Laboratory 5  The Measurement of Muscular Power

The ability to jump, sprint, shot-put, throw the javelin, or perform fast starts are few examples of an athlete’s conversion of energy into muscular power. The ability to develop muscular power is a prime factor in athletic success. Power is the performance of work expressed per unit of time (ft-lbs/sec or Hp). The term “Explosive Power” has been associated with the left side of the energy continuum (Figure 1). Metabolic energy provided for the first few seconds of high intensity muscular efforts is provided by breaking down stored molecules of ATP and Creatine Phosphate (CP) in the myofibrillar area. Specific tests and training practices have been devised to study, quantify, and perhaps modify the athlete’s explosive power capability.

Purpose

The purpose of this laboratory is to determine muscular power of the lower extremities by means of the Sargent-Lewis Jump Test and the Margaria-Kalamen Step test.

Figure 1. Energy System Continuum.
**Procedure**

1. The Sargent-Lewis Jump Test
   1.1 Obtain the subject’s body weight.
   1.2 Measure reach height (in).
   1.3 Perform a standard vertical jump test
   1.4 Measure the distance (D) of the jump in feet and fractions of a foot.
   1.5 Repeat the vertical jump test three times.
   1.6 Calculate the muscle power output using the highest D substituted into the following equation:

   \[
   \text{Power} = (4 \times \text{weight (lbs)} \times \sqrt[2]{D(\text{ft})})
   \]

   \[= \text{____________ft-lbs/sec}^*\]

   *(Note: Assume that jump occurs in a 1 second time interval)*

   1.7 Convert power in ft-lbs/sec to Horsepower (Hp) by means of the following transformation:

2. The Margaria-Kalamen Power Test
   2.1 Obtain subject’s body weight.
   2.2 The test requires at least 16 steps with a height of 6-8 inches.
   2.3 Subject takes a position 6 meters in front of the first step in preparation to sprint up the flight of stairs taking 3 steps at a time.
   2.4 The stopwatch is started when the subject’s foot strikes the third step and is stopped when the ninth step is reached.
   2.5 Record the time in 0.01 seconds.
   2.6 Each subject performs the test 3 times with rest periods of at least 3 minutes.
2.7 Calculate Power using the following formula:

\[
\text{Power} = \frac{\text{Body weight(lbs) x [6 steps x step ht. (ft)]}}{\text{Time (sec)}}
\]

\[= \underline{\text{______________}} \text{ft-lbs/sec}\]

2.8 Convert muscle power output in ft-lbs/sec to Hp units as illustrated in procedure 1.6.
Data Sheet

Name________________________________Body Weight__________lbs.

Sargent-Lewis Test

Reach Height = _______(ft) = ____________(in)

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<thead>
<tr>
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<tbody>
<tr>
<td>Jump 1</td>
<td>Jump 2</td>
<td>Jump 3</td>
</tr>
<tr>
<td>_______inches</td>
<td>_______inches</td>
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D = (jump height – reach height) = _______inches = _____ ft.

Power = ___________ft-lbs/sec.

= ___________Hp

Margaria-Kalamen Test

Step Height =__________ in = ______(ft)

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<tr>
<td>Time 1</td>
<td>Time 2</td>
<td>Time 3</td>
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<tr>
<td>_______seconds</td>
<td>_______seconds</td>
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Best Time =__________seconds

Power =__________ft-lbs/sec

=__________Hp