

The Retul Bicycle Fitting System

BY SANDY SCOTT



In my training articles, I have often preached the importance of a professional bicycle fitting as the most cost effective way of enhancing performance on the bicycle. The cyclist basically has four choices: 1) Self fitting using the generic formulas widely promulgated in books and on the internet, such as “The axle should appear under the handlebars when the rider is on the drops,” 2) The all-too-common bicycle shop fitting where only the seat is adjusted, 3) The static, measured fitting at a bicycle shop using an approach of “one set of measured parameters fits all,” 4) A fitting in a wind tunnel which from a cost/logistics perspective, is not a practical alternative for most riders, and finally, 5) A dynamic fitting that measures the rider in real time, and in real-life, three (3) dimensions—the newest and greatest system and my topic for this article.

I recently had the opportunity to be fitted by this incredibly innovative system that came to market in November of 2007. The

Retul system was recently named one of Entrepreneur magazine’s top 100 brilliant companies. Carmichael Training System has three (3) of these and the Garmin professional cycling team actually travels with a Retul fitting system.

I was fitted at Outspokin Bicycles at their beautiful, modern shop in Clearwater, FL., by Park Alsop, a certified Retul fitter and an outstanding competitive triathlete. Park was one of three original fitters who was factory-certified to use the Retul system.

Most fitting systems rely on static measurements attained through widely accepted formulas. We are each an experiment of one, and what works for one person might not necessarily work for another. Often the results attained from a static fitting are about as accurate as determining your maximum heart rate by subtracting your age from 220 – an often suggested method. In other words, often times totally inaccurate. Frequently, static measurements are subject to human error.

Enter Retul, based in Boulder, CO, which developed a system that is the only motion-capture technology (i.e. not video analysis) on the market that allows cyclists to be dynamically fitted through the use of true 3-D angles of their body to analyze the rider’s biomechanics in real-time. The Retul software captures thousands of data points from cycling specific movements using a 3-D spatial model and inputs real-time data into a detailed customer fit report.

Also, most typical fittings do not take into account the goal(s) of the rider. For example, when I have a fitting I have only one goal in mind – to race my bike as fast as possible. Others might have goals of performance, comfort, injury prevention, or just simply optimizing the efficiency of their long rides. It is typically one fitting formula fits all. With Retul, your goals will be discussed, and your certified fitter will do the appropriate fitting to accomplish those goals.

Technically, Retul is a state-of-the-art, 3-D motion capture system designed for capturing accurate/realistic data which can be used by the fitter. The data is collected from eight key anatomical points in the cyclist's riding position. The fitter is able to profile the rider's existing (before) and ideal (after) measurements to achieve the customer's desired goal. Whatever your goals, the Retul system provides the accurate data needed to accomplish the stated mission.

Two very detailed, hard copy reports are furnished by the system:

1. Personal Bicycle Setup Report detailing 20 different measurements with 16 of them depicted with diagrams.
2. Personal Bicycle Fitting Report detailing 14 measurements of the rider.



Personal Bicycle Setup Report Bike and Rider Information

MAKE/MODEL: Trek Madone
NAME: Carole Demo
SIZE: 54
YEAR: 2009
STYLE: Road
NOTES: Tri Position

STEM: 90 deg x +6 mm
SPACER STACK: 25 mm
CRANK LENGTH: 172.5 mm
PEDALS: Look Road
SADDLE: Specialized Jet 143
BARS: Profile D. T2 Cobras

MEASUREMENTS & ANGLES

KEY	DESCRIPTION	MEASUREMENT	KEY	DESCRIPTION	MEASUREMENT
	Saddle Height	708 mm		Handlebar Reach	488 mm
				Handlebar Drop	-94 mm
	Saddle Setback	-38 mm		Aero Pad Reach	418 mm
				Aero Pad Drop	-51 mm
	Eff. Seat Tube Angle	76 deg		Headtube Angle	73 deg
	Frame Stack	526 mm		Handlebar Stack	600 mm
	Frame Reach	385 mm		Handlebar Reach	450 mm
	Stem Stack	50 mm		Stem Reach	85 mm
	Wheelbase	977 mm		Wheel Diameter	675 mm
	Trail	60 mm		Rake	44 mm
	Grip Width	120 mm		Aero Pad Width	230 mm

SESSION & SITE INFORMATION

NAME: Your Shop
OPERATOR: You
PHONE: 303-555-1212
DATE/TIME: 2009/03/17 12:46

ADDRESS: Your Address
Boulder, CO 80301
USA
WEBSITE: www.yourshop.com

THIS BIKE FIT PERFORMED USING THE RETUL SYSTEM



Personal Bicycle Fitting Report Rider Information

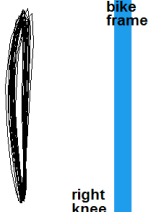
NAME: Jake Demo
AGE: 28
GENDER: Male
PHONE: 303-555-1212
EMAIL: jakedemo@domain.com

RIDING STYLE: Elite
GOALS: Comfort & Power
INJURIES/PAIN: None
FLEXIBILITY: Medium
TRAINING VOL: 15 hours/week

MEASUREMENTS & ANGLES

KEY	DESCRIPTION	MEASUREMENT	KEY	DESCRIPTION	MEASUREMENT
	Knee Angle Flexion	104 deg		Ankle Maximum	107 deg
	Knee Angle Extension	30 deg		Ankle Minimum	86 deg
				Ankle Range	21 deg
	Knee Forward of Foot	-78 mm		Knee Travel Tilt	0 deg
	Knee Lateral Travel	24 mm			
	Hip Angle Closed	55 deg		Hip Vertical Travel	51 mm
	Hip Angle Open	102 deg		Hip Back Angle	36 deg
	Hip to Wrist Vertical	-121 mm		Hip to Elbow Vertical	21 mm
	Hip to Wrist Horizontal	774 mm		Hip to Elbow Horizontal	549 mm
	Hip Foot Lateral Offset	7 mm		Armpit Angle to Elbow	76 deg
				Armpit Angle to Wrist	92 deg
	Elbow Angle	144 deg		Forearm Angle	-32 deg
	Thigh Length	421 mm		Power Output Ave (Max)	190 Watts (230 Watts)
	Shin Length	411 mm		Speed Ave (Max)	18 MPH (21 MPH)
				Cadence Ave (Max)	91 RPM (107 RPM)

KNEE TRACING (FRONT VIEW)



BIKE & SESSION INFORMATION

MAKE/MODEL: Felt F1
TYPE: Road
PEDALS: Look
HANDLEBAR: Felt
DATE/TIME: 2009/04/20 12:41
SIDE: right # 1
DURATION: 15 sec
NOTES: Pre Fit

SITE INFORMATION

NAME: Your Business Name
OPERATOR: You
ADDRESS: Your Address
Boulder, CO 80301
USA
PHONE: 303-555-1212
WEBSITE: www.yourshop.com

THIS BIKE FIT PERFORMED USING THE RETUL SYSTEM



The older, outdated manual systems, are not only typically designed to simply fit the customer on the bike without taking into account other goals, but as previously mentioned, tend to fall short due to human error among other issues. The Retul system can determine incredibly accurate, dynamic measurements accurate to less than 1 millimeter.

Due to my schooling as an aeronautical engineer and my profession as an airline pilot, I was particularly excited and fascinated to see this system in action. I'm quite interested in the subject of aerodynamic drag – the horrible phenomenon that makes us go slower on our bikes. I was anxious to experience a system that could lessen drag – one of the many things that a proper fitting can accomplish.



were measured and entered into the computer, I mounted my bicycle which was on a trainer. One side of my body was then “wired” for data capture. Note that each side of the body is separately measured, and often riders are surprised to find that each side operates a bit differently – not an ideal situation. Park started by wiring the eight (8) data capture points on the right side of my body. Data capture points include areas of the wrist, elbow, shoulder, hip, knee, ankle and two data points on the foot (shoe).

One of the things that Park noticed prior to commencing the dynamic fitting was that my cleats were not set in the most efficient position which ideally should position the first metatarsal over the pedal spindle. It was necessary to move my cleats forward approximately 2 ½ to 3 millimeters to attain that ideal position. I had actually thought that I was positioned with my metatarsal in the proper position, but I was not. As Park adjusted my cleats, my fear was that as a rider who trains 27 hours a week, a change in cleat position would be difficult to adjust to. The opposite turned out to be true. I felt that I had a stronger pedal stroke immediately now that I was exerting force on the most substantial, strongest part of the forefoot.

I then commenced a warm up in preparation for the computerized measurements. Park informed me that he would sample three (3), 15 second measurements at low, medium and hard efforts. Many riders have different form for different effort levels typically with a degradation of form as the effort increases – something the fitting is capable of alleviating. Park told me to maintain a cadence of approximately 90 which he was able to monitor for compliance on his readout. I then commenced the first 15 second effort, and ultimately completed three cycles at the different intensities (increases in power while maintaining the desired cadence). The computer gathers 20 samples per second of the pedal stroke; hence it obtains a very accurate overview of stroke efficiency and position. In that the measurements are taken in 3-D, the computer can measure

I arrived at Outspokin Bicycles on a recent afternoon with my road bike, a Guru Geneo. I had planned to be fitted on my trusty time trial bike, Jezebel, a Guru Cron ‘alu, but days prior to the fitting I received a sponsorship from Teschner Bicycles out of Australia, and I will save the time trial fitting for the Teschner 703 model that they will be supplying me. The Geneo was a bike custom made for me under a factory sponsorship with Guru. Contrary to what I preach, I was never fitted on the bicycle in that it felt perfect out of the box – I simply used the setup of my previous ride. I thought it would be a particularly interesting experiment to see what changes, if any, would be required of a bike that was not only built as a one-off custom for my exact body measurements, but one on which I have won a couple of state road race championships.

I was greeted by Val Tavanese, the owner of Outspokin who introduced me to her fitter Park Alsop. The fitting commenced with an interview by Park in which he ascertained, among other things, my goals, riding style and any injuries that might affect my riding both on and off the bike. I was then subjected to rather extensive measurements of my body which included measurements of flexibility and any limb length discrepancies. My bicycle was then totally scanned by a wand-like probe which was able to digitize the total geometry of my bike which was then compared to my measured physical data attained earlier. Once my bike and personal physical data



deviations in all three planes. For example, the computer can tell if one leg is stroking farther from the top tube than the other, and how much it is doing so.

The gathered data, coupled with Park's observation of my pedal stroking, indicated that my seat was too high. That caused some of my measurements to fall out of the ideal range. As an aside, Retul spent around two years gathering and computerizing data from a considerable number of successful riders to gain an insight into riding parameters that work most efficiently. The data gathered from the fitting process is compared with those ideal settings. Park, lowered my seat by 3 ½ millimeters, and the three-level testing process was repeated for the right side of my body. All of my parameters, including the very important hip angle, now fell comfortably within the optimum riding parameters. Understand that I was being fitted for maximum power/speed. Some fittings are done for maximum comfort or to work around an injury. Park then removed the data gathering hookups from the right side of my body and transferred them to the left side, and the

three, 15 second efforts were repeated. The computer generated an extensive amount of data indicating that the two sides of my body were working harmoniously (it was not prior to the fitting). The computer screen displays a considerable amount of data points showing the ideal readings and then adjacent columns showing the rider's readings both before and after the fitting for both the left and right sides of his body. All of my measurements fell within the limits of the ideal settings which they did not prior to the changes made by Park.

It is interesting to note that often times riders believe that they are riding a bike with a given, efficient seat tube angle. The truth is that there is the phenomenon of effective seat tube angle which is the actual angle you are riding based on your position on the bike. By getting a proper fit, the rider can rest assured that he or she is riding the most efficient seat angle for the mission of the bike.

The fitting took about 2 ½ hours, and the computer generated 4 hard copy reports. The first two are the Personal Bicycle Setup Report – one prior to any fitting changes and

the other when the fitting is accomplished with the most optimum settings for the rider. The report is a wonderful resource should a bicycle ever be disassembled enabling the person who reassembles the bike to put it back exactly as it was. The measurements include, stem length, crank length, saddle height, saddle setback, effective seat tube angle, frame stack and reach, stem stack, wheelbase, trail, grip width, handlebar reach and drop, aero pad reach and drop (time trial bikes), head tube angle, handlebar stack and reach, stem reach, wheel diameter, rake, and aero pad width (TT bikes). There are also notations as to the bike make, year built, style of bike, pedal type, seat type and handlebar type. As you can see, the report is a wonderful resource for future reference.

The second two reports are Personal Bicycle Fitting Reports. The following parameters are recorded again before and after the fitting: Knee angle flexion and extension, knee forward of foot, knee lateral travel, hip angle open and closed, hip to wrist vertical and horizontal, hip to foot lateral offset, elbow angle, thigh and shin lengths, ankle maximum, minimum and range, knee travel tilt, hip vertical travel, back angle, hip to elbow vertical and horizontal, armpit angle to elbow and wrist, forearm angle. There are also readouts as to the power outputs delivered by the rider both average and maximum, average speed and average and maximum cadence. The person being fitted is also provided two pages containing diagrams and explanations of each of the parameters measured.

I have heard people express the fear that the cost of a fitting has hidden costs such as stem, handlebar or seat replacements, etc. If in fact that is what you need, that is what will be recommended, but note that when all was said and done, the only thing ultimately needing adjustment on my bike was the seat height. My result is probably not typical in that I was fitted on a custom made bike on which I had successfully trained and raced for three years. Interestingly, I used to run my

seat at the height that it was at the end of the fitting. Unfortunately, I met an alleged expert who does static fittings one day in a bike shop who pointed out that I was losing power due to my seat being too low. I allowed him to raise it, but fortunately it is now back where it should have stayed. The lesson there is, get a professional opinion at a professional fitting – don't listen to everyone with an opinion.

No matter what your riding style or goals, riding a professionally fitted bicycle will enhance your comfort and experience. For a bicycle racer, a proper fitting is mandatory if you want to achieve your maximum potential. However any rider who wants to be faster, have more comfort on the bike, and wants to be less prone to injury, a professional bicycle fitting is the method to achieve those goals. I heartily recommend the Retul system. If you are located anywhere reasonably close to the Tampa Bay area of Florida, and desire a fitting by an expert in the field (Park Alsop), contact Outspokin Bicycles located in Clearwater, FL, 727-723-2453. If that is not geographically convenient, you can determine the closest Retul fitter to you on their website of <http://www.retul.com/>.

If you decide to do any type of bicycle fitting, I recommend that you make any proposed modifications to the bike prior to the fitting. For example, if you plan to buy new shoes, saddle or handlebars, do it before the fitting so that the new components can be properly adjusted if needed.

A Retul bicycle fitting will make an excellent Christmas present to yourself or a cyclist in your life. The cost of a Retul fitting is \$250 – probably the best \$250 expense you will ever incur that is bicycle related.

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Coming in December: “From Broken Neck to Broken Records” A Master Cyclist’s Guide to Winning, Rose Marie Ray, Author, Sandy Scott, and Co-Author