



How to Start Training with Power

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Introduction

Congratulations on becoming a power meter user, and more importantly, welcome to “the club”! You’re now part of the special group of athletes who have decided to make an investment in their potential on the bike by training and racing with the most accurate measure of their cycling output.

As you already know, a power meter can be one of the most effective tools for improving your results as a cyclist or triathlete. And while there is a lot of science and research behind power analysis, you can start to reap the benefits of your new tool by simply understanding a handful of basic principles.

This e-book 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)!

The information in this e-book is based on articles by Hunter Allen and Dr. Andrew Coggan, co-authors of [Training and Racing with a Power Meter](#); and Joe Friel, author of [The Power Meter Handbook](#), [The Cyclist's Training Bible](#), and [The Triathlete's Training Bible](#).

About TrainingPeaks

TrainingPeaks provides the complete web, mobile and desktop solution for enabling smart and effective endurance training. Our products include the web-based TrainingPeaks Athlete Edition and Coach Edition; WKO+ desktop software for deep, offline power analysis; and mobile apps for iOS and Android. TrainingPeaks also offers a Coach Match Service to help athletes find certified coaches, and a regular TrainingPeaks University program for Coach Edition users.

TrainingPeaks solutions are used by Tour de France teams, Ironman World Champions, Olympians, and age group athletes around the world to track, analyze and plan their training.



*With this book
you'll get an
introduction to the
basics of training
and racing with a
power meter, in an
hour or less.*

Introduction to Power Zones

In order to train effectively, you need the right amount of training load to induce aerobic adaptations, and you need the right amount of recovery so that the body is able to adapt. To quantify intensity, we use a system of power training levels or “zones”.

To train with a power meter, you need to know your personal power zones. But first let's introduce the concept of threshold power.

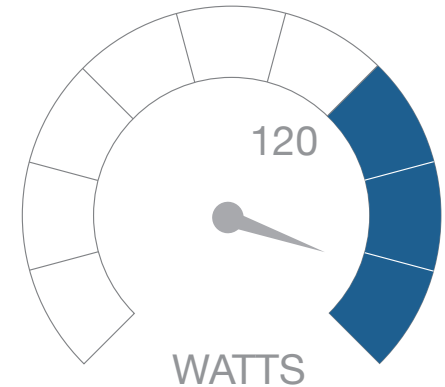
Threshold power refers to the maximum output (in watts) that you're able to maintain while your body can still remove the lactate acid being used by the muscles. For most trained athletes, this is similar to the maximum effort you can maintain for a 1-hour time trial.

Threshold Power

Your power zones are calculated relative to what's known as your “threshold power”. Threshold power is also referred to as “Functional Threshold Power (FTP)” or “Lactate Threshold (LT)” power.

Threshold power refers to the maximum output (in watts) that you're able to maintain while your body can still remove the lactate acid being produced by the muscles. For most trained athletes, this is similar to the maximum effort you can maintain for a 1-hour time trial. It's also the point at which your body begins to recruit more fast-twitch than slow-twitch muscle fiber. Going above this threshold effort will result in a “burn” in the muscles. After a few minutes above threshold, stopping or slowing will be required in order for the body to clear lactate acid.

Lactate threshold can be improved consistently through training. Consistent and long-term endurance exercise training will reduce the production of lactate by slowing the overall rate of carbohydrate utilization.



Power Training Zones

Here are your personal power training zones, based on the system established by Allen and Coggan. Using these zones will allow you to precisely determine your effort level in the most accurate way possible. During your ride 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.

Coggan Power Levels

Zone	Name	% of FTP	Description
1	Active Recovery	<55%	“Easy spinning” or “light pedal pressure”, i.e., very low level exercise, too low in and of itself to induce significant physiological adaptations. Minimal sensation of leg effort/fatigue. Requires no concentration to maintain pace, and continuous conversation possible. Typically used for active recovery after strenuous training days (or races), between interval efforts, or for socializing.
2	Endurance	56-75%	“All day” pace, or classic long, slow distance (LSD) training. Sensation of leg effort/fatigue generally low, but may rise periodically to higher levels (e.g., when climbing). Concentration generally required to maintain effort only at highest end of range and/or during longer training sessions. Breathing is more regular than in level 1, but continuous conversation still possible. Frequent (daily) training sessions of moderate duration (e.g., 2 hours) at level 2 is possible provided carbohydrate intake is adequate, but complete recovery from very long workouts may take more than 24 hours.
3	Tempo	76-90%	Typical intensity of fartlek workout, “spirited” group ride, or briskly moving paceline. More frequent/greater sensation of leg effort/fatigue than in level 2. Requires concentration to maintain alone, especially at upper end of range, to prevent effort from falling back to zone 2. Breathing deeper and more rhythmic than zone 2, such that any conversation must be somewhat halting, but not as difficult as at level 4. Recovery from level 3 training sessions more difficult than after level 2 workouts, but consecutive days of level 3 training still possible if duration is not excessive and carbohydrate intake is adequate.
4	Lactate Threshold	91-105%	Just below to just above TT effort, taking into account duration, current fitness, environmental conditions, etc. Essentially continuous sensation of moderate or even greater leg effort/fatigue. Continuous conversation difficult at best, due to depth/frequency of breathing. Effort sufficiently high that sustained exercise at this level is mentally very taxing - therefore typically performed in training as multiple repeats, modules, or blocks of 10-30 min duration. Consecutive days of training at level 4 possible, but such workouts generally only performed when sufficiently rested/recovered from prior training so as to be able to maintain intensity.
5	VO2 Max	106-120%	Typical intensity of longer (3-8 min) intervals intended to increase VO2max. Strong to severe sensations of leg effort/fatigue, such that completion of more than 30-40 min total training time is difficult at best. Conversation not possible due to often “ragged” breathing. Should generally be attempted only when adequately recovered from prior training - consecutive days of level 5 work not necessarily desirable even if possible.
6	Anaerobic Capacity	>121%	Short (30 sec to 3 min), high-intensity intervals designed to increase anaerobic capacity. Heart rate generally not useful as guide to intensity due to non-steady-state nature of effort. Severe sensation of leg effort/fatigue, and conversation impossible. Consecutive days of extended level 6 training usually not attempted.
7	Neuromuscular Power	Maximal	Very short, very high-intensity efforts (e.g., jumps, standing starts, short sprints) that generally place greater stress on musculoskeletal rather than metabolic systems. Power useful as guide, but only in reference to prior similar efforts, not TT pace.

To see the full table, read [“Power Training Levels”](#) on TrainingPeaks by Andrew Coggan.

Determine Your Power Zones

Now that you understand the various power zones, here's how to determine your own, so that you can start performing structured workouts.

Step 1: Determine FTP through a Field Test

The first step is to do a field test (performed “in the field” on the bike as opposed to a laboratory blood lactate level test). This field test, devised by Hunter Allen, can be done on an indoor trainer. However, for most accurate results, ride outside.

How to tell what your 20-minute power was?

After your test, upload your workout from your bike computer into TrainingPeaks. [Here's how](#). You'll want to download the desktop solution Device Agent, which will enable you to upload your power data from over 90+ different devices or mobile apps.

[Download Device Agent](#).

[Get your free TrainingPeaks account](#).

Pacing

A commonly asked question is whether or not you should go hard for the first 10 minutes. Allen advises, “Don't start too hard. In the first two to three minutes, start out at a hard pace but one you can sustain, and then gradually bring up the power.” The more you do this test, the more accurate your threshold power will be as you learn to pace yourself better at the start.

Safety

As you perform your test, please do so safely. Keep your head up, don't stare down at your bike computer (you should avoid doing this anyway as it may cause you to subconsciously “target” an expected power output), and pick an area or road where you won't have to contend with traffic.



Hunter Allen's FTP Test

Perform this field test on a flat course relatively free of stop signs or traffic, and if possible one that has a steady, uphill grade of less than 5%. The uphill grade helps you to maintain a constant output, as opposed to rolling terrain where it's difficult to keep your power up on the downhills.

Do at least a 15-minute endurance paced warm-up, then do 3 x 1 minute fast pedaling drills of at least 100 rpm with 1-minute recoveries in between each. This is to warm up the muscles without taking away energy for the 20-minute test itself. Then perform a 20-minute time trial all by yourself—no training partners, and not in a race. Your effort should be done as if it was a race for the entire 20 minutes—all out, but sustainable for the 20 minutes.

Your average power for that 20 minutes, less 5%, is an approximation of your FTP. For example, if your average power for the 20-minute test was 250 watts, then your FTP is $250 \text{ watts} \times .95 = 238 \text{ watts}$.

Step 2: Calculate your Power Zones

Now that you know your threshold power, you can determine your power zones using Coggan's Power Levels table on page 5. If you use TrainingPeaks, you can enter your threshold power within your Account Settings, select "Coggan Power Zones", and we will automatically calculate your zones for you.

Calculate Your Zones in TrainingPeaks

After you've uploaded your field test workout into TrainingPeaks, use your Peak 20 Minute Power less 5% as your FTP approximation. You can also use your Normalized Power® for the 20-minute test, less 5%. Then:

- Click your name in the upper right hand corner to access your Settings.
- Click "Zones", then "Power" from the left hand navigation.
- Enter your threshold power, choose Threshold Power as your type and select " Andy Coggan" as your auto-calculation method. This will open a preview window of your zones.
- Click "Apply" to save those zones. If you want, you can re-enter a different threshold value and click "Calculate" to view what your zones would be with a different threshold value.

Account Settings

Account

Zones

- Heart Rate
- Power**
- Speed/Pace
- Notifications

Equipment

Default Power

Threshold Value

Threshold

Auto Calculation

Threshold: 220 W

1	<input type="text" value="0"/>	to	<input type="text" value="123"/>	watts
2	<input type="text" value="124"/>	to	<input type="text" value="167"/>	watts
3	<input type="text" value="168"/>	to	<input type="text" value="200"/>	watts
4	<input type="text" value="201"/>	to	<input type="text" value="233"/>	watts
5	<input type="text" value="234"/>	to	<input type="text" value="266"/>	watts
6	<input type="text" value="267"/>	to	<input type="text" value="2000"/>	watts

Step 3: Keep Threshold and Zones Up to Date

As you perform structured power training, you'll get stronger and fitter, and your threshold will increase. Great news, that's why you bought your power meter in the first place! But that also means you need to continually monitor your threshold and zones 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.

Perform your threshold test and recalculate your zones every six weeks throughout your training to keep your threshold and zones up to date. If you use TrainingPeaks and turn on our Threshold Improvement Notification feature, we'll let you know when you upload a race or workout power file that indicates your threshold has improved.

There are other ways to estimate your threshold throughout the season, not least of which include estimating from race data or performing a one-hour TT. [You can read more about these methods in “What is Threshold Power?” on TrainingPeaks.](#)

Congratulations, you recently set a new threshold power value. We've automatically updated your zones in TrainingPeaks for optimal analysis.

New Threshold Power Value

248 Date Set 02/18/14 Previous Value 220

About Thresholds
What is a threshold, how is it measured and why is it important?
[Learn more >](#)

How to Update Thresholds in TrainingPeaks
Having your threshold set correctly allows TrainingPeaks to accurately measure your fitness.

* PREMIUM MEMBERS CAN HAVE THRESHOLD AUTO-UPDATED

Start Training With Power

Now that you know your power zones, you can really start to reap the rewards of your power meter.

As you likely know, unlike heart rate, power reflects the intensity of your effort immediately, regardless of external factors including fatigue, weather, wind, course profile, etc. Because of that, you're able to very precisely target your effort into a specific zone. Also, your power meter is able to measure the muscular demands of your training and racing, whereas your heart rate only measures aerobic demand. These advantages enable you to execute structured workouts like never before, and because of that it becomes even more

important that you follow a structured training plan designed by an expert and tailored towards your goals. Getting faster doesn't simply mean riding hard all the time. It means riding hard enough on your hard days, and easy enough on your easy days.

Whatever method you choose, the most important thing is to have a plan; a roadmap to get from where you are today to your ultimate goal—whether that's an A race or a process goal like improving your FTP by a certain percentage. A study by the British Journal of Health Psychology found that you are more than twice as likely to achieve your exercise goals when you plan how and when you will perform your workout.

3 Key Power Workouts

by Joe Friel

- 1 To train muscular endurance:** Do 5-12 minute intervals at Zone 4 power, with Zone 1 recoveries that are $\frac{1}{4}$ as long. Repeat until you have completed 20-30 minutes total at Zone 4.
- 2 To improve anaerobic endurance:** Do 5 x 3 minute intervals at Zone 5, with 3-minute recoveries in Zone 1. These may be done on flat terrain or a hill.
- 3 To improve sprint power as you get closer to your race:** Do 8-16 pedal revolutions (count one leg only) at max power (high gear and cadence) on varying terrains. Recover for at least 3 minutes after each. Stop doing them when power noticeably declines.



With a power meter, you're now able to execute structured workouts like never before.

Hire a Coach

Without a doubt, nothing can take your performance on the bike to the next level like working with a good professional coach. Look for a coach with a solid understanding of power-based training and analysis.

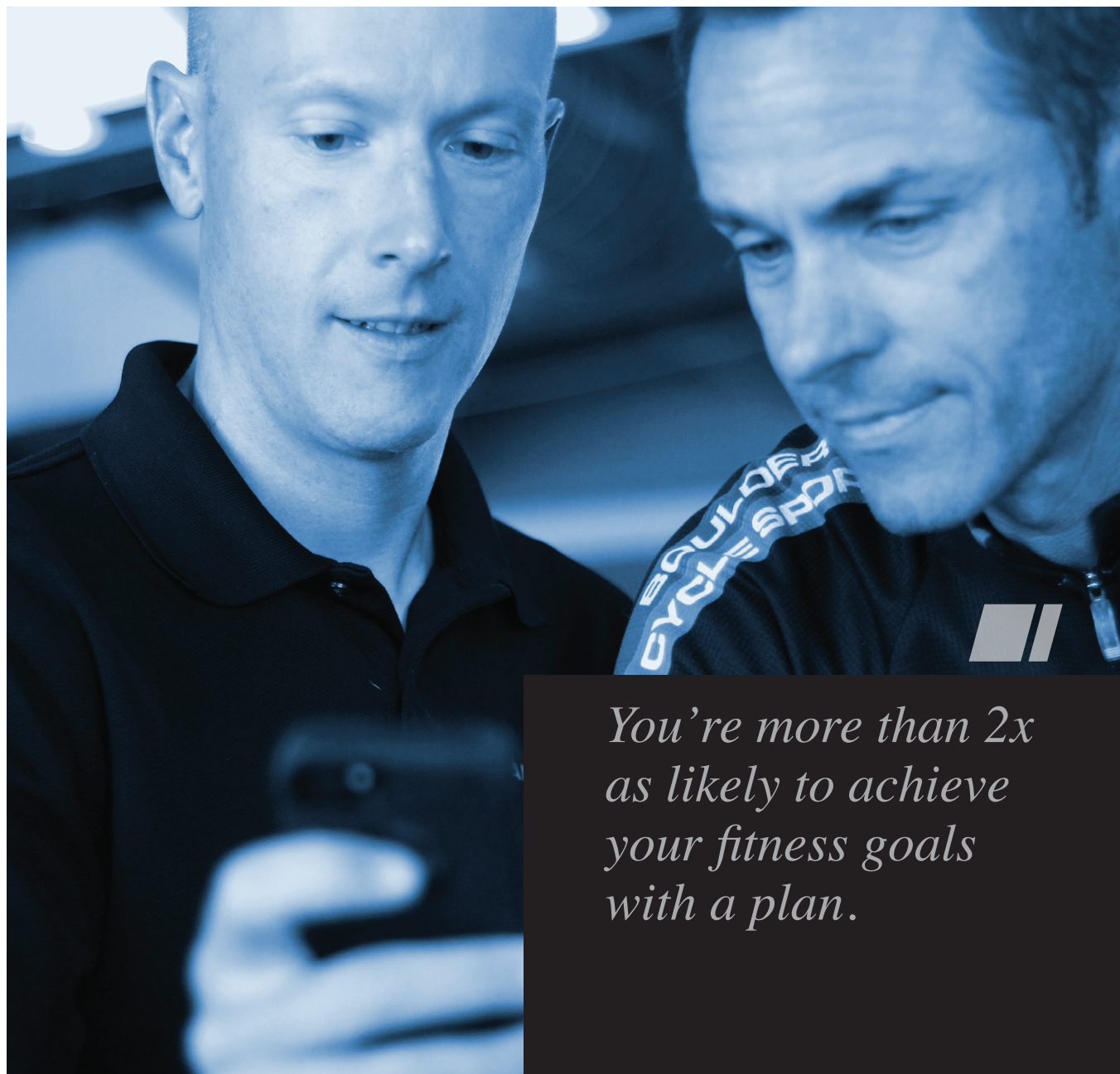
Not sure where to start? Use the free TrainingPeaks Coach Match Service—you can request power-based coaching within our questionnaire. [Get started.](#)

Get a Training Plan

With a power-based training plan loaded on TrainingPeaks, you'll get a daily email of your workout instructions, or take them with you on your iPhone or Android using the [free mobile app](#). You'll also see your daily workouts scheduled on your web-based TrainingPeaks calendar, and you can even sync with Google Calendar, iCal, or Outlook if you have a [TrainingPeaks Premium](#) account.

[View all power-based cycling training plans.](#)

[View all power-based triathlon training plans.](#)



*You're more than 2x
as likely to achieve
your fitness goals
with a plan.*



3 Myths about Hiring a Coach...Busted

Think you don't need a coach? Think again.

1

"It's too expensive."

There's a wide range in the level of coaching that is available. When we match athletes to coaches in our Coach Match Service, we ask you for your monthly budget and match you accordingly to a coach you can afford. The range we can search for starts at fees of less than \$100/month and goes up to over \$400/month.

2

"I'm not a serious enough athlete."

Coaching is not just for pros and elites. Many coaches specialize in recreational or amateur athletes. It's a matter of finding the right coach who will work with your background, your ability, and your goals for the future. 1 out of 4 athletes who use TrainingPeaks are coached.

3

"I can self-coach or work off a plan just fine."

Many athletes attain their goals through self-coaching or following a training plan. But one of the greatest values of a coach is the objectivity they bring to your program. With a coach you won't waste precious time second-guessing your rest days, your hard days, whether you're working the right systems, etc. A coach will give you peace of mind and help you make the most of your limited training time.

Track Your Power Data

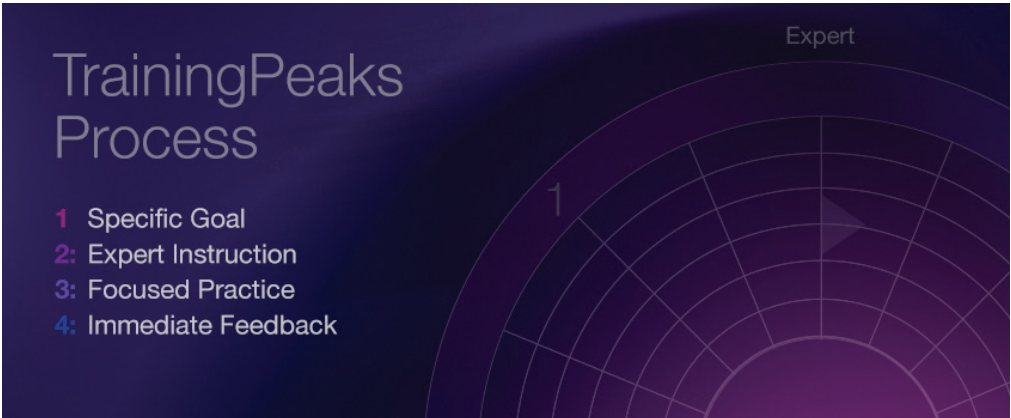
One of the greatest advantages to having a power meter is the ability to analyze your power and fitness trends over time. Analysis can inform your training and racing to the point where in some instances, Friel has gone as far as to say having a power meter is “almost cheating”.

To have data over time however, you have to start by tracking your power data from all of your training and racing. And for that, you'll need power software.

Using Power Software or Solutions

Due to the nature of power data, the only truly feasible way to track and derive the valuable knowledge from your power data is to use a web-based or desktop-based solution that can visualize and interpret the data for you. In particular this is valuable when you're racing or doing a tough group workout with your power meter—these are often the situations in which you'll exert your peak wattage. You'll need some sort of analysis software to spot these peak efforts afterwards.

TrainingPeaks Athlete Edition is a web-based solution where you can track, analyze and plan your power training. Here's how it works: after a ride plug in your device and use Device Agent to download the file into your account, then simply open the workout and start your analysis.



You have the option of starting a free Basic Athlete Edition account, where you can upload your workouts and do some basic analysis, or subscribe to the [Premium Athlete Edition](#) account to see your power, heart rate, speed, cadence and other trends charted or graphed over time. Here's a comparison of the Basic vs. Premium Athlete Edition account.

Basic vs Premium Benefits	BASIC	PREMIUM
Log your training on web, iOS or Android	●	●
Upload workouts from 90+ devices and mobile apps	●	●
View workout and fitness summaries	●	●
Use with a training plan or a coach	●	●
Track your equipment usage	●	●
Plan future workouts		●
Build and use unlimited workout libraries		●
Sync your calendar with Outlook, Google and iCal		●
Dig deep into your intervals and efforts within individual workouts		●
Analyze your fitness trends with 30+ power, HR, pace, distance and other charts		●
Target your perfect build and taper with the Performance Management Chart		●
Make your numbers more accurate with data editing and elevation correction		●

Analyze a Single Workout or Race

Got your first power file uploaded into TrainingPeaks? Great! Let's dive into it. But first, what are we looking for?

Why analyze a workout?

Analyze your workouts afterwards to get immediate feedback on how well you performed the workout relative to the instruction. With TrainingPeaks Premium you can zero in on specific segments or efforts. Make note of your pacing, whether you dropped off over a long effort, how "smooth" your power output was using Variability Index (more on that below), and how your heart rate and power related.

Why analyze a race?

Analyze your races to get a true sense for your peak efforts and where your fitness is at (how hard you can go). Also, analyze race data to gain an understanding of the specific demands of your goal events, so that you can structure your training specifically.

All else equal, the more power (watts) and/or the less weight (kg), the faster you go.

Power Metrics Explained

There are many different ways to analyze a power file from a workout or a race. Here's a quick introduction to some key metrics to look at within a power file.

Average Power

Your average power is simply that, the numerical average of your power for the entire ride. Many devices have non-zero averaging or smart recording enabled. Make sure to turn those features off to get the true accounting of your effort. Not recording zeros will make your numbers look better, but also less accurate.

w/kg

Your watts per kilogram (w/kg) is more meaningful than absolute watts. Two riders of different sizes (weight) can produce the same absolute wattage, but go different speeds because one rider is lighter than the other. All else equal, the more power (watts) and/or the less weight (kg), the faster you go. When analyzing an effort or a ride, make note of your w/kg in addition to your absolute wattage.

To make sure your w/kg is accurate, [enter your weight within TrainingPeaks](#) and track it over time. It will automatically be used to calculate your w/kg for any segment or ride with power.



Normalized Power® (NP®)

One of the first things that catches the attention of any beginning power meter user is how variable, or “jumpy”, their power output tends to be. This is largely due to the constantly changing resistance from small changes in elevation, gusts of wind, etc. that must be overcome when cycling outdoors. It is very difficult (as well as counterproductive) to try to keep power constantly within a certain range, or zone, at all times during a ride. Just as importantly, this variability means that the overall average power for a ride or part of a ride is often a poor indicator of the actual intensity of the effort. This is especially true for races, since power can vary dramatically from one moment to the next as, e.g., a rider first tries to conserve energy and then attacks.

Here's where Normalized Power (NP) comes in. It's an estimate of the power you could've maintained for the same physiological “cost” (in terms of glycogen utilization, lactate production, stress hormone levels, and neuromuscular fatigue) for a given effort or ride if your power output had been perfectly constant (e.g., as on a trainer) rather than variable. As such, NP is always higher than average power.

NP is a better indicator than average power of how metabolically challenging the workout was. It emphasizes power surges which require a lot of glycogen (carbs) and therefore contribute to an increase in fatigue.

Normalized Power is an estimate of the power you could've maintained for the same physiological ‘cost’ for a given effort or ride if your power output had been perfectly constant rather than variable.



Which leads us to...

Variability Index (VI)

The more surges you have in a ride, the higher your NP will be (and the harder and more fatiguing the ride will “feel”). Thus it stands to reason that the closer your NP and your average power are for a given segment, the smoother your power output was.

We measure how steady your power output was using a metric called Variability Index (VI), which is simply NP divided by average power. If NP and average power are the same, your VI will be 1.0. The closer to 1.0, the “smoother” your power output.

VI is particularly important for time trials and triathlon, where smooth pacing is key to success. Friel likes to see a VI of less than 1.06 for an Ironman bike. It is less important or irrelevant in road racing and criterium, where constant surging for position and attacking can lead to a VI of upwards of 1.2 or higher.

Intensity Factor® (IF®)

Still with me? Good, because now that you understand NP we can really get into the good stuff. Intensity Factor (IF) is simply the ratio of the NP as described above to your threshold power. For example, if your NP for a long training ride is 210 watts and your threshold power at the time is 280 watts, then the IF for that workout would be 0.75.

Typical IF values for various training sessions or races:	IF
Recovery rides	Less than 0.75
Endurance-paced training rides	0.75 - 0.85
Tempo rides, aerobic and anaerobic interval workouts (work and rest periods combined), longer (>2.5 h) road races	0.85 - 0.95
Lactate threshold intervals (work period only), shorter (<2.5 hr) road races, criteriums, circuit races, longer (e.g., 40 km) TTs	0.95 - 1.05
Shorter (e.g., 15 km) TTs, track points race	1.05 - 1.15
Prologue TT, track pursuit	Greater than 1.15

Training Stress Score® (TSS®)

Training Stress Score (TSS) measures the total workload of a ride, as a function of duration and intensity (as measured by IF). As a rule of thumb you can't accumulate more than 100 TSS points an hour, as 100 TSS denotes an all-out effort for 60 minutes at a 1.0 IF. A 1-hour effort at an IF of .75 will result in 75 TSS, an IF of .60 for 30 minutes will be 30 TSS, and so on.

TSS tells you how much training stress you put on your body, and conversely how much rest you need after a ride.

What your TSS means (for a well-trained athlete):	TSS
Equivalent to a 1-hour, all-out TT effort	100
Low (recovery generally complete by following day)	Less than 150
Medium (some residual fatigue may be present the next day, but gone by second day)	150 - 300
High (some residual fatigue may be present even after 2 days)	300 - 450
Very high (residual fatigue lasting several days likely)	Greater than 450

TSS is really important because when you measure your accumulated TSS over time, you can quantify your fitness as well as your fatigue. More on that later.

Kilojoules, or “Work” (kJ)

One of the other advantages of having a power meter is the ability to dial in your nutrition needs on the bike. Unlike heart rate or duration, your power meter can very accurately measure your calories burned within [5% accuracy](#). A power meter directly measures the energy transferred to the pedals in the form of kilojoules, and it is generally accepted in cycling that kilojoules and calories conveniently convert in a 1:1 ratio.

Here’s why: 1 kCal = 4.18 kJ, but your body is only about 25% efficient. Meaning, to generate 1 kCal of work at the pedals, it takes 4 kCals, 3 of which are lost as heat leaving the body. In this way, kJ’s recorded are an accurate 1:1 approximation of calories burned.

Matches

The key to success in road races and criteriums is the capacity for producing very brief but highly intense surges. This is called “burning matches.” You must be careful with how many matches you burn in a race in order not to “blow up.”

You can automatically detect matches in TrainingPeaks WKO+ desktop software, or spot them yourself in your power graph in TrainingPeaks.

As a starting point, Hunter Allen proposes that for most riders and racers, a match can be defined as an effort in which you go over threshold power by at least 20% and hold it there for at least one minute. Burning a match could involve an effort longer than 1 minute, but as the time period gets longer, the percentage above your threshold power would be lower. Table 2 shows how Allen proposes defining a match by various durations.

Table 2: Allen’s Definitions of a Match

Time	% over FTP
1 minute	20+%
5 minutes	15 - 20%
10 minutes	8 - 12%
20 minutes	0 - 8%

Peak Power

Take a look at your Peak 5-second, 1-minute, 5-minute and 20-minute power output for a race or a tough workout. Did you hit any new personal bests? Another quick way to check this after your upload is to look at your Peak Power Chart on your Dashboard in TrainingPeaks.

Cadence

Some power meters also measure your pedaling cadence. Coupled with knowledge of your power zones, you can work on finding the most efficient cadence for you. Certain workouts will include cadence instruction designed to increase or maintain leg speed, or increase your strength.

Heart Rate

When paired with your power data, heart rate data can be extremely valuable. For the sake of simplicity, we’ve excluded discussion of HR training from this e-book. But you can read more about the relationship between power and HR in Joe Friel’s article, “[Are you Fit? Aerobic Endurance and Decoupling](#)”, or see how HR zones and power zones correspond in Andrew Coggan’s article on [Power Training Levels](#).

Analyze Power Trends Over Time

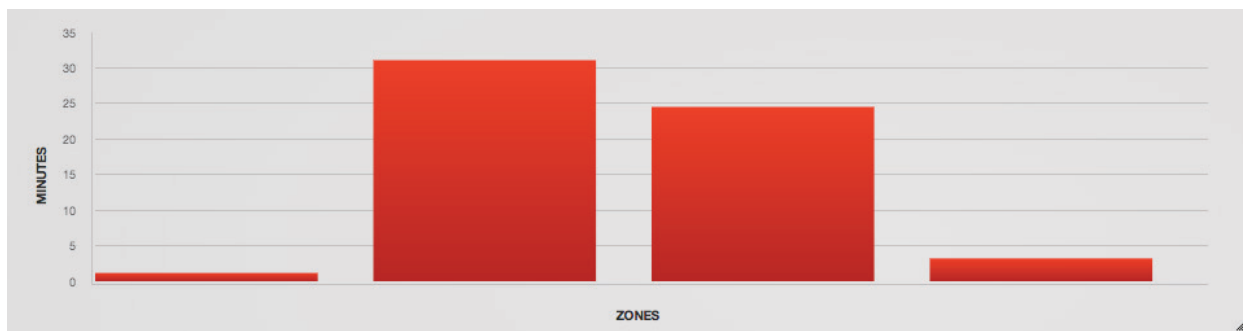
Analyzing a workout can be very informative for assessing your compliance to the planned workout, but it's when you can observe trends over time that your power data becomes truly...well, powerful.

Here are some analyses you can perform once you have a few weeks' worth of good, regular power data including some peak (hard) efforts of varying durations. All of these charts and graphs are available with a TrainingPeaks Premium account.

Time in Zones

The Time in Zones chart can show you how you have been allocating your time between the various zones. Depending upon your goal event, you'll want to allocate your efforts accordingly to match the demands of your "A" race.

One thing to consider, however, is that the Time in Zones Chart does not accurately reflect consecutive time in zones, so be careful in interpreting this chart. For example, if you live in a hilly area, the chart will say you spend a tremendous amount of time in anaerobic capacity, even if you haven't spent a lot of time specifically training anaerobic capacity.



Performance Manager Chart (PMC)

As mentioned above, each workout you complete can be assigned a TSS value. Your cumulative TSS is tracked over time in the Performance Manager Chart (PMC) within TrainingPeaks. The PMC helps you do two key things:

1) Target the perfect training build and taper to peak for your key events; and

2) Avoid injury that could happen from over-training.

Here's how the PMC works: As you accumulate TSS each day, your fitness improves. You can measure your overall long-term effect of training, which is fitness, using Chronic Training Load (CTL). CTL is the exponentially-weighted moving average of the previous 42 days of TSS accumulation. This means that it takes into account all of your workouts in the last six weeks, weighting the impact of the most recent ones more heavily. The CTL is an approximation of your current fitness: the higher your CTL, in general, the higher your FTP.

You can also measure fatigue, the short-term effect of training, using Acute Training Load (ATL). ATL is your exponentially-weighted moving 7-day average TSS. Similar to the way CTL is calculated, your most recent workouts are more heavily weighted. This accurately reflects your current fatigue. For example, if you did some big rides last weekend, then you may still be sore from those workouts, and have a high ATL as a result.

We know we cannot solely focus on raising training stress (ATL and CTL) since we also need to rest. We use a statistic called Training Stress Balance (TSB) to measure your “form”: the combination of how “fit” and how “fresh” (well-rested) you are.

- **Long term effects of workouts =**
Fitness, measured by Chronic Training Load (CTL)
- **Short term effects of workouts =**
Fatigue, measured by Acute Training Load (ATL)
- **Fitness (CTL) – Fatigue (ATL) =**
Form, measured by Training Stress Balance (TSB)

How it all fits together:

If your ATL is greater than your CTL, your TSB will be negative. You'll be well-trained and very “fit”, but because you are fatigued you will not be on peak form or performance. If your ATL is less than CTL, your TSB will be positive. At a certain TSB, your fitness and your fatigue will be in balance so that you are in peak “form” for your event. You're well-trained, fit, and rested—the recipe for a killer performance!

On your Performance Management Chart, aim for a neutral or positive Training Stress Balance (“form”) on race day.

Over time, you can observe the positive TSB that generates a peak performance for you in training or racing. Then, you or your coach can plan a build and taper that replicates a TSB for your A races.

Note: At some point, an overly positive TSB does indicate too much rest—detraining. This may be observed during the off-season or injuries.

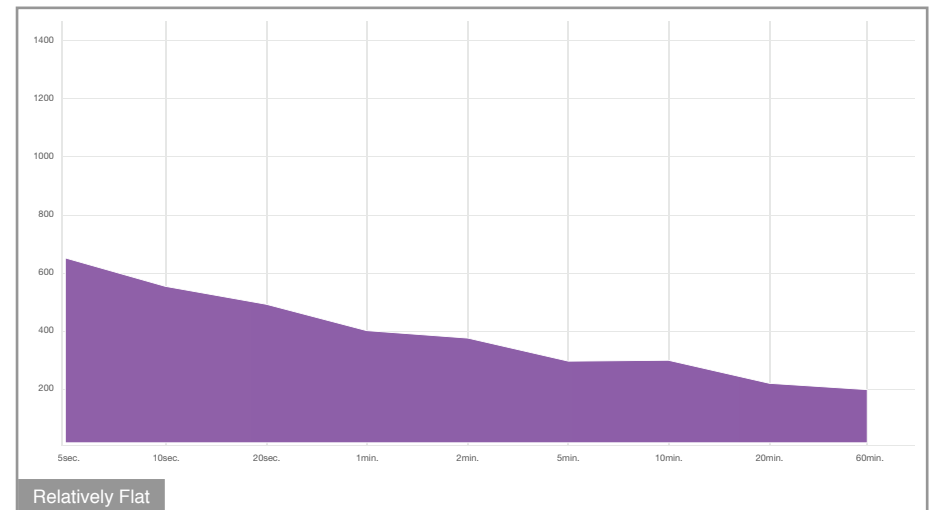
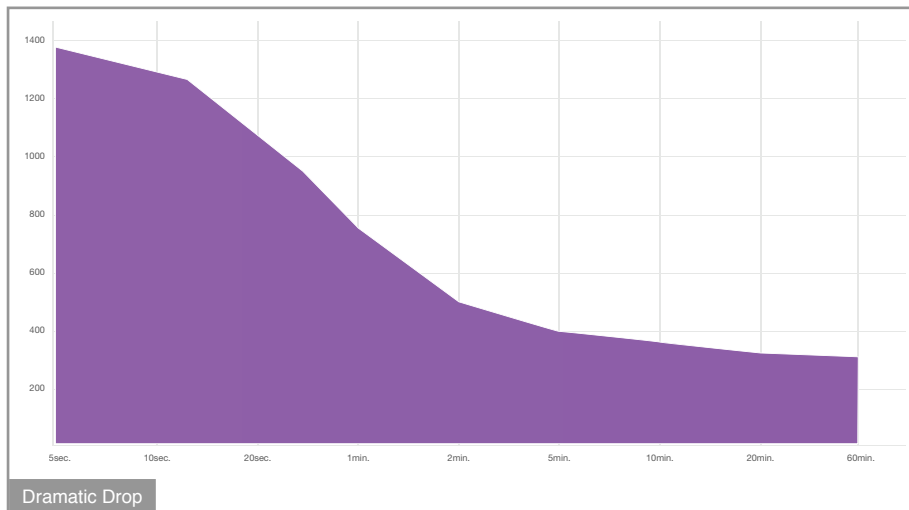
Peak Power

Looking at a chart of your Peak (maximal) Power for varying durations can help you to spot strengths and weaknesses on the bike. A Peak Power graph that is high in short durations (5-second to 1-minute) but drops off dramatically in the longer durations (20 minutes to 60 minutes) may indicate a need for more endurance.

Conversely, a Peak Power chart that is relatively flat may indicate solid endurance but some need for high-end power work (depending upon your goal event).

One of the best indicators of race readiness can be derived from your Peak Power Chart. As fitness improves and approaches a peak you should find you are frequently producing personal best power outputs for given durations such as 5 seconds, 1 minute, 5 minutes, and FTP.

You are ready to race when you have several recent seasonal best power outputs and your TSB is neutral or positive.



Racing With Your Power Meter

Equipped with knowledge about your power zones as well as historical power data, you're now ready to race with your power meter.

Cycling

Use your power meter to pace longer climbs or efforts. If you've only ever sustained 300 watts for up to 45 minutes during training, for example, you probably won't want to hold that effort for much longer than 45 minutes during a race.

However, that being said, it's often difficult to pace a road race, criterium, or even mountain bike race using power. Not only can it be difficult or unsafe to constantly watch your wattage, but your effort is often dictated by terrain or the dynamics of the race. However, you can still use a power meter to objectively guide when you may be able to go or when you need to back off.

The other key application of racing with a power meter is the valuable data gained during a race. As these are your peak efforts, having race day power data can be crucial to understanding your progress over time, as well as your strengths and limiters. As an example, as you become fatigued in a race your cadence will begin to decrease. After the race look to see if this happened. It's common and to be expected (although not too much) if you pushed your power output to your limits for the entire race.

Race data is also key to understanding the specific demands of your goal event. If you have a past file from an "A" race, you can target workouts that simulate the power demands.

This is why it's so important to consistently track and analyze your power data. The insights gained from reviewing your power files after races and workouts can help to guide pacing and racing strategy. Also, over time you'll learn what certain power zones "feel" like, and be able to gauge your effort in a race if for some reason you don't have a power reading that day.



Triathlon (Ironman)

During triathlon, where proper pacing on the bike is essential to a successful run, having a power meter can be so effective for pacing that Joe Friel has called it “almost cheating”. In particular, he has laid out specific guidelines for Ironman triathletes.

The two statistics that are most interesting to an Ironman triathlete are TSS and IF. To the right is a table created by Rick Ashburn that Friel uses to determine what an athlete's IF and TSS should be for an Ironman race.

Your bike-finish TSS should fall into either the light gray, dark gray, or yellow sections depending on how you categorize yourself (see the color-code legend to find your race category). Then on the left side of the table find your goal bike time. By looking to the right of the goal time and in your color-coded category you'll see a range of one to four TSS numbers. Then by glancing up to the top row for both ends of this colored range you'll see what your IF should be throughout the race. Then you simply ride in that IF range on race day and—voila!—you have your optimal bike time and are ready to actually run the marathon.

Read the full article, “How to Cheat by Using a Power Meter in an Ironman” [here](#).

The Relationship of Bike Intensity (IF) and Bike Time in an Ironman Triathlon (Expressed as TSS)

Time \ IF	67%	68%	69%	70%	71%	72%	73%	74%	75%	76%	77%	78%	79%	80%
6:30	292	301	309	319	328	337	346							
6:20	284	293	302	310	319	328	338	347						
6:10	277	285	294	302	311	320	329	338	347					
6:00	269	277	286	294	302	311	320	329	338	347				
5:50	262	270	278	286	294	302	311	319	328	337	346			
5:40	254	262	270	278	286	294	302	310	319	327	336	345		
5:30	247	254	262	270	277	285	293	301	309	318	326	335	343	352
5:20	239	247	254	261	269	276	284	292	300	308	316	324	333	341
5:19	232	239	246	253	260	268	275	283	291	298	306	314	322	331
5:00		231	238	245	252	259	266	274	281	289	296	304	312	320
4:50			230	237	244	251	258	265	272	279	287	294	302	309
4:40				229	235	242	249	256	263	270	277	284	291	299
4:30					227	233	240	246	253	260	267	274	281	288

NOTE: Intensity Factor (IF) = Normalized Power (NP) divided by Functional Threshold Power (FTP). Training Stress Score (TSS) = IF² x Time (in hours) x 100
SOURCE: Copyright 2008 by Rick Ashburn

- Left a little on the table
- Safe zone for unsure runners and novices
- Good range for most age group athletes with good preparation
- For proven, strong Ironman runners only
- Run a few miles, then walk it in
- You are likely blown; try again next year



Next Steps

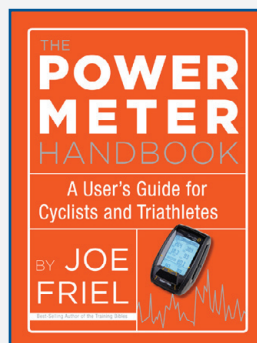
Keep Learning

Don't stop here—there's still plenty more you can learn about how to use your new power meter to achieve your on-the-bike goals. Here are a few great resources for furthering your knowledge and using power to get faster:

The Power Meter Handbook

by Joe Friel

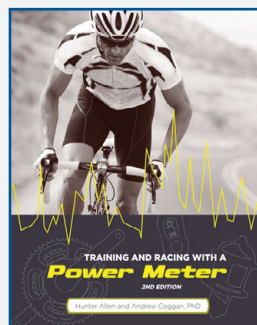
The Power Meter Handbook demystifies your power numbers, clarifies your setup and will show you how to train with power in simple terms. In clear language, the most trusted coach in endurance sports makes understanding a power meter easy—no advanced degrees or tech savvy required.



Training & Racing with a Power Meter

by Hunter Allen and Dr. Andrew Coggan

The comprehensive and definitive guide to training and racing with a power meter. Learn the scientific and mathematical foundation of NP, TSS, power profiling, the Performance Manager, and other deep power analysis tools.



Start Training

Everything you need to train and race with power can be found at [TrainingPeaks.com](https://www.trainingpeaks.com).

Track your Training

[Get a free TrainingPeaks Account](https://www.trainingpeaks.com/account)

Analyze your Power Data

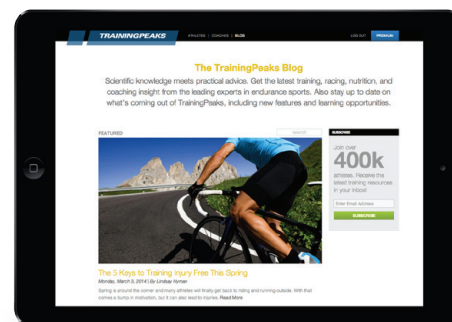
[Upgrade to TrainingPeaks Premium](https://www.trainingpeaks.com/premium)

Hire a Coach

[Use the Coach Match Service](https://www.trainingpeaks.com/coach-match)

Plan Your Season

[Find a Training Plan](https://www.trainingpeaks.com/season-plan)



The TrainingPeaks Blog

Scientific knowledge meets practical advice. Subscribe and get the latest training, racing, nutrition, and coaching insight from the leading experts in endurance sports. Also stay up to date on what's coming out of TrainingPeaks, including new features and learning opportunities.



Now You're Ready

You are now equipped with the right tools and knowledge to make the most of your training. Using this book and your new power meter you can execute your workouts with a level of precision that the professionals rely on. Congratulations, you're about to reach your true potential.