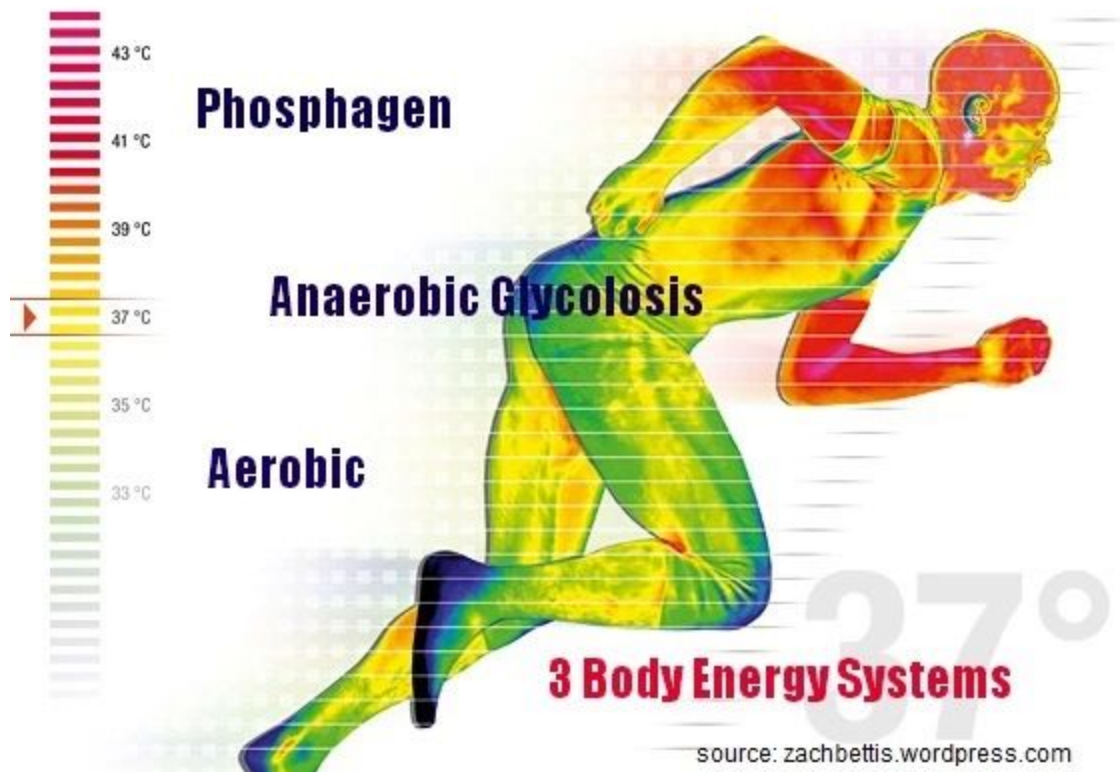


Energy Systems and Sport Conditioning Tests & Drills

The following is designed to help athletes and coaches understand the different energy systems utilized in sport performance, as well as, some of the conditioning drills and/or tests that can be utilized and tested in order to prepare for various sports. Included in this packet are the conditioning test requirements for the listed sport as required by their respective head coach.

Energy Systems and Sports



All bodily functions and movement of body parts need a constant supply of energy. This energy is provided to the body by the food we eat. But that food needs to be converted into a chemical compound for use within the body, call it a common currency used by the body for the supply of energy. This chemical compound otherwise known as ATP is that common currency regardless of the energy system employed. There are essentially 3 main energy systems in the human body and either one of them or a combination of them get activated depending upon the type of activity being performed. It is imperative that Sports coaches and athletes design their training sessions keeping in mind the workings and interplay of the various energy systems.

Furthermore, it is also important to understand that no energy system works independently and that different activities and sports have a dominant system at play, and therefore training and program design need to be planned around the dominant energy system. For example, a marathoner cannot perform short distance sprints while training to compete, as the training demands would not match the Sport specific demands.

A. The ATP-PC System (a.k.a. Phosphagen Energy System)

The ATP-PC System is the high power, short duration energy system of the body. In the absence of oxygen and with the help of enzymes, the body breaks down ATP (Adenosine Triphosphate), and as a result another chemical compound ADP (Adenosine Diphosphate) is produced when the last group of Phosphate is broken. This process is also accompanied with the release of energy of approximately 7.3 Kcal. Although this is a massive release of energy from just a single chemical reaction, it is insufficient to produce more than a few seconds of work. Therefore, this system of energy generation is very effective for activities that require short bursts of energy where the duration is no more than 10-15 seconds. Activities such as the 100-meter dash and the 25-meter swim. In addition to Adenosine, muscle cells also have another high-energy compound stored in them called CP (Creatine Phosphate or

Phosphocreatine System). CP plays a vital role in re-synthesizing ATP, thereby replenishing ATP for energy generation.

B. The Anaerobic Glycolytic System (a.k.a. Lactic Acid Energy System)

The Glycolytic system is the moderate power and short duration energy system of the body. When the body requires a high burst of energy for a duration longer than 10-15 seconds it engages the Anaerobic Glycolytic System. This system has a higher proportion of energy storing capability. Energy is provided by the breaking down of Blood Glucose and or Glycogen which is stored in the muscles and liver. Glucose is then further broken down through the process of Glycolysis to create ATP at approximately 16 [calories](#) of energy per minute.

C. The Aerobic Energy System (a.k.a. Oxidative Energy System)

The Aerobic system is the low power and long duration energy system of the body. The Aerobic system produces ATP through either [Fatty Acids](#) (Fats), Carbohydrates and as a last resort protein. Since the Aerobic system produces ATP in the presence of oxygen it has the capability to provide an endless supply of energy albeit at a much slower pace than the other two energy systems. Energy from this system fuels any activity that lasts longer than 3 minutes at low intensity or at complete rest and is estimated to create approximately 10 calories of energy per minute.

Summary of Energy Systems and Application to Various Sports

Relative Contribution of each Energy System (%)				
Sr. No	Sport/ Activity	ATP – PC	Anaerobic Glycolytic	Aerobic
1.	Aerobic Dance	5	15–20	75–80
2.	Baseball	80	15	5
3.	Basketball	60	20	20
4.	Hockey	50	20	20
5.	Football	90	10	0
6.	Golf Swing	95	5	0
7.	Gymnastics	80	15	5
8.	Rowing	20	30	30
9.	Skiing	33	33	33
a.	Skiing Jumping	80	15	5
b.	Skiing Downhill	50	30	20
c.	Skiing Cross-Country	5	10	85
10.	Soccer	50	20	30
a.	Soccer Goalie, Wing, Strikers	60	30	10
b.	Soccer Half-backs or Sweeper	60	20	20
11.	Swimming	10	20	70
a.	Diving	98	2	0
b.	Swimming 100-m	80	15	5
c.	Swimming 400-m	20	40	40
d.	Swimming 1500-m swim	10	20	70
12.	Tennis	70	20	10
13.	Walking	0	5	95
Source: ptdirect.com				

The Sport Specific Utilization of Various Energy Systems

As you can see from the table above that all three energy systems are interconnected but there will always be a dominance by one or a combination of two energy systems, coaches can effectively utilize this to plan and implement Sport specific energy system training.

Summary of the Various Energy Systems and their Application			
Energy System	ATP – PC	Anaerobic Glycolytic	Aerobic
Duration	1 – 15 Seconds	15 Secs – 2 Mins	Longer than 3 Mins
Description	Strength-Speed-Power	Muscular Endurance-Speed Endurance	Muscular Endurance-Aerobic Power
Sport	Track – 100 meters Swim – 25 meters Field Events	Track – 200, 400, 800 Meters Swim – 50, 100, 200	Mile, 2 Miles or more
Training for Optimal Performance	Utilize short explosive movements and exercises	Longer sessions but still maintaining high intensity. For e.g. Interval training for track, cricket, football etc.	Perform activity in the steady state for a minimum of 20-30 minutes (65-85% VO ₂ max)
Capacity to Generate Power	36kcal per minute	16kcal per minute	10kcal per minute

ATP-PC Energy System Conditioning **Drills/Tests (1-15 Seconds)**

20x Shuttle Test

Test Distance: 20yd x 20yd

Test Time: < 8sec with 30sec recovery

- You must start with your foot behind the line. Each trial will begin on the coach's signal. A false start is a failed try.
- The first 10 trials will be a right hand touch at the midpoint line. The second 10 will be a left hand touch. Failure to touch the line or touching with the wrong hand will be a failed try.
- Failure to make it back to the start line within the allotted time will result in a failed trial.
- You must complete all trials and pass 19 of the 20 trials to successfully pass the test.

50yd Sprint

Sprint 50 yards. Rest 30 seconds. Repeat 10 - 20 times.

Excellent: 8.4

Very Good: 8.6

Good: 8.8

Average: 9.0

Fair: 9.2

*** The above conditioning tests/drills are ideal for Football**

Football is well defined in terms of average work duration, work to rest ratios, etc.

Consider the following:

- An average play lasts 4-9 seconds.

- On Average, there are roughly 30 seconds of downtime between plays.
- One quarter contains 11-15 minutes of “playing time”, depending on the level.
- Each play demands almost max effort from each player on the field.
- Football is a change of direction sport, it is not played exclusively with linear movement.

Considering such, a [conditioning](#) test that demands short bursts of high-intensity with a work to rest ratio of about 1:5 is ideal.

Anaerobic Glycolytic Energy System (15 Seconds - 2 Minutes) Conditioning Tests/Drills

3x300 Shuttle Test

Test Distance: 25yd x 25yd

Goal: 1 minute

Recovery: 2 minutes

- You must start with your foot behind the line. Each trial will begin on the coach’s signal. A false start is a failed try.
- Your foot must cross the line at every 25yd interval.
- Failure to make it back to the start line in the allotted time will result in a failed trial.
- You must complete all 3 trials successfully to pass the test.

100's (sprint- jog back)

Sprint the length of the field (100 yards) then jog/walk back (active recovery) in goal time of 1min for each repetition.

Excellent: 15 repetitions

Very Good: 14 repetitions

Good: 12 repetitions

Average: 10 repetitions

Fair: 8 Repetitions

Cornell Conditioning Test and Goals:

Place two cones 25 yards apart from each other.

50: Goal Time 10 seconds: Recovery 20 seconds

100: Goal Time 20 seconds: Recovery 40 seconds

150: Goal Time 30 seconds: Recovery 60 seconds

200: Goal Time 40 seconds: Recovery 90 seconds

300: Goal Time 60 seconds: Recovery 120 seconds

Test:

200yd: Recovery 1:30

100yd: Recovery :40

300yd: Recovery 2:00

50yd: Recovery 20

150yd: Recovery 1:00

200yd: Recovery 1:30

50yd: Recovery 20

300yd: Recovery 2:00

100yd: Recovery :40

50yd: Finished

300's

Sprint 300 yards ($\frac{3}{4}$ of track) then jog/walk remainder $\frac{1}{4}$ of track (active recovery) in goal time for each repetition. Football field can also be used. Set one cone at each 20yd line on both sides of the field (4 total). Must run from 20yd line to 20yd line, then around 1st goal post, to the opposite side of the field 20yd line to 20yd line, then around 2nd goal post and back to the 20yd line where started.

Excellent: 1 minute

Very Good: 1:05 minutes

Good: 1:10 minutes

Average: 1:15 minutes

Fair: 1:20 minutes

Aerobic Energy System Conditioning **Tests**

1.5 Mile Run

Run 1.5 miles.

Excellent: 9:30 minutes

Very Good: 10:00 minutes

Good: 10:30 minutes

Average: 11 minutes

Fair: 12 minutes

1.0 Mile Run

Run 1.0 mile

Excellent: 6 minutes

Very Good: 6:30 minutes

Good: 7 minutes

Average: 8 minutes

Fair: 9 minutes

Beep Test (a.k.a Bleep Test, a.k.a. 20 Meter Shuttle Test, a.k.a. Pacer Test)

See link for test variations and standards: <https://beepfitness.com/help.html>

The beep test is a multi-stage [fitness](#) test used to measure cardiovascular fitness and maximum oxygen uptake (VO2 max). It is commonly used by coaches and trainers to measure athlete fitness, or used as a pre-requisite for police, emergency and military organizations. The test is also known as the bleep test, pacer test, 20m shuttle run test or Léger test.

- [Beep Test Rules](#)
- [Scoring and VO2 Max](#)
- [Test Variations](#)
- [Test History](#)
- [App Notes and Support](#)

Test Rules

The Standard test has 21 [levels](#), and each level consists of a different number of shuttles. The test is performed by running between two markers placed 20 meters (65.6 feet) apart, at an increasing pace as indicated by the beeps. The test ends when you can no longer keep pace, or level 21 is completed.

The test can be performed by an individual without assistance, or used by a coach to test an entire team.

Equipment

1. [Beep Fitness Test](#) for iOS.
2. Two or more markers, e.g. traffic cones.
3. A flat surface, suitable for running, which is at least 20m long with adequate space at each end for coming to a stop.

Procedure

1. Place markers 20 meters apart.

2. Position yourself, or athletes, at one of the markers.
3. Press the start button of the [Beep](#) Fitness Test app.
4. Run 20 meters to the opposite marker, getting there before the next beep sounds.
5. Wait there until the beep sounds before running back to the other marker.
6. Repeat this process for each shuttle until you are unable to keep up with the beeps. Remember, you must wait for the beep before starting the next shuttle.
7. When you miss a beep you must continue to run to the marker in front of you, turn at the end, and try to catch up with the pace within 2 more beeps. The test ends when you fail to reach the opposite marker for two consecutive beeps.
8. Your final score is the last level and shuttle you completed before missing a beep.