

Here it is "energy system training - beyond Heart Rate and zone training".

First a quick overview: the body uses aerobic and anaerobic processes to create the energy required to do work (or play as the case may be). Anaerobic processes are predominate say in jumps and plyometrics and sprints up to 30 seconds in duration. Aerobic processes takes over in Intensity workouts from 90 seconds on to endurance workouts up to 3 plus hours in length. So, anaerobic processes are high power (immediate response), low capacity (up to 60 to 90 seconds duration) and uses predominately type 11 (fast) muscle fibres while aerobic processes are low power (1 to 3 minute delay between demand and output), high capacity (several hours duration) and uses predominately type 1 (slow) muscle fibres.

The anaerobic processes consist of two types of energy pathways. The anaerobic alactic energy system which releases energy without producing lactic acid in the process which can supply energy for the first 10 to 15 seconds of a all out effort. And the anaerobic lactic energy system which does produce harmful acidic waste products (pyruvic (lactic) acid) in the muscles. The anaerobic lactic systems can supply energy for up to 60 to 90 seconds after which the muscle cannot function until some of the acid has been removed via the aerobic processes.

The aerobic energy systems produces energy from glucose , from stored fats or from protein. Mostly aerobic energy is produced by converting glucose to pyruvates in a slow glycolysis process, fats are used if the aerobic energy output is very low while proteins are used when energy demand is maximal and other energy sources are depleted.

So how does all this relate to training? Training intensities vary depending on what energy system you are trying to train. For cross country skiers there are five important training zones that needs to be targeted.

Endurance training is done at 70-80 percent of maximum heart rate (remember that you will need to do a maximum heart rate test to determine what your maximum heart rate while skiing is and if your HRmax is 180 and your resting heart rate is 60 then your work heart work capacity is $180-60= 120$ beats/min and 80% of that is 96 b/m add the 60 b/m resting HR and you get 156 b/m as 80% of HRmax). Blood lactate levels should be less than 1.0mM and the rating of perceived exertion (RPE) should be around 7-11 (from a scale of 1-20 in the Smith/Norris system of training intensities) 7-11 is extremely light to light. You should be going steady for 2 to 3 plus hours at this intensity which trains the aerobic glucose energy system and develops the central cardiovascular mechanisms that deliver oxygen to the muscles. The bulk of your training (up to 80%) should be at this intensity level.

Anaerobic threshold intensity training improves the muscles ability to function efficiently in an acidic environment and also improves their ability to clear lactate and use it as an energy source. This training should not be done until after the the anaerobic metabolism are mature, which is after the growth spurt experienced by children. Training is done at about 80-85% HRmax and blood lactate levels should be below 2.5 mM and RPE should be around 12-15

(somewhat hard to hard). Training should be from 20 to 30 minutes in duration. Perhaps up to 9% of the training should be at this level.

Race intensity training develops specific endurance by improving the central factors that contribute to oxygen delivery to the muscles and by improving the efficiency of the exercising muscles. VO₂ max improves the most by training at these intensities. Training is at 80-100 % of HRmax, blood lactate levels should be less than 4.5 to 5 mM and RPE is around 14-19 (hard to extremely hard).

Time trials and actual racing best simulate these training efforts so you should schedule some of this before your important races.

Lactic and Alactic sprint training should also be undertaken before important races. Remember lactic is all out efforts from about 30 to 90 seconds (what you use a lot of when passing) and blood lactate levels are from 6-10mM while RPE is 18-20 (very hard to maximal exertion). % HRmax is irrelevant in sprint training as often your heart rate does not have time to reach max. before the end of the sprint. Alactic sprints are all out efforts up to about 15 seconds, blood lactate levels does not reach 2 mM and RPE is 20 (maximal) and again HRmax is irrelevant. Alactic sprints are great for developing, or maintaining pure speed and works your central nervous system, the efficiency of your nerve firing and recruitment of muscle fibres. 1 to 2% of your training at this level close to when you want to peak is enough.

With proper aerobic and anaerobic energy system training you will have energy to use when you need it and range of speed at race pace will improve.

If you want to learn more about energy system training or have questions about this give me a shout...meanwhile, get out there and train!

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