GIH THE SWEDISH SCHOOL OF SPORT AND HEALTH SCIENCES

The EKBLOM-BAK test

- a submaximal cycle ergometry test for estimation of VO_2max

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 ≥ 50 years), respectively, aiming at a rated perceived exertion of ≈ 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
Inactive	59 or 64 W	88 or 95 W
Low	88 or 95 W	118 or 127 W
Moderate	118 or 127 W	147 or 159 W
High	147 or 159 W	177 or 191 W

The watts depends on whether the work rate is measured by the flywheel or the pedals

5. Start standard work rate pedalling for 4 min at 60 rpm and the standard resistance. Check each minute that both pedalling speed and resistance are kept constant.

6. Measure average heart rate during the 4th 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 2nd 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 4th 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_2max

Electronically
An application for estimating VO_2max with the EKBLOM-BAK test is available at www.gih.se/ekblombaktest.

Manually
Input the relevant variables* into the following equation:

Men
$VO_2max = Exp((2.04900 - 0.00858*Age) – (0.90742*\Delta HR/\Delta PO) + (0.00178*\Delta PO) – (0.00290*HR \text{ at standard work rate}))$

Women
$VO_2max = Exp((1.84390 - 0.00673*Age) – (0.62578*\Delta HR/\Delta PO) + (0.00175*\Delta PO) – (0.00471*HR \text{ at standard work rate}))$

* ΔHF/ΔPO with 2 decimals; Sex 0=Woman, 1=Man; Age in years.

Higher work rate (watts)#	Factor for higher work rate
59 or 64	32
88 or 95	64
118 or 127	95
147 or 159	127
177 or 191	159
206 or 222	191
235 or 254	222

Notate Bene
The test has not been validated for electronically braked ergometers.

The test is only valid within the VO_2max range 19-62 $ml \cdot min^{-1} \cdot kg^{-1}$ for women and 24-76 $ml \cdot min^{-1} \cdot kg^{-1}$ 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_2max 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 is a list over equipment needed for the test and the Borg RPE scale.