

Aerobic Training Categories Part 1

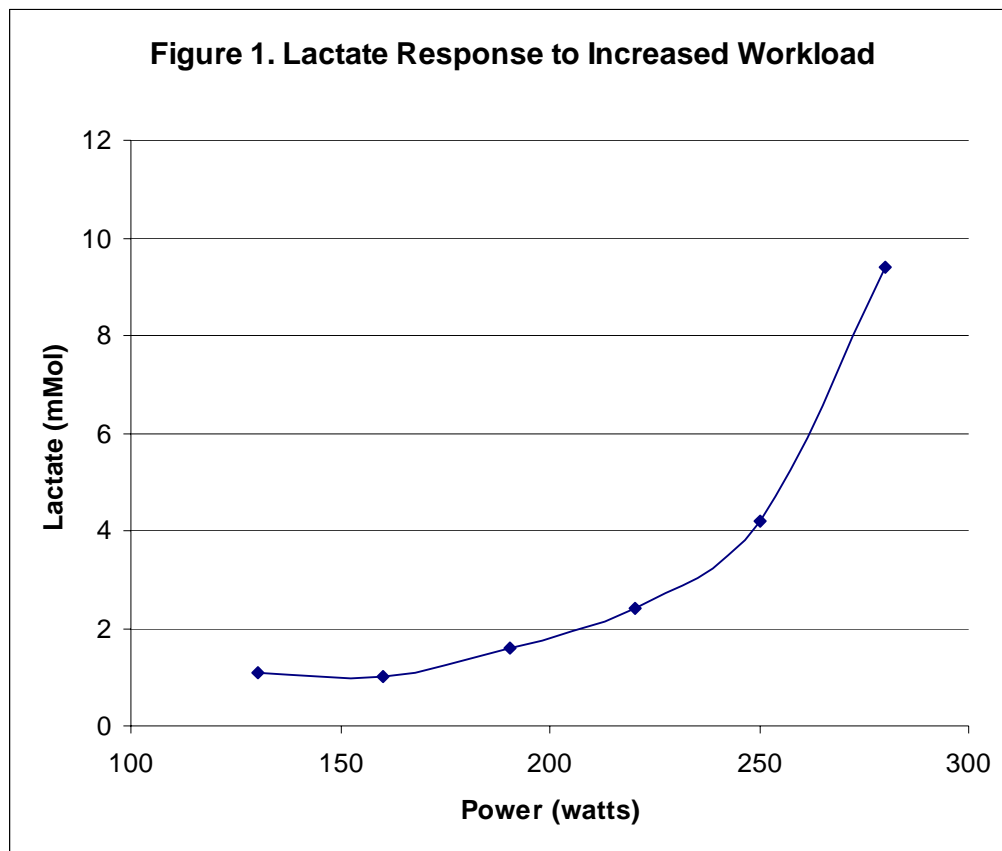
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Developing a high level of aerobic fitness is the key to rowing performance. To bring more accuracy to aerobic training programs sport scientists and coaches have developed systems of aerobic training categories. While there are as many versions of the training category system as there are countries using it, the physiological basis for the training systems are the same throughout the world.

Physiology of Training Categories

Most, if not all, of the category systems rely on the blood lactate response to exercise. Lactate, or lactic acid, is a substance produced by the muscles when the anaerobic energy systems become involved in an activity. If allowed to accumulate lactate will result in muscle pain, lack of coordination, accelerated breathing, loss of mental focus and fatigue. Measuring lactate at various workloads determines where the anaerobic system becomes an important part of energy production. The two physiological markers that are found through a lactate test are aerobic threshold and anaerobic threshold. These, combined with VO₂ max are the backbone of training category systems.

Lactate is preferred over heart rate in establishing training categories because the lactate level at any workload is more stable than the hear rate reading. This is particularly true when rowers are following very high volume training programs. Fatigue, external stress, and weather conditions can all have an influence on heart rate but have less of an impact on lactate.



VO2 max

VO2 max is the maximum amount of oxygen that the body can take in and use. It is a measure not only of how effectively the heart can deliver oxygen to the muscles but also of how effectively the oxygen can be removed from the blood and used in the muscles. There seems to be a strong genetic component to VO2 max. Some research has suggested that for most of us, over a lifetime of training VO2 max can only increase by 30-35%. This is a relatively small increase when you consider that strength can increase by several hundred percent over the same time period. Some of the very elite endurance athletes may be able to increase by much more than this. I have seen reports on some of the top Norwegian cross-country skiers showing changes in VO2 of 20% within a single year.

There is a strong correlation between VO2 max and 2000 m rowing performance, particularly in big boat racing. In small boat racing it is much less important. Exercise at VO2 max can only be done for a short period of time before fatigue sets in. Most people won't be able to hold this intensity for more than 4-5 minutes. In order to be successful in 1000m races a high VO2 max is crucial. Longer head races, 15-30 minutes, don't require as high a VO2 max.

Anaerobic Threshold

The body is always producing and using lactate. The rate of production and the rate of removal are normally equal so there is no build up of lactic acid in the blood or muscles. Anaerobic threshold is the point where the rate of production of lactic acid exceeds the

rate of removal. This causes a rapid accumulation of lactate in the blood and muscles resulting in fatigue. This normally occurs around 4mMol (a mMol is the unit of measure for lactate and represents the concentration of lactic acid in a liter of blood)

The speed at anaerobic threshold is the best indicator of rowing performance for head races and small boat 2000m rowing. In a 2000m race the middle 4-5 minutes are usually done at a speed that is equal to anaerobic threshold.

Aerobic Threshold

Aerobic threshold is the point where anaerobic metabolism first starts to make a contribution to energy production. This usually occurs around 2mMol and is seen as a slow rise in blood lactate levels. While it does not directly correlate to rowing performance exercise below the anaerobic threshold is very important to a rower. Exercise at this intensity is used to build an aerobic base and forms the platform from which other types of training can be launched.

Thresholds and Muscle Fiber Types

Depending on the analysis method there are usually three or four distinct types of muscle fibers. Their characteristics can be seen in table 1. While the general population has about equal numbers of slow twitch fibers and fast twitch fibers, rowers have a much larger proportion of slow twitch fibers. These slow twitch fibers are capable of using lactic acid as a fuel source. In other words, efficient, fit slow twitch fibers will eat up the lactic acid that your fast fibers are producing. This helps to decrease the impact of lactic acid on performance.

During exercise your body activates muscle fibers according to the size principal. The size principal states that motor units are activated from the smallest to the largest as intensity of exercise increases. Slow twitch fibers tend to be in the smallest motor units and are activated at lower intensities. Once the thresholds are determined training categories can be developed that allow a rower to target specific muscle fiber types, increasing the accuracy and effectiveness of the training program.

Table 1. Muscle Fiber Types and their Characteristics

Charateristic/ Fiber type	<i>Slow Twitch</i>	<i>Fast Oxidative Glycolytic</i>	<i>Undifferentiated Fast Twitch</i>	<i>Fast Glycolytic</i>
Speed of Contraction	Slow	Moderate	Fast	Very Fast
Fatigue Resistance	Very High	High	Moderate	Low
Anaerobic Power	Low	Moderate-Low	High	Very High
Aerobic Capacity	Very High	High-Moderate	Moderate-Low	Very Low

The training category system presented here was originally developed by Volker Note and Wolfgang Fritsch in Germany and has been modified slightly from the original. There are five aerobic and one anaerobic training categories. Each of the categories causes a specific adaptation that moves the rower one step closer to achieving their performance goals. Over the course of a training year the categories are performed in the order presented. When a higher category is introduced the lower category is maintained.

Category VI

Category VI (CAT VI) encompasses all intensities up to aerobic threshold. Slow twitch muscle fibers are targeted during category VI training leading to improved lactic acid removal and rowing efficiency. Aerobic base, built in CAT VI, is the foundation for higher intensity interval training. During the work phase of an interval lactic acid builds up. If the lactate is not removed during the recovery phase of the interval the next work period won't be done at the same speed as the previous one. In order for intervals to be effective the speed of each interval must be maintained. Without an adequate base a high volume of interval training is impossible.

The majority of the year will be spent training in CAT VI. There have been several studies that have looked at the training programs used by the top rowing countries in the world. They have consistently found that the top rowers perform only 5-10% of their total training volume as higher intensity intervals. Increasing the volume of these intervals doesn't seem to increase VO_2 max or rowing performance any more than the lower volume. In fact many countries have their athletes spend more than 80% of their training time below aerobic threshold.

CAT VI training is not only preparation for interval training but it is the ideal intensity for technical work. Skill learning is most effective at lower intensities. This is because lactic acid and fatigue impairs the ability to learn skills. It is only once the skill has become automated, following 5000 repetitions done exactly the same way, at low speed that the skill can be successfully transferred to higher intensity training and performance.

When designing exercise prescriptions for category VI several key concepts should be remembered. (1) Long training sessions are done less frequently. For example, four-hour training sessions need only be done three to four times per week but 60 minute sessions may be done eight to 10 times per week. (2) The duration of the training session should, in part, be based on the demands of the event. Head racers and marathon rowers need much longer sessions than 1000m or 2000m racers. In any case the minimum duration for a CAT VI session is 40 minutes. Anything less is insufficient to create a training effect. (3) During certain phases of the year training will be focused on specific event preparation. During this time category VI training should be maintained so that detraining does not occur. (4) If the training session is less than two hours long another category VI session could be done with two to four hours rest.

Category V

Category V (CAT V) represents those training intensities between aerobic threshold and anaerobic threshold. Category V is part of aerobic base training. Since category V is between the thresholds the lactate values for this category fall between two and four mMol of lactate.

CAT V training is important for head racing. In Longer head races, 30 minutes or more, as much as half of the race may be done at the upper end of CAT V. No more than 3-5% of total training volume should be dedicated to CAT V. This number can increase to 10% if several years of high volume CAT VI training have firmly established aerobic base.

Category V training uses ST fibers as well as some FOG (fast oxidative glycolytic) fibers. FOG fibers are an endurance fast twitch fiber with as much or more aerobic capacity than slow twitch fibers. In rowers, the FOG fibers are the largest fibers but are not as plentiful as the slow twitch fibers.

Training in category V can either be done as steady-state exercise or long undulating intervals. Since category V intervals are below anaerobic threshold they do not cause an accumulation of lactic acid. Therefore, there are no set work and rest periods. The main purpose of the intervals is to vary the motor units that are recruited by changing exercise intensity. Since the intensity is only slightly higher training volumes tend to be similar to Category VI.

Category V training is usually started after six to eight weeks of category VI training are completed. The key concepts outlined in category VI apply to category V. Category V sessions rely primarily on carbohydrate as an energy source. In order to replenish the carbohydrate used the time between CAT V sessions should be eight to 12 hours. When category V training is started there may be a reduction in the number of category VI sessions.

Category IV

Category IV (CAT IV) is a narrow band just above and just below anaerobic threshold. Lactate values for CAT IV fall between 3.5 and 5.5. There are two objectives to CAT IV training. For those racing 1000 and 2000 m the goal is to move anaerobic threshold closer to VO₂ max. Ideally anaerobic threshold occurs at 80-85% of VO₂ max. Interval training can be used to increase anaerobic threshold.

Most training at or above anaerobic threshold uses intervals. The volume of high intensity work is the key to improving in these categories. The recovery period between intervals lets the body deal with the lactate that is produced during the work period. This allows a high volume to be completed than if no recovery periods were taken. Recovery periods for aerobic training should not be less than 3-5 minutes. Using a 2-3:1 rest:work ratio will ensure adequate recovery between repeats. In other words, if your work interval is 3 minutes the recovery interval is 6-9 minutes. Recovery should be active in either CAT VI or V.

One of the goals in preparing for a head race is to increase the amount of time that anaerobic threshold can be maintained. Threshold endurance training uses steady state exercise at anaerobic threshold for periods of 20-30 minutes. These training sessions become very similar to races and should only be done in the 4-6 weeks prior to the racing season. Training for threshold endurance more than once a week can quickly lead to overtraining and possible injury.

Category III

Category III represents intensities between anaerobic threshold and VO₂ max. Since category III is above anaerobic threshold training has to be done interval style to obtain an adequate volume. One of the objectives of category III training is to let the athlete perform at higher levels of lactate and to promote lactate recovery. Many of the cardiac adaptations to aerobic training are seen at this training category. Since the intensity of category III training is quite high no more than 1-2 training sessions per week of this training should be scheduled.

Normally, category III is trained during the pre-competitive and competitive phases of the year with occasional maintenance sessions (once a month) during the rest of the year. More than four to six weeks of category III training is unnecessary and doesn't produce better fitness. The increase in peak power output following category III training is a good indicator of increased VO₂ max. Category III intervals are four to 10 minutes duration with eight to 20 minutes recovery. Recovery is active and is done in category VI. This is repeated for a total of 20 to 30 minutes of work time per training session.

Category II

Category II exercise is exercise in which the participants perform for as long as possible at VO₂ max. The objective of category II training is to increase VO₂ max and endurance time at VO₂ max. VO₂ max level exercise can normally be maintained for two to 12 minutes with an average of six minutes. In preparing for a 1000m race CAT II training should be done once a week for the final month before a major competition. However, if racing frequently, more than twice a month, CAT II training is unnecessary.

Training in category II is similar to category III. Intervals consist of two to seven minutes work followed by 10 to 20 minutes rest. This is repeated for a total of 10 to 20 minutes of work per training session. Since the intensity is very high this type of training should only be done one to two times per week and only during the final part of the pre-competitive phase. Regular racing is often enough to maintain and even improve category II fitness.

Category I

Category I is an anaerobic training category. Humans produce energy from two energy systems. The aerobic system requires oxygen to take part in the chemical reactions that produce energy. The anaerobic energy systems don't require oxygen. The anaerobic

systems produce energy at a much higher rate than the aerobic system but they have a limited capacity. In 2000 m racing about 70-80% of the energy used comes from the aerobic system and 20-30% from the anaerobic systems. A 1000 m race, which for the purposes of this chapter takes about 3:30-4:30 to complete, is probably about 50-60% anaerobic and 40-50% aerobic.

Anaerobic training, consisting of all out sprints for 10 second-2 minutes, also play a more important role for a Masters rower. Energy for the initial 20 seconds of the race is provided by the anaerobic alactic energy system. This means that the body is using the energy (ATP-CP) that is stored in the muscles for immediate use. Improvements in this system can be brought about either through training or by using a creatine supplement. While using a creatine supplement is the fast way to increase the capacity of the anaerobic alactic system it may result in water retention and weight gain, which may offset any performance improvement the supplement provides.

Anaerobic alactic training is done using short sprints of 5-20 seconds in duration. The sprints can be done from a stop or while the boat is moving. These sprints should be added to the program about 6 weeks prior to your major competition 1-2 times per week. They can be occasionally during winter training but not more than once a month.

The final sprint, with about 300–500 m left in the race, is supported by the anaerobic lactic energy system (anaerobic glycolysis). Accounting for up to 50% of the race, the final sprint is crucial for success in a 1000 m race. Training the anaerobic lactic energy system improves the rate of energy production in this system and increases the body's ability to buffer or tolerate lactic acid. As with the alactic sprints the anaerobic lactic training is introduced 6-8 weeks before the major competition and is done only about once a week. There should be at least one day between anaerobic training sessions.