

# FIGHTING FIT

By Leith Darkin

(Sep 2003)

## ABSTRACT

In this article we are going to look at the various components of fitness (aerobic/anaerobic) that are involved in combat sports as well as a brief overview of muscle fiber types and energy systems to help combatants put together effective training programs specific to their needs.

When we look at increasing our level of fitness, we tend to think about heart/ lung function (the cardiorespiratory system). The lungs being able to take in oxygen, the heart being able to transport oxygen around the body to the working muscles then gathering carbon dioxide for the return journey back to the lungs where it is expelled. When improving heart/lung function we look at increasing the strength of the heart muscle so that it can expel more blood with each contraction (stroke volume) and in turn circulate more blood and oxygen around the body to the working muscles. Although heart/lung function is a very important component of fitness, activities that require strength and power (working at higher intensities) require more than heart lung function for muscle fibers to be able to continually apply force at maximal or near maximal intensity.

When looking at Martial Arts, we have two subcategories, striking and grappling. In striking, the majority of combat revolves around power (strength with a speed component). The outcome here is to direct force away from your body at your opponent. In grappling, combat revolves around strength (to physically restrain and control your opponent or to apply force on limbs to manipulate joints) and power (strength with a speed component) to apply force rapidly to shoot (tackle your opponent to the ground), throw, escape, submit etc.

When looking at improving our fitness levels to be able to continually apply force for striking and grappling we need to look at

- 1) The three main types of muscle fibers and their characteristics.
- 2) The energy systems needed to fuel each of the three muscle fiber types.
- 3) To identify the muscle fibers and energy systems that are predominately involved when in your form of combat (striking and or grappling).
- 4) Then to specifically train the individual muscle fibers involved so as to bring about the specific biological changes needed to fuel the muscle fibers to apply force at higher intensities and or longer durations.

## TYPES OF MUSCLE FIBERS

### Type I Fibers (Slow Twitch Fibers)

The main characteristics of these fibers are they are red in color due to their high concentration of blood capillaries, this results in greater blood supply and in turn greater oxygen supply to the working muscles. Type I fibers are able to contract for long durations at low to medium intensities.

## Type II Fibers (Fast Twitch Fibers)

The main characteristics of these fibers are, they are white in color as they have lower concentrations of blood capillaries than type I fibers and they are able to contract at higher intensities over shorter durations.

Our type II fibers can be broken down into two sub categories.

Type IIa fibers, which contract at medium to high intensities over a medium to short duration.

Type IIb fibers, which contract at high intensities over a short duration.

Our type IIa fibers are best suited to contract at medium to high intensity over a short to medium duration (e.g. 400-meter or 800-meter track). However our type IIa fibers are also known as fence sitters, if your sport is predominantly aerobic in nature (which is low in intensity over a long duration, utilizing our aerobic energy system) then your type IIa fibers will over time go through biological changes which will give them the characteristics of type I fibers (slow twitch). If your sport is a power dominated sport such as a 100-meter sprint, which is very high in intensity over a short duration, your type IIa fibers will go through biological change, which will give them the characteristics of type IIb fibers. As a result of your type IIa fibers being able to adapt to support your type I and type IIb fibers, it is very important that you apply the training principle of specificity to your training. As competitive Martial Arts is generally strength based, speed based or a combination of both (power based) it is very important that you keep away from regular low intensity work done over long durations to build fitness such as running, cycling, swimming etc. This type of training will encourage your type IIa fibers to go through biological change to assist your type I fibers, which will contribute to minimizing your strength, speed and power potential and in turn be of detriment to your sporting performance.

## Applying Force

When our muscles apply force for any activity, our nervous system first recruits our type I fibers. If the intensity of the force required to complete the activity is low, then our type I fibers will be sufficient.

If the force required to complete the activity is greater than the force our type I fibers can produce, our type IIa fibers will also come into play to assist our type I fibers.

If the force required to complete the activity is greater than our type I and type IIa fibers can produce working together, then our type IIb fibers will come into play to assist our type I and IIa fibers.

## Muscle Fiber Types & Genetics

Our genetics will largely determine which sports we will excel at. You'll find that athletes that have higher percentages of "slow twitch" muscle fibers are more likely to excel in long distance endurance events such as triathlons and marathons, where as athletes that have higher percentages of "fast twitch" muscle fibers are more likely to excel in strength and power dominated sports such as discus, high Jump, 100 meter sprint, weightlifting etc.

In "striking" forms of Martial Arts we often see fighters with high win ratios, however their win ratio from "knockouts" may be low, although this could be partly due to the fighter not reaching their full power potential, more often than not you'll find that it comes down to "genetics" (the fighters ratio of fast twitch to slow twitch muscle fibers). When looking at fighters such as Mike Tyson (boxing), BJ Penn (MMA) and Gurkan Ozkan (kickboxing) who are very strong, fast and powerful individuals, their fights nearly always end in "knockouts", more than likely they have much higher percentages of "fast twitch" muscle fibers than their counterparts whom still have high win ratios, however a higher percentage of their wins come from the judges decision.

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## ENERGY SYSTEMS

ATP is always present in your muscle cells – and indeed in all the living cells in your body; without it your cells would quickly stop working and die. Because it supplies energy to all cells, ATP is often called the universal energy donor, but a better label would be the body's "primary energy currency".

(Anderson O. 2003/Peak Performance No 181 pg. 1)

Energy is created when ATP (adenosine triphosphate) is broken down to ADP (adenosine diphosphate), our three energy systems are three different pathways to rebuilding ATP from ADP.

Each of our three main muscle fiber types have their own unique characteristics enabling them to respond better to certain energy systems, this allows our different muscle fiber types to contract optimally under specific conditions.

### AEROBIC ENERGY SYSTEM

Our type I fibers are largely fueled by our "aerobic energy system".

Our "aerobic energy system" burns fats and carbohydrates in the presence of oxygen.

At very low intensities our "aerobic energy system" burns predominantly stored body fat, (fats + oxygen + ADP = carbon dioxide + ATP + water)

At low to medium intensity our "aerobic energy system" burns stored body fat and carbohydrates as fuel in the presence of oxygen.

At medium intensity our "aerobic energy system" burns predominantly carbohydrates as fuel in the presence of oxygen, this happens in 2 phases.

Phase 1 (Glucose + ADP = Lactic Acid + ATP) The lactic acid produced in phase 1 is the broken down in phase 2 in the presence of oxygen.

Phase 2 (lactic acid + oxygen + ADP = carbon dioxide + ATP + water).

### LACTATE ENERGY SYSTEM

Our type IIa fibers are largely fueled by our "lactate energy system" and burns carbohydrates as fuel (glucose + ADP = lactic acid + ATP). Our intensity is medium to high which means our body can't supply enough oxygen to maintain the second phase of our aerobic energy system (lactic acid will no longer be metabolized as quickly as it is being produced), resulting in an accumulation of lactic acid, eventually blood lactate levels will rise to levels where our intensity can no longer be maintained.

### ATP – PC ENERGY SYSTEM

Our type IIb fibers are largely fuelled by the "ATP-PC energy system" and like our "lactate energy system" it burns carbohydrates as fuel without the presence of oxygen, however no lactic acid is produced when solely utilizing the "ATP-PC energy system" (PC + ADP = ATP + creatine).

With in our type IIb fibers are stores of phosphocreatine (PC), these stores of phosphocreatine are used to rebuild ATP, this rebuilding of ATP allows our type IIb fibers to contract optimally at high intensities for approximately eight seconds. Once our PC stores become depleted our intensity drops as there is no longer fuel for our type IIb fibers to contract optimally, once this happens, maximal force comes from our type IIa fibers with assistance from our type I fibers, maintaining intensity will now result in the accumulation of lactic acid.

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## Duration of energy systems

If the intensity of our training stays constant and at a level to solely utilize our “aerobic energy system”, at a level where we are burning predominately carbohydrates we would generally have enough fuel for 60-90 minutes of training.

If the intensity of our training stays constant and at a level to solely utilize our “lactate energy system”, we would have enough fuel to last 45-60 seconds of training.

If the intensity of our training stays constant and at a level to solely utilize our “ATP-PC energy system”, then we would have enough fuel to last 6-8 seconds of maximal effort.

When training and competing we rarely work at levels that solely utilize only one energy system. This is because more often than not the intensity that we are working at often changes, this is especially true for competitive Martial Arts.

In competitive Martial Arts we generally utilize both the “ATP-PC energy system” and the “lactate energy system”. Our maximal efforts to throw strikes, execute shoots, throws, escapes and applying rapid force for submissions utilizes our “ATP-PC energy system”. Our submaximal efforts such as moving around, throwing scoring strikes (as opposed to knockout strikes), lightly restraining and controlling opponents will generally utilize our “lactate energy system” and depending on the intensity will use a combination of our “lactate” and “aerobic” energy systems.

## Recovery of Energy Systems

Our carbohydrate stores used to fuel our “aerobic energy system” will take approximately 24-36 hours to fully recover if they have been depleted, this may occur in a 60-90 minute training session that consist of medium to high intensity work loads. The likelihood of competing in combat over duration of 60-90 minutes is very small these days however it still occasionally happens (Royce Gracie v Kazushi Sakuraba May 2000 “Pride Fighting Championships”, fight went for 6x15 minute rounds).

Our “lactate energy systems” recovery is more dependent on our body’s ability to remove lactic acid as apposed to replenishing fuel stores for muscle contractions. Our bodies ability to remove lactic acid and fully recover so another maximal effort can be applied depends on how high blood lactate levels reached during the previous effort/efforts. Looking at a worse case scenario where you pushed your body to failure (where blood lactate levels rise to the point that you physically can no longer continue) it would take 25 minutes to remove 50% of the accumulated lactic acid and 75 minutes to remove 100% of accumulated lactic acid.

If blood lactate levels rise too high, lactic acid can damage the walls of the cells within the muscle fibers and damage the “enzyme system” responsible for generating aerobic energy. It can take anywhere from 24-96 hours to fully recover from such damage (Janssen P. 2001/Lactate Threshold Training Pg. 6)

Our ATP-PC energy system will reach 70% recovery in 30 seconds and 100% recovery in 3-5 Minutes

## TRAINING METHODS

When it comes to training there are three methods we can use to bring about the biological changes needed to apply force optimally.

### CONTINUOUS TRAINING

- 1) Continuous training is training that is low to medium in intensity and usually done over a medium to long duration (30-180 minutes). This type of training would utilize your aerobic energy system e.g. Long distance running, long distance swimming, long distance cycling etc.

### FARTLEK

- 2) Fartlek training is similar to continuous training with varying intensities. The duration of a Fartlek session and the intensities reached during bursts of maximal or near maximal efforts will depend on the requirements of your particular combat, your current training phase and what you are aiming to achieve in your training session. Maximal efforts will utilize your "ATP-PC energy system", near maximal efforts will utilize your "lactate energy system". In between bursts of maximal or near maximal effort you will go back to utilizing your "aerobic energy system", which will give your "ATP-PC energy system" time to replenish (or partly replenish depending on the duration of your low intensity activity), this will also give your body a chance to remove some of the accumulated lactic acid. Fartlek training is identical to the way that the majority of grappling contests are performed and therefor is a great training tool for grapplers.

### INTERVAL

- 3) Interval training is made up of rounds of varying intensities and durations with regular rest periods in between. The intensity reached, the duration of the rounds and the rest periods in between rounds will generally depend on the requirements of your particular type of combat (e.g. how many rounds in a contest, duration of rounds & rest period between rounds), your current training phase and what you are aiming to achieve in your training session. The rest period between rounds will give your "ATP-PC energy system" time to replenish or partly replenish. The rest period will also give your body time to remove some of the lactic acid accumulated over the previous round or rounds. Interval training is identical to the way that the majority of striking contests are performed and therefor is a great training tool for strikers.

## BIOLOGICAL CHANGES & ENERGY SYSTEMS

The duration of your particular form of combat, the intensities reached during combat and the rest periods between rounds (if applicable) are all contributing factors when looking at.

- a) The types of muscle fibers recruited to apply force.
- b) The energy systems needed to fuel the muscle contractions
- c) The types of training methods used to bring about the specific biological adaptations needed to apply force optimally for your particular form of combat.

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## ATP- PC ENERGY SYSTEM

All forms of combat will largely utilize your type IIb fibers (with assistance from your type I & type IIa fibers) when applying maximal force to strike, defend, restrain, control or submit your opponent, this in turn puts a huge reliance on your "ATP-PC energy system".

### TRAINING METHODS FOR ENHANCING YOUR ATP- PC ENERGY SYSTEM

#### MAXIMAL ALACTIC ANEROBIC TRAINING

This training is designed to generate absolute maximal power. The duration of this exercise is 5-20 seconds. The rest period must be such that a maximal speed effort can be repeated. Whilst lactic acid will be produced, this training is designed to minimize its build-up and allow time for its removal. The training adaptation is likely to be. (Pyke F.S. 1991/Better Coaching pg. 126)

- 1) 25-50% increase in ATP-PC stores.(This can occur over a 7 month period of specific training 3 times a week)  
(Janssen P. 2001/Lactate Threshold Training pg. 2)
- 2) An increase in the production of enzymes that break down and rebuild ATP. This results in a faster breakdown of ATP, which in turn will release energy more quickly. (This can occur over an 8 week period of specific training)  
(Janssen P. 2001/Lactate Threshold Training pg. 2).
- 3) Increased recruitment of motor units and neuro-muscular coordination during all out efforts.  
(Pyke F.S. 1991/Better Coaching pg. 126)

In addition "creatine" supplementation, when done correctly will increase the amount of creatine within the muscle cells. Phosphate molecules will adhere to the extra creatine, this will result in a more abundant supply of PC to re synthesize ADP into ATP.

(For further information on "creatine" click on "Articles" then click on "Nutrition" Then click on "fact sheets" then click on "creatine supplementation and sport performance").

#### STRIKING

When applying this form of training to striking Martial Arts you would initially warm up with a specific low intensity warm up of around 5-10 minutes (a warm up that would replicate the type of work about to be undertaken), you would then work on a particular kick, punch or knee strike or maybe a set combination of several strikes on a punching bag, each strike would be addressed with absolute maximal effort/power with no rests between each strike over a 5-20 second interval. You would address a series of intervals (6-10) of around 5-20 seconds each, with rest periods of around 3-5 minutes between each interval.

## GRAPPLING

When applying this form of training to grappling Martial Arts would initially warm up with a specific low intensity warm up of around 5-10 minutes (a warm up that would replicate the type of work about to be undertaken), you would then position yourself under your opponents "mount" or "side mount", then using absolute maximal effort/power to bridge, buck, push and throw your opponent off you over a 5-20 second interval. You would address a series of intervals (6-10) of around 5-20 seconds each, with rest periods of around 3-5 minutes between each interval. This type of training would be more effective if your opponent was considerably heavier than yourself.

## LACTATE ENERGY SYSTEM

If your PC stores used for fueling your type IIb fibers become depleted, then your type IIb fibers will no longer be able to contribute to force application, resulting in a drop of intensity. The maximal amount of force you can produce now will largely come from your type IIa fibers with assistance from your type I fibers. ATP will be produced via your "lactate energy system" to fuel your type IIa fibers to contract. If your PC stores used to fuel your type IIb fibers weren't depleted and the amount of force you decided to use to strike, defend, restrain, control or submit your opponent was only near maximal, then the majority of force would again come from your type IIa fibers with assistance from your type I fibers. If the intensity of the force you are applying is enough to keep blood lactate levels below 3-5 millimoles per liter, then lactic acid will be metabolized as quickly as it is being produced, If blood lactate levels rise above 3-5 millimoles per liter then the lactic acid that is being produced will start to accumulate and spill over into your blood stream where it will be pumped around the rest of your body. Lactic acid is the true opponent of most competitive Martial Artists, intensities reached during maximal effort when PC stores become depleted or near maximal effort where we utilize our lactate energy system to attack or defend will instantly start to produce a surplus of lactic acid. The amount of force you apply will govern how much blood lactate levels rise and as careful as you may be to pace yourself to keep blood lactate levels manageable, the opportunity to possibly finish off your opponent or the pressure your opponent can place on you can quickly get you out of your comfort zone allowing blood lactate levels to rise to the point where your intensity has to drop. This makes it hard to launch a serious offensive attack or to adequately defend yourself, or even worse putting you into a state of fatigue making it easier for your opponent to finish you off.

## TRAINING METHODS FOR ENHANCING YOUR LACTATE ENERGY SYSTEM

### LACTIC TOLLERANCE TRAINING

This training challenges the athlete to continue to work at a high to medium intensity during a period in which lactic acid build-up forces muscle and blood pH down. The likely training adaptation is a development of "tolerance" to the low pH by

- A) Increased "buffering" (or neutralizing) of acid in the muscle and blood.
  - B) Increasing the psychological capacity to work a given perceive discomfort level.
- (Pyke F.S. 1991/Better Coaching Pg. 126)

### **SINGLE- EFFORT- INDUCED TOLERANCE WORK**

In this type of training, lactic acid is accumulated during the first part of the effort and "tolerated" for the latter. An example would be an "all-out" 150-m swim, The last 75-m or so would be swum as the pH of the muscles become very low, as it would be in the last 200 m of a 600-m run. A long recovery is required in order to repeat the same intense effort and encourage a repetition of this lactic acid build-up during the following effort.

(Pyke F.S. 1991/Better Coaching Pg. 126).

### **STRIKING**

When applying this form of "interval training" to striking, you need to look at the duration of the round/rounds fought in a contest.<sup>8</sup>

If your round/rounds were 1 minute in duration, then your training tool would be a near maximal effort (95%) on the bag for one minute.

With 1-minute rounds you would be looking at 6 repeats/rounds.

(Pyke F.S. 1991/Better Coaching Pg. 127).

Rest intervals would be 2-3 minutes between rounds.

(Pyke F.S. 1991/Better Coaching Pg. 127).

If your round/rounds were 2 minute in duration, then your training tool would be a near maximal effort (95%) on the bag for the first 60 seconds, then one would attempt to work at the highest possible work rate on the bag for the later 60 seconds.

With 2-minute rounds you would be looking at 4 repeats/rounds.

(Pyke F.S. 1991/Better Coaching Pg. 127).

Rest intervals would be 3-5 minutes between rounds.

(Pyke F.S. 1991/Better Coaching Pg. 127).

If your round/rounds were 3 minute in duration, then your training tool would be a near maximal effort (95%) on the bag for the first 60 seconds, then one would attempt to work at the highest possible work rate on the bag for the later 120 seconds.

With 3-minute rounds you would be looking at 4 repeats/rounds.

Rest intervals would be 3-5 minutes between rounds.

(Pyke F.S. 1991/Better Coaching Pg. 127).

### **GRAPPLING**

When applying this method to "grappling", one would ideally work in defense (under your opponents mount or side mount) with a heavier opponent, as this will help to increase the intensity. The duration of your training interval would be ideally 2 minutes where you would work at a near maximal effort (95%) to bridge, buck, push and throw your opponent off you for 60 seconds, you would then attempt to work at the highest possible work rate bridging, bucking, pushing and throwing your opponent off you for the later 60 seconds.

With 2-minute rounds you would be looking at 4 repeats/rounds

(Pyke F.S. 1991/Better Coaching Pg. 127).

Rest intervals would be 3-5 minutes between repeats/rounds.

(Pyke F.S. 1991/Better Coaching Pg. 127).

### **MULTIPLE- EFFORT- INDUCED TOLERANCE WORK**

This involves a series of repeats that are not as fast, nor over as great a distance, as single effort tolerance work. The effort is still near maximal, but a carry-over of unmetabolised lactic acid from one effort to the next reduces speed. The lactic acid levels in the blood typically do not achieve quite as high a concentration as in "single-effort-induced tolerance work", but they do not fall as low between the repeats.

<sup>8</sup> Copyright Leith Darkin (Sep 2003)

(Pyke F.S. 1991/Better Coaching Pg. 126).

This is another form of interval training, the main difference between this and “single-effort-induced tolerance work” is the rest period between intervals is shorter (30 seconds as apposed to 2-5 minutes).

In “single-effort-induced tolerance work” the rest period is long enough to repeat the same effort in the next interval/round, where in “multiple-effort-induced tolerance work” the rest period is considerably shorter, allowing for unmetabolised lactic acid to effect the quality of the next interval/round.

## STRIKING

When applying this training method to “striking” you need to look at the duration of the round/rounds fought in a contest.

If your round/rounds were 1 minute in duration, then your training tool would be a near maximal effort on the bag for one minute.

Ideally your heart rate would reach 190-200 bpm.

(Pyke F.S. 1991/Better Coaching Pg. 127).

With 1-minute rounds you would be looking at 8 repeats/rounds.

(Pyke F.S. 1991/Better Coaching Pg. 127).

Rest intervals would be 20-30 seconds between repeats/rounds.

(Pyke F.S. 1991/Better Coaching Pg. 127).

If your round/rounds were 2 minute in duration, then your training tool would be a near maximal effort on the bag for 2 minutes.

Ideally your heart rate would reach 190-200 bpm.

(Pyke F.S. 1991/Better Coaching Pg. 127).

With 2-minute rounds you would be looking at 6 repeats/rounds.

(Better Coaching Pg. 127).

Rest intervals would be 30 seconds between repeats/rounds.

(Pyke F.S. 1991/Better Coaching Pg. 127).

If your round/rounds were 3 minute in duration, then your training tool would be a near maximal effort on the bag for 3 minutes.

Ideally your heart rate would reach 190-200 bpm.

(Pyke F.S. 1991/Better Coaching Pg. 127).

With 3-minute rounds you would be looking at 4-6 repeats/rounds.

Rest intervals would be 30 seconds between repeats/rounds.

## GRAPPLING

You can apply this method to grappling in which case you would be looking at a similar scenario to the “single-effort-induced tolerance work” for grappling, with 6x2minute rounds of near maximal effort, with 30 seconds rest in between. However there is a form of “Fartlek” training (the lactate stacker), which will have a similar effect to “multiple-effort-induced tolerance work” and is more specific to grappling.

## THE LACTATE STACKER

It doesn't matter what sort of endurance athlete you are. Simply warm up and then go almost all out for 60 seconds. Work easily for 120 seconds, then return to an all out effort for 60 seconds. Continue in this 60-120 pattern until significant fatigue rears its head. (Anderson O. 2002/Peak Performance no 169 Pg. 4)

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## STRIKING

Although you could apply this form of “Fartlek” training to striking you would have to question as to whether you could spend your valuable training time, training in a manner more specific to striking. As all striking contests to my knowledge are either a short single round or a series of short rounds/intervals where you have a set rest period between rounds/intervals for recovery, your forms of interval training would be more specific to striking when building “lactic acid” tolerance.

## GRAPPLING

When applying this method of “Fartlek” training to grappling, one would ideally work in defense (under your opponents mount or side mount) with a heavier opponent, as this will help to increase the intensity. You would work at near maximal effort to bridge, buck, push and throw your opponent off you for the first 60 seconds. As soon as your 60 seconds is up you would quickly mount or side mount (offensively) another opponent the same weight as your self where you would attempt to control them for the next 120 seconds. As soon as your 120 seconds is up you would quickly revert back to an all out defense under a heavier opponent for 60 seconds. You would continue this 60-120 second pattern until exhaustion.

### PROBLEMS ASSOCIATED WITH HIGH LEVELS OF LACTIC ACID

- 1) High levels of lactic acid causes damage in and around your muscle cells, inside your muscle cells, lactic acid can cause damage the enzymes responsible for generating aerobic power resulting in a reduction of your aerobic endurance capacity.  
(Jansen P. 2001/Lactate Threshold Training pg. 6-7)
- 2) High levels of lactic acid causes a disturbance in your coordination capacity, this is very important for sports that require technical skill (e.g. all forms of combat). This means that the development of offensive and defensive skills should never be attempted after or during training where blood lactate levels rise above 6-8 millimoles per liter (the point where lactic acid is no longer metabolized as quickly as it is being produced).  
(Jansen P. 2001/Lactate Threshold Training pg. 6-7)
- 3) High levels of lactic acid enhances the risk of injury.  
(Jansen P. 2001/Lactate Threshold Training pg. 6-7)

Because of the problems associated with high levels of lactic acid, it is recommended that you perform no more than 2 sessions a week (ideally with 3 rest days between sessions) where high levels of lactic acid are achieved.

Some authors suggest that even 2 sessions a week could be too much.

(Jansen P. 2001/Lactate threshold Training pg. 20).

Such heavy exercise should always be followed by very light workouts or recovery workouts.

(Jansen P. 2001/Lactate threshold Training pg. 20).

## AEROBIC ENERGY SYSTEM

When looking at training our “aerobic energy system” to supply fuel for our various forms of combat, it is very important we apply our principle of training “specificity”.

The intensities reached during combat are high and the duration of most contests (or rounds during contests) are short, therefore it would be inappropriate to train our “aerobic energy system” with sessions that were low in intensity and long in duration.

There are two main biological changes (within our muscles) we can achieve with the right training that will enable us to work at higher intensities without lactic acid causing us to slow down or fail.

- 1) An increase in our muscles ability to absorb and utilize more oxygen.
- 2) An increase in our “anaerobic threshold” or “ANT” (the point where lactic acid starts being produced in a quantity that is greater than it can be metabolised)

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## TRAINING METHODS FOR ENHANCING OUR AEROBIC ENERGY SYSTEM

### THE VELOCITY VO<sub>2</sub> MAX SESSION

Whether you are an endurance rower, runner, cyclist, swimmer, skier, or race walker, you can compute your “velocity VO<sub>2</sub> max” by going as far as you can in six minutes. The pace you establish over this 6-minute period is then your velocity at VO<sub>2</sub> max, one of the most powerful predictors of endurance performance. Once you have estimated your “velocity VO<sub>2</sub> max”, the workout you should use for “velocity VO<sub>2</sub> max” is straightforward: just warm up and complete 5x3-minute work intervals at your calculated “velocity VO<sub>2</sub> max”, with 3-minute recoveries. The workout is great for improving “velocity VO<sub>2</sub> max”, Lactate threshold (ANT), efficiency at close to VO<sub>2</sub> max paces, strength, power, and psychological courage and confidence during intense effort. (Anderson O. 2002/Peak performance no 169 Pg. 4)

### STRIKING

When applying this training method to striking, we need to slightly change the protocol to make it more appropriate and specific to striking. Our striker is fitted with a “heart rate monitor” while the trainer holds the “heart rate monitor watch”, the striker then goes about striking a punching bag, ideally in a set rhythm (the idea behind striking in a set rhythm will help to maintain a more consistent HR). Our goal here will be to determine the maximal HR that we can consistently maintain over our six-minute period. This HR will then become the equivalent to our “velocity VO<sub>2</sub> max”. When performing this test it is important that the striker is adequately rested beforehand (ideally 24-36 hours rest). Once you have established your training HR, you would go about your 5x3 minute rounds with 3-minute recoveries. You would complete your training intervals with your HR monitor on, working at your training HR, your trainer would be holding your HR monitor watch, giving you constant feed back on your HR.

The test to establish your training HR should be repeated every 2-3 months to re establish your training HR, if your training HR increases then your “ANT” has increased.

### GRAPPLING

When applying this training method to grappling, we have the problem of finding the appropriate training stimulus. The above mentioned sports rowing, running, cycling, swimming and skiing are all close chain sports (no out side influences) therefore it is easy to consistently maintain a constant pace or rhythm resulting in a constant HR. Although striking is an open chain sport (outside influences/opponent that have an effect on your performance) we can take away the outside influences/opponent and still get a specific training stimulus where we can maintain a set pace, rhythm, and HR for training (bag work). It is possible to use a HR monitor when grappling and establish an approximate training HR, although, even with set drills you would have to question the consistency of force applied (remembering that your opponent would also have to apply a consistent amount of resistance) to determine the maximal HR that you can consistently maintain over our six-minute period.

Once you have established your training HR you would go about your 5x3 minute rounds with 3-minute recoveries, or match the duration of your contests (e.g. if you fought a 5-minute grappling contest you would train 3 x 5-minute intervals with your three minute rests between intervals). You would complete your training intervals with your HR monitor on, working at you're training HR, your trainer would be holding your HR monitor watch giving you constant feed back on your HR.

The test to establish your training should be repeated every 2-3 months to re establish your training HR, if your training HR increases then your “ANT” has increased.

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<sup>11</sup> Copyright Leith Darkin (Sep 2003)

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