Biomechanical assessment procedure

An important part of the Biomechanics assessment procedure is the testing protocol, which must provide standard conditions and make results comparable between rowers and over the course of time. **There are two major factors affecting rowing technique: the stroke frequency and fatigue**. Therefore, historically, we used a test protocol consisting of two parts:

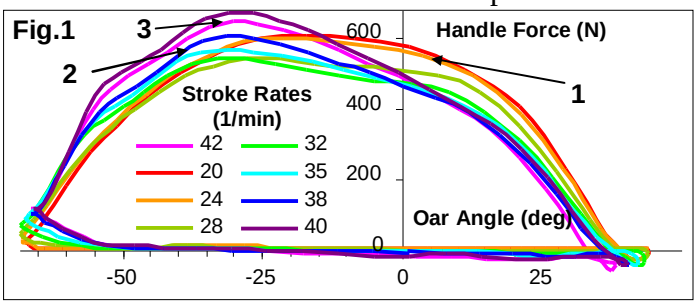
- Step test with increasing stroke rate: e.g. 5-6 pieces by 250m or 1 minute at 20, 24, 28, 32, 36 str/min with a free recovery about 3-5 minutes and 30 second maximal effort;
- Race piece 2000m with full effort or specified percentage of it (say, at 95%).

This test protocol takes quite a long time to complete (1-2 hours depending on recovery time between two parts) and puts a significant load on rowers. Therefore, last year we designed a combined test protocol, which allows determination of both effects at once. The test consists of one continuous 2000m piece at racing force application, but various rates (Table 1):

Table 1	Split	Lap	Stroke rate (1/min)	
Piece N	(m)	(m)	Singles	Crew boats
1	0 -100	100	Start max	Start max
2	100 - 500	400	18	20
3	500 - 1000	500	22	24
4	1000 - 1250	250	26	28
5	1250 - 1500	250	30	32
6	1500 - 1750	250	32 -34	34-36
7	1750 - 1900	150	35-36	38-40
8	1900 - 2000	100	Max.	Max.

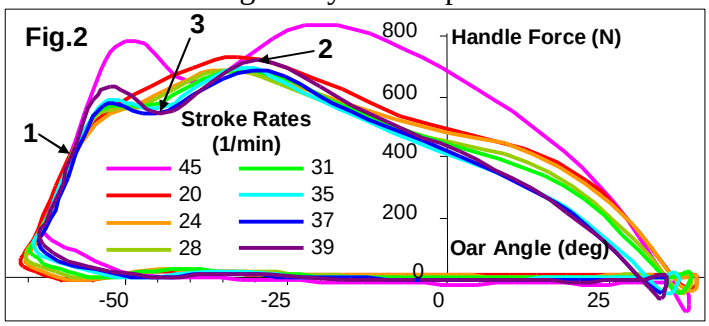
The feedback from rowers and coaches was that this test is a good training load itself: the first half of it is performed at aerobic training intensity, which allows smooth transition to the second half with anaerobic intensity. Only the last 500m is performed with the stroke rates close to racing. There can be some variation of this protocol for junior rowers and veterans: e.g. the pieces N5 and 7 could be replaced with light paddling with corresponding reduction of the stroke rate for the next pieces. The data samples are taken and averaged at every lap (RBN 2012/12).

Fig.1 shows an example of changes in the force curve over the course of the test in a top level sculler.

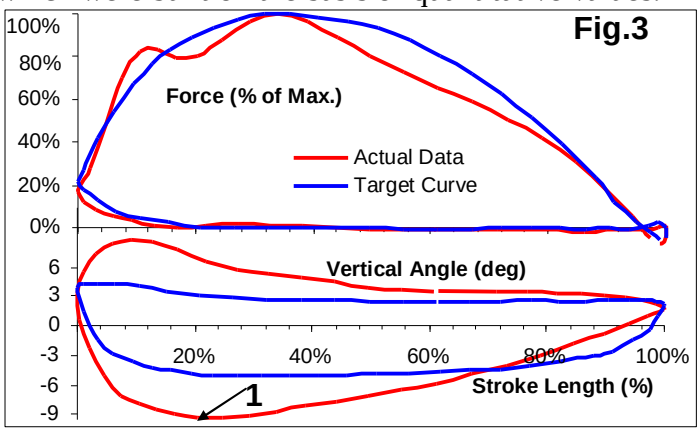


The specific feature of this sculler is a significant change in the timing of the maximal force application: at lower rates he applies more force at the second half of the drive (1), but at higher stroke rates the peak force is shifted to the first half of the drive (2). The comparison of the start and finish sections (3) gives us information about fatigue resistance, which was good.

Fig.2 shows another example of changes of the force curve at various stroke rates in a National level sculler. The force gradient (rate the force increasing) at the beginning of the drive (1) remains the same at all stroke rates, as well as the position of the peak force (2). However, at stroke rates higher than 30 this sculler suffers from the 'hump' in the force curve (3), which is caused by early activation of the trunk at the catch, then a decrease in its velocity when the leg drive is the fastest. The hump occurs at the moment of the second activation of the trunk (RBN 2010/06) and is also related to a weak posture of the sculler (2010/02) and very deep burying of the blade (Fig.3, 1). Such "disconnection" and double emphasis of force application significantly decreases rowing effectiveness at racing stroke rates and negatively affects performance.



It is assumed that the conditions of the second last piece are very close to the racing conditions in terms of stroke rate and fatigue. Therefore, we usually take this data sample and compare it with "targets" to evaluate the technique of each rower (2007/08, 2011/10). The comparison is made in two ways. Qualitative values are compared with the main criteria and percentage of differences are defined for variables of oar angle (2001/11), force (2008/02), blade work (2009/10) and body segments (2002/02-3). Qualitative evaluation is made by means of comparison of the real measured curves with some hypothetical target curves (Fig.3), which were built on the basis of quantitative values.



Our method allows clear and effective feedback for rowers, coaches and helps improving technique.