Information for Athletes, NTC Scientists and Pathways Programs

7 x 4 min Step Test Protocol

(Update 2 - 27/12/08)
(Update 3 - 25/01/10)
(Update 4 – 14/11/16)

Compiled by:

Tony Rice PhD

Rowing Australia | Australian Institute of Sport

Office: (02) 6214-7891

Email: Tony.Rice@rowing.ausportnet.com

Table of Contents

Introduction 3

7 x 4 min Step Test Protocol – Able Bodied Rowers 3
- Laboratory Environment and Subject Preparation 3
  - Training 3
  - Diet 3
  - Test Preparation 3
  - Equipment Checklist 3
  - Ergometer Settings 4
  - Step - Test Administration: 4
  - Determination of Test Protocol 5
  - 7 x 4 min step test procedure: 6
- Analysis of Test Results: Blood Lactate Profiles 7

References 7

Introduction

The laboratory test protocol adopted by Rowing Australia aims to provide detailed physiological information of the rower's submaximal capacity and efficiency and to measure maximal performance parameters in a time efficient manner. To do this a 7 x 4 min protocol has been implemented across the country since 2006.

The standard laboratory test will be completed at least two times within each season (all dates to be communicated late 2016 and confirmed at the beginning of each season). Rowing Australia and the Australian Rowing Team require a standard summary of data on all SIS/SAS athletes who are aspiring for National Selection in the current season to be returned to the Sports Science Coordinator shortly after the completion of each testing period.

NB Testing on Concept IID and IIE ergometers - there are no significant differences in the physiological responses to either the IIC or IID ergo and thus tests can be completed on either one with the proviso that all tests for an individual athlete are carried out on the same ergometer throughout the rowing season and every effort is made to continue using the same ergometer for all subsequent seasons.

The following information is designed as a detailed guide to the testing methods.

7 x 4 min Step Test Protocol – Able Bodied Rowers

Laboratory Environment and Subject Preparation

Training

The athlete must not train at all in the 12 hours preceding the test. On the day before the test, the afternoon training session should consist of no more than 12 km on the water, and should be of low intensity (T3-T2 range). There should be no heavy weight training, or exercise to which the athlete is not accustomed. It is suggested that the athlete replicate as closely as possible similar training loads in the 24 hours leading into each testing block.

Diet

A normal meal (incorporating a high carbohydrate component) should be eaten on the evening preceding the test and, if scheduling allows, also on the day of the test. No alcohol should be consumed in the 24 hours preceding the test. The athlete should give special attention to ensuring good hydration in the lead-up to the test.

Test Preparation

Each laboratory may have information and consent forms that may need to be provided prior to the test.

Equipment Checklist

- Concept IID or IIE rowing ergometer
- Heart rate monitoring system
- Expired gas analysis system (as per general recommendations)
- Stopwatch
- Lactate analyser (Lactate Pro2 or Lactate Edge are recommended)
    - Disposable rubber gloves
    - Sharps container

- Biohazard bag.

Ergometer Settings

Table 1: Ergometer Drag Factor Settings

Category	Drag Factor
Junior Female	100
Lightweight Female	100
Heavyweight Female	110
Junior Male	125
Lightweight Male	125
Heavyweight Male	130

Step - Test Administration:

Athletes will start the 7 step test protocol with a work load based and increment based purely on their **previous year's** best 2000m time. The range of times for the 2000m ergometer tests have been divided on 10 sec increments with the fastest 2000m times having the highest starting work load and increment (see Table 2).

In order to ensure that individual athlete's complete the identical amount of work prior to beginning the 7th step (4 min at maximal pace) every 7 x 4 min step test undertaken by the athlete for that seasonal year must use the same starting work load and increment. In other words there will be no increment of starting work load during the season. The only way an athlete will be able to change their starting work load or increment will be to perform a 2000m test that has a time that places them into a different time bracket. There should be a significant change in 2000m time for a change in work load and increment to be warranted.

The work loads and increments have been designed such that the 6th step (i.e. the step immediately preceding the maximal step) produces a blood lactate value in the range of 5-8 mmol/L and corresponds to a pace very close to their 5000m pace. Obviously this will change depending on the time of year and the athlete's current training status but importantly in a single season the athlete will complete an identical amount of work leading into the maximal performance component of the test and thus the work loads remain constant.

The scientist in charge is given flexibility in choosing if moving to the next 10 sec increment is valuable or not. An example would be that when an athlete has 4 years of data all starting at the same work load and increment but finally betters their 2000m time from 5:50.6 to 5:49.8. Taking the protocol to its exact description would mean the athlete would change their starting work load and increment. However the gain in doing this is far outweighed by the inability to compare the athlete across the 4 years of data using the previous starting work load and increment. In cases such as this it is left to the discretion of the coach and scientist to decide what should be the appropriate starting work load and increment for that athlete. Scientists can contact either the Head Coaches, HPD or Tony Rice for additional consultation if required.

The 2000m category times used in Table 2 are based on the athlete's best 2000m time from the previous year and **not their all-time personal best 2000m test**. Thus it is possible that work loads could change slightly from one year to the next. **If this is the case, comparison between years for the same individual, or in the same year between individuals, must only be done using variables such as heart rate, blood lactate, VO_2 and perceived exertion at LT1, LT2 and the maximal step. Distance covered in the final maximal step can only be used as a comparison between athletes when those athletes have completed the same amount of work prior to the maximal step i.e. identical starting work load and increment.**

Determination of Test Protocol

Table 2: Ergometer work loads (W and mm:ss.s) categorised with respect to the athlete's best2000m time in the previous year

Previous Years Selection Ergometer Time	<5:50:0	5:50.0 - 6:00.0	6:00.0 - 6:10.0	6:10.0 - 6:20.0	6:20.0 - 6:30.0	6:30.0 - 6:40.0	6:40.0 - 6:50.0	6:50.0 - 7:00.0	7:00.0 - 7:10.0	7:10.0 - 7:20.0	7:20.0 - 7:30.0	7:30.0 - 7:40.0	7:40.0 - 7:50.0
Work Load Increments (W)	45	45	40	35	35	30	25	25	25	20	20	15	15
Work Load 1 (W)	200	170	170	160	140	140	150	130	115	125	110	120	110
Work Load 2 (W)	245	215	210	195	175	170	175	155	140	145	130	135	125
Work Load 3 (W)	290	260	250	230	210	200	200	180	165	165	150	150	140
Work Load 4 (W)	335	305	290	265	245	230	225	205	190	185	170	165	155
Work Load 5 (W)	380	350	330	300	280	260	250	230	215	205	190	180	170
Work Load 6 (W)	425	395	370	335	315	290	275	255	240	225	210	195	185
Work Load 7 (W)	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX
Work Load 1 (mm:ss.s)	02:00.7	02:07.4	02:07.4	02:10.0	02:15.9	02:15.9	02:12.8	02:19.3	02:25.2	02:21.2	02:27.3	02:23.1	02:27.3
Work Load 2 (mm:ss.s)	01:52.7	01:57.8	01:58.7	02:01.7	02:06.2	02:07.4	02:06.2	02:11.4	02:15.9	02:14.3	02:19.3	02:17.6	02:21.2
Work Load 3 (mm:ss.s)	01:46.6	01:50.5	01:52.0	01:55.2	01:58.7	02:00.7	02:00.7	02:05.0	02:08.7	02:08.7	02:12.8	02:12.8	02:15.9
Work Load 4 (mm:ss.s)	01:41.6	01:44.8	01:46.6	01:49.8	01:52.7	01:55.2	01:56.0	01:59.7	02:02.7	02:03.8	02:07.4	02:08.7	02:11.4
Work Load 5 (mm:ss.s)	01:37.4	01:40.1	01:42.1	01:45.4	01:47.8	01:50.5	01:52.0	01:55.2	01:57.8	01:59.7	02:02.7	02:05.0	02:07.4
Work Load 6 (mm:ss.s)	01:33.8	01:36.1	01:38.2	01:41.6	01:43.7	01:46.6	01:48.5	01:51.3	01:53.5	01:56.0	01:58.7	02:01.7	02:03.8
Work Load 7 (mm:ss.s)	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX	MAX

7 x 4 min step test procedure:

1. Complete and give scientist your Informed Consent forms.

2. The scientist may measure the following physical parameters: height; weight; sitting height; arm span; sum of 7 skinfolds (only sum of 7 skinfolds is a requirement of RA but it is good practice if labs have the available resources to complete the additional measurements)

3. Attach a heart rate monitor and ensure it is working correctly

4. The scientist will adjust the ergometer drag factor to that appropriate to your competition category (*see* Table 1) and provide you with the work loads for your 6 increments (see Table 2).

5. The scientist will position the gas collection apparatus (respiratory valve etc) and ensure that the athlete is as comfortable as possible. Take several light strokes and the scientist will make any necessary adjustment to respiratory hoses or other apparatus to ensure that the hose is not pulling on the breathing apparatus at any stage during the stroke

6. The scientist will collect a pre-exercise blood sample from the earlobe using a Lactate analyser

7. The scientist should set the ergometer output display to show Watts for each stroke as well as set the work load time and rest interval.

8. The scientist will attach the nose clip and prepare to start the test if the test requires gas analysis.

9. Start rowing when instructed.

10. Blood is collected from your earlobe during each rest period and analysed. During the 1 min rest period, you may be permitted to remove the gas collection apparatus to have a drink. However, it is important to ensure that the breathing apparatus is back in position well before the start of the next work bout (approximately 10–15 s).

11. You are required to complete 6 submaximal work loads prior to beginning the maximal step. Your starting work load is based on your best 2000m time from the previous year and the work loads for all rowing categories are contained in Table 2.

12. **There is only the standard 1 min break between the end of the final submaximal step (6th step) and beginning the 4 min maximal step.**

13. Begin the 7th step of the test with a few seconds remaining in the 1 min recovery. Remember the aim of the test is to cover as many meters as possible in the 4 minutes so a racing start is recommended. You should be exhausted at the completion of the 4 minutes of rowing. If possible try to even split the 4 minutes rather than starting conservatively and then coming home strong. You should be able to hold or better your average 2000m split for the entire 4 minutes. Coincident with the maximal performance assessment will be the attainment of maximal heart rate, blood lactate concentration and oxygen consumption.

14. At the end of the test, the scientist will help you remove the breathing apparatus as rapidly as possible.

15. An earlobe blood sample should be collected and analysed at the completion and 4 min post completion of the final maximal step. The highest value of these two readings **must** be used as the peak blood lactate associated with the maximal 4 min step.

Analysis of Test Results: Blood Lactate Profiles

Submaximal oxygen uptakes are calculated by averaging the readings recorded during the final 2 min of each submaximal workload.

The maximum oxygen uptake is recorded as the highest value actually attained over a period of a full minute. Thus, if the gas analysis system is based on 30 s sampling periods, the maximum oxygen uptake is the sum, or if all results are expressed in $L.min^{-1}$, the average of the highest two *consecutive* readings. If 15 s sampling periods are used, the maximum oxygen uptake is the highest value obtained on the basis of any four consecutive readings.

Submaximal heart rates are the values for the final 30 s of each submaximal workload. The maximum heart rate is the highest value recorded over a 5 s sampling period during the entire test.

Computerised analysis allows for quite simple determination of the various blood lactate transition thresholds and associated measures. The ADAPT* (Automatic Data Analysis for Progressive Tests) software package is to be used to calculate these thresholds from the test data.
**(ADAPT software is available to the Australian sport science community from Sport Sciences, Australian Institute of Sport, PO Box 176, Belconnen ACT 2616.)*

Data from the final maximal step are included as the final work load values (including peak lactate) and used in combination with values from the submaximal workloads for calculation of the blood lactate thresholds and related measures in ADAPT.

References

Gore CJ. (Editor) (2000) Physiological Tests for Elite Athletes / Australian Sports Commission. Human Kinetics Champaign IL. Chapters 2, 3, 8 and 22.

Medbø JI, Mohn A-C, Tabata I et al. (1988) Anaerobic capacity determined by maximal accumulated O_2 deficit. *Journal of Applied Physiology* 64: 50–60.