Training with CycleOps PowerTap

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History of Training with Power

In recent years, the ability to monitor the demands of cycling through the use of a PowerTap has become extremely useful to the athlete and coach by giving an objective measure of training and racing intensity. Prior to power measuring devices heart rate monitoring was the standard in measuring intensity because it reacted in a linear form to changes in power output in the laboratory. However, in the real world this relationship proved to be more complicated than the laboratory indicated.

Heart rate is affected by variables such air temperature, humidity, arousal, fatigue, illness, altitude, stress, hydration levels and diet so it can vary greatly from one day to the next. Another complication with using heart rate alone is that there is a significant lag between the workload being done (power) and the body's response (heart rate) to the effort. This can have a profound impact on the intensity of the training sessions, often causing athletes to train too hard or to terminate training sessions too early when they are using heart rate to monitor workout intensity and progress.

Basics

Let's start off with the basic concept of power and what it means to you. Power is the rate of work being performed on the bike. This means that Power (P) = work/time or P = force x velocity with force being the pressure you put on the pedals and velocity being cadence. If you look at the formula, you will notice that there are two ways you could produce more power: pedal harder or pedal faster. Either technique will lead to increased power production and subsequently increased speed on the bike. Using the PowerTap will allow you to find the balance between power and cadence so you can determine your optimal cadence.

Another feature you will notice on your PowerTap is the kilojoules reading, (this is the value displayed above he "E", both on the cpu and once you have downloaded the workout). Kilojoules is a measure of the amount of total work that you performed during the workout and this is an important component when considering your caloric expenditure. Although Kilojoules (KJ) and Kilocalories (Kcal) are different measures, you are able to estimate how many Kcals you used during a workout by monitoring the KJ accumulated. There is an approximate conversion of 4.2 KJ to 1 Kcal and human metabolic efficiency of work performed on a bicycle is estimated at 23-25%. Based on this information, you can then take the KJ of mechanical work and extrapolate a 1-1 measure. For example, for a given ride you perform 1500 KJ, so based on the information discussed above you can estimate that your caloric expenditure for the workout is 1500 Kcals.

This information will allow you to monitor your caloric intake, which can help you manage your body weight. Proper calorie management will also improve the recovery process, thus allowing you to come back and perform subsequent workouts.

Getting Started

The best way to get started training with your PowerTap is to give yourself some time to become familiar with the numbers you are seeing while doing the rides or work-outs that are familiar to you. Take some time to monitor the readings during your training and familiarize yourself with the software.

After you are comfortable with the function of the PowerTap, you should perform a field test to establish your current level of fitness and baselines so you can gauge your progress. In addition, you will use this information to establish power ranges for your training intensities. Here are the details of the CTS Field Test:

CTS Field Test

The CTS Field Test for Fitness is essentially a time-trial that is repeated two times during the same workout. In other words, you're about to ride as hard as you possibly can for each time trial with 10 minutes of recovery between the efforts. CTS will be looking for the following data to be recorded from the CTS Field Test:

Time of each effort
Average power output from each effort
Average heart rate during each effort
Weather conditions
Perceived exertion for each effort

As you collect this data over a long period of time, you will learn how your body adapts to training and how to structure your training programs. Listed below are the steps involved in taking your CTS Field Test:

Step One: Find a test course

Locate and measure a flat three-mile course. Try to select roads that aren't busy — a semi-residential area of town or a large city park. Try to choose the same time of day to conduct your CTS Field Test. Repeatability is always important for testing. The reproduction of exact test conditions will ensure that comparison of results is as accurate as possible. Try to conduct the CTS Field Test when the wind is relatively calm and temperature is warm but not hot. Conditions are usually more favorable in the early evening.

Step Two: Fuel your body properly

Do not eat for at least two hours before your test. During the 40 minutes prior to your test, drink a sports drink that is high in carbohydrates to help aid hydration and fuel replacement. As always, eat the same as you did during the last test.

Step Three: Warm up

Perform a specific warm-up routine for the field test. If you do not have a specific routine, warm-up by riding hard enough to sweat for 10 to 20 minutes, but do not go as hard as you can. (Yet.)

Step Four: Start the ride with power

Start with your dominant leg. Place that right crank arm at the two o'clock position so you get the most power out of your first pedal stroke. If possible, ask a friend to hold you in position at the start. Select a gear that allows for a quick, stable start. Stay out of the saddle to build speed quickly. When you hit top pedal cadence in your starting gear, sit down and prepare to gear up. Don't start too fast — give yourself at least one minute to reach top speed.

Step Five: Find your ideal gear

Select a gear that allows you to maintain a cadence between 90-95 RPM (crank revolutions per minute) on flat terrain and 80-85 RPM if climbing. Avoid the impulse to mash a big gear at slow RPM —the greater resistance will allow more leg-burning lactic acid to develop. The secret is to use the gearing that is most efficient for your personal riding style. This will take some experimentation along with discussion - watch your speed and power as you use different gearing to help establish optimum cadence.

Step Six: Feel the burn

Settle into a steady rhythm of breathing. From here on, it's going to hurt. If it isn't hard and painful at this point, you're not working hard enough. Pedal harder and faster.

Step Seven: Time yourself

Time your ride to the nearest second. Record the weather conditions, gearing used and your perceived effort (rated from 1-10) for the test.

Step Eight: Recovery between efforts

Between time trial efforts, you will be given 10 minutes recovery time before you need to repeat the effort. During this recovery period, ride slowly at low intensity, stopping only long enough to drink or eat as necessary. Staying on the bike will help flush the lactic acid from your muscles and help keep them ready and warm for the next effort.

Step Nine: Cool down

Finish the CTS Field Test with an easy ride of 15-30 minutes of easy spinning to flush your system after the challenge.

Analyzing your Field Test

Now that you have completed your Field Test, we need to discuss what to do with the data. We will set up power ranges based on your data. These ranges will allow you to address your specific training needs and ensure that you are training at proper, individualized power ranges. These ranges will be set up based on your fitness level, so you will be able to train in a precise manner.

We know from physiological testing data and many years of using the power meters that most amateur and elite athletes can time trial about 10% above their Lactate Threshold (LT). Non-elite athletes tend to time trial near their actual LT. Thus, we establish the SteadyState or LT power training range to be 15% less than the average power from both CTS Field Test efforts. For this example, let's assume that the athlete had two field test averages at 330 Watts. The first power range we need to establish is for SteadyState Intervals. Start with the average wattage from the field test and subtract 15% from this power, which gives you 280 Watts. This will be the upper end of this power range. Generally speaking, the power ranges should be 10-20 Watts, so this complete range would be 260-280 Watts. You would then set up a Tempo range by following this same approach. Start with 280 Watts and subtract 15% to set the upper end of the Tempo range. For Elite level athletes, you would follow the same process except you would compute the ranges starting with 10% less than the average power from the Field Test.

Now let's consider your aerobic ranges for EnduranceMiles and FoundationMiles. These will form the bulk of your training time, the steady rides to develop your aerobic engine and improve your efficiency. You need to accumulate a volume of work at these intensities to lay the groundwork for the higher intensity workouts. The terrain in your area may make it difficult to stay within the power range for the entire ride, but aim to complete the ride with an average power that falls within this range.

This will ensure that you are producing power primarily with your aerobic pathways and allow you to do a greater volume of work in this power range and accumulate more total work. Keep in mind that there is a big difference between doing 170 Watts for one hour versus doing four hours with an average power of 170 Watts. For the shorter rides, you may want to be at the upper end of the range and aim for the lower end of the power range when you are doing longer rides.

The following chart illustrates the CTS training zones:

CTS workouts	**System (physiological)**	**Power**	**Example LT power and power ceilings (300 Watts)**	**Range**
FoundationMiles	Aerobic	15% less than EM	170 Watts	150-170 Watts
EnduranceMiles	Aerobic	15% less than Tempo	200 Watts	180-200 Watts
Tempo	Lactate Threshold	15% less then Steady State	235 Watts	200-235 Watts
SteadyState	Lactate Threshold	**15% less then Field test**	280 Watts	260-280 Watts
Field test	Lactate Threshold	Time trail Power 330 watts	N/A	1st TT 330 Watts 2nd TT 330 Watts *avg 330 Watts

When considering power ranges for maximal efforts, PowerIntervals or FlatSprints, we can once again start with data from the CTS Field Test. If the average power was 330 Watts from the field test, we can then use this power as a starting point or initial prescription for maximum intervals. This is a more complicated process, but one that will allow you to focus on the demands of your competition and train accordingly. We have to incorporate race data to determine the work time that you need to accumulate in order to get an adaptation. By examining a race data file, you can see how much time you spend in this power range. Then you will use this work time to determine the number of intervals needed. For example, if you determine that you spend 15 minutes in this maximal power range (above LT) then you could break this up into five 3-minute intervals.

You then determine what way the VO_2 Max system is going to be stressed. Is your goal to drive more lactate production or increased lactate tolerance? Your choice then determines whether you choose full recovery between the intervals or shorter recovery times. Regardless of the interval prescription, the intensity is always max and should only be compared to like intervals.

The major advantage with the power meter is that you know exactly how much power you can maintain for 3 minutes and how many times you can repeat that same effort. Further manipulations of this training are how much rest in between intervals and the number of workout sessions per unit time. This reflects back to measuring the demands of the sport and what volume of intensity is needed for adaptation. The HR philosophy would now consider all workouts in this power range (around 300 Watts) as the same and indicate they are adapting the same system. This is the flaw in HR-based training, since you could be doing 10 efforts of 3 minutes max and 3 minutes easy or 10 efforts of 3 minutes max and 1 minute easy. Both approaches show the same high HR averages, even though you're training separate physiological systems.

In the maximal VO_2 system, once the overall work time is generated you need to monitor the fatigue rate. Normally the drop off is severe and obvious when the correct power or effort is completed for the duration of the workout.

When to Stop a Workout

When you are unable to achieve the desired power ranges or complete the volume of work within the range, then it is time to terminate the workout. Although this is a subjective decision, but you will usually see a trend within your workout. There may be a steady decline in power production with each successive interval and you are able to complete the workout with only the final effort falling outside of the prescribed range. This is a good indication that you are not properly recovered or that you have reached the end of your block of work and need to enter your regeneration week. Another scenario is one in which you are able to complete the first two intervals, but upon starting the third interval you are unable to achieve the desired power output. Once again, this is an indication that you should end the workout and head home to recover. The power data gives you an objective measure of what you are doing and then you can compare that data with your intended work. This allows you to have precise control over your workouts and the progression through your training program.

Training Indoors with Power

Training indoors using your power meter and a stationary trainer allows you to control the environment and hone in on the desired power ranges because you do not need to worry about stop lights, wind conditions, hills, and other environmental factors. The power meter allows you to gauge your progress and compare workouts since you are able to control so many of the variables. In addition, there are times when you will want to perform certain workouts indoors because you can focus on the proper power and cadence. This makes for a higher quality workout and a safer workout. On the other hand, when you ride indoors you will generate power in a more controlled manner so you will lose the acceleratory power that is necessary out on the road. Riding outdoors will address the specificity aspect of your training, while riding indoors will allow you to accomplish sustained workouts within certain physiological parameters. Use a combination of indoor and outdoor riding to maximize your training potential.

Some riders report that they do not seem to be able to generate the same powers while riding indoors. For example, on the road they can maintain 250-270 Watts for a SteadyState workout, but they are only capable of 240-260 Watts while doing the same workout on a stationary trainer. There are a couple of reasons why this might occur. One, some athletes experience decreased motivation while riding indoors so they are unable to push themselves as hard on the trainer so they see a lower power for the same rate of perceived exertion (RPE). Two, some times it is easier to generate force when working against the resistance that you experience while climbing as opposed to while riding on the trainer. However, with a bit of practice and experience you should be able to produce similar powers while training indoors.

Training with HR alone will help you improve, but if you want to get the most out of your training, using a PowerTap is a more accurate and precise training tool.

Appendix A

CTS Workouts

RecoveryRide (RR) ™

Goal: To speed the recovery process by riding at an easy pace at low resistance on flat terrain. Benefits include: increasing blood flow to the muscles to help remove muscle soreness and reducing free radical build-up that causes muscle stress and damage. Studies have shown that active recovery at an appropriate pace leads to faster recovery than complete rest.

How to do it: Recovery rides should be between 30-120 minutes in length on flat to rolling terrain. Keep your pedal speed slower than normal, staying in a light gear to keep resistance low. Heart rate must also remain low even if you hit any hills, just slow down and use your gears to keep the resistance low. The key to recovery rides is to ride just enough to engage the active recovery process but not long or intense enough to induce a training stress upon yourself.

I. Foundation Period: workouts focus developing the aerobic system while training at relatively low intensities

FoundationMiles (FM) ™

Goal: This is the cornerstone workout for your endurance training. FM prepares your aerobic system for the physical adaptations that will be developed through other forms of more intense training. Expected benefits include:

Slow-twitch muscle fibers gain size and strength.
Increases capillary development.
Increases mitochondria, the structure within the muscle cell that produces ATP.
Decreases resting heart rate.

How to do it: This workout is not limited to the Foundation Period. Expect to do this workout year round. Riding below the prescribed power ceiling involves your aerobic energy system, the goal is not to exceed this ceiling. At end of your FM ride, you should have an average power that falls below your FM power ceiling. This ensures that you trained your aerobic energy system and didn't accumulate lactate within your muscles. Normally, pedal speeds range between 85-95 RPM during this exercise. At times, you may want to use lighter gears and pedal at higher speeds during this workout, which will increase the training load on the aerobic energy system and give you further aerobic benefits.

PowerStart (PS) ™

Goal: To increase your muscular power to the pedals.

How to do it: This workout should be performed on a relatively flat section of road. The gearing should be very large, depending on your level of physical development. The PowerStart should begin at a very low speed, a near stand still. Jump up on the pedals, out of the saddle, driving the pedals down as hard as possible. Use the leverage of the handlebars to move your body over each pedal as you drive the pedal downward. The PowerStart should not last longer than 8-10 pedal strokes or 8-12 seconds. This is a muscular workout and heart rate will not have time to respond.

FastPedal (FP) ™

Goal: Better and more efficient pedaling mechanics through high speed pedaling.

How to do it: This workout should be performed on a relatively flat section of road. The gearing should be light with low pedal resistance. Begin slowly working up your pedal speed, starting out with around 15-16 pedal revolutions per 10-second count. This equates to a cadence of 90-96 RPM. While staying in the saddle, increase the your pedal speed, keeping your hips smooth with no rocking. Concentrate on pulling through the bottom of the pedal stroke and over the top. After two minutes of FastPedal, you should be maintaining 18-20 pedal revolutions per 10-second count, or a cadence of 108-120 RPM for the entire amount of time prescribed for the workout. Your heart rate will climb while doing this workout, but don't use it to judge your training intensity. It is important that you try to ride the entire length of the FastPedal workout with as few interruptions as possible, since it should consist of consecutive riding at the prescribed training intensity.

Stomps (S) ™

Goal: To increase muscular power in the saddle.

How to do it: This workout should be performed on a relatively flat section of road with a slight tailwind. The gearing should be large, 53-12 (depending on your level of physical development). The effort should begin at a moderate speed (typically 15-20mph), then while you are seated in the saddle begin STOMPING the pedals as hard as possible! Concentrate on pulling through the bottom of the pedal stroke and smoothly stomping down during the down stroke. Keep your upper body as still as possible and let your legs drive the pedals. The Stomps should last 15-20 seconds, with at least 5 minutes recovery between efforts. This is a muscular workout and heart rate may not have time to respond.

II. Preparation Period: training volume and intensity increase and focus moves to working on power at lactate threshold (LT)

MuscleTension Intervals (MT) ™

Goal: Develop cycling specific strength. High muscle tension during the intervals assists in the recruitment of fast twitch muscle fibers, which are important during intense efforts.

How to do it: This workout should be performed on a long, moderate (5-8%) climb or on a trainer with your front wheel set on a slight incline, 4-6 inches above the normal horizontal plane to simulate your climbing position. Pedal cadence must be low (50-55 RPM) and the heart rate intensity is not important because your legs are moving slow your heart rate will be low. Large gears (such as 53x12-15 up hill) are required to produce the low cadence and high muscle tension. Correct form must be strictly maintained during these intervals. Strong concentration is needed to keep your upper body absolutely smooth and relaxed while concentrating on correct pedaling form (over the top & through the bottom of the pedal stroke).

EnduranceMiles (EM) ™

Goal: This is the next step after FoundationMiles. EM focus on building an aerobic energy system that will increase your endurance capabilities. Expected benefits include:

Slow-twitch muscle fibers gain size and strength.
Increase capillary development.
Increases mitochondria, structures within the muscle cells and produce ATP.
Increased stroke volume from your heart.
Improved temperature regulation.
Increased respiratory endurance.

How to do it: This workout is not limited to the Preparation Period. The pace during the EM workout is quicker than during the FoundationMiles (FM) workout. It is performed at a moderate pace, but at a slightly higher power than the FM workout. Use your gearing as you hit the hills to remain in the saddle as you climb. Keep your pedal speed up into the 85-95 RPM range. The goal is to not exceed the prescribed power ceiling. Even though the intensity is greater, you are still using aerobic energy to power your cycling. At end of your EM ride, you should have spent at least 95% of the ride below your power ceiling.

Tempo (T) ™

Goal: Strategically placing tempo workouts into your training program has many advantages:

Greater comfort while cruising on rolling terrain.
Better fuel utilization during long races or rides.
Increased capacity for more intense workouts.
Better power at moderate intensities.
Increased muscle glycogen storage capacity.
Improved free fatty acid oxidation, which spares muscle glycogen.
Increased mitochondrial development, structures within the muscle cells that produce energy.
Improved aerobic efficiency.

How to Do It: Pedal speed should be low. Try a 70-75 RPM range while staying at the prescribed power intensity. This helps increase pedal resistance and strengthens leg muscles. Also try to stay in the saddle when you hit hills during your tempo workouts. This adds more pedal resistance and readies the connective tissues and supporting muscle groups before training heads into more explosive workouts. It is important that you try to ride the entire length of the tempo workout with as few interruptions as possible - tempo workouts should consist of consecutive riding at the prescribed intensity to achieve maximum benefit.

SteadyState Intervals (SS) ™

Goal: Increase your lactate threshold by training at the edge of your aerobic/anaerobic threshold.

How to do it: This workout can either be performed on the road with a long steady climb, hills or flat terrain. The training intensity is at your individual lactate threshold (LT). Interruptions during the interval limit the adaptations from this workout. Pedal cadence for SS intervals while climbing should be 70-80 RPM, and flat terrain cadence should be 85-95 RPM. Maintaining the training zone intensity is the most important factor, not the pedal cadence. Focus on continuous riding for the length of the prescribed interval. SteadyState intervals are meant to be slightly **below** your individual time trial pace, so don't make the mistake of riding at your time trial pace during the SteadyState intervals.

ClimbingRepeats (CR) ™

Goal: Increase your climbing lactate threshold by training at the edge of your aerobic/anaerobic threshold.

How to do it: This workout should be performed on the road with a long steady climb. The training intensity is at your climbing individual lactate threshold (LT). Your climbing lactate threshold power is slightly higher than your individual lactate threshold power on flat terrain because you are involving more muscles while climbing than on flat terrain. Pedal cadence for CR intervals while climbing should be 70-85 RPM. Maintaining the training intensity is the most important factor, not pedal cadence. It is very important to avoid interruptions while doing these intervals. Focus on continuous riding for the length of the prescribed interval. Recovery time between the CR is normally 5-15 minutes.

PowerIntervals (PI) ™

Goal: To increase power output during short intense efforts.

How to do it: This workout should be performed on an indoor trainer because of the controlled environment allowing for a better comparison from one session to another. It can also be performed on a relatively flat section of road.

The gearing should be moderate, but pedal cadence must be high (110 or higher). Take one minute to build up to the desired training zone and maintain this intensity for the remaining interval. It will be during the last two minutes of each interval that will develop your maximum aerobic capacity. If you have to, shift into a lighter gear to maintain the cadence, but don't let the intensity of the interval drop. With a high cadence, your heart rate will remain extremely high and you will train your body's ability to deliver oxygen to the muscles. Recovery between intervals is easy spinning.

Lance Armstrong and George Hincapie this interval session. Since the addition of this workout to their training programs, CTS has seen them further develop their extraordinary ability to attack on steep hills late in races when everyone else is gasping for air.

OneLegged Pedaling (OL) ™

Goal: Better pedaling mechanics are developed with this interval. Expect increased power over top dead center and through bottom dead center of the pedal stroke.

How to do it: This workout is best performed on an indoor trainer. The length of each interval is the amount of time spent pedaling per leg. This workout should be performed at a moderate intensity level - don't try to pedal too hard while doing this interval because injury could occur. While pedaling, visualize scraping your toes through the bottom of the pedal stroke, like you are trying to rub mud of your shoes. Over the top of the pedal stroke, push your pedal forward just before you reach top dead center. You will begin to adapt to better pedaling slowly, but you will need to continue to focus on correct pedaling throughout the entire year.

III. Specialization Period: emphasis shifts to speed and repeatability at high speed

SpeedIntervals (SI) ™

Goal: To develop speed and power for repeatability.

How to do it: This workout should be performed on a relatively flat section road with a slight tailwind to enhance your top speed during the efforts. The gearing should be moderate but pedal cadence must be high (110 or higher). Speed, power and accelerations are the key elements, not heart rate. This workout builds up high levels of lactic acid and trains your body to dissipate and buffer lactate. Normally, CTS coaches limit the length of this interval to one minute or less. If you have to, shift into a lighter gear to maintain the cadence, but don't let the intensity of the interval drop. With a high cadence, you will train your body's adaptation to high-speed efforts. Recovery between intervals is easy spinning. Recovery time between SI is limited in order to build repeatability and recovery. Speed training is very stressful on the body and needs to be performed with great care.

FlatSprints (FS) ™

Goal: Sprints develop acceleration, pure and simple. Sprinting improves the effectiveness of your fast-twitch muscle fibers and improves your body's ability to use the high-energy adenosine triphosphate (ATP) stored in your muscle tissues.

How to do it: Sprints are always performed at 100% maximum output. On flat terrain, you should be rolling along at a moderate speed (15-22mph depending on your stage of development) in a light gear. Jump out of the saddle, accelerating the entire time, and then return to the saddle after a few seconds. You need to focus on maintaining high pedal speed with smooth and efficient form for the entire sprint. These sprints should be 8-10 seconds in length. Full recovery between sprints is very important to allow for rebuilding of ATP in the muscles and to ensure a quality sprint workout. Normally, 5-10 minutes allows for enough recovery before adding another sprint to your workout.

HighSpeedSprints (HSS) ™

Goal: HSS sprints develop your top end power and speed. This type of sprinting improves your peak power. Since it is performed slightly downhill at high speed and pedal cadence, the power demands will be huge due to the aerodynamic drag associated with beginning sprints at high speed.

How to do it: Sprints are always performed at 100% maximum output. On a slight downhill, you should be rolling along at a high speed (30-35mph depending on your stage of development) in a large gear. Jump out of the saddle, and accelerate. Upon reaching top speed, return to the saddle and focus on holding your top speed for the length of the sprint interval. Maintain good form and focus on maintaining high pedal speed in a smooth and efficient form for the entire sprint. These sprints should be 8-12 seconds in length. Full recovery between sprints allows the muscle to rebuild ATP and to ensure a quality sprint workout. Normally, 10-20 minutes allows for enough recovery between HSS. Pedal speed is high for these sprints, 110+ RPM.

HillSprints (HS) ™

Goal: These sprints develop strength and power for uphill accelerations. This type of sprinting improves your peak torque and leg strength. Since this sprint is performed uphill, speed and pedal speed will be lower than normal.

How to do it: Sprints are always performed at 100% maximum output. On a flat road leading into a steeply pitched uphill, you should be rolling along at a moderate speed (15-20mph depending on your stage of development) in a moderate-to-light gear. As you hit the hill, jump out of the saddle, stomping on the pedals as hard as possible. The resistance will be increasing as you head up the hill. Stay out of the saddle for the entire sprint. This will increase the stress on your lower back, butt muscles and triceps. Focus on holding this top speed for the entire length of the interval. These sprints should be 8-12 seconds in length, and full recovery between sprints is very important to allow for rebuilding of ATP in the muscles and to ensure a quality sprint workout. Recovery between HS should be 10 – 20 minutes.

RaceSimulation (RS) ™

Goal: This workout simulates the demands that occur in races. You will be bouncing between using all energy systems to maintain the intensity of the workout.

How to do it: This workout is best performed during a club/group ride. Riding with a group tends to push you to new heights of intensity and simulates the same demands of racing. During the ride, there should be a series of accelerations followed by slower riding, sudden attacks, increasing tempo on climbs, and random attacks and counterattacks. Generally, CTS will not prescribe a large volume of RS training. Since this simulates a race situation, you will need plenty of recovery time following one of these workouts. CTS coaches will prescribe this type of training year round, not just during the specialization period. During the preparation period, expect the length of the RS training to be short, 15-60 minutes. Pedal cadence should match that of a race, 80-110 RPM depending on the terrain and intensity.

HillAccelerations (HA) ™

Goal: This workout simulates the acceleration demands that occur in hilly races. HA will build power and climbing speed while riding at your individual lactate threshold.

How to do it: This workout is best performed on a long, moderate climb. When using a trainer, you can achieve the same climbing position by raised your bike's front wheel 4-6 inches above the normal horizontal position. This position simulates your climbing position so that you will use the same muscle groups as when you are climbing.

Begin a long climb and slowly increase the training intensity until you reach your lactate threshold, then maintain this effort for the prescribed time. As you approach the top of the climb, attack out of the saddle with a hard but controlled effort, increasing your acceleration the closer you get to the top of the hill. Normally, these accelerations are performed during the last 500 meters of the climb. Every 100 meters of this effort your intensity should be growing until you are nearly at your maximum heart rate during the last few meters of the hill.

SpeedAccelerations (SA) ™

Goal: This workout simulates the acceleration demands through various power output levels that occur in races. By increasing your gearing for each sprint, you are also increasing the resistance for each sprint and gaining greater power output.

How to do it: The workout should be performed on flat terrain with a tailwind, or it can also be performed on an indoor trainer. You will do 3 sprints in one set followed by 3-5 minutes of easy spinning for recovery between each sprint and 10 minutes of easy spinning between each set. Each sprint in the set should be fifteen seconds in length. Plan on doing 3-4 sets total.

Sprint 1. Start off in your small chain ring and the 17 or 16-tooth cog in the rear. While rolling along at a moderate pace, but below 15 mph, jump up out of the saddle and use your arms to pull hard on the handlebars and focus on pulling up on the pedals with your hamstrings. As you begin to spin out the gear, return to the saddle and focus on maintaining high pedal speed. Keep your upper body and hips smooth and your head up as you drive to the end of the sprint.

Sprint 2. The same as sprint one but increase your gearing to your big chain ring and 17- or 16 cog.

Sprint 3. The same as sprint two but increase your gearing to your big chain ring and 15- or 14 cog.

OverUnder Intervals (OU) ™

Goal: To develop lactate tolerance and buffering capability in order to build power at intensities just above lactate threshold.

How to do it: This workout should be performed on a relatively flat section road or on an indoor trainer. The gearing should be moderate and pedal cadence should be high (100 RPM or higher). Slowly bring your intensity up to lactate threshold heart rate. Maintain this heart rate intensity for five minutes then increase your heart rate intensity to the level that your CTS coach prescribes. Hold this intensity for the prescribed interval then drop your intensity back to your lactate threshold heart rate. You will continue this pattern of riding at your lactate threshold, increasing to above lactate threshold and returning to lactate threshold.

This workout builds up high levels of lactic acid. Working in this way trains your body to dissipate and buffer lactate, also known as increasing your lactate tolerance. Normally the CTS coaches will limit the length of the interval above lactate threshold to two to three minutes, while the intervals at lactate threshold are normally five to ten minutes long. Lactate threshold training is very stressful on the body and needs to be performed with great care.

DescendingIntervals (DI) ™

Goal: To increase anaerobic power, lactate tolerance and repeatability during short intense efforts.

How to do it: This workout should be performed on an indoor trainer because the controlled environment offers a better comparison from one session to another. It can also be performed on a relatively flat section of road. The gearing should be moderate and pedal cadence must be high (110 or higher) during each interval. Attack each interval as hard as possible. Jump out of the saddle as you begin the interval and build speed as the interval continues. If you have to, shift into a lighter gear to maintain the cadence, but don't let the intensity of the interval drop. With a high cadence, your heart rate will remain extremely high and you will train your muscles for high power and repeatability. Recovery between intervals is easy spinning. Recovery time between efforts is limited so that you will never fully recover between intervals. Heart rate intensity is not prescribed because the interval is a maximal effort. The recovery time between intervals is the same length as the maximal effort of the interval. Recovery time between DI sets is 10 minutes. Normally expect to do 2-3 sets total. Here is an example of a DI workout:

One set consists of the following efforts and recovery intervals.

- 75 seconds maximal effort followed by 75 seconds recovery spinning
- 60 seconds maximal effort followed by 60 seconds recovery spinning
- 45 seconds maximal effort followed by 45 seconds recovery spinning
- 30 seconds maximal effort followed by 30 seconds recovery spinning