever reason, instead of shifting immediately, you might let your cadence increase within your comfortable range, say from 80 to 90 or 95, and then shift to a higher gear that returns your cadence to 80. If you associate shifting with an understanding of your own cadence, the result is smoother and less jerky speed adjustments. The person riding behind you will appreciate it.

Spin to Protect the Knee Joints: Another advantage of spinning at a higher cadence is that it reduces pressure on the knees and prevents knee injury. This sounds like an empty promise to most beginners because they find themselves using their lowest possible gear combination on hills all the time and their cadence is still way below 80. If you find hills extremely difficult on most club rides, and especially if this condition continues even after having lost extra weight and partially conditioning the legs, consider changing the gearing on the bike as explained below.

How often should I shift? Shift early and often! Professionals shift every few seconds unless the terrain is dead flat.

Gears and Shift Levers

Shift levers: The left lever shifts the front gears called the chain rings; the right shifts the rear gears called the cassette.

Cassette: The cassette consists of 8, 9, 10 or 11 cogs that differ from each other by anywhere from one or two teeth to 4 or 5 teeth. These are used for fine tuning the shifting.

Chain rings: These are the front gears that are used for large changes in gearing. Bikes with three chain rings, called triples, are intended to be ridden mostly in the middle chain ring. Bikes with two chain rings, called doubles, are intended to be ridden mostly in the larger chain ring.

Doubles & Triples: Traditional doubles were intended for racers. The larger racing chain ring often has 53 teeth, while the smaller, for climbing hills, typically has 39 teeth. For most of us, the gearing of both rings is too high to help us climb hills and keep our knees healthy. For our kind of riding, triple chain rings are usually better. The smallest chain ring, or alpine gear, gives a very low gear for going uphill. The largest chain ring gives a very high gear for maintaining traction on the road while riding downhill. Traction is very important, especially if you need to power through gravel.

Compact Doubles: Recently, however, many road bikes are sold with compact doubles. These are smaller than regular doubles, having 50 or 48 teeth on the larger chain ring and 34 or 32 on the smaller chain ring. Compact doubles provide a combination of gears lower than racing gears, in fact very similar to triples but with less weight, faster shifting action, and, most important, they look cooler.

Modifying the Chain Rings: If you have a racing double and want something else, there may or may not be room in the frame to swap it for a triple. And this modification, even if possible on your bike, is expensive. But, you can swap the racing double for a compact double. This costs less than trying to modify to a triple, but still isn't cheap because you will need to change the pedal crank arms. This is because the circle of bolts that holds the pedal cranks to the chain rings has a smaller radius and requires cranks with bolt holes in different positions. Cost is relative of course. Nothing on a bike, short of buying a new one, is very expensive compared to even a small repair on a car.

Modify the Cassette: Another approach to an easier pull uphill is buying a different cassette. If you are having trouble getting up hills, it is very possible that the bike shop can sell you a cassette with a large cog that is slightly larger, and has one or two more teeth, than the largest cog on your current cassette. This will also give you lower gears and make riding uphill easier. Generally, the largest cog you can use on a road bike with a standard rear derailleur is 27 teeth. If presently your largest has 25 or 26 teeth, your climbing will benefit from a different cassette. You don't have to count teeth. Look closely and you will find tooth count numbers on the backs of the cogs. If adding one or two teeth still isn’t enough of a change for you, you could install a big mountain bike cassette with as many as 34 or 36 or even 40 teeth. This will require a switch to a mountain bike rear derailleur. That would make your road bike gearing more like a touring bike (bikes made to carry camping equipment on trips). Road bike riders with knee problems who ride long distances often do this.

Gearing charts: There are gearing charts readily available on the web that show the specific relationships between the number of teeth on the chain rings and the cogs and their effects on gear ratios. The ratios are made comparable by using the concept of "gear inches." For the

purposes of this briefing, we will ignore all of this, but charts and the concept of gear inches can be very useful if you are shopping for gears.

More Shifting Skills

Anticipating Shifting: It is important to shift just before you need the new gear. Here are three different times to anticipate shifting. When you are coming to a stop, shift to lower gears before you stop to make it easier to get going again. Second, when you approach a steep uphill, shift to a lower chain ring before you are on the hill. It is hard to shift the chain ring on a hill; doing so often results in the inconvenience of throwing the chain. And third, when you reach the top of a hill, shift to a higher gear just before you crest for a smooth transition to a flatter surface. There are plenty of other opportunities to anticipate shifting.

Double Shifting: What do you do if you are about to start up Churchill Road or the Alpe d'Huez, and you know that you must shift to the alpine chain ring, but you don't want to lose momentum during the last few feet before the hill by being in too low a gear? In this, and in other situations where a full shift of the chain ring is too much, you can double shift. In this case, you would shift the cassette one or two cogs higher a split second before shifting to a lower chain ring. Once you are on the steep uphill it is easy to shift the cassette to a lower cog, but hard to shift chain rings.

Crossed Gears: Avoid crossed gears. Gears are crossed when the chain is around the largest chain ring and one of the largest cogs, or when it around the smallest chain ring and one of the smallest cogs. Look at your bike and you will see that either combination puts the chain at a cockeyed angle. This is bad for several reasons. When the chain is on the biggest gears at both ends it is more likely to break. When it is on only the smallest it is more likely to come off. In either case, a crossed chain puts unnecessary wear on the chain and on the rear derailleur. A crossed chain may also rub against the front derailleur making noise. Crossing chains is generally a bigger problem for triples than for doubles.

Avoiding Crossing Gears: Most crossing of gears happens when a rider gets to the end of a hill, whether up or down, and forgets to shift the front gears back into the chain ring normally used for the flats and gentle rollers. For example, if the rider has just climbed a hill using the alpine chain ring and a large cog, then gets to the crest of the hill and leaves the front gears in the alpine chain ring, it is certain that the rider will start shifting to a higher and higher (that is, smaller and smaller) cog in the back. Eventually, the gears will be in the smallest chain ring and the smallest cog and they will be thoroughly crossed. Why does this happen so often? The problem is that when you first arrive at a hill, the hill itself tells you to shift chain rings. But, when the hill comes to an end and you are back to nice flat terrain, the flat terrain doesn't say anything to you. When you get to the flats you are happy, and you totally forget about your chain rings. You must develop the habit of shifting your chain ring back to its normal riding position at the end of hills, whether uphill or downhill. Here is a technique: When you shift chain rings at the start of a hill, yell at yourself to remember to shift them back at the end of the hill. Use colorful obscenities.

How to put a thrown chain back on: If you throw a chain off the chain rings on the flats, you might be able to get it back onto the chain ring while you continue riding by shifting the left gear lever in the appropriate direction so that the derailleur pushes the chain back over the gears and the chain will just pop back on while you pedal.

Usually, however, you will throw the chain on an uphill and the bike will come to a stop because the pedals will just spin and aren't connected to anything. Chains also drop off chain rings when the bike falls over or is laid down. In both cases, you need to put them back on manually.

To put the chain back on, get off the bike, push the rear derailleur forward to give the chain some slack, catch the chain on a tooth of the closest chain ring depending on whether the chain fell off to the inside or the outside, then lift the rear wheel off the ground by lifting on the seat. Finally, turn the closest pedal forward with your hand so the chain settles back onto the chain ring.

Have you tried this repeatedly and been driven to tears or a blinding rage? Here is the trick: Replacing a dropped chain is much easier if, before you start, even before you get off the bike, you use the left gear levers to move the front derailleur to the side that the chain fell off.

If the dropped chain is hanging over the pedal crank, upshift the left lever(s) to move the derailleur toward the outside chain ring. If the dropped chain is hanging inside against the bottom bracket, downshift the left lever a few times to bring the derailleur to the inside.

Replacing a dropped chain is like fighting a giant squid if you are fighting against the location of the front derailleur. It is extremely easy if you aren't.

Chain Maintenance

Clean the chain: A well maintained chain will give you good shifting for about 2,000 miles without damaging the gears. That is less than one long season of regular weekend riding for a C or B rider. If you have kept your gears clean and replaced the chain every 2,000 miles, you can probably get 4,000 miles from your gears. One consideration is that chains and gears wear into each other. Therefore, if you let the chain get too worn, the gears will also be worn. Then, you won't be able to replace your chain without it popping off all the time unless you replace the gears too.

I clean my chain about every 200 miles or so with citrus degreaser and a plastic chain cleaner, and wipe them off. After drying, I apply a light oil with cleaning properties such as PRO LINK oil, then again every few rides, or after any rain.

Don't clean the chain: Or, you can forget the whole thing, put some heavy all weather bike oil on our chain whenever it rattles, and ride with a filthy chain and worn out gears indefinitely, or until the lousy shifting irritates you, or until you crave a faster ride, or the chain breaks, or your friends make wisecracks about your filthy bike. If you aren't a racer, it probably doesn't matter which approach you take as long as the chain doesn't break in the middle of a busy intersection, or on my ride.

Measuring wear: Chain wear can easily be measured with a good ruler. It is easy to find directions on the Web about how to do this. Chain testing is based on the concept that all chain links are exactly one inch long, and they get longer as they wear out because metal on the inside of the links is worn away. Hint: You will be looking for 1/16 inch total over most of the length of the ruler, so first learn the error built into your ruler by measuring it against a new chain, then use the same ruler to check your worn chain. For accurate length an installed new chain, not your stupid office-supply ruler, is the "gold standard" as they say down on the cubicle farm.

Adjusting Gears

Maybe learn to adjust gears: This is another topic that is beyond the scope of this briefing. But, sometime during your first few years of riding a road bike, you might want to learn how to adjust your gears. This gives you a great sense of power and control...akin to learning how to repair a flat tire yourself. Several bike shops offer an evening class in this.

100 mile adjustment: You must take your new or refurbished bike back to the shop after 100 miles for the free 100 mile adjustment. All new cables stretch in the first 100 miles! At 50 miles you will probably need to use the barrel adjusters, then go to the bike shop at 100 miles.

Chain Repair

Fix a chain: If you want to be a road hero, learn to fix chains on the road. Details of this are beyond this briefing, but get started by buying a chain tool, obtaining a used chain, clean the chain with citrus degreaser from the bike shop, and take links apart and put them together again using the instructions on a web site or a bike maintenance book. The best way to obtain a used chain is by asking the bike repair guy to return yours when you have yours replaced at 2,000 miles.

Quick-Links: One further comment about chain repair: With quick-links, repairs can be made both better and more quickly than the conventional. You need to have in your bag a quick-link for the width of your chain. The width depends upon the number of cogs in the cassette. Using a quick-link replaces most (not all) of the work with the chain tool, and leaves the rider with a chain the original length instead of an inch shorter as with a conventional repair. A conventional repair requires that the rider get home using fewer gears than would normally be available. As a C-SIG leader, I carry 3 sizes of quick-links in an old patch kit box in the saddle bag.

Replace your own chain: Once you know how to fix a chain, it is a short step to learn how to replace your own on a regular basis. Buy a chain of the correct width by specifying the number of cogs you have (usually 8, 9, 10 or 11). Then, break the chain to the correct length. New chains come longer than you need. Charts on the web, or in the instruction sheet with the new chain, will tell you the number of links to remove for your gears. Break the chain with a heavy axe....No! No! Break it by separating a link with your chain tool.

Theory

Theoretical Question for Extra Credit: Why do larger gears make the gear ratio higher when they are in front, but lower when they are in back?

ANSWER: Remember the simple machines from junior high school science: the lever, the pulley, and the inclined plane?

Think of trying to move a boulder with a lever and a fulcrum. You apply effort with your hand to one end of the lever, and the other end of the lever does the work against the boulder. Everything at the one end is opposite from the other end. One end of the lever moves down while the other end moves up. When you move the fulcrum from closer to one end of the lever to closer to the other end, there is an opposite effect on the relationship between power and distance at the two ends of the lever.

Now, think of the gears as a lever. You apply effort to the chain with your feet on the pedals at the front of the bike, but the cogs in the rear are doing work of turning the hub of the rear wheel to make you go. Changing gears is like moving the fulcrum of a lever: The effect at the pedal end is opposite of the effect at the work end. Therefore, a physically larger gear does the opposite at the front from what it does at the back.

There are other ways to describe this, but no way to break it down further because simple machines are fundamental to nature. In nature, everything about “applying leverage” or “mechanical advantage” is opposite at the end where the force is applied from the end where the work is done.

Chill: If you still don't get it, don't worry, your hands will soon learn how to work the gears, if they don't already know.