II. AEROBIC TRAINING ZONES

Running and training in the aerobic energy zone or using aerobic training regimes will follow very specific guideline. This aerobic development hinges upon training with no build up of by-product (lactic acid) during the effort or session. The fuel is completely burned in order to produce energy to run. There are some very specific guidelines to follow. This brings up the topic of aerobic and anaerobic thresholds.

In aerobic training, the runner will use, as a primary fuel, either one of two substrates (food sources) for energy to run, fatty acids or glycogen (carbohydrates). Which one of the two will be used as the primary fuel is determined by the speed (intensity) of the run. We can judge the effort and primary fuel source by source by using the runners heart rate as the monitor.

1. Fatty Acids- Heart rates up to 130-150 beats per minute,FA will be primary fuel source to run.

2. Glycogen- Heart rates of 130-170 beats per minute, glycogen will be the primary fuel source, with no accumulation of lactic acid.

THESE VALUES DEFINE THE AEROBIC TRAINING REGIMES USED TO DEVELOP THE ENDURANCE BASE OF THE RUNNER'S TRAINING PROGRAM.

1. Aerobic Threshold is the break point (-130 -150 bpm) or shift from fatty acids to glycogen as the primary fuel needed to produce energy to run. Running at levels will adapt the runner's aerobic system to use Fatty Acids as an energy source thus sparing glycogen for faster paces. (This value is at 65% of Vo2 Max.).

2. Anaerobic Threshold is the break point (-170 bpm) at which the aerobic system can no longer fully supply the energy needed to run at a given effort. The endurance runner must rely on the anaerobic system to aid the aerobic system in supplying energy to run at intensities requiring a heart rate over -170 bpm. At this point the runner begins to accumulate excessive lactic acid. Training just below this threshold will enhance an efficient use of glycogen as the energy source. This will also spare glycogen and push the anaerobic system further away. (This value is approximately 85-90% of Vo2 Max).

III. ANAEROBIC TRAINING ZONES

Training and racing anaerobically requires two systems of breaking down fuel for energy to run at or near maximum velocities. These two systems are both producing energy without the presence of oxygen, The Anaerobic Alactic and Anaerobic Glycolytic. The only difference is again the fuel used to produce energy to run, in the alactic system the energy source is creatine phosphate, and in the energy source is glycogen.

Anaerobic Alactic: This system use creatine phosphate as an energy source at maximum velocities of running. Unfortunately the limiting factor of this system is that it only lasts for 6-7 seconds, the amount of time to breakdown all available creatine phosphate stores. There is no accumulation of by-product in this case but rather the elimination of available fuel, i.e. creatine phosphate. The athlete will improve their ability to maintain a higher velocity for 6-7 seconds as an adaptation to training but cannot extend the time frame beyond 6-7 seconds. This system is used at the very beginning of races and/or pace changes during the race, but does not have that significant of an impact in the endurance running events in track & field.

Anaerobic Glycolytic: As discussed in your Level I sprint curriculum, this system is responsible for producing energy, to run at very high intensities, without the presence of oxygen. This system is the primary source of energy to run a maximum or near maximum velocities from 7 to 90 seconds. This system is responsible for supplying energy for those events up to and including 400 meters. Again as stated before, the limiting factor this energy system is the excessive buildup of lactic acid and its' effect on working muscles in producing fatigue.

As stated in the Level I sprint curriculum the following definitions to describe sprint training and development in the anaerobic system are as follows:

	Speed	**Speed Endurance**	**Special Endurance I**	**Special Endurance II**
Intensity	95-100%	90-100%	90-100%	90-100%
Extent	30-60 meters	60-150 meters	150-300 meters	300-600 meters
Reps per Sets	2-4	2-5	1-5	1-4
Sets	2-4	2-3	1	1
Session Volume	300-600 meters	300-1200 meters	300-1200 meters	300-1800 meters

Training in the anaerobic zones will improve the overall speed and velocity an endurance runner can attain, and the runner's ability to efficiently cope with the buildup of lactic acid. In other words, the endurance runner's speed and lactic acid tolerance.

IV. COMBINED ZONES

The combined zone, drawing energy both aerobically and anaerobically to run, is of primary concern following the aerobic (base) development of the endurance runner. After the endurance runner has developed a sufficient aerobic base, the primary concern begins to turn toward race energies and the use of both energy systems to run efficiently with the buildup of different levels of lactic acid.

A major concept to grasp at this time is another major component of the aerobic system and that is: **Vo2 Max.**

Vo2 Max or Aerobic Power is concerned with the heart as a pump and its' ability to pump as much blood and oxygen to the working muscles as possible. The heart is a muscle and can be enlarged and strengthened as an adaptation to training. The stronger the heart is the more blood and oxygen that can be pumped to the working muscles, the better the performance in the endurance running events.

Running at Vo2 Max is at a heart rate of approximately 180-186 bpm. This heart rate will vary from one individual to another, but it is within this range we can generalize for the purposes of training. This speed is usually associated with ten (10) minutes of all out running. In the case of women and young male endurance runners it correlates to their best performance at 3,000- 3,200 meters. For older, more experienced, male runners and some elite women it is associated with their best performance at 5,000 meters.

The relationship of Vo2 Max to specific endurance running events is as follows:

EVENT	% of Vo2 Max
800 meters	120%
1500-1600 meters	110%
3000-3200 meters	102-100%
5000 meters	97%
10,000 meters	92%

As noted Vo2 Max is strongly connected with racing performances. It also is critical to understand that successful racing performances are reliant on an efficient anaerobic energy system. The buildup of excessive lactic acid throughout the race will be the limiting factor in the ability to achieve and maintain race pace. So the development of both Vo2 Max and the ability to cope with lactic acid buildup will be determining factors in successful race performances.

V. TRAINING DEFINITIONS

The following training methods and terms are used throughout the world of track and field:

1. **Continuous Running**
2. **Interval Running**
3. **Repetition Running**

Continuous Running: is defined as running continuously at a given tempo or intensity for a prescribed amount of time and volume. Different intensities and volumes are used to bring about specific adaptations designed to enhance endurance. These adaptations occur by the use of continuous running as a basic training tool to develop general to very specific aerobic capacities for endurance running events.

EXAMPLES:

1. 6 miles @ 6:30 minutes per mile or 160 bpm or 75% of Vo2 Max
2. 10-16 miles very easy below 150 bpm or 65% of Vo2 Max
3. 4 miles very medium/hard @ 5:45 per mile or 160-170 bpm or 85% of Vo2 Max
4. 8 miles @ 6:00 minutes per mile or 140-150 bpm or 80% of Vo2 Max

These are all different variations of explaining a continuous run. Each will bring about specific adaptations depending upon the athletes chronological age, training age, state of fitness, and ability level.

Interval Running: is defined as varying numbers of repetitions or bouts of running, usually short in duration, in a set or in multiple sets, with the volume of repetitions being high and the intensity low enough to successfully complete the given volume of the workout. The rest between each repetition or set is incomplete in nature, but designed to be able to aid in the completion of the given volume and intensity of the workout. Each interval running session will be designed to bring about a specific adaptation.

Rest or recovery can be described as complete or incomplete in nature (Gerschler & Reindahl). Complete or near-complete recovery is defined, as allowing enough rest or recovery to be completely restored to the athlete's previous homeostasis.

Incomplete recovery is defined as 1/3 of the time it takes to fully recover. Gerschler determined that within 1/3 of the time it takes to fully or completely recover, 2/3 of the athlete's recovery has taken place. If it takes nine (9) minutes to completely recover from a specific effort, then the athlete is 2/3's of the way towards complete recovery within the first three (3) minutes.

Incomplete recovery is the foundation of interval running training.

EXAMPLES:

1. 12 x 400 meters @ 75-77 seconds with 90 seconds recovery between repetitions.
2. 20 x 200 meters @ 35-37 seconds with 90 seconds between repetitions
3. 10 x 800 meters @ heart rates of 150-160 bpm with 2-3 minutes between repetitions.
4. 3 x (4x400 meters) @ 3200 meter race pace with 60 seconds between repetitions and 3 minutes between sets.

Normally the volume of the session will be equal to or not to exceed two (2) times the race distance depending on duration, intensity, volume and density of the session.

Repetition Running: is defined as varying numbers of repetitions or bouts of running, usually long in duration, at intensities and volumes needing complete or near- complete recovery between repetitions to successfully complete the given volume of the workout.

The individual repetitions are up to 2/3 of the race distance at near or exceeding race tempo, requiring complete or near complete recovery before the next bout or repetition.

EXAMPLES:

1. 2 x 1000 meters @ 1500 meter race pace with 20 minutes between repetitions.
2. 3-4 x 400 meters @ 800 meter pace or faster with 10-15 minutes between repetitions.
3. 3 x 1 mile @ fast with 8-10 minutes between repetitions.
4. 1200 meters/1000 meters/800 meters @ faster than 3000 meter race pace with 5-8 minutes between repetitions.

The total volume of the session should not exceed 2/3 to two (2) times the race distance depending on the duration, intensity, volume and density of the session.

Interval training should be used as a training tool in the pre-competition and competitive season. It is an especially good training tool for young developing athletes with limited to lower training ages.

Repetition running should be used as a training tool in the mid to late competitive season with experienced endurance runners rather than young developing athletes.

Below is a list of training zones and types of training used:

Training for:	**Adaptation**	**Heart Rate Zone**	**Type of Training**
Aerobic Threshold	FA energy source/aerobic base	130-150bpm	Continuous Running 1-3 hours
Anaerobic Threshold	Glycogen Efficiency/Aerobic Efficiency	150-174 bpm	Continuous Running 20-60 minutes & Interval Running Training 4-8 minutes
Vo2 Max	Aerobic Power	180-190 bpm	Interval & Repetition Running Training 3-5 minutes
Anaerobic Endurance/ Lactic Acid Tolerance	Race Energy/Oxygen Debt Capacity	Near Max HR or Max HR	Interval & Repetition Running Training 30 seconds to 3 minutes

These first two zones, aerobic threshold and anaerobic threshold, made the aerobic training zones, used throughout the year for endurance or base endurance. The next two zones are used for the development of race performance and race energies.