

Aerobic performance is one of the essential elements of physical fitness, along with muscle strength, flexibility, and body composition. Aerobic performance is defined by certain parameters that can be measured using carefully selected protocols. The best known of these parameters is maximum oxygen uptake (VO_{2max}) [1]. Other important parameters include the anaerobic threshold (AT), max and min heart rates, heart rate at AT, breathing rate at AT and heart rate recovery (HRR).

Establishing a Fitness Baseline is essential to designing a Fitness Program tailored to the needs of individual athletes or of a team. Field testing is a cost effective and time efficient method of establishing these fitness test baseline parameters. Fitness testing is typically done for the following reasons:

- to determine intensity levels for training program development
- to observe training progress
- to document changes in aerobic performance due to exercise training in order to evaluate the effectiveness of the training program

The Beep Test is a simple option for performing a fitness field test for a large number of people with a limited amount of equipment and space. With Zephyr's Physiological Status Monitoring systems, up to 64 individuals can be monitored with their data simultaneously recorded. The data is streamed and recorded live to a computer and analysis is conducted in the OmniSense software.

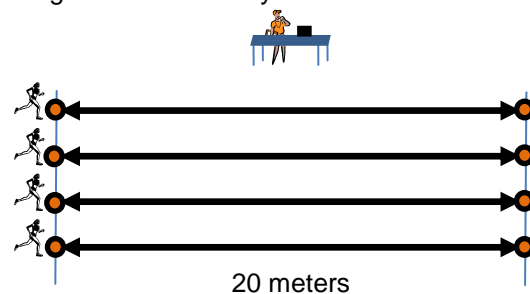
To conduct a Beep Test utilizing the capabilities of the Zephyr PSM system, the following equipment will be required:

- Complete Zephyr System with a laptop and OmniSense Software loaded
- 20 meter (65'7") measuring tape to measure 20 meter interval
- Marking cones (as many as needed to make start and finish obvious for all running lanes, recommend two per lane)
- CD-player, and external speakers loud enough to broadcast to the entire field

area being used (for test groups larger than 4-5 it is recommended to use a field PA system or amplified speaker system)

- Beep Test CD for audio commands (can be downloaded for free in .mp3 format at the following website): <http://www.runthepanet.com/trainingracing/training/bleeptest.asp> [3]

Set up the field area as in the following diagram with as many lanes as desired.



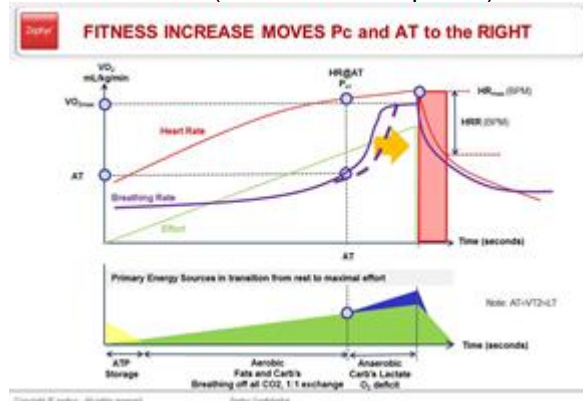
In live monitoring mode, a single monitor can manage a fitness test for up to 64 people per 15 minute test iteration. Further tests with additional subjects can be conducted by re-assigning the equipment to additional users or if desired an unlimited number of people can be tested simultaneously if live status monitoring is not required. The data can be uploaded individually at a later time.

A standard beep test will provide the monitor with a means to determine a VO_{2max} [3] (maximum oxygen uptake) for each subject. However, as a basis for establishing a training program, VO_{2max} alone is not very useful. While VO_{2max} can provide a picture of an athlete's potential (which does not change much in conditioned athletes, coupling this data with a measure of the anaerobic threshold of the athlete provides a benchmark for conditioning levels in relation to that potential. Furthermore, the amount of work that an athlete can achieve without passing the threshold is of utmost importance in finding what effort levels an athlete can sustain for an extended amount of time.

Another essential component of an athlete's conditioning level is the ability to recover from high exertion exercise. By measuring Heart Rate Recovery (HRR), the Zephyr System can

provide this highly important component of an athlete's conditioning profile. In a traditional beep test, these highly important parameters would be left unmeasured.

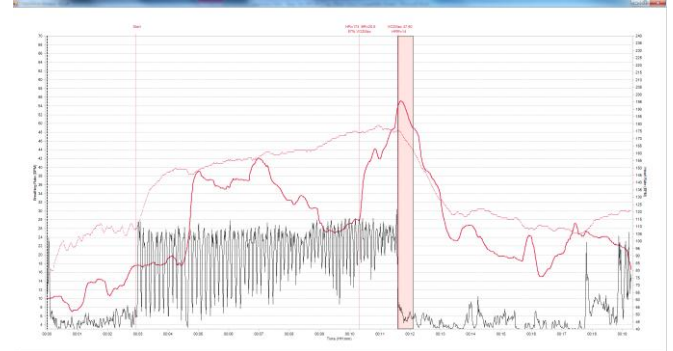
The following diagram depicts the relationships of these essential baseline parameters and how they relate to an incremental maximal effort fitness test (such as the Beep Test).



The Zephyr Physiological Status Monitoring system utilizes a combination of heart rate, breathing rate, activity, posture, and skin temperature measurements to provide the researcher, coach, or team leader with a more complete picture of an individual's status under virtually any type of activity. The aerobic performance of an individual is dependent on how much oxygen their body can utilize to metabolize energy and how efficiently disposal of by-products occurs. Beyond aerobic capacity is the body's anaerobic capacity, which utilizes lactate to metabolize glycogen, and produces lactic acid and carbon dioxide as a by-product. At the anaerobic threshold the body compensates for being unable to dispose of excess carbon dioxide that results from the jump in anaerobic metabolism by beginning to hyperventilate marked by a sharp inflection in breathing rate. Identification of this marker is essential in identifying exercise intensity zones. [1]

The monitoring of training intensity requires the setting of thresholds that are relevant to a particular athlete. The use of the Anaerobic Threshold as a marker of training intensity is well accepted in training circles.

The following screen capture of data collected during a beep test depicts how these benchmark data points are pulled out of the provided OmniSense software Fitness Test or Beep Test utilities:



For a discussion of how to apply these baseline parameters and markers to training program development, find additional Application Notes at www.zephyr-technology.com.

References:

- [1] Cooper, C. and Storer, T. (2001). Exercise Testing and Interpretation: A Practical Approach. Cambridge, UK: Cambridge University Press.
- [2] RunthePlanet.com. (2010). Retrieved from: <http://www.runtheplanet.com/trainingracing/training/bleepetest.asp>
- [3] Top End Sports. (2010). Retrieved from: <http://www.topendsports.com/testing/test/20mshuttle.htm>

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