RUNNING POWER

Training and Racing with Power

by Stryd

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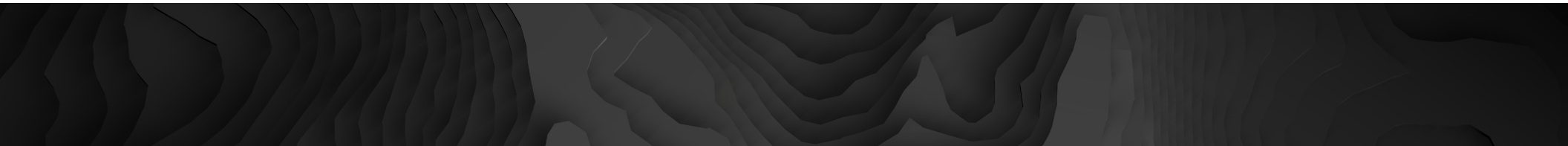


Introduction

Congratulations! You're now part of the special group of coaches and athletes who have decided to make an investment in their running potential by training and racing with the most accurate measure of their body output, power. Power meters in general and Stryd in particular provides a historical and revolutionary breakthrough in running.

This ebook will get you started training and racing with a power meter. By pulling information from what we've deemed to be the most important articles in power training, our goal is to provide you with an introduction to the basics of power training, in an hour or less (depending on how fast you can read)!

About Stryd

Stryd is the most advanced wearable technology for runners. Stryd currently provides the following metrics:

- Power
- Form Power
- Elevation
- Cadence
- Ground contact time
- Vertical Oscillation
- Leg Spring Stiffness
- Pace
- Distance

Stryd can be purchased at store.stryd.com.

Stryd is used by World Champions, Olympians, and age group athletes around the world to track, analyze, and plan their training and racing.

Chapter 1: Introduction to Run Power

What is running power?

Power is the mechanical measure of running effort and intensity. Power indicates how much energy you are expending during the run and how fast you are expending it.

Power is determined by calculating the amount of work done per unit of time as described by the formula:

Power = Work / Time

To better understand what power is we first need to get a better understanding of work. Work is equal to the force applied multiplied by the distance applied:

Work = Force x Distance

We can now substitute Force x Distance for work, resulting in the new expression of power as:

Power = Force x Distance / Time

Distance divided by time is also known as velocity, which is more commonly referred to as speed. If we substitute velocity into this equation we now have:

Power = Force x Velocity

This equation for power is where we would typically end while explaining how power is measured on a bike. On a bike, power is basically determined by multiplying the force applied to the pedals by the rate at which the pedals turn (cadence). However, running power meters do things slightly differently. Stryd breaks down the above equation further. Force is equal to the mass of an object multiplied by its acceleration:

Power = Mass x Acceleration x Velocity

The mass of the object (you) is given and Stryd takes extremely accurate measures of your acceleration and velocity to calculate power, measured in watts.

Running power considers speed , form, and elevation. Runners need quality training and guidance to succeed in their next race. Many runners struggle to find a repeatable and reliable way to attain high quality training and racing. Everyday there are questions that need correct answers: When should I run next? How hard should I run? Stryd answers these questions with a metric new to the running world: power. But how accurate is running power?

This white paper evaluates the accuracy of the Stryd's measurement of running power, ground time, and vertical oscillation, by comparing it with a lab grade force plate-based treadmill and a metabolic measurement system.

Why training with Stryd power meter is beneficial

Power quantifies your running performance into a single, real-time number. Using both power and Stryd's 3D motion capture capabilities, we can get a deeper understanding of running biomechanics and running efficiency (the mechanical energy produced relative to the metabolic energy expenditure).

Stryd, once you know how to use it, improves your training and racing, if you are willing to change the way you train. Power based training brings many benefits to both coaches and athletes, including following:

Precise intensity control

Different athletes have different goals, which demand a specific type of fitness. Effective training demands precision to become more fit, this comes down to getting the duration and intensity of the key workouts right. A 3-hour marathon race requires different intensity level from a marathon off of the bike in an Ironman triathlon. Training with the same intensity for both of these events simply will not work.

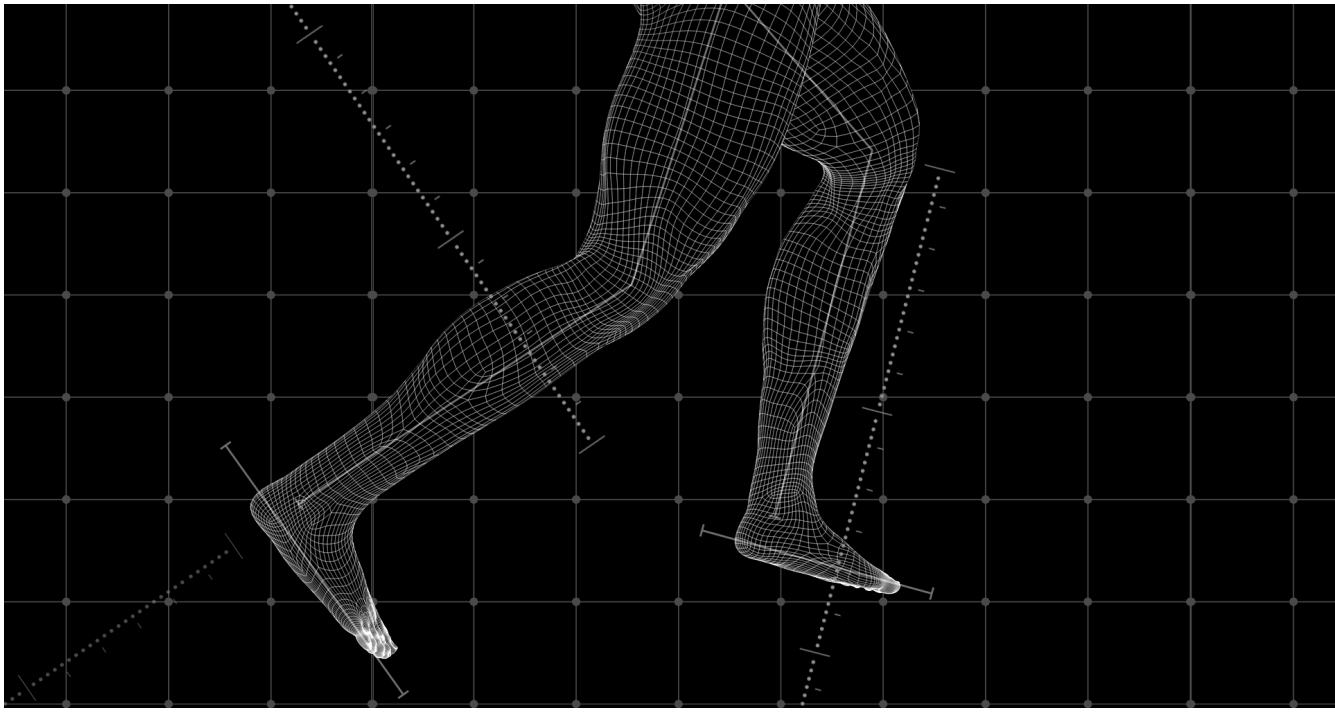
Power removes the guesswork for you to estimate how hard you want to make your key workout. With power, you know exactly what the intensity demands of your target event are so that you can replicate them in training so that come race day, there will be no surprises.

Organize your training phase

Training phase periodization involves manipulating training volume and intensity to produce high levels of fitness at times in the season when you have important races. With power, you can quantify your training stress in a specific, measurable way using "running stress score (RSS)", and use it to organize your season around your important races. We will dive further into RSS in chapter 4.

Pacing Workouts/Races

Steady-state workouts and races require the energy to be expended in a well-calculated manner. This is hard even for the most seasoned athletes. Most athletes go out much too fast at the start and pay the price in the second half of the race by having to significantly slow down. With a power meter, however, runners can pace themselves in a much more precise manner than with GPS readings or a HR monitor. GPS accuracy is dependent on weather,



Stryd's 3D motion capture helps you understand your running biomechanics and running efficiency

course conditions, satellite reception, etc. Heart rate is affected by temperature, caffeine, how much sleep you got and a whole host of other factors, whereas power is much more precise, these factors do not impact the calculated power.

But proper pacing goes well beyond the common problem of going out too quickly at the start. It also eliminates the guesswork of pacing on hills, descents, and HR fluctuations. Pacing with power eliminates all of these and thus gives confidence to the runner.

Competing with power

If your goal is to get to the podium, then the race intensity might not be steady at all, you are constantly challenged by other runners and your pacing strategy may be dictated by that. These periods of surges can be critical moments in dicatating who will be the winner. With power, you can train to handle these surges with confidence during a race.

Measure fitness changes/ performance progress

There is one question every athlete ask everyday in their training season: "Am I becoming fitter and faster"? With power, you can answer this question and fully understand if your training is effective or not. With power, you monitor changes in threshold power, power-to-weight ratio, power at specific durations, and efficiency. We will go further into these in chapter 4.

Quantifying fatigue and understanding how to manage it

In running, power is a multidimensional measure of performance, not only does it measure effort but also biomechanics. One of the most important factors to consider in running -- endurance -- is directly affected by biomechanics. By leveraging the biomechanics information, Stryd provides unprecedented insight into how your fatigue accumulates in the run. Knowing this allows Stryd to quantify your muscular endurance, and know when it is time to push your training and when it is time to rest.

Why not heart rate, speed, or feel?

Power and speed are measures of output, they tell us what is being accomplished during a run. Heart rate and feel are input, they tell us what the effort is to create the output.

Performance in the race is directly related to your output, not input. The input simply reflects what the runner is experiencing. The output decides who is going to come across the finish line first.

Compared to speed, power is not affected by terrain change and actually capture the performance impact caused by running efficiency. Unlike speed, power will show the real-time energy costs of running up and down hills allowing the runner to accurately know their energy expenditure over the course of a run. Here in lies the greatest benefit of pacing with power, a single numerical target to follow the entire race.

If you want to see the whole picture of the training, heart rate, speed and feel are still important metrics, it's just that looking at the run through the lens of power makes better sense of all that you are seeing and experiencing from the other three, it makes them more relevant, clearer and more meaningful.

Chapter 2: Introduction to Power Zones

By now you should have a good understanding of how Stryd power meter works and what it can do for you. Now let's take a look at how to set up your power training zones and know the basics of how to use those zones for workouts and races.

Critical power

In order to train effectively, you need the right balance of training load, intensity, and variety.

For running, a performance baseline can be quantified using critical power (CP). Once you know your CP you can calculate you power zones.

Critical Power (threshold power) represents the highest power that a runner can maintain in a quasi-steady state without fatiguing, where the duration may range from 30-70 minutes, depending on the individual.

To estimate your critical power, there are a couple of ways to do it. The most straightforward way is to do an one hour full out race, and the average power is your critical power. However, because different runners have different capabilities, it's hard for the majority of runners to find a race which happens to just take them one hour to finish.

There are other ways to get an accurate CP estimation without doing a real race, and that is to perform a critical power test. There are a couple of different critical power test protocols. Working with Dr. Andrew Coggan and Dr. Stephen Mcgregor, Stryd provides a 3/6 laps test protocol for runners with access to a 400m track, and 3/9 minutes test for runners without access to the track.

3/6 laps test

1. Warm up for 5 minutes. Do two to three 100-meter strides at approximately 80% maximum effort during warm up to enhance the blood circulation and ready your muscle for intense use.

2. 800 meters Easy-pace run. Two laps on a 400-meter track, please use the innermost lane. Run at an easy pace, such that you can comfortably maintain conversation.

3. Warm up for another 5 minutes.

4. 2400 meters Maximum-effort run. As is the case for the three-lap run, it is important to maintain a consistent pace during this run instead of dramatically changing pace (and effort) during the run.

5. Recovery for 30 minutes. Throughout the 30-minute recovery period, the runner should walk or jog slowly.

6. 1200 meters Maximum-effort run. Run at a consistent pace throughout the test, but so that you are nearly exhausted at the end of the test.

7. Cool down.

3/9 minutes test

1. Warm up for 10 minutes. Do five 100-meter strides at approximately 80% maximum effort during warm up to enhance the blood circulation and ready your muscle for intense use.

2. Maximum distance run for 9 minutes. Run at a consistent pace throughout the nine-minute test, but to be nearly exhausted at the end of the test.

3. Recovery for 30 minutes. Throughout the 30-minute recovery period, the runner should walk or jog slowly.

4. Maximum distance run for 3 minutes. Again, maintain a consistent pace during this run instead of dramatically changing pace (and effort) during the run.

5. Cool down.

With both the 3/6 lap and 3/9 minute test you will need to enter your power, and/or pace results from each segment of the test to calculate your critical power through Stryd's PowerCenter.

If the athlete is not currently in good shape, but it's still beneficial to know rough estimation on their current performance baseline, Stryd provides a way for the athlete to get the CP from their 5k or 10k time. The estimated CP is not going to as accurate as the value from the real test, but it's a decent reflection on your current fitness. This tool is provided on Stryd's PowerCenter as well.

30 minutes test

1. Warm up 15 minutes, preparing for a hard effort afterward.

2. Start a 30-minute time trial (best effort) on a flat road or track, collecting power data (collect pace and HR data as well, if possible).

3. Cool down 10 to 15 minutes.

4. Take the average power for the last 20 minutes of the time trial; this is your rFTPw

Power training zones

Once the athlete knows their current critical power, they can use the value to determine ideal training zones. Power zones are a simple tool; they are the various power intensities that you can use to plan and execute your training. It's similar to heart rate zones if you have used a heart rate monitor before.

When you are training every run has a purpose. Zone based training allows coaches and athletes to better focus each run to maximize its intended effect.

Similar to the critical power test protocols, there are different ways to define power zones based on different coaching philosophy. Stryd uses 5 zones: Easy, Moderate, Threshold, Interval and Repetition. Using these zones will allow you to precisely determine the effort level in the most accurate way possible. During your run you will know immediately whether or not you are in the correct zone. Plus, you can review your data to see how well you performed the workout.

How to use power zones

How exactly you use power zones depends on your goal and training plan.

Aerobic/muscular Endurance

Aerobic endurance is critical for all the endurance sports. This is the ability most closely tied to your race type. The muscle endurance requirement for a 5k runner is completely different from a ultra runner. Generally speaking, the muscle endurance is tightly correlated with the accumulated stress of the long run, and most long runs will fall in zone 1 and 2. There are many factors to determine your aerobic endurance, e.g. the muscle's ability to process lactate, the capillary density, the size of slow-twitch muscle fibers, etc. The workouts which are effective to promote most

Zone	Training Intensity	% of CP	Example Workouts	Adaptation
1	Easy	65-80%	Long run, base	Vascularization Cardiovascularity Injury resistance
2	Moderate	80-90%	Marathon sim, tempo	Vascularization Cardiovascularity Injury resistance
3	Threshold	90-100%	10k specific	Lactate clearing
4	Interval	100-115%	5k specific	Aerobic power
5	Repetition	115-130%	Track, short duration	Anaerobic power

of the factors are in zone 2 and higher range of zone 1. However, if you have some specific area to improve, the zone assignment becomes more specific. For example, if the purpose of the workout is to improve specifically the muscle's ability to process lactate, the workout should be done in the zone 3.

Anaerobic endurance

If your race requires anaerobic effort beyond your critical power, you want to do workout in the higher zones, e.g., zone 4 and lower end of zone 5.

Muscle Power

Muscular power is directly linked to running economy (energy expenditure for a given speed). By improving the strength of your muscles, the stiffness of your tendons, your technique, and your coordination, to get the most out of each and every step. Typically workouts in zone 5 would help you to develop muscle power, especially if you do it on the hill.

Recovery

Recovery is best accomplished in the zone 1 for most athletes.

Chapter 3: Training with power

In this chapter, we will introduce the general flow of training with power.

Step 0: Setup and allow the athlete to get out and run with power

Give the athlete a few days/weeks to get an idea of what power (watts) correlate with specific paces

Step 1: Determine your athlete's critical power

Field Tests

1. 3/9 test
2. 3 lap/6 lap test
3. 30 minute test

Other methods of determining CP

1. Current 5K or 10K time
2. Workouts
3. Athlete feel, RPE

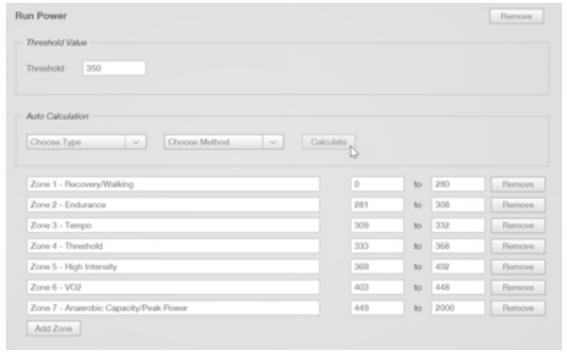
Step 2: Calculate power zones

Now that you know your critical power, you can determine your power zones. If you use PowerCenter, you enter test test results and we will automatically calculate your zones for you.

From Stryd's PowerCenter

ZONES	POWER (WATTS)	PACE (MIN/MILE)
Easy	198 to 243	10:18/mi to 8:24/mi
Moderate	243 to 274	8:24/mi to 7:30/mi
Threshold	274 to 304	7:30/mi to 6:42/mi
Interval	304 to 350	6:42/mi to 5:47/mi
Repetition	350 to 395	5:47/mi to 5:12/mi

From TrainingPeaks



If you use TrainingPeaks you can set run specific power zones directly on TrainingPeaks by following these instructions.

How do heart rate zones compare with power?

For the zones based on Karvonen formula, it's straightforward to do 1-on-1 match with Stryd power zone:

A simpler 5 zones system based on Karvonen formula for HR training, the percentage is used in this equation:

$$THR = ((HRmax - HRrest) \times \% \text{ intensity}) + HRrest$$

	Stryd Power Zones	Karvonen HR
Zone 1	65-80%	50% - 60%
Zone 2	80-90%	60% - 70%
Zone 3	90-100%	70% - 80%
Zone 4	100-115%	80% - 90%
Zone 5	115-130%	90% - 100%

TrainingPeaks use Lactate threshold heart rate(LTHR), and suggest 7 zones based on LTHR.

For the zones based on TrainingPeaks approach, the chart on the right shows a possible mapping method based on our understanding, under the assumption that the LTHR can be mapped to Critical Power.

A more comprehensive list of alternative power zones can be found here.

Zone Comparisons

TrainingPeaks Heart Rate Zones		Stryd Power Zones		Jim Vance Power Zones		Duration
Zone 1	< 85%	Zone 1	65-80%	Zone 1	<81%	3+ hours
Zone 2	85% - 89%	Zone 2	80-90%	Zone 2	81% - 88%	2 - 3 hours
Zone 3	90% - 94%	Zone 3	90-100%	Zone 3	89% - 95%	1 - 3 hours
Zone 4	95% - 99%			Zone 4	96% - 105%	1 hour
Zone 5a	100% - 102%	Zone 4	100-115%			
Zone 5b	103% - 106%					
Zone 5c	> 106%	Zone 5	115-130%	Zone 5	106% - 115%	20 - 45 min
				Zone 6	116% - 128%	2 - 18 min
				Zone 7	>129%	<2 min

Step 3: Keep critical power and zones up to date

Perform a critical power test and recalculate zones every 4-6 weeks throughout training to keep critical power and zones up to date. You can also monitor the effort level at a particular power output so that over a period of weeks, if the the same power is easier to produce then it is likely a good indication that your critical power has increased. Recent races are also a good replacement for a critical power test to assess your progress.

As you perform structured power-based training, increases in fitness and efficiency can be detected through:

- Increase in critical power (compare test by using your power to weight ratio in watts/kg)
- Increase in power:HR
- Increase in power:form power

Great news, these are all reasons why you bought your power meter in the first place! But that also means you need to continually monitor these as they increase over time, so that you can keep training at a high enough intensity to cause adaptations—or do your "easy days" at a low enough intensity to allow for recovery.

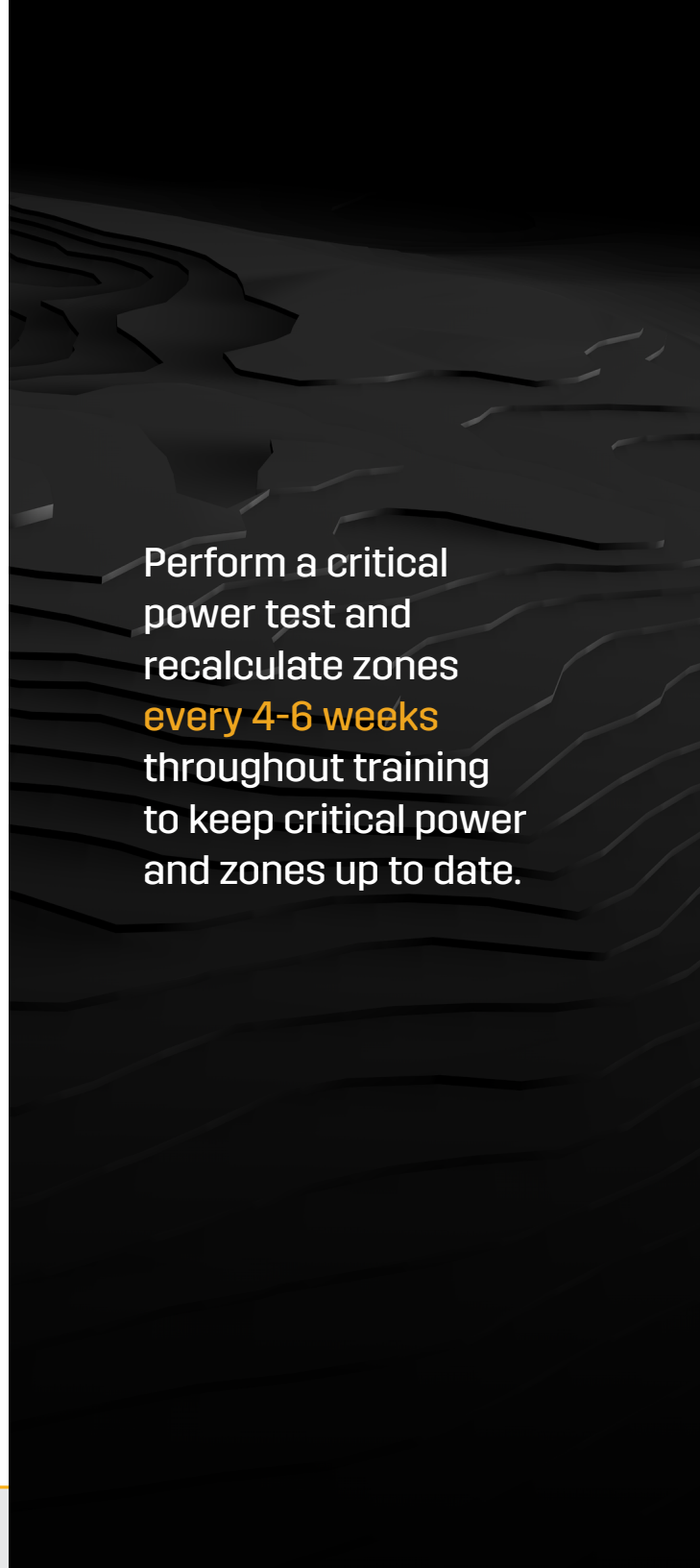
Step 4: Follow a power-based training plan

To start, you can adopt power into your existing non-power based training plan (e.g., heart rate, pace, or RPE based) as follows:

1. Train with your existing heart rate/pace/RPE-zone based plan for at least one training cycle, and monitor your run power at each heart rate/pace/RPE zone along the way.

2. Obtain your personal power zones by inputting your run power numbers alongside their heart rate/pace/RPE zones.

3. Train with power zones



Chapter 4: Analyze Workouts & Trends

Now that you have your Stryd power meter set up, your critical power tested, and the power zone configured. It's time to begin doing workouts based on power. This chapter is going to take you to the next level of understanding power and other related metrics.

We use PowerCenter platform provided by Stryd to demonstrate how the analysis can be done. PowerCenter by far has one of the best support for both power related data and running biomechanics data from Stryd. However, there are many softwares available on the market to help you to analyze power related data, e.g., TrainingPeaks, Final Surge, WKO4 and Golden Cheetah, feel free to choose the one that fits your needs best.

Analyzing single workouts

Analyze a single workout or race to gain an understanding of performance, fitness, and areas to improve on so that you can structure your training more efficiently.

Following is a quick introduction to some key metrics to look at:

Average Power

Average power is the total of all the watts generated during a run divided by the amount of time of the run. You can set your watch to display average power during your run or view this afterward in the software such as PowerCenter, TrainingPeaks, Final Surge, etc.. Average power is a simple metric and therefore most informative for straight runs or race scenarios.

Normalized power (NP) is widely used in cycling because you may have high variability in your power output over the course of ride. For example, on a bike you can coast down a hill and produce 0 watts and then perform short duration, all-out sprints later on in the same ride. However, for running you cannot coast down a hill with 0 watts as it still requires power to run downhill and sprinting during a run workout will not produce nearly as high of a wattage as you would on a bike. Therefore, normalized run power and average run power will be very similar in most cases and for simplicity only average power will be displayed in Stryd's PowerCenter. For those still wanting to use NP for running, you can find this metric on third party platforms as you would for cycling workouts.

Average power may not be informative over a workout that includes various intensity phases such as an easy warm-up, recovery, high intensity, and cooldown segment. It would be best to assess average power over each of these segments to assess quality of the workout and compliance to the plan. Average running power will range from 100-500 watts for most athletes.

Form Power

Form Power is a measurement of the amount of power that is produced to maintain the runner's individual form, but is not put towards the metabolic cost of running forward. Form power is equal to the power used to move your body vertically up and down in addition to any wasted power used to move you laterally (side-to-side). The lateral power component of form power is very small thus you will see form power trend very closely to your vertical oscillation. Decreases in your Form Power over time, when running at similar training speeds, is a good indication that you have improved your running economy. Monitor your form power to total power ratio over time to see trends in your running efficiency. Highly trained and economical runners may already have near optimal running form but can monitor how Form Power changes with fatigue. Form Power for most athletes will range from 30-100 watts.

Running Stress Score

RSS is a single number to help runners understand their day-by-day training. It takes into account the volume and intensity of your training session to give you a single number, or "score." The Running Stress Score is similar to TSS (training stress score) which allows you to compare the stress of workouts of various duration and intensities. The difference between TSS and RSS is small, the difference coming from the fact that the equation for RSS is intended to account for the additional biomechanical stress put on your body from running whereas cycling is largely an aerobic stress.

Here is how you would calculate TSS compared to RSS:

TSS = (duration of workout in seconds x NPx IF)/(FTP x 3600) x 100

The primary input to RSS is running power (collected each second) along with the time spent at different training intensity levels and can be calculated as follows:

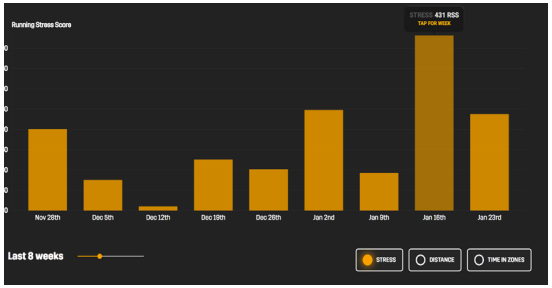
RSS for each second of your run =
a * (one second power / critical power)^b

where a and b are both constants developed by sports physiologist. As mentioned above, PowerCenter does not use normalized power so RSS is calculated for each second of the run and summed together over the entire run to give you a total RSS for the session.

Now that we have defined RSS we can take a look at how to monitor your workload in terms of RSS over days, weeks, and months.

For example, if on Tuesday you did a workout that included a 10 minute warm-up + strides, a 20 minute tempo, and cooldown. You finish your run and upload the data to PowerCenter to see your total RSS for this was 89, a much higher RSS than an easy run on Monday.

Once you have a history of scores for each run you will begin to see patterns at at the end of a week you can look back at your training and daily RSS such as the chart and table on the right.



Monday	35
Tuesday	89
Wednesday	40
Thursday	75
Friday	23
Saturday	30
Sunday	110

As shown by the relatively high RSS values above, we can see that quality workout sessions fell on Tuesday, Thursday, and Sunday. If we added all of the daily RSS values up, we get a weekly workload of 402 RSS.

Stryd offers training intensity breakdown to help you understand your training varieties, and help you adapt and optimize your day-by-day, week-to-week, and seasonal training.

Read more on how to monitor training load through a performance management chart (PMC) on WKO4.

Cadence

Cadence (stride rate) – is the number of steps a runner takes per minute (SPM) or the total number of 'revolutions per minute' (RPM). SPM takes into account steps of both feet and therefore is double the RPM.

Power Zone Breakdown

Analyzing power zone distribution as a tool for monitoring improvements and progression over time as well as determining how effective the athlete followed the prescribed intensity for a single workout. Breakdown of power zones can also be used to show or plateaus or improvements in training and efficiency.

Ground Contact Time

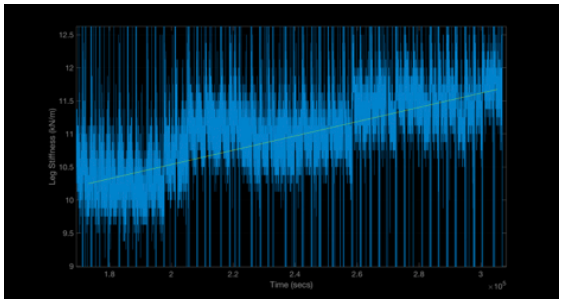
Ground contact tracks how much time your foot touches the ground each stride. Most running ground contact times are between 150 - 300 milliseconds. Elite runners are typically under 200-milliseconds. Rather than trying to consciously focus on decreasing your contact time while you run which could lead to injury, we recommend applying drills, plyometrics, strength, and speed work to your training and monitoring this metric over time for improvements and changes in how you run.

Vertical Oscillation

Vertical oscillation measures the amount of "bounce" – i.e. vertical up and down movement – generated while running. Similar to ground contact time, applying drills, plyometrics, strength, and speed work to your training and monitoring this metric over time may be the best approach for analysis and tracking improvements.

Leg Stiffness

Leg Spring Stiffness is a measure of how well a runner recycles the energy applied to the ground. LSS has been shown to be correlated with running performance. Think of your leg as a spring upon which your body "bounces." The stiffer the spring, the less energy you must produce to propel yourself forward with each step. This metric measures the stiffness of the muscles and tendons in your leg. Increases in LSS can indicate economy improvement over time. What is a "good" LSS value? LSS is individual and cannot easily be compared across different runners and should be standardized for body weight in your own comparisons over time. For this reason, trends in LSS/kg for specific speeds should be the focus of the analysis. Dynamic mobility and biomechanics drills along with strength training and hill repeat workouts have been shown to improve leg stiffness and running economy. All that said, LSS for most athletes range from 6 to 14 kN/M.



Additional studies and references to Leg Spring Stiffness:

STRYD White paper

STRYD Blog

Leg Spring Stiffness - Response to Plyometrics in Distance Runners?

Leg Spring Stiffness and Hills

Leg Spring Stiffness and Running Surface

Leg Spring Stiffness and Static Stretching in Distance Runners

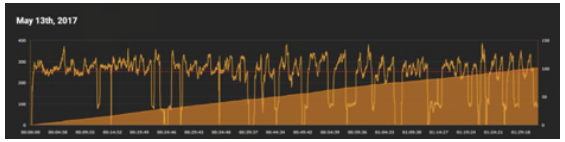
A Simple Method for Measuring Stiffness During Running.

Analyzing race

Pacing is the most important race strategy you can plan and control. Pacing not only controls how you expend your most precious commodity: glycogen, but also decides the body's acidosis.

If your goal is to evenly pace your race to achieve your personal best, the pacing strategy is simple: set your target power and go with it. However, it is not always easy to stick with a plan during a race. For example you could get passed by someone you really want to beat and want to surge to keep up, or you feel a need to hammer up a hill to try and drop nearby competitors. Unfortunately, these perhaps unnecessary surges will waste glycogen and create additional acidosis. By repeatedly speeding up and slowing down you will likely go slower overall than you would if you ran steady. Extreme variation in effort will needlessly say use a lot extra glycogen while increasing your blood's acidity and lead to slow and painful finish.

Example:



If your goal is to get to the podium, then you are likely facing a variably paced race, and pacing is also critical in this case. For this type of race, your power output will significantly change throughout, and your output power at any given moment will largely depend on what others around you are doing and your strength compared to your competitors. In some cases you can't leave a certain group and run it by your own due to psychological effect, therefore, staying with the group when it speeds up and matching its power surges are critical to your final placement. In these scenarios, your power will have high variation. When it comes to analysis for this race, what matters most is that if you can match the surge, and how the surge affects your race afterwards.With the ability to see the quick pace changes in the race files means you can now train more specifically for the demands of your racing.

Check out this example race analysis using power by Coach Steve Palladino.

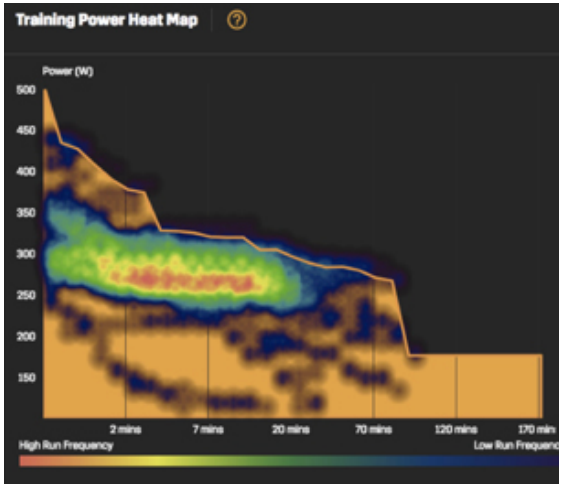
Analyzing power trend over time

Power duration profile & Power heatmap

Power and time are inversely related. The higher the power is, the shorter you can hold it. Power relative to duration is a great marker for fitness and performance. Therefore, if you can increase your power for a given duration, you are more fit for that duration.

The power duration profile represents the athlete's highest power output for every duration. It's unique to you and it changes as your fitness changes. It tells you the durations at which you are currently best and what type of training you need to boost power for a given duration.

Here is an example of power duration profile:



The Y axis represents power in watts, the X axis is time. Note that the X axis is not linear, as it puts greater emphasis on the shorter durations where most of the changes are likely to occur. Sprinters for example will have a steeper slope with higher power outputs for the shorter durations whereas ultra runners will likely see flatter curves than most. However, the shape of the power duration curve could be used to indicate areas where the training is lacking, for example without including strides or high-end work to your training the curve will appear flatter even if your target race is a 5km or 10km.

With power duration profile, you can create the fitness you need that is unique to the demands of your races by emphasizing training with appropriate intensity. And Stryd provides tool called Power heatmap for this exact purpose.

A visual description of your running history in terms of both intensity (power) and duration. Bright red "hot" areas indicate combinations of power and duration that you frequently achieve in your training. Dark blue areas occur less often.

The Training Power Heatmap has two primary purposes: 1) a time-in-zone comparison and 2) the maximum power that you have sustained in your training. The simple rendering of your time in zone allows you to quickly identify how you have been spending your time while training. It helps you to quickly determine if you have been targeting the correct running intensities for your target race. Additionally, the Curve Power will always display the maximum power that you have achieved in your training for that given duration. Use this information to determine what you are able to accomplish in your next race!

Is your training effective?

Analyze the workout to gain insight on well it was performed. Analyzing training over the course of a training block or a season allows you to quantify improvements and adjust training load or intensity if needed. Different athletes need different training strategy to enhance different areas like pace management, hill climbing, anaerobic capability, etc.

Effective training means watching for markers of change in many areas. The following are some of the power markers from workout analysis over the course of a training season that serve as indicators that your training is paying off as you become fitter and faster.

Critical Power Changes

The most basic way to gauge progress toward greater fitness and faster racing is to monitor changes of your critical power. Ideally you see the positive change throughout the whole training phase.

Power Distribution Changes

The shift in training time spent in each power zone is a direct indicator of the training progress and indirect indicator of the general improvement. During the base period most athletes display the relatively same distribution, however, once they get to race specific training, their power distribution changes due to different targeted races and the specific demand of each. The goal race distance and demands will define the training focus and your power distribution should change over the course of a season to reflect this.

Power Profile Changes

One of the best indicators of your preparedness to perform well in a certain type of race is how much absolute power you can generate for periods of time that are predictive of the demands of your race. Keeping track of changes in your power profile is a great way to measure race readiness, and you can achieve that by comparing the power profile of the current season with those from the previous one or from any other segments of time. This could be season-to-season comparison or phase-to-phase comparison within a season. The options are endless and provide a great tool for gauging how you are progressing relative to another known period of time.

Chapter 5: Race with Power

Plan the perfect race

There a few different ways you can go about selecting your target power for a specific race distance:

1. Estimate your maximum sustainable power the race distance based on your critical power (10k power for most). Below is a guideline that Stryd has derived from our own in-house results and through speaking with Stryd users; your own race distance power as a percent of 10k power will be different depending on your fatigue resistance.

Distance (km)	% 10k power
0.8	128.5
1.6	116
3	109.4
4	106.1
5	103.8
10	100
21.1	94.6
42.2	89.9

2. By analyzing the athlete's training data, through the power-time heat-map, you can estimate your athlete's peak sustainable run power across different race distances and estimated times.

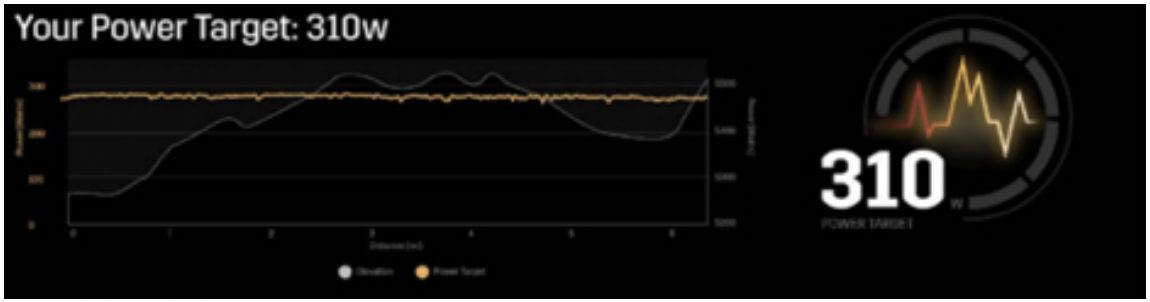
3. Have a goal time already in mind? Try using this third-party calculator to estimate the average power you need to hold to achieve a specific time for a given course.

4. Run your goal race pace on similar terrain/ elevation and use the power you produce at this pace for your target race power.

Pace the perfect race

Having a race plan is great, but executing said plan is where most runner typically falter. Download and use the Stryd PowerRace IQ APP to maintain your perfect race execution.

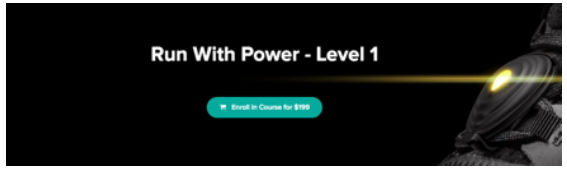
Set a target that your athlete is forced to follow, enabling them to run at the proper intensity throughout the race.

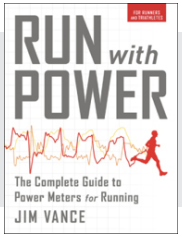


Chapter 6: Next Steps

Stryd Academy

Become a certified Stryd Coach through Stryd Academy - Run With Power Courses instructed by Coach Jim Vance (USAT CEUs also available). More information can be found at Stryd Academy.





Run With Power

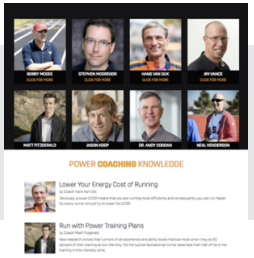
by Jim Vance

"From 5K to ultramarathon, a power meter can make you faster—but only if you know how to use it. Just viewing your numbers is not enough; you can only become a faster, stronger, more efficient runner when you know what your key numbers mean for your workouts, races, and your season-long training. In Run with Power, TrainingBible coach Jim Vance offers the comprehensive guide you need to find the speed you want."

The Secret of Running

by Hans Van Dijik & Ron van Megan

"How much power does your human engine have? How much power do you need for running in different conditions? How can you optimize your training and racing performance? How can you use power meters to improve your results? What are the ultimate limits of human performance? The Secret of Running answers all of these questions. It shows how power meters can be used to optimize your training, running economy and race result."



Power Coaching Group

https://www.stryd.com/coaching

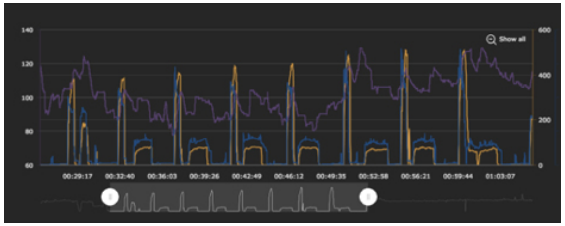
Stryd has been tested, used and proved by coaches all over the world in the past several years. We have created the power coaching group for those coaches actively using Stryd with their athletes.

If you are a coach interested in partnering with us you can find out more by applying here.

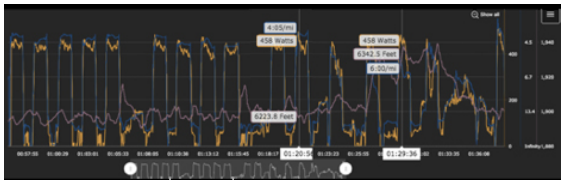
Appendix

Examples of power-based workouts

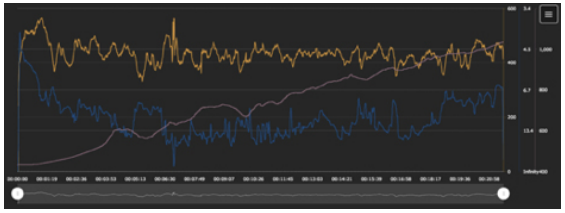
Progressive hill repeats



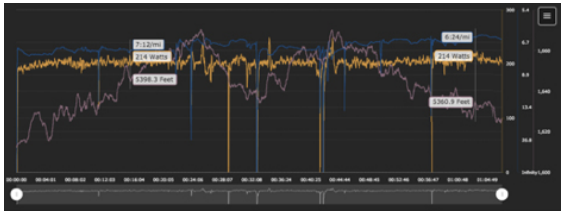
Interval



Tempo on the hill



Intensity control with recovery



Additional metrics, tools, and links

Once you become comfortable with power-based workouts and have collected enough baseline data for comparisons you can begin to take advantage of the additional benefits that run power provides.

1. Monitor changes in efficiency:
    a. Efficiency Index (EI)
    b. Form Ratio
    c. Running Effectiveness (RE)

2. Create & publish your own Power-Based Training Plan or purchase one through platforms like Final Surge and TrainingPeaks:
    a. Jim Vance Power Plans
    b. D3 Multisport Power Plans
    c. Peter Lijten Power-Based ½ and Full Marathon Plans
    d. Matt Fitzgerald 80/20 Run Plans

3. Tools to analyze power files
    a. PowerCenter
    b. Final Surge
    c. SportTracks
    d. TrainingPeaks
    e. WKO4
    f. Golden Cheetah

Other Resources

1. Explore the Stryd Support page for help troubleshooting.
2. Read the Stryd Blog to read about the most useful Stryd features.
3. Join the Stryd Facebook Community to learn from Stryd Experts.
4. Learn from Stryd Improve on PowerCenter to guide your training.