
# Two Important Factors in Aerobic Performance: VO2 Max and Anaerobic Threshold

In various contexts, I frequently discuss different capacities such as muscle strength, endurance, and aerobic ability. In terms of aerobic performance, two essential factors are VO2 Max and Anaerobic Threshold (AT), both of which can be enhanced through diverse training methods. VO2 Max represents the maximum oxygen consumption during intense exercise and is crucial for longer endurance events like marathons, while the Anaerobic Threshold marks the point where lactate production exceeds clearance, important for middle-distance races. While VO2 Max is influenced by genetic factors, both capacities can be significantly improved through effective training. Since anaerobic training is generally more trainable and less genetically limited compared to VO2 Max it should be part of your aerobic training program. I typically recommend a training approach that includes two days per week of High-Intensity Interval Training (HIIT) to enhance anaerobic threshold and overall aerobic ability, along with two or more days of continuous aerobic sessions. AT is a better predictor of performance than VO2max in elite athletes (study).

## Two Important Factors in Aerobic Performance: VO2 Max and Anaerobic Threshold

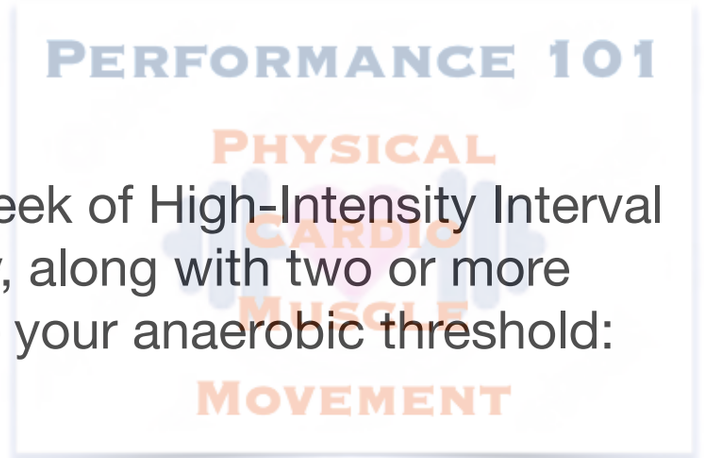
Anaerobic Threshold is often expressed as a percentage of VO2max (50% - 60% for the general population, 75% and above for athletes). The higher the AT, the higher intensity the athlete can sustain without producing lactic acid. Therefore, AT is a better predictor of performance than VO2max in elite athletes (see study).

VO2 Max represents an individual's maximum oxygen consumption during intense exercise and plays a crucial role in running performance, especially for longer endurance events like marathons, half-marathons, and long-distance races. A higher VO2 Max indicates better oxygen utilization, leading to improved aerobic endurance and the ability to sustain higher intensities for extended periods. Consequently, endurance runners often focus on enhancing their VO2 Max to maintain a fast pace over long distances. It is highly influenced by genetic factors, such as the distribution and capacity of oxygen-carrying red blood cells, heart size, and lung capacity. While training can certainly enhance VO2 max to a certain degree, there are limitations set by your genetic potential. In simpler terms, some individuals may naturally have a higher VO2 max due to their genetic predisposition, while others may have a lower VO2 max despite similar training efforts. However, it is crucial to understand that even though genetics play a role, most people can still significantly improve their aerobic fitness through effective training.

The Anaerobic Threshold (also known as lactate threshold) marks the point where the body starts producing lactate faster than it can be cleared. This threshold is particularly significant for middle-distance events like 5K and 10K races. Sustaining the intensity at the anaerobic threshold allows athletes to delay fatigue and muscle exhaustion, enabling them to maintain a faster pace for an extended duration. Anaerobic threshold improvements are achievable for most individuals through consistent and targeted training. As you train at intensities near your anaerobic threshold, your body adapts to become more efficient at using oxygen, which can delay the onset of anaerobic energy production. Therefore, it is generally considered more trainable and less genetically limited compared to VO2 max. Therefore you should not just train to increase VO2 Max. You need to train to increase your aerobic threshold. You can identify that you've reached onset of blood lactic acid accumulation OBLA when you experience a rapid increase in muscle fatigue, your breathing becomes even more challenging, and you feel a burning sensation in your muscles, indicating a shift to greater reliance on anaerobic metabolism.

In summary, both VO2 Max and anaerobic threshold are vital for running performance, with their relative importance depending on the race distance. For longer endurance events, a high VO2 Max is critical to sustain pace over extended periods. On the other hand, in middle-distance races, the anaerobic threshold's significance lies in determining how fast an athlete can sustain a pace before reaching the point of fatigue. Since anaerobic threshold is generally considered more trainable and less genetically limited compared to VO2 max you should consider incorporating training that will improve it.

## Training to improve Anaerobic Threshold




I typically recommend a training approach that includes two days per week of High-Intensity Interval Training (HIIT) to enhance anaerobic threshold and overall aerobic ability, along with two or more continuous aerobic sessions. Here are some other strategies to improve your anaerobic threshold:

• Threshold Runs (or other aerobic Activity): Perform runs at or slightly below your anaerobic threshold pace for extended periods. This challenges your body to efficiently clear lactate and adapt to higher intensity levels.

• Tempo Intervals: Include intervals at or just above your anaerobic threshold pace with short recovery periods. This type of training further enhances your ability to sustain higher intensities.

• Fartlek Training: Vary your pace during a run (or other aerobic Activity), incorporating bursts of faster running close to or slightly above your anaerobic threshold, followed by recovery periods.

• Progressive Long Runs: Gradually increase your pace during long runs (or other aerobic Activity), finishing at or near your anaerobic threshold. This simulates race fatigue and improves your ability to maintain pace.

• Hill Repeats: Running uphill challenges your anaerobic energy system and effectively improves your anaerobic threshold.

Monitor Progress: Regularly assess your anaerobic threshold using methods like heart rate and RPE, generally speaking when breathing starts to become labored is when you are reaching your anaerobic threshold (study). That is generally considered somewhat hard and a RPE of 6-7 based on a 1-10 scale or 13 based on the 6-20 scale.  At an RPE of 7-8, an individual would perceive the exercise intensity as "hard" to "very hard." See Anaerobic Threshold on RPE Chart.

To ensure a well-rounded training program, prioritize proper rest and recovery days to prevent overtraining and reduce the risk of injury. Balancing these training components will help you achieve optimal results in improving your anaerobic threshold and overall running performance.

PERFORMANCE 101

PHYSICAL

CARDIO

MUSCLE

MOVEMENT

Anaerobic Threshold

| RPE (Perceived Effort) | EFFORT TYPE | ZONE | POWER OR VELOCITY ZONE | HOW DOES THIS FEEL? |
|---|---|---|---|---|
| 0-1.5 | ACTIVE RECOVERY | 1 | <55% cFTP<br><70% RTP<br><75% STP | • Easiest pace utilized during warm-up and cool-down<br>• Recovery between intervals or on days of active recovery<br>• Takes focus to maintain this low intensity |
| 2.0-4.0 | ENDURANCE | 2 | 55-75% cFTP<br>70-84% RTP<br>75-85% STP | • Comfortable pace that can be maintained for long periods<br>• Fatigue will be low for up to a couple of hours at this pace<br>• Increased breathing rate, but still comfortable |
| 4.5-6.0 | TEMPO | 3 | 76-89% cFTP<br>85-90% RTP<br>86-95% STP | • Pace can be maintained for an hour or longer, but will begin to feel moderately hard after 30-60 minutes<br>• Steady, but fairly sustainable effort<br>• Breathing hard, but still controlled |
| 6.5-8.0 | THRESHOLD | 4 | 90-105% cFTP<br>91-107% RTP<br>96-104% STP | • Pace can be maintained for around an hour<br>• Challenging, difficult, and requires concentration to maintain effort, beginning of internal dialogue<br>• Breathing heavily, not as rhythmic |
| 8.5 + | MAP | 5 | 106-135% cFTP<br>108-115% RTP<br>105-112% STP | • Pace can be maintained for short intervals<br>• Loud and obnoxious internal dialogue<br>• Breathing extremely hard |
| 9.0 + | Anaerobic Capacity | 6 | 136-220% cFTP<br>116-125% RTP<br>113-120% STP | • Pace can only be maintained for short max and near max intervals<br>• Self preservation instincts kicking in<br>• Out of breath |
| 10 | Sprint/NM | 7 | >220% cFTP<br>>125% RTP<br>120% STP | • Sprinting pace and shortest max intervals<br>• Can feel effortless if rested or impossibly difficult if tired |