anaerobic performance testing

Here's a new running-based test of anaerobic performance for which you need only a stopwatch and a calculator.

The Running-based Anaerobic Sprint Test (RAST) has been developed at the University of Wolverhampton as a sports-specific anaerobic test. It is similar to the Wingate ANaerobic 30 cycle Test (WANT) in that it provides coaches with measurements on peak power, average power and minimum power along with a fatigue index. The tests differ with regard to specificity and cost of administration. The Wingate test is more specific for cyclists, whereas the RAST provides a test that can be used with athletes where running forms the basis for movement. The WANT necessitates the use of a cycle ergometer and computer which are not available for all coaches. The RAST requires only a stopwatch and a calculator for some simple computations. The RAST provides a more specific test of anaerobic performance in running-based sports.

Anaerobic performance and the WANT
A variety of aerobic performance tests have been have been developed based around measurement of *VO2max*. Popular tests include a variety of gas analysis protocols, the Coopers Twelve Minute Run, Astrand cycle ergometer submaximal test, the Harvard Step Test and the Multi-Stage Fitness Test (Bleep Test). These have been developed to provide coaches and interested individuals with information about the aerobic fitness of athletes. These tests have been developed for a variety of clinical and sporting uses. There are cycling- and running-based assessment tools which allow for more specific testing between runners and cyclists. The variety of tests is beneficial because it allows for differentiation between sports, cyclists performing better on cycle-based aerobic tests and runners performing better on running tests.

The same variety of tests have not been available for assessing anaerobic performance. The most popular anaerobic test to date has been the WANT. As a cycle ergometer test it is more specific to cycle-based sports. The development of the RAST provides a running-based test of anaerobic performance.

Anaerobic literally means without oxygen. It relates to short-term high-energy production where the predominant fuels are produced without the necessity of oxygen. Tests for anaerobic performance aim to assess relatively short duration exercise bouts. Anaerobic performance is obviously relevant to sprinters, but also to those who play team and individual sports where there is an anaerobic component such as sprinting in football or hockey. Assessment of anaerobic performance can provide the coach with valuable information about the athletes' fitness status as well as allowing them to monitor improvement through training.

The WANT was developed during the 1970s at the Wingate institute in Israel (Inbar, Bar-or, & Skinner, 1996). The most commonly used test length has been 30 seconds. This is a time period for maximal efforts where the major fuel source is anaerobic. Athletes warm up for a period of five to 10 minutes and then rest for three to five minutes before starting the test. At the start of the test a resistance is lowered against the fly wheel. The resistance is calculated according to the body weight of each individual. The athlete has to pedal maximally throughout the test. The computer then calculates the maximal, minimal and average power

outputs. The power output is measured every five seconds and the six points are used to plot a power curve for the athlete. From the maximal and minimum power outputs it is possible to calculate the fatigue index which is a measure of energy depletion over the 30 seconds. Each of these measures provides valuable information for the coach and as a consequence were built into the development of the RAST.

The Running-based Anaerobic Sprint Test

Prior to the test each athlete is weighed. They then need to warm up for a period of five to 10 minutes followed by a three to five minute *recovery*. The RAST is a six by 35m dis-continuous sprint. Each sprint represents a maximal effort with 10 seconds allowed between each sprint for turnaround. The time taken for each sprint should be recorded to the nearest hundredth of a second (the greater the accuracy the better). To perform the test accurately there will need to be two timers, one to time each run, the other to time the 10-second turnarounds. The athlete must sprint at maximum speed through the line each time. The arrangement for administration of the test can be seen in the diagram below. The next sprint starts from the opposite end of the measured track. The time between each run is designed to allow the athlete to return to the start line after running through the line, to record the time and reset the watch. The total running time is close to 30 seconds, making the test comparable with the WANT. At the end of the test the coach will have six times which can be used, along with body weight, to calculate maximal, minimal and average power outputs along with a fatigue index.

Example results and calculations

Power output for each sprint is found using the following formulas (Harman, 1995):
The result from the first sprint of one athlete (with a body weight of 74 kilograms and a first sprint of 4.79 seconds) at the University of Wolverhampton can be seen below.

The power output for the athlete's first run was therefore 825 watts. The power output for each of the other five sprints can be seen in the table below (having been calculated in exactly the same way)
From these power outputs the same measures as for the WANT can be easily found. Maximal power is the highest output, which in this case is the first sprint; 825 watts and minimum power the lowest output which is the final sprint; 376 watts. The average power is found by adding each of the outputs and dividing by 6 (the number of sprints); 3666/6 = 611 watts. The fatigue index is found by taking the minimum power away from the maximal power and then dividing by the total time for the sprints; (Max - Min 825 - 376 = 449), (Time 32.2) (Fatigue index = 449/32.2 = 14 watts/sec). The results can also be displayed on a graph and used to compare with previous results or other athletes.

Explanation of the results

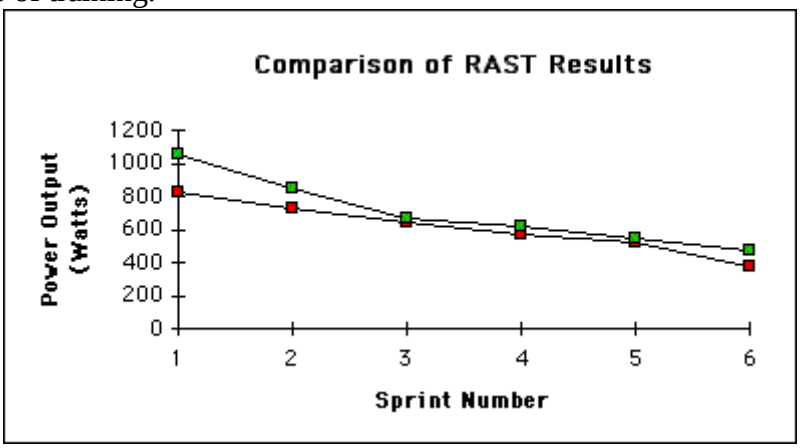
Maximal/Peak Power Output: is a measure of highest power output. The range in scores in our research has been between 1054 and 676 watts. It provides information about strength and maximal sprint speed.

Minimum Power Output: reveals the lowest power output achieved and allows the calculation of fatigue index. The range in scores has been between 674 and 319 watts.

Average/Mean Power Output: gives an indication of an athlete's ability to maintain power

over time. The higher this score the better the athlete's ability to maintain anaerobic performance.

Fatigue Index: indicates the rate at which power output declines for an athlete. The higher this rate the lower his or her ability to maintain power over the six runs. This can provide the coach with information about the athlete's anaerobic capacity or endurance. With a high fatigue index the athlete may need to focus on improving his or her *lactate* tolerance and this could be a focus of training.



Graphs: The above graph is designed to show how the results for an athlete could be plotted over time. The lower results represent an athlete's RAST prior to a training programme, the upper results after training. The training had a strong focus on weight training and sprint work with longer recoveries. The initial power output is improved through the training and the graph has moved upwards for all sprints, meaning that peak, minimum and average power outputs have risen. The fatigue index may be lower, showing improved anaerobic fitness; however, the greatest improvement is in peak performance which relates to the focus of training. The next phase of training would probably then aim to improve average and minimum power outputs while maintaining peak power. This could be carried out through an increased focus on lactate tolerance. Such rises would result in the slope of the curve (the fatigue rate) becoming less steep. This would indicate that the athlete was able to maintain higher power outputs over the time period, thus showing an improved anaerobic capacity.

Further information

The RAST can provide an excellent training indicator for athletes in a wide range of sports. The test is currently being used with a National League basketball team, footballers, sprinters, judo players and rugby players. Research into the RAST is continuing at the University of Wolverhampton. If you require any further information before trying the RAST, please contact either of the authors on (01902) 323058/323083.

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References

Inbar, O., Bar-Or, O & Skinner, J.S. (1996)
The Wingate Anaerobic Test. Human Kinetics: Champaign IL.