

#3 The Anaerobic System — Why Horses Fade

The Auxiliary Engine — and Why It Creates Lactate

When oxygen demand exceeds aerobic supply — during a surge, a sprint, or a sharp pace increase — the anaerobic system bridges the gap. It breaks down **muscle glycogen rapidly** to produce ATP without oxygen. Fast, powerful, and limited: it is the auxiliary engine, not the main one.

Lactate is the end-product of this process. For decades, lactate was blamed for muscle fatigue. We now know **lactate is not a waste product — it is a fuel signal** and an energy carrier. Lactate produced by fast-twitch fibres can be burned by slow-twitch fibres and the heart. The problem is not lactate itself but the **hydrogen ion accumulation** (acidosis) that accompanies excessive anaerobic output.

KEY POINTS

- Produces ATP without oxygen — fast but limited by glycogen supply
- Bridges the energy gap between the CP system and full aerobic engagement
- Lactate is a **fuel, not just a fatigue metabolite** — it can be burned aerobically
- The real fatigue driver is **acidosis** — excess hydrogen ion accumulation, not lactate itself
- Every race tactic decision flows from managing how much of this system is used and when

LACTATE EXPLAINED

Lactate produced by fast-twitch fibres **shuttles to slow-twitch fibres and the heart**, where it is burned aerobically. A high VO₂max means faster lactate clearance — the horse looks fresher than it actually is.

WHAT CAUSES THE FADE

When anaerobic output exceeds clearance capacity, **hydrogen ions accumulate**, pH drops, enzymes malfunction, and speed collapses. This is the "wall" — premature acidosis triggered by pacing error or underdeveloped aerobic capacity.

STABLE QUESTION

"When your horse fades in the last 200 metres — is it really 'not fit enough', or is it running out of aerobic capacity to clear the lactate being produced?"

TRAINER TAKEAWAY

Race fades are almost always an **aerobic problem dressed as a speed problem**. The horse that doesn't fade is not one that avoids lactate — it's one whose aerobic engine clears lactate fast enough to keep the anaerobic system working cleanly right to the line.

CONNECTS TO →

Monday #4: The aerobic system clears the lactate the anaerobic system produces. | **Friday #7 MLSS:** The lactate threshold is precisely the line at which clearance and production balance — the training anchor point.

#7 Lactate Threshold / MLSS — The Line Between Building and Breaking

Maximal Lactate Steady State — The Most Important Line in Training

The **Maximal Lactate Steady State (MLSS)** is the highest exercise intensity at which lactate production and lactate clearance are in balance — a steady state is maintained. Train below this line and the horse builds fitness. Push above it and lactate accumulates exponentially, acidosis follows, and **performance collapses**.

This line is not the same for every horse. In horses, MLSS has been measured anywhere from **2.5 mmol/L in elite distance horses** to **9.3 mmol/L in sprinters**. A sprinter's higher MLSS does not mean better fitness — it reflects a faster glycolytic rate. Knowing each horse's MLSS is the anchor point for prescribing every training zone.

KEY POINTS

- MLSS = the speed at which lactate production exactly equals lactate clearance
- Above MLSS: lactate accumulates exponentially → acidosis → performance collapse
- MLSS ranges from **2.5 mmol/L (distance elite)** to **9.3 mmol/L (sprinters)**
- Higher MLSS in sprinters reflects glycolytic rate — not necessarily superior fitness
- Every training zone prescription should be anchored to **this horse's individual MLSS**

TRAINING BELOW MLSS

Builds aerobic capacity, mitochondrial density, fat oxidation, and cardiovascular efficiency. **The horse adapts and gets fitter.** This is where most training volume should live.

TRAINING ABOVE MLSS

A powerful stimulus for anaerobic capacity — but only in controlled doses. Done too often it triggers acidosis, suppresses adaptations, and causes **paradoxical fitness regression**.

STABLE QUESTION

"If you don't know where each horse's lactate threshold sits, how do you know whether your training is building fitness or accumulating fatigue debt?"

TRAINER TAKEAWAY

MLSS is not a laboratory concept — it is the practical answer to the question every trainer asks daily: **"How hard should I push today?"** The sport science platform gives you the data to find this line for each horse. Once you know it, every session has a purpose.

CONNECTS TO →

Monday #3: Acidosis above MLSS is exactly what causes the race fade described on Monday. | **Friday #5:** Raising $\text{VO}_{2\text{max}}$ shifts the MLSS line upward — the horse can now run faster before crossing into the danger zone. | **Week 3 #43:** Zone 3 training targets the MLSS threshold directly.