SUUNTO ON

How Not to Rely on Luck

WHEN OPTIMIZING YOUR TRAINING EFFECT.

TRAINING GUIDEBOOK

CONTENTS

INTRODUCTION

Welcome to the world of Suunto sports instruments! This guide contains basic information about goal-oriented sports training and how the human body functions during exercise. It also informs you about how the Suunto t6 wristop computer can help you achieve better results in your training and helps you get the most out of Suunto t6's unique features.

ENSURE EFFECTIVE TRAINING

Suunto t6 is a new breed of training tool based on the accurate measurement of the time between heartbeats. Based on this time interval and its detected variations, the Suunto Training Manager PC software can calculate various information about the performance of your body during training.

The outstanding benefit of Suunto t6's physiological analysis is that it is now possible, for the first time, to measure the physiological training load to your body caused by the exercise, known as EPOC (Excess Post-exercise Oxygen Consumption). The software relates the estimated EPOC to your personal performance level, helping you find just the right level of exertion to give you the best possible training effect. Suunto t6 helps you make sure that the time you spend exercising really does improve your performance and the sweat you have poured will not have been in vain.

CORRECT TRAINING LOAD ENSURES OPTIMAL PROGRESS

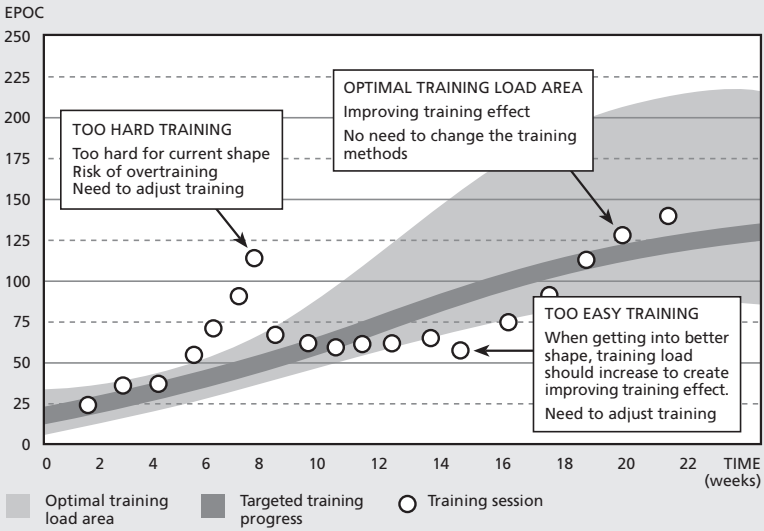

Figure 1. Suunto t6 guides you in your training to exercise optimally for your fitness level.

In addition to heart rate, EPOC and training effect, Suunto Training Manager's training analysis tells you your oxygen uptake, energy consumption, ventilation, and breathing frequency. The software also includes versatile diary and planning functions for monitoring your training.

Suunto t6 is also an excellent tool for controlling your exertion level during training. Its easy-to-use heart rate measurement, stopwatch, and alarm functions adapt to different kinds of training, helping you to perform your training in accordance with your goals.

SUUNTO t6 MEASUREMENTS

This chapter introduces the information related to exercise measured by Suunto t6, and describes its meaning in terms of sports.

Suunto t6's software requires some background information about the user for performance analysis. The most important of these are age, weight, height, sex, and level of performance depicting the amount of prior exercise.

Based on this information, the program calculates assumed values for certain parameters, such as maximum heart rate and maximum performance. Actual maximum heart rate and performance are, however, very dependent on the individual, so if you know the exact values of these parameters, we recommend entering them in the program manually. This improves the accuracy of the calculation.

EPOC (EXCESS POST-EXERCISE OXYGEN CONSUMPTION)

EPOC is short for Excess Post-exercise Oxygen Consumption and indicates the amount of extra oxygen your body needs for recovery after exercise. Due to the physiological training load caused by the exercise, your body consumes more oxygen after exercise than during rest. The more strenuous the exercise, the higher this extra consumption of oxygen (EPOC) is after exercise and the more your body´s homeostasis is disturbed.

So, EPOC is an indicator of how strenuous the exercise was. It is a numerical value comprising the duration and intensity of the exercise, as well as other physical and mental factors affecting your body, such as stress and fatigue.

So far EPOC has only been utilized in exercise physiology research, because it was only possible to measure it under laboratory conditions. Suunto t6 is the first device that allows the non-invasive prediction of EPOC already during exercise, which in turn makes it possible to monitor the exercise load and the training effect.

HOW DOES EPOC ACCUMULATE?

The greater the intensity and the longer the duration of a training session, the higher is the EPOC value measured from the session.

EPOC accumulates faster when the training's intensity increases than when the duration increases. This means that low -intensity training may not necessarily result in a high EPOC value, even if the duration of the training is exceptionally long. With high-intensity training, however, you can reach a high EPOC value even in a short period of time.

In interval training, periods of high heart rate and periods of recovery follow each other. If the recovery periods are short, EPOC can reach a high value, as it will not have time to decrease during a short rest.

The EPOC value attained from similar exercise can vary from day to day. On a good day, your body can handle the training more efficiently, resulting in a lower EPOC value, but on a bad day, the physiological training load to your body and EPOC may be higher. Many factors affect EPOC during training, such as your hydration status and the temperature and humidity of the air. If you have performance anxiety or are nervous, this may increase the EPOC value.

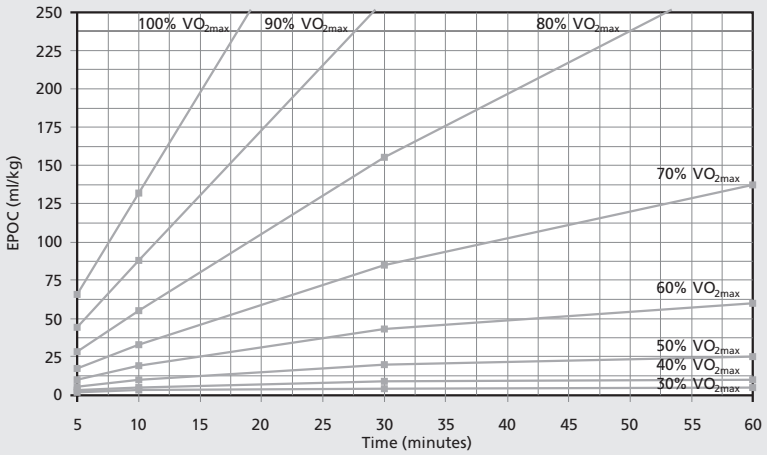

Figure 2. The effect of training duration and intensity (%VO_{2max}) on EPOC accumulation.

HOW DOES EPOC DECREASE?

EPOC accumulated during training may begin to decrease already during the session, if the training includes sufficiently long rest periods or lower intensity periods.

All substantial physical activity after the actual training session continues to consume energy delaying the start of full recovery.

Although EPOC decreases fastest during complete rest, light cool down exercise after hard training will help the total recovery. Cool down increases the circulation, flushing the lactic acid from the muscles faster and speeding up recovery.

EPOC IN DIFFERENT FORMS OF EXERCISE

EPOC is most useful for describing the stress caused to your body by forms of training that especially target the respiratory and cardiovascular system. These include endurance sports such as running and cycling.

Training involving only small or limited individual muscle groups (for example, weight training) will not necessarily result in an EPOC value as high as training that taxes large muscle groups (for example running or cross-country skiing). Weight training may feel very strenuous, because local muscle fatigue and lactic acid hinder performance even if your body still has energy for repetitions.

Fast-paced team sports often involve short but intense bursts of exertion intermingled with low intensity exertion or rest. During the low-intensity periods, EPOC increases more slowly than during high-intensity periods, and it may even decrease. For this reason, EPOC is usually lower in team sports compared to continuous exercise of the same duration. On the other hand, breaks in the play enable a high level of intensity during game time. In some team sports like basketball or soccer, where the breaks are short, this allows EPOC to rise to very high levels.

FREQUENTLY ASKED QUESTIONS ABOUT EPOC

Does heart rate influence EPOC?

Yes. The higher the heart rate in relation to the maximum heart rate, the higher the EPOC.

Why are my EPOC values always exceptionally high?

If the maximum heart rate used in the program's calculations is lower than your actual maximum heart rate, the program will overestimate the intensity of the exercise, resulting in an excessive EPOC value. Also, too high training intensity may give exceptionally high EPOC values.

Why are my EPOC values always exceptionally low?

If the maximum heart rate used in the program's calculations is higher than your actual maximum heart rate, the program will underestimate the intensity of the exercise, resulting in an EPOC value which is too low. Also, too low training intensity may give exceptionally low EPOC values.

Can I speed up the decrease of EPOC?

Yes. Complete rest is the fastest way to decrease EPOC. However, after high -intensity training, you should do some light cool down exercises even if this slightly delays the start of full recovery.

Why does EPOC only increase at the start of training, after which it stays nearly the same or even decreases?

In low-intensity training EPOC will not increase noticeably after a certain time. In low-intensity but long-duration training, EPOC will be lower than in high -intensity training. However, continuing training even after reaching the EPOC peak value is worthwhile, because long-duration, low-intensity training will develop your body to cope with hard training.

I always run the same distance in the same time. Why is my EPOC value sometimes higher, sometimes lower?

Even if training sessions are identical (same distance, same time), it may be harder on your body on one day, and easier on another. On a good day, the same training will have a lower impact on your body than on a bad day. Factors increasing EPOC include dehydration, stress, sleep deprivation, or the start of flu.

Why is my EPOC sometimes lower after training while tired than after an earlier, completely identical training, I did while well rested?

In certain situations, your body reacts to training by lowering the heart rate and maximum heart rate even if your body is clearly not fully recovered. This may result in a lower-than-usual EPOC. We recommend paying attention to such abnormal behaviour of the EPOC values and ensure that your training program includes a sufficient amount of rest, since continuous training without sufficient recovery leads to overtraining.

Is training more effective the higher the EPOC?

EPOC is an indicator of how hard the exercise session was to your body and how much your physiological homeostasis was disturbed, but the quality of training always depends on your personal goals and situation. It is important to have variety in your training program. In order to develop, you need both high-intensity training where EPOC rises to high levels, and long-duration, low-intensity training and recovery exercise where EPOC remains low.

I did short duration, high-intensity training, after which I was exhausted. Why was my EPOC value low?

In short-duration, maximal or near-maximal exercise, the cause of exhaustion is usually an extreme rise in acidity (lactic acid level) in your body, which makes you unable to continue training. Longer, more sustainable workouts may leave you feeling less exhausted but will cause more total stress, thus resulting in a higher EPOC value.

TRAINING EFFECT

When you practice sports or exercise, each training session has some kind of effect on your body. EPOC makes it possible to objectively measure whether the effect of the session was sufficient to improve your fitness level. This is called the Training Effect. The Training Effect can be determined by comparing the EPOC value measured from the training with the athlete's performance level.

The Training Effect is an indicator of how much the training session improved your aerobic fitness, especially the maximum performance of your cardiovascular system and the ability to resist fatigue during endurance training. It does not provide direct information about the effect to, for example, strength or speed attributes.

The Suunto Training Manager software divides the Training Effect into five categories, calculated from your personal background information. The divisions between these categories depend on your fitness level and prior training.

The Training Effect categories are:
1 Minor / recovering effect
2 Maintaining effect
3 Improving effect
4 Highly improving effect
5 Overreaching

Certain EPOC values correspond with each category. The better your fitness level, the more you have to push your body during the training in order to improve your performance, and the higher the EPOC values of the Training Effect categories. To recap, EPOC is a general measurement of the physiological load caused by training, used to determine the individual training value of each workout.

EPOC AND TRAINING EFFECT

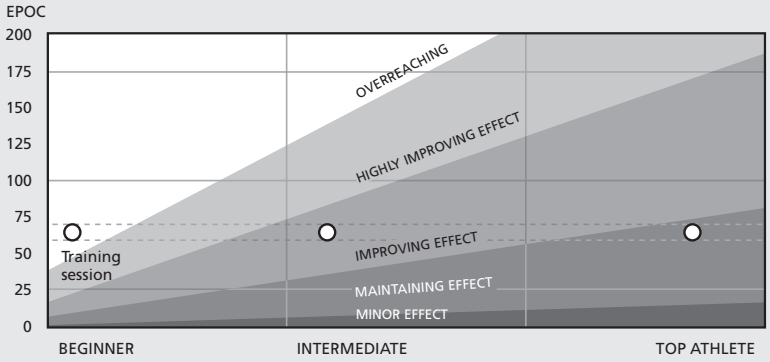

Figure 3. The EPOC value required for a certain Training Effect depends on the fitness level. An EPOC value that indicates highly improving training for a beginner is merely maintaining for a fit athlete.

TRAINING EFFECT IN DIFFERENT KINDS OF TRAINING

Long-duration, low-intensity endurance base training (>1h, <50% VO_{2max}) improves fat metabolism and increases capillary density and heart volume over the long term. This builds a foundation for better maximum performance and harder training in the future. Base endurance training does not usually have an immediate effect on maximum performance, so the Training Effect based on the EPOC value is relatively low.

High-intensity training (>75% VO_{2max}) directly improves physical properties that increase maximum endurance performance, such as oxygen transport from lungs to muscles, energy production and utilization, and nerve/muscle cooperation. Improving these properties increases the maximum oxygen intake (VO_{2max}) and resistance to fatigue, thus leading to a better endurance performance. The effect of such training depends on its duration.

Depending on individual differences, athletes' objectives and training history, the optimal intensity levels of training are different. Experienced athletes must usually train at a higher intensity or for much longer intervals than beginners in order to reach a Training Effect that increases fitness.

OTHER PERFORMANCE PARAMETERS

In addition to EPOC and Training Effect, Suunto t6 also measures other data about the functioning of your body. This provides you with more information about what happens in your body during training, and allows you to monitor your development and plan your training in more detail.

HEART RATE

Your heart rate indicates how effectively your cardiovascular system transfers oxygen from your lungs to your muscles. In addition to beats per minute, your heart's stroke volume, i.e., the amount of blood pumped by one beat, correlates directly to efficiency.

Up until now, heart rate has been the only value describing training intensity that could be measured for any exercise. For this reason it is commonly used as a gauge of how strenuous training is, and training is adjusted based on heart rate. Knowing what your heart rate is at any given moment, however, tells you only a small fraction of what effects the training has on your body.

There are several terms related to heart rate such as maximum heart rate and resting heart rate. Maximum heart rate is the highest possible heart rate your heart can achieve. It can be estimated based on your age. The latest recommendations suggest using the formula 210 - 0.65 x age when calculating the maximum heart rate. This formula gives a slightly higher maximum heart rate for older people than the earlier formula, 220 - age. Maximum heart rate is, however, very individual, and may differ from the calculated value by as much as 20-30 beats per minute. Determining its accurate value is only possible using a maximum performance test.

Resting heart rate is your heart's lowest number of beats per minute when you are at complete rest. Unlike maximum heart rate, resting heart rate and heart volume change as a result of regular training. Endurance athletes who have trained for a long time, for example, have an exceptionally low resting heart rate.

The difference between the resting heart rate and the maximum heart rate is called the heart rate reserve (HRR). The intensity of training is often defined as a percentage of the maximum heart rate (%HR_{max}) or the heart rate reserve (%HRR). The recommended heart rate zones in Suunto Training Manager's sample training sessions are based on maximum heart rate (%HR_{max}).

BREATHING PARAMETERS

Respiratory rate and ventilation (the amount of air breathed per minute) are called breathing parameters. Changes in the breathing parameter values indicate changes in your body's physiological state.

During exercise, muscles consume more oxygen than at rest, increasing your body's oxygen demand. Your body will respond by increasing ventilation in order to provide enough oxygen for your muscles. This is manifested by an increase in the respiratory rate and the volume of each respiration. Thus, both ventilation and the amount of oxygen provided to your body increase.

The increase in respiratory rate and ventilation is non-linear when exertion increases from rest to maximum intensity; the higher the intensity, the faster the increase. Breathing parameter graphs allow the determination of, for example, the aerobic (lactate threshold) and anaerobic (onset of blood lactate accumulation) thresholds which, for instance, represent the accumulation of lactic acid in your body.

These changes in breathing can be monitored at different levels of exercise as follows: at an easy pace, breathing does not hinder talking, but at a faster pace, talking is intermittent due to being out of breath.

When the exertion level exceeds the anaerobic threshold, respiration rises to such a high rate that talking becomes practically impossible.

RESPIRATORY RATE SCALE DURING EXERCISE

respirations/min

< 15	rest
< 20	low training intensity
< 35	moderate training intensity
< 50	hard training intensity
> 50	very hard training intensity

VENTILATION SCALE DURING EXERCISE

These values depend on body size, sex and fitness level and include ranges in the table below.

l/min

< 10-15	rest
< 30-50	low training intensity
< 60-100	moderate training intensity
< 80-150	hard training intensity
> 80-150	very hard training intensity

OXYGEN CONSUMPTION

Heart rate indicates the transfer of blood and oxygen to muscles. Oxygen consumption indicates how the muscles use the oxygen for work.

Compared to the breathing variables, oxygen consumption increases in a more linear manner as exertion increases. For this reason, oxygen consumption is, in practice, considered the most reliable variable when exercise intensity level is estimated.

Measurements of breathing variables provide important information about the functioning of your body during training, and, together with the heart rate and oxygen consumption, they allow a thorough analysis of the exercise, revealing things that cannot be deduced based on heart rate alone.

CATEGORIZING OXYGEN CONSUMPTION

Oxygen consumption (VO_2) is directly dependent on the amount of work your body does. Maximum oxygen uptake (VO_{2max}), on the other hand, is a personal value, affected by your training history and genes.

Maximum oxygen uptake will not, however, directly describe an athlete's performance level. This is because performance is to a large degree determined by how close to the maximum level the athlete is able to maintain his or her performance throughout the entire session, and by how economical the performance is. Economy of performance means how much of the oxygen consumed by the athlete's body actually converts into the performance.

OXYGEN CONSUMPTION SCALE DURING EXERCISE

Oxygen consumption of different levels of endurance training as a percentage of the athlete's maximum oxygen uptake:

$\%VO_{2max}$
- < 30% – daily physical activities, very light aerobic training
- < 50% – light to moderate pace, basic endurance training
- < 75% – moderate to hard pace, hard endurance training
- > 75% – very hard, VO_{2max} training

BREATHING PARAMETERS AND HEART RATE PROVIDE ACCURATE DATA ON IMPROVEMENTS IN FITNESS

Heart rate can be used to reliably measure improvements in your fitness level. When you perform a familiar standard exercise and improve your time while the heart rate remains the same, it is a sign of improved fitness. Lower heart rate with the same time also indicates improved fitness. As your fitness improves, ventilation and respiratory rate are also reduced during a standard exercise.

Oxygen consumption, however, will remain more or less the same or slightly decrease in a standard exercise, while the maximum level of oxygen consumption will increase along with the fitness.

The following table represents your fitness level in comparison to the entire population, based on your VO_{2max} level. The table can also be used for setting your Activity Level in Suunto Training Manager.

VO_{2max} classification	1	2	3	4	5	6	7
Age\Fitness level	Weak			Average			Excellent
20–24	<32	32–37	38–43	44–50	51–56	57–62	>62
25–29	<31	32–35	36–42	43–48	49–53	54–59	>59
30–34	<29	29–34	35–40	41–45	46–51	52–56	>56
35–39	<28	28–32	33–38	39–43	44–48	49–54	>54
40–44	<26	26–31	32–35	36–41	42–46	47–51	>51
45–49	<25	25–29	30–34	35–39	40–43	44–48	>48
50–54	<24	24–27	28–32	33–36	37–41	42–46	>46
55–59	<22	22–26	27–30	31–34	35–39	40–43	>43
60–65	<21	21–24	25–28	29–32	33–36	37–40	>40

Table 1. Aerobic fitness norms for men. (VO_{2max} unit ml/kg/min) (Shvartz, Reibold 1990)

VO_{2max} classification	1	2	3	4	5	6	7
Age\Fitness level	Weak			Average			Excellent
20–24	<27	27–31	32–36	37–41	42–46	47–51	>51
25–29	<26	26–30	31–35	36–40	41–44	45–49	>49
30–34	<25	25–29	30–33	34–37	38–42	43–46	>46
35–39	<24	24–27	28–31	32–35	36–40	41–44	>44
40–44	<22	22–25	26–29	30–33	34–37	38–41	>41
45–49	<21	21–23	24–27	28–31	32–35	36–38	>38
50–54	<19	19–22	23–25	26–29	30–32	33–36	>36
55–59	<18	18–20	21–23	24–27	28–30	31–33	>33
60–65	<16	16–18	19–21	22–24	25–27	28–30	>30

Table 2. Aerobic fitness norms for women. (VO_{2max} unit ml/kg/min) (Shvartz, Reibold 1990)

ENERGY CONSUMPTION

When muscles perform work, they consume energy. The most important energy sources for muscles are carbohydrates and fats. The energy contained in carbohydrates and fats is released for use in the muscles in a combustion reaction, for which the muscles require oxygen. Thus, the energy consumption of your body is directly proportional to oxygen consumption.

Suunto t6's computer analysis provides two data points of the energy consumption of a given training exercise. The momentary energy consumption kcal/min is a graphical indicator of how the energy consumption varied during training. Total energy consumption indicates how much energy in total was consumed during the exercise.

Information about energy consumption offers several possibilities for improving your performance. It allows you to plan the energy replenishment required during long-duration exercises and the pre-training loading. If you aim to lose weight, you can also estimate whether your total consumption is at a sufficient level to reach your goal.

Unlike earlier heart rate based methods for measuring energy consumption, Suunto t6 measures energy consumption from the entire range of heart rates, from rest to maximum. This enables the measurement of energy consumption from everyday activity and daily tasks as well, even for the entire day.

ALTITUDE

Suunto t6 also measures the current altitude, total ascent and descent, and stores an altitude profile of the entire training session. For top athletes the altitude data provides new possibilities for monitoring their system's adaptation to high-altitude training, by making it easier to relate the training stress and the heart rate and breathing variables to the altitude.

Because there is less oxygen available at high altitude, your body tries to compensate for this with elevated ventilation and heart rate level. Therefore your heart rate and ventilation at high altitude are higher than when exercising with the same workload (e.g. same running speed) at sea level, and your maximum performance capacity is lower.

Total ascent is a useful gauge for regular running or cycling exercises too. Training routes with a lot of ascent stress your body and muscles more and in a different way than an equal distance over even ground.

ACCURACY OF SUUNTO t6 PHYSILOGICAL MEASUREMENT VALUES

Measured variable	Unit	Typical value	Average error	Accuracy	Accuracy 8/10
Breathing frequency	1/min	20-30	±1.3	93%	96%
Oxygen Consumption	ml/kg/min	20-45	±1.5	88%	91%
Ventilation	l/min	30-75	±6.8	86% [1]	88% [1]
Energy Consumption	kcal/min	8-17	±0.5	89%	91%
$EPOC_{PEAK}$	ml/kg	40-150	±10.7	93% [2]	93% [2]

1: When ventilation > 30 l/min. 2: Relative accuracy for an individual person.

Accuracy 8/10 means accuracy for eight people out of ten.

Example: An average-sized male trains for 45 minutes. Suunto Training Manager displays a total energy consumption of 540 kcal. Calculated from this, the margin of error for the energy consumption is ±0.5kcal/min*45min = ±22.5 kcal = ±4.1%.

Table 3. The accuracy of the physiological measurement variables calculated from accurate heart rate ranges for the entire heart rate range from rest to maximal exercise.

SUUNTO t6 AS A TRAINING TOOL

This chapter describes how you can get the best results from your training with the help of Suunto t6.

COMMON TRAINING PRINCIPLES

TRAINING EFFECT

At rest, your system is in equilibrium (the homeostatic balance). In order to achieve a training effect, this equilibrium must be upset, i.e., the body must be put under stress to which it can react. This stress is known as training stimulus. Your body's reaction to the stimulus caused by exercise is called the generation of a training effect.

In practice, it is usually very difficult to estimate the level of stimulus caused and how much rest and recuperating exercises are required to recover from it. Until now, these estimates have been mainly based on measuring heart rate level and interpreting athletes' own feelings with the experience of the athlete or his or her trainer.

Suunto t6 allows you to accurately monitor the amount of your body's stress level and training stimulus based on the EPOC value, and also determine the personal Training Effect level.

Your body adapts rather quickly to the stimulus caused by physical exertion. The next time, the stimulus caused by exactly the same training will be lower, because your body will have prepared itself based on the earlier experience. Thus, the Training Effect is slowly reduced and the same repeated training will improve your fitness level less and less.

DIVERSE TRAINING

In order to ensure effective training, and therefore optimal development in your performance level, your training must include diverse training at several intensity levels. It is also important to monitor whether you reach your planned training effects, as this allows you to steer your training in the right direction.

You can achieve the best improvement in your physical condition by varying the weekly training amounts and levels, and the duration and intensity of individual exercises. Your training program should include different kinds of training so that all of the properties required in sports, such as endurance, muscle strength, agility, and speed develop equally.

A good training program combines improving training (Training Effect 3 to 5) with sufficient recovery and base endurance training that supports your maximum performance level. The final training program and the alternation between different levels of Training Effect (1 to 5) depends on your personal goals and your current fitness level.

REST AND RECOVERY

Well-timed rest is one of the most important factors of fitness-developing training. No matter how productive your training sessions, their effect on your fitness can be negligible or even detrimental if your program does not include enough rest at the right times.

Your body needs time for recovery, both after a single, high-intensity exercise and after a hard training period of several days. Without rest, your body's adaptation to the stimulus caused by training (fitness development) will not occur. In the worst case, training will lead to exhaustion and a state of overstress, otherwise referred to as "overtraining".

When you monitor your training with Suunto Training Manager, the Training Effect function in the Calendar View is a very important tool. At one glance, you can see whether your training is sufficiently diverse and whether hard training is followed by a sufficient amount of recovery. The Training Effect function also displays the general exertion level of the training: if your EPOC value is often at the highly improving or overreaching level, the risk of overtraining increases over the long term.

Figure 4 illustrates the Training Effects caused by five training sessions with different levels of intensity. The training sessions correspond to Training Effect levels 1 to 5. During training, performance level temporarily decreases, but begins to rise during recovery. After a certain amount of time, performance rises above the pre-training level, because the body is preparing to handle the next stimulus better than before.

EXERTION, RECOVERY AND TRAINING EFFECT

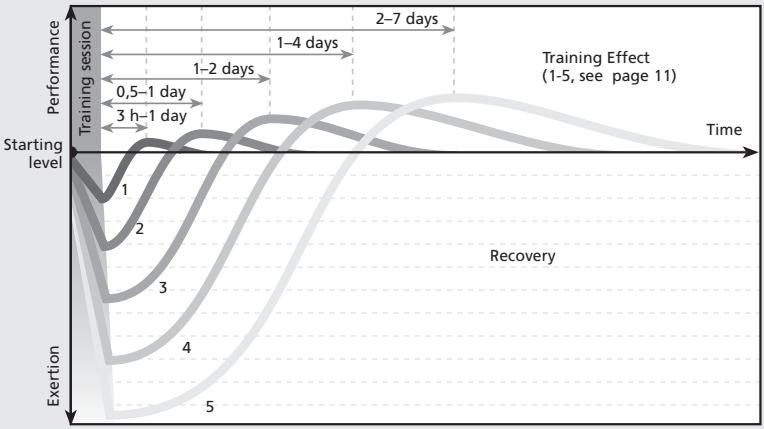

Figure 4. The time required for your body to recover from an individual training session depends on the training's exertion level (training load) and your training history. For the best development of performance, the optimal time until the next similar training is highly variable, but it is longer the higher the exertion level of the training.

The best improvement in performance is achieved when the next same-intensity training is performed when the effect caused by the previous training is at its highest. If your body does not receive the next training stimulus within a certain period of time, the achieved Training Effect begins to slowly decrease. If, however, the next high-intensity training session is held before your body has recovered from the previous one, the Training Effect will remain lower than it would have been after full recovery.

Top athletes sometimes include periods of overly strenuous training that require sufficient recovery to achieve a Training Effect. Continuous, hard training with insufficient recovery will slowly lead to lower performance and a long-term state of overtraining. When overtrained, even a long period of recovery training is not enough to return the performance to the original level. (Figure 5.)

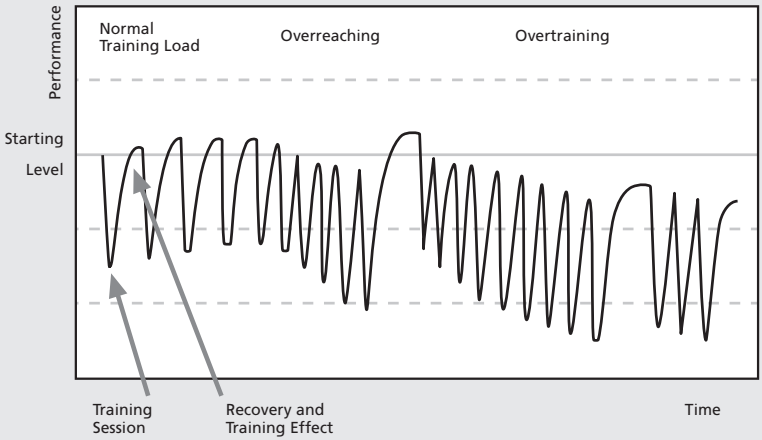

Figure 5. The development of a Training Effect from single exercises and after an overreaching period, and the development of overtraining.

SUUNTO t6 TIPS FOR BEGINNERS

It is never too late to start exercising. First, however, it is a good idea to be patient and slowly increase the amount of exercise. If you are over 40 years old and have not exercised before, or if you have a long-term illness, consulting your doctor before beginning an exercise program is absolutely necessary. We also recommend including an exercise stress test in the check-up.

EASY START

In the beginning, your body is not yet used to exercise, and it will react strongly to the training stimulus. Be patient and start off easy with regular low intensity exercising so that your body will have sufficient time to recover between training sessions. If you push your body too much, a state of overtraining may result, making even the lightest training feel harder and more exhausting. In developing your fitness, patience is a virtue!

We recommend starting training with endurance-improving, soft-impact exercise, where the movements are easy and the intensity rather low. This allows your body to get used to a new kind of activity, loading your cardiovascular system, which is the basic requirement for developing your fitness.

Good forms of exercise to begin your training with are walking, trekking, hiking, Nordic walking, cycling, cross-country skiing, swimming, and supportive muscle fitness training.

ESTIMATING YOUR STARTING LEVEL

In order for your training to be exactly right for your fitness level, it is important to know your starting level. For an estimate of your starting level, Suunto t6's software requires the following basic information from you: height, weight, age, sex, smoking (yes/no) and activity level on a scale of 0 to 7.

Activity level means the amount of earlier exercising activity on a scale of 0 to 7. Level 0 means a person who never exercises, while 7 means a person who trains actively. These levels are described more accurately in the software. Starting with version 2.0, the software also includes activity levels for competitive athletes.

If you know your maximum heart rate, maximum performance level, and your vital capacity (lung volume), you can enter them in the software to improve the accuracy of the calculation. Otherwise these values are determined based on mathematical formulas. Based on the background information you provide, the software will give you a personal EPOC scale, according to which different training sessions can be classified based on their effect. This ensures the correct level of training and makes it easier to monitor. Read more from the chapters EPOC and Training Effect.

The energy consumption (oxygen consumption) of exercise can be expressed as metabolic equivalents, METs. One MET corresponds to the oxygen consumption of a person's basic metabolism. The maximum performance level value in METs expresses the ratio of energy and oxygen consumption during maximum performance compared to the consumption at rest. One MET, the oxygen consumption at rest, is 3.5 ml/kg/min.

Based on your MET value, you can also calculate your maximum oxygen intake capacity (VO_{2max} ml/kg/min) by multiplying your maximum MET value by 3.5.

PROGRESSING IN TRAINING

In the early stages, you can follow the sample training programs of Suunto Training Manager. They include typical training weeks for a beginner for the first months. These sample programs ensure that your training is developing sufficiently but also includes enough rest.

A suitable amount of training on a weekly level, at first, is three or four training sessions with a duration of 20 to 60 minutes. One of these should reach at least the improving level (level 3 on the five -level EPOC scale). The program should also have one to two maintaining exercises and one recovery exercise.

At the beginning of regular training, your fitness will improve rather rapidly, and after a few weeks, we recommend checking your personal background information on the software's Personal page, and re-enter them if necessary. This way, the software can adapt to your training and adjust the Training Effect levels to match your fitness level. This enables you to ensure that your training remains optimal all the time and your fitness develops in the best possible way.

As your fitness improves and you update your background information, the EPOC levels describing Training Effect will increase. You must perform slightly harder training sessions than earlier for continuing improvement of your fitness. At the same time, you can slowly increase the amount of training.

After a couple of months of training you can accurately determine your maximum heart rate and maximum performance by performing control training. This helps you achieve even more accurate values and a more precise monitoring of your training.

SUUNTO t6 IN GOAL-ORIENTED ENDURANCE TRAINING

Suunto t6 is especially well suited for monitoring and controlling endurance training. At the top level, training is a balancing act between the best possible development and overtraining. Suunto t6's training load monitoring provides a new tool for determining where the balance point is.

Fitness enthusiasts and athletes training without a coach often find themselves in a situation where development seems to stop and training no longer improves their performance. Suunto t6 makes it possible to ensure that your training program includes a sufficient number of training sessions that disturb the equilibrium of your body enough to achieve an improving effect.

KNOW YOUR OWN TRAINING LEVELS

Suunto t6 provides you with a lot of new data about your training that previously could only be measured in laboratory tests. When you begin using Suunto t6 in your training, we recommend first finding out what your EPOC value and other measured values are in your normal training. This way you will slowly learn how to compare the training feeling to the measured values and estimate what kind of training you must do in order to reach the desired effect. As your experience grows, you will find out that your feelings will not always match the values measured from the training. This helps you identify situations where you may need to modify your training.

The accuracy of Suunto Training Manager's performance analysis is largely dependent on the correctness of the background information you have specified. If you have performed a maximum performance test in a laboratory, you will likely find all the background information required by the software from the test results. When you enter the data to the respective fields on the "Personal" page, your personal Training Effect levels are updated to match the test results.

If you have the chance to get tested in a laboratory while wearing the Suunto t6, you can get reference values from the laboratory results for all values measured by Suunto t6. You can later use this data in your normal training.

EPOC correlates strongly with the lactic acid level of your body. If the laboratory tests include lactate measurement, you can use the information as reference data in other training done at the same EPOC range as the laboratory test. In long-duration training, this correlation is not as strong.

CONTROL TRAINING

You can monitor the development of your fitness with the help of control training sessions. Control training is always done in the same way and in the same place, in conditions that are as identical as possible. Control training sessions include strenuous parts, so we recommend starting doing them only after you have trained regularly for at least two months. If you are not used to training of this type, first consult your doctor to ensure that you are suited for it.

Control training can be done in two different ways. Submaximal control training allows you to measure changes in your performance without having to exert yourself to the limit. Maximal control training, on the other hand, provides more accurate information about the development of your competitive performance level, and allows you to determine your maximum heart rate.

SUBMAXIMAL CONTROL TRAINING

Recording a submaximal control training session with Suunto t6
Press Start
Warm up for 5 to 10 min – press Lap
Run at target HR for submaximal control training (see table 4) for 7 to 15 min – press Lap
Cool down for 5 to 10 min – press Stop

Submaximal control training does not include very strenuous parts, so we recommend doing it regularly at one or two-week intervals. If you train by running, always perform the control training by running the same, standard route, that takes around 7 to 15 minutes at a speed that is slightly faster than your standard training speed. Choose terrain that is as even as possible. A sports field is an ideal location for control training, because there you can accurately determine the distance.

If you train by means other than running, try to find a way to perform the training so that external factors such as weather do not affect the performance. You can perform the control training, for example, with an exercise bike or a rowing machine.

Instructions:
1. Start the Suunto t6 training log.
2. Perform a warm up of 5 to 10 minutes. The warm up should last the same time in every control training so that the results are comparable. After warm up, store an intermediate time and continue running without pausing.
3. Run the route keeping your heart rate as even as possible, at a slightly faster speed than your normal base endurance training speed. This part should last 7 to 15 minutes. At the end of this phase, store another intermediate time, so that you store the average heart rate of the phase.
4. Finally, cool down for 5 to 10 minutes at a light pace and finish storing the training session.

5. Upload the training data to your PC and compare the result to earlier control training sessions.
See table 4 below for the target heart rate for submaximal running. It is very important to keep the heart rate as close to the same as possible in every control training session. You can use the Suunto t6 heart rate limit alarms to monitor your heart rate. The EPOC value of a correctly performed submaximal control training is at level 2.

Age	HR_{max} (210 – age x 0.65)	Beginner 73-80% HR_{max}	Enthusiast – Athlete 76-88% HR_{max}
20	197	144-158	150-173
25	194	141-155	147-171
30	191	139-152	145-168
35	187	137-150	142-165
40	184	134-147	140-162
45	181	132-145	137-159
50	178	130-142	135-156
55	174	127-139	132-153
60	171	125-137	130-150
65	168	122-134	127-148
70	165	120-132	125-145

Table 4. Target heart rate in submaximal control training.

If you always save the control training sessions in the same folder of your PC, you can monitor the development of your fitness as follows: Select the folder with the mouse and then click the Graph button. The software will then draw graphs of all control training sessions on top of each other. Based on the intermediate times, you can see how your time has developed, and the heart rate graphs display whether your heart rate remained constant in the different training sessions.

When your time is lower than in the previous control training session, but the heart rate is the same, your fitness has improved.

MAXIMAL CONTROL TRAINING

Recording a maximal control training session with Suunto t6
Press Start
Warm up for 5 to 10 min – press Lap
Submaximal exertion for 7 to 15 min – press Lap
Rest for 0 to 2 min – press Lap
Maximal exertion for 5 to 12 min – press Lap
Cool down for 5 to 10 min – press Stop

Maximal control training is best performed by running because then the external conditions will least affect the results. In this training, you run the same route twice. First, run the route at

submaximal level, following the above instructions, and then run the route as fast as possible. You can rest between the runs for a maximum of two minutes. In order to have comparable results, the rest pause should last the same time in every control training. The same instructions as in submaximal training apply for the route selection.

THE COOPER TEST

The 12-minute running test – the Cooper test – is excellent training for monitoring your endurance level. You can perform the Cooper test after warmup exercises or a submaximal phase. In the Cooper test, the purpose is to run on even ground or a sports track as long a distance as possible in 12 minutes. An even speed usually yields the best result. Select a location where you can measure the distance with an accuracy of ten meters.

Enter the test result, i.e., the distance you ran, in the field reserved for the distance in the Suunto t6 PC software, and you can monitor the development of the result as your training progresses.

Age	Weak	Fair	Average	Good	Excellent
Fitness enthusiasts					
Men 20 to 29	<1600m	1600 – 2199m	2200 – 2399m	2400 – 2800m	>2800m
Men 30 to 39	<1500m	1500 – 1899m	1900 – 2299m	2300 – 2700m	>2700m
Men 40 to 49	<1400m	1400 – 1699m	1700 – 2099m	2100 – 2500m	>2500m
Men over 50	<1300m	1300 – 1599m	1600 – 1999m	2000 – 2400m	>2400m
Women 20 to 29	<1500m	1500 – 1799m	1800 – 2199m	2200 – 2700m	>2700m
Women 30 to 39	<1400m	1400 – 1699m	1700 – 1999m	2000 – 2500m	>2500m
Women 40 to 49	<1200m	1200 – 1499m	1500 – 1899m	1900 – 2300m	>2300m
Women over 50	<1100m	1100 – 1399m	1400 – 1699m	1700 – 2200m	>2200m
Athletes					
Men	<2800m	2800 – 3099m	3100 – 3399m	3400 – 3700m	>3700m
Women	<2100m	2100 – 2399m	2400 – 2699m	2700 – 3000m	>3000m

Table 5. Fitness classification based on the result of the 12-minute Cooper running test (Oja et al, 1979)

Based on your Cooper test result you can calculate your maximum performance for the background information required in Suunto Training Manager. This formula can be used to estimate the maximum performance, when the Cooper test result is over 1600 m.

Men: MET = 0.005 x Result (in meters)
VO_{2max} = 0.0175 x Result (in meters)

Women: MET = 0.00514 x Result (in meters)
VO_{2max} = 0.018 x Result (in meters)

(Leger, Mercier 1984)

SUUNTO t6 AND WEIGHT MANAGEMENT

The basic principle of weight management is very simple: If your body consumes as much energy as you eat, your weight will remain constant. If your energy consumption is higher than your energy intake, you will lose weight.

Being overweight and not exercising often go hand in hand. Losing weight and attaining the resulting figure is best achieved by increasing exercise while lightening your diet.

Suunto t6 assists you in weight management in two ways: It accurately measures the amount of energy you have consumed in both sports and everyday tasks. The device's memory capacity is sufficient for measurements that last as long as a full day. Unlike conventional heart rate monitors, Suunto t6 accurately measures the total daily energy expenditure from rest and low intensity physical activities up to maximal exercise intensity. This allows you to estimate the level of your daily energy consumption in relation to your daily diet and energy requirements. On the other hand, it guides you to exercise at the correct level of exertion, so that your fitness is improved, and you can follow a training program that consumes enough energy.

SUITABLE TRAINING INTENSITY

Many dieting guides instruct you to exercise at an intensity level where the fat burning is as high as possible. The burned fat is not, however, the most important thing for the end result. Instead, your total daily energy consumption must be higher than the energy you get from your diet.

Your body will burn proportionally the highest amount of fat at rest, as much as 80%. When measured in absolute amount of fat, however, fat consumption is highest during exercise where your heart rate is 60 to 80% of the maximum. Most energy is consumed per unit of time in high-intensity training, because energy consumption is directly proportional to the intensity of the exercise.

ENERGY EXPENDITURE AT DIFFERENT INTENSITY LEVELS

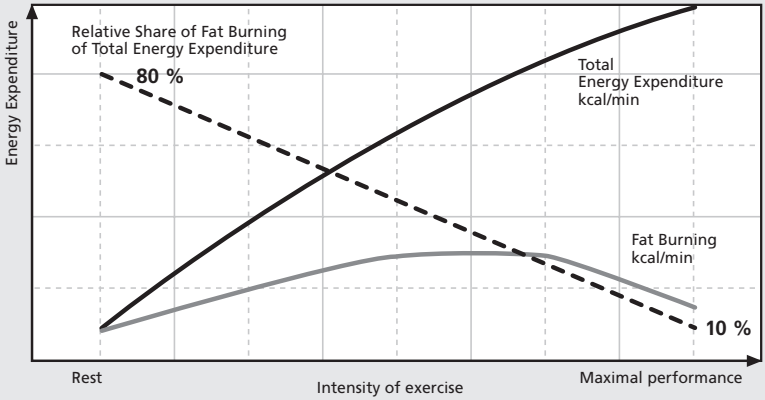

Figure 6. Schematic presentation of total energy expenditure, fat burning, and fat burning's share of the total energy expenditure at different levels of training intensity.

In weight management exercise, proportionately high fat burning is therefore not the deciding factor. Neither is high momentary energy consumption the most important factor. It is essential to perform training where the total amount of energy consumed will be the highest.

Usually this goal can be reached in low-intensity, long-duration training. If, however, you are short of time for exercising, the best effect for both fitness and weight is achieved with high intensity exercise. Despite this, we recommend being prudent when losing weight, as moderation in your exercise routine will reduce the risk of stress injuries and overexertion and helps you to maintain your motivation and reach long-term goals.

In addition to fat, your body produces the required energy from carbohydrates. In long-duration training, your body's carbohydrate stores are depleted, and they need to be replenished already during exercise. An intake of calories during the exercise may therefore be beneficial for losing weight, if it helps you to exercise longer. You should also remember sufficient hydration during training that lasts over an hour to ensure that you are able to finish your training effectively.

TIPS FOR THE PC SOFTWARE

The Suunto Training Manager PC software includes many practical functions for monitoring and planning your training. The use of these functions is described in more detail in the software's Help function. This chapter gives short examples of how you can utilize these functions.

FOLDERS AND CALENDAR VIEW

In the My Training/Calendar window you can view training sessions and training plans either in the folders or through a calendar view. You can switch between the views by clicking the buttons at the top of the window.

You can upload training data from the wristop computer to your PC in the My Training -window when the folders are shown. The folders also make it easier to group stored training sessions, make training programs, and plan individual training sessions. The calendar, on the other hand, allows you to monitor how your training has progressed over time. The calendar also includes the important Training Effect function, which makes it possible to analyze the intensity and variation of your training.

Figure 7. Suunto Training Manager, calendar view.

You can also add your own data to individual training sessions, such as comments on the session, the distance, your feelings during the training, and your daily resting heart rate and weight. You can find fields for this information on the "Details 1" and "Details 2" pages. You can also create a list of the sports you practice on the "Personal" page and define the Activity of your training. Future versions of Suunto Training Manager will feature functions that utilize this data in different graphic presentations.

PERSONAL BACKGROUND INFORMATION

The accuracy of the analysis depends on the background information you provide. If your information changes, for example if you lose weight or get to know your exact maximum heart rate, you must correct the background information. If necessary, you can reanalyze a training session saved earlier using the new parameter by selecting the Reanalyze function from the Actions menu.

CONTROL TRAINING SESSIONS

Regular control training sessions are an important tool in monitoring the development of your fitness. Accustom yourself to performing control training in accordance with the instructions in this guide, or use a method of your own. Store the results from the control training sessions in one folder so that you can easily compare them to each other.

ESTIMATING THE TRAINING EFFECT PRIOR TO TRAINING

You can use the Training Effect Calculator function to study how the duration, intensity, and EPOC value of a training session are related. You can find this function from the Actions menu. You can lock the duration, average heart rate, or EPOC value to a desired value. By modifying the two other values, you can plan a training session that best meets your target.

If you set a certain EPOC value in the calculator in order to reach a desired training effect, you can calculate what average heart rate and duration are required to achieve it. You can monitor the average heart rate and duration with the wristop computer during training. In this way you can ensure a successful training session.

The intensity of the Training Effect Calculator function's theoretical training session is completely even, which is never the case with actual training. For this reason, the EPOC given by the calculator and the EPOC resulting from the actual training may differ somewhat. Because EPOC increases relatively faster at a high heart rate than at a low heart rate, the measured EPOC is usually slightly higher than the one suggested by the calculator.

USING TRAINING PROGRAMS

The Training Plans folder contains several ready-made training program weeks. These training programs have been created based on common fitness training recommendations of ACSM (American College of Sports Medicine) and are well suited for those beginning regular exercising. Before you begin a training program, you may want to consult your physician. Furthermore, if you are not fully aware of the state of your health, we strongly recommend a full medical check-up. You can move a training program from the folder to your calendar by selecting it with the right mouse button and selecting the "Send to Calendar" function.

You can also create training programs of your own. Create a new program by selecting the folder with the right mouse button and selecting "Add new training program". You can add individual training sessions to this training framework with the "Add new plan" function. You can define the heart rate, EPOC level, duration, and other data for each training session. You can also define on which day, counting from the beginning of the training period, the training session in question should be performed. Once the program is ready, move it to the calendar to start on a suitable date.

TRANSFERRING TRAINING DATA AND TRAINING PROGRAMS

If you wish to send training sessions you have recorded and training programs you have created to others, open a folder and, select the desired session or program by clicking it with the right mouse button. Save it in a separate file by selecting "Export to file". You can then send this file in e-mail, for example, to your coach or your training partners. Correspondingly, by right-clicking a folder and selecting "Import from file", you can load training files sent to you by others.

SUUNTOSPORTS.COM

www.suuntosports.com is a web site intended for all users of Suunto sports instruments. There you can compare your performance in sports with those of others, share your experiences with other users, and find useful information for your own training. In the future, suuntosports.com will feature training programs, suited for different goals, that you can download from the site and insert in your own calendar.

GLOSSARY

ACSM	American College of Sports Medicine. A sports medicine organization in the USA.
Activity level	The amount of a person's average previous exercise.
Aerobic	Occurring only in the presence of oxygen.
Aerobic threshold	The highest level of exertion, where the body can still eliminate the generated lactic acid to such a degree that the lactic acid level does not rise above rest level.
Anaerobic	Occurring in the absence of oxygen.
Anaerobic threshold	The highest level of exertion, where the body can eliminate the generated lactic acid to such a degree that its level does not rise throughout the exercise.
Base endurance	A part of endurance describing the performance below the aerobic threshold.
Basic metabolism	Normal vital functions when the body is at rest.
EPOC	Excess Post-exercise Oxygen Consumption. Oxygen consumption exceeding rest level after exercise.
%HR_{max}	The level of the heart rate compared to a person's maximum heart rate.
%HRR	The level of heart rate reserve (HRR). Heart rate reserve is obtained by subtracting a person's maximum heart rate from his resting heart rate.
Intensity	The level of an exercise compared to a person's maximum performance level. Can be determined e.g. from heart rate, VO_2 or breathing variables.
kcal	Kilocalorie, a unit of energy. 1 kcal = 4.19 kilojoule (kJ), one gram of fat contains 9,0 kcal = 37,7 kJ of energy.
Lactate	A metabolic product generated by the body during physical exertion, lactic acid.
Lactic acid	See lactate.

Maximum heart rate	The highest heartbeat frequency, beats per minute. Often calculated based on age, using the ACSM -recommended formula, 210 - 0.65 x age. Maximum heart rate is very individual and can differ from the formula by as much as dozens of beats.
Maximum performance	The highest amount of power a person can produce.
MET	Metabolic equivalent, the oxygen consumption caused by basic metabolism (3.5 ml/kg).
ml/kg	Milliliters per kilogram of weight. A unit that describes, for example, the amount of excess post-exercise oxygen consumption (EPOC).
ml/kg/min	Milliliters per kilogram of weight per minute. A unit that describes, for example, the body's current oxygen consumption.
Training effect	The effect an individual exercise has on a person's performance level, defined by comparing the EPOC measured from the exercise to the person's activity level.
Ventilation	Lung ventilation, the volume of breathed air in liters per minute.
Vital capacity	The functional volume of the lungs. The largest volume of air a person can blow out of their lungs.
VO_2	Oxygen consumption. The amount of oxygen consumed by the body, measured either as an absolute amount (l/min) or proportioned to a person's weight (ml/kg/min).
VO_{2max}	Maximum oxygen intake capacity. The amount of oxygen that a person's body can take into use from breathed air during maximum performance. Measuring unit ml/kg/min or MET.
$\%VO_{2max}$	The level of the oxygen consumption during exercise compared to a person's maximum oxygen intake capacity.

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ADDITIONAL INFORMATION

Suunto t6:
www.suuntot6.com
www.suunto.com
www.suuntosports.com

Heart rate analysis and scientific sources:
www.firstbeattechnologies.com

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