

Concept2 Indoor Rower Fact Sheet 1:

Damper Lever, Drag Factor And The Speed Strap

Setting up the Concept2 Indoor Rower - Damper lever, drag factor and the Speed Strap

One of the most misunderstood features of the Concept2 Indoor Rower is the definition and use of **drag factor**. The most probable reason for this is the complexity of the **drag factor** calculation and how the data is provided to the Performance Monitor display.

This Fact Sheet defines and describes **drag factor**, explains how to set the correct **damper lever** and **drag factor** level to ensure a safe and effective workout, and sets out the optimum **drag factor** range for children and adults.

- **What is Drag Factor?**

Drag Factor is a numerical value for the rate at which the flywheel is decelerating.

To display **drag factor** on a PM3/PM4 choose **More Options** from the Main Menu then **Display Drag Factor**.

- **Damper lever setting**

The **damper lever** is on the side of the fan cage, is numbered 1 to 10 and controls the **drag factor**. With the damper lever set to level 10 more air can pass across the fan **increasing** the resistance (**drag**) on the flywheel and at setting 1 less air passes across the fan **decreasing** the resistance (**drag**) on the flywheel.

- **Recommended drag factor settings for children in Year Groups 7 to 10 and for adults**

The monitor displays the **drag factor** as a number in the order of 100 at level 1 and around 220 at level 10 on a new machine. For adults a **damper lever** setting of 2-5 for the best aerobic workout is recommended with a **drag factor** range of 115-140. For children the **damper lever** setting is 1-3 with a **drag factor** range of <100 to 125 (Year 7 – Year 10).

Why it is important to understand drag factor?

Using the correct **drag factor** focuses the activity of indoor rowing on developing good technique, improved agility and coordination skills and ensures the optimum biomechanical and physiological response. Good rowing technique is about speed of application of power and not just brute strength.

Rowing with the **drag factor** too high will be detrimental to a workout and will increase the risk of injury. Therefore understanding of the correct **drag factor** setting is a significant health and safety issue.

What is Drag Factor?

“Drag Factor” is a numerical value for the rate at which the flywheel is decelerating. This number changes with the volume of air that passes through the flywheel housing. Since higher damper settings allow more air into the flywheel housing, the flywheel decelerates more quickly, resulting in a higher Drag Factor value. The electronic Performance Monitor measures the Drag Factor on the recovery phase of each stroke and uses it to calculate your score. This method of “self-calibration” compensates for local conditions and damper settings, making scores on different Indoor Rowers comparable. Indoor racing and the Online Community are made possible by this method of self-calibration.”

The load on the Concept 2 Indoor Rower is unlike any normal resistance training equipment. There is no pre-set load; what is measured is the ability of the user to accelerate the flywheel overcoming the air resistance forces opposing the flywheel rotation.

The **damper lever** is on the side of the fan cage, is numbered 1 to 10 and controls the **drag factor**. With the damper lever set to level 10 more air can pass across the fan **increasing** the resistance (**drag**) on the flywheel and at setting 1 less air passes across the fan **decreasing** the resistance (**drag**) on the flywheel.

The **Gears on a Bike** analogy is very useful tool for explaining the relationship between the **drag factor**, the level of resistance and the calculated values for power and pace. The same amount of power will produce the same speed / pace whether it is applied when using a high gear / **drag factor** or when a lower setting is employed. In the case of a high gear / **drag factor** the power will be applied through a slower movement working against a higher load. Conversely in the case of a lower gear / **drag factor** the power is applied more quickly working against a lighter load.

Key Point 1: The damper level setting is not an indication of how fast the user can go - level 10 is not fast and level 1 is not slow.

Key Point 2: Drag is not a measure of how difficult it is to complete a workout. A damper setting of level 10 is not more difficult than an equivalent setting of 1. It is important to note that, unlike weight lifting or many types of CV equipment the goal on an Indoor Rower is not to use a higher **damper lever** or **drag factor** setting as a means of achieving fitness.

Key Point 3: The Performance Monitor detects any **increase** or **decrease** in the **drag factor** and compensates for the difference by calculating fair equivalent values for the power and pace before displaying them on the screen. The monitor detects the effect on the flywheel not the position of the **damper lever** so although the damper lever setting on different machines may not be the same the **drag factor** reading will always be correct.

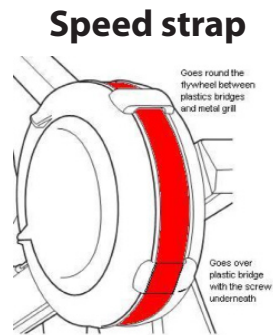
As a result the only means of measuring the intensity of a **Stroke** is by reading the **Power (Watts)** or **Pace** (mins:secs per 500 m) displayed on the screen regardless of the **drag factor** or damper setting (see **Fact Sheet 3 Force Curve, Power (Watts), Pace and Stroke Rate**).

Key Point 4: The harder a user rows the more resistance is felt. This is because the Concept2 Indoor Rower uses air resistance, which is generated by the spinning flywheel. The greater the increase made to the flywheel speed, the more resistance there will be.

Key Point 5: The longer the period of the recovery in between strokes the greater the deceleration of the flywheel. The slower the flywheel is moving the greater the acceleration required to achieve a given pace. This means that for a given pace more resistance will be generated at lower stroke rates.

Key Point 6: If the perforations on the fan cage become clogged or the ambient conditions change (pressure, temperature, humidity, flow of surrounding air) or the machine is next to surrounding objects the damper lever will need to be put on a higher/lower setting to achieve the same **drag factor**.

Key Point 7: For children, it is particularly important to set the **drag factor** at the correct, safe level. The **drag factor** can be lowered using a **speed strap** (the **speed strap** is a length of webbing which straps round the fan casing on the Concept2 indoor rowing machine to reduce the **drag factor**).



For younger users, use of a speed strap is a good way to build technical ability. This is because the strap gives the best biomechanical and physiological set up for youngsters and rewards better technique.

What is the correct drag factor setting?

With a little experimentation, the correct **drag factor** setting that gives the best workout and results can be found. Once the ideal set up has been established the **drag factor** rather than the **damper lever** setting should be noted, as this will remain constant across different machines.

The monitor displays the **drag factor** as a number in the order of 100 at level 1 and around 220 at level 10 on a new machine. For adults a **damper lever** setting of 2-5 for the best aerobic workout is recommended with a **drag factor** range of 115-140. For children the **damper lever** setting is 1-3 with a **drag factor** range of <100 to 125 (Year 7 – Year 10).

On-water rowers use the machine with a **drag factor** range of 125 to 140 or **damper level** 3 to 5. The reason for this is that at this level the feel is closest to that of a racing boat which makes the training rowing specific.

The effective range of **drag factor** settings on an indoor rower is narrow. Always set the **drag factor** at the same level for every session. As a general guide **drag factor** should be set in the following range:

Children

- Year 7 - below 100 to 100 (girls & boys) (use the speed strap to go below 100)
- Year 8 - 100 (girls) 110 (boys)
- Year 9 - 105 (girls) 115 (boys)
- Year 10 - 110-115 (girls) 120-125 (boys)

Adults

- Male heavyweight (over 75 kg) - 125-140
- Male lightweight (under 75 kg) - 120-135
- Female heavyweight (over 61.5 kg) - 120-130
- Female lightweight (under 61.5 kg) - 115-125

How do you set drag factor on the Performance Monitor?

To display **drag factor** on a PM3/PM4 choose **More Options** from the Main Menu then **Display Drag Factor**. Row for a few seconds - **drag factor** is displayed – adjust the damper level until the correct **drag factor** is shown – return to the **Main Menu**.

Concept2 Indoor Rower Fact Sheet 2:

Technique On The Concept2 Indoor Rower

Technique is the most important factor when using the rowing machine. If you get your technique right you'll be efficient, produce better results and avoid potential injuries.

The rowing stroke can be divided into two phases:

- The **Drive** phase where the handle is drawn away from the fan and the **Recovery** phase where the handle is allowed to return back to the fan before the next **Drive** phase. The **Drive** phase should be strong and vigorous.
- The **Recovery** phase should be steady and relaxed. **Rhythm** is the time relationship between the **Drive** phase and the **Recovery** phase. The ratio should be about 2:1 with the **Recovery** phase taking about twice as long as the **Drive** phase.

The overall stroke cycle has four segments:

- The **Finish** position
- The **Recovery** phase
- The **Beginning** position
- The **Drive** phase

Each segment is described in detail with a pictorial sequence showing the full stroke cycle.

There are three phases to developing good technique.

The first stage is developing **motor** skills to master the sequence of movements; this is the awareness stage of learning. Muscles respond to electrical impulses from the brain carried via the nervous system. Repeating a movement establishes a strong neurological pathway for these tiny impulses. Breaking the rowing stroke down into its component parts and carrying out each segment slowly until it is mastered is the best method of establishing this pathway. Gradually the segments are joined together to form the full stroke cycle.

The second stage is the **functional** stage. During the development of motor skills there is no consideration to load, this comes next. In this stage the muscles become familiar with the load, power and pace that are required to row efficiently.

The final stage is the **autonomous** stage. In this stage the muscles know their role and movements become automatic.

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The overall stroke cycle has four segments – the **Finish** position, the **Recovery** phase, the **Beginning** position and the **Drive** phase.

Key Point 1: The Finish Position (start of the recovery phase)

In the **Finish** position the legs are fully extended with the body leaning back slightly to about 11 o'clock on a clock face. A strong, neutral posture should be maintained. The handle is drawn to the body and held lightly in both hands with the hands positioned so that the little fingers are over either edge of the handle. The chain should be parallel with the ground and the top row of knuckles, the wrists and the elbows should be held flat in a straight line. The elbows are drawn past the body and should not be sticking out to either side. The shoulders and arms are held loose and relaxed. Once in this position the rower is ready to start the rowing sequence.

Key Point 2: The Recovery Phase

During the **Recovery** phase the handle is allowed to come towards the fan cage whilst the rower gets into position ready for the next stroke. The **Recovery** phase begins at the **Finish** position and ends at the **Beginning** position ready for the **Drive** phase to start. The **Recovery** phase starts with the arms reaching out until they are fully extended the body then rocks over from the hips into the 1 o'clock position and finally the knees bend until the body is in the **Beginning** position.

Key Point 3: The Beginning Position (start of the drive phase)

In the **Beginning** position the shins are vertical, the back is still in the 1 o'clock position and the arms are fully extended. Good posture should be maintained with the back in a strong neutral position. The arms should feel loose and relaxed and the weight of the body should be on the balls of the feet. The position should feel comfortable.

Key Point 4: The Drive Phase

The **Drive** phase is the power phase of the stroke where the handle is drawn away from the fan cage. It commences at the **Beginning** position where the handle picks up the load from the flywheel at the front of the stroke and ends at the **Finish** position with the handle drawn towards the body at the back of the stroke.

At the start of the **Drive** phase, the legs push down then the body begins to lever back whilst the arms remain straight. Once the legs are straight, the body stops levering back (when it has reached the 11 o'clock position). The arms then draw the handle past the knees and strongly to the body. The rower has now returned to the Finish position.

Top Tip 1: Check that the trunk is held firm so that the power developed on the footplate is transferred directly to the handle throughout the **Drive** phase. Make sure that the handle moves back at the same time as the seat so the legs are not just driving the rower back. A common error is for rowers to transfer stability from the trunk to the legs and use the trunk to supply power. This can go almost unnoticed at low intensity work but it is very inefficient.

Top Tip 2: Although the upper body is responsible for over 50% of the stroke length the legs are responsible for 70% of the total power. This is because the load is at its greatest at the beginning of the stroke and decays to the Finish. Good technique matches up the most powerful muscle groups in the legs to the greatest load and the faster muscles in the arms to the lighter but faster Finish.

Three times world champion Tom Kay illustrates ideal form.

THE FINISH POSITION



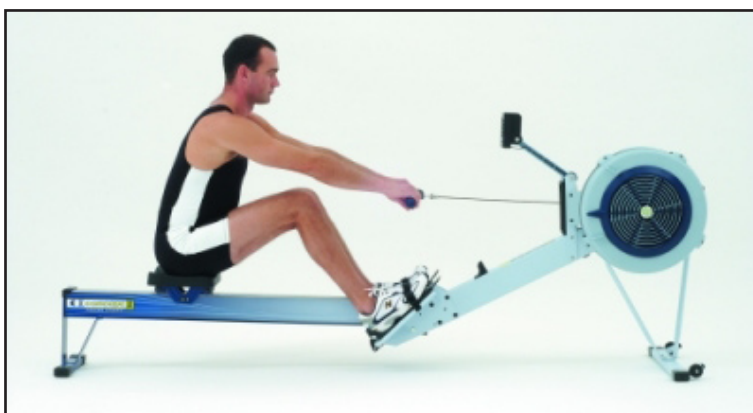
In the **Finish** position, lean back slightly to 11 o'clock position, legs flat, handle drawn to the body, forearms horizontal.

THE RECOVERY PHASE



In the **Recovery** phase the arms reach forward until they are extended fully, then the body rocks forward from the hips into the 1 o'clock position.

THE RECOVERY PHASE continued



AFTER the arms have fully extended and the body has rocked forward, the knees bend bringing the seat forwards while the position of the arms and body are maintained.

THE BEGINNING POSITION



In the **Beginning** position the shins are vertical with the body pressed up to the legs. The arms are straight and relaxed. The position should not feel uncomfortable.

THE DRIVE PHASE



At the start of the **Drive** phase the legs push down and the body begins to lever back.

THE DRIVE PHASE continued



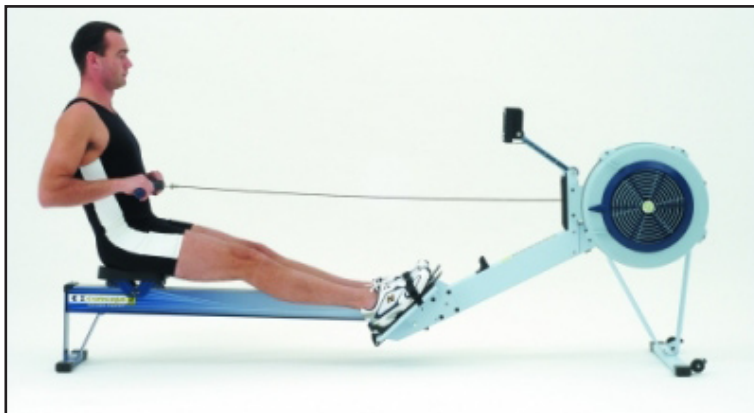
The legs continue to push as the body levers back. The arms remain straight.

THE DRIVE PHASE continued



The legs are fully extended and the body stops levering back. The arms draw the handle past the knees and then strongly to the body, returning to the **Finish** position.

THE FINISH POSITION



In the **Finish** position, the back is in the 11 o'clock position and the legs are flat. The handle is drawn to the body and the forearms are horizontal. You are now ready to take the next stroke.

The Recovery



The Finish
Lean back slightly, legs flat, handle drawn to the body



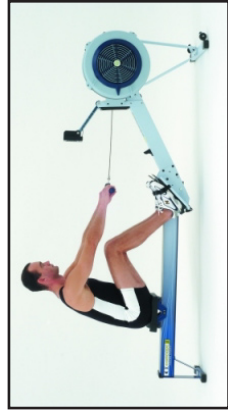
Arms extend forward



Body rocks forward
The arms are relaxed and extend fully. The body rocks forward from the hips



Quarter Slide
AFTER the arms have fully extended and the body has rocked forward, slide forward maintaining arm and body position. Hands, Body then Slide



Half Slide
Continue sliding forward, maintaining the arm & body position

Detailed Stroke Cycle



Holding the back in position draw the handle to the chest



Half Slide
Continue sliding forward, maintaining the arm & body position



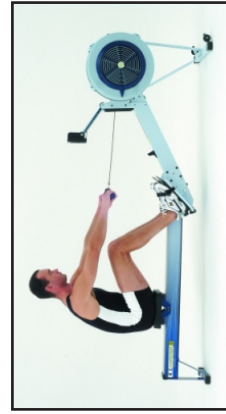
The Drive



The body stops levering back
The arms draw the handle to the body as the handle is drawn past the knees



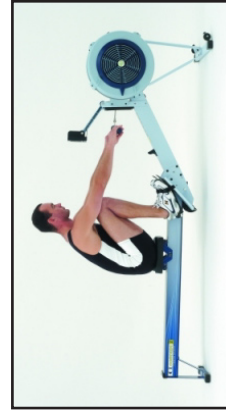
The Drive Continued
The legs continue to push as the body levers back. The arms remain straight



The Drive Continued
The legs continue to push as the body levers back. The arms remain straight



Start of the Drive
The legs push down and the body begins to lever back



Full Slide - the Beginning
Shins vertical with body pressed up to the legs. The arms are straight and relaxed. Position should feel comfortable

Concept2 Indoor Rower

Fact Sheet 3:

Force Curve, Power (Watts), Pace And Stroke Rate

The Performance Monitor (PM) of the Concept 2 Indoor Rower displays a range of useful features that allow the user to accurately monitor performance. It is important to understand how the **Force Curve**, **Power (Watts)**, **Pace** and **Stroke Rate** interrelate and how they can be used to optimise rowing performance.

- **Force Curve**

The **Force Curve** is an immediate graphical representation of the application of force during a stroke. It shows how the total force applied to the flywheel through the handle and chain, varies as you use your legs, back and arms in sequence during the **Drive**. A smoother-shaped curve indicates a smoother application of force.

- **Power (Watts)/Pace**

The average power applied during each stroke is displayed in **Watts** (the unit of power). In general the more **Power** applied the faster the **Pace**. The relationship between **Power** and **Pace** is non linear.

To get the best result for any rowing session, row at an even **Power/Pace** throughout the session – this will use less energy, concentrate technique and produce a smooth **Force Curve**.

- **Stroke Rate**

The **Stroke Rate** to use for a rowing session depends on the objective of the session – the **Stroke Rate** range varies from 18 strokes for low aerobic, base exercise and technique work through to as high as 34 strokes when racing over 2000 m or the School Year Group race time or even 36-38 for very short sprint intervals. The effective racing range is generally 28-34 but will vary from rower to rower.

Force Curve, Power (Watts), Pace and Stroke Rate

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What is the Force Curve and why is it important?

The **Force Curve** is an immediate graphical representation of the application of force during a stroke. It shows how the total force applied to the flywheel through the handle and chain, varies as you use your legs, back and arms in sequence during the **Drive**. A smoother-shaped curve indicates a smoother application of force.

Key Point 1: In general the greater the area under the curve the better the result for that stroke.

What should the Force Curve look like?

In general a broad arching **Force Curve**, without any sharp peaks or spikes should be the aim. This indicates that a smooth, continuous drive is being achieved (Figure 1).

How and why does the shape of the Force Curve change?

The shape of the **Force Curve** can be changed by varying the relative timing and emphasis of the legs, the back and the arms during the **Drive** phase of the stroke. "Exploding" at the **Beginning** of the **Drive** phase will shift the peak of the curve to the left (Figure 2). If the transition from legs to back swing through to the **Finish** position is not smooth multiple peaks may appear in the curve (Figure 3).

Key Point 2: If the application of force is applied smoothly throughout the entire **Drive** phase of the stroke the curve will be flatter and broader and a more efficient stroke will be achieved (Figure 1). It is not necessarily better to reach a higher maximum force. The aim should be to generate a smoother, more evenly distributed force profile.

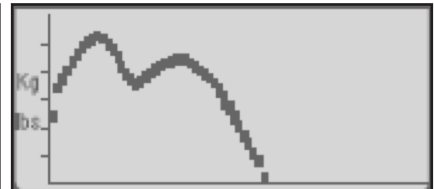
Figure 1



Figure 2



Figure 3



Key Point 3: An inefficient force profile will produce a slower pace than an efficient (less spiky) profile for the same average power.

NB – The Force Curve does not start at zero, this is because the Performance Monitor takes a moment to detect the stroke by which time force has already been applied.

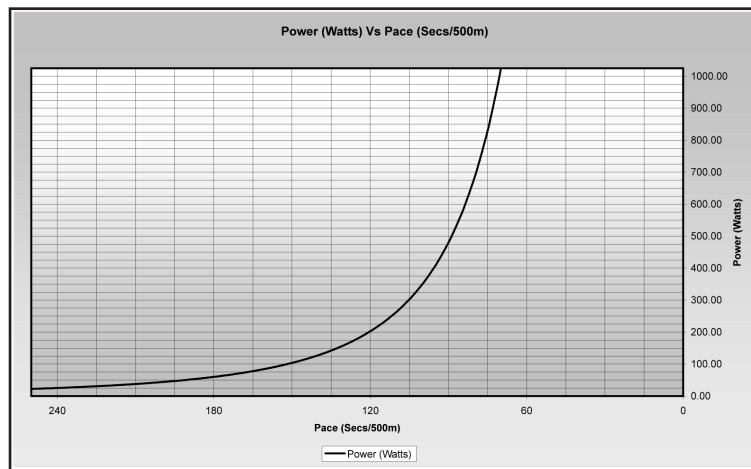
Top Tip 1: Row with the Force Curve profile display screen to develop an efficient stroke.



Power (Watts) and Pace

The relationship between **Power** and **Pace** is complex. The average power applied during each stroke is displayed in **Watts** (the unit of power). In general the more **Power** applied the faster the **Pace**. **Pace** is shown in terms of minutes and seconds per 500 m (mins:secs). There is no direct relationship between **Power** and **Pace** because of the variations in efficiency between strokes with different force time profiles (**Key Point 3**). For practical purposes a **Power** to **Pace** conversion equation gives an approximation of the relationship (**Table 1**).

Key Point 4: The relationship between **Power** and **Pace** is non linear – for this reason it is important to work in **Watts** and then for practical purposes use **Table 1** to convert to **Pace** in minutes and seconds per 500 m.



An example of the non linear relationship should make this clear:

A 2000 m row at 175 **Watts** would be completed in 8:24, a **Pace** of 2:06 per 500 m. A 25 **Watt** improvement to 200 **Watts** would improve that time by 22 seconds to 8:02, a **Pace** of 2: 00.5 per 500 m.

Conversely a 2000 m rowed at 475 (475.3) **Watts** would be completed in 6:01.2, a **Pace** of 1:30.3 per 500 m. A 25 **Watt** improvement to 500 (499.8) **Watts** would improve that time by only **6 seconds** to 5:55.2, a **Pace** of 1:28.8 per 500 m.

Key Point 5: When calculating paced based exercise/training intensities start with **Watts** and then convert to **Pace** per 500 m (**Table 1**) rather than **Pace** per 500 m +/- X seconds. This will ensure that intensities are not disproportionate, particularly at the slower end of the scale (very relevant when dealing with children and young adults – see **Fact Sheet 4 Children and Exercise Intensities**).

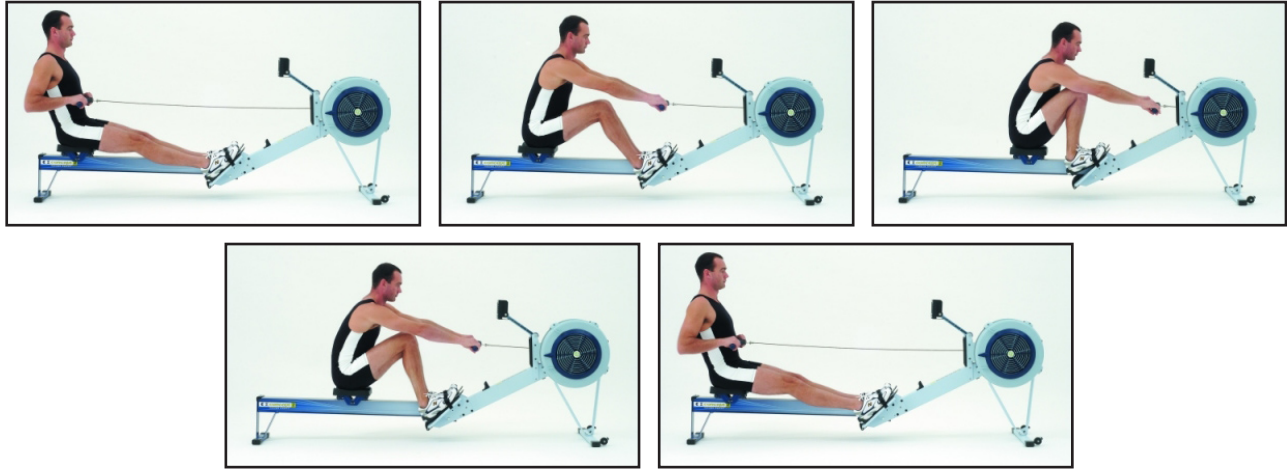
Table 1

Watts	25	50	75	100	125	150	175	200	225	250
Pace	4:01.0	3:11.0	2:47.1	2:31.8	2:20.9	2:12.5	2:06.0	2:00.5	1:55.9	1:51.9
Watts	275	300	325	350	375	400	425	450	475	500
Pace	1:48.3	1:45.2	1:42.5	1:40.0	1:37.7	1:35.6	1:33.7	1:32.0	1:30.3	1:28.8
Watts	525	550	575	600	625	650	675	700	725	750
Pace	1:27.3	1:26.0	1:24.8	1:23.6	1:22.4	1:21.4	1:20.3	1:19.4	1:18.4	1:17.6
Watts	775	800	725	850	875	900	925	975	1000	
Pace	1:16.7	1:15.9	1:15.2	1:14.4	1:13.7	1:13.0	1:12.3	1:11.1	1:10.5	

Top Tip 2: To get the best result for any rowing session, row at an even **Power/Pace** throughout the session – this will use less energy, concentrate technique and produce a smooth **Force Curve**.

Definition of a Stroke

If you pull on the handle the Performance Monitor will register a stroke. However in the context of effective rowing the definition of a stroke is a full cycle of the stroke technique sequence from the Finish position through the Recovery phase to the Beginning position and then through the Drive phase back to the Finish position (see Fact Sheet 2).



Optimum Stroke Rate Range

The **Stroke Rate** to use for a rowing session depends on the objective of the session – the **Stroke Rate** range varies from 18 strokes for low aerobic, base exercise and technique work through to as high as 34 strokes when racing over 2000 m or the School Year Group race time or even 36-38 for very short sprint intervals. The effective racing range is generally 28-34 but will vary from rower to rower.

For the best biomechanical and exercise response there is an optimum **Stroke Rate/Power/Pace** combination for any rowing session or race which will vary from rower to rower but which is usually in the ranges described above.

Varying the Stroke Rate and Power/Pace

As a general rule longer sessions are carried out at a lower **Stroke Rate** and slower **Power/Pace** – shorter sessions may have a higher **Stroke Rate** and greater **Power/Pace**.

Key Point 6: However, for the same **Stroke Rate** the **Power/Pace** can also be controlled by the application of more or less force during the **Drive** phase of the stroke. As a result of altering the force applied the time taken during the **Drive** phase will change and to compensate the timing of the **Recovery** phase will have to be adjusted in order to maintain a constant **Stroke Rate**.

Key Point 7: Similarly, for the same **Power/Pace** the **Stroke Rate** can be varied by changing the time taken during the Recovery to return the handle back towards the fan cage and the **Beginning** position. At lower **Stroke Rates** the fan will slow down more in between strokes resulting in a higher initial resistance at the start of each stroke.

Top Tip 3: To vary the **Power/Pace** while maintaining a constant **Stroke Rate** adjust the amount of power applied during the **Drive** phase accelerating the handle through to the body and the **Finish** position. To vary the **Stroke Rate** while maintaining a constant **Power/Pace** adjust the time taken returning the handle back to **Beginning** position.

Stroke Rate and Energy Use

The relationship between **Stroke Rate** and energy use is another complex non linear relationship – the higher the **Stroke Rate** the more disproportionate the energy required just to move the body mass up and down the slide. If the **Stroke Rate** becomes too high the energy required is so great that there is little left to contribute to the development of the **Power/Pace**. For this reason it is important to work within the **Stroke Rate** ranges for maximum benefit.

Concept2 Indoor Rower

Fact Sheet 4:

Children – Frequency, Duration and Intensity of Exercise, Warm Up and Cool Down

Rowing is a great cardiovascular workout for children and young adults. It uses most of the major muscle groups and is weight supporting. Closely supervised resistance training (rowing) using concentric (shortening) only muscle actions (rowing) with relatively high repetitions (stroke rate) & low resistance (drag) significantly improves muscular strength with no adverse effect on bone, muscle or connective tissue.

However caution is needed when prescribing exercise for children and young adults.

- **Frequency**

Frequency refers to the number of exercise sessions per week.

The maximum number of weekly sessions should be 2 for Year 7 and 8, 2/3 for Year 9 and 3 for Year 10.

- **Duration and Intensity**

Duration refers to the amount of time in minutes for an exercise session. The time spent exercising varies for each Year Group and within each Exercise Zone.

A suggested format to establish safe **Intensities of Exercise** for children and young adults is to use performance over the Year Group race time and base **Intensities of Exercise** on a percentage of the **Watts** equivalent for the average **Pace** achieved.

Five Exercise Zones (**Light, Easy, Medium, Hard** and **Very Hard**) can be identified for use in teaching good technique and as preparation for the Schools League Challenges.

- **Warm up and Cool down**

Warm up and cool down are vital components of exercise. The aim of a warm up is to prepare the body both physically and mentally for exercise.

A warm up should progress gradually and provide sufficient intensity to increase muscle and core temperature without causing fatigue or reduced energy stores (it should make you sweat and slightly breathless).

During cool down maintaining light, continuous exercise allows the body to pump oxygen around the fatigued muscles. This helps to reduce lactate, reduces blood pooling in the muscles, returns heart rate, core temperature and breathing to normal and prevents muscle soreness.

Children – Frequency, Duration and Intensity of Exercise, Warm up and Cool down

This Fact Sheet should not be viewed as an Indoor Rowing training programme but as part of a structured multi-skills physical activity programme for children with the emphasis on safety, fun, basic skills and good indoor rowing technique. Indoor Rowing should be part of a wide and varied programme of activities such as running, jumping, dancing, skipping, balancing and swimming, as well as ball and racket skills catching, kicking, striking and throwing etc. It should be fun and part of a healthy lifestyle including diet, rest and relaxation.

Caution is needed when prescribing exercise for children and young adults. However rowing is a great cardiovascular workout for children and young adults. It uses most of the major muscle groups and is weight supporting. Closely supervised resistance training (rowing) using concentric (shortening) only muscle actions (rowing) with relatively high repetitions (stroke rate) & low resistance (drag) significantly improves muscular strength with no adverse effect on bone, muscle or connective tissue.

Key Points to remember are:

- Children develop at different rates and there are differences between boys and girls. Maximum oxygen uptake (VO₂max) of boys and girls is similar until approximately 12 years old, by 14 it is 25% higher in boys and by 16 50% higher in boys. The difference reflects greater muscle mass in boys and gender differences in daily physical activity.
- The difference closely parallels the greater accumulation of fat in females – extra fat increases the energy cost of exercise.
- As children develop it is important to avoid injury by not excessively loading the musculoskeletal system and to remember that their oxygen consumption is 10-30% higher than an adult for the same level of exercise.
- Children have an inability to generate high levels of blood lactate, HRs are higher, they breathe greater volumes of air and they can suffer greater dehydration.
- Children also show a lower sweating rate and higher core temperature during heat stress. **Intensity of Exercise** should decrease for children exposed to heat stress although children cool faster than adults due to a greater body surface area ratio.
- In addition children generally have a shorter stroke length and therefore a higher stroke rate.
- This makes standard rowing pace more stressful (and performance scores poorer) – this disadvantage exists despite the higher specific aerobic capacity of children.

A suggested format to establish safe **Intensities of Exercise** for children and young adults is to use performance over the Year Group race time and base **Intensities of Exercise** on a percentage of the **Watts** equivalent for the average **Pace** achieved (a **Watts/Pace** conversion is attached as **Table 1** and also see **Fact Sheet 3**). 5 Exercise Zones (**Light, Easy, Medium, Hard** and **Very Hard**) can be identified for use in teaching good technique and as preparation for the Schools League Challenges.

Key Point 1: Children and young adults using the Indoor Rower for exercise only should be limited to the **Light** and **Easy** exercise zones with the emphasis on good technique and basic skills. **Medium, Hard** and **Very Hard** exercise zones should be used sparingly as part of preparation for the Schools League or British Indoor Rowing Championship. In all exercise zones the overriding consideration should be concentration on good technique (see **Fact Sheet 2**).

Year groups 11-13 could use the Year 10 Duration and Intensities of Exercise – however these are the age groups where progression to a more developed exercise and training programme can be beneficial – for specific 2000 m training and exercise programmes see:

<http://www.concept2.co.uk/training/interactive.php>

Frequency

Frequency refers to the number of exercise sessions per week. The maximum number of weekly sessions should be 2 for Year 7 and 8, 2/3 for Year 9 and 3 for Year 10. The majority of exercise should be in the **Light** and **Easy** exercise zones mixing in **Medium**, **Hard** and **Very Hard** exercise zones as Schools events approach. An example of 4 weeks structured sessions leading to a Schools League event:

Year 7/8/9 (two sessions)

Week	1	2	3	4
Session 1	Light	Light	Light	Light
Session 2	Easy	Medium	Hard	Very Hard

Year 9/10 (three sessions)

Week	1	2	3	4
Session 1	Light	Light	Light	Light
Session 2	Easy	Medium	Hard	Very Hard
Session 3	Light	Medium	Medium	Light

School Year Group Durations and Intensities of Exercise for each Exercise Zone

Year Group	Race Time	Light = 50% of race time Watts	Easy = 60% of race time Watts	Medium = 70% of race time Watts	Hard = 85% of race time Watts	Very Hard = 100% of race time Watts
Session Time - Stroke Rate						
7	2'	5-10' - 18-22	5' - 22-24	2x1'/1.5' rest - 24-26	2x1'/1.5' rest - 26-30	3/4x30"/1' rest - 30-36
8	3'	15' - 18-22	7.5-10' - 22-24	2/3x2'/2' rest - 24-26	2/3x1.5'/2' rest - 26-30	3/4x45"/1.5' rest - 30-36
9	4'	15-20' 18-22	10-12.5' - 22-24	2/3x3'/3' rest - 24-26	2/3x2'/3' rest - 26-30	3/4x1'/2' rest 30-36
10	5'	20-25' 18-22	12.5-15' - 22-24	3x3.5'/3.5' rest - 24-26	3x2.5'/3.5' rest 26-30	4x1.5'/3' rest - 30-36

Warm Up and Cool Down

Warm up and cool down are vital components of exercise. The aim of a warm up is to prepare the body both physically and mentally for exercise. Warm up increases muscle and core temperature, blood flow and improves the uptake, transport and utilisation of oxygen around the body as well as providing a comfortable way to lead into more vigorous exercise. Warm up also increases alertness and reaction time as the increased body temperature allows nerve impulses to travel more quickly. It also has psychological benefits as it helps mental preparation, focus on the task ahead and settles nerves.

A warm up should progress gradually and provide sufficient intensity to increase muscle and core temperature without causing fatigue or reduced energy stores (it should make you sweat and slightly breathless).

Warm up may need to vary depending on the environmental conditions (hot or cold venue) and should be completed within a few minutes of the start of an exercise or training session.

Warm up stretches the muscle tendons allowing greater length and less tension on exposure to the start of an exercise or training session. Injuring a warmed up muscle requires greater force than the force required to injure a cold muscle. A good warm up produces higher temperature, higher oxygen consumption and lower blood lactate in the first minute of exercise compared to no warm up at all (a considerable benefit for racing - but note the differences in children mentioned earlier in this Fact Sheet).

For those individuals who suffer with exercise induced breathlessness of any description warm up is

paramount as the intermittent intensity of some of the warm ups will assist in generating the necessary stimulus to keep the airways open sometimes without the need for inhalers (however always take medical advice).

Cool down is as important as warm up. During cool down maintaining light, continuous exercise allows the body to pump oxygen around the fatigued muscles. This helps to reduce lactate, reduces blood pooling in the muscles, (which can lead to dizziness) returns heart rate, core temperature and breathing to normal and prevents muscle soreness. A few minutes of gentle rowing can be sufficient to reduce blood lactate levels to near normal (but note the differences in children mentioned earlier in this Fact Sheet).

Warm Up for each Exercise Zone

Year Group	Light Zone	Easy Zone	Medium Zone	Hard Zone	Very Hard Zone
7	2' at slower than Light pace	2'-3' – 1'/1.5' at Light pace and 1'/1.5' slower than Easy pace	3' – 1.5' at Light pace and 1.5' at Easy - incl 2 x 8 strokes at 24-26 SR	3'-4' – 1.5'/2' at Light pace and 1.5'/2' at Easy pace - incl 2 x 8 strokes at 26-28 SR	4' – 2' at Light pace and 2' at Easy - incl 2 x 8 strokes at 30-36 SR
8	3' at slower than Light pace	3'-4' – 1.5'/2' at Light pace and 1.5'/2' slower than Easy pace	4' – 2' at Light pace and 2' at Easy pace - incl 2 x 10 strokes at 24-26 SR	4'-5' – 2'/2.5' at Light pace and 2'/2.5' at Easy pace incl 2 x 10 strokes at 26-28 SR	5' – 2.5' at Light pace and 2.5' at Easy pace incl 2 x 10 strokes at 30-36 SR
9	4' at slower than Light pace	4'-5' – 2'/2.5' at Light pace and 2'/2.5' slower than Easy pace	5' – 2.5' at Light pace and 2.5' at Easy pace - incl 2 x 12 strokes at 24-26 SR	5'-6' – 2.5'/3' at Light pace and 2.5'/3' at Easy pace - incl 2 x 12 strokes at 26-28 SR	6' – 3' at Light pace and 3' at Easy pace - incl 2 x 12 strokes at 30-36 SR
10	5' at slower than Light pace	5'-6' – 2.5'/3' at Light pace and 2.5'/3' slower than Easy pace	6' – 3' at Light pace and 3' at Easy pace - incl 2 x 15 strokes at 24-26 SR	6-8' – 3'/4' at Light pace and 3'/4' at Easy pace - incl 2 x 15 strokes at 26-28 SR	8' – 4' at Light pace and 4' at Easy pace - incl 2 x 15 strokes at 30-36 SR

Cool Down for Each Exercise Zone (all at SLOWER than Light Zone pace)*

Year	Light Zone	Easy Zone	Medium Zone	Hard Zone	Very Hard Zone
7	2"	2'-3'	3'	3'-4'	4'
8	3'	3'-4'	4'	4'-5'	5'
9	4"	4'-5'	5'	5'-6'	6'
10	5"	5'-6'	6'	6'-8'	8'

EXAMPLE: Year 7 metres rowed over 2 minutes – 426 m = Average **Pace** of 2:21 per 500 m = 125 average **Watts**

Light Zone - Slow technique rowing up to 10 minutes = 50% of 125 **Watts** = 63 **Watts** = **Pace** of 2.57 per 500m @ 18-22 strokes

Easy Zone - Fast technique rowing up to 5 minutes = 60% of 125 **Watts** = 75 **Watts** = **Pace** of 2:47 per 500m @ 22-24 strokes

Medium Zone – Fast technique/long Intervals 2 x 1.5 minutes/1.5 minutes rest = 70% of 125 **Watts** = 88 **Watts** = **Pace** of 2:38 per 500m @ 24-26 strokes

Hard Zone – Medium intervals 2 x 1 minute/1.5minute rest = 85% of 125 **Watts** = 106 **Watts** = **Pace** of 2:29 per 500m @ 26-30 strokes

Very Hard Zone – Short Intervals 3 x 30 seconds/1 minute rest = 100% of 125 **Watts** = 125 **Watts** = **Pace** of 2:21 per 500m @ 30-36 strokes

A Medium Zone session for this example:

Warm up - 3' – 1.5' at 2:57 pace and 1.5' at 2:47 pace - incl 2 x 8strokes at 24-26 SR

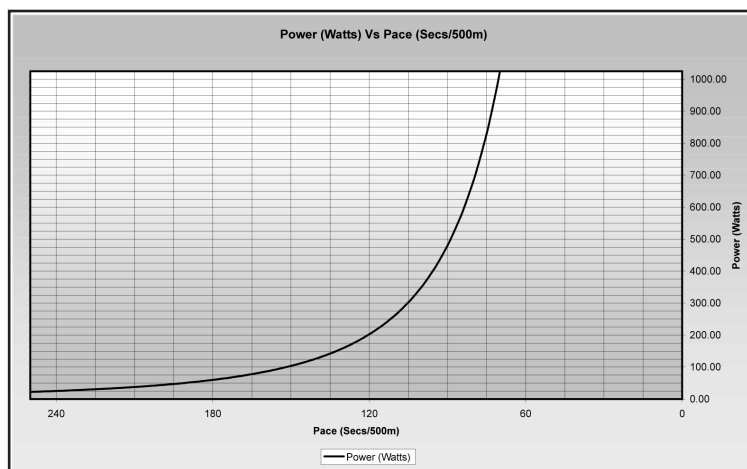
Main session - 2 x 1.5' at 2:38 pace /1.5' rest 24-26 SR

Cool down - 3' at 2:57 pace

Top Tip 1: To get the best result for any rowing session, row at an even Watts/Pace and stroke rate throughout the session – this will use less energy.

Top Tip 2: Concentrate on technique to produce a smooth Force Curve (see Fact Sheet 3).

Watts/Power Conversion



Watts	25	50	75	100	125	150	175	200	225	250
Pace	4:01.0	3:11.0	2:47.1	2:31.8	2:20.9	2:12.5	2:06.0	2:00.5	1:55.9	1:51.9
Watts	275	300	325	350	375	400	425	450	475	500
Pace	1:48.3	1:45.2	1:42.5	1:40.0	1:37.7	1:35.6	1:33.7	1:32.0	1:30.3	1:28.8
Watts	525	550	575	600	625	650	675	700	725	750
Pace	1:27.3	1:26.0	1:24.8	1:23.6	1:22.4	1:21.4	1:20.3	1:19.4	1:18.4	1:17.6
Watts	775	800	725	850	875	900	925	975	1000	
Pace	1:16.7	1:15.9	1:15.2	1:14.4	1:13.7	1:13.0	1:12.3	1:11.1	1:10.5	

Concept2 Indoor Rower

Fact Sheet 5:

How To Row An Indoor Rowing Race

Whilst indoor rowing is a great activity for children, and care must be taken not to over stretch the growing body (see Fact Sheet 4) many children respond well to a competitive environment. For children in Year Groups 7-10 a recommended race time, approved by NGB has been established. In Year Groups 11-13 young adults are allowed to race over the standard race distance of 2000 m.

- **Race Preparation**

Write out your race plan for the day in bullet point format. This prevents errors caused by miscalculations and nerves.

Know your warm up routine; it prepares the body and mind for competition. Be careful not to overdo your warm up. Warm up should progress gradually but provide sufficient intensity to increase muscle and core temperature without causing fatigue or reducing energy stores.

Finish your warm up in time to find your race machine, allow time to walk from the warm up area to the race arena and be ready to race 10 minutes before your start time.

- **The Race**

For energy distribution the best way to row a race is even pace and stroke rate.

The start: 'Use it or lose it' 5-10 hard drives to get the flywheel spinning and average pace on target. If you go off too fast in the early stages you will probably pay for it later in the race.

The middle: This is where you conserve energy and delay fatigue. Settle into race pace and keep stroke rate and pace as even as possible. Resist the temptation to 'chase' other rowers - row your own race.

The finish: Only you will know whether you have the energy to do a fast finish. Delay your finish spurt until you feel you can maintain technique, increase the stroke rate and pace and hold on until the finish.

- **After the Race**

Avoid falling on the floor, keep moving up and down the slide, active recovery will help the body recover quickly so do some cooling down on your race machine before leaving the race area.

Whilst indoor rowing is a great activity for children, and care must be taken not to over stretch the growing body (see Fact Sheet 4) many children respond well to a competitive environment. For children in Year Groups 7-10 a recommended race time, approved by NGB has been established. In Year Groups 11-13 young adults are allowed to race over the standard race distance of 2000 m.

Race time/distance by Year Group

Year Group	Race Time (mins)	Race Distance (m)
7	2'	
8	3'	
9	4'	
10	5'	
11	N/A	2000
12	N/A	2000
13	N/A	2000

These are the times/distances used at the British Indoor Rowing Championship and in a number of Schools and Regional Competitions.

The British Indoor Rowing Championship categories vary slightly with classification by age for J11, J12, J13, J14, J15, J16 and then J18 heavyweight and J18 lightweight. For example to enter the J11 competition a competitor must be under 11 years of age at the 31st August in the competition year. Male lightweights are 75 kg and under, female lightweights are 61.5 kgs and under. J11 and J12 competitors race 2 minutes, J13 – 3 minutes, J14 – 4 minutes, J15 – 5 minutes. J16 and J18 race 2000 m. All competitions encourage and welcome entries from Adaptive Rowers.

For many competitors (remembering that children develop at different rates) the competition is not about winning but improving the distance rowed in the time limit or improving their 2000 m performance. There is a huge range of distances and times completed and a look at the 2007 British Indoor Rowing Championship results show the diversity:

British Indoor Rowing Championship – 2007 Results

Category	Race Time/Distance	Result Range (metres)		Result Range (min:sec)	
		Boys	Girls	Boys	Girls
J11	2'	343-528	362-493	-	-
J12	2'	362-533	376-522	-	-
J13	3'	563-870	533-811	-	-
J14	4'	826-1177	786-1091	-	-
J15	5'	1095-1529	1023-1368	-	-
J16	2000m	-	-	6:29.4–9:27.9	7:27.2–10:43.2
J18 Hwt	2000m	-	-	6:07.9–7:45.6	7:06.2–8:48.8
J18 Lwt	2000m	-	-	6:32.7–8:14.4	7:21.5–10:44.7

Indoor Rowing is a sport for all irrespective of ability; over 800 Juniors competed in the 2007 Championship. Indoor Rowing is an excellent all round body exercise and if good technique and exercise habits are encouraged it is a safe and effective way for children to develop physical activity at their own pace.

Race Preparation

The day before:

DO

Rest (light row only if you must)
 Remain well hydrated
 Eat sensibly (lightweights must eat)
 Try to relax
 Pack kit ready for race day including food and drink
 Get to bed early
 Check the time of your race and route to venue

DON'T

Train hard
 Stay up late
 Drink alcohol or caffeine
 Worry

On the day:

DO

Get to the venue early
 Warm up properly for your race
 Find your race machine at least 10 minutes before your race
 Fix your race plan in your mind and imagine the race
 Cool down properly
 Relax and enjoy the experience
 Support each other

Top Tip 1: Write out your race plan for the day in bullet point format. This prevents errors caused by miscalculations and nerves.

Warm up

Know your warm up routine; it prepares the body and mind for competition. Be careful not to overdo your warm up. Warm up should progress gradually but provide sufficient intensity to increase muscle and core temperature without causing fatigue or reducing energy stores.

Finish your warm up in time to find your race machine, allow time to walk from the warm up area to the race arena and be ready to race 10 minutes before your start time.

Year Groups 7-10 (J11-J15) may use the Warm up routines for the Very Hard Exercise Zone detailed in **Fact Sheet 4**.

The race

For energy distribution the best way to row a race is even pace and stroke rate but:

The start: 'Use it or lose it' 5-10 hard drives to get the flywheel spinning and average pace on target. If you go off too fast in the early stages you will probably pay for it later in the race. Try to settle into your middle race pace within 10-15 strokes of the start.

The middle: This is where you conserve energy and delay fatigue. Settle into race pace and keep stroke rate and pace as even as possible. Resist the temptation to 'chase' other rowers - row your own race.

The finish: Only you will know whether you have the energy to do a fast finish. Delay your finish spurt until you feel you can maintain technique, increase the stroke rate and pace and hold on until the finish.

At the finish: Congratulate yourself! Try to avoid falling on the floor, keep moving up and down the slide, active recovery will help the body recover quickly so do some cooling down on your race machine before leaving the race area.

Cool down

Cool down is important; it helps the body recover. 10-15 minutes of gentle rowing should be enough.

Top Tip 2: from Graham Benton Open Indoor Rowing Champion 2004-2007 (PB 5:42.5)

Before you start, make sure you have a clear race plan in your mind and stick to it until at least 500m to go,

Have a split in your mind that you intend to pull for the whole middle section of the 2000 m - that is all that matters! That split can be 1-2 seconds slower than the average that you need to hit your target 2000 m time but with a faster start and finish you should get the 2000 m time that you want. For example, my magic number is 1:26. So I go off as hard as I can for about 7-8 strokes and then let my split drift back up to 1:26 by around 150-200m. Then I focus on making every stroke a 1:26. If I see a 1:27 then I focus on making the next one a 1:26.

Take it one stroke at a time, the next stroke is all that matters. Any strokes you have taken are history so don't let them worry you. Stick on your target split right through until about 400m to go. At that point look to stay strong and perhaps take 1-2 seconds off your split.

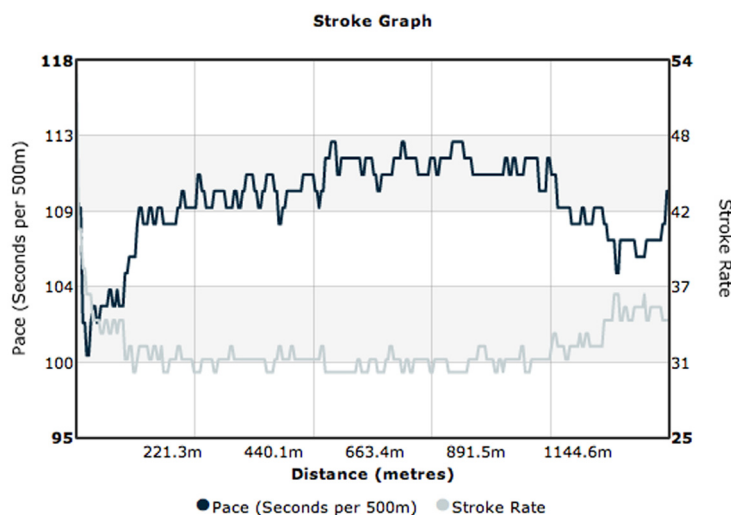
Sit on the new target until about 250m to go. Now you should be thinking about going for the finish. Don't change anything significantly about your stroke, just drive your legs down harder and this should take the rate up slightly. Keep building on the pace whilst keeping your technique good and you will find yourself going quicker and quicker.

The key things are - have a realistic target in your mind, keep your plan simple, don't change your plan through the race, keep your technique throughout. Good luck. Graham

Race Examples:

J15 Women 5 minute race

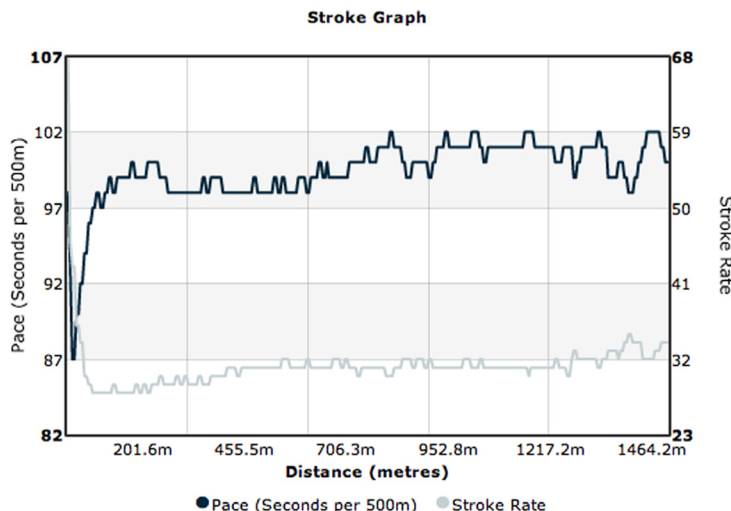
Distance	276m	273m	269m	269m	278m	1365m
Time	1:00.0	1:00.0	1:00.0	1:00.0	1:00.0	5:00.0
Split	1:48.7	1:49.9	1:51.5	1:51.5	1:47.9	
Av 500m Pace	1:49.9					



This graph is a good demonstration of even paced rowing in the middle part of the race with a fast start and very fast finish. Cut the pace back after 150 m and settled into a stroke rate range of 30-32 until inside the last minute. Increased the stroke rate slightly to 34-36 in the last minute to good effect and finished with a last minute average pace of 1:47.9. A well balanced row.

J15 Men 5 minute race

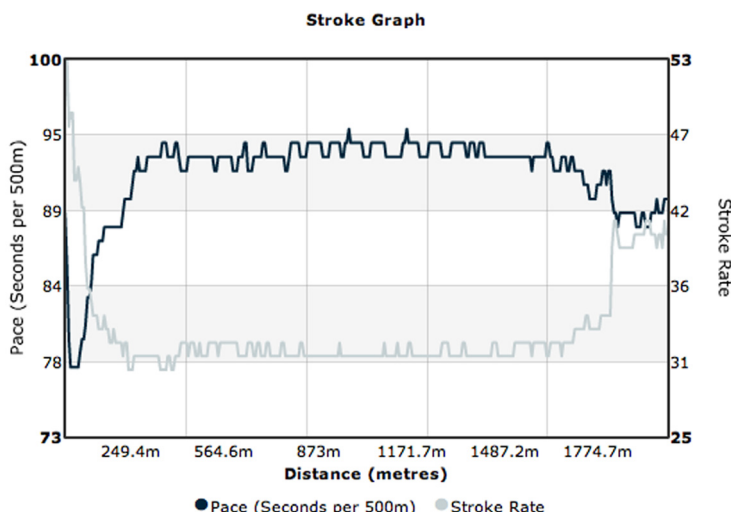
Distance	303m	305m	301m	297m	298m	1503m
Time	1:00.0	1:00.0	1:00.0	1:00.0	1:00.0	5:00.0
Split	1:39.0	1:38.4	1:39.7	1:41.0	1:40.7	
Av 500m Pace						1:39.8



A good demonstration of fairly even paced rowing, slight hint of too fast in the first 2 minutes but overall only 2.6 variance on the 1:00 split averages. After a fast start cut back quickly into race pace after approximately 100 m and maintained a good settled stroke rate range of 28-32 for most of the 5 minutes. A well controlled race.

J18 Men Hwt 2000m race

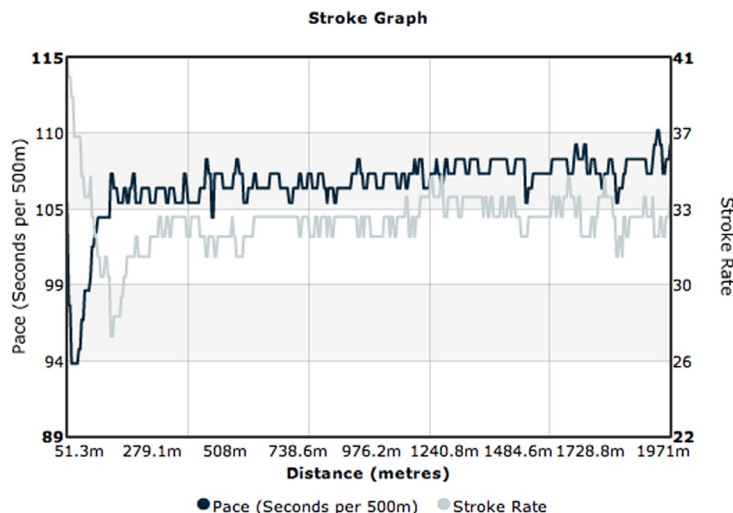
Distance	500m	1,000m	1,500m	2,000m
Time	1:30.1	3:03.4	4:36.9	6:08.0
Split	1:30.1	1:33.3	1:33.5	1:31.1
Av 500m Pace	1:32.0			



This graph shows a positive split race (first half slightly faster than the second half), a very fast start with the first 500 m the quickest of the race. The cut back to mid race pace was delayed until approximately 250 m but from this point the pace and stroke rate were very even at 1:33 and 31-32. Despite the fast start the pace and stroke rate were significantly increased in the last 200 m for a very fast finish. A very effective row.

J18 Women Hwt 2000m race

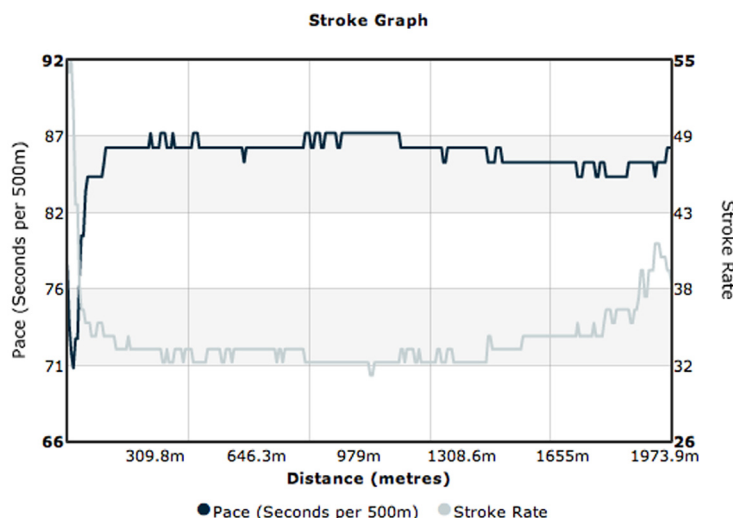
Distance	500m	1,000m	1,500m	2,000m
Time	1:45.3	3:31.6	5:18.8	7:06.3
Split	1:45.3	1:46.3	1:47.2	1:47.5
Av 500m Pace	1:46.6			



A positive split race (first half slightly faster than the second half). Cut back after 150 m and stroke rate maintained in a tight range of 32-34 for much of the race. A very even paced second half of the race with just 0.3 seconds between the average of the last two 500 m segments. A very controlled row.

Open Men Hwt 2000m race

Distance	500m	1,000m	1,500m	2,000m
Time	1:25.3	2:51.6	4:17.6	5:42.4
Split	1:25.3	1:26.3	1:26.0	1:24.8
Av 500m Pace	1:25.6			

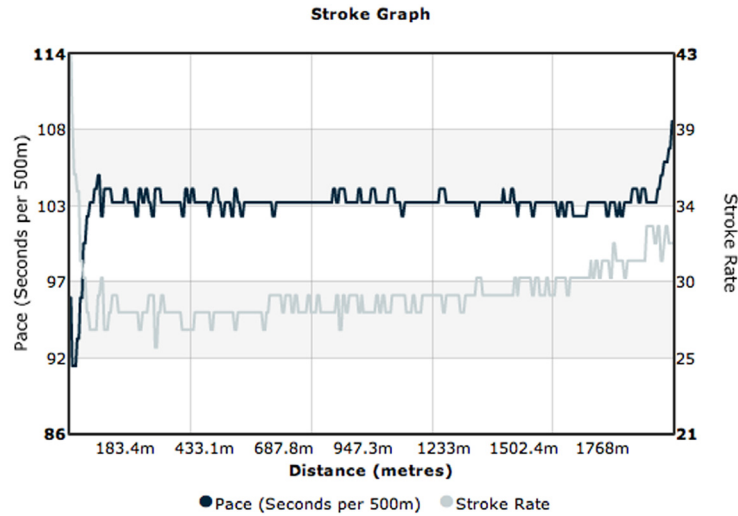


This is the graph for Graham Benton the reigning British Champion – probably demonstrates an ideal race profile for pace and stroke rate. Negative split the race (this means second half slightly faster than the first half) but pace range is very tight with only 1.5 seconds between the fastest and slowest 500 m segments. Fast first 500 m and even pace for the middle 1000 m, in the last 500 m he increased the pace to 1:24-1.25 to make the last 500 m the fastest segment of the race.

Stroke rate settled in the 32-34 range for the middle 1500 m of the race – note how quickly he cut back to race pace after a quick start (he was on 1:26 pace and 34 strokes at 150 m).

Open Women Hwt 2000m race

Distance	500m	1,000m	1,500m	2,000m
Time	1:43.3	3:26.5	5:09.6	6:52.7
Split	1:43.3	1:43.2	1:43.1	1:43.1
Av 500m Pace	1:43.2			



A slightly different approach from the Open Women’s Champion Jo Lyons, essentially even pace throughout only 0.2 of a second variance on the average pace per 500 m splits. Again note how she cut back to race pace after a quick start (1:43 pace and 28 strokes at 100 m). Stroke rate settled in the 28-30 range for the next 1600 m. A superb even paced row.