COACHING IRELAND
OILIÚINT ÉIREANN

Understanding Lactic Acid

The anaerobic energy system allows energy to be produced quickly without the use of oxygen. A by-product of the anaerobic energy system is lactic acid (lactate), and an accumulation of lactic acid can cause the muscle to slow down or to stop working. The measurement of blood lactic acid concentration during a graded exercise test gives an indication of the extent to which the muscle has to rely upon the anaerobic energy system.

The muscle constantly produces lactic acid; therefore even at rest lactic acid is present in the blood. Blood lactate concentration, and changes in it, result from the balance between adding lactic acid to the blood, and the clearance of lactate from the blood by muscle and the heart for metabolic purposes. At rest and low exercise intensities, lactic acid's rate of removal matches its rate of formation, resulting in a stable blood lactate concentration (see figure below). At higher workloads, the muscle produces a greater proportion of energy anaerobically, therefore more lactic acid is produced. This leads to an accumulation of lactate in the blood (see figure below). It has been shown that the greater the exercise intensity an individual can reach before there is an accumulation of lactate in the blood, the better their endurance performance.

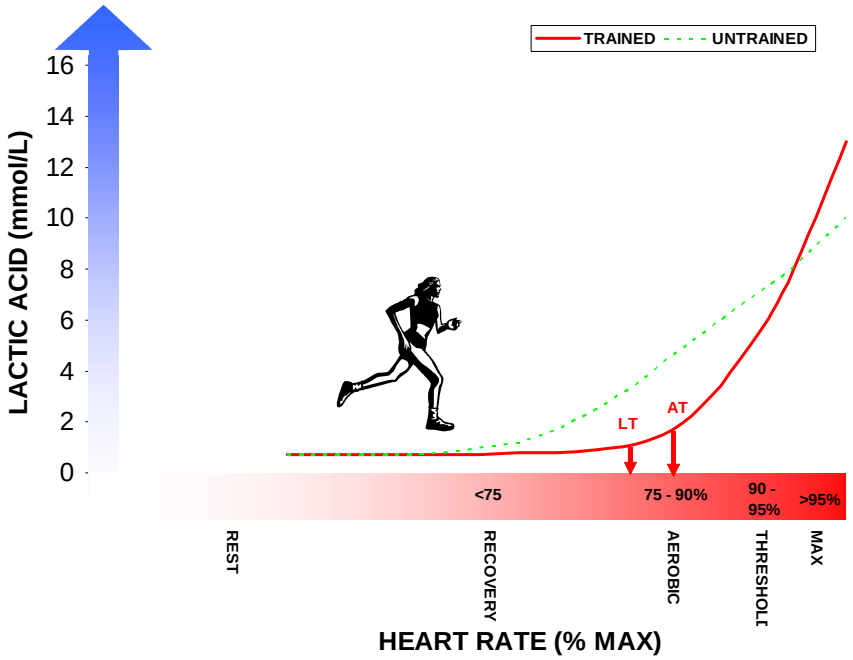

Figure 1: An example of possible blood lactate responses to a range of heart rates values (expressed as % maximum heart rate) during a graded exercise test. LT and AT indicated for ***trained*** *(red line) individual only.*

There are at least two apparent discontinuities or thresholds in your blood lactate response to graded exercise. The first of these thresholds, Lactate Threshold (LT), is associated with the first workload at which there is a sustained increase in blood lactate above resting levels. The second of these discontinuities, Anaerobic Threshold (AT) is marked by a very rapid rise in blood lactate concentration. This second point represents a shift from aerobic to partly anaerobic energy metabolism. The figure above shows blood lactate concentration for both trained and untrained individuals with increasing levels of exercise.

Training using Thresholds

The table below shows how threshold values might be used to establish and monitor training intensities. Training performed below LT is regarded as recovery or very low intensity aerobic training. Extensive aerobic training can be carried out over relatively long periods of time, and intensive aerobic is higher intensity aerobic training. Training above AT is termed maximum aerobic work, and can only be maintained for short periods of time, and is most suitable for interval training. You can ensure you are training in the correct zones by monitoring your training heart rate or power output (wattage).

Training Zone	**Threshold**	**% HRmax**	**Perceived Exertion**
Recovery	<LT	<75%	Easy
Extensive Aerobic	LT - AT	75 – 85%	Comfortable
Intensive Aerobic		80 – 90%	Uncomfortable
Threshold	AT	90 – 95%	Stressful
Maximal	>AT	>95%	Very stressful

Table 1: Approximate Guidelines for trained athletes for the training zones (adapted from Physiological tests for elite athletes *, Australian Sports Commission, ed. Christopher J. Gore editor, Human Kinetics, Champaign Illinois USA, 2000)*

Monitoring Training Adaptations

Changes in specific blood lactate thresholds can also serve as distinct indicators of change in an athlete's training status. Increases in the intensity at LT (shift in the curve to the right and/or downward at *lower* intensities) reflect an improvement in base aerobic condition. This delayed lactate production could be due to enhanced fat oxidation and enhanced aerobic mechanisms. Increases in exercise intensity at AT, represented by a graphical shift down and/or to the right at *higher* workloads, may be indicative of an improvement in higher-level aerobic endurance. Possible causes may be improved lactate clearance. The blood lactate response to incremental exercise should be evaluated periodically and the training intensity adjusted as aerobic fitness improves.