



Here's To Your Health!

A Phoenix Fire Department Health Center Publication

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This February issue of *Here's To Your Health* is dedicated to providing information on aerobic base conditioning. There is much confusion about aerobic conditioning and anaerobic conditioning. While any exercise is certainly beneficial, it benefits the person exercising to have a clear understanding of why they are exercising and how they should be exercising. Here are some definitions that must be presented prior to understanding the remaining information:

Aerobic – with, or in the presence of, oxygen

Anaerobic – without the presence of oxygen.

Aerobic system – the metabolic pathway that, in the presence of oxygen, uses glucose for energy production; also known as aerobic glycolysis.

Anaerobic threshold – the point during high-intensity activity when the body can no longer meet its demand for oxygen and anaerobic metabolism predominates. Also called lactate threshold.

Why Training Lowers Heart Rate

Resting heart rate varies widely from athlete to athlete. A low heart rate is advantageous because it usually reflects a strong and highly efficient heart. A heart with a lower rate uses less energy than a heart with a faster rate if both pump the same amount of blood per minute.

Like heart rate, cardiac output (the amount of blood pumped per minute) at rest varies from person to person; but in general, a large person will have a greater resting cardiac output than a small person, and people of comparable size will have comparable cardiac outputs. In a trained person, resting heart rate declines as aerobic fitness increases; thus, the stroke volume must increase to maintain a consistent cardiac output.

A lower heart rate offers a physiological advantage. During an endurance event, a highly trained athlete's heart rate range (the difference between the lowest heart rate and the highest rate for any one person) is expanded. If your resting heart rate is low, your heart works more efficiently to pump more blood with each beat. Because of this, your heart may not have to reach as high a rate as that of someone who is less trained in order to perform a given activity. Or, it takes longer to reach the maximum exercise heart rate.

The underlying mechanisms that control the heart rate and stroke volume changes are not fully understood. The resting heart rate declines somewhat after only a few weeks of endurance training. The reduced heart rate allows a longer rest between beats, and more blood enters the ventricles (the chambers of the heart that pump the blood). This larger amount of blood stretches the heart muscle and leads to a stronger contraction and a greater ejection of blood. Eventually, as a result of prolonged endurance training, the heart becomes larger and stronger, and the heart rate decreases further.

At a given workload, the lower the heart rate, the higher the stroke volume, and the more aerobically fit the person. Thus the resting heart rate can be used as a general indicator of aerobic fitness. A better measure, however, is the heart rate at sub maximal or maximal exercise. Training lowers the heart rate response during a standard amount of exercise. To get an accurate assessment of a person's fitness level, a standard sub maximal or maximal exercise test must be carried out either in a laboratory or in the field under controlled conditions.

Source: Edmund R. Burke, PhD, Precision Heart Rate Training, Human Kinetics Publishers, Inc., 1998

Aerobic Training

The aerobic zone, 70 – 85 percent of your maximum heart rate, is the standard training zone that for years has been referred to as “the target heart rate zone,” since it is the most popular intensity for general fitness. This is often the fastest pace you can maintain and still remain comfortable and talk while exercising. It is called the steady state zone, as it is the fastest pace you can maintain for long periods of time (for most people). Lactic acid does not build up in this zone.

Aerobic Training continued on page 2

Anaerobic Training

At 90-100 percent of your maximum heart rate, you have gone beyond your lactate (anaerobic) threshold and will be operating at a large oxygen deficit, meaning that your muscles will not be able to deliver the amount of oxygen they need to complete the work. Lactic acid will develop very quickly. Your body can tolerate efforts in this area of the zone for short periods of time.

Anaerobic Training continued on page 2

Aerobic Training continued

When you are unfit, your muscles will choose carbohydrate as their primary fuel, stored as glycogen in your muscles, during exercise at this intensity. As you become more fit, your body selects an increasing percentage of fat as its fuel, allowing you to race longer at this intensity while saving your limited stores of glycogen.

There are several benefits of training in this zone:

1. It improves endurance.
2. It “familiarizes” your body with a faster pace.
3. It begins to raise the speed you can maintain without building up lactate.

Anaerobic Training continued

There are two major benefits of training in this area of the zone:

1. It increases your muscles’ tolerance to very large amounts of lactic acid.
2. It helps improve your sprinting and hard, short-effort ability.



Discount Coupon on page 4

Aerobic vs. Anaerobic Training

The type of exercise you do dramatically effects how your heart responds to situations where you must exert yourself. If you do only anaerobic training (very high heart rate) you essentially are training your heart to respond to workloads and/or exercise with a high heart rate. So even when you are doing something that you perceive is not very hard (light jogging, fast walking, our treadmill test) your heart will be responding the way it has been trained, with a high heart rate.

If you exercise to build an **aerobic base** (70%-85% of your maximum heart rate) you are training your heart to respond to workloads and/or exercise with a gradual heart rate increase, which is obviously healthier. A good aerobic base will prolong the time it takes you to become anaerobic since more blood is pumped with each contraction resulting in fewer beats per minute to achieve the necessary oxygen delivery. In addition, when anaerobic conditions are encountered, a good aerobic base results in a lower peak heart rate.

On the flipside, anything less than 60 percent of the maximum heart rate usually benefits beginners and/or those recovering from an injury.



Lastly, there is a time and a place for anaerobic training. Doing the mountain, stadiums, wind sprints...are very good exercises to teach your heart to work in an anaerobic capacity. But you should first build an aerobic base, and then work in the anaerobic. As the “Worlds Fittest Man” and six time Triathlete of the Year writes; “the improvement you can get in performance from developing your aerobic fat burning system is huge compared to the improvement in performance you can get from doing the high-end anaerobic carbohydrate burning workouts. And our bodies cannot develop both systems very well at the same time. Which means that to build a base properly, an athlete has to have the patience to work the aerobic system exclusively for a huge block of time.”

This base building could be as short as a three-month period.

How and Why Train for an Aerobic Base

As firefighters, our job demands that we stay fit year round. Having muscular strength and endurance is important, but the number one killer of firefighters is cardiovascular. According to the NFPA study conducted from 1996 – 2005 “U.S. Firefighter Deaths Related to Training,” 53% of all fatalities were “sudden cardiac death” in **nature**, and 62% of all fatalities were “stress and overexertion” in cause.

How we exercise is just as important as why we exercise. The test we do at the Health Center is a measure of your cardiac fitness based on the length of time it takes you to get to a calculated heart rate based on your age. The intensity and workload is the same for everyone that steps on the treadmill. The only thing that changes is the target heart rate. The longer it takes you to get to that target heart rate, the more efficient your heart is.

To build an aerobic base, simply exercise at 70-85 percent of your maximum heart rate a minimum of 30 minutes, 3 times a week. You must be in your target heart rate for 30 minutes or longer. To calculate your maximum heart rate follow this equation: $208 - (.7 \times \text{age}) = \text{Maximum Heart Rate}$.

World Champion Triathlete Mark Allen describes base training and its importance on the following article.

Base training by Mark Allen

You can either try to race with an engine the size of a lawnmower, or you can build your engine up with a good base so that you are racing with a huge-turbo charged jet engine. There are many factors that will influence your racing. Nutrition, tapering, speed work, rest, and mindset are some of them. But the biggest physical factor is the base you build in the beginning of the season. A good base period when you develop your body's ability to burn stored fat for fuel is what determines the size of the internal engine that the other things have to work with. A well-designed base period enables you to take good nutrition, speed work, rest, and positive thoughts and transform them into your best race possible. The choice is yours. You can either try to race with an engine the size of a lawnmower or you can build your engine up with a good base so that you are racing with a huge-turbo charged jet engine. The catch is that most people do not have the patience to build a base correctly. The reason is that for the first 12 weeks or so of your season, you will have to strap on a heart rate monitor and put your ego aside. What the heart rate monitor will signal to you is when you are working out at heart rates that are aerobic (fat burning). These are in the lower training zones well below your maximum heart rate. The higher heart rates are anaerobic (carbohydrate burning) and shouldn't come until your base has been built. The reason is that the improvement you can get in performance from developing your aerobic fat burning system is huge compared to the improvement in performance you can get from doing the high-end anaerobic carbohydrate burning workouts. And our bodies cannot develop both systems very well at the same time. Which means that to build a base properly, an athlete has to have the patience to work the aerobic system exclusively for a huge block of time.

But before we go any further, let me give you a formula that you may have seen before. It is one that will help you determine what the upper limit of your aerobic training zone is.

1. Take 180

2. Subtract your age

3. Take this number and correct it by the following:

-If you do not workout, subtract another 5 beats.

-If you workout only 1-2 days a week, only subtract 2 or 3 beats.

-If you workout 3-4 times a week keep the number where it is.

-If you workout 5-6 times a week keep the number where it is.

-If you workout 7 or more times a week and have done so for over a year, add 5 beats to the number.

-If you are over about 55 years old or younger than about 25 years old, add another 5 beats to whatever number you now have.

-If you are about 60 years old or older OR if you are about 20 years old or younger, add an additional 5 beats to the corrected number you now have.

The number you now have is the upper heart rate limit that you can work out at and still develop your aerobic system. This is the heart rate that will build the size of your engine. Now back to the catch!

In the beginning of the season just about everyone will have lost a lot of their aerobic base, especially if in the season before you did little aerobic and mostly anaerobic training. What this means in your workouts is that you have very little ability to burn fat as a source of fuel for exercise and your heart rate will jump up very high at a relatively slow pace in an attempt to kick your metabolism into carbohydrate burning. And to keep from going over your aerobic limit you will have to slow your pace down, often significantly. This is where most athletes do not have the patience to stick with the aerobic training. You may have to slow down several minutes per mile from your normal everyday training pace just to keep your heart rate from going above the aerobic maximum. Your perceived effort can be very, very low while you are developing your aerobic engine. And this is when one's patience is tested. Workouts will feel the opposite of the mentality that says training should be painful and muscles need to burn to get benefit. This may be true later during the speed phase of the season. But right now, this is absolutely not correct. You will be getting huge benefit that will show up months down the road.

When I started back each season, I had always lost a lot of my aerobic capacity. This meant that I had a small internal engine. During those first few months of training, I would literally have to walk up even the easy hills on my runs to keep my heart rate from going too high and kicking my body into carbohydrate metabolism. But slowly, over those next 12 weeks, my body would develop the enzymes necessary to break down stored fat for energy and my pace would speed up. And by the time it came to do my interval training, I was able to run close to a 5:30 mile at my aerobic maximum heart rate of 150!

No triathlete has gained the recognition or success that Mark Allen has. After competing and losing in the Ironman Triathlon Championships six times, he emerged victorious in 1989, winning the most difficult one-day sporting event in the world.

It would be the first of six Ironman victories for Allen, the last coming in 1995 at age 37, making him the oldest champion ever. He has also excelled at the Olympic distance, winning the sport's inaugural World Championships in 1989 in Avignon, France, by more than a minute. He went undefeated in 10 trips to the Nice International Championships, and from 1988-1990 he put together a winning streak of 20 races.

Over the course of his racing career, which ended in 1996, he maintained a 90% average in top-three finishes. He was named Triathlete of the Year six times by Triathlete magazine, and in 1997 Outside magazine tabbed him The World's Fittest Man.

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