

## The EKBLÖM-BAK test

### - a submaximal cycle ergometry test for estimation of $\text{VO}_2\text{max}$

*The test is based on change in heart rate between a low standard workrate (same workrate for all subjects performing the test), followed by an individually chosen higher workrate (4 min each). The pedalling rate is 60 rpm, and average heart rate is measured during the last minute on each workrate, respectively.*

1. Calibrate the ergometry cycle according to standard procedures.
2. Ensure that the individual being tested has followed conventional pre-test conditions (comment on this in the end of this manual).
3. Adjust seat and handlebar, and introduce Borg's RPE-scale.
4. Before the test, estimate a suitable higher work rate to allow the individual to reach a heart rate in the range 120-150 bpm (for individuals < 50 years) and 110-140 bpm (for individuals  $\geq$  50 years), respectively, aiming at a rated perceived exertion of  $\approx$  14 according to the Borg RPE-scale. The table below gives a rough guide to reach these pre-requisites with regard to sex and activity level.

	Woman	Man
<b>Inactive</b>	1.0 kp	1.5 kp
<b>Low</b>	1.5 kp	2.0 kp
<b>Moderate</b>	2.0 kp	2.5 kp
<b>High</b>	2.5 kp	3.0 kp

5. Start standard work rate pedalling for 4 min at 60 rpm and resistance of 0.5 kp. Check each minute that both pedalling speed and resistance are kept constant.
6. Measure average heart rate during the 4<sup>th</sup> min by taking notes of the heart rate at four occasions (3.15, 3.30, 3.45, and 4.00) and average these.
7. Increase resistance to the higher individual work rate (point 4 above). Check each minute that both pedalling speed and resistance are kept constant.
8. Ask for RPE during the 2<sup>nd</sup> min at the higher rate.
9. If RPE is
  - < 10, increase resistance with 1 kp and redo point 8.
  - 10-11, increase with 0.5 kp and redo point 8.
  - 12 – 16, maintain rate and go to point 10.
  - 17 or higher, stop the test and let the subject rest for 20 min before performing a new test at a lower rate. However, it is preferable to cease testing and perform the test on another occasion.
10. Measure average heart rate during the 4<sup>th</sup> min at the higher rate by taking notes of the heart rate at four occasions (3.15, 3.30, 3.45, and 4.00) and average these.
11. After completed test, ask for RPE for the 4 min at the higher rate.

## **Procedure for estimating VO<sub>2</sub>max**

### *Electronically*

An application for estimating VO<sub>2</sub>max with the EKBLÖM-BAK test is available at [www.gih.se/ekblombaktest](http://www.gih.se/ekblombaktest).

### *Manually*

Input the relevant variables\* into the following equation:

#### **Men**

$VO_{2max} = \text{Exp}((2.04900 - 0.00858 * \text{Age}) - (0.90742 * \Delta HR / \Delta PO) + (0.00178 * \Delta PO) - (0.00290 * \text{HR at standard work rate}))$

#### **Women**

$VO_{2max} = \text{Exp}((1.84390 - 0.00673 * \text{Age}) - (0.62578 * \Delta HR / \Delta PO) + (0.00175 * \Delta PO) - (0.00471 * \text{HR at standard work rate}))$

\*  $\Delta HR / \Delta PO$  with 2 decimals; Sex 0=Woman, 1=Man; Age in years.

Higher workrate (kp)	$\Delta PO$ factor for higher workrate
1	32
1.5	64
2	95
2.5	127
3	159
3.5	191
4	222

### **Notate Bene**

The test is only valid within the VO<sub>2</sub>max range 19-62 ml·min<sup>-1</sup>·kg<sup>-1</sup> for women and 24-76 ml·min<sup>-1</sup>·kg<sup>-1</sup> for men, and age range 21-86 years for women and 20-84 years for men.

Conventional pre-test conditions include restrictions such as

- A heavy meal no later than 3 hours before the test.
- Smoking no later than 2 hours before the test.
- No vigorous activity on the day before and on the same day as the test.
- Avoiding running, cycling or stressing to the test.

If these pre-test conditions are not complied to, or if the individual being tested is taking medications that could influence the heart rate response, it is likely that the heart rate response and the estimation of VO<sub>2</sub>max could be influenced.

The test was developed using a mechanically braked Monark cycle ergometer (Model 828E). It is important to consider that other types of cycle ergometers may give different work rate responses when adding the same resistance at higher work rates, and consequently a variation in the pulse response.

Available on [www.gih.se/ekblombaktest](http://www.gih.se/ekblombaktest) is a list over equipment needed for the test and the Borg RPE scale.