

Guidelines for the new 7-STEPS rowing ergometer protocol to estimate VO₂max

Based on original articles:

JENSEN, K., FRYDKJÆR, M., JENSEN, N. M. B., BANNERHOLT, L. M. & GAM, S. 2021. A Maximal Rowing Ergometer Protocol to Predict Maximal Oxygen Uptake. *Int J Sports Physiol Perform*, 16, 382-386.

MAZZA, O. B., GAM, S., KOLIND, M. E. I., KLÆR, C., DONSTRUP, C. & JENSEN, K. 2023. A Maximal Rowing-Ergometer Protocol to Predict Maximal Oxygen Uptake in Female Rowers. *Int J Sports Physiol Perform*, 18, 861-865.

7-STEPS: Guidelines for carrying out the 7-STEPS test for estimating maximal oxygen uptake (VO₂max) in club and elite rowers

BACKGROUND: The test is based on a close correlation between achieved Watts in an individually adapted stair test (7-STEPS) and a directly measured VO₂max with 34 and 30 Danish male and female club and elite rowers, respectively.

PROCEDURE: First, select a level to start the test at. The level should be based on your expected 2k average time. See times in the columns to the right of the table. [see table below!](#)

EXAMPLE: You expect to be able to row 2k with an average time per 500m of 2:00. In the table, you select the nearest level. In this case, Level 9.

SETTING: DRAG FACTOR, and STROKE RATE: Then set the ergometer with the drag factor you prefer to row with (about the same as in a 2k is suggested) and program it for 2 min intervals with a 0 sec break. The test is completed at the pace that suits you best (most efficiently) in the individual steps. Typically, you will start low T18 and finish high T32-34.

WARM-UP: As the test starts very quietly, only a short light warm-up of e.g. 4-6 min on stage 1 of the chosen level. After this, a short stop after which the cover clothes is removed and the test starts at step 1 (40% of 2k).

IMPLEMENTATION: If you have hit your level right, the first 3-4 steps (from 40-70%) will feel easy and there is plenty of time for you to settle in - ie. hits the right wattage (cut) within the first 3-6 strokes of each step. It is important that you lie evenly and stably at the right wattage. Stages 5, 6 and especially 7 (100%) become harder and require full concentration. Remember that 100% corresponds to your 2k average watts but you "just" must keep it for 2 minutes. Even so, it will be difficult to fully complete step 7 – but if the level is chosen correctly, it will be possible to try (briefly) step 8. You must stop the test when you can no longer keep the step's wattage above 3 -4 continuous strokes ("to exhaustion"). The time for interruption of the test is to be remembered and written down. If you complete any of step 8 or step 9, it's because you underestimated yourself on a 2k. and next time you might choose a correspondingly higher level.

AFTER THE TEST: You will probably find that after 5 minutes of rest you are relatively ready again and will be able to complete a planned training program - possibly with a slight reduction. Accordingly, the test can be included in your normal training without any problems.

RESULT: The result of 7-STEPS is calculated as the last fully completed steps plus the increase in watts to the last (uncompleted step) multiplied by the achieved time's fraction of the entire step's time (2min). EXAMPLE You rowed level 9. managed to complete 6 stages, but had to stop after 90 seconds on stage 7. The result is thus the Watts of the last completed stage plus the increase per stage multiplied by 90/120: So, $189 \text{ watts} + (210-189) * (90 /120) = 205 \text{ Watts}$.

VO2max can be calculated via a formula but can also - more simply - be read from the nearest watt figure in step 7 of the table. (obs: table different for men (m) and women (k)). In the example above, oxygen uptake is read from the nearest whole watt figure (210W) to or approx. 3.0 and 3.2 L oxygen per min for woman and man, respectively.

VO2max is an expression of the circulation's total capacity to deliver oxygen to the muscles during maximum whole-body work ("Body motor"). In rowing, it is most often expressed in Liters of oxygen per minute, while in more everyday activities it is expressed per kg of body weight.

The 7-STEPS test has been designed so that the energy for the implementation comes primarily from the supply of oxygen to the muscles. Therefore, the achieved watt result will have a good correlation with VO2max. (However, on condition that the test has been completed correctly: i.e. with effective rhythmic and stable rowing without the large fluctuations over the individual steps).

INTERNATIONAL LEVEL ROWERS: The marked steps in the red and blue mark the levels for the international elite for respectively women and men.

Kurt Jensen 22-02-23

7-STEPS testprotokol i Roergometer

Trin → Niveau ↓	1 40%	2 50%	3 60%	4 70%	5 80%	6 90%	7 100%	8 110%	9 120%	2k 500m	tid 2k	k VO2max	m VO2max
1	44	55	66	77	88	99	110	121	132	02:27	09:48	2,0	2,1
2	48	60	72	84	96	108	120	132	144	02:23	09:32	2,1	2,2
3	52	65	78	91	104	117	130	143	156	02:19	09.16	2,2	2,3
4	56	70	84	98	112	126	140	154	168	02:16	09.04	2,3	2,4
5	60	75	90	105	120	135	150	165	180	02:13	08.52	2,4	2,5
6	64	80	96	112	128	144	160	176	192	02:10	08.40	2,5	2,6
7	68	85	102	119	136	153	170	187	204	02:07	08.28	2,6	2,8
8	76	95	114	133	152	171	190	209	228	02:03	08.12	2,8	3,0
9	84	105	126	147	168	189	210	231	252	01:59	07.56	3,0	3,2
10	92	115	138	161	184	207	230	253	276	01:55	07.40	3,2	3,5
11	100	125	150	175	200	225	250	275	300	01:52	07.28	3,4	3,7
12	108	135	162	189	216	243	270	297	324	01:49	07.16	3,5	3,9
13	116	145	174	203	232	261	290	319	348	01:46	07.04	3,7	4,1
14	124	155	186	217	248	279	310	341	372	01:44	06.56	3,9	4,4
15	136	170	204	238	272	306	340	374	408	01:41	06.44	4,2	4,7
16	148	185	222	259	296	333	370	407	444	01:38	06.32	4,5	5,1
17	160	200	240	280	320	360	400	440	480	01:36	06.24	4,8	5,4
18	172	215	258	301	344	387	430	473	516	01:33	06.12		5,8
19	184	230	276	322	368	414	460	506	552	01:31	06.04		6,1
20	196	245	294	343	392	441	490	539	588	01:29	05.56		6,4
21	208	260	312	364	416	468	520	572	624	01:28	05.52		6,8