

**Questions and Answers:**

✓ **Q:** Ben Stevenson of Richmond RC in Victoria wrote: “I was very interested by the topics of January and February this year...

I am particularly interested in the D3 phase. My interpretation of this phase is that it represents the time in which the body ‘takes up the strain’ and the oar flexes etc. The feeling of this micro-phase would be the ‘lock’ sensation. As this is wasted energy, and shortens the effective length of the stroke, wouldn’t it be better to use a weaker part of the body to effect this stage (ie arm grabbing)? However wouldn’t this be counteracted by the arms letting go once the stronger leg pressure comes on, and wouldn’t this then reduce the effectiveness of the strongest drive phase?

How about other options like extending the shoulder joint before the catch? Or because the legs are in a relatively weak position at the catch, wouldn’t they be a better tool for locking on?

A related topic to this is how D1-D2 affects lock on. At higher rating, the increased forward/back momentum forces the body to take up the strain during D1-D2, because the legs are stopping while the body continues. Does this mean that D3 shortens or disappears at higher ratings?”

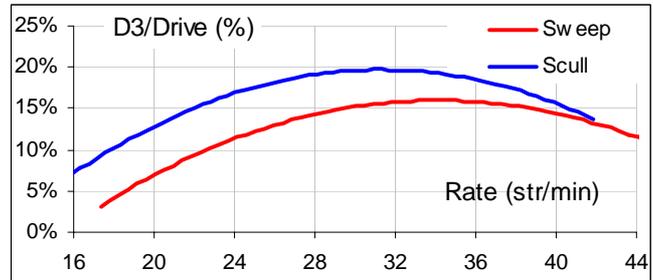
**A:** We analyzed behavior of the drive micro-phases at different stroke rates in 538 sweep and 743 sculling samples. The following table shows average ratio of each micro-phase to the drive time, its standard deviation, minimal and maximal values, and correlation with the stroke rate:

Phase/ Drive (%)	D1	D2	D3	D4	D5	D6
Sweep	13.3	11.6	13.7	20.9	28.1	12.5
STD	2.5	3.1	5.3	6.2	7.4	5.3
Min	6.1	4.0	0.0	0.0	11.2	0.5
Max	20.0	20.3	25.0	37.2	46.8	23.5
Corr.	0.13	-0.15	0.43	-0.02	-0.23	0.02
Scull	10.4	9.8	18.0	24.5	21.8	15.5
STD	1.9	2.6	6.8	4.9	4.6	3.4
Min	5.0	2.8	0.0	11.5	11.0	6.2
Max	14.9	17.4	31.6	37.6	36.5	25.1
Corr.	-0.11	0.06	0.35	-0.10	-0.28	0.04

The first two phases D1 (blade immersion) and D2 (initial rower’s acceleration) decrease their time proportionally with decreasing of the drive time at higher rates. Therefore, its shares in the drive time remain nearly constant. These phases are a bit shorter in sculling, which can be explained by the differences in the oar geometry

that allow quicker placement of the sculls. Inertial forces appear to be ineffective on these phases.

On contrary, time of the D3 (initial boat acceleration) has no direct relationship with the stroke rate. Therefore, its share increases as the drive time decreases and this phase has the most significant correlation with the stroke rate. We found the trends of D3 shares are non-linear:



The D3 share achieves its maximum at the stroke rates 32-36 and then goes down, but not disappears. It is 5-6% higher in sculling at low rates, but the trends coincide at about 15% at the rate 40. Don’t think that the longer D3 phase is better, because its longest values were found in the poorest crews. Some inefficient crews don’t have this phase at all. The duration of the D3 must be optimal at the level of 0.08-0.12s. This means that the switching from push into the stretcher during D2 to pull the handle during D3 and back to push during D4 must be present, but it must be done quickly.

Some very successful rowers do D3 using “grabbing” with arms, but we are not saying that this is the best method. It is inefficient, when arms as the weakest part of the body maintain static tension from beginning till the end of the drive. Other great crews (Appendix 1) manage to pull without “grabbing”, by means of stretching the shoulders at catch and using them together with trunk during D3, exactly as Ben questioned.

The next two phases D4 (rower’s acceleration) and D5 (boat acceleration) are the longest ones. D4 has the constant time share in the drive. This is very important phase, when rower’s mass accumulating kinetic energy, but its duration is not connected with better performance. D5 share has negative correlation with the stroke rate, i.e. its duration decreases at higher rates. Good rowers manage to maintain it longer that means better transfer of the kinetic energy to the boat. The D6 (blade removal) phase share is nearly constant at different rates. It is shorter in good crews.

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## Micro-phases of the stroke cycle.

Men's pair James Tomkins and Drew Ginn, Olympic Champions of Athens Games 2004.

Stroke rate 36.5 str/min, video 25 fps, frame number – micro-phase.



1 - R2



2 - R2



3 - R2



4 - R2



5 - R2



6 - R2



7 - R3



8 - R3



9 - R3



10 - R3



11 - R3



12 - D1



13 - D1



14 - D1



15 - D2



16 - D2



17 - D3



18 - D3



19 - D4



20 - D4



21 - D4



22 - D4



23 - D4



24 - D4



25 - D5



26 - D5



27 - D5



28 - D5



29 - D5



30 - D5



31 - D6



32 - D6



33 - D6



34 - D6



35 - R1



36 - R1



37 - R1



38 - R1



39 - R1



40 - R1



41 - R1



42 - R2



43 - R2