VO2 Max vs FTP: How Cyclists Should Evaluate Both — and What Matters Most



For any serious cyclist, understanding the physiological metrics that underpin performance is essential to training smarter and racing better. Two numbers sit at the heart of cycling science: **VO2 max** — your aerobic ceiling — and **FTP (Functional Threshold Power)** — your sustainable threshold. Both are critical, but they tell very different stories about your fitness, and knowing when to trust each one can transform how you approach training and competition.

This guide walks through how to measure and interpret each metric, explains the physiological relationship between them, and — crucially — settles the debate over which is the more practical and powerful predictor of real-world cycling performance. Whether you're a club racer or a seasoned amateur, these insights will sharpen your approach to both testing and training.

VO2 Max

Your aerobic *ceiling* — the maximum rate at which your body can consume and utilise oxygen to produce energy.

FTP

Your sustainable *threshold* — the highest power output you can maintain for approximately one hour before fatigue sets in.

The Relationship

FTP is typically expressed as a *percentage* of VO2 max power — the two metrics work together, not in isolation.

Step 1: Start with VO2 Max — the Aerobic Ceiling

VO2 max is the gold standard of aerobic fitness — it defines the absolute upper limit of your body's capacity to take up, transport, and utilise oxygen during intense exercise. Measured in millilitres of oxygen per kilogram of bodyweight per minute (mL/kg/min), it represents the ceiling of your aerobic energy-production system. The higher your VO2 max, the more oxygen your muscles can consume, and — in theory — the more power you can produce at maximal effort.

For cyclists, VO2 max is most accurately measured in a laboratory setting using an incremental ramp test on a cycle ergometer, with a metabolic analyser measuring expired gases breath by breath. As intensity increases in staged steps, oxygen consumption rises until it plateaus — that plateau is your VO2 max. Field-based estimates are also possible using maximal ramp tests (such as the British Cycling ramp protocol), where the final achieved power is used in a formula to estimate VO2 max. Wearables and cycling computers increasingly offer algorithmic estimates, though these carry greater uncertainty.

Here is where many cyclists misunderstand VO2 max: **two riders can share an identical VO2 max yet produce very different power outputs.** This is because performance depends not merely on how much oxygen you can consume, but on the power you can produce *at* that maximal oxygen uptake — often referred to as pVO2 max (power at VO2 max). A rider with superior cycling economy (the oxygen cost of a given power output) will produce more watts per litre of oxygen consumed, giving them a decisive edge over a rider with the same VO2 max but poorer mechanical efficiency.

VO2 max is also relatively fixed by genetics — elite endurance athletes are largely born with the structural capacity (cardiac output, lung diffusion, muscle fibre composition) to achieve high values. Whilst training can improve VO2 max by roughly 10–20% in untrained individuals, highly trained cyclists often find their ceiling changes little with further training. This means VO2 max is best understood as a measure of **aerobic potential**, not a direct gauge of cycling-specific fitness or race readiness.

How to Test VO2 Max as a Cyclist

1 Lab Ramp Test

Incremental steps on an ergometer with metabolic gas analysis — the most accurate method available.

2 Field Ramp Test

Maximum ramp test to exhaustion; final power is used in an equation to estimate VO2 max. Practical and repeatable.

3 Device Estimates

Cycling computers and smart watches estimate VO2 max algorithmically — useful for tracking trends, but not gold standard.

Elite male cyclists typically record VO2 max values of 70–85 mL/kg/min. World Tour professionals may exceed 90 mL/kg/min.



Step 2: Bring it onto the Road — FTP as Sustainable Threshold

Whilst VO2 max defines your physiological ceiling, **Functional Threshold Power (FTP)** defines the floor of your most demanding sustainable effort — and it is FTP that most directly translates into real-world cycling performance. FTP is classically defined as the highest average power output a rider can sustain for approximately one hour without rapidly accumulating fatigue. It corresponds closely to the physiological concept of **lactate threshold 2 (LT2)** or the maximal lactate steady state — the point at which lactate production and lactate clearance are precisely balanced.

Below FTP, your body is operating in a sustainable steady state: lactate produced by working muscles is being cleared efficiently, and you can maintain effort for extended periods. Above FTP, lactate accumulates progressively, hydrogen ions disrupt muscle contraction, and fatigue accumulates rapidly. This makes FTP the critical tipping point for race pacing — it predicts how hard you can ride a time trial, a long climb, or a sustained break without blowing up.



The 20-Minute Test

The most common field protocol. Ride all-out for 20 minutes; take 95% of your average power as your FTP estimate. Best done after a proper warm-up and a 5-minute hard effort to prime the system.



The Ramp Test

A short, progressive test to exhaustion. Your FTP is estimated from the final completed step. Less mentally demanding than 20-minute efforts and highly repeatable — now the standard in many platforms like Zwift and TrainerRoad.



Lactate Testing

The most precise method — incremental exercise with blood lactate sampling at each stage. LT2 is identified directly from the lactate curve. Used by professional teams and sports science labs.



60-Minute All-Out Effort

The original and most direct measure — average power for a genuine maximal one-hour effort is your FTP. Mentally brutal, but the gold standard for field testing when conditions allow.

FTP is also expressed as **watts per kilogram (W/kg)** to allow meaningful comparison between riders of different body weights. A well-trained amateur might achieve 3.5–4.0 W/kg; a professional road cyclist typically sustains 5.5–6.5 W/kg in peak condition. Because FTP reflects the interplay between VO2 max, lactate threshold percentage, and cycling economy simultaneously, it captures far more of a rider's race-specific fitness than VO2 max alone. It is the number that most directly answers the question: *how hard can this rider actually go, for how long?*

Step 3: Compare Them Fairly — Then Train to What They Predict

Having established what VO2 max and FTP each measure, the pivotal question for any cyclist is: **which metric should guide your training and racing decisions?** The scientific evidence offers a clear and perhaps surprising answer — and it has significant practical implications for how you structure your season.

The Evidence: FTP Wins for Race Prediction

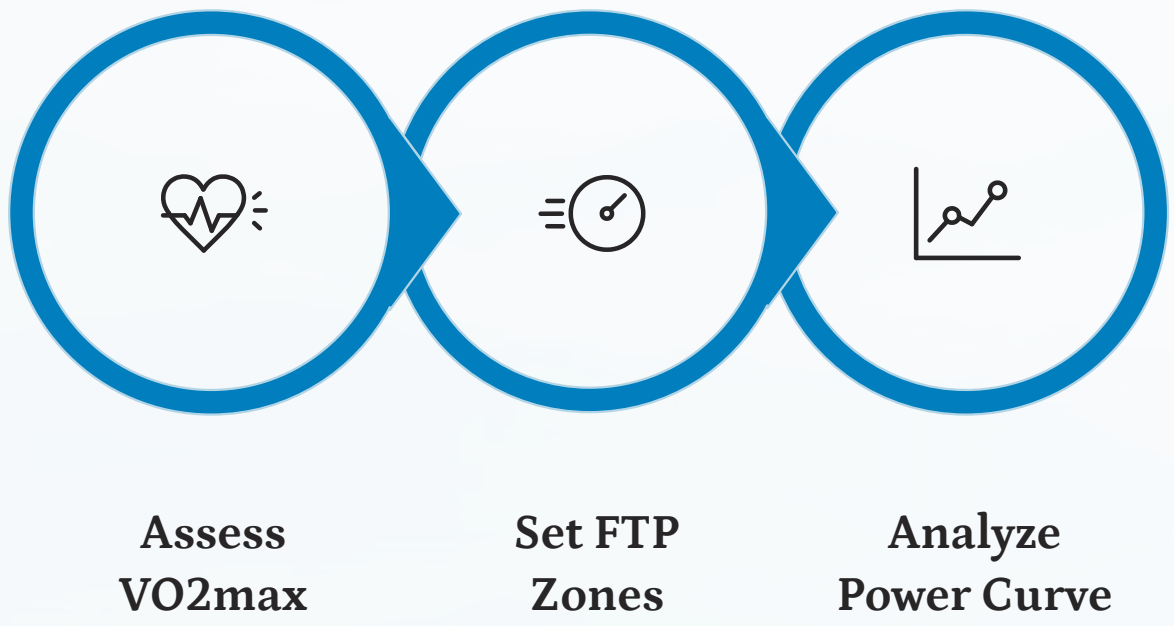
In a landmark study of moderately trained cyclists, **20-minute FTP expressed in W/kg significantly predicted 47 km time trial performance**, whilst VO2 max did not reach statistical significance as a predictor. This finding aligns with exercise physiology theory: a time trial lasting roughly an hour is almost entirely dependent on the power a rider can sustain at or near their lactate threshold — precisely what FTP measures. VO2 max, by contrast, is more relevant to shorter, maximal efforts where the aerobic system is fully taxed and anaerobic contribution is high.

This does not mean VO2 max is irrelevant — a high VO2 max creates the aerobic platform from which a high FTP can be built. But it does mean that two riders with the same VO2 max may have very different FTPs, and it is their FTP — not their VO2 max — that will determine who rides faster in a time trial or breaks away successfully on a long climb.

The Caveats: Don't Over-Trust FTP Either

FTP testing is not without limitations. The popular 20-minute test protocol is vulnerable to **anaerobic capacity inflation**: riders with a large anaerobic contribution (high W' — the anaerobic energy reserve) may sustain a higher average power over 20 minutes than their true lactate threshold would predict, leading to an overestimated FTP and training zones set too high. Conversely, a rider with low anaerobic capacity may underperform the test and underestimate their true threshold.

FTP is also a single-point metric: it captures sustainable one-hour power but says nothing about your 5-second sprint, your 5-minute VO2 max repeatability, or your 3-hour endurance ceiling. Cyclists with specific event demands — criteriums, track events, gravel epics — should supplement FTP with power duration curve analysis across the full range of efforts.



The Decision Rule: How to Use Both Metrics Together

The most practical framework is to treat VO2 max and FTP as **complementary lenses on your fitness**, each answering a different question. Use VO2 max to understand your aerobic potential and to identify whether your FTP is high relative to your ceiling (indicating good threshold efficiency) or low (suggesting threshold-focused training could yield large gains). Use FTP to set your training intensity zones — it is the anchor for Zone 2 through Zone 5 training, and accurate zones are essential for the correct physiological stimulus in each session.

If your FTP is a low percentage of your VO2 max power (pVO2 max), prioritise threshold and sweet spot training to push FTP upwards. If your FTP is already a high percentage of pVO2 max, VO2 max intervals (short, maximal efforts at 110–120% of FTP) may be needed to lift the ceiling itself. This interplay — raising the ceiling, then pushing the floor up to meet it — is the foundation of long-term cycling development.

Use VO2 Max To...

Understand your aerobic potential, identify whether threshold training or ceiling-raising intervals are your limiting factor, and contextualise your FTP relative to your maximum aerobic power output.

Use FTP To...

Set accurate training zones, predict and pace time trial and sustained climbing efforts, and track fitness gains across your season. It is the most race-relevant single metric available to a cyclist with a power meter.

Use Both Together To...

Build a complete picture of your cycling fitness, prioritise the right type of training block for your current limiters, and ensure your testing protocols are honest, accurate, and sport-specific.

The bottom line: VO2 max tells you what you *could* become. FTP tells you what you *are* right now. Train to both — but race to your FTP.