PLYMOUTH MARJON UNIVERSITY

Lactate Threshold

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CASES
The Chartered Association of Sport and Exercise Sciences

INTRODUCTION

Measurement of the blood lactate response to exercise, in conjunction with heart rate, oxygen consumption (VO_2), and intensity is often part of the routine physiological assessment of the high performance athlete. There are three main reasons:

- They serve as indicators of training adaptation.
- They correlate with endurance performance.
- They may indicate optimal training stimuli.

INDICATOR OF TRAINING ADAPTIONS

In the past, endurance training studies commonly used changes in maximal oxygen consumption ($VO_{2\ MAX}$) to indicate alterations in endurance capacity. However, more recently, research has suggested that the blood lactate response to training adapts to a greater degree than $VO_{2\ MAX}$.

CORRELATION WITH ENDURANCE PERFORMANCE

Blood LT's are highly related to performance in various types of endurance activities (10km, marathon etc.). In fact, it has been suggested by many researchers that these parameters are a better indicator of endurance performance than the traditional $VO_{2\ MAX}$.

OPTIMAL TRAINING STIMULUS

Accumulated data suggest that the various blood related thresholds provide strong indices of exercise intensity by which to prescribe guidelines for training. Essentially, this can help to optimize training and minimize the potential of overtraining.

DEFINITION

It's suggested that there are at least two apparent thresholds in the blood lactate response to incremental exercise. The first of these (LT1) is associated with the exercise intensity at which there is a sustained increase in blood lactate above resting levels. The second (LT2) is marked by a very rapid rise in blood lactate concentration and refers to the upper limit of blood lactate concentration, indicating an equilibrium between lactate production and lactate removal (i.e. maximal lactate steady state).

PRACTICAL APPLICATION

Following the completion of a LT test, endurance training intensities can be divided into three specific zones (moderate, heavy & Severe) based on their relationship to LT1 and LT2 on the lactate-exercise intensity curve. Follow up LT tests provide graphical overlays of test-retest lactate profiles, allowing assessments of lactate-intensity curve shifts (a shift down, to the right or both indicates increases in aerobic capacity) and changes in blood LT1 and LT2 values. Increases in the intensity at LT1 reflect improvements in base aerobic condition, possibly due to delayed lactate production or increased fat oxidation. Similarly, increases in intensity at LT2 indicates improvements in higher level aerobic endurance, potentially caused by decreased lactate production, improved lactate clearance or improved acid buffering.

PROTOCOLS

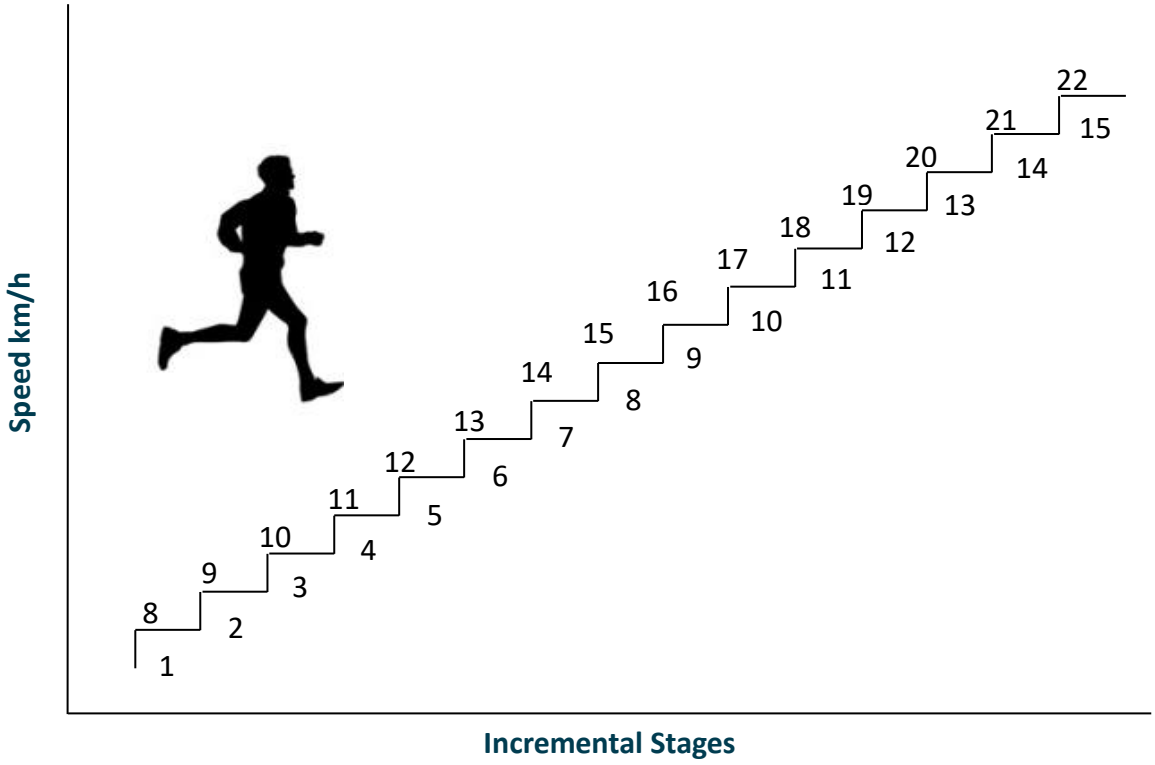
Warm up of 5 minutes at an RPE of 8-10 and HR at approx. 50-60% of age pred. max.

Lactate Threshold Test included 3 min progressive stages to just above LT2 with 60 seconds between stages to collect blood for measuring lactate (mmol/L). Test terminated once:

- Achieved a Blood lactate concentration of ≥ 5.5 mmol/L.
- Or participant reports an RPE ≥ 18

Subject to perform active cool down on the treadmill until HR returned below 120 bpm.

EXAMPLE DIAGRAM OF THE TEST



RECORDED DATA

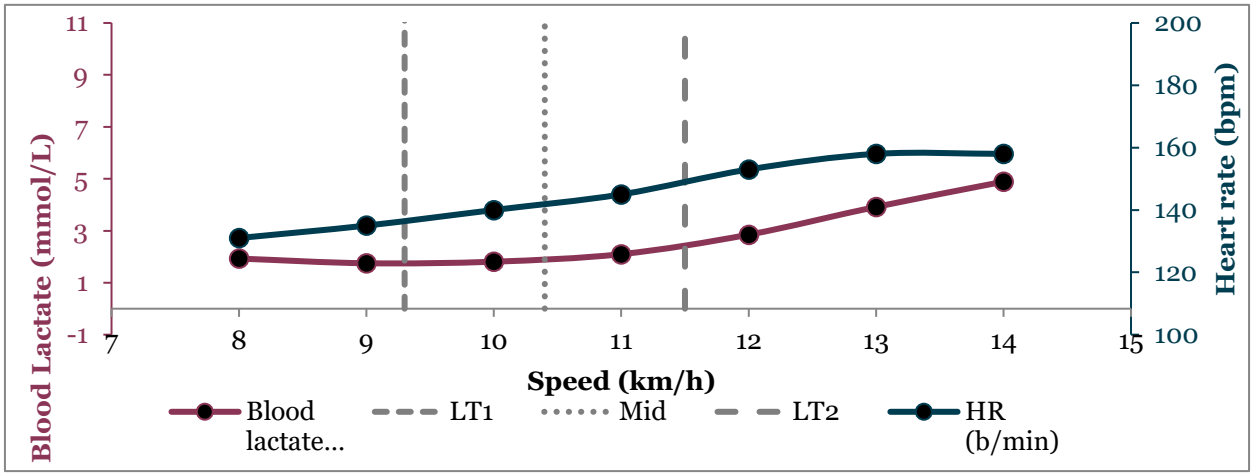
Exercise Description:	Running	**Date:**	02/02/2025
Informed Consent:	Y	**Time:**	2pm
Body mass (kg):	73.25	**Temp (◦C):**	22.2
Stature (cm):	174.1	**Humidity (%):**	43
Gradient of Treadmill:	1%	**Ambient Pressure (mbar):**	993
Pre Test Lactate (mmol/L):	1.15		

Stage	Speed (km/h)	Gradient %	HR (b/min)	RPE	VO_2 (ml.min.kg)	RER	Blood lactate (mmol/L)
Rest	0	0	X	X	X	X	1.85
1	8	1	131	11	31	0.87	1.93
2	9	1	135	11	35	0.9	1.75
3	10	1	140	13	37	0.91	1.81
4	11	1	145	14	40	0.95	2.1
5	12	1	153	15	43	0.99	2.85
6	13	1	158	17	46	1.03	3.92
7	14	1	158	20	48	1.07	4.89

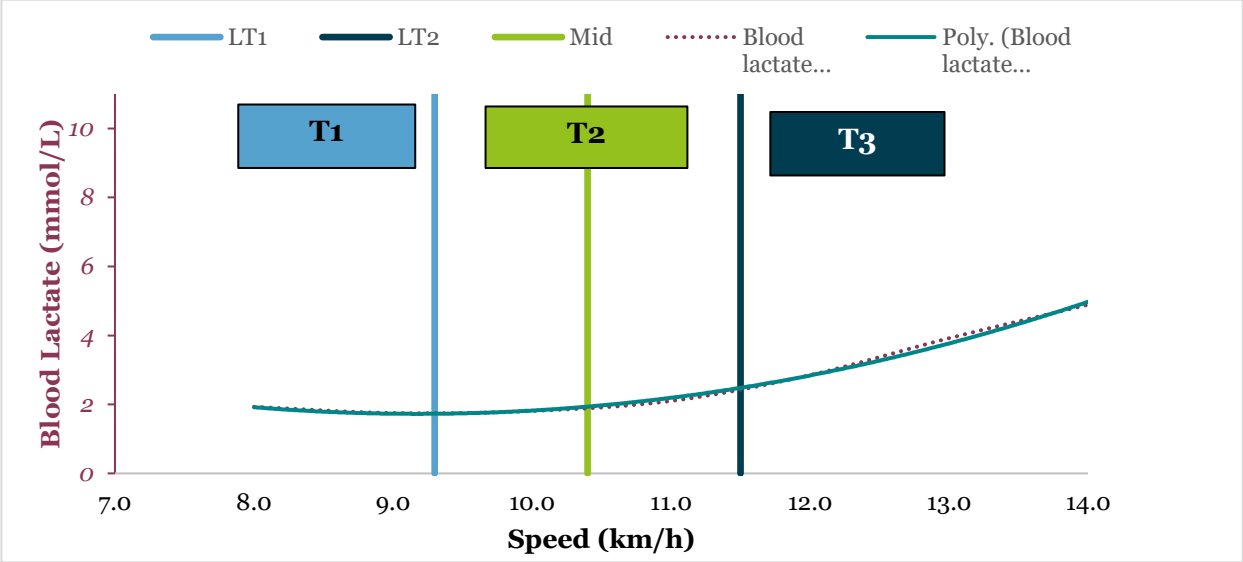
RESULTS

	Speed (km/h)	HR	RPE	VO2
LT1	**9.3**	137	12	36
LT2	**11.5**	146	15	41

TRAINING ZONES



Zone	Description	Speed (km/h)	HR	RPE Scale	Critical Duration h:min:s
T1	Moderate	<9.3	<137	<12	>3 hrs
T2	Heavy	9.3-10.4	137-142	12-13	1-3 hrs
		10.4-11.5	142-146	13-15	30-90 min
T3	Severe	>11.5	>146	>15	2-12 min



EQUIPMENT

- Stadiometer, Seca 287 Wireless Ultrasonic Measuring Station, Seca Medical, Birmingham, UK
- Blood Pressure Monitor, Omron 907 Professional Blood Pressure Monitor, Kyoto, Japan
- Cortex Metalyzer 3B R3; Cortex, Leipzig, Germany (Studio)
- Woodway Treadmill, Desmo HP, Woodway GmbH, Weil am Rhein, Germany
- Biosen Glucose and L-Lactate Analyser, Biosen C – Line, EKF Diagnostics, Indiana, USA
- Heart Rate Monitor, Polar H10, Polar Electro, Kempele, Finland
- Seca mBCA 515. Seca Medical, Birmingham, UK

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