# THEORETICAL MODEL FOR THE APPLICATION OF CRITICAL SPEED TO FIELD SPORTS

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**FIELD SPORT TRAINING CONSIDERATIONS:** Unlike strength-power or endurance athletes that are able to focus their training on just a few physiological characteristics, field sport athletes must balance a multitude of training variables to maximize performance. Field sport athletes require not only strength-power characteristics to meet the critical demands of high intensity actions, but also endurance characteristics to provide energy and ability to recover from the usage of high intensity actions. The difficult physical requirements placed on field sport athletes provide a unique set of obstacles for strength and conditioning coaches to ensure an optimal balance is achieved across training modalities. This complex nature of field sports makes performance testing and monitoring a time consuming and arduous task for coaches. Ideally coaches could employ one ecologically valid testing protocol which would provide a clear picture of the athlete's performance abilities specific to their sport.

**CURRENT TESTING AND MONITORNIG:** A number of tests are currently available to assess different qualities important to field sport athletes. Test batteries often consist of various jump protocols, isometric force production, repetition maximums (1 to 3RM), sprint, repeated sprint, and intermittent endurance tests. These tests are used to assess an individual's performance in the various fitness qualities needed for field sports such as strength, speed, power, rate of force development, and endurance.

The goals of these athlete monitoring tools are to evaluate training adaptations that may impact a player's performance abilities. However, changes in the tests can have varying effects on an individual's performance abilities. Therefore, it becomes important to utilize a performance test to measure changes to the player's maximum performance rates and capacities to elucidate which physiological components should be addressed in training.

Global positioning system (GPS) technology is a widely used tool in professional and collegiate field sports to measure components of player movement including speed, distance traveled, and the number of accelerations and decelerations. The most common application of this data has been to quantify training loads, establish normative data (position, gender and level of play), and examine game intensity dynamics. Such information provides coaches with an understanding of the specific physical activity performed during practices and games. However, this data commonly only informs what work was completed, with some indication of how, and requires significant assumptions to be made regarding the extent an athlete is progressing in terms of individual performance abilities.

**CRITICAL SPEED AND D':** The power-time relationship is a critical performance-monitoring tool that has been utilized in cycling and running (Clarke & Skiba, 2013; Jones, Vanhatalo, Burnley, Morton, & Poole, 2010). Critical power (CP) in non-weight bearing tests, and critical speed (CS) in weight bearing tests, has been defined as the upper limit of speed that can be sustained for a period of time or distance. The mathematical model has the capacity to predict an athlete's tolerance for constant high intensity work. Due to the nature of intermitted field sports it

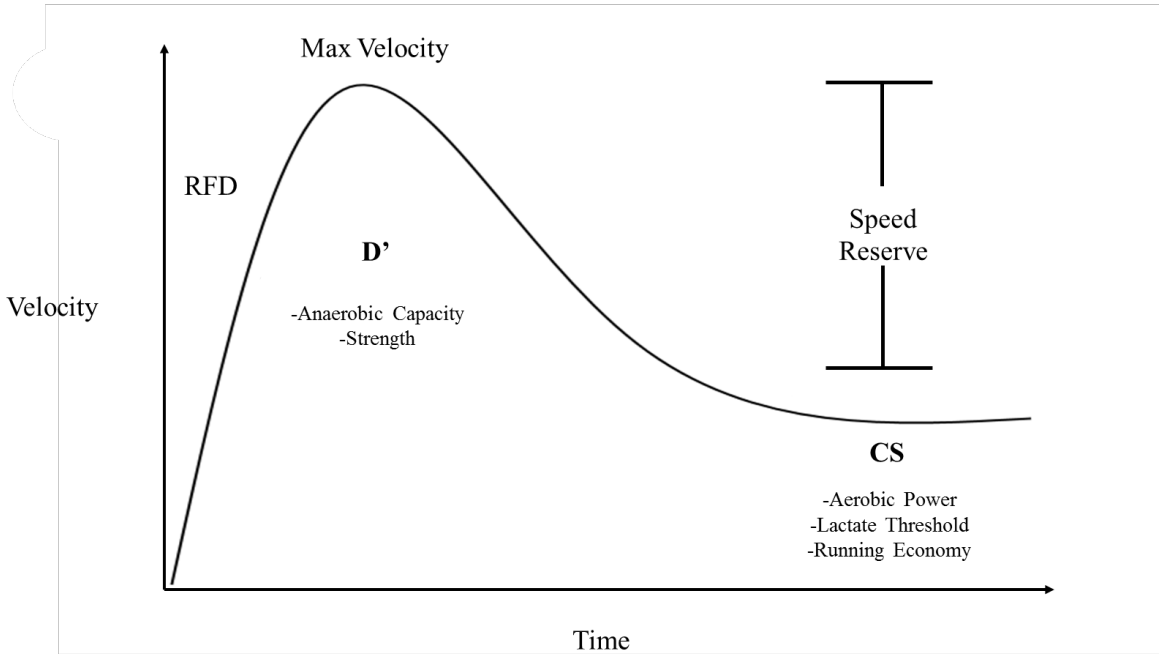
is important to discuss this relationship in terms of velocity, duration, distance, CS, and the capacity to work above critical speed (D').

Current tests for CS are built on the assumption that CS is the velocity that can be sustained for an extended period of time and that an athlete possesses a finite capacity for work over CS. The physiological underpinnings of CS are lactate threshold and maximal oxygen uptake, with increases corresponding to improved aerobic energy provision, while increases in D' are linked to the anaerobic system. Previously, multiple fatiguing tests of various velocities and durations have been utilized to develop the velocity-duration curve(Jones et al., 2010). Recently CS has been ascertained from a single bout of maximal effort exercise over a 3-minute period using global positioning system technology (Sperlich, Zinner, Trenk, & Holmberg, 2014). In these tests athletes are subjected to a 3-minute maximal effort run, causing the depletion of D' and regression of speed down to CS. The average speed during the final 30-seconds of the test is recorded as the CS, while total distance covered during the first 150-seconds of the test representing the distance that can be covered above D'. The visual representation of the velocity-distance relationship provided by the GPS technology allows for a more precise examination of CS, D' and an athletes speed reserve (figure 1).

The authors are unfamiliar with any attempt to adapt this drill from running and cycling to field sport athletes. However, several research studies on soccer match performance have observed the most intense periods of activity are followed by a period where work is below average (Bradley & Noakes, 2013; Bradley et al., 2009; Di Mascio & Bradley, 2013). In field sports the maximal duration of high intensity actions represents an athlete's D', and actions below average indicate the regression down to or below CS. It is possible that the elements of the critical speed model are the culprit in this phenomenon as this mimics the dynamics seen in CS testing, in which D' is depleted and work rate must drop below CS in order to have repletion of D'.

**THEORETICAL APPLICATION:** The primary benefit of the implementation of a CS test alongside an existing test battery is to potentially elucidate the contribution of the aerobic and anaerobic variables to an individual's performance, which would better identify training needs. With the establishment of sport or positional norms training can then be prescribed to focus adaptation on individual athlete differences (figure 1). This model provides a maximal work rate and performance reserve for each athlete which may assist the coaching staff in training and competition decisions. GPS units currently being used in field sports would provide a clear curvature picture of the athlete's time-velocity relationship (figure 1). A single, field based, 3 minute all out running test could determine the CS and D', for a large group of athletes in a minimal time. Additionally, it has been shown that running speed near lactate threshold (2mmM lactate), is strongly correlated with match performance of high intensity actions (Krustrup, Mohr, Ellingsgaard, & Bangsbo, 2005), therefore the daily integration of a 3 minute all out test would provide additional training benefits.

Table 1. Physiological Underpinnings of the 3 Minute All Out Critical Speed Test

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