

# Crew Selection

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## Introduction

The FISA CDP courses in Levels I and II attempted to provide a coaching educational package of useful information presented in a simple and practical way. One of the concepts emphasized has been that information obtained from using expensive and complicated equipment, although perhaps helpful at times, is not necessary to produce and select world class rowers.

Further, many coaches unfortunately lack not only information from scientific testing but also information about the performance capabilities of their athletes either individually or in specific combinations. Although the coach may have knowledge about the athletes' past performances, the coach may not have information about their present capabilities. This fact may be due either to the absence of sufficient or any competitions, or to a short period during which the coach must select the athletes.

This may apply to either a club coach or national coach selecting a few months or even a few weeks before a championship. This situation is especially challenging for the coach during the process of selecting a crew. To alleviate these difficulties, a simple and objective selection system was devised and has been used quite successfully in the United States.

This selection system is termed **seat racing**.

## Seat Racing

This term refers to the procedure whereby an athlete competes directly with another athlete for a seat in the boat by switching that athlete from one boat to another. Although the use of this procedure is generally in situations where the coach has more athletes than seats available in crew boats, it may also provide information about the placement of the athlete within the crew.

## Domestic Rowing in the United States

The major part of domestic American rowing is in the universities. The level varies from very good (6 to 7 schools) to very, very bad. Most of the schools start on-the-water training at the beginning of March, sometimes even the middle of the month, and will have a competition period commencing in April and culminating in May or June. Since the larger programs have about 18 to 30 athletes trying to make the first boat (the Varsity Eight), there is a need for a fast, simple and objective selection procedure. Seat racing is, therefore, commonly used.

Since there are only 2 to 4 clubs that have some type of systematic, annual training program, most clubs will rely on the influx of student athletes at the end of the college season for rowers to participate in the National Championships. As the Nationals are usually in June, the clubs must select quickly to choose crews, hence seat racing. It may be noted that early selection allows the "cuts" to leave the program and seek summer employment.

The high school rowing programs are generally much smaller than the university programs. In most cases, the schools are organized to allow students the opportunity of participating in a different sport during each semester (fall, winter and spring). Rowing is a spring sport. Since there are sometimes only 2 to 3 weeks of training before the first race, there is again a need for fast, yet effective, selection: seat racing.

Finally, the National Teams are generally formed using candidates from the clubs and universities who are often all together for the first occasion at the end of June. Since there is no real club racing season and information may be lacking about many of the candidates (for example, information on their ability to race either in boats other than an eight or in different combinations), seat racing is a valuable and efficient tool.

### Method

The seat racing process is often used to select from a group of athletes with different technique, skills or fitness, and unknown racing ability. The procedure is a direct race for a seat by switching the athlete with another athlete from one boat to another boat.

Although the race can take place over the standard course distance of 2000 m, **it is recommended that either a measured distance (1000 or 1500 m) or a timed interval (3 to 5 minutes) be used.** The reason is simply the fact that many races may be necessary either in one day or over a number of days which may cause too much stress on the athletes if the full distance is used.

It is also recommended that a fixed start not be utilized and, therefore, **it will be necessary to control the start by having the crews rowing into the start together while uniformly increasing the rate and pressure on the command of the starter.** Although it is recommended that the boats are reasonably aligned for rowing into the start, there is usually a difference in start position. This difference should be minimum and must be noted to ensure the determination of the correct difference at the finish.

**It is also usual to control the rate during the race.** The actual rate depends on the boat type, the ability of the rowers and the training period but will probably be in the range of 30 to 34 strokes per minute.

**After the race, the boats pull together and switch one of the rowers.** This switch takes place on the water immediately after the race. The crews then proceed to the start area for the next race.

An actual format may be the following:

We have a group of 16 sweep rowers (8 starboard and 8 port) and have perhaps already made a preliminary ranking from 1 to 8 for each side. We divide them into two groups of coxed fours (4+). We race them within each group and, after 2 to 3 sessions, we know the winners (the 2 best starboards and the 2 best ports) and the losers in each group.

Then, we race one 4+ of winners from one group against the winners from the other group and the losers against the losers. After that we are ready to make the final ranking.

The selection can be completed in 3 to 4 days if everything goes smoothly and without interruptions (injury, broken equipment, bad weather, etc.). Most coaches prefer using the 4+ for seat racing of sweep rowers because the results are readable, there are fewer variables and one session may be enough to learn about each group of the four athletes from one side.

### Example of a Seat Racing Session with Two 4+

The following is an example of seat racing with two 4+ designated A and B.

	A	B
#4 stroke	4A	4B
#3	3A	3B
#2	2A	2B
#1 bow	1A	1B
cox	John	Mark

#### 1st Race - 5 mins: A>B by 2 seats.

The difference of 2 seats is the coach's determination of the net difference of the bow of the boats at the finish. This difference is measured by an eye observation from the coach using a reference point of the space occupied by the athlete in the boat; that is, the space from the back of the slide to the front of the footstretcher. Thus, boat A finished 2 seats ahead of boat B.

*NO CHANGE.*

#### 2nd Race - 5 mins: A>B by 3 seats.

This demonstrates consistency and verifiable results. In the event that the results are otherwise (for example, B>A by 5 seats) it would be necessary to examine the two strokes or look for an athlete who is an "anchor."

*CHANGE #3. (3A to B; 3B to A)*

#### 3rd Race - 5 mins: B>A by 5 seats.

Since 3A won the 2nd race by 3 seats and, after the change, the 3rd race by 5 seats, athlete 3A is better than athlete 3B by 7-8 seats.

*CHANGE #1. (1A to B; 1B to A)*

#### 4th Race - 5 mins: B>A by 1 length or 10 seats.

Therefore, 1A is better than 1B by 5 seats.

*CHANGE #2. (2A to B; 2B to A)*

**5th Race - 5 mins: A>B by 5 seats.**

Therefore, 2B is better than 2A by 15 seats. Indirectly the strokes (4A and 4B) have now also been compared with the result that 4A is better than 4B by 7-8 seats.

To provide a different scenario for a change, it is possible to switch back any two individuals either immediately or later to confirm results.

**Analysis**

The results may be analyzed directly or indirectly.

**1. Direct results demonstrate:**

Port winners:	4A 2B	Starboard winners:	3A 1A
losers:	4B 2A	losers:	3B 1B

For the next session, we pair winners against winners and losers against losers. Thus, we will have for the next set of seat racing with two 4+ these designated A and B boats:

	A	B
#4 stroke	4A	2B
#3	3A	1A
#2	2A	4B
#1 bow	3B	1B
cox	John	Mark

After this session, we will have enough information to provide a final ranking for port and starboard within this group.

**2. Indirect results may be determined by counting won (+) and lost (-) races by the number of seats. This would demonstrate:**

Race:	1	2	3	4	5		
4A	+2	+3	-5	-10	+5	=	-5
3A	+2	+3	+5	+10	-5	=	+15

Note: The rowers are from different sides.

**3. In the case when most of boat A has been selected and we are seeking a final clarification, we could also examine the results to determine who has made boat A go the fastest. This may demonstrate:**

Boat A with 3A rows 1500 m in 4:15. Boat B with 1A rows 1500 m in 4:20.

Boat A with 1A rows 1500 m in 4:18. Boat B with 3A rows 1500 m in 4:24.

This result indicates that 3A would be selected because this athlete made boat A go the fastest in spite of the bigger difference when changed to boat B.

### Crucial Aspects

There are a number of important points that must be given consideration during seat racing. These are:

1. The equipment must be comparable, in good condition and properly rigged.
2. There should be no rigging changes during or between the sessions.
3. There must be a good clean start with no crew either jumping the start or overstroking.
4. The stroke rate must be in a narrow range and controlled closely at all times.
5. The situation during the race should be noted; that is, who led, who sprinted, etc.
6. If a crew suffers a crab, broken equipment, etc. during the race, note the time and position at the time of the mishap.
7. Seat racing should not be used to select from athletes who exhibit poor technique.
8. It is not proper to race tired rowers who have had a few sessions of seat racing against rested rowers who are making their first appearance.
9. It is important to note the different position of the bow of the boats at both the start and finish, even small differences, in order to determine the net difference at the finish.
10. If the race will determine an important selection, it may be advisable to repeat the race or immediately switch back for the next change.
11. The maximum number of races should be 5 in one session otherwise you may be selecting the survivors and not necessarily the fastest.
12. After each switch, ask the coxswains about the races, the switches and the feeling in the boat.

### Summary

Seat racing is a simple, objective tool for the selection of rowers especially when working with a large group.

It allows a direct comparison between two rowers under the same conditions with other factors constant (boat, stroke and crew combination). It is a great training and racing preparation device and **the rowers like it - the simple answer.**

But, it is easy to miss fast combinations; and, it is also easy to exaggerate the use of seat racing and overtrain the rowers.

**Remember, seat racing sessions that are well conducted and correctly analyzed will provide a valuable tool to be used for a simple, objective and effective selection.**

# Applied Rowing Ergometer Testing

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## Introduction

A number of fitness tests have been developed to measure the aerobic and anaerobic capacities of elite athletes and determine the effects of specific training regimens. Initially these tests utilized the indirect measurement of gas volumes and fractions to determine oxygen consumption during and following maximal exertion (3, 8, 11, 16, 17, 18, 19, 24, 27, 28, 29, 30). Pulse rates were then matched with  $\text{VO}_2$  and when correlated with power output were then used to predict fitness (1, 2, 5, 7, 9, 10, 14, 15, 31, 32). Some tests have utilized pulse rate responses either during an incremental exercise load or a standardized exercise to estimate aerobic fitness or physical working capacity (2, 5, 10, 14, 15). A test designed by Conconi (6) and the standardized blood lactate procedure devised by Mader and Heck (23) have been used extensively by a variety of sports to assess fitness and plot training responses. Anaerobic fitness has also been estimated with tests designed by Koutedakis (22), Margaria (24), and Bar-Or (3).

It is generally agreed among rowing trainers (coaches) that most training for rowing should be devoted to improving oxygen utilization and transport. With the exception of measuring  $\text{VO}_2$  during and following actual rowing or rowing ergometry (16, 17, 18, 20, 21, 29) or applying the Conconi test (12, 13) or lactate analysis (23), most of the current fitness tests are not specific enough to adequately measure rowing fitness. We have already demonstrated that the aerobic and anaerobic components of rowing could be estimated using rowing ergometer testing (17). However, the measurement of exercise and recovery  $\text{VO}_2$  is costly, requires special equipment, and is very time consuming. In addition any  $\text{VO}_2$  test by itself, whether steady-state incremental, or a simulated 2000 m, cannot determine the specific effects of utilization or transport training. With this in mind we wanted to design a test that: 1) would permit team testing over a one or two day period (effective use of time available during elite athlete test weekend); 2) would assess maximal work capacity, sub-anaerobic threshold, and anaerobic threshold responses; 3) would provide useful information to coaches and athletes concerning the relative development of utilization and transport systems and determine effects of training; and 4) would offer a simple, easily administered test procedure that could be carried out and reproduced in any boathouse.

## Methods

### *Maximal Test*

Each athlete being tested will initially perform a maximal 2000 m effort on a rowing ergometer followed by 3 successive submaximal efforts at 60%, 70%, and 80% of either the athlete's own maximal power output or the average team power output; most coaches prefer to use the latter. At least 24 hours must elapse

between the end of maximal testing and the beginning of submaximal testing for each subject to permit adequate physiological recovery.

The exercise test procedure begins with a maximum ergometer effort for 2000 m using a Concept II rowing ergometer fitted with the special low resistance sealing ring (speed ring) with the air vents completely closed and the chain engaged on the small sprocket of the flywheel. Immediately before this test the athlete is fitted with a telemeter pulse monitor unit (Polar CIC, Inc., USA) consisting of a transmitter attached to an elastic band worn around the upper back and chest and adjusted so that the transmitter is positioned just left of center on the chest at mid-sternal level. The pulse signal is transmitted to a pulse rate watch either worn on the athlete's wrist or, as used more often, hand-held by someone recording pulse rate data. Exercise pulse rate is recorded at each 500 m segment. In addition to pulse rate data the recorder notes total accumulated time and stroke rating and observes average time for each successive 500 m segment of the 2000 m exercise. The digital display on the Concept II ergometer can be set for continuous monitoring of 500 m split times or average power output in watts; in most cases athletes prefer 500 m split times. A 5 minute recovery period follows exercise with the rower in a seated position. At 5 minutes of recovery a microliter capillary blood sample is taken using a finger or ear lobe prick and the sample is then analyzed on a YSI lactic acid analyzer (models 23L or Sport 1500; Yellow Springs Instruments, Inc., USA). Pulse rate is recorded at the end of each minute of recovery in order to determine cardiovascular recuperative ability. Each athlete is encouraged to take a normal warm up before the maximal effort but warm down is not permitted as it may affect recovery lactate values. We have selected a 5 minute recovery period for sampling because lactate values seem to consistently peak at this time following maximal rowing efforts and the athlete sits quietly because a low intensity warm down exercise tends to increase lactic acid clearance from the muscle and blood and its subsequent resynthesis.

This 2000 m maximal effort should be performed no less than 24 hours before the successive submaximal 60%, 70%, and 80% of max efforts.

### ***Submaximal Tests***

At least a 24 hours period should separate the maximal test and the beginning of the submaximal testing. The submaximal testing requires the athlete to row at 60%, 70% and 80% of their own previously recorded maximal power output, the average team maximal power output, or if the coach desires, a series of predetermined 60%, 70%, and 80% submaximal efforts. Each of the 3 successive submaximal efforts are 5 minutes in duration and pulse rate is recorded at the end of every minute for each of the efforts. A microliter blood sample is taken by finger or ear lobe prick immediately following completion of the 60% and 70% of max efforts while a 5 minute recovery follows the 80% of max effort; pulse rate is recorded at the end of each recovery minute and a microliter blood sample is taken at 5 minute recovery via a finger or ear lobe prick. A recorder is assigned to each athlete being tested and will serve to assist the rower in maintaining the prescribed steady-state power intensity and note exercise time, heart rate, and stroke rating. No warm up is necessary prior to the 3 submaximal exercise bouts since the first exercise test (60% of max power) serves as an optimal warm up. The test subjects have had no problems maintaining the prescribed power outputs as there is a constant display of average watts or 250 m split times depending on the athlete's preference for pacing assistance.

We have successfully utilized the following predetermined work intensities for U.S. National Team testing:

*Table 1*

Group	60%		70%		80%	
	500m split	Stroke rate	500m split	Stroke rate	500m split	Stroke rate
Male Heavy	1:47	18-20	1:42	20-22	1:37	22-24
Female Heavy	2:03	18-20	1:58	20-22	1:53	22-24
Male Light	1:55	18-20	1:50	20-22	1:45	22-24
Female Light	2:11	18-20	2:06	20-22	2:01	22-24

These times and stroke ratings can be adjusted according to the quality of athletes being tested. If the athlete's own maximal power output is used then the submaximal test protocol simply involves using 60%, 70%, and 80% of the maximal values and although 500 m split times can be used it is often better to use watts as the power indicator; e.g., athlete's max power output is 350 watts, therefore 60% would equal 210 W, 70% would equal 245 W, and 80% would equal 280 W. These same calculations can be applied to the team maximal power output. We prefer to use the team average maximal power output to calculate the appropriate submaximal work intensities and in doing so believe that a standardized exercise intensity for all team members provides more useful comparative data.

Although submaximal testing can be conducted as many times as the coach desires we recommend the following schedule for National and Olympic Teams: maximal test conducted in late November or early December followed as closely as possible by first series of submaximal tests and then followed by submaximal testing in late February or early March, late May or early June, and finally in late July or early August. This test schedule can be adjusted accordingly for the usually shorter college and club seasons.

This schedule also allows for frequent testing but not so much that it will be disruptive to normal training. It will also permit adequate time to make the necessary training adjustments if results demonstrate that expected training goals are not being achieved. Because most club, college, and developing rowing programs may not have access to blood lactic acid analysis but can continuously measure pulse rates, it is possible to monitor and determine effects of training based on pulse rate data only.

## Results

### *Maximal Test*

Maximal power output, heart rate, and blood lactate data are used to determine maximal aerobic and anaerobic capacity. These data are more appropriately defined as peak data because the testing procedure does not follow the recommended increasing intensity of traditional maximal tests. However we believe a simulated 2000 m all-out ergometer effort provides more applied information to the coach and athlete and can provide excellent selection data and help to reveal talent and determine fitness for exhaustive exercise. The following

peak power output, heart rate, and lactate values for National and Olympic Team candidates have recently been reported:

Table 2: Range of Peak Values

Group	Power Stroke (Watts)	Heart Rate (beats/min)	Lactate (mmol/L)
Male Heavy	420-520	175-200	10-20
Female Heavy	260-360	175-200	8-18
Male Light	350-400	175-200	10-20
Female Light	220-320	175-200	8-18

### Submaximal Tests

The major purpose of these tests is to determine the effects of specific training programs, especially the balance between utilization and transport training. Because the emphasis is on utilization training during the out-of-competition period and it also represents a major proportion of training during the competitive period, test results are indicative of how closely the athletes have followed the prescribed training program.

Based on submaximal data observed for recent National and Olympic Teams the submaximal tests should yield the following results:

Table 3: Submax Test

Percentage of maximum	HR (beats/minute)	LA (mmol)
60%	120-140	1-2
70%	140-160	2-4
80%	160-180	4-6

It is important to note that these values are ideal and athletes should expect to achieve them only when they have followed prescribed training and have reached a high level of physical fitness. There are, of course, exceptions and some athletes, because of heredity factors or other influences, may demonstrate different than expected results.

### Discussion

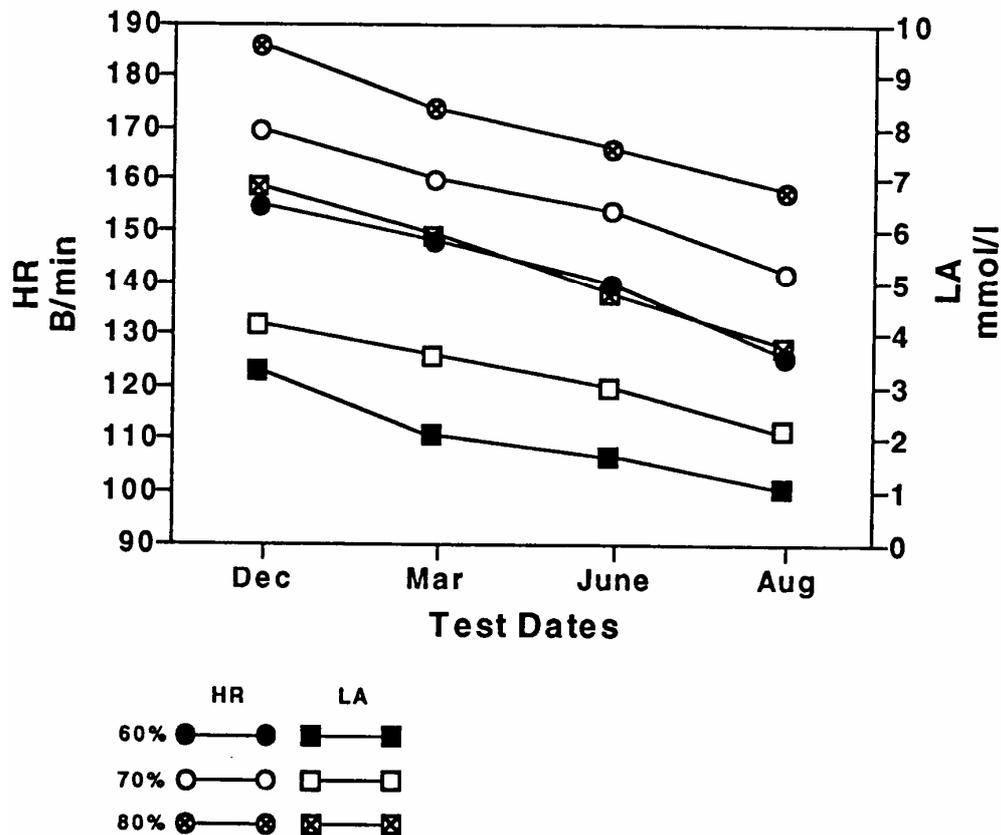
There are several advantages to this testing program: it requires very little time to administer and because the submaximal test results are based on the initial maximal test there is no need of repeating the maximal 2000 m ergometer test again unless additional maximal or peak data are needed. However, if it is desired to chart training effects accurately then all subsequent submaximal test results should be compared based on the initial maximal power output.

The submaximal data have proven valuable in charting training effects and thus have allowed time to modify or change training programs if necessary, discovered athletes who have not adhered to prescribed training, revealed overtrained and fatigued athletes, and have afforded important individual data for training diaries and schedules. This testing program has also provided a valuable learning experience for everyone. The optimal heart rate and lactate values of the upper end

of the 70% of maximal power test and lower end of the 80% of maximal power test approximate anaerobic threshold (AT), Lactate Takes Hold (LAT), or Onset of Blood Lactate (OBLA) for elite rowers. Our previous data have shown that elite rowers achieve an AT of about 85% of maximal working capacity when they are highly trained (26), and using Mader's standard AT value of 4 mmol/L seems to confirm that in most cases our recommended heart rate and lactate values for the 80% test are very near AT, LAT, or OBLA.

Results of the submaximal testing can be displayed in tables or plotted graphically. It may be more useful for displaying individual data to graph subsequent HR and LA data. In this way the athlete may be provided a clearer picture of his/her progress during training. A typical and expected graphic portrayal is presented and indicates significant training effects as both the submaximal heart rate and lactate curves shift to the right following extensive prescribed training. (see Fig. 1)

Figure 1: Typical submaximal heart rate and lactic acid responses during sequential submaximal ergometer testing.



There have been several examples recently where these series of periodic submaximal test data have been used to modify or change the training program. In one instance two athletes who were training without close supervision were tested early in their training program (March - Test 2) and were found to have excessively high submaximal pulse rates and lactates. It was discovered that both believed the prescribed utilization training was of too low an intensity and that there was not enough anaerobic work included. Therefore, they decided to perform their

utilization training at a higher intensity and also add significant amounts of anaerobic work to their training. It can be noted in their following data that heart rate and lactate data are not compatible with expected results for the second test but after convinced to follow the prescribed training, data for the third series of tests demonstrated each was back on proper physiological track. These submaximal tests are thus especially crucial in the early states of training.

Table 4

Rower		December		March		June	
		HR (b/min)	LA (mmol/L)	HR (b/min)	LA (mmol/L)	HR (b/min)	LA (mmol/L)
A	60%	148	3.3	161	4.9	141	2.9
	70%	165	5.2	171	6.6	153	4.2
	80%	185	6.4	190	9.1	166	5.9
B	60%	153	3.6	175	5.4	148	3.0
	70%	171	5.9	180	8.1	167	6.0
	80%	192	6.6	198	10.4	183	6.6

In another instance several National Team athletes, 4 weeks prior to the World Championships, complained of being over tired and fatigued and showed signs of overtraining as shown in Table 5. A comparison of average submaximal heart rate and lactate data for the U.S. Men's and Women's National Team reveals that indeed those values recorded at this juncture of training far exceeded those expected. As a result, training intensity and volume were reduced and although time did not permit further submaximal testing, competitive efforts 4 weeks later reflected that all National Team rowers were prepared to compete successfully.

Table 5

	Test 1 (Dec.)			Test 2 (Mar.)			Test 3 (June)			Test 4 (Aug.)		
	60	70	80	60	70	80	60	70	80	60	70	80
<b>Men</b>												
HR (b/min)	155	166	186	145	160	180	138	147	169	150	161	179
LA (mmol/L)	3.1	4.5	6.5	2.5	4.3	6.1	1.8	3.2	5.0	2.9	3.9	6.4
<b>Women</b>												
HR (b/min)	159	169	189	150	161	182	141	150	174	156	166	185
LA (mmol/L)	3.5	5.6	6.9	3.2	5.1	6.2	2.1	3.9	5.4	3.3	4.8	7.1

Finally, in our last example of test application, the second of four submaximal test sessions of Olympic team candidates revealed that heart rate values were excessively high for each test in December and as a result additional transportation training was added to the prescribed training program; results of the next testing conducted in March showed how successful this decision was (see Table 6). Consult Table 3 for desirable or target values.

Table 6: 1992 U.S. Olympic Candidates

MEN	DEC % max			MAR % max			JUNE % max		
	60	70	80	60	70	80	60	70	80
HR (b/min)	160	173	182	146	156	170	135	152	165
LA (mmol/L)	1.3	2.2	3.4	1.6	2.5	3.6	1.4	2.3	3.6

In summary, we are pleased with this rather rapid and accurate method of estimating rowing fitness. The use of periodic and successive submaximal testing following the initial maximal and submaximal tests can provide excellent predictive data of physiological potential and capacity and indicate training effects.

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